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VL6180X explorer kit (EVALKIT-VL6180X) software installation

Introduction

This document provides detailed firmware installation guidelines for a standalone demonstration, a PC graphical user interface (GUI) and an application programming interface (API) for the use of VL6180X explorer kit (EVALKIT-VL6180X). This explorer kit consists of the VL6180X plug-in board and the STM32 F401RE Nucleo board. This product is part of STMicroelectronics offering for demonstration and development tools designed around the VL6180X, 3-in-1 proximity, gesture and ALS sensor, based on ST patented FlightSense™ technology.

Figure 1. EVALKIT-VL6180X

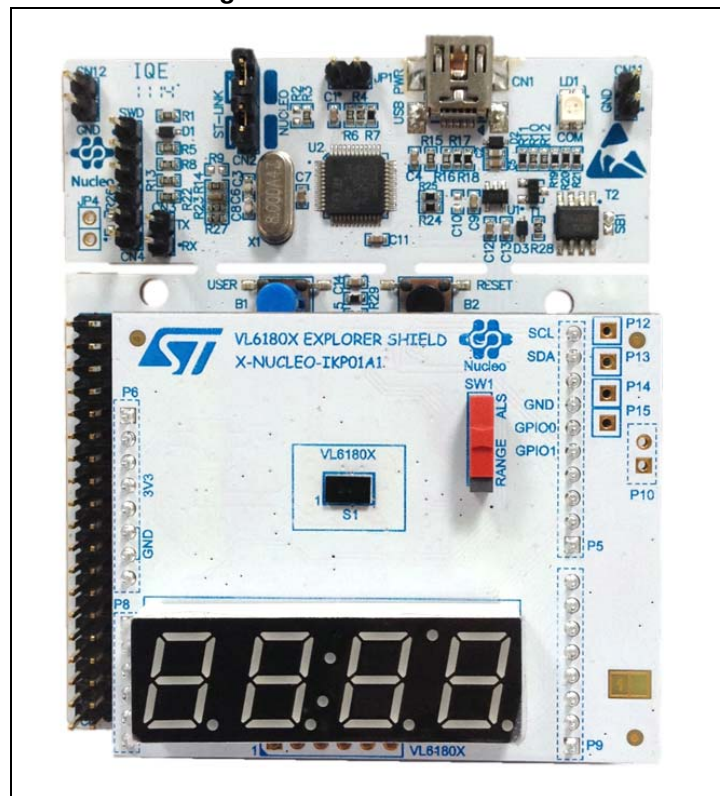


Table 1. Ordering information

Ordering code	Description
EVALKIT-VL6180X	VL6180X plug-in board and STM32 F401RE Nucleo board

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1 Getting started

1.1 Document references

Table 2. Document references

Description	DocID
Data brief - VL6180X plug-in and STM32F401 Nucleo board evaluation kit	DocID026599
Datasheet - VL6180X proximity and ambient light sensing (ALS) module	DocID026171
AN4545: application note: Getting started - VL6180X basic ranging	DocID026571
AN4466 application note: VL6180X cover glass selection	DocID026155
AN4478 application note: Using multiple VL6180Xs in a single design	DocID026250

1.2 Hardware description

The VL6180X plug-in is a board for use with most of the Arduino compatible connectors. With its companion software package, it is particularly well suited for STM32 Nucleo boards. To function in a nominal way, the VL6180X must be connected to the STM32 Nucleo board as shown in [Figure 2](#). and [Figure 3](#)

Figure 2. VL6180X plug-in connected to STM32 Nucleo board

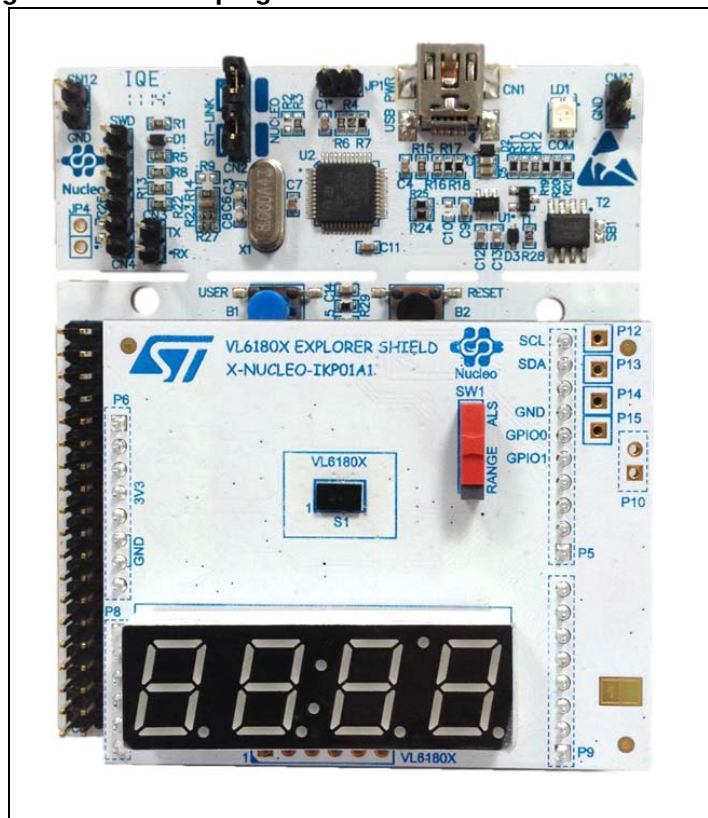
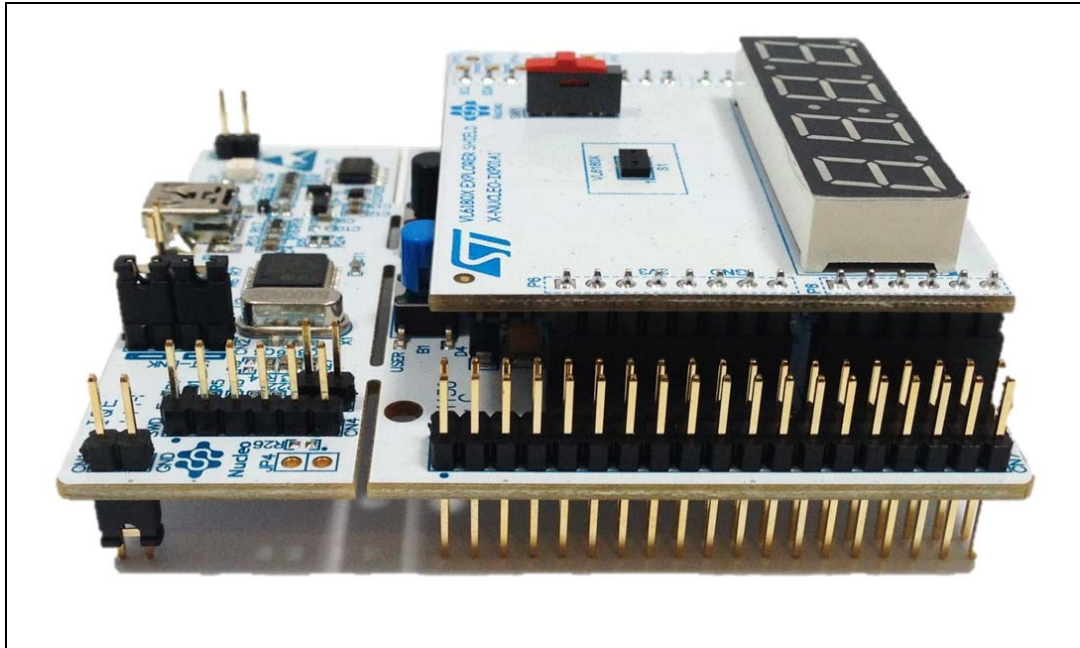


Figure 3. VL6180X plug-in connected to STM32 Nucleo board



The interconnection between STM32 Nucleo board and VL6180X plug-in is optimal with NUCLEO-F401RE.

The NUCLEO-F401RE is connected to the PC via a cable ended by a mini USB connector.

1.3 EVALKIT-VL6180X demonstration software installation

ST delivers a software suite allowing the user to discover, through a standalone demonstration and a PC graphical user interface (GUI), the VL6180X ranging and ambient light sensing (ALS) features.

1.3.1 Demonstration software suite

The demonstration software suite is available at the bottom of the page of the EVALKIT-VL6180X <http://www.st.com/web/en/catalog/tools/PF260896>. (see [Figure 4](#)).

This software suite is consisting of:

- **STSW-LINK008**, Windows vista , 7 and 8 driver for STM32 F401RE Nucleo board. This driver must be first installed.
- **STSW-LINK007**, STM32 F401RE Nucleo board communication driver with PC. When STSW-LINK008 and STSW-LINK007 firmware's are installed the STM32 F401RE Nucleo board is configured and ready to use with a PC.
- **STSW-IMG-001**, binary code to be downloaded into STM32 F401RE microcontroller in order to enable the EVALKIT-VL6180X standalone demonstration, showing on the display the result of a range or an ALS measurement. This stand-alone demonstration will start each time the USB cable is plugged between the EVALKIT-VL6180X and the PC.

In standalone demonstration mode, the USB cable is only used to supply the EVALKIT-VL6180X, no data are transferred on DP and DN.

- **STSW-IMG002**, this executable enables the graphical user interface (GUI) on the PC. The GUI shows, on the PC screen, the result of a range or an ALS measurement and allows the user to discover and test the different VL6180X settings.

Note: When the GUI is in use the display of the EVALKIT-VL6180X is disabled.

Figure 4. EVALKIT-VL6180X web page on st.com

Design Resources Top

Quick Links Product Specifications ▾

Technical Documentation

Product Specifications

Description	Version	Size
DB2370: VL6180X explorer kit, complete solution with STM32 F401RE nucleo board and VL6180X expansion board	3.0	475 KB

User Manual

Description	Version	Size
UM1796: VL6180X explorer expansion board with NUCLEO-F401RE board	1.1	2 655 KB

Related Tools and Software

Related Tools and Software

Part Number	Description
STSW-LINK008	ST-LINK/V2-1 USB driver on Windows Vista, 7 and 8
STSW-LINK007	ST-LINK/V2-1 firmware upgrade
STSW-IMG003	VL6180X API
STSW-IMG002	Graphic User Interface (GUI) for VL6180X Explorer kit
STSW-IMG001	Application SW for VL6180X Explorer kit

1.3.2 STM32 F401RE driver and upgrade firmware installation

STSW-LINK008: Windows USB driver installation

- In EVALKIT-VL6180X page select STSW-LINK008

Figure 5. NUCLEO-F401RE Windows USB driver installation - step 1

The screenshot shows a webpage with the following sections:

- Technical Documentation**
 - Product Specifications**

Description	Version	Size
DB2370: VL6180X explorer kit, complete solution with STM32 F401RE nucleo board and VL6180X expansion board	3.0	475 KB
 - User Manual**

Description	Version	Size
UM1796: VL6180X explorer expansion board with NUCLEO-F401RE board	1.1	2 655 KB
- Related Tools and Software**

Part Number	Description
STSW-LINK008	ST-LINK/V2-1 USB driver on Windows Vista, 7 and 8
STSW-LINK007	ST-LINK/V2-1 firmware upgrade
STSW-IMG003	VL6180X API
STSW-IMG002	Graphic User Interface (GUI) for VL6180X Explorer kit
STSW-IMG001	Application SW for VL6180X Explorer kit

- Then Click on “Download”

Figure 6. NUCLEO-F401RE Windows USB driver installation - step 2

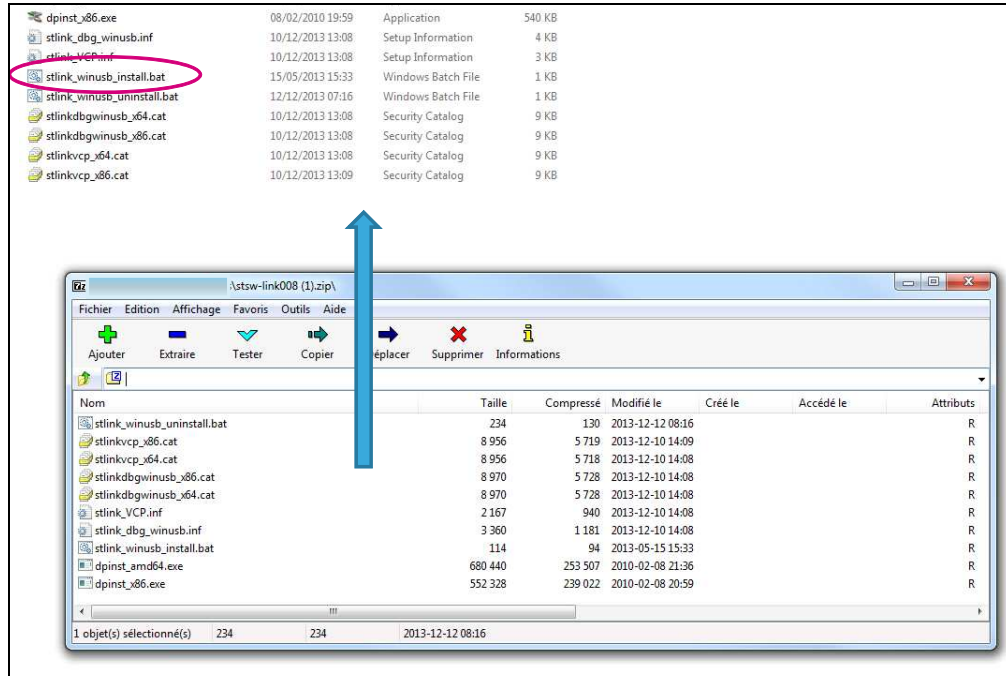
The screenshot shows the product page for STSW-LINK008. The page includes a navigation bar with 'Home', 'Products', 'Applications', 'Support', 'Sample & Buy', 'About', 'Contact', and 'My ST Login'. Below the navigation bar, there are tabs for 'Quick View', 'Design Resources', 'Get Software', and 'All'. The main content area displays the product name 'STSW-LINK008 ST-LINK/V2-1 USB driver on Windows Vista, 7 and 8' and a table with the following data:

Part Number	Version	Marketing Status	Order From ST
SW-LINK008	1.01	Active	Download

The 'Download' button is circled in red. To the right of the table, there is an 'Online Support' section with links for 'Online Support', 'FAQ', 'EZE Communities', and 'Learning'. At the bottom of the page, there is a disclaimer: 'Suggested Resale Price per unit (USD) for BUDGETARY USE ONLY. For quotes, prices in local currency, please contact your local ST Sales Office or our tributors. The Material Declaration forms available on st.com may be generic documents based on the most commonly used package within a package family. For this reason, y may not be 100% accurate for a specific device. Please contact our sales support for information on specific devices.'

- Following windows: From stsw-link008.zip, by unpacking the .zip file and running stlink_winusb_install.bat. This will install the necessary USB drivers to allow communications between the Nucleo board and the PC.

Figure 7. NUCLEO-F401RE Windows USB driver installation - step 3

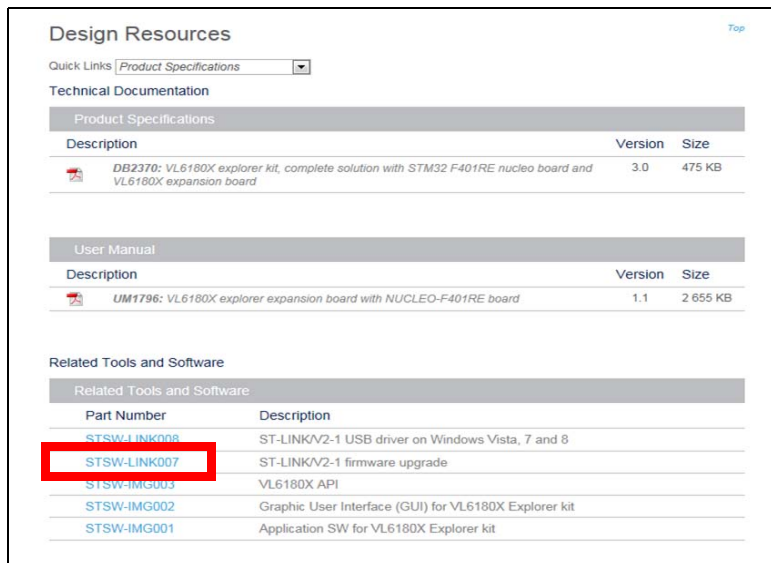


- Plug a USB cable between the PC and NUCLEO-F401RE board. Allow the board driver installations to complete before proceeding.

STSW-LINK007: NUCLEO-F401RE communication driver with the PC

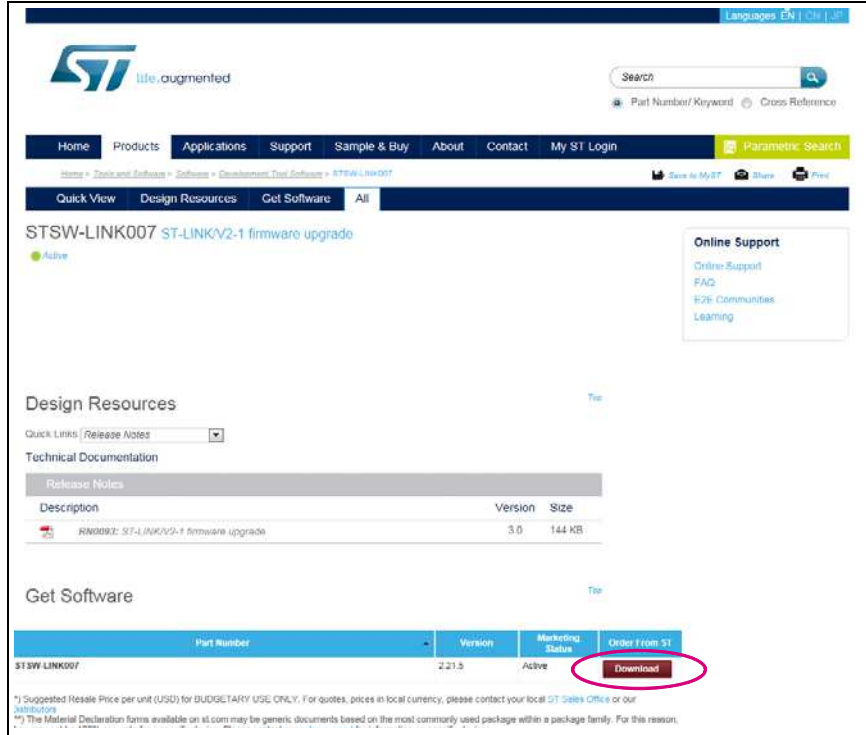
- In EVALKIT-VL6180X page select STSW-LINK007

Figure 8. Nucleo-F401RE communication driver with PC installation - step 1



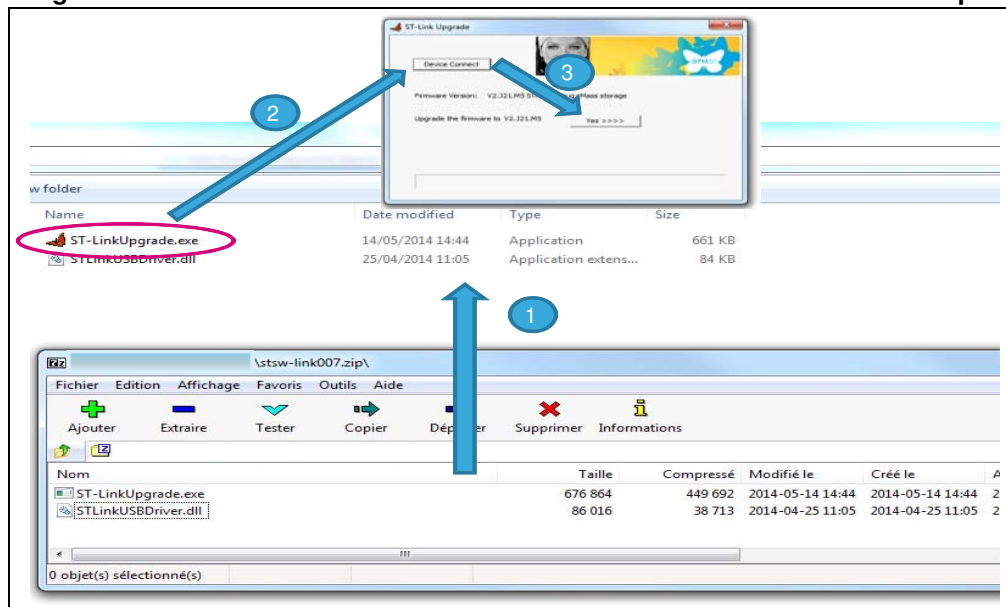
- Following windows: Click on “Download”

Figure 9. Nucleo-F401RE communication driver with PC installation - step 2



- Following windows: From stsw-link007.zip by unpacking .zip file and running ST-LinkUpgrade.exe. Press 'device connect' in the application. Then press 'YES' to upgrade the communication driver with the PC with the last version.

Figure 10. Nucleo-F401RE communication driver with PC installation - step 3



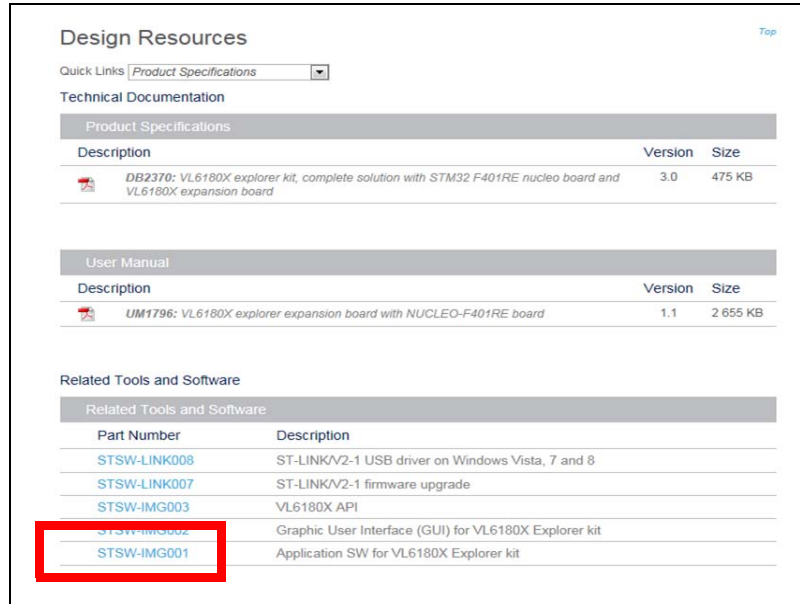
1.3.3 Installation of the VL6180X standalone demonstration

Note: If not already done, plug VL6180X plug-in on STM32 F401RE Nucleo board

To install VL6180X standalone demonstration

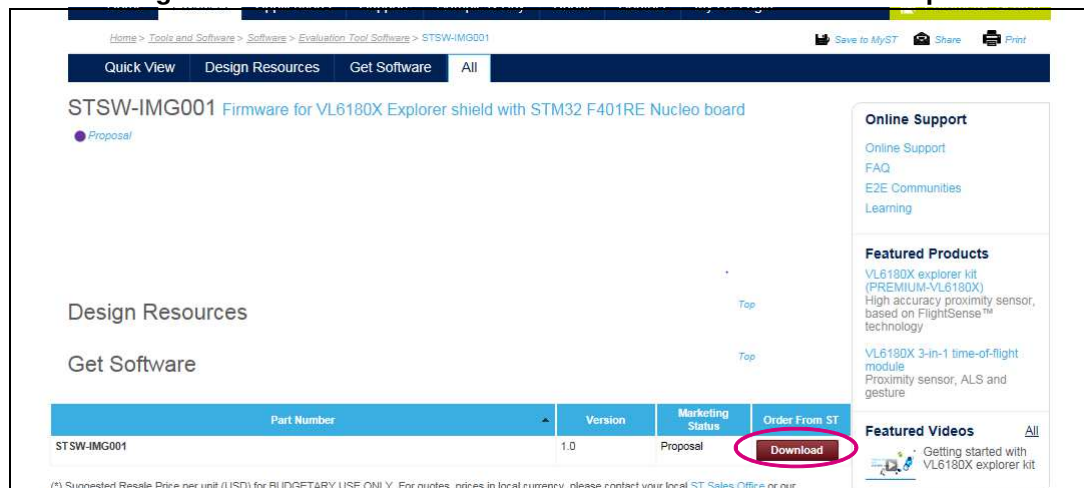
- In EVALKIT-VL6180X page select STSW-IMG001

Figure 11. VL6180X standalone demonstration installation - step 1



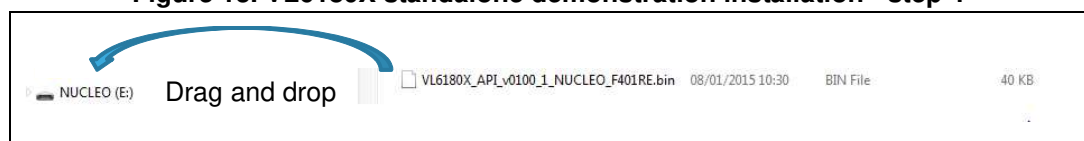
- Following windows click on “Download” then save it

Figure 12. VL6180X standalone demonstration installation - step 2



- then drag and drop the “.bin” file to Nucleo

Figure 13. VL6180X standalone demonstration installation - step 4

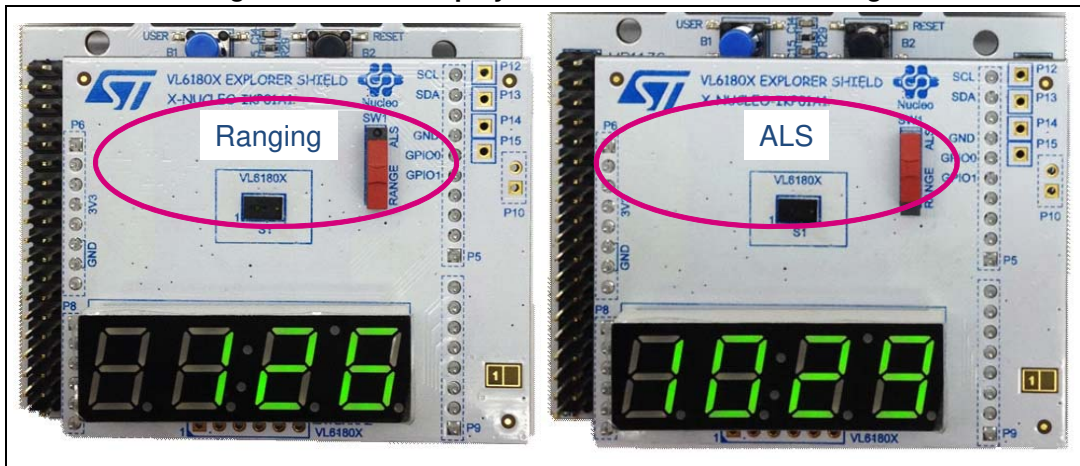


The explorer kit is now running in “standalone” mode, meaning no PC is required to control the explorer kit, USB connection is only used to power the explorer kit.

The switch SW1 can be changed on the fly.

- When running in Standalone mode, the SW1 switch on the VL6180X plug-in selects the value displayed on the 4-digit display, see [Figure 14](#).
 - If switch is on “range”, the distance detected between VL6180X and the nearest object is displayed in mm.
 - If switch is on “ALS”, the ambient light level is displayed in Lux.

Figure 14. Value displayed versus SW1 switch setting



- Move your hand or any object in front of VL6180X and read the value displayed on the 4-digit display.

1.3.4 Installation of the VL6180X PC software graphical user interface (GUI)

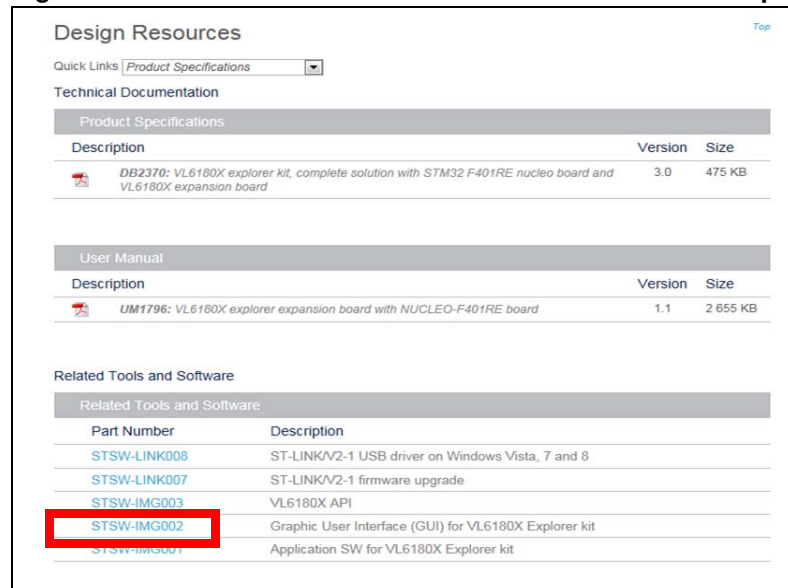
The GUI shows, on the PC screen, the result of a range or an ALS measurement and allows the user to discover and test the different VL6180X settings.

Caution: As soon as the PC software runs, the VL6180X plug-in display is Off and values are only visible on the PC screen.

To install the PC graphical user interface

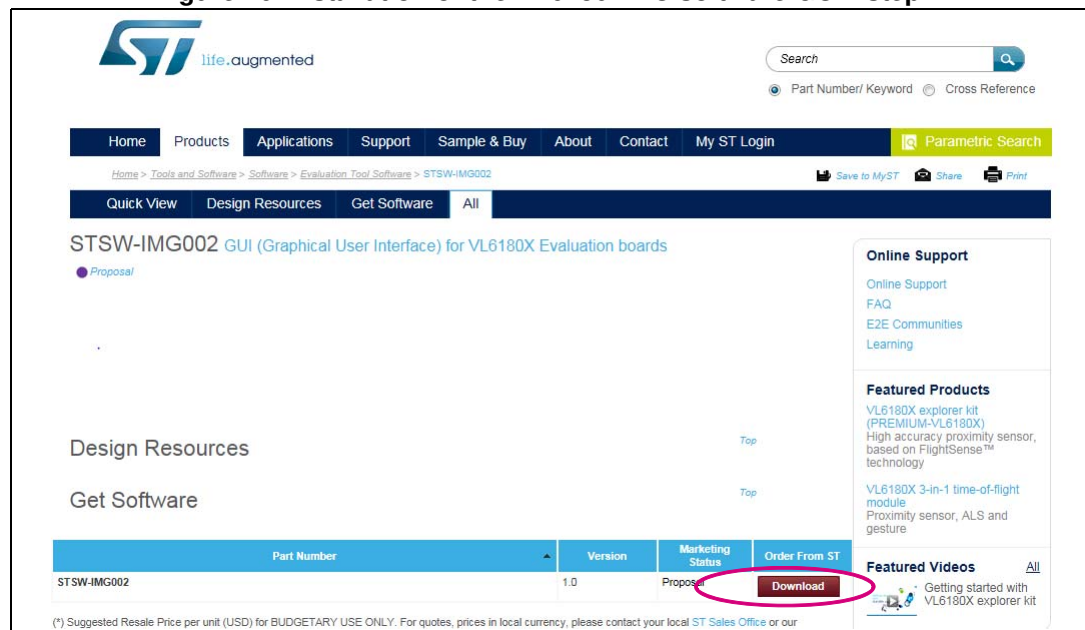
- In EVALKIT-VL6180X page select STSW-IMG002

Figure 15. Installation of the VL6180X PC software GUI - step 1



- Following windows click on “Download”

Figure 16. Installation of the VL6180X PC software GUI - step 2



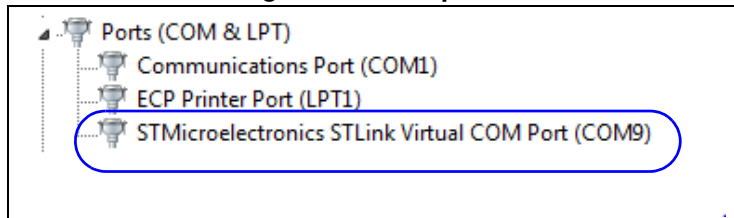
- Then “Save” and “Run” VL6180X_ExplorerSetup.exe, icon “VL6180X_Explorer” is installed on the user desktop space.

Figure 17. VL6180X_Explorer icon



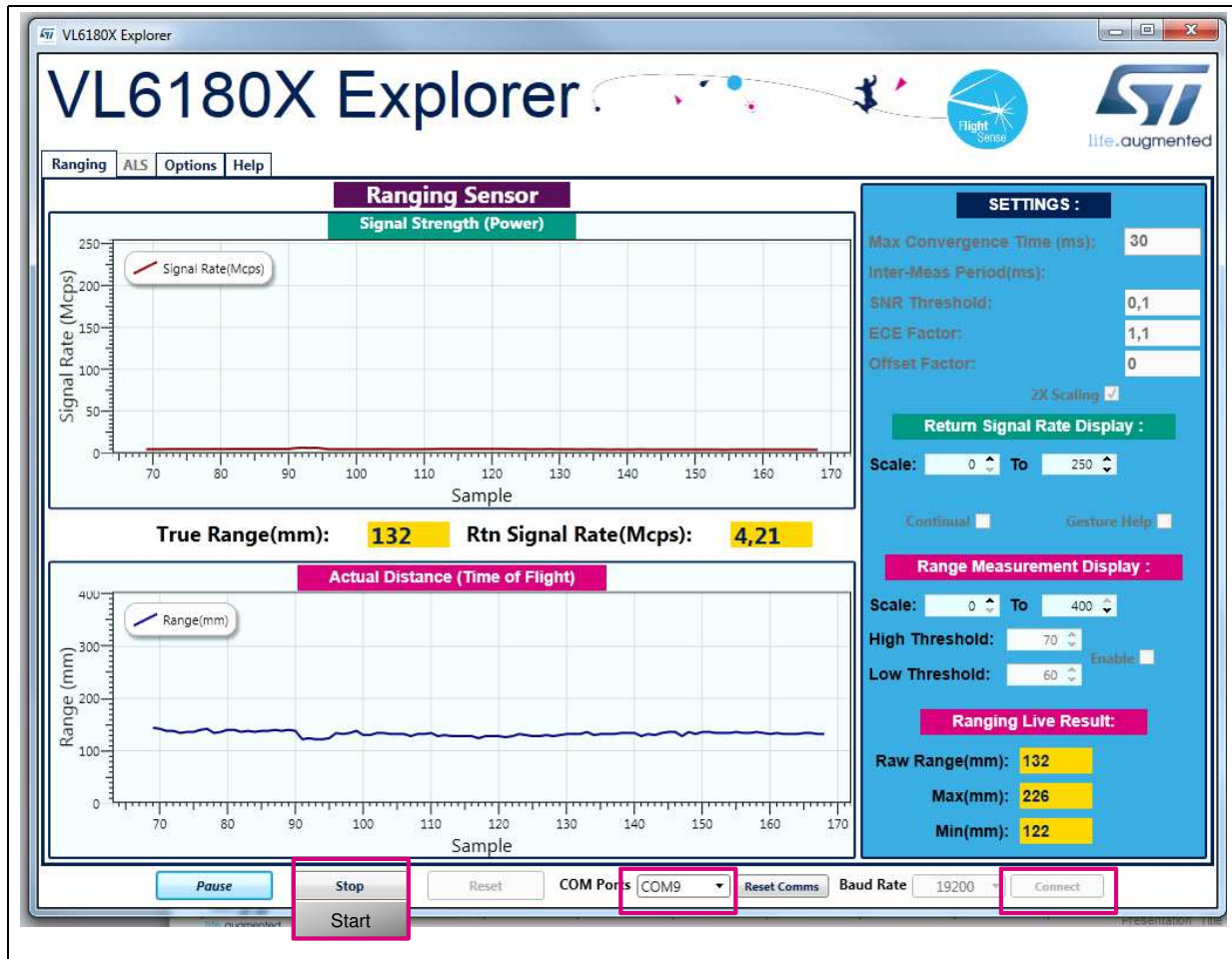
- The explorer software needs to know which COM Port the Nucleo is connected to the PC on. This can be found under Device Manager (Mouse right button on “Computer” icon, select “property” then click on “Device manager” and expand “Ports (COM & LPT) section”)

Figure 18. COM ports.



- Read the COM Port listed against “STMicroelectronics STLink Virtual COM Port” in the drop-down list of COM Ports.
- Start PC graphic user interface by clicking “VL6180X_Explorer” icon
- In the port list select the port com previously listed against “STMicroelectronics STLink Virtual COM Port” in the drop-down list of COM Ports
- Press the Connect button to establish communications between the software and the board.
- Press the Start/Stop button to start the device (Start then when running “stop”)

Figure 19. Starting the device



- Values are now displayed on the PC screen and no more on the VL6180X plug-in display.

2 VL6180X software GUI description

The VL6180X software GUI contains several tabs that can be used to display, calibrate and configure various features of the VL6180X. The available tabs are:

- **Ranging**, see [Section 2.1](#)
- **ALS**, see [Section 2.2](#)
- **Options**, see [Section 2.3](#)
- **Help**, see [Section 2.4](#)

2.1 Ranging

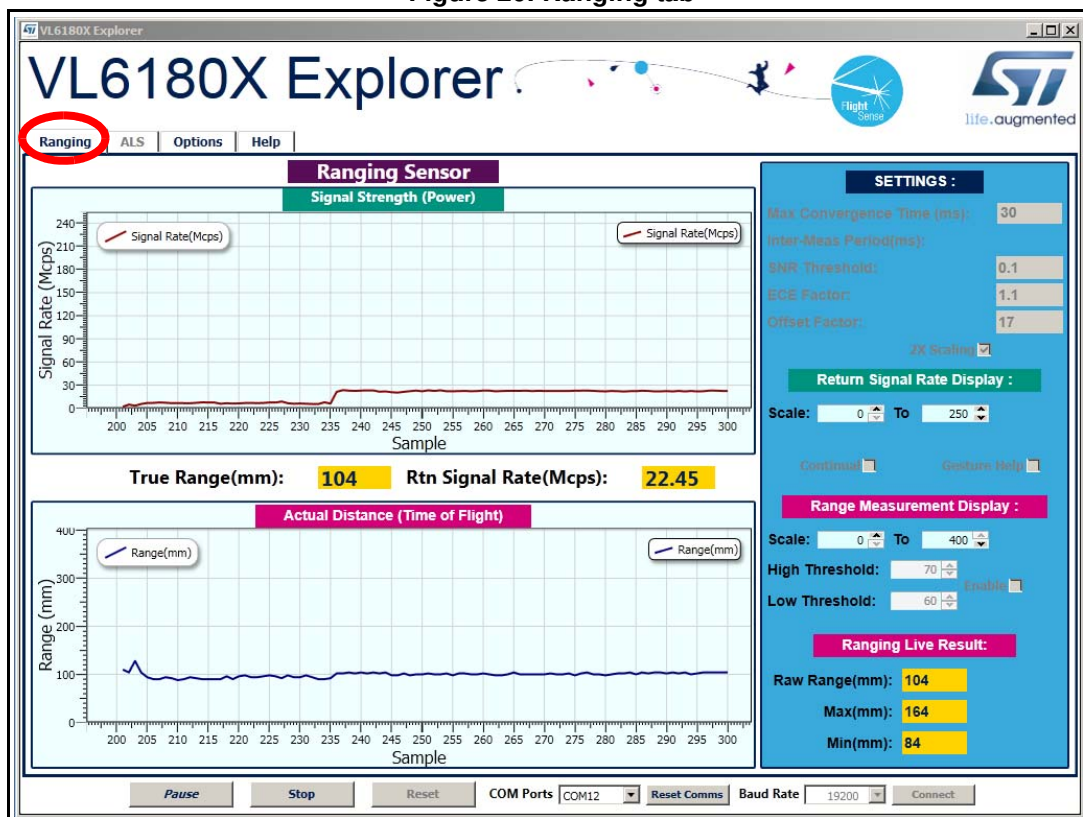
When the VL6180X explorer software is launched, the **Ranging** tab is displayed containing the ranging sensor interface as shown in [Figure 20](#).

In ranging mode, the VL6180X explorer measures absolute range from the sensor to a target. This is shown in graphical form in the two graphs displayed:

- **Signal Strength (Power)**, see [Section 2.1.1](#)
- **Actual Distance (Time of Flight - TOF)**, see [Section 2.1.2](#)

To use the software, place a target above the VL6180X device and click on **Start**. The device begins ranging and the **Signal Strength (Power)** and **Actual Distance (ToF)** graphs will display data in real-time and numerically in the settings and display boxes to the right.

Figure 20. Ranging tab



The buttons listed in [Table 3](#) are available at the bottom of the **Ranging** tab.

Table 3. Buttons in the ranging tab

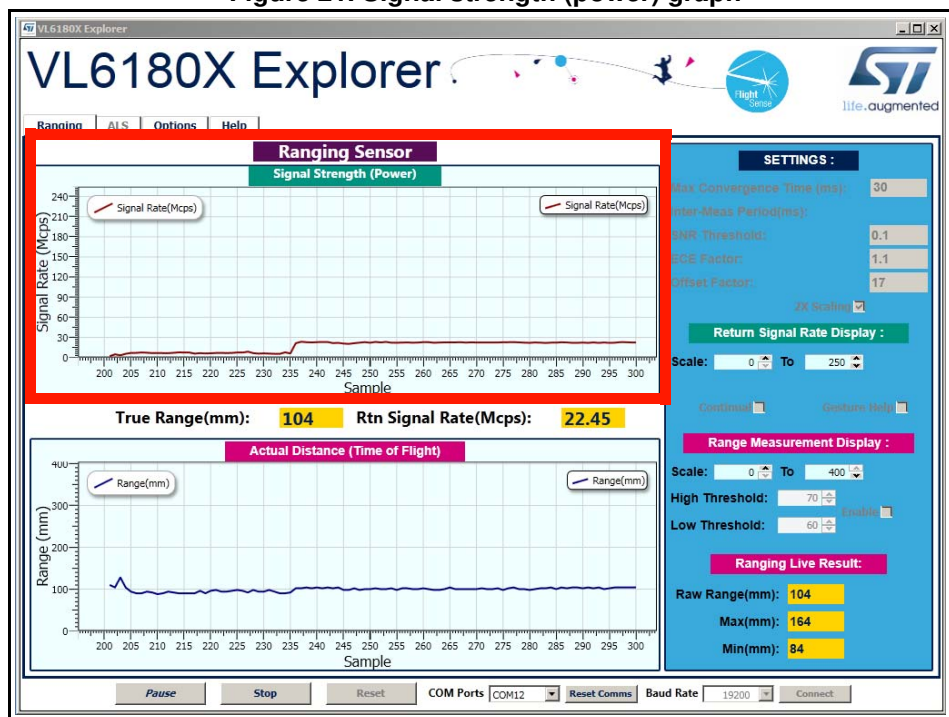
Button	Description
Start (Pause/Resume)	Click on Start to begin ranging. The Start button changes to Pause/Resume while the device is ranging.
Stop	Click on Stop to stop ranging.
Reset	The Reset button resets the I ² C communications interface between the application and the VL6180X.
COM Ports	The COM Ports box display a list of available connection ports to connect the VL6180X to the PC.
Reset Comms	Resets the COM Port connection to the VL6180X software.
Baud Rate	Port COM speed (bits per second). Default is 19200.
Connect	Connects the chosen COM Port to the VL6180X explorer software.

2.1.1 Signal strength (power) graph

The **Signal strength (power)** graph plots, in real time, the Signal Rate (Mega Counts per Second) returned from the target, as shown in [Figure 21](#).

The Signal Rate can be viewed as a measure of the reflectance of the target, with high reflectance targets producing stronger signal rates.

Figure 21. Signal strength (power) graph



To the right of the **Signal strength (power)** graph the settings and display information described in [Table 4](#) is shown.

Table 4. Signal strength (power) information

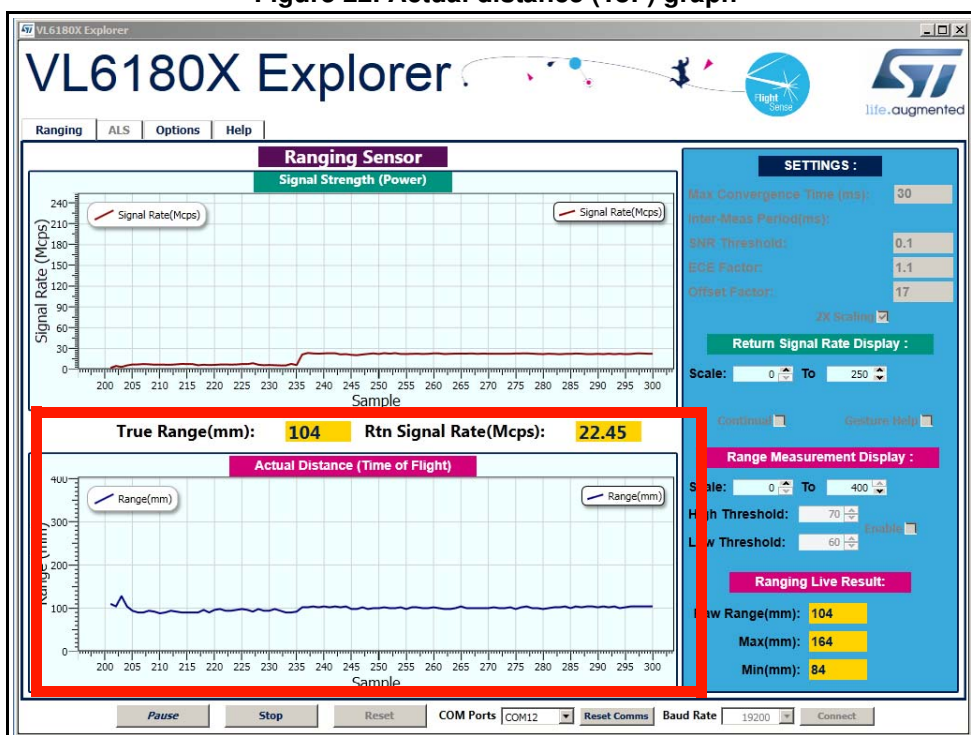
Field	Description
Max Convergence time (ms)	This is the maximum time allowed for a range measurement to be made. No range output is given if the system has not converged within the specified time (that is, no target or target out of range). Maximum convergence time default = 30ms.
Inter Meas period (ms)	Inter measurement period is the time delay between measurements in continuous range mode. Range = 10ms to 2.55 seconds (default = 50ms).
SNR threshold	The minimum SNR threshold below which a range measurement is rejected. The default value is 0.1.
ECE factor	The VL6180X has a built in Early Convergence Estimate feature. When enabled, the rate of convergence is automatically calculated 0.5ms after the start of each measurement. If the return count is below the ECE threshold the measurement is aborted. This minimizes power consumption and reduces red glow when there is no target. The ECE threshold is calculated as follows (example with ECE factor = 80%): ECE threshold = $(80\% \times 0.5 \times 15360) / \text{SYSRANGE_MAX_CONVERGENCE_TIME}$ (in ms)
Offset factor (mm)	This is fixed range offset parameter, which can be manually applied by the user to introduce a range adjustment.
2X Scaling	Default setting: maximum range measurement up to 400mm (if box not ticked, maximum range can be approximatively 200 or 400mm) ⁽¹⁾
Return Signal Rate Display	Manual adjustment of the Signal Rate vertical axis permissible range. Scale can be adjusted from 0...240 at the lower limit to 10...300 at the upper limit.
Continual	Changes ranging mode from single-shot to continuous mode.
Gesture Help	Provides some examples of gesture hand movements and signal comparison from a classical IR sensor with the VL6180X.

1. Under certain conditions, the VL6180X will detect targets above the specified 100mm. With the "2x Scaler" default setting, the maximum distance measurement can be up to 400 mm with a reported granularity of 2mm. For applications requiring a granularity of 1mm, scaling factor must be set to 1 and maximum distance measurement will be reported up to 200mm.

2.1.2 Actual distance (ToF) graph

The **Actual distance (ToF)** graph plots, in real time, range measurements (see [Figure 22](#)). The vertical axis can be changed using the **Range Measurement display** Scale. If a target is not detected, the maximum range is displayed.

Figure 22. Actual distance (ToF) graph



The VL6180X explorer can be run in single-shot ranging mode (default) or continual ranging mode (by ticking the **Continual** check box to the right of the **Signal Strength (Power)** graph, see [Figure 21](#)). If in Continual ranging mode the time between measurements can be changed by adjusting the **Inter-Meas Period (ms)**.

The **Actual Distance (ToF)** graph can be changed to show threshold information, see [Section 2.1.3](#).

To the right of and above the **Actual Distance (ToF)** graph, the information described in [Table 5](#) is displayed.

Table 5. Actual distance (ToF) information

Field	Description
Actual Distance (ToF) Display	Manual adjustment of the Range vertical axis permissible range. Scale can be adjusted from 0...110 at the lower limit to 10...255 at the upper limit.
Enable	Check the Enable box to allow thresholding to be enabled.
Low Threshold	Manual adjustment of the lower threshold limit (default is 60mm). When enabled, this threshold line is shown in the Actual Distance (ToF) graph. See Actual distance (ToF) graph showing thresholds .
High Threshold	Manual adjustment of the upper threshold limit (default is 70mm). When enabled, this threshold line is shown in the Actual Distance (ToF) graph. See Actual distance (ToF) graph showing thresholds .
Raw Range (mm)	This is the range measurement including the Offset Factor.
Max & Min (mm)	These are post-processed measurement statistics to make noise evaluation easier to characterize. The max and min are the range data measured by the sensor over 100 measured sample points.

2.1.3 Actual distance (ToF) graph showing thresholds

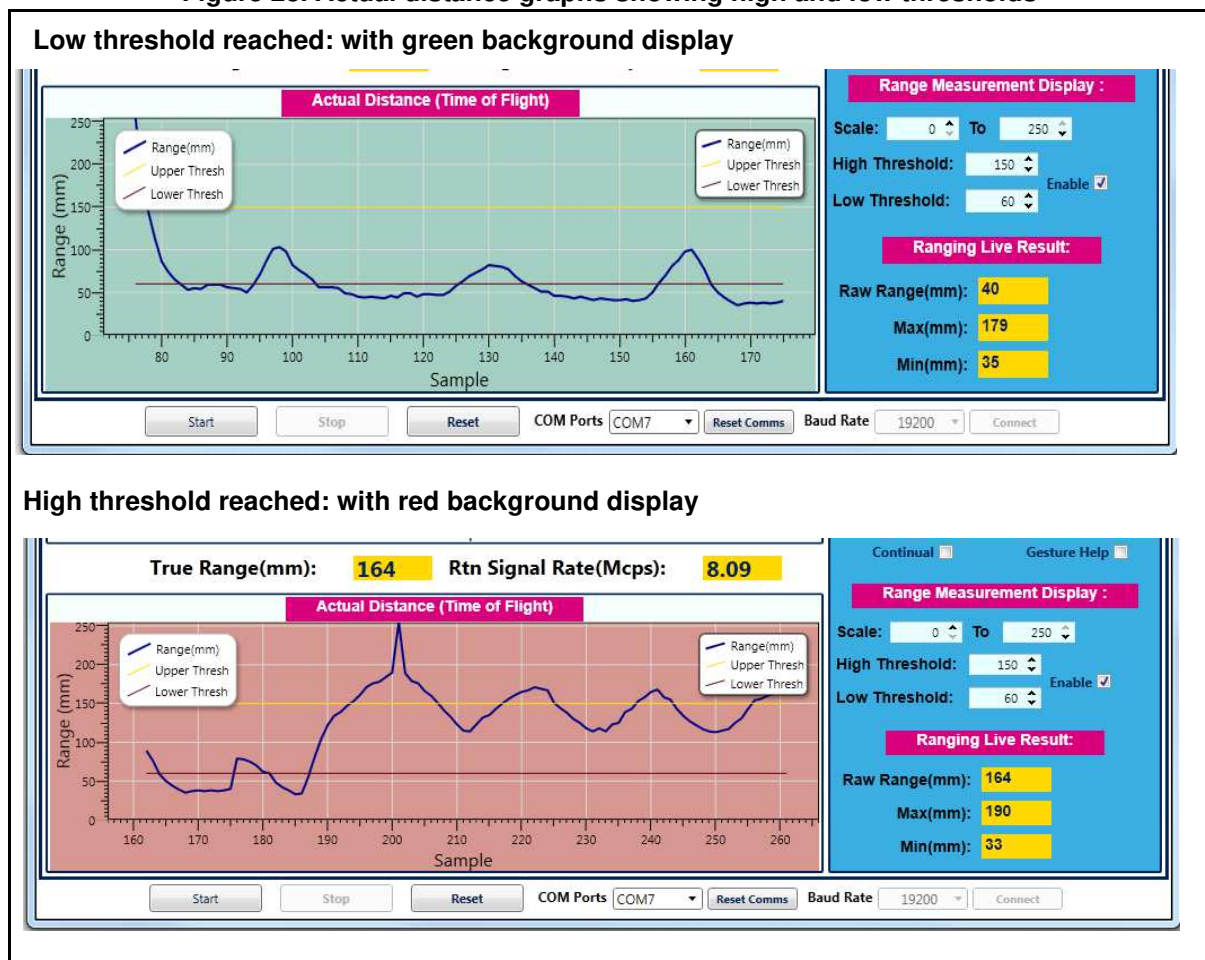
The thresholding feature allows the user to define upper and lower limits and be alerted as the range measurements transition across these limits by the display changing color.

Figure 23 shows examples of the **Actual Distance (ToF)** graph with high and low thresholding enabled. It shows a minimum threshold of 60 mm, a maximum threshold of 150 mm and range measurements above and below the thresholds.

If the range measurement goes below the lower threshold the graph turns green as shown in the top graph. If it goes above the upper threshold the graph turns pink as shown in the lower graph. The graph will stay pink/green, till the lower/upper threshold is crossed.

Thresholding is enabled by checking the **Enable** check box (see Table 5) and the upper and lower threshold settings can be modified in the **High & Low Threshold** settings.

Figure 23. Actual distance graphs showing high and low thresholds



2.2 Ambient light sensor (ALS)

The ambient light sensor can be activated in the **ALS** tab. This tab displays the **ALS Count** graph showing ALS Lux/count versus Samples, as shown in Figure 24. Table 6 lists the buttons available in the ALS tab.

Figure 24. ALS tab

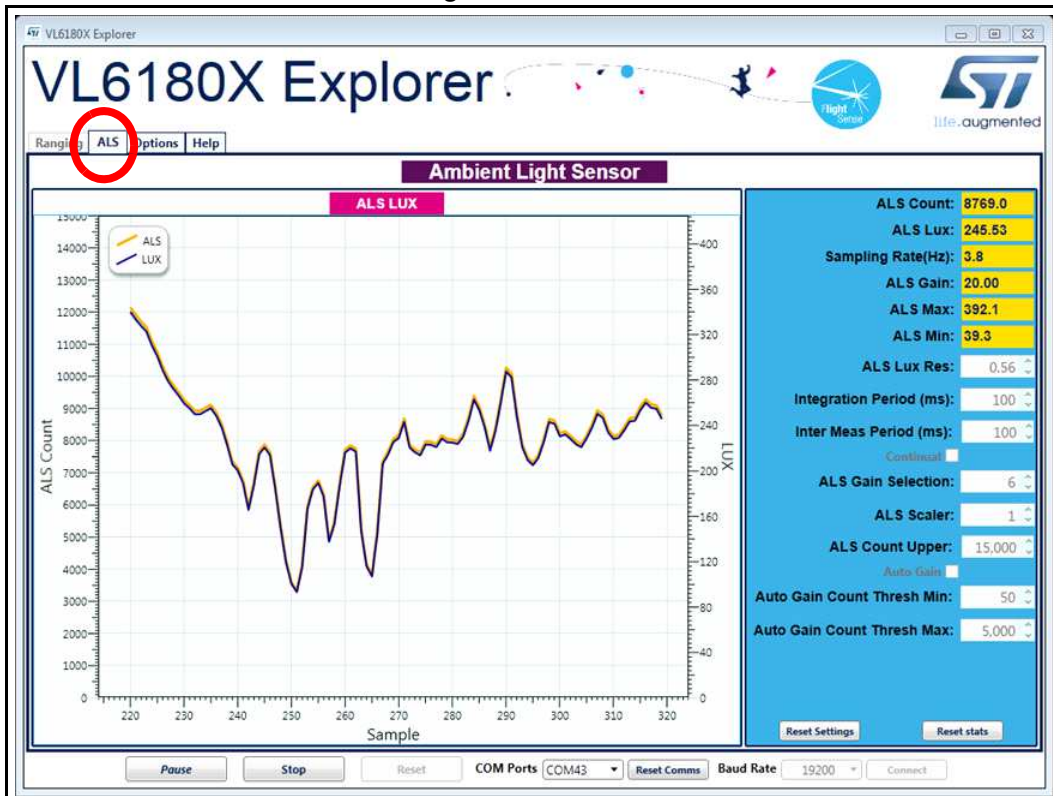


Table 6. Buttons in the ALS tab

Button	Description
Start (Pause/Resume)	Click on Start to begin measuring the ALS count. The Start button then changes to Pause/Resume .
Stop	Click on Stop to stop measuring the ALS count.
Reset	The Reset button resets the I ² C communications interface between the application and the VL6180X.
COM Ports	The COM Ports list shows available device ports.
Reset Comms	The Reset Comms button resets the comms between the device and the software.
Baud Rate	Port COM speed (bits per second). Default is 19200.

To the right of the **ALS** graph the information described in [Table 7](#) is displayed.

Table 7. ALS information

Field	Description
ALS Count	This is the raw output from the ambient light sensor. The count is proportional to the light level. The count output is a 16-bit binary value.
ALS Lux	The ALS Count value is converted automatically to a Lux value depending on the ALS Lux Res , ALS Gain , Integration Period and ALS Scaler settings.

Table 7. ALS information (continued)

Field	Description
Sampling Rate (Hz)	The number of ALS samples measured per second (PC dependent).
ALS Gain	Displays the actual gain value applied corresponding to the ALS Gain Selection setting.
ALS Max &Min	These are post-processed measurement statistics to make noise evaluation easier to characterize. The max, min and mean are the ALS data measured by the sensor over 100 sample points.
ALS Lux Res	This calibrates the ALS Lux/count conversion. The characterized ALS Lux Res is 0.32 (default).
Integration Period (ms)	The integration period is the time range, during a single ALS measurement, over which Lux data is captured and averaged. The default integration period is 100 ms.
Inter Meas Period (ms)	The inter-measurement period is the time between each ALS measurement in continuous ALS mode. The default inter-measurement period is 10 ms.
Continual	Changes ALS mode from single-shot to continuous mode.
ALS Gain Selection	This is the device register setting 0 to 7. The corresponding gain value is displayed in the ALS Gain box. Gain settings are as follows: 0: ALS Gain = 1 1: ALS Gain = 1.25 2: ALS Gain = 1.67 3: ALS Gain = 2.5 4: ALS Gain = 5 5: ALS Gain = 10 6: ALS Gain = 20 7: ALS Gain = 40
ALS Scaler	The count output is a 16-bit value. Internally, the device uses a 20-bit counter. Gain and integration time are normally used to increase sensitivity. However, if this is not sufficient and more resolution is required in low light, the ALS scaler can be used to access the 4 LSBs of the internal counter. Apply a value in the range 2 to 15 to apply additional gain.
ALS Count Upper	This is the maximum scale value for the vertical axis. The default value is 15000. The user can input a new value to scale the ALS Count graph up or down as required for measurements, up to a maximum value of 65,000.
Auto Gain	Enables and disables the auto-gain feature. Auto-gain automatically adjusts the gain selection in response to the current ALS Count value in order to provide an effective dynamic range for the current lighting conditions.
Auto Gain Count Thresh Min	The manual Auto Gain ALS count threshold minimum value in Auto Gain mode.
Auto Gain Count Thresh Max	The manual Auto Gain ALS count threshold maximum value in Auto Gain mode.

2.3 Options

The **Options** tab is used to enable I2C logging or data logging during ranging and ALS modes.

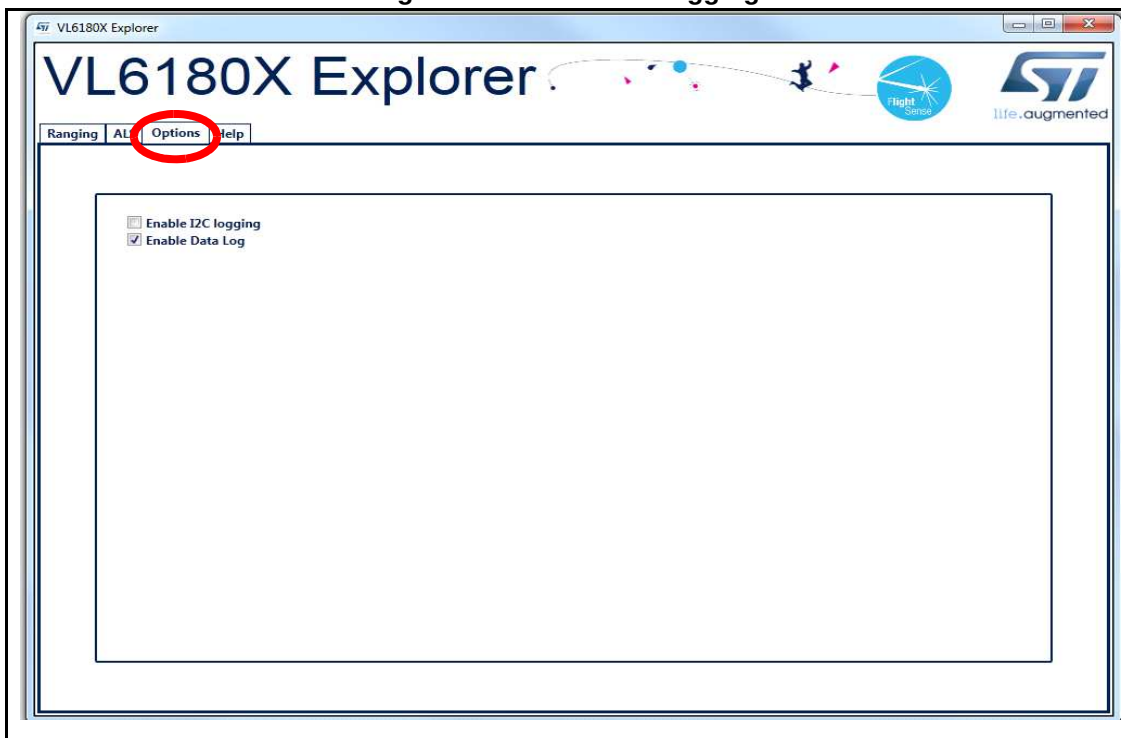
2.3.1 Recording Data Logs

For every measurement, relevant system data is stored in a comma separated value file (.csv) identified by date and time.

To enable data logging, in the **Options** tab, check the **Enable Data Log** box, see [Figure 25](#).

Data logging should be selected either prior to starting measurements or during the paused state.

Figure 25. Enable data logging



Data log files are created with unique filenames and stored in:
C...\Users\username\AppData\Local\STMicroElectronics\VL6180XEVK\DataLog\
See [2.5: Data log file](#) for an example.

Before you can switch off data logging, the device must first stop ranging or ALS measurements. To do this, click on the **Stop** button in the **Ranging** tab, see [Section 2.1: Ranging](#).

2.3.2 Recording I²C transactions

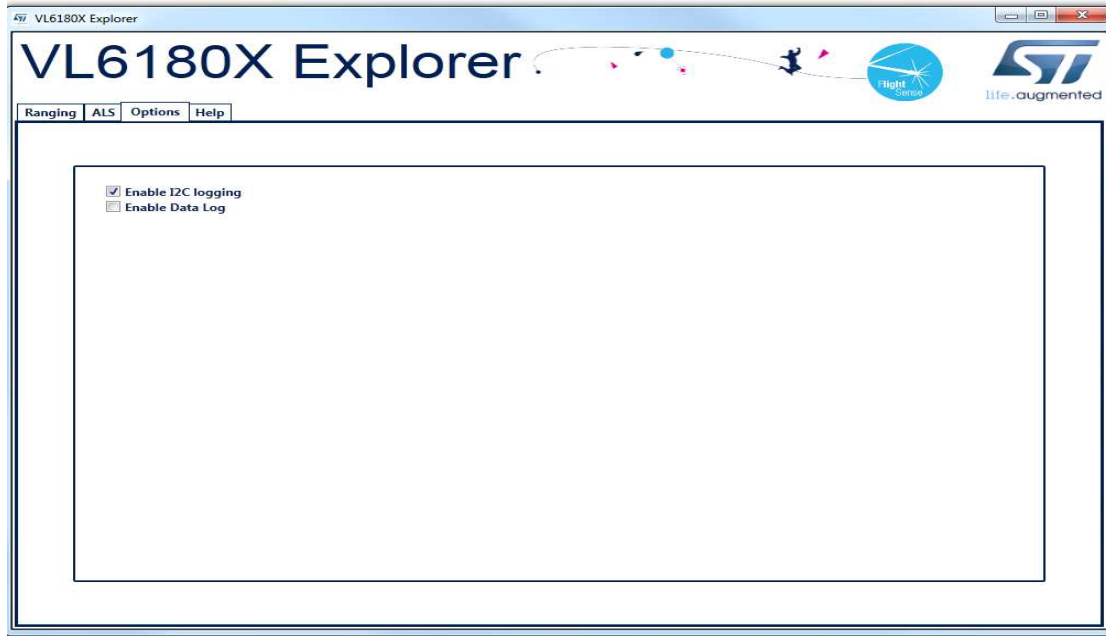
The **Enable I2C Logging** option is used to record I²C transactions during ranging or ALS mode. The I²C transactions are stored in a unique file (.txt) identified by date and time.

To enable I²C logging, in the **Options** tab, check the **Enable I2C Logging** box, see [Figure 25](#).

I²C log files are stored in:
C:\Users\username\AppData\Local\STMicroElectronics\VL6180XEVK\I2C\
See [2.6: I²C log file](#) for an example.

Before you can switch off I²C logging, the device must first stop ranging or ALS measurements. To do this, click on the **Stop** button in the **Ranging** tab, see [Section 2.1](#).

Figure 26. Enable I2C logging



2.4 Help

The **Help** tab provides links to documents and on line resources which provide details on the setup and functionalities of the VL6180X explorer and also details on the software version:

- HELP: To access help index
- HW User Manual: To access hardware user manual
- SW User Manual: To access software user manual
- www.ST.com/VL6180X: To access ST VL6180X product and support page
- About GUI Version: Provides the GUI version installed

2.5 Data log file

Each data log is stored in a uniquely named .csv file. The data log filename configuration is data_log_DD_MMM_YYYY_HHMM_SS_sss.csv.

Where:

- DD_MMM_YYYY is the date the log file was created, for example 17_Apr_2014
- HHMM is the time (hours, minutes) the log file was created, for example 1025
- SS_sss is the time (seconds, milliseconds) the log file was created, for example 17_367.

An example of a ranging data log is shown in [Figure 27](#)

Figure 27. Data log file example

	A	B	C	D	E	F	G	H	I	J	K	L	
1	TimeStamp	Range Ext	Range Va	True Rang	True Rang	Raw Rang	Max Rang	Min Rang	Mean Rang	Range Str	Filter Size	Rtn Signa	Ref
2	14.129	143	115	115	115	115	115	115	115	0	500	12.14	
3	14.268	136	97	97	115	97	115	115	106	12.73	500	15.55	
4	14.408	139	78	78	97	78	115	97	96.67	18.5	500	24.47	
5	14.542	133	65	65	97	65	115	78	88.75	21.88	500	36.42	
6	14.685	142	64	64	78	64	115	65	83.8	21.95	500	38.88	
7	14.82	134	78	78	78	78	115	64	82.83	19.77	500	24.46	
8	14.955	134	91	91	78	91	115	64	84	18.31	500	18.6	
9	15.09	134	97	97	91	97	115	64	85.63	17.57	500	16.91	
10	15.225	134	109	109	97	109	115	64	88.22	18.19	500	13.57	
11	15.36	134	130	130	109	130	115	64	92.4	21.64	500	9.13	
12	15.494	133	142	142	130	142	130	64	96.91	25.4	500	7.45	
13	15.629	134	109	109	130	109	142	64	97.92	24.47	500	13.65	
14	15.771	141	75	75	130	75	142	64	96.15	24.28	500	30.93	
15	15.906	134	55	55	109	55	142	64	93.21	25.79	500	58.76	
16	16.059	152	55	55	75	55	142	55	90.67	26.74	500	62.08	
17	16.195	135	82	82	75	82	142	55	90.13	25.92	500	24.81	
18	16.348	152	122	122	82	122	142	55	92	26.26	500	10.4	
19	16.484	135	112	112	112	112	142	55	93.11	25.91	500	12.43	
20	16.637	152	70	70	112	70	142	55	91.89	25.73	500	35.48	
21	16.778	140	58	58	112	58	142	55	90.2	26.17	500	53.05	
22	16.936	157	82	82	82	82	142	55	89.81	25.57	500	24.16	
23	17.075	138	114	114	82	114	142	55	90.91	25.48	500	12.21	
24	17.222	146	126	126	114	126	142	55	92.43	25.95	500	9.29	
25	17.357	134	101	101	114	101	142	55	92.79	25.44	500	15.88	
26	17.516	158	76	76	114	76	142	55	92.12	25.13	500	25.66	
27	17.651	134	98	98	101	98	142	55	92.35	24.64	500	16.35	

Range output column data definitions

- A: TimeStamp:** The time stamp is generated by the EVK software so the data can easily be plotted on a graph, and it represents the time of start of the test. There is latency, due to the USB interface, to send and receive data to the sensor.
- B: Range Execution Time (ms):** The range execution time is measured by the software for the amount of time that the test was executed to the time the data was received over the USB interface to display the data.
- C: Range Val:** The range value read directly from RESULT__RANGE_VAL (0x0062) in the VL6180X part on the EVK. This value includes the crosstalk compensation.
- D: True Range:** The range value read directly from the VL6180X part on the EVK. There is no difference between this value and the Range Value.
- E: True Range Smoothed:** The Raw Range value read from RESULT__RANGE_RAW (0x0064) on the VL6180X that would show a range measured without any stray light compensation.
- F to I: Max, Min, Mean, Standard Deviation:** Statistical data on the range data in mm gathered since the EVK software was started or the statistics were reset. Stopping and starting the capture will create a new file, but not reset the statistics.
- J: Rtn Signal Rate:** The actual count rate of signal returns of light measured by the return sensor when the laser is active on the return array. This is calculated by the formula:

$$\frac{\text{RESULT_RANGE_RETURN_SIGNAL_COUNT (0x006C)}}{\text{RESULT_RANGE_RETURN_CONV_TIME (0x007C)}}$$

This data is read directly from the VL6180X. Note: There are two photon triggering arrays. The first reference array is the reference array to measure the time photons have left the laser and the second return array is the array used to measure the time that the photons traveled to the target and back to the sensor.

- K: Ref Signal Rate:** The actual count rate of signal returns of light measured by the reference sensor when the laser is active. This is calculated by the formula:

$$\frac{\text{RESULT_RANGE_REFERENCE_SIGNAL_COUNT (0x0070)}}{\text{RESULT_RANGE_REFERENCE_CONV_TIME (0x0080)}}$$

- L: Rtn Signal Count:** This is the amount of sensor counts triggered by the return array on the VL6180X when the laser is active. This data is read directly from the VL6180X.

2.6 I²C log file

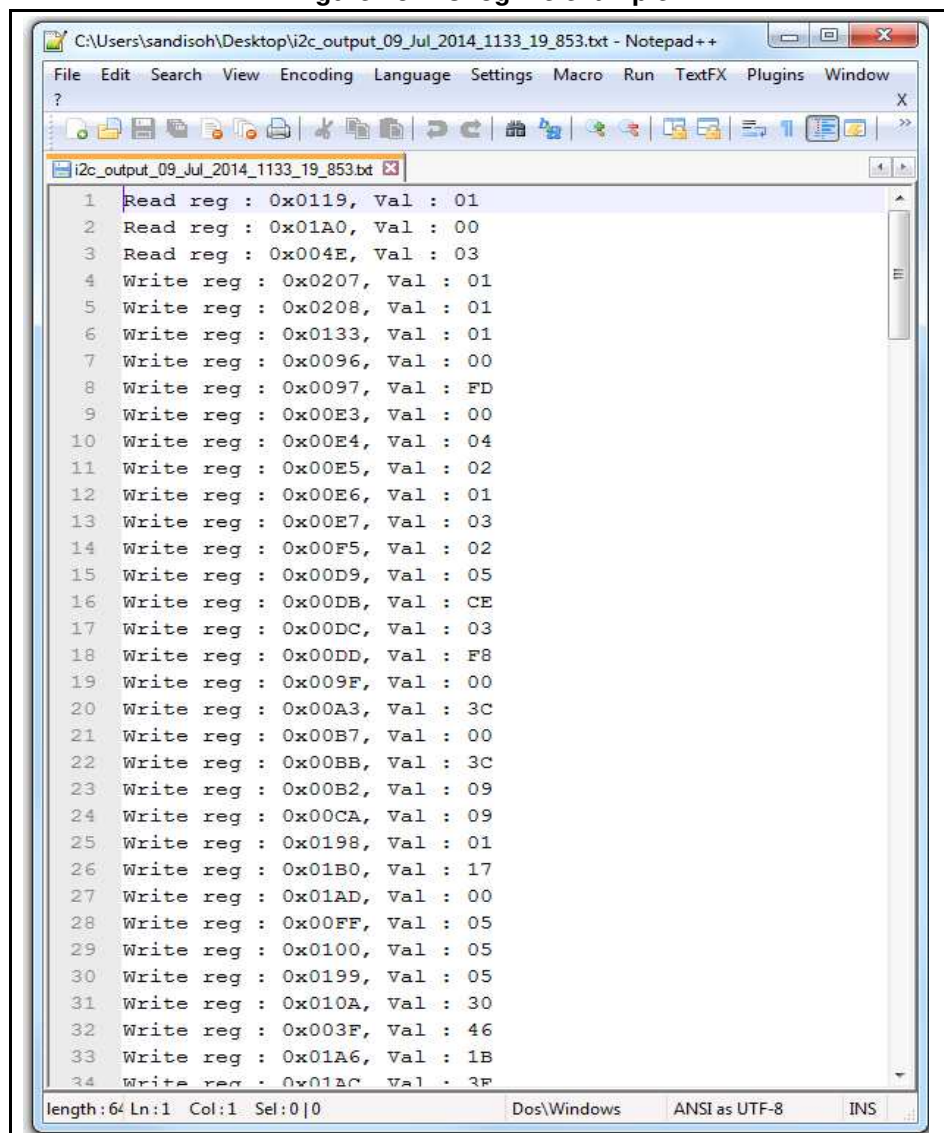
Each I²C log is stored in a uniquely named .txt file. The I²C log filename configuration is `i2c_output_DD_MMM_YYYY_HHMM_SS_sss.txt`.

Where:

- `DD_MMM_YYYY` is the date the log file was created, for example `07_May_2013`
- `HHMM` is the time the log file was created, for example `1553`
- `SS_sss` is the time (seconds, milliseconds) the log file was created, for example `17_367`.

An example of a I²C log is shown in [Figure 28](#).

Figure 28. I²C log file example



```
1 Read reg : 0x0119, Val : 01
2 Read reg : 0x01A0, Val : 00
3 Read reg : 0x004E, Val : 03
4 Write reg : 0x0207, Val : 01
5 Write reg : 0x0208, Val : 01
6 Write reg : 0x0133, Val : 01
7 Write reg : 0x0096, Val : 00
8 Write reg : 0x0097, Val : FD
9 Write reg : 0x00E3, Val : 00
10 Write reg : 0x00E4, Val : 04
11 Write reg : 0x00E5, Val : 02
12 Write reg : 0x00E6, Val : 01
13 Write reg : 0x00E7, Val : 03
14 Write reg : 0x00F5, Val : 02
15 Write reg : 0x00D9, Val : 05
16 Write reg : 0x00DB, Val : CE
17 Write reg : 0x00DC, Val : 03
18 Write reg : 0x00DD, Val : F8
19 Write reg : 0x009F, Val : 00
20 Write reg : 0x00A3, Val : 3C
21 Write reg : 0x00B7, Val : 00
22 Write reg : 0x00BB, Val : 3C
23 Write reg : 0x00B2, Val : 09
24 Write reg : 0x00CA, Val : 09
25 Write reg : 0x0198, Val : 01
26 Write reg : 0x01B0, Val : 17
27 Write reg : 0x01AD, Val : 00
28 Write reg : 0x00FF, Val : 05
29 Write reg : 0x0100, Val : 05
30 Write reg : 0x0199, Val : 05
31 Write reg : 0x010A, Val : 30
32 Write reg : 0x003F, Val : 46
33 Write reg : 0x01A6, Val : 1B
34 Write reg : 0x01A0, Val : 3F
```