

### Getting started with the STM32 Nucleo board firmware package

## Introduction

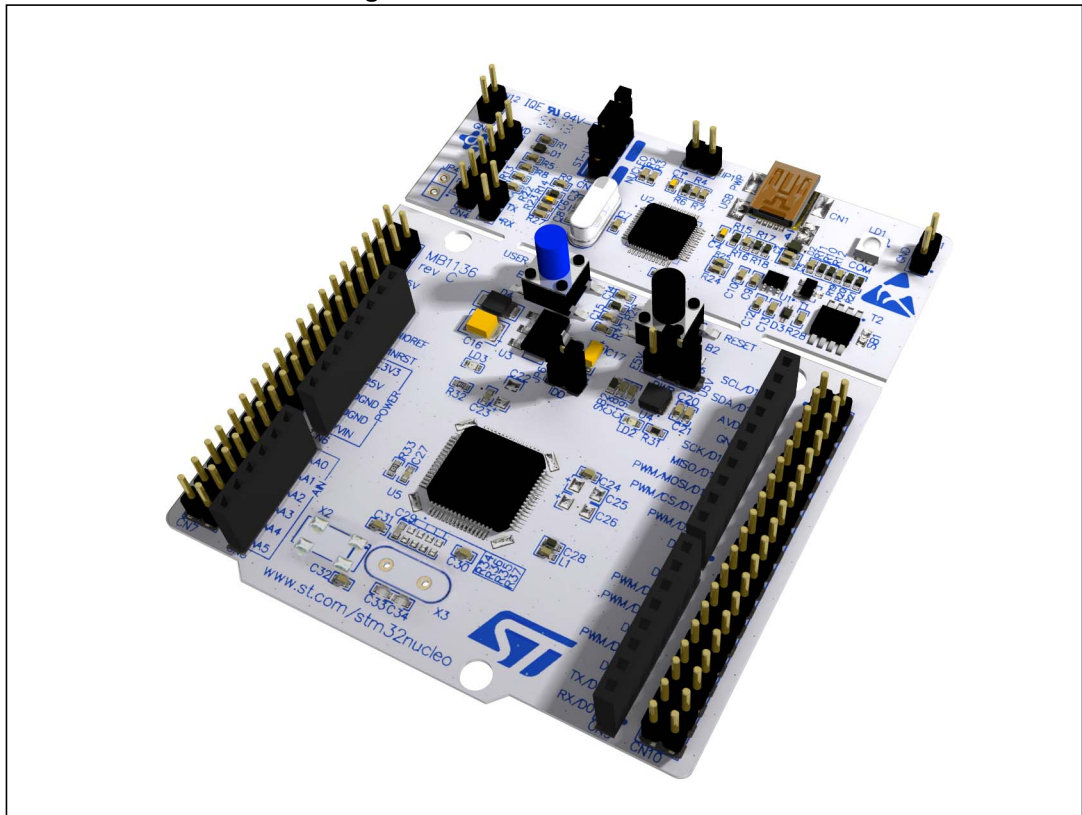
This document describes the software, firmware environment and development recommendations required to build an application around the STM32 Nucleo board (NUCLEO-F103RB, NUCLEO-L152RE, NUCLEO-F030R8 and NUCLEO-F302R8) with some demonstration firmware (STSW-STM32143).

The STM32 Nucleo board is a low-cost and easy-to-use development kit to quickly evaluate and start some development with ARM® 32-bit Cortex™-M microcontrollers of the STM32 series (STM32F103, STM32F030, STM32L152 and STM32F302). Before installing and using the product, please accept the Evaluation Product License Agreement available at [www.st.com/epl](http://www.st.com/epl).

This document also presents how to promptly start using STM32 Nucleo boards with mbed online tools (<http://mbed.org>).

For more information on the STM32 Nucleo board visit [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo).

Figure 1. STM32 Nucleo board<sup>(1)</sup>



1. Picture not contractual.

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# 1 Quick start

The STM32 Nucleo board demonstration software is already pre-loaded in the Flash memory on the STM32 Nucleo board. This demonstration implements led toggling according to user clicks on the button B1.

Download the latest versions of source code and associated documentation from [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo).

The STM32 Nucleo firmware package available at [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo), provides the updated version of the demonstration firmware that supports an Arduino shield sample with color TFT LCD, microSD and joystick. This shield is not provided with the STM32 Nucleo board, it has to be purchased by the user. When connecting this shield, the demonstration firmware offers additional functionality to the led toggling:

- Use the joystick to navigate between the images
- Read *\*.bmp* images from uSD card using the FatFS file system and display them on the TFT LCD

The following sections include the step-by-step description to start using STM32 Nucleo board demonstration software.

## 1.1 Hardware requirement

The requirements to configure the Nucleo board and start with the demonstration software are as follows:

- One 'USB type A to Mini-B' cable to power up the STM32 Nucleo board from the USB ST-LINK (USB connector CN1)
- Check jumper positions on the board
  - JP1 OFF,
  - JP5 (PWR) on U5V side ON,
  - JP6 (I<sub>DD</sub>) ON.

## 1.2 Running the pre-loaded demonstration software

Follow the sequence below to launch the pre-loaded demonstration application:

1. Connect the STM32 Nucleo board (connector CN1) to a PC using the USB- type-A to Mini-B cable to power the board.  
The red LED LD3 (PWR) and LD1 (COM) light up,  
The green LED LD2 blinks.
2. Press the user button B1
3. Observe how the blinking of the green LED LD2 changes according to your clicks on button B1.

## 1.3 Example of Adafruit shield

The STM32 Nucleo board supports Arduino connectivity.

The shield sample may be found on the Adafruit website (reference ID 802) with the following features:

- one 1.8" TFT screen,
- one microSD card slot,
- one 5-way joystick navigation.

*Note:* *this shield is just an example of Arduino shield usage, you can get more details on Adafruit website.*

You can download the latest firmware versions source code that supports this LCD shield from [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo).

Below, description of hardware requirement and how to start using the LCD shield and STM32 Nucleo board.

### 1.3.1 Hardware requirements

The following hardware is required for the example of LCD shield:

- STM32 Nucleo board
- Adafruit 1.8" TFT LCD shield (reference ID: 802)
- USB type A to Mini-B cable to power up the STM32 Nucleo board from the USB ST-LINK (USB Connector CN1)

In addition to gathering the hardware please follow the recommendations below.

1. Configure the STM32 Nucleo board as described in [Section 1.1: Hardware requirement](#)
2. Connect the LCD shield to the STM32 Nucleo board using the connectors CN5, CN6, CN8 and CN9 as shown in [Figure 2](#).

Figure 2. Hardware environment



### 1.3.2 Loading and running the demonstration software

The provided demonstration program display.bmp images using FatFs file system from the SD Card on the TFT.

There are two ways of programming the STM32 Nucleo board:

- Method 1: upload the *STM32xxx\_Nucleo\_Demo.hex* from the firmware package available under *Projects\NUCLEO-XXX\Demonstration\Binary* (for example for STM32F103, the demonstration binary is named *STM32F103\_Nucleo\_Demo.hex* and located under *Projects\NUCLEO-F103RB\Demonstration\Binary*).
- Method 2: program the demonstration software as explained in [Section 2.3.2: Programming application](#).

Follow the sequence written hereafter to discover the demonstration:

1. The demonstration starts by checking the availability of Adafruit 1.8" TFT shield on top of the STM32 Nucleo board. This is done by reading the state of the IO PB.00 pin which is mapped to the Joystick available on Adafruit 1.8" TFT shield.  
If the state of PB.00 is high it means that the Adafruit 1.8" TFT shield is available.
2. Adafruit 1.8" TFT shield is not available:  
LED2 remains toggling with a first frequency equal to ~1Hz. Press the USER button so LED2 toggles with a second frequency equal to ~5Hz then press again the USER button, and LED2 will toggle with 10Hz frequency. This is done in an infinite loop.
3. Adafruit 1.8" TFT shield is available:  
**SD Card not available:** a message is displayed on the TFT indicating that an SD Card is missing. Insert an SD Card and reset the STM32 Nucleo board.  
**SD Card available:** a menu is displayed on the TFT. Follow the instructions given below:
  - a) Press the JoyStick DOWN to keep the menu display.
  - b) Choose the desired display mode: press the Joystick DOWN for automatic mode or press the JoyStick UP for manual mode.
  - c) If the manual mode is selected, press the JoyStick RIGHT to display the next image or press the JoyStick LEFT to display the previous image.  
Press JoyStick SEL to switch the display mode automatically. If the SD Card is unplugged during this mode, a message indicating that the SD Card is missing is displayed on the first attempt to display the next or the previous image.
  - d) If the automatic mode is selected, the images available on the SD Card are displayed sequentially in a forever loop. To switch to manual mode apply a long press (~1s) on JoyStick SEL. If the SD Card is unplugged during this mode, a message indicating its absence is displayed on the first attempt to display next image.
  - e) If the SD Card is not FAT formatted, a message is displayed on the TFT indicating that the formatting of the SD Card is necessary.
  - f) If the content of the SD Card is other than a bitmap file, a message is displayed on the TFT mentioning that it is not supported. In this case, format the SD Card and upload some *.bmp* files with the following criteria:
    - Dimensions:** 128x160 pixels
    - Width:** 128 pixels
    - Height:** 160 pixels
    - Bit depth:** 16
    - Item type:** BMP fileThe name of the bmp image file must not exceed 11 characters (including the *.bmp* extension) and all files must be stored under the root of the uSD.

*Note:* Ready to use *.bmp* files are available within the firmware package under the "Projects\NUCLEO-XXX\Demonstration\Media" folder.



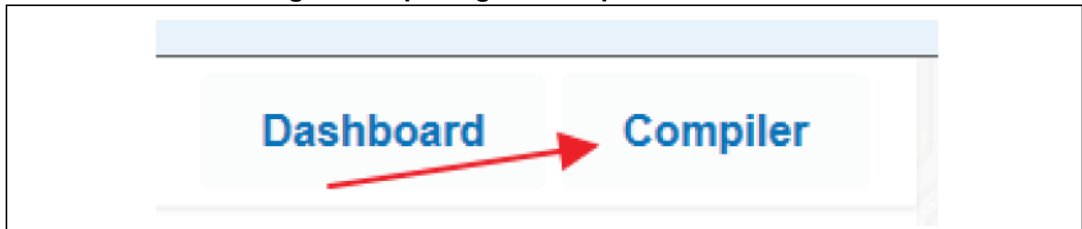
## 1.4 Quick start with mbed online tools

Access to the mbed on-line online tools at <http://mbed.org>.

Create your account by clicking on **signup**.

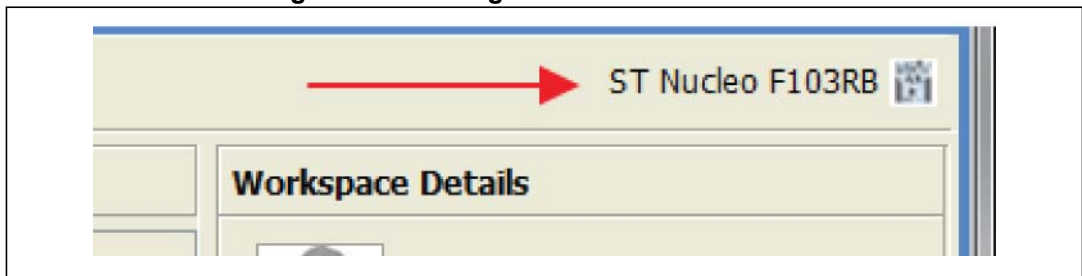
Once your account is created, open the compiler environment page by clicking on **Compiler** (Figure 3).

Figure 3. Opening the compiler environment



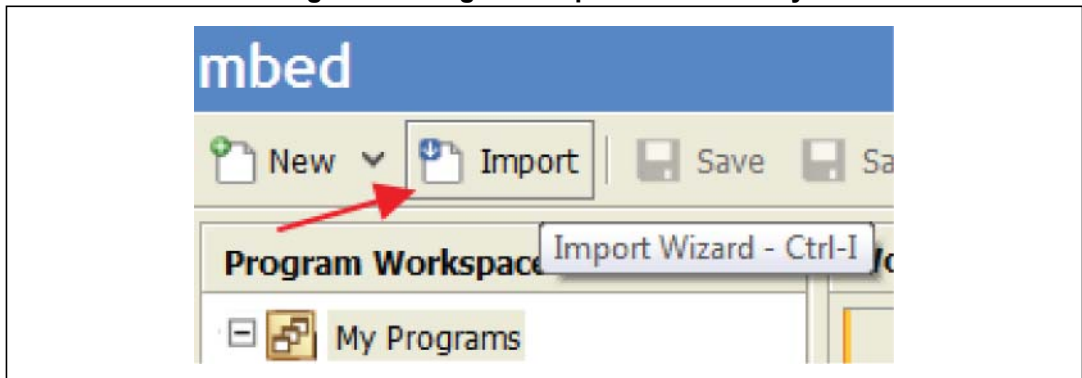
Select the STM32 Nucleo board of interest (Figure 4).

Figure 4. Selecting the STM32 Nucleo board



Click on **Import** and type "nucleo" in the search filter (Figure 5).

Figure 5. Using the "Import" functionality

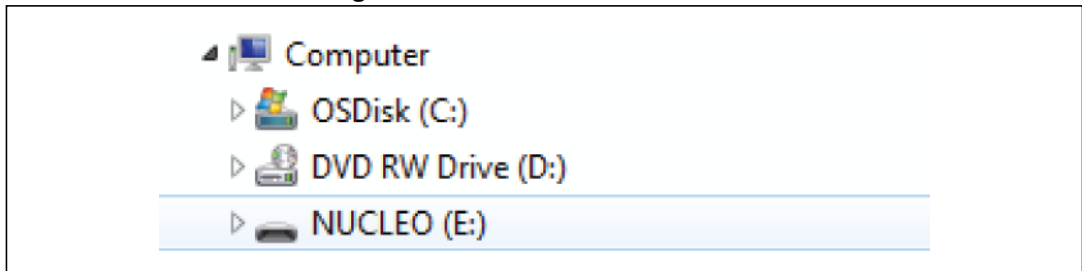


Import the example of your choice in your workspace.

*Note:* You can also go on the STM32 Nucleo board web page and import any example from this page.

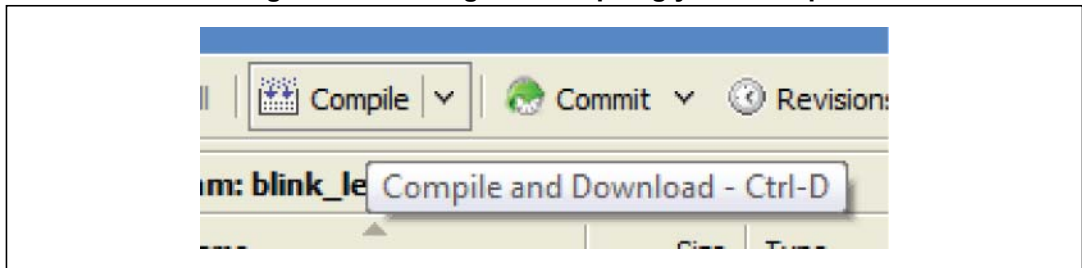
Plug-in the STM32 Nucleo board to the PC through the USB cable. You must see the NUCLEO drive (Figure 6).

Figure 6. Access to NUCLEO drive



Select and compile your example (Figure 7).

Figure 7. Selecting and compiling your example



When the compilation has ended, a window pops up asking to save the generated binary file.

Save the binary file on the NUCLEO drive.

The binary file is programmed into the MCU flash memory and the Nucleo board is automatically reset.

Your program is running. You can now create and share your own examples with others.

## 2 Firmware package based on Standard Peripheral Library

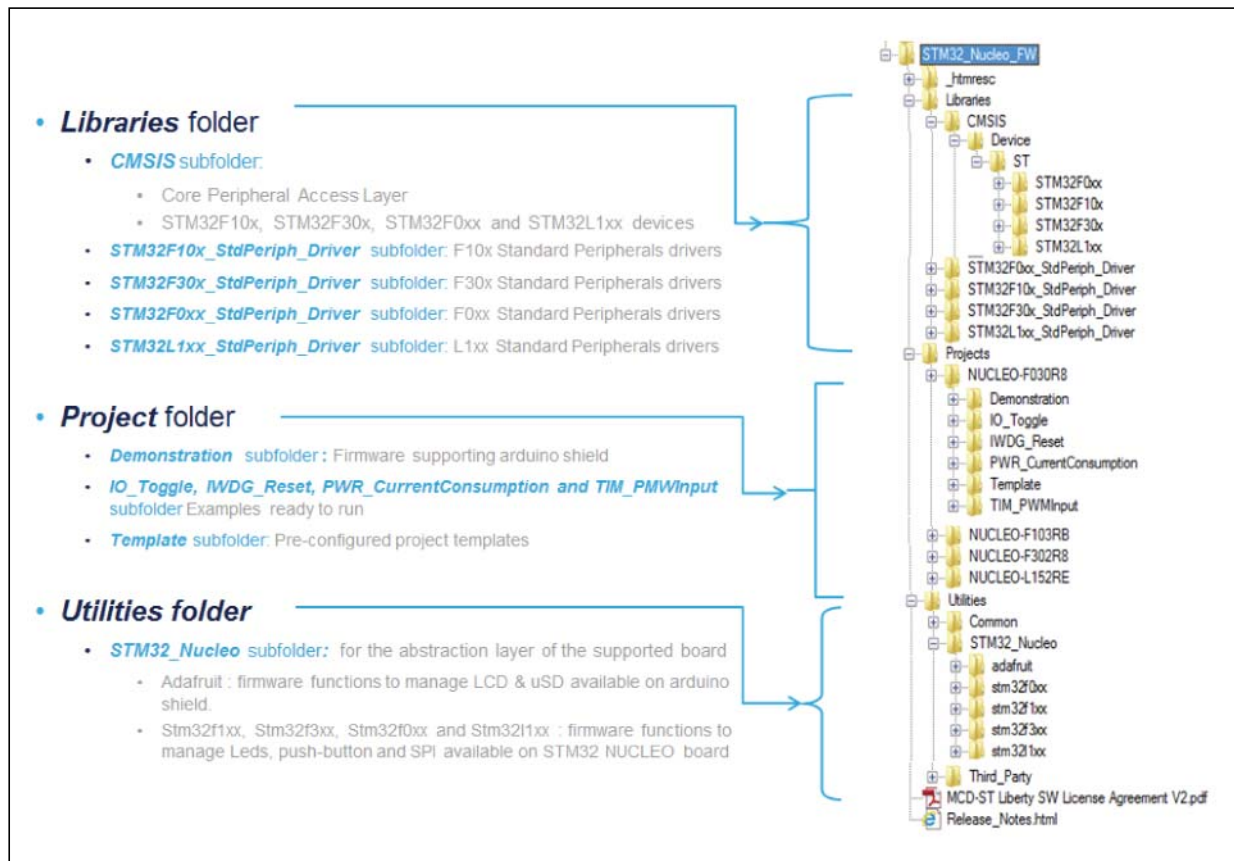
To start with the STM32 Nucleo board, we recommend that you use the firmware package that contains a set of IP examples and demonstration available at [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo).

### 2.1 Package description

The STM32 Nucleo board firmware drivers and examples are based on the Standard Peripheral library, and are provided in one single package supplied in a zip file. The extraction of the zip file generates one folder, STM32\_Nucleo\_FW\_VX.Y.Z that contains the sub folders shown in [Figure 8](#).

You can run the examples provided within this package (four examples are ready to be run).

Figure 8. Firmware package content

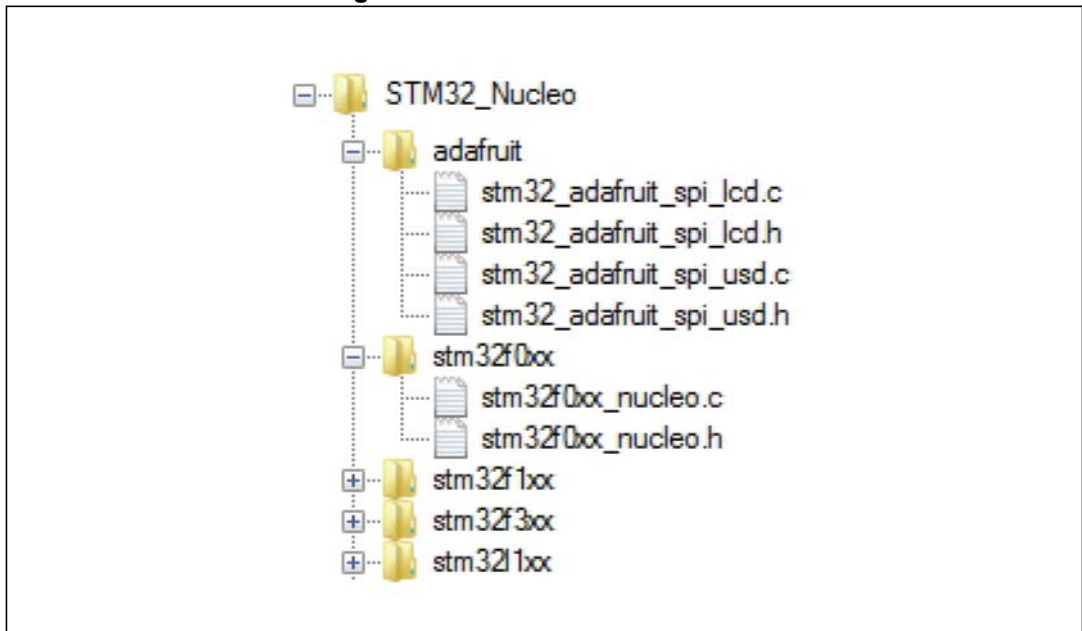


## 2.2 Nucleo BSP

The Nucleo BSP architecture driver supports three devices; the stm32f1xx, stm32f0xx and stm32l1xx. For each device, a set of Button, Led and Joystick drivers is stored in separate folders. The Adafruit folder includes the LCD and uSD driver of the Adafruit shield. These two drivers are common for all devices.

The SPI interface is used to drive the LCD and uSD card available on the Adafruit 1.8" TFT shield.

Figure 9. Nucleo BSP architecture



## 2.3 Programming firmware application

### 2.3.1 IDE requirement

Please proceed as follows to start programming:

1. Install the preferred Integrated Development Environment (IDE).
2. Install the ST-LINK/V2.1 driver available on ST website.

*Note: the required information to download and install the desired IDE and ST-LINK/V2.1 is detailed in [UM1727 - User manual - Getting started with STM32 Nucleo board software development tools](#).*

### 2.3.2 Programming application

Four IP examples are provided with the firmware package (*Figure 8*) under `STM32_Nucleo_FW_VX.Y.Z\Projects\`

Use one of two supported tool chains to program the application on the STM32 Nucleo board.

To program the demonstration application, follow the steps below:

1. Open the application folder `Projects\NUCLEO-XXX\Demonstration\`
2. Chose the desired IDE project (EWARM for IAR, MDK-ARM for Keil and TrueSTUDIO for Atmel)
3. Double click on the project file (for example `STM32xxx_Nucleo_Demo.eww` for EWARM)
4. Rebuild all files: Go to **Project** and select **Rebuild all**
5. Load the project image: Go to **Project-** and select **Debug**
6. Run the program: Go to **Debug** and select **Go**

The demonstration software as well as other software examples that allow you to discover the STM32 microcontroller features are available on ST website at [www.st.com/stm32nucleo](http://www.st.com/stm32nucleo).

### 3 References

1. STM32F103x8 STM32F103xB datasheet - Medium-density performance line ARM-based 32-bit MCU with 64 or 128 KB Flash, USB, CAN, 7 timers, 2 ADCs, 9 com. interfaces
2. STM32L151xE and STM32L152xE datasheet - Ultra-low-power 32-bit MCU ARM-based Cortex-M3 with 512KB Flash, 80KB SRAM, 16KB EEPROM, LCD, USB, ADC, DAC
3. STM32F030x4 STM32F030x6 STM32F030x8 datasheet - Value-line ARM-based 32-bit MCU with 16 to 64-KB Flash, timers, ADC, communication interfaces, 2.4-3.6 V operation
4. RM0091 - Reference manual - STM32F0x1/STM32F0x2/STM32F0x8 advanced ARM-based 32-bit MCUs
5. RM0008 - Reference manual - STM32F101xx, STM32F102xx, STM32F103xx, STM32F105xx and STM32F107xx advanced ARM-based 32-bit MCUs
6. RM0038 - Reference manual - STM32L100xx, STM32L151xx, STM32L152xx and STM32L162xx advanced ARM-based 32-bit MCUs
7. UM1724 - User manual - STM32 Nucleo board
8. UM1727 - User manual - Getting started with STM32 Nucleo board software development tools
9. STM32F302x4 STM32F302x6 STM32F302x8 datasheet- ARM<sup>®</sup>-Cortex<sup>®</sup>-M4 32b MCU+FPU, up to 64KB Flash, ADC, DAC, timers, I2C, USART, SPI/I2S, USB, CAN, COMP, PGA, 2.0 - 3.6 V
10. RM0365 - Reference manual - STM32F302xx advanced ARM-based 32-bit MCUs

## 4 Revision history

Table 1. Document revision history

Date	Revision	Changes
13-Feb-2014	1	Initial release.
09-Apr-2014	2	Replaced <i>Figure 1: STM32 Nucleo board<sup>(1)</sup></i> . Extended the applicability to NUCLEO-F302R8. Added the note in <i>Section 2.3.1: IDE requirement</i> . Updated: <ul style="list-style-type: none"><li>– the item 2. in <i>Section 2.3.2: Programming application</i>,</li><li>– <i>Figure 8: Firmware package content</i>,</li><li>– <i>Figure 9: Nucleo BSP architecture</i>,</li><li>– <i>Chapter 3: References</i>.</li></ul>

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