Getting started with STM32 Nucleo board software development tools

Introduction

The STM32 Nucleo board is a low-cost and easy-to-use development platform used to quickly evaluate and start a development with an STM32 microcontroller in LQFP64 package.

This document describes the software environment and development recommendations required to build an application around the STM32 Nucleo board. It provides guidelines to beginners on how to build and run a sample application and allows them to create and build their own application. It has the following structure:

- The first chapter presents software and hardware requirements (some toolchains supporting the STM32 families, ST-LINK/V2-1 installation and firmware package presentation).
- The second chapter provides step by step guideline on how to execute and debug an application example using some toolchains: – IAR Embedded Workbench® for ARM® (EWARM) by IAR systems® – Microcontroller Development Kit for ARM® (MDK-ARM) by Keil® – TrueSTUDIO® by Atollic®.

This manual doesn't cover all the topics relevant to software development environments, but it demonstrates the first basic steps necessary to get started with the compilers/debuggers and offers links to the documents needed to fully understand every single step.

Supported Nucleo boards are NUCLEO-F030R8, NUCLEO-F072RB, NUCLEO-F103RB, NUCLEO-302R8, NUCLEO-F334R8, NUCLEO-F401RE, NUCLEO-F411RE, NUCLEO-L053R8 and NUCLEO-L152RE. Others boards are under development, to get the updated list and for more information on the STM32 Nucleo board visit www.st.com/stm32nucleo.

Figure 1. Nucleo development tools

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1 System requirements

Before running your application, you should:

1. Install your preferred Integrated Development Environment (IDE).
2. ST-LINK/V2-1 driver will be installed automatically. In case of problem, you can proceed with manual installation of the driver from toolchains install directory (further details are available in *Section 3*).
3. Download the STM32 Nucleo firmware from www.st.com/stm32nucleo.
4. Establish the connection with the STM32 Nucleo board by connecting CN1 of the Nucleo board to the USB port of the PC.

The above steps will be details in the coming sections.

Figure 2. Hardware environment
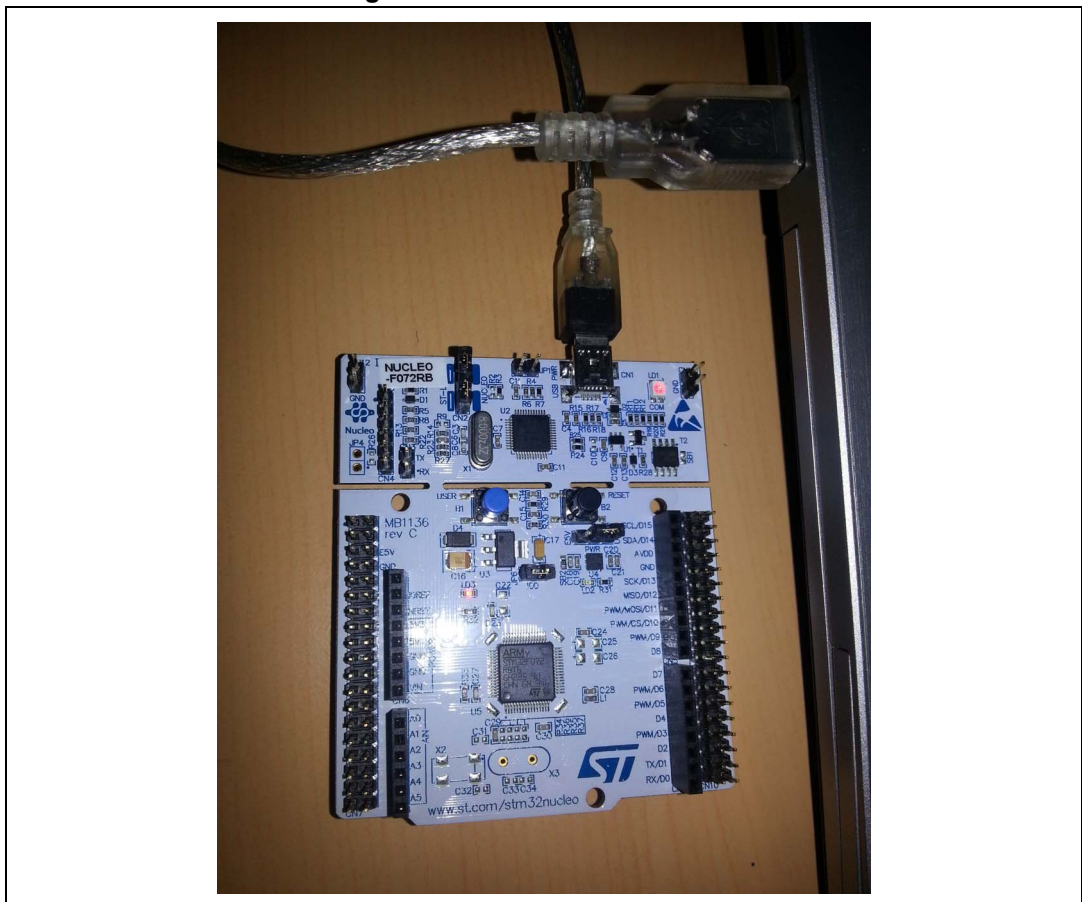
To run and develop any firmware application on an STM32 Nucleo board, the minimum requirements are as follows:

- Windows PC (XP, Vista, 7, 8)
- 'USB type A to Mini-B' cable, used to power the board (through USB connector CN1) from host PC and connect to the embedded ST-LINK/V2-1 for debugging and programming.

2 IDEs supporting STM32 Families

STMicroelectronics STM32 families of 32-bit ARM® Cortex®-M core-based microcontrollers are supported by a complete range of software tools. It encompasses traditional integrated development environment IDEs with C/C++ compilers and debuggers from major third-parties (free versions up to 64KB of code, depending on partner), completed with innovative tools from STMicroelectronics.

Toolchains supporting all Nucleo boards are:

- EWARM v7.10.3 or later[a]
    - 30-day evaluation edition
    - 32 KB Limited QuickStart edition(16KB Limitation for Cortex M0)
- MDK-ARM v5.01 or later [a][b]
    - MDK-Lite (32KB Code size limitation)
- TrueSTUDIO v5 or later[b]
    - 32 KB Limitation (8KB for Cortex-M0)

Information on the toolchain version supporting your STM32 device is available on toolchain's release note at partner web site (See *Section 4.2*).

Before installing and using the product, please accept the Evaluation Product License Agreement available at ww.st.com/epla.

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a. Registration before download is required.

b. The device support pack is separate from MDK-ARM releases.

3 ST-LINK/V2-1 installation

STM32 Nucleo board includes an ST-LINK/V2-1 embedded debug tool interface. The interface needs an ST-LINK/V2-1 dedicated USB driver to be installed. This driver is available at ST web site at www.st.com ST-LINK/V2-1 and supported within software toolchains:

- IAR Embedded Workbench® for ARM® (EWARM)

    The toolchain is installed by default in the C:\Program Files\IAR Systems\Embedded Workbench x.x directory on the PC's local hard disk.

    After installing EWARM, install the ST-LINK/V2-1 driver by running the ST-Link_V2_USB.exe from [IAR_INSTALL_DIRECTORY]\Embedded Workbench x.x\arm\drivers\ST-Link \ST-Link_V2_USBdriver.exe

- Keil Microcontroller Development Kit (MDK-ARM) toolchain

    The toolchain is installed by default in the C:\Keil directory on the PC's local hard disk; the installer creates a start menu µVision4 shortcut.

    When connecting the ST-LINK/V2-1 tool, the PC detects new hardware and requires to install the ST-LINK_V2_USB driver. The "Found New Hardware wizard" appears and guides you through the steps needed to install the driver from the recommended location.

- Atollic® TrueSTUDIO® STM32

    The toolchain is installed by default in the C:\Program Files\Atollic directory on the PC's local hard disk.

    The ST-Link_V2_USB.exe file is automatically installed when installing the software toolchain.

Complementary information on the firmware package content and the STM32 Nucleo requirements is available on the Getting started with STM32 Firmware.

Note: *The embedded ST-LINK/V2-1 only supports SWD interface for STM32 devices.*

4 Firmware package

The STM32 Nucleo firmware applications, demonstration and IP examples are provided in one single package and supplied in one single zip file. The extraction of the zip file generates one folder, STM32 Nucleo_FW_VX.Y.Z, which contains the following subfolders (see *Figure 3*).

Figure 3. Package contents
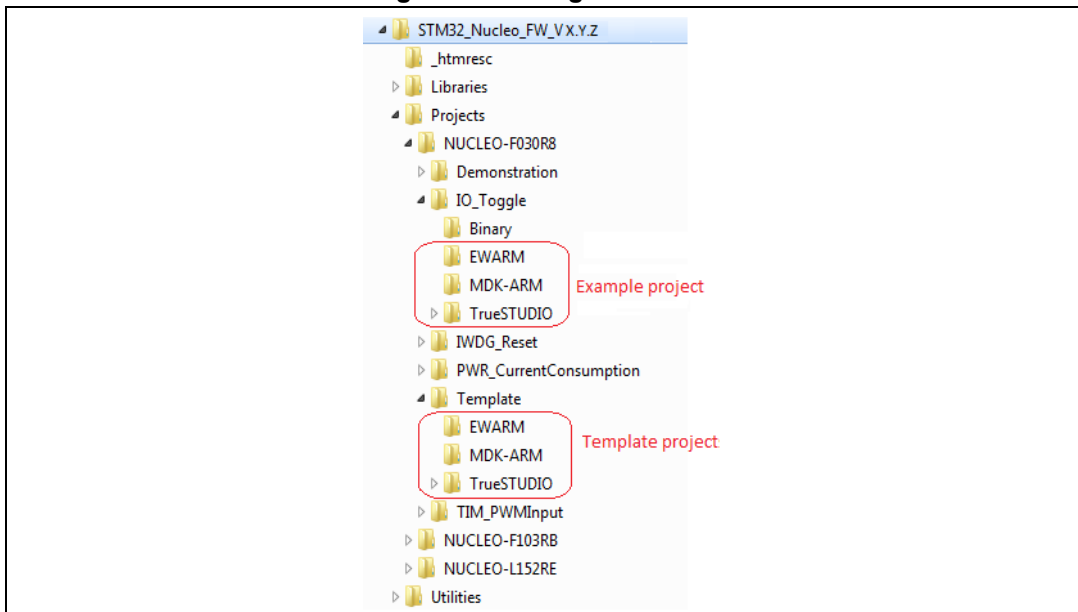
- **Template project** is a pre-configured project with empty main function to be customized by the user. This is helpful to start creating your own application based on the peripherals drivers.
- **Example project** includes toolchain projects for each peripheral example ready to be run.

4.1 Executing and debugging firmware using software toolchains

4.1.1 EWARM toolchain

The following procedure explains how to compile/link and execute an existing EWARM project.

The steps below can be applied to an already existing example, demonstration or template project available from STM32_Nucleo_FW_VX.Y.Z firmware at www.st.com web site.

First of all, you need to go through the firmware/readme.txt file which contains the firmware description and hardware/software requirements.

1. Open IAR Embedded Workbench® for ARM® (EWARM). *Figure 4* shows the basic names of the windows referred to in this document:

Figure 4. IAR Embedded Workbench IDE
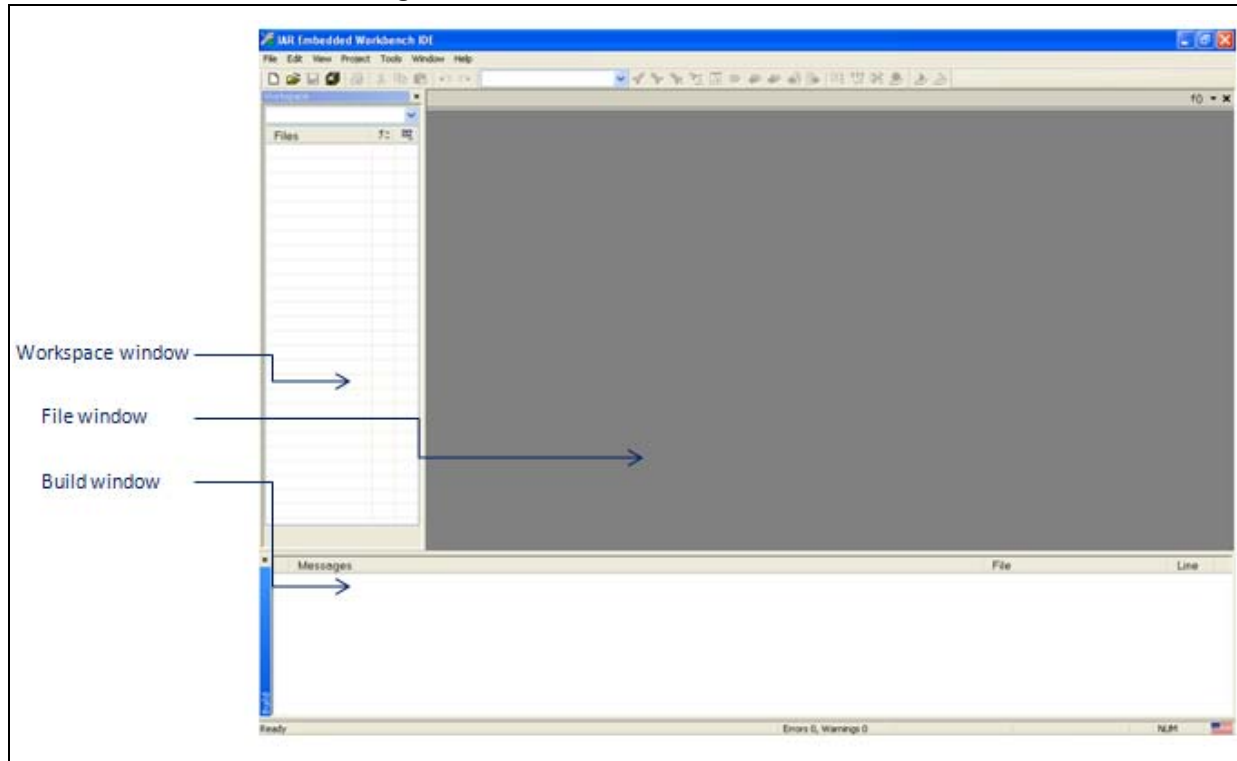
2. In the **File** menu, select **Open** and click **Workspace** to display the Open Workspace dialog box. Browse to select either an example or demonstration or template workspace file and click **Open** to launch it in the Project window.

3. In the **Project** menu, select **Rebuild All** to compile your project.

4. If your project is successfully compiled, *Figure 5* is displayed.

Figure 5. EWARM project successfully compiled
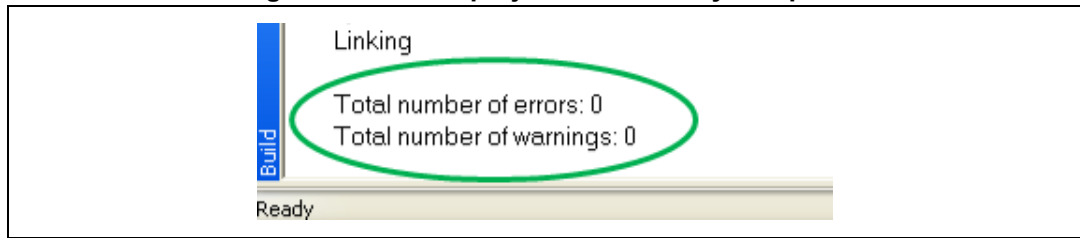
If you need to change the project settings (Include and preprocessor defines), go through the following project options:

– For Include directories:

Project>Options…>C/C++ compiler>

– For pre-processor defines:

Project>Options…C/C++ compiler>pre-processor>

5. In IAR Embedded Workbench IDE, from the **Project** menu, select **Download and Debug** or, alternatively, click the **Download and Debug** button in the toolbar, to program the Flash memory and start debugging.

Figure 6. Download and Debug button
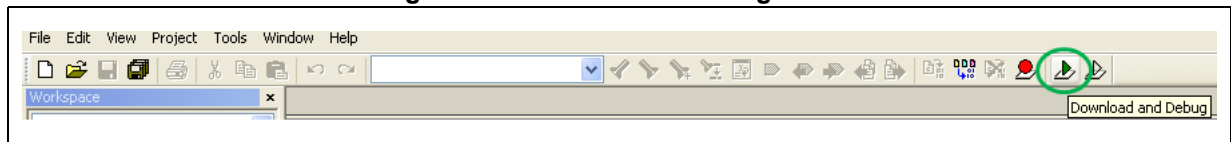
6. The debugger in IAR Embedded Workbench® can be used to debug source code at C and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.

Figure 7. IAR Embedded Workbench debugger screen
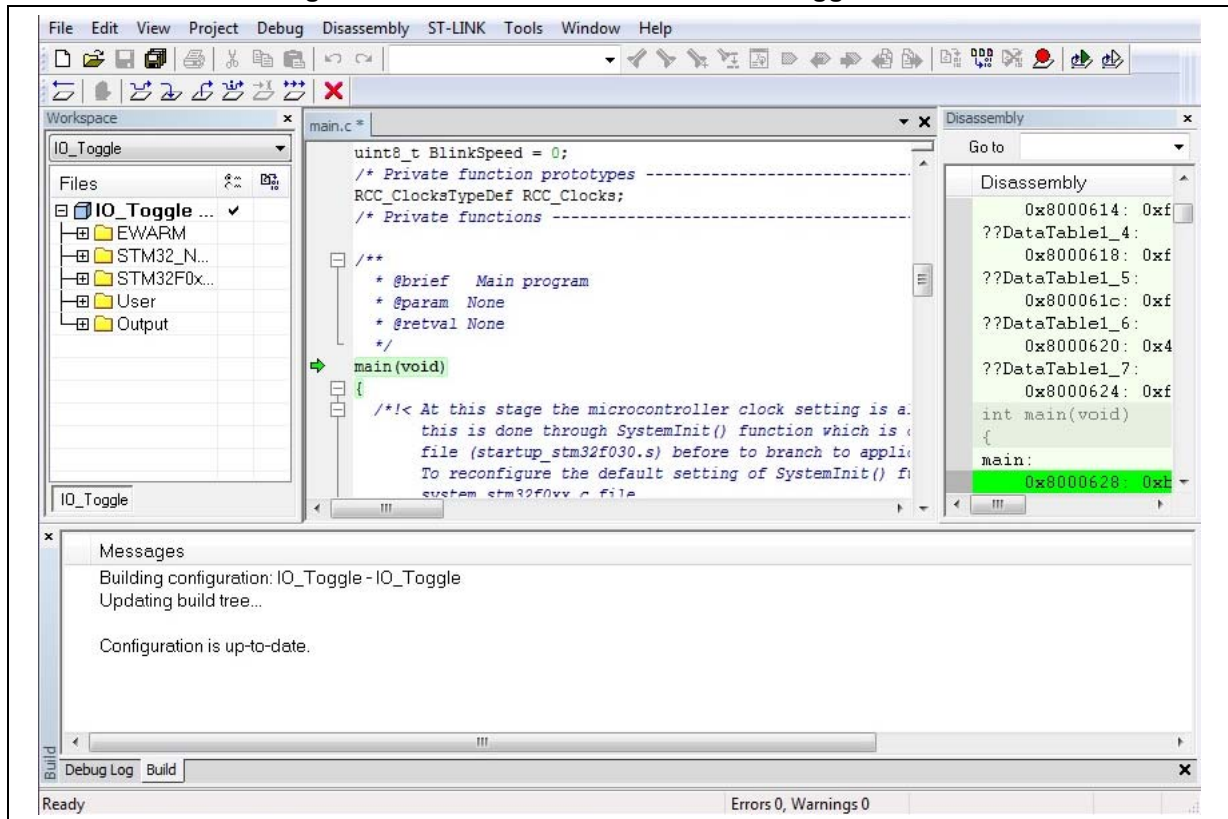
To run your application from the **Debug** menu, select **Go**. Alternatively, click the **Go** button in the toolbar to run your application.
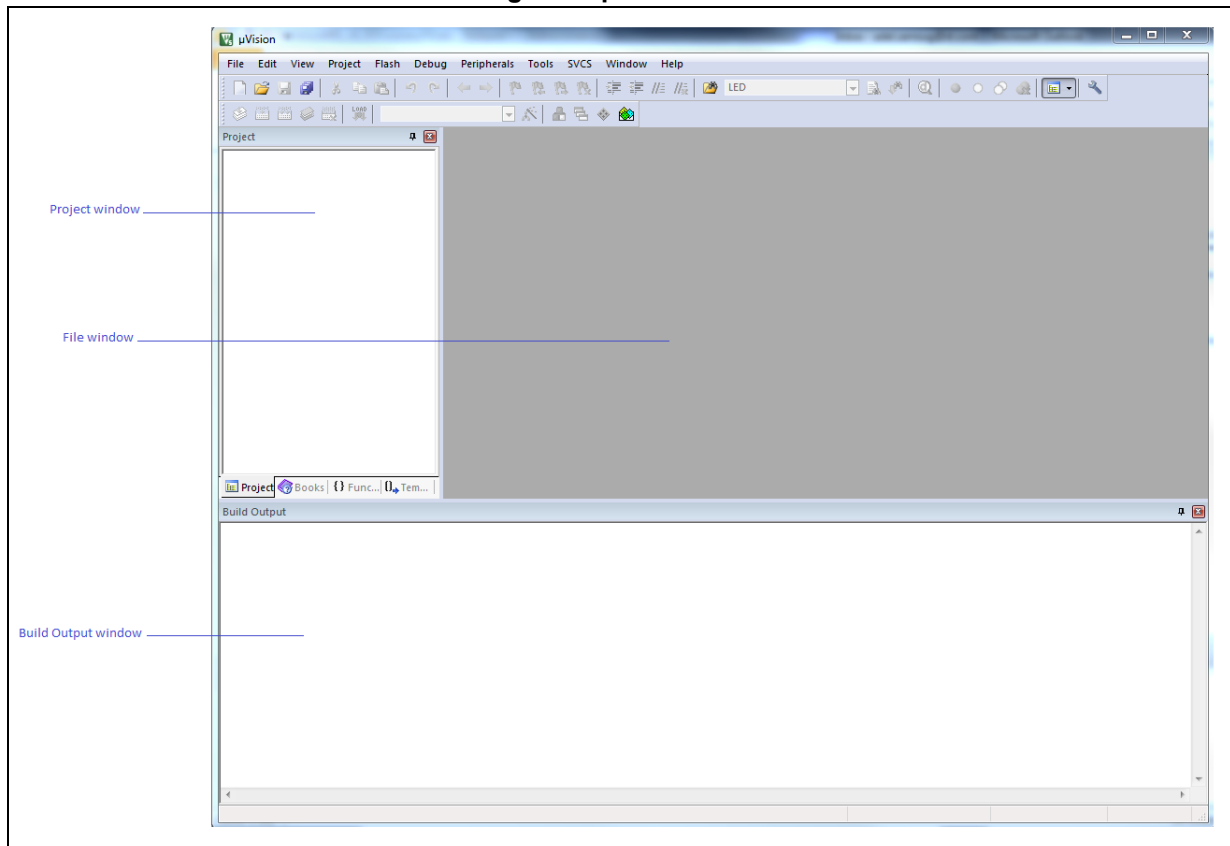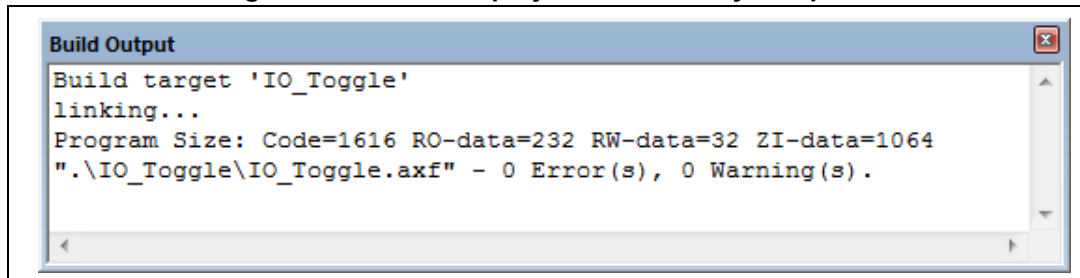
Figure 8. Go button
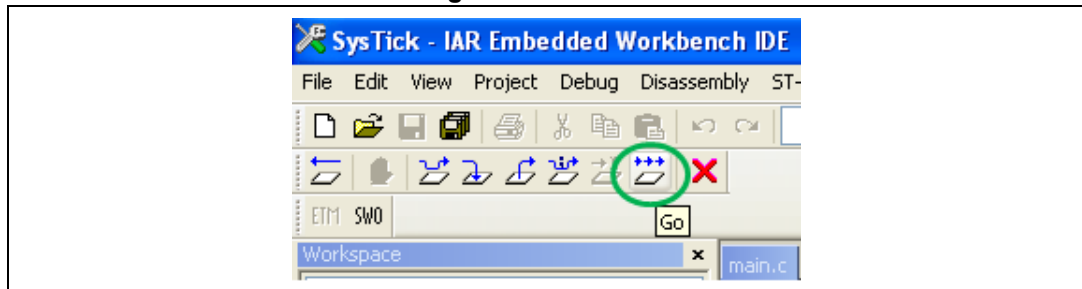
4.1.2 MDK-ARM toolchain

1. Open Keil MDK-ARM Microcontroller Development Kit. *Figure 9* shows the basic names of the "Keil μvision5" windows referred to in this document.

Figure 9. μvision5 IDE

2. In the **Project** menu, select **Open Project...** Browse to select either an example or demonstration or template project file and click **Open** to launch it in the Project window.
3. In the **Project** menu, select **Rebuild All target files** to compile your project.
4. If your project is successfully compiled, the following window is displayed:

Figure 10. MDK-ARM project successfully compiled


```
Build Output                                              ☒

Build target 'IO_Toggle'
linking...
Program Size: Code=1616 RO-data=232 RW-data=32 ZI-data=1064
".\IO_Toggle\IO_Toggle.axf" - 0 Error(s), 0 Warning(s).
```

If you need to change your project settings (Include and preprocessor defines), go through the project options:

– For Include directories:

Project>Options for Target > C/C++ > Include Paths

– For pre-processor defines:

**Project>Options for Target > C/C++ > Preprocessor symbols > Define**

5. In MDK-ARM IDE, from the **Debug** menu, select **Start/Stop Debug Session** or, alternatively, click the **Start/Stop Debug Session** button in the toolbar, to program the Flash memory and start debugging.

**Figure 11. Start/Stop Debug Session button**
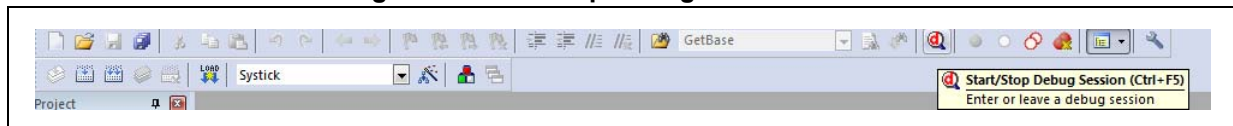
6. The debugger in the MDK-ARM can be used to debug source code at C and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.

Figure 12. MDK-ARM debugger screen
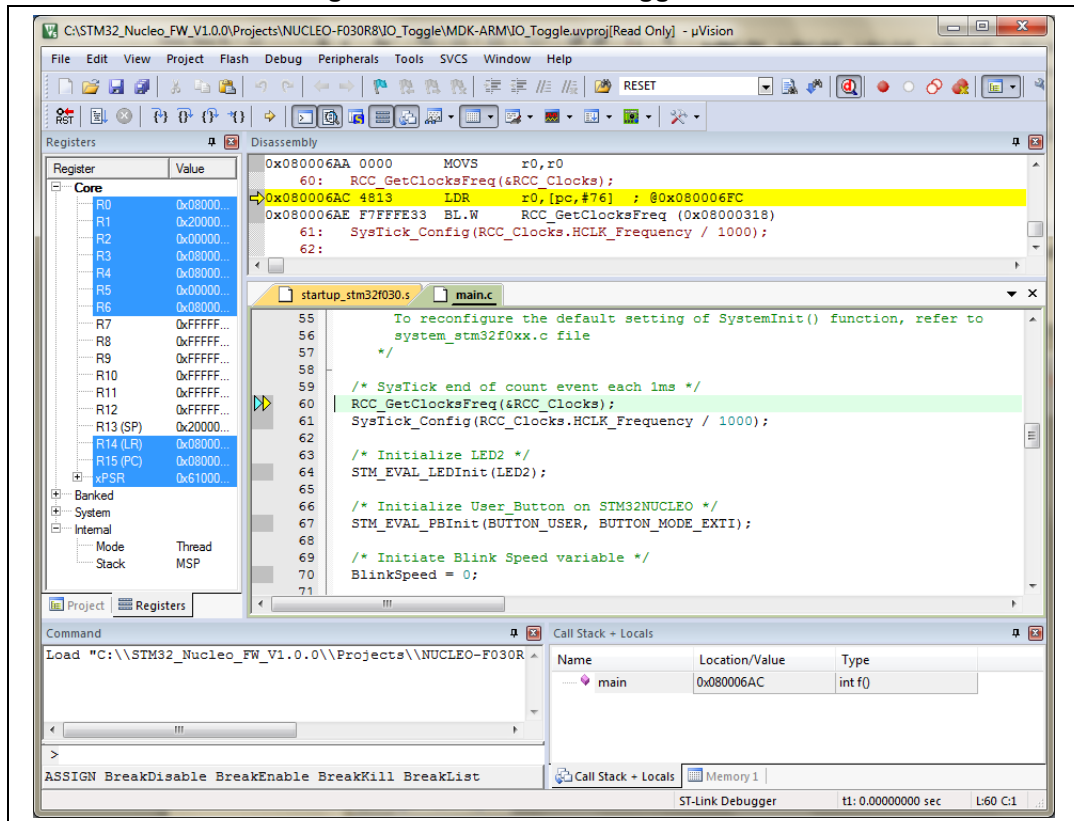
To run your application from the **Debug menu**, select **Run**. Alternatively, click the **Run** button in the toolbar to run your application.
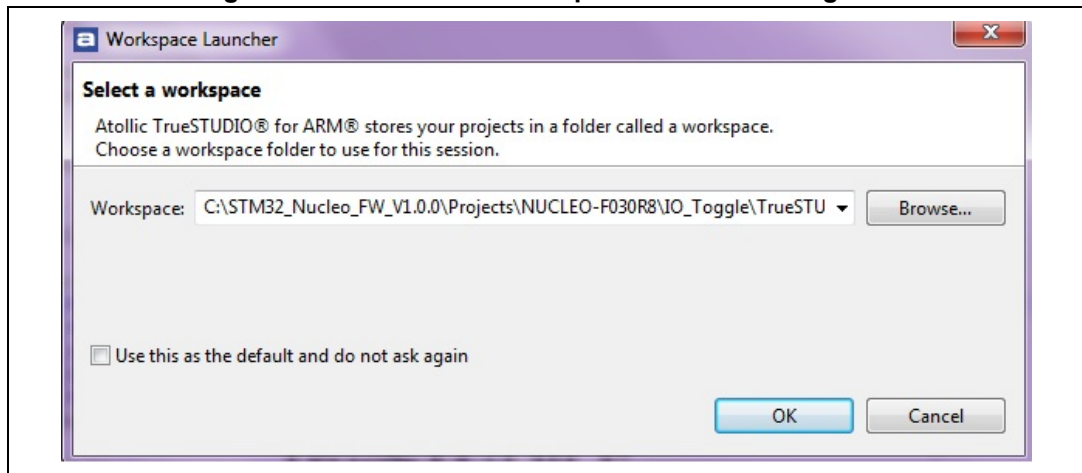
Figure 13. Run button
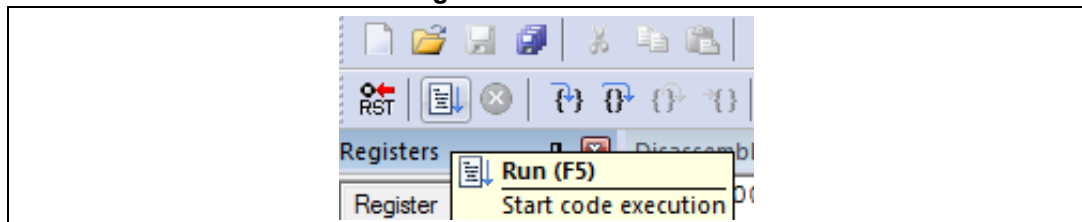
4.1.3 TrueSTUDIO toolchain

1. Open Atollic TrueSTUDIO® for ARM® product. The program launches and requires the Workspace location.

Figure 14. TrueSTUDIO workspace launcher dialog box

2. Browse to select a TrueSTUDIO workspace of either an example or demonstration or template workspace file and click **OK** to load it.

3. To load an existing project in the selected workspace, select **Import** from the **File** menu to display the **Import** dialog box.

4. In the **Import** window, open **General**, select **Existing Projects into Workspace** and click **Next**.

Figure 15. Atollic TrueSTUDIO® import source select dialog box
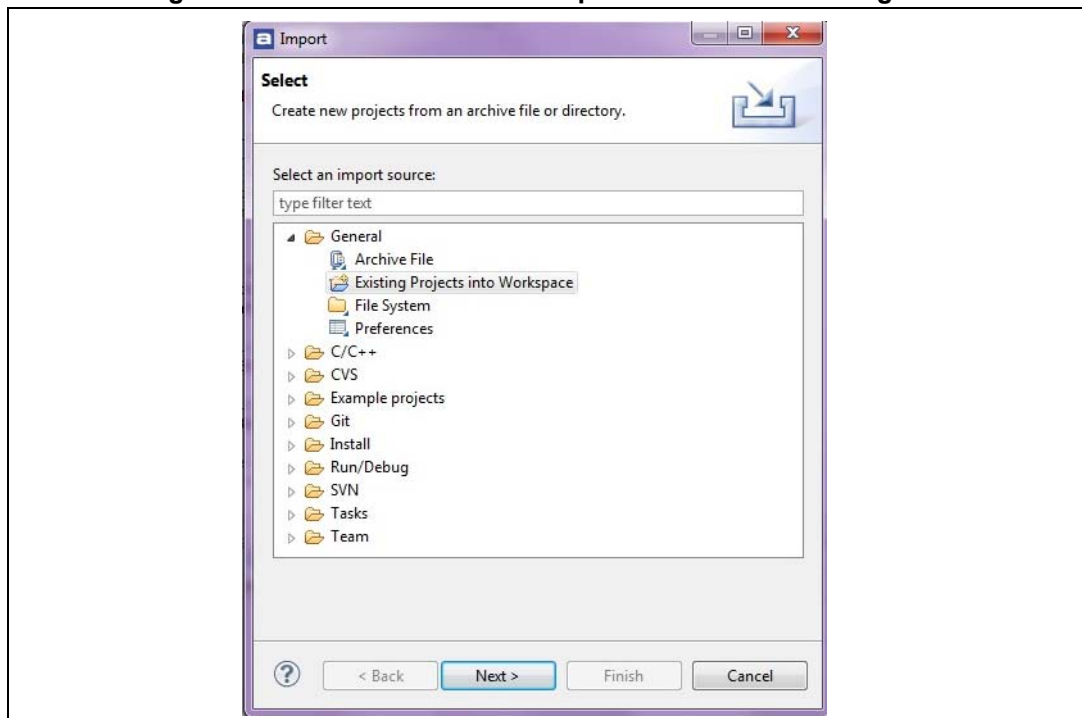
5.   Click **Select** root directory and browse to the TrueSTUDIO workspace folder.

Figure 16. Atollic TrueSTUDIO® import projects dialog box
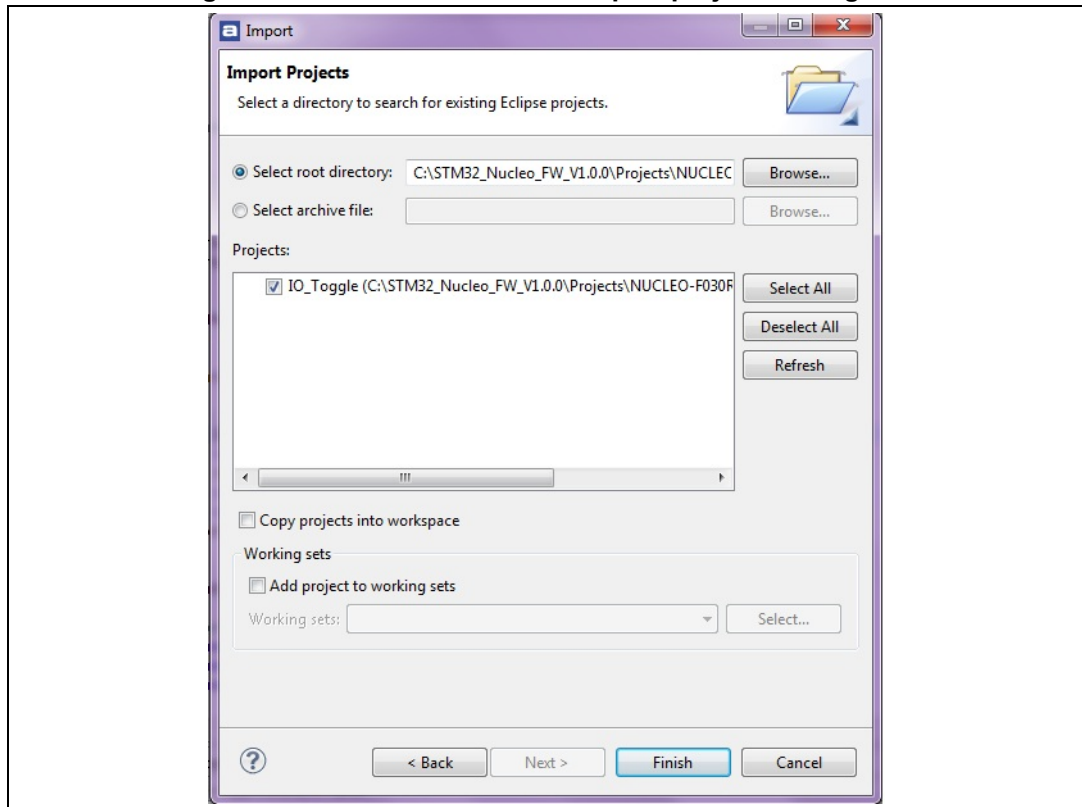
6. In the **Projects** panel, select the project and click **Finish**.

7. In the **Project Explorer**, select the project, open the **Project** menu, and click **Build Project**.

8. If your project is successfully compiled, the following messages will be displayed on the Console window.

**Figure 17. TrueSTUDIO® project successfully compiled**

If you need to change the project settings (Include directories and preprocessor defines), go through Project>Properties and select C/C++ Build>Settings from the left panel:

– For Include directories:

C Compiler>Directories>Include path

– For pre-processor defines:

C Compiler>Symbols> Defined symbols

9. To debug and run the application, select the project In the **Project Explorer** and press **F11** to start a debug session.

Figure 18. TrueSTUDIO debug window
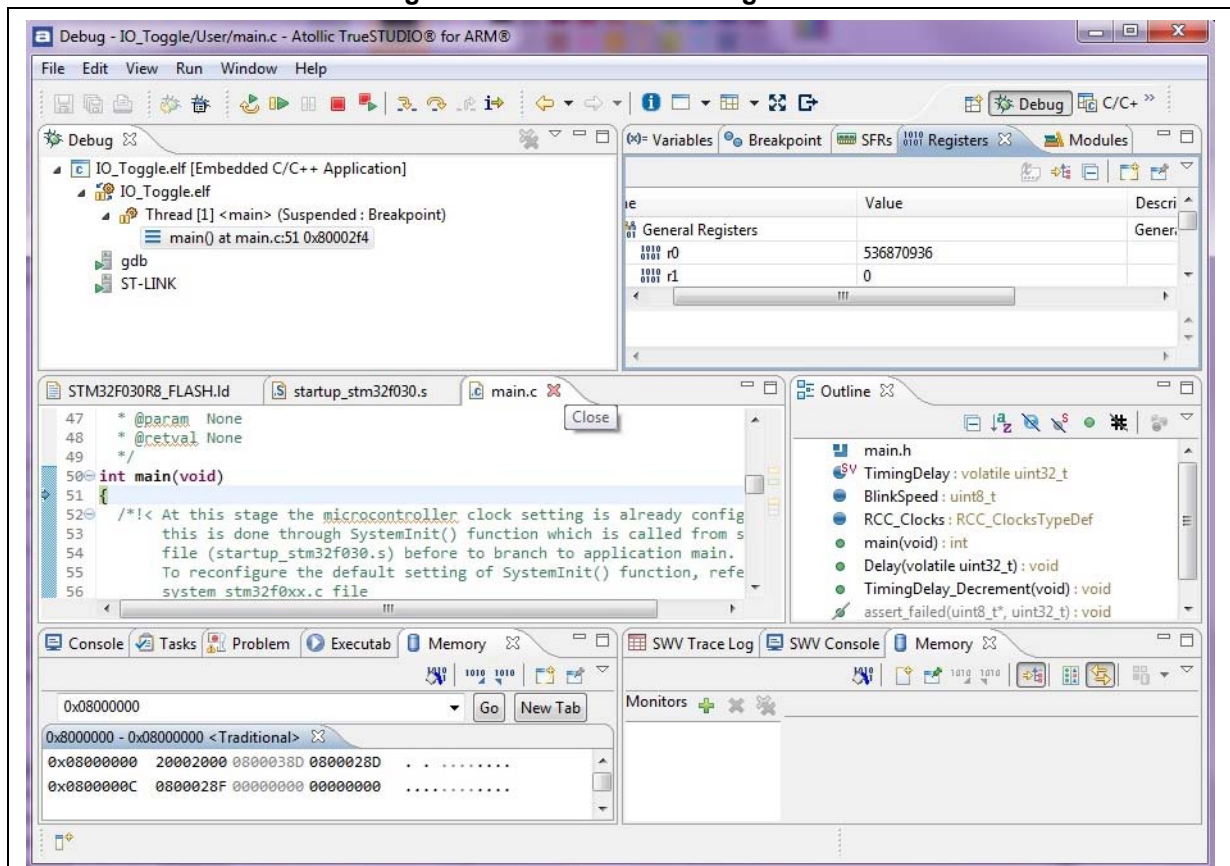
The debugger in the Atollic TrueSTUDIO can be used to debug source code at C and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.

To run your application, from the **Run** menu, select **Resume**, or alternatively click the **Resume** button in the toolbar.

4.2 Software toolchain helpful references and web sites

Table 1 gives useful references about the integrated development environments described in this document.

Table 1. References and web sites

Toolchain	Web sites
EWARM	www.iar.com
MDK-ARM	www.keil.com
TrueSTUDIO	www.atollic.com

5 Revision history

Table 2. Document revision history

Date	Revision	Changes
19-May-2014	1	Initial release
20-Jun-2014	2	Added new part numbers in the cover page. Removed Table1 Nucleo board General information.

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