NXP Semiconductors
User's Guide

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Getting Started with MCUXpresso SDK for MIMXRT105X

1 Overview

The MCUXpresso Software Development Kit (SDK) provides comprehensive software support for Kinetis and LPC Microcontrollers. The MCUXpresso SDK includes a flexible set of peripheral drivers designed to speed up and simplify development of embedded applications. Along with the peripheral drivers, the MCUXpresso SDK provides an extensive and rich set of example applications covering everything from basic peripheral use case examples to full demo applications. The MCUXpresso SDK contains FreeRTOS and various other middleware to support rapid development.

For supported toolchain versions, see the MCUXpresso SDK Release Notes Supporting EVK-MIMXRT105X (document MCUXSDKMIMXRT105XRN).

For the latest version of this and other MCUXpresso SDK documents, see the MCUXpresso SDK homepage MCUXpresso-SDK: Software Development Kit for MCUXpresso.

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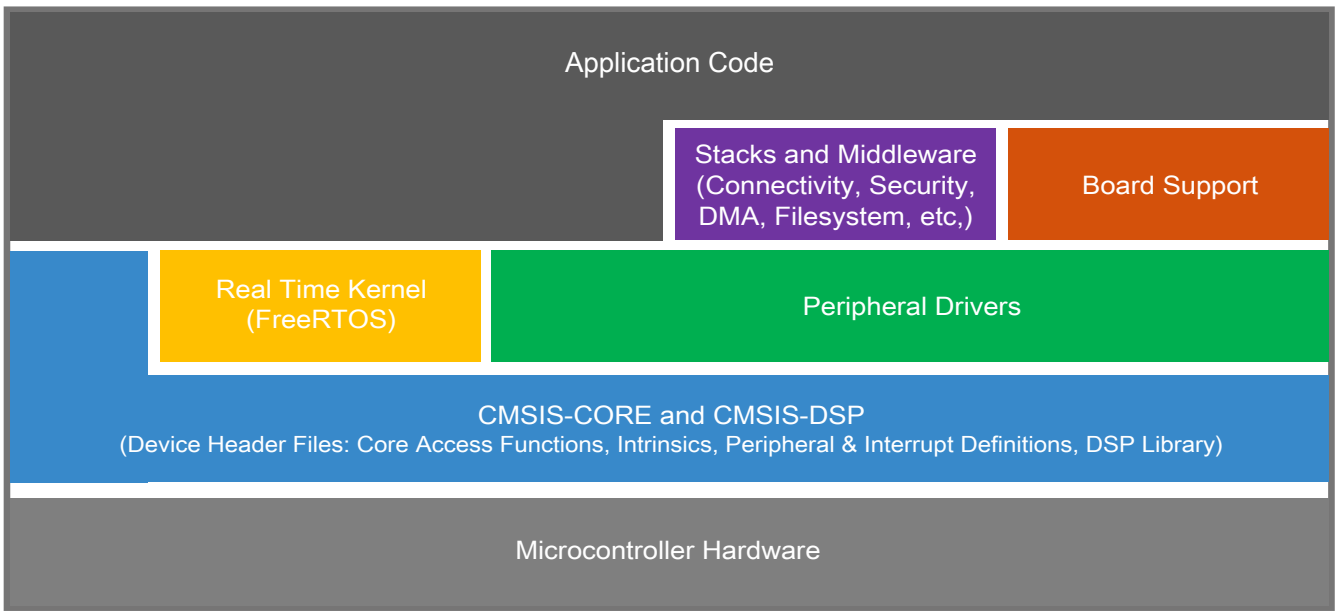

Figure 1. MCUXpresso SDK layers

2 MCUXpresso SDK Board Support Folders

MCUXpresso SDK board support provides example applications for NXP development and evaluation boards for Arm® Cortex®-M cores, including Freedom, Tower System, and LPCXpresso boards. Board support packages are found inside of the top level boards folder, and each supported board has its own folder (an MCUXpresso SDK package can support multiple boards). Within each <board_name> folder, there are various sub-folders to classify the type of examples they contain. These include (but are not limited to):

- demo_apps: Full-featured applications intended to highlight key functionality and use cases of the target MCU. These applications typically use multiple MCU peripherals and may leverage stacks and middleware.
- driver_examples: Simple applications intended to concisely illustrate how to use the MCUXpresso SDK's peripheral drivers for a single use case. These applications typically only use a single peripheral, but there are cases where multiple are used (for example, SPI conversion using DMA).
- rtos_examples: Basic FreeRTOS™ OS examples showcasing the use of various RTOS objects (semaphores, queues, and so on) and interfacing with the MCUXpresso SDK's RTOS drivers

2.1 Example Application Structure

This section describes how the various types of example applications interact with the other components in the MCUXpresso SDK. To get a comprehensive understanding of all MCUXpresso SDK components and folder structure, see the *MCUXpresso SDK API Reference Manual* document (MCUXSDKAPIRM).

Each <board_name> folder in the boards directory contains a comprehensive set of examples that are relevant to that specific piece of hardware. We'll discuss the hello_world example (part of the demo_apps folder), but the same general rules apply to any type of example in the <board_name> folder.

In the hello_world application folder you see this:

All files in the application folder are specific to that example, so it is easy to copy and paste an existing example to start developing a custom application based on a project provided in the MCUXpresso SDK.

2.2 Locating Example Application Source Files

When opening an example application in any of the supported IDE (except MCUXpresso IDE), there are a variety of source files referenced. The MCUXpresso SDK devices folder is the central component to all example applications. It means the examples reference the same source files and, if one of these files is modified, it could potentially impact the behavior of other examples.

The main areas of the MCUXpresso SDK tree used in all example applications are:

- devices/<device_name>: The device's CMSIS header file, MCUXpresso SDK feature file and a few other things.
- devices/<device_name>/drivers: All of the peripheral drivers for your specific MCU.
- devices/<device_name>/<tool_name>: Toolchain-specific startup code. Vector table definitions are here.
- devices/<device_name>/utilities: Items such as the debug console that are used by many of the example applications.

For examples containing an RTOS, there are references to the appropriate source code. RTOSes are in the *rtos* folder. Again, the core files of each of these are shared, so modifying them could have potential impacts on other projects that depend on them.

3 Run a demo application using IAR

This section describes the steps required to build, run, and debug example applications provided in the MCUXpresso SDK. The hello_world demo application targeted for the EVK-MIMXRT1050 hardware platform is used as an example, although these steps can be applied to any example application in the MCUXpresso SDK.

3.1 Build an example application

The following steps guide you through opening the hello_world example application. These steps may change slightly for other example applications as some of these applications may have additional layers of folders in their path.

1. If not already done, open the desired demo application workspace. Most example application workspace files can be located using the following path:

   <install_dir>/boards/<board_name>/<example_type>/<application_name>/iar

   Using the EVK-MIMXRT1050 hardware platform as an example, the hello_world workspace is located in

   <install_dir>/boards/evkmimxrt1050/demo_apps/hello_world/iar/hello_world.eww

2. Select the desired build target from the drop-down.
   There are four project configurations (build targets) supported for most MCUXpresso SDK projects:
   - Debug – Compiler optimization is set to low, and debug information is generated for the executable. The linker file is RAM linker, where text and data section is put in internal TCM.

- Release – Compiler optimization is set to high, and debug information is not generated. The linker file is RAM linker, where text and data section is put in internal TCM.
- sdram_debug - Project configuration is same as Debug target. The linker file is SDRAM linker, where text is put in internal TCM and data put in SDRAM.
- sdram_release - Project configuration is same as Release target. The linker file is SDRAM linker, where text is put in internal TCM and data put in SDRAM.

For some examples need large data memory, only sdram_debug and sdram_release targets are supported.

For this example, select the “hello_world – Debug” target.

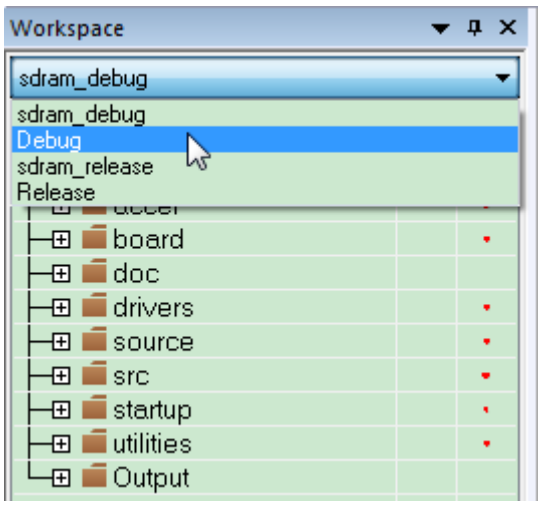

Figure 2. Demo build target selection

3. To build the demo application, click the “Make” button, highlighted in red below.

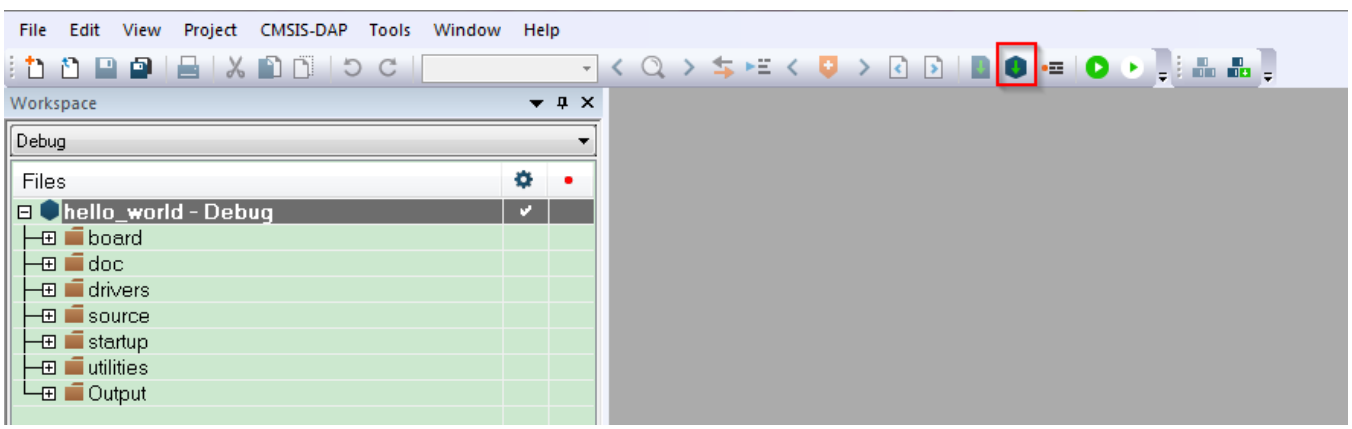

Figure 3. Build the demo application

4. The build completes without errors.

3.2 Run an example application

To download and run the application, perform these steps:

1. This board supports the CMSIS-DAP/mbed/DAPLink debug probe by default. Visit developer.mbed.org/handbook/Windows-serialconfiguration and follow the instructions to install the Windows® operating system serial driver. If running on Linux OS, this step is not required.
2. Connect the development platform to your PC via USB cable.
3. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug COM port (to determine the COM port number, see Appendix A). Configure the terminal with these settings:
   a. 115200 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in board.h file)
   b. No parity
   c. 8 data bits
   d. 1 stop bit

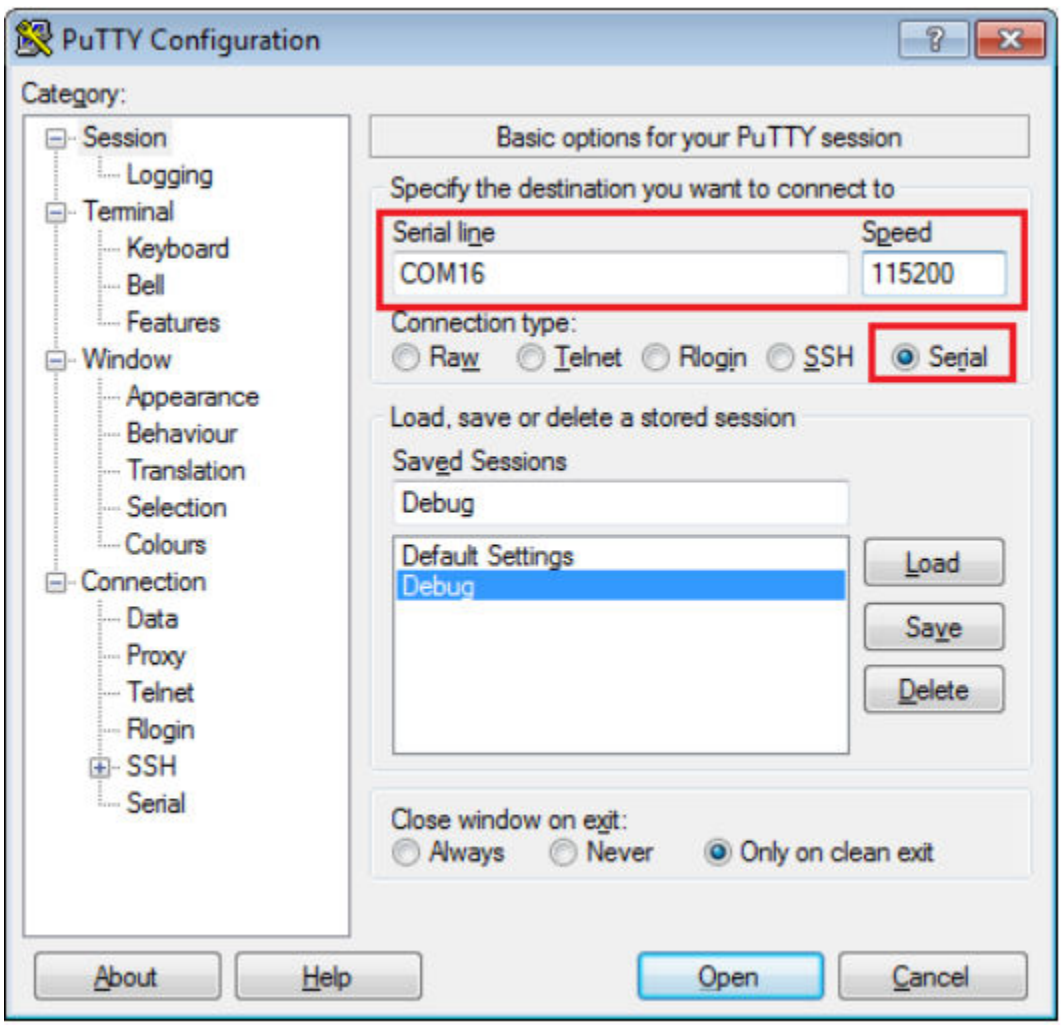

Figure 4. Terminal (PuTTY) configuration

4. In IAR, click the "Download and Debug" button to download the application to the target.

Figure 5. Download and Debug button

5. The application is then downloaded to the target and automatically runs to the main() function.

6. Run the code by clicking the "Go" button to start the application.

Figure 6. Go button

7. The hello_world application is now running and a banner is displayed on the terminal. If this is not true, check your terminal settings and connections.

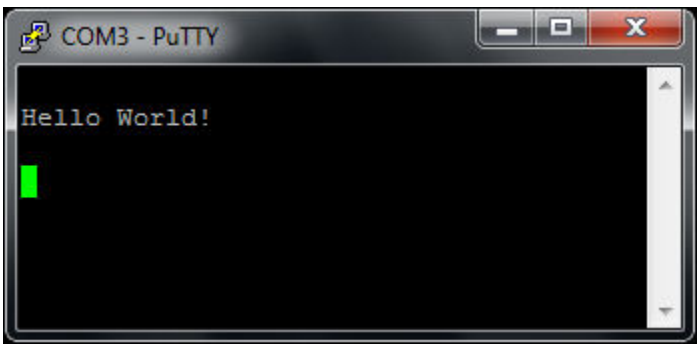

Figure 7. Text display of the hello_world demo

4 Run a demo using Keil® MDK/µVision

This section describes the steps required to build, run, and debug example applications provided in the MCUXpresso SDK.

4.1 Install CMSIS device pack

After the MDK tools are installed, Cortex® Microcontroller Software Interface Standard (CMSIS) device packs must be installed to fully support the device from a debug perspective. These packs include things such as memory map information, register definitions and flash programming algorithms. Follow these steps to install the MIMXRT105x CMSIS pack.

1. Download the iMXRT pack
2. After downloading the DFP, double click to install it.

4.2 Build an example application

- Open the desired example application workspace in: <install_dir>/boards/<board_name>/<*example_type*>/<application_name>/mdk

  The workspace file is named <demo_name>.uvmpw, so for this specific example, the actual path is:

  <install_dir>/boards/evkmimxrt1050/demo_apps/hello_world/mdk/hello_world.uvmpw
- To build the demo project, select the "Rebuild" button, highlighted in red.

Figure 8. Build the demo

- The build completes without errors.

4.3 Run an example application

To download and run the application, perform these steps:

1. This board supports the CMSIS-DAP/mbed/DAPLink debug probe by default. Visit developer.mbed.org/handbook/Windows-serialconfiguration and follow the instructions to install the Windows® operating system serial driver. If running on Linux OS, this step is not required.
2. Connect the development platform to your PC via USB cable.
3. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug serial port number (to determine the COM port number, see Appendix A). Configure the terminal with these settings:
   a. 115200 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in board.h file)
   b. No parity
   c. 8 data bits
   d. 1 stop bit

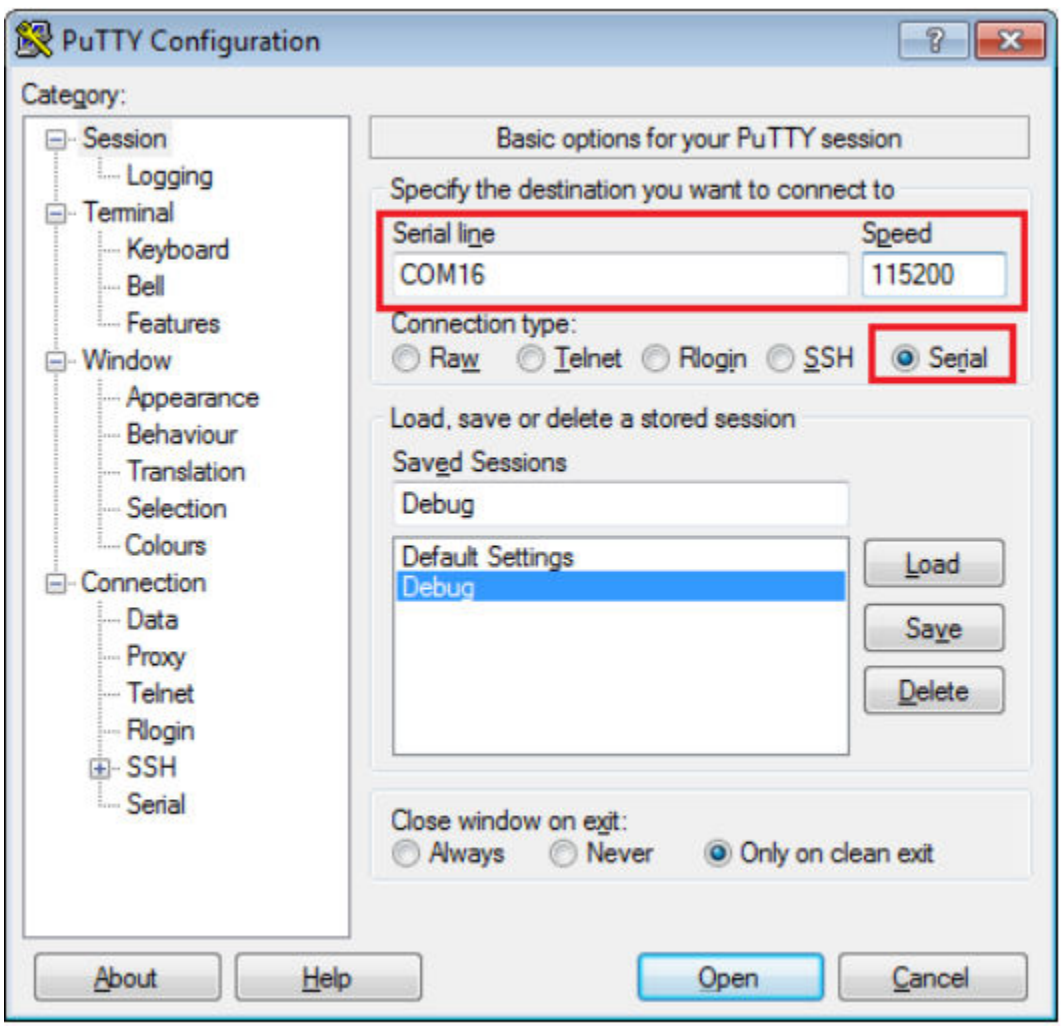

Figure 9. Terminal (PuTTY) configurations

4. To debug the application, click the “Start/Stop Debug Session” button, highlighted in red.

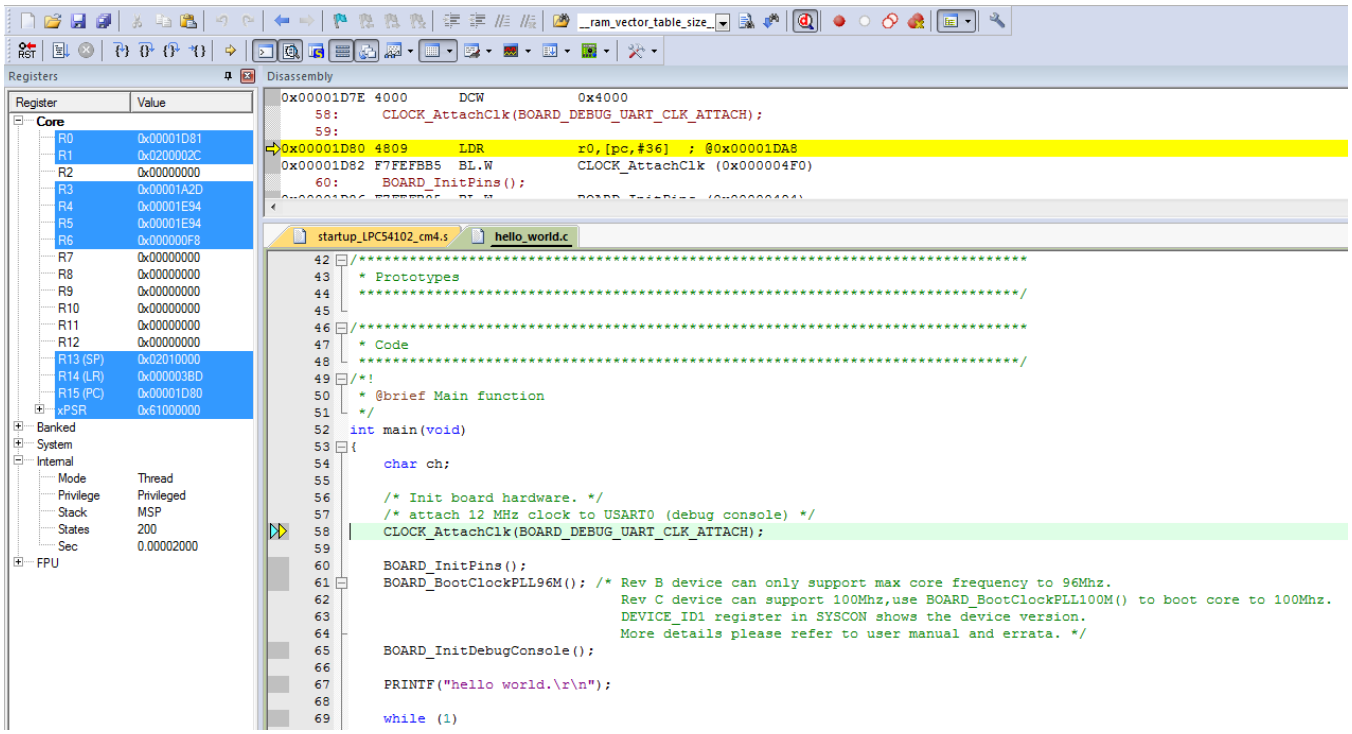

Figure 10. Stop at main() when run debugging

5. Run the code by clicking the “Run” button to start the application.

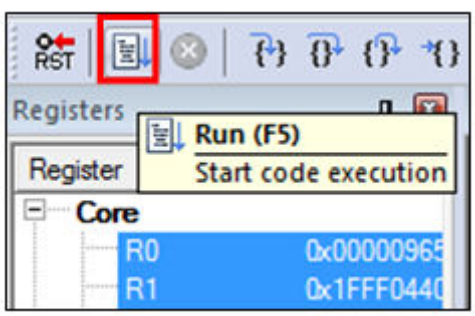

Figure 11. Go button

The hello_world application is now running and a banner is displayed on the terminal. If this is not true, check your terminal settings and connections.

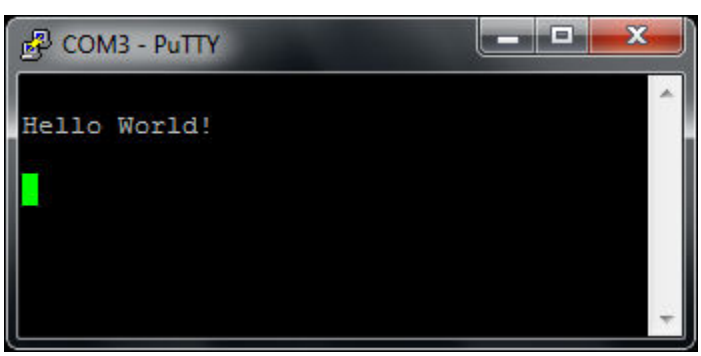

Figure 12. Text display of the hello_world demo

5 Run a demo using Arm® GCC

This section describes the steps to configure the command line Arm® GCC tools to build, run, and debug demo applications and necessary driver libraries provided in the MCUXpresso SDK. The hello_world demo application targeted for the is used as an example, though these steps can be applied to any board, demo or example application in the MCUXpresso SDK.

5.1 Set up toolchain

This section contains the steps to install the necessary components required to build and run a MCUXpresso SDK demo application with the Arm GCC toolchain, as supported by the MCUXpresso SDK. There are many ways to use Arm GCC tools, but this example focuses on a Windows operating system environment.

5.1.1 Install GCC ARM Embedded tool chain

Download and run the installer from launchpad.net/gcc-arm-embedded. This is the actual toolset (in other words, compiler, linker, etc.). The GCC toolchain should correspond to the latest supported version, as described in the *MCUXpresso SDK Release Notes Supporting EVK-MIMXRT1050*. (document MCUXSDKMIMXRT105XRN).

5.1.2 Install MinGW (only required on Windows OS)

The Minimalist GNU for Windows (MinGW) development tools provide a set of tools that are not dependent on third party C-Runtime DLLs (such as Cygwin). The build environment used by the SDK does not utilize the MinGW build tools, but does leverage the base install of both MinGW and MSYS. MSYS provides a basic shell with a Unix-like interface and tools.

1. Download the latest MinGW mingw-get-setup installer from sourceforge.net/projects/mingw/files/Installer/.
2. Run the installer. The recommended installation path is C:\MinGW, however, you may install to any location.

NOTE

The installation path cannot contain any spaces.

3. Ensure that the “mingw32-base” and “msys-base” are selected under Basic Setup.

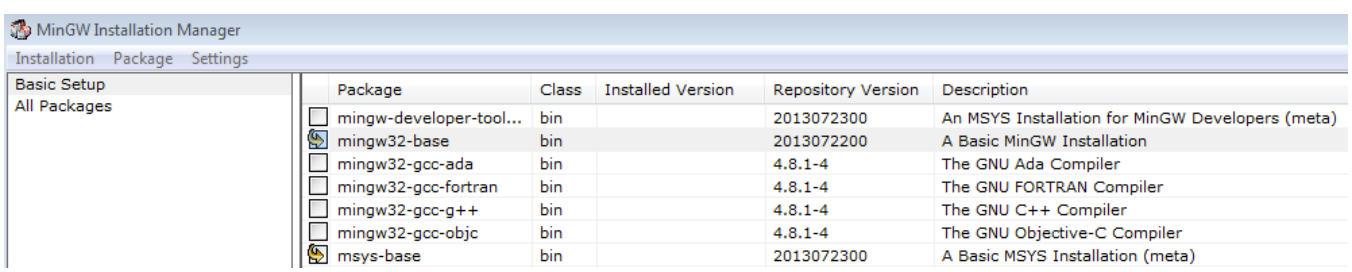

Figure 13. Setup MinGW and MSYS

4. Click “Apply Changes” in the “Installation” menu and follow the remaining instructions to complete the installation.

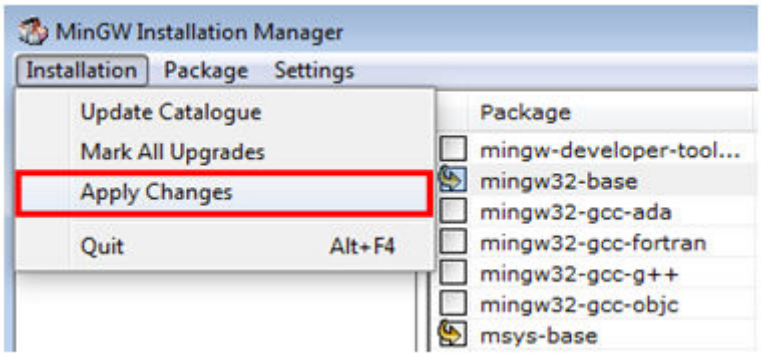

Figure 14. Complete MinGW and MSYS installation

5. Add the appropriate item to the Windows operating system path environment variable. It can be found under *Control Panel -> System and Security -> System -> Advanced System Settings* in the "Environment Variables..." section. The path is:

   <mingw_install_dir>\bin

   Assuming the default installation path, C:\MinGW, an example is shown below. If the path is not set correctly, the toolchain does not work.

NOTE

If you have "C:\MinGW\msys\x.x\bin" in your PATH variable (as required by KSDK 1.0.0), remove it to ensure that the new GCC build system works correctly.

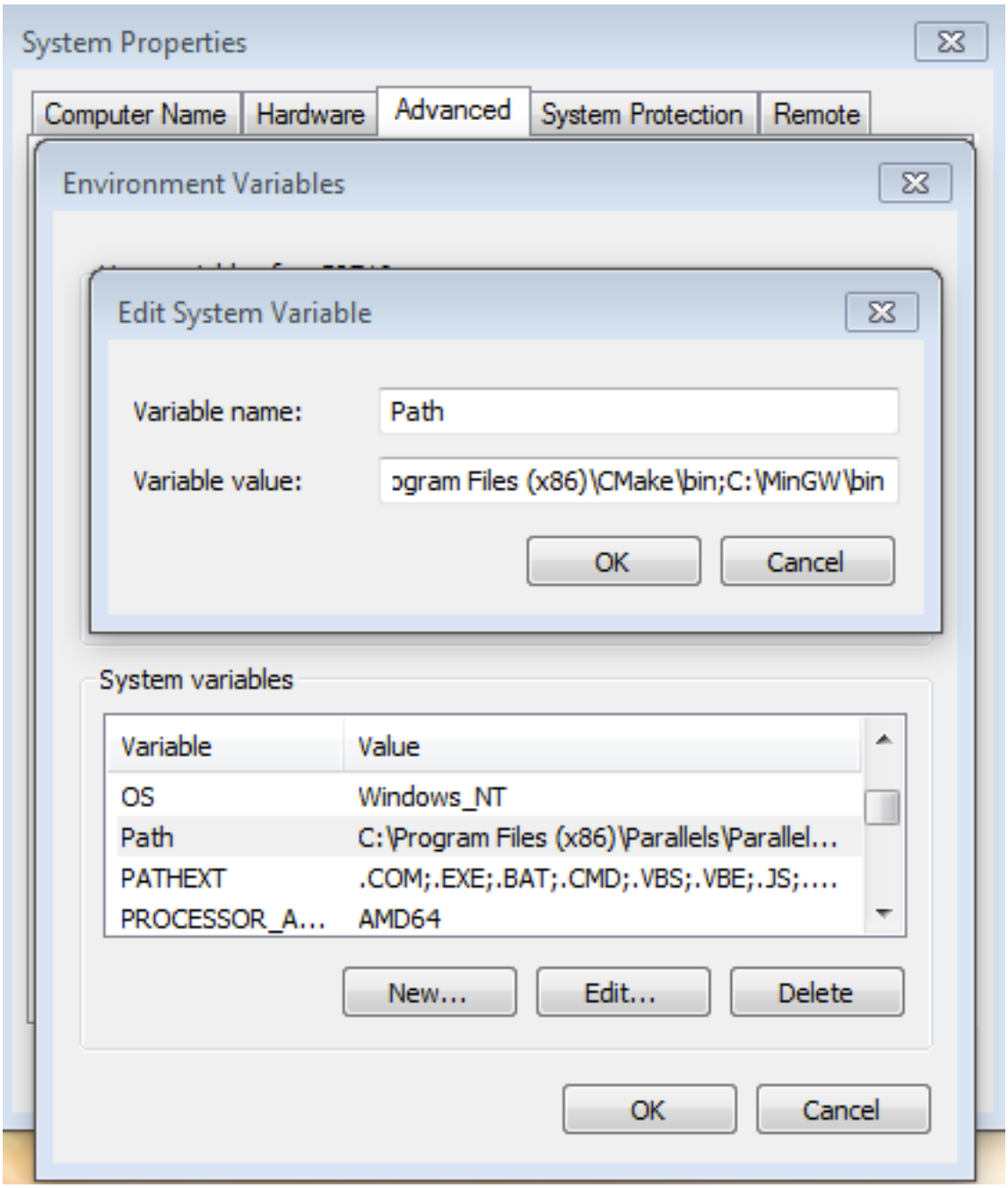

Figure 15. Add Path to systems environment

5.1.3 Add a new system environment variable for ARMGCC_DIR

Create a new *system* environment variable and name it ARMGCC_DIR. The value of this variable should point to the Arm GCC Embedded tool chain installation path. For this example, the path is:

Reference the installation folder of the GNU ARM GCC Embedded tools for the exact path name of your installation.

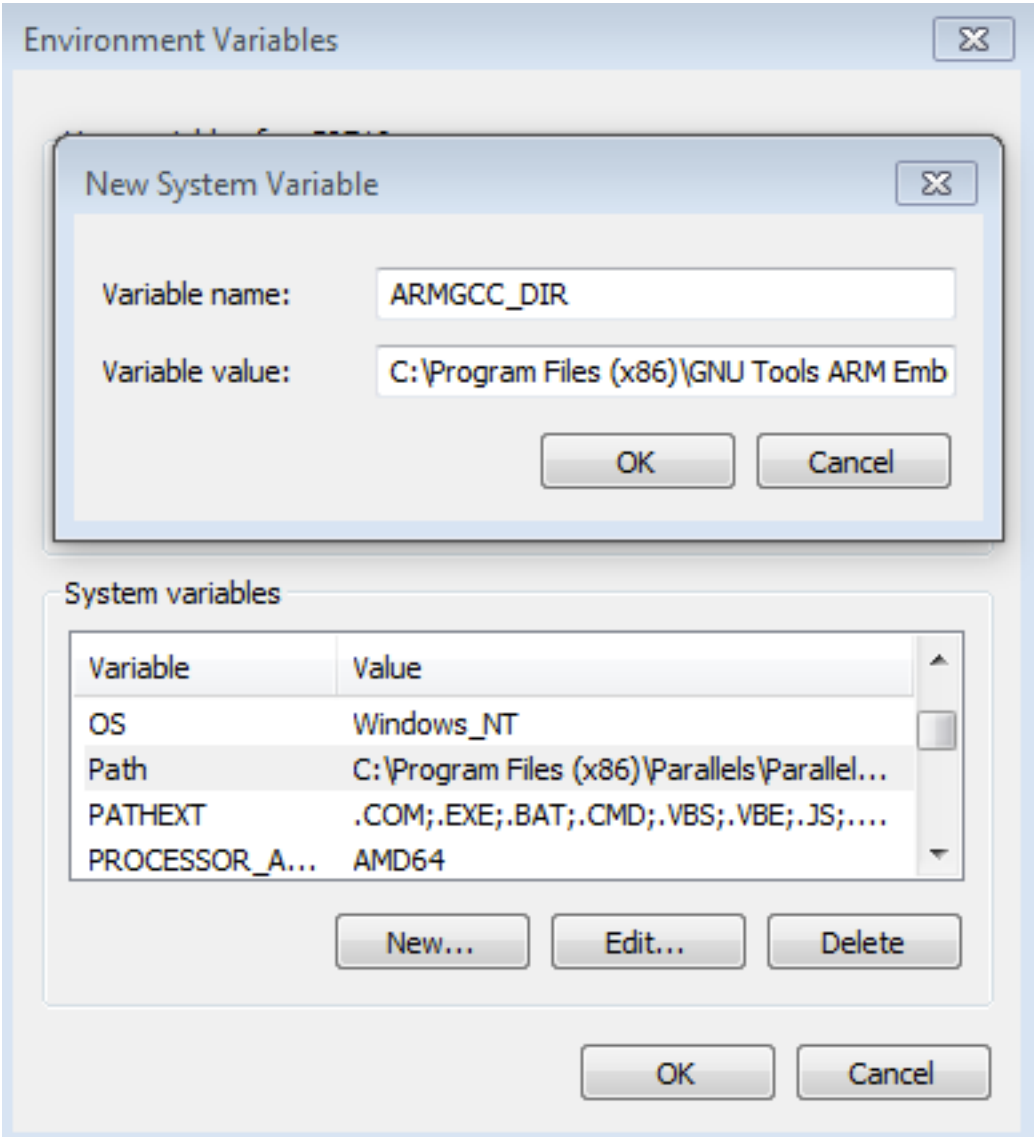

Figure 16. Add ARMGCC_DIR system variable

5.1.4 Install CMake

1. Download CMake 3.0.x from www.cmake.org/cmake/resources/software.html.
2. Install CMake, ensuring that the option "Add CMake to system PATH" is selected when installing. The user chooses to select whether it is installed into the PATH for all users or just the current user. In this example, it is installed for all users.

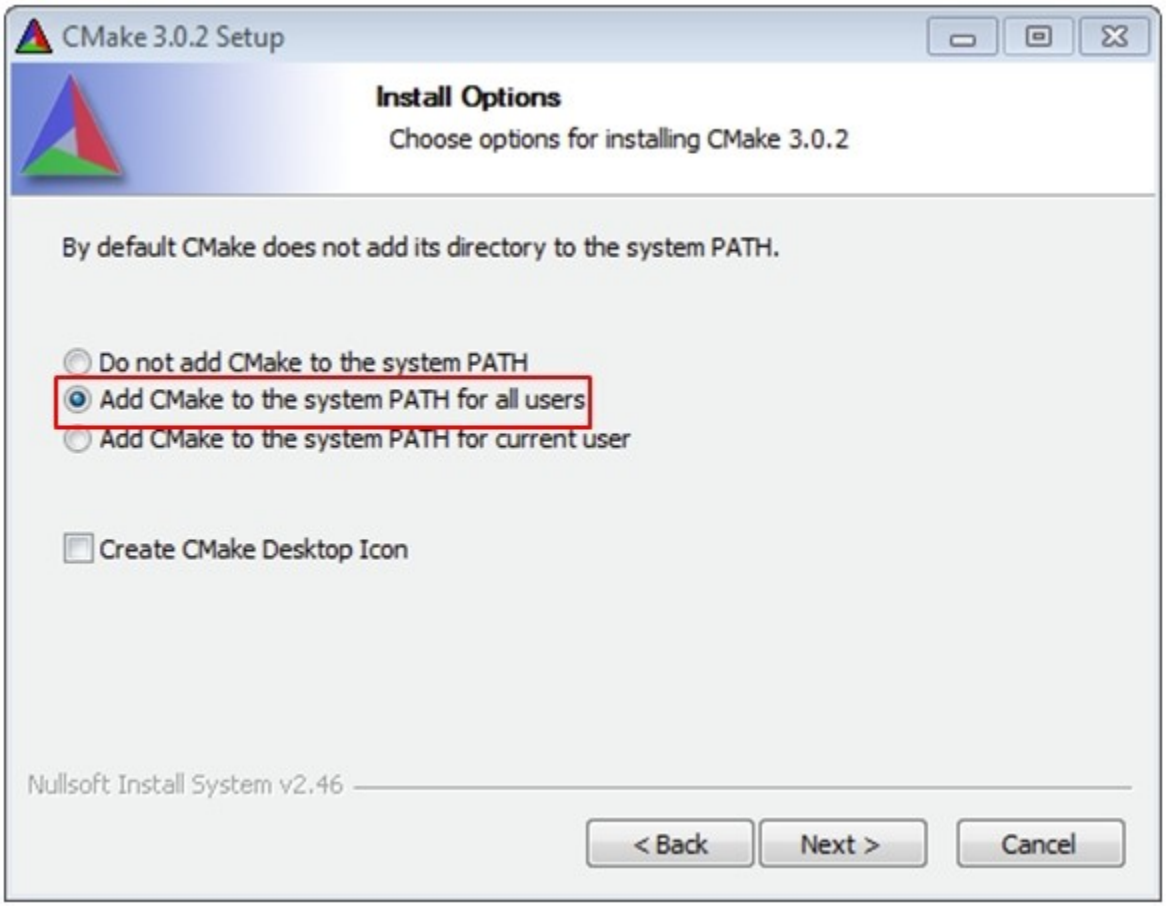

Figure 17. Install CMake

3. Follow the remaining instructions of the installer.
4. You may need to reboot your system for the PATH changes to take effect.
5. Make sure "sh.exe" is not in the Environment Variable PATH. This is a limitation of mingw32-make.

5.2 Build an example application

To build an example application, follow these steps.

1. Open a GCC Arm Embedded tool chain command window. To launch the window, from the Windows operating system Start menu, go to “Programs -> GNU Tools ARM Embedded <version>” and select “GCC Command Prompt”.

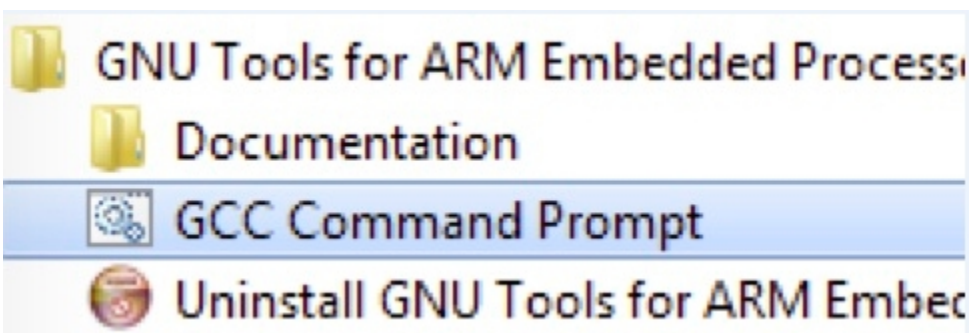

Figure 18. Launch command prompt

2. Change the directory to the example application project directory, which has a path similar to the following:

   <install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc

   For this example, the exact path is: *<install_dir>/examples/evkmimxrt1050/demo_apps/hello_world/armgcc*

   NOTE

   To change directories, use the 'cd' command.

3. Type “build_debug.bat” on the command line or double click on the "build_debug.bat" file in Windows Explorer to perform the build. The output is shown in this figure:

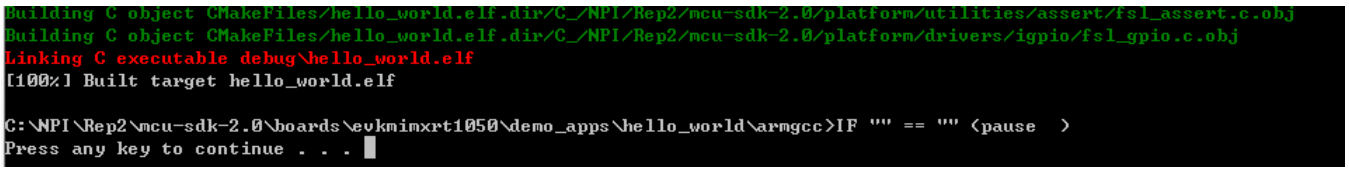

Figure 19. hello_world demo build successful

4.

5.3 Run an example application

This section describes steps to run a demo application using J-Link GDB Server application. To perform this exercise, two things must be done:

- Make sure that either:
  - The OpenSDA interface on your board is programmed with the J-Link OpenSDA firmware. If your board does not support OpenSDA, then a standalone J-Link pod is required.
  - You have a standalone J-Link pod that is connected to the debug interface of your board. Note that some hardware platforms require hardware modification in order to function correctly with an external debug interface.

After the J-Link interface is configured and connected, follow these steps to download and run the demo applications:

1. This board supports the J-Link debug probe. Before using it, install SEGGER software, which can be downloaded from http://www.segger.com
2. Connect the development platform to your PC via USB cable between the OpenSDA USB connector and the PC USB connector. If using a standalone J-Link debug pod, also connect it to the SWD/JTAG connector of the board.
3. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug serial port number (to determine the COM port number, see Appendix A). Configure the terminal with these settings:
   a. 115200 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in board.h file)
   b. No parity
   c. 8 data bits
   d. 1 stop bit

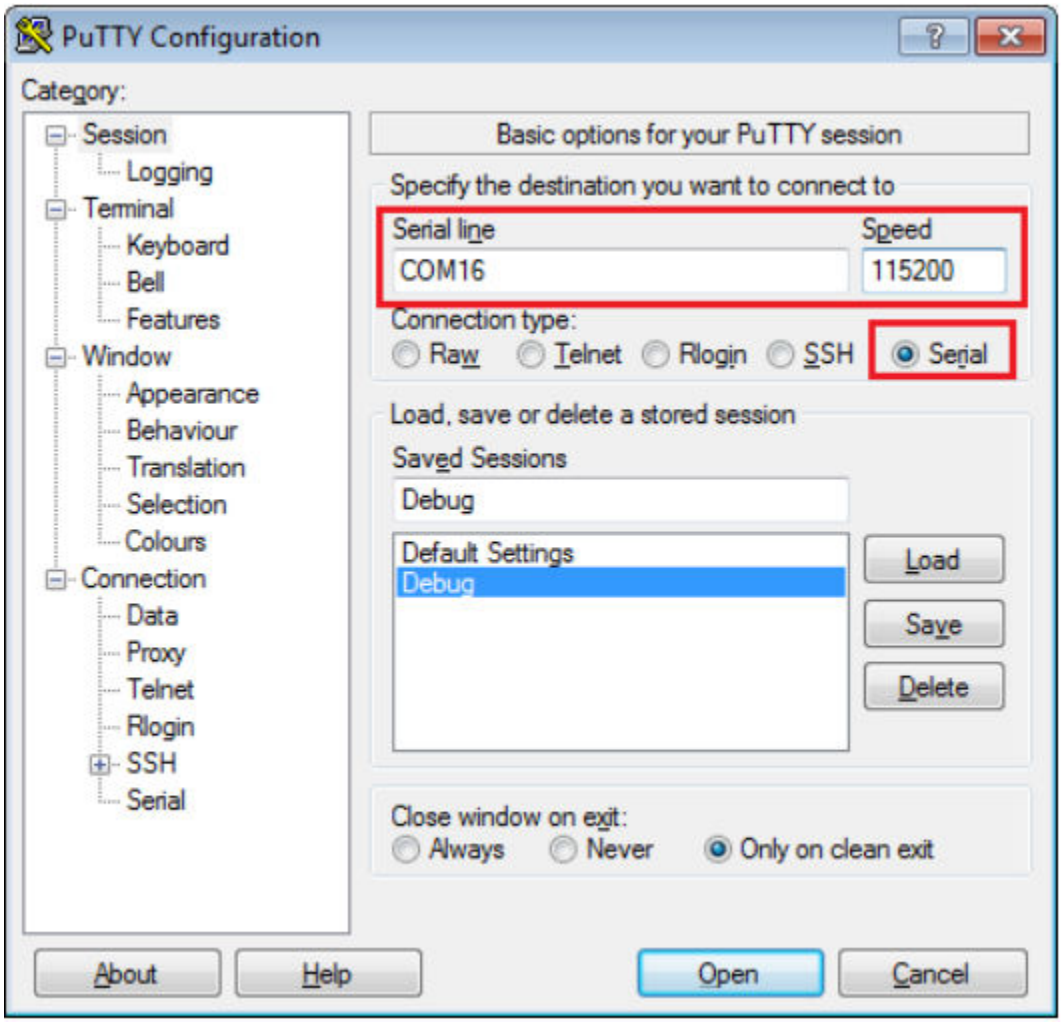

Figure 20. Terminal (PuTTY) configurations

4. Open the J-Link GDB Server application. Go to the SEGGER install folder, for example, C:\Program Files (x86)\SEGGER\JLink_V616f. Open the command windows here, for Debug and Release targets, and use the command "JLinkGDBServer.exe". For the sdram_debug and sdram_release targets, use the command "JLinkGDBServer.exe-scriptfile <install_dir>/boards/ evkmimxrt1050/demo_apps/hello_world/evkmimxrt1050_sdram_init.jlinkscript".
5. The target device selection chosen for this example is the Cortex-M7.
6. After it is connected, the screen should resemble this figure:

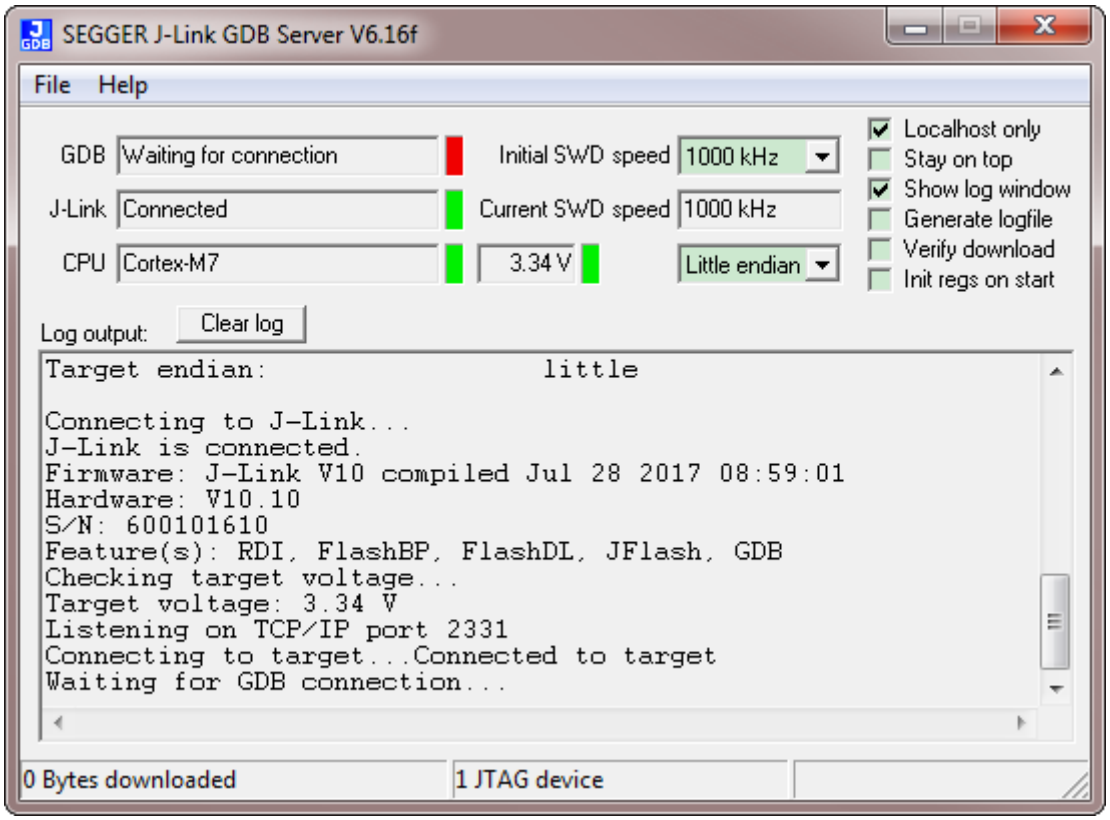

Figure 21. SEGGER J-Link GDB Server screen after successful connection

7. If not already running, open a GCC ARM Embedded tool chain command window. To launch the window, from the Windows operating system Start menu, go to "Programs -> GNU Tools ARM Embedded <version>" and select "GCC Command Prompt".

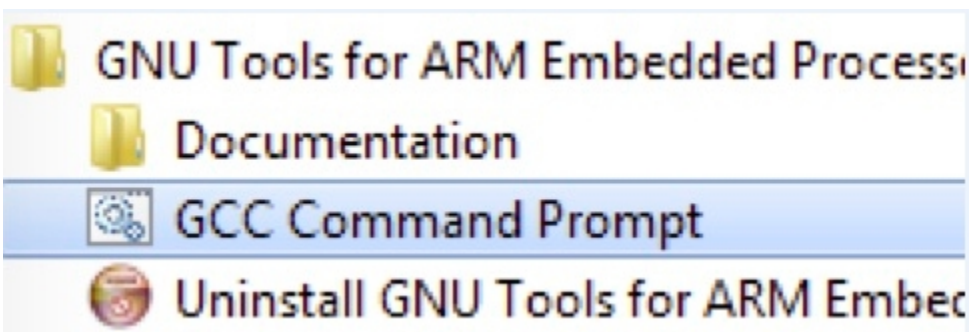

Figure 22. Launch command prompt

8. Change to the directory that contains the example application output. The output can be found in using one of these paths, depending on the build target selected:

   <install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc/debug

   <install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc/release

   For this example, the path is:

   <install_dir>/boards/evkmimxrt1050/demo_apps/hello_world/armgcc/debug
9. Run the command "arm-none-eabi-gdb.exe <application_name>.elf". For this example, it is "arm-none-eabi-gdb.exe hello_world.elf".

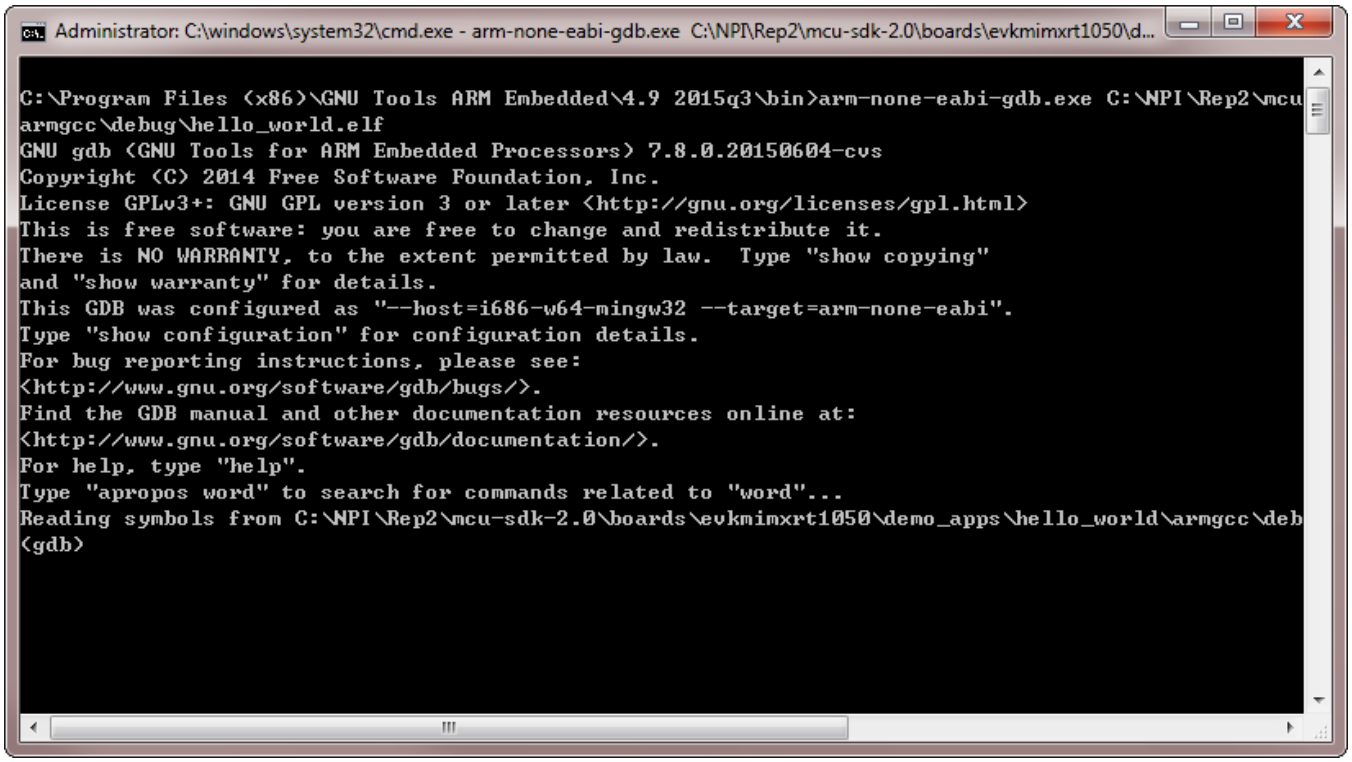

Figure 23. Run arm-none-eabi-gdb

10. Run these commands:
    a. "target remote localhost:2331"
    b. "monitor reset"
    c. "monitor halt"
    d. "load"
11. The application is now downloaded and halted at the reset vector. Execute the “monitor go” command to start the demo application.

    The hello_world application is now running and a banner is displayed on the terminal. If this is not true, check your terminal settings and connections.

6 Run a demo using MCUXpresso IDE

NOTE

Ensure that the MCUXpresso IDE toolchain is included when generating the MCUXpresso SDK Package.

This section describes the steps required to configure MCUXpresso IDE to build, run, and debug example applications. The hello_world demo application targeted for the EVK-MIMXRT1050 platform is used as an example, though these steps can be applied to any example application in the MCUXpresso SDK.

6.1 Select the workspace location

Every time MCUXpresso IDE launches, it prompts the user to select a workspace location. MCUXpresso IDE is built on top of Eclipse, which uses workspace to store information about its current configuration, and in some use cases, source files for the projects in the workspace. The location of the workspace can be anywhere, but it is recommended that the workspace be outside of the MCUXpresso SDK tree.

6.2 Build an example application

To build an example application, follow these steps.

1. Drag and drop the SDK zip file into the “Installed SDKs” view to install an SDK. In the window that appears, click the “OK” button and wait until the import has finished.

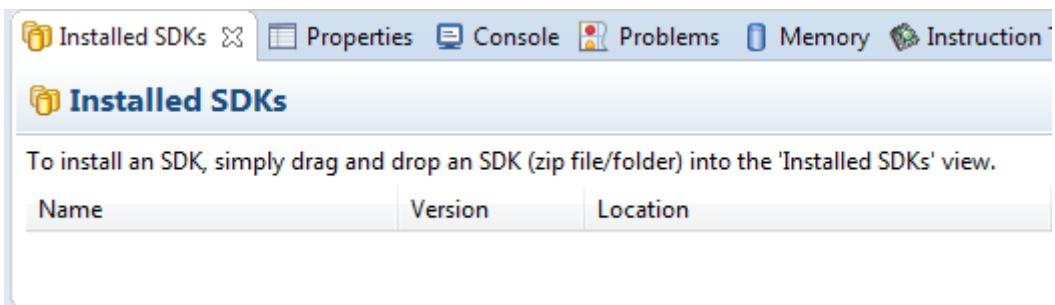

Figure 24. Install an SDK

2. On the *Quickstart Panel*, click “Import SDK example(s)…”.

Figure 25. Import an SDK example

3. In the window that appears, expand the “MIMXRT1050” folder and select “MIMXRT1052xxxxx”. Then, select "evkmimxrt1050” and click the “Next” button.

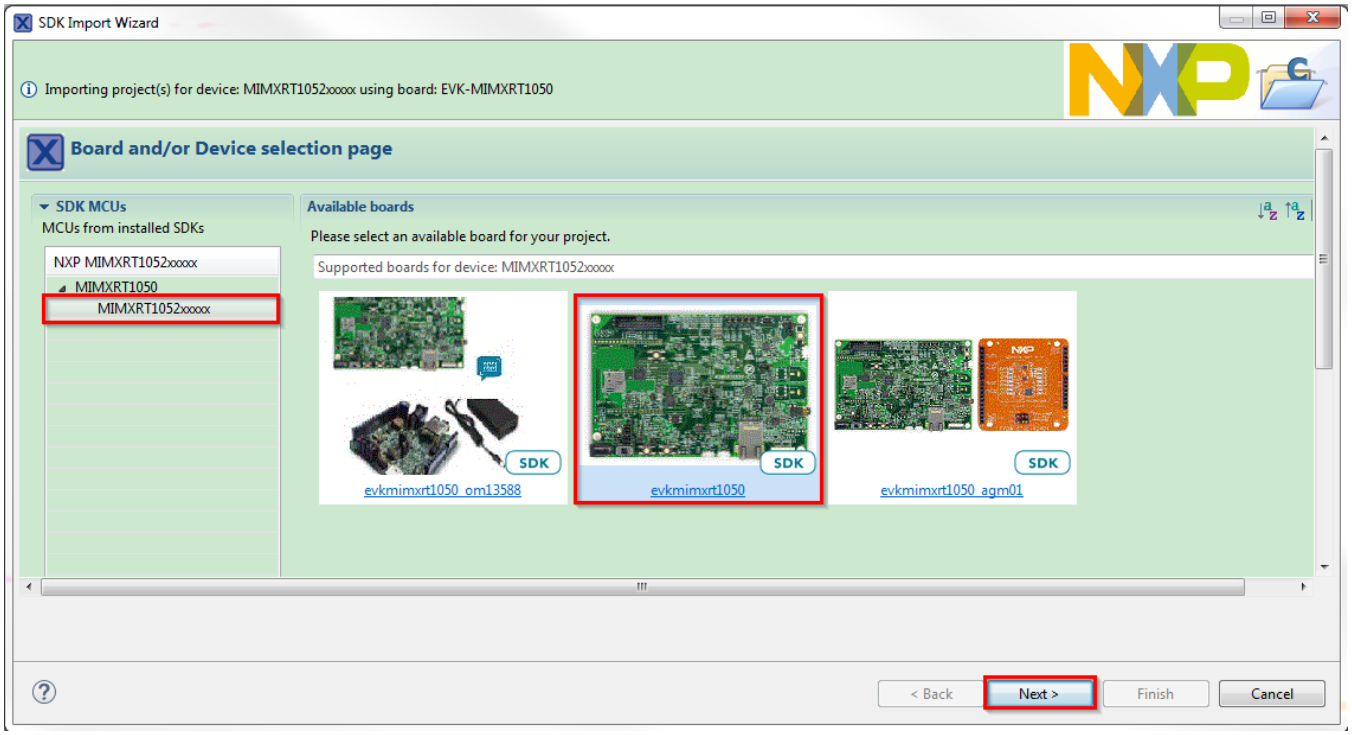

Figure 26. Select EVK-MIMXRT1050 board

4. Expand the “demo_apps” folder and select “hello_world”. Then, click the "Next” button.

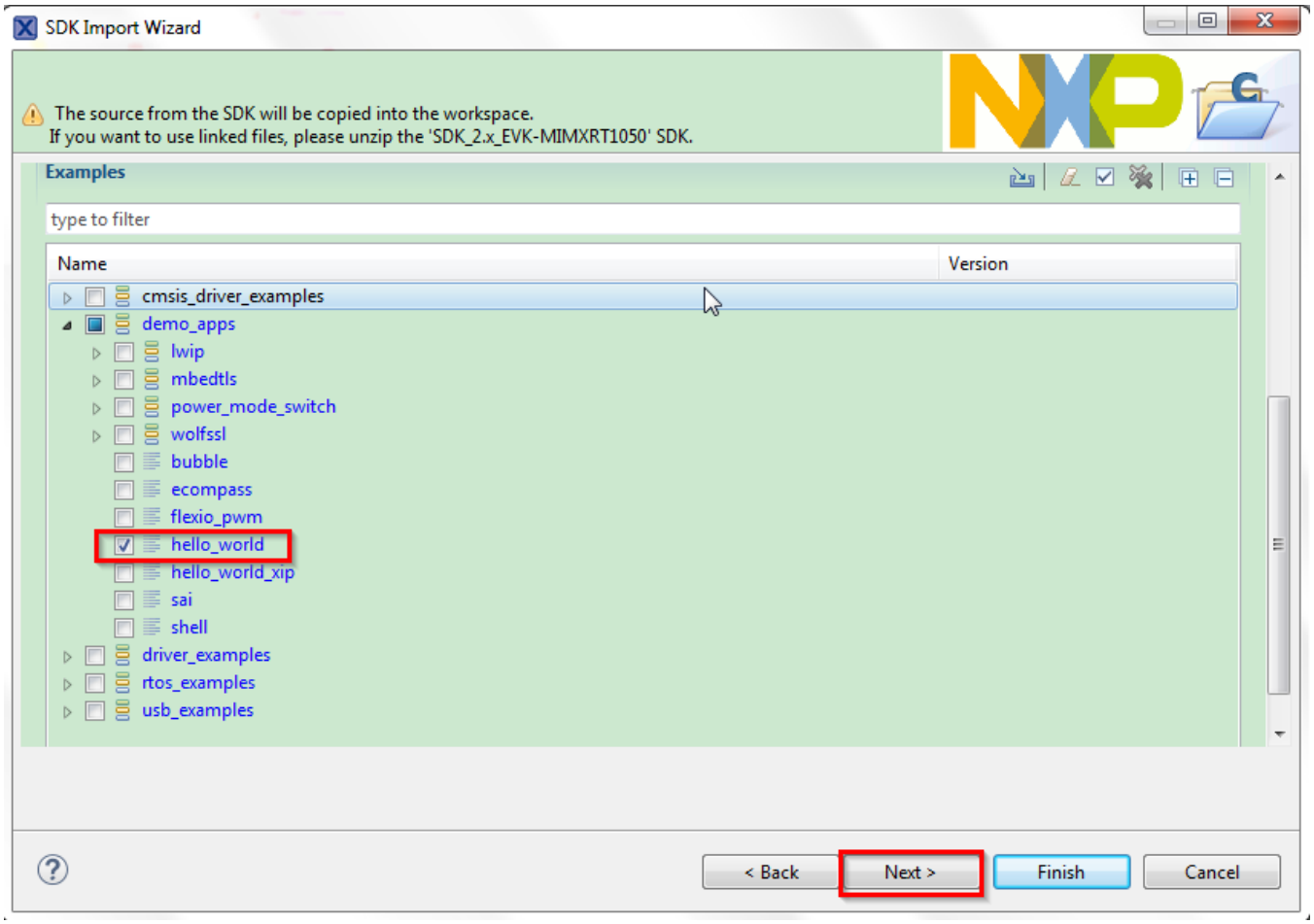

Figure 27. Select "hello_world"

5. Ensure the option “Redlib: Use floating point version of printf” is selected if the cases print floating point numbers on the terminal (for demo applications such as dac32_adc12, dac_adc, dac_cadc, ecompass, sai, coremark, mbedtls_benchmark, wolfssl_benchmark, and for mmcau_examples such as mmcau_api). Otherwise, there is no need to select it. Click the “Finish” button.

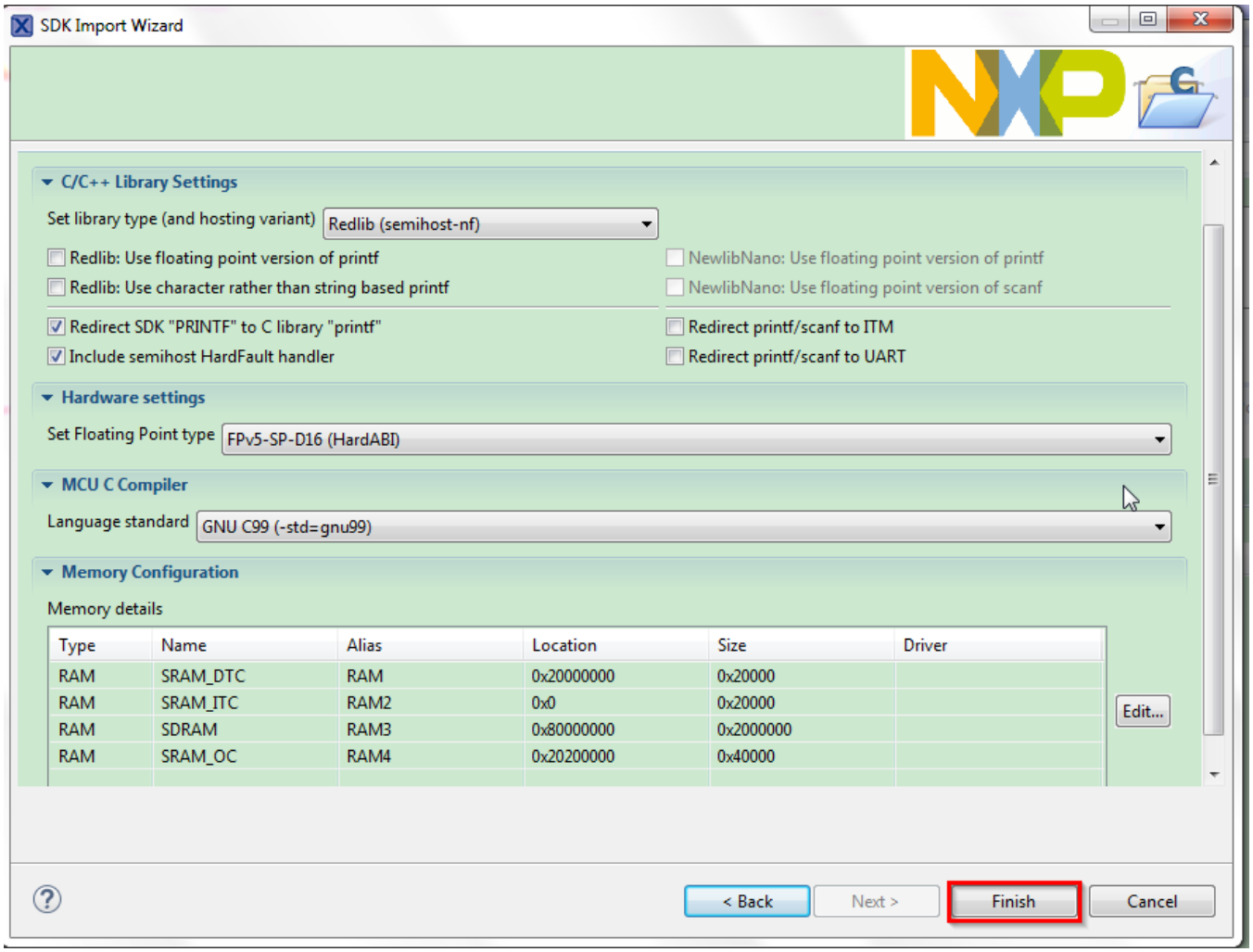

Figure 28. Select "User floating print version of printf"

6.3 Run an example application

For more information on debug probe support in the MCUXpresso IDE v10.0.0, visit community.nxp.com.

To download and run the application, perform these steps:

1. On the *Quickstart Panel*, click on "Debug evkmimxrt1050_demo_apps_hello_world' [Debug]".

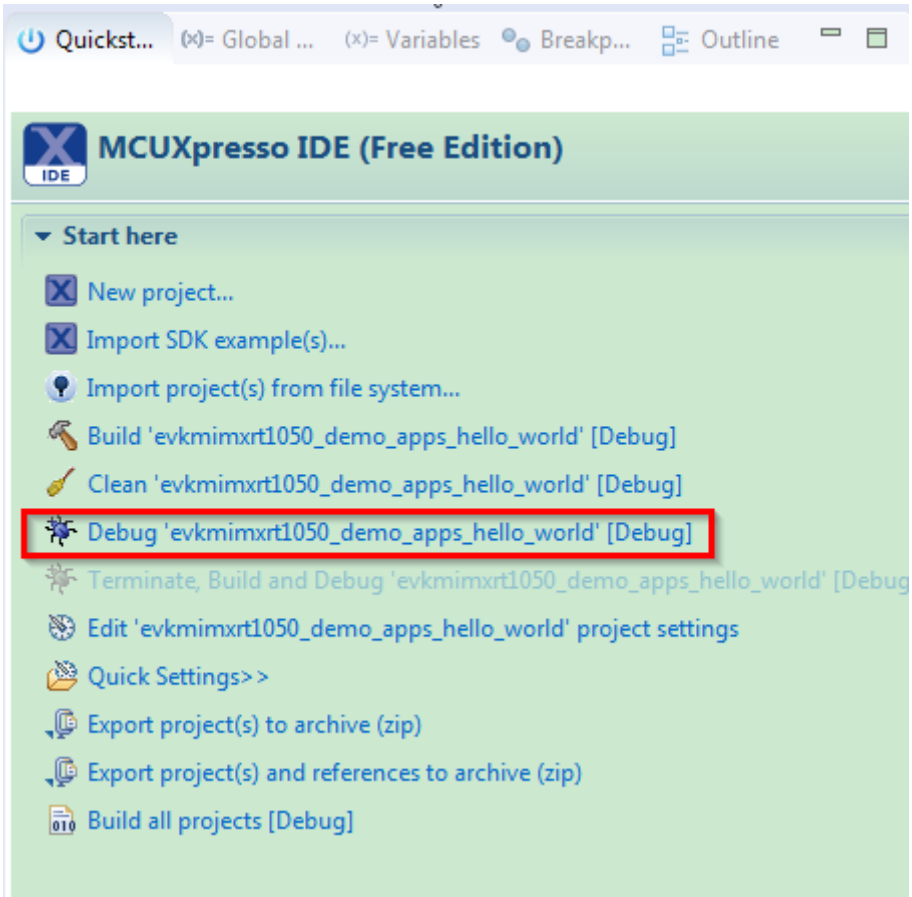

Figure 29. Debug "hello_world" case

2. The first time you debug a project, the Debug Emulator Selection Dialog is displayed, showing all supported probes that are attached to your computer. Select the probe through which you want to debug and click the “OK” button. (For any future debug sessions, the stored probe selection is automatically used, unless the probe cannot be found.)

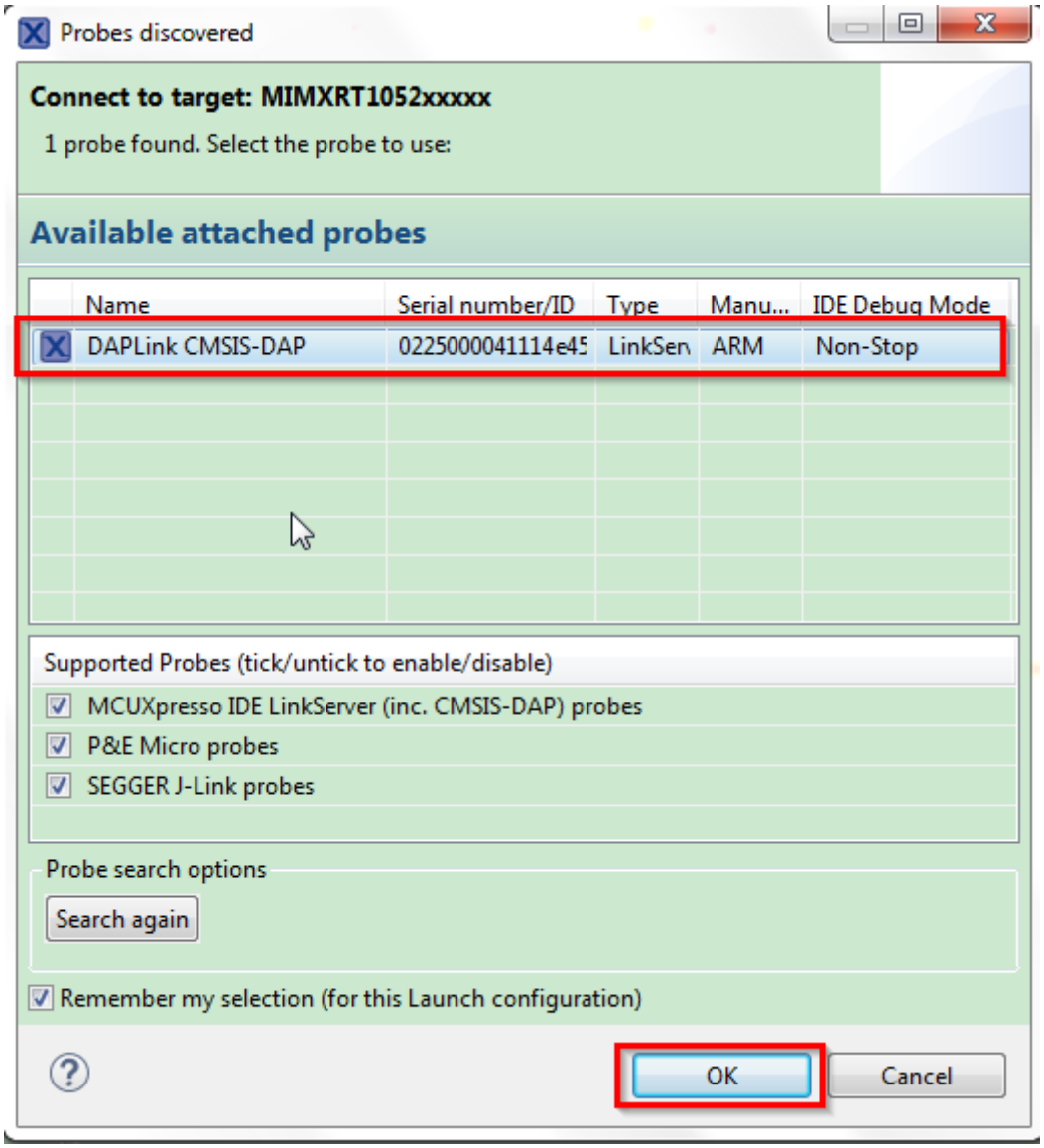

Figure 30. Attached Probes: debug emulator selection

3. The application is downloaded to the target and automatically runs to main():

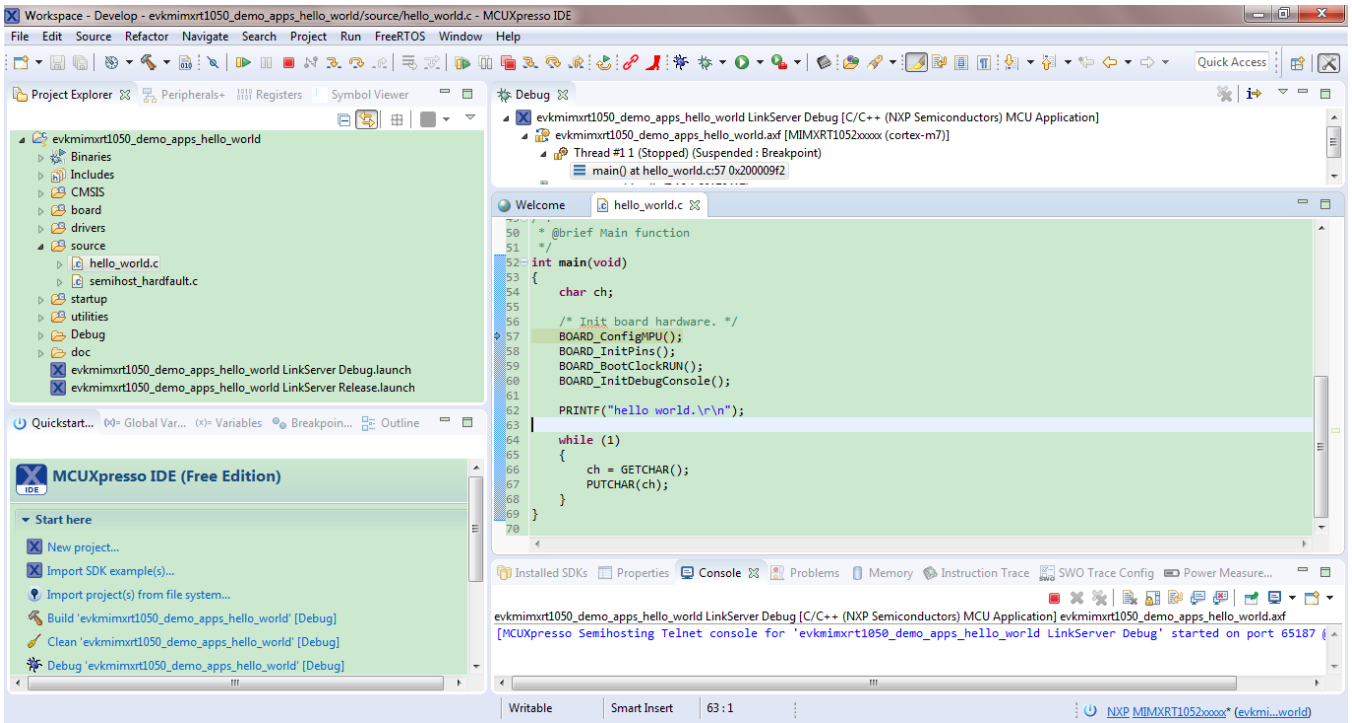

Figure 31. Stop at main() when running debugging

4. Start the application by clicking the "Resume" button.

Figure 32. Resume button

The hello_world application is now running and a banner is displayed on the MCUXpresso IDE console window. If this is not the case, check your terminal settings and connections.

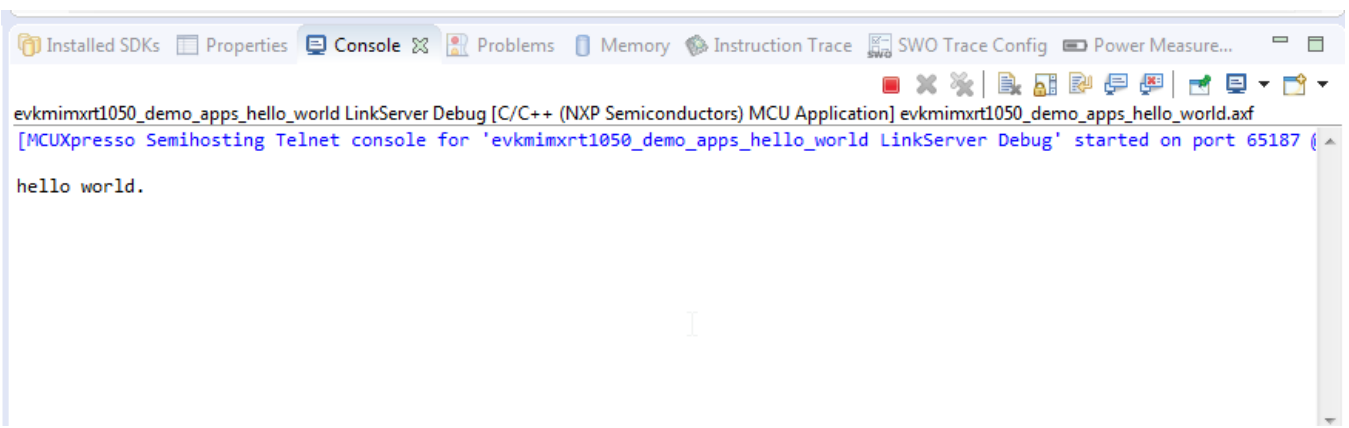

Figure 33. Text display of the hello_world demo

7 Appendix A - How to determine COM port

This section describes the steps necessary to determine the debug COM port number of your NXP hardware development platform.

1. To determine the COM port, open the Windows operating system Device Manager. This can be achieved by going to the Windows operating system Start menu and typing “Device Manager” in the search bar, as shown below:

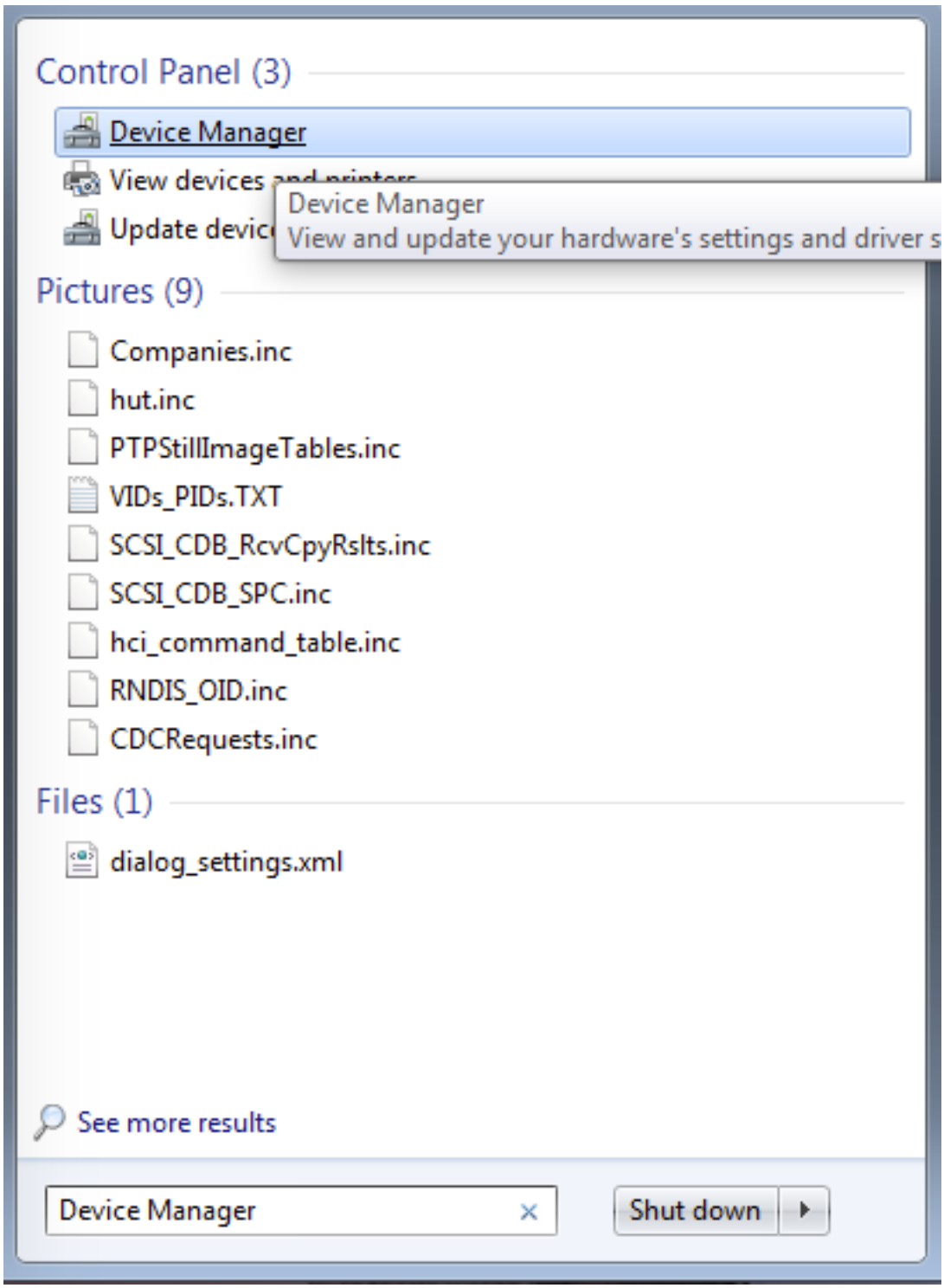

Figure 34. Device manager

2. In the Device Manager, expand the “Ports (COM & LPT)” section to view the available ports. Depending on the NXP board you’re using, the COM port can be named differently:

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