

# Getting Started with MCUXpresso SDK for i.MX 8QuadXPlus

## 1 Overview

The MCUXpresso Software Development Kit (MCUXpresso SDK) provides bare metal source code to be executed in the i.MX 8QuadXPlus M4 core. The MCUXpresso SDK provides comprehensive software support for NXP i.MX 8QuadXPlus microcontrollers' M4 core. The MCUXpresso SDK includes a flexible set of peripheral drivers designed to speed up and simplify development of embedded applications which can be used standalone or collaboratively with the A cores running another Operating System (such as Linux® Kernel). 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 demo applications. The MCUXpresso SDK also contains FreeRTOS, and various other middleware to support rapid development.

For supported toolchain versions, see the *MCUXpresso SDK Release Notes Supporting i.MX 8QuadXPlus* (document MCUXSDKIMX8QXRN)

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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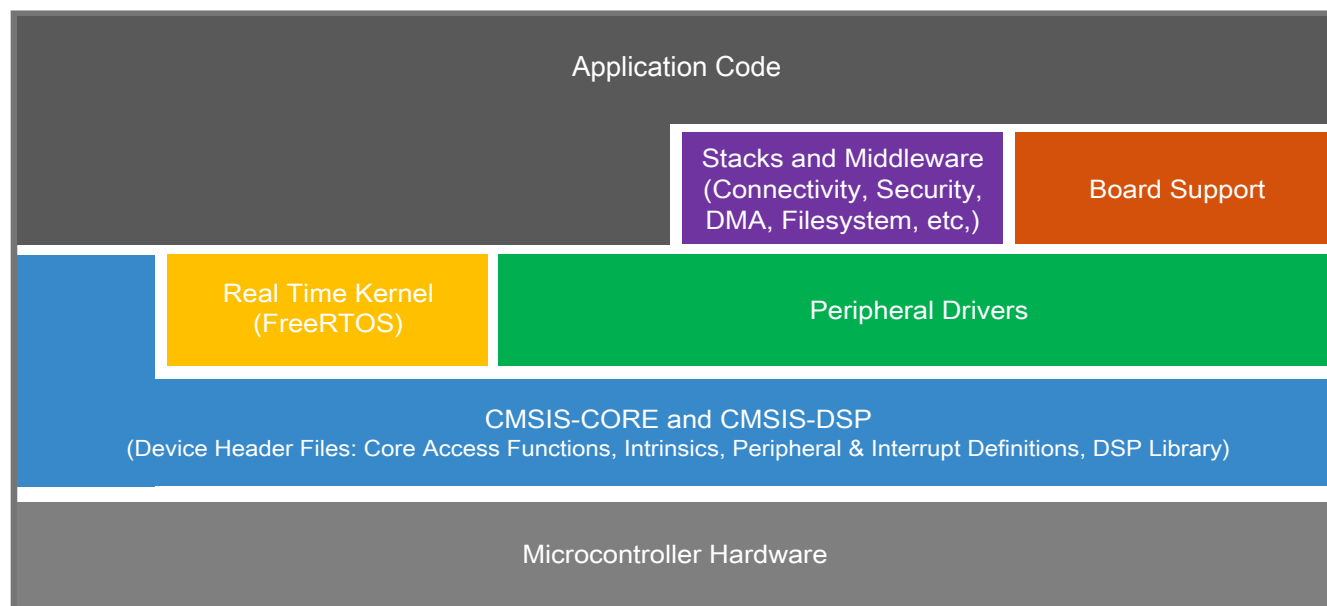


Figure 1. MCUXpresso SDK layers

## 2 MCUXpresso SDK Board Support Folders

MCUXpressoSDK board support provides example applications for NXP development and evaluation boards for Arm® Cortex®-M cores. Board support packages are found inside of the top level boards folder, and each supported board has its own folder (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):

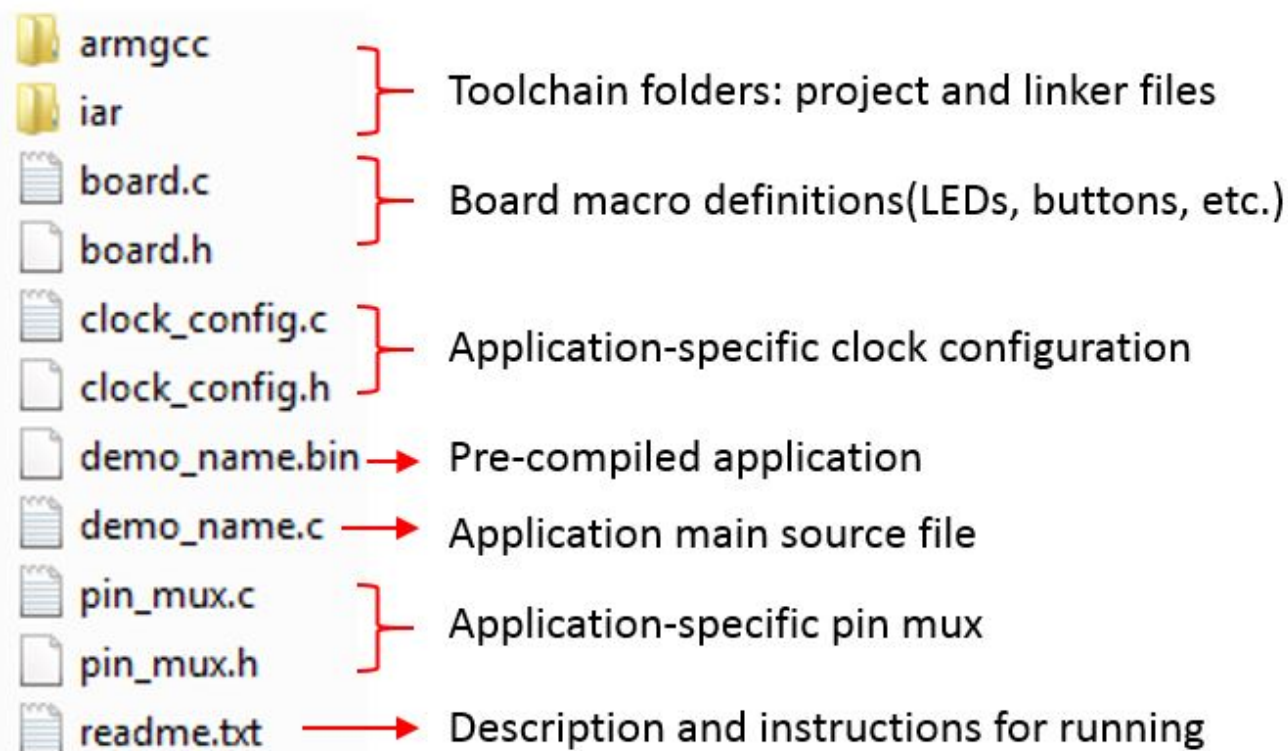
- **cmsis\_driver\_examples:** Simple applications intended to concisely illustrate how to use CMSIS drivers.
- **demo\_apps:** Full-featured applications intended to highlight key functionality and use cases of the target MCU. These applications typically use multiple MCU peripherals and may leverage 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.
- **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
- **multicore\_examples:** Simple applications intended to concisely illustrate how to use middleware/multicore stack.

### 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. Although we use the hello\_world example (part of the demo\_apps folder), the same general rules apply to any type of example in the <board\_name> folder.

In the hello\_world application folder you see the following contents:



**Figure 2. Application folder structure**

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 IDEs (except MCUXpresso IDE), a variety of source files are 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 middleware/stacks or an RTOS, there are references to the appropriate source code. Middleware source files are located in the *middleware* folder and 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 Toolchain introduction

The MCUXpresso SDK release for i.MX 8QuadXPlus includes the build system to be used with some toolchains. In this chapter, the toolchain support is presented and detailed.

### 3.1 Compiler/Debugger

The MCUXpresso SDK i.MX 8QuadXPlus release supports building and debugging with the toolchains listed in the below table.

The user can choose the appropriate one for development.

- Arm GCC + SEGGER J-Link GDB Server. This is a command line tool option and it supports both Windows® OS and Linux® OS.
- IAR Embedded Workbench® for Arm and SEGGER J-Link software. The IAR Embedded Workbench is an IDE integrated with editor, compiler, debugger, and other components. The SEGGER J-Link software provides the driver for the J-Link Plus debugger probe and supports the device to attach, debug, and download.

**Table 1. Toolchain information**

Compiler/Debugger	Supported host OS	Debug probe	Tool website
ArmGCC/J-Link GDB server	Windows OS/Linux OS	J-Link Plus	<a href="http://developer.arm.com/open-source/gnu-toolchain/gnu-rm">developer.arm.com/open-source/gnu-toolchain/gnu-rm</a> <a href="http://www.segger.com">www.segger.com</a>
IAR/J-Link	Windows OS	J-Link Plus	<a href="http://www.iar.com">www.iar.com</a> <a href="http://www.segger.com">www.segger.com</a>

Download the corresponding tools for the specific host OS from the website.

#### NOTE

To support i.MX 8QuadXPlus, the patch for IAR and Segger J-Link should be installed. The patch named iar\_segger\_support\_patch\_8qx.zip can be used with MCUXpresso SDK. See the readme.txt in the patch for additional information about patch installation.

### 3.2 Image creator

The i.MX 8QuadXPlus hardware is developed to only allow the boot if the SCFW firmware is properly installed. In the Linux OS release, this firmware is automatically built in the U-Boot binary. For the use cases when the demos from MCUXpresso are used along with U-Boot, the tool imx-mkimage is needed. This tool is used to combine the SCFW firmware with SDK images or U-Boot and to generate a binary to be used for i.MX 8QuadXPlus device. Currently, the tool can only be executed on Linux OS.

## 4 Run a demo application using IAR

This section describes the steps required to build, run, and debug example applications provided in the MCUXpresso SDK using IAR. The hello\_world demo application targeted for the 8QuadXPlus MEK board is used as an example, although these steps can be applied to any example application in the MCUXpresso SDK.

## 4.1 Build an example application

Before using IAR, get the IAR and Segger J-Link patch, iar\_segger\_support\_patch\_8qx.zip. Install the i.MX8QX support patch following the guides in readme.txt located in the archive.

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.

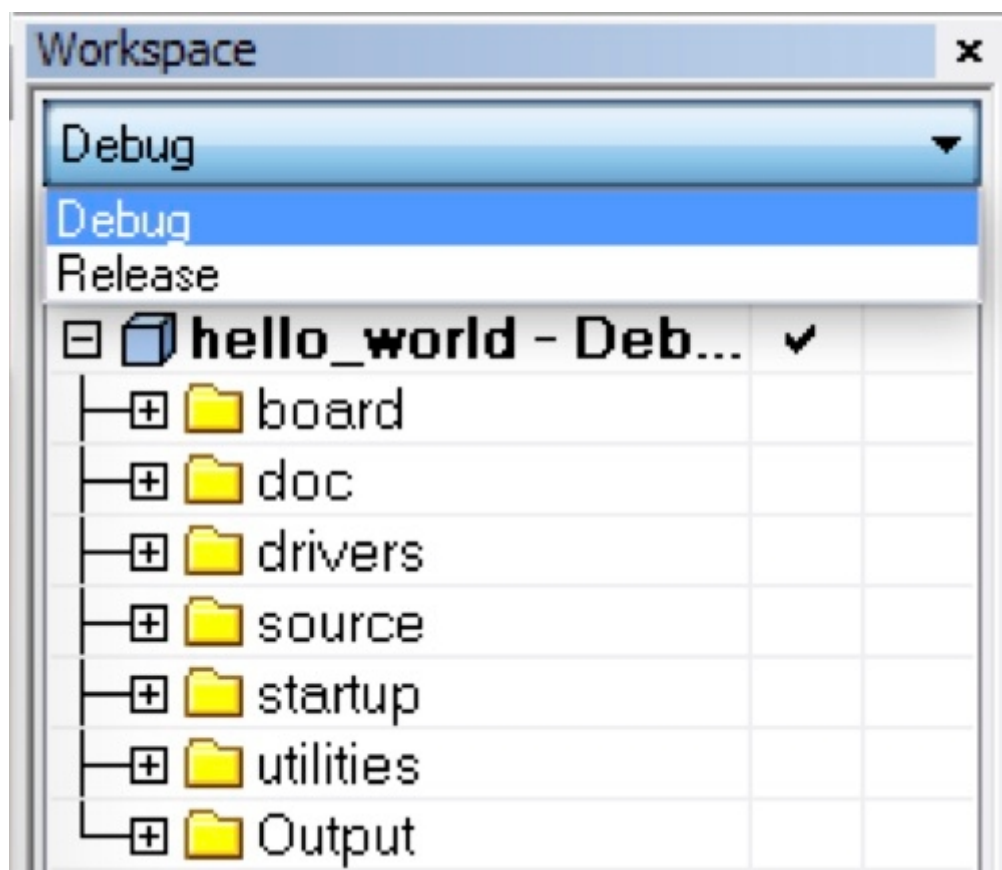
1. If not already done, open the desired demo application workspace. Most example application workspace files can be located using the following path:

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

Using the i.MX 8QuadXPlus MEK board as an example, the hello\_world workspace is located in

`<install_dir>/boards/mekmimx8qx/demo_apps/hello_world/iar/hello_world.eww`

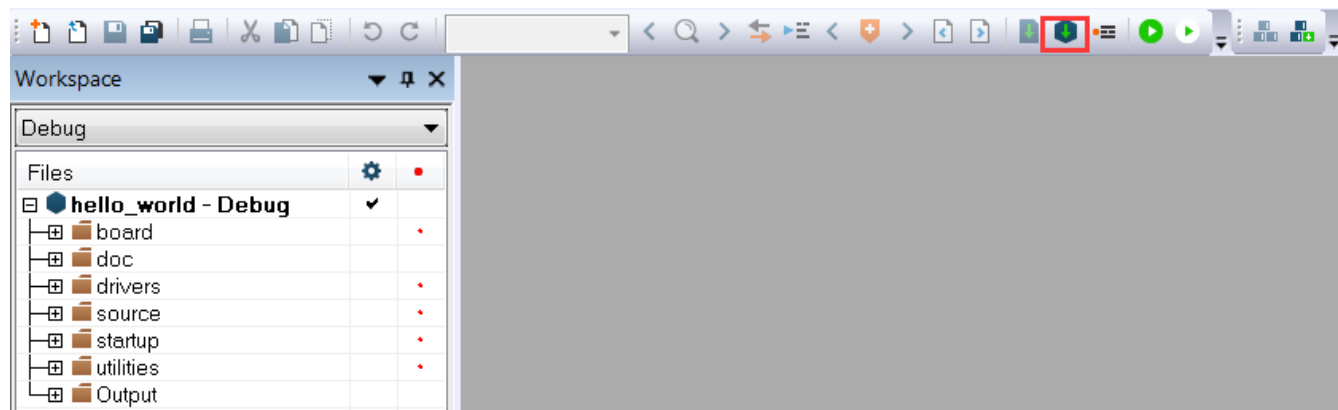
2. Select the desired build target from the drop-down. For this example, select the “hello\_world – Debug” target.



**Figure 3. Demo build target selection**

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

## Run a demo application using IAR



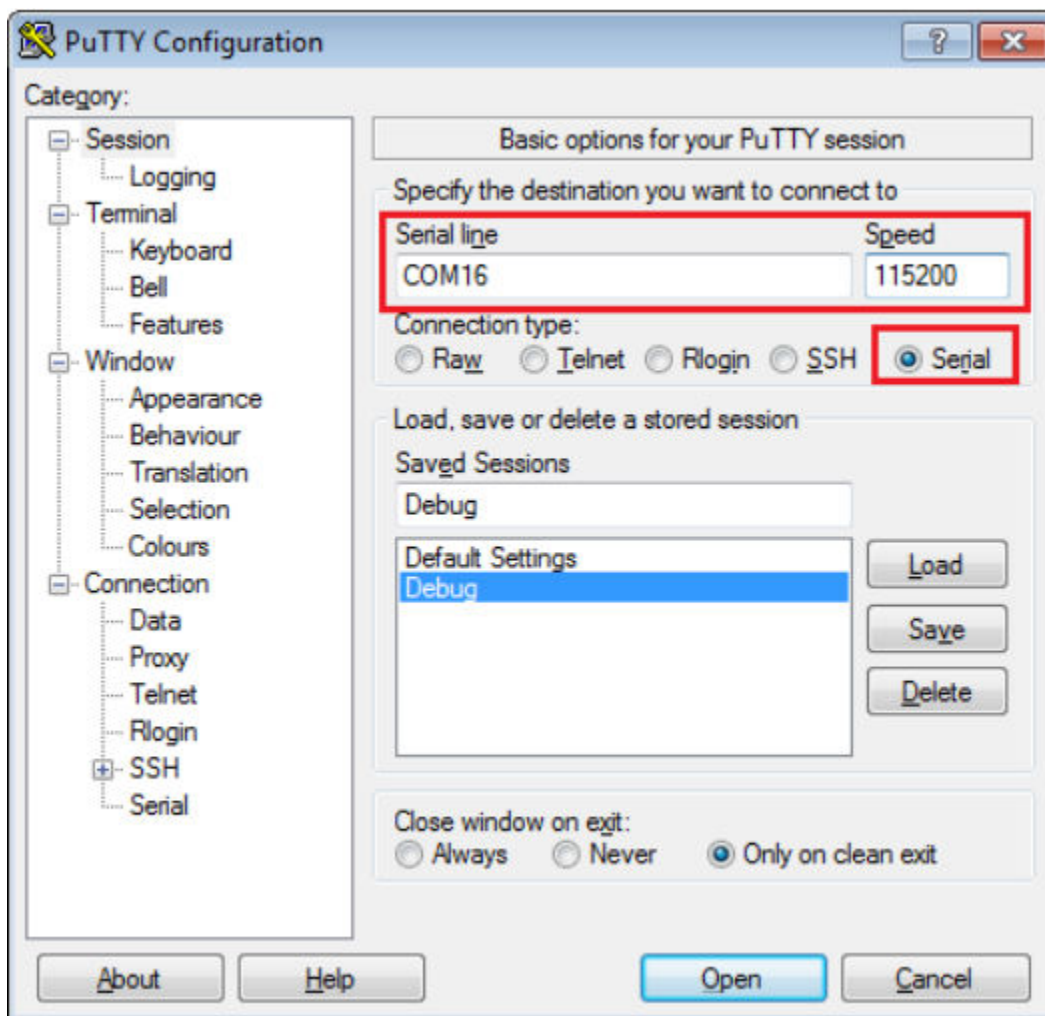
**Figure 4. Build the demo application**

4. The build completes without errors. There will be an elf file with *out* extension and a binary file with *bin* generated in the target directory.

## 4.2 Run an example application

Before running an example, a bootable SD card with the SCFW (System Controller Firmware) image is needed. See *Section 6.2, "Make a bootable SD card with System Controller Firmware (SCFW)"*. To download and run the application, perform these steps:

1. This board supports the J-Link debug probe. Before using it, install SEGGER J-Link software, which can be downloaded from [www.segger.com/jlink-software.html](http://www.segger.com/jlink-software.html).
2. Connect the development platform to your PC via USB cable between the USB-UART Micro USB connector and the PC USB connector, then connect 12 V power supply and J-Link Plus to the hardware platform.
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 baud rate
  - b. No parity
  - c. 8 data bits
  - d. 1 stop bit



**Figure 5. Terminal (PuTTY) configuration**

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



**Figure 6. Download and Debug button**

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



## Run a demo using ARM® GCC

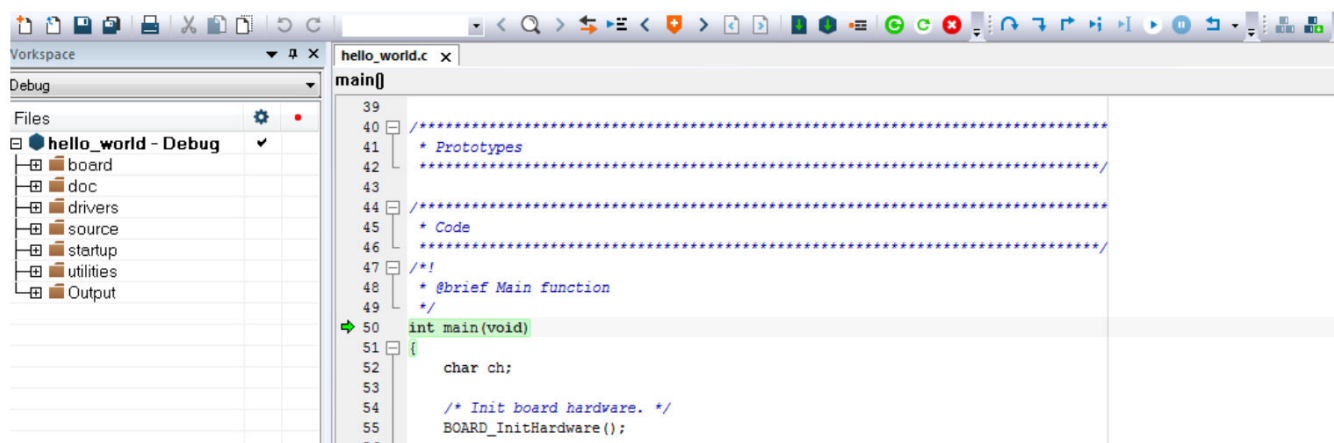


Figure 7. Stop at main() when running debugging

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



Figure 8. 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.

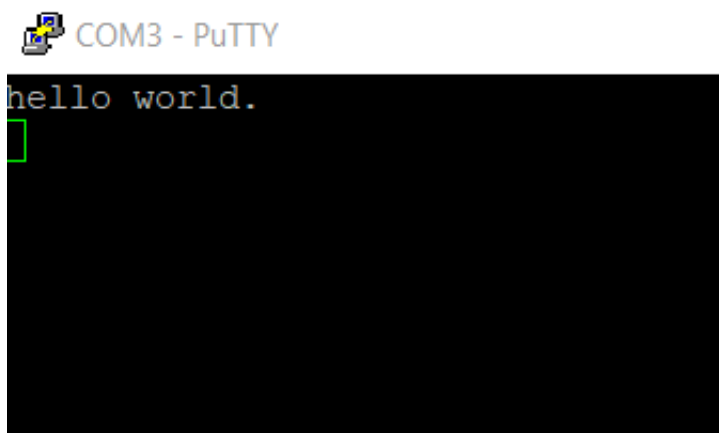


Figure 9. Text display of the hello\_world demo

## 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 i.MX8QX platform is used as an example, though these steps can be applied to any board, demo or example application in the MCUXpresso SDK.

### NOTE

Before running a demo, make sure the SEGGER patch is installed. See Appendix B to know how to install the patch. The Arm patch is not required.



## 5.1 Linux host

The following sections provide steps to run a demo compiled with Arm GCC on Linux Host.

### 5.1.1 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.

#### 5.1.1.1 Install GCC ARM Embedded tool chain

Download and run the installer from [launchpad.net/gcc-arm-embedded](http://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*. (document MCUXSDKRN).

#### NOTE

See the *Host Setup* Section in Appendix C for Linux OS before compiling the application.

#### 5.1.1.2 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:

```
$ export ARMGCC_DIR=<path_to_GNUARM_GCC_installation_dir>
```

### 5.1.2 Build an example application

To build an example application, follow these steps.

1. 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>/boards/mekmimx8qx/demo_apps/hello_world/armgcc`

2. Run the **build\_debug.sh** script on the command line to perform the build. The output is shown in this figure:

```
$ ./build_debug.sh
-- TOOLCHAIN_DIR: /work/platforms/tmp/gcc-arm-none-eabi-5_4-2016q3
-- BUILD_TYPE: debug
-- TOOLCHAIN_DIR: /work/platforms/tmp/gcc-arm-none-eabi-5_4-2016q3
-- BUILD_TYPE: debug
-- The ASM compiler identification is GNU
-- Found assembler: /work/platforms/tmp/gcc-arm-none-eabi-5_4-2016q3/bin/arm-none-eabi-gcc
-- Configuring done
-- Generating done
-- Build files have been written to:

/work/platforms/tmp/SDK_2.2_MEK_MIMX8QX/boards/mekmimx8qx/demo_apps/hello_world/armgcc
```

```
Scanning dependencies of target hello_world.elf

[ 4%] Building C object CMakeFiles/hello_world.elf.dir/work/platforms/tmp/
SDK_2.2_MEK_MIMX8QX/boards/mekmimx8qx/demo_apps/hello_world/board.c.obj

< -- skipping lines -- >
[100%] Linking C executable debug/hello_world.elf
[100%] Built target hello_world.elf
```

### 5.1.3 Run an example application

This section describes steps to run a demo application using J-Link GDB Server application. To perform this exercise, follow these steps:

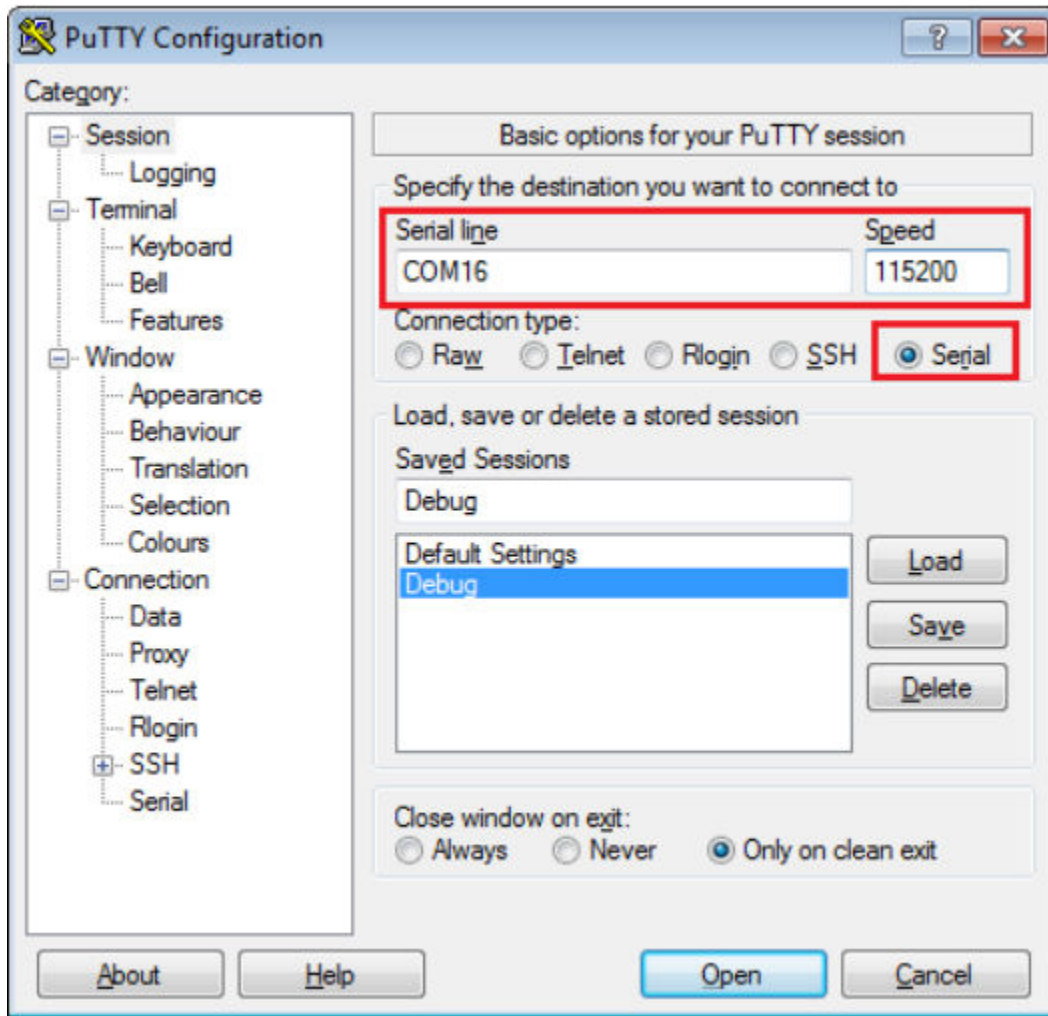
- Make a bootable SD card with the SCFW (System Controller Firmware) image. See *Section 6.3, "Make a bootable SD card with System Controller Firmware (SCFW)"*
- A standalone J-Link pod that is connected to the debug interface of your board.

#### NOTE

The Segger J-Link software has to be patched with the JLink\_<jlink\_version>\_8QX\_Patch.zip patch for i.MX8QX from iar\_segger\_support\_patch\_8qx.zip.

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

1. Connect the development platform to your PC via USB cable between the USB-UART 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.
2. 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 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 10. Terminal (PuTTY) configurations**

3. Open the J-Link GDB Server application. Assuming the J-Link software is installed, the application can be launched from a new terminal for the MIMX8QX6\_CM4 device:

```
$ JLinkGDBServer -if JTAG -device MIMX8QX6_CM4
SEGGER J-Link GDB Server V6.20f Command Line Version
JLinkARM.dll V6.20f (DLL compiled Oct 13 2017 17:18:54)
Command line: -if JTAG -device MIMX8QX6_CM4
-----GDB Server start settings-----
GDBInit file: none
GDB Server Listening port: 2331
SWO raw output listening port: 2332
Terminal I/O port: 2333
Accept remote connection: yes
< -- Skipping lines -- >
Target connection timeout: 0 ms
-----J-Link related settings-----
J-Link Host interface: USB
J-Link script: none
J-Link settings file: none
-----Target related settings-----
Target device: MIMX8QX6_CM4
Target interface: JTAG
Target interface speed: 1000 kHz
Target endian: little
Connecting to J-Link...
J-Link is connected.
Firmware: J-Link V9 compiled Oct 6 2017 16:38:28
```

## Run a demo using ARM® GCC

```
Hardware: V9.30
S/N: 609302772
Feature(s): RDI, FlashBP, FlashDL, JFlash, GDB
Checking target voltage...
Target voltage: 1.79 V
Listening on TCP/IP port 2331
Connecting to target...
J-Link found 1 JTAG device, Total IRLen = 4
JTAG ID: 0x5BA00477 (Cortex-M4)
Connected to target
Waiting for GDB connection...
```

4. 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/mekmimx8qx/demo_apps/hello_world/armgcc/debug
```

5. Start the GDB client:

```
$ arm-none-eabi-gdb hello_world.elf
GNU gdb (7.10-lubuntu3+9) 7.10
Copyright (C) 2015 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law. Type "show copying"
and "show warranty" for details.
This GDB was configured as "--host=x86_64-linux-gnu --target=arm-none-eabi".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from hello_world.elf...done.
(gdb)
```

6. Connect to the GDB server and load the binary by running the following commands:

- a. "target remote localhost:2331"
- b. "monitor reset"
- c. "monitor halt"
- d. "load"

```
(gdb) target remote localhost:2331
Remote debugging using localhost:2331
0x0000025e in ?? ()
(gdb) monitor reset
Resetting target
(gdb) monitor halt
(gdb) load
Loading section .interrupts, size 0xa00 lma 0x1ffe0000
Loading section .text, size 0x2684 lma 0x1ffe0a00
Loading section .ARM, size 0x8 lma 0x1ffe3084
Loading section .init_array, size 0x4 lma 0x1ffe308c
Loading section .fini_array, size 0x4 lma 0x1ffe3090
Loading section .data, size 0x68 lma 0x1ffe3094
Start address 0x1ffe0ad0, load size 12540
Transfer rate: 84 KB/sec, 1567 bytes/write.
```

The application is now downloaded and halted at the reset vector. Execute the “monitor go” command to start the demo application.

```
(gdb) monitor go
```

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.

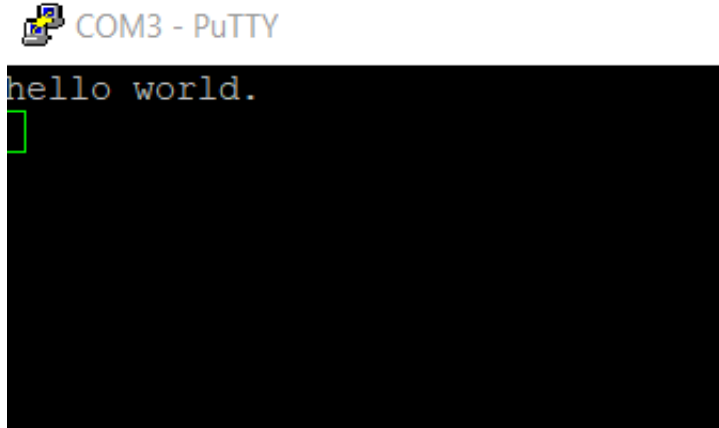


Figure 11. Text display of the `hello_world` demo

## 5.2 Windows OS host

The following sections provide steps to run a demo compiled with Arm GCC on Windows OS Host.

### 5.2.1 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 on Windows OS, as supported by the MCUXpresso SDK.

#### 5.2.1.1 Install GCC Arm Embedded tool chain

Download and run the installer from [developer.arm.com/open-source/gnu-toolchain/gnu-rm](https://developer.arm.com/open-source/gnu-toolchain/gnu-rm). This is the actual toolset (in other words, compiler, linker, and so on). The GCC toolchain should correspond to the latest supported version, as described in the *MCUXpresso SDK Release Notes*. (document MCUXSDKRN).

#### NOTE

See the *Host Setup* Section in Appendix C for Windows OS before compiling the application.

#### 5.2.1.2 Add a new system environment variable for `ARMGCC_DIR`

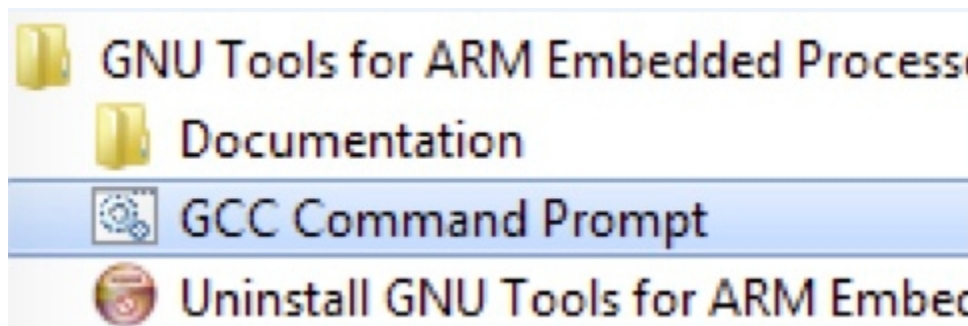
Create a new *system* environment variable and name it `ARMGCC_DIR`. The value of this variable should point to the Arm GCC Embedded tool chain installation path.

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

## 5.2.2 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 12. 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>/boards/mekmimx8qx/demo\_apps/hello\_world/armgcc

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:

## 5.2.3 Run an example application

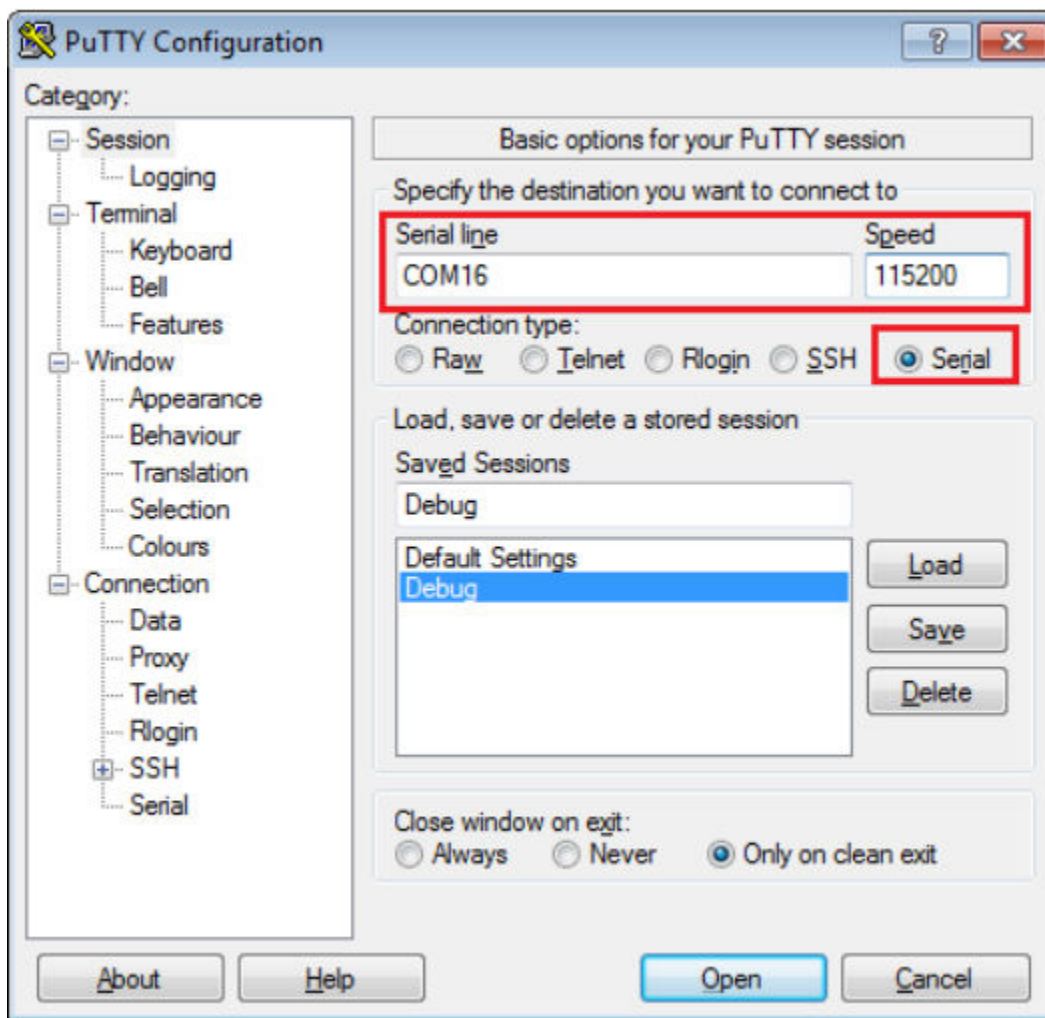
Running the Arm GCC built demo also requires J-Link support. Get the IAR and Segger J-Link patch, iar\_segger\_support\_patch\_8qx.zip. Install the i.MX8QX support patch following the guides in readme.txt located in the archive.

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

- Make a bootable SD card with the SCFW (System Controller Firmware) image. See *Section 6.2, "Make a bootable SD card with System Controller Firmware (SCFW)"*. You have a standalone J-Link pod that is connected to the debug interface of your board. Make sure the Segger J-Link software i.MX8QX supporting patch, iar\_segger\_support\_patch\_imx8.zip is installed.

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

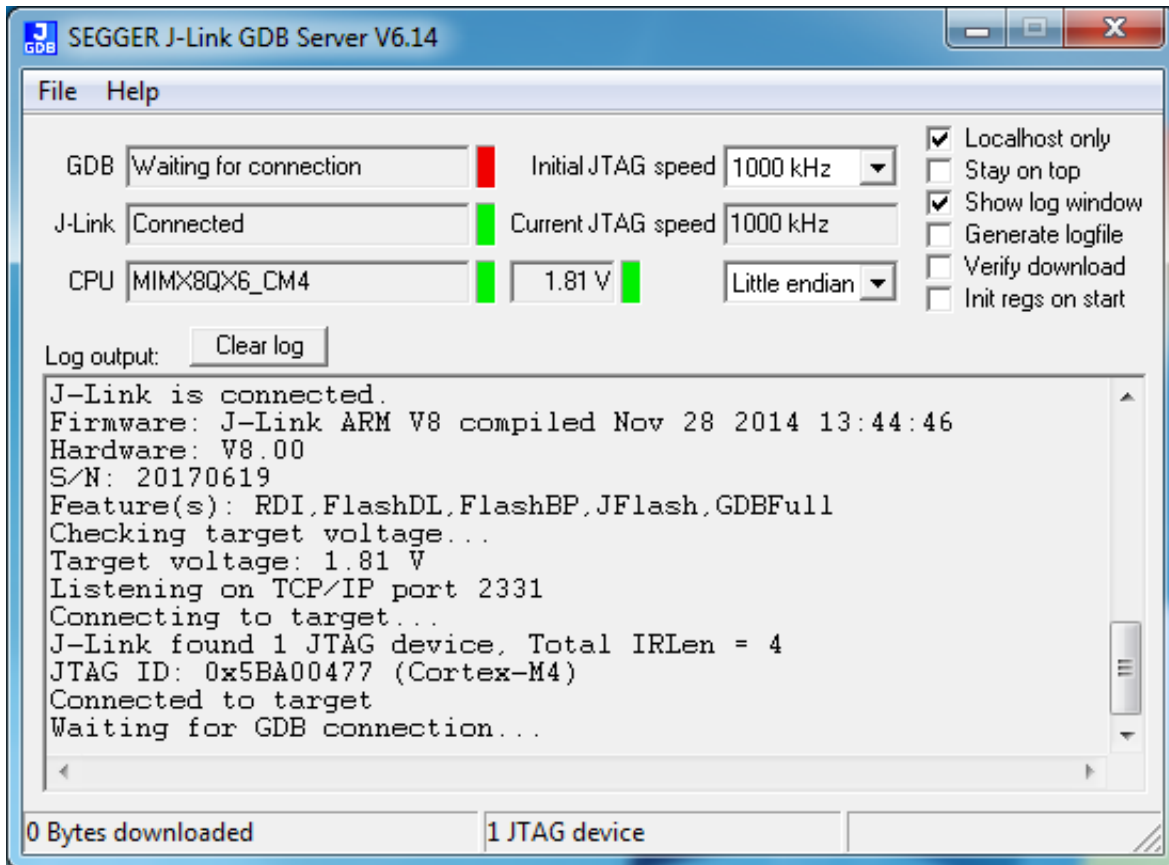
1. Connect the development platform to your PC via USB cable between the USB-UART connector and the PC USB connector. If using a standalone J-Link debug pod, also connect it to the SWD/JTAG connector of the board.
2. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug serial port number (to determine the COM port number, see Appendix A). Configure the terminal with these settings:
  - a. 115200 baud rate
  - b. No parity
  - c. 8 data bits
  - d. 1 stop bit



**Figure 13. Terminal (PuTTY) configurations**

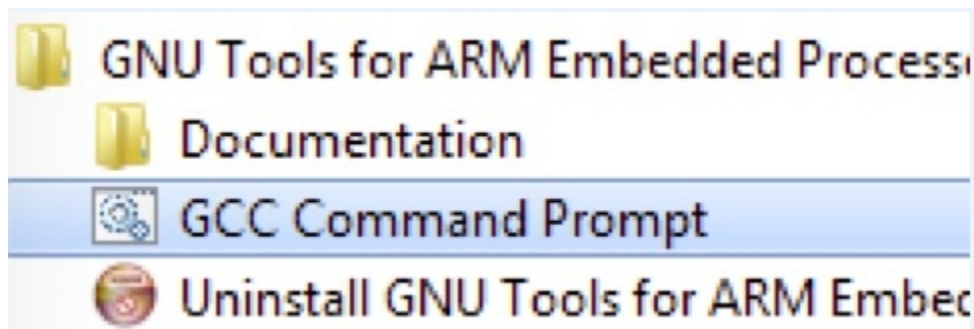
3. Open the J-Link GDB Server application. Assuming the J-Link software is installed, the application can be launched by going to the Windows operating system Start menu and selecting “Programs -> SEGGER -> J-Link <version> J-Link GDB Server”.
4. Modify the settings as shown below. The target device selection chosen for this example is the MIMX8QX6\_CM4.
5. After it is connected, the screen should resemble this figure:





**Figure 14. SEGGER J-Link GDB server screen after successful connection**

6. 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 15. Launch command prompt**

7. 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:

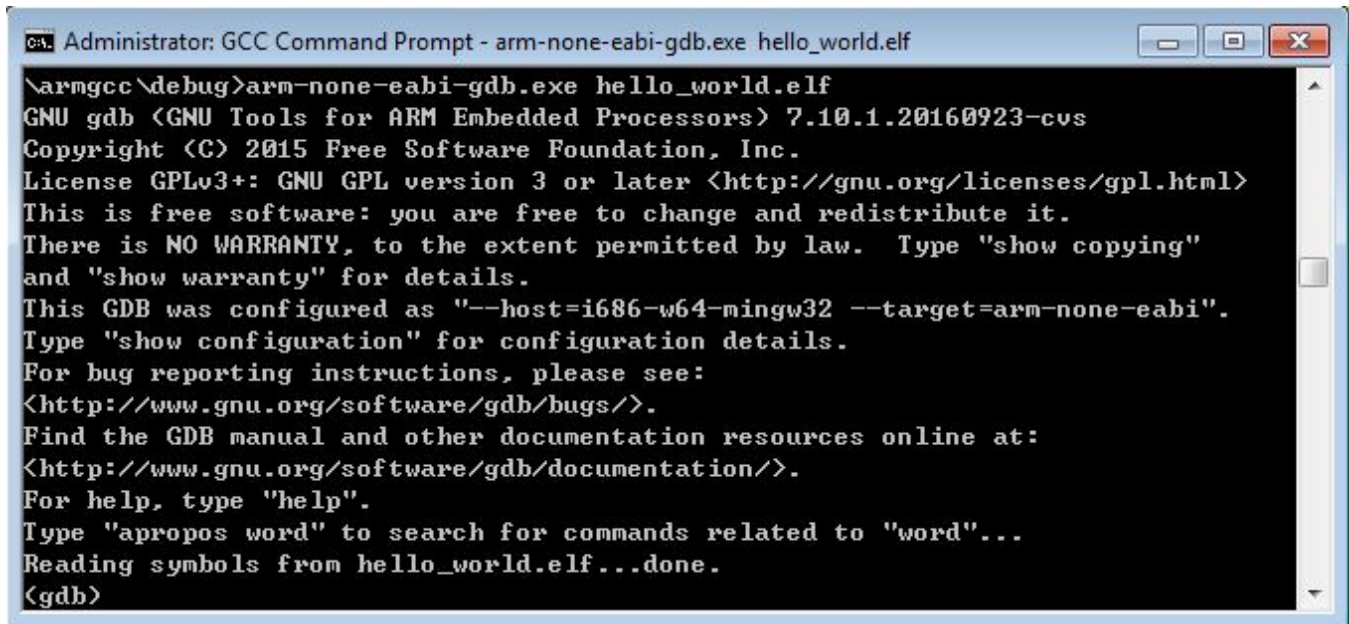
`<install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc/debug`

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

For this example, the path is:

`<install_dir>/boards/mekmimx8qx/demo_apps/hello_world/armgcc/debug`

8. Run the command “arm-none-eabi-gdb.exe <application\_name>.elf”. For this example, it is “arm-none-eabi-gdb.exe hello\_world.elf”.



```

Administrator: GCC Command Prompt - arm-none-eabi-gdb.exe hello_world.elf

\armgcc\debug>arm-none-eabi-gdb.exe hello_world.elf
GNU gdb (GNU Tools for ARM Embedded Processors) 7.10.1.20160923-cvs
Copyright (C) 2015 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law. Type "show copying"
and "show warranty" for details.
This GDB was configured as "--host=i686-w64-mingw32 --target=arm-none-eabi".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from hello_world.elf...done.
<gdb>

```

Figure 16. Run arm-none-eabi-gdb

9. Run these commands:
  - a. "target remote localhost:2331"
  - b. "monitor reset"
  - c. "monitor halt"
  - d. "load"
10. 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.

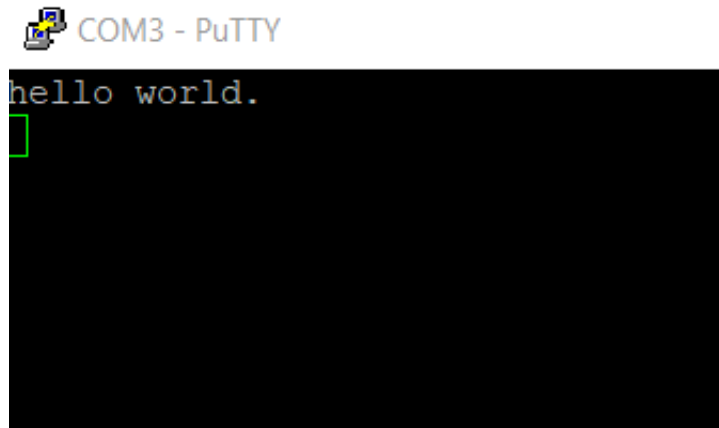


Figure 17. Text display of the hello\_world demo

## 6 Run a demo using imx-mkimage

## Run a demo using imx-mkimage

The imx-mkimage is used to combine various input images and generate the all-in-one boot image with the appropriate IVT (Image Vector Table) set. It can be directly flashed to boot medium, such as an SD card, to boot various cores in the SOC. This includes SCU firmware, U-Boot for A core, and the M4 image for M core. Currently the imx-mkimage can only work on Linux OS. Use the following steps to prepare for working with imx-mkimage:

1. Clone the imx-mkimage from NXP public git

```
$ git clone https://source.codeaurora.org/external/imx/imx-mkimage
```

2. Check out the correct version

```
$ git checkout rel_imx_4.14.62_1.0.0_beta
```

3. Get the SCU firmware for i.MX8QX from the [NXP website](#). Then, execute the following command:

```
$ chmod a+x ./imx-sc-firmware-1.0.bin
```

```
$ sh ./imx-sc-firmware-1.0.bin
```

This extracts the SCU firmware. Rename *mx8qx-mek-scfw-tcm.bin* to *scfw\_tcm.bin* and copy the file to *imx-mkimage/iMX8QX*.

4. Get the i.MX firmware package from [NXP website](#). Execute the following command:

```
chmod a+x ./firmware-imx-7.9.bin
```

```
sh ./firmware-imx-7.9.bin
```

This extracts the i.MX firmware. Copy *firmware/seco/ahab-container.img* to *imx-mkimage/iMX8QX*.

5. Generate the u-boot.bin from linux release package and copy it to *imx-mkimage/iMX8QX*
6. Generate the ARM Trusted Firmware bl31.bin from the linux release package and copy it to *imx-mkimage/iMX8QX*.

## 6.1 Run an example application on the M4 core

1. Build the M4 demo application. Rename the generated binary file (.bin file) to *m4\_image.bin*, and copy to this file to the *imx-mkimage/iMX8QX* folder.
2. In Linux OS, bash cd into the *imx-mkimage* installed directory, and run the following command to generate bootable image:

```
$ make clean
```

If the M4 image built is for TCM

```
$ make SOC=iMX8QX flash_cm4
```

If the M4 image built is for DDR

```
$ make SOC=iMX8QX flash_cm4ddr
```

This generates the bootable image flash.bin under the “iMX8QX” folder.

3. Write the image into the SD card. Insert the SD card into the Linux PC, and run the following command in Linux bash with ROOT permission:

```
dd if=./iMX8QX/flash.bin of=/dev/<SD Device> bs=1k seek=32
```

The <SD Device> is the device node of your SD card such as sdb.

4. Insert the SD card to SD1 card slot and power on the board. See Section 4.2, "Run an example application" for steps to connect the board with PC and configure debugging terminals. It can be observed that the M4 demo is running.

## 6.2 Make a bootable SD card with System Controller Firmware (SCFW)

When debugging or running MCUXpresso SDK with IAR and J-Link GDB Server, the bootable SD card with SCU firmware (SCFW) is required. The SCU handles setting the power, clock, pinmux, and so on for other cores, so the SCFW is needed to run MCUXpresso SDK. To keep the peripherals in the chip at reset status, do not put the CM4 image in the booting image (flash.bin) when debugging or running CM4 cores with IAR and the J-Link GDB Server.

To make a bootable SD card with only SCFW, use the following command to generate a bootable image in imx-mkimage.tool:

```
$ make clean
$ make SOC=IMX8QX flash_scfw
```

Follow the steps described in Section 6.1 to write the generated flash.bin into the SD card.

## 6.3 Make a bootable SD card with U-Boot support

When trying to use the facility U-Boot provides to boot M4, the bootable SD card with U-Boot is required.

To make a bootable SD card with only SCFW, use the following command to generate a bootable image in imx-mkimage.tool:

```
$ make clean
$ make SOC=IMX8QX flash
```

The generated image combines SCFW too.

Follow the steps described in Section 6.1 to write the generated flash.bin into the SD card.

## 7 Run a demo using facility provided by U-Boot

To run the M4 demo in U-Boot. The M4 demo image should be stored in a FAT32 partition on the SD card. Use the following steps:

1. Make proper partitions for a SD card. See Appendix B.
2. After proper partitions is created, U-Boot should be written to the boot partition. See *Section 6.4 "Make a bootable SD card with U-Boot support"*.
3. The FAT32 partition of the SD card is mounted to the file system on PC. Copy the M4 binary image generated by IAR or ArmGCC to this partition. In the following steps and example, suppose the M4 binary has the name *m4\_image.bin*
4. Insert the SD card into the SD1 card slot and power on the board. The U-Boot runs first on A35. The U-Boot console shows up on Cortex-A debug console.
5. In the U-Boot console, type the following command to store the M4 boot command.

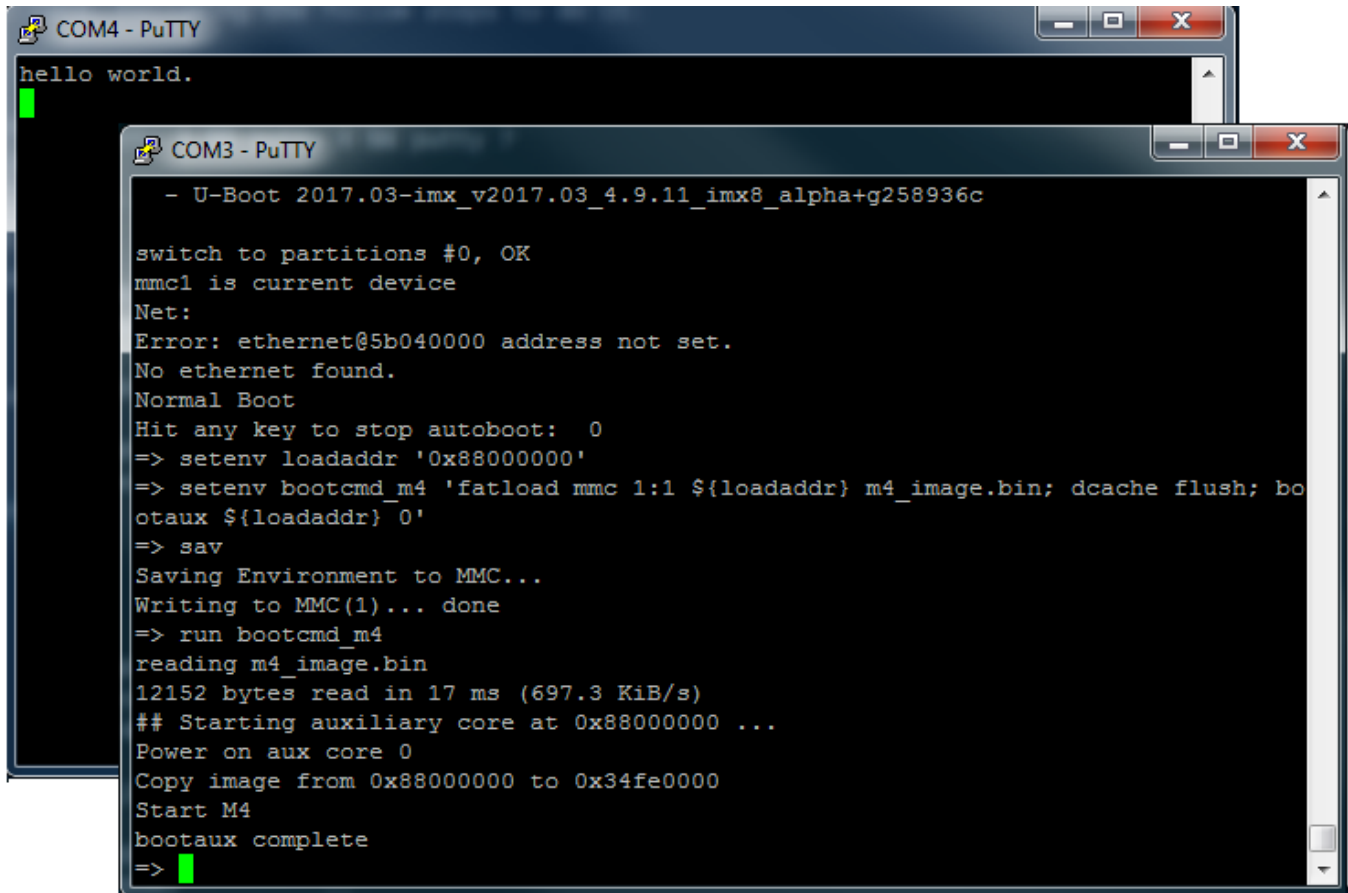
0x34fe0000 is the boot address for RAM type image.

```
> setenv loadaddr '0x88000000'
> setenv bootcmd_m4 'fatload mmc 1:1 ${loadaddr} m4_image.bin; dcache flush; bootaux $
{loadaddr} 0'
> save
```

## Run a flash target demo

6. The `bootcmd_m4` can now be executed in U-Boot console to run the M4 demo. See Section 4.2, "Run an example application" for steps to connect the board with PC and configure debugging terminals. After typing the following command on debugging console for A core, the M4 demo can be observed running.

```
run bootcmd_m4
```



```
COM4 - PuTTY
hello world.

COM3 - PuTTY
- U-Boot 2017.03-imx_v2017.03_4.9.11_imx8_alpha+g258936c

switch to partitions #0, OK
mmc1 is current device
Net:
Error: ethernet@5b040000 address not set.
No ethernet found.
Normal Boot
Hit any key to stop autoboot:  0
=> setenv loadaddr '0x88000000'
=> setenv bootcmd_m4 'fatload mmc 1:1 ${loadaddr} m4_image.bin; dcache flush; bo
otaux ${loadaddr} 0'
=> sav
Saving Environment to MMC...
Writing to MMC(1)... done
=> run bootcmd_m4
reading m4_image.bin
12152 bytes read in 17 ms (697.3 KiB/s)
## Starting auxiliary core at 0x88000000 ...
Power on aux core 0
Copy image from 0x88000000 to 0x34fe0000
Start M4
bootaux complete
=>
```

Figure 18. Boot M4 image from U-Boot

## 8 Run a flash target demo

This section describes the steps to use the UUU to build and run example applications provided in the MCUXpresso SDK. The `hello_world` demo application targeted for the i.MX 8QuadXPlus MEK hardware platform is used as an example, although these steps can be applied to any example application in the MCUXpresso SDK.

### 8.1 Set up environment

This section contains the steps to install the necessary components required to build and run a MCUXpresso SDK demo application, as supported by the MCUXpresso SDK.

## 8.1.1 Download the MfgTool

The Universal Upgrade Utility (UUU) is an upgraded version of MfgTool. It is a command line tool that aims at installing the bootloader to various storage including SD, QSPI, and so on, for i.MX series devices with ease.

The tool can be downloaded from [github](#). Use version 1.1.81 or higher for full support for the M4 image. Download libusb-1.0.dll and uuu.exe for Windows OS, and download uuu for unix. Configure the path so that the executable can later be called anywhere in the command line.

## 8.1.2 Switch to SERIAL mode

The board needs to be in SERIAL mode for UUU to download images:

1. Set the board boot mode to SERIAL[b'0001].
2. Connect the development platform to your PC via USB cable between the SERIAL port and the PC USB connector.  
The SERIAL port is J10 USB Type-C on the CPU board.
3. The PC recognizes the i.MX8QX device as (VID:PID)=(1FC9:012F), which is shown in the below figure.

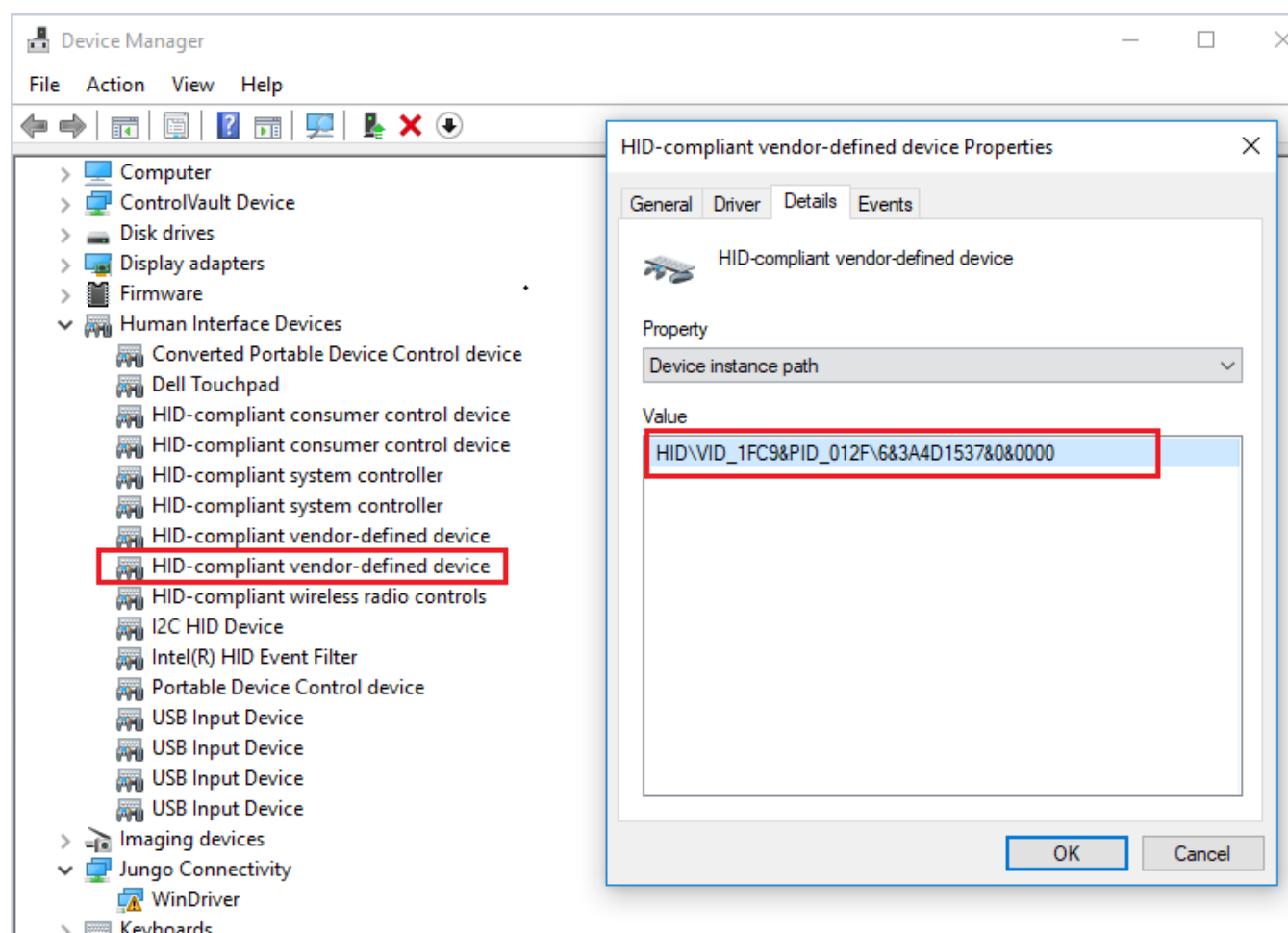


Figure 19. Device as shown in Device Manager

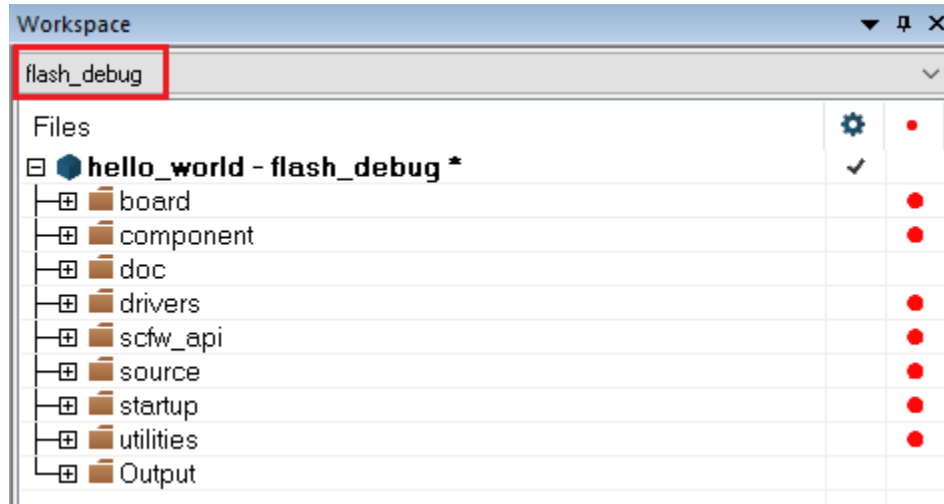
## 8.2 Build an example application

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`

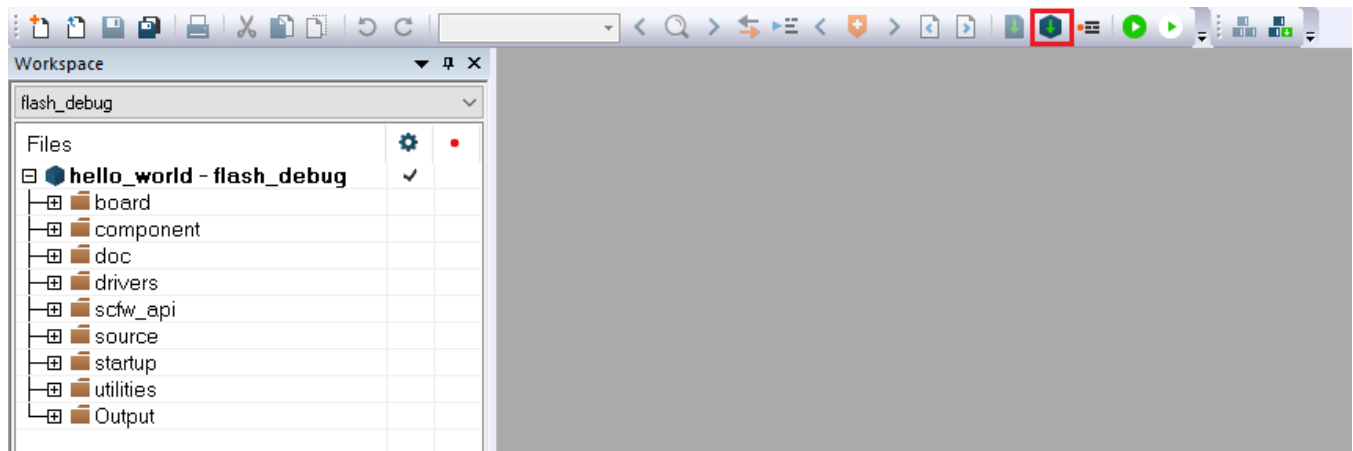
Using the i.MX 8QuadXPlus MEK board as an example, the `hello_world` workspace is located in `<install_dir>/boards/mekmimx8qx/demo_apps/hello_world/iar/hello_world.eww`

2. Select the desired build target from the drop-down. For this example, select the “`hello_world – flash_debug`” target.



**Figure 20. Demo build target selection**

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



**Figure 21. Build the demo application**

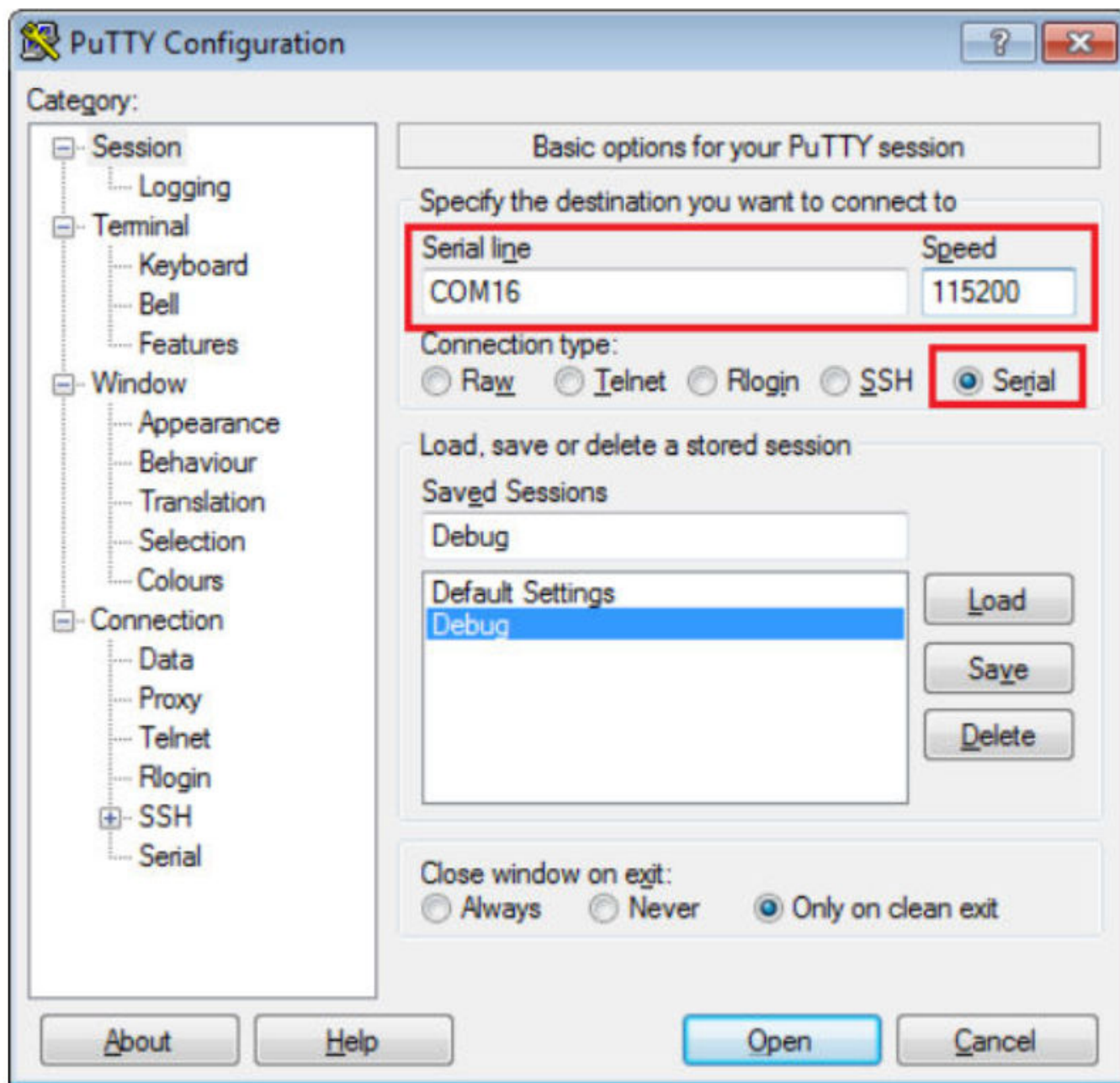
4. The build completes without errors.
5. Rename the generated “`hello_world.bin`” to “`m4_image.bin`”, then copy it to the mkimage tool under `imx-mking/imX8QX`.
6. There are 2 targets to generate `flash.bin` which contains the XIP M4 target in `imx-mkimage`: `flash_cm4flexspi` and `flash_flexspi_all`. The first one is to generate a `flash.bin` which only contains the M4 XIP image, the second one is to generate a `flash.bin` which contains both M4 XIP and U-Boot. Use `make SOC=iMX8QX flash_cm4flexspi` or `make SOC=iMX8QX flash_flexspi_all` to generate the desired `flash.bin`.
7. Use the `make SOC=iMX8QX flash_flexspi` to generate a `flash.bin` which contains flexspi U-Boot. Rename this to `flash_uboot_flash.bin` for future use



## 8.3 Run an example application

To download and run the application via UUU, perform these steps:

1. Connect the development platform to your PC via USB cable between the J11 USB DEBUG connector and the PC. It provides console output while using UUU.
2. Connect the J10 USB Type-C connector and the PC. It provides the data path for UUU.
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 baud rate
  - b. No parity
  - c. 8 data bits
  - d. 1 stop bit



**Figure 22. Terminal (PuTTY) configuration**

4. In the command line, execute uuu with *-b qspi* switch

```
uuu -b qspi flash_uboot_flash.bin flash.bin
```

The UUU puts the platform into fast boot mode and automatically flashes the target bootloader to QSPI. The command line and fast boot console is shown on the following picture:

```

e:\Doc\i.mx\8QX\Release\PRC3\MFGTool\uuu\Windows>uuu -b qspi flash_uboot_flash.bin flash.bin
uuu (Universal Update Utility) for nxp imx chips -- libuuu_1.1.81-0-ge39adc4

Success 1      Failure 0

1:54   6/ 6   [Done] FB: done

e:\Doc\i.mx\8QX\Release\PRC3\MFGTool\uuu\Windows>

Use default environment for mfgtools
Run bootcmd_mfg: run mfgtool_args;if iminfo ${initrd_addr}; then if test ${tee}
= yes; then bootm ${tee_addr} ${initrd_addr} ${fdt_addr}; else booti ${loadaddr}
${initrd_addr} ${fdt_addr}; fi; else echo "Run fastboot ..."; fastboot 0; fi;
Hit any key to stop autoboot:  0

## Checking Image at 83100000 ...
Unknown image format!
Run fastboot ...
l setuip mode 0
l cdns3_uboot_initmode 0
Detect USB boot. Will enter fastboot mode!
Starting download of 1319936 bytes
.....
downloading of 1319936 bytes finished
SF: Detected mt35xu5l2g with page size 256 Bytes, erase size 128 KiB, total 64 M
iB
Detect USB boot. Will enter fastboot mode!
SF: 1441792 bytes @ 0x0 Erased: OK
Detect USB boot. Will enter fastboot mode!
device 0 offset 0x0, size 0x142400
SF: 1319936 bytes @ 0x0 Written: OK
Detect USB boot. Will enter fastboot mode!

```

**Figure 23. Command line and fast boot console output when executing UUU**

5. In this example, the flash.bin is generated using the flash\_flexspi\_all target, which contains both M4 XIP and U-Boot. Then, power off the board, change the boot mode to QSPI[b'0110], and power on the board again. The 2 UART consoles display the U-Boot and M4 demo output respectively.

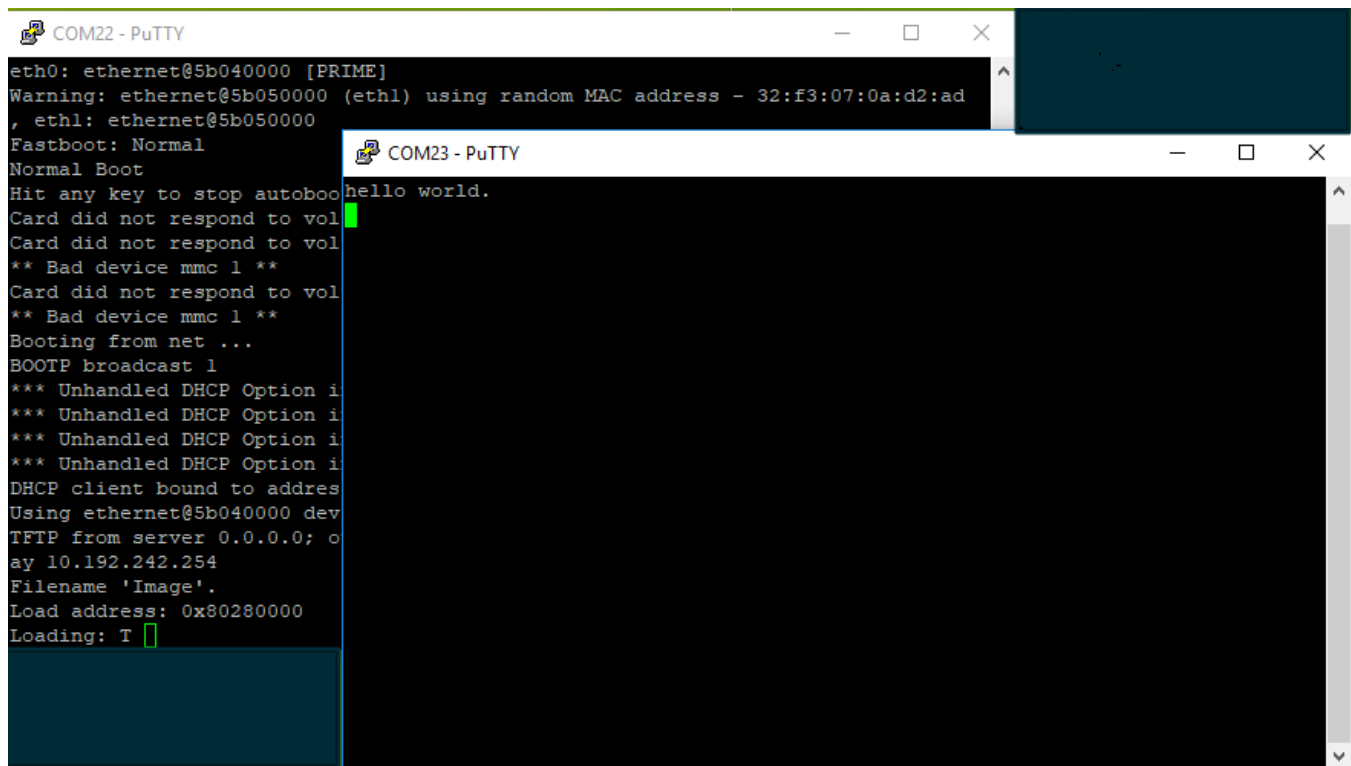


Figure 24. Console output from QSPI Boot

## 9 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.

### Linux:

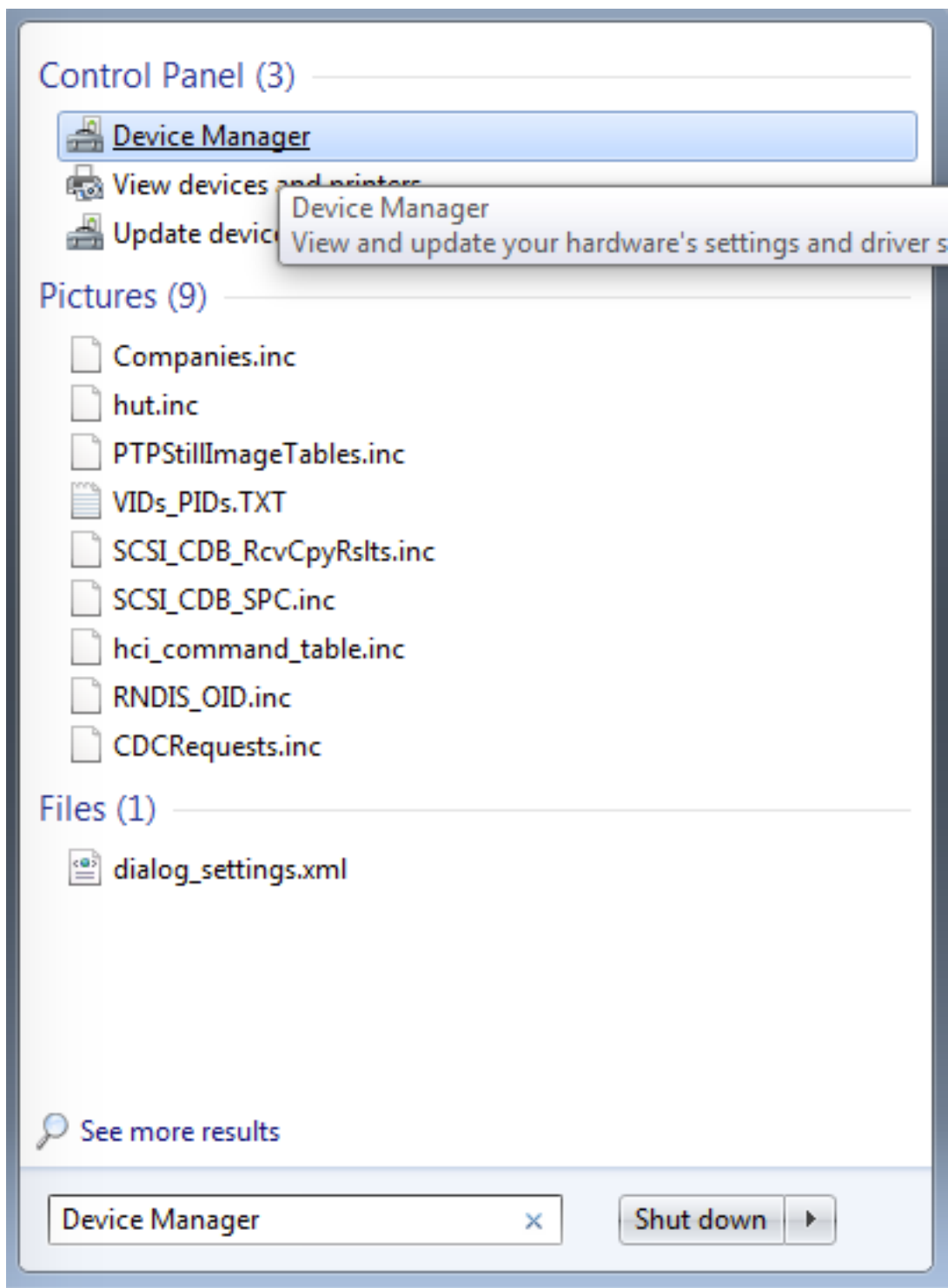
The serial port can be determined by running the following command after the USB Serial is connected to the host:

```
$ dmesg | grep ttyUSB
[434269.853961] usb 2-2.1: FTDI USB Serial Device converter now attached to ttyUSB0
[434269.857824] usb 2-2.1: FTDI USB Serial Device converter now attached to ttyUSB1
```

There are 2 Ports. The first is the Cortex-A debug console, and the second is for the CM4 debug console.

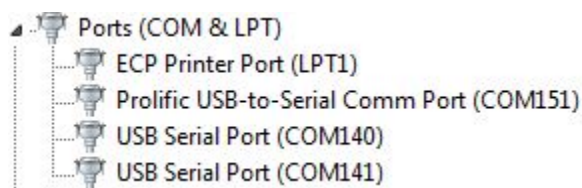
### Windows:

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 25. Device manager**

2. In the Device Manager, expand the “Ports (COM & LPT)” section to view the available ports.
  - a. USB-UART interface

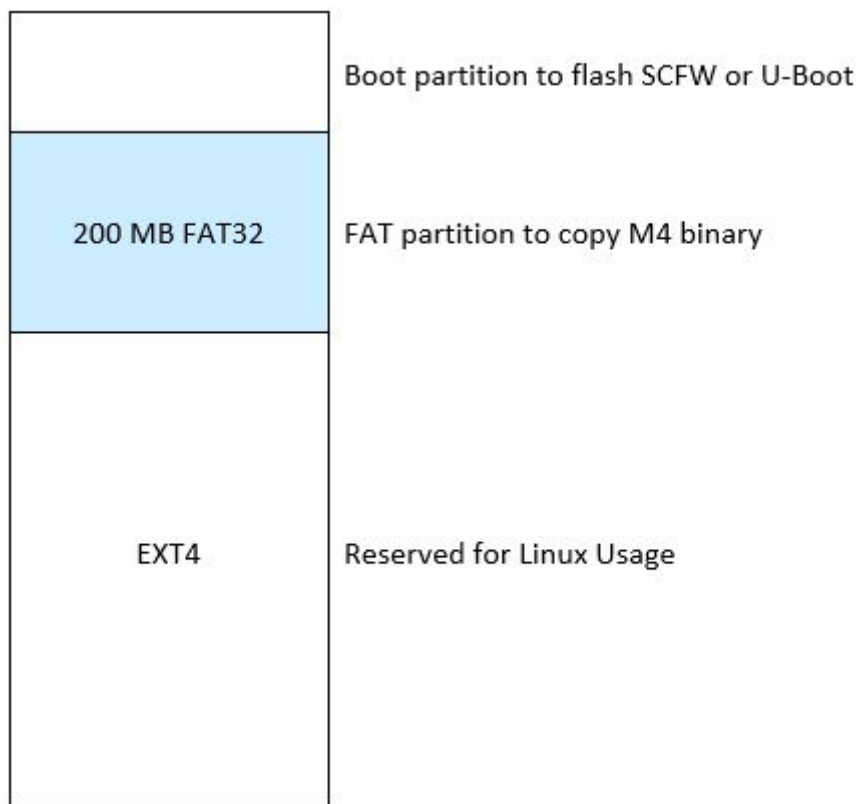


**Figure 26. USB-UART interface**

There will be 4 Ports. The first is the Cortex-A debug console, and the second is for the CM4 debug console.

## 10 Appendix B - Formatting SD card with boot, FAT32, and EXT4 partition

The Boot SD Card may be partitioned and formatted as shown the following figure. As it is shown, different partitions have different usages.



**Figure 27. Typical SD Card Partition and File System Format**

The following script can be used in Linux operating system to format a SD card in this manner:

```
#!/bin/bash
# 1. Erase the MBR
sudo dd if =/dev/zero of=<SD Device> count=2#
2. Make 3 partitions
sudo fdisk <sd card> <<EOF
d
```

```

n

+200M
n

w
EOF
# 3. Format the first partition as FAT32
sudo mkdosfs -F 32 -I <SD Device partition 1>
# 4. Format the second partition as EXT4
sudo mkfs.ext4 <SD Device partition 2>

```

## 11 Appendix C - Host Setup

An MCU SDK build requires that some packages are installed on the Host. Depending on the used Host Operating System, the following tools should be installed.

### Linux:

- Cmake

```

$ sudo apt-get install cmake
$ # Check the version >= 3.0.x
$ cmake --version

```

### Windows:

- MinGW

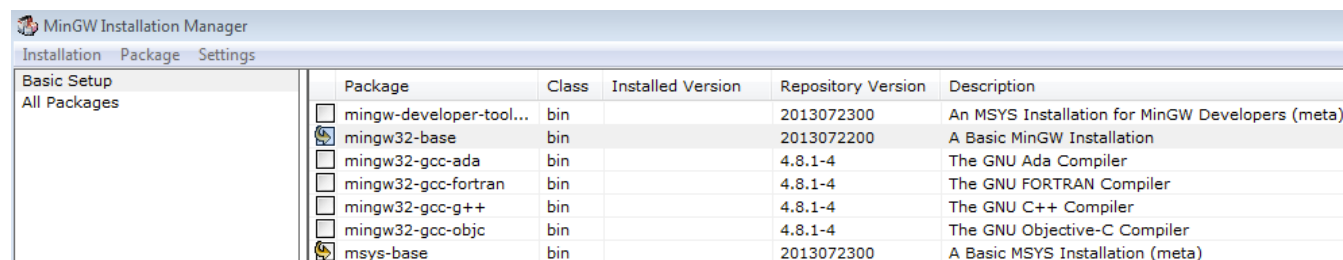
The Minimalist GNU for Windows OS (MinGW) development tools provide a set of tools that are not dependent on third party C-Runtime DLLs (such as Cygwin). The build environment used by the SDK does not utilize the MinGW build tools, but does leverage the base install of both MinGW and MSYS. MSYS provides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

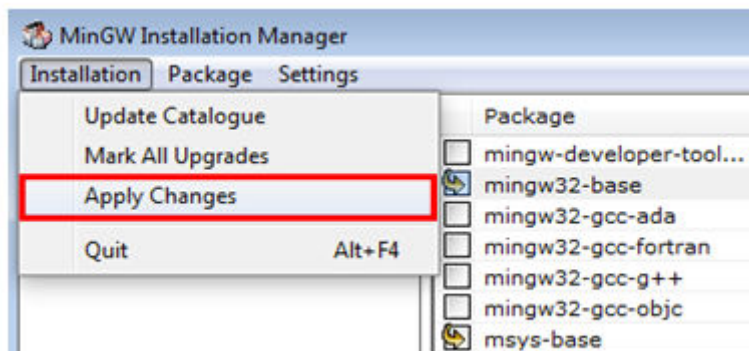
3. Ensure that the “mingw32-base” and “msys-base” are selected under Basic Setup.



**Figure 28. Setup MinGW and MSYS**

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





**Figure 29. Complete MinGW and MSYS installation**

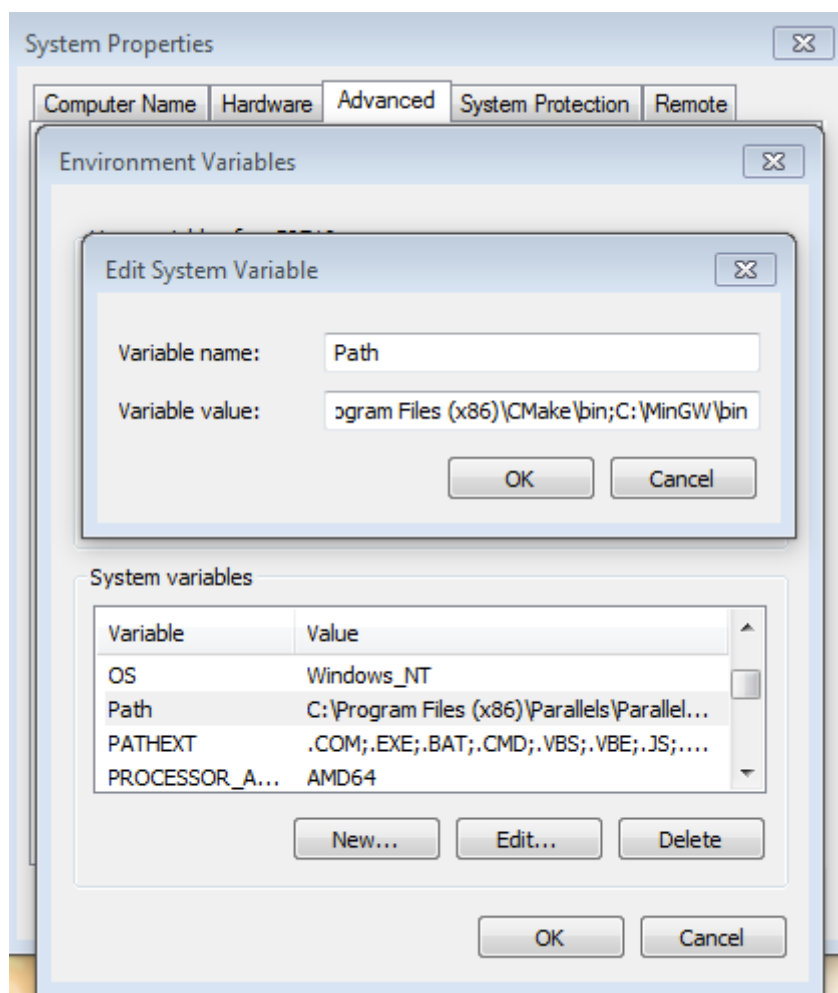
5. Add the appropriate item to the Windows operating system path environment variable. It can be found under *Control Panel -> System and Security -> System -> Advanced System Settings* in the "Environment Variables..." section. The path is:

`<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**

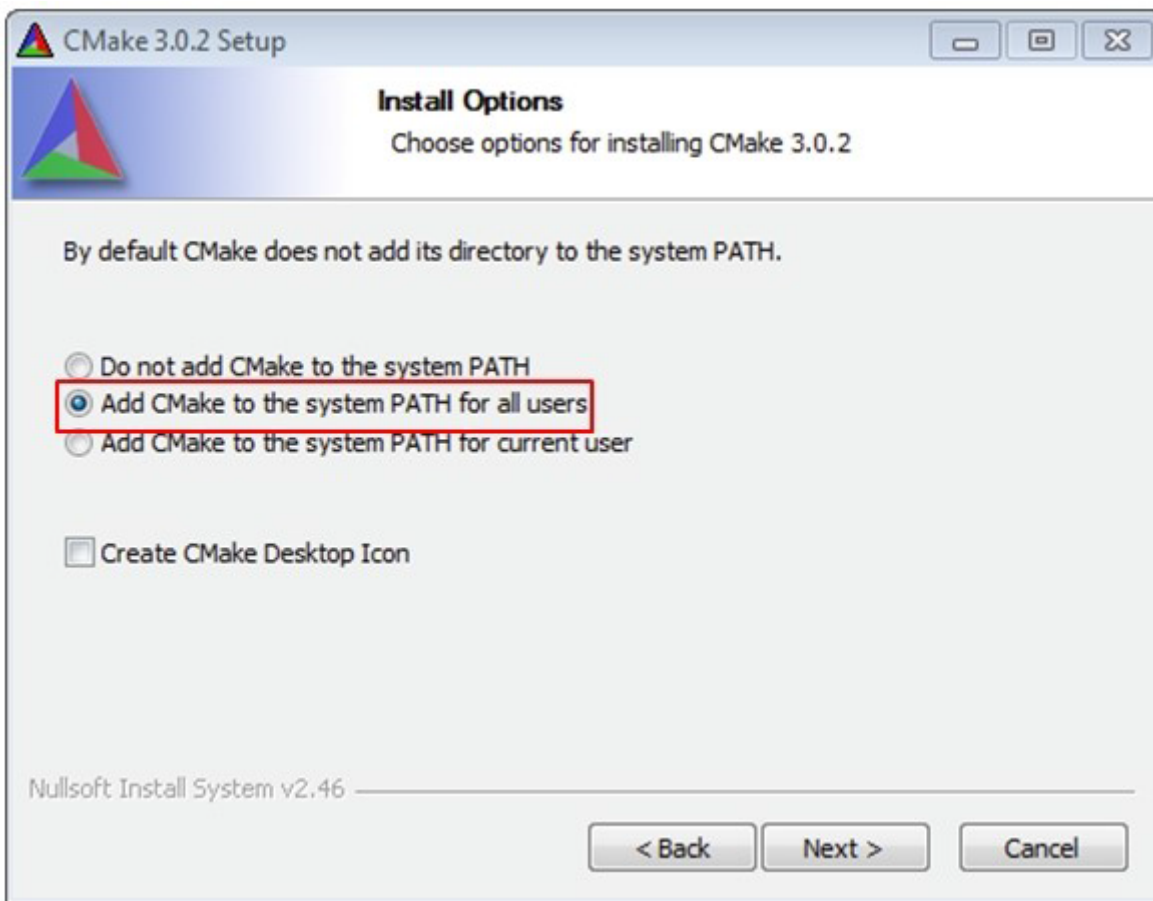
If you have "C:\MinGW\msys\x.x\bin" in your PATH variable (as required by KSDK 1.0.0), remove it to ensure that the new GCC build system works correctly.



**Figure 30. Add Path to systems environment**

- Cmake

1. Download CMake 3.0.x from [www.cmake.org/cmake/resources/software.html](http://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 31. 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.

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