**Freescale Semiconductor, Inc.**
User's Guide

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# Freescale MKW2xD IEEE® 802.15.4 Software

## Quick Start Guide

This document is a brief presentation of the Freescale IEEE® 802.15.4 MAC/PHY Software for the MKW2xD wireless microcontroller platforms, version 5.0.3. This software package is an add-on for the Kinetis Software Development Kit (KSDK) version 1.2.0. This document covers installation of the software packages, hardware setup, build and usage of the provided demo applications.

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# 1 Installation

This section covers the steps for a successful installation of the required software packages: connectivity and Kinetis SDK.

## 1.1 Kinetis SDK Installation

The first step is to install the KSDK (Kinetis SDK) version 1.2.0 using the installation package from the Freescale website. The installer must match your architecture, operating system and required KSDK version number for the connectivity functionality (1.2.0).

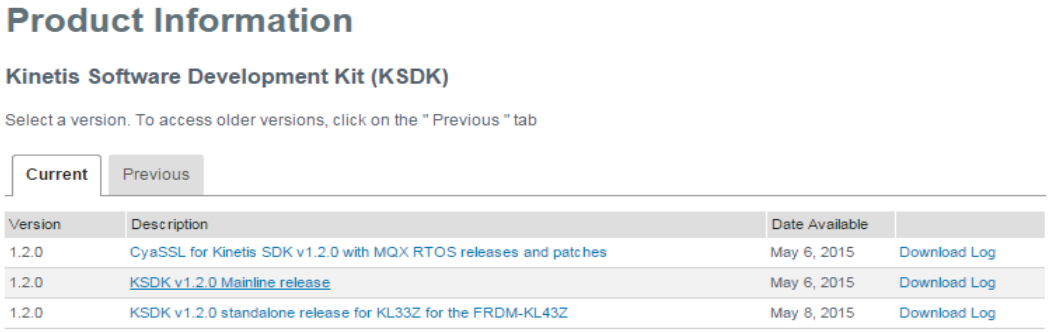
**KSDK installation example**

This example is based on the following setup:

Architecture: 64-bit

Operating System: Windows

Revision Number: 1.2.0



Product Information

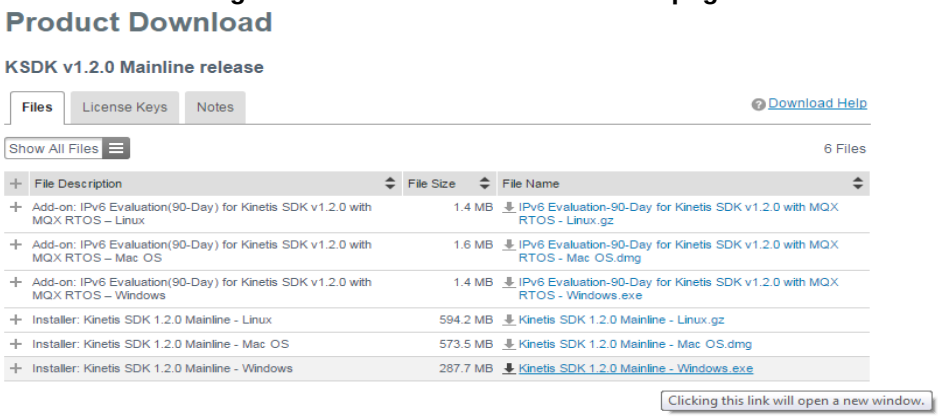
Kinetis Software Development Kit (KSDK)

Select a version. To access older versions, click on the " Previous " tab

Current | Previous

| Version | Description | Date Available | |
|---|---|---|---|
| 1.2.0 | CyaSSL for Kinetis SDK v1.2.0 with MQX RTOS releases and patches | May 6, 2015 | Download Log |
| 1.2.0 | KSDK v1.2.0 Mainline release | May 6, 2015 | Download Log |
| 1.2.0 | KSDK v1.2.0 standalone release for KL33Z for the FRDM-KL43Z | May 8, 2015 | Download Log |

**Figure 1: Freescale KSDK download page**



Product Download

KSDK v1.2.0 Mainline release

Files | License Keys | Notes

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6 Files

| File Description | File Size | File Name |
|---|---|---|
| Add-on: IPv6 Evaluation(90-Day) for Kinetis SDK v1.2.0 with MQX RTOS – Linux | 1.4 MB | IPv6 Evaluation-90-Day for Kinetis SDK v1.2.0 with MQX RTOS - Linux.gz |
| Add-on: IPv6 Evaluation(90-Day) for Kinetis SDK v1.2.0 with MQX RTOS – Mac OS | 1.6 MB | IPv6 Evaluation-90-Day for Kinetis SDK v1.2.0 with MQX RTOS - Mac OS.dmg |
| Add-on: IPv6 Evaluation(90-Day) for Kinetis SDK v1.2.0 with MQX RTOS – Windows | 1.4 MB | IPv6 Evaluation-90-Day for Kinetis SDK v1.2.0 with MQX RTOS - Windows.exe |
| Installer: Kinetis SDK 1.2.0 Mainline - Linux | 594.2 MB | Kinetis SDK 1.2.0 Mainline - Linux.gz |
| Installer: Kinetis SDK 1.2.0 Mainline - Mac OS | 573.5 MB | Kinetis SDK 1.2.0 Mainline - Mac OS.dmg |
| Installer: Kinetis SDK 1.2.0 Mainline - Windows | 287.7 MB | Kinetis SDK 1.2.0 Mainline - Windows.exe |

Clicking this link will open a new window.

**Figure 2: Freescale KSDK download page (continued)**

Once downloaded please open the installer and follow the steps indicated by the wizard.

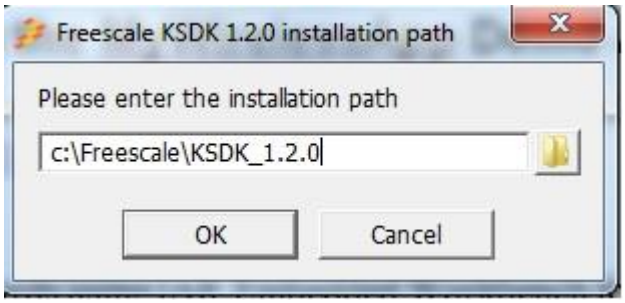


**Figure 3: KSDK install wizard first page**

The installer will prompt you with the installation path for the KSDK. By default this path is "C:\Freescale\KSDK_1.2.0".

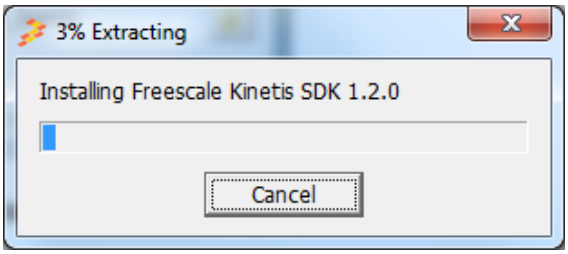


**Figure 4: KSDK install extract page**

## 1.2 Freescale MKW2xD IEEE 802.15.4 Software Installation

After completing the KSDK installation procedure, the installation of the IEEE 802.15.4 software package can begin. Please execute the installer and follow the steps presented in the example.

**Freescale MKW2x IEEE 802.15.4 Software Installation Example**

The first page is just a preamble for the installation. Choose next to continue.

**Figure 5: IEEE 802.15.4 software install wizard first screen**

The next page is the license agreement. If you accept the terms and conditions please select “I Agree” to continue the installation.

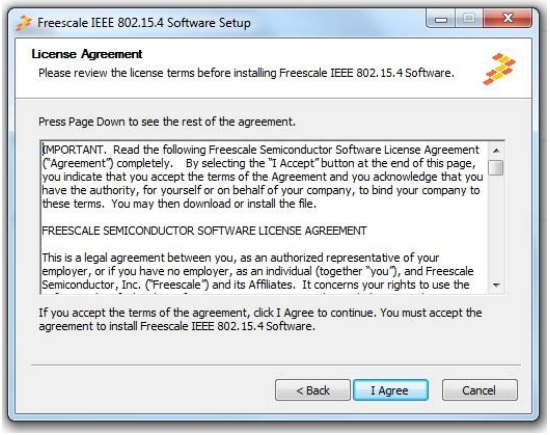


**Figure 6: IEEE 802.15.4 software install wizard license screen**

On the next page the wizard will detect the KSDK package location. If it does not match with the location of the package you want please change it accordingly. Also, it is advisable to leave the environment variable checkbox checked, so that the KSDK_PATH environment variable is properly updated. This variable is used by the MAC IDE projects to refer KSDK sources and libraries.

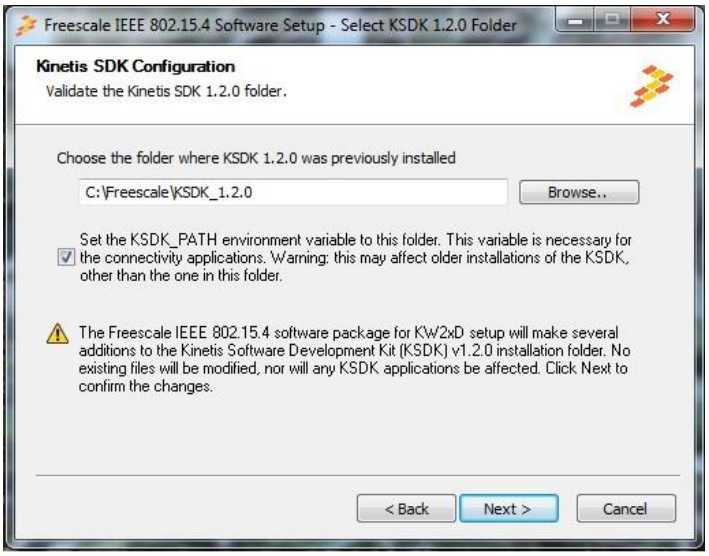


**Figure 7: IEEE 802.15.4 software install wizard KSDK location**

The next step is to select the install location for the Freescale IEEE 802.15.4 MAC/PHY software. By default the installer uses "C:\Freescale", but this may be changed, depending on your needs.

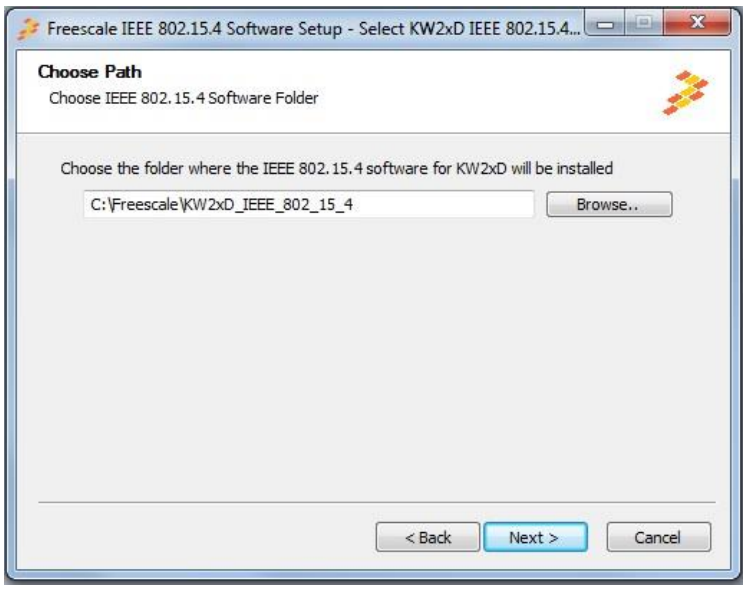


**Figure 8: IEEE 802.15.4 software install wizard location selection**

The last step is to choose whether you wish to create shortcuts for the IEEE 802.15.4 MAC/PHY software installation.

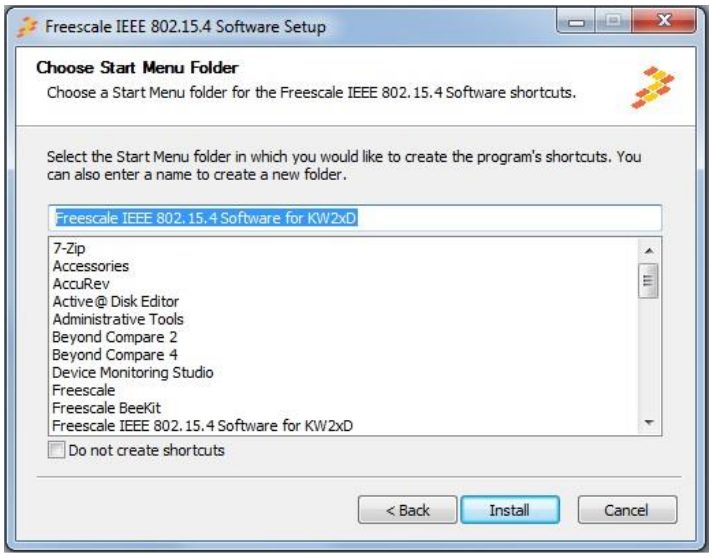


**Figure 9: IEEE 802.15.4 MAC/PHY software install wizard creates shortcuts**

# 2 Building the Binaries

This section details the required steps for obtaining the binary files for usage with the boards.

**NOTE**

In order to be able to build any of these packages you need a copy of the IAR Embedded Workbench for ARM® version 7.40.1 or higher. This connectivity software package does not include support for any other toolchains.

The packages must be built with the debug configuration in order to enable debugging information.

## 2.1 Building the KSDK Libraries

This release supports all development platforms based on the KW2xD wireless microcontroller. The RTOS support includes FreeRTOS and MQX kernels. The KSDK platform libraries are RTOS dependent, so appropriate libraries must be built for the RTOS chosen.

For any connectivity application, the following Kinetis SDK libraries must be built with the IAR Embedded Workbench for ARM® in order to enable the complete board support and RTOS kernel support:

- FreeRTOS or MQX Platform drivers library
- USB device library for FreeRTOS or MQX
- MQX Kernel library

The location of the KSDK MQX and platform projects is described using the following placeholders for text:

- <ksdk_path> : represents the root path of the KSDK installation folder
- <device> : represents the board MCU (KW24D5 or KW21D5)
- <board> : represents the board (for example frdmkw24, twrkw24d512, twrkw21d256 or usbkw24d512)

Using the placeholders, these are the required Kinetis SDK v1.2.0 projects locations:

- <ksdk_path>\rtos\mqx\mqx\build\iar\mqx_<board>\mqx_<board>.eww
- <ksdk_path>\lib\ksdk_mqx_lib\iar\<device>\ksdk_mqx_lib.eww
- <ksdk_path>\lib\ksdk_freertos_lib\iar\<device>\ksdk_freertos_lib.eww
- <ksdk_path>\usb\usb_core\device\build\iar\usbd_sdk_<board>_mqx\usbd_sdk_<board>_mqx.eww
- <ksdk_path>\usb\usb_core\device\build\iar\usbd_sdk_<board>_freertos\usbd_sdk_<board>_freertos.eww

**NOTE**

The IAR projects for KSDK libraries are included in the IAR workspaces corresponding to the IEEE 802.15.4 demo applications and it is recommended to access them this way.

## 2.2 Building and Flashing the Freescale IEEE 802.15.4 Software Demo Applications

This package includes various demo applications that can be used as a starting point.

The next section presents the steps required for building the MAC_FSCI_app, using the following placeholders for text:

- <connectivity_path> : represents the root path for the Freescale IEEE 802.15.4 software package
- <board> : represents the target board for the demo app, can be either “frdmkw24”, “usbkw24d512”, “twrkw24d512” or “twrkw21d256”
- <demo_app> : represents the demo app name

The demo applications general folder structure is the following:

<connectivity_path>\app\ieee_802_15_4\<demo_app>\<board>\build\iar

**Freescale IEEE 802.15.4 Software Demo Application Build Example**

Selected app: MAC_FSCI_app

Board: twrkw24d512

Resulting location:

<connectivity_path>\app\ieee_802_15_4\MAC_FSCI_app\twrkw24d512\buil\iar

**Step 1:**

Navigate to the resulting location.

**Step 2:**

Open the highlighted IAR workspace file (*.eww file format):

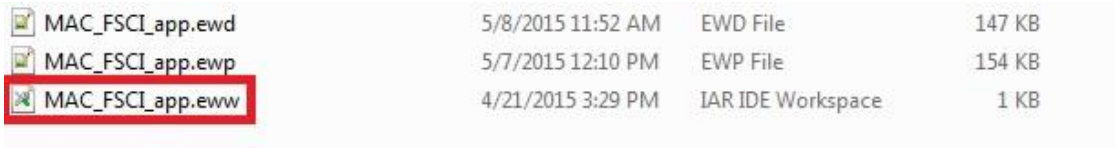


**Figure 10: “MAC_FSCI_app” demo project location**

**Step 3:**

Select the KSDK FreeRTOS platform library project.

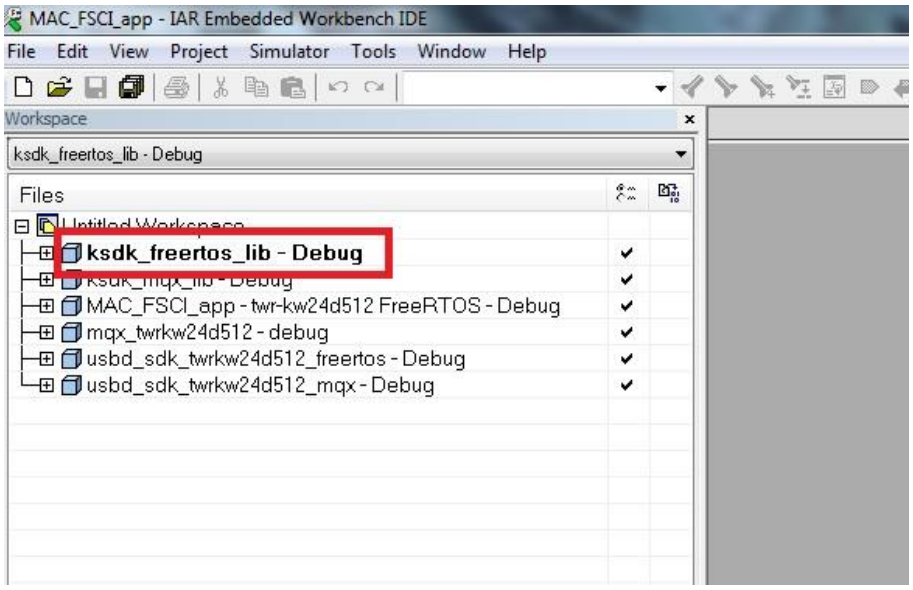


**Figure 101: KSDK FreeRTOS platform library IAR project**

**Step 4:**

Build the KSDK FreeRTOS platform library project.

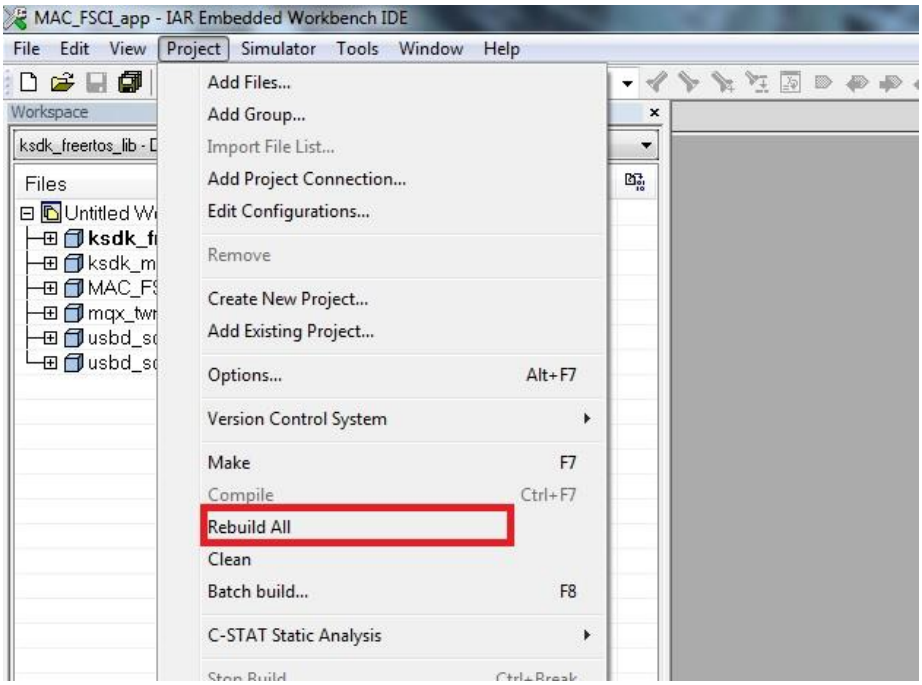


**Figure 112: KSDK FreeRTOS platform library build**

**Step 5:**

Select the USB twrkw24d512 FreeRTOS library project.

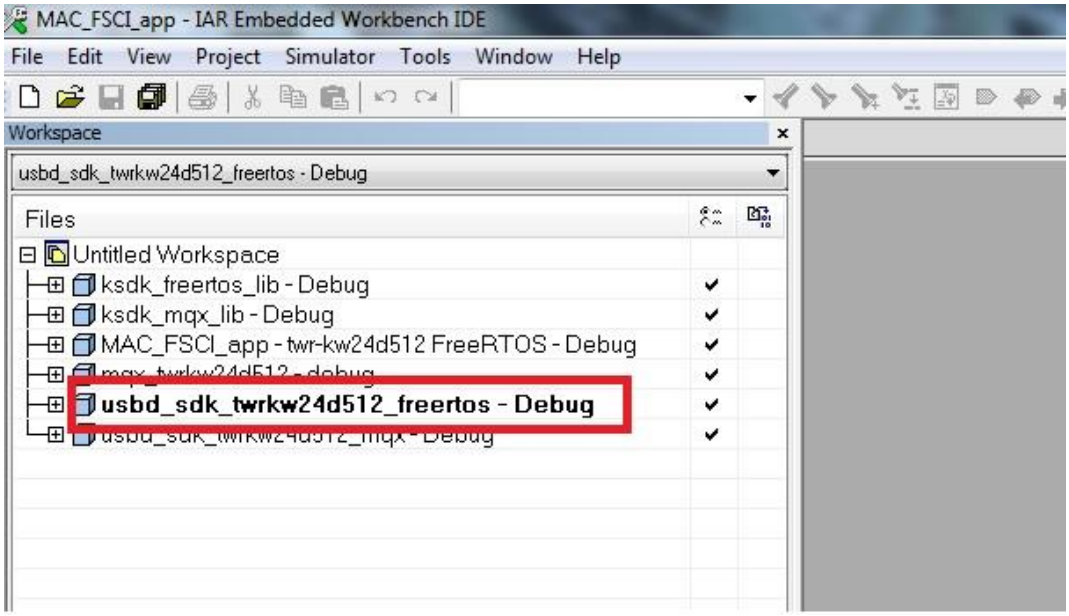


**Figure 123: KSDK FreeRTOS USB library**

**Step 6:**

Build the USB twrkw24d512 FreeRTOS library project

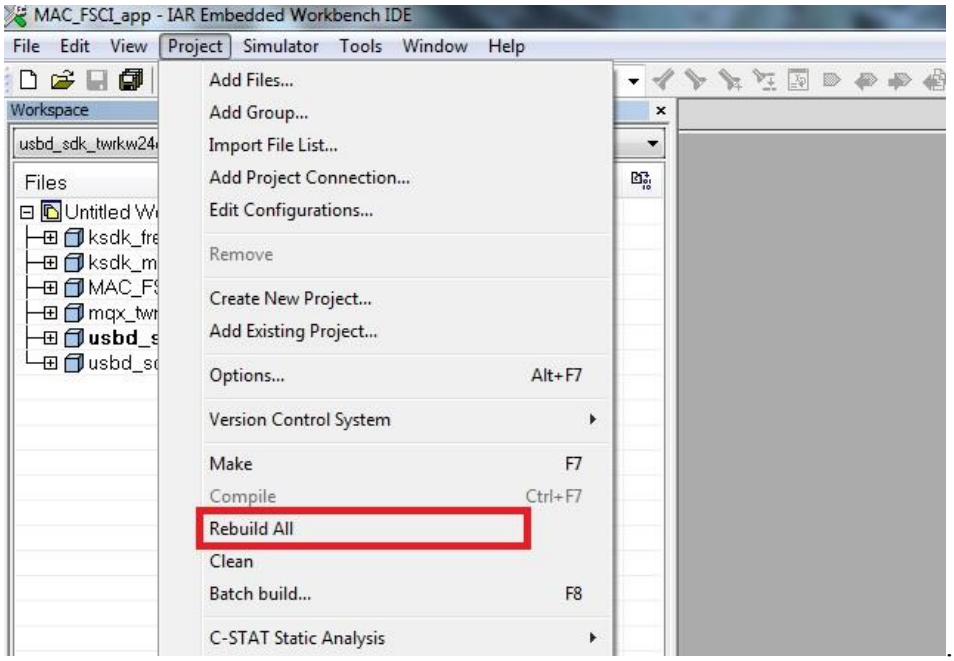


**Figure 134: KSDK FreeRTOS USB library build**

**Step 7:**

Select the MAC_FSCI_App project.

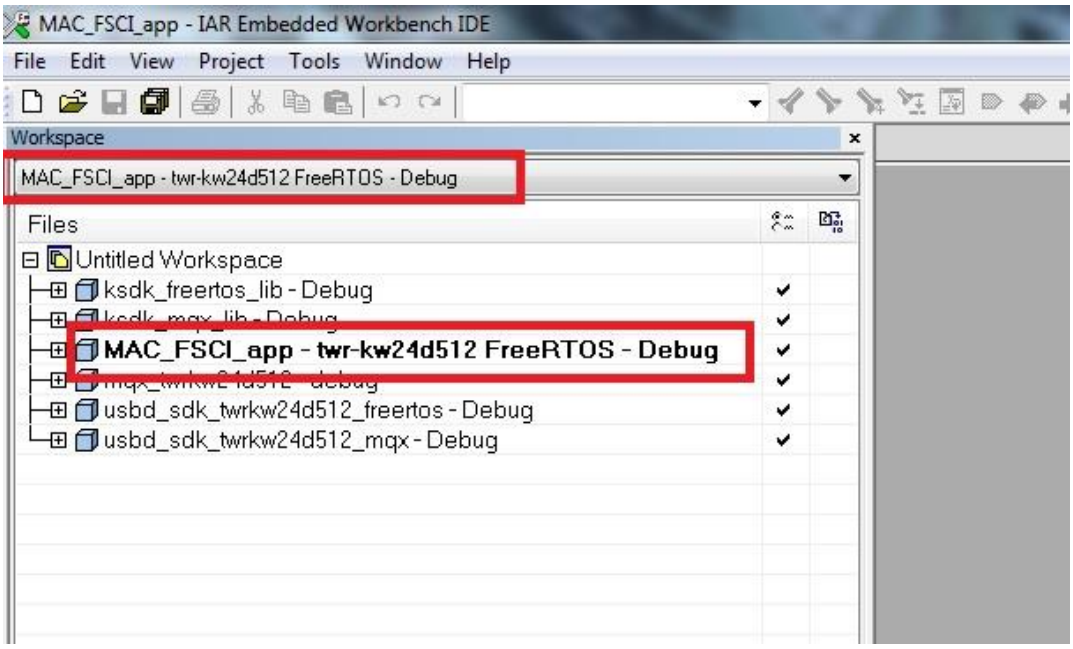


**Figure 15: MAC_FSCI_App FreeRTOS IAR project**

**Step 8:**

Build the MAC_FSCI_App project.

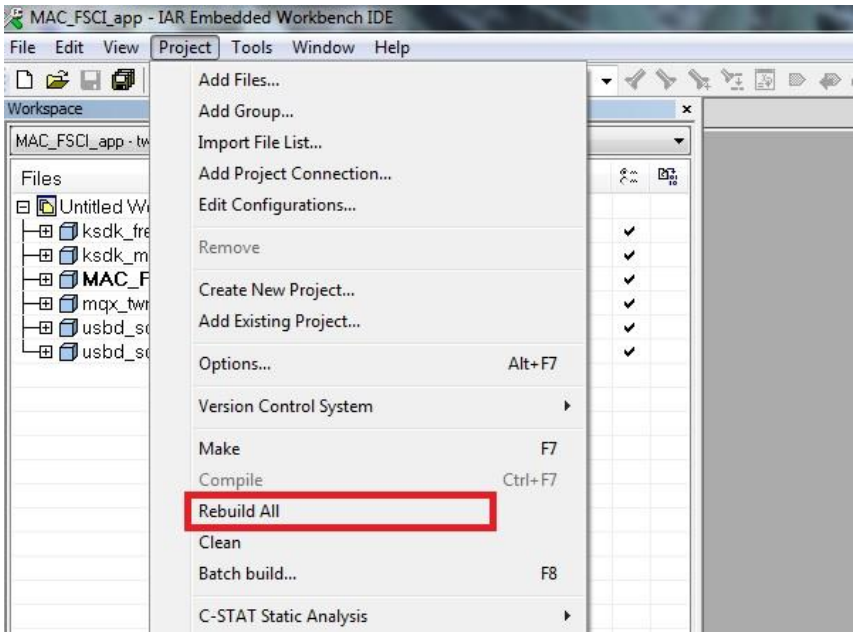


**Figure 16: MAC_FSCI_APP FreeRTOS build**

**Step 9:**

Make the appropriate debugger settings in the project options window:

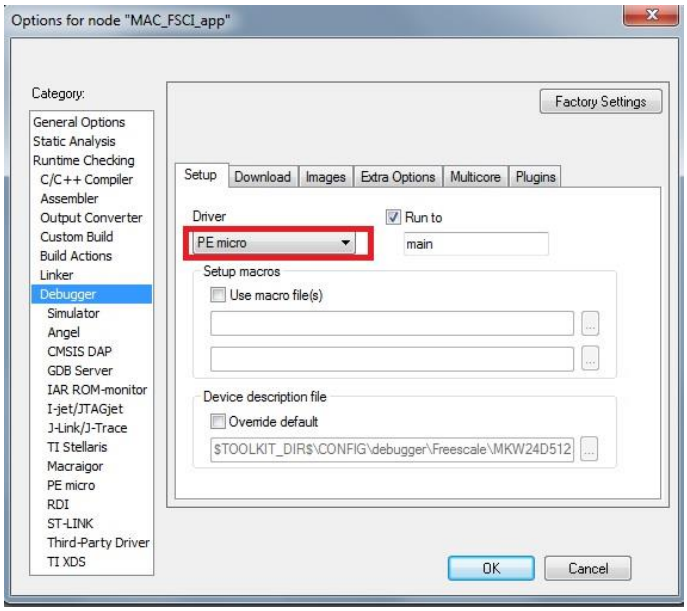


**Figure 147: Debugger Settings**

**Step 10:**

Click the "Download and Debug" button to flash the executable onto the board.

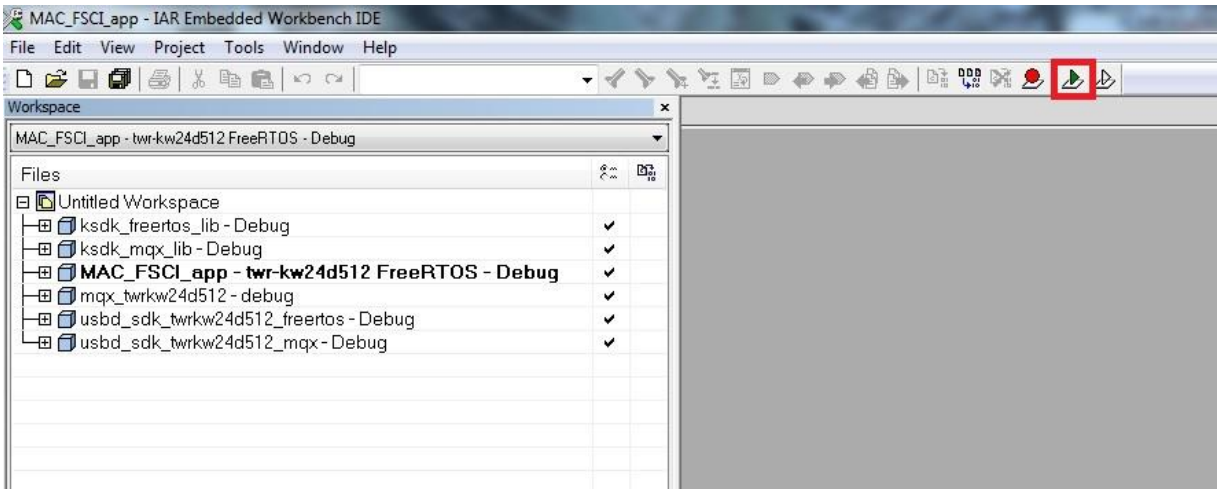


**Figure 158: MAC_FSCI_App Download and Debug**

**NOTE**

The projects are configured with "P&E Micro" firmware as the default debug configuration. Please make sure that your board's OpenSDA chip contains a P&E Micro firmware or that the debugger selection corresponds to the physical interface used to interface to the boards. See the section below for more information.

# 3 Hardware Setup

The hardware setup in this example uses a TWR-KW24D512 development platform shown in the figure below:

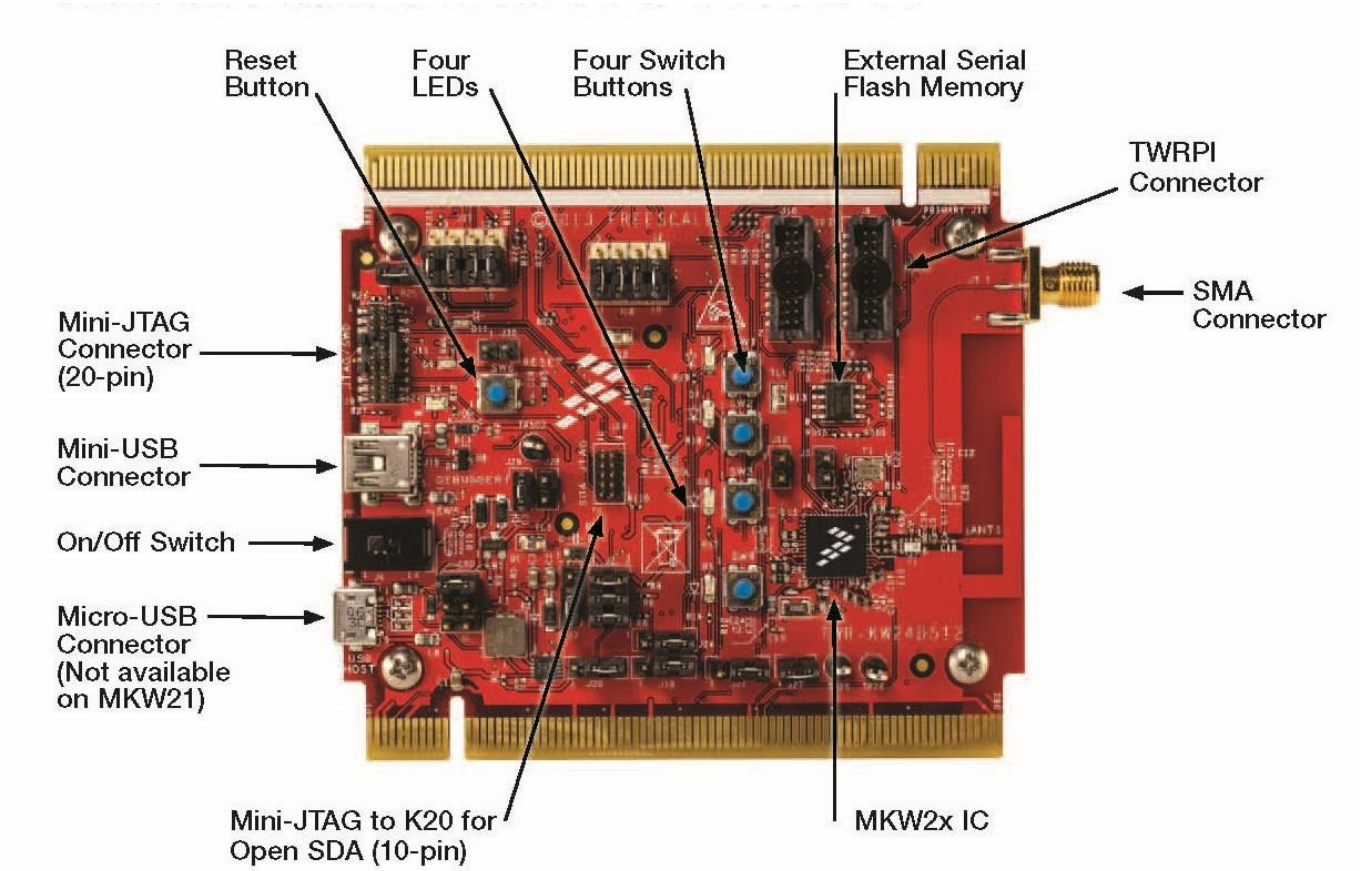


**Figure 19: TWR-KW24D512**

The TWR-KW24D512 should have its OpenSDA (OpenLink) USB port connected via micro-USB cable to a Windows PC. The OpenSDA chip on the tower platform should have appropriate firmware flashed, with debugging and virtual serial COM port capabilities. For more information on OpenSDA please refer to the following webpage: www.freescale.com/opensda.

Variants of embedded firmware for the OpenSDA chip can be downloaded from:

http://www.pemicro.com/opensda/
https://www.segger.com/opensda.html
http://developer.mbed.org/handbook/CMSIS-DAP

P&E Micro is the default interface selected in the IAR Embedded Workbench for ARM® projects included in this release.

# 4 Example: Running the MyWirelessApp Demo Application

The MAC "MyWirelessApp" demo application requires a serial terminal program to connect to the boards. For this example, Tera Term was chosen.

**Step 1:**

Load the applications on the boards using IAR Embedded Workbench for ARM®. This demo has two configurations: a "coordinator" and an "end device".

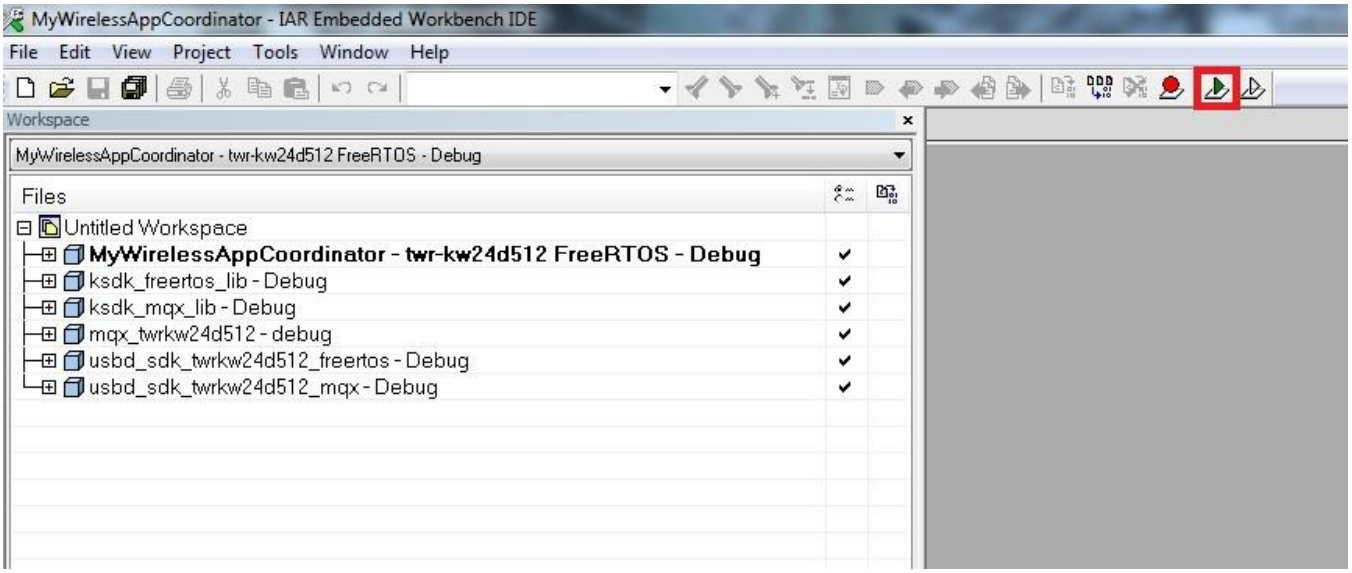


**Figure 20: MyWirelessApp coordinator project**

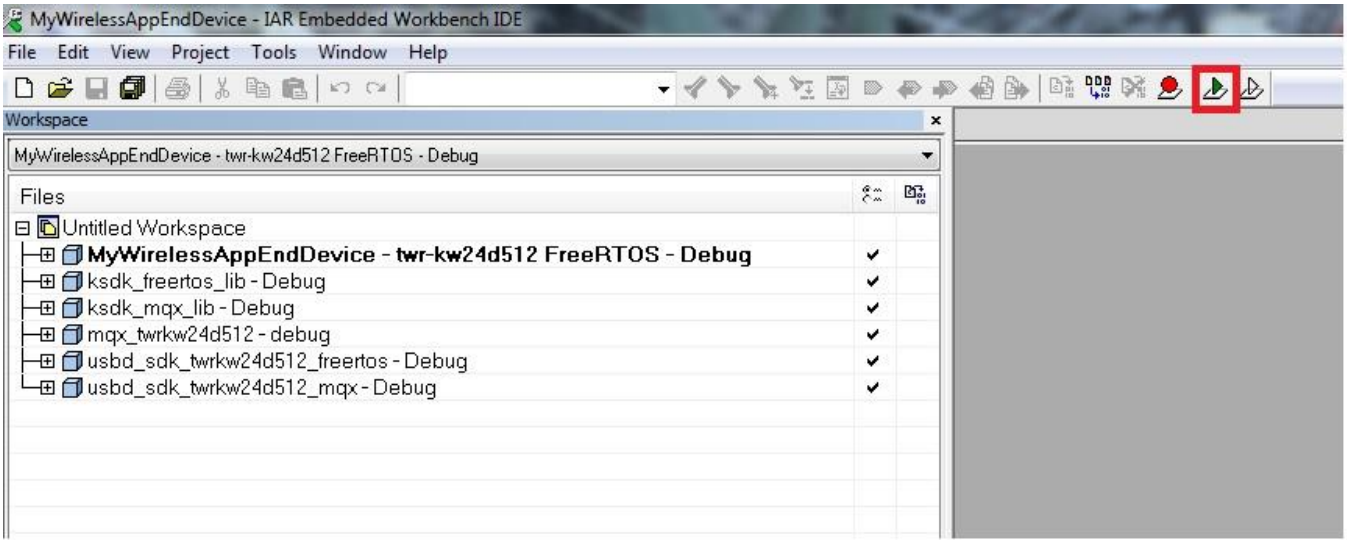


**Figure 21: MyWirelessApp end device project**

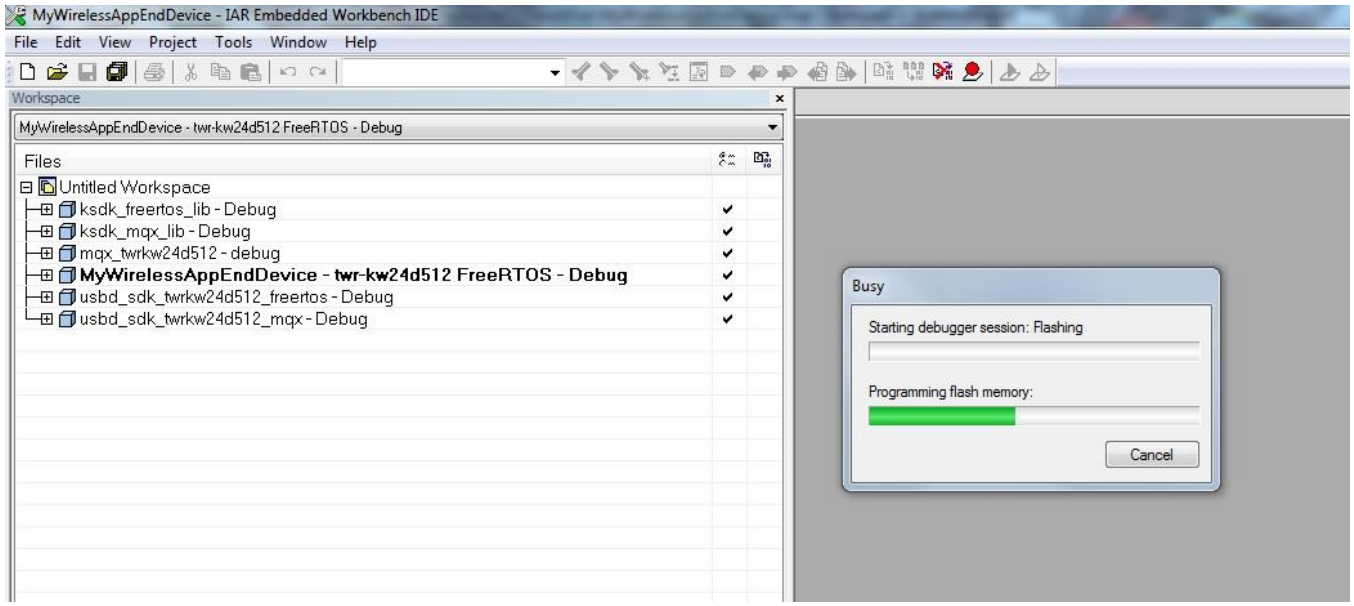


**Figure 22: MyWirelessApp end device loading stage example**

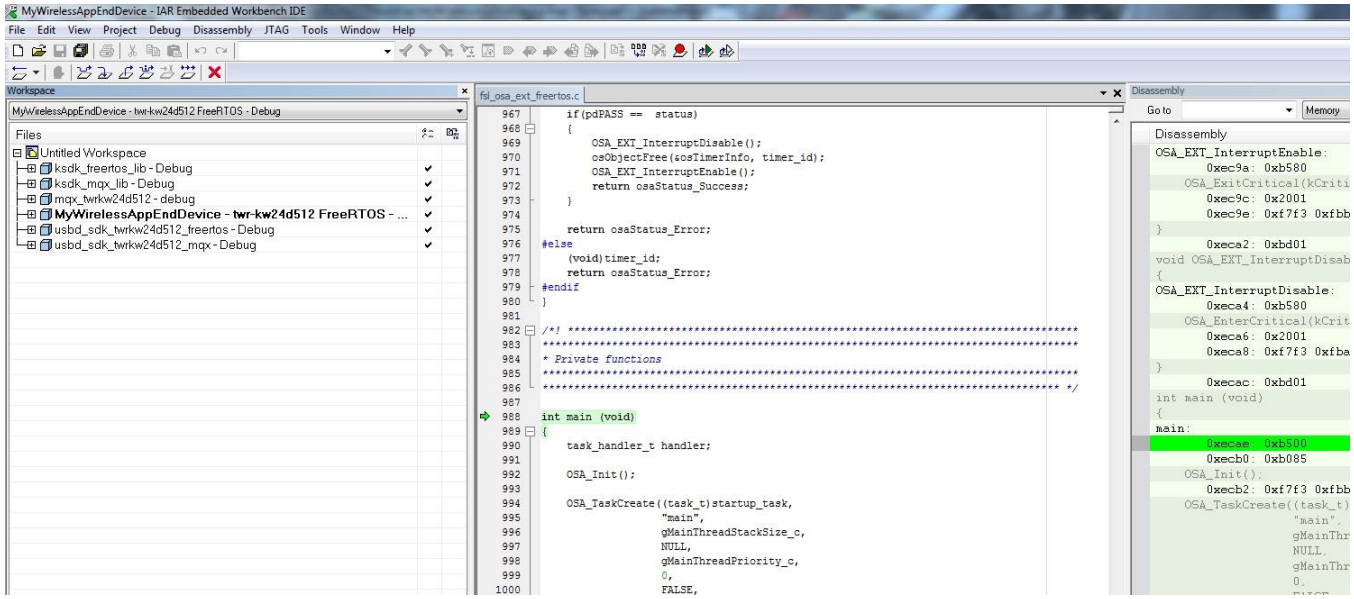


**Figure 23: MyWireless app end device application loaded**

## Step 2:

After loading both application check “Device Manager” to get the serial ports numbers. These should appear with the prefix “Open SDA”.

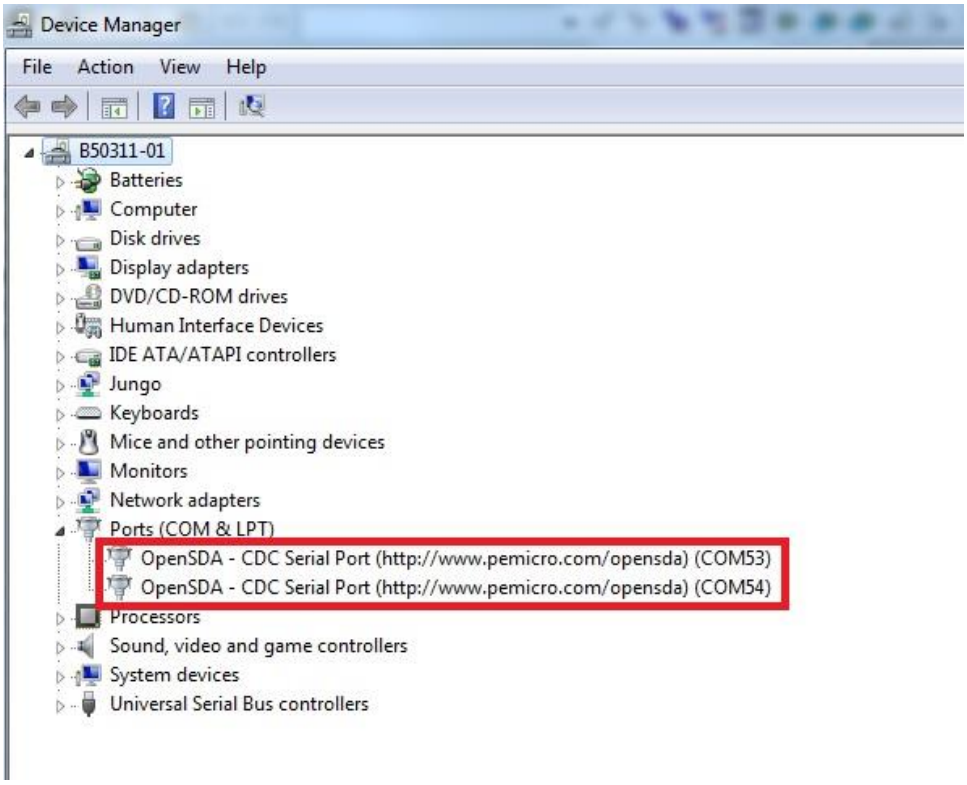


**Figure 24: Device Manager serial port look up**

**Step 3:**

Using the port numbers specified in Device Manager, open two Tera Term instances and connect to the devices using the 115200 baud rate. To change the baud rate of the terminal go to "Setup-> Serial Port" menu.

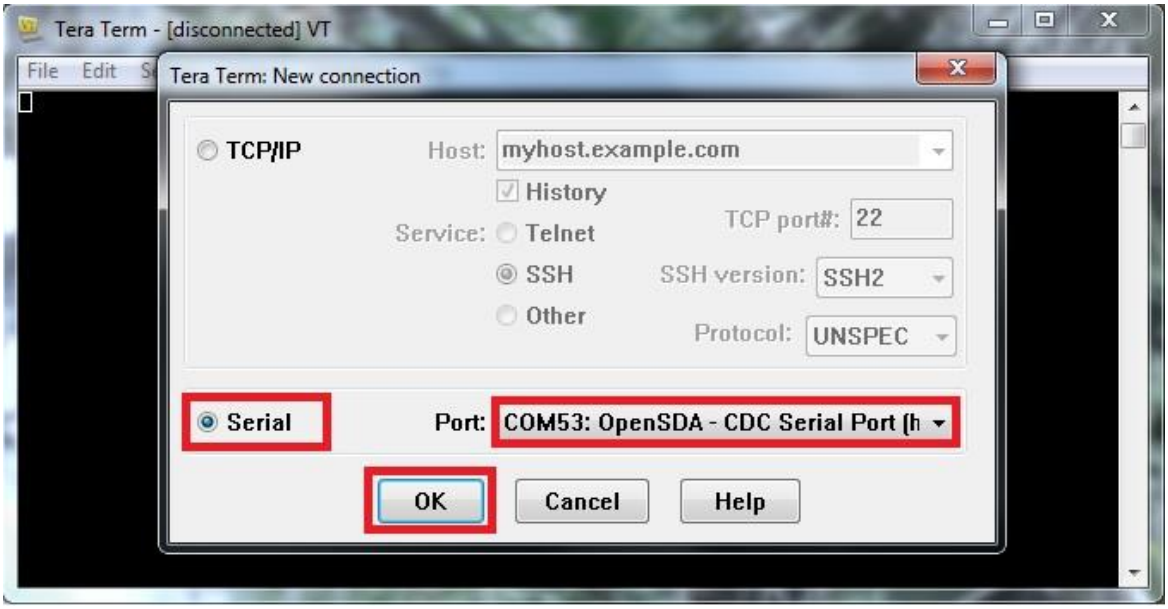


**Figure 25: Select mbed serial connection COM port**

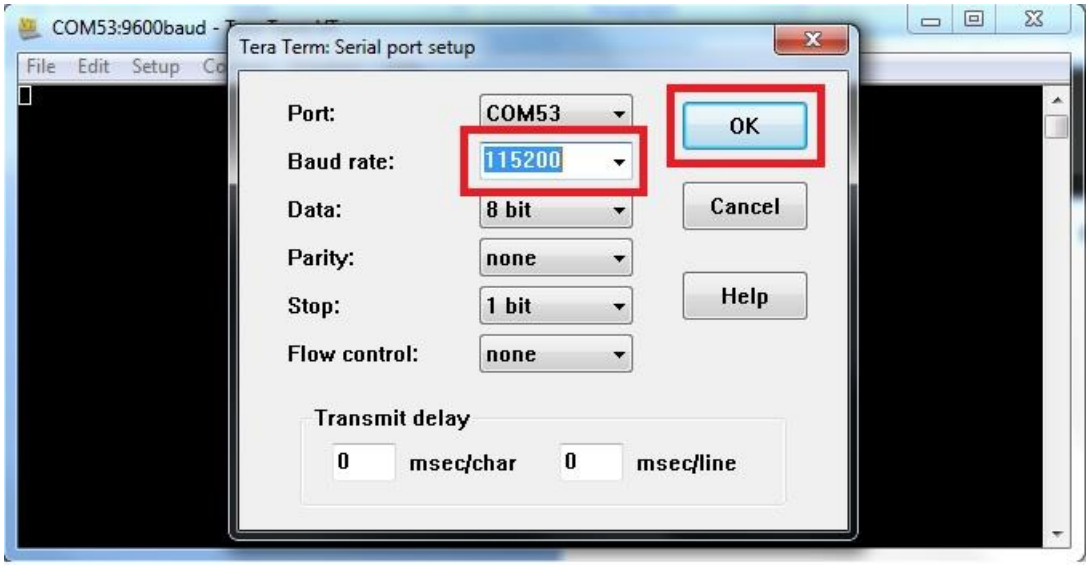


**Figure 16: Setting correct baud rate**

## Step 4:

Start the applications by pressing any available key on the TWR boards: first the coordinator and then the end device.

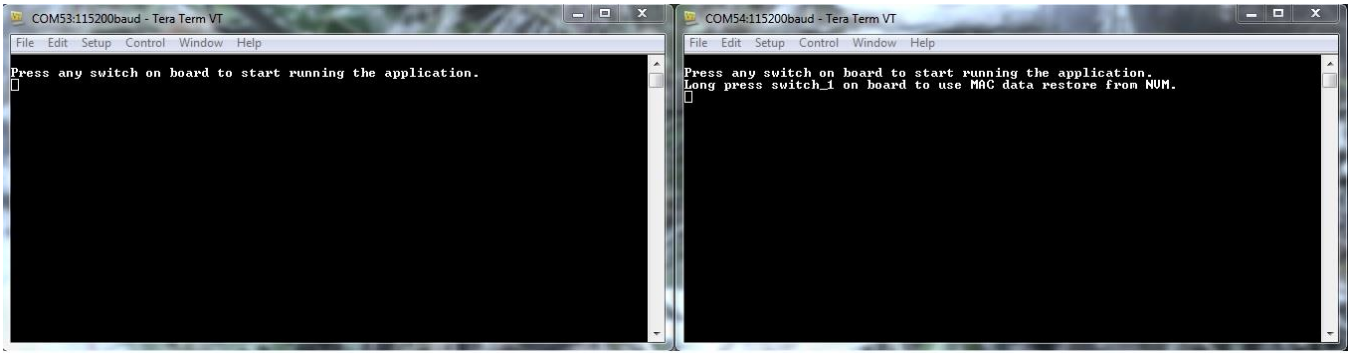


**Figure 27: Both applications after a reset**

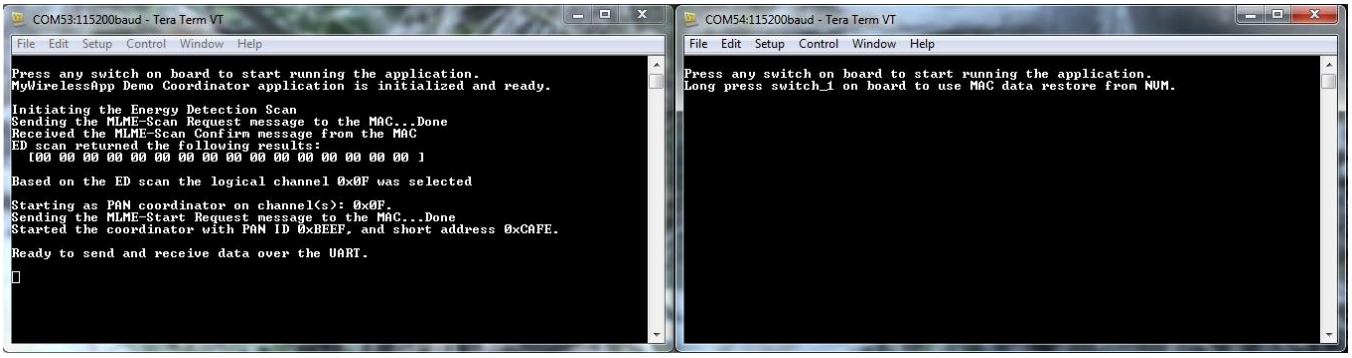


**Figure 28: MyWirelessApp coordinator started**

The coordinator performs an energy detect scan to determine the least occupied channel and then selects it to start the network. The end device performs an active scan and after receiving a beacon from a coordinator, it issues an association request.

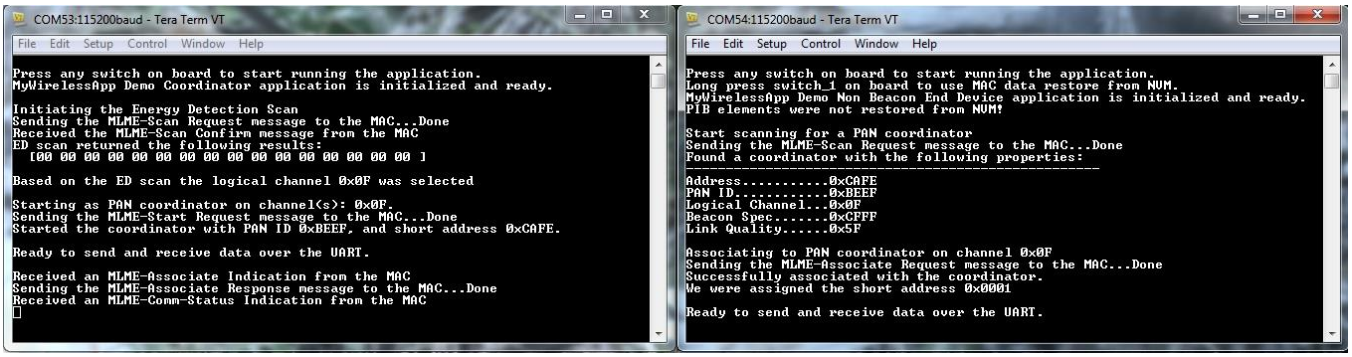


**Figure 29: MyWirelessApp end device associated to coordinator**

After the association procedure completes, in the two terminal windows messages can be written to be exchanged by the two wireless nodes.

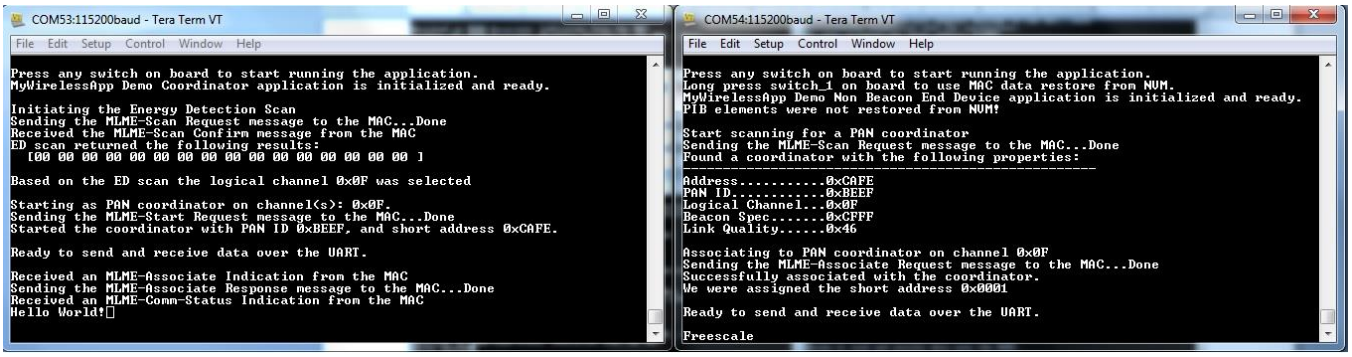


**Figure 30: MyWirelessApp message exchange**

The previous section demonstrates the basic steps to run a demo application. For detailed information about the demo applications, please refer the Demo Applications User's Guide included in the installer (*802154MPDAUG.pdf*).

**Home Page:**
freescale.com

**Web Support:**
freescale.com/support4

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