FreeRTOS User's Guide

FreeRTOS User's Guide
Version 2.0.0, July 2022

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Contents

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1 Introduction

1.1 Analog Devices FreeRTOS

The Analog Devices FreeRTOS product is an add-on to the FreeRTOS Real-time operating system that provides additional support for Analog Devices processors. The product is installed on top of the FreeRTOS operating system in order to gain additional platform support.

In order to avoid confusion the FreeRTOS operating system will be referred to as the **FreeRTOS product.** Components from Analog Devices are always referred to as the **Analog Devices FreeRTOS product** or the **FreeRTOS product from Analog Devices**.

The Analog Devices FreeRTOS product contains ports of FreeRTOS specific to Analog Devices processors and FreeRTOS example applications for Analog Devices processors. It is intended to be installed on top of version 10.0.x of the FreeRTOS operating system.

1.2 What's in the user's guide

This User's Guide document provides instructions on getting started with FreeRTOS for these boards using the CrossCore Embedded Studio development environment.

The following processors are supported with examples being provided for the following EZ-Kits:

Processors Supported	Examples Provided For
ADSP-SC5xx Cortex-A5 Core	ADSP-SC589 EZ-Kit ADSP-SC584 EZ-Kit ADSP-SC573 EZ-Kit ADSP-SC594 EZ-Kit
ADSP-SC5xx Cortex-A55 Core	ADSP-SC598 EZ-Kit
ADSP-SC5xx SHARC+ Core	ADSP-SC589 EZ-Kit ADSP-SC584 EZ-Kit ADSP-SC573 EZ-Kit ADSP-SC594 EZ-Kit
ADSP-BF7xx	ADSP-BF707 EZ-Kit

Processors Supported	Examples Provided For
ADSP-2156x	ADSP-21569 EZ-Kit

Detailed description for setting up the hardware and software environment, and how to run the demo examples on Analog Devices processor boards are included. An appendix containing RTOS benchmark data for various platforms is also provided.

2 Hardware and software set up

To run the FreeRTOS examples, this section would guide users how to get the hardware and software ready, including get the FreeRTOS source code and set up running environment.

2.1 Get the hardware ready

The Analog Devices FreeRTOS product supports several reference development boards from Analog Devices, including the ADSP-SC589/ADSP-SC584/ADSP-SC573 EZ-Kit board, BF707 EZ-Kit board and ADSP-21569 EZ-Kit board.

Below is a list of the hardware involved.

ADI reference board:

- ADSP-SC594 SOM and ADSP-SOMCRR-EZKIT: https://www.analog.com/en/products/adsp-sc594.html#product-evaluationkit
- ADSP-SC589 EZ-kit: http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/EVAL-ADSP-SC589.html
- ADSP-SC584 EZ-kit: http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/EVAL-ADSP-SC584.html
- ADSP-SC573 EZ-kit: http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/SC573EZKIT.html
- ADSP-BF707 EZ-kit: http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/eval-bf707.html
- ADSP-21569 EZ-kit: https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/ADZS-21569-EZKIT.html

Jtag debugger:

- ICE1000/2000: http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/emulators.html

PC:

A mainstream configuration of Windows PC is required. Verify that your PC has these minimum requirements:

- 2 GHz single core processor; 3.3GHz dual core or better recommended
- 4 GB RAM; 8GB or more recommended
- 2 GB available disk space
- One open USB port

2.2 Get the source code ready

This page describes how to get the FreeRTOS source code.

FreeRTOS 2.0.0 is provided as a single complete zip file.
Extract to your required location.

Note: The software is currently pre-release so not available for external download.

2.3 Software environment set up for CrossCore Embedded Studio

This part shows the software environment setup for CrossCore Embedded Studio on four kinds of boards: ADSP-SC589/ADSP-SC584/ADSP-SC573/ADSP-SC594/ADSP-2156X, AND ADSP-BF7XX EZ-Kit.

ADSP-SC589/ADSP-SC584/ADSP-SC573/ADSP-SC594

- Analog Devices CrossCore Embedded Studio version 2.10.0 or later

ADSP-BF7XX EZ-Kit

- Analog Devices CrossCore Embedded Studio version 2.10.0 or later

ADSP-2156X EZ-Kit

- Analog Devices CrossCore Embedded Studio version 2.10.0 or later

3 Running the Examples on the ADSP-SC589 EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Core	Toolchain	Example(s)
ADSP-SC589	ARM A5	CrossCore Embedded Studio	Basic Demo
ADSP-SC589	SHARC+	CrossCore Embedded Studio	Basic Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System. For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

3.1 Running the Basic Example for ARM on ADSP-SC589 EZ-Kit with CrossCore Embedded Studio

3.1.1 Overview

This page describes the steps to build and run basic example for ARM on ADSP-SC589 EZ-Kit board using CrossCore Embedded Studio.

3.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

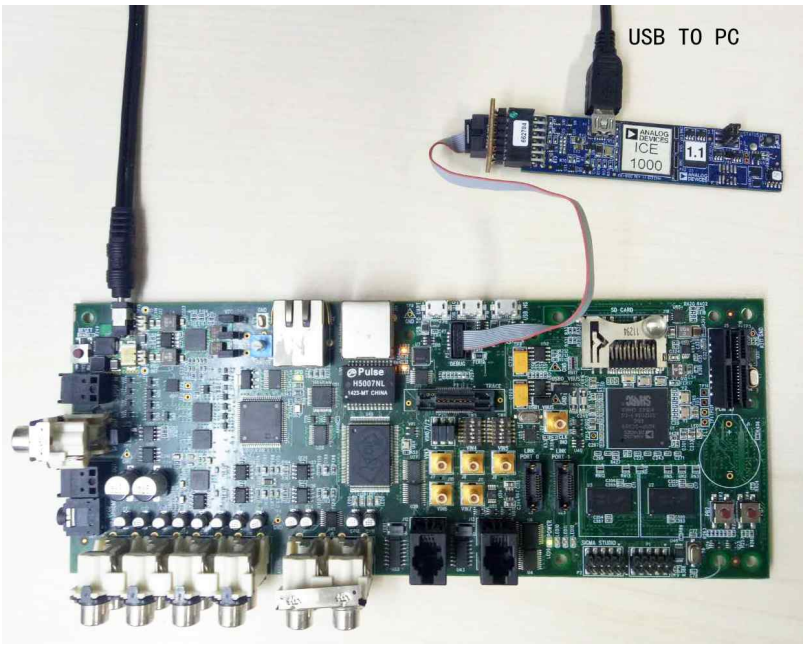
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more information please refer to Get the source code ready

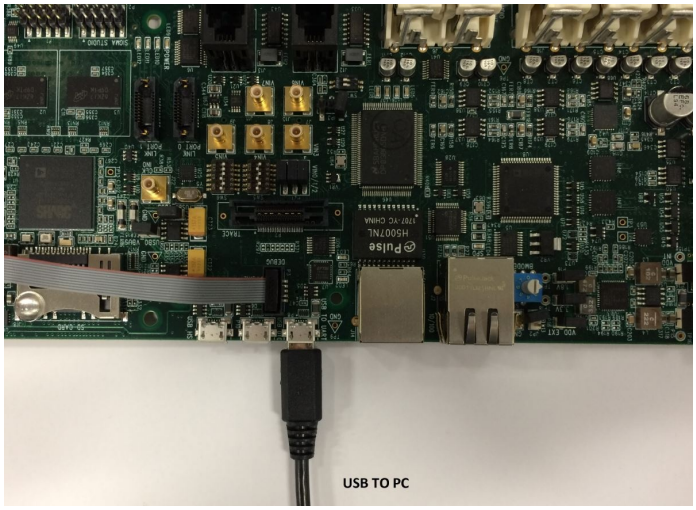
Hardware Setup

- An ADSCP-SC589 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P3** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 5 volts as in the diagram below.



Connect the **USB to UART** port of the EZ-Kit to the host PC with a USB cable as shown below:

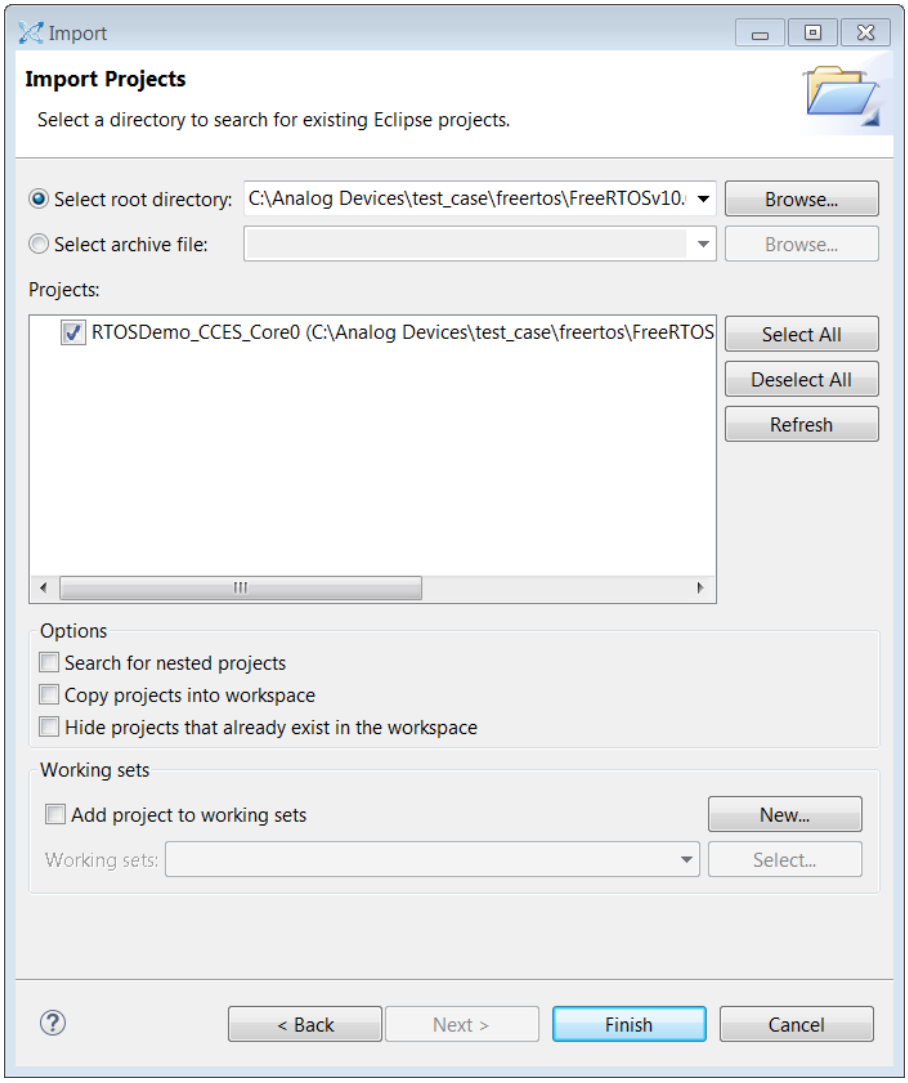


3.1.3 Build the Example

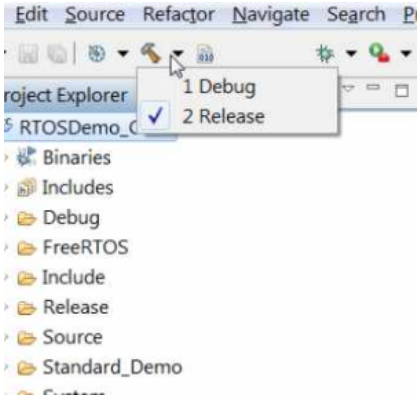
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\CORTEX_A5_ADSP_SC589_CCES** folder
- Click **Finish** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Import**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

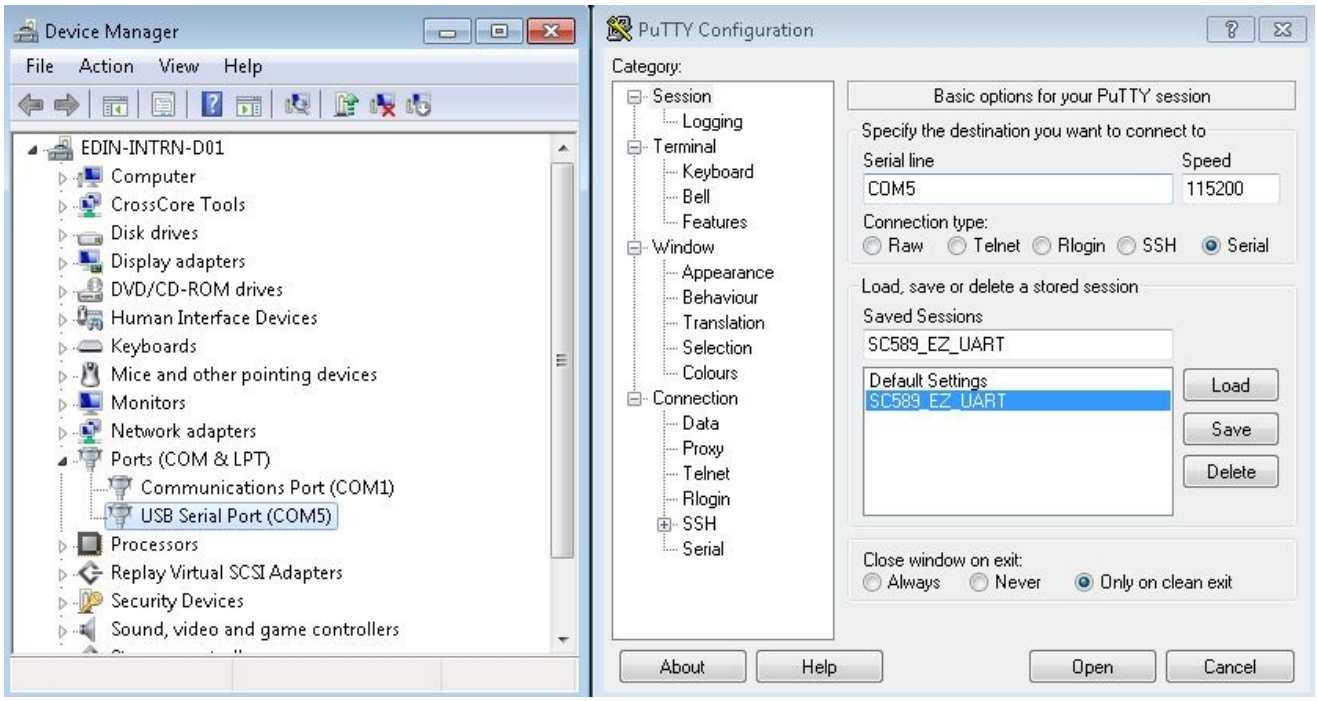
- In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Build Project** option from the menu

3.1.4 Run the Example

The semihosting I/O mechanism, which writes to the CCES console during debug sessions, uses SWI interrupts. This is incompatible with default GCC-compiled I/O code which also uses SWI interrupts. For this reason, stdio function calls initiated on the ARM core are routed out over UART instead and shall be read with a serial terminal external to CCES. Importantly, note that:

1. This is currently only supported *within* FreeRTOS threads, any stdio function call performed outwith a thread will crash the application.
2. If you need to use other peripherals, you should take care not to change the power service clock rate (which is set in the UART I/O device).

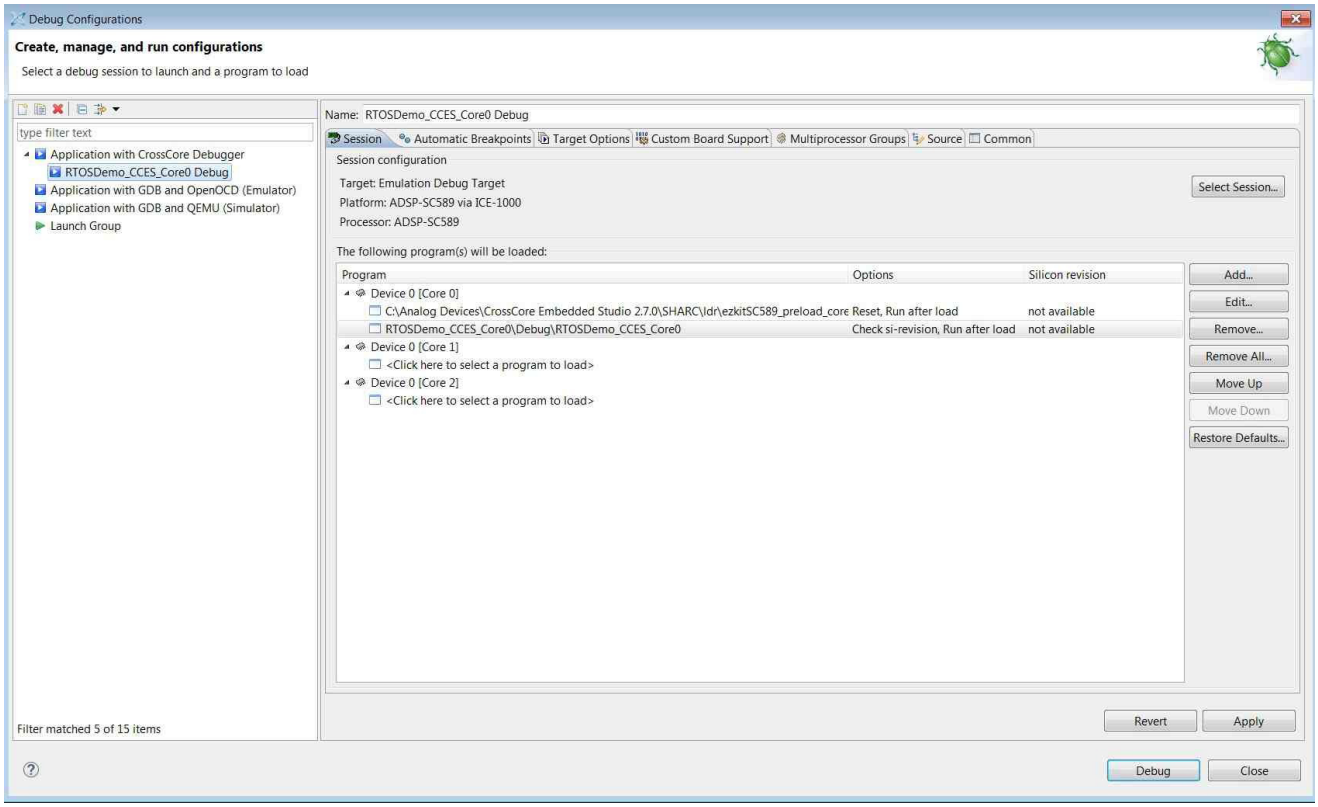
Before running the example, you need to setup the serial terminal of your choice to read the Cortex core output from the **UART to USB connection** on the HOST PC. The easiest way to determine the correct USB device is to view the **Ports** entry in the Windows Device Manager. From here identify the COM port. Configure your serial console application to connect to the port with a baud rate of 115,200.



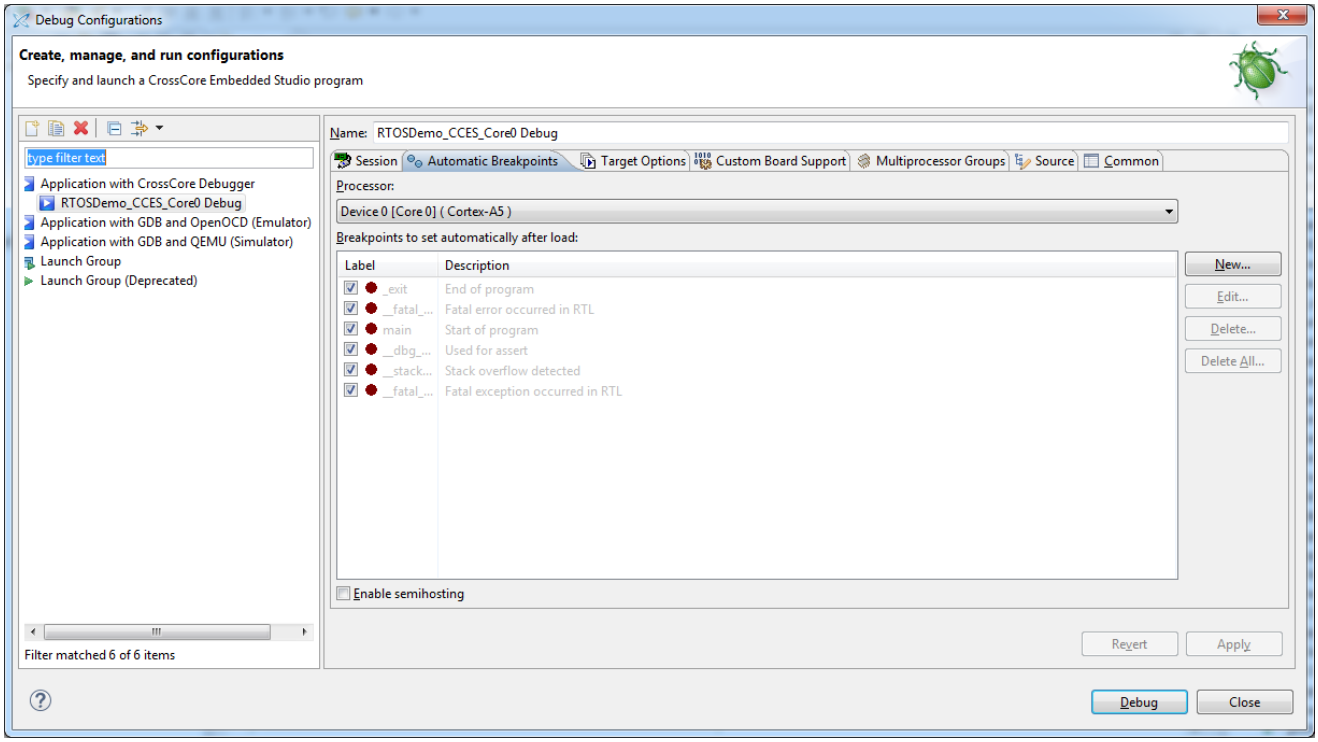
After this, follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board

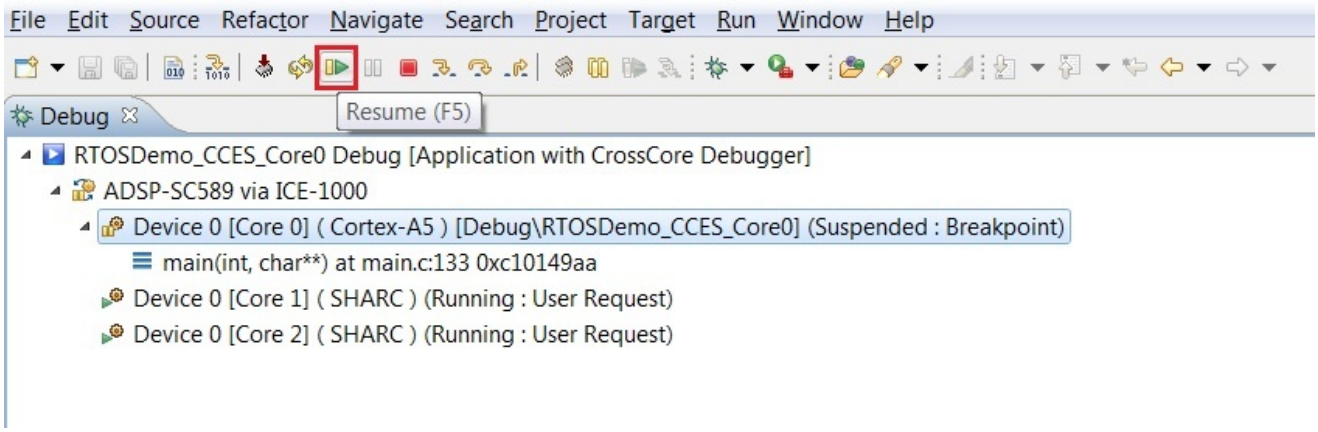


3 . Disable the **semihosting** function in **Automatic Breakpoints**



4. Click the **Debug** button to close the **Debug Configurations** window

5. Click the **Run/Resume** button to start running your application



3.1.5 Test Results

Output from the application should be visible within the TTY terminal (e.g. PuTTY/TeraTerm). You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if all the tests passed.

3.2 Running the Basic Example for SHARC+ on ADSP-SC589 EZ-Kit with CrossCore Embedded Studio

3.2.1 Overview

This page describes the steps to build and run basic example for SHARC+ on ADSP-SC589 EZ-Kit board using CrossCore Embedded Studio.

3.2.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

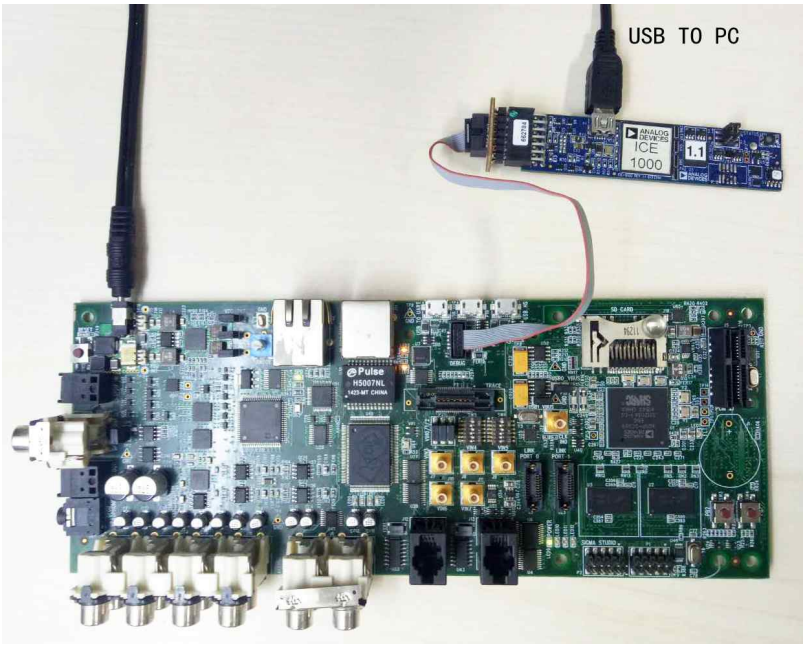
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more information please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC589 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P3** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 5 volts as in the diagram below.

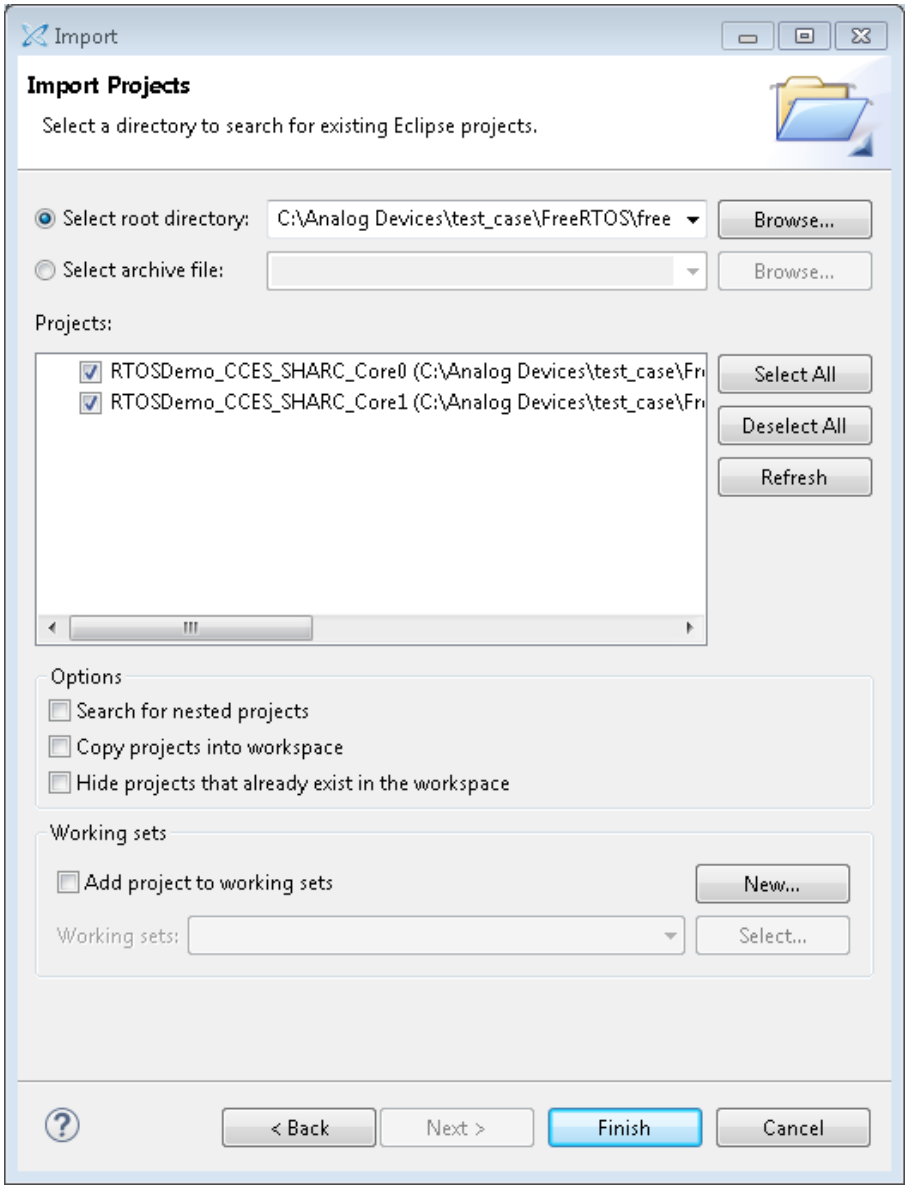


3.2.3 Build the Example

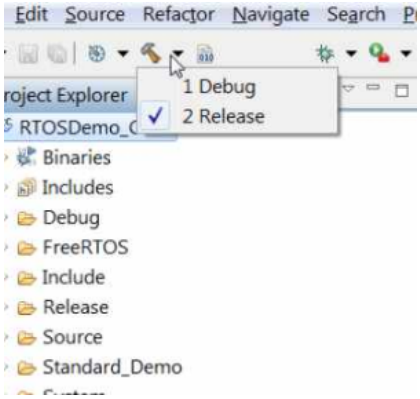
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC589_CCES** folder
- Click **Finish** to close the file browser dialog
- Two projects should appear in the **Project Explorer**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

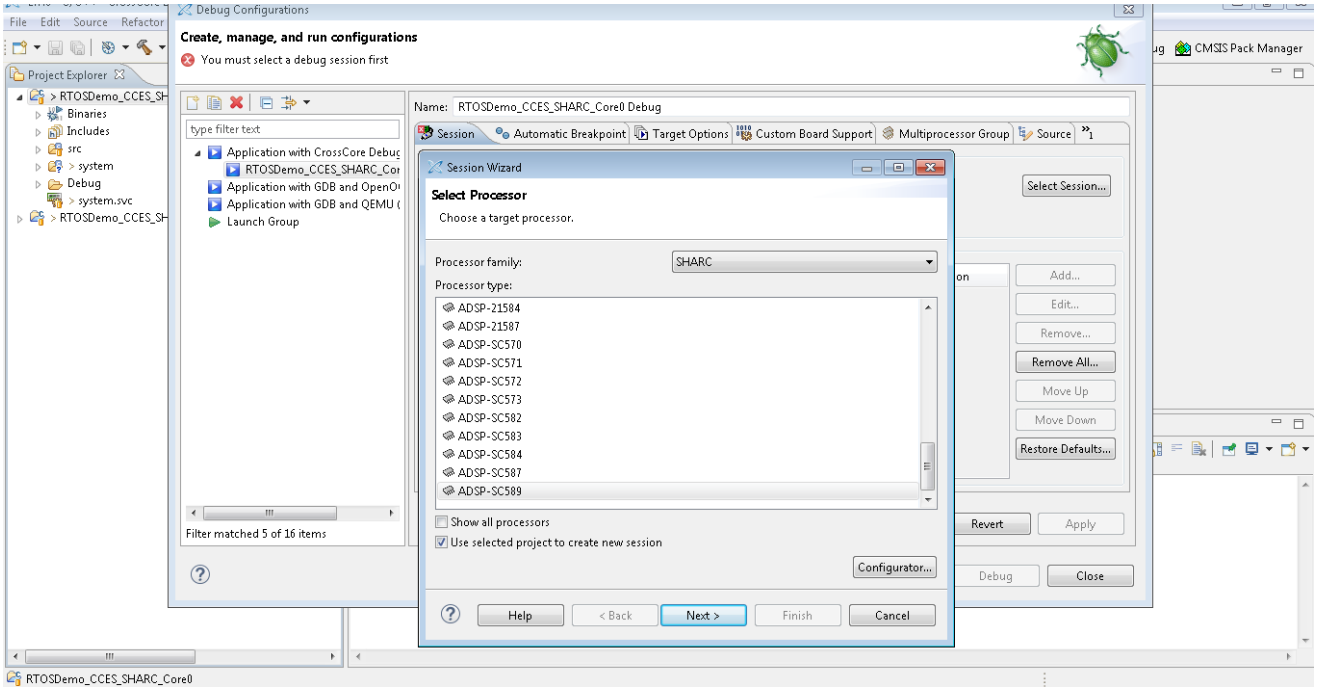
- In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** and **RTOSDemo_CCES_SHARC_Core1** project, then select the **Build Project** option from the menu

3.2.4 Run the Example

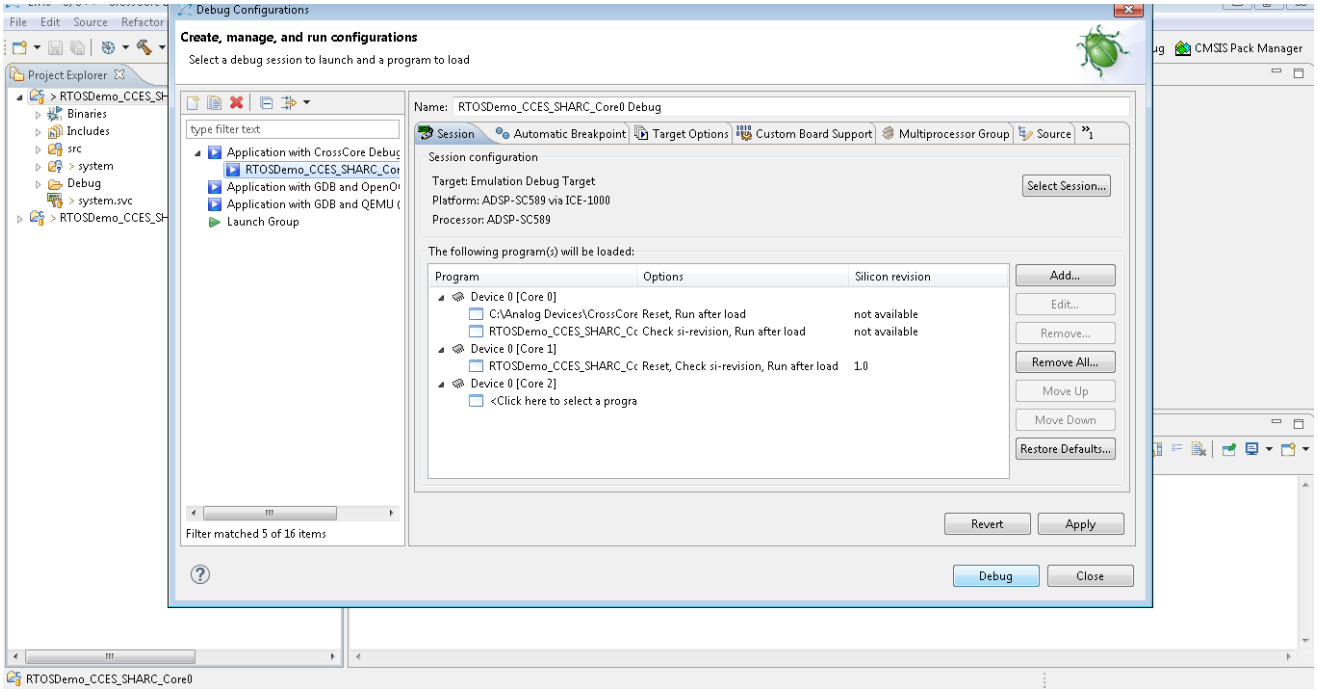
Follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** project and select the **Debug As** option from the menu

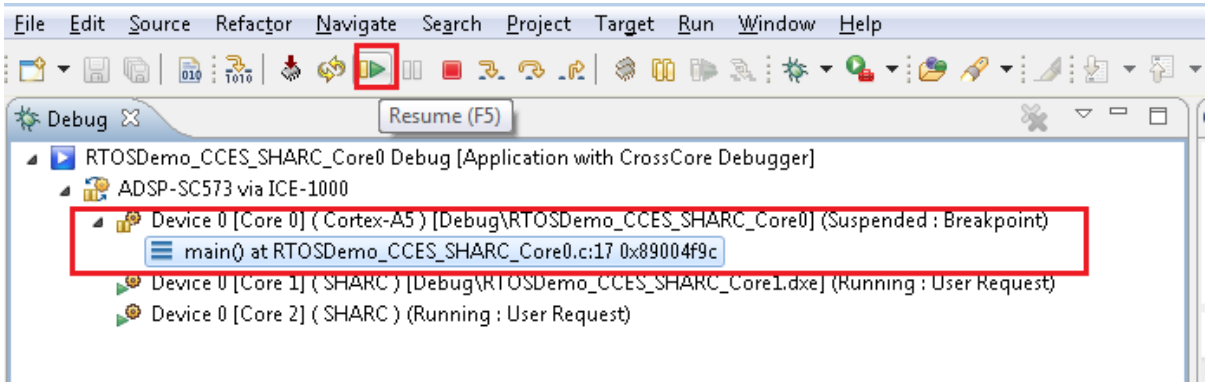
2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



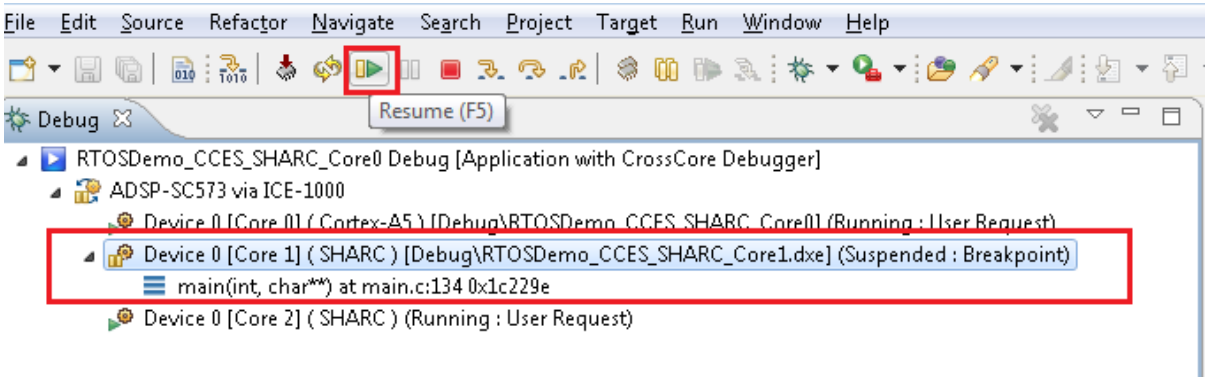
3. Click the **Debug** button to close the **Debug ConfigurationS** window



4. Choose Core0 and click the **Run/Resume** button to start running Core0 application

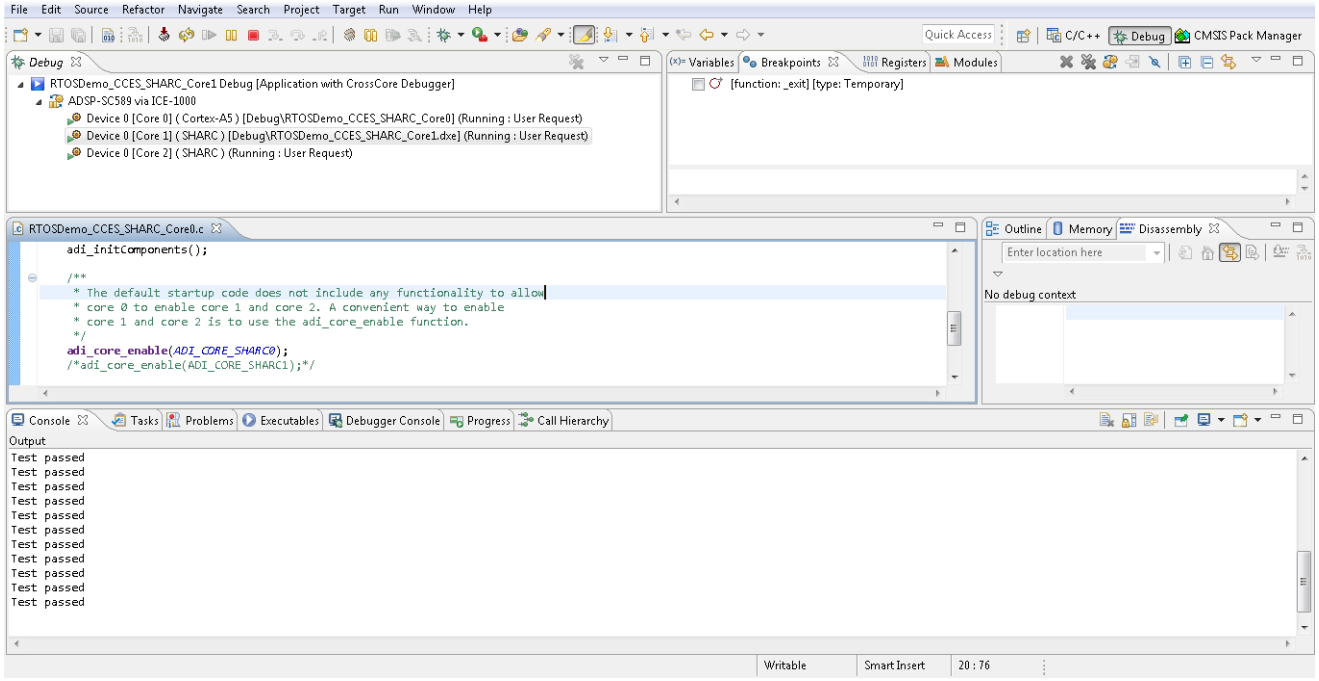


5. Then Choose Core1 and keep to click **Run/Resume** button to start running Core1 application



3.2.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see three LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.



4 Running the Examples on the ADSP-SC584 EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Core	Toolchain	Example(s)
ADSP-SC584	ARM A5	CrossCore Embedded Studio	Basic Demo
ADSP-SC584	SHARC+	CrossCore Embedded Studio	Basic Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System. For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

4.1 Running the Basic Example for ARM on ADSP-SC584 EZ-Kit with CrossCore Embedded Studio

4.1.1 Overview

This page describes the steps to build and run basic example for ARM on ADSP-SC584 EZ-Kit board using CrossCore Embedded Studio.

4.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

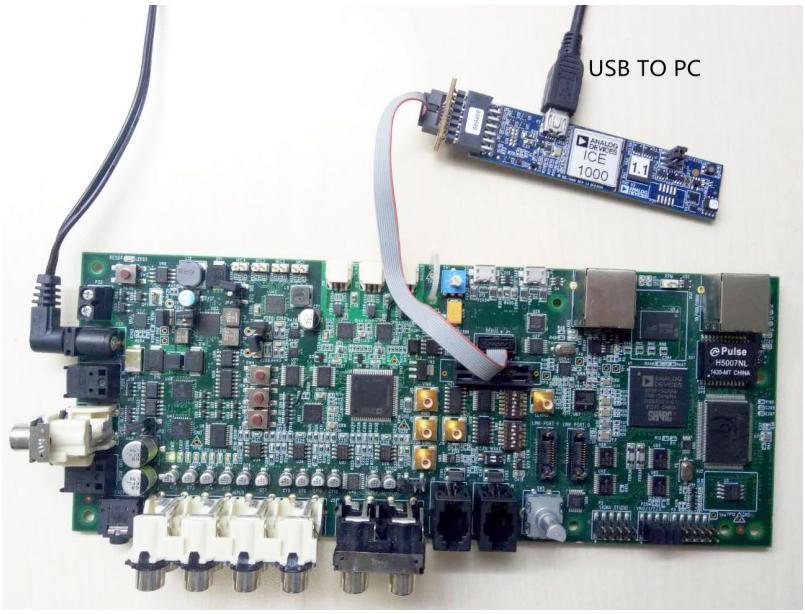
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC584 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P1** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below.



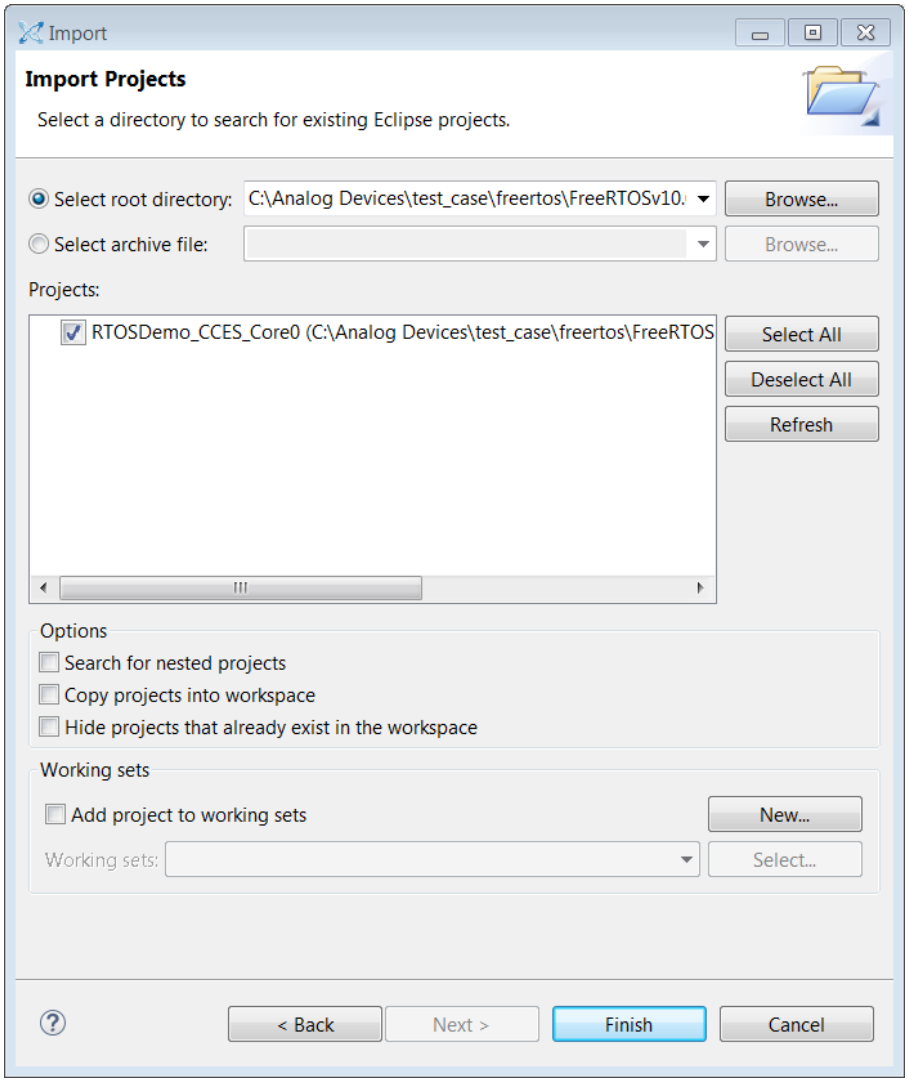
Connect the **USB to UART** port of the EZ-Kit to the host PC with a USB cable as shown below:

4.1.3 Build the Example

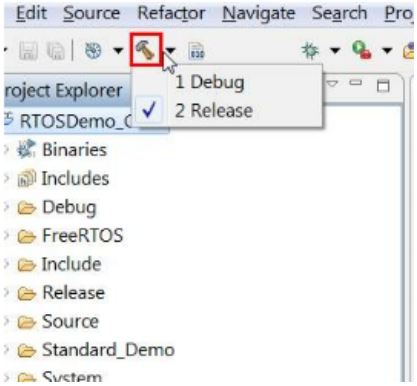
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\CORTEX_A5_ADSP_SC584_CCES** folder
- Click **Finish** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Import**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

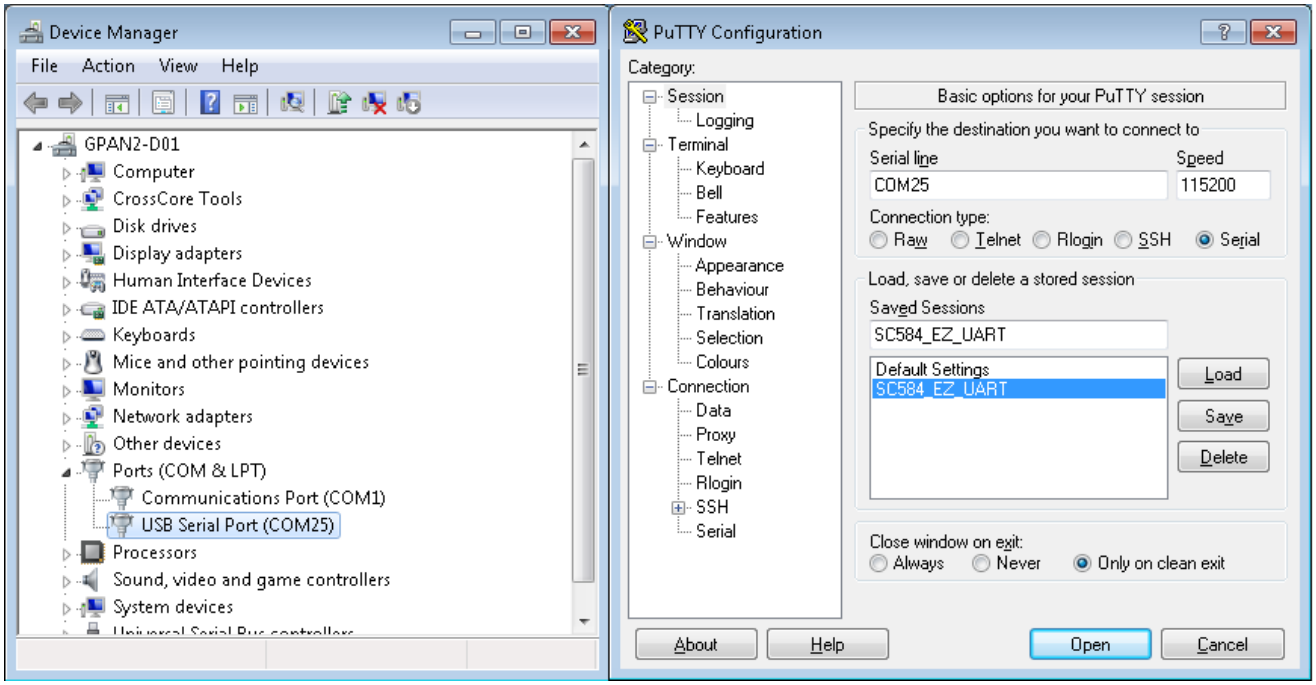
- In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Build Project** option from the menu

4.1.4 Run the Example

The semihosting I/O mechanism, which writes to the CCES console during debug sessions, uses SWI interrupts. This is incompatible with default GCC-compiled I/O code which also uses SWI interrupts. For this reason, stdio function calls initiated on the ARM core are routed out over UART instead and shall be read with a serial terminal external to CCES. Importantly, note that:

1. This is currently only supported *within* FreeRTOS threads, any stdio function call performed outwith a thread will crash the application.
2. If you need to use other peripherals, you should take care not to change the power service clock rate (which is set in the UART I/O device.)

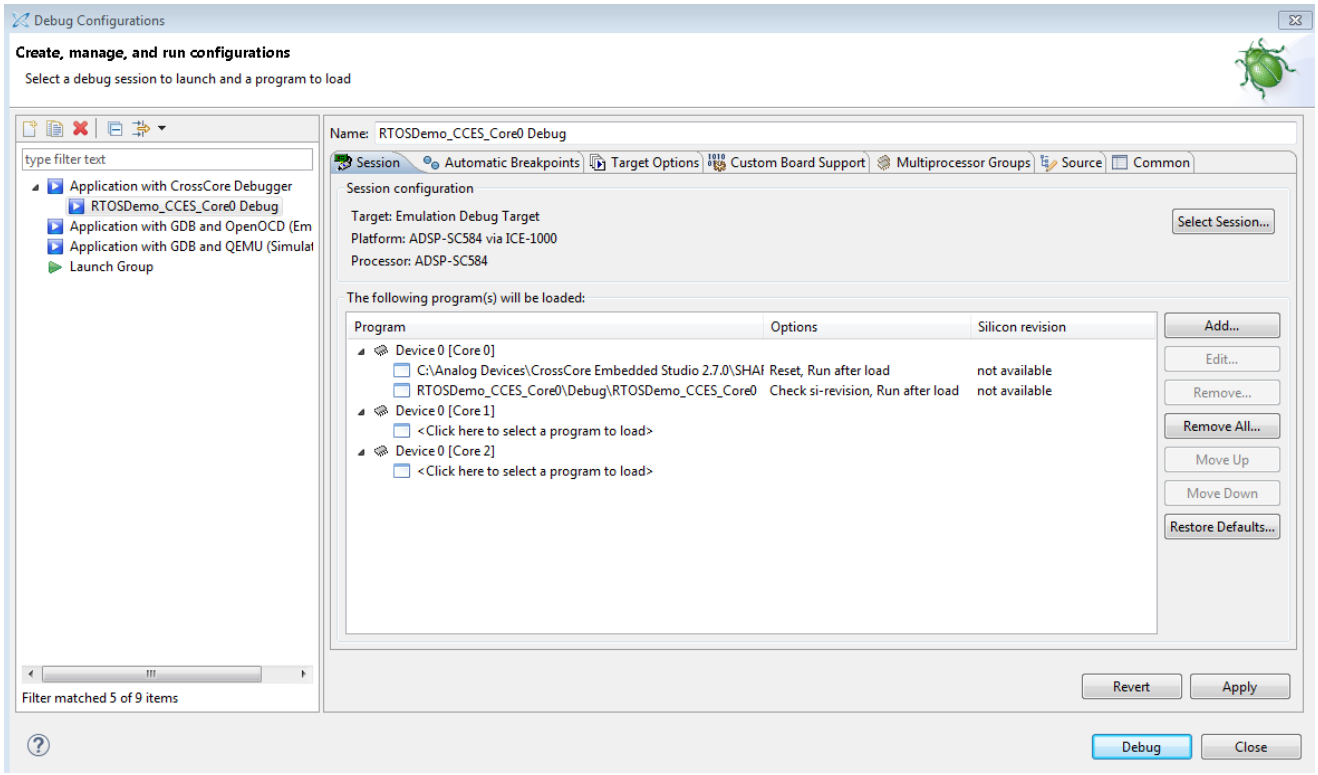
Before running the example, you need to setup the serial terminal of your choice to read the Cortex core output from the **UART to USB connection** on the HOST PC. The easiest way to determine the correct USB device is to view the **Ports** entry in the Windows Device Manager. From here identify the COM port. Configure your serial console application to connect to the port with a baud rate of 115,200.



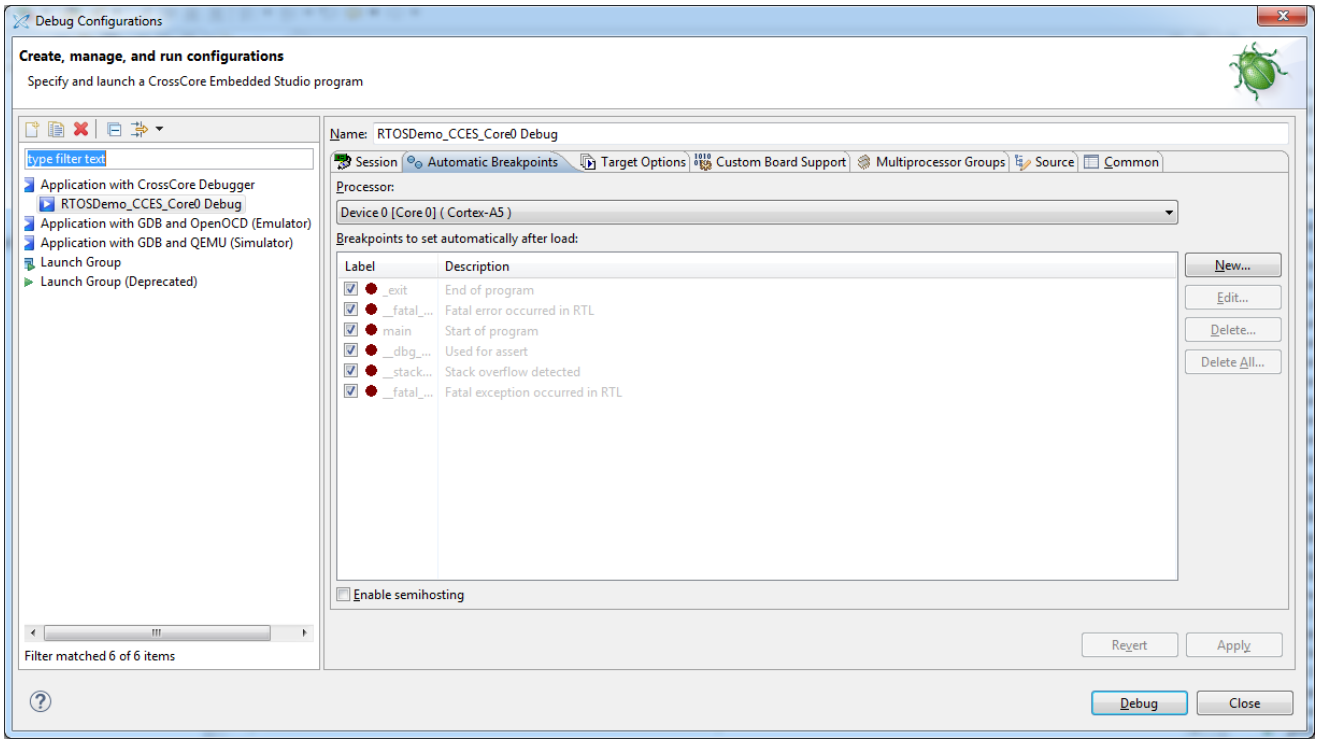
Follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board

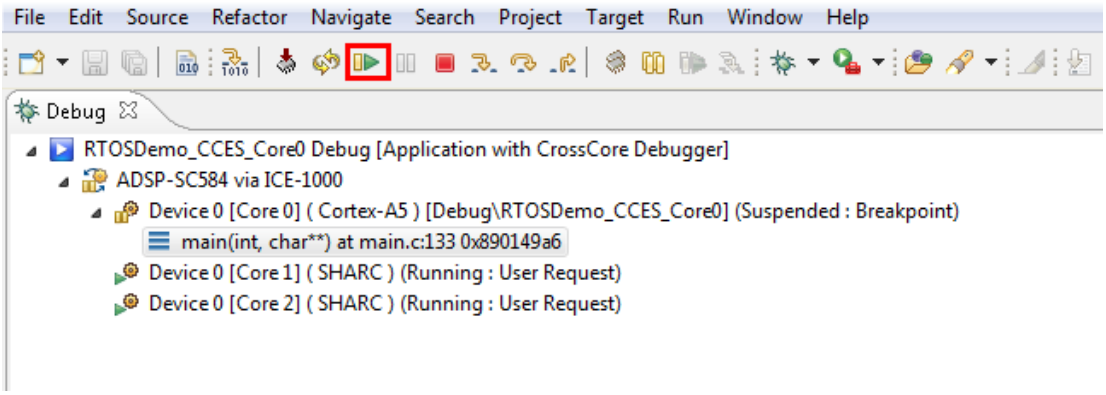


3. Disable the **semihosting** function in **Automatic Breakpoints**



4. Click the **Debug** button to close the **Debug Configurations** window

5. Click the **Run/Resume** button to start running your application



4.1.5 Test Results

Output from the application should be visible within the TTY terminal (e.g. PuTTY/TeraTerm). You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if all the tests passed.

4.2 Running the Basic Example for SHARC+ on ADSP-SC584 EZ-Kit with CrossCore Embedded Studio

4.2.1 Overview

This page describes the steps to build and run basic example for SHARC+ on ADSP-SC584 EZ-Kit board using CrossCore Embedded Studio.

4.2.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

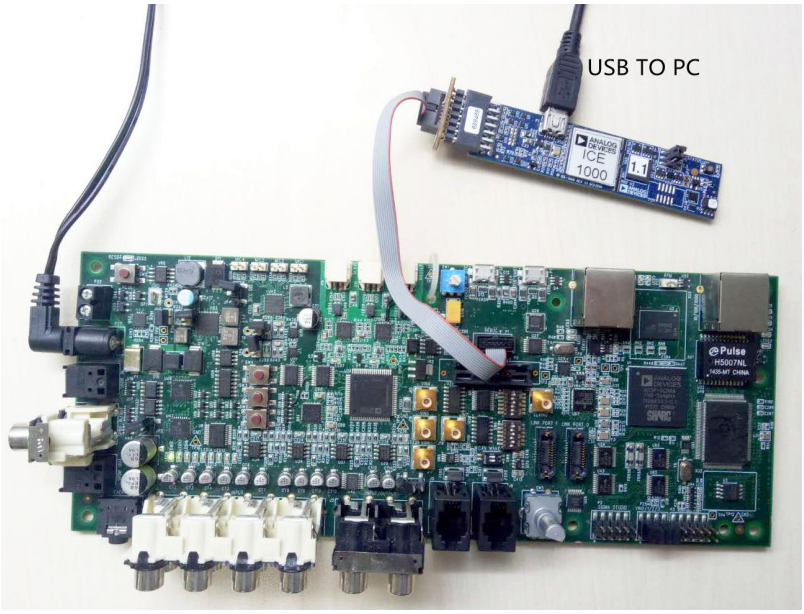
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC584 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P1** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below.

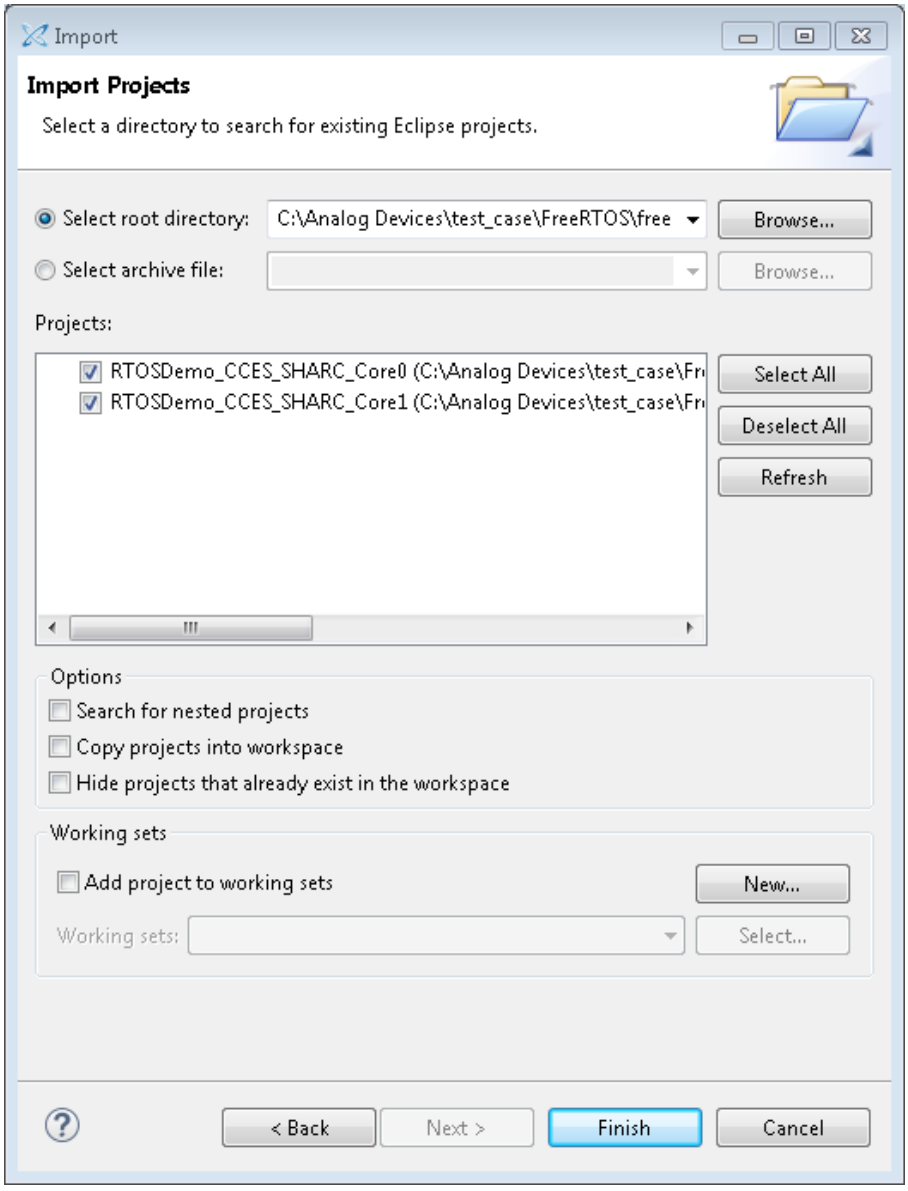


4.2.3 Build the Example

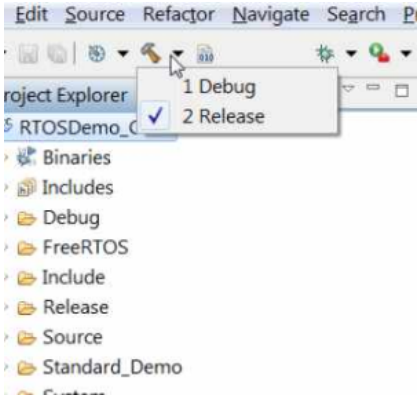
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- When the **Import** project window appears:
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC584_CCES** folder
- Click **Finish** to close the file browser dialog
- Two projects should appear in the **Project Explorer**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

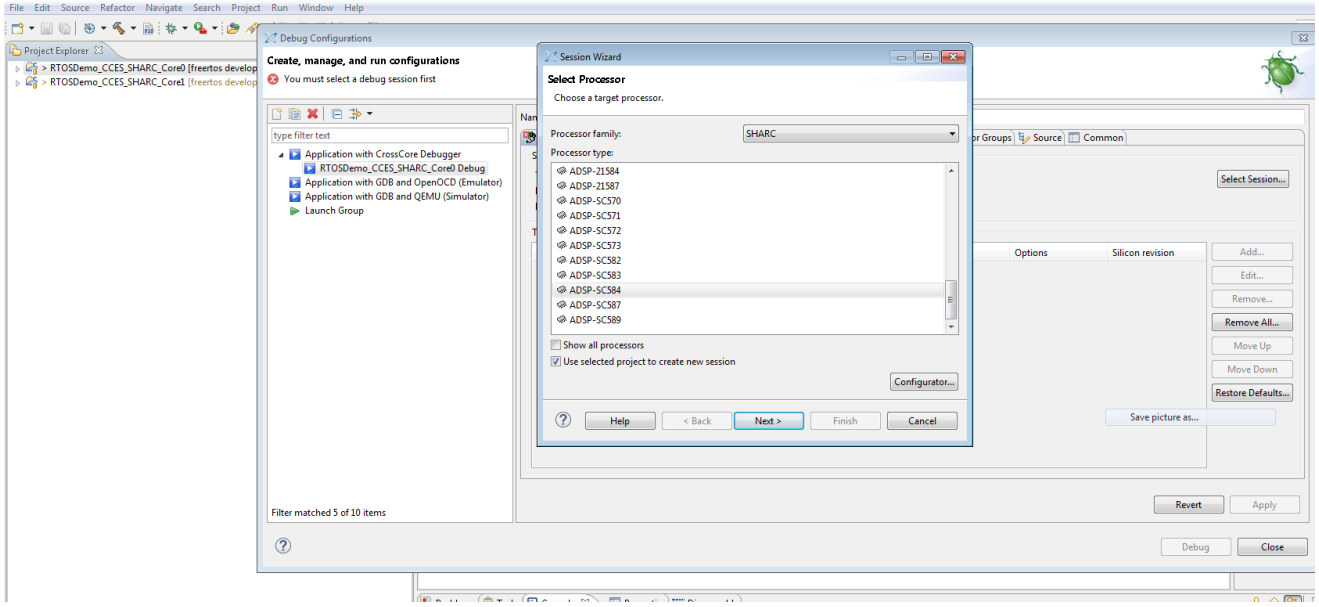
- In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** and **RTOSDemo_CCES_SHARC_Core1** project, then select the **Build Project** option from the menu

4.2.4 Run the Example

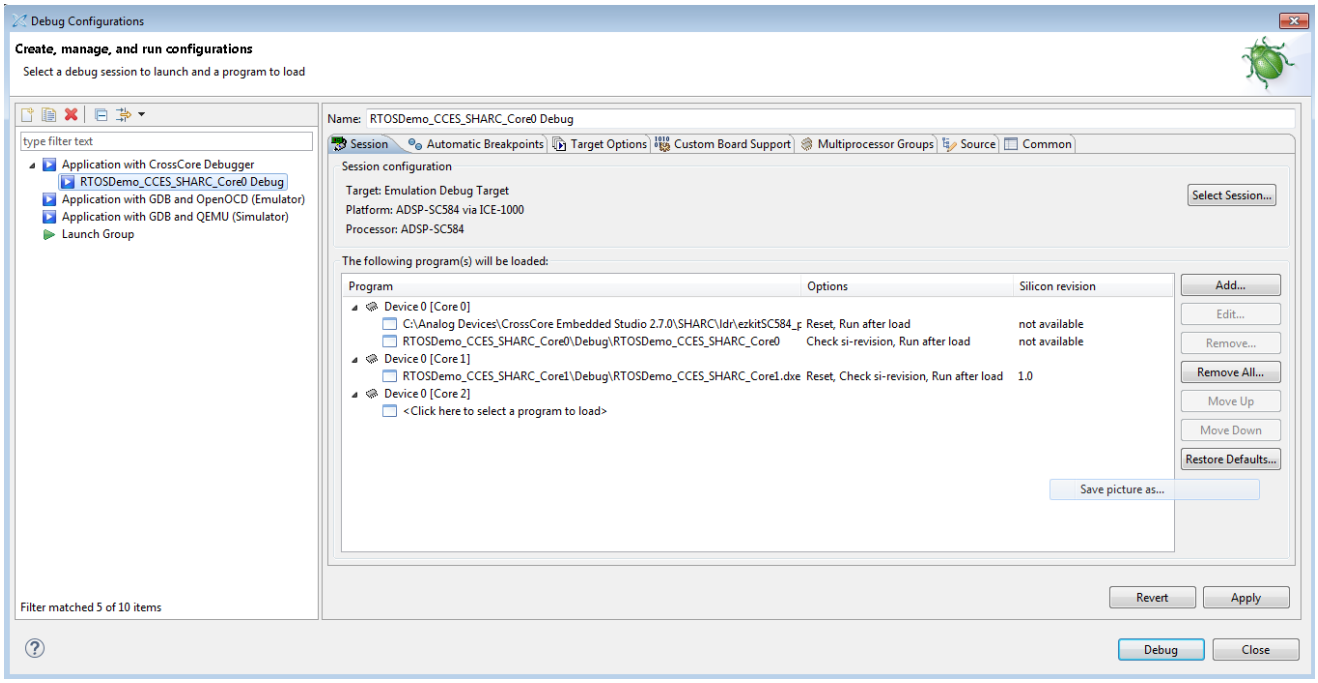
Follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** project and select the **Debug As** option from the menu

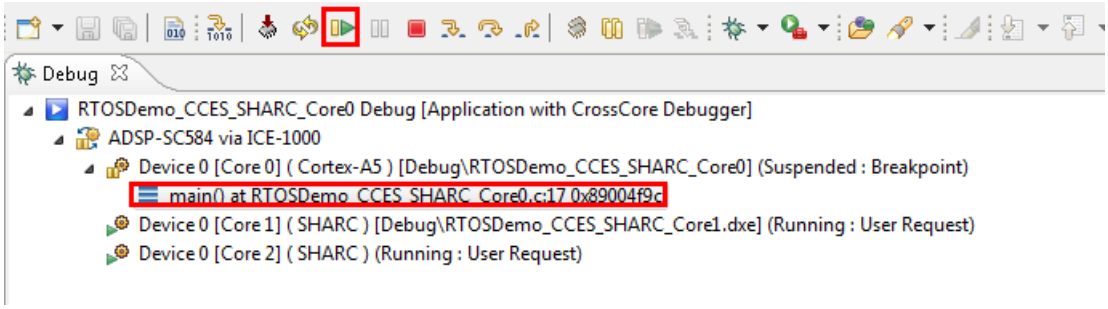
2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



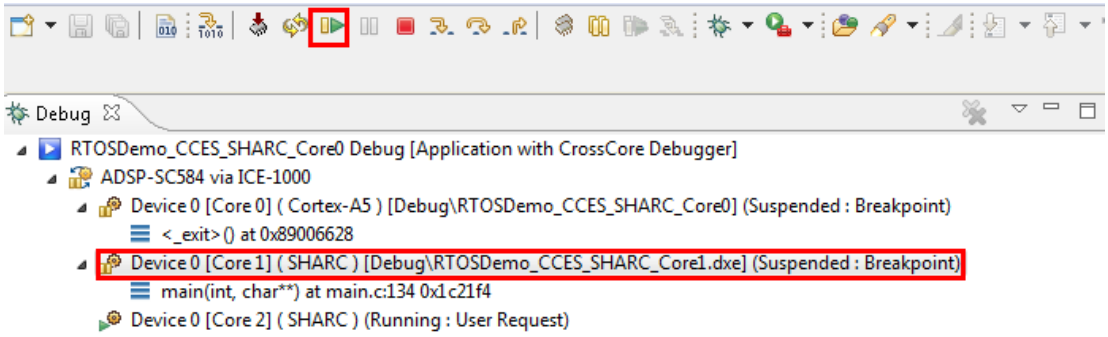
3. Click the **Debug** button to close the **Debug Configurations** window



4. Choose Core0 and click the **Run/Resume** button to start running Core0 application

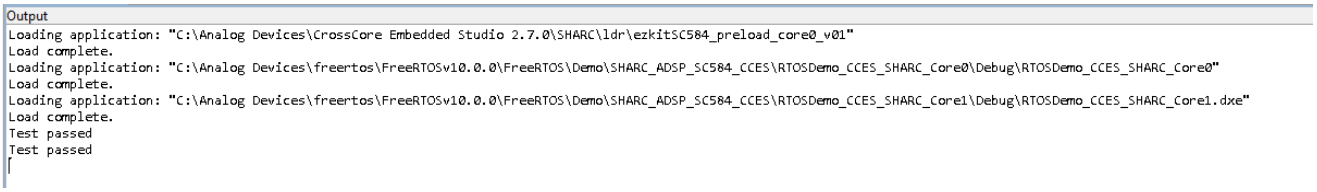


5. Then choose Core1 and keep to click **Run/Resume** button to start running Core1 application



4.2.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see three LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.


Output
Loading application: "C:\Analog Devices\CrossCore Embedded Studio 2.7.0\SHARC\ldr\ezkitSC584_preload_core0_v01"
Load complete.
Loading application: "C:\Analog Devices\freertos\FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC584_CCES\RTOSDemo_CCES_SHARC_Core0\Debug\RTOSDemo_CCES_SHARC_Core0"
Load complete.
Loading application: "C:\Analog Devices\freertos\FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC584_CCES\RTOSDemo_CCES_SHARC_Core1\Debug\RTOSDemo_CCES_SHARC_Core1.dxe"
Load complete.
Test passed
Test passed

5 Running the Examples on the ADSP-SC573 EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Core	Toolchain	Example(s)
ADSP-SC573	ARM A5	CrossCore Embedded Studio	Basic Demo
ADSP-SC573	SHARC+	CrossCore Embedded Studio	Basic Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System.

For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

5.1 Running the Basic Example for ARM on ADSP-SC573 EZ-Kit with CrossCore Embedded Studio

5.1.1 Overview

This page describes the steps to build and run basic example for ARM on ADSP-SC573 EZ-Kit board using CrossCore Embedded Studio.

5.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

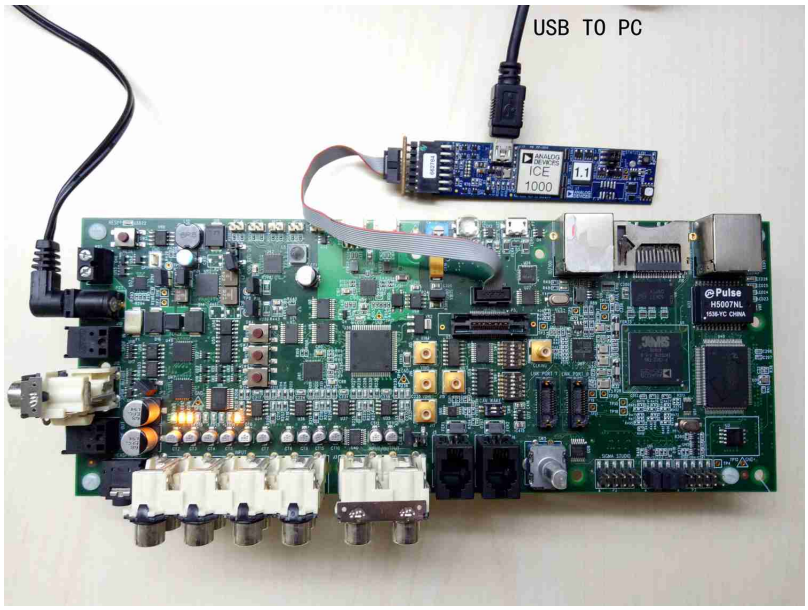
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

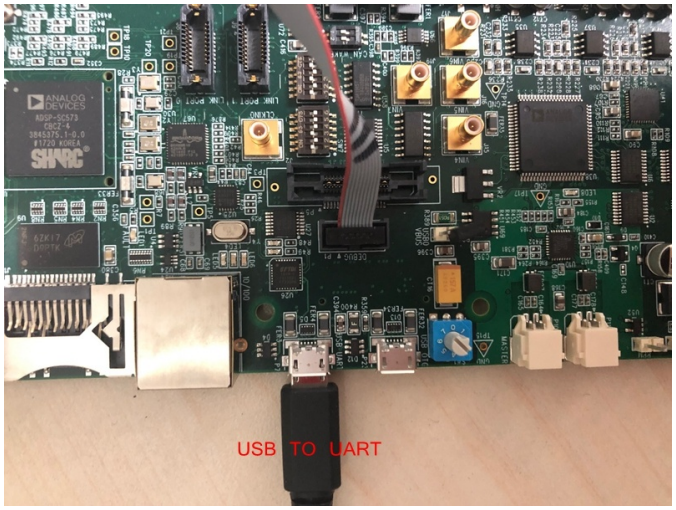
Hardware Setup

- An ADSCP-SC573 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P1** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below.



Connect the **USB to UART** port of the EZ-Kit to the host PC with a USB cable as shown below:

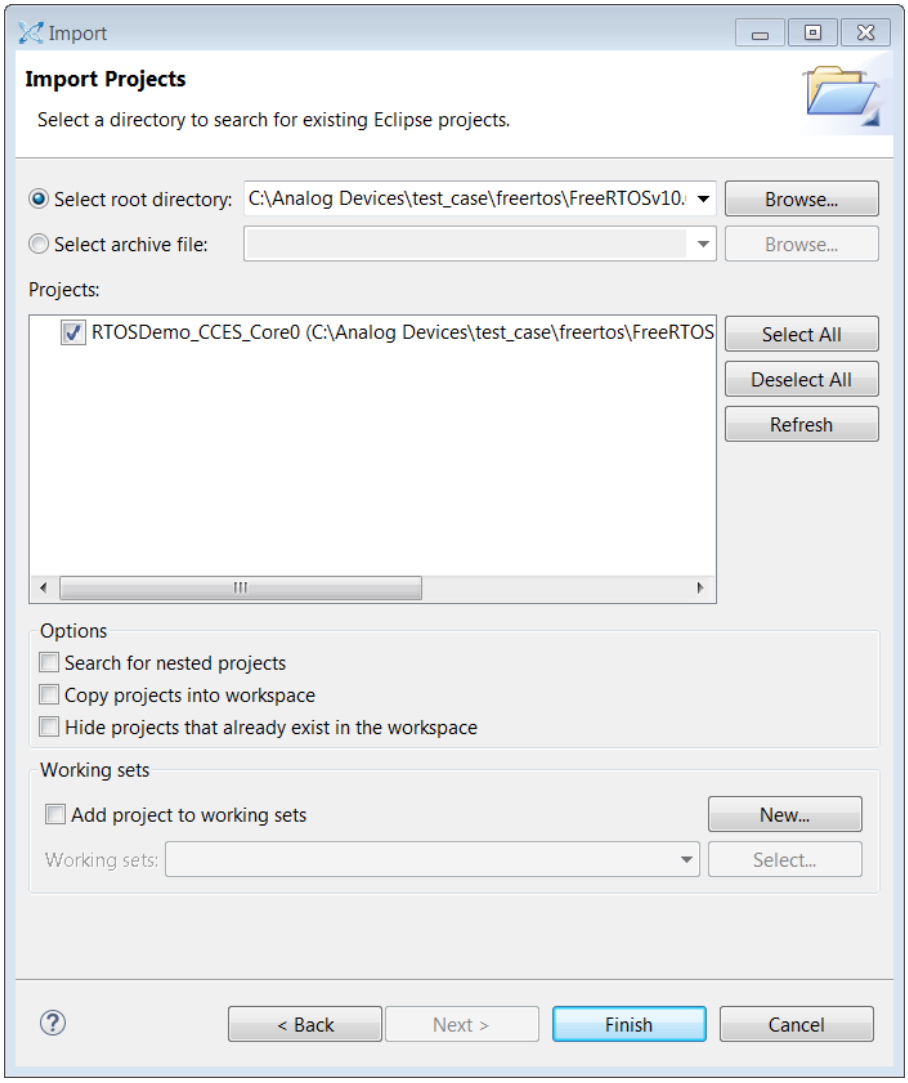


5.1.3 Build the Example

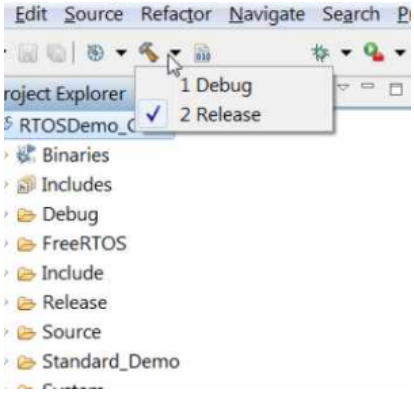
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\CORTEX_A5_ADSP_SC573_CCES** folder
- Click **Finish** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Import**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

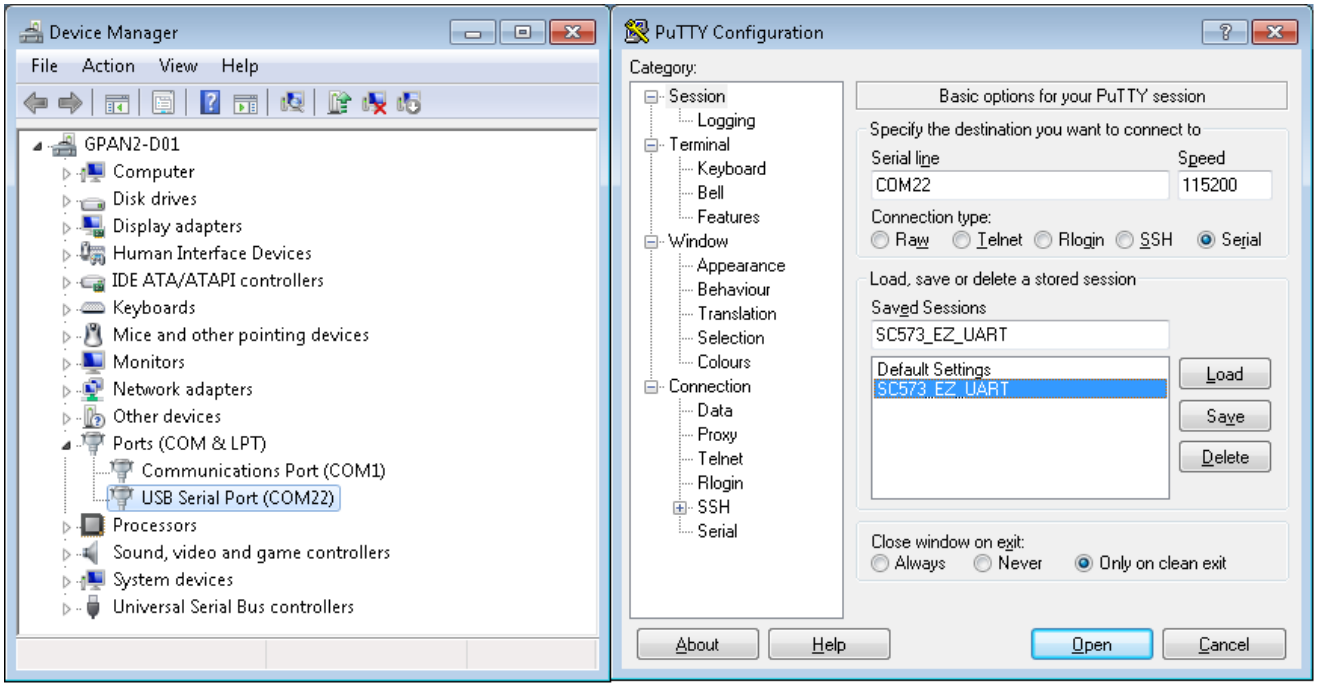
- In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Build Project** option from the menu

5.1.4 Run the Example

The semihosting I/O mechanism, which writes to the CCES console during debug sessions, uses SWI interrupts. This is incompatible with default GCC-compiled I/O code which also uses SWI interrupts. For this reason, stdio function calls initiated on the ARM core are routed out over UART instead and shall be read with a serial terminal external to CCES. Importantly, note that:

1. This is currently only supported *within* FreeRTOS threads, any stdio function call performed outwith a thread will crash the application.
2. If you need to use other peripherals, you should take care not to change the power service clock rate (which is set in the UART I/O device).

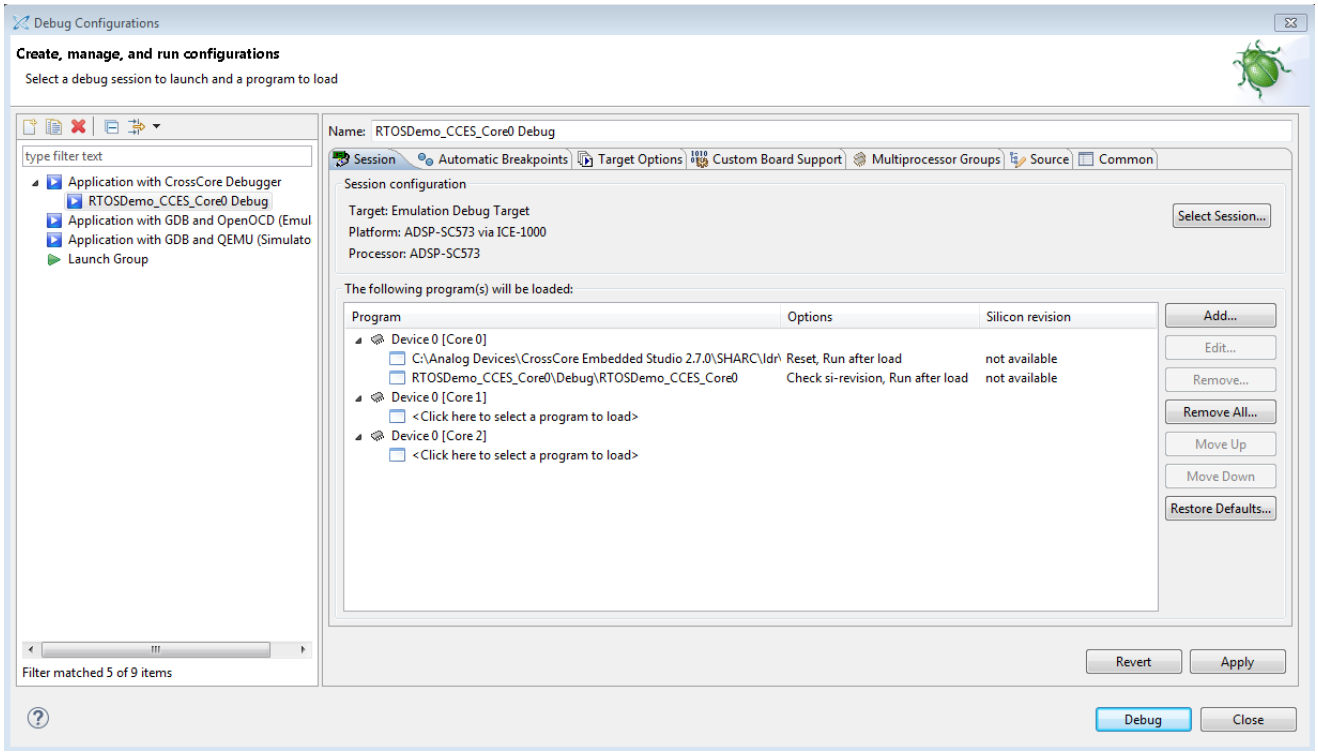
Before running the example, you need to setup the serial terminal of your choice to read the Cortex core output from the **UART to USB connection** on the HOST PC. The easiest way to determine the correct USB device is to view the **Ports** entry in the Windows Device Manager. From here identify the COM port. Configure your serial console application to connect to the port with a baud rate of 115,200.



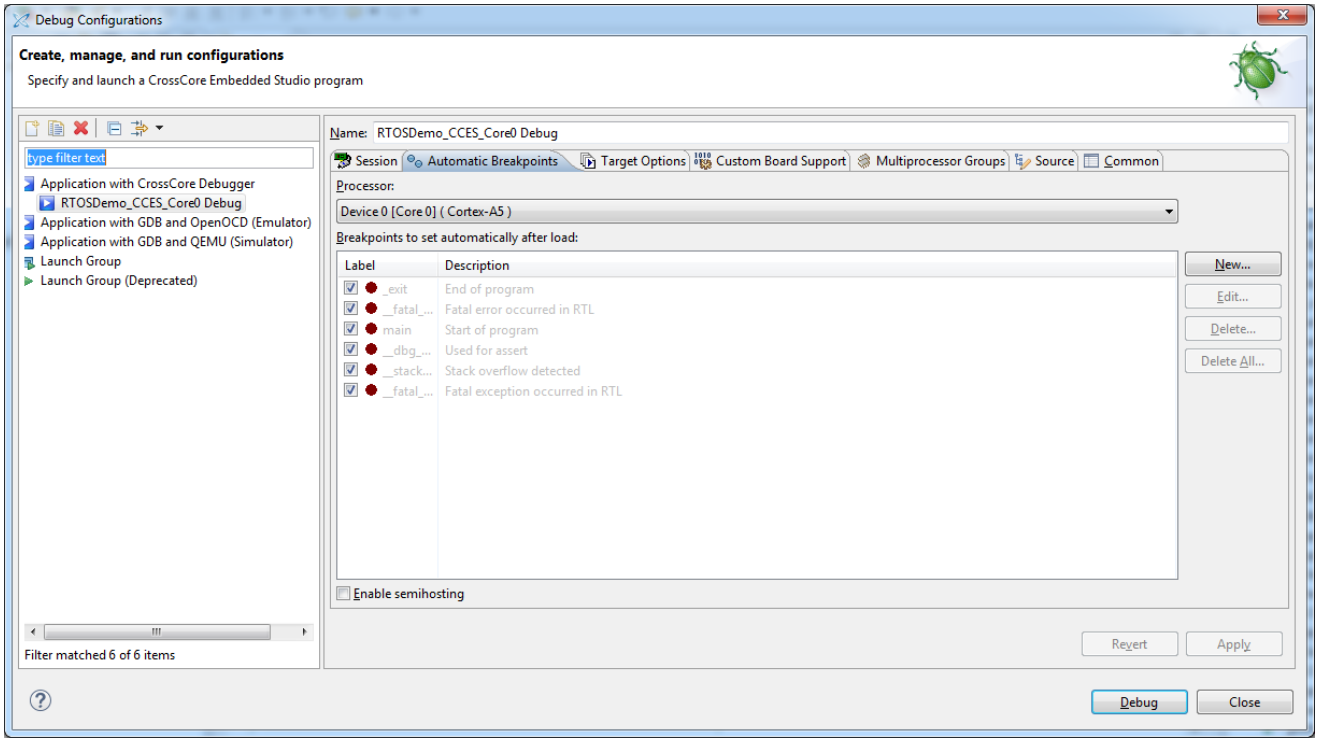
After this, follow the steps below to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board

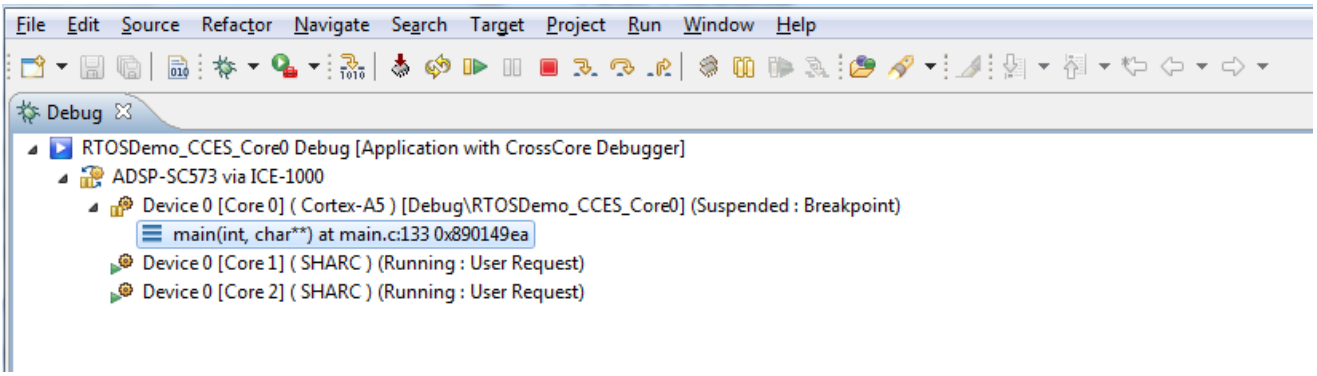


3. Disable the **semihosting** function in **Automatic Breakpoints**



4. Click the **Debug** button to close the **Debug Configurations** window

5. Click the **Run/Resume** button to start running your application



5.1.5 Test Results

Output from the application should be visible within the TTY terminal (e.g. PuTTY/TeraTerm). You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if all the tests passed.

5.2 Running the Basic Example for SHARC+ on ADSP-SC573 EZ-Kit with CrossCore Embedded Studio

5.2.1 Overview

This page describes the steps to build and run basic example for SHARC+ on ADSP-SC573 EZ-Kit board using CrossCore Embedded Studio.

5.2.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

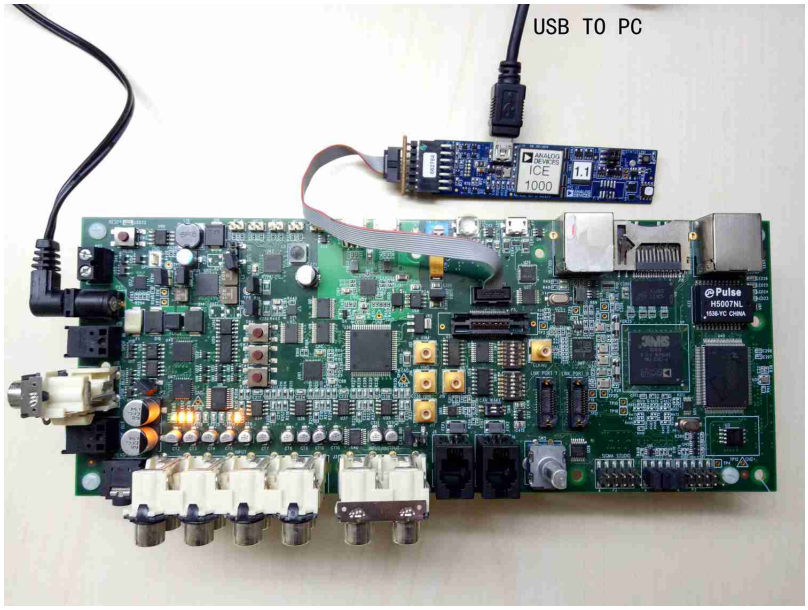
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC573 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P1** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below.

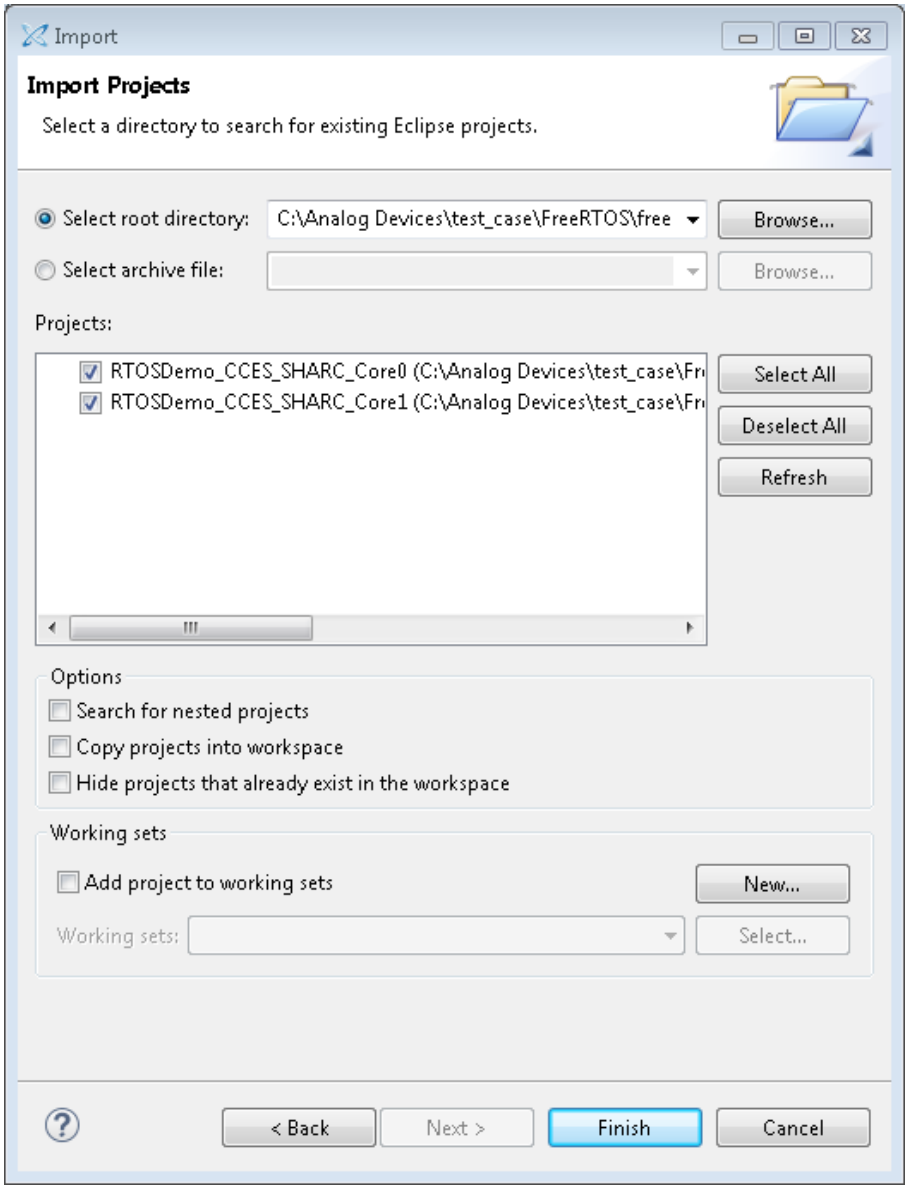


5.2.3 Build the Example

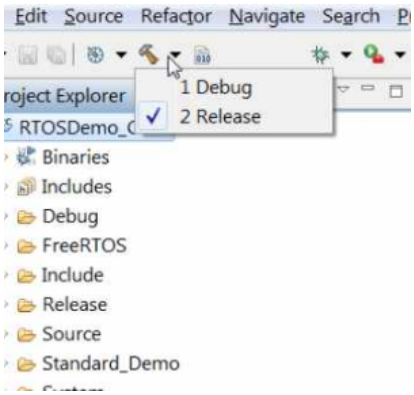
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- When the **Import** project window appears:
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC573_CCES** folder
- Click **Finish** to close the file browser dialog
- Two projects should appear in the **Project Explorer**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

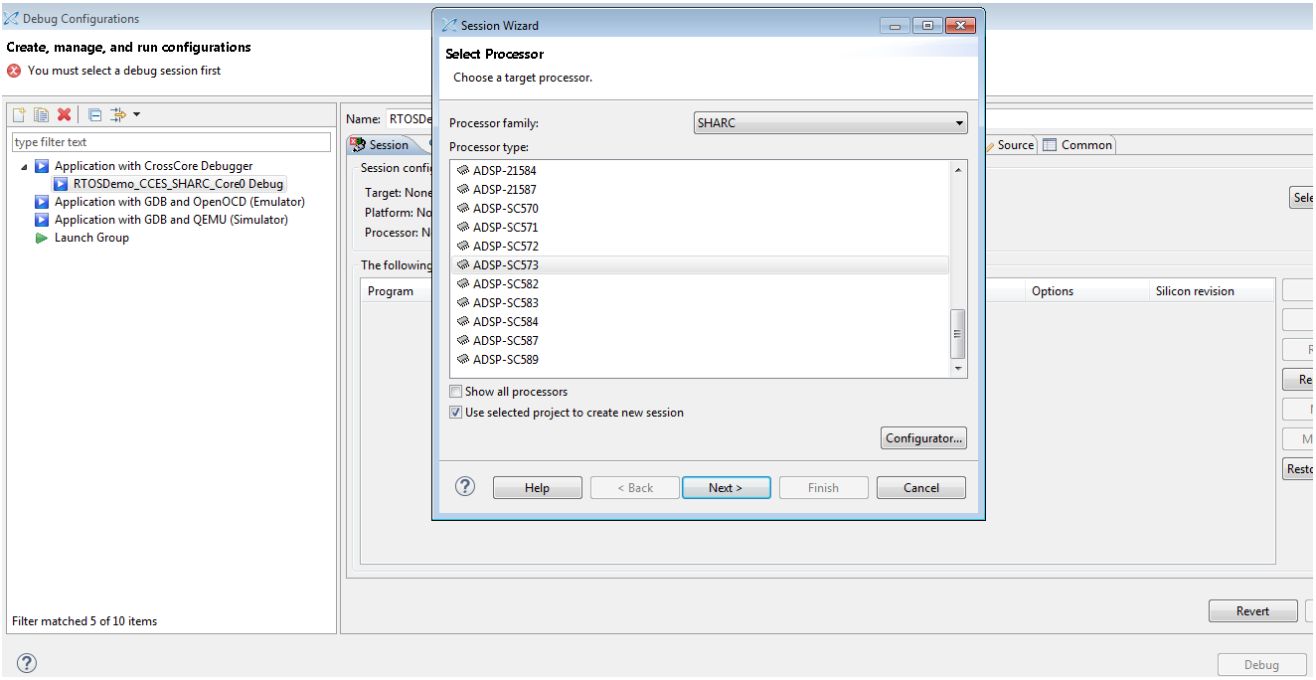
- In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** and **RTOSDemo_CCES_SHARC_Core1** project, then select the **Build Project** option from the menu

5.2.4 Run the Example

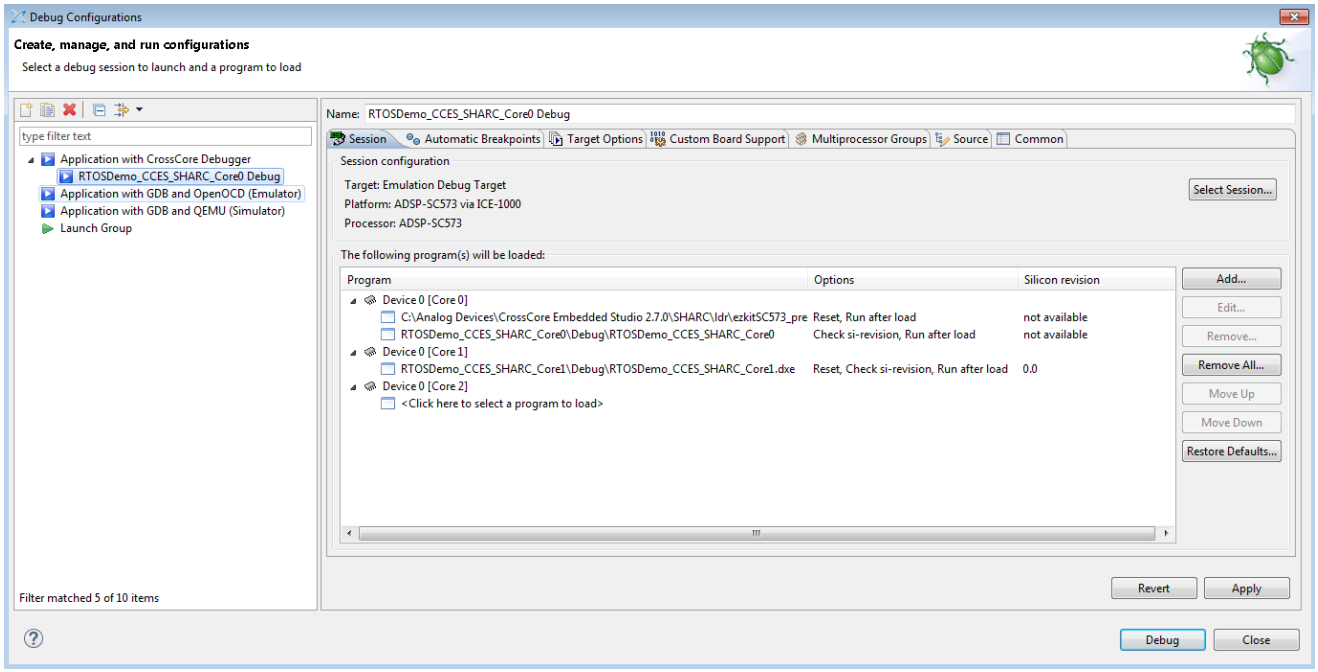
Follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** project and select the **Debug As** option from the menu

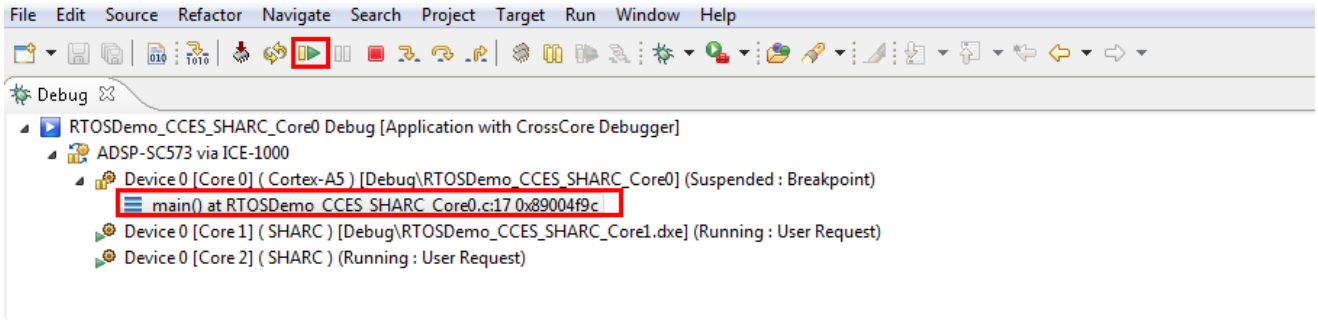
2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



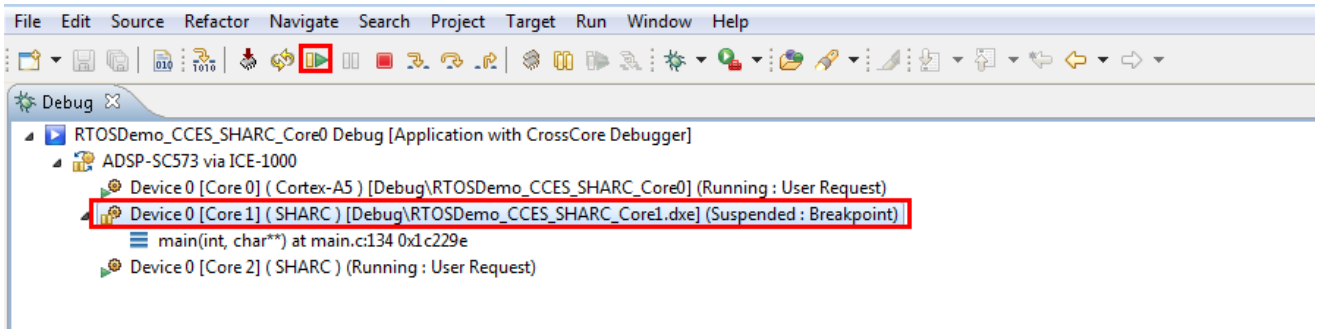
3. Click the **Debug** button to close the **Debug Configurations** window



4. Choose Core0 and click the **Run/Resume** button to start running Core0 application

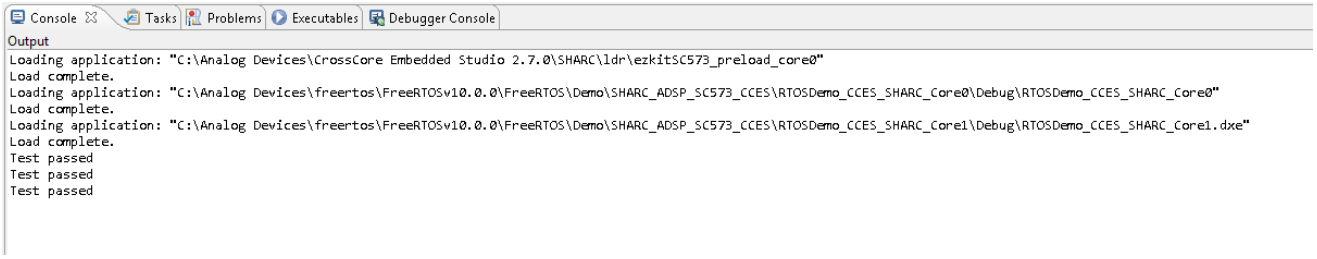


5. Then choose Core1 and keep to click **Run/Resume** button to start running Core1 application



5.2.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see three LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.


Console
Tasks
Problems
Executables
Debugger Console
Output
Loading application: "C:\Analog Devices\CrossCore Embedded Studio 2.7.0\SHARC\ldr\ezkitSC573_preload_core0"
Load complete.
Loading application: "C:\Analog Devices\freertos\FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC573_CCES\RTOSDemo_CCES_SHARC_Core0\Debug\RTOSDemo_CCES_SHARC_Core0"
Load complete.
Loading application: "C:\Analog Devices\freertos\FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC573_CCES\RTOSDemo_CCES_SHARC_Core1\Debug\RTOSDemo_CCES_SHARC_Core1.dxe"
Load complete.
Test passed
Test passed
Test passed

6 Running the Examples on the ADSP-SC594 EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Core	Toolchain	Example(s)
ADSP-SC594	ARM A5	CrossCore Embedded Studio	Basic Demo
ADSP-SC594	SHARC+	CrossCore Embedded Studio	Basic Demo
ADSP-SC594	ARM and SHARC+	CrossCore Embedded Studio	MCAPI Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System. For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

6.1 Running the Basic Example for ARM on ADSP-SC594 EZ-Kit with CrossCore Embedded Studio

6.1.1 Overview

This page describes the steps to build and run basic example for ARM on ADSP-SC594 EZ-Kit board using CrossCore Embedded Studio.

6.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

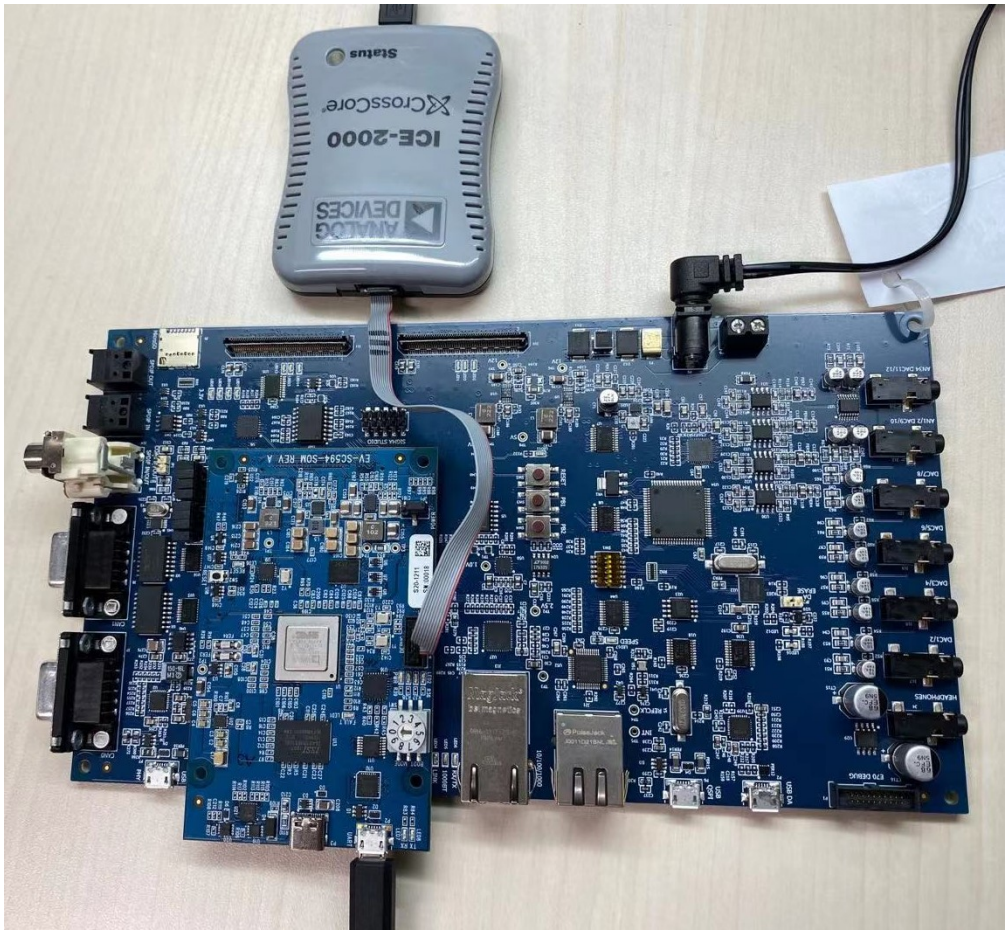
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more information please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC594 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below. A nd connect the **USB to UART** port of the EZ-Kit to the host PC with a USB cable as shown below:

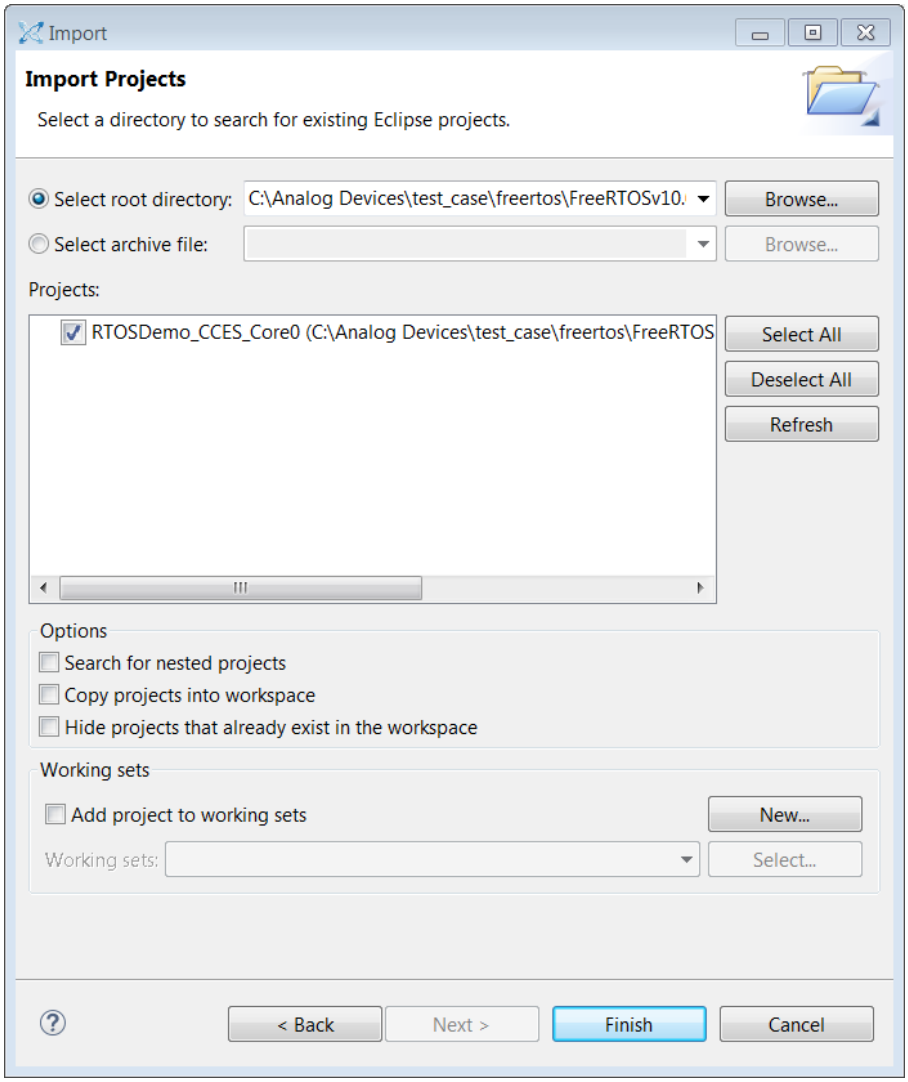


6.1.3 Build the Example

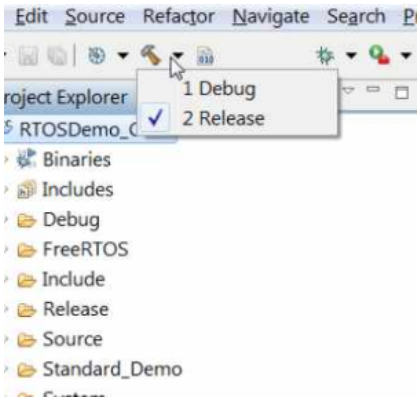
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\CORTEX_A5_ADSP_SC594_CCES** folder
- Click **Finish** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Import**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

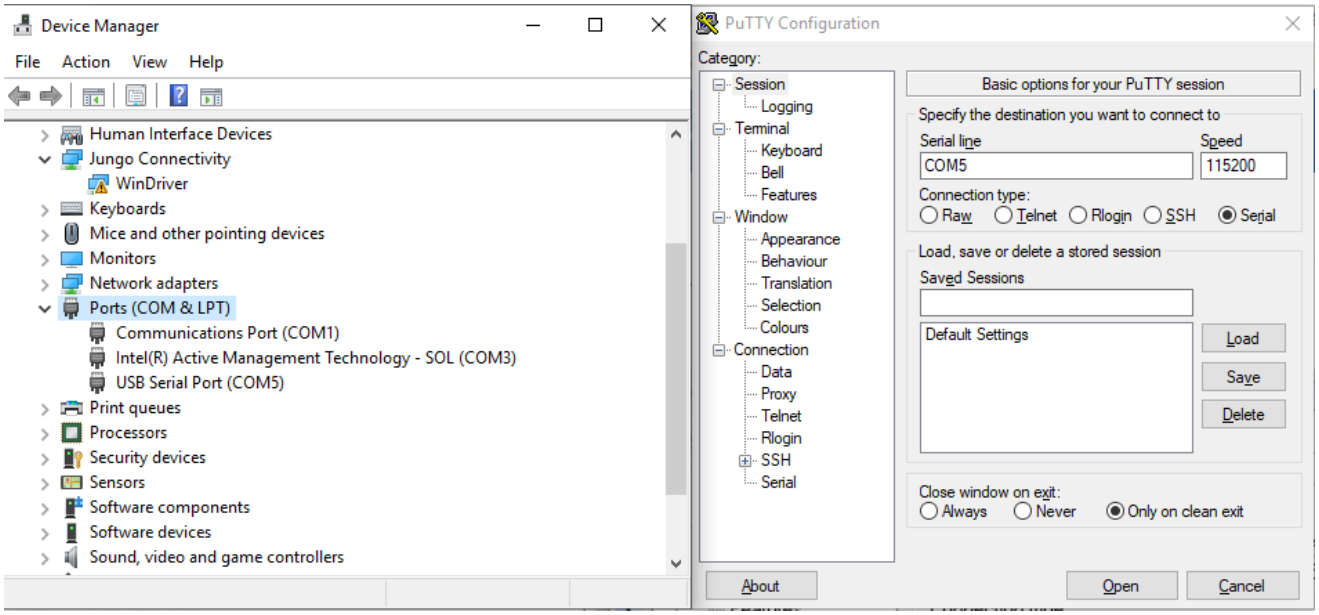
- In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Build Project** option from the menu

6.1.4 Run the Example

The semihosting I/O mechanism, which writes to the CCES console during debug sessions, uses SWI interrupts. This is incompatible with default GCC-compiled I/O code which also uses SWI interrupts. For this reason, stdio function calls initiated on the ARM core are routed out over UART instead and shall be read with a serial terminal external to CCES. Importantly, note that:

1. This is currently only supported *within* FreeRTOS threads, any studio function call performed out with a thread will crash the application.
2. If you need to use other peripherals, you should take care not to change the power service clock rate (which is set in the UART I/O device).

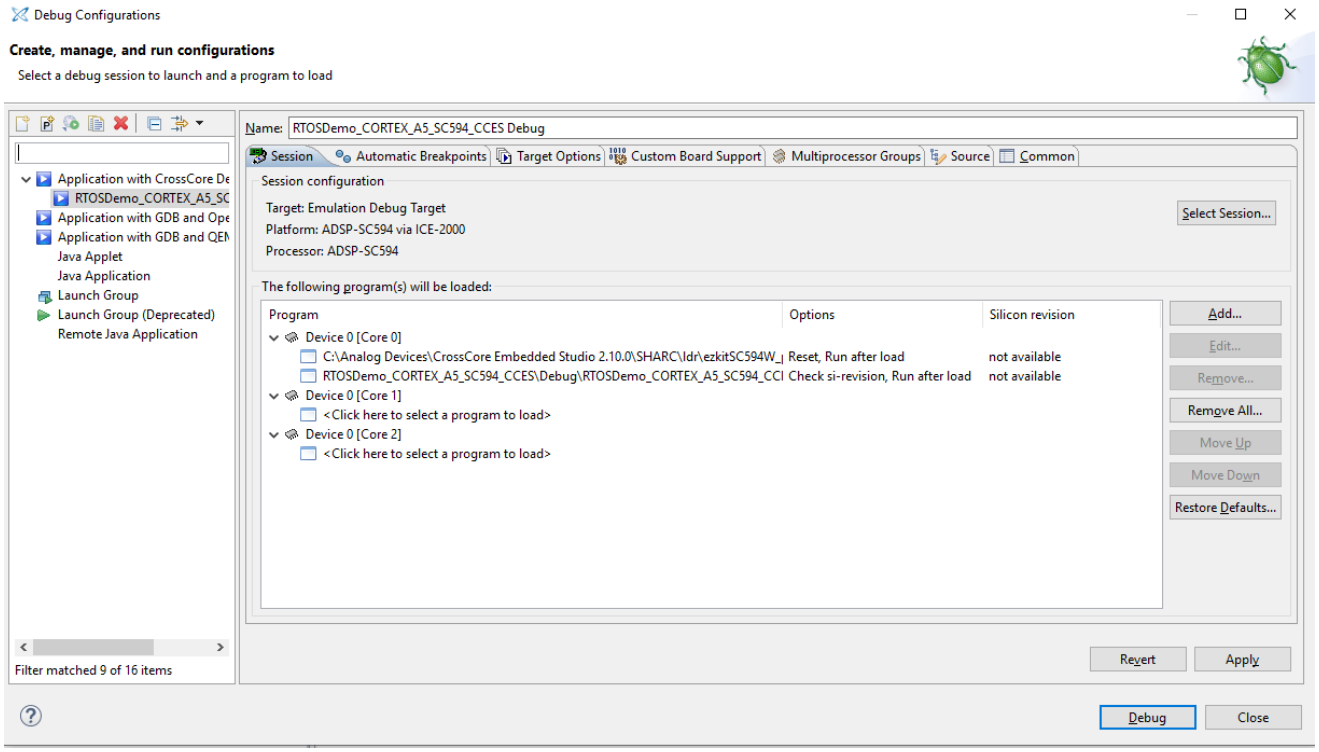
Before running the example, you need to setup the serial terminal of your choice to read the Cortex core output from the **UART to USB connection** on the HOST PC. The easiest way to determine the correct USB device is to view the **Ports** entry in the Windows Device Manager. From here identify the COM port. Configure your serial console application to connect to the port with a baud rate of 115,200.



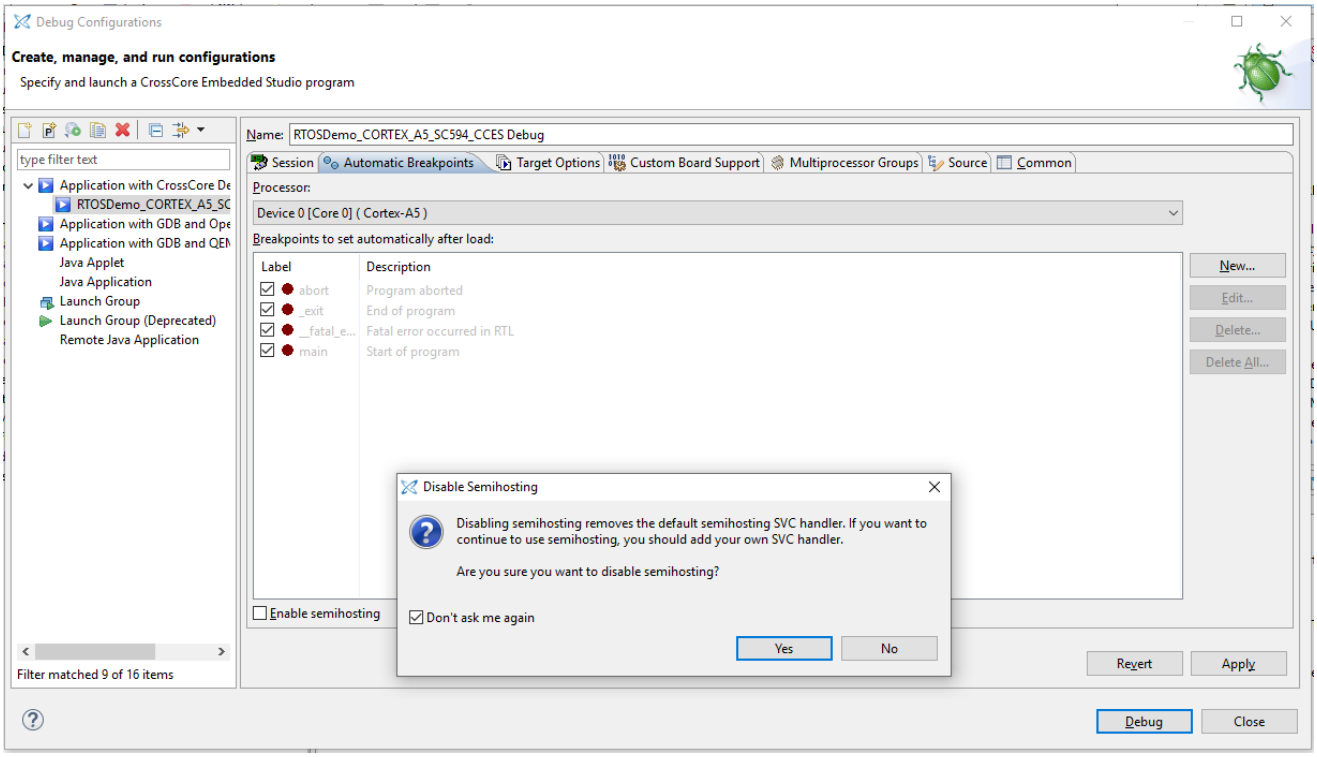
After this, follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_Core0** project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



3 . Disable the **semihosting** function in **Automatic Breakpoints**



4. Click the **Debug** button to close the **Debug Configurations** window

5. Click the **Run/Resume** button to start running your application

6.1.5 Test Results

Output from the application should be visible within the TTY terminal (e.g. PuTTY/TeraTerm). You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if all the tests passed.

6.2 Running the Basic Example for SHARC+ on ADSP-SC594 EZ-Kit with CrossCore Embedded Studio

6.2.1 Overview

This page describes the steps to build and run basic example for SHARC+ on ADSP-SC594 EZ-Kit board using CrossCore Embedded Studio.

6.2.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

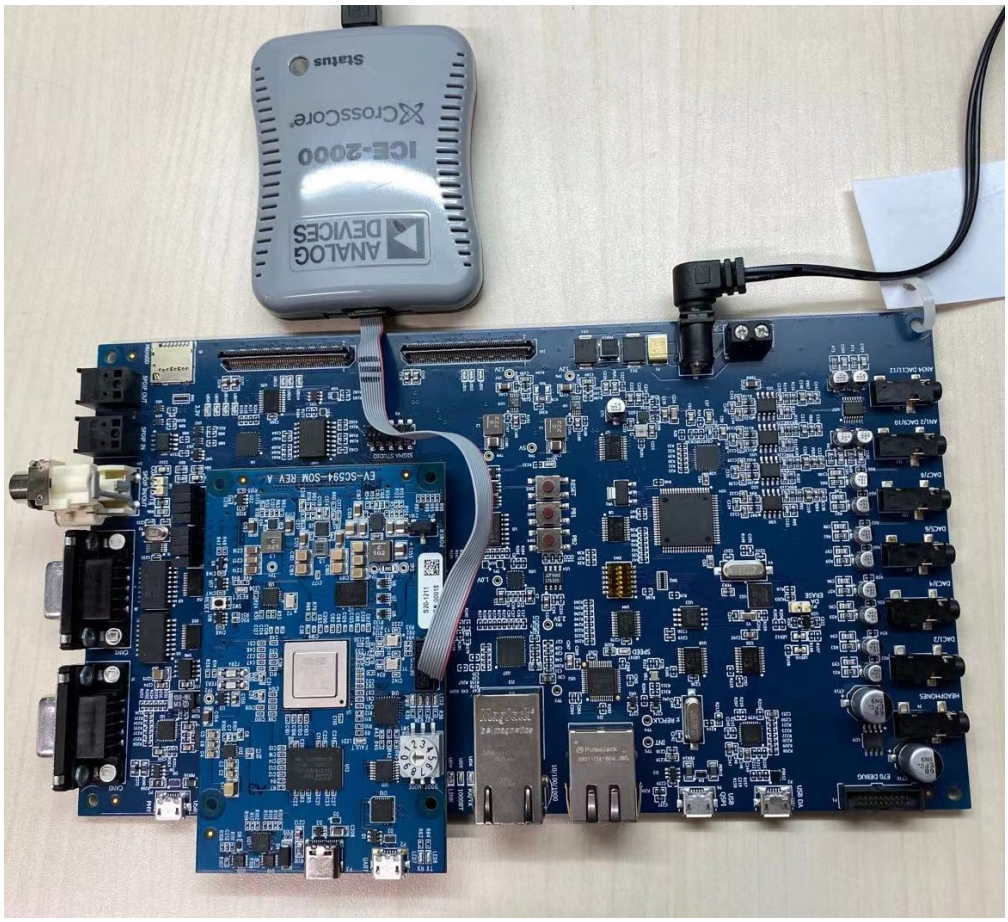
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more information please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC594 EZ-Kit board
- An ICE1000 or ICE2000 emulator

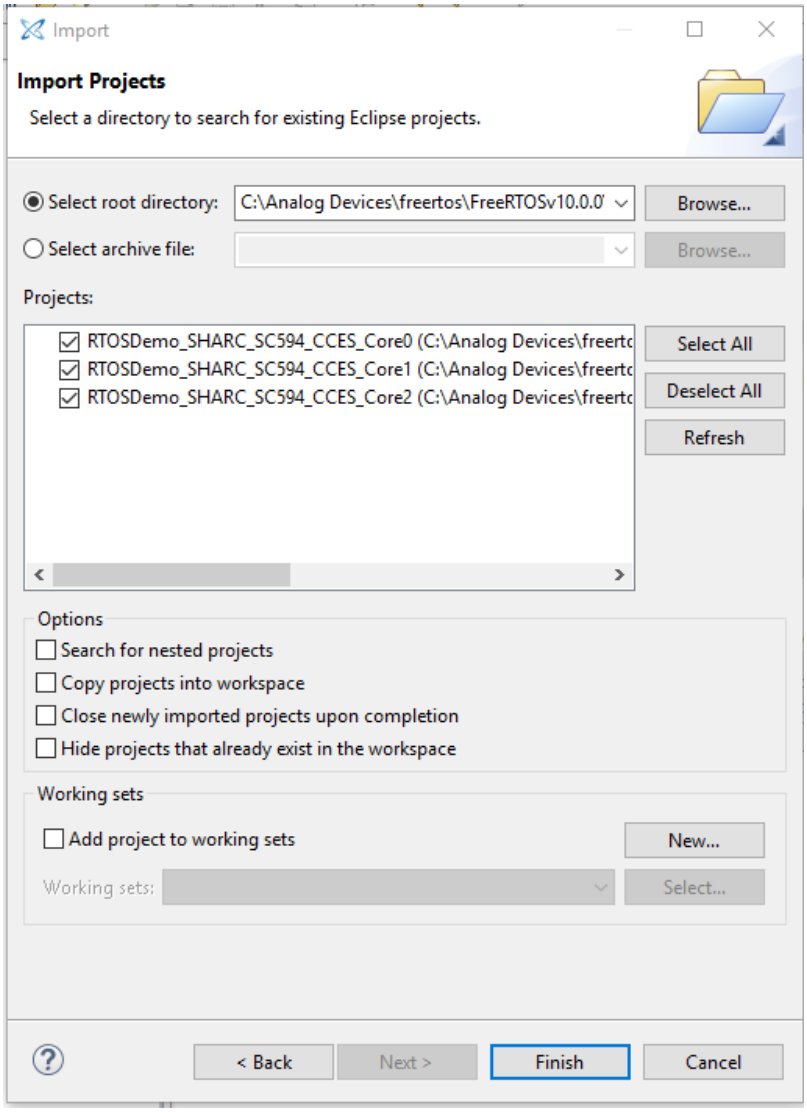
Connect the ICE1000 or ICE2000 emulator to **DEBUG** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below.



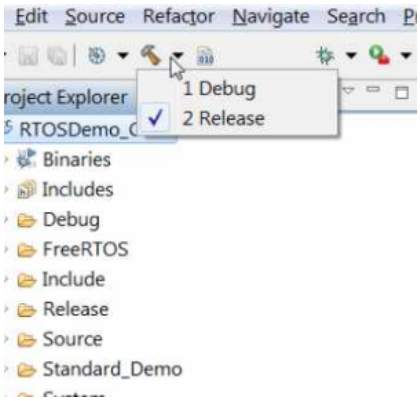
6.2.3 Build the Example

Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:
    - Select the **File** menu and then select the **Import** option from the menu
    - Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
    - Click the **Select root directory** radio button and then click the **Browse** button
    - Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0\FreeRTOS\Demo\SHARC_ADSP_SC594_CCES** folder
    - Click **Finish** to close the file browser dialog
    - Two projects should appear in the **Project Explorer**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

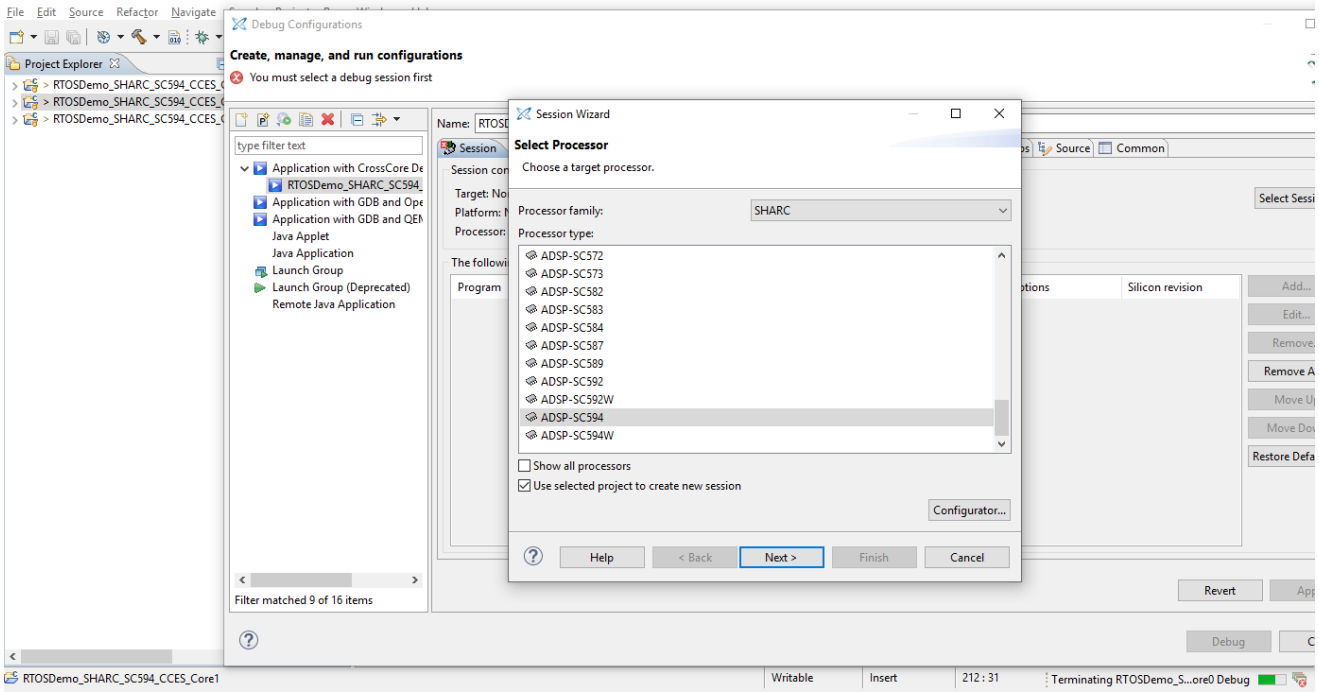
- In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core0** and **RTOSDemo_CCES_SHARC_Core1** and **RTOSDemo_CCES_SHARC_Core2** project, then select the **Build Project** option from the menu

6.2.4 Run the Example

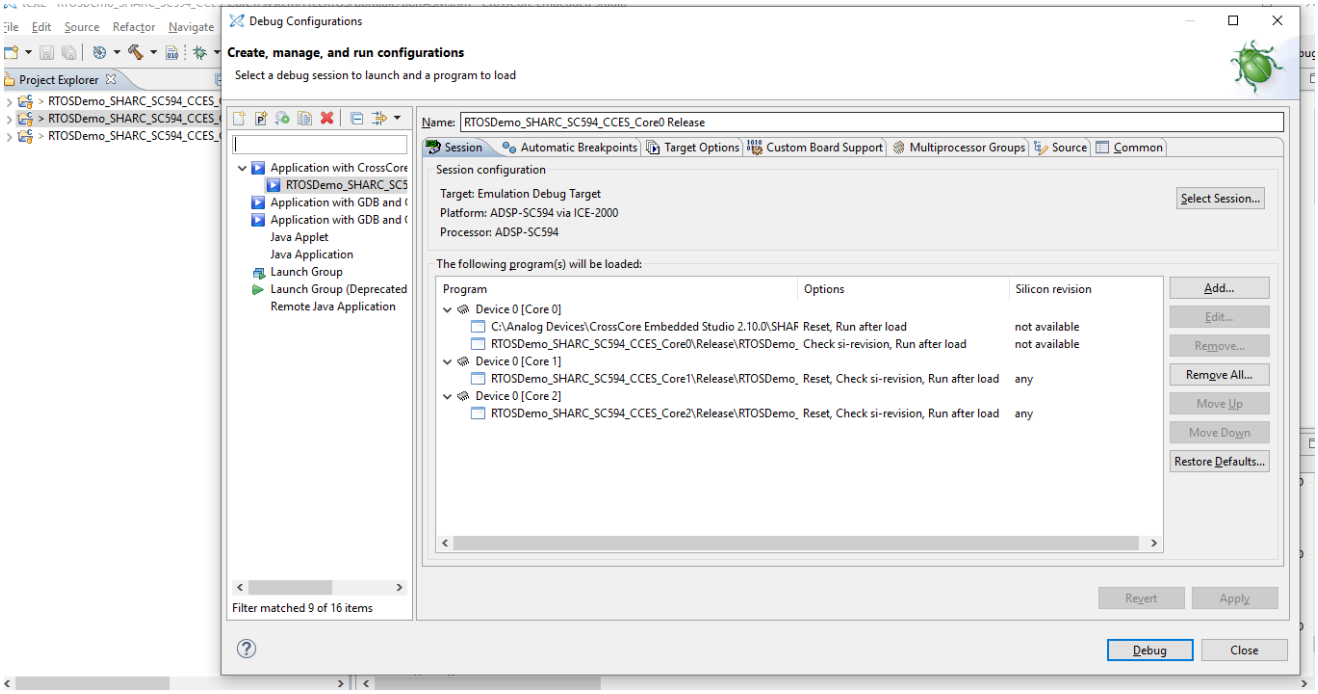
Follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_Core1** project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



3. Click the **Debug** button to close the **Debug Configurations** window



4. Choose Core0 and click the **Run/Resume** button to start running Core0 application

5. Then Choose Core1 and Core2 and keep to click **Run/Resume** button to start running Core1 application

6.2.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see three LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.

6.3 Running the MCAPI Example on ADSP-SC594 EZ-Kit with CrossCore Embedded Studio

6.3.1 Overview

This page describes the steps to build and run MCAPI example for ARM and SHARC+ on ADSP-SC594 EZ-Kit board using CrossCore Embedded Studio.

6.3.2 Environment Setup

Before running the MCAPI example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

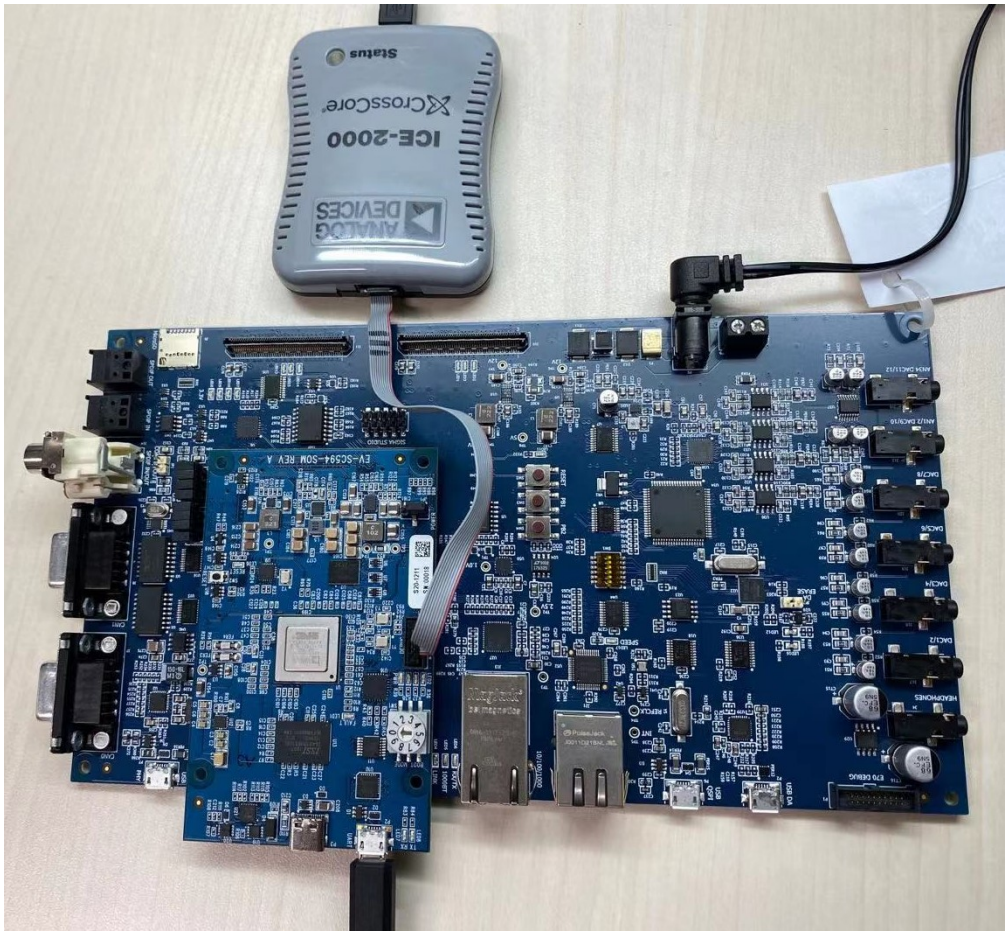
Software Requirement

- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio
- FreeRTOS product and the Analog Devices FreeRTOS product. For more information please refer to Get the source code ready

Hardware Setup

- An ADSCP-SC594 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below. A nd connect the **USB to UART** port of the EZ-Kit to the host PC with a USB cable as shown below:

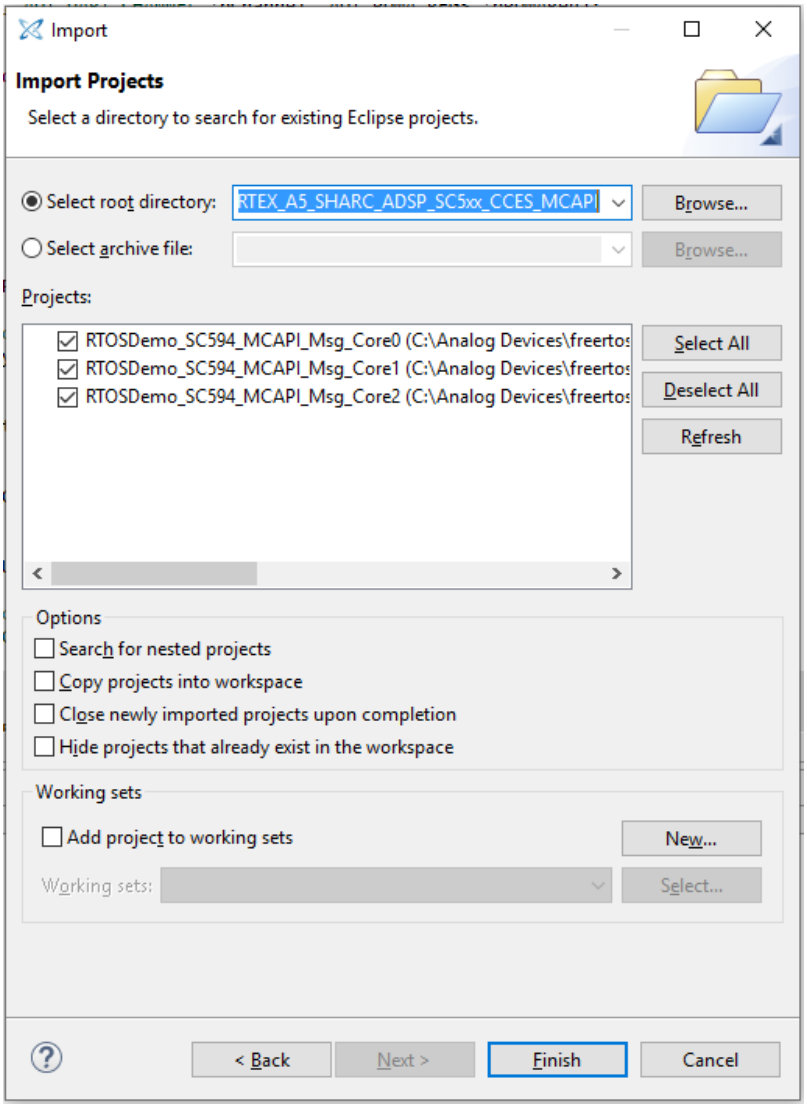


6.3.3 Build the Example

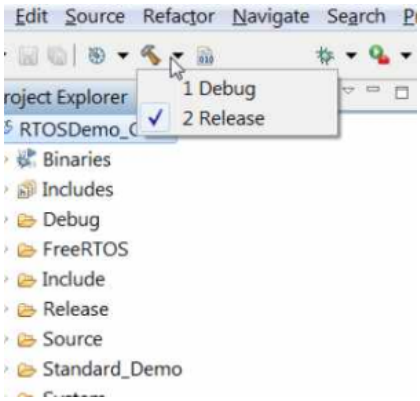
Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Import the FreeRTOS example into CrossCore Embedded Studio:

- Select the **File** menu and then select the **Import** option from the menu
- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0 \FreeRTOS\Demo\CORTEX_A5_SHARC_ADSP_SC5xx_CCES_MCAPI** folder
- Click **Finish** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Import**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio:

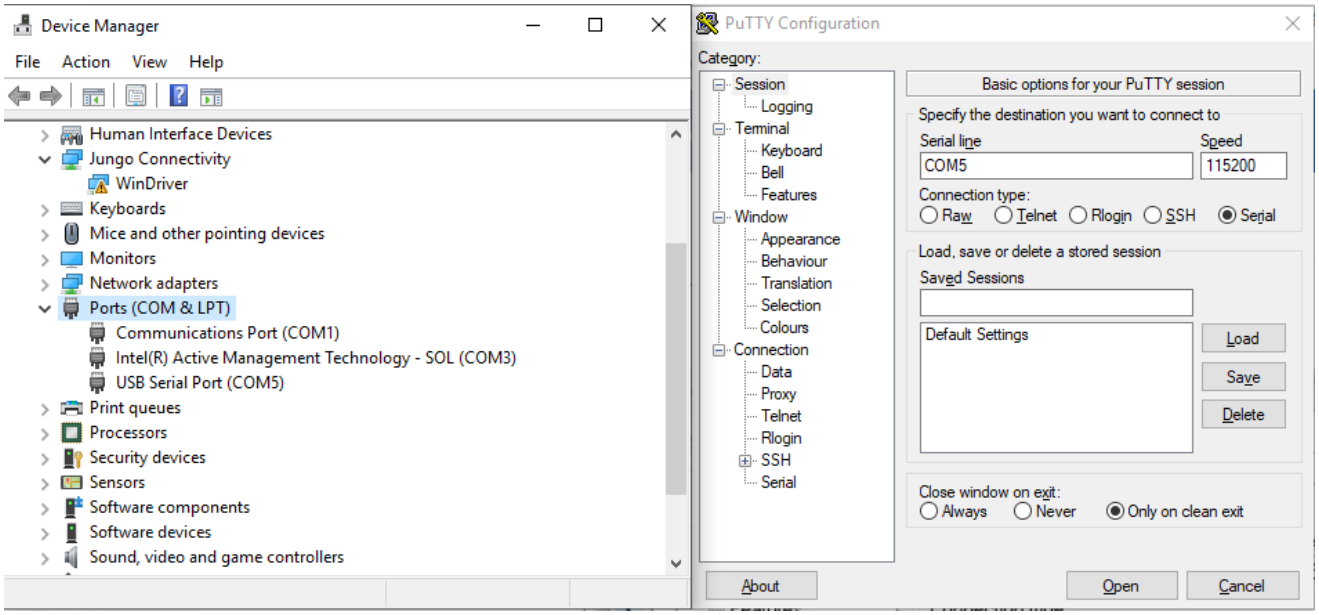
- In the **Project Explorer** right click on the RTOSDemo_CCES_Core0 project and select the **Build Project** option from the menu

6.3.4 Run the Example

The semihosting I/O mechanism, which writes to the CCES console during debug sessions, uses SWI interrupts. This is incompatible with default GCC-compiled I/O code which also uses SWI interrupts. For this reason, stdio function calls initiated on the ARM core are routed out over UART instead and shall be read with a serial terminal external to CCES. Importantly, note that:

1. This is currently only supported *within* FreeRTOS threads, any studio function call performed out with a thread will crash the application.
2. If you need to use other peripherals, you should take care not to change the power service clock rate (which is set in the UART I/O device).

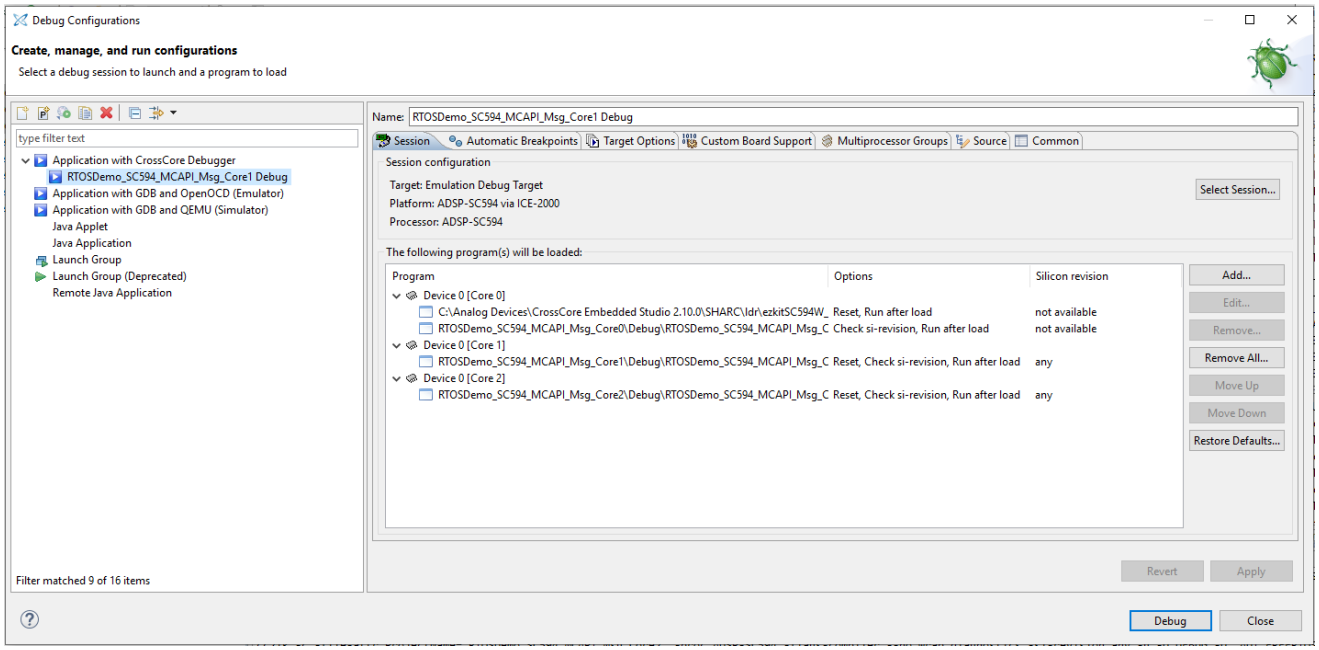
Before running the example, you need to setup the serial terminal of your choice to read the Cortex core output from the **UART to USB connection** on the HOST PC. The easiest way to determine the correct USB device is to view the **Ports** entry in the Windows Device Manager. From here identify the COM port. Configure your serial console application to connect to the port with a baud rate of 115,200.



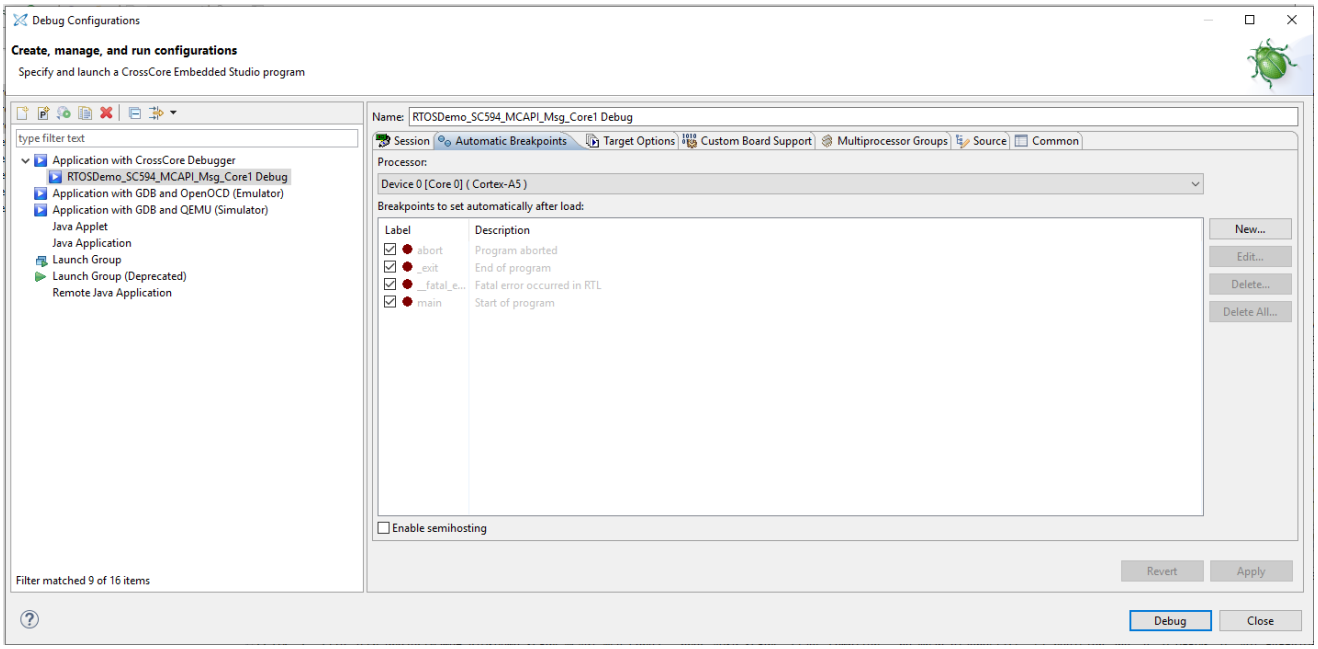
After this, follow below five steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the RTOSDemo_CCES_Core0 project and select the **Debug As** option from the menu

2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



3 . Disable the **semihosting** function in **Automatic Breakpoints**



4. Click the **Debug** button to close the **Debug Configurations** window

5. Click the **Run/Resume** button to start running your application for three cores.

6.3.5 Test Results

Output from the application should be visible within the TTY terminal (e.g. PuTTY/TeraTerm) and **Console** window in the CrossCore Embedded Studio IDE . You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if all the tests passed.

7 Running the Examples on the ADSP-BF7XX EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Toolchain	Example(s)
ADSP-BF707	CrossCore Embedded Studio	Basic Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System.

For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

7.1 Running the Basic Example for ADSP-BF707 EZ-Kit with CrossCore Embedded Studio

7.1.1 Overview

This page describes the steps required to build and run basic example on ADSP-BF707 EZ-Kit board using CrossCore Embedded Studio.

7.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

Software Requirement

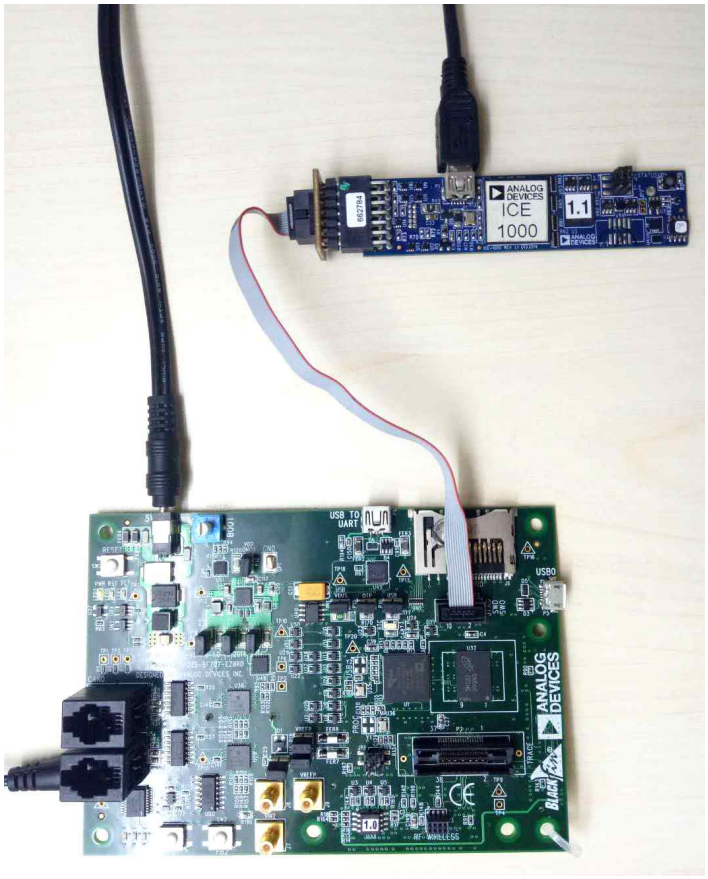
- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio

- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

Hardware Setup

- An ADSP-BF707 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P3** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 5 volts as in the diagram below



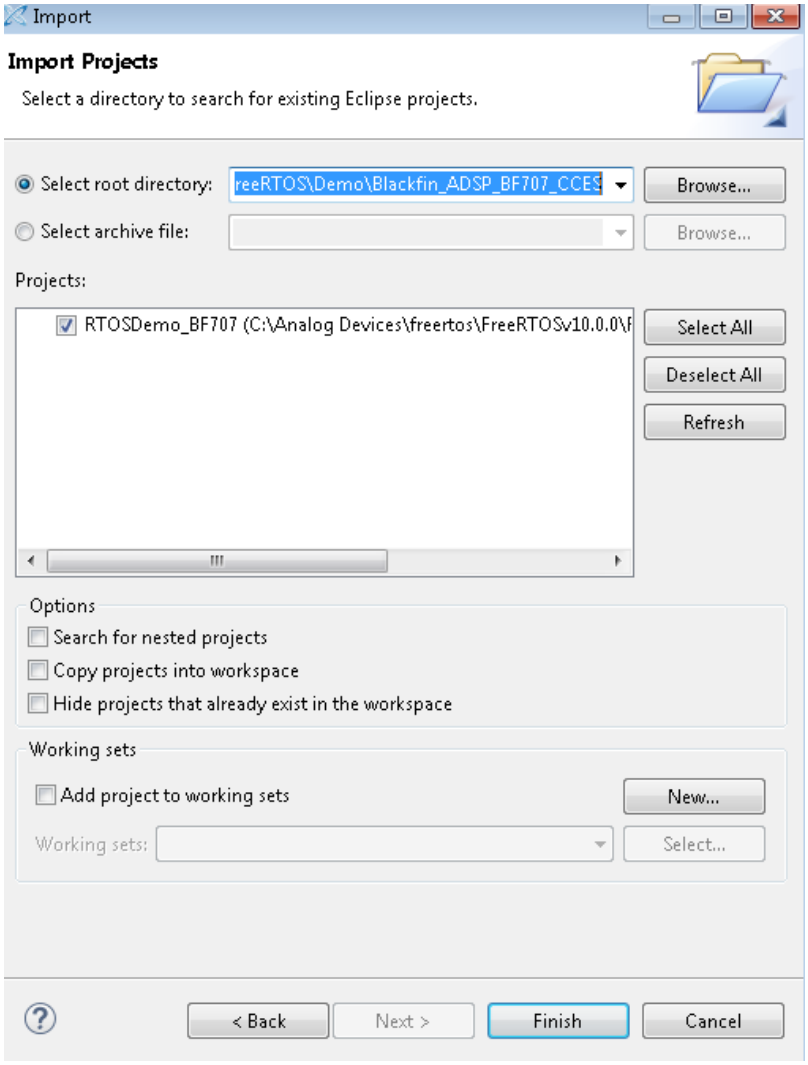
7.1.3 Build the Example

Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

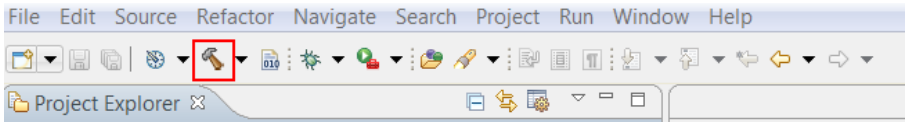
1. Select the **File** menu and then select the **Import** option.

- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button

- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **\FreeRTOSv10.0.0\FreeRTOS\Demo\Blackfin_ADSP_BF707_CCES** folder
- Click **OK** to close the file browser dialog
- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Finish**



2. Choose Debug/Release mode to build the project.



3. Build the project in CrossCore Embedded Studio

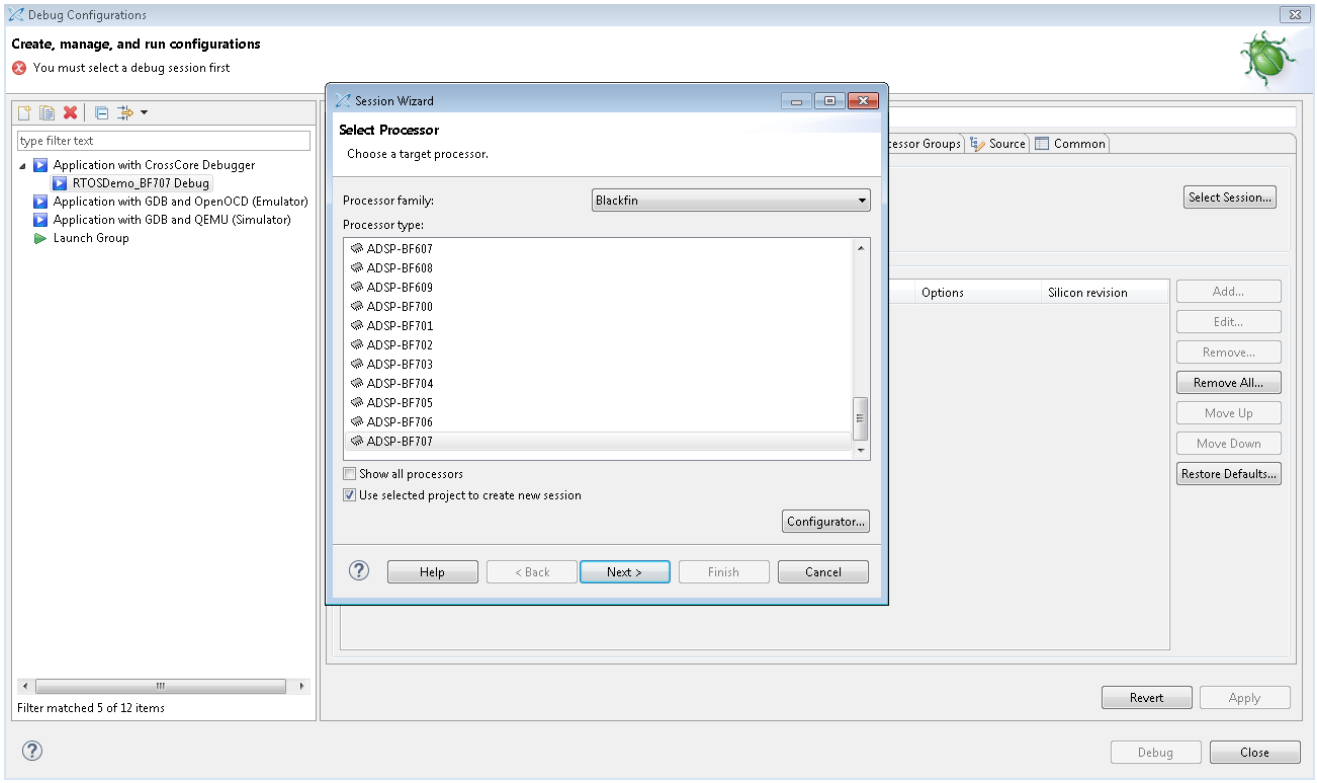
- In the **Project Explorer** right click on the **RTOSDemo_BF707** project and select the **Build Project** option from the menu

7.1.4 Run the Example

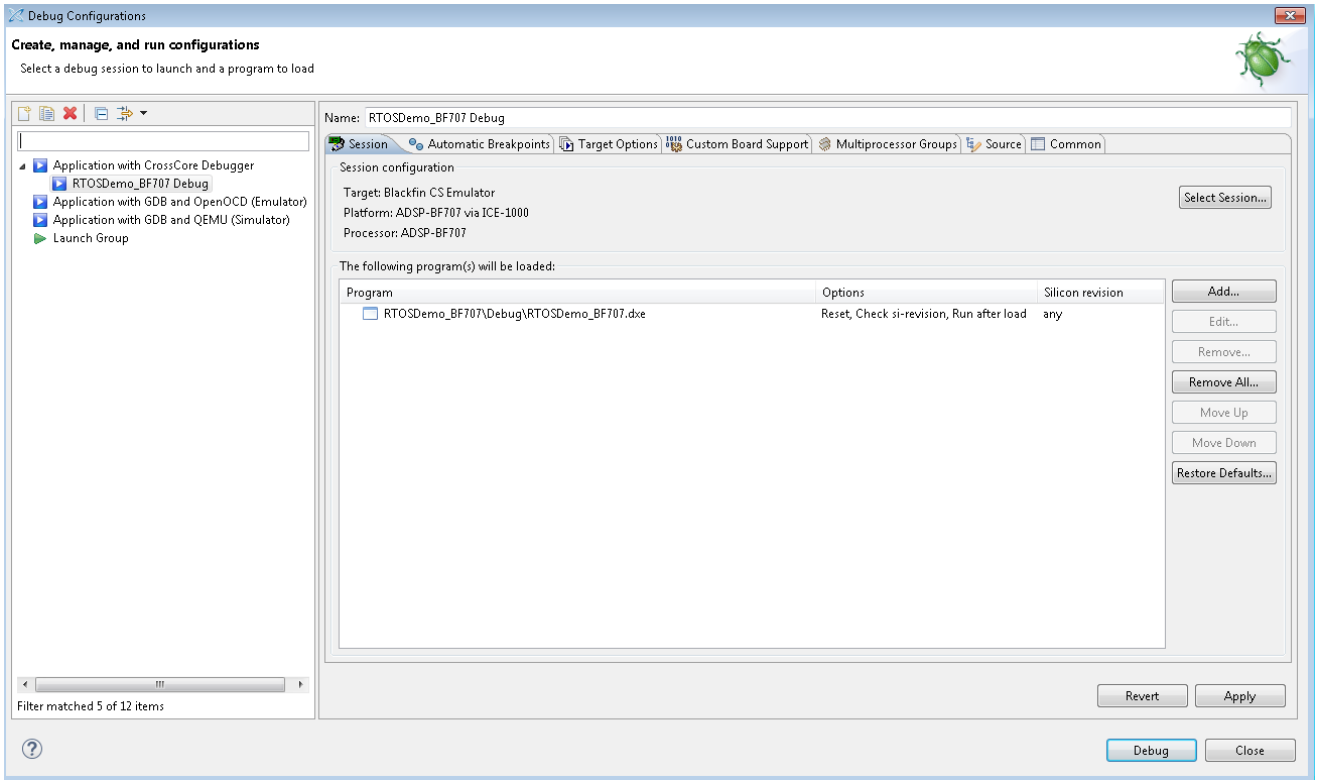
Follow below four steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_BF707** project and select the **Debug As** option from the menu

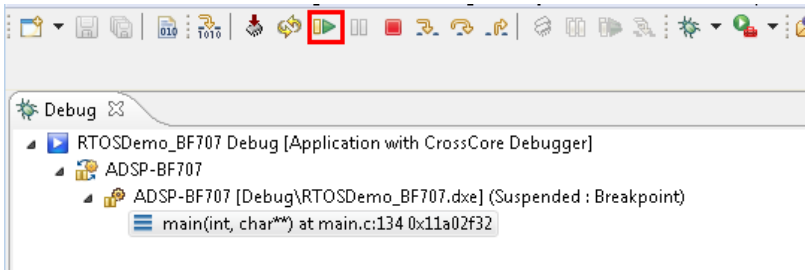
2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator and target board



3. Click the **Debug** button to close the **Debug Configuration** window

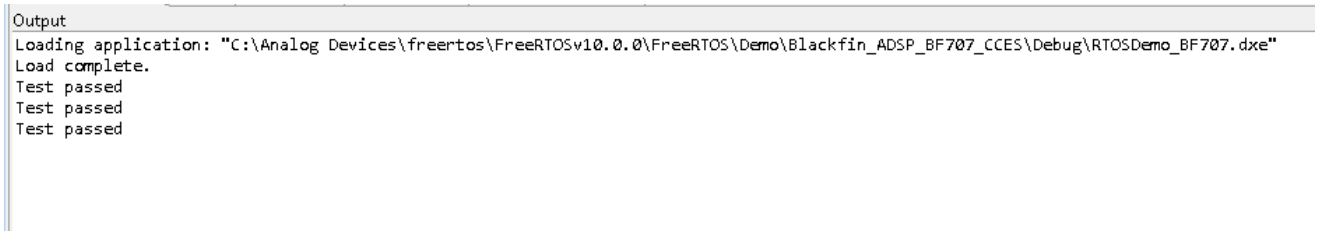


4. Click the **Run/Resume** button to start running your application



7.1.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see three LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.



8 Running the Examples on the ADSP-21569 EZ-Kit

The FreeRTOS product for Analog Devices processors contains the following examples:

Processor	Toolchain	Example(s)
ADSP-21569	CrossCore Embedded Studio	Basic Demo

The basic demo example is based on the **Standard Demo Tasks** that FreeRTOS recommend are provided for each port of the FreeRTOS Operating System.

For more information on the Standard Demo Tasks please refer to http://www.freertos.org/a00013.html.

The tasks performed in the Analog Devices Basic Demo include:

- LED flash
- Polled queue tasks
- Recursive Mutex tasks
- Blocking Queue tasks
- Statically allocated tasks
- Suicidal tasks

8.1 Running the Basic Example for ADSP-21569 EZ-Kit with CrossCore Embedded Studio

8.1.1 Overview

This page describes the steps required to build and run basic example on ADSP-21569 EZ-Kit board using CrossCore Embedded Studio.

8.1.2 Environment Setup

Before running the basic example with CrossCore Embedded Studio, you should make some preparation for environment setup including software and hardware.

Software Requirement

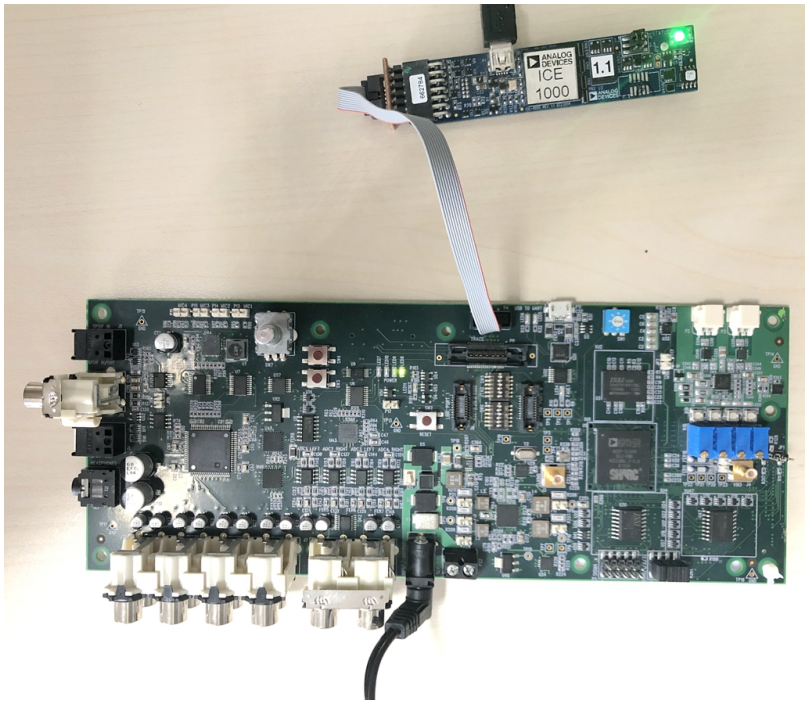
- Analog Devices CrossCore Embedded Studio. For more information please refer to Software environment set up for CrossCore Embedded Studio

- FreeRTOS product and the Analog Devices FreeRTOS product. For more inormation please refer to Get the source code ready

Hardware Setup

- An ADSP-21569 EZ-Kit board
- An ICE1000 or ICE2000 emulator

Connect the ICE1000 or ICE2000 emulator to **DEBUG P4** port of EZ-Kit and the host PC using USB cable and simultaneously connect the power supply with 12 volts as in the diagram below



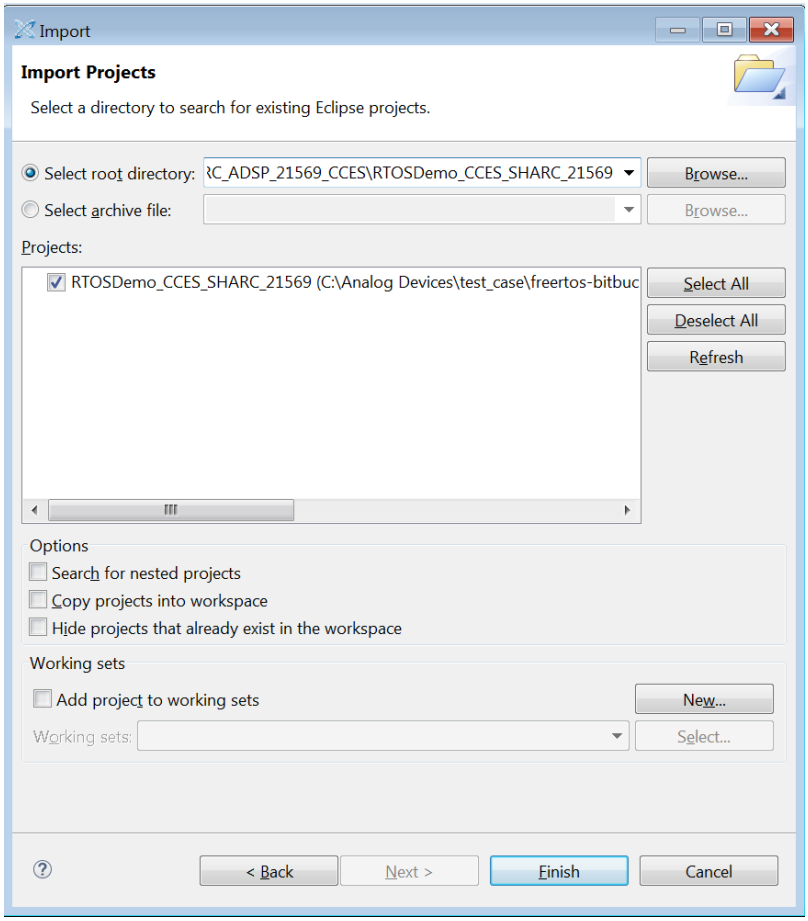
8.1.3 Build the Example

Before you run the FreeRTOS example in CrossCore Embedded Studio, follow below three steps to import and build it.

1. Select the **File** menu and then select the **Import** option.

- Click on the **General** folder, then click on the **Existing Projects into Workspace** entry, and click **Next**
- Click the **Select root directory** radio button and then click the **Browse** button
- Browse the root folder where you previously installed the FreeRTOS product and then browse down into the **FreeRTOSv10.0.0 \FreeRTOS\Demo\SHARC_ADSP_21569_CCES\RTOSDemo_CCES_SHARC_21569** folder
- Click **OK** to close the file browser dialog

- A single project should appear in the **projects** pane of the **Import** window
- Check the entry in the **projects** pane and click **Finish**



2. Choose Debug/Release mode to build the project.

3. Build the project in CrossCore Embedded Studio

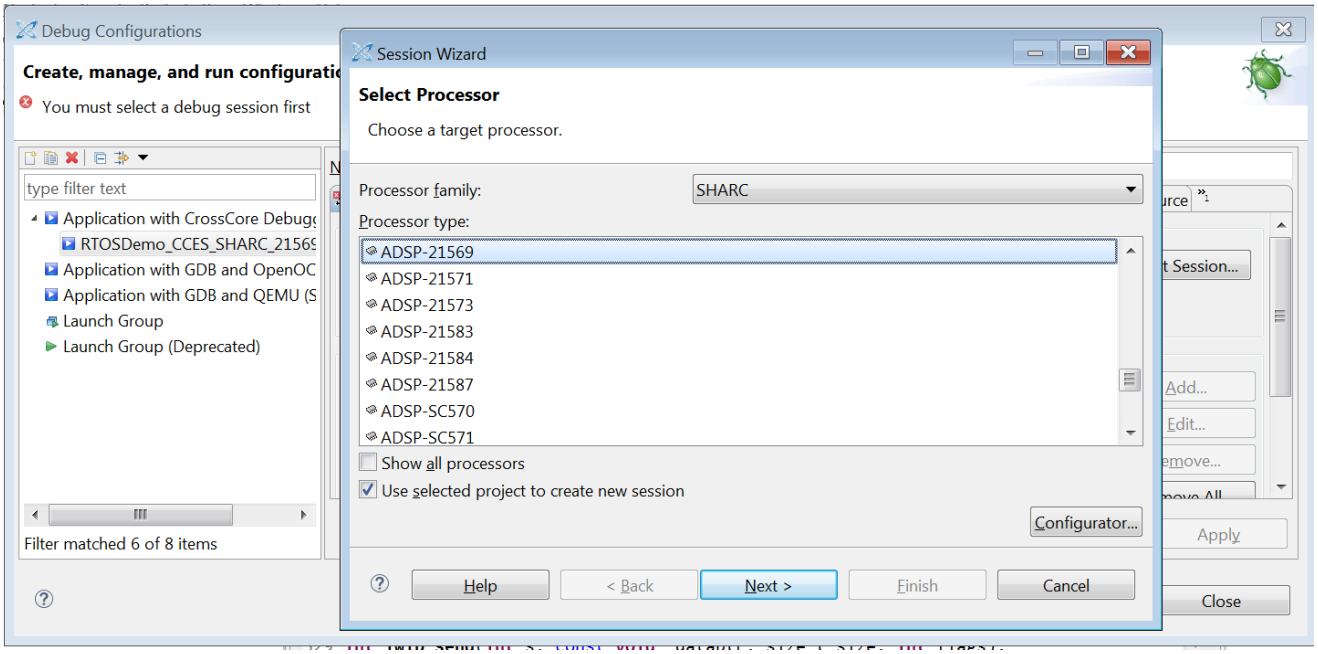
- In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_21569** project and select the **Build Project** option from the menu

8.1.4 Run the Example

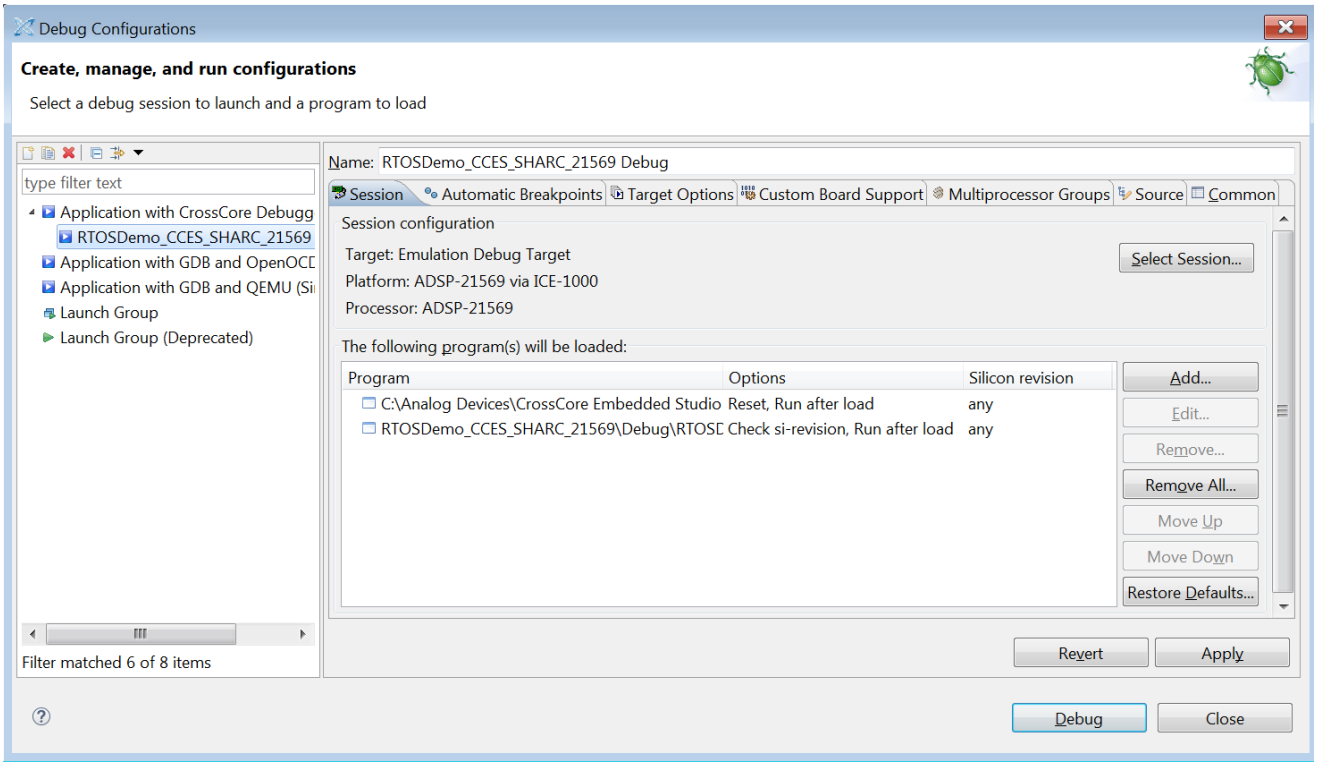
Follow below four steps to do debug configuration, download and run the built binary on the target board.

1. In the **Project Explorer** right click on the **RTOSDemo_CCES_SHARC_21569** project and select the **Debug As** option from the menu

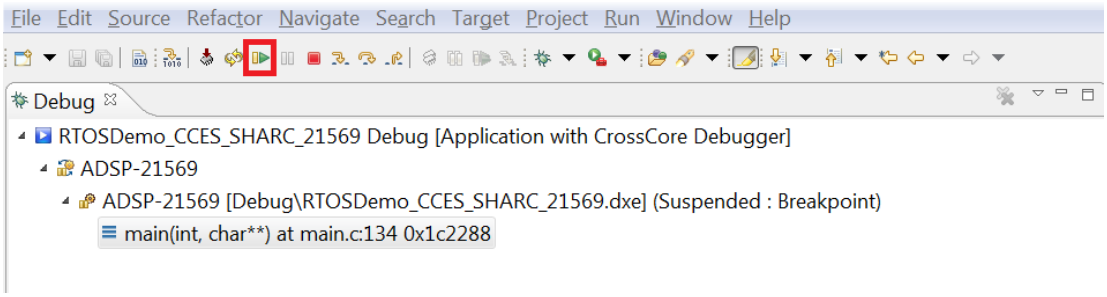
2. From the popup menu select **Debug Configurations** option to create a new debug configuration that matches your emulator(ICE1000 or ICE2000) and target board



3. Click the **Debug** button to close the **Debug Configurations** window

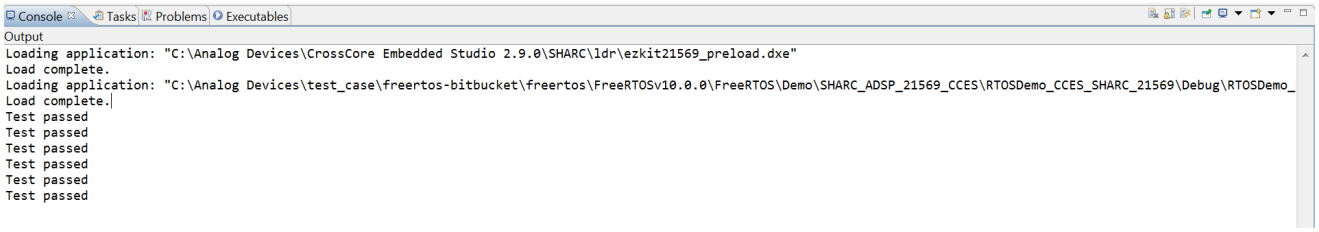


4. Click the **Run/Resume** button to start running your application



8.1.5 Test Results

Output from the application should be visible within the **Console** window in the CrossCore Embedded Studio IDE. You should see the LEDs on the EZ-Kit begin to flash. **Test Passed** will be printed if the all tests passed.



9 Using CrossCore Embedded Studio System Services and Device Drivers with FreeRTOS

Note: This section of the document applies to the ADSP-SC5xx (Cortex-A and SHARC+) and ADSPBF7xx processors. It does not apply to the ADuCM* processor families.

CrossCore Embedded Studio provides support for the on-chip peripherals and EZ-KIT hosted device drivers that are provided for its processors.

In order to use these features with FreeRTOS the source based versions of the drivers must be used rather than the default pre-built libraries that are provided.

Use of the library based version of the System Services and Device Drivers is not compatible with FreeRTOS. Use of the pre-built libraries may result in run-time corruption and execution failure.

To use the System Services and Device Drivers in your CrossCore Embedded Studio project:

1. Ensure that the pre-processor macro __ADI_FREERTOS is defined for all assembler,C/C++ and linker operations.
   This requires the pre-processor macro to defined in three separate locations in the project settings.
2. Ensure that the pre-built libdrv library is not linked into the application.
   a. For Cortex-A projects this is controlled by adding the following option to the Settings >Tool Settings > CrossCore ARM Bare Metal C Linker > Additional Options settings: -specs=PATH_TO_FREERTOS\FreeRTOS\FreeRTOSv10.0.0 \FreeRTOSSource\portable\CCES\ARM_CA5\freertos.specs where PATH_TO_FREERTOS is replaced with the path to the installation of your FreeRTOS product.
   b. For SHARC+ and Blackfin projects this is controlled by checking the Settings > Tool Settings > CrossCore Blackfin/SHARC Linker > Libraries > Omit device driver library checkbox
3. Enable the source based version of the required services and drivers:
   a. Double click the system.svc file in the Project Explorer
   b. Click the Add button in the System Configuration Overview
   c. Browse the list of Device Drivers and System Services to add new components to the project

4. Build the project

The provided demo examples for the EZ-KITs contain all the appropriate project settings already configured and are an easy way to get started with a new FreeRTOS project

10 Appendix A: FreeRTOS Performance

The following appendix contains code size and performance data for Analog Devices specific ports of FreeRTOS.

Timer Cycles

The following benchmarks report time and cycle count measurements for post and pending operations using varying methods of communication.

Benchmark data is available for the following EZ-Kits:

- ADSP-SC589 EZ-Kit (Cortex A5 Core)
- ADSP-SC589 EZ-Kit (SHARC+ Core)
- ADSP-SC573 EZ-Kit (Cortex A5 Core)
- ADSP-21569 EZ-Kit (SHARC Core)
- ADSP-BF707 EZ-Kit
- The following projects are executed to gather the benchmark data:
- **ISR:** calculate Interrupt service time and Time to return from an ISR when in FreeRTOS system.
- **FLAG ISR:** calculate FLAG Post/Pend available time,context switch time when unavailable, Interrupt service time and Time to return from an ISR when in FreeRTOS system
- **MSG ISR:** calculate Message queue Post/Pend available time,context switch time when unavailable, Interrupt service time and Time to return from an ISR when in FreeRTOS system
- **SEM ISR:** calculate Semaphore Post/Pend available time,context switch time when unavailable, Interrupt service time and Time to return from an ISR when in FreeRTOS system
- **MUT ISR:** calculate Mutex Post/Pend available time,context switch time when unavailable, Interrupt service time and Time to return from an ISR when in FreeRTOS system

Spaces

The following benchmarks report code size for several common RTOS operations within FreeRTOS. The benchmark data is available for the following EZ-Kits:

- ADSP-SC589 EZ-Kit (Cortex A5 Core)
- ADSP-SC589 Ez-Kit (SHARC+ Core)
- ADSP-21569 EZ-Kit (SHARC Core)

- ADSP-BF707 EZ-Kit

The following projects are executed to gather the benchmark data:

- **NONE:** Basic project
- **Message Queues:** Basic project using 1 static object / Basic project using 2 static objects
- **Flags:** Basic project using 1 static object / Basic project using 2 static objects
- **Mutexes:** Basic project using 1 static object / Basic project using 2 static objects
- **Semaphores:** Basic project using 1 static object / Basic project using 2 static objects
- **ALL:** Basic project using 1 static object / Basic project using 2 static objects

10.1 ADSP-21569 (SHARC Core) Benchmark Data

ADSP-21569 SHARC Core Performance Metrics

		cycles
FreeRTOS_FLGISR	xEventGroupWaitBits (flag available)	314
	xEventGroupWaitBits (flag unavailable, context switch to new task)	1244
	xEventGroupSetBits (no task pending, no context switch)	255
	xEventGroupSetBits (task waiting, context switch to pending task)	1156
	xEventGroupSetBits (from an ISR, switching to a pending task)	3742
FreeRTOS_ISR	Interrupt service time (FreeRTOS)	227
	Time to return from an ISR (FreeRTOS, no task switch)	174
FreeRTOS_MSGISR	xQueueReceive(message available)	298
	xQueueReceive(message unavailable, context switch to new task)	2108
	xQueueSend(no task pending, no context switch)	363
	xQueueSend(task waiting, context switch to pending task)	1434

		cycles
	xQueueSend(from an ISR, switching to a pending task)	1097
FreeRTOS_MUTISR	xSemaphoreTake(mutex available)	238
	xSemaphoreTake(mutex unavailable, context switch to new task	2411
	xSemaphoreGive(no task pending, no context switch)	329
	xSemaphoreGive(task waiting, context switch to pending task)	1540
FreeRTOS_SEMISR	xSemaphoreTake(semaphore available)	213
	xSemaphoreTake(semaphore unavailable, context switch to new task)	2097
	xSemaphoreGive(no task pending, no context switch)	313
	xSemaphoreGive(task waiting, context switch to pending task)	1293
	xSemaphoreGive (from an ISR, switching to a pending task)	1029

ADSP-21569 SHARC Core Sizing Metrics

		Data	Code	Total
NONE	Basic project	59307	29842	89149
Message Queues	Basic project using 1 static object	59403	29970	89373
	Basic project using 2 static objects	59483	29970	89453
Flags	Basic project using 1 static object	59459	31702	91161
	Basic project using 2 static objects	59491	31702	91193
Mutexes	Basic project using 1 static object	59395	32114	91509

		Data	Code	Total
	Basic project using 2 static objects	59483	32114	91597
Semaphores	Basic project using 1 static object	59395	31982	91377
	Basic project using 2 static objects	59483	31982	91465
ALL	Basic project using 1 static object	59547	34198	93745
	Basic project using 2 static objects	59667	34198	93865

10.2 ADSP-SC589 (Cortex-A Core) Benchmark Data

ADSP-SC589 Cortex-A Core Performance Metrics

		cycles
FreeRTOS_FLGISR	xEventGroupWaitBits (flag available)	321
	xEventGroupWaitBits (flag unavailable, context switch to new task)	1129
	xEventGroupSetBits (no task pending, no context switch)	324
	xEventGroupSetBits (task waiting, context switch to pending task)	1095
	xEventGroupSetBits (from an ISR, switching to a pending task)	3158
FreeRTOS_ISR	Interrupt service time (FreeRTOS)	109
	Time to return from an ISR (FreeRTOS, no task switch)	24
FreeRTOS_MSGISR	xQueueReceive(message available)	287
	xQueueReceive(message unavailable, context switch to new task)	2290
	xQueueSend(no task pending, no context switch)	309
	xQueueSend(task waiting, context switch to pending task)	1309

		cycles
	xQueueSend(from an ISR, switching to a pending task)	648
FreeRTOS_MUTISR	xSemaphoreTake(mutex available)	239
	xSemaphoreTake(mutex unavailable, context switch to new task	2630
	xSemaphoreGive(no task pending, no context switch)	274
	xSemaphoreGive(task waiting, context switch to pending task)	1438
FreeRTOS_SEMISR	xSemaphoreTake(semaphore available)	212
	xSemaphoreTake(semaphore unavailable, context switch to new task)	2442
	xSemaphoreGive(no task pending, no context switch)	317
	xSemaphoreGive(task waiting, context switch to pending task)	1344
	xSemaphoreGive (from an ISR, switching to a pending task)	638

ADSP-SC589 Cortex-A Core Sizing Metrics

		Data	Code	Total
NONE	Basic project	97812	18624	116436
Message Queues	Basic project using 1 static object	97812	18680	116492
	Basic project using 2 static objects	97812	18680	116492
Flags	Basic project using 1 static object	97812	19096	116908
	Basic project using 2 static objects	97812	19096	116908
Mutexes	Basic project using 1 static object	97812	18704	116516

		Data	Code	Total
	Basic project using 2 static objects	97812	18704	116516
Semaphores	Basic project using 1 static object	97812	18664	116476
	Basic project using 2 static objects	97812	18664	116476
ALL	Basic project using 1 static object	97812	19264	117076
	Basic project using 2 static objects	97812	19256	117068

10.3 ADSP-SC589 (SHARC+ Core) Benchmark Data

ADSP-SC589 SHARC+ Core Performance Metrics

		cycles
FreeRTOS_FLGISR	xEventGroupWaitBits (flag available)	440
	xEventGroupWaitBits (flag unavailable, context switch to new task)	1708
	xEventGroupSetBits (no task pending, no context switch)	340
	xEventGroupSetBits (task waiting, context switch to pending task)	1586
	xEventGroupSetBits (from an ISR, switching to a pending task)	4643
FreeRTOS_ISR	Interrupt service time (FreeRTOS)	236
	Time to return from an ISR (FreeRTOS, no task switch)	182
FreeRTOS_MSGISR	xQueueReceive(message available)	409
	xQueueReceive(message unavailable, context switch to new task)	2710
	xQueueSend(no task pending, no context switch)	476

		cycles
	xQueueSend(task waiting, context switch to pending task)	1877
	xQueueSend(from an ISR, switching to a pending task)	1160
FreeRTOS_MUTISR	xSemaphoreTake(mutex available)	321
	xSemaphoreTake(mutex unavailable, context switch to new task	3199
	xSemaphoreGive(no task pending, no context switch)	484
	xSemaphoreGive(task waiting, context switch to pending task)	2117
FreeRTOS_SEMISR	xSemaphoreTake(semaphore available)	275
	xSemaphoreTake(semaphore unavailable, context switch to new task)	2711
	xSemaphoreGive(no task pending, no context switch)	404
	xSemaphoreGive(task waiting, context switch to pending task)	1718
	xSemaphoreGive (from an ISR, switching to a pending task)	1019

ADSP-SC589 SHARC+ Core Sizing Metrics

		Data	Code	Total
NONE	Basic project	59838	29764	89602
Message Queues	Basic project using 1 static object	59934	29896	89830
	Basic project using 2 static objects	59934	29896	89830
Flags	Basic project using 1 static object	59966	31692	91658
	Basic project using 2 static objects	59966	31692	91658

		Data	Code	Total
Mutexes	Basic project using 1 static object	59926	32184	92110
	Basic project using 2 static objects	59926	32184	92110
Semaphores	Basic project using 1 static object	59926	32048	91974
	Basic project using 2 static objects	59926	32048	91974
ALL	Basic project using 1 static object	60054	34340	94394
	Basic project using 2 static objects	60054	34340	94394

10.4 ADZS-BF707 Benchmark Data

ADZS-BF707 Performance Metrics

		cycles
FreeRTOS_FLGISR	xEventGroupWaitBits (flag available)	420
	xEventGroupWaitBits (flag unavailable, context switch to new task)	1856
	xEventGroupSetBits (no task pending, no context switch)	356
	xEventGroupSetBits (task waiting, context switch to pending task)	1866
	xEventGroupSetBits (from an ISR, switching to a pending task)	3158
FreeRTOS_ISR	Interrupt service time (FreeRTOS)	98
	Time to return from an ISR (FreeRTOS, no task switch)	126
FreeRTOS_MSGISR	xQueueReceive(message available)	447
	xQueueReceive(message unavailable, context switch to new task)	2937

		cycles
	xQueueSend(no task pending, no context switch)	630
	xQueueSend(task waiting, context switch to pending task)	2412
	xQueueSend(from an ISR, switching to a pending task)	1417
FreeRTOS_MUTISR	xSemaphoreTake(mutex available)	337
	xSemaphoreTake(mutex unavailable, context switch to new task	3553
	xSemaphoreGive(no task pending, no context switch)	663
	xSemaphoreGive(task waiting, context switch to pending task)	2624
FreeRTOS_SEMISR	xSemaphoreTake(semaphore available)	271
	xSemaphoreTake(semaphore unavailable, context switch to new task)	2943
	xSemaphoreGive(no task pending, no context switch)	504
	xSemaphoreGive(task waiting, context switch to pending task)	2093
	xSemaphoreGive (from an ISR, switching to a pending task)	1235

ADZS-BF707 Sizing Metrics

		Data	Code	Total
NONE	Basic project	6535	13698	20233
Message Queues	Basic project using 1 static object	6623	13762	20385
	Basic project using 2 static objects	6707	13762	20469
Flags	Basic project using 1 static object	6567	14402	20969

		Data	Code	Total
	Basic project using 2 static objects	6599	14402	21001
Mutexes	Basic project using 1 static object	6619	14682	21301
	Basic project using 2 static objects	6703	14682	21385
Semaphores	Basic project using 1 static object	6619	14618	21237
	Basic project using 2 static objects	6703	14618	21321
ALL	Basic project using 1 static object	6655	15506	22161
	Basic project using 2 static objects	6771	15506	22277