Freescale Semiconductor, Inc.
Reference Manual

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CodeWarrior for ARMv7 Targeting Manual

Contents

Chapter 1 Introduction

This manual explains how to use CodeWarrior Development Studio tools to develop software for bareboard applications and embedded Linux® operating system running on NXP QorIQ LS series - ARM V7 ISA.

This chapter provides an overview of this manual and introduces you to the CodeWarrior development tools and development process.

This chapter includes the following sections:

- Release Notes on page 9: Lists new features, bug fixes, and incompatibilities.
- Contents of this Manual on page 9: Describes contents of this manual.
- Accompanying documentation on page 10: Describes the documentation included in this version of CodeWarrior Development Studio for QorIQ LS series - ARM V7 ISA.
- ARM Embedded Application Binary Interface on page 10: Provides information about the ARM Embedded Application Binary Interface (ARM EABI).
- CodeWarrior Development Studio Tools on page 11: Describes some important tools of CodeWarrior Development Studio.
- CodeWarrior IDE on page 12: Explains the CodeWarrior IDE and tells how to perform basic IDE operations.

1.1 Release Notes

Release notes include information about new features, last-minute changes, bug fixes, incompatible elements, or other sections that may not be included in this manual.

You should read release notes before using the CodeWarrior IDE.

1.2 Contents of this Manual

Each chapter of this manual describes a different area of software development.

The table below lists each chapter in the manual.

Table 1: Organization of this Manual

Chapter	Description
Introduction on page 9	This chapter.
Working with Projects on page 15	Describes the different types of projects you can create, provides an overview of CodeWarrior project wizards.
Build Properties on page 37	Explains build properties for QorIQ LS series - ARM V7 ISA projects.
Debug Configurations on page 53	Describes the different types of launch configurations you can create, provides an overview of the debugger.

Table continues on the next page...

Table 1: Organization of this Manual (continued)

Chapter	Description
Working with Debugger on page 79	Explains various aspects of CodeWarrior debugging, such as debugging a project, configuring connections, setting breakpoints and watchpoints, working with registers, viewing memory, viewing cache, and debugging externally built executable files.
Multicore Debugging on page 113	Explains multi-core debugging capabilities of CodeWarrior debugger.
JTAG Configuration Files on page 171	Explains JTAG configuration files that pass specific configuration settings to the debugger and support chaining of multiple devices.
Target Initialization Files on page 177	Discusses how to use a target initialization file, describes target initialization file commands, and explains how to perform target initialization using a tcl script.
Memory Configuration Files on page 181	Discusses how to use a memory configuration file and describes memory configuration file commands.
Working with Hardware Tools on page 183	Explains CodeWarrior hardware tools used for board bring-up, test, and analysis.

1.3 Accompanying documentation

The Documentation page describes the documentation included in this version of CodeWarrior Development Studio for QorIQ LS series - ARM V7 ISA.

You can access the Documentation page by:

- Opening `START_HERE.html` from the `<CWInstallDir>\CW_ARMv7\ARMv7\Help` folder
- Choosing **Help > Documentation** from the CodeWarrior IDE menu bar

1.4 ARM Embedded Application Binary Interface

The ARM Embedded Application Binary Interface (ARM EABI) specifies data structure alignment, calling conventions, and other information about how high-level languages can be implemented on a ARM processor.

The code generated by CodeWarrior for ARMv7 conforms to the ARM EABI. To learn more about the ARM EABI, information and documentation about all supported ARM hardware is available here: ARM® Technology-Based Solutions

The ARM EABI also specifies the object and symbol file format. It specifies Executable and Linkable Format (ELF) as the output file format and Debug With Arbitrary Record Formats (DWARF) as the debugging information format. For more information about these formats, see:

- *Executable and Linkable Format, Version 1.1*, published by UNIX System Laboratories.
- DWARF Debugging Standard website available at:

  infocenter.arm.com

1.5 CodeWarrior Development Studio Tools

This section talks about some important tools of CodeWarrior Development Studio.

Programming for processors is much like programming for any other CodeWarrior platform target. If you have not used CodeWarrior tools before, start by studying the Eclipse IDE, which is used to host the tools. For more details on IDE, see CodeWarrior Development Studio Common Features Guide available in the `<CWInstallDir>\CW_ARMv7\ARMv7\Help\PDF` folder.

The following are some important tools of CodeWarrior Development Studio:

- Eclipse IDE on page 11
- C/C++ Compiler on page 11
- Assembler on page 11
- Linker on page 12
- Debugger on page 12
- GNU newlib libraries on page 12

1.5.1 Eclipse IDE

The Eclipse Integrated Development Environment (IDE) is an open-source development environment that lets you develop and debug your software.

It controls the project manager, the source code editor, the class browser, the compilers and linkers, and the debugger. The Eclipse workspace organizes all files related to your project. This allows you to see your project at a glance and navigate easily through the source code files.

The Eclipse IDE has an extensible architecture that uses plug-in compilers and linkers to target various operating systems and microprocessors. The IDE can be hosted on Microsoft Windows, Linux, and other platforms. There are many development tools available for the IDE, including C, C++, and Java compilers for desktop and embedded processors.

For more information about the Eclipse IDE, read the Eclipse documentation at:

http://www.eclipse.org/documentation/

1.5.2 C/C++ Compiler

The CodeWarrior ARMv7 C/C++ compiler is an ANSI-compliant compiler.

It compiles C and C++ statements and assembles inline assembly language statements. You can generate ARMv7 applications and libraries that conform to the ARM EABI by using the CodeWarrior compiler in conjunction with the CodeWarrior linker for ARMv7 processors.

The IDE manages the execution of the compiler. The IDE invokes the compiler if you:

- Change a source file and issue the make command.
- Select a source file in your project and issue the compile, preprocess, or precompile command.

1.5.3 Assembler

The CodeWarrior ARMv7 assembler is a standalone assembler that translates assembly-language source code to machine-language object files or executable programs.

Either you can provide the assembly-language source code to the assembler, or the assembler can take the assembly-language source code generated by the compiler.

For each assembly-language module in a build target, the ARMv7 assembler can generate a file that lists the generated code side-by-side with the assembly-language source code.

1.5.4 Linker

The CodeWarrior ARMv7 linker generates binaries that conform to the ARM EABI (Embedded Application Binary Interface).

The linker combines object modules created by the compiler and/or assembler with modules in static libraries to produce a binary file in executable and linkable (ELF) format.

Among many powerful features, the linker lets you:

- Use absolute addressing
- Create multiple user-defined sections
- Generate S-Record files
- Generate PIC/PID binaries

The IDE runs the linker each time you build your project.

1.5.5 Debugger

The CodeWarrior ARMv7 debugger controls the execution of your program and allows you to see what is happening internally as the program runs.

You can use the debugger to find problems in your program. The debugger can execute your program one statement at a time and suspend execution when control reaches a specified point. When the debugger stops a program, you can view the chain of function calls, examine and change the values of variables, and inspect the contents of registers.

The debugger allows you to debug your CodeWarrior project using target hardware. The ARMv7 debugger communicates with the board through a hardware probe (such as the CodeWarrior TAP).

1.5.6 GNU newlib libraries

The GNU newlib runtime libraries are ANSI-compliant C and C++ standard libraries.

Use these libraries to help you create applications for processors. The versions of the GNU newlib runtime libraries have been customized and the runtime has been adapted for processor development.

For more information about GNU newlib, see *GNU C Reference* and *GNU C++ Reference*.

1.6 CodeWarrior IDE

While working with the CodeWarrior IDE, you will proceed through the development stages familiar to all programmers: writing code, compiling and linking, and debugging.

The difference between the CodeWarrior development environment and traditional command-line environments is how the software, in this case the CodeWarrior IDE, helps you manage your work more effectively.

See *CodeWarrior Development Studio Common Features Guide* for:

- Complete information on tasks, such as editing, compiling, and linking
- Basic information on debugging

The following sections explain the CodeWarrior IDE and describe how to perform basic CodeWarrior IDE operations:

- Project files
- Code editing
- Compiling
- Linking
- Debugging

1.6.1 Project files

A CodeWarrior *project* is analogous to a set of make files, because a project can have multiple settings that are applied when building the program.

For example, you can have one project that has both a debug version and a release version of your program. You can build one or the other, or both as you wish. The different settings used to launch your program within a single project are called *launch configurations*.

The CodeWarrior IDE uses the **CodeWarrior Projects** view to list all the files in a project. A project includes files, such as source code files and libraries. You can add or remove files easily. You can assign files to one or more different build configurations within the project, so files common to multiple build configurations can be managed simply.

The CodeWarrior IDE itself manages all the interdependencies between files and tracks which files have changed since the last build.

The CodeWarrior IDE also stores the settings for the compiler and linker options for each build configuration. You can modify these settings using the IDE, or with the `#pragma` statements in your code.

1.6.2 Code editing

CodeWarrior IDE has an integral text editor designed for programmers. It handles text files in ASCII, Microsoft® Windows®, and UNIX® formats.

To edit a file in a project, double-click the file name in the **CodeWarrior Projects** view. CodeWarrior IDE opens the file in the editor associated with the file type.

The editor view has excellent navigational features that allow you to switch between related files, locate any particular function, mark any location within a file, or go to a specific line of code.

1.6.3 Compiling

To compile a source code file, it must be among the files that are part of the current launch configuration.

If the file is in the configuration, select it in the **CodeWarrior Projects** view and select **Project > Build Project** from the CodeWarrior IDE menu bar.

To automatically compile all the files in the current launch configuration after you modify them, select **Project > Build Automatically** from the CodeWarrior IDE menu bar.

1.6.4 Linking

Choose **Project > Build Project** from the CodeWarrior IDE menu bar to link object code into a final binary file.

The **Build Project** command makes the active project up-to-date and links the resulting object code into a final output file.

You can control the linker through the IDE. There is no need to specify a list of object files. The workspace tracks all the object files automatically.

You can also modify the build configuration settings to specify the name of the final output file.

1.6.5 Debugging

Choose **Run > Debug** from the CodeWarrior IDE menu bar to debug your project.

This command downloads the current project's executable to the target board and starts a debug session.

NOTE

The CodeWarrior IDE uses the settings in the launch configuration to generate debugging information and initiate communications with the target board.

You can now use the debugger to step through the program code, view and change the value of variables, set breakpoints, and much more.

Chapter 2
Working with Projects

This chapter explains how to create and build projects for NXP QorIQ LS series - ARM V7 ISA processors using the CodeWarrior tools.

This chapter explains:

- CodeWarrior Bareboard Project Wizard on page 15
- CodeWarrior Linux Project Wizard on page 23
- Creating projects on page 29
- Building projects on page 34

2.1 CodeWarrior Bareboard Project Wizard

The term *bareboard* refers to hardware systems that do not need an operating system to operate. The CodeWarrior Bareboard Project Wizard presents a series of pages that prompt you for the features and settings to be used when making your program.

This section describes the various pages that the **CodeWarrior Bareboard Project Wizard** displays as it assists you in creating a bareboard project.

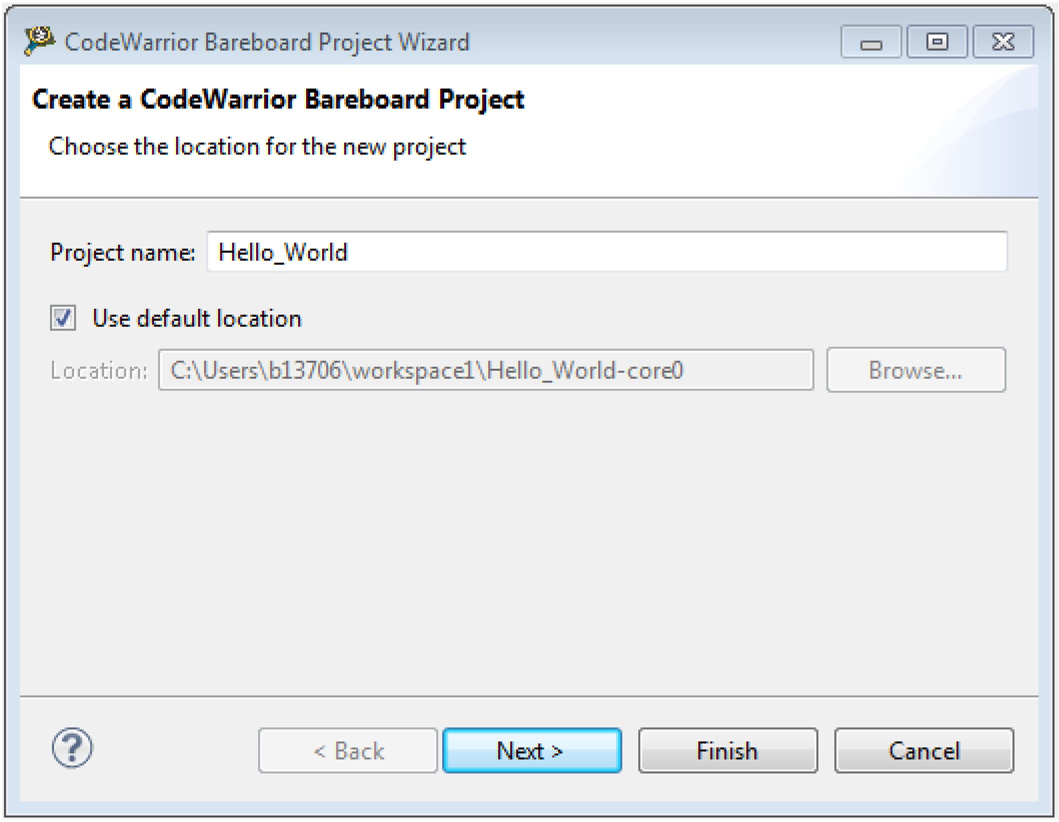
The pages of the **CodeWarrior Bareboard Project Wizard** are:

- Create CodeWarrior Bareboard Project page on page 16
- Processor page on page 17
- Debug Target Settings page on page 18
- Build Settings page on page 20
- Configurations page on page 22

2.1.1 Create CodeWarrior Bareboard Project page

Use this page to specify the project name and the directory where the project files are located.

Figure 1: Create CodeWarrior Bareboard Project page



Create a CodeWarrior Bareboard Project

Choose the location for the new project

Project name: Hello_World

☑ Use default location

Location: C:\Users\b13706\workspace1\Hello_World-core0 Browse...

The table below describes the various options available on the **Create a CodeWarrior Bareboard Project** page.

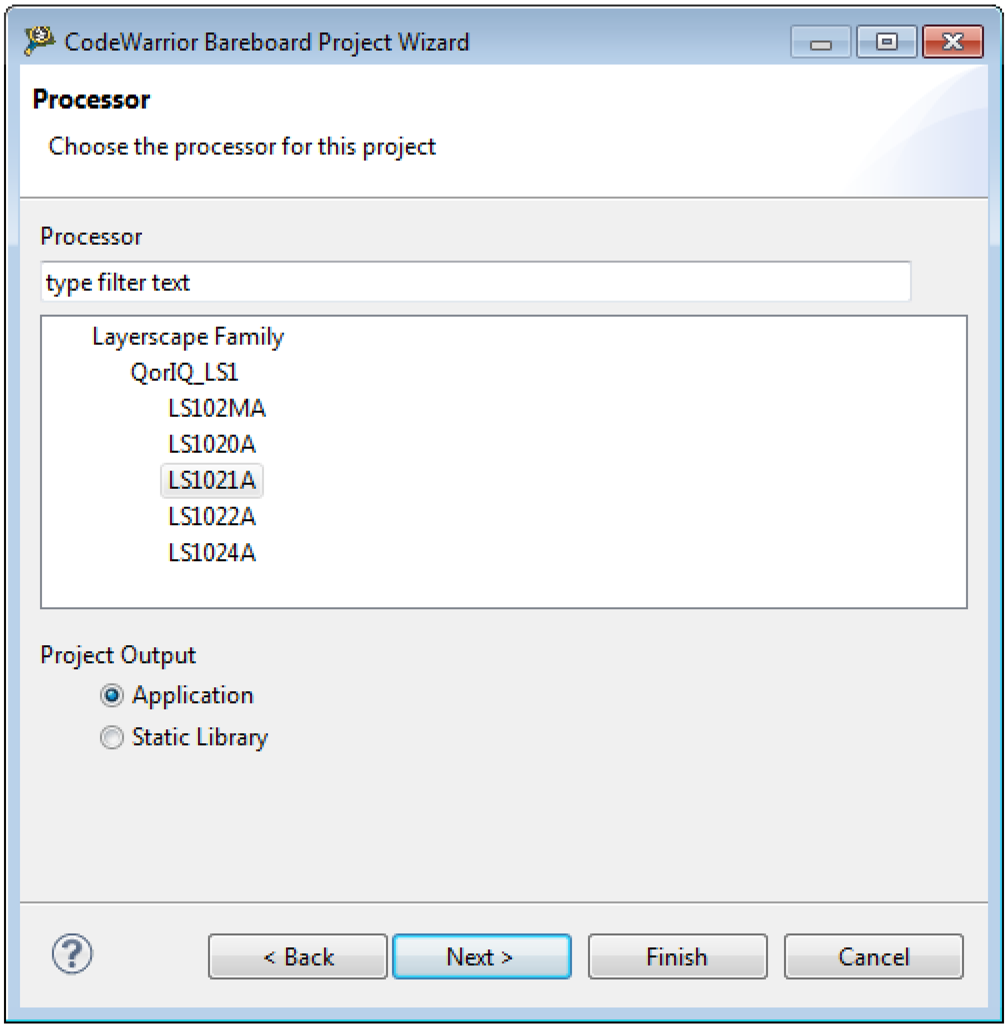
Table 2: Create CodeWarrior Bareboard Project page settings

Option	Description
Project name	Enter the name for the project in this text box.
Use default location	Select to choose the directory to store the files required to build the program. Use the **Location** option to select the desired directory.
Location	Specifies the directory that contains the project files. Use **Browse** to navigate to the desired directory. This option is only available when **Use default location** is cleared.

2.1.2 Processor page

This page displays the target devices supported by the current installation. Use this page to specify the type of processor and the output for the new project.

Figure 2: Processor page



The table below describes the various options available on the **Processor** page.

Table 3: Processor page settings

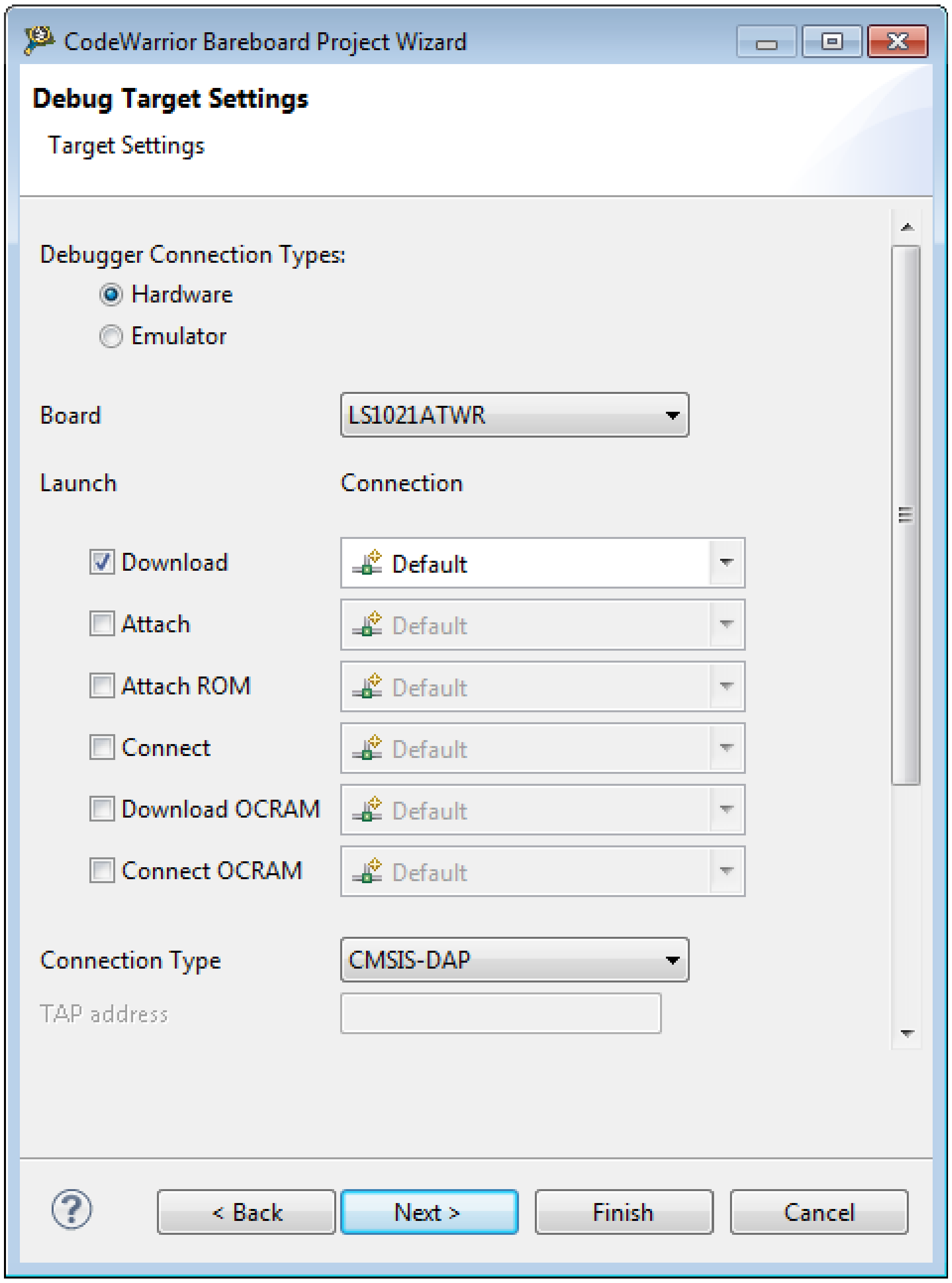
Option	Description
Processor	Expand the processor family tree and select a supported target. The toolchain uses this choice to generate code that makes use of processor-specific features, such as multiple cores.
Project Output	Select any one of the following supported project output: • **Application**: Select to create an application with "`.elf`" extension, that includes information related to the debug over a board. • **Static Library**: Select to create a library with "`.a`" extension, that can be included in other projects. Library files created using this option do not include board specific details.

2.1.3 Debug Target Settings page

Use this page to select debugger connection type, board type, launch configuration type, and connection type for your project.

This page also lets you configure connection settings for your project.

Figure 3: Debug Target Settings page



Debugger Connection Types:
[✓ Hardware] Emulator

Board: LS1021ATWR

Launch	Connection
[✓] Download	Default
[ ] Attach	Default
[ ] Attach ROM	Default
[ ] Connect	Default
[ ] Download OCRAM	Default
[ ] Connect OCRAM	Default

Connection Type: CMSIS-DAP

TAP address:

The table below describes the various options available on the **Debug Target Settings** page.

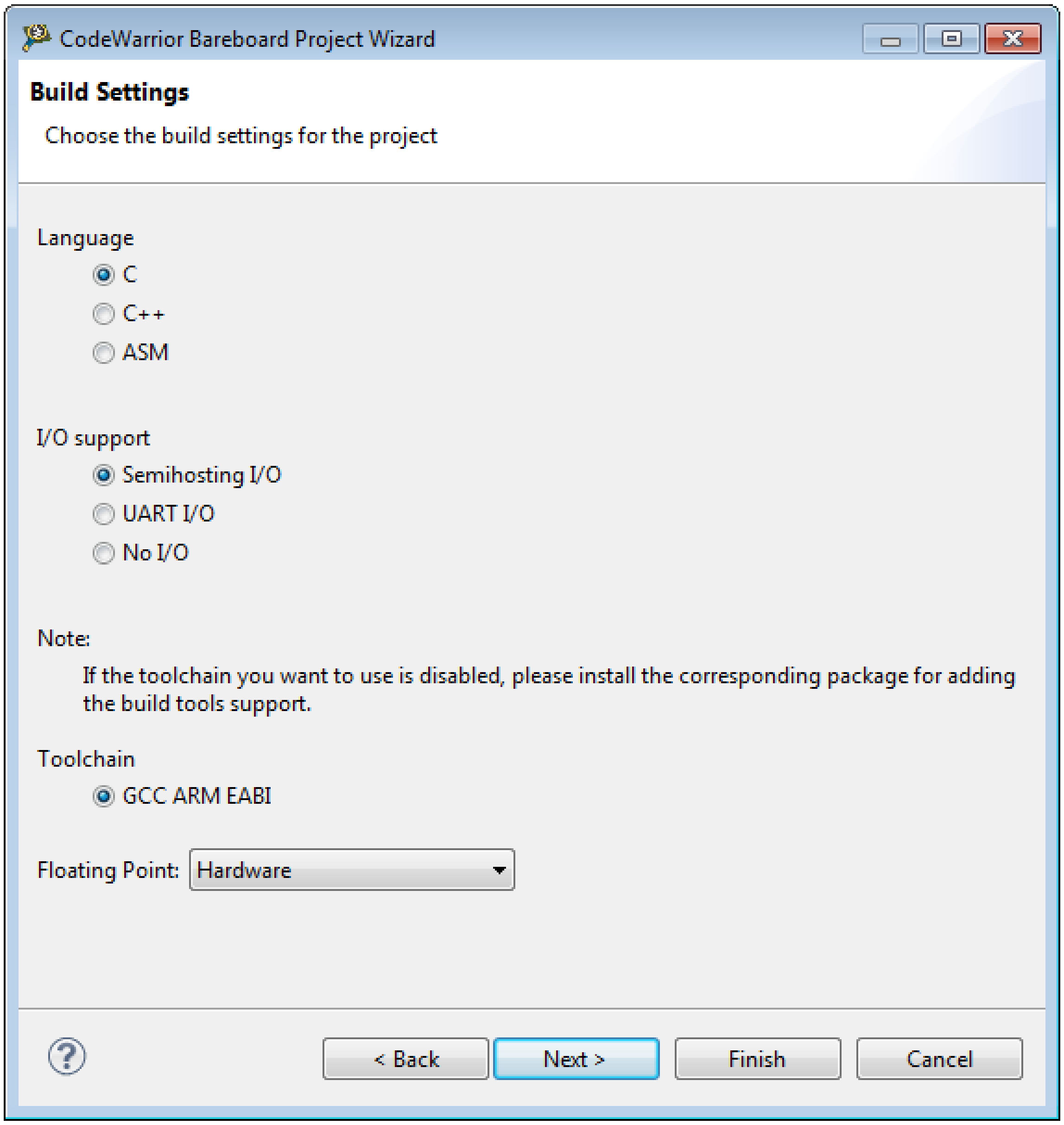
Table 4: Debug Target Settings page

Option	Description
Debugger Connection Types	Specifies the available target types: • **Hardware** - Select to execute the program on the target hardware available. • **Emulator** - Select to execute the program on a hardware emulator.
Board	Specifies the hardware supported by the selected processor. It could be either QDS or Tower board.
Launch	Specifies the launch configurations and corresponding connection, supported by the selected processor.
Connection Type	Specifies the interface to communicate with the hardware. • **CMSIS-DAP** - Select to use the CMSIS-DAP interface to communicate with the hardware device. This is the default connection type for Tower boards. • **CodeWarrior TAP (over USB)** - Select to use the USB interface to communicate with the hardware device. • **CodeWarrior TAP (over Ethernet)** - Select to use the Ethernet interface to communicate with the hardware device.
TAP address	Enter the IP address of the selected TAP device. Enter the IP address of the TAP device here. This option is available only if CodeWarrior TAP (over Ethernet) is selected as the connection type.

2.1.4 Build Settings page

Use this page to select a programming language, toolchain, and the output project typ for the new project for your project.

Figure 4: Build Settings page



Choose the build settings for the project

Language
[✓ C] C++ ASM

I/O support
[✓ Semihosting I/O] UART I/O No I/O

Note:
If the toolchain you want to use is disabled, please install the corresponding package for adding the build tools support.

Toolchain
[✓ GCC ARM EABI]

Floating Point: Hardware

The table below describes the various options available on the **Build Settings** page.

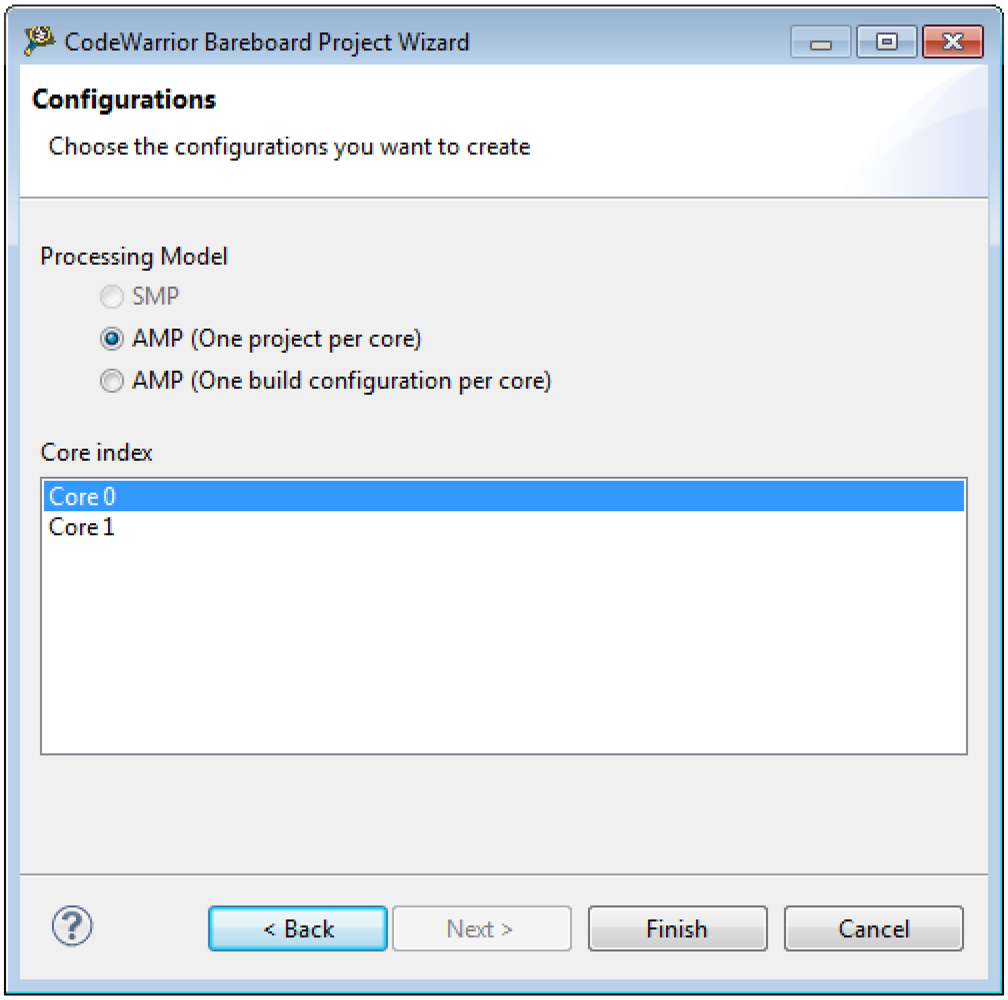
Table 5: Build Settings page

Option	Description
Language	Specifies the programming language used by the new project. The current installation supports the following languages: • C - Select to generate ANSI C-compliant startup code, and initializes global variables. • C++ - Select to generate ANSI C++ startup code, and performs global class object initialization. • ASM - Select to generate Assembly startup code.
I/O Support	• Semihosting I/O Support - Configures how the application deals with the I/O calls. For this case, it uses a virtual connection with the debugger (also known as `semi hosting'). • UART I/O - Configures how the application deals with the I/O calls. With `UART' it uses the physical serial device connection. • No I/O - No I/O support.
Toolchain	Specifies the toolchains supported by the current installation. Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.
Floating Point	Specifies how the compiler handles floating-point operations, encountered in the source code.

2.1.5 Configurations page

Use this page to specify the processing model and the processor core that executes the project.

Figure 5: Configurations page



CodeWarrior Bareboard Project Wizard

Configurations

Choose the configurations you want to create

Processing Model

- SMP
- [✓ AMP (One project per core)]
- AMP (One build configuration per core)

Core index

- [✓ Core 0]
- Core 1

The table below describes the various options available on the **Configurations** page.

Table 6: Configurations page setting

Option	Description
Processing Model	The current installation supports the following processing models: • **SMP** - This option is disabled for this installation. • **AMP (one project per core)** - Select this option to generate a separate project for each selected core. The option will also set the core index for each project based on the core selection. • **AMP (one build configuration per core)** - Select this option to generate one project with multiple targets, each containing an lcf file for the specified core. NOTE Selecting the **AMP (One build configuration per core)** option displays a checkbox, **Set up build references for build configurations of all cores**, just below this option. If you select the **Set up build references for build configurations of all cores** checkbox, then building the project for one core will automatically build the project for other cores as well. If you do not select this checkbox, then you would need to manually build the project for each core.
Core Index	Select the processor core that executes the project.

2.2 CodeWarrior Linux Project Wizard

The CodeWarrior Linux Project Wizard helps you create a Linux project by displaying various pages that allow you to specify settings for your project.

NOTE

The pages that the wizard presents can differ, based upon the choice of project type or execution target.

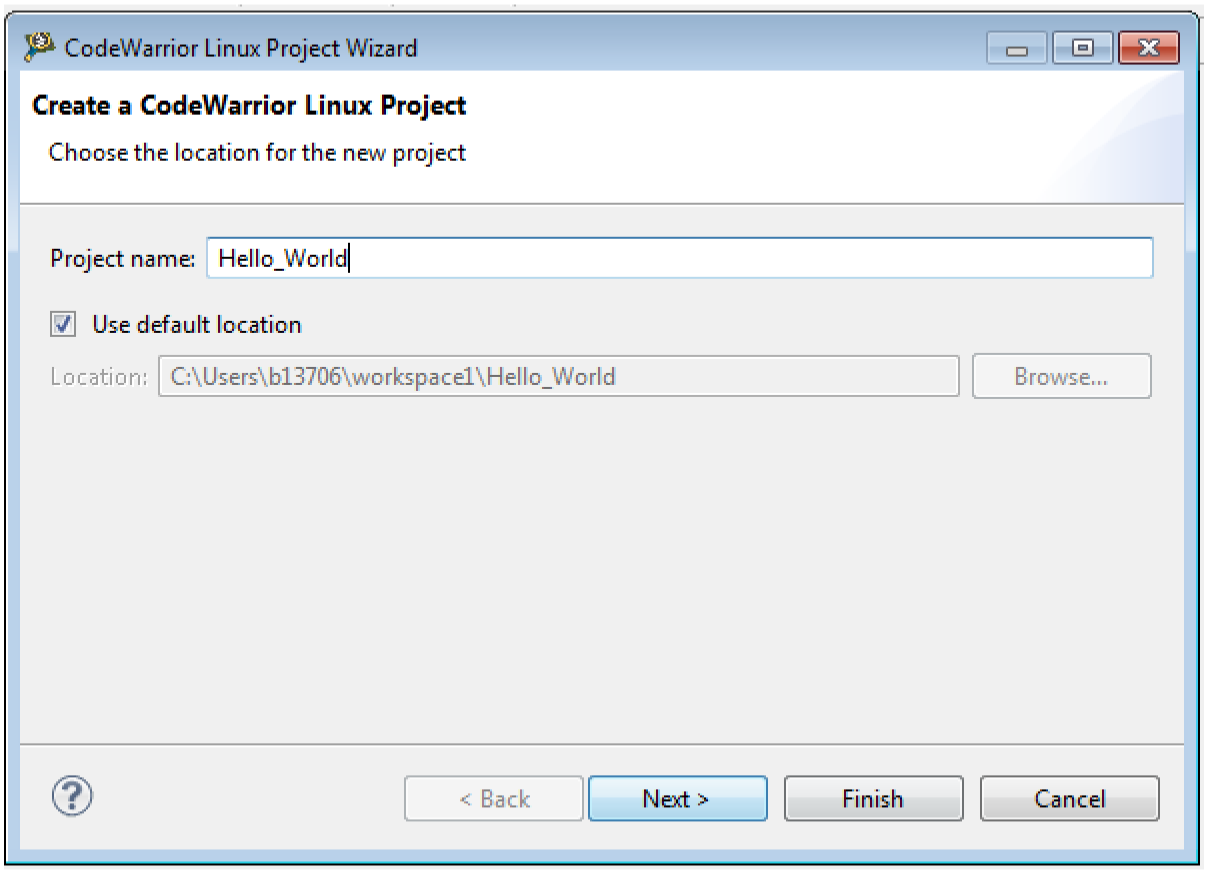
The pages of the CodeWarrior Linux Project Wizard are:

- Create CodeWarrior Linux Project page on page 24
- Processor page on page 25
- Build Settings page on page 26
- Linux Application page on page 27

2.2.1 Create CodeWarrior Linux Project page

Use this page to specify the project name and the directory where the project files are located.

Figure 6: Create CodeWarrior Linux Project page


CodeWarrior Linux Project Wizard

Create a CodeWarrior Linux Project

Choose the location for the new project

Project name: Hello_World

[✓] Use default location

Location: C:\Users\b13706\workspace1\Hello_World

The table below describes the various options available on the **Create CodeWarrior Linux Project** page.

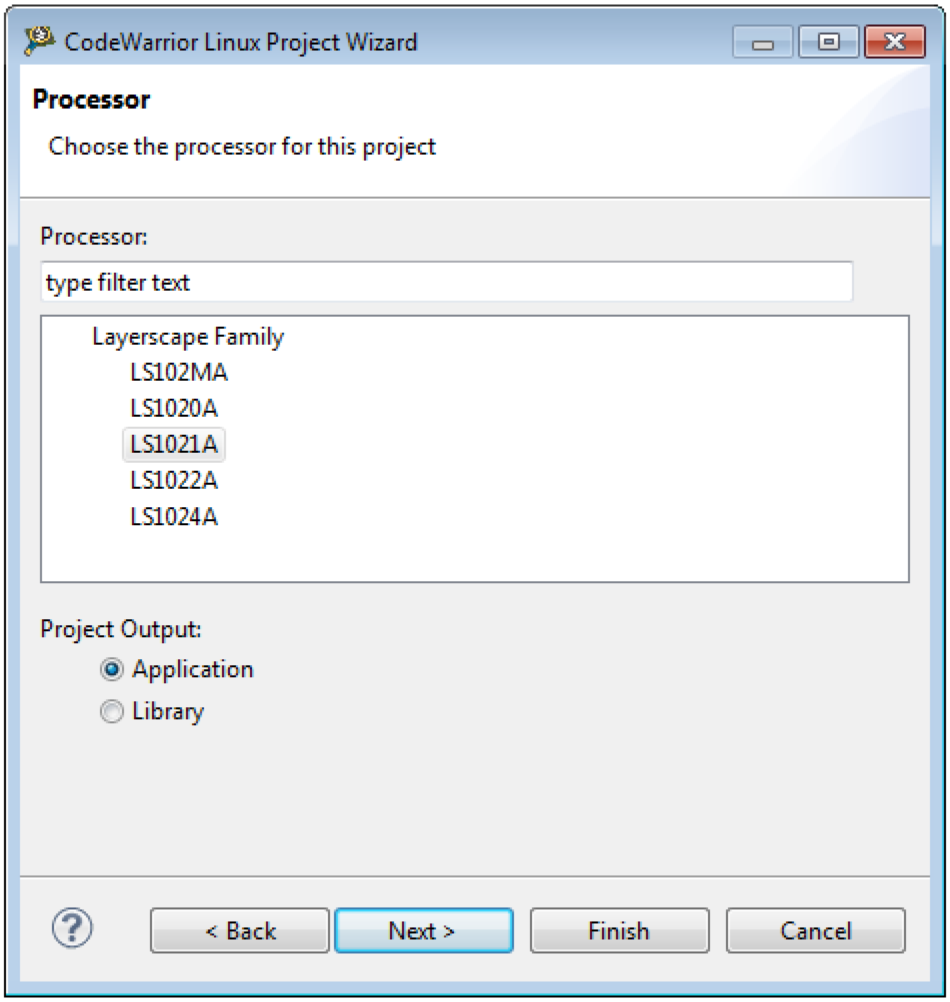
Table 7: Create CodeWarrior Linux Project page settings

Option	Description
Project name	Enter the name for the project in this text box.
Use default location	Select to choose the directory to store the files required to build the program. Use the **Location** option to select the desired directory.
Location	Specifies the directory that contains the project files. Use **Browse** to navigate to the desired directory. This option is only available when **Use default location** is cleared. Ensure that you append the name of the project to the path to create a new location for your project.

2.2.2 Processor page

This page displays the processors supported by the current installation. Use this page to specify the type of processor and the output for the new project.

Figure 7: Processor page



The table below describes the various options available on the **Processor** page.

Table 8: Processor page settings

Option	Description
Processor	Expand the processor family tree and select a supported target. The toolchain uses this choice to generate code that makes use of processor-specific features, such as multiple cores.
Project Output	Select any one of the following supported project output: • **Application** - Select to create an application with "`.elf`" extension, that includes information related to the debug over a board. • **Library** - Select to create a library with "`.a`" extension, that can be included in other projects. Library files created using this option do not include board specific details.

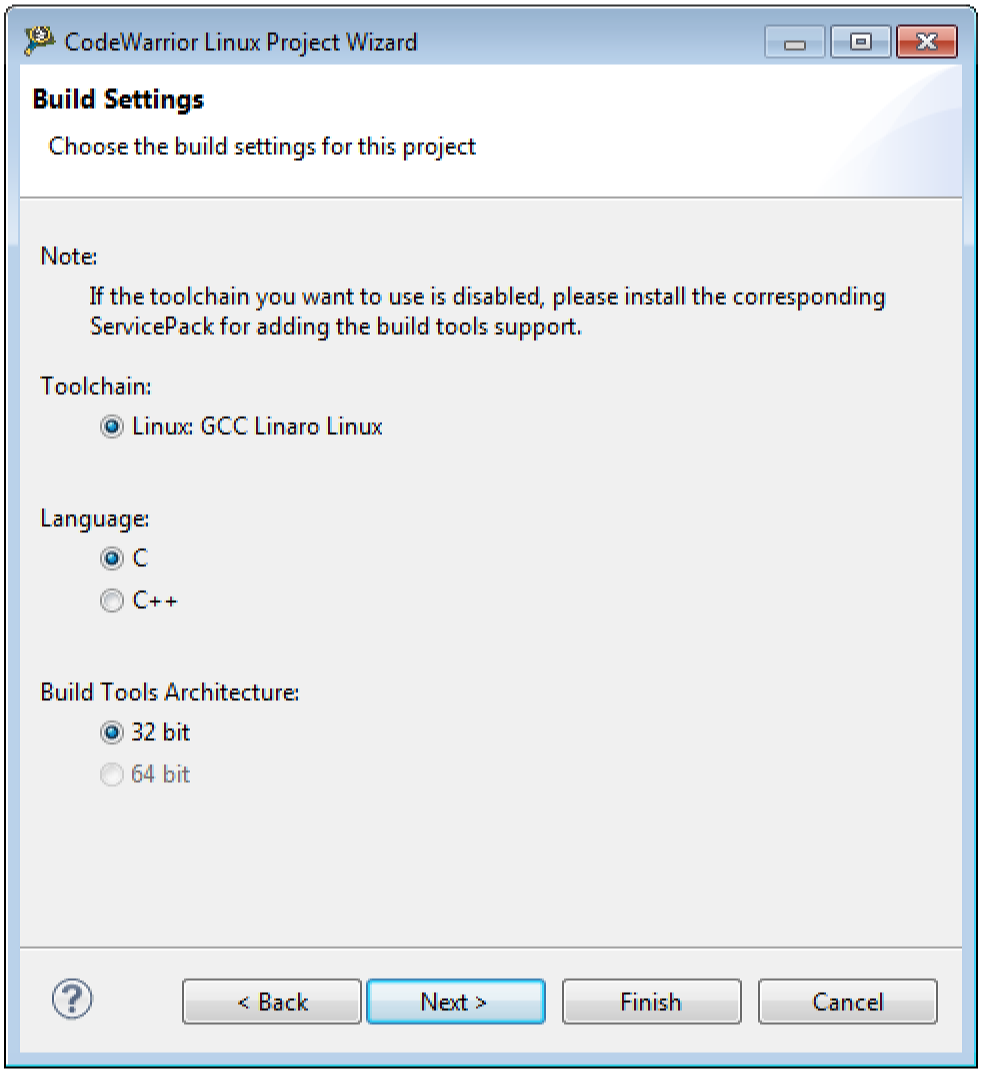
2.2.3 Build Settings page

This page displays the toolchains supported by the current installation. Use this page to specify the toolchain for the new project.

NOTE

The current release does not include toolchains for Linux applications by default. To add the required build tools support, you should install the corresponding service pack for the required target.

Figure 8: Build Settings page



Build Settings

Choose the build settings for this project

Note:

If the toolchain you want to use is disabled, please install the corresponding ServicePack for adding the build tools support.

Toolchain:

[✓ Linux: GCC Linaro Linux]

Language:

[✓ C] C++

Build Tools Architecture:

[✓ 32 bit] 64 bit

The table below describes the various options available on the **Build Settings** page.

Table 9: Build Settings page setting

Option	Description
Toolchain	Specifies the toolchains supported by the current installation. Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.
Language	Specifies the programming language used by the new project. The current installation supports the following languages: • **C** - Select to generate ANSI C-compliant startup code, and initializes global variables. • **C++** - Select to generate ANSI C++ startup code, and performs global class object initialization.
Build Tools Architecture	Specifies the processor used by the new project. The current installation supports the following architectures: • **32 bit** - 32-bit option is available by default for LS1021A processors. • **64 bit** - this option is disabled for this release.

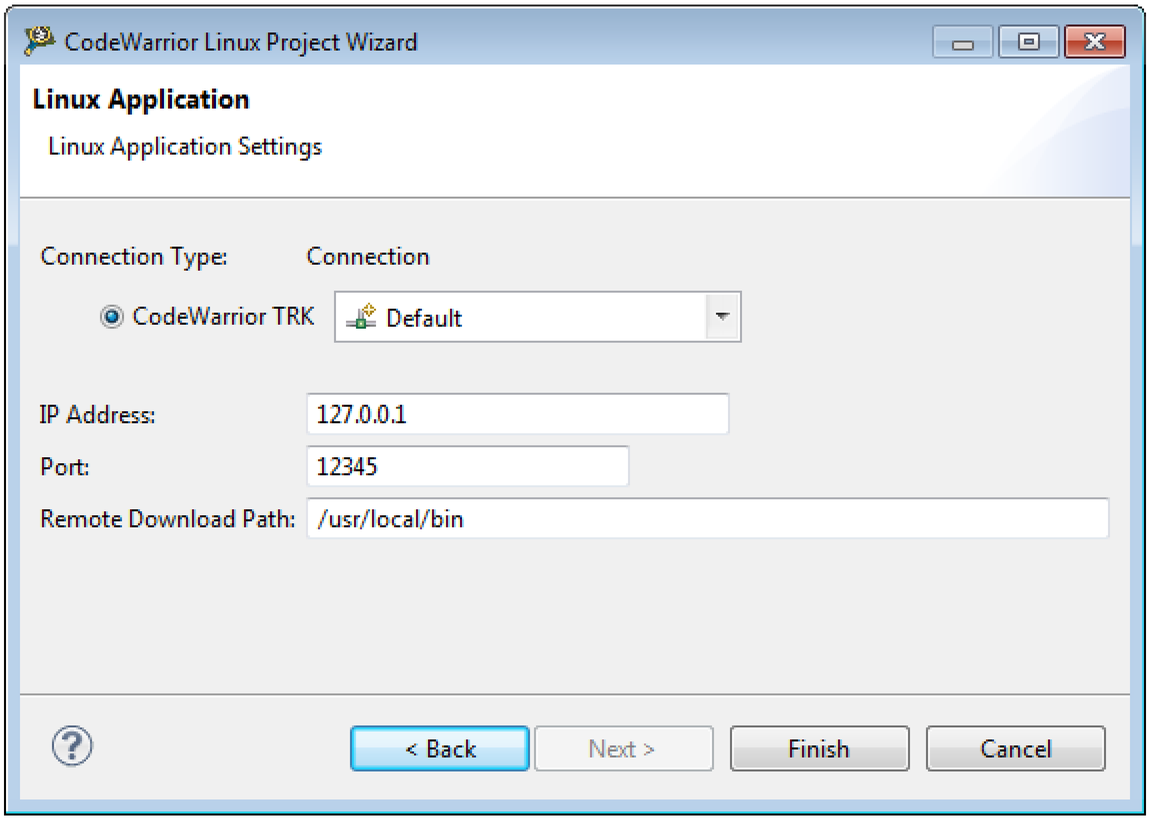
2.2.4 Linux Application page

Use this page to specify how the debugger communicates with the host Linux system and controls your Linux application.

NOTE

The **Linux Application** page appears, in the **CodeWarrior Linux Project** Wizard, only when you add the Linux build tools support, by installing the corresponding service pack for the required target.

Figure 9: Linux Application page



Connection Type: Connection

(●) CodeWarrior TRK Default

IP Address: 127.0.0.1

Port: 12345

Remote Download Path: /usr/local/bin

NOTE

When debugging a Linux application, you must use the **CodeWarrior TRK** to manage the communications interface between the debugger and Linux system.

The table below describes the various options available on the **Linux Application** page.

Table 10: Linux Application page setting

Option	Description
CodeWarrior TRK	Select to use the CodeWarrior Target Resident Kernel (TRK) protocol, to download and control application on the Linux host system.
IP Address	Specifies the IP address of the Linux host system, the project executes on.
Port	Specifies the port number that the debugger will use to communicate to the Linux host.
Remote Download Path	Specifies the host directory into which the debugger downloads the application.

2.3 Creating projects

You can use a project creation wizard provided by CodeWarrior Development Studio to create a CodeWarrior project according to your requirements.

This section explains you how to use the **CodeWarrior Bareboard Project Wizard** to quickly create new projects with default settings (build and launch configurations). After the project has been created, you can easily change any default setting to suit your needs.

This section explains:

- Creating CodeWarrior Bareboard Application project on page 29
- Creating CodeWarrior Bareboard Library project on page 31
- Creating CodeWarrior Linux Application project on page 32

2.3.1 Creating CodeWarrior Bareboard Application project

You can create a CodeWarrior bareboard application project using the CodeWarrior Bareboard Project Wizard.

To create a CodeWarrior bareboard application project, perform these steps:

NOTE
For details about the options in the **CodeWarrior Bareboard Project** wizard pages, see the topic CodeWarrior Bareboard Project Wizard on page 15.

1. Select **Start** > **All Programs** > **Freescale CodeWarrior** > **CW for ARMv7 v*number*** > **CodeWarrior**, where *number* is the version number of your product.

   The **Workspace Launcher** dialog appears, prompting you to select a workspace to use.

   NOTE
   Click **Browse** to change the default location for workspace folder. You can also select the Use this as the default and do not ask again checkbox to set default or selected path as the default location for storing all your projects.

2. Click **OK**.

   The default workspace is accepted. The CodeWarrior IDE launches and the **Welcome** page appears.

   NOTE
   The **Welcome** page appears only if the CodeWarrior IDE or the selected workspace is started for the first time. Otherwise, the Workbench window appears.

3. Click **Go to Workbench** from the **Welcome** page.

   The workbench window appears.

4. Select **File** > **New** > **CodeWarrior Bareboard Project Wizard**, from the CodeWarrior IDE menu bar.

   The **CodeWarrior Bareboard Project Wizard** launches and the **Create a CodeWarrior Bareboard Project** page appears.

5. Specify a name for the new project in the **Project name** text box.

   For example, enter the project name as `Hello_World`.

6. If you do not want to create your project in the default workspace:

a. Clear the **Use default location** checkbox.

b. Click **Browse** and select the desired location from the **Browse For Folder** dialog.

c. In the **Location** text box, append the location with the name of the directory in which you want to create your project. In the **Location** text box, append the location with the name of the directory in which you want to create your project.

> NOTE
>
> An existing directory cannot be specified for the project location. If created, the CodeWarrior will prompt an error message.

7. Click **Next**.

   The **Processor** page appears.

8. Select the target processor for the new project, from the **Processor** list.
9. Select **Application** from the **Project Output** group, to create an application with `.elf` extension, that includes information required to debug the project.
10. Click **Next**.

    The **Debug Target Settings** page appears.

11. Select a supported connection type (hardware or emulator), from the **Debugger Connection Types** group. Your selection determines the launch configurations that you can include in your project.
12. Select the board you are targeting, from the **Board** drop-down list. You can select a QDS or Tower, or an IOT or RDB board, depending on the processor selected on the **Processor** page.
13. Select the launch configurations that you want to include in your project and the corresponding connection, from the **Launch** group.
14. Select the interface to communicate with the hardware, from the **Connection Type** drop-down list.
15. Enter the IP address of the TAP device in the **TAP address** text box. This option is disabled and cannot be edited, if you select **CodeWarrior TAP (over USB)** from the **Connection Type** drop-down list. This option is available only if **CodeWarrior TAP (over Ethernet)** is selected as the connection type. **CMSIS-DAP** is the default connection type for Tower boards.
16. Click **Next**.

    The **Build Settings** page appears.

17. Select the programming language, you want to use, from the **Language** group.

    The language you select determines the libraries that are linked with your program and the contents of the main source file that the wizard generates.

18. Select the architecture type used by the new project, from the **Build Tools Architecture** group.
19. Select a toolchain from the **Toolchain** group.

    Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.

    > NOTE
    >
    > The current release does not include toolchains for Linux applications by default. To add the required Linux build tools support, you should install the corresponding service pack for the required target.

20. Select an option from the **Floating Point** drop-down list, to prompt the compiler to handle the floating-point operations by generating instructions for the selected floating-point unit.

21.Click **Next**.

The **Configurations** page appears.

22.Select a processing model option from the **Processing Model** group.

- Select **SMP** (**One build configuration for all the cores**) to generate a single project for the selected cores. This option is disabled for this release.
- Select **AMP (One project per core)** to generate a separate project for each selected core. The option will also set the core index for each project based on the core selection.
- Select **AMP (One build configuration per core)** to generate one project with multiple targets, each containing an `.lcf` file for the specified core.

23.Select the processor core that executes the project, from the **Core index** list.

24.Click **Next**.

25.Click **Finish**.

The wizard creates an application project according to your specifications. You can access the project from the **CodeWarrior Projects** view on the Workbench.

The new project is ready for use. You can now customize the project by adding your own source code files, changing debugger settings and adding libraries.

2.3.2 Creating CodeWarrior Bareboard Library project

You can create a CodeWarrior bareboard library project using the CodeWarrior Bareboard Project Wizard.

To create a CodeWarrior bareboard library project, perform these steps:

1. Select **Start > All Programs > Freescale CodeWarrior > CW for ARMv7 v*number* > CodeWarrior**, where *number* is the version number of your product.

   The **Workspace Launcher** dialog appears, prompting you to select a workspace to use.

   NOTE
   Click **Browse** to change the default location for workspace folder. You can also select the **Use this as the default and do not ask again** checkbox to set default or selected path as the default location for storing all your projects.

2. Click **OK**.

   The default workspace is accepted. The CodeWarrior IDE launches and the **Welcome** page appears.

   NOTE
   The **Welcome** page appears only if the CodeWarrior IDE or the selected workspace is started for the first time. Otherwise, the Workbench window appears.

3. Click **Go to Workbench**, on the **Welcome** page.

   The workbench window appears.

4. Select **File > New > CodeWarrior Bareboard Project Wizard**, from the CodeWarrior IDE menu bar.

   The **CodeWarrior Bareboard Project Wizard** launches and the **Create a CodeWarrior Bareboard Project** page appears.

5. Specify a name for the new project in the **Project name** text box.

   For example, enter the project name as `library_project`.

6. If you do not want to create your project in the default workspace:

a. Clear the **Use default location** checkbox.

b. Click **Browse** and select the desired location from the **Browse For Folder** dialog.

c. In the **Location** text box, append the location with the name of the directory in which you want to create your project.

NOTE
An existing directory cannot be specified for the project location.

7. Click **Next**.

   The **Processor** page appears.

8. Select the target processor for the new project, from the **Processor** list.

9. Select **Static Library** from the **Project Output** group, to create a library with `.a` extension, that can be included in other projects. Library files created using this option do not include board specific details.

10. Click **Next**.

    The **Build Settings** page appears.

11. Select the programming language, you want to use, from the **Language** group.

    The language you select determines the libraries that are linked with your program and the contents of the main source file that the wizard generates.

12. Select a toolchain from the **Toolchain** group.

    Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.

    NOTE
    The current release does not include toolchains for Linux applications by default. To add the required build tools support, you should install the corresponding service pack for the required target.

13. Select an option from the **Floating Point** drop-down list, to prompt the compiler to handle the floating-point operations by generating instructions for the selected floating-point unit.

14. Click **Finish**.

    The wizard creates a library project according to your specifications. You can access the project from the **CodeWarrior Projects** view on the Workbench.

The new library project is ready for use. You can now customize the project to match your requirements.

2.3.3 Creating CodeWarrior Linux Application project

You can create a CodeWarrior Linux application project using the CodeWarrior Linux Project Wizard.

To create a CodeWarrior Linux application project, perform these steps:

1. Select **Start > All Programs > Freescale CodeWarrior > CW for ARMv7 v*number* > CodeWarrior** , where *number* is the version number of your product.

   The **Workspace Launcher** dialog appears, prompting you to select a workspace to use.

   NOTE
   Click **Browse** to change the default location for workspace folder. You can also select the **Use this as the default** and do not ask again checkbox to set default or selected path as the default location for storing all your projects.

2. Click **OK**.

   The default workspace is accepted. The CodeWarrior IDE launches and the **Welcome** page appears.

   NOTE

   The **Welcome** page appears only if the CodeWarrior IDE or the selected workspace is started for the first time. Otherwise, the Workbench window appears.

3. Click **Go to Workbench,** on the **Welcome** page.

   The workbench window appears.

4. Select **File > New > CodeWarrior Linux Project Wizard**, from the CodeWarrior IDE menu bar.

   The **CodeWarrior Linux Project Wizard** launches and the **Create a CodeWarrior Linux Project** page appears.

5. Specify a name for the new project in the **Project name** text box.

   For example, enter the project name as `linux_project`.

6. If you do not want to create your project in the default workspace:

   a. Clear the **Use default location** checkbox.

   b. Click **Browse** and select the desired location from the **Browse For Folder** dialog.

   c. In the **Location** text box, append the location with the name of the directory in which you want to create your project.

   NOTE

   An existing directory cannot be specified for the project location.

7. Click **Next**.

   The **Processor** page appears.

8. Select the target processor for the new project, from the **Processor** list.

9. Select **Application** from the **Project Output** group, to create an application with `.elf` extension, that includes information required to debug the project.

10. Click **Next**.

    The **Build Settings** page appears.

11. Select a toolchain for Linux applications from the **Toolchain** group.

    Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.

    NOTE

    To add the required Linux build tools support, you should install the corresponding service pack for the required target.

12. Select the programming language, you want to use, from the **Language** group.

    The language you select determines the libraries that are linked with your program and the contents of the main source file that the wizard generates.

13. Select the architecture type used by the new project, from the **Build Tools Architecture** group.

14. Click **Next**.

    The **Linux Application** page appears.

15.Select **CodeWarrior TRK** to use the CodeWarrior Target Resident Kernel (TRK) protocol, to download and control application on the Linux host system.

NOTE

When debugging a Linux application, you must use the CodeWarrior TRK to manage the communications interface between the debugger and Linux system. For details, see Install CodeWarrior TRK on target system on page 125 topic.

16.Specify a **Remote System Configuration** option.

17.In the **IP Address** text box, enter the IP address of the Linux host system, the project executes on.

18.In the **Port** text box, enter the port number that the debugger will use to communicate to the Linux host system.

19.In the **Remote Download Path** text box, enter the absolute path for the host directory, into which the debugger downloads the application.

20.Click **Finish**.

The wizard creates a CodeWarrior Linux application project according to your specifications. You can access the project from the **CodeWarrior Projects** view on the Workbench.

The new CodeWarrior Linux application project is ready for use. You can now customize the project to match your requirements.

2.4 Building projects

CodeWarrior IDE supports two modes of building projects.

These modes are:

- Manual-Build mode on page 34
- Auto-Build mode on page 35

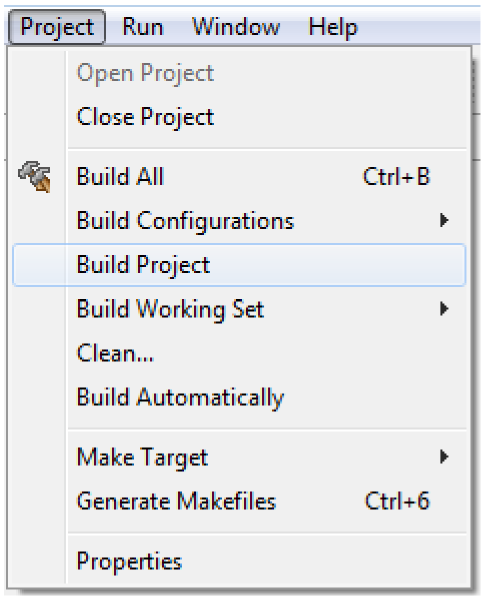
2.4.1 Manual-Build mode

This section explains the manual mode of building projects.

In large workspaces, building the entire workspace can take a long time if users make changes with a significant impact on dependent projects. Often there are only a few projects that really matter to a user at a given time.

To build only the selected projects, and any prerequisite projects that need to be built in order to correctly build the selected projects, select **Project > Build Project** from the CodeWarrior IDE menu bar.

Figure 10: Project Menu- Build Project



Alternatively, right-click the selected project in the **CodeWarrior Projects** view and select **Build Project** from the context menu.

To build all projects available in the **CodeWarrior Projects** view, select **Project > Build All**.

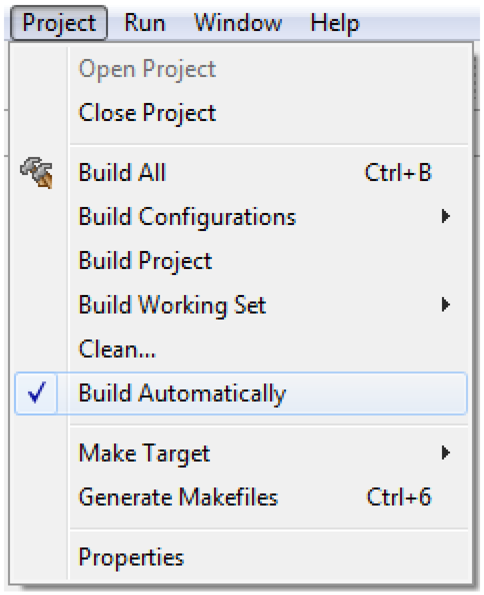
2.4.2 Auto-Build mode

This section explains the automatic mode of building projects.

CodeWarrior IDE takes care of compiling source files automatically. When auto-build is enabled, project build occurs automatically in the background every time you change files in the workspace (for example, saving an editor).

To automatically build all the projects in a workspace, select **Project > Build Automatically** from the CodeWarrior IDE menu bar.

Figure 11: Project Menu-Build Automatically



If auto-build is taking too long and is interfering with ongoing development, it can be turned off. Select **Project > Build Automatically** from the CodeWarrior IDE menu bar to disable auto-build mode.

NOTE

It is advised that you do not use the **Build Automatically** option for C/C++ development. Using this option will result in building the entire project whenever you save a change to the makefile or source files. This can take a significant amount of time for very large projects.

Chapter 3 Build Properties

This chapter explains build properties for projects. A project can contain multiple build and launch configurations.

A *build configuration* is a named collection of build tools options. The set of options in a given build configuration causes the build tools to generate a final binary with specific characteristics. For example, the binary produced by a **Debug** build configuration might contain symbolic debugging information and have no optimizations, while the binary product by a **Release** build configuration might contain no symbolics and be highly optimized.

This chapter explains:

- Changing build properties on page 37
- Restoring build properties on page 38
- Defining C/C++ build settings and behavior on page 38
- Properties for <project> on page 42

3.1 Changing build properties

You can modify the build properties of a project to better suit your needs.

Follow these steps to change build properties:

1. Start the CodeWarrior IDE.
2. In the **CodeWarrior Projects** view, select the project for which you want to modify the build properties.
3. Select **Project > Properties**.

   The **Properties for** *<project>* dialog appears. The left side of this window has a Properties list. This list shows the build properties that apply to the current project.
4. Expand the **C/C++ Build** property node.
5. Select **Settings**.
6. Use the **Configuration** drop-down list to specify the launch configuration for which you want to modify the build properties.
7. Click the **Tool Settings** tab. The corresponding page appears.
8. From the list of tools on the **Tool Settings** page, select the tool for which you want to modify properties.
9. Change the settings as per the requirements.
10. Click **Apply**.

    The CodeWarrior IDE saves your new settings.

You can select other tool pages and modify their settings. When you finish, click **OK** to save your changes and close the **Properties for** ***<project>*** dialog.

3.2 Restoring build properties

You can modify a build configuration of a project and might choose to restore the build properties to have a factory-default configuration, or to revert to a last-known working build configuration.

To undo your modifications to build properties, click the **Restore Defaults** button at the bottom of the **Properties for** *<project>* dialog.

This changes the values of the options to the absolute default of the toolchain.

3.3 Defining C/C++ build settings and behavior

The **C/C++ Build** page includes all builder-specific property pages.

This section contains the following subsections:

- Define build settings
- Define build behavior

NOTE

Modifying settings such as the **Generate makefiles automatically** option, might enable or disable some parameters in some situations and change the availability of other property pages.

3.3.1 Define build settings

The **Build Settings** page of the **C/C++ Build** page allows you to define build settings for your project.

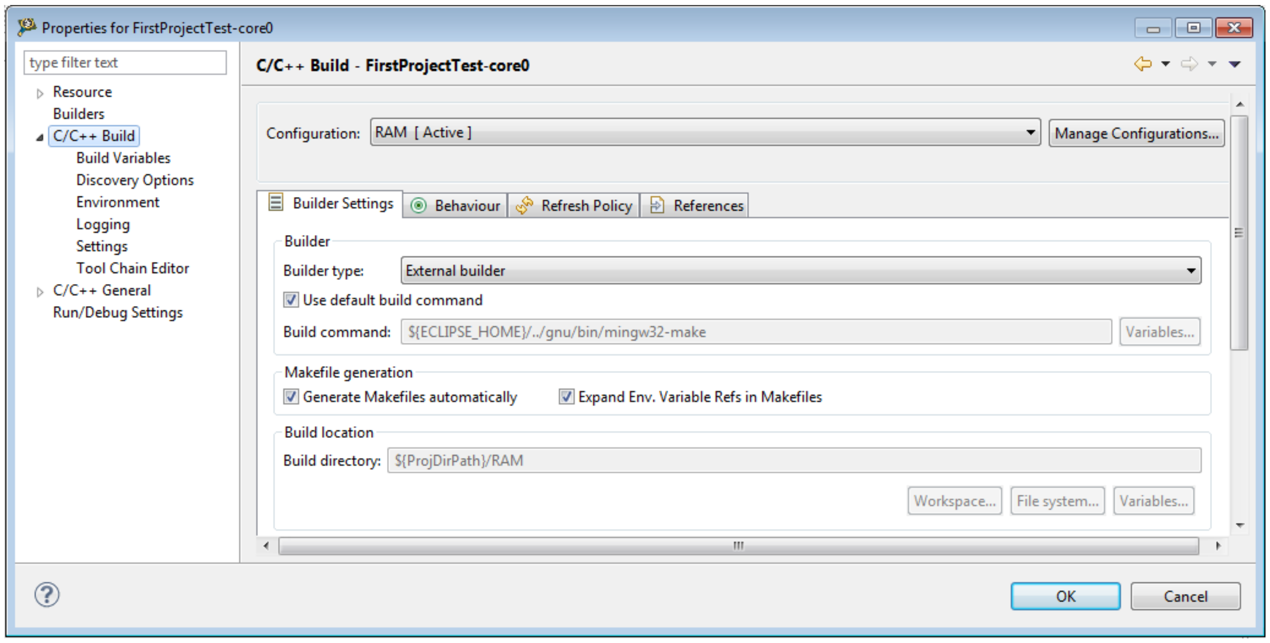
To define build settings, perform these steps:

1. Start CodeWarrior IDE.
2. In the **CodeWarrior Projects** view, select the project for which you want to modify the build settings.
3. Select **Project** > **Properties**.

   The **Properties for <project>** window appears. The left side of this window has a properties list. This list shows the build properties that apply to the current project.
4. Select **C/C++ Build**.

   The **C/C++ Build** page appears.

Figure 12: C/C++ build page - builder settings


Properties for FirstProjectTest-core0

C/C++ Build - FirstProjectTest-core0

Configuration: RAM [Active]

Builder type: External builder

[✓] Use default build command

Build command: ${ECLIPSE_HOME}/../gnu/bin/mingw32-make

Makefile generation

[✓] Generate Makefiles automatically

[✓] Expand Env. Variable Refs in Makefiles

Build location

Build directory: ${ProjDirPath}/RAM

5. In the **Builder Settings** tab, the builder settings for the selected build configuration appears.

   The table below describes the builder settings options.

Table 11: Builder settings options

Group	Option	Description
Build Configuration	Configuration	Specifies the type of configurations for the selected project.
Build Configuration	Manage configurations	Click to open the **Manage Configurations** dialog that lets you set configurations based on the specified toolchains of the selected project. You can also create new configurations, rename an existing configuration, or remove the ones that are no longer required.
Builder	Builder type	Specifies the type of builder to use: • Internal builder - Builds C/C++ programs using a compiler that implements the C/C++ Language Specifications. • External builder - External tools let you configure and run programs and Ant buildfiles using the Workbench, which can be saved and run at a later time to perform a build.
Builder	Use default build command	Select to indicate that you want to use the default make command. Clear when you want to use a new make command. This option is only available when the Builder type option is set to External.

Table continues on the next page...

Table 11: Builder settings options (continued)

Group	Option	Description
Builder	Build command	Specifies the default command used to start the build utility for your specific toolchain. Use this field if you want to use a build utility other than the default make command.
Builder	Variables	Click to open the **Select build variable** dialog and add the desired environment variables and custom variables to the build command.
Makefile generation	Generate Makefiles automatically	Select to enable Eclipse change between two different CDT modes: it either uses the customer's makefile for the build, if one exists, or it generates makefiles for the user.
Makefile generation	Expand Env. Variable Refs in Makefiles	Select to define whether environment variables should be expanded in makefile.
Build location	Build directory	Specifies the location where the build operation takes place. This location will contain the generated artifacts from the build process. This option appears disabled when the Generate Makefiles automatically option is enabled.
Build location	Workspace	Click to open the **Folder Selection**dialog and select a workspace location for the project. This is the directory that will contain the plug-ins and features to build, including any generated artifacts.
Build location	File system	Click to open the **Browse For Folder** dialog and select a folder.
Build location	Variables	Click to open the **Select build variable** dialog and select a variable to specify as an argument for the build directory, or create and configure simple build variables which you can reference in build configurations that support variables.

6. Make the desired changes and click **OK**.

   The **Properties for <project>** window will close.

3.3.2 Define build behavior

The **Behaviour** page of the **C/C++ Build** page allows you to define build behavior for your project.

To define build behavior, perform these steps:

1. Start CodeWarrior IDE.
2. In the **CodeWarrior Projects** view, select the project for which you want to modify the build settings.
3. Select **Project > Properties**.

   The **Properties** window appears. The left side of this window has a properties list. This list shows the build properties that apply to the current project.
4. Select **C/C++ Build**.

   The **C/C++ Build** page appears.
5. Click the **Behaviour** tab.

   The behavior settings for the selected build configuration appears.

   The table below describes the behavior settings options.

Table 12: Behavior options

Group	Option	Description
Build settings	Enable project specific settings	Select if you want to enable project specific settings.
Build settings	Stop on first build error	Select to stop building when Eclipse encounters an error. Clearing this option is helpful for building large projects as it enables make to continue making other independent rules even when one rule fails.
Configure Workspace Settings	Enable parallel build	Select to activate the generation of parallel builds. However, you need to determine the number of parallel jobs to perform: • Use optimal jobs number - Lets the system determine the optimal number of parallel jobs to perform. • Use parallel jobs - Lets you specify the maximum number of parallel jobs to perform. • Use unlimited jobs - Lets the system perform unlimited jobs.
Workbench Build Behavior	Workbench build type	Specifies the builder settings when instructed to build, rebuild, and clean.
Workbench Build Behavior	Build on resource save (Auto build)	Select to build your project whenever resources are saved. By default, this option is selected and builds occur automatically each time resources are modified. Clear if you do want that the build occurs only manually using a menu item.
Workbench Build Behavior	Build (Incremental Build)	Defines what the standard builder will call when an incremental build is performed.
Workbench Build Behavior	Variables	Click to open the **Select build variable** dialog and add variables to the make build target command.
Workbench Build Behavior	Clean	Defines what the standard builder calls when a clean is performed. The make clean is defined in the makefile.
Workbench Build Behavior	Variables	Click to open the **Select build variable** dialog and add variables to the make build target command.

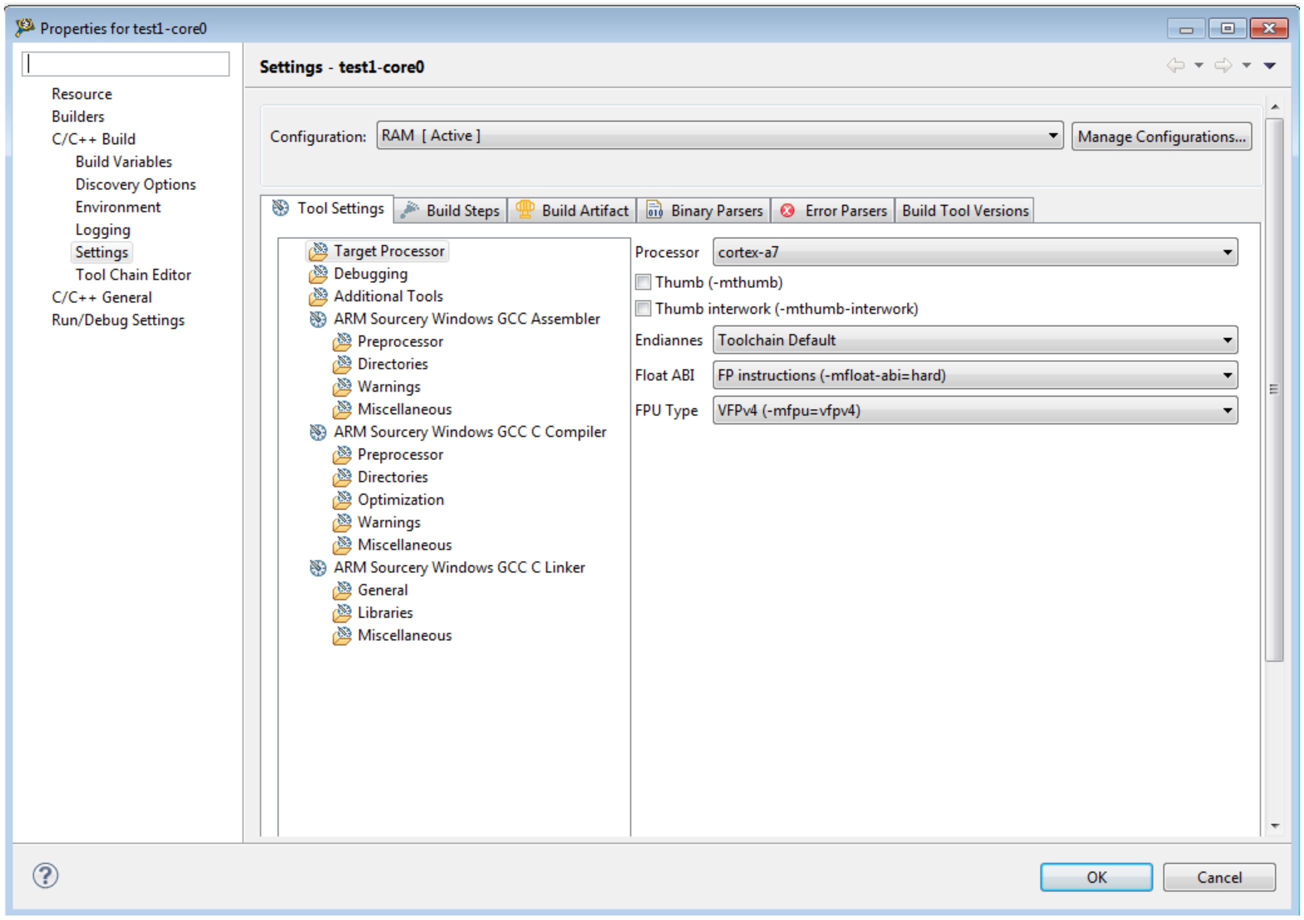
6. Make the desired changes and click **OK**.

   The **Properties for <project>** window will close.

3.4 Properties for <project>

The **Properties for** *<project>* window shows the corresponding build properties for a bareboard project.

Figure 13: Build properties



Configuration: RAM [Active]

Processor: cortex-a7
Thumb (-mthumb): ☐
Thumb interwork (-mthumb-interwork): ☐
Endiannes: Toolchain Default
Float ABI: FP instructions (-mfloat-abi=hard)
FPU Type: VFPv4 (-mfpu=vfpv4)

The following table lists the build properties specific to developing software for.

The properties that you specify in the **Tool Settings** panels apply to the selected build tool on the **Tool Settings** page of the **Properties for** *<project>* dialog.

Table 13: Build properties for bareboard project

Tool Settings	Sub Tool Settings
Target Processor on page 43	Target Processor on page 43
Debugging on page 44	Debugging on page 44
ARM Sourcery GCC Assembler on page 44	Preprocessor on page 45
	Warnings on page 45
ARM Sourcery GCC C Compiler on page 46	Preprocessor on page 46

Table continues on the next page...

Table 13: Build properties for bareboard project (continued)

Tool Settings	Sub Tool Settings
	Optimization on page 47
	Warnings on page 48
	Miscellaneous on page 48
ARM Sourcery GCC C Linker on page 49	General on page 50
	Libraries on page 50
	Miscellaneous on page 50

3.4.1 Target Processor

This section describes the options in the **Target Processor** panel.

The options are listed in the table below.

Table 14: Target Processor options

Option	Description
Processor	Use to specify the processor. Default: cortex-a7
Thumb (-mthumb)	Select to have the processor generate Thumb code instructions. Clear to prevent the processor from generating Thumb code instructions. The IDE enables this setting only for architectures and processors that support the Thumb instruction set. Default: Clear
Thumb interwork (-mthumb-interwork)	Use to generate suitable interworking veneers when it links the assembler output. You must enable this option if you write ARM code that you want to interwork with Thumb code or vice versa. The only functions that need to be compiled for interworking are the functions that are called from the other state. You must ensure that your code uses the correct interworking return instructions. Default: Clear
Endianness	Use to specify the byte order of the target hardware architecture: • Little Endian: Right-most bytes (those with a higher address) are most significant • Big Endian: Left-most bytes (those with a lower address) are most significant Default: Toolchain Default
Float ABI	Use to specify the float Appiication Binary Interface (ABI). Default: FP instructions (-mfloat-abi=hard)

Table continues on the next page...

Table 14: Target Processor options (continued)

Option	Description
FPU Type	Use to specify the type of floating-point unit (FPU) for the target hardware architecture: The assembler might display error messages or warnings if the selected FPU architecture is not compatible with the target architecture. Default: VFPv3-D16 (-mfpu=vfpv3-d16)

3.4.2 Debugging

This section describes the options in the **Debugging** panel.

The options are listed in the table below.

Table 15: Debugging options

Option	Description
Debug level	Specify the debug levels: • None - No Debug level. • Minimal (-g1) - The compiler provides minimal debugging support. • Default (-g) - The compiler generates DWARF 1.xconforming debugging information. • Maximum (-g3) - The compiler provides maximum debugging support.
Debug format	Specify the debug formats for the compiler.
Generate prof information (-p)	Generates extra code to write profile information suitable for the analysis program prof. You must use this option when compiling the source files you want data about, and you must also use it when linking.
Generate gprof information (-pg)	Generates extra code to write profile information suitable for the analysis program gprof. You must use this option when compiling the source files you want data about, and you must also use it when linking.
Other debugging flags	Specify additional command line options; type in custom debugging flags that are not otherwise available in the UI.

3.4.3 ARM Sourcery GCC Assembler

This section describes the options in the **ARM Sourcery GCC Assembler** panel.

The options are listed in the table below.

Table 16: ARM sourcery GCC assembler options

Option	Description
Command	Shows the location of the assembler executable file. Default:`arm-none-eabi-gcc`
All Options	Shows the actual command line the assembler will be called with. Default: `-x assembler-with-cpp -Wall -Wa,-adhlns="$@.lst" -c -fmessage-length=0 -mcpu=cortex-a7 -mfloat-abi=hard -mfpu=vfpv3-d16 -g -gdwarf-2`

Table continues on the next page...

Table 16: ARM sourcery GCC assembler options (continued)

Option	Description
Expert settings	
Command line patterns	Shows the expert settings command line parameters. Default: `"${ARMv7GCCToolsDir}/${COMMAND}" ${INPUTS} ${FLAGS} ${OUTPUT_FLAG}${OUTPUT_PREFIX}${OUTPUT}`

This section contains the following subsections:

- Preprocessor on page 45
- Warnings on page 45

3.4.3.1 Preprocessor

Use this panel to specify preprocessor-related settings of the ARM sourcery GCC assembler.

The available options are listed in the table below.

Table 17: Preprocessor settings of ARM sourcery GCC assembler

Option	Description
Use preprocessor	Select this option to use the preprocessor for the assembler.
Do not search system directories (-nostdinc)	Select this option if you do not want the assembler to search the system directories. By default, this checkbox is clear. The assembler performs a full search that includes the system directories.
Preprocess only (-E)	Select this option if you want the assembler to preprocess source files and not to run the compiler. By default, this checkbox is clear and the source files are not preprocessed.
Defined symbols (-D)	Use this option to specify the substitution strings that the assembler applies to all the assembly-language modules in the build target. Enter just the string portion of a substitution string. The IDE prepends the -D token to each string that you enter. For example, entering opt1 x produces this result on the command line: -Dopt1 x. Note: This option is similar to the DEFINE directive, but applies to all assembly-language modules in a build target.
Undefined symbols (-U)	Undefines the substitution strings you specify in this panel.

3.4.3.2 Warnings

Use this panel to specify warning-related settings of the ARM sourcery GCC assembler.

The available options are listed in the table below.

Table 18: Warning options for ARM sourcery GCC assembler

Option	Description
Check syntax only (-fsynatx-only)	Check the code for syntax errors, but don't do anything beyond that.

Table continues on the next page...

Table 18: Warning options for ARM sourcery GCC assembler (continued)

Option	Description
Pedantic (-pedantic)	Issue all the warnings demanded by strict ISO C and ISO C++; reject all programs that use forbidden extensions, and some other programs that do not follow ISO C and ISO C++. For ISO C, follows the version of the ISO C standard specified by any -std option used.
Pedantic warnings as errors (-pedantic-errors)	Like -Wpedantic, except that errors are produced rather than warnings.
Inhibit all warnings (-w)	Inhibit all warnings
All warnings (-Wall)	This enables all the warnings about constructions that some users consider questionable, and that are easy to avoid (or modify to prevent the warning), even in conjunction with macros.
Extra warnings (-Wextra)	This enables some extra warning flags that are not enabled by -Wall.
Warnings as errors (-Werror)	Make all warnings into errors.

3.4.4 ARM Sourcery GCC C Compiler

This section describes the options in the **ARM Sourcery GCC C Compiler** panel.

The options are listed in the table below.

Table 19: ARM sourcery GCC C compiler options

Option	Description
Command	Shows the location of the compiler executable file. Default: `arm-none-eabi-gcc`
All Options	Shows the actual command line the compiler will be called with.
Expert settings	
Command line patterns	Shows the expert settings command line parameters. Default: `"${ARMv7GCCToolsDir}/${COMMAND}" ${INPUTS} ${FLAGS} ${OUTPUT_FLAG}${OUTPUT_PREFIX}${OUTPUT}`

This section contains the following subsections:

- Preprocessor on page 46
- Optimization on page 47
- Warnings on page 48
- Miscellaneous on page 48

3.4.4.1 Preprocessor

Use this panel to specify preprocessor-related settings of the ARM sourcery GCC C compiler.

The available options are listed in the table below.

Table 20: Preprocessor settings of ARM sourcery GCC C compiler

Option	Description
Do not search system directories (-nostdinc)	Select this option if you do not want the compiler to search the system directories. By default, this checkbox is clear. The compiler performs a full search that includes the system directories.
Preprocess only (-E)	Select this option if you want the compiler to preprocess source files and not to run the compiler. By default, this checkbox is clear and the source files are not preprocessed.
Defined symbols (-D)	Use this option to specify the substitution strings that the compiler applies modules in the build target. Enter just the string portion of a substitution string. The IDE prepends the -D token to each string that you enter. For example, entering opt1 x produces this result on the command line: -Dopt1 x. Note: This option is similar to the DEFINE directive, but applies to all assembly-language modules in a build target.
Undefined symbols (-U)	Undefines the substitution strings you specify in this panel.

3.4.4.2 Optimization

Use this panel to specify optimization-related settings of the ARM sourcery GCC C compiler.

The available options are listed in the table below.

Table 21: Optimization settings of ARM sourcery GCC C compiler

Option	Description
Optimization level	Select the required optimization level • None (-O0) - Reduce compilation time and make debugging produce the expected results. This is the default. • Optimize (-O1) - Optimize. Optimizing compilation takes somewhat more time, and a lot more memory for a large function. • Optimize more (-O2) - Optimize even more. GCC performs nearly all supported optimizations that do not involve a space-speed tradeoff. As compared to -O, this option increases both compilation time and the performance of the generated code. • Optimize most (-O3) - Optimize yet more. -O3 turns on all optimizations specified by -O2 and also turns on the `-finline-functions`, `-funswitch-loops`, `-fpredictive-commoning`, `-fgcse-after-reload`, `-ftree-loop-vectorize`, `-ftree-slp-vectorize`, `-fvect-cost-model`, `-ftree-partial-pre` and `-fipa-cp-clone` options. • Optimize size (-Os) - Optimize for size. -Os enables all -O2 optimizations that do not typically increase code size. It also performs further optimizations designed to reduce code size.

Table continues on the next page...

Table 21: Optimization settings of ARM sourcery GCC C compiler (continued)

Option	Description
Pack structures	Packed data structures are supported in the compiler with the keyword `__packed` or `__attribute__((packed))`. There is no code generation support for accessing un-aligned, packed data members.Users should exercise caution when accessing packed data structures because data might not be aligned.
Short enumerations	Select to use short enumerated constants and is equivalent to `-fshort-enums`.
Function sections	Select to use function sections and is equivalent to `-ffunction-sections`.
Data sections	Select to use short data sections and is equivalent to `-ffunction-sections`.
Other optimization flags	Specify additional command line options; type in custom optimization flags that are not otherwise available in the UI.

3.4.4.3 Warnings

Use this panel to specify warning-related settings of the ARM sourcery GCC C compiler.

The available options are listed in the table below.

Table 22: Warning options for ARM sourcery GCC C compiler

Option	Description
Check syntax only	Select the code for syntax errors, but don't do anything beyond that.
No common	Select this option if you want to issue all the warnings demanded by strict ISO C and ISO C++; reject all programs that use forbidden extensions, and some other programs that do not follow ISO C and ISO C++. For ISO C, follows the version of the ISO C standard specified by any `-std' option used.
Pedantic	Issue all the warnings demanded by strict ISO C and ISO C++; reject all programs that use forbidden extensions, and some other programs that do not follow ISO C and ISO C++. For ISO C, follows the version of the ISO C standard specified by any -std option used.
Pedantic warnings as errors	Like -Wpedantic, except that errors are produced rather than warnings.
Inhibit all warnings	Inhibit all warnings
All warnings	This enables all the warnings about constructions that some users consider questionable, and that are easy to avoid (or modify to prevent the warning), even in conjunction with macros.
Extra warnings	This enables some extra warning flags that are not enabled by -Wall.
Warnings as errors	Make all warnings into errors.

3.4.4.4 Miscellaneous

You can use this panel to specify miscellaneous settings related to the ARM sourcery GCC C compiler.

The available options are listed in the table below.

Table 23: Miscellaneous ARM sourcery GCC C compiler options

Option	Description
Language Standard	Select the programming language or standard to which the compiler should conform. • ISO C90 (-ansi) - Select this option to compile code written in ANSI standard C. The compiler does not enforce strict standards. For example, your code can contain some minor extensions, such as C++ style comments (//), and $ characters in identifiers. • ISO C99 (-std=c99) - Select this option to instruct the compiler to enforce stricter adherence to the ANSI/ISO standard. • Compiler Default (ISO C90 with GNU extensions) - Select this option to enforce adherence to ISO C90 with GNU extensions. • ISO C99 with GNU Extensions (-std=gnu99)
Assembler Listing (-Wa, -adhlns="$@.lst")	Enables the assembler to create a listing file as it compiles assembly language into object code.
Do not inline functions	Select this option if you do not want to inline function.
'char' is signed	Select this option if you want to ensure that the char is signed.
Bitfields are unsigned	Select this option to ensure bitfields are unsigned.
Verbose (-v)	Select this option if you want the IDE to show each command-line that it passes to the shell, along with all progress, error, warning, and informational messages that the tools emit. This setting is equivalent to specifying the -v command-line option. By default, this checkbox is clear. The IDE displays just error messages that the compiler emits. The IDE suppresses warning and informational messages.
Other compiler flags	Specify additional command line options; type in custom flags that are not otherwise available in the UI.

3.4.5 ARM Sourcery GCC C Linker

This section describes the options in the **ARM Sourcery GCC C Linker** panel.

The options are listed in the table below.

Table 24: ARM sourcery GCC C linker options

Option	Description
Command	Shows the location of the linker executable file. Default:`arm-none-eabi-gcc`
All Options	Shows the actual command line the assembler will be called with. Default: `-T "${ProjDirPath}"/Linker_Files/aarch64elf.x -nostartfiles -nodefaultlibs -L"C:\Users\b14174\workspace-15\FirstProjectTest" -Wl,-Map,"FirstProjectTest.map"`
Expert settings	
Command line patterns	Shows the expert settings command line parameters. Default: `${COMMAND} ${cross_toolchain_flags} ${FLAGS} ${OUTPUT_FLAG} ${OUTPUT_PREFIX}${OUTPUT} ${INPUTS}`

This section contains the following subsections:

- General on page 50
- Libraries on page 50
- Miscellaneous on page 50

3.4.5.1 General

Use this panel to specify general settings of the ARM sourcery GCC C linker.

The available options are listed in the table below.

Table 25: General ARM sourcery GCC C linker options

Option	Description
Script file	*${ProjDirPath}/Linker_Files/LS1021A_QDS_Core0_ram.ld*
Do not use standard start files	Marks the object that the search for dependencies of this object will ignore start files
Do not use default libraries	Marks the object that the search for dependencies of this object will ignore any default library search paths.
No startup or default libs	Marks the object that the search for dependencies of this object will ignore any default library search paths and start files.
Remove unused sections	List all sections removed by garbage collection. The listing is printed on stderr. This option is only effective if garbage collection has been enabled via the `--gc-sections') option.
Print removed sections	List all sections removed by garbage collection. The listing is printed on stderr. This option is only effective if garbage collection has been enabled via the `--gc-sections') option.
Omit all symbol information	Omit all symbol information from the output file.

3.4.5.2 Libraries

Use this panel to specify library-related settings of the ARM sourcery GCC C linker.

The available options are listed in the table below.

Table 26: Library settings for ARM sourcery GCC C linker

Option	Description
Libraries (-l)	This option changes the build target's search order of access paths to start with the system paths list. The compiler can search #include files in several different ways. You can also set the search order as follows: For include statements of the form #include"xyz", the compiler first searches user paths, then the system paths. For include statements of the form #include<xyz>, the compiler searches only system paths. This option is global.
Library search path (-L)	Use this option to specify the include library search path.

3.4.5.3 Miscellaneous

You can use this panel to specify miscellaneous settings related to the ARM sourcery GCC C linker.

The available options are listed in the table below.

Table 27: Miscellaneous ARM sourcery GCC C linker options

Option	Description
Linker flags	This option specifies the flags to be passed with the linker file.
Other objects	The linker searches the paths in the order shown in this list.
Generate Map	This option specifies the map filename. Default: *$ {BuildArtifactFileBaseName}.map*
Cross Reference (-Xlinker --cref)	Select this option to instruct the linker to list cross-reference information on symbols. This includes where the symbols were defined and where they were used, both inside and outside macros.
Print link map (-Xlinker --printf-map)	Select this option to instruct the linker to print the map file.
Verbose (-v)	Select this option to show verbose information, including hex dump of program segments in applications; default setting
Other flags	Specify additional command line options for the linker; type in custom flags that are not otherwise available in the UI.

Chapter 4 Debug Configurations

A CodeWarrior project can have multiple associated debug configurations. A debug configuration is a named collection of settings that the CodeWarrior tools use.

Debug configurations let you specify settings, such as:

- The files that belong to the debug configuration
- Behavior of the debugger and the related debugging tools

This chapter explains:

- Using Debug Configurations dialog on page 53
- Customizing Debug Configurations on page 75
- Reverting Debug Configuration settings on page 77

4.1 Using Debug Configurations dialog

The Debug Configurations dialog allows you to specify debugger-related settings for your CodeWarrior project.

NOTE

As you modify a launch configuration's debugger settings, you create pending, or unsaved, changes to that launch configuration. To save the pending changes, you must click the **Apply** button of the **Debug Configurations** dialog or click the **Close** button and then the **Yes** button.

Table 28: Debug Configuration tabs

Main on page 54	
Arguments on page 58	
Debugger on page 59	Debug on page 60
	Exceptions on page 62
	Interrupts on page 62
	Download on page 63
	PIC on page 65
	Other Executables on page 66
	Symbolics on page 67
	OS Awareness on page 68
Source on page 72	
Environment on page 73	
Common on page 74	

4.1.1 Main

Use this page to specify the project and application you want to run or debug.

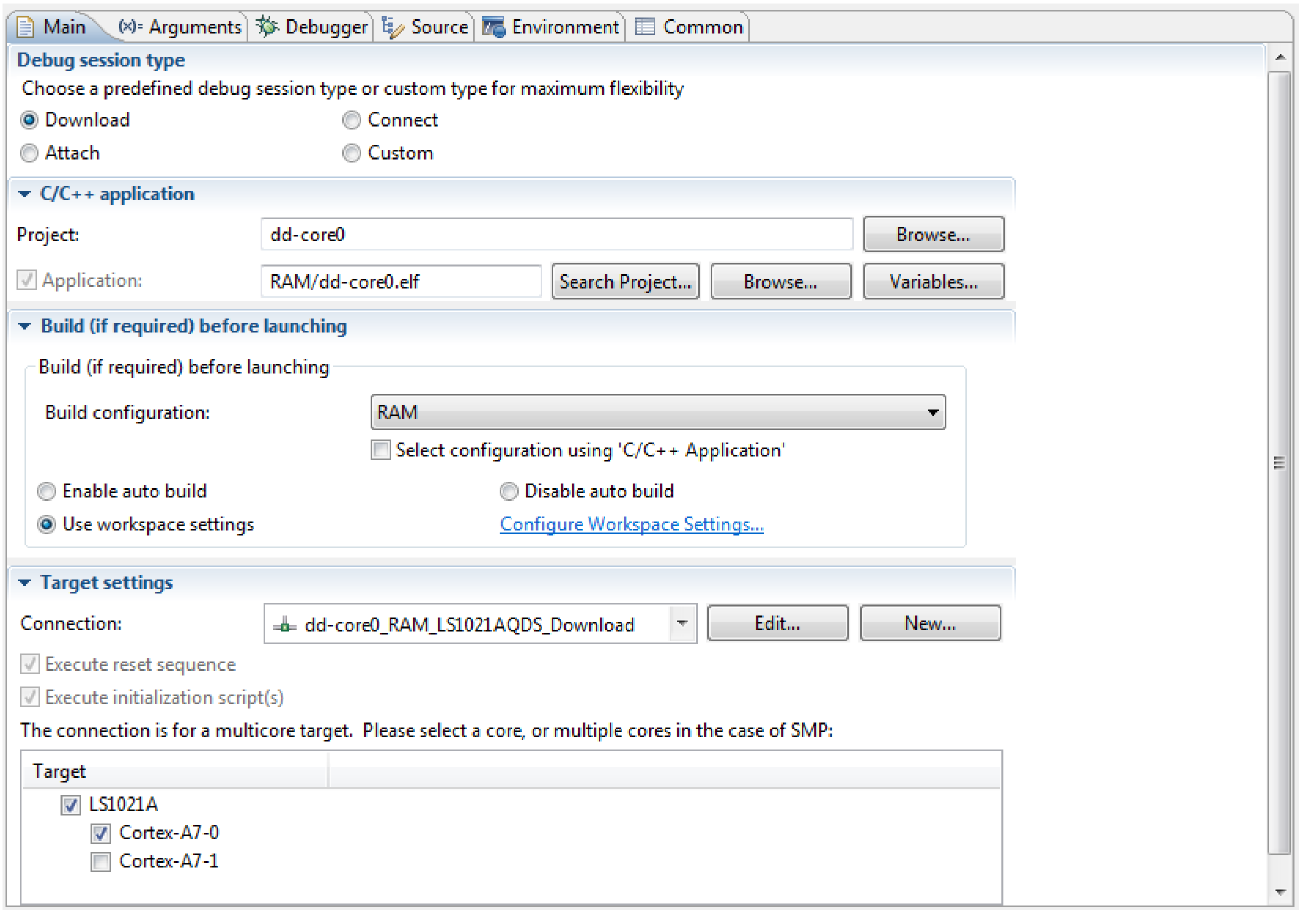
You can also specify a remote system configuration on this tab. The remote system configuration is separated into connection and system configurations allowing you to define a single system configuration that can be referred to by multiple connection configurations. The launch configurations refer to a connection configuration, which in turn refers to a system configuration.

NOTE

The options displayed on the **Main** tab vary depending on the selected debug session type.

The following figure shows the **Main** tab.

Figure 14: Debug Configurations-Main tab



Debug session type

Choose a predefined debug session type or custom type for maximum flexibility

[✓ Download] Connect
Attach Custom

C/C++ application

Project: dd-core0 — Browse...

[✓] Application: RAM/dd-core0.elf — Search Project... Browse... Variables...

Build (if required) before launching

Build (if required) before launching

Build configuration: RAM

[ ] Select configuration using 'C/C++ Application'

Enable auto build — Disable auto build

[✓ Use workspace settings] — Configure Workspace Settings...

Target settings

Connection: dd-core0_RAM_LS1021AQDS_Download — Edit... New...

[✓] Execute reset sequence

[✓] Execute initialization script(s)

The connection is for a multicore target. Please select a core, or multiple cores in the case of SMP:

Target
- [✓] LS1021A
  - [✓] Cortex-A7-0
  - [ ] Cortex-A7-1

The table below lists the various options available on the **Main** page.

Table 29: Main tab options

Option	Description
Debug session type	Specifies the options to initiate a debug session using pre-configured debug configurations. The options include: • **Download** - Resets the target if the debug configuration specifies the action. Further, the command stops the target, (optionally) runs an initialization script, downloads the specified ELF file, and modifies the program counter (PC). • **Attach** - Assumes that code is already running on the board and therefore does not run a target initialization file. The state of the running program is undisturbed. The debugger loads symbolic debugging information for the current build target's executable. The result is that you have the same source-level debugging facilities you have in a normal debug session (the ability to view source code and variables, and so on). The function does not reset the target, even if the launch configuration specifies this action. Further, the command loads symbolics, does not stop the target, run an initialization script, download an ELF file, or modify the program counter (PC). NOTE The debugger does not support restarting debugging sessions that you start by attaching the debugger to a process. • **Connect** - Runs the target initialization file specified in the RSE configuration to set up the board before connecting to it. The **Connect** debug session type does not load any symbolic debugging information for the current build target's executable thereby, denying access to source-level debugging and variable display. The **Connect** command resets the target if the launch configuration specifies this action. Further, the command stops the target, (optionally) runs an initialization script, does not load symbolics, download an ELF file, or modify the program counter (PC). NOTE The default debugger configuration causes the debugger to cache symbolics between sessions. However, selecting the **Connect** option invalidates this cache. If you must preserve the contents of the symbolics cache, and you plan to use the **Connect** option, clear the **Cache Symbolics Between Sessions** checkbox in the **Symbolics** tab page. • **Custom** - Provides user an advantage to create a custom debug configuration.

Table continues on the next page...

Table 29: Main tab options (continued)

Option	Description

C/C++ application	Specifies the settings for the C/C++ application. The options include:
	• **Project** - Specifies the name of the project associated with the selected debug launch configuration. Click Browse to select a different project.
	• **Application** - Specifies the name of the C or C++ application executable.
	NOTE
	This option is disabled when **Connect** debug session type is selected.
	• **Search Project** - Click to open the **Program Selection** dialog box and select a binary.
	NOTE
	This option is disabled when **Connect** debug session type is selected.
	• **Variables** - Click to open the Select build variable dialog and select the build variables to be associated with the program.
	The dialog displays an aggregation of multiple variable databases and not all these variables are suitable to be used from a build environment. Given below are the variables that should be used:
	`ProjDirPath` - returns the absolute path of the current project location in the file system
	`${ProjDirPath}/Source/main.c"`
	`workspace_loc` - returns the absolute path of a workspace resource in the file system, or the location of the workspace if no argument is specified
	`${workspace_loc:/ProjectName/Source main.c"${workspace_loc}`
	`Gnu_Make_Install_Dir` - returns the absolute path of the GNU `make.exe` tool
	`${Gnu_Make_Install_Dir}\make.exe`
	NOTE
	This option is disabled when **Connect** debug session type is selected.

Table continues on the next page...

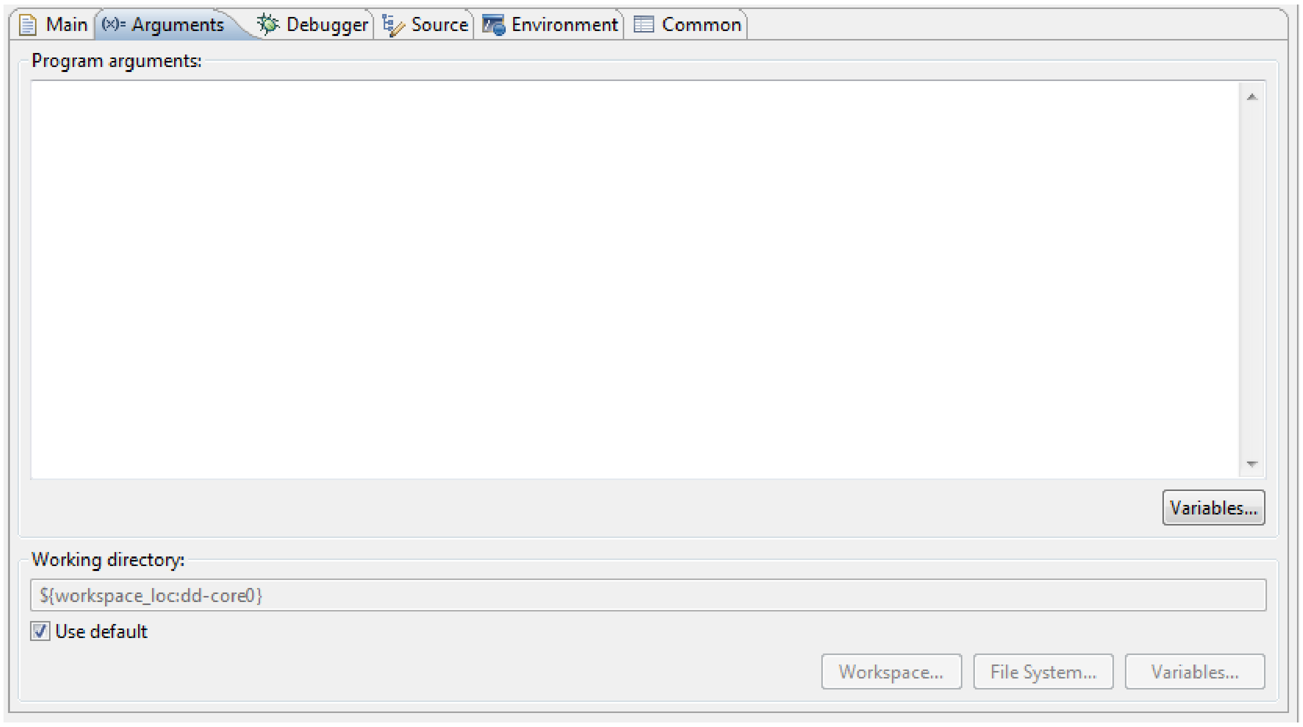
Table 29: Main tab options (continued)

Option	Description
Build (if required) before launching	Controls how auto build is configured for the launch configuration. Changing this setting overrides the global workspace setting and can provide some speed improvements. NOTE These options are set to default and collapsed when **Connect** debug session type is selected. The options include: • **Build configuration** - Specifies the build configuration either explicitly or use the current active configuration. • **Select configuration using `C/C++ Application'** - Select/clear to enable/ disable automatic selection of the configuration to be built, based on the path to the program. • **Enable auto build** - Enables auto build for the debug configuration which can slow down launch performance. • **Disable auto build** - Disables auto build for the debug configuration which may improve launch performance. No build action will be performed before starting the debug session. You have to rebuild the project manually. • **Use workspace settings (default)** - Uses the global auto build settings. • **Configure Workspace Settings** - Opens the Launching preference panel where you can change the workspace settings. It will affect all projects that do not have project specific settings.
Target settings	Specifies the connection and other settings for the target. The options include: • **Connection** - Specifies the applicable Remote System configuration. • **Edit** - Click to edit the selected Remote System configuration. • **New** - Click to create a new Remote System configuration for the selected project and application. • **Execute reset sequence** - Select to apply reset settings, specified in the target configuration, when attaching to a target. Alternatively, clear the option to ignore reset settings. NOTE This option is not available when **Attach** debug session type is selected. • **Execute initialization script(s)** - Select to execute the initialization script(s), specified in the target configuration, when attaching to a target. Alternatively, clear the option to ignore the initialization script(s). • **Target** (multicore only) - Select the core to be debugged. For SMP debugging, select all cores in the SMP group.

4.1.2 Arguments

Use this tab to specify the program arguments that an application uses and the working directory for a run or debug configuration.

Figure 15: Debug Configurations-Arguments tab



The table below lists the various options available on the **Arguments** page.

Table 30: Arguments tab options

Option	Description
Program arguments	Specifies the arguments passed on the command line.
Variables	Click to select variables by name to include in the program arguments list.
Working Directory	Specifies the run/debug configuration working directory.
Use default	Select to specify the default run/debug configuration working directory, which is a directory within the current project directory, or clear to specify a different workspace, a file system location, or a variable. For Linux applications, the default working directory is the current directory on the process that started CodeWarrior TRK on the target. This should not be confused with the directory where the CodeWarrior TRK binary resides.
Workspace	Click to specify the path of, or browse to, a workspace relative working directory.
File System	Click to specify the path of, or browse to, a file system directory.
Variables	Click to specify variables by name to include in the working directory.

4.1.3 Debugger

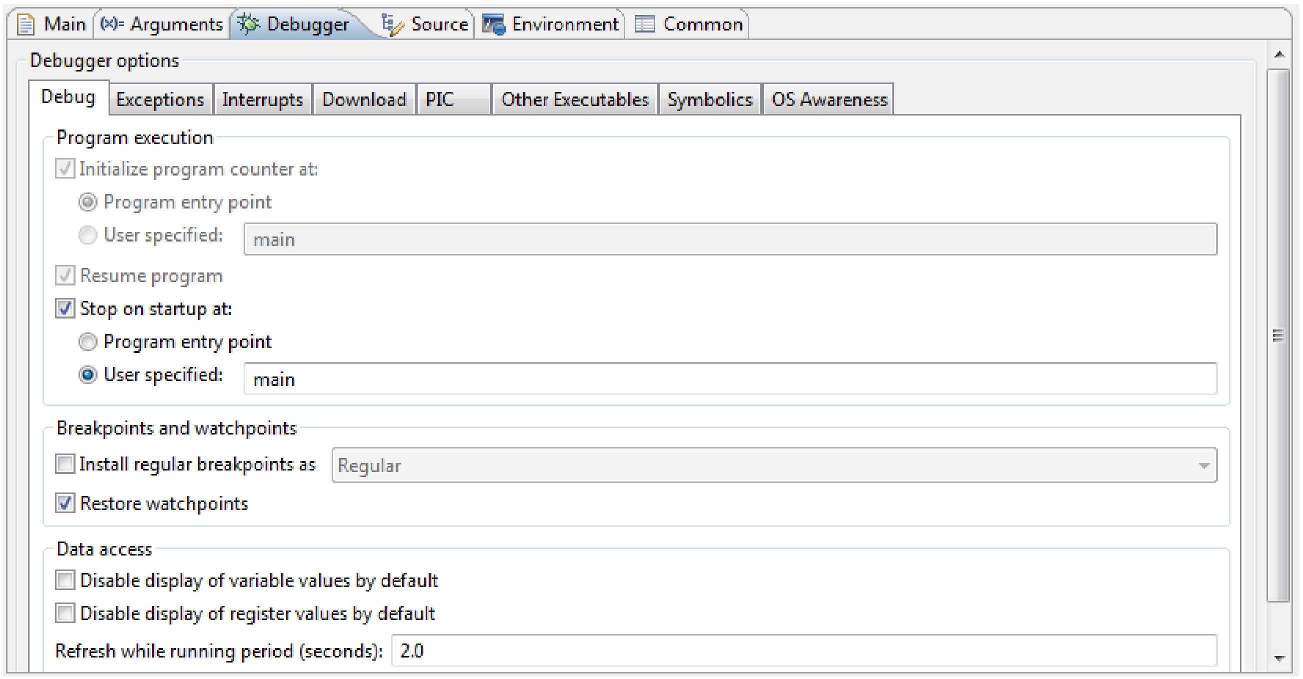
Use this tab to configure the debugger settings.

The **Debugger** tab presents different pages for specifying different configuration settings specific to the selected debugger type.

NOTE

The content in the **Debugger Options** panel changes, depending on the **Debug session type** selected on the **Main** page.

Figure 16: Debug Configurations-Debugger tab



Program execution

[✓] Initialize program counter at:

(●) Program entry point

( ) User specified: main

[✓] Resume program

[✓] Stop on startup at:

( ) Program entry point

(●) User specified: main

Breakpoints and watchpoints

[ ] Install regular breakpoints as Regular

[✓] Restore watchpoints

Data access

[ ] Disable display of variable values by default

[ ] Disable display of register values by default

Refresh while running period (seconds): 2.0

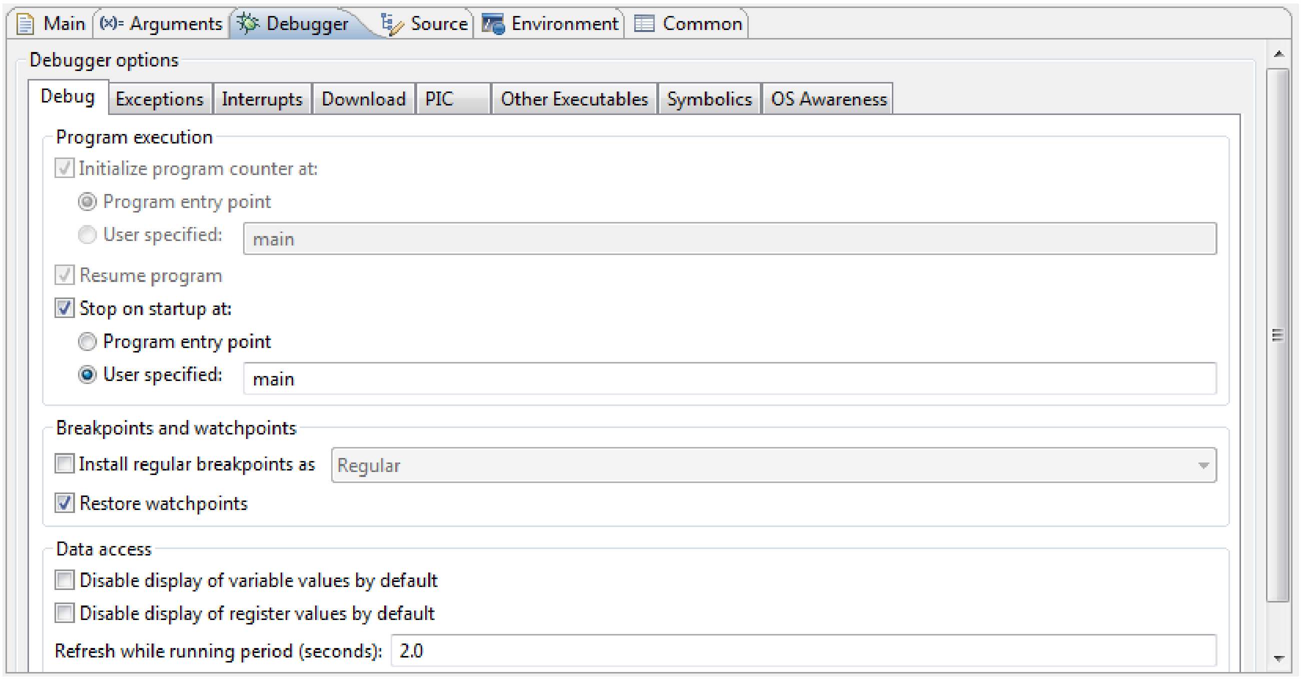
The different pages available on the **Debugger** tab are grouped in the **Debugger options** group. The pages are listed below:

- Debug on page 60
- Exceptions on page 62
- Interrupts on page 62
- Download on page 63
- PIC on page 65
- Other Executables on page 66
- Symbolics on page 67
- OS Awareness on page 68

4.1.3.1 Debug

Use this page to specify the program execution options, breakpoint and watchpoint options, and target access behavior.

Figure 17: Debugger options-Debug page



Program execution
- [✓] Initialize program counter at:
  - (●) Program entry point
  - ( ) User specified: main
- [✓] Resume program
- [✓] Stop on startup at:
  - ( ) Program entry point
  - (●) User specified: main

Breakpoints and watchpoints
- [ ] Install regular breakpoints as: Regular
- [✓] Restore watchpoints

Data access
- [ ] Disable display of variable values by default
- [ ] Disable display of register values by default
- Refresh while running period (seconds): 2.0

NOTE

The options displayed on the **Debug** tab varies depending on the selected launch configuration.

The table below lists the various options available on the **Debug** page.

Table 31: Debugger options - Debug

Option	Description
Initialize program counter at	Controls the initialization of program counter. • **Program entry point** - Select to initialize the program counter at a specified program entry pont. • **User specified** - Select to initialize the program counter at a user-specified function. The default location is `main`. NOTE Disabling this option will also disable the **Resume program** and **Stop on startup at** options.

Table continues on the next page...

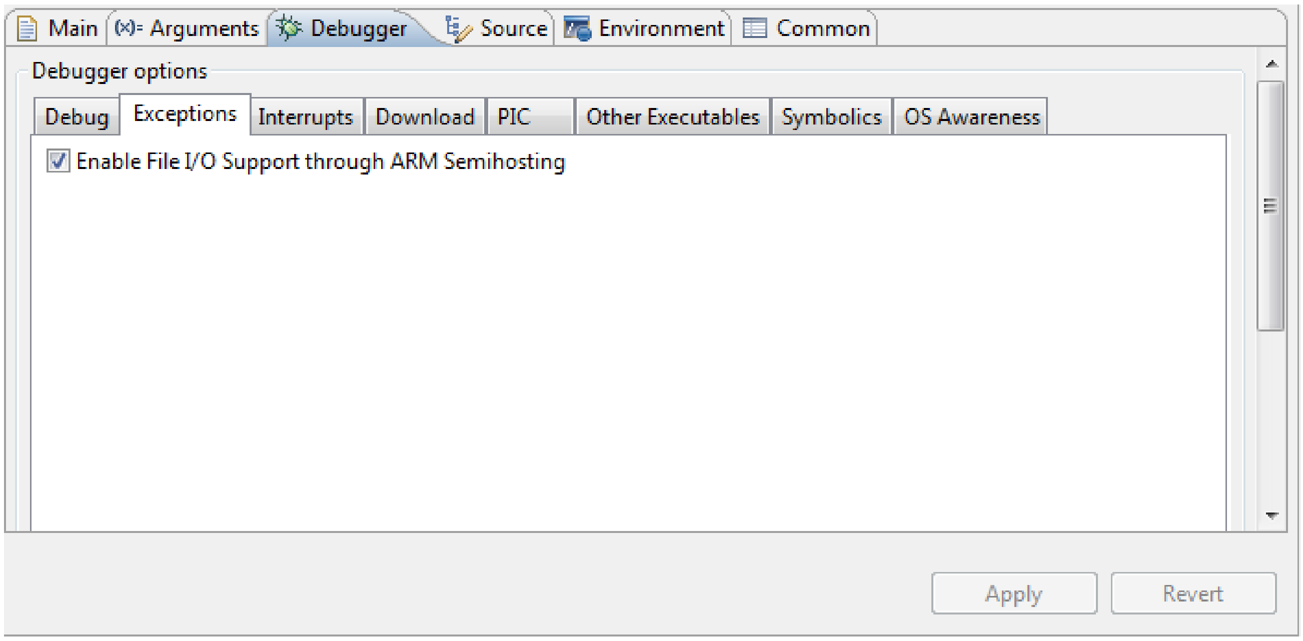
Table 31: Debugger options - Debug (continued)

Option	Description
Resume program	Select to resume the execution after the program counter is initialized. NOTE Disabling this option will also disable the **Stop on startup at** option.
Stop on startup at	Stops program at specified location. When cleared, the program runs until you interrupt it manually, or until it hits a breakpoint. • **Program entry point** - Select to stop the debugger at a specified program entry point. • **User specified** - Select to stop the debugger at a user-specified function. The default location is `main`.
Stop on exit	Select this option to have the debugger set a breakpoint at the code's exit point. For multicore projects, when you set this option for one project on one core, it is set for projects on the other cores. Clear this option to prevent the debugger from setting a breakpoint at the code's exit point.
Install regular breakpoints as	Select this option to install breakpoints as either: • Regular • Hardware • Software Clear this option to install breakpoints as Regular breakpoints.
Restore watchpoints	Select this option to restore previous watchpoints.
Disable display of variable values by default	Select this option to disable the display of variable values. Clear this option to enable the display of variable values
Disable display of register values by default	Select this option to disable the display of register values. Clear this option to enable the display of register values
Refresh while running period (seconds)	Specifies the refresh period used when a view is configured to refresh, while the application is running. By default, the refresh period is set to two seconds.

4.1.3.2 Exceptions

Use this page to specify the processor exceptions you want the CodeWarrior debugger to catch.

Figure 18: Debugger options- Exceptions page



☑ Enable File I/O Support through ARM Semihosting

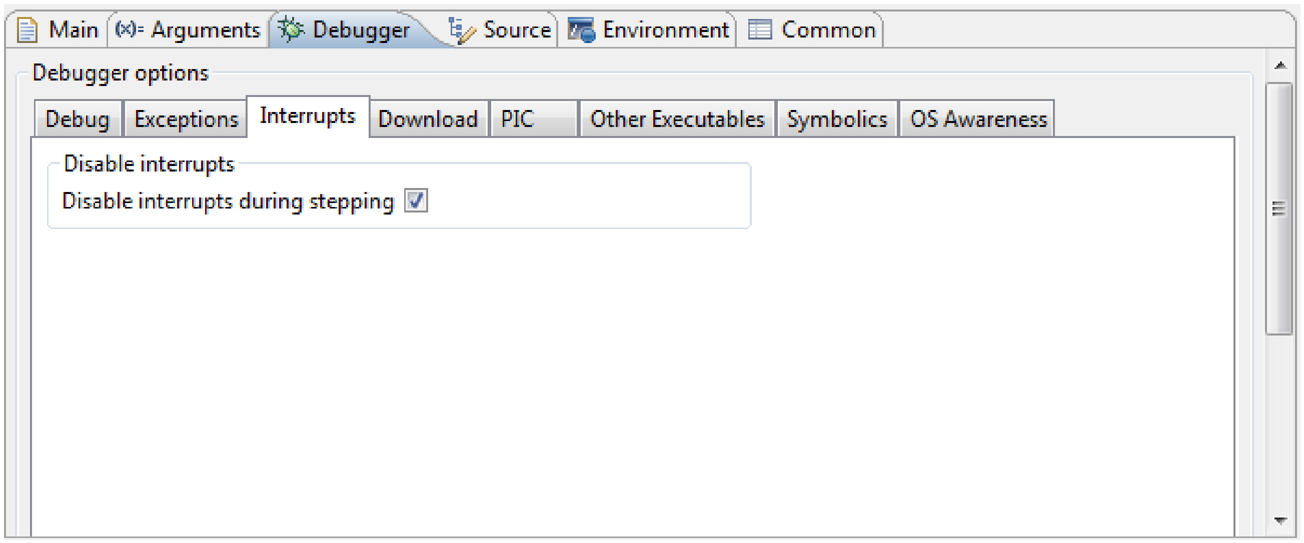
Selecting the checkboxes, available on the Exceptions page, configures the core to automatically halt when the corresponding exception is taken. The debugger stops at the entry point of the interrupt handler for the selected exception, allowing you to inspect the processor state and continue debugging from there.

4.1.3.3 Interrupts

Use this tab to inhibit or allow interrupts.

Debugging an application involves single-stepping through code. However, if you do not modify the behavior of interrupts that are part of normal code execution, an interrupt may occur and the debugger jumps to the interrupt handler code, rather than single-stepping to the next instruction. Therefore, you must mask, or inhibit, certain interrupt levels to prevent the interrupts from happening. When inhibiting interrupts, you can mask interrupts below a level that you specify.

Figure 19: Debugger options-Interrupts page



Disable interrupts during stepping ✓

The table below lists the various options available on the Interrupts page.

Table 32: Debugger options - Interrupts

Option	Description
Disable interrupts during stepping	Select this checkbox if you want to disable interrupts during stepping.

4.1.3.4 Download

Use this page to specify which executable code sections the debugger downloads to the target, and whether the debugger should read back those sections and verify them.

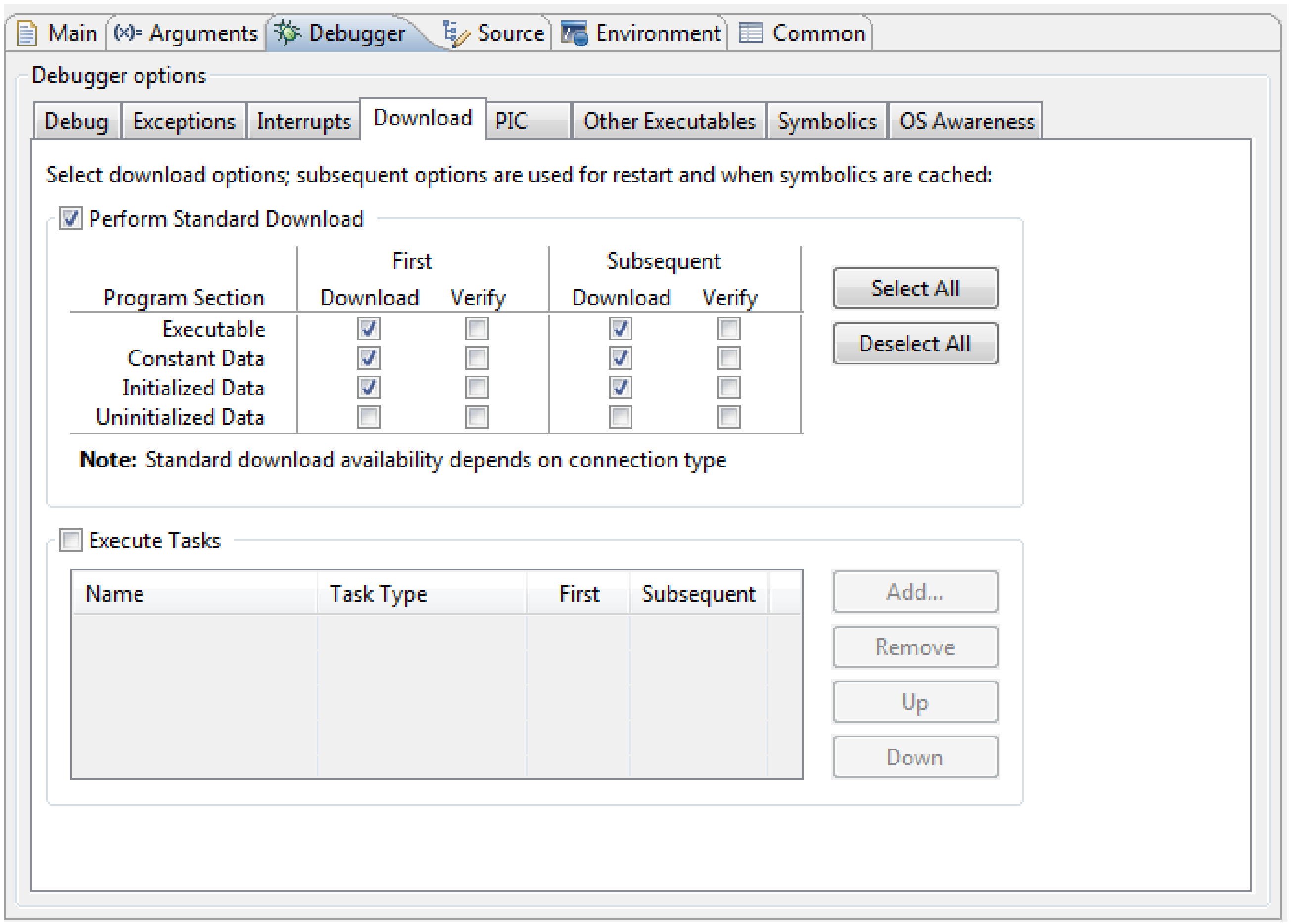
NOTE

Selecting all options in the **Program Download Options** group significantly increases download time.

Initial Launch options apply to the first debugging session. Successive Runs options apply to subsequent debugging sessions.

The **Download** options control whether the debugger downloads the specified Program Section Data type to the target hardware. The **Verify** options control whether the debugger reads the specified Program Section Data type from the target hardware and compares the read data against the data written to the device.

Figure 20: Debugger options-Download page



Select download options; subsequent options are used for restart and when symbolics are cached:

☑ Perform Standard Download

Program Section	First Download	First Verify	Subsequent Download	Subsequent Verify
Executable	☑	☐	☑	☐
Constant Data	☑	☐	☑	☐
Initialized Data	☑	☐	☑	☐
Uninitialized Data	☐	☐	☐	☐

Note: Standard download availability depends on connection type

☐ Execute Tasks

Name	Task Type	First	Subsequent

The table below lists the various options available on the Download page.

Table 33: Debugger options - Download

Section Data Type	Explanation
Perform standard download	Controls download of the target application using memory write command.
First	Represents a group of settings that are used when an application is debugged for the first time.
Subsequent	Represents a group of settings that are used when the application is debugged subsequent times. To make these settings be used during debugging, you need to select the **Cache Symbolics Between Sessions** option on the **Symbolics** page.
Executable	Controls downloading and verification for executable sections. Check appropriate checkboxes to specify downloading and verifications, for initial launch and for successive runs.
Constant Data	Controls downloading and verification for constant-data sections. Check appropriate checkboxes to specify downloading and verifications, for initial launch and for successive runs.

Table continues on the next page...

Table 33: Debugger options - Download (continued)

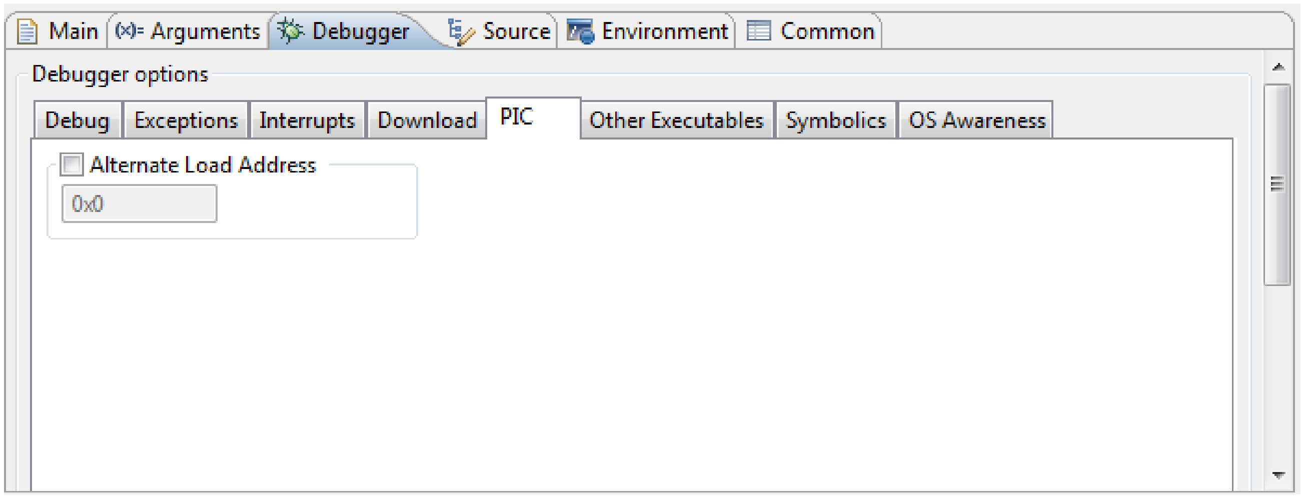
Section Data Type	Explanation
Initialized Data	Controls downloading and verification for initialized-data sections. Check appropriate checkboxes to specify downloading and verifications, for initial launch and for successive runs.
Uninitialized Data	Controls downloading and verification for uninitialized-data sections. Check appropriate checkboxes to specify downloading and verifications, for initial launch and for successive runs.
Execute Tasks	Enables the execution of target tasks.
Name	For target tasks, this is the name of the target task as seen in the Target Task view. For Debugger Shell scripts, this is the path to the CLDE script.
Task Type	Contains either Debugger Shell scripts or target tasks (such as Flash Programmer).
First	Represents a task that is executed first.
Subsequent	Represents a task that is executed subsequent times.

4.1.3.5 PIC

Use this page to specify an alternate address at which the debugger loads the PIC module onto target memory.

Usually, Position Independent Code (PIC) is linked in such a way that the entire image starts at address 0x00000000.

Figure 21: Debugger options-PIC page



Alternate Load Address: 0x0

The table below lists the various options available on the **PIC** page.

Table 34: PIC page options

Option	Description
Alternate Load Address	Specify the starting address at which the debugger loads your program. You can also use this setting when you have an application which is built with ROM addresses and then relocates itself to RAM (such as U-Boot). Specifying a relocation address lets the debugger map the symbolic debugging information contained in the original ELF file (built for ROM addresses) to the relocated application image in RAM. Clear the checkbox to have the debugger load your program at a default starting address.

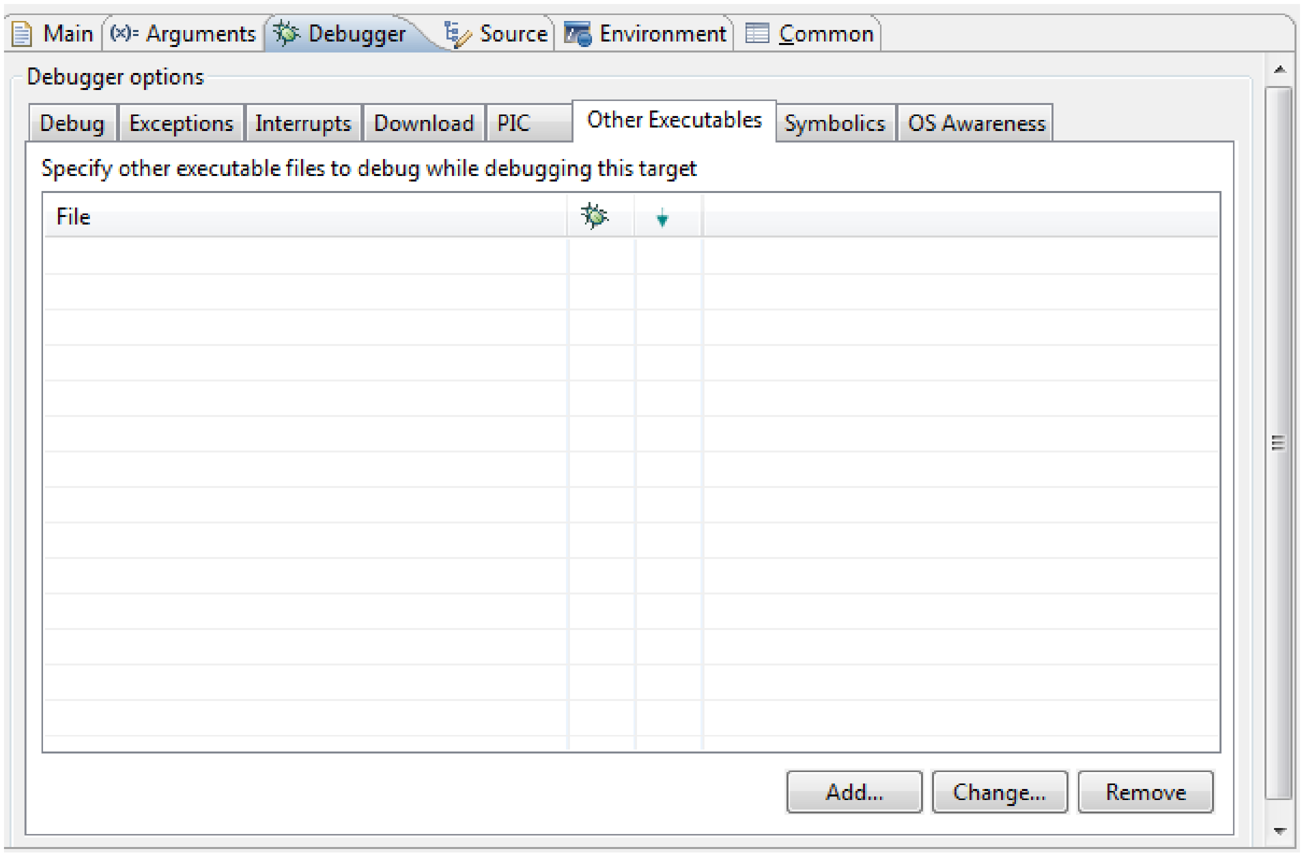
NOTE

The debugger does not verify whether your code can execute at the specified address. As a result, the PIC generation settings of the compiler, linker and your program's startup routines must correctly set any base registers and perform any required relocations.

4.1.3.6 Other Executables

Use this page to specify additional ELF files to download or debug in addition to the main executable file associated with the launch configuration.

Figure 22: Debugger options-Other Executables page



Specify other executable files to debug while debugging this target

The table below lists the various options available on the **Other Executables** page.

Table 35: Debugger options - Other Executables

Option	Description	
File list	Shows files and projects that the debugger uses during each debug session.	
	🐞	Debug column: • **Selected**-The debugger loads symbolics for the file. • **Cleared**-The debugger does not load symbolics for the file.
	↓	Download column: • **Selected**-The debugger downloads the file to the target device. • **Cleared**-The debugger does not download the file to the target device.
Add	Click to open the **Debug Other Executable** dialog, and add other executable file to debug while debugging this target. Use this dialog to specify the following settings: • Specify the location of the additional executable - Enter the path to the executable file that the debugger controls in addition to the current project's executable file. Alternatively, click **Workspace**, **File System**, or **Variables** to specify the file path. • Load symbols - Check to have the debugger load symbols for the specified file. Clear to prevent the debugger from loading the symbols. The Debug column of the File list corresponds this setting. • Download to device - Check to have the debugger download the specified file to the target device. Specify the path of the file in the **Specify the remote download path** text box. Clear the **Download to device** checkbox to prevent the debugger from downloading the file to the device. The **Download** column of the File list corresponds to the **Download to device** setting. • OK - Click to add the information that you specify in the **Debug Other Executable** dialog to the **File** list.	
Change	Click to change the settings for the entry currently selected in the **File** list column. Change this information as needed, then click the **OK** button to update the entry in the File list.	
Remove	Click to remove the entry currently selected in the **File** list.	

4.1.3.7 Symbolics

Use this page to specify whether the IDE keeps symbolics in memory.

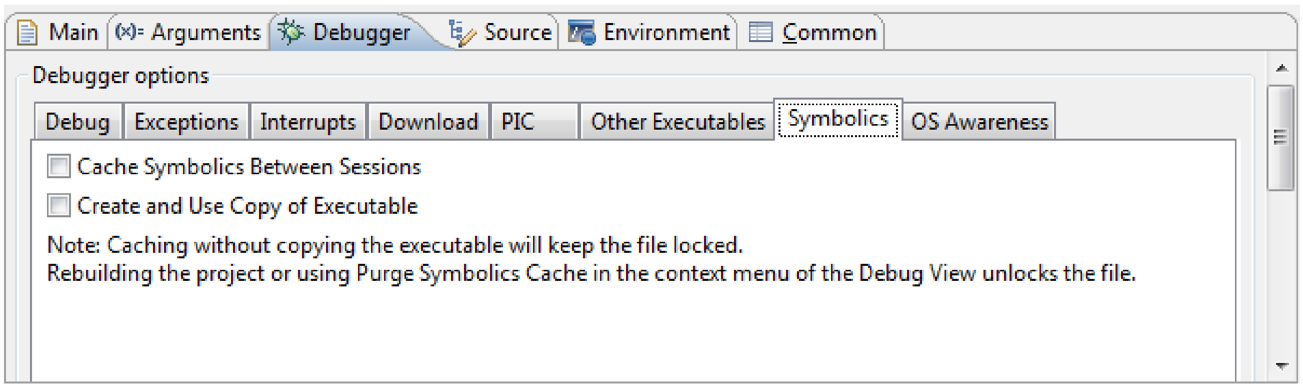
Symbolics represent an application's debugging and symbolic information. Keeping symbolics in memory, known as caching symbolics, is beneficial when you debug a large-size application.

Consider a situation in which the debugger loads symbolics for a large application, but does not download content to a hardware device and the project uses custom makefiles with several build steps to generate this application. In such a situation, caching symbolics helps speed up the debugging process. The debugger uses the readily available cached symbolics during subsequent debugging sessions. Otherwise, the debugger spends significant time creating an in-memory representation of symbolics during subsequent debugging sessions.

NOTE

Caching symbolics provides the most benefit for large applications, where doing so speeds up application-launch time. If you debug a small application, caching symbolics does not significantly improve the launch times.

Figure 23: Debugger options-Symbolics page



☐ Cache Symbolics Between Sessions
☐ Create and Use Copy of Executable

Note: Caching without copying the executable will keep the file locked.
Rebuilding the project or using Purge Symbolics Cache in the context menu of the Debug View unlocks the file.

The table below lists the various options available on the **Symbolics** page.

Table 36: Debugger options - Symbolics

Option	Description
Cache Symbolics Between Sessions	Select this option to have the debugger cache symbolics between debugging sessions. If you select this checkbox and clear the **Create and Use Copy of Executable** checkbox, the executable file remains locked after the debugging session ends. In the **Debug** view, right-click the locked file and select **Un-target Executables** to have the debugger delete its symbolics cache and release the file lock. The IDE enables this menu command when there are currently unused cached symbolics that it can purge. Clear this option so that the debugger does not cache symbolics between debugging sessions.
Create and Use Copy of Executable	Select this option to have the debugger create and use a copy of the executable file. Using the copy helps avoid file-locking issues with the build system. If you select this checkbox, the IDE can build the executable file in the background during a debugging session. Clear this option so that the debugger does not create and use a copy of the executable file.

4.1.3.8 OS Awareness

Use this page to specify the operating system (OS) that resides on the target device.

The table below lists the options available on the **OS Awareness** page.

Table 37: OS Awareness page options

Option	Description
Target OS	Use the **Target OS** list box to specify the OS that runs on the target device, or specify **None** to have the debugger use the bareboard.
Boot Parameters tab	Enable Command Line Settings - Select this option to specify settings for regular initialization. Enter the specific command line parameters in the **Command Line** and **Base Address** text boxes.Enable Initial RAM Disk Settings - Select this option to specify settings for flattened device tree initialization that downloads parameters to the kernel during its initialization. You specify a *.dts* file that contains initialization information. • File Path - Specifies the path of the ramdisk that you transferred from the Linux machine • Address - Specifies the address specified in Linux, initrd-start from the dts file • Size - Specifies the size of the dts file • Download to target - Downloads the initial RAM disk settings to the target Open Firmware Device Tree Settings - Select this option to load parameters to the kernel from a bootloader on the ARMv7 processors • File Path - Specifies the path to the dtb file for kernel debug • Address - Specifies the address specified in Linux, initrd-start from the dts file

Table continues on the next page...

Table 37: OS Awareness page options (continued)

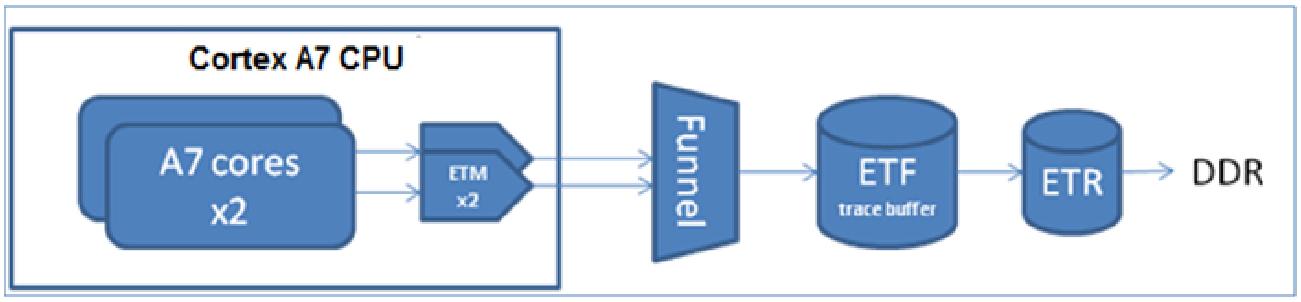
Option	Description
Debug tab	Specifies the parameters required for Linux kernel debug. • Enable Memory Translation - Select this option to translate memory by specifying the following values Physical Base Address - this is the CONFIG_PHYSICAL_START option of the kernel configuration Virtual Base Address - this is the CONFIG_KERNEL_START option of the kernel configurationMemory Size - this is the CONFIG_LOWMEM_SIZE option of the kernel configuration **Note**: The virtual memory space should not overflow the 32-bit memory space. This indicates that the Virtual Base Address + Memory Size shouldn't be greater than 0xFFFFFFFF. CodeWarrior displays an error when this happens. • Enable Threaded Debugging Support - Select this option to enable support for Linux kernel threaded debugging • Update Background Threads on Stop - Select this option only if you want to update the background threads on stop. Keep this option unchecked as it may increase debug speed. • Enable Delayed Software Breakpoint Support - Select this option to enable support for delayed software breakpoints during kernel debug
Modules tab	This tab allows you to add modules to the Linux kernel project and configure the module's symbolics mapping. For more information on the **Modules** tab, see Configure the Modules' Symbolics Mapping topic.

4.1.4 Trace and Profile

CodeWarrior Tracing and Performance Analysis Tools provide visibility into an application as it runs on the hardware. This visibility can help you understand how your application runs, as well as identify operational problems.

The UI Platform Configurator tool reads the user settings from the input XML file and transforms them into target access memory writes to the configuration registers.

Figure 24: Core Trace Path



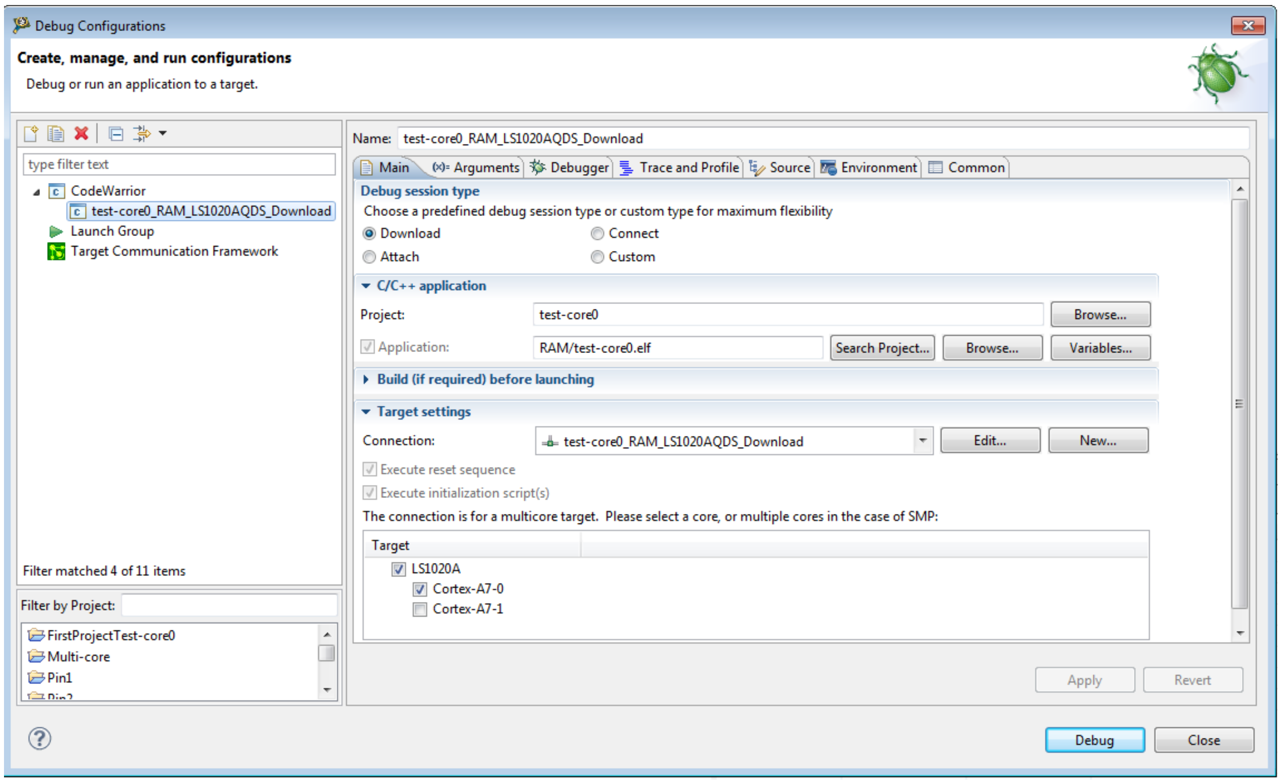
The figure above shows the core trace path within the ARMv7 architecture. The UI Platform Configurator configures the ARMv7 cores embedded trace macrocell (ETM), Funnel, embedded trace FIFO (ETF) and embedded trace router (ETR) modules. The ETF stores and forwards trace data using a dedicated RAM buffer. This reduces trace loss by absorbing spikes in trace data. The ETR redirects trace to the system bus for collection from alternative channels. For ARMv7, it is double data rate (DDR) memory.

The destination of the raw trace is either the internal trace buffer of the ETF module or a user defined buffer in DDR.

The basic setup can be done using the **Trace and Profile** tab in the Debug launch configuration:

- To enable tracing for any new project created, go to the **Debug Configuration**, select a launch configuration from **CodeWarrior** in the left panel. Select **Trace and Profile** tab from the right panel.

Figure 25: Main tab



Name: test-core0_RAM_LS1020AQDS_Download

Debug session type

Choose a predefined debug session type or custom type for maximum flexibility

(●) Download ( ) Connect ( ) Attach ( ) Custom

C/C++ application

Project: test-core0

Application: RAM/test-core0.elf

Target settings

Connection: test-core0_RAM_LS1020AQDS_Download

✓ Execute reset sequence

✓ Execute initialization script(s)

The connection is for a multicore target. Please select a core, or multiple cores in the case of SMP:

Target

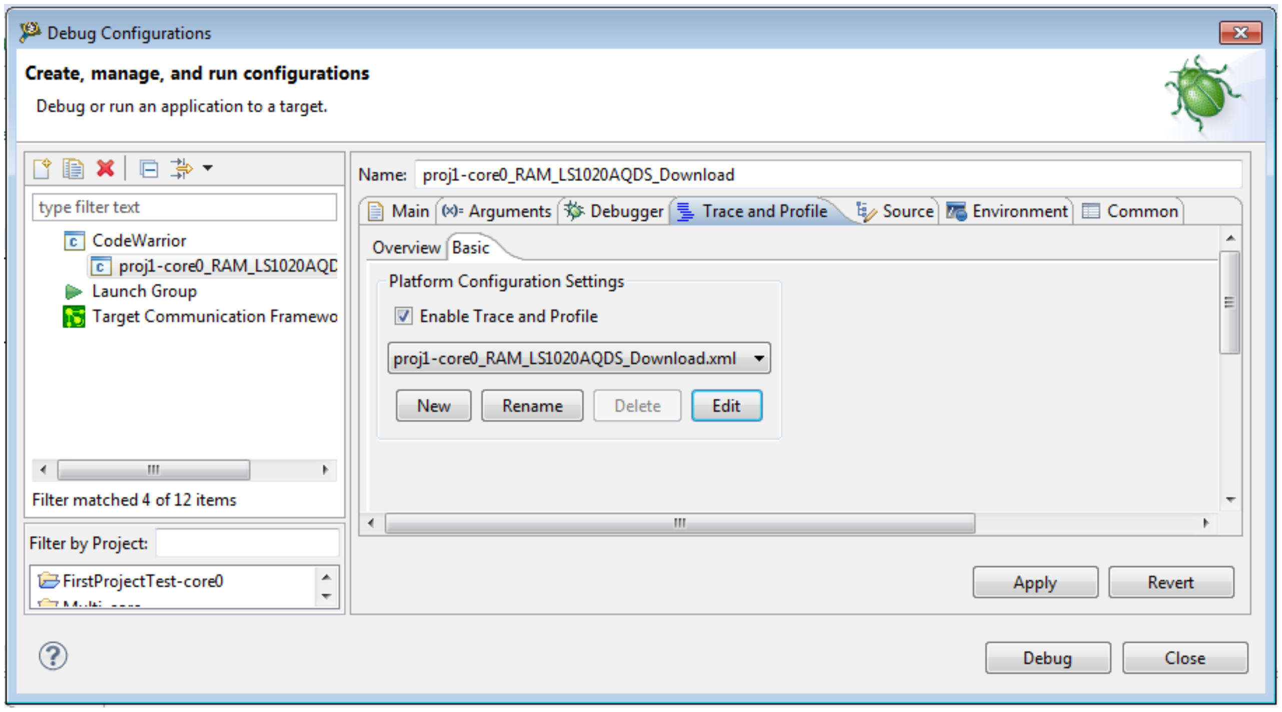
✓ LS1020A

✓ Cortex-A7-0

☐ Cortex-A7-1

- The **Overview** tab displays the information about the ARMv7 architecture.
- The **Basic** tab displays the predefined settings. For **Platform Configuration Settings**, you can apply different values based on what you want to achieve. The values are called profiles, and the framework allows creation of different profiles for a configuration block. The profiles dialog is used to create new, rename, delete or edit the settings of a profile for a configuration provider.

Figure 26: Trace and Profile tab


Debug Configurations

Create, manage, and run configurations

Debug or run an application to a target.

type filter text

CodeWarrior
proj1-core0_RAM_LS1020AQD
Launch Group
Target Communication Framewo

Filter matched 4 of 12 items

Filter by Project:

FirstProjectTest-core0

Name: proj1-core0_RAM_LS1020AQDS_Download

Main | Arguments | Debugger | Trace and Profile | Source | Environment | Common

Overview | Basic

Platform Configuration Settings

[✓] Enable Trace and Profile

proj1-core0_RAM_LS1020AQDS_Download.xml

New | Rename | Delete | Edit

Apply | Revert

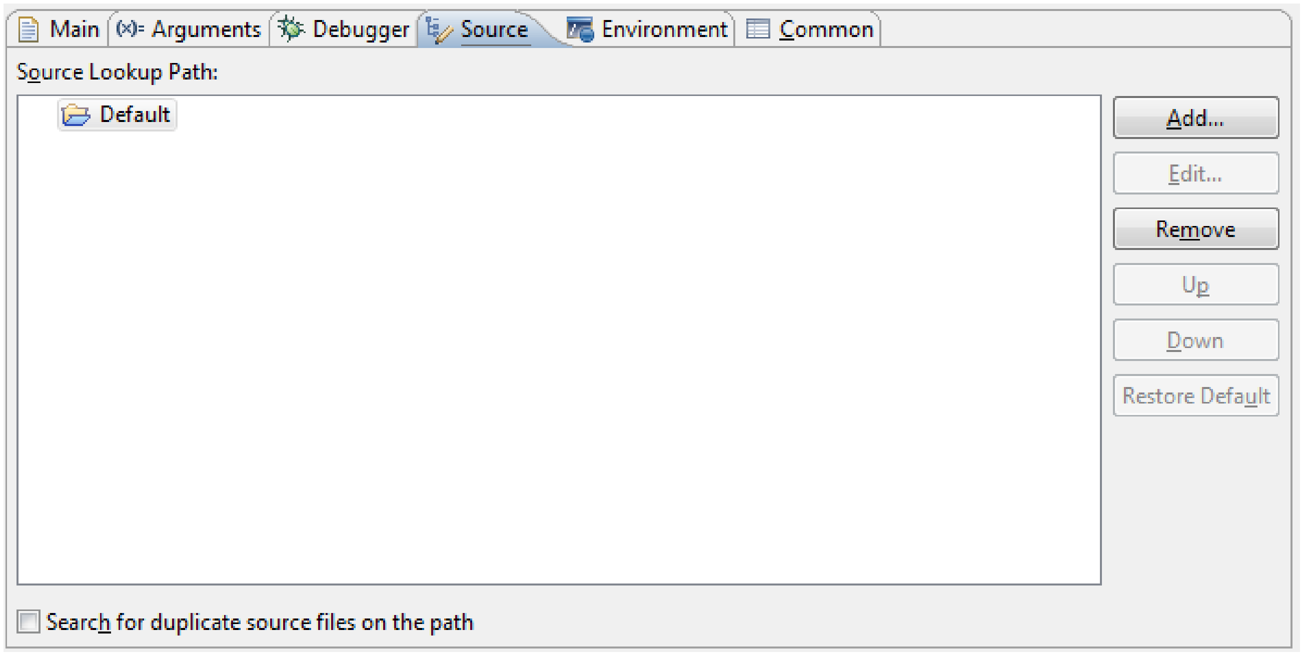
Debug | Close

4.1.5 Source

Use this tab to specify the location of source files used when debugging a C or C++ application.

By default, this information is taken from the build path of your project.

Figure 27: Debug Configurations-Source tab


Main | Arguments | Debugger | Source | Environment | Common

Source Lookup Path:

Default

Add... | Edit... | Remove | Up | Down | Restore Default

[ ] Search for duplicate source files on the path

The table below lists the various options available on the **Source** page.

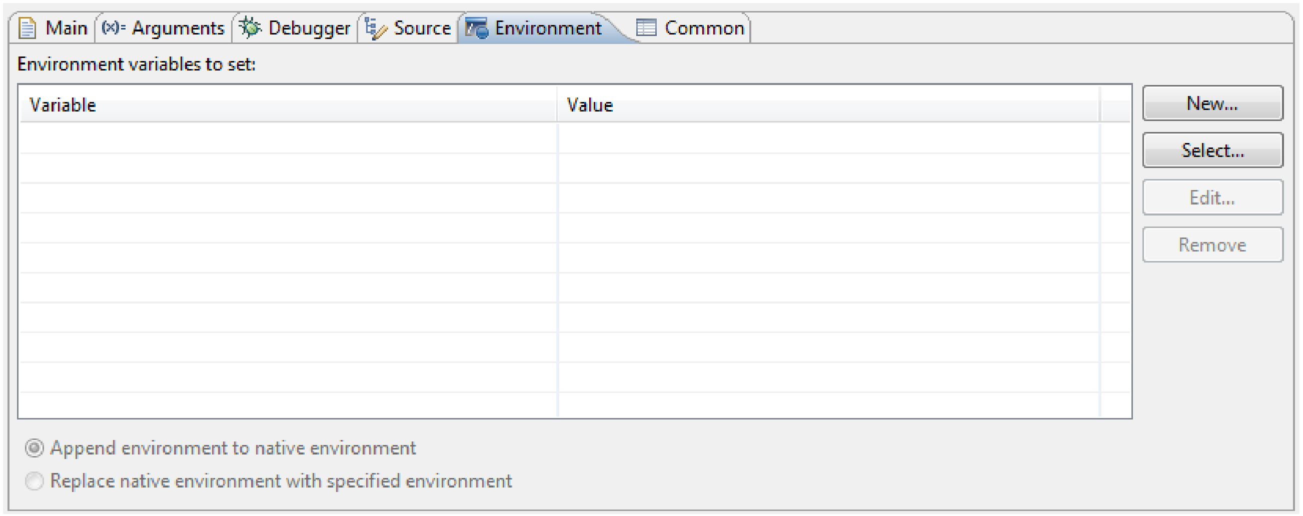
Table 38: Source tab options

Option	Description
Source Lookup Path	Lists the source paths used to load an image after connecting the debugger to the target.
Add	Click to add new source containers to the Source Lookup Path search list.
Edit	Click to modify the content of the selected source container.
Remove	Click to remove selected items from the **Source Lookup Path** list.
Up	Click to move selected items up the **Source Lookup Path** list.
Down	Click to move selected items down the **Source Lookup Path** list.
Restore Default	Click to restore the default source search list.
Search for duplicate source files on the path	Select to search for files with the same name on a selected path.

4.1.6 Environment

Use this tab to specify the environment variables and values to use when an application runs.

Figure 28: Debug Configuration-Environment tab



Environment variables to set:

Variable	Value

Append environment to native environment
Replace native environment with specified environment

The table below lists the various options available on the Environment page.

Table 39: Environment tab options

Option	Description
Environment variables to set	Lists the environment variable name and its value.

Table continues on the next page...

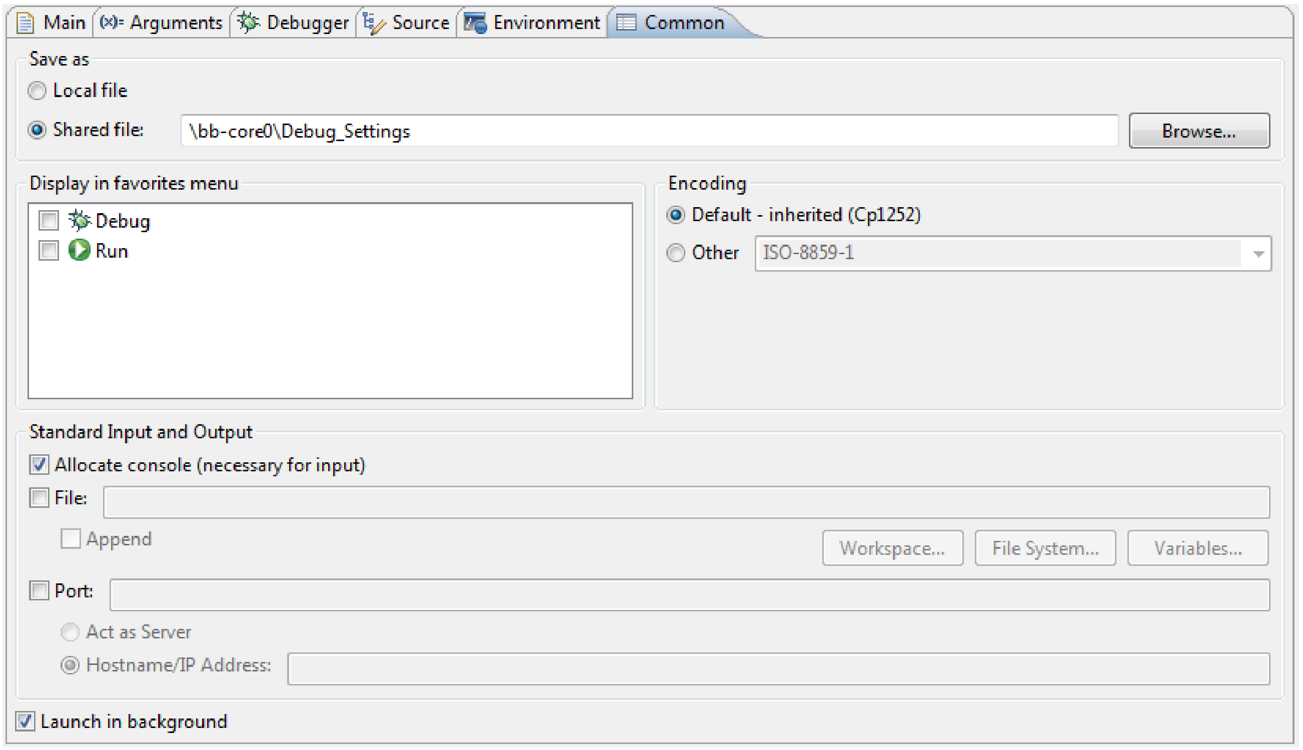
Table 39: Environment tab options (continued)

Option	Description
New	Click to create a new environment variable.
Select	Click to select an existing environment variable.
Edit	Click to modify the name and value of a selected environment variable.
Remove	Click to remove selected environment variables from the list.
Append environment to native environment	Select to append the listed environment variables to the current native environment.
Replace native environment with specified environment	Select to replace the current native environment with the specified environment set.

4.1.7 Common

Use this page to specify the location to store your run configuration, standard input and output, and background launch options.

Figure 29: Debug Configuration-Common tab



Save as
Local file [✓ Shared file: \bb-core0\Debug_Settings]

Display in favorites menu
☐ Debug
☐ Run

Encoding
[✓ Default - inherited (Cp1252)]
Other ISO-8859-1

Standard Input and Output
☑ Allocate console (necessary for input)
☐ File:
☐ Append
☐ Port:
Act as Server [✓ Hostname/IP Address:]

☑ Launch in background

The table below lists the various options available on the **Common** page.

Table 40: Common tab options

Option	Description
Local file	Select to save the launch configuration locally.
Shared file	Select to specify the path of, or browse to, a workspace to store the launch configuration file, and be able to commit it to a repository.
Display in favorites menu	Select to add the configuration name to Run or Debug menus for easy selection.
Allocate console (necessary for input)	Select to assign a console view to receive the output. You must select this option if you want to use the host CodeWarrior to view the output of the debugged application.
File	Specify the file name to save output. For Linux applications, this option provides a way to select a host-side file to redirect the output forwarded by CodeWarrior TRK to host CodeWarrior (if redirections are specified in the Arguments tab, then this feature makes no sense because redirections are using target-side files).
Append	Select to append output. Clear to recreate file each time. Selecting this option means that the file (host-side file, in case of Linux applications) mentioned in the File text box will not be overwritten for new content. Instead, the new content will be appended to the file.
Port	Select to redirect standard output (`stdout`, `stderr`) of a process being debugged to a user specified socket. NOTE: You can also use the `redirect` command in debugger shell to redirect standard output streams to a socket.
Act as Server	Select to redirect the output from the current process to a local server socket bound to the specified port.
Hostname/IP Address	Select to redirect the output from the current process to a server socket located on the specified host and bound to the specified port. The debugger will connect and write to this server socket via a client socket created on an ephemeral port
Launch in background	Select to launch configuration in background mode.

4.2 Customizing Debug Configurations

When you use the CodeWarrior wizard to create a new project, the wizard sets the project's launch configurations to default values. You can change the default values of your project's launch configurations, according to your program's requirements.

To modify the launch configurations:

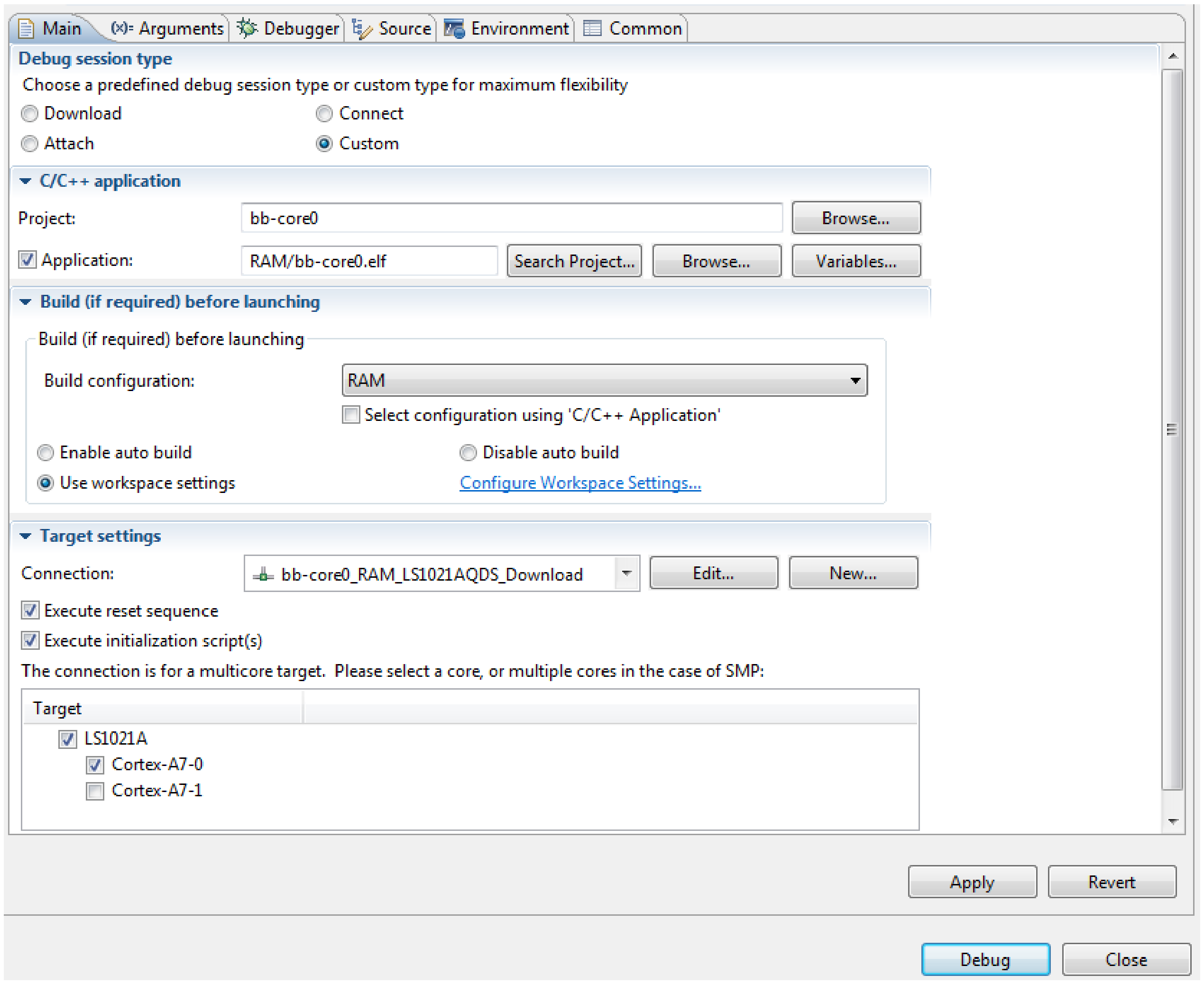
1. Start the CodeWarrior IDE.
2. From the main menu bar of the IDE, select **Run > Debug Configurations**.

The **Debug Configurations** dialog appears. The left side of this dialog has a list of debug configurations that apply to the current application.

3. Expand the **CodeWarrior** configuration.
4. From the expanded list, select the debug configuration that you want to modify.

   The following figure shows the **Debug Configurations** dialog with the settings for the debug configuration you selected.

Figure 30: CodeWarrior Debug Configuration-Main tab



Debug session type

Choose a predefined debug session type or custom type for maximum flexibility

Download Connect Attach [✓ Custom]

C/C++ application

Project: bb-core0

[✓ Application:] RAM/bb-core0.elf

Build (if required) before launching

Build configuration: RAM

Select configuration using 'C/C++ Application'

Enable auto build Disable auto build [✓ Use workspace settings]

Target settings

Connection: bb-core0_RAM_LS1021AQDS_Download

[✓ Execute reset sequence]

[✓ Execute initialization script(s)]

The connection is for a multicore target. Please select a core, or multiple cores in the case of SMP:

Target

[✓ LS1021A]

[✓ Cortex-A7-0]

Cortex-A7-1

5. In the group of tabs in the upper-right side of the dialog, click a tab.
6. Change the settings on the debug configuration page as per your requirements. See Using Debug Configurations dialog on page 53 for details on the various settings of this page.
7. Click **Apply** to save the new settings.

When you finish, you can click **Debug** to start a new debugging session, or click **Close** to save your changes and close the **Debug Configurations** dialog.

4.3 Reverting Debug Configuration settings

After making some modifications in a debug configuration's settings, you can either save the pending (unsaved) changes or revert to last saved settings.

To save the pending changes, click the **Apply** button of the **Debug Configurations** dialog, or click the **Close** button and then the **Yes** button.

To undo pending changes and restore the last saved settings, click the **Revert** button at the bottom of the **Debug Configurations** dialog.

The IDE restores the last set of saved settings to all pages of the **Debug Configurations** dialog. Also, the IDE disables the **Revert** button until you make new pending changes.

Chapter 5
Working with Debugger

This chapter explains various aspects of CodeWarrior debugging, such as debugging a project, configuring connections, setting breakpoints and watchpoints, working with registers, viewing memory, viewing cache, and debugging externally built executable files.

NOTE

This chapter documents debugger features that are specific to CodeWarrior Development Studio for QorIQ LS series - ARM V7 ISA.

This chapter explains:

5.1 Debugging CodeWarrior project

This section explains how to change the debugger settings and how to debug a CodeWarrior project.

The CodeWarrior Bareboard Project Wizard or the CodeWarrior Linux Project Wizard sets the debugger settings of a project's launch configurations to default values. You can change these default values as per your requirements.

To change the debugger settings and start debugging a CodeWarrior project, perform these steps:

1. From the CodeWarrior IDE menu bar, select **Run > Debug Configurations**. The CodeWarrior IDE uses the settings in the launch configuration to generate debugging information and initiate communications with the target board.

   The **Debug Configurations** dialog appears. The left side of this dialog box has a list of debug configurations that apply to the current application.
2. Expand the **CodeWarrior** configuration.
3. From the expanded list, select the debug configuration that you want to modify.

4. Click **Apply** to save the new settings.

TIP

You can click **Revert** to undo any of the unsaved changes. The CodeWarrior IDE restores the last set of saved settings to all pages of the **Debug Configurations** dialog. Also, the IDE disables **Revert** until you make new pending changes.

5. Click **Debug** to start the debugging session.

You just modified the debugger settings and initialized a debugging session.

5.2 Consistent debug control

This section describes the *consistent debug control* feature of the CodeWarrior debugger.

When you attempt to stop the target during a debugging session, the *consistent debug control* feature enables the debugger to report core's Doze and Nap low power management states.

In addition, the debugger at the same time grants you access to the system states, such as core registers, TLB registers, caches, and so on.

When you attempt to resume the debugging session, the debugger displays a warning message and puts the respective core in the same power management state (Doze or Nap, whichever is the previous one). The debugger waits for the core to exit out of Doze or Nap state to continue with the attempted operation.

5.3 Secure Debug mode

This section describes the secure debug feature of the CodeWarrior debugger.

If the processor is in the Secure Debug mode and if the unlock key is not provided, then a popup is displayed requesting the unlock key. If you provide a wrong key and an unlock sequence is run by the debugger with the erroneous key, then the associated part will be locked until a rest occurs, and you will need to hard reset the target board to connect to it again.

5.4 Connection types

This section describes the different connection types provided by the CodeWarrior debugger for connecting the target board to the host computer.

The CodeWarrior debugger provides the following three connection types for connecting the target board to the host computer:

- CMSIS-DAP: Available only for TWR and IOT boards
- CodeWarrior TAP (over USB): Available for QDS, RDB, TWR, and IOT boards
- CodeWarrior TAP (over Ethernet): Available for QDS, RDB, TWR, and IOT boards

5.5 Editing remote system configuration

The remote system configuration model defines the connection and system configurations where you can define a single system configuration that can be referred to by multiple connection configurations.

To edit the system configuration, perform these steps:

1. Select **Run > Debug Configurations**.

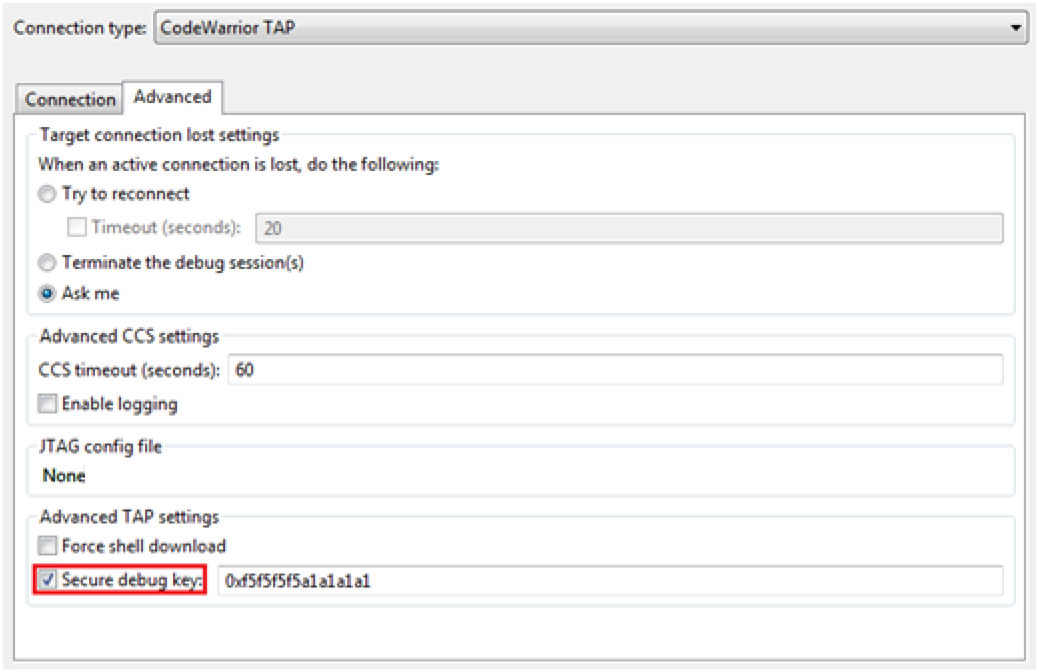
   The **Debug Configurations** dialog appears.

2. In the **Target Settings** panel, click **Edit** next to the **Connection** drop-down list.

   The **Properties for <*connection launch configuration*>** window appears.

   For targets that support the secure debug feature, the **Secure debug key** option is available on the **Advanced** tab of the **Properties for <*connection launch configuration*>** window, as shown in the figure below.

   Figure 31: Setting Secure debug key option

   Connection type: CodeWarrior TAP

   Target connection lost settings
   When an active connection is lost, do the following:
   Try to reconnect
   Timeout (seconds): 20
   Terminate the debug session(s)
   [✓ Ask me]

   Advanced CCS settings
   CCS timeout (seconds): 60
   Enable logging

   JTAG config file
   None

   Advanced TAP settings
   Force shell download
   [✓ Secure debug key:] 0xf5f5f5f5a1a1a1a1

   Select the **Secure debug key** checkbox to enable the CodeWarrior debugger to unlock the secured board with the secure debug key provided in the associated text box. If this option is not selected, then you will receive a secure debug violation error when you try to perform debugging on the locked board, and a window will appear where you can provide a secure debug key.

   If you provide a wrong key and an unlock sequence is run by the debugger with the erroneous key, then the associated part will be locked until a rest occurs, and you will need to hard reset the target board to connect to it again.

   CodeWarrior connection server (CCS) checks if the board is secured or not during chain configuration and/or reset to handle automatic unlocking with the provided secure debug key.

3. Click **Edit** next to the **Target** drop-down list.

   The **Properties for <*system launch configuration*>** window appears.

4. Select the appropriate system type from the **Target type** drop-down list.

5. Make the respective settings in Initialization tab on page 82 and Memory tab on page 83.
6. Click **OK** to save the settings.
7. Click **OK** to close the **Properties** window.

This section contains the following subsections:

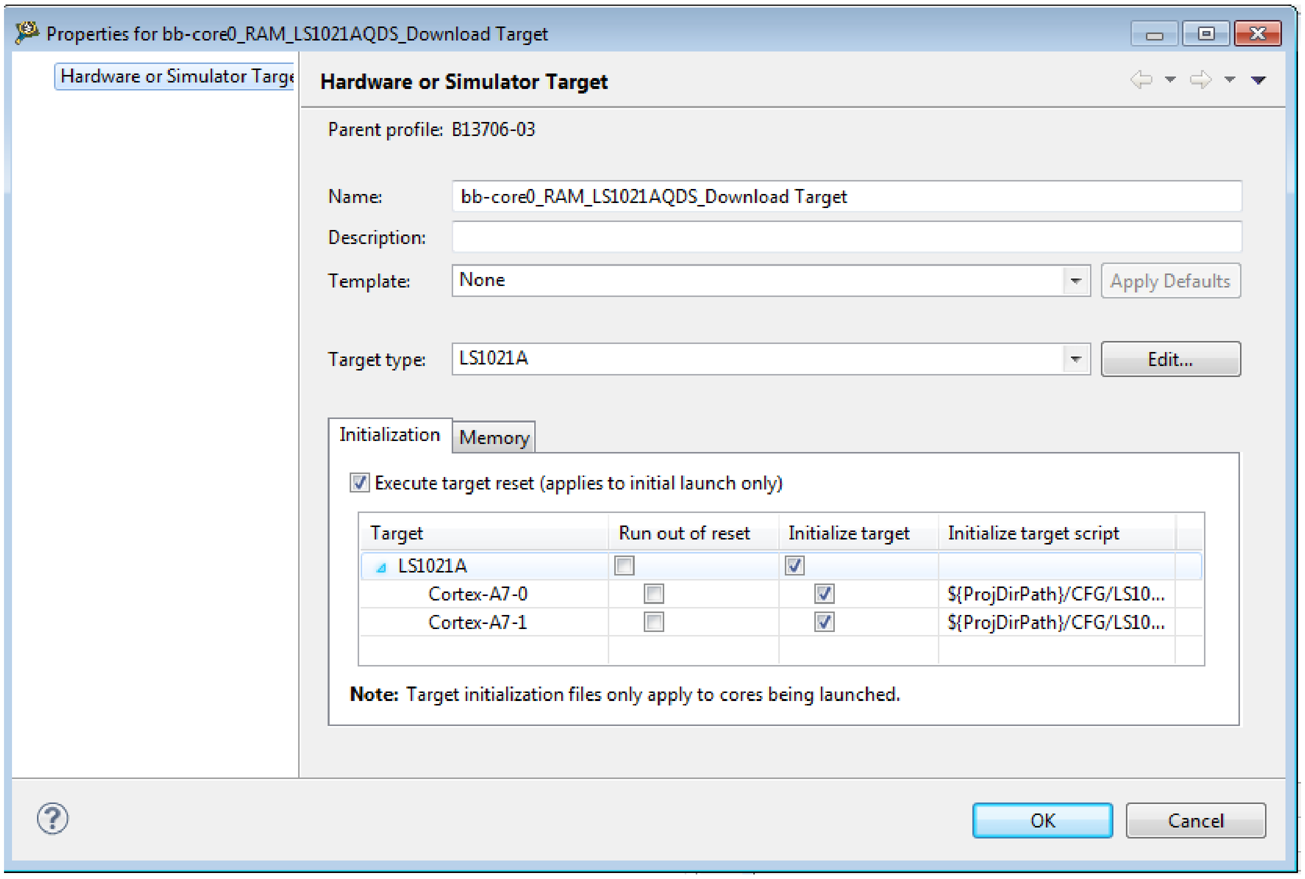
- Initialization tab on page 82
- Memory tab on page 83

5.5.1 Initialization tab

Use the Initialization tab to specify the target initialization file for various cores.

The figure below shows the settings on the Initialization tab.

Figure 32: CodeWarrior TAP connection type - Initialization tab



Properties for bb-core0_RAM_LS1021AQDS_Download Target

Hardware or Simulator Target

Parent profile: B13706-03

Name: bb-core0_RAM_LS1021AQDS_Download Target
Description:
Template: None
Target type: LS1021A

Initialization | Memory

☑ Execute target reset (applies to initial launch only)

Target	Run out of reset	Initialize target	Initialize target script
LS1021A	☐	☑	
Cortex-A7-0	☐	☑	${ProjDirPath}/CFG/LS10...
Cortex-A7-1	☐	☑	${ProjDirPath}/CFG/LS10...

Note: Target initialization files only apply to cores being launched.

The table below lists the various options available on the **Initialization** page.

Table 41: Initialization tab options

Option	Description
Execute target reset	Select to execute target system reset.
Target	Lists the targets and the supported cores.
Run out of reset	Select to include the respective core for run out of reset operation.

Table continues on the next page...

Table 41: Initialization tab options (continued)

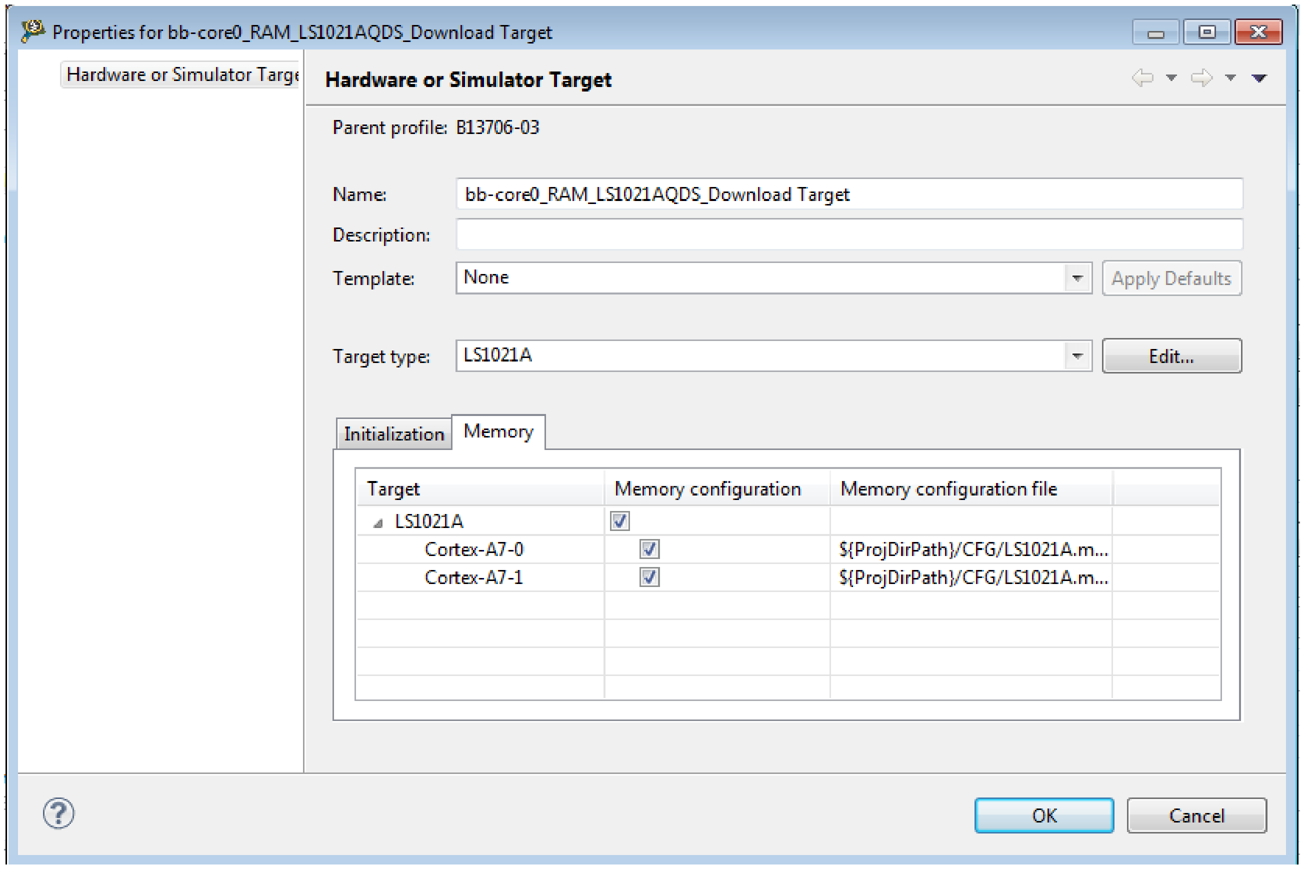
Option	Description
Initialize target	Click to specify a target initialization file for the respective core.
Initialize target script	Lists the path to a Debugger Shell Tcl script that runs when launching a debug session for the respective core. To edit, select a cell, then click the ellipsis button to open the **Target InitializationFile** dialog. The settings for a group of cores can be changed all at once by editing the cell of a common ancestor node in the Target hierarchy.

5.5.2 Memory tab

Use the Memory tab to specify the memory configuration file for various cores.

The figure below shows the settings on the Memory tab.

Figure 33: CodeWarrior TAP connection type - Memory tab


Properties for bb-core0_RAM_LS1021AQDS_Download Target
Hardware or Simulator Targe
Hardware or Simulator Target
Apply Defaults
Edit...
Initialization
Memory
OK
Cancel

Parent profile: B13706-03

Name: bb-core0_RAM_LS1021AQDS_Download Target

Description:

Template: None

Target type: LS1021A

Target	Memory configuration	Memory configuration file
LS1021A	✓	
Cortex-A7-0	✓	${ProjDirPath}/CFG/LS1021A.m...
Cortex-A7-1	✓	${ProjDirPath}/CFG/LS1021A.m...

The table below lists the various options available on the **Memory** page.

Table 42: Memory tab options

Option	Description
Target	Lists the targets and the supported cores.

Table continues on the next page...

Table 42: Memory tab options (continued)

Option	Description
Memory configuration	Select to specify a memory configuration file for the respective core.
Memory configuration file	Lists the path to the memory configuration file for the respective core. To edit, select a cell, then click the ellipsis button to open the **Memory Configuration File** dialog. The settings for a group of cores can be changed all at once by editing the cell of a common ancestor node in the Target hierarchy.

5.6 CodeWarrior command-line debugger

CodeWarrior supports a command-line interface that you can use to interact with the CodeWarrior debugger, by issuing commands.

You can use the command-line interface together with various scripting engines, such as the Microsoft® Visual Basic® script engine, the Java™ script engine, TCL, Python, and Perl. You can even issue a command that saves your command-line activity to a log file.

You use the **Debugger Shell** view to issue command lines to the IDE. For example, you enter the command `debug` in this window to start a debugging session. The window displays the standard output and standard error streams of command-line activity.

To open the **Debugger Shell** view, follow these steps:

1. Switch the IDE to the **Debug** perspective and start a debugging session.
2. Select **Window > Show View > Other**.

   The **Show View** dialog appears.
3. Expand the **Debug** group.
4. Select **Debugger Shell**.
5. Click **OK**.

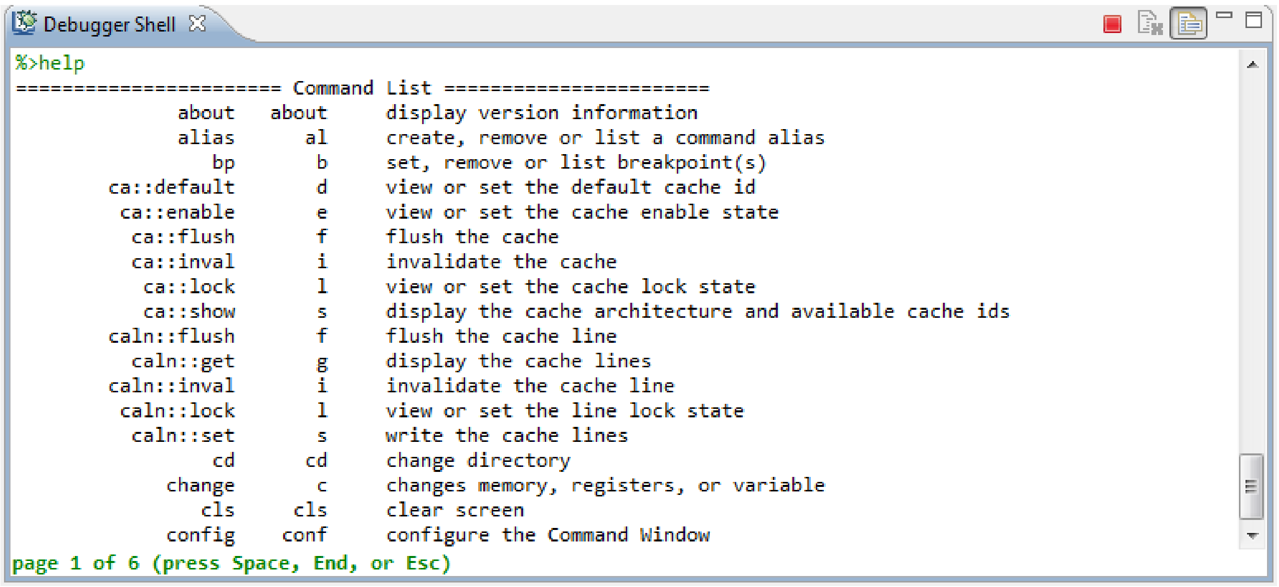
   The **Debugger Shell** view appears in the view stack at the bottom of the IDE.

To issue a command-line command, type the desired command at the command prompt (`%>`) in the **Debugger Shell** view, then press **Enter** or **Return**. The command-line debugger executes the specified command.

NOTE

To display a list of the commands the command-line debugger supports, type `help` at the command prompt and press **Enter**. The `help` command lists each supported command along with a brief description of each command.

Figure 34: Debugger Shell view


Debugger Shell

```
%>help
====================== Command List ======================
              about   about     display version information
              alias      al     create, remove or list a command alias
                 bp       b     set, remove or list breakpoint(s)
        ca::default       d     view or set the default cache id
         ca::enable       e     view or set the cache enable state
          ca::flush       f     flush the cache
          ca::inval       i     invalidate the cache
           ca::lock       l     view or set the cache lock state
           ca::show       s     display the cache architecture and available cache ids
        caln::flush       f     flush the cache line
          caln::get       g     display the cache lines
        caln::inval       i     invalidate the cache line
         caln::lock       l     view or set the line lock state
          caln::set       s     write the cache lines
                 cd      cd     change directory
             change       c     changes memory, registers, or variable
                cls     cls     clear screen
             config    conf     configure the Command Window
page 1 of 6 (press Space, End, or Esc)
```

If you work with hardware as part of your project, you can use the command-line debugger to issue commands to the debugger while the hardware is running.

TIP

To view page-wise listing of the debugger shell commands, right-click in the **Debugger Shell** view and select **Paging** from the context menu. Alternatively, click the **Enable Paging** icon from the view toolbar.

The table below lists the instructions for common command-line debugging tasks.

Table 43: Common command-line debugging tasks

Task	Instruction	Comments
Open the Debugger Shell view.	Choose **Window > Show View > Other > Debugger Shell**.	The Debugger Shell view appears.
Use the help command.	1. On the Debugger shell command prompt (%>), type `help`. 2. Press Enter key.	The command list for CodeWarrior appears.
Enter a command.	1. On the **Debugger shell**, type a command followed by a space. 2. Type any valid command-line options, separating each with a space. 3. Press Enter key.	You can use shortcuts instead of complete command names, such as `k` for `kill`.
View debug command hints.	Type alias followed by a space.	The syntax for the rest of the command appears.

Table continues on the next page...

Table 43: Common command-line debugging tasks (continued)

Task	Instruction	Comments
Review previous commands.	Press Up Arrow and Down Arrow keys.	
Clear command from the command line.	Press the Esc key.	
Stop an executing script.	Press the Esc key.	
Toggle between insert/overwrite mode.	Press the Insert key.	
Scroll up/ down a page.	Press Page Up or Page Down key.	
Scroll left/right one column.	Press Ctrl+Left Arrow or Ctrl+Right Arrow keys.	
Scroll to beginning or end of buffer.	Press Ctrl+Home or Ctrl+End keys.	

5.7 Working with Breakpoints

A breakpoint is set on an executable line of a program; if the breakpoint is enabled when you debug, the execution suspends before that line of code executes.

The different breakpoint types that you can set are listed below:

- Software breakpoints: The debugger sets a software breakpoint into target memory. When program execution reaches the breakpoint, the processor stops and activates the debugger. The breakpoint remains in the target memory until the user removes it.

  The breakpoint can only be set in writable memory, such as SRAM or DDR. You cannot use this type of breakpoints in ROM.

- Hardware breakpoints: Selecting the Hardware menu option causes the debugger to use the internal processor breakpoints. These breakpoints are usually very few and can be used with all types of memories (ROM/RAM) because they are implemented by using processor registers.

TIP

You can also set breakpoint types by issuing the `bp` command in the **Debugger Shell** view.

In this section:

- Setting Breakpoints on page 86
- Setting Hardware Breakpoints on page 89
- Removing Breakpoints on page 90

5.7.1 Setting Breakpoints

This section explains how to set breakpoints within a program in CodeWarrior IDE.

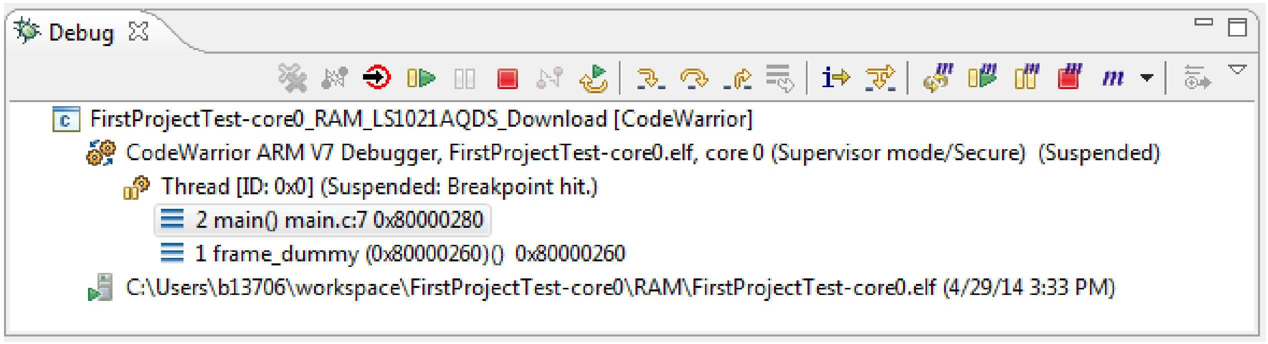
To set a breakpoint, perform the following steps:

1. Switch to the **Debug** perspective in CodeWarrior IDE.

2. Open the **Debug** view if it is not already open by selecting **Window** > **Show View** > **Debug**.

   The **Debug** view appears, shown in the figure below.

Figure 35: Debug view

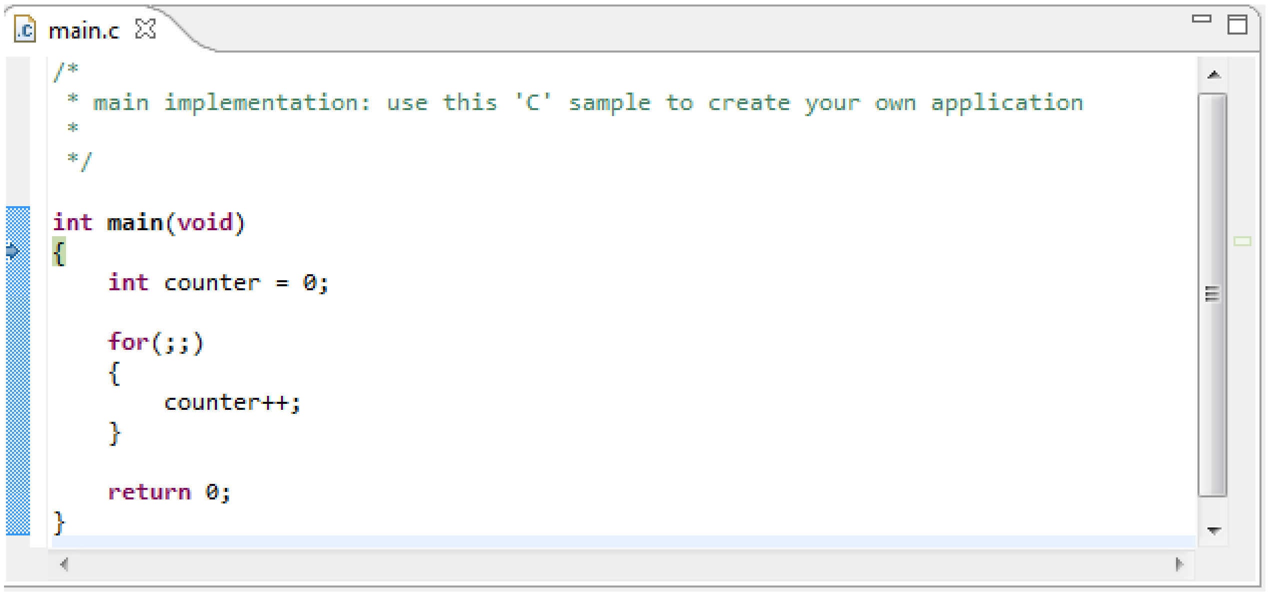


```
FirstProjectTest-core0_RAM_LS1021AQDS_Download [CodeWarrior]
    CodeWarrior ARM V7 Debugger, FirstProjectTest-core0.elf, core 0 (Supervisor mode/Secure)  (Suspended)
        Thread [ID: 0x0] (Suspended: Breakpoint hit.)
            2 main() main.c:7 0x80000280
            1 frame_dummy (0x80000260)()  0x80000260
    C:\Users\b13706\workspace\FirstProjectTest-core0\RAM\FirstProjectTest-core0.elf (4/29/14 3:33 PM)
```

3. Expand the **Thread** group.
4. Under the **Thread** group, select the thread that has the `main()` function.

   The source code appears in the **Editor** view (shown in the figure below). The small blue arrow to the left of the source code indicates which code statement the processor's program counter is set to execute next.

Figure 36: Editor view



```
/*
 * main implementation: use this 'C' sample to create your own application
 *
 */

int main(void)
{
    int counter = 0;

    for(;;)
    {
        counter++;
    }

    return 0;
}
```

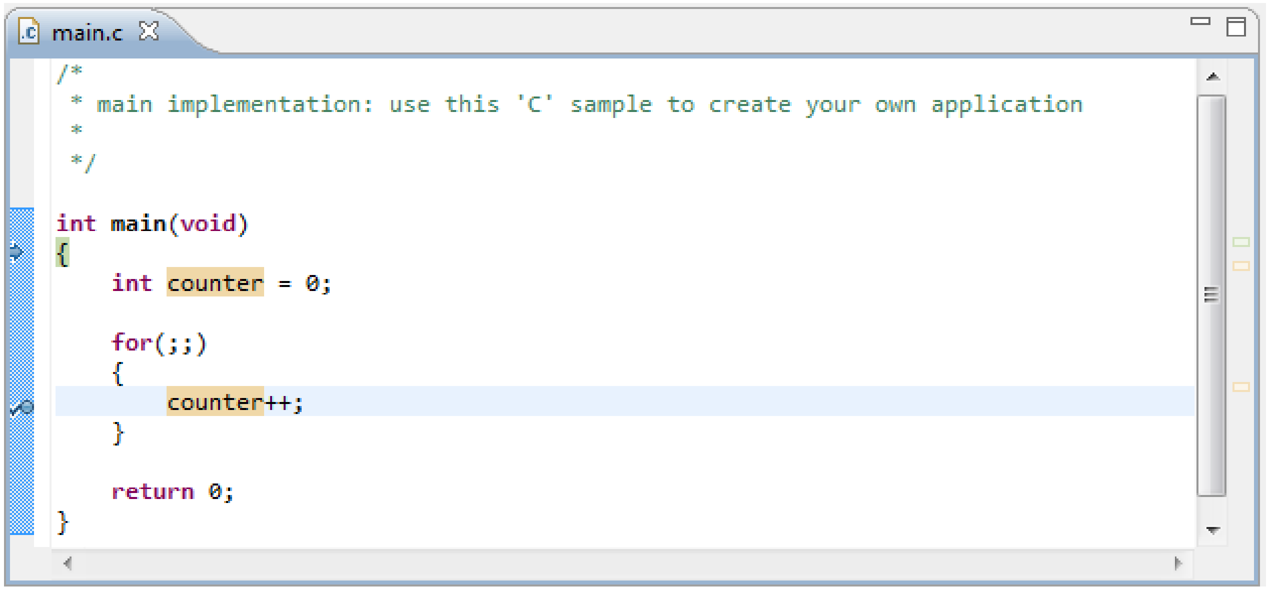
5. In the **Editor** view, place the cursor on the line that has this statement: `counter++;`
6. Select **Run** > **Toggle Line Breakpoint**.

   A blue dot appears in the marker bar to the left of the line (shown in the figure below). This dot indicates an enabled breakpoint. After the debugger installs the breakpoint, a blue checkmark appears beside the dot. The debugger installs a breakpoint by loading into the Java™ virtual machine the code in which you set that breakpoint.

TIP

An alternate way to set a breakpoint is to double-click the marker bar to the left of any source-code line. If you set the breakpoint on a line that does not have an executable statement, the debugger moves the breakpoint to the closest subsequent line that has an executable statement. The marker bar shows the installed breakpoint location. If you want to set a hardware breakpoint instead of a software breakpoint, use the `bp` command in the **Debugger Shell** view. You can also right-click the marker bar to the left of any source-code line, and select **Set Special Breakpoint** from the context menu that appears.

Figure 37: Editor view - after setting breakpoints

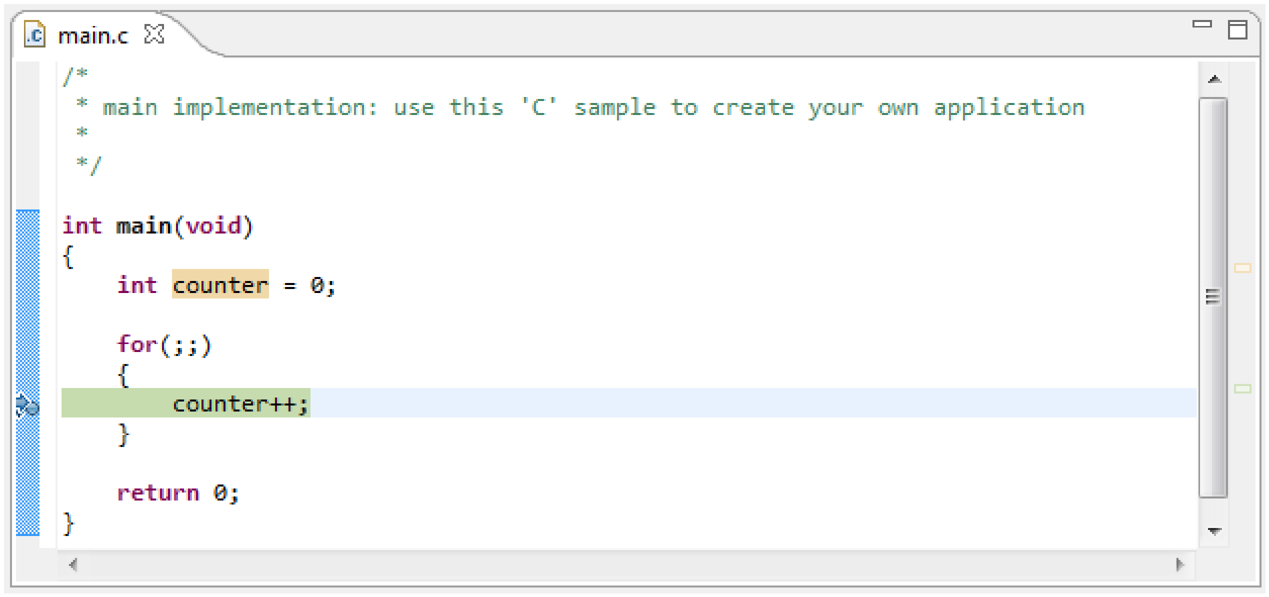


```
/*
 * main implementation: use this 'C' sample to create your own application
 *
 */

int main(void)
{
    int counter = 0;

    for(;;)
    {
        counter++;
    }

    return 0;
}
```

7. From the menu bar, select **Run > Resume.**

The debugger executes all lines up to, but not including, the line at which you set the breakpoint. The editor view highlights the line at which the debugger suspended execution (shown in the figure below). Note also that the program counter (blue arrow) is positioned here.

Figure 38: Editor view - after reaching a breakpoint



```
/*
 * main implementation: use this 'C' sample to create your own application
 *
 */

int main(void)
{
    int counter = 0;

    for(;;)
    {
        counter++;
    }

    return 0;
}
```

5.7.2 Setting Hardware Breakpoints

This section explains how to set hardware breakpoints within a program in CodeWarrior IDE.

There are two ways to set hardware breakpoints:

- Using IDE to set Hardware Breakpoints on page 89
- Using Debugger Shell to set Hardware Breakpoints on page 89

5.7.2.1 Using IDE to set Hardware Breakpoints

This section explains how to set a hardware breakpoint using CodeWarrior IDE.

The steps are as follows:

1. In the CodeWarrior IDE, select **Run > Breakpoint Types > C/C++ Hardware Breakpoints**.
2. In the **Editor** view, click in the source line where you want to place the breakpoint.
3. Select **Run > Toggle Breakpoint**.

   A hardware breakpoint appears in the marker bar on the left side of the source line.

5.7.2.2 Using Debugger Shell to set Hardware Breakpoints

This section explains how to set a hardware breakpoint using the **Debugger Shell** view.

The steps are as follows:

1. Open the **Debugger Shell** view.
2. Begin the command line with the text:

```
bp -hw
```

3. Complete the command line by specifying the function, address, or file at which you want to set the hardware breakpoint.

For example, to set a breakpoint for line 6 in your program, type:

```
bp -hw 6
```

4. Press the Enter key.

   The debugger shell executes the command and sets the hardware breakpoint.

   TIP

   Enter help `bp` at the command-line prompt to see examples of the `bp` command syntax and usage.

5.7.3 Removing Breakpoints

This section explains how to remove breakpoints from a program in CodeWarrior IDE.

To remove a breakpoint from your program, you have two options:

- Remove Breakpoints using Marker Bar on page 90
- Remove Breakpoints using Breakpoints view on page 90

5.7.3.1 Remove Breakpoints using Marker Bar

This section explains how to remove an existing breakpoint using the marker bar.

The steps are as follows:

1. Right-click the breakpoint in the marker bar.
2. Select **Toggle Breakpoint** from the menu that appears.

5.7.3.2 Remove Breakpoints using Breakpoints view

This section explains how to remove an existing breakpoint using the **Breakpoints** view.

The steps are as follows:

1. Open the **Breakpoints** view if it is not already open by selecting **Window > Show View > Breakpoints.**

   The **Breakpoints** view appears, displaying a list of breakpoints.

2. Right-click the breakpoint you wish to remove and select **Remove** from the menu that appears.

   The selected breakpoint is removed, and it disappears from the both the marker bar and the list in the view.

   NOTE

   To remove all of the breakpoints from the program at once, select **Remove All** from the menu.

5.8 Working with Watchpoints

A watchpoint is another name for a data breakpoint that you can set on an address or a range of addresses in the memory.

The debugger halts execution each time the watchpoint location is read, written, or accessed (read or written). You can set a watchpoint using the **Add Watchpoint** dialog. To open the **Add Watchpoint** dialog, use one of the following views:

- **Breakpoints** view

- **Memory** view
- **Variables** view

The debugger handles both watchpoints and breakpoints in similar manners. You can use the **Breakpoints** view to manage both watchpoints and breakpoints. It means, you can use the **Breakpoints** view to add, remove, enable, and disable both watchpoints and breakpoints. The debugger attempts to set the watchpoint if a session is in progress based on the active debugging context (the active context is the selected project in the **Debug** view).

If the debugger sets the watchpoint when no debugging session is in progress, or when re-starting a debugging session, the debugger attempts to set the watchpoint at startup as it does for breakpoints. The **Problems** view displays error messages when the debugger fails to set a watchpoint. For example, if you set watchpoints on overlapping memory ranges, or if a watchpoint falls out of execution scope, an error message appears in the **Problems** view. You can use this view to see additional information about the error.

The following sections explain how to set or remove watchpoints:

- Setting Watchpoints on page 91
- Removing Watchpoints on page 93

5.8.1 Setting Watchpoints

Use the **Add Watchpoint** dialog to create a watchpoint for a memory range.

You can specify these parameters for a watchpoint:

- An address (including memory space)
- An expression that evaluates to an address
- A memory range
- An access type on which to trigger

To open the **Add Watchpoint** dialog, follow these steps:

1. Open the **Debug** perspective.
2. Click one of these tabs:
    - **Breakpoints**
    - **Memory**
    - **Variables**

    The corresponding view appears.
3. Right-click the appropriate content inside the view as mentioned in the table below.

Table 44: Opening Add Watchpoint dialog

In the view...	Right-click...
Breakpoints	An empty area inside the view.
Memory	The cell or range of cells on which you want to set the watchpoint.
Variables	A global variable.

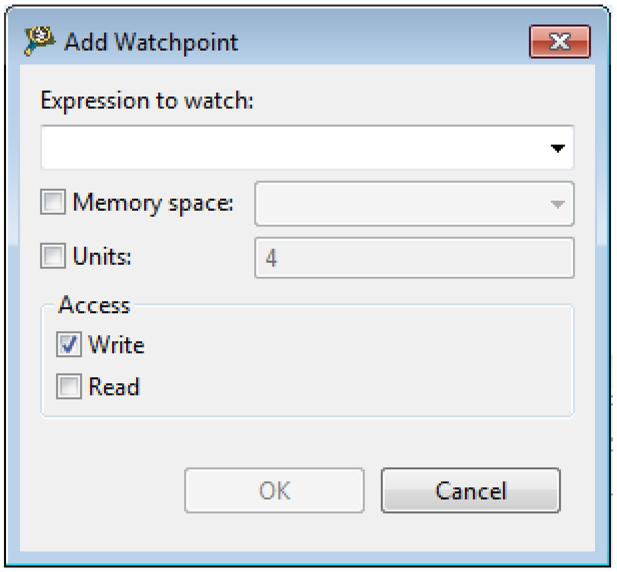
NOTE

The debugger does not support setting a watchpoint on a stack variable or a register variable.

4. Select **Add Watchpoint (C/C++)** from the context menu that appears.

The **Add Watchpoint** dialog appears (shown in the figure below). The debugger sets the watchpoint according to the settings that you specify in the **Add Watchpoint** dialog. The **Breakpoints** view shows information about the newly set watchpoint. The **Problems** view shows error messages when the debugger fails to set the watchpoint.

Figure 39: Add Watchpoint dialog



The table below describes the options available in the **Add Watchpoint** dialog.

Table 45: Add Watchpoint dialog options

Option	Description
Expression to watch	Enter an expression that evaluates to an address on the target device. When the specified expression evaluates to an invalid address, the debugger halts execution and displays an error message. You can enter these types of expressions: • An r-value, such as `&variable` • A register-based expression. Use the $ character to denote register names. For example, enter `$SP-12` to have the debugger set a watchpoint on the stack pointer address minus 12 bytes. The **Add Watchpoint** dialog does not support entering expressions that evaluate to registers.
Memory space	Select this option to specify an address, including memory space, at which to set the watchpoint. Use the text box to specify the address or address range on which to set the watchpoint. If a debugging session is not active, the text/list box is empty, but you can still type an address or address range.
Units	Enter the number of addressable units that the watchpoint monitors.
Write	Select this option to enable the watchpoint to monitor write activity on the specified memory space and address range. Clear this option if you do not want the watchpoint to monitor write activity.

Table continues on the next page...

Table 45: Add Watchpoint dialog options (continued)

Option	Description
Read	Select this option to enable the watchpoint to monitor read activity on the specified memory space and address range. Clear this option if you do not want the watchpoint to monitor read activity.

5.8.2 Removing Watchpoints

This section explains how to remove a watchpoint.

The steps are as follows:

1. Open the **Breakpoints** view if it is not already open by selecting **Window > Show View > Breakpoints.**

   The **Breakpoints** view appears, displaying a list of watchpoints.
2. Right-click the watchpoint you wish to remove and select **Remove** from the menu that appears.

   The selected watchpoint is removed, and it disappears from the list in the **Breakpoints** view.

5.9 Working with Registers

Use the **Registers** view to display and modify the contents of the registers of the processor on your target board.

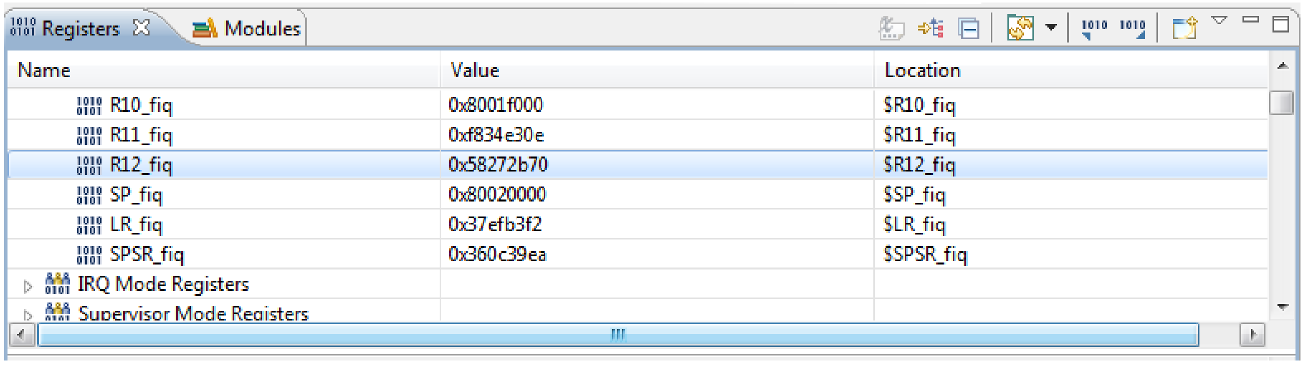
To display the **Registers** view, select **Window > Show View > Other > Debug > Registers**. The **Registers** view appears (shown in the figure below). The default state of the **Registers** view provides details on the processor's registers.

The **Registers** view displays categories of registers in a tree format. To display the contents of a particular category of registers, expand the tree element of the register category of interest. The figure below shows the **Registers** view with the **General Purpose Registers** tree element expanded.

TIP

You can also view and update registers by issuing the `reg`, `change`, and `display` commands in the **Debugger Shell** view.

Figure 40: Registers view



Name	Value	Location
R10_fiq	0x8001f000	$R10_fiq
R11_fiq	0xf834e30e	$R11_fiq
R12_fiq	0x58272b70	$R12_fiq
SP_fiq	0x80020000	$SP_fiq
LR_fiq	0x37efb3f2	$LR_fiq
SPSR_fiq	0x360c39ea	$SPSR_fiq
IRQ Mode Registers		
Supervisor Mode Registers		

In this section:

- Changing bit value of register on page 94

- Viewing Register details on page 94
- Registers view context menu on page 98
- Working with Register Groups on page 99

5.9.1 Changing bit value of register

This section explains how to change a bit value in a register.

The steps are as follows:

1. Switch the IDE to the **Debug** perspective and start a debug session.
2. Open the **Registers** view by selecting **Window > Show View > Other > Debug > Registers**.
3. In the **Registers** view, expand the register group that contains the register with the bit value that you want to change.
4. Click the register's current bit value in the view's **Value** column.

   The value becomes editable.
5. Type in the new value.
6. Press the Enter key.

   The debugger updates the bit value. The bit value in the **Value** column changes to reflect your modification.

5.9.2 Viewing Register details

You can view the registers and their descriptions using the **Registers** view.

The steps are as follows:

1. Start a debug session.
2. In the **Debug** perspective, click the **Registers** view tab.

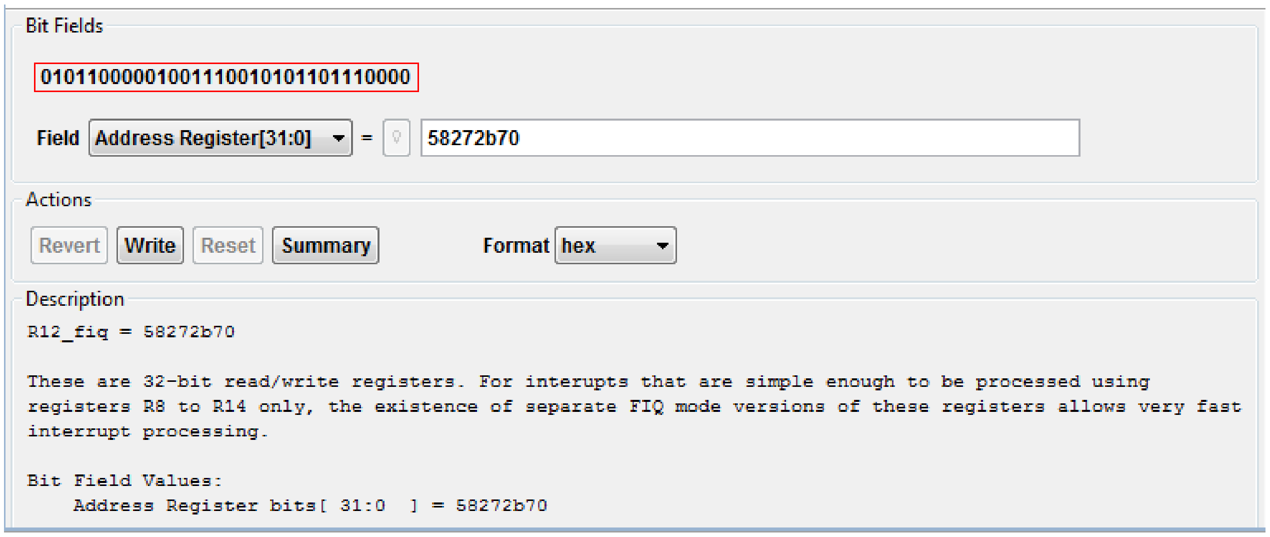
   The **Registers** view appears.
3. Click the **View Menu** button (the inverted triangle) on the **Registers** view toolbar.
4. Select **Layout > Vertical** or **Layout > Horizontal** to show register details.

   NOTE

   Selecting **Layout > Registers View Only** hides the register details.

   The details of the register, selected by default in the **Registers** view, are displayed, as shown in the figure below.

Figure 41: Registers view - Register details



01011000001001110010101101110000

Field Address Register[31:0] = 58272b70

```
R12_fiq = 58272b70

These are 32-bit read/write registers. For interupts that are simple enough to be processed using
registers R8 to R14 only, the existence of separate FIQ mode versions of these registers allows very fast
interrupt processing.

Bit Field Values:
    Address Register bits[ 31:0   ] = 58272b70
```

5. Expand a register group to see individual registers.
6. Select a specific register by clicking it.

   The details of the selected register get displayed.

NOTE
Use the **Format** list box to change the format of data displayed for the selected register.

7. Examine register details. For example,
   - Use the Bit Fields on page 96 group to see a graphical representation of the selected register's bit fields. You can use this graphical representation to select specific bits or bit fields.
   - Use the Actions on page 97 group to perform operations, such as update bit field values and format the displayed register data.
   - Use the Description on page 98 group to see an explanation of the selected register, bit field, or bit value.

TIP
To enlarge the **Registers** view, click **Maximize** on the view's toolbar. After you finish looking at the register details, click **Restore** on the view's toolbar to return the view to its previous size. Alternatively, right-click the **Registers** tab and select **Detached**. The **Registers** view becomes a floating window that you can resize. After you finish looking at the register details, right-click the **Registers** tab of the floating window and select **Detached** again. You can rearrange the re-attached view by dragging its tab to a different collection of view tabs.

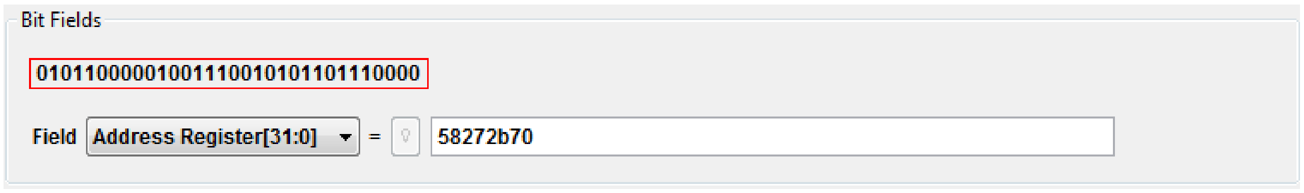
This section contains the following subsections:

5.9.2.1 Bit Fields

The **Bit Fields** group of the **Registers** view shows a graphical representation of the selected register's bit values.

This graphical representation (shown in the figure below) shows how the register organizes bits. You can use this representation to select and change the register's bit values. Hover the cursor over each part of the graphical representation in order to see additional information.

Figure 42: Register Details - Bit Fields group



01011000001001110010101101110000

Field: Address Register[31:0] = 58272b70

TIP
You can also view register details by issuing the `reg` command in the **Debugger Shell** view.

A bit field is either a single bit or a collection of bits within a register. Each bit field has a mnemonic name that identifies it. You can use the **Field** list box to view and select a particular bit field of the selected register. The list box shows the mnemonic name and bit-value range of each bit field. In the Bit Fields graphical representation, a box surrounds each bit field. A red box surrounds the bit field shown in the **Field** list box.

After you use the **Field** list box to select a particular bit field, you see its current value in the **=** text box. If you change the value shown in the text box, the **Registers** view shows the new bit field value.

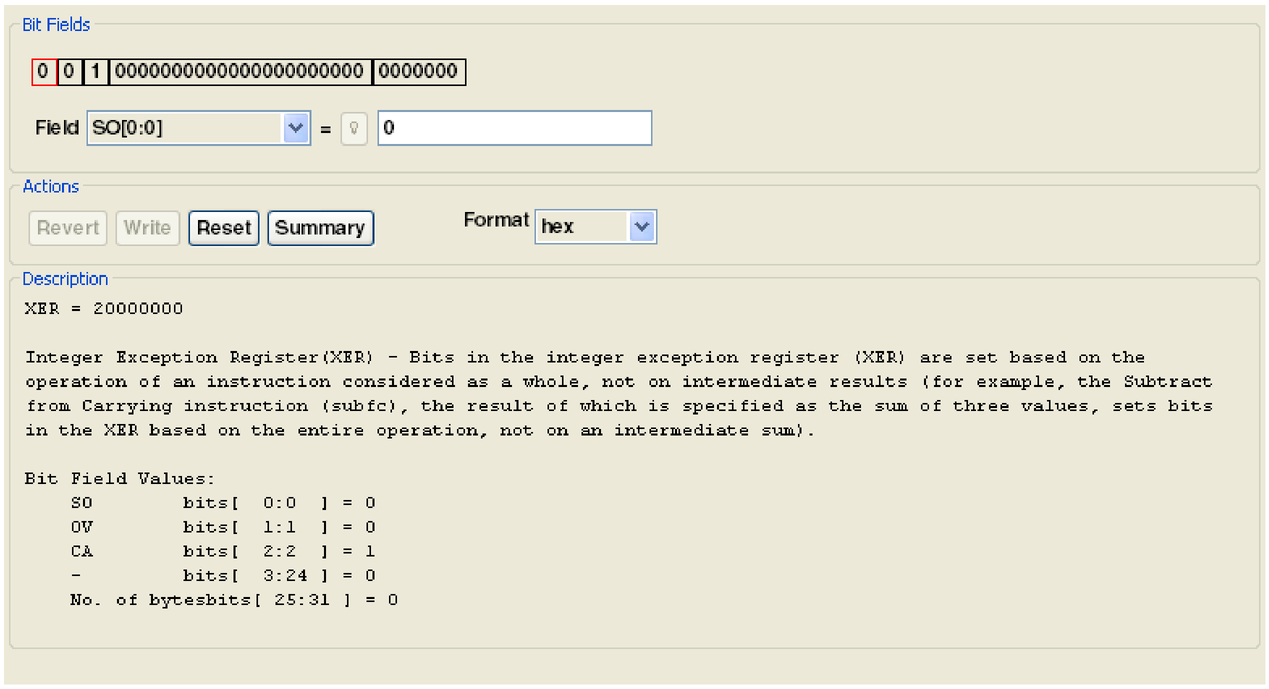
To change a bit field in a register, you must first start a debugging session, and then open the **Registers** view.

To change a bit field, perform these steps:

1. In the **Registers** view, view register details.
2. Expand the register group that contains the bit field you want to change.

   Register details appear in the **Registers** view (shown in the figure below).

Figure 43: Registers view - Register Details



```
XER = 20000000

Integer Exception Register(XER) - Bits in the integer exception register (XER) are set based on the
operation of an instruction considered as a whole, not on intermediate results (for example, the Subtract
from Carrying instruction (subfc), the result of which is specified as the sum of three values, sets bits
in the XER based on the entire operation, not on an intermediate sum).

Bit Field Values:
    SO        bits[  0:0  ] = 0
    OV        bits[  1:1  ] = 0
    CA        bits[  2:2  ] = 1
    -         bits[  3:24 ] = 0
    No. of bytesbits[ 25:31 ] = 0
```

3. From the expanded register group above the register details, select the name of the register that contains the bit field that you want to change.

   The **Bit Fields** group displays a graphical representation of the selected bit field. The **Description** group displays explanatory information about the selected bit field and parent register.
4. In the **Bit Fields** group, click the bit field that you want to change. Alternatively, use the **Field** list box to specify the bit field that you want to change.
5. In the **=** text box, type the new value that you want to assign to the bit field.
6. In the **Action** group, click **Write**.

   The debugger updates the bit field value. The bit values in the **Value** column and the **Bit Fields** group change to reflect your modification.

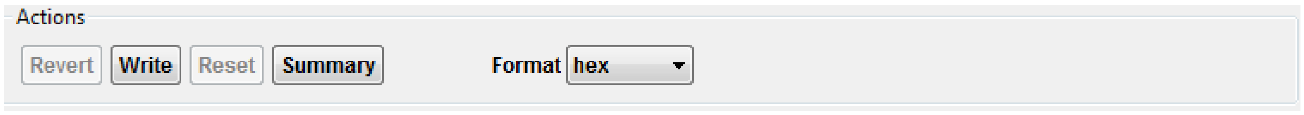
NOTE
Click **Revert** to discard your changes and restore the original bit field value.

5.9.2.2 Actions

Use the **Actions** group of the **Registers** view to perform various operations on the selected register's bit field values.

The figure below shows the **Actions** group.

Figure 44: Register view - Actions Group



The table below lists each item in the **Actions** group and explains the purpose of each.

Table 46: Actions Group Items

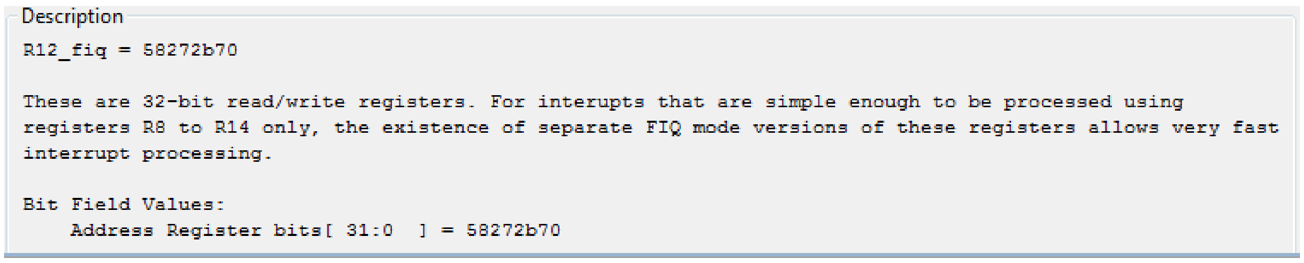
Item	Description
Revert	Discard your changes to the current bit field value and restore the original value. The debugger disables this button if you have not made any changes to the bit field value.
Write	Save your changes to the current bit field value and write those changes into the register's bit field. The debugger disables this button after writing the new bit field value, or if you have not made any changes to that value.
Reset	Change each bit of the bit field value to its register-reset value. The register takes on this value after a target-device reset occurs. To confirm the bit field change, click **Write**. To cancel the change, click **Revert**.
Summary	Display **Description** group content in a pop-up window. Press the Esc key to close the pop-up window.
Format	Specify the data format of the displayed bit field values.

5.9.2.3 Description

The **Description** group of the **Registers** view shows explanatory information for the selected register.

The figure below shows the **Description** group.

Figure 45: Register view - Description group



```
R12_fiq = 58272b70

These are 32-bit read/write registers. For interupts that are simple enough to be processed using
registers R8 to R14 only, the existence of separate FIQ mode versions of these registers allows very fast
interrupt processing.

Bit Field Values:
    Address Register bits[ 31:0  ] = 58272b70
```

The register information covers:

- Current value
- Description
- Bit field explanations and values

Some registers have multiple modes (meaning that the register's bits can have multiple meanings, depending on the current mode). If the register you examine has multiple modes, you must select the appropriate mode.

5.9.3 Registers view context menu

The registers view context menu provides you various options for working with registers.

To display the registers view context menu, right-click a register in the **Registers** view.

The table below lists the options of the registers view context menu.

Table 47: Registers view context menu options

Option	Description
Select All	Selects the entire contents of the current register.
Copy Registers	Copies to the system clipboard the contents of the selected register.
Enable	Allows the debugger to access the selected register.
Disable	Prevents the debugger from accessing the selected register.
View Memory	Displays the corresponding memory for the selected register.
Cast to Type	Opens a dialog that you can use to cast the selected register value to a different data type.
Restore Original Type	Reverts the selected register value to its default data type.
Find	Opens a dialog that you can use to select a particular register.
Change Value	Opens a dialog that you can use to change the current register value.
Add Register Group	Opens a dialog that you can use to create a new collection of registers to display in the **Registers** view.
Restore Default Register Groups	Resets the custom groups of registers created using the **Add Register Group** option, and restores the default groups provided by the debugger as they were when CodeWarrior was installed. Note that if you select this option, all custom groupings of registers done by you are lost.

5.9.4 Working with Register Groups

This section describes different operations that can be performed on register groups.

You can perform the following operations on the register groups:

- Adding Register Group on page 99
- Editing Register Group on page 100
- Removing Register Group on page 101

5.9.4.1 Adding Register Group

The default display of the **Registers** view groups related registers into a tree structure. You can add a custom group of registers to the default tree structure.

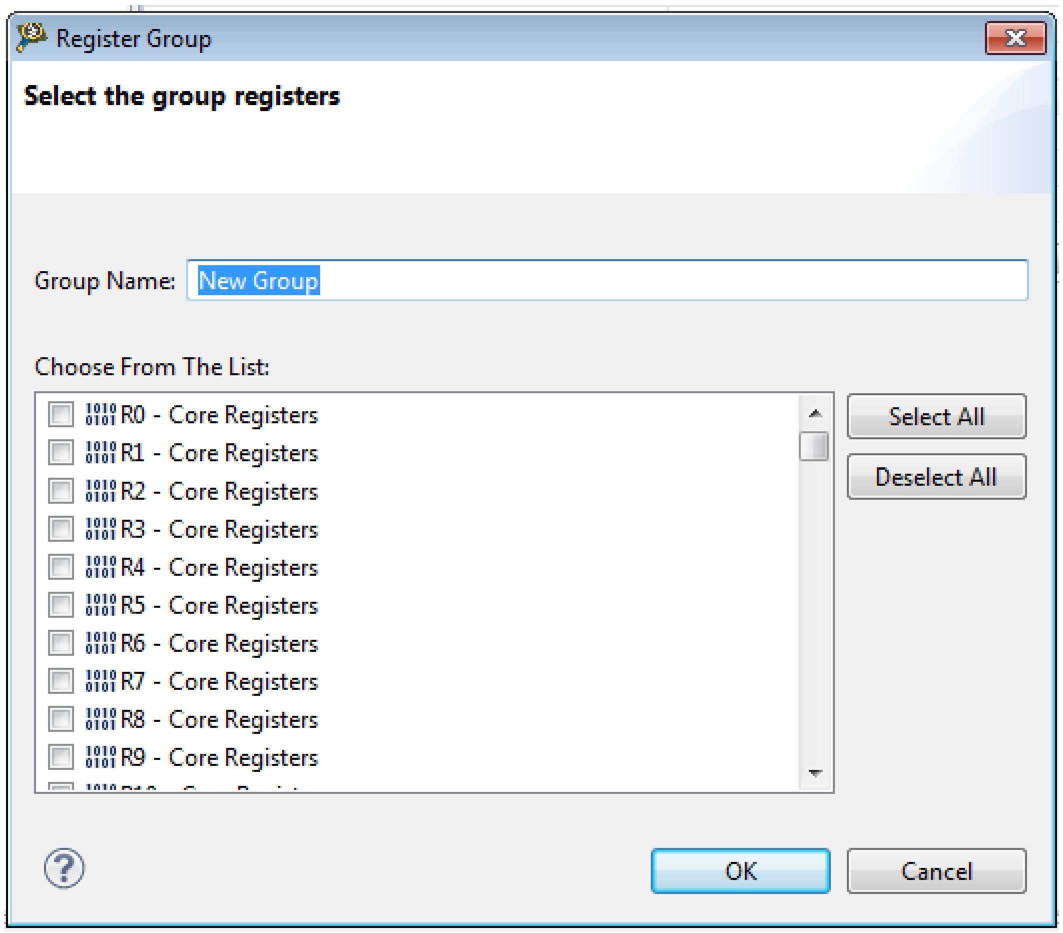
To add a new register group, perform these steps:

1. Right-click in the **Registers** view.

   A context menu appears.
2. Select **Add Register Group** from the context menu.

   The **Register Group** dialog appears, as shown in the figure below.

Figure 46: Register Group dialog



Group Name: New Group

R0 - Core Registers
R1 - Core Registers
R2 - Core Registers
R3 - Core Registers
R4 - Core Registers
R5 - Core Registers
R6 - Core Registers
R7 - Core Registers
R8 - Core Registers
R9 - Core Registers

3. Enter in the **Group Name** text box a descriptive name for the new group.
4. Select the checkbox next to each register you want to appear in the new group.

TIP
Click **Select All** to check all of the checkboxes. Click **Deselect All** to clear all of the checkboxes.

5. Click **OK**.

   The **Register Group** dialog closes. The new group name appears in the **Registers** view.

5.9.4.2 Editing Register Group

In the **Registers** view, you can edit both the default register groups and the groups that you add.

To do so, use the following steps:

1. In the **Registers** view, right-click the name of the register group you want to edit.

   A context menu appears.
2. Select **Edit Register Group** from the context menu.

   The **Register Group** dialog appears.
3. If you wish, enter in the **Group Name** text box a new name for the group.

4. Select the checkbox next to each register you want to appear in the group.

   TIP
   Click **Select All** to check all of the checkboxes. Click **Deselect All** to clear all of the checkboxes.

5. Click **OK**.

   The **Register Group** dialog closes. The new group name appears in the **Registers** view.

5.9.4.3 Removing Register Group

In the **Registers** view, you can remove register groups.

To remove a register group, follow these steps:

1. In the **Registers** view, right-click the name of register group that you wish to remove.

   A context menu appears.

2. Select **Remove Register Group** from the context menu.

   The selected register group disappears from the **Registers** view.

5.10 Viewing Memory

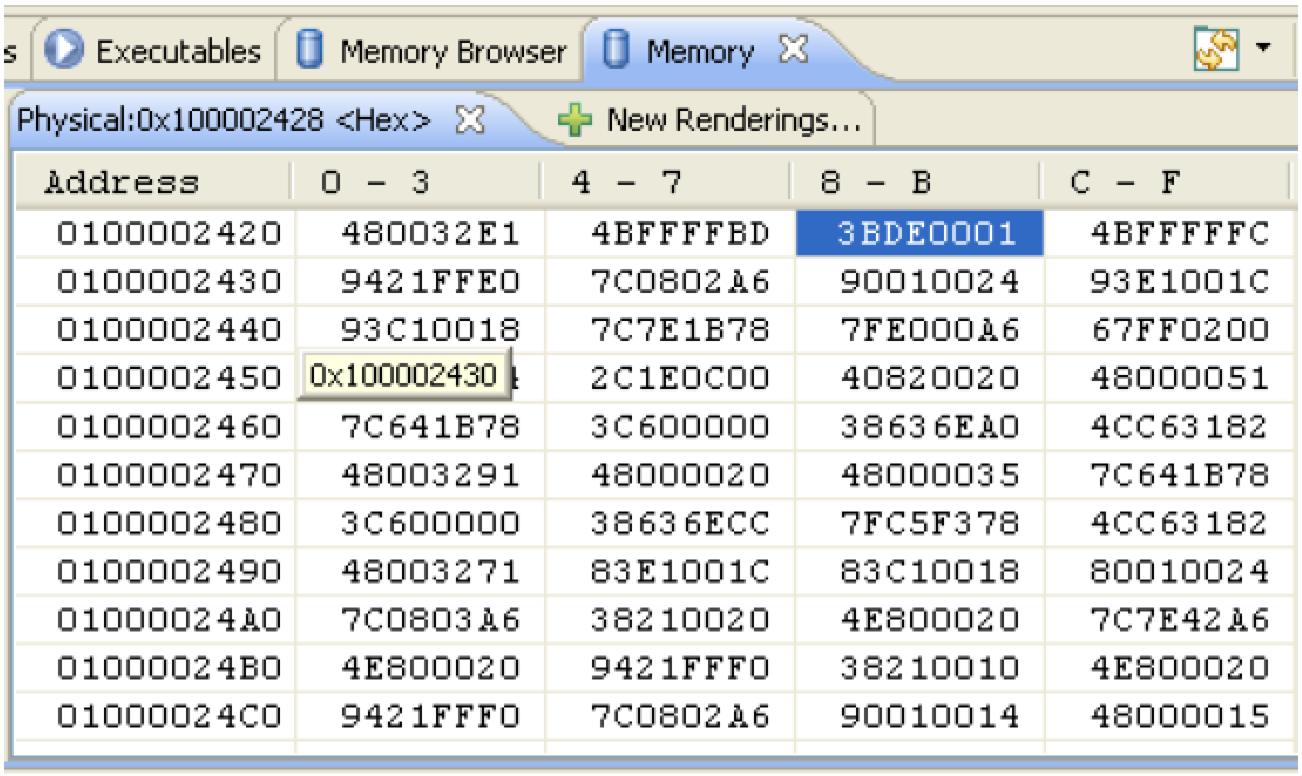
This section explains how to view memory of a target processor.

The debugger allocates multiple memory spaces in the IDE for flexible control over the memory access. The number of supported memory spaces and their properties depends upon the debugged processor.

You can display and access the supported memory spaces for a target in the **Memory** and **Memory Browser** views, in the Import/Export/Fill Memory Action Task View or in the **Debugger Shell** view using the designated memory space prefix. Use the `mem -ms` command to list the supported memory spaces for a processor.

To display the **Memory** view, select **Window > Show View > Other > Debug > Memory**. The figure below shows a **Memory** view displaying physical memory address space.

Figure 47: Memory view



```
Address      0 - 3      4 - 7      8 - B      C - F
0100002420   480032E1   4BFFFFBD   3BDE0001   4BFFFFFC
0100002430   9421FFE0   7C0802A6   90010024   93E1001C
0100002440   93C10018   7C7E1B78   7FE000A6   67FF0200
0100002450   0x100002430  2C1E0C00   40820020   48000051
0100002460   7C641B78   3C600000   38636EA0   4CC63182
0100002470   48003291   48000020   48000035   7C641B78
0100002480   3C600000   38636ECC   7FC5F378   4CC63182
0100002490   48003271   83E1001C   83C10018   80010024
01000024A0   7C0803A6   38210020   4E800020   7C7E42A6
01000024B0   4E800020   9421FFF0   38210010   4E800020
01000024C0   9421FFF0   7C0802A6   90010014   48000015
```

NOTE
The **Memory** view seamlessly displays 32-bit, 36-bit, 40-bit, and 64-bit addresses depending upon the selected memory space and the target processor currently under debug process.

This section contains the following subsection:

- Adding Memory Monitor on page 102

5.10.1 Adding Memory Monitor

The **Memory** view provides you option to display the supported memory spaces for a target.

Perform these steps:

1. In the **Memory** view, click the **Add Memory Monitor** icon.

   The **Monitor Memory** dialog appears.
2. Specify the address in the **Enter address or expression to monitor** drop-down list.
3. Select one of the supported memory spaces from the **Memory space** drop-down list.
   - Virtual Secure (x)

     Indicates that the specified address space is same as the address space in which the processor executes in Secure mode.
   - Virtual Non Secure (nx)

     Indicates that the specified address space is same as the address space in which the processor executes in Non Secure mode.
   - Physical (p)

Indicates that the specified address is interpreted as a physical address and the access disregards the cache and accesses whatever is in the memory.

- Physical Cache-coherent (c)

  Indicates that the specified address is interpreted as a physical address. If the data is in cache, the debugger gets it from there, otherwise the access goes to the memory.

5.11 Changing Program Counter Value

This section explains how to change the program counter value in CodeWarrior IDE to make the debugger execute a specific line of code.

To change the program-counter value, follow these steps:

1. Start a debugging session.
2. In the **Editor** view, place the cursor on the line that you want the debugger to execute next.
3. Right-click in the **Editor** view.

   A context menu appears.
4. From the context menu, select **Move To Line**.

The CodeWarrior IDE modifies the program counter to the specified location. The **Editor** view shows the new location.

5.12 Hard Resetting

Use the reset hard command in the **Debugger Shell** view to send a hard reset signal to the target processor.

NOTE

The **Hard Reset** command is enabled only if the debug hardware you are using supports it.

TIP

You can also perform a hard reset by clicking **Reset** ( ) on the **Debug** perspective toolbar.

5.13 Setting Stack Depth

This section describes how to control the depth of the call stack displayed by the debugger.

Select **Window > Preferences > C/C++ > Debug > Maximum stack crawl depth** option to set the depth of the stack to read and display. Showing all levels of calls when you are examining function calls several levels deep can sometimes make stepping through code more time consuming. Therefore, you can use this menu option to reduce the depth of calls that the debugger displays.

5.14 Importing CodeWarrior Executable file Wizard

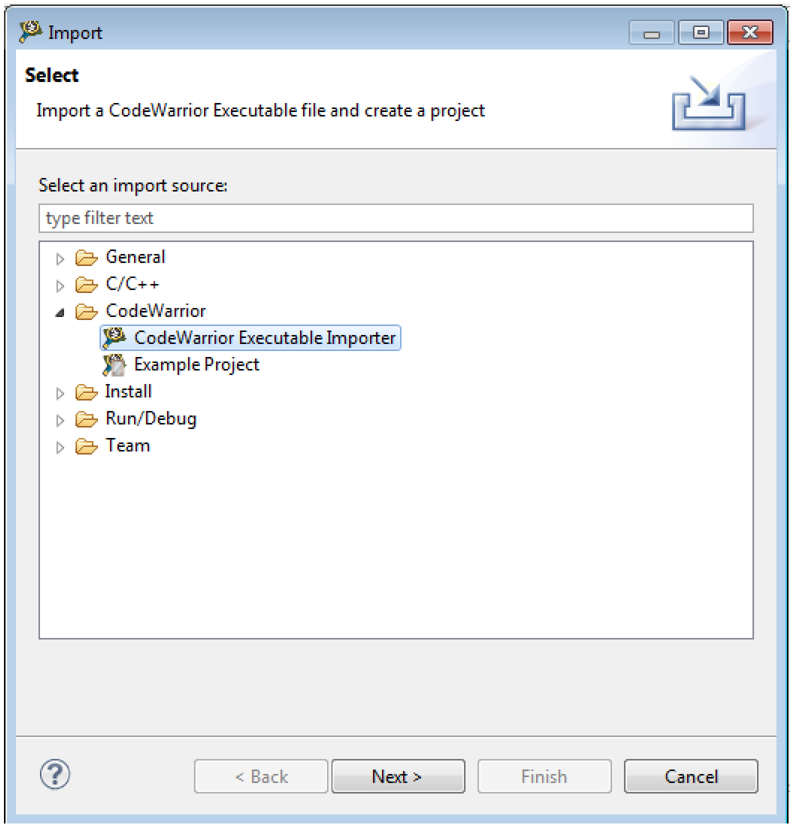
The **Import a CodeWarrior Executable file** wizard helps you to import a CodeWarrior executable file and create a new project.

To use the **Import a CodeWarrior Executable file** wizard, perform these steps:

1. From the CodeWarrior IDE menu bar, select **File > Import**.

   The **Import** wizard launches and the **Select** page appears, as shown in the figure below.

Figure 48: Import Wizard - Selecting CodeWarrior Executable Importer


Import
Select
Import a CodeWarrior Executable file and create a project
Select an import source:
type filter text

2. Expand the **CodeWarrior** group.
3. Select the **CodeWarrior Executable Importer** to import a `.elf` file.
4. Click **Next**.

   The wizard name changes to **Import a CodeWarrior Executable file.**

The following sections describe the various pages that the wizard displays as it assists you in importing an executable (.elf) file:

- Import a CodeWarrior Executable file page on page 105
- Import C/C++/Assembler Executable Files page on page 105
- Processor page on page 105
- Linux Application Launch Configurations page on page 106
- Debug Target Settings page on page 107

- Configurations page on page 107

5.14.1 Import a CodeWarrior Executable file page

The **Import a CodeWarrior Executable file** page allows you to specify the name and location for your project.

The table below describes the options available on this page.

Table 48: Import a CodeWarrior Executable file page settings

Option	Description
Project name	Specify the name of the project. The specified name identifies the project created for debugging (but not building) the executable file.
Use default location	If you select this option, the project files required to build the program are stored in the current workspace directory of the workbench. If you clear this option, the project files are stored in the directory that you specify in the **Location** option.
Location	Specifies the directory that contains the project files. Use the **Browse** button to navigate to the desired directory. This option is only available when the **Use default location** option is cleared.

5.14.2 Import C/C++/Assembler Executable Files page

Use the **Import C/C++/Assembler Executable Files** page to select an executable file or a folder to search for C/C++/assembler executable files.

The table below explains the options available on the page.

Table 49: Import C/C++/Assembler Executable Files Page Settings

Option	Description
File to import	Specifies the C/C++/assembler executable file. Click **Browse** to choose an executable file.
Copy the selected file to current project folder	Select this option to copy the executable file in the project folder.

5.14.3 Processor page

Use the **Processor** page to specify the processor family for the imported executable file and also specify the toolchain to be used.

The table below describes the options available on the page.

Table 50: Processor page settings

Option	Description
Processor	Expand the processor family and select the appropriate target processor for the execution of the specified executable file. The toolchain uses this choice to generate code that makes use of processor-specific features, such as multiple cores. TIP: You can also type the processor name in the text box.
Toolchain	Chooses the compiler, linker, and libraries used to build the program. Each toolchain generates code targeted for a specific platform. These are: • **Bareboard Application**: Targets a hardware board without an operating system. • **Linux Application**: Targets a board running the Linux operating system.
Target OS	Select if the board runs no operation system or imports a Linux kernel project to be executed on the board. The option is applicable only for bareboard application projects.

5.14.4 Linux Application Launch Configurations page

Use the **Linux Application Launch Configurations** page to specify how the debugger communicates with the host Linux system and controls your Linux application.

NOTE

The **Linux Application** page appears, only when select the **Linux Application** toolchain option on the **Processor** page in the **Import a CodeWarrior Executable file** wizard.

NOTE

When debugging a Linux application, you must use the **CodeWarrior TRK** to manage the communications interface between the debugger and Linux system.

The table below lists the options available on the page.

Table 51: Linux Application Launch Configurations page setting

Option	Description
CodeWarrior TRK	Select to use the CodeWarrior Target Resident Kernel (TRK) protocol, to download and control application on the Linux host system.
TAP Address	Specifies the IP address of the Linux host system, the project executes on.
Port	Specifies the port number that the debugger will use to communicate to the Linux host.
Remote Download Path	Specifies the host directory into which the debugger downloads the application.

5.14.5 Debug Target Settings page

Use the **Debug Target Settings** page to specify debugger connection type, board type, launch configuration type, and connection type for your project.

This page also allows you to configure connection settings for your project. The table below describes the options available on the page.

Table 52: Debug Target Settings Page Settings

Option	Description
Debugger Connection Types	Specifies what target the program executes on. • **Hardware**: Select to execute the program on the hardware available for the product. • **Emulator**: Select to execute the program on a hardware emulator.
Board	Specifies the hardware (board) supported by the selected processor.
Launch	Specifies the launch configurations and corresponding connection configurations, supported by the selected processor.
Connection Type	Specifies the interface to communicate with the hardware. • **CodeWarrior USB TAP**: Select to use the CodeWarrior USB TAP interface to communicate with the hardware device. • **CodeWarrior Ethernet TAP**: Select to use the CodeWarrior Ethernet TAP interface to communicate with the hardware device. For more details on CodeWarrior TAP, see *CodeWarrior TAP User Guide* available in the `<CWInstallDir>\CW_ARMv7\ARMv7\Help\PDF` folder.
TAP address	Enter the IP address of the selected TAP device.

NOTE

The **Debug Target Settings** page may prompt you to either create a new remote system configuration or select an existing one.

A remote system is a system configuration that defines connection, initialization, and target parameters. The remote system explorer provides data models and frameworks to configure and manage remote systems, their connections, and their services.

5.14.6 Configurations page

Use the **Configurations** page to select the processor core that executes the project.

The table below lists the options available on the page.

Table 53: Configurations page

Options	Description
Core Index	Select the processor core that executes the project.

5.15 Debugging Externally Built Executable Files

You can use the **Import a CodeWarrior Executable file** wizard to debug an executable (`.elf`) file that has no associated CodeWarrior project.

For example, you can debug a `.elf` file that was generated using a different IDE. The process of debugging an externally built executable file can be divided into the following tasks:

- Import Executable File on page 108
- Edit Launch Configuration on page 110
- Specify Source Lookup Path on page 110
- Debug Executable File on page 112

5.15.1 Import Executable File

First of all, you need to import the executable file that you want the CodeWarrior IDE to debug.

The IDE imports the executable file into a new project. To import an externally built executable file, follow these steps:

1. From the CodeWarrior IDE menu bar, select **File > Import**.

   The **Import** wizard appears.
2. Expand the **CodeWarrior** group.
3. Select **CodeWarrior Executable Importer** to import a .elf file.
4. Click **Next**.

   The wizard name changes to **Import a CodeWarrior Executable file** and the **Import a CodeWarrior Executable file** page appears.
5. In the **Project name** text box, enter the name of the project. This name identifies the project that the IDE creates for debugging (but not building) the executable file.
6. Clear the **Use default location** checkbox and click **Browse** to specify a different location for the new project. By default, the **Use default location** checkbox is selected.
7. Click **Next**.

   The **Import C/C++/Assembler Executable Files** page appears.
8. Click **Browse**.

   The **Select file** dialog appears. Use the dialog to navigate to the executable file that you want to debug.
9. Select the required file and click **Open**.

   The **Select file** dialog closes. The path to the executable file appears in the **File to import** text box.

   TIP

   You can also drag and drop a `.elf` file in the CodeWarrior Eclipse IDE. When you drop the `.elf` file in the IDE, the **Import a CodeWarrior Executable file** wizard appears with the `.elf` file already specified in the **Project Name** and **File to Import** text box.
10. Select the **Copy the selected file to current project folder** checkbox to copy the executable file in the current workspace.
11. Click **Next**.

The **Processor** page appears.

12. Select the processor family for the executable file.
13. Select a toolchain from the **Toolchain** group.

    Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.
14. Select if the board runs no operation system or imports a Linux kernel project to be executed on the board. The **Target OS** options are applicable only for bareboard application projects.
15. Click **Next**.

    The **Debug Target Settings** page appears.
16. Select a supported connection type, from the **Debugger Connection Types** group. Your selection determines the launch configurations that you can include in your project.
17. Select the hardware or simulator, you plan to use, from the **Board** drop-down list.

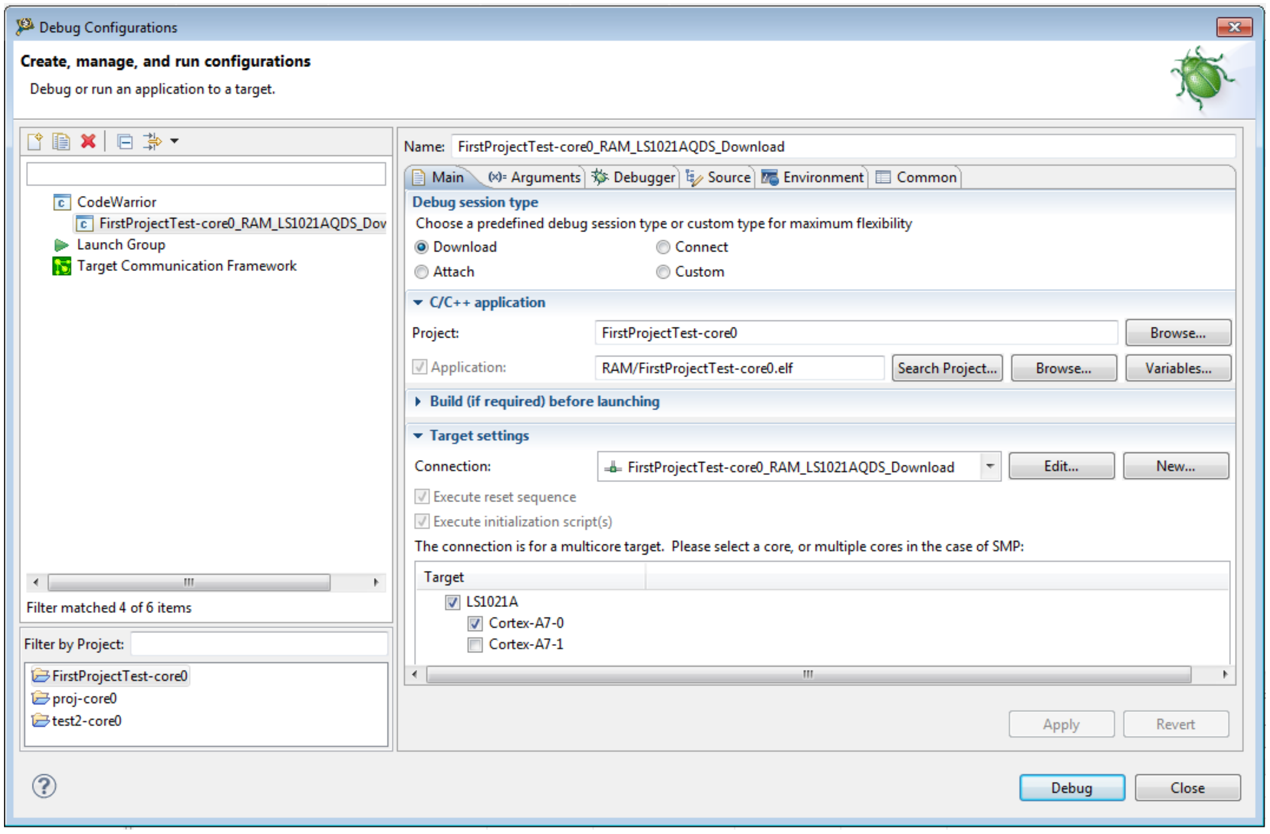
    NOTE

    Hardware or Simulators that supports the target processor selected on the **Processors** page are only available for selection.
18. Select the launch configurations that you want to include in your project and the corresponding connection.
19. Select the interface to communicate with the hardware, from the **Connection Type** drop-down list.
20. Enter the IP address of the TAP device in the **TAP address** text box. This option is disabled and cannot be edited, if you select **USB TAP** from the **Connection Type** drop-down list.
21. Click **Next**.

    The **Configurations** page appears.
22. Select the processor core that executes the project, from the **Core index** list.
23. Click **Finish**.

    The **Import a CodeWarrior Executable file** wizard ends. The project for the imported `.elf` file appears in the **CodeWarrior Projects** view. You can now open the **Debug Configurations** dialog by selecting **Run > Debug Configurations**. The **Debug Configurations** dialog shows the current settings for the launch configuration that you just created. A remote system is created with details of all the connection, initialization, and target parameters you had set while importing the `.elf` file.

Figure 49: Debug Configurations dialog - Launch Configuration for Executable File



Debug Configurations

Create, manage, and run configurations

Debug or run an application to a target.

- CodeWarrior
  - FirstProjectTest-core0_RAM_LS1021AQDS_Dov
- Launch Group
- Target Communication Framework

Filter matched 4 of 6 items

Filter by Project:

- FirstProjectTest-core0
- proj-core0
- test2-core0

Name: FirstProjectTest-core0_RAM_LS1021AQDS_Download

Main | Arguments | Debugger | Source | Environment | Common

Debug session type

Choose a predefined debug session type or custom type for maximum flexibility

[✓ Download] Connect
Attach Custom

C/C++ application

Project: FirstProjectTest-core0

[✓] Application: RAM/FirstProjectTest-core0.elf

Build (if required) before launching

Target settings

Connection: FirstProjectTest-core0_RAM_LS1021AQDS_Download

[✓] Execute reset sequence

[✓] Execute initialization script(s)

The connection is for a multicore target. Please select a core, or multiple cores in the case of SMP:

Target
- [✓] LS1021A
  - [✓] Cortex-A7-0
  - [ ] Cortex-A7-1

5.15.2 Edit Launch Configuration

Using the tabs of the **Debug Configurations** dialog box, you can change the launch configuration settings that you specified while importing the `.elf` file.

To edit the launch configuration for your executable file, follow these steps:

1. On the **Main** tab, click **Edit** in the **Connection** panel.

   The corresponding **Connection** page appears.
2. Use the **Connection type** list box to modify the current connection type.
3. Configure the various connection options as appropriate for your executable file by using the various tabs available on the **Connection** page.

   For example, specify the appropriate target processor, any initialization files, and connection protocol.
4. Click **OK** to close the **Connection** page.

5.15.3 Specify Source Lookup Path

Source lookup path is specified in terms of the compilation path and the local file system path.

The CodeWarrior debugger uses both these paths to debug the executable file. The compilation path is the path to the original project that built the executable file. If the original project is from an IDE on a different computer, you need to specify the compilation path in terms of the file system on that computer.

The local file system path is the path to the project that the CodeWarrior IDE creates to debug the executable file.

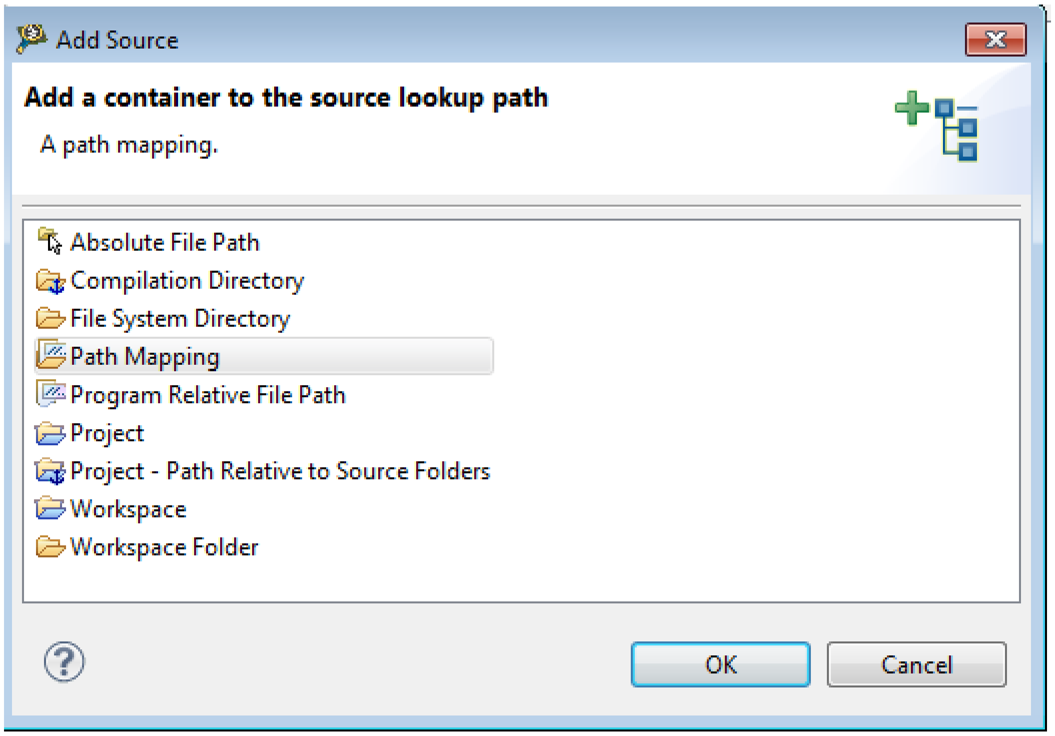
To specify a source lookup path for your executable file, perform the following steps:

1. Click the **Source** tab of the **Debug Configurations** dialog.

   The corresponding page appears.
2. Click **Add**.

   The **Add Source** dialog appears.
3. Select **Path Mapping** from the available list of sources.

Figure 50: Add Source dialog



Add Source

Add a container to the source lookup path

A path mapping.

- Absolute File Path
- Compilation Directory
- File System Directory
- Path Mapping
- Program Relative File Path
- Project
- Project - Path Relative to Source Folders
- Workspace
- Workspace Folder

4. Click **OK**.

   The **Add Source** dialog closes. The **Path Mappings** dialog appears.
5. In the **Name** text box, enter the name of the new path mapping.
6. Click **Add**.

   The cursor blinks in the **Compilation path** column.
7. In the **Compilation path** column, enter the path to the parent project of the executable file, relative to the computer that generated the file.

   Suppose the computer on which you debug the executable file is not the same computer that generated that executable file. On the computer that generated the executable file, the path to the parent project is `D:\workspace\originalproject`. Enter this path in the **Compilation path** text box.

TIP

You can use the IDE to discover the path to the parent project of the executable file, relative to the computer that generated the file. In the C/C++ Projects view of the C/C++ perspective, expand the project that contains the executable file that you want to debug. Next, expand the group that has the name of the executable file itself. A list of paths appears, relative to the computer that generated the file. Search this list for the names of source files used to build the executable file. The path to the parent project of one of these source files is the path you should enter in the Compilation path column.

8. In the **Local file system path** text box, enter the path to the parent project of the executable file, relative to your computer. Click the ellipsis button to specify the parent project.

   Suppose the computer on which you debug the executable file is not the same computer that generated that executable file. On your current computer, the path to the parent project of the executable file is `C:\projects\thisproject`. Enter this path in the **Local file system path** text box.

9. Click **OK**.

   The **Path Mapping** dialog closes. The mapping information now appears under the path mapping shown in the **Source Lookup Path** list of the **Source** page.

10. If needed, change the order in which the IDE searches the paths.

    The IDE searches the paths in the order shown in the **Source Lookup Path** list, stopping at the first match. To change this order, select a path, then click **Up** or **Down** to change its position in the list.

11. Click **Apply**.

    The IDE saves your changes.

5.15.4 Debug Executable File

You can use the CodeWarrior debugger to debug the externally built executable file.

To debug the executable file:

1. Select the project in the **CodeWarrior Projects** view.
2. Click the **Debug** button from the IDE toolbar.

The IDE switches to **Debug** perspective listing the debugging output.

Chapter 6 Multicore Debugging

This chapter explains how to use the multicore debugging capability of the CodeWarrior debugger.

In this chapter:

- Debugging Multicore projects on page 113
- Multicore debugging commands on page 119

6.1 Debugging Multicore projects

This section explains how to set launch configurations and how to debug multiple cores in a multi-core project.

The CodeWarrior debugger provides the facility to debug multiple ARMv7 processors using a single debug environment. The run control operations can be operated independently or synchronously. A common debug kernel facilitates multicore, run control debug operations for examining and debugging the interaction of the software running on the different cores on the system.

To debug a multicore project, perform the steps given in the following sections:

- Setting launch configurations on page 113
- Debugging multiple cores on page 116

6.1.1 Setting launch configurations

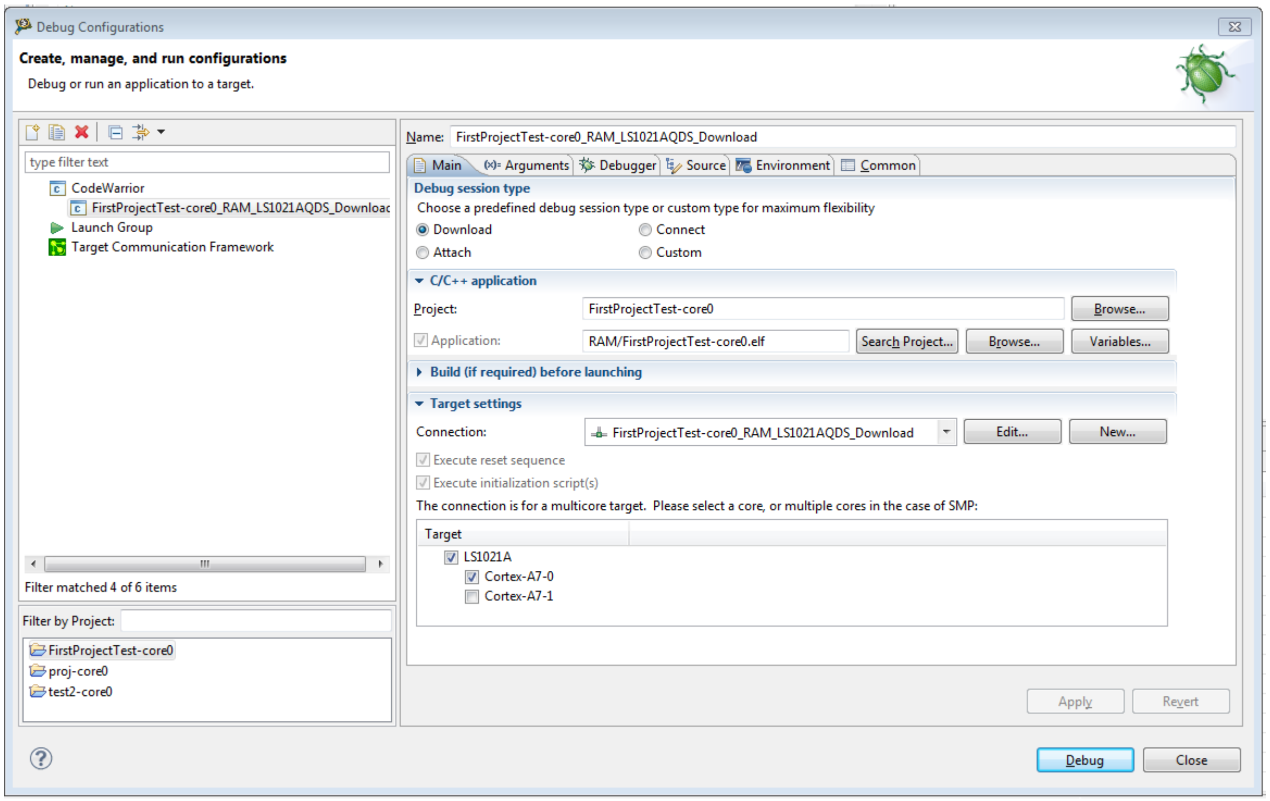
Setting a launch configuration allows you to specify all core-specific initializations.

To set up the launch configurations, follow these steps:

1. Open the CodeWarrior project you want to debug.
2. Switch to the **Debug** perspective.
3. Select **Run > Debug Configurations.**

   The **Debug Configurations** dialog appears (shown in the figure below) with a list of debug configurations that apply to the current application.
4. Expand the **CodeWarrior** tree control.
5. From the expanded list, select the debug configuration for which you want to modify the debugger settings. For example, `FirstProject-Test-core0_RAM_LS1021AQDS_Download`

Figure 51: Debug Configurations dialog


Debug Configurations

Create, manage, and run configurations

Debug or run an application to a target.

type filter text

- CodeWarrior
  - FirstProjectTest-core0_RAM_LS1021AQDS_Downloac
- Launch Group
- Target Communication Framework

Filter matched 4 of 6 items

Filter by Project:

- FirstProjectTest-core0
- proj-core0
- test2-core0

Name: FirstProjectTest-core0_RAM_LS1021AQDS_Download

Main | Arguments | Debugger | Source | Environment | Common

Debug session type

Choose a predefined debug session type or custom type for maximum flexibility

[✓ Download] Connect Attach Custom

C/C++ application

Project: FirstProjectTest-core0

Application: RAM/FirstProjectTest-core0.elf

Build (if required) before launching

Target settings

Connection: FirstProjectTest-core0_RAM_LS1021AQDS_Download

[✓] Execute reset sequence

[✓] Execute initialization script(s)

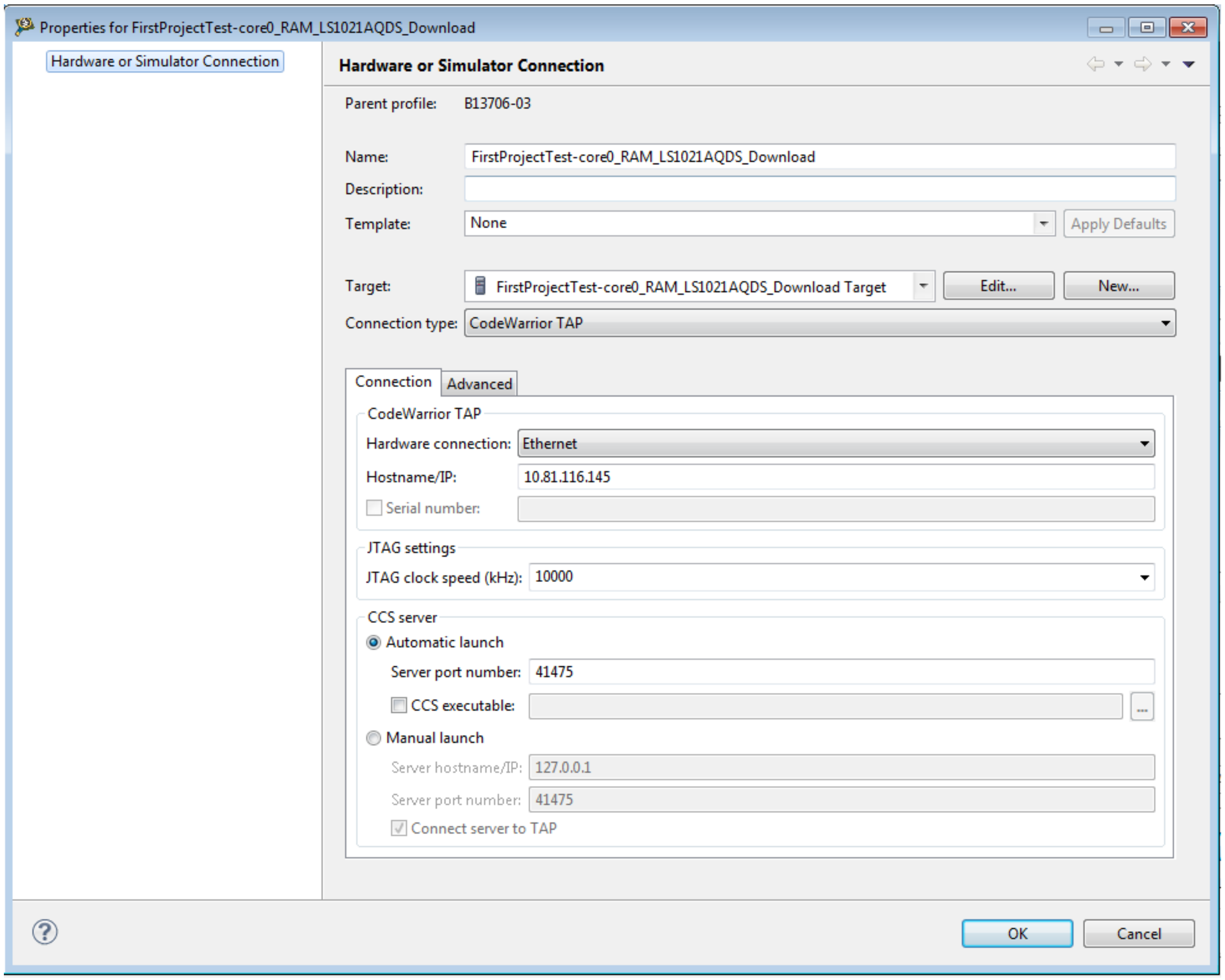
The connection is for a multicore target. Please select a core, or multiple cores in the case of SMP:

Target
- [✓] LS1021A
  - [✓] Cortex-A7-0
  - [ ] Cortex-A7-1

6. On the **Main** tab, select a connection from the **Connection** drop-down list.
7. Select a core from the **Target** list.
8. Click **Edit** next to the **Connection** drop-down list.

   The **Properties for <connection>** dialog appears.

Figure 52: Properties for <connection> dialog


Properties for FirstProjectTest-core0_RAM_LS1021AQDS_Download

Hardware or Simulator Connection

Parent profile: B13706-03

Name: FirstProjectTest-core0_RAM_LS1021AQDS_Download

Description:

Template: None

Target: FirstProjectTest-core0_RAM_LS1021AQDS_Download Target

Connection type: CodeWarrior TAP

Connection | Advanced

CodeWarrior TAP

Hardware connection: Ethernet

Hostname/IP: 10.81.116.145

☐ Serial number:

JTAG settings

JTAG clock speed (kHz): 10000

CCS server

● Automatic launch

Server port number: 41475

☐ CCS executable:

○ Manual launch

Server hostname/IP: 127.0.0.1

Server port number: 41475

✓ Connect server to TAP

9. Select a target from the **Target** drop-down list.

10. Select the required TAP connection from the **Connection type** drop-down list. For example, **CodeWarrior TAP**.

11. On the **Connection** tab, specify the hostname/IP of the target board in the **Hostname/IP** text box.

12. Enter the JTAG clock speed in the **JTAG clock speed** text box.

13. Specify the port number of the CCS server in the **Server port number** text box.

14. Click **OK**.

15. Click the **Debugger** tab in the **Debug Configurations** dialog.

    The **Debugger** page appears.

16. Ensure that the **Stop on startup at** checkbox is selected and `main` is specified in the **User specified** text box.

17. Click **Apply** to save the changes.

    You have successfully configured a debug configuration.

18. Similarly, configure remaining debug configurations.

NOTE

To successfully debug multiple cores, the connection settings must be identical for all debug configurations.

6.1.2 Debugging multiple cores

The CodeWarrior debugger enables system developers to simultaneously develop and debug applications on a system with multiple processors, within the same debug environment.

NOTE

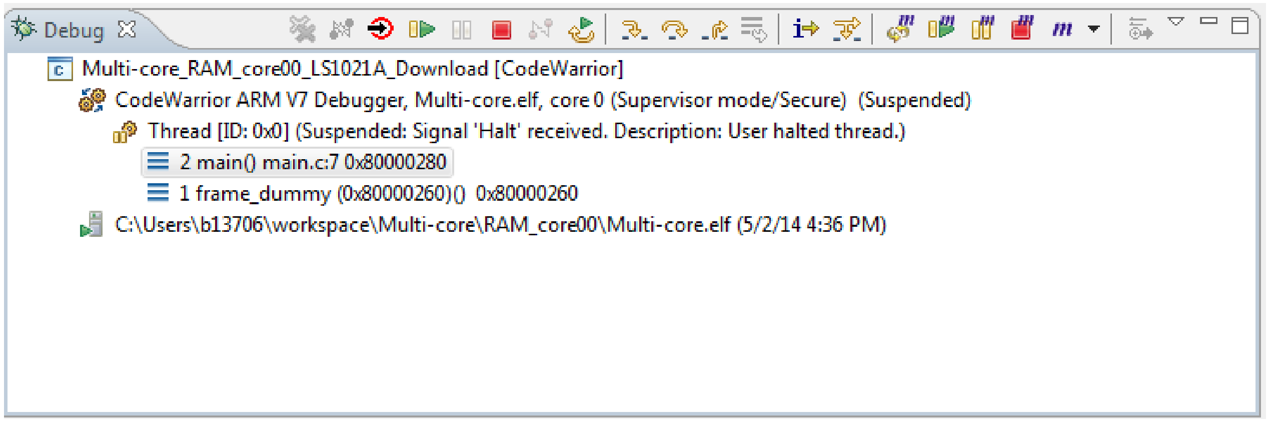
Ensure that you have attached a debug probe to the target board and to the computer hosting the CodeWarrior IDE before performing the steps listed in this section.

To debug multiple cores, follow these steps:

1. Select a multicore project in the **CodeWarrior Projects** view.
2. Select **Run > Debug**.

   The debugger downloads core 0 and switches to the **Debug** perspective. The debugger halts execution at the first statement of `main()`. The **Debug** view displays all the threads associated with the core.

   Figure 53: Multicore Debugging - Debug Core 0

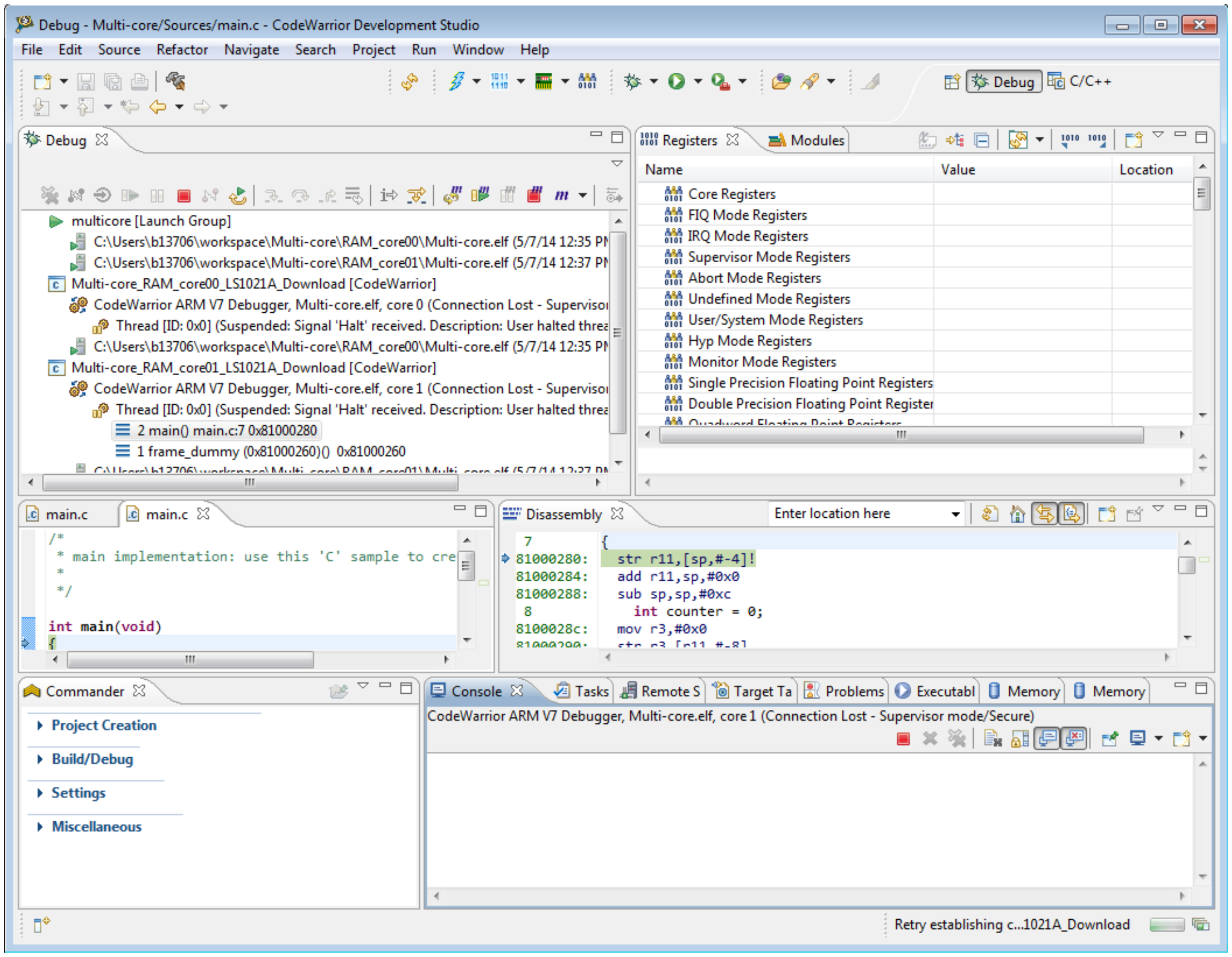
   

   ```
   Multi-core_RAM_core00_LS1021A_Download [CodeWarrior]
     CodeWarrior ARM V7 Debugger, Multi-core.elf, core 0 (Supervisor mode/Secure)  (Suspended)
       Thread [ID: 0x0] (Suspended: Signal 'Halt' received. Description: User halted thread.)
         2 main() main.c:7 0x80000280
         1 frame_dummy (0x80000260)() 0x80000260
     C:\Users\b13706\workspace\Multi-core\RAM_core00\Multi-core.elf (5/2/14 4:36 PM)
   ```

3. Download all other cores associated with the project.
4. Select a thread from core 1 in the **Debug** view.

   All the views in the **Debug** perspective will be updated to display the debug session for the selected core. The figure below displays the debug session for a selected thread in core 1.

Figure 54: Viewing Debug Information for Core 1


Debug - Multi-core/Sources/main.c - CodeWarrior Development Studio
File Edit Source Refactor Navigate Search Project Run Window Help
Debug
C/C++
Registers
Modules
Commander
Project Creation
Build/Debug
Settings
Miscellaneous
Console
Tasks
Remote S
Target Ta
Problems
Executabl
Memory
Memory
Enter location here
Retry establishing c...1021A_Download

```
multicore [Launch Group]
  C:\Users\b13706\workspace\Multi-core\RAM_core00\Multi-core.elf (5/7/14 12:35 PM
  C:\Users\b13706\workspace\Multi-core\RAM_core01\Multi-core.elf (5/7/14 12:37 PM
Multi-core_RAM_core00_LS1021A_Download [CodeWarrior]
  CodeWarrior ARM V7 Debugger, Multi-core.elf, core 0 (Connection Lost - Supervisor
    Thread [ID: 0x0] (Suspended: Signal 'Halt' received. Description: User halted thread
  C:\Users\b13706\workspace\Multi-core\RAM_core00\Multi-core.elf (5/7/14 12:35 PM
Multi-core_RAM_core01_LS1021A_Download [CodeWarrior]
  CodeWarrior ARM V7 Debugger, Multi-core.elf, core 1 (Connection Lost - Supervisor
    Thread [ID: 0x0] (Suspended: Signal 'Halt' received. Description: User halted thread
      2 main() main.c:7 0x81000280
      1 frame_dummy (0x81000260)() 0x81000260
```

Name	Value	Location
Core Registers		
FIQ Mode Registers		
IRQ Mode Registers		
Supervisor Mode Registers		
Abort Mode Registers		
Undefined Mode Registers		
User/System Mode Registers		
Hyp Mode Registers		
Monitor Mode Registers		
Single Precision Floating Point Registers		
Double Precision Floating Point Register		

```
/*
 * main implementation: use this 'C' sample to cre
 *
 */

int main(void)
{
```

```
7           {
81000280:     str r11,[sp,#-4]!
81000284:     add r11,sp,#0x0
81000288:     sub sp,sp,#0xc
8               int counter = 0;
8100028c:     mov r3,#0x0
```

CodeWarrior ARM V7 Debugger, Multi-core.elf, core 1 (Connection Lost - Supervisor mode/Secure)

5. Select and expand the **Core Registers** group.
6. Select **Run > Step Over**.

   The following actions occur:

   - Debugger executes the current statement and halts at the next statement.
   - The program counter (PC) indicator moves to the next executable source line in the **Source** view.
   - In the **Debug** view, the status of the program changes to (`Suspended`).
   - Modified register values are highlighted in yellow.
7. Select a thread from core 1 in the **Debug** view.

   All the views in the **Debug** perspective will be updated to display the debug session for the selected core.
8. Select and expand the **Core Registers** group.
9. Select **Run > Step Over**.

   The following actions occur:

   - Debugger executes the current statement and halts at the next statement.
   - The program counter (PC) indicator moves to the next executable source line in the **Source** view.

10. Issue several more **Step Over** commands and watch the register values change.
11. Select `main()` thread from core 0 again.

    Notice that the register values remain unchanged. This is because the CodeWarrior debugger controls each core's execution individually.
12. With core 0 still selected, click the **Step Over.** button several times until you reach the `printf()` statement.

    Debugger executes the current statement, the following statements, and halts at the `printf()` statement.
13. Switch to the other debug window.
14. Select the `main()` thread for core 1 by clicking it. Notice that the program counter icon in the **Source** view did not move. The debugger controls the execution of each core individually.
15. In the **Debug** view, click the **Resume** button.

    Core 1 enters an infinite loop. The status of the program changes to (`Running`).
16. In the **Debug** view, click the `main()` thread for core 0 and click the **Resume** button.

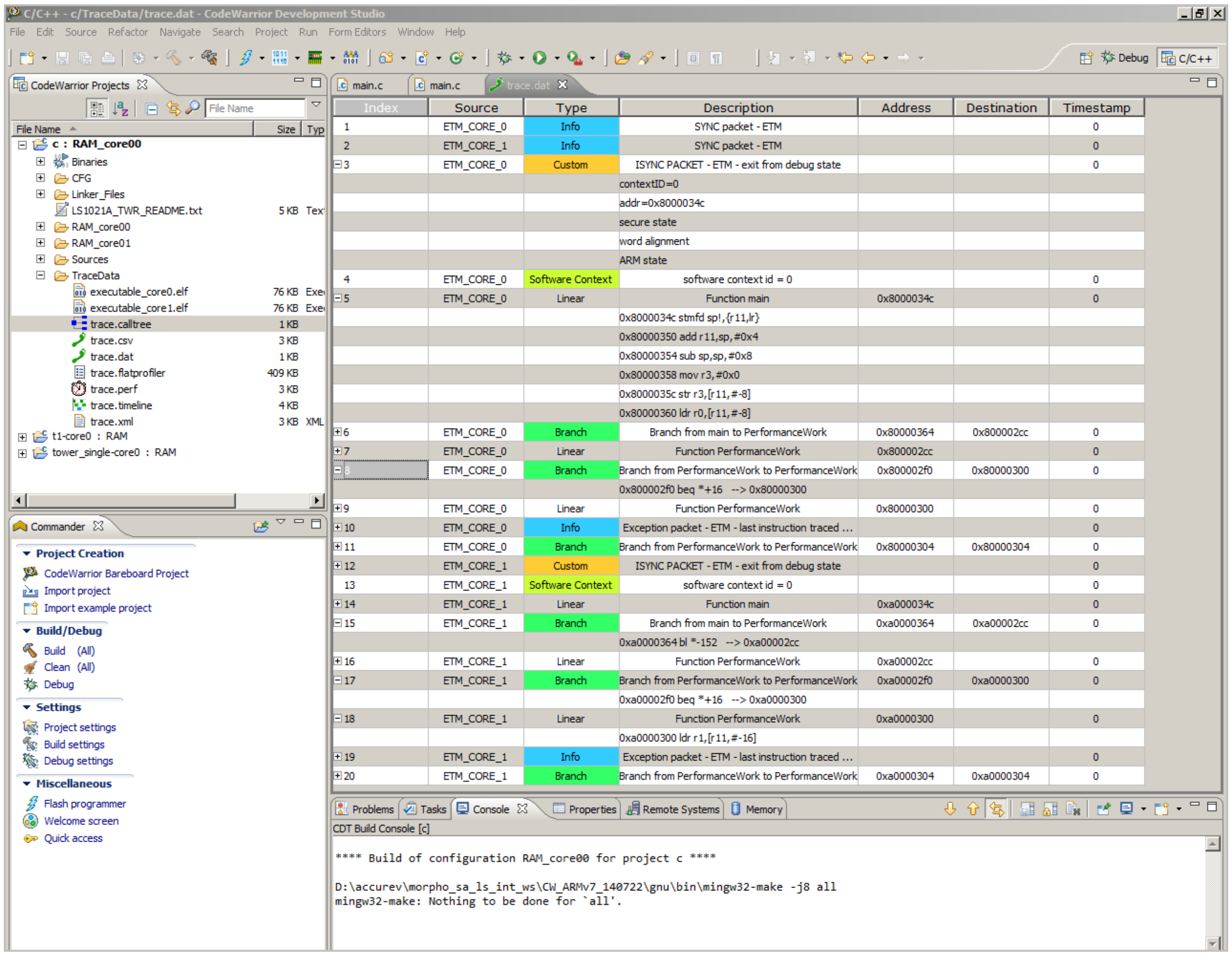
    Core 0 enters an infinite loop and core 1 continues to execute in its loop.
17. Select `main()` thread from core 1 and click the **Suspend** button.

    The debugger halts core 1 at the current statement and the status of the program changes to (`Halted`). Core 0 continues to execute.
18. Select **Run > Multicore Terminate**.

    The debugger terminates the active debug session. The threads associated with each core in the **Debug** view disappear.

Similary, you can collect muticore trace data. In the **Debug** view, click **Multicore Resume**; the execution begins and data measurement starts. Wait for some time. When output starts displaying for all the cores, click **Multicore Terminate**. Trace viewer will show trace of all the cores as shown below.

Figure 55: Multicore Tracing



Index	Source	Type	Description	Address	Destination	Timestamp
1	ETM_CORE_0	Info	SYNC packet - ETM			0
2	ETM_CORE_1	Info	SYNC packet - ETM			0
3	ETM_CORE_0	Custom	ISYNC PACKET - ETM - exit from debug state			0
			contextID=0			
			addr=0x8000034c			
			secure state			
			word alignment			
			ARM state			
4	ETM_CORE_0	Software Context	software context id = 0			0
5	ETM_CORE_0	Linear	Function main	0x8000034c		0
			0x8000034c stmfd sp!,{r11,lr}			
			0x80000350 add r11,sp,#0x4			
			0x80000354 sub sp,sp,#0x8			
			0x80000358 mov r3,#0x0			
			0x8000035c str r3,[r11,#-8]			
			0x80000360 ldr r0,[r11,#-8]			
6	ETM_CORE_0	Branch	Branch from main to PerformanceWork	0x80000364	0x800002cc	0
7	ETM_CORE_0	Linear	Function PerformanceWork	0x800002cc		0
8	ETM_CORE_0	Branch	Branch from PerformanceWork to PerformanceWork	0x800002f0	0x80000300	0
			0x800002f0 beq *+16 --> 0x80000300			
9	ETM_CORE_0	Linear	Function PerformanceWork	0x80000300		0
10	ETM_CORE_0	Info	Exception packet - ETM - last instruction traced ...			0
11	ETM_CORE_0	Branch	Branch from PerformanceWork to PerformanceWork	0x80000304	0x80000304	0
12	ETM_CORE_1	Custom	ISYNC PACKET - ETM - exit from debug state			0
13	ETM_CORE_1	Software Context	software context id = 0			0
14	ETM_CORE_1	Linear	Function main	0xa000034c		0
15	ETM_CORE_1	Branch	Branch from main to PerformanceWork	0xa0000364	0xa00002cc	0
			0xa0000364 bl *-152 --> 0xa00002cc			
16	ETM_CORE_1	Linear	Function PerformanceWork	0xa00002cc		0
17	ETM_CORE_1	Branch	Branch from PerformanceWork to PerformanceWork	0xa00002f0	0xa0000300	0
			0xa00002f0 beq *+16 --> 0xa0000300			
18	ETM_CORE_1	Linear	Function PerformanceWork	0xa0000300		0
			0xa0000300 ldr r1,[r11,#-16]			
19	ETM_CORE_1	Info	Exception packet - ETM - last instruction traced ...			0
20	ETM_CORE_1	Branch	Branch from PerformanceWork to PerformanceWork	0xa0000304	0xa0000304	0

CDT Build Console [c]

```
**** Build of configuration RAM_core00 for project c ****

D:\accurev\morpho_sa_ls_int_ws\CW_ARMv7_140722\gnu\bin\mingw32-make -j8 all
mingw32-make: Nothing to be done for `all'.
```

6.2 Multicore debugging commands

This section describes the multi-core commands available in the **Run** menu of CodeWarrior IDE and in the Debugger Shell.

If you are debugging a multicore project, you can use single and multicore debugging commands to debug parts of each core project.

This section contains the following subsections:

- Multicore commands in CodeWarrior IDE on page 119
- Multicore commands in Debugger Shell on page 120

6.2.1 Multicore commands in CodeWarrior IDE

When you start a multicore debug session, multicore commands are enabled on the CodeWarrior IDE **Run** menu. These commands, when issued, affect all cores simultaneously.

The table below describes each menu choice.

Table 54: Multi-core debugging commands

Command	Icon	Description
Multicore Resume		Starts all cores of a multicore system running simultaneously.
Multicore Suspend		Stops execution of all cores of a multicore system simultaneously.
Multicore Restart		Restarts all the debug sessions for all cores of a multicore system simultaneously.
Multicore Terminate		Kills all the debug sessions for all cores of a multicore system simultaneously.
Multicore Groups		**Use All Cores:** If the selected debug context is a multicore system, then all cores are used for multicore operations. **Disable Halt Groups:** Disables breakpoint halt groups. **Limit new breakpoints to current group:** If selected, all new breakpoints set during a debug session are reproduced only on cores belonging to the group of the core on which the breakpoint is set. **Edit Target Types:** Opens **Target Types** dialog that lets you add and remove system types. **Edit Multicore Groups:** Opens the **Multicore Groups** dialog to create multicore groups. You can also use this option to modify the existing multicore groups.

To use the multi-core commands from the **Debug** perspective, follow these steps:

1. Start a debugging session by selecting the appropriately configured launch configuration.
2. If necessary, expand the desired core's list of active threads by clicking on the tree control in the **Debug** view.
3. Click the thread you want to use with multicore operations.
4. From the **Run** menu, specify the multicore operation to perform on the thread.

NOTE

The keyboard shortcut for the **Multicore Resume** operation is Alt+Shift+F8.

6.2.2 Multicore commands in Debugger Shell

In addition to the multicore-specific toolbar buttons and menu commands available in the **Debug** view, the **Debugger Shell** has multicore specific commands that can control the operation of one or more processor cores at the same time.

Similar to the menu commands, the multicore debugger shell commands allow you to select, start, and stop a specific core. You can also restart or kill sessions executing on a particular core. The table below lists and defines the affect of each multicore debugging command.

Table 55: Multi-Core debugging commands

Command	Shortcut	Description
mc::config	mc::c	List or edit multicore group options. **Syntax** `mc::config`
mc::go	mc::g	Resume multiple cores **Syntax** `mc::go` **Examples** `mc::go` Resumes the selected cores associated with the current thread context.

mc::group	mc::gr	Display or edit multicore groups
		Syntax
		`group group new <type-name> [<name>] group rename <name>|<group-index> <new-name>group remove <name>|<group-index> ... group removeall group enable|disable <index> ...|all`
		Examples
		`mc::group`
		Shows the defined groups, including indices for use in the `mc::group rename|enable|remove` set of commands.
		`mc::group new 8572`
		Creates a new group for system type `8572`. The group name will be based on the system name and will be unique. The enablement of the group elements will be all non-cores enabled, all cores disabled.
		`mc::group rename 0 "My Group Name"`
		Renames the group at index 0 to "My Group Name".
		`mc::group enable 0 0.0`
		Enables the group at index 0 and the element at index 0.0 of the `mc::group` command.
		`mc::group remove "My Group Name"`
		Removes the group named "My Group Name".
		`mc::group removeall`
		Removes all groups.

Table continues on the next page...

Table 55: Multi-Core debugging commands (continued)

Command	Shortcut	Description
mc::kill	mc::kill	Terminates the debug session for selected cores associated with the current thread context. **Syntax** `mc::kill` **Examples** `mc::kill` Terminates multiple cores.
mc::reset	mc::reset	Resets multiple cores. **Syntax** `mc::reset`
mc::restart	mc::restart	Restarts the debug session for selected cores associated with the current thread context. **Syntax** `mc::restart` **Examples** `mc::restart` Restarts multiple cores.
mc::stop	mc::stop	Stops the selected cores associated with the current thread context. **Syntax** `mc::stop` **Examples** `mc::stop` Suspends multiple cores.

Table continues on the next page...

Table 55: Multi-Core debugging commands (continued)

Command	Shortcut	Description

mc::type	mc::t	Shows the system types available for multicore debugging as well as type indices for use by the `mc::type remove` and `mc::group new` commands.
		Syntax
		`type type import <filename> type remove <filename>| <type-index> ... type removeall`
		Examples
		`mc::type`
		Display or edit system types.
		`mc::type import 8572_jtag.txt`
		Creates a new type from the JTAG configuration file.
		`mc::type remove 8572_jtag.txt`
		Removes the type imported from the specified file.
		`mc::type removeall`
		Removes all imported types.

Chapter 7
Debugging Embedded Linux Software

This chapter explains how to use the CodeWarrior Development Studio tools to debug embedded Linux® software for ARMv7 processors.

This chapter includes the following sections:

- Debugging Linux application on page 125
- Viewing multiple processes and threads on page 134
- Debugging applications that use fork() and exec() System Calls on page 135
- Debugging shared library on page 145
- Debugging Linux Kernel on page 153
- Debugging loadable kernel modules on page 165

7.1 Debugging Linux application

This section describes CodeWarrior Target-Resident Kernel (TRK) and provides information related to using it with CodeWarrior projects.

For embedded Linux development, CodeWarrior TRK is a user-level application that resides on target embedded Linux systems and accepts connections from the CodeWarrior debugger. You use the CodeWarrior remote connections feature to download and debug applications built with CodeWarrior projects. The CodeWarrior debugger connects to CodeWarrior TRK on the remote target system through a serial or ethernet connection.

On embedded Linux systems, CodeWarrior TRK is packaged as a regular Linux application, named `apptrk`. This application runs on the remote target system along side the program you are debugging to provide application-level debug services to the CodeWarrior debugger.

To debug a Linux application using CodeWarrior TRK:

- Install CodeWarrior TRK on target system on page 125
- Start CodeWarrior TRK on target system on page 126
- Create CodeWarrior download launch configuration for Linux application on page 128
- Specify Console I/O redirections for Linux application on page 131
- Configure Linux Process Signal Policy on page 132
- Debug Linux application on page 134

7.1.1 Install CodeWarrior TRK on target system

This section explains how to install CodeWarrior TRK on target system.

To connect the CodeWarrior debugger to CodeWarrior TRK, the CodeWarrior TRK binary executable file must be installed and running on the remote target system. Once CodeWarrior TRK is running on the target system, the debugger can upload your application and debug the application on the target system.

NOTE

If CodeWarrior TRK is not present on a given target system, you need to use a file transfer facility, such as Secure Copy (SCP) or File Transfer Protocol (FTP) to download the CodeWarrior TRK binary executable file, `AppTRK.elf`, to a suitable location on the file system of the target system. You also need to place the unstripped versions of the `ld.so`, `libpthread.so`, and `libthread_db.so` files in the `/lib` directory of the target system to debug shared library code or multi-threaded code with CodeWarrior TRK.

7.1.2 Start CodeWarrior TRK on target system

This section explains how to start CodeWarrior TRK on target system.

How you start CodeWarrior TRK on the target hardware depends on the type of connection between the host computer and that target hardware:

- Transmission Control Protocol/Internet Protocol (TCP/IP): The host computer communicates with the target hardware over a TCP/IP connection
- Serial cable: A serial cable connecting the host computer to the target hardware

CodeWarrior TRK can be started as either a root user or a normal user; however, if the application to be debugged requires root permission, then you need to start CodeWarrior TRK as a root user. In other words, CodeWarrior TRK must have all the privileges required by the application that it will debug. You also need to ensure that the download directory specified in the **Remote** tab of the launch configuration matches the user privileges of the CodeWarrior TRK running on the target system.

This section contains the following subsections:

- TCP/IP connections on page 126
- Serial connections on page 127

7.1.2.1 TCP/IP connections

This section explains how to start CodeWarrior TRK through a TCP/IP connection.

The steps are as follows:

1. Connect to the remote target system.
   a. On the host computer, open a new terminal window.
   b. At the command prompt in the terminal window, enter the following command, where *IPAddress* represents the target system's IP address:

      ```
      telnet IPAddress
      ```

      The telnet client connects to the telnet daemon on the target system.
2. Navigate to the directory that contains the `AppTRK.elf` binary executable file.

   The system changes the current working directory.
3. Type the following command (where *Port* is the listening port number optionally specified in the Connections panel of Debug window- typically `1000`):

   ```
   ./AppTRK.elf :Port
   ```

   CodeWarrior TRK starts on the target system, and listens to the specified TCP/IP port for connections from the CodeWarrior IDE.

TIP

To continue use of the terminal session after launching CodeWarrior TRK, start CodeWarrior TRK as a background process by appending the ampersand symbol (&) to the launch command. For example, to start CodeWarrior TRK as a background process listening to TCP/IP port number 6969, you would enter the following command:

```
./AppTRK.elf :6969 &
```

7.1.2.2 Serial connections

This section explains how to launch CodeWarrior TRK through a serial connection.

The steps are as follows:

TIP

To improve your debugging experience, we recommend the host computer running the IDE have two serial ports. In an ideal scenario, you would connect one serial port of the host computer to the first serial port of the target board to monitor startup and console log messages. You would then connect another serial port of the host computer to the second serial port of the target board; the debugger would use this connection to communicate with CodeWarrior TRK on the target system.

1. Connect a serial cable between the host computer's serial port and the second serial port of the target system.
2. On the host computer, start a terminal emulation program (such as minicom).
3. Configure the terminal emulation program with baud rate, stop bit, parity, and handshake settings appropriate for the target system.
4. Connect the terminal emulator to the target system.

   A command prompt appears in the terminal emulation program.
5. Boot the system. Log in as the root user.
6. Use the `cd` command at the command prompt to navigate to the directory where the CodeWarrior TRK binary executable file, `AppTRK.elf`, resides on the target system.

   The system changes the current working directory.
7. Configure the serial port on which CodeWarrior TRK is going to connect.
   a. Enter this command: `stty -F /dev/ttyS1 raw`

      This command configures the serial port for raw mode of operation. If you do not use raw mode, special characters sent as part of packets may be interpreted (dropped), causing the connection to break.
   b. Enter this command: `stty -F /dev/ttyS1 ispeed 115200`

      The serial input speed is set to 115200 baud.
   c. Enter this command: `stty -F /dev/ttyS1 ospeed 115200`

      The serial output speed is set to 115200 baud.
   d. Enter this command: `stty -F /dev/ttyS1 crtscts`

      The terminal emulation program enables handshake mode
   e. Enter this command: `stty -a -F /dev/ttyS1`

      The system displays the current device settings.

8. Enter the command: `./AppTRK.elf /dev/ttyS1`

   CodeWarrior TRK launches on the remote target system.

7.1.3 Create CodeWarrior download launch configuration for Linux application

This section explains how to create a CodeWarrior download launch configuration for debugging a Linux application on target system.

Follow these steps to create a CodeWarrior download launch configuration:

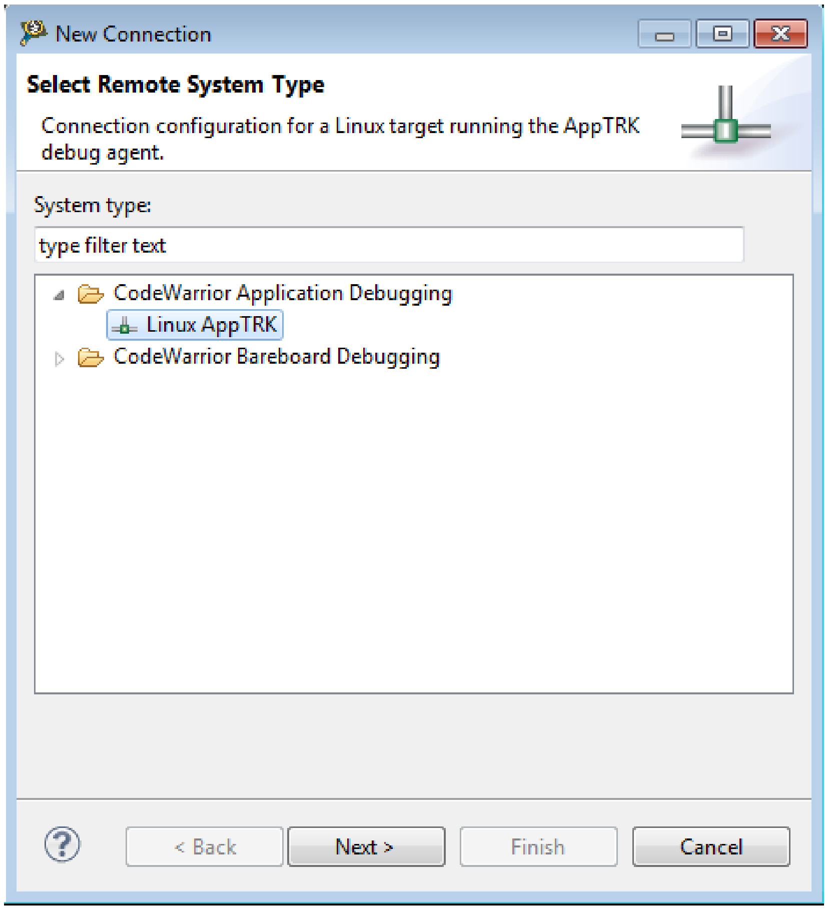
1. In the **CodeWarrior Projects** view of the **C/C++** perspective, select the name of the project that builds the Linux application.
2. Select **Run > Debug Configurations**.

   The **Debug Configurations** dialog appears.
3. Select CodeWarrior on the left-hand side of the **Debug Configurations** dialog.
4. Click the **New launch configuration** toolbar button of the **Debug Configurations** dialog.

   The IDE creates a new launch configuration under the **CodeWarrior** group. The settings pages for this new launch configuration appear on the right-hand side of the **Debug Configurations** dialog.
5. In the **Main** tab of the **Debug Configuration** dialog:
   a. Select **Download** from the **Debug session type** group.
   b. Click **New** next to the **Connection** drop-down list.

      The **New Connection** wizard appears.
6. Expand the **CodeWarrior Application Debugging** group and select **Linux AppTRK**, as shown in the figure below.

Figure 56: Remote System - new connection wizard


New Connection

Select Remote System Type

Connection configuration for a Linux target running the AppTRK debug agent.

System type:

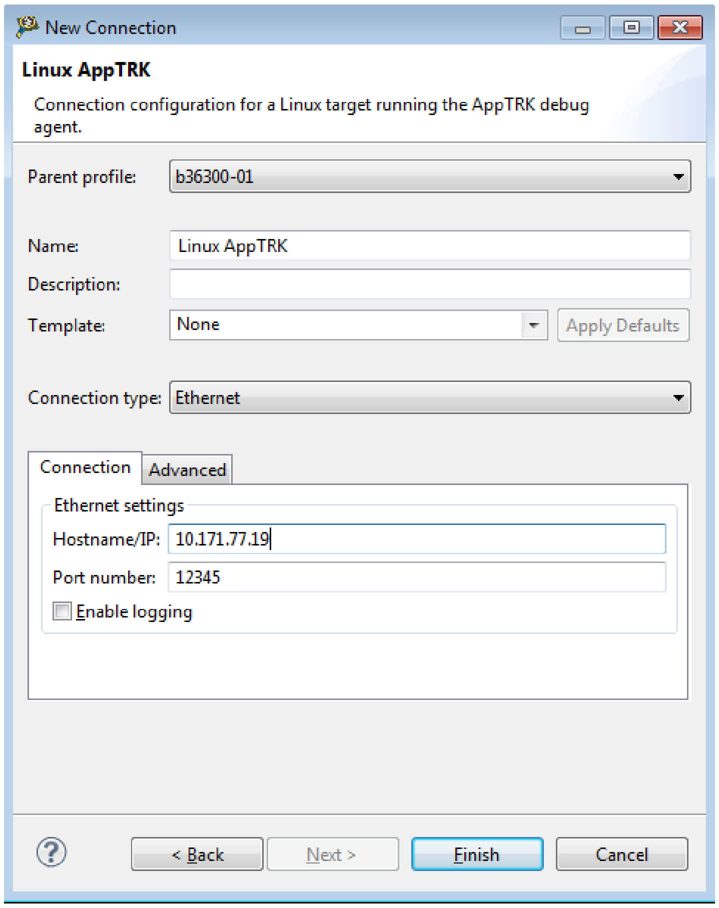
type filter text

CodeWarrior Application Debugging
Linux AppTRK
CodeWarrior Bareboard Debugging
< Back
Next >
Finish
Cancel

7. Click **Next**.

   The **Linux AppTRK** page appears.
8. Specify the connection name, description, template and connection type on this page.
9. When you select the connection type, the corresponding **Connection** tab appears (shown in the figure below).

Figure 57: Remote Linux AppTRK System connection Page



Linux AppTRK

Connection configuration for a Linux target running the AppTRK debug agent.

Parent profile: b36300-01
Name: Linux AppTRK
Description:
Template: None
Connection type: Ethernet

Ethernet settings
Hostname/IP: 10.171.77.19
Port number: 12345
Enable logging

10.Specify the settings as appropriate for the connection between the host computer and the target hardware on this page.

11.Click **Finish**.

The new remote system that you just created appears in the **Connection** drop-down list.

12.Click the **Debugger** tab.

The **Debugger options** panel appears with the respective tabs.

13.On the **Debug** tab, if required, specify a function or address in the application where you want the program control to stop first in the debug session:

a. Select the **Stop on startup at** checkbox.

The IDE enables the corresponding text box.

b. Enter in the text box an address or a function inside the application.

14.Click the **Remote** tab.

The corresponding sub-page comes forward.

15.Enter in the **Remote download path** text box the path of a target-computer directory to which the Linux application, running on the target hardware, can read and write files.

NOTE
The specified directory must exist on the target system.

16. If required, specify information about other executable files to debug in addition to the Linux application:
    a. Click the **Other Executables** tab.

       The corresponding sub-page appears.
    b. Use the sub-page settings to specify information about each executable file.
17. Click **Apply**.

    The IDE saves the pending changes you made to the launch configuration.

You just finished creating a CodeWarrior download launch configuration that you can use to debug the Linux application.

7.1.4 Specify Console I/O redirections for Linux application

CodeWarrior TRK allows you to specify I/O redirections as arguments for applications to be debugged.

This feature allows users to use a file on the target or even the target console for file descriptors, including `stdin`, `stdout`, and `stderr`. By default, the CodeWarrior TRK running on the target forwards the output of the application to the host CodeWarrior. The host CodeWarrior will be able to print the received output only if the **Allocate Console (necessary for input)** checkbox is selected in the **Common** tab of the **Debug Configurations** dialog.

NOTE

The CodeWarrior console, allocated for the debugged application, can only be used to view the output of the application running on the target; forwarding the input from a CodeWarrior console to the debugged application is not supported currently for Linux applications.

The listing below displays the syntax to specify I/O redirections for the `stdin`, `stdout`, and `stderr` file descriptors.

Figure 58: Specifying I/O redirections

```
- '< <filename>' - stdin redirection from <filename>
- '> <filename>' - stdout redirection to <filename>
- '2> <filename>' - stderr redirection to <filename>
```

To specify I/O redirections for a Linux application:

1. In the **CodeWarrior Projects** view of the C/C++ perspective, select the name of the project that builds the Linux application.
2. Select **Run > Debug Configurations.**

   The **Debug Configurations** dialog appears.
3. Expand **CodeWarrior** group and select the launch configuration associated with the project.

   The settings pages for the selected launch configuration appears on the right-hand side of the **Debug Configurations** dialog.
4. Click the **Arguments** tab.
5. Specify the I/O redirections in the **Program arguments** text box.
6. Click **Apply** to save the changes.

The listing below displays an example of redirections, added to the list of arguments, to forward the output to the console where CodeWarrior TRK was started.

Figure 59: Sample I/O redirections

```
 - '< /proc/self/fd/0' -> use target console for stdin (this way, stdin
is functional and can be used - using a CW console it isn't)
 - '> /proc/self/fd/1' -> use target console for stdout
 - '2> /proc/self/fd/2' -> use target console for stderr
```

7.1.5 Configure Linux Process Signal Policy

This section explains how to control applications being debugged using signals and how to manage signals, using CodeWarrior IDE.

AppTRK and CodeWarrior can be configured to stop the application being debugged, whenever the application receives a signal. A user can send signals to the application directly from CodeWarrior, when the application resumes execution. To send a signal to an application, right-click the signal name in the **Signals** view and select **Resume With Signal** from the context menu that appears.

This section contains the following subsections:

- Signal inheritance on page 132
- Default Signal Policy on page 132
- Modifying Signal Policy on page 132

7.1.5.1 Signal inheritance

When a new process is forked, it inherits the signal settings from the parent process.

For example, if a process has a setting that if the SIGUSR1 signal is received, the application being debugged will be stopped, then a child process forked by this process will also inherit this setting. It will stop the application being debugged if the SIGUSR1 signal is received.

All the threads created by a process share the signal settings of that process. Signal settings cannot be configured at thread level.

7.1.5.2 Default Signal Policy

By default, the SIGINT, SIGILL, SIGTRAP, SIGSTOP, and SIGSEGV signals are caught by the debugger.

The debugger stops the application being debugged if any of these signals is received.

7.1.5.3 Modifying Signal Policy

CodeWarrior IDE provides a view, Signals, which can be used to view signals and change the debugger's policy for a signal.

To open the Signals view, perform the following steps:

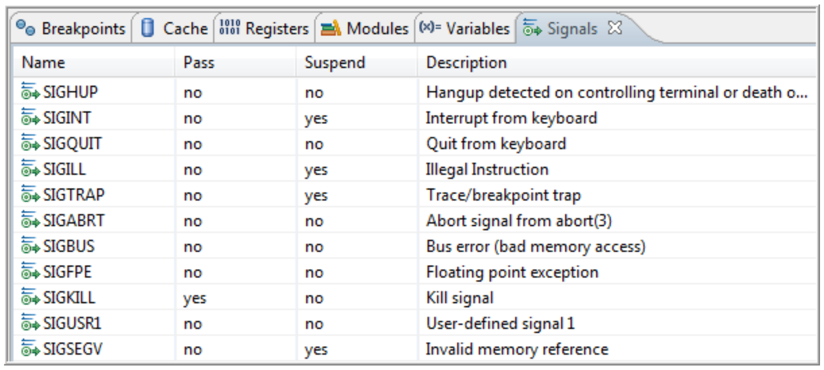
1. Select **Window > Show View > Other** in the CodeWarrior IDE.

   The **Show View** dialog appears.

2. Select **Debug > Signals**.

   The **Signals** view appears, as shown in the figure below.

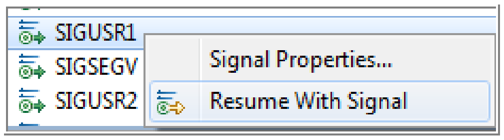
Figure 60: Signals view



Name	Pass	Suspend	Description
SIGHUP	no	no	Hangup detected on controlling terminal or death o...
SIGINT	no	yes	Interrupt from keyboard
SIGQUIT	no	no	Quit from keyboard
SIGILL	no	yes	Illegal Instruction
SIGTRAP	no	yes	Trace/breakpoint trap
SIGABRT	no	no	Abort signal from abort(3)
SIGBUS	no	no	Bus error (bad memory access)
SIGFPE	no	no	Floating point exception
SIGKILL	yes	no	Kill signal
SIGUSR1	no	no	User-defined signal 1
SIGSEGV	no	yes	Invalid memory reference

To send a signal to a stopped process or thread, right-click the signal in the **Signals** view and select **Resume With Signal**, as shown in the figure below.

Figure 61: Sending Signal to Process or Thread



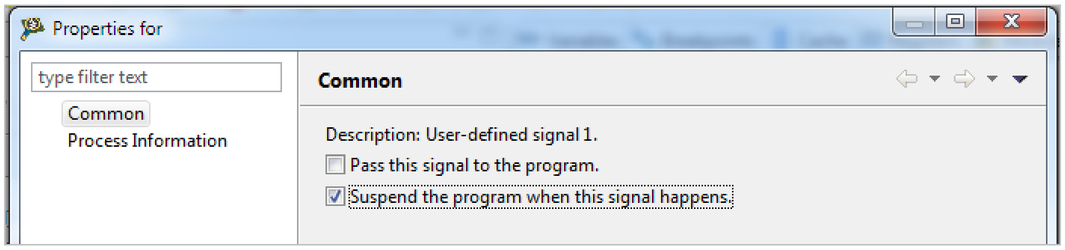
To catch a signal, perform the following steps:

1. Right-click the signal in the **Signals** view and select **Signal Properties**.

   The **Properties for** window appears (shown in the figure below).

2. Select the **Suspend the program when this signal happens** checkbox, as shown in the figure below.

Figure 62: Catching Signal



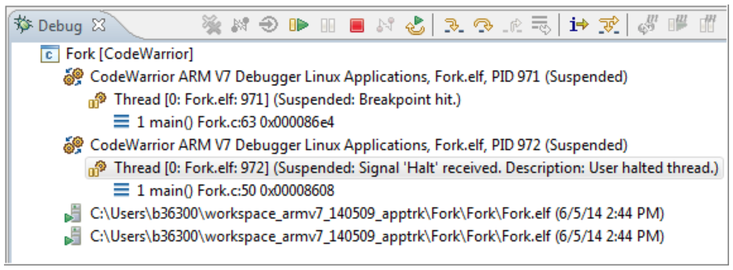
Description: User-defined signal 1.

☐ Pass this signal to the program.

☑ Suspend the program when this signal happens.

The figure below shows a child process stopped on receiving the SIGUSR1 signal.

Figure 63: Stopped Child Process



```
Fork [CodeWarrior]
  CodeWarrior ARM V7 Debugger Linux Applications, Fork.elf, PID 971 (Suspended)
    Thread [0: Fork.elf: 971] (Suspended: Breakpoint hit.)
      1 main() Fork.c:63 0x000086e4
  CodeWarrior ARM V7 Debugger Linux Applications, Fork.elf, PID 972 (Suspended)
    Thread [0: Fork.elf: 972] (Suspended: Signal 'Halt' received. Description: User halted thread.)
      1 main() Fork.c:50 0x00008608
  C:\Users\b36300\workspace_armv7_140509_apptrk\Fork\Fork\Fork.elf (6/5/14 2:44 PM)
  C:\Users\b36300\workspace_armv7_140509_apptrk\Fork\Fork\Fork.elf (6/5/14 2:44 PM)
```

Some signals cannot be caught, but they can be passed to the debugged application. These signals have read-only properties. One such signal is SIGKILL.

7.1.6 Debug Linux application

You can use the CodeWarrior download launch configuration created earlier to debug the Linux application on the target system.

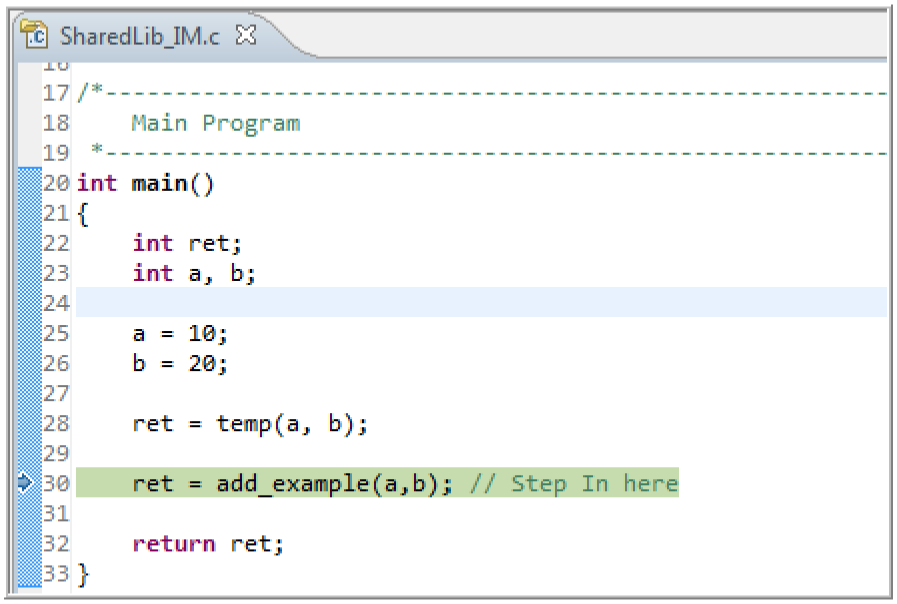
You can use that launch configuration to start a debug session that can be used to debug a Linux application.

The steps are as follows:

1. On the left-hand side of the **Debug Configurations** dialog, ensure to select the CodeWarrior download launch configuration that you created to debug the Linux application.
2. Click **Debug** in the **Debug Configurations** dialog.

   The IDE uses the selected CodeWarrior download launch configuration to start a debugging session and opens the **Debug** view, as shown in the figure below.

Figure 64: Debug view - Sample Linux application



```
/*----------------------------------------------------------------
    Main Program
 *----------------------------------------------------------------
int main()
{
    int ret;
    int a, b;

    a = 10;
    b = 20;

    ret = temp(a, b);

    ret = add_example(a,b); // Step In here

    return ret;
}
```

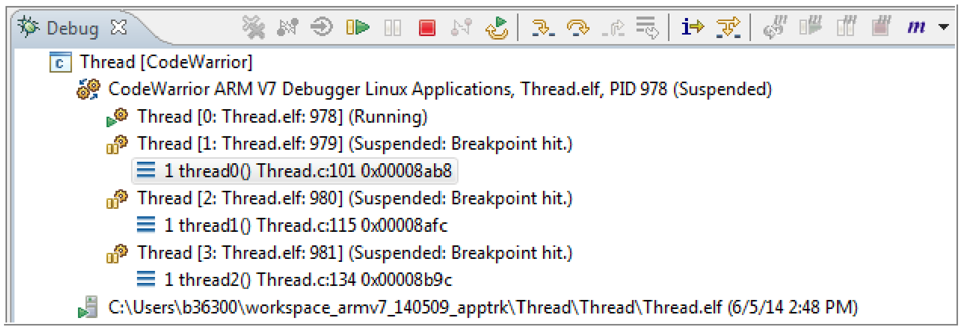
You just finished using the CodeWarrior download launch configuration to debug a Linux application.

7.2 Viewing multiple processes and threads

This section explains how to view all processes and threads on a target.

When you debug an application, the CodeWarrior debugger opens the **Debug** view. In this view, you can see only processes and threads/tasks on which debugger is attached, as shown in the figure below.

Figure 65: Debug view - processes and threads



```
Thread [CodeWarrior]
  CodeWarrior ARM V7 Debugger Linux Applications, Thread.elf, PID 978 (Suspended)
    Thread [0: Thread.elf: 978] (Running)
    Thread [1: Thread.elf: 979] (Suspended: Breakpoint hit.)
      1 thread0() Thread.c:101 0x00008ab8
    Thread [2: Thread.elf: 980] (Suspended: Breakpoint hit.)
      1 thread1() Thread.c:115 0x00008afc
    Thread [3: Thread.elf: 981] (Suspended: Breakpoint hit.)
      1 thread2() Thread.c:134 0x00008b9c
  C:\Users\b36300\workspace_armv7_140509_apptrk\Thread\Thread\Thread.elf (6/5/14 2:48 PM)
```

For Linux debugging, you can view all processes on target in the **System Browser** view.

To view processes and threads in **System Browser** view:

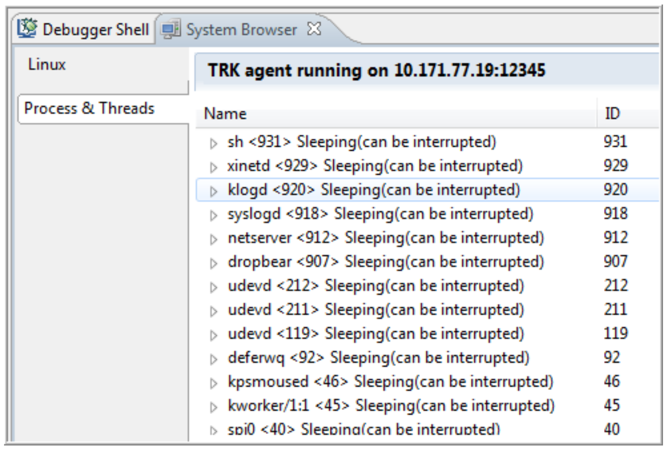
1. Open a Linux application in the CodeWarrior IDE.
2. Select **Run > Debug**.

   The **Debug** perspective appears.
3. While the application is running, select **Window > Show View > Other**.

   The **Show View** dialog appears.
4. From the **Debug** group, select **System Browser**.
5. Click **OK**.

   The **System Browser** window appears with the process and thread information (shown in the figure below). Keeping this view open increases the time required to suspend a core.

Figure 66: System Browser window



TRK agent running on 10.171.77.19:12345

Name	ID
sh <931> Sleeping(can be interrupted)	931
xinetd <929> Sleeping(can be interrupted)	929
klogd <920> Sleeping(can be interrupted)	920
syslogd <918> Sleeping(can be interrupted)	918
netserver <912> Sleeping(can be interrupted)	912
dropbear <907> Sleeping(can be interrupted)	907
udevd <212> Sleeping(can be interrupted)	212
udevd <211> Sleeping(can be interrupted)	211
udevd <119> Sleeping(can be interrupted)	119
deferwq <92> Sleeping(can be interrupted)	92
kpsmoused <46> Sleeping(can be interrupted)	46
kworker/1:1 <45> Sleeping(can be interrupted)	45
spi0 <40> Sleeping(can be interrupted)	40

7.3 Debugging applications that use fork() and exec() System Calls

This section shows you how to use the CodeWarrior debugger to debug programs that contain `fork()` and `exec()` system calls.

The table below describes the `fork()` and `exec()` system calls.

Table 56: fork() and exec() description

System Call	Description
`fork()`	This generic Linux system call creates a new process that is the exact replica of the process that creates it. This call returns 0 to the child process and returns the PID (Process ID) of the newly-created child process to the parent process.
`exec()`	This Linux system call launches a new executable in an already running process. The debugger destroys the instance of the previous executable loaded into that address space and a new instance is created.

NOTE

You can also pick up sample Linux applications from the following folder:

```
<CWInstallDir>\CW_ARMv7\ARMv7\ARM_Linux\AppDebug\Examples
```

For CodeWarrior debugging purposes, when applications call the `fork()` system call, the debugger instead calls the `clone()` system call with the flag `CLONE_PTRACE`. This causes:

- The operating system to attach CodeWarrior TRK to the child process
- The child process to stop with a `SIGTRAP` on return from the `clone()` system call

To make this happen, you must add a static library to your CodeWarrior project. The source code for building the static library is described later in this section.

Before you start the tutorial, ensure that you have:

- Installed the BSP on Linux
- Created a TCP/IP connection between the host computer and the remote target
- Launched CodeWarrior TRK on the target system

These steps demonstrate how to use the CodeWarrior IDE to debug programs that contain `fork()` and `exec()` system calls:

1. Create a CodeWarrior project with the settings listed in the table below.

Table 57: Static Library Project Settings

Option Name	Value
Project name	`Fork`
Location	`<workspace-dir>\Fork`
Project type	Linux application
Language	C

   The IDE creates a project with a debug launch configuration.

2. Create a new build configuration. Right-click the project folder and select **Build Configurations > Manage**.

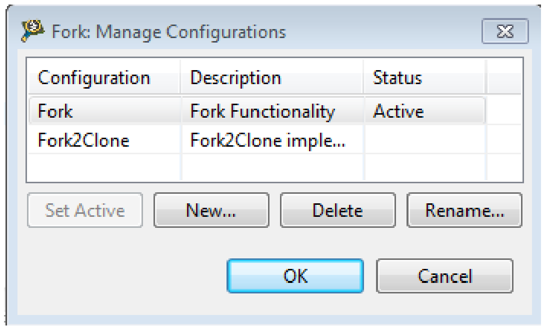
   The **Fork: Manage Configurations** dialog appears.

3. Rename the default debug configuration to `Fork`.
4. Click **New** to create a new build configuration.

   The **Create New Configuration** dialog appears.

5. In the **Name** field, enter the configuration name, `Fork2Clone`.
6. From the **Copy settings from** options, select **Existing configuration**.
7. Click **OK**. The **Fork: Manage Configurations** dialog appears (shown in the figure below).

Figure 67: Fork: Manage Configurations dialog



Configuration	Description	Status
Fork	Fork Functionality	Active
Fork2Clone	Fork2Clone imple...	

8. Activate the `Fork2Clone` build configuration.
9. Build the `Fork2Clone` build configuration by right-clicking it in the **CodeWarrior Projects** view and selecting **Build Project** from the context menu. The CodeWarrior IDE builds the project and stores the support library, `libfork2clone.a`, in the *Output* directory within the project directory.

NOTE

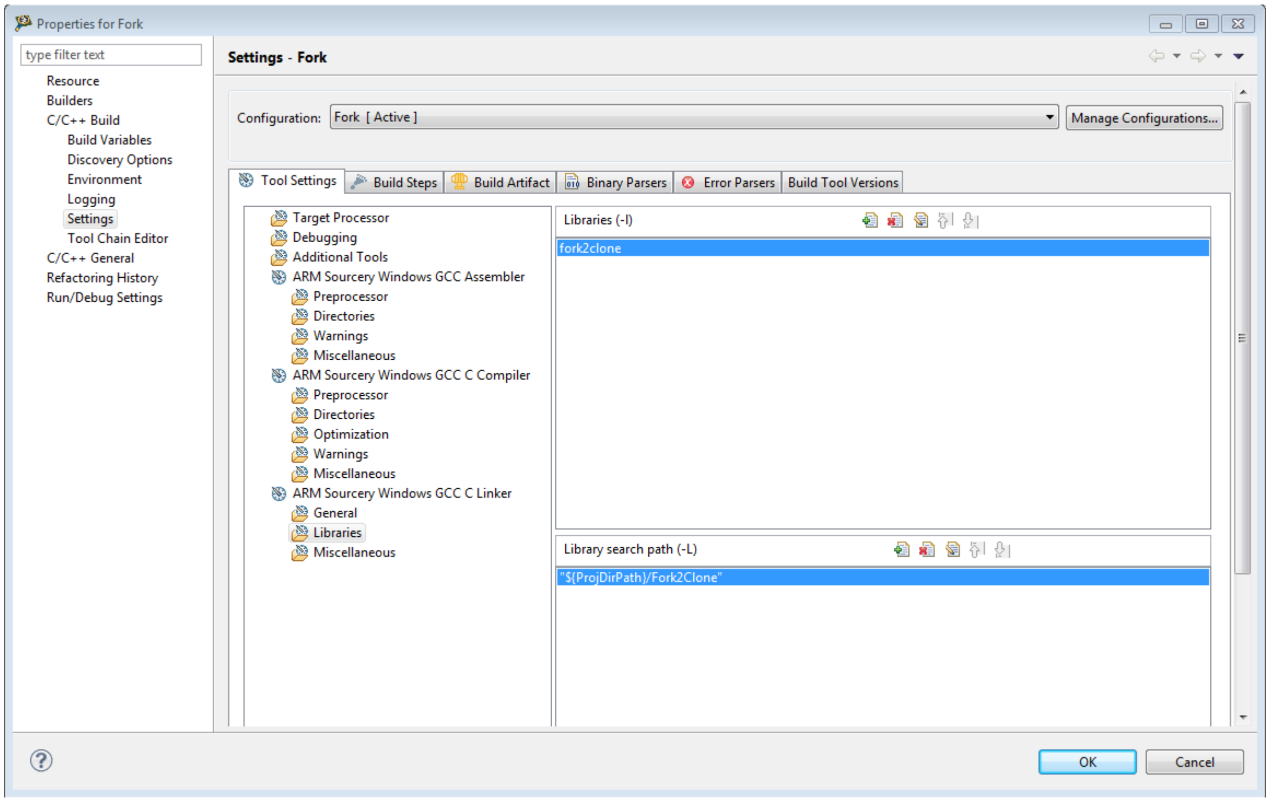
Remember to build the `Fork2Clone` build configuration before the `Fork` build configuration to avoid getting a library file missing error as the `libfork2clone.a` is used in the Fork project.

10. To specify the linker settings and add the support library to the project.
    a. Right-click the `Fork` build configuration in the **CodeWarrior Projects** view.
    b. Select **Properties** from the context menu. The **Properties** window for the shared library project appears.
    c. From the **C/C++ Build** group, select **Settings**.
    d. On the **Tool Settings** page, from the **ARM Sourcery Windows GCC Linker** container, select **Libraries**.
    e. In the **Libraries (-l)** panel, click **Add** ( ). The **Enter Value** dialog appears.
    f. Enter the library file name in the **Libraries** field.
    g. In the **Libraries search path (-L)** panel, click **Add** ( ). The **Add directory path** dialog appears.
    h. Enter the library path in the **Directory** field, as shown in the figure below.

NOTE

These settings enable the CodeWarrior IDE linker to locate the shared library `libfork2clone.a`. For detailed information on other linker command line arguments, refer to GNU linker manuals. You can find GNU documentation here: http://www.gnu.org .

Figure 68: Libraries Linker Settings - Fork project


Properties for Fork

Settings - Fork

Configuration: Fork [Active]

Tool Settings | Build Steps | Build Artifact | Binary Parsers | Error Parsers | Build Tool Versions

- Target Processor
- Debugging
- Additional Tools
- ARM Sourcery Windows GCC Assembler
  - Preprocessor
  - Directories
  - Warnings
  - Miscellaneous
- ARM Sourcery Windows GCC C Compiler
  - Preprocessor
  - Directories
  - Optimization
  - Warnings
  - Miscellaneous
- ARM Sourcery Windows GCC C Linker
  - General
  - Libraries
  - Miscellaneous

Libraries (-l)

fork2clone

Library search path (-L)

"${ProjDirPath}/Fork2Clone"

11.Remove the default `main.c` file from the project.

12.Add a new `db_fork.c` file to the project.

13.Enter the below code in the editor window of `db_fork.c` file.

Figure 69: Source code for db_fork.c

```
/*
  -------------------------

  User Include files

  -------------------------

*/

#include "db_fork.h"

/*

  ------------------------

  Main Program

  ------------------------

*/
```

```
int __libc_fork(void)

{

  return( __db_fork() );

}

extern __typeof (__libc_fork) __fork __attribute__ ((weak, alias
("__libc_fork")));

extern __typeof (__libc_fork) fork __attribute__ ((weak, alias
("__libc_fork")));
```

14.Create a header file `db_fork.h` in your project directory and add the below code in the header file.

Figure 70: Source code for db_fork.h

```

#include <asm/unistd.h>
#include <sys/syscall.h>
#include <errno.h>
#include <signal.h>
#include <sched.h>
#define __NR___db_clone__NR_clone
#define __db_fork()
syscall(__NR___db_clone, SIGCHLD | CLONE_PTRACE, 0);
```

15.Enter the below code in the editor window of `fork.c` file.

Figure 71: Source code for fork.c

```

/*
/*

 *  fork.c

 *

 */

/*-----------------------------------------------------------------*

 System Include files

 *----------------------------------------------------------------*/

#include <stdio.h>

#include <unistd.h>

#include <stdlib.h>

#include <sys/ptrace.h>

#include <sys/errno.h>
```

```
#include <sys/types.h>

#include <signal.h>

#include <sched.h>

#include <fcntl.h>

#include <dlfcn.h>

/*-------------------------------------------------------------------*

  Function Prototypes

 * -----------------------------------------------------------------*/

int fn1(int j);

int fn2(int i);

/*------------------------------------------------------------------*

  Global Variables

 *------------------------------------------------------------------*/

int gint;

/*------------------------------------------------------------------*

  Main Program

 *-----------------------------------------------------------------*/

int main(void)

{

  int pid,x;

  int shared_local;

  printf( "Fork Testing!\r\n" );

  fflush( stdout );

  gint = 5;

  shared_local =5;

  pid = fork();

  if(pid == 0)

  {

    x=0;

    gint = 10;
    shared_local = fn1(9);

    printf("\nForked : Child");

    printf("\nChild:Global=%d,Shared_Local=%d",gint,shared_local);

    printf("\nChild pid = %d, parent pid =%d \n", getpid(),getppid());

    fflush( stdout );

  }

  else

  {

    x=0;

    gint = 12;

    shared_local = fn2(11);

    printf("\nForked : Parent");

    printf("\nParent:Global=%d,Shared_Local=%d",gint,shared_local);

    printf("\nParent pid = %d, Parent's parent pid =%d \n",
getpid(),getppid());

    fflush( stdout );


  }

  return 0;

}

int fn1(int j)

{

  j++;

  return j;

}

int fn2(int i)

{

  i++;

  return i;
```

```
}
```

The code of the parent process creates a forked process (child process) when the `__db_fork` function executes. The debugger opens a separate thread window for the child process. When the child process finishes executing, the debugger closes the thread window. To debug the code of the child process, you need to set a breakpoint in the child process code. You can debug the code of the child process the same way you debug code of any other process.

16.Create another project, `Exec`, and create two new build configurations with the following settings:

Table 58: Exec example project settings

Option Name	Value
Project name	`Exec`
Location	`<workspace-dir>\Exec`
Project type	Linux application
Language	C
Build configurations	• `Exec` • `Exec-1`

17.Add the source files `exec.c and exec-1.c` to the `Exec` project.

- `exec.c`: The code demonstrating `exec()` functionality
- `exec-1.c`: Generates the executable file `exec-1.elf`

As you step through the code of the `exec.elf` file, the `exec()` function call executes and a separate debugger window for the `exec-1.elf` appears. You can perform normal debug operations in this window. The debugger destroys the instance of the previous file (`exec.elf`) and creates a new instance for the `exec-1.elf` file.

18.Enter the below code in the editor window of `Exec.c` file.

Figure 72: Source code for Exec.c

```
/**  Exec.c
 *
 *    Demonstrates Exec system call functionality
 */

/*------------------------------------------------------------------------------*
    System Include files
 *------------------------------------------------------------------------------*/
#include <stdio.h>
#include <unistd.h>
/*------------------------------------------------------------------------------*
    Constant Defintions
 *------------------------------------------------------------------------------*/
#define EXEC_1    "/tmp/Exec-1.elf"

/*------------------------------------------------------------------------------*
    Main Program
 *------------------------------------------------------------------------------*/
int main(void)
{
    char *argv[2];
    printf("Exec Testing!\r\n" );
    printf("Before exec my ID is %d\n",getpid());
    printf("My parent process's ID is %d\n",getppid());
    fflush( stdout );

    /*Calling another program exec-1.elf*/
    argv[0] = EXEC_1;
    argv[1] = NULL;
    printf("exec starts\n");
    execv(argv[0],argv);
    printf("This will not print\n");
    fflush( stdout );
    return 0;
}
```

19.Enter the below code in the editor window of `Exec-1.c` file.

Figure 73: Source code for Exec-1.c

```
/**  Exec-1.c *
Demonstrates Exec system call functionality */
/*-------------------------------------------------------------------*
System Include files
*-------------------------------------------------------------------*/
#include <stdio.h>
#include <unistd.h>
/*-------------------------------------------------------------------*
Main Program
*-------------------------------------------------------------------*/
int main(void){
  printf("After exec my process ID is %d\n",getpid());
  printf("My parent process's ID is %d\n",getppid());
  printf("exec ends\n");
  fflush( stdout );
  return 0;
}
```

20.Create the build configurations for building `Exec.elf` and `Exec-1.elf` (similar to creating the build configurations for the `Fork` project).

21.Build `Exec` project.

a. Select the `Exec` build configuration, if not selected.

b. Select **Project > Build Project.**

The CodeWarrior IDE generates the `exec.elf`, and `exec-1.elf` executable files and places them in the project folder.

22.Specify the remote download path of the executable files to be launched by the `exec()` system call.

a. Select **Run > Debug Configurations** to open the **Debug Configurations** dialog.

b. In the left panel from the **CodeWarrior** group, select the `Exec` launch configuration.

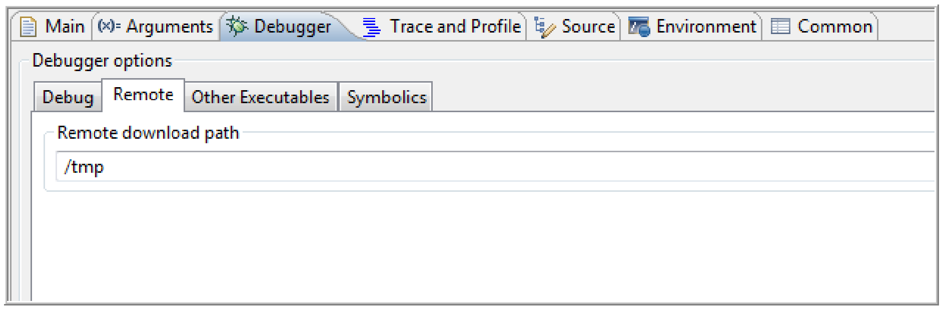
c. On the **Debugger** page, click the **Remote** tab.

d. Type `/tmp` in the **Remote Download Path** field, as shown in the figure below. This specifies that the final executable file will be downloaded to this location on the target platform for debugging.

NOTE

For this tutorial, the remote download path is specified as `/tmp`. If you wish, you may specify an alternate remote download path for the executable file.

Figure 74: Remote download path - shared library project



Remote download path: /tmp

23.Specify the host-side location of the executable files to be launched by the `exec()` system call.

a. Click the **Other Executables** tab.

b. Click **Add**. The **Debug Other Executable** dialog appears.

c. Click **File System**. The **Open** dialog appears.

d. Navigate to the location of the `exec-1.elf` file in your project directory.

e. Select the `exec-1.elf` file name.

f. Click **Open**. The host-side location of `exec-1.elf` appears in the **Additional Executable File** text box.

g. Select the **Load Symbols** checkbox.

h. Select the **Download to Device** checkbox. The **Specify the remote download path** field is activated.

NOTE

If you do not want to download the selected file on the target platform, do not select the **Download to Device** checkbox.

i. Type `/tmp` in the **Remote download path** text box. The shared library will be downloaded to this location when you debug or run the executable file.

j. Click **OK**. The settings are saved.

24.Click **Apply** to save the settings made to the launch configuration.

25.Set breakpoints in the child and parent processes.

a. Double-click the `fork.c` file name in the **CodeWarrior Projects** view.

b. Set a breakpoint in the code of the child process at this line: `x=0;`

c. Set a breakpoint in the code of the parent process.

d. Close the `fork.c` file.

26.Select **Run > Debug**.

The debugger window appears and the `Fork` project starts debugging. As a result, the `Fork.elf` and `libfork2clone.a` files are downloaded on the target system.

27.Step over the code until you reach the line of code that calls the `fork()` system call: `pid = fork ();`

When the `fork()` system call is called, the child process debugger window appears. You can now perform normal debugging operations in this window.

28. Step over the code in the child process debugger window a couple of times.
29. Next, step over the code in the parent process debugger window a couple of times.

> NOTE
> The console window of the parent process is shared by the child process.

30. Terminate the debug session.
31. Clear previously set breakpoints.
32. Select **Run > Debug** for `Exec` project.
33. Set a breakpoint in the `Exec.c` file on the line containing the `execv()` function call.
34. Click **Resume**. The target stops at the line where you set the breakpoint.
35. Click **Resume**. The `exec()` call is executed and the debugger stops in the `main()` function of the `Exec-1.elf` file.
36. Execute some steps in `Exec-1.c` file.
37. Terminate the debug session and remove all breakpoints.

7.4 Debugging shared library

This section demonstrates how to debug a shared library that is implicitly linked to an application.

CodeWarrior allows you to do source-level debugging of shared libraries. When you debug an executable file using a shared library, you can step into the shared library code.

This tutorial demonstrates how to debug a shared library that is implicitly linked to an application. In this tutorial:

- Create an example project on page 145
- Configure shared library build configuration on page 148
- Configure executable build configuration on page 148
- Build shared library on page 149
- Build executable on page 149
- Configure launch configuration on page 149
- Debug shared library on page 151

7.4.1 Create an example project

First of all, you need to create an example Linux project that uses a shared library.

To create an example Linux project, perform the following steps:

1. In the CodeWarrior IDE, use **File > New > CodeWarrior Linux Project Wizard** to create a new Linux project with the settings given in the table below.

> NOTE
> Instead of creating a new Linux project, you can import an example Linux project, `SharedLibrary`, available in the *`<CWInstallDir>`* `\CW_ARMv7\ARMv7\ARM_Linux\AppDebug\Examples` folder as a reference. The example project can be imported as a CodeWarrior Example Project using the **File > Import** menu bar option.

Table 59: Example Project Settings

Option Name	Value
Project name	`SharedLibraryExample`
Location	`<workspace-dir>\SharedLibraryExample`
Project type	Linux application
Language	C
Build configurations	• `LibExample` (generates the dynamic library needed by the launch configurations) • `SharedLib_IM` (used to demonstrate implicit linking with the library generated by `LibExample` build configuration)
Launch configurations	`SharedLib_IM` (launches the application that demonstrates implicit linking with a shared library)

NOTE

In this tutorial, we only mention implicit library linking; however, in the example project shipped with CodeWarrior, `SharedLibrary`, we have also demonstrated explicit library loading. For explicit library loading, we have used another build/launch configuration, `SharedLib_EX`.

2. Remove the default `main.c` file and add the source files (`SharedLib_IM.c` and `LibExample.c`) to your project.
3. In the CodeWarrior IDE, create a header file, `LibExample.h`, as depicted in the listing below.

Figure 75: Source Code for LibExample.h

```
/* LibExample.h */
int add_example(int x,int y);
int add_example_local(int x,int y);
```

4. Save the `LibExample.h` file in the project directory.
5. Enter the below code into the editor window of the `SharedLib_IM.c` file.

Figure 76: Source Code for SharedLib_IM.c

```
/*
  Sharedlib_IM.c

  Demonstrates implicit linking.

*/

// User Include files

#include "LibExample.h"

// function prototype declaration

int temp (int, int);
```

```
// main program

int main ()

{

  int ret;

  int a, b;

  a = 10;

  b = 20;

  ret = temp (a, b);

  ret = add_example (a, b);   // step in here

  return ret;

}

int temp(int i, int j)

{

  return i + j;

}
```

6. Enter the below code into the editor window of the `LibExample.c` file.

Figure 77: Source Code for LibExample.c

```
/*
  LibExample.c

*/

// user include files#include "LibExample.h"// functions definitions

int add_example( int x, int y)

{

  int p,q;

  p=100;

  q=p+200;

  add_example_local (2, 3);  // step in here

  return x+y+q;

}

  int add_example_local (int x, int y)
```

```
{
  int p,q;
  p = 100;
  q = p + 200;
  return x + y + q;
}
```

7.4.2 Configure shared library build configuration

The next action is to configure the `LibExample` build configuration, which generates `libexample.so`.

The steps are given below:

1. Select the `SharedLibraryExample` project in the **CodeWarrior Projects** view.
2. Select the `LibExample` build configuration by selecting **Project** > **Build Configurations** > **Set Active** > *<Build Configuration Name>*.
3. Check *LibExample.c* and *LibExample.h* in the **Build** column.

TIP

Use the CodeWarrior example project, `SharedLibrary`, as a reference to set up the build configuration settings of the `LibExample` build configuration.

7.4.3 Configure executable build configuration

Now, you need to set up the `SharedLib_IM` build configuration.

For this, perform the following steps:

1. Select the `SharedLibraryExample` project in the **CodeWarrior Projects** view.
2. Select the `SharedLib_IM` build configuration by selecting **Project > Build Configurations > Set Active > <*Build Configuration Name*>**.
3. Specify the linker settings.
   a. Select the `SharedLib_IM` build configuration in the **CodeWarrior Projects** view.
   b. Select **Project > Properties**. The **Properties** window for the shared library project appears.
   c. In the **Tool settings** page, from the **ARM Sourcery Windows GCC C Linker** container, select **Libraries**.
   d. In the **Libraries (-l)** panel, click **Add** ( ). The **Enter Value** dialog appears.
   e. Enter the library file name, example, in the **Libraries** field.
   f. In the **Library search path (-L)** panel, click **Add** ( ). The **Add directory path** dialog appears.
   g. Enter the library path in the **Directory** field. The library path is the path of the *Output* directory that is used by `LibExample` build configuration.

NOTE

These settings enable the CodeWarrior IDE linker to locate the shared library, `libexample.so`. For detailed information on other linker command line arguments, see GNU linker manuals. You can find GNU documentation here: http://www.gnu.org.

7.4.4 Build shared library

The next action is to build the shared library.

To build the shared library, perform the following steps:

1. Select the `SharedLibraryExample` project in the **CodeWarrior Projects** view.
2. Select the `LibExample` build configuration by selecting **Project > Build Configurations > Set Active > <*Build Configuration Name*>**.
3. Select **Project > Build Project**. The CodeWarrior IDE builds the project and stores the output file `libexample.so` in the *Output* directory within the project directory.

7.4.5 Build executable

Now, you need to build the executable that uses the shared library.

To build the executable that uses the shared library, perform the following steps:

1. Select the `SharedLibraryExample` project in the **CodeWarrior Projects** view.
2. Select the `SharedLib_IM` build configuration by selecting **Project > Build Configurations > Set Active > <*Build Configuration Name*>**.

TIP

You can also select a build configuration from the drop-down list that appears when you click the down arrow next to the project name in the **CodeWarrior Projects** view.

3. Select **Project > Build Project**. The CodeWarrior IDE builds the project and stores the output file `SharedLib_IM.elf` in the *Output* directory within the project directory.

7.4.6 Configure launch configuration

The next action is to configure the `SharedLib_IM` launch configuration.

Configuring the `SharedLib_IM` launch configuration involves:

- Specifying the remote download path of the final executable file
- Specifying the host-side location of the executable file to be used for debugging the shared library
- Specifying the environment variable that enables the shared object loader to locate the shared library on the remote target at run time

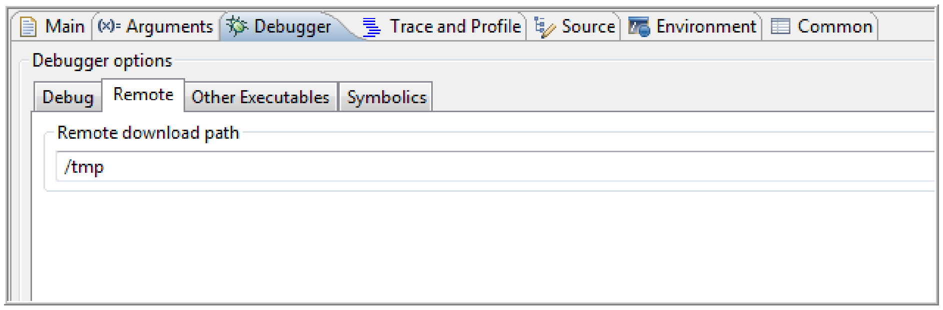
The steps are as follows:

1. Activate the `SharedLib_IM` launch configuration in the project.
2. Specify the remote download path of the final executable file.
   a. Select **Run > Debug Configurations** to open the **Debug Configurations** dialog.
   b. In the left pane from the **CodeWarrior** group, select the `SharedLib_IM` launch configuration.
   c. On the **Debugger** page, click the **Remote** tab.
   d. Type `/tmp` in the **Remote Download Path** field, as shown in the figure below. This specifies that the final executable file will be downloaded to this location on the target platform for debugging.

NOTE

For this tutorial, the remote download path is specified as `/tmp`. You can replace `/tmp` with any other directory for which CodeWarrior TRK has the necessary access permissions.

Figure 78: Remote download path - shared library project



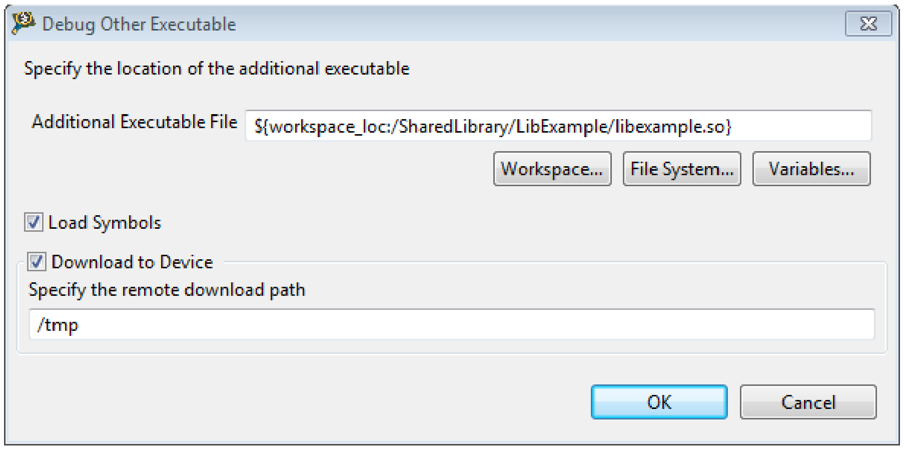
Debugger options

Remote download path: /tmp

3. Specify the host-side location of the executable file to be used for debugging the shared library.
   a. Click the **Other Executables** tab in the **Debugger** page.
   b. Click **Add**. The **Debug Other Executable** dialog appears.
   c. Click **Workspace**. The **Open** dialog appears.
   d. Navigate to the location where you have stored the `libexample.so` file in your project directory.
   e. Select the `libexample.so` file name.
   f. Click **Open**. The host-side location of the shared library appears in the **Specify the location of the other executable** field.
   g. Select the **Load Symbols** checkbox, so that the debugger has visibility of symbols within the library.
   h. Select the **Download to Device** checkbox. The **Specify the remote download path** field is activated.
   i. Type `/tmp` in the **Remote download path** text box. The shared library will be downloaded to this location when you debug or run the executable file.

      The default location of shared libraries on the embedded Linux operating system is `/usr/lib`. For this tutorial, the remote download location of `libexample.so` is `/tmp`.
   j. Click **OK**. The settings (shown in the figure below) are saved.

Figure 79: Debug Other Executable dialog



Specify the location of the additional executable

Additional Executable File: ${workspace_loc:/SharedLibrary/LibExample/libexample.so}

☑ Load Symbols

☑ Download to Device

Specify the remote download path: /tmp

4. Specify the environment variable that enables the shared object loader to locate the shared library on the remote target at run time.

   At run time, the shared object loader first searches for a shared library in the path specified by the `LD_LIBRARY_PATH` environment variable's value. In this case, the value of this environment variable will be `/tmp`, which is the remote download path for the shared library you specified in the **Debug Other Executable** dialog. If you have not specified the environment variable or have assigned an incorrect value, the shared object loader searches for the shared library in the default location `/usr/lib`.

   a. In the Debug window, click **Environment** to open the **Environment** page.

   b. Click **New** to open the **New Environment Variable** dialog.

   c. In the **Name** field, type `LD_LIBRARY_PATH`.

   d. In the **Value** field, type `/tmp`.

   NOTE

   Ensure that you type the same remote download path in the **Value** field that you specified in the **Debug Other Executable** dialog.

   e. Click **OK**. The environment variable is added to the launch configuration.

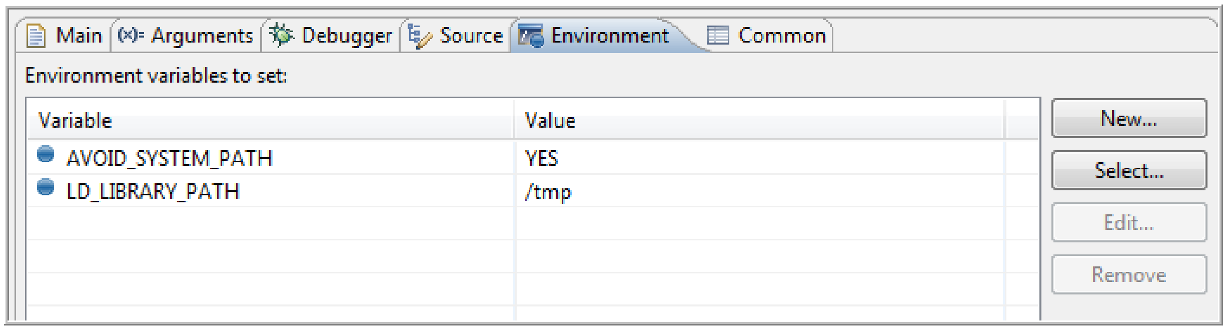
   f. Add another environment variable with name, `AVOID_SYSTEM_PATH` and value `YES`.

   NOTE

   The `AVOID_SYSTEM_PATH` variable sets the launch configuration to use the library path settings you specify. By specifying the value `YES` you avoid the launch configuration from picking up any other system path.

   g. Click **Apply** to save the launch configuration settings. The target settings are saved (shown in the figure below).

   Figure 80: Environment variables - shared library project



Environment variables to set:

Variable	Value
AVOID_SYSTEM_PATH	YES
LD_LIBRARY_PATH	/tmp

   h. Click **OK** to close the **Debug** view.

7.4.7 Debug shared library

Finally, you need to debug the shared library.

In the steps that follow, you will launch the debugger. Next, you will step through the code of the executable file `SharedLib_IM.elf` until you reach the code that makes a call to the `add_example` function implemented in the shared library. At this point, you will step into the code of the `add_example` function to debug it.

1. Activate the `SharedLib_IM` launch configuration in the project.
2. Select **Run > Debug**.

The debugger starts and downloads the `SharedLib_IM.elf` and `libexample.so` files to the specified location on the remote target, one after another. The **Debug** perspective appears.

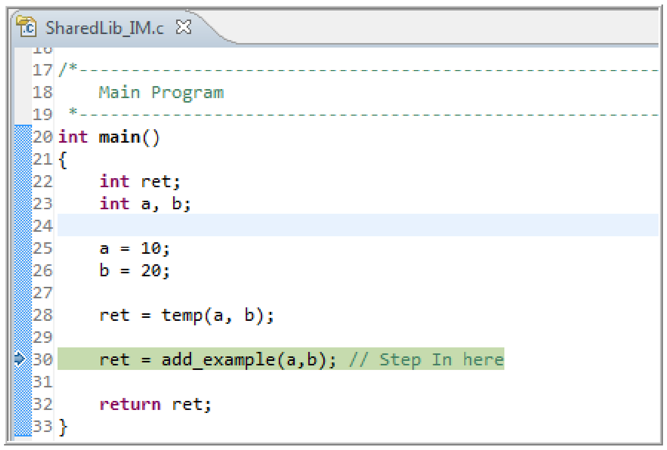
3. Click **Step Over** in the debugger window until you reach the following line of code (shown in the figure below):

```
ret=add_example(a,b)
```

TIP

Before you set breakpoints in the code of an imported shared library to step into the code, you can use the **Executables** view to navigate and check the source files of the library. For more information on the **Executables** view, open CodeWarrior Eclipse Help by selecting **Help > Help Contents** in the CodeWarrior IDE, and then select **Third Party References > C/C++ Development User Guide > Reference > C/C++ Views and Editors > Executables** view in the **Contents** pane.

Figure 81: SharedLib_IM.c - step in location

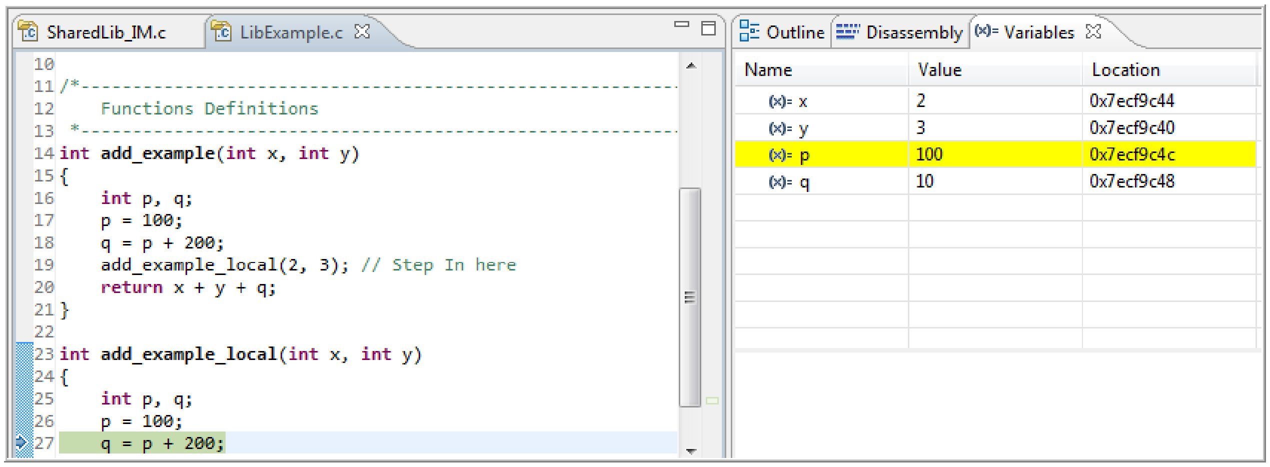


```
/*-----------------------------------------------------------------
    Main Program
 *-----------------------------------------------------------------
int main()
{
    int ret;
    int a, b;

    a = 10;
    b = 20;

    ret = temp(a, b);

    ret = add_example(a,b); // Step In here

    return ret;
}
```

4. In the **Debug** view, click **Step Into** to step into the code of the `add_example` function.

The debugger steps into the source code of the `add_example` function in the `LibExample.c` file (shown in the figure below).

Figure 82: LibExample.c - add_example function



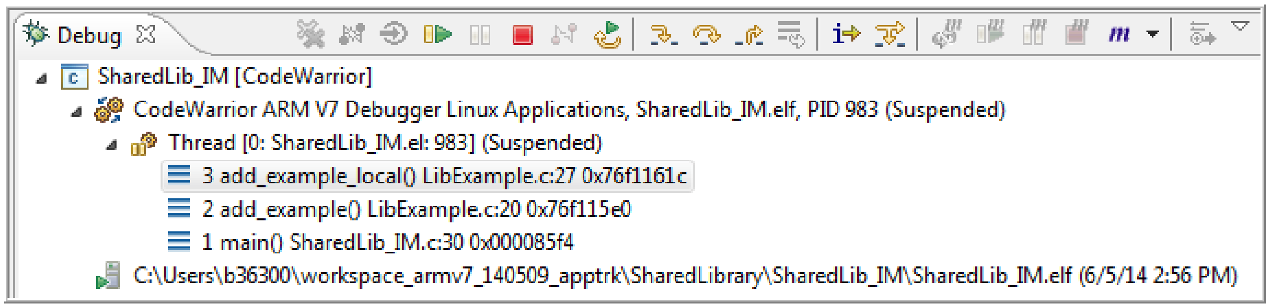
```

/*-----------------------------------------------------------------
    Functions Definitions
 *-----------------------------------------------------------------
int add_example(int x, int y)
{
    int p, q;
    p = 100;
    q = p + 200;
    add_example_local(2, 3); // Step In here
    return x + y + q;
}

int add_example_local(int x, int y)
{
    int p, q;
    p = 100;
    q = p + 200;
```

Name	Value	Location
x	2	0x7ecf9c44
y	3	0x7ecf9c40
p	100	0x7ecf9c4c
q	10	0x7ecf9c48

5. After stepping in, you can step through the rest of the code.

The **Debug** view shows the function calls to the `add_example` function (shown in the figure below).

Figure 83: Debug view - shared library project

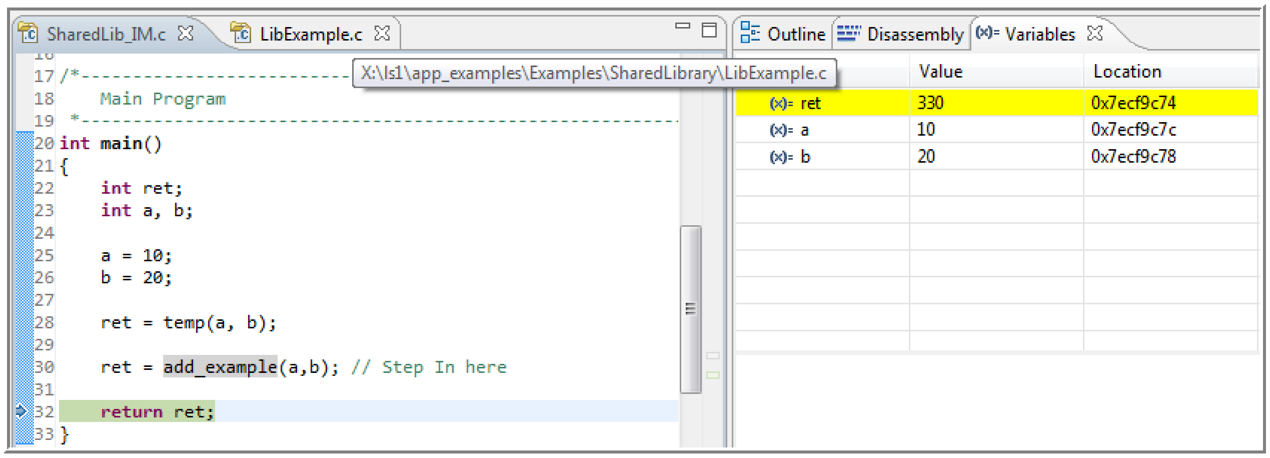


```
SharedLib_IM [CodeWarrior]
  CodeWarrior ARM V7 Debugger Linux Applications, SharedLib_IM.elf, PID 983 (Suspended)
    Thread [0: SharedLib_IM.el: 983] (Suspended)
      3 add_example_local() LibExample.c:27 0x76f1161c
      2 add_example() LibExample.c:20 0x76f115e0
      1 main() SharedLib_IM.c:30 0x000085f4
  C:\Users\b36300\workspace_armv7_140509_apptrk\SharedLibrary\SharedLib_IM\SharedLib_IM.elf (6/5/14 2:56 PM)
```

6. View the output of the program.

   The rest of the code is executed and the output appears in the **Variables** view (shown in the figure below).

Figure 84: Variables view - shared library project



```
/*--------------------------------------------------------
    Main Program
 *--------------------------------------------------------
int main()
{
    int ret;
    int a, b;

    a = 10;
    b = 20;

    ret = temp(a, b);

    ret = add_example(a,b); // Step In here

    return ret;
}
```

	Value	Location
ret	330	0x7ecf9c74
a	10	0x7ecf9c7c
b	20	0x7ecf9c78

7.5 Debugging Linux Kernel

This section shows you how to use the CodeWarrior debugger to debug the Linux kernel.

The Linux operating system (OS) works in two modes - *kernel mode* and *user mode*. The Linux kernel operates in kernel mode and resides at the top level of the OS memory space, or *kernel space*. The kernel performs the function of a mediator among all the currently running programs and between the programs and the hardware. The kernel manages the memory for all the programs (processes) currently running and ensures that the processes share the available memory such that each process has enough memory to function adequately. In addition, the kernel allows application programs to manipulate various hardware architectures via a common software interface.

User mode uses the memory in the lowest level of the OS memory space, called the *user space* or the application level. At the application level, a program accesses memory or other hardware through system calls to the kernel as it does not have permission to directly access these resources.

Debugging the Linux kernel involves the following major actions:

1. Setting up target hardware on page 154
2. Installing Board Support Package (BSP) on page 155

3. Configuring build tool on page 156
4. Configuring Linux kernel on page 156
5. Creating a CodeWarrior Project using Linux kernel image on page 158
6. Configuring kernel project for debugging on page 160
7. Debugging kernel by attaching to a running U-Boot on page 163

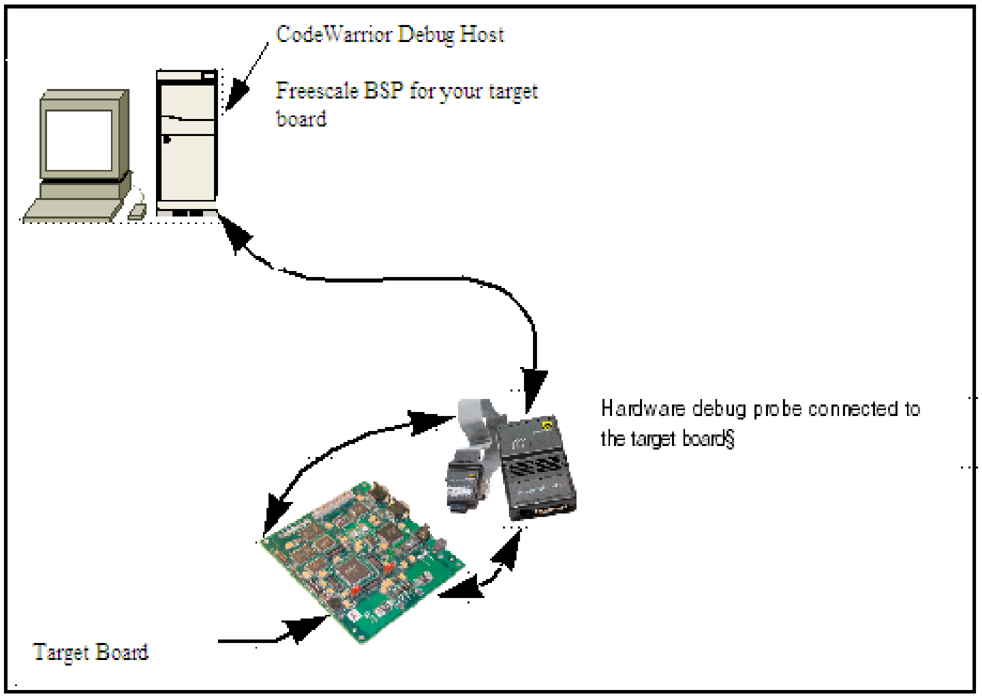
7.5.1 Setting up target hardware

Before you use the CodeWarrior IDE to debug the Linux kernel, you need to set up the target hardware.

One requirement of the setup is to have a debug probe connected between the CodeWarrior debug host and target board.

The figure below illustrates the setup required to use the IDE to debug the Linux kernel running on a ARMv7 target board.

Figure 85: Setup for kernel debugging using CodeWarrior IDE


CodeWarrior Debug Host
Freescale BSP for your target board
Hardware debug probe connected to the target board§
Target Board

Connect the hardware debug probe between the target board and the CodeWarrior debug host. Kernel debugging is possible using a Linux-hosted or Windows-hosted CodeWarrior installation. There are a variety of debug probes. The kernel debugging tutorial uses the USB Tap. Connection information for other debug probes can be determined from documentation provided with the probes.

This section contains the following subsection:

- Establishing console connection on page 154

7.5.1.1 Establishing console connection

This section explains how to establish a console connection to the target hardware.

You need to establish a console connection to the target hardware to:

- View target generated log and debug messages
- Confirm successful installation of the bootloader (U-Boot)

- Use the bootloader to boot the Linux OS
- Halt the booting of the Linux OS

The bootloader receives keyboard input through a serial port that has default settings 115,200-8-N-1.

Follow these steps to establish a console connection to the target hardware.

1. Connect a serial cable from a serial port of the CodeWarrior debug host to a serial port of the target board.
2. On the CodeWarrior debug host computer, open a terminal-emulator program of your choice (for example, `minicom` for a Linux host).
3. From the terminal-emulator program, open a console connection to the target hardware.

   Use the connection settings given in the table below.

Table 60: Terminal connection settings

Name	Setting
Baud rate	115, 200 bits per second
Data bits	8
Parity	None
Stop bits	1
Flow control	Hardware

NOTE

Refer to the board specific README file inside the stationery wizard project to find out more details on the serial connection settings, changing the serial port on the board, and the type of serial cable to use.

4. Test the connection by turning on the test board with the power switch and viewing the boot messages in the console connection.

7.5.2 Installing Board Support Package (BSP)

This section describes how to install a BSP on a Linux computer.

NOTE

The BSP versions keep changing frequently. For different BSP versions, you might encounter build environments based on ltib, bitbake, or other tools. The subsequent sections will describe necessary procedures and use specific examples from real NXP BSPs for illustration. The examples in these sections will need to be adapted based on the BSP versions or build tools you are currently using.

1. On the Linux computer, download the Board Support Package (BSP) for your target hardware to install kernel files and Linux compiler toolchains on your system.

   Board Support Package image files for target boards are located at Linux Board Support Packages.
2. Download the BSP image file for your target board.

   NOTE

   You will need to log in or register to download the BSP image file.

   The downloaded image file has an `.iso` extension.

For example,

```
LS1021A-SDK-<yyyymmdd>-yocto.iso
```

3. Mount the image file to the CDROM as root, or using "sudo":

```
<sudo> mount -o loop LS1021A-SDK-<yyyymmdd>-yocto.iso /mnt/cdrom
```

NOTE

`sudo` is a Linux utility that allows users to run applications as `root`. You need to be setup to run `sudo` commands by your system administrator to mount the BSP image files.

4. Execute the BSP install file to install the build tool files to a directory of your choice, where you have privileges to write files:

```
/mnt/cdrom/install
```

NOTE

The BSP must be installed as a non-root user, otherwise the install will exit.

5. Answer the questions from the installation program until the file copy process begins.

   You will be prompted to input the required build tool install path. Ensure you have the correct permissions for the install path.

6. Upon successful installation, you will be prompted to install the ISO for the core(s) you want to build.

   For example, if you want to build the SDK for ARMv7, that is a Cortex-A7 core, then you have to install the ISO images for Cortex-A7 core:

NOTE

You can refer to the SDK User Manual for instructions about how to build the BSP images and run different scenarios from the `iso/help/documents/pdf` location.

7.5.3 Configuring build tool

After installing the BSP, you need to configure the build tool and build the Linux kernel and U-boot images for CodeWarrior debug.

For more information on configuring the build tool, refer to the SDK User Manual from `iso/help/documents/pdf`.

7.5.4 Configuring Linux kernel

After you complete the BSP configuration, configure the Linux kernel to enable CodeWarrior support.

Follow these steps:

1. Launch a terminal window and navigate to the `<yocto_installtion_path>/build_<board>_release` folder.
2. Execute the following command to get a new and clean kernel tree:

```
bitbake -c configure -f virtual/kernel
```

3. Configure the Linux kernel using the various configuration options available in the kernel configuration user interface. For example, run the following command to display the kernel configuration user interface:

   ```
   bitbake -c menuconfig virtual/kernel
   ```

   The kernel configuration user interface appears.

4. CodeWarrior supports both SMP and non-SMP debug. To change the default settings, you can make changes by selecting the Processor support options.
5. To run a monolithic kernel, you do not need to enable loadable module support. However, during the debug phase of drivers, it is easier to debug them as loadable modules to avoid rebuilding the Linux kernel on every debug iteration. If you intend to use loadable modules, select the **Loadable module support** menu item.
6. Select the **Enable loadable module support** option.
7. Select the **Module unloading** option.

   NOTE

   If you want to use the `rmmod -f <mod_name>` command for kernel modules under development, select the **Forced module unloading** option.

8. Select **Exit** to return to the main configuration menu.
9. Select **Kernel hacking**.
10. Select **Compile-time checks and compiler options**.
11. Select **Compile the kernel with debug info** by pressing Y. Enabling this option allows the CodeWarrior debugger to debug the target.
12. Select other desired configuration options for Linux kernel debug.
13. Select **Exit** to return to the main configuration menu.
14. Select the **General Setup** option.
15. Select **Configure standard kernel features (expert users)** and ensure that the **Sysctl syscall support** option is selected.
16. If you are using the Open Source Device Tree debugging method, under the **General Setup > Configure standard kernel features (expert users)** option, then select:
    - Load all symbols for debugging/ksymoops.
    - Include all symbols in kallsyms.

   NOTE

   These settings are optional. They aid the debugging process by providing the vmlinux symbols in `/proc/kallsyms`.

17. Select **Exit** to exit the configuration screen.
18. Select **Yes** when asked if you want to save your configuration.
19. Execute the following command to rebuild the Linux kernel:

   ```
   bitbake virtual/kernel
   ```

The uncompressed Linux kernel image with debug symbols, `vmlinux`, is created.

NOTE

The location of the images directory might differ based on the BSP version being used. For the correct location of where the Linux kernel images are stored, refer to the SDK User Manual from `iso/help/documents/pdf`.

You just created a Linux kernel image that contains symbolic debugging information.

Now, you can use this image and create a CodeWarrior project for debugging the Linux kernel. The various use cases for the Linux kernel debug scenario are:

- CodeWarrior allows you to download this Linux kernel image (`vmlinux.elf`), ramdisk, and dtb files to the target
- You can start the Linux kernel and ramdisk manually from U-Boot. The U-Boot, the kernel, ramdisk, and dtb images are written into flash memory.
- You can perform an early kernel debug before the mmu is enabled or debug after the Linux kernel boots and the login prompt is shown.

The Linux kernel debug scenarios are explained in the following sections:

- Creating a CodeWarrior Project using Linux kernel image on page 158
- Configuring kernel project for debugging on page 160

7.5.5 Creating a CodeWarrior Project using Linux kernel image

After creating a Linux kernel image with symbolic debugging information, you need to create a CodeWarrior project using the kernel image.

To create a CodeWarrior project, follow these steps:

1. Start the CodeWarrior IDE from the Windows system.
2. Select **File > Import**. The **Import** wizard appears.
3. Expand the **CodeWarrior** group and select **CodeWarrior Executable Importer**.
4. Click **Next**.

   The **Import a CodeWarrior executable file** page appears.
5. Specify a name for the project, to be imported, in the **Project name** text box.
6. If you do not want to create your project in the default workspace:
   a. Clear the **Use default location** checkbox.
   b. Click **Browse** and select the desired location from the **Browse For Folder** dialog.
   c. In the **Location** text box, append the location with the name of the directory in which you want to create your project.

   NOTE

   An existing directory cannot be specified for the project location.
7. Click **Next**.

   The **Import C/C++/Assembler Executable Files** page appears.
8. Click **Browse** next to the **Executable** field.
9. Select the vmlinux file obtained.
10. Click **Open**.
11. From the **Processor** list, expand the processor family and select the required processor.

12. Select the **Bareboard Application** toolchain from the **Toolchain** group.

    Selected toolchain sets up the default compiler, linker, and libraries used to build the new project. Each toolchain generates code targeted for a specific platform.

13. Select the **Linux Kernel** option from the **Target OS** list.

    NOTE

    Selecting Linux Kernel will automatically configure the initialization file for kernel download, the default translation settings (these settings need to be adjusted according to the actual Linux kernel configuration) in the OS Awareness tab, and the startup stop function to `start_kernel`.

14. Click **Next**.

    The **Debug Target Settings** page appears.

15. From the **Debugger Connection Types** list, select the required connection type.

16. Specify the settings, such as board configuration, launch configuration, connection type, and TAP address if you are using CodeWarrior Ethernet or USB TAP.

17. Click **Next**.

    The **Configurations** page appears.

18. From the **Core index** list, select the required core.

19. Click **Finish**.

    The wizard creates a project according to your specifications.

You can access the project from the **CodeWarrior Projects** view on the workbench.

This section contains the following subsection:

- Updating Linux kernel image on page 159

7.5.5.1 Updating Linux kernel image

By modifying the Linux kernel image, you can update the project you just created.

There are two use cases for this scenario:

- Cache symbolics between sessions is enabled on page 159
- Cache symbolics between sessions is disabled on page 160

7.5.5.1.1 Cache symbolics between sessions is enabled

This section provides steps to replace the current `vmlinux.elf` file with the new `vmlinux.elf` file when the cache symbolics between sessions is enabled.

Follow these steps:

1. Terminate the current debug session.
2. Right-click in the Debug window.
3. From the context menu, select **Purge Symbolics Cache**. The old `vmlinux.elf` file is being used by the debugger, but after you select this option, the debugger stops using this file in the disk.
4. Copy the new `vmlinux.elf` file over the old file.

   Now, when you re-initiate a debug session, the updated `vmlinux.elf` file is used for the current debug session.

7.5.5.1.2 Cache symbolics between sessions is disabled

This section provides steps to replace the current `vmlinux.elf` file with the new `vmlinux.elf` file when the cache symbolics between sessions is disabled.

Follow these steps:

1. Terminate the current debug session.
2. Copy the new `vmlinux.elf` file over the old file.

   Now, when you re-initiate a debug session, the updated `vmlinux.elf` file is used for the current debug session.

7.5.6 Configuring kernel project for debugging

After you have created a CodeWarrior project using the Linux kernel image, the next action is to configure this project for debugging.

This section contains the following subsection:

- Configuring attach kernel debug scenario on page 160

7.5.6.1 Configuring attach kernel debug scenario

This section describes how to configure an attach debug scenario.

For the attach scenario, CodeWarrior does not download any file on the target. The kernel is started directly from U-Boot. You need to burn the U-Boot image to the flash memory of the hardware.

After the boot process, the U-Boot console is available and the Linux kernel can be started manually from U-Boot. For this, the following files can be either written into flash memory or can be copied from U-Boot using TFTP.

- Binary kernel image file, `uImage`
- Ramdisk to be started from U-Boot, for example,

  ```
  <target version>.rootfs.ext2.gz.u-boot
  ```
- dtb file, for example, `uImage-<target version>.dtb`

After the Linux boot process, the Linux login appears and you can connect to debug the kernel using the CodeWarrior Attach launch configuration. As all the files are manually loaded from U-Boot, these files must not be specified in the launch configuration.

The table below describes the settings you need to provide in the launch configuration.

To specify the launch configuration settings in CodeWarrior:

1. Select **Run > Debug Configurations**.
2. Enter the launch configuration settings, given in the table below, in the **Debug Configurations** dialog.

Table 61: Kernel Project Attach Launch Configuration Settings

Debug Window Component	Settings
Main Tab	Select an appropriate system (if existing) from the **Connection** drop-down list or define a new system. • To define a new system, click **New**. • Select Hardware or Simulator Connection from the CodeWarrior Bareboard Debugging list. Click **Next**. • Specify a name and a description for the connection. • Select an appropriate target (if existing) from the **Target** drop-down list or define a new target. • To define a new target, click **New** on the **Hardware or Simulator Connection** dialog. • Select **Hardware or Simulator Target** from the CodeWarrior Bareboard Debugging list. Click **Next**. • Specify a name and a description for the target. • Select a target from the **Target type** drop-down list. On the **Initialization** tab, ensure there are no initialization files selected. • Click **Finish** to create the target and close the **Hardware or Simulator Target** dialog. • Select the type of connection you will use from the **Connection type** drop-down list. • Click **Finish**. • Select all the cores on which Linux is running (for example, core 0 for single-core or cores 0-7 for 8-core SMP).
Debugger Tab > Debugger options > Symbolics Tab	Select the Cache Symbolics between sessions checkbox. The symbolics are loaded from the elf file to the debugger for the first session only. This shows a speed improvement for `vmlinux.elf` as the size is bigger than around 100 MB.
Debugger Tab > Debugger options > OS Awareness Tab	Select **Linux** from the **Target OS** drop-down list.
Debugger Tab > Debugger options > OS Awareness Tab > Boot Parameters	Disable all settings on the **Boot Parameters** tab.

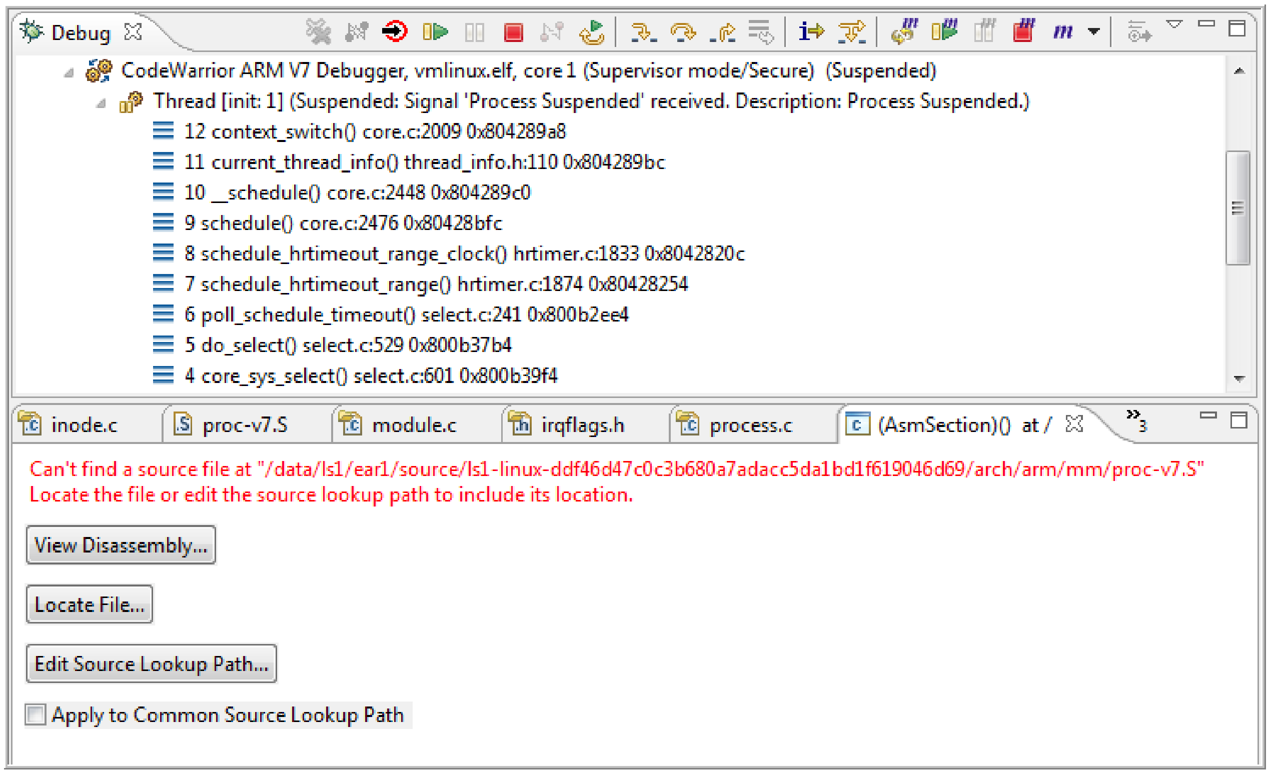
Table continues on the next page...

Table 61: Kernel Project Attach Launch Configuration Settings (continued)

Debug Window Component	Settings
Debugger Tab > Debugger options > OS Awareness Tab > Debug Tab	Debug tab • Select the **Enable Memory Translation** checkbox **Physical Base Address** is set to value CONFIG_KERNEL_START (0x80000000) **Virtual Base Address** is set to value CONFIG_KERNEL_START (0x80000000 for 32-bits) • **Memory Size** is the kernel space translation size. NOTE The values shown above should be set as configured in the Linux configuration file (`.config`). You can read the MMU registers to verify what you have configured and do a correction, if required. • Select **Enable Threaded Debugging Support** checkbox • Select **Enable Delayed Software Breakpoint Support** • If required, also select **Update Background Threads on Stop**. When enabled, the debugger reads the entire thread list when the target is suspended. This decreases the speed. If the option is disabled, the speed is increased but the **Debug** window might show non-existent threads, as the list is not refreshed.

3. Click the **Source** page to specify path mappings. Path mappings are not required if the debug host is similar to the compilation host. If the two hosts are separate, the `.elf` file contains the paths for the compilation host. Specifying the path mappings helps establish paths from compilation host to where the sources are available to be accessed by the debugger on the debugger host. If no path mapping is specified, when you perform a debug on the specified target, a source file missing message appears (shown in the figure below).

Figure 86: Debug view when no path mapping is specified



```
CodeWarrior ARM V7 Debugger, vmlinux.elf, core 1 (Supervisor mode/Secure) (Suspended)
  Thread [init: 1] (Suspended: Signal 'Process Suspended' received. Description: Process Suspended.)
    12 context_switch() core.c:2009 0x804289a8
    11 current_thread_info() thread_info.h:110 0x804289bc
    10 __schedule() core.c:2448 0x804289c0
    9 schedule() core.c:2476 0x80428bfc
    8 schedule_hrtimeout_range_clock() hrtimer.c:1833 0x8042820c
    7 schedule_hrtimeout_range() hrtimer.c:1874 0x80428254
    6 poll_schedule_timeout() select.c:241 0x800b2ee4
    5 do_select() select.c:529 0x800b37b4
    4 core_sys_select() select.c:601 0x800b39f4
```

Can't find a source file at "/data/ls1/earl/source/ls1-linux-ddf46d47c0c3b680a7adacc5da1bd1f619046d69/arch/arm/mm/proc-v7.S"
Locate the file or edit the source lookup path to include its location.

You can specify the path mappings, either by adding a new path mapping on the **Source** tab or by clicking the appropriate buttons (**Locate File**, **Edit Source Lookup Path**) that appear when a source path mapping is not found.

4. Click **Apply** to save the settings.
5. Click **Close**.

7.5.7 Debugging kernel by attaching to a running U-Boot

This section explains how to debug the Linux kernel by attaching it to a running U-Boot.

To debug the kernel, perform these steps:

1. Create a project for the Linux kernel image. For more details, See Creating a CodeWarrior Project using Linux kernel image on page 158 topic.
2. Configure the launch configuration for Linux kernel debug. For more details, see Configuring attach kernel debug scenario on page 160 topic.
3. Select **Run > Debug Configurations**. The **Debug Configurations** dialog appears.
4. From the left pane, expand the **CodeWarrior Attach** tree and select the appropriate launch configuration.
5. From the **Debugger** tab, select the **PIC** tab.
6. Clear the **Alternate Load Address** checkbox.
7. Click **Apply**.
8. Click **Debug** to start the debug session. The **Debug** perspective appears.
9. While the U-Boot is running, attach the target.

   The debugger displays a warning, in the console, as the kernel is not being executed on the target.

NOTE

For multi-core processors, only `core0` is targeted in the **Debug** view. This is normal as the secondary cores are initialized in the Linux kernel after MMU initialization. CodeWarrior will automatically add other cores, in the **Debug** view, after the kernel initializes the secondary cores.

10. Set software or hardware breakpoints for any stage (before or after MMU initialization).

    Set a HW breakpoint at address 0x80008000. Issue the following command in the **Debugger Shell** view.

    ```
    bp -hw 0x80008000
    ```

11. Using the U-boot console, load the Linux Kernel, DTB file and ramdisk/rootfs from flash or from TFTP.
12. Debug the kernel.

    The debugger halts execution of the program at whatever breakpoints have been set in the project. Typical stages involved in debugging the kernel are discussed below:

    a. **Debugging the kernel at the entry point**

    The CodeWarrior debugger will stop at the kernel entry point, if any software or hardware breakpoint has been set for entry point.

    NOTE

    For the debugger to stop at the kernel entry point, set a breakpoint before loading the kernel from the U-boot console.

    At the entry point, the MMU is not initialized and therefore debugging before MMU initialization also applies in this stage.

    b. **Debugging the Kernel before the MMU is enabled**

    Being in early debug stage, the user should set the correct PIC value, in order to see the source correspondence, in the **Debugger Shell** view.

    Before setting a breakpoint for the stage after MMU initialization (for example, breakpoint at `start_kernel`) the correct PIC should be set, in the **Debugger Shell** view. This is required to ensure that the new breakpoint is set with the correct PIC for the stage after MMU initialization.

    The user can set breakpoints and run/step to navigate, before MMU initialization. The correct PIC should be set in the **Debugger Shell** view, before the debuggers enters the next stage.

    c. **Debugging the Kernel after the MMU is enabled**

    After the MMU is initialized, the PIC value must be reset in the **Debugger Shell** view. During the Linux Kernel booting, you can debug this stage directly, if no breakpoint has been set for the stage before MMU initialization. Alternatively, you can also debug this stage after run or step from the stage before initialization.

    NOTE

    In case of SMP, all the secondary cores are targeted and displayed in the **Debug** view.

13. When finished, you can either:

    a. Kill the process by selecting **Run > Terminate**.

    b. Leave the kernel running on the hardware.

7.6 Debugging loadable kernel modules

This section explains how to use the CodeWarrior debugger to debug a loadable kernel module.

This section contains the following subsections:

- Loadable Kernel Modules - An Introduction on page 165
- Creating CodeWarrior project for Linux Kernel image on page 165
- Configuring Modules' Symbolics Mapping on page 168

7.6.1 Loadable Kernel Modules - An Introduction

The Linux kernel is a *monolithic kernel*, that is, it is a single, large program in which all the functional components of the kernel have access to all of its internal data structures and routines.

Alternatively, you may have a micro kernel structure where the functional components of the kernel are broken into pieces with a set communication mechanism between them. This makes adding new components to the kernel using the configuration process very difficult and time consuming. A more reliable and robust way to extend the kernel is to dynamically load and unload the components of the operating system using Linux *loadable kernel modules*.

A *loadable kernel module* is a binary file that you can dynamically link to the Linux kernel. You can also unlink and remove a loadable kernel module from the kernel when you no longer need it. Loadable kernel modules are used for device drivers or pseudo-device drivers, such as network drivers and file systems.

When a kernel module is loaded, it becomes a part of the kernel and has the same rights and responsibilities as regular kernel code.

Debugging a loadable kernel module consists of several general actions, performed in the following order:

1. Create a CodeWarrior Linux kernel project for the loadable kernel module to be debugged. See Creating CodeWarrior project for Linux Kernel image on page 165 topic.
2. Add the modules and configure their symbolics mapping. See Configuring Modules' Symbolics Mapping on page 168 topic.

7.6.2 Creating CodeWarrior project for Linux Kernel image

The steps in this section show you how to create a CodeWarrior project from a Linux kernel image that contains symbolic debugging information.

NOTE

The following procedure assumes that you have made an archive of the Linux kernel image and transferred it to the Windows machine. For kernel modules debugging, ensure that you build the kernel with loadable module support and also make an archive for the rootfs directory, which contains the modules for transferring to Windows.

The steps are as follows:

1. Launch CodeWarrior IDE.
2. Select **File > Import**. The Import wizard appears.
3. Expand the **CodeWarrior** group and select **CodeWarrior Executable Importer**.
4. Click **Next**.

   The **Import a CodeWarrior Executable file** page appears.
5. Specify a name for the project, to be imported, in the **Project name** text box.

6. If you do not want to create your project in the default workspace:
    a. Clear the **Use default location** checkbox.
    b. Click **Browse** and select the desired location from the **Browse For Folder** dialog.
    c. In the **Location** text box, append the location with the name of the directory in which you want to create your project.

NOTE
An existing directory cannot be specified for the project location.

7. Click **Next**.

    The **Import C/C++/Assembler Executable Files** page appears.
8. Click **Browse** next to the **Executable** field.
9. Select the **vmlinux.elf** file.
10. Click **Open**.
11. From the **Processor** list, expand the processor family and select the required processor.
12. Select **Bareboard Application** from the **Toolchain** group.
13. Select **Linux Kernel** from the **Target OS** list.
14. Click **Next**.

    The **Debug Target Settings** page appears.
15. From the **Debugger Connection Types** list, select the required connection type.
16. Specify the settings, such as board, launch configuration, connection type, and TAP address if you are using Ethernet or USB TAP.
17. Click **Next**.

    The **Configuration** page appears.
18. From the **Core index** list, select the required core.
19. Click **Finish**.

    The wizard creates a project according to your specifications. You can access the project from the CodeWarrior Projects view on the Workbench.
20. Configure the launch configuration for Linux kernel debug.
    a. Select **Run > Debug Configurations**.

        The **Debug Configurations** dialog appears.
21. Enter the launch configuration settings in the **Debug Configurations** dialog. The table below lists the launch configuration settings.

Table 62: Kernel Project Attach Launch Configuration Settings

Debug Window Component	Settings
Main tab	Select an appropriate system (if existing) from the **Connection** drop-down list or define a new system. • To define a new system, click **New**. • Select **Hardware or Simulator Connection** from the **CodeWarrior Bareboard Debugging** list. Click **Next**. • Specify a name and a description for the connection. • Select an appropriate target (if existing) from the **Target** drop-down list or define a new target. • To define a new target, click **New** on the **Hardware or Simulator Connection** dialog. • Select **Hardware or Simulator Target** from the **CodeWarrior Bareboard Debugging** list. Click **Next**. • Specify a name and a description for the target. • Select a processor from the **Target type** drop-down list. On the **Initialization** tab, ensure that there are no initialization files selected. • Click **Finish** to create the target and close the **Hardware or Simulator Target** dialog. • Select the type of connection you will use from the **Connection type** drop-down list. • Click **Finish**. • Select all the cores on which Linux is running (for example, core 0 for single-core or cores 0-7 for 8-core SMP).
Debugger tab > Debugger options > Symbolics tab	Select the **Cache Symbolics between sessions** checkbox. The symbolics are loaded from the elf file to the debugger for the first session only. This shows a speed improvement for `vmlinux.elf` as the size is bigger than around 100 MB.
Debugger tab > Debugger options > OS Awareness tab	Select **Linux** from the **Target OS** drop-down list.
Debugger tab > Debugger options > OS Awareness tab > Boot Parameters tab	All options should be cleared.

Table continues on the next page...

Table 62: Kernel Project Attach Launch Configuration Settings (continued)

Debug Window Component	Settings
Debugger tab > Debugger options > OS Awareness tab > Debug tab	• Select the **Enable Memory Translation** checkbox **Physical Base Address** is set to value CONFIG_KERNEL_START (0x80000000) **Virtual Base Address** is set to value CONFIG_KERNEL_START (0x80000000 for 32-bits). • **Memory Size** is the kernel space translation size. NOTE The values shown above should be set as configured in the Linux configuration file (`.config`). Select the **Enable Threaded Debugging Support** checkbox Select the **Enable Delayed Software Breakpoint Support** checkbox
Debugger tab > Debugger options > OS Awareness tab > Modules tab	• Select the **Detect module loading** checkbox • Click **Add** to insert the kernel module file. See Configuring Modules' Symbolics Mapping on page 168 topic • Select the **Prompt for symbolics path if not found** checkbox

22.Click the **Source** page to add source mappings for `rootfs` and `linux-<version>`.

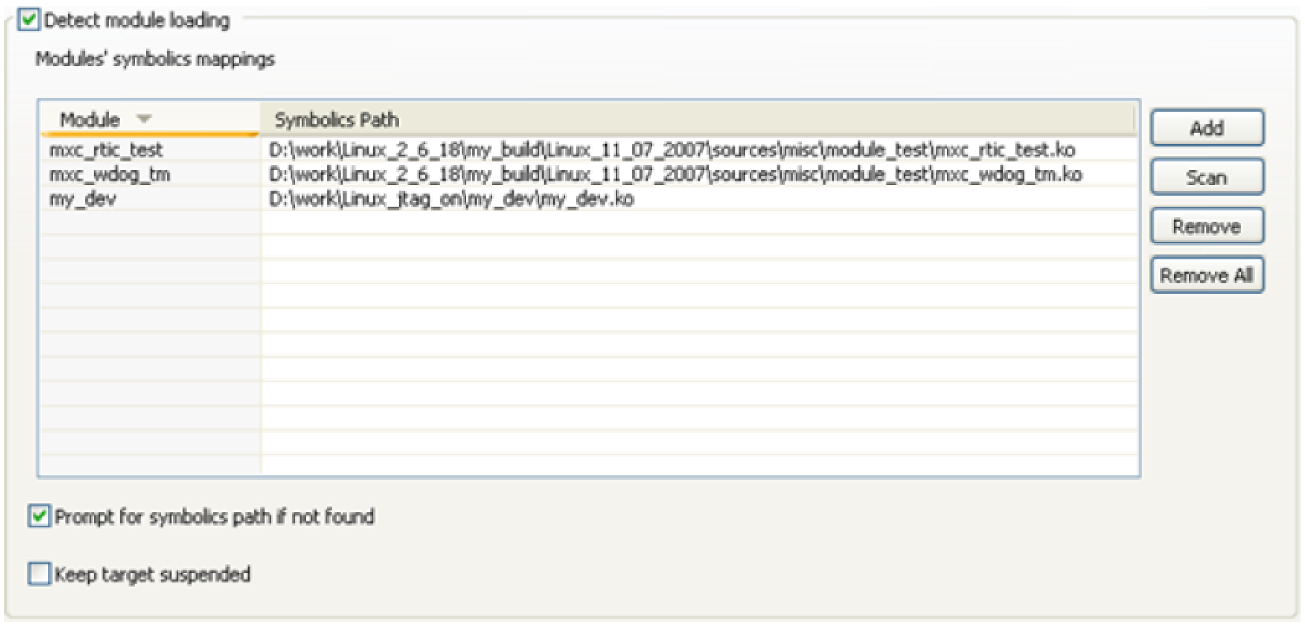
23.Click **Apply** to save the settings.

7.6.3 Configuring Modules' Symbolics Mapping

You can use the **Modules** tab in the **Debug Configurations** dialog to add modules to the Linux kernel project and configure the module's symbolics mapping.

The figure below shows the **Detect module loading** group of the **Modules** page.

Figure 87: Kernel Module Debug - Modules tab



Module	Symbolics Path
mxc_rtic_test	D:\work\Linux_2_6_18\my_build\Linux_11_07_2007\sources\misc\module_test\mxc_rtic_test.ko
mxc_wdog_tm	D:\work\Linux_2_6_18\my_build\Linux_11_07_2007\sources\misc\module_test\mxc_wdog_tm.ko
my_dev	D:\work\Linux_jtag_on\my_dev\my_dev.ko

✓ Prompt for symbolics path if not found

☐ Keep target suspended

The table below describes the various options available on the **Modules** tab.

Table 63: Kernel Module Project Launch Configuration - Modules tab settings

Option	Description
Detect module loading	Enables the debugger to detect module load events and insert an eventpoint in the kernel. Disabling this setting delays the module loading. This is useful in scenarios where multiple modules are loaded to the kernel and not all of them need to be debugged. You can enable this setting again in the **Modules** dialog. The dialog is available during the Debug session from the **System Browser View** toolbar **>** **Module** tab.
Add	Adds a module name along with the corresponding symbolic path This option displays a dialog box in the following scenarios: • The file that you have selected is not a valid compiled kernel module • If the selected module already exists in the list with the same path
Scan	Automatically searches for module files and populates the kernel module list.
Remove	Removes the selected items. This button will be enabled only if a row is selected.
Remove All	Removes all items. This button will be enabled only if the kernel list contains any entries.

Table continues on the next page...

Table 63: Kernel Module Project Launch Configuration - Modules tab settings (continued)

Option	Description
Prompt for symbolics path if not found	Prompts to locate the symbolics file if a mapping for it is not available in the settings A **Browse** dialog appears that allows you to browse for a module file containing symbolics. The debugger will add the specified symbolics to the modules' symbolics mapping.
Keep target suspended	Keeps the target suspended after the debugger loads the symbolics file for a module. This option is useful if you want to debug the module's initialization code. It allows you to set breakpoints in the module's initialization code before running it. NOTE This option is automatically enabled when activating the **Prompt for symbolics path if not found** option.

NOTE

Breakpoints are resolved each time a symbolics file is loaded and the debugger uses the modules unload events for symbolics disposal and breakpoints cleanup.

Chapter 8
JTAG Configuration Files

This chapter explains about JTAG configuration files that pass specific configuration settings to the debugger and support chaining of multiple devices.

A JTAG configuration file is a text file, specific to the CodeWarrior debugger, which describes a custom JTAG scan chain. You can specify the file in the remote system settings.

This chapter explains:

- JTAG configuration file syntax on page 171
- Using a JTAG configuration file to override RCW on page 172
- Using JTAG configuration file to specify multiple linked devices on a JTAG chain on page 173
- Setting up a remote system to use a JTAG configuration file on page 174

8.1 JTAG configuration file syntax

This section describes the syntax of a JTAG configuration file.

You can create a JTAG configuration file that specifies the type, chain order, and various settings for the devices you want to debug. To create the JTAG configuration file, list each device on a separate line, starting with the device that is directly connected to the transmit data out (TDO) signal (Pin 1) of the 16-pin COP/JTAG debug connector on the hardware target, and conclude with a blank line.

The listing below shows the complete syntax for a JTAG configuration file.

Figure 88: JTAG configuration file syntax

```
cfgfile:
     '\n'

     '#' 'any other characters until end of line'

     line

     cfgfile line

line:

     target

     target filter_list_or_params

target:

     target_name

     target_name = target_id

     'Generic' number number number

filter_list_or_params:

     filter_list_entity
     filter_list_or_params filter_list_entity

filter_list_entity:

     '(' number number ')'

     filter_name

     %
```

8.2 Using a JTAG configuration file to override RCW

You can use a JTAG configuration file to override reset configuration word (RCW) for a processor, such as LS1021A, revision 2.0.

In the following scenarios, the JTAG configuration files are used for overriding RCW:

- Programming RCW in a target board that does not have RCW programmed already
- New board bring-up
- Recovering a target board having a blank or corrupted flash: This feature is only available for LS1021A processor revision 2.0 and LS2085A. Board recovery scenarios involving a blank/corrupted flash require an external CodeWarrior TAP probe connection for overriding RCW; RCW override is not supported with a CMSIS-DAP connection.

NOTE

For more information on RCW, see the reference manual for your processor.

The CodeWarrior software includes example JTAG configuration files that can be used to override the RCW (see the listing below). The JTAG Configuration files are available at the following location:

```
<CWInstallDir>\CW_ARMv7\ARMv7\ARM_Support\Configuration_Files\jtag_chains
```

Figure 89: Sample JTAG configuration file for overriding RCW

```
# Example file to allow overriding a portion of the RCW
#
# Syntax:
#   LS102xA (0 RCW_source) (0x1000 RCW_option) (RCWn value) ...
#
#   where:
#   x = Processor version (LS1020/1/2A); default is LS1021A
#   RCW_source = The RCW source that you want to override (for example, 0x9b for hard-
coded mode)
#   RCW_option = 0 [RCW override disabled]
#                1 [RCW override enabled]
#
#   RCWn = 4096+n (n = 0 .. 15; index of RCW value)
#
#   value = 32-bit value
```

As specified in the listing above, the JTAG configuration files can be used to override a portion of the RCW for LS1021A, by specifying (index, value) pairs for some of the 16 x (32-bit words) of the RCW. For some targets (for example, LS2085A), you do not need to specify `RCW_source`; therefore, you can remove `(0 RCW_source)` from the JTAG configuration file.

NOTE
You can use the pre-boot loader (PBL) tool to configure the various settings of the RCW and output the RCW in multiple formats, including CodeWarrior JTAG configuration files. For more information on the PBL tool, see QCVS PBL Tool User Guide.

8.3 Using JTAG configuration file to specify multiple linked devices on a JTAG chain

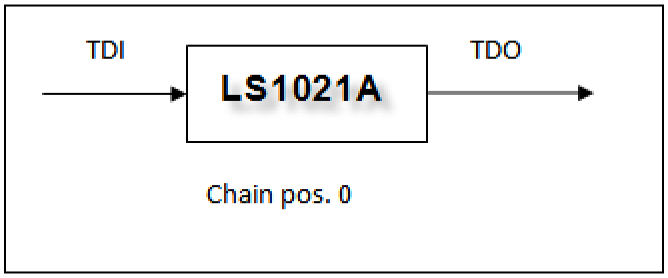
This section explains how to connect multiple processors through a single JTAG chain and how to describe such a JTAG chain in a JTAG configuration file.

The listing and figure below show a sample JTAG initialization file with a single core.

Figure 90: Sample JTAG initialization file for LS1021A processor

```
# A single device in the chain
LS1021A
```

Figure 91: A single device in a JTAG chain



The listing below show a sample JTAG initialization file with two devices in a JTAG chain.

Figure 92: Sample JTAG initialization file for LS1020A and LS1021A processors

```
# Two devices in a JTAG chain
LS1020A

LS1021A
```

NOTE
The devices are enumerated in the direction starting from TDO output to TDI input.

The listing below show two devices connected in a JTAG chain.

Figure 93: Sample JTAG initialization file for LS1020A and LS1021A processors

```
# Two devices in a JTAG chain
LS1020A (0x80000000 1)

LS1021A (2 1) (210005 0x90404000)
```

The listing below show two devices connected in a JTAG chain with a filter applied for the second device.

Figure 94: Sample JTAG initialization file for two devices with filter for second device

```
# Two devices in a JTAG chain
8306 (1 1) (2 0x44050006) (3 0x00600000)

8309 log
```

In the above example, the entry for the 8306 also includes the Hard Reset Control Word (HRCW) data that will overwrite the HRCW fetched by the 8306 upon power up or Hard Reset. The Hard Reset Control Word parameters are optional.

The CodeWarrior debugger not only supports NXP devices but also supports non-NXP devices in a JTAG scan chain. Each non-NXP device used in a scan chain is declared as "Generic" and it takes the following three parameters:

- JTAG Instruction Length
- Bypass Command
- Bypass Length

The values for these three parameters are available in the device's data sheet or can be obtained from the manufacturer of the device.

The listing below show an NXP device, 8560, connected with a non-NXP device, PLA, in a JTAG scan chain. From the PLA's data sheet, the JTAG Instruction Length = 5, the Bypass Command = 1, and the Bypass Length = 0x1F.

Figure 95: Sample JTAG initialization file including non-NXP devices

```
8560
Generic 5 1 0x1F
```

8.4 Setting up a remote system to use a JTAG configuration file

This section explains how to configure a remote system to use a JTAG configuration file.

To connect to a JTAG chain, specify these settings in the launch configurations:

1. Create a JTAG initialization file that describes the items on the JTAG chain. For more information on how to create a JTAG initialization file, see JTAG configuration file syntax on page 171 and Using JTAG configuration file to specify multiple linked devices on a JTAG chain on page 173.
2. Open the CodeWarrior project you want to debug.
3. Select **Run > Debug Configurations**.

   The **Debug Configurations** dialog appears with a list of debug configurations that apply to the current application.
4. Expand the **CodeWarrior** tree control.
5. From the expanded list, select the debug configuration for which you want to modify the debugger settings.

   The **Debug** view shows the settings for the selected configuration.
6. Select a remote system from the **Connection** drop-down list.
7. Select a core from the **Target** list.

8. In the **Connection** group, click **Edit**.

   The **Properties for** ***<project>***window appears.
9. Click **Edit** next to the **Target** list.

   The **Properties for** ***<remote system>*** window appears.
10. Click **Edit** next to the **Target type** drop-down list.

    The **Target Types** dialog appears.
11. Click **Import**.
12. The **Import Target Type** dialog appears.
13. Select the JTAG initialization file that describes the items on the JTAG chain from this location:

    ```
    <CWInstallDir>\CW_ARMv7\ARMv7\ARM_Support\Configuration_Files\jtag_chains
    ```
14. Click **OK**.

    The items on the JTAG chain described in the file appear in the **Target Types** dialog.
15. Click **OK**.

    The selected JTAG configuration file appears on the **Advanced** tab.
16. Click **OK**.
17. Click the **Debugger** tab.

    The **Debugger** page appears.
18. Ensure that the **Stop on startup at** checkbox is selected and `main` is specified in the **User specified** text box.
19. Click **Apply** to save the changes.

    You have successfully configured a debug configuration.

Chapter 9 Target Initialization Files

A target initialization file is a file that contains commands that initialize registers, memory locations, and other components on a target board.

The most common use case is to have the CodeWarrior debugger execute a target initialization file immediately before the debugger downloads a bareboard binary to a target board. The commands in a target initialization file put a board in the state required to debug a bareboard program.

NOTE

The target board can be initialized either by the debugger (by using an initialization file), or by an external bootloader or OS (U-Boot, Linux). In both cases, the extra use of an initialization file is necessary for debugger-specific settings (for example, silicon workarounds needed for the debug features).

This chapter includes the following section:

- Using target initialization files on page 177

9.1 Using target initialization files

This section describes how to configure the CodeWarrior debugger to use a specific target initialization file.

A target initialization file is a command file that the CodeWarrior debugger executes each time the launch configuration to which the initialization file is assigned is debugged. You can use the target initialization file for all launch configuration types (Attach, Connect and Download). The target initialization file is executed after the connection to the target is established, but before the download operation takes place.

The debugger executes the commands in the target initialization file using the target connection protocol, such as a JTAG run-control device.

NOTE

You do not need to use an initialization file if you debug using the CodeWarrior TRK debug protocol.

To instruct the CodeWarrior debugger to use a target initialization file:

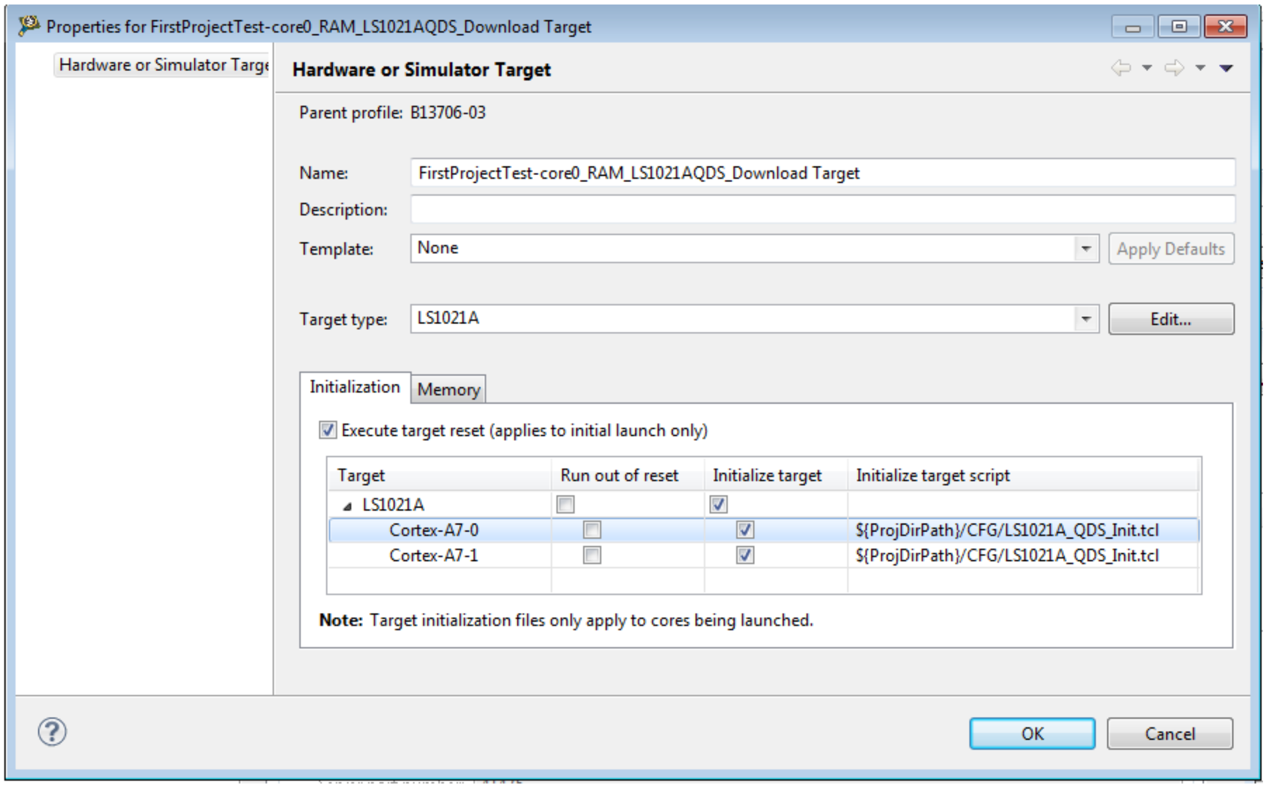
1. Start the CodeWarrior IDE.
2. Open a bareboard project.
3. Select one of this project's build targets.
4. Select **Run > Debug Configurations**.

   The **Debug Configurations** dialog appears.
5. Select the appropriate launch configuration from the left panel.
6. In the **Main** tab, from the **Connection** panel, click **Edit** next to the **Connection** drop-down list.

   The **Properties for** ***<Launch Configuration Name>*** window appears.
7. Click **Edit** next to the **Target** drop-down list.

   The **Properties for <remote system>** window appears.
8. In the **Initialization** tab, select the appropriate cores checkboxes from the Initialize target column, as shown in the figure below.

Figure 96: Initialization tab



Properties for FirstProjectTest-core0_RAM_LS1021AQDS_Download Target

Hardware or Simulator Target

Parent profile: B13706-03

Name: FirstProjectTest-core0_RAM_LS1021AQDS_Download Target

Description:

Template: None

Target type: LS1021A

Initialization | Memory

☑ Execute target reset (applies to initial launch only)

Target	Run out of reset	Initialize target	Initialize target script
LS1021A	☐	☑	
Cortex-A7-0	☐	☑	${ProjDirPath}/CFG/LS1021A_QDS_Init.tcl
Cortex-A7-1	☐	☑	${ProjDirPath}/CFG/LS1021A_QDS_Init.tcl

Note: Target initialization files only apply to cores being launched.

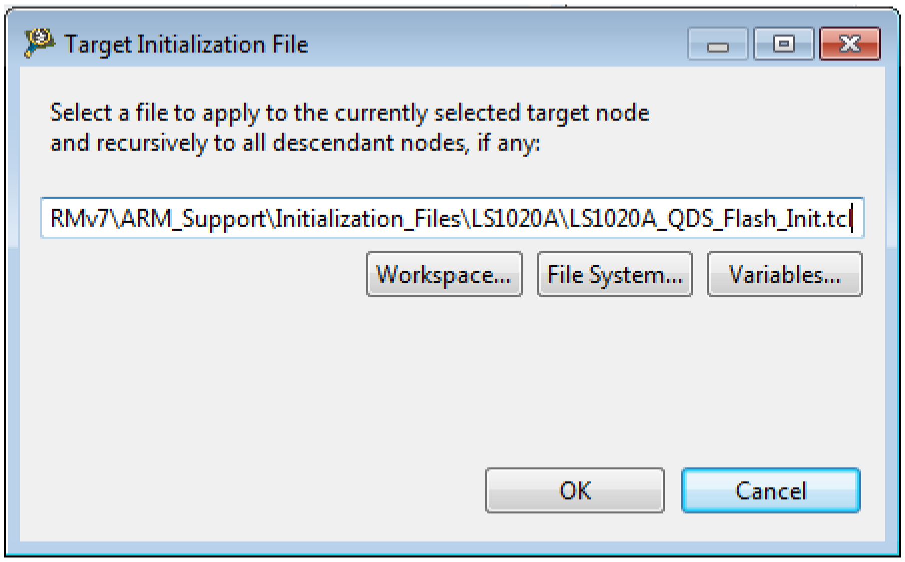
9. In the **Initialize target script** column, click the ellipsis button, as shown in the figure above.

TIP

Click in the specified cell of the **Initialize target script** column for the ellipsis button to appear.

The **Target Initialization File** dialog appears, as shown in the figure below.

Figure 97: Target initialization file dialog



Target Initialization File

Select a file to apply to the currently selected target node and recursively to all descendant nodes, if any:

RMv7\ARM_Support\Initialization_Files\LS1020A\LS1020A_QDS_Flash_Init.tcl

10.Select the target initialization file by using the buttons provided in the dialog and click **OK**.

The target initialization files are available at the following path:

```
<CWInstallDir>\CW_ARMv7\ARMv7\ARM_Support\Initialization_Files\
```

You can also write your own target initialization files.

Chapter 10 Memory Configuration Files

A memory configuration file contains commands that define the rules the debugger follows when accessing a target board's memory.

NOTE

Memory configuration files do not define the memory map for the target. Instead, they define how the debugger should treat the memory map the target has already established. The actual memory map is initialized either by a target resident boot loader or by a target initialization file. For more information, see Target Initialization Files on page 177 chapter of this manual.

If necessary, you can have the CodeWarrior debugger execute a memory configuration file immediately before the debugger downloads a bareboard binary to a target board. The memory configuration file defines the memory access rules (restrictions, translations) used each time the debugger needs to access memory on the target board.

NOTE

Assign a memory configuration file to bareboard build targets only. The memory of a board that boots embedded Linux® is already set up properly. A memory configuration file defines memory access rules for the debugger; the file has nothing to do with the OS running on a board. If needed, a memory configuration file should be in place at all times. The Linux Kernel Aware Plugin performs memory translations automatically, relieving the user from specifying them in the memory configuration file. In addition, for certain processors, the debugger can automatically read the translations from the target in a bareboard scenario, relieving the user from specifying them in the memory configuration file.

This chapter includes the following section:

- Using memory configuration files on page 181

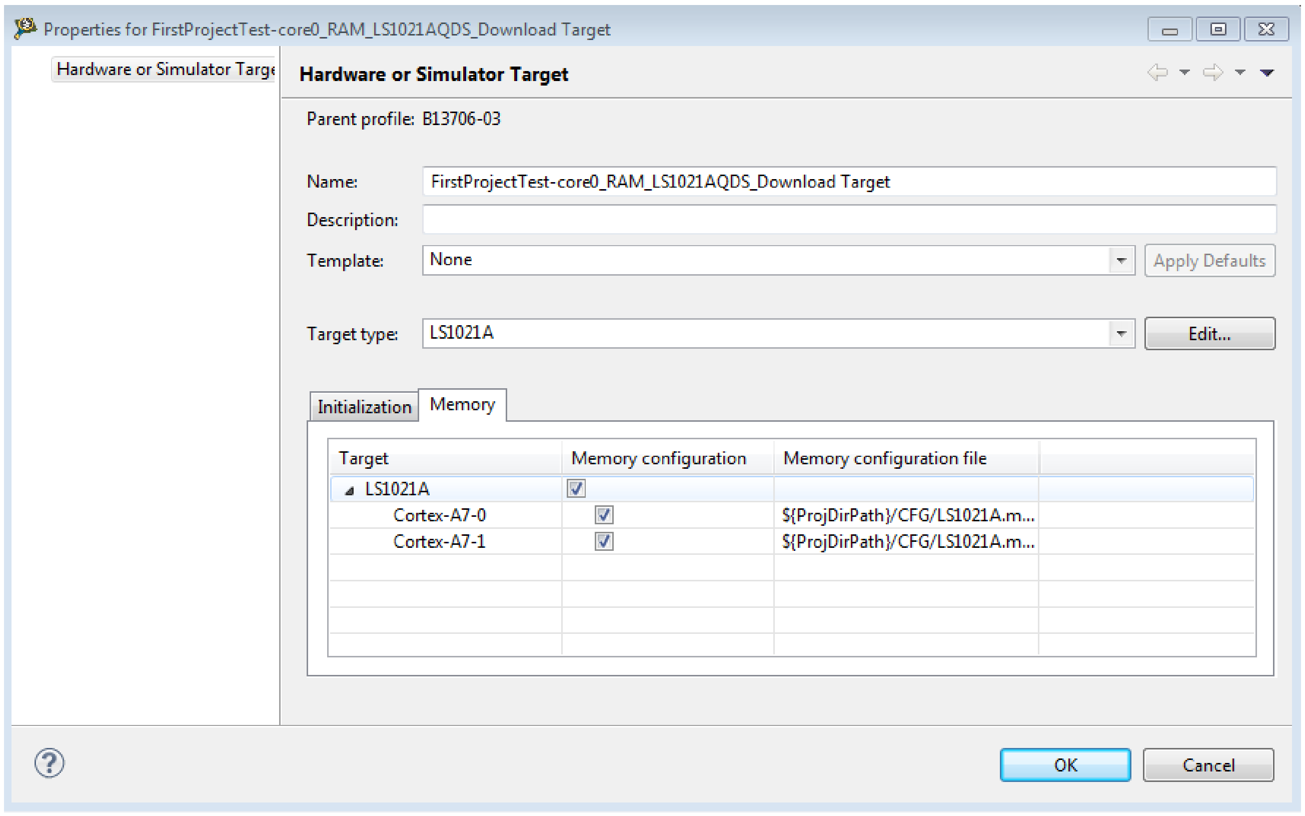
10.1 Using memory configuration files

This section describes how to configure the CodeWarrior debugger to use a specific memory configuration file.

A memory configuration file is a command file that contains memory access rules that the CodeWarrior debugger uses each time the build target to which the configuration file is assigned is debugged.

You specify a memory configuration file in the **Memory** tab of the remote system configuration (shown in the figure below).

Figure 98: Specifying memory configuration file


Properties for FirstProjectTest-core0_RAM_LS1021AQDS_Download Target
Hardware or Simulator Targe
Hardware or Simulator Target
Apply Defaults
Edit...
Initialization
Memory
OK
Cancel

Parent profile: B13706-03

Name: FirstProjectTest-core0_RAM_LS1021AQDS_Download Target

Description:

Template: None

Target type: LS1021A

Target	Memory configuration	Memory configuration file
LS1021A	✓	
Cortex-A7-0	✓	${ProjDirPath}/CFG/LS1021A.m...
Cortex-A7-1	✓	${ProjDirPath}/CFG/LS1021A.m...

You can also write your own memory configuration files.

Chapter 11
Working with Hardware Tools

This chapter explains how to use the CodeWarrior hardware tools. You can use these tools for board bring-up, test, and analysis.

The following tools are described in this chapter:

- Flash programmer on page 183
- Hardware diagnostics on page 195

11.1 Flash programmer

Flash programmer is a CodeWarrior plug-in that lets you program the flash memory of the supported target boards from within the IDE.

The flash programmer can program the flash memory of the target board with code from a CodeWarrior IDE project or a file.

The flash programmer runs as a target task in the Eclipse IDE. To program the flash memory on a target board, you need to create, configure, and execute a flash programmer target task. You can click the **Save** button or press **Ctrl+S** to save task settings.

The following subsections describe how to work with flash programmer:

- Create flash programmer target task on page 183
- Configure flash programmer target task on page 185
- Execute flash programmer target task on page 190
- SD/eMMC flash programmer on page 192
- Flash File to Target on page 193

11.1.1 Create flash programmer target task

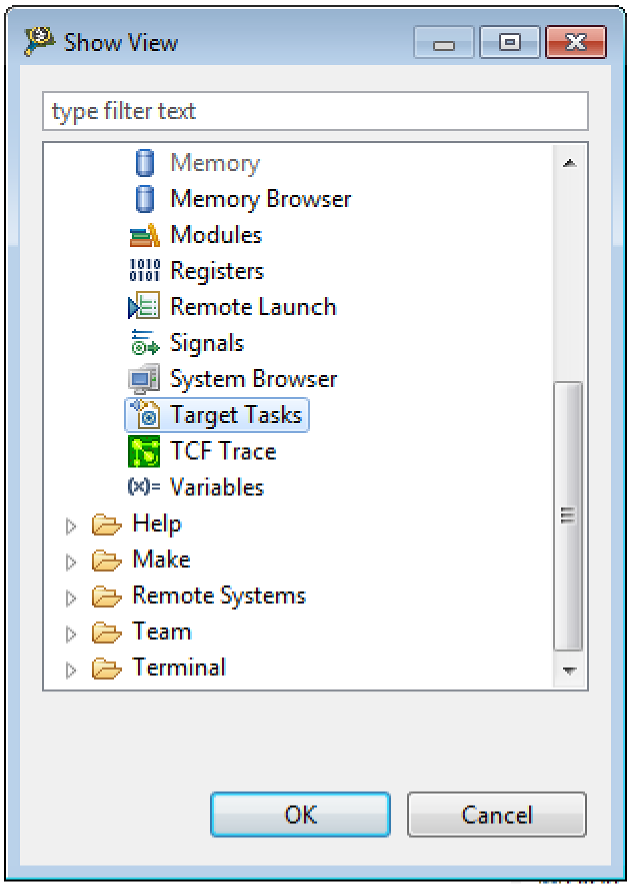
You can create a flash programmer task using the **Create New Target Task** wizard.

Follow these steps:

1. Choose **Window** > **Show View** > **Other** from the CodeWarrior IDE menu bar.

   The **Show View** dialog appears.

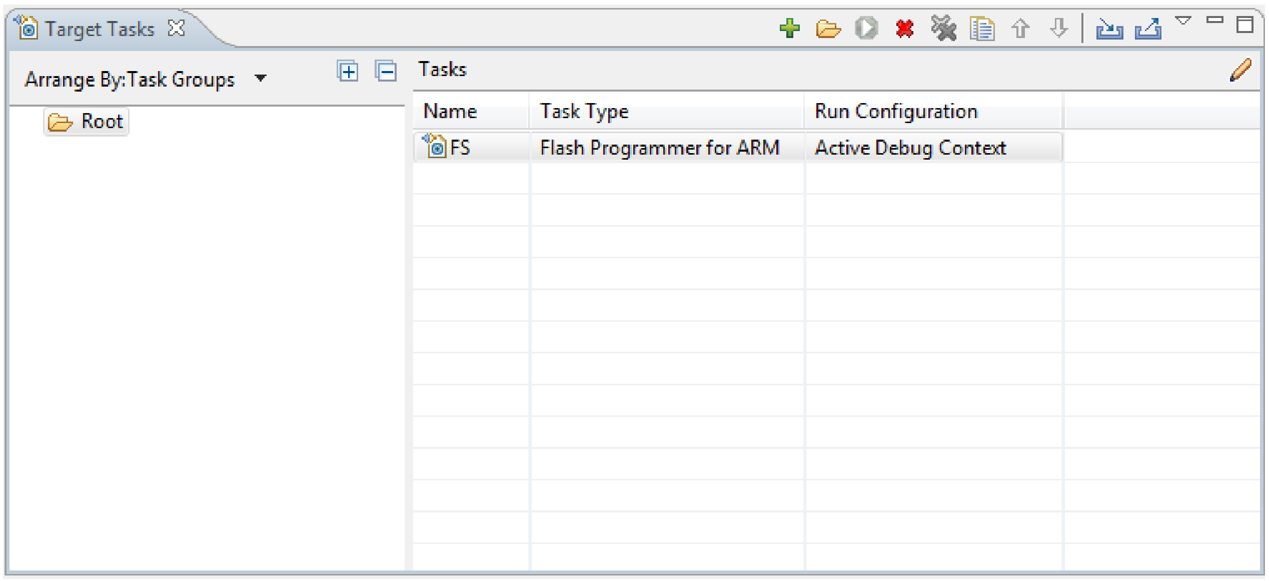
Figure 99: Show View dialog



2. Expand the **Debug** group and select **Target Tasks**.
3. Click **OK**.

   The **Target Tasks** view appears.

Figure 100: Target Tasks view

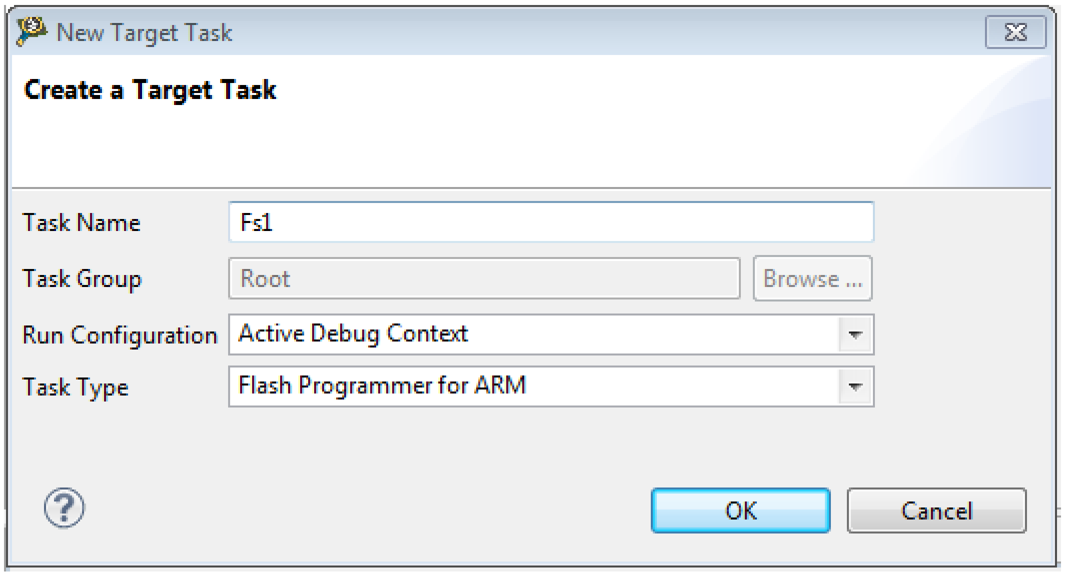


Name	Task Type	Run Configuration
FS	Flash Programmer for ARM	Active Debug Context

4. Click the **Create New Target Task** button in the **Target Tasks** view toolbar.

   The **Create New Target Task** wizard appears.

Figure 101: Create New Target Task window



New Target Task

Create a Target Task

Task Name: Fs1

Task Group: Root

Run Configuration: Active Debug Context

Task Type: Flash Programmer for ARM

5. In the **Task Name** text box, enter a name for the new flash programming target task.
6. Choose a launch configuration from the **Run Configuration** pop-up menu.
   - Choose **Active Debug Context** when flash programmer is used over an active debug session.
   - Choose a project-specific debug context when flash programmer is used without an active debug session.
7. Choose **Flash Programmer for ARM** from the **Task Type** pop-up menu.
8. Click **OK**.

   The target task is created in the **Target Tasks** view. Click **Edit Task Configuration** button and the **ARM Flash Programmer Task** editor window appears. You use this window to configure the flash programmer target task.

   - Flash Devices - Lists the devices added in the current task.
   - Target RAM - Lets you specify the settings for Target RAM.
   - Flash Program Actions - Displays the programmer actions to be performed on the flash devices.

11.1.2 Configure flash programmer target task

You can add flash devices, specify Target RAM settings, and add flash program actions to a flash programmer task to configure it.

This section contains the following subsections:

- Add flash device on page 186
- Specify target RAM settings on page 186
- Add flash programmer actions on page 186

11.1.2.1 Add flash device

This section explains how to add a flash device to the **Flash Devices** table.

In the **ARM Flash Programmer Task** editor window, to add a flash device to the **Flash Devices** table:

1. Click the **Add Device** button.

   The **Add Device** dialog appears.

2. Select a flash device from the device list.
3. Click the **Add Device**button.

   The flash device is added to the **Flash Devices** table in the **ARM Flash Programmer Task** editor window.

   NOTE

   You can select multiple flash devices to add to the **Flash Devices** table. To select multiple devices, hold down the **Control** key while selecting the devices.

4. Click **Done**.

   The **Add Device** dialog closes and the flash device appears in the **Flash Devices** table in the **ARM Flash Programmer Task** editor window.

   NOTE

   For NOR and QSPI flashes, the base address indicates the location where the flash is mapped in the memory. For NAND flashes, the base address is usually 0x0.

11.1.2.2 Specify target RAM settings

The Target RAM is used by Flash programmer to download its algorithms.

NOTE

The Target RAM memory area is not restored by flash programmer. If you are using flash programmer with Active Debug Context, it will impact your debug session.

The **Target RAM** (Add flash device on page 186) group contains fields to specify settings for the Target RAM.

- **Address** text box: Specify the address from the target memory. The **Address** text box should contain the first address from target memory used by the flash algorithm running on a target board.
- **Size** text box: Specify the size of the target memory. The flash programmer does not modify any memory location other than the target memory buffer and the flash memory.
- **Verify Target Memory Writes** checkbox: Select this checkbox to verify all write operations to the hardware RAM during flash programming.

11.1.2.3 Add flash programmer actions

The **Flash Programmer Actions** group in the **ARM Flash Programmer Task** editor window allows you to add flash programmer actions.

The **Flash Programmer Actions** group contains the following UI controls to work with flash programmer actions:

- **Add Action** pop-up menu:
  - **Erase / Blank Check**: Allows you to add erase or blank check actions for a flash device
  - **Program / Verify**: Allows you to add program or verify flash actions for a flash device
  - **Checksum**: Allows you to add checksum actions for a flash device
  - **Diagnostics**: Allows you to add diagnostics actions for a flash device

- **Dump Flash**: Lets you add a dump flash action
- **Protect/Unprotect**: Lets you add protect or unprotect action
- **Secure/Unsecure**: Lets you add secure or unsecure action

- **Duplicate Action** button: Allows you to duplicate a flash program action in the **Flash Programmer Actions** table.
- **Remove Action** button: Allows you to remove a flash program action from the **Flash Programmer Actions** table.
- **Move Up** button: Allows you to move up the selected flash action in the **Flash Programmer Actions** table.
- **Move Down** button: Allows you to move down the selected flash action in the **Flash Programmer Actions** table.

NOTE

Actions can also be enabled or disabled using the **Enabled** column. The **Description** column contains the default description for the flash programmer actions. You can also edit the default description.

This section contains the following subsections:

- Erase/Blank check actions on page 187
- Program/Verify actions on page 188
- Checksum actions on page 188
- Diagnostics actions on page 189
- Dump Flash actions on page 189
- Protect/Unprotect actions on page 190

11.1.2.3.1 Erase/Blank check actions

The Erase action erases sectors from the flash device.

You can also use the erase action to erase the entire flash memory without selecting sectors. The blank check action verifies if the specified areas have been erased from the flash device.

NOTE

Flash Programmer will not erase a bad sector in the NAND flash. After the erase action a list of bad sectors is reported (if any).

To add an erase/blank check action:

1. Choose **Erase/Blank Check Action** from the **Add Action** pop-up menu.

   The **Add Erase/Blank Check Action** dialog appears.

2. Select a sector from the **Sectors** table and click the **Add Erase Action** button to add an erase operation on the selected sector.

NOTE

Press the **Control** or the **Shift** key for selecting multiple sectors from the **Sectors** table.

3. Click the **Add Blank Check Action** button to add a blank check operation on the selected sector.
4. Select the **Mass erase all devices** checkbox to erase the entire flash memory.

NOTE

After selecting the **Mass erase all devices** checkbox, you need to add either erase or blank check action to erase all sectors.

5. Click **Done**.

   The **Add Erase/Blank Check Action** dialog closes and the added erase/blank check actions appear in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

11.1.2.3.2 Program/Verify actions

The program action allows you to program the flash device and the verify action verifies the programmed flash device.

To add a program/verify action:

1. Choose **Program/Verify Action** from the **Add Action** pop-up menu.

   The **Add Program / Verify Action** dialog appears.
2. Select the file to be written to the flash device.
3. Select the **Use File from Launch Configuration** checkbox to use the file from the launch (run) configuration associated with the task.
4. Specify the file name in the **File** text box. You can use **Workspace**, **File System**, or **Variables** buttons to select the desired file.
5. Choose a file type from the **File Type** pop-up menu. You can select any one of the following file types:
   - Auto - Detects the file type automatically.
   - Elf - Specifies executable in ELF format.
   - Srec - Specifies files in Motorola S-record format.
   - Binary - Specifies binary files.
6. Select the **Erase sectors before program** checkbox to erase sectors before program.
7. [Optional] Select the **Verify after program** checkbox to verify after the program.

   NOTE

   The **Verify after program** checkbox is available only with the processors supporting it.
8. Select the **Restricted To Address in this Range** checkbox to specify a memory range. The write action is permitted only in the specified address range. In the **Start** text box, specify the start address of the memory range sector and in the **End** text box, specify the end address of the memory range.
9. Select the **Apply Address Offset** checkbox and set the memory address in the **Address** text box. Value is added to the start address of the file to be programmed or verified.
10. Click the **Add Program Action** button to add a program action on the flash device.
11. Click the **Add Verify Action** button to add a verify action on the flash device.
12. Click **Done**.

    The **Add Program / Verify Action** dialog closes and the added program/verify actions appear in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

11.1.2.3.3 Checksum actions

The checksum can be computed over host file, target file, memory range, or entire flash memory.

To add a checksum action:

1. Choose **Checksum Action** from the **Add Action** pop-up menu.

   The **Add Checksum Action** dialog appears.
2. Select the file for checksum action.
3. Select the **Use File from Launch Configuration** checkbox to use the file from the launch (run) configuration associated with the task.
4. Specify the filename in the **File** text box. You can use the **Workspace**, **File System**, or **Variables** buttons to select the desired file.
5. Choose the file type from the **File Type** pop-up menu.
6. Select an option from the **Compute Checksum Over** options. The checksum can be computed over the host file, the target file, the memory range, or the entire flash memory.
7. Specify the memory range in the **Restrict To Addresses in this Range** group. The checksum action is permitted only in the specified address range. In the **Start** text box, specify the start address of the memory range sector and in the **End** text box, specify the end address of the memory range.
8. Select the **Apply Address Offset** checkbox and set the memory address in the **Address** text box. Value is added to the start address of the file to be programmed or verified.
9. Click the **Add Checksum Action** button.
10. Click **Done**.

    The **Add Checksum Action** dialog closes and the added checksum actions appear in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

11.1.2.3.4 Diagnostics actions

The diagnostics action generates the diagnostic information for the selected flash device.

NOTE

Flash Programmer will report bad blocks, if they are present in the NAND flash.

To add a diagnostics action:

1. Choose **Diagnostics** from the **Add Action** pop-up menu.

   The **Add Diagnostics Action** dialog appears.
2. Select a device to perform the diagnostics action.
3. Click the **Add Diagnostics Action** button to add diagnostic action on the selected flash device.

   NOTE

   Select the **Perform Full Diagnostics** checkbox to perform full diagnostics on a flash device.
4. Click **Done**.

   The **Add Diagnostics Action** dialog closes and the added diagnostics action appears in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

11.1.2.3.5 Dump Flash actions

The dump flash action allows you to dump selected sectors of a flash device or the entire flash device.

To add a dump flash action:

1. Choose **Dump Flash Action** from the **Add Action** pop-up menu.

The **Add Dump Flash Action** dialog appears.

2. Specify the file name in the **File** text box. The flash is dumped in this selected file.
3. Choose the file type from the **File Type** pop-up menu. You can choose any one of the following file types:
   - Srec: Saves files in Motorola S-record format.
   - Binary: Saves files in binary file format.
4. Specify the memory range for which you want to add dump flash action.
   - Enter the start address of the range in the **Start** text box.
   - Enter the end address of the range in the **End** text box.
5. Click the **Add Dump Flash Action** button to add a dump flash action.
6. Click **Done**.

   The **Add Dump Flash Action** dialog closes and the added dump flash action appear in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

11.1.2.3.6 Protect/Unprotect actions

The protect/unprotect actions allow you to change the protection of a sector in the flash device.

To add a protect/unprotect action:

1. Choose the **Protect/Unprotect Action** from the **Add Action** pop-up menu.

   The **Add Protect/Unprotect Action** dialog appears.
2. Select a sector from the **Sectors** table and click the **Add Protect Action** button to add a protect operation on the selected sector.

NOTE

Press the **Control** or **Shift** key for selecting multiple sectors from the **Sectors** table.

3. Click the **Add Unprotect Action** button to add an unprotect action on the selected sector.
4. Select the **All Device** checkbox to add action on full device.
5. Click **Done**.

   The **Add Protect/Unprotect Action** dialog closes and the added protect or unprotect actions appear in the **Flash Programmer Actions** table in the **ARM Flash Programmer Task** editor window.

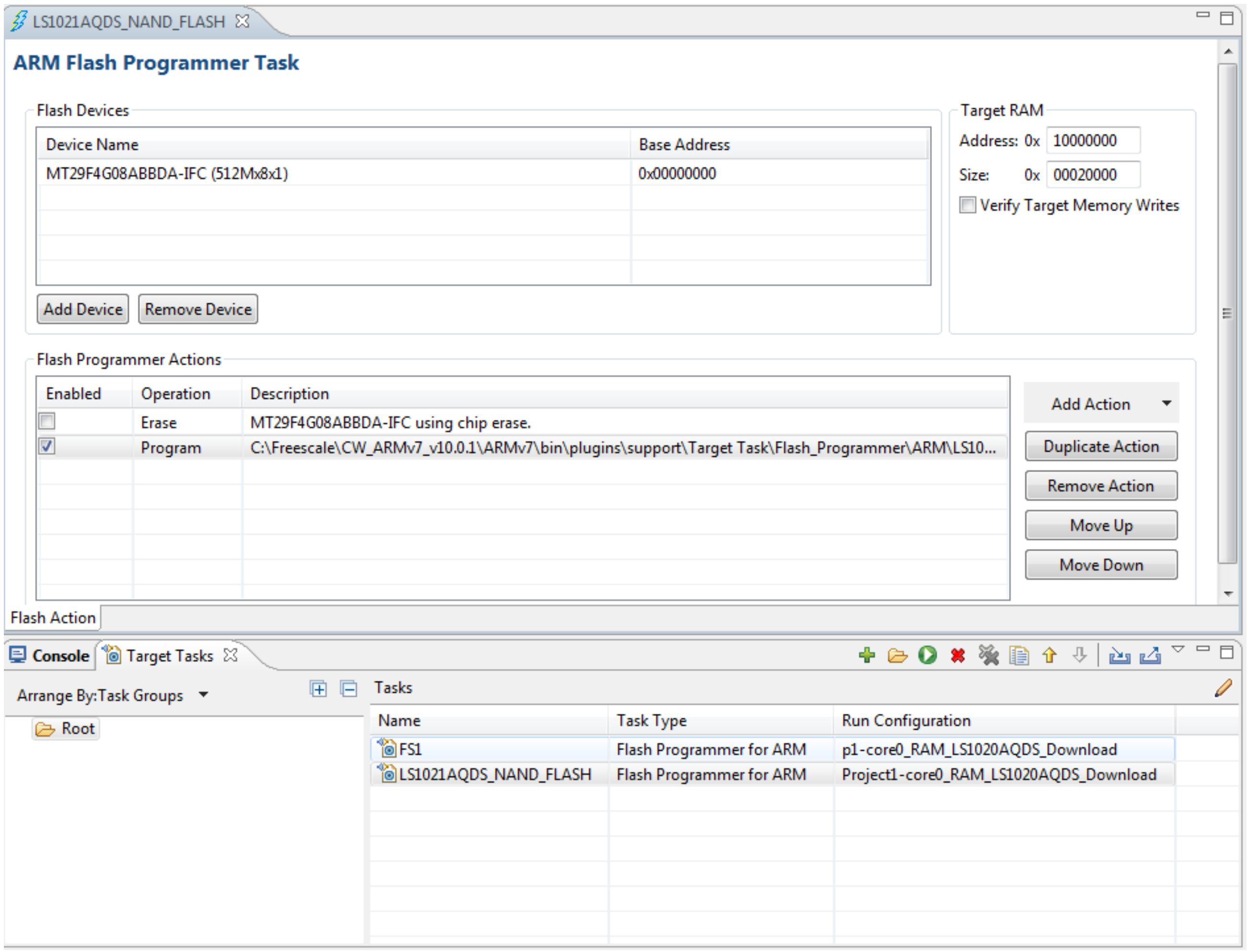
11.1.3 Execute flash programmer target task

You can execute the flash programmer tasks using the **Target Tasks** view.

To execute the configured flash programmer target task, select a target task and click the **Execute** button in the **Target Tasks** view toolbar. Alternatively, right-click a target task and choose **Execute** from the shortcut menu.

You can use predefined target tasks for supported boards. To load a predefined target task, click **Import** button in the **Target Task** view. Select the task, for example, `LS102xAQDS_NAND_FLASH.xml` from `{CW folder}\ARMv7\bin\plugins\Support\Target Task\Flash_Programmer\ARM\ folder`. Change the **Run Configuration** and then double-click the imported task, the **ARM Flash Programmer Task** view appears.

Figure 102: Execute target task



LS1021AQDS_NAND_FLASH

ARM Flash Programmer Task

Flash Devices

Device Name	Base Address
MT29F4G08ABBDA-IFC (512Mx8x1)	0x00000000

Target RAM

Address: 0x 10000000

Size: 0x 00020000

☐ Verify Target Memory Writes

Flash Programmer Actions

Enabled	Operation	Description
☐	Erase	MT29F4G08ABBDA-IFC using chip erase.
☑	Program	C:\Freescale\CW_ARMv7_v10.0.1\ARMv7\bin\plugins\support\Target Task\Flash_Programmer\ARM\LS10...

Target Tasks

Arrange By:Task Groups

Root

Tasks

Name	Task Type	Run Configuration
FS1	Flash Programmer for ARM	p1-core0_RAM_LS1020AQDS_Download
LS1021AQDS_NAND_FLASH	Flash Programmer for ARM	Project1-core0_RAM_LS1020AQDS_Download

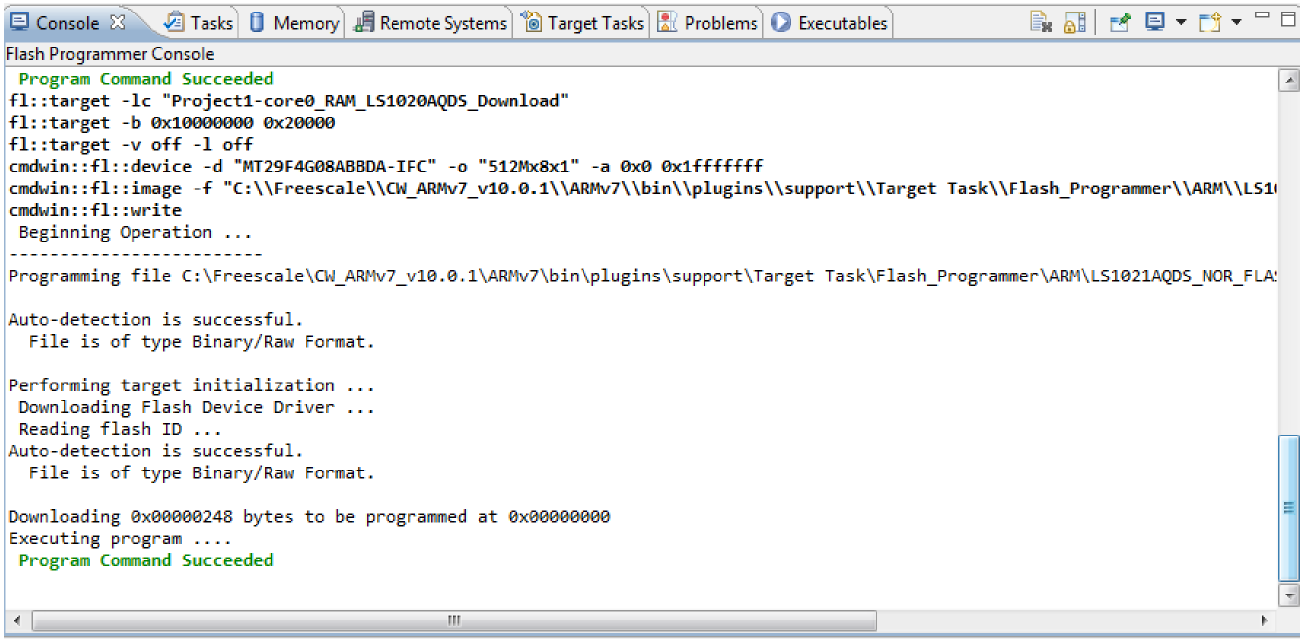
In the **ARM Flash Programmer Task** view, click **Add Action** button to add the **Flask Programmer Actions** as shown in above figure. Select the checkbox for the operation that you want to execute. Click **Execute** button in the **Target Task** view.

NOTE

To load a predefined target task, right-click in the **Target Tasks** view and choose **Import** from the shortcut menu. To save your custom tasks, right-click in the **Target Tasks** view and then choose **Export** from the shortcut menu.

You can check the results of flash batch actions in the **Console** view. The green color indicates the success and the red color indicates the failure of the task.

Figure 103: Console view



```
 Program Command Succeeded
fl::target -lc "Project1-core0_RAM_LS1020AQDS_Download"
fl::target -b 0x10000000 0x20000
fl::target -v off -l off
cmdwin::fl::device -d "MT29F4G08ABBDA-IFC" -o "512Mx8x1" -a 0x0 0x1fffffff
cmdwin::fl::image -f "C:\\Freescale\\CW_ARMv7_v10.0.1\\ARMv7\\bin\\plugins\\support\\Target Task\\Flash_Programmer\\ARM\\LS1
cmdwin::fl::write
 Beginning Operation ...
-------------------------
Programming file C:\Freescale\CW_ARMv7_v10.0.1\ARMv7\bin\plugins\support\Target Task\Flash_Programmer\ARM\LS1021AQDS_NOR_FLA

Auto-detection is successful.
  File is of type Binary/Raw Format.

Performing target initialization ...
 Downloading Flash Device Driver ...
 Reading flash ID ...
Auto-detection is successful.
  File is of type Binary/Raw Format.

Downloading 0x00000248 bytes to be programmed at 0x00000000
Executing program ....
 Program Command Succeeded
```

11.1.4 SD/eMMC flash programmer

This section explains what is SD/eMMC flash programmer and how to use it to program U-Boot.

The SD/eMMC card uses the notion of blocks, not addresses. One block has 512 bits. The flash programmer UI still uses address at operations; therefore, when you want to write something, for example, from block 4, you need to compute the address by multiplying the number of the block with 512 and converting the result into hexadecimal (for example, sector 4 x 512 = 2048 = 0x00000800). In case of a program operation, if you select the **Erase sectors before program** checkbox (which is always recommended) in the **Add Program / Verify Action** dialog, then the flash programmer will only erase the sectors that are written.

Because the size of a block is small and the size of the card is large, all the available blocks cannot be displayed in the **Add Erase/Blank Check Action** dialog; therefore, the card has been divided into sectors of 4 MB each. So, when you choose an erase/blank check operation, you will erase/check sectors of 4 MB.

By default, the algorithm is set to run from DDR, because it uses direct memory access (DMA) for data transfer. If the DDR memory is not functional, change in the **ARM Flash Programmer Task** editor window the running address of the algorithm (**Target RAM** field) for the target task with the OCRAM address of your processor, which will enable the use of the internal buffer of the eSDHC controller. This will reduce the performance as DMA is not used in this mode.

This section contains the following subsection:

- Programming U-Boot using SD/eMMC flash programmer on page 192

11.1.4.1 Programming U-Boot using SD/eMMC flash programmer

This section explains how to program U-Boot using the SD/eMMC flash programmer.

The example described in this section uses the LS1021AQDS Rev. 2.0 target. The steps given here are applicable to all targets that support SD/eMMC flash programmer.

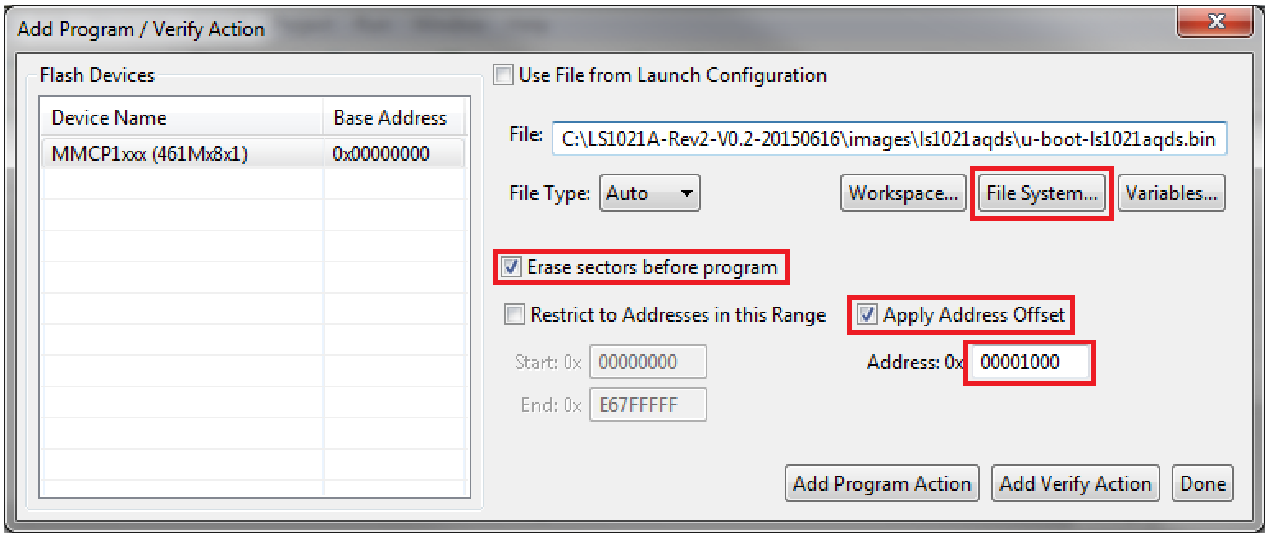
The steps to program U-Boot using SD/eMMC flash programmer are as follows:

1. Import the preconfigured target task for the target (in the current example, eMMC flash programmer is used; for the SD flash programmer, the steps are same but only the preconfigured target task is different): `ARMv7/bin/plugins/support/TargetTask/Flash_Programmer/ARM/LS102xAQDS_MMC_FLASH.xml`.

2. Choose **Program/Verify Action** from the **Add Action** pop-up menu.

   The **Add Program / Verify Action** dialog appears, as shown in the figure below.

Figure 104: Add Program / Verify Action dialog



3. Select the U-Boot image you want to write by clicking **File System**.
4. Select the **Erase sectors before program** checkbox to erase sectors before U-Boot is programmed.
5. Select the **Apply Address Offset** checkbox and set the start address of the U-Boot image to be programmed.

NOTE

The U-Boot image for the LS1 targets is written from block 8 (the address that you have to specify in the **Address** field is computed as described earlier in this section: block 8 x 512 = 4096 = 0x00001000).

6. Click **Add Program Action** to add a program action on the flash device.
7. Click **Done** to close the **Add Program / Verify Action** dialog.
8. Execute the flash programmer target task.

11.1.5 Flash File to Target

You can use the **Flash File to Target** feature to perform flash operations, such as erasing a flash device or programming a file.

You do not need any project for using **Flash File to Target** feature, only a valid **Remote System** is required.

To open the **Flash File to Target** dialog, click the **Flash Programmer** button on the IDE toolbar.

- **Connection** pop-up menu- Lists all run configurations defined in Eclipse. If a connection to the target has already been made the control becomes inactive and contains the text Active Debug Configuration.
- **Flash Configuration File** pop-up menu - Lists predefined target tasks for the processor selected in the Launch Configuration and tasks added by user with the **Browse** button. The items in this pop-up menu are updated based on the processor selected in the launch configuration.
  - **Unprotect flash memory before erase** checkbox - Select to unprotect flash memory before erasing the flash device. This feature allows you to unprotect the flash memory from **Flash File To Target** dialog.
- **File to Flash** group - Allows selecting the file to be programmed on the flash device and the location.

- **File** text box - Used for specifying the filename. You can use the **Workspace**, **File System**, or **Variables** buttons to select the desired file.
- **Offset:0x** text box - Used for specifying offset location for a file. If no offset is specified the default value of zero is used. The offset is always added to the start address of the file. If the file does not contain address information then zero is considered as start address.

- **Save as Target Task** - Select to enable **Task Name** text box.
  - **Task Name** text box - Lets you to save the specified settings as a Flash target task. Use the testbox to specify the name of the target task.
- **Erase Whole Device** button - Erases the flash device. In case you have multiple flash blocks on the device, all blocks are erased. If you want to selectively erase or program blocks, use the Flash programmer on page 183 feature.
- **Erase and Program** button - Erases the sectors that are occupied with data and then programs the file. If the flash device can not be accessed at sector level then the flash device is completely erased.

This feature helps you perform these basic flash operations:

- Erasing flash device on page 194
- Programming file on page 194

11.1.5.1 Erasing flash device

This section explains how to erase a flash device using the **Flash File to Target** feature.

To erase a flash device, follow these steps:

1. Click the **Flash Programmer** button on the IDE toolbar.

   The **Flash File to Target** dialog appears.
2. Choose a connection from the **Connection** pop-up menu.

   NOTE
   If a connection is already established with the target, this control is disabled.

   The **Flash Configuration File** pop-up menu is updated with the supported configurations for the processor from the launch configuration.
3. Choose a flash configuration from the **Flash Configuration File** pop-up menu.
4. Select the **Unprotect flash memory before erase** checkbox to unprotect flash memory before erasing the flash device.
5. Click the **Erase Whole Device** button.

11.1.5.2 Programming file

This section explains how to program a file using the **Flash File to Target** feature.

The steps are as follows:

1. Click the **Flash Programmer** button on the IDE toolbar.

   The **Flash File to Target** dialog appears.
2. Choose a connection from the **Connection** pop-up menu.

   NOTE
   If a connection is already established with the target, this control is disabled.

The **Flash Configuration File** pop-up menu is updated with the supported configurations for the processor from the launch configuration.

3. Choose a flash configuration from the **Flash Configuration File** pop-up menu.
4. Select the **Unprotect flash memory before erase** checkbox to unprotect flash memory before erasing the flash device.
5. Type the file name in the **File** text box. You can use the **Workspace**, **File System**, or **Variables** buttons to select the desired file.
6. Type the offset location in the **Offset** text box.
7. Click the **Erase and Program** button.

11.2 Hardware diagnostics

The **Hardware Diagnostics** utility lets you run a series of diagnostic tests that determine if the basic hardware is functional.

These tests include:

- Memory read/write: This test only makes a read or write access to the memory in order to read or write a byte, word (2 bytes) and long word (4 bytes) to or from the memory. For this task, the user needs to set the options in the **Memory Access** group.
- Scope loop: This test makes read and write accesses to memory in a loop at the target address. The time between accesses is given by the loop speed settings. The loop can only be stopped by the user, which cancels the test. For this type of test, the user needs to set the memory access settings and the loop speed.
- Memory tests: This test requires the user to set the access size and target address from the access settings group and the settings present in the **Memory Tests** group.

This section contains the following subsections:

- Creating hardware diagnostics task on page 195
- Working with Hardware Diagnostic Action editor on page 196

11.2.1 Creating hardware diagnostics task

You can create a hardware diagnostic task using the **Create New Target Task** wizard.

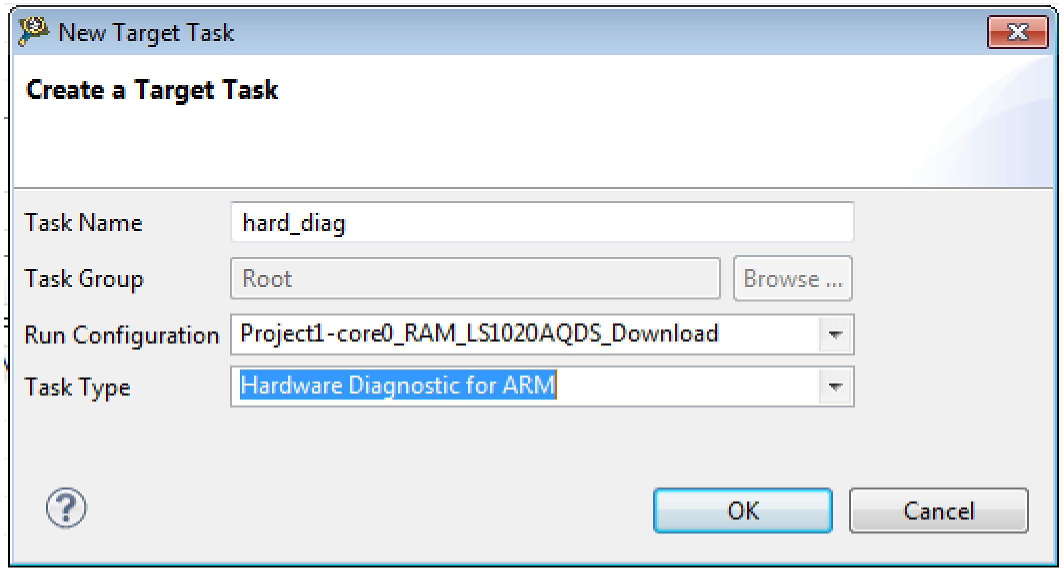
To create a task for hardware diagnostics:

1. Choose **Window** > **Show View** > **Other** from the IDE menu bar.

   The **Show View** dialog appears.
2. Expand the **Debug** group and select **Target Tasks**.
3. Click **OK**.
4. Click the **Create New Target Task** button on the **Target Tasks** view toolbar. Alternatively, right-click in the **Target Tasks** view and choose **New Task** from the shortcut menu.

   The **Create a Target Task** dialog appears.

Figure 105: Create a Target Task



Task Name: hard_diag
Task Group: Root
Run Configuration: Project1-core0_RAM_LS1020AQDS_Download
Task Type: Hardware Diagnostic for ARM

5. Type name for the new task in the **Task Name** text box.
6. Choose a launch configuration from the **Run Configuration** pop-up menu.

NOTE

If the task does not successfully launch the configuration that you specify, the **Execute** button on the **Target Tasks** view toolbar appears disabled.

7. Choose **Hardware Diagnostic for ARM** from the **Task Type** pop-up menu.
8. Click **Finish**.

   A new hardware diagnostic task is created in the **Target Tasks** view.

NOTE

You can perform various actions on a hardware diagnostic task, such as renaming, deleting, or executing the task, using the shortcut menu that appears on right-clicking the task in the **Target tasks** view.

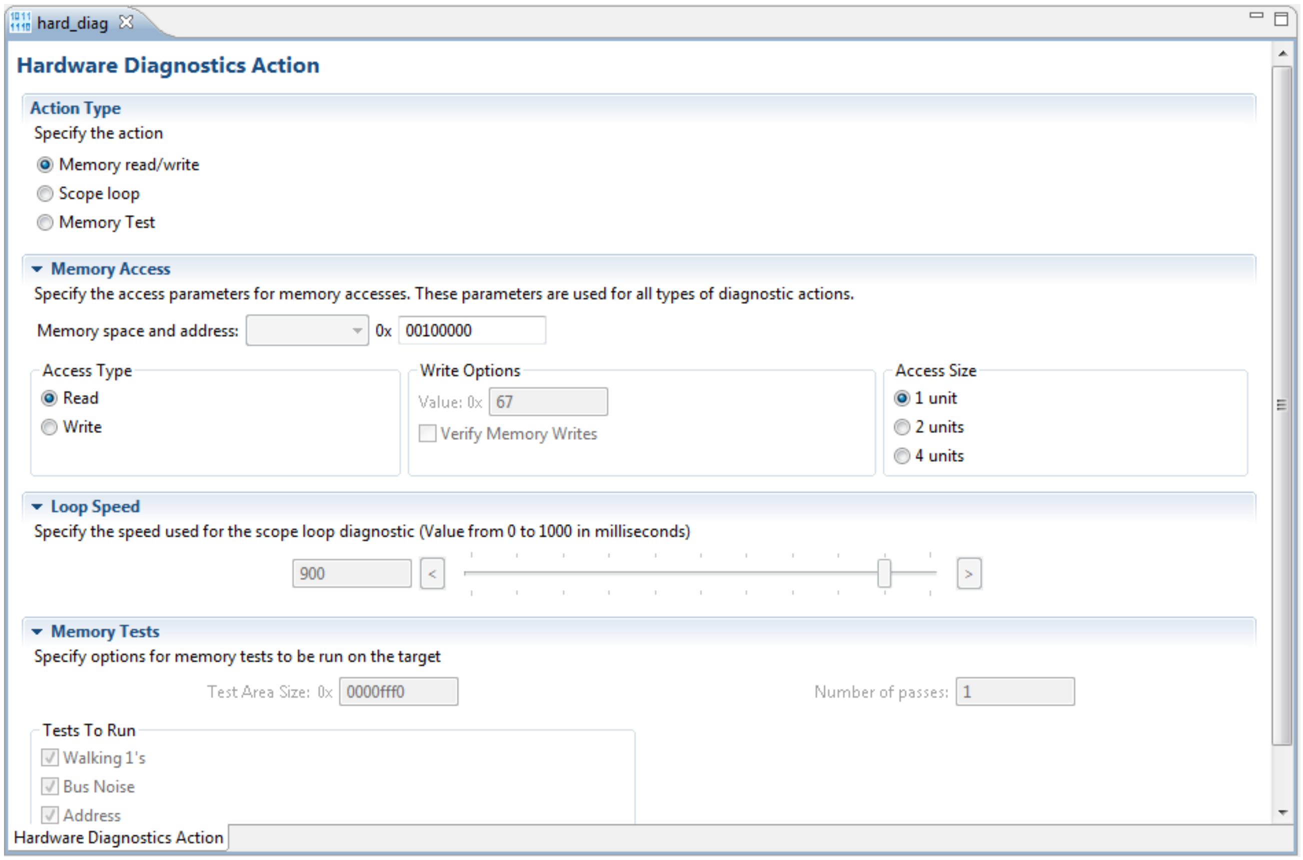
11.2.2 Working with Hardware Diagnostic Action editor

The **Hardware Diagnostic Action** editor is used to configure a hardware diagnostic task.

To open the **Hardware Diagnostic Action** editor for a particular task, double-click the task in the **Target Tasks** view.

The following figure shows the **Hardware Diagnostics Action** editor.

Figure 106: Hardware Diagnostics Action editor


hard_diag
Hardware Diagnostics Action
Action Type
Specify the action
Memory read/write
Scope loop
Memory Test
Memory Access
Specify the access parameters for memory accesses. These parameters are used for all types of diagnostic actions.
Memory space and address: 0x 00100000
Access Type
Read
Write
Write Options
Value: 0x 67
Verify Memory Writes
Access Size
1 unit
2 units
4 units
Loop Speed
Specify the speed used for the scope loop diagnostic (Value from 0 to 1000 in milliseconds)
900
Memory Tests
Specify options for memory tests to be run on the target
Test Area Size: 0x 0000fff0
Number of passes: 1
Tests To Run
Walking 1's
Bus Noise
Address
Hardware Diagnostics Action

The **Hardware Diagnostics Action** editor window includes the following groups:

- Action Type on page 197
- Memory Access on page 197
- Loop Speed on page 198
- Memory Tests on page 198

11.2.2.1 Action Type

You can choose the action type from the **Action Type** group in the **Hardware Diagnostics Action** editor window.

You can choose any one of the following actions:

- Memory read/write - Enables the options in the **Memory Access** group
- Scope loop - Enables the options in the **Memory Access** and the **Loop Speed** groups
- Memory test - Enables the access size and target address from the access settings group and the settings present in the **Memory Tests** group

11.2.2.2 Memory Access

The **Memory Access** pane configures diagnostic tests for performing memory reads and writes over the remote connection interface.

The table below lists and describes the items in the pane.

Table 64: Memory Access pane items

Item	Description
Read	Select to have the hardware diagnostic tools perform read tests.
Write	Select to have the hardware diagnostic tools perform write tests.
1 Byte	Select to have the hardware diagnostic tools perform byte-size operations.
2 Bytes	Select to have the hardware diagnostic tools perform word-size operations.
4 Bytes	Select to have the hardware diagnostic tools perform long-word-size operations.
Memory space and address	Specify the address of an area in RAM that the hardware diagnostic tools should analyze. The tools must be able to access this starting address through the remote connection (after the hardware initializes).
Value	Specify the value that the hardware diagnostic tools write during testing. Select the **Write**option to enable this text box.
Verify Memory Writes	Select the checkbox to verify success of each data write to the memory.

11.2.2.3 Loop Speed

The **Loop Speed** pane configures diagnostic tests for performing repeated memory reads and writes over the remote connection interface.

The tests repeat until you stop them. By performing repeated read and write operations, you can use a scope analyzer or logic analyzer to debug the hardware device. After the first 1000 operations, the **Status** shows the estimated time between operations.

NOTE

For all values of **Speed**, the time between operations depends heavily on the processing speed of the host computer.

For **Read** operations, the Scope Loop test has an additional feature. During the first read operation, the hardware diagnostic tools store the value read from the hardware. For all successive read operations, the hardware diagnostic tools compare the read value to the stored value from the first read operation. If the Scope Loop test determines that the value read from the hardware is not stable, the diagnostic tools report the number of times that the read value differs from the first read value. The following table lists and describes the items in **Loop Speed** pane.

Table 65: Loop Speed pane items

Item	Description
Specify the speed	Enter a numeric value between 0 to 1000 in the text box to adjust the speed. You can also move the slider to adjust the speed at which the hardware diagnostic tools repeat successive read and write operations. Lower speeds increase the delay between successive operations. Higher speeds decrease the delay between successive operations.

11.2.2.4 Memory Tests

The **Memory Tests** pane lets you perform three hardware tests: Walking Ones, Address, and Bus Noise.

You can specify any combination of tests and number of passes to perform. For each pass, the hardware diagnostic tools performs the tests in turn, until all passes are complete. The tools compare memory test failures and display them in a log window after all passes are complete. Errors resulting from memory test failures do not stop the testing process; however, fatal errors immediately stop the testing process.

The following table explains the items in the **Memory Tests** pane.

Table 66: Memory Tests pane items

Item	Explanation
Walking 1's	Select the checkbox to have the hardware diagnostic tools perform the Walking Ones on page 199 test. Deselect to have the diagnostic tools skip the Walking Ones on page 199 test.
Address	Select to have the hardware diagnostic tools perform the Address on page 200 test. Deselect to have the diagnostic tools skip the Address on page 200 test.
Bus Noise	Select to have the hardware diagnostic tools perform the Bus Noise on page 200 test. Deselect to have the diagnostic tools skip the Bus Noise on page 200 test.
Test Area Size	Specify the size of memory to be tested. This setting along with Target Address defines the memory range being tested.
Number of Passes	Enter the number of times that you want to repeat the specified tests.

This section contains the following subsections:

- Walking Ones on page 199
- Address on page 200
- Bus Noise on page 200
- Memory test use cases on page 200

11.2.2.4.1 Walking Ones

This section describes the Walking Ones test.

This test detects these memory faults:

- Address Line: The board or chip address lines are shorting or stuck at 0 or 1. Either condition could result in errors when the hardware reads and writes to the memory location. Because this error occurs on an address line, the data may end up in the wrong location on a write operation, or the hardware may access the wrong data on a read operation.
- Data Line: The board or chip data lines are shorting or stuck at 0 or 1. Either condition could result in corrupted values as the hardware transfers data to or from memory.
- Retention: The contents of a memory location change over time. The effect is that the memory fails to retain its contents over time.

The Walking Ones test includes four sub-tests:

- Walking Ones: This subtest first initializes memory to all zeros. Then the subtest writes, reads, and verifies bits, with each bit successively set from the least significant bit (LSB) to the most significant bit (MSB). The subtest configures bits such that by the time it sets the MSB, all bits are set to a value of 1. This pattern repeats for each location within the memory range that you specify. For example, the values for a byte-based Walking Ones subtest occur in this order:

```
0x01, 0x03, 0x07, 0x0F, 0x1F, 0x3F, 0x7F, 0xFF
```

- Ones Retention: This subtest immediately follows the Walking Ones subtest. The Walking Ones subtest should leave each memory location with all bits set to 1. The Ones Retention subtest verifies that each location has all bits set to 1.
- Walking Zeros: This subtest first initializes memory to all ones. Then the subtest writes, reads, and verifies bits, with each bit successively set from the LSB to the MSB. The subtest configures bits such that by the time it sets the MSB, all bits are set to a value of 0. This pattern repeats for each location within the memory range that you specify. For example, the values for a byte-based Walking Zeros subtest occur in this order:

```
0xFE, 0xFC, 0xF8, 0xF0, 0xE0, 0xC0, 0x80, 0x00
```

- Zeros Retention: This subtest immediately follows the Walking Zeros subtest. The Walking Zeros subtest should leave each memory location with all bits set to 0. The Zeros Retention subtest verifies that each location has all bits set to 0.

11.2.2.4.2 Address

This section describes the Address test.

This test detects memory aliasing. *Memory aliasing* exists when a physical memory block repeats one or more times in a logical memory space. Without knowing about this condition, you might conclude that there is much more physical memory than what actually exists.

The address test uses a simplistic technique to detect memory aliasing. The test writes sequentially increasing data values (starting at one and increasing by one) to each successive memory location. The maximum data value is a prime number and its specific value depends on the addressing mode so as to not overflow the memory location.

The test uses a prime number of elements to avoid coinciding with binary math boundaries:

- For byte mode, the maximum prime number is 28-5 or 251.
- For word mode, the maximum prime number is 216-15 or 65521.
- For long word mode, the maximum prime number is 232-5 or 4294967291.

If the test reaches the maximum value, the value rolls over to 1 and starts incrementing again. This sequential pattern repeats throughout the memory under test. Then the test reads back the resulting memory and verifies it against the written patterns. Any deviation from the written order could indicate a memory aliasing condition.

11.2.2.4.3 Bus Noise

This section describes the Bus Noise test.

This test stresses the memory system by causing many bits to flip from one memory access to the next (both addresses and data values). *Bus noise* occurs when many bits change consecutively from one memory access to another. This condition can occur on both address and data lines.

11.2.2.4.4 Memory test use cases

This section describes some memory test use cases.

The memory read/write, scope loop tests, and memory tests are host-based tests. The host machine issues read and write action to the memory through the connection protocol. For example, CodeWarrior connection server (CCS). Memory tests are the complex tests that can be executed in two modes: Host based and Target based depending upon the selection made for the **Use Target CPU** checkbox. The Host based tests are slower. The target based tests are not available.

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