Getting Started with the Student Learning Kit

Featuring the Freescale HCS12 Microcontroller Application Module

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1 Introduction

This guide provides the steps necessary to begin development with a HCS12 family microcontroller (MCU) using your application module and/or in conjunction with the Freescale project board (PBMCUSLK).

This guide is separated into three main sections. First, the software setup section will assist in installing the CodeWarrior™ development tools. Second, the hardware setup section will step through configuring the project board and application module. Third, the development section illustrates how to create, build, and debug an application.

Refer to the project board user guide, application module user guide, and CodeWarrior documentation for more details.

For demonstration applications, source code examples, current documentation and resources; visit www.freescale.com\universityprograms

Contents

2 Unpack

Open the shipping carton and remove the contents. Locate the packaging list and verify items have been received from the packaging list.

Inspect both the project board and the application module for damage that may have occurred during shipping. If damage is found, contact the manufacturer at support@axman.com for assistance.

3 Software Setup

The following software installation is a one-time, required procedure per host PC that you intend to use with the project board and/or application module. After completing the software setup on your host PC, you can skip the software section on subsequent uses of your project board and/or application module and begin the hardware setup or development sections.

To install and register CodeWarrior development tools for HCS12(X) Microcontrollers onto a host PC, complete the instructions found inside the CodeWarrior Development Studio for Freescale HCS12(X) Microcontrollers case.

Additional tools and training materials for CodeWarrior are available at www.freescale.com

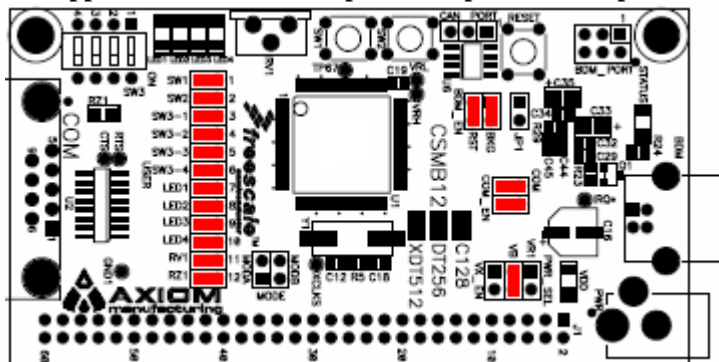| **NOTE** |
| --- |
| Academic Edition development tools are full-featured and not for commercial development. They may only be licensed to students, faculty, and staff of accredited institutions. |
| Periodically check http://www.freescale.com/codewarrior for updates and patches to your development tools. For questions on CodeWarrior development tools, visit http://www.freescale.com/support |

4 Hardware Setup

For more information on the Application Module operation, jumper descriptions and settings please refer to the development board User Guide or visit www.freescale.com\universityprograms for latest information.

4.1 Configuring the Application Module for independent operation

1) By default, the application module is configured to run independently out of the box. Verify that all the jumper settings are configured properly on the application module as shown by Figure 1.
2) Connect the provided USB cable from your host PC to the Application Module.
3) You are done! Jump to Section 4.3

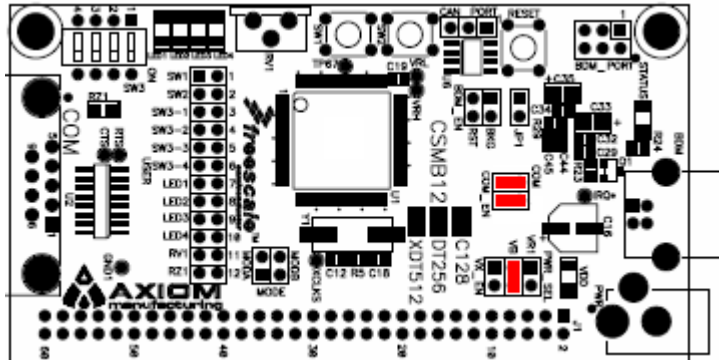**Figure 1. Application Module: Independent Operation Jumper Settings**

Jumper Position	Jumper ID	Description
VR1 VB VX_EN	PWR_SEL	Source power input from connector on-board USB.
SW1 SW2 SW3_1 SW3_2 SW3_3 SW3_4 LED1 LED2 LED3 LED4 RV1 RZ1	USER	Jumpers enable access to application modules features. For push button switch (SW1:2), 4-position DIP switch 3 (SW3_1:4), LED[1:4], and to simplify circuit connections and emphasize software development.
RX TX	COM_EN	Jumpers enable the application modules serial communication port.
BKG RST	BDM_EN	Jumpers enable the application modules background debug mode (BDM) circuit.

4.2.1 Configuring the Application Module for use with the Project Board

1) Remove all USER jumpers from the Application Module as shown by Figure 2.
2) Remove all BDM_EN jumpers from the Application Module as shown by Figure 2.

Figure 2 Application Module: with Project Board Operation Jumper Settings

Jumper Position	Jumper ID	Description
VR1 / VB / VX_EN	PWR_SEL	Source power input from connector J1
SW1 / SW2 / SW3_1 / SW3_2 / SW3_3 / SW3_4 / LED1 / LED2 / LED3 / LED4 / RV1 / RZ1	USER	Remove Jumpers to disable access to application modules features. For push button switch (SW1:2), 4-position DIP switch 3 (SW3_1:4), LED[1:4], and to simplify circuit connections and emphasize software development. *Note: Features on the application module MAY be used while interfaces to the project board, but care must be taken to avoid signal conflicts. Unless you specifically intend on using one of these features we recommend that you default to disable all.
RX / TX	COM_EN	Remove jumpers to disable the application module serial communication port. *Note: The COM pins are shared when using the PBMCUSLK with the application module. Conflicts may occur if both are in use simultaneously.*
BKG / RST	BDM_EN	Remove jumpers to disable the application modules background debug mode (BDM) circuit. *Note: The BDM pins are shared when using the PBMCUSLK with the application module. Conflicts may occur if both are in use simultaneously.*

4.2.2 Configure the Project Board

Place the project board on a flat and sturdy surface. Ensure sufficient space is available around the project board to safely construct and test prototyped circuits.

Verify that all the jumper settings are configured properly on the project board as shown by Figure 3. Highlighted blocks indicate the on or installed position of jumpers. Circles indicate the location on the project board where the jumpers are located.
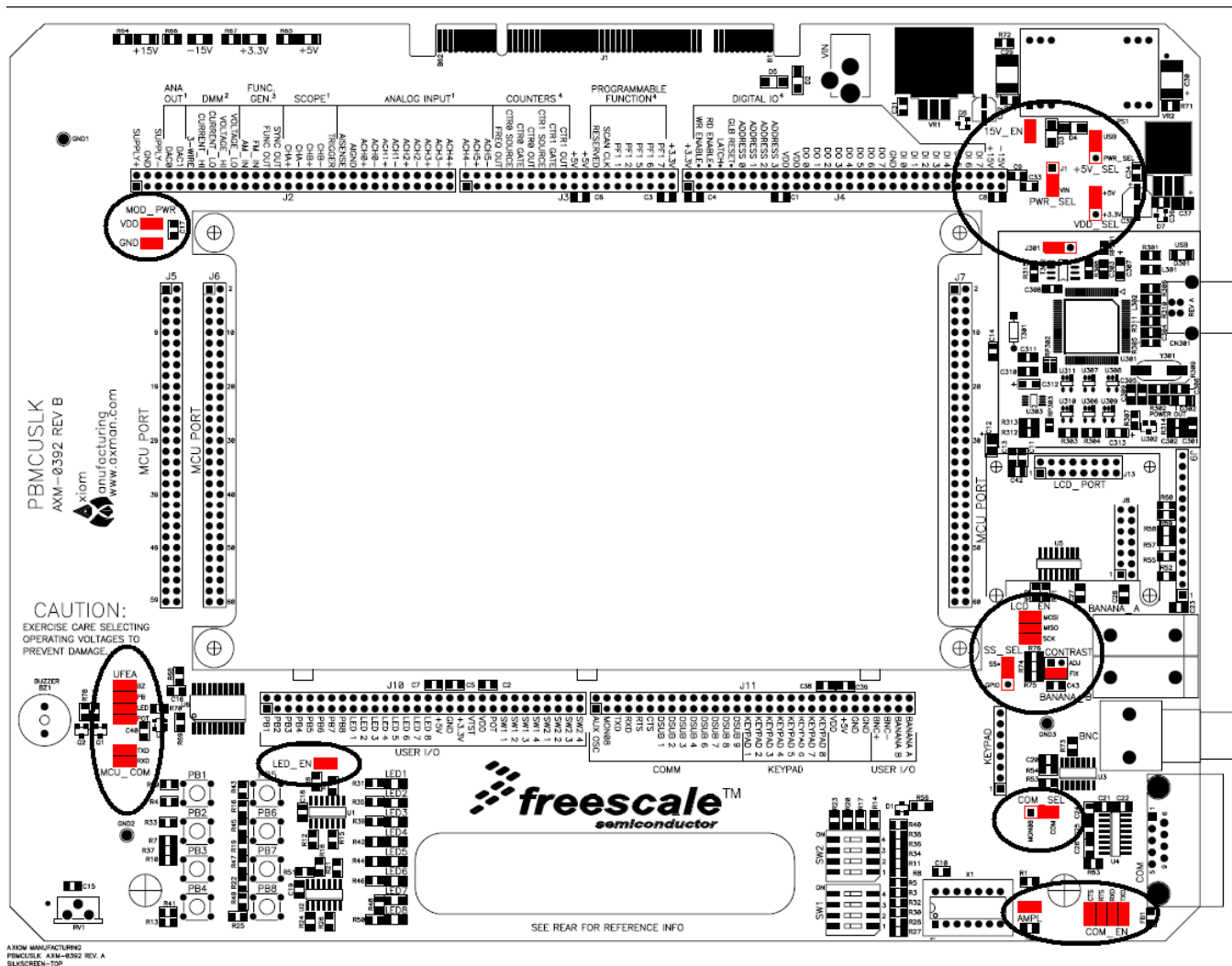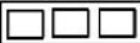

Figure 3. Project Board Jumper Settings

The table below summarizes the required jumper settings for use with the S12 Application Modules. Please refer to project board user guide for more details and alternative configurations.

| Jumper Position	Jumper ID	Description
J1 VIN	PWR_SEL	Selects V$_{In}$ (wall power transformer) as the default power source for the project board.
USB PWR_SEL	+5V_SEL	Selects USB (power via USB cable from host PC) as the default power source for the project board. This jumper overrides PWR_SEL in USB position.
+5V +3.3V	VDD_SEL	Sets V$_{DD}$ to +5V for project board.
15V_EN	15V_EN	Enables PS1 output (±15 V supply from dc-dc converter) to the project board. Selects if BDM Multilink pod on the project board has a generic or unique ID associated with the host PC.
J301	J301	Selects if BDM Multilink pod on the project board has a generic or unique ID associated with the host PC.
VDD / GND	MOD_PWR	Selects dedicated SS input source to MCU_23 (SS) on MCU PORT connector to transfer data to LCD panel.
$\overline{SS}$ GPIO	$\overline{SS\_SEL}$	Selects dedicated SS input source to MCU_23 (SS) on MCU PORT connector to transfer data to LCD panel.
MOSI / MISO / SCK	LCD_EN	Connects dedicated SPI signals to LCD port.
ADJ / FIX	CONTRAST	Selects fixed LCD contrast voltage
MONO8 COM	COM_SEL	Selects RS-232 communications for project board COM port.
CTS / RTS / RXD / TXD	COM_EN	Enables all RS-232 communication signals individually for project board COM port.
AMPL	AMPL	Oscillator output at reduced amplitude – 3.3 Vpp
LED_EN	LED_EN	Enables all LED outputs on project board.
BZ / PB / LED / POT	UFEA	Enables access to direct connect features for buzzer, four push buttons, four LEDs, and potentiometer to MCU PORT connector to simplify circuit connections and emphasize software development.
RXD / TXD	MCU_COM	Connects dedicated SCI signals to COM port.

4.2.3 Installing the Application Module

1) Install the application module in the MCU PORT connector (J5) on the project board. Align pin 1 on the application module with pin 1 of the MCU PORT connector on the project board as marked by Figure 4.
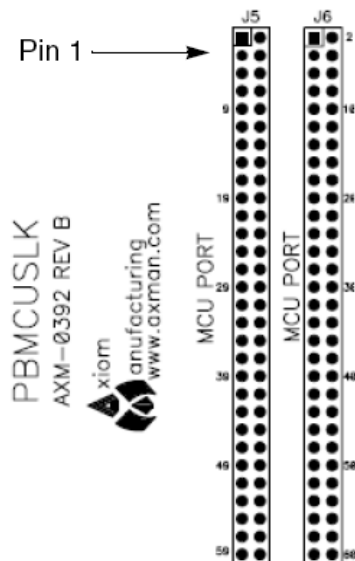
Figure 4. Installation of Application Module

2) Power up your host PC and connect one end of the supplied USB cable between an available USB port on your host PC.

3) Connect the other end of the USB cable to the USB connector on the project board. Figure 5 illustrates the USB connector on the project board for the BDM Multilink pod interface to power, program, erase, and debug the application module board.
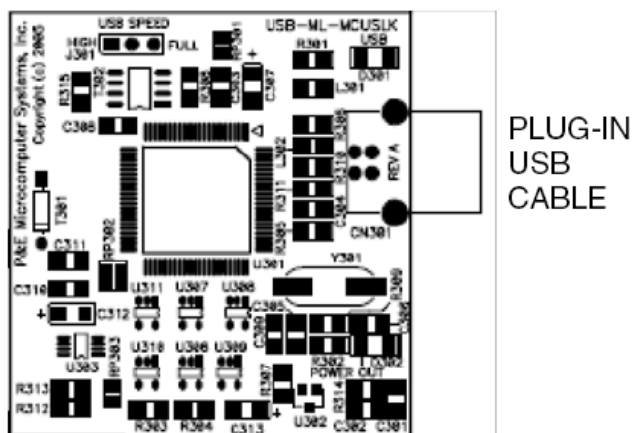
Figure 5. Installation of USB Cable

4.3 Windows Operating System Hardware Detection

NOTE

Steps 1 through 4 are a one-time, required procedure per host PC that you intend to use with the project board and can be skipped on subsequent uses of your project board.

1) Once you plug in the USB cable to the hardware Windows will detect the new hardware and launch the "Found New Hardware Wizard".

2) If you have installed the latest version of CodeWarrior prior to this step, simply follow the prompts provided by Windows to automatically detect new hardware as illustrated by Figure 6 and prompt you to install software for USB Multilink 2.0 or Turbo BDM.

Figure 6. Found New Hardware Wizard (Screen 1)

3) Select Install the software automatically (recommended) from the Found New Hardware Wizard and click Next to continue with installation.

4) Installation will begin with the Found New Hardware Wizard (Screen 2) illustrated by Figure 7. No user action necessary until software is completed installing.

Figure 7. Found New Hardware Wizard (Screen 2)

5) Successful installation is verified by Found New Hardware (Screen 3) illustrated by Figure 8. Click Finish to complete installation and close the wizard.

Figure 8. Found New Hardware Wizard (Screen 3)

6) Validation that the USB is properly installed can be done by verifying that the VDD LEDs, and USB status lights are lit.

7) The hardware is now ready for development and use.

5 Running the Demonstration Application

By default the Application Module is configured and programmed for independent operation. By correctly following the previous chapters you should now be able to.

   I)   Press PB1 on the application module to illuminate LED1.

   II) Press PB2 on the application module to illuminate LED1.

   III) Observe LED4 blinking at a periodic rate.

   IV) Connect a DB9 cable between HOST PC and Application Module to observe serial communications.

      i)   Host PC terminal settings

         Baud: 9600, Data Bits: 8, Parity: None, Stop Bits: 1, Flow Control: None

NOTE
To "un-embed" this code and/or running a demonstration application with the Project board read the next section.

5.1 Demonstration Application Source Code and Project Board Demonstration Application

2) Browse to www.freescale.com and search for UVP_S12_DEMO

3) Unzip and extract UVP_S12_DEMO.zip to a directory on your PC.

4) From the location that you extracted the files to, open the UVP_S12_DEMO folder. Double-Click on "UVP_S12_DEMO.mcp" file.

NOTE
If you have multiple versions of CodeWarrior installed you must open the .mcp file from within the correct version of CodeWarrior. Double-Clicking will open your project with the last version of CodeWarrior installed on the PC.

5) From the Drop-Down Menu select a Target Application as shown in Figure 9. For a list of target options and descriptions see Table 1.
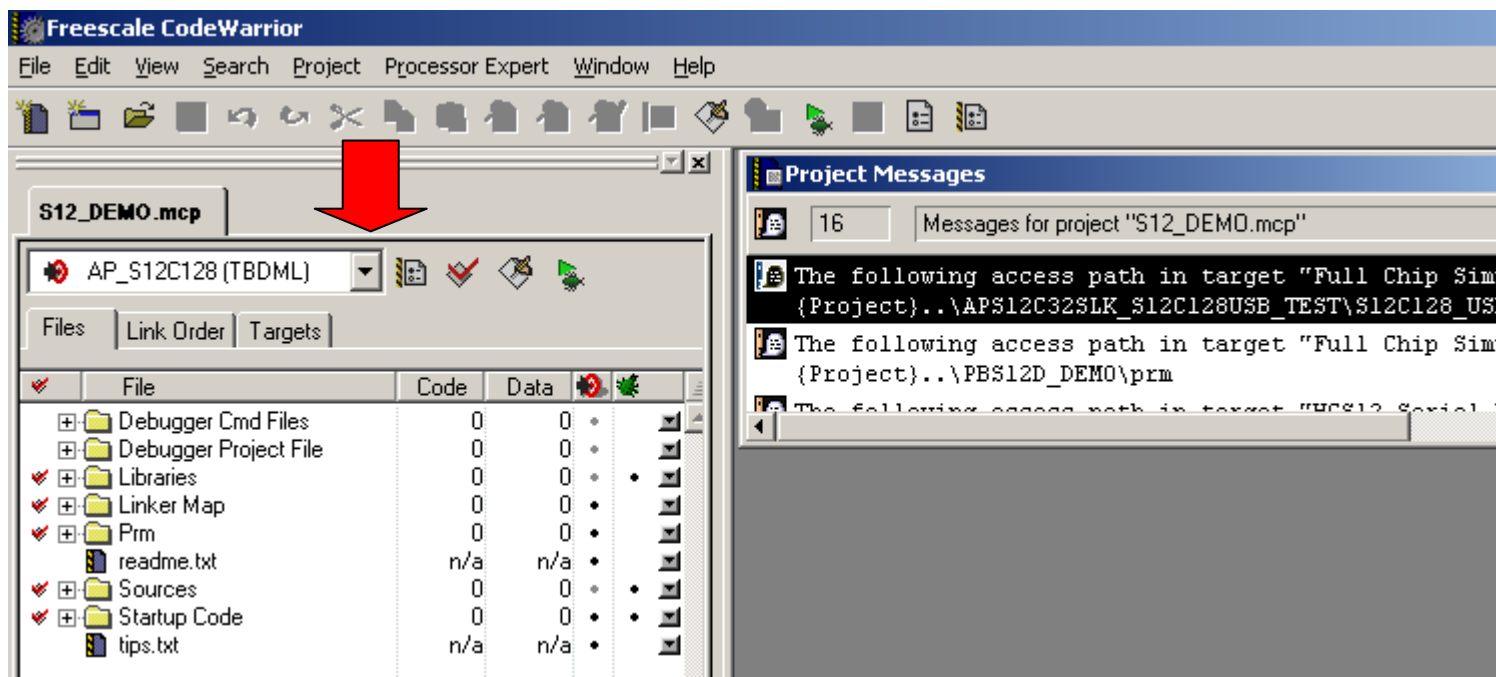
Figure 9. CodeWarrior Target Selection

Table 1. Project Target Options and Descriptions

AP_S12C128SLK	To use the HCS12C128 Application Module features independently
AP_S12DT256SLK	To use the HCS12DT256 Application Module features independently
AP_S12XDT512SLK	To use the HCS12XDT256 Application Module features independently
PB_S12C128SLK	To use the HCS12C128 Application Module connected to the Project Board
PB_S12DT256SLK	To use the HCS12DT256 Application Module connected to the Project Board
PB_S12XDT512SLK	To use the HCS12XDT256 Application Module connected to the Project Board

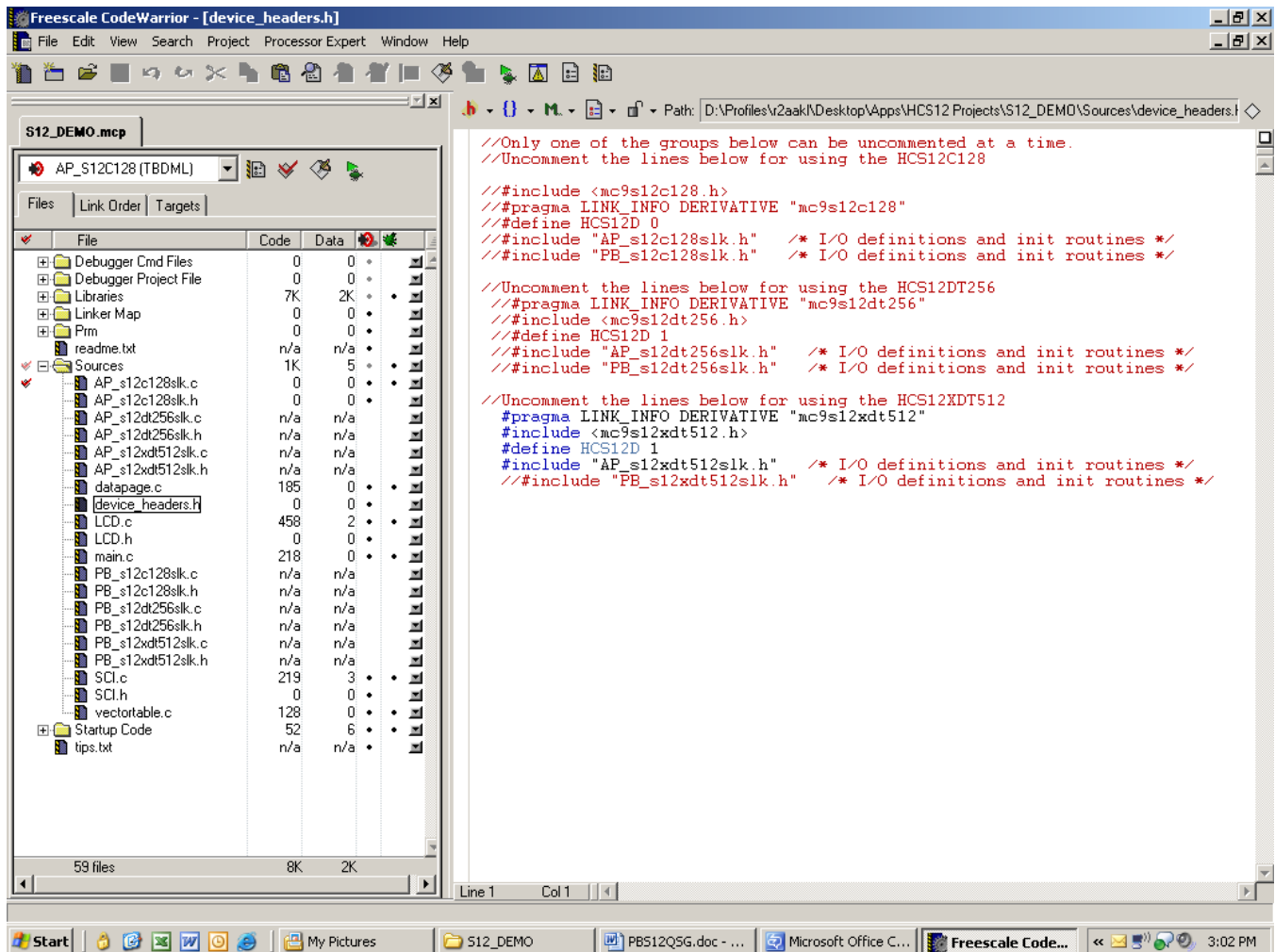6) Expand the Sources Folder and double-click the device_headers.h file as show in Figure 10 below.


Figure 10. Changing Device_header.h file

7) Based on which HCS12 you are using you will need to uncomment the respective sections. Follow the instructions provided in the device_headers.h file.

8) When you have the proper target selected and the device_headers.h file modified, Click the Run Debug [button] button to compile, program, and launch the real-time debugger.

NOTE
Disregard the Warnings messages after you click this button. Due to the nature of multiple target references not all the source code is used, and therefore generates several warning messages.

9) In the debugger window, shown in Figure 11, click the RUN button [button] to run the application in the debugger.
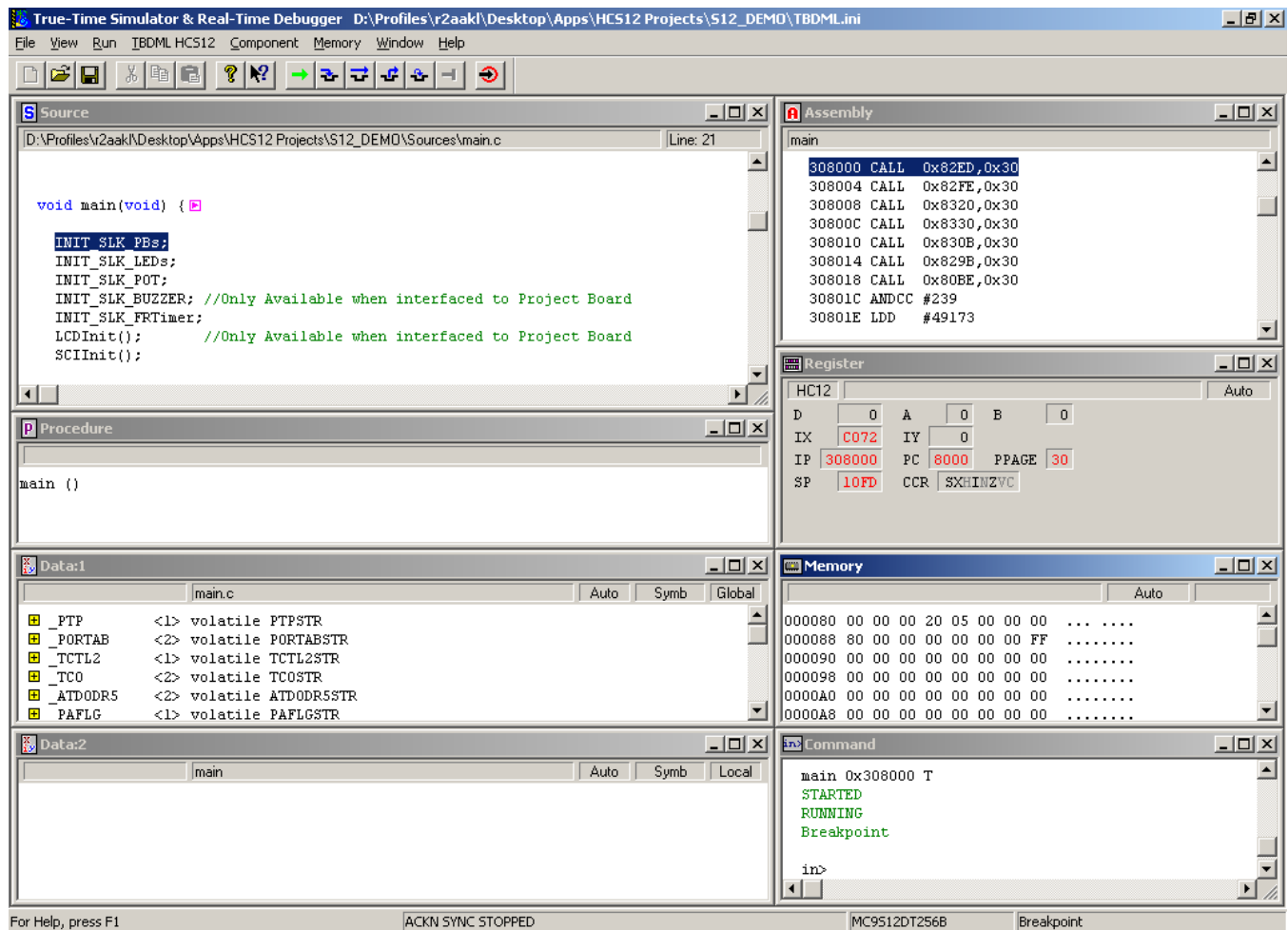
Figure 11 CodeWarrior Debugger Window

10) If you are using one of the PB_ applications demonstrations at this time you should be able to:

I)   See the LCD on the Project Board displaying a message

II) Press PB1 on the project board to illuminate LED1 and see the LCD display a new message.

III) Press PB2 on the project board to illuminate LED2 and see the LCD display a new message.

IV) Press PB3 on the project board and adjust the potentiometer. The buzzer is enabled with a preset frequency and the potentiometer value is sampled to control the volume of the buzzer while the button is pressed. Also, note that while pressed the LCD display is now a new message.

V) Press PB4 on the toggle LED4 on/off. (**Can you see the switch bounce? View our online CourseWare to find out ways to eliminate switch bounce.)

6 Custom Software Development

The sections below walk you through the steps to create a blank project to begin your own programming with.

6.1 Creating and Building a Project in CodeWarrior Environment

1) Launch the CodeWarrior IDE
   a) Select: Start > Programs > Freescale CodeWarrior > CW for HC12 V4.5; a menu will appear
   b) Select: CodeWarrior IDE. IDE will start and a CodeWarrior window will appear

Create a new project

2) From the IDE main menu bar, select: File > New; a new window will appear as seen in Figure 12.
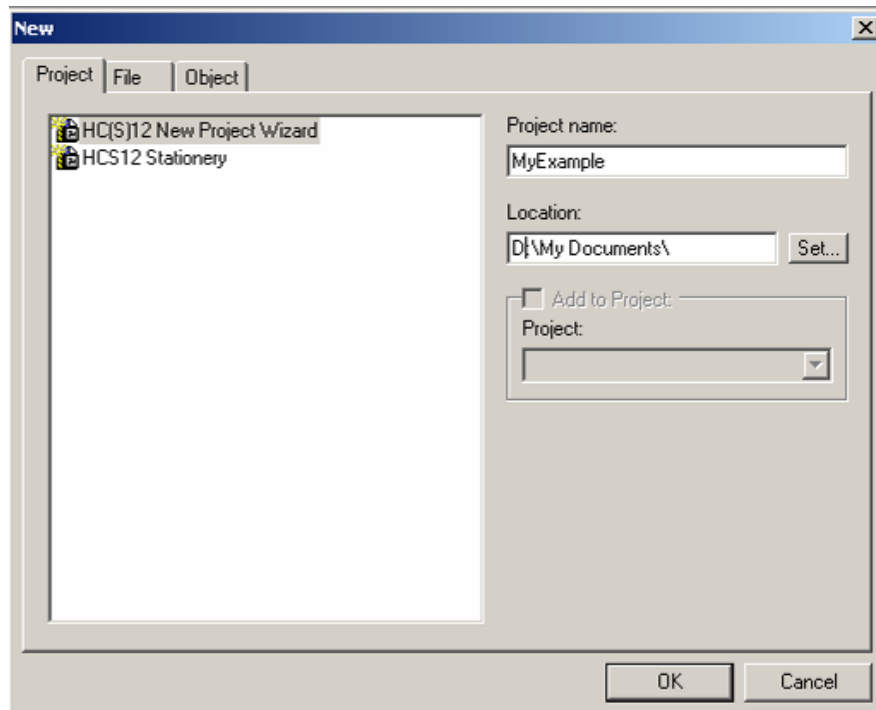
Figure 12. CodeWarrior New Project Window

   a) Select: HC(S)12 New Project Wizard.
   b) In the Project name text box, type the name you want to give the project. IDE automatically adds .mcp extension when it creates project.
   c) In the Location text box, set location where you want the project to be created.
   d) Click OK — the first page of the new project wizard will appear explaining to you how the project wizard works, proceed to the second page by clicking OK again (see Figure 13)
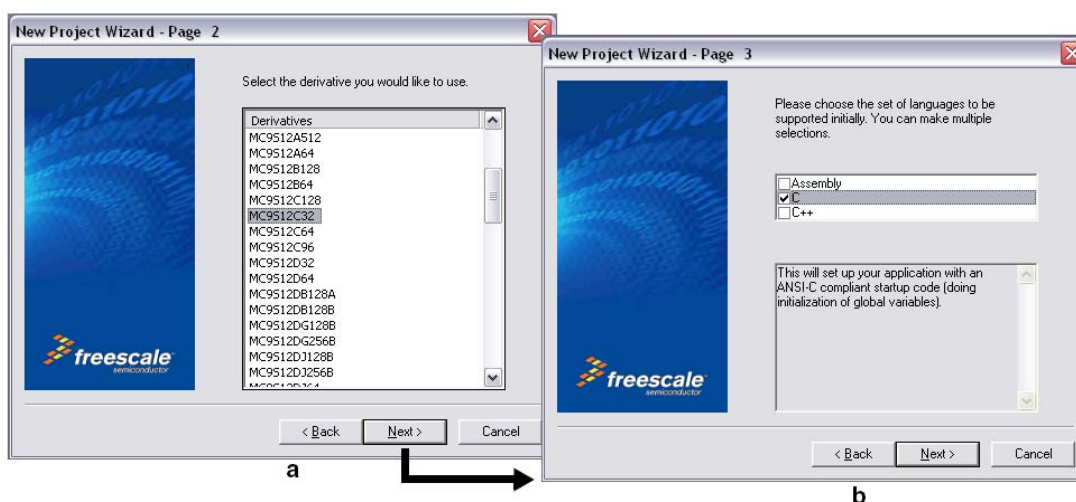
Figure 13. CodeWarrior New Project Wizard - Page 2 and Page 3

e) Select your microcontroller.

f) Click Next — page 3 of the new project wizard will appear (see Figure 13).

g) Make sure C checkbox is marked. If you are using assembly or C++, mark the respective selection.

h) Click Next — page 4 of the new project wizard will appear (see Figure 14).
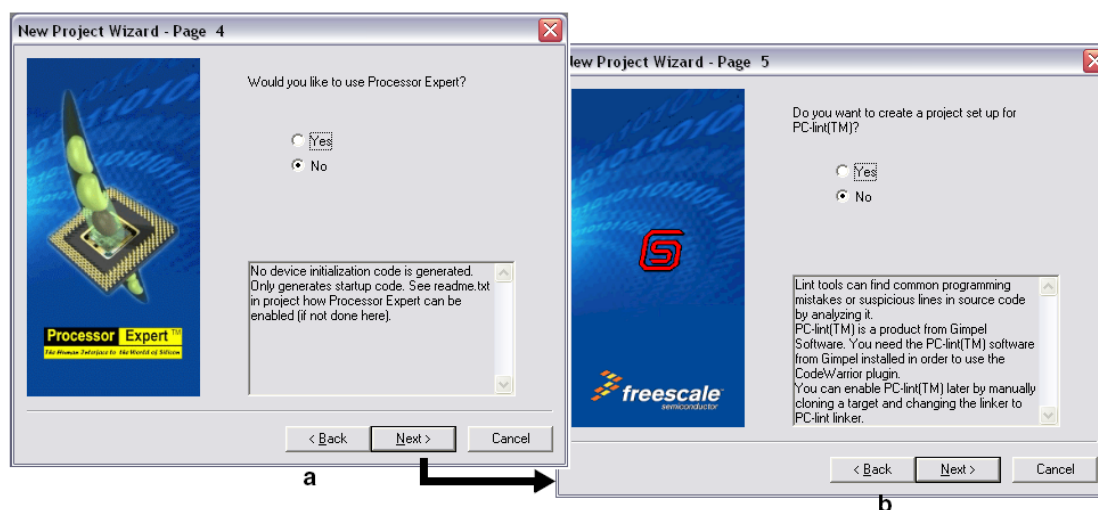
Figure 14. CodeWarrior New Project Wizard Page 4 and Page 5

i) Select No, you do not want your project configured with Processor Expert.

j) Click Next — page 5 of the new project wizard will appear (see Figure 14).

k) Select No, you do not want your project configured to work with PC-lint.

l) Click Next — page 6 of the new project wizard will appear (see Figure 15).
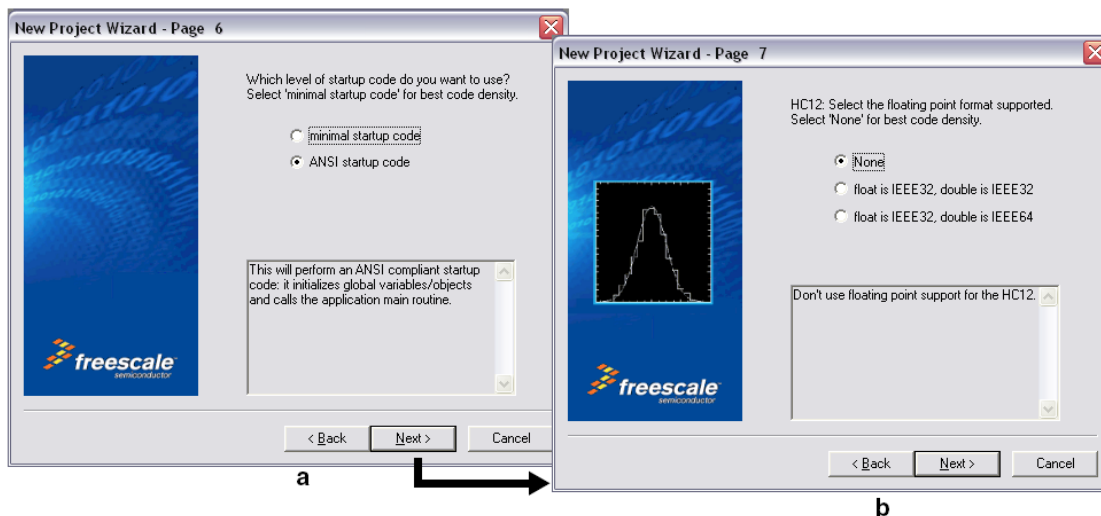
Figure 15. CodeWarrior New Project Wizard Page 6 and Page 7

m) Select ANSI startup code.

n) Click Next — page 7 of the new project wizard will appear (see Figure 15).

o) Select None, you do not want to specify a floating point format.

p) Click Next — page 8 of the new project wizard will appear (see Figure 16).

q) Select Small memory model

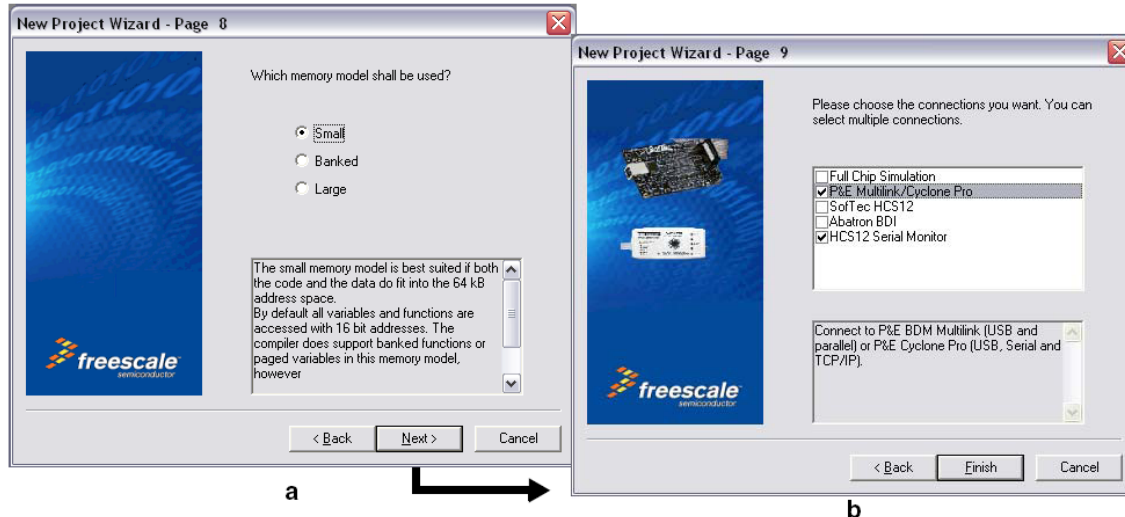r) Click Next — page 9 of the new project wizard will appear (see Figure 16)

Figure 16. CodeWarrior New Project Wizard Page 8 and Page 9

s) Page 9 allows you to specify connections that the project should be configured to support.

NOTE
Select as many connections as you would like! Having more than one selection does not impact your compiled code size.

t) Select P&E Multilink/Cyclone Pro and HCS12 Serial Monitor.

u) Click Finish — the wizard creates a new project based on information you specified. A project window will appear, docked at left side of main window (see Figure 17).
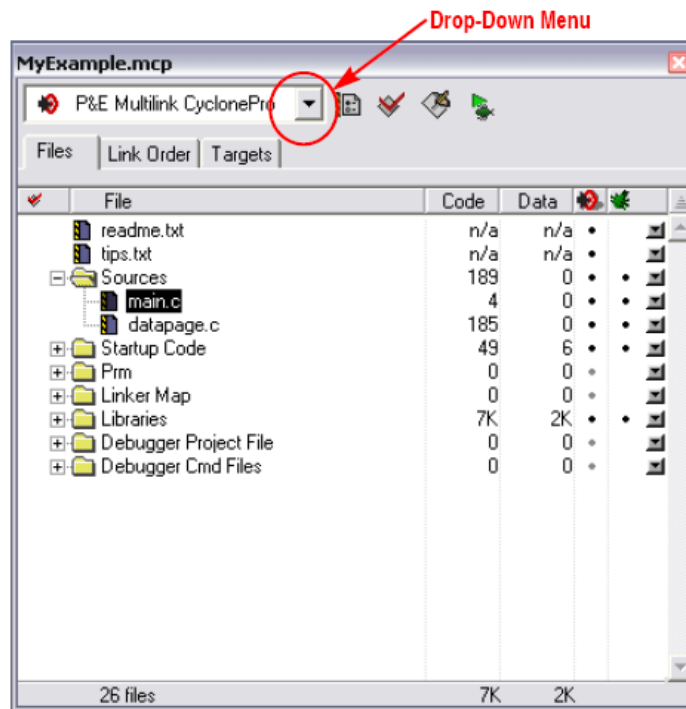
Figure 17. CodeWarrior Project Window

NOTE

To undock the project window, double-click the docking handle (double gray lines at top of the project window). To re-dock window, right click in title bar of project window, and select Docked.

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1) Select Build Target.

Your project can contain multiple build targets. For this example, we use the P&E Multilink CyclonePro target, which uses the USB BDM pod on the project board. This BDM pod provides bidirectional communication between the microcontroller and the debugger.

a) Click the drop-down menu of the project window (see Figure 17).
b) Select P&E Multilink CyclonePro.

2) Edit source code.
a) Click the + sign next to the sources folder to reveal files (see Figure 17).
b) Double-click the main.c file. An editor window will open and display the contents of main.c similar to that shown (see Figure 18)
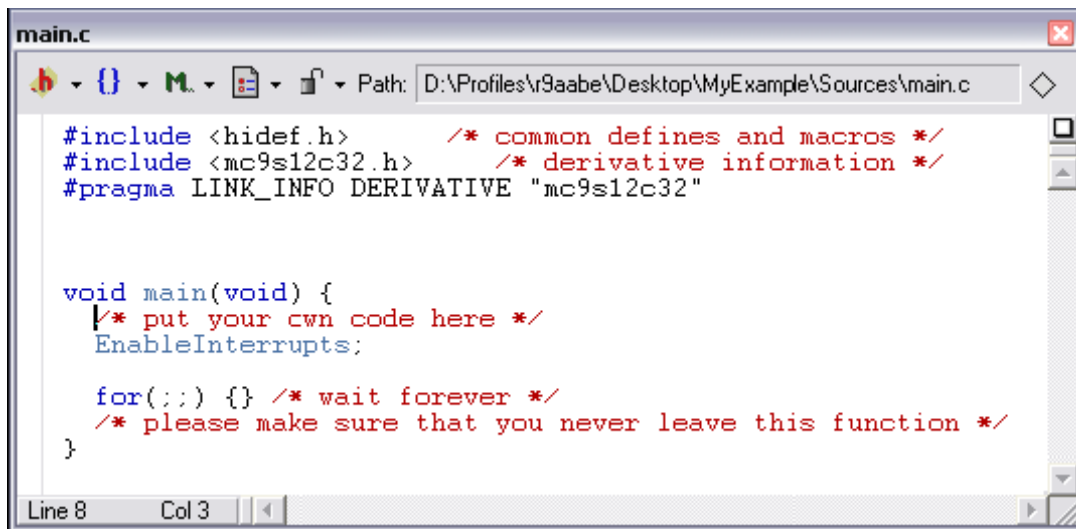
Figure 18. Example Editor Window - main.c

    c) Make changes to the contents of main.c file, if desired.

    d) If you make changes to main.c, from IDE main menu bar, select File > Save.

3) Add files (if appropriate).

    a) Highlight the Sources folder.

    b) From the IDE main menu bar, select Project; a menu will appear.

    c) Select Add Files. A dialog box will appear.

    d) Navigate to the directory that contains the file you want to add.

    e) Highlight the filename of the file you want to add to your project.

    f) Click Open — the Add Files dialog box will appear.

    g) Check the checkbox for each build target to which the file applies.

    h) Click OK — the Add Files dialog box closes. In the Project window, the filename of added file will appear under the Sources folder.

4) Build project.

    a) From the IDE main menu bar, select Project.

    b) Select Make. IDE builds (assembles, compiles, and links) project. Error and warnings window will open and show error messages and warning messages, if appropriate.

6.2 Debugging your Application

The following steps explain how to establish communication and upload your application software to the application module. This will allow you to debug your application through CodeWarrior True-Time Simulator & Real-Time Debugger using the BDM pod interface on the project board. "Software Setup" and "Hardware Setup" sections described earlier must be completed before executing the steps in this section.

1) Make sure power is applied to the project board. If not, go back and complete hardware setup section instructions.

2) Start debugger.

    a) From the main menu bar in CodeWarrior IDE, select Project.

    b) Select Debug — the Debugger window will open in MultilinkCyclonePro target.

    c) You will be prompted by a Loader Warning window that the debugger will mass-erase and program the microcontroller with your application. Click OK to continue.

NOTE

If prompted by debugger with a communication setup window, select the appropriate host PC USB port being used by the BDM pod and click OK.

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    d) Once the debugger is launched a window similar to Figure 19 will appear. The operation of the various sub windows is listed in Table 2 on the subsequent page. The configuration of sub-windows can be user configured and saved using File->Save Workspace
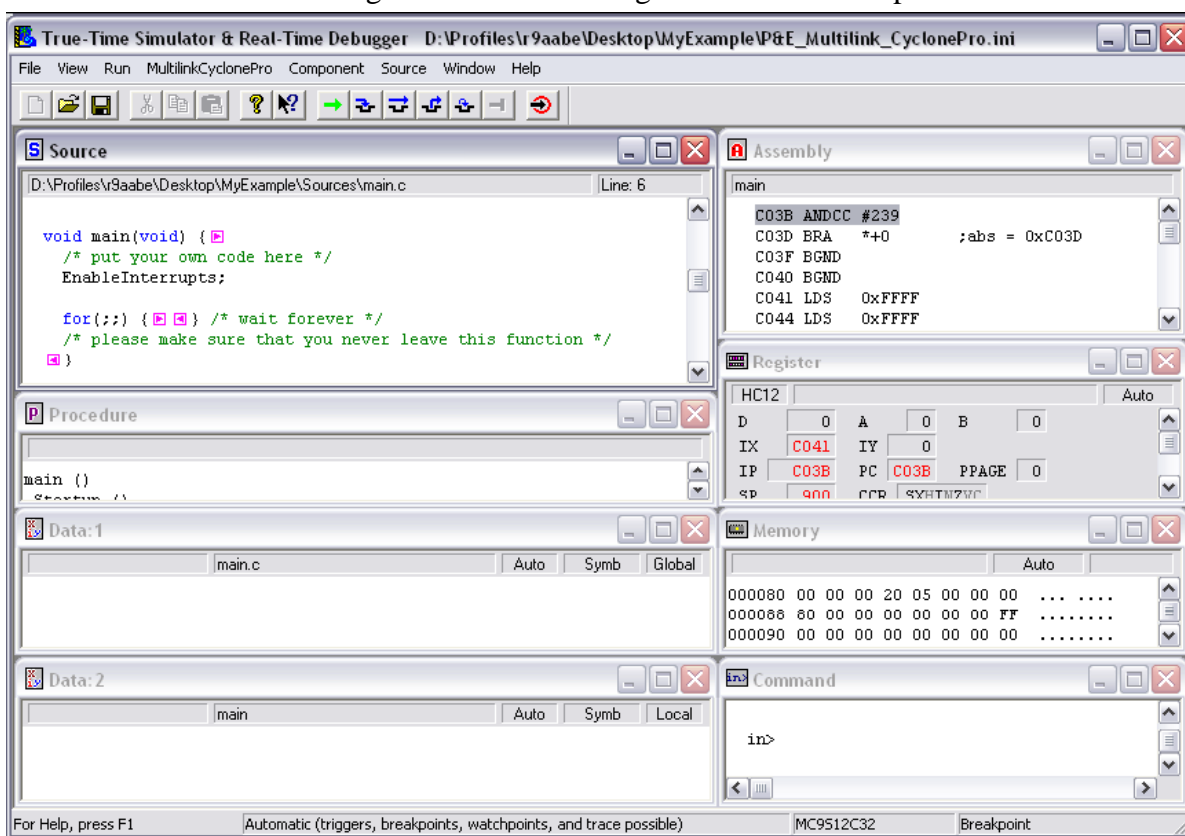
Figure 19. CodeWarrior Debugger Window

Table 2. Debugger Window Descriptions

Window Name	Description
Source and Assembly	Display programmed application software in C and assembly programming languages, respectively
Register	Displays the MCU internal registers
Memory	Displays the active value at each memory address in the MCU internal memory map

Procedure	Displays the active procedure being evaluated
Data 1 and Data 2	Display and global or local variables in your application software and their active value.
Command	Allows user control and log command execution

3) Reset the target by clicking on the reset target icon.

4) Right-click anywhere in the Source window and select Open Source File. The Source Files menu will appear. To view between source files in your application software, select the appropriate file in the menu, then click OK.

5) Right-click on executable line of source code in Source window to set breakpoints or triggers in program code.

6) Run application.

   a) From debugger main menu, select Run — the Run menu will appear.

   b) Select Start/continue; program will execute until encountering first breakpoint, if breakpoint is present. Command pane displays program status.

NOTE

Alternatively, you can click on start/continue icon in the debugger taskbar

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7) Click start/continue icon, , to resume program code execution (if breakpoint occurred) or click halt icon, , to stop program execution.

NOTE

The debugger taskbar includes other icons for debugging which allow single step , step over , step out , assembly step , and reset target functions.

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8) In the debugger window tool bar, select: File > Exit (to exit debugger).

9) In the IDE main window tool bar, select: File > Exit (to exit CodeWarrior IDE).

Congratulations — You have successfully developed a project using CodeWarrior development tools with your project board and application module.

7 Revision History

Version	Date	Revised By	Description of Changes
0	9/2007	r2aakl	Initial Revision

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