

Getting Started with the Microcontroller Student Learning Kit (MCUSLK)

Using the MC9S12C32 MCU Application Module (CSM-12C32)

By **Eduardo Montañez**
Applications Engineering
Austin, Texas

By **Spencer Ruggles**
Axiom Manufacturing
Garland, Texas

Overview

This document will guide you through all the steps necessary to begin development on an HCS12 Family microcontroller unit (MCU) using your MCUSLK. The software setup section will assist you install the Metrowerks' CodeWarrior software and necessary software to support your MCU Project Board – 2. The hardware setup section will walk you through configuring the MCU Project Board – 2 for use with the MC9S12C32 MCU application module (Axiom's CSM12C32). The development section will show you how to create, build, and debug your application. Refer to the MCU Project Board – 2 user guide, MC9S12C32 MCU application module user guide and Metrowerks' CodeWarrior documentation for details.

Software Setup

The following software installation is a one-time, required procedure per host PC that you intend to use with the MCU Project Board – 2. After completing the software setup section on your host PC, you can then skip the software section on subsequent uses of your project board and begin with the hardware setup or development sections.

1. To install and register CodeWarrior development tools for HC(S)12 MCUs onto a host PC, follow the instructions outlined in sections A, B, and C of the CodeWarrior Development Studio for Freescale 68HC(S)12 Microcontrollers quick start pamphlet found inside the supplied 3-cd case labeled CodeWarrior Development Studio for HC(S)08 Special Edition and HC(S)12 Special Edition. Make sure to request the special edition license when registering.¹ The special edition license version of CodeWarrior is necessary for developing applications for the MC9S12C32 MCU application module board.
2. Install a CodeWarrior service patch labeled “**CW12_V3_1_ICD12_USB2_0_Sim_patch.exe**” located in the Service Pack CD found inside the supplied 3-cd case labeled CodeWarrior Development Studio for HC(S)08 Special Edition and HC(S)12 Special Edition. The patch is located under the **E:\HC(S)12\CW12_V3_1** directory in the Service Pack CD. Install by double-clicking on the file and by following the on-screen instructions.

NOTE

The CW12_V3_1_ICD12_USB2_0_Sim_patch.exe is REQUIRED for the USB multilink pod on the MCU Project Board – 2 to function with the Metrowerks CodeWarrior development tools and must be installed prior to the hardware setup section. Other patches included on the Service Pack CD are recommended if developing an application on a HC(S)12 microcontroller other than the MC9S12C32.

NOTE

Periodically check the corresponding development tool product page for patches and updates. For questions on CodeWarrior development tools, contact support@metrowerks.com

1. Registering will email you instructions for how to acquire the special edition license. After you acquire the special edition license, place it in the root CodeWarrior directory. If you encounter problems with registration, you can acquire your special edition license online at <http://www.metrowerks.com/MW/Develop/Embedded/HC12/Downloads>.

Hardware Setup

Unpack

1. Open the shipping carton and remove the contents. Verify that all packing list items have been received.
2. Inspect both the MCU Project Board – 2 and the MC9S12C32 MCU application module for any damage that may have occurred during shipping. If damage is found, contact the manufacturer at support@axman.com for assistance.

Configuring the MCU Project Board – 2

1. To begin, place the MCU Project Board – 2 on a flat sturdy surface. Ensure sufficient space is available around the project board to safely construct and test prototyped circuits.
2. Verify that all the factory default jumper settings are configured properly on the MCU Project Board – 2 as shown by [Figure 1](#). Highlighted blocks indicate the “on” or “installed” position of jumpers. Circles indicate the location on the project board where the jumpers are located. Table 1 summarizes the default state for the jumper settings. Please refer to MCU Project Board – 2 User Guide for more details and alternative configurations.

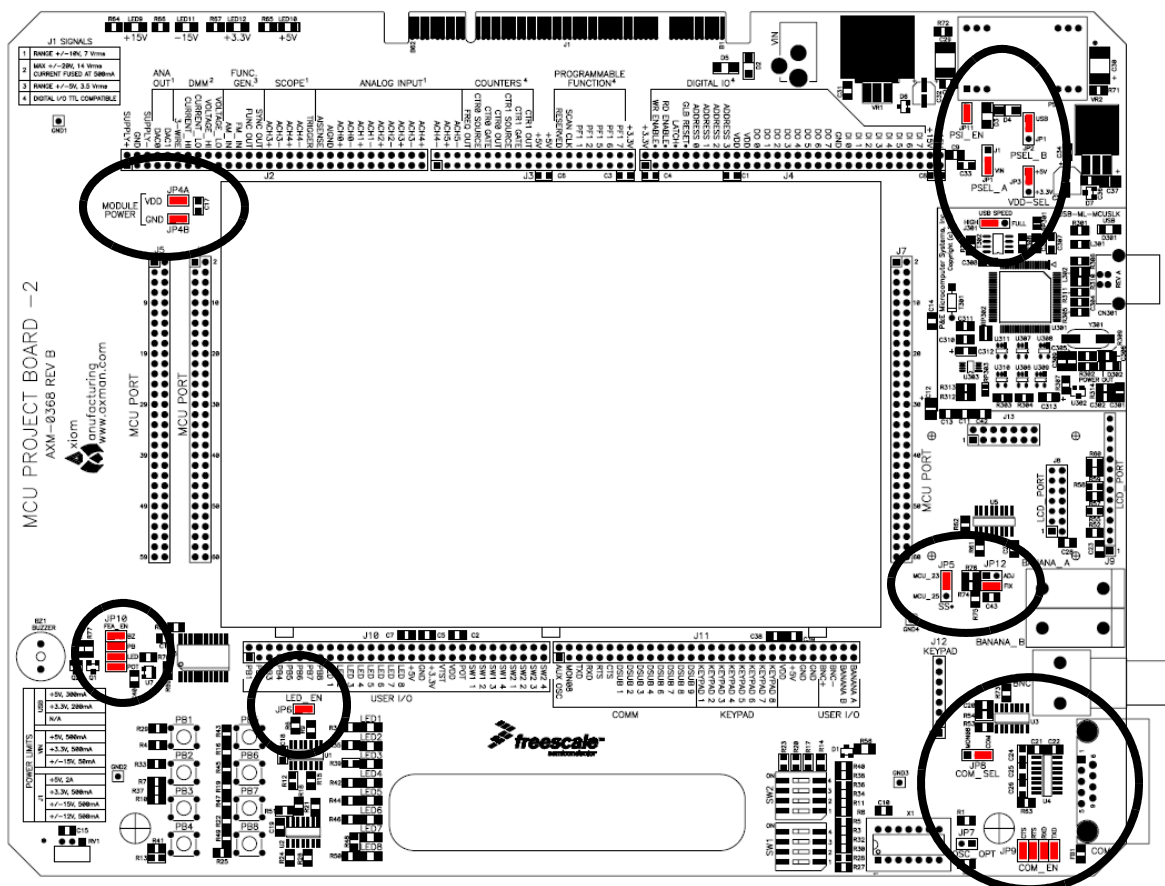


Figure 1. MCU Project Board – 2 Default Jumper Settings

Getting Started with the MCUSLK for MC9S12C32 Application Module, Rev. 0

Table 1. Summary of Default Jumper Settings (Sheet 1 of 2)









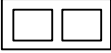



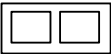

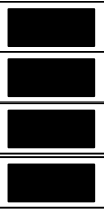
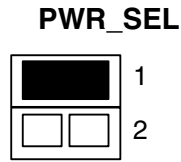
Jumper Position	Jumper ID	Description
PSEL_A  J1 VIN	JP1	Selects V_{In} (wall power transformer) as the default power source for the project board.
PSEL_B  USB JP1	JP2	Selects USB (power via USB cable from host PC) as the default power source for the project board. This jumper overrides PSEL_A in USB position.
VDD_SEL  +5V +3.3V	JP3	Sets V_{DD} to +5 V for project board.
PS1_EN 	JP11	Enables PS1 output (± 15 V supply from dc-dc converter) to the project board.
USB_SPEED  HIGH FULL	USB-ML -MCUSLK	Selects USB high-speed communications for the BDM Multilink pod on the project board. If the user encounters a communication failure, USB communication speed may be reduced by setting this option jumper to FULL.
MODULE POWER  VDD  GND	JP4A JP4B	Routes V_{DD} to MCU_1 and GND to MCU_3 to power a plugged in application module board on MCU PORT connector.
\overline{SS}  MCU_23 MCU_25	JP5	Selects dedicated \overline{SS} input source to MCU_23 on MCU PORT connector to transfer data to LCD panel.

Table 1. Summary of Default Jumper Settings (Sheet 2 of 2)

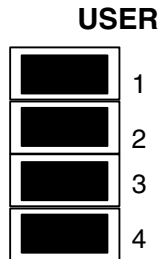
Jumper Position	Jumper ID	Description
CONTRAST  ADJ  FIX	JP12	Selects fixed LCD contrast voltage.
COM_SEL  MON08 COM	JP8	Selects RS-232 communications for project board COM port.
COM_EN  CTS RTS RXD TXD	JP9	Enables all RS-232 communication signals individually for project board COM port.
OSC_OPT 	JP7	Oscillator output at reduced amplitude – 3.3 Vpp.
LED_EN 	JP6	Enables all LED outputs on project board.
FEA_EN  BZ PB LED POT	JP10	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.

Hardware Setup

- Configure the MC9S12C32 MCU application module (CSM12C32) PWR_SEL option header. Install jumpers as shown.



- Configure the MC9S12C32 MCU application module (CSM12C32) USER option header. Install jumpers as shown below.



- Install the MC9S12C32 MCU 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 2.

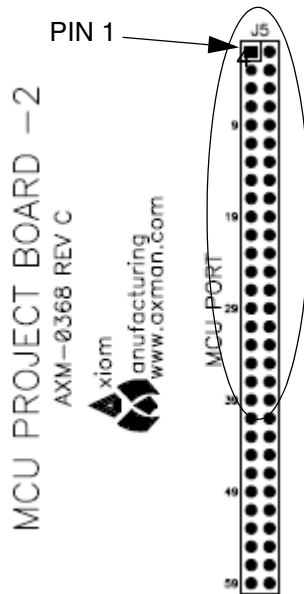


Figure 2. Installation of MC9S12C32 MCU Application Module

- Power up your host PC and connect the supplied USB cable to an available USB port on your host PC.

NOTE

Prior to executing the following steps, all CodeWarrior development tools for the HC(S)12 and USB 2.0 service patch software included in the CodeWarrior Development Studio for HC(S)08 Special Edition and HC(S)12 Special Edition 3-cd case must be installed per the instructions in the software setup section.

- Connect the other end of the USB cable to the USB connector on the MCU Project Board – 2. Figure 3 illustrates the USB connector on the project board for the BDM Multilink pod interface to power, program, erase, and debug the MC9S12C32 MCU on the application module board.

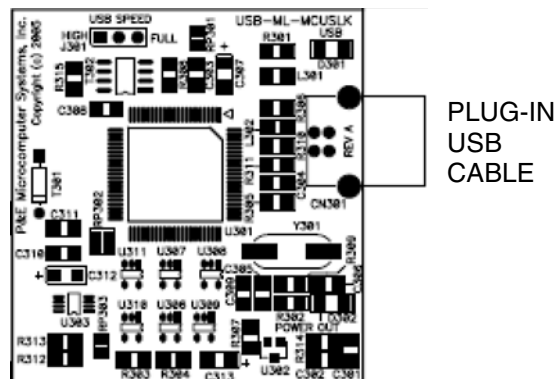


Figure 3. Installation of USB Cable

NOTE

Steps 8 through 11 are a one-time, required procedure per host PC that you intend to use with the MCU Project Board – 2 and can be skipped on subsequent uses of your project board.

- Allow your host PC to detect your new hardware. You will see a popup message in the task bar stating, “Found New Hardware.” Without any user action, the Found New Hardware Wizard will appear as illustrated by Figure 4 and prompt you to install software for USB Multilink 2.0.



Figure 4. Found New Hardware Wizard (Screen 1)

Hardware Setup

9. Select “Install the software automatically (recommended)” from the Found New Hardware Wizard (Screen 1) and click “Next” button to continue with installation.
10. Installation will begin with the Found New Hardware Wizard (Screen 2) illustrated by Figure 5. No user action necessary until software is completed installing.



Figure 5. Found New Hardware Wizard (Screen 2)

11. Successful installation is verified by Found New Hardware (Screen 3) illustrated by Figure 6. Click on “Finish” button to complete installation and close wizard.



Figure 6. Found New Hardware Wizard (Screen 3)

12. Verify that the +3.3 V LED, +5 V LED, and both green and yellow USB LEDs on the MCU Project Board – 2 are lit.
13. Verify that the V_{DD} LED on the MC9S12C32 MCU application module board (CSM12C32) is lit.
14. If the LEDs in steps 13 and 14 are not lit, make sure the jumper options are set as described in steps 2 through 6. Also, see the troubleshooting tips section in the MCU Project Board – 2 user guide.
15. The MCU Project Board – 2 and the MC9S12C32 MCU application module are now ready for use.

Development

Creating and Building a Project in CodeWarrior Environment

After properly installing and registering the CodeWarrior development tools as described in the [Software Setup](#) section, and completing the MCU Project Board – 2 configuration as described in the [Hardware Setup](#) section, you can now begin to develop your application for a target microcontroller. This section will create and build a project under the CodeWarrior for HC(S)12 development tool platform.

NOTE

The instructions below are slightly different from the steps described in the quick start pamphlet included in the CodeWarrior for HC(S)12 development tools CD case. The instructions below are adjusted for the MCUSLK and MC9S12C32 development module.

1. Launch the CodeWarrior IDE

- a. Select: Start> Programs> Metrowerks CodeWarrior> CW12V3.1; a menu will appear
- b. Select: CodeWarrior IDE; IDE will start and a CodeWarrior window will appear

2. Create a new project

- a. From IDE main menu bar, select: File> New; a new window will appear (see [Figure 7](#))

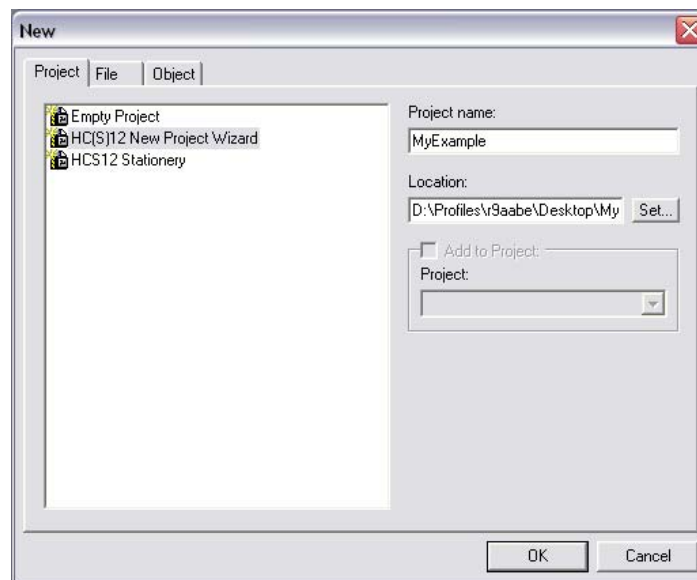


Figure 7. New Window

- b. Select: “HC(S)12 New Project Wizard”
- c. In the “Project name” text box, type the name you want to give the project (IDE automatically adds .mcp extension when it creates project)
- d. In the “Location” text box, set location where you want the project to be created
- e. Click “OK” — the first page of the new project wizard will appear (see [Figure 8a](#))

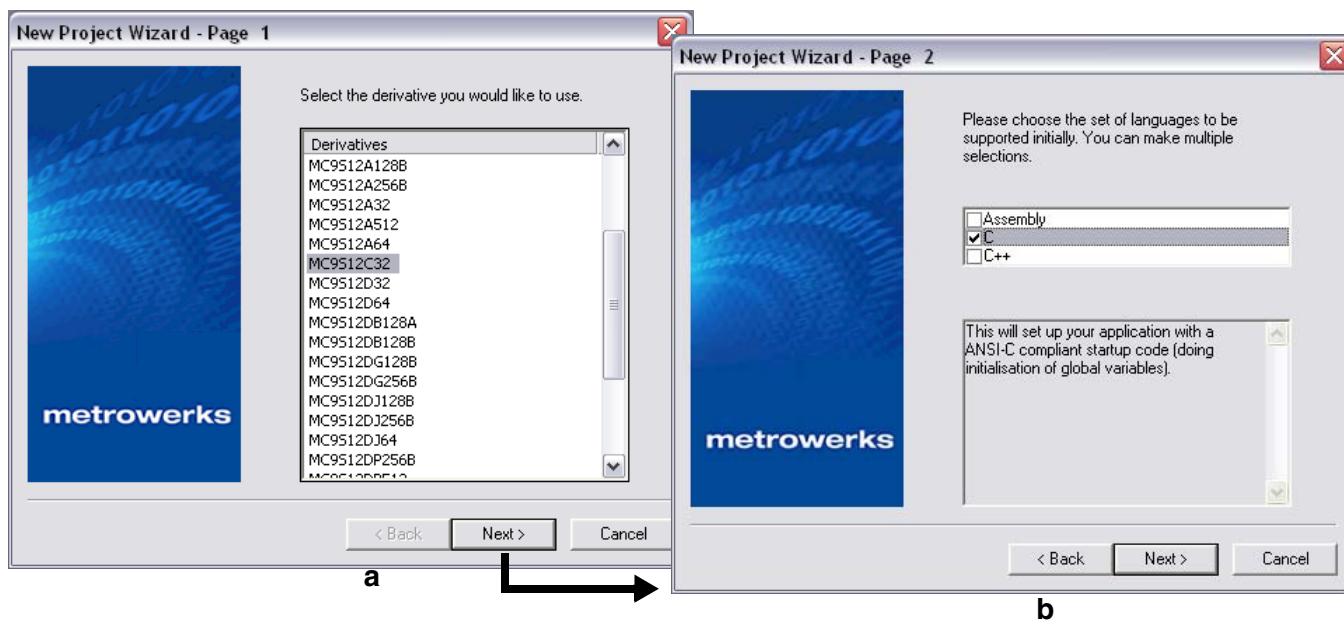


Figure 8. New Project Wizard — Page 1 and Page 2

- f. Select “MC9S12C32”
- g. Click “Next” — Page 2 of the new project wizard will appear (see [Figure 8b](#))
- h. Make sure “C” checkbox is marked (if using assembly or C++, mark the respective selection)
- i. Click “Next” — Page 3 of the new project wizard will appear (see [Figure 9a](#))

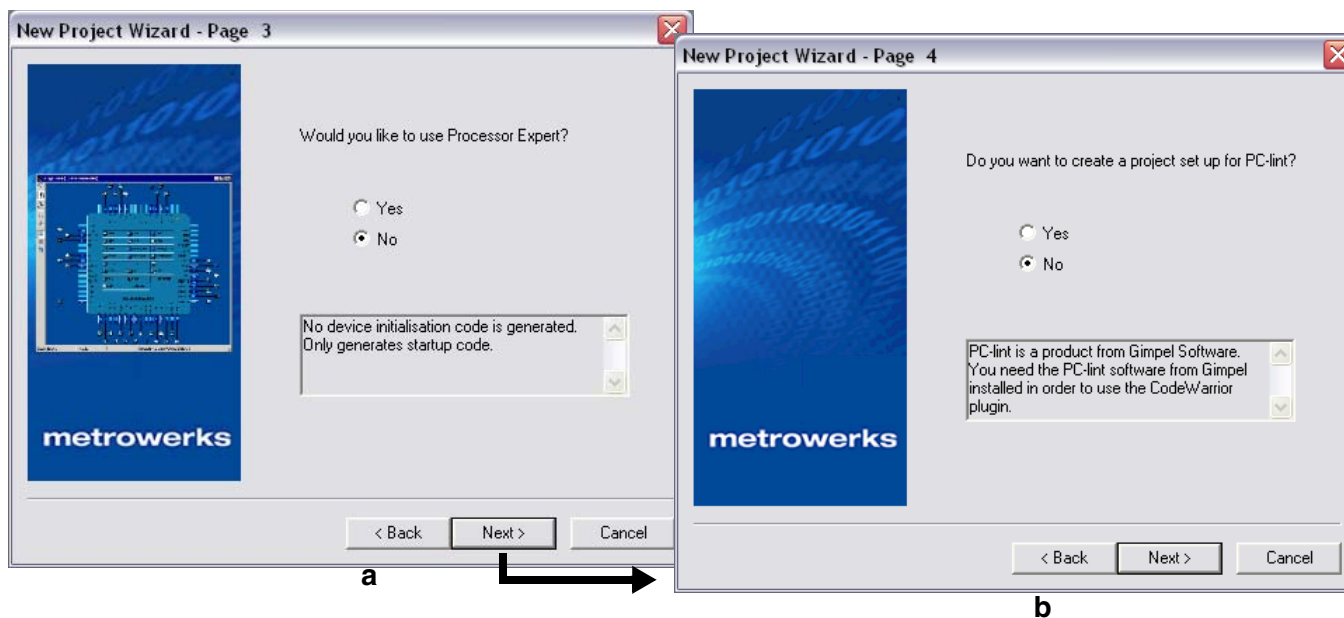


Figure 9. New Project Wizard — Page 3 and Page 4

- j. Select “No”, you do not want your project configured with Processor Expert
- k. Click “Next” — Page 4 of the new project wizard will appear (see [Figure 9b](#))
- l. Select “No”, you do not want your project configured to work with PC-lint
- m. Click “Next” — Page 5 of the new project wizard will appear (see [Figure 10a](#))

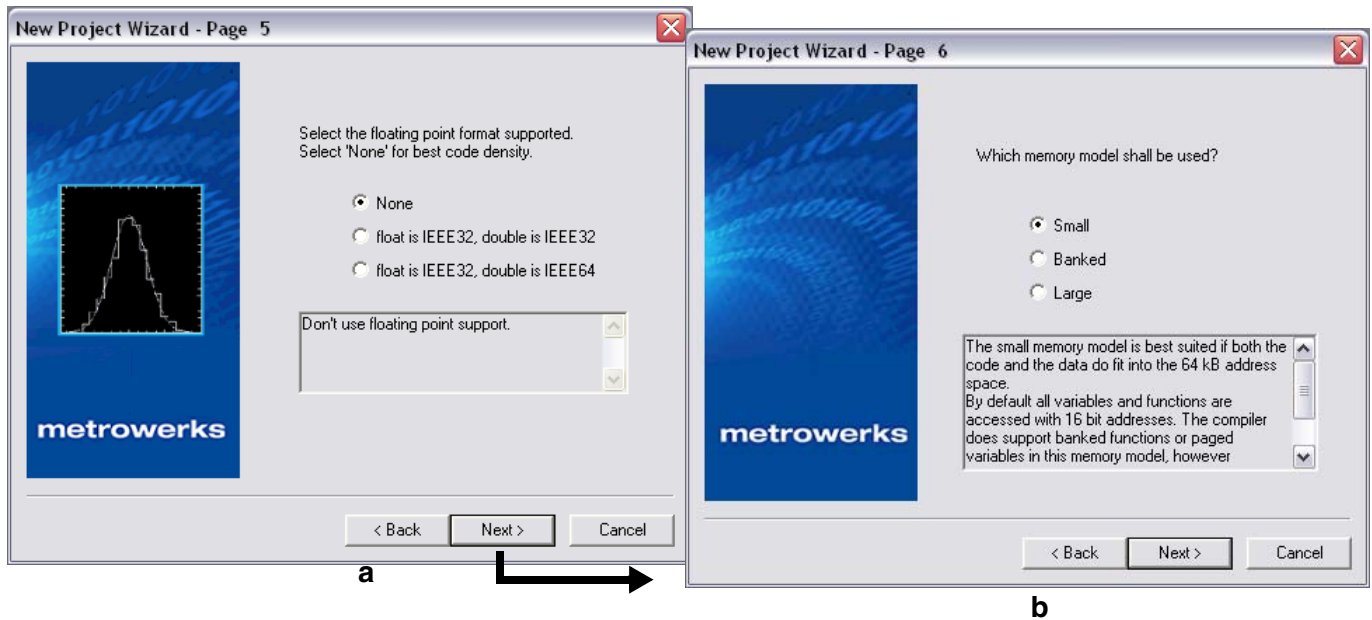


Figure 10. New Project Wizard — Page 5 and Page 6

- n. Select “None”, you do not want to specify a floating point format
- o. Click “Next” — Page 6 of the new project wizard will appear (see [Figure 10b](#))
- p. Select “Small” memory model
- q. Click “Next” — Page 7 of the new project wizard will appear (see [Figure 11](#))

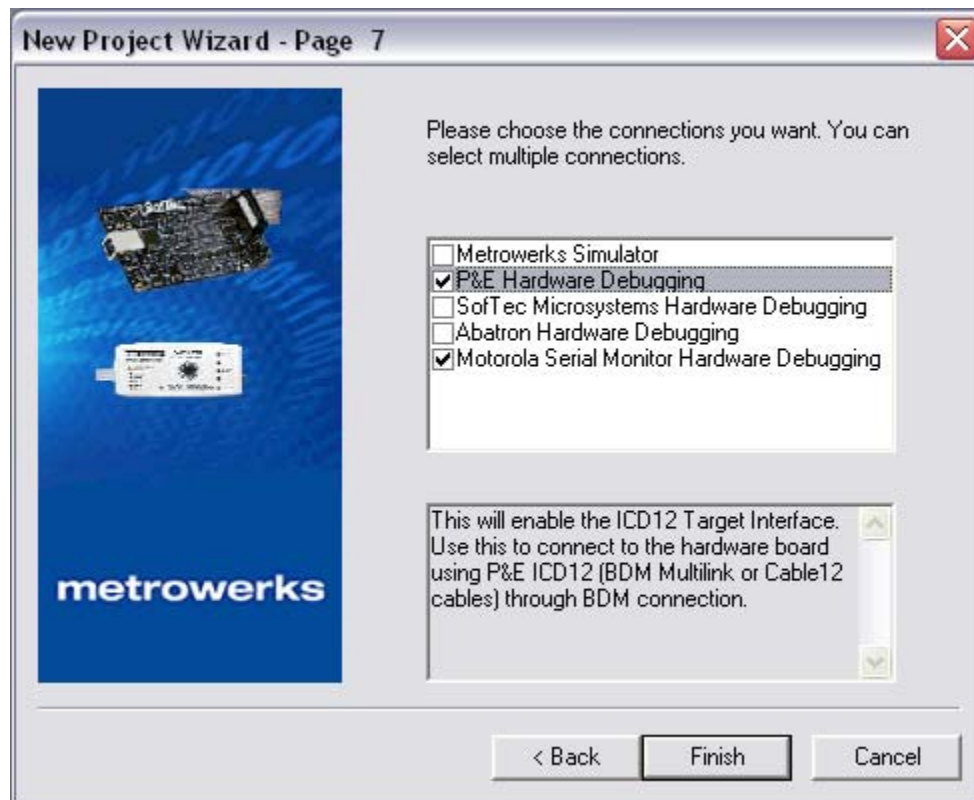


Figure 11. New Project Wizard — Page 7

- r. Page 7 allows you to specify connections that the project should be configured to support. Select “P&E Hardware Debugging” and “Motorola Serial Monitor Hardware Debugging”
- s. 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 12](#))

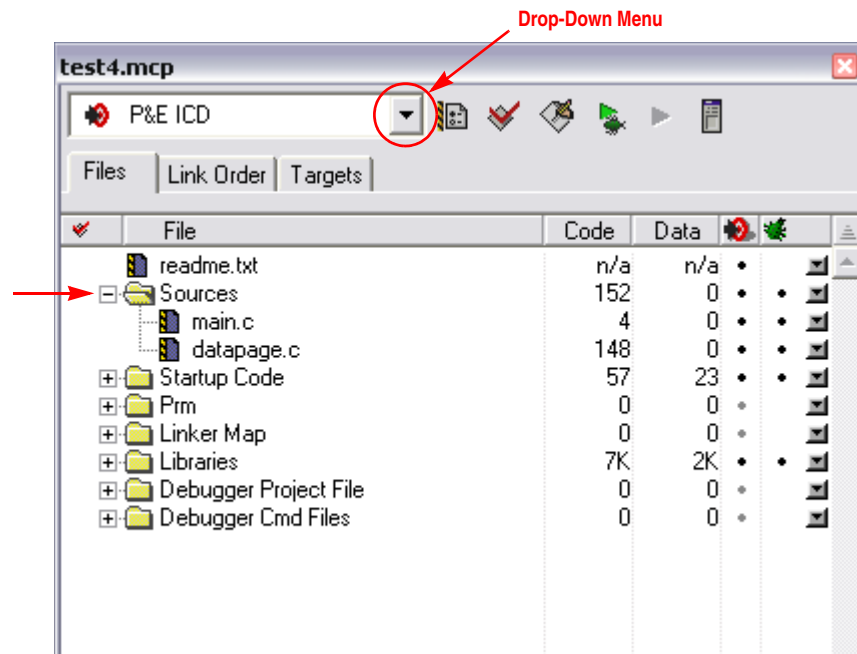


Figure 12. Project Window

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”.

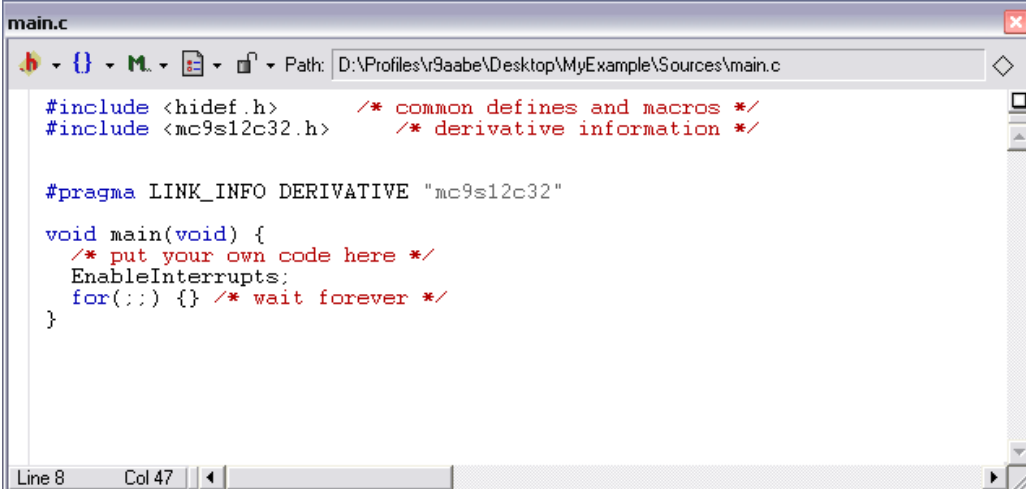
3. Select build target

Your project can contain multiple build targets. For this example, we use the P&E ICD target, which uses the USB BDM pod on the MCU Project Board – 2. This BDM pod provides bidirectional communication between the microcontroller and the debugger.

- a. Click the drop-down menu of the project window (see [Figure 12](#))
- b. Select “P&E ICD”

4. Edit source code

- a. Click the “+” sign next to the “sources” folder to reveal files (see [Figure 12](#))
- b. Double-click the main.c file; an editor window will open and display the contents of main.c



```

main.c
D:\Profiles\r9aabe\Desktop\MyExample\Sources\main.c

#include <hidef.h>      /* common defines and macros */
#include <mc9s12c32.h>  /* derivative information */

#pragma LINK_INFO DERIVATIVE "mc9s12c32"

void main(void) {
    /* put your own code here */
    EnableInterrupts;
    for(;;) {} /* wait forever */
}
Line 8 Col 47

```

Figure 13. main.c in Editor Window

- 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
- 5. 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 that 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
- 6. Build project**
- a. From 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

Debugging your Application

The following steps explain how to establish communication and upload your application software to the MC9S12C32 MCU application module (CSM-12C32). This will allow you to debug your application through Metrowerks’ True-Time Simulator & Real-Time Debugger using the BDM pod interface on the MCU Project Board – 2. The [Software Setup](#) and [Hardware Setup](#) sections 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 follow hardware setup section instructions.
2. Start debugger

Debugging your Application

- From the main menu bar in CodeWarrior IDE, select “project”
- Select “debug”; Debugger window will open in ICD-12 target

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”.

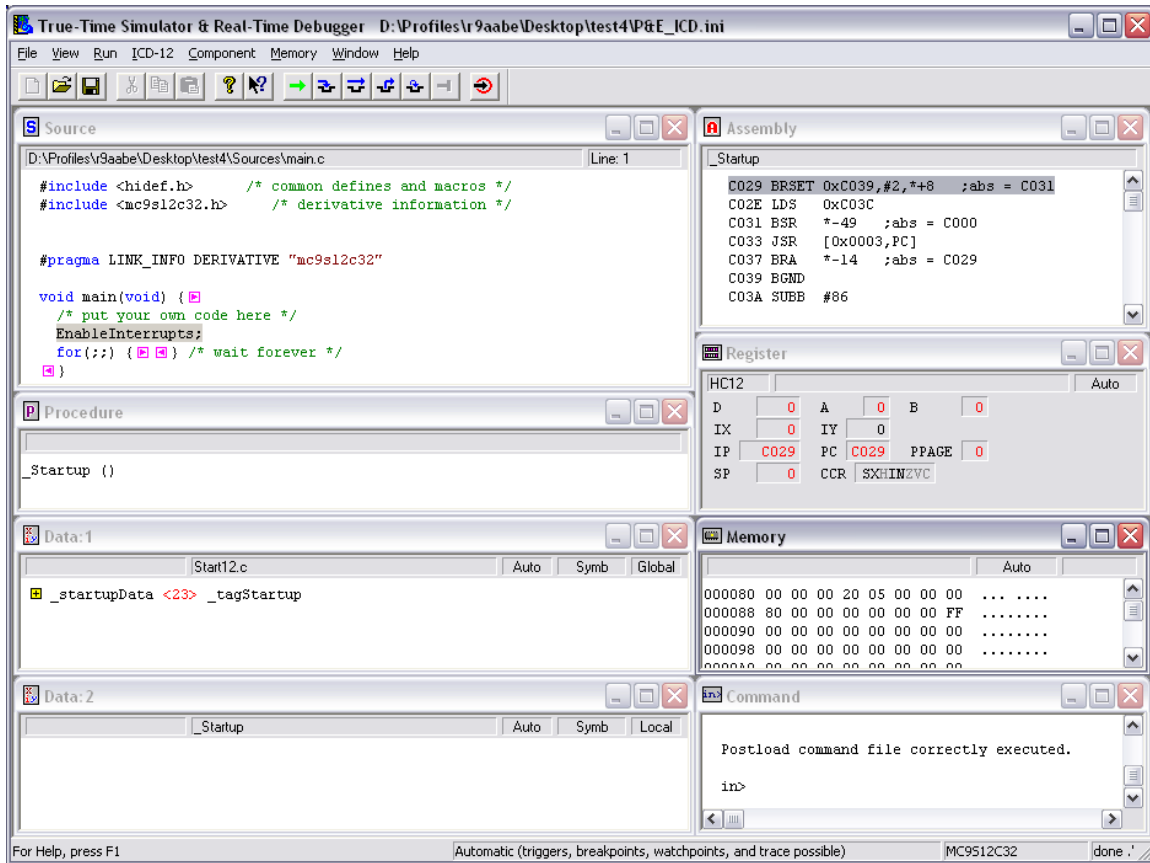


Figure 14. Debugger Window¹


Table 2. Debugger Windows

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


1. For a description of debugger windows, see [Table 2](#)



Table 2. Debugger Windows

Window Name	Description
Data 1 and Data 2	Display any global or local variables in your application software and their active value
Command	Allows user control and logs commands executed






3. Reset the target by clicking on the reset target icon, .
4. Right-click on “source” window and select “open source file”; “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”; “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

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.

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 Metrowerks CodeWarrior development tools and your MCUSLK!

How to Reach Us:

USA/Europe/Locations not listed:

Freescale Semiconductor Literature Distribution
P.O. Box 5405, Denver, Colorado 80217
1-800-521-6274 or 480-768-2130

Japan:

Freescale Semiconductor Japan Ltd.
SPS, Technical Information Center
3-20-1, Minami-Azabu
Minato-ku
Tokyo 106-8573, Japan
81-3-3440-3569

Asia/Pacific:

Freescale Semiconductor H.K. Ltd.
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T. Hong Kong
852-26668334

Learn More:

For more information about Freescale Semiconductor products, please visit <http://www.freescale.com>

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.
© Freescale Semiconductor, Inc. 2004.