ICDPPCNEXUS
MPC55xx / MPC56xx In-Circuit Debugger

Quick Start Guide

Document Version History

Version	Date	Notes
1.0	21 Sep 2009	Initial version

CONTENTS

1 Introduction

This document is a step-by-step guide to using the P&E ICDPPCNEXUS in-circuit debugger software, which is compatible with Freescale MPC55xx / MPC56xx processors. This guide covers the most commonly used features of the debugger: loading binary & debug information, accessing CPU registers & memory, stepping code, setting breakpoints, and monitoring variables.

1.1 P&E Compatible Hardware

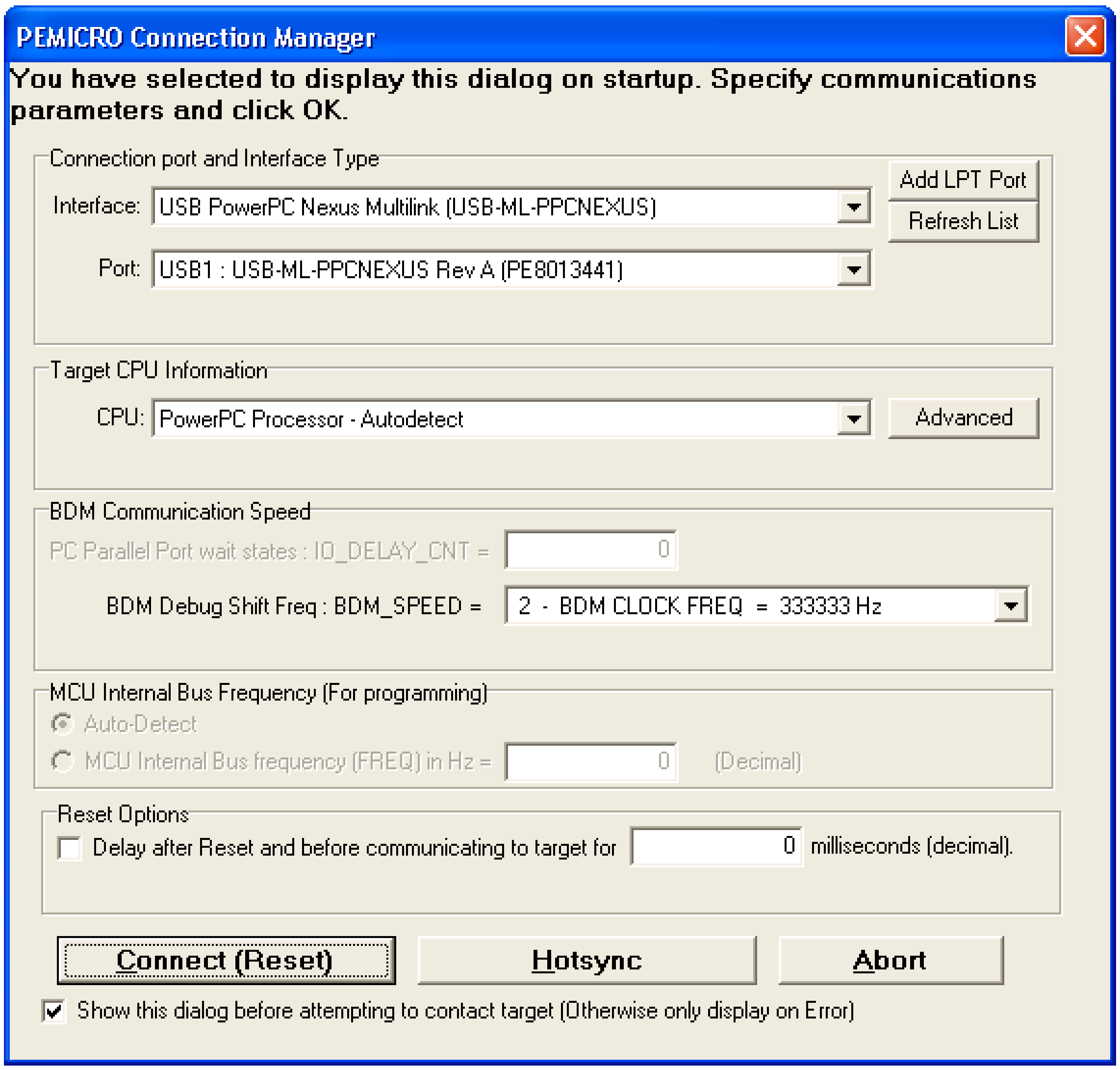
The following lists the P&E hardware compatible with the ICDPPCNEXUS debugger software.

P&E Part Number	**Interface to host PC**
CABPPCNEXUS	Parallel (LPT) port
USB-ML-PPCNEXUS	USB 2.0 (Backwards compatible with USB 1.1 ports)
Cyclone MAX	Serial (RS232) port USB 1.1 (Upwards compatible with USB 2.0 ports) Ethernet

2 Getting Started

2.1 Connecting to your Target

Upon starting the debugger, the connection assistant dialog appears:



PEMICRO Connection Manager

You have selected to display this dialog on startup. Specify communications parameters and click OK.

Connection port and Interface Type

Interface: USB PowerPC Nexus Multilink (USB-ML-PPCNEXUS)

Port: USB1 : USB-ML-PPCNEXUS Rev A (PE8013441)

Target CPU Information

CPU: PowerPC Processor - Autodetect

BDM Communication Speed

PC Parallel Port wait states : IO_DELAY_CNT = 0

BDM Debug Shift Freq : BDM_SPEED = 2 - BDM CLOCK FREQ = 333333 Hz

MCU Internal Bus Frequency (For programming)

[✓ Auto-Detect]

MCU Internal Bus frequency (FREQ) in Hz = 0 (Decimal)

Reset Options

☐ Delay after Reset and before communicating to target for 0 milliseconds (decimal).

☑ Show this dialog before attempting to contact target (Otherwise only display on Error)

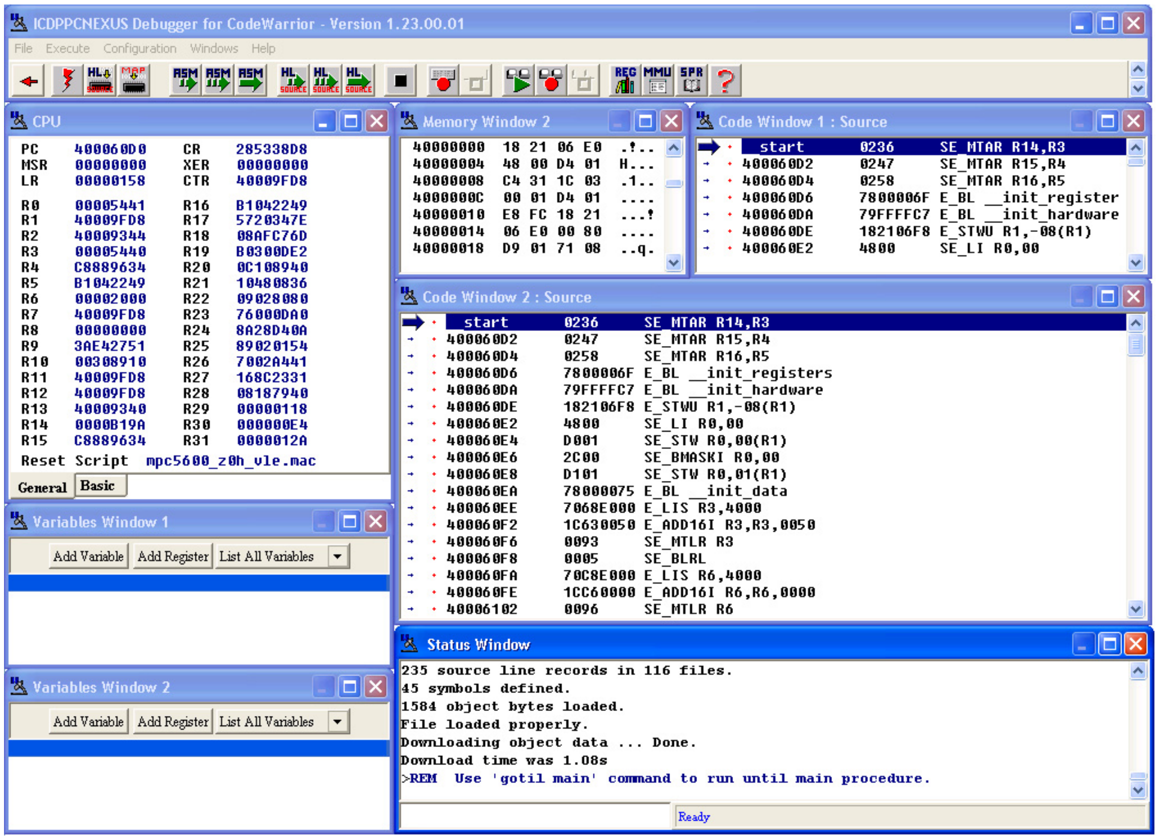
- Use the "Interface" and "Port" drop-down menus to choose the P&E hardware interface connected between the PC and your target board.

- The "Target CPU" setting can safely be left at the "Autodetect" setting for most users. If you experience problems connecting, you can try specifying the exact Freescale device that you are connecting to.

- A BDM_SPEED parameter between 2 to 4 can typically be used. Processors running at slower clock speeds will require higher values.

Click the Connect button, and ICDPPCNEXUS will attempt to contact the processor. Using the default debugger settings, ICDPPCNEXUS will establish communications and reset the processor.

After establishing communications, the main debugger screen will appear, and a debugger reset script macro should automatically execute and complete.


ICDPPCNEXUS Debugger for CodeWarrior - Version 1.23.00.01
File Execute Configuration Windows Help
CPU
Memory Window 2
Code Window 1 : Source
Code Window 2 : Source
Variables Window 1
Add Variable Add Register List All Variables
Variables Window 2
Add Variable Add Register List All Variables
Status Window
General Basic
Ready

```
PC     400060D0    CR     285338D8
MSR    00000000    XER    00000000
LR     00000158    CTR    40009FD8

R0     00005441    R16    B1042249
R1     40009FD8    R17    5720347E
R2     40009344    R18    08AFC76D
R3     00005440    R19    B0300DE2
R4     C8889634    R20    0C108940
R5     B1042249    R21    10480836
R6     00002000    R22    09028080
R7     40009FD8    R23    76000DA0
R8     00000000    R24    8A28D40A
R9     3AE42751    R25    89020154
R10    00308910    R26    7002A441
R11    40009FD8    R27    168C2331
R12    40009FD8    R28    08187940
R13    40009340    R29    00000118
R14    0000B19A    R30    000000E4
R15    C8889634    R31    0000012A
Reset Script  mpc5600_z0h_vle.mac
```

```
40000000  18 21 06 E0  .!..
40000004  48 00 D4 01  H...
40000008  C4 31 1C 03  .1..
4000000C  00 01 D4 01  ....
40000010  E8 FC 18 21  ...!
40000014  06 E0 00 80  ....
40000018  D9 01 71 08  ..q.
```

```
 start      0236     SE_MTAR R14,R3
 400060D2   0247     SE_MTAR R15,R4
 400060D4   0258     SE_MTAR R16,R5
 400060D6   7800006F E_BL __init_register
 400060DA   79FFFFC7 E_BL __init_hardware
 400060DE   182106F8 E_STWU R1,-08(R1)
 400060E2   4800     SE_LI R0,00
```

```
 start      0236     SE_MTAR R14,R3
 400060D2   0247     SE_MTAR R15,R4
 400060D4   0258     SE_MTAR R16,R5
 400060D6   7800006F E_BL __init_registers
 400060DA   79FFFFC7 E_BL __init_hardware
 400060DE   182106F8 E_STWU R1,-08(R1)
 400060E2   4800     SE_LI R0,00
 400060E4   D001     SE_STW R0,00(R1)
 400060E6   2C00     SE_BMASKI R0,00
 400060E8   D101     SE_STW R0,01(R1)
 400060EA   78000075 E_BL __init_data
 400060EE   7068E000 E_LIS R3,4000
 400060F2   1C630050 E_ADD16I R3,R3,0050
 400060F6   0093     SE_MTLR R3
 400060F8   0005     SE_BLRL
 400060FA   70C8E000 E_LIS R6,4000
 400060FE   1CC60000 E_ADD16I R6,R6,0000
 40006102   0096     SE_MTLR R6
```

```
235 source line records in 116 files.
45 symbols defined.
1584 object bytes loaded.
File loaded properly.
Downloading object data ... Done.
Download time was 1.08s
>REM  Use 'gotil main' command to run until main procedure.
```

2.2 Reset Script

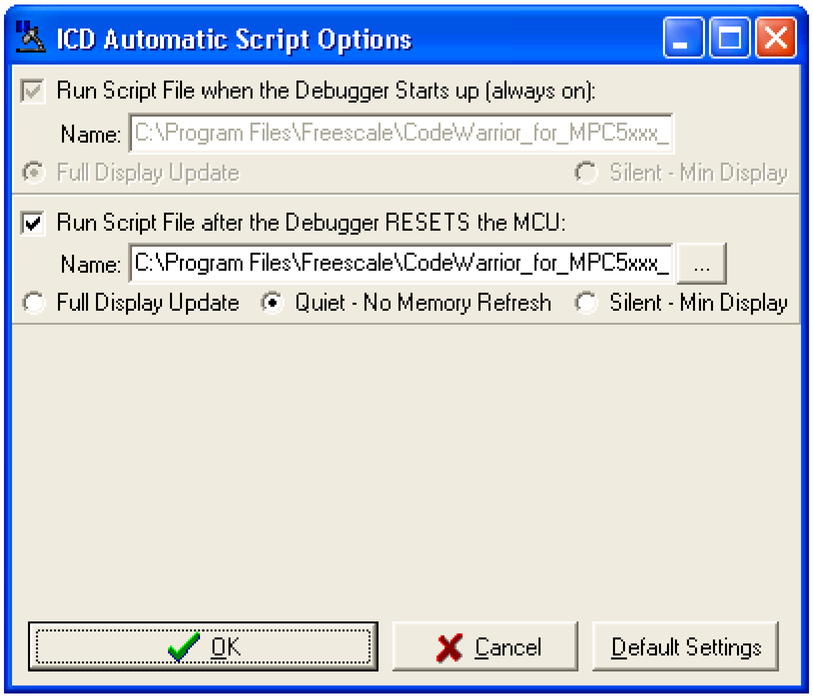
This section explains the initialization that the debugger, using a reset script macro file, performs on the processor. The user can view and modify all of the macro file's initialization tasks.

The processor Boot Assist Module (BAM) would normally initialize the memory of the processor. However, when running the target application from the debugger, the BAM functionality is disabled. To account for this, the debugger must run a script file on reset. The script initializes the memory of the processor similar to the way in which the BAM would initialize the processor.

If ICDPPCNEXUS is launched from the Freescale CodeWarrior IDE, the correct reset script file is automatically selected.

If ICDPPCNEXUS is launched stand-alone, the reset script file may need to be configured. Several reset script macros are included with the ICDPPCNEXUS debugger and have a .mac extension. For detailed information, you can view each macro file using a simple text editor such as Notepad. The macro contents will contain useful comments, such as which devices are supported by that particular macro.

To configure the debugger reset script macro, select the debugger Configuration menu, Automated Script Options dialog, shown here:



[✓] Run Script File when the Debugger Starts up (always on):

Name: C:\Program Files\Freescale\CodeWarrior_for_MPC5xxx_

[✓ Full Display Update] Silent - Min Display

[✓] Run Script File after the Debugger RESETS the MCU:

Name: C:\Program Files\Freescale\CodeWarrior_for_MPC5xxx_

Full Display Update [✓ Quiet - No Memory Refresh] Silent - Min Display

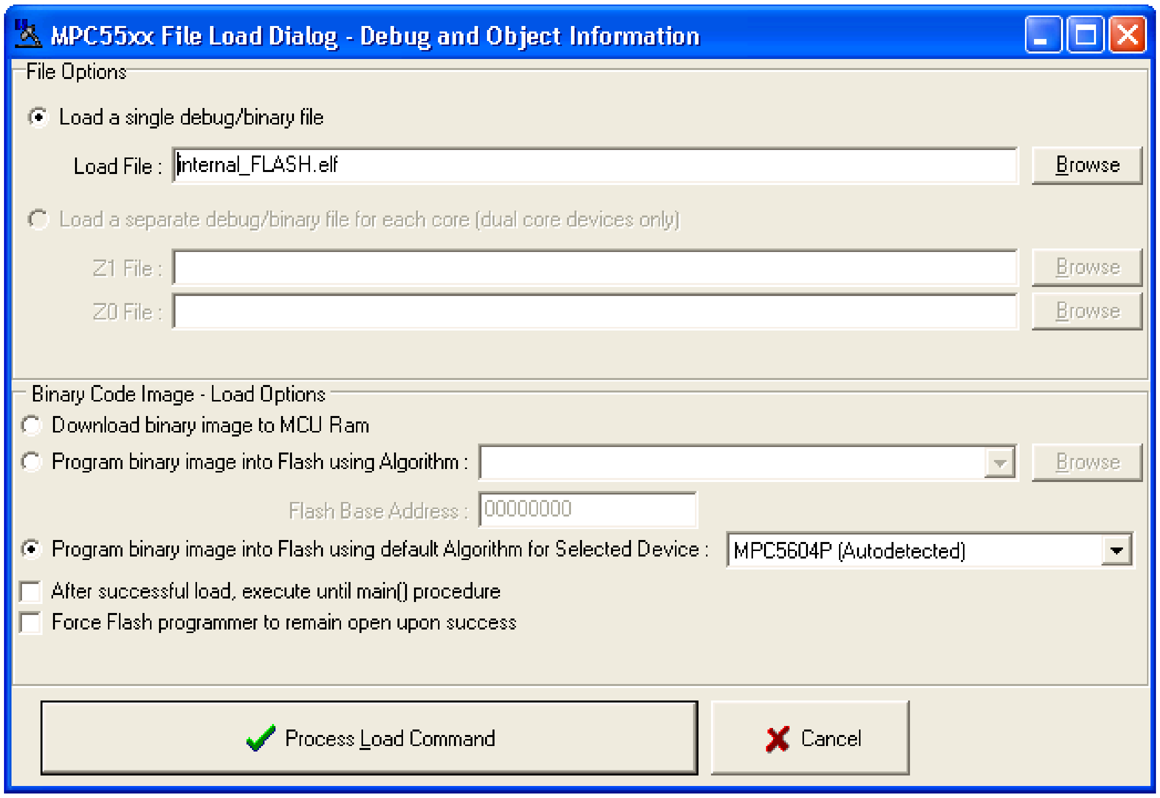
2.3 Loading Data and Debug Information

If ICDPPCNEXUS is launched from the Freescale CodeWarrior IDE, your code will automatically be downloaded to the processor.

- RAM projects are loaded into the processor's internal SRAM.
- FLASH projects will invoke the CPROGPPCNEXUS Flash programming software to burn the code into the processor's internal FLASH.

The debug information is also automatically loaded from CodeWarrior, which will allow you to debug using your high level source code and variables.

If ICDPPCNEXUS is launched stand-alone, you will need to manually download the code and debug information. Launch the Load Dialog by clicking on the High Level Load button on the debugger tool bar:



MPC55xx File Load Dialog - Debug and Object Information

File Options

[✓ Load a single debug/binary file]

Load File : internal_FLASH.elf — Browse

Load a separate debug/binary file for each core (dual core devices only)

Z1 File : — Browse

Z0 File : — Browse

Binary Code Image - Load Options

Download binary image to MCU Ram

Program binary image into Flash using Algorithm : — Browse

Flash Base Address : 00000000

[✓ Program binary image into Flash using default Algorithm for Selected Device : MPC5604P (Autodetected)]

After successful load, execute until main() procedure

Force Flash programmer to remain open upon success

This dialog allows you to specify the binary/debug file and whether to load into RAM or FLASH. Once you are satisfied with your settings, press the “Process Load Command” button to begin the download process. This step will also load the debug information.

2.4 CPU and Memory Windows

The CPU Window displays all CPU core registers, including the Program Counter (PC) and all general purpose registers.

- To modify CPU register contents, double-click the register value. You will be prompted for a new value.

The Memory Window displays data at any given memory address. It can be used to view RAM contents, FLASH contents, and values of peripheral registers.

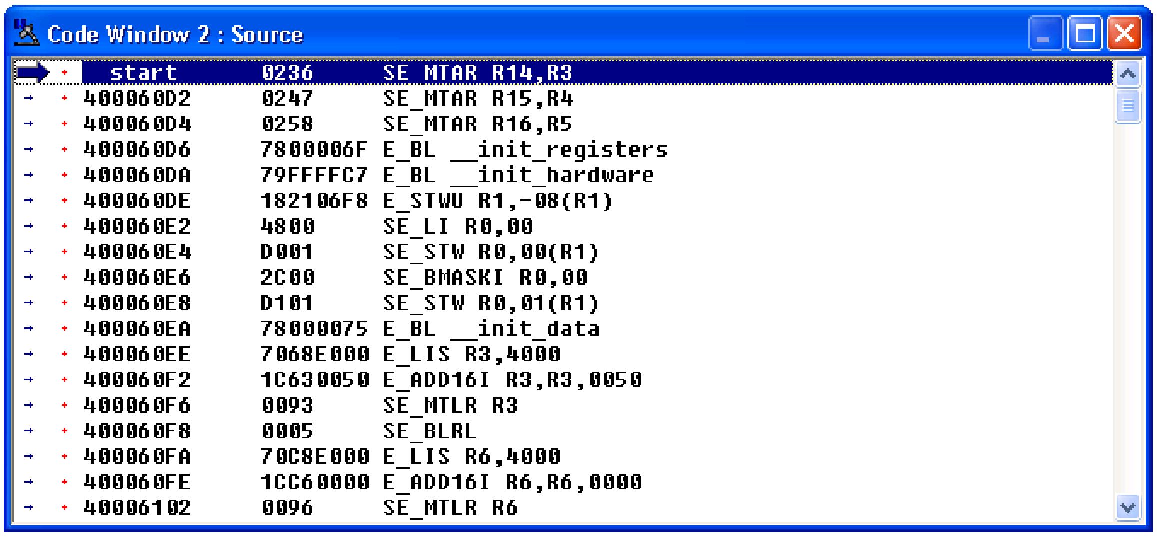
- To change the memory address, right-click inside the Memory Window and select “Set Base Address”. You will be prompted for a new address to begin displaying data.
- To change the contents in memory, double-click the value in memory that you would like to change. You will be prompted for a new value.

3 Debugging

This section outlines the different debugging capabilities available in the ICDPPCNEXUS debugger once the debug information has been loaded.

3.1 GOTIL command

At this point, your source window will show the assembly language startup code generated by the compiler:

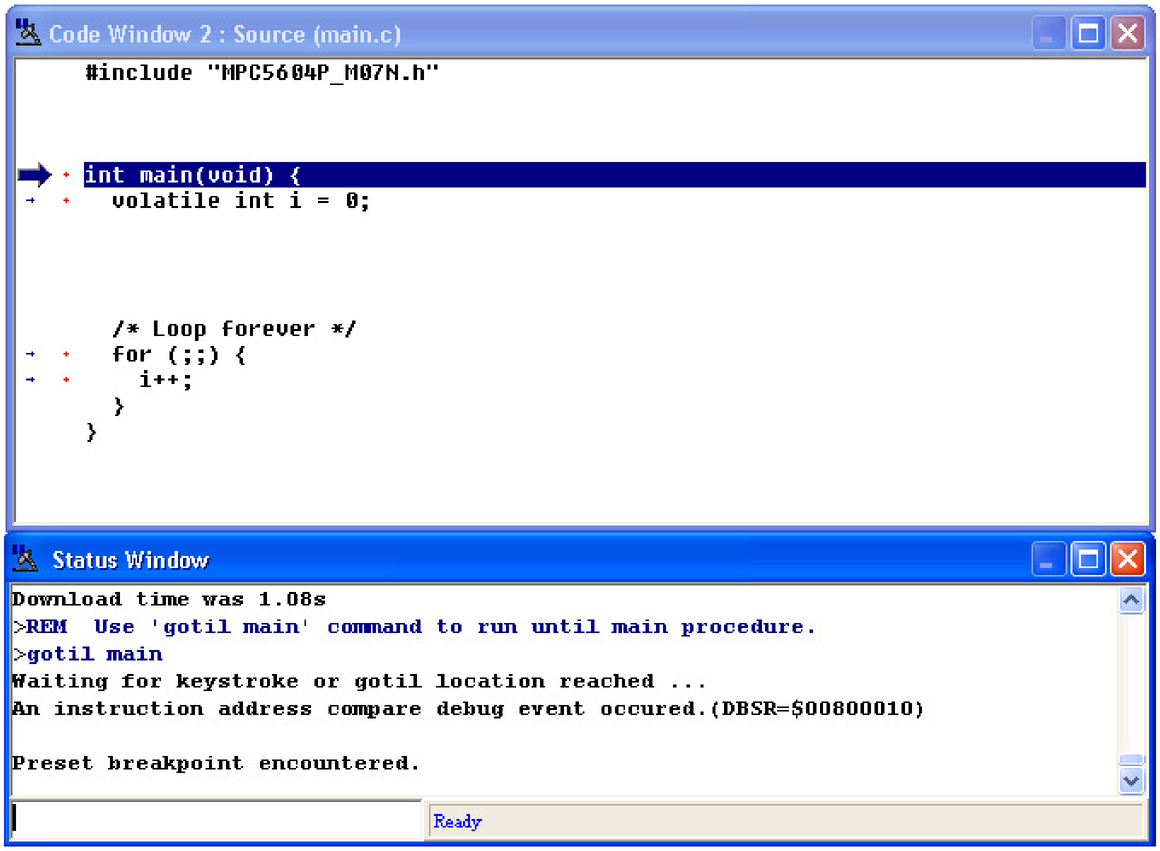


```
start       0236     SE_MTAR R14,R3
400060D2    0247     SE_MTAR R15,R4
400060D4    0258     SE_MTAR R16,R5
400060D6    7800006F E_BL __init_registers
400060DA    79FFFFC7 E_BL __init_hardware
400060DE    182106F8 E_STWU R1,-08(R1)
400060E2    4800     SE_LI R0,00
400060E4    D001     SE_STW R0,00(R1)
400060E6    2C00     SE_BMASKI R0,00
400060E8    D101     SE_STW R0,01(R1)
400060EA    78000075 E_BL __init_data
400060EE    7068E000 E_LIS R3,4000
400060F2    1C630050 E_ADD16I R3,R3,0050
400060F6    0093     SE_MTLR R3
400060F8    0005     SE_BLRL
400060FA    70C8E000 E_LIS R6,4000
400060FE    1CC60000 E_ADD16I R6,R6,0000
40006102    0096     SE_MTLR R6
```

If you do not need to debug this section and would like to run the processor until the beginning of your “main” function, you can use the “GOTIL” command.

- Type “GOTIL main” in the Status window to tell the debugger to run code until it reaches the “main” function of your code.

The “GOTIL” command works with any function in your code.



```
    #include "MPC5604P_M07N.h"


    int main(void) {
      volatile int i = 0;



      /* Loop forever */
      for (;;) {
        i++;
      }
    }
```

```
Download time was 1.08s
>REM  Use 'gotil main' command to run until main procedure.
>gotil main
Waiting for keystroke or gotil location reached ...
An instruction address compare debug event occured.(DBSR=$00800010)

Preset breakpoint encountered.
```

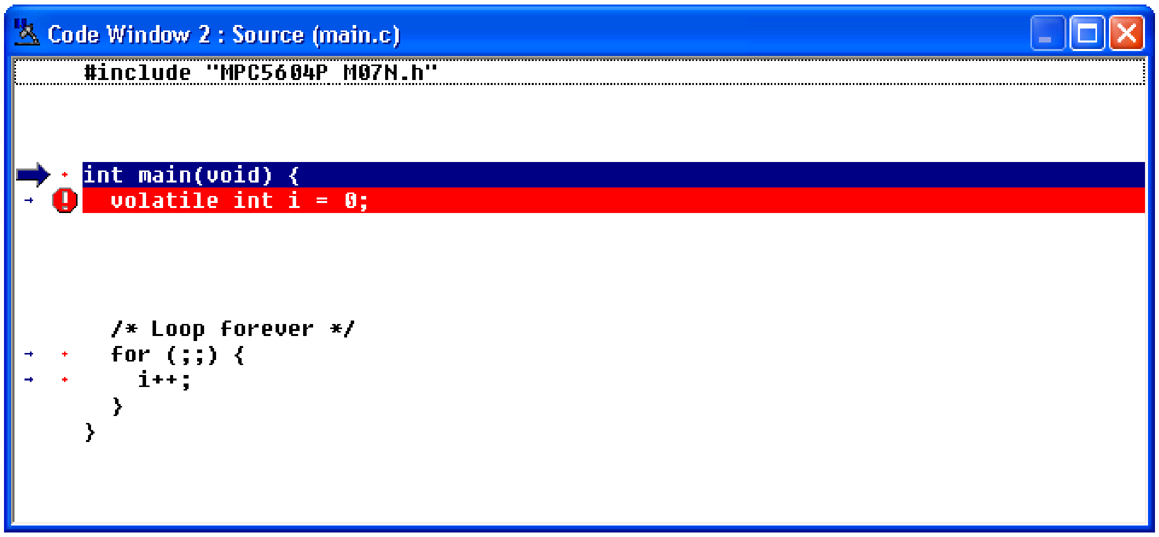
3.1 Stepping through C instructions

Step through the initialization code, or any source code, using the high-level language source step command. Use this feature by typing “HSTEP” in the Status window or by clicking the high-level step button on the debugger tool bar:

Each time the HSTEP command executes, the debugger will rapidly single step assembly instructions until it encounters the next source instruction, at which point target execution will cease. When the debugger reaches the next source instruction, all visible windows will be updated with data from the board. After reaching the main function, step through several C language instructions. Notice that some instructions will take longer to step through than others because each C instruction may consist of a greater or fewer number of underlying assembly instructions.

3.3 Setting and Reaching Breakpoints

In the source code window, there will be a small red dot and a small blue arrow next to each source instruction that has underlying object code. If a large blue arrow appears on a source line, this indicates that the program counter (PC) currently points to this instruction. If a large red stop sign appears on the source line, this indicates that a breakpoint exists on this line.



```
#include "MPC5604P_M07N.h"


int main(void) {
  volatile int i = 0;



  /* Loop forever */
  for (;;) {
    i++;
  }
}
```

- Set a breakpoint at an instruction by double-clicking the tiny red dot.
- To remove a breakpoint, double-click the large red stop sign.

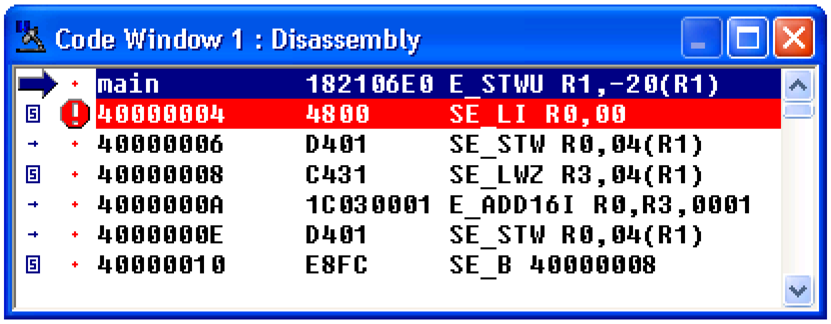
Execution will begin in real-time when you issue the HGO command or click the high-level language GO button on the debugger tool bar:

If the debugger encounters a breakpoint, execution will stop on this source line. If it does not encounter a breakpoint, target execution will continue until you press a key or use the stop button on the debugger tool bar:

- By double clicking the small blue arrow, you will be issuing a GOTIL command to the address of this source line.

A GOTIL command will set a single breakpoint at the desired address, and the processor will begin executing code in real-time from the current program counter (PC). When the debugger encounters the GOTIL address, execution stops. If the debugger does not encounter this location, execution continues until you press a key or use the stop button on the debugger tool bar. Note that all user breakpoints are ignored when the GOTIL command is used.

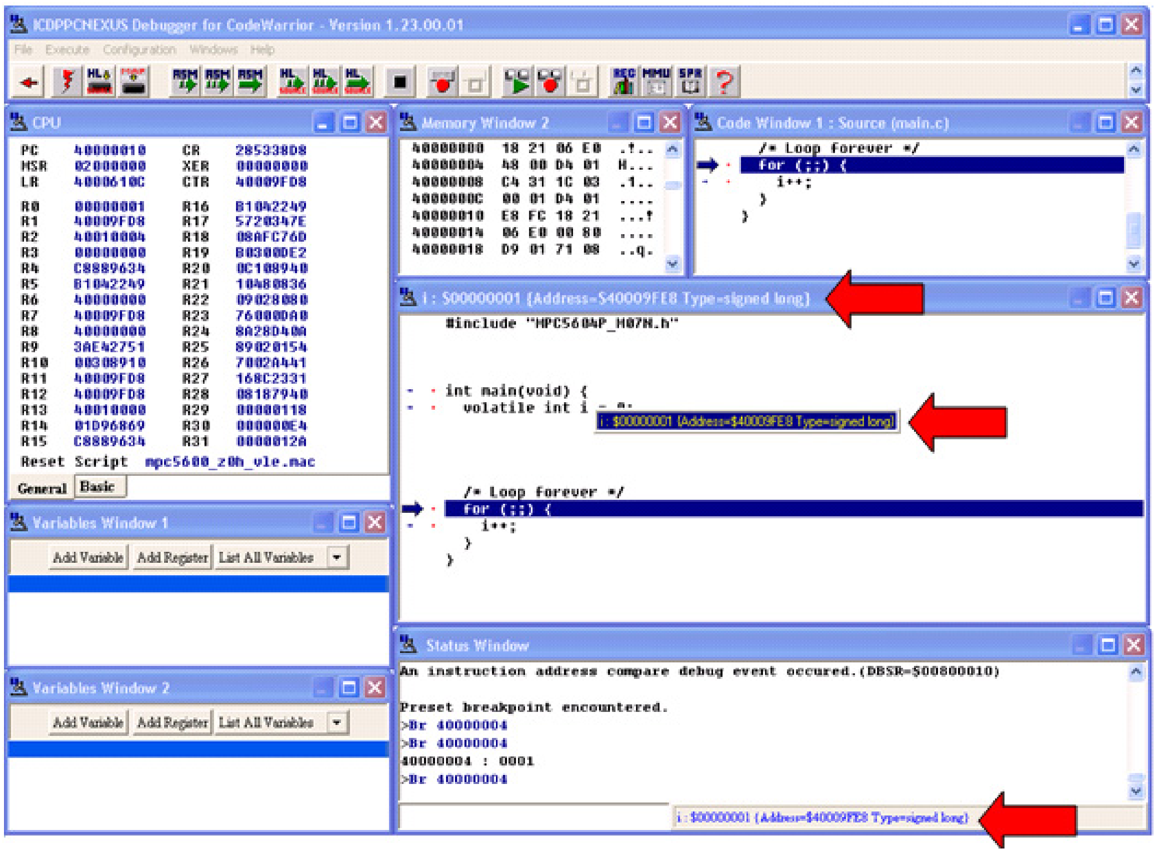
You may also double-click the red and blue symbols in the disassembly window. The disassembly window may display an additional symbol, a small, blue "S" enclosed in a box. This indicates that that a source code instruction begins on this disassembly instruction.



```
main       182106E0 E_STWU R1,-20(R1)
40000004   4800     SE_LI R0,00
40000006   D401     SE_STW R0,04(R1)
40000008   C431     SE_LWZ R3,04(R1)
4000000A   1C030001 E_ADD16I R0,R3,0001
4000000E   D401     SE_STW R0,04(R1)
40000010   E8FC     SE_B 40000008
```

3.4 Using Code Window Popup Debug Evaluation Hints

When debugging source code, it is convenient to view the contents of a variable while viewing your source code. The in-circuit debugger has a feature, debug hints, which displays the value of a variable while the mouse cursor is held over the variable name. The hint may be displayed in any of three locations, as shown below.


ICDPPCNEXUS Debugger for CodeWarrior - Version 1.23.00.01
File Execute Configuration Windows Help
CPU
Memory Window 2
Code Window 1 : Source (main.c)
i : $00000001 (Address=$40009FE8 Type=signed long)
General
Basic
Variables Window 1
Add Variable
Add Register
List All Variables
Variables Window 2
Add Variable
Add Register
List All Variables
Status Window
i : $00000001 (Address=$40009FE8 Type=signed long)

```
PC     40000010    CR     285338D8
MSR    02000000    XER    00000000
LR     4000610C    CTR    40009FD8

R0     00000001    R16    B1042249
R1     40009FD8    R17    5720347E
R2     40010004    R18    08AFC76D
R3     00000000    R19    B0300DE2
R4     C8889634    R20    0C108940
R5     B1042249    R21    10480836
R6     40000000    R22    09028080
R7     40009FD8    R23    760000A0
R8     40000000    R24    8A28D40A
R9     3AE42751    R25    89020154
R10    00308910    R26    7002A441
R11    40009FD8    R27    168C2331
R12    40009FD8    R28    08187940
R13    40010000    R29    00000118
R14    01D96869    R30    000000E4
R15    C8889634    R31    0000012A
Reset Script  mpc5600_z0h_vle.mac
```

```
40000000  18 21 06 E0  .!..
40000004  48 00 D4 01  H...
40000008  C4 31 1C 03  .1..
4000000C  00 01 D4 01  ....
40000010  E8 FC 18 21  ...!
40000014  06 E0 00 80  ....
40000018  D9 01 71 08  ..q.
```

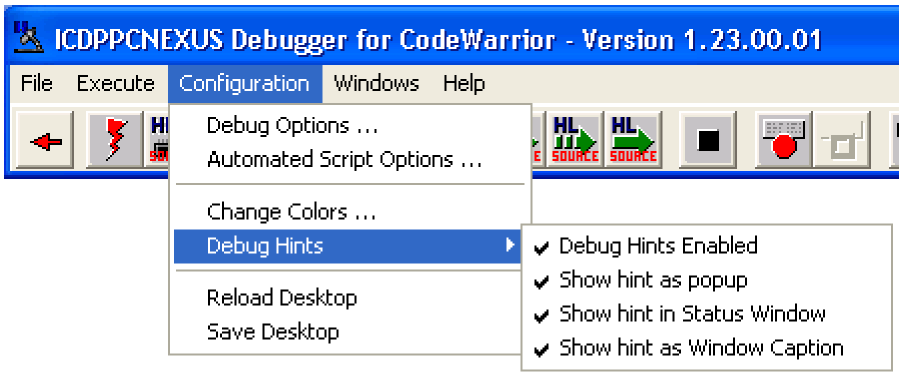
```
  /* Loop forever */
  for (;;) {
    i++;
  }
}
```

```
#include "MPC5604P_M07N.h"


int main(void) {
  volatile int i = 0;
  i : $00000001 (Address=$40009FE8 Type=signed long)


  /* Loop forever */
  for (;;) {
    i++;
  }
}
```

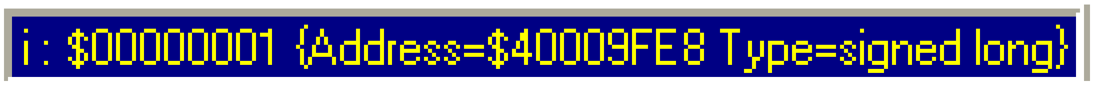
```
An instruction address compare debug event occured.(DBSR=$00800010)

Preset breakpoint encountered.
>Br 40000004
>Br 40000004
40000004 : 0001
>Br 40000004
```

The three locations for the debug hints are the code window title bar, the status window caption bar, and a popup hint that appears over the variable in source code. You can configure the hints to display in any combination.

- Set the locations of debug hints in the configuration menu of the debugger


ICDPPCNEXUS Debugger for CodeWarrior - Version 1.23.00.01
File Execute Configuration Windows Help
Debug Options ...
Automated Script Options ...
Change Colors ...
Debug Hints
Reload Desktop
Save Desktop
✓ Debug Hints Enabled
✓ Show hint as popup
✓ Show hint in Status Window
✓ Show hint as Window Caption

The information in the popup hint box is similar to the information displayed in the variables window.

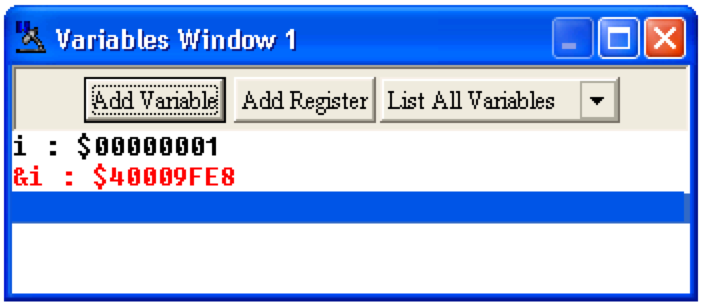


```
i : $00000001 {Address=$40009FE8 Type=signed long}
```

The information includes the variable name (i), value ($1), and type (signed long).

3.5 Using the Variables Window

The variables window displays the current value of application variables. The following window shows a display of variables from the example application.

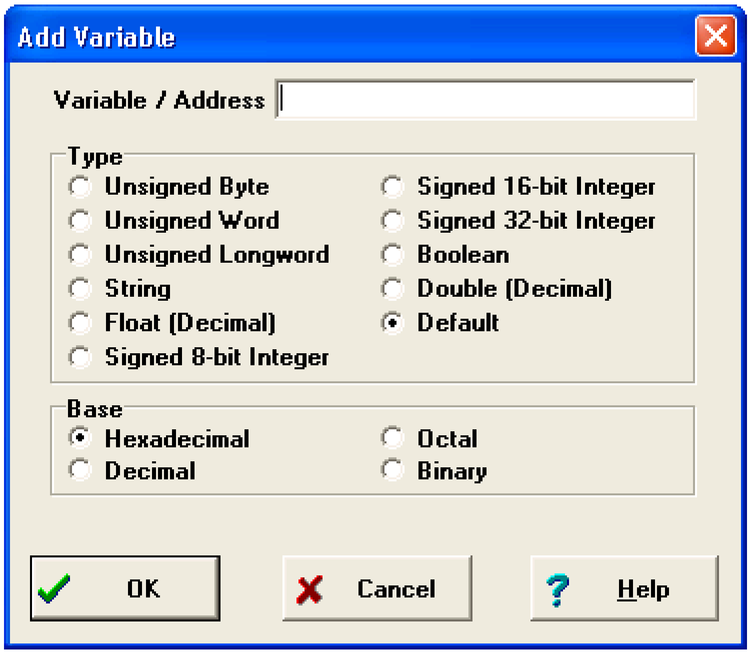


```
i : $00000001
&i : $40009FE8
```

Variables that are pointer or reference types are displayed in red. Normal variables are displayed in black.

- Add a variable by typing the VAR command, by right clicking the variables window and choosing “Add a variable”, or by hitting the "Add Variable" button in the variables window.

When adding a variable using the pop-up menu, the debugger displays the following screen.


Add Variable

Variable / Address

Type
- Unsigned Byte
- Unsigned Word
- Unsigned Longword
- String
- Float (Decimal)
- Signed 8-bit Integer
- Signed 16-bit Integer
- Signed 32-bit Integer
- Boolean
- Double (Decimal)
- [✓ Default]

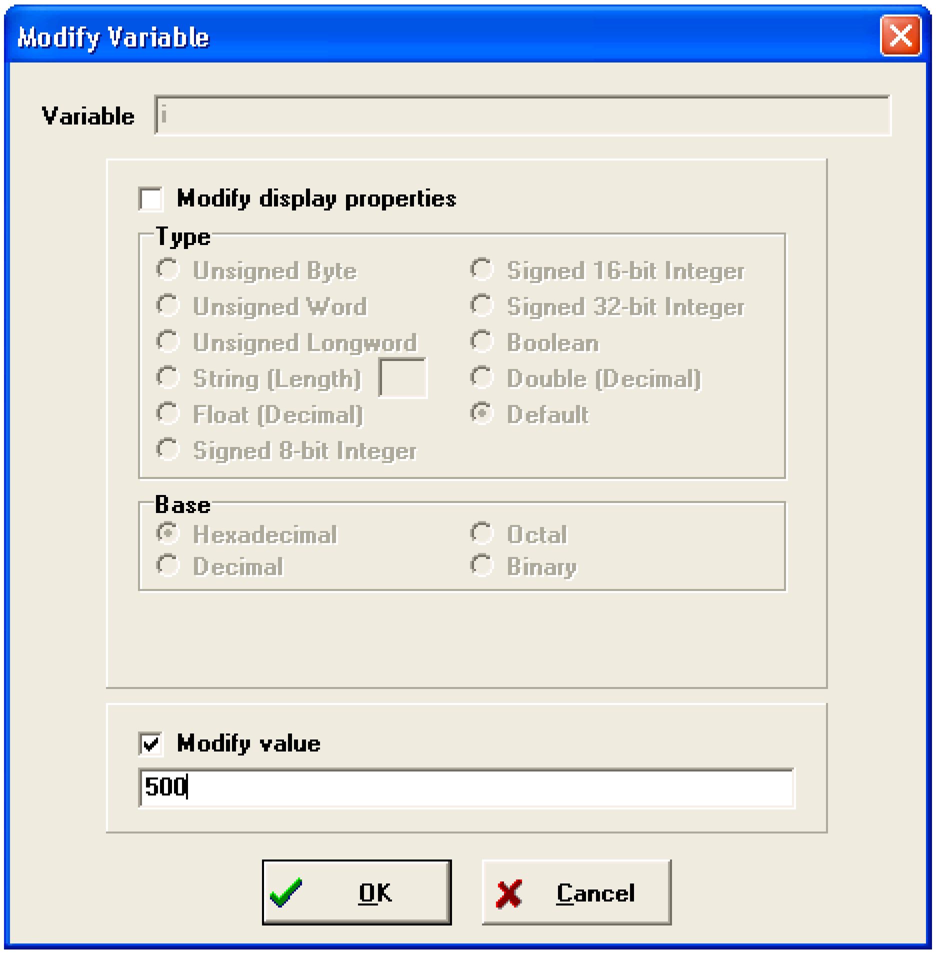
Base
- [✓ Hexadecimal]
- Decimal
- Octal
- Binary

In the variable field, type the address or name of the variable. Typically, set the type of the variable to “Default”, which means that the variable will be displayed as it is defined in the debugging information. When adding a variable, you may specify the numeric display base of the variable.

3.6 Modifying a Variable

- To modify the current value of a variable, right-click the variable name in the variables window and select “Modify Variable” to display a dialog.

Check the “Modify value” checkbox, and type the variable’s new value. After you click the OK button, the debugger updates the variable value on the target, and the debugger refreshes the variable window to display the new value. Note that the debugger will not edit certain user-defined types, such as enumerated types.


Modify Variable

Variable: i

[ ] Modify display properties

Type: Unsigned Byte, Unsigned Word, Unsigned Longword, String (Length), Float (Decimal), Signed 8-bit Integer, Signed 16-bit Integer, Signed 32-bit Integer, Boolean, Double (Decimal), [✓ Default]

Base: [✓ Hexadecimal], Decimal, Octal, Binary

[✓] Modify value

500

- You may also modify a variable's display properties, such as the type or numeric display base using this dialog.

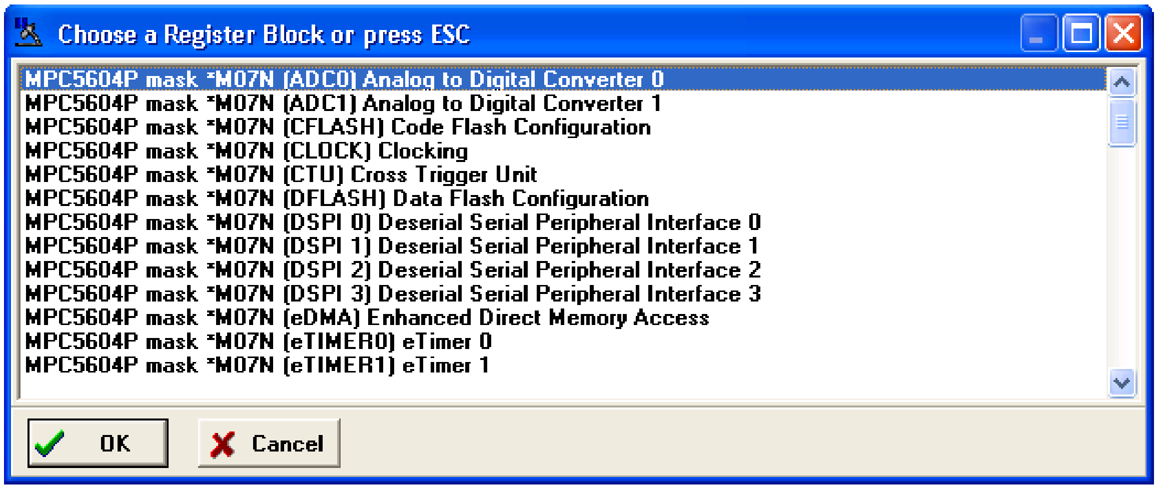
3.7 Using the Register Interpreter

The register interpreter provides a descriptive display of bit fields within the processor's peripheral registers. The register interpreter allows you easily to change the value of these registers. You may quickly check the current state of a peripheral and examine the configuration of the target device.

When you use the register interpreter within the debugger, it reads the current value of the peripheral register, decodes it, and displays it.

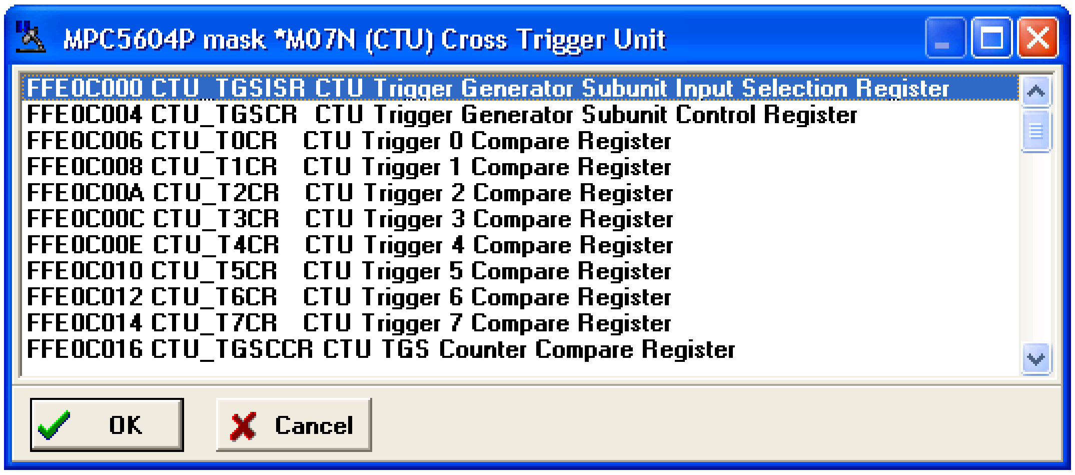
To launch the register interpreter in the debugger, either use the "R" command or click the view/edit register button on the tool bar:

A window will appear that allows you to select a peripheral block to examine.



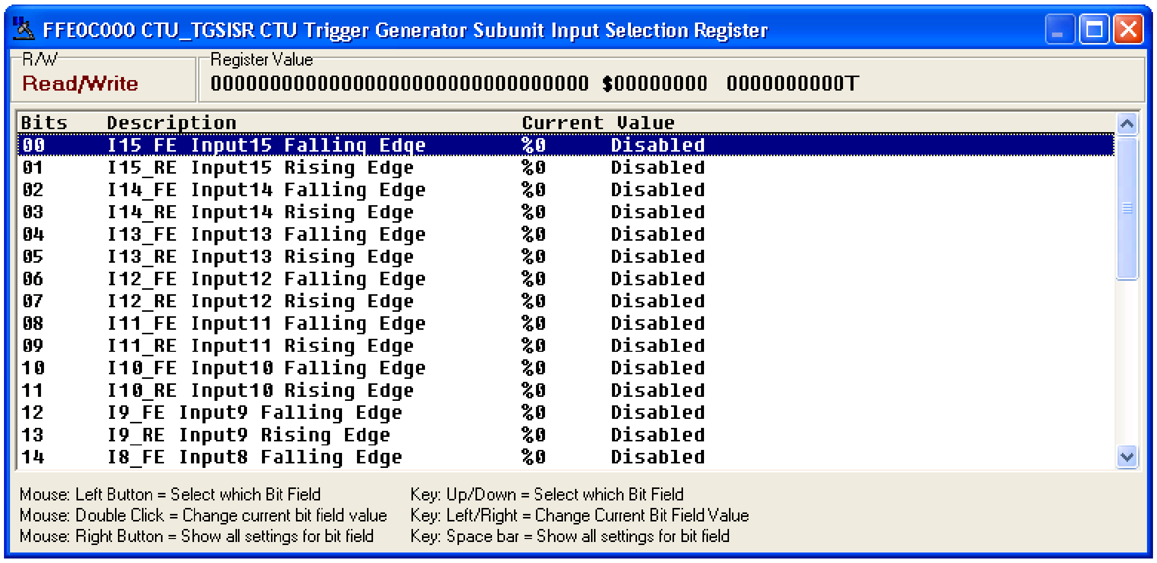
```
Choose a Register Block or press ESC
MPC5604P mask *M07N (ADC0) Analog to Digital Converter 0
MPC5604P mask *M07N (ADC1) Analog to Digital Converter 1
MPC5604P mask *M07N (CFLASH) Code Flash Configuration
MPC5604P mask *M07N (CLOCK) Clocking
MPC5604P mask *M07N (CTU) Cross Trigger Unit
MPC5604P mask *M07N (DFLASH) Data Flash Configuration
MPC5604P mask *M07N (DSPI 0) Deserial Serial Peripheral Interface 0
MPC5604P mask *M07N (DSPI 1) Deserial Serial Peripheral Interface 1
MPC5604P mask *M07N (DSPI 2) Deserial Serial Peripheral Interface 2
MPC5604P mask *M07N (DSPI 3) Deserial Serial Peripheral Interface 3
MPC5604P mask *M07N (eDMA) Enhanced Direct Memory Access
MPC5604P mask *M07N (eTIMER0) eTimer 0
MPC5604P mask *M07N (eTIMER1) eTimer 1
```

Double clicking the module of choice will launch the register selection window.



```
MPC5604P mask *M07N (CTU) Cross Trigger Unit
FFE0C000 CTU_TGSISR CTU Trigger Generator Subunit Input Selection Register
FFE0C004 CTU_TGSCR  CTU Trigger Generator Subunit Control Register
FFE0C006 CTU_T0CR   CTU Trigger 0 Compare Register
FFE0C008 CTU_T1CR   CTU Trigger 1 Compare Register
FFE0C00A CTU_T2CR   CTU Trigger 2 Compare Register
FFE0C00C CTU_T3CR   CTU Trigger 3 Compare Register
FFE0C00E CTU_T4CR   CTU Trigger 4 Compare Register
FFE0C010 CTU_T5CR   CTU Trigger 5 Compare Register
FFE0C012 CTU_T6CR   CTU Trigger 6 Compare Register
FFE0C014 CTU_T7CR   CTU Trigger 7 Compare Register
FFE0C016 CTU_TGSCCR CTU TGS Counter Compare Register
```

Double clicking a specific register will launch the edit/display window for that register.



FFE0C000 CTU_TGSISR CTU Trigger Generator Subunit Input Selection Register

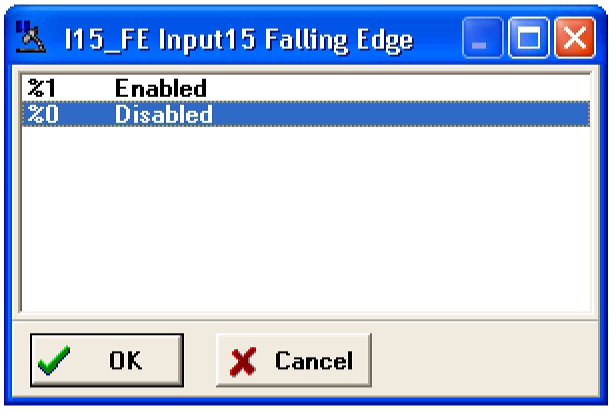
R/W: Read/Write

Register Value: 00000000000000000000000000000000 $00000000 0000000000T

```
Bits   Description                      Current  Value
00     I15_FE Input15 Falling Edge      %0       Disabled
01     I15_RE Input15 Rising Edge       %0       Disabled
02     I14_FE Input14 Falling Edge      %0       Disabled
03     I14_RE Input14 Rising Edge       %0       Disabled
04     I13_FE Input13 Falling Edge      %0       Disabled
05     I13_RE Input13 Rising Edge       %0       Disabled
06     I12_FE Input12 Falling Edge      %0       Disabled
07     I12_RE Input12 Rising Edge       %0       Disabled
08     I11_FE Input11 Falling Edge      %0       Disabled
09     I11_RE Input11 Rising Edge       %0       Disabled
10     I10_FE Input10 Falling Edge      %0       Disabled
11     I10_RE Input10 Rising Edge       %0       Disabled
12     I9_FE Input9 Falling Edge        %0       Disabled
13     I9_RE Input9 Rising Edge         %0       Disabled
14     I8_FE Input8 Falling Edge        %0       Disabled
```

Mouse: Left Button = Select which Bit Field
Mouse: Double Click = Change current bit field value
Mouse: Right Button = Show all settings for bit field
Key: Up/Down = Select which Bit Field
Key: Left/Right = Change Current Bit Field Value
Key: Space bar = Show all settings for bit field

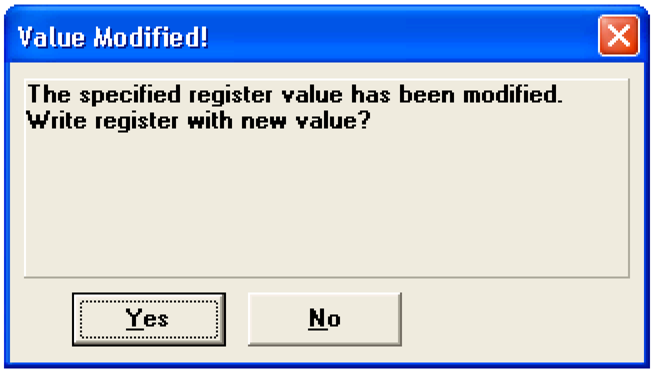
The window lists the keystrokes and mouse actions, allowing you to modify the values of each of the fields. After right clicking on a specific field, the register interpreter will display all options for that field.



I15_FE Input15 Falling Edge

```
%1    Enabled
%0    Disabled
```

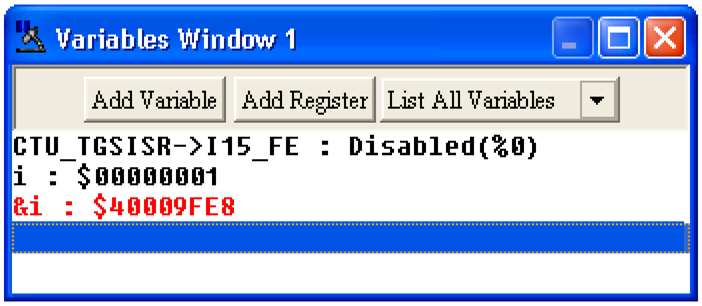
When you quit the register view/edit window by hitting the ESC key, you will be given the opportunity to write the new value into the register, as shown in the following window.



The specified register value has been modified.
Write register with new value?

3.8 Adding Register Field Descriptions to the Variables Window

Add register bit fields to the variables window by using the "_TR" command in the debugger or by clicking the "Add Register" button in the variables window. After selecting the register field, the field appears in the debugger variables window, and the debugger will continually update its value.



```
CTU_TGSISR->I15_FE : Disabled(%0)
i : $00000001
&i : $40009FE8
```