Z8051™ Family of 8-Bit Microcontrollers

Z51F6412 Development Kit

User Manual

UM025901-1112

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Revision History

Each instance in the Revision History table below reflects a change to this document from its previous version.

Date	Revision Level	Description	Page
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Introduction

This manual describes how to set up Zilog's Z51F6412 Development Kit (Zilog part number Z51F6412000ZCOG) and use it to evaluate your Z8051-based designs and applications.

The Kit features a development board consisting of five LEDs, five pushbuttons, a buzzer, port pin headers and a UART-to-USB port. The Board features the Z51F6412 MCU in an 80-pin LQFP package, plus a DBG connector to connect the Board to a host development PC using the Z8051 USB On-Chip Debugger (OCD) cable. For more details about the Z51F6412 MCU, please refer to the Z51F6412 Product Specification (PS0303).

This document guides you through the following tasks:

- Install the Z8051 OCD Software and Documentation – see page 6
- Configure the Z8051 OCD and Z51F6412 Development Board – see page 16
- Build and Run the Z51F6412 Demo Project – see page 19

Figure 1 shows an image of the Z51F6412 Development Kit.

Figure 1. The Z51F6412 Development Kit

Kit Contents

Table 1 lists the contents of the Z51F6412 Development Kit.

Table 1. Z51F6412000ZCOG Contents

Item	Description	Quantity
1	Z51F6412 Development Board	1
2	Z8051 USB On-Chip Debugger (OCD)	1
3	Z8051 OCD Target Cable (10ckt)	1
4	USB Cable: A (male) to Mini-B	2
5	Z51F6412 Development Kit Insert (FL0150)	1

Figure 2 shows an image of the Z51F6412 Development Board.

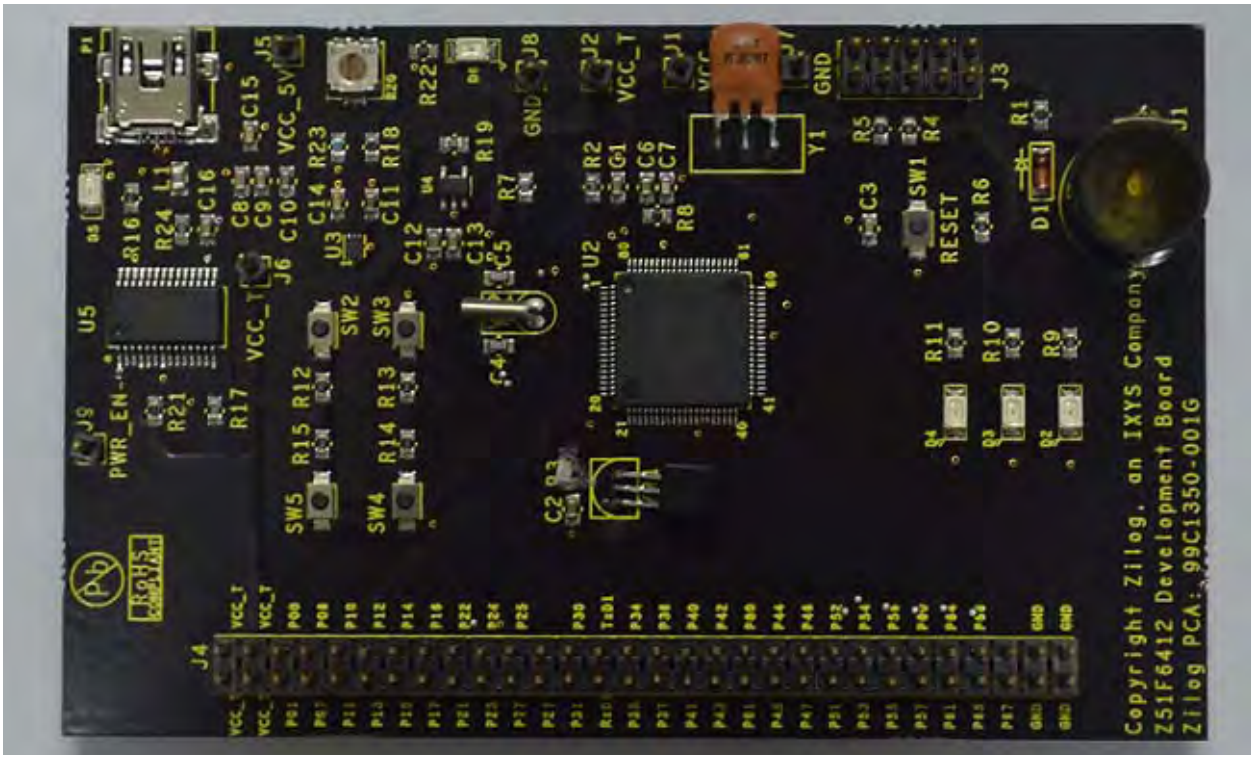

Figure 2. Z51F6412 Development Board

Supported Operating Systems

The Z51F6412 Development Board and the Z8051 On-Chip Debugger support the following operating systems:

- Microsoft Windows XP
- Microsoft Windows Vista (32-bit/64-bit)
- Microsoft Windows 7 (32-bit/64-bit)

Z51F6412 Development Board Block Diagram

Figure 3 shows a block diagram of the Z51F6412 Development Board.

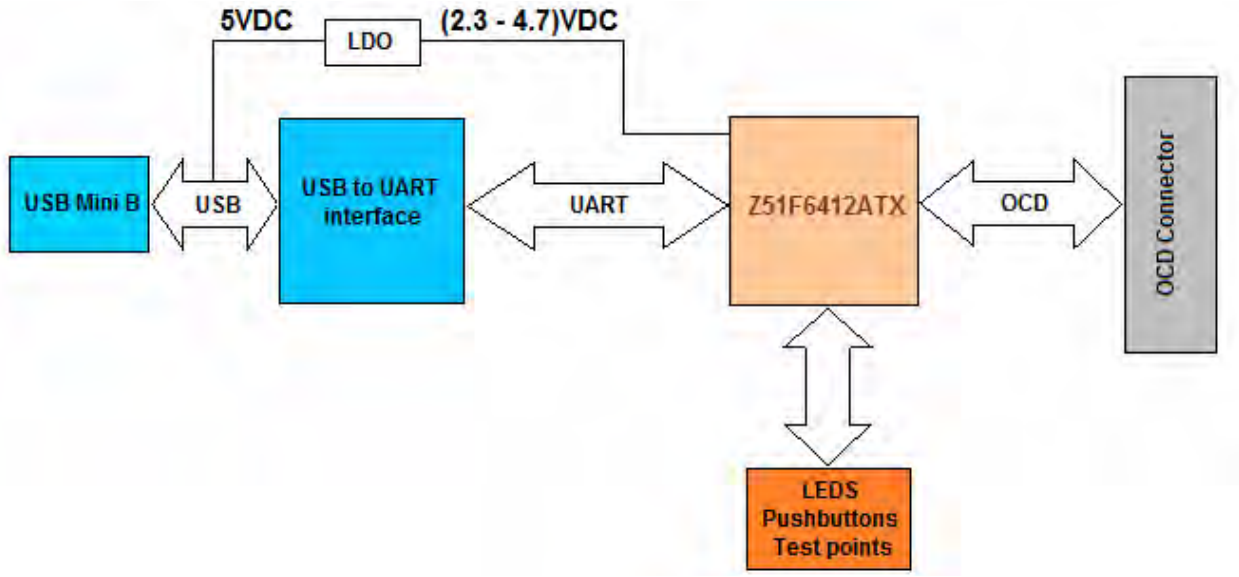

Figure 3. Block Diagram of the Z51F6412 Development Board

Z51F6412 Development Board Description

The Z51F6412 Development Board consists of the following components:

- Z51F6412: U2, 80-pin LQFP chip
- 3 LEDs: Green (D2), Red (D3) and Yellow (D4) connected to the GPIO pins of the Z51F6412 MCU
- 1 green LED to indicate USB power: D5

- 1 red LED to indicate an overcurrent condition: D6
- 5 pushbuttons:
  - SW1: RESET
  - SW2–SW5: connected to the GPIO pins of the Z51F6412 MCU

- USB connector: P1
- OCD connector: J3
- USB-to-UART interface: U5
- USB interface providing power and communication to the Board through adjustable LD0: U3
- Power supply level that can be adjusted with potentiometer R20
- Overcurrent protection circuit on the Board: U4 and D6
- External source of reference voltage (2.5V) for the on-chip ADC: VR1
- MCU current consumption measurement resistor R2 with test points J1 and J2
- Buzzer: U1
- Test points and headers

The Z51F6412 Development Board, with its key components highlighted, is shown in Figure 4.

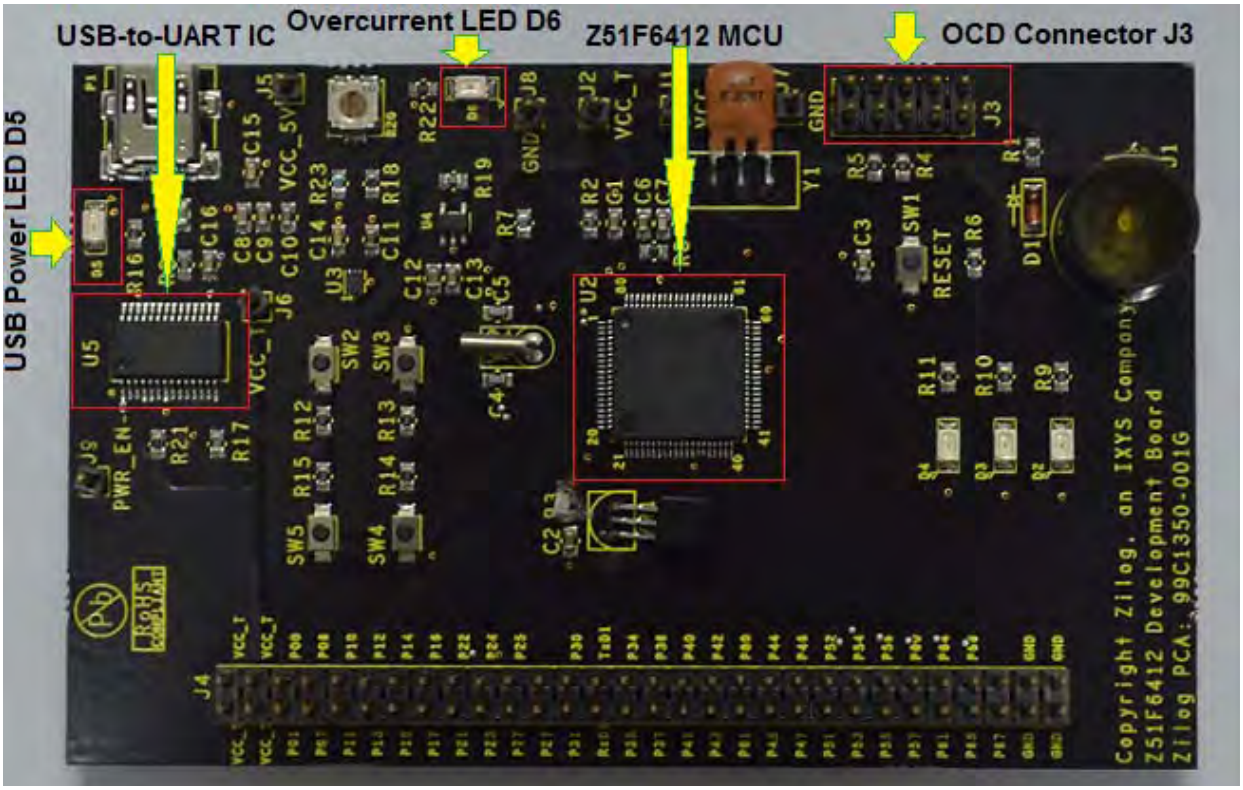

Figure 4. Z51F6412 Development Board: Highlighted Components

If a short on the Board should occur, or if its attached component(s) require more than 500 mA, the overcurrent protection functionality will trigger the red LED D6 to illuminate. In this instance, power to the Board will be terminated, and the USB port of the PC will be protected from shorting.

Schematic diagrams of the Z51F6412 Development Board are presented on pages 37 and 38 of this document.

The physical dimensions of the Board are 4.01" x 2.50" (101.8 mm x 63.5 mm).

Install the Z8051 OCD Software and Documentation

The Z8051 On-Chip Debugger (OCD) interface is the interface by which your PC will communicate with the Z51F6412 MCU to download and execute code. In addition to the OCD, software such as development tools and sample applications will be installed.

Note: If you have already downloaded the Z8051 software and documentation from the Zilog Store and installed it following the procedure on the paper insert in your kit (FL0150), skip this section, and proceed to the Z8051 OCD Driver Installation section, below.

Observe the following procedure to install the Z8051 On-Chip Debugger software and documentation on your computer.

1. Ensure that the OCD interface hardware is not connected to your PC.
2. In a web browser, download the Z8051 Software and Documentation v2.1 or later from the Zilog Store. When the download is complete, unzip the file to your hard drive and double-click to launch the installation file named `Z8051_<version>.exe`.
3. From the main menu, select **Go to the installation page**, then select one of the following options:
   - If you do not plan to use the Keil µVision4 IDE, select **Zilog OCD + Samples + SDCC**.
   - If you will be using the Keil µVision4 IDE, select **Zilog OCD + Samples + Keil µVision4 IDE Debugging Support**.
   - If you only plan to use the programming features and do not plan to perform any development, select **Zilog OCD**.
   - To install all files, select **All of the above**.

Note: In this filename, `<version_number>` refers to the version number of the OCD Software and Documentation release. For example, this version number may be `2.1`.

4. Follow the on-screen instructions to complete the OCD software installation.

Z8051 OCD Driver Installation

The driver programs for the Z8051 On-Chip Debugger are copied during the software and documentation installation. In the following procedure for PCs running the Windows 7 32- and 64-bit operating systems, ensure that the target side of the OCD will remain unconnected while you install these drivers.

Note: If you are running Windows Vista, see Appendix A on page 39 to install your device drivers. If you are running Windows XP, see Appendix B on page 42.

1. Connect the OCD hardware to the USB port of your PC by connecting the A (male) end of one of the two USB A (male)-to-Mini-B cables with the host PC's USB port. Connect the Mini-B end to the OCD device.
2. After the PC detects the new hardware, it will display the *Installing device driver software* dialog shown in Figure 5.

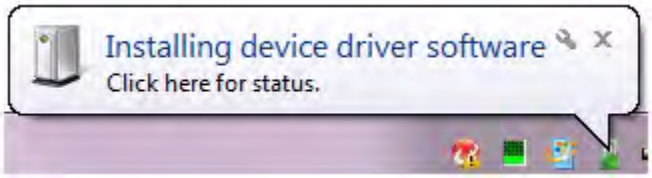

Figure 5. Install Device Driver Dialog, Windows 7

IMPORTANT NOTE: If you should encounter the scenarios indicated in Figures 6 or 7, right-click your mouse on **ZILOG OCD I/F** (highlighted in Figure 6) or **Unknown device** (highlighted in Figure 7) and select **Update Driver Software...**

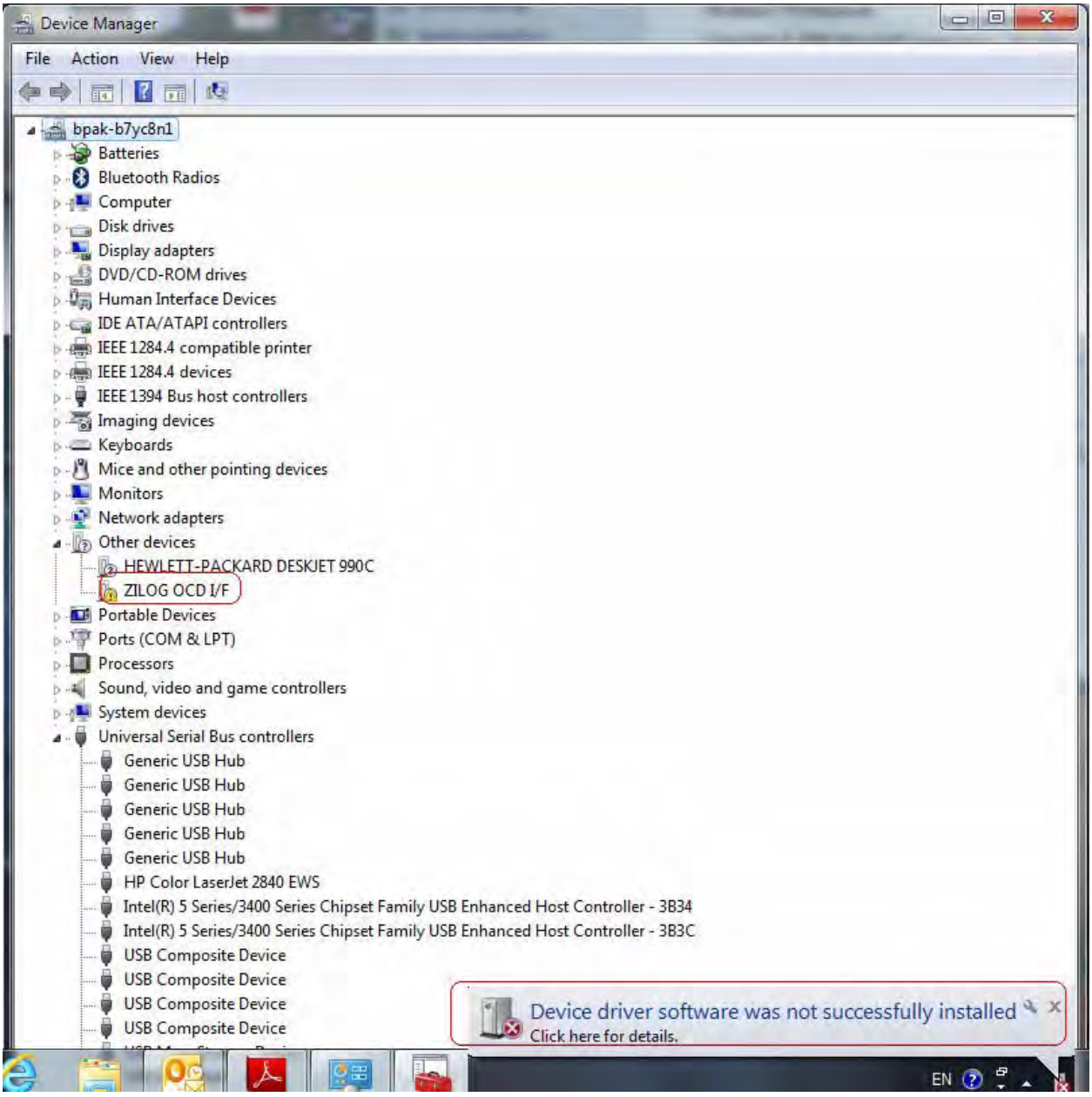

Figure 6. Unsuccessful Installation, Scenario 1

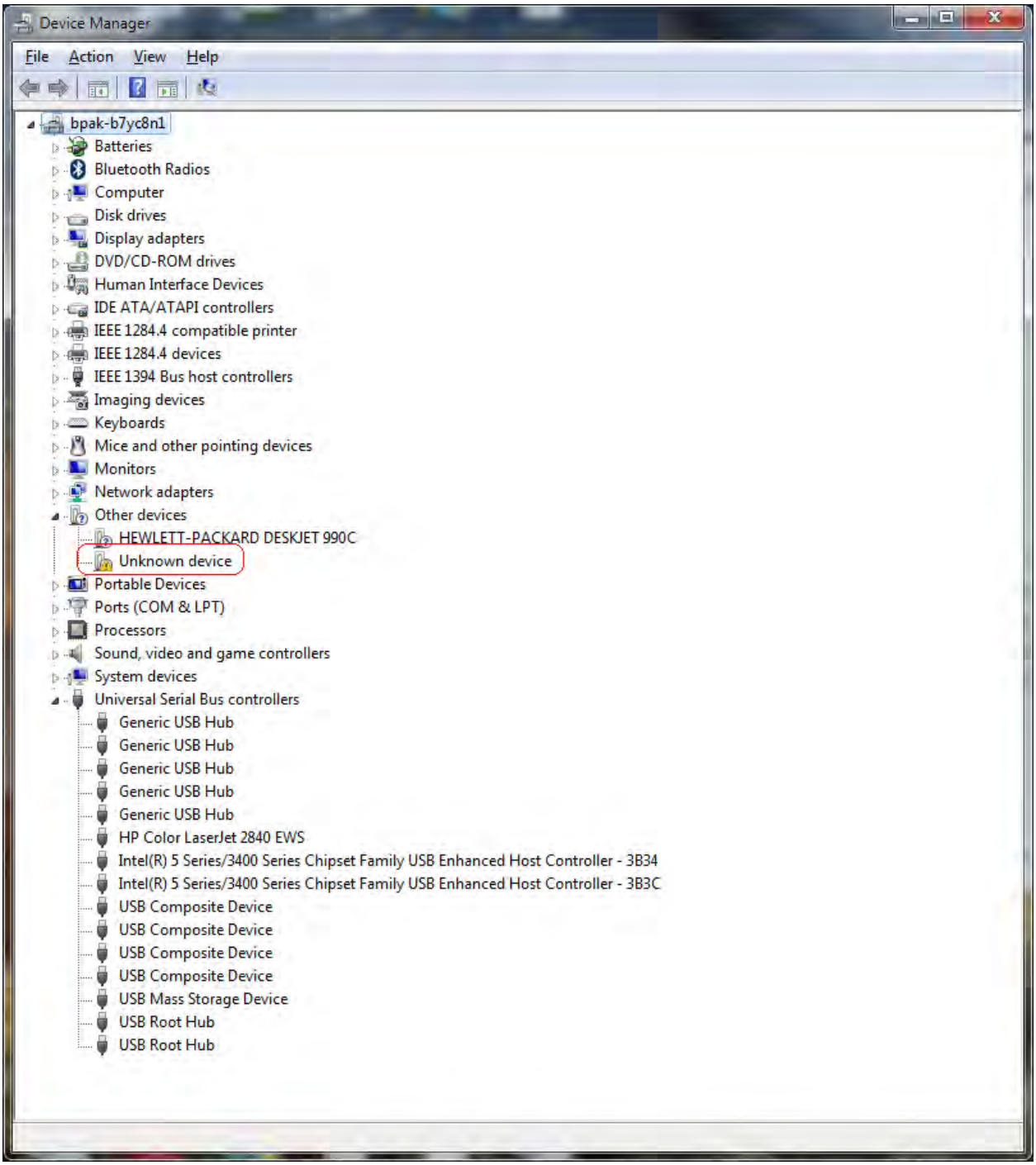

Figure 7. Unsuccessful Installation, Scenario 2

3. Select **Browse my computer for driver software (advanced)** to display the dialog shown in Figure 8, which prompts you to key in or browse for the location of the `.inf` file. Depending on the type of computer you use (32- bit or 64-bit), use the **Browse** button to navigate to one of the following paths, then click the **Next** button.
   – On 32-bit machines, use the following path:

     <Z8051 Installation>\Z8051_<version_number>\device drivers\OCD USB\x32

   – On 64-bit machines, use the following path:

     <Z8051 Installation>\Z8051_<version_number>\device drivers\OCD USB\x64

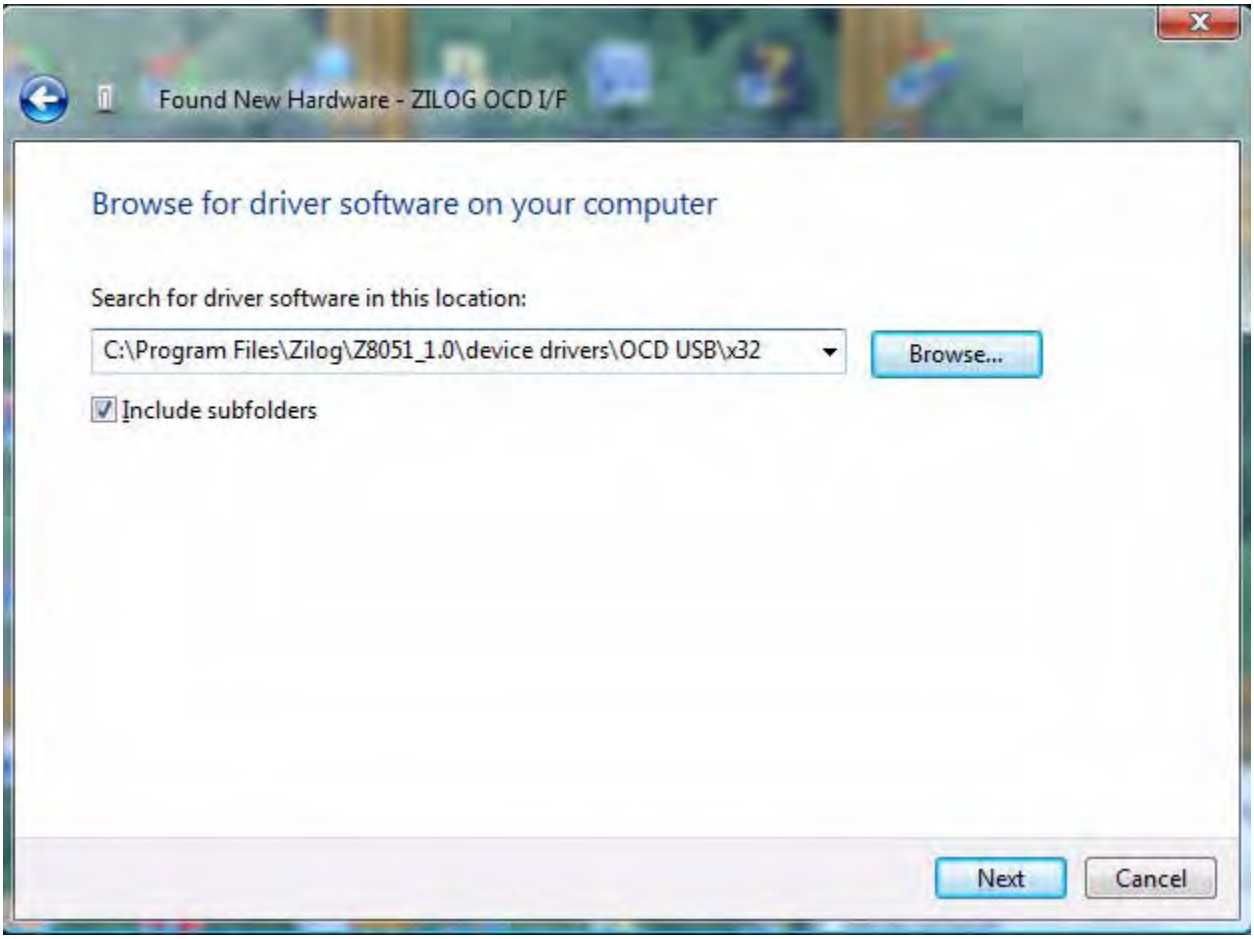

Figure 8. Browse For Driver Dialog, Windows Vista

4. When Windows prompts you whether to install or not install, as shown in Figure 9, click **Install this driver software anyway** and wait until the installation is completed (Windows may prompt you more than once).

Figure 9. Can't Verify Publisher Dialog, Windows Vista

5. When the installation is complete, the screen shown in Figure 10 will appear. Click **Close** to exit the OCD driver installation.

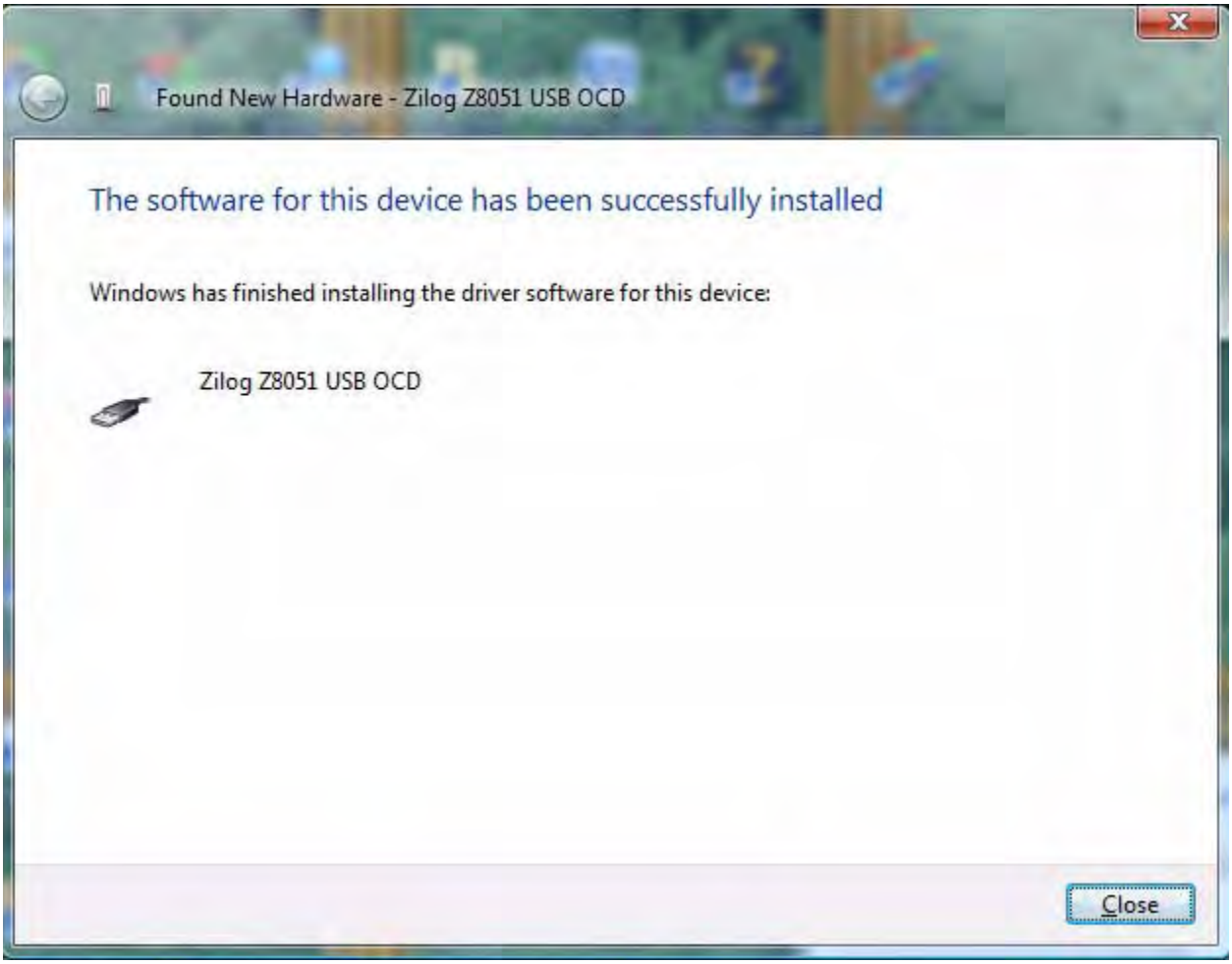

Figure 10. Successfully Installed Dialog, Windows Vista

Note: On some installations, the Found New Hardware screen shown in Figure 10 may also display the text string, `Zilog Z8051 USB OCD - No Firmware`. This occurrence is normal and can be disregarded.

6. If *Zilog Z8051 USB OCD* appears in the Device Manager (as highlighted in Figure 11), the OCD driver software has been successfully installed.

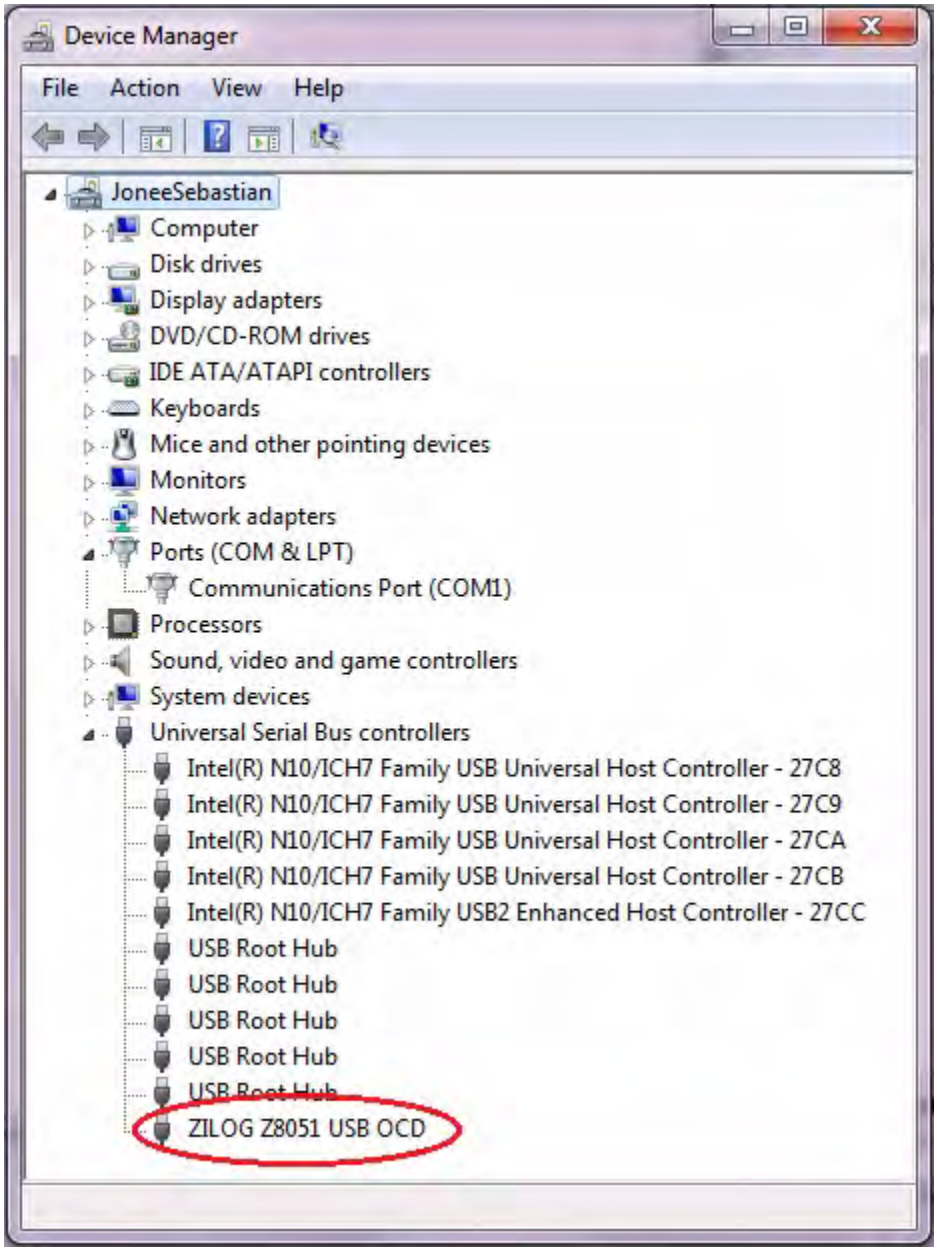

Figure 11. Device Manager Dialog, Windows 7

FTDI USB-to-UART Driver Installation

An FTDI USB-to-UART driver is required to allow your PC to communicate through its USB port to the on-chip UART of the Z51F6412 MCU. Observe the following procedure to perform these connections.

1. Ensure that the USB cable is not plugged in to the Z51F6412 Development Board's P1 connector.
2. Navigate to the following filepath and double-click the `CDM20802_setup.exe` file to begin the driver installation.

   <Z8051 Installation>\Z8051_<*version_number*>\device drivers\FTDI Uart

3. The installation process will begin and you should observe output similar to the following messages on the screen of your PC:

```
32-bit OS detected
<installation path>\dpinstx86.exe
Installation driver
FTDI CDM driver installation process completed.
```

Note: The above message may appear for a short time, but will then disappear from your window. This occurrence is normal.

4. When the installation is complete, plug in the Mini-B connector of the second USB cable into the Board, and the larger A connector into the USB port of your PC. Refer to Figure 15 on page 18 for guidance.
5. If the driver installation was successful, the *Ports (COM & LPT)* section of the Device Manager will display *USB Serial Port (COMx)* or similar message, as highlighted in Figure 12.

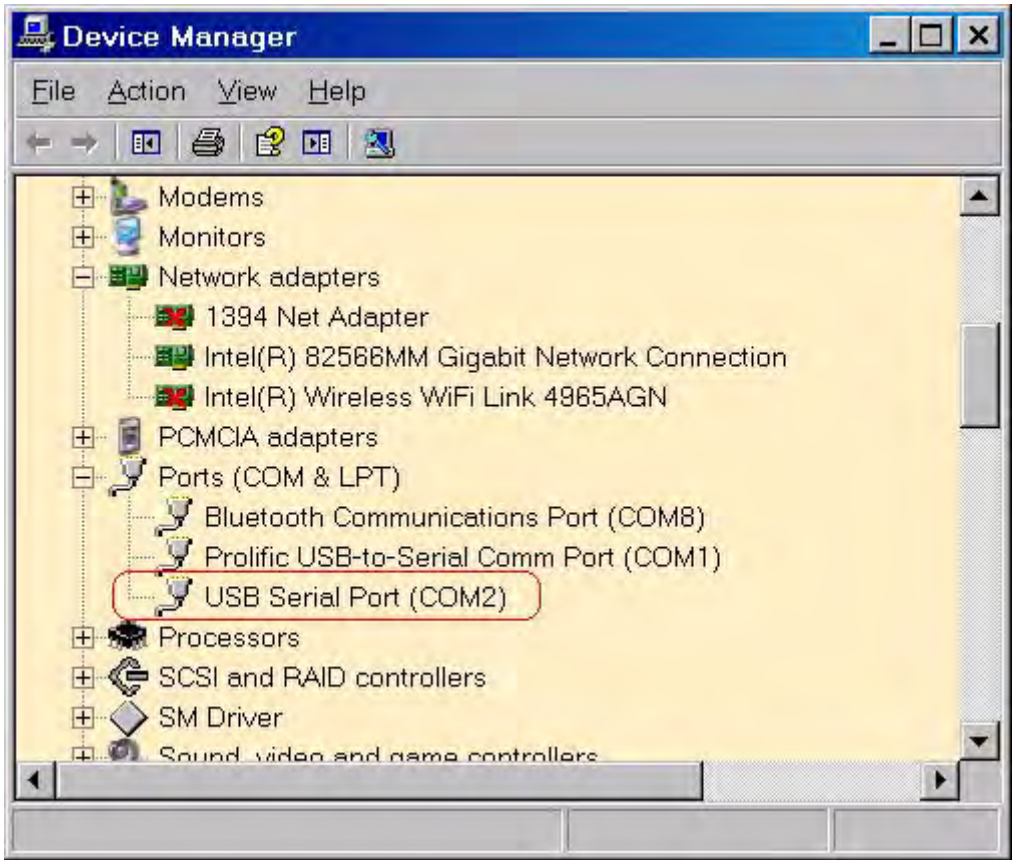

Figure 12. A Successful USB-to-UART Driver Installation

Note: To launch the Device Manager on Windows 7 systems, launch the Start menu, enter *device manager* in the **Search programs and files** field, and press the Enter key.

To open the Device manager on earlier Windows systems, navigate via the following path:

Start → Control Panel → System → Hardware → Device Manager → Ports (COM& LPT)

Configure the Z8051 OCD and Z51F6412 Development Board

Observe the following procedure to set up and configure the Z8051 On-Chip Debugger and the Z51F6412 Board.

Caution: Steps number 1 to 4 present the power-up sequence. Carefully follow these steps to avoid encountering an improper connection or disconnection.

1. Connect the Z8051 On-Chip Debugger (OCD) to the host PC's USB port.
2. Connect one end of the 10-circuit cable to the Z8051 OCD.
3. Connect the other end of the 10-circuit cable connector to the Board's J3 connector. Pin 1 of the cable connector is indicated by a red stripe, as shown in Figure 13.

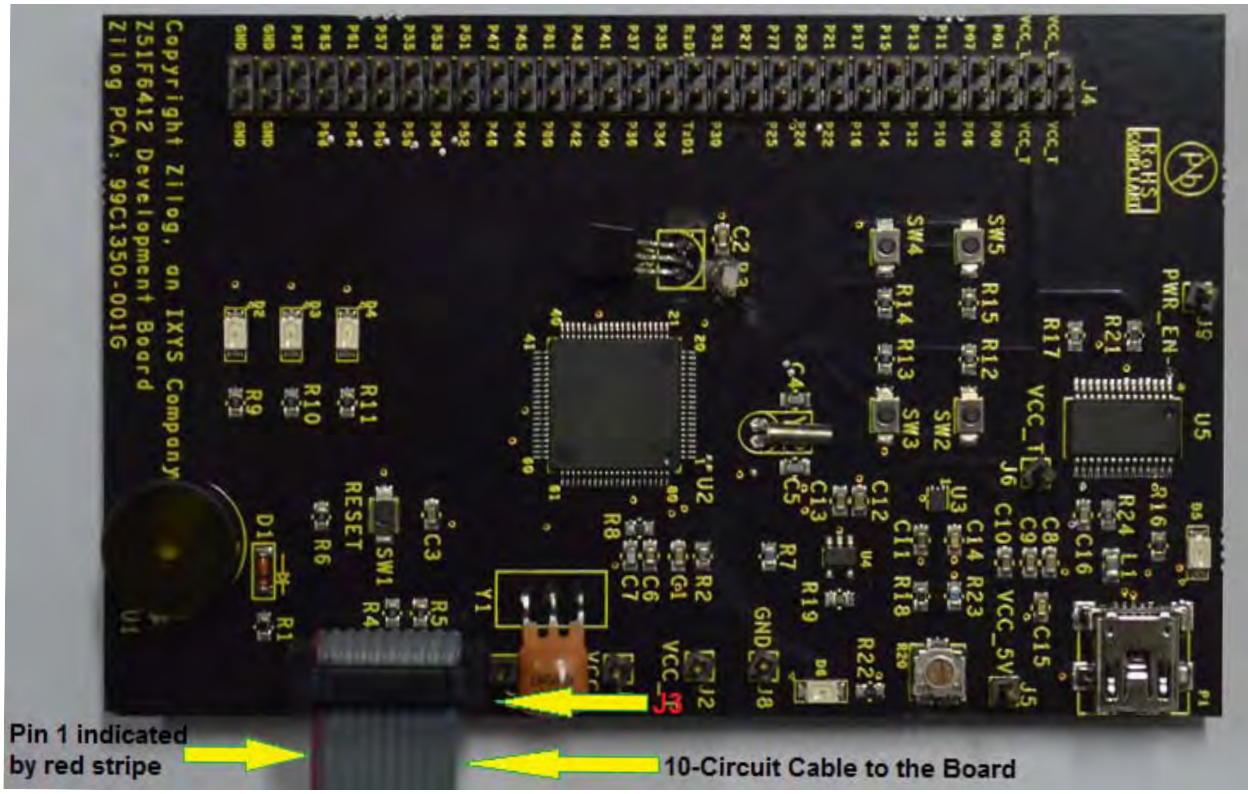

Figure 13. Connecting the 10-Circuit Cable to the Board

4. Using the second USB-to-Mini-B cable, connect the standard USB end to the host PC's USB port.
5. Connect the other end of this second Mini-B cable to the Z51F6412 Board's P1 connector to apply power to the Board. Note that the green LED D5 is ON; see Figure 14.

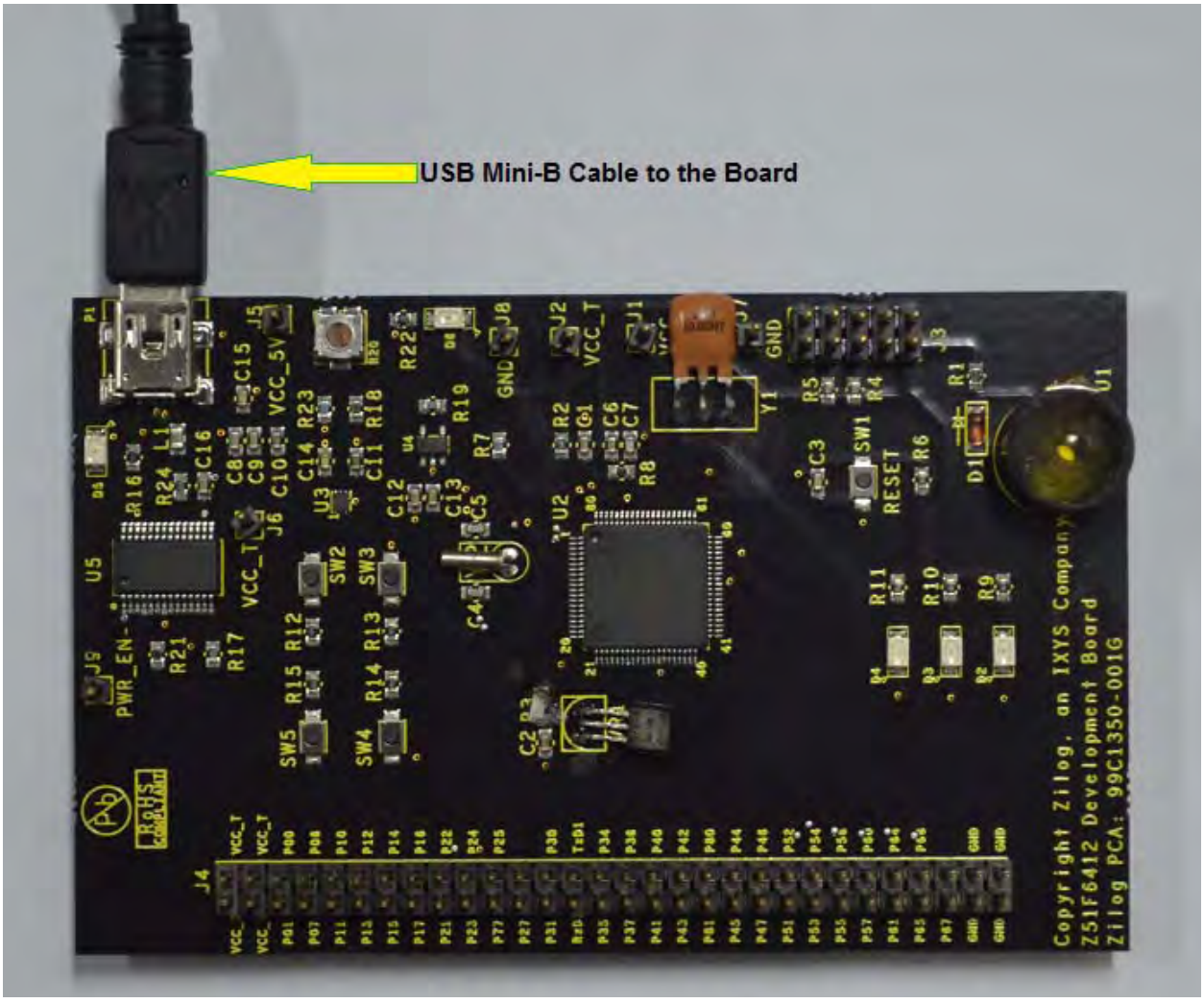

Figure 14. Connecting the USB Mini-B Cable to the Board

Figure 15 shows an example of a completed hardware and software setup.

Figure 15. An Example Setup

Build and Run the Z51F6412 Demo Project

Observe the following procedure to build and run the Z51F6412 demo project.

Note: If you plan to use the Keil µVision IDE, please skip to the the Using the Keil µVision IDE on a Demo Project section on page 25.

1. Browse to the following location and double-click the `build_sdcc.bat` batch file to build the project:

   <Z8051 Installation>\Z8051_<*version_number*>\samples\Z51F6412\Demo\build_sdcc.bat

Note: Refer to the Z8051 Tools Product User Guide (PUG0033) for additional information about these project files and Small Device C Compiler (SDCC) development tools.

2. When the build is complete, the command window will prompt the user to press any key to continue. Proceed by pressing any key on your keyboard; as a result, a hex file for the demo will be created in the following path:

   <Z8051 Installation>\Z8051_<*version_number*>\samples\Z51F6412\Demo\demo.hex

3. Set up the OCD and Development Board. If you have not already configured these items, please return to the Configure the Z8051 OCD and Z51F6412 Development Board section on page 16.
4. Run the Z8051 OCD software. From the **Start** menu, navigate to **All Programs → Zilog Z8051 Software and Documentation <version_number> → Zilog Z8051 OCD <version_number>**. Once launched, the program will display *Connected*, as shown in Figure 16.

Note: If you encounter a message that says `Disconnected`, return to the Configure the Z8051 OCD and Z51F6412 Development Board section on page 16 to configure the proper power-up sequence. If the problem persists, Zilog recommends that you review the Z8051 OCD Driver Installation and FTDI USB-to-UART Driver Installation sections.

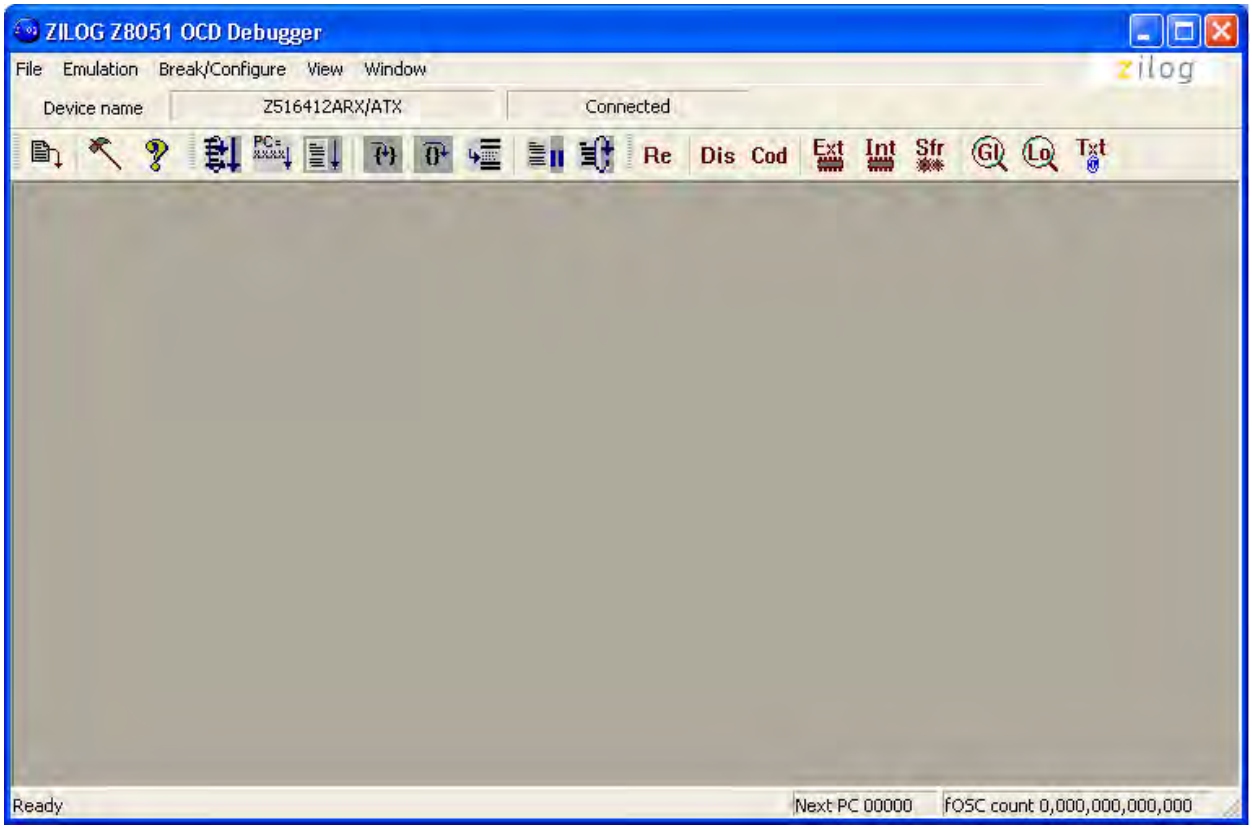

Figure 16. Initial OCD Screen

Note: For a free download of the latest version of the OCD software, visit the Zilog website and navigate via the **Tools and Software** menu to **Software Downloads**.

5. In the Debugger window, select **Load Hex** from the **File** menu to display the Object File dialog, which is shown in Figure 17.

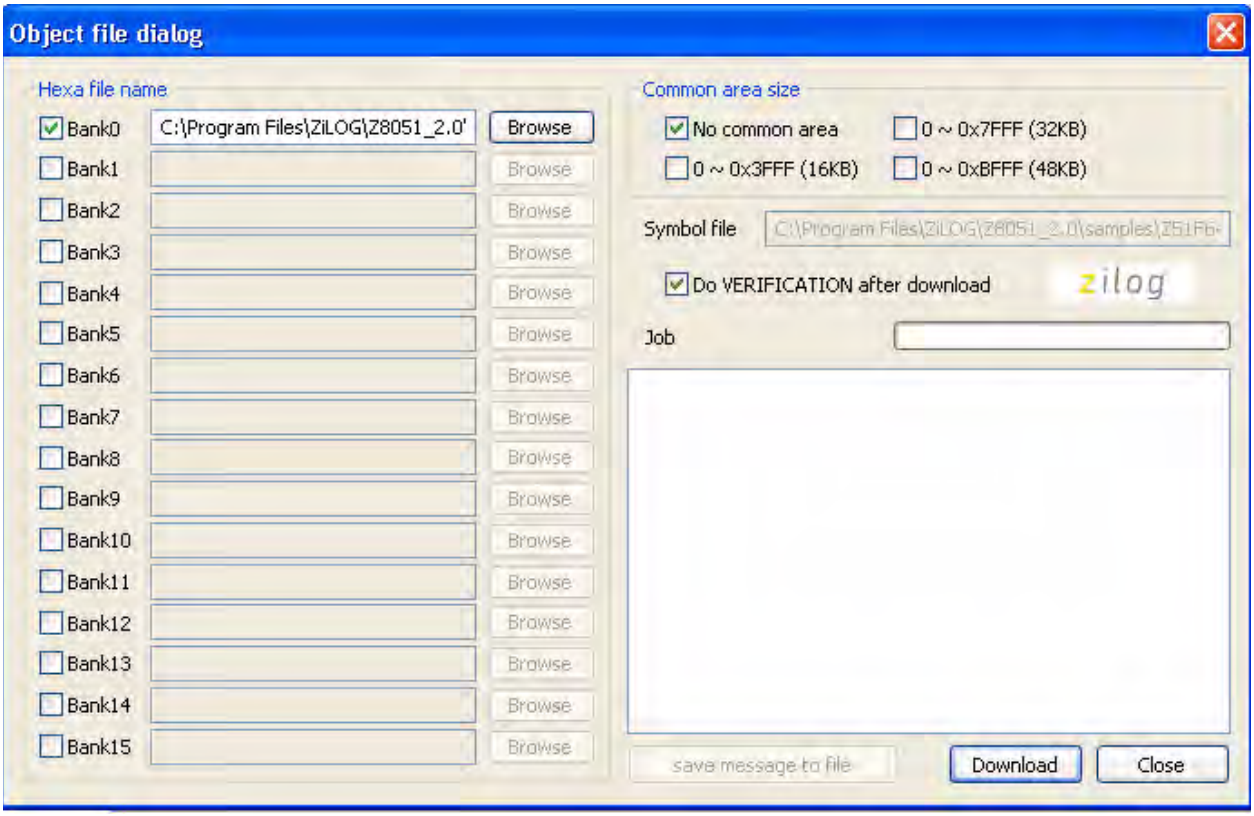

Figure 17. Object File Dialog

6. In the Object File dialog, browse to the hex file that you created in Step 2 and click **Open**.
7. Click the **Download** button to open the Configuration dialog box, shown in Figure 18.

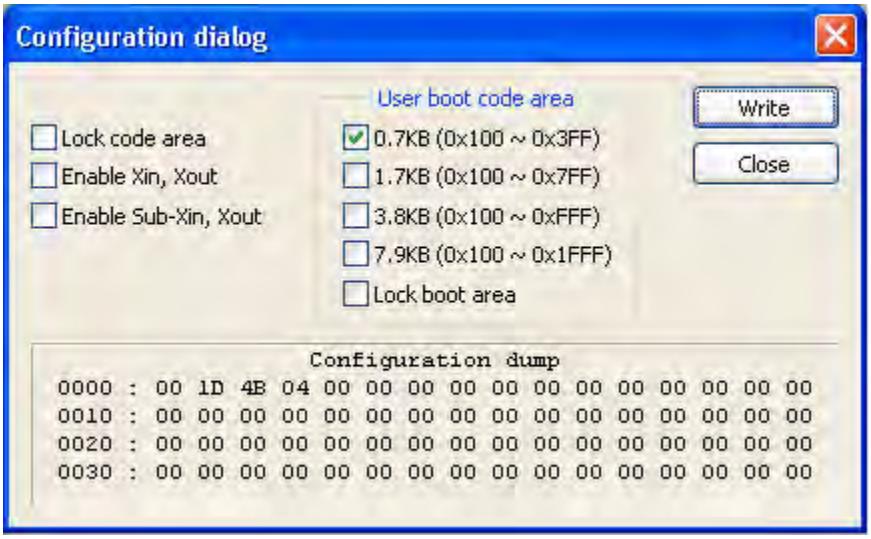

Figure 18. Configuration Dialog

8. Click the **Write** button to open the Configuration Is Changed dialog.
9. Click **OK** to open the On-Chip Debugger's main window. A typical OCD display is shown in Figure 19; Figure 20 shows an OCD window with child windows open.

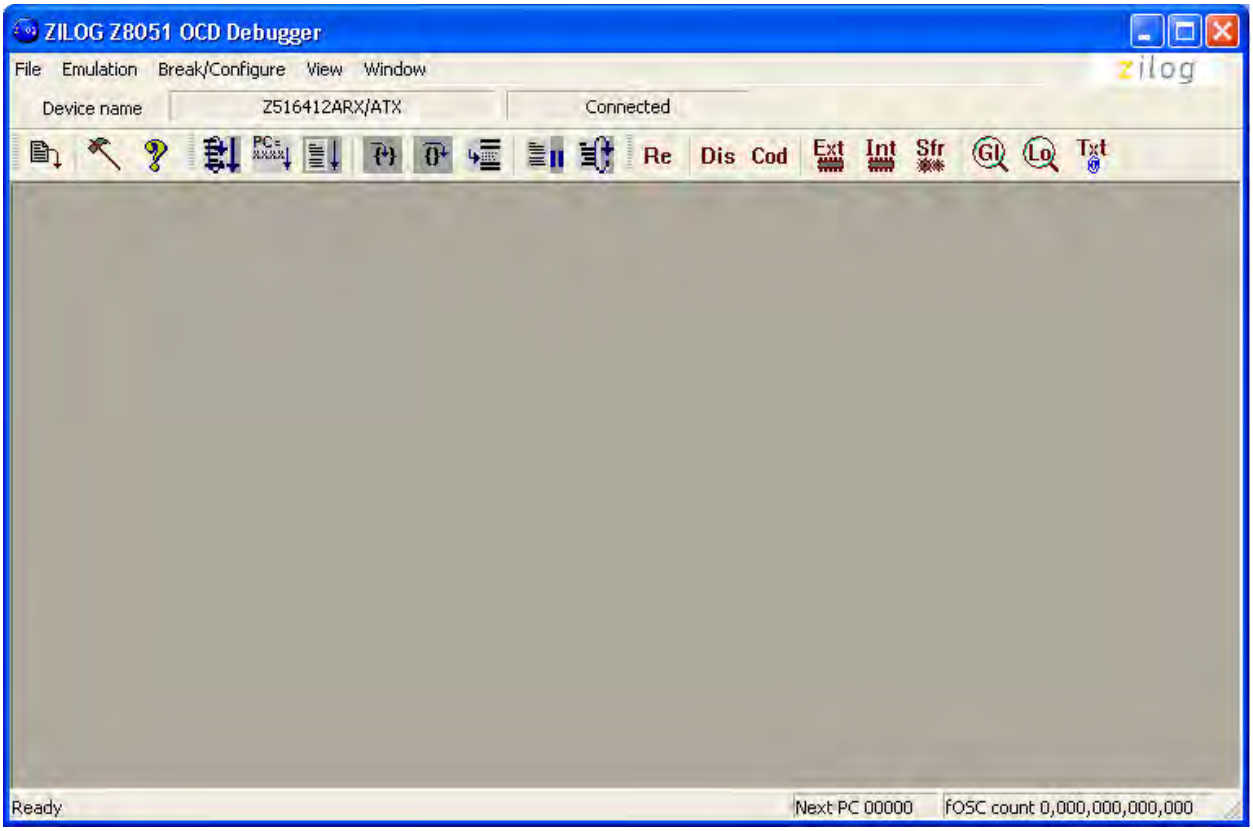

Figure 19. A Typical On-Chip Debugger Window

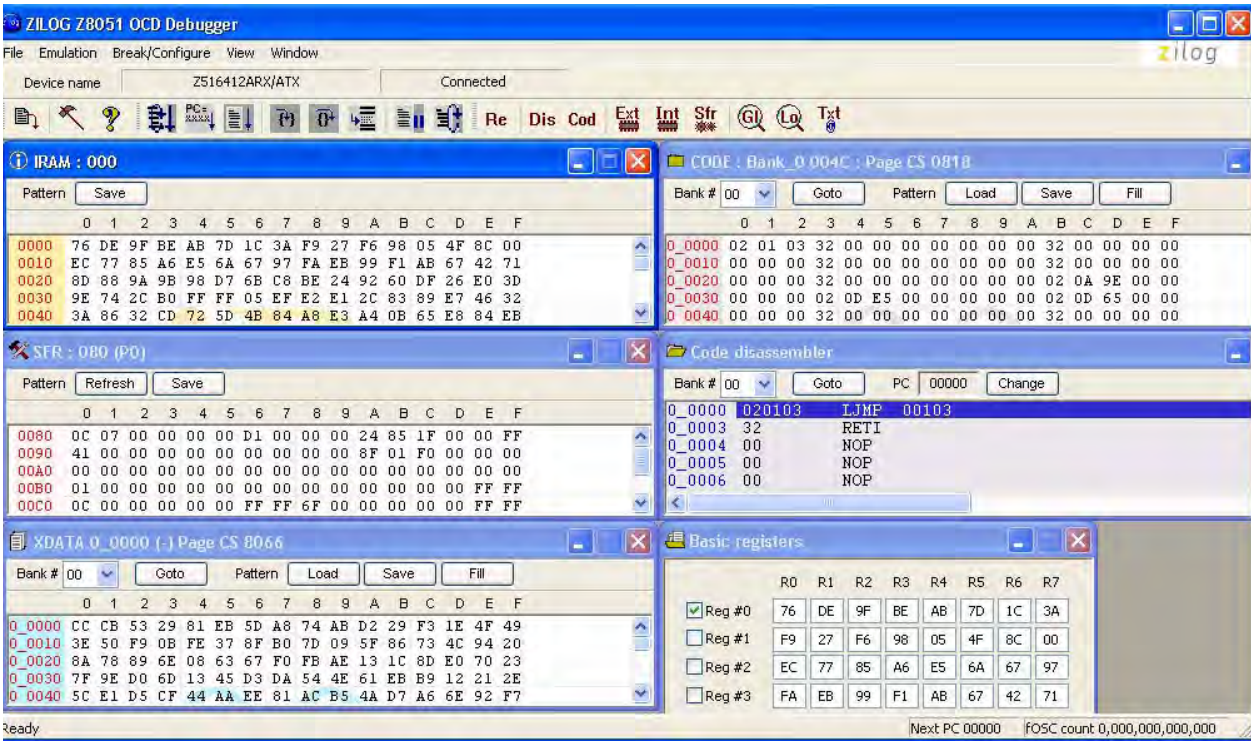

Figure 20. A Typical On-Chip Debugger Window with Child Windows Open

Note: Use the View menu to open the child windows. For this demonstration, the example windows shown in Figure 20 do not need to be opened.

10. Click the **Reset & Go** toolbar icon, shown in Figure 21. As a result, LEDs D2, D3 and D4 on the Z51F6412 Board will blink in sequence.

Figure 21. Reset & Go Toolbar Icon

Note: Similar projects that you can use as references are listed in Table 2 on page 35.

Using the Keil µVision IDE on a Demo Project

Zilog's On-Chip Debugger hardware now fully supports the Keil µVision IDE. Our target driver is seamlessly integrated with the Keil debugger, allowing Keil C51 users to work within the µVision4 environment without switching between the Keil compiler and Zilog's external OCD software. In the demo project example that follows, the Z51F6412 MCU-related project is referenced as `Demo`.

Notes: This document refers to the Keil µVision IDE V4.53.0.6 (PK51 Prof. Developers Kit) or later.

Refer to the Z8051 Tools Product User Guide (PUG0033) for additional information about these project files and debugging with the Keil µVision IDE and Zilog On-Chip Debugger.

Debugger Configuration

Observe the following procedure to build and run a Z51F6412 demonstration project using the Keil µVision IDE.

1. Start the Keil µVsion4 IDE.
2. From the **Project** menu, select **Open Project** and navigate to the following filepath:

   <Installation directory>\Z8051_<version>\samples\Z51F6412\Demo

3. Select the `Demo.uvproj` file and click **Open**; see Figure 22.

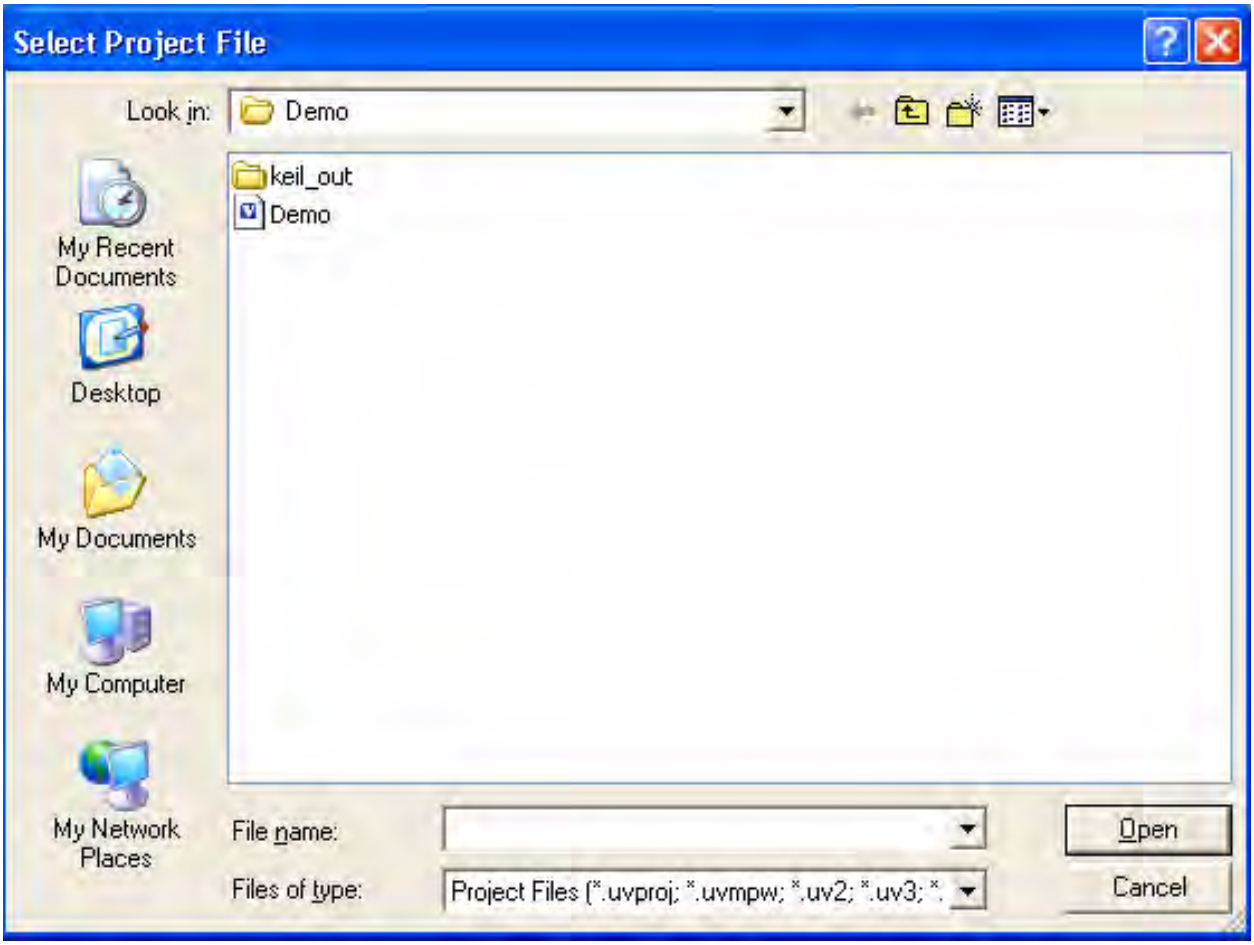

Figure 22. Selecting the Demo Project File

4. Return to the **Project** menu and select **Options for Target 'Demo'**.
5. In the Options for Target 'Demo' dialog that appears, click the **Device** tab and ensure that your target is properly selected for your project, as illustrated in Figure 23.

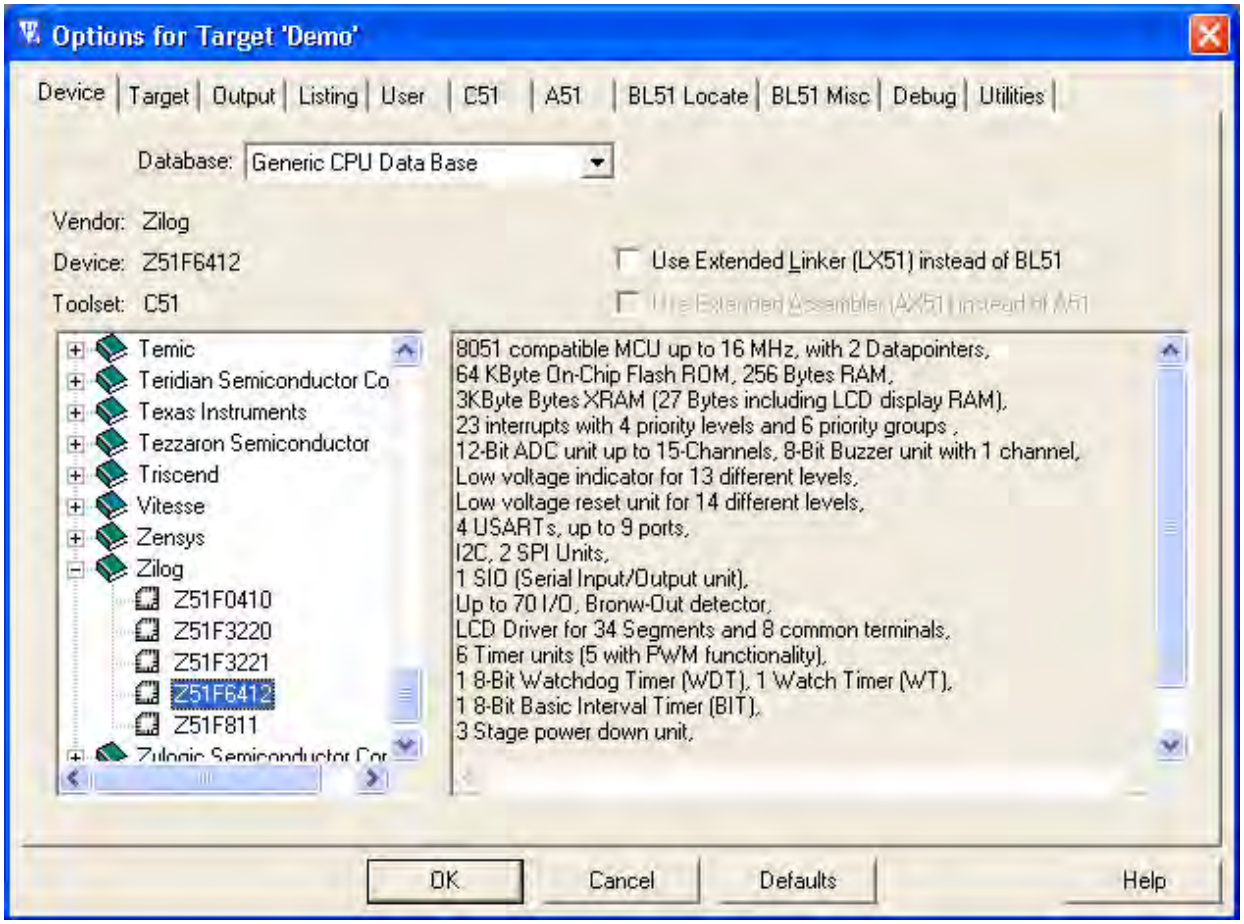

Figure 23. Selecting the Target

6. After selecting the target, click the **Debug** tab and select the **Zilog Z8051 Target Driver** from the **Use:** drop-down menu, as highlighted in Figure 24.

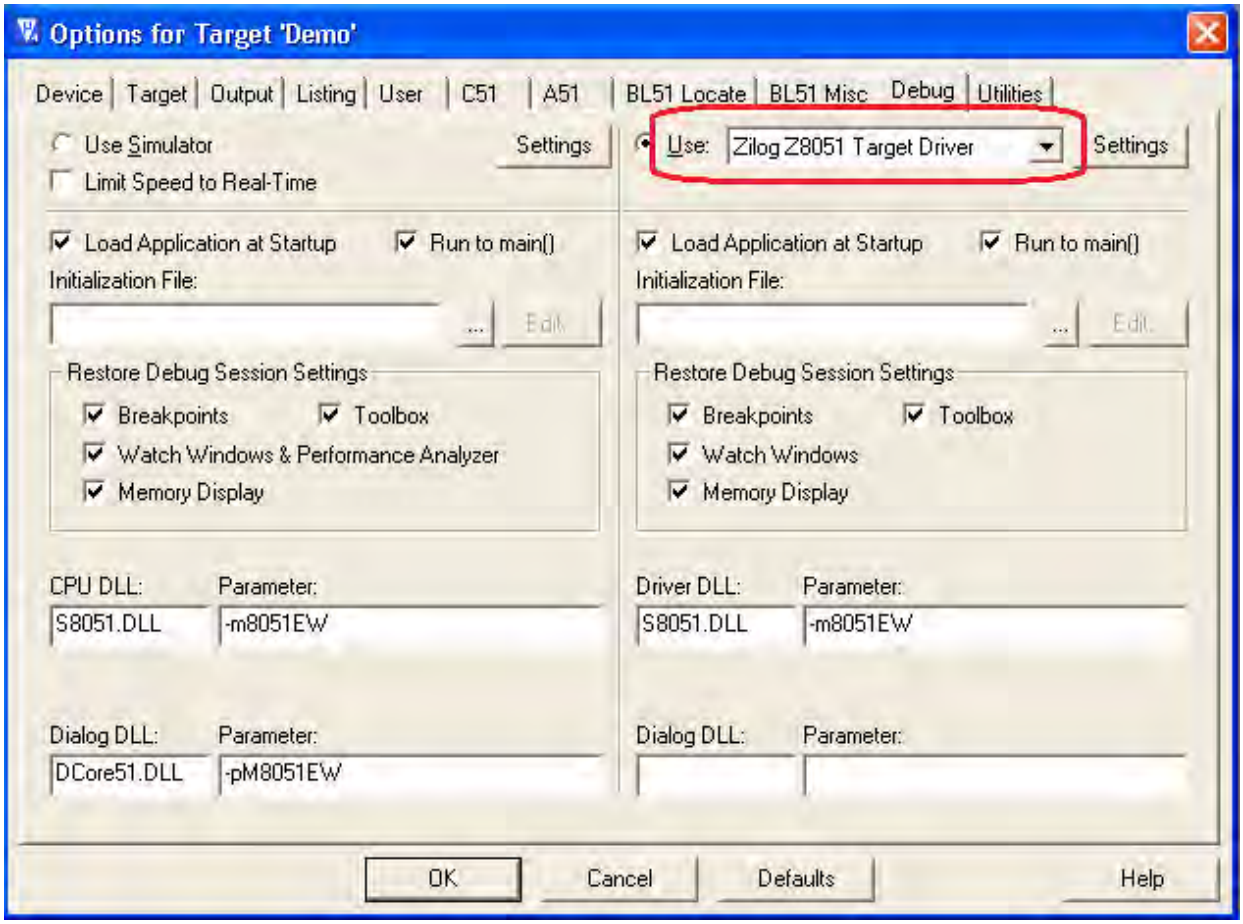

Figure 24. Selecting the Target Driver

7. Click the **Settings** button, located to the right of this drop-down menu, to configure your Debug and Flash options. The Settings dialog is displayed with the Debug Options tab appearing by default, as shown in Figure 25.

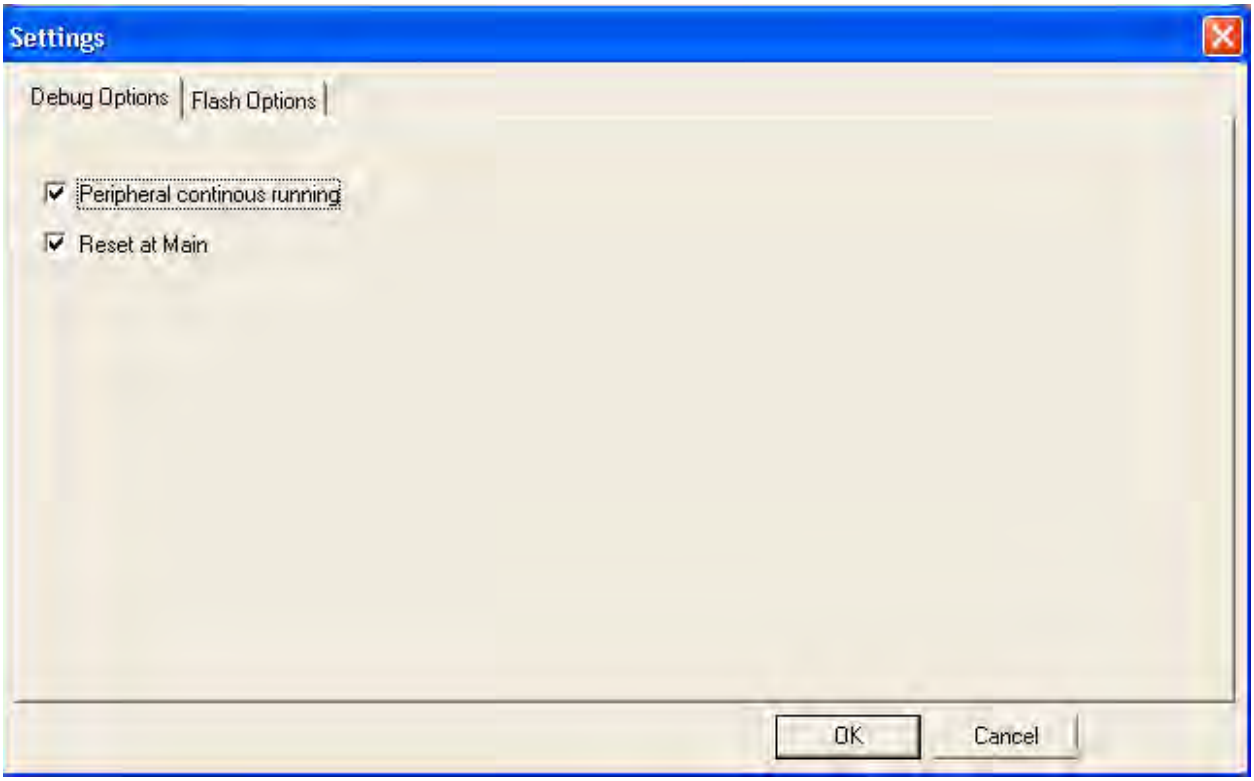

Figure 25. Configuring the Debug Options

Notes: When configuring the appropriate Debug option, be aware of the following stipulations:

- Checking the **Peripheral continues running** option means that the timers used in your project will run while the processor is stopped by the debugger.
- The **Reset at Main** option will only work if you have a `main` file in your project; otherwise you should deselect this option.

8. Click the **Flash Options** tab. The Flash Options Settings dialog will appear, as shown in Figure 26. To select the proper options for Flash programming, refer to the Z51F6412 Product Specification (PS0303).

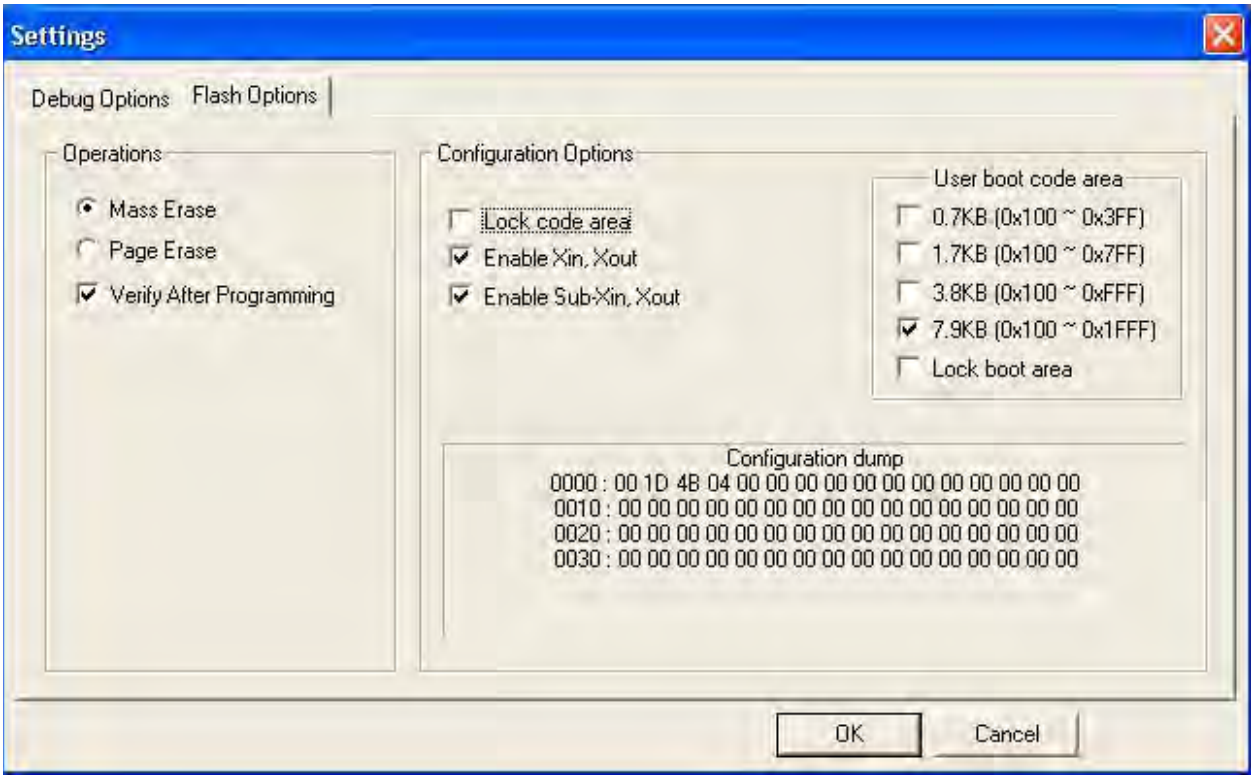

Figure 26. Configuring the Flash Options

9. Click **OK** to exit the Settings dialog.
10. From the **Options for Target 'Demo'** dialog, select the **Load Application at Startup** checkbox, as shown in Figure 27, the so that the IDE will download the code upon connection. There is no need to select or enter an initialization file.

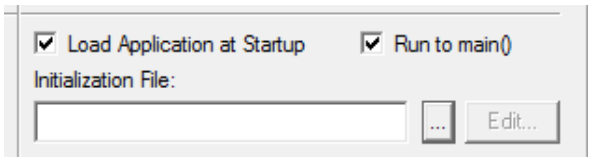

Figure 27. Load Application at Startup Settings

11. Click **OK** to exit the **Options for Target 'Demo'** dialog.
12. From the **Project** menu, select **Rebuild All** to rebuild all target files.

13. Start your debugging session by clicking the **Start/Stop Debug Session** icon, as indicated in Figure 28. A default Windows configuration of the debug session is shown in Figure 29.

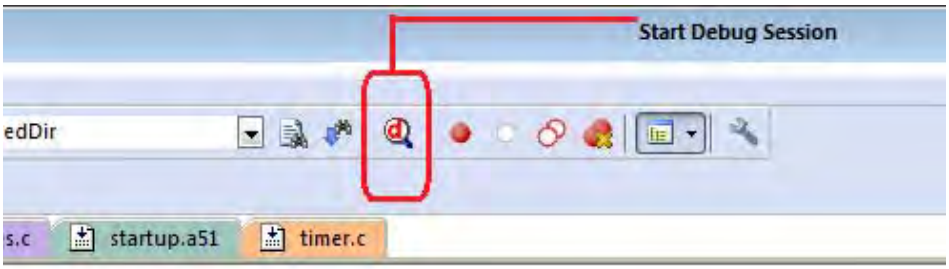

Figure 28. Beginning a Debug Session

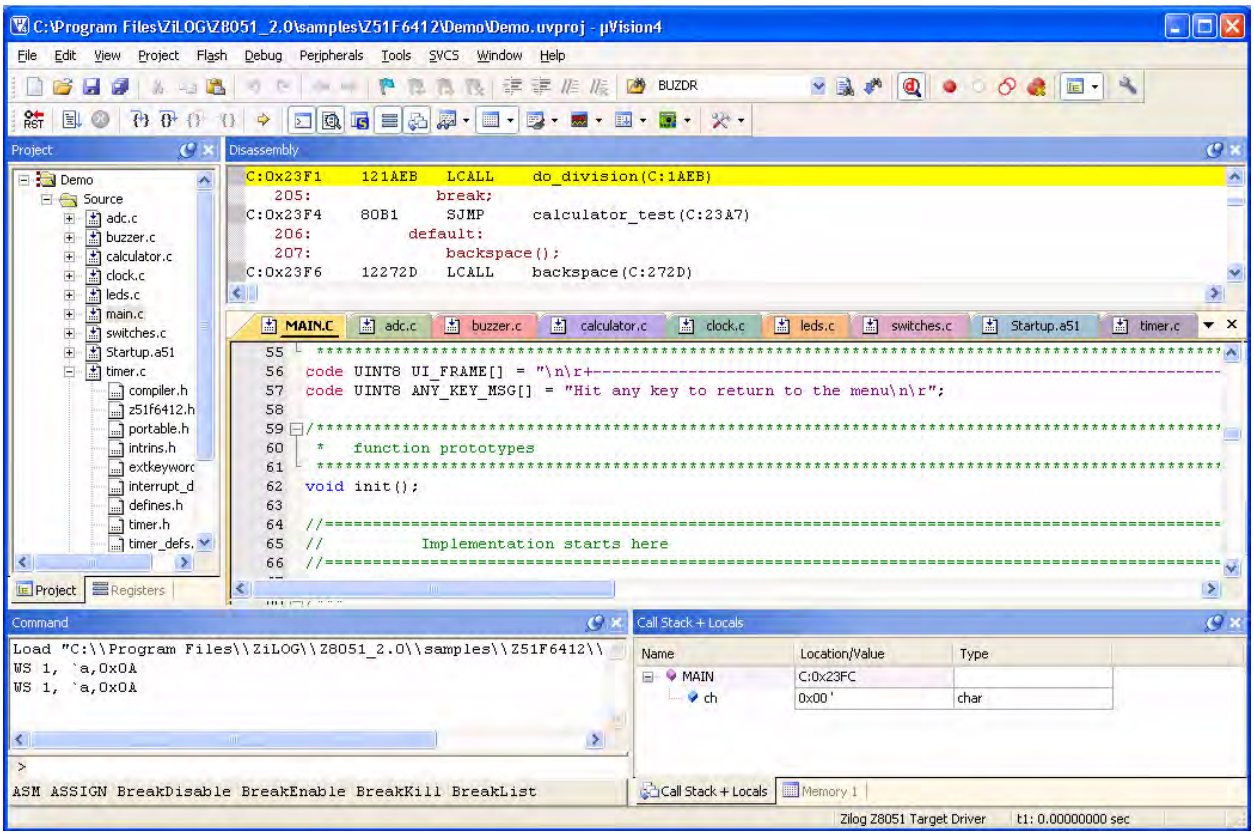

Figure 29. A Default Debug Session

Note: The following buttons in the Keil µVision IDE are not supported by the Zilog OCD driver:

To learn more about the full functionality of the Keil µVision IDE, please refer to the Keil Keil µVision4 IDE documentation.

14. From the **Debug** menu, select **Run**, or simply press the **F5** key on your Windows keyboard to run the demo project. As a result, LEDs D2, D3 and D4 on the Z51F6412 Development Board will blink in sequence.
15. To stop code execution, select **Stop** from the **Debug** menu.
16. To stop your debugging session, click the **Start/Stop Debug Session** icon.

Note: Refer to Appendix C on page 45 for a discussion of Stand-Alone Flash Programming Using the Keil µVision IDE.

HyperTerminal Configuration

A communications program such as HyperTerminal can be used on Windows XP systems to view the messages from the Z51F6412 Development Board. The following procedure examines how to configure HyperTerminal for the Z51F6412 demo project.

Note: The HyperTerminal application is not available in Windows Vista and Windows 7 systems. If you are using either of these operating systems, consider using/installing different communication software, such as Tera Term. Please refer to the documentation for the particular emulation software you use to configure it for communication with the Z51F6412 Development Board.

1. In HyperTerminal, select the COM port assigned to the USB-to-UART interface cable that is connected to the P1 connector on the Development Board.

Note: This COM port can be determined from the Device Manager, as described in the the FTDI USB-to-UART Driver Installation section on page 14.

2. Configure this port to reflect the following settings:
   - 9600bps
   - 8 data bits
   - No parity
   - 1 stop bit
   - No flow control

3. Click the **Call** button to connect to the Z51F6412 Board. Upon connection, you should be able to see the Demo program menu shown in Figure 30.

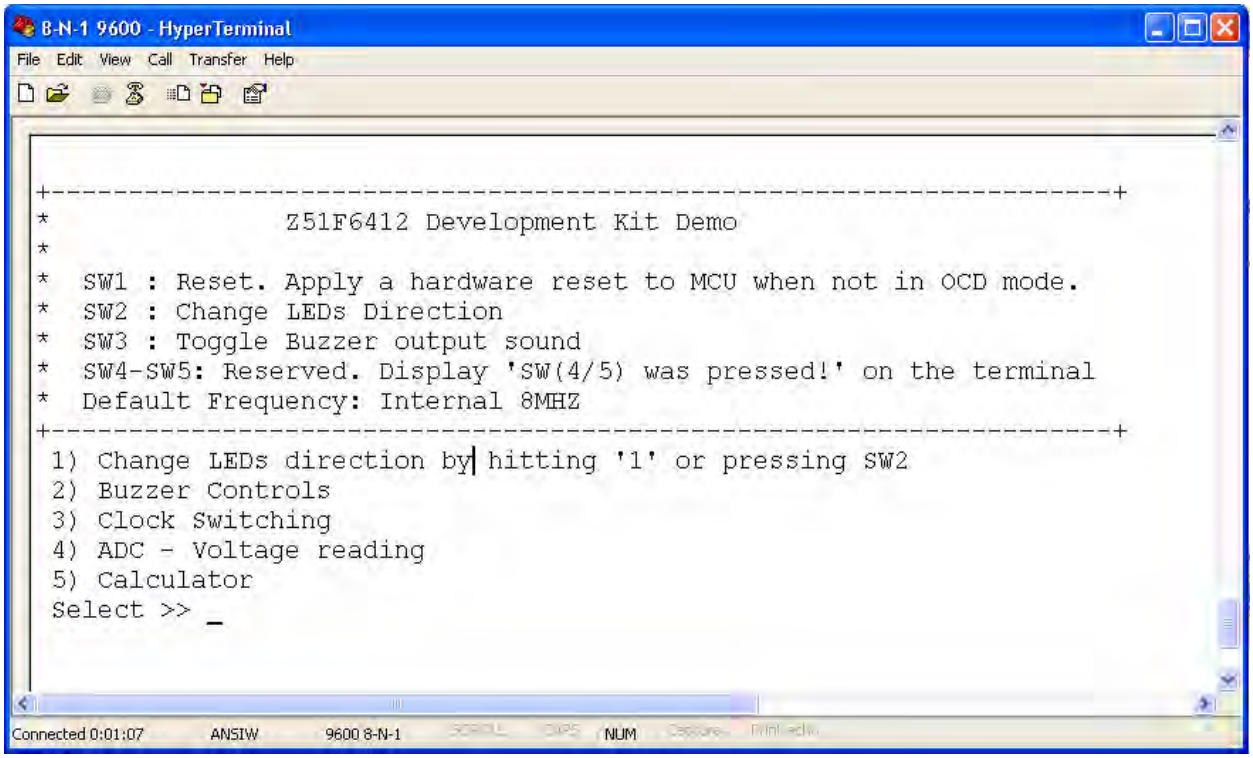

Figure 30. Demo Program Menu in HyperTerminal

At this point, you have successfully run the Z51F6412 demo project, but you are welcome to continue evaluating the demo in HyperTerminal. For additional information about how

to create, edit, run and debug this project, please see the Z8051 Tools Product User Guide (PUG0033) and/or the Z8051 On-Chip Debugger and In-System Programmer User Manual (UM0240).

Note: Turn off the power by removing the USB cable from the P1 connector on the Development Board.

Sample Projects and Documentation

A number of sample projects are included on the CD that ships with the Z51F6412 Development Kit, and their locations, listed in Table 2, will be accessible upon installation.

Table 2. Z51F6412 Development Kit Sample Projects

Description	Location
Demo	samples\Z51F6412\Demo
Led Blink	samples\Z51F6412\Led_Blink
	samples\Z51F6412\Led_Blink_Asm

A number of Z8051-related documents are included in the Z51F6412 Development Kit, and their locations, listed in Table 3, will be accessible upon installation. You can also find current versions of each of these documents on the Zilog website.

Table 3. Z51F6412 Development Kit Documentation

Description	Document	Location
Z51F0410 Product Specification	PS0295	Documentation\Chip_Documentation
Z51F0811 Product Specification	PS0296	Documentation\Chip_Documentation
Z51F3220 Product Specification	PS0299	Documentation\Chip_Documentation
Z51F3221 Product Specification	PS0300	Documentation\Chip_Documentation
Z51F6412 Product Specification	PS0303	Documentation\Chip_Documentation
Z51F0410 Product Brief	PB0237	Documentation\Chip_Documentation
Z51F0811 Product Brief	PB0238	Documentation\Chip_Documentation
Z51F3220 Product Brief	PB0239	Documentation\Chip_Documentation
Z51F3221 Product Brief	PB0240	Documentation\Chip_Documentation
Z51F6412 Product Brief	PB0241	Documentation\Chip_Documentation
Z8051 OCD and ISP User Manual	UM0240	Documentation\Tools_Documentation
Z51F0410 Evaluation Kit User Manual	UM0257	Documentation\Tools_Documentation
Z51F0811 Evaluation Kit User Manual	UM0242	Documentation\Tools_Documentation
Z51F3220 Development Kit User Manual	UM0243	Documentation\Tools_Documentation
Z51F3221 Development Kit User Manual	UM0258	Documentation\Tools_Documentation

Table 3. Z51F6412 Development Kit Documentation (Continued)

Description	Document	Location
Z51F6412 Development Kit User Manual	UM0259	Documentation\Tools_Documentation
Z8051 Tools Product User Guide	PUG0033	Documentation\Tools_Documentation

Schematic Diagrams

Figures 31 and 32 show schematic diagrams of the Z51F6412 Development Board.

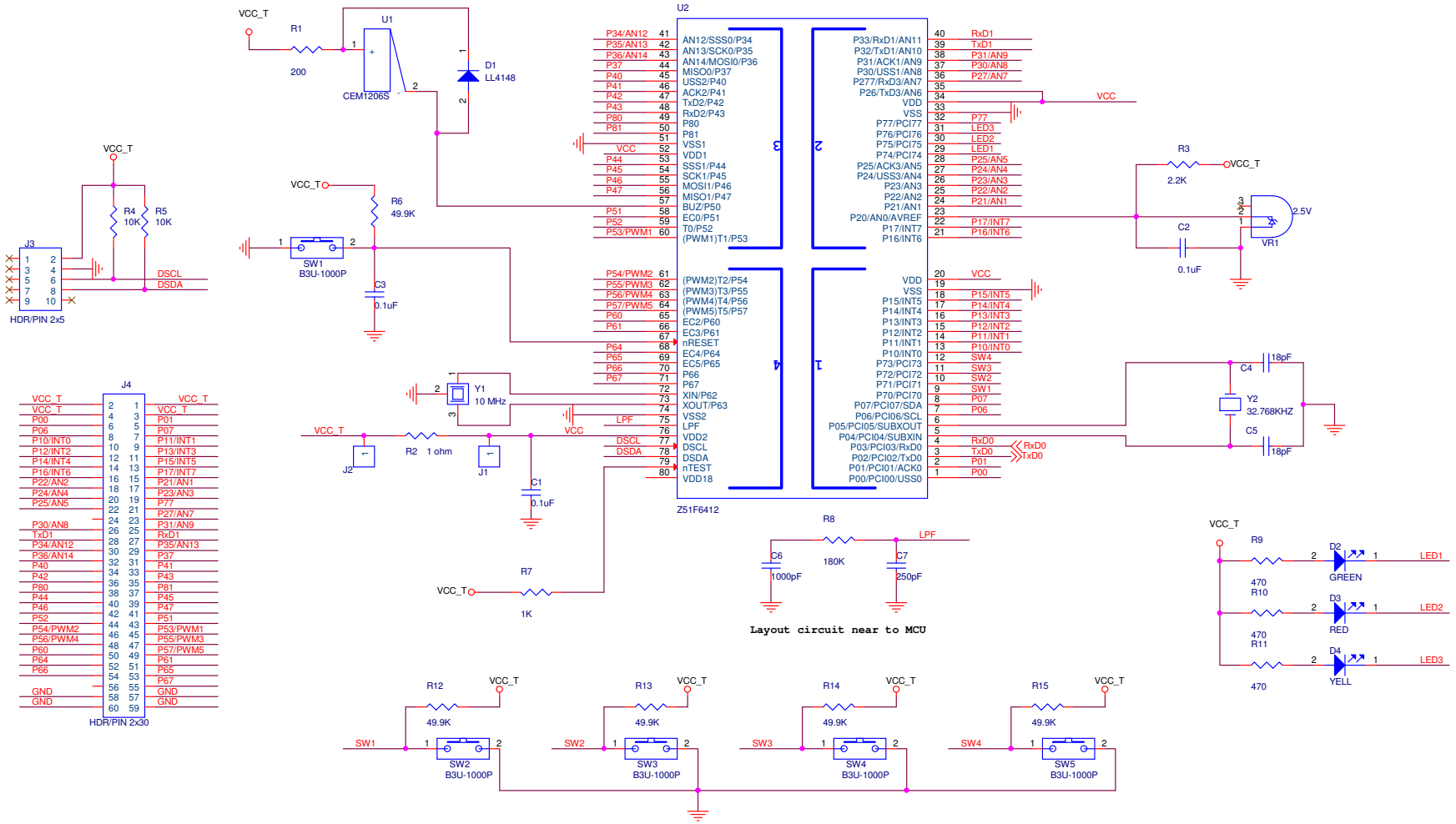

Figure 31. Z51F6412 Development Board, #1 of 2

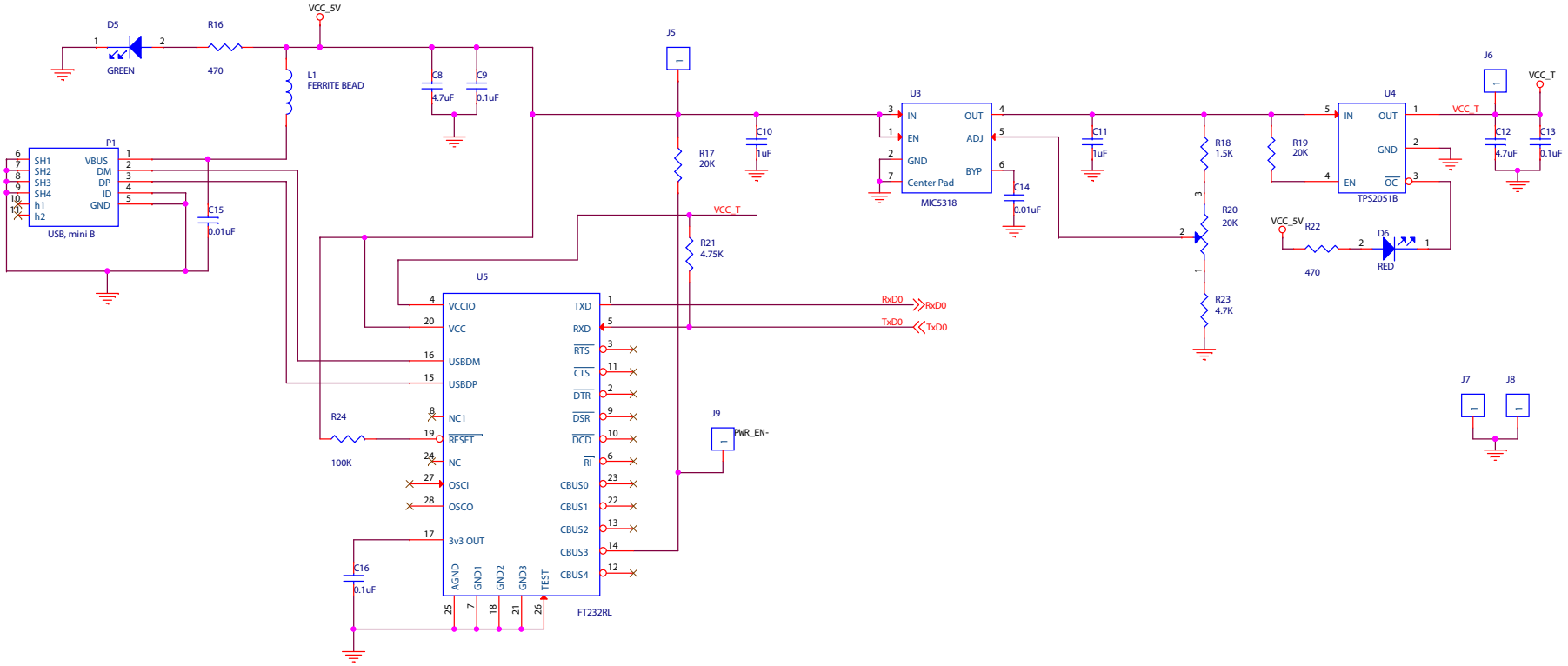

Figure 32. Z51F6412 Development Board, #2 of 2

Appendix A. OCD Driver Installation on Windows Vista Systems

The driver programs for the Z8051 On-Chip Debugger are copied to the development PC during the software and documentation installation. In the following procedure for PCs running Windows Vista 32- and 64-bit operating systems, ensure that the target side of the OCD will remain unconnected while you install these drivers.

1. Connect the OCD hardware to the USB port of your PC by connecting the A (male) end of one of the two USB A (male)-to-Mini-B cables with the development PC's USB port. Connect the Mini-B end to the OCD device.
2. After the PC detects the new hardware, it will display the Found New Hardware Wizard dialog box, shown in Figure 33. Click **Locate and install driver software (recommended)**.

Figure 33. Found New Hardware Dialog, Windows Vista

3. Depending on your development PC's User Account Control settings, Windows may ask for permission to continue the installation. Click **Continue**.

4. When the **Insert the Disc** dialog appears, as shown in Figure 34, select **I don't have the disc. Show me other options.** Click the **Next** button to display the dialog that follows, which is shown in Figure 35.

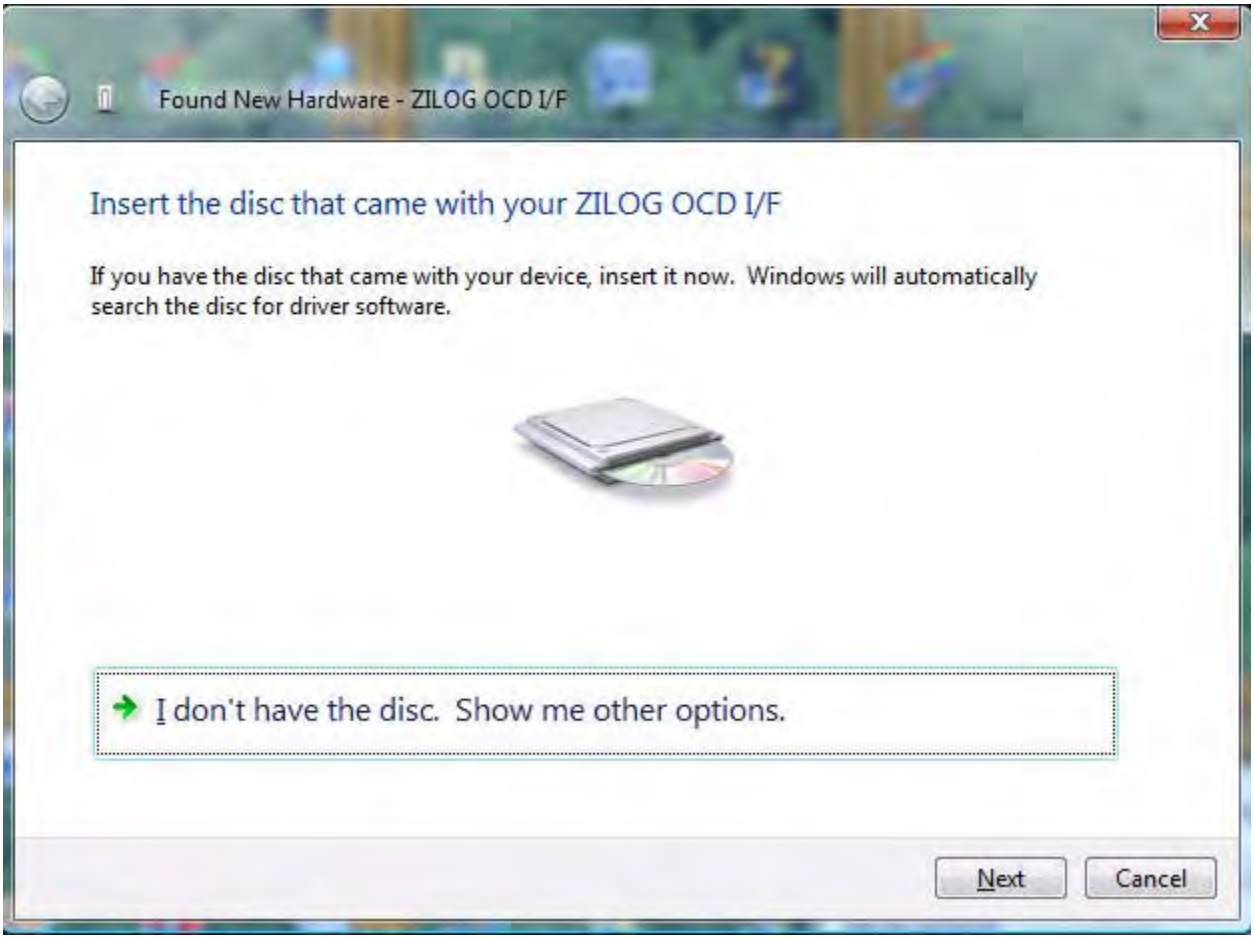

Figure 34. Install Device Driver Dialog, Windows Vista

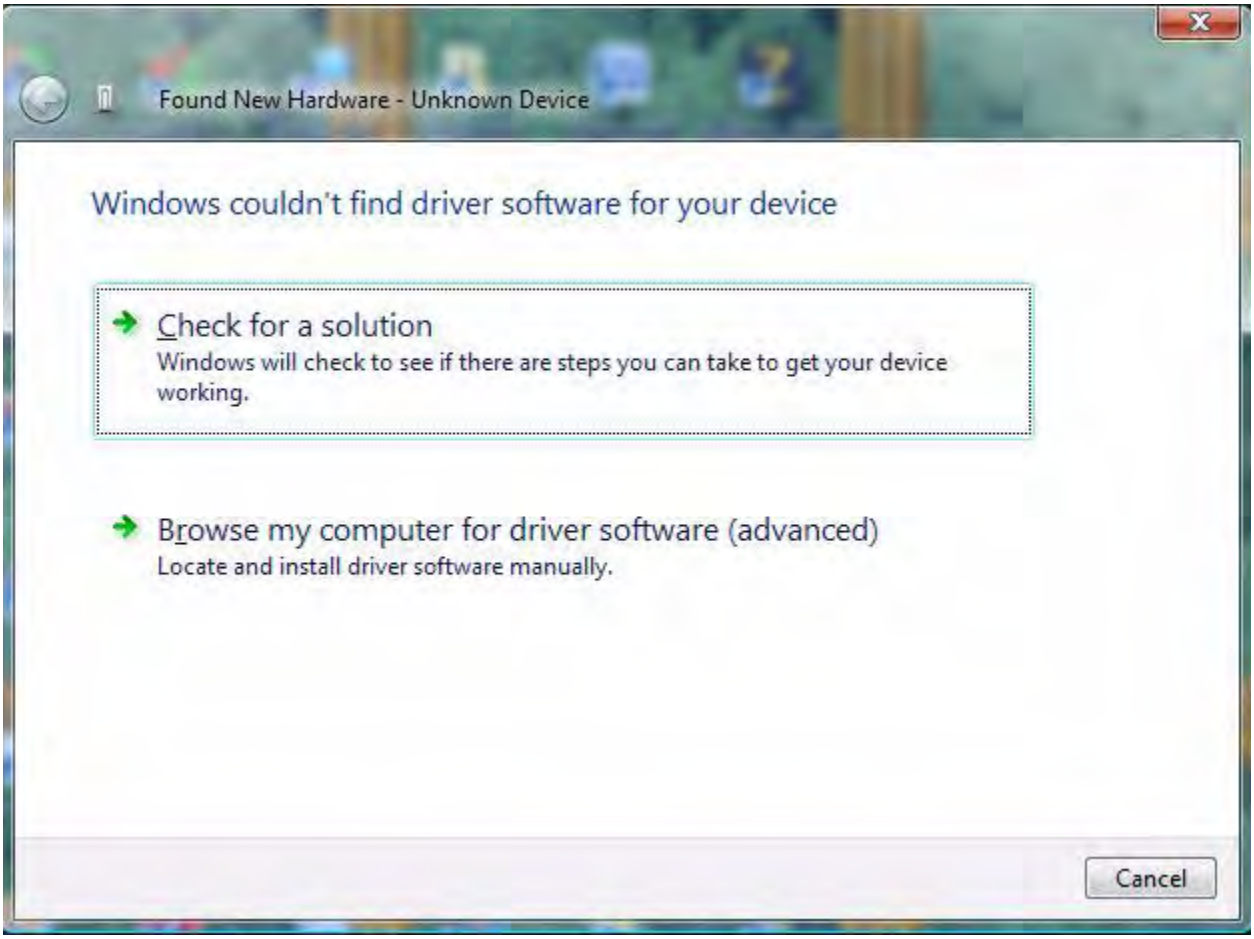

Figure 35. Couldn't Find Driver Dialog, Windows Vista

5. Return to page 8 and follow Steps through 6.

Appendix B. OCD Driver Installation on Windows XP Systems

The driver programs for the Z8051 On-Chip Debugger are copied during the software and documentation installation. In the following procedure for Windows XP systems, ensure that the target side of the OCD will remain unconnected while you install these drivers.

1. Connect the OCD hardware to the USB port of your PC by connecting the A-Male end of one of the two USB A (male)-to-Mini-B cables with the host PC's USB port, and connect the Mini-B end to the OCD device.
2. After the PC detects the new hardware, it will display the **Found New Hardware Wizard** dialog box, shown in Figure 36. Select **Install from a list or specific location (Advanced)**; then click **Next**.

Figure 36. The Found New Hardware Wizard Welcome Screen

3. The next dialog box, shown in Figure 37, prompts you to enter a path or navigate to the directory in which the `.inf` file was installed. Depending on the type of computer you use (32- bit or 64-bit), use the **Browse** button to navigate to one of the following paths and click the **Next** button, leaving all other selections at their default settings.
   – On 32-bit machines, use the following path:

     <Z8051 Installation>\Z8051_<*version_number*>\device drivers\OCD USB\x32

   – On 64-bit machines, use the following path:

     <Z8051 Installation>\Z8051_<*version_number*>\device drivers\OCD USB\x64

Note: On some installations, the Found New Hardware screen shown in Figure 8 on page 10 may also display the text string, `Zilog Z8051 USB OCD - No Firmware`. This occurrence is normal and can be disregarded.

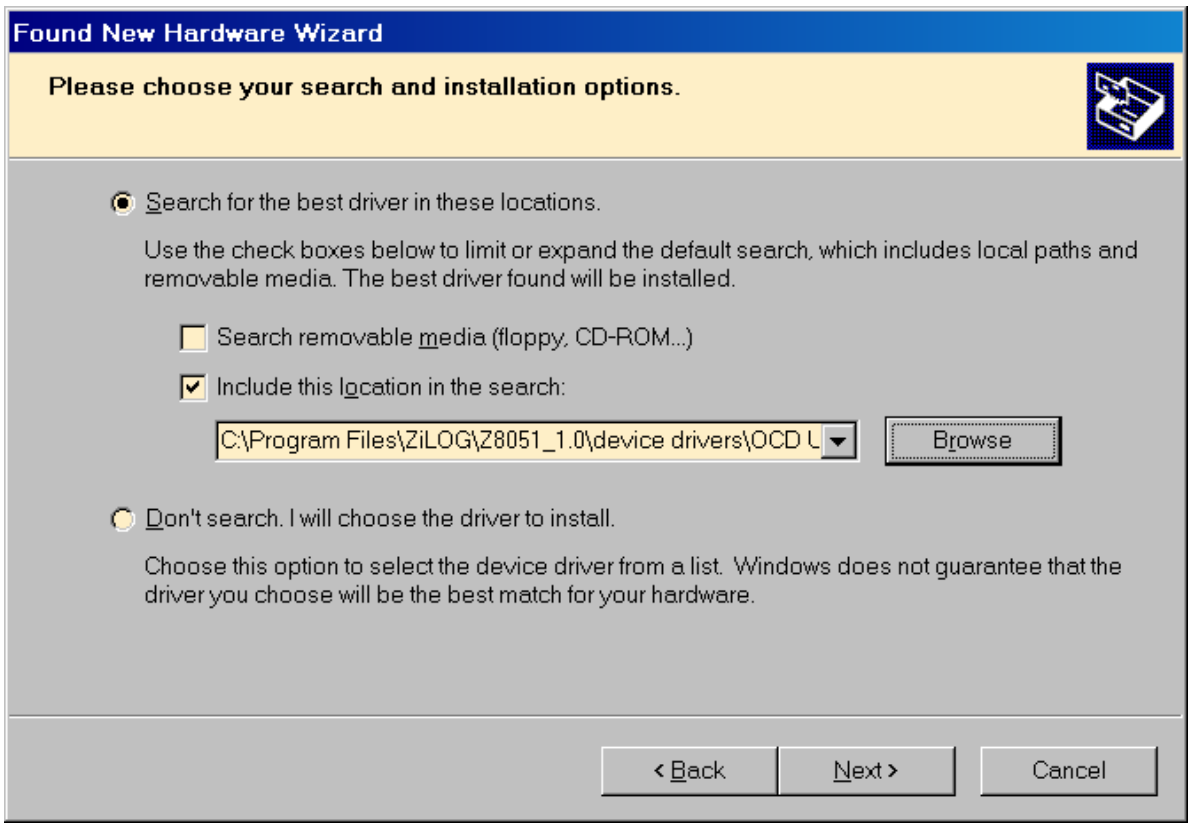

Figure 37. The Found New Hardware Wizard's Browse Screen

4. When Windows prompts you whether to continue the installation or stop, click the **Continue Anyway** button and wait until the installation is completed (Windows may prompt you more than once). When the installation is complete, click **Finish**.

Appendix C. Stand-Alone Flash Programming Using the Keil µVision IDE

Observe the following procedure to program Flash memory without debugging.

1. From the **Project** menu, open the **Options for Target 'your project'**, and click the **Utilities** tab. In the **Use Target Driver for Flash Programming** drop-down menu within the Configure Flash Menu Command pane, ensure that **Zilog Z8051 Target Driver** is selected, as indicated in Figure 38.

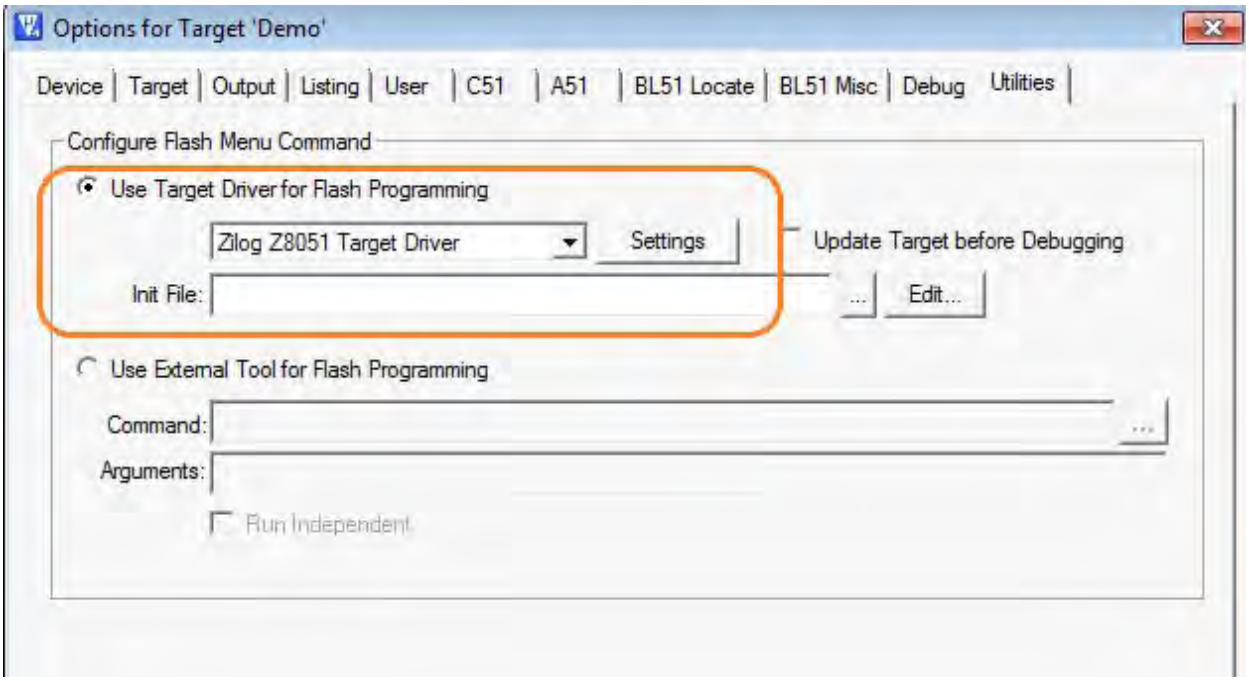

Figure 38. Selecting A Target Driver For Flash Programming

2. Click the **Settings** button to change any additional Flash options. The Settings dialog will appear, as shown in Figure 39.

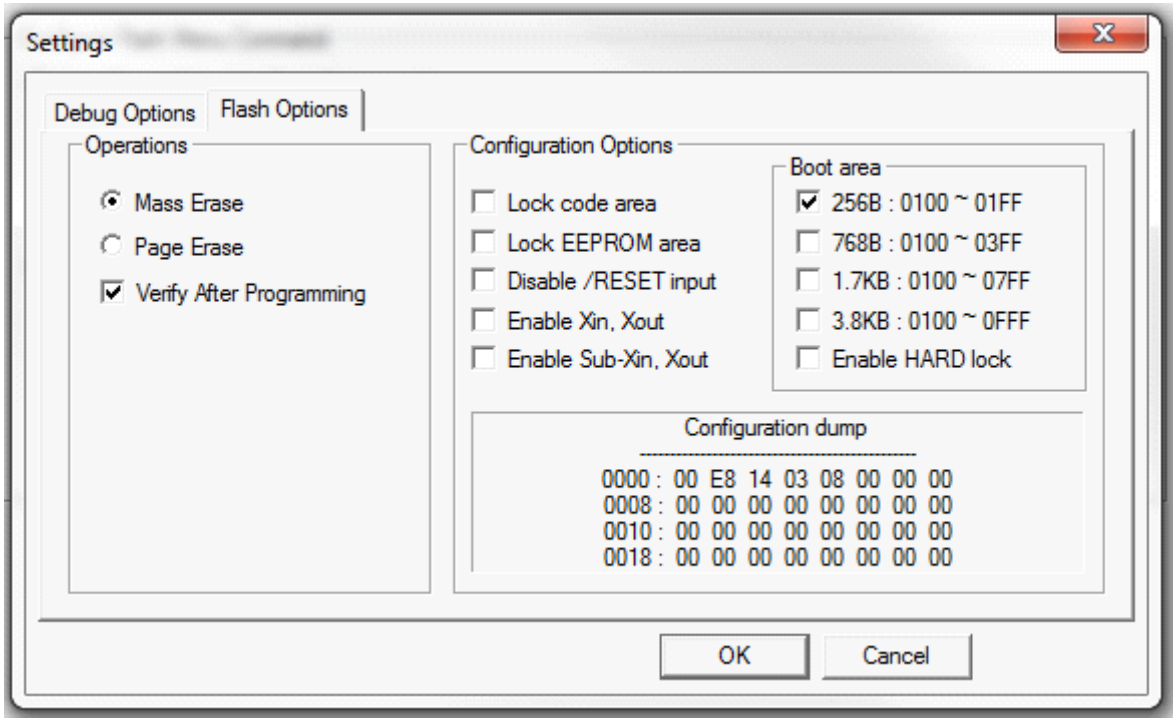

Figure 39. Configuring Additional Flash Options

3. After you have selected your Flash options, click **OK** to exit the **Flash Options** dialog.
4. Click **OK** to exit the **Options For Target 'Demo'** dialog.
5. From the **Flash** menu of the Keil IDE (see Figure 40), select either of the following options:
   – Select **Download** to program Flash memory with the current project
   – Select **Erase** to perform a mass erase of internal Flash memory

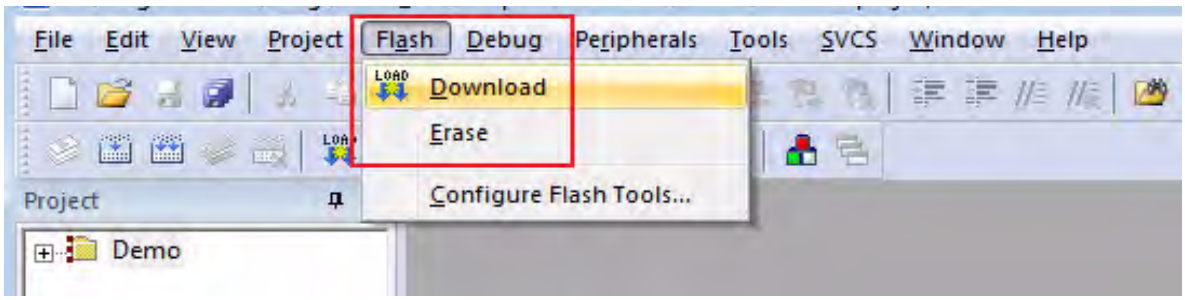

Figure 40. The Keil IDE Flash Menu

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