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ADuCM360 Development Systems Getting Started Tutorial

INTRODUCTION

The ADuCM360 is a fully integrated, 4 kSPS, 24-bit data acquisition system that incorporates dual, high performance multichannel sigma-delta (Σ-Δ) analog-to-digital converters (ADCs), a 32-bit ARM Cortex™-M3 processor, and Flash/EE memory on a single chip. The ADuCM360 is designed for direct interfacing to external precision sensors in both wired and battery-powered applications. The ADuCM361 contains all the features of the ADuCM360 except that only ADC1 is available.

Refer to the ADuCM360/ADuCM361 product page for future updates.

Additional support for the ADuCM360/ADuCM361 is available through the EngineerZone® website.

GENERAL DESCRIPTION

The ADuCM360 development system allows evaluation of ADuCM360 silicon. This getting started guide introduces the support features and the tools supplied with the evaluation kit. In addition, it shows and describes how to connect the evaluation hardware.

This guide describes the software files that are included on the CD and FTP site, and how to download them. The FTP site, should be opened in Windows® Explorer.

This guide works as a tutorial by providing a step-by-step account of how to download evaluation versions of third-party software tools. Instructions are provided on how to load code examples that are supplied on the CD and on the FTP site. These examples demonstrate simple operation of the ADuCM360.

Working through this guide brings the user to a stage whereby they can start to generate and download their own user code for use in their own unique end-system requirements.

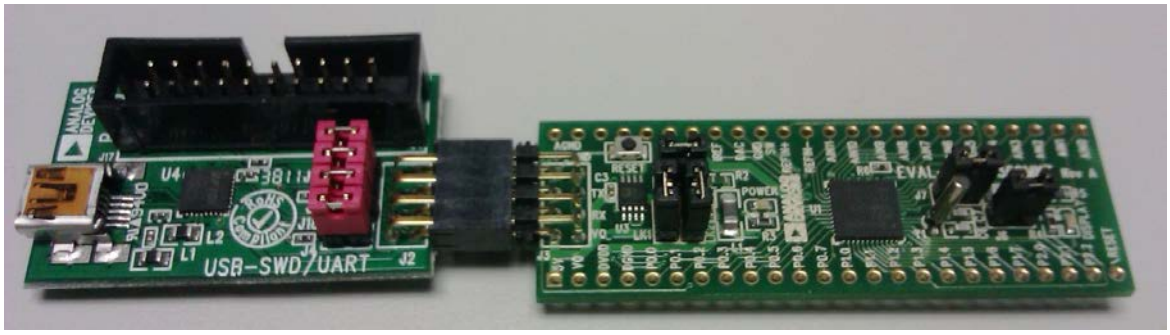

Figure 1. ADuCM360 USB-SWD/UART Board and EVAL-ADUCM360MKZ Board

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REVISION HISTORY

9/12—Revision 0: Initial Version

BEFORE SOFTWARE INSTALLATION

MINI-KIT CONTENTS

The mini-kit contains the following:

- A mini-board (EVAL-ADUCM360MKZ) that facilitates performance evaluation of the device with a minimum of external components. The mini board schematic is available after installation of the software in the documentation folder.
- An interface board (USB-SWD/UART) that connects to a PC USB port via a USB cable
- A J-Link Lite debug/programming board
- 2 USB cables
- A CD that provides documentation and software. The documentation and software is also available on the FTP site which should be opened in Windows Explorer.

EVALUATION HARDWARE

The EVAL-ADuCM360QSPZ is an evaluation kit for the ADuCM360 and ADuCM361. This kit features a mini-board (EVAL-ADuCM360MKZ), an interface board (USB-SWD/UART) that connects to a PC USB port via a USB cable, and a J-Link Lite debug/programming board. A comprehensive set of development tools is included on the CD.

The EVAL-ADUCM360MKZ mini-board facilitates performance evaluation of the device with a minimum of external components. The board schematic is available after installation of the software in the documentation folder. By default, this is:
\ADuCM360V1.0\Documentation\Evaluation Board.

The USB-SWD/UART interface board interfaces a PC USB port to the ADuCM360 mini-board, providing a power supply, UART communication, and debugging capability. The board schematic is also available on the CD in the documentation folder.

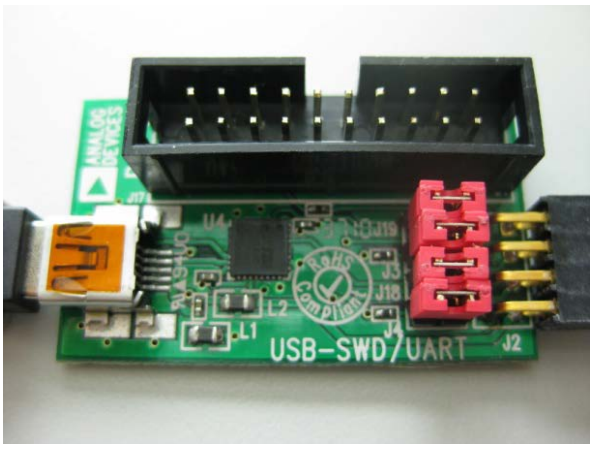

Figure 2. USB-SWD/UART Board

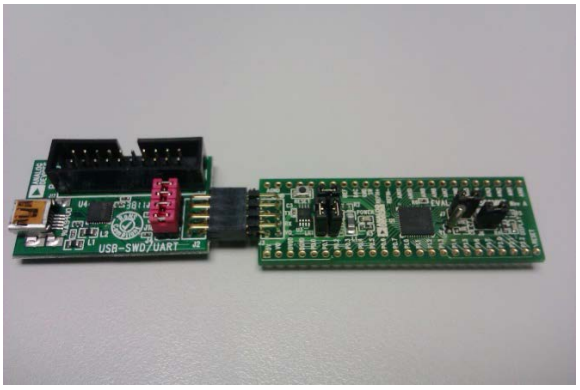

Figure 3. USB-SWD/UART Board and EVAL-ADUCM360MKZ

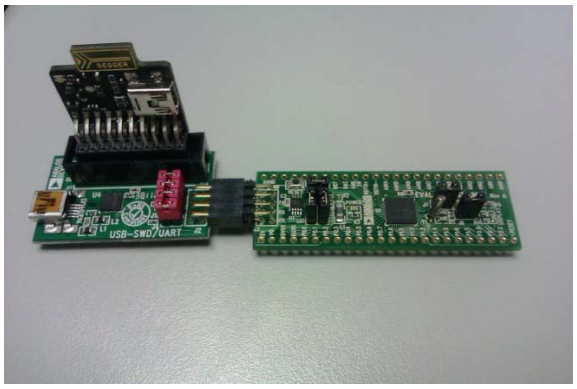

Figure 4. USB-SWD/UART Board and EVAL-ADUCM360MKZ and J-Link Lite Board

Required software for the USB-SWD/UART-CONVZ is included in the software installation.

Assembling the Hardware

Do not plug in the mini-kit before the software is installed. See the Software Installation section.

SOFTWARE INSTALLATION

Perform the steps described in this section before plugging any of the USB devices into the PC.

COPYING CONTENTS FROM CD OR THE FTP SITE

Before you begin, open the FTP site in Windows Explorer. Then, follow Step 1 through Step 5.

1. Close all open applications.
2. Insert the development system CD into you CD ROM drive and copy the entire folder (ADuCM360V1.0) into your root directory. Optionally, download the entire ADuCM360V1.0 folder from the FTP and save it to your root directory.
   Although you can install the development system, the IAR Embedded Workbench®, and Keil™ software onto any hard drive and into any directory you wish, for the purposes of simplicity, this guide assumes that you have installed at the default location of **C:\ADuCM360V1.0, C:\Program Files and C:\keil**. In addition, the Keil tools are automatically installed under an ARM directory and are fully compatible with µVision3 or tools for 8051.
3. To reduce the download time, consider excluding either the IAR or Keil folders depending on which development environment you chose to use.
   If you chose the IAR tools, these will be installed by default into **\Program Files\IAR Systems\Embedded Workbench 6.4 Kickstart**.

SUMMARY OF PROGRAMS TO BE INSTALLED AFTER THE DOWNLOAD

Ensure that Step 1 to Step 5 are completed before plugging any of the supplied hardware to your PC USB ports.

1. J-Link driver for J-Link Lite programming debug device. In the folder **ADuCM360V1.0/Segger**, you will find the following executable: **Setup_JLinkARM_V451g.exe**. Run this executable, to install the drivers for the J-Link Lite.
2. Drivers for USB-SWD/UART board. This board with the evaluation kit allows communications to a PC USB port. To install the drivers for this USB interface, run the executable **CDM20814_Setup.exe** from the **\ADuCM360V1.0\Documentation\Evaluation Board\USB-SWD_UART** folder.
3. Install the development toolset. There are two options: Keil's µVision or IAR's Embedded Workbench.

   If you want to use Keil µVision4 for compiling/debugging and code development, a 32-kB limited version is provided in the **\ADuCM360V1.0\Keil** folder. Just run the **mdk454.exe** to install this version of Keil µVision.

   If you want to use IAR's Embedded Workbench for compiling/ debugging and code development, a 32-kB limited version is provided in the IAR folder on the FTP site. Just run the **EWARM-KS-CD-6402.exe** to install this version of the IAR Embedded Workbench.
4. CM3WSD. The folder **\ADuCM360V1.0\Software Tools\CM3WSD** provides an executable called **cm3WSD.exe**. This software accepts a hex file and allows it to be downloaded via the USB interface to the ADuCM360 device on your evaluation board. No installation is required here but, you may want to add a shortcut link for this executable to your desktop.
5. Elves. In the **\ADuCM360V1.0\Software Tools\Elves** folder you will find the **elves.exe** files. These files are useful tools that accompany the software function libraries in **\ADuCM360V1.0\Code\common**. Again, no installation is required here, but you may want to add a shortcut link for this executable to your desktop.

INTALLING THE J-LINK LITE DRIVER

Installing the J-Link Lite driver is a four-step process.

1. Run the executable **Setup_JLinkARM_V451g.exe** located in the **\ADuCM360V1.0\Segger** folder.
2. Follow the sequence of instructions that display until the software is installed.
3. Once software installation is completed and closed down, plug in J-Link Lite via the USB ports.
4. Check that it appears in the Windows Device Manager.

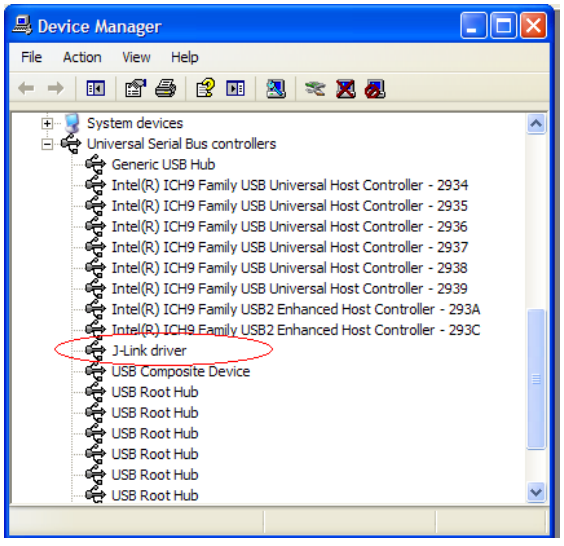

Figure 5. Device Manager

INSTALLING THE USB-SWD/UART DRIVER INSTALLATION

Installing the USB-SWD/UART driver is a four-step process.

1. Run the executable **CDM20814_Setup.exe** from the **\ADuCM360V1.0\Documentation\Evaluation Board\ USB-SWD_UART** folder.
2. A CMD window opens automatically to install the drivers and should finish by displaying this message shown in Figure 6.

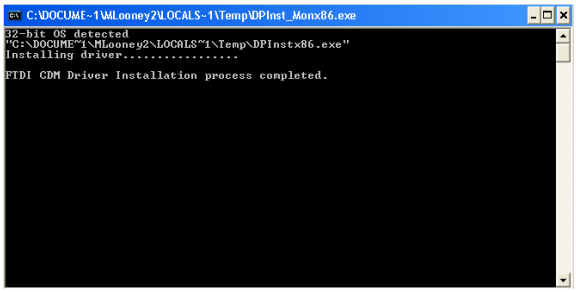

Figure 6. CMD Window

3. Once this has completed and closed down, plug in J-Link Lite via the USB ports.
4. Check that it appears in the Windows Device Manager as shown in Figure 7.

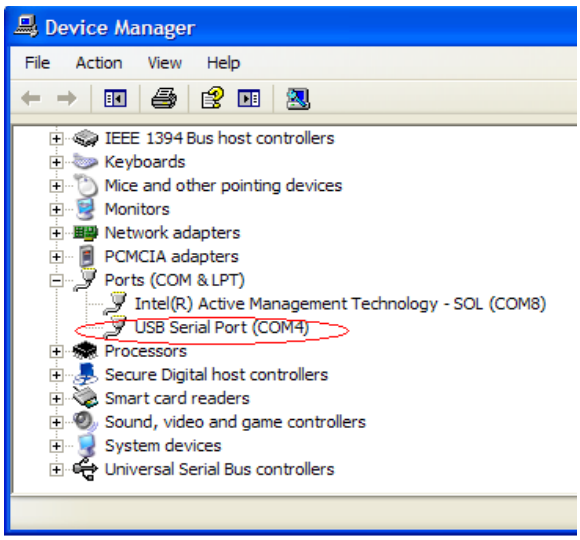

Figure 7. USB Serial Port Displays

INSTALLING THE KEIL µVISION4

Installing the USB-SWD/UART driver is a seven-step process.

1. The Keil µVision4 installation is initiated by running the **mdk454.exe** file from the **\ADuCM360V1.0\Keil** folder. A message appears to confirm that the installs have been selected.

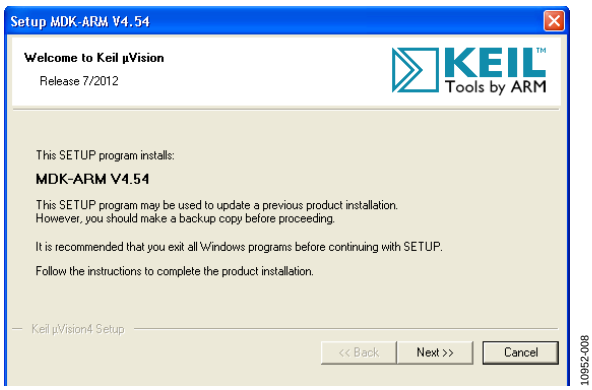

Figure 8. Confirmation Message

2. Select **Next** and follow the instructions displayed.

   Note that versions V4.54 and earlier of Keil µVision need additional files to support the ADuCM360. Your µVision installation can be updated to support the ADuCM360 by running the **ADuCM360KeilUpdateForMDKv454.exe** from the **\ADuCM360V1.0\Keil** folder. In the next window (see Figure 9), set the destination folder as the folder where you have just installed Keil µVision.

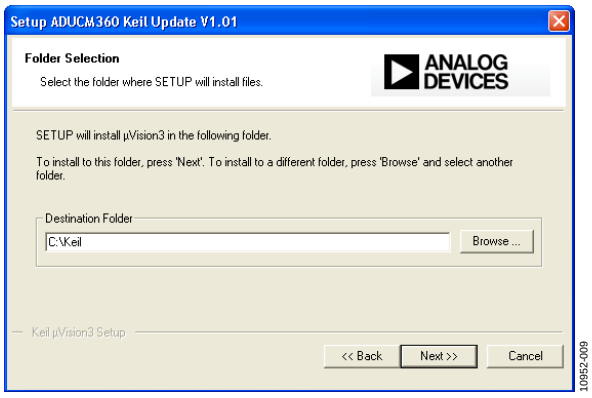

Figure 9. Folder Selection

3. When plugging in the J-Link Lite emulator for the first time, the window shown in Figure 10 appears.

Figure 10. Found New Hardware Wizard Welcome

4. Select **Install from a list or specific location** and **Next.**
5. Select **Include this location in the search** and enter the path of the USB driver: **C:\Program Files\SEGGER\JLinkARM_V451g**. Then, select **Next**.
6. In the Hardware Installation window, select **Continue Anyway**.

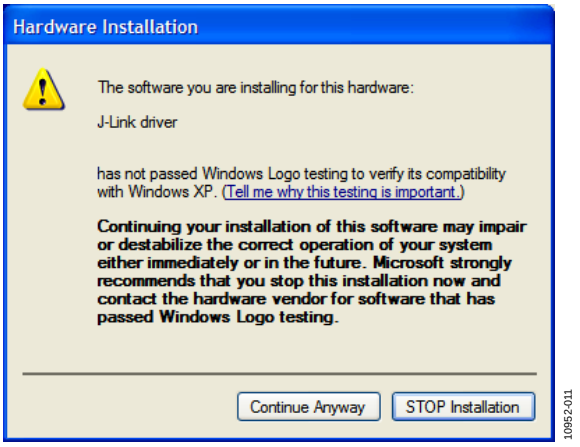

Figure 11. Hardware Installation

7. When the Found New Hardware Wizard window (see Figure 12) appears, select **Finish**.

Figure 12. Found New Hardware Wizard Complete

INSTALLING THE IAR EMBEDDED WORKBENCH

The IAR Embedded Workbench is required for building the supplied examples, and also to download and debug applications via the serial wire interface.

An evaluation version of the IAR Embedded Workbench is included in the IAR folder on the FTP site.

The IAR Embedded Workbench is a complier/debugger toolset that can be used for building the supplied IAR examples, and also for downloading/debugging of applications via the serial wire interface.

To install the IAR Embedded Workbench

1. Copy the file **EWARM-KS-CD-6402.exe** from the FTP folder to your PC and double-click on this file.
2. Follow the on-screen instructions. The IAR Embedded Workbench requires registering on the IAR website to obtain a free license key.

KEIL µVISION4 INTEGRATED DEVELOPMENT ENVIRONMENT

INTRODUCTION

The µVision4 Integrated Development Environment (IDE) integrates all the tools necessary to edit, assemble, and debug code. The ADuCM360 development system supports nonintrusive emulation limited to 32 kB code. This section describes the project setup steps in order to download and debug code on an ADuCM360 evaluation system. Analog Devices, Inc., recommends using the J-Link debugger driver.

QUICK START STEPS

Starting µVision4

From the **Start** menu, choose **All Programs>Keil µVision4**. This loads the µVision4 IDE. The µVision4 executable is located at **C:\Keil\UV4\Uv4.exe**.

1. To open one of the prepared Keil µVision example projects in µVision, select **Project>Open Project**.

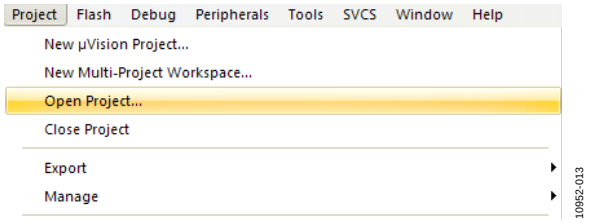

Figure 13. Open an Example Project

2. In the folder **\ADuCM360V1.0\Code\examples\RTD_Demo**, select the file **RTD_Demo.uvproj**. This opens the RTD example project.

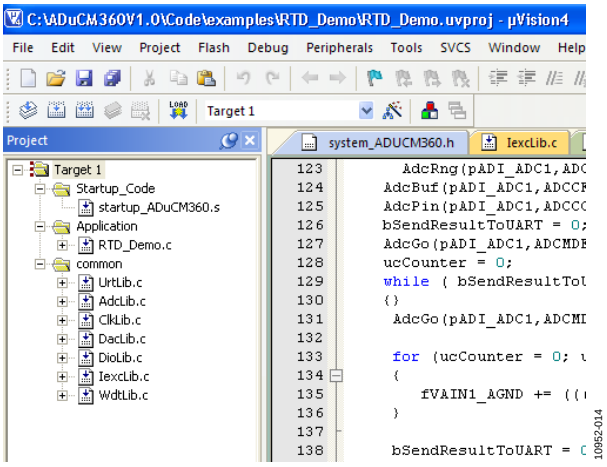

Figure 14. RTD Example Project

To compile and build all files, select the **Build All** icon

Once the build has completed, the code shown in Figure 15 appears.

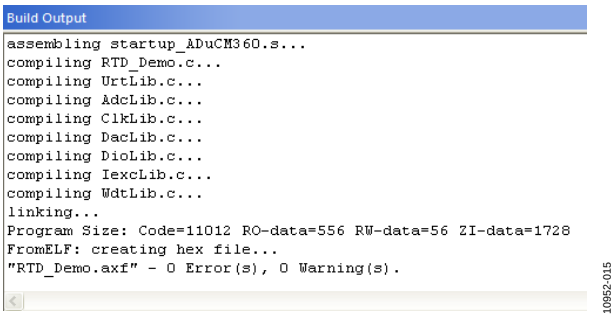

Figure 15. Build Output

3. To download the code to the EVAL-ADUCM360MKZ board and begin a debug session, connect the J-Link Lite EVAL-ADUCM360MKZ and USB-SWD/UART boards together, and then connect these boards to your PC.
4. In µVision, click the **Start/Stop Debug** session icon

or press Ctrl + F5 to start a debugging session.
5. Click **OK** when the window shown in Figure 16 appears.

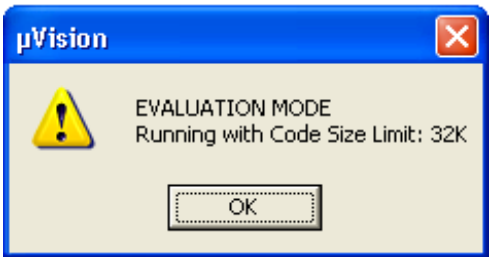

Figure 16. Evaluation Mode

6. Begin debugging your source code.

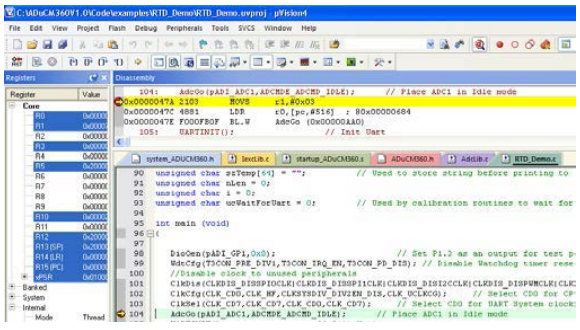

Figure 17. Debug Source Code

EXTRA OPTIONAL DETAILS ON µVISION

This section provides a more detailed explanation of the setup described in the Quick Start Steps section. Some users may prefer to setup via the Quick Start Steps section.

Toolbars

Under the **View** menu, two toolbars are available.

- File toolbar
- Build toolbar

The **File** toolbar is always available. The **Build** toolbar is active only when the IDE is in edit/compile mode. When a debug session is started, the debug toolbar appears. The debug toolbar is active only in download/debug mode.

Starting a Project

1. From the **Project** menu, select **New µVision Project**.

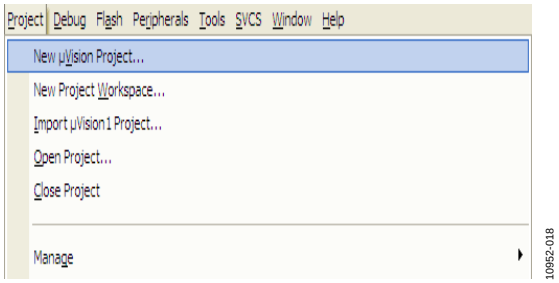

Figure 18. Project Menu

2. Create a new folder (**ADIdemo**). To do so, go to **C:\ADuCM360V1.0\Code\examples\ADIdemo** and enter **Demo** as the project name. When asked to **Select a CPU Data Base File**, select ADuCM360.

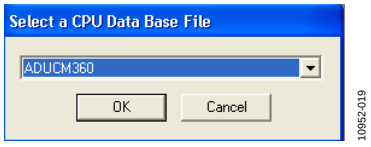

Figure 19. Select a CPU Data Base File

3. Select the ADuCM360 as the target device.

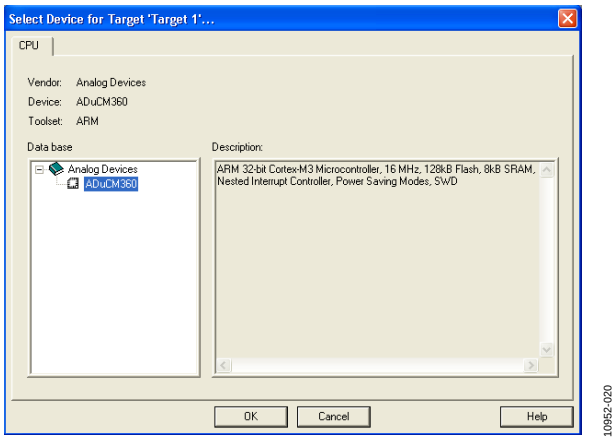

Figure 20. Select Device for Target

4. Select **No** to the question that appears (see Figure 21). This indicates you are not automatically including the startup file **startup.s** to your project.

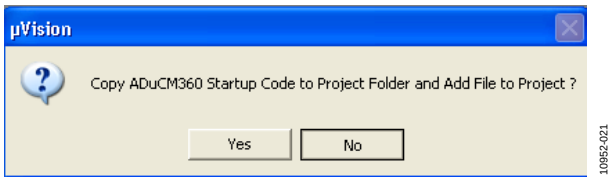

Figure 21. µVision Startup Question

5. Note that it is possible to change the compiler by selecting the **File Extensions, Books and Environment** folder extension.

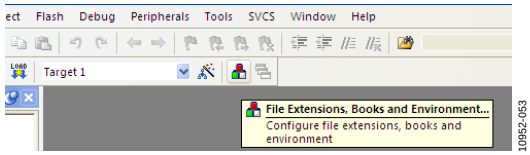

Figure 22. File Extensions, Books and Environment

6. For this demo, select the **Use RealView Compiler**, under the **Folders/Extensions** tab.

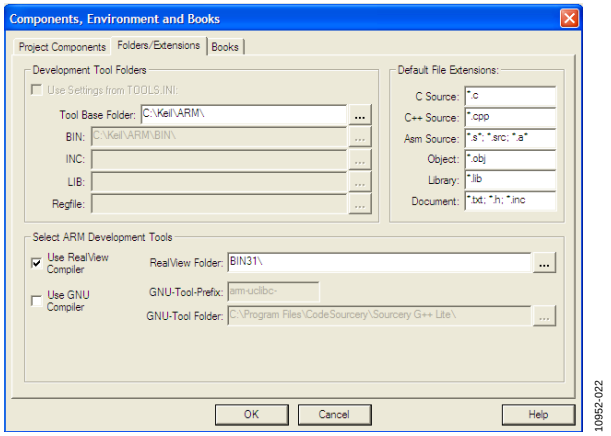

Figure 23. Components, Environment and Books

7. Right-click on **Target1** and select **Option for Target1** to configure the settings for this project. By default, µVision4 uses the RealView compiler.
   - Select the **Target** tab.
   - Add 0x00000000 into the **R/O Base** and 0x20000000 in to the **R/W Base** to indicate to the compiler the Flash and RAM start addresses.
   - Ensure the **IROM1** and **IRAM1 Start** and **Size** fields are filled in correctly.
   - Ensure that the **Use MicroLIB** option is enabled.

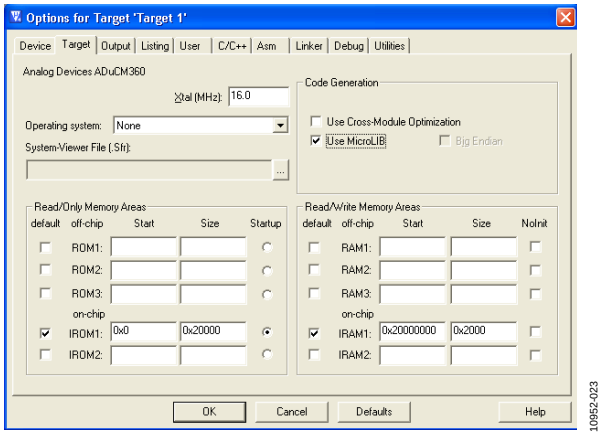

Figure 24. Options for Target

8. Select the **Linker** tab and then select **Use Memory Layout from Target Dialog**.

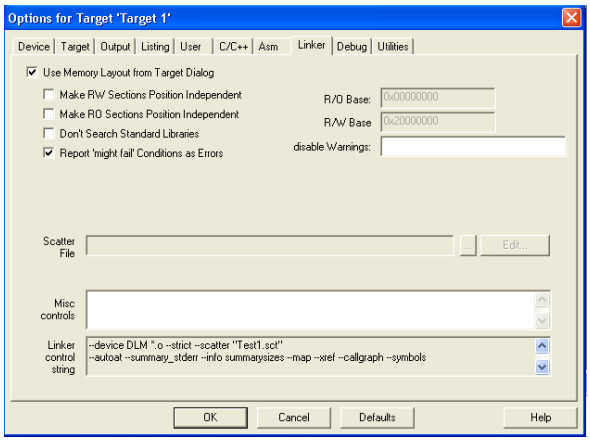

Figure 25. Options for Target

9. In the **Output** tab, select **Create HEX File**. The hex file can be used by the I²C downloader.

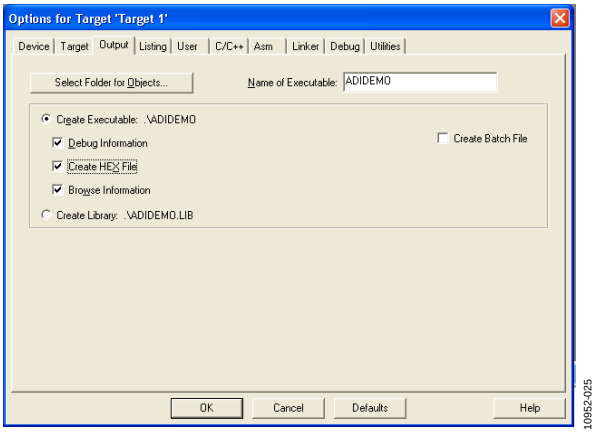

Figure 26. Output Tab

10. If you have an emulator, power up the evaluation board via the USB connection and the interface board. Connect the interface board to the J-Link Lite, and connect J-Link Lite to your PC's USB port using a USB cable.

    Note that an LED on the J-Link Lite emulator blinks several times before staying on, indicating that the emulator is communicating correctly with the PC.

Configuring the J-Link Debugger Driver

1. Right-click on **Target1** and select **Option for Target1** to configure the settings of this project.
2. In the **Debug** tab, select **Use:** and then select **J-LINK/ J-Trace Cortex**.

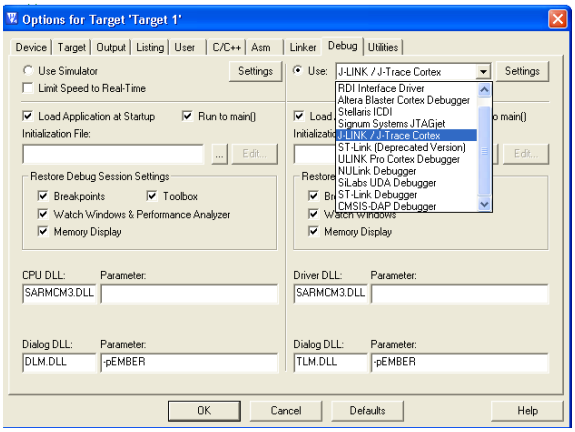

Figure 27. Choose a Debugger

3. Select **Settings** in Figure 27 and then configure as shown in Figure 28.

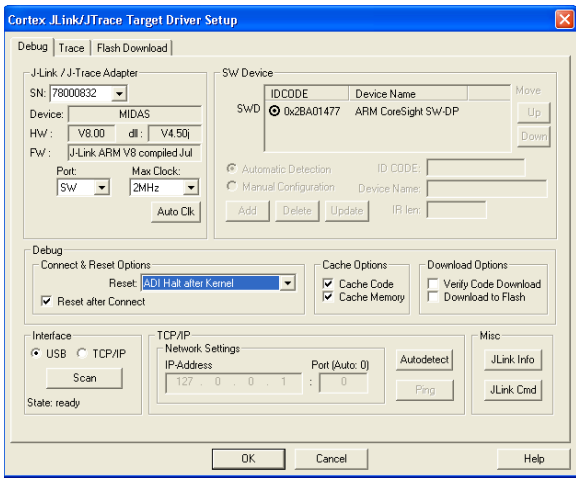

Figure 28. Target Driver Setup

4. Under **Utilities**, select **Use Target Driver for Flash Programming**. Then, choose **J-LINK/J-Trace Cortex** and select the option **Update Target before Debugging**.

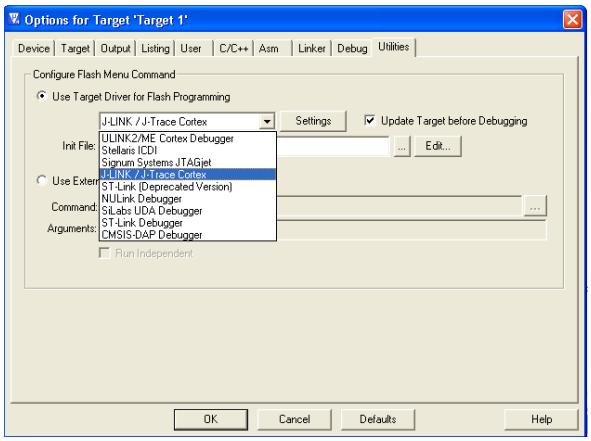

Figure 29. Continuing with Target Driver Setup

5. Select **Settings** to display the dialog box shown in Figure 30.

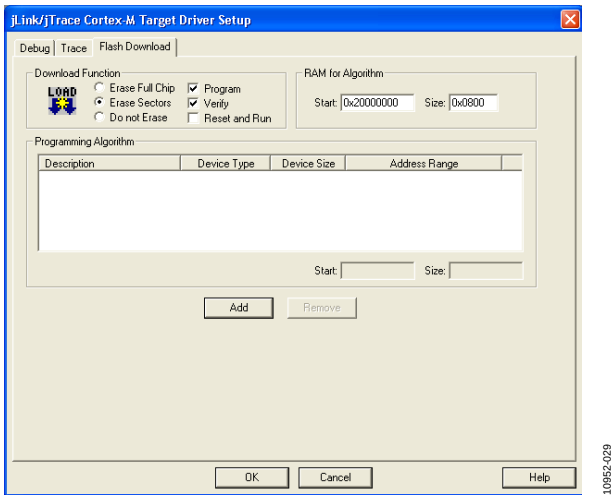

Figure 30. J-Link/J-Trace Cortex Setup

6. Select **Add** to display the window shown in Figure 31.
7. Select the driver for the generic that you are evaluating. For this example, use **ADuCMxx 128kB Flash** and then select **Add**.

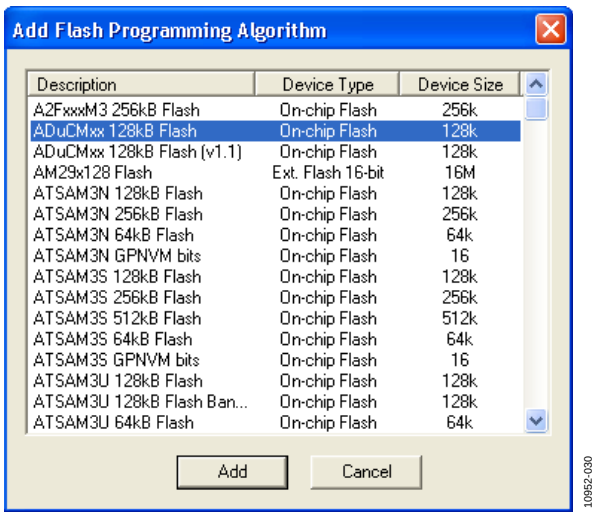

Figure 31. Add Flash Programming Algorithm

8. Select **OK** when the window shown in Figure 32 appears.

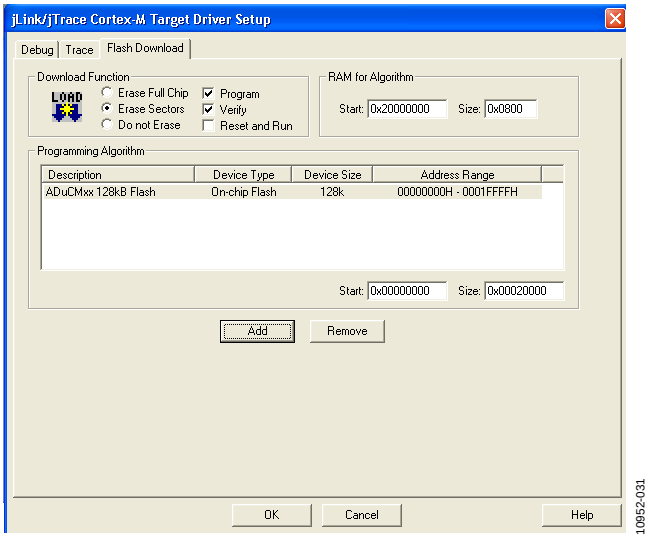

Figure 32. Finishing Target Driver Setup

9. Select **OK**. All the options should be properly configured to compile, assemble, link, download, and debug using J-Link Lite or the simulator.
10. In the **C/C++** tab, add the include path as shown in Figure 33.

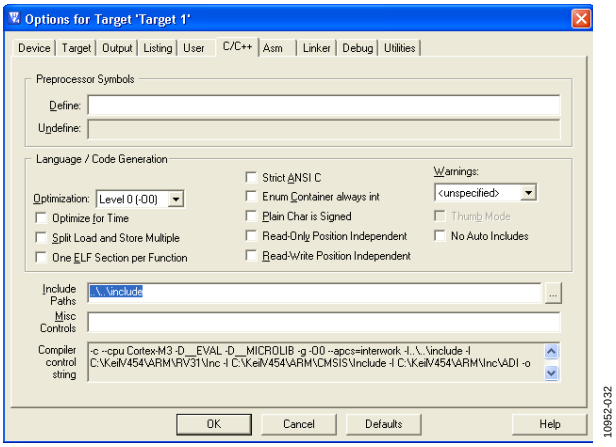

Figure 33. Options for Target Setup

Adding Project Files

All the files relative to the project are in the folder **\ADuCM360V1.0\Code\examples\Adc**.

Copy the files **\ADuCM360V1.0\Code\examples\Adc \ADCMeter.c** into the new directory **C:\ADuCM360V1.0\Code\examples\ADIdemo**.

1. To add the files to the project, right-click on the **Source Group** folder in the **Project Workspace** and select **Add Files to Group**.

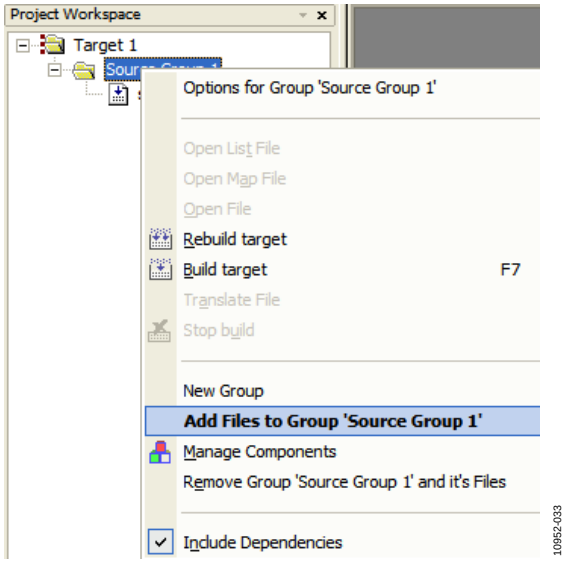

Figure 34. Adding Files to the Project

Note that under **Project>Manage**, the option **Components, Environment, Books** can be used to rename the target and add the file relative to your project.

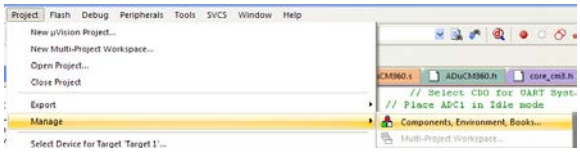

Figure 35. Renaming the Target

2. Add all the files listed in Figure 36 from the directory **\ADuCM360V1.0\Code\common**.

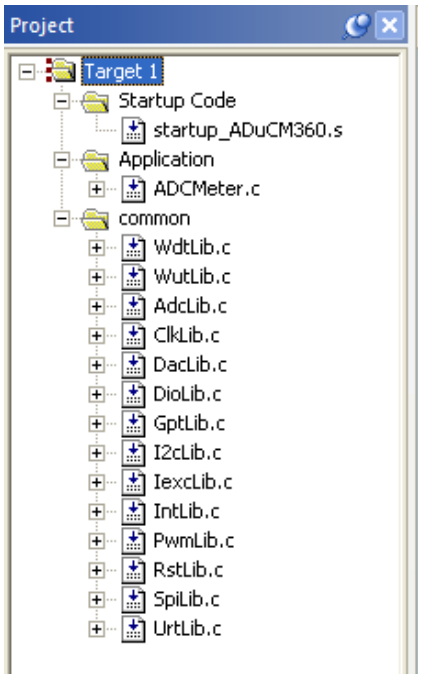

Figure 36. Project Files

3. Double-click on the file name (**ADCMeter.c**) in the Workspace window to open the source file.

Assembling/Compiling Code

To compile/link **ADCMeter.c**, click on the  (translate current file) icon in the toolbar. The file should compile correctly and the information shown in Figure 37 will appear in the build output window. If there are errors in your source code, these will appear in the status window. To identify the line of code that corresponds to the error, double click on the error in the Output window and an arrow will highlight the line of code in error. Before the code can be downloaded to the MicroConverter, the entire project must be built.

This is done by clicking on the  (rebuild all target files) icon on the toolbar. It will also create a demo.elf file used by the debugger.

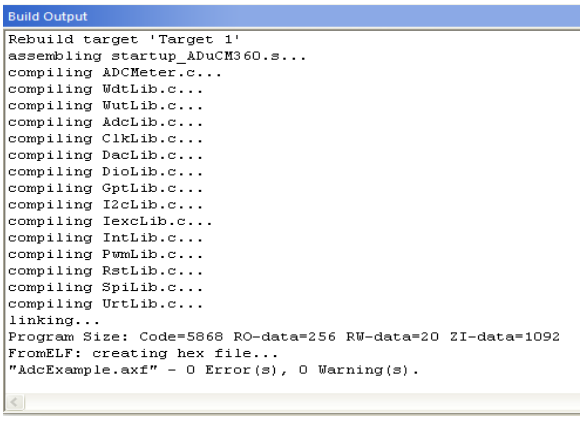

Figure 37. Build Output

Downloading/Debugging Code

Select **Start/Stop Debug** or press the icon  to start debugging (start/stop debug session). The debugger indicates that you are using an evaluation version. Select **OK**.

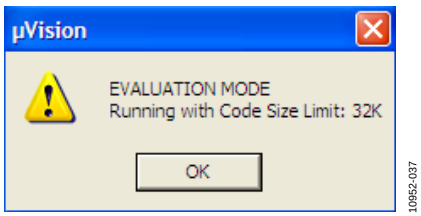

Figure 38. Starting Debugging

Close the disassembly window. Go to the **ADCMeter.c** file. Set a breakpoint on the instruction UARTInit(B9600). This is done by right-clicking on the line of code and then selecting **insert/remove breakpoint** or by double-clicking on the left of the instruction. Notice that the breakpoint is indicated by a large red dot to the left of the line in Figure 39.

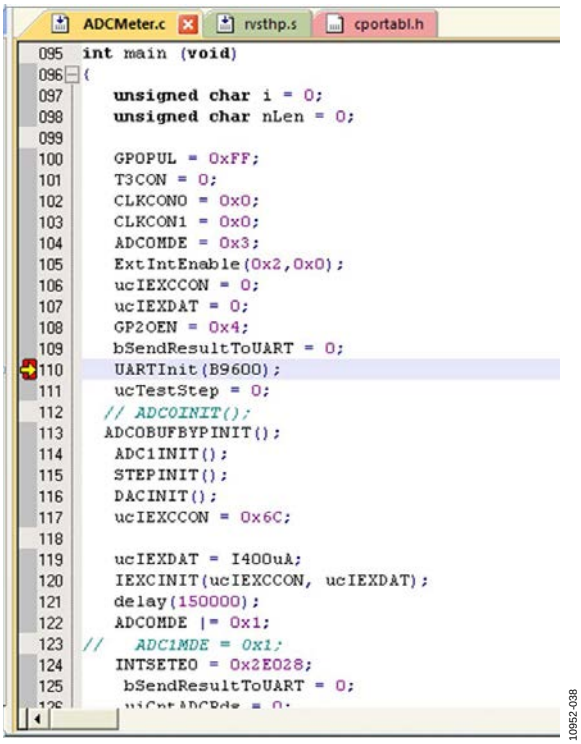

Figure 39. ADCMeter.c File

Press the run code button  twice. The program measures the input signal applied across AIN0 and AIN1, converts this to a voltage, and sends this information in an ASCII string to the UART – baud rate 9600-8-N-1.

To stop the code from running, press  .

To stop debugging, press  .

IAR EMBEDDED WORKBENCH IDE

The IAR Embedded Workbench IDE integrates all the tools necessary to edit, assemble, and debug code. The ADuCM360 development system supports nonintrusive emulation limited to 32 kB code. This section describes the project setup steps in order to download and debug code on an ADuCM360 evaluation system. Analog Devices recommends using the J-Link debugger driver.

STARTING IAR EMBEDDED WORKBENCH

From the **Start** menu, choose **All Programs> IAR Systems> IAR Embedded Workbench for ARM 6.40 KickStart> IAR Embedded Workbench**. This loads the Embedded Workbench IDE.

QUICK START STEPS

Follow the steps in this section to get up and running with the example code provided with the evaluation software.

These steps use the default driver and compiler settings.

1. To open the prepared IAR example projects using the Embedded Workbench tools, select **File>Open> Workspace**. Open the file **ADuCM360.eww** in the directory **\ADuCM360V1.0\Code\examples**.

Figure 40. IAR Embedded Workbench

2. After a few seconds, the workspace opens and the individual projects are launched as shown in Figure 41.

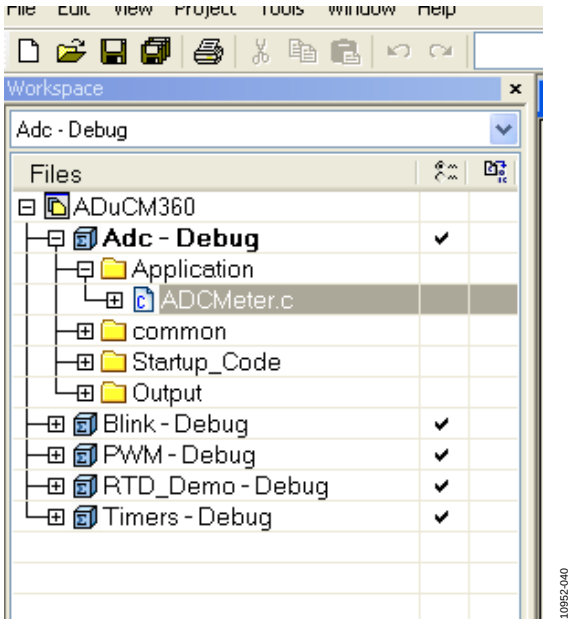

Figure 41. Individual Projects

3. To change the selected project, select the required project from the drop-down list.

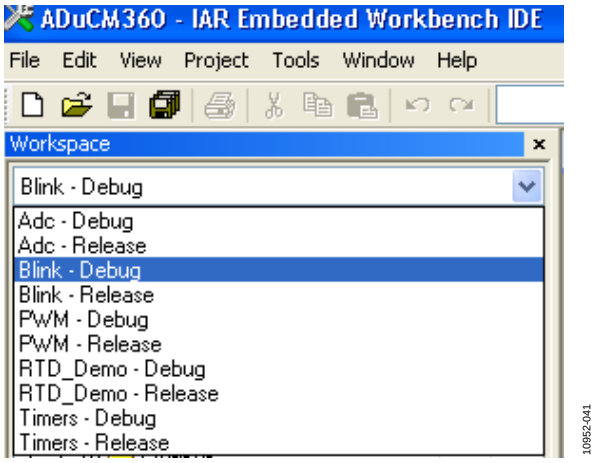

Figure 42. Changing Selected Projects

If, for example, the **Blink** project is chosen, this toggles the LED connected to P1.3 on the EVAL-ADUCM360MKZ board.

4. To compile all files, select **Project>Rebuild** all files.

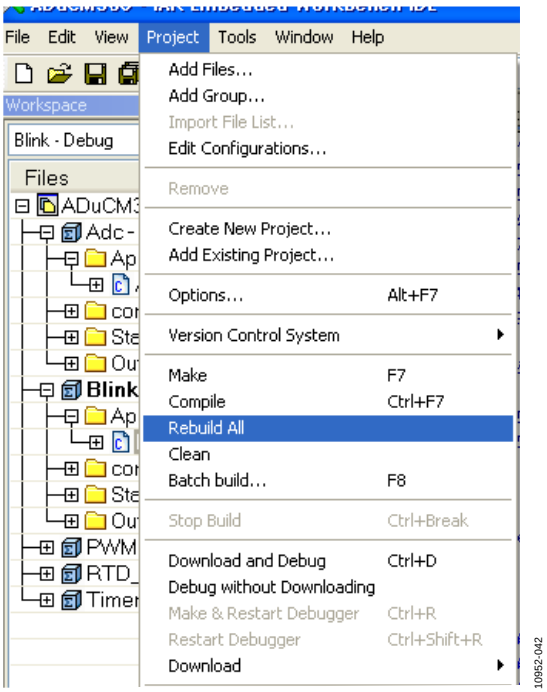

Figure 43. Compiling All Files

5. If the build is successful, the information is displayed in the **Build** details window.

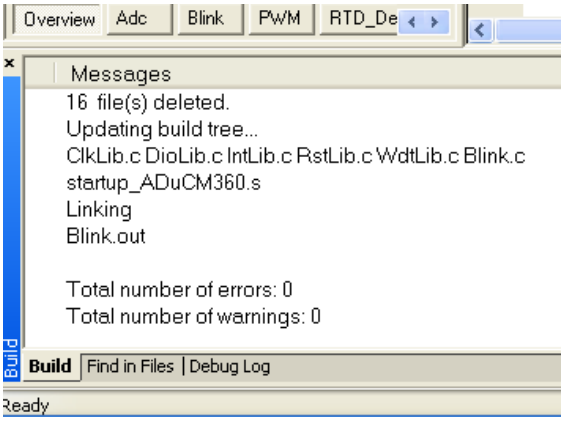

Figure 44. Build Details

6. To program the device and to begin debugging the source code, select **Project>Download and Debug**.

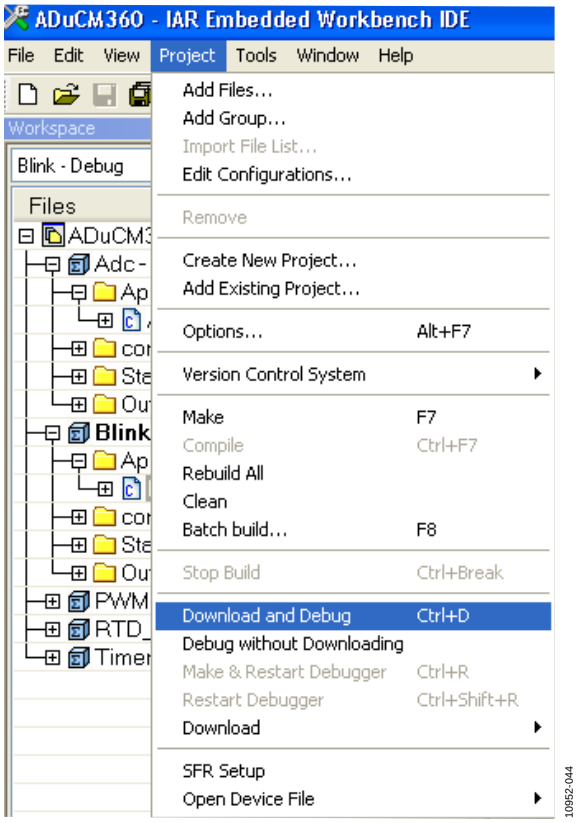

Figure 45. Begin Debugging

This launches the debugger.

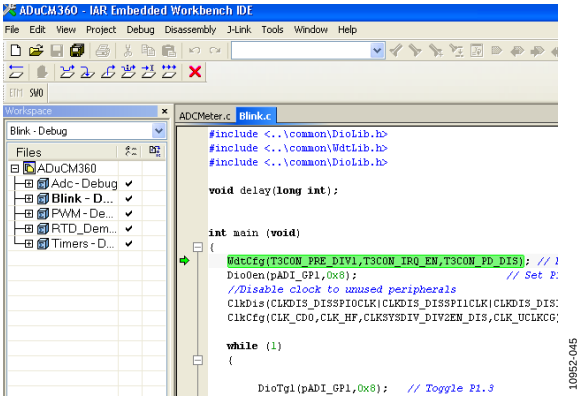

Figure 46. Debugger

7. To begin code execution, select the **Go** icon,  . You should now see the LED toggle on your EVAL-ADUCM360MKZ board.

ELVES

USING ELVES.EXE WITH µVISION4

Elves is a useful tool for generating simple C function libraries to get you started on evaluating any peripheral. All the user needs to do is choose the required parameters for each function and Elves generate the C source code that configures all the appropriate ADuCM360 registers.

1. In the folder, **C:\ADuCM360V1.0\Software Tools\Elves**, open the file **Elves.exe** to launch Elves.

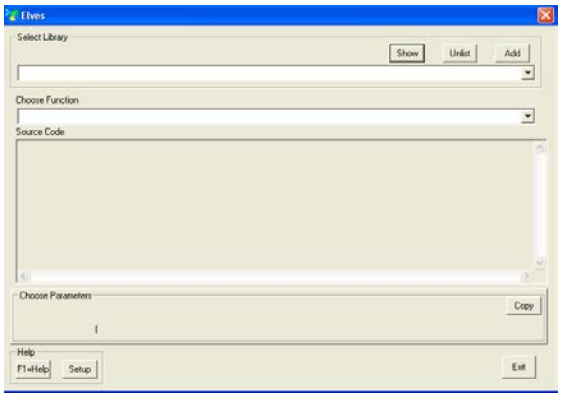

Figure 47. Launching Elves

2. To add a library, click **Add** and go to the directory **C:\ADuCM360V1.0\Code\common**.

   A list of header files is available. Add the header file(s) that you wish to use.

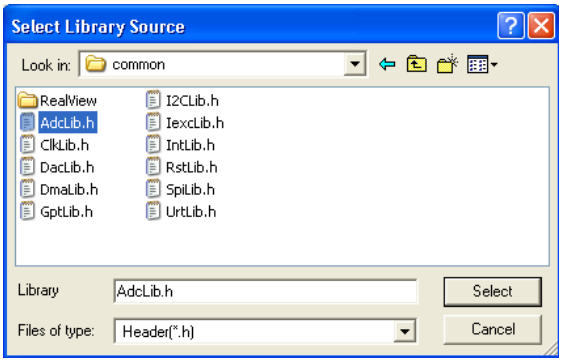

Figure 48. Select Source Library

For example, if the AdcLib.h library is added, the user can generate functions to control the ADC.

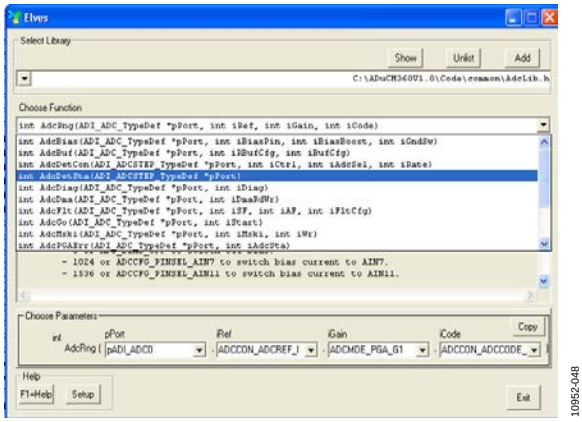

Figure 49. List of Functions

Take, for example, the function **AdcBias**, in the **Choose Parameters** section at the bottom of Figure 49. The user configures the parameters to meet their needs and each parameter is explained in the Source Code section of the window shown in Figure 50.

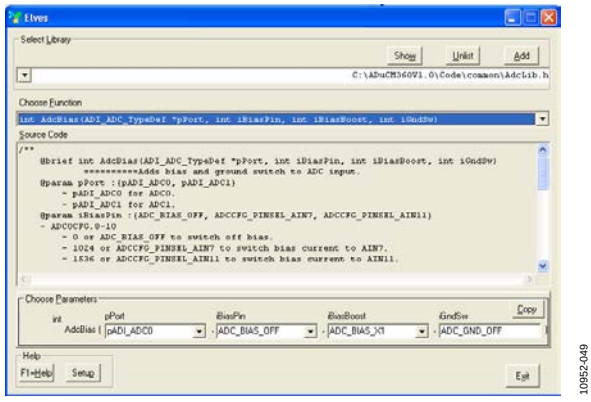

Figure 50. Source Code

3. Once satisfied with the register settings, select **Copy** and then paste this function into your source code in Keil or IAR as shown in Figure 51.

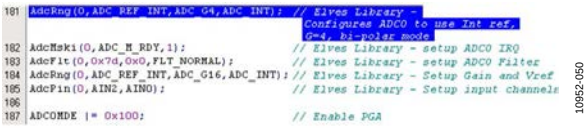

Figure 51. Copying and Pasting Source Code

4. Before using the Help option, click **Setup** and point to the following file**folder: C:\ADuCM360V1.0\Software Tools\Elves\help docs\Docs\Start_P.html**.

WINDOWS SERIAL DOWNLOADER

The Windows Serial Downloader for Cortex-M3 based parts (CM3WSD) is a windows software program that allows a user to serially download Intel Extended Hex files as created by assembler/compilers to the ADuCM360 via the serial port. The Intel Extended Hex file is downloaded into the on-chip Flash/EE program memory via a selected PC serial port (COM1 to COM31).

PREPARING FOR DOWNLOAD

1. Connect the ADuCM360 mini-board (EVAL-ADUCM360MKZ) to the interface board (USB-SWD/UART).
2. Connect the interface board (USB-SWD/UART) to the PC using a USB cable.
3. Ensure all the links are inserted on both boards.
4. Place the ADuCM360 into serial download mode using the following sequence:
   - Pull P2.2 low.
   - Pull the RESET pin low and then high (float).
   - P2.2 can be left floating once RESET is high.

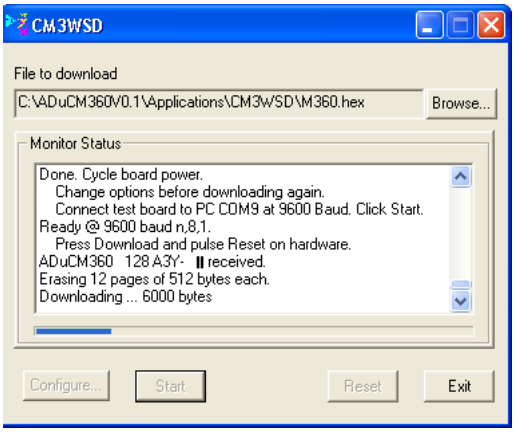

Figure 52. Preparing for Download

DOWNLOADING USING CM3WSD

1. In the software tools **\CM3WSD** folder, open the file **CM3WSD.exe**.
2. Select the file at **C:\ADuCM360V1.0\Code \examples\Adc\AdcExample.hex**.
3. Select **Configure**.
4. In the **Parts** tab, select ADuCM360.
5. In the **Comms** tab, select the correct COM port and a baud rate of 38400. Select **OK**.
6. Select **Start**. The CM3WSD sends a reset command to the ADuCM360. If the ADuCM360 is in serial download mode, and the COM port between the PC and the mini-board are setup correctly, then the CM3WSD should start downloading the hex file and display a progress bar while the file is downloading. Once the file has been successfully downloaded, the monitor status box will be updated with **Flashing Complete Click Reset to run program**.

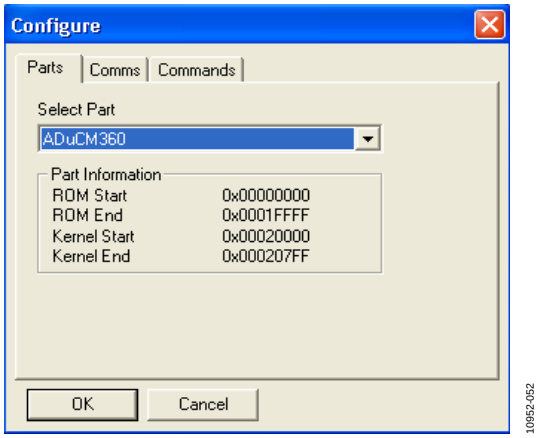

Figure 53. Downloading Using CM2WSD

RUNNING THE DOWNLOADED FILE

Running Using the CM3WSD

Select **Reset** with P2.2 floating or pulled high. The monitor status box updates with the message: **Running**.

Manual Run Option

Pull RESET low, then high (or float) on the mini-board (EVAL-ADUCM360MKZ) to reset the ADuCM360, with P2.2 floating or pulled high. The program starts running automatically.

NOTES

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I^2C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

UG10952-0-9/12(0)

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