

# **ADuCM36x Precision Analog Microcontroller GetStarted Guide**

**A Tutorial Guide for use with the ADuCM36x Software Development Kit**

**The following products are covered by this guide**

**ADuCM360, ADuCM361**

**Version 0.2**

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## Introduction

The following GetStarted tutorial guide will bring the user through the various tools that are part of the ADuCM36x Software Development kit. This application will install tools required for the ADuCM36x generics.

The tools discussed during this GetStarted tutorial guide are as follows:

Tool	Executable	Function
Keil µVision4 Integrated Development Environment		µVision4 is a complete IDE (Integrated Development Environment) integrating all the tools necessary to edit, assemble/compile/link and debug Thumb2 code and C code, via the SWD port (Serial Wire Debug). A simulator is also available, simulating the peripherals of the ADuCM36x parts. Non-intrusive emulation is done through SWD using the JLink-lite pod or through the USB Interface board provided in the Software Development Kit.
IAR Embedded Workbench IDE		The IAR Embedded Workbench IDE provided in a separate FTP folder is a complete IDE (Integrated Development Environment) integrating all the tools necessary to edit, assemble/compile/link and debug Thumb2 code and C code, via the SWD port (Serial Wire Debug). Non-intrusive emulation is done through SWD using the JLink-lite pod or through the USB Interface board provided in the Software Development Kit.
Downloader	CM3WSD.exe	The UART Downloader is a windows software program that allows a user to download Extended Intel Hex files as created by µVision4 or IAR to the MicroConverter via the UART bus while in circuit.
Software Generation	Elves.exe	Elves.exe is an application that assists a C programmer in choosing appropriate functions from ADI libraries and simplifies deciding what values to place in the function parameters.

## (1) Hardware

**EVAL-ADuCM360MK1ZU2** is a Mini-Kit for ADuCM360 first samples. It features a Mini-Board (**EVAL-ADUCM360MKZ**) and comprehensive development tools included on the CD.

The 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.

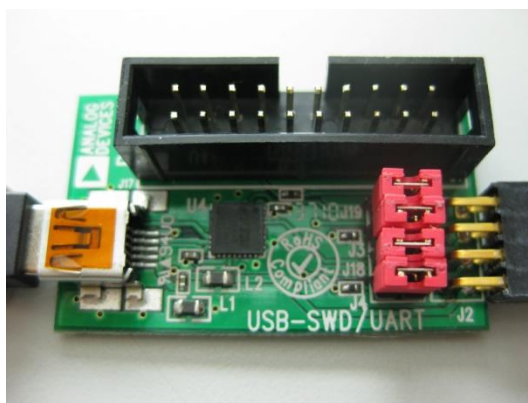
By default, this is:

\\ADuCM360V0.2\Documentation

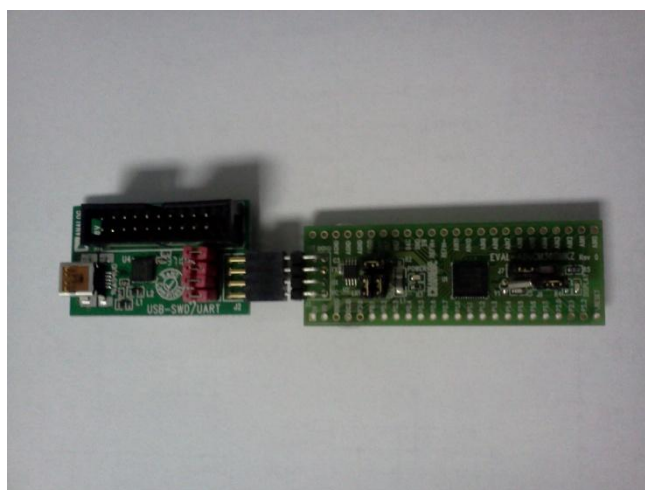
It is recommended to use the ADuCM360 mini-board in conjunction with the Interface board (**USB-SWD/UART-CONVZ**) for non-intrusive Serial Wire Emulation.

The **USB-SWD/UART-CONVZ** kit includes a J-Link Lite from Segger as well as the interface board.

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



**Figure 1. Interface board.**



**Figure 2. Interface board + ADuCM360 MINIKIT**

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

This GetStarted Guide covers tools installation in the following sections:

## (2) Installation

### Installing from CD or FTP site:

(<ftp://ftp.analog.com/pub/MicroConverter/ADuCM360V0.2/>)

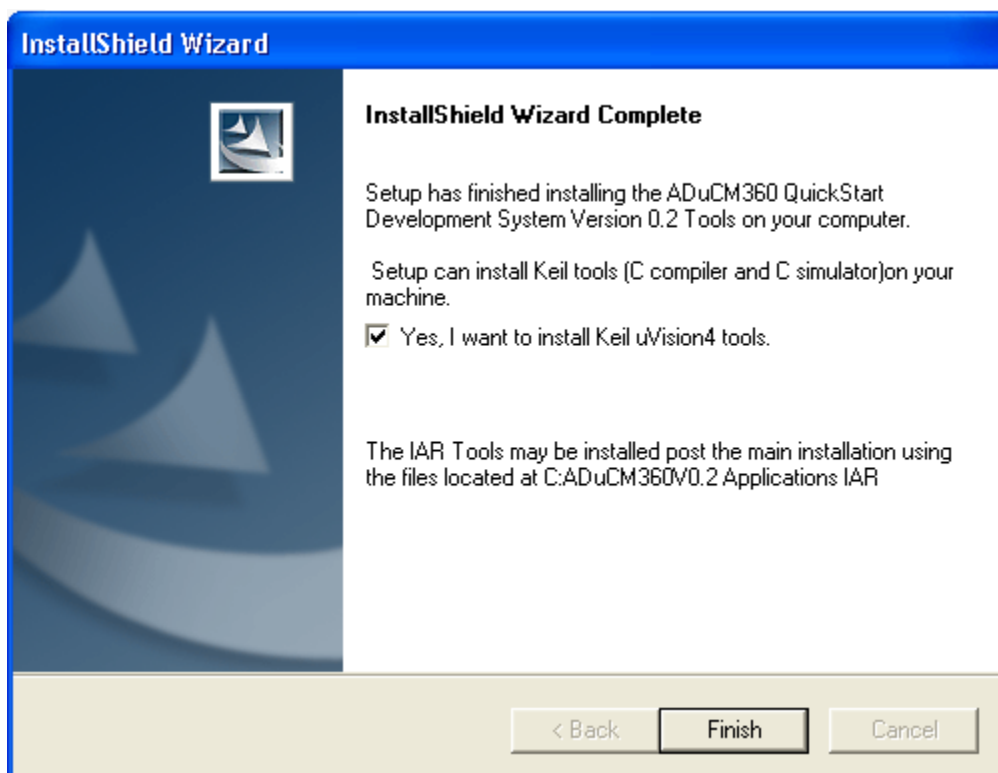
1. Close all your applications.
2. Insert the MicroConverter<sup>®</sup> Development System CD ROM into you CD ROM drive and double-click on the file "setup.exe" if installation doesn't start automatically. Or, download the executable ADuCM360V02.exe from the FTP site and run it.
3. Follow the installation process to the final menu. The following applications will be installed
  - a. Segger J-LINK Application
  - b. CM3WSD Application
4. Press "yes" to the above applications. Then follow the on-screen instructions to install the software on your PC.
5. Although you can install the MicroConverter<sup>®</sup> Development System, the IAR Embedded workbench and Keil software onto any hard drive and into any directory you wish, for the purposes of simplicity, the rest of this document will assume that you've installed at the default location of C:\ADuCM360V0.2, C:\Program Files and C:\keil. Also the Keil tools will automatically be installed under an ARM directory and are fully compatible with uVision3 or tools for 8051.

### Tools installation options:

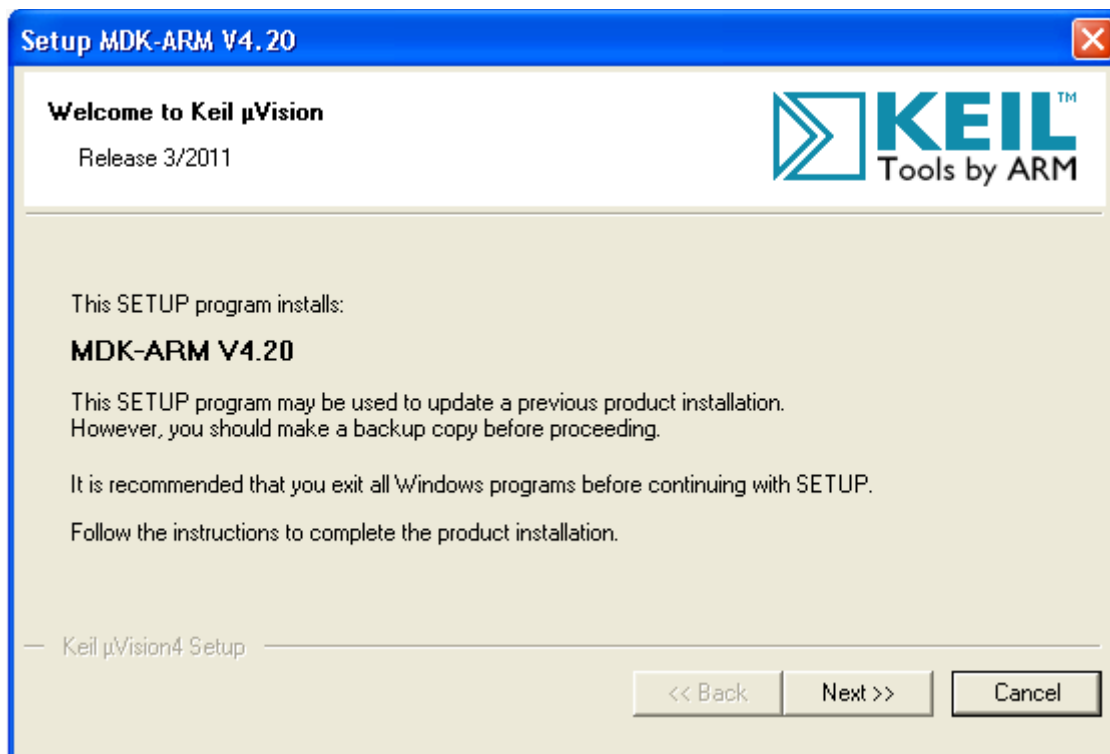
By default, documents, code examples and utilities provided by ADI are installed. The installation will offer you the option to select the Keil uVision4 tools to be installed automatically by this setup. In addition using the separate IAR Embedded Workbench CD or using the IAR installer located at C:\ADuCM360V0.2\Applications\IAR, the IAR tools may be installed.

### Keil uVision4 installation:

The Keil  $\mu$ Vision4 Installation is initiated by ticking the "Yes, I want to install Keil uVision4 tools" as shown below:

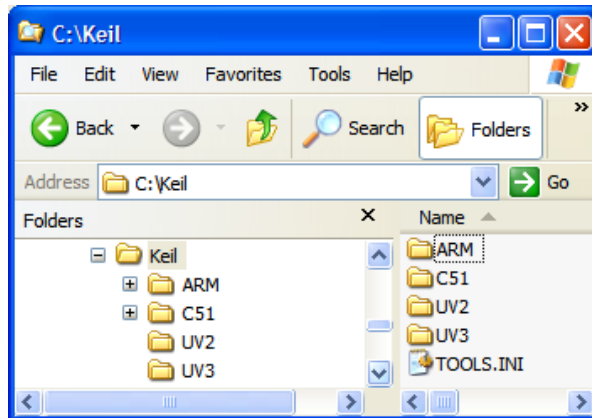


A message will appear to confirm that the installs have been selected:



Press “Next” and follow the on screen instruction.

If you choose not to install the tools now, you can install them later by double clicking on the file “MDK420.EXE” in the Applications\Keil folder on the CD. Then, install the ADuCM360 upgrade via ADuCM360KeilUpdatev100.EXE.



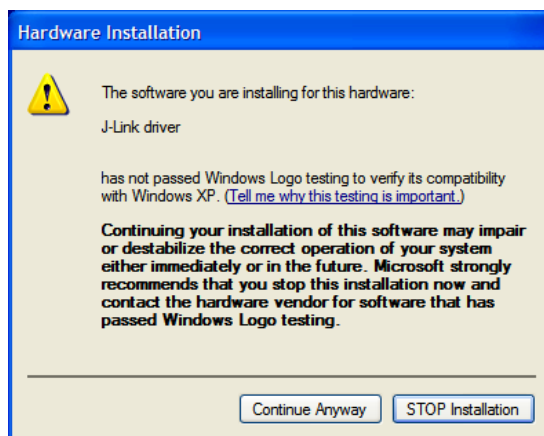
When plugging the mIDAS-Link or JLINK-lite emulator for the first time, the following window appears:



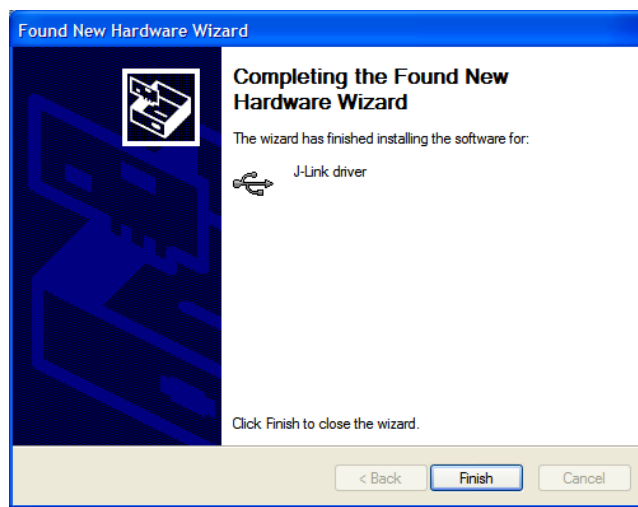
Select “Install from a list or specific location” and press next.

Then select “Include this location in the search” and enter the path of the USB driver: C:\ADuCM360V0.2\Applications\usbdriver. Press next.

In the hardware installation window, select Continue anyway.



Finally when the following window appears press the Finish button.



## IAR Embedded Workbench installation:

An evaluation version of IAR Embedded Workbench is included on the CD and in the <ftp://ftp.analog.com/pub/MicroConverter/ADuCM360V0.2/IAR> folder on the FTP site

IAR Embedded Workbench is required for building the supplied examples, and also for download and debug of applications via the Serial Wire interface.

To install the IAR Embedded Workbench:

- (1) Double click on the file “EWARM-KS-CD-6101.exe” under the IAR folder on the CD.
- (2) Follow the on screen instructions: IAR Embedded Workbench will require registering on IAR website to obtain a free license key.
- (3) Download and unzip the file M360OctoberIARUpdateforIAR.zip to add support for the ADuCM360.
- (4) After unzipping this zip file, you need to copy certain ADuCM360 specific files into the appropriate IAR directories:
  - (a) Copy M360October/arm/config/debugger/AnalogDevices/ioADuCM360.ddf into corresponding folder in your IAR installation By default this is: C:\Program Files\IAR Systems\Embedded Workbench 6.0 Kickstart\arm\config\debugger\AnalogDevices
  - (b) Copy M360October/arm/config/devices/AnalogDevices/ADuCM360.i79 and ADuCM360.menu into corresponding folder in your IAR installation By default this is: C:\Program Files\IAR Systems\Embedded Workbench 6.0 Kickstart\arm\config\devices\AnalogDevices
  - (c) Copy M360October/arm/config/flashloader/AnalogDevices/FlashADuCM3xx.mac, FlashADuCM3xx128K\_8k.board, FlashADuCM3xx128K\_8k.flash and FlashADuCM3xx128K\_8k.out into corresponding folder in your IAR installation By default this is: C:\Program Files\IAR Systems\Embedded Workbench 6.0 Kickstart\arm\config\flashloader\AnalogDevices

- (d) Copy M360October/arm/inc/Analogdevices/*ioaducm360.h* into corresponding folder in your IAR installation  
By default this is: C:\Program Files\IAR Systems\Embedded Workbench 6.0 Kickstart\arm\inc\AnalogDevices

## (3) Keil uVision4 Integrated Development Environment

The  $\mu$ Vision4 IDE integrates all the tools necessary to edit, assemble and debug code. The ADuCM360 Development System supports non-intrusive emulation limited to 32kByte code. This section describes the project setup steps in order to download and debug code on an ADuCM360 evaluation system. ADI recommends using the J-Link debugger driver.

### Starting $\mu$ Vision4

From the START menu choose All Programs  $\rightarrow$  Keil uVision4. This loads the  $\mu$ Vision4 IDE. The  $\mu$ Vision4 executable is located at C:\Keil\UV4\Uv4.exe.

### Toolbars

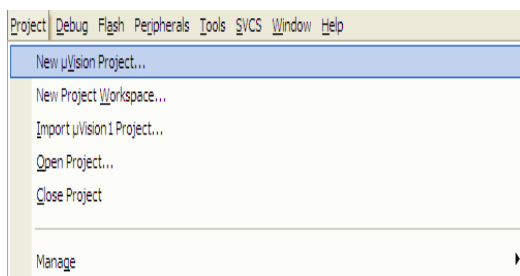
Under the VIEW menu, two toolbars are available:

1. File Toolbar
2. Build Toolbar

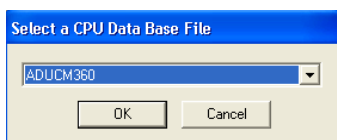
The Build Toolbar will be active only when the IDE is in Edit/Compile mode.  
The Debug toolbar will be active only in Download/Debug mode.

### Starting a project

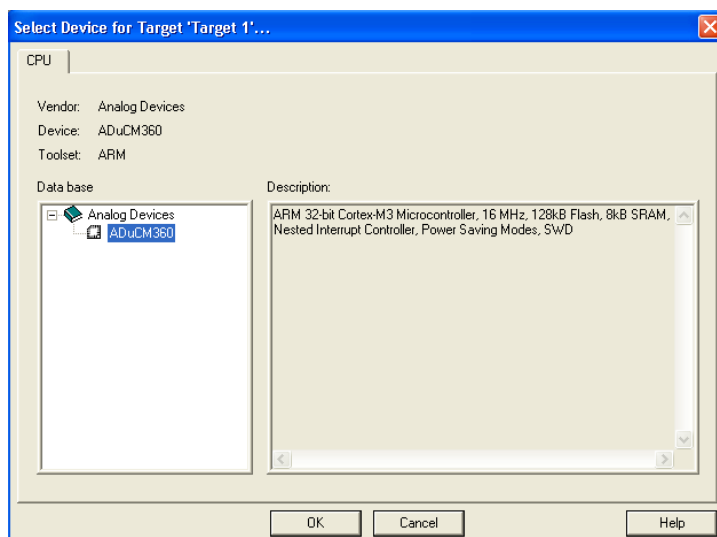
From the project menu select New Project as shown below.



Create a new folder ADIdemo under C:\ADuCM360V0.2\Example Code\RealView\Programs\ and enter the name of the project as Demo. You will then be asked to select the CPU Data Base File – select the ADuCM360.

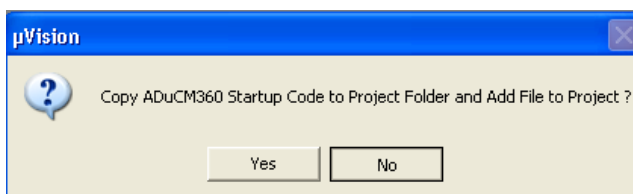



Next, Select the ADuCM360 as the target device.



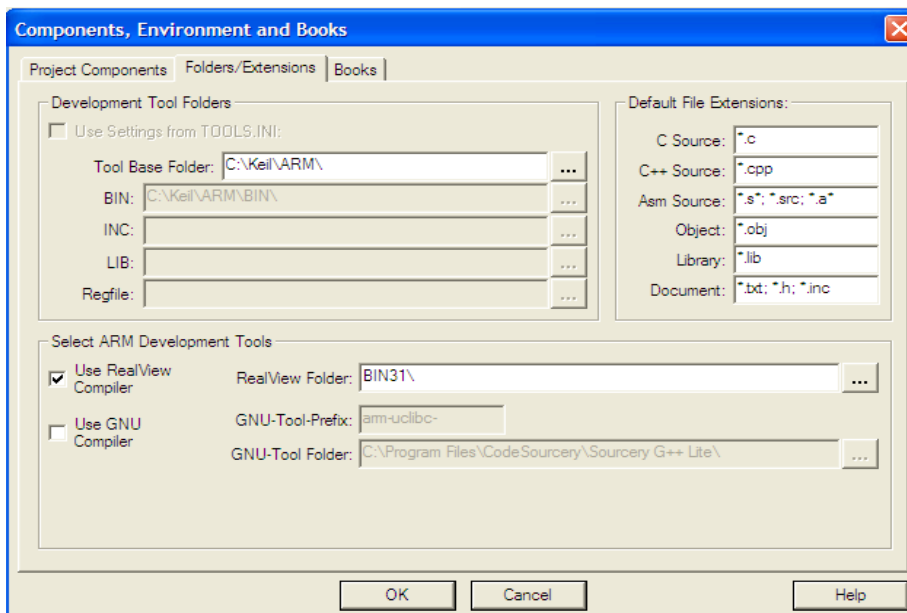


The following message appears. Select “No” not to include automatically the startup file startup.s to your project.

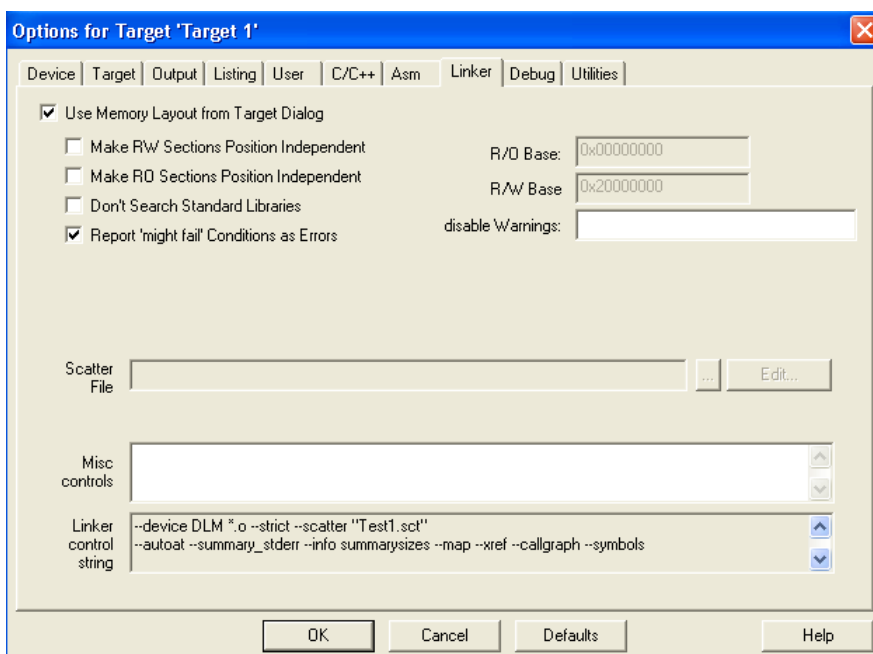


It is possible to change compiler by selecting  “setup file extensions, books and environment”, “folder extension”.

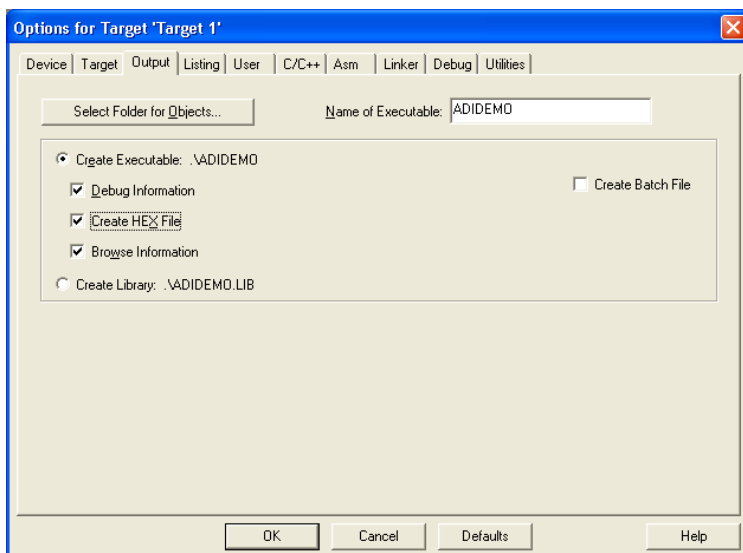
For this demo, select the RealView Compiler:



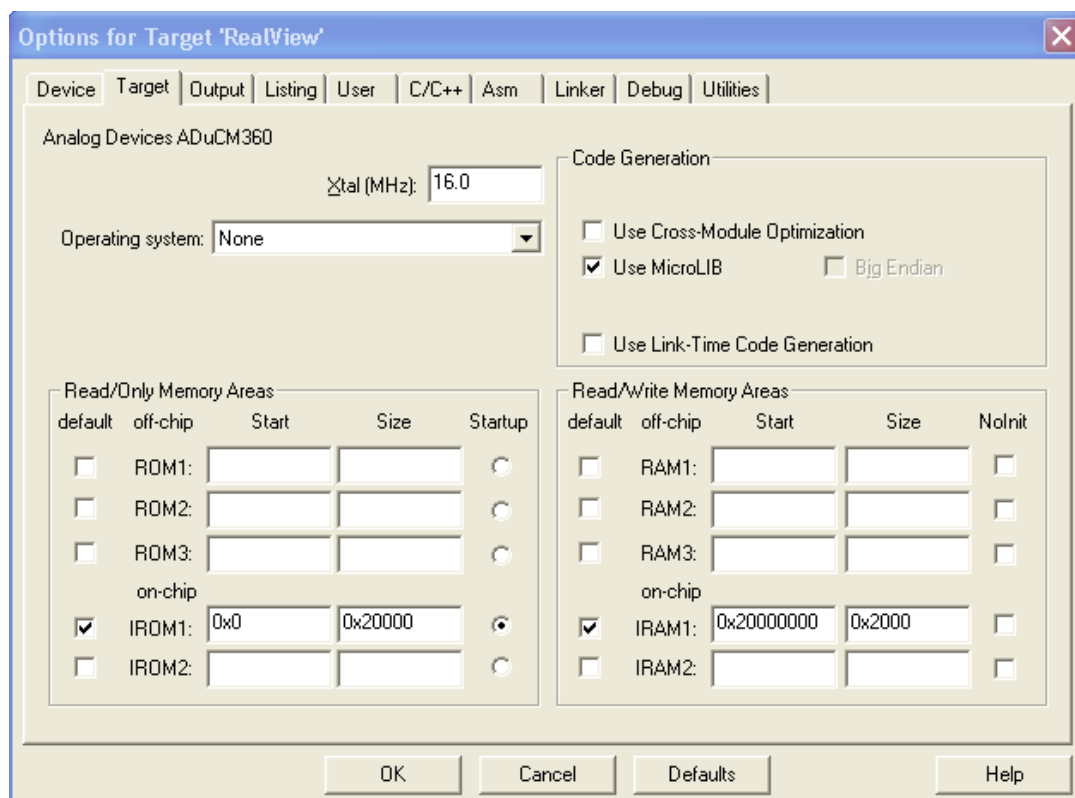
Right click on Target1 and select “Option for Target1” to configure the settings of this project. By default, uVision4 will use the RealView compiler. Add “0x00000000” into the R/O Base and “0x20000000” in to the R/W Base to indicate to the Compiler the Flash and RAM start addresses. Check the button “Use Memory Layout from Target Dialog”.



In the “Output” panel select “Create HEX File”. The HEX file can be used by the I2C downloader.



In the “Target” panel, ensure the IROM1 and IRAM1 Start and Size tabs are filled in correctly. Also, ensure the “Use MicroLIB” option is enabled.

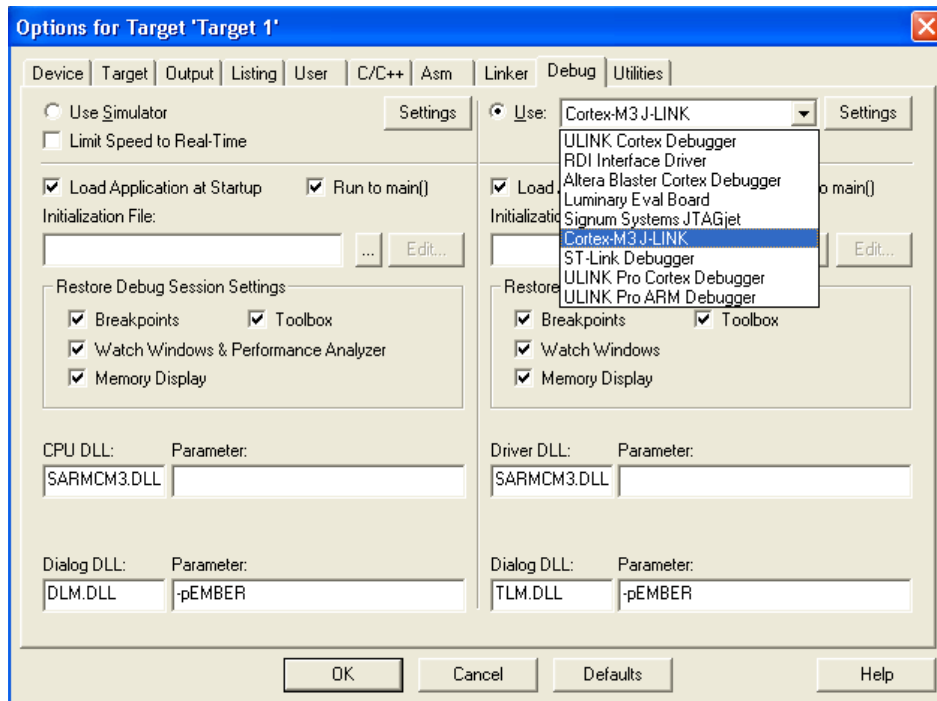


If you have an emulator, power up the evaluation board via the USB connection and the interface board. Connect the interface board to the JLink-Lite and JLink-Lite to your PC’s USB port using the provided USB cable.

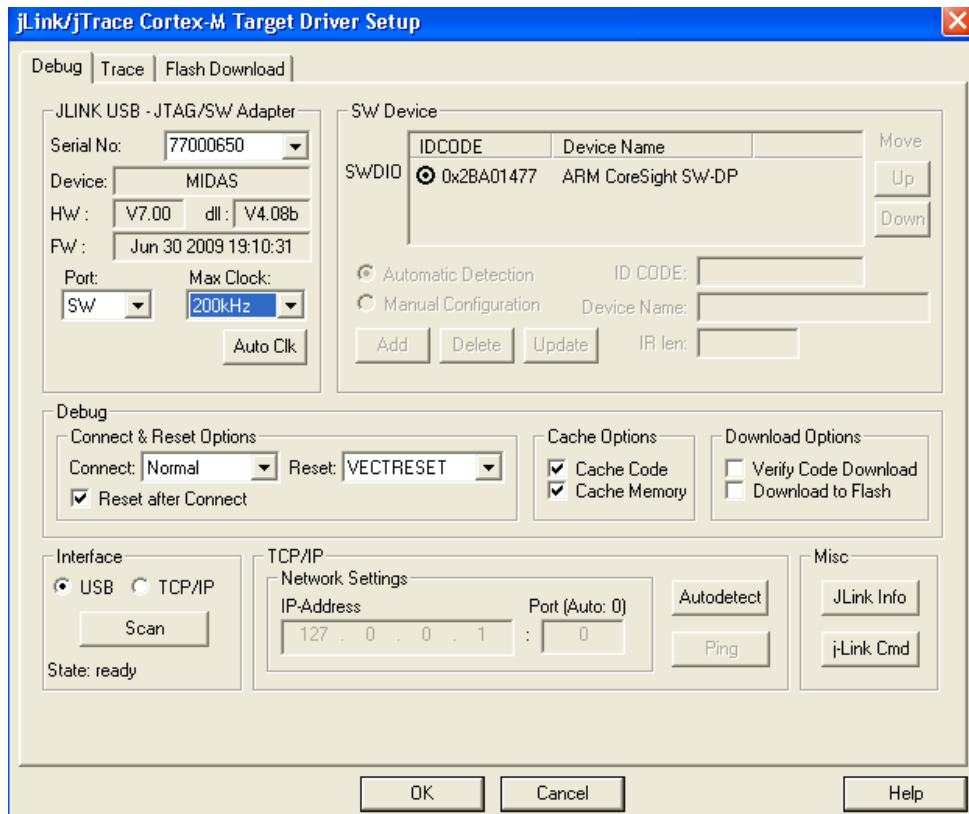
Note: a green LED on the mIDAS-Link emulator blink a few times before staying on, indicating that the emulator is communicating correctly with the PC.

## Configuring the J-Link Debugger driver

Right click on Target1 and select “Option for Target1” to configure the settings of this project. In the “Debug” panel, select Use ... and choose “Cortex-M3 J-LINK”.

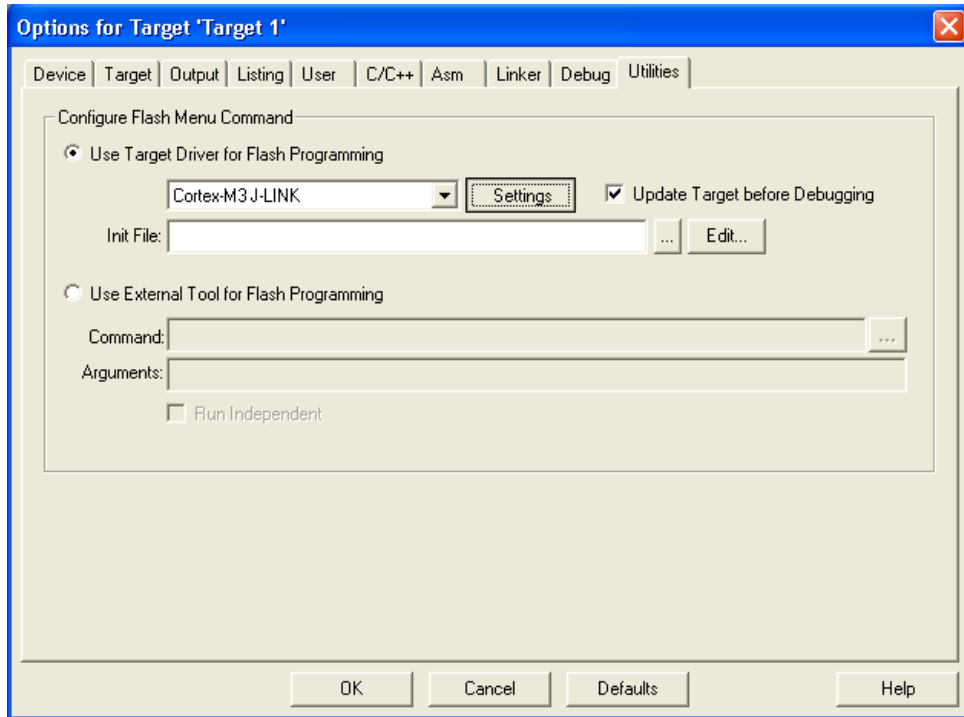


Select the settings button and configure as follows.

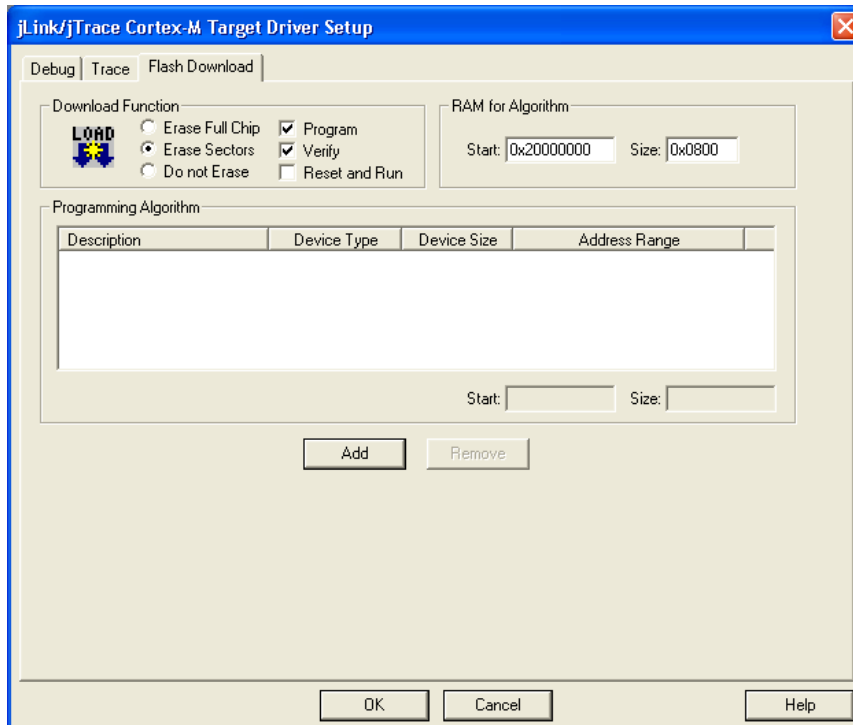


If your development system doesn't include a JTAG emulator, use the simulator for this exercise.

In the “Utilities” panel, select “Use Target Driver for Flash Programming”, chose “J-LINK / J-TRACE” and tick the option “Update Target before Debugging”.

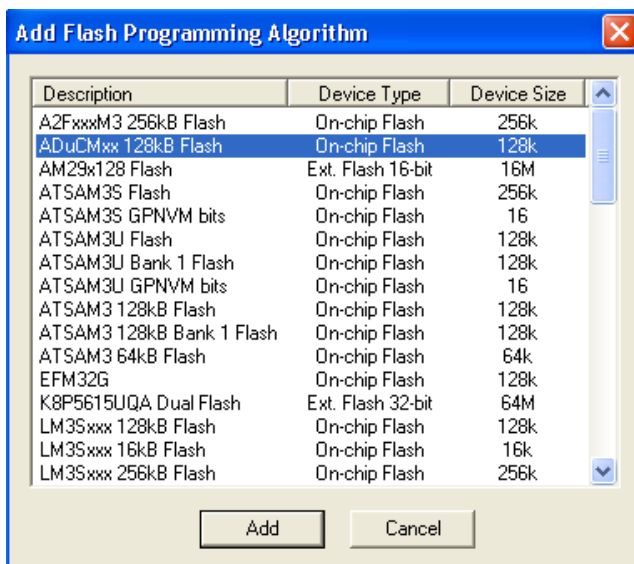


Select the “Settings” option and the following dialog box will appear –

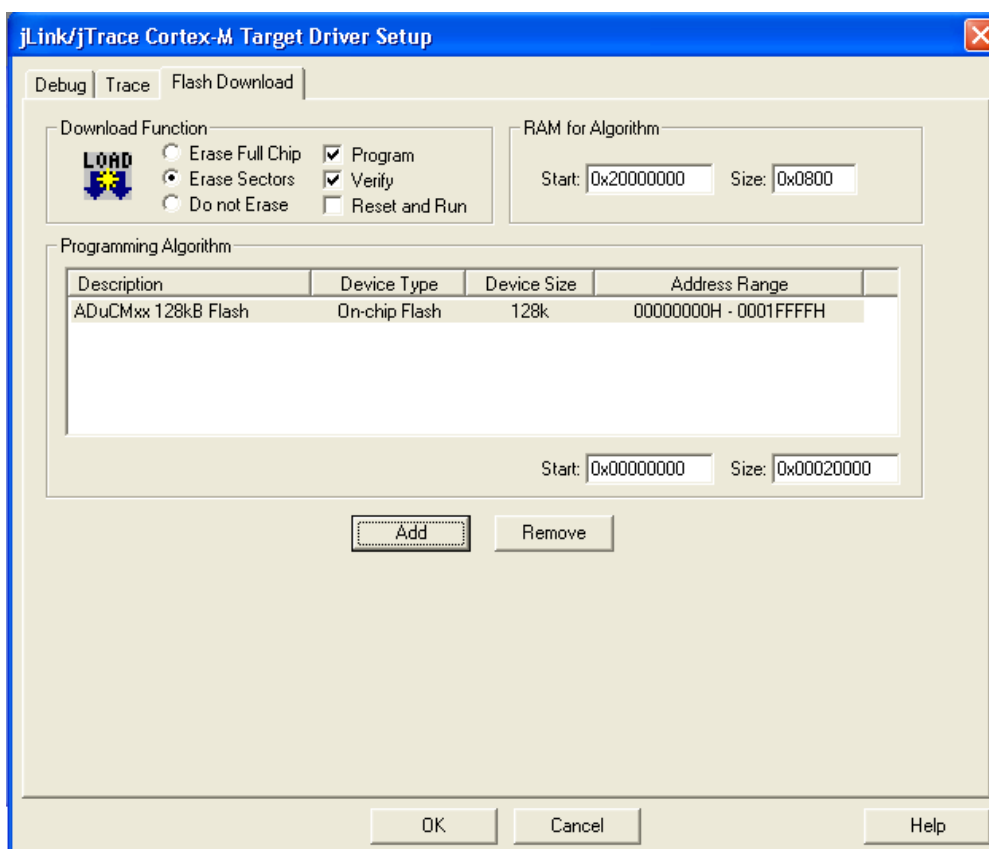


Select “Add” for the next window.

Select the driver for the generic that you are evaluating. For this example use “ADuCMxx 128kB Flash” and press “Add”



Then the following window will appear – Press “ok” at this point.

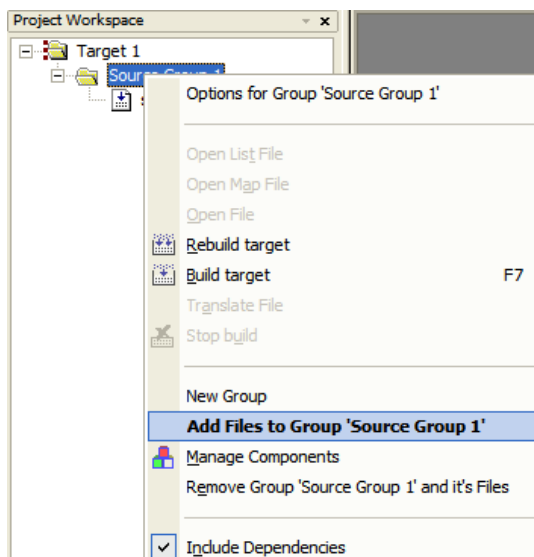


Press OK again, all the options should be properly configured to compile, assemble, link, download and debug using JLink-Lite or the simulator.

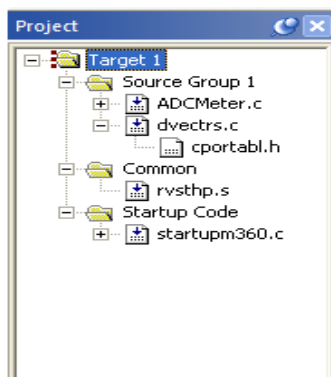
### Adding Project files

All the files relative to the project will be in the folder C:\ADuCM360V0.2\Example Code\RealView\Programs\ADC0. From Windows Explorer or any other way, copy the files C:\ADuCM360V0.2\Example Code\RealView\Programs\ADCMeter.c, into the new directory C:\ADuCM360V0.2\Example Code\RealView\Programs\ADIDemo.

To add the files to the project right click on the “Source Group” folder in the “Project Workspace” and select “Add Files to Group”.





Note: You can use under Project the option “Component, Environment, Books” to rename the target and add the file relative to your project. Also add the following files from the directory C:\ADuCM360V0.2\Example Code\RealView\Programs\common: dvectrs.c, startupm360.c and rvsthp.s



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 following will be seen in the status window. If there are errors in your source code these will appear in the status window. To identify the line of code which corresponds to the error double click on the error in the Output window and an arrow will appear highlighting the line of code in which the error appears.

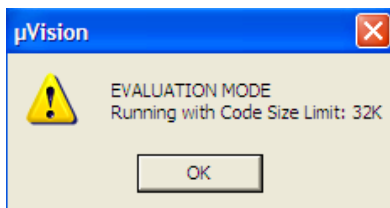
Before the code can be downloaded to the MicroConverter the entire project must be built. This is done by clicking on the  (rebuild all target files) icon on the toolbar. It will also create a demo.elf file used by the debugger.

```

Build Output
Build target 'Target 1'
compiling ADCMeter.c...
compiling dvectrs.c...
assembling rvsthp.s...
compiling startupm360.c...
linking...
Program Size: Code=5732 RO-data=256 RW-data=1088 ZI-data=576
FromELF: creating hex file...
"ADIDEMO.axf" - 0 Error(s), 0 Warning(s).
    
```

## Downloading/Debugging Code


To start debugging, select Start/Stop Debug in the Debug dropdown menu or press the icon  (Start/stop debug session). The debugger will indicate that you are using an evaluation version. Press OK.



Close the disassembly window. Go to 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.

```

095 int main (void)
096 {
097     unsigned char i = 0;
098     unsigned char nLen = 0;
099
100     GPOPUL = 0xFF;           // Enable pullup on P0.7/0.6
101     T3CON = 0;             // Turn off Watchdog timer
102     CLKCON0 = 0x0;        // 16MHz CPU clock
103     CLKCON1 = 0x0;
104     ADCOMDE = 0x3;       // ADC0 into Idle mode
105     ExtIntEnable(0x2,0x0);
106     ucIEXCCON = 0;
107     ucIEXDAT = 0;
108     GP2OEN = 0x4;
109     bSendResultToUART = 0;
110     UARTInit(B9600);
111     ucTestStep = 0;
112     // ADC0INIT();
113     ADC0BUFEBYPINIT();
114     ADC1INIT();
115     STEPINIT();
116     DACINIT();
117     ucIEXCCON = 0x6C;    // Enable IEXC0&1, Internal IREF, AIN4 = IEXC1, AIN5 = IEXC0
118
119     ucIEXDAT = I400uA;
120     IEXCINIT(ucIEXCCON, ucIEXDAT);
121     delay(150000);
122     ADCOMDE |= 0x1;
123     // ADC1MDE = 0x1;
124     INTSETEO = 0x2E028; // UART/ADC0/ADC1/IRQ2/IRQ4 interrupt sources - M360
125     bSendResultToUART = 0;
126     ucTestStep++;
    
```

Press the run code button  twice. The program will measure the input signal applied across AIN0 and AIN1, convert this to a voltage and send an ASCII string to the UART – baud rate 9600-8-N-1.

To stop the code running press  and to stop debugging press .

**(4) IAR Embedded Workbench IDE**

Instructions for using IAR Workbench IDE will follow in the next version.

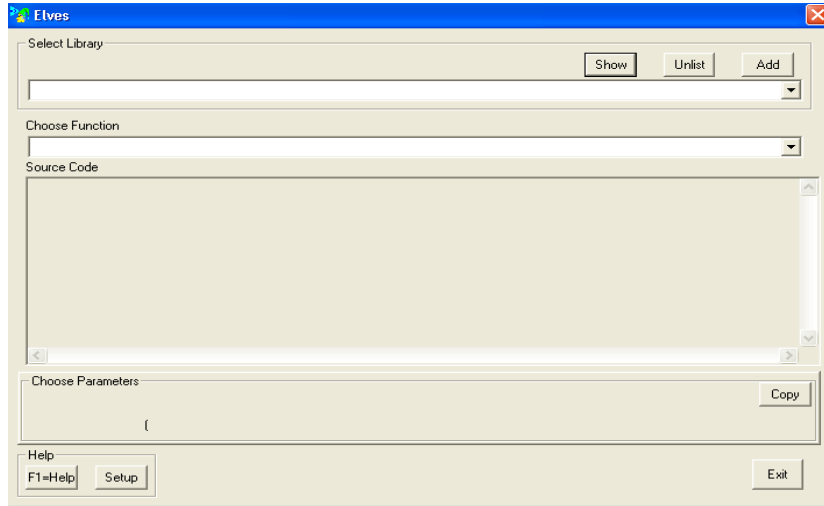


**(5) *Elves***

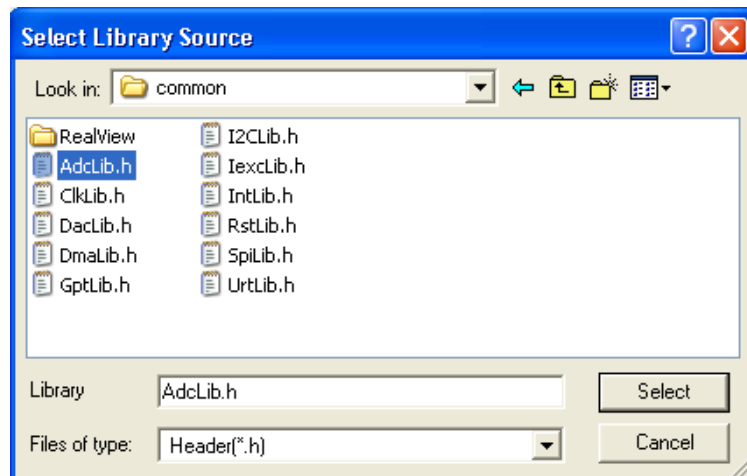
***Using Elves.exe with uVision4***

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 will generate the C source code that configures all the appropriate ADuCM360 registers.

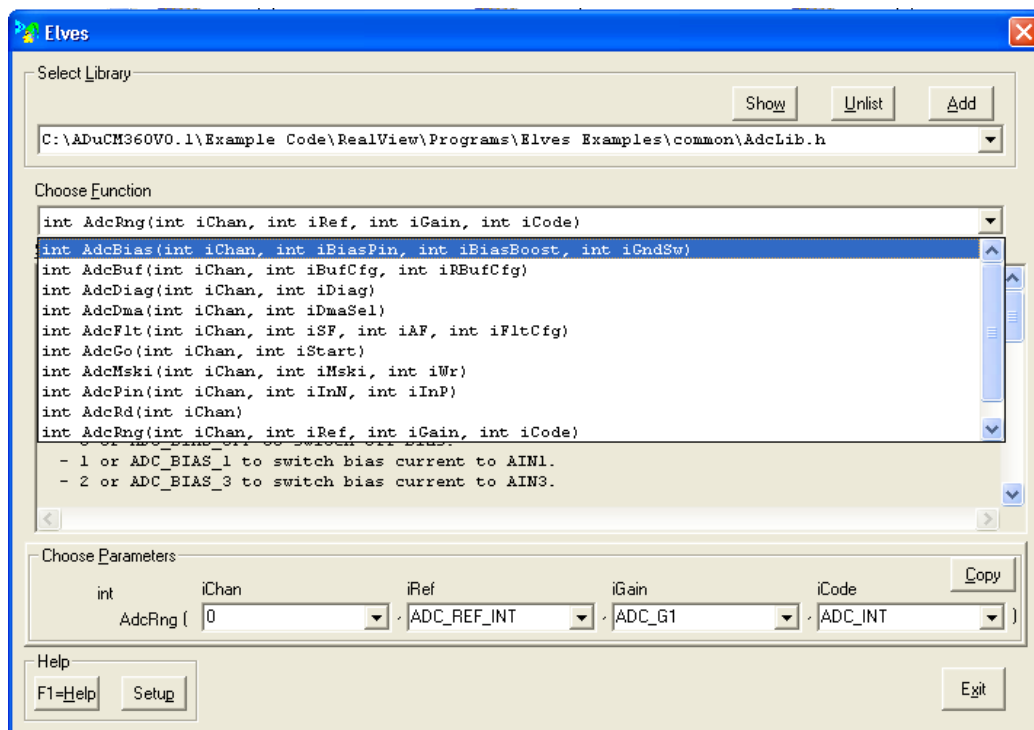
In the folder, C:\ADuCM360V0.2\Example Code\RealView\Programs\ElvesLibs, open the file Elves.exe to launch Elves.



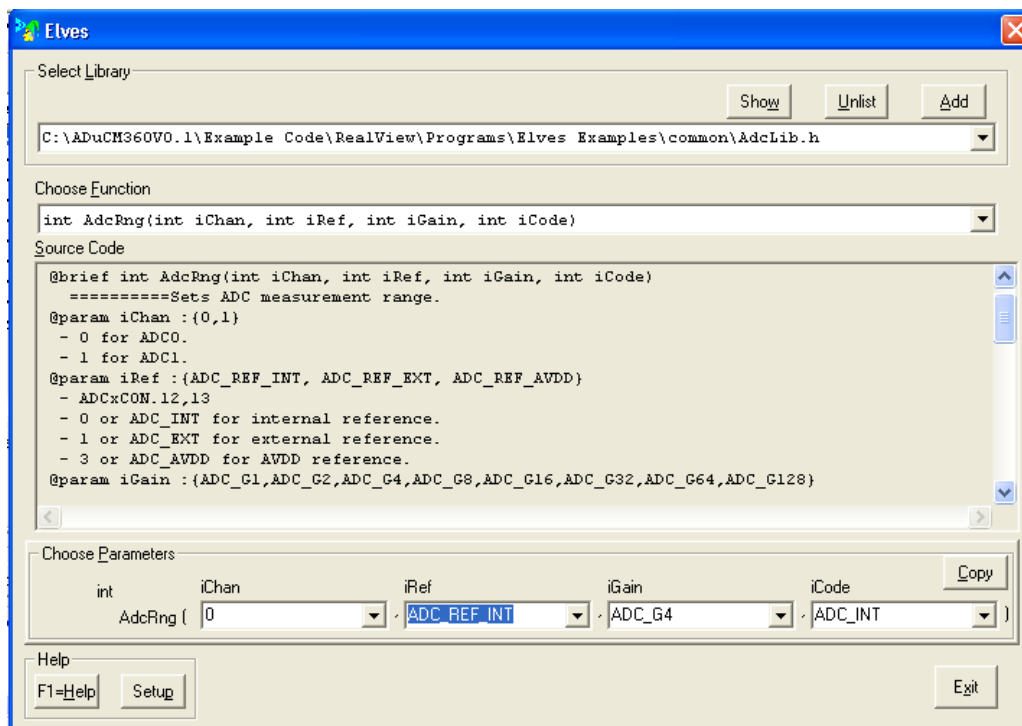
To add a library, click on “Add” button and go to the directory C:\ADuCM360V0.2\Example Code\RealView\Programs\Elves Examples\common. In here there is a list of header files – add the header file(s) that you wish to use.



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



If for example we take the function `AdcBias`, in the “Choose Parameters” section at the bottom, the user configures the parameters to meet their needs – each parameter is explained in the Source Code window:



Once you are happy with the register settings, simply hit the “Copy” button and paste this function in to your source code in Keil or IAR as shown below:

```

181 AdcRng(0, ADC_REF_INT, ADC_G4, ADC_INT); // Elves Library - Configures ADC0 to use Int ref, G=4, bi-polar mode
182 AdcMski(0, ADC_M_RDY, 1); // Elves Library - setup ADC0 IRQ
183 AdcFlt(0, 0x7d, 0x0, FLT_NORMAL); // Elves Library - setup ADC0 Filter
184 AdcRng(0, ADC_REF_INT, ADC_G16, ADC_INT); // Elves Library - Setup Gain and Vref source
185 AdcPin(0, AIN2, AINO); // Elves Library - Setup input channels
186
187 ADCOMDE |= 0x100; // Enable PGA

```

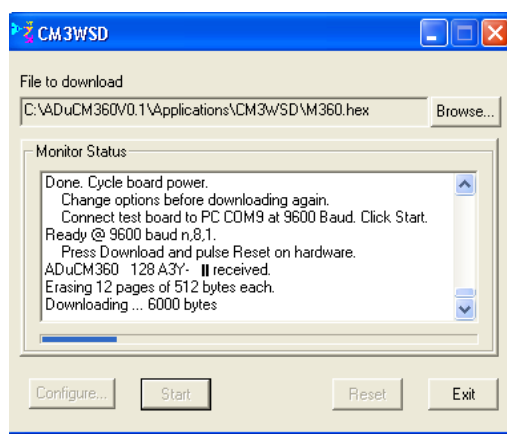
Note: before using the Help option, you need to click Setup and point to the following file\folder:  
 \Example Code\RealView\Programs\ElvesLibs\Docs\AO\_P.html

## (6) The Windows Serial Downloader

The Windows Serial Downloader for Cortex-M3 based part (CM3WSD) is a windows software program that allows a user to serially download Intel Extended Hex files as created by assembler/compiler 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).

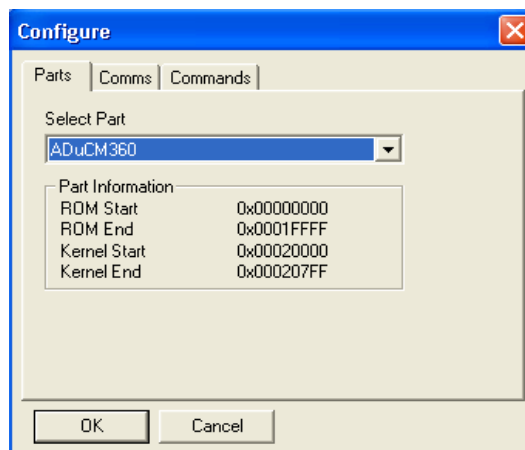
### Preparing for Download

1. Connect the ADuCM360 mini-board to the interface board.
2. Connect the interface board to the PC using a USB cable.
3. Ensure all the links are inserted on both boards.
4. The user should place the ADuCM360 into serial download mode using the following sequence:
  - a. Pull P2.2 low
  - b. Pull the RESET pin low and then high (float)
  - c. P2.2 can be let float once RESET is high



### Downloading using CM3WSD

1. Launch CM3WSD.exe under the software tools\CM3WSD folder.
2. Select the file at C:\ADuCM360V0.2\Applications\CM3WSD\M360.hex.
3. Press the Configure button and in the Parts panel select ADuCM360. Press OK.
4. Select the correct COM port and a baud rate of 115200.
5. Press the Start button. 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 monitor status box will be updated with "Flashing Complete Click Reset to run program".



## ***Running the downloaded file***

### **Running using the CM3WSD**

Click the Reset button with P2.2 floating or pulled high. The monitor status box will be updated with the message “Running”.

### **Manual Run option**

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

**(7) Installed Documentation and Code Directory*****Installed Documentation Directory***

C:\ADuCM360V0.2\Documentation

C:\ADuCM360V0.2\Applications

C:\ADuCM360V0.2\Example Code