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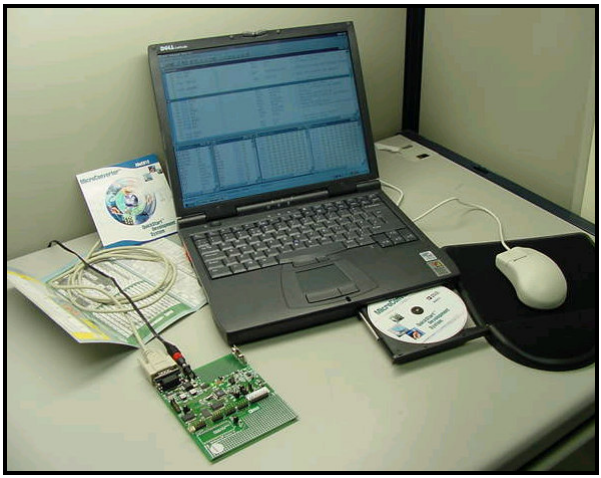
ADuC8xx Evaluation Kit
Get Started Guide

CONTENTS:



The ADuC8xx QuickStart Development System

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INTRODUCTION

The following GetStarted tutorial guide will bring the user through the various tools that are part of the MicroConverter QuickStart development system. As all our tools are ADuC8XX generic, this tutorial guide should be read for a development on any of our ADuC8XX parts.

The ADuC8XX parts and the evaluation boards that are referenced in this tutorial guide are as follows:

PART	EVALUATION BOARD
ADuC812	MicroConverter SAR Eval Board Rev A3
ADuC814	Eval-ADuC814QS SAR Eval Board Rev B1
ADuC831	MicroConverter SAR Eval Board Rev A3
ADuC832	MicroConverter SAR Eval Board Rev A3
ADuC841	MicroConverter SAR Eval Board Rev A3
ADuC842/ADuC843	MicroConverter SAR Eval Board Rev A3
ADuC816	MicroConverter ΣΔ Eval Board Rev B
ADuC824	MicroConverter ΣΔ Eval Board Rev B
ADuC834	MicroConverter ΣΔ Eval Board Rev B
ADuC836	MicroConverter ΣΔ Eval Board Rev B
ADuC845	MicroConverter ΣΔ Eval Board Rev 0
ADuC847	MicroConverter ΣΔ Eval Board Rev 0

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

TOOL	EXECUTABLE	FUNCTION
ASSEMBLER	Asm51.exe	The Metalink 8051 Cross Assembler takes an assembly language source file created with a text editor, saved with a .ASM extension and translates it into two files, a listing file output (.lst) and a machine language object file in standard Intel Hex format (.hex).
DOWNLOADER	WSD.exe	The Windows Serial Downloader (WSD) is a windows software program that allows a user to serially download standard Intel Hex files, as created by the ASM51 assembler, to the MicroConverter, while in circuit.
INTEGRATED DEVELOPMENT ENVIRONMENT (IDE) - ASSEMBLY SOURCE -	SEE KEIL OR IAR IDES AT www.IAR.com **WWW.KEIL.COM**	Keil and IAR provide a complete IDE (Integrated Development Environment) integrating all the tools necessary to edit, assemble, simulate and debug Assembly source code via the serial port. Download the latest 8051 tools from these vendors from their websites: www.IAR.com www.Keil.com
WINDOWS ANALOG SOFTWARE PROGRAM	WASP.exe	The **Windows Analog Software Program** (WASP), is an analysis tool allowing the user to easily measure the analog noise performance of the MicroConverter.

USB-EA EMULATOR	None	For non-intrusive debugging using Keil or IAR development tools. Also, it can be used for Serial downloading via the EA pin and WSD software.

(1.0) INSTALLATION

Installing from CD:

- Insert the MicroConverter® QuickStart™ Development System CD ROM into your CD ROM drive, select the CD-ROM drive and double-click on the file "setup.exe".
- Follow the on screen instructions to install the software on your PC.

Notes:

- Although you can install the 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 have installed the software at the default location of C:\ADuC.
- If you already have a previous ADuC8XX QuickStart Development System tool-suite installed on your machine, this version may also be installed by default at C:\ADuC. The ADuC8XX Software Tools installation will automatically update any previous ADuC8XX tools in this directory.

2.0 THE METALINK 8051 CROSS ASSEMBLER:

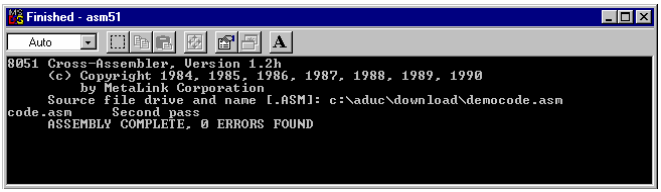
The Metalink 8051 Cross Assembler takes an assembly language source file created with a text editor, saved with a .ASM extension and creates two files, an output list file (.LST) and a machine language object file in standard Intel Hex format (.HEX).

The list file output (.LST) displays the results of the assembler operation, including any syntax or other errors present in the original source code.
The Intel Hex file (.HEX) is used to program the part using the Windows Serial Downloader (WSD) as described in section 3.0.

2.1 Using the Metalink Assembler

1. In the C:\ADuC\ASM51 directory, double-click on the *ASM51.exe* executable.

2. In the DOS window that comes up, type the path of the assembly file you wish to assemble. For example, to assemble the example file C:\ADuC\Download\DemoCode.asm, simply type "C:\ADuC\Download\DemoCode.asm" as shown below.



The assembler will display the text "ASSEMBLY COMPLETE, 0 ERRORS FOUND" indicating that it has successfully assembled the file and has created the hex and list files (i.e. DemoCode.hex & DemoCode.lst) along side the assembly input file (i.e. DemoCode.asm). If the assembler indicates assembly errors, you should view the list file (i.e. DemoCode.lst) to examine the errors. To view the list file, open it with notepad or any standard text editor.

Note: ***If the assembler returns an error message indicating a failure to read drive A, or a fatal error opening a file on the A drive, then it is most likely failing to find the MOD52 or MOD8XX file referenced by the assembly file. Make sure all MOD files (plus any other "include" files referenced in your assembly code) are located in the C:\ADuC\ASM51 directory (where you clicked the ASM51.exe executable).***
The ASM51.exe program can be copied/moved to another directory to prevent typing in the long path name each time. Make sure that the relevant MOD files are also moved with the ASM51.exe program.

For additional details on the use of the Metalink ASM51 assembler, please refer to the ASM51 user manual at C:\ADuC\ASM51\ASM51.pdf.

3.0 THE ADUC WINDOWS SERIAL DOWNLOADER (WSD):

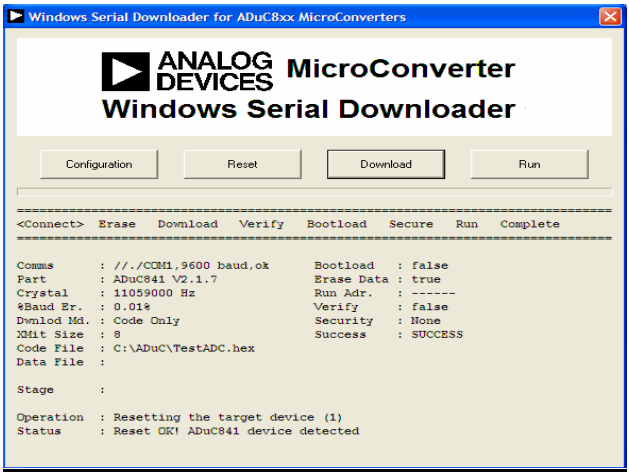
The Windows Serial Downloader (WSD) is a windows software program that allows a user to serially download standard Intel Hex files as created by the ASM51 assembler to the MicroConverter via the serial port. The standard Intel hex file is downloaded into the on-chip FLASH/EE program memory via a selected PC serial port (COM1 to COM32). The WSD also incorporates the protocols for downloading to FLASH/EE data memory, setting of security bits and various RUN options.

3.1 Opening the Windows Serial Downloader

1. Power up the evaluation board using the 9V power supply. Connect the evaluation board header J4 to your PC's COM1 serial port using the RS-232 dongle cable provided. The PC serial COM port may be changed from COM1 via the WSD '**configuration**' option…see section 3.4 below.

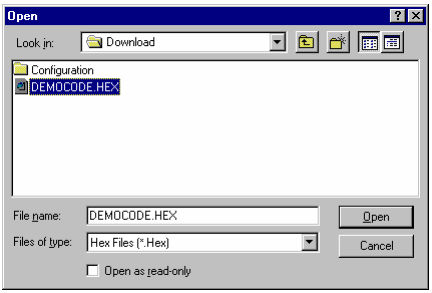
2. The user should put the MicroConverter into serial download mode.
   To enter serial download mode on the **ADuC814** the user should:
   Connect S3 into the DLOAD/DEBUG position and press the RESET button.
   To enter serial download mode on any of the other **ADuC8xx** products the user should:
   While holding down the "SERIAL DOWNLOAD" button press and release the RESET button.

3. From the START menu choose Programs → ADuC → WSD. This launches the Windows Serial Downloader application. The WSD executable is located at
   C:\ADuC\Download\WSD.exe.
   The WSD automatically sends the reset command to the MicroConverter. If the MicroConverter is in serial download mode and the comms between the PC and the evaluation board are setup correctly then the WSD should display the following text above the top right corner of the Status Box.
   'ADuC8XX version 2.Y
   i.e. the screen shot for an ADuC841 below shows the result….



3.2 Downloading using the WSD

4. Click the Download Button. Select the file at C:\ADuC\Download\DemoCode.hex. Double click on the selected file or click on 'Open' to download the file.



While the file is downloading a progress bar will appear indicating how much of the file has been downloaded.

Once the file has been successfully downloaded the progress bar will disappear and the Status Box will be updated with the message

DOWNLOADING CODE [C:\ADuC\Download\DEMOCODE.HEX]:.....OK

3.3 Running the Downloaded File

Running using the WSD

5. Click on the Run Button. The Status Box is updated with the message.

Run OK!

The program starts running from address 0000h, as can be seen by a flashing LED on the Evaluation Board.

To perform additional downloads; repeat step 2 and press the RESET button on the WSD.

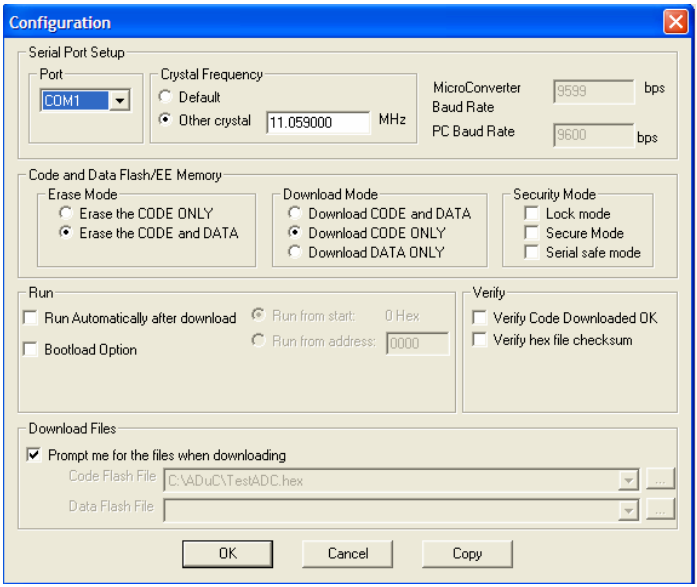
Manual Run Option.

6. Press RESET on the Evaluation Board with the SERIAL DOWNLOAD switch released (for the ADuC814 switch S3 to the NORMAL position). The program starts running automatically after reset as can be seen by the flashing LED.

Note: DemoCode.hex blinks a LED on the eval board. The rate of blinking is reduced each time the INT0 button is pressed

3.4 Additional Download/RUN Options

The MicroConverter incorporates a serial download protocol that also allows various Download/RUN options (see uC004 at C:\ADuC\Documentation\TechNotes). These options can be easily selected in the Configuration window as shown below (the Configuration button can be found on the front panel of the WSD as shown in 3.1.3 previously). As you can see various Erase, Download and RUN options exist here.



Certain options may be grayed out depending on the particular MicroConverter you may have.

Run Automatically after Download

7. Click on the Configuration button. Tick the box for 'Run automatically after download' as shown in the configuration window above. Click on OK. Enter serial download mode as in step 3.1.2. Download as in step 3.2.4. The program starts running automatically after download as can be seen by the flashing LED.

NOTE: Use of the PC COM Port:

Only one application may use the PC serial port at any one time.
The WSD only uses the PC COM serial port when

- Resetting the device
- Downloading to the device
- Sending the Run command to the device

Therefore, the WSD does not have to be closed before launching the Debugger/WASP/Hyperterminal or any other application that uses the PC COM serial port.

However if another application, that uses the PC serial port, is open then the WSD will not be able to communicate with the MicroConverter until the PC serial port is released by disconnecting/closing the other application.

3.5 Downloading via the USB-EA emulator

Chapter 4 will discuss using the USB-EA emulator for debug purposes. However, it is also possible to use the USB-EA emulator to serially program the ADuC8xx parts via the EA pin – I.e., it doesn't require the a connection to the UART pins.
After you have installed the USB-EA emulator, your PC will assign the emulator a COM port.
When using the USB-EA emulator to download to the ADuC8xx, simply select this COM port in the WSD application and proceed as per the earlier instructions.
For more details on the USB-EA emulator, see chapter 4.

(4.0) USB-EA EMULATOR FOR ADUC8XX DEBUGGING

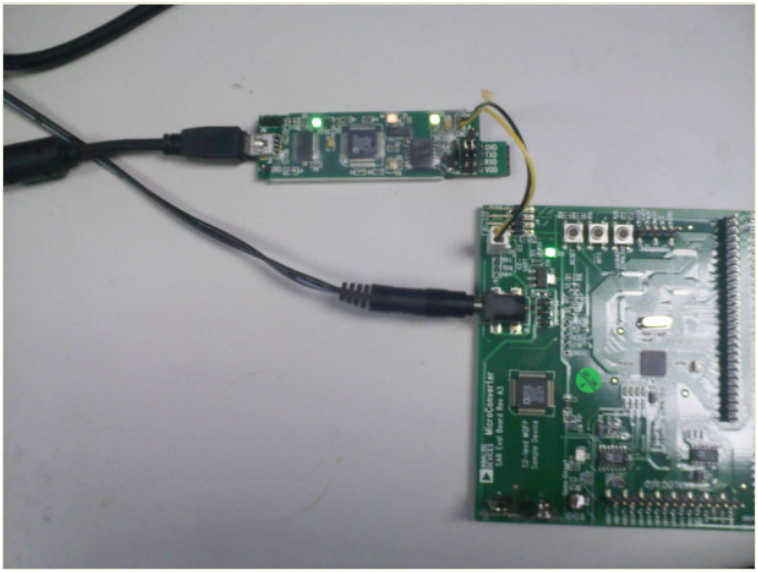
The USB-EA emulator allows non-intrusive debugging of the ADuC8xx series of devices.
The USB-EA Pod is shipped as part of the Quick Start Plus kits or, it may be purchased separately.
The following parts are supported by the USB-EA emulator:

ADUC831
ADUC832
ADUC841
ADUC842/ADUC843
ADUC834
ADUC836
ADUC845
ADUC847
ADUC848

Note, the ADuC812/814/816/824 are not supported.
The debugger interfaces to the ADuC8xx via a single pin – the EA pin of the ADuC8xx part. To enter debug mode, the part must first be placed into download mode by toggling the Reset pin while holding the Serial download pin low. When using the evaluation boards, this involves keeping the Serial download button pressed while toggling the reset button.

4.1 Connecting the USB-EA emulator to the target board

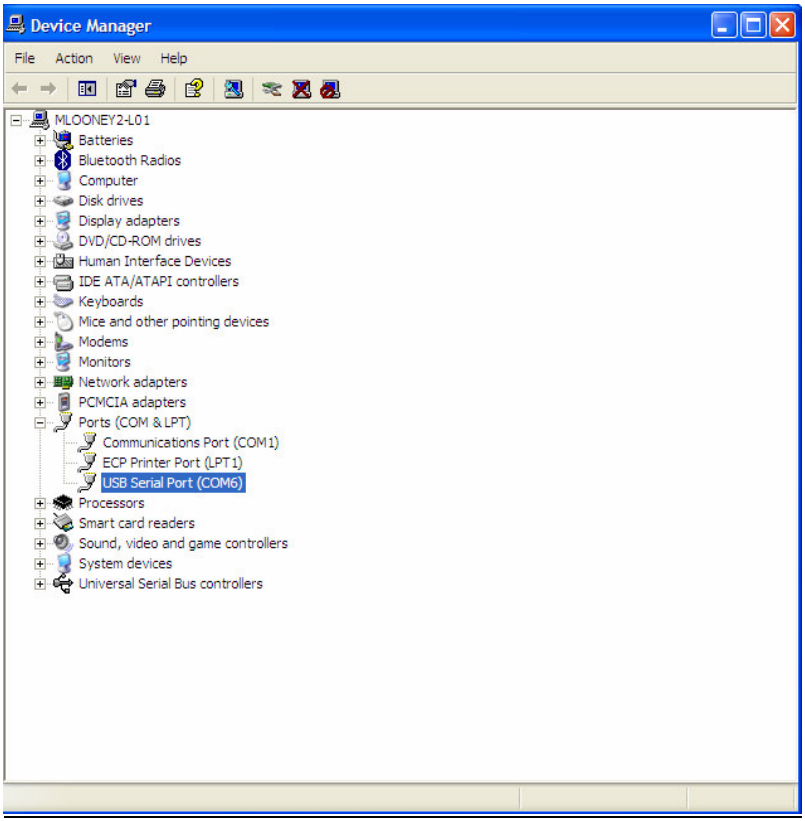
The pod connects to a PC via a standard mini-USB cable. It connects to a target board via a 2-pin header. See the pictures below.



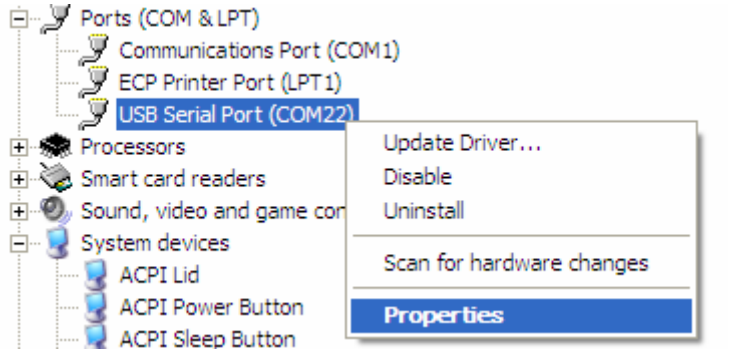
4.2 Drivers for the USB-EA emulator

If the USB drivers for the USB-EA dongle do not install automatically on your PC, then download drivers for the FT245R part for your operating system from the following website: http://www.ftdichip.com/Drivers/D2XX.htm

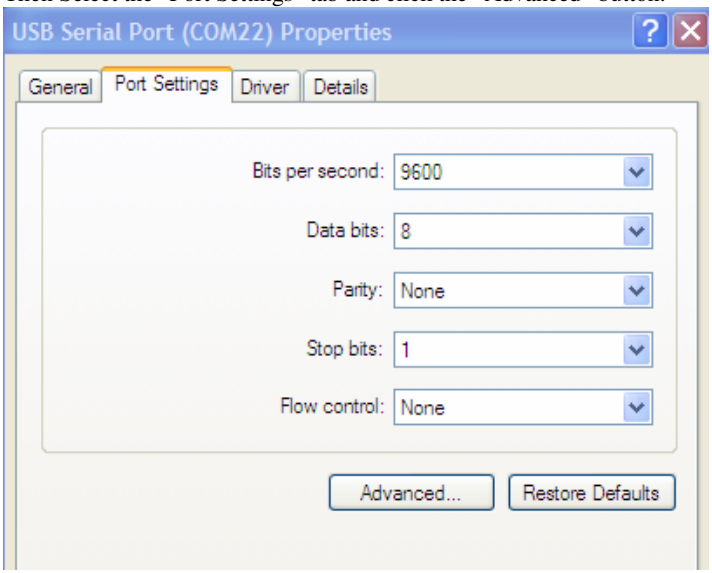
When the drivers are installed and USB-EA dongle is connected to the PC, it will appear as an extra COM port under the Device Manager window – see the figure below.



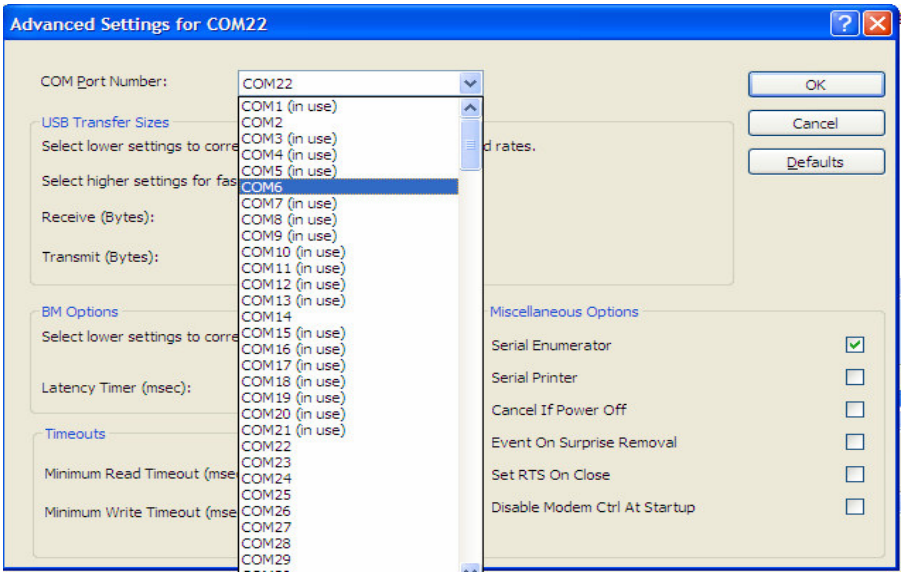
Note: The older versions of the Keil tools only work with COM port numbers of COM8 or lower.
If your PC allocates a COM port number of COM9 or higher, then you will need to change the COM port to a lower number.
To do this, right-click your mouse on the USB-EA entry in the Device Manager window and select ***Properties***.



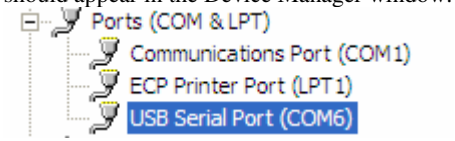
Then Select the “Port Settings” tab and click the “Advanced” button.



In the Advanced Settings window, change the COM port number to a port lower than COM 9.



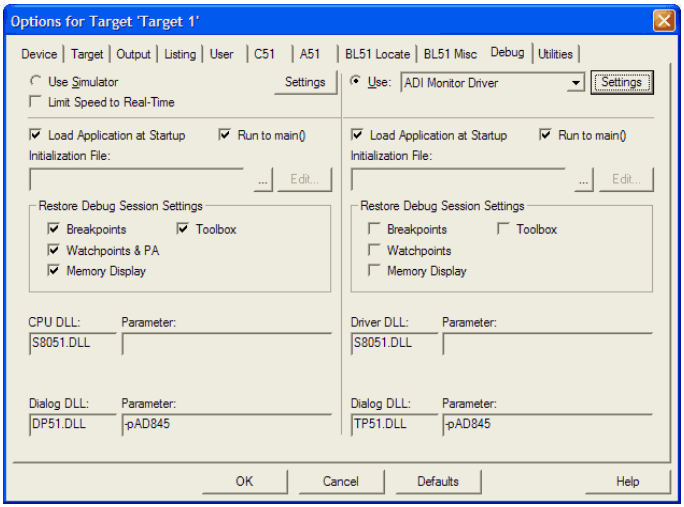
Click “OK” and return to the main Device Manager window. To update the newly selected COM port, unplug and re-plug the USB cable to the USB-EA dongle and the newly selected COM port should appear in the Device Manager window:



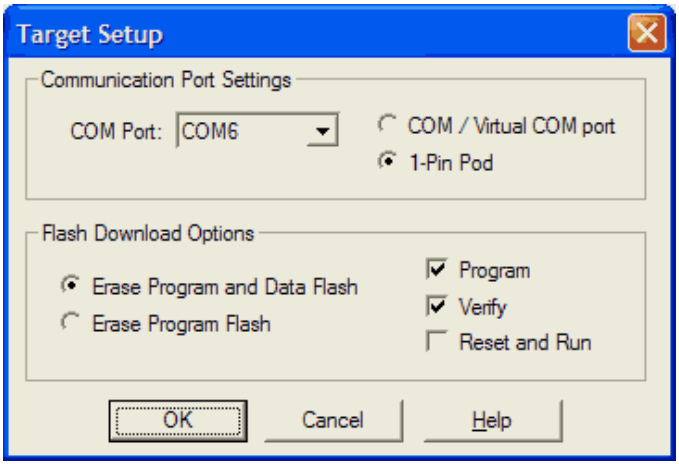
4.3 Configuring Keil tools for the USB-EA emulator

Open your project using a recent version of Keil PK51 development software.
From the Keil uVision menu select Flash -> Configure Flash Tools -> Debug

Make the selections as shown on the right half of the screen below, ensuring to select the ADI Monitor Driver.



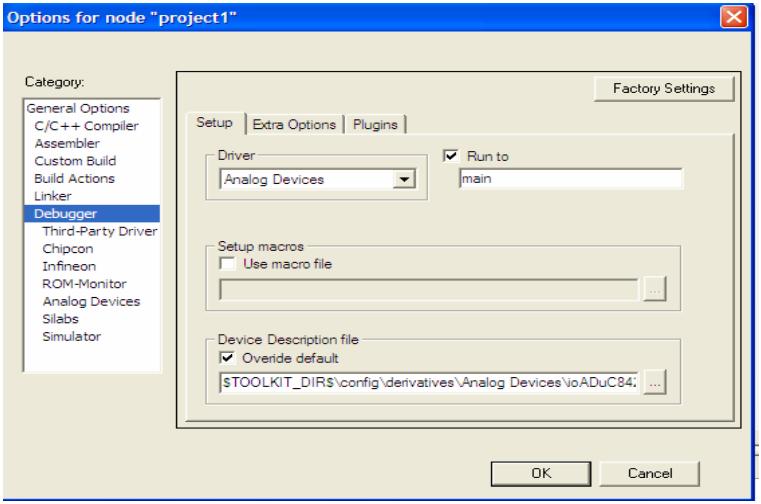
Click on Settings at the top right. Select 1-Pin Pod and the COM port assigned to the emulator as shown below. Use Device Manager to identify the appropriate COM port as describer previously.



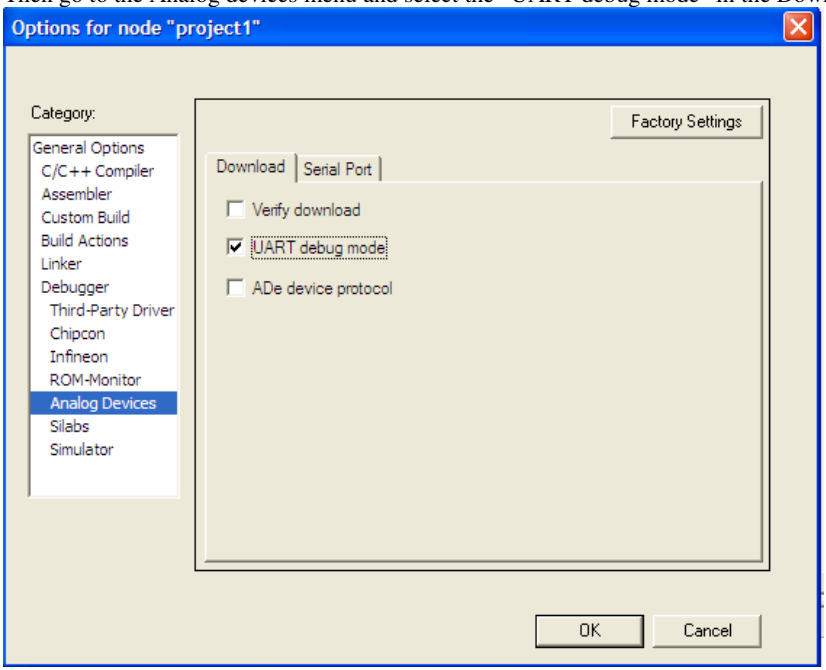
Download the latest 8051 tools from these vendors from their website:
www.Keil.com

4.4 Configuring IAR tools for the USB-EA emulator

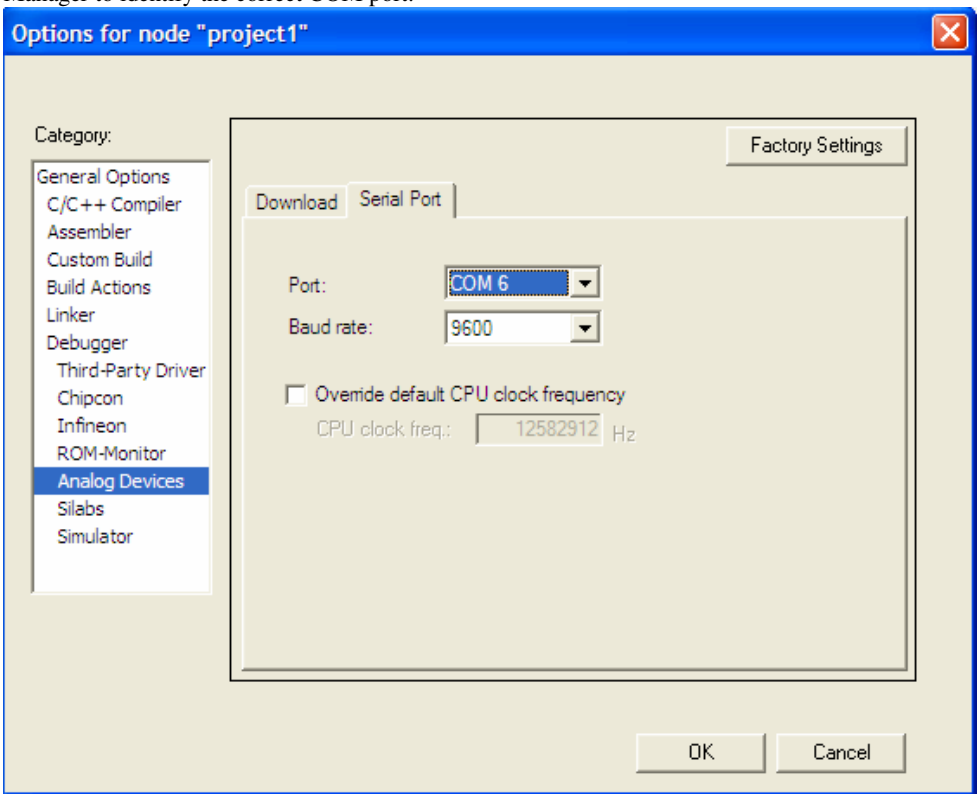
Open your project using a recent version of IAR's EW51 development software.
In the "Project Options" menu, go to the "Debugger" section and select the "Analog Devices" driver.



Then go to the Analog devices menu and select the "UART debug mode" in the Download menu.



In the “Serial Port” menu, ensure the correct COM port is selected. As described earlier, use Device Manager to identify the correct COM port.



Download the latest 8051 tools from these vendors from their website:
www.IAR.com

4.5 Keil/IAR limitations when using the USB-EA emulator

The “Halt” feature does not work in either Keil or IAR.
To stop the program, breakpoints should be inserted.

(5.0) THE ADUC WASP

The Windows Analog Software Program (WASP) is a general application for all MicroConverter products that allows analysis of their analog performance. The WASP recognizes which MicroConverter the PC is communicating with, before automatically downloading the appropriate code. In this tutorial we will briefly introduce both the SAR WASP (for the SAR ADC parts … ADuC812, ADuC814, ADuC831, ADuC832, ADuC841, ADuC842 and the ADuC843) and the ΣΔ WASP (for the ΣΔ ADC parts … ADuC816, ADuC824, ADuC834, ADuC836, ADuC845, ADuC847 and ADuC848). The terms SAR WASP and ΣΔ WASP relate to the same WASP software. The software differentiates between the different products.
After downloading the appropriate code the WASP launches the Acquisition Window. This allows the user to configure, control and analyze the ADC noise performance with the various analog and digital peripherals enabled/disabled.

1. Power up the evaluation board using the 9V power supply. Connect the evaluation board to your PC's COM1 serial port using the RS-232 dongle cable connected to the 4-way header, J4.

2. The user should put the MicroConverter into serial download mode as described in section 3.1.2.

3. From the START menu choose Programs → ADuC → WASP. This launches the WASP application. The WASP executable file, WASP.exe, is located at C:\ADuC\WASP\WASP.exe.

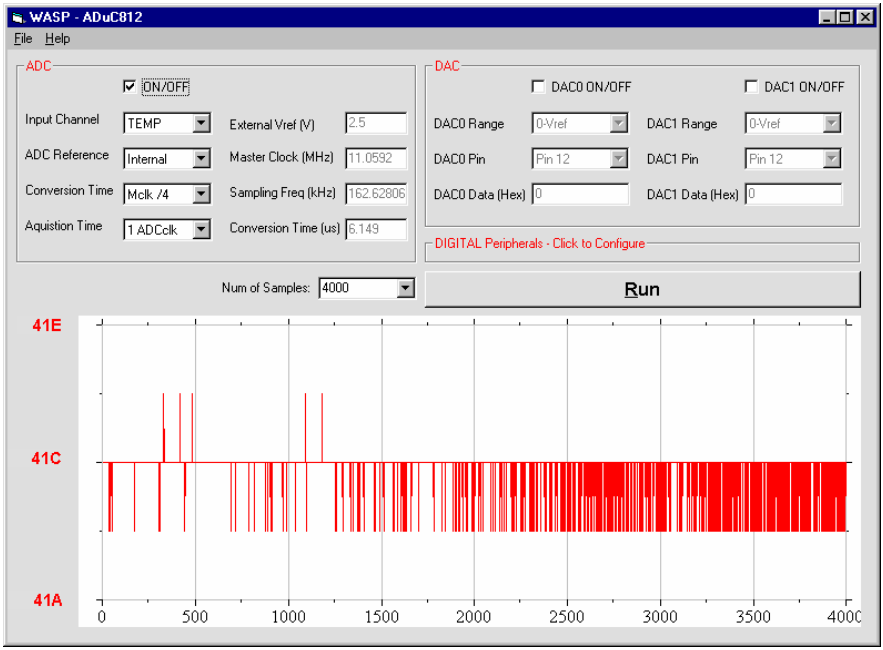
4. Click the **DOWNLOAD** Button. 'ADuC8XX' should appear and the code starts to download. A task bar indicates the download progression. A message appears to tell you when the file is downloaded. The program automatically runs after this download.

Note: The **NEXT** button bypasses the 'Download' sequence and can be used if the WASP code is already downloaded and running on the MicroConverter.To identify the MicroConverter for the WASP software the user should select the appropriate MicroConverter from the "MicroConverter Select" option box and the click on NEXT.

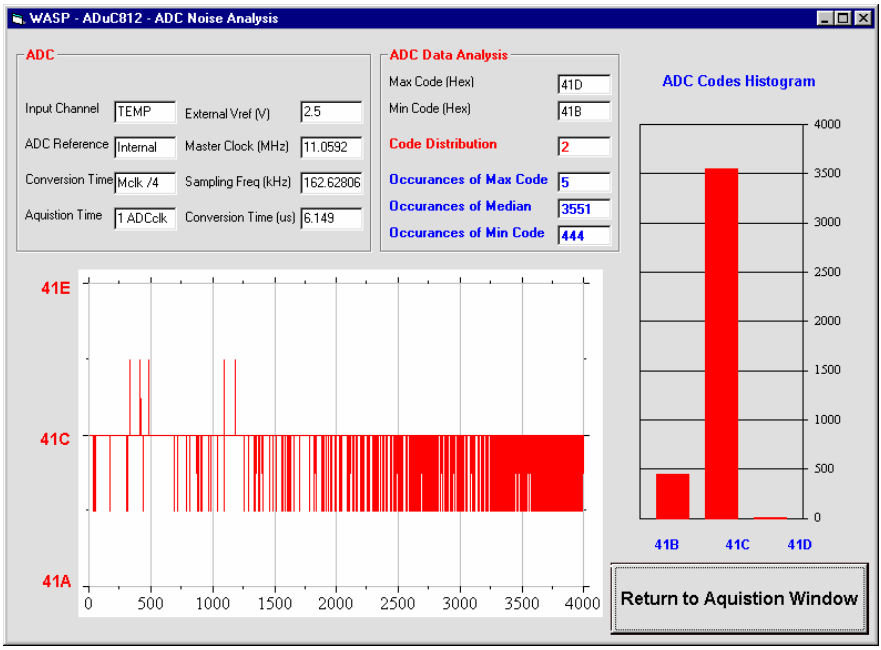
SAR WASP

5. The SAR Acquisition window (as shown below) opens for any of the SAR ADC MicroConverter products (ADuC812, ADuC814, ADuC831, ADuC832, ADuC841, ADuC842 or the ADuC843)
   From the Acquisition window you can…
   a. Select the channel on which you want to convert
   b. Set up the ADC Conversion time and Sampling Parameters.
   c. Select the number of samples that you want to acquire.
   d. Set up voltages on the DAC channels
   e. Select the use of the Internal Reference or an External Reference device.
   f. Enable/Disable various Analog/Digital Peripherals

6. In this example we will convert on the temperature sensor using the internal reference as shown below. With the parameters shown below selected, press the RUN button. The acquired ADC samples will appear on the chart as shown for the ADuC812 example below.



7. When all the samples are collected the WASP immediately launches the Analysis window. The histogram plot and the ADC Data Analysis fields within the analysis window gives a measure of the code distribution for the ADC input.



8. Click on the *Return to Acquisition Window* button in the Noise Analysis window to return to the acquisition panel.

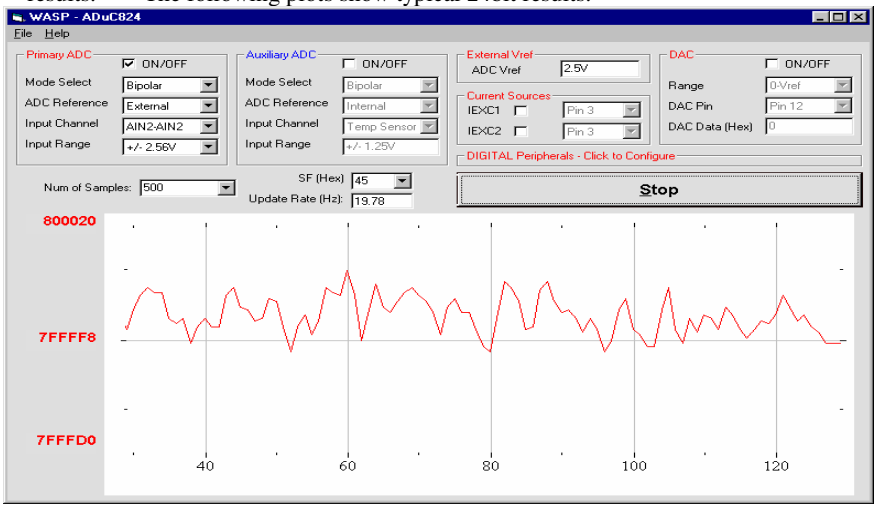
9. The functionality of the DAC(s) and general Digital Peripherals can also be exercised via the options available from the WASP front panel.

Sigma Delta WASP

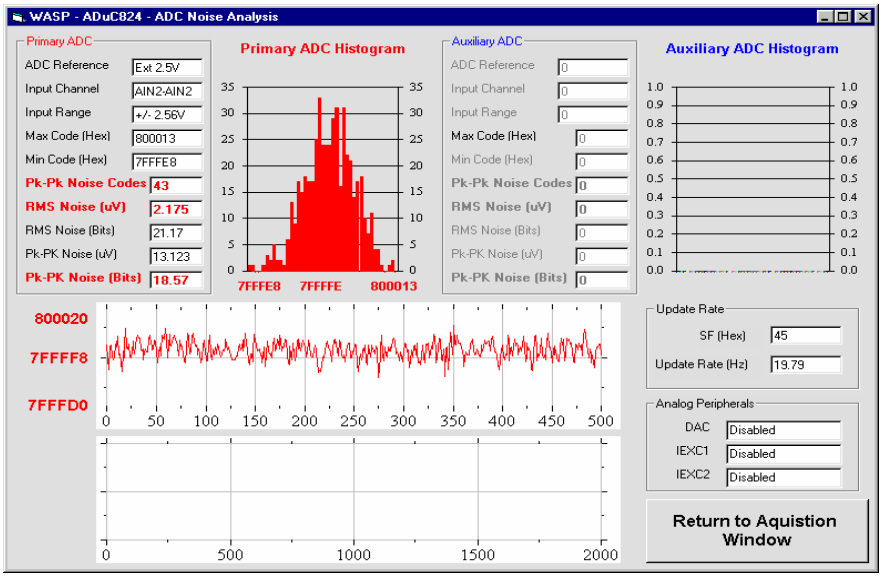
10. The Sigma Delta Acquisition window (as shown below) opens for any of the Sigma Delta ADC MicroConverter products (ADuC816, ADuC824, ADuC834, ADuC836, ADuC845, ADuC847 and ADuC848)
From the Acquisition window you can…
    a. Select the channel on which you want to convert
    b. Set up the ADC Update Rate.
    c. Select the number of samples that you want to acquire.
    d. Set up voltages on the DAC channels
    e. Select the use of the Internal Reference or an External Reference device.
    f. Enable/Disable various Analog/Digital Peripherals

11. **Note: Switch Configuration**
Make sure that the external reference (2.5v REF+) is connected (S1.6 ON), for ADuC845/847 (S4.5 ON), and that AIN2 is biased to 2.5V (S1.7 ON), for ADuC845/847 read AINCOM for Ain2 and ensure AINCOM is biased to 2.5V (S4.7 ON). Also ensure that REF- is grounded (S1.5 ON), ADuC845/847 (S4.4 ON). All Other connections should be OFF.

By default the WASP enables the Primary ADC configured as below (i.e. Primary ADC converting in bipolar mode using an external reference on the 2.56V range with internally shorted inputs Ain2 → Ain2 (ADuC845/847 AINCOM → AINCOM). The Auxiliary ADC, DAC and Current sources are all disabled). Note: Aux ADC and DAC are not available on ADuC847. Press the RUN button to send this default configuration to the MicroConverter device and begin the conversions. The screen changes to configure for a single Primary ADC acquisition sequence. The results of conversion are displayed in real time. Because the channel is configured for an internal short then we can expect ADC conversions close to 80000h. The WASP performs 500 ADC conversions by default and displays the conversion results. The following plots show typical 24bit results.



11. When all the samples are collected the WASP immediately launches the Analysis window. This window displays some mathematical analysis on the ADC conversions, including RMS noise (in µV and bits) and Peak-to-Peak Noise (Code Distribution, µV and Bits). The most important performance figures are highlighted in Red.



12. Click on the *Return to Acquisition Window* button in the Noise Analysis window to return to the acquisition panel.

13. The functionality of the DAC(s) and general Digital Peripherals can also be exercised via the options available from the WASP front panel.

(6.0) Installed Documentation and Code Directory

Installing the MicroConverter® QuickStart™ Development System CD installs documentation for all the MicroConverter products at C:\ADuC\Documentation. Directories for each product exist in the Documentation folder, as well as QuickStartTools and TechNotes directories.
Each of the product directories follows a similar folder structure as shown below. All Technical Notes for any of the MicroConverter products appear in the \TechNotes directory. Check our website for the latest tech notes (www.analog.com/microconverter).

```
C:\ADuC\Documentation\ADuC8XX\
    DataSheets\
       ADuC8XX_Y.pdf            ADuC8XX DataSheet version Y
       Errata8XX_Y.pdf          ADuC8XX Errata Sheet version Y
       8XXqrefY.pdf             ADuC8XX Quick Reference Guide version Y
    EvalDocs\
        8XXEvalGuide_Y.pdf      ADuC8XX Eval Board Reference Guide version Y
        8XXPCB_Y.pdf            ADuC8XX Eval Board Schematic version Y
        8XXgbrs\8XXgbrs_Y.zip   ADuC8XX Eval Board Gerber files version Y.
    Other\
        8XXFAQs_Y.pdf           ADuC8XX Frequently Asked Questions version Y
        8XXgetstartedY.pdf      Get Started Guide version Y
        USERGuideDRAFTY.pdf     Draft User guide version Y
```

It is recommended that all documentation mentioned above be reviewed before starting the QuickStart Development System.

Installed Code Locations

Installing the MicroConverter® QuickStart™ Development System CD installs an Assembly code directory for each MicroConverter products at C:\ADuC\Code. Product directories (e.g. ADuC832 below) for each MicroConverter exist with Assembly code examples.

```
C:\ADuC\Code\832\
          ADC           - code examples for the ADC
          DAC           - code examples for the DAC
          DualDPTR      - code example for using the Dual Data Pointer
          FlashEE       - code example for using the Flash/EE Data Memory
          I2C           - code examples for I2C master and slave operation
          Misc          - Miscellaneous MicroConverter code example
          PDown         - code example demonstrating powerdown mode
          PSMon         - code example for the power supply monitor
          SP            - code example for the extended stack pointer
          SPI           - code examples for SPI master and slave operation
          TIC           - code example for the Time Interval counter
          Uart          - code examples for configuring the UART
          WDTimer       - code example for watchdog timer
```

C example code is available in the C-Code directory. C-Code for the ADuC832 is in the \832 folder.

```
C:\ADuC\C-Code\832\
          ADC           - code examples for the ADC
          DAC           - code example for the DAC
          MISC          - Miscellaneous MicroConverter code example
          PDOWN         - code example demonstrating powerdown mode
          PLL           - code example for changing the core execution speed
          TIC           - code example for the Time Interval counter
```