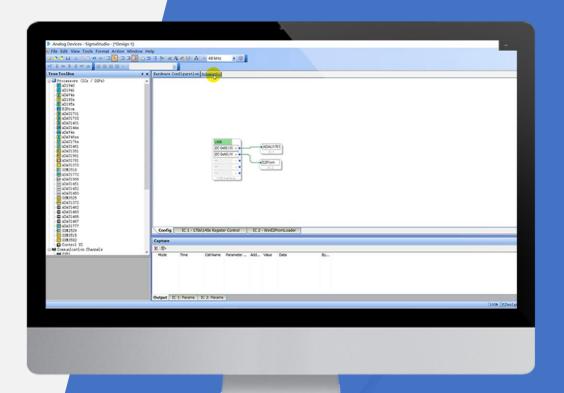
How to Program WONDOM Products with ADAU1701 through SigmaStudio

By Sure Electronics





ADAU1701 is a high performance digital signal processor of Analog Devices Inc. We have developed many products integrated with ADAU1701, which support programming via SigmaStudio after connection with our programming boards.

This document is meant to show you how to program WONDOM ADAU1701 DSP products with SigmaStudio.



We need to know the products and software that we need before start.

In this part, we will focus on introduction of WONDOM products integrated with DSP and ICP programmers.



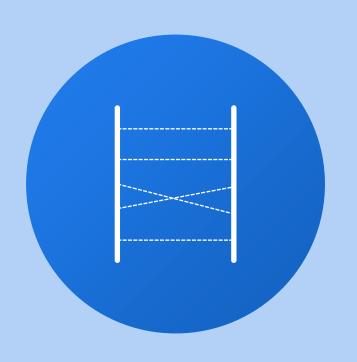
Configuration

In this part, we will give you a brief introduction of SigmaStudio interface and some documents you may need.



Examples

We will demonstrate to write basic programs based on WONDOM DSP products for your reference, so that you can get started quickly.



Preparation

We need to know the products and software that we need before start.

In this part, we will focus on introduction of WONDOM products integrated with DSP and ICP programmers.



Products List – with ADAU1701 DSP

The following are the products list of WONDOM products that are integrated with ADAU1701 DSP.

The functions vary to different products. Please select to your requirements.

Model	Description	SS Program	APP Control	PC UI Control
APM2	2-in, 4-out ADAU1701 DSP Kernel Board	Υ	Υ	Υ
JAB3	Mono / Stereo Class D Audio Amplifier Board Integrated with ADAU1701 DSP	Υ	Υ	Υ
JAB3+	Mono / Stereo Audio Amplifier Board Integrated with ADAU1701 DSP & BT V5.0	Υ	N	Υ
JAB4	4CH 30W Audio Amplifier Board Integrated with ADAU1701 DSP & BT V5.0, Supporting Configuration as 4.0 / 2.1 / 2.0 / 0.2 Output Mode	Υ	N	Υ
JAB5	4CH 100W Audio Amplifier Board Integrated with ADAU1701 DSP & BT V5.0, Supporting Configuration as 4.0 / 2.1 / 2.0 / 0.2 Output Mode	Υ	N	Υ



Products List – ICP Series

Different ICP products support different functions. Please select to your requirements.

Model	Description	SS Program	APP Control	PC UI Control
ICP1	In-Circuit Programmer	Υ	N	N
ICP3	In-Circuit Programmer Integrated with Bluetooth BLE	Υ	Υ	N
ICP5	In-Circuit Programmer Integrated with Bluetooth BLE & USB to UART	Υ	γ*	Υ

^{*} The function only works when both products with ADAU1701 DSP and the ICP board support it, i.e. JAB3+ doesn't support APP control, so even if you buy ICP3 or ICP5 that supports APP control, JAB3+ still cannot support APP control after connection.



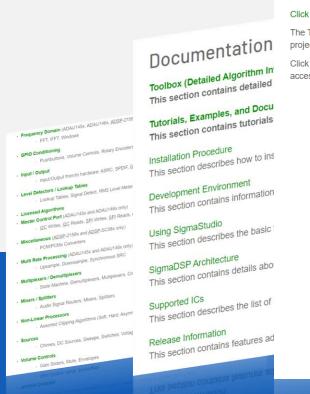
Software - SigmaStudio

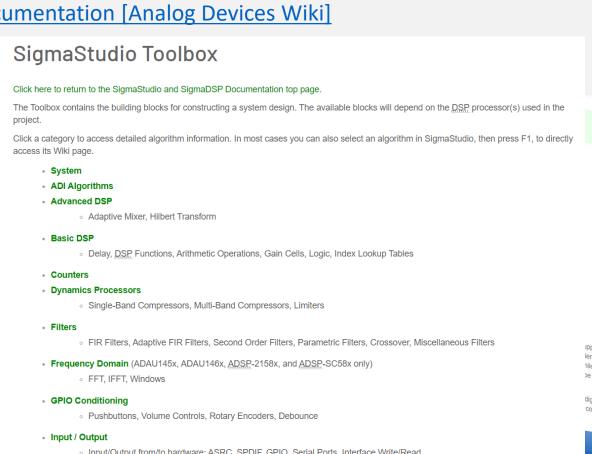
If you never install SigmaStudio, you can click the following link for download and installation.

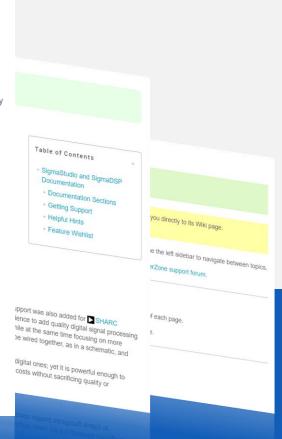
https://www.analog.com/sigmastudiodownload

It's highly suggested that you remember the following link for official support. You can find algorithm information, tutorials, examples and other useful documentation as reference.

SigmaStudio and SigmaDSP Documentation [Analog Devices Wiki]









Configuration

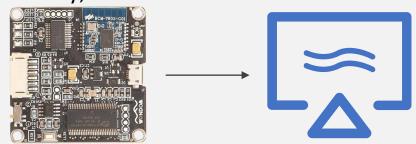
In this part, we will give you a brief introduction of SigmaStudio interface and some documents you may need.



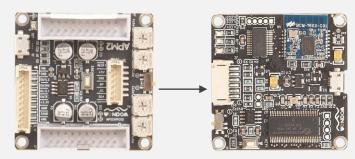
Hardware Connection

We will take connection of APM2 and ICP3 as an example here. Connection based on other products are similar.

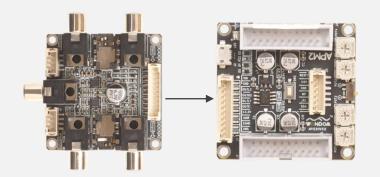
1) Connect ICP3 to PC, run SigmaStduio, create a new project, drag "USBi", "ADAU1701", "E2Prom", complete logic connection to see if ICP3 has been recoginized successfully;



3 Connect APM2 with ICP3 through a 6-pin cable



2 Connect APM2 & APM3, connect audio source and speakers, power up the system

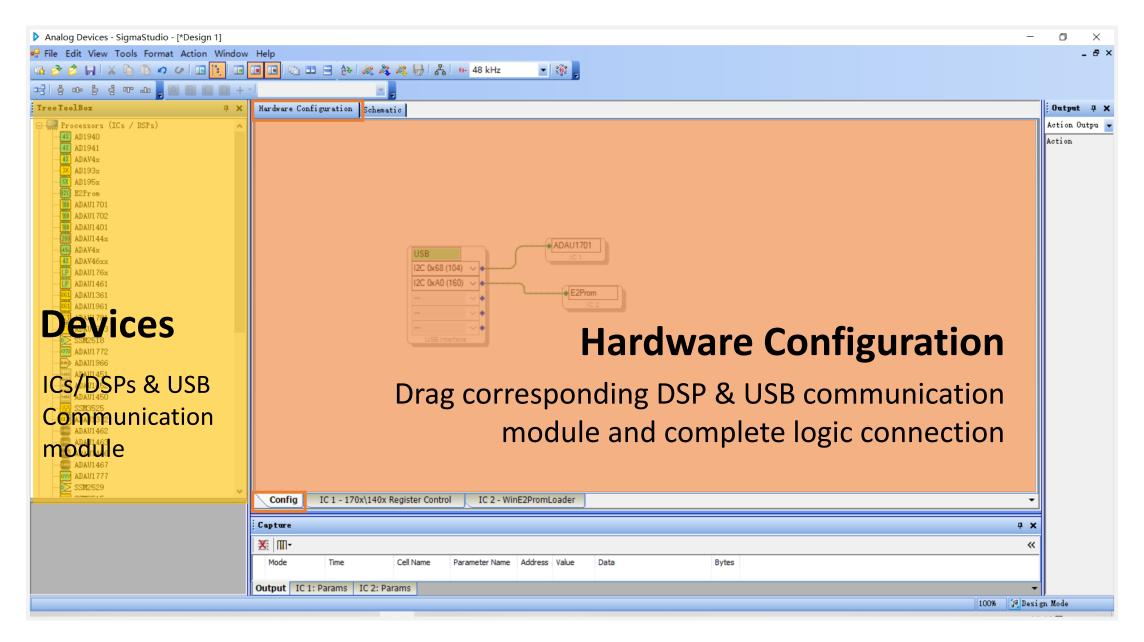


4 Write program



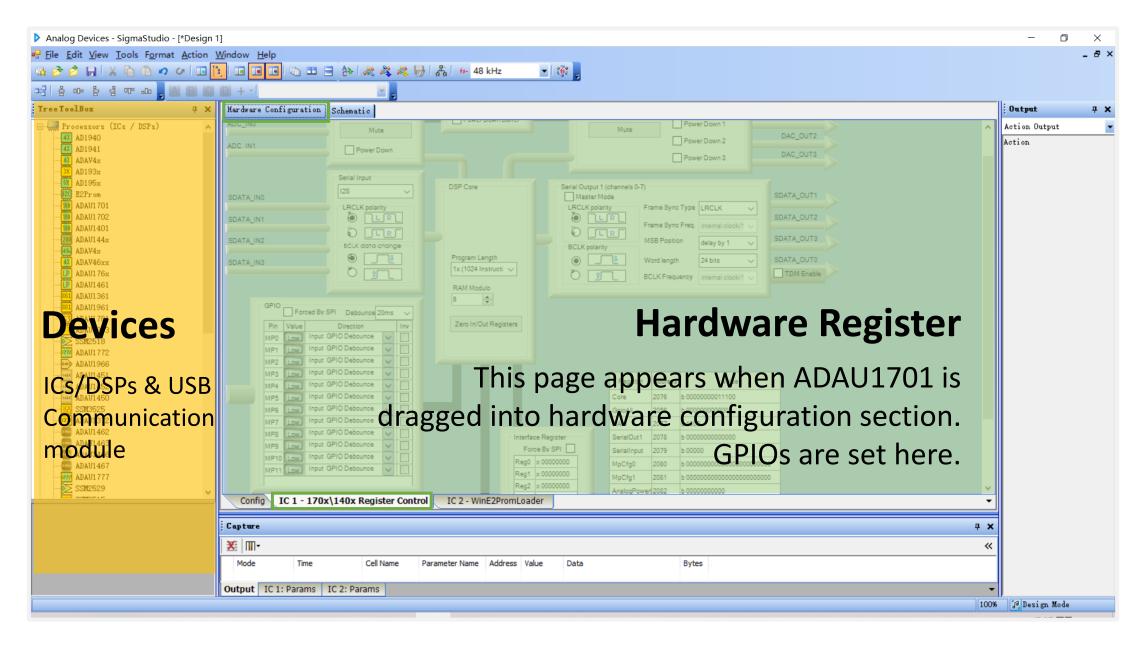


Brief Interface Introduction



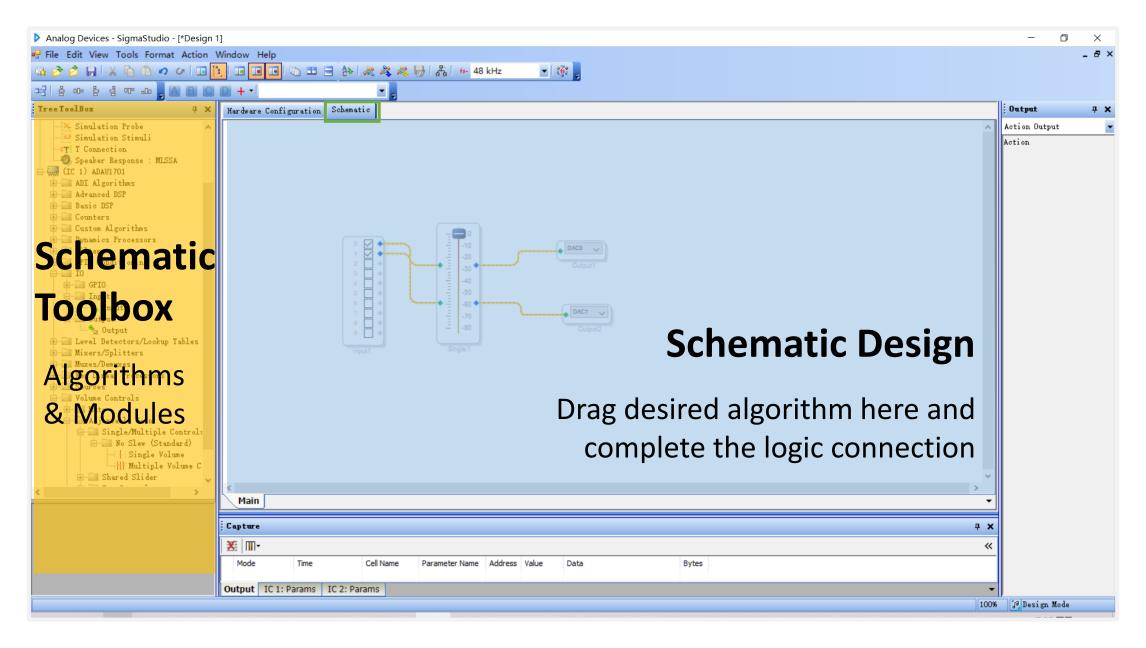


Brief Interface Introduction





Brief Interface Introduction

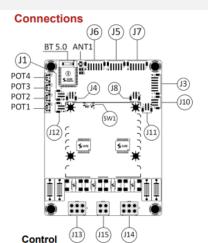




Products Pin Definition

WONDOM products integrated with ADAU1701 DSP are equipped with terminal interfaces for various functions. You can get the detailed introduction in datasheet. Please find the documentation in the detailed product page on our website.

ICP series is self-developed programming board, which can be used with WONDOM DSP products. After connection with ICP programmer, DSP products can support programming and remote control (It's up to specific product). Please find the user guide in the detailed product page on our website.



Bluetooth Pairing Cancellation Port:

·J4, I	PH-2Pos- 2r
Pin	Definition
1	cancel
2	+3.3V

Short circuit 'cancel' with '+3.3V' to cancel Bluetooth

Programming Connector:

JS, PH- OPIN- ZITIM				
Pin	Definition	Pin	Definition	
1	RST	4	WP	
2	+5V	5	SCL	
3	GND	6	SDA	

This port is for connection with WONDOM ICP5 to achieve programming and remote control functions.

Standby Control:

J11, PH-2Pos-2mm

Pin	Definition
1	STBY
2	GND

Short circuit 'STBY' and 'GND' to enter into standby

Control Compatible Port

010,111-0100-211111					
Pin	Definition	Pin	Definition	Pin	Definition
1	STBY	2	GND	3	MUTE
Connect 110 ports when IARE is used to concede					

Connect J10 ports when JAB5 is used to cascad with another JAB5 for high sound quality.

Power Supply

Power Supply Connector:

0.0	, INDION TO OC	
Pin	Definition	
1	GND	
2	GND	
3	VCC	
4	VCC	

Audio Input

Bluetooth Input: BT 5.0

Line Input Connector:

35, PH- 5P0S- 2IIII				
Pin	Definition			
1	INL			
2	AGND			
3	INR			
4	NC			
5	NC			

I2S Input Connector:

- 00,	11 01 00 E
Pin	Definition
1	MCLK
2	+5V
3	GND
4	DATA1
5	BCLK
6	LRCLK

External LED Indicator

External Bluetooth Indicator Connector:

 J1, PH-2Pos-2n 			
Pin	Definition		
1	LED+		
2	LED-		

When Bluetooth is paired, the LED will be ON

When Bluetooth is searching, the LED will BLINK.

External Signal Detection Connector: ·J12. PH-2Pos-2mm

Pin	Definition
1	LED+
2	LED

When there is signal detected, the LED will be ON:

When there is no signal detected, the LED will be OFF.

Audio Output

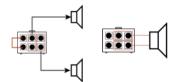
Speaker Output Connector: J14, Molex-MiniFit-2x3Pos-3mm

Pin	Stereo	Mono
1	OUTR1+	MONO1+
2	OUTL1+	MONO1+
3	GND	GND
4	OUTR1-	MONO1-
5	OUTL1-	MONO1-
6	MODE1	MODE1

J13, Molex-MiniFit-2x3Pos-3mm

n	Stereo	Mono
	OUTR2+	MONO2+
2	OUTL2+	MONO2+
3	GND	GND
ļ	OUTR2-	MONO2-
5	OUTL2-	MONO2-
6	MODE2	MODE2

JAB5 supports PBTL, so it can work as 4.0 mode, 2.1 mode or 2.0 mode. The switch between the three modes is achieved by automatic cables identification.



I2S Output Connector:

J7, PH- 6Pos- 2mm

Pin	Definition
1	MCLK
2	+5V
3	GND
4	DATA0
5	BCLK
	LRCLK

JAB5 supports I2S output, which can be transmitted into an I2S input amplifier.

JAB5 supports cascading with another JAB5 through I2S I/O ports, in which condition, the one outputting I2S signal should be set as master mode and the other receiving I2S signal should be set as slave mode through the switch (SW1) on the board.

Slave Mode



Demo Programs for Programming

Here are the demo programs for the products. You can download them for reference. The demo program is only for demonstration of signal flow chart.

Products	Demo Program	Document you may need	
APM2	APM2_DemoProgram	APM2 Demo Program Explanation	
JAB3 - Mono	JAB3_DemoProgram_MONO	IAD2 12C 1 1 0 O 1 - 1	
JAB3 - Stereo	JAB3_DemoProgram_STEREO		
JAB3+ - Mono	JAB3+_Mono_ADAU1701_DEMOProgram		
JAB3+ - Stereo	JAB3+_Stereo_ADAU1701_DEMOProgram	JAB3+ Demo Program Explanation	
JAB4	JAB4_ADAU1701_DEMOProgram	-	
JAB5	JAB5_ADAU1701_DEMOProgram	JAB5 Demo Program Explanation	



Resources Correspondence

WONDOM products are developed based on ADAU1701 DSP. We have made use of ADAU1701 resources to provide basic functions like audio input & output, control. Therefore, it's necessary for us to understand the correspondence relationship between the hardware and program for further development.

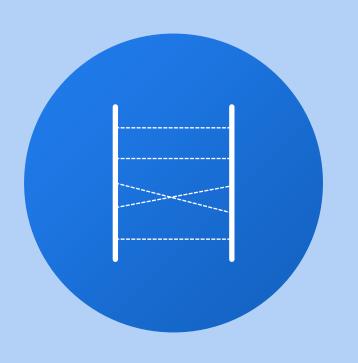
Model	Document	Vide
APM2	APM2 Demo Program Explanation	
JAB3	JAB3 I2S Input & Output	Watc
JAB3+	JAB3+ Demo Program Explanation	<u>Watc</u>
JAB5	JAB5 Demo Program Explanation	Watc



Original Firmware for Restore

Here are the factory program for the products. You can download them if you want to restore factory settings.

Products	Original Firmware	Products	Original Firmware
.PM2	<u>Download</u>	JAB4	<u>Download</u>
AB3 - Mono	Download	JAB5	Download
AB3 - Stereo	Download		
AB3+ - Mono	Download		
AB3+ - Stereo	Download		



Examples

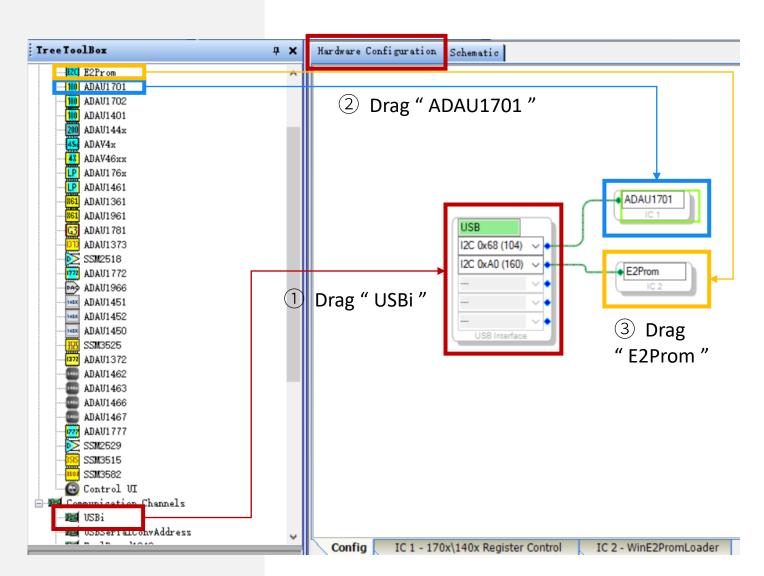
We will demonstrate to write basic programs based on WONDOM DSP products for your reference, so that you can get started quickly.



First step, double click to run SigmaStudio. Then click "File"-->"New Project" to create a new project_o

Second step, after connecting ICP programmer to PC, find "USBi"、"ADAU1701"、"E2Prom" in "TreeToolBox" and then drag them into "config" section. Please pay attention to order to ensure that ADAU1701 shows IC1 and E2Prom shows IC2.

If USBi displays in green, it means ICP has been recognized successfully; If it's orange, please try to reconnect ICP.

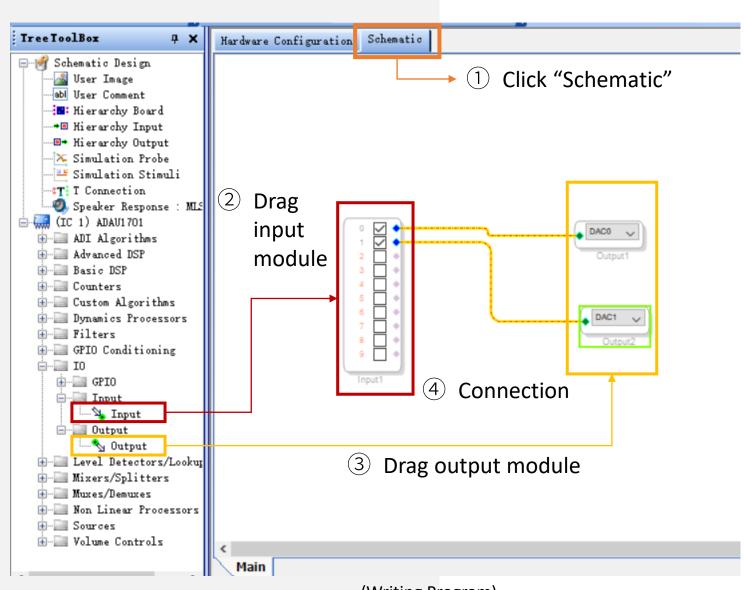




Basic Program - Bypass

Let's write a bypass program at first.

- Click "Schematic" to enter schematic design section
- ② Drag "IO"-"Input"-"Input" to design section from "TreeToolBox". We can see 0 & 1 of input module are ticked. They are for analog input.
- ③ Drag "IO"-"Output"-"Outnput". We want stereo output, so we need to drag two output modules. Stereo output on APM3 are corresponded with DACO & DAC1.
- 4 Complete logic connection between input and output modules.



(Writing Program)



Basic Program – Bypass

Download finished program into DSP. Please note, here, download refers to online simulation under debug mode. The program will be lost once the power is off. If you need to operate offline, please refer to "Program Writing" chapter.

- ⑤ Click "Link Compile Download" on the menu to download program into ADAU1701, as shown below
- 6 If it shows "Active: Downloaded" at the bottom right corner, program is downloaded successfully
- Play music to see if there is music playing from speakers



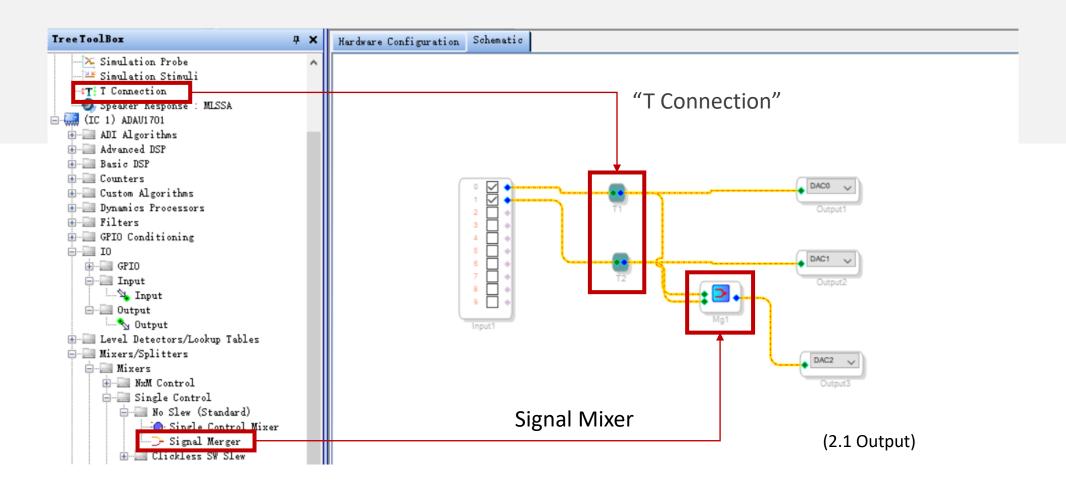
(Program Download)





Basic Program – Bypass

APM2 is the kernel board and APM3 is the matched 2-in, 3-out interface board. In last example, we write stereo output. What if we want subwoofer output for 2.1 system? We can drag another output module, then mix left and right channel.

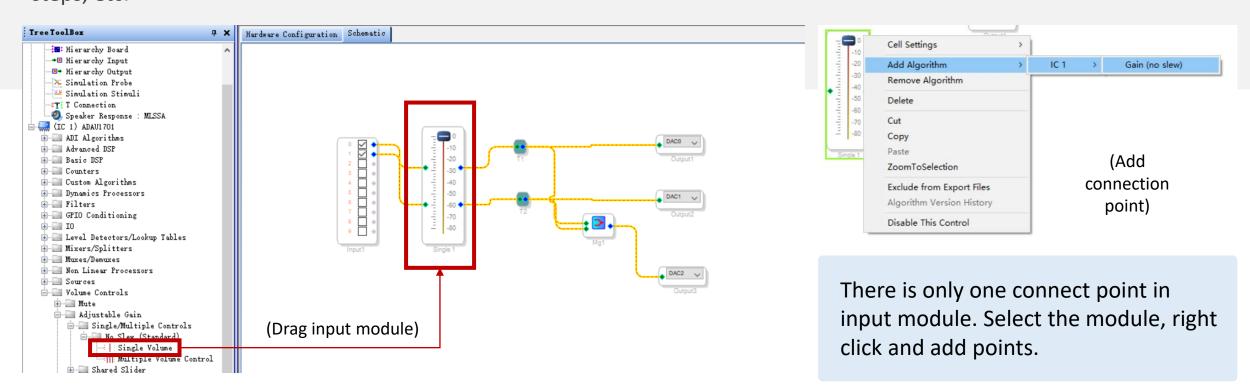




Basic Program – Volume Control

How to adjust overall volume? We need to make use of "Volume Controls" modules. There are many functions in this module group. We will use one for demonstration only. You can explore other modules on your own.

Put volume control module into design section as below. You can adjust overall volume by dragging the slider. Put cursor on this module, then right click without selecting it, you will find detailed settings of volume control, such as max value, steps, etc.

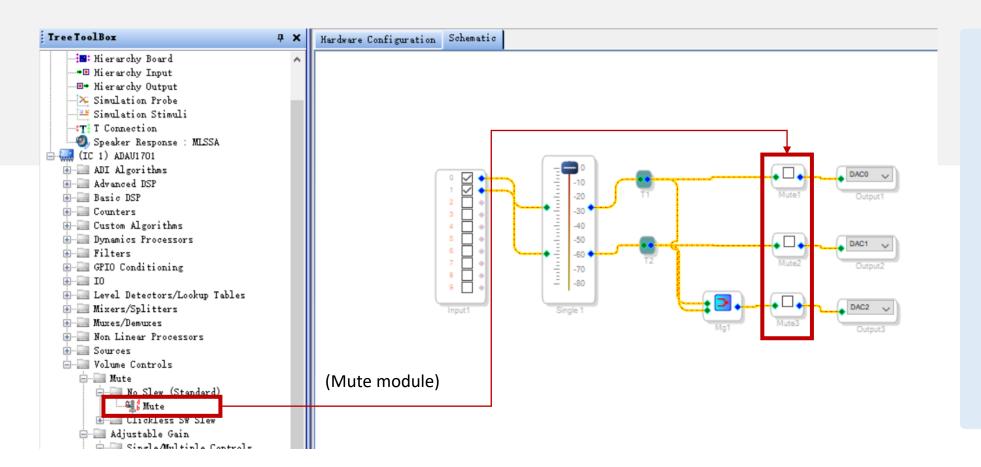




Basic Program – Volume Control

I want to control whether a channel is mute or unmute, what should I do?

This function can be realized by "Mute" module in the "Volume Controls" group. The connection is as follows.



If the mute module is unticked, this channel plays music normally.

If it's ticked, this channel will be mute.

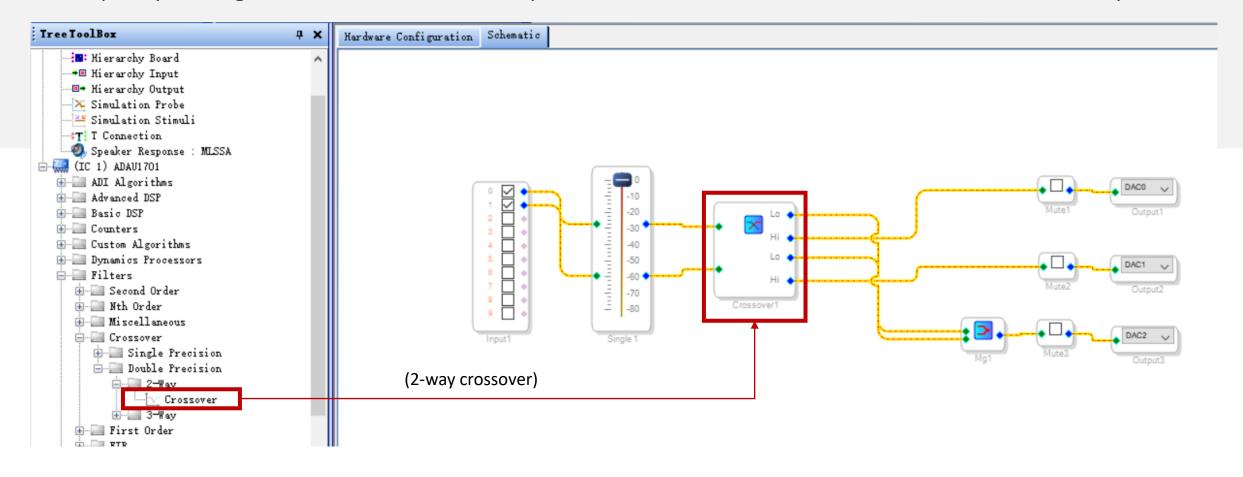
It's usually used to check if each channel works.



Basic Program – Crossover

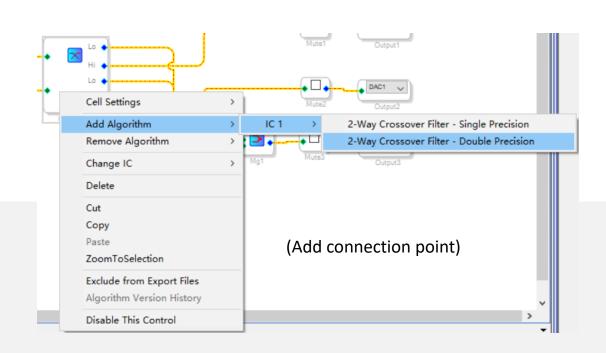
This time, let's add crossover function. We employ "Filters"-"Crossover"-"Double Precision"-"2 -Way"-"Crossover" module here. You can try other modules by yourself.

Signal Flow: Input left and right channel signal, go through volume control, each channel is split into high frequency and low frequency. The high is transmitted to stereo output while the low is mixed and transferred to subwoofer output.

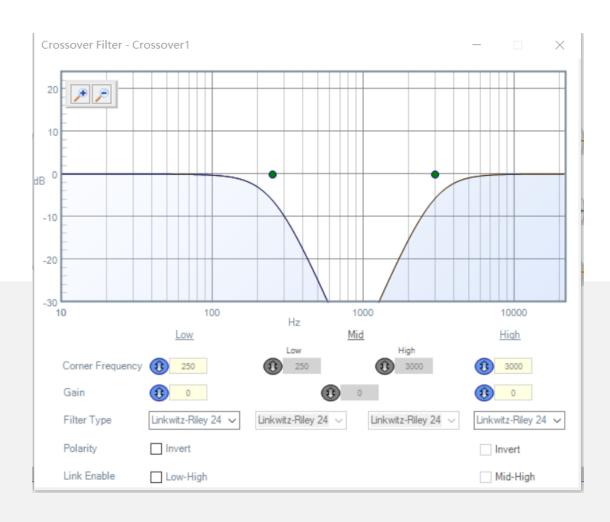




Basic Program – Crossover



If crossover module doesn't have enough the connection points, you can select the module and right click, then choose "Add Algorithm".

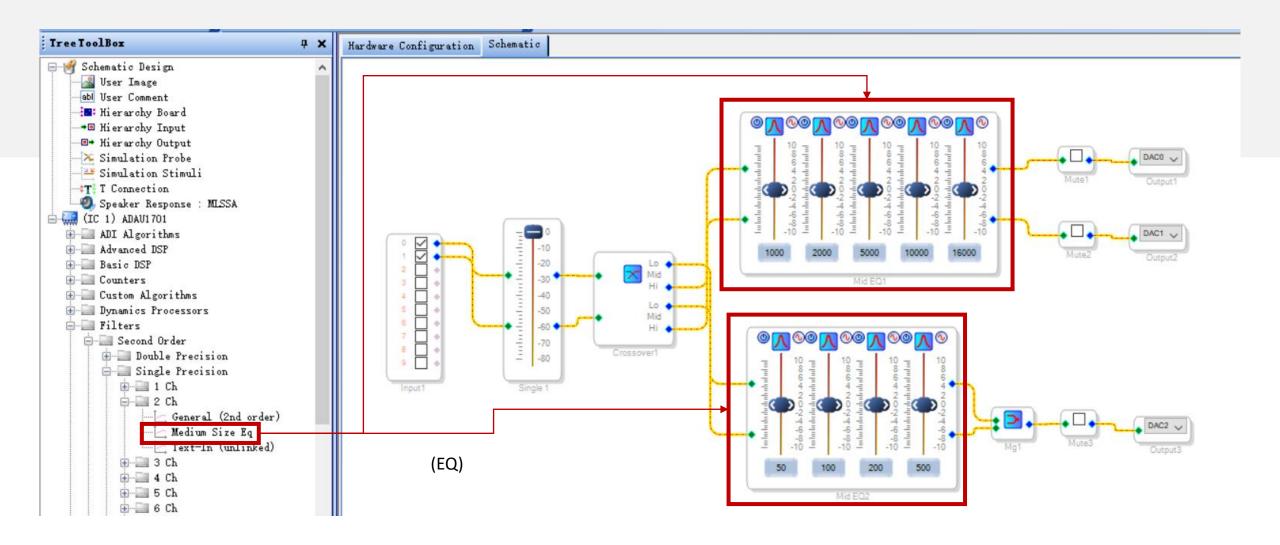


Click the curve icon of the crossover module, you can see detailed settings. You can adjust cut-off frequency, gain, filter type and polarity.



Basic Program – EQ

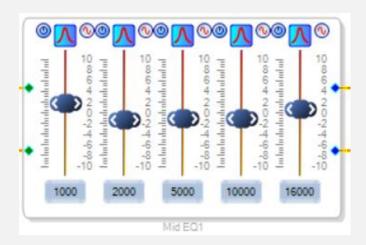
Now, we want to add EQ based on finished program, through which we can adjust gain of each frequency to achieve desired effects. Here we use "Filters"-"Second Order"-"Single Precision"-"2ch"-"Medium Size Eq" module.

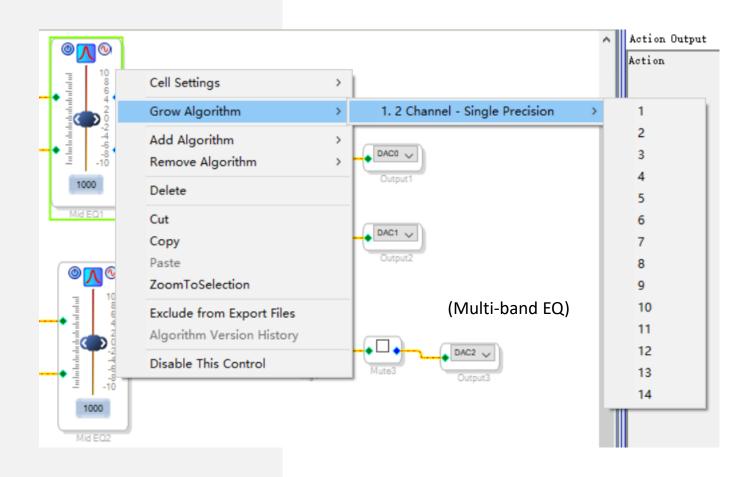




Basic Program – EQ

There is only one frequency band of the module. We can right click with it selected and choose how many bands you want. Each center frequency and gain are adjustable. Here is just for example.

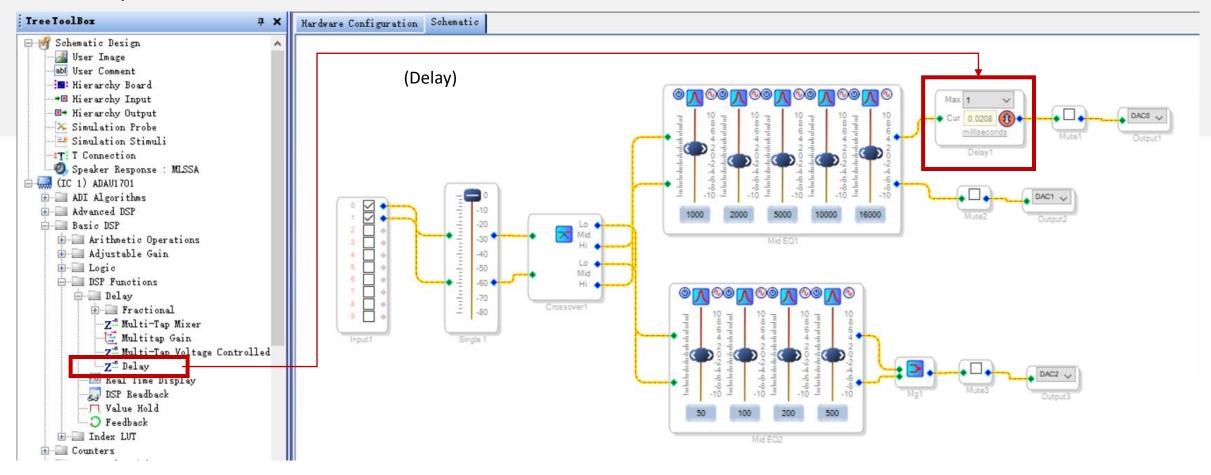






Basic Program – Delay

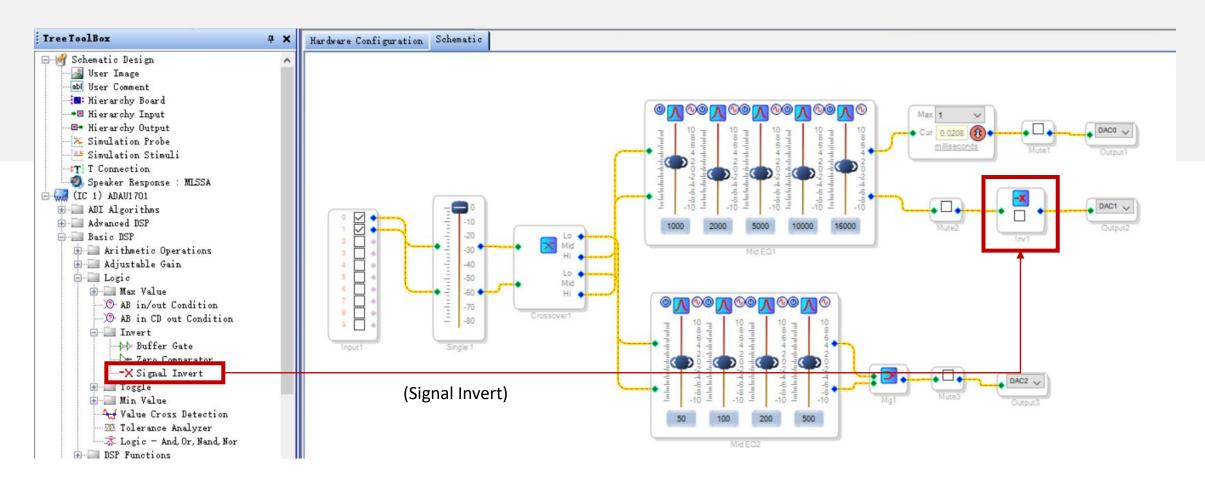
If you can hear apparent time difference when listening to music, you can use delay module to improve listening experience. We employ "Basic DSP"-"DSP Functions"-"Delay"-"Delay" module here. Click "Samples" of "Delay" module to switch delay unit to "milliseconds", which will be more convenient.





Basic Program – Signal Invert

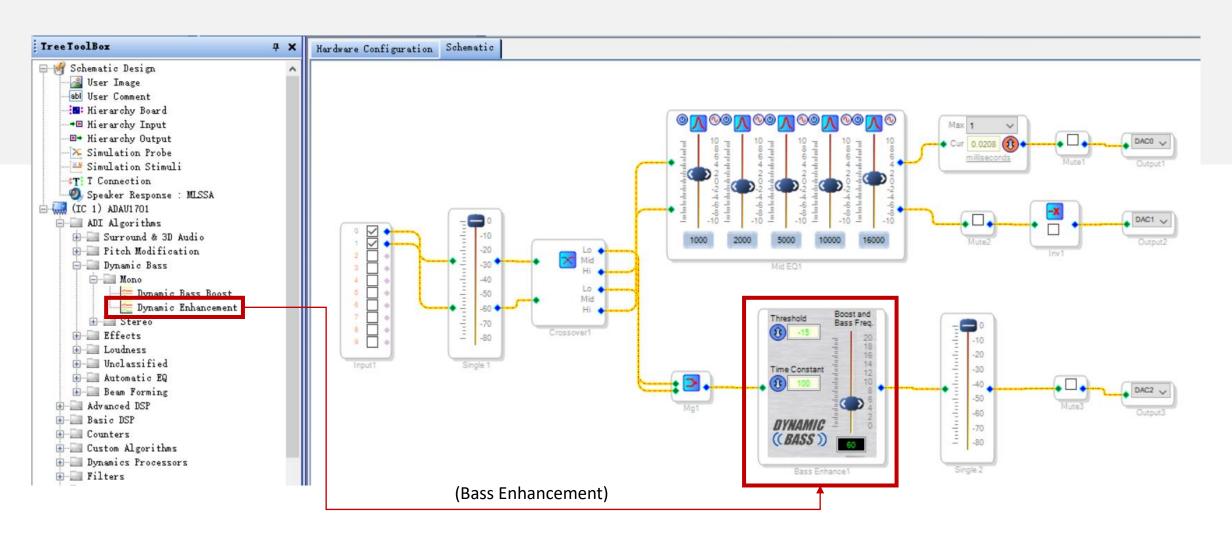
We may connect speakers reversely by accident and sometimes we don't want to reconnect. Then, we can use signal invert module. We use "Basic DSP"-"Logic"-"Invert"-"Signal Invert" module. Signal will be inverted after ticked.





Basic Program – Bass Enhancement

Many customers want bass enhancement. We can get this function through "ADI Algorithms"-"Dynamic Bass" module. You can set the parameters according to the requirements of your audio project.

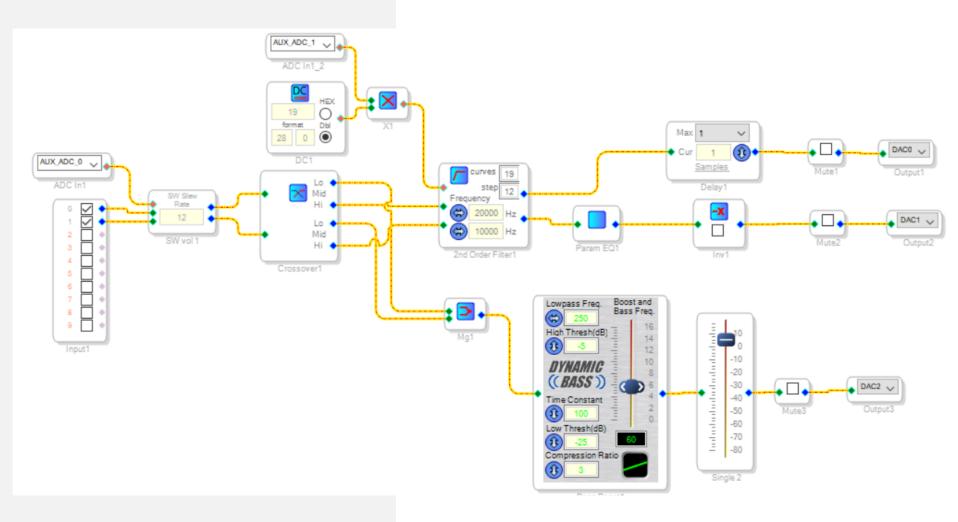




Basic Program – Potentiometers

APM2 provides four onboard potentiometers by extending resources of ADAU1701 DSP. You can use them for desired functions. Here is just for example.

Please note, if you add potentiometer modules, beside logic connection in schematic design section, you need to configure GPIO in hardware register section.

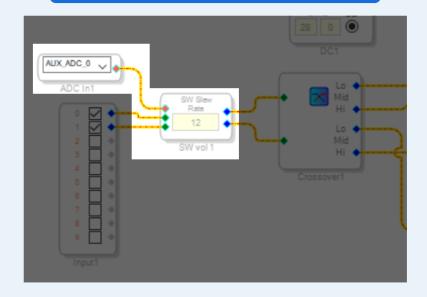




Basic Program – Potentiometers

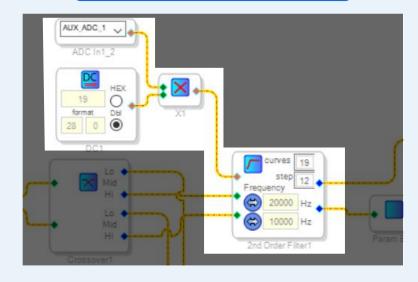
The potentiometers need to read hardware parameters then transmit to related modules for signal processing. Therefore, we need to adopt modules with control parameters.

① Overall Gain Adjustment



Employ gain control module with control parameters, drag "Auxiliary ADC Input" module, and complete logic connection

② High-pass Filter



This potentiometer works as high-pass filter of stereo.

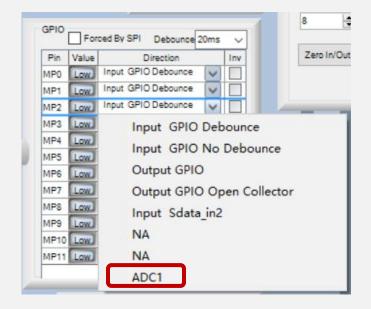
The filter module divides 10k-20kHz frequency into 19 curves. The potentiometer reads hardware voltage and multiply with the value of DC input Block to convert into frequency signal, which is transferred to filter to choose corresponding curve.

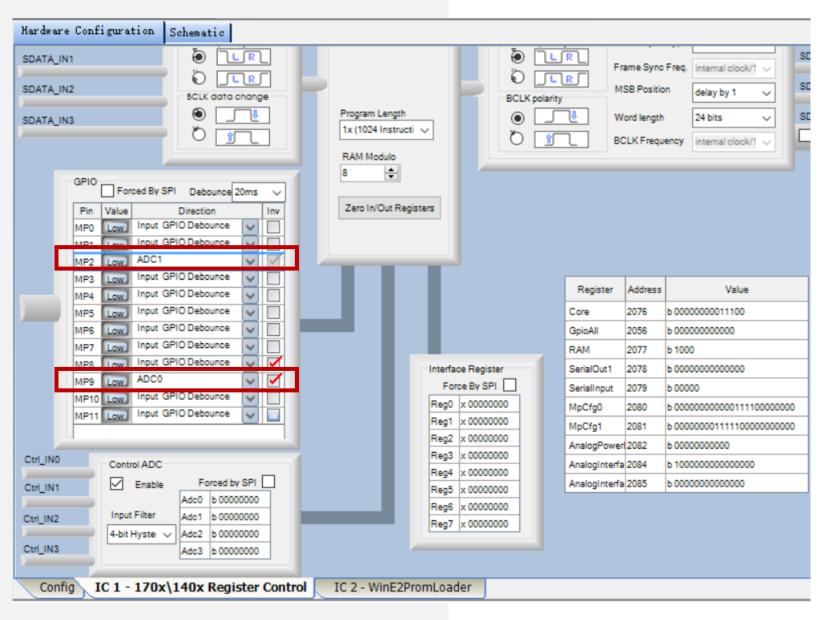


Basic Program – Potentiometers

After schematic is done, we need to set GPIO in hardware register section. Otherwise, the potentiometers won't work normally.

Find the GPIO and choose the corresponding ADC in the drop-down menu.



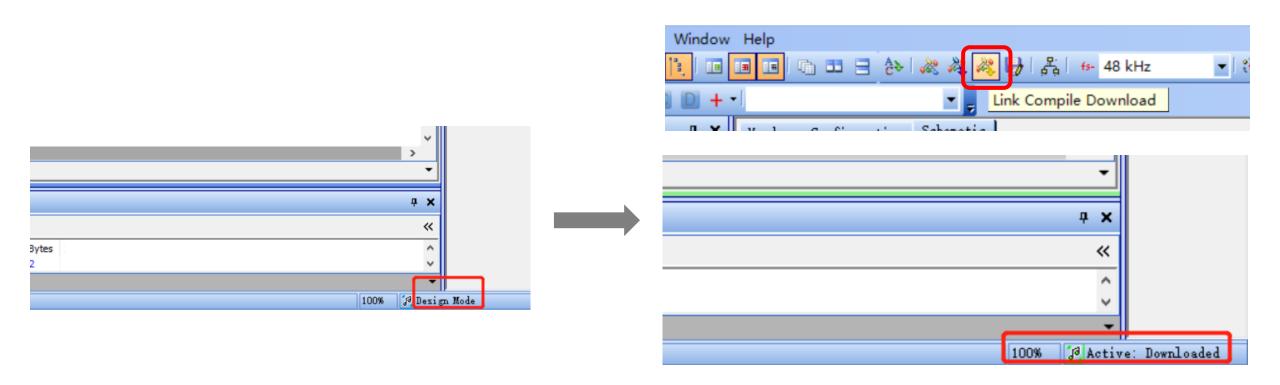




Basic Program – Program Writing

How to run finished programs offline? We must write them into E2Prom.

① If it shows "Design Mode" at the bottom right corner, you need to click "Link Compile Download". When it shows "Active: Downloaded", we can move on to next step.





Basic Program – Program Writing

- ② Click "Hardware Configuration"
- Select "ADAU1701" module and then right click
- 4 Choose "Write Latest Compilation to E2PROM", you will see the right window. Click "OK" and wait for finish.

