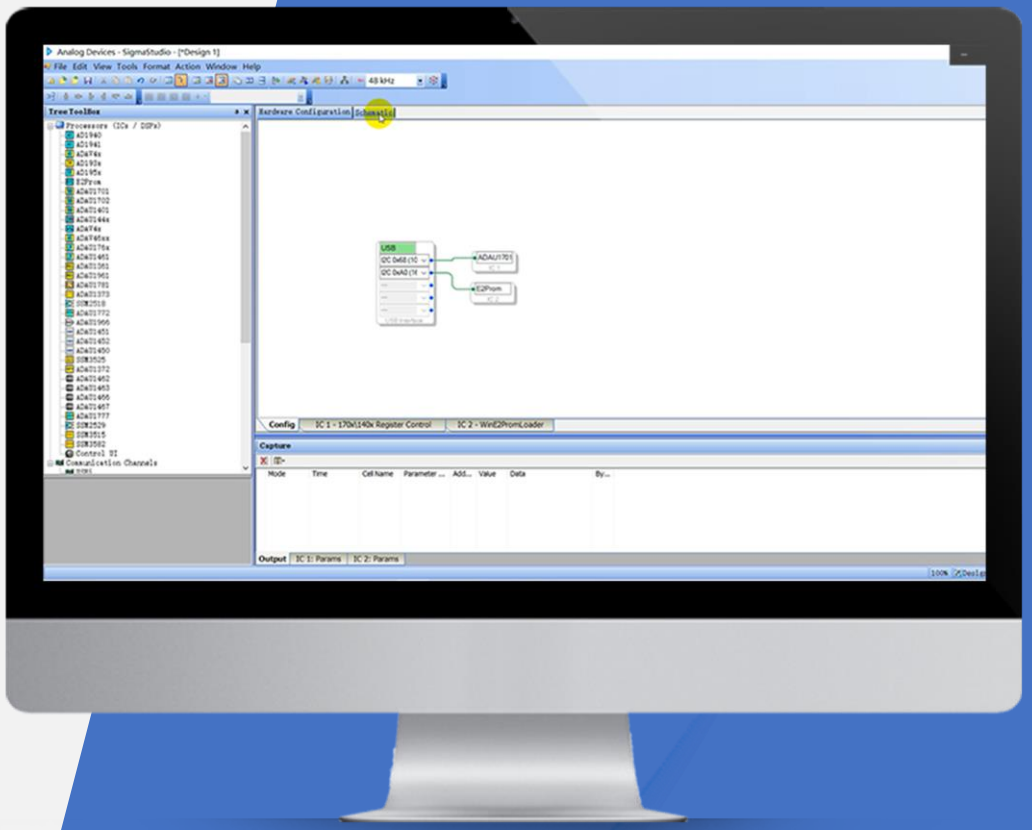
How to Program WONDOM Products with ADAU1701 through SigmaStudio

By Sure Electronics



Overview

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.

Preparation

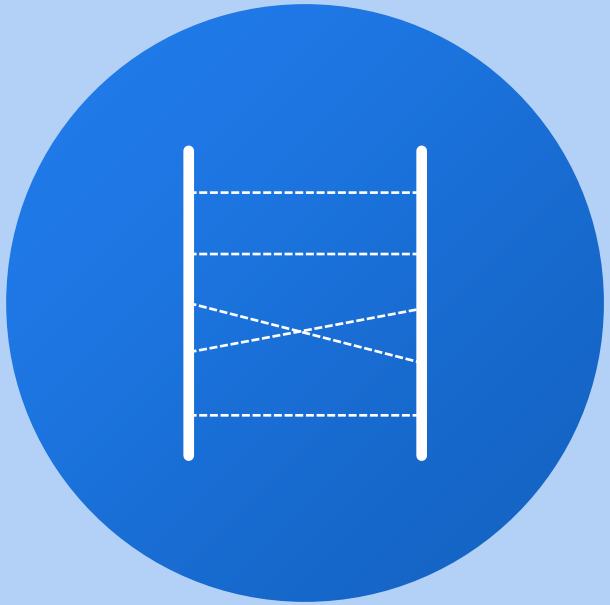
We need to know the products and software that we need before start.
In this part, we will focus on introduction of WONDOM products integrated with DSP and ICP programmers.

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	Y	Y	Y
JAB3	Mono / Stereo Class D Audio Amplifier Board Integrated with ADAU1701 DSP	Y	Y	Y
JAB3+	Mono / Stereo Audio Amplifier Board Integrated with ADAU1701 DSP & BT V5.0	Y	N	Y
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	Y	N	Y
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	Y	N	Y

Products List – ICP Series

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

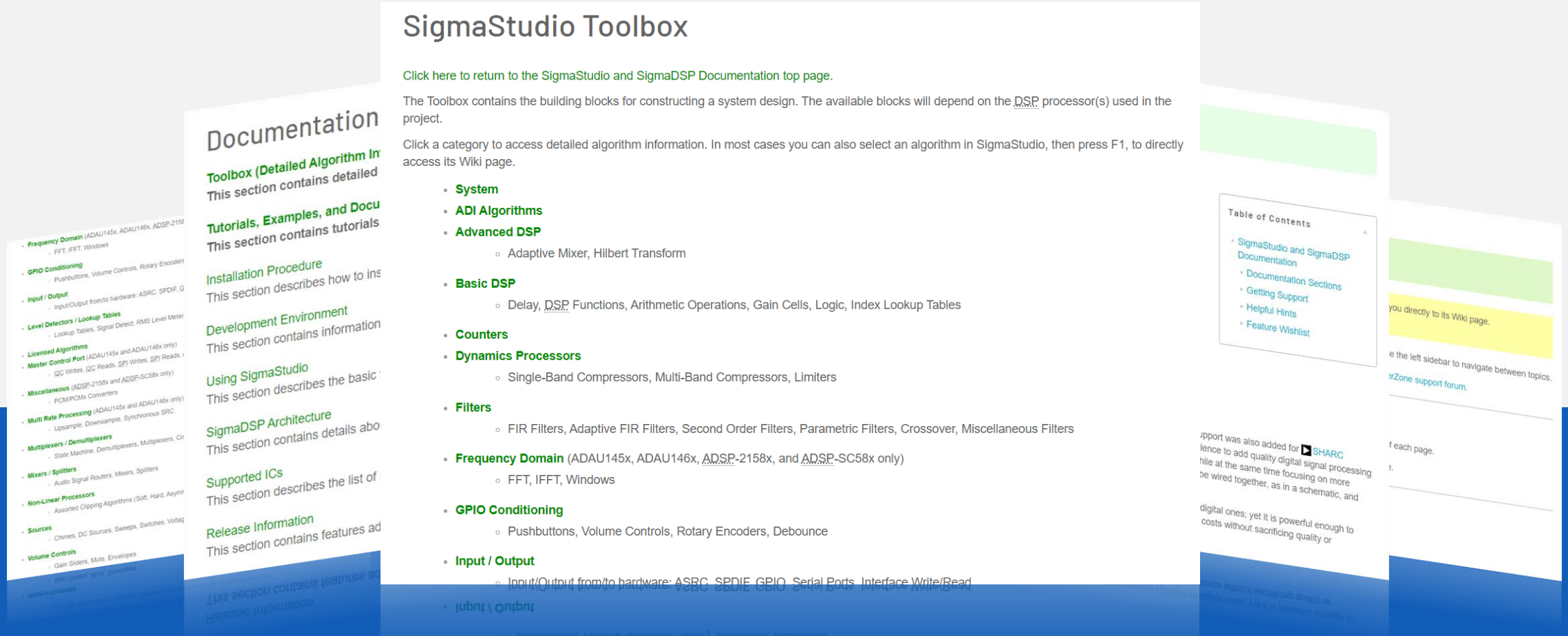
Model	Description	SS Program	APP Control	PC UI Control
ICP1	In-Circuit Programmer	Y	N	N
ICP3	In-Circuit Programmer Integrated with Bluetooth BLE	Y	Y	N
ICP5	In-Circuit Programmer Integrated with Bluetooth BLE & USB to UART	Y	Y*	Y

* 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

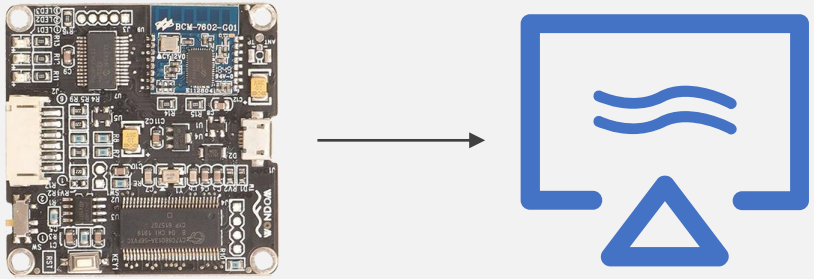
In this part, we will give you a brief introduction of SigmaStudio interface and some documents you may need.

Hardware Connection

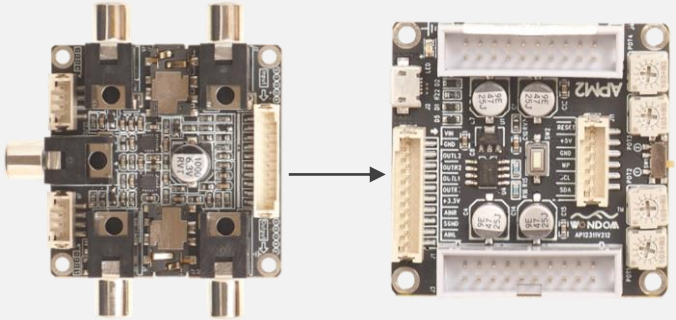
We will take connection of APM2 and ICP3 as an example here.

Connection based on other products are similar.

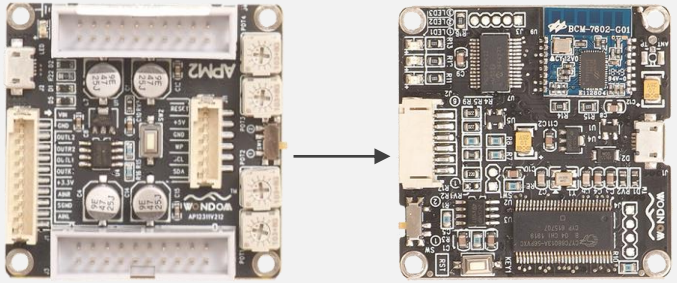
① Connect ICP3 to PC, run SigmaStduio, create a new project, drag “USBi”, “ADAU1701”, “E2Prom”, complete logic connection to see if ICP3 has been recoginized successfully;



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

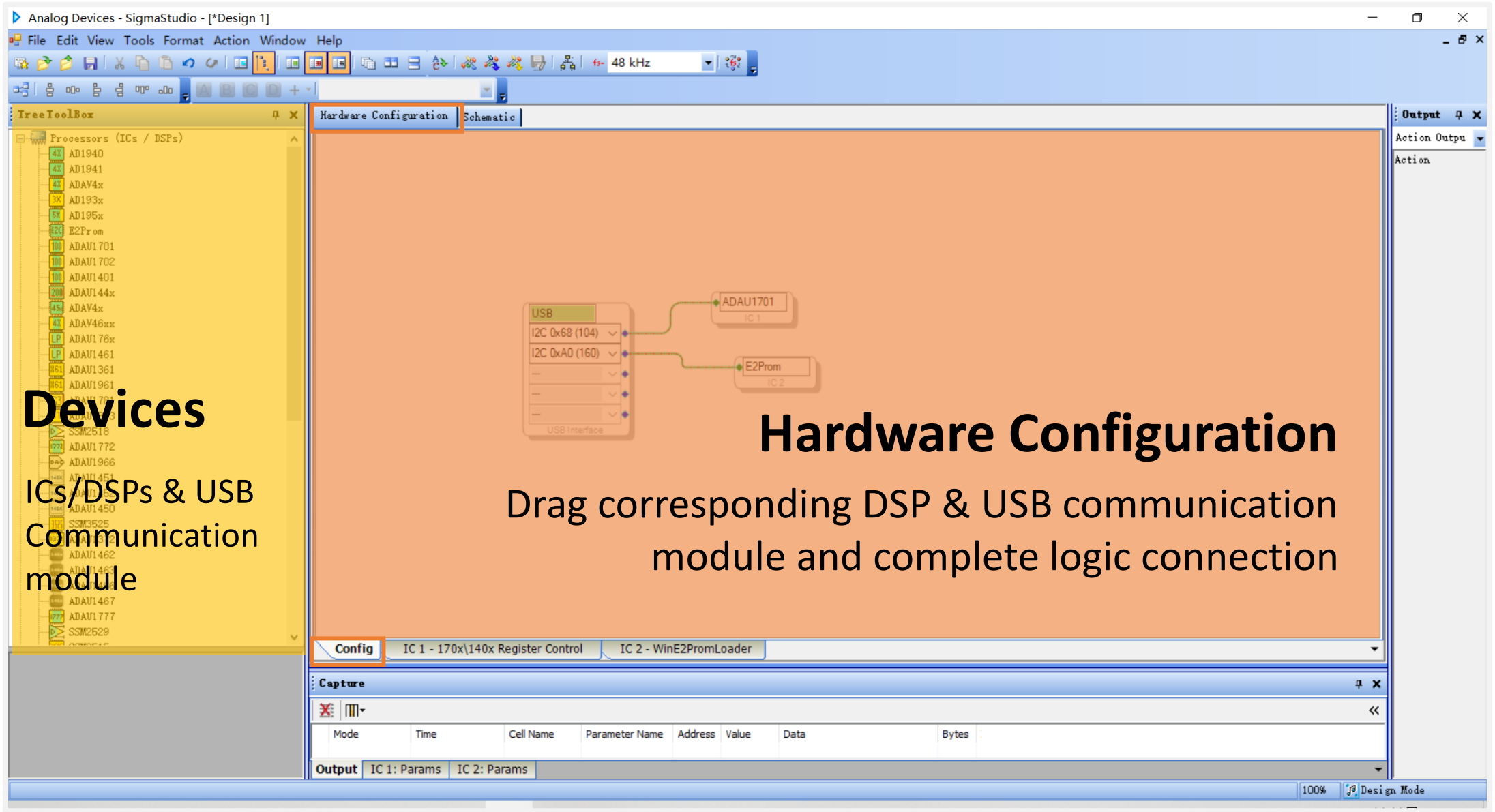


③ Connect APM2 with ICP3 through a 6-pin cable

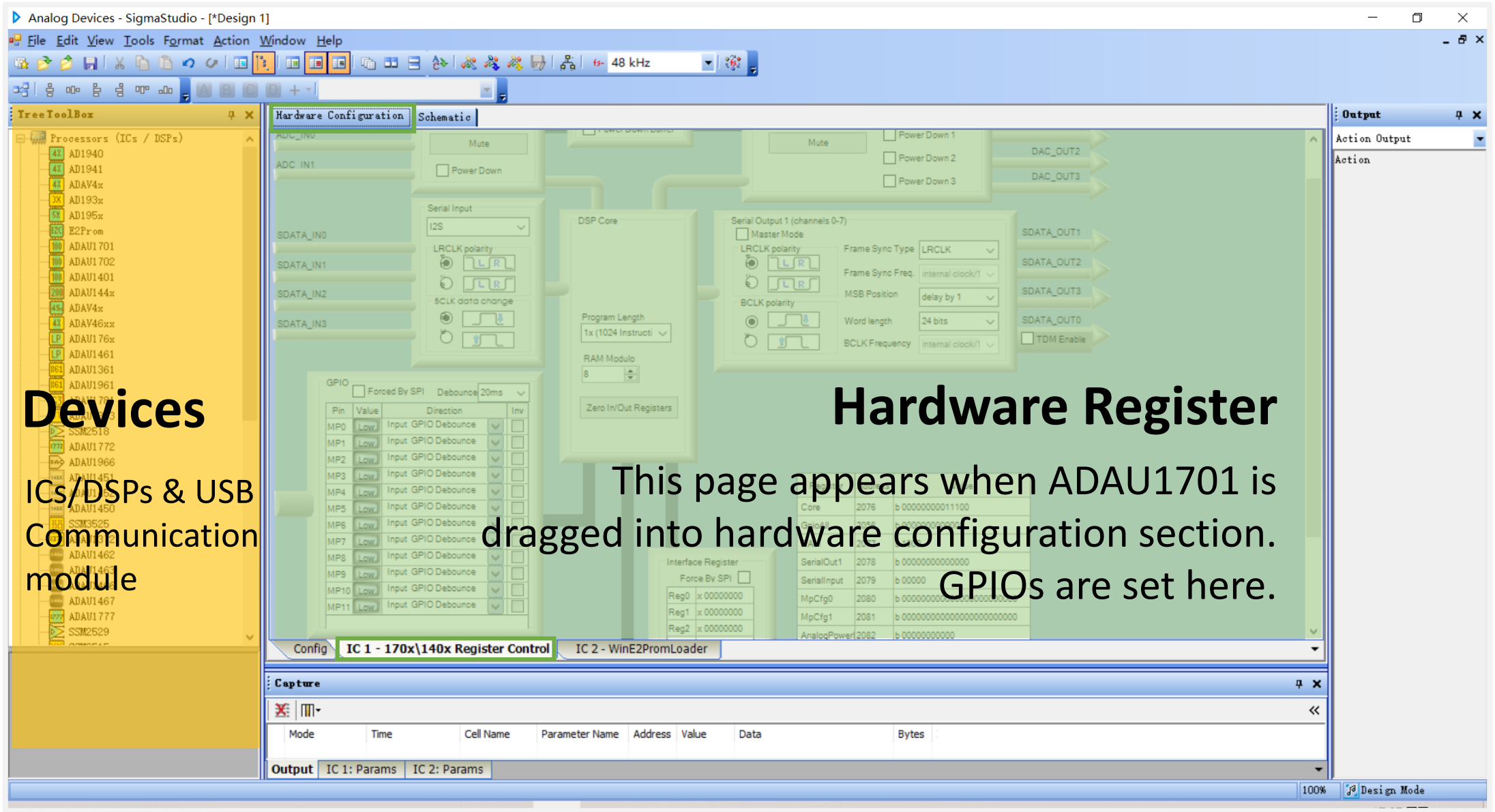


④ Write program

Brief Interface Introduction



Brief Interface Introduction



Devices

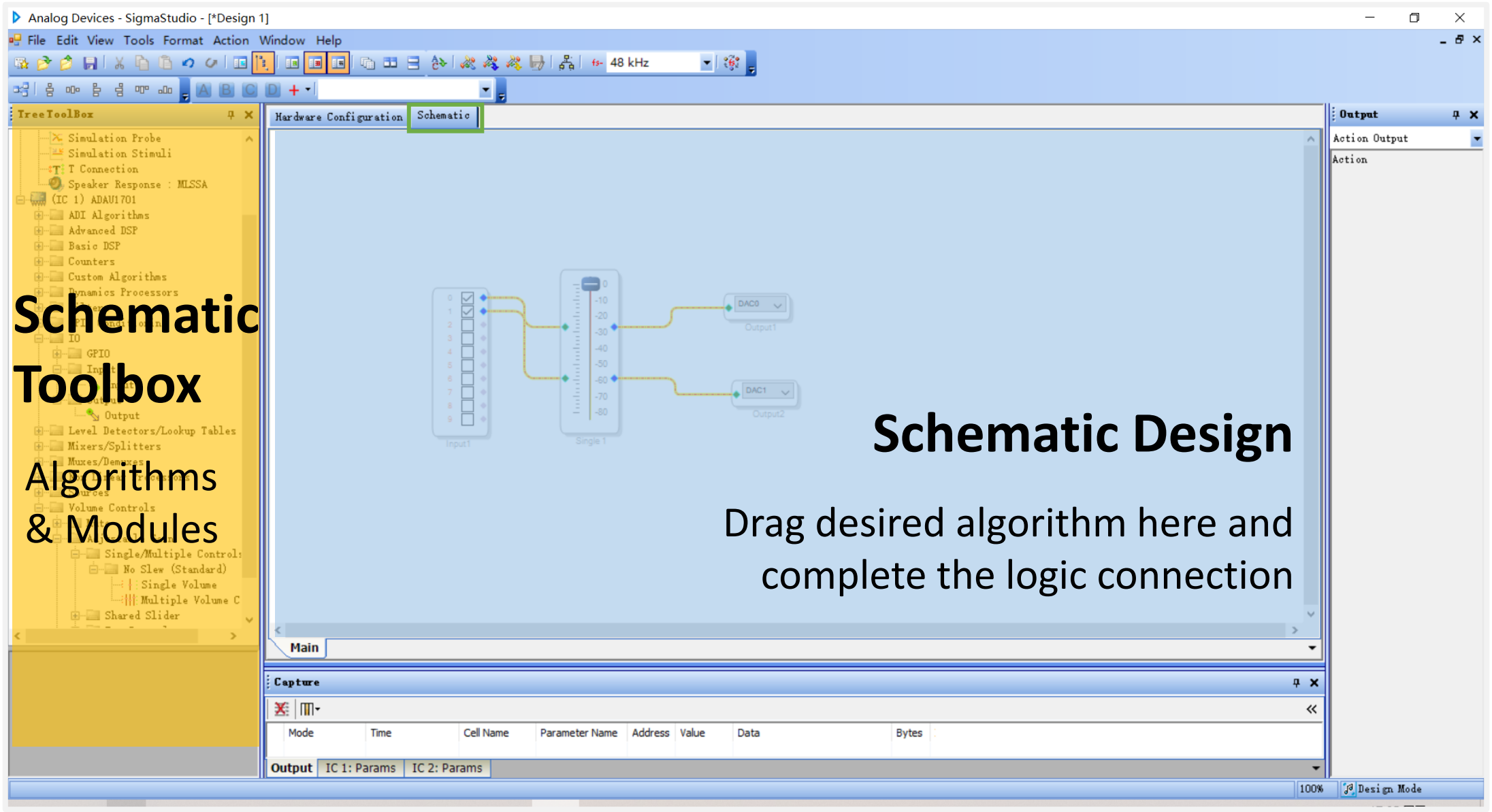
ICs/DSPs & USB Communication module

Hardware Register

This page appears when ADAU1701 is dragged into hardware configuration section.

GPIOs are set here.

Brief Interface Introduction



DSP 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.

Model	Document
APM2	AA-AP23122 ADAU1701 Kernel Board
JAB3	Audio Amplifier Boards Integrated with ADAU1701 DSP
JAB3+	Audio Amplifier Boards Integrated with ADAU1701 DSP & Bluetooth V5.0
JAB4	4CH 30W Audio Amplifier Boards Integrated with ADAU1701 DSP & Bluetooth V5.0
JAB5	4CH 100W Audio Amplifier Boards Integrated with ADAU1701 DSP & Bluetooth V5.0

ICP Programmer Pin Definition

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.

Model	Document	Video
ICP1	WODNOM ICP1 User Guide - Programming	-
ICP3	WODNOM ICP3 User Guide – Programming & APP Control	Watch
ICP5	WODNOM ICP5 User Guide – Programming, APP & PC UI Control	-

Demo Programs for Programming

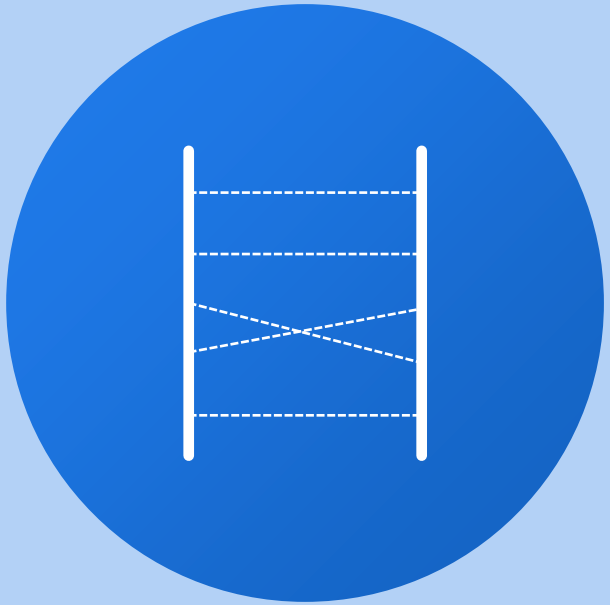
Here are the demo programs for the products. You can download them for reference. The demo program is only for demonstration of signal flow chart.

Products	Demo Program	Document you may need
APM2	APM2_SigmaStudio.dspproj	Download
JAB3 - Mono	JAB3_SigmaStudio_MONO.dspproj	Download
JAB3 - Stereo	JAB3_SigmaStudio_STEREO.dspproj	
JAB3+	JAB3+_Stereo_ADAU1701_DEMOProgram.dspproj	Download
JAB4	JAB4_ADAU1701_DEMOProgram.dspproj	-
JAB5	JAB5_ADAU1701_DEMOProgram.dspproj	Download

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	Video
APM2	The correspondence between APM2 hardware and program	-
JAB3	How to develop JAB3 & Integrated ADAU1701 DSP	Watch
JAB3+	How to program JAB3+ through SigmaStudio	Watch
JAB5	How to program JAB5 through SigmaStudio	Watch



Examples

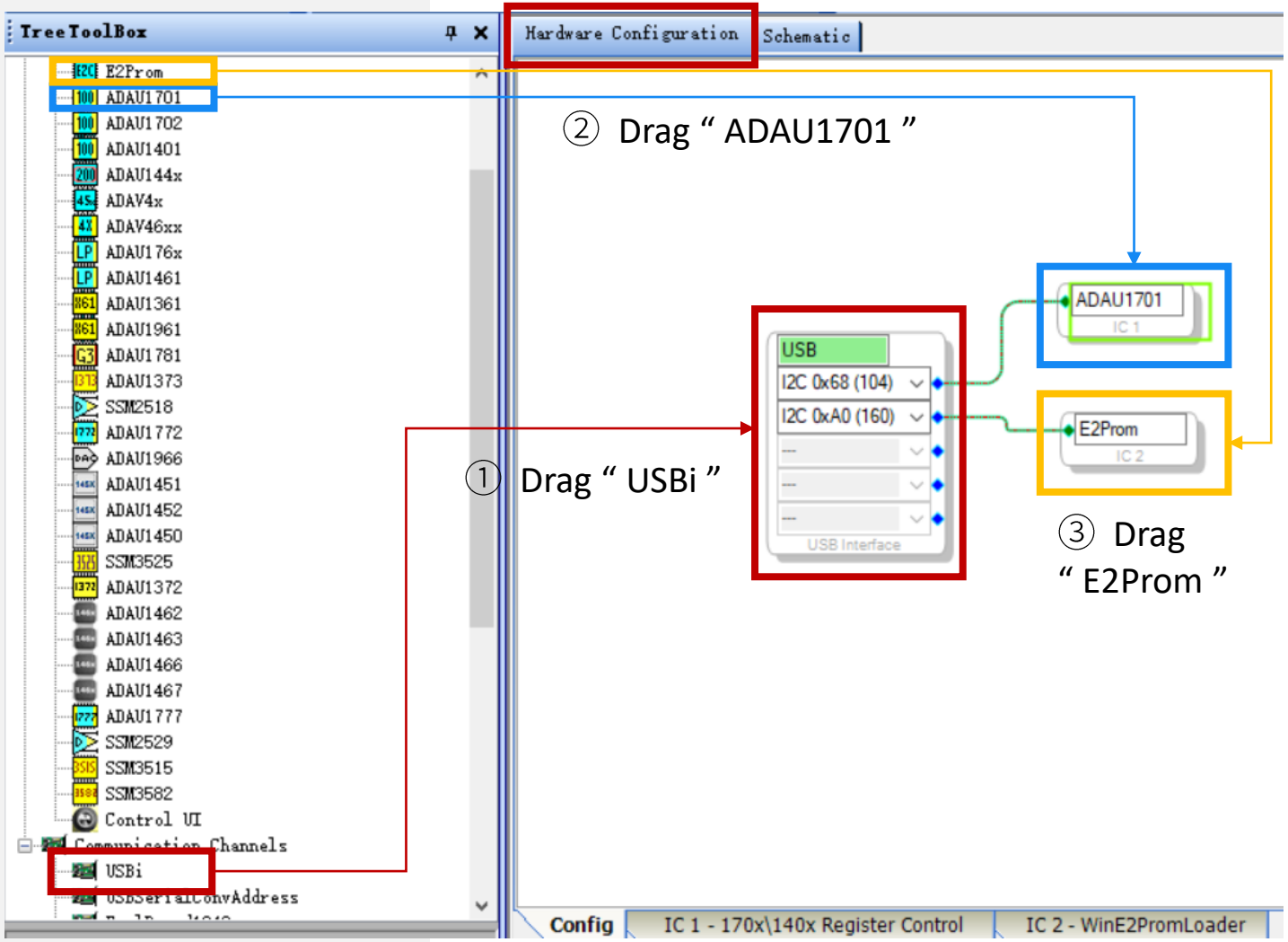
We will demonstrate to write basic programs based on WONDOM DSP products for your reference, so that you can get started quickly.

Basic Program

First step, double click to run SigmaStudio. Then click “File”-->“New Project” to create a new project。

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

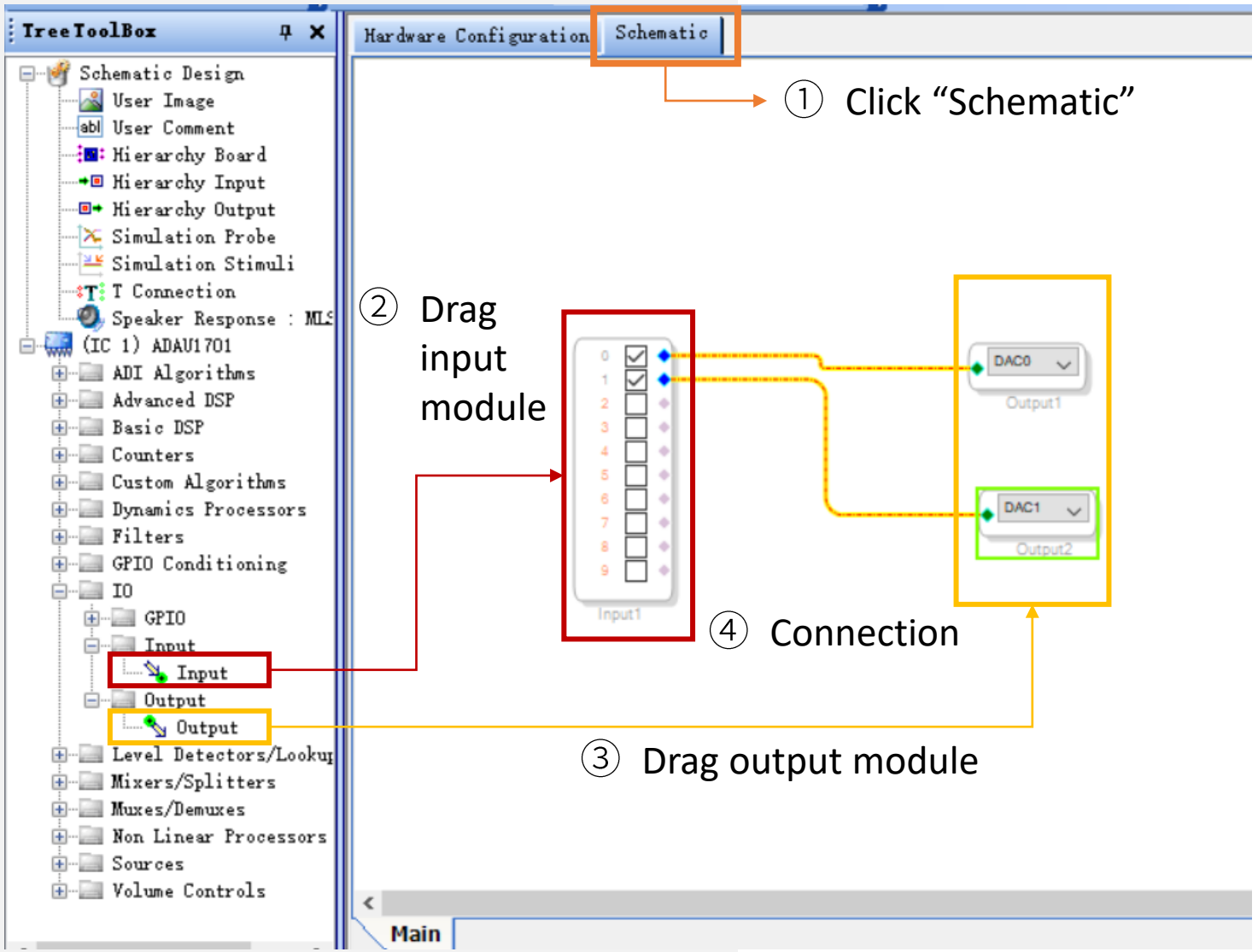
Let’s write a bypass program at first.

① 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 DAC0 & DAC1.

④ Complete logic connection between input and output modules.



(编写程序)

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

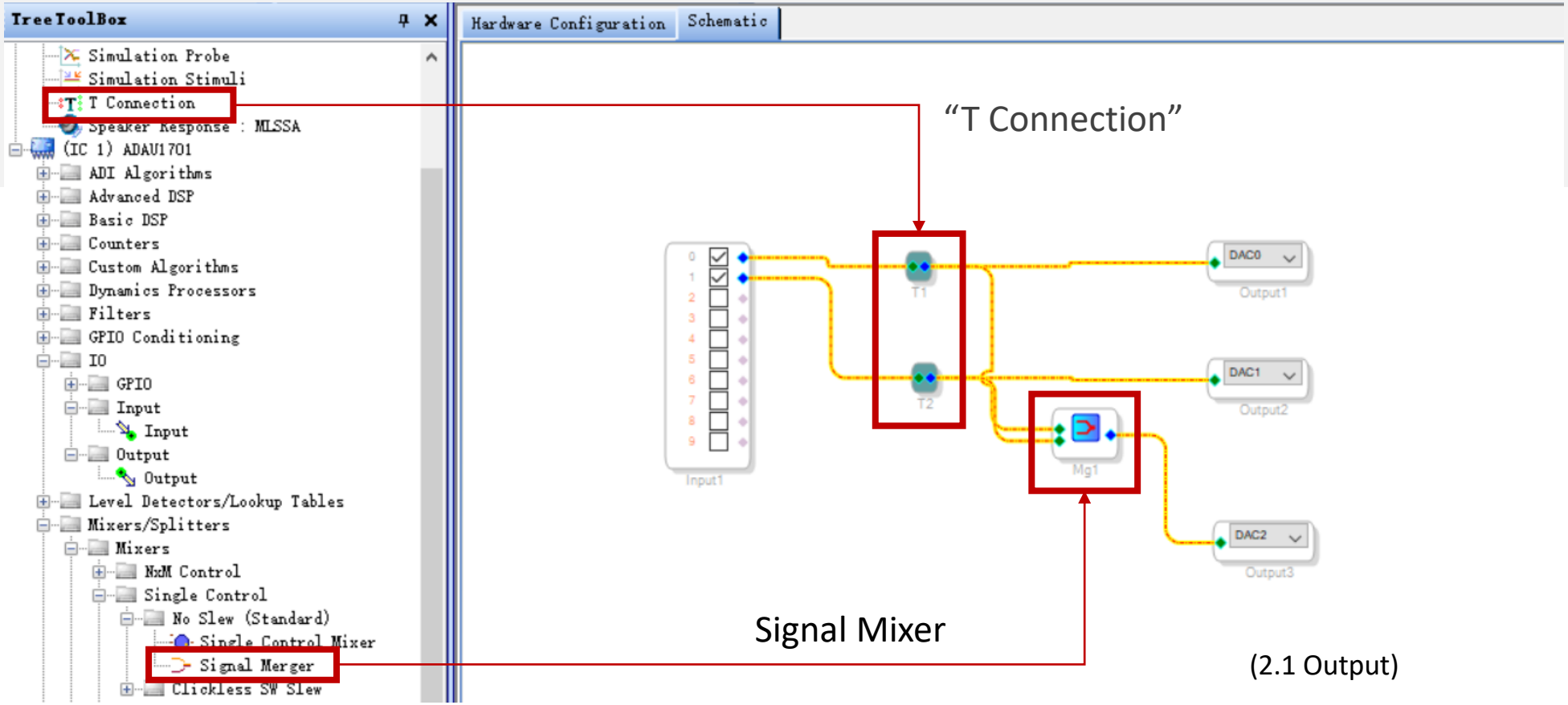
⑦ Play music to see if there is music playing from speakers

(Program Download)

(Download Success)

Basic Program – Bypass

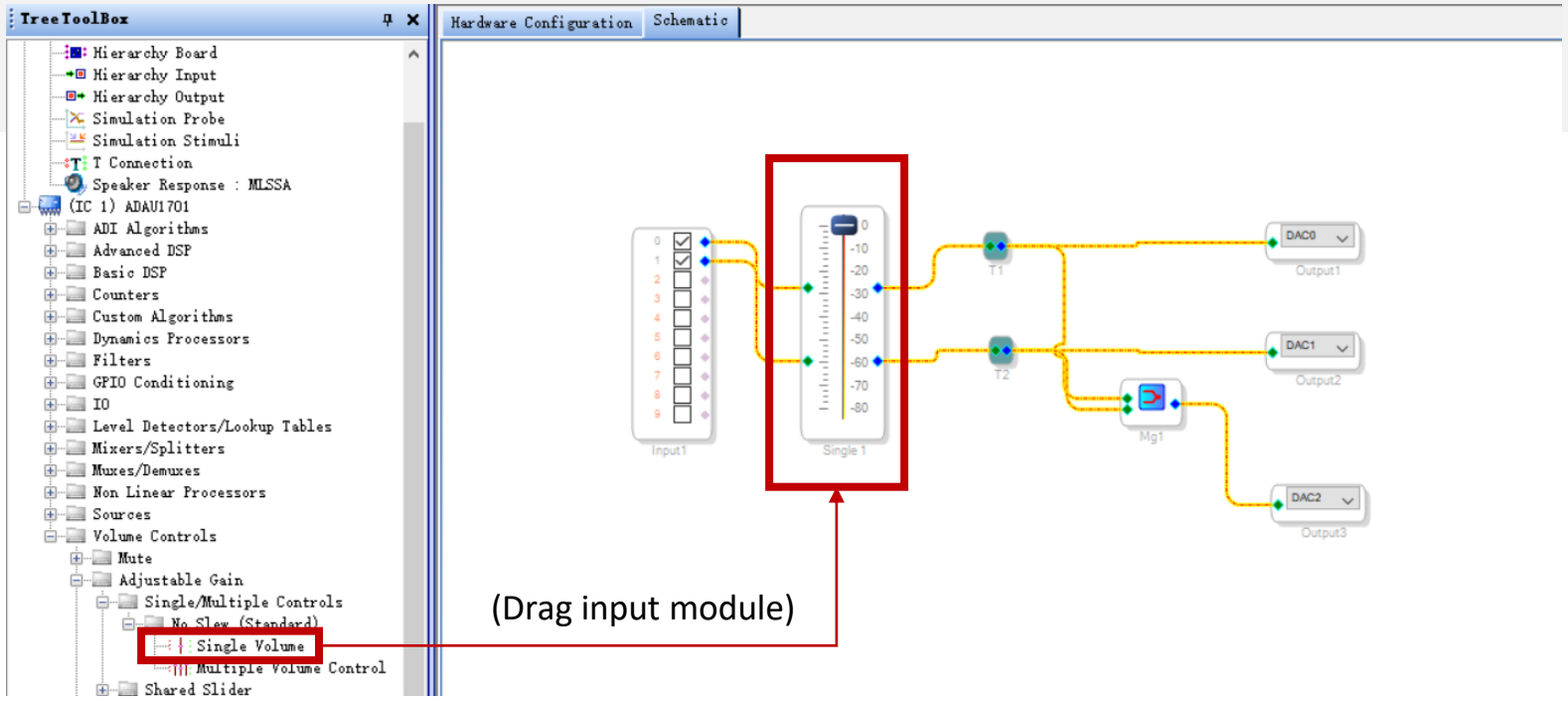
APM2 is the kernel board and APM3 is the matched 2-in, 3-out interface board. In last example, we write stereo output. What if we want subwoofer output for 2.1 system? We can drag another output module, then mix left and right channel.

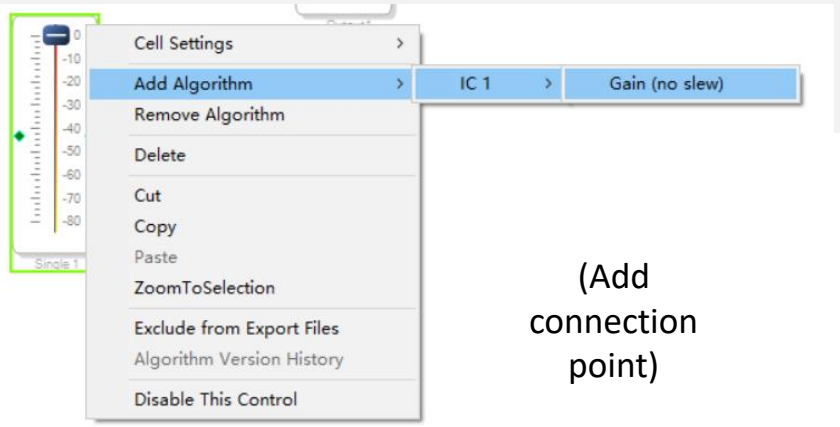


Basic Program – Volume Control

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.





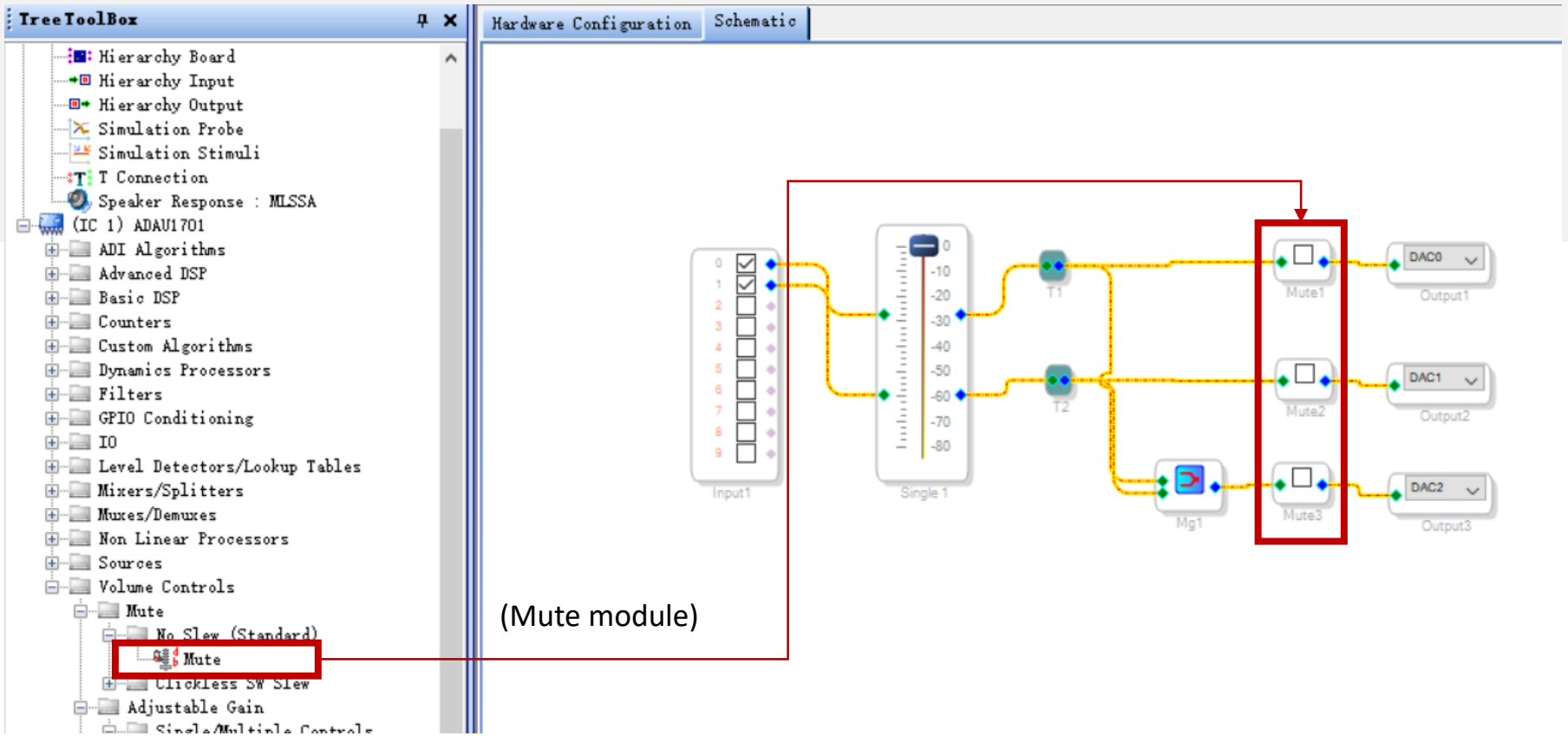
(Add connection point)

There is only one connect point in input module. Select the module, right click and add points.

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.

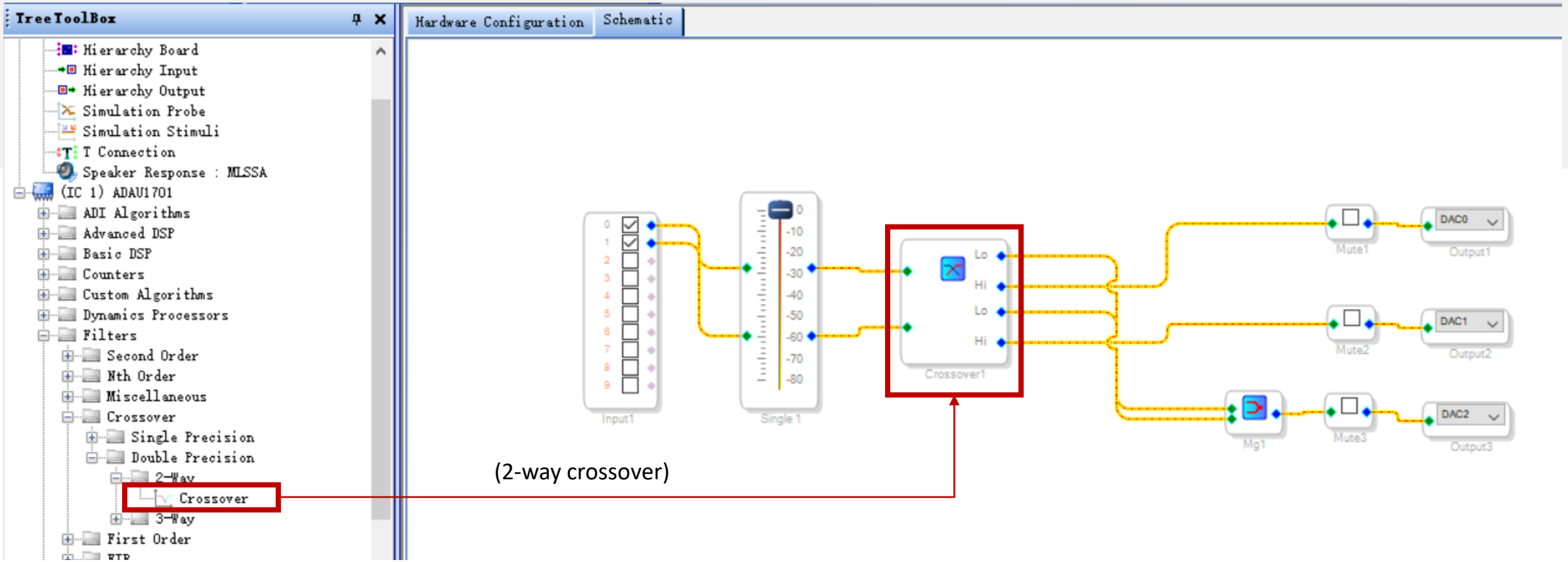
If it’s ticked, this channel will be mute.

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

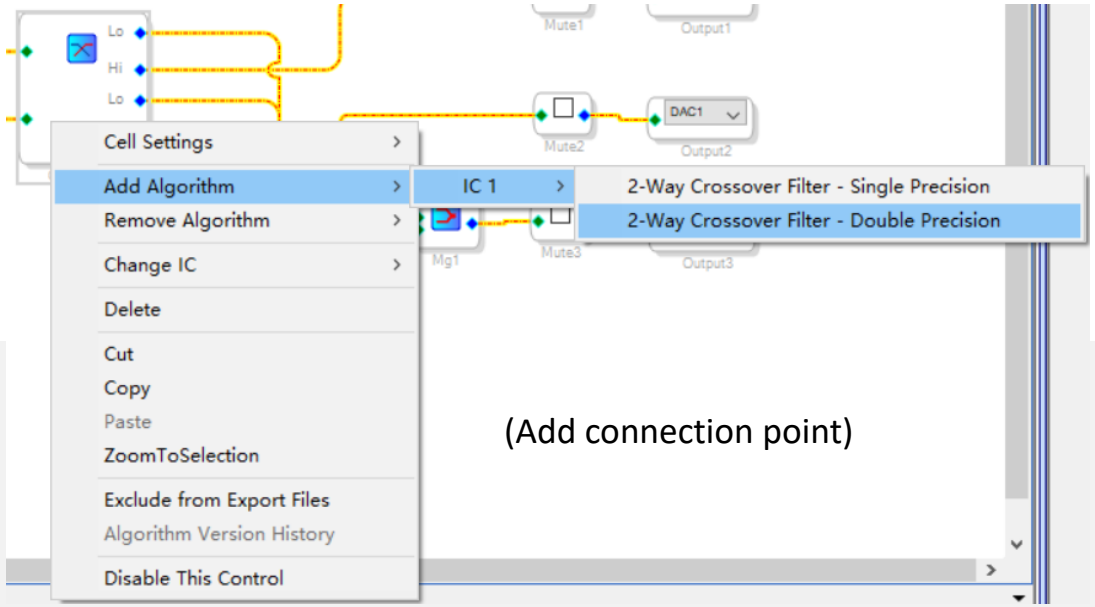
Basic Program – Crossover

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.

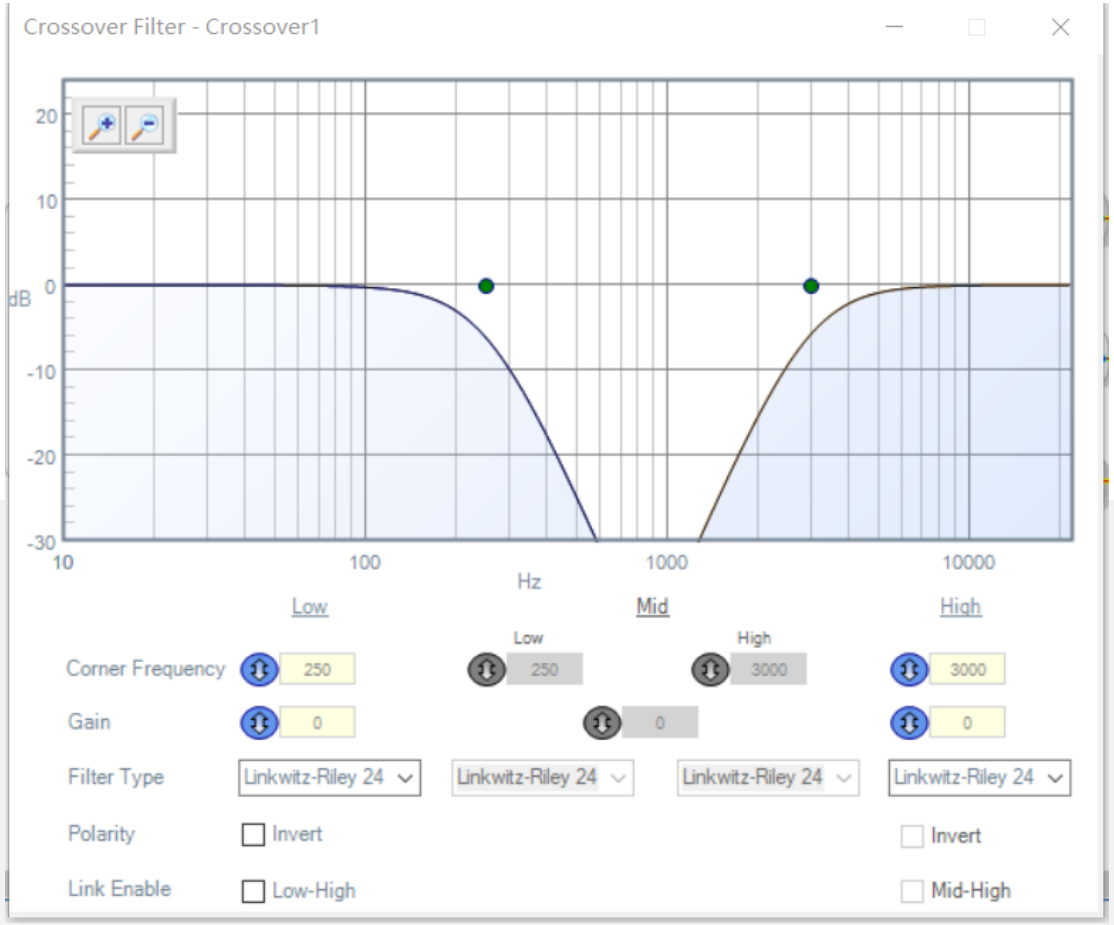


Basic Program – Crossover



(Add connection point)

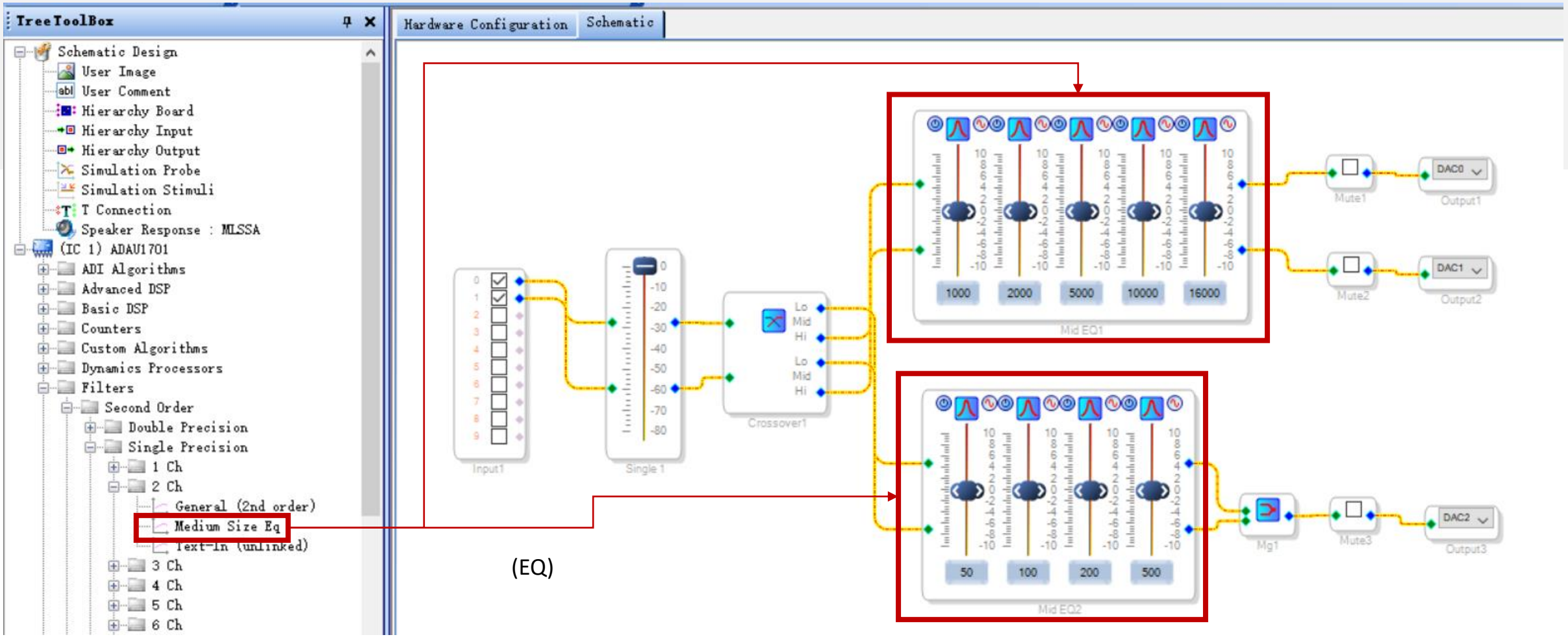
If crossover module doesn't have enough the connection points, you can select the module and right click, then choose "Add Algorithm".



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

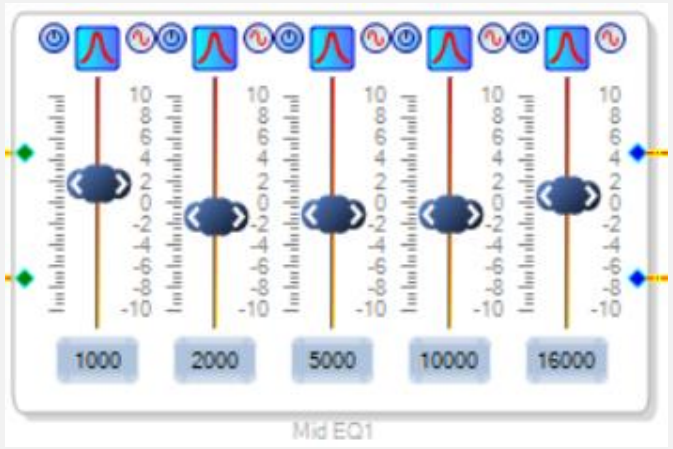
Now, we want to add EQ based on finished program, through which we can adjust gain of each frequency to achieve desired effects. Here we use “Filters”-“Second Order”-“Single Precision”-“2ch”-“Medium Size Eq” module.

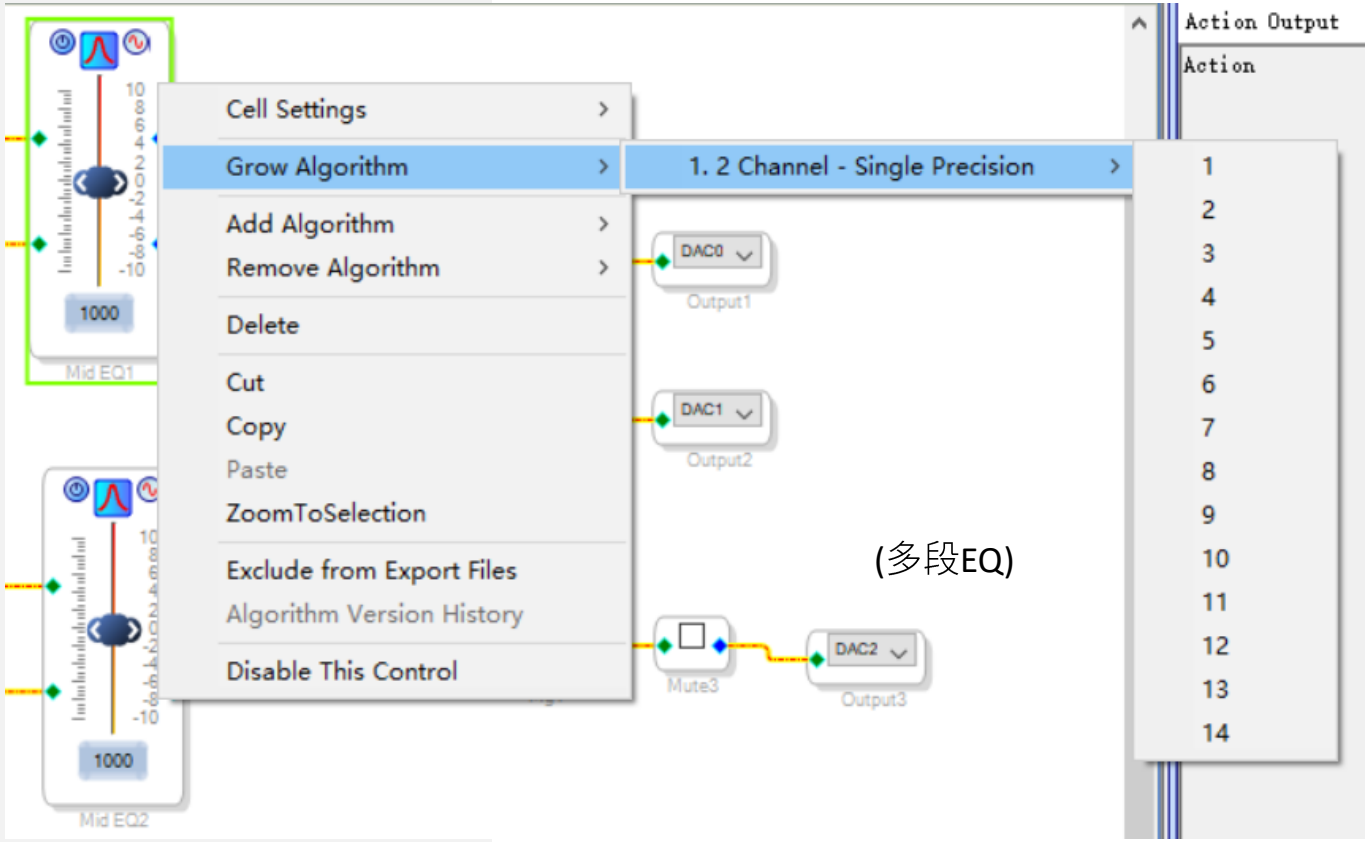


(EQ)

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.

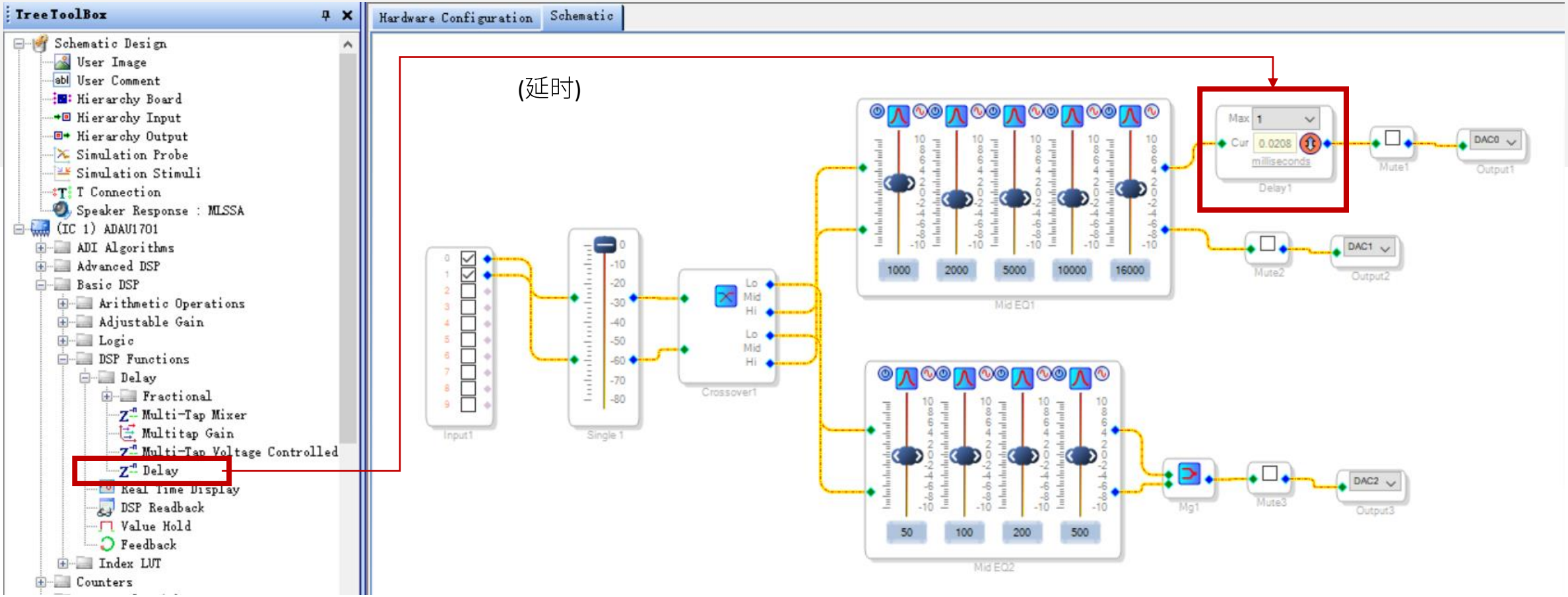




(多段EQ)

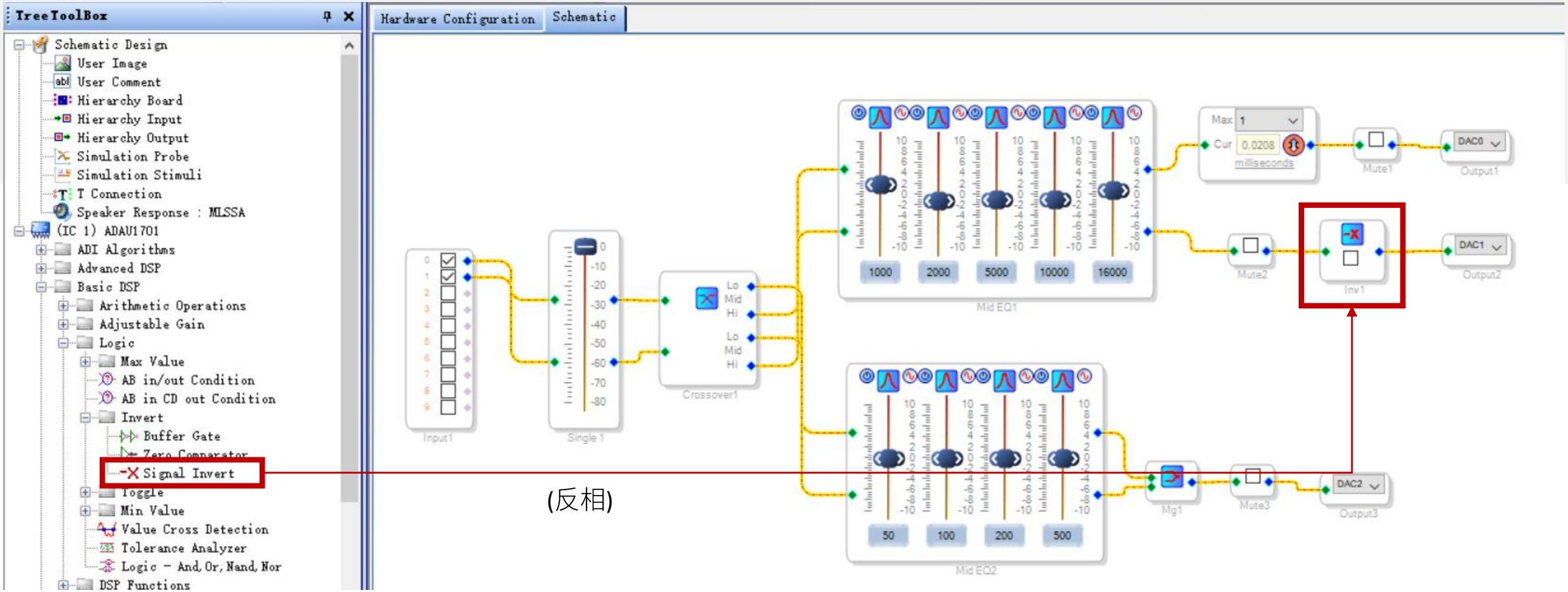
Basic Program – Delay

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.



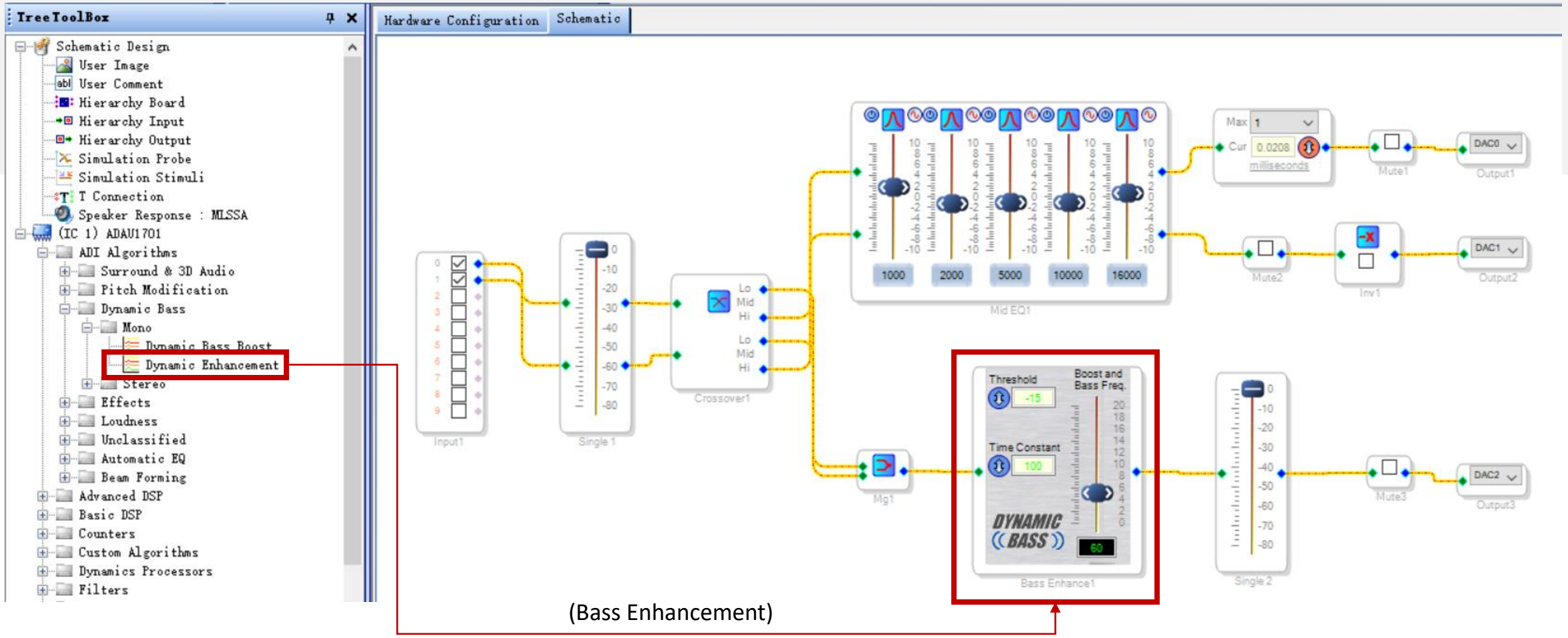
Basic Program – Signal Invert

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.

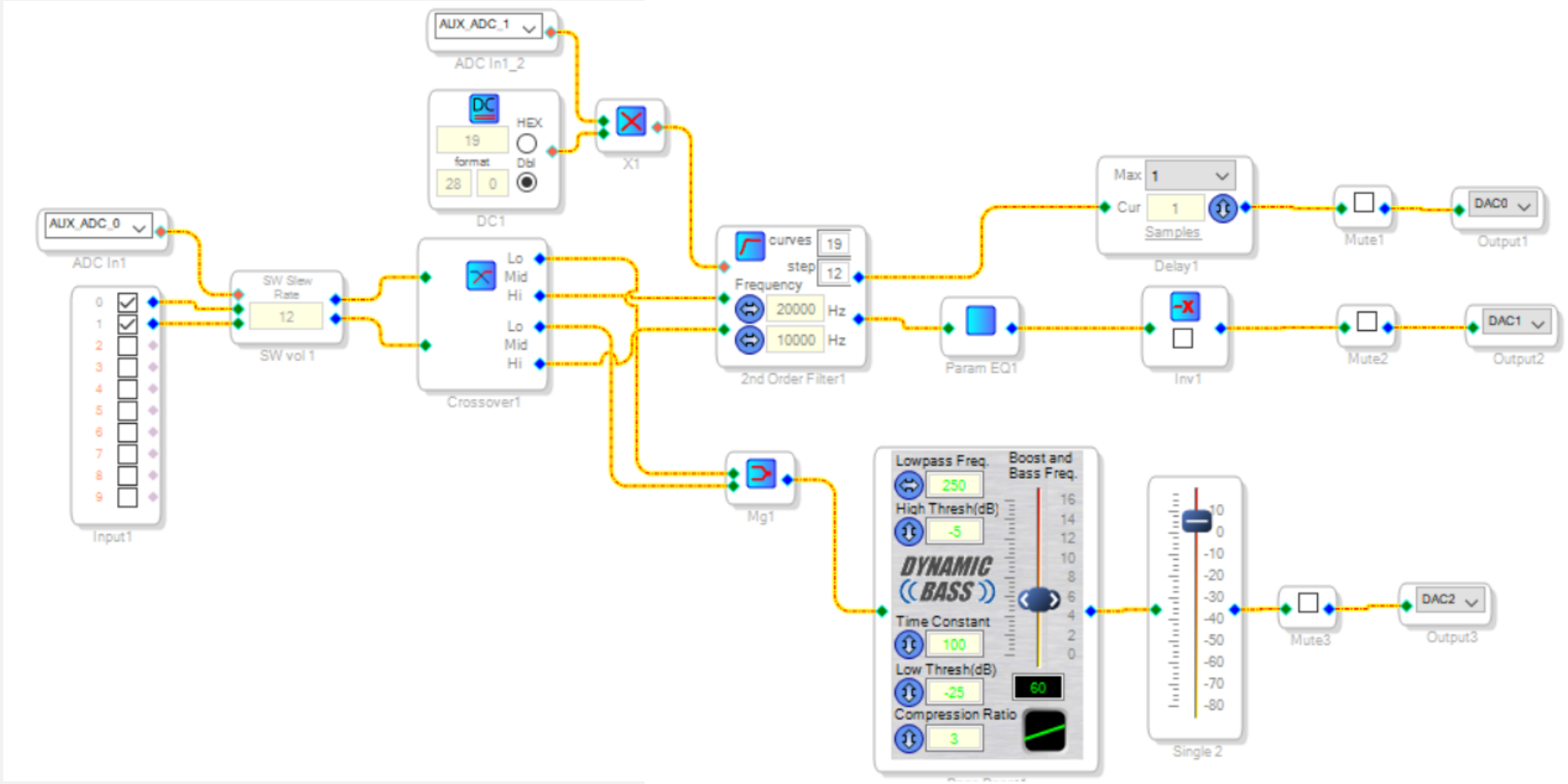


(Bass Enhancement)

Basic Program – Potentiometers

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

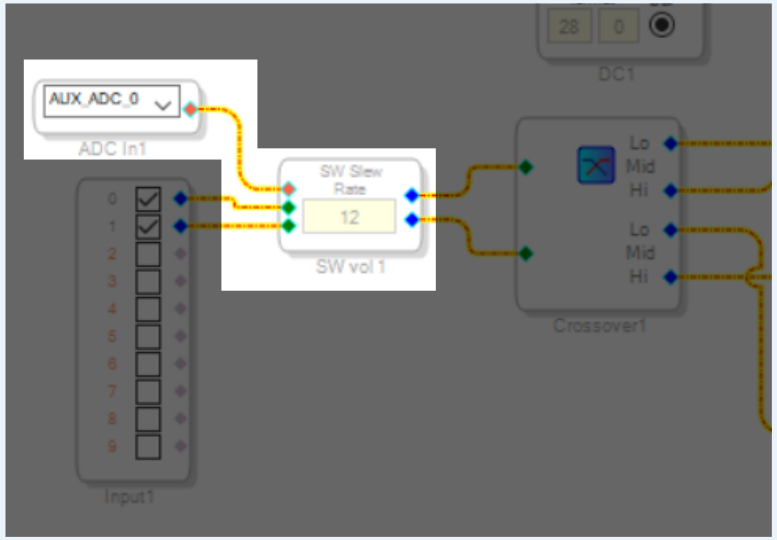
Please note, if you add potentiometer modules, beside logic connection in schematic design section, you need to configure GPIO in hardware register section.



Basic Program – Potentiometers

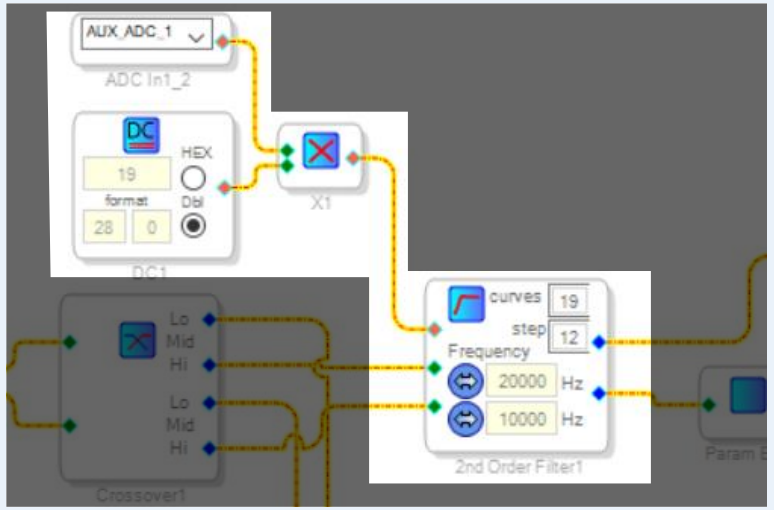
The potentiometers need to read hardware parameters then transmit to related modules for signal processing. Therefore, we need to adopt modules with control parameters.

① Overall Gain Adjustment



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

② High-pass Filter

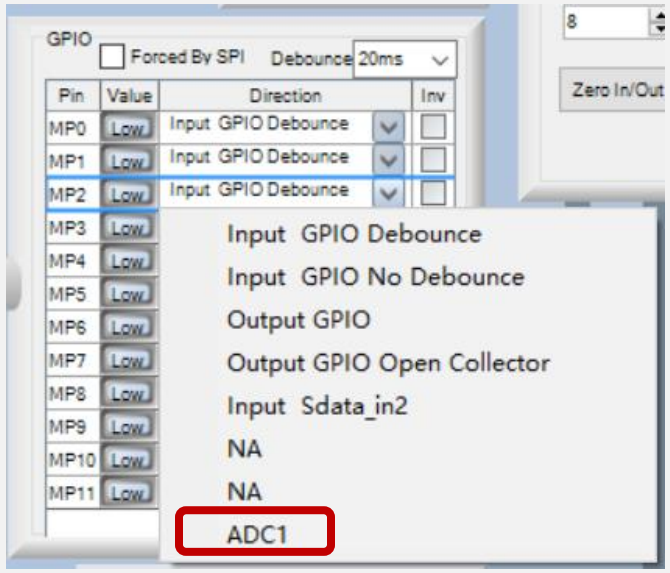


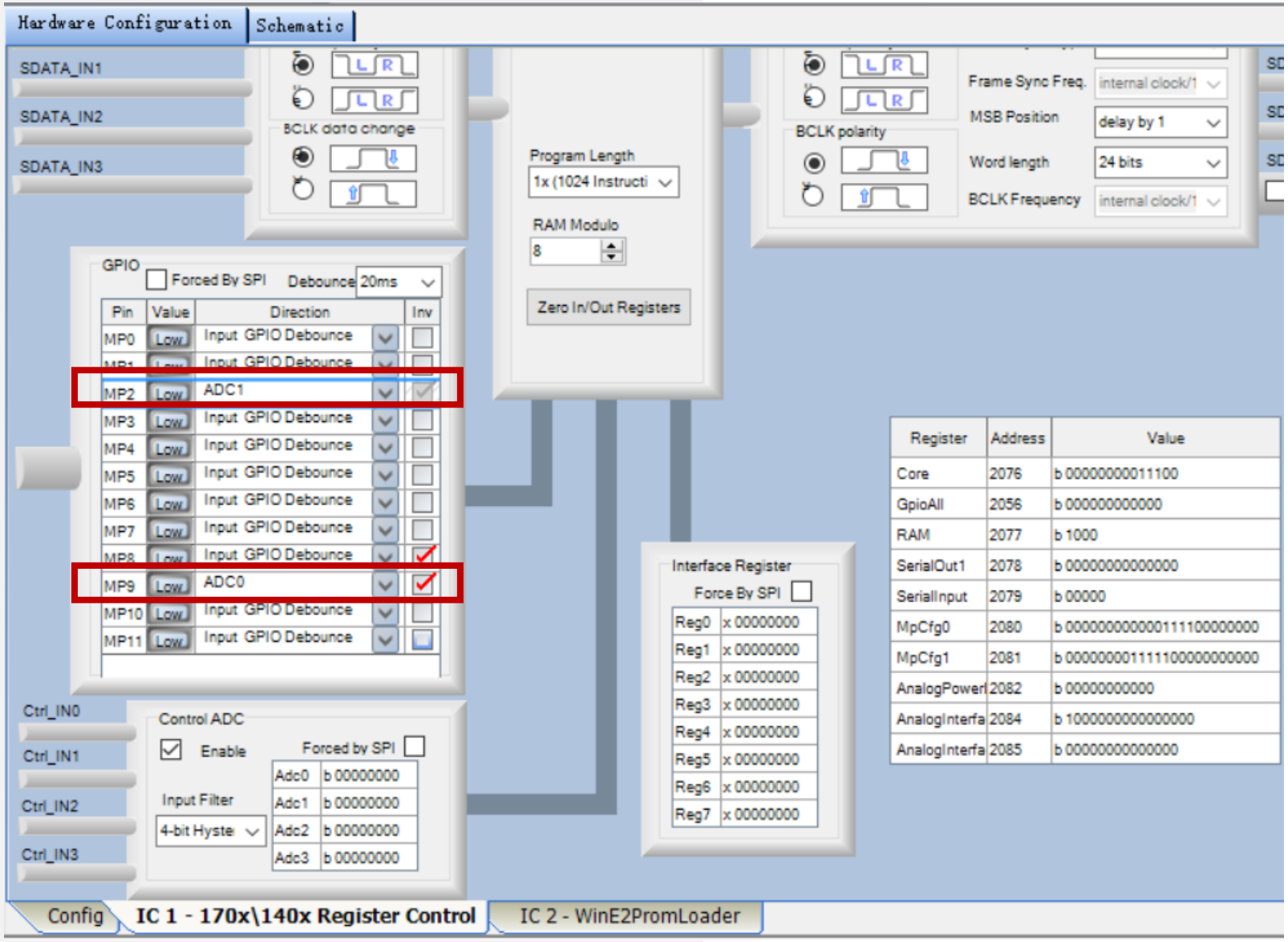
This potentiometer works as high-pass filter of stereo.
The filter module divides 10k-20kHz frequency into 19 curves. The potentiometer reads hardware voltage and multiply with the value of DC input Block to convert into frequency signal, which is transferred to filter to choose corresponding curve.

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.

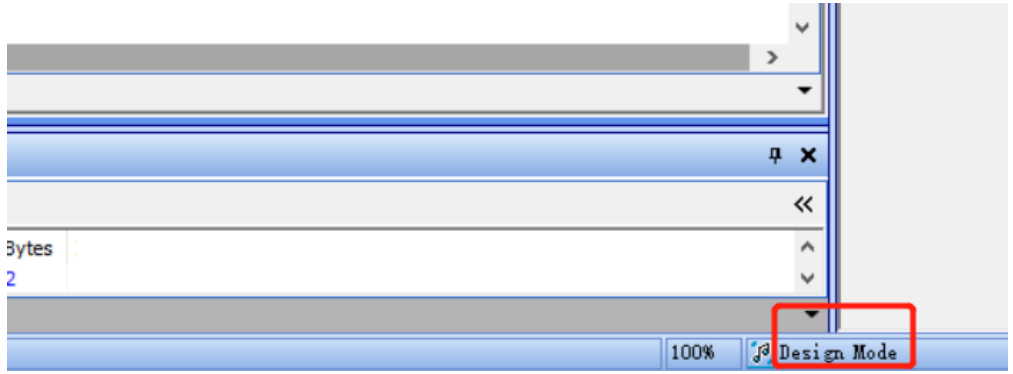


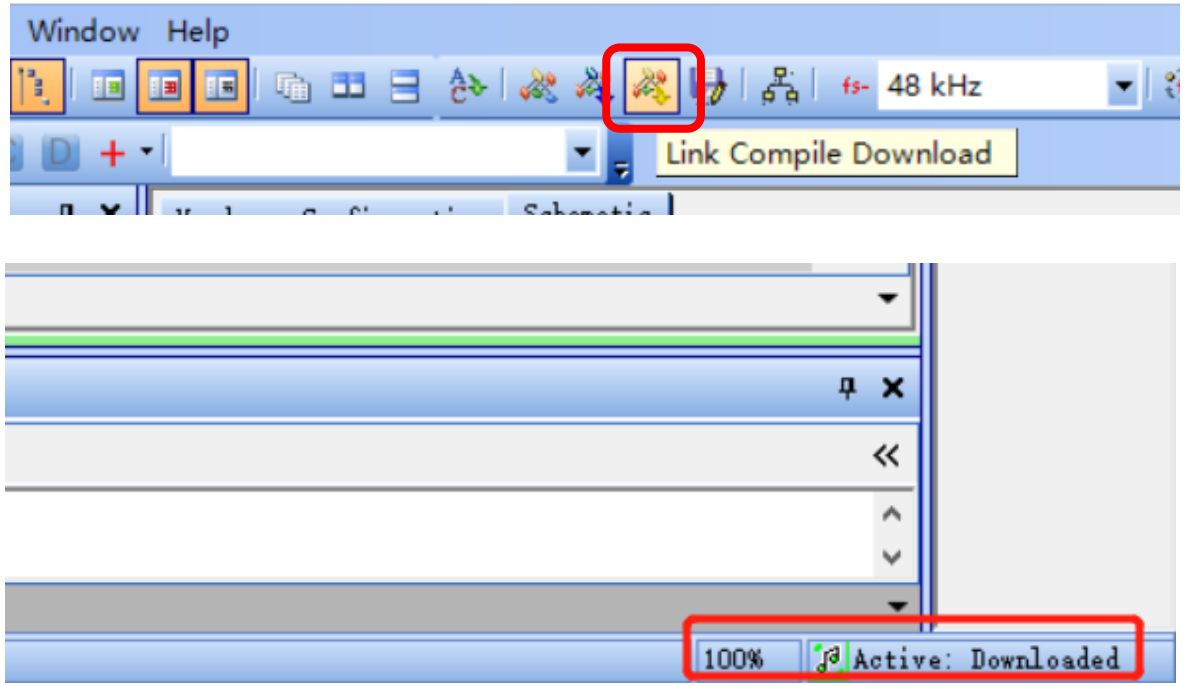


Basic Program – Program Writing

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”

③ 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.