KABD-250 User Manual

Check back on December 6th 2021 for an updated user manual with more advanced detail, project examples, troubleshooting and more.

The new Dayton Audio KABD series of boards leverages the convenience of Bluetooth 5.0 with AptX HD streaming along with the powerful Analog Devices ADAU1701 DSP chip to allow for almost limitless possibilities for sound customization and still have the convenience of high quality Bluetooth streaming. Out of the box, basic customizations and volume control can be made by attaching the optional potentiometers, but to unlock the full potential of your amplifier, attach an ICP1 or ICPX programming board to program your KABD amplifier with the SigmaStudio development tool from Analog Devices. This allows for limitless possibilities of EQ, limiting, bass enhancement, delays and more.

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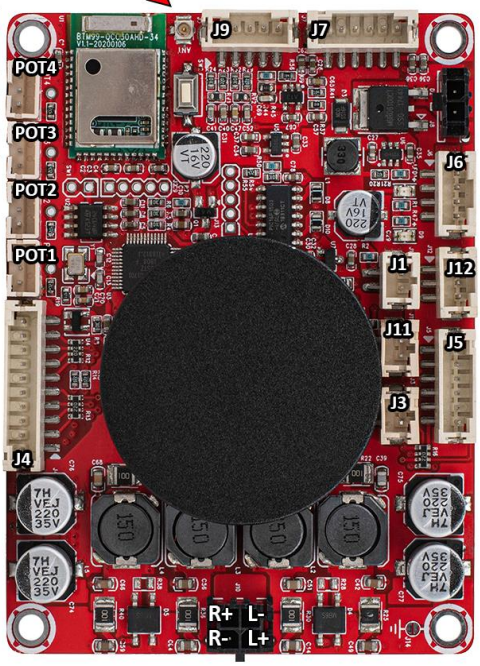
What's new with the KABD-250 compared to the DSPB-250?

1. Potentiometers have been removed from the board, and replaced with 3-pin JST ports. In the optional cable pack for the KABD series, there are 4 potentiometers with cables to connect directly to these ports, no soldering required. This allows for convenient external volume controls, filter controls and more.
2. Bluetooth 5.0 with AptX HD streaming. High quality Bluetooth streaming is now built right onto the board. Example projects have been updated accordingly to use this input. If your SigmaStudio project is not setup correctly, you will not hear any input when connected with Bluetooth.
    a) Bluetooth is represented as input 4 and 5 in SigmaStudio (this is an I2S connection directly to the ADAU1701), and must be routed in your project in order to work
    b) Additional configuration in the Hardware Configuration / Register Control menu is required to make the Bluetooth input function correctly. If unsure, download a KABD example project and modify the example to fit your project needs.
3. 4 Channel versions of this amplifier are coming soon! Both amplifiers will use the same Bluetooth 5.0 module, and also allow for external potentiometers like the KABD-250. The boards can also be configured into 2.1 mode, or higher powered 2.0 mode.
    a) The KABD-430 will allow for 4 x 30 Watt channels of DSP and amplification in the same size as a KABD-250. Configurable as 4x30W, 2x30W+1x60W, or 2x60W
    b) The KABD-4100 is a larger board, and allows for up to 4 x 100 Watts of DSP and amplification! Configurable as 4x100W, 2x100W + 1x200W, or 2x200W.
4. Because of the addition of a built in 5.0 Bluetooth chip in the KABD series, it is not recommended to use the KABD in combination with a KAB for additional outputs in the same way as the DSPB+KAB. We will be releasing the 4 channel KABD amplifiers soon for this purpose of having 4 channels of amplification.
    a) These additional line outputs are still accessible via J7 on the KABD-250. A 6-pin cable mates to this connector, and can be found in the optional cable pack, and can be easily be soldered to your choice of 3.5mm jacks, RCA jacks or directly to another amplifier for creating something like a SUB OUT jack, line output passthrough, etc.

KABD-250 Overview



Line In
J9
PH-5Pos-2mm

Pin	Definition
1	RIN
2	AGND
3	LIN
4	NC
5	NC

Line Out
J7
PH-6Pos-2mm

Pin	Definition
1	LOUT
2	NC
3	GND
4	GND
5	NC
6	ROUT

Potentiometer / GPIO Headers
POT 1-4
PH-6Pos-2mm

Pin	Definition
1	GND
2	INPUT - MP9, MP8, MP3, or MP2
3	3.3V

GPIO #	BOARD LABEL
MP9	POT4
MP8	POT3
MP3	POT2
MP2	POT1

DC Power (12-24V)
J8
Molex-2Pos-3mm

Pin	Definition
1	VCC
2	GND

DC Battery In (12-24V)
J6
PH-4Pos -2mm

Pin	Definition
1	VCC
2	VCC
3	GND
4	GND

BT LED
J1
PH-2Pos-3mm

Pin	Definition
1	LED-
2	LED+

Signal LED
J11
PH-2Pos-3mm

Pin	Definition
1	LED-
2	LED+

Mute & Sync Control
J12
PH-3Pin-2mm

Pin	Definition
1	STBY
2	GND
3	MUTE

DSP Extension
J4
PH-10Pin-2mm

Pin	Definition
1	GND
2	MP11
3	MP10
4	MP06
5	MP07
6	MP00
7	DATA
8	BCLCK
9	LRCLK
10	+3.3V

BT Disconnect
J3
PH-2Pos-3mm

Pin	Definition
1	Cancel
2	+3.3V

Programming
J5
PH-6Pin-2mm

Pin	Definition
1	RST
2	+5V
3	GND
4	WP
5	SCL
6	SDA

Speaker Output
J10
Molex-4PIN-3mm

Pin	Definition
1	ROUT-
2	ROUT+
3	LOUT-
4	LOUT+

Quick Start and Wiring Guide

General Notes

- Make sure that any speakers and input devices you plan on connecting to the KABD are working properly.
- If using SigmaStudio to use the full potential of the DSP, make sure you have purchased at least one programmer board (ICP1 or ICPX), an appropriate USB cable capable of data transfer and make sure you have a Windows PC available to use for Analog Devices' free SigmaStudio software.
- Take care when attaching and especially removing jumper cables from the KABD.
    - A damaged cable can cause issues that are difficult to troubleshoot, such as noises like popping or clicking. A damaged cable can also cause programming failure.
- Note that there is a 'tips and troubleshooting' section at the bottom of this document.
- This guide will frequently reference ports on the amplifier such as "J8" or "J6". These markings are written on the board itself in small print and are usually easy to find, but if unsure, reference the quick start wiring diagram below.
- This guide is for the KABD amplifiers, which have a built in Analog Devices ADAU1701 signal processing chip. The normal KAB (without the D at the end) amplifiers do not have this chip, and this user guide **does not apply** to these boards.

Power Supplies

- **DC Power** - The KABD-250 can be powered via J8 a DC power supply from 12-24V with current capabilities greater than 1A. Any power supply outside of this specification can damage the KABD-250. In general, the higher wattage the power supply, the more power that can be supplied to your speaker. For maximum power, use a 24V, 5A power supply.
- **Battery Power** - The KABD-250 can also be easily powered with an external Dayton Audio battery board via J6. The KABD-250 does NOT have a battery charging circuit on the board, so the attached battery board must have this built in, such as the LBB-3v2 (12V) or LBB-5Sv2 (21V) from Dayton Audio. Battery modules such as the KAB-BE are not compatible with the KABD series because these battery modules do not have built in charging circuits (amplifiers such as the KAB-250v4 have charging circuits on the board, but the KABD-250 does not have this circuit on the board).

Input Devices

- **Bluetooth -** The KABD-250 has Bluetooth 5.0 built directly onto the board wired directly to the ADAU1701 DSP chip via I2S. This supports apt-X, aptX-HD, apt-X LL, SBC and AAC.
- **Analog -** Analog audio sources can be input to the KABD-250 via J9. A 3.5mm aux-in cable is available in the function cables kit for the KABD series.
- **Mixing -** By default, input from I2S (Bluetooth) and J9 (analog) are mixed together within the DSP before being sent for amplification. This can be reprogrammed via a custom SigmaStudio project.

Output Speakers and Line Output

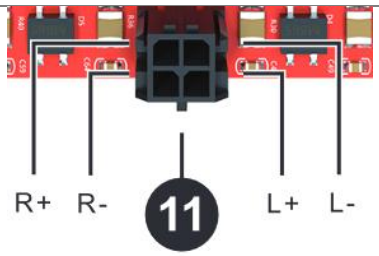
- **Speaker Output -** The KABD-250 speaker output (via J10) is stable down to 4ohm, which means it can power almost any speaker. This also means it can power any impedance of

speaker greater than 4ohm, however the efficiency will go down as the impedance goes up. Do not bridge J10, the KABD-250 is not intended to be bridgeable.

- **Line output** - The ADAU1701 DSP is capable of 4 channels of analog output with DSP applied. 2 of these channels are connected to the amplifier chip (DAC0 and DAC1 in SigmaStudio), and the extra 2 channels can be accessed as a line level output via J7 (DAC2, DAC3 in SigmaStudio).
    - This port is designed to make it easily cascadable with similar amplifiers, but a line output jack could be simply wired to J7 as well. The optional functional cable pack comes with a 6 pin-6 pin JST cable, which could be cut in half and wired to a 3.5mm or RCA jacks

Quick Start Steps

1. Connect speakers to J10 with the provided 4-wire harness according to the wiring diagram or by following the labels on the back side of the board.

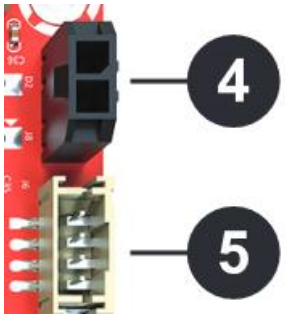


2. Connect power through either J8 (4) if using a power adapter or J6 (5) if using a Dayton Audio battery.

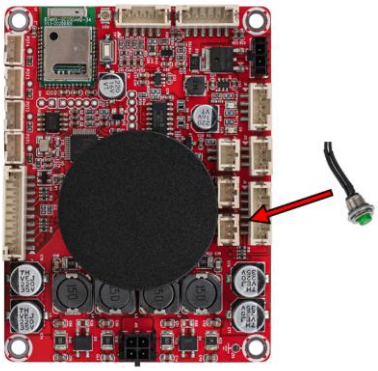
a. It is recommended to use a power supply of at least 12V but less than or equal to 24V. The higher the voltage input (with adequate current capabilities), the more power the amplifier can supply to your speakers.

b. The KABD-250 does not have a built in battery charging circuit, so a board such as LBB-3v2 (12V) or LBB-5Sv2 (21V) that has this capability built in is required to use the amplifier with batteries.

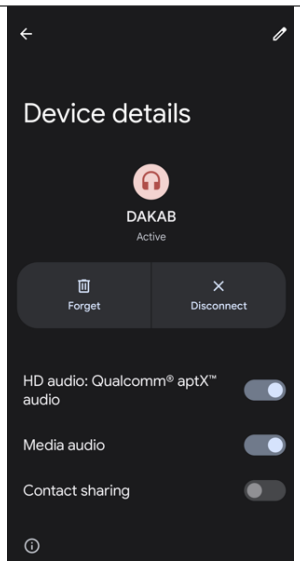
c. Connect a 2.5mm or 2.1mm DC jack to J9 to allow a variety of power supplies to be attached to the KABD-250.



3. A Bluetooth pairing switch (green) that comes in the box can be added to the KABD by attaching its 2 pin connector to the corresponding port (J3). See the quick start diagram or look for the “BT Pair” port as labelled on the underside of the board. Holding this button down for about a second will allow a new device to be paired to the KABD. Do not hold this button for longer than 5 seconds. Use this button if you are not seeing “DAKAB” in your bluetooth list.



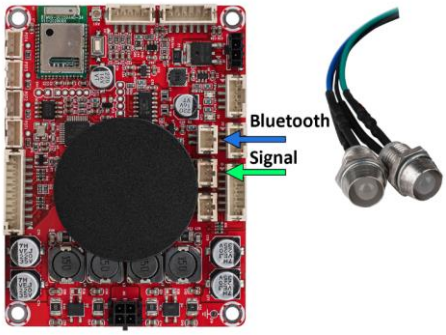
4. Once powered on, the board’s Bluetooth connection will be available on your phone, tablet, laptop, etc and will show as “DAKAB” in your bluetooth menu. Once connected and music is playing on the source device, audio should begin playing through your connected speakers.

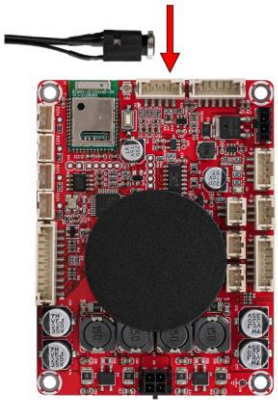
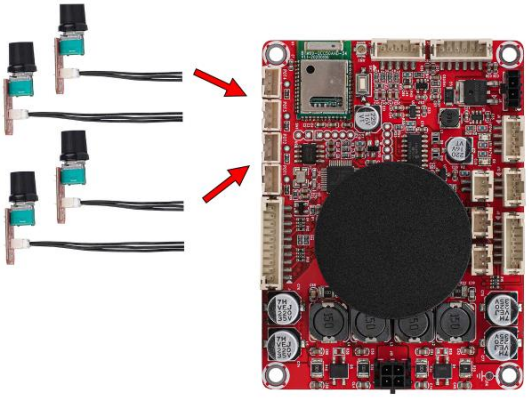
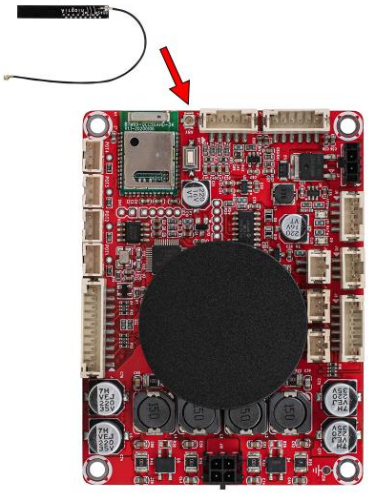


Troubleshooting

a. Check that your audio source is functioning correctly and connected to the KABD’s bluetooth.
b. Check that your speaker connections match the diagram on the underside of the KABD.
c. If you had an ICP programmer attached to the KABD when the KABD was turned on, detach it and reboot your KABD.
d. Unpair and repair the KABD bluetooth connection to your phone or other source device.

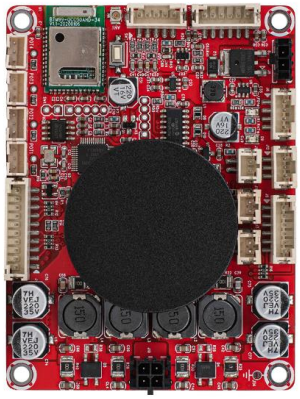
5. (Optional) Bluetooth and Signal/Status LEDs found in the functional cable kit can be added to the KABD by plugging them into the corresponding 2-pin connectors on the board. See the quick start diagram or look at the underside of the KABD for the correct locations for these LEDs.



6.	(Optional) A 3.5mm jack comes included in the functional cable pack, which can be plugged into J9 to function as a line input for external audio sources.	
7.	(Optional) Attaching the potentiometers found in the function cable kit (sold separately) to the board in the 3-pin POT1-4 ports can allow quick adjustments without any programming. See the potentiometers section for more details. POT1 can immediately be used out of the box as an external volume control.	
8	(Optional) Attaching the external bluetooth antenna in the function cable kit can be helpful when the KABD is installed in situations where the bluetooth signal is restricted	

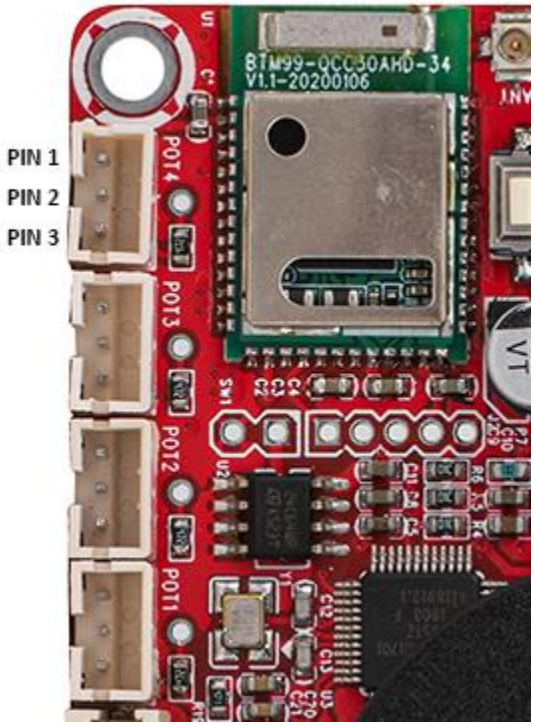
9 (Optional) Because the ADAU1701 has 4 DAC outputs, and only 2 of them are used for the powered outputs via J10, the other 2 are available via J7. These can be wired to 3.5mm jacks, RCA jacks, or even connected directly to another amplifier. For example, you could wire an RCA jack to this output and use it as a line level “sub out” and connect your project to a powered subwoofer.

Line Out	
J7	
PH-6Pos-2mm	
Pin	Definition
1	LOUT
2	NC
3	GND
4	GND
5	NC
6	ROUT



Potentiometer Headers

POT / GPIO Headers	
POT 1-4 PH-6Pos-2mm	
Pin	**Definition**
1	GND
2	INPUT - MP2, MP3, MP8 or MP9
3	3.3V



The KABD series of amplifiers come with 4 3-pin headers to make it incredibly easy to add external potentiometers, button, switches or rotary encoders to your project. Each of these 3-pin headers expose a voltage supply, GND, and a multipurpose pin on the ADAU1701. The optional cable pack for the KABD series comes with 4 potentiometers with cables that connect directly to these ports, so no soldering is required and they are easy to add to your project. Buttons can also be easily attached to these ports. The ports for these potentiometers are 3-pin JST headers and are clearly labelled as POT1-4. The potentiometers in the cable pack are 1k Ohm.

Out of the box, each KABD amplifier is pre-programmed for the potentiomers to have some basic functions, however there are example projects for most use cases and can be easily customized with SigmaStudio. A chart of the default potentiometer functions is below.

Note: if you are going to use the potentiometers for making on-the-fly adjustments, the potentiometers **must be left plugged in** for the changes to remain active. For example, if you use POT3 to enable a high pass filter on your speaker outputs, you must leave that potentiometer plugged in for the HPF to remain active. When you remove the potentiomers, the HPF will deactivate.

	KABD-250/230	Specifications	ADC Input (Example Projects / Stock FW)	ADAU1701 Pins
POT1	Gain Control – J7 (Line Output)		AUX_ADC_1	MP2
POT2	High Pass Filter Control for Line Out – J7 (Line Output)	12dB/Octave Butterworth, 250 – 2kHz	AUX_ADC_2	MP3
POT3	High Pass Filter Control for Speaker Output – J10	12dB/Octave Butterworth, 250 – 2kHz	AUX_ADC_3	MP8
POT4	Master Gain Control – J10 (Speaker Out) and J7 (Line Output)		AUX_ADC_0	MP9 (ADC0

Sigma Studio Connection - Quick Start

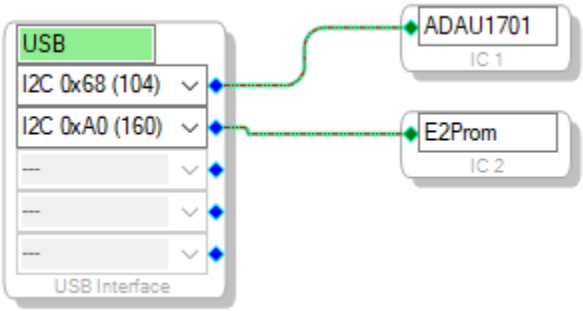
A DSPB-ICP1 or ICPX (USBi) programmer board is required to program the DSP chip on KABD amplifiers. The programmer can be thought as the bridge between the DSP chip and the computer. The programming board translates instructions from the computer controlling SigmaStudio into a signal that the KABD's ADUA1701 can understand. The programmer only needs to be connected while the device is being programmed. After programming, it can be removed and used to program as many other KABD amplifier boards as needed.

The following steps make it easy to connect your programmer to the SigmaStudio development tool. The steps require a basic knowledge of computer operation, but if the steps are followed closely, it is not too complicated.

Note: Sigma Studio connection **requires a Windows PC and an ICP1 or ICPX programming board.**

1. Download and install the most recent version of SigmaStudio to your system for free.
2. Make sure your ICP1 or ICPX is disconnected from USB and from your KABD amplifier before starting, to ensure the proper steps are taken.
3. Open an example project from downloadable from the Parts Express product page for the KABD-250 or KABD-230.
4. If starting a project from scratch (not recommended), open a new project in SigmaStudio by pressing File->New Project. We recommend using an example project and modifying it for your needs, rather than starting from scratch.
5. Ensure that your ICP1 or ICPX is **not** yet connected to the KABD. Set the switches on your ICP1 or ICPX appropriately for programming the KABD.
    a. **ICPX** – Set the switches on your ICPX are set to "USBi" and "IIC" for proper programming with the KABD.
    b. **ICP1** – Set the switch on your ICP1 to "PROGRAM" mode

6. Plug a micro USB cable (ICP1) or USB C cable (ICPX) into the PC running SigmaStudio, and then connect that USB cable to your programmer
7. If all is correct, you will see the USB block turn green, like below.



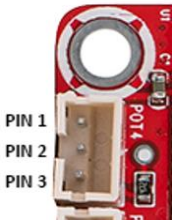
    a. Note that this block turning green means that SigmaStudio recognizes your programmer, **it does not indicate that SigmaStudio can communicate with your KABD amplifier yet.**
    b. If the connection is not successful (the block stays orange), it is imperative to try a different USB cable. Many USB cables endure a lot of abuse from charging devices, and

although they might still provide power, they might have issues transferring data. Some micro USB cables might not have been wired internally to transfer data at all. If it is not the cable that is the problem, it is likely a driver problem that can be resolved by reinstalling SigmaStudio, using a different USB port, manually uninstalling the driver from Device Manager and then reconnecting the ICP1 / ICPX.

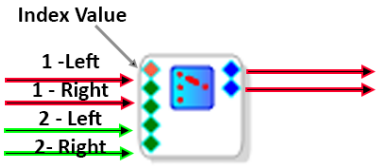
8. If not already, make sure your KABD is now connected to its own power source.
    a. If the PC connected programmer is plugged into the KABD, but your KABD does not have its own power, it will light up LEDs on the KABD (making the amplifier look like it is powered), but it will fail to program and function. **The KABD needs to be connected to its own power source.**
9. Plug the 6-pin connector on the ICP1 or ICPX to the 6-pin programming port on the KABD (J5). Your programmer comes with this 6-pin cable. Make sure that you connected your programmer via USB to your PC BEFORE completing this step.
    a. Note: The ICPX has two ports, but you will use the 6-pin port for programming the KABD series of amps.
10. You are now almost ready to make your own projects in SigmaStudio or to use example projects and modify them for your project. if you are making your own project rather than basing it on an example project, register configuration is required for proper function of the Bluetooth input and also for external potentiometer usage. For most users, is recommended to start with a KABD example project, and modify it rather than trying to setup the registers yourself.

Example Projects

At the time of writing, 4 example projects are available on the KABD-250 product page. The full user guide (to be released in December) will have more detail about how these projects work, how they are constructed, and even more examples of projects. Until then, modify these projects to suit your projects' needs. If you are trying to use a project file you had for the DSPB instead, make sure you follow the resgister configuration guide below to make sure your Bluetooth input works correctly. In most cases, it is easier to modify an example project file for your project's needs.

1. **KABD Basic 2 Channel Project with Line out Passthrough.dspproj**
    a. This project uses basic filters and volume control for a 2 channel system.
    b. Example – Bluetooth Boombox using 2 full range drivers
2. **KABD Stereo 2-Way Speaker Project.dspproj**
    a. This project uses the crossover block and basic filters to create a 2-Way, stereo speaker project. Because it requires 4 powered outputs, this project requires you to connect an external amplifier to J7. In the future release of the 4 channel KABD boards, this could be completed with a single board.
    b. Example – 2-Way Stereo Bookshelf speakers, each with a tweeter and woofer.
    c. Example – 2 Way Stereo Boombox, with a tweeter and woofer for left and right channel each
3. **KABD 2 Channel Project with Potentiometer FIlter Control.dspproj**
    a. This is a 2 channel project that utilizes potentiomers for on the fly control of a high pass filter, mid range filter, and high shelf filter.
    b. Example – This project was designed especially for tuning 2channel projects using audio exciters or full range drivers. It could also be quickly modified such that the potentiomers control any type of filters on the fly that are desired.
4. **KABD 2 Channel Project with EQ Preset Switching via GPIO switch.dspproj**
    a. This project allows for preset switching on the fly. In this simple example, we connect a toggle switch to the POT4 header. 

Connect your switch to pin 1 and 2 of the POT4 header.
        i. The "MX1" block has 2 sets of stereo inputs. It will switch which of these sets of inputs goes to the output of the block based on the position of your toggle switch. Our 'index value' in this project is the position of the toggle switch.



    b. In the example project, this switch is used to change EQ presets. But it could be modified for almost any purpose, such as turning a filter on and off. For example, a

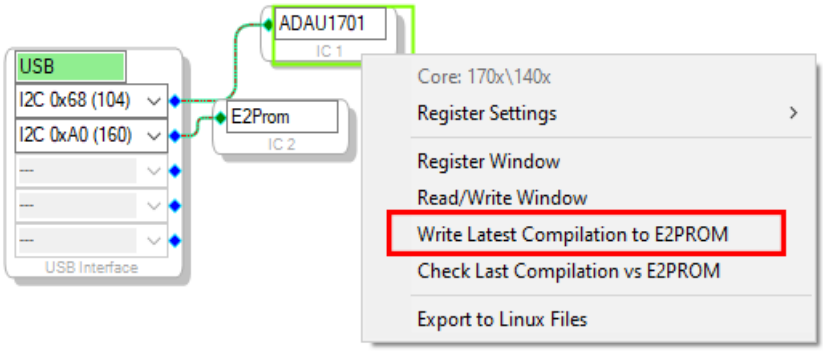
'night mode' could be created by having one option have a bass boost (day mode), and another option has a bass cut (night mode). Another example is that a treble / midrange boost filter and a bass cut filter could be turned on/off by flipping a switch. This could be useful to create an 'outdoor' mode.

Writing to E2Prom – Burning custom SigmaStudio programs to non-volatile (non-temporary) memory

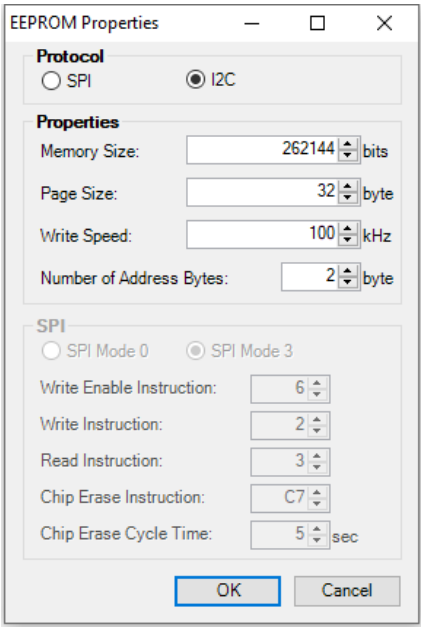
This step writes your custom program to non-volatile memory on the KABD amplifier. This means that the program will be retained on the KABD even after it has been turned off and then back on again. When you are programming via SigmaStudio and making changes on the fly, the program is only stored in TEMPORARY memory. It is not until you write the program to E2Prom that your custom program can be reprogrammed to the DSP as the board turns on**. If you find that your custom program is lost on a power cycle, it means you have not written the program to E2Prom.**

IMPORTANT – This step will erase the stock configuration of the board! This means that the default functions of POT1-4 will reprogrammed or removed, depending on the custom SigmaStudio project that is burned. There is a project file on the product page where this manual is found called "Stock_Firmware.dspproj" that will restore the original firmware if you need It.

1. This guide assumes that you have successfully re-programmed your board with a custom program using the 'link compile download' button  , and you are ready to burn it to the E2Prom memory (it can be rewritten as many times as desired).
2. Right click your "ADAU1701" block and click "Write Latest Compilation to E2PROM". This means it will burn the latest program you have compiled to E2Prom. This means the program that was configured the last time you pressed "Link Compile Download" or just "Link Compile Connect".



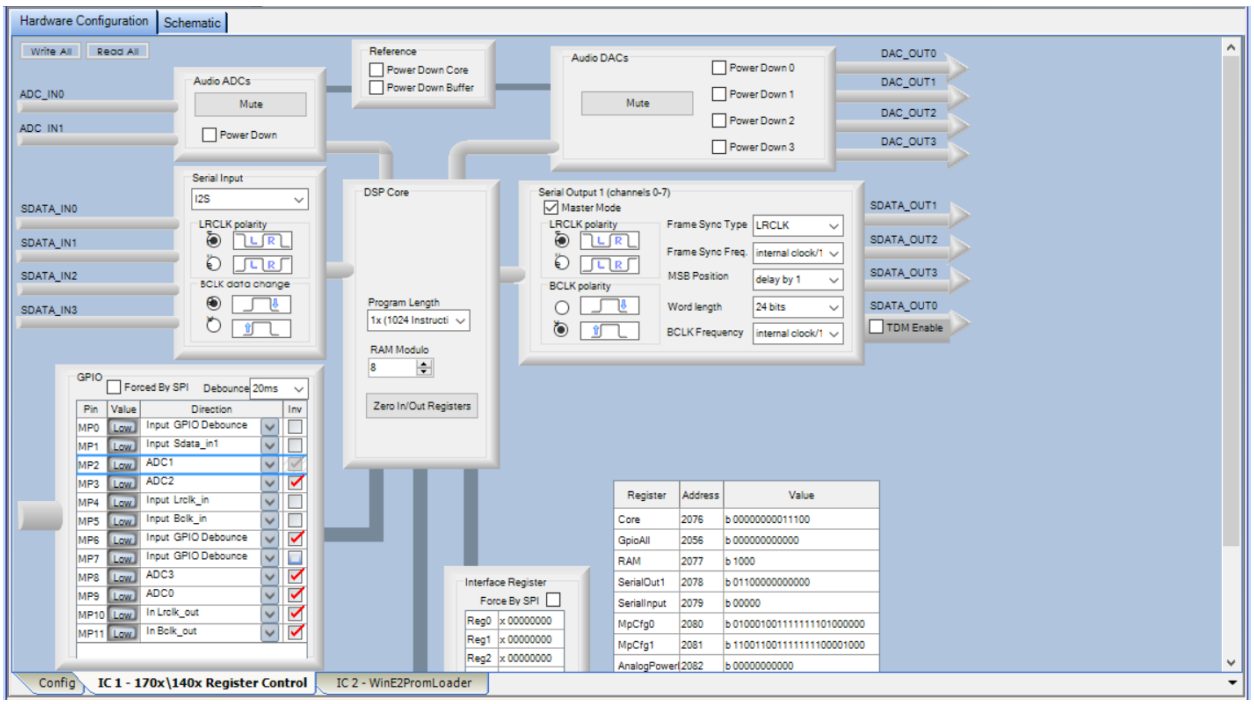
3. In the window that opens, make sure the settings match what is in the screenshot below (they are the default settings), and press OK.
    a. NOTE: Your programmer's switch(es) need to be set properly for this step to work.
        i. The ICP1 switch's position must be set to "PROGRAM"
        ii. The ICPX's switches must be set to "USBi" and "IIC".



4. The program should now be written to E2PROM after it finishes programming. This means you can remove your programmer from the KABD, and your program should remain programmed on the board after power cycling the KABD.

Register Configuration for usage of Potentiometers and Bluetooth input (via I2S)

If using an example project for the KABD, this will already be configured for you. If upgrading a DSPB project or creating a project from scratch, make sure your register settings match the screen below. If unsure, modify an example project to suit your project's needs rather than starting from scratch.



Version History

V1.0 - Initial Release of the condensed version of the KABD-250 manual.

A more extensive version of this manual is scheduled to release on December 6, 2021. The new version of the manual will be more detailed in every way, have more project examples/descriptions, SigmaStudio guides, advanced usage information and more.