Application Report
SLAA943–June 2020

How to Enable the TAS5805 Soundfield Spatializer

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ABSTRACT

The Spatializer increases the field of sound for a broader and more encompassing audio experience. This application note instructs how to implement the sound field spatializer step by step on the each block in the PurePath™ Console 3 platform.

In Figure 1, the left and right channels are subtracted from each other. The purpose for this subtraction is to create a signal that removes any audio or instrumentation that is existed by both channels. Bandpass filters are used for setting the frequency range for which the effect is active. After which, an effect gain stage determines how much effect weighting this channel before being added back into the original left and right channels.

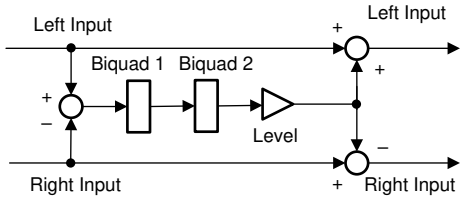

Figure 1. Soundfield Spatializer Block Diagram

In general, setting the high-pass filter corner frequency higher than 300 Hz is recommended due to low-frequency content often presenting itself in both channels. If extending the bandpass frequency is too low, it results in a loss of bass response. In other words, reserving two much high-frequency component in sound can create an effect similar to reverb which can also blur the spatial cues of music.

In the gain weighting, the pass band can be set as well as the effect intensity which controls the effect flavor level. By adjusting the right channel, left channel and effect channel weighting, it provides the option for application design to fine-tune the preferred type of spatializing effect based on the mechanical design. HPF, LPF, and effect intensity can determine the cues of the spatial.

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Trademarks

1 Environmental Setup

1.1 HW Setup

Spatializer tuning setup in Figure 2 shows a PurePath Console 3 platform along with the EVM board and the stereo speaker. Once the setup is ready, spatializer tuning work is easily performed on TI's PPC3 platform.

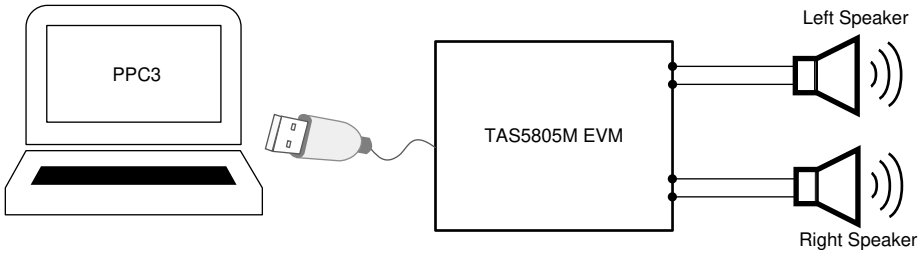


Figure 2. Spatial Tuning Setup

1.2 PPC3 Process Flow Selection for Spatializer

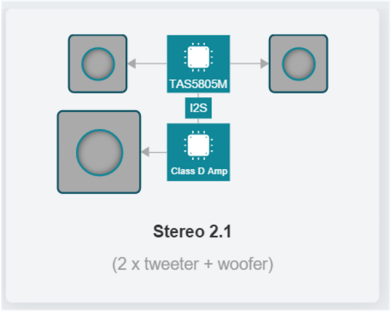
The TAS5805M, TAS5806M, and TAS5806MD process flows have been generated based upon several popular configurations, primarily around the number and type of amplified outputs. Customers can choose the different process flows based on requirements. All the three process flows are available in the PPC3 platform.

Table 1. Processing Features Comparison Table

Feature	Process Flow 1 (3-Band DRC, 96 kHz, 2.0)	Process Flow 2 (3-Band DRC & FIR, 48 kHz, 2.0)	Process Flow 3 (3-Band DRC & FIR, 48 KHz, 2.0)
Maximum internal sample rate	96 kHz	48 kHz	48 kHz
SRC and Auto detect	Yes	No	No
Supported input sample rates (32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz and 96 kHz)	Yes	88.2 kHz and 96 kHz are not supported	88.2 kHz and 96 kHz are not supported
Biquads for EQ Filtering (Individual Left / Right)	15	15	15
Input mixer	Yes	Yes	Yes
Click & Pop Free Volume	Yes	Yes	Yes
DRC	3-Band 4" order crossover	3-Band 4" order crossover	3-Band 4" order crossover and 1-band
Automatic gain limiter	Yes	Yes	Yes
Output clipper	Yes	Yes	Yes
FIR Filter	No	Yes	No
Hybrid PWM mode	Yes	Yes	Yes

The spatializer can be supported by choosing 2.1 Mode process flows and PPC3 GUI.

Table 2. Support Use Case for Spatializer

Mode	Also Known As	Amplifier Output Configuration	Symbol in PPC3 GUI
2.1	N/A	One Device uses 2.0 mode and a separate device uses Mono mode	

1.3 Spatializer Setting in PPC3 Process 3 Flow

This process flow supports 2.1 speaker configurations with a maximum internal sample rate of 48 kHz. The blocks in Figure 3 correspond to the functions found in the PPC3 GUI. This application uses the woofer channel to process the effect sound.

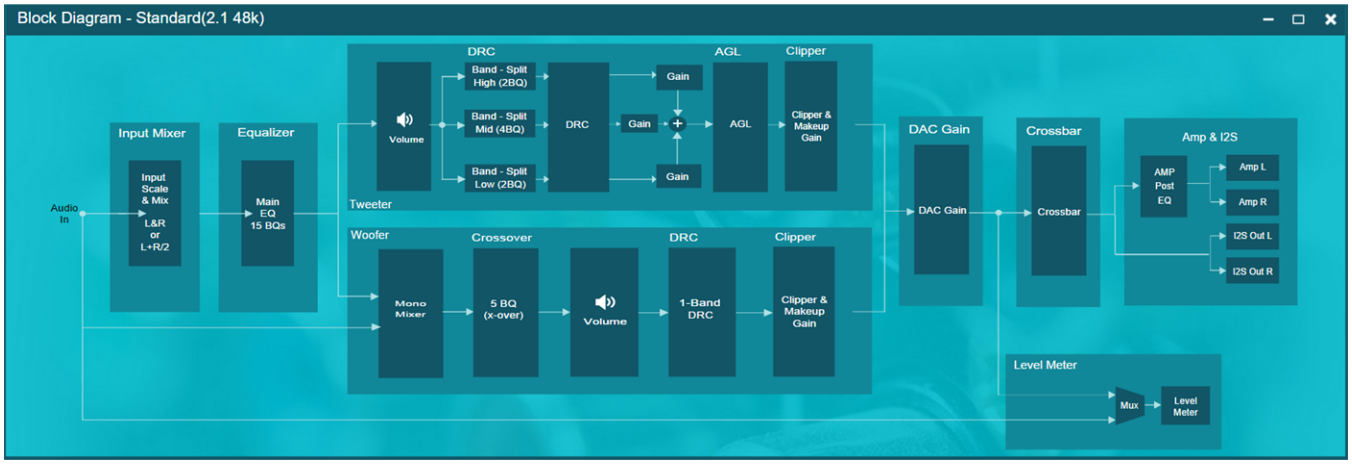


Figure 3. Process Flow 3 Block Diagram

Figure 3 depicts the signal path of this flow. As Figure 3 shows, this process flow consists of several processing blocks. In Spatializer tuning, the Input mixer, mono mixer, crossover, and output crossbar are the components to be equipped. See the *General Tuning Guide for TAS58xx Family Application Report* for more information.

- Input mixer: The input mixer is designed to mix both left and right channel input signals. The *Basic Tab* (see Figure 4) offer an intuitive method for configuration in PPC3 GUI. Switch to the *Advanced Tab* if all the four coefficients need to be fine-tuned. The parameters need to be specified in decibels (dB). The *Invert* option reverse the sign of the gain values.
  If the application requires sufficient headroom, negative gain in certain blocks can be used to increase headroom. With proper headroom configuration, it is better for dynamic range. Usually, gain compensation can be obtained in the output cross bar as Figure 6 shows after more headroom was set in the input mixer.

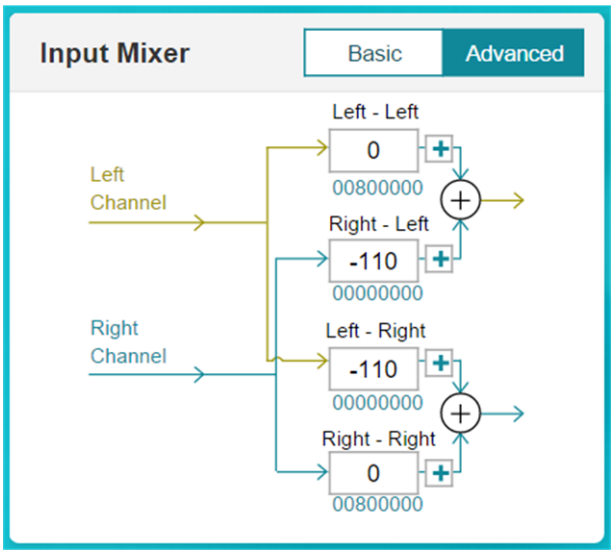


Figure 4. Input Mixer Setting

Mono Mixer (see Figure 5): The mono mixer configures the mixing of the digital audio data going to the woofer channel. It is similar to the input mixer.

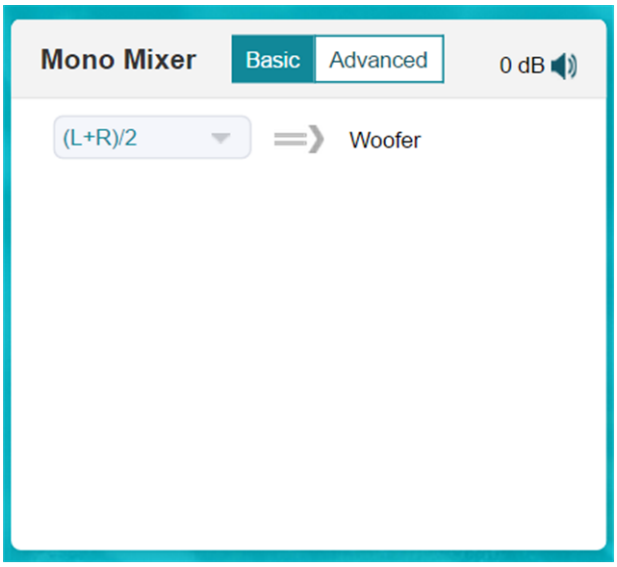


Figure 5. Mono Mixer Setting

- Crossover: The crossover block is used to set filters on the woofer. Five more filters are available. In the spatializer effect, two BiQuads are set to LPF and HPF to limit the boundaries of the effect to a band-pass region. Set by the user Gain determines *How Much* of the effect is desired.
- Output crossbar: The crossbar provides the end user with a flexible way to control what finally appears on amplifier outputs and I2S SDOUT.
- The crossbar provides the end user with a very flexible way to control what finally appears on amplifier outputs and I2S SDOUT. The *Basic Tab* provides the easiest way for configuration. Figure 6 shows the *Advanced Tab*. Use the *Advanced Tab* to adjust parameters. Note that all the parameters need to be specified in decibels (dB). In spatializer, select the *Advanced Tab* to mix the effect using different weights.

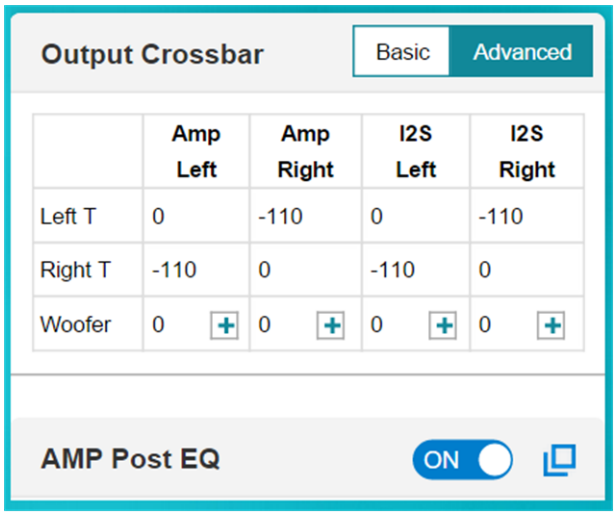


Figure 6. Output Crossbar Setting

2 Spatializer Setting Parameter Example

The application provides an example on the spatializer setting. The following setting provides an idea on how to configure the spatializer step by step. Based on this example, the designer can adjust the proper parameter based on the mechanical, speaker position and the flavor of the spatializer effect further.

First, the input mixer set to –12 dB at left and right channel to provide sufficient headroom which is better for dynamic (see Figure 7). To get the reverb component, the example inverts the right channel.

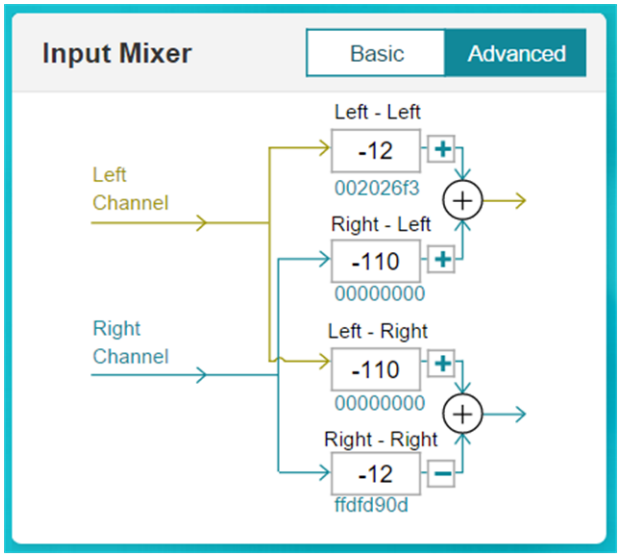


Figure 7. Example on Input Mixer Setting

Figure 8 shows where to set left EQ and right EQ weighting in 0 dB and added together in the mono mixer. The purpose for the mono mixer here is to generate the reverb component.

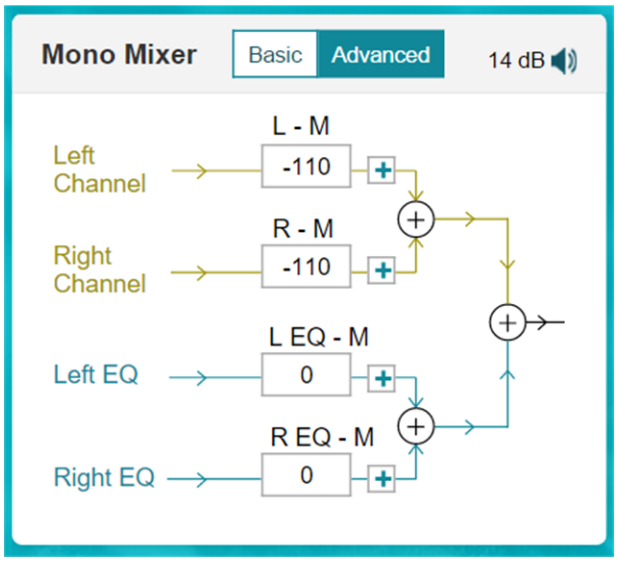


Figure 8. Example on Mono Mixer Setting

In the crossover window (see Figure 9), the band-band can be set to low frequency and content normally presents in both channels. Due to content, this is simply attenuated wide bandwidth bandpass range by extending bandpass down below 300 Hz–450 Hz may result in light bass response. The result in sound is similar to reverb. This blurs spatial queues and can be overwhelming which depending on the preferences of the listener.

Figure 9. Example on Bandpass EQ Setting in the Crossover Page

As the woofer channel is used for the reverb component of the left and right channel, the weighting on the output crossbar controls the level of the effect. The effect sound in the woofer channel weighting is set to 6 dB. In the Left T and Right T, the weighting is set to 12 dB for both channels (see Figure 10).

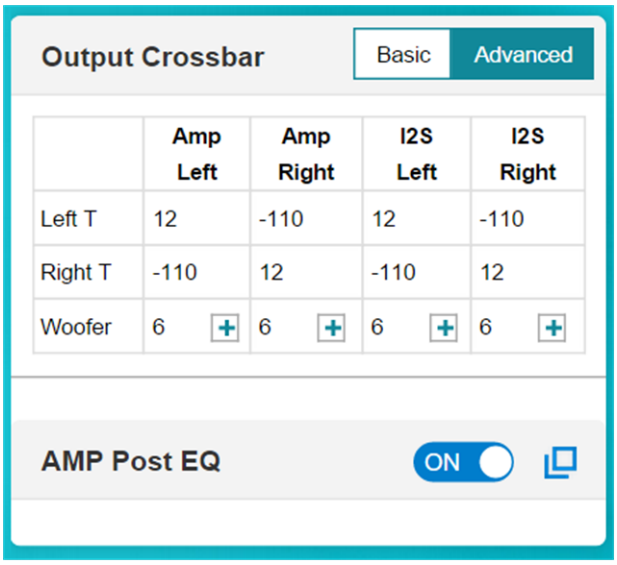


Figure 10. Example on Output Crossbar Setting

At this moment, the right channel signal is inverted due to the input mixer setting. We use AMP Post EQ to invert the right channel again to change the right channel signal back to the original phase. Without this AMP Post EQ invert, the right channel phase will not correctly generate the spatial experience (see Figure 11).

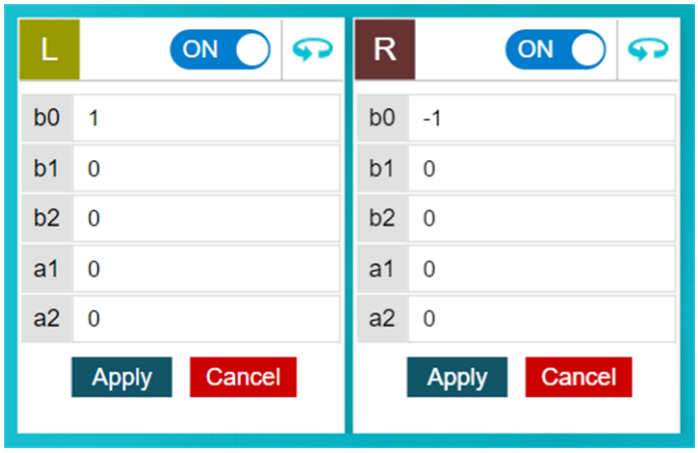


Figure 11. Example on AMP Post EQ Setting

3 References

- Texas Instruments, *TAS5805M 23-W, Inductor-Less, Digital Input, Stereo, Closed-Loop Class-D Audio Amplifier with Enhanced Processing and Low Power Dissipation Data Sheet*
- Texas Instruments, *TAS5805M Evaluation Module User's Guide*
- Texas Instruments, *TAS5825M Process Flows Application Report*

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