

How to set the Peak Limiter on SigmaStudio 3.3 for DigiMod and D-Cell504



I. Preliminary Considerations

I.1. Help and support for SigmaStudio®

Along with this documentation, a number of other resources can be used to learn more about SigmaStudio, get more details about algorithms and techniques, optimize your design or just ask for support and troubleshooting.

- ▶ SigmaStudio 3.3 user guide released by Powersoft, available for download at:

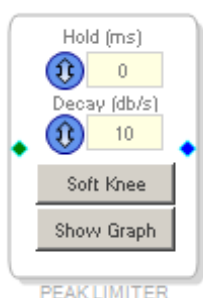
<http://www.powersoft-audio.com/en/products/software/dsp-programming-software.html> (download section)

- ▶ SigmaStudio Help file: SigmaStudio has an extensive help file included with the installation explaining all of the software's features, signal processing blocks and possible operations. You can access the help file in the Help menu (shortcut F1), or by opening the file located in the help folder inside your SigmaStudio installation folder
- ▶ All help and support requests regarding the use of SigmaStudio with Powersoft products can be addressed to:

support@powersoft.it

- ▶ <http://www.analog.com/en/technical-documentation/frequently-and-rarely-asked-questions/resources/embedded-processing-dsp/sigmadsp/listing.html>
- ▶ Further SigmaDSP® or SigmaStudio support inquiries can be directed to the EngineerZone forum (<http://ez.analog.com/community/dsp/sigmadsp>)

I.2. Where to find the Peak Limiter function in SigmaStudio



In order to use the Peak Limiter, first create a schematic area and then locate the Peak Limiter feature in the ToolBox tree. This can be found under ADAUI702 objects in the folder PEAK Dynamics Processor, by following this route:

ADAUI702 / Dynamics Processor / Peak / Standard Resolution / Lower Range (-90 to +6dB) / No Post Gain / Mono / No Ext Detector input / Mono Peak (no gain).

Drag this object in a schematic area to use it.

I.3. General description

SigmaStudio's Peak Limiter is a stereo/mono peak compressor, i.e. a dynamics processors that can limit the peak value of output signals. The detection path uses the peak level of the input signal to calculate the output gain. Hold and decay parameters are user selectable to allow output control over time.

SigmaStudio's Peak Limiter settable parameters are:

- ▶ **Threshold:** this indicates the output level value above which the effect of the peak limiter begins. Output voltage values below this threshold value are untouched by the limiter's action. The threshold value is measured in dBs with respect to a specific module model-based reference value.
- ▶ **Decay:** this is the rate at which the limiter's effect wanes off. It is measured in dB/second. It is strictly related to the limiter's release time, which measures the duration of the limiter's effect after the output voltage has dropped below the threshold value.
- ▶ **Hold:** the time the output gain is limited before the limiter's decay ramp begins. Hold time begins at the moment at which the output signal reaches levels above the threshold value and finishes when the decay ramp begins.

To make sure you are using the limiters in Powersoft devices correctly, first calculate specific key parameters of your acoustic system that will be needed to determine the optimal parameter values to apply to the Peak Limiter by following the procedure illustrated in the next chapter.

2. Procedure

2.1. Preliminary

In the following section you will find the description of the steps needed to calculate the correct values with which to set the Peak Limiter for a single channel. In the Reference Files folder you will find a Microsoft Excel® file that automatically executes the following steps.

2.2. Find the speaker's PEAK voltage (V_{PEAK}) value

- ▶ Start from obtaining the declared musical (or sometimes "program") power rating and nominal impedance of each loudspeaker.
- ▶ If 2 speakers are connected in series, the total power rating "P_MUS" is twice that of the single speaker. The same goes for the total nominal impedance "Znom" which is twice that of the single speaker.
- ▶ If 2 speakers are connected in parallel, the total power rating "P_MUS" is still twice that of the single speaker; but the total impedance "Znom" is half that of the single speaker.
- ▶ The single speaker's peak voltage level starting from the musical power and nominal impedance is:

$$V_{PEAK(speaker)} = \sqrt{(2 * P_MUS * Znom)}$$

where $V_{\text{PEAK(speaker)}}$ is the speaker's peak voltage value, P_{MUS} is the speaker's declared power rating and Z_{nom} is the speaker's nominal impedance.

2.3. Find the amplifier's output peak voltage (V_{PEAK}) value

- ▶ If your system is single ended the amplifier's output peak voltage is equal to the speaker's peak voltage:

$$V_{\text{PEAK(ampifier)}} = V_{\text{PEAK(speaker)}}$$

- ▶ If your system is in bridge mode, the amplifier's output peak voltage is half a single speaker's peak voltage

$$V_{\text{PEAK(ampifier)}} = V_{\text{PEAK(speaker)}} / 2$$

2.4. Calculate the Threshold value

To calculate the limiter's threshold value, use one of the following formulas according to the type of module you have.

- ▶ Threshold dB = $-1.5 + 20\log_{10}(V_{\text{PEAK(ampifier)}}/198.0)$ for DigiMod 2000HV/2000HV IS/3000PFC - DigiMod 2004PFC2/3004PFC4 @ 38 dB gain.
- ▶ Threshold dB = $-1.5 + 20\log_{10}(V_{\text{PEAK(ampifier)}}/99.0)$ for DigiMod 1000/I500/I000 IS/I500 IS - DigiMod 2004PFC2/3004PFC4 @ 32 dB gain.
- ▶ Threshold dB = $-1.5 + 20\log_{10}(V_{\text{PEAK(ampifier)}}/54.7)$ for D-CellI504

2.5. Decay/Release time conversion table

Given F_{min} , the minimum frequency the speaker can reproduce, the required release time in seconds can be calculated using the following formula:

$$T_{\text{rel}} = (K/F_{\text{min}}) * 1000$$

where T_{rel} is the equivalent release time (in milliseconds) and K is a constant generally between 2 and 8. Our suggestion is to use 4 as value for K , but different values can be used on the basis of your own criteria or taste. Once you have calculated the T_{rel} , use the following table to convert the value in the proper "Decay" parameter value in SigmaStudio's Compressor Peak object.

- ▶ $T_{\text{rel}} \Rightarrow \text{dB/s}$
 - ▶ 130 ms $\Rightarrow$ 25 dB/s
 - ▶ 100 ms $\Rightarrow$ 33 dB/s
 - ▶ 65 ms $\Rightarrow$ 50 dB/s
 - ▶ 50 ms $\Rightarrow$ 65 dB/s
 - ▶ 30 ms $\Rightarrow$ 108 dB/s
 - ▶ 13 ms $\Rightarrow$ 250 dB/s
 - ▶ 3 ms $\Rightarrow$ 1080 dB/s
- ...
- ▶ $x \text{ ms} \Rightarrow (3250/x) \text{ dB/s}$

2.6. Hold Time

The limiter's hold time does not affect the filter's ability to safeguard speakers from accidental overloads, but it is simply related to the loudspeaker designer's preference in terms of sound. As a rule of thumb, start using the minimum frequency of the speaker range F_{min} with a value of $T_{\text{hold}} = (1/F_{\text{min}}) \Rightarrow (1/20 \text{ Hz}) * 1000 = 50 \text{ ms}$

3. Example

Set limiter parameters for an EighteenSound I8LWI400 woofer to be used in bridged mode with a DigiMod 1500 IS (use the Microsoft Excel file in the Reference File folder).

- ▶ Declared Program Power = 1400 W
- ▶ Nominal Impedance = 8 Ohm

In the Microsoft Excel file:

- ▶ Enter 1400 in the P_{MUS} cell
- ▶ Enter 8 under the Z_{nom} cell
- ▶ Press Enter

The pertaining threshold value is the one corresponding to the DigiMod 1500 in bridged mode and it's -3.9 dB. In SigmaStudio®, click the "Show Graph" button on the block to see the graph and set this value graphically.

- ▶ Release Time = $4/(20\text{Hz}) = 0.2 * 1000 = 200\text{ms} \Rightarrow 3250/200 = 16\text{dB/sec}$. Therefore, set 16 dB/sec in the Decay text box.
- ▶ Hold Time = $1/(20\text{Hz}) = 50\text{ms}$. Set 50 ms as hold time in the Hold text box at top of the object.

4. Note

Limiter behavior and effectiveness can strongly depend on the specific application details and on how (and with what degree of accuracy) speaker manufacturers declare their specifications; therefore, we encourage you to take special care in evaluating your speaker's true performance to avoid the risk of compromising your system's integrity by setting the limiters incorrectly and thus allowing the amplifier to deliver excessive power the speakers cannot handle.

