IGNITE AMPS

engineering for the moshpit

TPA-1

AUDIO PLUG-IN

USER MANUAL

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Introduction

The TPA-1 is a digital emulation of a class AB tube power amplifier for guitar. It has been designed and developed to be paired with any guitar preamp (VST/AU or even hardware).

Its circuit is not based on any particular physical power amplifier, but it has been designed to have enough versatility to range from vintage to modern tones, letting the user be free to shape its dynamic behaviour with ease, without the need to be a tube amplifier tech.

Every single component on the signal path of the analog circuit has been taken into account and modeled in the best possible way to match the original sound as it was meant to be, while keeping an eye on CPU performances and real-time playability at the same time.

The TPA-1 is meant to be used as a guitar tube power amplifier simulator for live playing and jamming, tracking or mixing inside hosts capable of VST or AU Plug-Ins support.

Minimum System requirements

Windows:
Windows XP/Vista/7/8 (32/64 bit)
Intel Pentium 4 or AMD Athlon XP

Mac:
OSX 10.5
Intel processor with SSE2 instructions support

Installation

To install the TPA-1 Plug-In, just follow the instructions below, according to the platform and plug-in format you want to use.

Windows VST:
Copy the file **TPA-1.dll** into your VST Plug-Ins folder.
(for example C:\Program Files\Steinberg\VSTPlugins)

Mac OSX VST:
Copy the bundle **TPA-1.vst** into the path: /Library/Audio/Plug-Ins/VST/

Mac OSX AU:
Copy the bundle **TPA-1.component** into the path: /Library/Audio/Plug-Ins/Components/

For Windows VST format, we provide separate x86 (32 bit) and x64 (64 bit) binaries, so make sure to choose the right one according to your operative system and plug-in host specifications.
Keep in mind that x64 binaries will not run on 32 bit environments, while x86 binaries will most likely run on 64 bit environments, although we do not recommend such usage for performance and stability reasons.
We strongly advice Windows users against putting both x86 and x64 versions in the host VST folder(s), as it may cause one of the versions not to be recognized as a plug-in.

Mac OSX plug-ins (VST/AU) are compiled in Universal Binary format for Intel processors, containing both 32 bit and 64 bit code in the same bundle, which means that the user doesn't need to care about choosing x86 or x64 version, as the system will handle that automatically.

After that, you should (re)start your favourite VST/AU host, making sure it re-scans your Plug-Ins folder(s) to recognize the TPA-1 as a new “Effect” Plug-In (please note that some hosts may not re-scan the plug-in folder automatically at every start-up, so you may need to do that manually. Refer to your host’s manual for instructions).
If everything is right, you should now see the TPA-1 entry into the “Effect” Plug-Ins list of your host.

Main Features

- Dynamic EL34 / 6L6GC / KT88 pentodes/tetrodes analog modeling (push-pull stage)
- Dynamic ECC83 / 12AX7 triode analog modeling (phase inverter stage)
- Mono / Stereo processing support
- Selectable oversampling rate (up to 8x)
- Global input / output level controls
- Double precision (64 bit) floating point mathematical model
- Fully automatable controls

TPA-1 Circuit Diagram

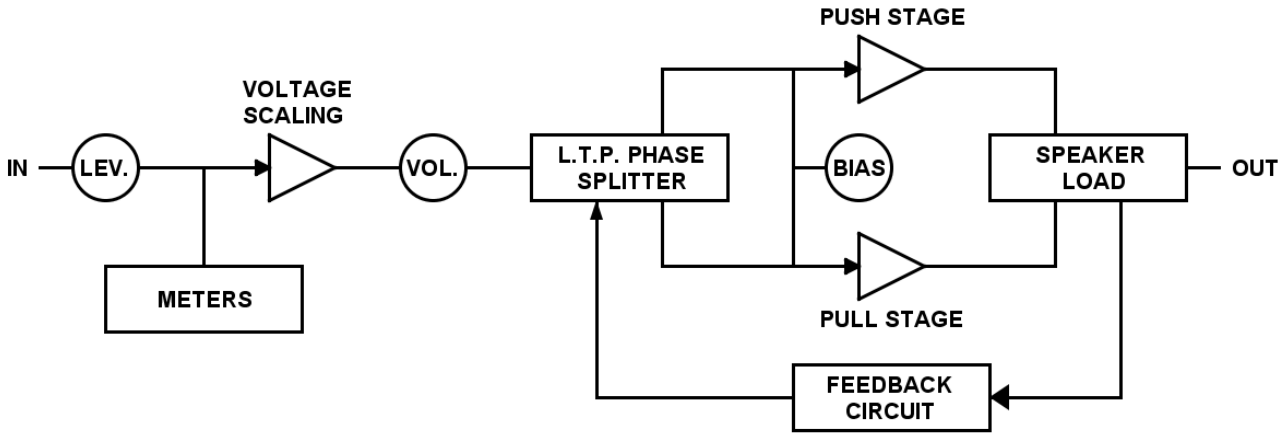

Fig. 1 - TPA-1 Circuit Diagram

Graphic User Interface

Fig. 2 – TPA-1 Front Panel

Fig. 3 – TPA-1 Back Panel

As you can see from the screenshots (fig.2 and fig.3), we've decided to make the TPA-1 as similar as possible to a real hardware tube power amp, in order to make the user experience easier, giving the chance to tweak the controls of the plug-in like one would do when having a real rackmount power amplifier in front

of him/herself.
The GUI is divided in two main sections: front panel and rear panel, freely switchable using the double arrow button placed at the right side of the interface.

Front Panel Controls

In the front panel of the TPA-1 you'll find all the controls you're used to see in a real guitar power amplifier, with some additions. From left to right:

Mono / Stereo: lets the user select the processing mode of the plug-in. It is extremely important to note that a complete stereo separation, and so a correct stereo image preservation, is only possible when the TPA-1 is placed on a stereo bus and fed with a stereo signal with left and right components panned at 100%. Feeding the TPA-1 with two preamp tracks panned at less than 100% left and right, will not preserve the correct stereo separation of the tracks at the output.
Stereo Mode will obviously double the CPU load of the plug-in, as the two audio channels are being implicitly processed by two separated instances of the TPA-1.

Depth: controls the low-end response of the plug-in. Like in real tube amplifies, it acts on the negative feedback loop of the power-amp circuit, so its impact on the tone is strictly dependent on the Feedback control setting.
It has been designed as a low shelving filter.

Presence: controls the high-end response of the plug-in. Like in real tube amplifies, It acts on the negative feedback loop of the power-amp circuit, so its impact on the tone is strictly dependent on the Feedback control setting.
It has been designed as a high shelving filter.

Volume: controls the amount of signal that feeds the phase inverter stage. It changes the dynamic behaviour of the circuit: the higher the setting, the more the phase inverter and, consequently, the push-pull stages are driven into saturation, adding even and odd harmonics to your guitar tone and eventually increasing the natural compression known as “sagging” (see the Sagging control paragraph).
It basically acts like an “drive” control for the plug-in.

Rear Panel Controls

On the TPA-1 rear panel you'll find controls to best manage the plug-in to suit your system, guitar preamp and cabinet simulator. From left to right:

Oversampling: lets you choose the internal processing sample rate of the plug-in. The available options are 2x, 4x or 8x. This means that if your host is set up to process at 44100Hz sample rate, by selecting 4x oversampling, for example, the TPA-1 will process your signal at 44100 x 4 = 176400 samples per second. Oversampling is needed to avoid digital artifacts (aliasing) and improve the accuracy and musicality of the plug-in.
Obviously, the higher the oversampling, the higher the CPU usage.
In our experience and tests, we've found 4x oversampling to be the best compromise for accurate processing and good performance, but we've decided to add other two options to help users with slower machines to run the plug-in without CPU overloading (2x) or run the plug-in at its full potential when having a powerful system at disposal (8x).
Keep in mind that the sound difference between these three modes is not going to be night and day, for mixing purposes it's unlikely you will need to rework the mix settings when switching between different oversampling values. A good practice would be to run the plug-in at 4x or 2x during mixing and switch it to 8x right before rendering your project. This will avoid CPU usage problems when using multiple plug-ins during the mixing phase and still give you full processing quality once your tracks are exported.
Click on the led to select the desired oversampling rate.

Bias: lets you choose the bias point of the power amp tubes. It controls the amount of (negative) voltage offset applied to the signal at the grid of the tubes. Colder settings will make the pentodes/tetrodes draw less current, decreasing the overall output volume and potentially introducing cross-over distortion due to the class AB design (which may be what a guitarist needs to achieve a more dirty/loose tone). Hotter settings will make the pentodes/tetrodes draw more current, increasing the overall output level and eventually the power supply "sagging" effect (depending on the Sagging control setting), adding compression or, in extreme cases, saturation and cleaning up the tone from potential cross-over distortion.
Keep it in the default range (around half-way) for standard/real world operations, but feel free to experiment without fear of blowing something up.
It is important to note that the range of this control changes depending on the selected tubes (see the Tubes control), for practical reasons. In fact, in a real world situation, biasing a KT88 with the same grid voltage offset of a 6L6GC, would cause the KT88 to draw almost two times the current drawn by the 6L6GC, causing a huge output volume difference and potentially damaging the tube itself by exceeding the maximum power dissipation rate of its anode.
Scaling the bias control range according to the selected tube, guarantees output volume coherence (making it easier to compare different tubes and choose the right one for you), and makes the virtual tubes work with currents that make sense in a real world situation, allowing you to set the bias of the power amp correctly, without the need to be a tube amplifier technician.

Feedback: controls the amount of negative feedback coming from the output of the power amp. The higher the value, the more feedback is applied, decreasing the overall volume and making the power tubes work within a more "linear" range. Lower values will make the plug-in sound more raw and "modern", with more harmonic content.
It is really important to note that the value of this control has a great impact on the behaviour of the Depth and Presence controls, as they're placed on the feedback loop. In fact, the lower the Feedback amount, the less those controls will influence the tone, to the point of being completely disconnected from the circuit when the Feedback is set to zero.

Resonance: controls the interaction between the power amp and the speaker(s). Even if speakers are rated with a constant impedance (2, 4, 8, 16 ohms), they're not purely resistive, but reactive components: their real impedance has a strong variation, depending on the frequency. The image below (fig. 4) shows you what a real speaker impedance looks like, at different frequencies:

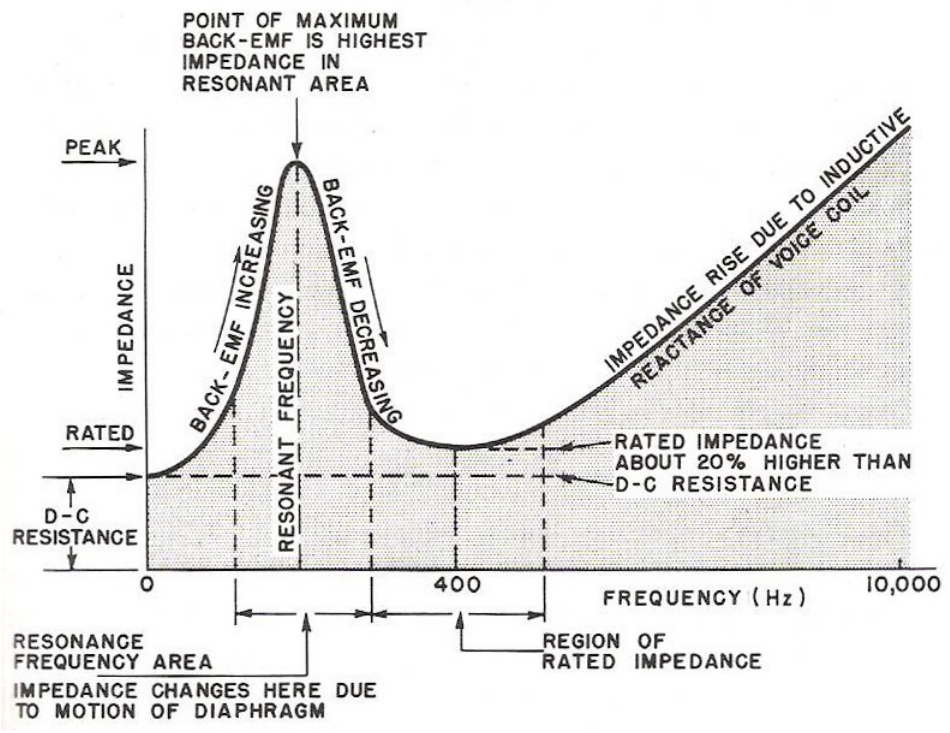

Fig. 4 – Speaker Impedance vs Frequency graph
(image source: Harmony Central forum)

As you can see, there is a huge impedance increase on the speaker resonant frequency (usually between 70Hz and 90Hz, depending on the speaker model and brand) and a more gentle increase from mid to high frequencies.
How does this impact the tone?
The speaker impedance is in series with the power amp output impedance, forming a voltage divider. The voltage drop caused by this divider is then frequency dependent (for the reasons discussed above), which means that more signal will be preserved where the speaker impedance is higher and more attenuation will occur at those frequencies where the speaker impedance is lower.
Tone-wise, this will result in a considerable peak “boost” in the speaker resonant frequency and a gentle shelving “boost” in the higher frequencies (it is worth noting that we're using the term “boost” for simplicity here: we should rather talk about “less attenuation”, to be correct).
The Resonance control lets you decide how much of this interaction will happen: lower values translate to a flatter frequency response of the plug-in, higher values will introduce more lows and highs, scooping the tone for a more modern type of sound.
This control should be set according to the cabinet used after the TPA-1 plug-in. Please read the Setting the Resonance paragraph (under the Getting the best out of the TPA-1 chapter) for some guidance.

Sagging: controls the dynamic behaviour of the plug-in. During normal operations, pentodes/tetrodes draw a significant amount of current, which leads to a voltage drop on the power supply transformer and rectifier circuit, due to the impedance of these elements. This voltage drop causes the plate and screen grid voltage of the power tubes to decrease, reducing the output headroom and adding a smooth and natural compression to the tone, usually referred to as “sagging”. In real power amplifiers, the power supply rectifier circuit may use silicon diodes or rectifier tubes: silicon diodes will cause a smaller voltage drop and a faster response compared to rectifier tubes, which will cause more “sagging” to occur, with a slower response.
This control lets you choose the power supply circuit behaviour: you can range from an ideal and transparent circuit (setting it to zero, eliminating the sagging effect completely), to a modern tone oriented diode rectifier (values from 2 to 4) up to a more vintage tone oriented tube rectifier (values from 5 to 10).

Tubes: lets you decide what kind of tubes you want to use in the push-pull stage. Clicking on this control will make a drop down menu appear and you will be able to select your preferred tube model. As described in the Bias control section, the range of the Bias control will change according to the selected tubes, avoiding the need to re-bias the power-amp, like you would do in a real world situation and making it easier for you to compare different tubes.

Output: lets you change the overall output level of the plug-in. Unlike the Volume control located in the front panel, this control is completely linear and doesn't affect the dynamic behaviour of the plug-in in any way.

Input: lets you change the overall input level of the plug-in. It is very important to set the input level correctly in order to make the TPA-1 work in optimal conditions. In this regard, please refer to the Setting the input level paragraph (under the Getting the best out of the TPA-1 chapter) for some guidance.

Getting the best out of the TPA-1

Since there are a number of different scenarios where you may want to use the TPA-1, we'll briefly describe how to set the plug-in in order to obtain the best results depending on the rest of your rig: the preamp and the cabinet.

Setting the Input Level

When using a VST/AU or a hardware preamp in front of the TPA-1, we strongly suggest you to set the TPA-1 input level (using the small red knob on the right side of the rear panel) in order to have the input signal peaking close to the clipping threshold, according to the input meters placed next to the control.

This is needed because the TPA-1 has an internal input signal level scaling algorithm, which makes the simulated circuit work with voltages coherent with real tube power amplifiers circuits. In order for the scaling result to be optimal, the input signal should have a swing of circa 2 Volts peak-to-peak (2Vpp), which is about full scale on the input meters. If the swing is bigger, the clipping indicators above the input meters will light on.

Please note that even if the input meters indicate clipping, the signal is not getting clipped at all! It only means that the power amp circuit is working with voltages that are higher than expected by design. The input signal dynamics is always 100% preserved in the TPA-1.

After tweaking the input level knob, if you need to reset the clipping indicators to check if clipping is still occurring, just click on the indicator and it will light off.

Setting the Resonance

There are a lot of free and commercial solutions for emulating guitar and bass cabinets (and microphones), but in this section, we'll analyse just what we consider to be the “state of art” on this field: impulse response (IR) based cabinet + microphone simulators.

Since these IRs are “captured” from real world equipment (by sending a test-tone through the system and then recording and de-convolving the output to obtain the system's impulse response, containing the linear frequency response of the system itself to be then convolved with the input signal of the cabinet simulation plug-ins) and since a power amplifier has to be used to drive the speaker and capture its frequency behaviour, they may already contain some of the inherent interactions that happen between the power amplifier and the load it drives (the speakers).

We can divide cabinet IRs in two main categories: solid state power amp based and tube power amp based. The biggest difference lies in the output impedance of the power amp used to capture them.
Solid state power amps usually have a considerably lower output impedance compared to tube power amps, which means that they behave in a more transparent way when paired with a guitar/bass cabinet.
Tone-wise, it means that the frequency shaping described in the Resonance control section (see Rear Panel Controls), has a lot less influence on the final tone, making the cabinet sound middy, with poor low frequencies content and presence.
This is one of the main reasons why tube power amps are usually preferred by guitarists overs solid state power amps: because of their higher output impedance, they sound considerably fatter, deeper, more present and generally more pleasant to the ears.
Depending on what power amp has been used to drive the speakers when capturing the IR of the system, those frequency response differences are going to be contained in the IR itself, after the de-convolution process.
Vendors of commercial IR based cabinet simulators or IR libraries, usually describe the chain used to capture their IRs, so you should know what category of IR you're using.

The TPA-1 emulates a tube power amplifier, but we wanted it to work perfectly with both IR categories, that's why we added the Resonance control.
In particular, when you're using a cabinet IR captured with a tube power amplifier, you should keep the Resonance value to zero (or use very low values if you want some additional tone shaping), because the bass and treble boosts due to the speaker impedance are already contained in the IR itself, so you don't want to double the effect.
On the other hand, when using a cabinet IR captured with a solid state power amplifier, you should crank the Resonance knob to get back the fatness and presence of a real tube power amplifier. Don't be afraid to turn it to the max! This is what you should usually do in these cases!
If you have no idea of what chain has been used to capture your preferred IR, just go by ears: by comparing it to other IRs of known sources, you should be able to discern if it has been captured with a tube power amp or not.

If you're using a cabinet simulator which is not IR based, you'd better read the product manual to search for more details or contact the vendor directly, to understand how you should set the Resonance control.

Tips for “digital” guitarists

- Always use the high impedance (Hi-Z) input of your sound-card (when featured). This will ensure less noise and signal loss. Most real (pre)amplifiers and stomp boxes, have an input impedance of 1MegaOhm, so it would be a good idea to get a sound-card with 1MegaOhm input impedance to use Ignite Amps simulators at their best.

- Make always sure to have the highest input signal before the AD conversion, while still avoiding clipping.

- Amp sims and stomp box simulators are not noisy, they do not add noise. In fact, they're a lot less noisy than real hardwares. If you have noise issues, check your guitar electronic circuit, cables and sound-card settings.

- In almost all cases, amp sims and stomp box simulators don't introduce noticeable latency. The TPA-1 doesn't introduce noticeable latency. If you're experiencing latency issues, check your sound-card settings (specifically reduce the “Input Buffer Size”).

- The TPA-1 is a power amplifier simulator, so it needs a preamp (like our NRR-1, The Anvil, SHB-1 plug-ins, or even a real hardware preamp) and a cabinet simulator after it, to sound like a real mic'd tube amplifier. There are numerous free and commercial cabinet simulator plug-ins available, so make sure to place one (and only one!) of them right after the TPA-1.

Acknowledgments

Ignite Amps wants to thank all the musicians interested in Ignite Amps projects who have shown great enthusiasm toward us, always pushing us to improve our work, helping us beta test and find bugs, everyone who has provided precious suggestions, kick-ass audio clips or videos, or who have donated money for our research and development in the DSP field. Without these people, this plug-in would have never been created.

Thanks to You too, for downloading and trying the TPA-1 plug-in and for reading the f***ing manual! :-)

Sincerely
The Ignite Amps Crew

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