

Amplifier Power Explained

POWER OUTPUT

When shopping for a new amp we tend to base our decision largely on power output, but there is more to a good amplifier besides its power rating.

In order for one amplifier to reproduce sound twice as loud as another at any given volume setting, you need 10 times more wattage output. An amplifier rated at 100 Watts is capable of twice the volume level of a 10 Watt amp, an amplifier rated at 100 watts needs to be 1,000 watts to be twice as loud. In other words, the relationship between volume and wattage output is not parallel.

Amplifier power ratings are typically established by driving the device-under-test to the onset of clipping, to a predetermined distortion level, variable per manufacturer or per product line. Driving an amplifier to 1% distortion levels will yield a higher rating than driving it to 0.01% distortion levels.

It takes a lot more power to drive low frequencies than it does to drive high frequencies. The higher the frequency, the more efficient the amplifier is at amplifying it. When an amplifier's power rating is determined, it is typically done with at 1khz test frequency. If an amplifier can output 500 watts at 1kHz, then advertising this amp as a 500-watt amp is correct. Real world use is at full bandwidth between 20hz and 20,000khz. The low E on a bass is around 41hz, which takes a considerable amount more power when compared to 1khz. That is why having massive amounts of low end in your sound results in distortion and overheating much quicker than more midrange and treble.

HEADROOM

Compare, for example, a 50w amplifier and a 200w amplifier. Let's say we are playing bass through the amp with our peak level of 10db and we are playing at an average level, 1db, which requires 10w of output from the amplifier. When those 10db dynamic peaks occur, they will require a 10x increase in power, to 100w. If we are using a 50w amplifier, then these peaks would require the 50w amplifier to output *twice* its output capabilities, which means we will be clipping the amplifier during those peaks. In this particular scenario, you reduced your unclipped dynamic headroom capabilities from the necessary 10db to 7db(meaning you must lower the volume to avoid clipping). On the other hand, if we are using the 200w amplifier and that 10db dynamic peak occurs, we are still well under the amplifier's capabilities, so no more need to worry about clipping and the increase in distortion and compressed dynamics.

So far we have only talked about the power amp. If we take into consideration the many gain stages in the preamp, there is a potential of +37db from the EQ section alone (in the PF-500) further increasing the demand on the power amplifier. So essentially the higher the levels of the preamp (gain+EQ+playing dynamics) the less you can turn up the master volume.

PREAMP

GAIN and COMPRESSION

Let's go through gain structure and see how to optimize settings for maximum performance from your amp.

There are multiple gain stages in the preamplifier starting with the input gain. This is the first stage of amplification that the low level output signal from your bass will see. Throughout this explanation we will use the Ampeg PF-500 for reference.

The input gain is much too often used as a volume boost when it should be more of a set it and leave it alone control. Since every bass' output varies depending on pickups, potentiometers, on-board preamps, playing style, cables, pedals, etc. so the input gain needs to be adjusted relative to the level being fed to the input jack. Always have the -15db button engaged when using an active bass. Having it disengaged while using an active bass will only make it harder to have enough headroom and could cause problems later. Think of it like a man standing in a room. His height is our gain, the ceiling is the point at which clipping will happen or max headroom. What we need to do is give him enough room to jump as high as he can while avoiding smashing his head into the ceiling. The headroom in the preamp works the same way that power amplifier headroom was explained earlier. The PF-500 has a helpful red LED that indicates clipping of the input gain stage. An easy way to set this control is by playing at your average level, and increase the gain control till you see it clip with every note you play. At this point, while still playing, decrease the gain till the LED stops lighting up completely. Now you should only see the clip LED light up when playing your hardest notes (slap solo for example).

This leads us to the next important control on this amplifier. The Compressor.

Going back to our analogy of the man in the room, say every once in a while the man jumps a little too high and hits the ceiling. What the compressor will do is push him back down just enough so that he doesn't hit the ceiling. The quick and easy way to set this is to play your bass at your hardest level that you think you will hit. You will see the red clip LED light up with each note. Now slowly increase the compression till the LED stops blinking completely.

To summarize what we have just done, we have given ourselves ample gain to push the rest of the amp, maintained enough headroom for dynamics, and have tamed the extreme notes that can be devastating on the rest of the amp if not controlled.

EQUALIZATION

The EQ on any amplifier is a key part of fine tuning your own personal sound. The PF-500 offers a 3-band EQ with selectable mid frequencies.

As with most modern Ampeg bass amplifiers, they are voiced to have a deep, low-end heavy sound signature. So even with the EQ set flat (no cutting or boosting), it will exhibit a pleasing amount low frequency response.

One thing to note, Ampeg amps sound great without any EQ applied and it is suggested you play for a few minutes to get acquainted with the sound signature of the amp before adjusting the EQ.

To set the EQ, we should first have it set flat (all EQ knobs at noon) and leave the ultra hi and lo buttons up for now. If your bass is lacking some low end response, especially the low E or B, then you might want to slightly increase the Bass control to compensate, the same goes for midrange and treble.

The midrange selector gives you choices of various frequencies that the midrange control will affect. The five choices are 220hz, 450hz, 800hz, 1.6khz, and 3khz. Start by turning the Midrange level all the way up, then switching the selector around to find the frequency you want to affect. Once you find the one you like, you can then back off the Midrange level and adjust to your preference.

Like many Ampeg amps, the PF-500 features Ultra Hi and Ultra Lo switches. These are powerful tone shaping tools to essentially change the tone “style” of your sound. Beware that using these switches in combination with the EQ can potentially add massive amounts of gain causing you to loose headroom in the power amp (having to turn down the master volume).

The **Ultra Lo** increases the gain of your sound by 2db at 40hz (same frequency as the Bass control) and lowers the gain of your sound by 10db at 500hz(low mids). This is to help give you more of a “HiFi” or “scooped” sound. Be cautious when using the “scooped” sounds as it will further increase the low frequency output of the preamp making the power amplifier section work even harder. It can also cause you to perceive the volume of your amp to be quieter in a full band situation. This is caused by the fact that many other instruments and speakers are pushing the same low frequencies that will try to mask yours, and by emphasizing only the low end sound of your bass, it is possible to get “lost in the mix”. If you feel like you need to keep turning up the volume of the amp, first try turning off the Ultra Lo, turning the Bass control down a bit, and increasing the Midrange control.

The other tone shaping switch is the **Ultra Hi**. This increases the gain of your sound by 9db at 8khz. This is a fairly big boost in the high frequencies. It is going to especially emphasize the sounds of your strings touching the frets, pick attack, and is good at making slap bass on dull strings stand out. This is another setting to be conservative with as it can make it easy to damage horns and tweeters in cabinets. You may not always hear the effect of this switch depending on your playing style and the natural sound of your bass.

I HAVE MY AMP TURNED UP HIGH BUT I CAN'T HEAR MYSELF!!!

This is a common occurrence for many bass players. Luckily, there are many ways to cure this quickly!

One thing that is usually pleasing to our ears is bass, bass, and more bass. But this is actually the last thing to be turning up for more perceived volume (actually hearing yourself and sounding good to everyone else).

Despite our urges to increase the low end to sound bigger, we need to shift our focus to the Midrange. The midrange is where tone and most of your volume call home. For the most powerful tone shaping we want to utilize this control on your amplifier.

By decreasing the Bass, and increasing the midrange, we can drastically improve how well we can hear ourselves in a live situation, separate the bass guitar from the rest of the mix, reduce muddiness, and bring more of the unique sound of your bass guitar to the forefront. This can also drastically reduce the workload on your power amp meaning more headroom and less chance of clipping and thermal issues.

Besides the great personal benefit of giving the Midrange frequencies more of a spotlight, your sound guy will also appreciate it, as it will give him more to work with and will be willing to send you through the front of house speakers at a higher level.