

For speaker design, there are many different configurations that can be used for amplifying the audio signal. The types of amplifiers can be divided into two groups, the first is a small signal amplifier which consists of taking the audio signal and directly amplifying the voltage levels. The other type of amplifier is a large signal amplifier which are often called power amplifiers since they will amplify the power of the signal so it can drive a much larger load. In addition to several types of amplifier types, there are also different types of wiring that can be used to deliver power, that can allow for more power efficiency, cheaper cost, and clearer audio signals. Depending on the system, there can be multiple options for the amplifiers. For example, according to Aperion Audio, the most common request for their amplifiers is to have the option to be Bi-Amped or have the audio signal split and amplified based off their frequency, in which the mid band and high band will be amplified together, while the low frequencies will be amplified by itself [1]. Additionally, Yamaha has two lines of receivers that allow for a Bi-Amp setup, they are the AVENTAGE and the RX-V receivers [3]. Bi-Amp amplifiers can be split into passive amplifiers, active amplifiers, horizontal amplifiers, and vertical amplifiers, with each having different benefits and impacts on the sound quality, power efficiency, and cost [1,2,3].

First, the passive Bi-Amp amplifiers consist of having a single amplifier that runs two channels to each set of speakers in which the speakers will filter out the audio signal for their specific speakers. This effectively doubles the amount of power being supplied to the speakers [1]. The use of a passive amplifier allows for an increase in the overall output, less chances of damaging a speaker through underpowering, cleaner and fuller sounds, as well as additional power for low frequencies or bass. Additionally, the system becomes more efficient since the system is no longer wasting power that would end up being filtered for subwoofers and tweeters [2].

As mentioned with the passive Bi-Amp amplifiers, the audio signal is being split at the amplifier and travels to the speakers where they are then filtered before going through the speaker. However, according to Aperion Audio an active Bi-Amp is better since the audio signal can be split into the high and low frequencies before being amplified, allowing for more power

efficiencies. Although the active Bi-amp can be more efficient, this wiring configuration comes at the expense of bypassing the internal speaker filters leading to a best-case scenario of matching the speaker's internal circuitry or operating the speaker in a less than optimal frequency range [4], impacting the audio quality. Often it is highly recommended to use a passive Bi-amp since it will allow for the use of the speaker's own crossover, unless the installer can match the speaker's crossover well enough to provide clear audio [1].

Next, the Bi-amp amplifiers fall into either a vertical and horizontal layout. First, the vertical layout utilizes two power amplifiers to power different speakers. The main advantage of the vertical layout allows for different amplification for the speakers, like having a more powerful amplifier power a subwoofer which is usually more power intensive than a tweeter [1]. Second, the horizontal layout uses a second channel in the amplifier, leading to one channel being amplified differently than the other channel. The benefit of the horizontal layout comes from the fact that a second amplifier is not needed; however, since the amplifier can be amplifying at two different levels, the amp becomes more power hungry and power inefficient than a single amplifier. From Amazon, the Rockford Fosgate R500X1D single channel amplifier goes for around \$130 while the R600X5 which is a 5-channel amp goes for \$249 [5,6]. Additionally, the power required for a 4-ohm speaker is around 300 watts for a 4-ohm speaker using the R500X1D, while the R600X5 50 watts per channel, up to 4, with the 5<sup>th</sup> channel using 200 watts, all powering 4-ohm speakers. The total power used for the R600X5 comes out to 400 watts in total to power 5 speakers, while the R500X1D uses 300 watts to power 1 speaker [5,6].

In conclusion, Bi-Amping can be used to provide clearer audio as well as a more efficient power amplification system. From Rega Brio Integrated Amplifier, the spec sheet lists the power that is needed for different configurations. For a 4-ohm 2 channel driven system, the power requirement is 73 watts, while for a 4-ohm 1 channel driven system, the power requirement is 93 watts [7]. When comparing active versus passive Bi-Amps, for most situations, the passive Bi-Amp is the most recommended since this form of Bi-Amp allows for the least amount of filter matching to the specific speaker. Additionally, the passive Bi-Amp allows for a more interchangeable design with speakers being able to be replaced or upgraded whenever a newer model comes out or if there is any damage to the speakers. However, if the system that is being designed is entirely controlled by the manufacturer then the active Bi-Amp is the most optimal

since the active filter can be matched with a specific speaker in mind while also allowing for the system to be more power efficient. When comparing vertical versus horizontal Bi-Amps, the most recommended is the horizontal Bi-Amp since the total cost becomes cheaper for the system.

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