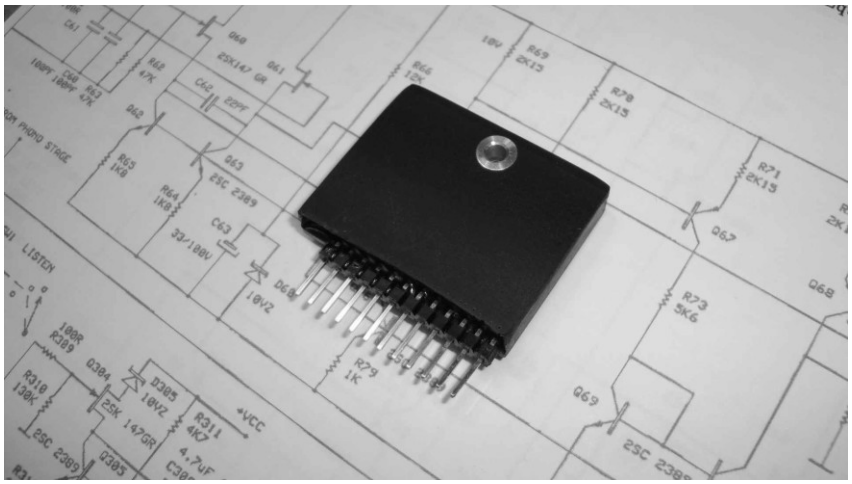
BYBEE MUSIC RAIL™
White Paper

What are they? How do they work? Why do I need them? We hear these questions all the time. The short answer is: Bybee Music Rails actively increase the resolution and definition of both audio and video signals by removing noise and unwanted signal from DC power supplies. This paper will explain conceptually the function and purpose of the new, ***active-circuit*** **Music Rail™.**



I. The Vibrating String Analogy

You probably think this section is going to create a tie-in to quantum string theory. Not exactly. Remember the talking string we used to play with as kids? The one with a tin can attached at each end? One person speaks into the first can while the other person listens into the second one. The vocalized air in the first can causes the string to vibrate. This in turn causes the second can to move air into the ear of the listener. So far everything is clear. Now imagine that a sandstorm blows up. The sand impacts the cans as well as the string. There is now a granular surf noise constantly impacting everything that is spoken or heard. This granular noise alters the vibrations of the string in unpredictable ways. This noise is analogous to power supply noise in audio systems.

II. The Niagra Falls Analogy

Imagine a sheet of crystal clear water falling over a glass wall. You can see right through the water, through the wall, and into the next room. In that room are rows of flower pots. All kinds of flowers in many colors. You can see all the details of the flowers. The colors, the petals, the pistils, the pollen–every detail is crystal clear. Now imagine that there is a box of sand at the top of the waterfall that begins slowly sifting into the falling water. The sandy water will degrade the pattern of the floral details in unpredictable ways. This granular sheet of sand is analogous to power supply noise in video systems.

III. The Rusty Pipes Analogy

Imagine a thin stream of pure water flowing smoothly out of a faucet. The stream is clear, calm, and continuous. We can see right through it. Now imagine that the pipes are rusty and that the water has become tinted by a brownish muck. Tiny specs of rust cause the water to fizz and flicker. Everything we look at through the water now takes on a fuzzy, brownish tint. When we install a charcoal filter in line with the pipe, the water turns clear again. This filter is analogous to the effect of a Bybee Music Rail.

IV. Vibrating Strings Again

Before explaining what actually happens in the power supply of an audio amplifier, we must first string these analogies together. It has been shown mathematically by many practitioners over many decades that electric current is analogous to flowing water and vibrating strings. Let's now combine the two concepts of the vibrating string and the water faucet.

Imagine a thin stream of pure water flowing smoothly out of a faucet. The stream is clear, calm, and continuous. We can see right through it. Now imagine that a piano string has been pulled tightly from one end of the stream to the other. The piano string runs right down the middle of the stream, affecting all of it. A tap on the piano string makes it vibrate. This in turn causes the stream to vibrate. If there is rust or sand in the water, the audio vibrations will intermix with them in unpredictable ways, causing distortion. The sound is then no longer pure and transparent. It is polluted by noise.

In an audio amplifier, the stream of water is replaced by a stream of electrons. The electron stream originates in the power supply. There is no piano string, but the effect is the same. The audio signal (music or voice vibrations in electrical form) enters the electron stream through tubes or transistors, which act as gates. The audio signal causes the electron stream to "vibrate" (the stream is actually modulated by the signal, and forced to conform to the pattern of the signal). So far all is well, but what happens if the electron stream is impure? You can be sure that it is.

V. The Electron Stream

The power supply electron stream originates from the wall socket (long before that, but let's start there for now). The electron stream from the wall is a polluted sine wave (AC + noise). A sine wave looks in many ways like a rope that has been yanked at one end. When it jumps, the rope ripples from one end to the other. This ripple, in electronic form, is what actually enters the power supply from the wall socket.

The first task of the power supply is to smooth out the ripples in the electron stream. We want the electron stream to behave like "pure water flowing smoothly out of the faucet." That way, when the audio signal enters the stream through tubes or transistors, there will be no interference by the ripples. We want the stream to remain clear, calm, and continuous, so we can hear right through it to the music.

This is critical, because if there is any kind of noise on the power supply rails, that noise will intermix with the audio, distorting it in unpredictable ways. Noise on the rails can appear in many forms: it can be ripple; emi; rfi; unwanted audio signal; etc. All of these noise sources can degrade the audio signal.

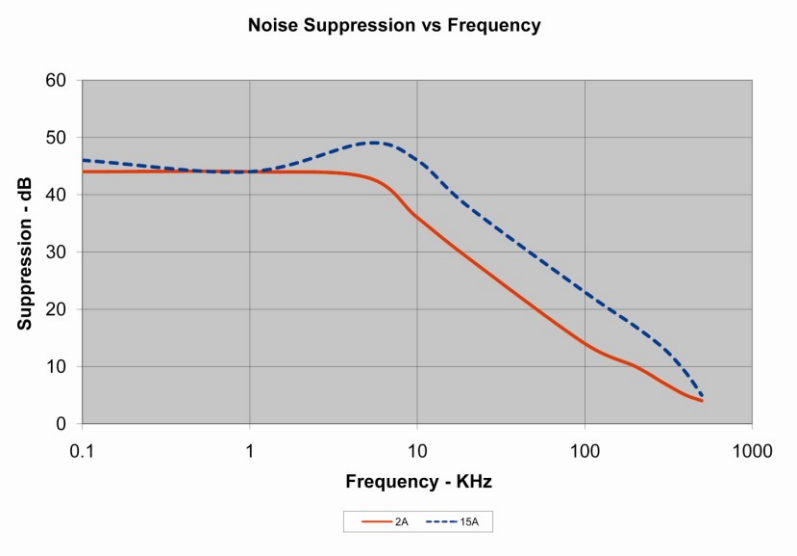
VI. Getting the Noise Out Lets the Music In

There are many ways to block, filter, suppress, and bypass noise from the power supply rails. The question is, which way is best? The standard method is to use large banks of filter capacitors to bypass noise around the rails. Capacitors, however, quickly consume space. Electrically they are far from ideal. The Music Rail is designed to replace excess filter capacitors. It performs the same function as filter caps, but it does so actively, efficiently, and in far less space.

The Music Rail can also improve the performance of voltage regulators. Regulators operate by locking down the rail voltage at some specific value. In so doing, the regulator samples the output voltage and compares it to a reference voltage. If there is a difference, the output voltage is pulled back to the reference voltage. The reference voltage is most often provided by a zener diode, which is itself a source of noise. The zener flickers constantly and emits a stream of low-level noise that interferes with the sampling process. The net result is that the electron stream exiting the regulator can be jumpy. The Music Rail will smooth out this jumpiness.

Switching power supplies behave similarly, but are worse, because the electron stream is polluted with high-frequency switching spikes. The Music Rail can smooth out switching power supplies to levels representative of the very best analog

supplies. This is readily measured: up to 45dB of power supply noise is eliminated (depending on the level of input noise–see Datasheet for performance data and installation instructions).



VII. How it Works in a Nutshell

When a Bybee Music Rail is installed in any kind of DC power supply, the electron stream passes through it. Power supply noise is then actively filtered out of the electron stream and returned to the wall socket (earth). The electron stream itself, however, is barely affected. The Music Rail drops only 0.5V for any load up to 2A, and drops only 2.1V for any load up to 15A. The electron stream enters the Music Rail in polluted form, and exits as a pure stream of clarified current, ready to be modulated at high resolution by the music signal.

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