FASST

Field Associate Sound System Training

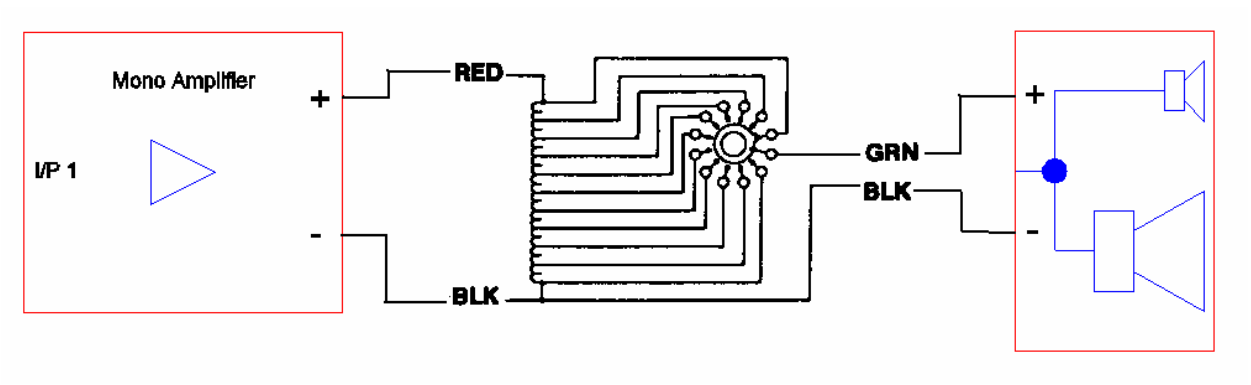
Volume Controls

In sound systems there is almost always more than one way to accomplish a task. Controlling volume is no different. For our discussion, we will look at controlling volume levels pre and post-amplification.

Post Amplification

The devices used to make volume adjustments, post amplification, are more appropriately termed attenuators. That is because the only function they do is to attenuate or reduce the signal that is reaching the loudspeakers from the amplifier. It's a bit like driving a vehicle with the accelerator in a fixed position and adjusting your speed with the break.

Actually an attenuator is nothing more than a transformer with 10 different taps mounted on the back of a plate. Each of these taps, which ironically are in 3dB increments, is wired to an input on a rotary switch and the output of this switch is the output of the attenuator. The knob on the front of the plate allows the user to conveniently change or switch the desired tap setting thereby changing the volume in 3dB steps



The schematic above is fairly typical of all constant voltage attenuators. The red conductor is the input signal from the amplifier and the green is the output to the loudspeaker. Thankfully, most manufacturers now include a sticker to indicate which wire is the input to the attenuator and which is the output. However, amazingly enough, there is still a fairly large percentage of installers who have difficulty getting this right. If you are servicing a system that is experiencing strange intermittent problems, especially volume fluctuations, this is a good place to start looking.

There are a couple benefits to having an attenuator. The first is a convenience factor. Most commercial sound systems have the source and amplification equipment located away from the loudspeakers. Very often it is located in a manager's office or a similarly sized closet. Hopefully under lock and key, protected from wandering fingers, grease and dust bunnies. By mounting the attenuator on a wall on the sales or restaurant floor, the person making the changes can listen to what is happening.

The second allows us to have separate, independently controlled volume zones on a single amplifier channel. When more than one volume control is being used, it is important to parallel the *inputs* to each attenuator so that adjustments made to one, do not effect the others. If the input to one attenuator was the output of another, any adjustments made on the initial one would directly effect the second (and its corresponding loudspeakers). As a rule of thumb, the best system designs only have one place for users to make volume adjustments per zone. Anything more leads to confusion and eventually unnecessary service calls.

Speaking of service calls, there is a proper way to use these attenuators in a sound system. A customer called claiming that he could hardly hear his music and paging, yet what he could hear was very distorted. A little investigation showed the attenuator turned nearly all the way down on 2 and the amplifier turned up so high that it was clipping out and distorting the signal. In effect he had pushed his accelerator even further to the floor so that his engine was red lining around 5000 rpm, yet he was pushing his brake so hard that he was only moving 20 miles per hour. The irony is that the complaint has nothing to do with his engine or brakes as they are doing what he has asked them to do. Be assured that under these conditions, sooner or later one of the devices is going to give up and quit.

The ideal setup would have the attenuator on 10 at the loudest the customer would ever want the system to be. This can be done by setting it to 10 and turning the amplifier down to that maximum point. If there are multiple attenuators on that amp channel, it can only be done with the loudest zone and everything else must be attenuated from there. Remember that you always have the option to change taps on individual loudspeakers to help balance the system out. Experience shows that most customers will have the attenuator between 6 and 8 for normal operation.

There are a couple disadvantages with attenuators. Anytime audio goes through a transformer, we run the risk of signal degradation, particularly in the lower frequencies. Also, attenuators are rated based upon the load that they can handle. For example, a 10 watt attenuator can safely support a 10 watt speaker load on the output side of the transformer. Typical sizes are 10, 35, 75 , and 100 watt loads. Sound systems that have speaker loads larger than 100 watts require volume adjustments be performed pre-amplification.

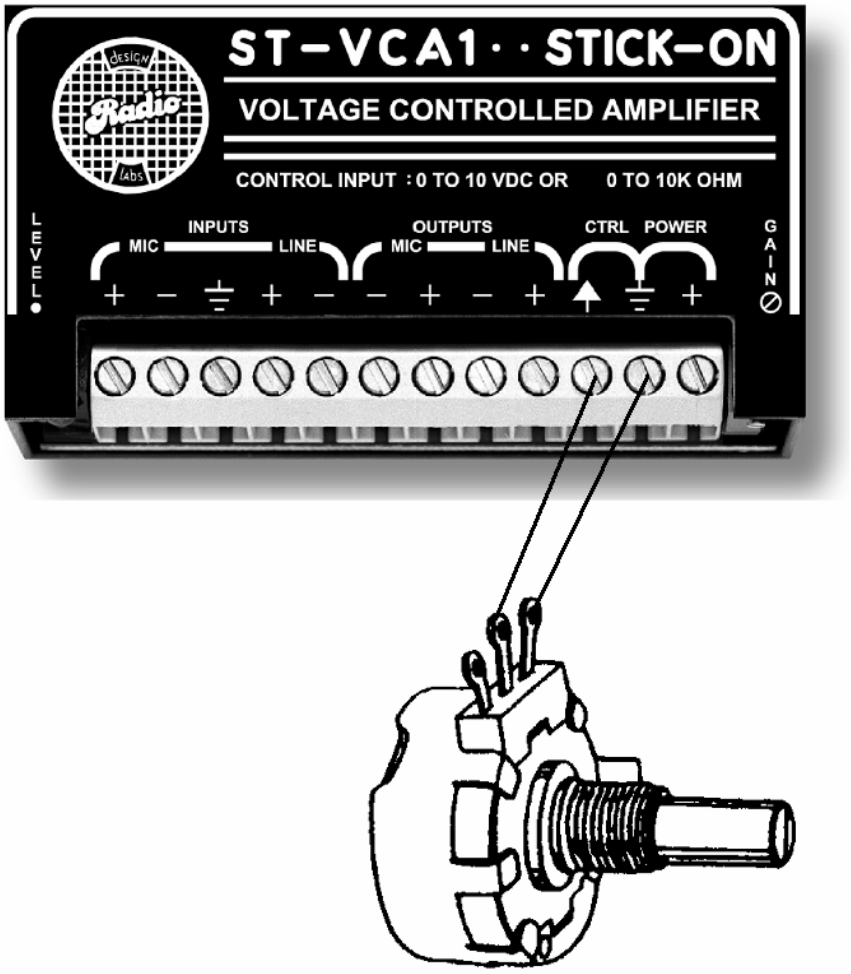
Pre-Amplification

The second way to adjust volume levels is by controlling the voltage getting to the amplifier in the first place. Many of the DMX source players allow for volume adjustments at the source. If you only have the source and a power amplifier in your system, this can be valuable. However signal to noise considerations beg to have the adjustment done on the other end of the chain immediately prior to the amplification stage.

Unfortunately, this is not always possible. A sound system that has subwoofers on one amp channel and the upper frequencies on another would require two controls. This wouldn't be very user friendly and would probably sound like CRAP (a Completely Ridiculous Audio Procedure).

Another example of a relatively simple system would be a DR501 satellite receiver that has no level control, connected directly to a standard two channel power amp with no user controls. How are you going to adjust levels? How about a system where the customer simply wants to control the volume remotely, but the speaker load is greater than 100 watts?

These problems can be resolved with a voltage controlled amplifier (VCA) and a 10k ohm linear taper potentiometer. Essentially, this device will take the mic or line level signal and vary it based upon the resistance of the pot. Keep in mind that this device is an amplifier and can therefore increase the signal above the input level. It is imperative that the installer adjust the gain pot on the VCA to prevent damage to the next piece of equipment. On the RDL device, this pot can be turned 25 times to cover the entire range of the device. We recommend setting the gain control to unity when the 10k ohm potentiometer is set to 7 on a scale up to 10.

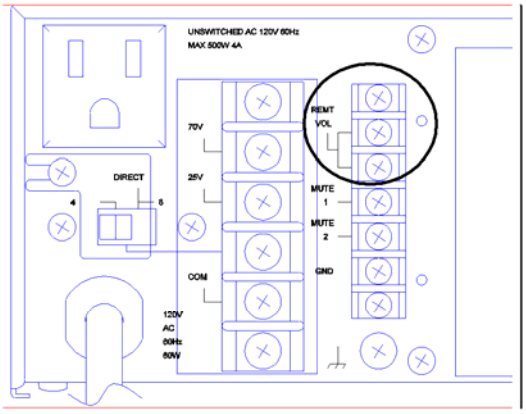


Potentiometers typically are not very well labeled so the installer must be able to determine which 2 of the 3 legs need to be used. Fortunately, the middle leg is almost always the ground, so there is really a 50-50 shot of getting the other one right. (Don't worry. If you get it wrong, it is just going to operate backwards.)

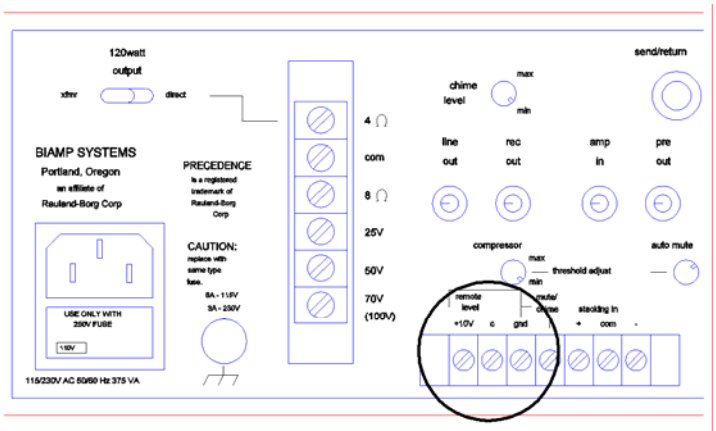
Our goal is to have no signal pass when the pot is turned 100% counter clockwise and full power when turned clockwise. Somewhere along the line the human brain has determined this to be 'normal' operating procedure. Think about the VCA for a moment with no potentiometer connected. Standing alone, with no resistance across the control contacts, it is going to pass full power. Therefore we want no resistance from the pot when it is turned completely clockwise. Similarly, the VCA will want to see the 10000 ohms of resistance when turned completely counterclockwise.

This configuration can be confirmed using an ohm or multi meter. Connect the ground lead to the center leg, the hot lead to one of the other legs, and move the potentiometer to its extremes to see if these are the values you read. If it is backwards, the other leg is the one you want.

TOA Electronics (900 series) and Biamp Systems (CMA series) have incorporated a VCA into some of their mixer/amps that allow a potentiometer to be connected directly to the mixer/amp. This allows for relatively simple connection but like the external VCA, it will control all zones being powered by that amplifier channel. TOA uses a standard 10k ohm linear taper pot, while Biamp uses a 25k ohm linear taper pot.



TOA 900 Series



Biamp CMA Series

April 19, 2002