

Amplifier Terms As They Relate To The TVA30

All-Tube Signal Path - There are three general types of active components used in the signal path of amplifiers: vacuum tubes (a.k.a. valves), solid state and digital. Solid state consists of components such as transistors, diodes, ICs (integrated circuits) and solid-state switches. Digital components are solid state but convert the analog signal (the signal coming from your guitar is analog) into a digital representation of the signal, process the digital information and then converts it back to an analog signal to eventually drive the speakers.

There is no solid state component, active or otherwise, in the path that the signal takes through the TVA30, only tubes, resistors and capacitors. There are no diodes or solid-state switches, only electro-mechanical relays. The reverb is driven and received by an integrated circuit, but this is a side-chain circuit isolated from the signal path so that the solid state circuit has absolutely no effect upon the actual guitar sound or the main signal path.

Amplifier Stage - Within a device such as a guitar amplifier there are actually several different amplifying circuits connected together to form the complete amplifier. Each of these circuits is a stage. For instance, the first stage in the guitar amp is the input amplifier, which has the job of increasing the very small signal from your guitar to a level at which it may be altered by tone controls, run through a distortion stage or stages and eventually used to drive the output stage (the power amplifier) of the guitar amp.

Amplifier Class - generally describes how the amplifier works. Describing this brings up several related terms...

Class A - This is defined in the RCA Tube Manual as an amplifier stage in which "the grid bias and alternating grid voltages are such that plate current in a specific tube flows at all times." Class A power amplifiers may have one or more power tubes, may be single-ended or push/pull and may be cathode biased or DC biased.

Class B - This is defined as an amplifier where each tube conducts for only half of the waveform (180°). Generally applied in a push/pull power amp circuit with an even number of tubes; half of the tubes conduct the positive phase, the other half conduct the negative phase with the signals combined by the output transformer. This type of amplifier circuit can provide high power, but can also have problems with distortion, especially in the region of the waveform where the positive half crosses over into the negative half.

Class AB - Similar to a Class B amplifier, except each tube conducts for more than half of the waveform, but less than the entire waveform. Like Class B, it can provide higher output power, but it generally will have less crossover distortion. This is the most common type of tube power amplifier circuit. At low input signal levels Class AB amplifiers actually operate as Class A amplifiers, while at higher signal levels the tubes do not conduct for the entire waveform (similar to Class B operation), hence the name AB.

Preamp - This is an amplifier circuit operating at low signal levels, previous to the power level stage(s). These tubes are generally smaller. The TVA30 uses 12AX7 preamp tubes.

Power amp - This is an amplifier circuit operating at higher levels in order to power speakers. These tubes are generally larger. The TVA30 uses EL84/6BQ5 power tubes.

Single-ended - A single-ended power amplifier is one in which the power is applied to one terminal of the primary of the output transformer and the plate of the tube (or tubes connected in parallel) is connected to the terminal on the opposite end of the primary winding. Signal flows through the entire primary winding for the entire 360° of the waveform. In normal operation, single-ended amplifiers are Class A and may be cathode biased or DC biased.

Push/Pull - With respect to a transformer-coupled output tube amplifier; a push/pull power amp generally consists of an even number of two or more power tubes. Each end of the primary of the output transformer has half of the power tubes connected to it and power is applied to the center-tap of the primary. The tubes on one end of the primary "pull" the signal through the transformer while the tubes on the other end are driven by a signal of inverted (or opposite) phase (180° out of phase) which "pushes" the signal through the transformer. It's kind of like a see-saw with the fulcrum being the center-tap of the output transformer primary winding. Push/Pull designs may commonly operate as class A, B or AB amplifiers.

Bias - In tube amplifiers, bias refers to a voltage relationship between the grid (the controlling element of the vacuum tube) and the cathode (the tube element closest to ground which is the source of the current flowing through the tube). For normal operation, the grid voltage must be negative with respect to the cathode. Two common methods biasing the tube are cathode bias and DC bias (which may be either fixed or adjustable). A cathode bias circuit places a resistor between the cathode and ground. The resistor may be bypassed with a capacitor to increase the gain of the circuit for AC signals (your guitar signal) while maintaining the DC bias required for operation of the tube, since capacitors pass only AC and block DC. A DC bias circuit applies a voltage (negative with respect to the cathode) to the grid from a voltage source such as a separate power supply circuit.

Boutique Construction & Performance - There is no specific definition for “boutique amplifiers”, but they are generally characterized by high quality, extreme attention to sound quality and performance, hand-building, custom components, smaller quantities and higher prices. The TVA30 is characterized by many of the same things, custom designed and manufactured transformers, hand wiring and construction, a higher quality of manufacturing than its competitors, a lot of attention paid to sound and performance; but they are available in much larger quantities than boutique amplifiers and do not cost nearly as much.

Circuit Board - see printed circuit board

Direct Out - This is labeled as Effects Send, but can be used as a direct output for connection to sound and/or recording systems. See “preamp out”.

Effects Level Control - controls the signal level being sent into the amp from whatever is plugged into the Effects Return jack.

Effects Loop - (Effects Send & Return) - Effects Send can be connected to the input of an effects unit (a signal processor such as an EQ, flanger, digital effects processor, echo/delay, etc.). The signal from the Effects Send comes after the amplifier preamps and tone controls and will include reverb and/or overdrive/distortion if they are being used. Connect the output of your effects unit back into the Effects Return. Plugging into the Effects Return breaks the signal path inside the amplifier so that your effects unit is inserted into the signal path. The entire signal then flows from the amp, goes out the Effects Send, through the effect, back into the Effects Return and proceeds on to the power stages of the amplifier. The Effect Level control on the front panel controls the level of the signal being returned to the amplifier, becoming the final volume control, essentially a Master Volume.

Impedance - see speaker load

Internal Connectors - It is common to interconnect various assemblies inside of electronic equipment by using spade connectors or multi-conductor cables (such as a ribbon cable) with multi-pin connectors which mate to multi-pin connectors mounted on the circuit board. We do not use connectors in the signal path of the TVA30 except for the input and speaker jacks because we’ve found that there can be slight movement or changes in the quality of the connection which results in a lot of noise and loss of quality in the guitar sound or, sometimes, an outright loss of sound. So, instead, we hard-wire (solder) all of the connections for the greatest reliability, long-term service, lowest noise and best sound quality.

Output Transformer - is the device which couples the plate circuit of the output power tubes to the speakers and matches impedance. It consists of a primary winding, which is connected to the power supply and the plates of the power tubes, and a secondary winding which connects to the speaker(s) and may have taps to match different speaker loads (impedances), such as 4 or 8 ohms. The output transformer is a major influence on the sound quality and effective output power of an amplifier, which is why the TVA30 transformer is over-sized and custom-made.

Point-to-Point Wiring – This is a method of connecting internal circuit components together by direct connection from one component to another or by means of an interconnecting wire rather than mounting the components to a circuit board with

the interconnections being made through the copper traces on the circuit board.

The TVA30 combines the methods of point-to-point wiring and circuit boards to make direct connection from each particular component on the circuit board to its intended point on a preamp tube, to a rear panel jack, or sometimes to another section of the circuit board so that the signal path may be protected by a shielded wire to reduce noise, static and/or hum. Though more costly, this method of construction gives the TVA30 long-term reliability and better performance and sound quality.

Power Amp In - "Effects Return" functions as a power amp input. Plugging into this jack breaks the signal path in the amplifier so only the signal going into the "Effects Return" jack will run through the power amplifier section and out to the speakers.

Power Transformer, Toroidal - A power transformer is the device which takes the electricity provided from a power outlet (applied to the primary winding of the power transformer) and isolates it from the internal circuitry of the amplifier while providing operating proper voltages from various secondary windings. The TVA30 uses a custom-made toroidal power transformer, which looks like a donut instead of a box. Toroidal power transformers are more expensive, but provide several advantages over conventional transformers such as lighter weight, lower electro-magnetic interference (EMI) and more stable voltage output.

Preamp Out - This is labeled as "Effects Send". This is the signal from the amplifier taken after the reverb and tone controls. It is the signal which is being applied to the power amplifier. Plugging into this jack does not stop the signal from going to the power amplifier. This output is isolated from the main signal path, so that it does not influence or alter the signal through the amplifier. This signal may be used to drive effects devices, other amplifiers or may be used to provide signal to a recording console or sound (PA) system.

Printed Circuit Board (PCB) - is a board made of some material such as glass fiber that has copper foil traces forming interconnecting paths between components which are mounted to the board by soldering their leads to mounting pads or holes through the circuit board.

Shielded Wire - is wire in which one or more conductors are enclosed within some type of wire or foil sheath which is drained to (connected to) ground. The inner conductor(s) is shielded from noise and interference from adjacent circuitry and electro-magnetic and radio frequency interference because those emissions are intercepted by the outer shield and are drained to ground.

Speaker Load; Impedance – Whatever you connect to the output jack(s) of the amplifier forms the speaker load, including the speaker, plugs, jacks, wire, connectors and connections. The load is whatever is doing the work of the circuit, thus drawing current. We usually ignore all of these things except the speaker's impedance rating (expressed in ohms Ω) when figuring the speaker load presented to the amplifier, unless we're using long speaker wire. When a speaker cabinet has more than one speaker inside the cabinet it is given a total impedance rating determined by the rating of each individual speaker and whether they are connected together in series, parallel or a combination of the two.

To figure the total impedance of speakers connected in series:

$$\Omega_{\text{Total}} = \Omega_1 + \Omega_2 + \Omega_3 + \Omega_4, \text{ etc. where } \Omega_1, \Omega_2, \Omega_3, \text{ etc.}$$

are the impedances given for each individual speaker connected in series

To figure the total impedance of speakers connected in parallel:

$$\Omega_{\text{Total}} = \frac{1}{\frac{1}{\Omega_1} + \frac{1}{\Omega_2} + \frac{1}{\Omega_3}}, \text{ etc.}$$

Series connection is when the current must flow through one speaker to get to the next. Parallel is when current can flow through each speaker individually without going through another speaker. When plugging two speaker cabinets into the back of the TVA30 they are connected in parallel. It is easy to figure the total load presented to the amplifier for two 8Ω speaker cabinets plugged into the two speaker jacks of the TVA30, it is 4Ω . Two 16Ω speaker cabinets present a load of 8Ω .

Standby Switch – This switch disconnects the power transformer high voltage secondary winding from the power supply which provides power to the plates of the tubes. The amplifier will make no sound, but the heaters of the tubes still function so that the amplifier, once the tubes are warmed up, is ready to operate at the flip of the standby switch. Since tube amps take time to warm up, this switch allows the amplifier to be ready for operation without making sound. It also helps the life of the tubes to have them warm up without any signal or power being applied to the tube.

Vacuum Tube or Valve – an active electronic component in which electrons flow through a vacuum from one element of the tube to another. The element which emits electrons is called the cathode and is usually in the center of the tube. You will see a red glowing element inside the cathode. This is the heater element. When the cathode is heated it emits electrons, dependent upon the voltage applied to the plate, which is the outer element you can see surrounding the other tube elements, and the grid(s). The electrons flow from the cathode, through the grid(s) to the plate. The grid(s) control the flow of electrons. A small change in the voltage applied to the control grid (such as the signal from your guitar) causes a larger variation in the large flow of electrons from cathode to plate providing an amplification of the signal. The grid acts like a valve for the flow of electrons, hence the other name given to vacuum tube, valve.