

H.H. Scott 299 & 299B EL84 Stereo Amplifiers

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In the Beginning

Home hi-fi really gathered momentum in the late 1940s. Better speakers, transformers and circuit designs all made the quest for musical realism more accessible to the hi-fi enthusiast. During this era, Hermon H. Scott started a hi-fi equipment and test instrument manufacturing operation in Cambridge, Massachusetts. Scott, an MIT graduate during the early 1930s, was initially employed by General Radio Company where he developed the RC oscillator, sound level meter and many other audio and electronic innovations.

The first commercial H. H. Scott amplifier was the model 210A Laboratory Amplifier (1948). This instrument was a 6L6 push-pull 20 watt unit featuring the famous Scott Dynaural Noise Reduction, designed to reduce the surface noise from 78 rpm records. The 210 series was continued until the late 1950s with the 210E which used push-pull EL34s. In 1953, Scott introduced the 99A Transcription Amplifier, the first "flat" styled amplifier designed with all the tubes enclosed and the output tubes mounted horizontally out the back. The 99A produced 10 watts from push-pull 6V6GTAs and featured switchable Rolloff and Turnover phono equalization. The 99 series was continued until the early 1960s with the 99D, a 24 watt unit using 6L6GBs.

Stereo records became a commercial reality in 1957 with the introduction of stereo discs by Audio Fidelity Corporation of New York. Mono hi-fi system diehards

claimed that stereo was just a conspiracy devised by the equipment manufacturers to sell more amplifiers and speakers. Many others were swept off their feet during hi-fi trade show demonstrations and retail audio shop listening sessions showcasing the "stereo" effect. Early stereo setups were a complicated maze of wires, mono amps, mono preamps and stereo adapters. As a result, the need for packaged, one-piece dual channel amplifiers was created.

H.H. Scott was in a growth mode in the mid-1950s due to increased consumer enthusiasm about hi-fi. In 1957, Scott moved from Cambridge to Maynard, a small mill town west of Boston. Scott built a new 30,000 square foot facility that was capable not only of electronic assembly, but also housed a machine shop for chassis fabrication and a transformer winding operation. The new facility was completed just in time to handle the increased demand from the emerging stereo equipment market.

222 and 299 Circuit Design

Daniel von Recklinghausen began his career as an audio design engineer with H.H. Scott in 1951 soon after graduating from MIT. He was intimately involved in most of the audio designs Scott produced from 1951 through 1973, when the company was sold to Emerson Electric. Daniel was assisted by Peter Globa, a Ukraine engineer who emigrated to the USA from Brazil and was hired in 1956. From the beginning, H.H. Scott pursued and

achieved audio excellence. His attention to detail, good sounding circuit design and component selection was evident in all Scott products.

The concept for a Scott stereo amplifier probably began sometime in 1957. The first stereo amplifier was the legendary model 299, introduced in mid-1958. The lower power, less expensive 222 was introduced a few months later. The design and execution are excellent examples of quality American audio engineering. It was built with craftsmanship to last a lifetime.

Most music in the late 1950s was played using either stereo or mono LPs and 78 records, so the phono section of an integrated amplifier was very important. The 299 phono stage was a product of 10 years of progressive experience with previous designs. Von Recklinghausen went for a conservative design using two super quiet Telefunken ECC83/12AX7A dual triodes. Telefunken used a process during manufacture that reduced barium getter deposits on the control grid, thus minimizing electrostatic and mechanical noise. In addition, Telefunken tubes were made with precision and strict QC standards to reduce variations in individual tubes. The phono stage utilized frequency-selective negative feedback in the pre-amplifier stage. Positive feedback was used from the cathode of the second ECC83 triode to the cathode of the first triode. This design brought overall loop gain up and produced a rich, musical mid range with good response on the frequency extremes.

The tone control stage has two ECC83s and uses separate bass and treble Baxandall-type tone control circuits for each channel followed by another stage of amplification. This is fed into the gain control and the loudness-volume switch. Scott operated all four ECC83s with DC on the filaments for a significant reduc-



H. H. Scott 299

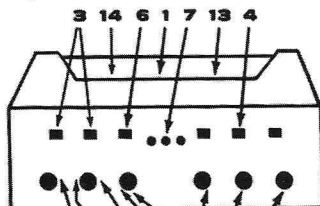
Now! The Most Important Product Announcement in the History of H. H. Scott!



Here are the exciting details on

The Stereo Amplifier that sets the Standards for the Next Decade!

The H. H. Scott engineering laboratories proudly introduce the new Model 299 40 watt stereophonic amplifier and control center. It contains many advance features that not only meet the needs of today's stereophonic program sources, but anticipate the requirements of the future. Check the details of this new amplifier, and see for yourself why the new 299 is superior to any other amplifier available.



1 40 watt power stage consisting of dual 20 watt power amplifiers. You need this much power to meet the requirements of today's speaker systems. 2 Completely separate Bass and Treble controls on each channel so that different speakers may be matched. 3 Provision for connecting both a stereo phono cartridge and stereo

tape heads. 4 Phase reverse switch to compensate for improperly phased tape recordings or loudspeakers. 5 Special balancing circuit for quick and accurate volume balancing of both channels. 6 Separate record scratch and rumble filters. 7 Unique visual signal light control panel. Instantly indicates mode of operation. 8 Can be used as an electronic crossover (bi-amplifier). 9 Special compensation for direct connection of tape playback heads without external preamp. 10 Special switching lets you use your stereo pickup on monaural records. 11 You can play a monaural source such as an FM tuner through both channels simultaneously effectively doubling power. 12 Loudness compensation. 13 Stereo tape recorder output. 14 D.C. filament supply for preamp to virtually eliminate hum (80 db below full power output). 15 Distortion (first order difference tone) less than 0.3%.



Size in accessory walnut case: 15 1/2" w x 5 1/2" h x 12 1/2" d. Price \$199.95. (West of Rockies \$204.95)

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tion of hum. The selenium bridge rectifier supplied DC for the filaments and negative bias voltage for the output tubes. After the gain control, the signal fed into the phase inverter stage.

Most vacuum tube research in the 1950s and early 1960s was for television applications. Nine pin miniature tubes including the 6GH8, 6BL8/ECF80, 6U8 and 6EA8 were originally designed for home television sets. They eventually found their way into audio applications in the mid-1950s in Dynaco, Fisher, McIntosh, etc. audio equipment. In order to save precious chassis real estate, Scott chose to use ECF80/6BL8 triode-pentode tubes for the integrated amplifier driver and phase inverter stages. To allow for better fine-tuning of the amplifier, a voltage-type divider phase inverter circuit design was employed.

The output stage in the 299 used the relatively new 7189 nine-pin miniature output tube (a higher voltage-rated version of the EL84/6BQ5). Output tubes were configured in push-pull tetrode in fixed-bias mode. The 299 utilized several adjustment pots for fine-tuning the output stage including output tube bias, DC balance, and AC balance.

Power Supply and Capacitors

There was lots of reserve capacitance in the 299 design. The 299 had five Sprague multi-section electrolytic cans mounted on the top of the chassis. This allowed for quicker reserve power recovery during demanding musical transients. Additional filtering also improved decoupling, channel separation, and overall fidelity.

The power transformer was made by Stancor and designed to operate at a 40 degree centigrade (150 degree F) rise operating temperature. In the Scott 299, the power transformer was mounted with laminations perpendicular to the top of the chassis. The 299C and D had the transformer mounted parallel to the top of the chassis.

Coupling and bypass caps initially were the paper and foil "striper" plastic molded types in Scott mono gear. In the Scott stereo amplifiers, they chose to use the white ceramic American Radionic mylar and foil types. These caps are notorious for failure and all of them should be replaced if you plan to use the amplifier.

Output Transformers

Von Recklinghausen designed the transformers used in the 299. His spec was for a transformer that was not saturable at rated power and capable of both good low

H. H. Scott 299 Type 1 Chassis



and high frequency response. The proper size of the laminations and core density were very critical to achieve this performance. Von Recklinghausen used scramble windings on both sides of the primary for improved tonal balance.

Golden Era Styling

H.H. Scott home audio products produced in the 1950s and early 1960s were very attractive and stylish. 299s sported a beautiful one-piece champagne gold anodized formed aluminum faceplate with black lettering. The original Scott "champagne gold" styling was introduced in 1954 by Victor Pomper, VP of Marketing for Scott. One of the problems with the anodizing process was color matching. Different anodizing batches ranged from a dark copper-red to a light gold champagne appearance. Dealers of the era found that if a customer bought a Scott amp with a darker anodizing finish, it was tougher to sell the customer a matching tuner with a lighter finish.

The 299's gold anodized solid aluminum machine-turned knobs were actually made in the Scott factory with a screw machine. The 222 and some other models used brown bakelite knobs with gold rims that were manufactured in Germany. Later versions such as the 222D and 299D used the fluted bakelite knobs with metal caps.

Scott 299

Probably the most popular stereo tube integrated amplifier series ever produced, the 299 was an audio sensation that changed the course of home hi-fi stereo.

There were six control knobs, two of them dual-ganged type, six slide switches and three function lights. Controls included from left to right, input selector, stereo/mono selector, bass/treble for channel A, bass/treble for channel B, stereo balance and loudness. The three pilot lights enabled the user to know at a glance whether the 299 was operating in one of the seven operating modes: true stereo, reverse stereo, simulated stereo, etc.

There were four inputs per channel including two for magnetic phono cartridges, one for tuner and one for tape heads. The magnetic inputs were switchable between either one, allowing for use of either a record changer or a turntable. The second magnetic input had two jacks, one for low level cartridges and one for high level cartridges. The speaker output terminals will handle either 4, 8 or 16 ohm loads. Speaker loads were changeable by an external jumper terminal for each channel. The 299 also featured a center channel output for a third amplifier and speaker. This "three channel" stereo system gave the listener a very impressive "wall of sound" effect.

Von Recklinghausen noted that Scott made amplifiers and tuners in batches of 1,000. One production batch would be tuners and when it was completed, they would switch to building amplifiers. There were actually two versions of the 299 sold. The first version (pictured) was produced through the first 8 months of 1958. It is estimated that approximately 8,000 to 10,000 Type 1 299s were made.

A pair of output transformers were mounted one behind the other with the output tubes installed in a row right next to the transformers. The part number of these transformers is TRA-8-3-1 and they are smaller in size compared to the later versions. Apparently, these transformers could have been made in-house by Scott as they have 100 stamped where the manufacturer EIA code should be.

Scott introduced a second version of the 299A in late 1958, apparently for the 1959 model year. It is estimated that approximately 8,000 to 10,000 of the Type 2 299s were made. This version used different appearing and slightly larger output transformers (part number TRA-8-4) that were mounted at the back of the amp, horizontal to the rear panel. The later transformer has better specs, but they do sound fairly similar.

Factory power ratings for the 299 were 20 watts per channel with harmonic distortion at 0.8% at full power output. Maximum sensitivity was 3 millivolts for rated output. Frequency response was rated at 20 to 30,000 Hz with noise and hum at better than 80 dB below full power output. Dimensions of the accessory case were 15 1/2" wide x 5" high x 12 1/2" deep.

Audio Magazine reviewed both the Scott 299 and the 222 in their November 1959 issue. Right out of the box, their review sample had fairly high distortion in one channel. After adjusting the AC balance control to the phase inverter, distortion in that channel decreased significantly. After adjusting the AC balance control for best performance, the official measurement for the 299 was as follows:

1. At 1000 Hz, 0.19% IM distortion at 1 watt, 0.23% IM distortion at 10 watts and 1.4% IM distortion at 15 watts.
2. With gain on maximum and tone controls flat, response was 2 dB down at 20 Hz and 3 dB down at 20 KHz.
3. Signal to noise on the high-level inputs was 72dB with an input of 0.5 volts at 1000 Hz. Signal to noise on the phono stage was measured at 63dB.

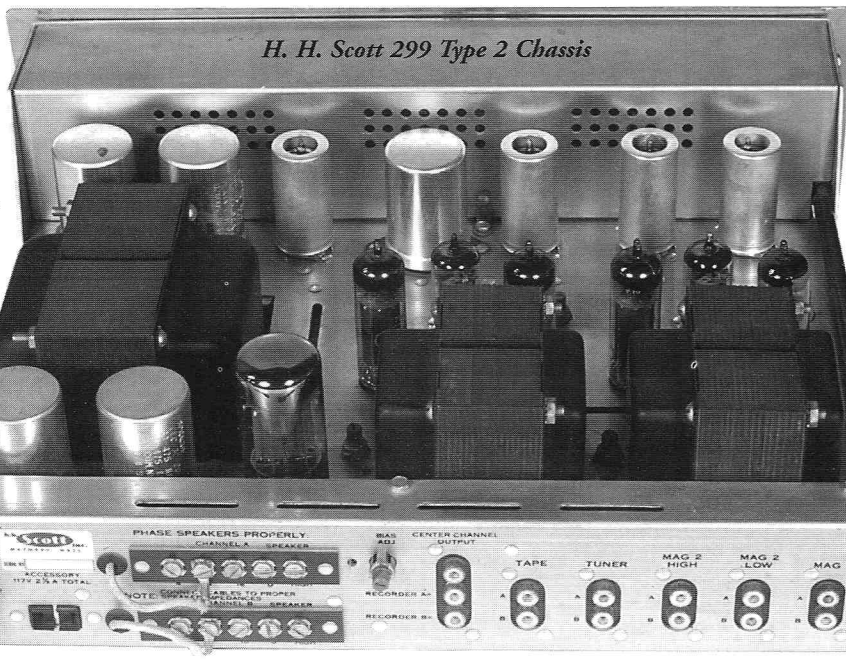
Scott 299B

As a result of "new model" pressure from the marketing department, Scott introduced the 299B in the summer of 1960 for the 1961 model year. The faceplate was slightly different with a newly designed Scott logo and another slide switch added to the center of the panel. The knobs were still gold anodized turned

aluminum, but were more rounded looking and similar to the knobs used on the 299C. The three neon pilot lights were new flat-faced non-fluted plastic. New features included tape monitoring facilities and an additional high-level input for use with an electronic organ. Power rating was boosted from 20 watts per channel to 25 watts per channel (Institute of High Fidelity Manufacturers standard). In reality, this power rating was probably optimistic by 25%. In addition, the mechanical layout of the chassis, including placement of tubes, ceramic dropping resistors, filter capacitors and transformers, was changed.

Output transformers were larger in size, and apparently the power of the amplifier was increased to a rated 25 watts. The driver stage had a slightly different circuit design. It is estimated that less than 10,000 299Bs were made.

For the 1962 product year, Scott introduced the 299C, which featured octal-type 7591 output tubes. Power rating went from 25 watts per channel to 40 watts per channel (IHFM). This, as well as the 299D, LK-72 and LK-72B, will be discussed in a future issue of VTV.



have a balanced sonic spectrum, great bass response for EL84s and detailed, extended highs. They work well with speakers that have an efficiency of 91dB or greater.

Owning and Upgrading a 299

If you are looking for an easy to maintain and compact amplifier, a Scott 299 or 299B is an excellent choice. They are currently easy to find in want ads and on eBay.

How Does the 299 Sound?

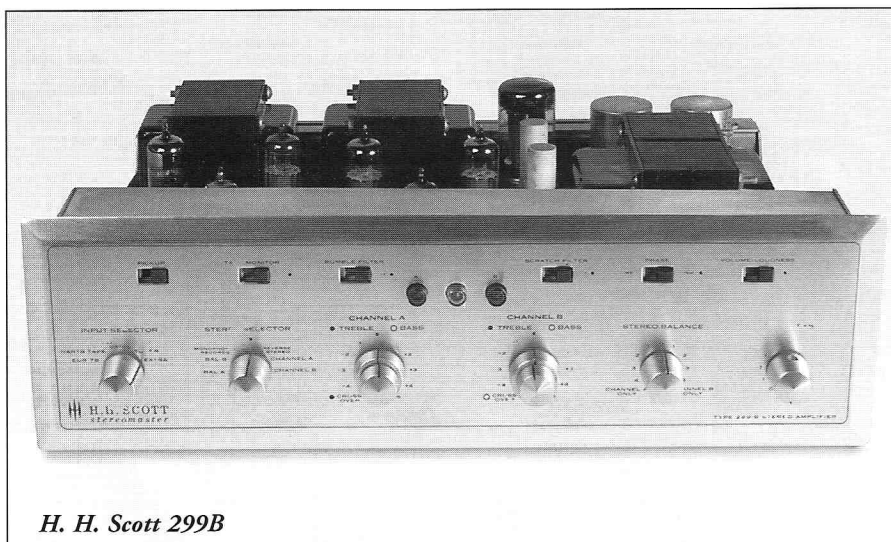
As von Recklinghausen told me, "sine and square waves are pretty dull. It's what happens with musical transients that makes the difference." Scott spent a lot of time and money to ensure that the 299 would make great music. Attention to detail was obvious. In fact, according to von Recklinghausen, Scott brought in professional musicians including members of the Boston Symphony for listening evaluations of Scott amplifiers during product development. Not only does the 299 sound great, but it is extremely versatile. In my opinion, the 299 and 299B Scotts are two of the best sounding vintage EL84 integrated amps ever produced. They are very lively, involving, sweet, and musical. In addition, they

Typical 1999 price should range from \$150 to \$400 or more for an unrestored amplifier. Buying a restored and rebuilt one will cost more. I have recently noted in *MJ Magazine* (a high-quality Japanese audio publication) that companies like Sansui, Marantz and Luxman have introduced tube stereo integrated amplifiers. These look surprisingly similar to early 1960s Fisher and Scott amplifiers, but with modern components. However, the cost in Japan for these tube integrateds ranges from \$3500 to \$6000! At those prices, a Scott 299 is a bargain.

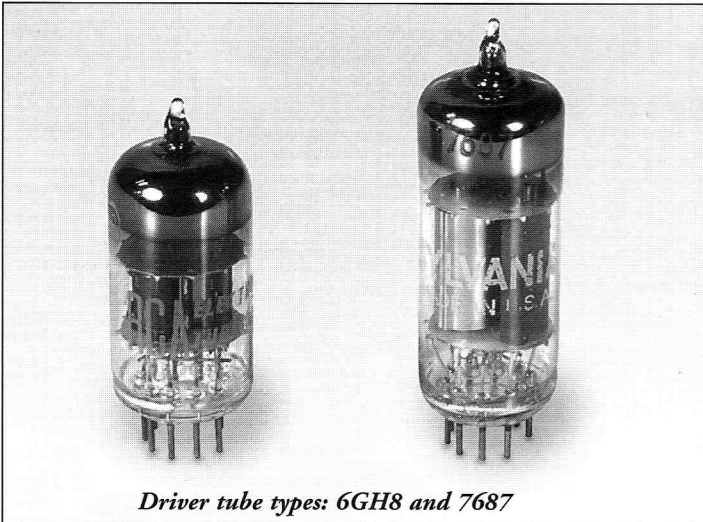
Because 299s and 299Bs use inexpensive EL84/7189s, output tube replacement will not break the bank. A few recommended vintage speakers to use with a 299 include: AR-4X, most Bozak models; Dynaco A-25; most Electrovoice models and KLH 23, 24, and 32. For modern speakers, see our bookshelf speaker review in this issue.

Remember that if you purchase a 299, **Do Not Plug It In** until you have checked it out and rebuilt it. When upgrading a 299 here are some steps to follow:

1. Remove all tubes and clean chassis with compressed air or a soft clean brush. Clean and lubricate all contacts, controls and switches with Cramolin R-5 or similar product. Check all tube sockets and re-tension them using a dentist's pick or similar tool.
2. Remove and replace all white or striper tubular ceramic or molded plastic "striper" signal capacitors one at a time



H. H. Scott 299B



Driver tube types: 6GH8 and 7687

to avoid making a mistake. Replace them with good quality modern film and foil capacitors. I have had excellent results with Illinois Capacitor ICMWR foil and film types. They retain the vintage sound and are very reasonably priced. Replacing all the caps with expensive premium foil and film caps can be a mistake because they can change the original sound characteristics.

3. Check and replace all carbon-composition plate resistors in the phono and tone control circuits with 1% low noise carbon or metal film types. It is best to experiment with the type of resistor that sounds the best to you. Using all metal film types can cause the sound to be too hard or irritating.

4. Replace the selenium bridge rectifier (filament and bias supply) module with a newer silicon diode bridge. The original selenium bridge is located on a side mounting bracket under the chassis. Replacement is essential because the older selenium bridges usually develop high series resistance, thus lowering bias voltage. This can cause your output tubes to draw too much current and overheat, causing plates to turn red or orange. Allowing any tube amplifier to operate in this condition will burn out transformers. You may have to add a series dropping resistor to compensate for the lower voltage drop of the silicon bridge.

5. Clean all tube sockets and tube pins with solvent, R-5 or suitable material. Check and replace all tubes that test bad. The original phono and tone

control tubes were probably Telefunken ECC83/12AX7s. Finding these in NOS condition could be costly. It is OK to use newer US or import 12AX7s as long as they test well and are quiet.

The driver tubes were either 6GH8 or 6BL8 triode-pentode nine-pin miniatures in the original Scott amps.

It is possible to substitute a 6U8A or 6EA8 in this position. A better substitute (if you can find it), is the Sylvania 7687 (see photo) triode-pentode which is a superior plug-in replacement for the above types. The gain of both tube sections is slightly different, but the sonic improvement is incredible. Just adding a pair of 7687s will give you more headroom, better bass, high frequency extension, and a more 3-D soundstage.

The output tubes were originally Amperex Bugle Boy EL84s made in Holland. These are now very rare and

expensive. As modern replacements, the Sovtek EL84s and the JAN/Sylvania military surplus 6BQ5s are good performers. The original GZ34 rectifier was made either by Amperex or Mullard which are both costly. You can use the Chinese 5AR4 but be sure to check it in-circuit first because these can have a relatively high failure rate.

6. Check all can-type electrolytics for leakage by measuring current draw while forming them on a regulated DC supply. Any electrolytics that have leakage of over 5-10mA at rated voltage should be replaced with newer cans or under-chassis axial electrolytics.

7. Check all wiring and soldered wire terminations for crumbly solder joints or shorts. When ready, bring the amp up slowly on a variac. If it passes the smoke test, hook up your input sources, connect your speakers, and then enjoy the music!

References:

1. **Audio Magazine**, Scott 299 and 222 Amplifier Review and Test, November 1959.

A special thanks to Daniel von Recklinghausen, former Vice President of Engineering at H. H. Scott, for his assistance with this article.



Cartoon by Jack Elliano

