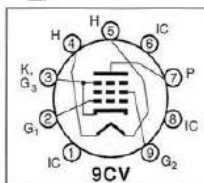


# EL84: The Baby With Bite

By Eric Barbour

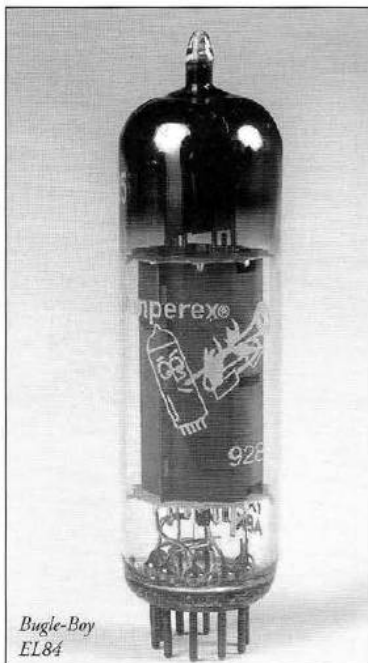
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## Intro

It is getting routine to speak of popular audio tubes as having little or no history. Whereas truly innovative tubes such as the 6L6 started an electronic revolution, there are many types which hardly rated mention—until recently, when they became essential to musical sound. The development of such popular tubes was more-or-less accidental, or at least of little importance at the time.

A fine example is our present subject. The small power pentode EL84 is now regarded as a leading guitar tube, and as a classic for high fidelity. Yet it was developed from an undistinguished series of audio-output pentodes, used in low-power hi-fi, tape recorders and many AC powered European radios. One small change in the screen grid, to allow its operation at voltages similar to the plate (300 volts), made a low-cost radio tube into a high-fidelity audio device.



Bugle-Boy  
EL84

Like many audio tubes of today, EL84 originated with Philips BV in Eindhoven. This highly productive R&D operation could fill up a book with just their better-known electron tube developments. All from the minds and hands of nameless engineers in Holland. This popular 9-pin miniature tube was derived from the very different Rimlock base tube found in most countries where Philips had a presence.

## History

Just after World War II, much of northern Europe was in ruins. Populations were utterly weary of war, and now that it was over, they got on with their lives. And they started buying radios again. As a result, more new electronic tubes were introduced in the 1946-1950 period than in any other time.

The tube manufacturers were well-acquainted with the new glass-base miniature tubes from the USA, first introduced by RCA in 1939-1941, and it was obvious that the future was in miniature types. So, starting in 1947 with the British MOV Z77 pentode, a rush of types appeared. Known as B7Gs in Britain, they were usually identical to American types already existing.

Except, that is, for a new line. Produced by Mullard and Mazda, later by Philips (Mullard's owner) and Telefunken, the Rimlock series of tubes were essentially like 9-pin miniatures, except that their bases had 8 pins. And early examples were equipped with a large metal ring on the base, with an alignment pin to allow use in twist-and-lock sockets. The appearance was like a small Loktal base, minus the center locating bung. A major introduction in the Rimlock types was the Mullard/Philips UL41, one of the first audio output pentodes with a miniature base and the precursor of an entire family.

The UL41 was intended for 100-mA series heater strings in AC-DC radios and televisions. It led directly to the EL41, identical except for the more conventional 6.3v heater. The EL41 begat the EL81,

for

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MINIATURE tubes**



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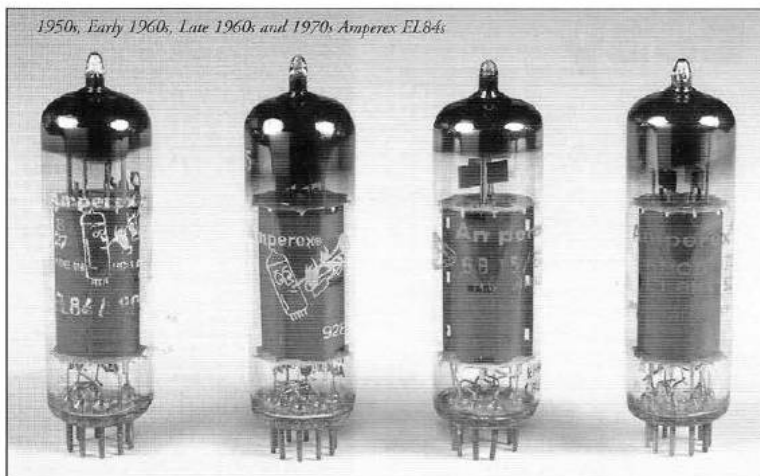
- 6CA7/EL34 High-power pentode; 100 W PP
- EF86/6267 Low-noise high-μ pentode
- ECC81/12AT7 Low-noise medium-μ dual triode
- ECC82/12AU7 Low-noise low-μ dual triode
- ECC83/12AX7 Low-noise high-μ dual triode
- ECC85/6AQ5 High-μ dual triode for FM tuners
- GZ34/5AR4 Cathode-type rectifier; 250 ma.
- EZ80/6V4 9-pin rectifier; cathode; 90 ma.
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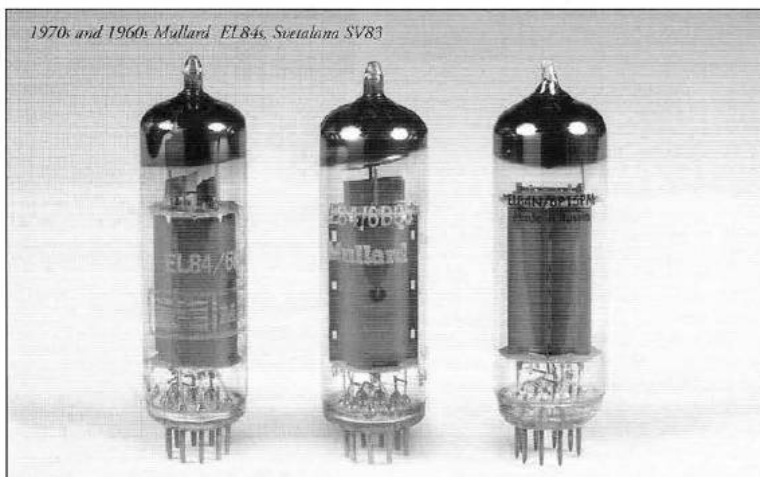
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## EL84: THE BABY WITH BITE

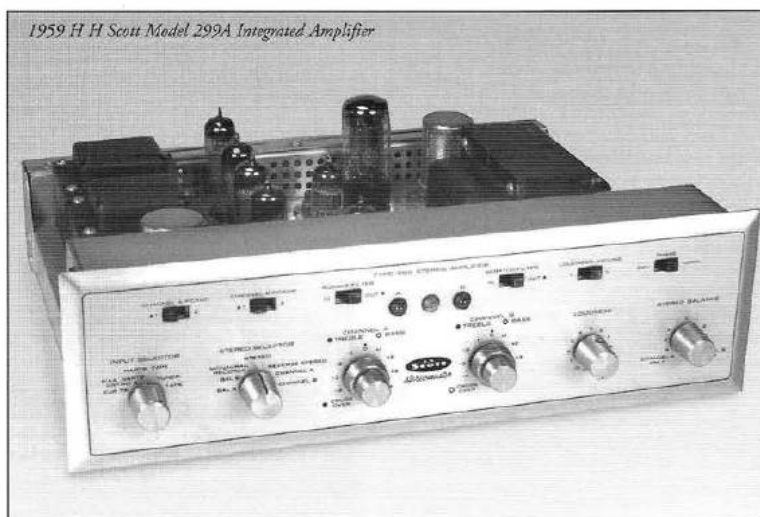
1950s, Early 1960s, Late 1960s and 1970s Amperex EL84s



1970s and 1960s Mullard EL84s, Svetlana SV83



1959 H H Scott Model 299A Integrated Amplifier



which bore a newfangled 9-pin miniature base in the American style. The EL81 was a very different tube, intended for early TV horizontal-sweep applications and possessing a plate cap and much lower transconductance than the UL/EL41.

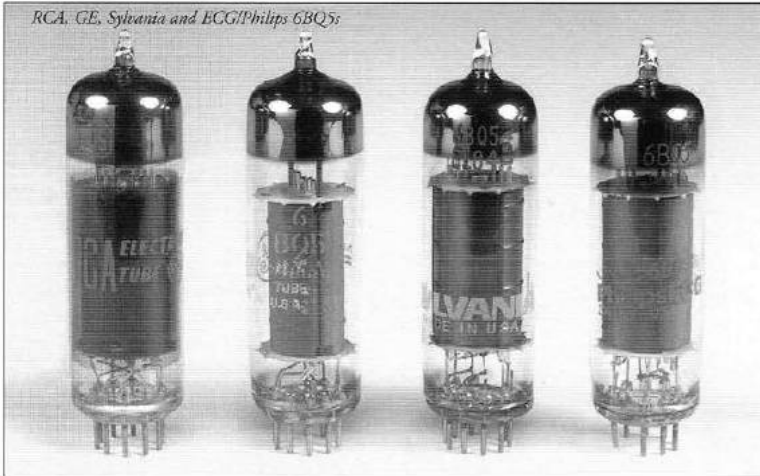
From the EL81 came the EL82, designed especially for audio output. From the EL82 came the EL83, similar except for an internal shield and intended for video amplification. And from the EL82 came the demand, circa 1952, that output tubes should have screen-grid ratings allowing their use in triode or in the Hafler-Keroes ultralinear connection. All these tubes up to this point were rated for screen operation at 250v maximum. It seems that Philips had already produced a pentode with a screen voltage rating equal to the plate rating, the obscure developmental type BA9 of 1950. Now that there was a demand for its use in the burgeoning hi-fi market, Philips made it into an official type: EL84. (There was one "final" entry, the EL86, which was very similar to the EL82 except for a higher plate dissipation rating, and thus was not suitable for ultralinear connection due to its low screen grid voltage rating.)

The EL84, believed to first appear in Philips data books in 1953, was the start of an industry—small, inexpensive hi-fi amplifiers for the average person. Mazda introduced their 6P12 equivalent to the EL84 in 1955. Previous American 10-watt amps usually used the prewar 6V6 beam tube, which was relatively low in transconductance and required additional driver stages. The EL84 seized this market from the 6V6 and its kin within a scant two years. Not only were EL84s smaller than 6V6s and required less-expensive miniature sockets, they had much higher transconductance. A push-pull pair of EL84s could be driven with a very simple circuit, using a high-gain pentode for voltage gain, followed by a triode as a split-load phase inverter. The standard EL84 driver circuit quickly became a 7199 or other triode-pentode, pushing a pair of EL84s into an 8000-ohm-primary transformer, biased with a common 130-ohm cathode resistor. Officially, this combination gave 11 watts into a speaker.

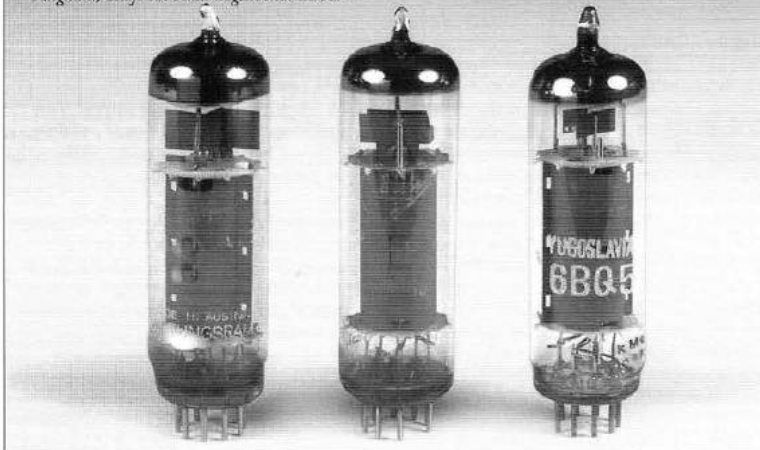
Early UK application of the type EL84 were early circuits/kits including the GEC 912 (1954) and the Mullard 5-10 which was used by many early radio/hi-fi businesses, including Radford. Leak used the EL84 in push-pull for their Leak TL12+ in the mid-fifties. The first production US hi-fi amplifier believed to use the EL84 was the Fisher CA-40 of

## EL 84 : THE BABY WITH BITE

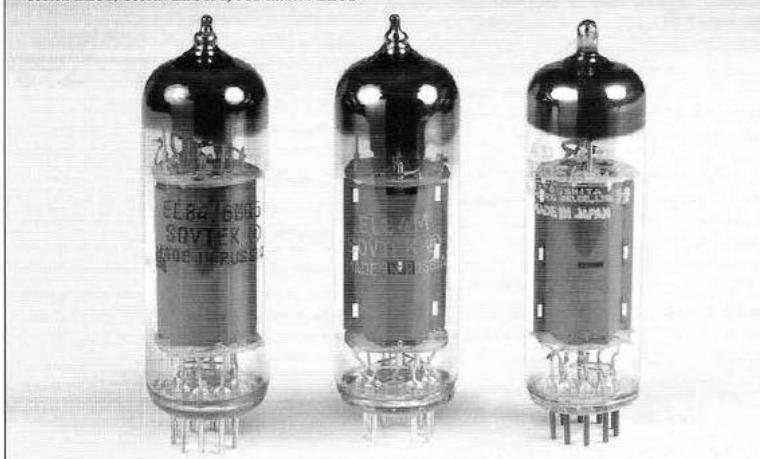
*RCA, GE, Sylvania and ECG/Philips 6BQ5s*



*Tungram, Telefunken and Yugoslavian EL84s*



*Sovtek EL84, Sovtek EL84M, Matsushita EL84*



1955. It used four tubes to give (optimistically) 40 watts. At the time, the CA-40 caused a stir. Here was a small monophonic integrated amplifier, designed to look good, designed to be easy to use (its unique tone controls displayed the frequency response with a small illuminated graph--the green line, made of flexible plastic, was distorted into the actual response when the bass and treble knobs were operated). Suddenly, hi-fi wasn't just an obscure hobby for the technically sophisticated.

The number of high-fidelity amplifiers using EL84s, introduced between 1955 and 1965, is considerable. They include giant sellers like the Dynaco ST-35 and SCA-35, the EICO HF81, the Fisher SA-100 and X-202A, the Scott 222 series and 299A and 299B, and a vast array of models by Bogen, Eico, Fisher, Heathkit, Pilot, Sherwood, Lafayette and too many others to count. Most were mono or stereo integrated amplifiers, rated for anything from 8 to 25 watts per channel, always from a pair of EL84s. Since the American hi-fi market was driving this design, Sylvania introduced American-manufactured EL84s in 1956 under the standard name 6BQ5. All large U.S. tube factories either produced 6BQ5s, or imported and relabeled European-made EL84s. Most of their other UL41-series tubes (with 9-pin bases) were also offered in America under standard EIA designators, yet none approached the popularity of the EL84/6BQ5.

The power-rating uncertainty above shows how vague the audio business was getting in the late 1950s. Amplifier designers wanted ever-more power and dissipation from the same low-cost tubes, which resulted in some unreliable designs. It also resulted in semi-chaos in the EL84 market. Since designers (and therefore, supposedly, consumers) wanted and needed more power, RCA and GE introduced the 7189 in 1958. Although the original 6BQ5 was supposed to be a true pentode, with suppressor grid, the 7189 was a beam tetrode. It was intended to be an exact plug-in replacement for the 6BQ5/EL84, except having higher ratings for dissipation and plate voltage. This was followed by the 7189A of 1960, with a plate voltage rating of 440 volts. Some later amps, such as the Scott 299B, were designed for such voltages. Although a good-quality EL84 pentode might work in a 299B, it really requires a beam-type 7189. During this period came the premium version E84L, apparently intended for "mobile" applications (perhaps in two-way radios) and offered in America under the obscure number 7320.

# EL84: THE BABY WITH BITE

Since beam tubes suffer from less screen-grid heating than true pentodes, some smart-aleck tube factories made and sold beam tubes labeled 6BQ5 or EL84. Often you will see old-stock EL84s which are really beam types. It is difficult to tell which are which, since many EL84s don't have holes in the sides of their plates, to allow inspection of the tube structure. GE's popular 1973 tube manual refers to the 6BQ5 as a "beam power amplifier" and to the 7189/A as a "beam pentode," further muddying the waters. All this, plus the perennially-popular sport of relabeling, make determination of the identity and capabilities of an NOS EL84 type more difficult.

**Table 1**

Escalation of miniature output pentode/beam tube ratings in the 6X41 family:

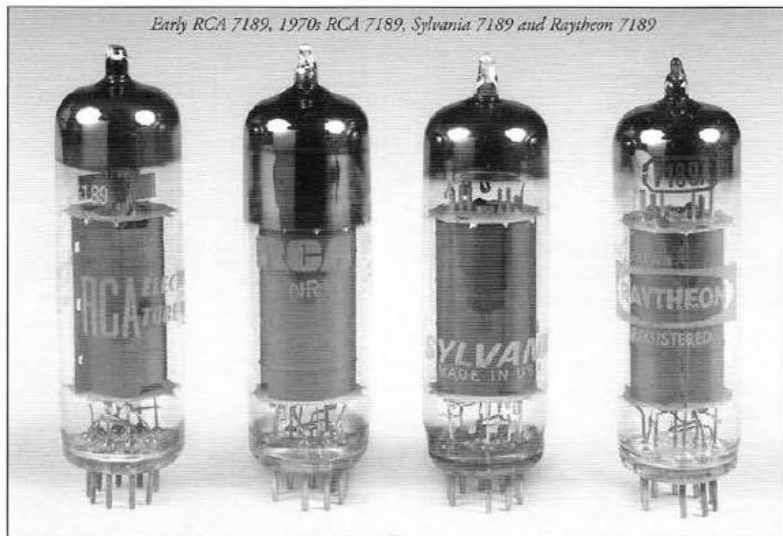
Type	Plate Diss.	V <sub>plate</sub>	V <sub>screen</sub>	g <sub>m</sub>
UL/EL41	9 watts	250V	250V	10,000 uS
EL81	8 watts	300V	250V	4600 uS
EL82	9 watts	300V	250V	9000 uS
EL83	9 watts	300V	250V	10,000 uS
EL84	12 watts	300V	300V	11,300 uS
EL86	14 watts	275V	220V	10,000 uS
7189	12 watts	400V	300V	11,300 uS
7189A	13.2 watts	440V	400V	11,300 uS

Today's scene is much simpler. Although there is a Shuguang EL84, it has a very poor reputation for reliability. The major producers of EL84s are the Reflector Saratov factory in Russia (usually sold under the Sovtek brand), Teslovak in Slovakia, and Ei in Serbia. Also, an EL84-like tube is sold by Svetlana. Their "new" SV83 is a unique Russian type roughly similar to the EL82 or EL83.

The applications for EL84s have also simplified. High-end audio amplifiers using EL84s are not common now. The only high-end EL84 amp currently available from a US manufacturer is the Mesa Engineering "Tigris." Admittedly, EL84s have been overshadowed in hi-fi by larger tubes. It is because of the distinctive distortion behavior that the vast majority of EL84 amps made today are guitar amps.

## Guitar Amplifier Applications

First use of the EL84 started in the late 1950s with Vox. Created by Jennings Musical Instrument Co. to manufacture and market musical-instrument amplifiers, Vox made mostly smaller amps for the amateur and low end of the professional trade. Their AC4 used one EL84 in single-end Class A, the AC15 had two in the typical 130-ohm cathode-resistor circuit, and the AC30 ran four tubes in



close to Class A push-pull operation. It was the "Top Boost" version of the AC30 which became a standard, primarily because it was the amplifier of the Beatles (as well as most other British Invasion groups). Although Selmer, Hohner and other European firms produced similar amps, the Top Boost AC30 enjoyed the blinding star power of John Lennon, Paul McCartney and George Harrison. And furthermore, the Top Boost was apparently the first guitar amp to incorporate extra gain stages, allowing the amp to distort easily. The Vox name, idle for many years, was recently revived by Korg USA and Marshall. So the AC30 and AC15 are available once again in music stores.

Not that they were really missed--the Top Boost was one of the most copied amplifiers of all time. In the pre-1970 era, EL84s were usually used in inexpensive "student" amps, bearing brand names such as Silvertone, Harmony and Kay. The only other American guitar amps with EL84s from this period were a single unusual Fender model and the Gibson Skylark.

Yet long after this period, starting in the 1970s, custom amp makers such as Trainwreck Circuits (Colonia, NJ) made a name by producing EL84 amps that were capable of the distinctive Vox sound. This is usually described as very distorted and bluesy, changing tonal characteristics over a wide range with changes in picking force--a "British blues" sound.

Since 1985, numerous firms have made a big dent with AC30 or AC15-like amps. The biggest is currently Matchless Amplifiers (Santa Fe Springs, CA), fol-

lowed by smaller outfits like Bruno, Hound Dog, Budda and others. Even big factories are getting into it: Mesa-Boogie, which made their name with big 6L6GC "hot rod" amps, now has EL84 amps like the Subway Blues combo and the 20-20 Stereo rack-mount unit. Crate, better known for their low-cost solid-state amps for beginners, now sells the E112 combo amp with two EL84s in the classic circuit, with an all-tube preamp section. Hiwatt, recently revived by Japanese guitar manufacturer Fernandes, has a small EL84 combo amp. The unique distortion of the EL84 has become a major paradigm of rock guitar sound.

## Tests

As usual, we subjected a wide array of EL84 types to both electrical and listening tests. In this case, because the EL84 is now nominally a guitar tube, we place extra emphasis on the guitar-amp tone tests. Even so, past VTV tests have shown unexpected correspondences between guitar tones produced by certain tubes, and their measured distortion. Peak power was checked but proved to be very similar for all the tubes listed below.

**Table 2 - DISTORTION OF EL84s AT ONE WATT RMS**

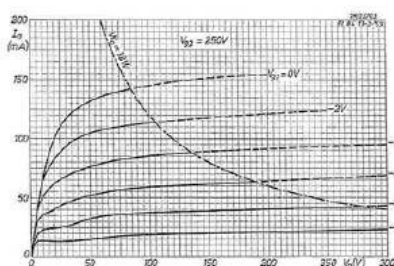
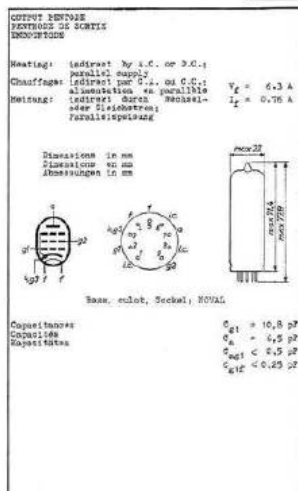
Tests were done at 300v plate, 300v screen, 50 mA idle current, into a 3200-ohm load, using the same test amp and distortion analyzer as in previous VTV tests. All tested tubes bore EL84 or 6BQ5 markings except as noted. Used tubes were verified for transconductance on a tube tester beforehand.



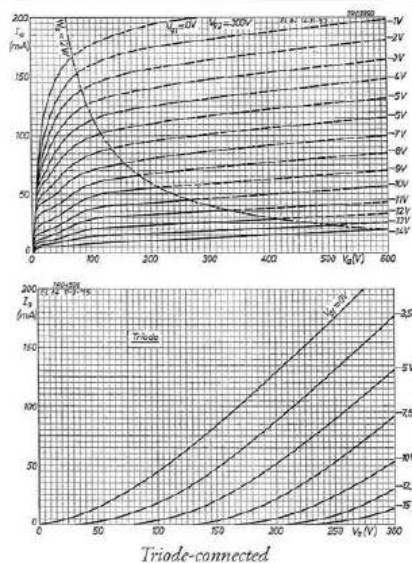
# EL84: THE BABY WITH BITE

**PHILIPS**

**EL 84**



Original Philips EL84 data sheet  
and curves



Type	Dist.	Samples
Tungsram Hungary 1970s	0.52 %	2 used
RCA 7189 1960	0.60	2 used
Raytheon "Uniline" 1970s	0.60	2 used
Amperex Globe 1973	0.65	2 used
Ei current production	0.65	2 NIB
Telefunken 1960s	0.65	2 used
Amperex Bugle Boy 1968	0.70	2 used
Sovtek current production	0.72	7 NIB
Sylvania 1980s JAN	0.73	2 used
Amperex Bugle Boy early	0.75	2 used
Sovtek/Reflector early '90	0.75	2 NIB
Mullard 1960s	0.76	2 NIB
Philips/Syl 7189 1970s	0.77	2 used
Raytheon 7189 1960	0.79	1 used
Matsushita 1970s	0.86	2 used
Philips/Syl 7189A 1980s	0.86	1 used
Tung-Sol 1960s	0.87	2 NIB
GE 6BQ5 1970s	0.92	2 NIB
Sovtek EL84M current	0.92	1 NIB
RCA 7189A 1970s	0.95	1 NIB

Note: NIB = "New In Box"

The Raytheons above were physically identical to the Amperex globe EL84s, so it's safe to assume they were made by Philips and rebranded. We already had discovered that the low-cost Sovtek EL84 is a good sounding tube, making it a best buy (and better-sounding than the premium EL84M).

Compare these figures to the listening tests in the sidebar, and draw your own conclusions. Since many, many EL84s have been made all over the world in the

last 40 years, it was impossible to get samples of them all. We have tried to concentrate on versions that are often seen in today's marketplace. Of course, that doesn't count tubes (or, should I say, the tube) that is similar to the classic EL84 yet not compatible with it.

Since the Svetlana 6BM8 is not really close to the EL84 in its basic ratings, we left it out of this test. However, Svetlana recently introduced a new tube, the SV83, which might be called a brother of the EL84. The SV83's pinout is similar to the EL84, except for a built-in shield. (The tube was intended for video amplifiers, like the old EL83; it could not be called an EL83 because the pinout is unique). The SV83 can NOT be used in most EL84 amps! The screen grid of the SV83 is rated 200v maximum. As we verified, plug this tube into a typical EL84 guitar amp with 350+v on both screen and plate, and its plate current will run away. We used the same equipment as before to test sample SV83s versus Sovtek EL84s, with one change: regulated 150v was attached to the screen grid, rather than 300v.

Table 3 - SV83 vs. EL84

Test parameters as in Table 2, except regulated +150v on screen grid.

Type	Dist.	Samples
SV83 Svetlana	0.69 %	4 NIB
EL84 Sovtek	0.72	4 NIB

The SV83 is NOT USABLE IN

MOST GUITAR OR HI-FI AMPS. Do not attempt to use it unless you are certain that the screen voltage is 200v or less. One interesting discovery was that the SV83 was much more sensitive than any of the EL84s tested. So, if properly operated, it has great potential for new applications in guitar or hi-fi amplifiers.

## Exit

Accident has determined the basis of tube sound at the end of the 20th century, although some engineering went into the equation. More worthy tubes, such as big TV sweep tetrodes, have been elbowed into history by tiny, inexpensive things like the EL84. Its continued manufacture in several locations, and its continued popularity as a music maker, will take it into the next century.

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A special thanks to British tube collector Phil Taylor for his assistance.