KEL 84 Amplifier Description by Noel Keywood

Valve amplifiers offer superb sound quality, They have a sweetness and lucidity that defies transistor amplifiers. Trouble is, commercial valve amplifiers are expensive, whilst building one at home seems a daunting task to many people.
Here is an inexpensive, easy to build design that has enough power to go loud with modern, sensitive loudspeakers. It`s aimed at enthusiasts and beginners who want to experiment but fear committing sums of money and time on the unknown.

KEL-84, as we call it, produces 15W per channel, has choke smoothing and is as quiet as a dormouse, when there`s no music playing that is. With a printed circuit board (PCB) to minimise wiring errors, this is one easy amplifier - easy to build, easy on your wallet and on your ear!

Powerful valve amps of 40W or more run at very high voltages (500V+), demanding expensive transformers and capacitors. High power output valves are costly too and, eventually they need replacement. Here in Hi-Fi World towers, where enthusiasm overcomes fear, we`ve had plenty of experience with esoteric high voltage designs. Our masterpiece was a 211 amplifier running at 1200V, with transmitter rectifiers in the power supply. This is something we would never commercialise though, for safety reasons. The output transformers were wound by a power line transformer company solely for their knowledge of safety requirements at such high voltages. We provided the winding instructions; they worried about the insulation (so did we!).

KEL-84 is a kitten by comparison but at the same time nearly every valve enthusiast started out building a design like this, thinking "wow!" and going on to build bigger and better designs. High voltage triodes like the 211 and 845 are amplifying devices to aspire to, or expire to if you touch the wrong pin.

Within the worldwide hi-fi industry there are plenty of valve enthusiasts, old and young, who entered hi-fi by first building a modest valve amplifier like KEL-84. The internet, that wonderful place where individual talent shines so bright, is another testament to the valve`s (or "tube" as it is more commonly known) wonders and mysteries. Yet it is not easy to find a starter design, especially one from a uniquely talented engineer like Gary Devon prepared to address real life wants. Simple designs are often rather esoteric, such as low power (3W) single-ended types that offer great simplicity but also very little volume from everyday hi-fi loudspeakers.

KEL-84 will go loud and it will give the same basic tonal balance and intrinsic accuracy as a solid-state amplifier. By this I mean it is fundamentally accurate. Vintage amplifiers were commonly unable to swing full output at high frequencies, a large reason for their comparatively soft, warm sound. It did not matter so much in the early days of the LP but CD and DVD produce a lot more energy up to 10kHz and slowly declining energy levels that extend past 20kHz our measurements show. KEL-84 can swing full output at 10kHz and reproduce harmonics out to 50kHz (-2dB), the limit of DVD video sound track (24bit at 96kHz sampling rate) audio. It is a modern design that meets today`s requirements. Distortion is low, through the use of Ultra-Linear working that requires output transformer taps. Noise is minimal too, with one of the lowest hum levels ever from a valve amplifier through the use of DC heaters. So although KEL-84 is a budget design, it isn`t a cost cut design, nor an unsophisticated one. What you do get though

is that wonderful sweetness, lucidity and naturalness that only valves provide.

Why do they sound different? We are not certain. Most of the theories, like the presence of second harmonic distortion, are a bit simplistic. Valve amplifiers with almost no distortion, like our Kit/Kat-88 designs, still retain all the clarity and freedom from harshness that is the hallmark of a valve amplifier. It seems likely that their sound is a function of many beneficial properties. It is rarely stated that transistor amplifiers are so inherently poor (i.e. distorted) that they must have feedback applied. It is not possible to design a solid-state audio amplifier without feedback (local or loop).

By way of comparison, valve amps are so inherently good that they do not need feedback. It is of arguable benefit.
There is a paradox in the use of feedback: the more it is needed the worse an amplifier must be. That it works is unarguable; that it is the real solution is arguable. If amplifiers were better in the first place they wouldn`t need something to make them work properly.
Although KEL-84 has feedback applied it is a relatively small amount, enough just to "tiddle" the performance figures so they are modern and appropriate, as people expect.
Then there`s the sheer simplicity of valve amplifiers. Fewer components and fewer amplifying devices make for a cleaner, less coloured sound. They are very transparent sounding and particularly amenable to tuning by the addition of special high quality components.
Simplicity makes assembly easy for beginners, and valves are robust too. They will survive abuse. They are well suited to DIY.
Valves do wear out of course, having a life of a few thousand hours. The EL-84s used in this amplifier are plentiful though and cheap. Our use of auto-bias means bias re-adjustment is unnecessary when a valve is changed.

With 380mV input sensitivity KEL-84 will match any modern source, be it MD, CD, DVD or tuner. So it can form the centre of a system. It`s always satisfying to build your own kit and this is a great way to start out. The amplifier`s easy going, fluid sound will make it all worthwhile. Valve amplifiers offer superb sound quality, They have a sweetness and lucidity that defies transistor amplifiers. Trouble is, commercial valve amplifiers are expensive, whilst building one at home seems a daunting task to many people. Here is an inexpensive, easy to build design that has enough power to go loud with modern, sensitive loudspeakers. It`s aimed at enthusiasts and beginners who want to experiment but fear committing sums of money and time on the unknown.

MEASURED PERFORMANCE

KEL84 produces 15W into an 8ohm load, which with a sensitive loudspeaker will give good volume levels in the average room. The World Designs loudspeaker kits, with a flat impedance curve, are a good match for a small amp like this, although in practice valve amps are far more able to cope with difficult loudspeakers than theory suggests.

Frequency response extends from 17Hz up to 30kHz (-1dB) with a smooth roll-off above this frequency, so KEL84 covers the audio band and beyond quite confidently.

The use of d.c. heaters keeps hum down to a very low 0.4mV on each channel, making

it virtually inaudible even at the loudspeaker. We usually aim for 1mV, which is inaudible at the listening position, but can be heard as a gentle hum at the loudspeaker. Some find this disconcerting, even though it does not affect sound quality. Directly heated triodes like 300B and 211 produce 2-3mV of hum even with hum bucking, yet have a reputation for superb sound quality, so hum is no arbiter of quality. However, it is satisfying to produce a silent amp and KEL84 manages to be supremely quiet. Hiss is just about inaudible at -98dB CCIR weighted.

The use of ultra-linear operation where the screens work from primary tappings contributes to a low distortion figure of 0.02% at 1kHz, 1W output. Distortion rises to 0.15% at 10kHz, 1W output, comprising second and third harmonics only. At full output distortion rises to 0.3% in the midband and 1% at 10kHz, but again low-order harmonics only appear. This is a good, clean performance, free from the high order harmonics that add roughness and grittiness to an amplifiers sound. Indeed, a valve amp`s sound usually thickens up and gets muddled at overload, rather than producing the ripping sound of solid-state, mainly due to the lower levels of feedback used. This is why valve amps seem to go much louder than their power output suggests.

KEL84 measures well in all respects. It`s a quality design for beginners that offers a sweet alternative to solid-state, since the EL84 valve has a great reputation for sound quality.

SOUND QUALITY by Simon Pope

The quality that can be gleaned from this amp is a fine introduction to the joys of the valve sound. The KEL84 will highlight all the intricacies and depth of detail in your favourite recordings whilst retaining a warmth and fullness. This combination of both detail and warmth is almost the exclusivity of pure valve amps and is rare at this price point.

Playing an Opus3 recording of Eric Bibb`s "Good Stuff" highlighted just what this amp is capable of. Using our own KLS14 high sensitivity, infinite baffle standmount KEL-84 revealed a delicate yet controlled sound. This recording is all-acoustic and guitars had ambience and an luminosity that was very involving, with details such as hand movements along the bridge as clear as a bell. Eric Bibb`s plaintive voice was positioned nicely forward of the `speakers, with a touch of warmth added to the slightly dry voice. This amp excels with this type of fare.

Moving on to the excellent SACD/CD hybrid disc of Faure and Ravel`s piano trios on the Hyperion label, the KEL84 demonstrated its deft and graceful handling of the music. The imaging and depth in this recording is near perfect and KEL-84 made the most of the simple but effective mix. Balance between the piano and strings was perfect - the piano placed, with the right amount of sonic weight, slightly to the back right whilst the string soloists bowed with dexterity in front. The KEL84 handled the dextrous playing deftly and gracefully, bringing a high-end sound to the performance.

This amplifier manages to combine presence and depth to recordings, matched by a smooth and rounded overall sound which simply defies it`s humble price tag. It has good, controlled bass weight and an exceptionally sweet sound in upper frequencies.

It`s a great introduction for those uninitiated to the valve-sound world, a subtle and sophisticated performer for those who crave more presence from their music.

KEL84 CIRCUIT DESCRIPTION by designer Gary Devon

KEL84 uses a very simple circuit, possibly as simple as is possible for a push-pull amplifier. The signal first passes through the input switching and volume control network then via a grid stopper (R4/5) to the input stage of the amplifier.

This first amplifying stage uses the pentode section of an ECF80 triode / pentode valve. Here, a pentode is used with associated components to get sufficient gain to enable some overall feedback to be applied, while retaining the sensitivity needed for an integrated amplifier.

R10/R11 is the anode resistor, whilst R6/R7 and C4/C5 form the voltage dropper and decoupling network for the screen grid (pin 3). R8/R9, C6/C7 and R32/R33 form the cathode / feedback network with compensation capacitor C16/C17 to ensure a clean square wave.
R34/R35 and C16/C19 form a step network across the anode load resistor of the input stage. These components are necessary in this circuit to form a well defined open loop response ensuring stability when the feedback loop is closed.

The voltage amplifier formed by the pentode feeds directly into the phase splitter which is of the Concertina type. This phase splitter uses the triode section of the ECF80 with equal anode and cathode resistors, R12/R13 and R14/R15. The DC potential from the anode of the pentode provides the necessary DC bias point for the Concertina.
The ECF80 is a commonly available valve. It was used extensively in televisions and radios of a bygone era. It`s a shame this valve isn`t used more often because it has a super smooth, colourful sound quality.

C8/C9 and C10/C11 are the DC blocking/ coupling capacitors from the phase splitter to the output valves, a pair of EL84 pentodes. The EL84 really is an excellent little valve, one of the best sounding output valves available. It has a warm and sweet sound together with superb micro and macro dynamics which belie it s relatively small power rating.

Also, modern EL84s are rugged little valves, especially the Russian EL84M which has an increased anode power rating of 14W as compared to the 12W of Mullard`s original.
In KEL-84 they are operated with cathode or automatic bias. The cathode resistors R24/R25 and R26/R27 develop the bias potential and decoupling is performed by C12/C13 and C14/C15. R16/R17 and R18/R19 are the grid resistors and R20/R21 and R22/R23 are grid stoppers.

The output transformer has Ultra Linear taps to allow experimentation with this mode of operation. These taps are at 12.5% of the total primary winding which is a little less than that used in vintage amplifiers, where 15% to 20% was commonly used for the EL84. Ultra Linear operation attempts to convert the pentode's characteristic to something similar to that of a triode. Hence Ultra Linear`s other commonly used name

which is "partial triode operation". If one could imagine the screen grid being connected directly to the anode, then the valve would operate as a triode. At the other end of the scale, with the screen connected directly to the H.T. line then we have pure pentode operation. Ultra Linear mode takes the screen grid to a tapping point on the output transformer primary which is somewhere between the triode and pentode extremes, giving a similar power output to the pentode condition but with the triode`s mainly second harmonic distortion structure. It is entirely possible for the experimenter to change the operation of the output stage of KEL84 by moving the screen grid connection around. The kit is supplied wired for Ultra Linear, but by changing the screen grid connections of the output valves Triode, Pentode and Ultra Linear operation can be tried. With triode operation the power output will drop drastically however. We didn`t get enough time in the lab to get measurement results for all these operational modes, but we will try to publish results and modification tips in the next supplement.

The power supply is a semiconductor rectified unit with capacitor input. The H.T line is further smoothed with an inductor and capacitor combination for the output stage. Further decoupling is achieved by R1 and C3 for the input stages.

GRID STOPPER

A "grid stopper" is a resistor used to prevent oscillation. It is wired hard up against the input of a valve by cutting the resistor`s lead as short as possible.
Grid stoppers range in value from 1k-5k usually. You can see them in the diagram above as R4/5, R20/21 and R22/23. They do not attenuate the signal since they are working into a high impedance of megohms.

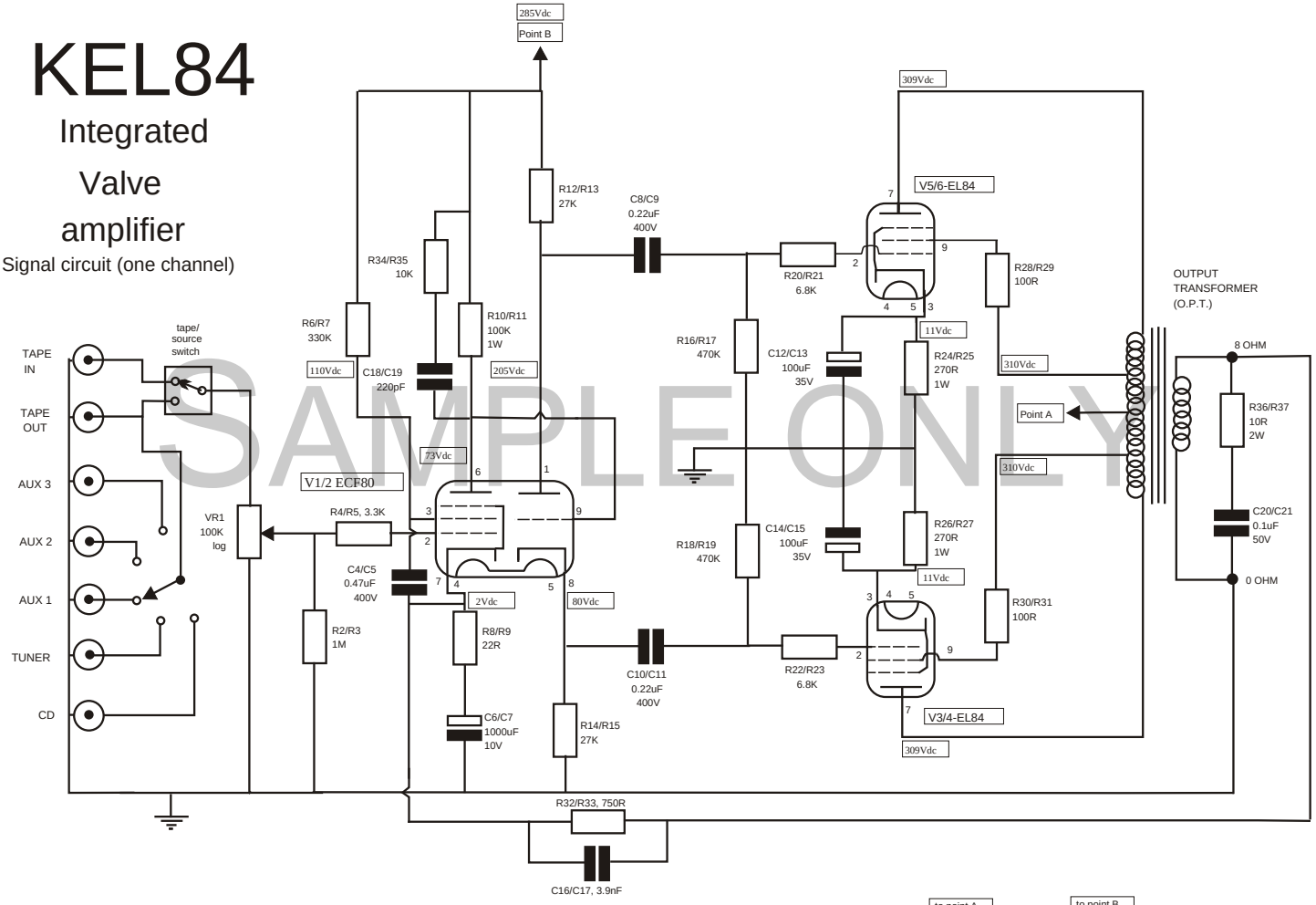
SAFETY

Although KEL-84 is an easy build we do not recommend you tackle it if you lack simple basic skills, such as the ability to solder, and are unacquainted with electricity. Exposed electrical connections inside carry potentially lethal voltages (320V). Safety gloves (500V DC rating) are necessary when testing, since they make electric shock impossible. These are available from our online catalogue.

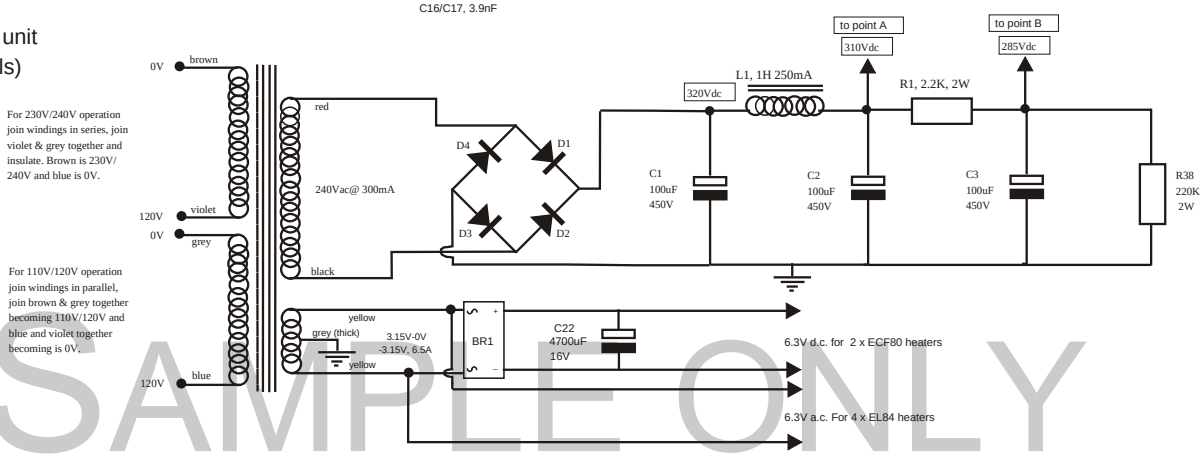
KEL84

Integrated Valve amplifier

Signal circuit (one channel)



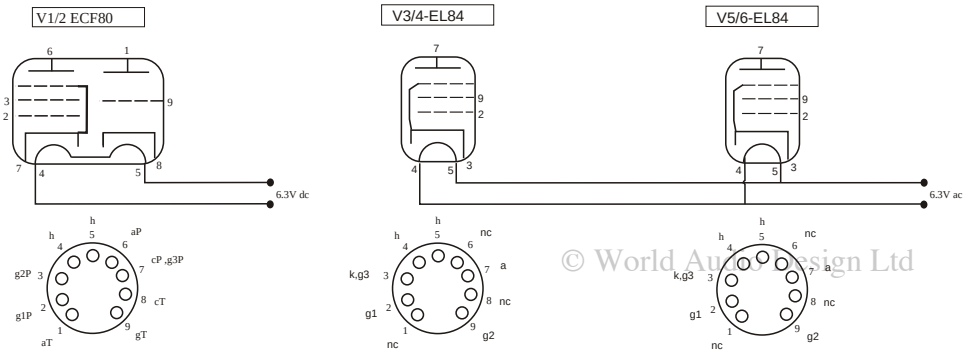
Power supply unit (both channels)



For 230V/240V operation join windings in series, join violet & grey together and insulate. Brown is 230V/ 240V and blue is 0V.

For 110V/120V operation join windings in parallel, join brown & grey together becoming 110V/120V and blue and violet together becoming is 0V.

VALVE PIN LAYOUT



Views are from underneath valve or valve holder

h = heater hct = heater centre tap c = cathode a = anode g1= grid 1 g2 = grid 2 g3 = grid 3 nc = no connection (T=triode P=pentode for V1)