

When I first published my semiconductor phono preamp some ten years ago,<sup>1</sup> I never thought I would try to make a tube version of it. It is hard enough to deal with the necessary low noise levels for MC (moving-coil) pickups using semiconductors, but with a pure tube MC phono, it is practically impossible to achieve the same quality of noise performance that exists in the best semiconductor models. Even if you use tubes having the lowest noise—such as the EC86 with an equivalent noise resistance of 250Ω—and parallel a number of them, it will always sound noisy compared to semiconductors.

This was not an issue in the golden days of tube audio, because the pickups at that time, mostly MM (moving-magnet), had much higher outputs than the current MCs. So when the MCs appeared, people had to use input transformers. Some of these were of high quality, providing very satisfactory performance, but they tended to be expensive, and not everyone could afford them.

The solution is, of course, to combine old and new technology: use low-noise JFETs to manage the input-noise problem, and let tubes handle the large signals. Then you will get the best of both worlds: low noise and high overload capability. And it sounds good, too.

### MC-Preamp Considerations

I don't believe much has happened in terms of pickup sensitivity in the last several years. Most MCs fall in what I call the medium output category, which means an output of approximately 0.5mV at 5cm/s RMS lateral velocity. This is about 20dB lower than the normal MM output of 5mV. Naturally, there are lower output pickups than 0.5mV, but they need an additional gain. The high-output MCs are very close to the MMs and need no extra gain. Overall, an extra gain of up to 30dB can be necessary in front of the MM input to handle all MCs on the market.<sup>1</sup>

Two advantages of tubes are that they work with very high supply voltages and that their signal-handling capability is significantly better than that of transistors. It is easy to envisage an output voltage of 30–40V RMS from a tube stage, compared to the usual 5–10V of transistor amplifiers. So the upper limit of the amplifier's "dynamic range" is very good with tubes.

But what about the lower limit, which is normally restricted by noise? Here, semiconductors are much better than

tubes. Suppose you want an 80dB signal-to-noise ratio in an MM system. Referred to 5mV, the input noise of a phono stage must be less than 0.5μV. This is just about the limit of what is possible with simple tube circuitry. However, if you want the same signal-to-noise ratio in an MC system with 0.5mV output, the input noise must be less than 50nV, which would be very difficult with tubes. In fact, such noise levels are not easy even with semiconductors.

Clearly, a compromise is necessary, and the best one I have found is to use semiconductors to handle the low noise and tubes to work with the large

signals. This is done in a cascode circuit, where the lower part of the cascode is a low-noise, dual JFET, and the upper part is a low-noise dual triode.

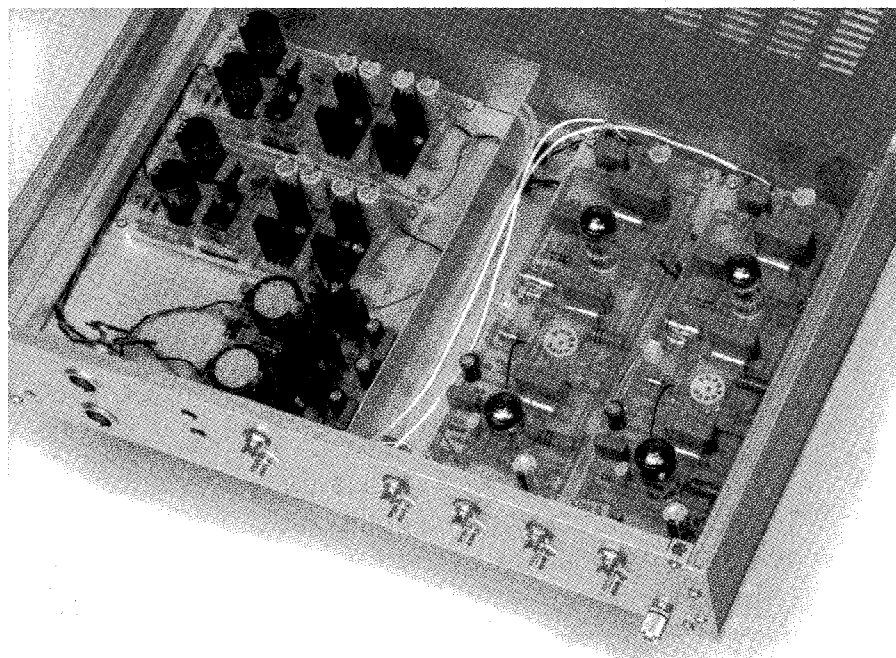
### The MC/MM Phono Preamp

The EB-1195/221 MC/MM phono preamp is a high-quality, two-stage tube preamplifier with approximately 63dB gain on the MC input and 44dB gain on the MM input. The circuit uses three tubes and one dual, low-noise JFET per channel, and works without feedback (*Fig. 1*).

The MC input stage is a low-noise, hybrid circuit made up of dual (or two matched) JFETs and a 6922 double tri-

# AN MC/MM PREAMPLIFIER

BY ERNO BORBELY



**PHOTO 1:** Prototype of phono preamp, with only MC input tube installed. Note the two HV regulators and dual-filament regulator on the left-hand side. Two LEMO connectors are used for the AC connections from the transformer.

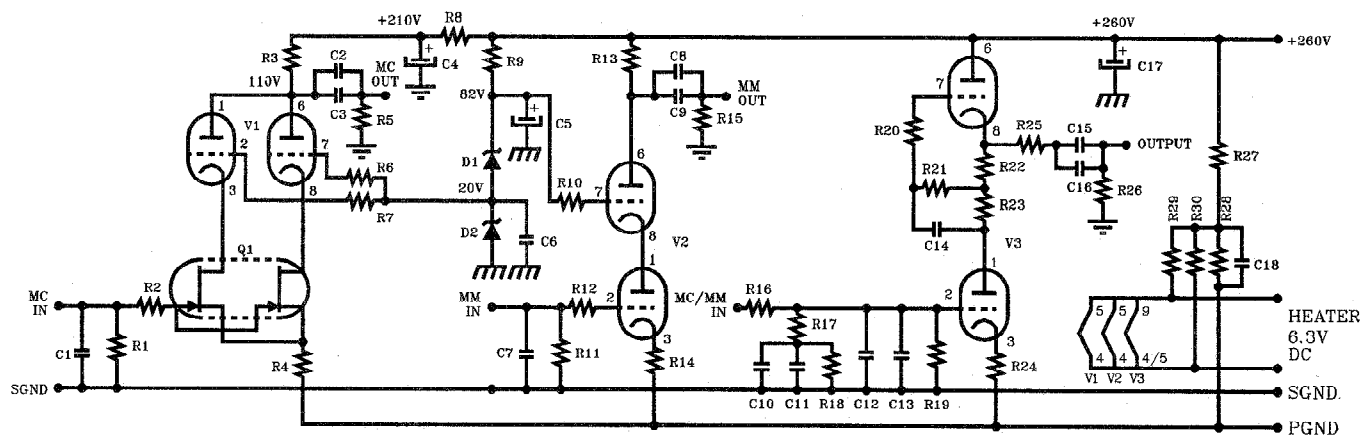


FIGURE 1: MC/MM phono preamplifier.

ode. The two JFETs and the two halves of the double triode are connected in parallel and then in cascode. The cascode circuit derives from high-frequency amplification, where low noise, wide bandwidth, and overload capability are the major requirements.

The current in the input stage, determined by the JFET source resistor R4, is set to about 10mA to optimize noise. The reference voltage for the triodes develops across a 20V zener diode. The voltage drop across V1 is 90V, the maximum permitted for the tube. The stage must be supplied from +210V, which can be derived from the main 260V supply through a 3.3k/4.5W resistor, or from a second regulated supply of 210V (see below).

Typical specifications for the MC input stage (all specs measured with 100k load):

Gain	50dB
Frequency response	-3dB at 80kHz
THD	1V 0.08%
	3V 0.25%
	10V 0.8%

The distortion is second harmonic. Equivalent input noise: 120nV

### MM Input Stage

The MM input stage is a cascode-connected 6922. The reference voltage for the cascode tube is 80V, developed across two zener diodes. The circuit works at around 9mA to get the best noise performance.

Typical specifications for the MM input stage (measured with a 100k load):

Gain	30dB
Frequency response	-3dB at 80kHz
Distortion	0.3V 0.027%
	1V 0.05%
	3V 0.15%
	10V 0.5%
	20V 1%

All distortion is second harmonic. Equivalent input noise: 0.6µV

Both MC and MM inputs have an impedance of 47k. If you need other terminating resistors for your pickups, you can solder the appropriate resistor either on the PCB or on the input connector. Capacitors C1 and C7 are soldered on the PCB. Again, you might want to leave these off the board and solder the appropriate ones on the input terminal or connector. You can also place both the terminating resistor and capacitor on a back-panel switch.

Both input stages use the 6H23P-EB/6922 Russian military tube, which has the lowest noise I have ever measured on any tube. Equally important, it has practically no microphony. You can use other equivalent tubes, but, although they might provide better sound, they would probably degrade the circuit's noise performance. Our kits are deliv-

TABLE 1

### PARTS LIST FOR PHONO PREAMPLIFIER

#### EB-1195/221

##### Resistors

R1, R11**	47k5
R2	2.21Ω
R3, R13	10k, 1%, 2W, ROE MK-8
R4	12.1Ω, adjusted for 10mA
R5, R15, R21, R26**	1M
R6, R7, R10**	1k
R8*	3k3, 4.5W, ROE WK-8
R9	33k, 4.5W, ROE WK-8
R12, R20, R25**	47.5Ω
R14**	150Ω
R16**	75k
R17**	8.25k
R18	412k
R19	2M20
R22, R24**	825Ω
R23**	10k, 2.3W, ROE WK-5
R27	150k, 1.4W, ROE WK-4
R28	100k, 1.4W, ROE WK-4
R29, R30	470Ω, 1.1W ROE WK-2

All resistors are ½W, 1% metal film, unless otherwise noted.

##### Capacitors

C1, C11	2200pF, 160V or 630V, PP
C2, C8, C12, C15	10nF, 160V or 630V, PP
C3, C9, C14	0.22µF, 400V, WIMA MKP-10
C4, C17	10µF, 450V, ROE EKO
C5	47µF, 100V, ROE EKO
C6, C18	0.1µF, 400V, WIMA MKP-10
C7	100pF, 160V or 630V, PP
C10	39nF, 1%, 63V, RIFA PHE 425
C13	3.3nF, 160V or 630V, PP
C16	1µF, 250V, WIMA MKP-10

##### JFET, Tubes, Diodes

Q1	2SK146BL, or 2x2SK147BL matched
V1, V2	6922/E88CC Russian
V3	ECC83/E83CC Tungstam
D1	62V, 1W zener, ZPY62
D2	20V, 1W zener, ZPY20

##### Miscellaneous

6	9-pin ceramic sockets with gold-plated contacts
30	1.3mm solder pins
2	EB-1195/221 PCB

\* Leave out R8 if MC input stage is supplied from separate, +210V regulator.

\*\* A Tantalum resistor upgrade kit is available for these resistors (34 × ½W, 2 × 1W).

### ABOUT THE AUTHOR

Erno Borbely has been employed by National Semiconductor Europe for the last 17 years. He was manager of technical training and worked as a consultant in human resources development. He received an MSc degree in electronic engineering from the Institute of Technology, University of Norway in 1961 and worked seven years for the Norwegian Broadcasting Corporation designing professional audio equipment. For a time, he lived in the US and was director of engineering for Dynaco and The David Hafner Company. From 1973-1978 he worked for Motorola in Geneva, Switzerland, as senior applications engineer and applications manager. He is about to take an early retirement from National Semiconductor, and is looking for OEM customers for whom he can design high-end audio equipment. His E-mail address is: BorbelyAudio@t-online.de

ered with the Russian tubes, but we can also provide them with Siemens E88CC or other equivalent tubes. Please see our price list for upgrades.

### The Second Stage

The second stage, common to both MC and MM, contains the passive RIAA equalization and a mu stage. The RIAA

network has an attenuation of 25dB and provides an RIAA accuracy of better than  $\pm 0.5\text{dB}$  across the audio band.

to page 38

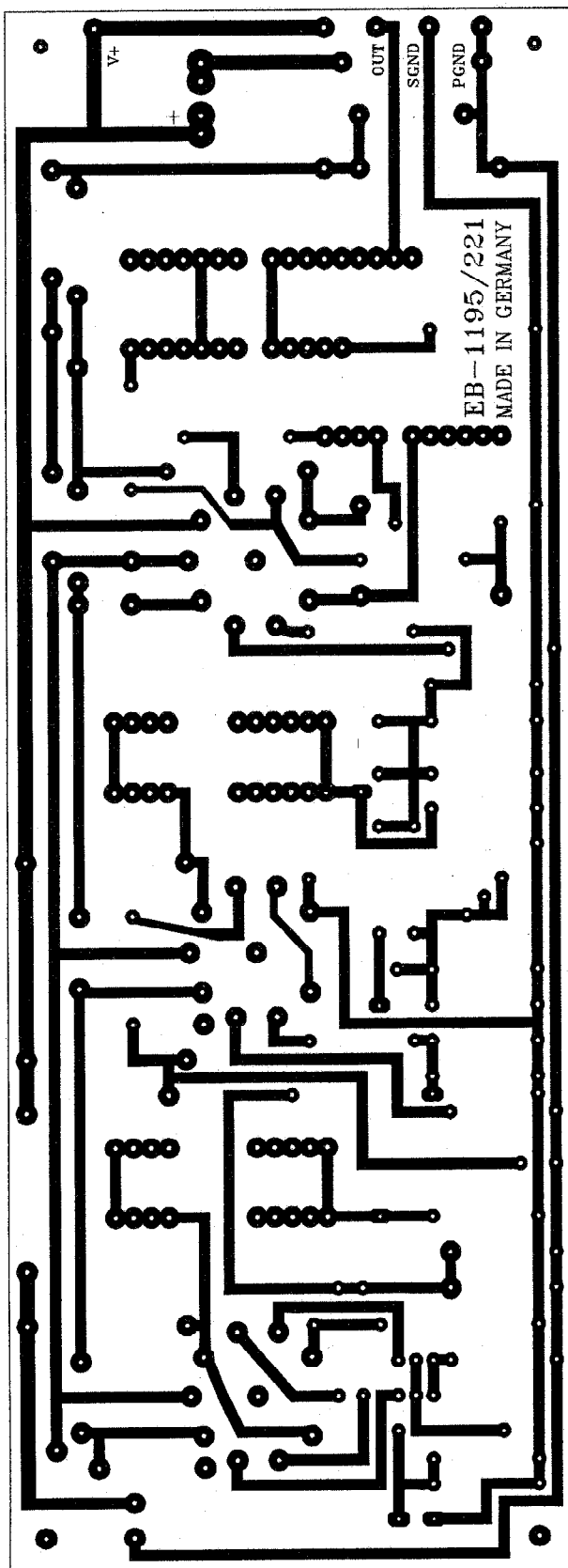


FIGURE 2: Preamp copper side (100%).

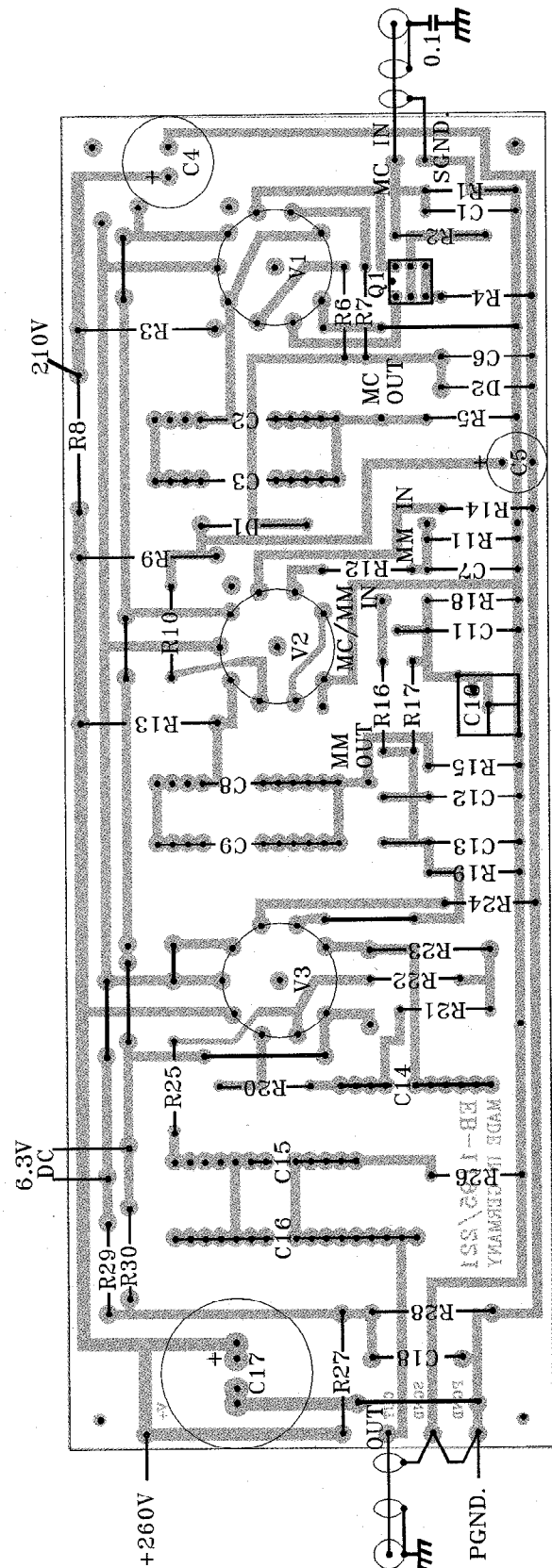


FIGURE 3: Preamp component side (85%).

from page 34

The mu stage uses an ECC83 and operates at approximately 1mA. The typical specifications are:

Gain	38dB
Frequency response	-3dB at 75kHz
THD	1V 0.012%
	3V 0.028%
	10V 0.095%
	20V 0.2%

The mu stage reaches 1% distortion at about 30V and saturates at over 40V. This stage determines the overall distortion of the phono preamp because it works with the highest signal levels. Although the output impedance is reasonably low (several k $\Omega$ ), you can't load the stage very much without loss of amplitude and distortion. The recommended minimum load is 100k, but it can drive 50k without significant losses. A 50k or 100k volume control in the following lineamp works very well.

Note that all coupling capacitors consist of two capacitors in parallel. Although all the coupling caps are polypropylene, I use a smaller one in parallel with a larger. This appears to improve the midrange and the high end of the audio range. The layout accommodates the use of two caps. Feel free to experiment with different capacitors to get the best sound from your amplifier.

In case you wish to experiment with different types of tubes, the second-stage layout allows the use of both ECC83 and 6922 pinout tubes in this position. All that's necessary is to reconfigure the filaments: the 6922 needs 6.3V between pins 4 and 5; for the ECC83, connect pins 4 and 5 and make the 6.3V connection between pins 4/5 and 9. In case you use a 6922 here, you should connect pin 9 to ground.

### Combining Stages

Only one of the input stages is operational at any one time, and only the appropriate tube is installed (V1 for MC, or

TABLE 2			
PARTS LIST FOR TWO-OUTPUT MOSFET REGULATOR			
<b>EB-296/218A</b>		Q2, Q3	BUZ92 600V, 3A, Siemens
<b>Resistors</b>		D1, D2, D3, D4	BYT11-1000 1000V, 1A fast rec.
R1	1k, 4.5W	D5	ZPD5.1 5.1, 0.5W, zener
R2, R5, R8	1k, 1.1W	D6	ZPY51 51V, 1W, zener
R3, R6, R9	270k, 1.4W	D7, D8	ZPY100 100V, 1W, zener
R4, R7	10k, 1.1W	D9, D10	ZPY18 18V, 1W, zener
<b>Capacitors</b>		<b>Miscellaneous</b>	
C1, C2	47 $\mu$ F, 450V Radial, Siemens	1	EB-296/218A PCB
C3, C4	0.1 $\mu$ F, 400V WIMA MKP-10	10	1mm solder pins
C5, C6, C7, C8	10 $\mu$ F, 450V Radial, ROE EKO, or Rubycon	2	SK75 heatsink for Q2, Q3
<b>Semiconductors</b>		1	FK209 heatsink for Q1
Q1	2SA1156 400V, 0.5A, NEC	1	Fuse holder/fuse Wickman 19646, 19648 holder and cover
		1	5 $\times$ 20mm, 100mA, medium-fast fuse

V2 for MM). This limits the filament current to about 600mA per channel. If you have two pickups, one MC and one MM, you can operate both input stages and switch between them. The filament current will then be 900mA. The kit comes with all three tubes for each channel.

Due to the high gain and the RIAA bass boost, the circuit is very sensitive

to hum pickup. Hum can come from power supplies or transformers. I recommend using regulated power supplies for both the high voltage and the filament. It is also good procedure to place the mains transformer and the regulators in a separate box for maximum hum protection.

For additional protection, you should

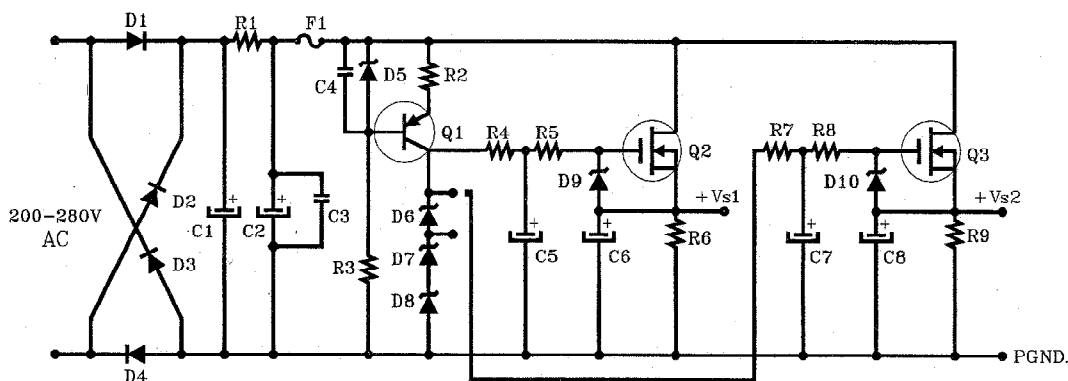


FIGURE 4: Two-output MOSFET regulator.

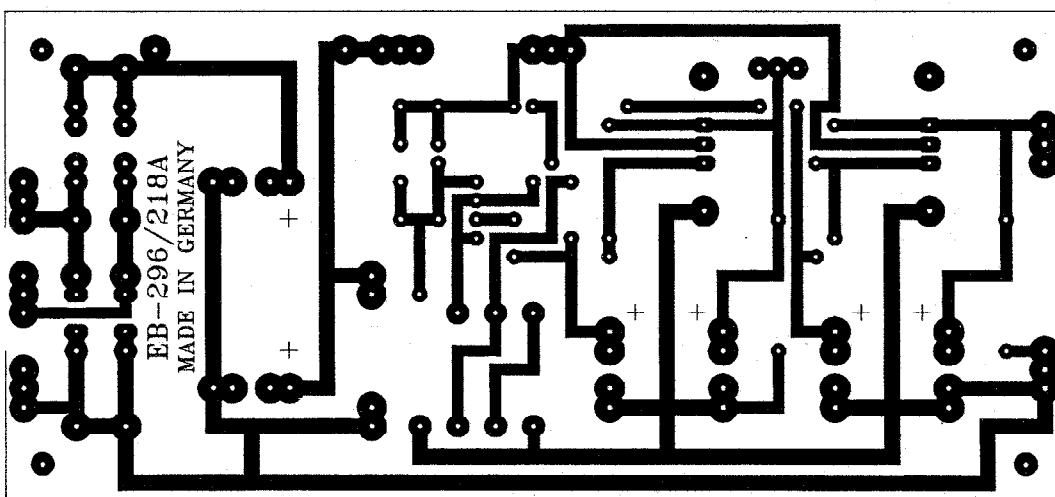


FIGURE 5: MOSFET regulator copper side (100%).

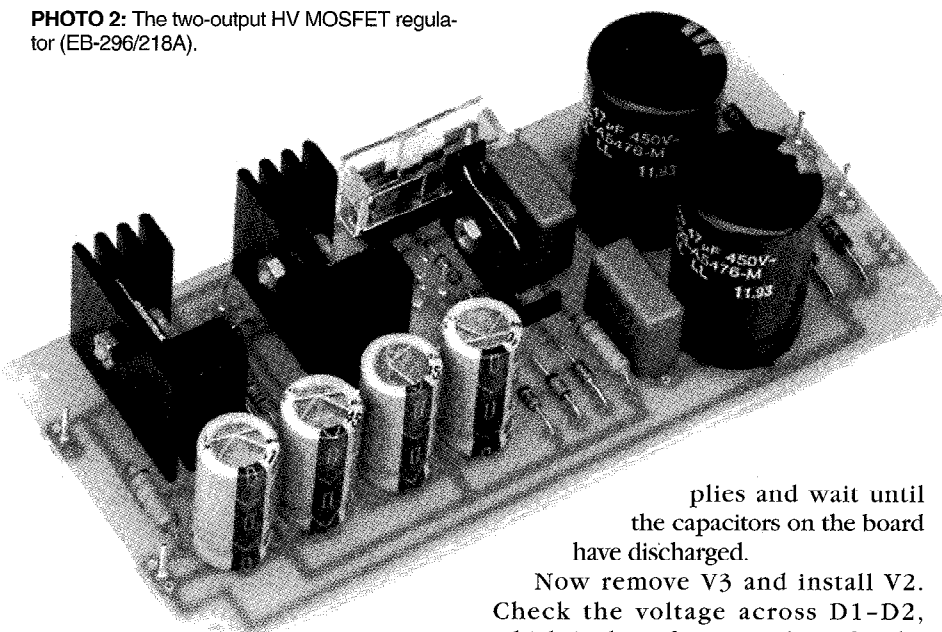
use shielded tube sockets for V1 and V2. Although shielded PCB sockets are not readily available (and are not supplied with the kit), you can make them from shielded chassis-type sockets by cutting off half of the pins with a pair of very sharp pliers, and then grounding the socket and the shield to a ground track on the PCB.

The filaments are biased to approximately +100V, which keeps the maximum voltage between cathode and filament within the limits given in the data sheet. This also helps reduce the tubes' hum susceptibility, which is very important in low-noise circuits like a phono preamp.

### Phono-Preamplifier Setup Procedure

I recommend that you test the amplifier modules separately before building them into the chassis (Figs. 2 and 3). As a minimum, you will need a digital voltmeter (DVM) to set up the circuit. Use utmost caution in testing the circuit, for you are dealing with high voltages. If you have no experience with tube circuits, you should ask an experienced friend or an electronics technician to test your circuit for you.

**PHOTO 2:** The two-output HV MOSFET regulator (EB-296/218A).



plies and wait until the capacitors on the board have discharged.

Now remove V3 and install V2. Check the voltage across D1-D2, which is the reference voltage for the cascode tube. It should be 82-84V. Connect the DVM across R14. The voltage drop is 135mV, indicating a current of 9mA in V2. Also check the anode voltage on pin 6 of V2; it should be close to 170V.

Repeat the procedure of switching off the supplies and discharging the

**NHC BRENNER'S CORP.**  
**MISKOLC**  
**Perczel Mor u.2.**  
**H-3529 HUNGARY**



**Order** : by Fax or letter:  
**Payment**: by Credit Card,  
EuroCard Mastercard, VISA, Bankers  
Draft, Trasfer or Postal money order

#### Our N.O.S. list:

ECC 81	.....	TUNGSRAM	.....	9,0- USD/each
ECC 82	.....	TUNGSRAM	.....	5,5- USD/each
ECC 83	.....	TUNGSRAM	.....	6,5- USD/each
12AX7M	.....	TUNGSRAM	.....	7,5- USD/each
ECC 85	.....	TUNGSRAM	.....	6,5- USD/each
E80 CC	.....	TUNGSRAM	.....	14,5- USD/each
E80 CC	Gp.	TUNGSRAM	.....	18,5- USD/each
EF 40	.....	TUNGSRAM	.....	6,5- USD/each
EF 86	.....	TUNGSRAM	.....	8,5- USD/each
E83 F	.....	TUNGSRAM	.....	5,6- USD/each
AZ 1	.....	TUNGSRAM	.....	9,0- USD/each
AZ 12	.....	TUNGSRAM	.....	11,0- USD/each
AZ 21	.....	TUNGSRAM	.....	5,5- USD/each
AZ 4	.....	TUNGSRAM	.....	7,5- USD/each
AZ 41	.....	TUNGSRAM	.....	5,5- USD/each
PV200/600	.....	TUNGSRAM	.....	6,5- USD/each
PV200/1000	.....	TUNGSRAM	.....	18,5- USD/each
EZ 4	.....	TUNGSRAM	.....	8,5- USD/each
EZ 40	.....	TUNGSRAM	.....	6,5- USD/each

#### All tubes we give the original manufacturer!

EZ 80	.....	TUNGSRAM	.....	5,5- USD/each
EZ 81	.....	TUNGSRAM	.....	6,0- USD/each
ECC82	.....	RFT	.....	4,5- USD/each
ECC83	.....	RFT	.....	6,0- USD/each
ECC84	.....	RFT	.....	6,5- USD/each
EL 84	.....	RFT	.....	6,0- USD/each
ECC82	.....	TESLA	.....	5,5- USD/each
EF806S	.....	TESLA	.....	16,0- USD/each

**Russian tubes:**

...../6H2II-EB	.....	RUSSIAN	.....	4,0- USD/each
.....12BH7(U,-6,3V)/6H6II	.....	RUSSIAN	.....	4,5- USD/each
6N7GT/6H7C	.....	RUSSIAN	.....	3,5- USD/each
6J5GT/6C2C	.....	RUSSIAN	.....	3,5- USD/each
...../6C19II-EB	.....	RUSSIAN	.....	5,0- USD/each
...../6C41C	.....	RUSSIAN	.....	19,0- USD/each
5Y3GT/5II3M	.....	RUSSIAN	.....	2,8- USD/each
6X5GT/6II5C	.....	RUSSIAN	.....	2,2- USD/each
6AS7G/6H5C	.....	RUSSIAN	.....	3,6- USD/each
LS50/IIY-50	.....	with socket	.....	16,0- USD/each

PL509/40KG6...	.....	TUNGSRAM	.....	7,0- USD/each
PL519/40KG6A	.....	TUNGSRAM	.....	9,5- USD/each
RG250-3000/866E with socket	.....			16,5-USD/each
6SL7GT	.....	RUSSIAN	.....	2,9- USD/each
6C5G	.....	RUSSIAN	.....	3,5- USD/each
807	.....	RUSSIAN	.....	8,0- USD/each
5V4GA	.....	RCA	.....	6,0- USD/each
5V4GA	.....	SYLVANIA	.....	6,0- USD/each
E80CF	.....	TFK	.....	12,5- USD/each
E180F	.....	TESLA	.....	6,0- USD/each
E88CC	.....	PHILIPS	.....	9,5- USD/each
ECC86	.....	PHILIPS	.....	5,0- USD/each
6267	.....	USA	.....	8,0- USD/each
E130L	.....	TUNGSRAM	.....	25,0- USD/each
ECL82	.....	TUNGSRAM	.....	3,5- USD/each
EM80	.....	TUNGSRAM	.....	5,5- USD/each
EM84	.....	TUNGSRAM	.....	5,5- USD/each
EC360	.....	RFT	.....	18,0- USD/each
E83F	.....	TFK	.....	8,0- USD/each
6SN7WGB	.....	GEC	.....	8,5- USD/each

All price is export + shipping fee + packing. Min. order: 100USD  
Quantity discount available. We shall send proforma invoice if necessary.  
Shipping: SEA MAIL, AIR MAIL, EMS, UPS, TNT EXPRESS.

#### We will get in small quantity:

2E26/USA; 3B28/GXU1GEC/UE; 8068/GEC; 7586/RCA; 8056/USA;  
7734/USA; E188CC/SIEMENS; E288CC/SIEMENS; E88CC/SIEMENS;  
4B32/GXU2/GEC; E82CC/SIEMENS; QB3/300GA/PHILIPS;  
QB2/250/PHILIPS; QEL2/250/PHILIPS; QE08/200/PHILIPS;  
QQE06/40/PHILIPS/RFT; 6JE6C/6LQ6/GEC/USA; 6JS6C/GEC/USA.

**Our fax number:**  
**36-46-431-742**  
**36-30-807-891**

**NHC BRENNER'S CORP.**  
**MISKOLC**  
**Perczel Mor u.2.**  
**H-3529 HUNGARY**

... and other types: E82CC, E83CC, ECC802S,  
ECC803S, EC80, E180CC, E181CC, E182CC,  
EL3, EL6, EL6spec, 6L6, 6FQ6, etc.

Manufactured: TUNGSRAM, TESLA, TELEFUNKEN, SIEMENS, PHILIPS,

The next Ei/Yugo tubes available: ECC82,  
ECC83, EL34, 6CA7, 6L6GC, KT90, EL519  
big quantity available.

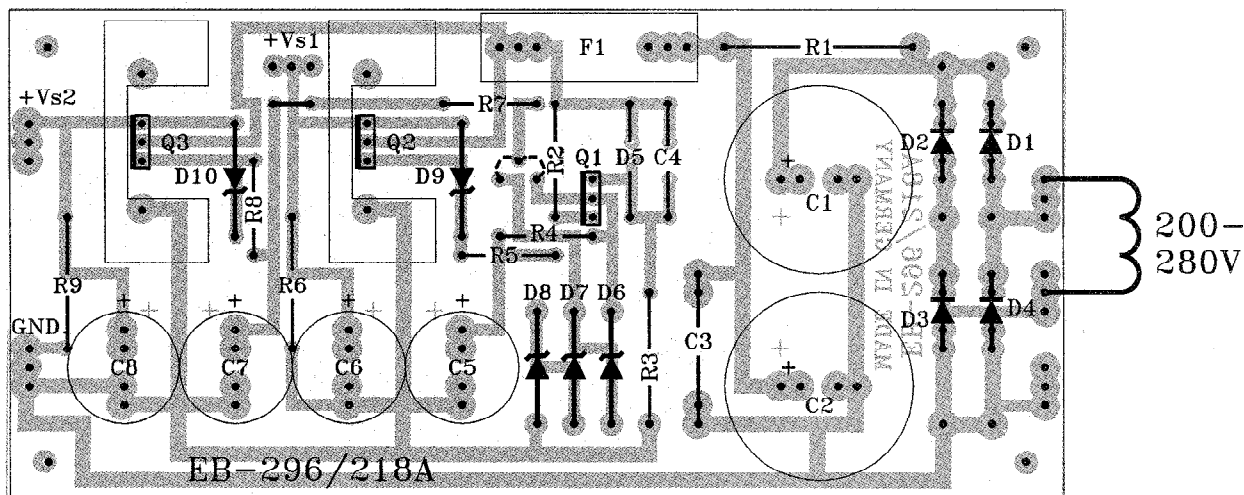


FIGURE 6: MOSFET regulator stuffing guide (100%).

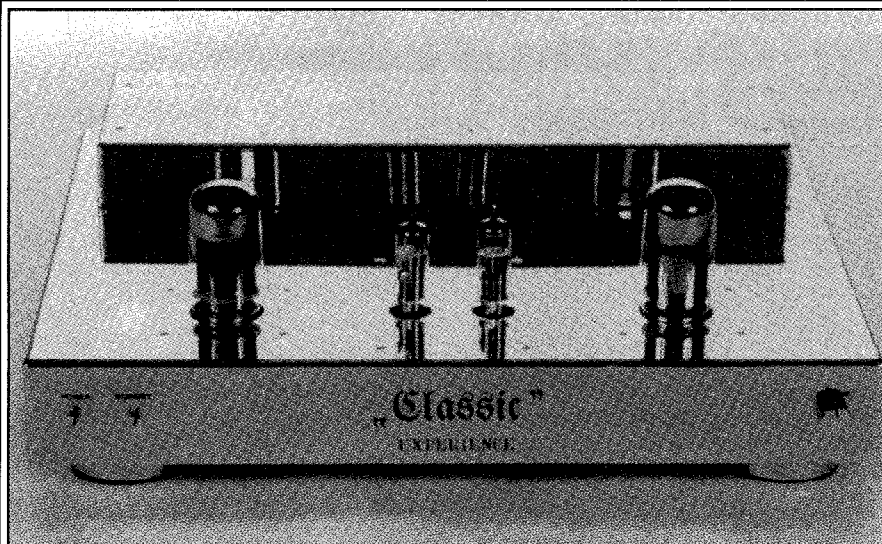
capacitors on the board. Remove V2 and install V1. Then switch on the supplies and check the voltage across D2, which should be 20V. Connect the DVM across R4, where the voltage drop should be 120mV, indicating a current of 10mA. If the current is more than that, increase the value of R4; if it

is less, decrease the value of R4. After adjusting the current to 10mA, check the anode voltage on pins 1-6 of V1, which should be 110V.

If you have audio instrumentation, I recommend you test each stage separately. Connect the audio oscillator to the MC input and measure its performance

at the output of that stage. Similarly, connect the oscillator to the MM input and check the performance there. Finally, connect the oscillator to the second stage (V3) and check it through.

If you wish to check the whole circuit, you may need to connect a 40-50dB attenuator at the input of the amplifier



The "Eintakt-A" Class A Single Ended stereo amplifier 2 x 13 watts. Frequency response 20Hz-20kHz -0.3dB. (<20Hz-50kHz -3dB) Regulated high voltage supply, regulated DC heater supply. Soft start circuitry. Turn off mute circuit, standby switch to select bias level. Tube compliment ECL86 predriver, KT88/6550A output. Optional with 300B's (extra charge).

Excellent sound quality and low distortion makes this an ideal amplifier for use with high sensitivity and horn loudspeaker systems. Flawless nickel plated finish makes this unit a work of art. Experience the difference!

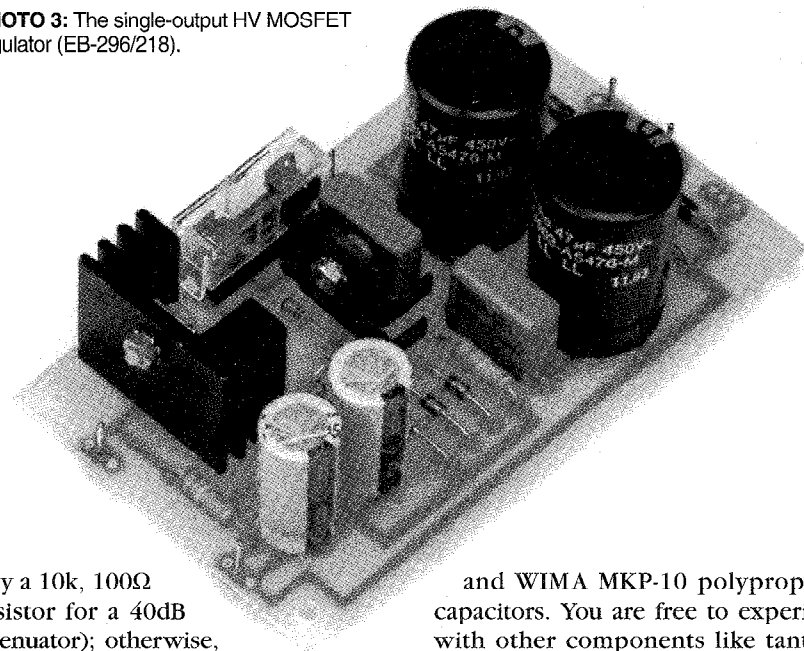
## -EXPERIENCE-

- Classic Series High End Tube Amplifiers from 13W to 180W. Fully assembled or Kit.
- Output and power transformers, chokes.
- Line and moving coil transformers.
- Low cost kits also available.

Experience Electronics, Classic Series, for over ten years these high quality tube amplifiers have been manufactured in Germany by Gerhard Haas, designer and builder of Sennheiser's Orpheus tube headphone amp. All units feature a highly polished Nickel Plated aluminum chassis, Roederstein 1% resistors, Wima capacitors, WBT connectors, custom designed power and output transformers and soft-start circuitry. 3 Year parts and labor warranty on factory assembled units. Mail order only Visa/Master/MO.

**International Audio Group, Inc.**  
**5014 Bending Trail**  
**Killeen, TX 76542**  
**Tel (817) 699-8702**  
**Fax (817) 699-8792**

**PHOTO 3:** The single-output HV MOSFET regulator (EB-296/218).



(try a 10k, 100Ω resistor for a 40dB attenuator); otherwise, ground loops and hum will make the measurements difficult. To check the RIAA accuracy use an inverse RIAA circuit, such as the one described by Lipshitz and Jung.<sup>2</sup> The RIAA accuracy should be within ±0.5dB.

The phono-preamp kit comes with Roederstein MK-2 metal-film resistors

and WIMA MKP-10 polypropylene capacitors. You are free to experiment with other components like tantalum resistors, other capacitors, and so on. I recommend using tantalum resistors in selected locations. These are available as an upgrade kit; please see our price list.

#### High-Voltage Regulator

In order to preserve the low-noise capability of the phono preamp, it is

## Sterling Audio

Custom Crafted Output Transformers

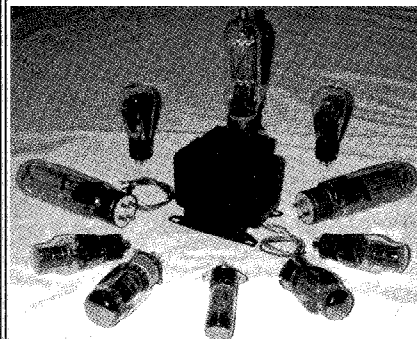
*Made in the USA*

**Pre-Amp & Power Tubes**  
by Tesla, Sovtek, Svetlana, GE, & Others

**Now In Stock**

**9.5Kct Push-Pull 150W OT**  
4, & 8 Ohm Secondary Taps, M6 Laminations  
Endbells, Vertical Type Mounting  
(for use with 211, 845, & Others)  
**Price \$220.00ea.**

*If Interested, Call Us for Details!!!*



#### SA-70 (MA230 Replacement)

5.4K Primary, 4, 8, 16 Ohm Sec. M6 Lams.  
70W Max (Midband); Feedback Windings

**Price \$120.00ea.**

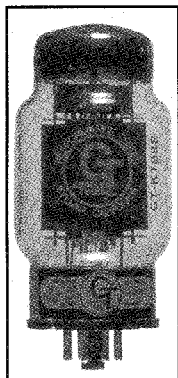
5 Hillcrest Park, South Hadley, MA 01075  
Phone/24Hr FAX (413) 538-7841  
Hours: M-F 4:30p.m. - 9:30p.m. EST

Reader Service #16

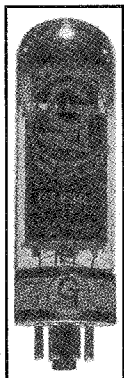
## IMPROVE YOUR HEARING.

We're a company of musicians and engineers in our 17th year researching ways to relate laboratory data measured from a tube to the way the tube will sound. Our unique system produces sets of tubes that have various performance characteristics, much like the choices you'd find in speakers and microphones. Groove Tubes not only sound better and last longer, but cater to the type of music you're producing or listening to.

Our clients include thousands of professional musicians ranging from Stevie Wonder to Chet Atkins and world class recording engineers such as Eddie Kramer and Roy Thomas Baker. Our matched power tube sets are rated 1 to 10 and our preamp tubes are selected for low noise. We also build world class vacuum tube recording mics, tube preamps, tube reference amps, tube equalizers and tube compressor/limiters... and all our GT products are guaranteed to Improve Your Hearing!



Our new GT-888s by **TESLOVAK™**  
The first legitimate European KT-88 made in 30 years. This newly developed beam power tube has special heat dispersion wings welded to the plate structure to help keep the tube's audio performance stable at high power handling levels and Gold wound grids for improved fidelity. Available in Blue and Red Glass.



Our new GT-34Ls by **TESLOVAK™**  
This totally new design upgrades and replaces all EL34 applications, producing more power, wider frequency response and dynamic range than any other EL34 past or present! This new tube also has special heat dispersion wings to improve the audio response at higher power levels and Gold wound grids for improved fidelity. Available in Blue and Red Glass.

TESLOVAK Tubes are exclusive designs manufactured for GT and Penta Labs at the newly reorganized Tesla European factory.

*Send \$5 for a color catalog with power tube comparison charts and a Beethoven sticker.*

*Send \$20 and we'll include a Beethoven T-Shirt.*



**Groove Tubes**

12866 Foothill Blvd., Sylmar  
California 91342 USA

Tel: (818) 361-4500 Fax: (818) 365-9884  
e-mail: GrooveTube @ AOL.com

Reader Service #28



# High Resolution Vacuum Tube Audio Modules

- Design Package w/ PC Boards & Full Instructions
- Blank or Assembled Boards & Finished Units
- Premium Quality Audiophile Grade components
- Active Regulation of All Stages & Channels

## VACUUM TUBE DIGITAL PROCESSOR

- Discrete TUBE Design from DAC to Output
- Proprietary PLL for Ultra Low Jitter
- Separate Regulated Digital, Analog, & HV Power Supplies

## PREAMPLIFIERS & CROSSOVERS

- Daniel II Reference Preamp & Crossover
- DYNA PAS Phono, Line, & Power Supply / Regulator Modules

## POWER AMPLIFIERS

- DYNA ST-70 & MK-3 Driver & Reg Power Supply Modules
- Unique Cascode Diff Amp / Current Source Driver Design
- Ultra Hi Stability Direct Coupled Driver w/ On Board Regulation

POST OFFICE BOX 24605  
SAN JOSE, CA 95154  
PHONE (408) 269-4273

**CURCIO  
AUDIO  
ENGINEERING**

Visit us & view our catalogue & designs at <http://www.enter.net/-cae>

essential to feed it from a power supply having little ripple and noise. Older designs used capacitors and choke filters to reduce the ripple to an acceptable level. I have found that in addition to reducing the ripple, it is also an advantage to regulate the supply voltage, especially in low-level stages, because it tends to improve the imaging. This applies to both semiconductor and tube circuits.

The degree of regulation can vary from circuit to circuit, and in tube circuits you might get away with less regulation than with semiconductors. The important thing is, of course, that the regulator removes the ripple and adds very little wideband noise to the DC.

The EB-296/218A power supply (Photo 2; Figs. 4-6) combines a full-wave rectifier with fast-recovery diodes, high-quality capacitors, and two MOSFET source-follower regula-

## REFERENCES

1. Erno Borbely, "A Moving Coil Preamp," Parts 1 and 2, TAA 4/86, 1/87.
2. Stanley P. Lipshitz and Walt Jung, "A High Accuracy Inverse RIAA Network," TAA 1/80.

Reader Service #61

**Parts  
Express**

NEW  
LINE OF  
TUBE  
BOOKS

## Mullard Tube Circuits For Audio Amplifiers

First published in 1959 by Mullard, Britain's premier vacuum tube manufacturer, this do-it-yourself guide includes eleven vacuum tube power and control amplifier projects. The four chapter tutorial on achieving the best sound from tubes is worth the cost alone! 142 pages. Copyright: 1959, 1993. Net weight: 3/4 lb.

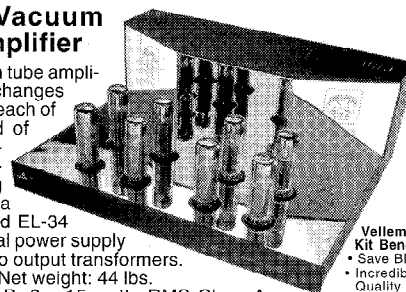


#GA-500-098 ..... \$16<sup>95</sup> EACH

## High Q Velleman-kit Stereo Vacuum Tube Amplifier

For most of us, a high power, high end vacuum tube amplifier is unaffordable. This kit from Velleman changes that ... the classic "tube sound" is now within reach of everyone! The warm, rich, detailed sound of vacuum tubes has yet to be surpassed by either transistors or FETs. In designing this amplifier, special attention was paid to displaying the glowing tubes in a pleasing manner on a beautiful chassis. Kit includes eight matched EL-34 output tubes, two 12AX7s, one 12AU7, toroidal power supply transformer, and two Ultralinear, toroidal audio output transformers. Recommended for experienced builders. Net weight: 44 lbs.

◆Output power: 2 x 95 watts RMS Class AB, 2 x 15 watts RMS Class A  
◆Output impedance: 4 or 8 ohms ◆Frequency response: 4-100 KHz (-3 dB)  
◆Harmonic distortion: 0.08% at 1 watt, 0.63% at 95 watts ◆Signal to noise ratio: >102 dB (A-weighted) ◆Channel separation: >67 dB ◆Input impedance: 100K ohms ◆Input sensitivity: 0.775mV RMS ◆Damping factor: 20.



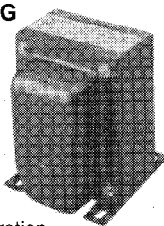
Velleman  
Kit Benefits  
• Save Big \$  
• Incredible  
Quality  
• European  
Design  
• Stunning Good  
Looks

#GA-320-250 ..... \$999<sup>95</sup> EACH

**PARTS EXPRESS NOW STOCKS HAMMOND, SVETLANA, AND SOVTEK. CALL OUR SALES STAFF FOR OUR WIDE SELECTION OF THESE FINE PRODUCTS.**

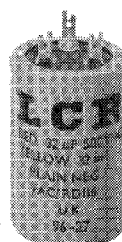
## Hammond Manufacturing Audio Output Transformers

Hammond audio transformers all feature "X" type bell end mounts with a black matte finish. All units include 40% screen grid tap for Ultra-Linear operation and 4, 8, and 16 ohm secondary taps. Frequency response is 30-30,000 Hz (+/-1 dB max. ref. 1KHz) at full output power, not at 1 watt like many manufacturers use!



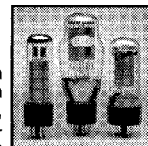
## LCR Dual Section Capacitors

These high voltage, dual section electrolytic capacitors are perfect for tube power supplies. Used in many guitar vacuum tube amps. Each cap is radial style, light blue in color, and has 3 solder lugs. Made in Great Britain.



## SOVTEK® Vacuum Tubes

Parts Express now stocks an extensive selection of vacuum tubes from Sovtek, Svetlana, plus many hard to find USA Military JAN vacuum tubes that are all new and in the original box. Trust Parts Express to be your number one vacuum tube source!



340 E. FIRST ST., DAYTON, OH 45402-1257  
PHONE: 937-222-0173, FAX: 937-222-1644  
E-MAIL: [xpress@parts-express.com](mailto:xpress@parts-express.com)  
WEB SITE: <http://www.parts-express.com>  
Source Code: GAM

**CALL US FOR YOUR FREE COPY OF OUR  
FULL LINE ELECTRONIC PARTS CATALOG  
1-800-338-0531**

Reader Service #10



tors. Using 450V capacitors, the maximum AC input should be limited to approximately 280V. With 400V caps, the AC input should be less than 250V.

R1 and C2 provide additional filtering after C1. You can also use R1 to drop the incoming DC voltage in case the required regulated voltage is significantly lower than the unregulated.

The regulated output voltage is defined by the zener string at the gate of the MOSFETs. This string is fed from a constant-current source to make sure

that ripple is not transmitted to the zeners. The constant-current source, Q1, is again using a zener (5.1V) as a reference.

The 5.1V zener is fed through a 270k resistor, and both it and the string of high-voltage zeners are fed with a current of 1-2mA. The output of the zener string is further filtered with a 10k $\Omega$  resistor and a 10 $\mu$ F capacitor. The 1k $\Omega$  resistors in series with the gate, as well as the 18V zener between the gate and the source, provide protection for the MOSFET in case of overload.

Output +Vs1 is fed directly from the top of the three zener diodes; the second output, +Vs2, can be selected between the top and the second zener. You can therefore have two equal voltages, or one higher and one lower. In the case of the phono preamp, the higher voltage is 260V, and the lower one, which feeds the MC input stage, is 210V. By using different zeners, you can adjust the two voltages to your needs.

Naturally, you can use the two-output regulator in many other applications, such as lineamps, crossovers, and driver stages for power amplifiers, as well as for stabilizing the voltage for grid 2 of output pentodes.

You should heatsink Q1, Q2, and Q3. The heatsinks for Q2 and Q3 are mounted on the PCB, and that for Q1 is free-standing. All heatsinks should be mounted with mica or silicon rubber for insulation.

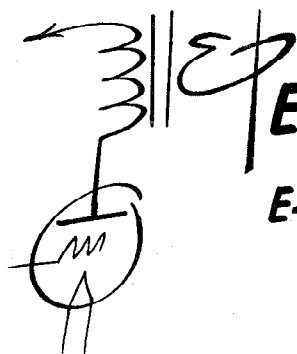
#### Regulator Setup Procedure

To test the regulator, connect 27k, 4.5W resistors to both outputs. Connect 250V AC to the AC input. Insert a 100mA medium fuse in F1. If you have a Variac, increase the mains slowly and monitor the output voltages with a DC voltmeter. The DC should stabilize close to the zener reference voltage(s) after a couple of minutes. If you have a scope or an AC mV meter, check the ripple at the output. It should be less than 5mV peak-to-peak.

Borbely Audio also offers a simplified version of the high-voltage regulator with only one output (type number EB-296/218) (*Photo 3*). All BA kits include epoxy PC boards, all resistors, capacitors and mechanical components that go on the board. Main transformers for 115/230V, 50/60Hz are also available on request. ♦

Borbely Audio reserves the right to improve or otherwise alter any specification supplied in this document or any documentation supplied hereafter.

The EB-1195/221 Phono Preamplifier and the EB-296/218A Two-Output MOSFET Regulator design is the property of Erno Borbely/Borbely Audio. Commercial use is not permitted without a license from Erno Borbely/Borbely Audio.



## ELECTRA-PRINT AUDIO

### E-X-P-A-N-D-I-N-G OUR SERVICES

*"for those who appreciate  
fine sound for a sound price"*

#### QUALITY HANDWOUND S.E. OUTPUT TRANSFORMERS

- Primaries from 1.8K to 10K
- Exclusive wideband design
- 16, 8, 4, or 2 ohm secondary
- Gold plating

#### CUSTOM-BUILT POWER TRANSFORMERS/CHOKES

- Wound to your requirements
- Heavy-duty design for Class A use
- DC filament supply windings
- HV chokes to 15H, 300ma
- Low voltage, high current filament chokes

#### S.E. TRIODE AMPLIFIERS BUILT TO ORDER

- Stereo or monoblocks
- Our exclusive Harmonic Cancelling circuit
- Your choice of power triode/s
- 2.5 to 50 watts, pure Class A
- Chrome-plated chassis or hardwood base

#### PREAMPLIFIER AND LINE AMPS

- Choice of circuitry and components available
- Conventional chassis layout
- Choice of input/output arrangements

**Component pricing and specifications catalog available. Call, write or fax for preliminary design and quotes on custom-built amplification.**

### ELECTRA-PRINT AUDIO

4117 Roxanne Drive  
Las Vegas, NV 89108  
702-396-4909  
FAX 702-396-4910