EB-703/325 ALL-FET LINE/HEADPHONE AMPLIFIER.

The EB-703/325 is an ALL-FET line/headphone amplifier with exceptional resolution, and dynamics. Its natural and transparent sound makes it equally applicable in high-end home systems as in studio monitor and recording applications. The EB-703/325 can drive the AKG-K1000 headphone to full power (1W!). The EB-703/325 outperforms most high-end line/headphone amps on the market in terms of sonic quality, irrespective of price.

Only FETs (JFETs and MOSFETs) are used as active elements in the amplifier. The resistors are all high quality Vishay-Dale, PRP and Caddock. All electrolytic caps are Nichicon FINE GOLD MUSE/KZ, ELNA CERAFINE/SILMIC II and the compensation caps are polystyrene or MICA.

Two amplifiers are laid out on one board (the size is 110x145mm), but they can be used independently. This facilitates testing and trouble-shooting. Two of the 325 boards are needed to provide a fully balanced line amplifier, see Application notes. The 325 is only available on Teflon PCB.

Circuit description.

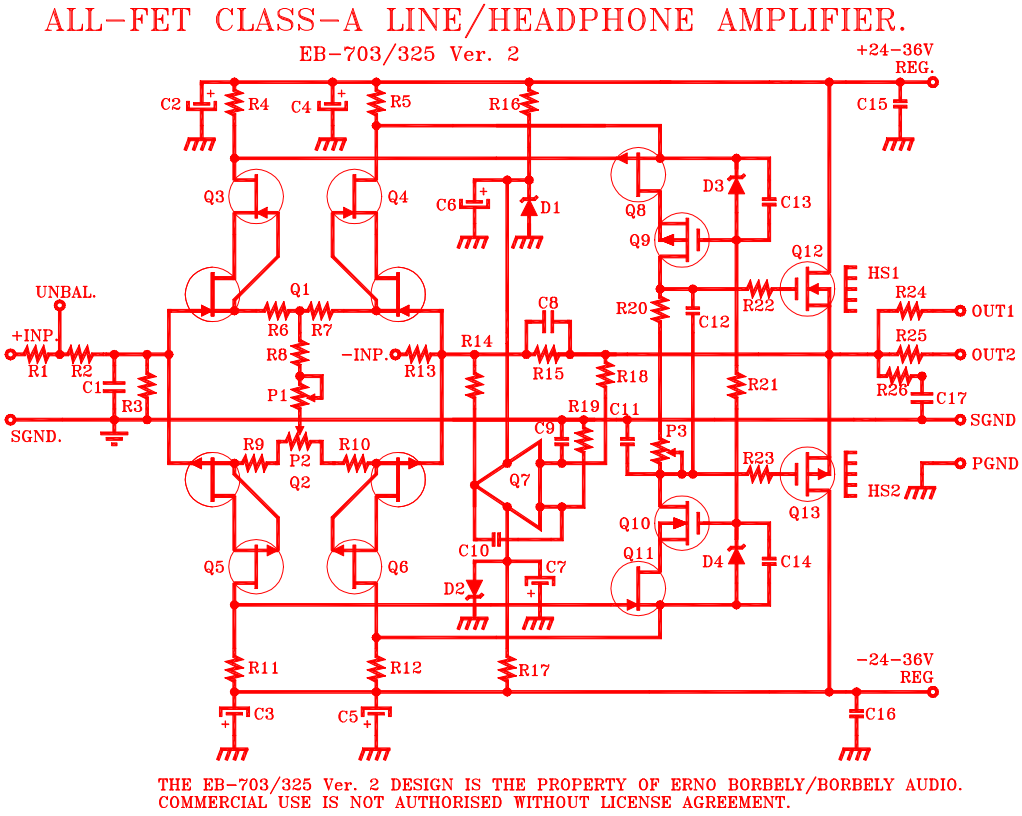

Fig. 1.

The schematic of the ALL-FET 325 is shown in fig. 1. The complementary differential input consists of very closely matched single JFETs: Q1 and Q2 are 2xK170BL and 2xJ74BL respectively. They are cascoded with Q3/Q4 and Q5/Q6. The second stage, consisting of JFETs Q8/Q11 and MOSFETs Q9/Q10, are also cascoded for good linearity. D3 and D4 provide the necessary 5V bias for the cascode MOSFETs Q9 and Q10. The output devices: Q12/Q13 are TO-220 MOSFETs. They are operating in Class-A at approx. 70mA; proper heat sinking is therefore mandatory.

The amplifier is using the best components available today. The resistors are Vishay-Dale or PRP except for the input and feedback resistors, which are Caddock. The frequency compensation capacitors are polystyrene or Mica caps, the electrolytics C2, C3, C4, and C5 Nichicon FIND GOLD MUSE, Nichicon KZ, ELNA CERAFINE or ELNA SILMIC II.

The open loop linearity of the amplifier is exceptionally good; O.L. THD is <0.05% at 1kHz, 3VRMS. This is reduced to below the measurement limit of the HP 339A distortion analyzer when feedback is applied with resistors R15-R13. Normally R15 is 10k and R13 is 1k1. This gives a closed loop gain of 20 dB. The rise time of the amplifier is about 200 nanoseconds for an output of +10V and the closed loop frequency response is close to 1 MHz! Output impedance is less than 1 Ohm, so resistor R24/R25 determine the actual output impedance seen by the outside world.

The closed loop gain can be reduced by changing the value of R13, however, at very low gain the compensation cap C11 has to be changed as well. These are the necessary changes for lower gain settings:

16dB: R13=1k82 (No other change)
12dB: R13=3k32 (NO other change)
6dB: R13=10k, C11=330pF

NOTE: the 325 in Not Unity Gain Stable (NUGS), so it should not be considered for unity gain buffer operation.

REGULATORS AND POWER SUPPLY.
Recommended power supply/regulator for the 325 is the dual low-noise EB-703/259 PS/regulators, fig. 2. These can supply up to 200mA current each, so theoretically each can supply two amps in balanced operation. However, for an all-out set-up we recommend to use a separate +/-regulator for each amplifier, meaning four regulators for a fully balanced lineamp.

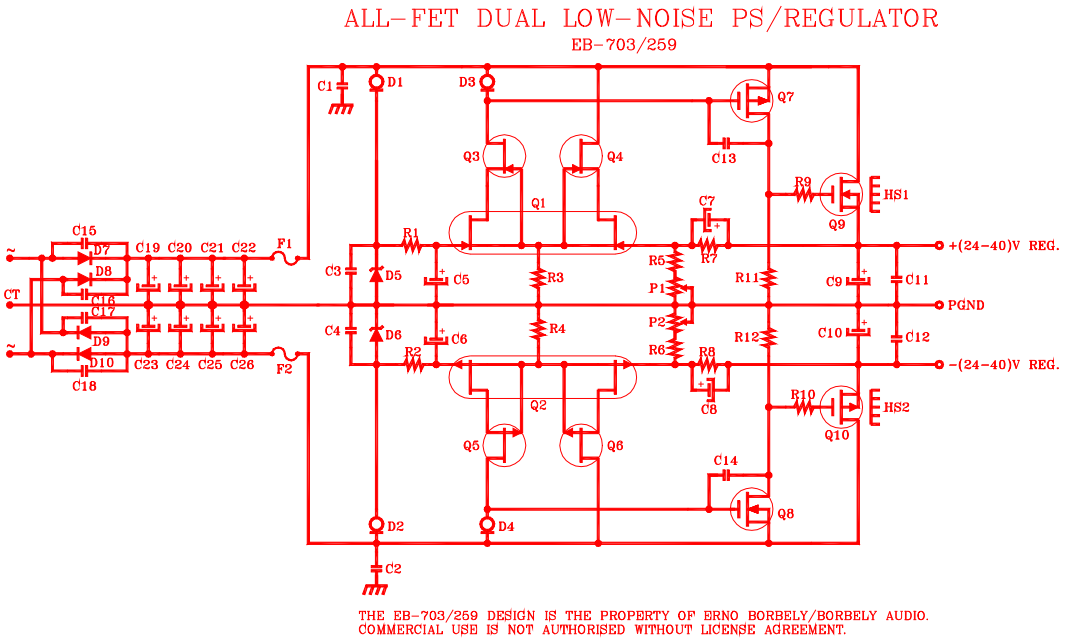

Fig. 2. The EB-703/259 ALL-FET Wide-band, Low-noise PS/regulator.

The EB-703/259 consists of fast recovery diodes, eight low ESR filter capacitors and two dual wide-band, low-noise regulators, using only FETs (JFETs and MOSFETs) as active elements. Maximum input voltage is ±45V and maximum output voltage is ±40V. Maximum output current with 5V input/output voltage difference is ±200mA.

Application notes.

For normal, non-inverting lineamp application the source is connected to the +INP, and the –INP is grounded to SGND. This will give the normal lineamp gain of 20dB. If a shunt attenuator is used with the amp, the proper value of R1 has to be installed (normally 10k). If a normal potentiometer or DACT stepped attenuator is used R1 has to be shorted.

The output is capable of driving loads down to 32 Ohm. Consequently, you can use the amplifier as a headphone amplifier. Use OUT1 and reduce R24 to 10 Ohm when used to drive low-impedance headphones (the 10 Ohm is serving as a short circuit protection). The amp can also be used with terminated cables. If you are using a 75-Ohm coax cable, insert a 75-Ohm resistor for R25 and terminate the cable at the other end (normally at the input of the power amplifier) also with 75 Ohm. Use 110-Ohm resistors at both ends if the cable is a balanced 110 Ohm one. In case of terminated cables the proper 75-Ohm BNC connector or a Neutrik XLR3 connector has to be used instead of the RCA connectors.

The two amplifiers can be connected for balanced operation. Remove the ground wire from both –INP and connect them together. The +/- balanced inputs are then connected to the two +INP of the two amps. The output of the amps that amplifies the + signal becomes the +output and the one amplifying the –signal is the –output. Both inputs and outputs have to be connected through XLR connectors. Note that if you use an unbalanced source with this setup, the input of the –AMP has to be grounded, see block schematic in fig. 3!

Fig 3 shows a balanced setup with 4-gang DACT stepped attenuators. The two amps are fed from separate 259 ALL-FET regulators. Both balanced and unbalanced sources can be connected to the input, assuming that the input of AMP2 is grounded when unbalanced sources are used. A SUPER BUFFER (EB-602/403) is used as a balanced-to-unbalanced converter for the tape output. The unbalanced output is taken from the output of AMP1. Optional mute circuit (EB600/312) is shown at the output to avoid DC thumps at turn-on and turn-off.

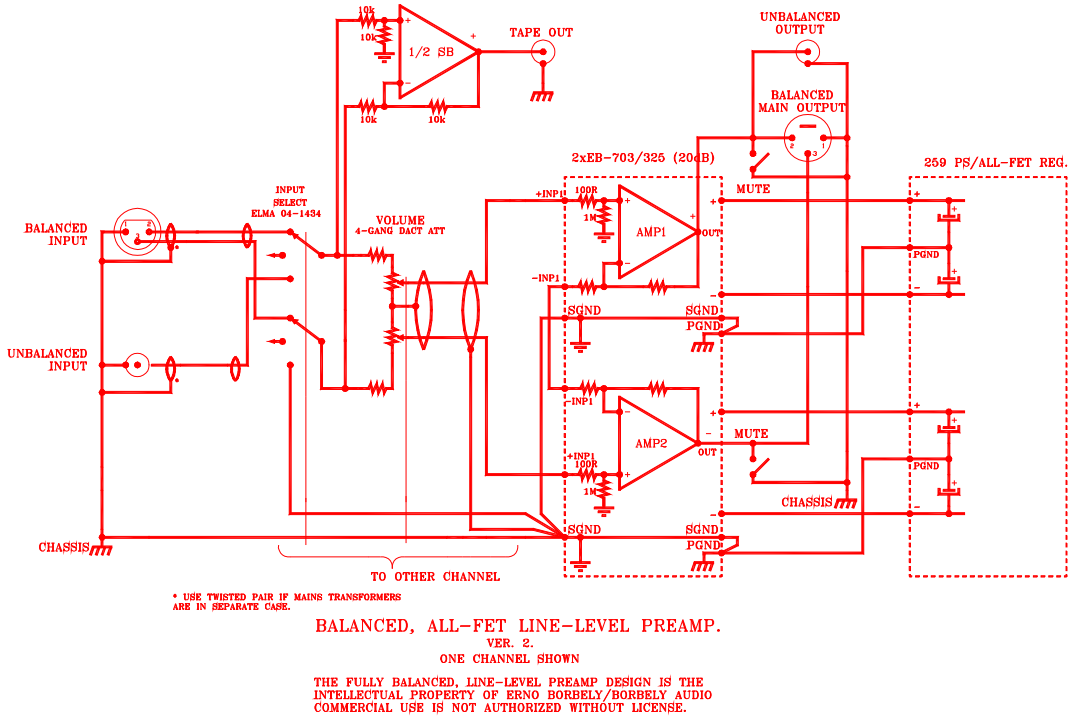

Fig. 3. The two EB-703/325 amps wired for balanced operation with tape output, using 4-gang stepped attenuator.

The vertical ground wire on the left-hand side of fig. 3 is a bus bar connecting all pin 1's of the XLRs and the groundside of the RCA connectors together. This is grounded to the chassis, normally on the back panel. A single insulated wire is then connected from this point to the SGND of AMP2. Shielded wiring is indicated in fig. 3, however, if the mains transformer(s) are mounted in a separate box (strongly recommended!!), the wiring can be done with twisted wires. Teflon insulated silver plated copper wires or pure silver wires are recommended for internal signal wiring!

The ALL-FET LINEAMP EB-703/325 and the dual low-noise EB-703/259 PS/regulators are the intellectual property of ERNO BORBELY/BORBELY AUDIO. Commercial use and duplication in any form is forbidden.