With so much open loop gain at high bandwidth, there is hardly more argument for the necessity of high-transconductance vertical MOSFETs.

Prototype Build

A first prototype was built using the original schematics. The n-JFET was a matched pair of 2SK370, which is actually 2SK170 in a smaller package. The smaller package is advantageous here as it allows even better thermal coupling, and at 2mA bias still has plenty of reserve for power dissipation. A 2SA970BL was used for the PNP, and a 2SC3324BL for the NPN. A single 2SK209BL degenerated to 4mA replaces the 2x E-202 specified, for lower noise.

The output stage bias was 160mA as intended and is stable with heatsink temperature. The DC offset (with input grounded) was -10mV without any trimming. Soldering a (pre-calculated) 20k resistor in parallel with R5 reduces this to < 5mV, and it hardly drifted with time. The trimming is actually not necessary, but was done just to demonstrate that it can be done.

With no load, the frequency response has a slight hum of +2dB at 700kHz, and -3dB bandwidth at 1.1MHz. Changing C4 to 22p flattened the hump completely, with -3dB at 900kHz, and no overshoot with 10kHz square wave.

Clipping behaviour was as predicted. Especially with 27R load, the current limit on the negative swing was very obvious. This is in the topology itself, typical of single ended class A, but then so is the sound (2nd harmonic dominant). It was still capable of +/-3.5V with 30R load, which is 200mW, exactly the maximum power rating of most over-ear headphones.

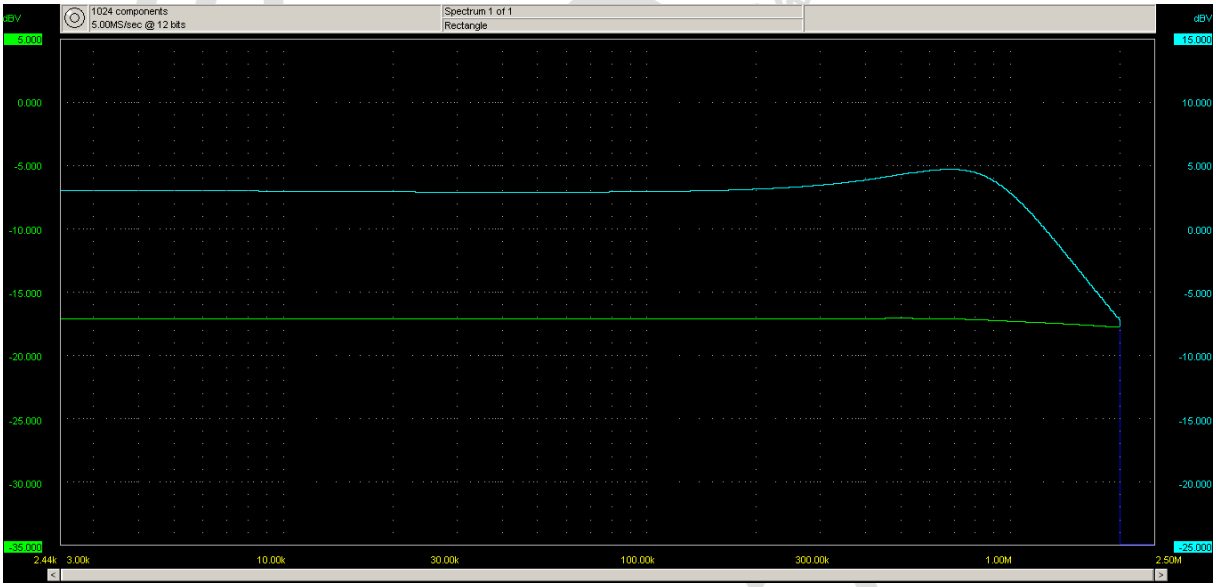

Fig. 1 Original EB602 Frequency Response with No Load, C4 = 10p

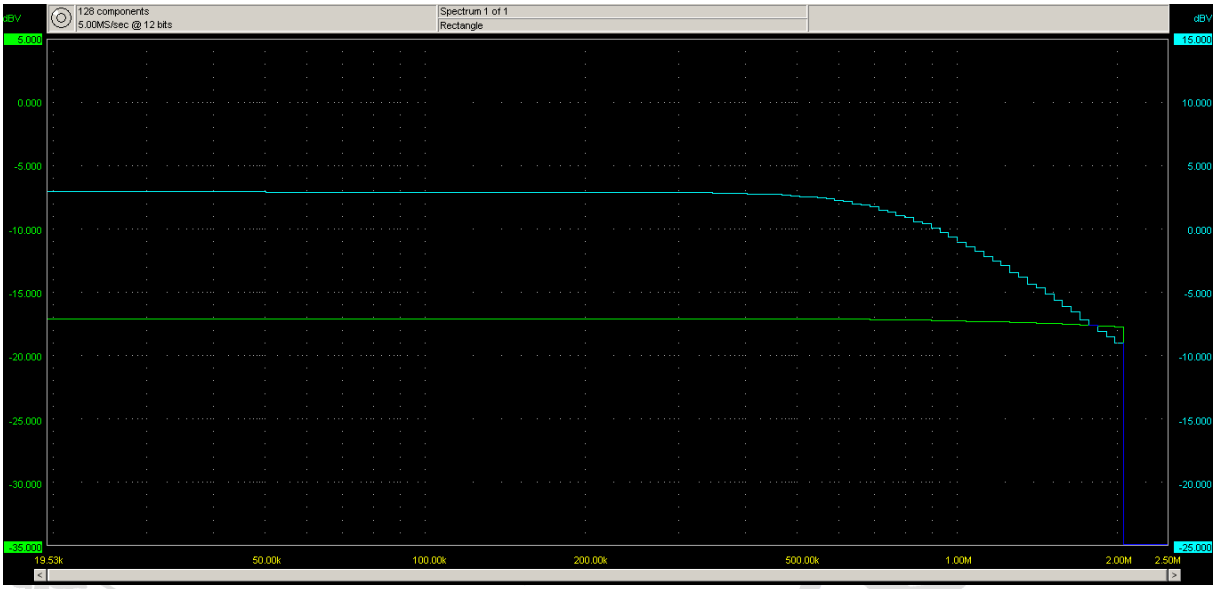

Fig. 2 Original EB602 Frequency Response with No Load, C4 = 22p

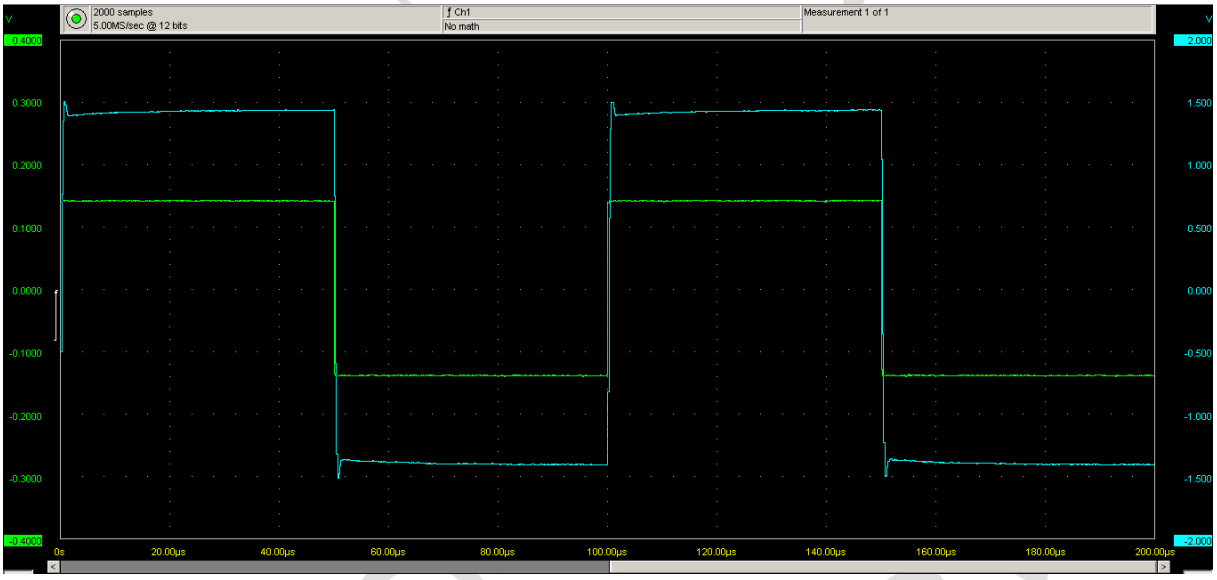

Fig. 3 Original EB602 10kHz Square Wave with No Load, C4 = 22p

Fig. 4 Original EB602 Voltage Clipping with No Load

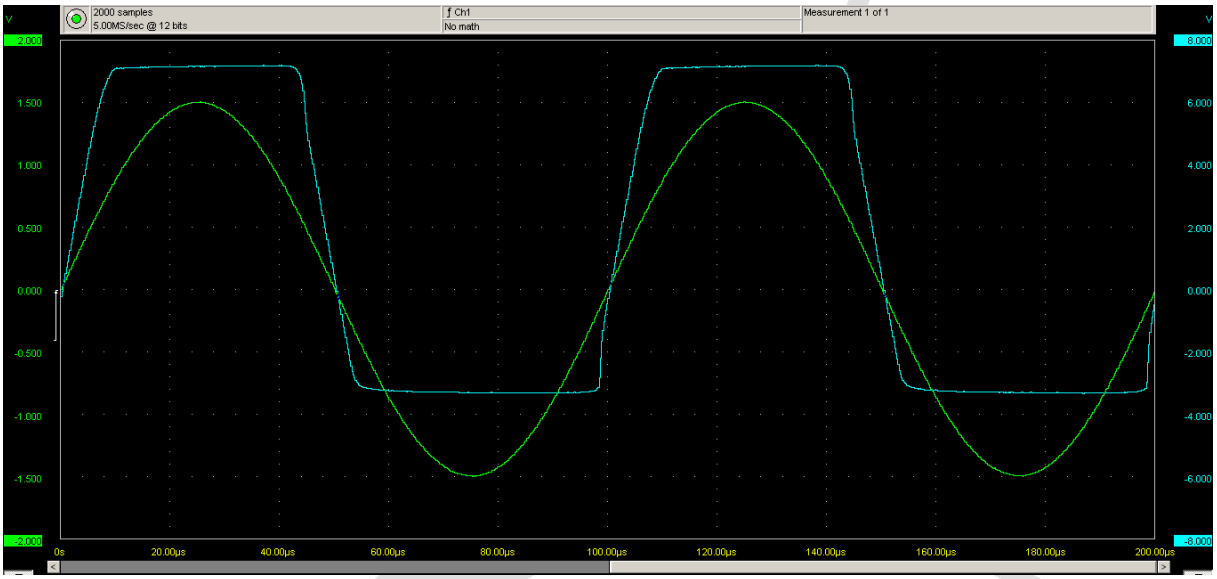

Fig. 5 Original EB602 Current Clipping with 27R Load

Modern Day Changes

All of the devices specified in the original EB602 schematics are now obsolete. While there are no real replacements for the lateral MOSFETs, there are good replacements for the others. Most of these are SMD versions of previously TO92 devices.

For example, the 2SK389 can be replaced by a matched pair of 2SK209, 2SK170, 2SK117, 2SK332 (dual), or the more expensive LSK170 and of course LSK389. The Best replacement for 2SA872 and 2SC1775 would be 2SA970 and 2SC2240, or their SMD equivalent 2SA1312 and 2SC3324.