Dual LTP Discrete Opamp JCOPA
XEN Audio
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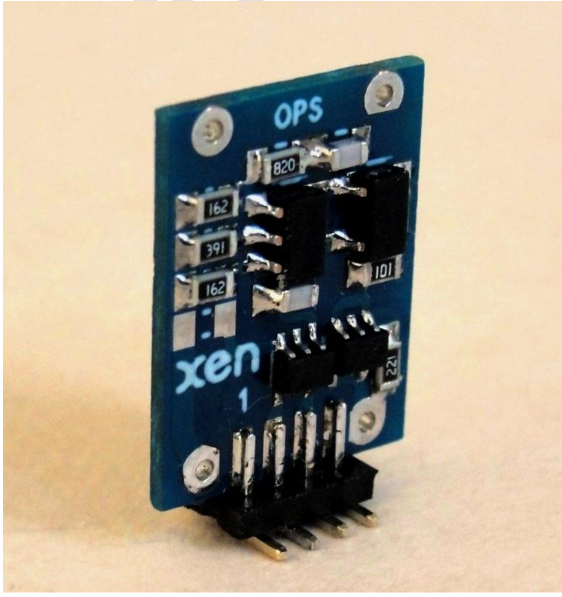

The second topology that was built was the JCOPA. As already described previously, this topology follows that of the LH0032 IC, or the discrete JC Pro-1 opamp module. Voltage gain is achieved in 2 cascaded LTP stages, followed by an output buffer.

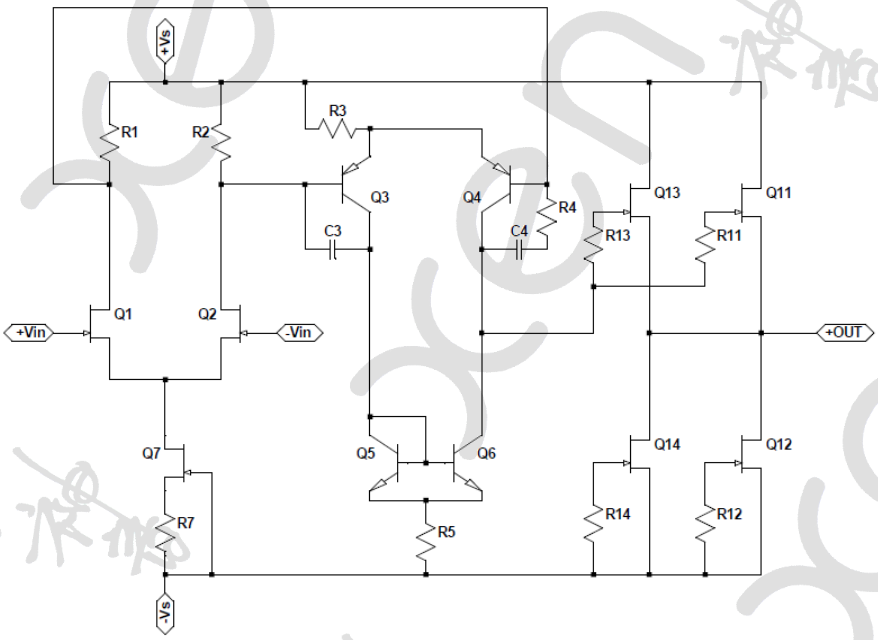

Fig. 1 **JCOPA Schematics**

Again, for best possible thermal tracking of the circuit, dual N-JFETs were used in both the input and the output stages. Two pairs of JFETs were used for the output, biased at 4mA each, in order to limit the thermal dissipation for each device. Low-noise dual BJTs with matched hfe were also used for the second stage.

Mechanical Layout

Just for fun, we used the same vertical PCB layout as the XEN SOPA but made that to fit a standard SOIC 8-pin SMD header for a single opamp. As one can see, with success. The only space requirement on the main circuit PCB is 10mm x 0.8mm in the axial direction at a height > 2mm. Below 2mm (as in case of most SMD components), the SOIC header has essentially the same footprint as an SOIC 8 package. We have yet to see a discrete opamp that can replace SOIC-8 opamp's without huge and clumsy adaptors.

Measured Performances

Similar to the SOPA, the measured performance of the prototype agrees with simulations.

As before, gain of 10 bandwidth is at about 500kHz, limited by the design slew rate to ensure unity gain stability. Both can be increased if unity gain stability is not required.

The distortion figures and the effect of output load has a more complex picture than the SOPA. When not loaded, distortion is as good as, if not better than the SOPA, especially at higher frequencies. However, when loaded by 1k load or lower, 2nd harmonics increases noticeably, although third harmonics remains lower than the SOPA. Since the only variable is the load, the output buffer stage has to be the major contributing factor. The hypothesis is that the 2nd harmonics of the gain stage in the SOPA has, by chance, an opposite sign to that of the output buffer. So there must be some cancellation effect present when loaded, resulting in the lower second harmonic distortions.

The table below compares the 2 opamp's against each other under different loading conditions.

Output Voltage	2	Vrms					
Output bias	5	mA			Output bias	8	mA
NFB Network	18k / 2k	ohm			NFB Network	100k / 10k	ohm
		XEN SOPA			**JCOPA**		
Freq	**RL**	**H2**	**H3**	**THD**	**H2**	**H3**	**THD**
Hz		dB	dB	%	dB	dB	%
1k	10k	-101	-122	0.0009	-108	-123	0.0004
1k	1k	-102	-113	0.0008	-90	-116	0.0032
1k	600R	-92	-95	0.0031	-83	-105	0.0071
5k	10k	-96	-115	0.0016	-111	-120	0.0003
5k	1k	-93	-100	0.0025	-87	-107	0.0045
5k	600R	-77	-81	0.0167	-80	-95	0.0102

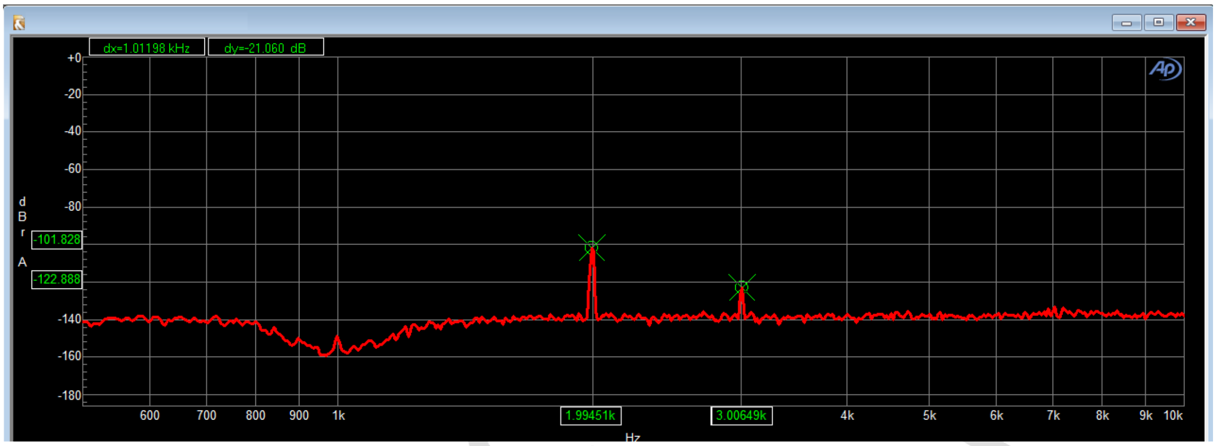

Fig. 2 Distortion Spectrum at 1kHz, 2Vrms out (notched)

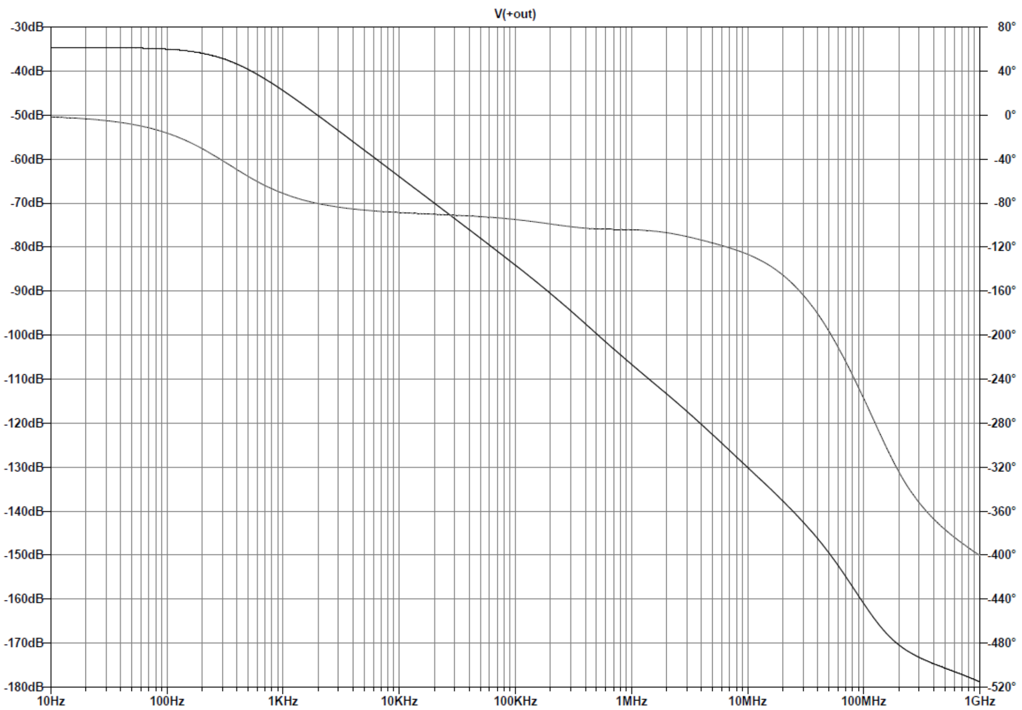

Fig. 3 Simulated Open Loop Characteristics (input level at -120dB)