VLBA Acquisition Memo # 47

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5 August 1985

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To: VLBA Acquisition Group

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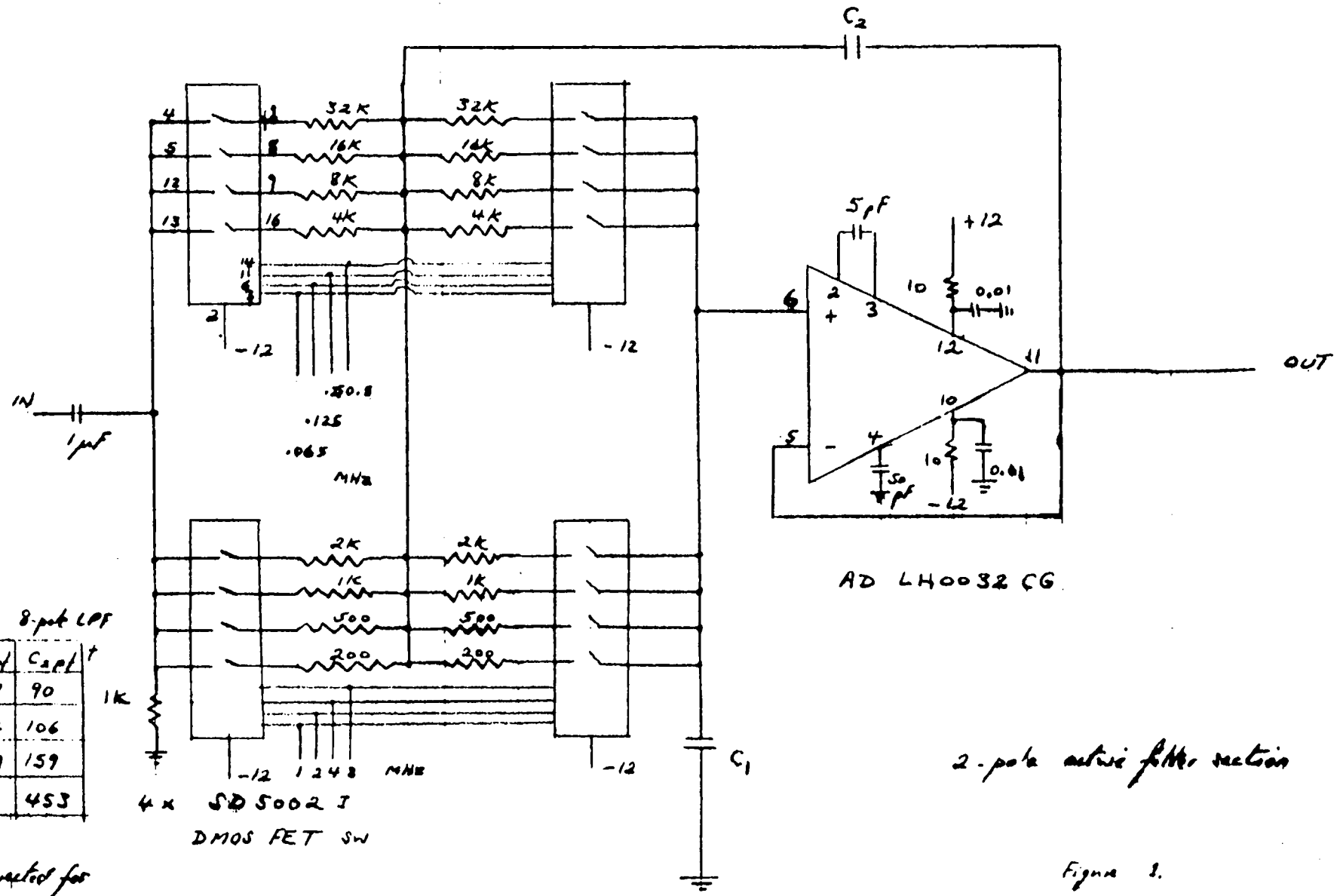
Subject: Active Low Pass Filters for Baseband Converters

Several ultra-high-speed operational amplifiers are now available that might be capable providing the poles for low pass filters up to 8 MHz. A simple circuit can provide two poles per operational amplifier with reasonably low component sensitivity. Since the fast operational amplifiers are fairly expensive, a very attractive approach would be to use the same amplifiers for all 8 bandwidths by switching resistive components to scale the pole locations. With this approach only 8 amplifiers would be needed for all the USB and LSB filters in one baseband converter. Figure 1. shows one possible circuit for a 2-pole low pass section (4 cascaded sections being required for an 8-pole filter). I plan to breadboard and test the circuit. The potential problems are as follows:

1) Effects of cross-talk in the analog switches.
2) Variation of the "on" resistance in the switches.
3) Capacitive loading in the switches.
4) Phase shifts in the operational amplifiers.

An initial breadboard test of a simple 8 MHz 2-pole LPF (without switches) produced performance within 2 degrees of phase of a perfect 2-pole filter plus 5 nanoseconds of additional delay. I also tested the performance of the all pass (single pole/zero pair) section shown in Figure 2. Again, performance is very close to a perfect pole/zero pair again with an added delay of 5 nanoseconds. While the use of active elements in the SSB mixer all-pass filter would increase the component count it would eliminate the need for stable inductors.

Attachments: Figure 1.
Figure 2.



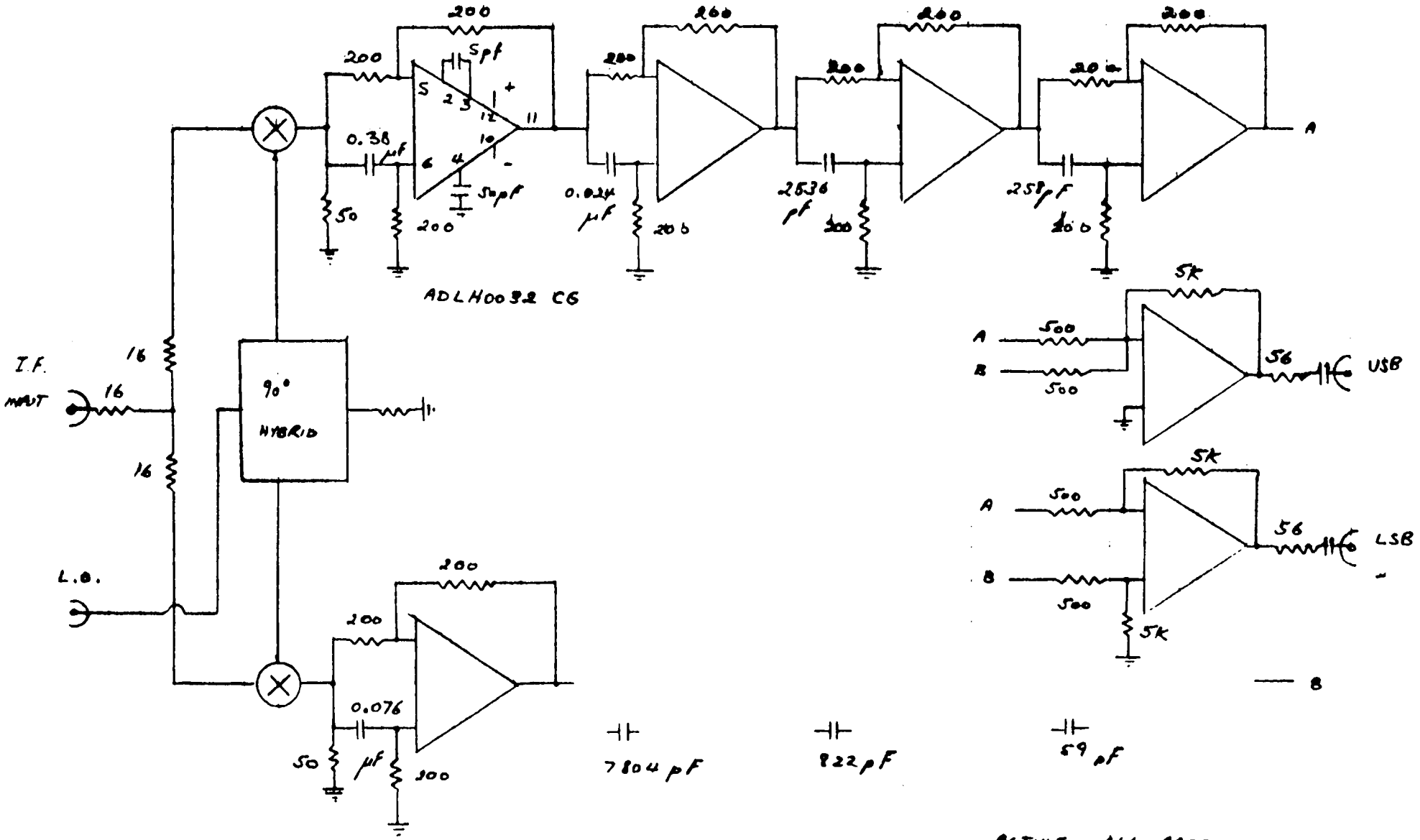
Butterworth 8-pole LPF

section #	C_1 pf	C_2 pf †
1	87	90
2	74	106
3	49	159
4	17	453

† Not yet corrected for capacitance of switches

2-pole active filter section

Figure 8.



ACTIVE ALL-PASS
ALTERNATE DESIGN FOR SSB MIXER

Figure 2. AUG 85 AEER