Application Brief

Long-Term Drift Measurements on Op Amps

DESIGN PREDICTIONS SHOWN TO BE CONSERVATIVE

Representative samples (at least 5 units of each type) of chopper, low-drift chopperless, and low-cost operational amplifiers have been placed on long-term drift test for periods exceeding 1 year. Typical preliminary results are shown here.

The units were kept in oil baths, and buffered by thermal insulation from short-term transient effects. Ambient temperature was measured each time readings were taken, and the readings were individually corrected for temperature, except where noted.

In some cases (the low-drift chopperless units seemed especially susceptible because of the sensitive scale), artifacts turned up that were correlatable between units, but were left in the data for the sake of completeness. These could probably be explained in terms of occasional power outages, and at least two physical moves of the equipment from one location to another.

The data, as a whole, are quite reassuring, in that they seem to indicate that—at least over a year—there is minimal tendency for drift to increase continually. The measurements also indicate that the "long-term drift specifications" on the data sheets were realistic, at worst, and generally quite conservative, and that low long-term drift is characteristic of units designed for low thermal drift.

TEST RESULTS

Model 230 is a chopper-stabilized amplifier whose specified temperature drifts range from 0.5μV/°C down to less than 0.1μV/°C. The data plotted here are uncorrected for temperature coefficient. All units had the same type of history; the "best" and "worst" histories are reproduced here. Although there seems to be a seasonal correlation, the average temperature variation (27°C average in winter to 25°C in summer) does not directly account for it. Nevertheless, *including* temperature effects in the laboratory, the specified typical long-term drift of 5μV/year seems quite conservative. The 231, 232, and 233 families should have long-term drift performance similar to that of the 230 family.

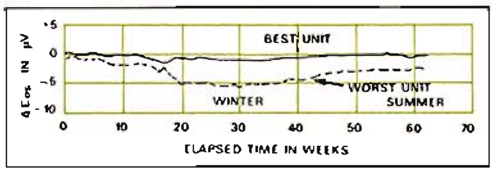
Model 180 is a chopperless unit designed for low offset-voltage and current temperature coefficient (1.5 to less than 0.5μV/°C and 0.05nA/°C to less than 0.02nA/°C). It is also designed for low warmup drift. As can be seen in the curves, the maximum (corrected) voltage drift of this typical unit over a year was less than 10μV, and the maximum (uncorrected) current drift was less than 7nA. Considering an average 5-week "monthly" period, the respective fluctuations are of the order of 4μV and 2nA p-p. The worst unit was about twice as bad. Some of the worst swings seemed to be correlated from unit to unit, and may have resulted from artifacts, as mentioned above.

Model 183 is also a chopperless unit designed for low cost, with about 10X the current drift of the 180 family. Except for the artifacts, as noted above, its long-term (uncorrected) drift is commensurate with that of the 180 family. The 184 and 153 families should have similar performance.

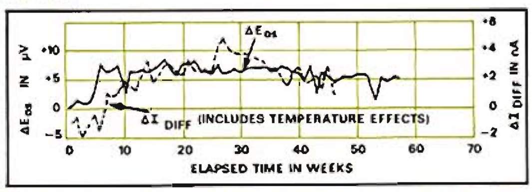
Model 118 is a low-cost unit having a bipolar-transistor input circuit, with average E_{os} TC of 5 to 20μV/°C. The long-term (corrected) drift can be seen to be commensurately larger than that of the low-drift units, but with smaller medium-term (monthly) fluctuations. Its 200μV/month "typical" specification would appear to be grossly conservative. Actually, none of the units tested exceeded 400μV in 9 months. The 119, 163, and 165 families should have similar performance. The design of 118 has been improved since these units were put on test, and should now be—if anything—better.

Model 144 is a low-cost FET-input unit, with average E_{os} TC of 30 and 100μV/°C. Its (corrected) long-term drift over a 4-month period appears to be commensurate with—perhaps less than—that of the 118 family. Again, the 250μV/month specification appears unduly conservative. The 40 family should have comparable performance.

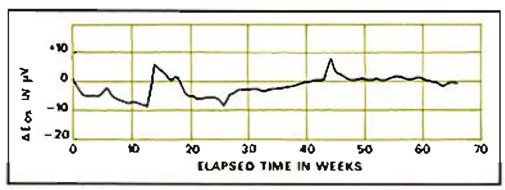
MODEL 230 CHOPPER-STABILIZED AMPLIFIER (UNCORRECTED – INCLUDES TEMPERATURE EFFECTS)



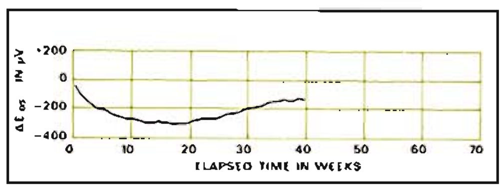
MODEL 180 LOW-DRIFT CHOPPERLESS (COMPENSATED) AMPLIFIER



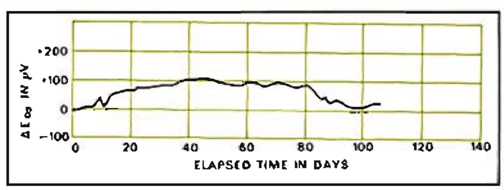
MODEL 183 LOW-DRIFT CHOPPERLESS AMPLIFIER



MODEL 118 LOW-COST BIPOLAR AMP. (DISCRETE)



MODEL 144 LOW-COST FET-INPUT AMPLIFIER



The tests reported on here were designed by and performed under the direction of Bob Demrow, Manager of Applications.