

## **Technote 161—PA4 triangulation of ultrasonic frequencies.**

In the some versions of the PA4, an output amplifier chip was changed to reduce switching transients during changes in attenuation. This change appears in PA4s purchased after about 1993. This change does not affect the performance of the PA4 in the audible range other than to reduce the switching transients by about 3 dB. However, the newer chip distorts high level ultrasonic signals.

Tests were carried out with 0 dB attenuation set on the PA4. Distortion was seen at frequencies above 35 kHz for full-scale input, which appears as a triangulation of sine wave input. Decreasing the level of the output signal, either by reducing the level of the input signal, or by entering an attenuation value into the PA4, removes the distortion. At 100 kHz, the output signal level must be decreased by about 9 dB to restore the signal (max input level ~3.5V with 0 dB attenuation).

### **How to check your signal**

We recommend that everyone using a PA4 to attenuate ultrasonic signals check the output of their PA4s for distortion. TDT can replace the amplifier chip in your PA4 if higher switching transients do not present a problem for your application. The newest programmable attenuator, the PA5, produced linear attenuations up to 100 kHz with lower switching transients than the PA4.