

Using the HB6 to Drive Etymotic ER-1/2/3A Insert Earphones

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THE HB6 AND LOW IMPEDANCE LOADS

Tech Note 108 describes the extended specifications of the HB6. In short, the HB6 has two stereo output channels: the "Main Output" and the "Monitor" channel. Each of the two Main Output channels can drive 200 mA (up to 800 mA peak with a 5% duty cycle) and has 25 ohm output impedance. The Monitor channels can drive 100 mA each (up to 400 mA peak, 5%), and each has a 100 ohm output impedance.

The HB6 was designed to drive headphones, which typically have high impedances (>100 ohm). The ER-1, ER-2, and ER-3/10¹ have an impedance of only 10 ohms. This means that you can only get about a 3V peak output signal to the ER-1/2 from the HB6 ($10V \cdot (10\text{ohm}/(10+25\text{ohm}))$). However, for a sinusoidal input, that translates into over 400 mW of power delivered to the 10 ohm load of the ER-1/2/3 ($V_p^2/2R$). Etymotic recommends that the ER-1/2 and ER-3/10 not be driven more than 2.5 V_{rms} (which is about 3.5 V_{peak} , for a sinusoid), so the HB6 drives the ER-1/2/3 at their practical limits.

CALIBRATION AND MEASUREMENT

The ER-2 specifications claim that a 1 mW excitation will give a flat response of about 80 dB SPL into a Zwislocki coupler. 400 mW, by extension, should give a 26 dB ($10 \cdot \log(400/1\text{mW})$) louder output, or about 106 dB SPL. The ER-1 is 3 to 10 dB more sensitive than the ER-2, so it will play even louder. (And the ER-3A, which is similar to the TDH-39, is 25 dB more sensitive than the ER-1. You could theoretically drive the ER-3A at 130 dB SPL with the HB6.)

The method of measurement that you use for calibration is especially important. Clicks, because they are of such short duration, are particularly difficult to calibrate. One method suggested in the literature is to create a sinusoid that has the same peak-to-peak or base-to-peak voltage as your click.² Then calibrate your system with that continuous sinusoid. This will give you a peak equivalent SPL (peSPL).

CONCLUSION

The TDT HB6 is capable of driving the ER-1/2/3 series of Etymotic tubephones to their maximum recommended limits. The ER-1 and ER-2 are less sensitive than the ER-3/TDH-39 and may not give the same power output. Before concluding that intensity output is not sufficient, consider your method of measurement and calibration.

¹ The ER-3A/50 has a 50 ohm impedance, but its reduced sensitivity means that the HB6 will drive it at the same power level as the ER-3A/10. The ER-3A/50 has the advantage of drawing less current, however.

² Burkhard, Bob. "Sound Pressure Level and Spectral Analysis of Brief Acoustic Transients." *Electroencephalography and Clinical Neurophysiology*, 1984, S7:83-91