ISCE

The Institute of Sound and Communications Engineers

Engineering Note 2.2

Measuring the wide-band noise sensitivity of a loudspeaker

J M Woodgate *FInstSCE*

ISCE Engineering Note 2.2

Measuring the wide-band noise sensitivity of a loudspeaker

J. M. Woodgate F Inst SCE

The idea of using a noise signal to measure an 'average' sensitivity over a frequency band is quite attractive, but there is a hidden pitfall. It wouldn't exist if the loudspeaker had a perfectly flat frequency response, but then if it did, you could measure with a sine-wave signal!

The need for care arises because the measured sensitivity (Sound pressure level at 1 m for a stated input voltage level) varies according to what extent the noise band embraces peaks and dips in the loudspeaker response. This means that the noise bandwidth and the centre frequency of the noise band must be both controlled and specified with the results. It is particularly important to do this **for inexpensive loudspeakers**, because these are likely to have the most uneven frequency responses.

To demonstrate the effect, without needing acoustic measurements of sound pressure levels, a simulation was set up using a two-channel graphic equalizer, (Figure 1).

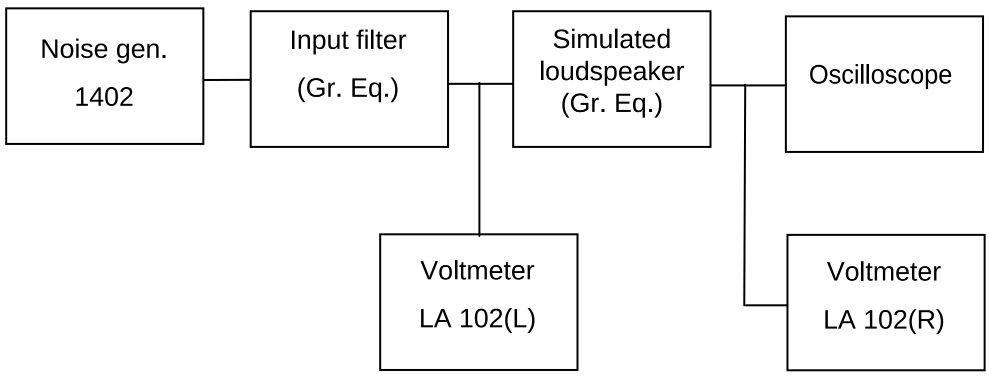

Figure 1: Set-up for simulation

The nose generator was set to produce pink noise, band-limited to 20 Hz to 20 kHz. The input filter was adjusted successively to produce pink noise of four different bandwidths, as follows:

Test 1: Wideband, 20 Hz to 20 kHz. See Figure 2.

Test 2: -5 dB at 45 Hz and 10 kHz. See Figure 3. This bandwidth corresponds to the 'effective frequency range' (IEC/EN60268-5) of the simulated loudspeaker (see Figure 6).

Test 3: -5 dB at 100 Hz and 5 kHz. See Figure 4. This bandwidth corresponds approximately to a summation of the octave bands with centre frequencies from 125 Hz to 4 kHz.

Test 4: -5 dB at 500 Hz and 2 kHz. See Figure 5. This bandwidth corresponds approximately to a 2-octave band centred on 1 kHz.

The signal level in each case was set to give the same r.m.s. voltage, using the voltmeter LA102(L), irrespective of the bandwidth. The graphic equalizer was set up as a simulated loudspeaker of the inexpensive kind, having a peaked high-frequency response and a small enclosure that results in a raised main (bass) resonance, as shown in Figure 6. The 'sensitivity' of the simulated loudspeaker was represented by the r.m.s output voltage measured with the LA102(R). The purpose of the oscilloscope

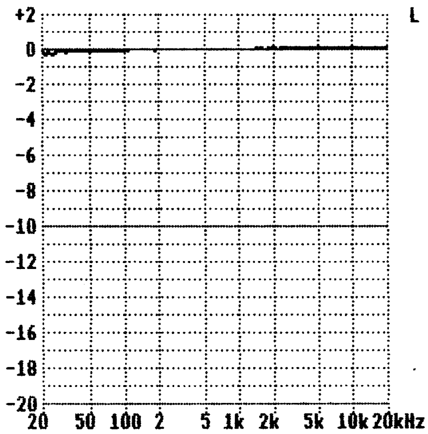

Figure 2: Flat response of input filter

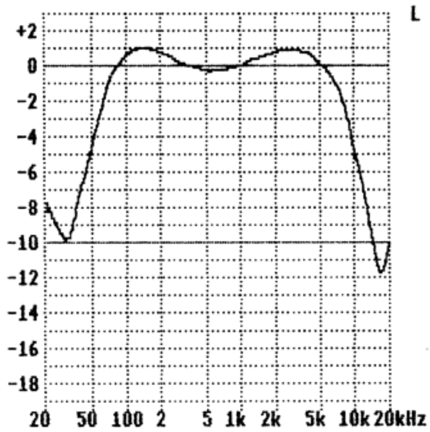

Figure 3: Filter - 45 Hz to 10 kHz

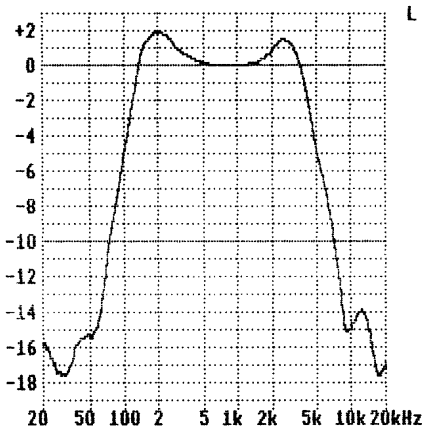

Figure 4: Filter – 100 Hz to 5 kHz

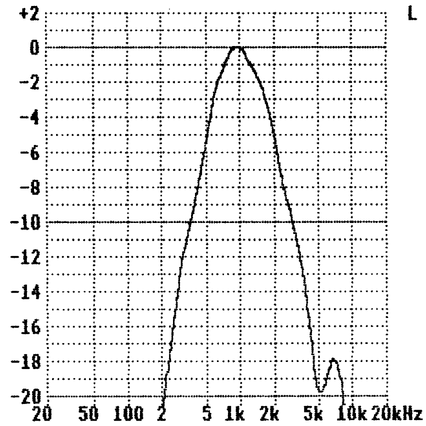

Figure 5: Filter – 500 Hz to 2 kHz

was to check that clipping was not occurring in the equalizer.

Note that the vertical scale for the simulated loudspeaker response (7 dB =1 decade of frequency) is much larger than in normal plots, which have 50 dB = 1 decade (IEC60263).

Results:

The standard method of measurement in IEC/EN60268-3 corresponds to test 2, so that result is taken as the 0 dB reference. The other results then are:

Test 1 (wide band): -1.25 dB

Test 3: (100 Hz – 5 kHz): +0.55 dB

Test 4: (500Hz to 2 kHz): - 1.75 dB

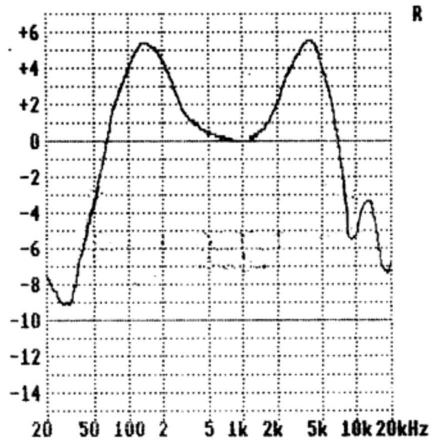

Figure 6: Simulated loudspeaker

It is clear that the differences are enough to form the basis of many an argument between supplier and user! The simulated loudspeaker does not represent a 'worst-case' for differences.