Comparison of frequency response: double-coated tape vs epoxy resin

R H Brown 16 May 2002

In an effort to determine the coupling efficiency at audio frequencies of double-coated tape, in comparison with liquid two-part epoxy resin, the following experiment was performed:

Two similar piezo film elements were selected, with 30 x 12 mm active electrode area. One of these was a standard production item (p/n 0-1001777-0), supplied pre-laminated with 3M #444 pressure-sensitive adhesive tape. The other was specially supplied without PSA tape, but otherwise identical.

The two elements were bonded side-by-side to a sheet of thin (2.5 mm) glass, dimensions 500 mm x 400 mm approx (one edge broken, irregular). The epoxy material used for one sensor was Pattex Kraft-Mix from Henkel KgaA (Germany), a fairly typical transparent 2-part 10 minute epoxy. A thin layer was applied to one surface of the sensor, which was then slid back and forth a few times on the glass, and rubbed down using waxed paper above the sensor to achieve a thin bond line to the glass.

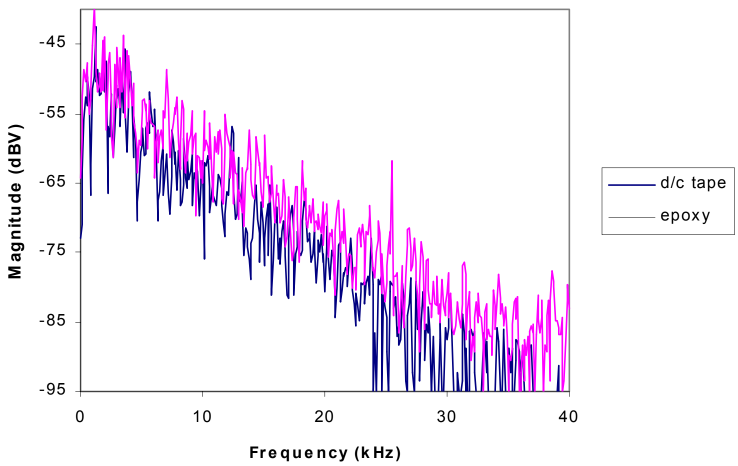
Both sensors were fitted with 10 K shunt resistance, to achieve a high-pass filter network with –3 dB frequency of approx 12 kHz. Standard probes were then used to connect into two channel DSO, sampling at 102.4 kHz (giving 40 kHz span in frequency domain).

Light impacts were delivered using a scalpel handle to the (already broken) edge of the glass sheet, approx 200 mm distant from the sensors. For frequency-domain results, a process average of 20 such events was calculated. The average spectra showed that, overall, the epoxy-bonded sensor gave higher output, but also a slight trend with frequency, with the epoxy appearing even better at high frequencies. To clarify this picture, the spectral plots were then post-processed to give RMS energy in 4 kHz bands. These band energies were finally divided, to give a ratio (d/c tape to epoxy) as a function of frequency. Although not smooth, the trend runs from about –3 dB at low frequencies to –8 dB at highest frequency measured (36 kHz to 40 kHz band).

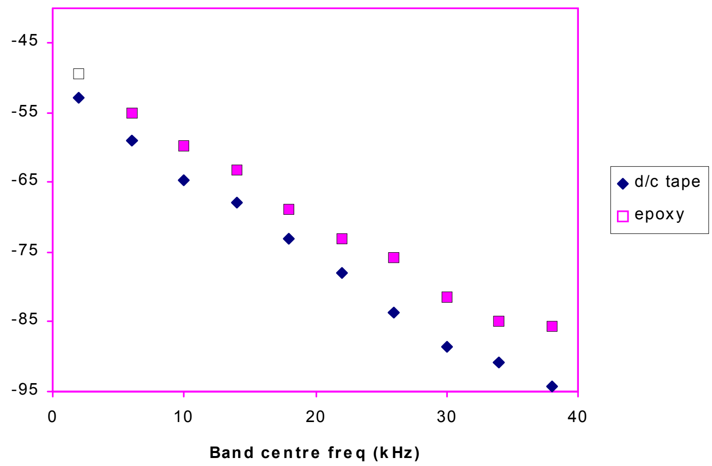
In a second experiment, a rigid metal plate was impacted with and without a piezo film sensor 0-1001777-0 attached, and the acoustic response (metal to metal impact) recorded with a high quality microphone. This gave interesting results: for a short time span (8 ms), virtually no difference between the emitted acoustic energy could be seen. Only when the time record was greatly extended did the difference in damping of the plate show up. This suggests that the damping effect of the tape on the substrate may NOT be significant (for impact analysis), although the earlier experiment suggests that the tape may not be as efficient as epoxy in gathering the signal energy from the substrate.

Waveforms from the first experiment are shown on the following page.

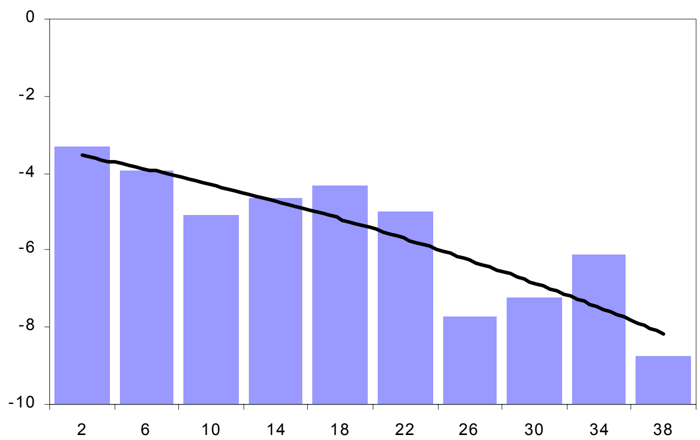
Raw spectra, proc avg 20



Band energy (4 kHz bands)



Ratio of band energies



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