Old Style Design as a Problem

What follows is an examination of the characteristics and limitations for an “advanced” design in current production that still follows the old design concepts. The transducer is 5.25 inch diameter midwoofer with a claimed response to seven kHz. The advertising copy for the transducer states that it has “minimal” breakup because of its carbon and mica composite polypropylene cone. What the manufacturer does not advertise, but is important for performance is the use of an extended neck dip feature in the cones shape.

Figures one and two show the impulse response and frequency response of this transducer. Cone breakup is caused by the presence of uncontrolled material vibration modes. In comparison to an unidentified transducer, this unit may have “minimal” breakup. Yet this transducer has a two large vibration modes with a center frequency of just over five kHz and a second vibration mode causing a rising response from two kHz to 11 kHz. The peak of the second mode is just below 10 kHz.

Figure One. Stock impulse response of 5.25 inch diameter midwoofer featuring a heavy die cast basket, carbon and mica composite polypropylene cone, rubber surround, and a small poly dust cap glue to the cone.

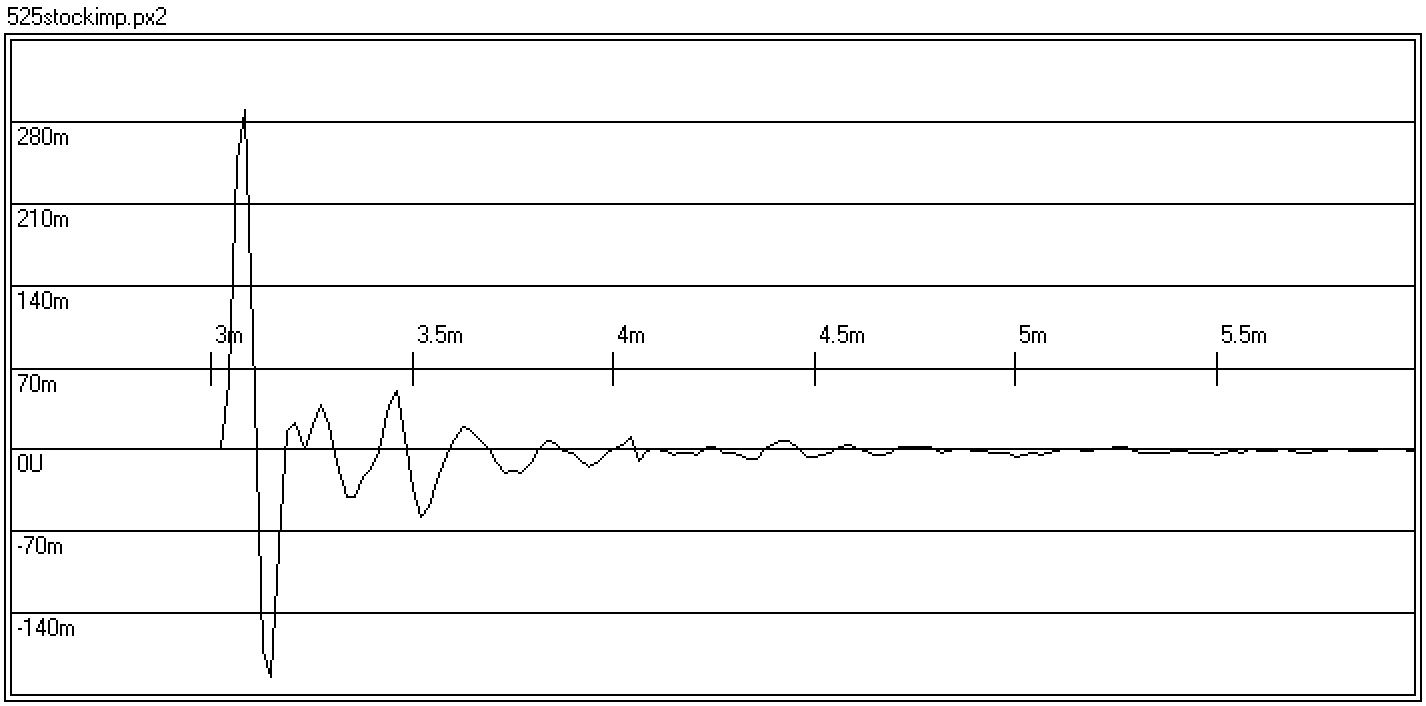
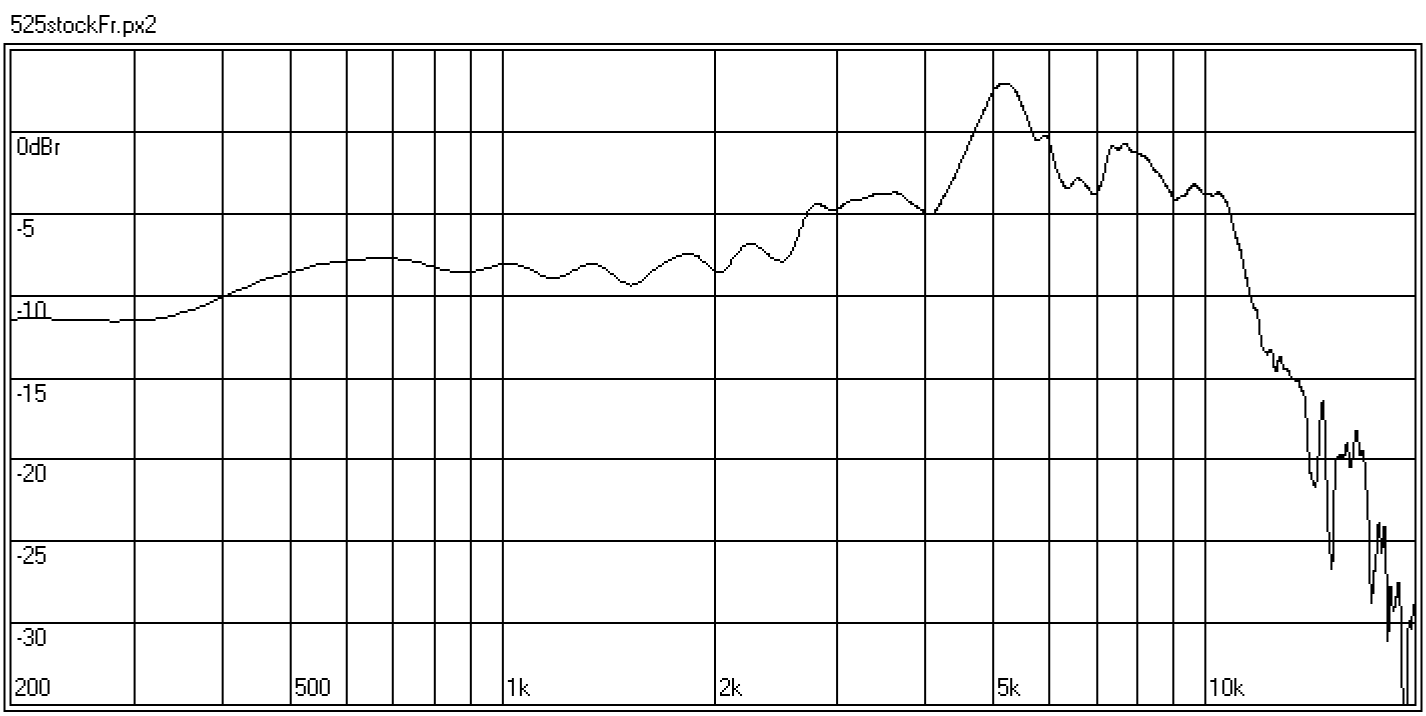


Figure Two. Stock frequency response of the 5.25 inch diameter midwoofer, composite poly cone with extended neck dip.



Cone manufacturers will describe the extended neck dip feature as a way to extend frequency response. They are correct in that claim. Unfortunately, the extension of frequency response is because the extended neck dip causes another cone material vibration mode. These vibration modes or cone breakup do not reproduce the signal applied by the voice coil, instead it is the spurious vibration of the cone that is creating the sound.

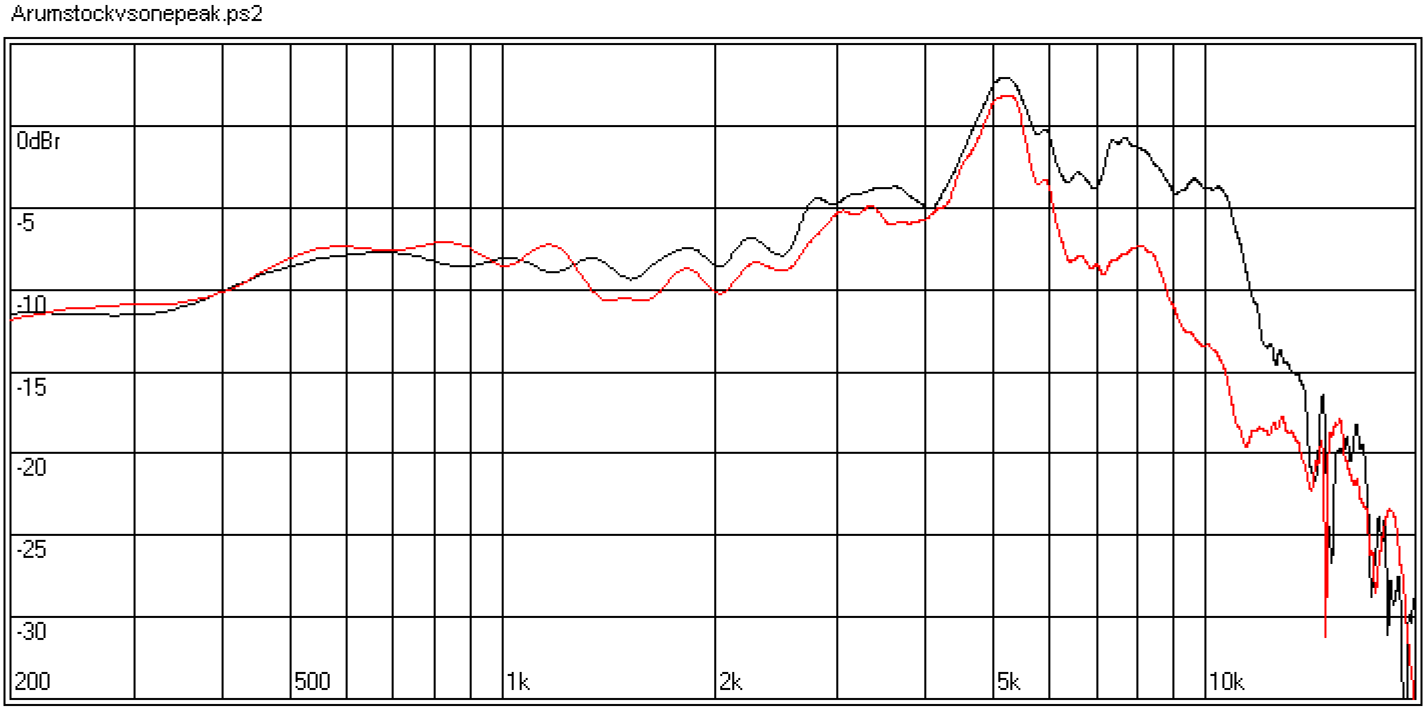
Here, the extended neck dip does provide what appears to be a couple of kHz more top end. It also causes a generally rising frequency response, a rise so great in magnitude as to almost swamp the response error caused by the major cone material vibration mode.

Figure three again shows the frequency response of the stock transducer. This time, there is a second frequency response drawn in red overwriting the stock response. The second response, drawn in red, is with the vibration mode caused by the neck dip treated to control that mode. The response, while not as extended, is still beyond the seven kHz claimed by the manufacturer. In addition, the overall response has been flattened considerably. The 5.2 kHz vibration mode, however, has been barely effected.

Without the negative effects of the extended neck dip, the performance of transducer is comparable to polypropylene cones without the carbon and mica doping. If the non extended neck dip vibration modes are also controlled, then there seems to be little reason to bother with doping the cone material with all manner of substances.

And if you desire to have the top end extend as far as it does with the extended neck dip cause vibration mode, it is possible to do so by replacing the plastic dust cap with a simple plug design. Starting on page three, I show the performance with a plug instead of a dust cap for both the stock and with the 5.2 and 11 kHz material vibration modes treated.

Figure Three. A repeat of the stock frequency response and the frequency response of the transducer with the 11 kHz vibration mode caused by the extended neck dip feature treated. The treated response is overdrawn in red.



Figures four and five show the impulse and frequency response of the transducer with the small plastic dust cap replaced with a simple plug of our own design. There are minor changes in the response and a significant increase in output above 12 kHz, although this extreme high frequency increase is still well down from the output magnitude in the bandpass region. Otherwise, the significant features of the transducer's response remain unchanged. The major vibration modes are still evident, including the mode caused by the extended neck dip.

Figure Four. The impulse response of the transducer after the dust cap has been replaced with a plug.

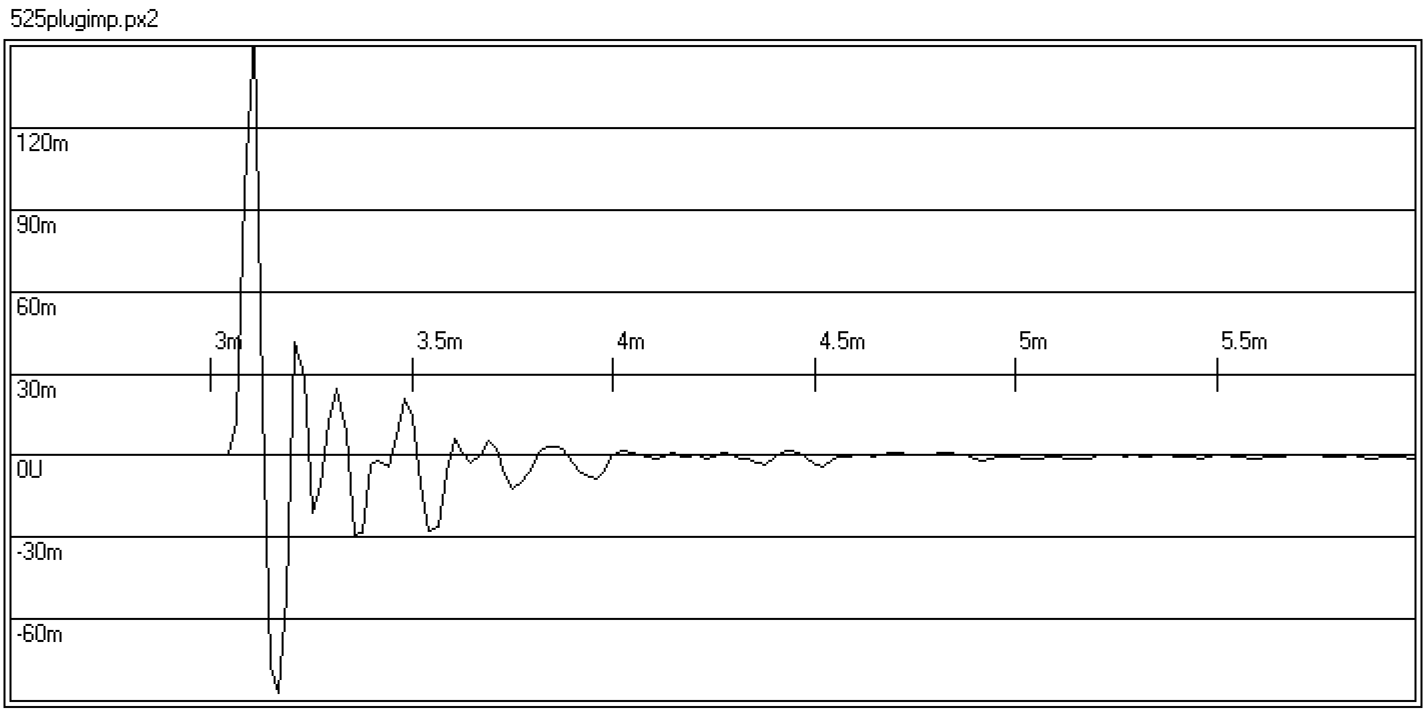
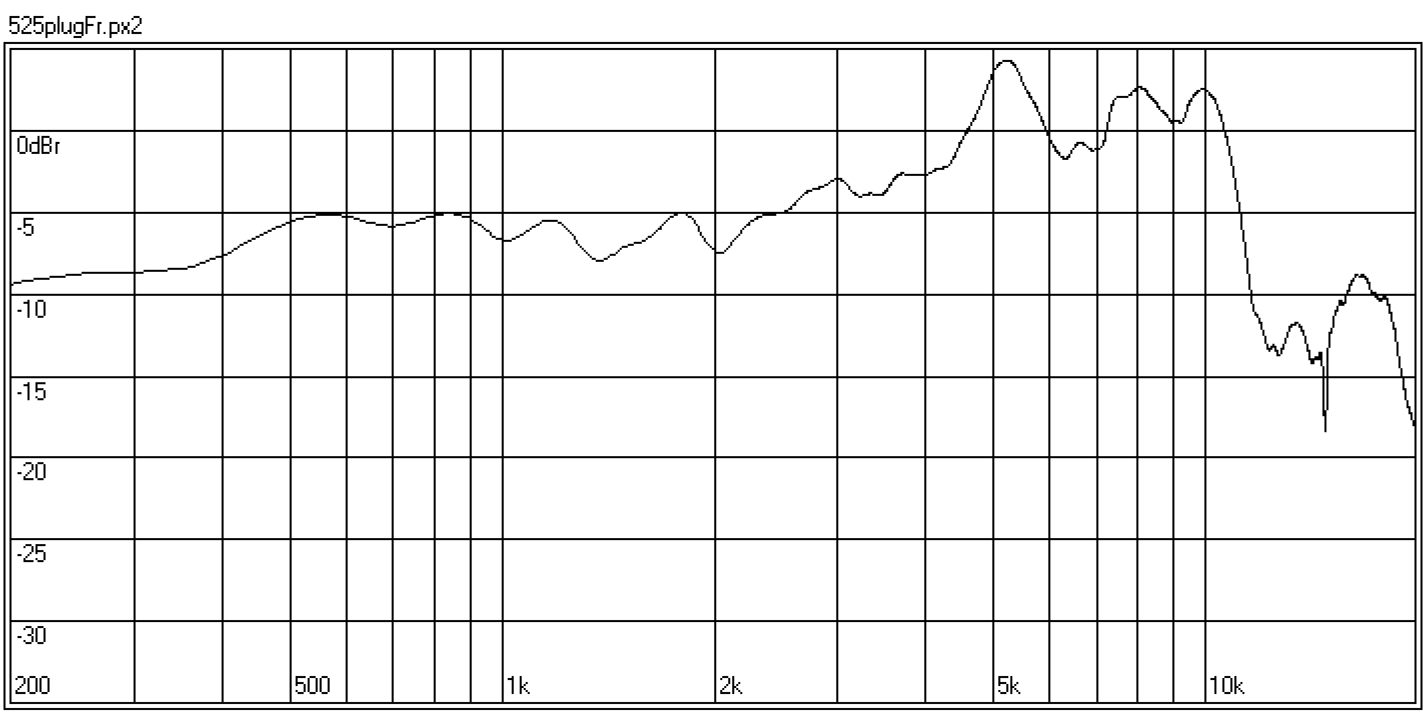


Figure Five. The frequency response of the transducer with the dust cap replaced with a plug. This change produces very little difference in response with the cone in stock condition.



Figures six and seven show the impulse and frequency response of the transducer with plug after the cone is treated to control the major material vibration modes. Two modes are treated, the mode associated with the extended neck dip and the mode with center frequency of 5.2kHz.

Neither mode was treated to fully control the mode. This was done for two reasons. One was to show that these two graphs show the performance of the same transducer. All of the features of the stock transducer are still present. They have just been minimized. The second reason is to show the degree of control possible in controlling material vibration modes. They can be adjusted with some degree of precision.

With the treated cone and using a plug instead of a dust cap, bandwidth is once again out to 12 kHz. The overall response, however, has been improved by about six dB. The total deviation within the claimed bandwidth for the transducer has been reduced from about 13 dB to about seven dB. This improvement is audible. It is easily audible when listening to test signals and it is just as audible when the transducer is reproducing music.

Should a loudspeaker manufacturer decide to use this transducer, the complexity of compensation network

Figure Six. Impulse response of the 5.25 inch midwoofer with plug and cone treated to control two material vibration modes.

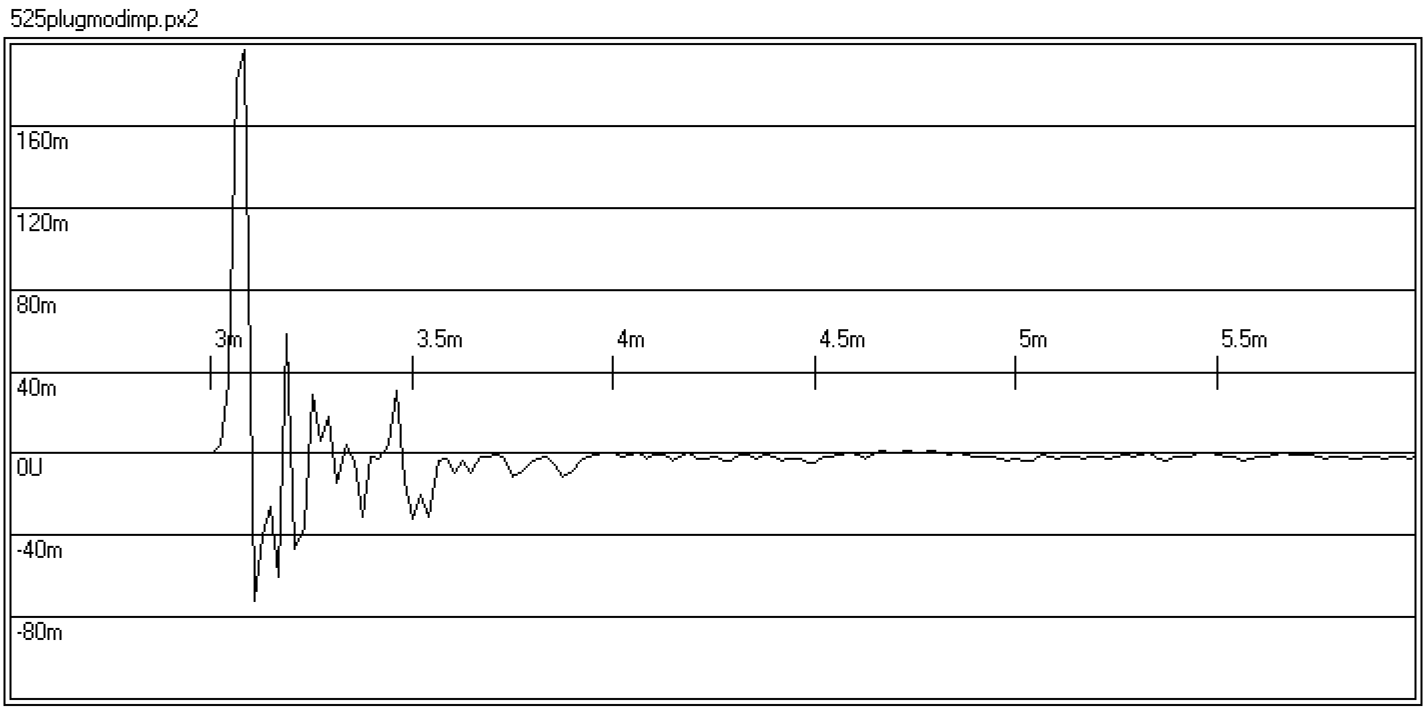


Figure Seven. Frequency response of transducer using plug and with two cone material vibration modes treated. Stock response with plug is overdrawn in red for easy comparison.