Subject: Behaviour of vented loudspeaker systems
Posted by Wayne Parham on Mon, 17 Jun 2002 02:25:48 GMT
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All bass-reflex systems have two impedance peaks, fl and fh. The Helmholtz frequency (fb) and the free-air resonance of the woofer (fs) interact and modify each other to create fl and fh. Minimum excursion is at fb and maximum is below fl, where excursion tends to rise rapidly as frequency goes down. The woofer is unloaded under fl and the woofer is for all practical purposes moving as it would in free air. There is another maximum at fh and this is the one you should concern yourself with the most. Excursion at fh should not exceed Xmax. You can high-pass the woofer to remove signals from being presented to it below fl in a high-power application because it will not be generating any useable output below fl anyway. But fh is in the passband, so this sets your excursion limit.

At frequencies below fl, the woofer and port are moving together, so that the woofer goes out when the port's air mass goes in. This causes complete cancellation, and the system is unloaded. But as frequency rises above fl - as frequency passes through fb - the two resonators are moving towards a condition where they push against one another and provide an in-phase signal. That's why diaphragm excursion is reduced at fb, the air mass in the port is moving opposite to the diaphragm. Between fb and fl, the system is still resonant but not as tightly coupled. Above fh, the system is no longer at resonance and the port is for all practical purposes acoustically invisible. At frequencies above fh, it is like it weren't even there at all.

As we rise much beyond fh, the port begins to act as though it weren't there. Pressure changes are too rapid for the area of the port to be of any significance, so above fh, the port does nothing at all. Of course, there is a possibility of wavelength-related phenomenon, but that is why we use acoustic insulation in the cabinet. We want to minimize wavelength related phenomenon and ensure that the significant mechanism be only that of the Helmholtz resonator and its interaction with the woofer. In this way, the fl-fb-fh resonance region mentioned above is all that is affected by the system.