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Subject: Re: PiAlign port

Posted by [Wayne Parham](#) on Sun, 14 Sep 2003 07:24:43 GMT

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What I am referring to as waveguide behaviour is the same thing that you are calling self-resonance or "pipe-organ" resonance. It is caused by standing waves within the duct, and is different from Helmholtz resonance. It is entirely reasonable to explore this property, and it is good that you brought it up. All ducts will exhibit waveguide behavior at frequencies determined by their dimensions. All will act as organ-pipes and will resonate with standing waves at specific frequencies. This is true whether or not the duct is also being used as part of a Helmholtz resonator in a bass-reflex cabinet. But one of the design goals in a bass-reflex system is to limit energies presented to the port near the frequencies where standing waves would develop. They are designed to excite the Helmholtz frequency but to suppress standing wave modes. The only way to do this is to limit energies at frequencies that will excite the port as a waveguide. That's what insulation is for, and port placement is fairly important too. You don't want the port to be facing right at a driver that will generate a lot of midrange. That will probably introduce energies that excite the duct at standing wave frequencies. Transmission lines are speakers that use standing wave resonance as their tuning mechanism. The ducts in them are usually much longer, because they are trying to tune the pipe for bass frequencies which are long. But standing waves also develop at harmonics of the fundamental, so the designer usually tries to limit midrange frequencies from exciting his resonator too. They usually want one or two standing wave modes to be excited, and no more. In a bass-reflex speaker, the duct is usually relatively short so that the first standing wave mode is pretty high in the frequency band, and easily filtered. The idea is to tune the Helmholtz frequency to under 100Hz, and limit energies above that. An example is a duct having a first standing wave mode of 1kHz, which is then suppressed by using insulation and with careful placement in relation to the woofer. If the crossover frequency is below the first standing wave mode, then that's even better because more energy is attenuated that might have excited the pipe. So you are right to be concerned by the standing-wave issue within the duct. Energy near these standing wave frequencies will excite the duct and make it resonate. For more information, see the paper called "Acoustic High-Pass, Low-Pass, and Band-Stop Filters," by Daniel Russell.

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