

# FSE – Quiz 1 Answer Key

## Scenario:

2 Loudspeakers are separated by 2.2 feet (2 hoagies), as shown below. They are emitting the same sound at the same time (no delay between them).

## Questions:

- 1) How long does it take the sound to travel from speaker 1 to speaker 2 assuming the speed of sound is 1100 feet per second? (2 pts)

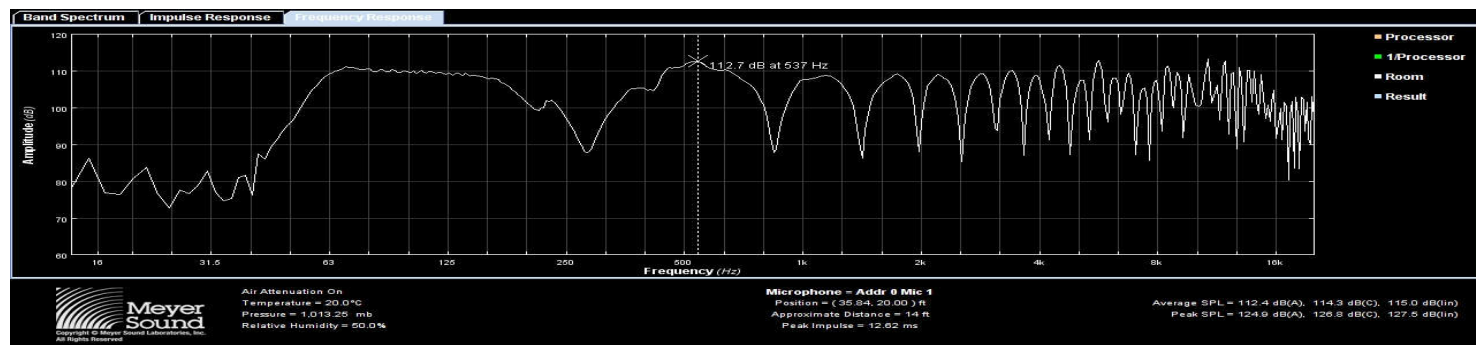
2.2 feet divided by 1100 feet per second gives 2 thousandths of a second, 0.002 seconds, or 2 milliseconds. 2 milliseconds is the period of the wave that fits perfectly in this gap.

- 2) This time is the period (the time for a full 360 degree wave cycle) of what frequency of sound? (2pts)

Frequency is 1 divided by period.  $1/.002 = 500$  Hz. You could also calculate this with the formula  $frequency = velocity/wavelength$ . You could also arrive at this using the mini cooper, hoagie, pinky scale. As frequency increases, wavelength decreases and vice versa. If we remember that 1,000 Hz has a wavelength of 1 hoagie, 500 Hz. Is 2 hoagies.

- 3) What will happen to the volume of this frequency? (3 pts)

This frequency will increase in volume. For now we don't care by how much. This is what your overall frequency response would look like:

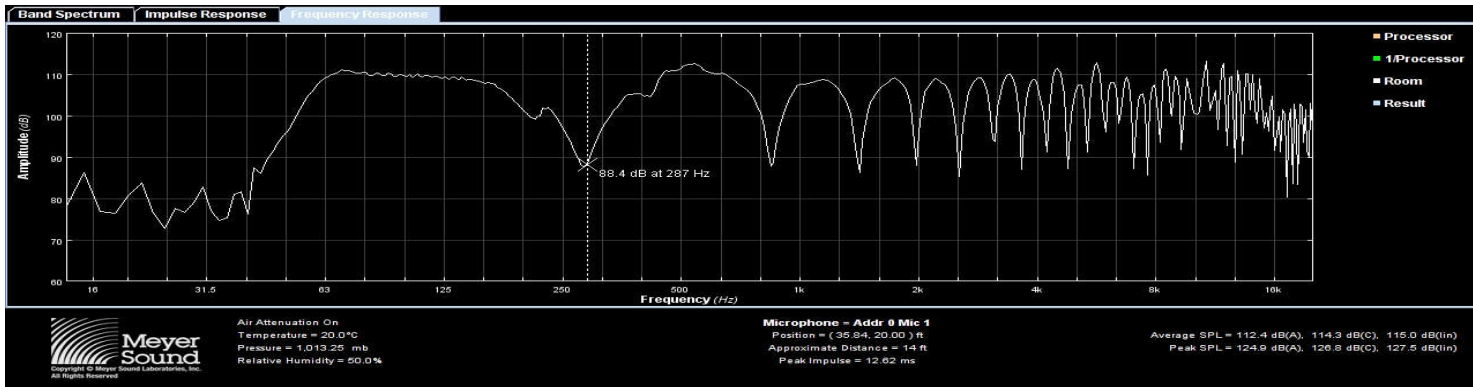


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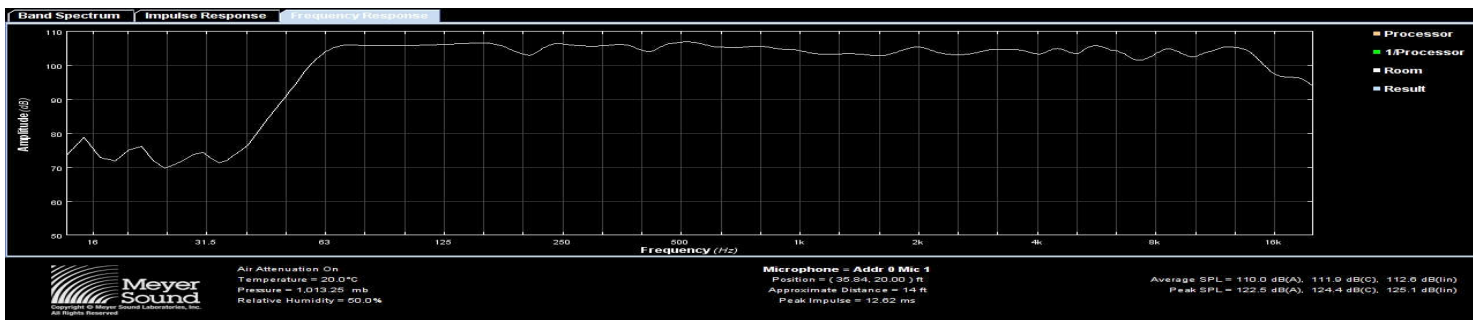
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4) What will be the lowest frequency to cancel completely because of a 180-degree phase offset? (3 pts)

Refer to day 2 lecture notes for this one if you need a graphical picture of how the waves fit in the physical space between the two speakers. The first 180 cancellation occurs at half the frequency – 250 Hz.



Compare this to the frequency response of a single speaker, or of the speaker with the appropriate delay setting:



The response here is much flatter, meaning that the speaker will be able to more “truthfully” deliver whatever acoustic content you put into it.

5) Bonus: Name 2 ways of restoring a flatter frequency response to this speaker system. (2 pts)

The easiest way to eliminate the comb filter would be to eliminate the separation between the speakers, but this may not be possible. Another way to apply a delay to speaker 2 of 2 milliseconds, so that sound was produced as the sound from speaker 1 arrived. The equalizer is not the right tool for this job.