

SET UP

**SUBWOOFER PLACEMENT  
RECOMMENDATIONS GUIDE**

*This guide provides recommendations on where to place  
your subwoofer(s) in your listening room.*

**Velodyne®**

1    **INTRODUCTION**

Introduction

2    **PLACEMENT CAUTIONS**

Subwoofer Placement Cautions

3    **GUIDELINES**

General Subwoofer Placement Guidelines

Single Subwoofer Placement Guidelines

Twin Subwoofer Placement Guidelines

Quad Subwoofer Placement Guidelines

4    **PLACE**

Place a Single Subwoofer

Place Twin Subwoofers

Place Quad Subwoofers

10   **APPENDIX A**

Case Study

## INTRODUCTION

This guide gives recommendations on where to place your subwoofer(s) in your listening room to:

- Get clean, high-impact bass
- Protect your subwoofer(s) from damage
- Avoid hazard(s)

The recommendations are based on an idealized rectangular room. However, as many rooms are not rectangular, have openings into other rooms or hallways, or have unique architectural features such as cathedral ceilings, these should be used as a starting point. It's best to experiment with both your subwoofer and listening position seating to get the best results.

Everyone's room layout is different. If you have a specially designed listening room, you probably already have a designated spot for your subwoofers(s). If not, your room layout may limit where you can safely and cosmetically place your subwoofer. Don't worry, do the best you can at picking a safe location based on the constraints of your room.

One method of determining a single subwoofer placement that has been very successful is the "reversed positions" or as it's sometimes called, the "crawl test." Using this method, you move your preferred seating out of the way, connect the subwoofer to the system and place the subwoofer in the preferred seating position. While playing a source with deep, powerful bass, move around the room, preferably literally crawl, until you find the best position where the bass is powerful, deep and tight (not boomy). You have now discovered a very good choice for placing your subwoofer. Now, move the subwoofer to the discerned position and return your seating to its original place. For detailed information on a test case of this method, see Appendix A: Case Study: Determining Optimal Subwoofer Placement using the "Crawl Test" Technique in Velodyne's Listening Room.

You may find that moving your subwoofer(s) by as little as six to eight inches can improve how your subwoofers sound to you. Remember, the safe location that your subwoofer(s) sound best to you is the best location for you. The recommendations in this guide serve as a starting point for subwoofer placement. But remember to always heed the **Subwoofer Placement Cautions**.

**Subwoofer Placement Cautions**

PLACE THE SUBWOOFER CABINET ON A STABLE, FLAT AND LEVEL SURFACE. An uneven or unstable surface can cause the subwoofer to tip over and cause injury and/or be damaged. This type of surface can also result in buzzing and rocking sounds that could make the subwoofer sound broken. Protruding objects from the surface or an uneven surface could cause damage to the speaker cone in down-firing subwoofers.

DO NOT CREATE A TRIP HAZARD WITH THE POWER CORDS. Route power, audio and microphone cables so that persons walking in the room don't trip on them. Route the power cord so that it will not be walked on, pinched or compressed in any way that could result in damaging the insulation or wire.

DO NOT BLOCK THE TUNED PORT. A port may be located on the back, front, or bottom of the cabinet. A cabinet with a downward-firing port or passive radiator uses the complete available periphery for radiation, so block this opening as minimally as possible.

PLACE THE SUBWOOFER ON THE FLOOR. If the subwoofer is placed on a stand, bracket, tripod, table or similar device, it could fall or be knocked over causing injury and/or damage to the subwoofer and other items.

KEEP THE SUBWOOFER IN ITS UPRIGHT POSITION. Using, shipping or otherwise storing the subwoofer in any other position for an extended period of time may result in damage to the unit that is not covered by the product warranty.

KEEP THE SUBWOOFER FAR ENOUGH AWAY FROM A TV TO PREVENT COLOR DISTORTION. Some TVs are particularly sensitive to stray magnetic fields, such as those caused by the magnet in the subwoofer. If your television produces distorted colors after installing your subwoofer, simply increase the distance between the subwoofer and your TV or video monitor.

### General Subwoofer Placement Guidelines

Refer to the recommended placement diagrams below for general seating and subwoofer placement guidelines.



The seating positions shown in the diagrams below are general guidelines for most room types. Walls, floors and ceilings reinforce bass response. Sitting near a wall almost always results in the perception of more bass than elsewhere in the room. If your seating position is near a wall or a corner, the bass may sound overly heavy and boomy, so try moving your listening position more towards the center of the room. If your seating is at the exact center of the room, it's possible that the bass will seem weak. If you experience this condition, try moving your seating position away from the center.

FACE THE GRILLE towards the room's main seating location in the case of a front-firing subwoofer.

MAKE SURE:

- You can access the controls on the rear of the subwoofer.
- The included 6' power cord for the subwoofer can safely reach a power outlet.

Square rooms are the most challenging acoustically for low frequencies.

Move your seating location to a more optimal location, if your room layout allows for it.

### Single Subwoofer Placement Guidelines

The tips below apply to placing a single subwoofer in your room. Generally, bass frequencies, if reproduced without excessive distortion, are non-directional, that is, you cannot normally tell where the bass is coming from. However, if the subwoofer's crossover is set very high, the subwoofer is played at very high levels so that it distorts, or the subwoofer causes a rattle or other sympathetic vibration to occur, it might give away its location. Other tips:

PLACE in a CORNER (loudest but not the most accurate) or within a few feet of a wall (smoothest but not the loudest).

AVOID locations far away from a wall, close to the room center, by a door, near a partial-height wall, or behind seating arrangements.

### Twin Subwoofer Placement Guidelines

In addition to the above general guidelines for single subwoofer placement, when using TWIN subwoofers follow the guidelines below:

- CENTER OPPOSITE WALL PLACEMENT gives smoothest output and even response throughout the room.
- OPPOSITE CORNER PLACEMENT gives more output and least intrusion into floorplan, but not as smooth or as even throughout the room.
- 1/4 or 1/3 ADJACENT WALL PLACEMENT can give a blend of output and smoothness which could be advantageous in problem rooms.
- DON'T put one subwoofer next to listening seats and one far away, as signals could cancel each other out and limit the output. In extreme cases, this precedence effect can cause the nearer subwoofer to be localized, i.e. you can tell where the bass is coming from.
- Preferably place each subwoofer by the satellite speaker of the same channel.

### Quad Subwoofer Placement Guidelines

In addition to the above general guidelines for subwoofer placement, when using FOUR subwoofers follow the guidelines below.

FOUR (or more) subwoofers give the best sound in a room.

- CORNER PLACEMENT gives more output and least intrusion into floorplan.
- CENTER WALL PLACEMENT controls room nodes but more intrusion into floorplan.

Don't put some subwoofers next to listening seats and others far away, as signals could cancel each other out and limit the output. In extreme cases, this precedence effect can cause the nearer subwoofer to be localized.

## Place a Single Subwoofer

This section provides general recommendations on where to place a single subwoofer in your listening room. You can try placing a single subwoofer in the:

1. Front corner
2. In the center in front of your audio system; or
3. A quarter or third away from the front of the room on either the right or left side of the room.

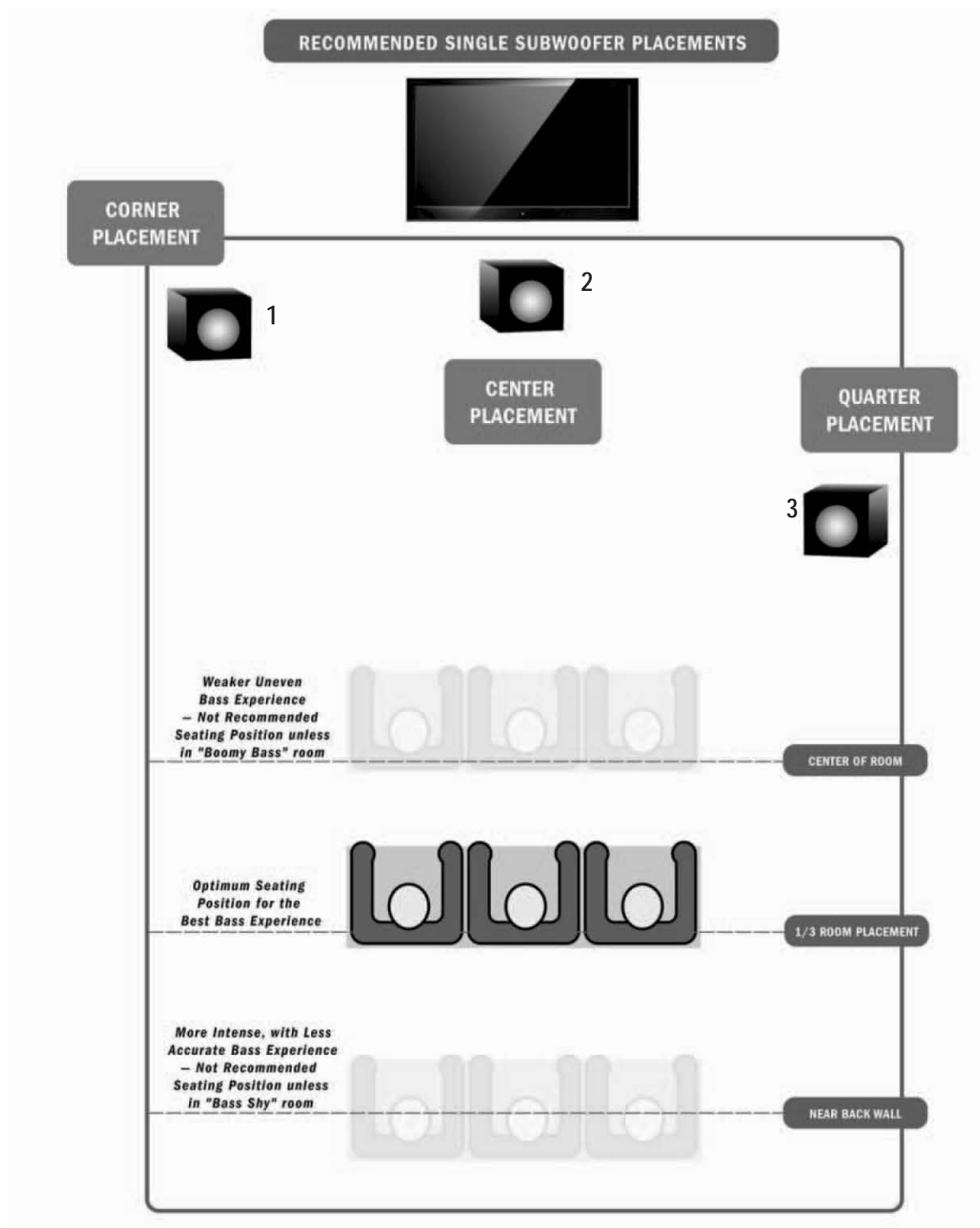


Figure 1: Recommended Single Subwoofer Placements

### Place Twin Subwoofers

This section provides general recommendations on where to place twin subwoofers in your listening room. You can try placing twin subwoofers in any of the following configurations:

- One in each of two opposite diagonal corners
- One in the front center and one in the rear center; or
- One a quarter or one third away from the front of the room on both the right and left sides of the room.

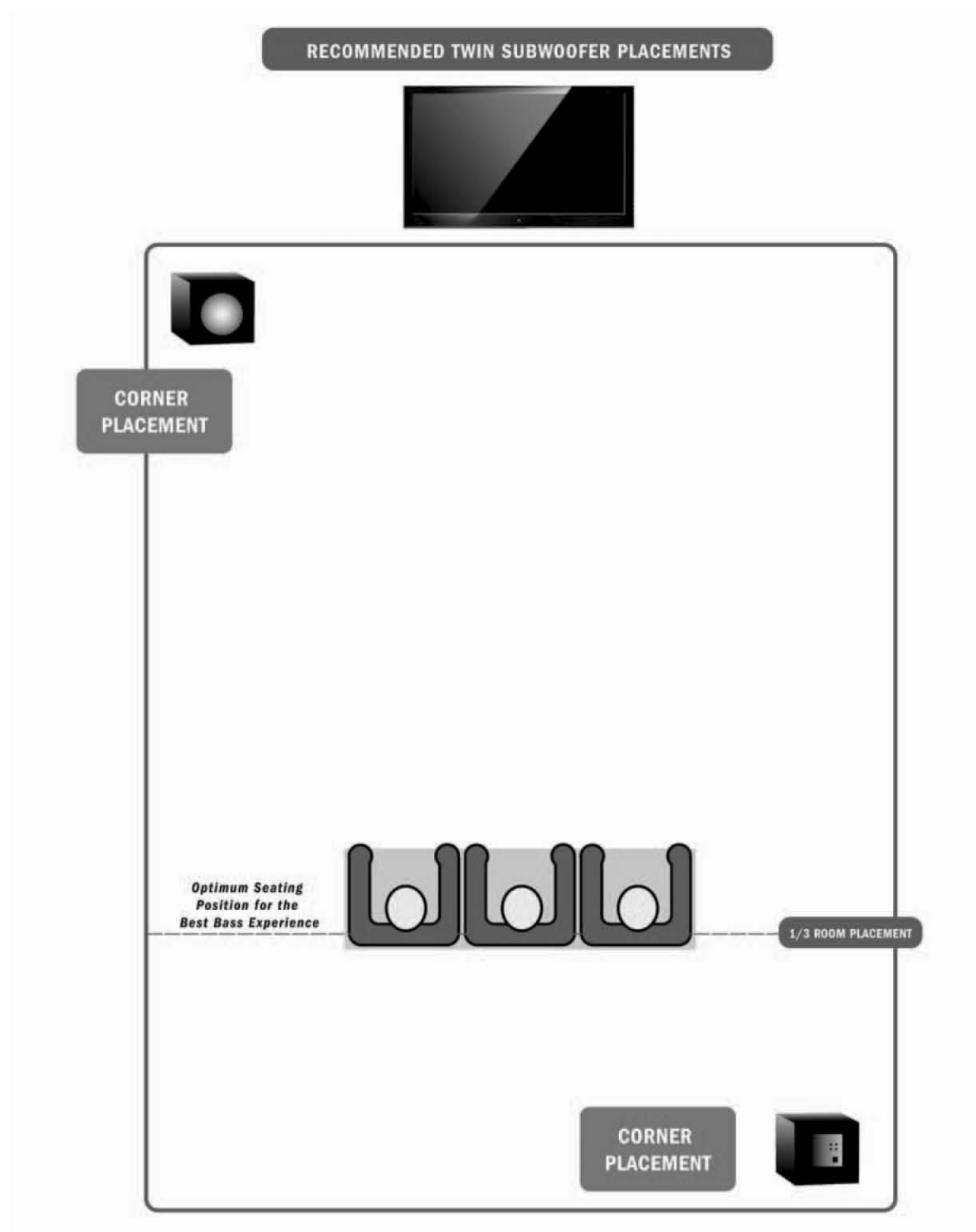


Figure 2: Recommended Twin Subwoofer Corner Placements

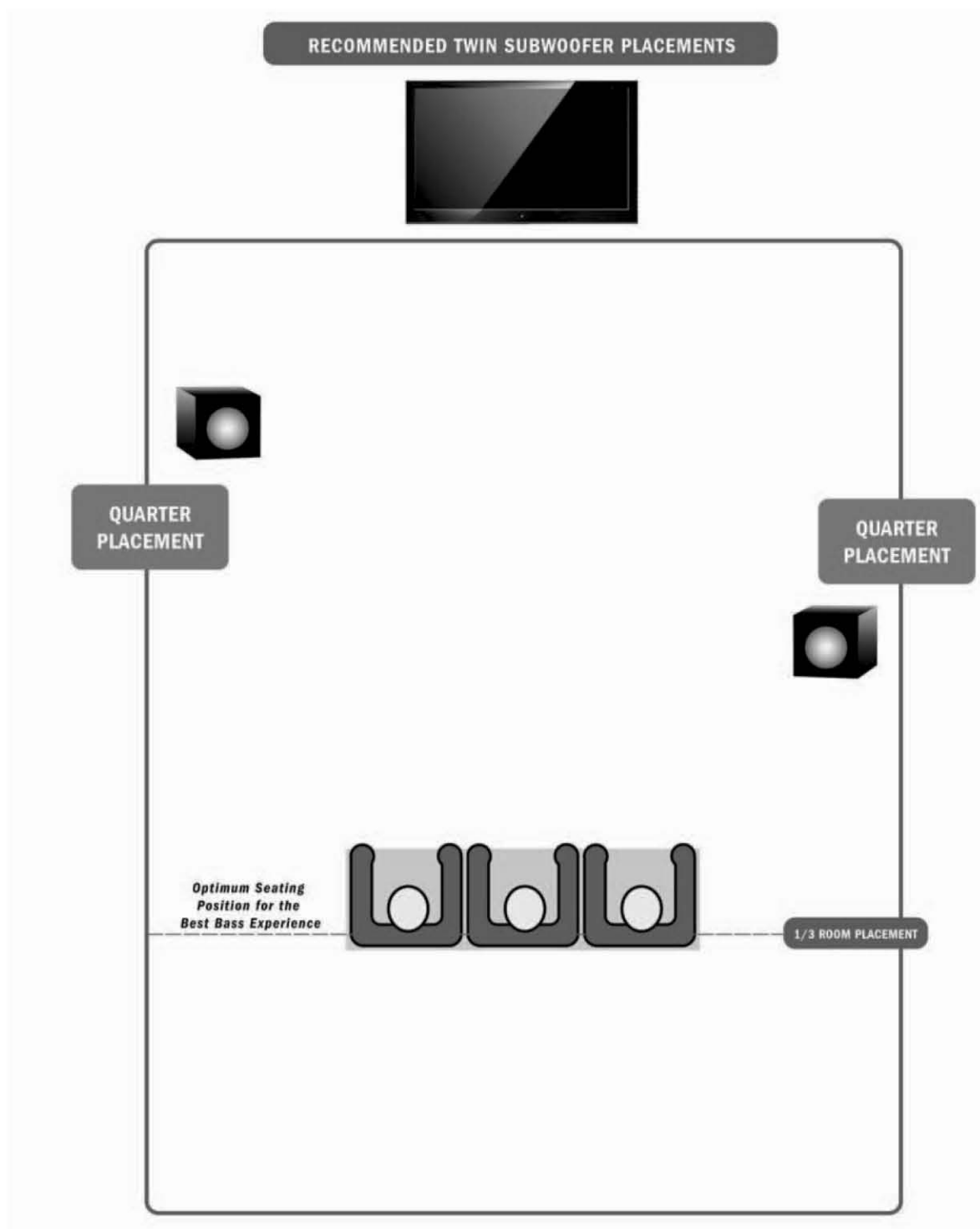


Figure 3: Recommended Twin Subwoofer Quarter Wall Placements



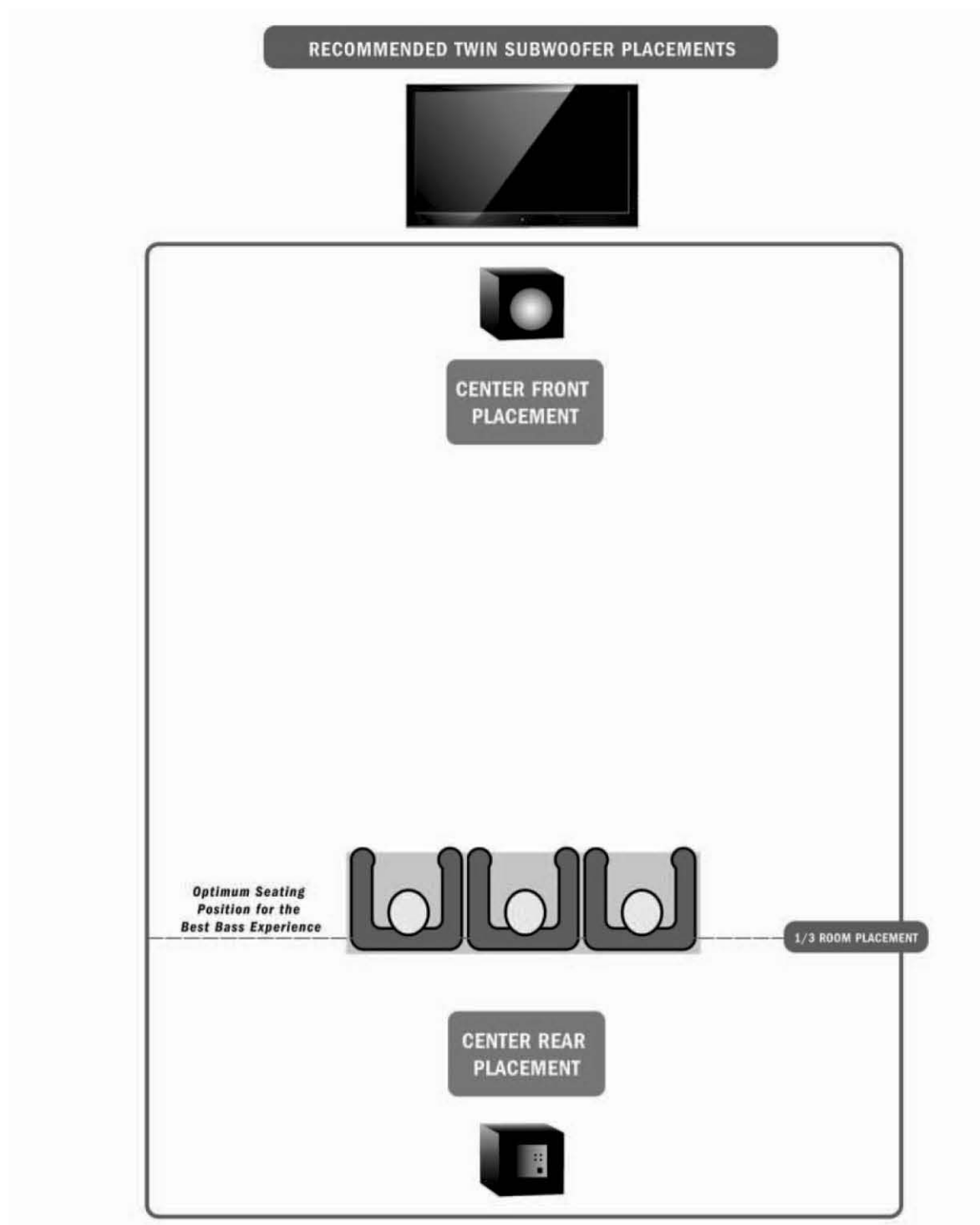


Figure 4: Recommended Twin Subwoofer Center Placements

### Place Quad Subwoofers

This section provides general recommendations on where to place four subwoofers in your listening room. You can try placing four subwoofers in either of the following configurations:

- One in the center of each wall; or
- One in each corner

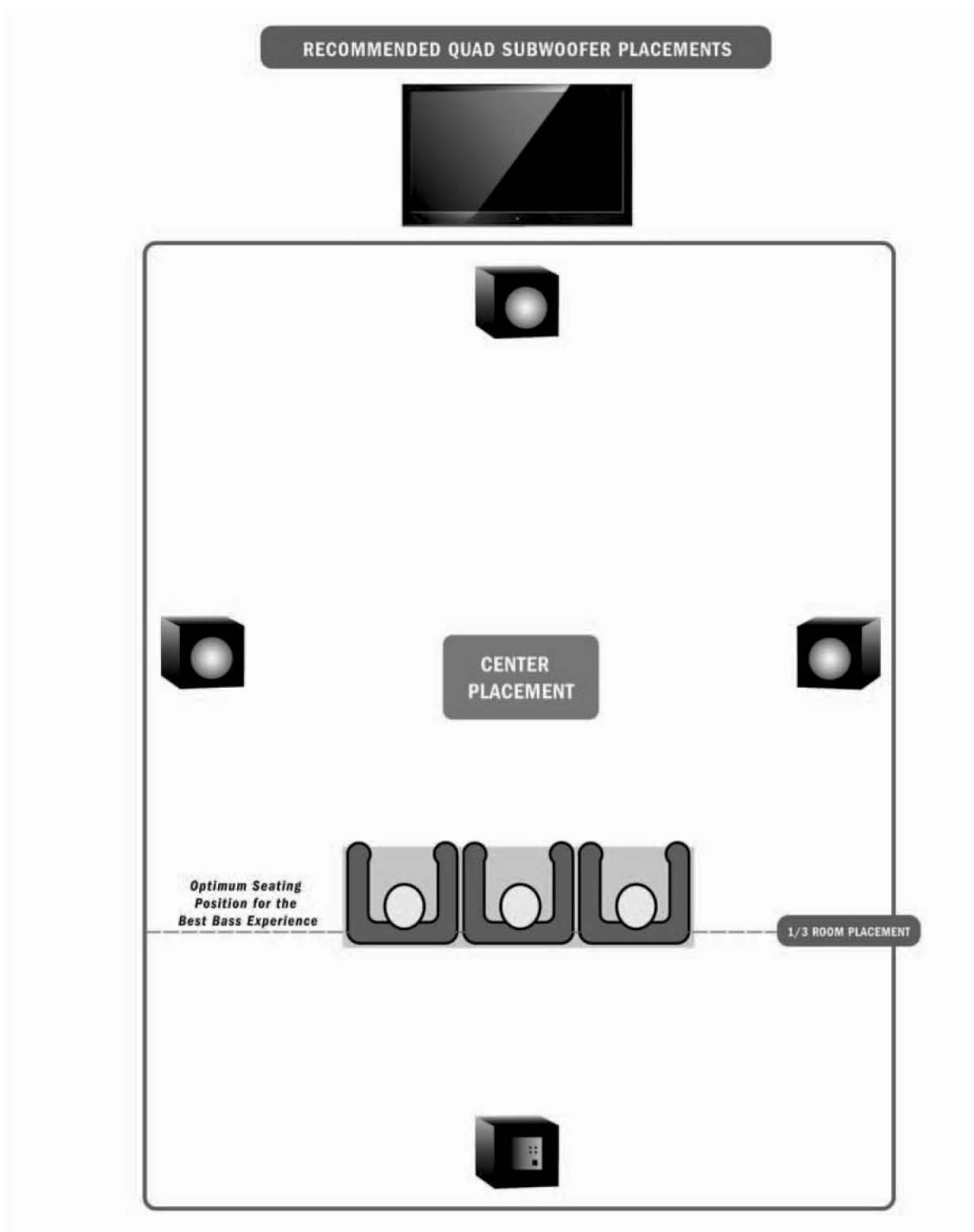


Figure 5: Recommended Quad Subwoofer Center Placements

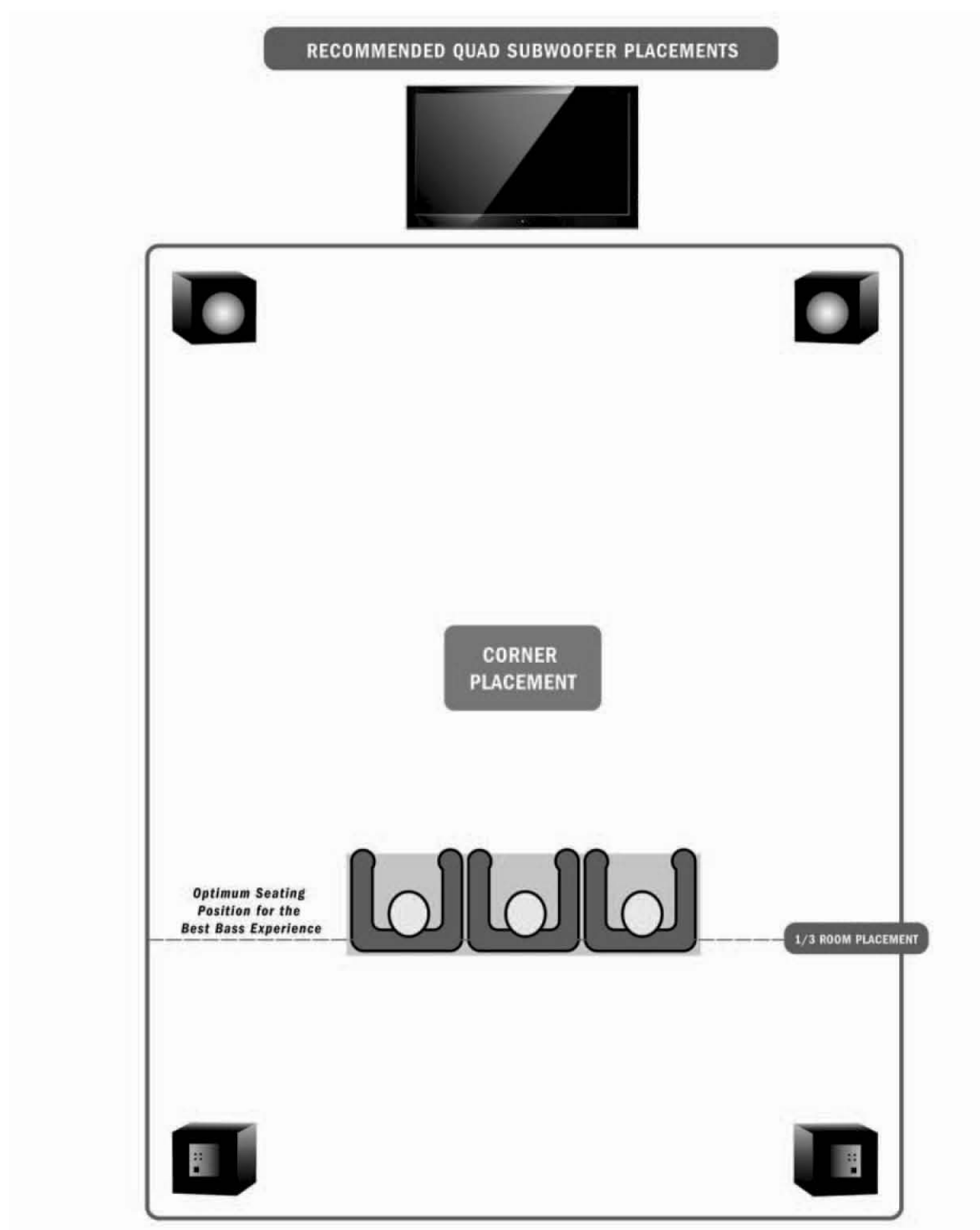


Figure 6: Recommended Quad Subwoofer Corner Placements

## APPENDIX A

**Case Study:** *Determining Optimal Subwoofer Placement using the "Crawl Test" Technique in Velodyne's Listening Room*

### Overview

To illustrate the use of the "Crawl Test" Technique described in the Subwoofer Placement Recommendations Guide, we used this technique to determine the best locations for subwoofers in the Velodyne listening room.

### Room Layout and Subwoofer Locations Evaluated

The drawing below shows the layout of the Velodyne listening room and the subwoofer locations evaluated.

The room is located near the center of the offices and, hence, has no windows. The room's two doors and the walkway between them can't be blocked by subwoofers. Also, access to the storage cabinets can't be obstructed by a subwoofer. The main listening seat is located at about two-thirds of the length of the side walls and in the center of the length of the front and rear walls. Our satellite speakers were located on each side of the TV. The doors were closed for this evaluation.

The initial spots we choose for evaluation as possible locations for subwoofers were based on the general placement guidelines and open areas of the room. These locations were adjusted slightly based on what the evaluator heard at the initial locations. The final evaluated locations were:

- **Location 1:** *Left front corner.*
- **Location 2:** *Left side wall between the door and storage cabinet.*
- **Location 3:** *Center back wall.*
- **Location 4:** *Right side wall about 1/4 way between storage cabinet and wall.*

We used a DD-10+ 10" Digital Drive<sup>PLUS</sup> subwoofer for our evaluation so that we could compare the results from listening to music to those obtained with the frequency responses.

### Illustrative of Technique

If you use the “Crawl Test” technique in your listening room, what you hear or the variations you see in the frequency response curves will be different than those in this document. The evaluation we did was to illustrate the validity of the “Crawl Test” technique. What you hear and see depends on the acoustical properties of your room.

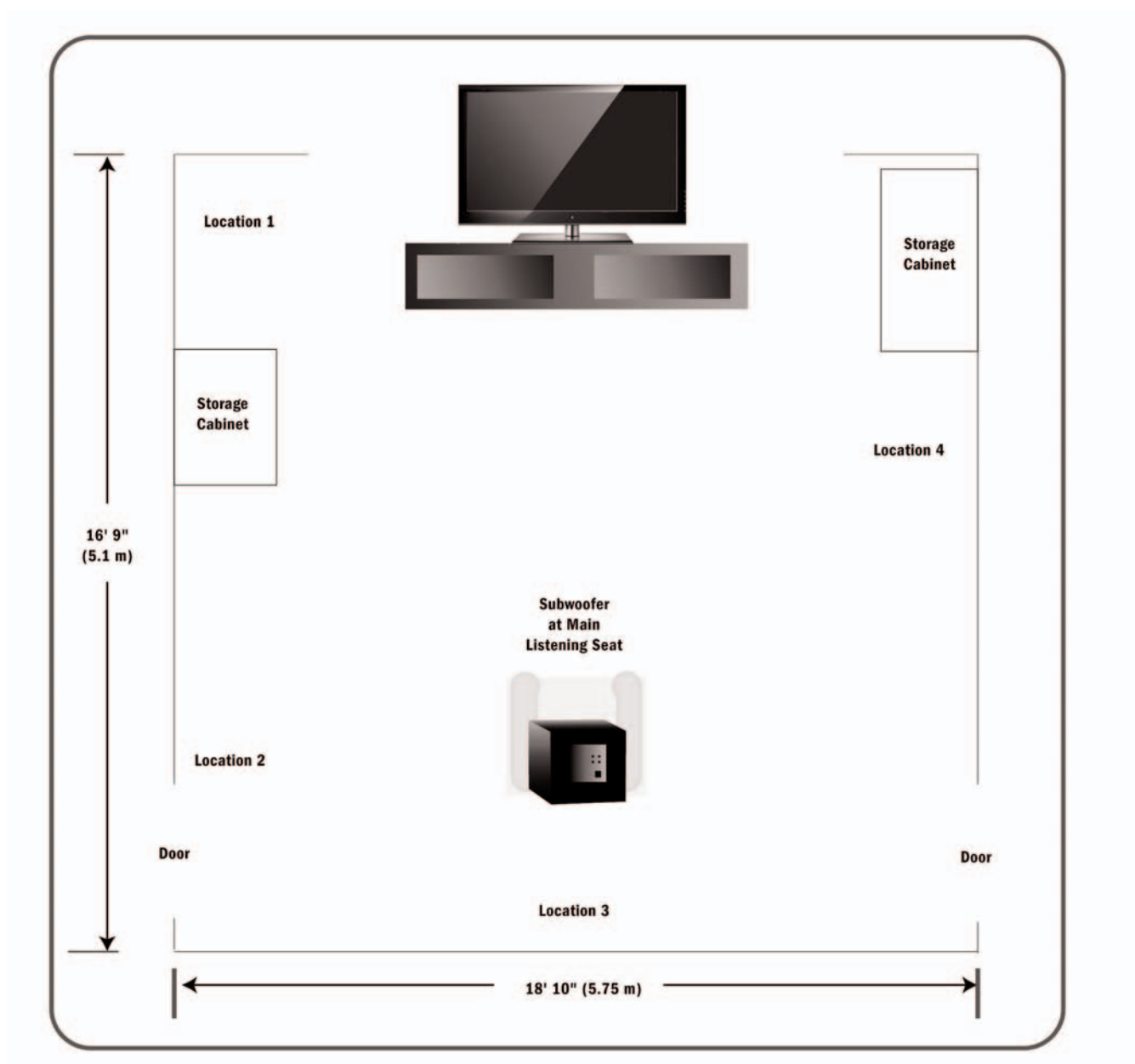


Figure 1: Listening Room Layout & Evaluated Subwoofer Locations

### Evaluation by Listening

In order to use the “Crawl Test” technique:

1. We put the subwoofer in the location of the main listening seat. To avoid having to lift the heavy subwoofer onto the seat of the chair, we moved the chair back slightly and put the subwoofer on the floor where the chair normally is.
2. We played some music through the audio system. We choose a song that had somewhat repetitive and moderate amount of bass in it.
3. We reset the subwoofer volume to its factory setting.

4. We set the receiver volume such that we heard a moderate music volume.
5. Our evaluator walked to each initial location and listened. The evaluator took a step in several directions around each initial location to hear what improvement, if any was heard compared to the initial location. The evaluator chose a final location near each initial location.
6. We placed a small object at each final location so that later we could locate a subwoofer there and could also test these locations using frequency responses.
7. The evaluator's observations were as follows:
  - Location 1: Bass sounded crisp.
  - Location 2: Bass sounded "hot," i.e. heavy or boomy.
  - Location 3: Bass seemed thin compared to Location 1.
  - Location 4: Bass sounded the same as at Location 1.

### Recommended Locations

Based on the above evaluation, we picked Location 1 as the best place for a single subwoofer because it and Location 4 had the best sounding bass, but Location 1 was closer to the receiver and thus would not require cables to be run around the room as with Location 4.

Also, we picked Location 1 and Location 4 as the best places for two subwoofers because these two locations sounded the same to our evaluator.

### Evaluation by Frequency Response

If you have a microphone and a Digital Drive<sup>PLUS</sup> subwoofer you can view the frequency response of the subwoofer on one of the visual interfaces; either a Windows® computer screen or a TV screen.

In order to use the "Crawl Test" technique:

1. We kept the subwoofer in the same location as described in the Evaluation by Listening section.
2. We connected the microphone to the subwoofer.
3. We played the Auto-EQ<sup>PLUS</sup> Sweep Tone CD through the audio system.
4. We set the subwoofer volume to its factory setting of 30.
5. We set the receiver volume such that we heard a moderate music volume.
6. We evaluated final evaluation locations as marked in Step 4 of the Evaluation by Listening section by placing the microphone at the location and looking at the frequency response.



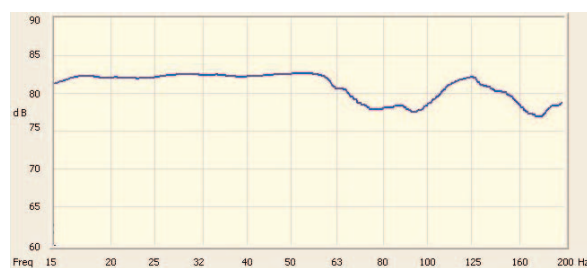
**Note:** These are the frequency responses without Self-EQ, Auto-EQ<sup>PLUS</sup> or Manual-EQ of the subwoofer. We want to evaluate the effect of the placement location, not the effect of optimizing the equalization. The subwoofer equalization will be optimized after its optimal location is determined.

7. The frequency responses measured are shown below.

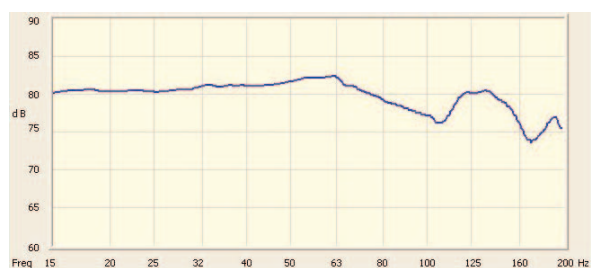
### Recommended Locations

Based on the frequency responses, we picked Location 1 as the best place for a single subwoofer because it had the smoothest response curve.

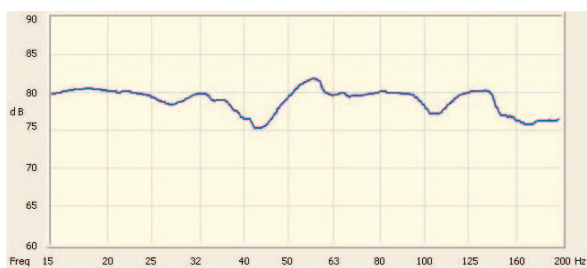
Also, we picked Location 4 as the best location for a second subwoofer because the peak in its frequency response at about 60 Hz was narrower than the one in Location 2.



Location 1



Location 2



Location 3



Location 4

Figure 2: Bass Frequency Responses at each Location

### Comparison of Results

Because not everyone has a Digital Drive<sup>PLUS</sup> subwoofer, we will now compare the results from listening to music and looking at frequency responses. This shows that with the "Crawl Test" technique, if you have a good ear for how bass sounds, you can choose the same locations as the more advanced method of viewing frequency response curves.

We picked the same best locations for one and two subwoofers using both listening to music and viewing the frequency responses.

Location	Listening Evaluation	Frequency Response Evaluation
1	Crisp	The curve was flat and within +/- 3 dB which is why the bass sounded crisp when listening at this location.
2	Hot, heavy, boomy	More level at 50 to 63 Hz. Hence, this curve has more energy in it than for Location 1. This accounts for why the evaluator thought there was too much bass at this location.
3	Thin	The dip in the curve at around 42 Hz to 50 Hz explains why the bass sounded thin when listening at this location. The overall bass level was lower at this location than at Location 1.
4	Crisp	Although visually this curve is slightly less flat than the one for Location 1, it is still within +/- 1 dB. This amount of variation isn't perceptible to most people. This curve also doesn't start to roll off until 80 Hz as compared to 63 Hz in Location 1. The evaluator couldn't hear the differences between these two curves.



### Example of Change in Frequency Response Due to Change in Subwoofer Placement

To illustrate how moving the subwoofer can impact the frequency response, we moved the subwoofer in Location 4 towards the center of the room one foot. We ran the Auto-EQ<sup>PLUS</sup> optimization at each location to determine the frequency response. The results are shown below.

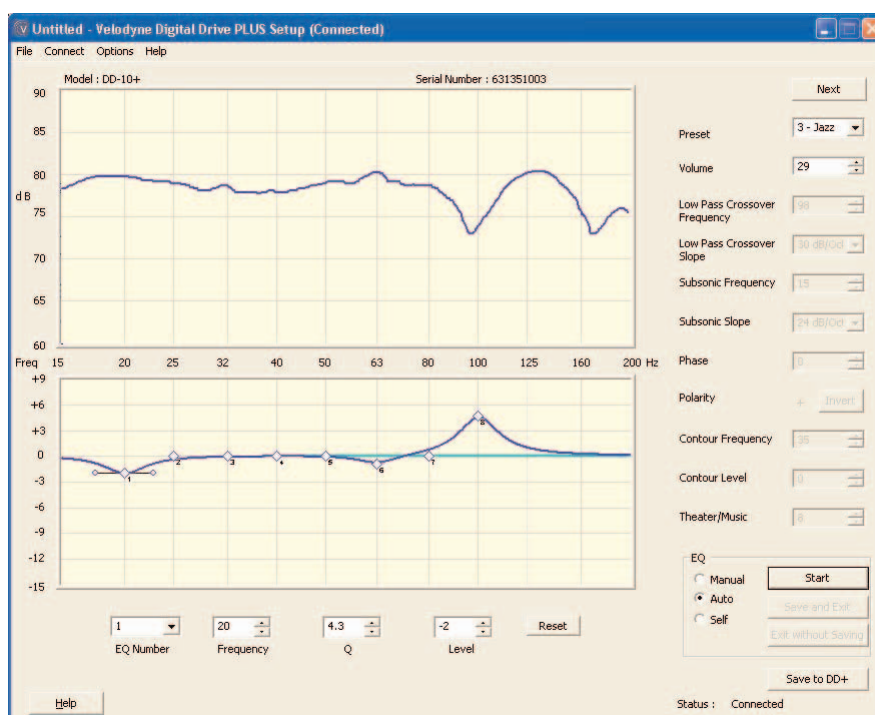


Figure 3: Auto-EQ<sup>PLUS</sup> Location 4

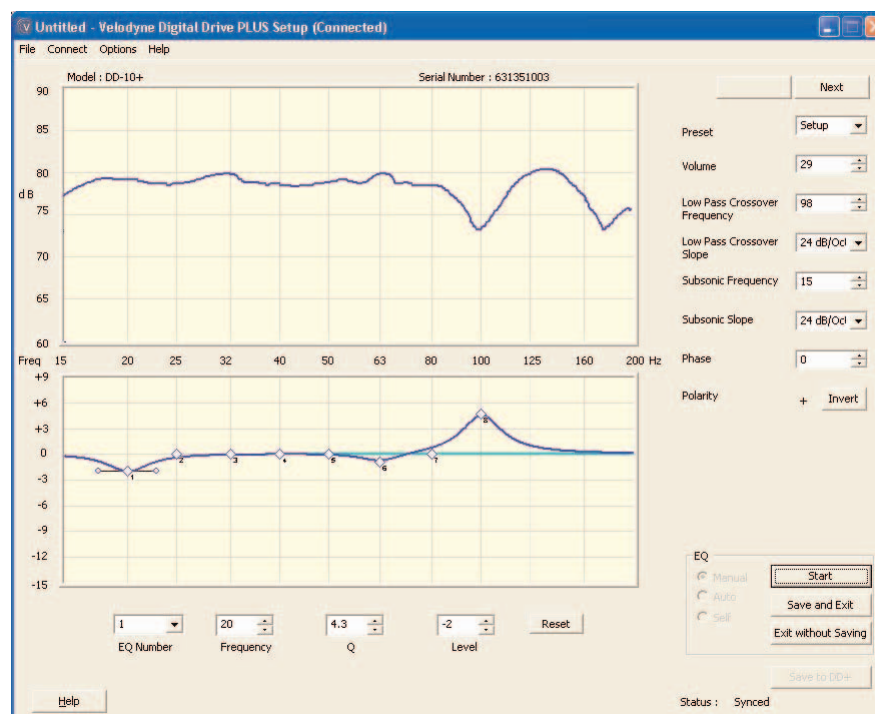
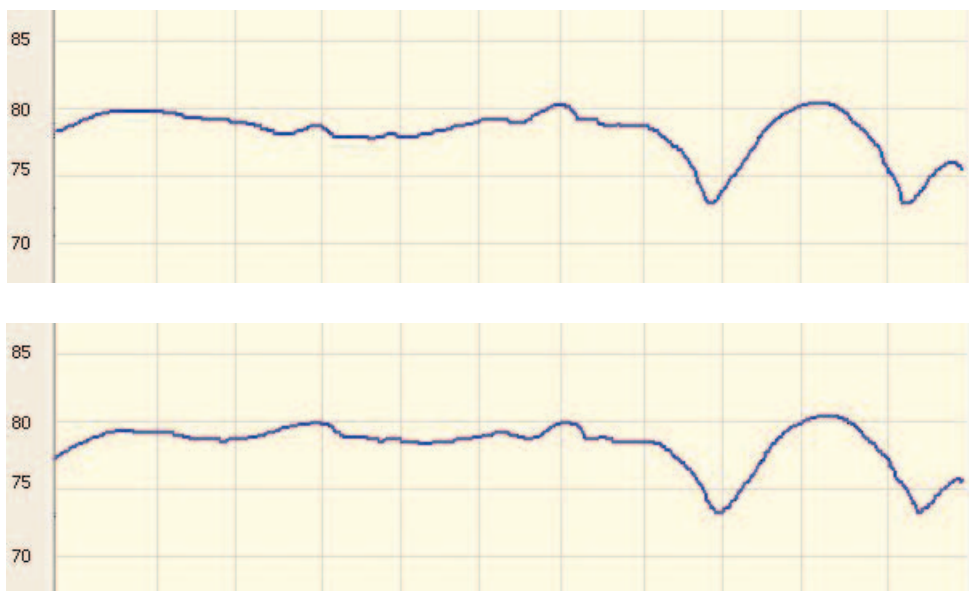


Figure 4: Auto-EQ<sup>PLUS</sup> Location 4 moved one foot

The difference is hard to see at the above scale, so we have enlarged the curves below. The first image is the original curve, and the second image the curve after moving the subwoofer one foot.



Difference between the curves and parameters:

- The low-pass crossover frequencies are the same, but the original crossover slope is 30 dB and the second slope is 24 dB.
- Note the level increase of up to 1 dB between 20 Hz and 50 Hz. This shows that even small placement changes of the subwoofer can greatly improve the performance in the bass region.



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