

# Grid method speaker calibration v2

By Andy Moore



## What's this all about..?

Over the last 30+ years I have had the opportunity to work within the Hifi industry, and a lot of this time has been spent calibrating high performance audio systems both for work and at home. One thing I realized early on was that we need some control and that simply placing an incredible speaker in a room doesn't always yield incredible results. So how can we nail down the optimal speaker position?

This guide sets out in simple terms to educate a little and break the "loop of frustration". Lets put the band in the room.

I have lost count of how many system conversations I have had with customers who will say "I am not 100% happy with the sound of my system, I need to change my cables, my speakers, my amplifier" etc. As the loudspeaker is the final room interface my question is always, "do you have the speakers in the correct place? The answer is typically "I don't know", or "how would I know".

Let me show you a trick that I have used for 20+ years allowing for the maximum performance of any speaker system in any room, often with award winning results, without measurement, a technique that anyone can use. No golden ears are required, simply trust in your own instincts. You will find recommended test tracks later in the document.

## Tools required

- Tape measure or meter rule
- Masking tape and marker pen
- 12" vinyl record cover
- Note pad and pen
- Spirit or bubble level
- Headphones (optional)
- Music and ears



## Subjective audio. Hmmm.

Before we start, for this to work we need to get one thing out of the way. The sonic character of reproduced music in the home is not subjective *if* the goal is to calibrate a system that makes a piano sound like a piano and a drum sound like a drum. If we say audio is subjective, what do you want a piano to sound like? Trust your senses, you know what a real piano sounds like. We have all spent a lifetime gathering references for real sound, so let's use them.

## Lingo explained

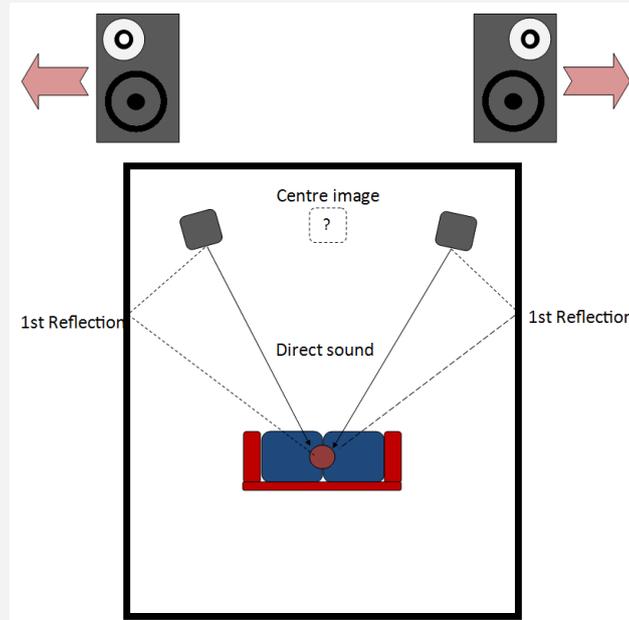
**Centre image** - the centre image is the sonic illusion of a speaker or voice between a stereo pair of loudspeakers This will be strongest when the listener is sitting equidistant between the stereo pair of speakers and is created by mono content in the mix, such as vocal being produced by the two speakers at the same time, and the same level.



**Depth of image** - the depth of image is dictated by the position and dispersion of the loudspeaker. A on wall speaker by nature has no depth of image. Moving a loudspeaker out into the listening room will progressively increase the depth of image however you are loosing bass reinforcement from listening room boundary walls, know as boundary gain.

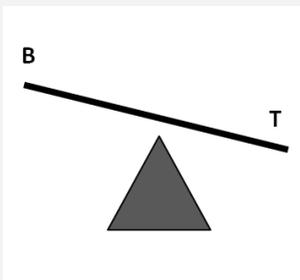
## Lingo explained *continued*

**Stereo Width** — the illusion that sound is coming from beyond the sides of the loudspeaker. The stereo width is a sum of the off axis dispersion characteristics and the room itself. The very best speakers will have a wide and even off axis frequency response. Part of what we perceive as stereo width is a reflection from the side wall, known as the mirror point or 1st reflection.

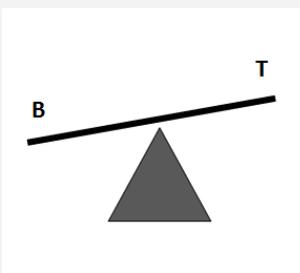


**Frequency response (tilt)** — you will find that the most realistic sounding systems have a falling response (fig 4 over page) from bass to treble. The issue is that as humans we do not hear sound as individual frequencies and we find it impossible accurately identify problems in terms of a specific frequency. However, we decode groups of frequencies and we harmonics on the fly to decide a truck is a truck. We can make this much easier and deal in groups of frequencies.

**The pivot point** - Take a look at the diagram below. You will see four seesaw's (bass on the left seat and treble on the right). Now consider the pivot point to be in the middle of the midrange or vocal range. Which of the diagrams best depict your system at present?

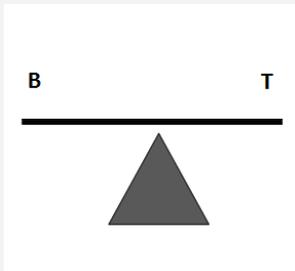


**Figure 1** shows a system that is bass heavy with overly prominent bass guitars, double bass, kick drums and lower vocal registers. With this tilt the system will also sound dull. This response can often be caused by a speaker that is too large for the room, or a speaker that is placed too close to a boundary.

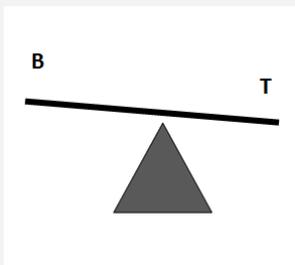


**Figure 2** shows a system that is bright, over emphasising s-s-s-s-s sibilance. Brass and violins will be overpowering. Short term this system will be a fatiguing listen. This can be caused by choosing a speaker that that is unsuitable for the room, or a speaker that is lacking bass reinforcement from rear or side walls.

## Frequency response (tilt) - Continued



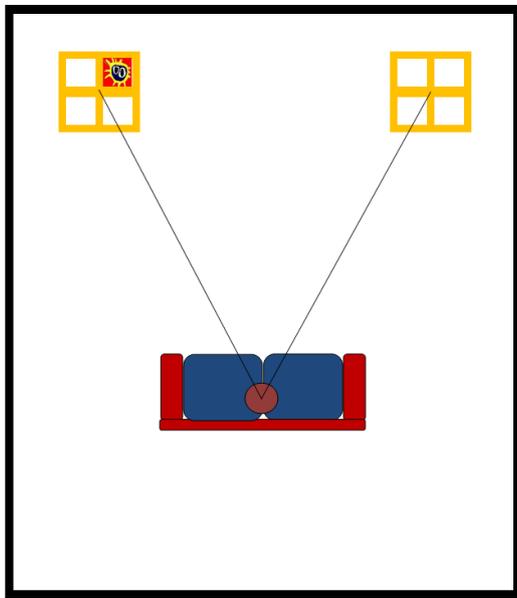
**Figure 3** shows a ruler flat response, this will sound bright in the listening room. Whilst we want our electronics to measure flat on the test bench, in our listening room a speaker needs to show a falling response for it to sound real and natural.



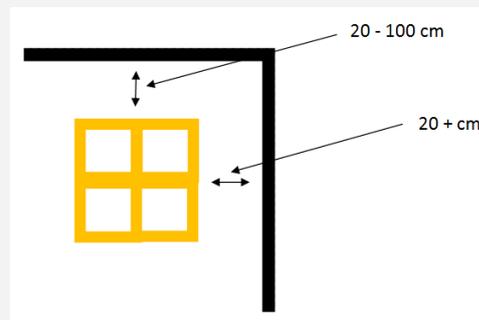
**Figure 4** Based on research performed over many years shows the in room response required if we are to perceive the system performance as real. In room notes from bass to treble will appear to have equal energy with no single point in the response drawing undue attention.

## Let's get the system singing

For best results I recommend starting with a triangulated plan with a ratio of 1:1 on the speaker distance from the listener. For example if the speakers are 10ft apart the distance to the listening position will be 11ft (10x1.1).



**Figure 5** shows a room plan with two groups of four boxes marked with masking tape on the floor. It is critically important that the middle of both boxes is of equal distance to the primary listening position (remember centre image) a 12" record sleeve is an ideal reference for the size of each box, spend time ensuring that both left and right groups are identical. Below is a potential right channel grid placement.



## Making the reference grid

The easiest way to accurately construct a grid is to use a vinyl record sleeve as a reference . in a rectangular room we can also use a record sleeve as reference for the boundary, follow the below steps 1 to 4 left (channel shown only).

Step 1



Step 2



Step 3



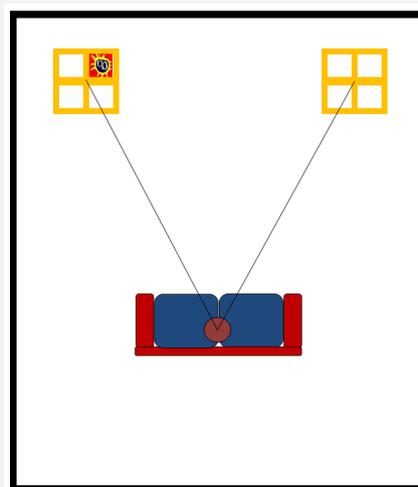
Step 4



Finished grid (left channel)



Full plan.

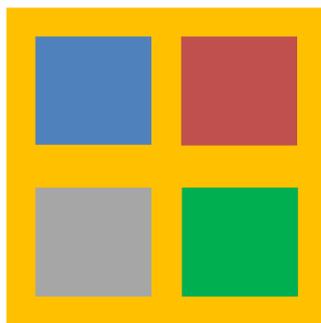


**Note:** Take time and ensure the grids are accurate. This will save time by being able to move the speakers accurately and quickly.

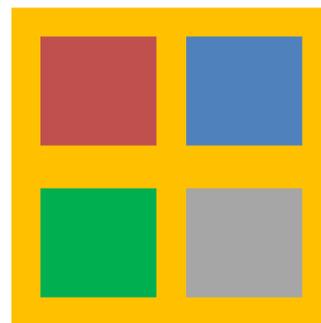
## Working the grid (a balancing act)

You are encouraged to experiment as much as possible to find the golden point that the system sonically gels. However take a look at the calibration grids below. The four sections are highlighted with a different colour, these are your controls. Remember you will be moving both speakers at the same time. The observations below are based on the perceived results over many hundreds of calibrations.

Left Speaker



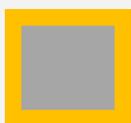
Right Speaker



Moving the speakers into the red zone almost certainly yields more bass as you are moving back towards a boundary. And at the outer edges this may lead to booming bass, especially with a floor standing design, although may be beneficial with a stand mount design. This position may also narrow the image, although may be beneficial if the speaker is overly close to the side wall, or if the walls are overly reflective. The image depth may also shut down at the back edge position. If the stereo width is ok, but you experience uneven bass, try moving the speaker towards the green box.



Moving the speakers into the blue zone will yield the widest stereo image, but be aware that you may lose definition in the centre image. To correct that you need to balance the width overall with the definition of the centre image. The far corner position will also be a bass hot zone, and may be prone to bass boom, due to the proximity of two boundaries. If the bass is good but the centre image is not, then try moving the speakers towards the red box.



Moving the speakers into the grey zone will again yield a wide image, but be mindful of the centre image. A small stand mount speaker may also lack bass energy. Again you can strengthen the centre image by moving the speakers towards the green box. A benefit of this position may be the depth of image achieved.



Moving the speakers into the green zone will yield the least boundary gain and the narrowest stereo width, combined with a strong centre image. This position may work for a floor standing speaker with lots of low end.

Hopefully you can see that by using the grid method above we can carefully manipulate the performance achieved. We simply balance the acoustic flavours of one box with another, whilst having the ability to move quickly and accurately between potential speaker placements.

## Bringing in some control

Please see the photographs below and you will notice within there are lines of masking tape just in front of the loudspeaker these are labelled Ref 1 to 4. All are potential speaker placement points. On a note pad make brief notes about the performance of each potential position. Note: you may have already instantly dismissed a number of no go options, so mark these point with an X so that you can avoid obviously poor position (remember

	<i>Ref 1. Bass overly heavy although good central image, no depth.</i>	
	<i>Ref 2. Good image, width and centre strong, bass light / bright high freq.</i>	
	<i>Ref 3. Good balance in freq although centre image in suppressed.</i>	
	<i>Ref 4. Great stereo width, centre focus, frequency is balanced.</i>	

Ref. one



Ref. two



Ref three



REF four



You may end up with up to ten reference points. However, as long as you are keeping notes, you will be able to jump back to likely perfect positions. Don't feel disheartened if you are struggling to locate the perfect position within the grid. After a period of time you will start to form an instinct for the controls at hand. Keep at it you will find that point were the system simply takes of. Please also refer to the **recommended listening tracks** on page 7 for further guidance.



When you have found the optimum position for the loudspeaker ensure that the speakers are level and free from wobble.

## The Headphone trick

As headphones will typically have a more even response than a loudspeaker placed in a listening room, you can use them to remove the room. This technique can be very useful in the bass region. simply pug in your headphones and listen to the bass response. Now unplug and consider how well is the system playing the same musical extract. Note : we cannot use headphones for imaging purposes as this is room dependent.



## Toe in or not (after finding the optimum speaker placement point using the grid method)

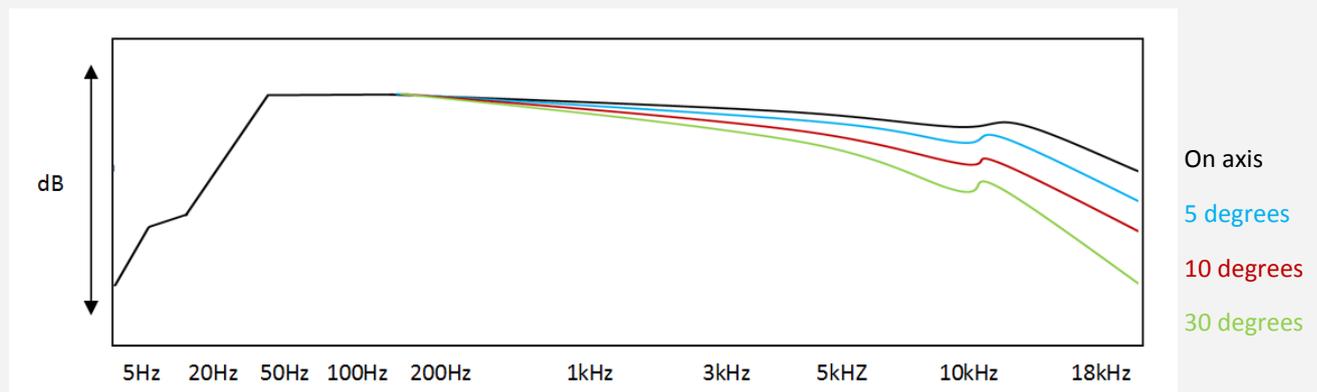
Due to the number of performance variables at play with various speaker design types the original version of this document did not offer guidance on toe in calibration, however this did prompt a few questions. The following instruction like the Grid method is tried and test over many years.

### A little background

At low frequencies the speaker will be Omni directional. As the frequency increases the speaker will start to beam with a narrowing directivity. When you move left to right of the speakers centre point the high frequency content will typically be attenuated and a good speaker will retain the same curve shape (see graph below) both on and off axis.

Toe in can be used to:

- 1 - Alter the high frequency response, as on-axis will be full output, and off-axis attenuated (see below).
- 2 - Reduce the impact of early reflections from nearby side wall by turning the speaker towards the listener slightly reducing the energy at the first wall reflection.



## Laser time (let's get accurate)

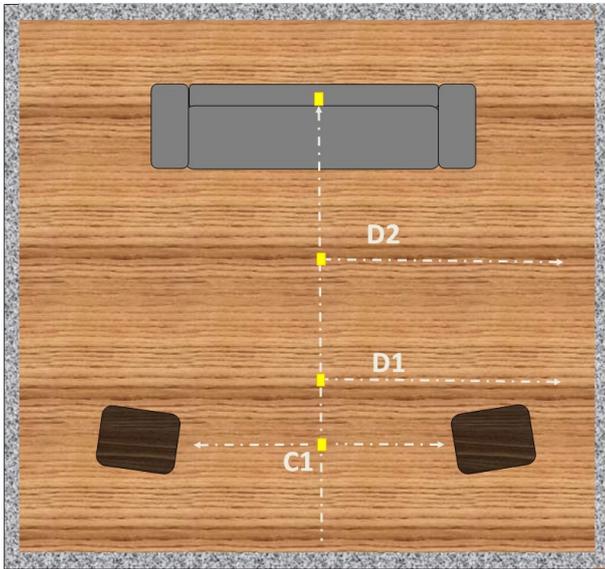
As the above diagram indicates, for absolutely equal response, the angle of toe in on both channels should be identical for both speakers. The following method utilizes a laser line to ensure accuracy.

Tools required.



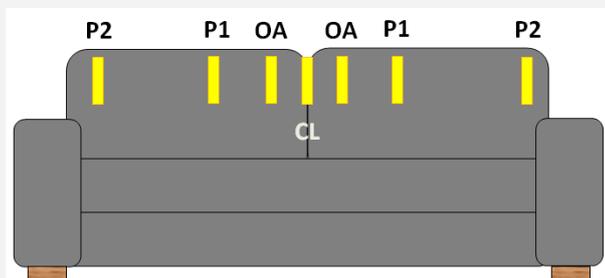
Method continues over page.

## Toe in calibration



### Finding the centre line

1. Measure the distance between the inner edge of the left to the inner edge of the right speaker, the half distance is C1. Place a piece of masking tape at this point and mark exact middle with a pen line.
2. Measure the distance from C1 to the side wall, this becomes our reference for both D1 and D2. Place masking tape at these points and mark the exact measurement with a pen. (Position masking tape roughly as shown in the diagram).
3. Now place the laser line on the floor and beam the laser so that it travels through the pen lines at C1 - D1 and D2. The laser point on the sofa is our centre line reference (listening position). Place masking tape at this point.



### Target

Using masking tape mark reference points on the listening chair or sofa as per diagram.

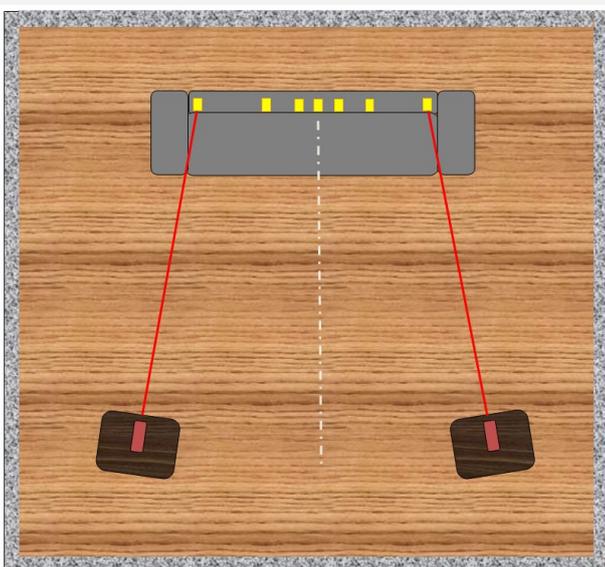
**CL** = Centre line of system.

**OA** = On Axis - 10cm either side of the centre line.

**P1** = Off axis 35cm either side of the centre line.

**P2** = Off axis with slight toe in.

You can add as many points as you wish but always measuring accurately from the centre line



### Calibration

Place the laser line centrally on top of a speaker and aim the speaker at reference point OA on the near side of the sofa (being careful to only change the angle and not the position) now aim the other speaker at its near side OA point (make listening notes as before) now move out to P2 again make notes.

Our aim is to find the optimum toe in quickly and accurately using our target points. Remember you can easily add extra points if necessary. Listen for a focused central image and image width beyond the loudspeakers. Making broad steps to start with will give an indication of the potential. Narrowing in until you achieve the optimum result.

## Recommended listening tracks

**Note:** I recommend that for listening tracks you try not to select overly polished recordings such as used by many manufacturers at hifi shows. Many of these recordings will sound passable on a clock radio. We want to give ourselves a “play anything” system, aside from the Lee Ritenour track used for frequency balance. We can consider these regular recordings. if you can get these correct, Keith Don’t Go and anything by Diane Krall, will sound even better!

### Lets focus on the Bass

**Jack Johnson - Taylor** from **On and On**. First listen to the opening bass riff, every note should be defined without a single note blooming or standing out. Jack Johnson’s vocal should be centre stage without, exaggerated sibilance.

**Lee Ritenour - 4 on 6** from **Wes Bound**. This track is wonderfully produced, almost a looking glass into the studio session. Listen for a perfect balance across the musicians you should be able to follow every band member with ease. The bass line should be even and easy to follow, the soundstage should be well beyond the edge of the speakers and the Hammond organ should move between left , middle and right of stage.

### Focus on the Soundstage / vocal and centre image

**Paul Kelly - From Little Things Big Things Grow** from **Live May 1992** . This fabulous live recording should give you a vivid sense of the size of the venue and an soundstage that is far bigger than your own listening room. Listen for stereo width and depth. You should feel like you are perfectly positioned in the front third of the venue. Paul Kelly is centre stage, the harmonica solo should not be piercing, and the vocal should not exhibit any sibilance. The acoustic guitar should sound believable.

### Putting the band in the room

**Whiskeytown - Dancing With The Women At The Bar** from **Strangers Almanac**. The tracks starts with a solo vocal from Ryan Adams with acoustic guitar and slide. Ryan Adams should be fixed centre stage between the speakers. His vocal should not be over sibilant, and when the band joins in the soundstage should grow beyond the speakers with a warm live feel.

**The Who-Five-Fifteen** from **Quadrophenia**. (the album not the OST) the track is characterised by guitars, brass, a bass line that is forever changing and drums rolling . When the system is properly calibrated you should be able to pick out the piano dancing from speaker to speaker, Roger Daltrey always fixed centre stage. You should also be able to pick out layer upon layer of this glorious rock masterpiece.

**Big thanks to Steve Crowe for his editorial efforts.**



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