Tonochi's Audio Room – Supplemental Info

Subsystem Kinglet

2021/04/20

Introduction of My Audio Subsystem Kinglet

Kinglet was originally a nameless audio subsystem which consisted of used audio devices and was used for background music in my study room. Recently, it has been improved so much to be a high-quality audio system that can be used for music appreciation. It is also used for checking power amplifiers and some audio experiments. It lives up to my expectation. So, I gave it the name 'Kinglet'.

Contents

Concept 2
Room 2
System Design 3
Goals 3
Specifications 3
Components 4
Output Power & Gain 4
Layout 6
Cabling 8
AC Power Supply 8
Ground Potential 9
Room Acoustics 9
Suppression of Vibration 9
Actual Kinglet 9
Components 10
Layout 10
Cabling 11
AC Power Supply 11
Measurements 12
Layout A 12
Frequency Response 12
Impulse Response 12
Waterwall Charts 12
Layout B 13
Frequency Response 13
Impulse Response 13
Waterfall Charts 13
Layout C 14
Frequency Response 14
Impulse Response 14
Waterfall Carts 14
Discussion 14
Quasi-anechoic Measurements vs System-level Measurements 14
About Channel Balance 16
Waterfall Charts 17
Effectiveness of Quasi-anechoic Measurements 17
My Own Review 18
Sound Quality 18
User-friendliness 18

Looks 18

Concept

I made the old subsystem for the study in 2003, when my wife and I moved to this house. In the first place, it consisted of old used audio devices. The budget was only 10,000 yen. I used it for background music in the study.
In 2006, I built loudspeaker SS-312 for this subsystem. That's the beginning of my attempt to improve its sound quality (SQ).

In 2019 through 2020, I changed the system design to improve SQ drastically.
I built new amplifiers for this system, and improved SS-312. And, I named this system Kinglet.

Now, the concept of Kinglet is a quality compact audio system that can be used for music appreciation.
Kinglet is installed in my small room that is a study and sometimes a lab. Kinglet mustn't spoil the functionality of this room. The highest SQ in this restriction is the goal of Kinglet.

My main system (Gaudi II) is a large-scale system (a tri-amplified system). On the contrary, Kinglet is a simple system using full-range loudspeaker units. It's helpful to learn audio technologies to have two different systems.
The simple system is also useful for experiments. For example, it's hard to audition a power amplifier with a multi-amplifier system like Gaudi II, but it's easy with a simple system like Kinglet.

Room

The room is my study/lab, and its size is only 10m^2. There are bookshelves, a desk, racks and a workbench (low table) in it. So, there is a scant space to place audio equipment. Each component must be compact.
It's impossible for the listener to sit away from the loudspeakers. The layout is a so-called near-field type.

The wall outlets are not audio-grade but ordinary AC100V type. They are 2P x2 without the earth.

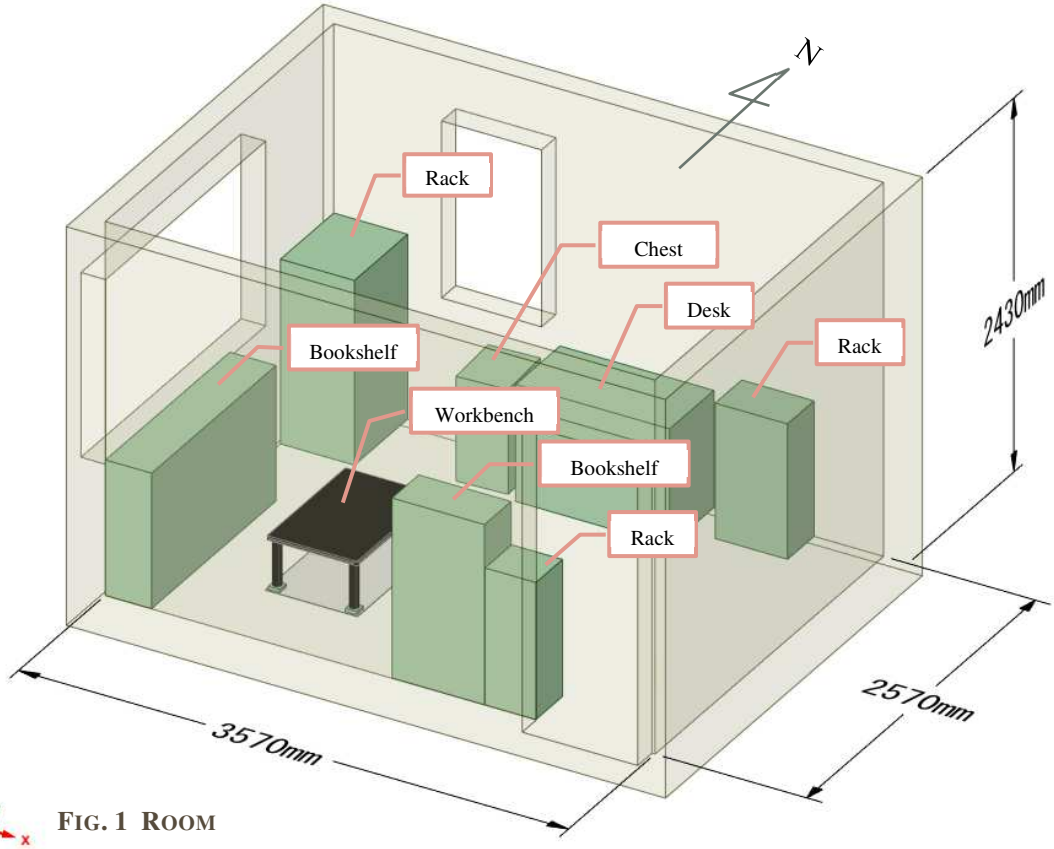


FIG. 1 ROOM

System Design

The version of this system design is 1.0 (Ver. 1.0). It was fixed on March 1, 2019.
Though this audio subsystem was built in the year 2003 originally, it has been a mere mishmash of old components without system design. I gave the version number for the first time.

Goals

Only compact loudspeakers can't be used in Kinglet. There should be compromise on reproduction of bass.
The goal of the low end is 60Hz (-10dB). Most music may sound good with this performance.
If possible, I'll try to extend the low end to 40Hz.

A laptop PC can be used for a media player. I have one in my study/lab, whose main purpose is measurements of audio devices. It is one of must items in a lab. There is no room for another player like a CD player. So, the PC is also used as the player.

Specifications

- Sources
  All media the PC can play
  - Music files: DSD (up to 5.6Mbps), PCM (up to 192kHz/24bit)
  - Radio: Radiko, TuneIn, etc
  - TV: Terrestrial, BS (except 4K), CS
  - Optical disk: CD, DVD
  - Others: Any devices equipped with LINE OUT
- Inputs of the preamplifier
  - LINE IN
  - AUX
- Outputs rather than SP OUT
  - PHONES (3P standard jack)
- Frequency range
  60Hz ~ 20kHz (-10dB)
- Distortion ratio
  THD+N: less than 0.01％ (from the player through SP OUT)
- Max SPL
  100dB (L+R at the listening position)
- Power dissipation
  100W

Components

Kinglet is a small but full-fledged audio system that includes separate amplifiers. The 2-channel master volume MV-217 X'tal, used as a preamp, and the loudspeaker SS-312A Study are designed and built for Kinglet, and will be used continuously as key components. The other components may be replaced in order to improve the system.

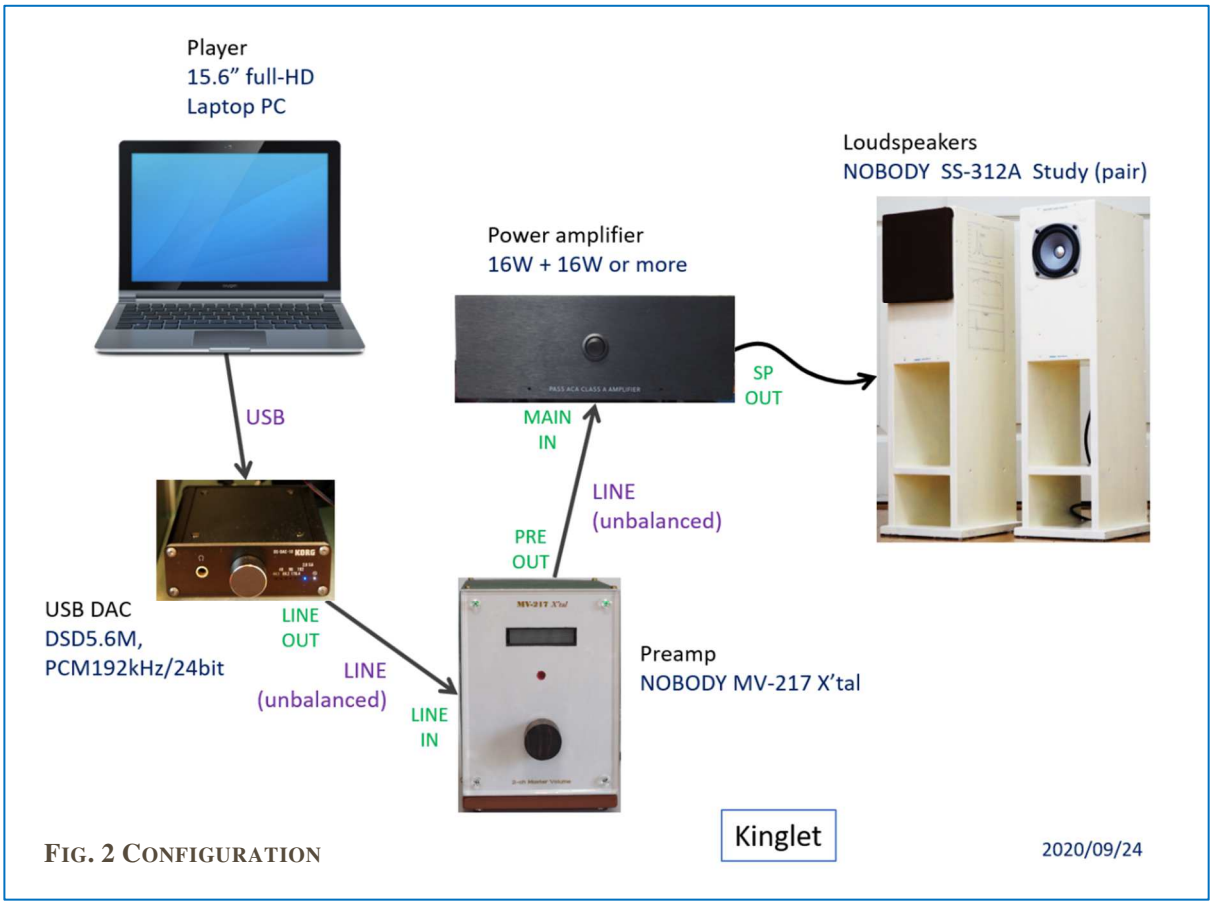


FIG. 2 CONFIGURATION

Component	Outline specification
Laptop PC	Display 15.6" Full-HD or larger, CPU: 8th generation Core i-3 1.6GHz or higher, Memory: 8GB or more, Storage: 1.5TB or more
USB DAC	DSD: up to 5.6Mbps, PCM: up to 192kHz/24bit, w/ PHONE OUT
Preamplifier	NOBODY MV-217 X'tal (https://nobody-audio.com/mv-217.html)
Power amplifier	Output power: 16W + 16W, Gain: 10dB ~ 20dB
Loudspeaker	NOBODY SS-312A Study (https://nobody-audio.com/ss-312.html)

Output Power & Gain

- Max output of preamplifier
  2.5V or higher (RMS)
- Max output of power amplifier
  16W or more per channel
- Gains of each amplifying stage

See the block diagram (fig.3) and the level diagram (fig.4).

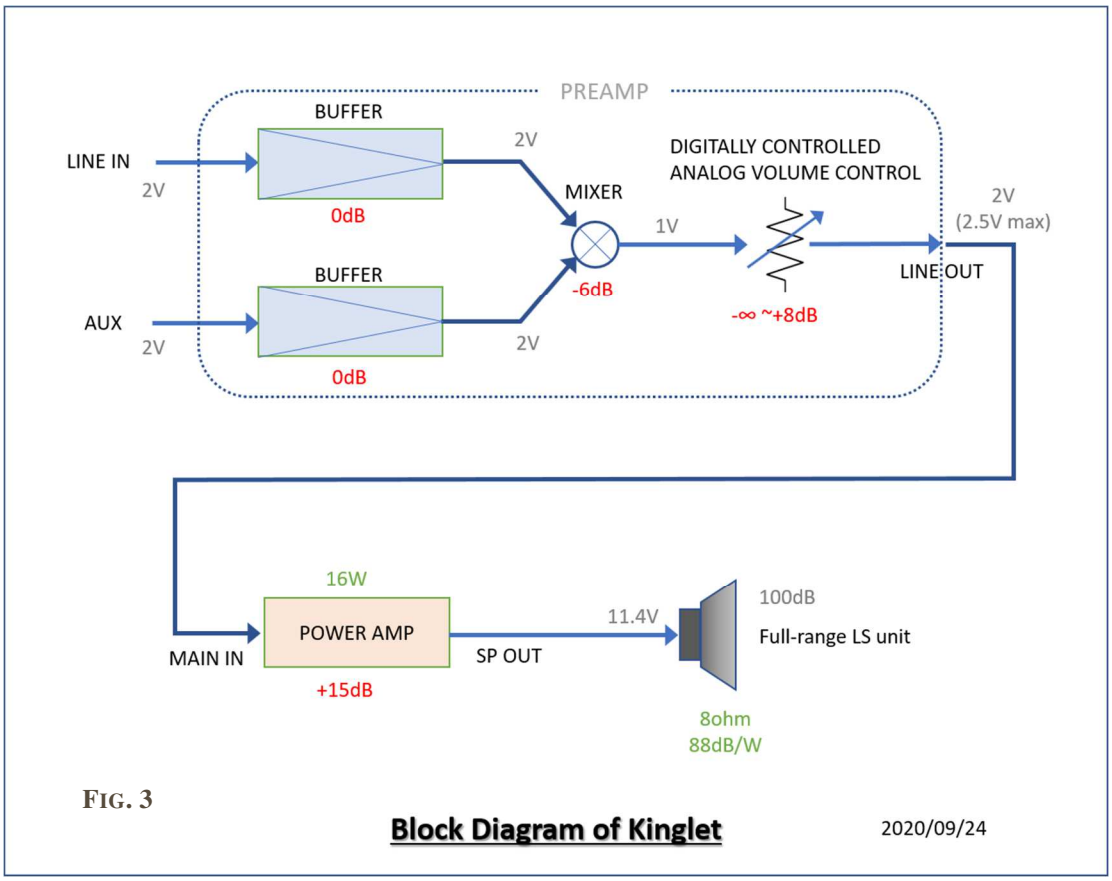


FIG. 3

Block Diagram of Kinglet

2020/09/24

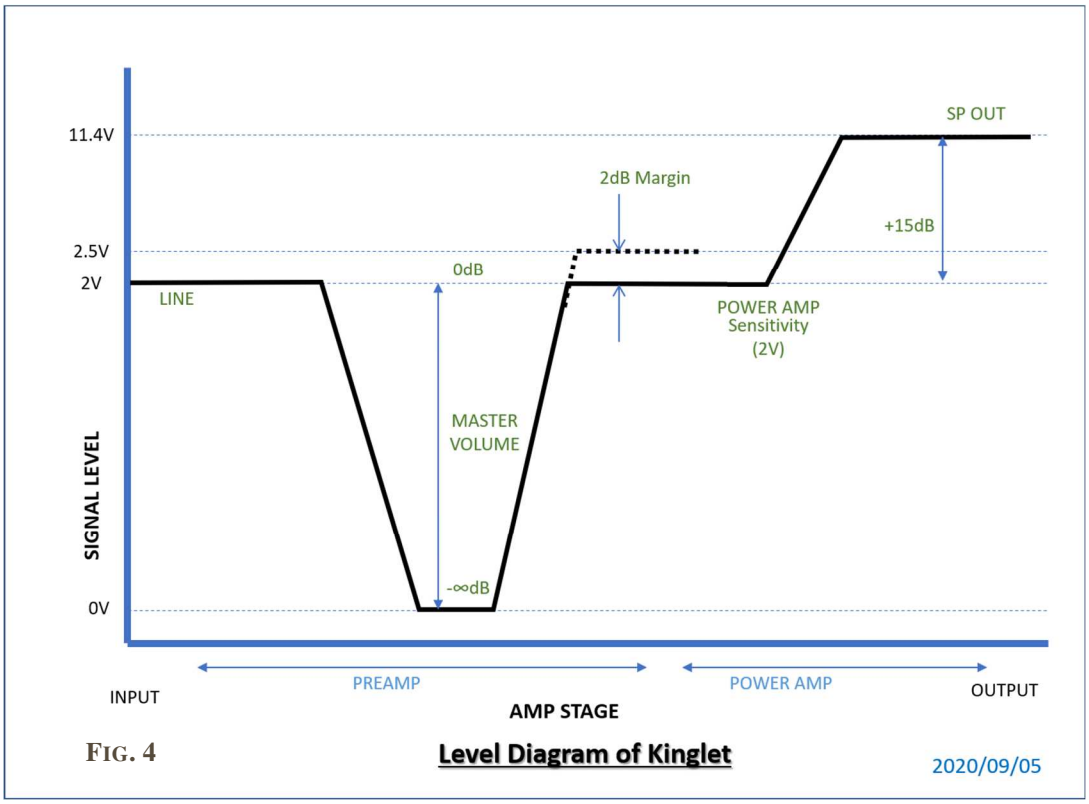


FIG. 4

Level Diagram of Kinglet

2020/09/05

Layout

The most important thing is the position of the loudspeakers. I determined the typical position, but I'll move the loudspeakers to more desirable position according to purposes, since SS-312A is compact and easy to move.
The typical position is the both sides of the workbench. The workbench could distort the sound acoustically, but it's the most important thing for experiments or assembly of audio devices. The position of the workbench has priority over that of the loudspeakers and other audio devices.

The listening position is in front of the workbench. A cushion of a legless chair is placed at the position. When I take a rest hearing music, I tilt the chair back backward. The listening position is nearly at the center of the room.

The height of the listening position is so low. The height of the loudspeaker unit (LS unit) is 540mm. It is the same as that of the listening position. The primary reflection from the floor could deteriorate SQ, but I ignore this because the low position has an effect to boost bass.

The laptop PC is placed on the workbench. The amplifiers are below the bench top. Placing the amplifiers on the floor exposes them to dust. A small rack is placed on the floor under the workbench, and the amplifiers on the rack. The small rack is desinged to fit the workbench.

Fig.5 through Fig.7 show the layout of Kinglet. They are the overview, the top view, and the front view, respectively. The position of the loudspeakers in this layout is the typical one. It is called 'Layout A'.

The toe-in (the angle between the loudspeakers) is determined to be 16 deg (8 deg + 8 deg). This angle is more important than the position of the loudspeakers. A mere small error of 2 deg deteriorates SQ. Especially stereo imaging.

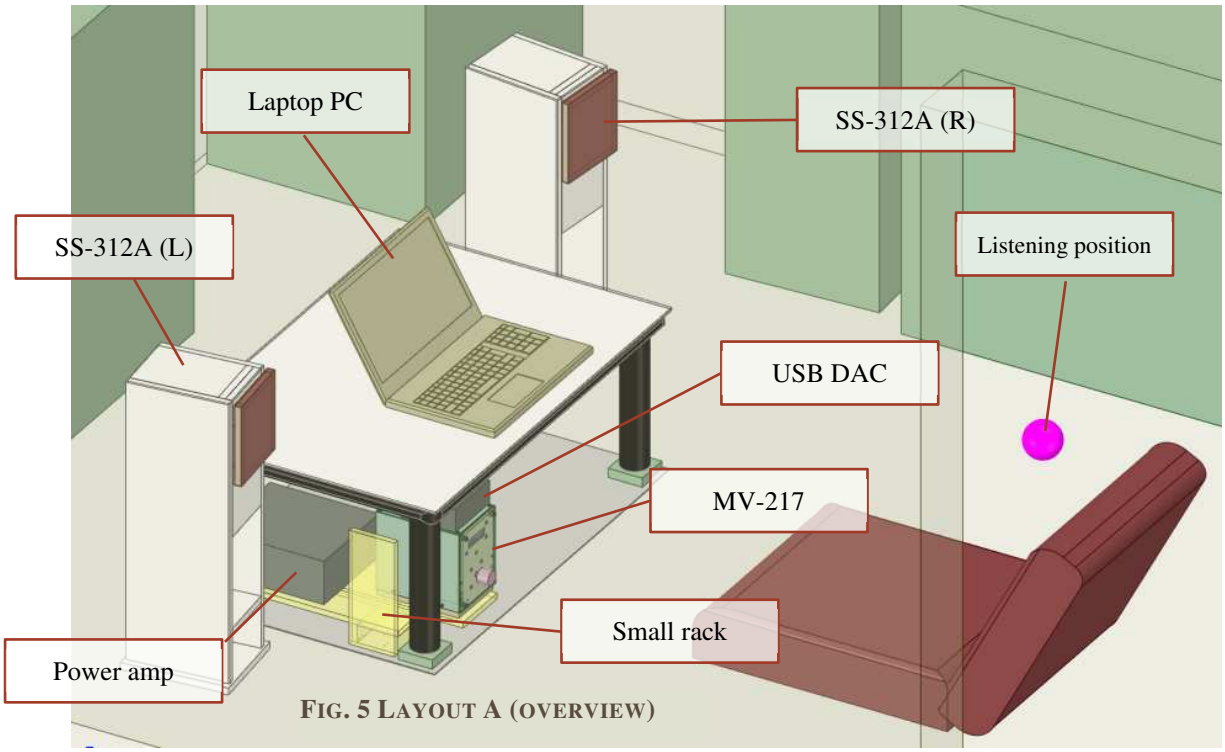


FIG. 5 LAYOUT A (OVERVIEW)

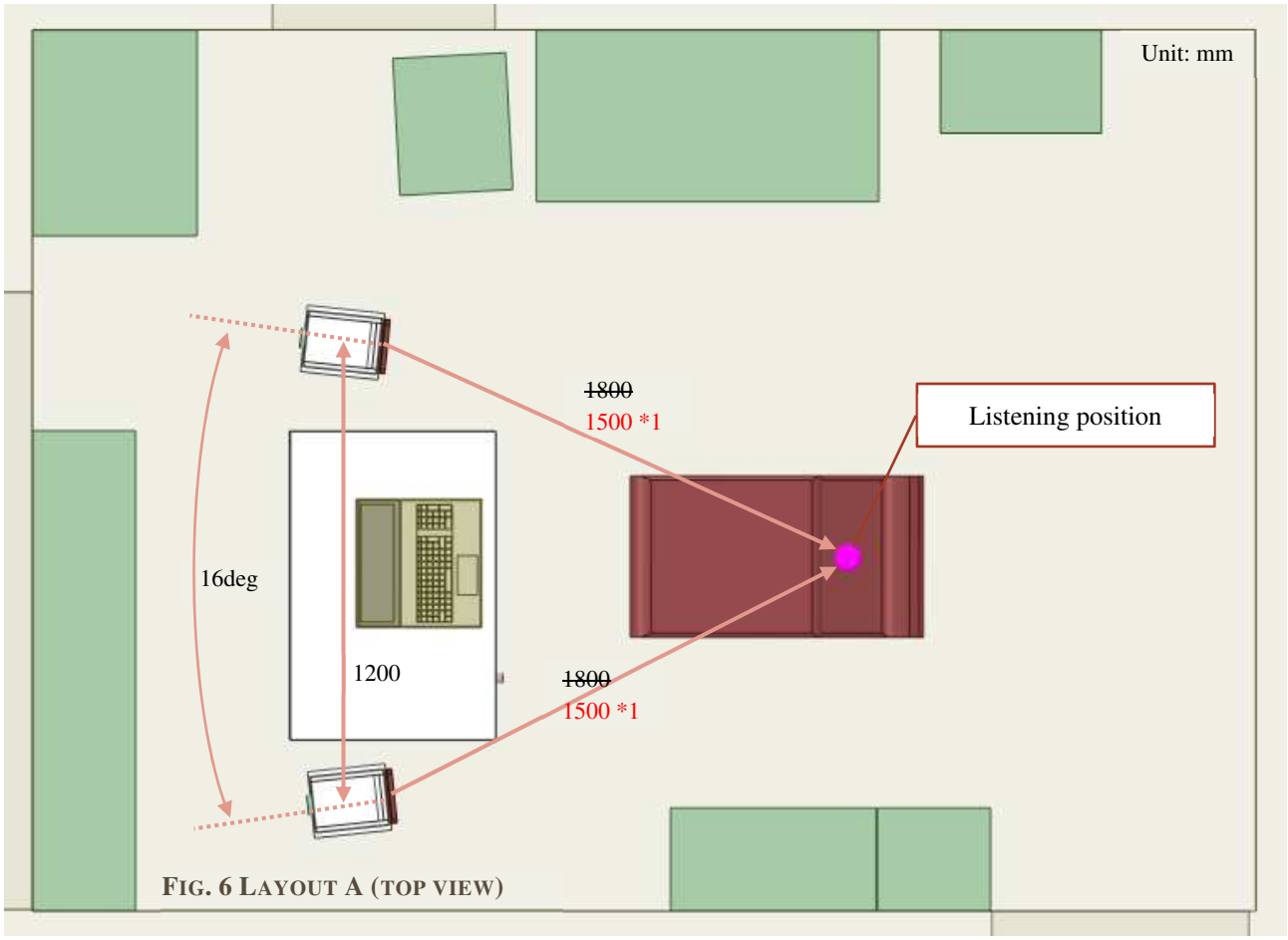


FIG. 6 LAYOUT A (TOP VIEW)

*1 [2021/04/20 revised]

Fig. 8 through Fig. 10 show the variation of the layouts; Layout B, Layout C, and Layout D, respectively.
The 'Layout B' is a layout for music appreciation. The loudspeakers and the listening position are moved forward (eastward) by 30cm. This reduces the adverse effect of the workbench in SQ.

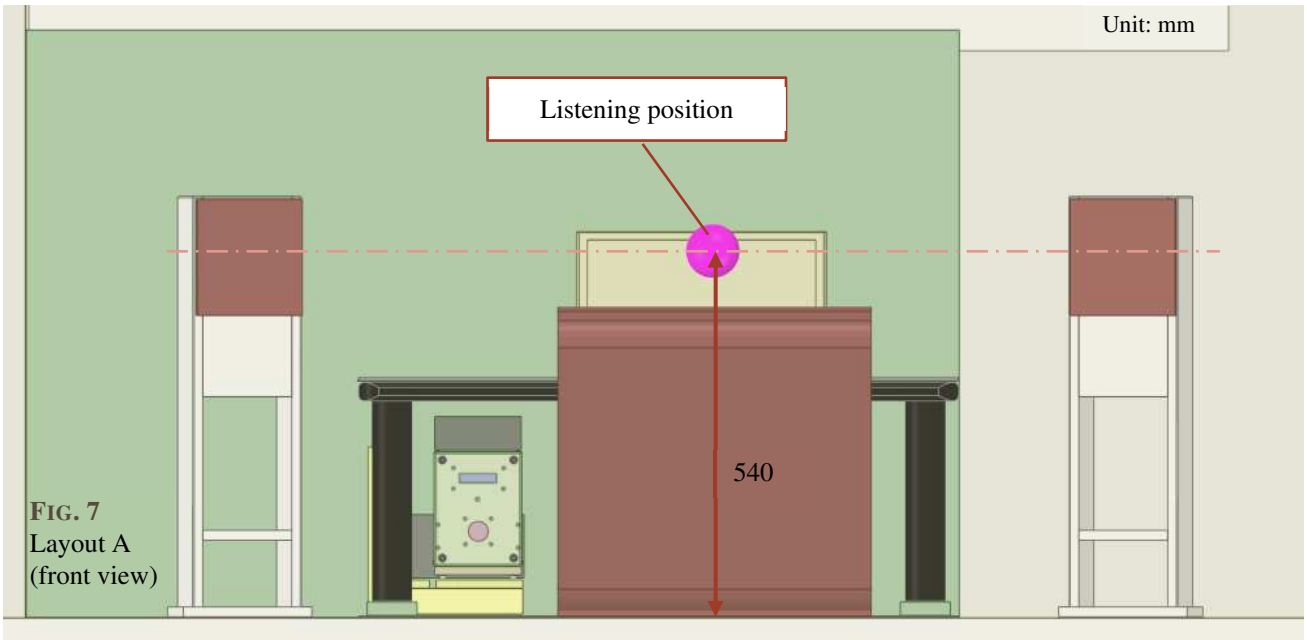


FIG. 7
Layout A
(front view)

The ‘Layout C’ is for watching movies. The positions of the loudspeakers and the listener are moved backward (westward) by 30cm. The listening position (viewing position) is nearer to screen than Layout A, in order to have better look at the small screen of the laptop PC. The loudspeakers were placed near the back wall. That boosts deep bass. It is good for watching a movie.
The ‘Layout D’ is for relaxation. The chair back is tilted backward and the listening position if farther from the workbench than Layout A. The position of the loudspeakers is moved backward. The distance between the listening position and the loudspeakers is longer than the other layouts. It is suitable for listening to music in a drowse.

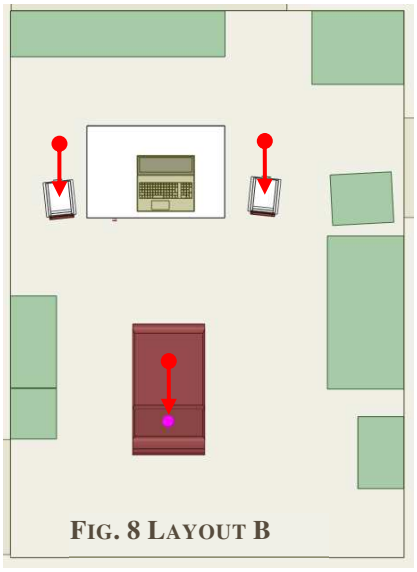


FIG. 8 LAYOUT B

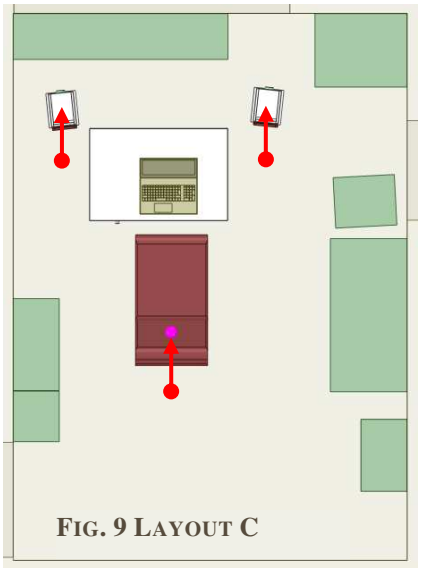


FIG. 9 LAYOUT C

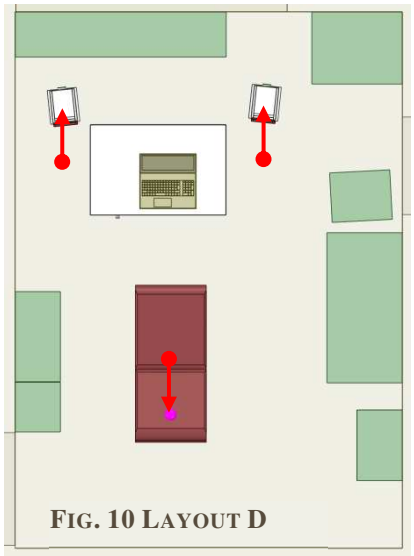


FIG. 10 LAYOUT D

Cabling

The cables to connect the devices are ordinary ones which are available at a home appliance shop. The speaker cables are exception. They are the part of SS-312A and undetachable. They are used as they are. No extension cables are used.

The table below shows the specifications of the cables:

Devices	Wire	Length	Sender end connector	Receiver end connector	Note
DAC ➔ Preamplifier	OFC, unbalanced	0.3m	RCA plug	RCA plug	
Preamp ➔ Power amp	OFC, unbalanced	0.7m	RCA plug	RCA plug	
Power amp ➔ Speaker	OFC, quad (Canare 4S6G)	1.8m	Spade terminal	Soldered	Part of SS-312A

AC Power Supply

As for AC power supply, I won’t do anything special. The power is fed from an ordinary wall outlet via a power strip with a switch. No earth pin is available.

I don’t use audio-grade power cables but commonly used power cords.

Each audio device in Kinglet has a switching regulator in it. The regulator eliminates fluctuation of the voltage and noises on the AC line. The quality of the AC power supply doesn't matter.

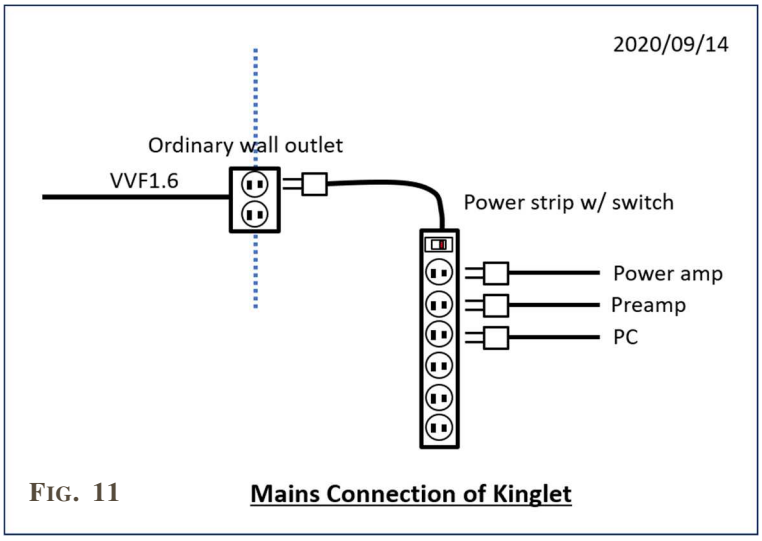


FIG. 11 **Mains Connection of Kinglet**

Ground Potential

The ground potential of commercial products is not predictable. I checked the AC/DC convertor of my PC, and found that the neutral (cold) pin of the AC plug is connected to the ground of the DC output. The ground might be insulated in the inner circuit of the PC. But, to be on the safe side, I decided not to connect the FG (frame ground) of MV-217 to the earth.

Room Acoustics

The room is so small that there isn't a space to put acoustic panels. If acoustic panels are fixed on the walls, the room may look too small.
I'm planning to put something that diffuses sonic waves like a cat tower in the corner of the room, instead of acoustic goods.

In practice, there are already many pieces of furniture such as a desk, bookshelves and racks in the room. Standing waves are so weak.

Suppression of Vibration

Any vibration sensitive parts and devices such as ADP, CDP and vacuum tubes are not used in Kinglet. I don't do anything special for anti-vibration.

Actual Kinglet

The version is Ver.1.00.
This version of Kinglet was completed in April, 2020.

Components

The components are selected as in the system design except the power amplifier diyAudio ACA V1.6. Its output power is only a half of the target. But it is acceptable because the target itself has fairly good margin. In practice, the power amp never clips in that near-field configuration.

Component	Model	Outline specification
Laptop PC	HP Pavilion Laptop 15-cu1000	Display: 15.6" Full-HD, CPU: 8th generation Core i-5 1.8GHz, Memory: 8GB, SSD: 128GB, HDD: 1TB, Built-in DVD drive
Player app	KORG AudioGate 4 Foobar 2000	DSD: 最大 5.6Mbps, PCM, 最大 192kHz/24bit (same above)
USB DAC	KORG DS-DAC-10	DSD: up to 5.6Mbps, PCM: up to 192kHz/24bi, PHONES output
Preamplifier	NOBODY MV-217	2 inputs, 2-ch digitally controlled analog volume control (https://nobody-audio.com/mv-217.html)
Power amplifier	diyAudio ACA V1.6	Output power: 8W+8W, Gain: 10dB
Loudspeaker	NOBODY SS-312A	Compact loudspeaker w/ 10cm full-range LS unit (Fostex FF105WK) (https://nobody-audio.com/ss-312.html)
Rack	ACA Rack	Small rack specially built to place ACA V1.6 and MV-217 under the workbench

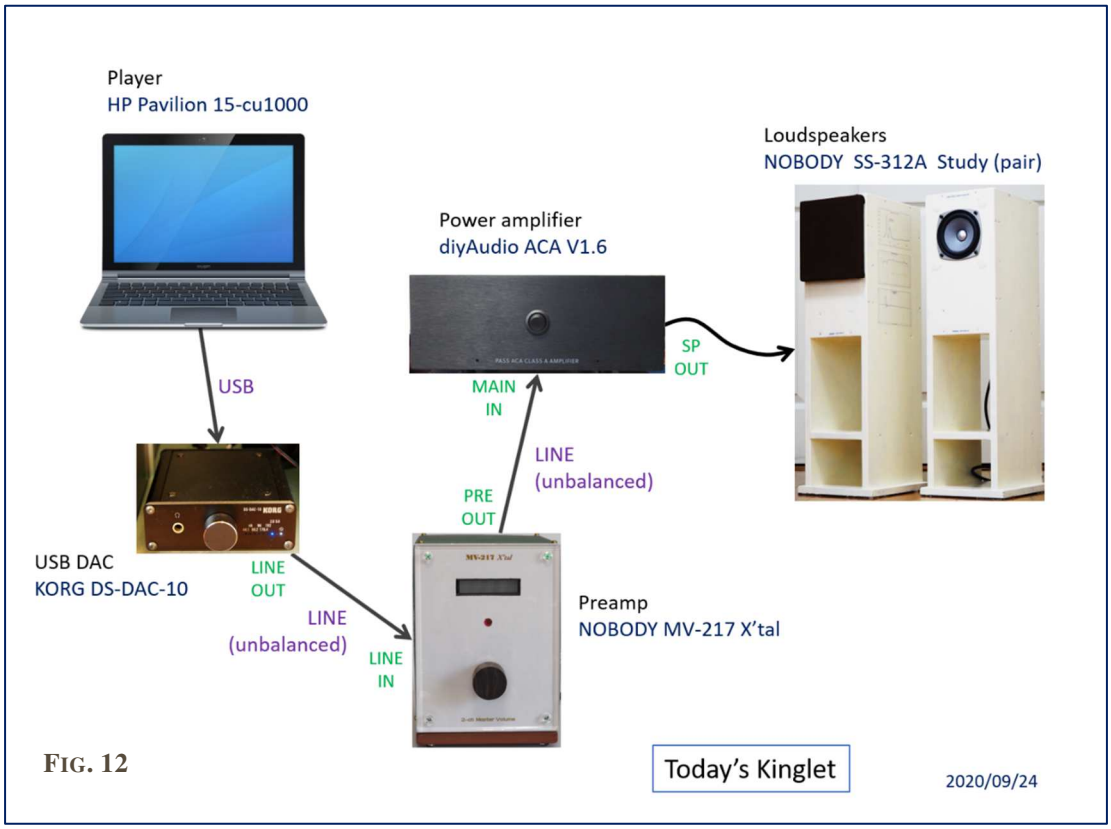


FIG. 12

Layout

The components are laid out as specified by the system design.

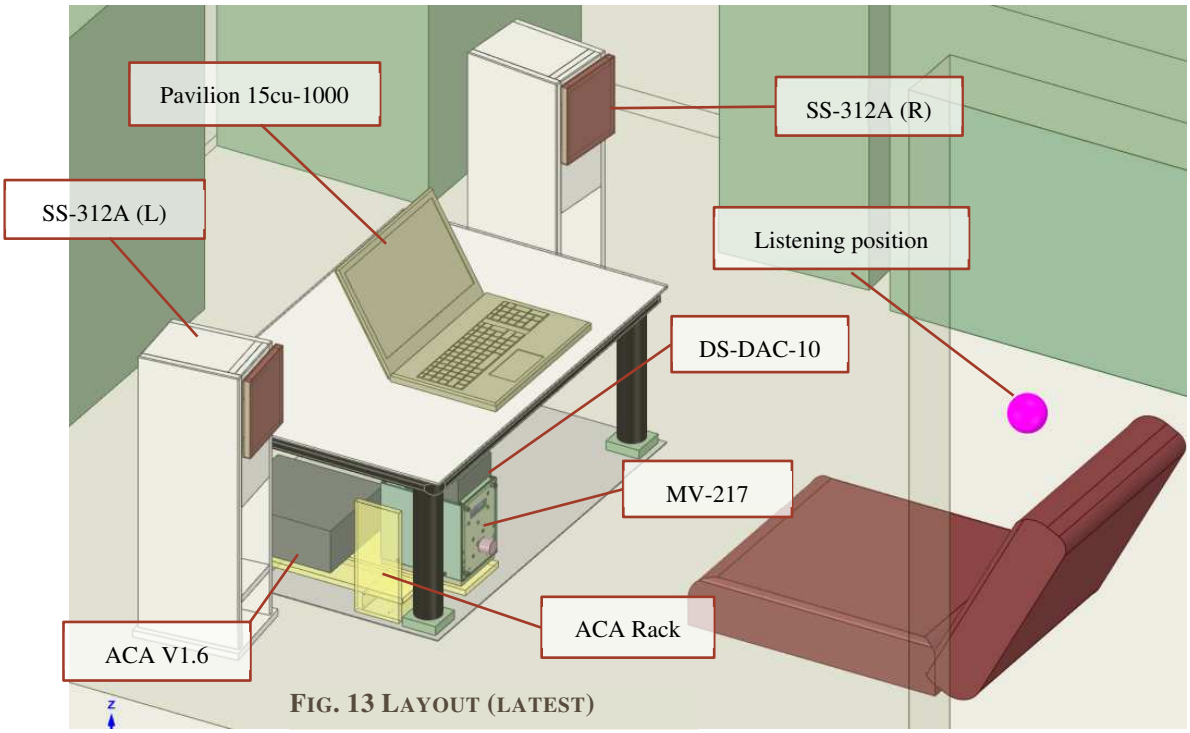


FIG. 13 LAYOUT (LATEST)

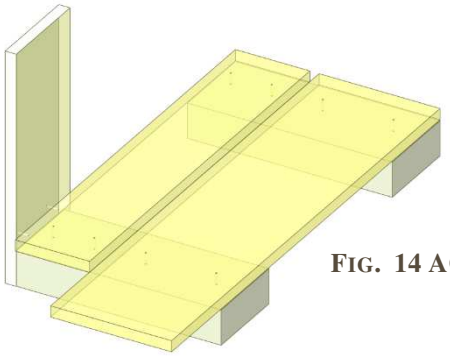


FIG. 14 ACA RACK

Cabling

The cables meet the system design except that the cable connecting the preamp and power amp is too long. I'm going to replace it with a 0.7m-long cable. [2020/12/07revised] {The cable has been replaced with a 0.5m RCA cable}

Components	Cable	Length	Sender end connector	Receiver end connector	Note
PC → DAC	---	1m	USB Type-B plug	USB Type-A plug	Accessary of DS-DAC-10
DAC → Preamp	audio-technica OFC Audio Cable	0.5m	RCA plug	RCA plug	
Preamp → Power amp	JVC CN-165G	0.5m	RCA plug	RCA plug	
Power amp → Loudspeakers	Canare 4S6G	1.8m	M8 spade terminal	Soldered	Part of SS-312A

AC Power Supply

A power strip with a built-in switch is used as in the system design. The amplifiers are turned on/off by the switch of the power strip. The power strip isn't audio-grade.

Measurements

System-level measurements were made for each layout: Layout A, Layout B, and Layout C. The measurement wasn't made for Layout D because it is designed for easy-listening at low volume.

- SPL and phase frequency response, which represent performance in frequency domain
- Impulse response, which represents performance in time domain
- Waterfall chart, which represents the system's total performance

Layout A

Frequency Response

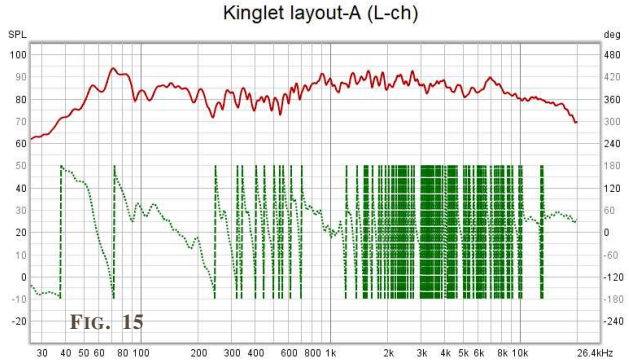


FIG. 15

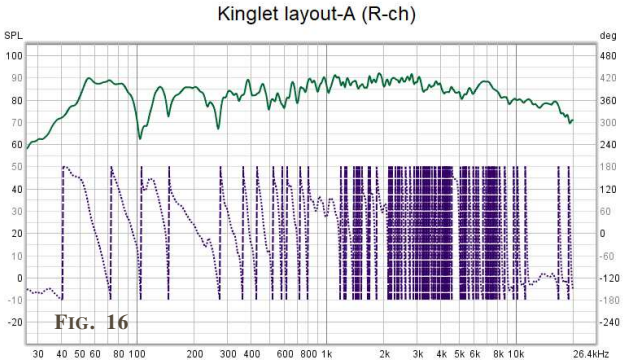


FIG. 16

Impulse Response

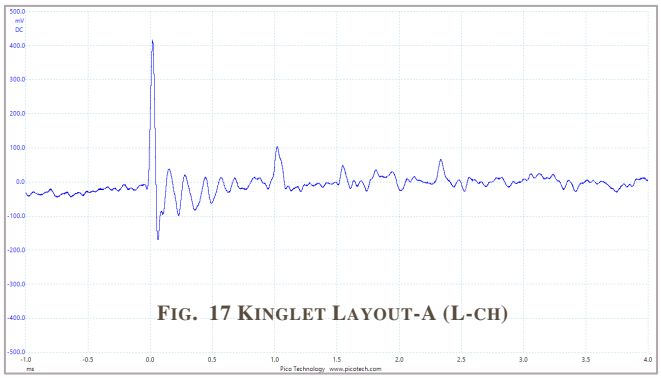


FIG. 17 KINGLET LAYOUT-A (L-CH)

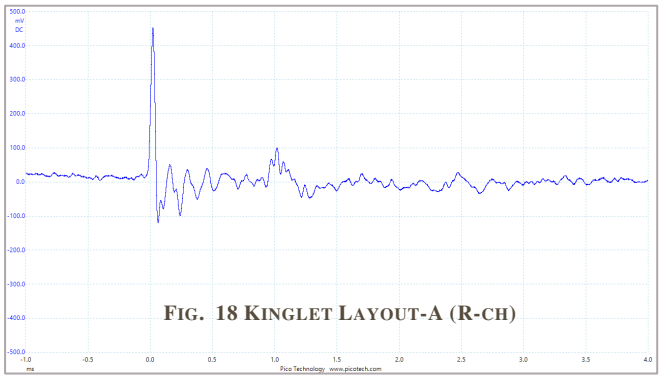


FIG. 18 KINGLET LAYOUT-A (R-CH)

Waterwall Charts

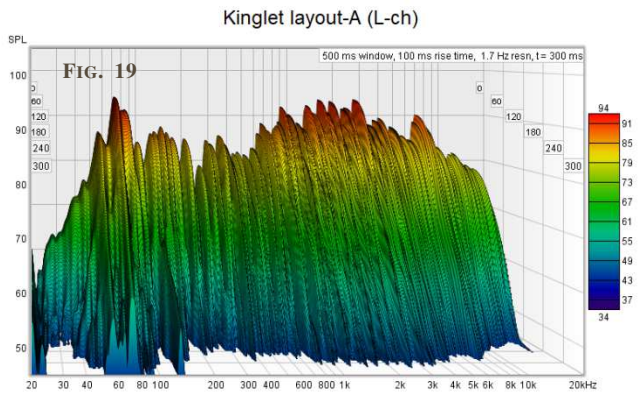


FIG. 19

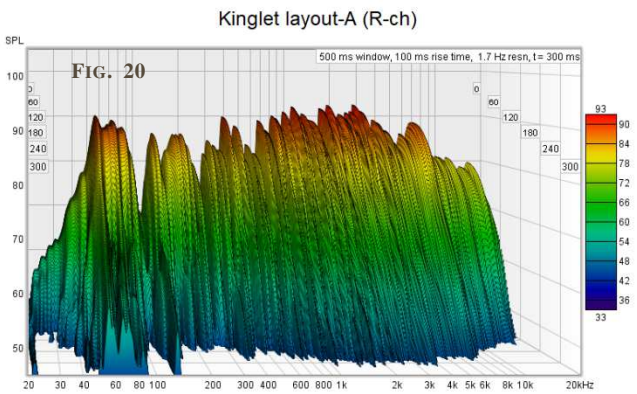


FIG. 20

Layout B

Frequency Response

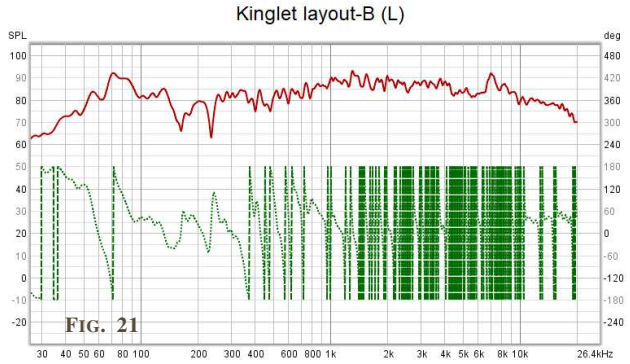


FIG. 21

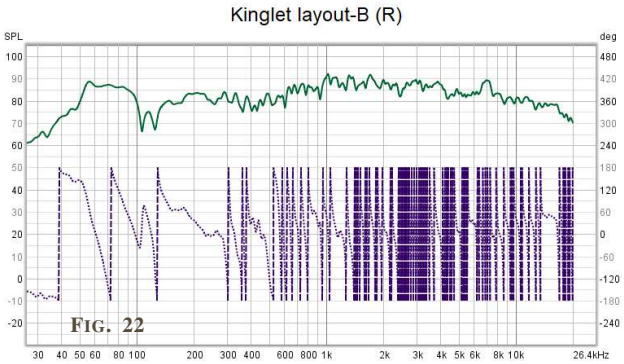


FIG. 22

Impulse Response

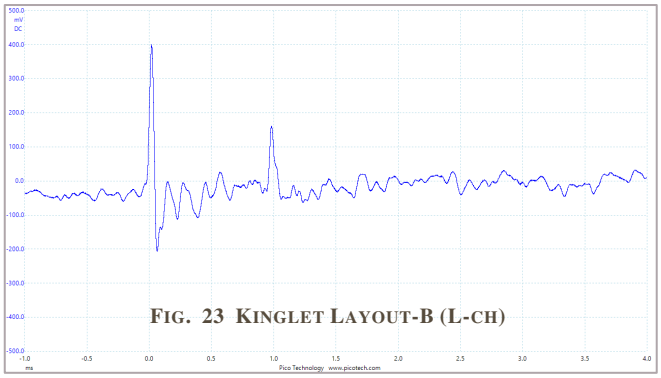


FIG. 23 KINGLET LAYOUT-B (L-CH)

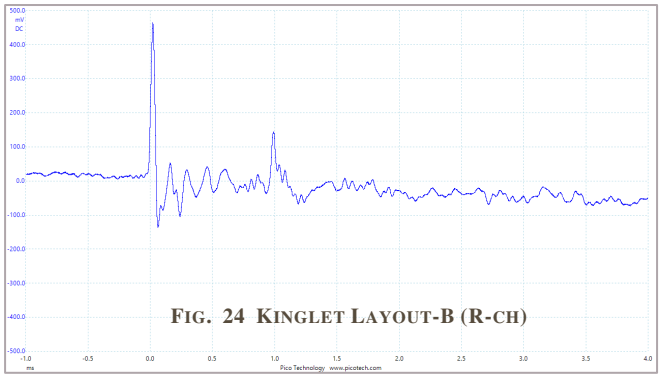


FIG. 24 KINGLET LAYOUT-B (R-CH)

Waterfall Charts

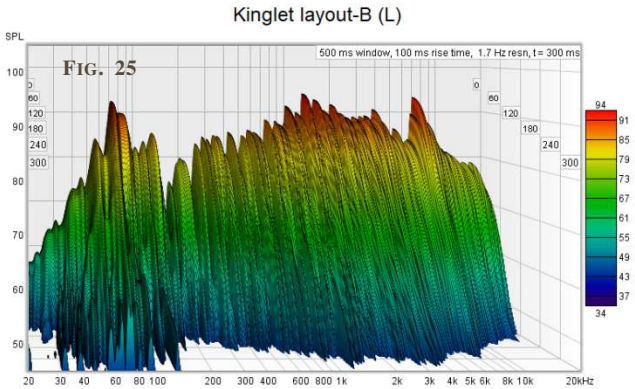


FIG. 25

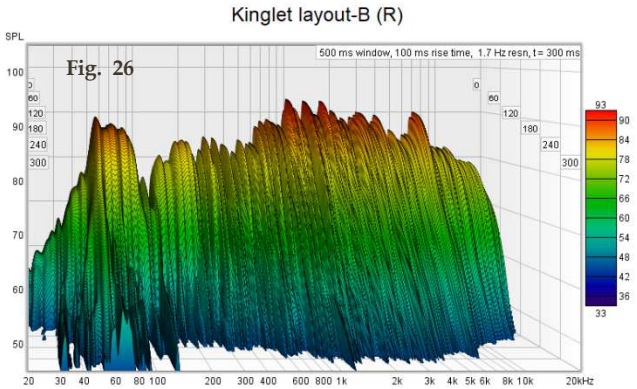


Fig. 26

Layout C

Frequency Response

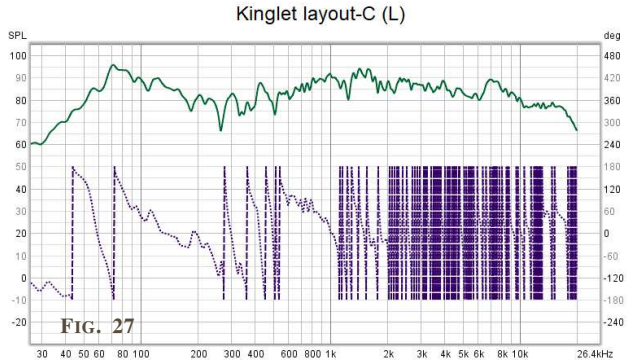


FIG. 27

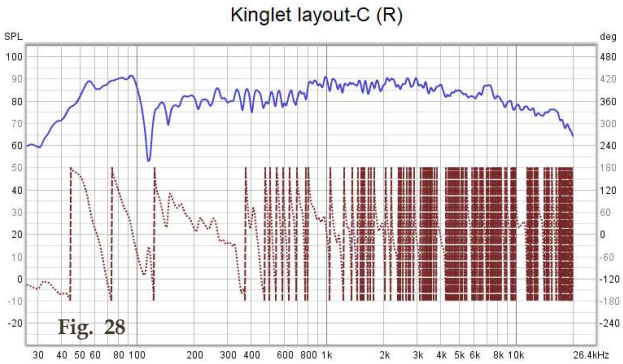


Fig. 28

Impulse Response

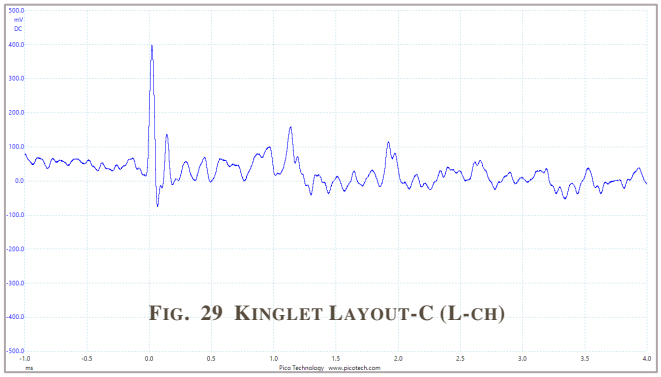


FIG. 29 KINGLET LAYOUT-C (L-CH)

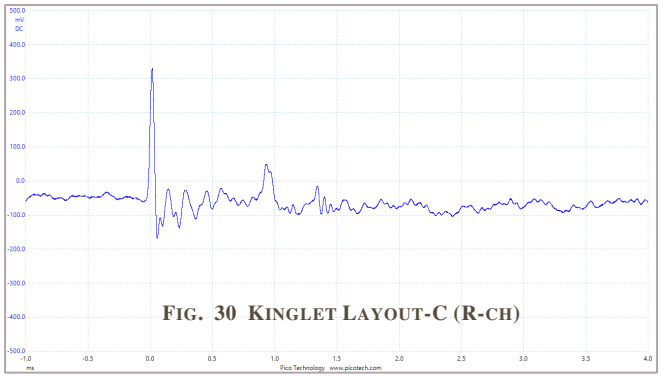


FIG. 30 KINGLET LAYOUT-C (R-CH)

Waterfall Carts

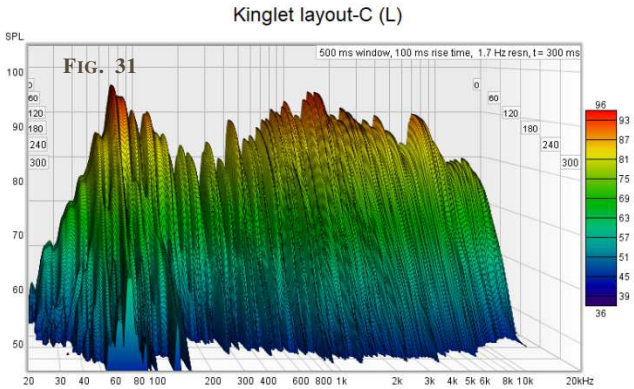


FIG. 31

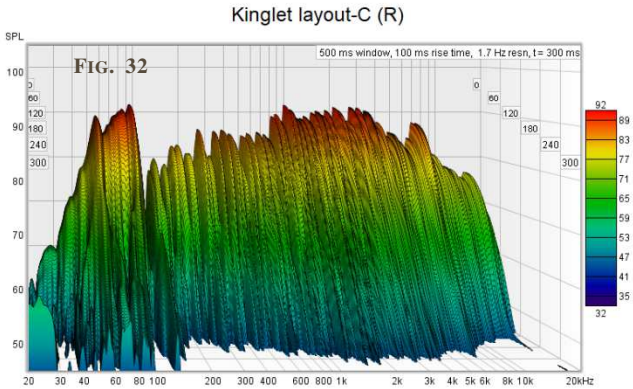


FIG. 32

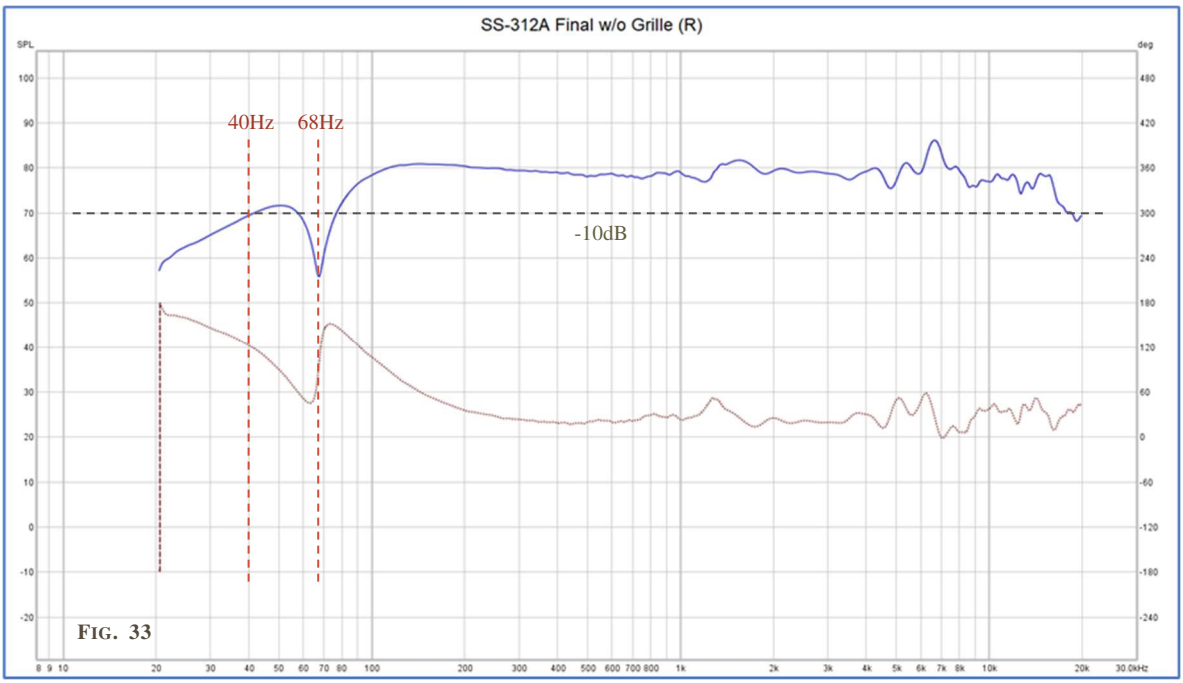
Discussion

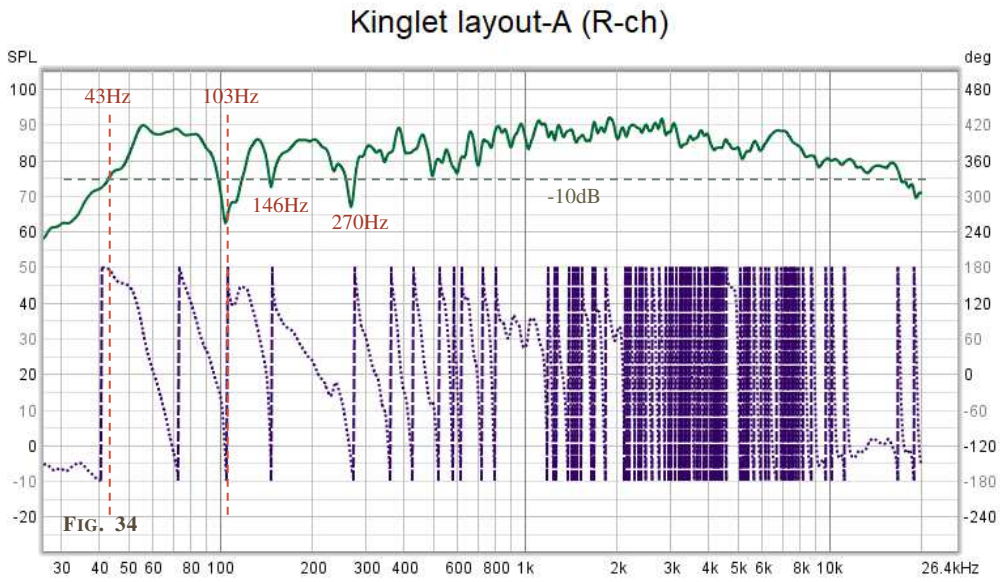
Quasi-anechoic Measurements vs System-level Measurements

Let's compare the result of the system-level measurements with the result of the quasi-anechoic measurements conducted in the SS-312A project. They both are the data of the right channel, and the data of the system-level measurements are measured in Layout A.

The data of the quasi-anechoic measurements were copied from the page of SS-312 (https://nobody-audio.com/ss-312.html).

The following figure (Fig.33) shows the frequency response in the quasi-anechoic measurements. The next one (Fig.34, which is the same as Fig.16) is the result of the system-level measurement.





Naturally, there is a difference between them.
In the quasi-anechoic measurement (Fig.33), there appears a deep notch at 68Hz. This occurs because this curve represents the SPL from the LS unit only. In the system-level (Fig.34), the SPL from the bass-reflex duct and the reflection from the floor are added so that the bass response is boosted.

Though I had expected the low end (-10dB cutoff) would be extended in the system level, it is the same as the quasi-anechoic condition. However, the SPL in the band between 50Hz and 90Hz is higher and the volume of bass is increased. This volume of bass is enough for almost every music source.
The deep notches at 103Hz, 146Hz and 270Hz may be caused by the steel rack near the right speaker and its contents. There aren't such deep notches in the left channel (Fig.15). This implies that the acoustical condition on the right side is worse than the left.

Looking at the impulse response, the timing of the reflection is earlier than the quasi-anechoic measurement, since the position of the loudspeakers is different.
Fig.35 shows the data of quasi-anechoic measurement, and Fig.36 is the system-level (same as Fig.18)

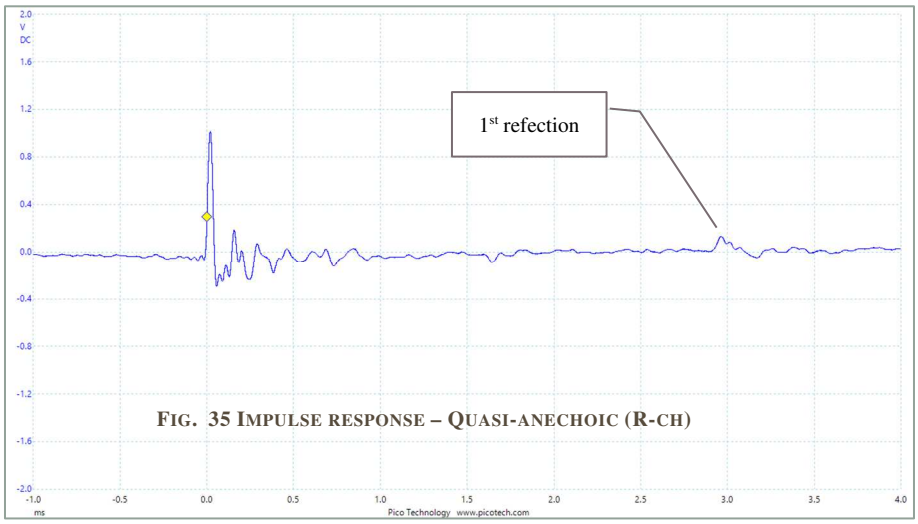


FIG. 35 IMPULSE RESPONSE – QUASI-ANECHOIC (R-CH)

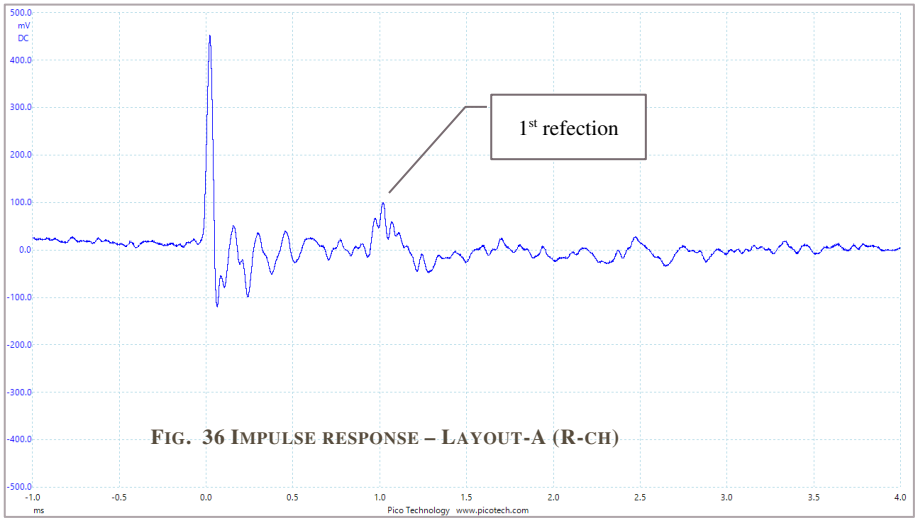


FIG. 36 IMPULSE RESPONSE – LAYOUT-A (R-CH)

In the system-level measurement, the height of the LS unit was as low as 540mm, so the first reflection from the floor reached the mic quicker and stronger than the quasi-anechoic measurement. It's not favorable in respect of acoustics, but the loudspeakers (SS-312A) are designed to be placed on the floor. It has high priority in the system design. I should compromise.

About Channel Balance

There are the deep notches at frequencies between 100Hz and 200Hz in the frequency response of the right channel. This makes acoustic images shifted left. To compensate this imbalance, I shift the right speaker toward the listening position by several centimeters in use, since the amplifier of Kinglet doesn't have a balance control.
This method is simple, yet effective.

When one of the speakers is shifted forward or backward, the timings the acoustic waves reach the listening position don't match between channels.
Fig.37 shows the waveform when the impulse came out of the both speakers at the same time. The impulse from the right channel speaker arrived earlier at the listening position (the position of the microphone).

Is this a problem that impairs sound quality? The answer is 'no'. Even if it affects sound quality, the channel imbalance is a more serious matter.

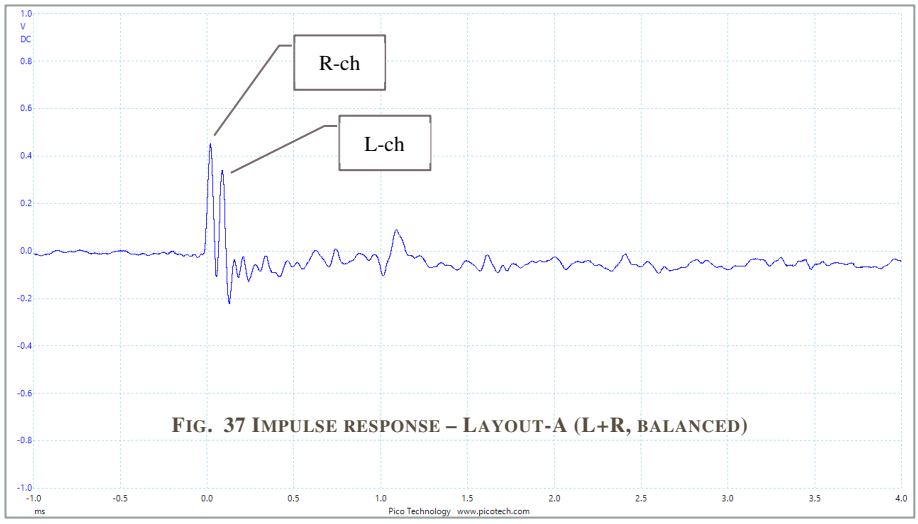


FIG. 37 IMPULSE RESPONSE – LAYOUT-A (L+R, BALANCED)

The difference between the channels in frequency response is smallest in Layout B (Fig.21, Fig.22). The layout B is the layout for music appreciation. This result is what I wanted in the system design.

Waterfall Charts

The waterfall charts indicate that the reverberation time is longer in bass region than in the other regions for all the layouts. This isn't what I expected. I believed the wall made of plaster boards tends to let bass through it and reflect midrange and treble.
I suppose that the bookshelves and the books in them reflect bass.

In the range between 120Hz and 300Hz, the SPL is relatively low and the reverberation time is short. I suppose the objects around the loudspeakers absorb the sounds in this range.

Effectiveness of Quasi-anechoic Measurements

In the system-level measurement, the sound the mic picks up is the same as one that comes to the listener's ears. That implies that the system-level measurement represents sound quality better than the quasi-anechoic measurement. Is the quasi-anechoic measurement really necessary?

Fig.38 shows the SPL frequency response curve for Layout B overlapped with the curve of the quasi-anechoic measurement (both are the data of the right channel). The dark green curve is the Layout B, and the purple is the quasi-

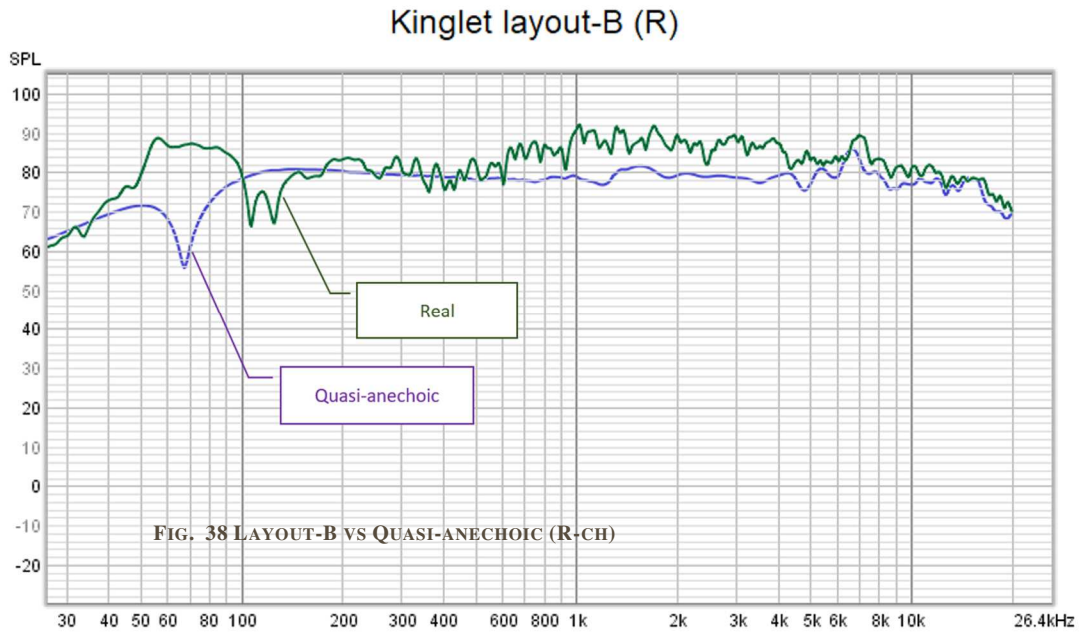


FIG. 38 LAYOUT-B VS QUASI-ANECHOIC (R-CH)

anechoic (I failed to align the overall SPL levels. Please see the dark green curve as shifting it by two notches downward (-4dB)).

The system-level curve isn't flat. This unevenness is related to phase shifts. As shown in Fig.22, the phase curve is so 'bumpy', and inversed at many frequencies. The SPL is relatively low in the band between 100Hz and 400Hz, and relatively high between 1kHz and 4kHz.

The system-level curve implies that the listener may hear coloration caused by the room acoustics. However, I don't hear any coloration. To my ears, the frequency response is flat, even when I compared it with monitor headphones (AKG K245), unlike the characteristics the system-level measurement implies.
This phenomenon is caused by compensation in the human brain, by which the reflection components are lessened and the sound that is nearly equal to the original sound is brought up in one's consciousness. That is, the real sound shown as the dark green curve in Fig.38 is converted almost to the purple curve by the signal processing in the brain.
If you're familiar with the room, this compensation works more effectively, since you've already learned the room acoustics.

I believe the quasi-anechoic measurement is more important. If the results of the measurement are good, the sound quality of the system must be good.
Of course, if the frequency response in the system-level measurement is not flat at all, or there are big peaks and notches, there must be a problem in the room acoustics, and you must resolve it. In such a case, the room acoustics must be improved, not the audio devices.

My Own Review

Sound Quality

I am very satisfied with SQ of Kinglet. It is suitable for easy listening.
Though it can't reproduce deep bass, I seldom feel bass is missing as long as I listened to jazz and pops.

The details of my evaluation is as written on the page on SS-312. But that evaluation is a little too harsh because it was written shortly after SS-312A was completed. I am very happy with SQ of Kinglet now.
https://nobody-audio.com/ss-312.html

I like listening to music in relaxation after taking a bath (Most Japanese take a bath before going to bed). It is the happiest moment when I listen to Bosa Nova or AOR in that situation.

There's a catch, though. If the grilles aren't detached, vocals sound a bit unnatural. I have to detach them if I want to have the happiest moment. It's a bit troublesome.

User-friendliness

Kinglet is use-friendly except for the volume control of MV-217.

As reported on the page on MV-217, operationality of AEDIO's digitally controlled analog volume control is not good. I am always stressed that it takes more than 10 minutes to turn up the volume from zero to max.
https://nobody-audio.com/mv-217.html

The system design of Kinglet specifies the proper gains of the amplifiers which don't have excess margin. So, I turn the volume up to nearly the maximum when I want high volume. I have to turn the knob a lot with might each time I turn up/down the volume. I think I have to do something to improve this.

Looks

I love the looks of Kinglet.

Especially, the looks of MV-217 X'tal is decent yet stylish. The more I look at it, the more I love it.

The color of the workbench is black. It doesn't fit the room. I put a whitish tablecloth and 3mm-thick clear vinyl sheet on the workbench to fit it with the atmosphere of the room. It also fits with MV-217.

The PC is placed on the workbench. It is finished metallic in champagne gold and silver. The PC is not a high-end PC, though, it doesn't look cheap and I like the design.

The power amplifier is placed under the workbench and not seen from the front. The design of ACA V1.6 is good, but nothing special for a power amplifier. If it's placed so that it can be seen from the listening position, it may give off a mechanical atmosphere. I think it's a good idea to hide it from the listener's eyes.

The small rack under the workbench (ACA Rack) is designed specially for ACA V1.6 and MA-217. It fits with them with less than 1mm margin.

[END OF DOCUMENT]

NOBODY Audio
Tonochi's Audio Room - Supplemental Info