Tonochi's Audio Room – Supplemental Info

Review of dbx DriveRack VENU360

2022/12/25

Review of dbx DriveRack VENU360, a digital crossover network

Behringer CX3400 was employed in Gaudi II Rev.2.11 system in place of the DIY crossover network CD-211B, which had a problem. However, I wasn't satisfied with CX3400. To my ears, CX3400 was worse than CD-211B in sound quality. So, I've decided to replace CX3400 with a digital crossover as in the system design (Ver.2.3). I selected dbx DriveRack VENU360.

Contents:

Outline of dbx DriveRack VENU360

dbx DriveRack VENU360 (called VENU360 from here) is a device that performs features of crossover network and equalizer by using a DSP in it. It also has other functions necessary for loudspeaker setting and tuning. VENU360 should be named 'speaker processor' rather than crossover network. It is designed for PA systems, though, it can be used for home use.

Outline Specifications

Item		Specification	Note
Input		Balanced x3	Two of them can be configured for digital inputs (AES)
	Connector	XLR female	
	Impedance	>30kΩ (line to line)	
	Maximum level	+28dBu (19.5V)	
Output		Balanced x6	
	Connector	XLR male	
	Impedance	120Ω (line to line)	
	Maximum level	+22dBu (9.75V)	
AD/DA		48/96kHz, 24bit	
DSP		32bit floating point	
Dynamic range		114dB	With A-curve filter
Frequency range		20Hz-20kHz (+0/-0.5dB)	
THD＋N		0.0025%	Typical value
AC power supply		100-240V, 50/60Hz	
Power dissipation		30W	
Dimension		483(W) x 203(D) x 44(H) mm	
Weight		2.5kg	

Reasons for Selection

I need equalizer feature, because my squawker, Fostex D1405+H400, has uneven frequency response. Signal delay feature is also needed for time alignment. I wanted a "speaker processer" rather than a simple crossover network.

I considered Mackie SP260, but its sampling frequency for ADC and DAC is as low as 48kHz. I didn't choose it.

I chose VENU360, because I didn't find any competitive rival.

Initial settings of VENU360

I set up VENU360 as follows:

- Configuration: stereo 3-way
- Sampling frequency: 96kHz
- Crossover frequencies: f_{c1}=900Hz, f_{c2}=6kHz
- Filter type: Butterworth 48dB/oct (BW48)
- Input gain: 0dB
- Output gain: 0dB
- Limiter: off
- Phase: normal
- Muting: off
- Delay: 0msec

The other settings remained as default.
VENU360 can be connected to PC through LAN, but I didn't connect it during measurement.

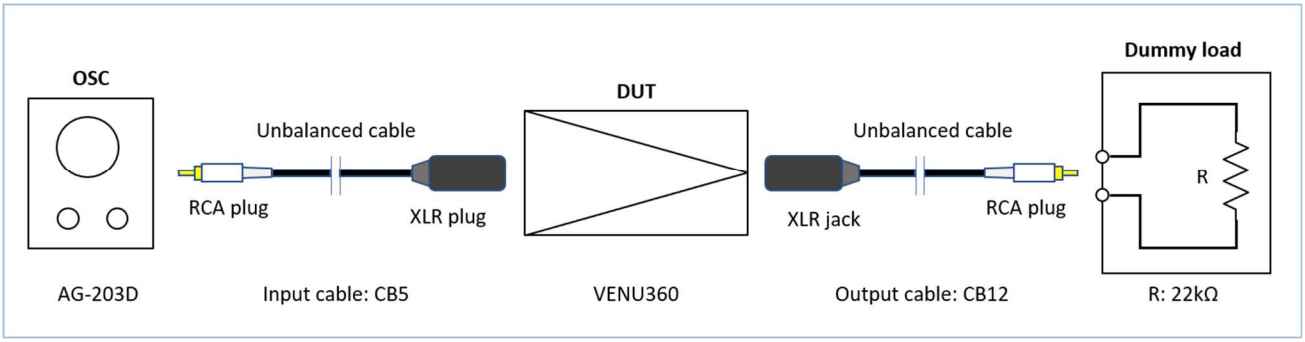
The settings above are subject to change during measurement according to the purpose of the measurement.
After the measurement, the settings are going to be changed to the optimum values based on the measured data and analysis.

In this system, the outputs are divided into three bands. In this document, the outputs are denoted by 'LOW', 'MID', 'HIGH'. When the channel needs to be explicit, the suffixes '-L" or '-R' is added like 'LOW-L', 'HIGH-R'.

Measurements

Measurements in unbalanced connection

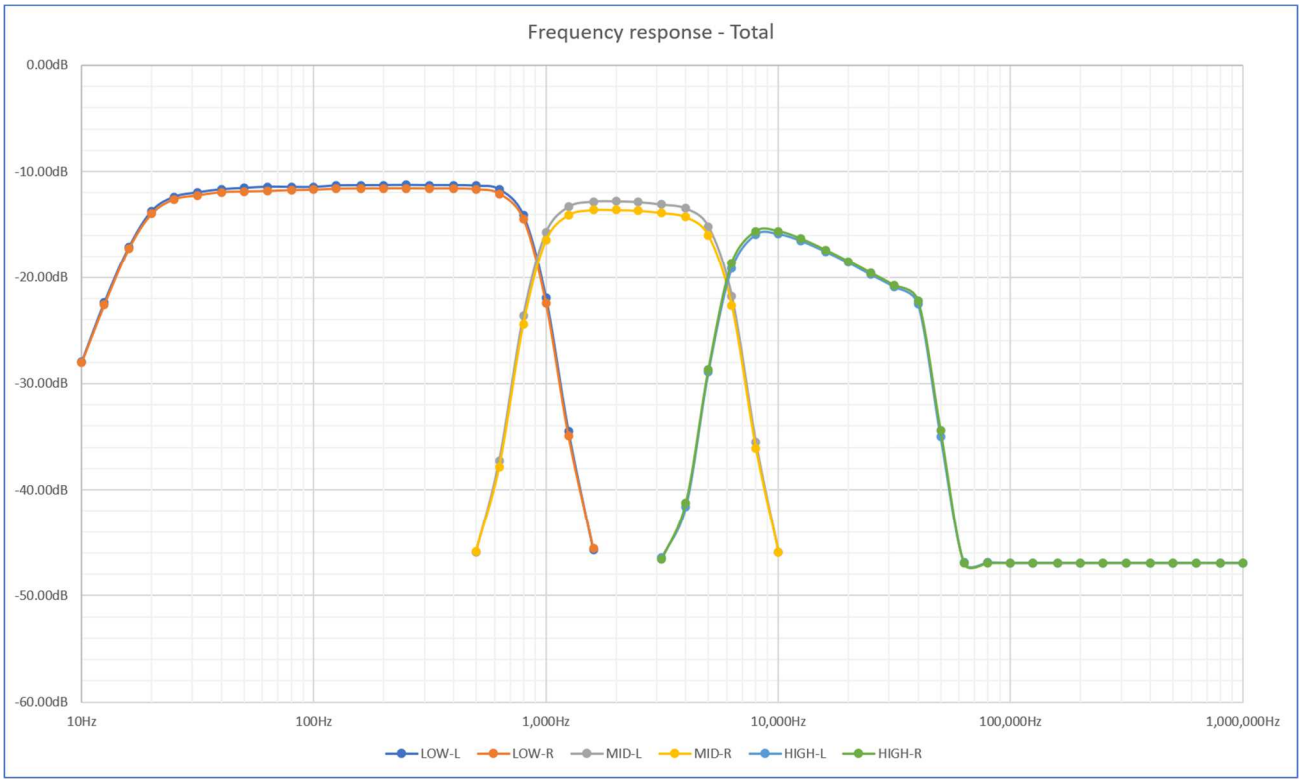
Both the oscillator and the dummy load are connected to DUT (VENE360) with unbalanced cables. CB5 is used for the oscillator and CB12 for the dummy load (see the figure below). Both the oscillator and dummy load don't have an RCA jack, so adaptors are used for connection.
For the details of the cables, refer to the document below:
https://nobody-audio.com/img/LineCable_Design.pdf



Frequency Response

Frequency response was measured first, since it is the most important for the crossover network.

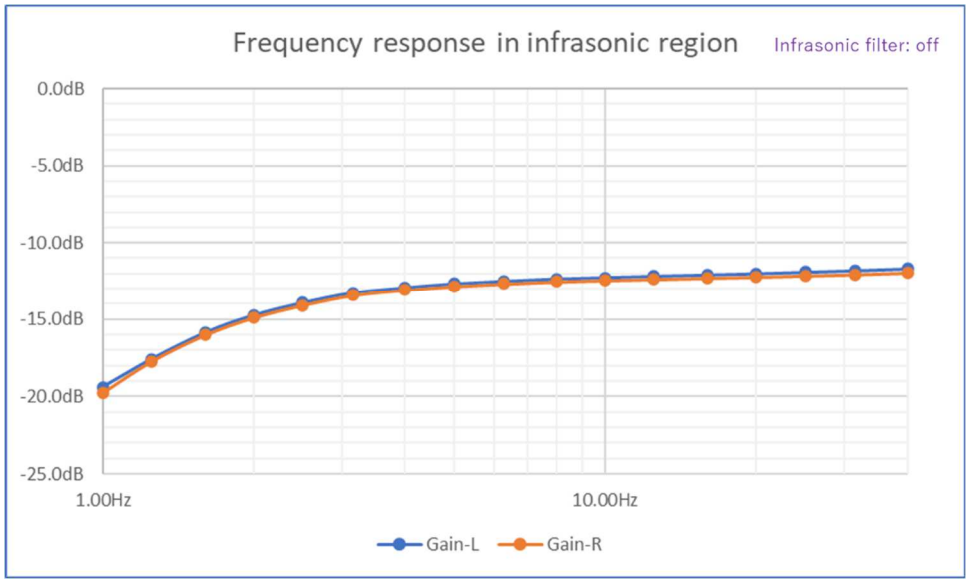
The figure below shows the frequency response between 10Hz and 1MHz.



As frequency rises, the gain decreases. It is no good.
At 50kHz, the gain sharply drops. It is so like a digital network. The sampling rate of 96kHz explains this.

The frequency response in infrasonic region is shown in the figure below.

The -3dB cutoff is about 1.8Hz.



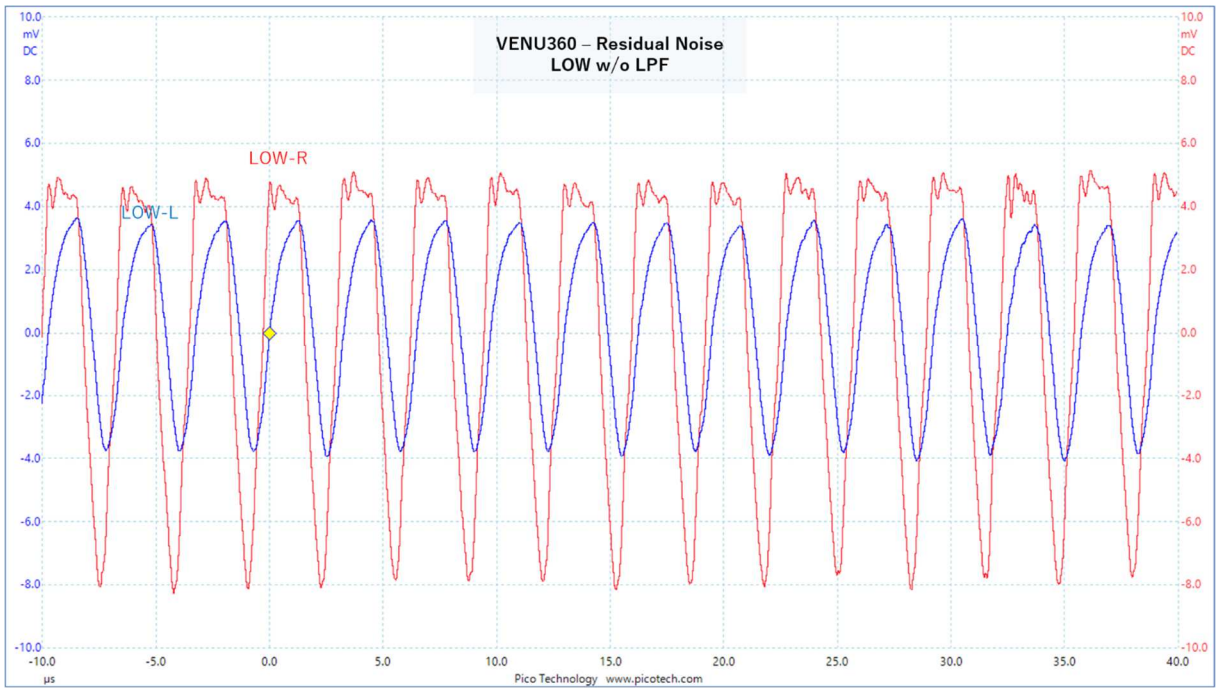
Residual Noise

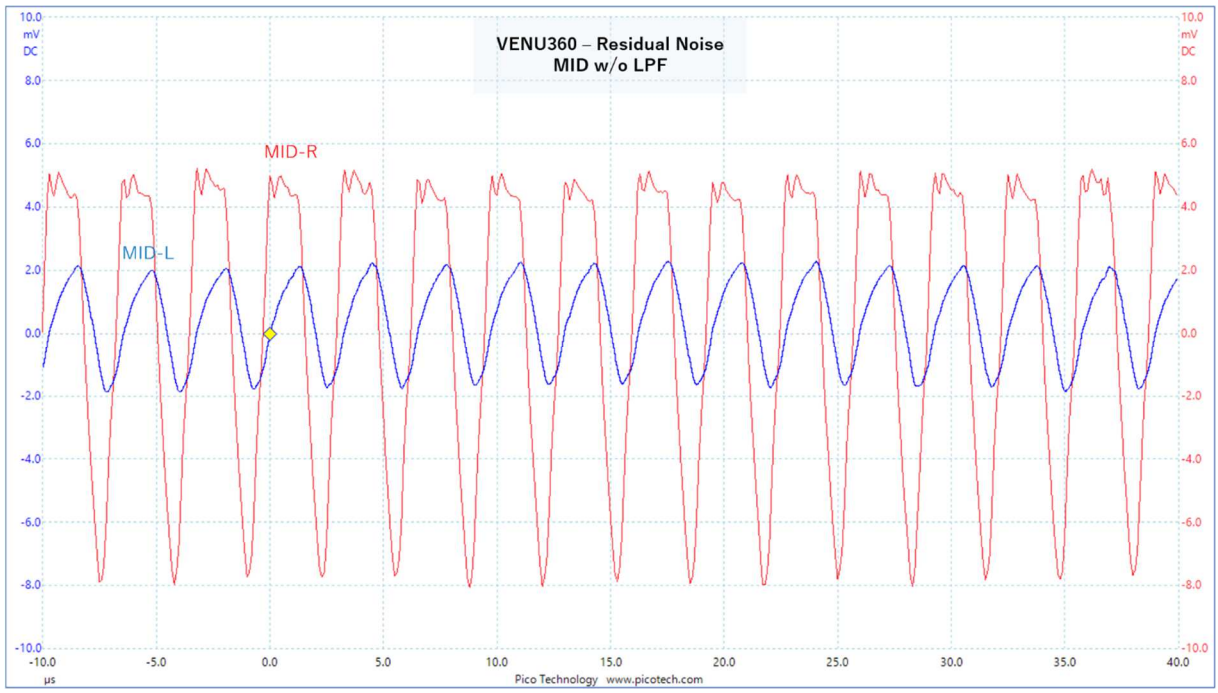
A substantial level of noise appears at the output. The component is obvious at a glance. It is 308kHz, which may be the internal clock of VENU360.

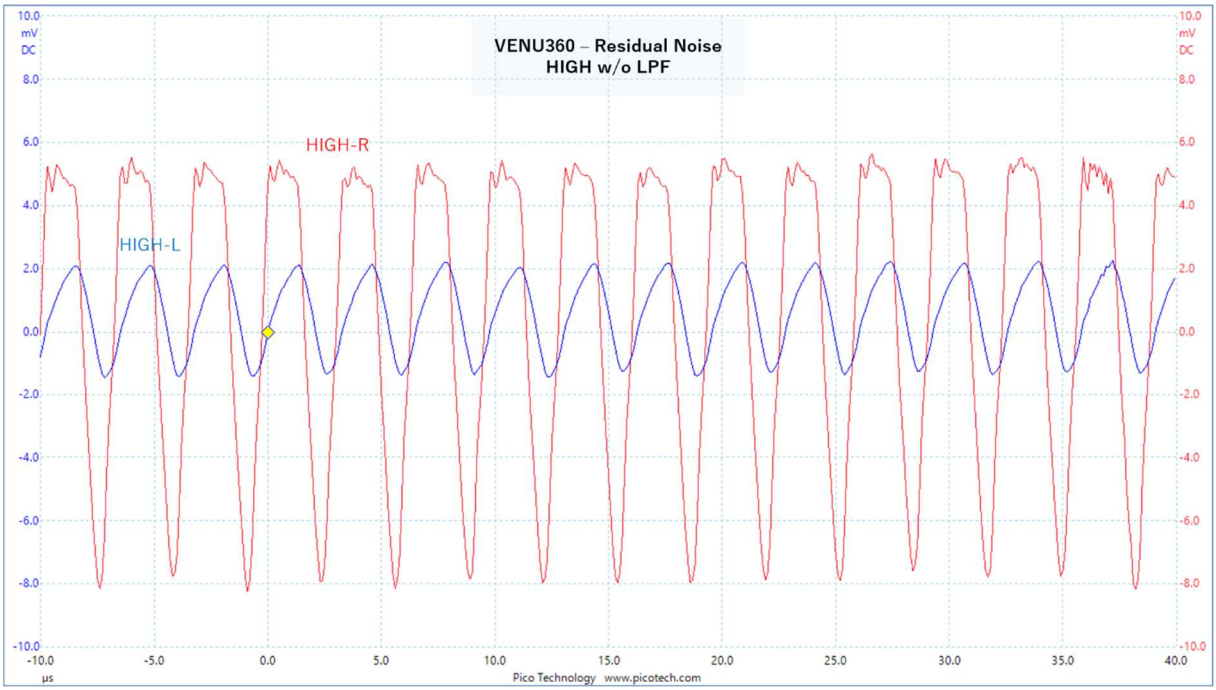
Condition	Output	L-ch (AC)	L-ch (DC)	R-ch (AC)	R-ch (DC)	Note
Output MUTE off	LOW	2542 [uV]	413 [uV]	4573 [uV]	301 [uV]	Noise component: 308kHz
	MID	1310 [uV]	438 [uV]	4590 [uV]	405 [uV]	Noise component: 308kHz
	HIGH	1190 [uV]	558 [uV]	4752 [uV]	610 [uV]	Noise component: 308kHz
Output MUTE on	LOW	2191 [uV]	386 [uV]	4589 [uV]	145 [uV]	Noise component: 308kHz
	MID	175 [uV]	360 [uV]	4594 [uV]	272 [uV]	Noise component: 308kHz
	HIGH	1188 [uV]	507 [uV]	4364 [uV]	476 [uV]	Noise component: 308kHz

When the output MUTE is on, the noise level falls a little bit, but it's still high.

The figure below shows the waveform of the residual noise. The waveform of the right channel is more like a square wave. The left channel noise looks like a waveform resulted from filtering the right channel noise.







The level of the noise is high, but the frequency is in RF region. The measurement method of industrial standard ignores a noise like this. However, RF noise like this may degrade sound quality if the power amplifier isn't immune to RF noise. In my opinion, RF noise shouldn't be ignored.

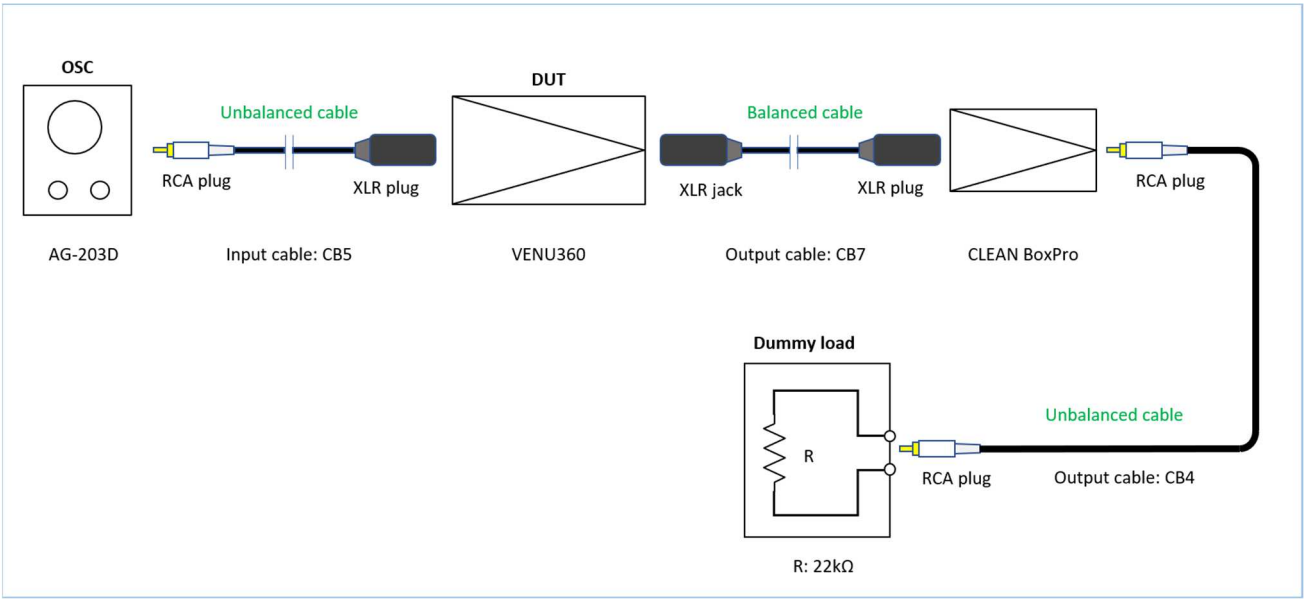
Measurements in Balanced Connection

At first, I expected little degradation in the unbalanced connection, though the gain is halved (-6dB). But I was too optimistic. As mentioned above, the frequency response was no good. I decided to use balanced/unbalanced converter. I had no energy to spare for building it myself. I bought commercial converters.

I selected ARTcessories CLEAN BoxPro. I searched and found it on Internet. The unit price was about 8,000 JPY. It performs both balanced/unbalanced and unbalanced/balanced conversions. It has two channels.

I used it as shown in the figure below.

CLEAN BoxPro is equipped with gain controls. During measurement they were kept maximum.



The settings of VENU360 was changed in part.

- Configuration: stereo 3-way
- Sampling rate: 96kHz
- Crossover frequencies: f_{c1}=900Hz, f_{c2}=~~6~~7kHz
- Filter type: Butterworth 48dB/oct (BW48)
- Input gain: 0dB
- Output gain: 0dB
- Limiter: off
- Phase: normal
- Muting: off
- Delay: 0msec
- Infrasonic filter: ~~off~~18Hz

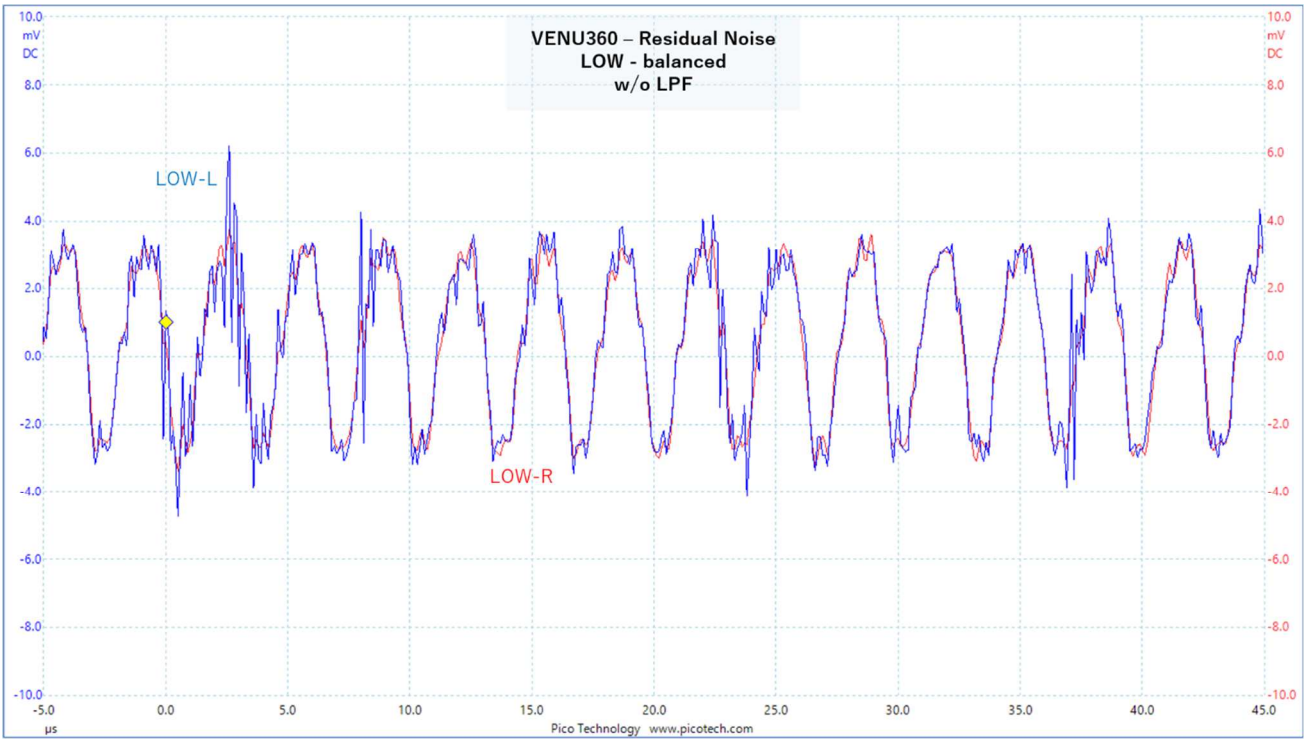
The upper crossover frequency (f_{c2}) was changed to 7kHz to reduce the load of T925A.
The recommended crossover frequency of T925A is 6.0kHz (12dB/oct) or higher. If f_{c2}=6kHz, it won't cause any damage to the tweeter, though.

I set the infrasonic filter to 18Hz, because it is a desirable setting when VENU360 is used in Gaudi II.

Residual Noise

I had expected the noise would be reduced by the balanced connection, but that didn't happen. Now it is clear that the noise is a common mode noise.
However, a normal mode noise had mixed with the common mode noise in the right channel. The normal mode noise is reduced by the balanced connection and the waveforms of the right channel became the same as the left channel.

Condition	Output	L-ch (AC)	L-ch (DC)	R-ch (AC)	R-ch (DC)	Note
Output MUTE Off	LOW	2045 [uV]	241 [uV]	2037 [uV]	165 [uV]	Noise component: 308kHz
	MID	2021 [uV]	266 [uV]	2034 [uV]	143 [uV]	Noise component: 308kHz
	HIGH	2040 [uV]	252 [uV]	2052 [uV]	140 [uV]	Noise component: 308kHz
Output MUTE On	LOW	2043 [uV]	260 [uV]	2035 [uV]	152 [uV]	Noise component: 308kHz
	MID	2021 [uV]	249 [uV]	2043 [uV]	148 [uV]	Noise component: 308kHz
	HIGH	2048 [uV]	262 [uV]	2056 [uV]	115 [uV]	Noise component: 308kHz


VENU360 – Residual Noise
LOW - balanced
w/o LPF
LOW-L
LOW-R
10.0
mV
DC
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
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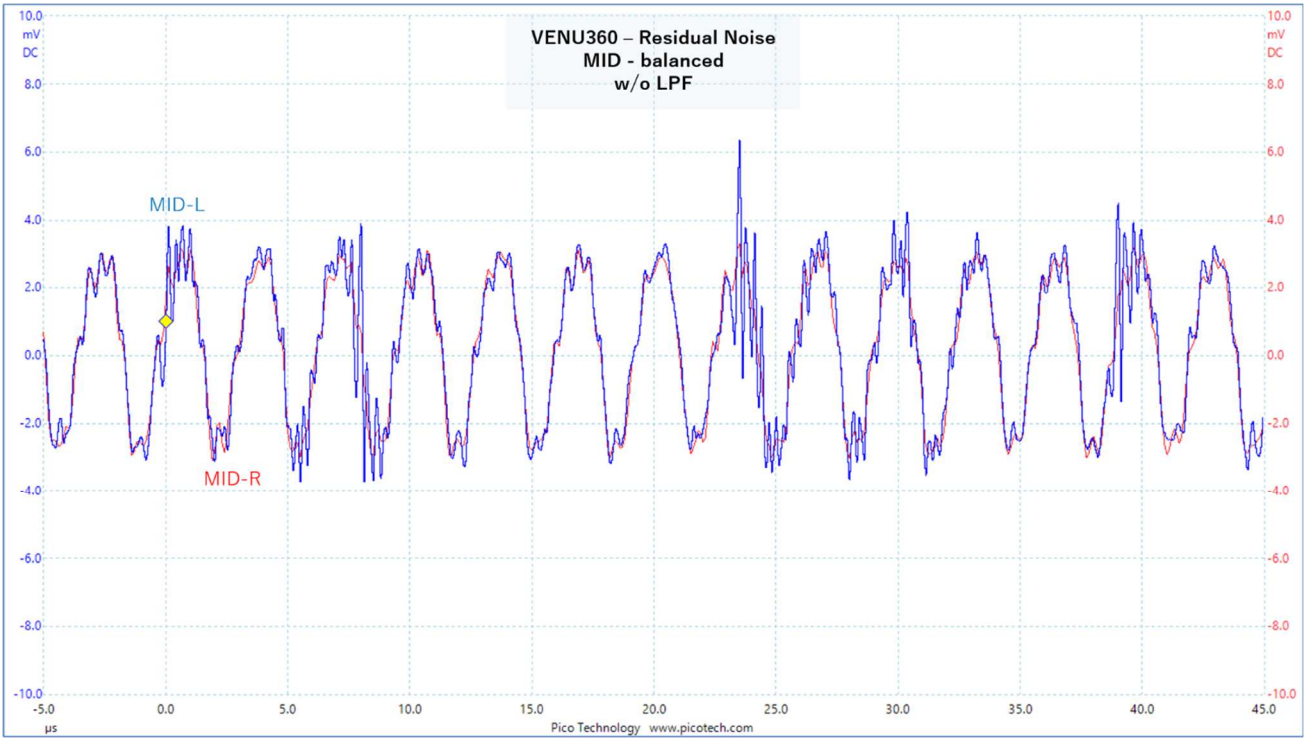
40.0
45.0
µs
Pico Technology www.picotech.com


VENU360 – Residual Noise
MID - balanced
w/o LPF
MID-L
MID-R
10.0
mV
DC
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
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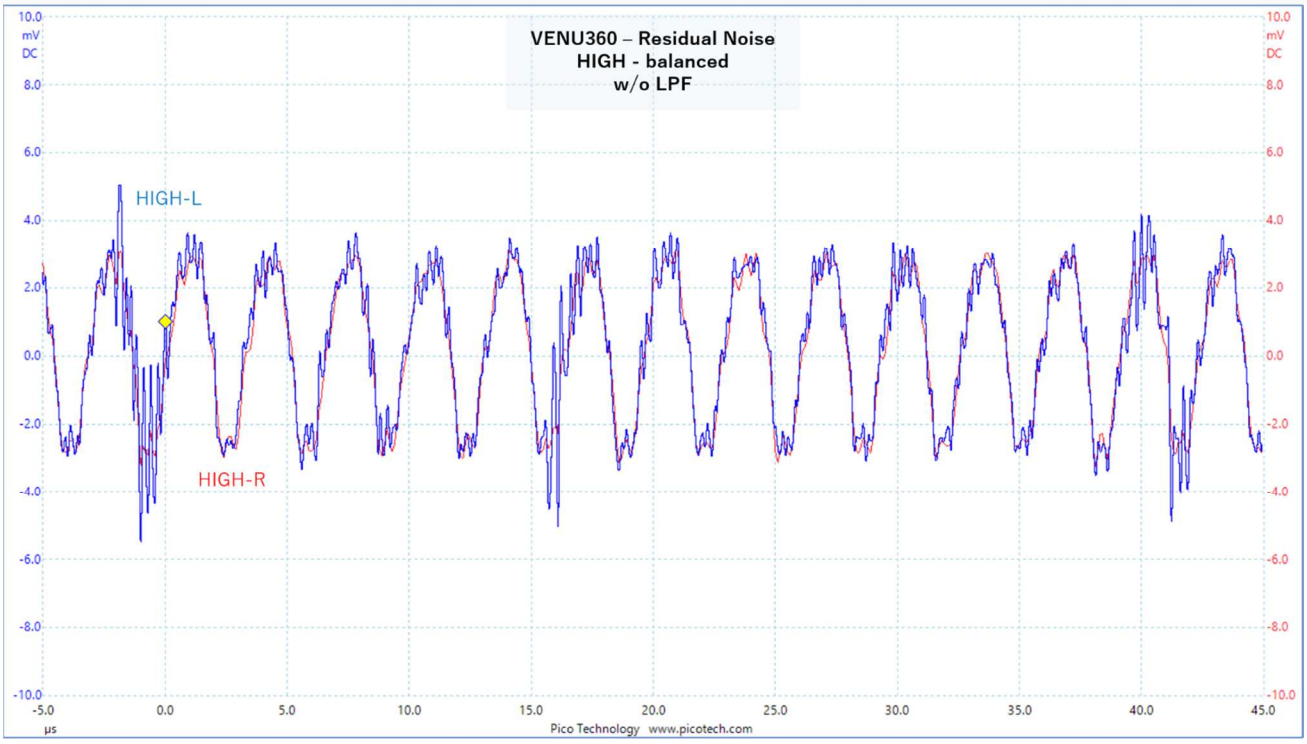
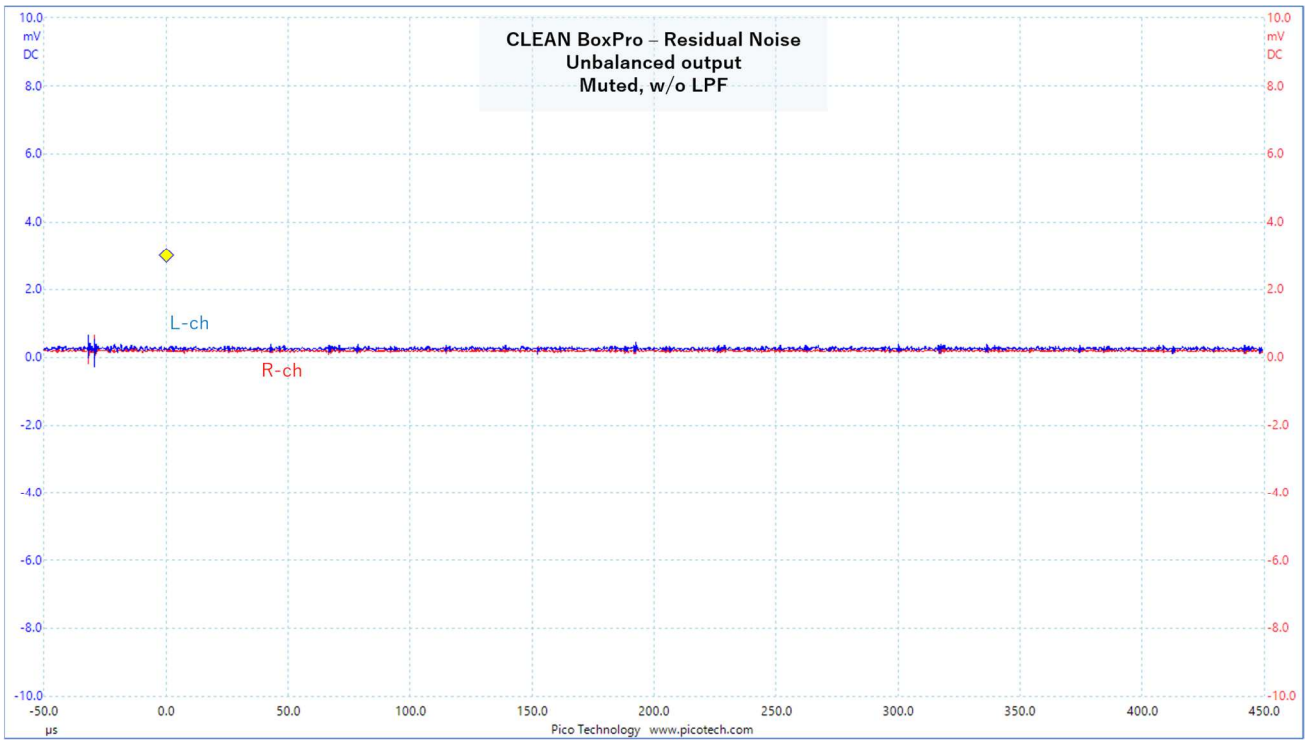


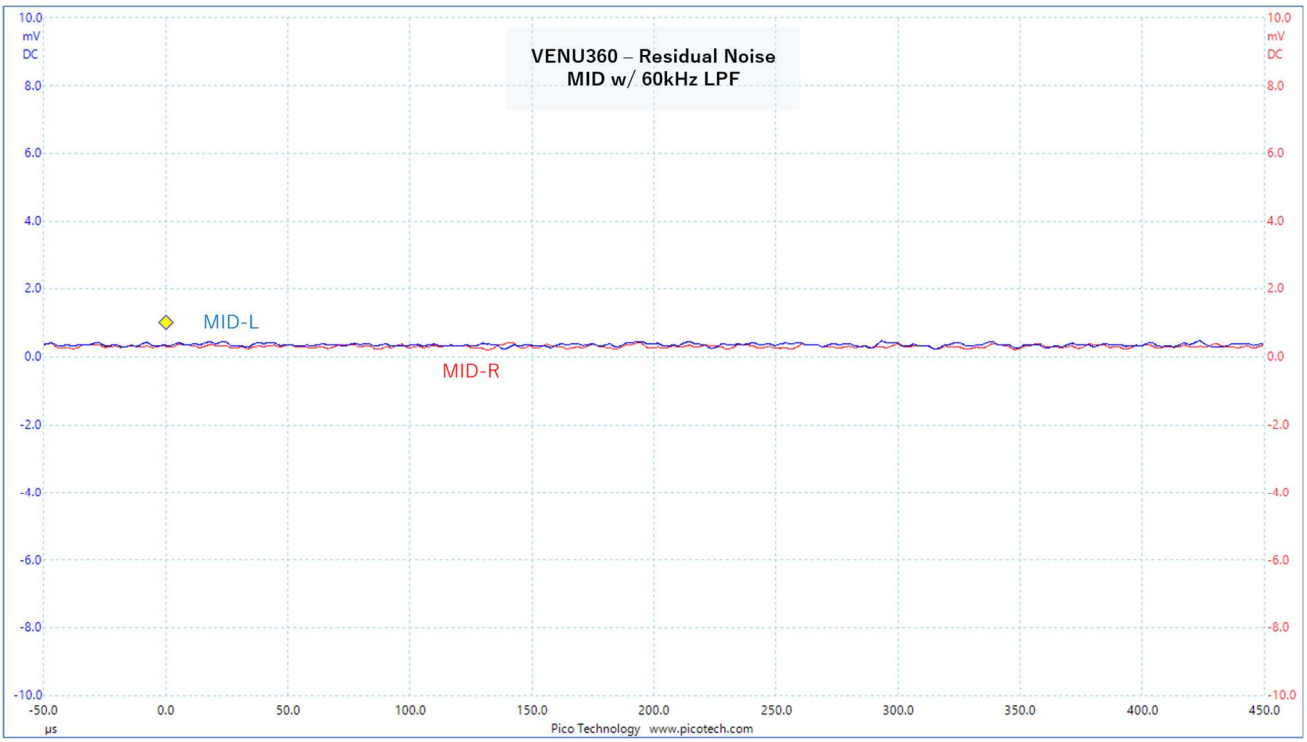
The figure below shows the residual noise of CLEAN BoxPro only. The level is less than 30uV.



I used the LPF of the oscilloscope to eliminate the RF noise. The cutoff frequency is 60kHz. This condition is close to the industrial standards.
In this condition, the residual noise is low enough.

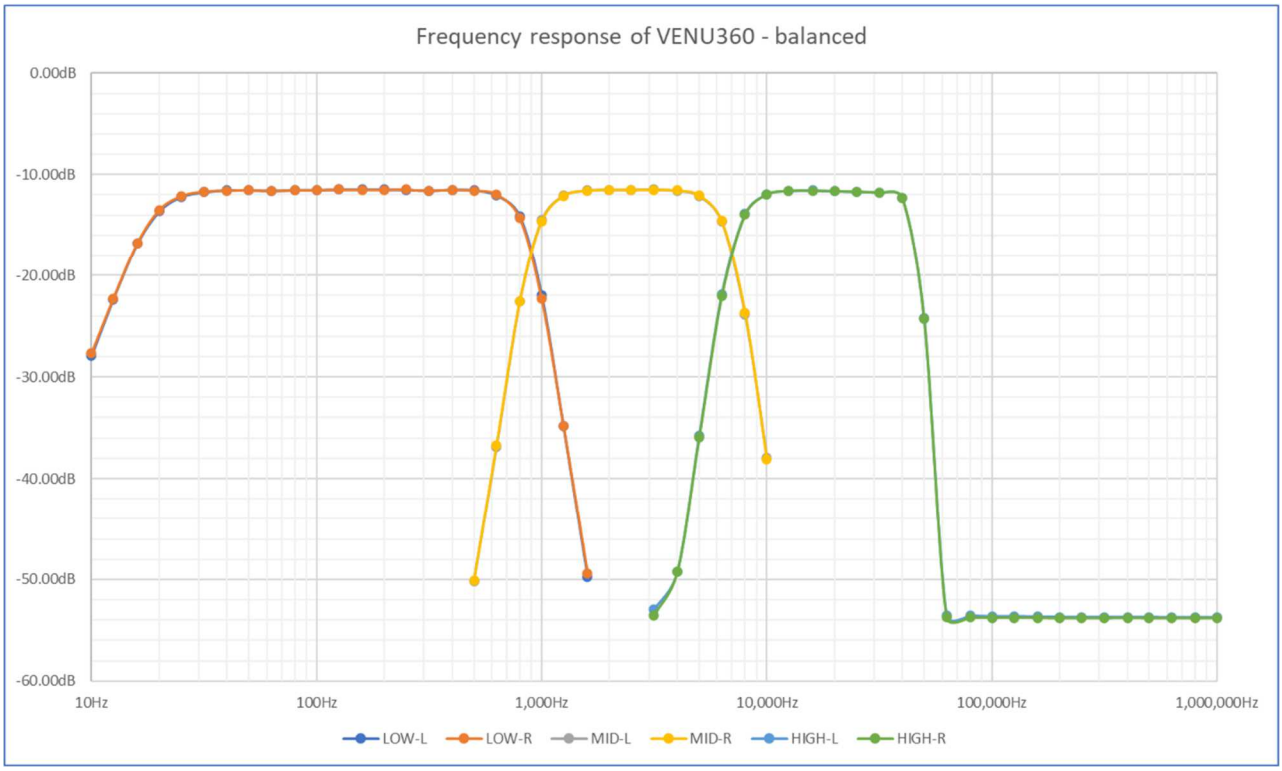
Condition	出力端子	L-ch (AC)	L-ch (DC)	R-ch (AC)	R-ch (DC)	Note
Output MUTE Off	LOW	38 [uV]	384 [uV]	39 [uV]	298 [uV]	
	MID	40 [uV]	366 [uV]	39 [uV]	316 [uV]	
	HIGH	44 [uV]	389 [uV]	49 [uV]	356 [uV]	

The waveform of MID is shown in the figure below. The other outputs exhibit the same waveform.



Frequency Response

The frequency response was improved as I had expected.

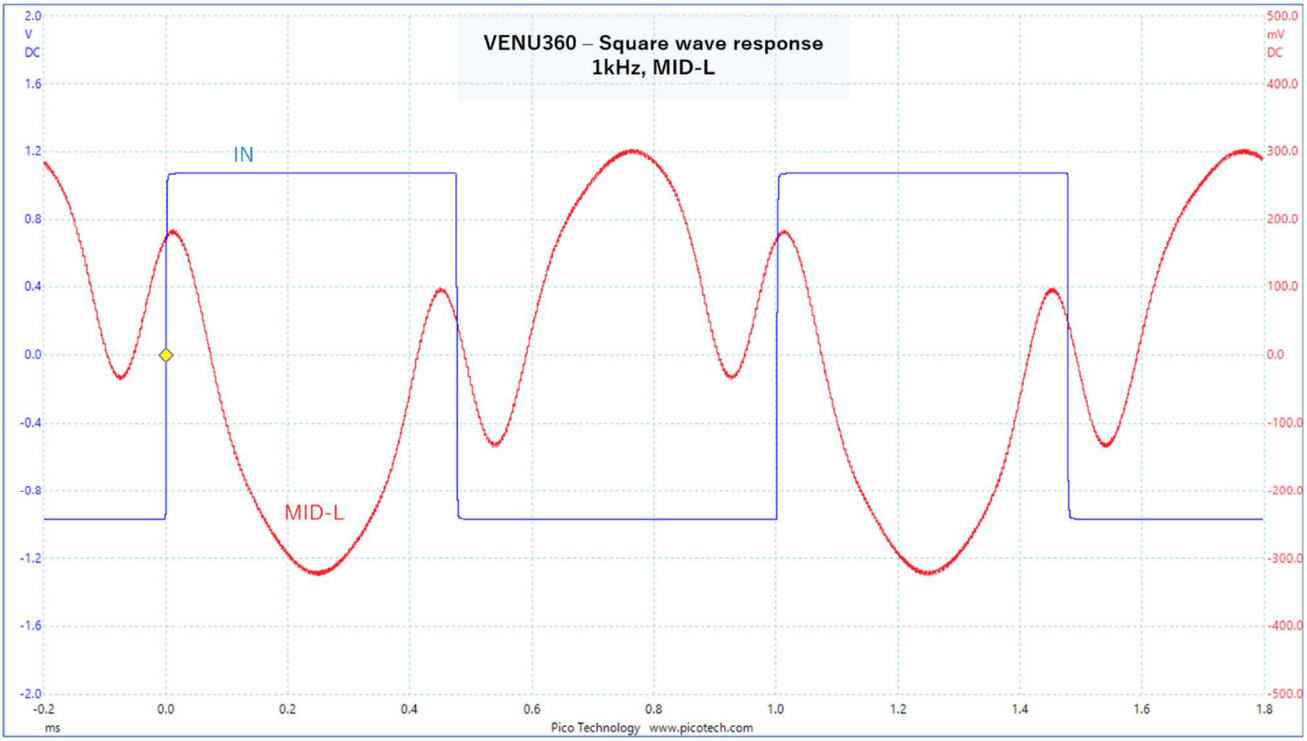


The curves are exactly as what I aimed.

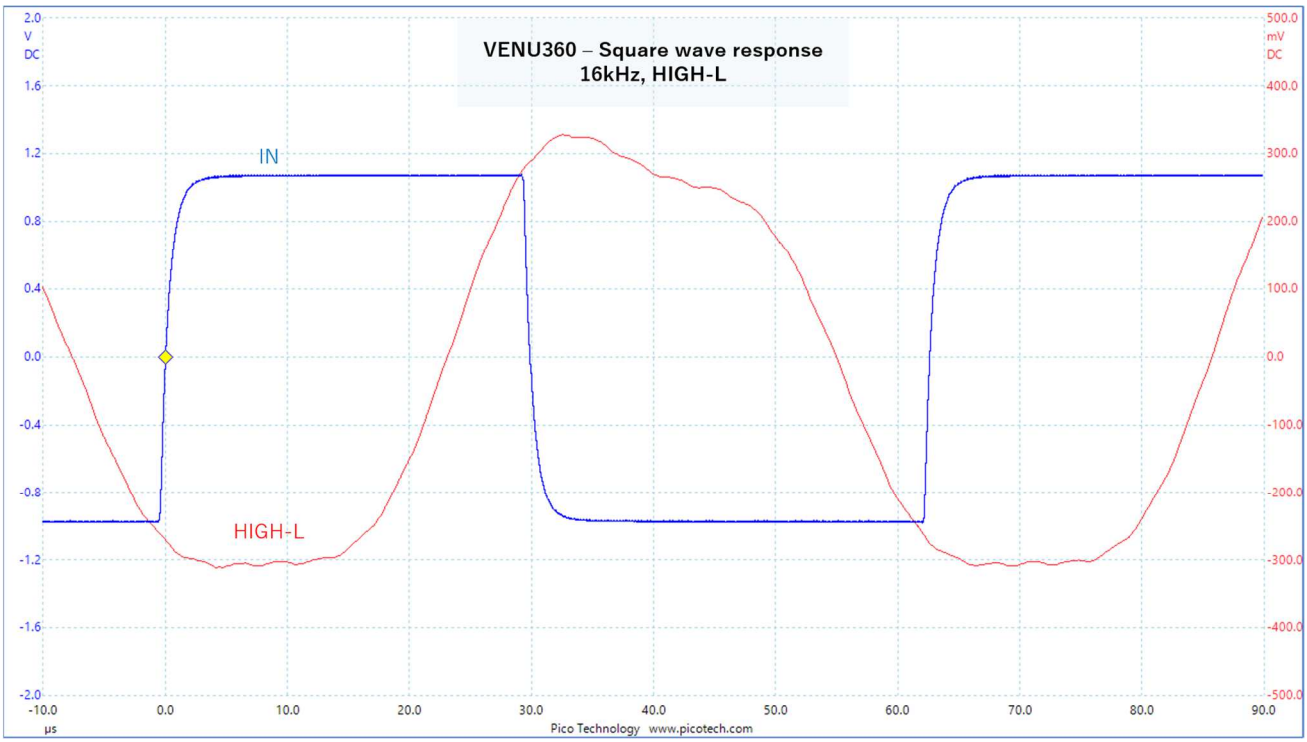
Square Wave Response

Only the waveforms of the left channel are shown since those of the right channel exhibit the same waveforms.
The input level is 1V.

The following figure shows the response of MID-L when square wave of 1kHz is incident on the input.
The waveform is complicate. It is typical for the bandpass filter.

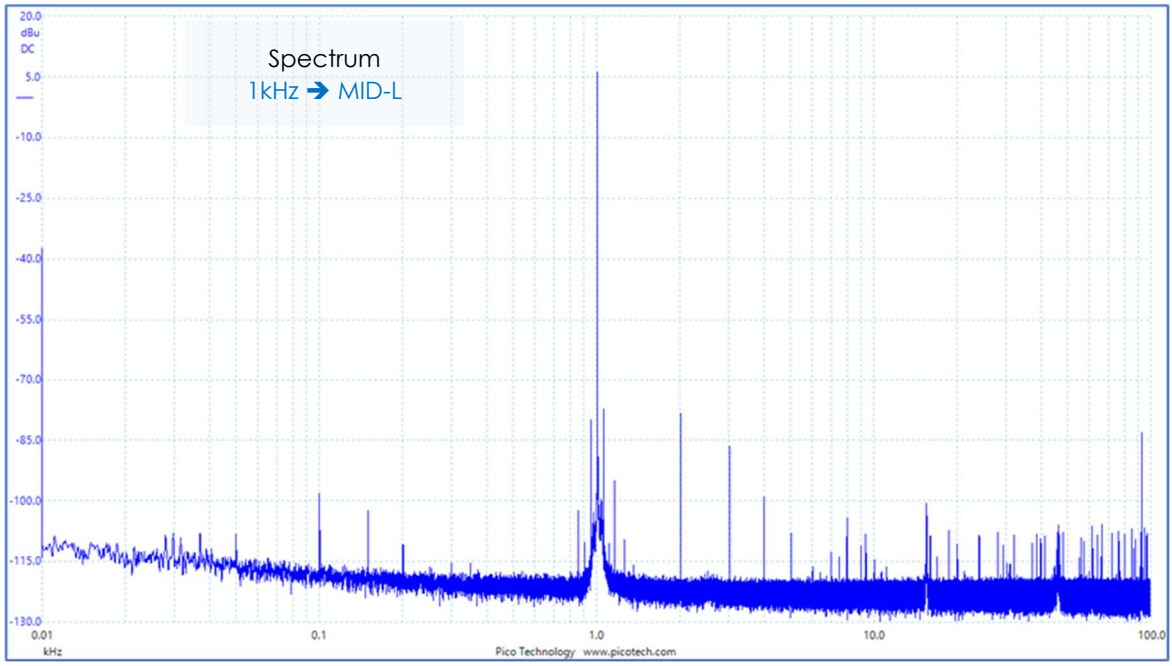


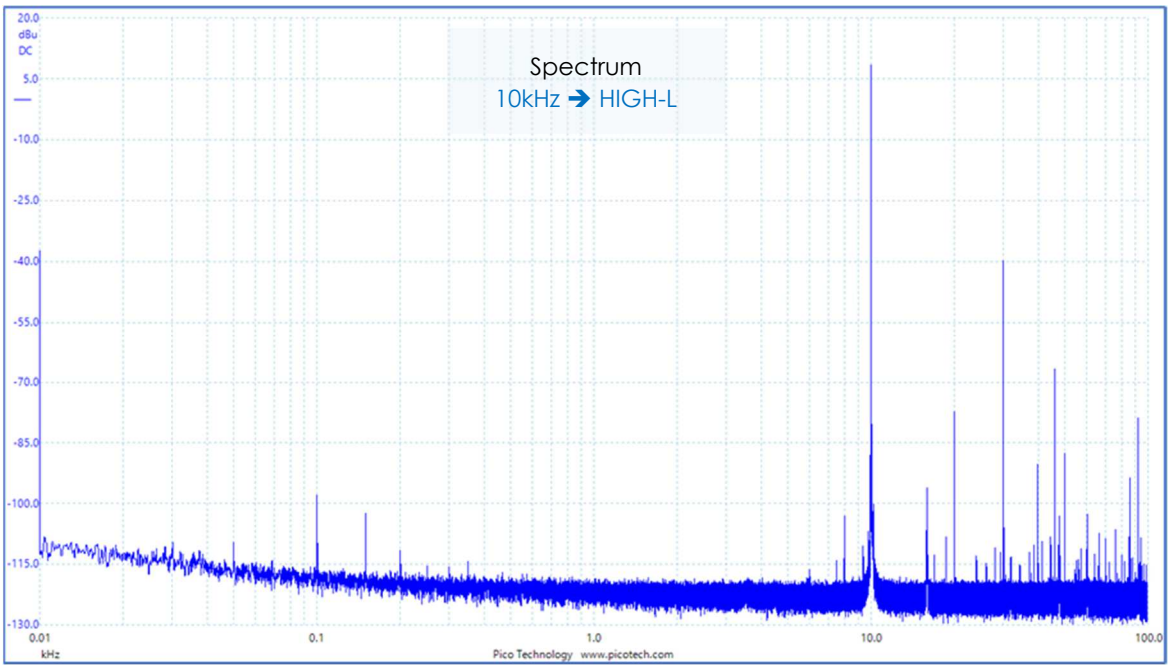
The following figure shows the response of HIGH-L when square wave of 16kHz is incident on the input.
The waveform is less influenced by the filter, and looks nearly square. The output is delayed by half the cycle, though the phase setting of VENU360 is normal.



FFT Analysis

Spectrum of MID is measured for the input of sine wave of 1kHz, and HIGH is measured when 10kHz is incident on the input. Both the measured spectrums happen to be just the same, so only the data of the left channel are shown here. 100kHz LPF of the oscilloscope is used.





Some harmonics are seen, but they are at a level where they don't affect SQ.

The numeric data are shown in the table below, though they are measured in the 'Tonochi Method' and shouldn't be compared with those measured in the industrial standard.

Fundamental	Output	Measurements	L-ch	R-ch
1kHz	MID	THD	0.008%	0.007%
		THD+N	-61.8dBc	-59.7dBc
		SNR	61.8dBc	61.9dBc
		Dynamic range	80.8dBc	78.9dBc

		IMD	0.04%	0.04%
10kHz	HIGH	THD	0.650%	0.473%
		THD+N	-43.6dBc	-46.2dBc
		SNR	59.1dBc	57.6dBc
		Dynamic range	44.7dBc	50.2dBc
		IMD	0.504%	0.581%

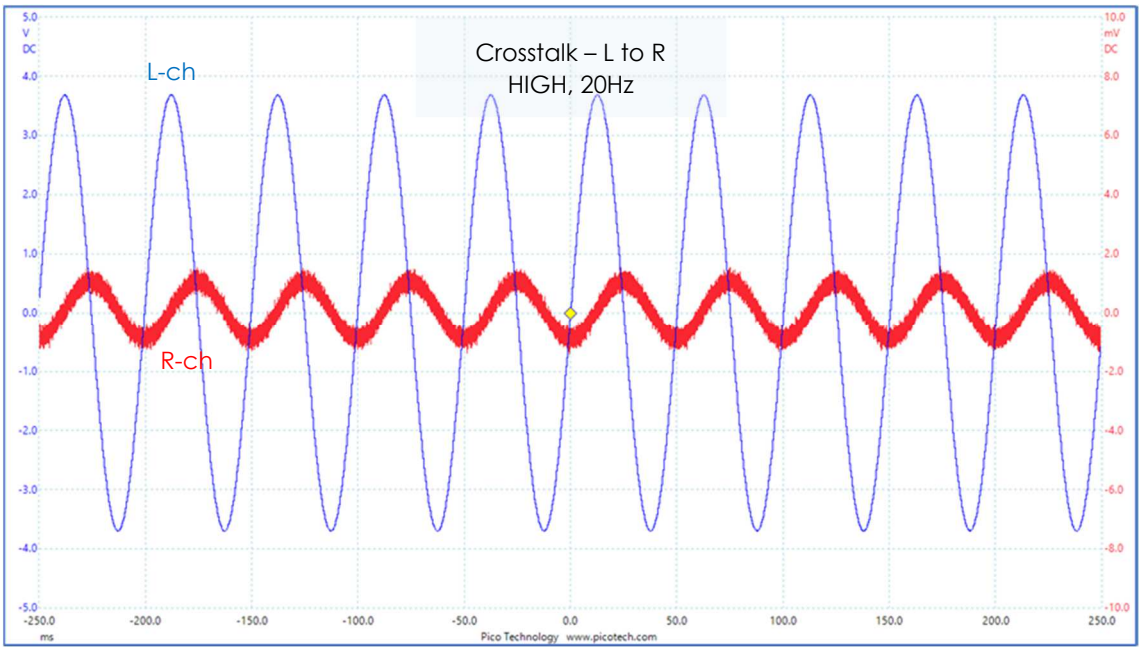
The SNR data are as low as 58 to 62dBc, though, they may be 100 to 110dB in the standard measurement.

Channel Separation

The input signal are sine waves of 10V, 20Hz, 2.5kHz and 20kHz.
60kHz LPF of the oscilloscope is used to eliminate the RF noise.

Output	Frequency	Direction	Separation
LOW	20 [Hz]	L ➔ R	71.4 [dB]
		R ➔ L	71.6 [dB]
MID	2.5 [kHz]	L ➔ R	91.9 [dB]
		R ➔ L	97.0 [dB]
HIGH	20 [kHz]	L ➔ R	78.8 [dB]
		R ➔ L	90.4 [dB]

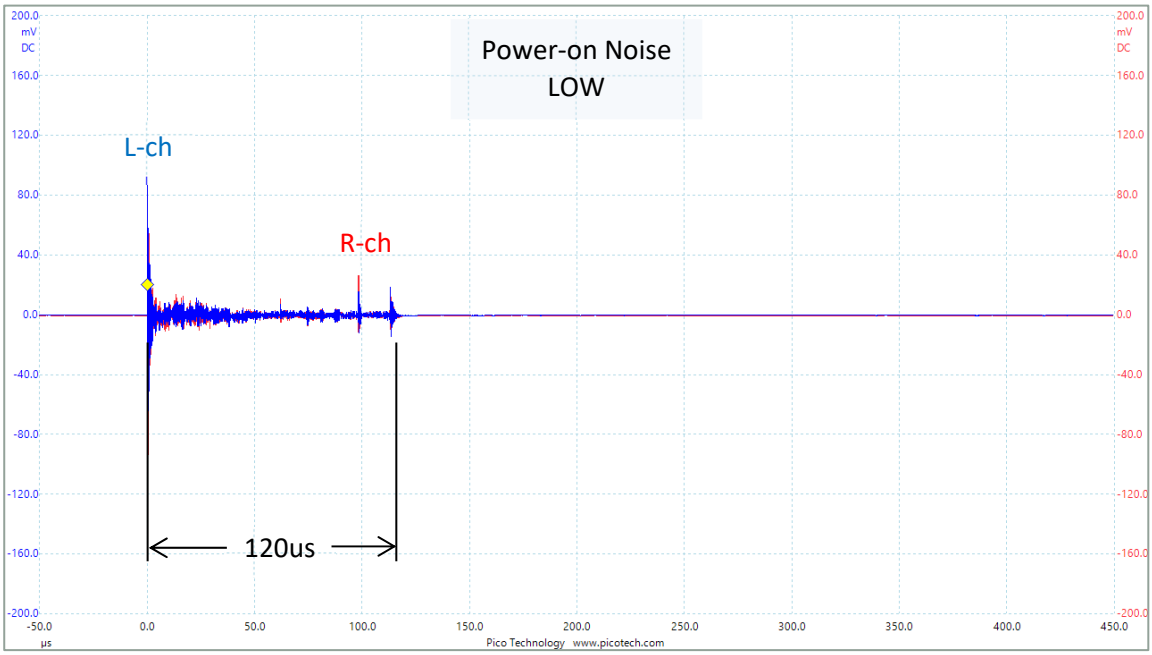
The separation at 20Hz is a bit too low. But now I care less about channel separation than I used to be. I think this result is acceptable.

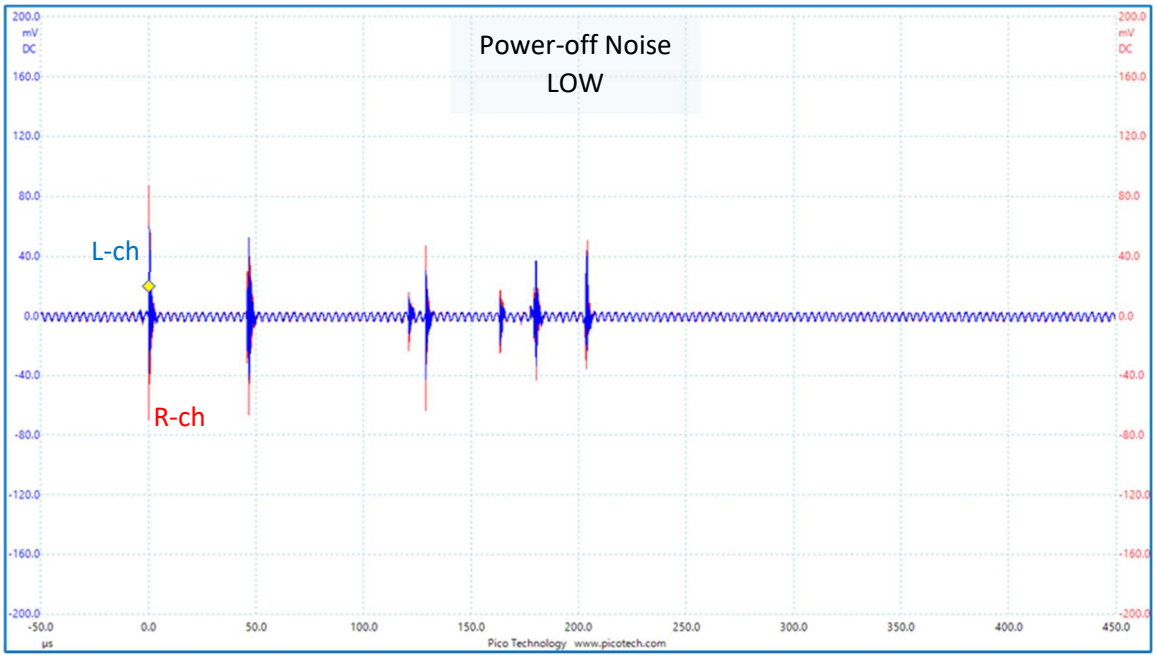


Power-on/off Noises

VENU360 generates some power-on and power-off noises.
Particularly, the noise from LOW is higher, but the noises don't cause a problem.

In Gaudi II system, the AC power is supplied from the power distributor. The power amplifiers are turned on 5 seconds later than VENU360. When the power is turned off, the power amps are turned off 5 seconds earlier than VENU360. The power-on/off noises are never radiated from the loudspeakers.





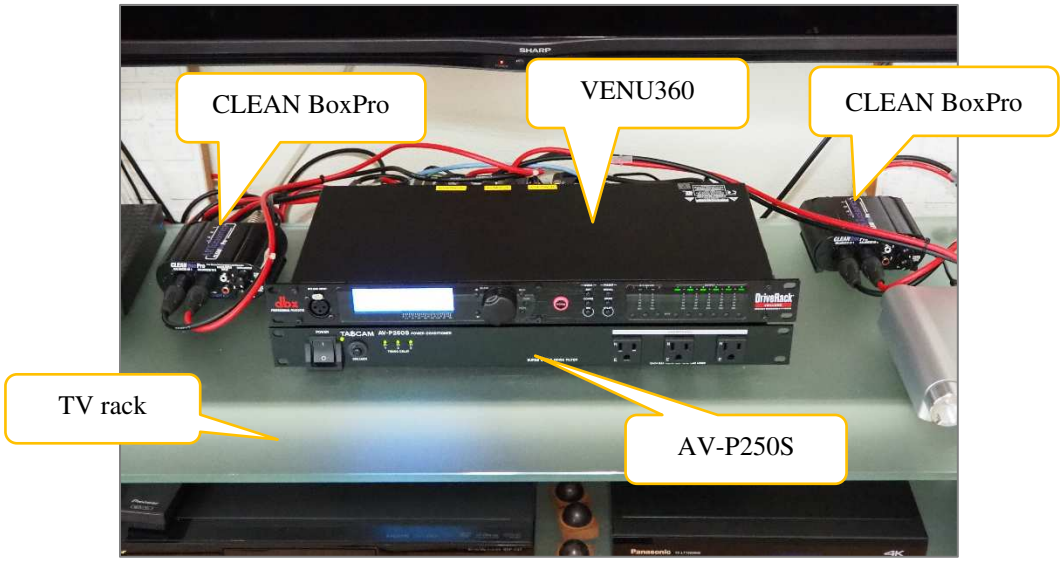
Sound Quality

I installed VENU360 in Gaudi II system before evaluating the sound quality (SQ), because it's impossible to evaluate SQ of the crossover network alone.
VENU360 replaced CX3400. Now the revision of the Gaudi II is Rev.2.12.

Installation and System-level Tuning

MID and HIGH are converted to unbalanced output by using two units of CLEAN BoxPro.
As for LOW, I compromised. LOW is directly connected to the woofer amp through an XLR-RCA cable.

I evaluated SQ after system-level tuning of Gaudi II.
For the system-level tuning, see the webpage on Gaudi II Rev.2.12.



VENU360 installed in Gaudi II

Evaluation of SQ

I do a trial listening on each step of the tuning. In addition to that, I carry out a thorough trial listening after the tuning is done. I replay and listen to music every day for more than one month. This is necessary to lessen psychological bias resulted from knowledge and belief.

Test Records

The test records are not only vinyl discs but digital sources (in my website, every recorded media is called 'record').

I've been recently using 2xHD 'Audio Speaker Set-up' for SQ check. In this album, I use the tracks #2-#7, where performances by jazz combos and vocalists are recorded. These tracks are recorded with a one-point stereo microphone, and not edited. They are useful to check not only tone quality but also stereo imaging. The mic arrangement and the positions of the musical instruments are illustrated in the manual. The format is DSD5.6M (DSD128).

My Favorite Records

I have many favorite records, so it's hard to select a few of them. This time, I selected the records in the table below. They are all vinyls.

Artist	Album title	Record number	Note
Eden Atwood	Waves – The Bossa Nova Sessions	Groove Note GRV1012	Bossa Nova, female vocal + sextet
Count Basie Jam Session	Basie Jam	Pablo APJ-022	Jaxx, octet
Vladimir Ashkenazy	Liszt Recital	London KIJC-9206	Classical, piano solo
M. Abravanel / Utah Symphony Orchestra	Leroy Anderson: Fiddle, Faddle	Analog Productions APC-030	Semi-classical, orchestra

Result

The SQ can be said to be the best in the history of Gaudi.
I also asked my friends to evaluate Gaudi R.2.12. They said the same thing.

I've had a long-time dissatisfaction that the piano didn't sound like the piano, but now Gaudi II can reproduce the sound of the piano very well. The lingering sound is beautiful.
Harmony of an orchestra is also well reproduced.

VENU360 obviously excels CX3400 in SQ, but there's one thing that worries me. As I had anticipated, I don't sense the healing effect which I feel when a vinyl is replayed.

Though CX3400 was not so good in SQ, I felt the healing effect like what I get from hot spring bathing, such as warming my body, refreshing my mood, throwing off constipation, and so on.
However, I don't feel such healing effects with VENU360 in spite of its high SQ.
The question still remains whether an analog crossover network is better than a digital one for me.

Final Settings

Through the tuning, trial listening and evaluation, the settings of VENU360 turned to be as follows:

- Configuration: stereo 3-way
- Sampling rate; 96kHz
- Crossover frequencies: f_{c1}=900Hz, f_{c2}=7kHz
- Filter type: Butterworth 48dB/oct
- Input gain: L-ch: -2.0dB, R-ch: 0.0dB
- Gain of each band: HIGHs: 2.0dB, MIDs: -8.5dB, LOWs: 0.0dB (*1)
- Time delay: HIGH-L: 0.1ms, HIGH-R: 0.44ms, MID-L: 0ms, MID-R: 0.52ms, LOW-L: 0ms, LOW-R: 0ms (*2)
- PEQ: MID-L: -2.2dB @1kHz, +3.0dB @6.6kHz, MID-R: -2.2dB @1kHz, +3.0dB @6.6kHz
- Limiter: off
- Phase: 0 deg
- Infrasonic filter: 18Hz (BW12)

*1: The input attenuators of the power amps are also used to adjust gain.

*2: This adjustment is not so precise because of the ringing of the squawkers.

Usability

The handling is inevitably complex since VENU360 has many features. But it is easy to use thanks to its well-designed user interface. It is acceptable that the user needs the manual when he/she uses a feature that is rarely used.

Manual

The manual of VENU360, which consists of as many as 124 pages, is understandable with tips and trouble shootings. It could be used as a textbook on PA systems.

VENU360 Control App

If you install VENU350 Control App in your PC or smartphone, you can operate VENU360 by using it.

VENU360 doesn't have Wi-Fi interface but the wired LAN.
I connected VENU360 to the PC I use as a media player (OlioSpec canarino Fils9) with a crossover Ethernet cable, since the LAN port of Fils9 was available.

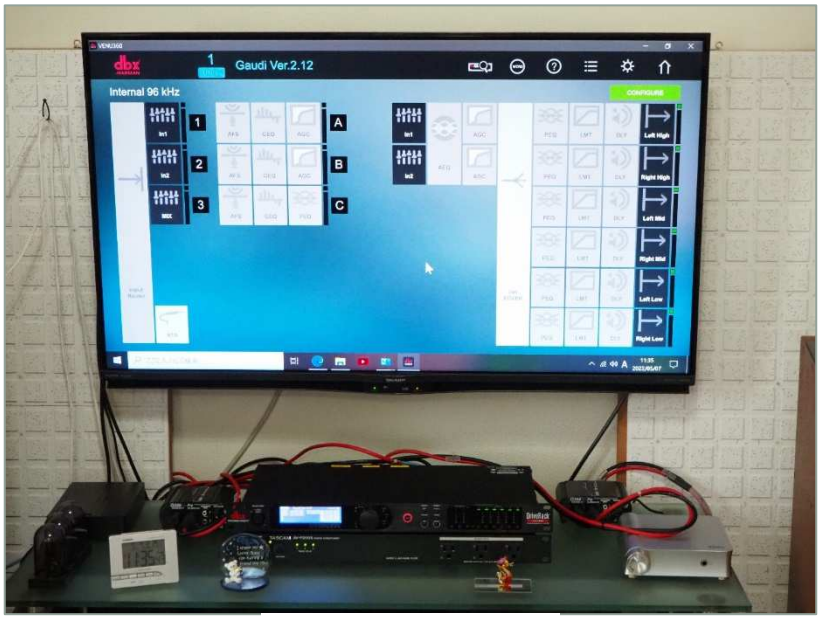
The manual describes how to connect VENU360 to LAN in detail, including troubleshooting. It's so helpful.
But I was a bit puzzled to connect it. Here are some tips to connect devices without a LAN router.

- Use a crossover Ethernet cable
- Set VENU360 so that it doesn't use DHCP
- Be sure the LAN port of PC is active

You have to change DHCP setting of VENU360 because the default is DHCP on.
Turn off [DHCP] under [Utility]-[Network] menu.

It seems that the LAN port is inactive by default when the PC is connected to Internet via Wi-Fi.
Check the settings of Window, and turn on the LAN port if it is inactive.

I use a wireless keyboard/mouse combo with Fils9, so I can control VENU360 from the listening position. It is so handy.



Home Screen of the app

Crossover Module Screen

Preset Feature

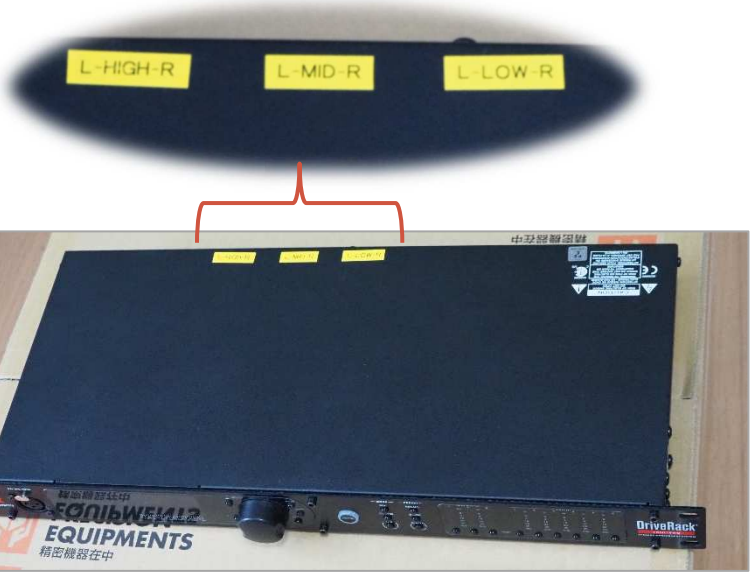
VENU360 has ‘preset memory’, which is a nonvolatile memory. The user can store the settings in the preset memory and give a name to it. The memory can store up to 75 presets.
This feature is so helpful when the user tries out another setting. He/she can go back to the previous setting easily and quickly at any time.

Only Snag

I said the user interface of VENE360 is so good, but there is one snag.
The layout of the output connectors and, in association with it, that of ‘Output Meter’ and ‘Output Mute Button’ are opposite to the order in common sense.

In the front view, the output connectors, meters and buttons are laid out in the order of HIGH, MID and LOW from left to right. It’s beyond my comprehension. LOW → MID → HIGH is the standard.
On the other hand, the order of the left and right channels is left to right as common-sense.

In case that you take LOW for HIGH when you connect VENU360 to the tweeter amp, the tweeter could be blown as soon as you replay a record.
I printed ‘L-HIGH-R’, ‘L-MID-R’ and ‘L-LOW-R’ on yellow adhesive tape, and affixed them on the top panel of VENU360 near the rear panel. They are helpful not only when you connect the cables but press ‘Output Mute’ buttons.



Appearance

The appearance of VENU360 is better than I expected. The neatly designed, hairline-finished front panel looks good. VENU360 is suitable even for home use.

However, the LEDs of Output Meter are too bright and unpleasant to the eye. The brightness is not adjustable unlike the LCD display, which can be dimmed by the setting.
I am going to put a half-transparent acrylic board in front of VENU360 as I planned in the system design.

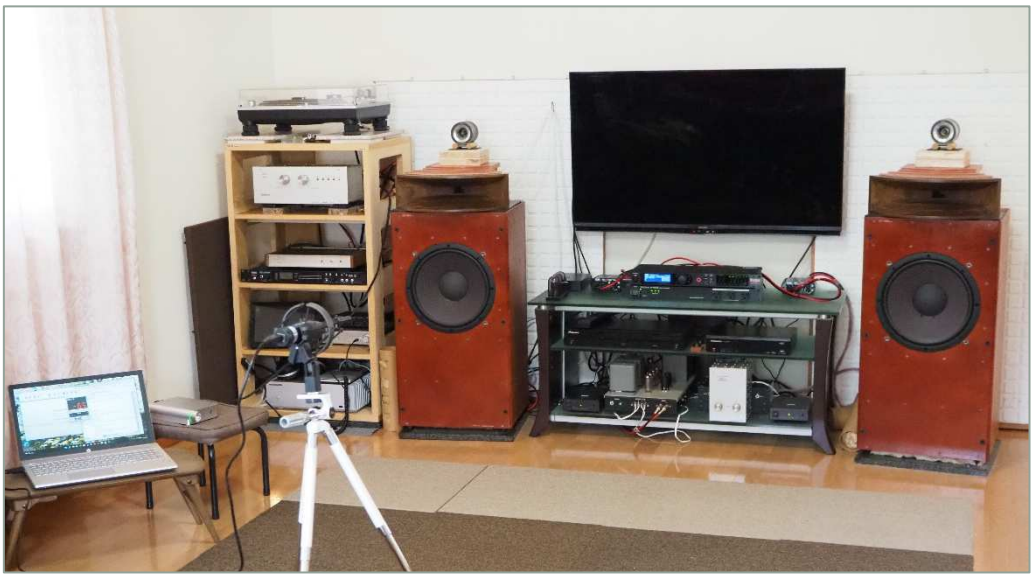
Wrap-up

SQ of Gaudi II becomes the best ever.
But, there still are some problems.

VENU360 has a shortcoming that it emits high-level RF noise through the output.
Are radio frequencies not harmful because they are so high above the audible band? The answer is “No.” For instance, Flying Mole DAD-M100pro converts the input RF noise into the audible noise.
This time, I reduced the noise to the maximum allowable level by turning down the input attenuator of DAD-M100pro. But, it’s not a fundamental solution.

Another problem is that the healing effect of vinyl disc has been lost.
This is so deep theme, and seems very difficult to figure out. I’ll try to solve this problem in the next project.

It is not the problem of VENU360, but I was troubled with the ringing of the squawker as in Gaudi Rev.2.11. I’ll thoroughly investigate this problem and solve it in the next project.



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NOBODY Audio
Tonochi’s Audio Room - Supplemental Info