

Folded Horn Acoustic Guitar Patent # 10,177,172



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How can I give the acoustic guitar 4X the power, and keep the beautiful tone?

Machine folded horns (waveguides) into a guitar body, add speakers and electronics.

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Chamber divider (not shown) is placed on top of folded horns. 1/2" thick Baltic Birch prevents feedback.



Soundboard (not shown) is placed on top of guitar sides.

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Class D amplifier and battery pack placed here

Option #2, use external circuit boards, battery pack, and potentiometers. Amp housing and speakers not needed, as they are in the guitar.

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Partially and fully assembled guitar shown, wood not finished yet.

Screws are required to disassemble guitar as needed, takes about 30 minutes.

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Chamber divider

Front of
soundboard

Back of
soundboard
CNC machined
from one
piece of Baltic
Birch (except
bridge support
is glued).

Moves like a
speaker, light
but very
strong. Sitka
Spruce also an
option.

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Decorative features are actually designed to give soundboard more flex/volume and still maintain strength.

(48) #4-40 screws with washers, each needs to offset 4 lbs. of force from the strings (192 lbs. total). Screw and washer assembly is able to handle 4X this amount of force.
Guitar body wall section is 1/4" thick Rock Maple, enough room for screws. No glue required.

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(12) **United States Patent**
Katzenberger

(10) **Patent No.:** US 10,777,172 B1
(45) **Date of Patent:** Sep. 15, 2020

(54) **FOLDED HORN ACOUSTIC GUITAR**

(71) Applicant: **Joseph J. Katzenberger**,
Crawfordsville, IN (US)

(72) Inventor: **Joseph J. Katzenberger**,
Crawfordsville, IN (US)

(73) Assignee: **Joseph J. Katzenberger**,
Crawfordsville, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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G10D 1/08 (2006.01)

(52) **U.S. Cl.**
CPC **G10D 3/02** (2013.01); **G10D 1/08** (2013.01)

(58) **Field of Classification Search**
CPC G10D 3/02; G10D 1/08
See application file for complete search history.

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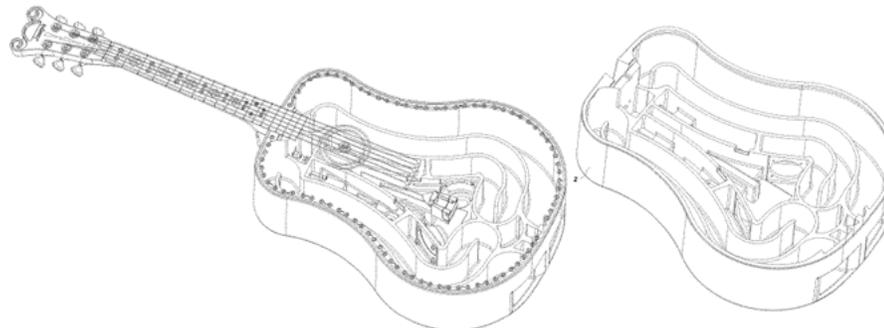
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Primary Examiner — Kimberly R Lockett

(57) **ABSTRACT**

This invention is an acoustic guitar with two internal folded horns built into the guitar body. Each left and right horn is five feet long. The natural acoustic sound inside the guitar is captured by a microphone (not a pickup under the strings), inside the guitar's upper chamber. It is then sent to an internal preamp, which sends the signal to left and right speakers, which are mounted to the compression chamber at the start of each folded horn. It then travels through the throat of each folded horn, which increases exponentially until it reaches the end of the horn. The sound waves are concentrated throughout this shape (does not lose sound energy), and are also directed to left and right exits out the end of the instrument. The material for the body is Rock Maple, and the other materials are Sitka Spruce, Rosewood and Mahogany.

6 Claims, 5 Drawing Sheets



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Body wood is 100% Hard
(Rock) Maple, same as a violin.

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CNC machine start.

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CNC machine about halfway through.

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CNC machine almost complete. I can cut the entire body and horns in about two full days, runs at night.

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Solid stock on the CNC machine.

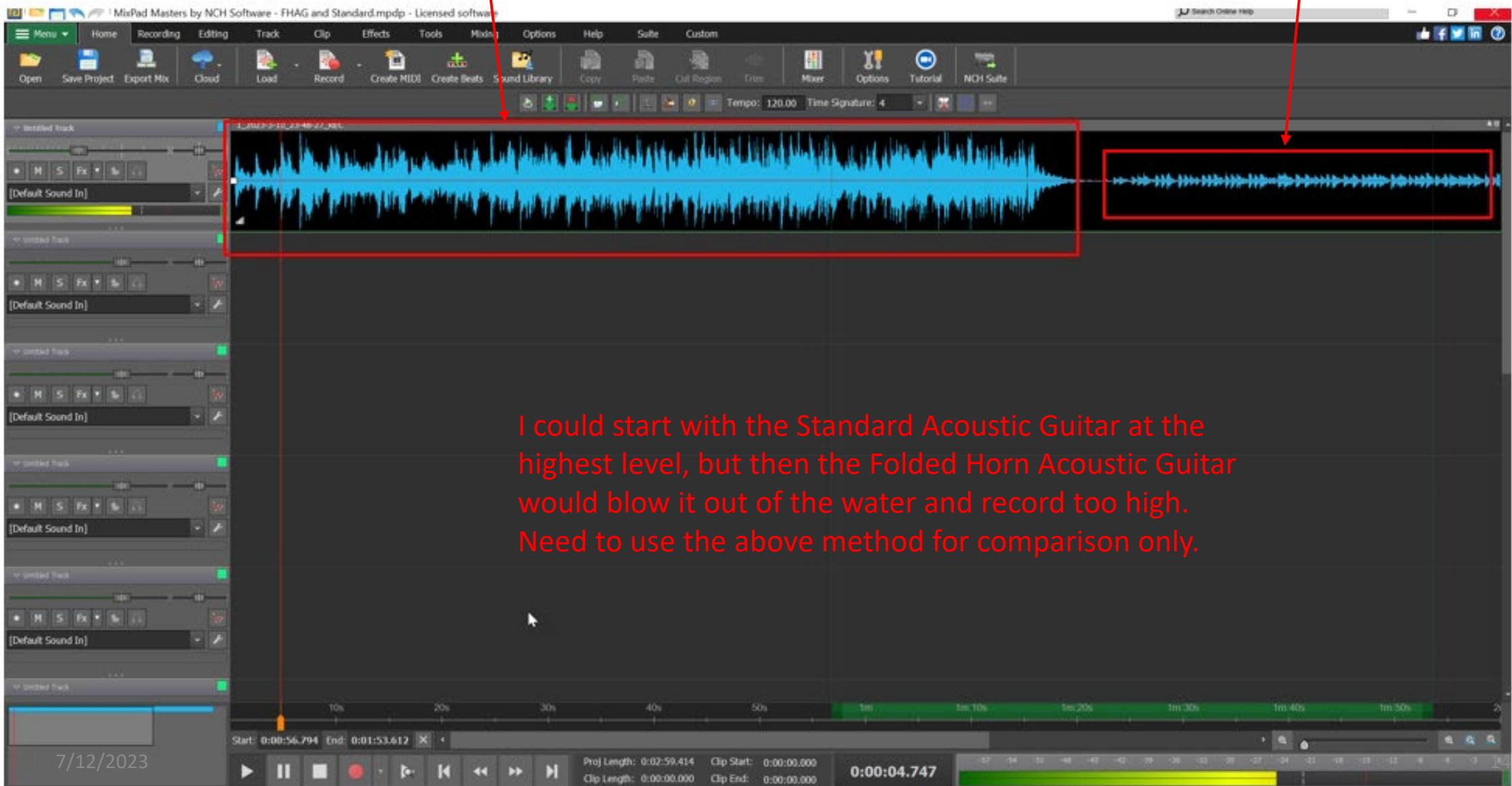


Not final shape, but close!

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Folded Horn Acoustic Guitar at highest recording level without clipping.

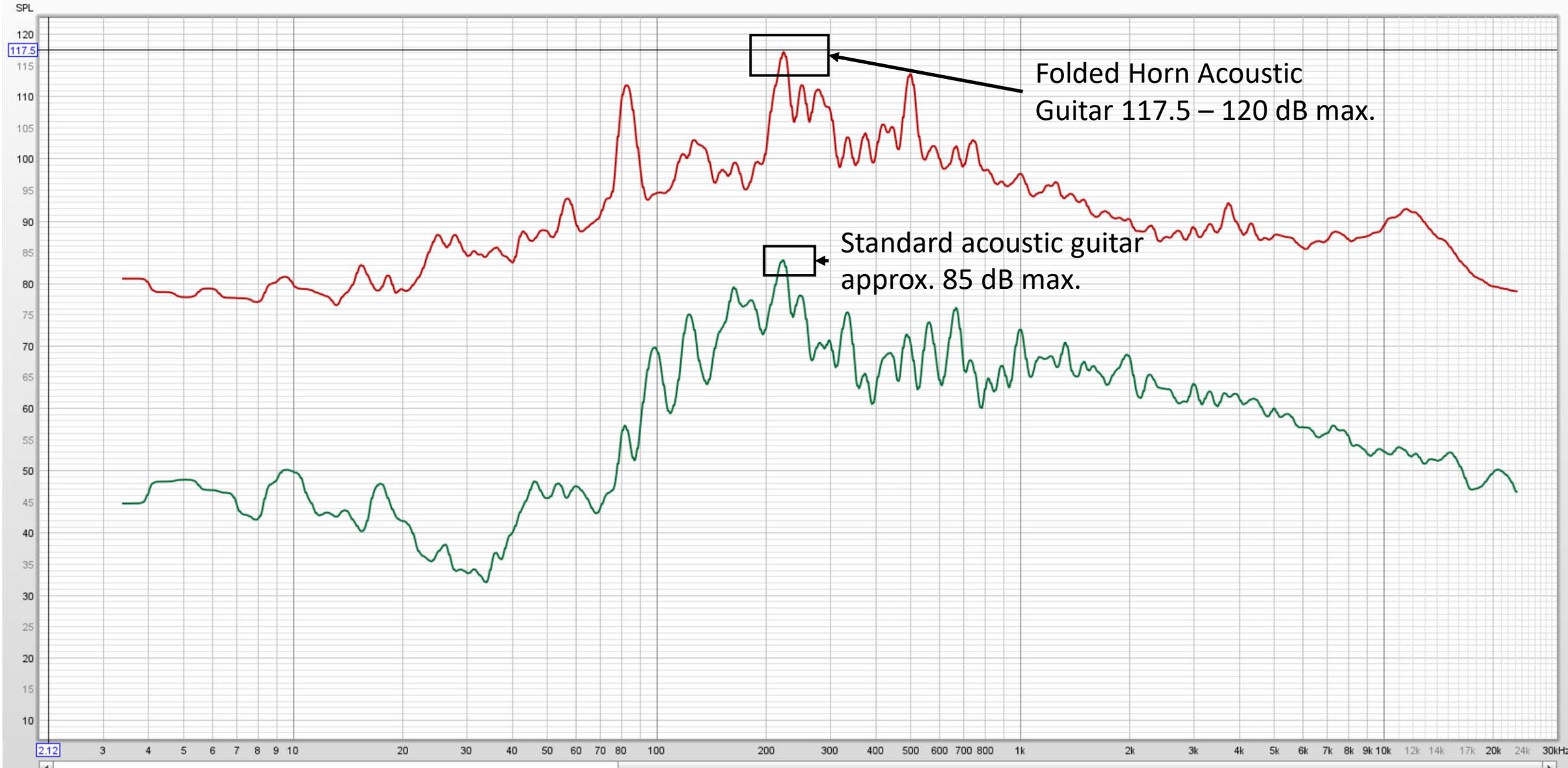
Standard Acoustic Guitar at same recording level.



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Overlays

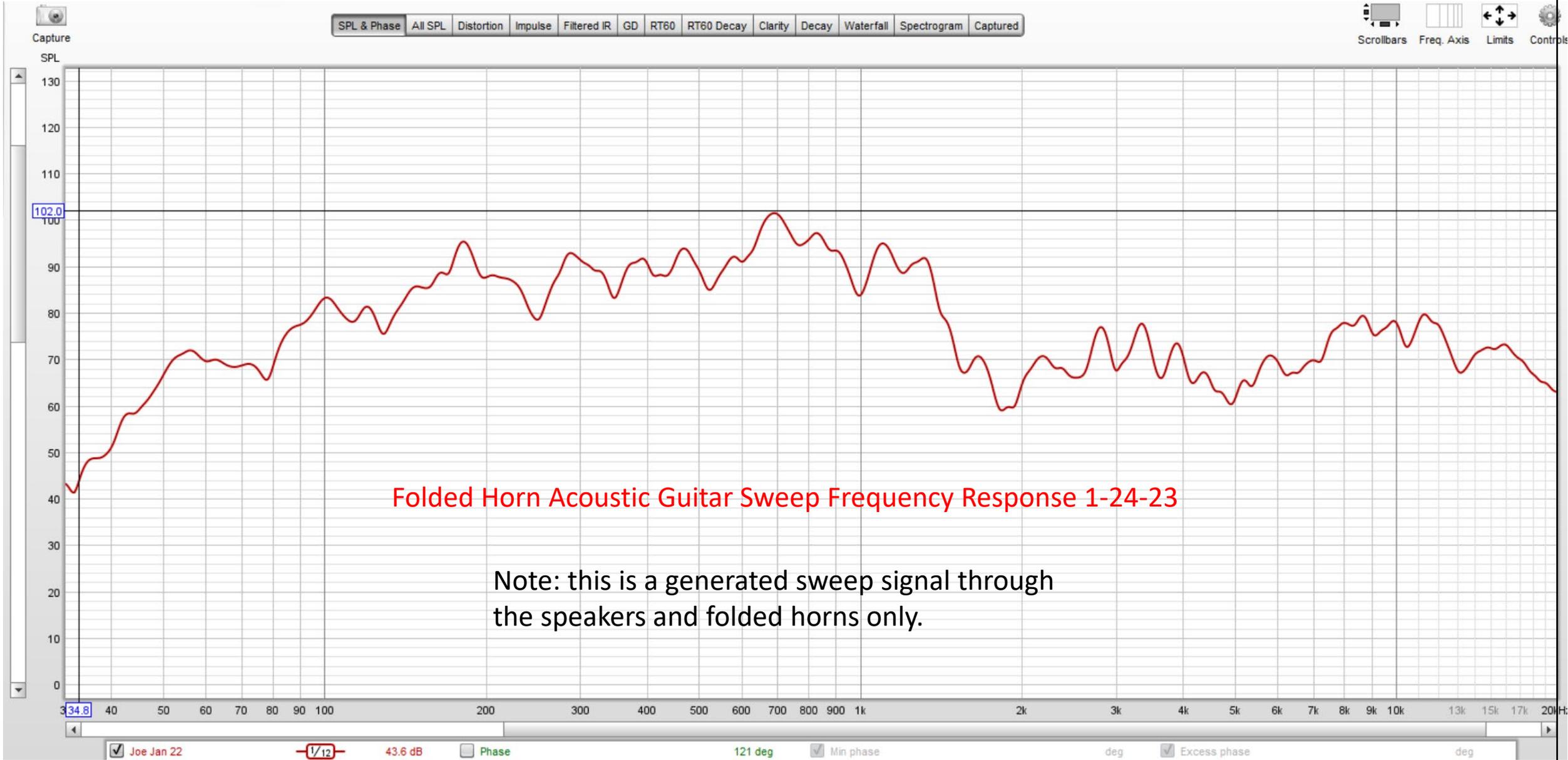
All SPL Predicted SPL Phase Predicted Phase Distortion Impulse ETC Step GD RT60 Clarity



Folded Horn Acoustic Guitar 117.5 – 120 dB max.

Standard acoustic guitar approx. 85 dB max.

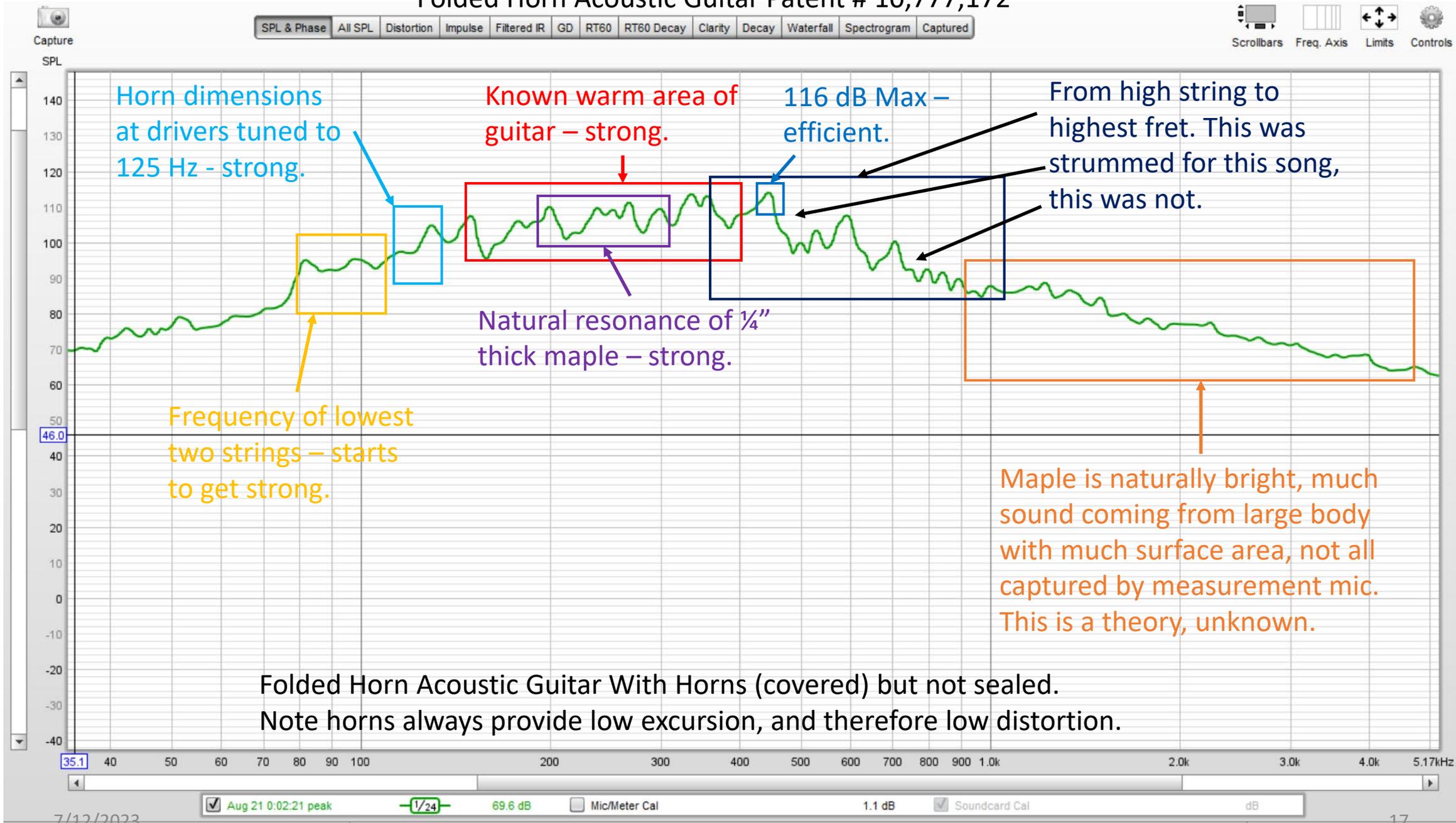
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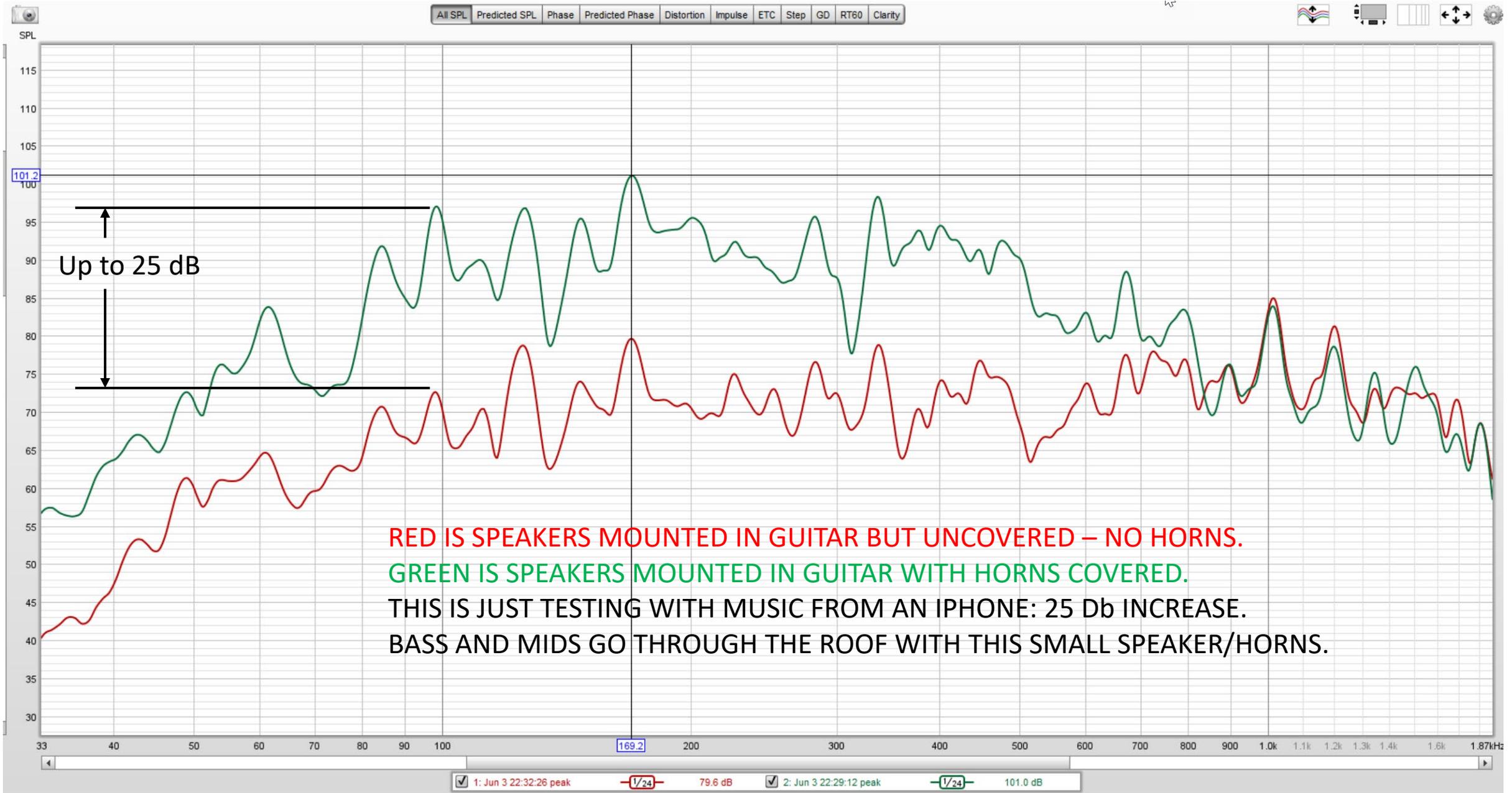
Folded Horn Acoustic Guitar Sweep Frequency Response 1-24-23

Note: this is a generated sweep signal through the speakers and folded horns only.

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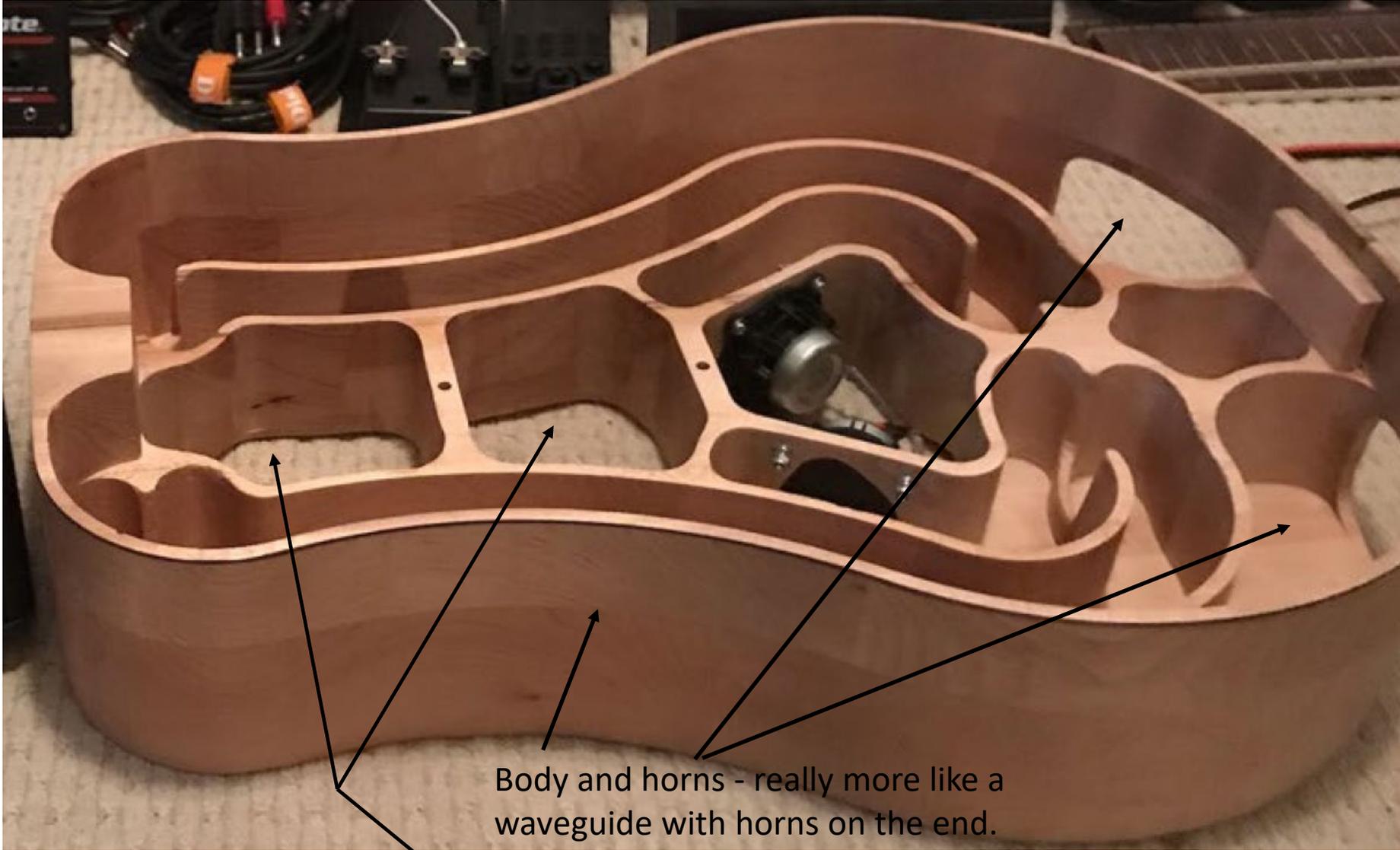


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RED IS SPEAKERS MOUNTED IN GUITAR BUT UNCOVERED – NO HORNS.
GREEN IS SPEAKERS MOUNTED IN GUITAR WITH HORNS COVERED.
THIS IS JUST TESTING WITH MUSIC FROM AN IPHONE: 25 Db INCREASE.
BASS AND MIDS GO THROUGH THE ROOF WITH THIS SMALL SPEAKER/HORNS.

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Body and horns - really more like a waveguide with horns on the end. Speakers shown, amp and battery pack go here (charge at night like your iPhone).

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7/12/2023

Made three guitars to start.

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7/12/2023

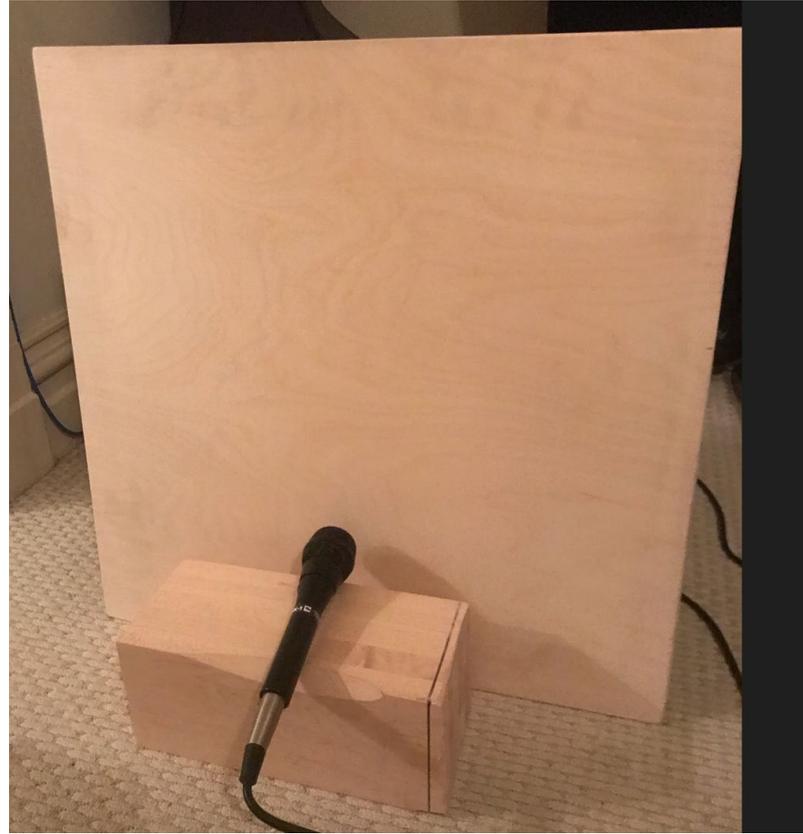
Dovetail neck fit is great! CNC machining is accurate to 1/5 the thickness of a human hair (.001"). Straight as an arrow.

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Leave this on full volume Master and Gain, for more than a second and your ears will split of course.

7/12/2023



Try this at full volume Master and Gain, with 1/4" Baltic Birch, and IF you find the right spot, it will feedback like a mother.



Try this at full volume Master and Gain, with 1/2" Baltic Birch, and it WILL NOT feedback at any position!

1/2" Baltic Birch is being used for the chamber divider to prevent feedback.

(12) **United States Patent**
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(10) **Patent No.:** **US 10,777,172 B1**
(45) **Date of Patent:** **Sep. 15, 2020**

- 1) The guitar body and soundboard on this guitar are three inches longer, so the soundboard is louder. The soundboard is made from light yet strong material (Baltic Birch), so it moves more, which also makes it louder. The natural sound of the acoustic guitar provides much of the great tone of this guitar, in addition to speakers and folded horns.
- 2) Two folded horns are built into the guitar body for true stereo sound. Four speakers is also possible.
- 3) Each folded horn is five feet long, which captures the lowest frequency of the guitar (80 Hz). This can not be done with small speakers only, that need to fit inside guitar, without these horns.
- 4) An 80 Hz wavelength is actually (14) feet long. The speed of sound is 1,125 feet per second, divided by this frequency of 80 Hz gives us a 1/4 wavelength of (3.50) feet. Horns that are (5) feet long easily capture this wavelength, with room for side ports, and still will not break this critical 1/4 wavelength rule. The 1/4 wavelength rule is a truth in physics and acoustic engineering. If you do not capture this, the sound will be greatly diminished. Do not take my word for it, Google it!

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- 5) The folded horns (also known as waveguides, if not tapered) provide sound directivity, and does not lose sound energy. It is not possible to amplify a sound wave once it is in air, but it is possible to prevent sound loss, by directing sound to a desired source.
- 6) Battery powered. Uses Lithium Ion batteries, similar to what Tesla and all other Electric Vehicles use.
- 7) The guitar body is cut from a 6" thick maple block, and the walls are ¼" thick, which resonates more like a piano than a standard acoustic guitar that has very thin walls (needed for traditional bending of the sides).
- 8) The vibrations are so powerful, you can feel them in your body as you play, similar to a violinist that can feel the vibration of the instrument through their neck.
- 9) A piano is powerful due to a large soundboard, thick wood and substantial size. This guitar has a larger soundboard, thicker wood, and a more substantial size than a standard dreadnought guitar.

10) A violin, which is approx. 1/3 the size of a guitar, produces greater volume because it is bowed, not plucked or strummed like a guitar. Also the soundboard has only one brace and a bass bar, which allows it to vibrate more.

11) The soundboard and chamber divider are made of Baltic Birch. This ¼" thick wood is laminated with (5) pieces of Birch, each one having the grain 90 degrees from the piece below it, for exceptional strength. This is NOT plywood, it is solid Birch on every laminate. The soundboard is machined down to a much thinner size, while leaving braces in solid. This requires only two CNC machining processes (top and back sides). This provides great soundboard movement, which increases natural acoustic volume, before the sound is captured and fed into the folded horns.

Many harps have Baltic Birch sound boards due to strength required on such a large soundboard, with tremendous amounts of string pressure.

12) The nut is pocketed and floats for ease of removal. The saddle and nut can be easily removed, and both replaced with different heights of nut and saddle. This allows action adjustment at the nut, and also the saddle/bridge. Action height combinations are available in many combinations not seen previously with standard acoustic guitars.

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Testimonials #1:

What a remarkable, beautiful bit of work you've put into this! And CNC skills *to the moon!* Wow. Can you see how green I am?

Unbelievable work.

I HATE !!!! the fact I did not think of this, I play guitar and would love to hear this, it's a great idea. So very fricken cool !!!!

Done right, I would think this to be a revolutionary instrument.

Jaw-dropping just to see part of it.

Beyond impressive!

Beautiful, a work of Art.

This is frigging wild, awesome, crazy cool!

Intriguing acoustic design.

Wild idea, flying close to the sun.

I'd like to see the guitar. Do It. Play it.

Very, very interesting.

Cant wait to hear this thing, and please have someone with a slide rip a riff, love the concept!

I love the creativity of your project.

If its a success tonally then I'd expect a good audience for such an instrument.

The patent is notably well written. Much of it is a re-cap of the guitar's weaknesses and a teaching of new fabrication technology for complex but natural shapes.

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Testimonials #2:

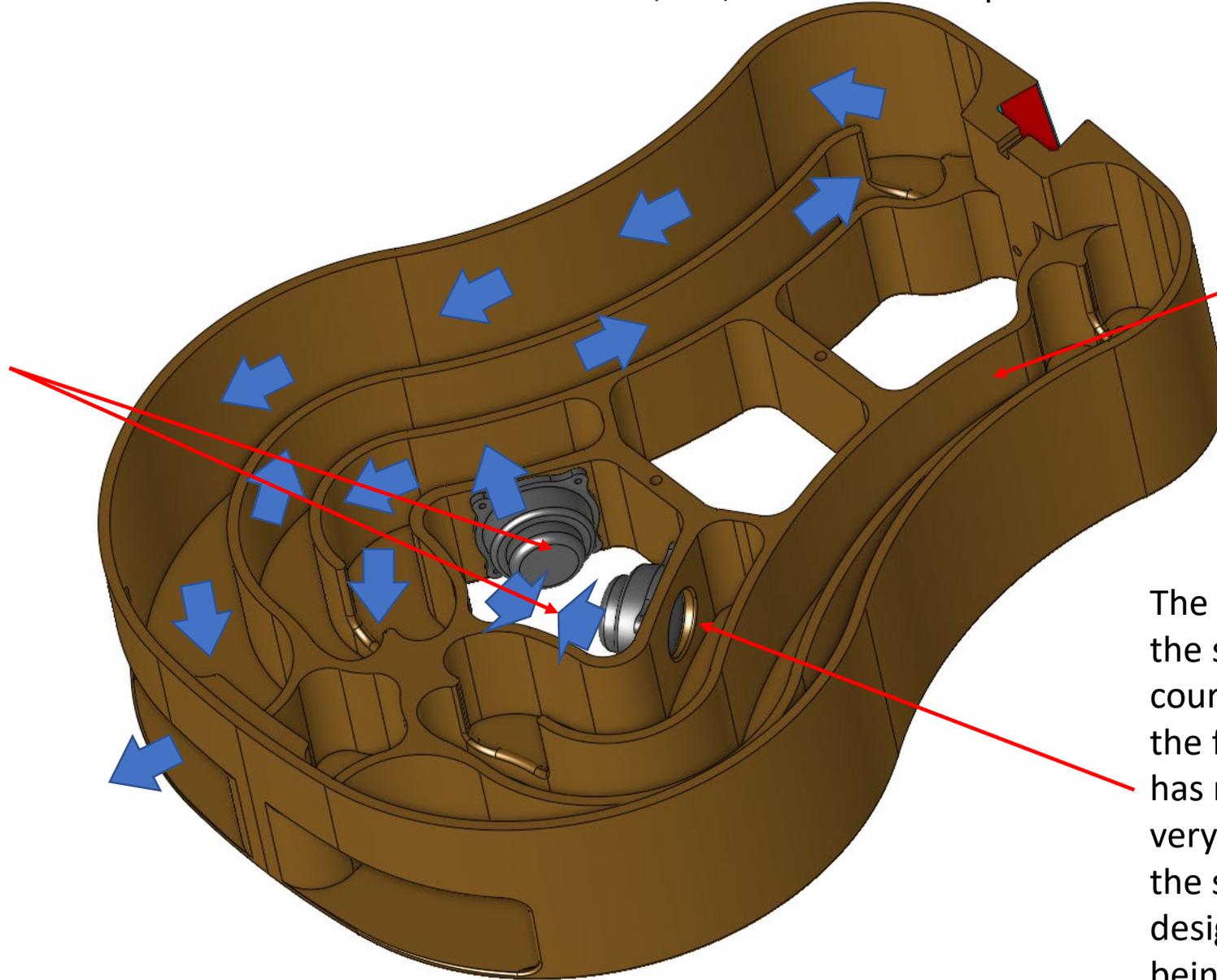
If it is truly better and takes over the world, that is a blessing for all. But if sales are tiny until 2039, Joseph gets little to no compensation for his effort. The telephone, the electric car, the vacuum tube, burbled in small sales for most of their patent periods.

Very cool and great job sticking with your idea!

If you were near me, I'd be round to yours like a shot, with my measurement mic.

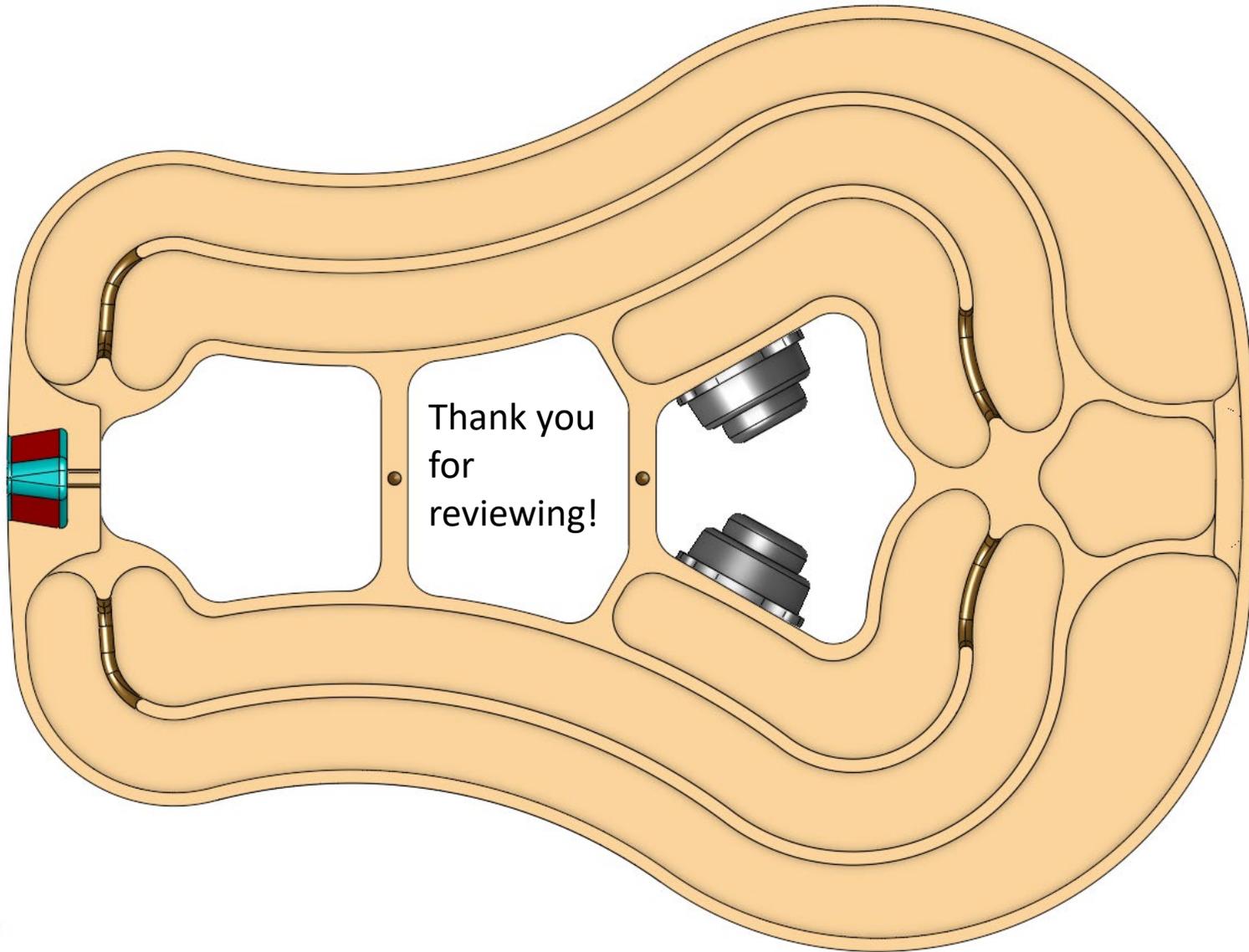
Your DIY thread is beautifully focused on your guitar/horns.

The sound coming from the back of the speakers is constructive interference with each other (no loss of sound) due to design.



Please note the waveguides are shown uncovered for clarity, they are fully covered at final assembly.

The sound from the back of the speaker (which of course is out of phase from the front of the speaker) has no interference (or very little) with the front of the speaker due to guitar design and waveguides being covered.



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