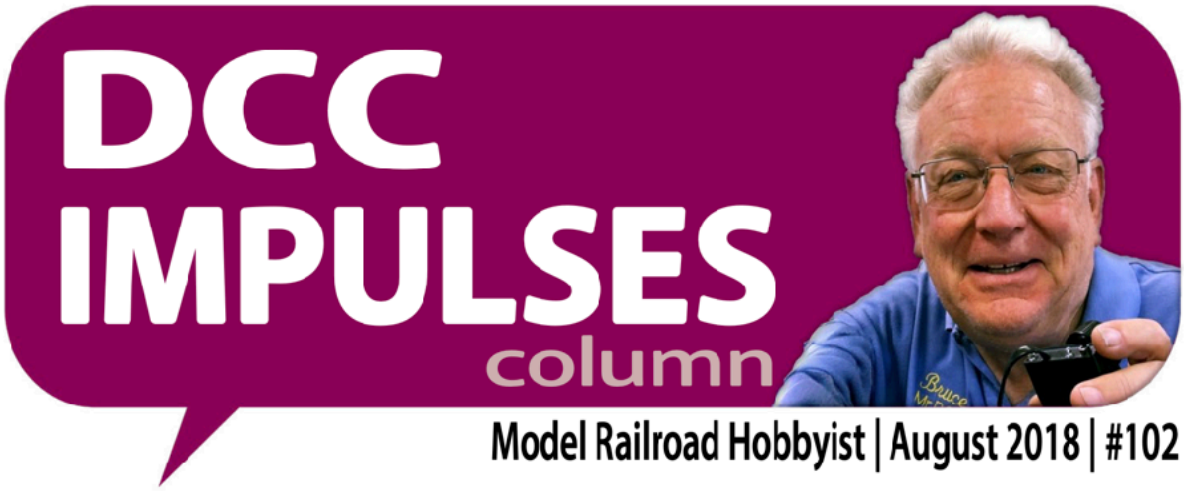

Bruce Petrarca, MMR

discusses speaker technology for decoder installations ...

As was mentioned in my June column, this will be my last hurrah as the regular DCC columnist for MRH.

It has been a fun run – almost seven years. This is my 74th column.

Thanks to you, the readers. Without you and your encouragement and support, this column wouldn't have lasted and prospered.

Thanks to the MRH staff, including two Joes:

Joe Fugate, the publisher who probably didn't know what he had agreed to when he accepted me as the DCC columnist for his baby.

Joe Brugger who has been more than just my copy editor. He has been a sounding board, coach, and cheerleader.

Both Joes have suggested topics and directions for the column over the years.

This has not been my column, but, rather, "our column."

Whose? The Joes, Patty (who does the paste-up), the readers, the advertisers who pay the bills and me.

Long-time readers know the passion I have for good sound. One of my early goals was to share my "How Do I Get the Sound Out?" concept. I got folks to think outside the box in my August, 2012 column. You might want to circle back on that column before you move on with this one. It will help establish us all on a common footing. The companion video is a good thing to review (youtu.be/j4kgLeDltxg), as well.

Wow! Has it been six years since I wrote that? I did the original clinic more than a decade ago.

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True to that pedigree, my final words will deal with getting good sound out of your models, or at least as good as possible for various situations. Both designs that I'm going to discuss here are "inside the box," speakers with sealed enclosures. While I still prefer an unboxed speaker installation because it presents the most open sound to my ears, there are times where a baffled speaker just isn't possible. You just gotta go with a box.

"There are times where a baffled speaker just isn't possible"

Many folks are trying to install sound in smaller and smaller spaces. Thus, there is lots of work being done on trying to overcome the "nothing beats cubic inches" maxim.

"Good sound from small speakers" is the backbone of the smart phone, tablet, and notebook computer world. It is natural for us to look to those sources for good sounding small speaker systems for our models.

With boxed speakers, there is still an onus on the installer to plan for and enhance, wherever possible, the path from the speaker to the listeners' ears. Not doing so can result in muffled or muddy sound.

These small speakers are very sensitive to the physical environment around them. Play music on your smartphone or tablet and cup your hand around the speaker opening. You can "tune" the sound by the way you cup your hand. The locomotive shell and mechanism and other parts surrounding the air path from the speaker to your ears will color the sound. This makes the planning and experimentation phase more important, not less.

Much of perceived sound is subjective. I'm reporting on what I hear and like. Your mileage may vary.

About these little buggers (sugar cube or iPhone speakers). Soldering to them is tricky. Have your soldering skills tuned up on the day you try to work with them or get help from a friend.

Sugar cube speakers

These guys broke onto the scene a few years ago. I've dabbled with them, but never found one that lit my fire. So, lets compare a bunch of sugar cube speakers and see how they relate to each other and how they stack up to traditional speakers.

I created a test board [1] with samples of several speakers I've collected over the years. Not all of them are currently offered. However, they represent a cross-section of the product.

Sugar cubes are designed to be enclosed. I'll be looking at them that way. Perhaps in the future, I'll try some "out of the box" and work with them, but that's not now.

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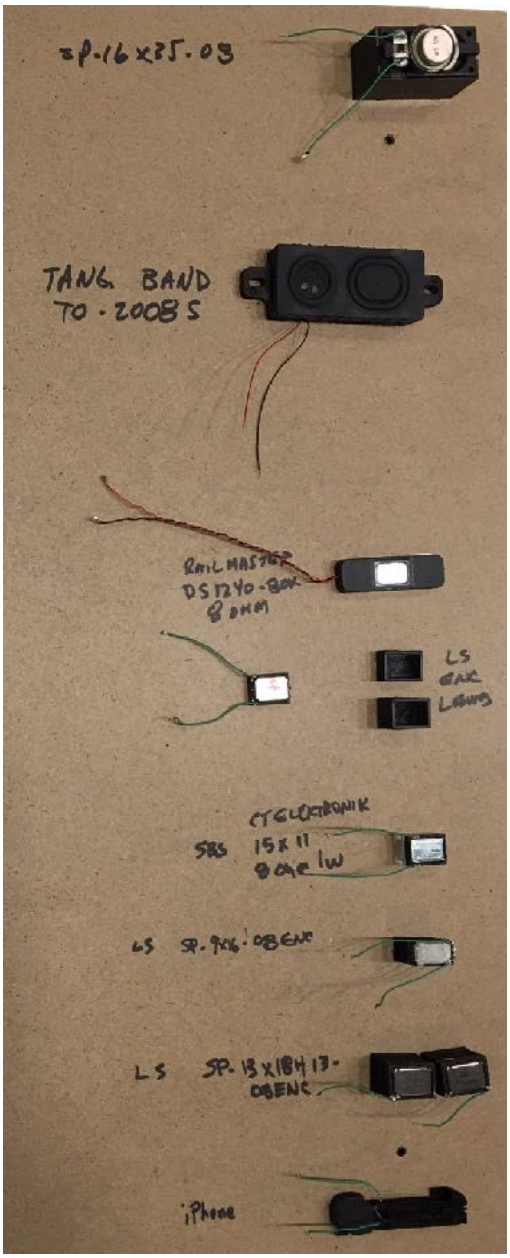
This board has my “go to” small speaker, the 16x35mm unit, set up so that it can be in the box or out of the box, for comparison purposes. I drove all these speakers with a first-generation Tsunami decoder with EMD 567 motor sounds. I listened to the horn, bell, and motor (at idle and at notch 8).

1. THIS TEST BOARD WAS CREATED TO COMPARE SPEAKERS SIDE BY SIDE.



While most of the evaluation was subjective, I did do some sound pressure level (SPL) measurements. I’m not going to bore you with these numbers, but I used them to rank how loud various speakers are.

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Given the size of these little guys and the technology of 3D printing, many folks buy the naked speaker and build their own enclosure. This allows maximum design creativity and adaptable enclosure dimensions. My fiddling shows that the larger the enclosure, the better (more open and louder) the sound is. I'm sure there is some optimum size, but that will probably vary from one model of speaker to the next.

Based on my measurements, sugar cube speakers are quieter than my reference 16x35mm speaker (-10dB). However, the increased power of modern decoders can compensate for the loss of efficiency. The trick is getting the speakers to accept the amount of power the beefier decoders can deliver.

To handle the new higher-power decoders, some dealers are working on 4-ohm speakers. Two of these in series will yield the 8-ohm impedance most decoders seek. Being wired this way will double the power-handling capability of these little guys, as well as enhancing the audio performance.

For more information on multiple speakers, see my January, 2014 column.

Does it seem complicated? Yes, I think it can be, and I'm an electrical engineer. Let's not worry about that and just listen to some speakers.

---

13 x 18mm 4-ohm speaker

Jack, who bought Litchfield Station from me, has been working to directly import speakers and mate them with 3D printed enclosures. One of his latest versions is known as SP-13x18H12-04ENC. Being 4-ohm, 1-watt speakers, a single unit will work marginally with current generation decoders.

Putting two of these speakers in series will provide an 8-ohm load and 2-watt power handling capability, better matched to the current crop of decoders.

He provided to me, for evaluation, one of the speakers and two enclosures of different heights [2] to create sugar-cube-sized speakers.

Of the sugar cube speakers that I evaluated, I liked these the best.

They were the most efficient (loudest sound for the same input power) and provided the cleanest sound to my ears. The taller enclosure provided a bit more detail to the sound (especially the bass) and a bit more volume than the shorter one.

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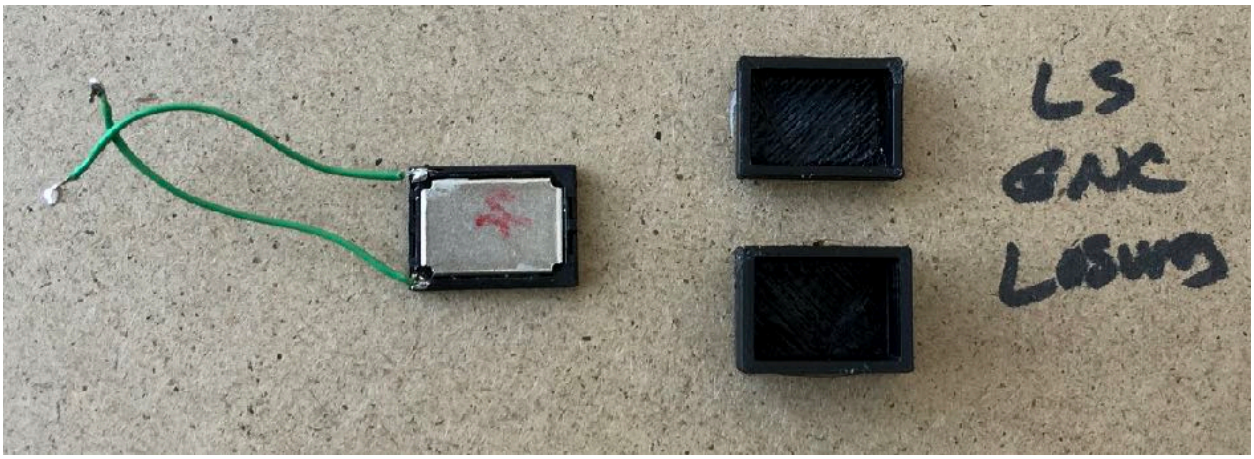
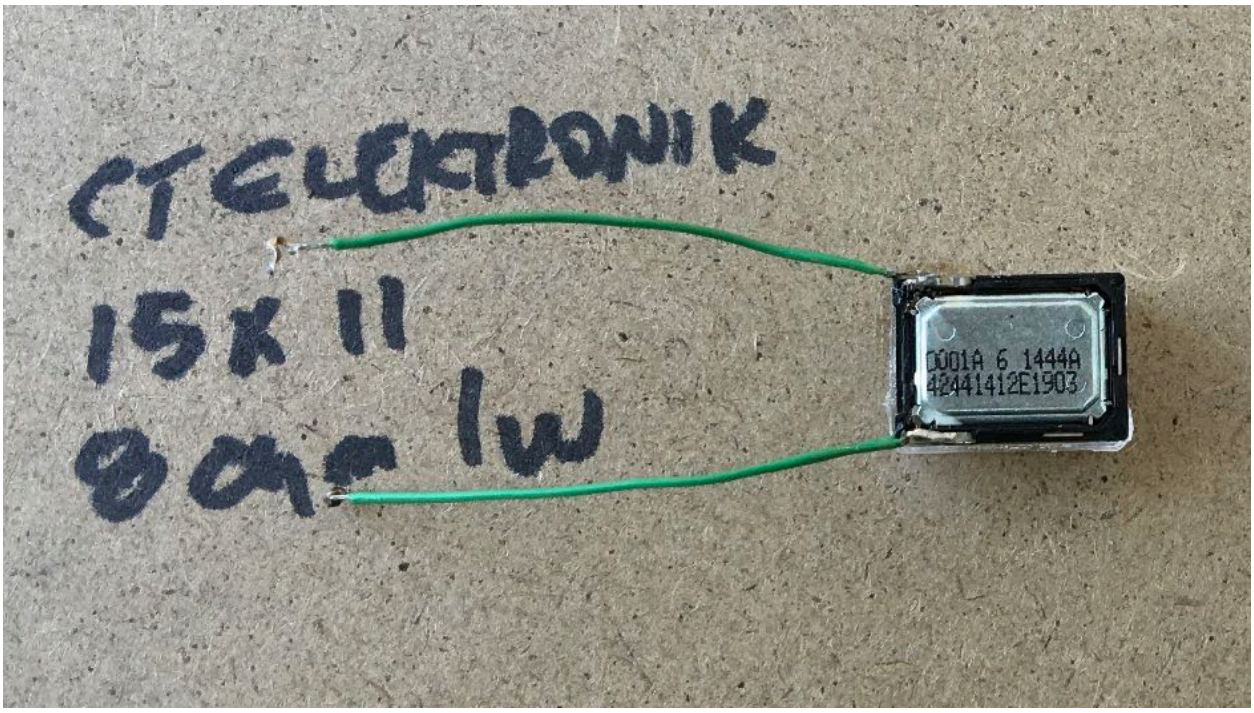
2. LITCHFIELD STATION SP-13X18-04 SPEAKER WITH 12MM AND 6MM HIGH ENCLOSURES.



CT Electronik sugar cube speaker

Bryan at Streamlined Back Shops (sbs4dcc.com) provided a CT Elektronik [3] speaker for me to evaluate a while back. Bryan has since been working on his own line of sugar cube speakers (sbs4dcc.com/sbs4dcc-products/sbs4dcc-sugar-cube-speakers).

3. CT ELEKTRONIK SUGAR CUBE SPEAKER.



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I thought the CT offering was slightly inferior to the 13x18mm Litchfield Station speaker [2]. The clarity of sound was comparable to the best sugar cubes, but the CT was a bit quieter for the same input sound level.

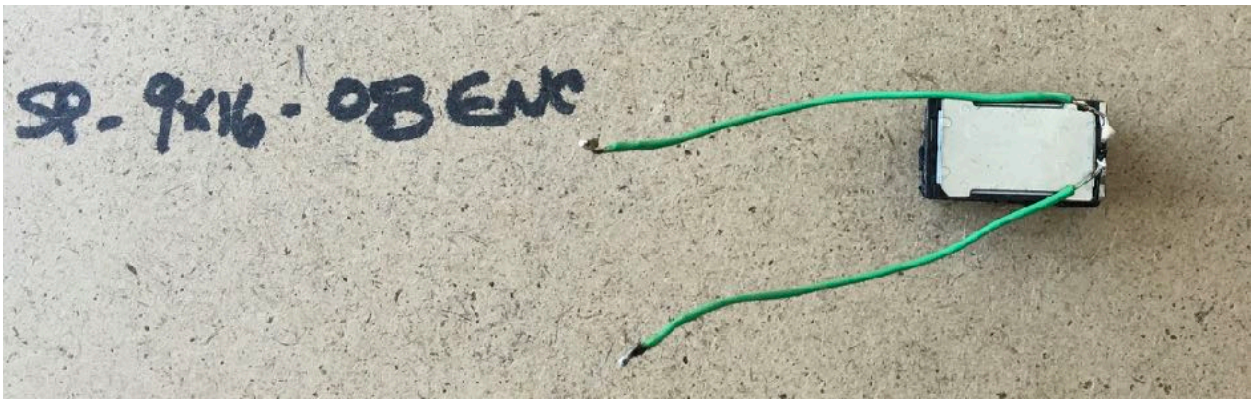
If Bryan is starting with this good speaker, I expect his upcoming privately branded offerings to be stellar. He is offering, by far, the most extensive collection of enclosure options I have seen. There are many configurations for larger air volume enclosures (better bass) and multiple speaker arrangements. The tinkerers in the crowd should be well pleased. Perhaps one of his enclosures will work for your needs and obviate the need for your own 3D printed enclosures.

Interesting how one item (the CT speaker) can lead to the discovery of a whole array of new ideas. Thanks, Bryan.

Litchfield Station SP-09x16-08ENC sugar cube speaker

An older offering (SP-09x16-08ENC) from Litchfield Station came in third in the sugar cube evaluation [4]. While it provided equally clear sound, the smaller size limits its ability to make louder sounds. Again, with that “cubic inch” argument.

4. A SMALLER SUGAR CUBE FROM LITCHFIELD STATION IS THE SP-09X16-08ENC.



Railmaster DS-1240-Box

The only sugar cube style speaker that didn’t impress me was this particular unit from Railmaster [5].

The enclosure is long and thin to fit into a locomotive more easily than others might. The speaker is upside down compared to comparable designs. This exposes the cone side of the speaker, allowing magnetic particles to be picked up and rattle against the cone. Conventional designs have the cone inside the box, protected from contamination.

I felt that the sound was muffled and indistinct in comparison to the units mentioned earlier. Sound volume was a bit weaker, too.

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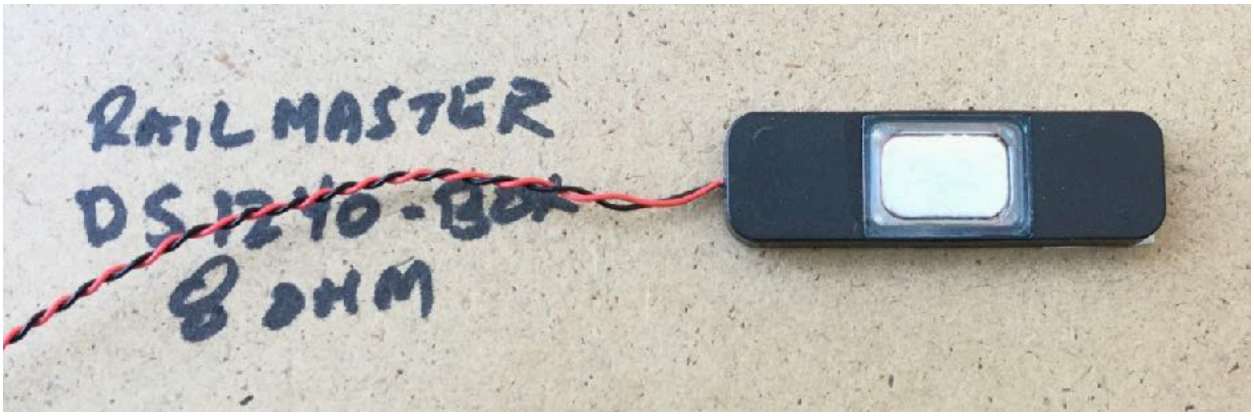
5. RAILMASTER DS-1240-BOX SPEAKER HAS AN INNOVATIVE ENCLOSURE SIZE AND SHAPE.



But, the installer doesn't have to solder to the tiny and delicate terminals. That has been done in the assembly process and is inside the box. Which is why the cone side of the speaker faces out, I'm sure.

To be fair, this particular speaker has been in my "to do" box for quite a while and may not reflect the current state-of-the art of what Jeff offers. I present it here, not to denigrate Railmaster, but to show what can be done with various enclosure designs, as food for thought and experimentation.

Multiple Sugar Cube Speakers

I made a "line array" of two SP-13x18H13-08ENC speakers to verify the advantages of two speakers side by side [6]. These are an older offering from Litchfield Station that I happened to have a pair of.

Singly, or in pairs, they had a muffled sound to me, reminiscent of the Railmaster offering above. But, again, they are older items in this rapidly moving market sector.

The line array was successful. It enhanced the bass response and provided more power handling capability than a single speaker. Since they are 8-ohm speakers, they will create a 16-ohm system when they are wired in series. The 4-ohm speakers discussed earlier would create a more desirable 8-ohm load when configured this way.

They are wired in series, so the impedance doubles to 16 ohms and the power handling capacity doubles as well, to 2 watts.

I didn't have enough speakers or enclosures to try a line array of two or four of the better sounding speakers. There is more experimentation to do here.

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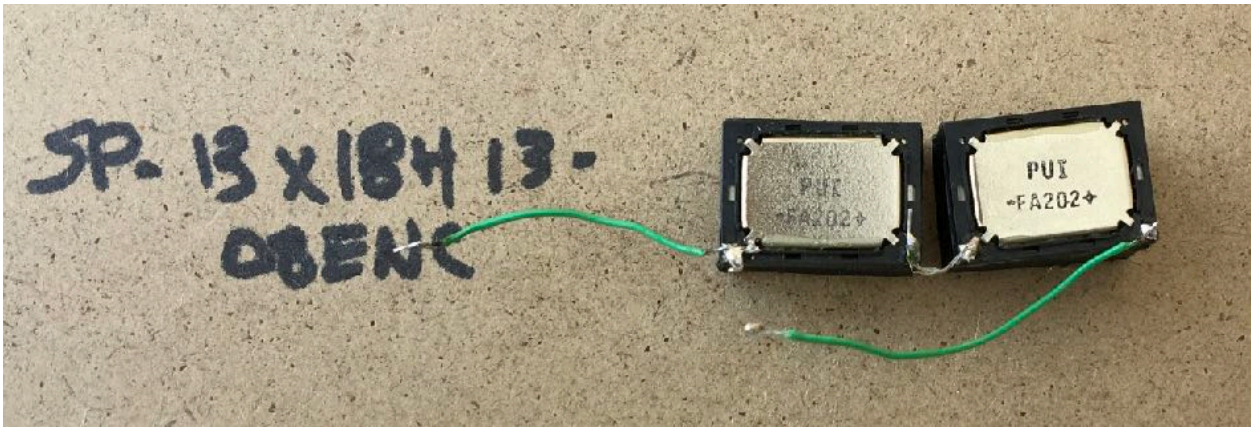
6. TWO SP-13X18H13-08ENC SPEAKERS AS A LINE ARRAY.



Sugar cube speaker summary

In table [7], I've summarized my experience with these samples of sugar cube speakers.

7. SUGAR CUBE SPEAKER SUMMARY, SHOWN IN ORDER OF DECREASING LOUDNESS.

Speaker	Motor	Horn	Bell	Comments
SP-13x18H12-04ENC	clear	clear	clear	A bit more depth to the motor than the small box
SP-13x18H6-04ENC	clear	clear	clear	
CT Electronik	clear	clear	clear	
SP-09x16-08	clear	clear	clear	
SP-13x18H13-08ENC	closed	muffled	muffled	sound very closed
DS-1240-Box	muffled	distant	clear	speaker exposed

iPhone 4s speaker

I heard good things about iPhone 4s speakers. I found that MRH reader Bill Brillinger has them for sale on his Precision DesignCompany web site. Go to: pdc.ca/rr/catalog/products/railpro-and-accessories/13 and select where in the world you are. The catalog will open and there they are. Being in the USA, I was able to get them at four for $6 with free shipping. A buck and a half per speaker. Can't be good for that price, right? What the heck, I bought a four-pack anyway.

When I got them [8], I found them to be an engineered sound assembly with amazingly good results for such a small item. They are about 50% longer than the pair of 13x18mm [6] speakers but about half the thickness. The shape is funky because they are engineered to fit in the bottom of an iPhone 4s and still meet acoustic design parameters. The proof is in the listening. For starters, they were about twice as loud as the sugar cube speakers (+3 dB). What got me was the

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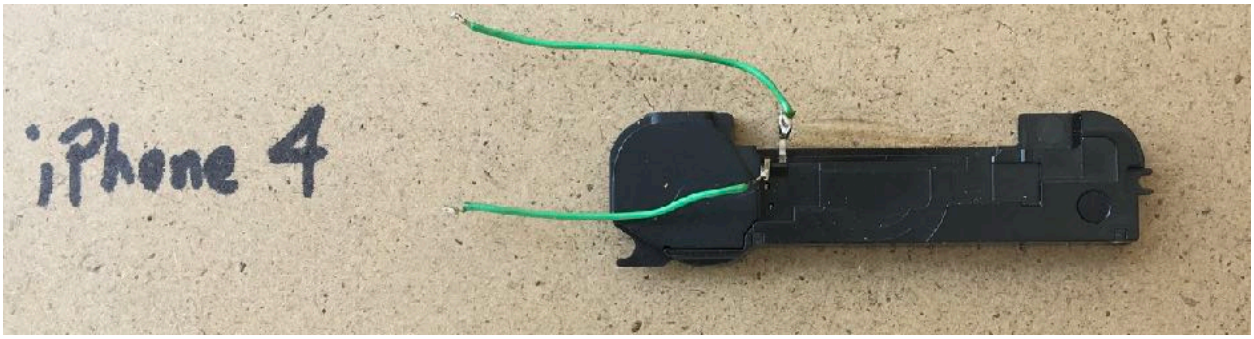
sound was amazingly clean. Wow, not at all what I was expecting. There was no sugar cube that I tested that performed better, or even as well.

8. IPHONE 4 SPEAKER



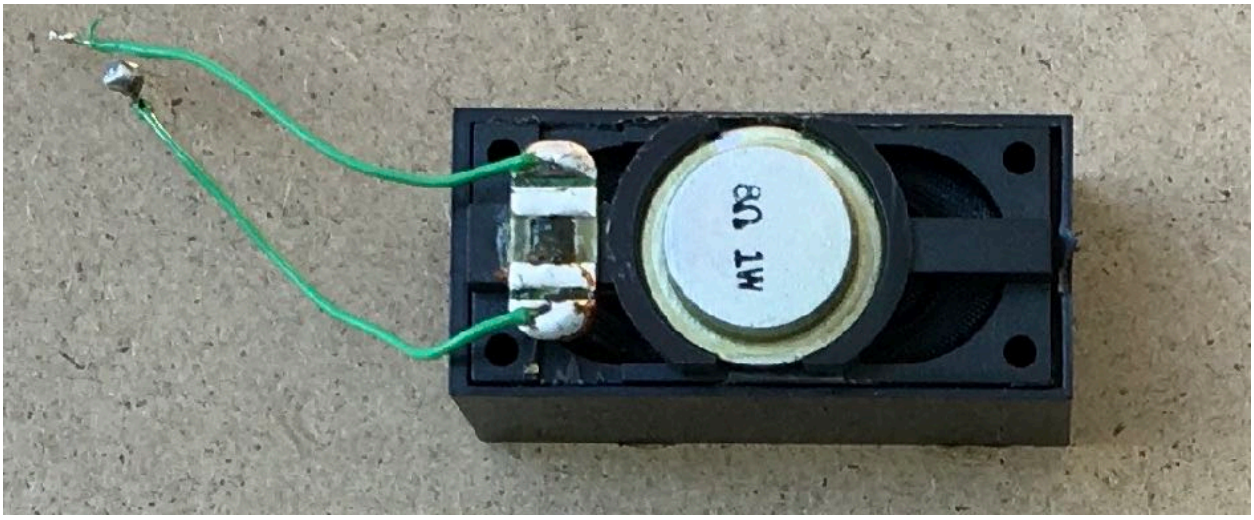
I must admit, I don't have a power handling specification on these speakers and didn't try to operate them on a higher power decoder, like a Tsunami2. However, they provide clean renditions as tested. Just keep the volume level under control.

Conclusions about the small speakers

I had thought that sugar cubes were over-hyped. I learned that they can make some sweet sound. The thin bass is a function of the size. Better bass needs a bigger speaker. Bryan (sbs4dcc.com) is offering some ingenious enclosures for them. So, I find there are some places where they might save an installation.

If possible, I'd use an iPhone 4s speaker instead of a sugar cube. Lower price and better sound, both quality and quantity.

9. 16X35MM TRADITIONAL SPEAKER WITH ENCLOSURE SP16X35-08ENC



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None of them come close to my 16x35mm traditional speaker [9] in terms of clarity and volume of sound. So, if the 16x35 will fit, that's still my choice, preferably without the box, as discussed in my August 2012 column: ***How Do I Get The Sound Out?***

Two 4-ohm versions can be put in series for wonderful sound with an 8-ohm impedance and a 2-watt power handling capacity.

Now, let's end talking about bigger speakers.

Passive radiator modules

Starting in 1946, what is now known as JBL was called James B. Lansing Sound, Inc. Early on, they focused on professional speaker systems. They built a solid reputation based partially on passive radiator bass designs. These systems rely on a sealed enclosure with a normal woofer and a same size passive radiator (a woofer without wiring). When the enclosure is properly sized, the pressure off the rear of the woofer couples to the passive radiator, effectively doubling the cone area of the woofer. If properly designed, a passive radiator system will have an extra octave of bass over the woofer by itself. For example, bass down to 35 Hz, instead of ending at 70 Hz.

10. TANG BAND TO-2008S SPEAKER MODULE CAN PROVIDE AMAZING SOUND.

The speaker is the round item on the left in this photo [10]. The oval is the passive radiator, which has more cone area than the speaker.

A Chinese company, Tang Band, makes passive radiator speaker systems today. The company, sometimes referred to as TB Speakers, call them speaker modules. These modules do it all: great sound for their size, capability to handle the power coming out of modern decoders, impedance

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(4 ohms to 8 ohms) to match the amplifiers in modern decoders. The only drawback is that they don't do it in a size that is small enough to readily fit in HO or smaller locomotives. The smallest version might fit in some HO steamer tenders or a covered wagon dummy.

I learned of the TB Speakers from Kevin Leyerle during Prairie Rail this winter. Thanks, Kevin. Everyone that I've demonstrated them to has been very favorably impressed.

In this evaluation, I looked at the smallest version that is available through their primary USA vendor, Parts Express. The TO2008S module [10] is 55 x 24 x 10mm (2.17 x 0.95 x 0.4 inches). They can be found on the Parts Express web site:
parts-express.com/tang-band-t0-2008s-speaker-module-2-5-32-x-1--264-943

The frequency response is rated at 200 Hz - 20 KHz.

A larger version (T1-1942S) will be going into the garden loco that I discussed in my June column. Another garden loco, a Santa Fe F7A & B set, will get a pair of these behemoths (5-¼ x 2-⅛ inches). The frequency response is rated at 78 Hz - 20 KHz. I've put a T1-1925S, intermediate sized module (2-½ x 1-⅛ inches), in my 1:20.3 scale Bachmann rail truck with equally satisfactory results. The frequency response is rated at 150 Hz - 20 KHz.

I am sold on these modules for model railroading. If they fit, I'm using one. By the way, the mounting tabs can be carefully sawed off to reduce the footprint a bit. Just remember to engineer the acoustic path from the speaker face to the listeners' ears.

Goodbye for now

That concludes my last DCC Impulses column. As I'm writing this, the future for the column is not clear. Joe Fugate jumped in with a few topics as I was phasing out. He won't be able to do that very often and still publish MRH.

As for me, I plan to travel more. I may get to meet more of you at conventions or operations weekends or in your communities or homes.

As I come across situations or ideas, I may write about them. I just don't want the pressure of a monthly column going forward.

We'll be discussing topics from this column on the blog. Please share your ideas with us all. I'd love to hear what you think. Just click on the Reader Feedback icon at the beginning or the end of the column. While you are there, I encourage you to rate the column. "Awesome" is always appreciated.

Once again, I thank you all for being part of this great run. I wish you green boards in all your endeavors as we all go forward on this great adventure called life.

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