8 The Criteria for a good DCC Sound Install

By Mick Moignard
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Photos by the author

Sound-equipped Rio Grande Southern Ten Wheeler in action on the author's layout. A Mashima motor replaced an awful Sagami which had no low speed capability at all. It's fitted with a SoundTraxx TSU-1100 decoder in the tender with a speaker in the smokebox. There's no mistaking where the sound is coming from!

These words were originally written for *Virtual Scaleforum 2020*. For Australian readers *Scaleforum* is the annual exhibition by the Scalefour Society in the UK. For 2020 it became an online exhibition, available for viewing at any time. The Scalefour Society promotes 4 mm scale modelling to Protofour (P4) standards and is what P87, the HO equivalent, was derived from. This paper is based on the slide deck used at various exhibition demonstrations, and that in itself is based on a quick talk used at Missenden Railway Modellers between 2015 and 2019.

Mick Moignard: who he?

I've been modelling the narrow gauge—3 foot—empire of the Denver & Rio Grande Western Railroad and its impecunious offshoot, the Rio Grande Southern, since the mid-1970s. I've always had an interest in common carrier main line style narrow gauge. That's an uncommon prototype in the UK, though there was quite a lot of such 3 foot railways in Ireland, and plenty more metre gauge in continental Europe. I was introduced to HOn3 by a local model shop where I lived at that time in Solihull, UK, and the rest is history. My modelling has been a fairly standard journey with kits and scratchbuilt rolling stock, a modest amount of RTR and some far eastern brass locomotives, most of which have been worked over to a greater or lesser extent. I had always found DC operation even in my Triang days to be limiting and artificial, so as DCC started to appear I took an interest—though at that time, while I was building rolling stock on the dining room table, I had no layout.

I decided in summer 2000 to take two plunges, one was to start to build a layout, the second to buy a DCC system; two great decisions. By 2003 I was the club DCC bore, but people were starting to pay attention to the facts that DCC layouts were faster to build and just plain operated better. In 2005, one of the members and I started to build and exhibit an On30 layout based around Bachmann's burgeoning range of locos, determining that this would be an all DCC and all sound effort, using SoundTraxx's then new Tsunami decoders. This layout was a startling success, being seen at over 50 shows between 2005 and retirement in 2013. All the time the home layout was still developing in HOn3.

I'd started to do some DCC and sound installations for friends and club members when my then employer decided in 2011 to close the business unit I was working in. This was consulting services around Lotus/IBM Notes and software development, which in itself had given me skills that I'm using today in my hobby. New employment, both part time and home based, though still in the Notes world, enabled me to expand my DCC installations business markedly as well as giving me a tiny bit more time for my own layout and models.

I've long been a writer of magazine articles for both work and hobby. I wrote around 100 articles for *DominoPower* magazine, a web-based publication in the Notes world in the 2000s. I've written many more for modelling magazines such as a series in *Continental Modeller* in the '90s on HOn3, *Scalefour News* in the 2000s on DCC, and various articles for NMRA *Roundhouse* magazine here in the UK, among others, gaining my NMRA AP Authors award along the way. I've also been a demonstrator in modelling techniques and in DCC at many exhibitions here in the UK.

In my business career standing up and presenting made it easy for me to start doing clinics at modelling events; NMRA conventions here in the UK and in the US, Narrow Gauge conventions, talks at Scaleforum, and 009 Society shows. I've also authored and presented courses at Pendon Museum on DCC and DCC Sound, as well as tutoring the Missenden Railway Modellers DCC Sound workshop weekend.

As you read on you're going to get my take on the eight things that make a good DCC sound install. You may have questions or observations. Feel free to reach out to me. Email is the simplest way: mick@mickmoignard.com. You'll also find me on some groups.io forums and in a few other obvious places, but email remains the best way to get my attention.

1—The Locomotive

When adding DCC sound to a model locomotive you want to be able to enjoy the sound and hear all the nuances of your chosen sound decoder. What you don't want to be hearing is motor whine, gearbox noise, or clicks and ticks from the valve gear and pickups. To get the best from your sound-equipped loco it does need to be as mechanically silent as possible, especially at slow speeds. Fortunately, most modern RTR locomotives are very quiet out of the box and lend themselves easily to good results.

It's older locos and some kitbuilds that cause the problems, and for UK modellers the Portescap motor-gearboxes of the early P4 years were quite horribly noisy, and for one simple reason: the motor is running too fast. This requires massive gear reduction which is done with straight cut gears running at that high motor speed. My experience is that a decent 5-pole skewed armature motor driving a 20-1 worm reduction can be as silent as we need and still deliver strong and smooth low-speed pulling power. Indeed, these days, one of the best motors around is the 15 mm square Minebea 6-pole 4-magnet motor; 6500 rpm no load, more torque than I've seen in motors twice the size, silent, small and easy to mount. OK, and £3 [$US2.00] for two!

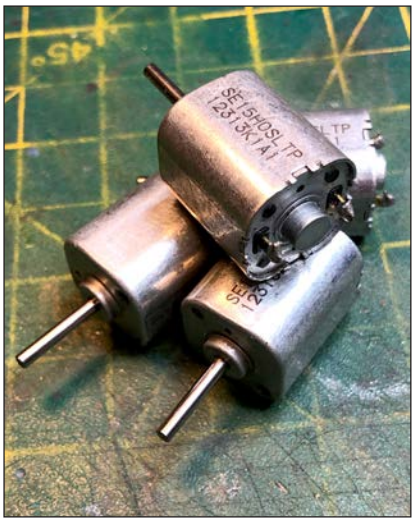
Once you have the motor-gearbox issued sorted, pay attention to the rest of the chassis. Adding sound will exacerbate and make more visible binds and stutters. And add as many pickups to the loco as you can, and particularly on tender locos, add pickups on the rear tender axle. DCC locos will suffer from poor pickup more than DC locos, and you really don't want your sound decoders losing power and restarting, nor do you want your lights to flicker, except possibly the firebox.

That need to assure the loco power supply extends to the layout design, wiring and maintenance. Make sure that every piece of rail is properly powered, the turnout crossings appropriately powered and that the track, and all the wheels that run on it, are kept clean.

2—The Sound Recordings

Most of us buy over the counter sound decoders. That may be decoders like the SoundTraxx and TCS offerings where the sound is canned into the decoder in the factory, or it may be Loksound or Zimo decoders where the sound project is created and loaded by the dealer or supplier, or possibly even by yourself. Most of these sound projects

With the withdrawal of Mashima motors, popular in kits and scratchbuilt locos, from the market, Mick's description of Minebea motors is timely. We've followed up on this and produced a summary of replacement motors in the sparate paper at page 4-557—Editor



Left. *Minebea 15m square motors. These are exceptional value. They're 6-pole, 4 magnet with massive torque and 6400 rpm top speed, easily outperforming motors twice the size and ten or even a hundred times the price.*

available in the UK have been developed by UK hobbyists and dealers and are loaded into the decoder on demand. [*And many Australian diesel sounds have been developed by Australian importers—Editor*] With these, we have little control over the sound packages and projects that we use, other that the normal choice we have over what to purchase. We'll all have our favourite decoders and our favourite project authors.

The more amateur projects do need care in selection. We're listening to our trains from a scale-prototype distance of around 100 metres or so. That means that we are not hearing sounds from the cab, and those of you who've had cab rides know that the cacophony in the cab of a steam loco is not remotely the same soundscape that you hear from 100 metres away. While some modellers do indeed want cab recordings, I for one do not. Nor do I want the sounds to contain anything extraneous like aeroplanes or birdsong. This means that the person making the recording needs to have taken care to get clear and clean recordings and then be able to mix them properly to get the volumes and intensities to match. You cannot hear the sound of an injector, or the fireman shoveling at 100 metres, so that sound should not be as loud as the chuff.

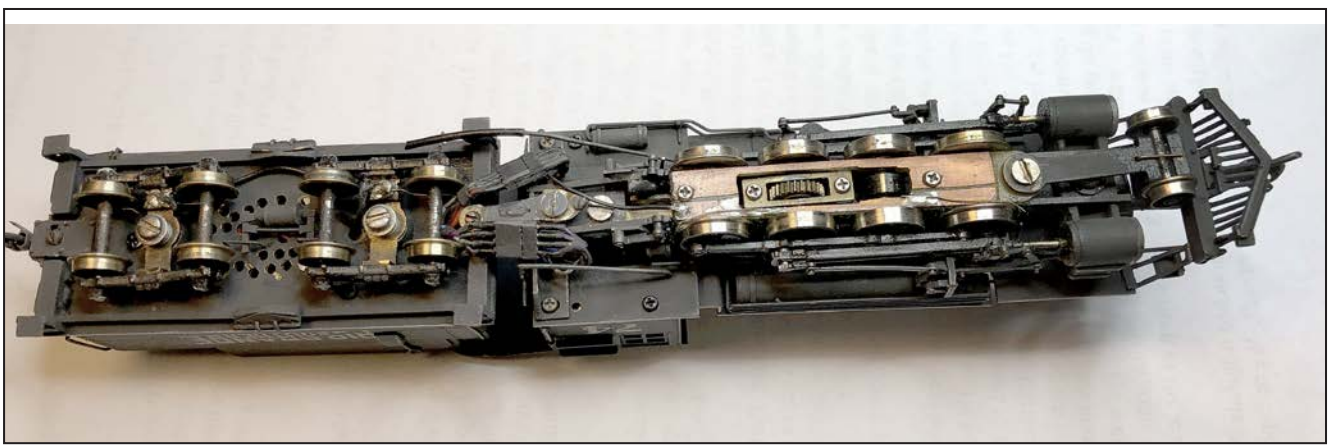
Be aware that quite a few supposedly locomotive-specific sound projects are not as specific as you might think, often being assembled from generic sounds. There's nothing wrong with that, and it may even be that the generic sounds are better recordings than more loco-specific ones. After all, nobody has a recording of, say, the whistle and chuff of a Highland Railway Skye Bogie, but examination of the whistle may well lead to another recording of a whistle with a similar shape. The better aftermarket sound project vendors will tell you where a project has been assembled from generic recordings, but not all will.

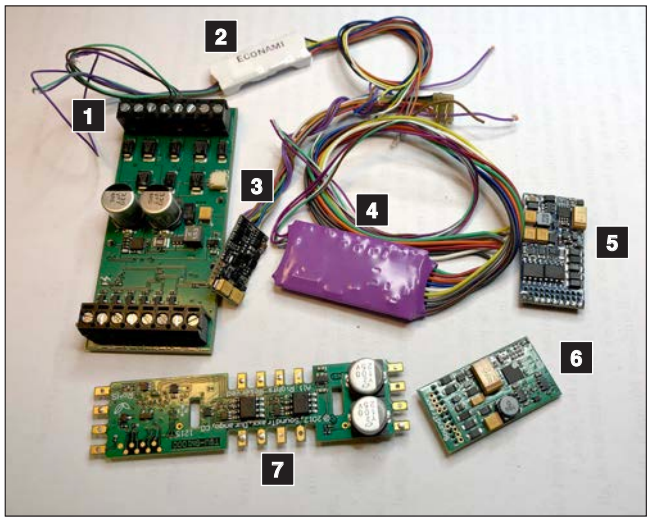
Looping is another sound editing issue that is often ignored in dealer-projects. The most common use of looped sound is the whistle or diesel horn. There are many sound projects out there that blow a fixed length whistle signal as you press the appropriate function; and even if you hold F2 down, they blow that fixed length sound. These are not looped. A looped whistle will play for as long as you hold F2 down. That's how real locomotive whistles work, and real locomotive horns. And the horn in your car—the horn sounds in your car when you press the horn button and stops when you let it go.

Looping a sound is hard. You need three parts: the start, a middle, and the end. They each need to start and stop without clicks or blank bits. The idea is that as you press F2, it plays the start, and if the button is still down, it plays the middle, and keeps playing it over and over until you let go, completing by playing the end piece. Which means that the end of the start has to match the start of the middle, and the end of the middle must match the start of the end, so you get a clean and crisp whistle sound with no clicks, interruptions or discords. Doing that is hard and time-consuming, which I suspect is the main reason why quite a lot of aftermarket sound projects don't feature looped sounds.

And don't get me started on wheel clickety-clack sounds that are not speed dependant. Indeed some of the projects out there, to my ears, don't bear a lot of similarity to a railway locomotive at all.

Below. The underside of an HOn3 2-8-0 locomotive. This is made with American style pickup: loco from left rail and tender from right, and you can see here that it has extra pickups on both the loco left side and the tender right side. The initial install was a TSU-750 in the tender sharing the space with a speaker; it now has a TSU-1100 in the tender with the speaker in the loco. The chuff cam visible on the second axle is no longer used. You can also see the two sets of plugs and sockets that carry track power, motor power, headlight and speaker wires between the tender-mounted decoder and the loco mounted everything else. The eagle eyed will also note the dirty wheels!





Left. *Various sound decoders:*

1. *Soundtraxx ECO-400, a 4 Amp decoder for O scale, no longer made. The TSU-4400 is the same size.*
2. *Soundtraxx ECO-100, a 1 Amp 4 function decoder, available with UK steam and diesel sound selections.*
3. *Zimo MX648, about the smallest complete sound decoder available, at just 21 mm long.*
4. *Soundtraxx TSU-2200, 2 Amp decoder available in steam, electric and multiple diesel variants.*
5. *ESU Loksound 4, 21-pin variety.*
6. *SoundTraxx, Tsunami-2 21-pin, also available in various versions.*
7. *SoundTraxx board replacement decoder aimed at US diesel models.*

Spend a little time listening and choosing. If the vendor doesn't offer sound samples, and doesn't have much in the way of documentation about their projects, you have to ask yourself how serious are they at helping you make a choice?

3–The Decoder

As we've already noted, there are choices for decoder and sound project. And we noted that not all sound projects are as good as others. But in all cases, these sound projects, factory or aftermarket, are loaded into decoders to install in the loco.

Like non-sound decoders, there are hygiene factors that need to be taken into account. Physical size, number of functions for lights, how the decoder is connected (6, 8, 21, 22 pin, wires, board replacement…) and maximum current, but these are no different to any non-sound decoder.

Specific questions with sound decoders are about their ability to make sound. The sound is digitized for storage; the decoder uses a digital to analog converter to create the electrical signal sent to the speaker to play these sounds. There are a few things that affect this:

- The bit rate of the sound. 16 bits is not far off CD quality. There are a few 8-bit decoders still on the market, and the sound from these tends to be a bit mushy and indistinct. Ensure you have a 16-bit decoder—all premium sound decoders are these days.
- The sampling rate. Divide by two to get the highest frequency that the decoder can produce. While the adult human hearing range is roughly 20Hz to 15kHz we're not going to get much below 100Hz from a speaker in a model, nor is there much point in going above about 10kHz, which suggests that a sampling frequency of 15–20k is required.
- Number of voices. This is the number of different sounds that the decoder can play at once. I'd suggest that for a steam engine the acceptable minimum is 8, and 10 or even 16 will give a more complete sound picture. The last thing you want is for one sound to be stopped just so another one can start. At the other end of the scale Hornby's TTS range has just two voices; one for the loco chuff or diesel sound and the other voice plays everything else.
- Amplifier output. We'll come back to this later.

You'll also want a decoder that uses the back EMF

Below. *A page from the SoundTraxx Tsunami2 website showing sounds available on the TSU-2 Steam-2 decoder. Yes, all these different whistles and so on are present in that one decoder.*

Tsunami2™

Sound Selections for Tsunami2 for Steam Prototypes

Tsunami2 Steam-2 Part Numbers: 884006, 884007, 884008, 884009

CV 120 Whistles	CV Value	CV 120 Whistles	CV Value
ATSF Step Top 6-Chime	0	Reading Flat Top 6-Chime (2)	45
Baldwin 3-Chime	1	Southern Railway 8" Flat Top Single-Chime	46
Baldwin Single-Chime	2	Southern Railway Iron Top 3-Chime	47
Baldwin Flat Top 3-Chime	3	Southern Railway Flat Top 3-Chime	48
Baltimore & Ohio 3-Chime	4	Southern Pacific Step Top 6-Chime (1)	49
Boston & Maine Step Top 5-Chime	5	Southern Pacific Step Top 6-Chime (2)	50
C&O Flat Top Single-Chime	6	Southern Pacific GS-4 No. 4449 Whistle	51
Colorado & Southern No.74 (Road)	7	SP GS-AC Classes A200 Airhorn	52
Colorado & Southern No. 74 (Yard)	8	Hancock 3-Chime Union Pacific No.3985	53
Colorado & Southern No. 801	9	USRA Step Top 6-Chime	54
Crosby 5" Flat Top 3-Chime	10	Westside Lumber Co. 5-Chime	55
Crosby 6" Flat Top 3-Chime (Road)	11	Westside Lumber Co. 6-Chime	56
Crosby 6" Flat Top 3-Chime (Yard)	12	Heisler	57
D&RGW Flat Top Single-Chime	13	Round Top Single-Chime "Peanut"	58
C-19 No.340 (Road)	14	Wabco E2 Airhorn	59
C-19 No.340 (Yard)	15	ATSF Single-Chime	60
D&RGW K-27 No.463 (Road)	16	British Rail Single-Chime	61
D&RGW K-27 No.463 (Yard)	17	LNER A4 3-Chime	62
D&RGW Flat Top 3-Chime K-28 No.473	18	Western Pacific 5-Chime	63
D&RGW Step Top 5-Chime K-36 No.487	19	ALCO Step Top 5-Chime (Road)	64
Nathan Step Top 5-Chime D&RGW No.488	20	ALCO Step Top 5-Chime (Yard)	65
Powell Round Top 3-Chime D&RGW No.489	21	Frisco Step Top 6-Chime (Road)	66
K-36 No.489 (Broken Chime)	22	Frisco Step Top 6-Chime (Yard)	67
K-37 No.497 5-Chime	23	CB&Q Step Top 3-Chime Cut Down	68
Frisco No.1522 3-Chime "Steamboat"	24	Bell Field Bowl 3-Chime	69
Hancock Step Top 3-Chime	25	Star Brass 3-Chime	70
Hancock Flat Top 3-Chime UP No.4018	26	Nathan Step Top 6-Chime	71
Hancock Flat Top 3-Chime	27	SP Step Top 6-Chime (Road)	72
Hancock Short Bell 3-Chime (Road)	28	SP Step Top Desert 5-Chime	73
Hancock Short Bell 3-Chime (Yard)	29	Canadian 6-Chime	74
Illinois Central 3-Chime "Steamboat"	30	W&LE Step Top 5-Chime	75
Lehigh Valley Single-Chime	31	Replica 6-Chime Long Bell	76
Lima Step Top 5-Chime	32	T&P Step Top 5-Chime	77
Lunkenheimer Flat Top 3-Chime	33	ATSF 6-Chime	78
L&N Passenger 3-Chime	34	Southern 3-Chime Brass (Road)	79
L&N Freight 3-Chime	35	Crosby 3-Chime	80
Milwaukee Road Step Top 6-Chime	36	Hancock Short Bell 3-Chime	81
Nathan Step Top 5-Chime (Road)	37	Hancock Step Top 3-Chime	82
Nathan Step Top 5-Chime (Yard)	38	CB&Q Step Top 3-Chime (Road)	83
Nathan Step Top 5-Chime	39	CB&Q Step Top 3-Chime (Yard)	84
N&W Step Top 3-Chime No.611	40	N&W Flat Top Single-Chime "Hooter"	85
N&W Flat Top Single-Chime No.1218	41	ATSF Flat Top 3-Chime	86
PRR Round Top 3-Chime	42	D&RGW 8" Single-Chime	87
PRR Flat Top Single-Chime "Banshee"	43	CN Flat Top 3-Chime	88
Reading Flat Top 6-Chime (1)	44	ACL Round Top 3-Chime	89

CV 122 Bells	CV Value	CV 122 Bells	CV Value
Heavy Brass	0-4	Heavy Brass (3)	27-31
Light Brass (1)	5-9	Air Rung Medium Brass	32-33
Medium Brass (1)	10-14	Medium Brass (3)	34-38
Medium Brass (2)	15-19	Medium Brass (4)	39-43
Heavy Brass (2)	20-24	Light Steel	44-48
Air-Rung Heavy Brass	25-26	Heavy Brass (4)	49-53
CV 123 Exhaust Chuffs	**CV Value**	**CV 123 Exhaust Chuffs**	**CV Value**
Light (1)	0	Medium (3)	5
Light (2)	1	Heavy (1)	6
Light (3)	2	Heavy (2)	7
Medium (1)	3	Heavy (3)	8
Medium (2)	4	Geared	9
CV 124 Airpumps	**CV Value**	**CV 124 Airpumps**	**CV Value**
Single-Phase (1)	0	Cross-Compound (4)	5
Single-Phase (2)	1	Dual "Whistling" Cross-Compound	6
Cross-Compound (1) (Westside Shay)	2	Dual Single-Phase	7
Cross-Compound (2)	3	Dual Cross-Compound	8
Cross-Compound (3)	4	Vacuum Pump	9
CV 125 Dynamos	**CV Value**	**CV 125 Dynamos**	**CV Value**
Dynamo (1)	0	Dynamo (5)	4
Dynamo (2)	1	Muffled Dynamo	5
Dynamo (3)	2	Double Dynamos	6
Dynamo (4) Union Pacific No.4018	3	Triple Dynamos	7

(BEMF) feedback not just to regulate the motor but also to influence the sound; so that as the loco load varies the sound intensity varies. Your trains will then make a lot of noise going uphill and more quietly roll downhill. Depending on brand, there are other functions available that blend sound and operation; inertia/momentum, active brakes, being able to notch diesel sounds up and down, or move the cutoff on steam locos, and much more. Better still are decoders that offer such sound management features like graphic equalizers and reverb.

Two other musts that we will also come back to are individual volume settings for each sound, and the ability to remap the function keys easily and simply.

You want decent and comprehensive documentation. You're spending upwards of £80 or £100 ($140-$180) on the decoder, so a flimsy piece of till-roll paper to tell you what the functions are as the only documentation provided doesn't cut it (yes, that happened to me). You need that documentation to enable you to get the best out of the decoder. Most factory canned decoder brands have very decent documentation, but the aftermarket sound project vendors vary greatly here. Indeed I would suggest that just as with sound sample availability, the completeness and comprehensiveness of documentation tells you a lot about the vendor's attitude to his products and his customers.

Lastly, there is no point in a magic decoder if the number of sounds or projects available for it is small. The factory canned decoders contain vast selections for you to build your unique loco. The SoundTraxx steam Tsunami2 for example contains 90 whistles, 50 bell selections, 10 or 15 airpumps, half a dozen turbogenerators and so on. Aftermarket sound projects have one loco in each project, which means that your selection of decoder might be predicated by the availability of a specific sound project.

4—The Speaker

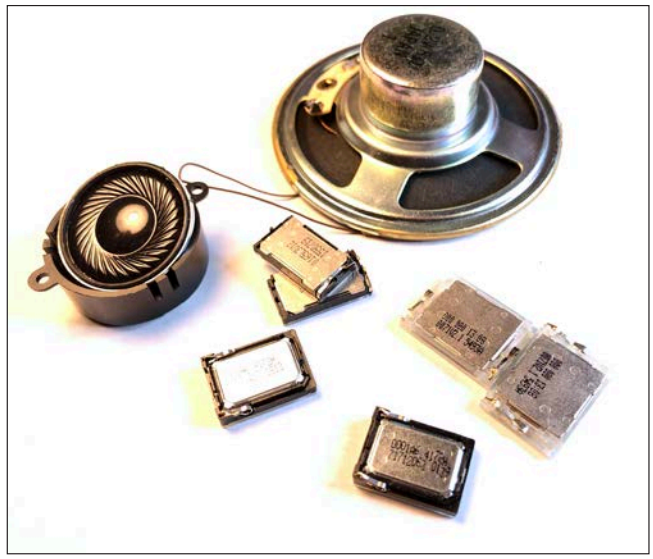
We're not going to get HiFi quality sound from model locomotives, but that doesn't stop us trying. The speaker or speakers that we use are key to getting good sound, but we are limited by size and that generates compromise. The biggest one of these is bass response.

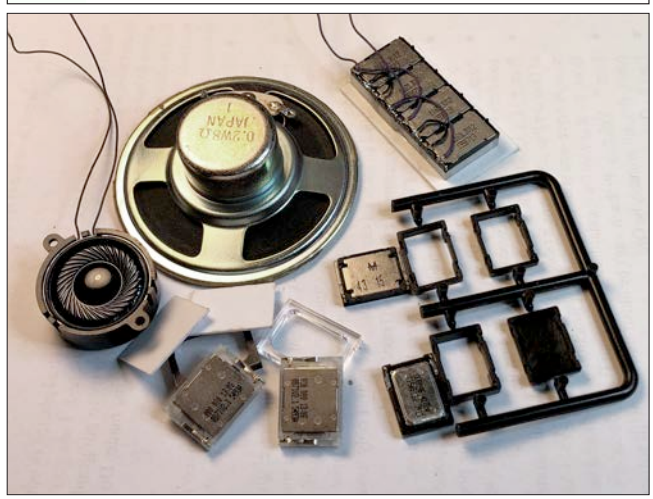
Real locomotives emit a mixture of low as well as middle and high audio frequencies, and their operation—rumbling over rails—generates some more. As we've seen, human audio hearing goes down to around 20Hz, but to generate that sound electronically needs a large speaker, as there isn't a lot of sound energy at low frequencies and so more air needs to move.

The compromise is a mixture of speaker design and baffling. Strictly, what we call a speaker is actually a driver, and to make it a speaker, it needs to be in an enclosure, and baffled to prevent the sound that comes out from one side affecting—nullifying—the sound from the other, and to make the driver do some work.

In the past, small speakers use a small round magnet surrounded by the voice coil, and connected to the centre of a paper or mylar cone, the outer edge of which is attached to the speaker frame. This is then placed in a box so that the rear of the speaker is covered, and occasionally, in reflex speaker designs, there is a tuned exit from that rear encapsulation. Such speakers can generate good bass response, down to 100Hz or so, if the driver supports that. Most don't, however. The lowest decent frequency, even for speaker drivers sold as 'MegaBass' or 'HiBass', is often quoted as around 200–300Hz. Then a speaker enclosure to promote low-frequency bass is likely to be too large for many modern RTR locos in particular where space can be at a premium.

Like many aspects of DCC, however, we can now piggyback on the mobile phone world. You're all aware of just how loud the ringtone of modern smartphone is (right across a noisy pub, for example), and many of you are also aware of just how good the sound generated is when you use the





Right. *Some speaker drivers. A 2 inch and a 23 mm traditional style, plus three sizes of 'sugar cube', 9 x 16, 11 x 15 and 15 x 18, all in mm.*

Right Below *Speakers and enclosures. The 2 inch speaker will only fit in larger O-scale models where the only practical enclosure is to use part of the model itself; note this huge thing is only labelled as 0.2W, that is however a continuous and not peak rating. The 23 mm on the left is inside an injection moulded box from ESU. Top right is an array of four 9 x 16 speakers wired series/parallel to give a 2-watt 8 ohm array, using laser cut enclosure parts. To the right is an injection moulded set of enclosure parts for 11 x 15 drivers. These come from ESU. In the lower centre are laser cut parts made on my club's cutter for the 15 x 18 drivers.*

phone to listen to music. All that comes from one speaker, possibly two, with drivers that may be 15 x 11 mm and just a couple of millimetres thick. They're also cheap; when bought in bulk (say 50) from an electronics supply house, they're often under $2 each, not including the enclosure.

Such speaker drivers are constructed differently; they have a rigid diaphragm, with the voice coil wrapped around its edge. This rigid element is attached to the frame by a small flexible mount. The entire rigid plate vibrates the air, generating a decent response curve—often down to 100Hz and up to 15kHz, and plenty of volume. It still needs to be encapsulated—and with these things, the moving element must be inside the box, not outside. You then end up with a small rigid box, say 15 x 11 x 7 mm, which is where the name 'sugar cube' comes from, because that's about the size of them. And a small speaker like that starts to generate more freedom in where you are able to put it, which we'll come to in a minute.

There are a couple of other things that matter that affect speaker choice.

Most sound decoders these days have at least 1 Watt amplifiers and 2 Watt are becoming quite common. This means that the locomotive can be loud, if you really need it loud, but more importantly it has the headroom to deal with transients without distortion or clipping at the kind of volumes we're likely to use. Such high power also means that you should choose speakers carefully, to have enough speaker capability to absorb that power. A 2 Watt amplifier will need a 2 Watt speaker, which you can make by using two one Watt speakers connected in series.

The decoder world is also standardizing on the need for 8 Ohm speakers. SoundTraxx, TCS and Zimo all use 8 Ohm, in the past ESU Loksound have required both 100 Ohm and 4 Ohm. You do need to pay attention here: using a 4 Ohm speaker with a decoder that requires an 8 Ohm speaker will overload the amplifier and it will fail. But the converse—using 16 Ohm speakers with an 8 Ohm decoder is fine, you'll lose a little volume but you'll gain safety and possibly a little sound reproductive quality. The key here is to connect speakers in series, to raise the overall resistance. Two 8 Ohm speakers in series is 16 Ohm, but in parallel, is 4 Ohm.

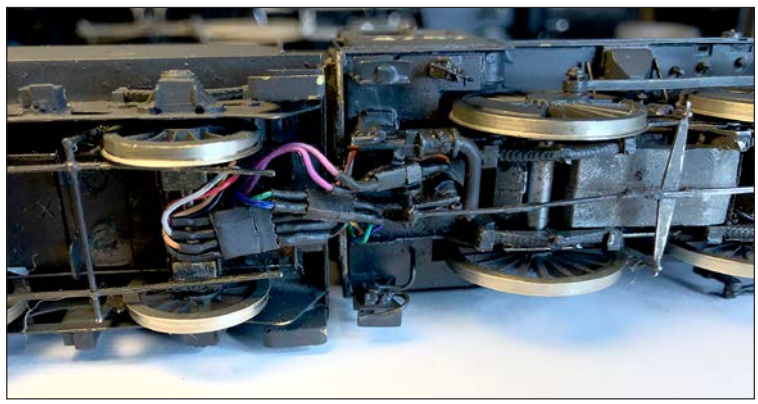
So, check your decoder: do you need 4- or 8 Ohm minimum speakers, and does the decoder have a 1- or 2 Watt amplifier.

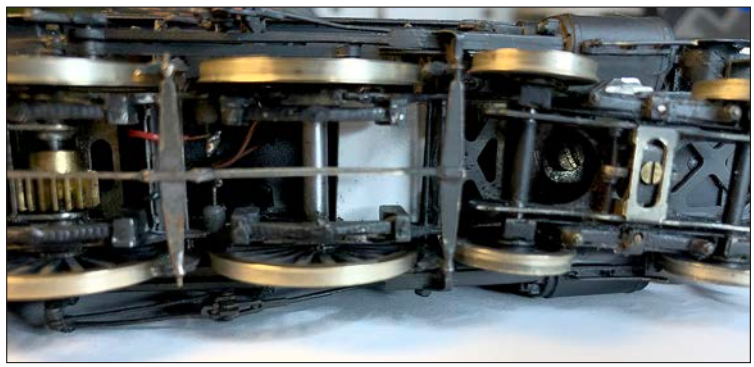
5—The Speaker Installation

The speaker installation is where the loco is transformed. RTR manufacturers are starting to recognize this, but still too many tender locos are made with an expectation that the speaker will be placed in the tender, when a much better place is in the smokebox. Tank locos ditto; an expectation that the speaker is placed in the bunker and the decoder in the smokebox. And of course some kits come with solid resin boiler/smokebox assemblies, but at least in P4 [*and P87 broad gauge*] the frame spacing may well allow the speaker often to be placed in or immediately behind the cylinder area. Even with small locos where the smokebox and tender are only about 10 cm apart benefit, and it can be done. I have an HOn3 4-6-0 (HO scale, 3 foot gauge) loco with the speaker in the smokebox, and it is easy to tell where the sound is coming from. No chuffing tenders here. See the lead photo.

I'd go so far as to say that placing a decent speaker in the smokebox will always beat an exceptional speaker in the tender. The bigger the loco, and the longer it is, the more this is the case—and of course the more space there is up front for the speaker, too. In large locomotives it is likely to be a mistake to fill the smokebox with ballast; while it may make the loco heavier, tipping the balance point too far forward may well actually reduce the traction. That then gives a large smokebox space ready and waiting to be filled with speaker.

Apart from the speaker and its two wires, the rest of the installation is the same as non-sound one. Just be neat and tidy, heatshrink on wire joints (no masking tape





Right Top. *A P4 model of an LMS Black 5, showing plugs and sockets between loco and tender. The 4-pin connector carries track and motor power to and from the tender decoder, and the two-pin ones carry speaker and firebox light wires. Eight flexible wires of 30 AWG size between a loco and tender are not a problem. I have an HOn3 loco with nine. These plugs are 1.27 mm pitch items, made by Mill-Max. I buy them in rows of 50 pins, cutting off what I need. They're part numbers 850-10-050-10-001000 for the plugs and 851-93-050-10-001000 for the sockets. Google will find you a supplier locally.*

Right Bottom. *This is a little fuzzy as I tried to focus on the speaker which in this Black 5 is between the frames behind the cylinders; the white rectangle. The loco is made from a Brassmasters kit which has a solid resin boiler/smokebox single piece casting, so the speaker could not go there.*

or Sellotape) and learn that you only need bare two millimeters of the wire to be able to make a good soldered joint with it. You do not need to bare a centimetre of wire and then leave it flapping about.

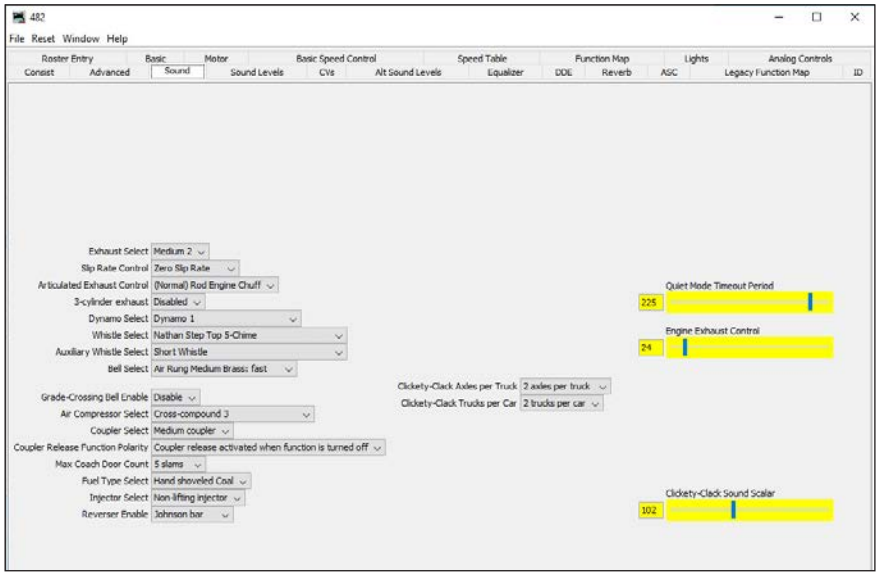
Small plugs and sockets are easily available—I buy them at both 1.27 mm and 1 mm pitch in strips of 50 and cut off what I need. Having several wires between loco and tender is not an issue with fine wire such as that used on most decoders. I have locos with as many as nine, with no problems. These small plugs make not just separating loco and tender easier but also make dismantling the loco for maintenance simpler as you can just unplug the boiler from the frame.

6—Careful CV Programming

CV programming is where you bring your locomotive to life. Many people, having installed a sound decoder, do nothing more to it than set the address. While that's just fine, and will get the loco working, there is so much more that you can do get the best from the locomotive. And I have to say at this point that the best way to do that is to use the free JMRI DecoderPro computer program (at jmri.org). This works with pretty much all DCC systems or with the SPROG stand-alone decoder programmer. I encourage you to check DecoderPro out, and to look at the Sprog if connecting DecoderPro to your DCC system is likely to be problematic. (The SPROG standalone programming unit connects the loco to the computer without requiring a complete DCC system. It is complementary to JMRI/Decoder Pro.)

Left. *This photo shows an 11 x 15 mm speaker with laser cut enclosure in the smokebox of an HOn3 C-16 2-8-0. The outside diameter of the boiler is just 15 mm, so the speaker assembly was enclosed in heatshrink to ensure that the contacts would not short against the boiler. It has a Mashima motor in the cab with an ECO-1000 decoder in the roof.*

Whether you are or are not a DecoderPro user, you do need to check CV values before you change them. This matters particularly for Loksound and Zimo decoders because the default settings for your project will not be the standard blank decoder defaults, and changing values without checking first may render your sound decoder non-functional, requiring a factory reset (CV8=8, in most cases) to get it going again.



Right Above. *DecoderPro sound selection page for TSU-2 Steam-2 decoder: This screengrab from DecoderPro shows the selections I've made for my D&RGW K-36 #482 from the sounds available on the Soundtraxx Tsunami-2 steam-2 decoder.*

Right. *DecoderPro Volume settings page for TSU-2 Steam decoders: shows the choices of volume settings I've made for 482. I've set the whistle to full volume and then set other volumes relative to that, finally using the master volume at top left to set the overall volume or my layout. Check out, too, the tabs across the top. From a sound perspective with aTsunami-2 decoder you will also visit the Equalizer, Reverb and DDE pages. The Soundtraxx manuals will tell you the reason why you visit these pages and how to get the best from them.*

However you do the programming, the first thing is to do is make sure it runs properly. Most decoders will run the loco just fine out of the box, but occasionally a little more work is required. If you're an ESU Loksound user, you should recalibrate the BEMF for your loco by following the process that ESU have documented. Southwest Digital (southwestdigital.co.uk) have good documentation for this and also host downloads of the English versions of the ESU manuals. You can find other manufacturers' manuals on their websites.

Once you've got the BEMF sorted, for a steam engine, next is to set the chuff rate. ESU again document a specific procedure and two CVs for this, requiring you to time a wheel revolution at speed step 1. The other manufacturers have their own methods and you again need to refer to the manual. SoundTraxx even have a CV for 3-cylinder engines; you set the chuff rate to 4 per revolution and then set the 3-cylinder option and you'll get the accurate but slightly offbeat 6 chuffs to suit. A nice bonus with SoundTraxx decoders is that once you've set the chuff rate, further fiddling with the BEMF doesn't affect it.

Now set some momentum; CV3 and 4. If your decoder has an active brake, set this up too, particularly with lots of momentum in CV4 so that you can coast and brake. Lots of momentum is really required by all sound decoders to enable the automagic. Do be aware that not all decoders are equal here. Some decoders, and some projects, have more automagic than do others. I personally use CV3 values between 50 and 70 and CV4 values of around 170 with my SoundTraxx decoders, and use their active brakes. Those of you with Loksound decoders also need to pay attention to which specific model you have. The multi-protocol European versions use smaller multipliers for CV3 and 4, which means that they accelerate and decelerate faster than the NMRA specification as used in the Loksound DCC decoder made mainly for the US market. The European Loksound 4 and 5 require much larger values in CV3/4 to match a decoder that uses the NMRA CV3/4 multipliers.

Set up the lighting next, whatever lighting you have. For steam locos, possibly just a flickering firebox. You might want to have that on all the time. Lights on diesels, particularly modern diesels, can be quite complex and I'm not discussing lights at all here, even though they may have a direct relationship with sound, such as the generator spooling up and running on steam locos with electric lights, or synchronised firebox flashes with the sound of coal shovelling.

Look at the function mapping. I cannot emphasize enough the need to have all your locos with consistent function setup. If you don't, you'll end up not using all those fun functions effectively. If your throttle can only cope with four or eight functions, upgrade or replace it to ensure you have at least 28 functions. Then plan to have on the 0-9 buttons, or 0-12 if your throttle offers 0-12 on single key presses, the functions you will use while actually operating a train. That will include whistles and horns, brakes, cylinder cocks for steam and possibly some lights, but it won't include the driver opening and closing the cab door; such auxiliary functions can safely be relegated to higher functions that need more than one key press to activate.

If your decoder supports manual diesel throttling or notching, steam cutoff adjustments and suchlike, these are also things that you need to able to reach with a single key press. But I say again, be sure you're consistent. If you have to refer to different setups or lists depending on what loco you are running, you just won't use those functions. And that will be a pity. I know that some European DCC systems allow function button labelling as do some smartphone apps, but even then it important that the positioning is also consistent so that you're not hunting around the screen to find the whistle or brake. The last thing you need, following on from that, is for the F2 key to be a looped whistle on some locos and a graduated brake on others. Consistency of functions is absolutely vital, possibly the most important thing to get right. I really cannot emphasize this strongly enough.

Next up is to look at sound modifiers, things like equalizers and reverb, if the decoder supports them. Most sound projects on aftermarket decoders are equalized for one particular speaker, most likely the one that the project developer has attached to their computer. The chances are that this has a different set of frequency responses to the one you'll have in your loco. And of course your ears hear differently to his, and your expectations may differ too.

Lastly look at the random sounds, where you have control of these. You don't want a random water stop sound sequence happening every time the loco stops, nor do you need the fireman frantically shoveling away, assuming you can hear him, on a shunting loco which in reality needs firing about once every 30 minutes or so.

After that, set up the active brake. You'll love this. Assuming your decoder has one, that is. SoundTraxx Tsunami2 decoders have two for steam and three for diesels. TCS Wow has one graduated one, so more like a car brake. Loksound 5 has three, assuming the project is using the the brakes. Zimo decoders have one, which again works more like a car brake than a train brake, and which—unprototypically— forces you to close the throttle to use it.

7—Volumes

This is the area which all the vendors get wrong; SoundTraxx arguably less wrong than others. Many aftermarket sound projects have the various volumes poorly mixed and blended. In most cases this is because they've added a whole pile of what we might call auxiliary sounds (diesel cab door openings, cab warnings before starting the prime mover…) that are really not audible to the 100 metre away observer, but they want you to know that they're there, so they leave them all fully loud. And often set the master volume of the whole thing too loud too. It's just a pity that in so many cases the project author has gone for quantity of different sounds rather than making sure that the key sounds are well presented and that they are integrated into the decoder operation properly.

On real locomotives the horn or whistle is way, way louder than anything else. I use that as a base; set that fully loud, and then adjust the master volume so that the whistle/horn is at the correct volume for use at home. I then adjust each other sound volume to match; exhaust sounds on steam locos so that they're still audible with the whistle, but well drowned by it. Diesel engine sounds

are much quieter, particularly modern—non-first generation—diesels. Next time you're near a piece of fast railway, stop and listen to the trains passing. You just don't hear the engine of modern diesels, or railcars, except as they get a train under way. TBH, the same also applies to steam; the loud chuff that we all think of as hallmark of a steam loco happens only at low speeds and under load when the cutoff is at a high value—over 50%. That loud chuff is basically boiler pressure steam escaping. As the loco speeds up and the cutoff is pulled back to maybe 25% or less, the steam expands much more in the cylinder and is thus at much lower pressure as it escapes up the chimney, so less noise—and of course it happens faster. A steam loco running at 70 mph makes more of a ticking noise than a chuffing sound.

Once you have the main and loud sounds set up—horn/whistle, exhaust, bell if you're a US modeller, plus the cylinder cocks and safety valves on a steam loco, the rest of the sounds should be set to be pretty quiet; after all, can you hear the fireman shovelling coal, or the injectors, at 100 metres? Does the guard's whistle even come from the locomotive? Let alone station announcements!

If your decoder supports something like quiet mode, this is also the time to set that. SoundTraxx's decoders do that; if the loco is parked with the throttle at zero and all functions turned off, the sound mutes itself automatically after the timeout. More importantly, all your locos stay quiet when you power the layout up, until you start to use them.

Lastly, re-adjust the master volume to suit. If you take the loco to an exhibition, and need more volume, then just raise the master volume. I'd caution going too high with this because you will risk sound distortion and clipping, the decoder will run hotter, and there is the risk of damage to decoder and/or speaker. Be aware too that exhibitions are awful places for sound-equipped locos, because the ambient noise levels are so high that whatever you do, the only thing that will be heard is the horn or whistle and the loco under load. Coasting locos are pretty much silent at exhibitions, and those auxiliary fireman cooking breakfast sounds will be totally inaudible.

8—Operate it properly

This is where it all pays off. Once you've got all that gorgeous sound in the loco and the loco properly set up, now you want to use it properly. As we've already said, you'll need lots of momentum to make the decoder automagic really work, so you need to learn to drive like the prototype and not like a toy train or a slot car. You'll get used to quickly opening the throttle up to running speed to start a train and wait for it to noisily reach that set speed, you'll close the throttle when approaching hazards or stations and let the train coast, using the active brakes if need be to slow further. You're letting the decoder simulate the weight of the train as being hundreds of tons of steel and wood and not just a kilo of plastic, brass and mazak.

Left. *Sound isn't just for locos. Here's an RGS caboose built from a PSC kit with Blackstone trucks, and a SoundTraxx Soundcar decoder. This will give that delicious fading clickety-clack sound from the caboose as the train it tails rolls around the layout.*

Try, too, using the throttle and brakes to slowly buffer up to things that you're coupling to. Remember that in reality those wagons sitting in the siding may be twenty or forty tons in weight and they are sitting there with the handbrake on. You can't charge up to them at 10 miles an hour, bang into them and keep going. All sorts of damage to the loco, the wagons and the expensive shipment in those wagons will have occurred let alone the flats on the wheels of the wagons. No; come to a stand a few centimetres away, set the throttle to step 1 or 2 (you are using 128 steps, aren't you?), and then use the brakes to move up and nuzzle the buffers or couplers together. Recall now that the shunter has to couple vehicles; give him a few seconds to couple and connect any hoses.

If your prototype uses automatic couplers, there will still be air hoses to connect—and you should do a standing brake test to be sure, as well as a tug to ensure that the couplers are secure. Even when you have the train all made up, you should do a standing brake test and, probably the first time you move, a moving brake test before you go too far or have gained too much speed. The standing brake test is just waiting a short while before starting off for the 'examiner' to walk to the end of the train examining the brakes, and return. SoundTraxx Tsumami2 decoders also lets you do a set and release of the train's brakes which will generate brake release sounds and the air pump starting up again to pump the brakes off again.

You should also start to use appropriate whistle/horn signals. In the UK, this is actually less used than in the US and Australia where horn/whistle signals were and are standardised and mandatory. Whistle boards would indicate hazards in need of warning of the train approach—tunnels, some bridges, level crossings, and the usual response from the train is a long note—hold down F2 on your looped whistle. Similarly, the whistle would be used to warn signalmen when a train was standing at a signal, and there were plenty of local whistle signals used to mean specific things particular to that location.

Getting it all right is a bit of a journey, but I can assure you it's a worthwhile one; getting your railway to run smoothly and sweetly is one thing, then adding all the appropriate sounds adds so much more.

Sound-equipped locos in action on my layout.

Left. *A K-28 class built by Alco for the D&RGW narrow gauge in 1923. The model is a redetailed Westside Models product from the early '70s, with a Mashima motor replacing the original and useless coreless motor. The loco has a SoundTraxx TSU-1100 decoder in the tender, which still drives a tender-mounted speaker and is on my list for an upgrade to include placing the speaker in the loco.*

Left Middle. *462 is based on the mid-2000s MMI diecast and brass details model. MMI made a number of D&RGW models in 1:48 scale but only made K-27s in HOn3. I've reworked the generic model to more closely match 462 right at the end of her career in around 1950. The model has a SoundTraxx TSU-750 decoder in the tender and a speaker in the smokebox.*

Left Below. *Yes, this HOn3 crew speeder has sound! The Rio Grand Southern bought a Fairmont crew speeder in around 1945 to assist the track gangs in getting about. The model was scratchbuilt and sits on the chassis block of an Arnold N scale German diesel shunter. It has new axles, modified wheels using Grandt Line handcar wheel centres, and a new and tiny motor. It's only 24 mm long inside, meaning that the only sound decoder I could get into it was a Zimo MX648. It has the sound of a small industrial diesel installed. This is horizontally mounted below the roof and drives an 8 x 12 mm speaker tucked down beside the worm gear. There is no space for a proper speaker enclosure, so it just has a plate attached to form a tiny chamber. It works though. When turned well up is is easily audible in a busy exhibition and runs at home with the volume turned down to around 15 or so (CV266 in a Zimo decoder). The lights also work, with 0402 LEDs. It's very light, so requires the track, wheels and pickups to be scrupulously clean, but it's fun when it's running nicely. I have managed to get 200uf of 'stay-alive' capacitance into it, which helps a little.*