O-scale Decoder Issues

Converting to DCC

article and photographs by James EuDaly, MMR

After operating my O scale layout for many years using CTC80 command control, I decided to update to DCC. After joining the Digitrax and NCE Yahoo groups and observing the kinds of problems users were having, and upon advice from persons with more wide-ranging operations experience than mine, I settled on an NCE, 10 amp system with radio throttles and a PowerCab for use on the workbench as a programming track and for initial testing of decoder installations. All my engines were gathered in the West Yard at Hinton to be taken off the railroad, and CTC80 was removed in July 2009.

The layout is wired for common rail and is fully signaled but was using diode drop detection. DCC puts A/C on the track and requires current detection for occupancy. With major help from Bill Scheerer, who designed the circuits, I built 170 track detectors and 70 frog detectors to replace the diodes. Due to Bill's ingenious circuit design the computer signal program was unchanged. Bill says we're lying, and the computer program thinks it is still seeing DC track voltage. This took about nine months, and we thought the difficult part of the conversion was complete. To our surprise, the decoder issue was more difficult to solve and

Above: C-16 No. 190 (0-8-0) is switching empty hoppers in the West Yard. Engines immediately behind the cabs are on the inbound track headed for the engine servicing tracks and two H-8 Alleghenies are at the Mallet house. They will be a pusher and puller for the run up to the summit at Alleghany with a loaded coal train — a DF or Drag Freight in C&O parlance. The switcher is powered with a Zimo MX645 1.2 amp sound decoder; the other engines with Zimo MX695 6 amp or MX696 4 amp versions.

took much longer. Although I was searching for steam and diesel decoders concurrently, I've separated my discussion of them.
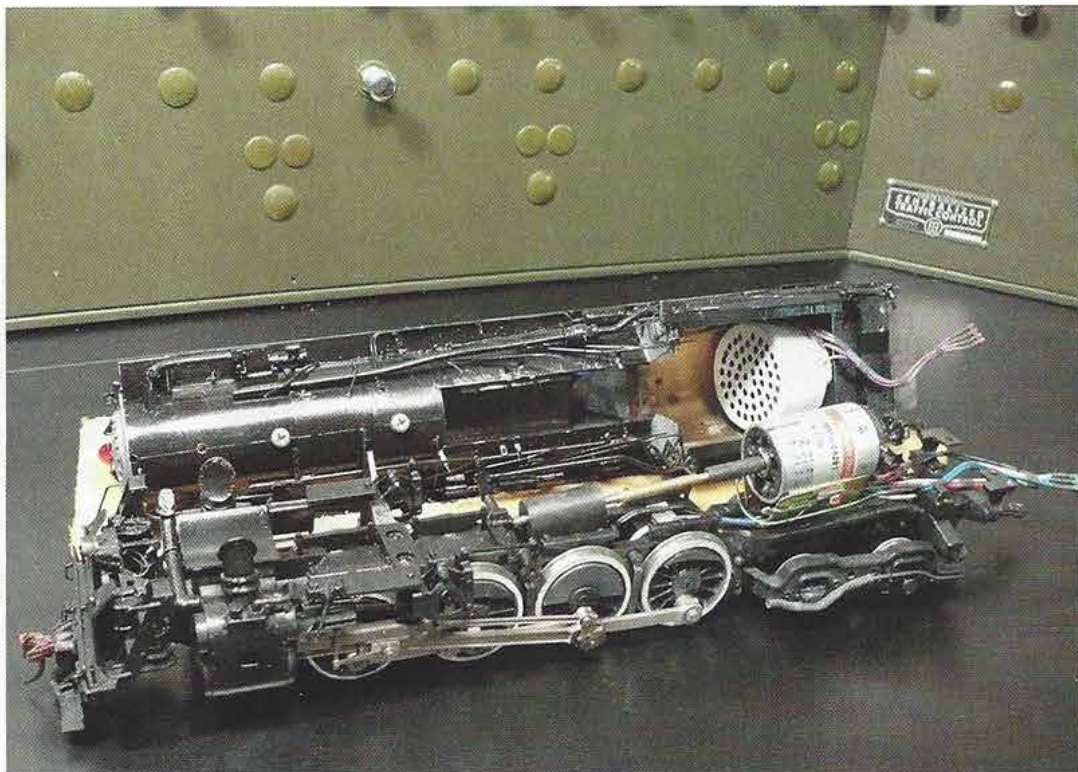
Diesel Decoders

Although I was testing steam and diesel decoders simultaneously, diesels were the first to be solved. Most of my diesels are

powered with Holland can motors on each truck. A worm and gear drives one axle while Derlin sprockets and chain power the other axles. Because of the low current draw, I tried Soundtraxx Tsunami decoders. However, an over voltage issue showed up as it did in steam. Bill brought his oscilloscope to check the signal, and we discovered that under load the Tsu generates a 27 volt spike at the leading edge of each motor pulse resulting in a 54 volt swing. In effect, it generates a voltage spike that causes it to shut down. We spent weeks trying to snuff out that spike. We tried capacitors, Varistors, voltage regulators, and inductors and finally gave up on using a Tsu to drive motors.

After experiencing the excellent motor control of a LokSound steam decoder, I hoped to use LokSound. However, at that time LokSound's diesel programs were quite mediocre. I understand that new diesel sounds have been recorded and are now quite good, but by the time they became available, my diesels were done. Because there is no loss of sound function in diesel two-decoder installs, I finally settled on LokPilot XL v3.0 for motor drive and Tsu's for lights and sound. I think that O scale diesels are large enough to deserve a sound decoder in each unit. Most of my diesels run in permanent consists, and to reduce costs, I tried running consisted sets with one LokPilot. The units are wired together for track pickup and motor control with a Tsu in each unit for lights and sound. One LokPilot XL will drive up to three units. I don't understand how the decoder interprets BEMF from six motors, but operation is excellent. Single diesel units have both a LokPilot and a Tsunami installed. Twenty ohms of resistance in the track pickup lead of each Tsu partially clips the 27 volt spike, although occasionally the lights blink and the sound stutters if a diesel binds and draws an unusual amount of current. The Tsu will not run a motor with a resistor in the track pickup lead, although lights and sound work okay.

Installation Notes: Diesels

I'm using QSI Hi-Bass speakers; 1.77-inch and 1.57-inch sizes. Covered wagon-style diesels have 1.77-inch speakers in styrene enclosures mounted on the roof firing down. Hood-style diesels have 1.57-

inch speakers in styrene enclosures in the fuel tank firing upward. I encountered an ironic situation with the diesels. The Hi-Bass speakers emphasized the bass so much that the prime mover sounded muffled with too much bass and not enough treble. Bill and I spent a couple hours with the Tsu equalizer and ended with the following settings for it: CV 154=96, 62Hz; CV 155=128, 125 Hz; CV 156=140, 250 Hz; CV 157=128, 500Hz; CV 158=255, 1K Hz; CV 159=255, 2K Hz; CV 160=255, 4K Hz.

A few LokPilot settings are Acceleration-CV 3=64 (of 64), Deceleration-CV4=32 (of 64), and "Range of load control" (BEMF) CV 56=32 (of 64). The LokPilot motor decoders have a couple interesting features that I use. LokSound decoders have a programmable start delay that allows time for the prime mover to rev up before the diesel moves. LokPilot decoders have the same start delay to match the sound decoders. I program the delay to allow the Tsu's to rev up before movement and map it to the headlight so it's invisible to the crews.
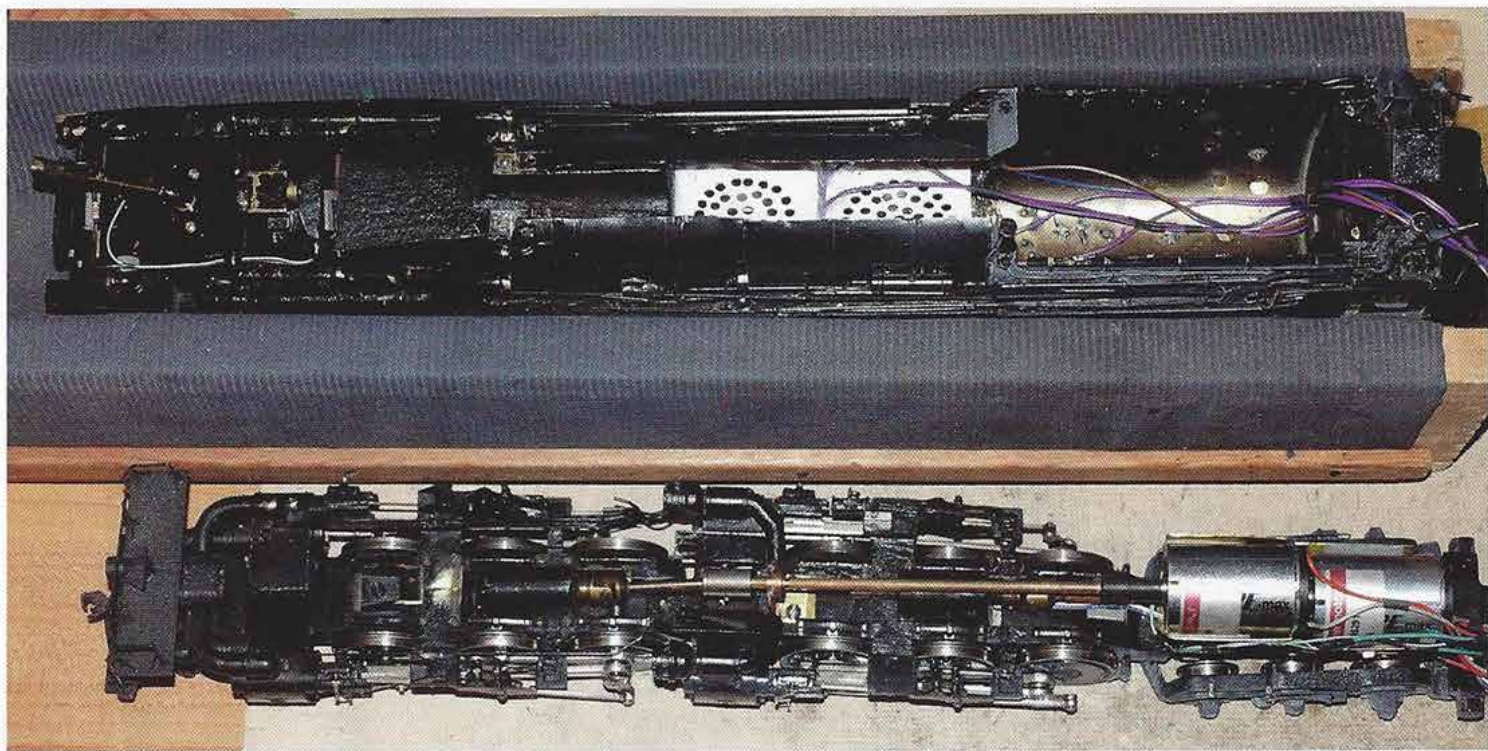
A second feature is "shunting" ("switching" to us in the U.S.) that cuts the speed in half. With the speed steps showing on the NCE ProCab, each speed step (of 28) is two miles per hour, the automatic Tsu notching is programmed for Run 8 at speed step 16, and the shunting is mapped to button 6 on the cab. With the shunting button on, the

Above: The chassis of a class K-4 2-8-4 shows the Maxon motor attached to a U-shaped bracket with 3-M permanent mounting tape. An enclosure containing a QSI 1.77-inch Hi-Bass speaker is mounted on the boiler backhead. Wires to the boiler and chassis are on separate color-coded connectors for easy separation of the two.

diesels will drag up the mountain at 16mph in Run 8!

Steam Decoders

Upon advice from a commercial installer of O scale decoders, I started with Digitrax DG583S decoders driving steam engine motors with Tsunami Steam for sound and lights. His comment was that with two-decoder installs, the only thing you give up is the dynamic chuff volume that changes with load. I learned later that his railroad is flat, and dynamic chuff is ineffective and, therefore, unimportant. His engines are consequently not very heavy, but I'm running heavy engines pulling long trains on steep grades. With an engine weighing eight to ten pounds, the moment the engine started to move the Tsu would indicate an "over voltage" with 10 blinks of the lights and shut down. Bill and I first blamed the Digitrax decoder. I installed an NCE 408SR decoder, and the Tsu stayed on for reasons that I don't understand. The problem was that NCE doesn't have BEMF, and I could adjust the "Kick" and "Dither" for smooth starts with a light engine or with a load, but not both situations. In addition, train speeds were very difficult to control on my 3 percent grades. I next installed a

Above: Two RE-max 29 coreless motors drive the two engines of this Allegheny. The motors came from Micro Locomotion also known as The Motorman (Eldon Shirey). Two 1.77-inch QSI Hi-Bass speakers are visible in the boiler. There is ample room in the huge firebox for two motors.

Tsu in a Mike weighing seven pounds, and the engine pulled a short train until it came to a grade, at which point the over-voltage showed up, the lights blinked, and the engine stuttered along, barely moving. The decoder was turning off and on with each motor pulse!

Another trial was an ESU LokSound XL V3.0 for steam. The LokSound has excellent motor control, and the steam sound was good with one exception — there was no "dynamic chuff" volume. The only change in volume was to throttle changes. With my heavy trains on steep grades, I really wanted the engines to bark pulling upgrade and drift quietly going down. If LokSound had dynamic chuff volumes, I would have looked no further!
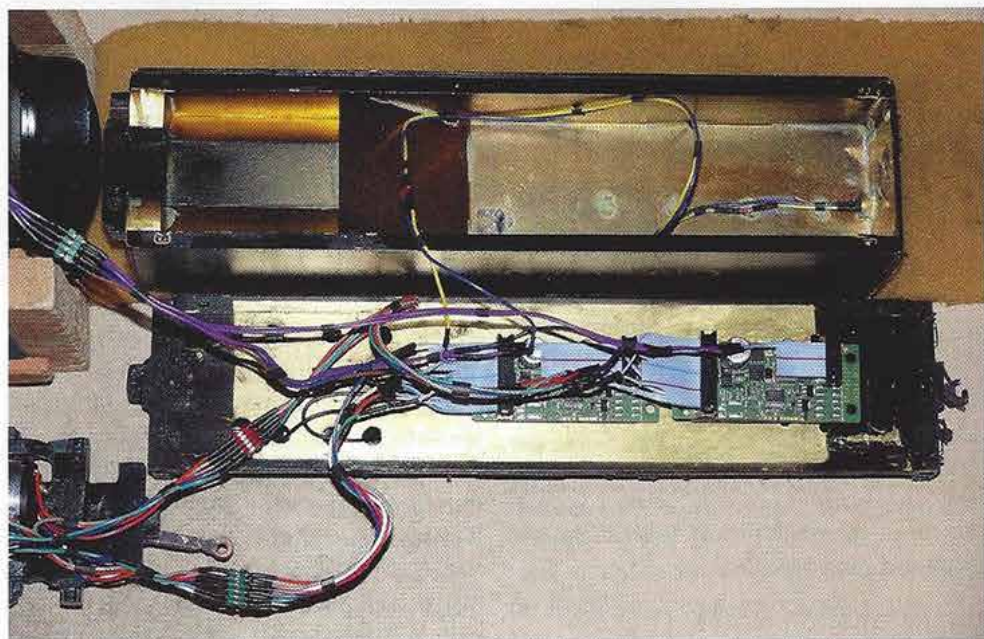
A friend who is a QSI fan loaned me a Titan for a trial. All my steam engines are powered with Maxon RE-max 29 coreless motors. The steam engine moved in jerks as the motor stopped and started after turning about one revolution at a time. When I called QSI, I was told "That decoder won't drive a coreless motor. We have a guy out west that's working on a fix for it." I returned the decoder to my friend, and that ended my foray into the world of QSI.

During that time I was offered two Digitrax DG886 sound decoders for beta

testing and put a decoder in an Allegheny for a trial. Although the Digitrax DG583S (non-sound) had good motor control, the beta sound version did not. After changing direction, the engine exhibited a large lurch when starting. The chuff was acceptable at low speeds, but at track speed it became a pounding sound, nothing like a chuff. I was so put off by the poor sound that I didn't attempt to correct the motor control. Digitrax never responded to my concerns,

so I proceeded on. I do not find a DG886 decoder listed on the Digitrax website.

At this point I had tried NCE, Soundtraxx, ESU, QSI, and Digitrax and was more than two years into the conversion with no satisfactory steam decoders. With the cost of large scale decoders, I was not willing to install decoders with the intent to replace them later with something better. By this time, my diesels were in service, and we resumed operations with small crews and

Above: The two decoders are Zimo MX696 with the front decoder at short address 1 driving the front engine Maxon and the rear decoder at short address 3 driving the rear engine Maxon. After programming the sounds to the correct function buttons using the short addresses, all other CVs are "programmed on the main" at the same time using the long address. Different short addresses enables "programming on the main" for each unit individually if necessary. One decoder drives the lights in the boiler plus one pair of firebox flicker LEDs and the second drives the lights on the chassis including the second pair of firebox flicker LEDs on the chassis. Chuff rates are calibrated using the excellent "virtual chuff" CV.
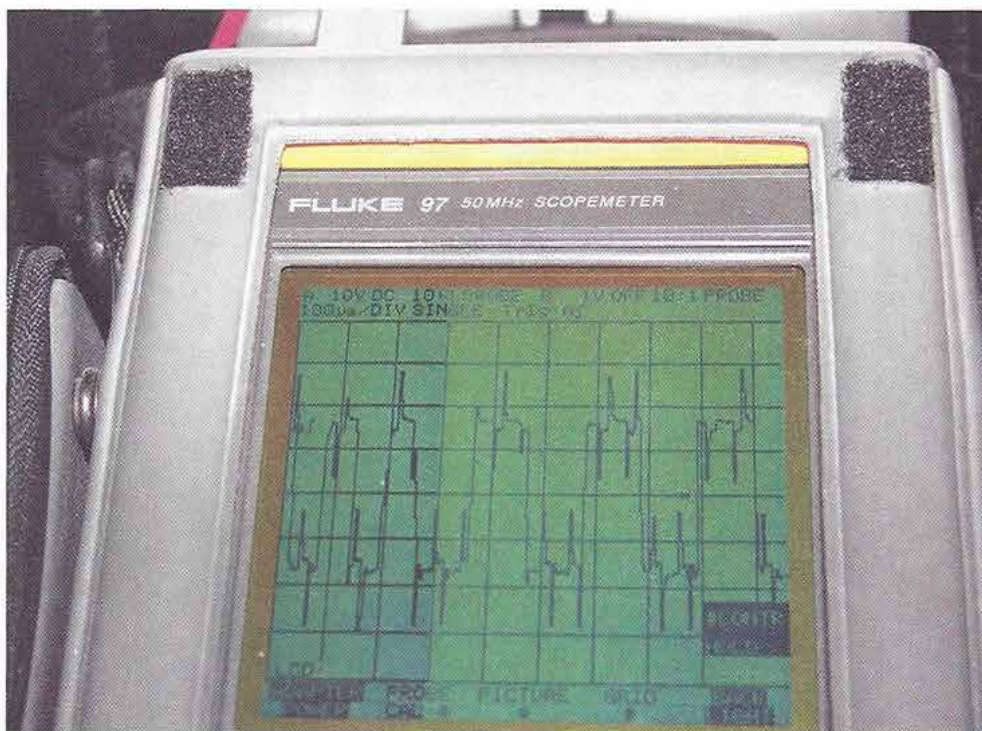
limited schedules and a few steam engines running with test decoders.

The only other sound units available were from Zimo, and only a 1.2 amp decoder for HO was listed with a large scale decoder promised. Zimo was almost totally unknown in my area. I had no other option, so I ordered a few Zimo MX645 HO sound decoders. I was happy with the motor control and sound but a four-pound engine was about the limit for them. I have them in three small engines: a 4-4-2, 0-8-0, and 0-10-0, and was at an impasse until the large scale version became available. The promised delivery date was missed; however, after a few months, a 6 amp MX695KS decoder became available. With Maxon coreless motors in my steam engines, I certainly didn't need 6 amps (and the additional cost), but the decoders were available. Most of my steam engines use them. After a few more months, a 4 amp MX696S was produced, and they finished my steam roster.

I ordered the "U.S. Steam Program" that comes with six chuff sets (German chuffs, but a chuff is a chuff). Actually, two of the chuffs are German three-cylinder engines and are not usable for U.S. engines. However, one of the chuff sets is a short, sharp sound that I have in two poppet valve Hudsons. The dynamic chuff volumes are programmable and work off a calibration run of the light engine on straight, level track as a baseline for the volumes. There is a programmable open cylinder cock sound at startup that the Tsunami lacks. The BEMF program is not quite as robust as the ESU, and there is sometimes slight lurching on downgrades. Otherwise, the performance is very good.
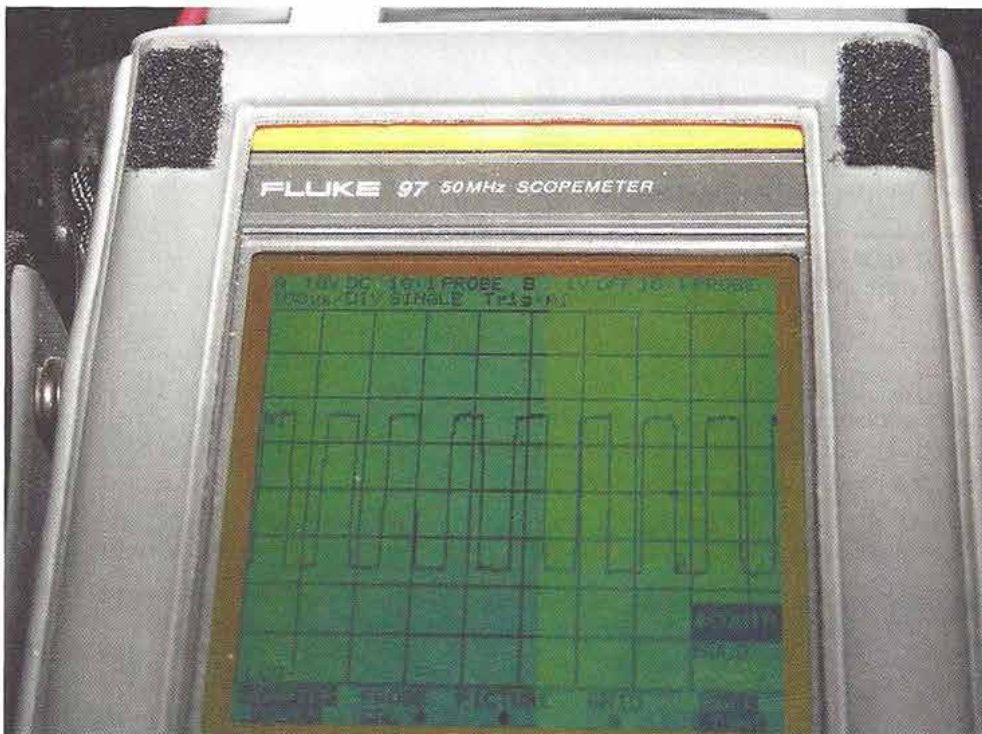
Installation Notes: Steam

The Maxon RE-max 29 coreless motors that replaced Pittman 9xxx-series motors draw less current, run at higher rpm's, have more torque, and are smaller. I discovered that if I mounted the motor as far forward as possible, I could mount a 1.77-inch Hi-Bass speaker with enclosure on the front of the backhead firing forward and down. This is only possible in engines with large fireboxes: 2-8-4, 4-8-4, 4-6-4, and 2-10-4 in my case. In smaller engines, I usually put the same size speaker in the tender, preferring a large speaker in the tender over a small speaker in the boiler. My Alleghenies are a special situation. They have two Maxons in the firebox, two 1.77-inch speakers in the boiler firing down, and two MX696S

Above: This is the scope as connected below but at speed step 4, this trace shows the 27 volt spike that the Tsu sees and shuts down due to "over voltage."
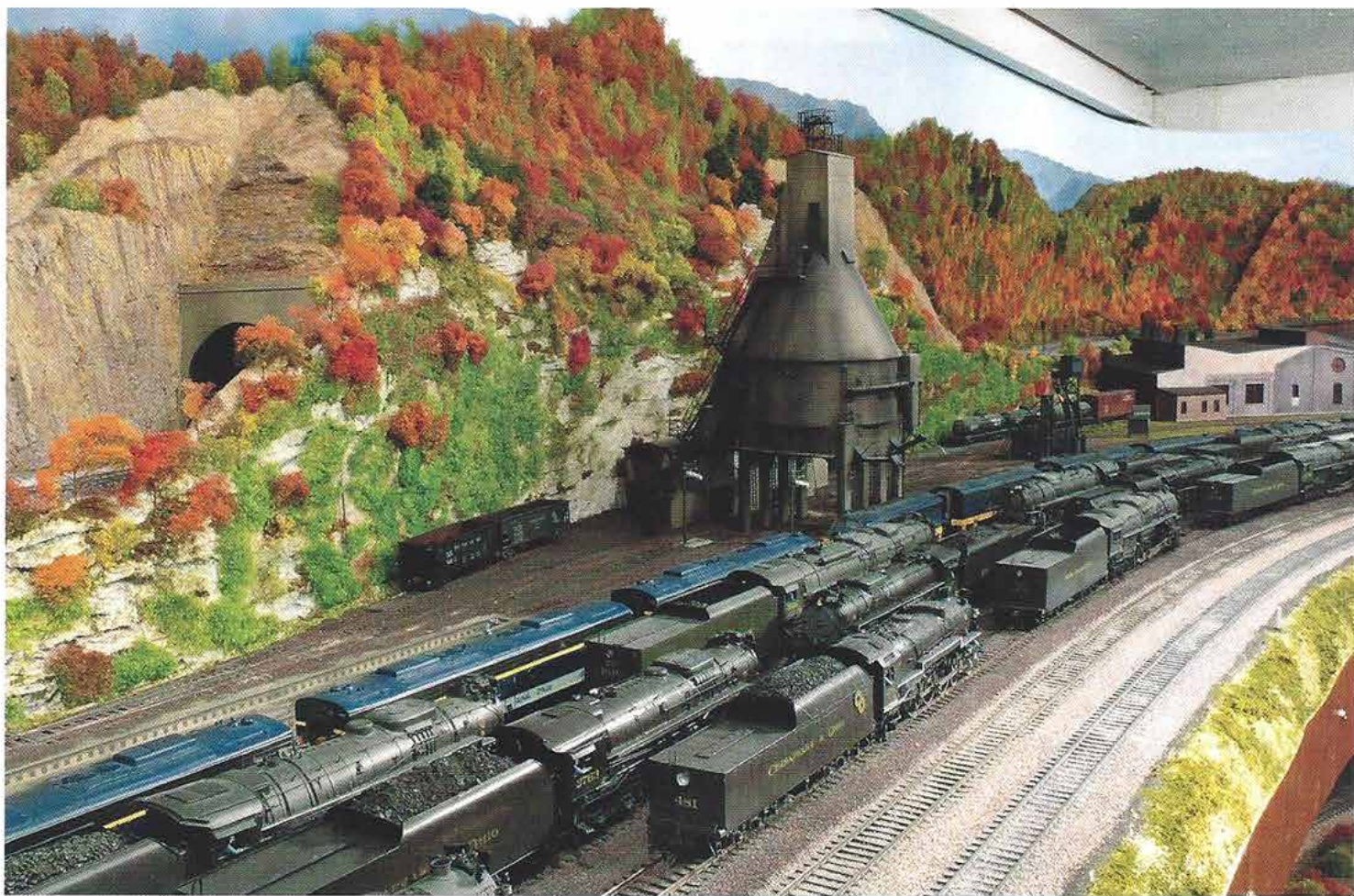
Below: Here is the scope connected across the track with the Digitrax decoder controlling the Pittman 9xx4 motor, TSU sound only at speed step 0. With each vertical division at 10 volts, the track voltage for O scale is 16 volts AC.

decoders in the tender. The firebox is so long that I install SMD LEDs for each decoder to get two flickering fires on each side. It takes a lot of wires to connect two decoders in the tender to the engine!

With the 28 speed step mode visible on the NCE ProCab, I program the speed table for 2mph for each speed step for both steam and diesels. All engines except switchers have high momentum settings: CV3=100

and CV4=50 with BEMF intensity CV 58=225 (of 255). These settings are the same in all steam road engines so they can be double-headed (consisted) in any combination. Trains slow down realistically on upgrades. The open cylinder cock sound at startup is programmed with a high volume and long enough for at least one and one-half driver revolution. The length of time the engine stands before the sound turns

Above: A few of my 30 steam engines and 22 diesel units that were gathered in the West Yard to be removed for the conversion from CTC80 to DCC. The engines filled the four long tracks in the yard.

on is programmable so that brief stops don't initiate the sound.

Decoder Notes

There have been some changes in decoder availability for O scale since I completed my installs. As mentioned earlier, the LokSound diesel programs have been updated. Because of its excellent motor control, a LokSound XL diesel program should be considered. I am not familiar with Zimo diesel programs since my diesels were done before I found Zimo, but there is a long list of available sounds on the website. Protocraft has listed a "Super Tsunami" with a 3.5 amp rating; however, the open cylinder cocks at startup is missing from the steam program, and I do not know if the 27 volt spike has been resolved. If dynamic chuff and open cylinder cock sounds are important, then Zimo decoders for steam seem to be the only possibility. The QSI Titan Large Scale is listed on the manufacturer's website, but I don't know if it will run coreless motors. I'm very happy with my current decoders, and when I add more engines, I'll

probably stay with them to standardize as much as possible.

Although it has been a long, expensive changeover, the improvement in motor control and the addition of lights and sound has been well worth the costs in time and money.

I want to acknowledge the expertise and many hours of help from Bill Scheerer. Without his generous offer of help I probably would not have attempted the conversion. During this time, he was converting his B&O layout with its Color Position Light signals from RailCommand to DCC and used the same signal circuits he provided to me.

Bill is an electrical engineer and professional railroader. He has worked in the industry for 43 years and is retired CSX Transportation Chief Engineer Communications and Signals. He has also worked as an executive for Harmon Industries and GE Global Signaling. He has been a model railroader since childhood and enjoys sharing his love of both railroading and model railroading with his grandchildren.

Art Luescher (Zimo) and Matt Herman (ESU) were very helpful in my search for suitable O scale decoders. 🚂