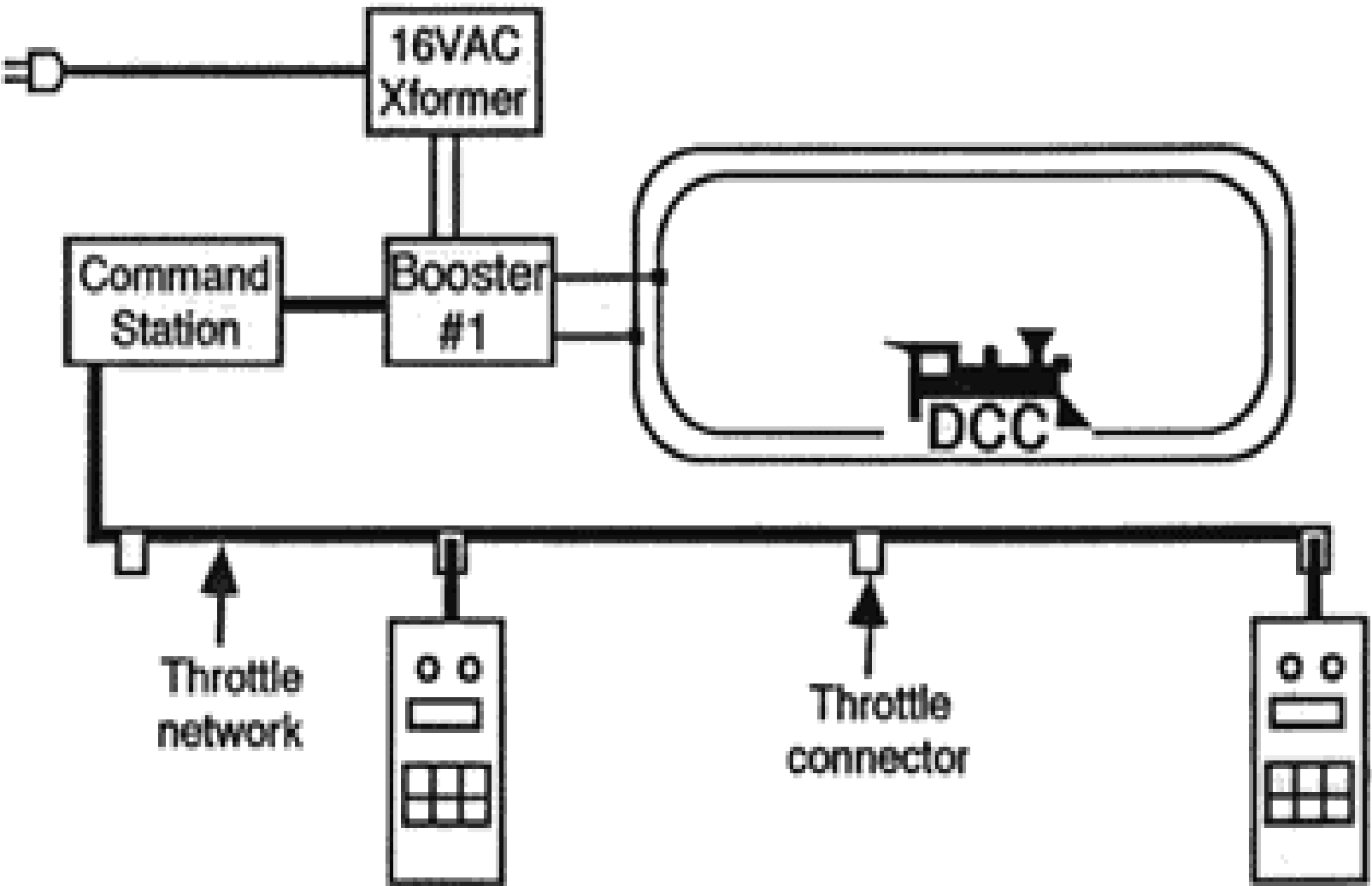


DCC Basics and Beyond

Lee Dobyns

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DCC Overview



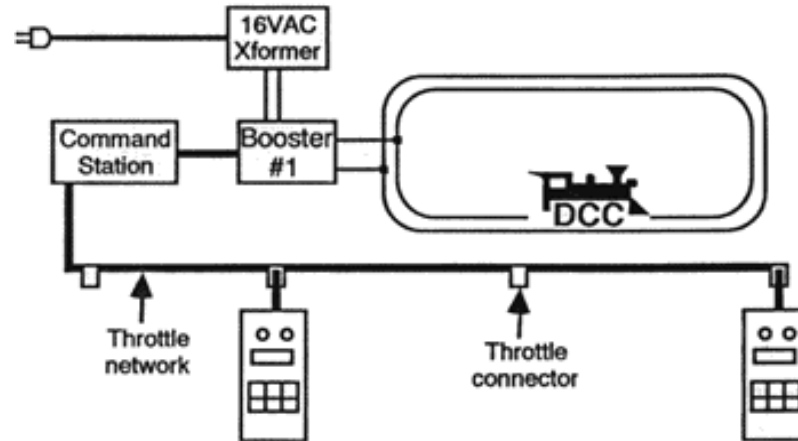
Why use DCC instead of DC

- Control more than one train on a track at the same time.
- Eliminates the need for blocks.
- Track wiring is simplified.
- Reversing loops are invisible.
- Puts wireless control in the hands of the operator. More realistic.
- Operate Loco's on different layout.
- Most new equipment supports DCC. Loco's and Accessories.

What is DCC

- Digital Command Control
 - DCC puts digital control information into the electrical power. Call this the DCC signal, although its both power and control information together. The DCC signal is put on the model railroad's tracks.
 - DCC "mobile decoders" in locomotives or tenders on the tracks use the DCC signal to power and control their locomotive's speed, direction, lights and sound.
 - DCC "stationary decoders" may also be connected to operate the track's turnouts and other accessories.

How DCC Works



- The user operates a throttle or "cab" equipped with a numeric keypad and other control buttons. Information from the throttle is sent to a DCC "command station" which converts it into DCC control information. This DCC control information is then fed to a "booster" which uses it to create the DCC signal and feed it to the tracks.

DCC Capabilities

- Control Execution
 - Each locomotive on the track layout is equipped with a uniquely addressed DCC mobile decoder. Using a throttle, the operator can select any locomotive on the track by its address and alter its speed, direction, lighting, and other features.
- Sound
 - Some manufacturers offer "sound decoders". In addition to implementing all the standard DCC locomotive control functions, these decoders are connected to a small audio speaker through which they play locomotive sounds.
 - Diesel locomotives play a diesel motor hum which changes pitch relative to engine speed.
 - Steam locomotives emit the characteristic chuff sounds at speed appropriate rates. Brakes squeal and valves hiss. High end sound decoders feature programmable sound tables.

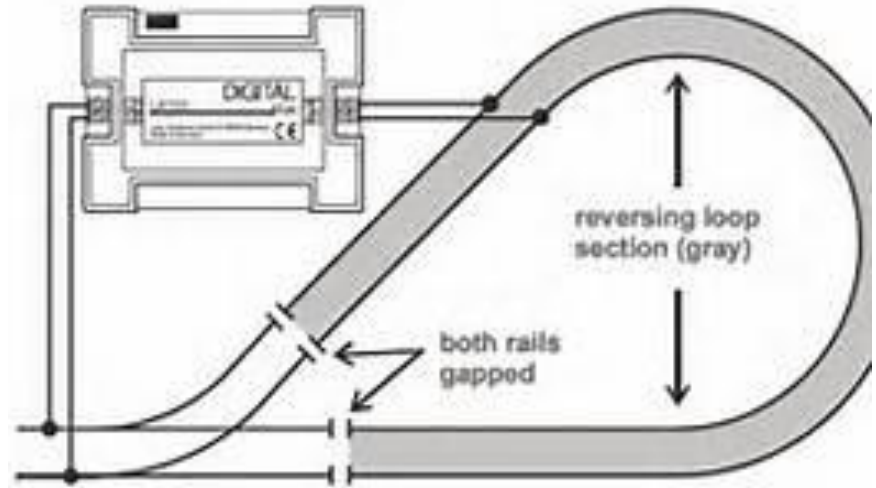
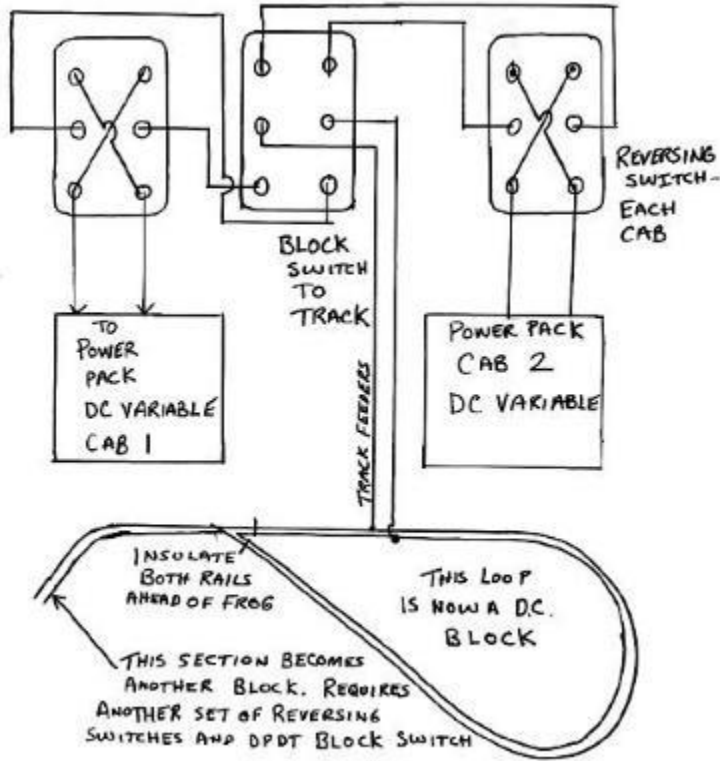
DCC Compatibility

- The DCC standards specify voltage levels, pulse durations, and digital information formats. This means that a decoder from any manufacturer will respond to commands and programming signals from DCC systems made by any manufacturer.
- Connection of DCC control system components has been left up to the individual manufacturers. Unfortunately this means that throttles, command stations, and boosters from different manufacturers aren't usually compatible.

Converting to DCC

- Blocks are no longer necessary. Mainlines should be always powered. Can still switch off sidings to reduce power load. Best to use electro-frog turnouts. Insulfrog turnouts will work. Power Routing turnouts should never be used. Burned and be careful where you put the ashes.
- Break up layout into power districts with max running load of 4 trains per district. No more than 6 QSI decoders per district to help in restart after shorts.
- Total running trains will determine the Booster size (Amps).
- Use PSX CB's/RL's for power protection. Club as 32 CB's and 17 RL's. Life time warranty.
- Must isolate all rails on RL's.
- RL's must be longer than the train.
- Club uses Yellow LED's to indicate track power.
- Convert passenger cars and loco lights to LED's to reduce DCC load. Avoid powering things off the DCC power.

Reversing Loops



- What happens when a track loop back?
- Manual DC, auto exists
- Automatic DCC, invisible

DCC Systems (Pros and Cons)

- **Digitrax** – For small layouts the Zephyr (DCS 50-51-52) supports 4-5 trains. For large layouts the DCS100/ DB150 5 Amp system supports 30+ trains. DCS200 8 Amp system. Duplex supports 30+ wireless throttles. Additional receivers can be added to reduce dead spots. Computer Interface via PR3 and Locobuffer USB. Very limited Circuit Breaker and Reversing Loop products.
- **Lenz** – Modular, expandable, computer interface via USB. No wireless control.
- **NCE** – DCC Twin for small layouts. PH10R for large layout, radio controlled. Add DB5 booster for more capacity. Can operated 60 wireless throttles. Can add RPT1-Radio Repeater for coverage. Computer interface via USB card. Battery door awkward. Four AAA batteries.
- **MRC** – 1.6 to 10 Amp systems. Additional 8 Amp boosters. 32 wireless throttles. Computer support via cable module.
- **CVP Products** – EasyDCC. Design looks good. Limited to 2 receivers, 16 wireless throttles. ZoneShare gives CB and RL functions. No Computer interface.
- **ESU** – Cab controlled Wi-Fi system.
- **Zimo** – New system.
- **DCC Specialties** – PSX (CB) and PSX-AR (AR) products.
- **SPROGII** – Used to program simple to complex decoders via DecoderPro.
- **Raspberry Pi** – Wi-Fi controller that connects via Locobuff-usb to Digitrax.

Batteries and Chargers

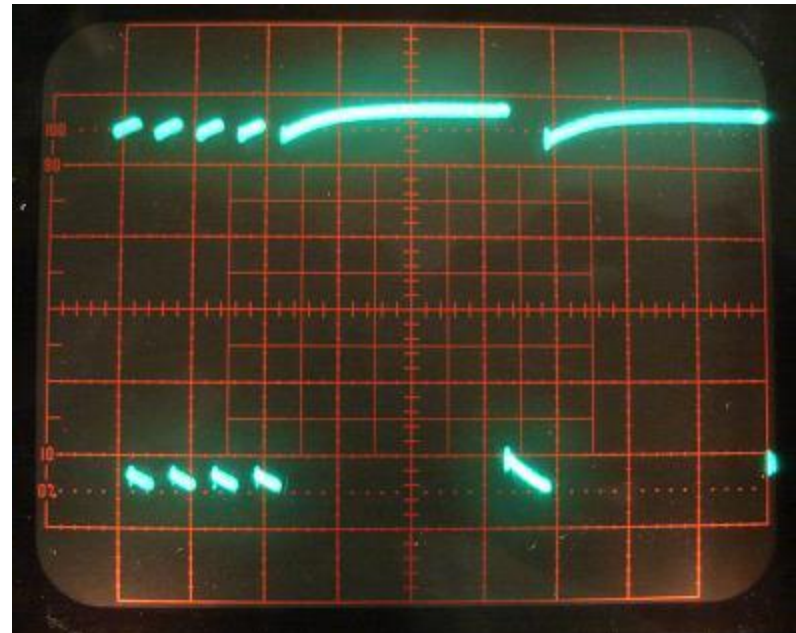
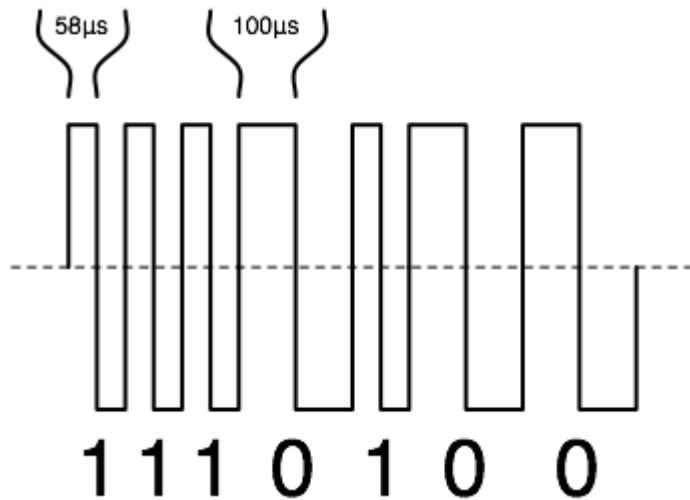
- **Maha Powerex MH-C1090F** charger
 - 8.4, 9.0, 9.6 volt
 - NiCad and Nimh batteries
 - Brand: **Maha PowerEx 9.6V 230mAh IMEDION**
 - \$12.97 / each. Amazon
 - Last about 2-3 years
- **Never put them in your pocket.** Change can short them out and burn you. It will also kill the battery. They melt in seconds.
- **Never put them in the throttle backwards this will short out and kill the battery.**

Diving Deeper into DCC

- Track Power
- Some more details on DCC
- Mobile and Stationary decoders
- CV Registers
- Programming Track
- Programming decoders
- Consisting
- Larger DCC layout
- Out club layout
- Troubleshooting

Track Power

Track Power is a square wave. Basic troubleshooting can be done with a digital meter set to AC. HO will read about 13.8 Volts AC. N Scale lower and O/G higher. The digital information is sent through the track to the loco by varying the width of the pulses. The left side shows a theoretical waveform the right side is a picture from an oscilloscope. A meter will show you have track power but not that it's really working.



What happens when you press Select on the throttle

- Enter loco address and press select.
- Throttle sends address and select to wireless receiver.
- Receiver verifies RA address, logs throttle ID then sends address and Select to Command Station via loconet.
- Command Station opens Slot for loco address.
- Command station sends back message to throttle to turn on Green Select Light.
- All additional commands for this loco go through this slot.
- The Address and Select are sent to the layout via track power.
- All Loco's are listening. The correct loco decodes the address and is then ready for additional commands. Sound loco's would power up at this point. Next throttle commands might be direction, speed, horn, bell or lights.
- Our command stations is set to have 120 slots. Slots are set to auto-purge after 600 seconds of being inactive.

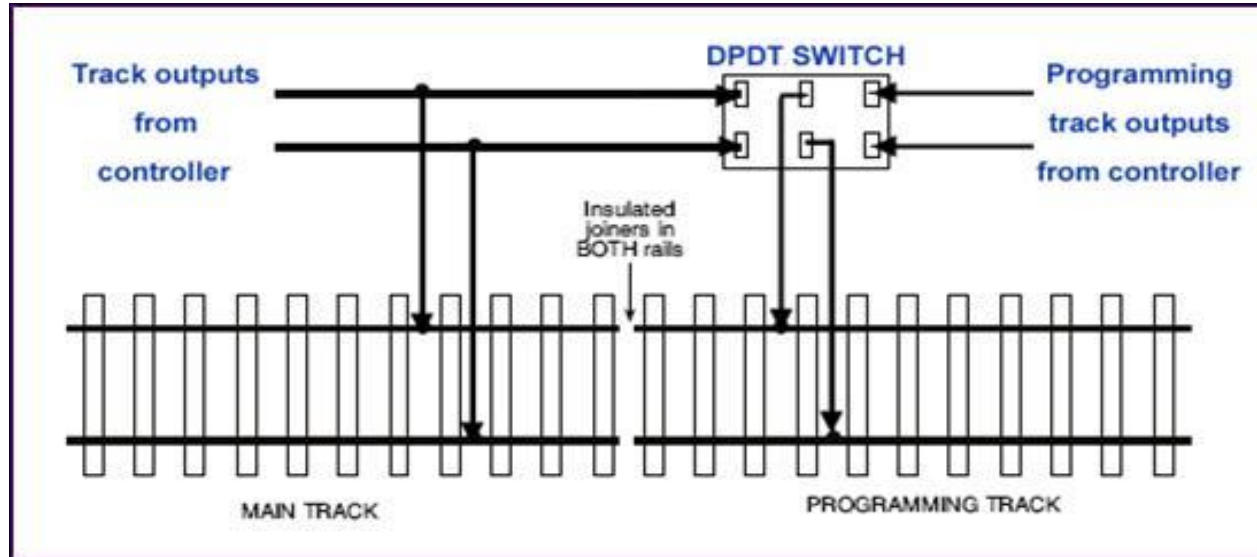
Mobile and Stationary Decoders

- Decoders in loco's are mobile decoders. You have addresses from 1-9999. All decoders come set as 3. Most get changed to the cab number.
- Stationary Decoders use a different address range (1-999). They are separate address types from mobile decoders.
- We use one type of stationary decoder.
 - Walthers Cornerstone DCC turntable (70).

DCC CV Registers

- DCC uses CV registers to control the functions within the decoders (Configuration Value).
- Motion Decoders have about 80 registers.
- Sound and motion have about 280 registers.
- Setting a 2 digit address uses CV 3,4
- Setting a 4 digit address uses CV 3,4,17,18,29.
- CV's can be programmed with a throttle but this is not user friendly. It requires detailed knowledge of each CV and math.

Programming Track



- Isolated Track section for programming decoder
- Suggest completely separate section of track.
- When in program mode, never let loco wheels connect main and program together.
- Suggest area away from main layout for programming track and computer. Programming on the main can be done but it is risky.
- Controller and Command Station are the same meaning.

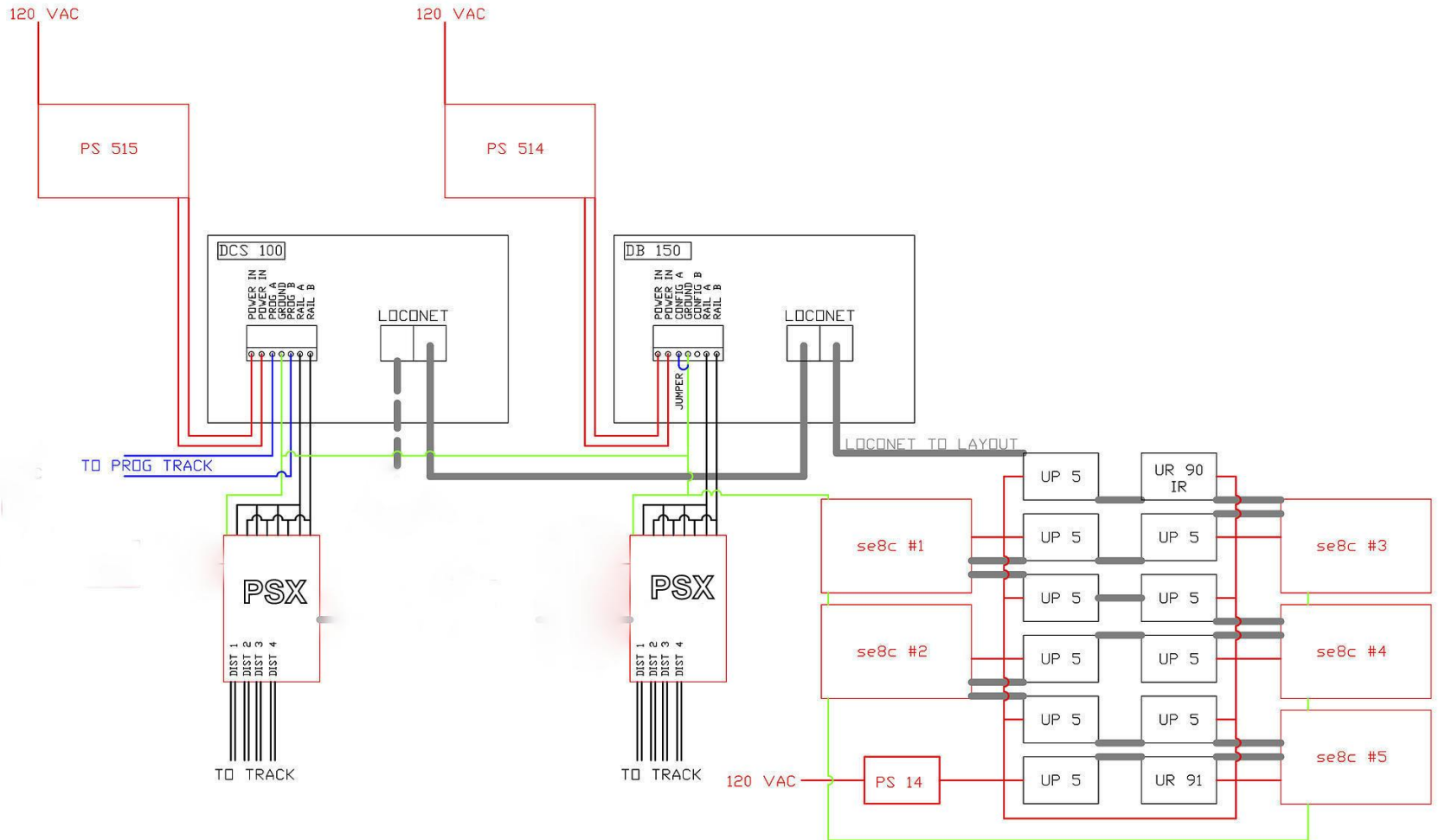
DCC Decoder Programming

- The computer is the only sane way to program decoders. Decoder Pro is the free JMRI program. We like free.
- Decoder Pro does the math and tells you the meaning of each register. No manuals needed. Each screen is organized by functional area. What you want to do.
- It also has a CV mode for those that like pain.
- **Only select decoders that have read back capability.** This excludes early MRC decoders. Blueline can be a pain. Suggest Digitrax or Soundtracks.
- SPROGII will program any decoder. This is the best way to go for decoders plus it has a built in Command Station to allow testing without taking your loco to the layout.
- With Digitrax use a Locobuffer USB to interface from computer to the command station for programming stationary decoders.

DCC Consisting

- Consisting allows two or more locomotives to operate with one throttle.
- If you always want the AB.. pairing to be the same then the simple way is to set all decoders to the same address (direction can be modified as well). Make sure you label the one with the different cab number. You will forget and back to the computer to read it.
- If you frequently change the consist pairing then use the DT400R/402D throttle to setup consisting via the MU function. The DCC command station will store the consist pairing. If the backup battery fails you will loose the consists. Not hard to fix. Make sure you write down the consists.
- Before you connect the couplers check to see if the speeds are matched. Use DecoderPro to adjust the speed tables if they are different. This takes some time and patience's.

Typical Large DCC Layout



Scalerails DCC Design

San Berdo Summit Denver Colorado Springs

LA, Cajon Victorville Castle Rock Pueblo / Staging

Upper Helix Rock Island Lower Helix

Hon3

DCS100 DB150 DB150 DB150

!_____!_____!_____! loconet

!

!___UR92___UR92___UR92___Raspberry Pi connects to Wi-Fi

!

Router then to Smartphones

!_____LNRP_____LNRP

!

!

Upper Level

Lower Level

UP5's

UP5's

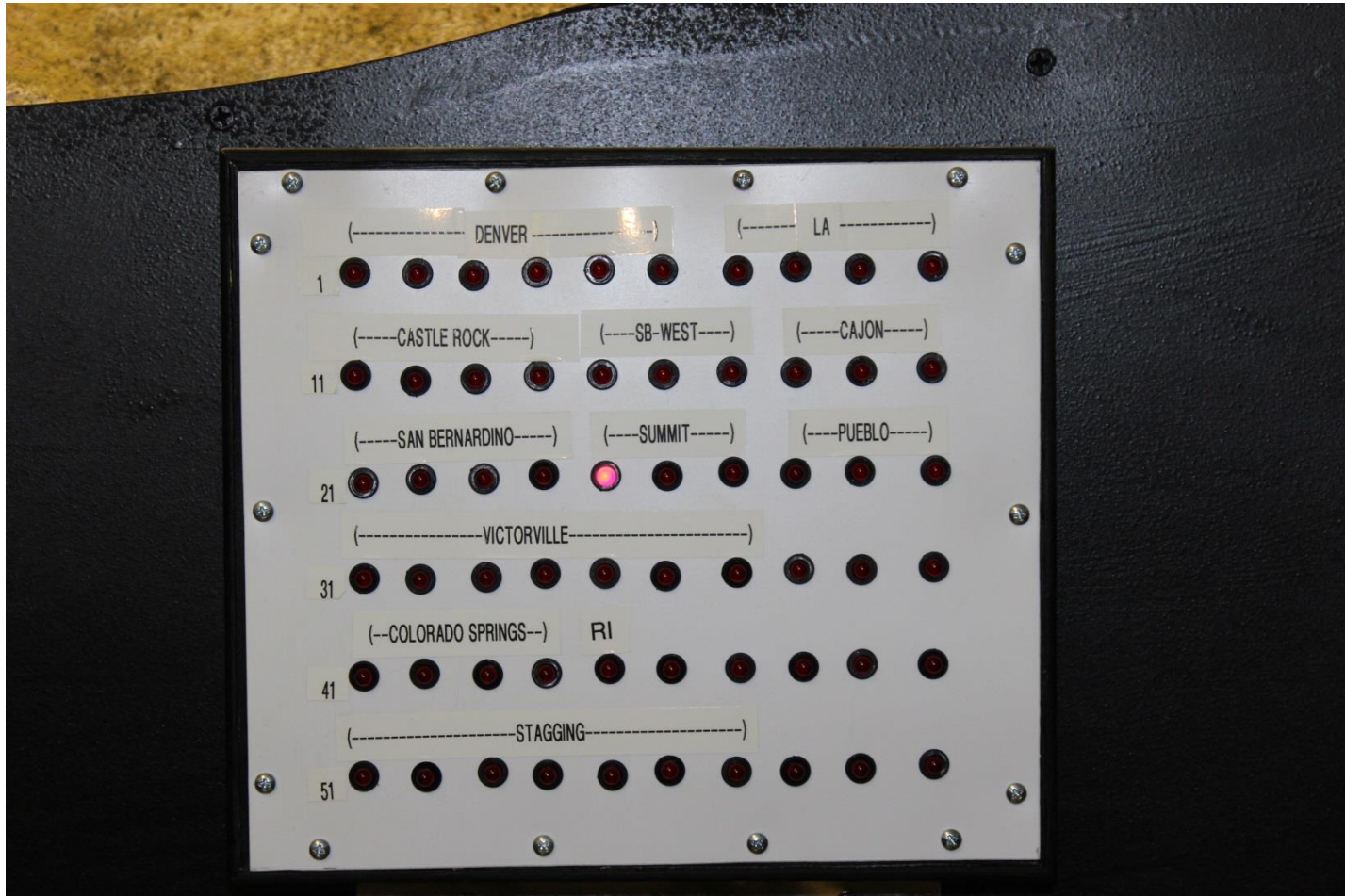
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Turntable, Throttles

Throttles

Central Power Status



Troubleshooting

- Good idea to add Sonalerts to PSX products to hear the short. LED's can be added as well.
- Use meter set to AC to test power. Reverse leads to make sure square wave is balanced. Can indicate a DCC Command Station or booster problem if you get different readings.
- Flashing headlight mean DCC communications problem. Often need to reset DCC system.
- Most shorts are turnouts set wrong or de-rails.
- Broken point rails cause most problems.
- Always turn off track power before soldering.
- If a loco stops responding check to see if the address is correct first. We have seen them reset to 3 on their own.

Locomotives

- Most new locomotives come with DCC (motion and/or sound).
- All are set to address 03. Usually want to set to the cab number (1-9999).
- Address can be changed with throttle or computer.
- Newer MRC decoders support read back capability. Required to set by computer. Older ones do not.
- BLI (Blueline) series is also difficult to work with. Other BLI OK.
- New MTH are easier to program. Ones from 2009 can have firmware updated.
- Most manufactures support the 8 pin plug if decoder is not already installed. Easy.
- If not DCC ready then you have some work to do. You may need help.
 - Check the running and stall current of the motor.
 - Set the DC track voltage to 12VDC.
 - Set the meter to high/10 amp range. Connect meter in series with DC track power and the loco.
 - Connect power to the motor. See how much current the loco draws running. Hopefully 250-300 ma.
 - Then stall the loco to measure the peak current. If it stays around 500 ma then you are ok. If it goes over 1 amp then you must repower the loco or buy a high current decoder. Digitrax is the only company making a 2 amp decoder. 2 amps running 4 amps peak. It is large and would require a steam tender. Would not fit in a diesel frame.
 - Can type motors usually draw less current when stalled. Open frame (5 pole) motors will cause trouble.
 - Check if the motor is isolated from the frame.
 - Find the two motor wire leads. Disconnect them. Use the ohms setting on the meter to make sure that the motor wires are not in contact with the rail pickups (track power).
 - Many old motors use the frame of the motor for one of the power connections.
 - If so, you must isolate the motor or you will burn out the decoder.

DCC System Basics

- Many systems available today.
 - Layout size and total number of operating locomotives are key parameters.
 - Don't suggest mixing DC and DCC.
- Most DCC systems require the following:
 - AC power pack (converts 120VAC to 16-18VAC)
 - Command station (Develops DCC track voltage and digital controls).
 - Throttle (allows user to operate one or two locomotives).
 - Decoder (installed in locomotive, receives DCC signal from throttle via track to operate DC motor in locomotive (also lights and sound if installed)).
- Digitrax products
 - DCS50, 51, 52 – good for up to 4 basic locomotives. 22 slots. Keep in mind that complex sound takes more start up power. (\$150-225)
 - DCS100 – good for 8-10 locomotives. Complex sound OK. 22-120 slots. (\$400)
 - DB150 – good for 8-10 locomotives. 22 slots.
 - DT402D – dual throttle (\$200)
 - UT4/UT4D – single throttle (\$70, \$119)
 - UR90 - IR receiver (\$40)
 - UR92 – IR and Radio receiver (\$120)