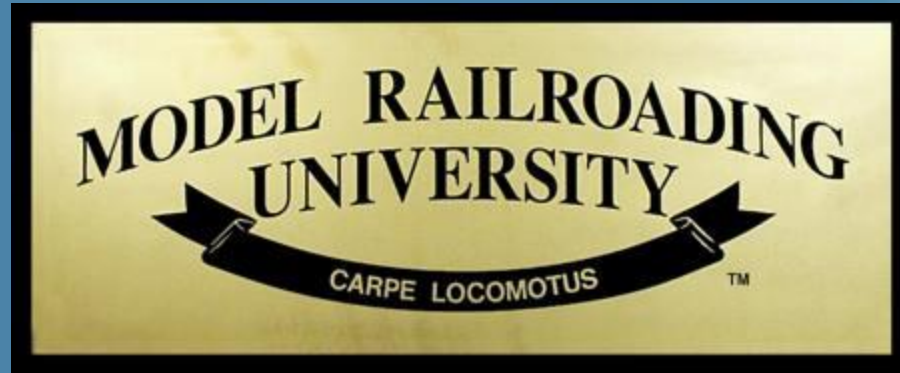


DCC Layout Wiring Basics

By Barry Rosier and Mike Dettinger



DCC Layout Wiring Basics

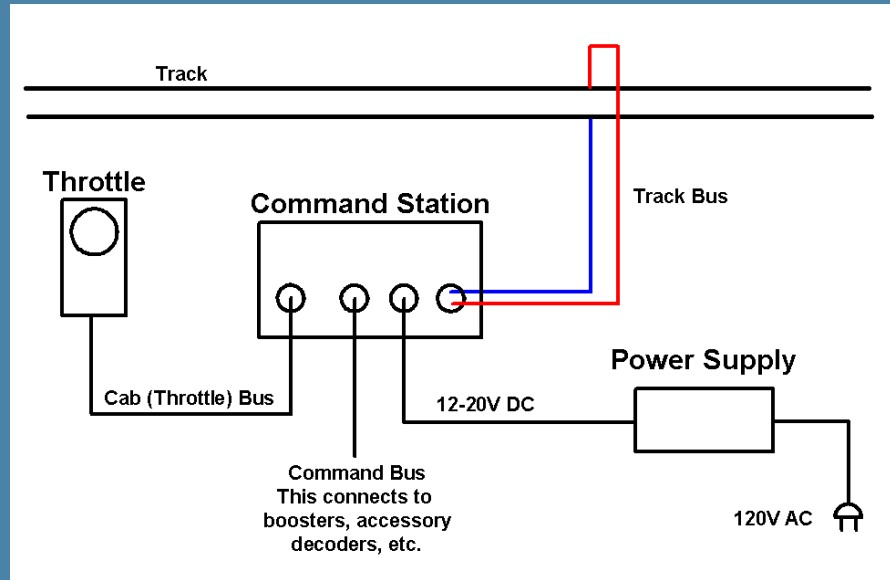
- This presentation will discuss different wiring techniques for DCC layouts. We will cover the following:
 - DCC System components
 - Different wiring runs (i.e.: busses) needed
 - Modular wiring and connectors
 - Determining power requirements
 - Wire sizes
 - Power districts and booster power wiring
 - Wiring for reverse loops
 - Programming track
 - Connectors for modular layouts

DCC Layout Wiring Basics

- We will cover bus wiring for the following DCC systems:
 - Digitrax
 - NCE
 - MRC
 - *Most of this information is universal in nature and applies to all DCC systems*

DCC Layout Wiring Basics

- Basic DCC system diagram
 - Common components of all systems



DCC Layout Wiring Basics

– System Components

- Command Station – The command station is the heart of your DCC system. This outputs the DCC signal to your layout that controls your locomotives and accessories such as turnouts, etc.



DCC Layout Wiring Basics

- System Components
 - *Booster – Boosters provide additional power capacity to your DCC system. This allows you to operate more locomotives and accessories at the same time*



DCC Layout Wiring Basics

- System Components
 - Cabs – Cabs, or Throttles, connect to the cab bus and allows you to control your locomotives and accessories such as turnouts, etc. by sending commands over the track bus and command bus



DCC Layout Wiring Basics

– System Components

- **DCC Circuit Breakers:** Provide short protection after the booster. The primary reason for this is to create additional power districts so a short affects a smaller portion of the layout. These must have a lower current trip point and quicker response than your booster to work correctly.
- **Auto Reversers:** Automatically switches the power phase on the track when shorted. Commonly used on reverse loops, turntables and wyes.
- **Accessory Decoders:** Decoders that control accessories on your layout. The most common use for these are switches and signals, but many other applications are possible such as lighting control, etc..

DCC Layout Wiring Basics

- DCC busses
 - Track bus
 - This bus is connected directly to your track. It carries the DCC signal to your locomotives and any other device connected to the track. This bus is common to all DCC systems as it carries the NMRA standard DCC signal. It consists of two individual wires

DCC Layout Wiring Basics

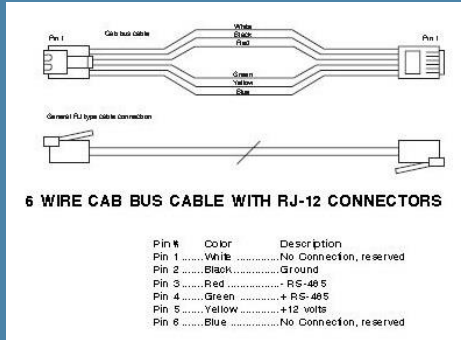
- DCC busses
 - Command bus
 - This bus is proprietary to each DCC system. It allows all of the manufacturers DCC devices (boosters, accessory decoders, etc.) to communicate with each other, as well as certain 3rd party devices that support that manufacturer. There is no common connector standard. Each manufacturer has their own. This bus does carry the NMRA DCC signal

DCC Layout Wiring Basics

- DCC busses
 - Cab bus
 - *This bus is proprietary to each DCC system. It connects the throttles to the command station. NCE throttles plug into the NCE cab bus, etc.*
 - Loconet
 - *Note: on Digitrax systems the command and cab busses are one and the same. This is the Digitrax Loconet bus. All devices that communicate with a Digitrax command station use Loconet.*

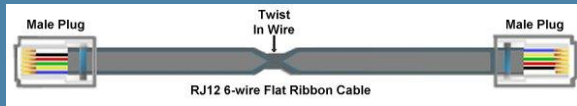
DCC Layout Wiring Basics

- Wiring DCC busses
 - Cab/command bus wiring



NCE Cab Bus

Digitrax Loconet

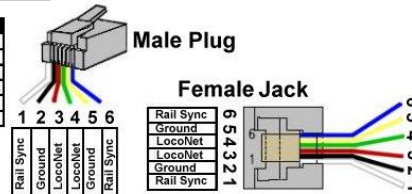


– Follow the specifications provided by each manufacturer for wiring. Most systems use some form of RJ connector and six to eight wires. You can buy premade cables or make your own. MRC uses an eight wire cable for it's cab bus. NCE and Digitrax use six wires

Digitrax Wiring Standards

Pin No	Colour	Function	Voltage
1	White	Rail Sync-B	7 vdc
2	Black	Ground	—
3	Red	LocoNet	14.5 vdc
4	Green	LocoNet	14.5 vdc
5	Yellow	Ground	—
6	Blue	Rail Sync-A	7 vdc

All components are RJ12 6-wire
Do not use RJ11 4-wire.



DCC Layout Wiring Basics

- *Wiring DCC busses*
 - *Command bus wiring*
 - The DCC standard specifies the signal on the command bus. The DCC standard does not specify the wiring or connectors.
 - You can mix most vendors boosters, but you will have to create custom cables to connect them. Mixing different manufacturer's boosters is not recommended unless you are reusing existing hardware.
 - For modular (RJ) cables, do **NOT** use phone cables as they typically reverse the pins in the cable. If you make your own connectors, be sure to use the proper type for either stranded or solid wires.

DCC Layout Wiring Basics

- *Wiring DCC busses*
 - *Cab bus wiring*
 - There is no standard for the cab bus, each manufacturer is proprietary. You generally must use the same brand for your cab and your command station.
 - The cab bus is usually in a “daisy-chain” around your layout
 - Many DCC systems provide a wireless cab option, but you should still plan on installing a cab bus so you can plug in if required.
 - Same rules regarding phone cables applies to the cab bus.

DCC Layout Wiring Basics

- Wiring DCC busses
 - Track bus wiring
 - Carries electrical power to track
 - Use heavy wire! This is due to voltage drop not current carrying requirements.
 - Wire run length* recommendations:
 - Track feeder wire should be #18 to #24 AWG, connected to every individual section of flex track. Should a rail joiner solder joint fail you will still have conductivity
 - Track bus wires should be twisted to help eliminate interference from and with other wire busses under your layout. Run the track bus away from other wire runs

Stranded Wire Size	10% V Drop 5A Booster	5% V Drop @5A 10% V Drop @ 10A	5% V Drop 10A Booster
18 AWG	20 Ft	15 Ft	7 Ft
16AWG	40 Ft	20 Ft	10 Ft
14 AWG	70 Ft	35 Ft	18 Ft
12 AWG	100 Ft	50 Ft	25 Ft
10 AWG	130 Ft	65 Ft	33 Ft

* Run length is distance **out to track and back.**

DCC Layout Wiring Basics

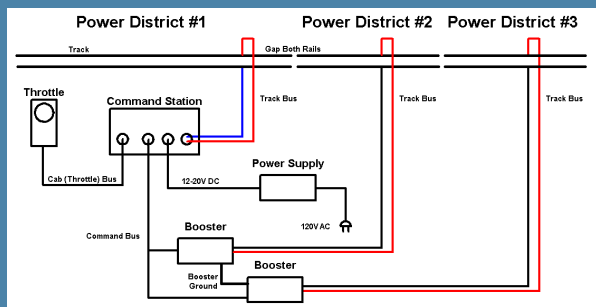
- *Determining power requirements*
 - You need to add up the current, in amps, of all the devices powered by your DCC system. This includes:
 - Locomotives: Be aware that sound locomotives draw more power than non-sound locomotives, especially at power up.
 - Switch Machines, if you plan on using DCC powered accessories
 - Rolling stock lighting and any other special effects
 - Anything else attached to your DCC buses that do not have their own power supply
 - If the load exceeds the rating of your DCC system you will need to divide your layout into power districts using boosters

DCC Layout Wiring Basics

- *Determining power requirements*
 - Total Locomotive Current Draw: Be aware that sound locomotives draw more power than non-sound locomotives, especially at power up
 - Count the number of simultaneous operating locomotives, rolling stock lighting, and any other devices or special effects connected to the track
 - Determine motor current per locomotive
 - Don't know? Use: N=½ Amp, HO=¾ Amp, S=1½ Amps, O=4 Amps for nonsound, add about ¼ Amp for sound locomotives
 - Calculate total current
 - Example: 14 HO locos with sound x 1 Amp per locomotive = 14 Amps

DCC Layout Wiring Basics

- Booster Sizing and Wiring
 - Boosters are used to separate your layout into power districts. This distributes the load of the locomotives and accessories to different areas of your layout. They also provide short protection
 - The booster should have enough capacity to handle the load of the power district it feeds
 - The booster connects to the command bus and to the track bus of it's power district
 - Do not daisy chain your boosters with your cab bus. Connect the boosters to the command bus
 - Boosters should be placed near the location of the power district the feed



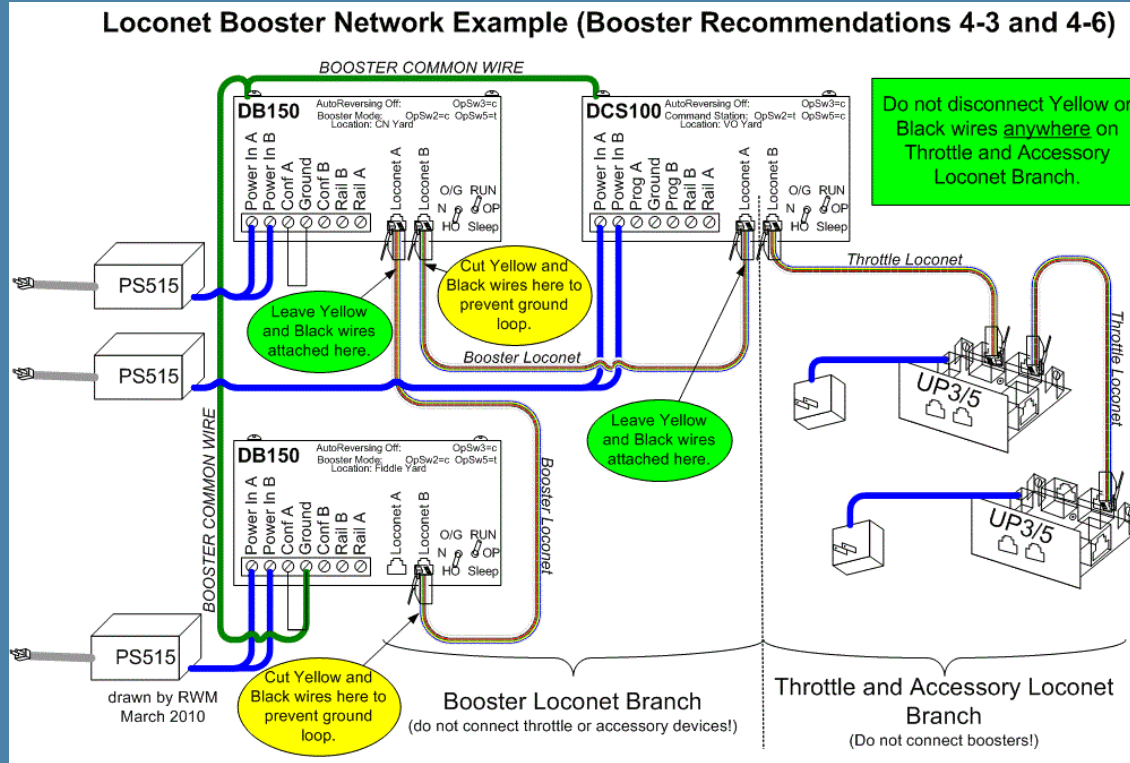
DCC Layout Wiring Basics

- Booster Wiring
 - Do not daisy chain your boosters with your cab bus on Digitrax systems. Connect two separate Loconet busses, one for the throttles and one for the boosters. Make sure you do not connect pins 2 and 5 of the booster command bus cable if you make your own cables. If buying Loconet cables you will need to cut the wires to pins 2 and 5 (Loconet ground). If not you will cause a ground loop and corrupt the DCC signal

DCC Layout Wiring Basics

– Digitrax booster wiring

Loconet Booster Network Example (Booster Recommendations 4-3 and 4-6)

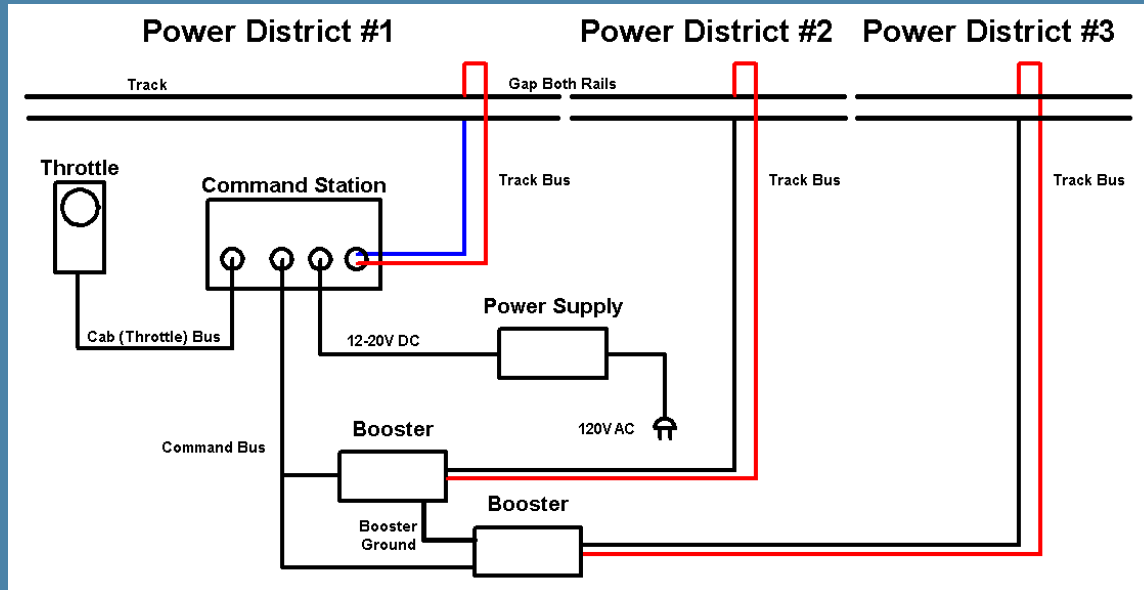


DCC Layout Wiring Basics

- Power Districts with circuit breakers
 - Circuit breakers are an additional layer of short protection for your layout. They can trip at a lower current level than a booster. They also handle current inrush (a sudden rise in current flow due to locomotives or devices starting) much faster than a booster
 - Circuit breakers can be used to break power districts powered by a booster into sub districts, spreading the power load out more
 - You should use a separate booster for power to DCC accessories
 - And **Always** gap both rails between power districts and sub districts

DCC Layout Wiring Basics

- Booster Grounding
 - Boosters should be connected via a heavy wire between their ground terminals



DCC Layout Wiring Basics

- Auto Reversers
 - Auto reversers are used to reverse the power phase (no polarity in DCC) when a short is detected.
 - The reverse section of track needs to be longer than your longest train
 - Auto reversers are commonly used for:
 - Reverse loops
 - Turntables
 - Wye's

DCC Layout Wiring Basics

- Auto Reversers
 - Two Types
 - Relay. Older design, cheaper costs, but usually trip slower (could cause sound engine to reset)
 - Electronic. Modern design. Trips very fast. Costs more than a relay design but necessary for sound locomotives to prevent sound resets

DCC Layout Wiring Basics

- Program Track
 - The program track is a separate connection on your DCC system that is used to program your locomotives
 - It is isolated from your track bus connection in your DCC system
 - It **MUST** be connected to an isolated section of track, preferably off of your layout. If you short the program track to your track output you can damage your DCC system

DCC Layout Wiring Basics

- Connectors for Modular Layouts
 - Connectors are used to connect the different wiring busses under a modular layout. If you are building to a module standard use the recommended wiring standard and connector type
 - Anderson Power Pole PP30 connectors are recommended in several modular standards
 - Molex is another connector manufacturer. Their .093 pin size series works very well. They make housings in various pin counts



DCC Layout Wiring Basics

- Connectors for Modular Layouts
 - DCC bus connections (cab bus, command bus) are best ran directly between DCC devices such as universal throttle panels, etc.
 - Using connectors between each module may cause signal issues in larger layouts
 - The cables can be ran through holes in the module ends and clips or ty-wraps with bases under the modules to support the cables.

DCC Layout Wiring Basics

A great resource

www.wiringfordcc.com

This is a go to website for tons of great information on DCC and wiring

Thank you for attending our clinic