WIRING FOR DCC

PREPARED FOR METRO NORTH
OCTOBER 2, 2010
VIN GALLOGLY
WHAT WE WILL NOT COVER

• CHOOSING A DCC SYSTEM
• DECODERS
• CV’S
• PROGRAMMING
WHAT WE WILL COVER

the wires under the benchwork

• POWERING THE BASE STATION – 18-24 Volts AC
• POWERING THE RAILS – Sq wave AC 14 - 22 volts
  – Districts
  – Wye
  – Reverse loops
  – Programming track
• THE COMMAND BUS – digital encoding
• The 12 volt DC supply
Typical DCC system setup
Base/Command Station

12 Volt 21watt automotive “flashing” lamp to restrict current to about 1.7 Amps when there is a short circuit.

To the Control Panel connections that the DC cab was disconnected from, that go to the layouts tracks.
Base Station Size

• It’s not layout size that determines if a base station is “big enough” it is the number of locos operating at ONE time.

• Plus the other items one will drive with the system
  – Turnouts
  – Lighted passenger cars
  – Structures . . . . . . .
Counting Amps

- Booster
- Number of decoder-equipped locomotives = Number of AMPS
- Number of turnout motors controlled by accessory decoders = Number of AMPS
- Light bulbs in passenger cars, cabooses, etc. = Number of AMPS
- Lighted structures, cranes, etc. controlled by accessory decoders = Number of AMPS
Volts  Amps  Ohms

• Volts  -  think water pressure
• Amps – think gallons per unit of time
• Ohms – think resistance to flow
least 27 volts as measured at the track.

Minimum Voltage for Power Stations

Maximum Voltage for Power Stations
POWERING THE COMMAND STATION

- Transformer output should be 18 volts AC with sufficient amperage to match your Base station.
- on/off switch to power depower the transformer
- A circuit breaker - between the transformer and the Command Station.
A Systematic Approach

• Establish wire colors and size standards for:
  – Primary bus
Typical DCC system setup

- Track
- Program Track
- PowerPRO
- P515: 14 to 18 volts AC, 5 amp power supply
- Optional Extra Cabs
- UTP
A Systematic Approach

• Establish wire colors and size standards for:
  – Primary bus
  – power shields between primary and Track buses
  – Track Drops
  – Powering frogs
  – The 12 volt DC circuit for powering accessories

• Color Insulated wire
  – Available from the hardware stores, white, red, black, green, yellow, blue, brown, etc.
  – Record your choices
Destroying Your Systematic Approach

• Using short segments of a different color because you (fill in this blank)
Wire for DCC

Stranded or Solid?
Suitcase - Insulation Displacement Connector

§ **Red** (IDC #905) is for bus sizes #14-18 with feeder sizes #18-22.
§ **Pink** (IDC #558) is for bus and feeder sizes #16-22.
§ **Brown** (IDC #567) is for bus sizes #10-12 with feeder sizes #14-18.
Wire for DCC

• Stranded or Solid?

• Primary track bus – Base Station to Power Shields
  – White and Black or Red and Black - 14 gauge stranded (14awg)

• Power Shield to track drops
  – White and Black or Red and Black 14awg stranded. (color tab or marker to differentiate from the Primary Bus)
Wire for Track Drops

- **Red** and black - but 22 gauge (22awg) stranded, normally under six feet in length.
- Which rail is Black?
  - I use **red** and black push pins along the rails while wiring drops
THE TURNOUT – FROG ISOLATED

POINT AND STOCK RAILS AT SAME POLARITY

GUARD RAIL ADJOINING FROG NOT AT OPPOSING POLARITY OR IS INSULATED.

POWER ROUTING SWITCH MECHANICALLY LINKED TO POINTS.

FROG IS INSULATED OR POWER ROUTED.

TRACK BUS ‘A’ WIRE

TRACK BUS ‘B’ WIRE
Powering Frogs

- Same gauge as track drops
- I use green 22awg
- I use green push pins
Safety Point

If you run 120 volts under your layout do so in conduit.
Track Wiring

- Bus length

- Voltage drops per 100 feet of wire (round trip)
  - #18 1.91 V
  - #16 1.20 V
  - #14 0.76 V
  - #12 0.48 V
Track Wiring

• Bus length

• Frequency of drops
  – Rail joiners
  – Power routing via turnout points to branch line
  – Powering the frog
Connecting Track Wiring

My own railroad, the Allegheny & Lackawanna Northern, is approximately 20 x 30 feet and is winded with just two wires to the track. The track on the railroad is divided into many sections or blocks. Circuit breakers are cut into the wire, limit the effect of short circuits, the same two wires always (if from the booster/power station) provide power to the track. The two wires are more commonly known as the track bus. The track bus wires should for the most part be parallel to each other, keep the wires on my rails parallel at all times, even when crossing wires through breaks in the track or around obstacles.

Typically, I use two-size wire around the layout: a main track bus in #8-ga wire, which is heavy enough to carry as much power as many boosters are capable of producing. For the main track bus I use track feeders, wire if the bus to the track. These be #20 or #22-gauge wire. Stranded solid wire will do; but it should be copper.

But you're asking yourself, why do we need such a large wire to carry power from the main bus to the track, when we need gauge wire to carry the power, digital signals from the booster?

The answer relates to resistance. In electrical terms, the smaller the wire, the more resistance is seen for the voltage coming from the booster. Think of electricity as water flowing through a pipe. Larger-diameters can handle more current, as larger pipes can handle a water flow.

To avoid creating a lot of resistance, 14-gauge wire is needed. It is vital. The power from the bus around the layout because of 2-ga runs that might be required. However, track feeders should be no more than 3 feet long for short distances. You can use this wire because the resistance can be over 3 feet is minimal.

Many of the companies that Digital Command Control
INSULATION STRIPPER
Powerpole Connectors
Another view from Mark Gurries

New Wiring: Modular Track Bus Example (2)

Device of your choice:
- Circuit Breaker
- Occupancy Detector
- AutoReverser

Local Bus (From Red/Blk track bus)

Booster (Example has 3)

Track Bus (Backbone)

Track Bus Example Shows:
1) Main #1 Red/Blk
2) Main #2 Org/Blu
3) Accessory Yel/Bm

DCC Wiring

Version 5.1

Mark Gurries

8 Feet

Tap Point

Device
SHORTS

• Why worry?
• The Full power of the DCC booster can be applied to a Decoder if a short occurs!
• Decoders are in the range of one amp – booster can put out 5 amps
• Hence - fried decoder in the absence of a power interrupter.
Color coding of rails helps to display a short
SHORTS - THE TURNOUT – FROG ISOLATED

POINT AND STOCK RAILS AT SAME POLARITY

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FROG IS INSULATED OR POWER ROUTED.

POWER ROUTING SWITCH MECHANICALLY LINKED TO POINTS.
Shorts  Partial Solution - PowerShield
Confirming presence of power with a Ramp Meter
As you wire each section ---- **TEST**

- Confirm the section is powered
- Confirm there is no short
- Confirm the section is connected to the correct Power Shield/circuit breaker
Wiring For

• Wyes

• Reverse loops

• The Programming Track
Wye requiring a Reverser
The WYE

Wye track - reversing
One leg MUST be insulated

Double insulators
DPDT reversing switch needed

Wye
The Wye

• Solutions
  – Permit change of polarity of one leg of wye
  – Permit Changing of polarity of branch leg of wye
Power Shield /Reverser
The Reverse Loop
WIRING THE PROGRAMMING TRACK

12 Volt 21-watt automotive "flashing" lamp to restrict current to about 1.7 Amps when there is a short circuit.

To the Control Panel connections that the DC cab was disconnected from, that go to the layout's tracks.

Separate Program Track on work bench.
Programming Track

TO PROGRAMMING OUTPUT ON BOOSTER OR PROGRAMMING DEVICE LIKE SOUNDTRAXX OR QSI

TO BOOSTER OUTPUT
THE CAB BUS
Normally the Cab Bus is a Daisy Chain
Back of a UTP
The Cab Bus – NCE Digitrax
All plugs are wired the same - Straight Through
The DC 12 Volt Accessory Supply

- 16 gauge speaker wire
- I string this separately
- I keep it as a paired cord
WHAT WE COVERED

*the wires under the benchwork*

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  - Wye
  - Reverse loops
  - Programming track
- THE COMMAND BUS – digital encoding
- The 12 volt DC supply
Advanced DCC system setup
THANK YOU
References

- How to wire: [www.wiringfordcc.com/](http://www.wiringfordcc.com/) Track wiring Parts 1 and 2
- Books on DCC.
  - DCC Made Easy by Lionel Strang. Kalmbach
  - DCC Projects & Applications; DCC Projects & Applications, volume 2; both by Mike Polsgrove. Kalmbach
  - The DCC Guide by Don Fiehmann. Kalmbach
  - Basic Wiring For Model Railroaders by Rick Selby, Kalmbach 2007
  - A Practical Introduction to Digital Command Control For Railway Modelers, by Nigel Burkin, The Crowood Press
- Presentation by Jim Scorse, of NCE: NER Convention in Stamford, CT Fall 2005 “What is DCC anyway”
- Mark Gurries’ DCC presentations: [www.siliconvalleylines.com/dcc/presentations.html](http://www.siliconvalleylines.com/dcc/presentations.html)
REFERENCES

• For Anderson Power Poles try:
  – [www.andersonpower.com](http://www.andersonpower.com) then search PP30
  • To purchase single connectors: C.W. Distribution Inc.,
    5779 N. Tischer RD, Duluth, MN 55804  (218) 525-2205

• NMRA DCC recommended Practices
Rail polarity and the NMRA DCC Standards

• Is Left & Right Rail applicable to DCC during decoder installation?

• If you never plan to operate with Direct Current on this layout, it does not matter how you connect the red and black wires to the rails in terms of which goes to which rail. Direction of the locomotive is controlled solely by the decoder and not the rail polarity.

• The NMRA DC polarity convention covering rail polarity is: The red wire goes to the positive rail.
When Many amps are Needed
Add Boosters