DCC 101

Getting Started in DCC

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http://denversrailroads.com/

Introduction

- **We will cover in this clinic:**
  - The Origins of DCC
  - What is DCC?
  - DCC Starter Systems
  - DCC Manufacturers
  - Bus Wiring
  - Wire Sizes
  - Stranded vs Solid Wire
  - Converting from DC

Origins of DCC

- Digital Command Control (DCC) is a system patented by Bernd Lenz in the early 1990s.
- Patents assigned to the NMRA, who then created a set of Standards and Recommended Practices for DCC.
- Standards describe the track interface: voltages, pulses, data and waveforms. Recommended Practices related to CV (configuration variable) values, communication, Manufacturer ID, etc.
- All DCC manufacturers accept the Standards, and most the Recommended Practices.
- Refer: www.nmra.org/standards/DCC/Index.html

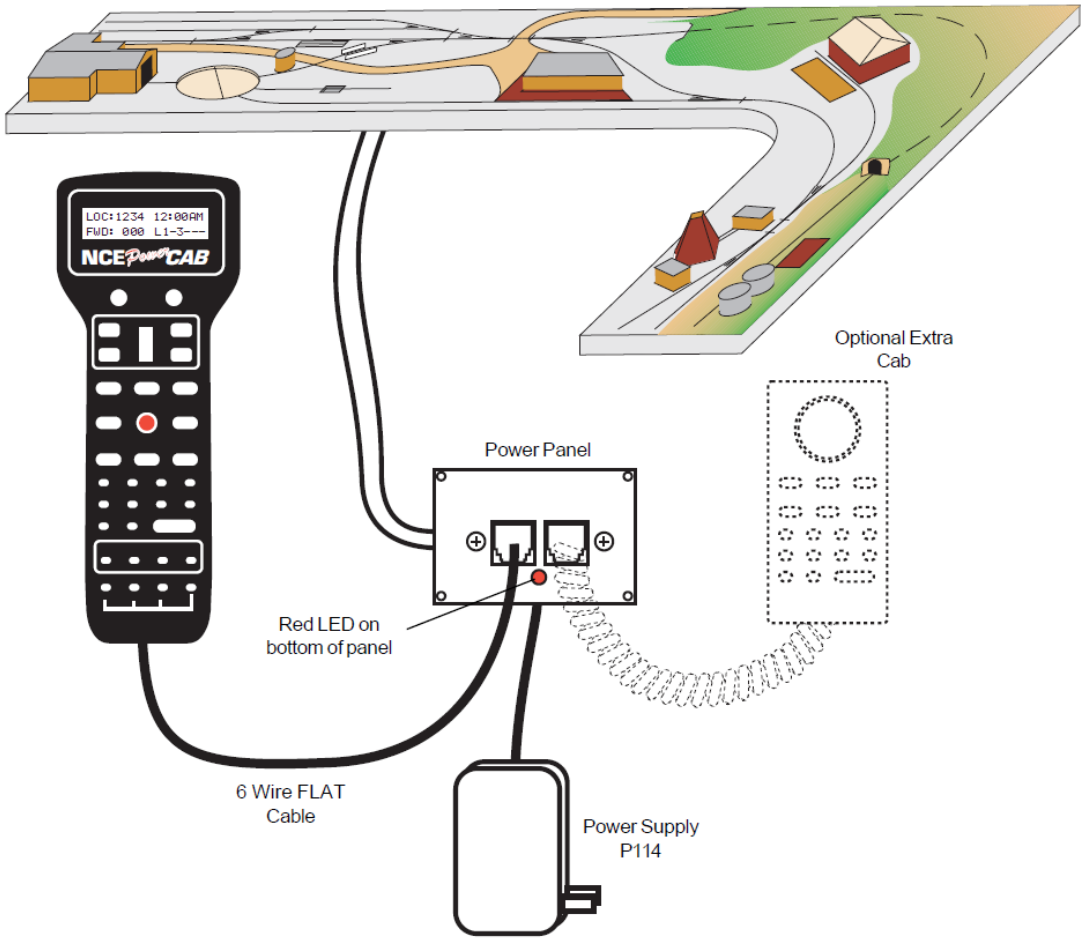
What is DCC?

- **DCC is an alternative method of running Trains**
  - Using DC the Loco receives its instructions on how fast to run from the amount of DC volts applied to the rails.
  - Using DCC a signal is sent – via the rails - to a decoder installed in the Loco instructing it on, not just how fast to run, but also on which lights to turn on and if sound equipped what noises (bell, horn, etc) to make.
  - Because the power to the rails is always "on" DCC can provide additional functions such as constant passenger car lighting.

DCC System Components

- Command Station
- Power Supply
- Throttle
- Power Panel – if using Walkaround throttles
- Booster
- Circuit Breakers
- Wireless Radio Control

Basic DCC System

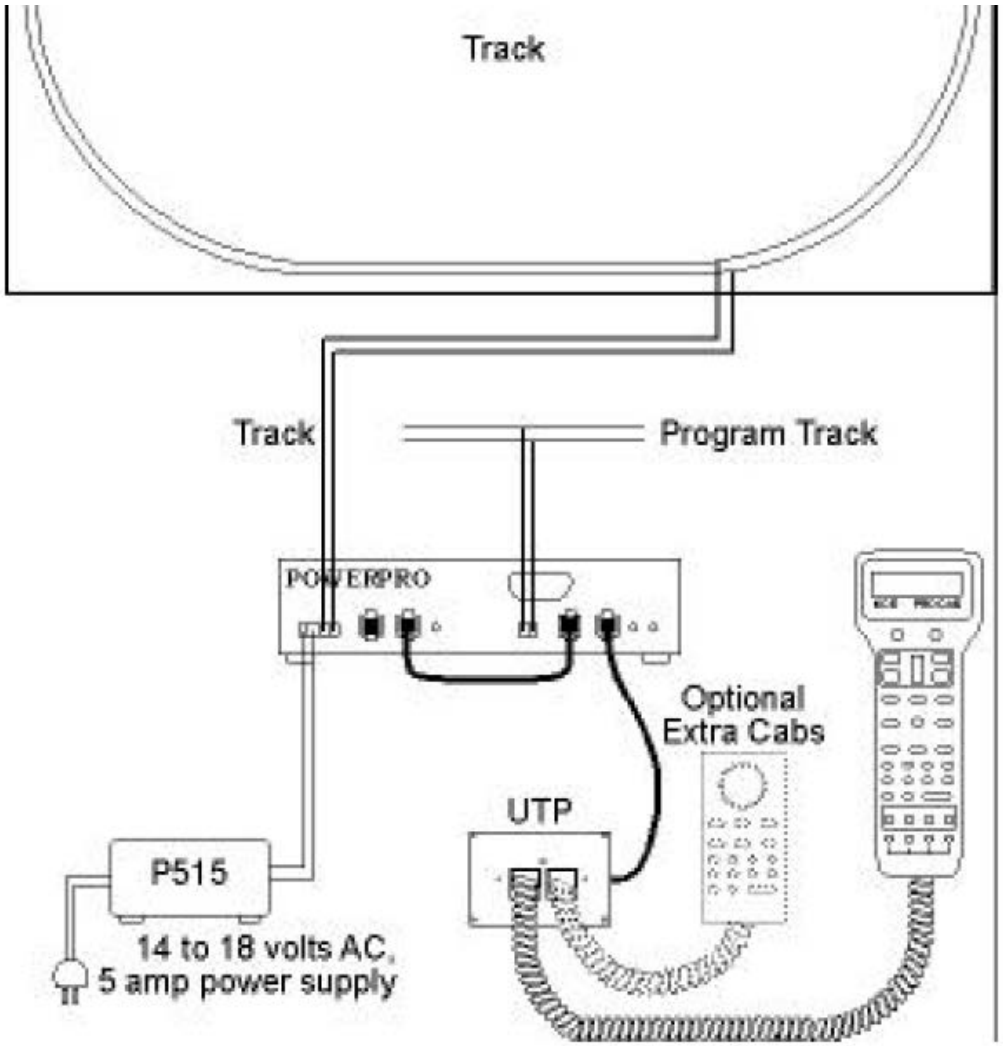


Command Station & Throttle (Cab)

Power Supply

Power Panel

Intermediate DCC System



Command Station

Throttle (Cab)

Power Supply

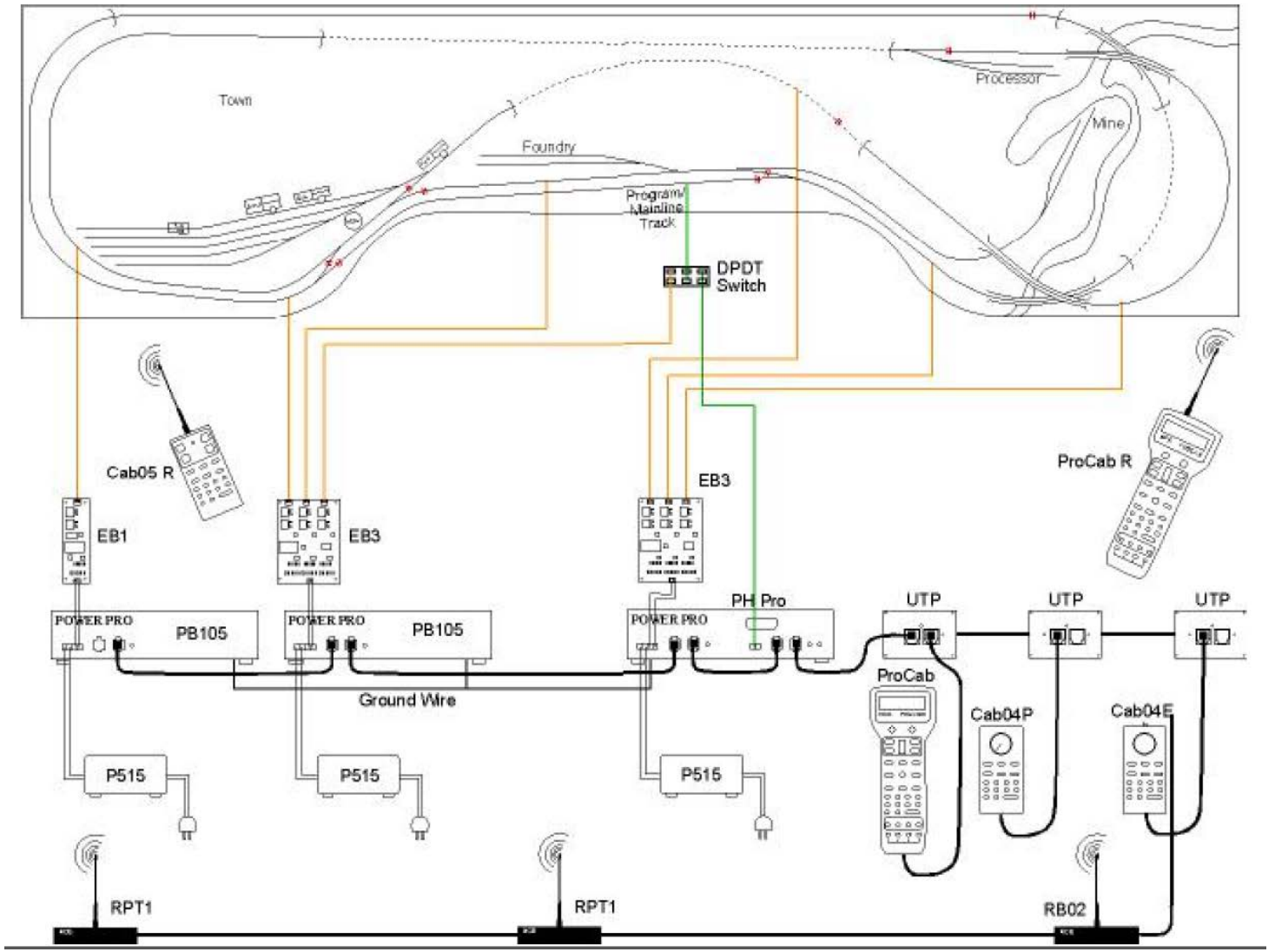
Power Panel

+

Booster

Additional Cabs

Advanced DCC System



- Command Station
- Throttle (Cab)
- Power Supply
- Power Panels
- Multiple Boosters
- Additional Cabs
- Circuit Breakers
- Radio Control

Why convert from DC to DCC?

- The ability to control individual locomotives without any complicated control panels, block switching and wiring.
- In the DC environment, no matter how much you grow your power availability, all you ever control is the track.
- With DCC, you control the Locos — i.e. you drive the train!
- Speed matching — all your Locos running at the same speed.
- Advanced Consisting — running two or more Locos together.
- Wireless Radio Control
- Greater realism.

DCC Starter Systems

- Basic 2 Amp systems **without** Booster (eg. NCE PowerCab, MRC Prodigy Explorer).
- Basic 3 Amp fixed position throttle with Booster (eg. NCE Twin, Digitrax Zephyr Xtra).
- Intermediate 5 Amp system with Booster (eg. NCE PowerCab combined with NCE SB5 Booster).
- Advanced 5 Amp system (eg. NCE Power Pro, Digitrax EVO, EasyDCC CVP2)
- Wireless Radio system
- 10 Amp system for "O" scale and above

Refer: http://denversrailroads.com/DCC-Systems.htm

Which Manufacturer to chose?

- **Considerations:**
  - What systems are your friends using? Having the same system means:
    - You have someone to talk to if you experience a problem
    - Your throttle will work on your friends system when you operate
  - Is local Sales support important to you? Only available in Sydney, Melbourne and Brisbane.
  - Is local Service support important to you? Only available in Sydney at this time . . .
  - However Sydney is closer than the United States.

DCC Manufacturers

- **The four top players are:**
  - **NCE**
  - **Digitrax**
  - **EasyDCC**
  - **MRC**

DCC System Starter Sets

- The following slides are based on the detailed analysis of the DCC Starter sets for the four top manufacturers which can be found at:

  http://denversrailroads.com/DCC-Systems.htm

MRC

- MRC manufacture a full range of DCC systems under the Prodigy name.
- However they have no sales or service support in Australia.
- They can be purchased directly from MRC or from Tony's Train Xchange (https://tonystrains.com/product-category/manufacturer/model_rectifier_corporation_mrc/)
- To avoid 240v power supply problems it might be more prudent to purchase the range under the Gaugemaster brand from the UK. See http://www.gaugemaster.com

EasyDCC

- EasyDCC are only available in the USA from the manufacturer — CVP.
- They are however available from Gwydir Valley Models in Glen Innes, NSW and given the uncertainty regarding their power supplies that may well be a prudent choice. See http://www.gwydirvalleymodels.com
- Note that their wireless DCC system is not licenced outside of America and Japan, severely limiting future expansion.

Digitrax

- Digitrax are a major player in the DCC systems market with a full range of options.
- Digitrax also market a large range of DCC decoders and DCC accessories.
- However they only have 7 dealers in Australia and all repairs are made in the USA.
- Furthermore there is limited stocks held in Australia and as at August 2017, their major dealer, Brunel Hobbies in Melbourne are still selling the old Super Chief range of Advanced Starter sets.

NCE

- Which brings us to NCE who currently appear to be the DCC systems market leader in both Australia and the USA.
- They have a solid range of Starter Systems which cover every requirement, as well as a good range of accessories.
- NCE have a "Nothing Wasted" Growth Path in that all major components purchased while growing an NCE system can be reused in another form.
- NCE systems purchased in Australia can be serviced by their Australian service agent in Blacktown, NSW. They charge an additional $100 surcharge to support USA purchased systems.

Small Layout Recommendation

- **For small (approx. 8'x4'/2400mmx1200mm) layouts running two Locos at once:**
  - Either
  - A NCE PowerCab Starter system (A$275) + one additional throttle Cab06 (A$148) for walkround control
  - Or
  - A NCE DCC Twin (A$192) with two fixed throttles.

Note that due to the low power output of the NCE PowerCab you have limitations on what circuit breakers are compatible. Your options are covered in my next clinic, DCC102: DCC Power Districts and Short Circuits.

Note also that NCE Power Cabs supplied with Australian power supplies and used without a circuit breaker have been known to melt! This does not appear to be the case with US supplied power supplies.

Medium Layout Recommendation

- **For medium sized (approx. 6mx3m single car garage) layouts running up to 4 Locos at once:**
  - A NCE PowerCab Starter system (A$275) for walkround control
  - + NCE SB5 5 Amp Smart Booster ($A355)
  - + additional NCE Cab06 throttles (A$148) as necessary.

Large Layout Recommendation

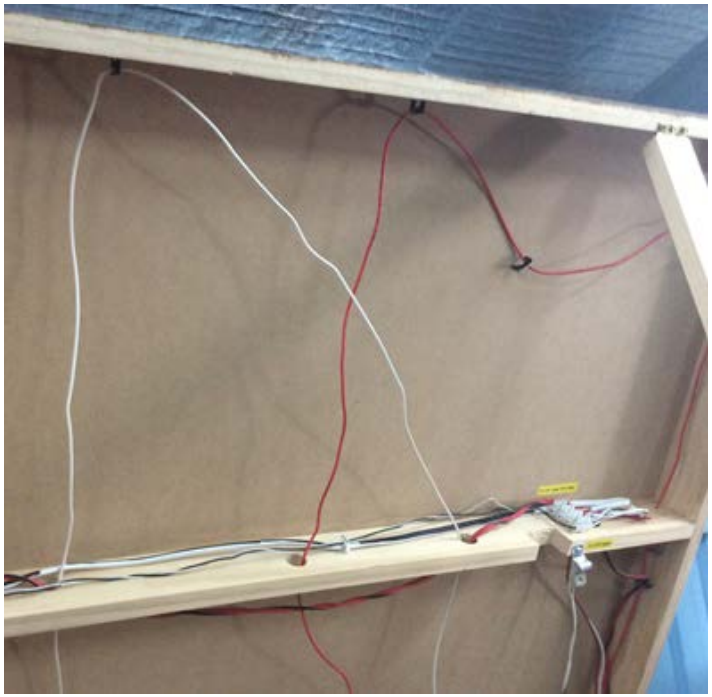
- **For large (two car garage or greater) layouts running up to 50 Locos at once:**
  - A 5 Amp NCE Power Pro Starter system (A$859) for walkround control
  - + additional NCE Cab06 throttles (A$148) as necessary.

Ultimate Recommendation

- **For any layout:**
  - A 5 Amp NCE Power Pro **Radio** Starter system (A$1,072) for walkround control
  - + additional NCE Cab06r throttles (A$262) as necessary.
- **Savings when buying direct from USA:**
  - If purchased from USA the price would be approximately:
    - US$520 (base price) +US$59 (postage) = US$579
    - = @.75 exchange rate A$772+A$71 (power supply)
    - = A$843 TOTAL
    - = A$229 saving over purchasing in Australia
    - + a saving of approximately A$23 on each CAB06r throttle.

Bus Wiring

- The idea is to run two "Bus" wires around your layout — something like this:



- And then run smaller feeder wires from the track to the Bus wires.

Wire Sizes

- **This is a very confusing area.**
  - Most of the books and articles on DCC are American and so quote wire sizes in AWG (American Wire Gauge) sizes.
  - Not only is this unhelpful but metric sizes are quite different.
  - They are quoted for example as 1.5mm2 (AWG 15½)
  - Furthermore the wire sizes quoted are for HO layouts — not N scale layouts.

Recommended Wire Sizes

- **Based on a chart published by Model Railway Hobbyist of BUS lengths I have complied the following table:**

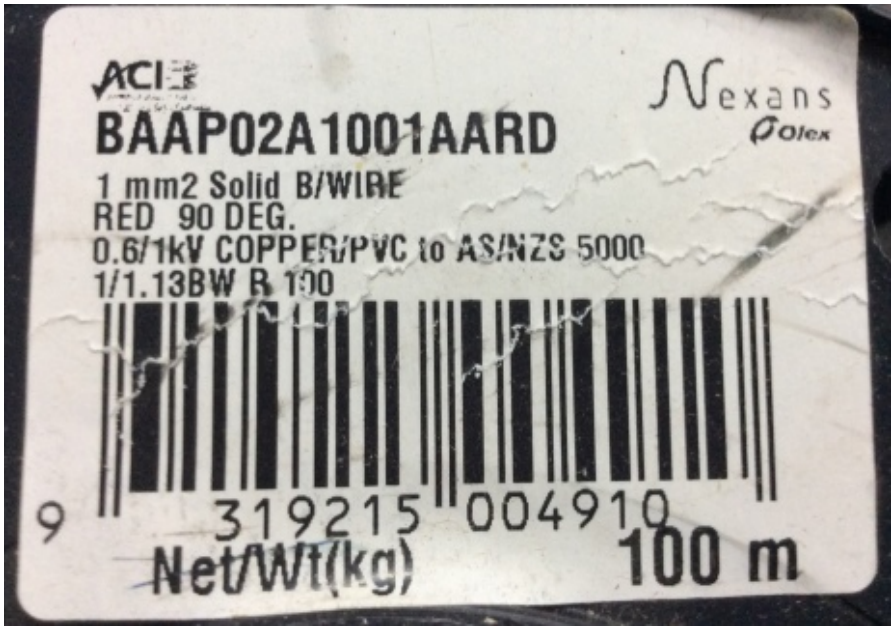
Length	Metric	AWG Size	Metric Size
50’	15.24m	12	3.31mm2
31.45’	9.58m	14	2.08mm2
19.77’	6.02m	16	1.31mm2
12.44’	3.79m	18	0.823mm2
7.82’	2.38m	20	0.518mm2
4.92’	1.50m	22	0.326mm2
3.09’	0.94m	24	0.205mm2

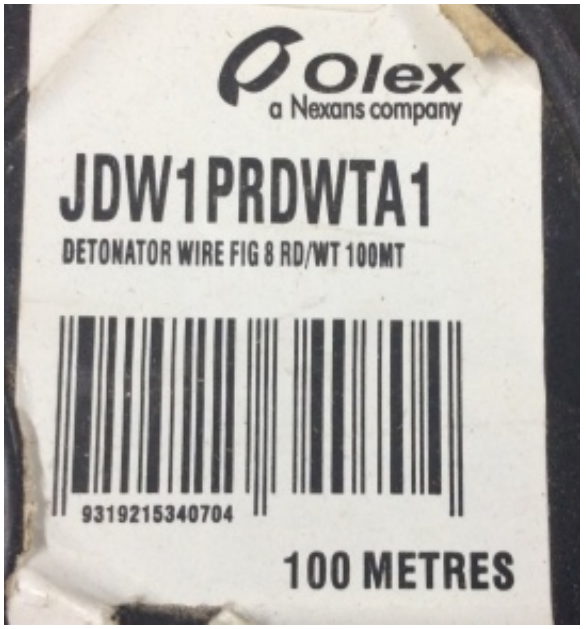
Wire Size in Reality

- Size AWG 12 (3.31mm2) wire is larger than that used for 240 volt house cabling and I think an overkill for N Scale.
- I have a layout which is 37 feet long and I use a Bunnings stranded wire which is 1.5mm2 (AWG 15½) between each of my modules.

BUS and Feeder Wire Sizes

- I then use a solid 1mm2 (AWG 17) wire as a "BUS" wire from the module connection to my feeder wires.
- My feeder wires are generally size AWG 21.
- Both are available from Bunnings:





Stranded vs Solid Wire

- The books all say use stranded wire and the guy who does the NCE videos believes that it will carry the DCC signal further.
- It is also true that if some strands are broken the current will still get through on the unbroken wires.
- And solid wire does tend to be more brittle and break more often.
- But solid wire is so much easier to work with and to solder — so it is my choice!

Converting from DC

- **Myth:**
  - DCC wiring is easier than DC
- **Reality:**
  - DCC requires a feeder wire every 600 – 900mm

- What is easier is that DCC does not require block switches on a control panel in order to operate . . .
- Once the feeders are attached to the BUS wiring trains should run.
- However . . .

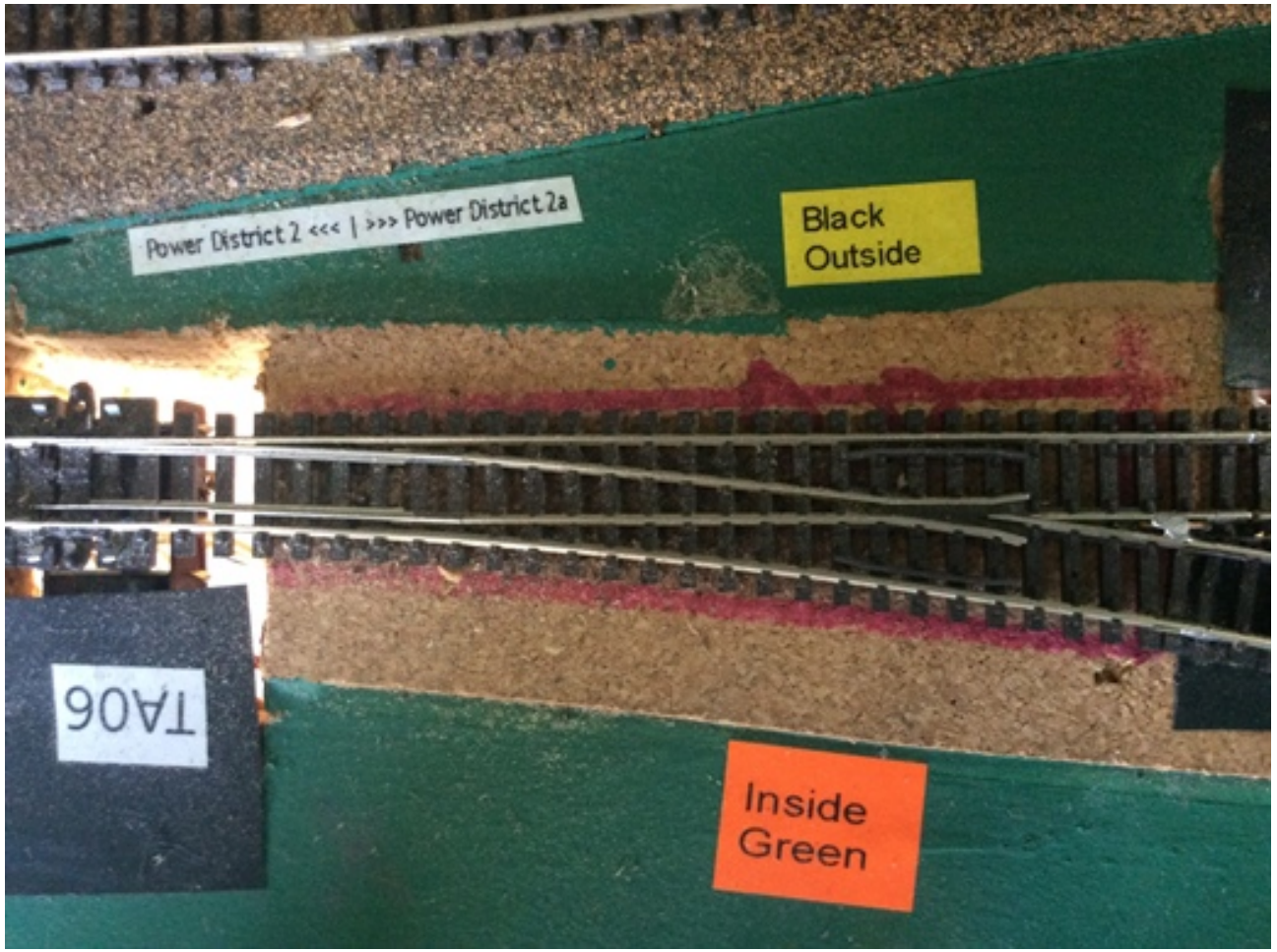
DCC positive and negative rails

- DCC uses AC track power whereas DC uses DC power.
- DC always has a + (positive) and — (negative) side.
- But DCC does not. To quote from Model Railway Hobbyist magazine:
  - ***"DCC puts a voltage across the rails that is a collection of computer data pulses. Assume a 15 volt track voltage; at any given time, the voltage on one rail will be 15 volts higher than the other. They take turns being the higher voltage and they switch at the same time. The time span between when they switch varies based on the data being sent between the DCC system and the decoders."***

The reality of Positive & Negative rails

- With DC you always know which track is which.
- With DCC you have no idea, although you can use a multimeter across two rail blocks. See video to follow later.
- A simple solution for mainline track is to colour code a freight car and push it around the track to indicate which side is “red” and which side is “white” (the most common wire colours). For example:

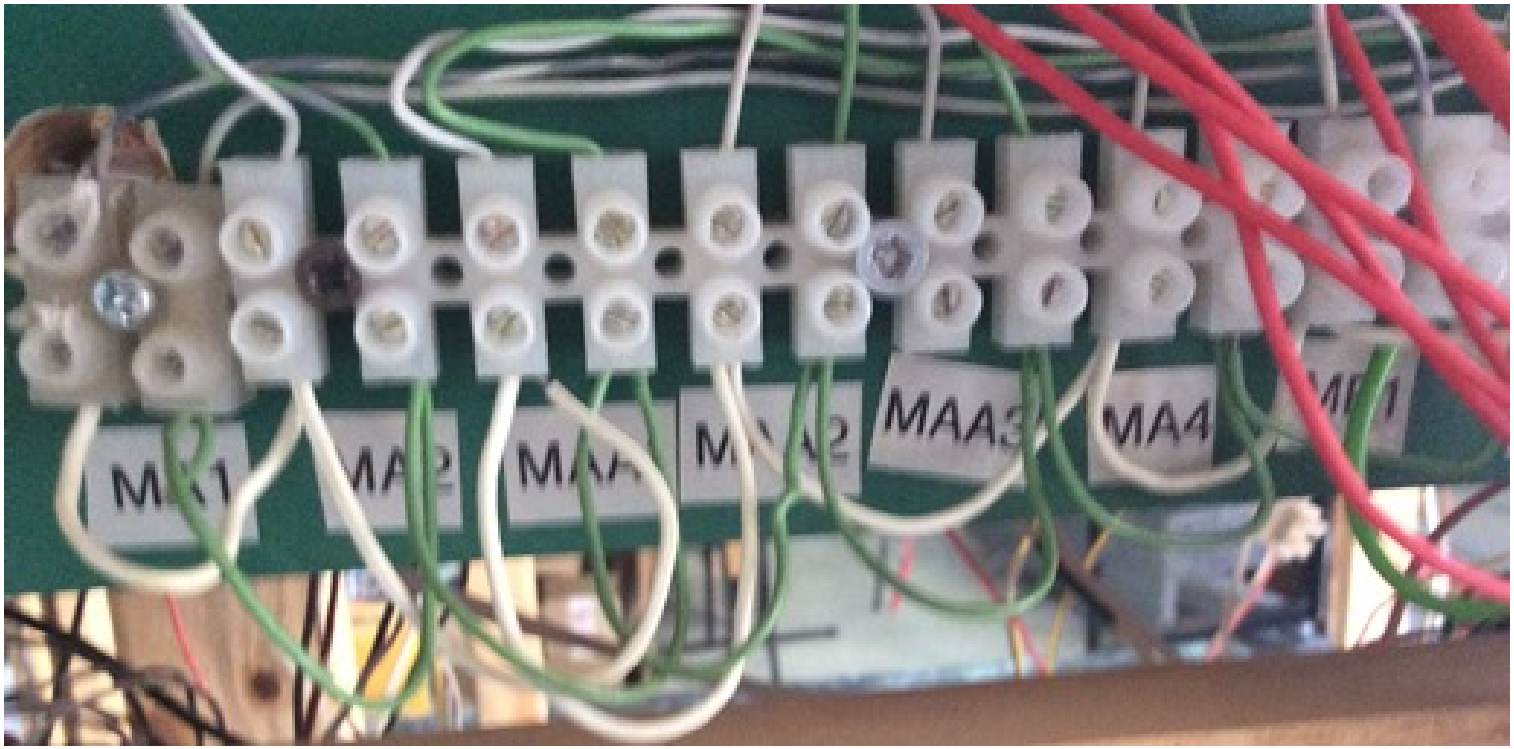
And then label the rails on the layout



DCC Wiring Challenges

- Where it gets more difficult is in yards and significantly more difficult with reversing loops.
- How to wire reversing loops will be covered in my next clinic — DCC102: DCC Power Districts and Short Circuits.
- But the biggest challenge can come when trying to convert existing DC wiring to DCC.
- You would think that all you had to do was to link up all of the DC blocks into one big block like this:

Linking DC blocks together



The problem

- If just one connection is reversed (eg a red rail is connected to a white rail) you may have a short, or at the very least a Loco will stall.
- And if you do not have circuit breakers in place you could overheat your Command Station. It has happened to a PowerCab (it has happened more than once).
- Then you have the problem of finding just one bad connection amongst many.
- Installing circuit breakers and additional boosters will be covered in my next clinic — DCC102: DCC Power Districts and Short Circuits.

The Solution

- Wire a block – or two at the most – and then test:
  - First with a multi-meter and
  - Then with a locomotive
- If all is ok go on to the next bock or two
  - Then test again
- And so on.
- Easy really — but time consuming!

Testing for Shorts: Video 1

- https://youtu.be/UqL2CwVkVIk

Testing for Shorts: Video 2

- https://youtu.be/uhmLBLok8pw

Turnouts

- **This is an even more challenging issue particularly for people used to a DC layout and even more so if you use Peco Electrfrog turnouts.**
- **This challenge will also be covered in my next clinic — DCC102: DCC Power Districts and Short Circuits.**

Summary

- **We have covered in this clinic:**
  - The Origins of DCC
  - What is DCC?
  - DCC Starter Systems
  - DCC Manufacturers
  - Bus Wiring
  - Wire Sizes
  - Stranded vs Solid Wire
  - Converting from DC