DRAFT

Aus-moN

(previously known as Australian Free-moN-A)

Specifications and guidelines

Version 0.6002 (PWH)
28 April 2012

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1 Introduction

Aus-moN (An Australianised version of N scale Free-mo: - Free-moN) is a free form N scale modular railway system that specifies standards for benchwork, track and digital control. Aus-moN attempts to raise the bar for N scale modular railways in Australia by promoting prototypical appearance and operational characteristics.

Quoting from the US Free-mo standard (**www.free-mo.org/standard**):

> "The objective of the Free-mo Standard is to provide a platform for prototype modelling in a flexible, modular environment. Free-mo modules not only provide track to operate realistic models, but also emphasize realistic, plausible scenery; realistic, reliable trackwork; and operations. Free-mo was designed to and continues to push the envelope of modular model railroading to new heights. It goes beyond the traditional closed-loop set-up in creating a truly universal "free-form" modular design that is operations oriented and heavily influenced by prototype railroading."

The Aus-moN standard also aspires to these objectives.

The Aus-moN Standard has been based on the American Free-moN standard but includes variations to the American Free-moN specifications to suit conditions for Railway modelling here in Australia, such as metric dimensions and materials which are commercially and readily available here in Australia.

The main features of Aus-moN modules are: single or double track main line, finescale rail (Code 55 for the main line), prototypical scenery and operations, DCC control and rolling stock and trackwork that meets standards appropriate to modelling Australian Railway prototype in N scale using Aus-moN modules.

> (**Note**: Aus-moN track and wheel standards are based on NMRA track and wheel Standards and Recommended Practices, but also allow modified PECO code 55 track and modified NEM wheel sets. The use of these variations makes the Aus-moN standard suitable for those wishing to model Australian 4-wheeled rollingstock)

Where as the Aus-moN standard is aimed at modelling Australian prototype, it is not restricted to only being used for Australian prototype, other prototypes can be represented also.

The Aus-moN Standard is a collection of requirements for building model railway modules that can work together with little effort, even when they have never been assembled together before. The Aus-moN standard allows builders to replicate any freelance or prototype track plan within their module boundaries, yet can be combined for interoperability with other Aus-moN modules.

An Aus-moN module is a free form module that conforms to the Aus-moN Standard. The Aus-moN Standard governs the ends of the module (track location etc), basic track requirements (minimum allowed radius and point size etc) and wiring. Other than these basic standard requirements, the Aus-moN module builder is afforded the freedom to innovate within these minimum specifications as they see fit. An Aus-moN module can be any length and the end plates can be at any angle to each other. An Aus-moN module can be one section, or two or more sections that form a module set. Most Aus-moN modules have two end plates, but modules can have one, two, three or more ends. For example, a junction module may have three "ends". (See Figure 1 below.)

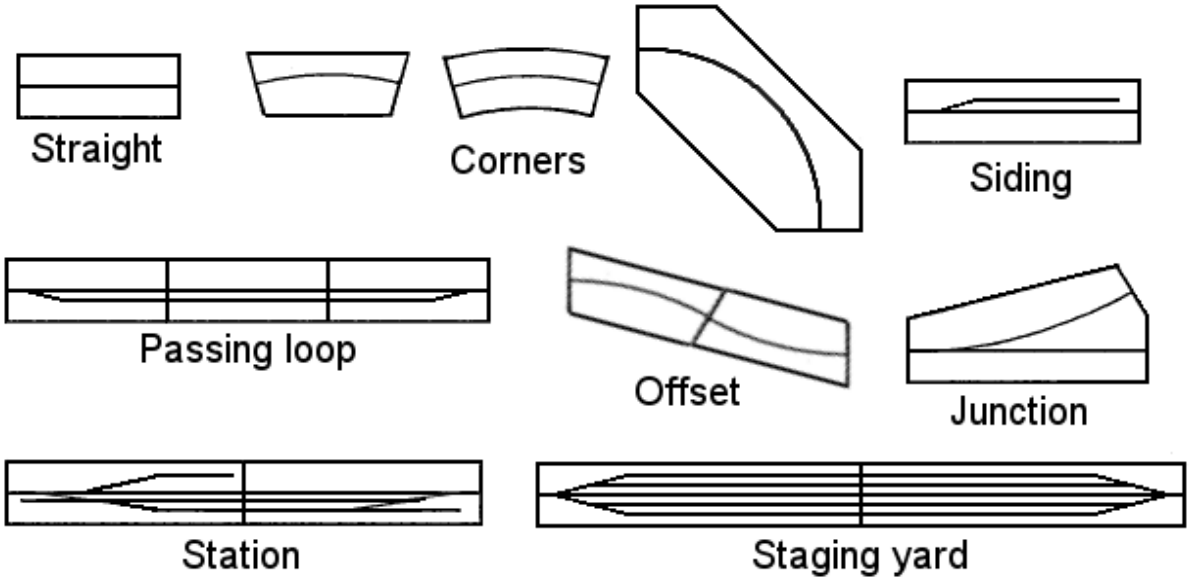


Figure 1: Examples of possible module forms.

PLEASE NOTE:

Where as there is a great deal of information provided in this document most of the information in this document is in the form of recommendations. However there are certain requirements in this document that **MUST** be adhered too, in order to construct an Aus-moN module that will be fully interoperable with other Aus-moN modules.

All new module construction should comply with the current standard published in this document. If you have something that is non-compliant with the current standard, try to fix it, but if that isn't possible, it should be at least compliant with the version of the standard that was current at the time of module construction.

Modules built to previous versions of the standard are allowed to be used, even if they do not currently follow the current standard in all details. (But note: inclusion of any non compliant Aus-moN module in any layout set up is purely at the discretion of the Layout Coordinator.)

The standard will continue to evolve based upon the input and discussion from those on the Yahoo, “Aus-moN” list:

http://groups.yahoo.com/group/Aus-moN

, but the chief philosophy of Aus-moN remains always - to provide a platform for realistic prototypical modeling, in a flexible, modular environment.

2 Definitions

In many standards documents, several standard key words are used to signify the requirements in the specification.

Key words	**Specification requirement**
MUST REQUIRED SHALL	An **absolute requirement** of the specification to ensure compatibility or interoperability.
MUST NOT PROHIBITED SHALL NOT	An **absolute prohibition** of the specification to avoid incompatibilities or potential harm.
SHOULD RECOMMENDED	There may exist valid reasons in particular circumstances to ignore a particular feature, but the full implications MUST be understood and carefully weighed before choosing a different course.
SHOULD NOT NOT RECOMMENDED AVOID	There may exist valid reasons in particular circumstances when the particular feature is acceptable or useful, but the full implications MUST be understood and carefully weighed before implementing any such feature.
MAY OPTIONAL NOT REQUIRED	The item is truly optional. A module which does not include a particular option MUST be interoperable with another module which does include the option, though perhaps with reduced functionality. A module which does include a particular option MUST be interoperable with another module which does not include the option, except for the feature the option provides.

MODULE: Any component (or group of "sections") of bench work that is meant to be operated as a single unit in a fixed configuration. A module can have any number of sections. The ends of a module comply with the mechanical standards defined in the Framework description, below.

SECTION: A component of a module, complete with bench work, track, scenery, etc. Except where otherwise noted, standards for module end interfaces do not apply to inter-section interfaces, as these are considered to be internal to the module. Track, electrical and DCC connections between sections are at the discretion of the module builder.

ENDPLATE: Endplates are the standardised end surfaces of a module, usually two, that join to another module.

2.1 Module types

Mainline module

A Mainline module is typically a representation of rail corridors in and between major population centers and smaller communities which a mainline runs through, mainline modules cover all classes of mainlines.

Mainline modules are either single track through route or double track through route. Depending on prototype preference or if a particular prototype is being followed or if a particular location is being modelled.

Mainline modules are designed with large radius curves and minimal grades.

Branchline module

A Branchline module is of single track through route construction, Branchline modules represent rail corridors to population or agricultural centers that are not located on a mainline and may only see seasonal traffic. They usually diverge from the mainline at a major population centre, though it is not uncommon for a Branchline to split off from the mainline at smaller communities along the route or off another Branchline.

Branchline modules are designed with smaller allowable radius curves and steeper grades than mainline modules.

Mini module (or “Mini-mo”)

Mini-modules (or Mini-mo) are intended to be a lighter weight and economical to construct modules to provide plain trackwork between normal Aus-moN modules. A Mini-mo is a subset and is not to replace or exclude an equivalent length standard module which should be used where ever possible. Mini-mo's can be both a Mainline or Branchline module and either single track through route or double track through route.

Mini-mo's have endplates that are narrower than the standard width endplate and only have plain trackwork.

3 Summary of specifications

3.1 Mainline Module

	Minimum	Maximum	Recommended	Nominal
End Plate width	400mm	-	400mm	-
End Plate material thickness	-	-	16-20mm	18mm
End Plate depth	150mm	150mm	150mm	150mm
Module width	400mm	-	-	-
Track base width (single track)	-	-	150mm	-
Roadbed – thickness (cork or other)	-	-	-	3mm
Rail head – height above track base	-	-	-	6mm
Rail head – height above floor	1200mm	1500mm	-	-
Rail end set back from End plates	0mm	0.3mm	0.1-0.2mm	-
End plate – elevation increment	20mm	20mm	20mm	20mm
Curve radius – main line	600mm	-	750mm	-
Curve radius – sidings	450mm	-	600mm	-
Points – main line	#6	-	#7	-
Points – sidings	#5	-	#6	-
Track centres	30mm	-	-	-
Straight track from module ends	100mm	-	-	-
Straight track between reverse curves	150mm	-	-	-
Track to side edge of module	-	-	100mm	-
Gradient	Flat (0%)	1in50 (2%)	-	-
Power bus wire	16 AWG	-	12 AWG	-
Track feeds	24 AWG	-	-	-
Accessory bus wire	16 AWG	-	12 AWG	-
Accessory bus	-	5A	DCC	16V AC

3.2 Branchline Module

	Minimum	Maximum	Recommended	Nominal
End Plate width	400mm	-	400mm	-
End Plate material thickness	-	-	16-20mm	18mm
End Plate depth	150mm	150mm	150mm	150mm
Module width	400mm	-	-	-
Track base width (single track)	-	-	150mm	-
Roadbed – thickness (cork or other)	-	-	-	3mm
Rail head – height above track base	-	-	-	6mm
Rail head – height above floor	1200mm	1500mm	-	-
Rail end set back from End plates	0mm	0.3mm	0.1-0.2mm	-
End plate – elevation increment	20mm	20mm	20mm	20mm
Curve radius – main line	500mm	-	750mm	-
Curve radius – sidings	450mm	-	600mm	-
Points – main line	#6	-	#7	-
Points – sidings	#5	-	#6	-
Track centres	30mm	-	-	-
Straight track from module ends	100mm	-	-	-
Straight track between reverse curves	150mm	-	-	-
Track to side edge of module	-	-	100mm	-
Gradient	Flat (0%)	1in40 (2.5%)	-	-
Power bus wire	16 AWG	-	12 AWG	-
Track feeds	24 AWG	-	-	-
Accessory bus wire	16 AWG	-	12 AWG	-
Accessory bus	-	5A	DCC	16V AC

3.3 Mini Module (or “Mini-mo”)

	Minimum	Maximum	Recommended	Nominal
End Plate width	200mm	200mm	200mm	200mm
End Plate material thickness	-	-	16-20mm	18mm
End Plate depth	150mm	150mm	150mm	150mm
Module width	200mm	200mm	200mm	200mm
Track base width (single track)	-	-	100mm	-
Roadbed – thickness (cork or other)	-	-	-	3mm
Rail head – height above track base	-	-	-	6mm
Rail head – height above floor	1200mm	1500mm	-	-
Rail end set back from End plates	0mm	0.3mm	0.1-0.2mm	-
End plate – elevation increment	20mm	20mm	20mm	20mm
Curve radius – Main line	600mm	-	750mm	-
Curve radius – Branch line	500mm	-	750mm	-
Track centres	30mm	-	-	-
Straight track from module ends	100mm	-	-	-
Straight track between reverse curves	150mm	-	-	-
Gradient – main line	Flat (0%)	1in50 (2%)	-	-
Gradient – branch line	Flat (0%)	1in40 (2.5%)	-	-
Power bus wire	16 AWG	-	12 AWG	-
Track feeds	24 AWG	-	-	-
Accessory bus wire	16 AWG	-	12 AWG	-
Accessory bus	-	5A	DCC	16V AC

4 Framework

Frame work refers to a module's structural frame including endplates, sides, fascias, interior supports, legs, and braces. There are no requirements to use specific materials or construction methods; however the basic trade-off is sturdiness versus weight.

4.1 End Plates

End plates must be 150mm deep and a minimum of 400mm wide. End plates should be constructed of 16-20mm exterior plywood, hardboard or stable equivalent to provide sufficient strength for clamping to adjacent modules. Interior plywood is not recommended as it is not designed for strength. Pine is not recommended for the end plates as it has a tendency to warp with age. MDF is not recommended for the end plates as it can swell with age if not properly sealed.

Endplates **MUST** be parallel to each other in the vertical plane, and perpendicular to track both vertically and horizontally. They must also be flat (e.g. not bowed, twisted, etc.).

The only allowance for error in the construction of the end plates is; when a square is placed on the track base and the end plate, the square must touch the top edge of the end plate and there shall be no more than a 1.0mm gap at the bottom edge of the end plate. The reverse is not acceptable.

End plates should be painted satin or equivalent COLORBOND® Wilderness® colour.

To allow room for clamps, keep the inner surfaces of end plates clear of obstructions (electrical terminal blocks, DCC connectors, etc). The recommended clearance is 50mm high by 100mm wide, centered on the bottom edge of the endplate inner surface. An additional clearance of 50mm in height may be provided for clamping.

Module-To-Module attachment suggestions.

- C-clamps are used at the endplates, positioned near the endplate centre (directly below the tracks).
- Use "deep-throat" C-clamps to apply pressure closer to module top and draw track ends together
- Wide modules with multiple tracks (e.g., yard modules) may be secured with two clamps, one toward each side of the module.

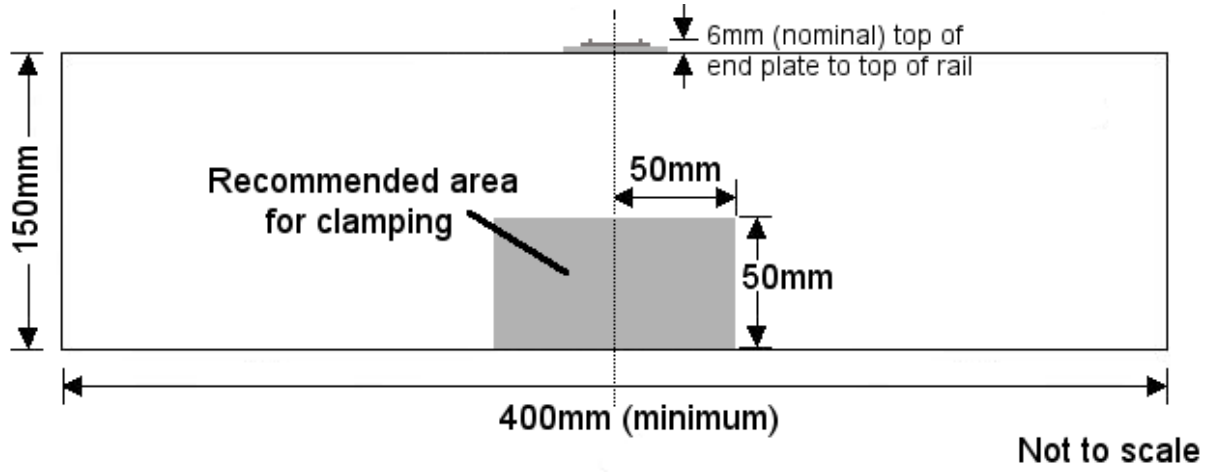


Figure 2: End plate dimensions

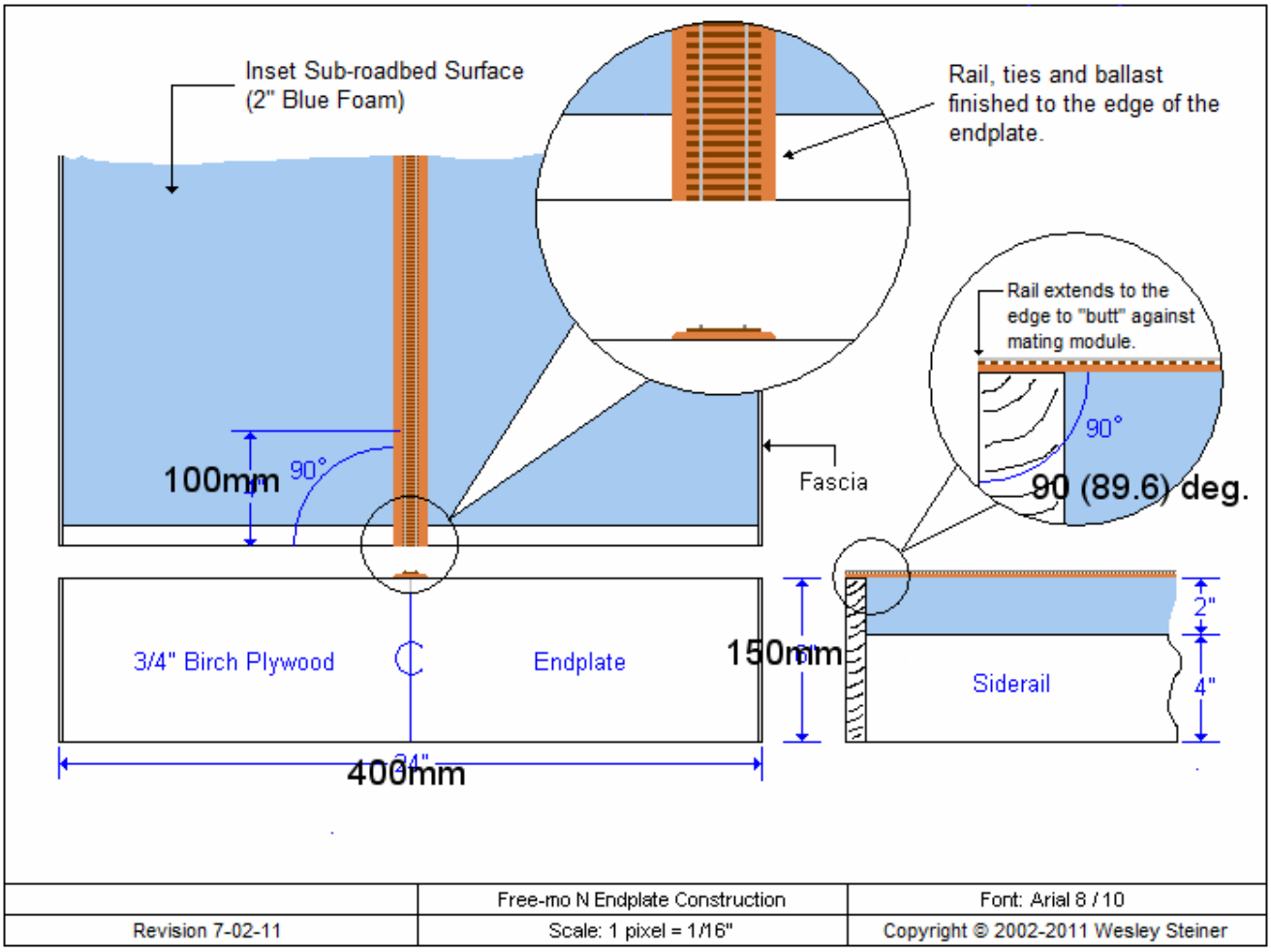


Figure 3: Insert diagram of end plate profile & tolerance, above is place holder example

4.2 Frame

The frame should be 16-20mm exterior plywood, hardboard or stable equivalent. Pine is not recommended for the frame as it has a tendency to warp with age. The method of construction; plywood box, “L girder”, etc. is at the discretion of the module builder. All screws should be countersunk and flush.

The length and geometry of the module may be freely chosen by the builder, provided the minimum track radius can be maintained. A module may be any length, width and shape provided it is fitted with at least one standard end plate.

Holes may be cut through the sides for access to the rear of the fascia, but care should be taken not to affect the strength of the module.

4.3 Benchwork

The top of the module should be at least 6mm exterior plywood, Masonite or stable equivalent and flush with the top of the end plates. Interior plywood and MDF is not recommended. This material should be supported by any material that prevents flexing or sagging.

Alternatively, the top of the module may be extruded polystyrene foam (“green, blue or pink foam”) not less than 50mm thick and flush with the top of the end plates.

Or alternatively the top of the module may be extruded polystyrene foam (“green, blue or pink foam”) not less than 25mm thick on top of a 6mm exterior plywood, Masonite or stable equivalent base.

4.4 Fascia

Modules must be constructed to be used by operators or viewed by spectators from either side. Each side should have a fascia of plywood, MDF, Masonite or equivalent at least 3mm thick. The fascia must not be structural or bear any load.

The top of the fascia must be level with the end plates at each end. Between the ends, the fascia should be contoured to match the scenic topography of the module. The bottom of the fascia must be at least level with the bottom of the end plates but may be lower.

The fascia should be painted satin or equivalent COLORBOND® Wilderness® colour.

The fascias on both sides must carry a label with the name of the module and the module owner using printed text easily readable from 1 metre. If the module is fitted with an integral DCC booster, this must be indicated clearly on the label with the brand name and model. If the module is fitted with an integral accessory bus power pack, the nominal voltage and current should be noted on the label.

Protruding items such as toggle switches are not recommended, to prevent damage to modules or injury to operators. Electrical switches should be recessed into the fascia and clearly labelled using printed text easily readable from arm's length.

Perspex barriers on the sides of modules are not recommended.

4.5 Legs

Each module longer than 600mm must have at least four legs and be able to stand on its own.

Legs may be permanently attached or removable. Permanently attached legs must be folding.

Each leg must have a screw type adjustment of +/- 25mm to compensate for uneven floors.

The bottom of each leg must have a rubber foot or equivalent for floor protection.

Painting of legs is optional, but if painted it is recommended they match the fascias.

4.6 Skirting

Skirting is required for public events but is optional for private events.

Both sides of each module must have a black skirt. The skirt must be 100% cotton or equivalent non-flammable material. Polycotton, polyester and nylon must not be used due to high flammability.

The skirt should be attached with Velcro strips – hard 'hooks' on the lower edge fascia and soft 'loops' on the skirt. Black Velcro is recommended.

Each end of the skirt must extend 50mm past the module end plate to overlap with adjacent module skirting. The bottom edge of the skirt should be even with the bottom of the leg vertical member to prevent dragging on the floor.

5 Track

5.1 Track base

The track base should be at least 6mm exterior plywood, Masonite or stable equivalent, flush with the top of the end plates and extend 75mm either side of the track centreline, with allowance for scenery considerations. Care should be taken in spacing supports for the track base to prevent sagging or flexing.

5.2 Roadbed

Roadbed shall be 3mm cork, Trackrite foam or equivalent is recommended. Before laying track, the cork should be sealed to prevent movement due to temperature or humidity. Sealing with paint similar in colour to the ballast is recommended.

5.3 Trackwork

Main lines and all other through tracks must be code 55 nickel silver rails.

Plain track may be flex or hand laid with prototypical sleeper spacing and dimensions and should conform to either NMRA S-3.2 or NEM110 standard for track gauge. PECO, Atlas or Micro Engineering code 55 is suitable.

Sidings and industrial tracks may be code 55 or code 40.

Track should be glued to the roadbed with PVA or similar glue rather than nailed or spiked.

The minimum permitted radius for all through tracks (main lines and passing loops) is 600mm for Mainline modules and 500mm for Branchline modules. 750mm or larger is recommended. Where main line curves are less than 750mm, there must be a minimum of 150mm straight track between reverse curves.

The minimum permitted radius for sidings and industrial tracks is 450mm. 600mm or larger is recommended.

For special purpose modules, such as “off stage” storage, staging or balloon tracks, 450mm minimum radius may be used.

The minimum centre line spacing between parallel tracks is 30mm. This distance should be increased on curves in accordance with NMRA standards S-7, S-8 and RP-11 for class Ia rolling stock.

On single track modules, the through track must be centered on the end plate.

On double track modules, the through track centrelines must be 15mm either side of the centre of the end plate.

All through tracks must be perpendicular to the end plates and straight for at least 100mm from the outside face of the end plate before any deviation (point, curve, etc).

Laying sidings and industrial track less than 100mm from the sides is not recommended.

The rails of track ends must be cut off at the End plates to form a butt joint with the adjoining module. The rails should end short (about 0.1-0.2 mm) of the end of the module to avoid electrical and mechanical contact with rails on the adjoining module. The rail ends shall be set back no more than 0.3mm from the End plates.

Note: Rails **must** not extend beyond the endplates.

Tracks will connect at the end-plates by clamping securely so that the rail-heads align without the use of rail joiners. It is also recommended that the inner running edges of the rail ends should be chamfered/rounded slightly (See figure 5). Sleepers and ballast must be continued to the module end for good appearance and matching with the adjacent module. The sleeper closest to the end of the module is set back half the spacing distance between sleepers. This will result in the sleeper spacing being maintained across the joint.

Rail ends should be “hardened” in some way, either brass screws or PCB sleepers is acceptable, with the rails soldered securely.

All track connections/joiners should be soldered. If track sections and/or turnouts, are not soldered then that section(s)/turnout(s) must be physically connected to the track bus by means of track feeders. It is the responsibility of the module builder/owner to ensure dead spots do not exist on the module.

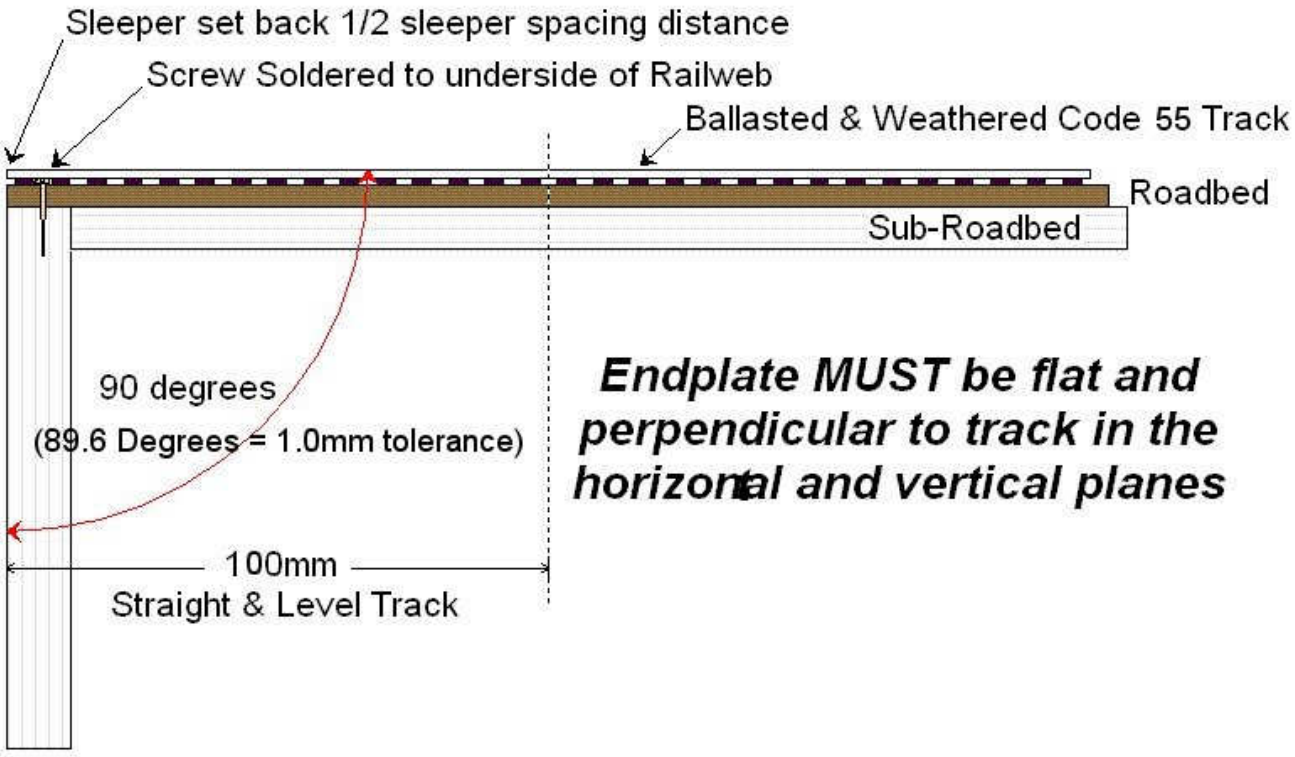


Figure 4: Place holder for similar diagram

Figure 5: Butt rail joins between Modules

Rail joints between sections may use any joining system desired by the module builder.

The nominal and minimum height of the rail head at the end plate is 1200mm from the floor. On modules with gradients, the height of the rail head at the end plate must be in some multiple of 20mm above the low end. The maximum height of the rail head is 1500mm from the floor. The maximum permitted gradient is 1 in 50 (2%, 20mm per metre) on main line modules and 1 in 40 (2.5%, 25mm per metre) on branch line modules.

Uncoupling magnets of the permanent magnet type are not permitted on through tracks due to the possibility of unintended train separation.

5.4 Points

Points may be PECO, Atlas, Micro Engineering or hand laid equivalent code 55 with nickel silver rail. PECO code 55 points may be used provided that the check/guard rails are shimmed with 0.25mm styrene, this is mandatory for their use (See appendix 14.1 for details). It is also recommended that PECO points be made “DCC friendly”.

Points on the main line must be at least #6 with #7 or larger recommended. PECO points must be at least Medium radius with Large radius recommended.

Points on sidings and industrial track may be code 55 or code 40, at least #5 with #6 or larger recommended. PECO points must be at least Medium radius.

All points should be DCC ready or made “DCC friendly”. All frogs must be powered with power routed from the stock rails or power bus. Point control may be mechanical or electrical. If stationary DCC decoders are used for point control, local control must also be provided.

6 Wiring

6.1 Power bus

The power bus is a two wire daisy chain that carries track power between modules. The power bus must be 16 AWG (1.6mm diameter, 2mm2) or larger stranded copper wire. 12 AWG (2.1mm diameter, 3.3mm2) is recommended. The power bus should be two single wires, which may be twisted together.

At the end plate, each power bus wire must have a lead at least 150mm long and end with a red 14/45 Anderson Powerpole connector with 30A contacts. The contacts may be crimped or soldered (or both) to the power bus wires. The connectors must be joined together in a vertical stack (tabs to the top) such that the top wire goes to the left hand rail (when facing the end plate) and the bottom wire goes to the right hand rail.

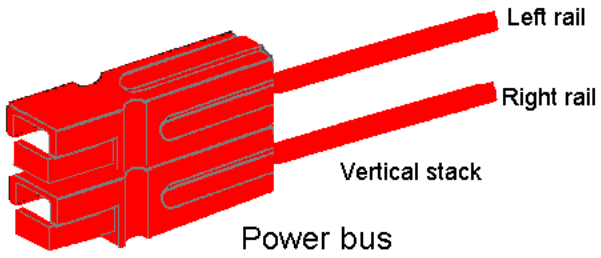


Figure 6: Arrangement of power bus connectors.

6.2 Track feeds

Track feeds from the power bus to the rails must be 24 AWG (0.5mm diameter, 0.2mm2) or larger copper wire. Every rail must have its own feed wire and should be kept as short as possible, not longer than 150mm is recommended from the power bus.

Wyes, reversing loops and turntable rails must have their own DCC reversing circuit.

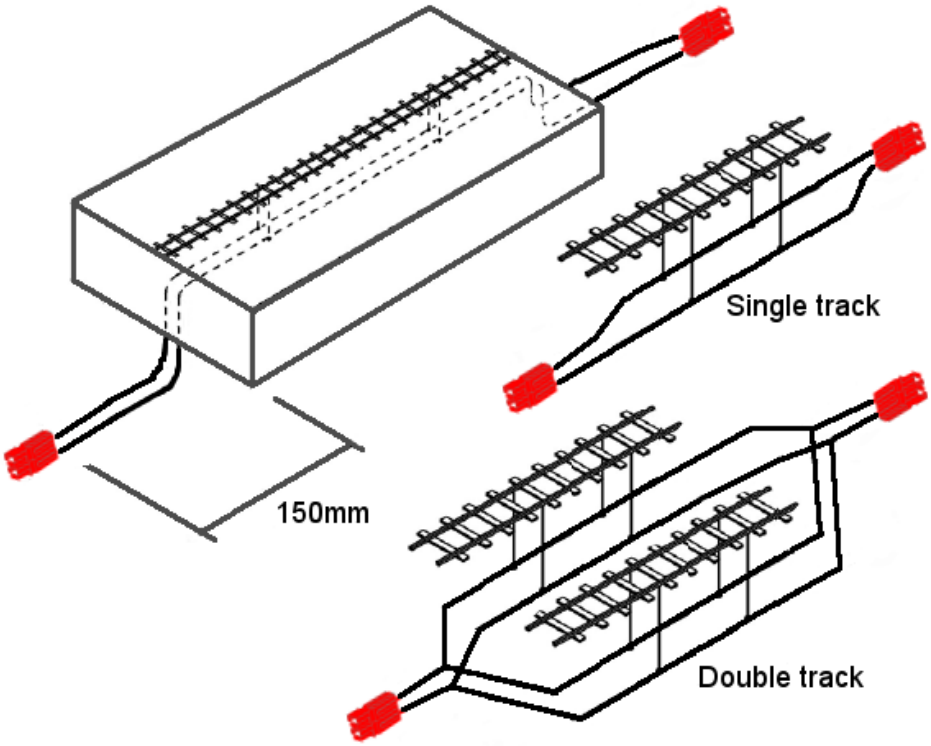
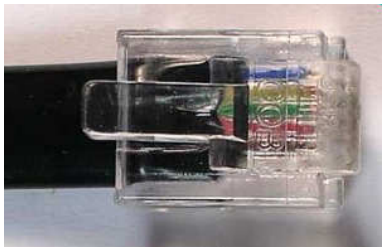


Figure 7: Basic track wiring.

6.3 DCC command bus

The DCC command bus must be 6 conductor flat telephone cable. Do not use older style round telephone cable. Connections external to the module must be through RJ12 plugs and sockets.



RJ12 plug

RJ12 surface mount sockets

All RJ12 plugs and sockets must have 6 wires (6p6c) and all cables must have “straight through” wiring.

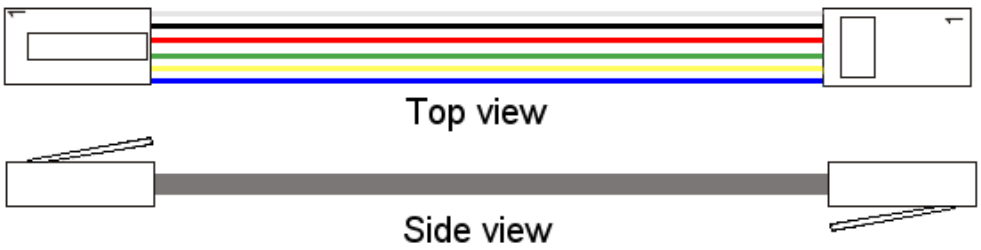


Figure 8: RJ12 straight through cable

Pin	Colour	NCE	NCE Power Cab CS	Lenz (LA152 adaptor)	Lenz LH200 CS	Digitrax
Pin 1	White	Not used	Power to track	Not used	Control Bus	Railsync +
Pin 2	Black	Ground	Ground	Ground	Ground	Ground
Pin 3	Red	- RS-485	- RS-485	- RS-485	- RS-485	LocoNet
Pin 4	Green	+ RS-485	+ RS-485	+ RS-485	+ RS-485	LocoNet
Pin 5	Yellow	+12 volts	+12 volts	+12 volts	+12 volts	Ground
Pin 6	Blue	Not used	Power to track	Not used	Control Bus	Railsync -

Note: It is not recommend that either an NCE Power Cab Command Station or a Lenz LH200 Command Station be used to control any Aus-moN layout set up. (Should only be used for private home use.)

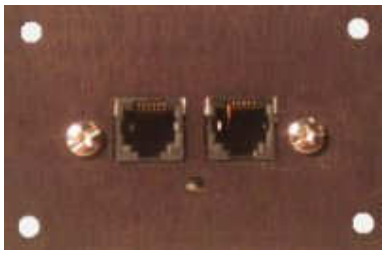
All modules with junctions or sidings must have:

- a 6 conductor (6p6c) RJ12 jack mounted on the inside of each end plate within 150mm of the centre line; and
- at least one jack mounted on each side.

Modules with only plain track (no points) are not required to have a DCC command bus or throttle jacks, but may be so fitted if desired by the module builder.

Jacks may be DCC controller brand or telephone/data wall plates. The position of throttle jacks on each side is at the discretion of the owner. It is recommended that Jacks be mounted with contacts to the top to prevent dust settling on them when not in use.

WARNING: Digitrax UP-5 throttle plates cannot be used with NCE and Lenz DCC systems (Command Stations). When using NCE and Lenz DCC systems all UP-5 throttle plates MUST be disconnected from the DCC Command Bus. (Digitrax UP-5 throttle plates have a connection between pins 2 and 5.)



Commercial DCC throttle panel

RJ12 telephone/data wall plates

Figure 9: Commercial DCC and telephone/data RJ12 sockets

For convenience in areas where operators congregate e.g. yards, such modules should have additional throttle jacks.

Module owners must provide one RJ12 plug to RJ12 plug “straight through” cable per module at least 400mm long, or as long as necessary to bypass modules without throttle jacks, to connect the command bus to the next module.

If the module is fitted with an integral DCC booster, it must be accessible.

Figure 10: Wiring path for command bus using RJ12 surface mount jacks, walls plates and 6 wire flat telephone cable. No soldering or crimping required.

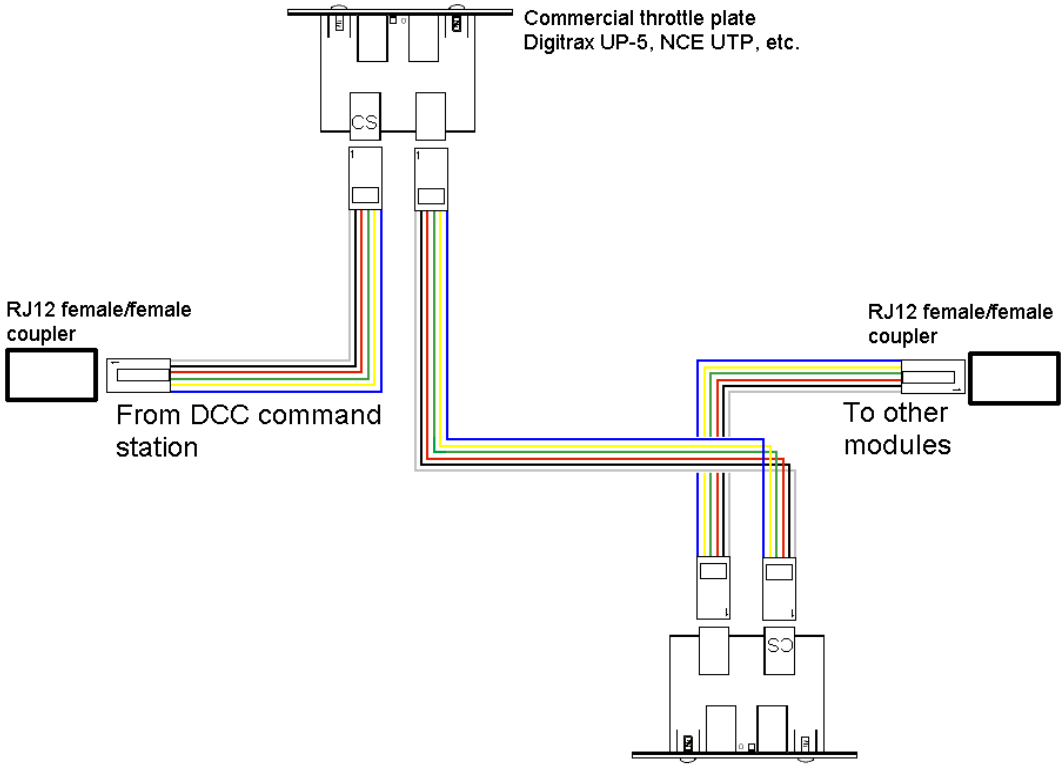


Figure 11: Wiring path for DCC command bus using commercial throttle jacks and RJ12 patch leads. Patch leads can be bought or home made.

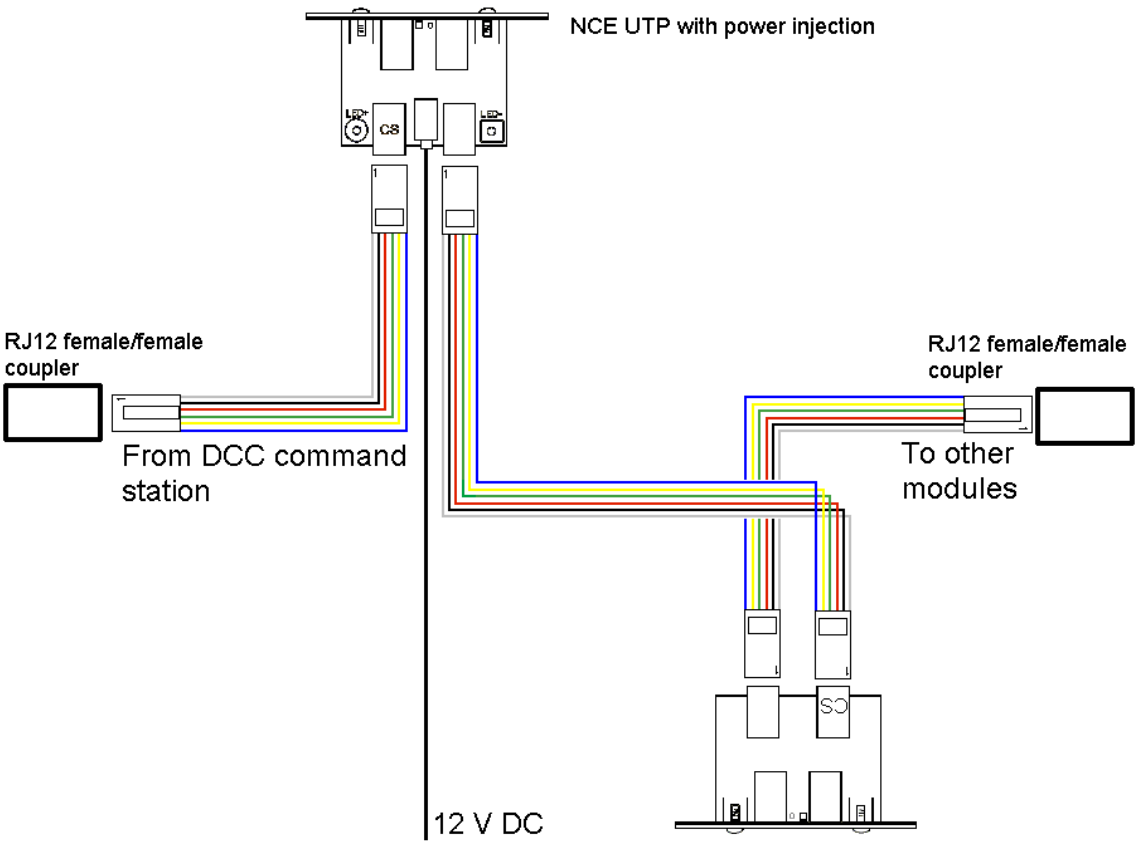


Figure 12: Wiring path for DCC command bus with power injection for NCE or SystemOne

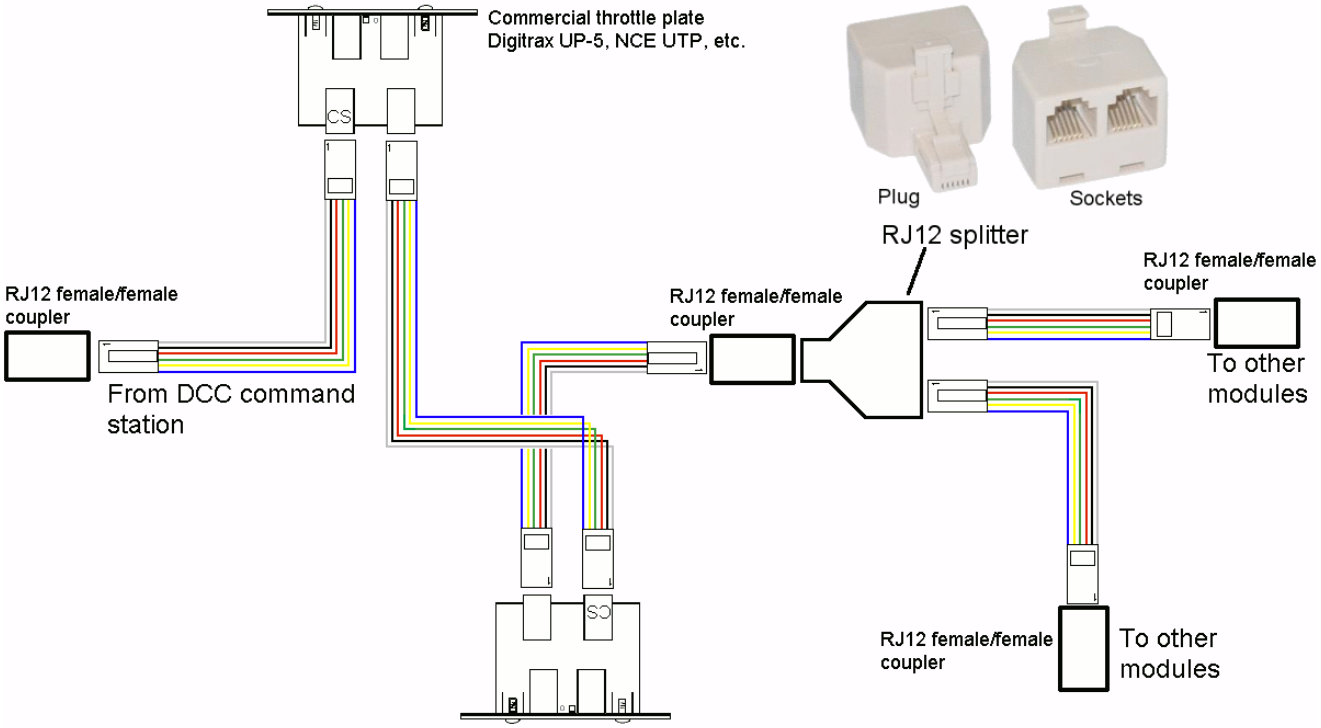


Figure 13: Wiring path for DCC command bus on junction module using commercial throttle jacks, modular telephone components and RJ12 patch leads.

When using commercial throttle plates, the rear of each plate must be accessible so the patch cables can be swapped if necessary to ensure the correct direction of data flow. The direction of the data flow must be noted to prevent boost power from feeding back to the command station.

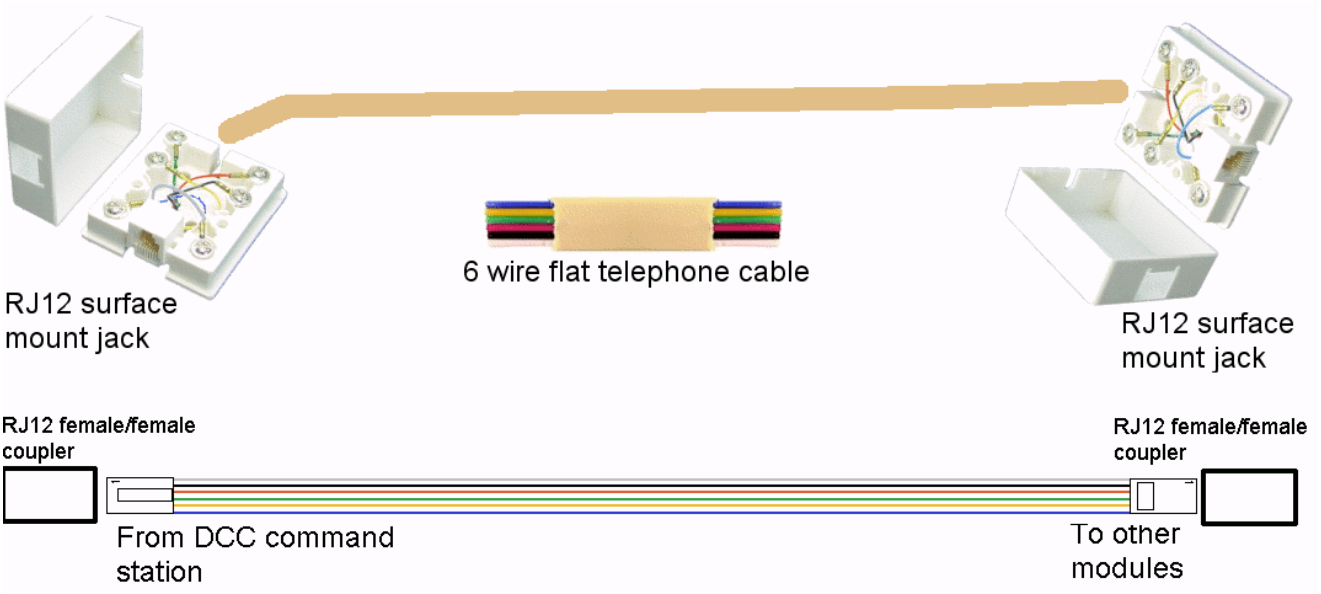


Figure 14: Wiring options for short modules without throttle jacks.

6.4 AC accessory bus

The accessory bus should be 16 volts AC, 5 amp max. or another DCC booster. Using a DCC booster is the recommended method for powering the accessory bus.

Note: If a DCC Booster is used for the accessory bus then DCC controlled points may use the accessory bus for their control signals as well as power. Doing this allows the points to still be operated/controlled even if there is a short on the Track bus and the DCC track booster has shut down.

The accessory bus must be 16 AWG (1.6mm diameter, 2mm2) or larger stranded copper wire. 12 AWG (2.1mm diameter, 3.3mm2) is recommended. Which may be twisted together.

At the end plate, each power bus wire must have a lead at least 150mm long and end with a black 14/45 Anderson Powerpole connector with 30A contacts. The contacts may be crimped or soldered (or both) to the power bus wires. The connectors must be joined together in a horizontal stack.

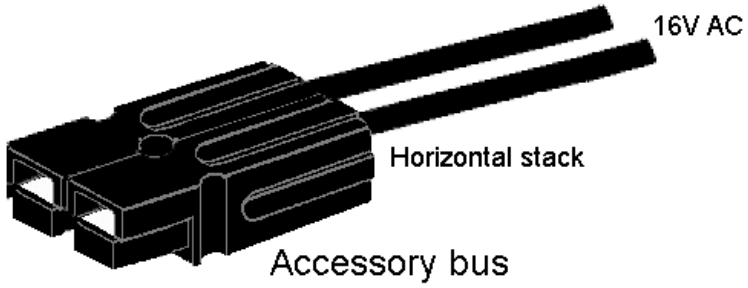


Figure 15: Arrangement of accessory bus connectors.

A suitable DCC Booster or 240V to 16V AC (5A max) plug pack provides power to the accessory bus. This may be connected within a suitable module (e.g. yard or station) by making a “T” joiner and connecting it into the bus at a module join.

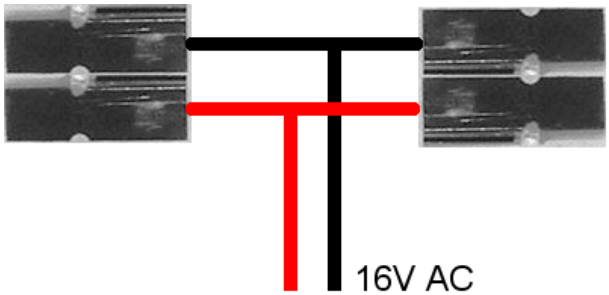


Figure 16: “T” joiner to power AC accessory bus.

Where necessary, the accessory bus may be broken up into separate power divisions, each with its own DCC booster or plug pack.

Accessories must not be powered from the power bus or DCC command bus.

Applications requiring DC power may be rectified off the AC bus. Full wave rectifiers should be used. 6A1 or equivalent rectifier diodes (100V, 6A) are recommended or commercial 6A bridge rectifier.

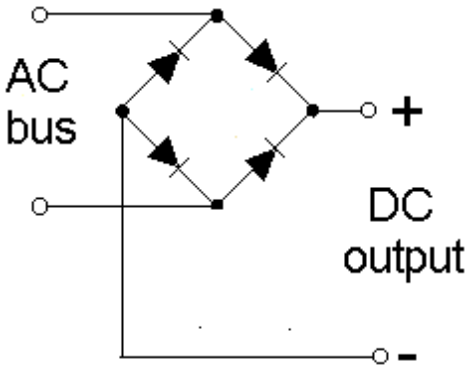


Figure 17: Unregulated full wave rectifier

For applications requiring smoothed and regulated DC power, one or more smoothing capacitors (electrolytic type) and a voltage regulator should be added. The voltage regulator must suit the application (e.g. 5, 9 or 12V). A hobby electronics shop can provide advice on selecting a suitable voltage regulator. Most voltage regulators will require a heat sink.

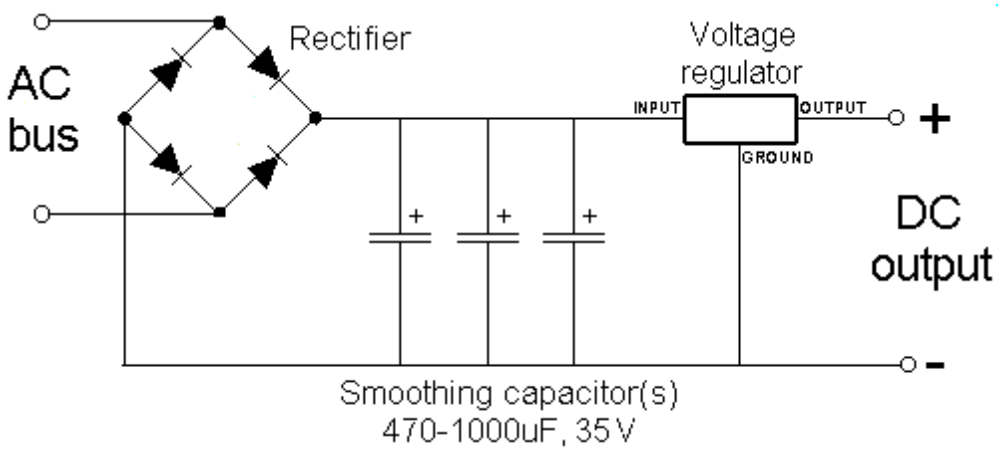


Figure 18: Smoothed and regulated DC power supply

6.5 Safety

Boosters must shut down if a short circuit occurs anywhere on the layout. Check every track by placing a coin or other piece of metal across the rail to ensure the booster shuts down.

7 Scenery

7.1 Landscape

All benchwork must be hidden by some form of scenery. Scenery must be realistic and prototypical. Care should be taken to ensure that scenic exaggerations are kept to a minimum.

Scenic ground level at the end plates is a nominal 6mm below the top of the rails for at least 75mm either side of the track centreline.

Scenic contours within a module are not restricted.

Clearances from the track must conform to NMRA standard S-7 and allow hand cleaning of track.

Scenery at the ends of each module or set of modules must match adjoining modules. The base landscape colour must be Woodland Scenics T44 Burnt Grass for at least 100mm from the end of each module.

Landscaping along the module ends must be designed to flow smoothly into adjacent modules. Features such as roads, lakes, etc should be avoided from running against the module ends.

Polyfibre or fine gauze covered with ground foam may be temporarily placed over module joins to help hide the joins and help scenery blend between modules. Such material must be kept clear of the track.

Backdrops are not permitted as modules are reversible and viewed and operated from either side.

For public displays where viewing is only from one side a temporary backdrop curtain of a sky blue cotton material, no higher than 400mm may be used.

7.2 Track

Main lines and all other through tracks must be ballasted with Woodland Scenics Fine Light Gray or equivalent. Ballast should be weathered with thinned Floquil/Polly-S grimy black or similar.

Rails should be weathered with thinned Floquil/Polly-S Roof Brown or similar.

8 Module registry

A registry and inventory of known modules is kept in the Database at the Aus-moN email group at Yahoo! Groups and placed on the Aus-moN web site. It includes details such as module owner, module name, module type, size and shape, etc.

All modules builders should provide CAD drawing or good quality 1/10th scale hand drawing. The purpose of the registry is to allow a Run Chief to obtain accurate details of modules to assist with event planning.

Aus-moN Yahoo Group: http://groups.yahoo.com/group/Aus-moN/

Aus-moN web site: http://aus-mon.nscale.org.au/

9 Rolling stock

Wheels must meet or exceed NEM 310/311.1, except for the back-to-back dimension which must be altered to operate over NMRA Points (See appendix 14.1 for details) this slight variation to the standard will enable all types of rolling stock to operate over all code 55 track and points. (NEM 310/311 may be used but is not recommended)

Couplers must be Micro Trains or compatible which can be operated by a Rix Pick N scale uncoupling tool or equivalent. Permanently coupled sets, block or unit trains which are not uncoupled en route may use different couplers within the consist, but must have Micro Trains or compatible couplers at each end of the set or rake.

Vehicle weight should follow the “AMRA Carriage Mass standard”. (See appendix 14.2 for details)

Locomotives must be fitted with NMRA compliant DCC decoders.

10 Operation

10.1 Set up

The power bus may be divided into power districts, each powered by a separate DCC booster, by leaving the power bus unconnected and rails isolated at power district boundaries. Each power district should have a circuit breaker. The booster output should be plugged into the power bus near the electrical centre of the power district.

The power bus of each power district should be terminated with a noise filter.

Track power status indicators are optional.

10.2 DCC control

Where modules from more than one owner are set up into a layout, the Run Chief shall determine the brand of DCC system to be used. The Run Chief is responsible for providing the command stations, any required boosters and connections to the track bus. Boosters should not be connected to plain track modules.

Operators may bring any DCC throttles compatible with the Run Chief's command station. Unless otherwise provided by the Run Chief, operators with wireless throttles must provide their own base station with their own power supply.

Note: If NCE or SystemOne DCC systems are used on large layouts, care must be taken in the placement of suitable Universal Throttle Plates (UTPs) with power injection every 10-12 metres. The direction of the data flow must be noted to prevent boost power from feeding back to the command station. The rear of the UTP must be accessible so the command bus cables can be swapped if necessary to ensure the correct direction of data flow. Consult the DCC system's manual for further guidance. Additional power is not required for Digitrax or Lenz systems.

10.3 Point and accessory control

Point and accessory controls should be located on the fascia and be recessed. Point and accessory controls must not be mounted on any visible horizontal surfaces.

Point controls may be mechanical or electrical. For any given set of points, controls must be on both sides of the module, located close to the points and easy to operate by operators unfamiliar with the module.

Point and accessory controls must be clearly labelled using printed text easily readable from arm's length.

If stationary DCC decoders are used for point control, local control must also be provided.

11 Glossary

Accessory bus: The continuous two wire 16V AC, or DCC bus for powering electrical accessories.

Command bus: The continuous six wire bus carrying DCC command information between various DCC system components such as throttles, boosters, radio receivers, etc.

DCC “Friendly” Point: A point which has its point rails and closure rails electrically connected to the adjacent stock rails and that the frog is isolated from all other rails. The power to the frog is provided by a set of contacts that are part of the point machine used to throw the points. (Point machine can be either a manual or electrically powered device.)

DCC Ready Point: See **DCC “Friendly” Point.**

Endplate: Endplates are the standardised end surfaces of a module that join to another module.

Event: Any meeting, exhibition or show where Aus-moN modules will be set up to form a layout, whether for public display and/or private operation, construction or testing, irrespective of the number of modules or members participating.

Module: Any component (or group of "sections") of bench work that is meant to be operated as a single unit in a fixed configuration. A module can have any number of sections. The ends of a module must comply with this standard.

Power bus: The continuous two wire bus feeding power and DCC commands to the track.

Run Chief: The official representative of the group at a specific event. The Run Chief coordinates participation of module owners, plans the layout, nominates the DCC system to be used, obtains details of the participating modules, makes the layout plan available to participants prior to set-up, provides the DCC command station and boosters(s), and supervises the set-up as needed. The Run

Chief compiles a roster of locomotive decoder addresses to be used on the layout and ensures that conflicts in locomotive decoder addresses during layout operations are avoided. The responsibilities of the Run Chief may be delegated as needed.

Section: A component of a module, complete with bench work, track, scenery, etc. Except where otherwise noted, standards for module end interfaces do not apply to inter-section interfaces, as these are considered to be internal to the module. Track, electrical and DCC connections between sections are at the discretion of the module builder.

12 References and further reading

Aus-moN Yahoo Group: http://groups.yahoo.com/group/Aus-moN/

Aus-moN web site: http://aus-mon.nscale.org.au/

References to AMRA, NMRA & MOROP standards

13 Miscellaneous

13.1 Disclaimer

The authors, the publisher and their successors expressly disclaim any liability however arising in the event of any person suffering damage or loss by any reason of reliance upon this publication.

13.2 Copyright and Licence

14 Appendix

14.1 Track and Wheel standards

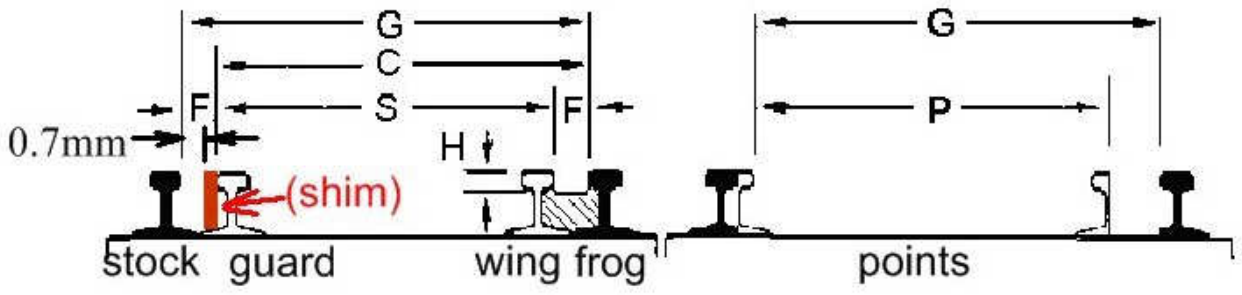
In order to maximise wheel and track performance, certain modifications must be made to commercially available items. These modifications allow the mixed Australian prototype modelling environment of 4 wheel and bogie rollingstock with their use of differing wheel standards to operate successfully together.

Points

In order for PECO points to be used a shim must be added to the guard rail in order to reduce the guard rail to stock rail flangeway to 0.7mm. This is best achieved by using a piece of Evergreen styrene strip (0.25 x 1.5mm) fixed in place with MEK or similar.

Insert Photo here of shimmed PECO point

All dimensions are in millimetres.

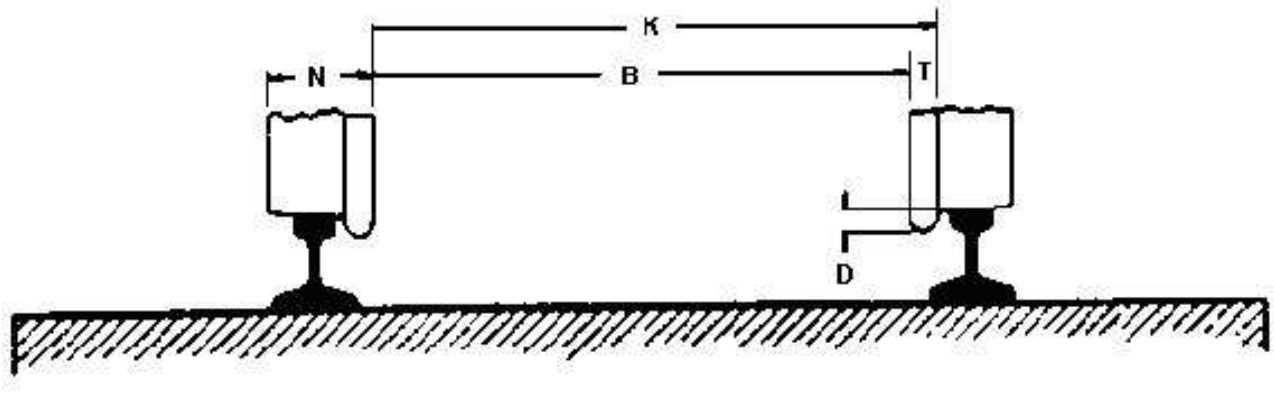


Note: C=G-0.7
S=G-(0.7+F) for modified PECO point
**modified dimensions when Fmin=0.7mm for stock rail to guard rail flangeway for modified PECO point.

Norm/standard	Gmin G Gmax	Fmin F Fmax	Cmin C Cmax	Smin S Smax	Hmin H Hmax
PECO code 55 point (Modified with shim)	8.95 - 9.1	0.7**(0.9) - 1.0	Now 8.25** - Now 8.4**	Now 7.25** - Now 7.5**	- 1.15 -
NEM 110, NEM 124	9.0 - 9.2	0.8 - 0.9	8.1 - 8.2	7.2 - 7.3	0.9 - -
NMRA S-3.2	8.97 9.02 9.12	0.68 0.71 0.76	8.21 8.26 8.29	7.44 7.49 7.52	0.51 - -

Wheels

Commercially available wheel sets which have been manufactured to NEM standards or similar require the back-to-back dimension to be increased to at least the NMRA S-4.2 standard Bmin of 7.55mm.



Note: K=B+T

Norm/standard	Kmin K Kmax	Bmin B Bmax	Nmin N Nmax	Tmin T Tmax	Dmin D Dmax
NEM 310, NEM 311.1	Now 8.04 (7.9) - Now 8.05 (8.1)	7.55**(7.4) - 7.6	1.8 - -	0.5 - 0.6	0.5 - -
NEM 310, NEM 311	Now 8.04 (7.9) - Now 8.05 (8.1)	7.55**(7.4) - 7.6	2.0 - 2.2	0.5 - 0.6	0.5 - 0.9
NMRA S-4.2, RP25	8.05 8.15 8.20	7.55 7.65 7.7	- 1.83 -	0.46 0.51 0.56	- - 0.56

**NEM310 Bmin (Back-to-back) dimension altered to equal NMRA S-4.2.

The following wheel sets that are used for 4 wheeled rollingstock need to be modified accordingly.

Aust-N-Rail GY and K wagon wheel sets can be altered by the addition of a 5 thou (0.13mm) styrene shim (**Note**: B van wheel sets do not require this modification).

Romford wheels have to be moved out on their axels. (Warning, be very careful)

PECO wheel sets require no modification.

Graham Farish wheel sets…..?????

All wheel sets should be checked with an NMRA N scale mark IV standards gauge or similar.

Insert photo of modified Aust-N-Rail wheel set with NMRA standards gauge.

14.2 AMRA Carriage Mass standard for rollingstock

Prototype passenger carriages generally weigh less than freight wagons of the same length therefore 2 different mass length ratios are specified.

Definitions

Passenger carriage: Any vehicle that is typically used on a passenger train excluding freight carriages that are used on both passenger and freight trains.

Freight carriage: Goods carrying vehicles, brake vans and locomotive tenders.

Carriage length: The distance from the coupling faces at opposite ends of the carriage.

Passenger carriages Mass length ratio	Freight carriages Mass length ratio
0.22 g/mm	0.30 g/mm

Recommended Tolerance: +/- 15%

Note: Freight carriages can use the lighter passenger carriage mass length ratio if they are not mixed with freight carriages that use the heavier mass length ratio.

Extract from the AMRA Carriage Mass standard Version 1.0 July 2010

14.3 DCC Setup procedures

To be added.

Free-mo actually prides itself in NOT being an organisation. The founders avoid all the political trappings by not organising into a club. Instead they have instituted standards designed to ensure interoperability between modules constructed by a vast network of like-minded modellers. The concept of Free-mo originated in Europe, and was adapted to the North American modelling styles and equipment.