

FREE-MO at NMRA AR Div 1

More than Just a Standard

NMRA AR Div 1 proposed Standard Version 0.5

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Disclaimer - This is not an official NMRA standard. It is no more than a suggestion for an approach that will work for the members of AR Div1. The author has borrowed freely from the Free-Mo.org and AMRA standards. The changes suggested are to adopt the metric system and make minor adjustments to the measurements to fit with plywood that comes in 1200mm x 2400mm sheets.

The work of AR Div7 has been influential, and the changes selected mean Div1 and Div7 modules should be compatible regarding track positions, cable paths and the positioning of connecting bolts. However, Div1 has specified options for double and single tracks. It also specifies a Track Bus and a Layout Bus but no DCC system.

Modern practice has moved firmly to WiFi controllers, removing the requirement for docking stations to service proprietary CABS.

The Mini mo and branch line standards will be distributed at a later date.

Legend

The following preference number system is used to cross-reference paragraphs that occur in this document. These references have the following structure: -

S x.y, where x. and y are number – for example, S2.15

RP x.y, where x. and y are numbers – for example, RP 5.11

FAQ abx.y, where ab are S or RP, and x. and y are numbers – for example, FAQ SI.7,

FAQ RP3.2

A prefix to a reference has the following meaning:

S = Standard. All Free-Mo modules and participants must conform to the requirement/standard stated.

RP = Recommended Practice. These procedures or specifications are strongly encouraged for maximal reliability or fidelity.

FAQ = Frequently Asked Questions which explain the reasoning behind a particular Standard or Recommended Practice.

1.0 Introduction

SI.1 The objective of the Free-Mo Standard is to provide a platform for prototype modelling in a flexible, modular environment. Free-Mo modules provide tracks to operate realistic models and emphasise realistic, plausible scenery; realistic, reliable track work; 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.

SI.2 Interoperability: The Free-Mo Standard is a collection of requirements for building scale model railroad modules that can work together with little effort, even when they have never been assembled before. The beauty of the Free-Mo standard is that it allows builders to replicate any freelance or prototype track plan within your module's boundaries yet can be combined for maximal interoperability with other Free-Mo modules. ([FAQ SI.1](#))

SI.3 A Free-Mo module is a free-form module that conforms to the Free-Mo Standard outlined below. ([FAQ SI.3](#))

SI.3.1A Free-Mo module can be any length, and the endplates on the same module can be at any angle to each other.

SI.3.2A Free-Mo module can be one section or a set of two or more sections that form a module.

SI.4 The Free-Mo Standard governs the ends of the module and basic track requirements. Most Free-Mo modules have two ends but can have one, two, three, or more ends. ([FAQ SI.4](#))

SI.5 Free-Mo modules fall into three basic categories:

SI.5.1 Mainline - Mainline modules represent Mainline rights-of-way. Mainline modules are designed with ample radius curves and minimal grades.

SI.5.2 Branch line - Branch line modules represent branch line rights-of-way. branch line modules can have smaller radius curves and steeper grades than Mainline modules. See the Free-Mo Branch Line Supplement for more details.

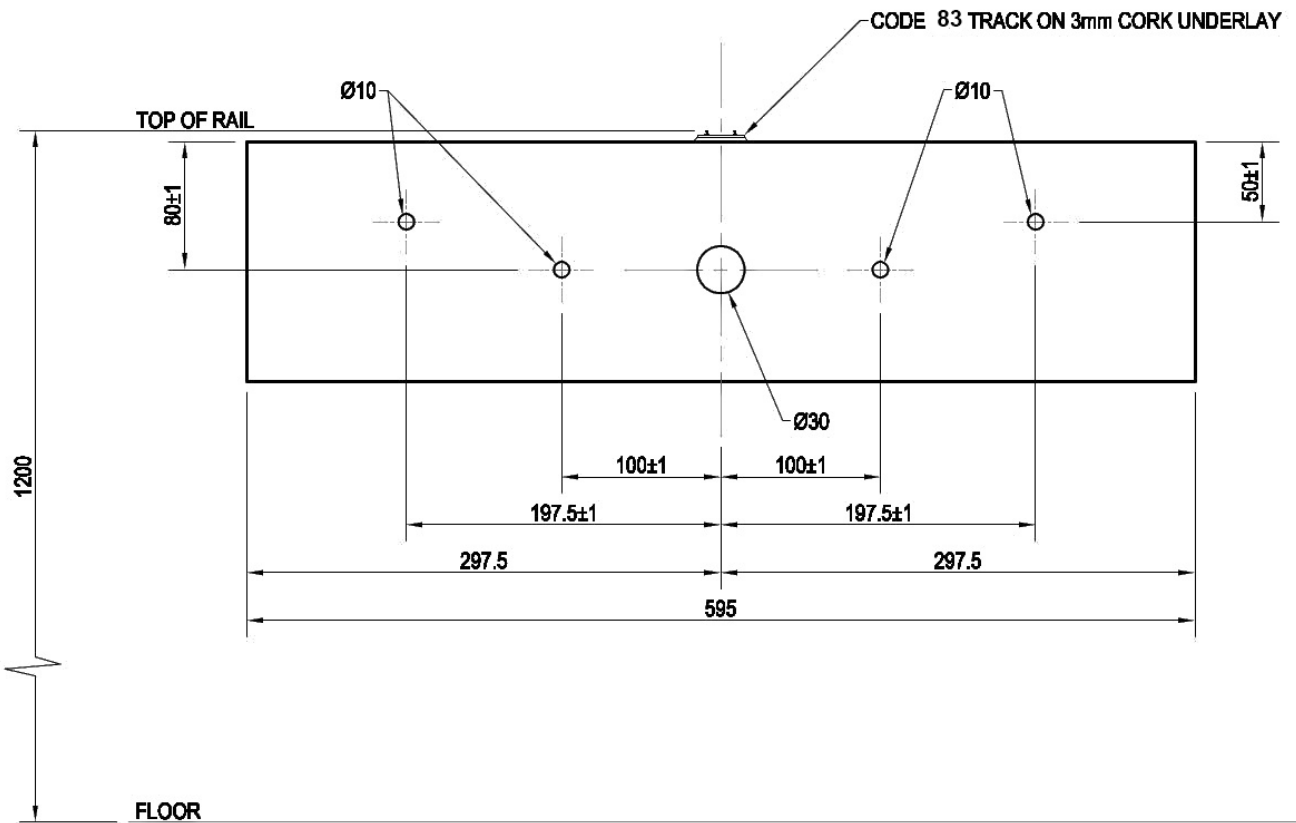
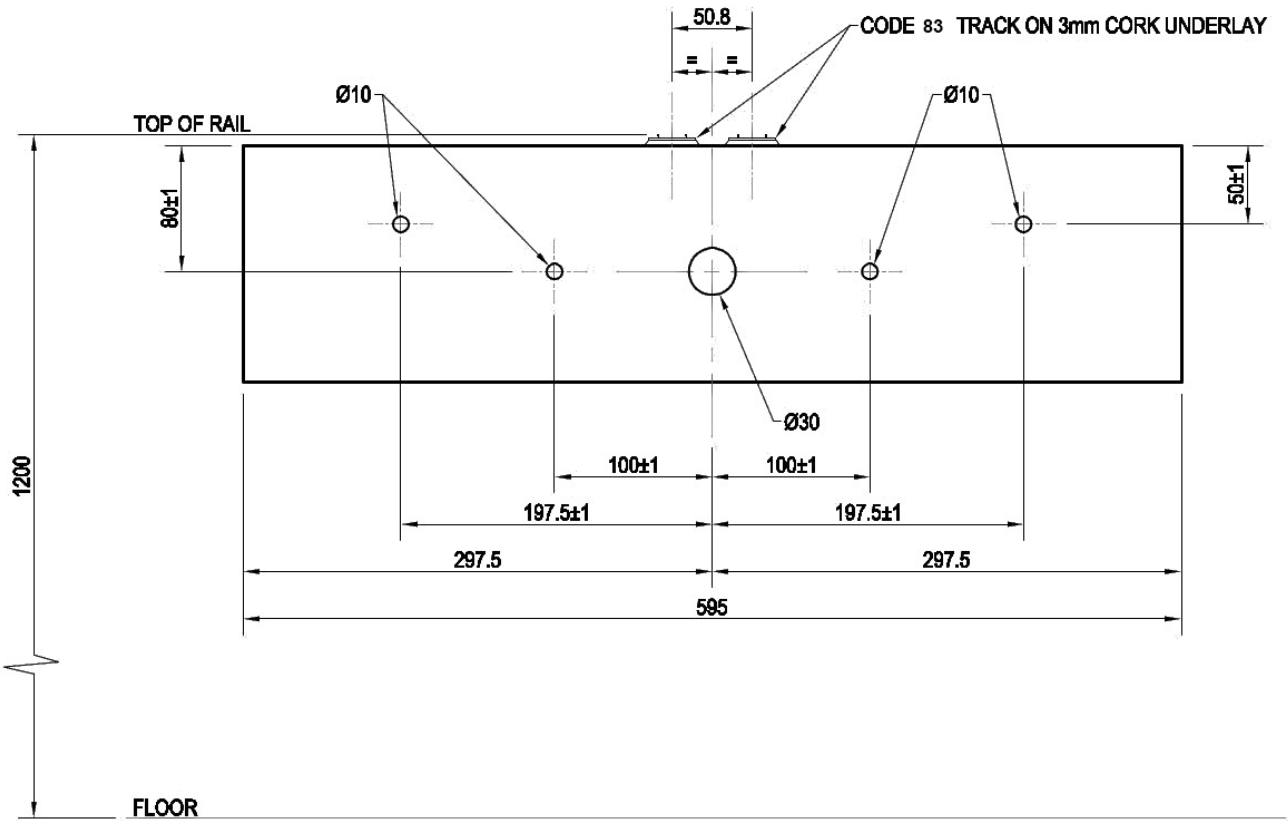
SI.5.3 Mini-Mo - Mini-modules (Mini-Mos) have narrower endplates than the standard width endplate. A mini-Mo can be a Mainline or Branch line module, single-track or double-track. (FAQ SI.6) See the Free-Mo Mini-Mo Supplement for more details.

SI.6 Mini-Mo type modules are intended to be a Free-Mo subset and not replace or exclude an equivalent length standard module. Full-width modules are generally more stable and should be used wherever possible.

2.0 Frame and Legs

S2.1 Endplates shall be 17mm plywood or equivalent (birch plywood works well) to provide sufficient strength for clamping to adjacent modules. (FAQ S2.1, RP2.1.1). (Plywood thickness is a nominal dimension, actual thickness will be approx. 15mm).

RP2.1.1 Avoid Dimensional Pine Lumber for your framework. It tends to warp and "cup" with age, throwing off-track alignment. It has also been found that good quality plywood (birch plywood works well) warps and twists less than dimension lumber (3/4-inch pine boards). Form Ply is also unsuitable for the same reason. ([FAQ S2.1](#))



S2.2 Track endplates shall be 595mm wide and at least 100 tall. Endplates that are 150mm are more stable. The endplate will have three holes the centres of which are to be 50mm below the top edge. The centre hole radius is 30mm in diameter and

centred on the end plate. The remaining four holes have a diameter of 10mm and centres 197.5mm and 100mm from the vertical centre line of the end plate. This arrangement allows the end plate to work with Div 7 and Free-mo Australia modules.

S2.3 The top of railhead is the datum point from which all vertical distances are calculated.

S2.4 Roadbed shall be cork or foam equivalent on 17mm plywood or equivalent. Foam tops are acceptable if braced to prevent sagging or flexing. The top of rail should be 7mm above the top edge of the end-plate.

S2.5 The nominal and minimum height of the railhead, at the end plate, is 1200mm from the floor. (FAQ S2.5)

S2.6 On modules with grades, the elevation of the high end shall be some multiple of 20mm above the low end. (FAQ S2.6)

S2.7 The maximum height of the railhead, at the end plate, is 1575mm from the floor. (FAQ S2.7)

S2.8 The module (set) shall have at least four legs and stand independently.

S2.9 Legs shall be adjustable within a range of plus or minus 25mm (screw-type foot).

S2.10 The bottoms of the legs shall have rubber tips or equivalent floor protection.

S2.11 Modules may be used with operators and spectators on either or both sides. (FAQ S2.11)

3.0 Track

S3.1 Modules shall use flex or hand-laid track.

S3.2 The centreline of all tracks shall be always 100 mm or more from the sides of the module. (FAQ S3.2)

S3.3 The through track shall be centred on the endplate on a single-track module. (see S2.2)

S3.4 On Double-track modules, the two through-track centrelines shall be spaced precisely 50.8mm (2 inches) apart and each displaced by 25.4mm (1 inch) from the centreline on the endplate. (see S2.2)

S3.5 Track on the through route must be perpendicular to the endplate for 150mm from each end of the module.

S3.6 Track on the through route must be straight and level for 150mm from each end of the module.

RP3.6.1 Any turnout points should not be within 150mm of the end of a module.

S3.7 Rail shall be cut off 25mm away from the module end; ties and ballast shall be continued to the module end for good appearance and matching with the adjacent module. Ties shall be notched under the ends of the rails and to the module end, to clear bridge rail joiners and provide freedom of adjustment for bridge rails. ([FAQ S3.7](#))

RP3.7.1 To enable DCC power districts, your module must accommodate insulated rail joiners at each Free-Mo endplate.

RP3.7.2 Free-Mo printed circuit board tie plates are recommended for ends. ([FAQ RP3.7.2](#))

RP3.7.3 Tie plates where the bridge rails go over should be excavated slightly to permit fitter rails to accommodate any vertical irregularity in track alignment between adjacent modules.

S3.8 Turnouts shall be at least #6.

RP3.8.1 Turnouts on the module through route should be #8 or larger.

S3.9 There shall be a minimum of 300mm of straight track between reverse curves.

S3.10 Track on the through route of a Mainline module must ALL be Code 83 nickel-silver rail without exception.

S3.11 Sidings, spurs and other tracks of a Mainline module may be Code 83 or smaller but shall be no less than Code 40.

S3.12 The minimum permitted curve radius on a through-route of a Mainline Module is 1066mm. This includes through track sidings and other tracks where through-traffic will run.

RP3.12.1 While the minimum permitted radius of curves on the through route of a Mainline module is 1066 mm, larger curves are preferred.

S3.13 Spacing between tracks on curves of a Mainline module shall allow for long cars to operate without fouling each other; observe [NMRA Standards S-8 Track Centers](#) for "Class 1a" equipment.

S3.14 Mainline maximum permitted grade on the through-route of a Mainline module is 2.0 per cent. (FAQ S3.14)

S3.15 Curves on the through-route of a Mainline module shall be appropriate for the Mainline operation of contemporary long cars, see:

Standard S-7 Clearances and the NMRA Gauge, and
NMRA Recommended Practices RP-II Curvature and Rolling Stock.

4.0 Wiring

S4.1 Wiring consists of 2 buses each of 2 wires (Track Bus and Accessory Bus), a single wire Booster Common.

RP4.1 The length of the free ends of the Track Bus, Accessory Bus and Booster Common at each end plate shall be a minimum of 18 inches.

S4.2 Track and Accessory Bus wire shall be 14 AWG stranded or larger.

S4.2.1 Not Used

S4.3 Not Used.

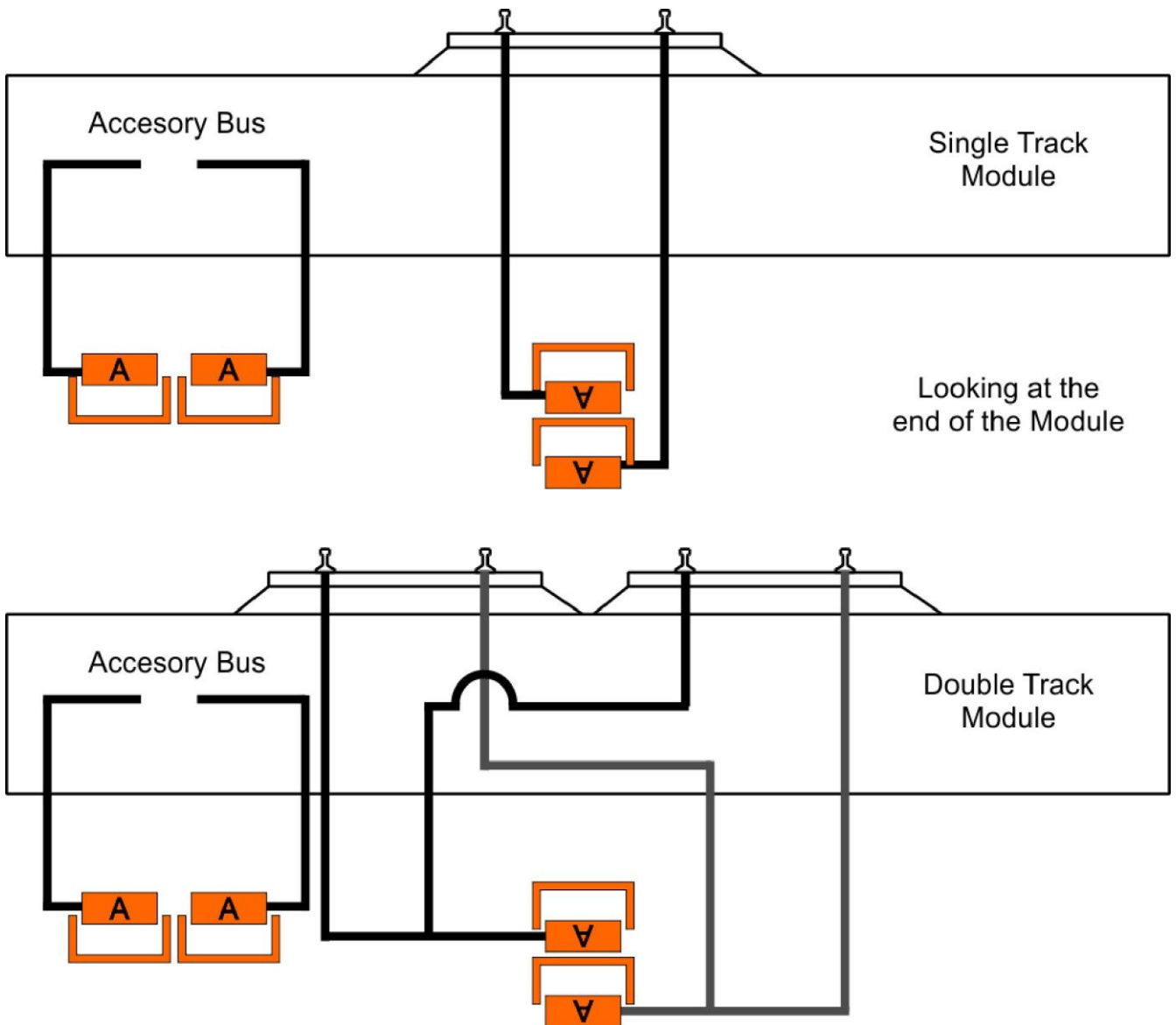
RP4.3 Not Used

S4.4 There shall be a 4 (or more) position barrier strip under the module at each end for track and Accessory Bus wire hook-up.

S4.5 the Track Bus shall be terminated on all ends with a pair of Anderson Powerpole PP15-45 Standard Housing incorporating a 30 amp power contact for use with 12-14 gauge wire. The PP15-45 connectors shall be stacked vertically (hood up, tongue down).

While facing the module from the end with the hood of the stacked connectors up:

- The top PP15-45 shall connect to the left rail.
- The bottom PP15-45 shall connect to the right rail.



S4.5 & S4.6 - Free-mo Anderson Powerpole Standards for Accessory and Track Buses
(colours of housing are optional)

S4.5.1 Not Used

S4.6 The Accessory Bus shall be terminated on all ends with a pair of Anderson Powerpole PP15-45 Standard Housing connectors incorporating a 30 amp contact for use with 12-14 gauge wire. The PP15-45 connectors shall be stacked horizontally (tongue-to-tongue, hood-to-hood). (See figure in S4.5)

S4.6.1 Not Used.

S4.7 NotUsed.

S4.8 Through route wiring is as follows for Anderson Powerpole plugs (must be facing module end for correct perspective): ([FAQ S4.8](#))

S4.8.1 Single-track -

- Male contact 2 right rail
- Male contact 1 left rail
- Female contact 2 left rail
- Female contact 1 right rail

S4.8.2 Double-track -

- Male contact 2 right rails
- Male contact 1 left rails
- Female contact 2 left rails
- Female contact 1 right rails

RP4.8.1 - On double track modules, to facilitate optional train signalling/detection, separate feeders are recommended for each track so that detection can discern a train on track A or track B.

S4.9 Track feeder wire must be 24 AWG or larger, but not longer than six inches to the Track Bus to avoid voltage loss.

S4.10 All turnout frogs shall be powered. Turnouts shall not rely on switch points to power the frog.

S4.11 Accessory power shall be approximately 16 volts AC or DCC. The bus is wired straight through. A bridge rectifier and filtering capacitor may be used to convert AC or DCC signal to DC. Applications that require AC or DCC signal may utilize power directly from the bus. ([FAQ S4.11](#))

S4.12 Not Used

RP4.12.1 Not Used.

RP4.12.2 Not Used.

S4.13 Not Used.

S4.14 Not Used.

S4.15 Not Used.

S4.15.1 Not Used

S4.15.2 Not Used.

S4.16 Not Used

S4.17 Booster Common shall be terminated on all ends with an Anderson Powerpole

S4.18 The Anderson Powerpole PP15-45 connectors for the Track Bus, Accessory Bus, and the Booster Common shall be three separate sets of connectors.

5.0 Control

S5.1 DCC and accessories are standard for interoperability within and between Free-Mo groups. For more information about DCC Technical specifications consult the [NMRA](#) website.

S5.2 For a given turnout, turnout controls must be on all sides of the module or module section, excepting any endplates.

RP5.2.1 Turnout controls should be located on the fascia, not on your scenery's horizontal or vertical surfaces.

6.0 Scenery

S6.1 All benchwork shall be hidden by some form of scenery that is representative of inland Australia. Buildings and structures shall be based on Australian prototypes.

S6.2 General module fascia colour shall complement the scenery and not draw attention from the scene.

S6.3 Scenery at the Free-Mo standard end(s) shall have a flat profile 9.5 below the top of the rail on the through route.

S6.4 Track ballast shall be Woodlands Scenics Fine Dark Brown ballast mixed in equal proportions with Woodlands Scenics Fine Grey ballast for the through tracks.

S6.5 Standard rail colour on the through route is Floquil/Polly-S Roof Brown or equivalent.

RP6.5.1 Ballast on the through-route will be weathered with a fine mist of thinned Floquil/Polly-S grimy black or equivalent.

RP6.5.2 Recommended scenery materials for Australian inland scenery

Brand	Type	Code/Description	Colour
HEKI	Static grass	3363 Grafaser 100g 'Winterboden'	Dead/brown grass
		3367 Grafaser 75g 'Wildgras Wiesengrün'	Green/brown grass
		3368 Grafaser 75g 'Wildgras Waldboden'	Green
	Foreground Trees	1971 10 tree armatures + some foliage 'Baum-Bausatz'	
		1940 Oak Tree x 1 - No foliage Excellent for large gum	
Woodland Scenics	Tree Armatures	114 ¾ - 2" bushes/small trees	Brown plastic trunks
	Tree Armatures	57 2 – 3" small trees	Brown plastic trunks
	Clump Foliage	FC181 165 cu.in. bag Ground cover and Tree Foliage	Burnt Grass
	Clump Foliage	FC182 165 cu.in. bag Ground cover and Tree Foliage	Light Green
	Clump Foliage	FC1644 50 cu.in bottle Bushes	Olive Green

	Static Grass	FL631 50 cu.in bottle 'Wild Honey'	Fawn
	Static Grass	FL632 50 cu.in bottle 'Harvest Gold'	Brown
	Static Grass	FL634 50 cu.in bottle 'Light Green'	Light olive
Model Terrain	FineLeaf Foliage	F1133 75 cu.in. box Bushes	Olive Green
	Foliage	500ml bag Tree foliage	Olive Green
Scenic Express	Foliage	500ml bag Tree foliage	Light Olive
	Foreground Trees	EX1228 8" White Birch Trees x 2 Good gum trees Other smaller trees in 2 and 4 packs	
Mini Natur	Static Grass	006-34	Late Fall
MRC (Also JTT Trees)	Small bushes or branches	95080 (Fb1001) – 1" to 3" approx. 100	Mid green
Noch	Static Grass	Various	

7.0 Glossary

- Anderson Powerpole Connector - refers to the PP15-45 Standard Housing incorporating a 30 amp contact for use with 12-14 gauge wire.

<http://www.powerwerx.com/techdata/PP30.pdf>,
[http://www.andersonpower.com/files.php?file=DS-PP1545\(25\).pdf](http://www.andersonpower.com/files.php?file=DS-PP1545(25).pdf)

One source for the Anderson Powerpole connectors referenced throughout this standard is:

<http://www.powerwerx.com/anderson-powerpoles/powerpole-sets/>
<http://www.powerwerx.com/anderson-powerpoles/housings-contacts/>

- Booster Common
- Branchline Module • Mainline Module • Mini Mo-
- Through Route

8.0 Revision History

V0.1 First Draft created from Free-Mo.Org standards

V0.2 Second Draft correcting grammar and measurements.

v0.3 Third Draft incorporating AMRA free module standards with respect to the target distance to the floor.

v0.4 Corrected measurement conversion errors, provided more commentary on plywood specification. Corrected reference to "Jones" plug. Extended scenery specification.

