O SCALE

MODULAR STANDARD

PART 1 - TWO TRACK (OR MORE) MAINLINE MODULES

A Standard for Mainline Modules to Operate
O Scale 2-Rail Model Trains

Record of Changes and Revisions

Change or Revision Number	Purpose of change or revision	Date Imple-mented

The O Scale Modular Standard (OSM)

Glossary.

Anderson Powerpole - This is a modern wire connection system that is robust and reliable, but easily connected and disconnected. See References in Section 10.

O Scale Mainline Module - O Scale Module built to this standard.

BUS - BUS refers to electric wires that run from one module endplate across the module to the other endplate(s), usually through a barrier strip.

DCC - Digital Command Control. DCC is the modern NMRA standard train control protocol for scale model railroads. It provides independent control of locomotives and supports sound effects and other realistic features.

Endplate - The ends of a module that have tracks running across from adjacent modules (“through tracks”) are called endplates.

Faceplate - DCC manufacturers offer flat-faced devices, designed to mount flush in the fascia, that have jacks for connecting throttles (and potentially other external equipment) to the module DCC control BUS. These are called faceplates in this standard.

FAQ - Frequently Asked Question, with Answer which explains the reasoning behind a given Standard or Recommended Practice.

Free-Mo - Free-mo stands for "free modular.” It is a standard that emphasizes flexibility in track design and prototypical scenery and operation. Setups are generally linear, but may have turn-around loops. An O Scale Free-Mo standard is used in Europe but there is not yet an North American Standard.

Module - A module is a portable table-like structure which is part of a group of similar tables which when assembled together form a large and fully operable

model railroad. A module is designed to fit anywhere in the layout, and in any orientation of endplates, and in this regard differs from a “section” (see below).

NCE – North Coast Engineering (https://www.ncedcc.com), one of several manufacturers of DCC equipment.

NMRA - National Model Railroad Association https://www.nmra.org

MRP - Module Recommended Practice. Principle, procedure or practice which is strongly encouraged for reliability, operability, appearance, and/or prototype fidelity.

MS - Module Standard. All new OSM modules must conform to the requirement/standard stated.

Safety Lip and Safety Shield - A safety lip is a strip of thin but stiff material, like Luan plywood, that is attached to the front side of a module to stop runaway rolling stock from going off the side. A safety shield is a plexiglass panel that is attached to the side of a module to prevent prying hands from disturbing artifacts on the module during exhibition. These should be removable for home or trusted rails fan operations.

Scene - Two or more modules that, when attached together in a singular specific order, produce a track plan and/or scenery arrangement that requires more lateral distance to display in full than the base unit of the standard; that mate with other like-modules at their outermost endplates, while possibly, but not necessarily, deviating from the endplate standard within its outermost endplates.

Section - A section (as opposed to “module”), is a portable table-like structure which is part of a group of similar tables which when assembled together form a large and fully operable model railroad. Each section fits in a specific place and orientation in the overall layout and may not fit in any other place.

Through track - As used in this standard, the term “through track” refers to tracks that run across the endplates of all modules, for the continuous run or end-to-end run of trains.

Transportation Plate (or Transport Plate) - A transportation plate is a stiff material attached to the exterior endplate of a module to prevent damage to the track, rails, and scenery during transportation and storage. It may also be designed to enable stacking modules for expeditious transport or storage.

UTP – Universal Throttle Panel. UTP is the NCE Corporation “Faceplate” design.

UTP-CAT5 - UTP-CAT5 is an NCE Corporation alternative Faceplate design that uses standard CAT5 cables as the control BUS. One significant feature is the ability to easily boost power to the control BUS in very large layouts.

0.0 Guiding Principles

MS0.01 **Fellowship**: This standard is intended to promote live setups, and is not intended to exclude otherwise functional modules for technical or mechanical reasons.

MS0.02 Modules with themes may exhibit signage to explain/describe the theme. In the same vein, name(s) or builder(s) and owner(s) may be displayed.

MS0.03 **Precision:** This standard is intended to be simple enough for the average modeler to build and assemble functional modules without special tools or precision machining. (One exception is the Anderson Powerpoles crimping tool). In addition, the effort to make a layout need not fall to any one participant. It is technically possible for 12 individuals to each bring one curved utility module to make a circle layout.

MS0.04 **Time**: This standard promotes techniques and designs to significantly reduce the amount of time spent assembling and adjusting a layout.

MS0.05 **Excluded.** Three Rail O Gauge (Tinplate, High-Rail, O27), Proto:48, Trolley, Subway, Interurban, and Narrow Gauge modules are not included in this standard. Three Rail O Gauge (Tinplate, High-Rail, O27) and Proto:48 are incompatible with this standard. The East Penn Traction Club O Scale module specifications are recommended for trolley, subway, and interurban railroads. It may be possible to design interchanges with trolley, subway, interurban, and narrow gauge module systems, for example by transition modules, but this is not addressed in this version of the standard.

1.0 Introduction

MS01.01 **Objective:** The objective of the O Scale Modular Standard (OSM) is to provide a light-weight platform for prototypical main line O Scale train operation in a flexible, modular environment; as well as to facilitate improvements to, and interoperability of, existing legacy modules. OSM supports O Scale Central's objective to show off O Scale 2-rail trains in all sorts of situations. Ultimately, OSM can enable realistic prototypical operation, plausible scenery, historical context, and solid entertainment.

MS01.02 **Interoperability**: The OSM Standard is a collection of requirements for building scale model railroad modules in O Scale that can be set up and connected with minimal effort, even when they have never been assembled together before. Builders can replicate any prototypical track plans within the framework of a modular system.

MS01.03 **OSM**: An OSM is a module that conforms to the OSM Standard as prescribed below.

MS01.03.01: A OSM straight module set can be any multiple of four feet.

MRP01.03.01: Modules built four feet in length can be easily fitted in pairs into an oval or dog bone layout form. Six foot long modules are better for O Scale crossovers and turnout ladders, besides reducing the number of joints in a setup. Five foot modules can fit sideways in most vehicles, but must be made in a set of 4 to come out to a multiple of 4 feet. If built in pairs, any module length can be accommodated in an oval.

MS01.03.02: A OSM module can be a set of two or more sections that have OSM conforming endplate(s) at all ends connecting to OSM module(s). This may be called a module set. This is the basis for sidings, staging tracks, yards, etc., and for accommodating legacy sections within the layout, or as a branch.

MS01.04: The OSM Standard governs the ends of the module and basic track and wiring. Most modules have two ends, but modules can have one, two, three, or more ends, such as for junctions and wyes.

MS01.05: **Module Categories**. OSM modules fall into two initial categories, Two or More Track Mainline and Single Track Modules (Future Part II):

MS01.05.01: Mainline modules. Mainline modules represent with 2-track, intercity rights-of-way, for operation of long freights and fast passenger consists. Mainline modules feature wide radius curves and no grades.

MS01.06: General Consideration. Except as specified in the standard, NMRA standards for Modern Era O Scale track, rolling stock, and wiring are required.

The latest NMRA standards are complex to accommodate many modelers. Defer to “Modern Era” categories to ensure that most equipment will operate satisfactorily, and the modules should accommodate catenary (In particular, tunnel and overhead structure clearances), 85-ft Passenger Cars, and large modern equipment like Autoracks, Double-Stacks, 89-ft Flatcars, and Auto Parts cars. Where conflict exists between NMRA and this standard, defer to this standard.

MRP01.07: **Recommended OSM Module Layout.** For simplicity the recommended module type for OSM application is a double track Mainline module. In an oval configuration two trains can be kept running In opposite directions. A passing siding and/or lead off to a set of sectional yard modules and staging track will provide a way to makeup and take down trains. At least one module with a crossover is required to move trains between the two mainlines.

2.0 Construction Standards

MS02.01: **Endplates** shall be 3/4 inch 5-ply hardwood plywood or hardwood (oak, maple, poplar) to provide sufficient strength and endurance for clamping to adjacent modules. Pine plywood is prohibited in the standard. Endplates are 3/4" by 2 1/2" boards using actual not nominal measurements.

FAQ02.01: Why not pine? ANS. Dimensional pine lumber has a tendency to warp, twist, or bow with age, throwing off module dimensions and geometry. Also, pine crushes under repeated clamping. Thick plywood (3/4-in) and hardwoods are less likely to warp and twist.

MS02.02: **Joining Modules at Endplates**. Modules shall be fastened together at the endplates with two common 3-inch steel C-clamps.

FAQ 02.02: Why C-clamps? ANS. C-clamps are fast and easy. They avoid the need for machining, precision dowels, bolts and nuts, or wing nuts to find and fuss with; wrenches, socket sets, or other tools; yet they are secure and adjustable, and not affected by weather or age.

MS02.02.01: The entire endplate shall be kept as clear as possible on the interior, to allow for multiple clamps across the width. Experience has shown that layouts are far more stable with two or more clamps at every joint, as opposed to just one.

MRP02.02: **Module Length, Height and Width.** Endplate length shall be made such that with sides and fascia, the module width is a minimum of 24-inches.

MS02.02.01: Modules must be built in multiples of 4 feet or a set of Modules must be a multiple of 4 feet

MRP02.05: **Tops**. Lightweight materials are recommended. "Door-skin" Luan plywood (3mm or 1/4") and high density foam-board are well-tested, popular selections. Adequate cross-bracing to prevent sagging and strumming, and to support the roadbed is necessary 1x2-in. pine works well as cross-bracing, nailed and glued to the tops and sides. Foam-board introduces some complexity in mounting switch machines and catenary poles.

MS02.06: **Sides.** Height of sides shall be 2 1/2" inches. Sides should be 3/4" plywood or hardwood (Actual Dimension).

MRP02.06.01: Sides may be extended with additional material such as 1/2" plywood to protect under layout equipment.

MRP02.06.02: **Safety lip or Safety Shield.** A safety lip may be fastened to the side to prevent trains falling off the module. Lips should extend 1.5-inches above

the top and be firmly fastened to effectively restraint heavy O Scale equipment. Luan plywood or plexiglass may be used. Safety may also be accomplished with scenery such as bushes, hedges, trees, fence, berms, small structures, and the like. A safety shield accomplishes the same thing but is taller and has a wider purpose, to prevent spectators from disturbing artifacts on the module. This should be made removable, or movable to a lower position on the fascia.

MS02.07: Each module shall be equipped with at least three legs. Any module larger than 4 feet must have 4 legs.

MS02.08: Legs should be detachable, or fixed with hinges for easy deployment. The latter results in a heavier module to transport and maneuver.

MRP02.08: Leg Construction shall be at the discretion of the module builder.

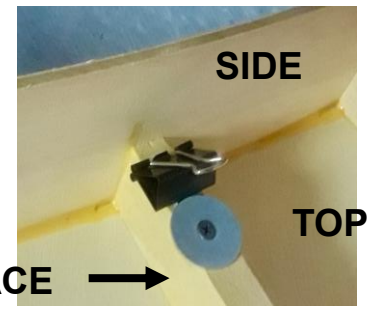
MS02.09: Legs shall be adjustable 1 inch (25mm) plus/minus minimum.

MRP02.10: **Skyboards**. Skyboard height shall normally be 8 inches above the railhead, but allowed to rise to 14-inch when necessary to support a special scene. Skyboards should be removable wherever possible, since modules may be used with operators and spectators on either or both sides. Legacy modules may have permanent skyboards, though it may interfere with viewing. See also section 6.5.

MS02.11: **Orientation**. Modules shall have one side designated and clearly marked as “Front” for the purpose of identifying tracks and wires. This marking must be easily visible during assembly of the layout. Letter the endplates, and inside the front side piece and top.

MS02.12: **Skirts**. Module Owners shall provide a black skirt to cover any side of the module which is facing the public.

MRP02.12.01: Binder Clips. A simple way to attach skirting is with binder clips, as sold in the office supply stores. The larger size works best, two under each module side. These clamps also help fasten wire looms out of the way to transport modules. See illustration below. Alternatively, Velcro may be used to attach skirting.



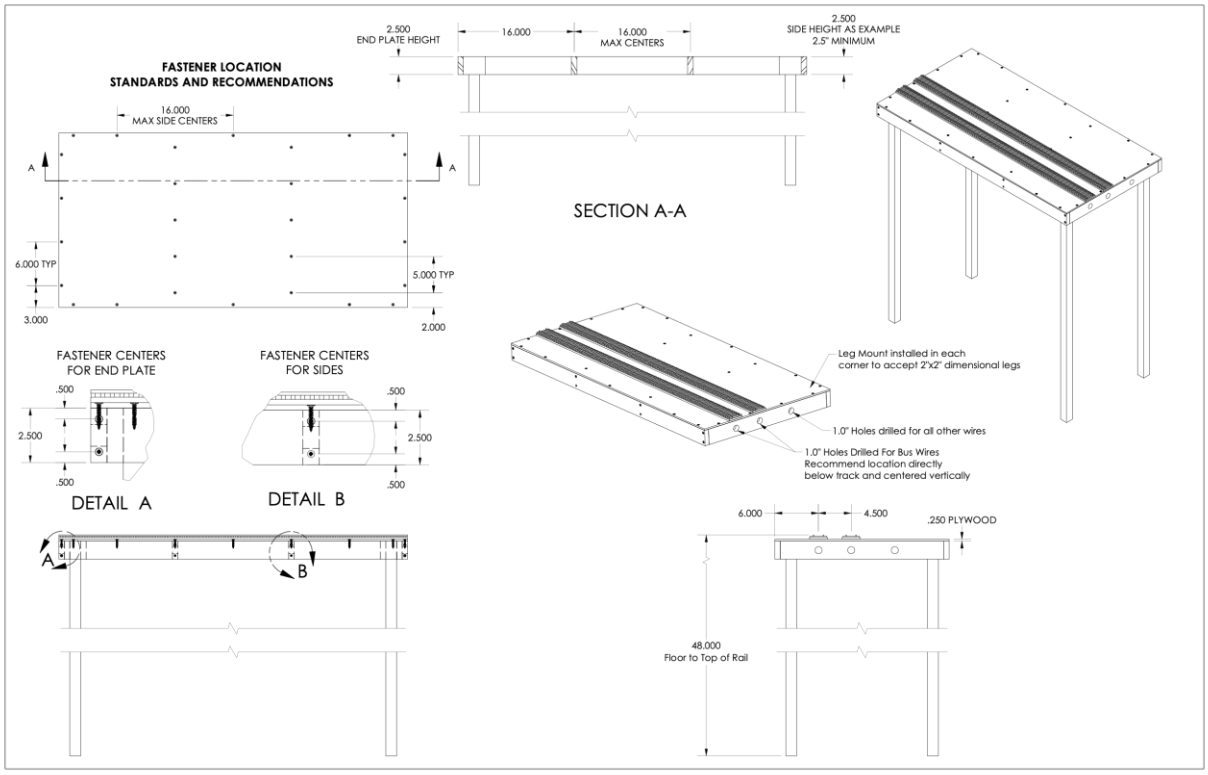
MRP02.13: Transportation Plate. Transportation Plate(s) may be applied to the module endplate(s) to protect the track, rail, and scenery at the edge of the module from damage during transportation and handling. They may be made of wood, metal, fiberglass, or whatever lightweight but stiff material suits the builder. These may also be designed to help stack modules for transport.

MS02.14: All modules shall have their owners name marked underneath or on the back side in the middle of the module.

MRP02.15: Modules may be named and a sign attached to the module front

MS02.20: Modules should be painted Semi-Gloss Black. Rust-Oleum Semi-Gloss Black should be used to paint all four sides of the module and the legs.

MRP02.30: Module undersides should be painted white to facilitate tracing of wiring.



3.0 Track

MS03.01: **Track Type.** Modules may use 2-rail flex, sectional, or hand-laid track. All rail shall be no less than Code 125 and no larger than Code 148. All track must be able to pass a check of the standard NMRA O Scale Track Gauge.

MRP03.01.01: **Track Appearance.** Track should be ballasted, painted and weathered. A good rail color is Camo Brown, by most any vendor. Gray ballast is always acceptable. Weather track with a fine mist of thinned Grimy Black.

MS03.02: **Track Location.** The centerline of the nearest through track shall be 6 inches from the front fascia of the module. The second through track from front shall be 10.5 inches from front. Exception is made for Duck Unders/Walk through modules, bridge modules and corner modules.

MS03.03: **Tangent Track Centers.** Tangent Mainline parallel tracks shall be 4.5 inches apart, centerline to centerline.

MS03.05: **Curved Track Radius**.

MS03.05.01: Tracks shall not have a radius less than 72 inches.

MS3.05.02: Three or Four Track Mainlines. When using greater than 2 Mainline Tracks the minimum radius of 72 inches and 4.5 inch tangent shall be maintained for all main line track.

MS03.05.03: No minimum radius is specified for industrial or spur tracks. Large equipment may have to be restricted from these sites.

MRP03.06: **Easements and Super Elevation.** Easements are not required although they are operationally desirable. Easements in a modular environment introduce complexity. If a builder wants easements, he should build a transition module including the easements and enough final curve to replace one sector of the corner modules being connected. If super elevation is used it must be uniform for the entire curve and tapered though each spiral easement. See OSC WEBSITE for a discussion of Easements and Super Elevation.

MS03.07: **Rail Ends.** Rail shall continue directly to the module end.

MS03.07.01: Rail Ends. Printed circuit board ties, or equal, must be used to firmly anchor rail ends in gauge by soldering the rail to the tie. The last four ties on Rail Ends shall be PCB Ties. The rails shall be soldered to all four ties.

O Scale Central List of Tie Suppliers

MS03.07.02: Railhead ends shall be filed lightly on inside of railheads to a slight taper as illustrated in photo in MS03.07.01.

MS03.07.03: PCB Ties shall have gap cut on inside of both rails as illustrated in photo in MS03.07.01.

MS03.08: **Turnouts** (aka “switches”). Turnouts shall meet NMRA standards.

MS03.08.01: Mainline Turnouts. Minimum turnout size = No. 6.

MRP03.08.02: Turnouts No. 8 and larger look better and operate better on main-line track. A No. 8 crossover at 4.5-inch centers will require at least a 6-foot module.

MS03.08.03: Point throws must reliably and completely close the points against the stock rails. Turnout reliability is more important than appearances.

MS03.08.05: **Crossovers.**

MS03.08.05.01: The diverging track between the two turnouts must be isolated electrically.

MRP03.08.05.02: At least one crossover module is necessary for a double track mainline to move trains between staging track(s) and the far main. Two crossovers laid in opposite directions are ideal for moving trains between main lines and staging without the need to back up a whole train. A double crossover can also perform this function.

MS03.09: **Rail Composition**.

MS03.09.01: Rail Composition. Rail shall be made of nickel-silver or steel. Brass rail is not acceptable.

MS03.10 **Track Roadbed**: Roadbed shall be made of Cork, Homasote, or equivalent sound-mitigating material. Mainline Minimum Roadbed height = 0.25-inch.

MS03.11 **Track Grades**: Mainline Trackage - maximum grade = 0%.

MS03.13 **Track Configuration**:

MS03.13.02 **Reverse Loops**: When track returns to itself in a loop or wye, the polarity difference at the junction will cause a short circuit. Therefore automatic DCC polarity reversal electronics are required, such as PSX-AR by Tony’s Train Exchange and AR-10 by NCE Corporation, or other suitable product. Module builders are responsible for installing these devices.

MS03.02.01: Reverse loops that connect the front main and rear mains shall connect red to black on the front main to reverse polarity on the curve

MS03.02.02: Reverse loops electrically shall be longer than the longest train to be operated. The converse is also correct: No train longer than the reverse loop shall be operated through the loop.

MS03.02.03 Wyes: Where a wye is located on the main, such as to turn steam locomotives or to serve a branch line, the reversing track must not be the main-line.

MS03.02.04 Turntables: Automatic DCC polarity reversal electronics are required for turntables.

MS03.14 **Staging Track** / **“Ready Track”**:The staging track shall be insulated completely from the main and furnished with a power kill switch. This switch, normally OFF, will prevent shorting the main when placing locomotives and cars onto the staging track.

MRP03.14.01 Staging tracks are recommended to be part of yard trackage. However, it can be a siding or its own set of modules inside the circle. A staging track is desirable for preparing a train to go out on the main, without interfering with trains already running on both mains.

MS03.15 **Siding and Spur Tracks**: Sidings are desirable for serving industries, for storage tracks, to provide “run-around” track for switching operations, and allowing mainline trains to pass each other within the flow of traffic. If sidings are used in the track plan, they must be identified as either "industrial" or "mainline". Track identified as "mainline" must follow the turnout standard provided for main-line track. Sidings identified as "industrial" must follow the standards for industrial track.

MS03.15.01: All of the modules connecting with the siding track extent, constitute a scene.

MS03.16: **Yard Track.** Yard tracks are highly desirable for storage of rolling stock that is not currently running on the mains.

MRP03.16.01: The yard track modules shall have a separate circuit breaker so that working with rolling stock will not short the mains.

MRP03.16.02: A yard lead separate from the mains is helpful for shuffling switching rolling stock and making up new trains without interrupting traffic on the mains.

MRP03.16.03: It makes sense is recommended to incorporate the staging track into the yard design as a separate track. The yard or a yard track may qualify as a staging track if the track can be isolated for the purpose of loading and unloading locomotives and rolling stock onto the layout.

MS03.16.4 All of the modules connecting with the yard tracks constitute a scene

MS03.17: **Programming Track**. DCC equipped Locomotives and Cars brought to modular layouts shall be programmed off-layout prior to use. Programming using Main Track is prohibited.

MS03.17.01: Programing Tracks shall be completely isolated from any modular trackage on a separate DCC System and only tied into the DCC programming track output. The track may be on a module or a separate table like structure/rollers off-layout.

MS03.20: Clearance - Overhead Clearance of all structures, tunnels, Catenary, etc shall to be 5.75 inches from top of rail. (NMRA RP-7.1 Modern Era Clearances)

4.0 Wiring

MS04.00: **Summary of wire requirements**:

1. One pair of wires for each through track;
2. One pair of wires for accessory power (12vdc);
3. DCC Command BUS (NCE term is “Cab Bus”)
4. Booster control BUS, only if more than one booster is required;
5. Booster Common Connector Wire, only if more than one NCE booster is employed connected per NCE specification

FAQ04.00 The following potential wire requirements are not addressed in this edition of the standard:

1. Catenary;
2. Signals;
3. LCC, Layout Command Control.

MS04.00.01: High voltage wires, such as 120 VAC power, shall not be installed on the modules. Instead, as needed, run extension cords along the floor, check with local show organizer regarding electrical code requirements.

MS04.01: **Wire Barrier Strip**. One 8 position wire barrier strips, or Euro-block, or other suitable screw-connector type base shall be fastened to the aisle side near the front corner of each module on each end. All track power should be on the block All wires passing across the module endplates, except DCC control wires, shall terminate on the barrier strip. The barrier strip serves as the connection point for track feeders, accessory decoders, accessory power such as turnout motors, etc.

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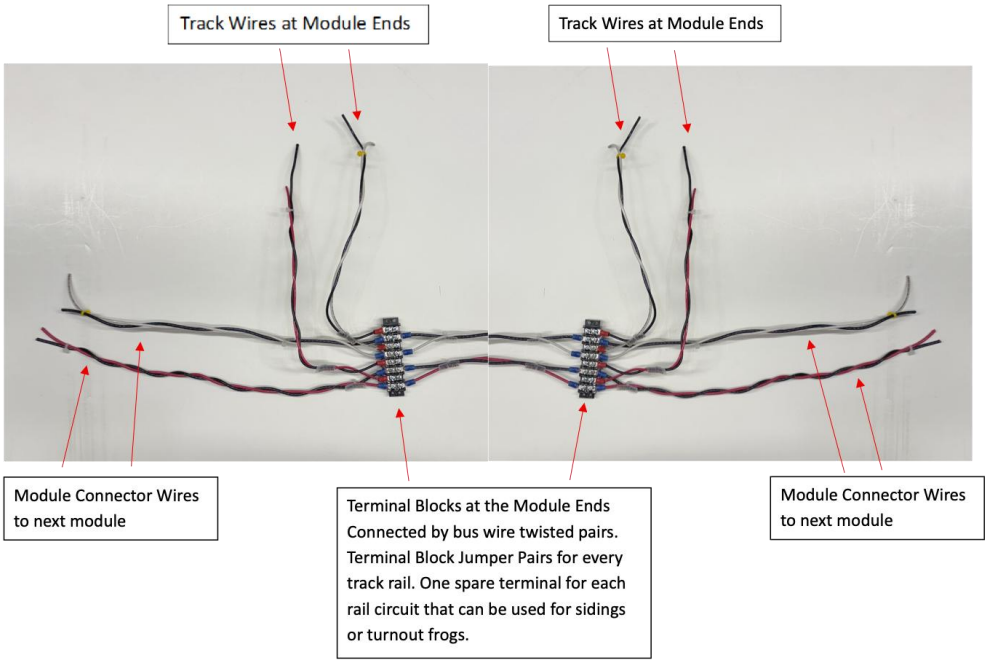
Eaton Bussmann Series TB100-08 Double Row Terminal Block 8 Positions, 30A, 300VDC This terminal block using 6-32 Phillips head/slot screws . Numerous Suppliers

NMRA/OSC Module Track Power Wiring



MS04.02: **Track Wire.** Mainline and Secondary modules shall have an independent twisted wire pair for each through track. Each rail has its own wire. No common rail. No cross-wired tracks.

FAQ04.02: Why twisted wire pairs? ANS. Twisted track wires promote better signal clarity for DCC over long distances (over 30 ft from the booster).

MS04.02.01: Track Wire Length. Track wires shall extend a minimum of 12 Inches beyond the endplate. This gives sufficient slack to ease making connections between modules.

MS04.02.02: Track Wire Gauge.

MS04.02.02.01: Track Wire that forms the BUS running module to module shall be minimum 12AWG stranded wire.

MS04.02.02.02: Track Wire feeders that connect the rails to the barrier strip shall be minimum of 16AWG, and as short as possible.

MRP 04.02.02.02: Track feeders should be run from barrier strip on aisle side of each end.

MS04.02.30: Track Identification. Identification is necessary to avoid confusing tracks, and to avoid short circuits and mis-wiring. Designating module front and back facilitates track identification. The colors below refer to the front rail. The rear rail is considered to be Black.

MRP04.02.03: Colored wire may be used for each track bus, though not mandatory. Colored wire is beneficial to finding wiring errors or other problems. Colors are mandatory for the connectors, described below in chart in section 04.05.03.

MS04.02.03.02: Mainline tracks are identified as Red and Yellow from front to rear.

MS04.02.03.05: Identification of siding, yard, storage, or staging tracks, that are NOT through tracks. Identification of non-through tracks is not specified. However, colors should not be selected to confuse these tracks with through tracks. Modules that include siding, yard, storage, or staging tracks are essentially sectional.

MS04.03: **Turnout Wiring**.

MS04.03.01: Turnout Frogs shall be insulated from the running rails, be powered, and provide for changing polarity to agree with the position of the points. DCC Frog Juicers are acceptable, see References section 7.

MS04.03.02: Turnout point rails shall be insulated from each other and powered by the adjacent running rail.

MS04.03.03: Turnout wire gauge is 16AWG or larger shall be used for turnout wire.

MRP04.03.03: Recommended way of wiring a switch.

Link to O Scalę Central Web Site Diagram

MS04.04: **Track BUS Connectors**. Anderson Powerpoles, type PP15-45, with 30-amp contacts, shall be used to terminate all Track BUS wires.

FAQ04.04: Why Anderson Powerpoles? ANS. The connectors are colored plastic housings with metal contacts inside. BUS wires are crimped to the contacts with a special crimping tool before being pushed into the back end of the housing where it snaps in place. Qualities: (1) The contacts are made of highly conductive silver or tin plated copper for minimal contact resistance at high currents. The average contact resistance is 600 micro-ohms. (2) The Powerpole insulated housings are durable, high impact-resistant, high temperature polycarbonate plastic with a UL94 V-0 flammability rating. The connector design allows air to flow through the housing, assisting in cooling. (3) Powerpole housings have a modular design that allows for multi-pole (multi-conductor) configurations. Housings slide together via molded-in dovetails. (The front end, which is the connection end, has a recognizable “hood” shape which is designated the top.) See diagram below.

Anderson PowerPole Color Chart							
Track/Line	**Color Code**	**Pos-tion**	**Min Radius**	**Height**	**% Grade**	**Power-pole Plug1**	**Powerpole Plug 2**
Front Main	**Red**	6”	72	48	0	Red	Black
Inner Main	**Yellow**	10.5”	72	48	0	Yellow	Black
Third Main	**Gray**	15”	72	48	0	Gray	Black
Fourth Main	**Pink**	19.5”	72	48	0	Pink	Black
Branch*	**Blue**		60	48	0	Blue	Black
Branch Option*	**Blue/Yellow**			48	0	Blue	Yellow
Mountain Divi-sion*	**Green**			48	0	Green	Black
Setup Track	**Orange/Yel-low**	0”		48	0	Orange	Yellow
Front Passing	**Orange**	Not Recom-mended		48	0	Orange	Black
On3/30 Front Track*	**Red/Green**			40	No Std	Red	Green
On3/30 Center Track*	**Yel-low/Green**			40	No Std	Yellow	Green
On3/30 Rear Track*	**Blue/Green**			40	No Std	Blue	Green
Booster Output	**Purple**				N/A	Violet	Black
DC Supply 12v	**White**	No Track Con-nection white on 12V Positive				White	Black
AC Supply 15v	**Brown**	No Track Con-nection.				Brown	Black

MS 04.04.01: FAQ The Anderson PowerPole Color Chart references track names and gauges not referenced in this standard. Why is that?
Ans. The starred track names and color codes are left on the table as placeholders in this publication of the modular standards to be updated and referenced in future/application specific documents.

MRP04.05.01 A kill switch on the module may be useful for each non-through track.

MS04.05.03: The colored housing is the front rail of each pair, and the black housing is the rear rail of each pair.

MS04.07: **Accessory BUS Wire.** Accessory BUS power shall be nominally 12 volts DC. The purpose of this BUS is to power accessories such as LED lighting (structures, billboards, signals), turnout motors, etc.

MS04.07.01: **Accessory BUS Wire Length**. Accessory BUS wires shall extend a minimum of 12 Inches beyond the endplate. This gives sufficient slack to ease making connections between modules.

MS04.07.02: **Accessory BUS Wire Gauge**. Accessory BUS Wire Gauge shall be the same as Track BUS wire gauge.

MS04.07.03: **Accessory BUS Connectors**. Accessory BUS Connectors shall be the same type of Anderson Powerpoles as the Track BUS wires.

MS04.07.04: Accessory BUS Connector colors shall be as specified in the Anderson Power Pole Color Chart :
MS04.07.05: No AC accessory bus will be used in this standard.

MS04.09: **DCC BUS wiring.**

MS04.09.01: DCC BUS wiring shall be in accordance with North Coast Engineering (NCE) system requirements.

FAQ04.09.01: Why NCE? Different DCC Systems (i.e., different manufacturer) are not compatible with each other. Thus the throttles and faceplate wiring of one maker will not work with another maker. There is no reason to pick NCE, but one system has to be chosen.

FAQ04.09.01.01: Is NCE Radio robust? ANS. NCE radio works great after upgrades released some years ago. One problem remains however - Only one NCE system can be in operation at a time in radio range of others. There are no “channels” for multiple operation. Therefore faceplates are required to permit tethered throttle operation.

MRP 04.09.01: WIFI access points are recommended for all layout and meeting setups. The recommended systems are JMRI or WIFITRAX.

MS04.09.02: The **DCC Cab BUS** (aka “command BUS,” or “throttle BUS”) shall be 6-conductor, straight through, flat wire with RJ-12 connectors. Telephone cable is not acceptable and may damage the system (because it is normally cross-wired).

MS04.09.02.01: DCC Cab BUS Throttle Jacks. A number of modules shall be equipped with a flush mounted faceplate on the fascia near the center of the module, for throttles to be plugged in to the Cab BUS. These are called “UTP” by NCE. The UTP has two modular RJ-12 jacks on the face. Internally the UTP has two more jacks for the Cab BUS cables to plug in.

MS04.09.02.01.01: NCE UTP-CAT5 may be used as an alternative. The primary use of a UTP-CAT5 is to easily add power to long cab BUS cables 30 to 40 feet or longer. **Digitrax UP5 must not be used on modules**.

WARNING: DO NOT CONNECT FACEPLATES OF DISSIMILAR DCC SYSTEMS TOGETHER UNLESS PROVEN SAFE. FOR INSTANCE, BY EXPERIENCE, IT IS KNOWN THAT DIGITRAX “UP5” FACEPLATES WILL SHORT CIRCUIT AN NCE SYSTEM.

MS04.09.02.02: UTPs should be provided at least every 20 ft of module run. When modules are operated from both sides then UTPs should be mounted on both sides. A power supply for the UTP should be considered so that no UTP is more than 35 ft from a UTP powered by a power supply (Wall Wart)

MRP04.09.02.03: For convenience in areas where operators congregate (such as yard modules) one or more modules in these areas should have more than one UTP per side.

MS04.09.02.04: DCC Cab BUS connection between modules. The Cab BUS shall originate at the command station and run daisy chain to each of the UTPs installed on the modules in the layout. No looping back –single path to last UTP.

MRP04.09.02.05: Faceplate lamp. A convenience for operators is to install a blue LED in each UTP, wired to the cab BUS. When lighted this makes it easier to locate UTPs, and confirms the cab BUS is active. Instructions for adding the LED are in the UTP manual. (ADDITIONAL WORK REQUIRED)

MS04.09.02.06: Each module shall include a Cab BUS cable that is long enough to extend from the installed UTP to the faceplate on the next module. Four foot modules should include a 7-ft cable, and six foot modules a 12-ft cable. In case there is no UTP on the module, then the cable must include an “adapter”, i.e., a RJ12 connector to join two cables together (common telephone adapter – not crossed).

MS04.09.03: **DCC Booster Wiring**. Generally, a single booster is necessary and sufficient for a DCC layout. For large layouts, additional power may be required to operate trains hundreds of feet away from the command station and home booster. Planning for additional boosters is necessary on a case-by-case basis to determine the location and to supply the additional booster wiring and power supply.

MS04.09.03.01: Booster BUS wire (aka “Control BUS”). The NCE Control BUS Cable shall be a 4-conductor (4P4C) flat wire, with RJ-H / RJ9 connectors, to connect boosters to the command station, and to each other. Maximum cable length is 300 feet. The cable shall be run in daisy chain fashion from the home booster to each outlying booster, with no branching.

MRP04.09.03.01: It is recommended to use Control BUS cables custom made to a specific length by NCE Corporation.

MS04.09.03.02: Booster Common Cabinet Connector. All boosters in an NCE layout shall be connected together by a single 12AWG insulated wire that is firmly screwed to the booster cabinet. (Insulation is cut away at the booster cabinet connection). This wire must NOT be connected to earth ground. To avoid mistakes, a unique color shall be used for this wire, and provide many tags.

Booster Common, Bonding, Or "Floating Ground" For Multiple Boosters Article

MRP04.09.04: DCC Cables. It is recommended that spare DCC cables of each kind, and of various lengths, be taken to module setups. Cables should be clearly tagged as to type and function, and kept in marked, protective packages.

MS04.10: **Additional Wiring Considerations.**

MS04.10.01: DCC wiring must not emanate in two directions to meet at some location such as the other side of an oval. The DCC signals will interfere. Wiring must go out from the command station and boosters in star fashion. This rule includes track rails and track wires. So, in an oval for instance, choose a place about half way around the oval from the booster. Leave the track BUSes at the endplates unconnected. Ensure the rails are not touching. Consider installing insulated rail joiners.

MS04.10.02: Snubbers. Snubbers are RC-circuits that dampen signal spikes to protect DCC equipment. Signal spikes can occur when long track runs (over 30-ft) are not wired with twisted wire pairs. Since wiring is never perfect, large layouts should be furnished with snubbers at the ends of long track runs. It is not obvious where to place them in advance of making a modular layout. Snubbers could be made up separately with Anderson Powerpoles, then plugged into the track BUS of the module at the end of a track run.

5.0 Controls

MS05.01: **Central Control Station.** One module shall be equipped to include a central control station, as described below, or to accept all the outputs of a separately constructed control station.

MS05.01.01: The control station shall provide power distribution strip(s), extension cord(s), and circuit breakers to connect to the host facility 120VAC power. This station supplies all the layout power requirements.

MRP05.01.01: NMRA recommends that 120VAC equipment be UL approved and labeled, and that a GFI circuit breaker be in the path from the host facility.

MS05.01.02: The DCC equipment shall include an NCE Command Station, 10 Ampere Booster, power supplies (typically transformers), meters to read DCC voltage and current, circuit breakers for each through track, a programming track (per S3.17), and associated cables. If additional boosters are required then they shall be NCE 10 Amp Powerhouse Boosters with a Brutus, P1024 or equivalent 10 amp power supply

MS05.01.02.01: The booster shall be set at 16 volts using the method established by NCE (Link to NCE Specification)

MS05.01.03: A 12 Volt DC (nominal) power supply, minimum 5 Amperes, shall be provided for the Accessory BUS.

MRP05.1.4 A tool kit including a portable multimeter for troubleshooting, a level, and common electrical and mechanical tools shall be included.

MS05.02: Circuit Breakers

MS05.02.01: Circuit Breakers should be between the booster and the track with one circuit breaker for each main track.

MS05.02.02: Additional circuit breakers shall be provided for branch lines and yard / staging tracks.

MS05.03: T**urnout controls** Turnout controls must be either mechanical or electro-mechanical.

MS05.03.01: Mechanical switch machines are operated by hand and are typically simple switch stands directly next to the points, e.g. red caboose switch stands or similar product.

MS05.03.02: Electro-mechanical switch machines are operated by a switch motor which is placed under the tabletop and actuated via electrical toggle switch, eg tortoise switch machine or similar product.

MS05.03.03: Toggle switches for electro-mechanical switch machines must be placed in proximity to the connected switch machine as either a clearly marked toggle switch on the facia or as part of a switch panel that may be part of, or a separate piece attached to, the facia.

6.0 Scenery

This standard recognizes the artistic quality in tabletop scenery as being left to the discretion of modelers and groups adopting this standard

MS06.01: **Module fascia** color shall be Semi-Gloss Black (Rustoleum Black Semi Gloss is the recommended paint).

MS06.02 All scenery (structures, trees, bushes, tunnels, etc) shall conform to MS3.20 regarding track clearances

MS06.03: **Below grade scenery**. Benchwork may be shaped such that the facia starts at the endplate height and is lowered below track grade to allow for scenery below the standard tabletop height provided at the ends of the module/scene the facia returns to the standard endplate height.

MS06.03.01: It is required that if the facia is dropped below grade that the track is supported with an extension of the plywood tabletop the width of the ties, not foam. The exception is in cases where the track is crossing a bridge.

FAQ06.03.02: Why is the track supported by wood not foam? ANS: Foam alone is not stable enough to withstand transportation; wood is more durable.

MRP06.05: **Skyboards** may be used on the rear side of modules to improve the realism of the setting. See MS2.10. Skyboards restrict operation and monitoring trains from the rear side. Skyboards should not be used on modules intended to be viewed and operated from both sides.

MRP06.06: **Landscape,** structures, vehicles, and figures are all encouraged on modules. Light Weight Materials are recommended for all scenic elements.

7.0 Operational Requirements

MS07.01: Weight of Cars - Minimum 75% of NMRA RP for O Scale.

MS07.02: Wheel Gauge and Coupler Height per NMRA RP for O Scale.

MS07.03: All locomotives shall have a NMRA compatible DCC decoder for operation.

MS07.03.01: This standard makes no provision for DC operations.

MS07.03.02: All locomotives and cars shall have axles insulated on one side of the model.

MRP07.04: Right Hand running shall be considered Normal.

MRP07.05: Clearance/Loading Gauge shall conform to MS3.20 (reflective of Modern Plate clearances NMRA RP-7.1).

10.0 References

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10.01: **Anderson Powerpole Connector** - The PP15-45 Standard Housing incorporating a 30 amp contact for use with 12-14 gauge wire.
Anderson Powerpole Housing Data Sheet

10.01.01: **Source for the Anderson Powerpole Connectors**:
https://powerwerx.com/anderson-powerpole-colored-housings
https://powerwerx.com/anderson-1331-powerpole-contact-pp30

10.01.02: **Independent testimonial,** Instruction videos for Anderson Powerpoles:

https://www.youtube.com/watch?v=8_DPPuQN8R4

https://www.youtube.com/watch?v=QzLvdR6X81k

https://www.youtube.com/watch?v=34kKlRQPOL8

https://www.youtube.com/watch?v=1ijV0-QpaIU

10.03: **NMRA Standards and Recommended Practices**
https://nmra.org/standards

10.03.01: **NMRA Modules Standard**:
https://www.nmra.org/introduction-layout-modules

10.06: **East Penn Traction Club Module Standard**.
http://eastpenn.org/standard.html

10.07: **North Coast Engineering (NCE)**
https://www.ncedcc.com

10.08: **Tam Valley Depot, Dual Frog Juicers and Auto Reversers**
https://tamvalleydepot.com/products/dccfrogjuicers.html