

‘Country RRoads’ Free-mo

HO Scale Free-Form Modular Model Railroading

Standards and Guidelines

1.0 Overview

The Standard: www.free-mo.org/standard

The objective of the Free-mo Standard is to provide a platform for prototype modeling in a flexible, modular environment. Free-mo modules not only provide track to operate realistic models, but also emphasize 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.

2.0 Definitions

MODULE:

Any layout component (or group of "sections") meant to be operated as a single unit in a fixed configuration. A module can have any number of sections. Both ends of a module comply with the Free-mo physical and electrical standards defined within this document.

SECTION:

A part of a larger 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.

ENDPLATE:

The standardized end surface of a module that joins with an adjacent module in a Free-mo layout. The physical aspects of the endplate are defined in the Frame Work description, below.

FITTER RAILS:

The 2" long removable rails and joiners used to bridge the joints between adjacent modules or sections. Must be Code 83.

TRACK (POWER) BUS:

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

ACCESSORY (POWER) BUS:

The continuous two wire bus powering electrical accessories such as turnout motors, structure lighting, animation, etc.

LOCONET (DCC) BUS:

The continuous six-wire bus carrying DCC information among the Digitrax system components such as throttles, boosters, radio receivers, etc.

3.0 Frame Work

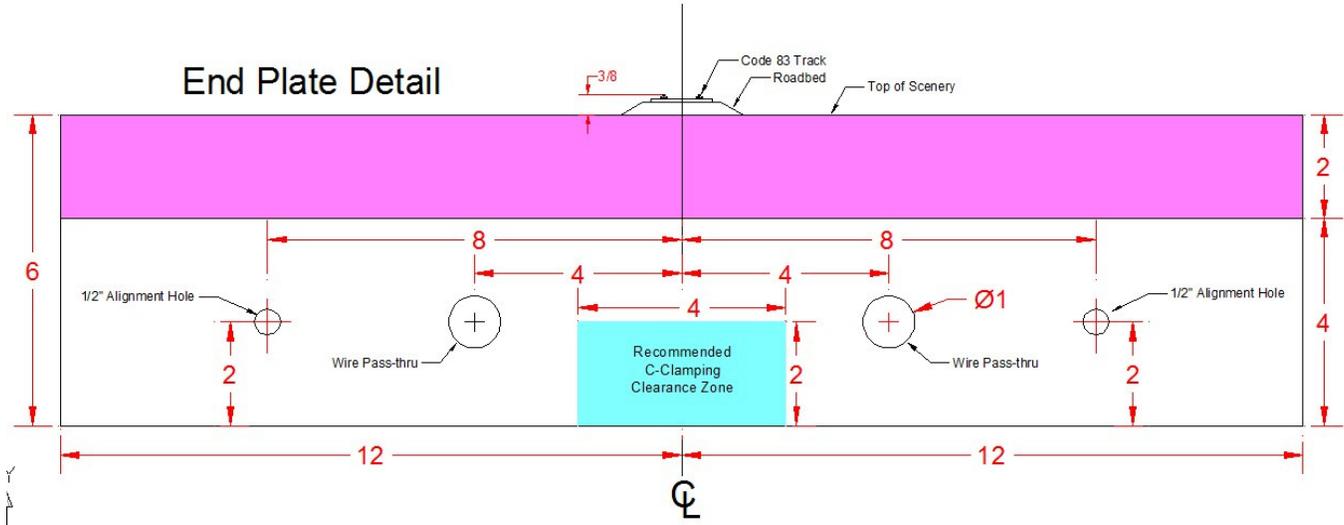
“Frame work” refers to a module’s structural frame including endplates, interior supports, legs, and braces. There are no requirements to use specific materials or construction methods; however, the basic trade-off is sturdiness versus weight. The Country RRoads Free-Mo group recommends ½” plywood for all frame work other than legs. ¾” plywood may be used. Legs should be poplar hardwood to limit warping and size difference found in 2x2 construction grade lumber.

Generally, dimensional lumber is discouraged due to warping issues.

HEIGHT:

The nominal module height measured from floor to top of rail shall be 50-3/8", adjustable from 49-1/2" to 50-1/2" above floor.
- Suggestion: the height adjustment range of 1" is a minimum.

ENDPLATES (SINGLE TRACK):



24" wide, 6" tall from bottom to scenery top surface; roadbed and track adds 3/8" to top of the end plate.

Endplates MUST be parallel to each other, and perpendicular to track both vertically and horizontally. They must be as flat as possible (e.g. not bowed, twisted, etc.). Material must be solid and sturdy for bolting to adjoining modules.

Module end plates shall be 4" height of 1/2" or 3/4" plywood and allow 2" foam on top to bring the end height to a total of 6" height, bottom of joining plate to top of scenery deck.

Suggestions:

- Make endplates from 1/2" plywood or equivalent stable material to maintain flatness. Dimensional pine lumber is not recommended as it often warps over time.
- To allow room for Free-Mo compatible C-clamps, keep inner surface of endplate clear of obstructions (electrical terminal blocks, LocoNet connectors, etc.). Recommended clearance area is 2" high by 4" wide, centered at bottom edge of endplate inner surface. The Country RRoads modules will use bolts in the alignment holes to secure the modules together.
- Cut handholds into endplates to assist transporting and positioning the module.

WIDTH, LENGTH, SHAPE:

- Module width at the endplate shall adhere to the endplate specifications (above). The width may change once the 6" setback has been exceeded.
- Long sides of the modules are to be 1/2" plywood and can follow the terrain of your module. Standard 6" flat terrain setbacks from the joining ends must be followed (see Free-mo standard) (see 'fascia' below).
- Both long sides of the module (parallel to track) shall have fascia covering module sides, foam, and scenery edges. 1/8" thick tempered hardboard should be used. More below.
- Fascia shall be painted green with semi-gloss paint. This makes module width at the joining plates 24-1/4" wide. In addition to painting the fascia, paint the exposed foam at the end of the module. Some narrow format modules expose the foam.

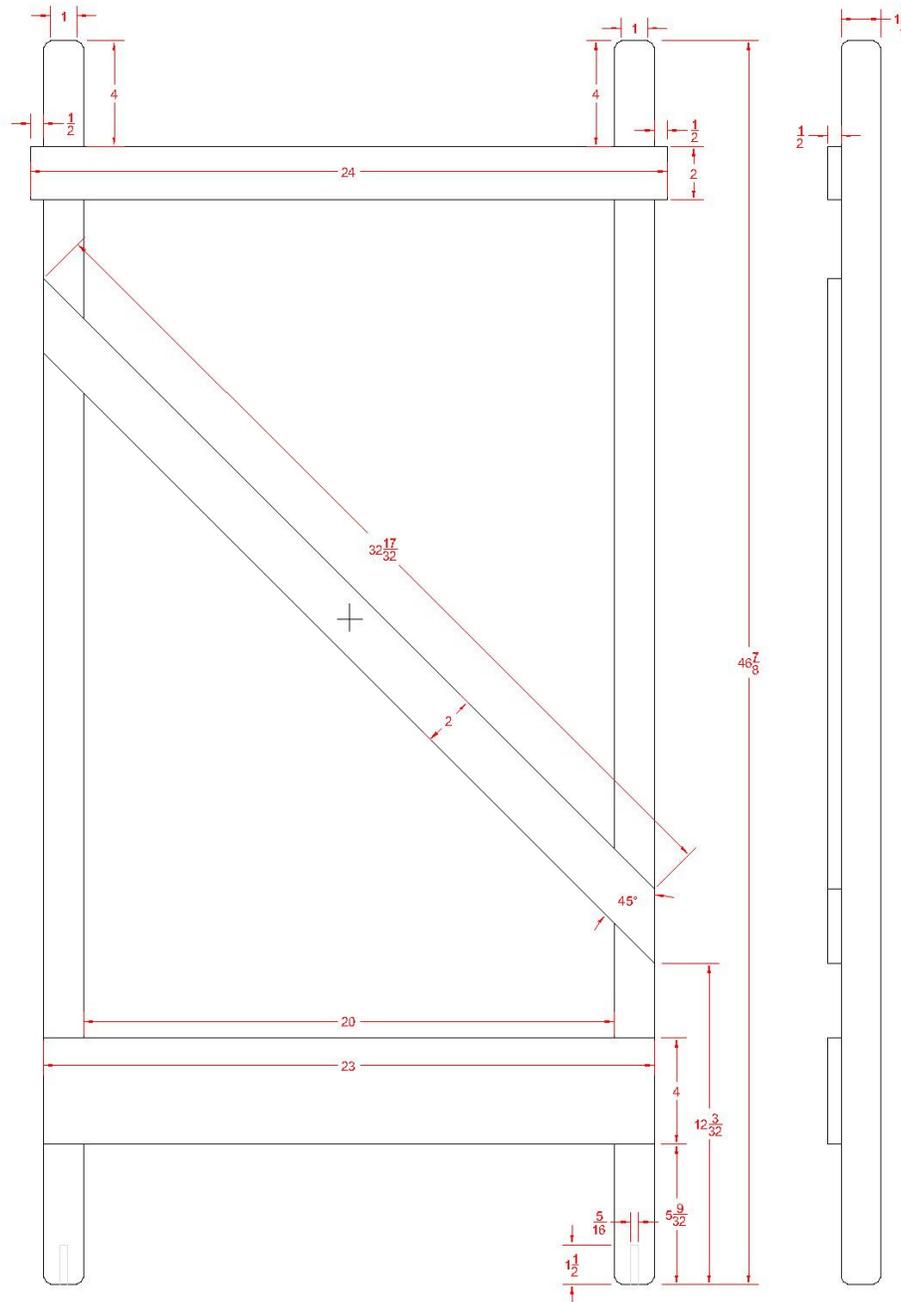
Suggestion: Modules over 6' long are difficult to move and transport.

LEGS AND LONGITUDINAL BRACING:

Two pairs of legs, one pair for each end, is desirable for modules 4 feet long and longer. This is to accommodate angle cross-bracing parallel to the track run.

A module must stand secure and level, independent of other modules.

Each leg must include vertical adjustment of plus and minus 1" minimum to compensate for uneven floors (e.g. rail top height above floor must be adjustable minimum of 49" to 51"). Painting legs is optional. Painting the top 4" is not recommended.

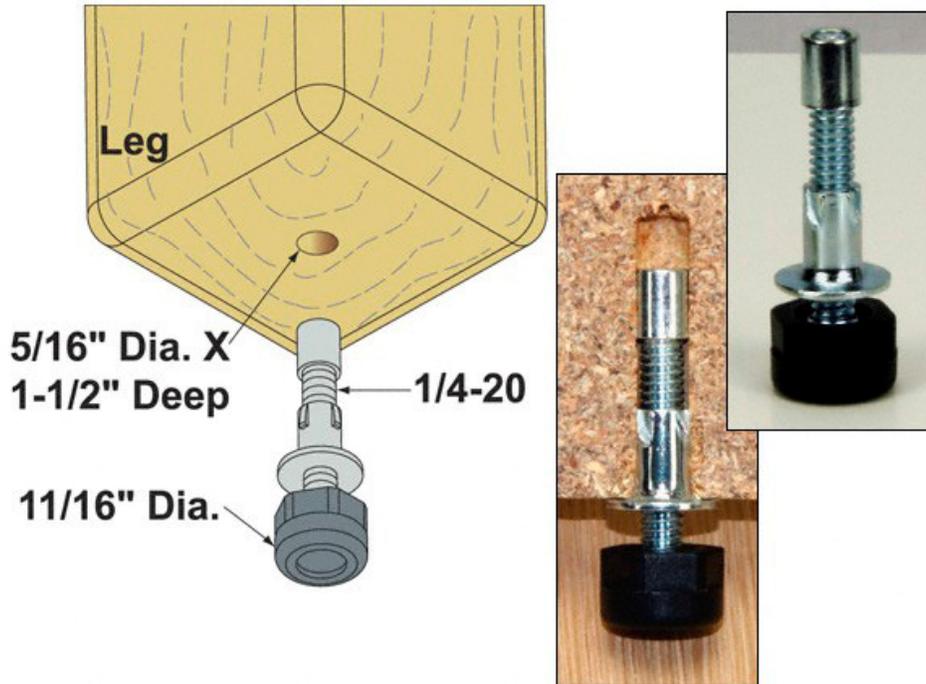


Suggestions:

- Install cross- and angle-bracing on legs for added stability on modules 4 feet long and longer.
- Add angled longitudinal braces to prevent module from swaying parallel to the track. This stabilizes the module for fine adjustments during setups, and when working on the module during construction.

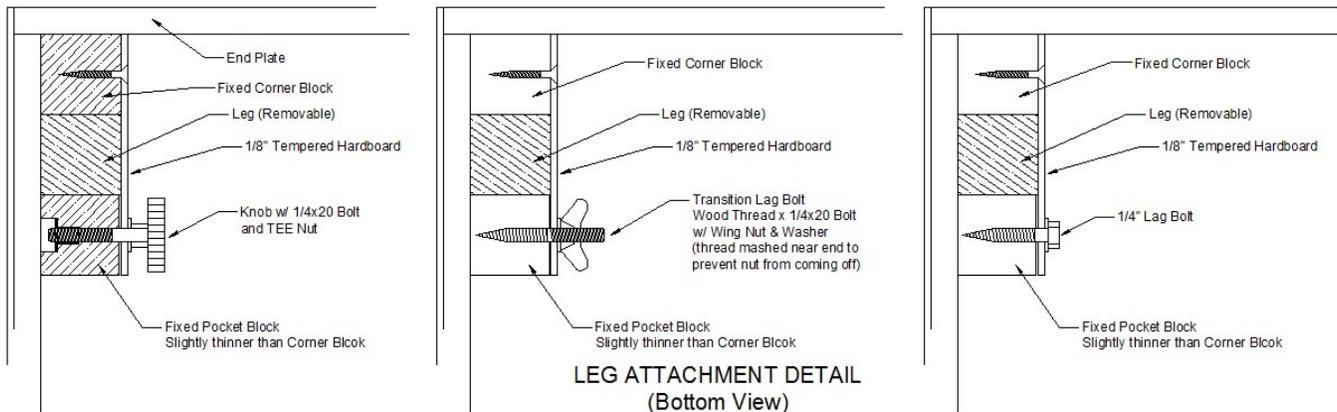
Leg levelers can be obtained from:

Woodworkers Supply www.woodworker.com Part number: 158504
 MES holds a stock of these levelers.



LEG POCKET DETAIL:

The sketch below shows the recommended leg-to-module attachment. The method of tightening the leg assembly in the module leg pocket can vary.



SIDES AND FASCIA:

Fascias must be smooth and made of 1/8" thickness tempered hardboard.

Suggestions:

- Use "semi-gloss" to permit easier clean-up of fingerprints and the like.
- Avoid protruding items like toggle switches to prevent accidental damage or injury to operators; recess these items into cutouts in the fascia.
- Label electrical switches and other operational items. Chartpak Dry Transfer Lettering "Franklin Gothic" 18 point (#00200) is recommended.

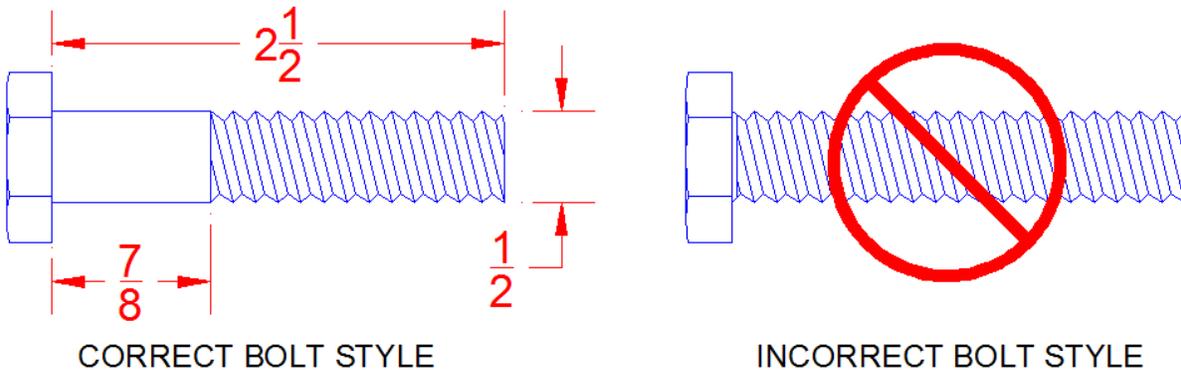
MODULE-TO-MODULE ATTACHMENT:

Bolts and nuts shall be used to attach modules to each other. These 1/2" bolts act as alignment pins as well as holding the modules together. (see Sourcing Section at end of document)

Bolt specification:

Bolts shall be 1/2" diameter, 13 threads per inch (standard)
2-1/2" long with a smooth shoulder to act as an alignment pin.

Source: ACE Hardware - 1/2" dia x 13 threads per inch, 2-1/2" length, with 1" shoulder



4.0 Track Work

GENERAL:

All NMRA standards must be met.

SUB-ROADBED:

Sub-roadbed construction and materials are not specific, but must be built to prevent sagging or flexing, and must be installed to comply with the endplate requirements (see section 3.0 "Frame Work"). Track **MUST** be perpendicular to the endplate both horizontally and vertically!

Suggestions:

- In the past, modules have used plywood, Homasote, and foam insulation board. The main trade-off is rigidity/stability versus weight.
- If foam board is used, include plywood gussets across the width of the module. Supports should be placed to provide maximum support for the foam.

ROADBED:

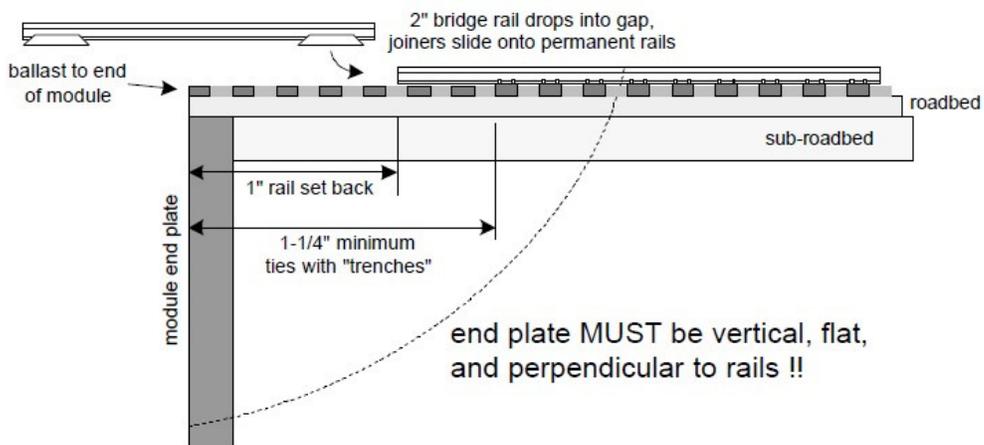
Material choice is up to the owner, but must comply with the 3/8" standard for top-of-scenery to rail-top dimension. See section 3.0. Cork, and Homasote are both acceptable.

Suggestion: Standard HO scale cork roadbed used under flex track meets the 3/8" requirement.

MAINLINE LOCATION:

The mainline must cross the module end plate centered on the 24" width; it MUST be perpendicular to the endplates both horizontally and vertically! The mainline must run straight and level for at least 6" from each endplate. Otherwise its location is free (within limits of standards for curves and turnouts). This guideline ensures there is at least 12" of straight track between reverse curves. Check with the Country RRoads members for a template that you can verify the accuracy of your track location.

JOINING TRACK BETWEEN MODULES:



Rails end 1" from end of module (outer surface of the endplates). Ties and ballast continue to end of module. The ties within 1.25" (minimum) must accommodate installation of fitter rails with accompanying rail joiners, which are slid onto the module's fixed rail ends (typically these ties have a small "trench" where the spikes normally are found). Modules are connected with 2" fitter rails and rail joiners, which are dropped into the rail gaps and join the module rail ends.

RAIL:

All track must be nickel-silver commercial or hand laid. Mainline track must be Code 83. Other track may be smaller (e.g. Code 70 or 55), but must permit reliable travel by rolling stock with NMRA RP25 flanges. All active rails must be clean and flange ways clear. Rail and ties must be weathered. CRR recommends Micro-Engineering, pre-weathered flex track.

Suggestion: clean rails and clear flangeways before each operating event.

RAIL JOINERS:

Rail joiners shall be Atlas N-scale code 80 nickel silver. These fit code 83 rail and present a much smaller profile, more closely the prototype.

CURVES:

Minimum track radius is 27-1/2" for mainline. Branch lines and industrial tracks may be a minimum of 24" radius. There must be at least 8" of straight track between reverse curves. All mainline curves should include easements.

DOUBLE TRACK:

No provision is made in our club for double track mainline operation across two independently owned modules. A module can include double track, or adjacent sidings provided the mainline is at the center of the module end plate and all adjacent tracks meet the 2-1/2" on center spacing requirement.

TURNOUTS:

This club requires #6 Peco Insulfrog turnout for mainline, #5 may be used for branch and industrial trackage. All mainline turnouts are controlled locally. (see Note 1) Point throw must reliably and completely close the point rails against the stock rails. Method of throw (powered or manual) is unspecified.

Note 1: Turnouts on the club's reverse modules are controlled automatically by Tortoise Switch Machines and Hare controllers.

Note 2: DCC accessory decoders are allowed for turnout control as long as there is at least one other method available to throw the turnout (fascia buttons, hand throw, etc.).

CLEARANCES:

All clearances (curves, tunnels, structures, etc.) must meet club standards.

Note: potentially every type of rolling stock will run over all modules; clearances must accommodate the tallest double stack, longest piggyback flat, etc. NMRA rules for HO apply.

5.0 Electrical

ELECTRICAL MODULE INTERCONNECTION:

Track buss: Two blue connectors, on each end of the module.

Note: These connectors are to be located apart near the module connecting bolts. When facing the end plate of the module, the leftmost connector is the left rail. The rightmost connector is the right rail.

Accessory buss: Two white connectors, unpaired, on each end of the module.

Note: These connectors are to be located near the center of the module end plate.

Anderson Powerpole Connectors needed for one, two ended, module.

Four blue housings

Four white housings

Eight connector contacts

Part numbers for PP15-45 Standard Connectors

Housing, blue, part number 1327G8

Housing, white, part number 1327G7

Contact, high mating force, 16-12 AWG, part number 269G1

Source: Mouser Electronics - Web: <http://www.mouser.com/>

For compatibility with existing Free-Mo standard modules, a pig-tail cable set (two required) would interface on one end with Powerpole connectors and the other end with Cinch-Jones barrel connectors. Care must be taken when using the pigtail to ensure the correct track polarity is maintained.

Track buss and feeder wire colors

Wire connecting to the Powerpole connectors listed above MUST be stranded.

Blue #14 stranded wire is recommended for track buss.

Blue #18 wire is recommended for track feeders.

Accessory buss wire color

White #14 stranded wire is recommended for accessory buss.

White #18 wire is recommended for accessory feeders.

The accessory bus is 16 volts AC, no color or polarity consideration is required.

DIGITRAX DCC AND LOCONET BUS

LocoNet Buss

From a LocoNet perspective, each module will be one of three types.

1. LocoNet pass through, no LocoNet devices on board.
2. LocoNet devices on board.
3. No LocoNet buss.

For type 1 modules, two jacks shall be installed, one near each end of the module. The two jacks are wired color for color to each other. One 12" LocoNet cable shall accompany the module that will extend to the next module's jack.

For type 2 modules, the jacks on the each end can be connected to the LocoNet device. All Digitrax devices have two jacks. The device or devices can be daisy chained into a single string, starting with one end of the module and extending device to device to the other end of the module.

Type 3 modules are end-loop modules used in point-to-point meets only. There is no wiring for LocoNet on these modules.

LocoNet Wiring

You have three options for installing Digitrax LocoNet on your module.

1. Use data cable and jacks.
2. Use telephone cable and jacks.
3. Use only Digitrax components with telephone cable.

The minimum number of jacks on a module is two, one for each end. That allows LocoNet to pass through your module without any "on-board" connections. All modules other than the end loops MUST have this as a minimum.

Optional: Adding a throttle plug-in on your module offers convenience to you and the other engineers. A throttle plug-in location may be on one side, or both sides of the module. Therefore, a module with a single throttle plug-in location requires three jacks: One on each end, and one in the middle. Placing a throttle plug-in on both sides of your module requires four jacks. Keep in mind that a throttle can plug directly into these jacks, without using a Digitrax port.

Option One: Data cable and jacks.

This option uses round, solid 24 or 26 gauge wire, such as CAT3 or CAT5 wire. It has the advantage of being relatively easy to make connections at the jacks, using press-in wire terminations. When passing through a jack, the wire is unbroken, and continues on to the next jack. It is the best option to choose if you are NOT installing throttle jacks along the side of your module.

Two components are needed for each jack location. These are available at Home Depot and Lowe's. They are shown below.

CETECH | Model # 5001-WH | Internet # 202689872 | Store SKU # 579644

1-Port Wall Plate - White

★★★★★ (1) | Write a Review +



\$0.97 / each



Ship to Home **FREE** with \$45 Order

Estimated Arrival: APR 29 - MAY 5

[See Shipping Options](#)



Pick Up in Store **FREE**

Available for Pick Up: Today

1

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Item cannot be shipped to the following state(s): AK, GU, HI, PR, VI

The wall plate shown above can be trimmed of the curved portion and flat mounted on the back of the 1/2" plywood joists. It holds the jack assembly.

Home > Electrical > Wall Plates & Jacks > Wall Jacks

CE TECH | Model # 5016-WH | Internet # 204298358 | Store SKU # 1000015570

Ethernet Category 6 Jack - White

★★★★★ (1) | Customer Images (1) | Write a Review +



\$4.97 / each

Pick Up In Store FREE
Available for Pick Up: Today

13 In stock at:
Cumming #134
Change Pick Up Store

1

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Cumming, GA 30041
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13 In Stock
Aisle 02, Bay 005

These jacks can be CAT6 (shown) or CAT5 if available. The jack assembly connector above snaps into the wall plate shown previously. It allows wiring to be pressed into the slots located on the gray area, and cover clips pressed on to retain the wiring. Wiring may terminate at the jack, such as at the end of a module, or may pass through as with a throttle plug-in location. Note that there are 8 conductors in these jacks. LocoNet only uses the middle 6.

Option Two: Telephone cable and jacks.

This option uses flat 6-conductor telephone cable. It is preferred by some Free-Mo groups and is recommended by Digitrax. The advantage or disadvantage of using this cable is that the terminal blocks use screw terminals. The wire is stranded. To land the wire on the terminals requires each wire to be stripped of insulation, twisted, solder tinned to prevent fraying out of the individual strands, then be wrapped around a screw terminal, and the screw tightened.



Click to open expanded view

SALE Model: LT-468 | Catalog #: 2790005

RADIOSHACK® 6-PIN SURFACE-MOUNT MODULAR PHONE JACK (WHITE)

★★★★★ (0.0) Write a Review

\$6.39 Reg \$7.99

In Stock

1

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Wall plate versions of this jack exist as well. Remember, they MUST have screw terminals to work with the flat stranded telephone wire. Press-in data style connectors will NOT work with the flat telephone cable.

Option Three: Digitrax Components.

This option uses one or more Digitrax UP5 panels. One can be mounted on one side of the module or one on each side of the module. These can be connected to jacks at the end of the module using either technique outlined above. The male plugs required to mate to the back of the UP5 panel may be installed on either round solid wire cable or on flat stranded wire cable.

UP5 LocoNet Universal Interconnect Panel

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[<< Browse Current Products in Universal Panel, IR & Radio Receivers](#)

PRICE: \$16.95 MSRP



Add more connections to your LocoNet system.

UP5 Simplifies hook-up, maintenance & troubleshooting of LocoNet, add a few to make traditional tethered walk-around operation a snap.

ACCESSORY POWER BUS

This two wire bus is used to power turnout motors that control track switches (i.e. Circuitron Tortoises), and it also may be used to power other accessories on modules such as structure lighting, signals, animation, and the like. It normally carries a DCC signal similar to that found on the Track Power bus (a separate booster is recommended to avoid robbing power from trains); however it may carry 16V AC as an alternate, lower cost implementation (but less flexible). Electrical accessories within modules can use the DCC power directly (e.g. to control and power stationary decoders), or rectify and regulate it to DC (e.g. to power lights or electronics). If 16V AC is on this bus it may be used directly or may be rectified and regulated to DC as well.

This bus must be installed in every module similar to the track power bus with a 14 gauge 2-wire bus running the length of each module, and connector pigtails on each end to connect to adjacent modules.

6.0 Scenery

END PROFILE AND LANDSCAPE:

A flat horizontal scenery profile is used at module ends. Scenic "ground level" at module ends is nominal 3/8" below top of rails (see sketch in Section 3.0). Landscaping along the module ends must be designed to smoothly flow into adjacent modules - avoid features such as roads, lakes, and so forth from running against the module ends.

Suggestion: Using HO cork roadbed under mainline track to meet the 3/8" ground level guideline.

Note: scenic contours within a module between the flat end profiles are free (i.e. entire module does not have to be flat; in fact table-top flat modules are discouraged).

BACKDROP:

No backdrop is allowed as modules are viewed from either side and are also meant to be reversible.

7.0 Public Displays

CROWD CONTROL BARRIER SYSTEM:

Each module that is 5' or longer must provide two barrier stands for every 5' of length. Barrier stands consist of bases and uprights designed for simple construction and setup, and which may be separated for more efficient storage and transport. ¼" yellow nylon style ropes (available at any hardware store) are threaded through the stands as a barrier.

Stand bases are 12" square made from 1.5" plywood (or equivalent multiple plywood layers). Painting is optional. A hole is centered in the base to accommodate a ½" white PVC pipe end cap, firmly wedged into the hole and used to receive the stand upright. Stand uprights press-fit into the base and are 36" tall ½" white PVC pipe with a PVC "T-junction" mounted on top, through which the nylon rope is threaded. Painting is not allowed – leave uprights white.

PLEXIGLAS SHIELDS:

Plexiglas shields may be used at the discretion of the builder, but should be easily removable for access to track for cleaning, uncoupling cars, etc.

8.0 Locomotives and Rolling Stock

WHEELS:

- Metal
- Clean
- Back-to-back spacing meets NMRA gauge
- Gauge meets NMRA gauge
- Flange contours are RP-25 or have equivalent flange depth

ROLLING QUALITY:

- Cars roll freely down a 3% grade

TRUCKS:

- Pivot freely
- Slight lateral rock on at least one end (three-point mount)
- Able to negotiate a #5 turnout
- Able to negotiate a 28" radius curve
- Able to negotiate vertical rail curves as specified in Section 4.0 TRACK WORK standards
- Match to center of Kadee coupler height gauge or NMRA Standards Gauge, plus or minus 1/32"
- Knuckle and centering springs work freely
- Metal couplers are insulated from the rail
- Trip pins clear Kadee coupler height gauge or equivalent

OPTIONAL: Coupler trip pins may be cut off at the bottom of the coupler body

LOCOMOTIVE ELECTRONICS:

- Locomotives shall be equipped with DCC decoders compatible with NMRA DCC compliant systems
- Effort must be made at meets to ensure your locomotive address is unique on the layout for the day.

9.0 Setup Checklist

REQUIRED ITEMS:

In addition to the obvious items to bring to a Free-mo setup such as modules, legs, and rolling stock, the following items are required for each module:

- Minimum of two 2" fitter rails with joiners at both ends to join main line across module joints. Additional fitter rails are always welcome. Bring additional fitter rails and joiners to connect any additional tracks that cross module joints (i.e. yard extension modules). Fitter rail joiners can be pushed easily onto the module's permanent rail ends with a small screwdriver.
- Two bolts and nuts for joining modules.
- Minimum of one 12 to 18" long, six conductor flat phone cable with RJ12 plugs on both ends, wired straight through, to connect the Digitrax DCC LocoNet across module joints.

SUGGESTED ITEMS:

Other items suggested to bring, but not required:

- Digitrax DCC throttles - the more throttles available, the more people can run trains at once.
- Tools including rail cutters, files, wood glue, levels, wrenches, screwdrivers, tape measures, pliers, wire cutters and strippers, multi-meter, soldering iron, track gauge, track cleaner, etc. These help resolve problems that may crop up, and to repair minor damage that may occur while transporting modules.
- Model tools including coupler height gauge, wheel gauge, small screwdrivers, ACC and styrene glues, tweezers, files, etc. These help repair or adjust rolling stock and track to keep things running smoothly.
- Folding chair or stool.

REVISIONS

22-Mar-15	This document translated from NorCalF-module specification, Free-Mo.org site, and discussions.
24-Mar-15	Removed "See Below" for section 6, Scenery; Added wire pass-thru holes to end plate drawing; Added leg sketch; Added section "Sources" and moved source references in the text to that section; Added leg attachment sketch.
23-Apr-15	Added Digitrax wiring options. Corrected "required items" to include bolts instead of c-clamps and corrected LocoNet cable lengths.
07-Jul-15	Revised minimum track curvature, made barriers optional, revised bolt diagram. Removed extension cord from suggested items.

Recommended Practices -

- a. Ballast
 - Ballast is an approximate 50:50 mixture of Light Gray and Gray Blend. No dark gray.
 - Ballast shall be securely glued in place by first applying a mist of a 50:50 mix of water and isopropyl alcohol. Once damp, the ballast can be secured using 30% white glue 70% water mixture.
- b. The majority of modules will use gravel paved roads. Gravel roads are created using locally available material. See other members for the material. Road materials shall be secured using the same method as ballast.
- c. State highways (paved) shall be styrene, primed with rattle can light gray primer and painted with "aged concrete" acrylic paint. When dry, the surface is weathered using dilute India ink. See a member for details.
- d. Trees made from Sedum or Supertrees should be soaked in 7:1 dilute matt medium for 1 hour and hang dried prior to flocking.
- e. A road name for locos and rolling stock may be the owners choice, but the era must be transition years.
- f. Rolling stock shall be identified as to owner. Suggest they be initialed on a small white stick-on dot on bottom.
- g. Common ground cover shall consist of one third Woodland Scenics Earth Blend 1350 and two thirds WS Green Blend 1349. Use it in an irregular pattern at least in the first 6" of mating ends. Ground cover may vary once inside the 6" boundary.
- h. All ground cover shall be securely glued in place by first applying a mist of a 50:50 mix of water and isopropyl alcohol. Once damp, the ground cover can be secured using 30% white glue 70% water mixture.
- i. Clump foliage and trees should be secured using either Eilene's Tacky Glue or 100% Elmer's white glue.
- j. Ties shall be weathered in place throughout using craft paints - Barnwood - dry brushed/scrubbed onto ties.
- k. Flex track should be laid using DAP Dynaflex 230 caulk.
- l. Track feeders shall be attached to the bottom of rails prior to laying when possible.