A Gentle Guide to the Free-mo Standards

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1. Introduction

For many model railroaders, modular railroading is an excellent means to become involved in the hobby. It allows the modeler to approach the hobby in small, digestible chunks. And with our more mobile society, modular model railroading allows the modeler to often start earlier in their life, before they even purchase a home, since they can take their modules with them as they relocate.

One of the modular standards rapidly gaining in popularity is the Free-mo standard. This document will walk through those standards, and explain the why's and wherefore's of the standards for the beginning model railroader.

2. Overview

The *Free-mo* standards are an adaptation for modelers in North America of the European *FREMO* standards. The original FREMO standards have been in use since 1981 in Europe, and are in active use by approximately 800 modelers in 11 countries. The Free-mo adaptation in the US started in 1995 in the Southwest and California, and is rapidly gaining momentum, and is spreading throughout North America.

The general concept for the standards are to allow for prototypical railroad operations, originally on a single-track mainline. This is in contrast to the multiple mainlines and continuous running that is typical of modules based on the NTrak-like NMRA HO standards. Current standards exist for Free-mo in HO-scale, but there are also groups attempting to create similar standards in other scales, such as S, N, and G. Recent modifications of the standard allow for double-track mainlines, as well as branchline operations.

The next most important factor of Free-mo is that other than the interface ends, there is *no* restriction on module geometry. The relationship between the ends can be any distance and angle, and a module may have as little as one standard end, if a turning loop or similar, or three or more interfaces. NMRA modules are rectangular modules in even multiples of two feet.

The modules are designed so that the ends of any two modules can be joined together, eventually creating an entire layout that can be set-up and dismantled easily, and in various configurations. The standards concentrate on this inter-connection capability.

The Free-mo standards are meant to be of continental scope. The intention is that one modeler in New York, another in Montreal, and another in Los Angeles should all be able to connect their modules together and have *no* mechanical or electrical issues preventing their inter-operation.

This document will attempt to explain the various points of the Free-mo standard, and describe the value in pursuing this aspect of model railroading. The 'formal' text of the standards are in the last section.

3. Modules

The first section of the standards deals with the basic dimensions and structure of the module.

- Ends shall be 1x6 birch (birch plywood works well) or equivalent to provide C-clamping to adjacent modules.

This is to ensure that the surfaces where two modules join together have a flat surface, to ensure that the two sides are level and square with one another. The C-clamps will be used to maintain the alignment during the setup. The reason birch or birch plywood are recommended over basic pine lumber is because pine almost always changes shape as it ages, often twisting or 'cupping,' which prevents the modules from being placed in proper alignment with one another.

- Single-track ends are to be 24 inches wide. Double track ends are to be 26" wide, Mini-mo ends are to be no smaller then 8" wide. For Mini-mo, however, 12" is preferred for Mini-mo end width.

This ensures that the ends are neat, and also facilitates the alignment of the modules. Note that this refers to the *ends*; the module itself can be wider or narrower, as long as it tapers at the end to either 24 or 26 inches, as appropriate.

Double-track modules need the extra width so they can potentially mate with single-track modules. By aligning one of the two tracks on a double-track module with the track on a single-track module, the fascia on the closest side will also align.

Mini-mo's are small modules, often used to extend distance between full modules, or built with a specific setup limitation in mind. Mini-mo's will have more information at the end. They can be either single or double track.

- Roadbed to be $\frac{1}{4}$ inch cork or equivalent on $\frac{1}{2}$ inch plywood or equivalent (Foam tops are acceptable), braced to prevent sag or flexing.

This point helps to ensure that the track (to be covered in the next section) will be at the right height relative to the module. It also ensures that the track will not be susceptible to being thrown out of alignment on the module itself. All the alignment issues so far are ultimately designed so that the track from two modules can be properly aligned.

- The module (set) shall have at least four legs and stand alone. This does not apply to Mini-mos; Mini-mos must have legs for adjustment but not need to stand alone

This ensures that a module can be set up, then brought into position and aligned with a minimal number of people. If a module had to be held in place by two or more people, while others made sure of the track alignment then put the C-clamps in place, this would dramatically impair the ability to set up a Free-mo layout quickly. Also, relying on adjacent modules for support can put strain on their structure, possibly causing bending or sagging.

Mini-mo's are the exception, since they are meant as scenic filler in many cases. They often only have one leg centered on each end, for adjusting the module height.

- Nominal and Minimum height of railhead from the floor is 50 inches. Maximum height of rail is to be 62 inches. On modules with grades, the elevation of the high end shall be some multiple of $\frac{3}{4}$ inch above low end.

This establishes how high off the floor the module will sit. Note again the focus on the track rather than the module as a whole. 50 inches allows for easy viewing by adults, with more of an eye-level view. It also establishes rail height for those modules that represent changes in elevation. In actual practice, almost every module so far is level, but the standard is in place for future use. The NMRA modules, for comparison, are at a 40-inch height from rail to floor.

- Legs shall have adjustment of at least plus or minus 1 inch. The bottoms of the legs shall have rubber tip or equivalent floor protection.

This provides some adjustment capability, because floors may not always be level, and for some variation in module construction. The floor protection is there to provide for 'good neighbor' common sense.

- Mainline maximum grade is 2.0 percent ($\frac{1}{4}$ inch per foot) with the track level for 6 inches from each end. Vertical curves shall be appropriate for mainline operation of contemporary long cars.

This deals with the changes in elevation mentioned earlier. The degree of change is important, because if its too steep, many problems could result. The 'vertical curves' mentioned deal with issues like bottoming out or lifting that could occur with long cars like passenger cars or piggyback-carrying flatcars if the change from level to slope is not managed well.

- Modules may be used with spectators on either side.

This last point is in contrast to the NMRA standards, which often like the NTrak standards that inspired them, have modules that are designed to viewed only from a particular side. Free-mo modules should be viewable from either side, which increases the flexibility of placement for a particular setup. While NMRA modules usually have a skyboard, Free-mo modules never do.

4. Track

The track standards are the second half of the mechanical standards. The structure of the module as mentioned above is to support the track and its alignment between modules.

- Track shall be code-83 nickel-silver on the mainline, allowance for code-70 on the through route for modules specifically designated as branchline only. Modules may use flex or handlaid.

Model railroad track height is measured in thousandths of an inch. Thus, code 100 is 0.100 inch, and code 83 is 0.083 inch. Most train-set track is code 100. Code 100 track is visually too high relative to the train wheels, and looks out of proportion. Also, it sometimes does not have a proper cross-section, being just a bar of metal, rather than rail-shaped, which has a thinner web connecting the wider top and even wider bottom, similar to an I-beam. Code 83 is smaller, and looks to be in better proportion to the train wheels. In actual practice, very few people hand-lay track on Free-mo modules, because of the wide variety of high-quality track in code 83 from a number of manufacturers.

Modules designed for other than heavy through-traffic are branchline modules, and may use code 70 track on them.

- Minimum radius is 42 inches (preference to 48 inch for minimum radius; modules with 36-inch radius curves will be used but usually limited to branchline service) with at least 12 inches of straight track between reverse curves. Spacing between tracks on curves should allow for long cars to operate without fouling each other, observe NMRA Recommended Practices for curved track spacing.

Minimum radius standards have two main aspects: physical and aesthetic. Physically, some long locomotives and cars are prone to problems in trying to negotiate tight curves, and often derail. In order to allow most models to negotiate the modules, a minimum radius for curves is established. The other reason for a minimum radius is aesthetics. While most model equipment can physically negotiate a 36-inch radius curve, it often looks poorly doing it. The front and back of the car or locomotive swings too wide, or otherwise looks awkward. The 42-inch minimum radius minimizes the aesthetic issue. Note that these are *minimum* radius standards; you could easily build a module that uses curves of a larger radius, from 48 inches to 72 inches or more. Larger radius curves often look better, but take up more room.

Branchline-use modules are allowed to use the 36-inch minimum radius, with larger still being preferred where possible. Often these branches will be restricted as to engine and car length, often similarly to the prototype.

The “12 inches of straight track between reverse curves” clause is to prevent issues that arise when two cars are coupled together and pass through a section of track that first curves in one direction, then another. One car is pulled one way while the second is pulled in the opposite, usually resulting in one or both cars becoming derailed. By placing a section of straight track between these two curves, this shoving action is reduced.

By following the NMRA RP's for track center spacing on curves, long equipment can be run without fouling on those curves with multiple tracks. Under Standard S-8, the Class Ia centers should be used on modules intended for mainline service, Class I on those modules intended for branchline service.

- Mainline turnouts shall be at least #6.

Turnouts, sometimes called switches, have a measurement system of their own. A number 6 switch has an angle of 1 unit of divergence for every six units of length. A number 4 has one unit of divergence for every 4 units of length, and is therefore a sharper turn. Most turnouts in train sets are #4, while on real railroads mainline turnouts are much higher, often ranging between a #10 to #20. For the same reasons that wider-radius curves are better, turnouts with a more gradual divergence are also preferred. And also like the curve radius, while the #6 is the minimum, often modelers will use a narrower turnout, such as a #8 on their modules. Note that a common, but often overlooked, location of reverse curves, mentioned earlier, takes place where two turnouts 'face' each other, such as in a crossover section.

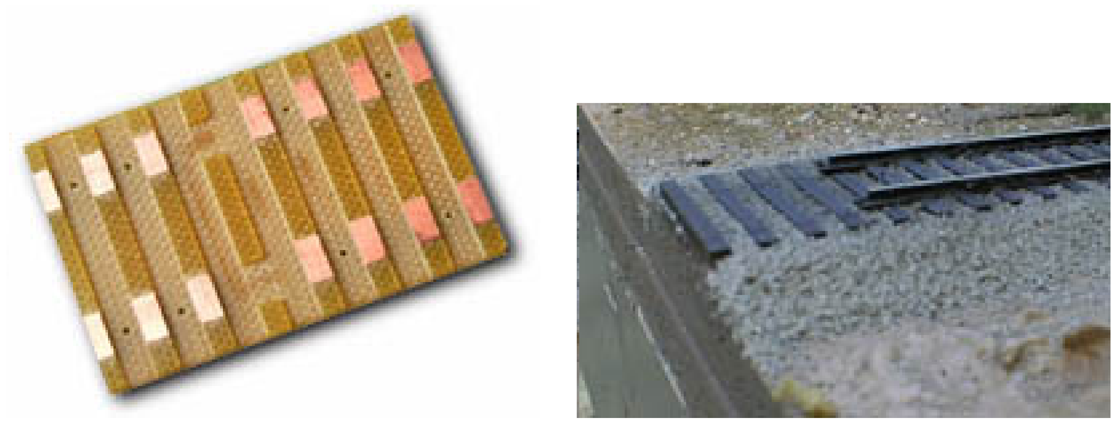
- At the ends of the single-track module the track shall be centered on the 24 inch width; double track modules shall have the first track located offset 1 inch from the center on the 26 inch wide end, and the second track offset 1 inch to the other side of the center, allowing 2 inches between the two tracks. Track must be perpendicular to the end, also straight and level for 6 inches from each end of the module.

This defines the track placement relative to the end, and therefore how the track will connect to the next module. The perpendicular, straight, and level requirements make sure that the transition from one module to the next will be as smooth as possible. The six inches called for here provide 12 inches of straight track between curves on adjacent modules, preventing reverse-curve issues as mentioned above in the radius section.

Note that this track placement means that the ends of the module are fully interchangeable. Other standards often have the track placement relative to one edge, often the front, of the module, producing a module with a front, back, left end, and right end, requiring the left end of one module to join with the right end of the other. Free-mo modules are reversible, providing for more flexibility in setting up a layout.

The two-track variation allows for two mainline tracks, and this is used for those scenes with a double-track mainline. The endplates are instead 26 inches wide, and the tracks are 2 inches apart, each 1 inch from the module end centerline. This means the tracks are 12 inches from each side, which allows one of the tracks on a two-track module to link to a single-track module. Note that the double-track standard is meant for connecting two mainlines, *not* a main track with a passing siding. Currently, all passing sidings must be internal to a given module set.

Figure 1: Free-mo PCB Plate



- Rail shall be cut off 1 inch away from module end; ties and ballast shall be continued to the module end for good appearance and matching with the adjacent module.

By avoiding full bridge tracks, the modules will seem to blend in with one another fairly well. In order for the modules to work with only bridge rails, alignment must be even more exact than in NMRA modules. The 2-inch bridge rails are connected using standard rail joiners for code 83 track.

- Free-mo printed circuit board tie plates are recommended for ends

One of the founding members of the Free-mo movement has come up with an interesting gadget (see Figure 1). It is made from single piece of printed circuit board 1.5 inches long. There are two set of ties with copper plating, one set of three and another of four, separated by a tie with cutouts for the rail joiners. You epoxy the plate to the module, solder the rails to the three-tie section, then paint and ballast the track and plate. The combination of epoxy and solder make sure that the track ends do not move or come out of alignment. The bridge rail will then lay on top of the four-tie section when the modules are connected.

Instructions for making these plates are expected to be available soon.

Design considerations

The truly powerful thing about Free-mo modules is the *freedom*; they can be *any* length, and the ends can have *any* relative angle to one another.

Note that a module is *not* required to have exactly two ends; a module must have at least one, and possibly three or more. A module with one end must be a loop module or similar, such that a train may enter and leave by that same end. A wye module, or an interchange, might have three or four ‘ends.’

Also, a ‘module’ may actually consist of several separate sections. Only the module interfaces on the ends need to conform to the Free-mo standard. Internal joints may have any track arrangement the builder desires.

5. Wiring

- Turnouts shall not rely on points to power frog.

The purpose of this is to provide rock-solid, bullet-proof physical operation of trains on the layout. Using the points to power the turnout frog is fraught with peril. Points are notorious for losing contact with the main rails, sometimes causing the locomotive to stall. On most turnouts, part of the frog is electrically isolated from the points, to prevent shorts, and some short wheelbase locomotives will stall on them even if the points remain in contact. To prevent such incidents, the Free-mo standards call for the frog to be powered by some sort of switch, although turnouts can still be hand-thrown if the module owner wishes. For example, note that Caboose Industries makes a version of their ground throw with electrical contacts just for such purposes; you don’t *have* to use a fancy switch machine to do this.

- Wire shall be #18 or larger stranded. Feeder wire can be of 24 gauge or heavier. There shall be a 4 (or more) position barrier strip at each end under the module for wire hook-up.

By using the heaviest gauge of wire that will conveniently work, the possibility of power and DCC signal loss is minimized. The barrier strips make wiring and wiring repairs simpler.

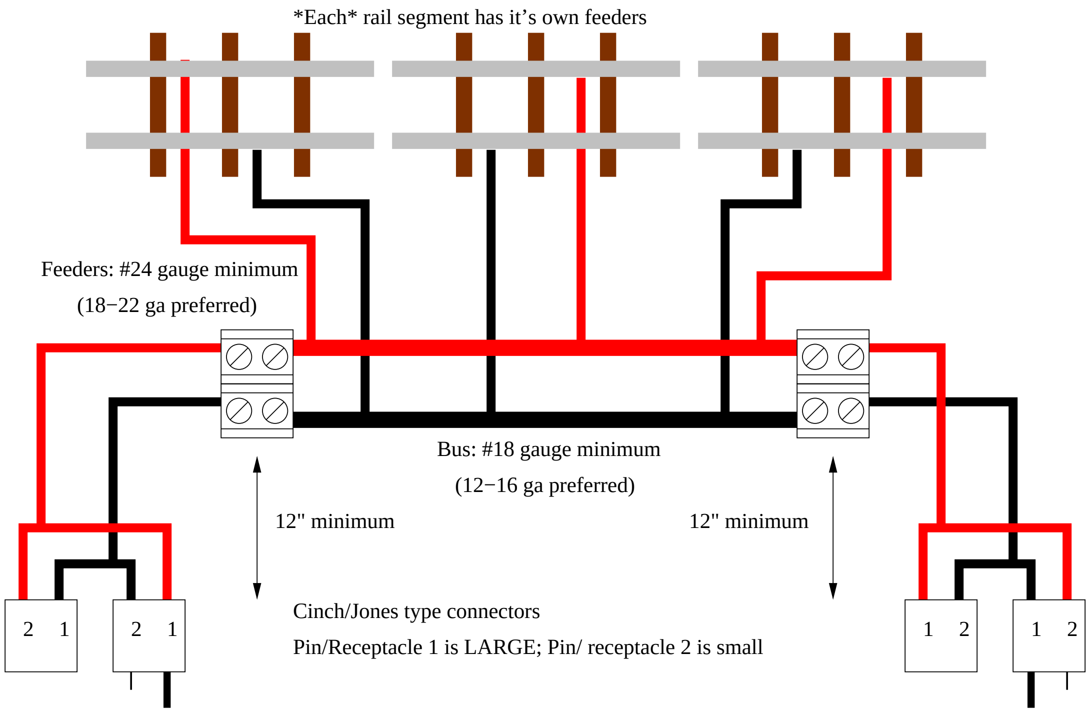
- Wiring consists of 4 separate bus wires and a 6-conductor DCC Digitrax Loconet bus. All ends have a pair of male and female 2 pin jones plug (Part Number P-302-CCT and S-302-CCT) for the mainline, a single 2 pin trailer plug (Radio Shack PN 270-026) for the accessory power, and a surface-mount 6-conductor RJ12 box mounted to inside of module 1x6 end.

While there have been concerns about using the jones plugs, there have been no incidents at any shows with them; all connections are soldered and not just crimped. Most of the Free-mo modules have soldered them, and this seems to reduce disconnects. The N gauge Free-MoN group is looking at considering a new connector plug, and the HO group will see how that works.

- Mainline wiring is as follows for jones plugs (must be facing module end for correct perspective):
  - Single-track modules – Male pin 2 right rail, male pin 1 left rail. Female pin 2 left rail, female pin 1 right rail. The same wiring situation would be found for the other end(s).

– Double track – Male pin 2 right rail, right track, male pin 1 left rail, right track. Female pin 2 left rail, left track, female pin 1 right rail, right track. The same wiring situation would be found for the other end(s).

A picture is worth a thousand words:



The wiring requirements allow the module to be matched to either end of the adjacent module, and still prevent shorts.

On the double-track modules, the wiring allows for easier detection on trains on one main or the other. There is a Free-mo standard signalling system being designed.

- Accessory power 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 [accessory] bus.

Accessory power is usually 16v AC, since DC can be derived from an AC line; a line bearing a DCC signal is effectively an AC line. Note that the accessory bus has a very different connector from the track bus, to prevent major accidents.

- Each module needs a RJ12 Loconet connection point, one on every end, mounted on the inside of the module, and one dual flush mount 6 conductor RJ12 faceplate mounted on each exposed side of module, for throttles.

Recently, there has been much discussion on the merits of using the low-cost phone-style connector plates instead of the Digitrax UP5 connector. Several groups have found the low-cost plate to cause problems, and are looking at making the UP5 a local requirement.

- All of the Loconet connectors and associated cables need to be connected together straight through (i.e. pin 1 – pin 1, pin 2 – pin 2, pin 3 – pin 3, etc. ... note standard telephone cables are NOT wired straight through).

By using telephone cables rather than network cables, various phasing problems that can cause erratic behavior in boosters can arise. Such problems are avoided by requiring the use of straight-wired, or network, cables.

- To connect the DCC bus between modules, a 2 foot RJ12 to RJ12 cable is utilized.

Like the internal DCC cabling, these should also be wired straight through. NGM used to use a scheme similar to this before the trailer plugs were introduced.

- To connect a DCC booster to a module, a 4 foot RJ12 to RJ12 cable is utilized. A 4 foot cable with one female and one male 2 pin Jones plug on one end, plugged between interfacing modules, connected to the output of the booster.

A large setup will often need to be broken down into separate power districts, each with their own booster. The booster is connected into the Loconet, and instead of using the Jones plug to connect the two modules, the booster is hooked into one module's track connector.

6. Control

- Digitrax, and/or rather Loconet compliant, DCC and accessories are standard for interoperability among Free-mo clubs. For more information about Technical specifics consult the Digitrax website (`http://www.digitrax.com/`).

Both the FREMO and Free-Mo groups have found Digitrax's Loconet technology to be far superior to any other DCC technology, and especially useful in a modular setting. Note that this is *only* a restriction to boosters, throttles, and accessories being used; *any* DCC-compliant decoder can be used in your locomotives.

7. Scenery

- General module fascia color shall complement scenery and not draw attention from the scene.

The Free-Mo group is striving for having the trains and track be the focal point, not the modules themselves. Like a permanent layout, the idea is to draw the viewer into the scene, rather than have them as an outside observer.

- Mainline shall be ballasted Woodland Scenics Fine Light Gray or equivalent, and some form of scenery hiding the benchwork.

The ballast color here is for having scenic uniformity across modules. This allows a set-up to appear to be just one layout, rather than a collection of modules. All modules should be scenicked before display.

- Standard mainline rail color is Floquil Roof Brown or equivalent.

This is referring to the rust-coloring to be applied to the sides of the rail, once again for scenic uniformity.

- Scenery at the Free-mo standard end(s) shall have a flat profile roughly $\frac{3}{8}$ inch below top of mainline rail.

A module should not only have a universal end in a *structural* and *electrical* sense, but also in a *scenic* sense as well. Having a scenic element that abruptly ends at one module end, like a mountain, river, or road, detracts from the 'one layout' scenic ideal. Remember, this applies to the universal module end; on an internal interface between two sections of one 'module', these requirements do not apply. Most groups recommend that the flat scenery profile should continue for 6 inches into the module.

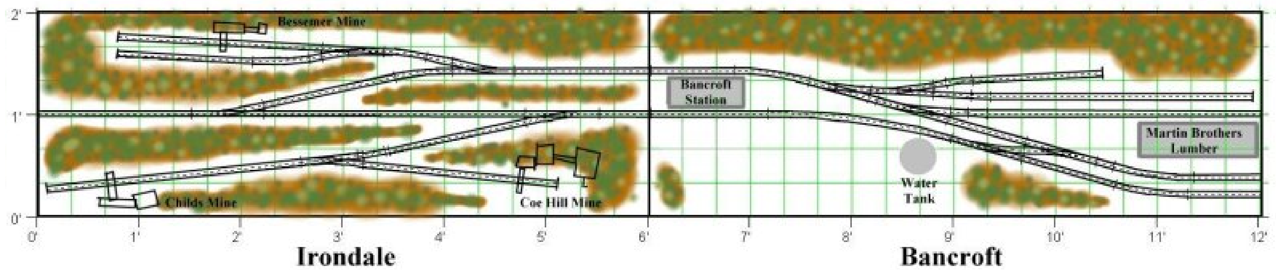
8. Recommended Practices

- Mini-mo type modules are intended to subset Free-mo and not replace or exclude an equivalent length standard module. Full width modules are generally more stable and should be used wherever possible. Mini-mos are a subset of the branchline minimum radius specifications.

Mini-mos's are often the 'filler' modules mentioned earlier. They are used to increase mainline length or fill spaces in a particular set-up. Preference would be for all modules to be 'full' modules rather than Mini-mo's.

Some groups are using Mini-mo's as the main track between towns and other switching locations, which are themselves on standard-width modules. This visually emphasizes the towns and industries over the trackage.

Figure 2: one possible NMRA to Free-mo transition module



9. Putting It All Together

So, what does the Free-Mo standard give the modeler that isn't available under the NMRA-style standards? Freedom of design: the distance and angular relationship between the module ends is determined by the track plan of the module; one doesn't have to fit a track plan into a square box. The single mainline requires some level of operation, and avoids caboose-chasing loops.

One comment heard is "operations bores the public." Most Free-Mo participants counter with the argument that they model railroads mainly for themselves and other model railroaders, not primarily for the general public. If they do *what they enjoy*, and *do it well*, the public will notice it. Also, it isn't operations that bores the public, but idle trains. A properly established and practiced operations procedure will make things run smoothly at any setup.

One does not have to abandon the NMRA-style modules to start enjoying Free-mo. One possible transition module set is in Figure 2. The only other requirement would be sets of alternate legs, to compensate for the difference in module heights; whether one wanted to raise the NMRA modules or lower the Free-Mo modules would depend on the setup manager.

In Figure 3, you can see a point-to-loop setup with only Free-Mo modules in it. Look at the different designs and track plans that were done, including the balloon loop module, and small town in the middle. Also note the passing siding in the four-module curve set.

In Figure 4, you can see a mixed setup of NMRA and Free-Mo modules.

Again, in Figure 5, you can see a mixed setup of Free-mo and NMRA-style modules.

Free-mo lends itself to modeling actual prototypical track usage. For example, the location at Circlesville, Ohio (Figure 6) shows a double-track mainline curving from the top left to the bottom right in an S-shape, while another railroad crosses from the left side to the right side. A general layout element based on this location might look like Figure 7.

This, in theory, *could* be done using the NMRA module standards, but the offset would be awkward to place in one of the layout sides, and a two-section inside-curve + outside-curve could also be awkward. Doing this as a Free-mo module or module set would be far more straightforward.

Figure 3: A sample Free-mo setup

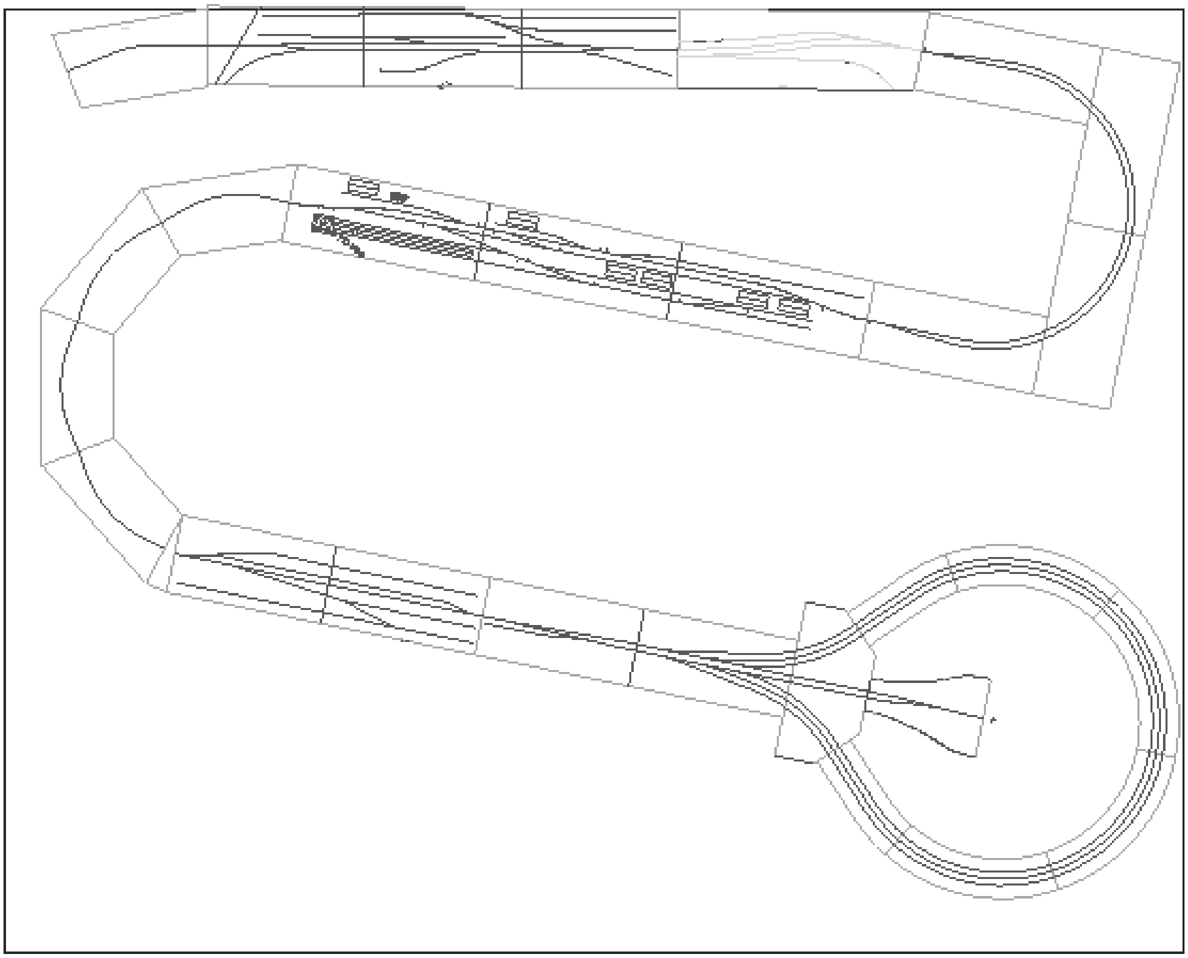


Figure 4: Another large setup, involving mixed NMRA and Free-mo modules

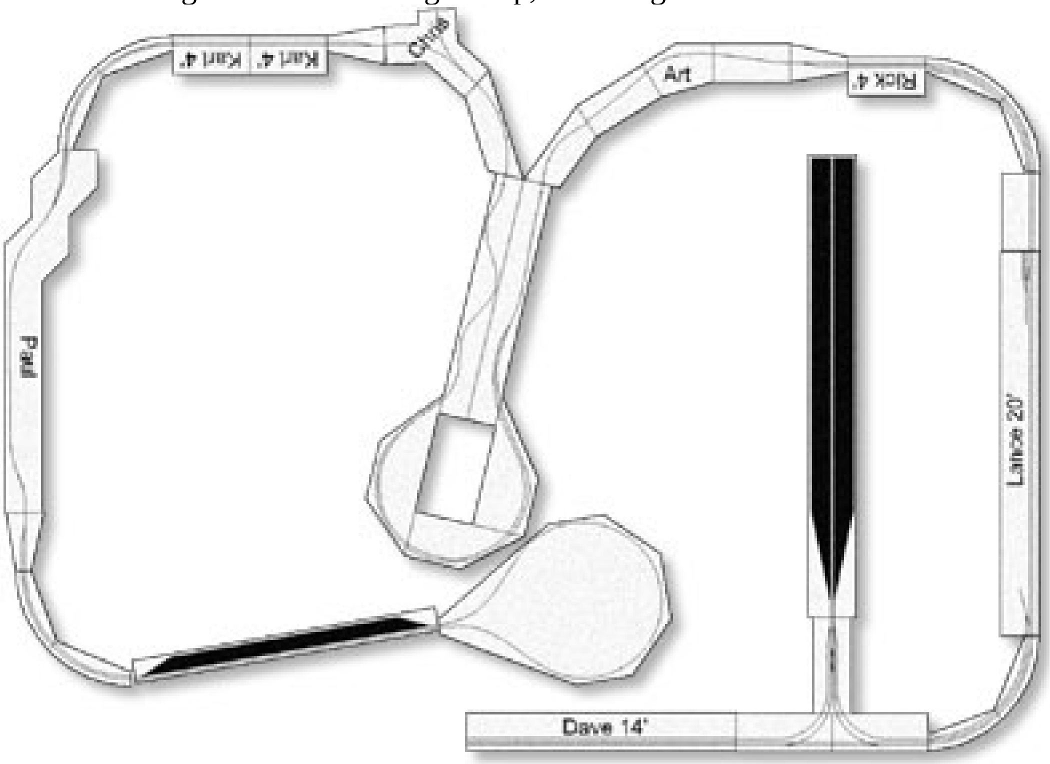


Figure 5: Another mixed setup

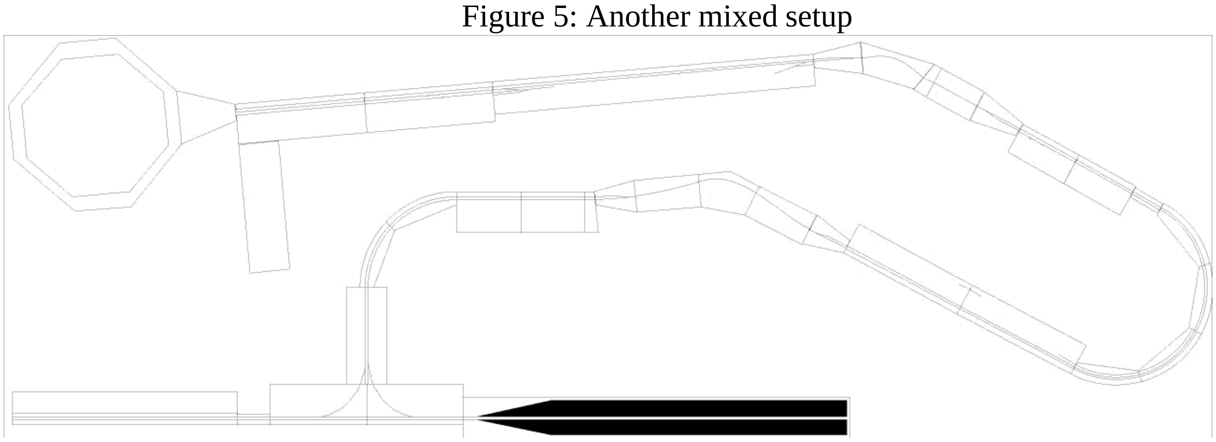


Figure 6: Circleville, OH

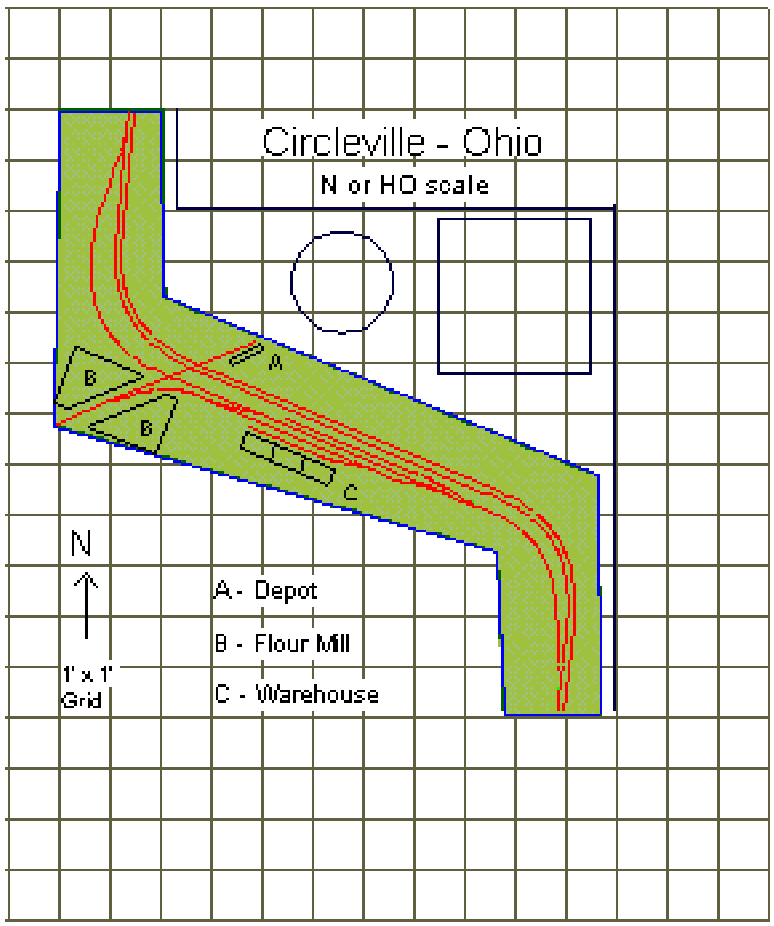
A. Appendix: The Free-mo Standards

[Items in *italics* were altered or amended on January 14th, 2004.]

Modules

Ends shall be 1x6 birch (birch plywood works well) or equivalent to provide C-clamping to adjacent modules. Single track ends are to be 24 inches wide, *Double track ends are to be 26" wide, Mini-mo ends are to be no smaller then 8" wide. For Mini-mo, however, 12" is preferred for Mini-mo end width*. Roadbed to be 1/4 inch cork or equivalent on 1/2 inch plywood or equivalent (Foam tops are acceptable), braced to prevent sag or flexing. The module (set) shall have at least four legs and stand alone, *this does not apply to Mini-mos. Mini-mos must have legs for adjustment but not need to stand alone*. Nominal and Minimum height of railhead from the floor is 50 inches. Maximum height of rail is to be 62 inches. On modules with grades, the elevation of the high end shall be some multiple of 3/4 inch above low end. Legs shall have adjustment of plus or minus 1 inch. The bottoms of the legs shall have rubber tip or equivalent floor protection. Mainline maximum grade is 2.0 percent (1/4 inch per foot) with the track level for 6 inches from each end. Vertical curves shall be appropriate for mainline operation of contemporary long cars. Modules may be used with spectators on either side.

Figure 7: Circleville LDE



Track

Track shall be code-83 nickel-silver flex or handlaid *on the mainline, allowance for code-70 on the through route for modules specifically designated as 'branchline only'*. Minimum radius is 36 inches (preference to 42 inches for minimum radius, modules built with 42 inch radius curves will be used but usually limited to branchline service, this is now official) with at least 12 inches of straight track between reverse curves. *Spacing between tracks on curves should allow for long cars to operate without fouling each other, observe NMRA Recommended Practices for curved track spacing*. Mainline turnouts shall be at least #6. At the ends of the module the track shall be centered on the 24 inch width, *double track modules shall have the first track located 12 inches from a side on the 26 inch wide end, and the second track 12 inches from the opposite side allowing 2 inches between the two tracks. Track must be* perpendicular to the end, also straight and level for 6 inches from each end of the module. Rail shall be cut off 1 inch away from module end; ties and ballast shall be continued to the module end for good appearance and matching with the adjacent module. Free-mo *printed circuit board tie* plates are recommended for ends.

Wiring

Turnouts shall not rely on points to power frog.

Wire shall be #18 or larger stranded. Feeder wire can be of 24 gauge or heavier. There shall be a 4 (or more) position barrier strip at each end under the module for wire hook-up.

Wiring consists of 4 separate bus wires and a 6 conductor DCC Digitrax Loconet bus. All ends have a pair of male and female 2 pin jones plug (Part Number P-302-CCT and S-302-CCT) for the mainline, a single 2 pin trailer plug Radio Shack (PN 270-026) for the accessory power, and a surface-mount 6-conductor RJ12 box mounted to inside of module 1x6 end.

Mainline wiring is as follows for jones plugs (must be facing module end for correct perspective):

- Single track – Male pin 2 right rail, male pin 1 left rail. Female pin 2 left rail, female pin 1 right rail. The same wiring situation would be found for the other end(s).

- *Double track – Male pin 2 right rail, right track, male pin 1 left rail, right track. Female pin 2 left rail, left track, female pin 1 right rail, right track. The same wiring situation would be found for the other end(s).*

Accessory power 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.

Each module needs a RJ12 Loconet connection point, one on every end, mounted on the inside of the module, and one dual flush mount 6 conductor RJ12 faceplate mounted on each exposed side of module, for throttles.

All of the Loconet connectors and associated cables need to be connected together straight through (i.e. pin 1 - pin 1, pin 2 - pin 2, pin 3 - pin 3, etc. . . . note standard telephone cables are NOT wired straight through).

To connect the DCC bus between modules, a 2 foot RJ12 to RJ12 cable is utilized.

To connect a DCC booster to a module, a 4 foot RJ12 to RJ12 cable is utilized. A 4 foot cable with one female and one male 2 pin Jones plug on one end, plugged between interfacing modules, connected to the output of the booster.

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Digitrax, *and/or rather Loconet compliant*, DCC and accessories are standard for interoperability among Free-mo clubs. For more information about Technical specifics consult the Digitrax website (`http://www.digitrax.com/`).

Scenery

General module fascia color *shall complement scenery and not draw attention from the scene*. Mainline shall be ballasted Woodland Scenics Fine Light Gray or equivalent, and some form of scenery hiding the benchwork. Standard mainline rail color is Floquil/Poly-S Roof Brown or equivalent. Scenery at the Free-mo standard end(s) shall have a flat profile roughly $\frac{3}{8}$ inch below top of mainline rail.

Recommended Practices

Avoid dimensional pine lumber. It has a tendency to warp and ‘cup’ throwing off track alignment.

Mini-mo type modules are intended to subset Free-mo and not replace or exclude an equivalent length standard module. Full width modules are generally more stable and should be used wherever possible. Mini-mos are a subset of the branchline minimum radius specifications.