CALIFORNIA CENTRAL COAST

MODULAR ON30

Module Specification

September 2015

www.ccc-on30.org

Overview

The California Central Coast module group has been influenced by many module groups and module design philosophies spanning multiple scales. The catalyst for the group's founding was a meeting with a couple members of the On30 Texas Outlaws module group. The Texas Outlaws had adopted a form factor for a module interface a couple years prior. We followed in their footsteps rather than invent a wheel.

Connectivity is the key to our standards – physical and electrical – with an eye to operational reliability. The module dimensions are free form apart from the connectivity aspects. This helps to break up the linearity of our setups and foster creative scenes which might not fit in an x by y module.

Our setting is California from the central coast to the Sierra foothills and around the central valley. This broad geographic area provides plenty of variety for module terrain features. The time period is between 1900 and 1940. Since this is a freelance railroad, the full spectrum of California's early 1900's industry is fair game to model. The season isn't specifically set. However, we focus on times of the year when the grasses have some green. For California, this implies late Fall to Spring.

Physical Construction

There are just a few key physical specifications used with our modules. As mentioned in the overview, the focus is on connectivity. The first of these specifications is for the module-to-module physical interface. The width of a module's interface is 24 inches with a height of 6 inches. The lower 4 inches is the area where the physical union between modules is created. Bolt holes are provided to join modules with bolts. Clamps could also be used. The other key physical parameter is table height which is 48” above the floor. Figure 1 shows the design of the interface plate.

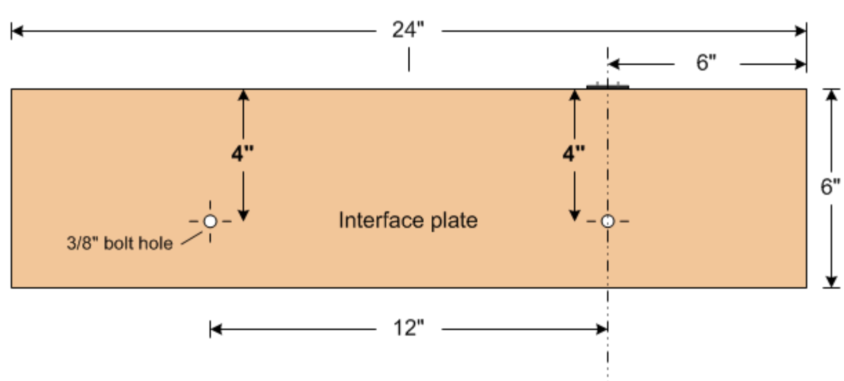


Figure 1

Interface plate – At a minimum, the lower 4 inches of the interface forms the interface plate; the point where modules are mechanically connected. The plate should be the full 6 inch height of the interface. The plate will form a protective barrier for less durable materials used to form terrain.

Interface plate material – high grade ½ inch plywood, or ¾ inch hardwood.

Plate width – 24 inches (excluding any side fascia material).

Plate height – 6 inches (exceptions may be allowed if critical to the strength of the module).

Interface plate mounting – Plate will be secured to a module's frame with both glue and screws.

Mounting holes – Interface plate must have 3/8 inch holes placed as shown in figure 1. These holes are used with 2 inch by ¼ inch *standard bolts* to physically connect modules. 5/16 inch bolts and carriage bolts should *not* be used because they impair the adjustability between modules.

Module height – 48 inches above the floor as measured to the top of the interface (see figure 2).

Leg adjustment – Each leg will have adjustable feet with at least 1 inch of variability. Module height should be adjustable from 47 ¾ inches to 48 ¾ inches to allow for floor irregularities (see figure 2).

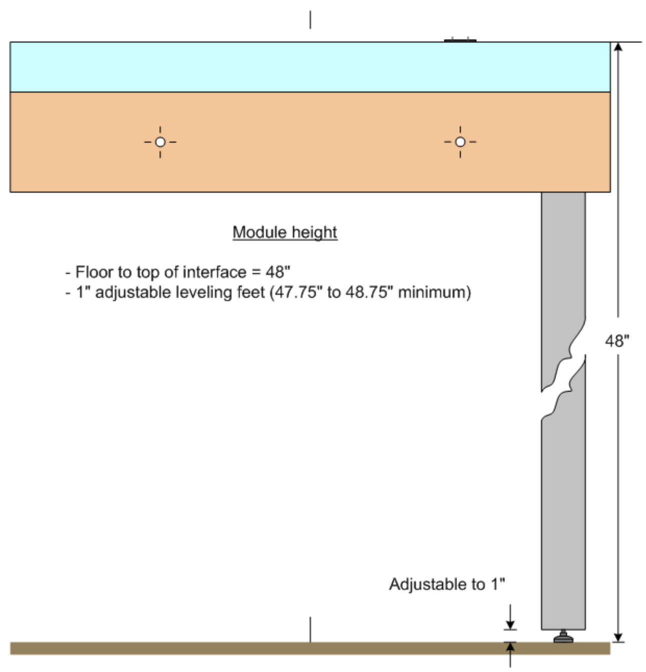


Figure 2

Leg mounting – There are many possible methods for attaching legs. If they are mounted to the interface plate, then the mounting hardware must not protrude beyond the plate's surface.

Maximum length – The maximum length of an individual module, or of a set-piece of modules, is 14 feet. A set-piece of modules consists of two or more modules which form a contiguous scene by use of secondary routes and/or common terrain profiles at the interfaces. Loop, wye, and yard modules are exempt from this requirement.

Side fascias must reserve the lower 1 inch so that side skirts may be attached for indoor shows.

Backdrops – The modules are intended to be viewed from both sides. Backdrops are discouraged.

Track & Operating Requirements

The modules utilize a single track at the interface. As can be seen in figure 1, the track is placed asymmetrically at the interface. This asymmetric design affords space for terrain and/or structures on the most basic straight-through rectangular modules. On more complex modules, this facilitates placement of passing sidings, spurs, yards, etc. The reference track products used for the modules are Peco's On30 flex track and turnouts. These products use code 100 rail and measure 3/16ths of an inch from the underside of the ties to the top of the rail. Using Peco products is not a requirement but adhering to the overall tie/rail height and code 100 rail between modules is needed to ensure smooth operation.

The track at the interface must be:

- Straight, level and perpendicular to the interface in the 4 inches closest to the interface.
- Rails must end 1 inch before the interface. Bridge rails (code 100) are used to span the gap between modules. After allowances for insulator rail joiners and human error, bridge rails are between 1 7/8 to 2 1/16 inches (have an assortment on hand).
- Rail ends must be free of scenery / ballast so that an insulating rail joiner may slide on easily.
- Faux ties must be in place between the rail ends and the interface to support joiner rails.
- Track centerline must be 6 inches in from one edge of the interface (excluding fascia material, see Figure 1)
- The point side of a switch may be within 4 inches of an interface provided that its straight route conforms to the above.

The track between interfaces:

- A module must have at least one route (main route) between its interfaces unless it is an end of line (yard, loop, turntable, or similar).
- The minimum radius on the main route is 22 inches.
- The main route may pass no closer than 3 inches to a module edge as measured from the track centerline.
- Clearances on the main route must follow the minimums defined by the NMRA for On30 (see Appendix A). On curves, the “A” and “G” dimensions should be increased by 3/8 inch to allow for equipment overhang.
- The main route may use either code 83 or 100 rail, but must have code 100 rail at the interfaces.
- HO flex and sectional track is not allowed (exception – sectional HO crossovers and turnouts may be used if the ties are blended into the scene).
- Track which is not part of the main route may be code 70, 83 and/or 100.
- Within a module, the main route may branch into two or more routes, form a wye, or form a return loop provided that it adheres to all other requirements for a main route.
- Grades are allowed as follows (See Appendix D for further info):

- There must be at least 8 inches of track between changes in grade (level-to-grade and grade-to-grade).
- Grades on the main route must return to the standard rail height at the interfaces (48 3/16 inches). As an exception, if a set of modules have a main route with a grade spanning them, the main route must return to standard rail height at the interfaces on the ends of the module set.
- On the main route, the initial starting grade from level track must be 2% or less.
- After the initial starting grade, grade changes are limited to 1% increments or less (e.g. 2% to 3%).
- The maximum main route grade is 4%. It is recommended that the grade on the main route be kept at or below 2.5% to allow the maximum diversity of motive power.
- All grades must have proper vertical transition curves.
- Rail joiners should be kept at least 4 inches away from the vertical transition curves.
- Grades on secondary routes staying within a module or passing between modules can be as steep as the module builder desires.

Electrical and DCC

Electrical connectivity has a direct impact on the successful operation of a modular layout. We have adopted the practices of other groups who've established reliable electrical standards based on practical experience. We operate using Digital Command Control (DCC). There are three electrical aspects to DCC wiring – the track power bus, the command bus, and the control bus. There are multiple DCC systems available on the market with each having unique designs for the connection of their respective hand-held controllers. The command bus will utilize 8-wire cables which will provide support for both 6-wire DCC command bus schemes (e.g. NCE), and 8-wire command bus schemes (e.g. MRC). The control bus will always be DCC system specific. (Note: All wiring diagrams below are top-down views through the modules.)

The track power bus:

- The track power bus will utilize insulated, stranded copper wire (16 gauge minimum, up to 12 gauge).
- The power bus wire will be anchored to the underside of the module at each end and, as necessary, in between the ends to prevent sagging.
- At each interface, the power bus will extend 12" beyond the interface and will be fitted with an appropriate track bus connector.
- The track power bus wire will terminate with 4-conductor .093" Molex connectors. (Note: 5-pole Molex's were used previously but are not longer available)
- Molex connectors are oriented as follows:
  - With the mainline track closest to you (relative to the interfaces, see figure 3), the right-hand Molex will have female pins and the left hand Molex will have male pins.

- On the Molex connectors, pin 1 will be the angled (pointed) side and attach to the mainline rail closest to the module edge. Pin 4 is at the opposite side of the connector and attaches to the adjacent mainline rail. Female pins go into the male molex housing. Male pins go into the female (shrouded) molex housing (the shroud protects male pins from transport damage).

- When power districts are used, modules in adjacent districts must ***not*** have their track power buses interconnected.

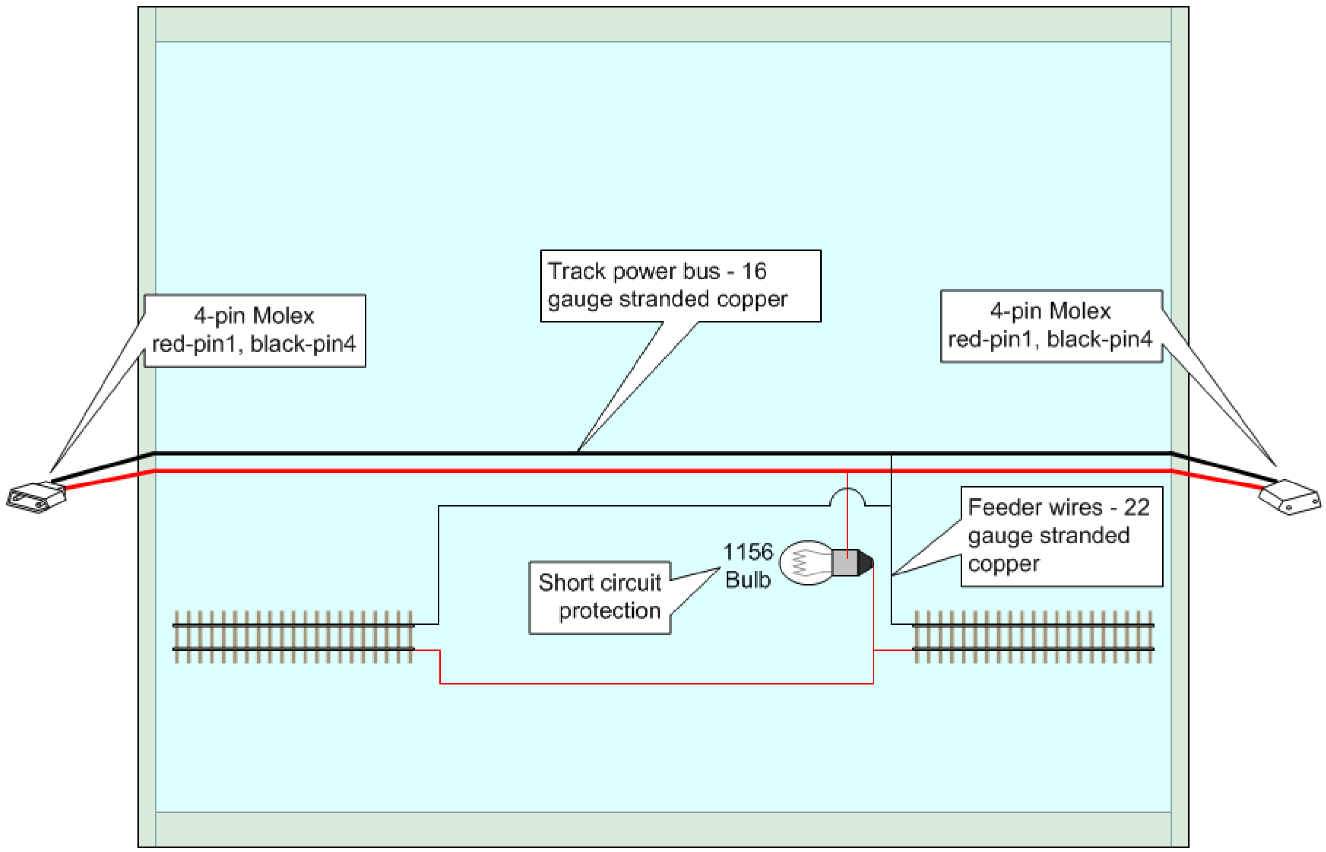


Figure 3

Power connections to the track:

- All feeder wires from the track power bus to the rails must be insulated, 22 gauge copper wire (stranded preferred).
- The track bus will be accessed once to feed all of the rail feed wires on a module.
- Short circuit protection must be inserted between the power bus and the rail feed wires. A tail light bulb (type 1156) wired in series on one of the rail feeds will accomplish this (see Figure 3). DCC circuit breaker products may also be used provided that they have a visual short indicator.
- Each module will be electrically isolated from its neighbors at the rails by using insulating rail joiners (such as Atlas ATL55) on one side of each set of joiner rails.

DCC Command bus:

- Each module will have a pass-through command bus cable and port to establish the layout command bus. If the module requires a command port (see below) then a 2F/F connector will be used as shown in Figure 4.
- Command bus ports will be RJ45, 2-to-1 (2F/F) connectors (or similar) with the dual port side (2F) under the module and at least a single port protruding through the side fascia. As shown in Figure 4, the fascia side ports daisy chain back to the 2F/F module-to-module connector.
- Modules with one or more functional turnouts must have at least one command bus port on the side nearest the track or module controls (whichever is most appropriate).
- Modules that have only a straight-through route are not required to have a command bus port on the fascia if the module length is under 6 feet. However, they are required to have the command bus pass-through terminating in an F/F connector (in lieu of the 2F/F shown in Figure 4).
- Any module over 7 feet in length, and modules containing passing sidings, should have at least two command bus ports on the side closest to the controls for the passing sidings.
- The command bus will consist of network Cat3/5/6 cables with RJ45 plugs on each end.
- The module-to-module command bus will connect back to the DCC system as appropriate for the make/model of the system in use.

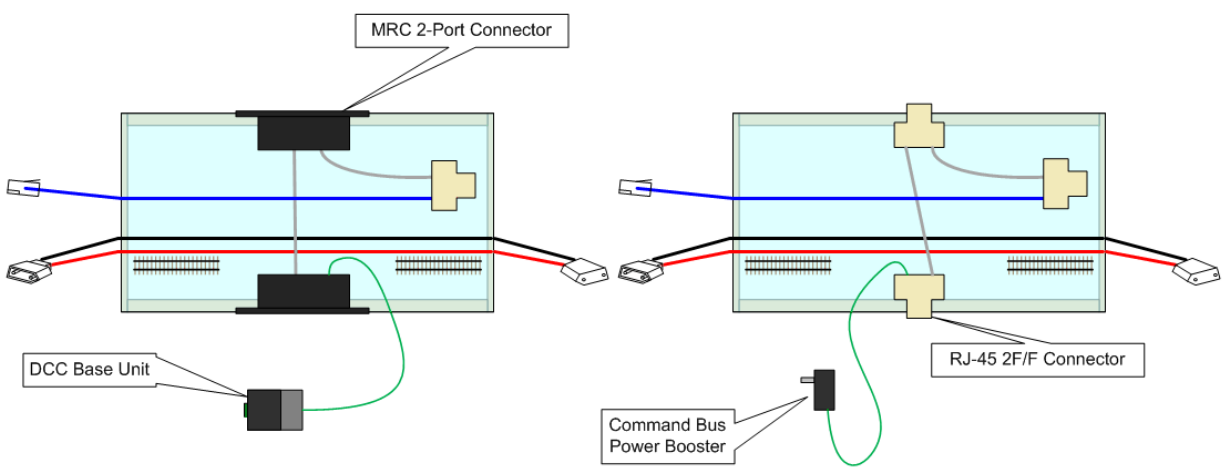


Figure 4

Wyes and Reverse loops:

- Any module with a reverse loop must have an isolated section of the loop wired through a reverse loop circuit (or equivalent, see Figure 5).

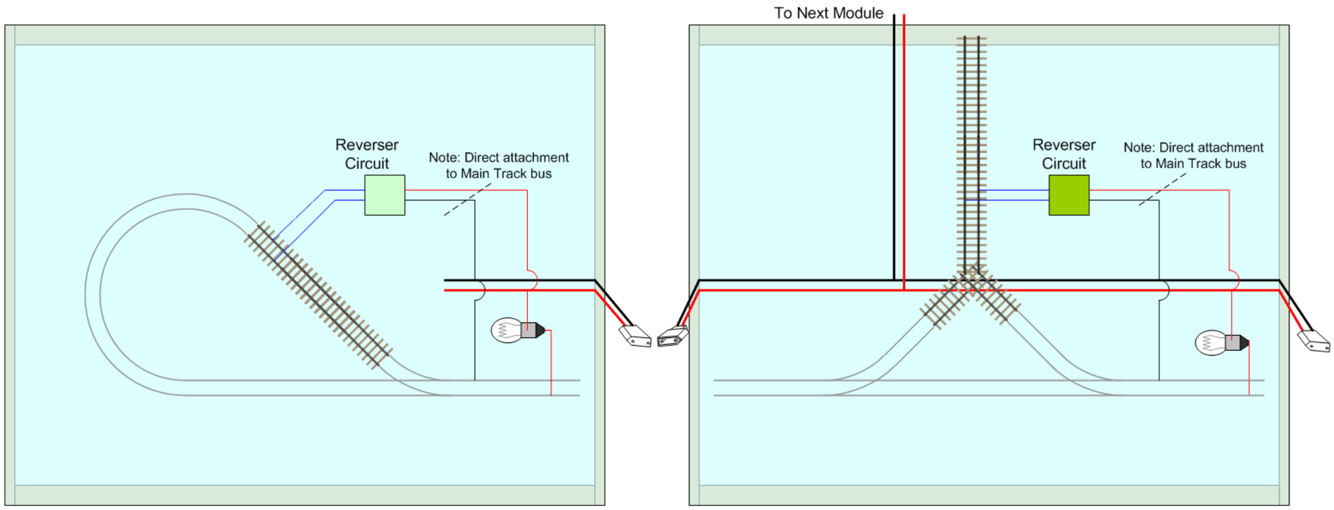
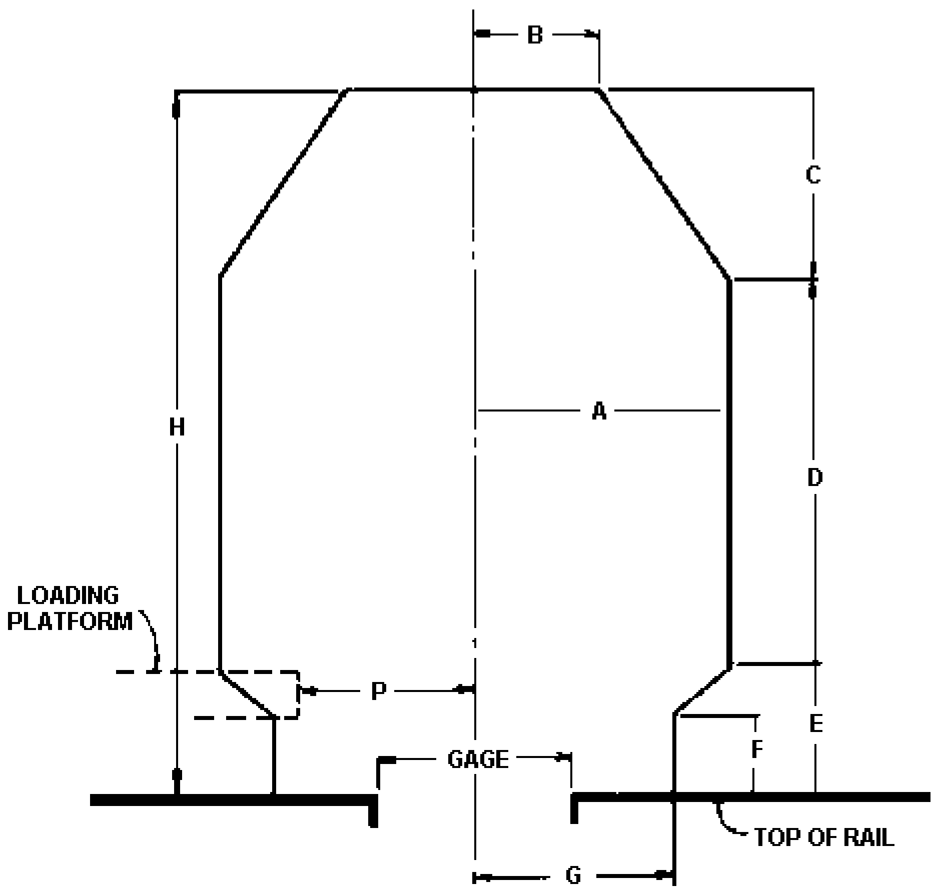


Figure 5

- Any module with a wye must have one branch of the wye isolated with the isolated branch wired through a reverser circuit (or equivalent).
- The length of the isolated track section on a loop module must be at least 60” long.
- The isolated track section on a wye module must be at least 15” long (long enough to turn a locomotive). If the wye is intended to have a full train in the isolated section, then that isolated section must be at least 60” long.
- If a wye module is intended to function as a 3-way branching module, special consideration must be made to ensure that the isolated section can hold a full train within the wye module. The reverser circuit cannot be used to power any adjacent module.

Appendix A

NMRA STANDARDS	
CLEARANCES	
Sheet No. S-7	Revised: July 2002



BRIDGE AND STRUCTURE CLEARANCES - TANGENT TRACK

A*	B	C	D	E	F	G*	H	P
On30 Scale								
1-1/2"	3/4"	1"	2-1/2"	3/4"	1/2"	1-3/8"	4-1/4"	1-3/8"

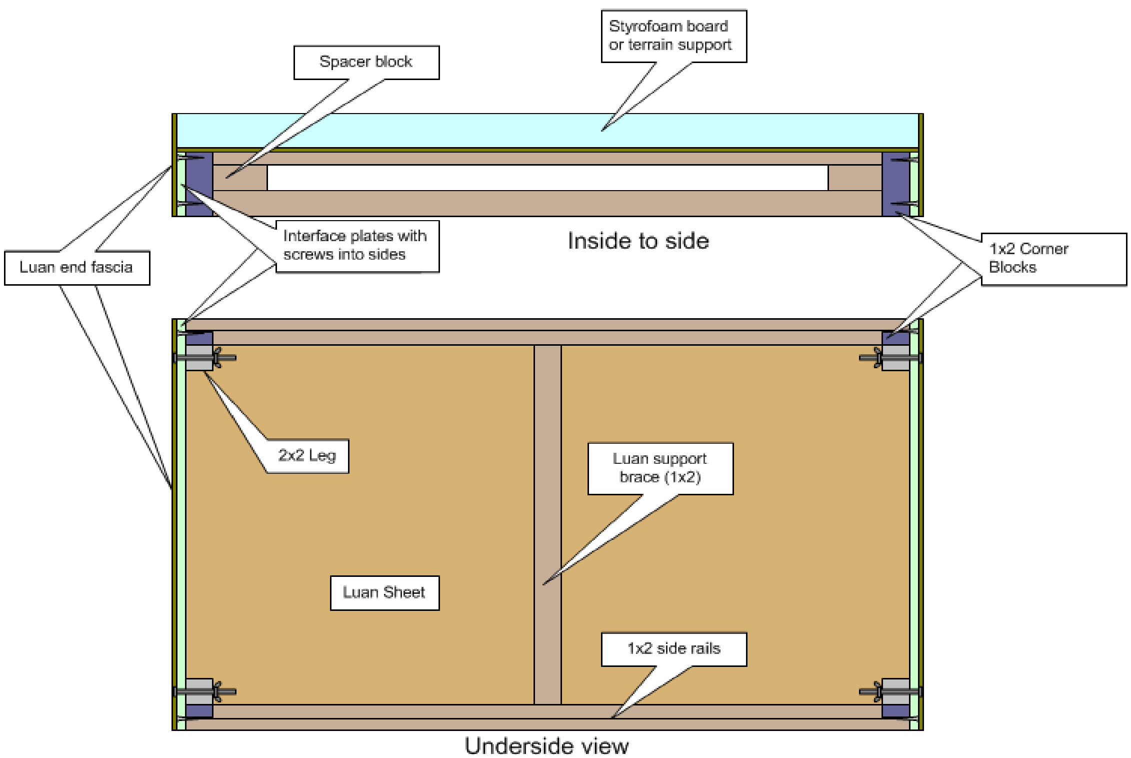
* An additional 3/8" should be added on curves.

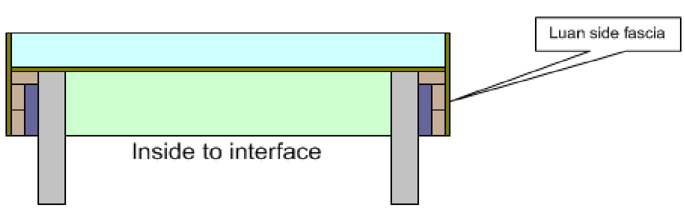
Appendix B

Module Construction Suggestions:

As a group, we don't dictate how you should build your modules. However, we've tried a few methods and the following is a good baseline module. For modules with a length of 4 feet or longer, incorporating fold up legs is encouraged. This adds to the module weight but speeds up set up and tear down.

A basic rectangular module consists of two interface plates and two sides. The end result should be a box which resists twisting and torquing while minimizing weight. The diagrams below show one possible way to build a basic module. Whatever shape and method you use, the bonds between the sides and interfaces are critical. For these key joints, glue and screws are suggested. Gorilla Glue produces a very good bond between wood parts. To help prevent the rectangular box formed by the sides and interfaces from racking, we suggest that a layer of 1/8” luan (aka “door skin”) plywood be attached to the top of the box. This will also provide much more gluing surface to bond foam sheet and/or other terrain support materials. Luan is very flexible. It may be necessary to add a cross support between the sides to help support the luan in the middle of the module.



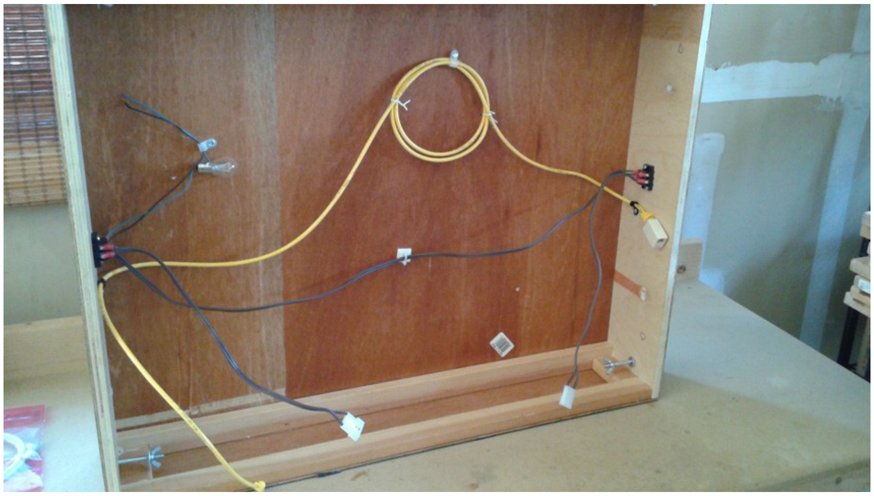


Module Construction Photos:

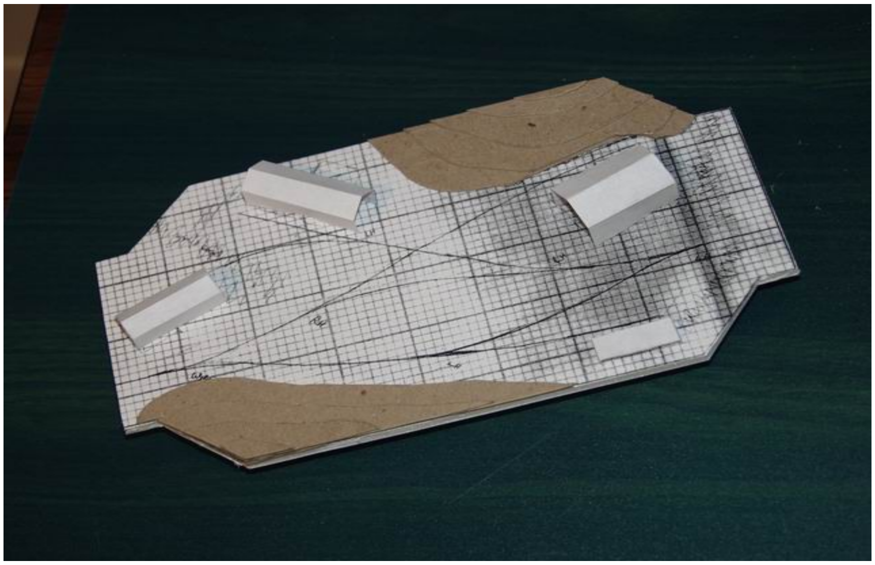
Here are some photos of modules built by the group. The first few photos show a very small, simple straight-through module similar to the drawings above. This module measures 24” wide by 30” long. A module doesn't get much more basic than this. It assembles quickly and needs only a minimum of scenic work to complete it.

Here's the same module with the scenery finished. The rail setback from the interface and faux ties are clearly shown on the lower right.

This next photo shows the underside of this module. Shown in the photo are the track bus (brown wire), command bus (yellow wire) and track feeder wires (green and black wires). The command bus daisy chains to the connectors into which the yellow wire is plugged. On the left of the photo is an 1156 bulb wired in series on the green power feed which provides protection from shorts.



The next series of photos shows a much more elaborate module. This module deviates from the basic rectangular shape. When designing a complex module such as this, it's useful to draw it up as large as possible. In this case, it was drawn up at 1/8th scale (1/8th inch = 1 inch). This was then translated into a mock up model to get a better 3D perspective. This module measures 40” wide at its widest by 72” long.



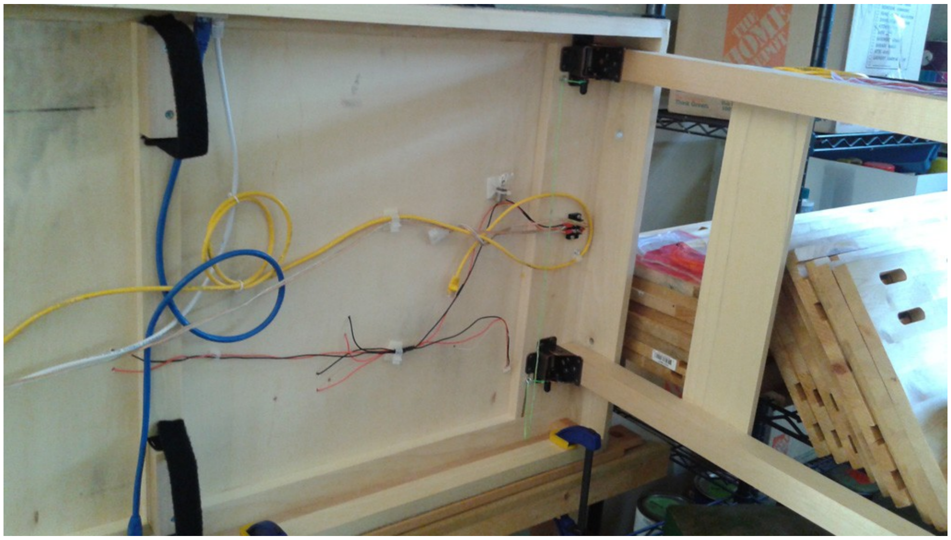
The photo below shows the underside of the module. The frame construction is much more complex than that of the simple module shown above. There's no one right way to build the frame. This also applies to attaching the legs. In this case, the legs were placed in from the end on the main side rails. This module has two pieces of 2' by 6' blue foam board making up the top. Had this module been topped with luan plywood before adding the foam board (as suggested), the aluminum support down the centerline would not have been needed. There would also have been a much greater surface area for bonding the foam to the frame.

The next photo shows the module with the rough terrain in place. This is the time to finalize the track alignment. The track plan has been sketched onto the foam and switches have been set in place to ensure than everything lines up properly. Paper templates for the planned structures have also been put in place to make certain that clearances around the buildings will be sufficient.

This next photo shows the track in place. Prior to securing the track, the foam board terrain was painted with flat latex paint. A light brown/tan shade was used though any earth tone brown shade with do (check the local home store for "oops" mis-mixed paints). The paint serves a couple purposes. First, it seals the foam which protects it from solvents used in glues and some track cleaning solutions. Second, it provides an earthy color under the scenic materials should they get rubbed off. Lastly, it gives some tooth for the glue medium used to adhere dirt, ground foam and other scenic materials. The track on this module was attached using Liquid Nails for Projects. This glue does have solvents which can attack the foam. The paint layer prevents this.

Below is a view of the the module with most of the scenery and structures completed. This is a fairly big module to transport. With track, electrical, structures, and scenery in place, the total weight of the module is just over 35 pounds. This can easily be lifted by a single person. Due to its size, it's more practical to move this with two people.

The above modules utilized detachable legs. This does reduce a module's carry weight but at the expense of additional setup and tear-down time. For modules that are 4 feet in length or longer, fold-up legs are also an option. The legs and hinge hardware do add to the carry weight but getting a module up on its legs takes less than a minute. This particular module has locking furniture hinges. Additional velcro strapping is also present to ensure that they stay secure during transport.



Appendix C

Creating Operable Grades:

Grades and railroads go hand in hand. Seeing a locomotive and a string of cars crawling up an incline is a great feature on any model railroad. However, constructing these inclines so that there are no operational headaches can be challenging.

There are many ways to construct grades on a layout. Since we are working with modules, and one of the goals is to keep the weight down, using techniques that involve wood risers, wood sub-roadbed, splines, etc. are not viable. What will work are the Woodland Scenics line of inclines and risers. Since these are foam products, they'll keep the weight down. Being a manufactured product, you can be certain that your grades are consistent. It's recommended that these products be used for the construction of grades on modules.

Before looking at how to employ the Woodland Scenics inclines, a little background info on grades is in order. A grade (or incline) is measured in percent based on a rise in elevation over a certain length (ie. 1 ft up over 100ft length is 1%). On either end of a grade are vertical transition curves which create a smooth flow from level to grade and back to level. These transition curves are critical to smooth, reliable operation when using grades. Without them, couplers disengage, locomotive pilots hit rail heads, and locomotive wheels can lift off of the rails. These are just a few of the possible bad things that can happen when vertical curves are missing or not done correctly. These curves are very soft changes. If plotted out for our use, they would be 25 foot radius curves (or larger)! One more critical point to using grades is level easements. If you're planning to climb a hill, level out for a short distance before heading down again. Similarly, level out at the bottom of a valley.

Woodland Scenics inclines come in 2%, 3% and 4% sizes – either as pack of starter inclines or as a set of inclined risers totaling 8 feet in length. In many cases, the starter inclines may be all that you'll need. It should be noted that these are 2 foot lengths (with ½ inch, ¾ inch and 1 inch rises per length), so the inclines are actually slightly steeper than the indicated percentages.

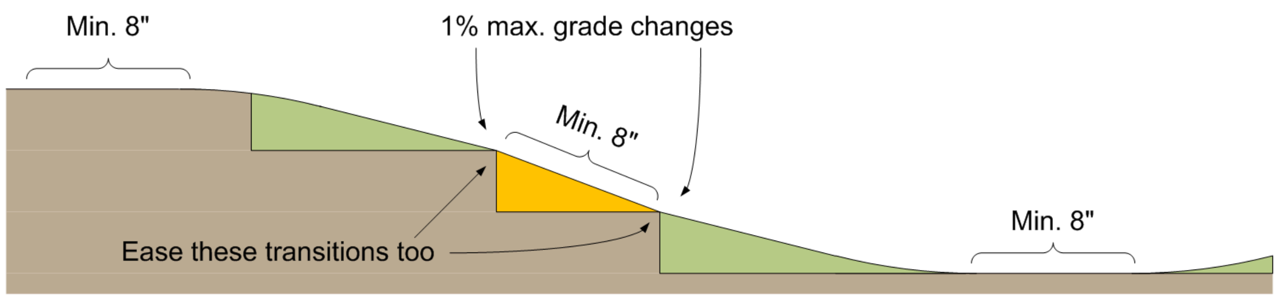


Figure D.1

Using these is simple matter of gluing them in place over the centerline for the track's route. However, for things to work well, a little more effort and planning is involved. Plan in at least 8 inches of level track between grades. Allow extra track length to accommodate vertical transition curves. A simple rule of thumb for this is 1.5 inches times grade percent at the top, and at the bottom (e.g. For a 3% grade, allow an extra 4.5 inches (3 x 1.5") at the top and at the bottom – 9 inches total). Always start a grade with the smallest incline possible (ideally, always a 2% incline or less). Always hold a grade for at least 8 inches before transitioning to a steeper or lesser grade. When transitioning to steeper or lesser grades, try to limit the change to 1% increments (e.g. 3% to 2%; 4% to 5%). Always keep rail joiners at least 4 inches away from any vertical transition curve.

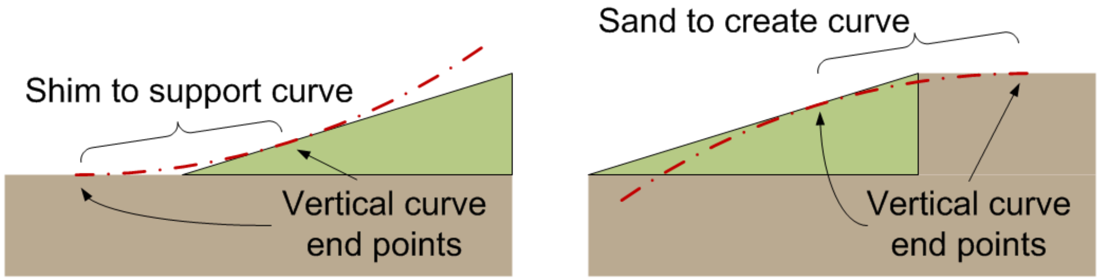


Figure D.2

Creating the vertical transition curves is fairly easy. The curve leading from level to an upward incline tends to naturally form when laying the track. For a given grade, take its percentage and multiply this by 1.5 inches to find the curve length. From the point where the incline meets the level terrain, measure back the number of inches you just calculated in both directions. These two points are the end points for the vertical curve. On the level portion, anchor the track at that end point and let the track rest on the incline. Now, hold the track at the other end point to determine if shims will be needed in the center of the curve. Shim as needed and glue the track in place. Do not force the track against your sub-roadbed between the two marks you made. Doing so will defeat the transition curve. It's okay to anchor the track at points outside of your curve's marks. This will create a softer transition curve but may require more shimming.

For the vertical curve at the top of an incline, again mark the end points of the curve from the junction of the incline and level as was done for the lower transition curve. This time no shimming is needed; it will take a little sanding. Get a sanding block and a piece of sandpaper (between 120 and 320 grit). Starting at the junction, sand down the area until there is a nice smooth vertical curve between the end points. Be careful, especially with coarser sandpaper. You're not removing a lot of material – just smoothing the angle formed at the junction into smooth transition from incline to level. It's okay to sand beyond you end point marks as long as you maintain that smooth, flowing transition. One last tip, it may prove useful to notch the tie strip so that the rail can flex vertically more easily without fighting the tie strip.

Appendix D

Club/Organization Rules and Miscellaneous Guidelines:

The following apply to the California Central Coast modular On30 group.

- Have fun with On30.
- Do not 'fix' or modify another member's module in any way unless expressly directed to by the owner of the module.
- All modules must be tested electrically and operationally before being allowed to participate in a layout. Operational checks to include adherence to track and module interface standards and verification that the main route does not derail cars and locomotives. Electrical checks to include verification of cabling connectors and short circuit protection. All checks should be made via connection to previously verified modules.
- For a module to be considered for testing, all bus cabling and short circuit protection must be permanently installed on the module. Additionally, all track work related to the main route must be permanently installed and wired to the track bus. It's highly recommended that ballasting of the main route be completed prior to testing.
- The fascias of modules will be painted Hunter Green. (Some modules built prior to 2008 are excluded from this requirement).
- Modules must have skirts for participation in a layout. Skirt dimensions must be forwarded to the skirt coordinators at least 4 weeks in advance of when they will be needed. If a fascia of the module has an unusual shape, or whose bottom edge is less than 42 inches above the floor, this information must be clearly noted in the skirt request.
- During show operation, trains should operate at realistic scale speeds for the locomotive. In no case should they exceed 25 scale miles per hour.
- No member of the public may operate any train on the layout during shows. Family of group members is excluded provided that they are supervised by a member of this group.

Revision History

Revision	Date	Changes
1.00	06/05	Original Spec. with many separate documents
2.00	01/08	Original consolidated format
2.01	04/08	Corrected typos and fixed Molex appendix to reflect 0.093" connector
2.10	09/10	Corrected reverse loop and wye wiring diagrams. Changed short circuit protection to focus on 1156 bulbs. Changed track bus connectors to Anderson PowerPoles. Modified mainline track to include code 83 between the interfaces. Added allowance for switches within 4" of interfaces. Added clarifications on the use of grades. Added appendix on creating operable grades. Added maximum module length. Updated command bus port requirements. Reworded some existing items for better clarity. Added revision history.
2.11	09/15	Added integrated command bus pass-through cabling Removed code 83 between the interfaces Removed Apnderson PowerPoles Replaced 5-pin Molex (obsolete) with 4-pin Molex (.093) Updated diagrams for new command bus cabling Added appendix with group rules and requirements