



Atlantic Coast S Gaugers - ACSG



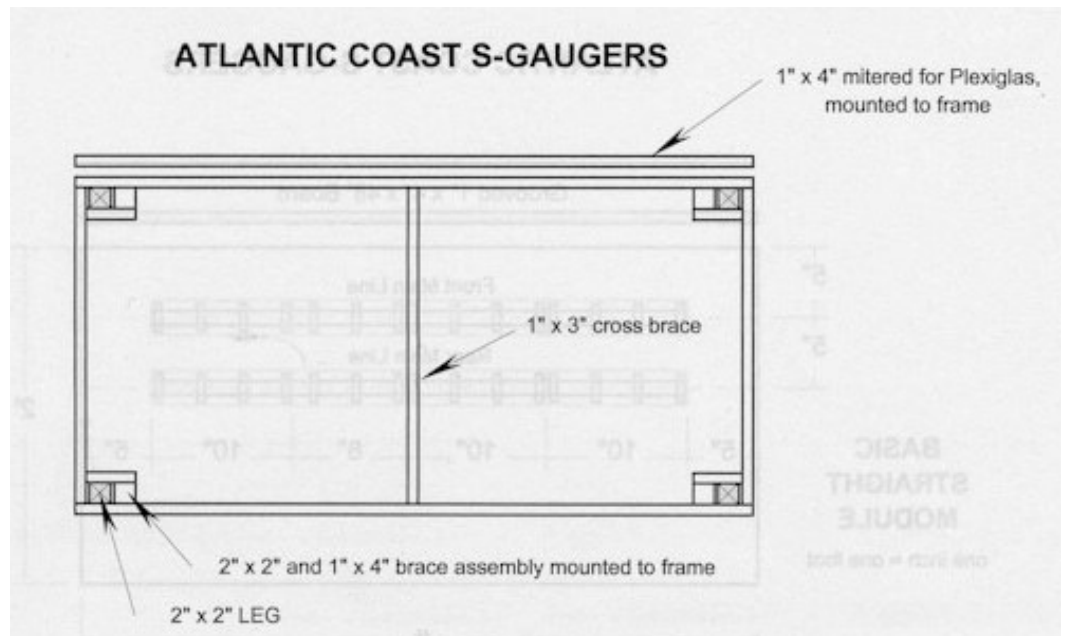
"Promoting S Gauge along the East Coast"

ACSG Modular Layout Specifications

Module Construction

Overall Specification for a Module:

Size: 2' x 4'
Height: 36 3/8" for Tidewater
37 3/8" for Virginia
41 3/8" for Carolinas
Legs: 2" x 2"
Edges: 4" for 4' sides and 3" for 2' sides

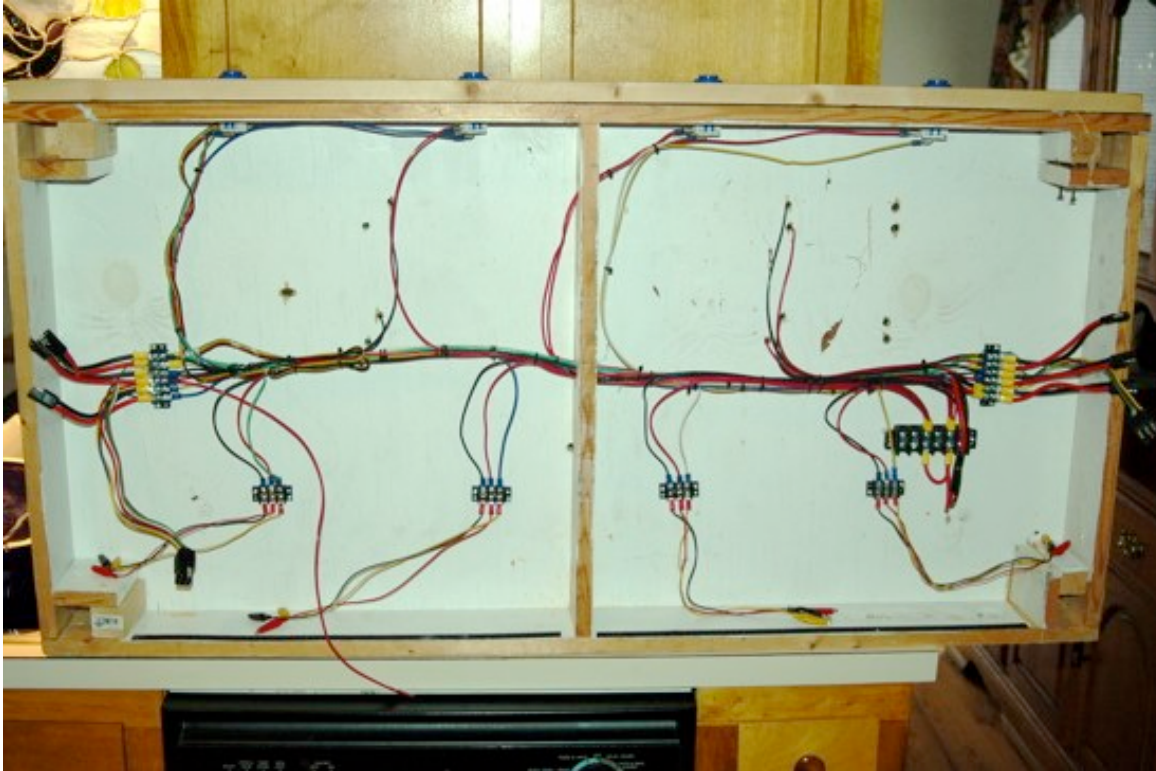


Bill of Materials

Quantity	Description	Use
4	2" x 2" boards - length depends on the division	legs
4	3" carriage or elevator bolts and "T" nuts (3/8")	leg height adjusters
3	1" x 4" x 48" boards	sides and plexiglas holder
3	1" x 3" x 22 1/2" boards	module ends and brace
1	2' x 4' x 3/8" plywood sheet	module top
4	2" x 2" x 2 1/2" boards	leg supports
4	1" x 3" x 3" boards	leg supports

3	red wire - 16 gauge - 5' long	module wiring
3	black wire - 16 gauge - 5' long	module wiring
6	2 pin connectors	module wiring
2	6 pin connectors	module wiring
1	2' x 4' green cover (carpet)	module cover
2	3" C clamp	module to module clamp

An example 4' module:



Framing Method:

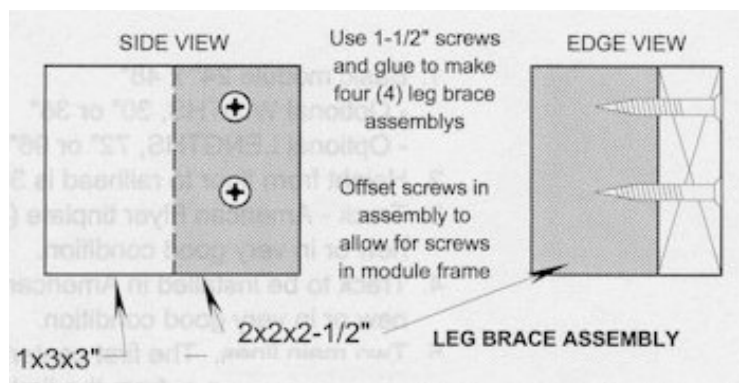
Use screws and glue to build frame and secure plywood to the frame.

Use a good grade carpet adhesive to secure the carpet to the plywood.

Mount legs so that the module is stable and level with neighboring modules.

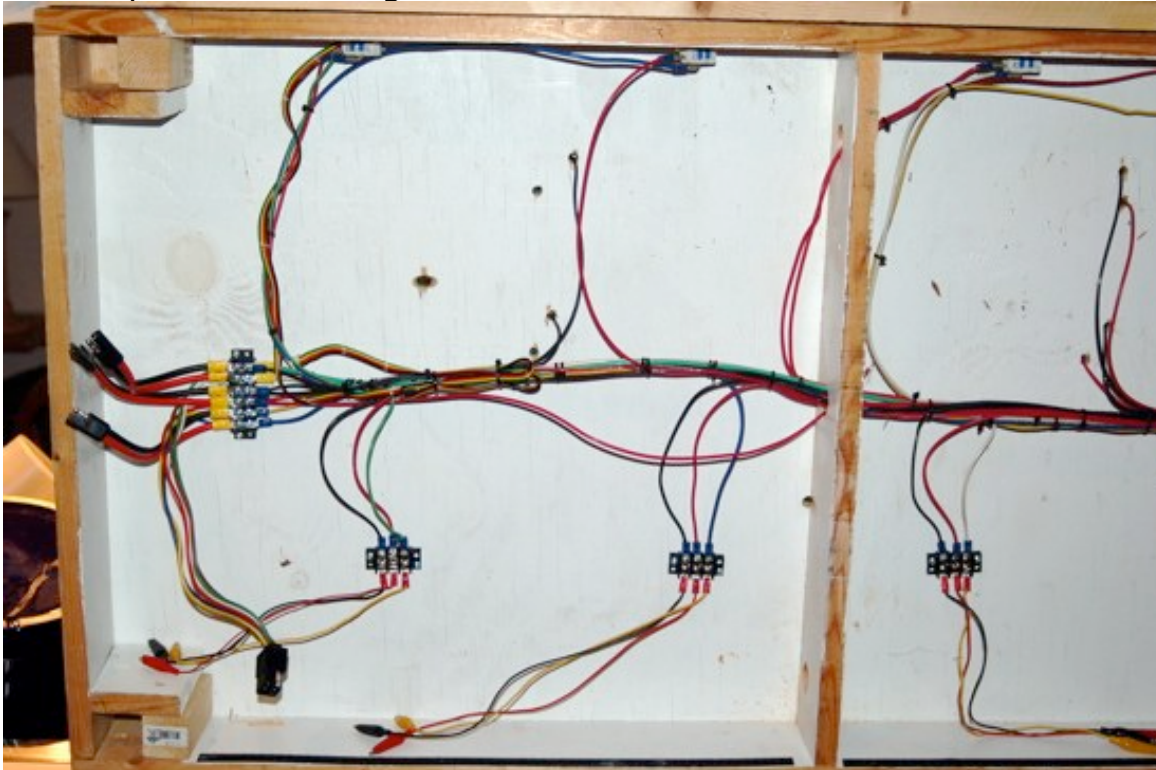
Use screws to mount the plexiglas holder to the frame.

Secure the holder flush to the top of the module frame after plywood is



attached.

Close up of the framing:



Track Specifications:

Two parallel lines

Track: American Flyer track or equivalent

4 straight track pieces per line mounted on module

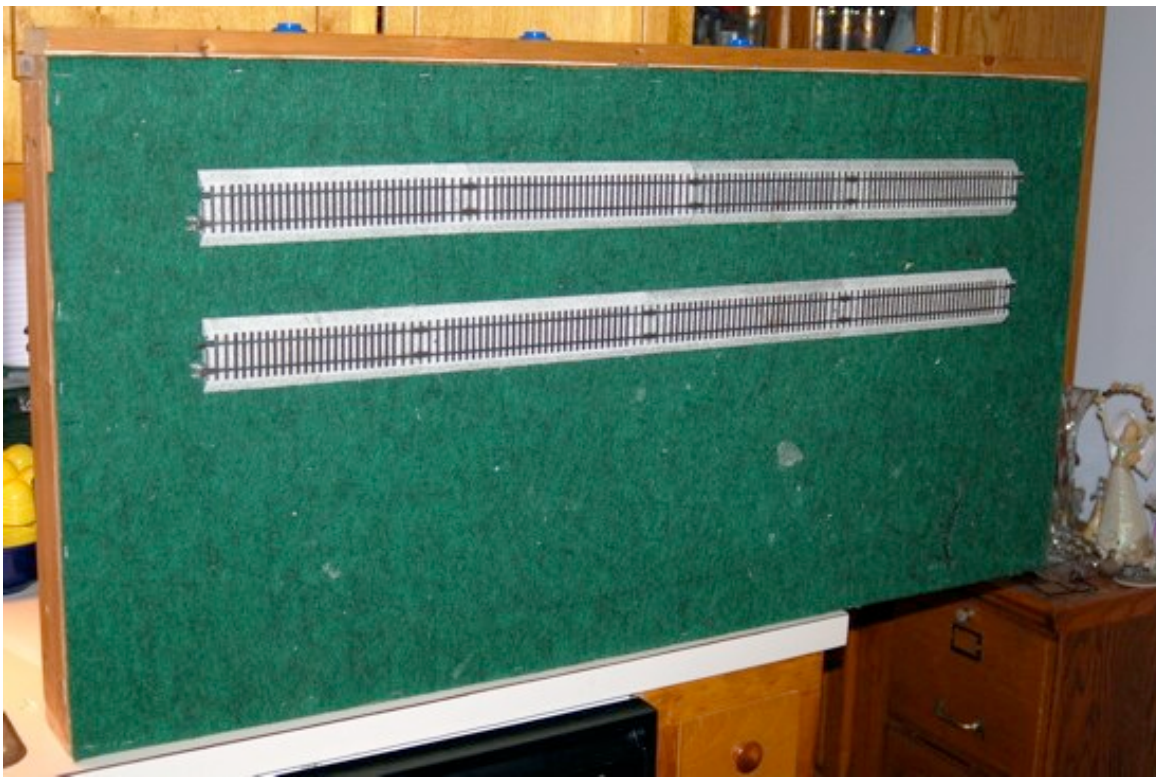
2 straight track pieces - not mounted - for connection to next module

10 straight American Flyer rubber roadbed or equivalent

Front track: 5" from each end of module and 5" from front edge

Rear track: 5" from each end of module and 5" from front track

Track side view of 4' module:



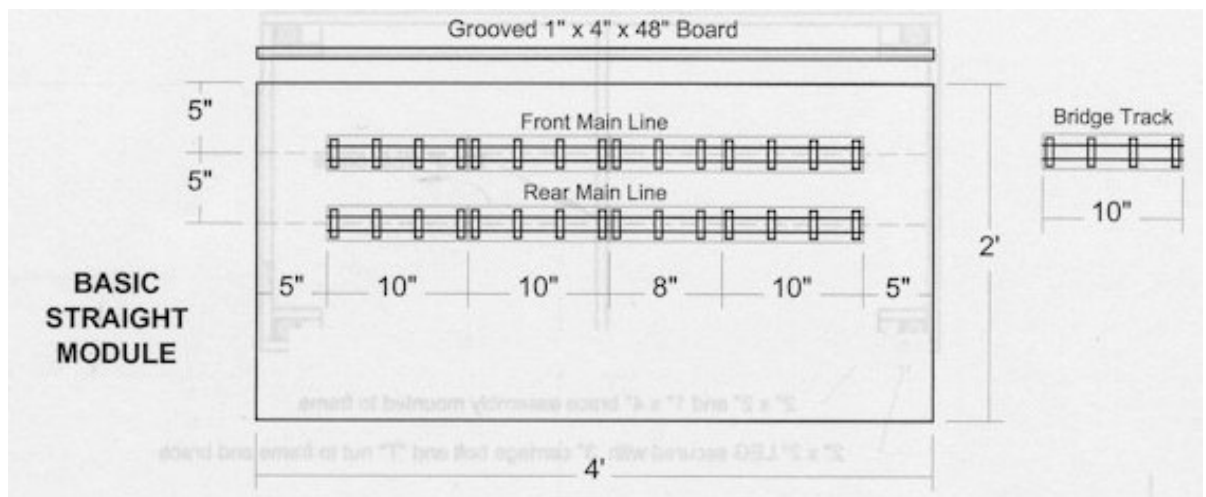
S-Helper Service sectional track.

Straight Module Specifications:

Basic module:
24" x 48"

Optional
widths: 30"
and 36"

Optional
length: 72"



American Flyer track, or equivalent, in very good condition

American Flyer rubber roadbed on all sections of track

Outside track centered 5" from front edge of module

Inside track centered 5" from outside track

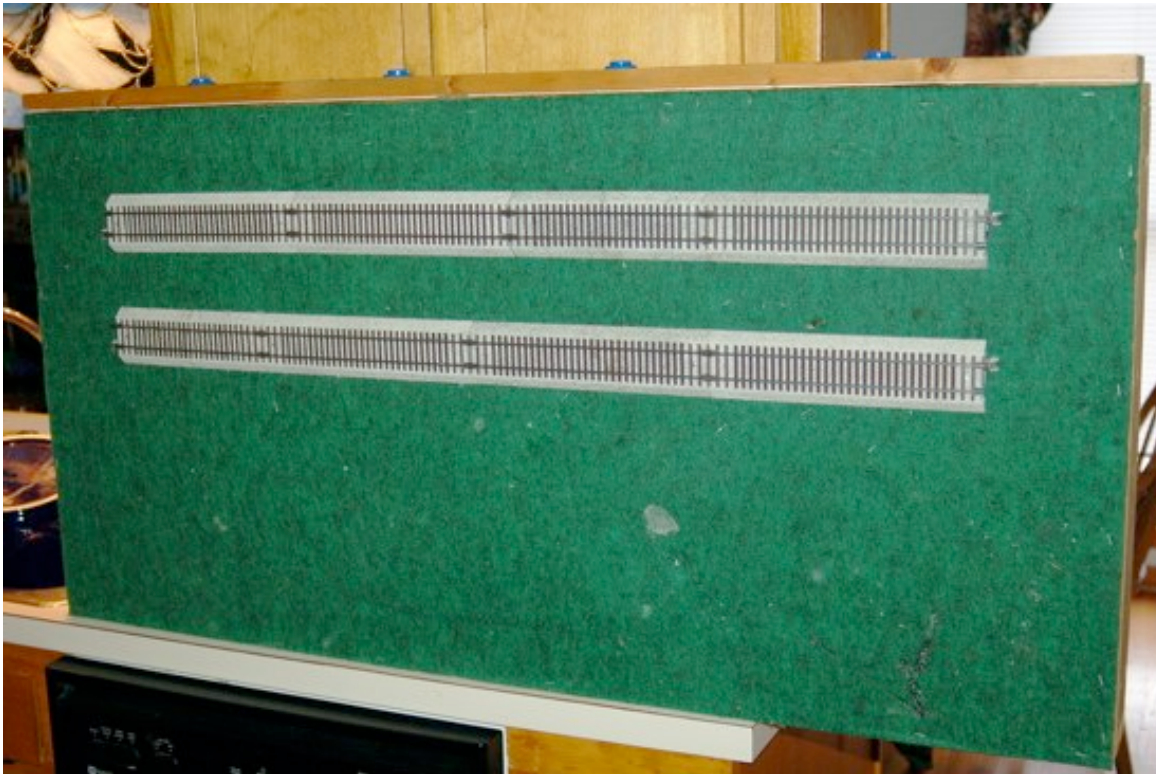
Tracks end 5" from each end of the module

Two 10" "bridge" sections of straight track supplied to connect to next module

Modules are structurally connected to the next using C clamps

Owner can scenic the module as he/she wishes

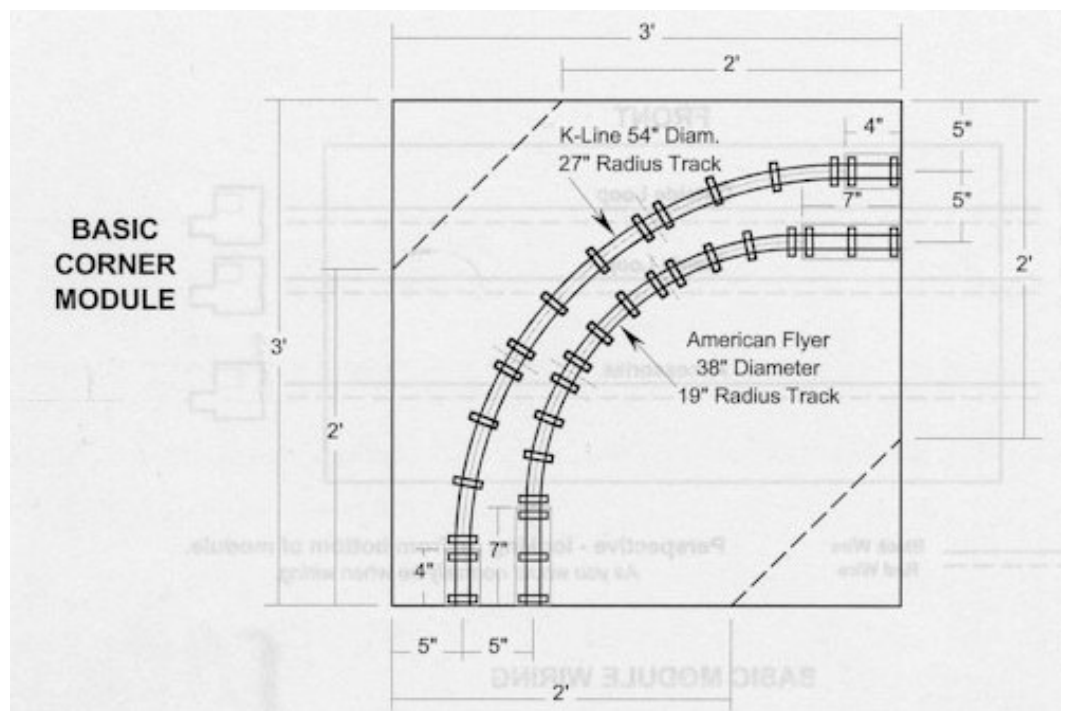
Plexiglas is inserted into a holder screwed onto the front edge of the module
The holder is mounted flush with the top of the module



Corner Module Specifications:

Basic module: 36" x 36"

Optional sizes: 48" x 48" and 60" x 60"



American Flyer track, or equivalent, in very good condition
American Flyer rubber roadbed on all sections of track

Outside track centered 5" from front edge of module at end to connect with next
Inside track centered 5" from outside track at end to connect with next module
Tracks end flush with end of module in 36" x 36" version
Four 5" "bridge" sections of straight track supplied to connect to next module
Tracks end 5" from each end of the module in 4' and 5' versions
Two 10" "bridge" sections of straight track supplied to connect to next module
Modules are structurally connected to the next using C clamps
Owner can scenic the module as he/she wishes

LUMBER

- A. Lowes sells 2x 2 lumber with finger joints. It is called "Top Choice". Since the grain does not always run parallel with the wood, it will not sand smooth. Use it to build a nice fire in the fireplace. Home Depot is not any better. Go to a real lumberyard and get wood with straight grain, very few knots, and no finger joints. The reason they use finger joints is to use up short pieces of wood that would otherwise become pulpwood. Lowes and Home Depot sell nice hardwood 2x 2s for more \$\$\$\$\$. Cutting a 2x 4 down works if you have a table saw. A 2x 2 is actually 1 3/8" x 1 3/8". A 2x 4 is 1 1/2 by 3 1/2". You will need to set the table saw to 1 3/8" and cut the wood twice to make it 1 3/8" x 1 3/8". This will allow you to use either a 2x 2 or the specially cut legs. Be advised, you need a GOOD table saw and GOOD skills to match a preformed 2x 2. Be sure to place the factory cut edges of the 2x 4 against the fence and saw table. Clear the saw dust off after each pass through the saw, if it ain't level it won't be square.
- B. 3/8-inch plywood is now called 11/32 plywood at some stores. (Don't travel the entire universe hoping to find 3/8".) A/C is rarely found, B/C is more typical. This will do fine under carpet or other ground covering material. They sell it cut into 2 foot by 4-foot sections, but the grain does not always run lengthwise. You will have to check around. If you buy a whole sheet you can build four 24" x 48" modules and the grain will run lengthwise. This will help minimize warping and sagging of the tabletops. The last cost we paid was \$15.70 for a whole sheet. The 2-foot by 4-foot pieces are \$4 or \$5. Lowes no longer sells 3/8 cut sheets in Columbia as of 10/02. Home Depot still has the 2' by 4' pieces so check with your local dealers.

LAYOUT

- A. Measuring: Be careful how you mark lumber, track and wire. Which side of a line you cut on can make a 1/16" to 1/8" difference. This can make the difference between a track bridge that fits and one that doesn't.
- B. Make sure your module is square and flat. If your plywood grain does not run

perpendicular to your module ends, add another 1x 3 cross brace and space the two of them equally in the 4'-0" length of the module. Be wary of building your module on a concrete floor, they are seldom flat. All modules wider than 24" need 2 cross braces.

- C. Do not use 1x 4 cross braces or end braces as they will damage track on other modules when yours are stacked on top of them during moves, setup, take down or storage. Using 1x 3s allows a 1-inch space between the cross bracing and the top of the board on the module below. If you have later style turnouts you will need more space than this to clear the signal light housing. Design a spacer to be used with your modules that have turnouts or be careful how they are handled. Even if you can stack them OK, be careful that someone doesn't inadvertently slide a module off of yours and displace or damage the turnout.

SOME MEASUREMENTS TO HELP YOU REGARDLESS OF THE TYPE OF TRACK

- A. At the Columbia GATS show in June of 2001, the top of the plywood was 40" to 40 1/16" from the floor. If you use AF track with rubber roadbed on the Lowes Carpet, adjust your legs for this before you leave home and you should be "show ready". Railhead height should be about 40 11/16" (40.671" if you are picky). In real life, the trains run fine going up and down a 1/16" module to module difference as long as the railheads meet. The bridge track can handle a 1/16" difference and the hi-rail couplers are large enough to stay together. In the future, as we try to better accommodate scale equipment, this differing railhead and table top height between modules becomes more critical mainly because the scale knuckle couplers are much smaller and so cannot slide up and down as far without sliding past one another and coming uncoupled. The most common top of plywood height at Raleigh was 40 1/16". At the Richmond benefit show in August of 2001 almost all modules had a top of plywood between 36" and 36 1/16". (Add .671" to get to the railhead: Carpet .1", AF rail .545", rubber road bed .026" equals .671".) In order to get these numbers the adjusters must almost be flush if you cut 35" or 39" legs.
- B. Track measurements from bottom of the tie to railhead:
1. AF .542" to .545" without roadbed, this includes switches
 2. K-Line .525" without roadbed
 3. Pike Master .265"
 4. Gargraves .450"
 5. SHS Flex .271"
 6. American Models Flex .249"
- C. Some other measurement to consider: We recommend using 3/8" carriage or elevator bolts, but show 1/4" bolt measurements unless noted otherwise (UNO).
1. Carpet thickness for Lowes #98016 is .100"
 2. Cork roadbed from "Midwest" .200"

3. AF roadbed adds .026"
 4. 3/8" plywood is really 11/32" now. $11/32 = .344$ "
 5. 1/4" diameter elevator bolt with .185" jamb nut and T-nut adds .500" adjusted all the way down
 6. 1/4" diameter elevator bolt without jamb nut adds .315" adjusted all the way down
 7. 1/4" diameter carriage bolt with .185" jamb nut and T-nut adds .540" adjusted all the way down
 8. 1/4" diameter carriage bolt without jamb nut adds .355" adjusted all the way down
 9. 3/8" diameter elevator bolt adds .400" adjusted all the way down
- D. Sample of how to use this information for something productive. Start at the top of the rail and add everything up for your module.

.545"	Standard AF track
.026"	Rubber Road bed
.100"	Lowes Carpet
.344"	3/8 plywood
35.000"	Wood leg (Virginia)
39.000"	Wood leg (Carolina)
34.000"	Wood leg (Tidewater)
.355"	1/4" Carriage/Elevator bolt and "T" Nut
1.000"	+/- 1-inch travel, add 1"
-----	Total Floor to Rail Head
37.370"	Virginia
41.370"	Carolina
36.370"	Tidewater

For the two Virginia divisions, this number is 1.37" or 2.37" off the Virginia specifications, and even more in Carolina since they have an unpublished 39" leg length.

- E. Our suggestion to keep the divisions on the same page is to set your modules up per the following railhead heights. At least until such time as there is a meeting of the minds on this issue. The club really needs to address this issue in a more formal manner or start making transition modules to get from one height to another. Some folks have multiple sets of legs or leg extensions so they can run with their friends in different divisions. This costs everyone extra work at show

setups, and individuals extra money for multiple legs or adapters. Plus, the Murphy factor goes up. Alright, we'll get down off our soapbox now...

RAILHEAD OF 37 3/8" FOR VIRGINIA WITH ADJUSTERS EXTENDED ABOUT AN INCH IS CORRECT,

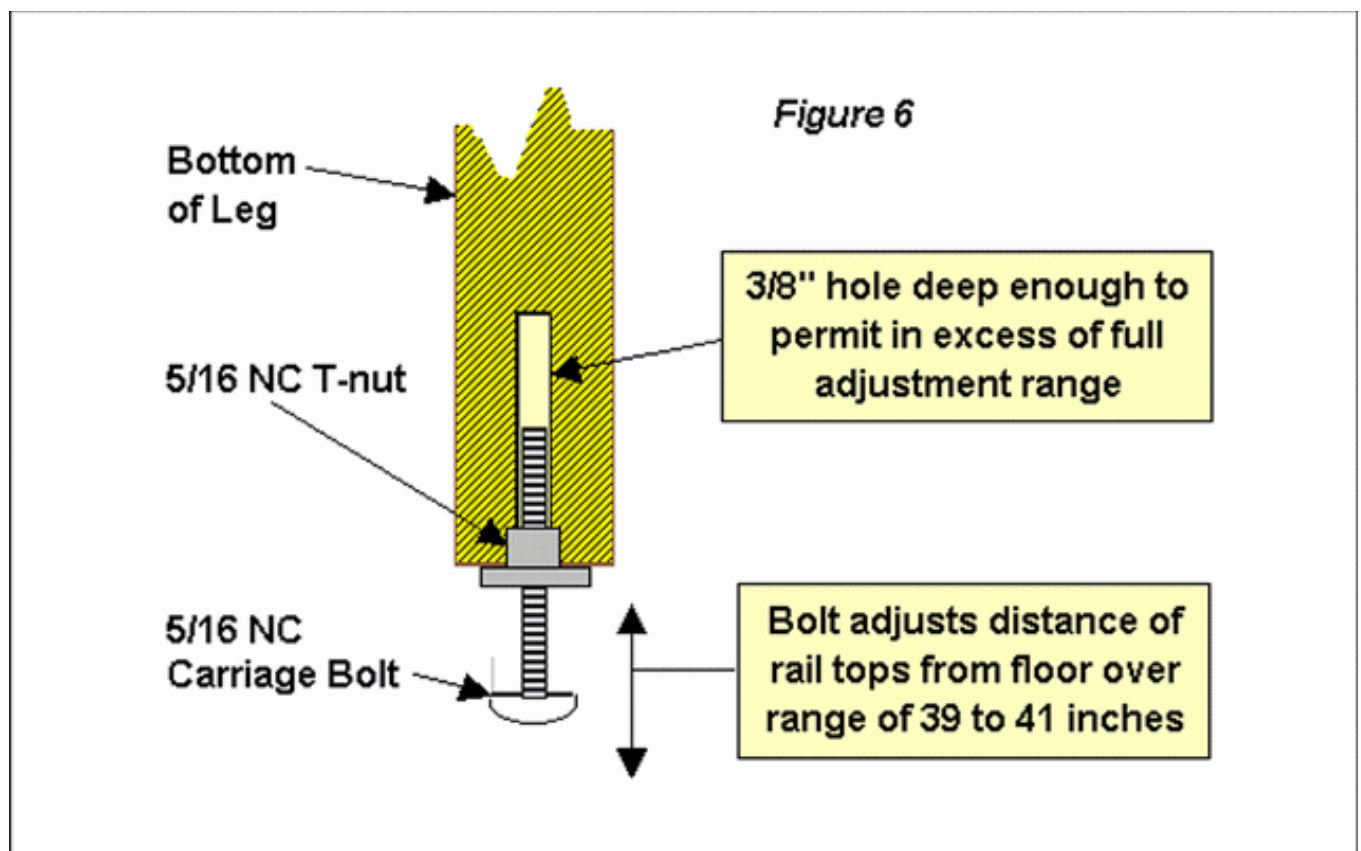
RAILHEAD OF 41 3/8 " FOR CAROLINA WITH ADJUSTERS EXTENDED ABOUT AN INCH IS CORRECT,

RAILHEAD OF 36 3/8 " FOR TIDEWATER WITH ADJUSTERS EXTENDED ABOUT AN INCH IS CORRECT and the **ONLY** DIVISION THAT CAN ADJUST TO A 36" Railhead.

If you aim for this range in making your modules, you'll be compatible with everyone else AND, the math will work. Work on being consistent with these numbers, and it will be easier to set up our modules to handle scale equipment in the coming years.

MODULE LEGS

- A. The Specifications do not explain how to make the legs adjustable. This is how:
1. Drill a hole at least 3 1/2" deep in the bottom of the leg. This hole should be slightly larger than the diameter of the adjusting bolt. Lowes sells an excellent doweling jig for drilling this straight. Drilling a slightly larger hole will make adjusting the bolt easier later. "Dowl-it" in Hastings, MI makes a nice jig as well.
 2. Elevator bolts make the nicest adjuster since this is their designed purpose. Carriage bolts will work also. Get them at least 3" long. This is required in order to have +/- 1" of adjustment and still have 1" threaded into a "T" nut. You can find elevator bolts at Lowes in the specialty hardware section in blue bin G12. Use only 3/8" bolts. Don't use 1/4" bolts, they get bent too easily.
 3. Use "T" nuts that have holes in their flanges so they can be secured to the end of the legs with small screws. If you use glue or epoxy you have to be careful not to get it into the hole or onto the treads of the tee nut, as it will make adjustment difficult. Drawer "N" at Lowes has the "T" nuts for 70 cents.
 4. Do not use adjustable furniture glides with 1 1/4" adjusters. They are too short and will not allow +/- 1 inch of travel and 1" to be threaded. The nylon inserts cracked on 50% of the legs after 1 show.
 5. If you've done everything correctly, the adjusters should turn easily without a wrench. If not, check to see if the tee nuts are perpendicular to the hole you drilled into the end of the leg.
 6. Diagram of how this goes together:



Just use the 3/8" hardware noted above.

- B. If you plan to take your modules to any Virginia shows you will have to have 2 sets of legs with 35" and 39" wood portions, or make a set of 35-inch legs and make a suitable extender for use at the Carolina shows. The Carolinas chapter uses the 39" leg length so it is harder for tiny hands to reach the tabletop. The Virginia Central chapter has theirs at 35-inches so the little ones can better see the action. You may find that 34" or 38" legs allow a little more adjustment with the 3" bolts. It is always easier to cut them shorter than cut them longer later. You may want to do this after your first show. So maybe you'll need 3 sets of legs! (1x4 and 2x4 blocks help solve the problem and need to be in your tool box when running with other divisions. Some extra 34", 35" or 39" Legs don't hurt and they are relatively cheap. So far, Rhett George gets our award for the best extension for 35" to 39". He uses PVC tubing that slides over specially formed wood legs. We've tried a short 4" leg that screws into the "T" nut where the elevator bolt normally is set. The "T" nut tends to pull out and it is time consuming to install at a show. As long as Tidewater has 1x4 blocks and adjusters at least 3" long they do ok participating in Virginia Central events. In Carolina, if there is a shortage of 39" legs, just use 39" legs on one end of each module instead of both. The clamps will hold the adjacent module in place next to the one with the legs. You can also clamp a module to the two adjacent modules as if the middle one is a bridge.
- C. If you paint the 39" legs AF yellow and the 35" legs AF Blue, it may help to keep them straight in your attic and keep you from loading up the car at six in the morning, driving to a show, and THEN discovering you've brought the wrong length legs! True story.
- D. Sand the legs smooth so they will slide in and out of the socket easily. Since one

side of the leg socket is made of the same 2 x 2 as the leg, the fit allows for zero tolerance. Just enough sanding to smooth the legs will fix this. Another way to handle this is to slip in a spacer on two sides of your legs when you are fitting the socket assembly together. Thin cardboard from a "Band Aid" box or a couple of layers of construction paper is all you need.

- E. The Specifications call for a carriage bolt and T-nut to secure the legs to the frame. A carriage bolt and T-nut will not work in this application since neither is intended to rotate. You can use a hex head bolt but this is tough to tighten without a wrench. An alternative is to drill a small hole where the bolt is shown and put a nail in the hole to keep the leg from falling out when setting the module upright. Attach a piece of string or wire from the nail to the module so it doesn't get lost. (This idea is from Joe Haenn.) If you drill a 1/8-inch hole in the leg sockets and a 1/4-inch hole in the legs, and you're careful, you shouldn't have to worry about marking which leg goes into which socket. They'll all interchange.

CARPET

- A. Lowes no longer carries the #98016 indoor/outdoor carpet. It might be available with a special order. Home Depot has some that is similar but it has ridges. HD Emerald Green SKU 384-835 \$2.96 LF 6' wide. Lowes nearest substitute is Stratos Emerald 98007 for \$2.97 LF in 6' wide.
- B. A good adhesive to use on carpet is the type made for securing carpet tiles. This type of adhesive will hold the carpet in place, yet allow you to reposition it many times over the life of the module. It is kind of like having a tacky tape hold the carpet in place. Changes are easier to accomplish and you don't ruin the carpet in the process of taking it up. One of these that Ted has used is produced by Milliken for their commercial installations and there are others on the market.
- C. You can also use 3M "77 Spray Adhesive" to glue down carpet. It is spray contact cement. It works for installing Formica, wood veneer and upholstery. Lowes sells it. One can will do 4 modules with plenty to spare. It is about \$8 a can, but worth the convenience. It will provide a very uniform coat of contact cement. Carpet set with contact cement can be removed if you are careful and patient. The carpet will stretch so be careful how much you pull on it.

PLEXIGLAS "NOSE" GUARD

- A. The club provides the Plexiglas, but for building purposes you may find this information useful. The Plexiglas is 5" by 48" .125" thick. Lowes and Home Depot only carry .093 inch thick Plexiglas unless you get a huge sheet. Your module will need a 1" deep slot along the top of the front fascia board into which to place the Plexiglas. Your module must arrive at the show ready to receive this plexi so the trains can be protected from falling off the modules and so they can also be protected from little hands. Tidewater uses 1/4" plexi. They transport them in a wooden box and ALWAYS insert them with the same edge going into the module. This reduces the number of scratches Tidewater also uses the fascia board as the

button board, more on this later.

- B. The 1x4-facia board is kerfed along its top back edge. You can run it across a table saw or use a router to create a 3/16" (5/16" in Tidewater) wide notch, 1-inch deep, on it's top back edge. This is a "kerf." When this fascia board is screwed to the tabletop's front 1x4, the two boards will come together and form a 3/16" wide, 1-inch deep slot into which is placed the "nose" guard Plexiglas. A table saw will work great for forming this kerf. Most blades give a .125 cut (1/8") so you'll have to run the board through twice.
- C. Be sure not to use screws longer than 1 1/4-inches to secure the fascia board in the leg socket area or they will tap into the legs and it will be very hard to remove them. (I learned from experience on this. 1 1/2" screws will go into the leg just a little and make knock down tough!-CA) If you prepare your own Plexiglas, you will need to notch the ends to allow the installation of button boards. More on that later.

TRACK

- A. Cutting track with an Xacto saw medium blade works well. This is their most common blade and refers to the width of the blade, not the number of teeth. A moto tool with the grinder blade also works well. If you buy the standard weight wheels combine two of them onto your spindle, this will increase the life expectancy and works just as well. Thanks to Dave Bulkin for this hint.
- B. Keep in mind that a number of companies make s-gauge track. Old flyer is still available. K-Line, Gargraves, American Models and S-Helper Service make new track. Generally, you can see each type when we all get our modules together at shows. Someone has used each brand.
- C. None of the track sold for use on the modules will work out to the even 38-inches required by the module standards. (48-inch module minus half a 10-inch bridge at each end) You need to make a choice about how you want to lay your track because of this. Do you cut and piece the track somewhere on the module so you end up with the start of your bridges at 5-inches from the module ends, or do you make one standard bridge and one custom bridge so you can minimize track joints on the module?
- D. Keep the amount of very short pieces of track to a minimum, and do not place the short tracks at the ends of your module where the bridges connect. This area gets a lot of abuse during set up and take down and the short pieces are hard to secure. If not secured they rotate or are displaced and the line of track will have a wiggle in it where your module joins the next. Not a good operational characteristic. If you are using American Flyer or K-Line track, you will have to cut a piece of track down to 8-inches in order to have 38-inches of track on your 48-inch module. Place this track in the middle of your three 10-inch sections. (Yes, we know, there's only three 10-inch sections so how do you put the 8-inch one in the middle? Surprise us, all you "type "A"s!) Things get trickier if you are using turnouts on your module. You will probably end up with some 2-4 inch pieces of track and these should be placed near the middle of your module if at all possible.

- E. If you are using turnouts, they are a good thing to use as your first section of track because they are secured to the module with three screws. This helps your track resist the jostling and displacement that occurs during set-up and takedown.
- F. When cutting rail ends, be sure the cut is square or slightly angled back from the top of the rail toward the trackbed. This ensures that the top of the rails will touch and the rest of the rail end will align with this point or step back from it so that it does not project in front and cause a gap at the railhead. This is especially important if insulator pins are used. The insulator will keep the top of the rail separated, but if the bottom of the rails touch, they are no longer insulated. Turnouts will also be a problem as a projecting bottom will hit against the plastic base and keep the railheads separated.
- G. Special Gargraves track instructions:
 - 1. Calvin and Ted have built ten modules now and have used Gargraves for all of them. Here's a few hard won tips.
 - 2. Use the Special ACSG wood tool or some other secure means to hold the Gargraves track still while cutting. It is much thinner, and consequently flexes a great deal more than AF track, when you are cutting it, shaping it or securing it in place. If you are using an Xacto saw, cut the rails one at a time, the rails move back and forth too much in the ties to cut both at the same time. You will end up with a rail 1/8" or more off!
 - 3. Consider using stainless steel track unless you enjoy cleaning track. It's not that much more of a monetary investment now that you've taken the plunge and put in the time to create your module.
 - 4. Gargraves 37" flex track is really 37 1/4". You need to do one of two things to make your module compatible with others:
 - a) In order to use 10-inch bridge tracks at each end of your module you will need to piece the track somewhere in the middle to eliminate the 3/4-inch shortfall in length and have 38-inches of track on your module. Cut two long sections and piece the track near the middle of the module or cut at least a ten-inch piece and shorten the other from 37 1/4" to 28" to avoid having a 3/4-inch section of track.
 - b) If you'd rather eliminate all track joints on your module, you will need to cut two 10" and two 10 3/4" bridge tracks per module. The extra 3/4" corrects for the Gargraves track being 37 1/4" instead of 38" as called for in the guidelines. Lay the track so that it is 5" from the end of the module on the left side and 5 3/4" from the right end, as you look at the module from inside the layout looking out. (Otherwise, it won't mate with other Gargraves modules built using only a 37 1/4-inch piece of track. If you put it on the right you will need to make an 11 1/2-inch bridge track to join two modules, 5 3/4" + 5 3/4". Now, do you REALLY want to make yet another unique bridge track?)
 - c) In case your Gargraves module should be set up next to one of the club's corner modules, you will need to make at least two 5-inch bridge tracks. If

you followed step "b" above then you will need two 5" bridges for the left end and two 5 3/4" bridges for the right end. This will bring your track flush to the ends of your module as required to mate it with a corner unit.

d) Bring your saw and an extra piece of track just to be safe!

5. For roadbed, use 1/2 of an "O" gauge cork roadbed and 1/2 of an "HO" gauge cork roadbed. Just be sure they are both the same thickness. When you use Gargraves the carpet must be removed under the roadbed or the railhead will be too high. Getting the railhead and table height correct doesn't make the trains run more quietly, but it does help keep your fellow modelers quiet.
6. Use blade connectors (or ring connectors) inserted into the bottom of the rails. Solder bows the rails and makes it difficult to replace damaged track. You will need to drill two holes in the plywood and roadbed to allow the power wires to pass through. Suit yourself on the size of the holes but remember you will probably need to take the wires out several times during the life of your module. Using 1/2" holes allows adjustment and will make replacement easier. Slide the ties apart when inserting the blade and then slide them back together so they tighten up the rail onto the blade connector.
7. The Gargraves rails easily slide through the wooden ties. At shows, people will displace the rails quite a bit during set up. They will force a tight track pin into the rail at one end of your module and slide the whole rail toward the other end. Then when they go to connect that end to the next module everyone will wonder why you don't have the 5-inch setback correct. Use a small hammer or a piece of wood to tap the free end of each rail so that it realigns with the 5 or 5 3/4-inch alignment point at the end of your module. Be careful not to deform the rail end. It's a good idea to take the palm of your hand and press firmly down on the rails when you are placing track pins into the rail ends. Using Gargraves pins in gargraves track will avoid these issues and they work in Flyer or K-Line track as well. Also remember to slide the end ties back from the end of the rail. This opens up the rail ends and allows the pins to more easily slide into the rail ends.

Module Wiring

Basic module wiring:

2 pin and/or 6 pin connectors

If both are supplied, connections to mating modules with either is possible

The projecting part of the connector in the drawing is the exposed silver pin of the connector.

Track and accessory power lines are no smaller than 16 gauge wire

Black wire to the rail closest to the spectator side of the module

Red wire to the rail on the inside of the module

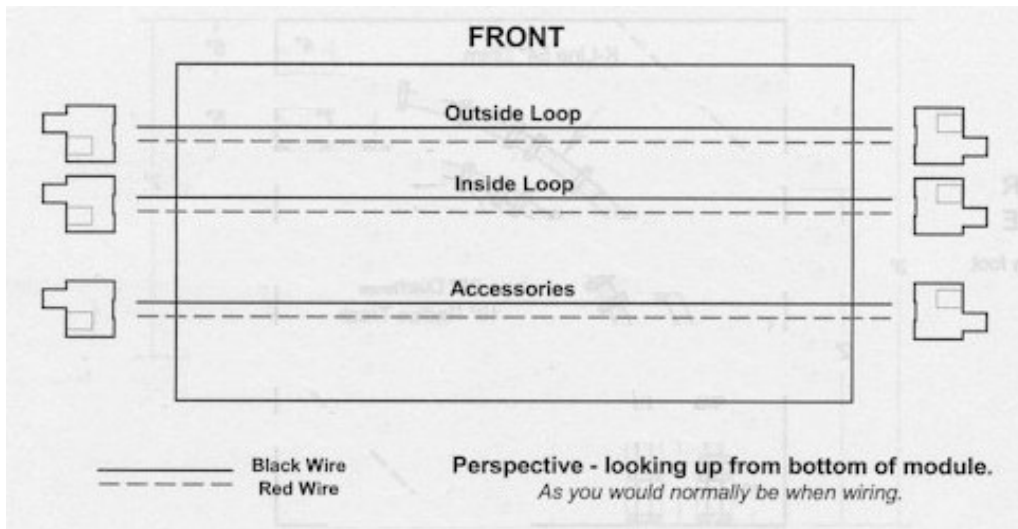
Feeder wires to track from power lines no smaller than 18 gauge

All connections should be soldered.

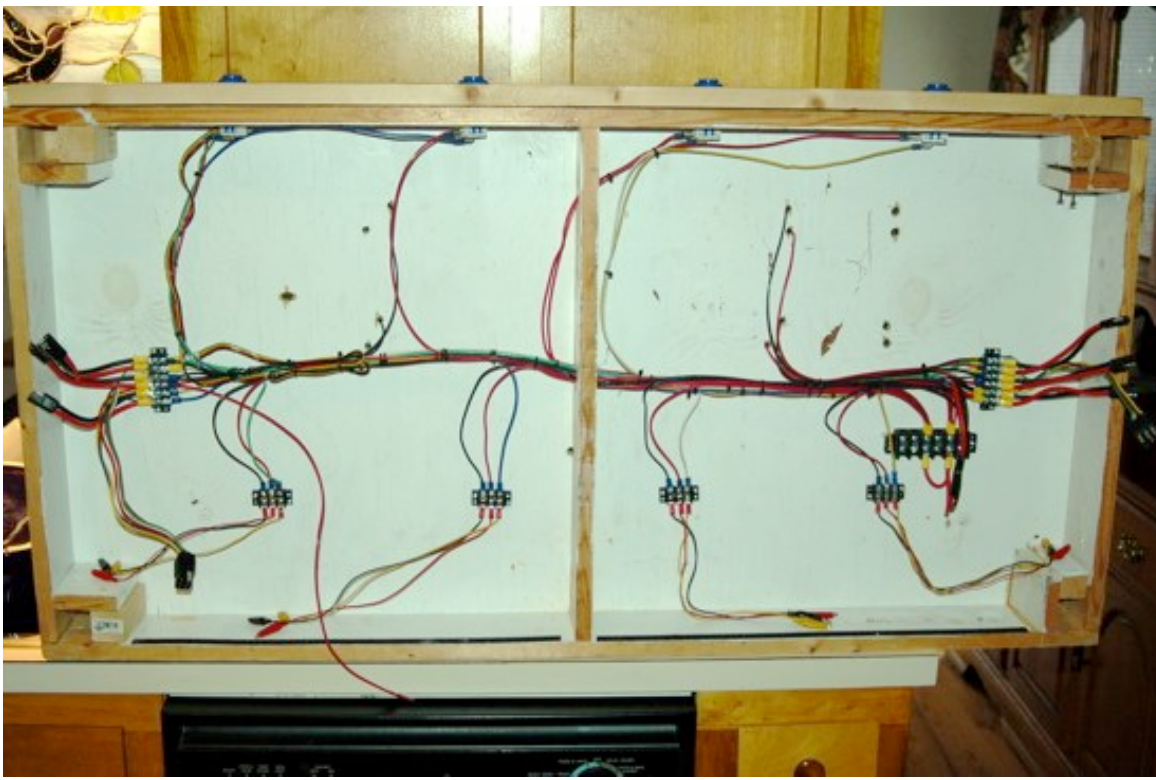
Other connection methods that have an equivalent degree of reliability and current transfer capacity would be crimp fasteners (double crimp is best) or reusable Swenco brand butt splices.

Each wire pair marked: outside loop, inside loop, accessory

The accessory power lines are required even if the accessories on a module are powered from separate power supplies



An example showing the buttons along the top, track feed wires, the main bus of wires in the middle, module-to-module connectors on each end, and accessory connectors along the bottom:

**Electrical connections:**

Two wires (red and black) for each line and for accessories

16 gauge wire - 5' long

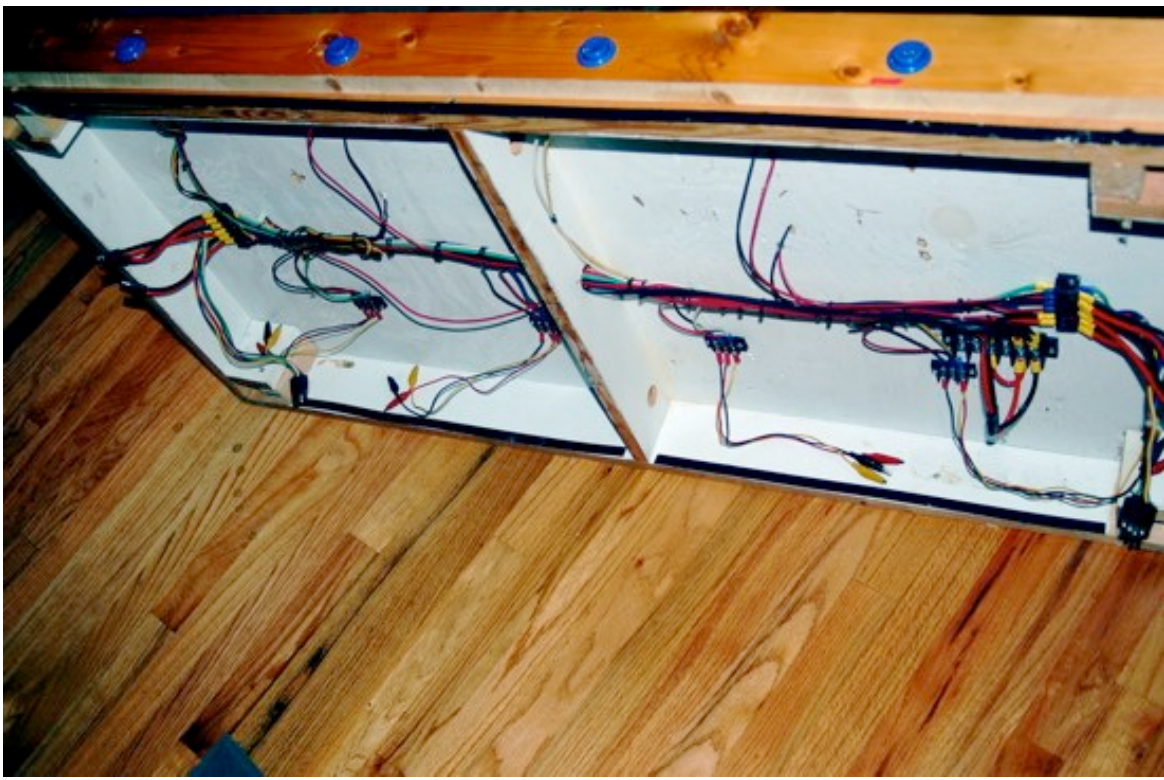
Connectors:

- 3 two pin connectors on each end of the module

- OR 1 six pin connector on each end of the module

- OR both so that connections to mating modules with either is possible

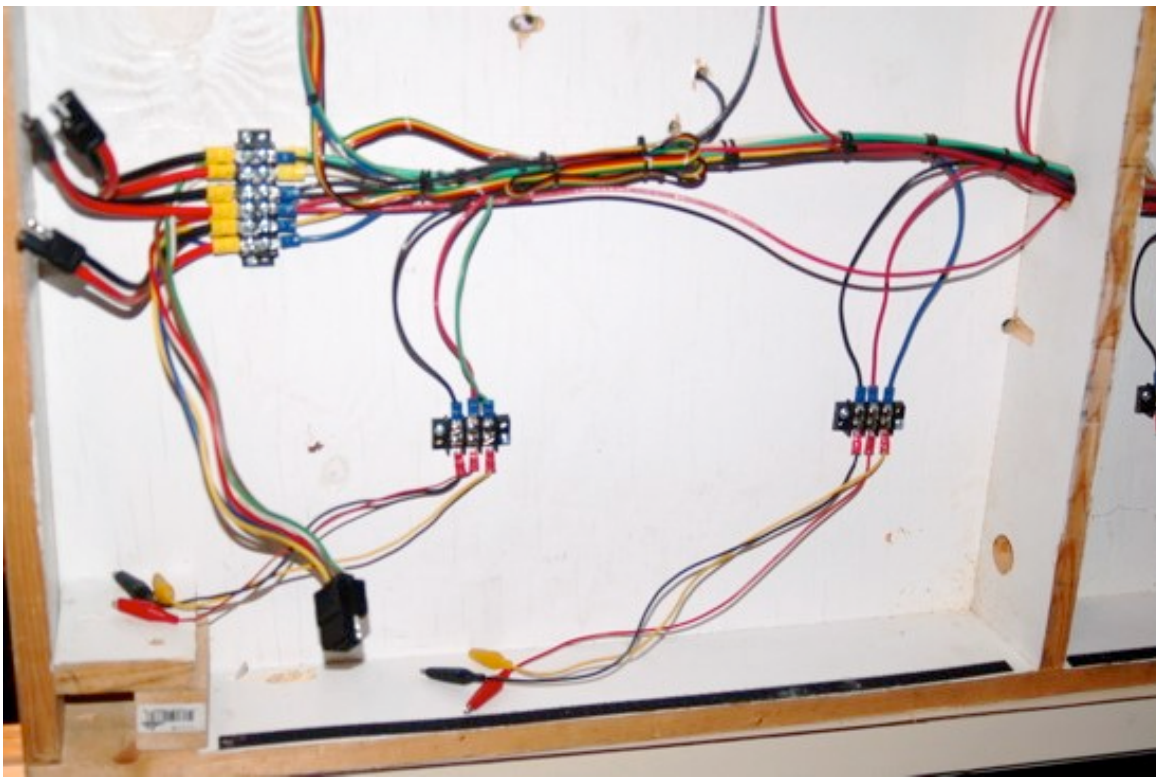
The diagrams are based upon the use of an AC power source. If using a DC source, modify the circuiting diagrams as required.



BASIC MODULE WIRING TIPS

There are separate wiring busses for the outer loop, inner loop and accessories. Some additional features have been added to the original concept to increase the module's flexibility at shows. These modifications allow members to: arrange and change the accessory layouts on the fly during show set up or operation, remove and replace an accessory that fails during a show, or incorporate accessories into a show layout brought by members who do not own modules. These modifications to the module wiring have lead to some additional modifications being made to operating accessories so that these can be quickly set up on the modules.

An example showing the details of the accessory connectors:



WIRE COLOR CONVENTIONS

Some wiring standardization is starting to be employed by several members in order to simplify module set up at shows. The common color coding of wire helps the members hook up and troubleshoot other member's modules.

- | | |
|---------|---|
| Black: | Common power (AC) or negative pole (DC). |
| White: | This color is used a couple of different ways because it comes in pre-made connector harnesses that we use for module to module and button board connections. The automotive two-pin trailer connectors come with one red wire and one white wire, instead of red and black. Here the white wire carries the "black" common power. On the button boards, where we have been using the Hoppy brand 48035 4-pin connectors, the white wire carries the switched voltage from one of the buttons to one of the accessories. On three-button, button boards, it carries the constant voltage, red wire, to the buttons. |
| Red: | AC "hot" or DC positive. This color is used for power that is going to the inner or outer loops. It is also used for accessory power that is NOT controlled by a switch or button. |
| Yellow: | Switched voltage (AC or DC), used to power accessories and controlled by the operator, the visitors or a sensing device. (Same as red except switched.) |
| Green: | Variable voltage for tracks in controlled blocks on sidings, i.e. CAB controlled track power. |

Ribbon Wire: Black/Red/Yellow/Green: Remote control turnout wiring.

Green/Yellow/Brown/White: Used to supply power to the accessories from the button boards. The Hoppy brand 4-pin connector, #48035, has these colors. Each wire carries the switched voltage from a button to the accessory it controls. A separate red wire supplies constant power to the buttons from the accessory buss. A black wire from the accessory to the black accessory buss completes the circuit. If you use three buttons per module instead of four buttons, the white wire carries the "hot" voltage to all the buttons. The green, yellow and brown wires carry the switched voltage to the accessories.

If you use 6-pin connectors (Hoppy 47995) to connect your modules to the next module, the following color codes are being used in the Carolina Division:

Green: Outer loop common.

White: Outer loop "variable."

Brown: Inner loop common.

Red: Inner loop "variable."

Yellow: Accessory common.

Blue: Accessory "hot", unswitched.

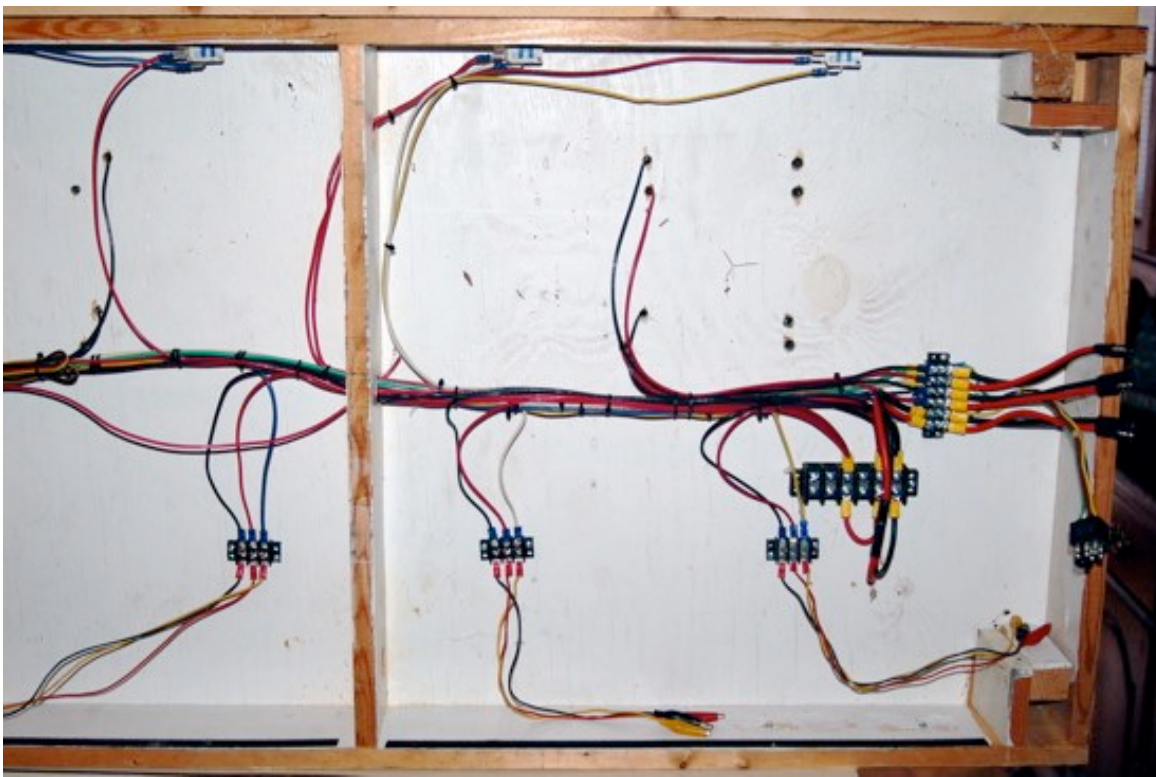
Red, White and Blue are positive.

The Yellow and Blue are AF box colors and since they have not been used for track power they were chosen as the accessory colors.

All the "positive" voltage colors are aligned on "top" of the connector. The Green/White, Brown/Red, Yellow/Blue are next to each other.

The RED pin has the same male/female orientation at the module ends as the old 2 pin connectors.

An example showing buttons along the top, track feeds, 2 pin and 6 pin module-to-module connectors, and accessory connections along the bottom:



WIRING MATERIALS TIPS

- A. Radio Shack does not sell 16 gauge stranded wire. The best source for wire is at automotive stores. They sell 14 and 16 gauge "primary wire." Thirty feet of 16-gauge wire is \$2.79. One hundred feet is about \$5.99. If you build more than one module, the 100-foot roll is a better deal since you need extra wire if you have operating accessories wired to your module. Northern Tools and other automotive supply shops sell unusual colors of wire, white, brown, green blue, etc. Some Advance Auto Stores have \$4.99 as the price on the shelf. They will honor that if you get a price check before purchase, otherwise they charge \$5.99. Metro Auto Supply in Columbia SC sells it for \$4.97. Auto Zone does not sell 100' spools of 16 AWG, only 30'. NAPA sells some wire for 3X the cost of everyone else. Hesco in Columbia sells NICE 12 AWG black and red "Zip Wire" for \$0.30 per foot. This may be the ultimate overkill or it may be a really good idea. One chart we have seen lists 14-gauge wire as suitable for carrying 15-volt 3-amp circuits for 30 feet without appreciable loss of current. For a 35'x 35' layout the current must travel a minimum of 70-feet. Twelve gauge may not be a bad idea for the through wire part of each module. Our current modules are wired with a minimum of 16-gauge wire as of 4/03. Hoppy Brand 4-conductor 14 AWG wire, 49905, is available for \$10.89 per 25'. Add a Blue and Red 14 AWG wire and you are set for using 6-pin connectors.
- B. Radio Shack electrical connector #270-026 is specified in the ACSG module standards and is constructed with only 22-gauge wire. Auto stores sell the same basic connector as a 2-wire trailer connector with 16-gauge wire. 16-gauge wire has 400% less resistance than 22 gauge. 22-gauge wire does cause voltage drop problems on the larger layouts. Most of these automobile supply store connectors

are set up with red and white wire as opposed to RS's red/black scheme. When you are doing your wiring just match the red wires up and mate the white and black wires together. This will match what others have done. Some packages claim the wire to be 24" long. Most are really only 12" long. If there is very little wire in the package, expect it to be 12-inches long when you open it. Several auto stores sell the incorrectly marked wire. Auto Zone, Advanced and Pep Boys sell "Hoppy " brand 2-pole flat 12" trailer connectors, #47965, these work, but as noted above the wires are white and red.

- C. Don't cut the #270-026 2-pin style connector wire in half. If you cut the 12-inch wire so there is one long end and one end with about 1" of wire, then you can use the long end and connect directly to a RS #274-656 2-position dual row barrier strip. If you do this, you can tap off the 2-position barrier strip to your rails or to the accessory buss, and also tap off for the through wire used to connect to the next module. Piece the short wire 2-pin connector to the far end of this through wire buss. Using the barrier strip makes a neat way to tap off to whatever you are doing locally on your module and it allows for changes on the fly. Soldering connections slows down modifications. Wait, this may be a good thing! See diagrams.
- D. When looking at the Specifications wiring diagram, pay attention to male / female. The ACSG Module Standard drawing is a little confusing but has the male / female correct. The silver pin is male but is shorter than the female on the actual connector. Hook up the wiring while the module is upside down so you don't have to work underneath it. The diagram will be correct this way also. Even if you do this wrong and short out the transformer, just disconnect your module wires and allow the adjacent modules track to power your track until next show. Also, see the attached diagrams.
- E. "Hoppy" brand 6-pin connectors are \$2.39 in Kansas. This is way cheaper than getting 3 of the 2-pin connectors. Currently 21 of the Carolina modules are being converted to 6-pin connectors. Contact Calvin or Ted for wiring information if you plan on converting. The red pin has the same Male / Female orientation as the 2-pin set up. Treat the Red, White and Blue wires on the connector as Red and the other 3 wires on the connector as Black. White is outer loop variable voltage, red is inner loop and blue is accessory loop. Converting the modules to the six-pin connectors eliminates the possibility of connecting the inner and outer loops together and eliminates four connections per module, saving setup time. Currently, if you decide to use the six-pin connectors, you need to also provide a two-pin connector for each buss so we will be able to hook up to modules that have not been converted. This would include all the other divisions of ACSG. An alternative is to make 2-pin to 6-pin adapter harnesses that you can use to connect to a module that still uses 2-pin connectors. Tractor Supply, they have stores in Columbia and elsewhere, sells the 6-pin connectors for \$1.99.
- F. Lowes is about the best source for ring terminals and crimp type connectors. "GB" brand connectors are \$1.05 for 22. Lowes does not carry red #6 stud ring connectors. Lowes only has the blue ones for #6 ring terminals. It is cheaper to buy them in the small packages. Radio Shack has #6 stud red ring connectors.
- G. Reusable butt splices available at auto parts stores work very well. Autozone and

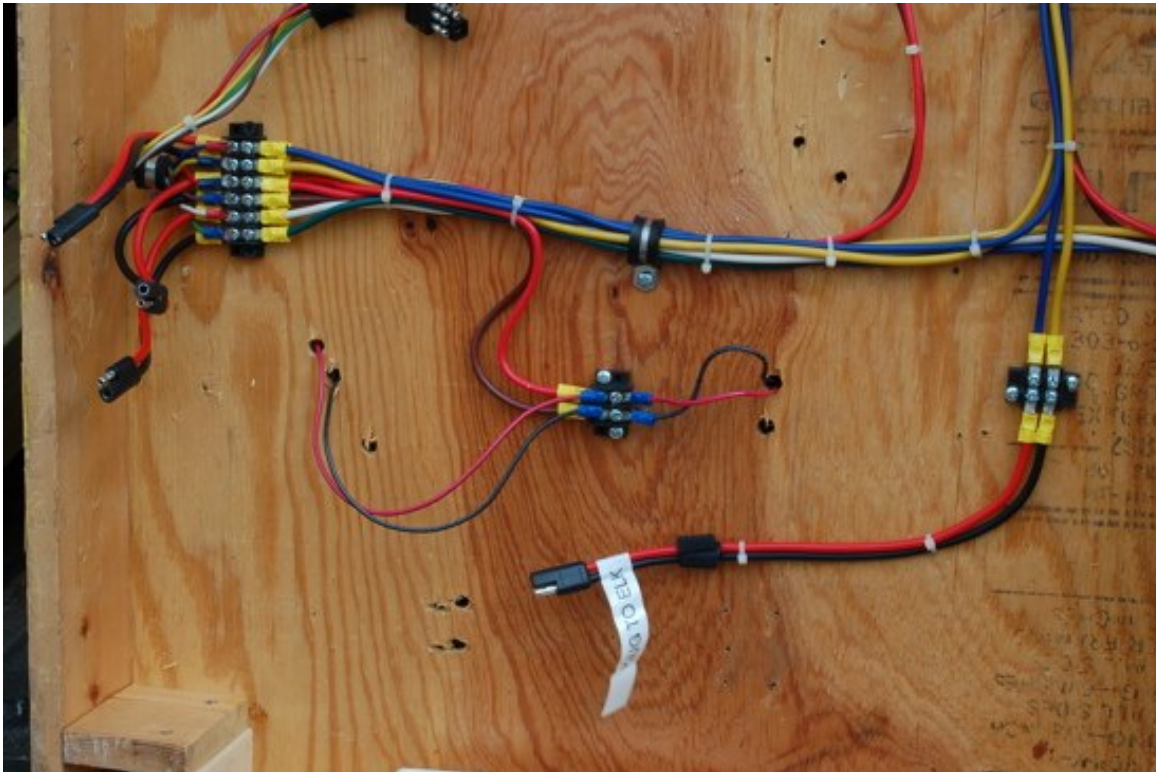
Advanced sell them as "Posi-Lock" by Swenco. The part number for the 10 piece pack is PL1824-10. The 18-24 Gauge size fits 16-gauge wire also. The connector is even UL listed for 600 VAC. Extreme overkill for toy trains. (We like that in an electrical system.) Tractor Supply Company sells 100 piece packages. They have other items by Swenco also. See Swenco @ www.posi-lock.com

- H. Auto Zone and Pep Boys have a "flush mount horn button" made by Conduct Tite, model #85929. It sells for \$2.99. Most have a high failure rate. Buy only the ones with shiny chrome, head of terminal screw should be same size as mounting screw. Stamping should have crisp, not rounded corners. It may be safer trying a different button. On the poorly constructed ones, the spring goes flat and the button won't "push" after one or two shows. This generally sucks. AC Delco U1980 horn button for \$3 is available at parts stores selling AC Delco. We have not had any failures with these. They are worth the extra effort to special order. Caltherm at Pep Boys is OK (\$3.99). (\$2.79 in Kansas) Vending machine or video game buttons may be the best choice. They have a large face and the actual switch is a high quality micro switch. The switch has Normally Open and Normally Closed contacts. Skycrafters electronic surplus in Orlando Florida has these for about \$3 each. Ted Zanders has them mounted on his button boards and the Tidewater division has also started to use them on their units. They require a recessed hole so the micro switch can fit behind the push button. This requires that the button boards hang below the fascia board or that the buttons be mounted into the fascia board and the skirts must be modified as the Tidewater Division has done. Call Tidewater up if you are interested in this scheme. Since vending machine buttons are lit, they look REALLY GOOD when connected to a flasher. (Automotive flasher won't work since the bulbs don't draw enough current to heat up the flasher.)
- I. April 2003 update: Caltherm buttons do not hold up well near the ocean, the "chrome" turns dark and the internal contacts corrode. High use buttons such as whistles need to be replaced before every show. Make wiring long enough to accommodate changing out the buttons from the public side of the module on the fly at shows. Ken Mc Nelly will be trying the Skycraft micro switch buttons.
- J. To make accessory busses that are very flexible, use the following: 8-position dual-row barrier strip and an 8-position bus strip RS #274-650. Make a black wire buss and a red wire buss with these to hook up operating accessories. RS jumper leads 278-1157B with one end cut off and replaced with a red #6 stud terminal ring make quick set up accessory connections. See diagrams for additional detail.
- K. Add an accessory buss kill switch and mount it on the inside fascia of the module. Radio Shack #275-731 works nice. It is a lighted automotive rocker switch. Drill a 15/16 hole in the 1 x 4 and just push it in. It works fine with 3 to 18 Volts AC or DC. A little red LED comes on when the buss is powered and confirms to the operators, at a distance, that your module's accessory buss is receiving power. The kill switch allows you to shut off power to just your module if something starts to smoke or someone is pushing a whistle button too often. Switches have a failure rate of 1 in 50 per show. Get an extra one. (Credit for the kill switch concept goes to Joe Haenn).
- L. Add a circuit breaker or fuse to your accessory buss between the dual row 8-

position barrier Strip and the accessory Buss kill switch. This breaker should be less than 10 amps so it trips before the 10-amp automotive blade fuse on the club's transformer blows. Without this protection, if you accidentally spark a wire, it will take out the accessory power to every module on the layout. (C'est le grande bummer!) Make sure to have a through wire for the accessory buss that goes from one end of the module to the other, just like the track power, that doesn't have a switch or breaker. The switch and breaker tap off this wiring and feed your module's local accessory buss. "Philmore" brand breakers are mislabeled. I have purchased 5 amp breakers from 2 different sources in packages that say 15 amps and have a 5-amp label on the breaker. They are 15 amp. GC brand is OK, but hard to find. Philips EGC makes a USA manufactured breaker part number CB2-5A that looks good and works well. NTE makes an identical in appearance breaker Part Number R59-5A; it is made in the Philippines.

- M. Radio Shack mall stores will carry fewer electronic components in the coming years. Strip center stores will still have a full selection of electronic parts as of fall 2002.
- N. Another accessory buss that has been used successfully is a bare copper wire. If using this it is helpful to make a transition harness with alligator clips which would allow a "standard" button board to be attached to your module. These button boards are typically set up to connect to a barrier strip.

An example showing the details of the track feed wires and an Elk power supply connector:



ELECTRICAL MATERIALS LIST

A. The following list of materials is what is typically used in one of Calvin's modules:

1. (4) 8 position barrier strips RS 274-670
 2. (4) buss strips RS 274-650
 3. (4) 3 or 4 position barrier strips RS 910-3193 or 274-658
 4. (2) 6 position barrier strips RS 274-659
 5. (2) six pin connectors Hoppy 47995 (only 1 if not making a conversion harness to 2 pin)
 6. (4) 2 pin connector pairs (only 1 if not making a conversion harness)
 7. (1) RS LED Switch RS 275-731
 8. (1) 5 amp breaker
 9. (1) surge strip with 4' cord Belkin F5C050 or equivalent
 10. Krylon Spray paint for module edges (dries fast)
 11. (26) small Adel clamps
 12. 100 #6 ring crimp connectors
 13. Gator Grip tape
 14. Hoppy 49905 14 AWG wire, plus a spool of red and a spool of blue
 15. Hoppy 48035 4 wire connector
 16. 14 Swenco butt splices (PL 1824-10 fits 14-16 AWG, but not supposed to)
 17. RS alligator clip leads 24" RS 278-1157b
 18. 60 #8 screws 1/2"
 19. White Gloss Kitchen and bath paint (for underside)
- Cost is about \$89 plus paint

B. The following list of materials is what is typically used in one of Calvin's button boards:

1. (4) Caltherm horn buttons
2. (1) 48" Oak 1x 4
3. (1) 4 pin connector
4. Misc wire (scrap from #14 above)
5. 8 crimp #6 ring connectors
6. 1 "Bullet" crimp connector

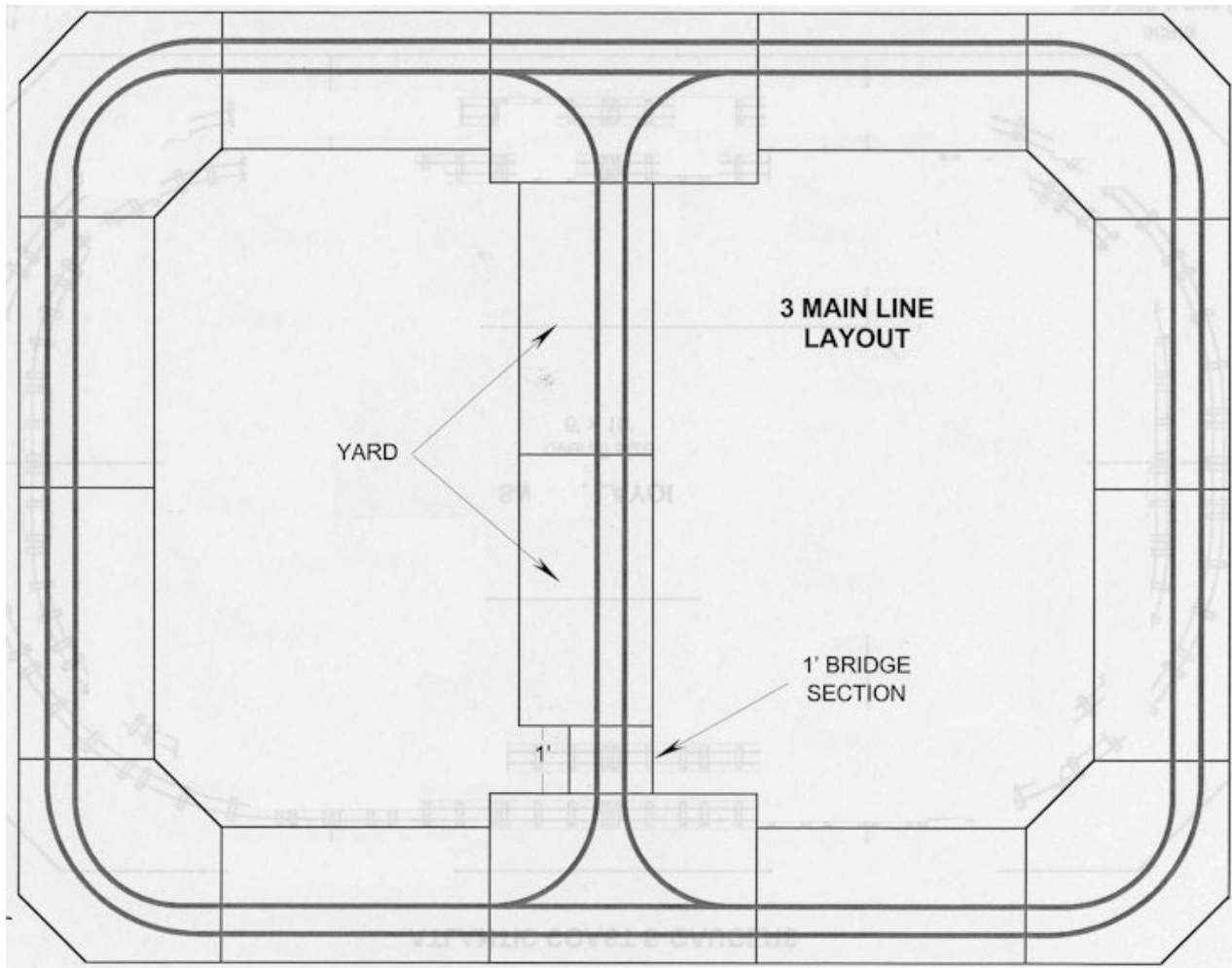
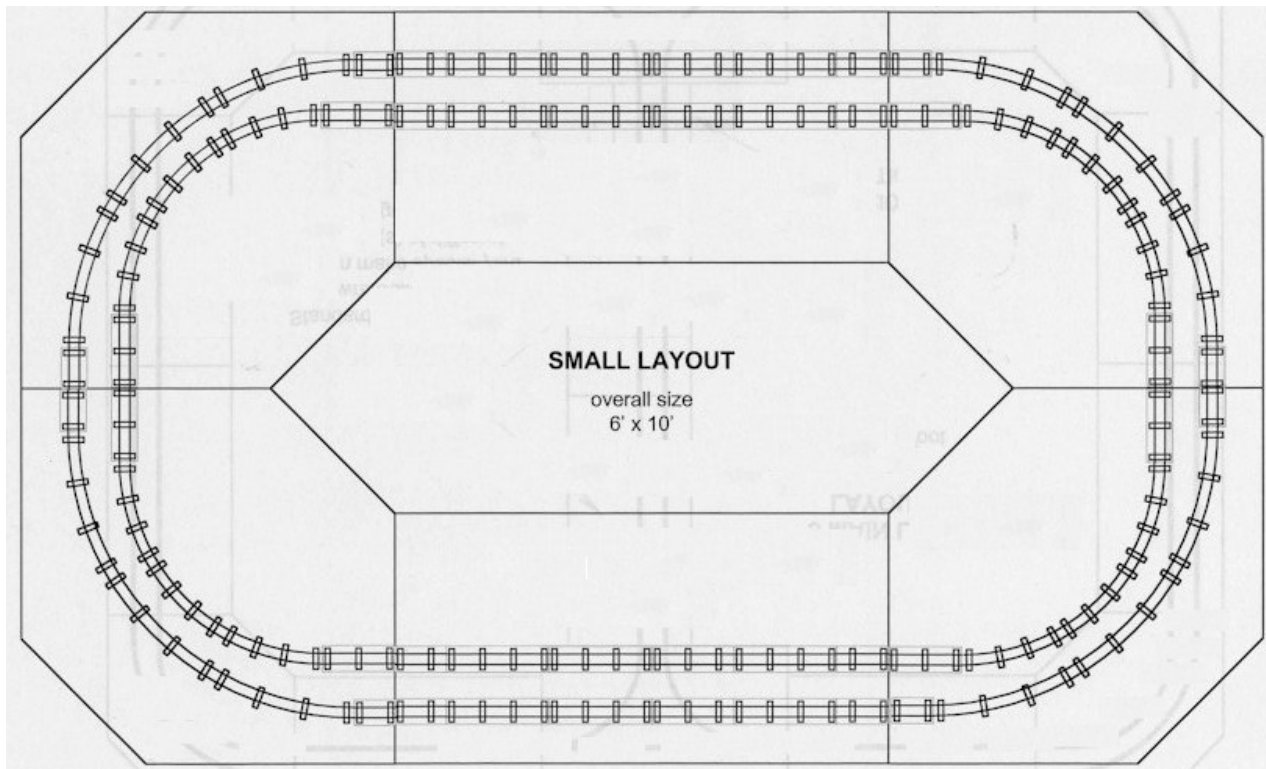
7. 3 Swenco butt slices
8. Tie wraps
9. (4) brass Card Holders and #2 screws

Cost about \$27.00

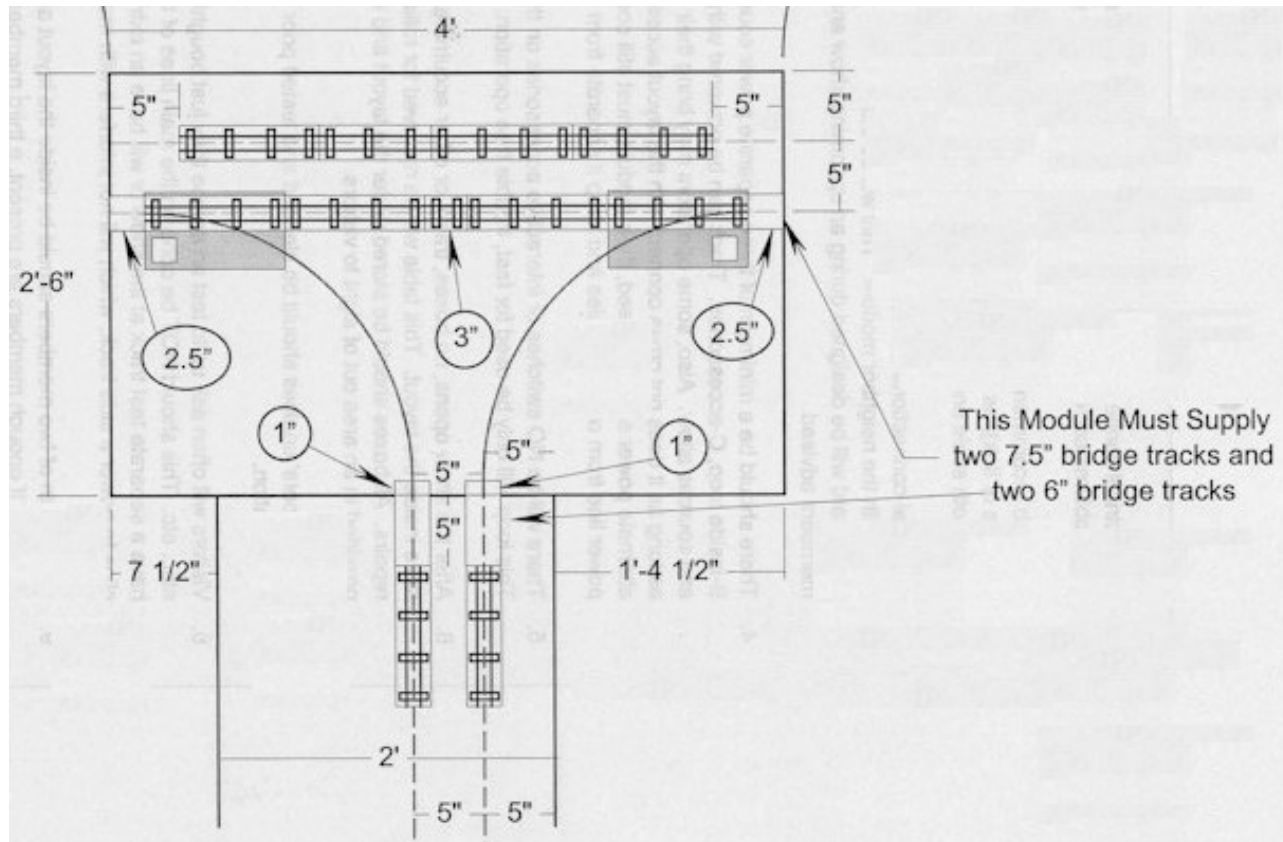
C. The following list of materials is what is used in the auto-block control unit:

1. Radio Shack Metal Utility Box 270-253A
2. "The Detective"
3. SKY brand relay SKMP-4C12VDC (4PDT with 12 VDC coil and 5 amp minimum)
4. Young ND8Q-14 Socket for above
5. RS Full wave Bridge Rectifier 276-1185 50 V 25 Amp for \$2.99
6. Tie wraps
7. Red Swenco posi-loc butt splices
8. Crimp connectors for relay socket
9. Skycrafters vending machine switch
10. Several 2-pin connectors
11. Rubber grommets

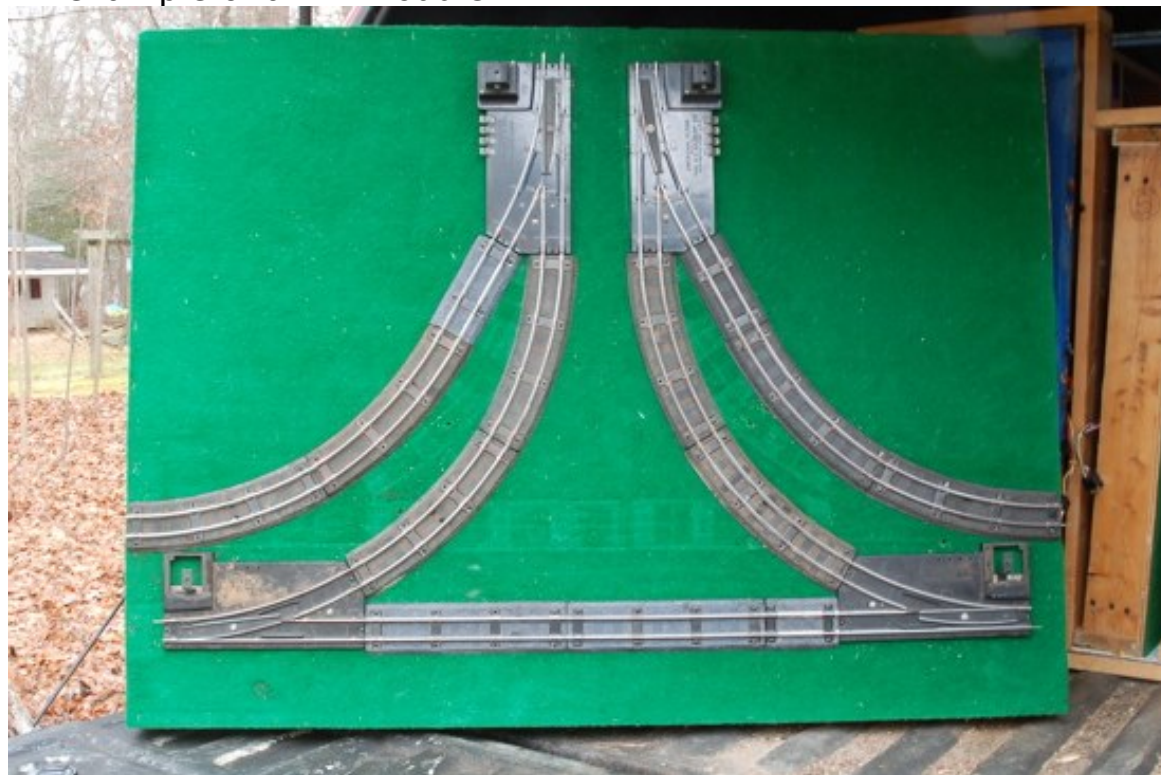
Example Layouts & Modules



"T" Module Details:



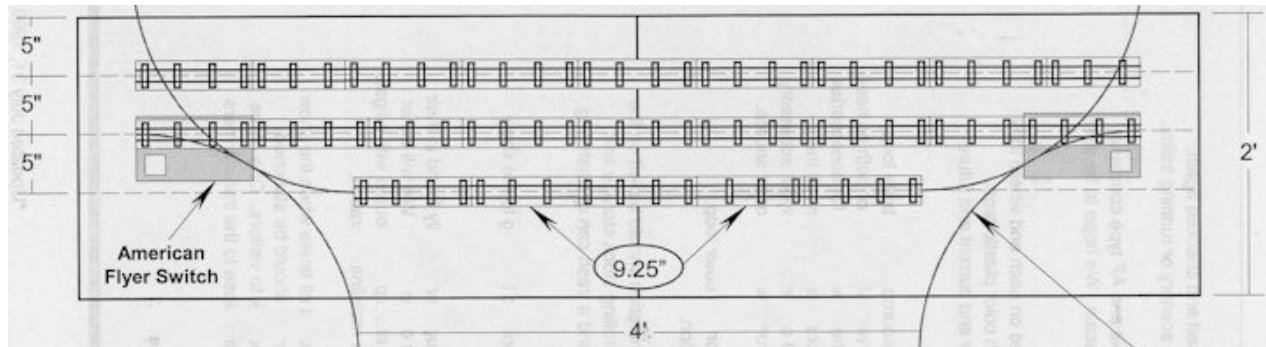
An example of a "T" module:



The design has been modified to allow trains on the outer loop to enter and leave the

yard.

Design for 2 modules with siding:



Tips and Hints

All tips, hints, commentary, calculations, and advice provided by Calvin Azarowicz & Ted Zanders.

Butch Henion provided the photos of his 4 foot and T modules.

Conventions used in these guidelines

In all of the diagrams in this and the other module tips, the module wiring diagrams are shown as viewed from the underside of the module top, as if you have it turned upside down on the floor and are working on the wiring. The "inside" (operator) of the modular layout will be towards the bottom of the page and the "outside" (public) side of the module will be towards the top of the page. Instances where this is not the case are so noted. If track layouts are being diagrammed these are shown as if you are standing on the operator side with the top of the page again being the public's side.

Often times a supply source will be noted in the explanations. The following abbreviations are used for these sources:

HESCO: Hesco Electronics Supply, Columbia, SC 803-254-4575

Lowes: [Lowes Home Improvement](#), Everywhere, USA

RS: [Radio Shack](#), Everywhere, USA

Skycraft: Skycraft Parts and Surplus
2245 W. Fairbanks Ave
Winter Park, FL 32789
www.Skycraftsurplus.com

(407) 628-5634

Hoppy: Hopkins Manufacturing (Hoppy brand electrical connectors)
www.hopkinsmfg.com

Operating guidelines:

All electrical connections should be checked, rechecked, and checked again.

Problems must be corrected before working on accessories or scenery.

High-rail wheels and American Flyer link or knuckle couplers are recommended.

Three power sources are needed: outside loop, inside loop, and accessories.

Track can be powered with AC or DC as needed.

All engines should be repaired, cleaned, and tested prior to any show.

Visitors are encouraged to bring in their engines and/or rolling stock to test and/or run.

A minimum of 2 club members should be inside the layout at all times.

Additional members can be stationed outside the layout to help with re-railing.

One of the members inside the layout should stay close to the transformer(s).

Operating Accessory Tips

- A. Power output varies quite a bit from one Gilbert transformer to the next. The amount of power available at a show also varies with the number of accessories. We have started using one Elk Products ELK-TRG 1640 16.5 VAC transformer for each module or group of modules for accessory power. 800-797-9355 or www.elkproducts.com. They cost about \$9 and include auto-resetting overload protection. The voltage is more consistent than AF transformers. If you do this, make an accessory buss bypass wire 54-inches long so the club layout's accessory loop can maintain continuity through your module.
- B. To power up these transformers, and for other uses as well, we have started installing power strips on each module or group of modules. These need to have 4-foot cords, so you can plug one module into another, and have the outlets oriented 90-degrees to the length of the power strip so that transformers will hang down vertically when plugged in and not get pressed against the bottom of the table top. Ace Hardware has them for \$7.99 and Office Max occasionally has them for free, after rebates, in their Sunday ads. The less expensive ones at ACE Hardware have a 3-foot cord and will not work on a 4-foot module. Four foot models as follows.

Ace #33529

Belkin F5C050

Recoton "Spikemaster" SMSG7

- C. We have modified all accessories to operate well from the ELK supplies. K-Line solenoid accessories will need 8 to 10 ohms resistance with the Elk power supplies. Get the good 50-watt metal ones since they run cool and won't melt the plastic if you mount them to the bottom of the accessory. The Lionel barrel loader will need a 50 ohm 50 watt resistor. Required resistors will range from 3 to 10 ohms with AF transformers for K-Line stuff and 40 to 70 ohms for the Lionel Barrel loader.
- D. If you intend to build a module where the accessory layout will vary from show to show, use lots of barrier strips. Have extra unused spaces on the barrier strips for future use.
- E. Have 3 wires go to each typical accessory location on your module: Common or negative (Black), positive or 15V (Red) and switch controlled positive or 15V (Yellow). This will allow you to control an accessory by pressing a button connected to the yellow wire, and also allow you to power up lights or other features not to be controlled with a switch, using the constant 15V red wire.
- F. Use extension wires with alligator clips at each end to attach accessories to the module buss wiring. Alligator clips will attach to bare wire, fahnstock clips, post and nut connections etc. You are making a temporary connection that only has to last for 8-16 hours. If the alligator clips would be exposed on the top of the layout then run wire from the accessory to under the table and then connect to the accessory under the table with the alligator clips. Having alligator clip wire in red, black, yellow and green is a plus.
- G. Solenoid items don't buzz on DC and work better at lower volts. HOWEVER, kids like the BUZZ. And enjoy quicker moving accessories. The K-Line Forklift gets more use than the Lionel /AF unit! (I think it is pure JUNK.-CA)
- H. 16 VAC stuff that runs well without modification:
 - 1. Horn and Whistles
 - 2. Burning Building
 - 3. Most "train" lights
 - 4. Shell Oil Rig
 - 5. Lionel truck train hand truck (On a personal layout slower would be more realistic)
 - 6. Crossing gates and cross bucks
- I. 16 VDC stuff that needs electrical modification:
 - 1. Cornerstone Oil Rig. This is a DC unit so add a rectifier.
- J. 11 VAC or 11 VDC accessories that need modification to run well:
 - 1. K-Line Diesel Fueller (10 ohm resistor @ 16.5 volts OK also.)

2. K-Line Fork Lift (0-15 ohm rheostat @ 16.5 volts). As solenoid heats, more voltage is required. Adjusting the rheostat keeps it working well. Remove the solenoid and drill it out to accept a piece of aluminum tubing. The plastic melts and causes binding otherwise.
 3. Lionel 6-14092 Floodlight Tower, The light sockets will melt and the chrome bezels will fall off at 16V, so use a 15 ohm resistor to drop the voltage.
- K. Lionel Barrel Loader 3-6 VDC or AC. 3 volts is realistic, but too slow for kids at shows. I think this is why the K-Line is played with more. A 50-ohm resistor @ 16.5 volts works OK.
- L. Due to train speed control, unique voltage requirements, etc., the Circus module(s) are easiest to be dealt with as being unique animals that don't follow the "standards." ELK makes a 12 VDC power supply the works well with the ELK 1640. Try to make everything work well on the ELK 1640 and you will save yourself a lot of headaches at shows.
- M. Items that can have hidden wire if wires come up through a hole 1 1/2" from the aft edge of the module:
1. Steam Whistle
 2. Lionel diesel Horn
 3. AF Diesel Billboard horn
 4. Oil Rig
 5. Lionel Station
 6. Burning Building
 7. Lionel Drum Loader
 8. Truck Train Terminal
 9. K-line Drum loader
- N. Items that do not have hidden wires. Holes must be drilled at desired location:
1. K-Line Diesel Fueler
 2. Some Crossing gates
- O. Accessories that HAVE NOT been used successfully at our shows or that have not been durable enough for continuous operation over a two day show. Consider setting them up with a button on the operator side of the module so you can demonstrate it for people rather than have them operate the unit.
1. Lionel/AF sawmill: The nylon gears fail after just a few hours and the boards tend to jamb.
 2. Vib Rotor Lionel windmill: The rubber "fingers" wear and can't be easily replaced since the "washer" is glued on. Lasts about 20 hours of light duty.
 3. Coal loaders, electro-magnetic cranes, etc. Anything that requires stopping and

reversing direction or other sequential operations won't do well with "button pushers" that don't read.

Auto-Block Control System

- A. The heart of the system is the Erie Signal Systems Current Sensing Detector, "The Detective". Joes Train Repair sells them for about \$19.95. There is also a 4 pole double throw relay, and a rectifier in the "Auto-Block" Control box, the ABC.
- B. The modular layout is divided into 4 sections:
 - 1. The protected block consisting of 1/2 the modules in the entire layout.
 - 2. The unprotected block consisting of at least 2 modules.
 - 3. The slowing block consists of at least one module but more are good.
 - 4. The stop block consists of a single module.

These blocks are always set up in the following order going either clockwise or counter clockwise around the layout: Protected, unprotected, slow, stop. An insulator pin must be placed in the variable voltage track between each of these blocks.

- C. The transformer connects to the unprotected block and powers the layout through the under table buss as always. Any time current flows through the under module wiring (the buss) to the protected blocks, current flow is sensed by "The Detective". When current is sensed, the relay in the "ABC" opens and cuts power to the slow and stop blocks. When no current is sensed, the relay is closed and the slow and stop block get whatever power the transformer is set to supply.
- D. The slow block is always connected through the ABC to the unprotected block through a 1 to 5 ohm rheostat or a 1 or 2 ohm resistor of at least 50 watts. Be careful, a 50 watt resistor will still get HOT in this application. Skycrafters sells 100 to 250 watt resistors that stay COOL. When current is sensed in the protected block and the relay is opened, then power to the slow block runs through this resistor and the train receives reduced voltage while it is in the slow block. When the relay closes, the slow block is powered through a connection that bypasses the resistor or rheostat and it once again receives what ever voltage the transformer is supplying to the layout.
- E. What it does: The system allows two trains to run on the same loop of track without one catching up to the other. As they go around the loop together one train will invariably start to catch up to the other. When the slower one enters the protected block, its current draw is sensed by the ABC and power is reduced to the slow block and cut off to the stop block. This first slows and then stops the train catching up to the slower consist until the slower train leaves the protected block and enters the unprotected block. When it enters the unprotected block its current is no longer sensed by the ABC and the faster train is released from the slow or stop block to once again try and catch up. The length of the protected block determines how far ahead the slower consist can get before the faster train is

once again released to chase it around the loop.

F. Problems:

1. The "E" units must be locked in forward. New engines from SHS and American Models don't have this feature and so cannot be used with this auto-block system.
2. If a train derails in the protected block, it no longer draws current and won't be protected. Shorting out the whole layout in the process is NOT considered "protection."
3. Unless a second unprotected block is added, the trains can only run in one direction.
4. In addition to adding 4 insulator pins, the rails ends MUST be cut so they do not touch on the insulated sections.

G. Some cool thoughts on the use of this device:

1. Organize accessories on the slow block adjacent to the stop block to take advantage of the train coming to a stop. Some of these ideas may require use of an "IR" detector or give an opportunity for uses to operate accessories:
 - a. Turn on a Red block light.
 - b. Have a water tower or standpipe fill the tender on steam engines.
 - c. Load coal into the tenders or into hoppers or gondolas in the consist.
 - d. Use the MTH freight or passenger stations to load/unload.
 - e. Use the K-Line, or other, diesel fueler.
 - f. Have crossing gates come down the entire time train is stopped.

Miscellaneous Top Secret Stuff

- A. Typically the outer loop is run counter clockwise and the inner loop is run clockwise. Plan the placement of your infrared sensors, block control/detectors, signage accordingly. However, this is all subject to change at the whim of the operators.
- B. When operating the layout, if the cars uncouple, call "Break Away Inside" or "Break Away Outside" depending on the track with the problem.
- C. If you can, look at a module closely before building one of your own. This will help answer a lot of questions that all the verbiage and diagrams just can't explain.
- D. If you can't think of something to bring to the show, bring a small trash can for inside the layout. Oh yes, bringing trains and accessories to run and display is good! Just bringing yourself is also good!

