Building an HO Max Trax Slot Car Track

by Jim Kostinden

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Introduction

During the ten months it took me to build this track, I documented the build process in a series of emails that were sent out to my friends and fellow racers (and yes, my fellow racers are also my friends). I did this for a couple of reasons: 1) to document information during the build that I might refer to if needed in the future, and 2) to share with my friends who were interested in the progression of the build. Sending out the email updates was my way of keeping them informed. There was a total of 16 emails sent out, usually sent out every 2-3 weeks. It is the contents of these 16 emails that will be used as the basis for this document.

This document is not intended to provide a step-by-step build of the track. Instead, it will provide the methods I used to build this track with some methods covered at a "40,000 feet view" while other methods will get into the details. Some of the methods I used are well known, and in those cases, I will simply reference them with a suggestion to "Google" the term to find out more information. Since this information is already available on the internet, there is no need to repeat it in this document.

Before we begin the build sections of this document, I will provide a brief history of the track which had some interesting twists and turns prior to me acquiring it. In the Overview section, I will provide a list of the goals I set out to accomplish before I began the actual construction, explaining the reasoning behind these goals

Track History

The track was designed by Philip Hilgert in early 2006. Phil told me he designed the track to run everything from T-Jets to CMPM HO slot cars. Figure 1 below is the actual track diagram provided by Max Trax Racing.

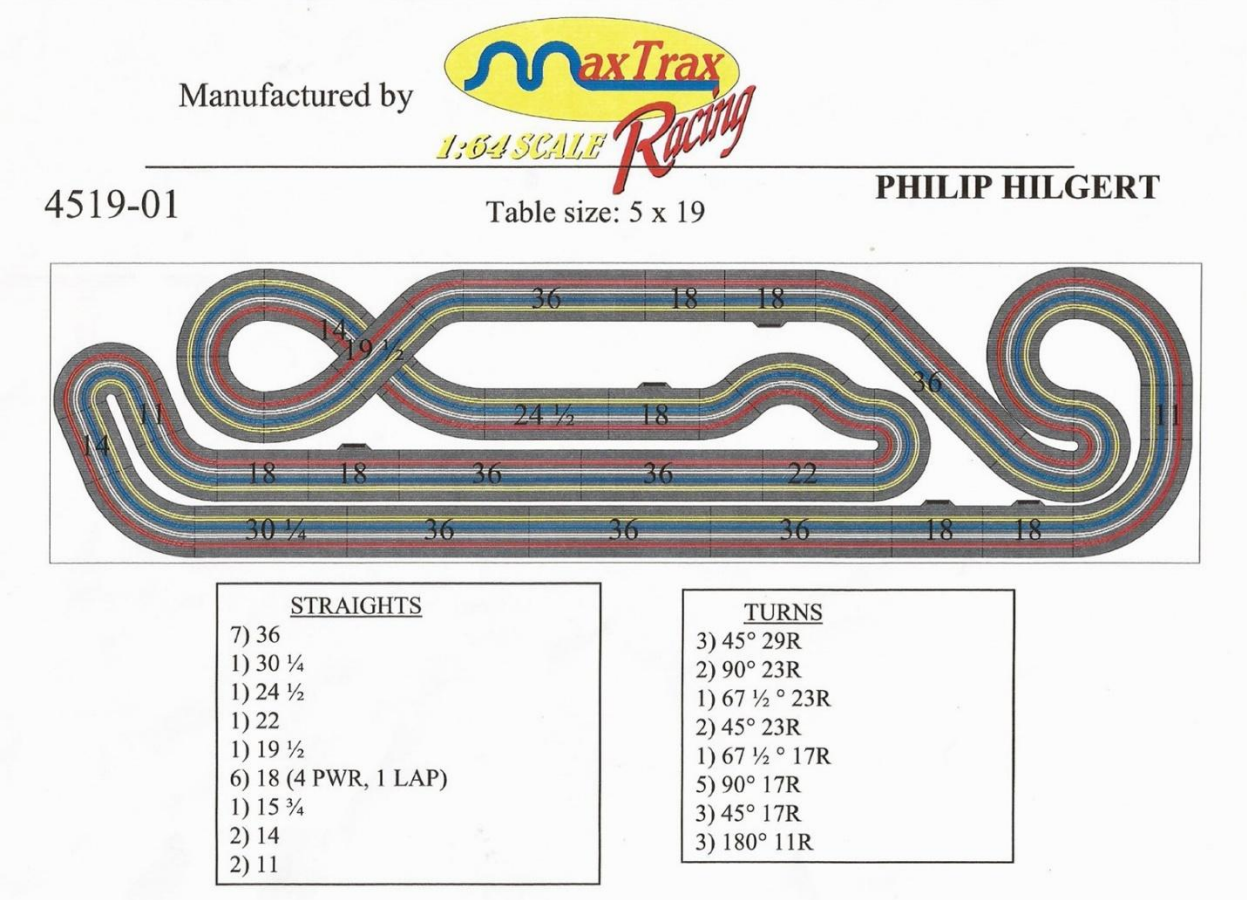


Figure 1 – Track Diagram

In May 2006, Phil commissioned Max Trax racing to build the track. After almost 7 months, the track was delivered to Phil, who was living in Colorado, in January 2007. The track was shipped in 2 flat boxes that contained the 42 pieces of track sections. Unfortunately for Phil, life sometimes gets in the way of slot car racing and he was not able to setup and run the track. The only thing Phil was able to do with the track while he was in Colorado was unpack it and lay it out on the floor to make sure all the pieces were there (they were) and then packed back in the original shipping boxes. Phil was in the process of downsizing his home and moving to Rhode Island. With his new home in Rhode Island, Phil had no room to set up the large 5' x 19' track so he put it up for sale.

Enter Peter Lentros, of LenJet Raceway fame, who purchased the track from Phil with the intention of eventually setting up the track at LenJet Raceway. I don't have a clear timeline of when Peter bought the track from Phil, but I am guessing Peter had the track for at least 10 years (probably more). During that entire time, the track, still in its original 2 shipping boxes, sat under the Champion raceway at LenJet.

Fast forward to late summer 2024, when I informed my friends and fellow racers that I was in the market to buy an HO track. Enter Richard Payne from Modelville Hobbies who told me Peter had a "new track" still in boxes under the Champion raceway at LenJet. After some discussions with Peter and Richard we agreed upon a price and I went to pick up the track with the caveat that I could inspect the track, take all the pieces out of the boxes, before handing over payment. While the track was now 17 years old and had been kept in a climate-controlled environment, I did find a couple of pieces of track that had heavy corrosion on the rails. This was not something that could be sanded or polished, like surface corrosion. No, some sections of the rail were heavily pitted and corroded. Since it is impossible to replace the rail on a Max Trax due to the track design, the only way to fix this was to have 2 new track sections built. Of course, the owner of Max Trax had retired almost a year ago, so it did not look good since the track could not be built without these 2 pieces.

Enter another fellow racer and friend, who shall remain nameless, who was able to reach out to his extensive network of HO slot car contacts and was able to connect me with someone who could fix the problem with the track pieces. After a few months, 2 new pieces arrived and I was able to complete the purchase of the track from Peter in December 2024. Finally, after 17 years, Phil's track was going to be built and raced on!

Overview

As with any project, a set of goals is defined prior to the start of the project to help guide the process for the project. In the case of my Max Trax raceway, I set several goals that I planned to accomplish during the build of this track. Following is a bullet-list of these goals along with a brief description of each goal:

- **Light weight, modular benchwork**: In my humble opinion, most of the race tracks I have seen, have benchwork that is way overbuilt using heavy lumber (2x4's, ¾" plywood, etc.). This results in a higher expense for the larger size lumber and more importantly, makes the benchwork extremely heavy and very difficult to move. Also, most benchwork is built with no thought about moving the track in the future. To overcome these issues, and as a former model railroad hobbyist, I used a well-known construction method used on model railroad layouts called "L-Girder" construction. L-Girder benchwork uses engineered beams and light weight 1x3 lumber to form a solid, stable, and light weight benchwork. Also, because of the size of the track, 5' x19', the benchwork would be built in modules. This would make the track easier to move as it could break down into 3 smaller modules.
- **Smooth transitions between track elevation changes and banking of some turns**: With the carousel or doughnut turn at one end of the track that loops over itself, it

would be necessary to elevate the track so that it could cross over itself. To do this and provide a smooth consistent elevation change of the track, I used another model railroad method, known as a "cookie cutter" bench top. The cookie cutter bench top is typically a lightweight plywood (3/8" thick or less) in which the plywood area under the sections of track that are to be elevated are simply cut out in a way that the plywood can be elevated for those sections of track that need to be raised but still provide a smooth transition back to the base level (non-elevated) section of the track. Another advantage to this method is that it will allow subtle banking of the turns, again with a smooth transition back to the flat sections of track.

- **Ability to run the track in both directions**: I wanted to have the ability to run the track in both directions. This would basically give you 2 tracks in one. Doing so would require some additional wiring and most importantly, a smooth connection between track sections so that cars will go across these connections in either direction smoothly.
- **A club racetrack**: The track is intended to be raced on. As such, racers' sight lines were important. Little to no obstructions impeding a driver's view of their car as it lapped the track. Of course, with the doughnut section of the track, there is nothing that can be done to eliminate the lack of visibility of a car as it goes through the underpass. I find that your mind and responses to this obstruction adjust to this as you are racing.
- **Basic scenery to look like a miniature race track**: While this is intended to be a club racetrack, I also wanted it to look like a miniature racetrack. This would mean some very minimal scenery (i.e. grass and bushes) with maybe a few racetrack inspired structures that did not impede a driver's view of the track.
- **Clean wiring with full documentation**: As a retired electrical/software engineer, I know the importance of documenting things such as wiring. Designing a schematic of the wiring diagram that can be used during construction which then becomes a reference in the future if there are any maintenance issues is invaluable. Other documentation such as bill of materials identifying parts used for a particular component of the construction are also very important.
- **Professional looking finish to track**: The track would be located in a finished basement, so I wanted the track to have a finished look to it. This would entail installing a fascia around the edge of the track to cover the ends of the rough benchwork and provide a clean surface to mount the drivers' stations.
- **Efficient track marshaling**: With such a large track, it was important that races could be run and marshaling performed as efficiently as possible. To help with marshaling, I rounded the corners of the benchwork and added a "marshal nook" to the back side of the track that would allow easy reach for a marshal to access de-slotted cars in the

in-field section of the track. In addition, I installed track call buttons at each driver station, so if there were not enough marshals (minimum of 4 for this track) available, the drivers could use the track call buttons to stop the race and re-slot their car.

- **Animation/automation of race status (red, green, yellow flag/race status**): Finally, I wanted to add some automation/animation to my track by installing red/green/yellow indicators around the track to notify racers of the race (track) status.

As you will see in the remaining portion of this document, just about all these goals were achieved. I will explain in more detail how each of these goals were attained, as the build process is explained in the rest of this document.

Building the Benchwork

As mentioned above in the Overview section, the first goal was to build light weight, modular bench work that would provide smooth elevation transitions for the track (2nd goal). To accomplish this, I would use two proven model railroad benchwork methods: L-girder benchwork and cookie-cutter tabletop. I won't go into a lot of detail on how these components are built but will provide pictures showing you the benchwork for the track. You can Google these terms as there is plenty of information and videos on how these components are built.

Below is a picture, Build 1, of all the benchwork material. You are looking at about $500 worth of lumber. Lumber ain't cheap anymore. Most of the material in the picture below consist of: 3 sheets 4x8 plywood 3/8" finished on one side, primed 1x4's and 1x2's that I assembled into L-girder beams (left side on floor), 1x3's primed wood at base of plywood that will be used as cross braces across the top of the L-girder (these will eventually be cut down to 5' width or less). On the floor are 1x2's (unfinished pine) that I routed round edges on and cut to size that will be used to brace the legs and will be stained the same color as the legs. In front of the plywood are the 2x2 legs that have been cut to size, routed round edges, and stained, and leveling sliders/feet placed on the bottom of each leg to ensure the track benchwork is level once set up. The small pieces of 1x2 and 2x2 in front of the legs are spacers that will help align the 1x2 braces to the legs and bench top.

Build 1 - Benchwork Material

Next step is to assemble all of this into 3 modular pieces (that I will bolt together using carriage bolts). The size of these sections will be 5'x4', 5'x7', and 5'x8'.

Picture Build 2, below, is of the base frames for the 3 sections that will be used to make up the complete benchwork. From left to right is the 4-foot section, the 7-foot section, and the 8-foot section. This will create an overall length of 19 feet for the benchwork. These frames consist of 2 L-girder sides and two 1x4 3' long ends. In the picture the 7' and 8' sections are perpendicular to the 4' section for space/build purposes. Once assembled, all 3 sections will be bolted together at their ends, aligned in the direction of the 4' section in the photo. Those cross braces on the 4' and 7' sections are temporary to ensure the frames are square while the glue sets on the end pieces. I was lucky when I built the 8' section as it came out perfectly square!

Build 2 - Base Frames

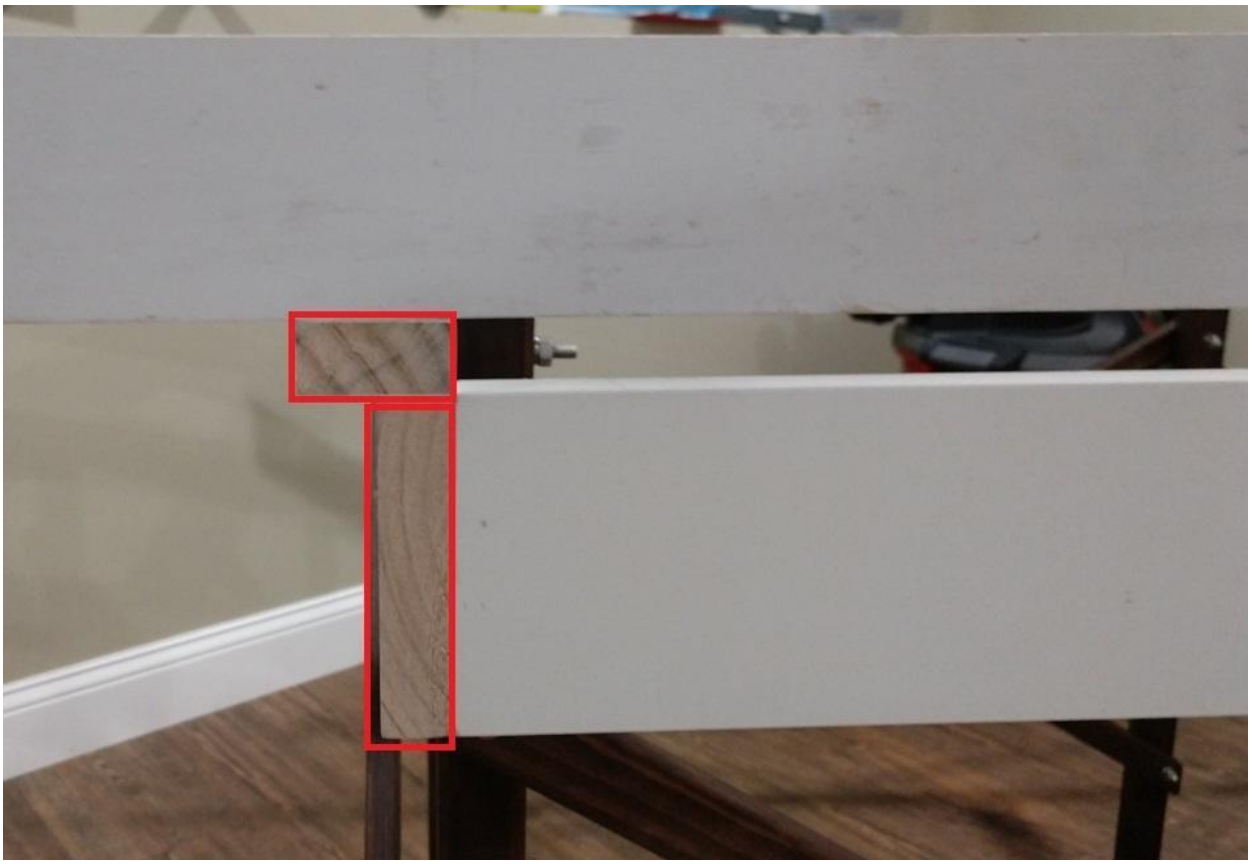
Picture Build 3 is the completed 4' section. The 5' long 1x3 cross beams are mounted across the top of the L-Girders. These provide structural support and allow a place for the plywood top to be attached to the benchwork. The legs (2x2's) and braces (1x2's) have been stained and bolted to the benchwork section. This bench section weighs about 30 pounds but is rock solid and will support many times its weight (8x or about 250 pounds).

Build 3 – Completed 4 Foot Section

Picture Build 4 is an end view of the 4' section. Eventually this section will bolt up to one of the ends of the 8' section. This also gives you a better view of the cross bracing on the legs to keep them stable and parallel.

Build 4 – 4 Foot Section End View

Picture Build 5 is a close up of the benchwork end, with the L-Girder outlined. The horizontal piece of the L-Girder is a 1x2 while the vertical piece is a 1x4. Assembling these 2 pieces of lumber in this manner creates an "engineered beam" that is vertically and horizontally structurally sound (i.e. it will never warp horizontally or vertically). The 1x3 cross beams are attached to the L-Girder by running a screw threw the open (left side in this photo) of the L-Girder top, thus attaching the 1x3 to the rest of the benchwork.



Build 5 – L-Girder Close Up

Picture Build 6 is a closeup of the legs and braces. The X-braces between the legs offer side-to-side stability for the benchwork. The angled brace running from the middle of the leg to the benchwork offers longitudinal stability. As I previously mentioned, this benchwork is rock solid and has no sway in any direction! I used 1/4" carriage bolts (with washers, lock washers, and nuts) to attach the legs to the bench work and the braces to the legs. This allows easy disassembly when it comes time to move the track (in the future). All of this hardware was ordered from Bolt Depot (boltdepot.com) located here in Hingham, MA. They offer all sorts of hardware at very good prices, especially if you need a large quantity, like I did.

Looking closely at the picture, you can also see the screw that secures one of the 1x3 cross braces to the L-girder just to the left of the 2 carriage bolts holding the leg in place

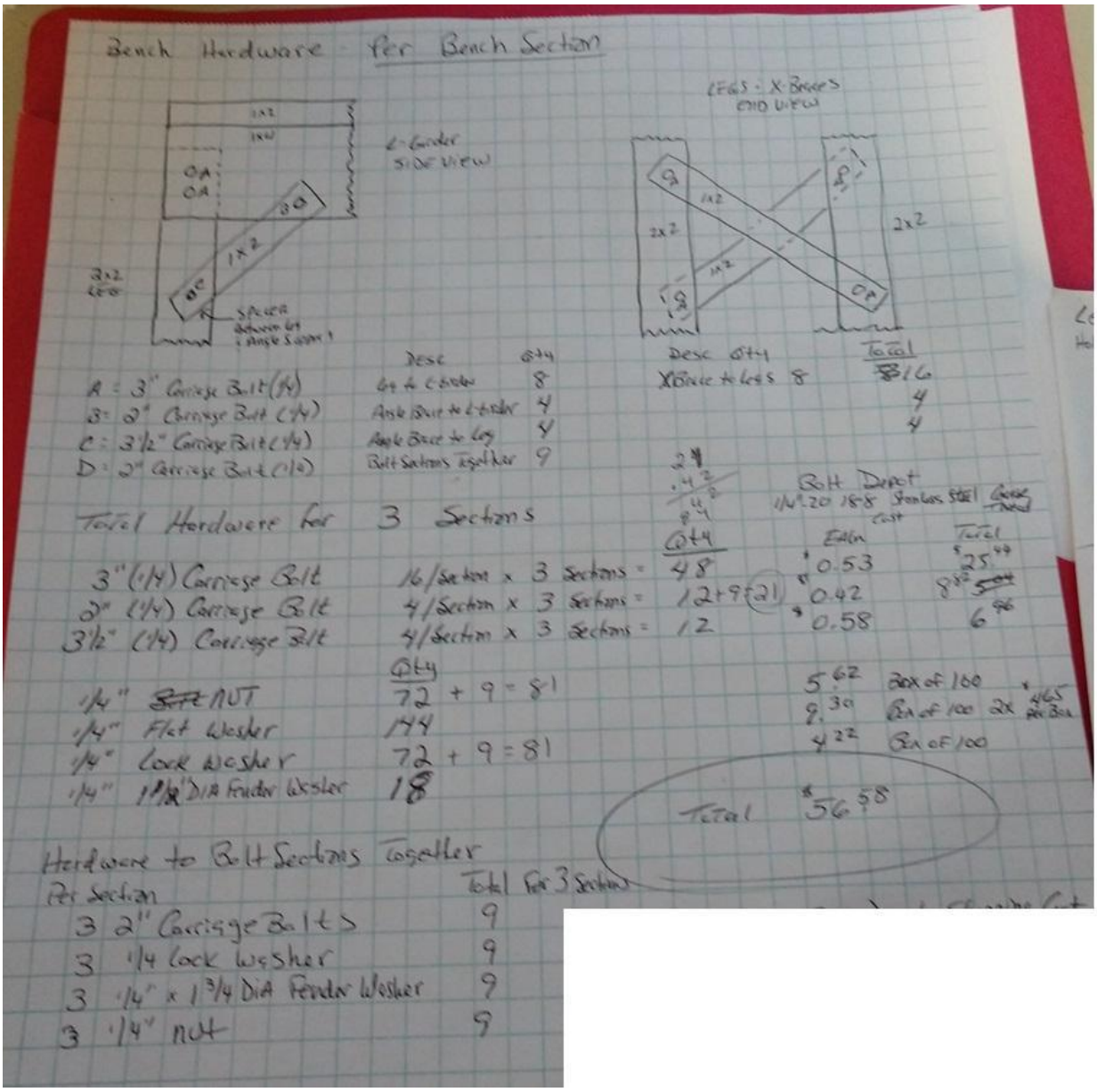
Build 6 – Legs and Braces Close Up

Picture Build 7 is a shot of the 3 benchwork sections in various stages of construction. Left to right: 4' section completed and awaiting installation of plywood top, 7' section has all 1x3

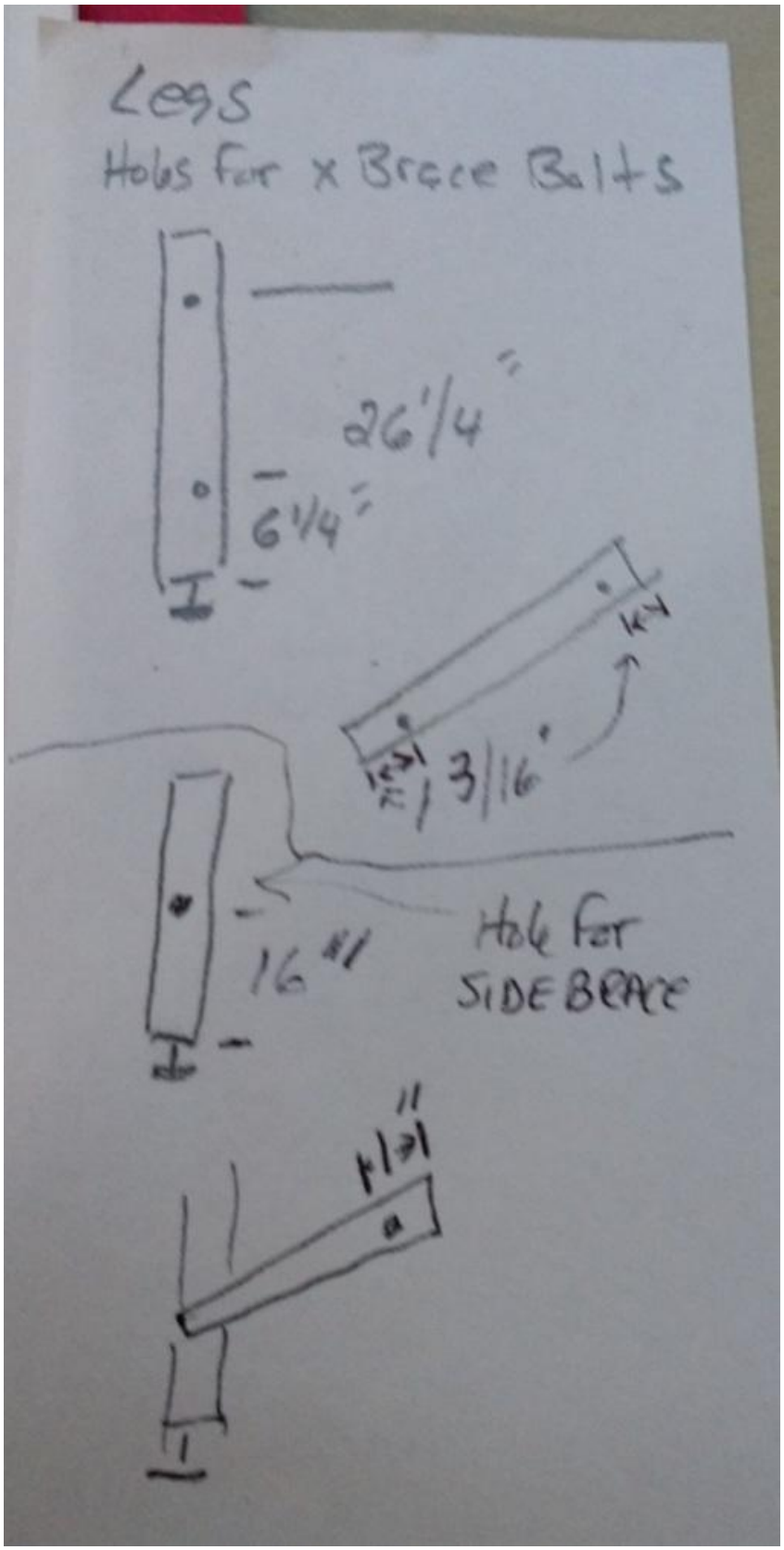
cross beams attached and is ready for installation of legs, 8' section is still on floor awaiting installation of 1x3 cross beams.

Build 7 – Benchwork Sections Under Construction

Below in Build 8 and Build 9 are my BOM (bill of materials) for the nuts and bolts that were purchased from Bolt Depot, along with a sketch of the critical bolt hole locations for the legs and braces.



Build 8 – Bill of Materials for Benchwork Hardware



Build 9 – Hole Locations for Legs and Braces

All 3 sections of the base portion of the benchwork are complete (picture below, Build 10) and placed end-to-end. I just need to stain the leg braces in the middle (8') section. That's a 19' x5' area of benchwork you are looking at. Looking at the picture from left to right are the 7’ module on the left end, the 8’ module in the middle, and the 4’ module on the right.

Build 10 – Benchwork Sections Placed Together

Next, I roughly leveled all 3 sections using the leveling pads at the bottom of each benchwork leg. With the 3 sections roughly leveled, I then prepared to bolt them together. I bolted the three benchwork sections together using 3 2" long 1/4" carriage bolts between each section. Here's a couple of photos of the sections of the benchwork bolted together.

Build 11 picture below is a top view of the bolted ends of the benchwork sections.

Build 11 – Top View of Benchwork Sections Bolted Together

Build 12 picture below is another view from underneath.

Build 12 – Bottom View of Benchwork Sections Bolted Together

With all 3 sections bolted together, I made the final leveling adjustments so that all 3 sections are perfectly leveled across the top of the 1x3's both end to end (19' length) and side to side (5' length).

With the base benchwork assembled, bolted together, and leveled, the next step is to trim the 3 4'x8' plywood sheets to fit across the top of the benchwork's 1x3's. I trimmed 2 of the sheets of plywood to 4' and 7' lengths to align with the 4' and 7' length modules of the benchwork. The 3rd piece of plywood that is 8' long was placed over the 8' long module. The extra pieces left over from the sheets of plywood that were trimmed for the 4' and 7' modules were trimmed to fill out the 5' width of the benchwork. Build 13 picture below shows all the trimmed plywood pieces temporarily laid across the top of the 3 benchwork modules.

Build 13 – Plywood Trimmed and Placed Across Top of the Benchwork

With the plywood placed on top of the benchwork, I temporarily tacked down all of the plywood pieces to the benchwork 1x3's using 1" or 1¼" #8 dry wall screws that were countersunk so that the screw heads are flush or slightly below the plywood top surface. Since the track will be laid directly on top of the plywood, countersinking the screws will allow the track to sit flush on the plywood top without any interference from a protruding screw head (if they were not countersunk).

I need to point out that at this time; the plywood is only attached to the benchwork with the minimal amount of screws. The reason for this is that I will be removing the plywood pieces to cut them for elevation changes as well as trimming the pieces in the corners so that all 4 corners of the benchtop are rounded after we dry fit the track onto the benchtop.

Next step is to begin preparing the track for placement on the plywood benchwork top. We'll cover this in the next section. However, before proceeding, I wanted to share pictures of several unique pieces of equipment I used during the benchwork build.

First is this drill block jig, Build 14 picture below. This is used to guarantee that the hole you are drilling in a piece of wood is perpendicular (90 degrees) to the surface of the wood. You simply insert the drill bit into the appropriate size hole (I used 1/8" and 1/4" drill bits), place the drill block flat on the surface of the wood, and drill away. This drill block is critical when

drilling holes for the carriage bolts that I used to bolt the legs to the benchwork and the cross braces to the legs.

Build 14 – DrillBlock Drilling Jig

Next is a cross-cut jig from Kreg, Build 15 picture below, that I used to make nice straight cross-cuts on the plywood pieces using my hand held circular saw. While I do have a small table saw, it is too small to handle a 4x8 sheet of plywood.

Build 15 – Kreg Panel Cut Guide

That completes the base build of the benchwork. There is still more benchwork building to do that will be covered in later sections of this document. For now, we need to start preparing the track as described in the next section, so that the track can be mounted to the benchwork.

Preparing the Track

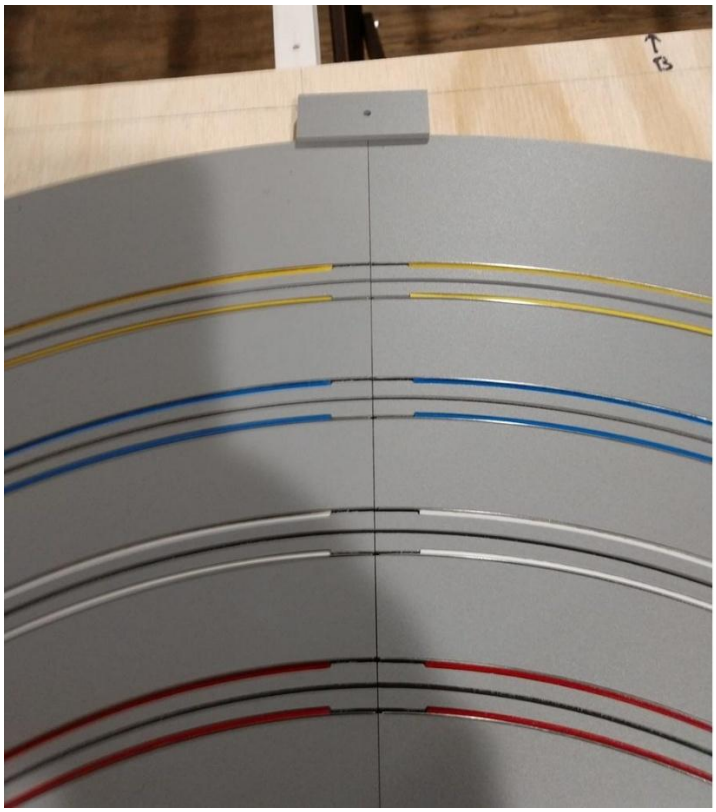
A couple of very important goals for the building of this track is for the track to have smooth transitions between track elevations and the banking of some turns along with the capability to run (race) the track in both directions.

While the Max Trax is a high-quality track, it is ultimately a sectional track, with 42 different sections making up the track I am building. Thus with 42 section joints, it is important to ensure each of these joints is as smooth as possible. To accomplish this, I performed a couple of modifications to the track: 1) A better method to mount the track sections to the plywood benchwork top, and 2) Pinning the track sections together. The following sub-sections describe these modifications in more detail.

Track Mounting Modifications

This Max Trax was built in 2006 and utilizes external blocks/clamps, that clamp over the edge of the track to hold it in place on the bench top.

Here are pictures, Mount 1 and Mount 2, showing how the block/Clamp is placed at the edge of the track right at the joint of two track sections. The hole in the block/clamp is for a screw that would then screw into the bench top securing the track to the bench top.



Mount 1 – Max Trax Track Mount Block circa 2006

Mount 2 – Closeup of Track Mount Block

I had a couple of concerns with this type of track mount: 1) These block/clamps are placed at every track joint, both on the inside and outside edges of the track sections, that I believe detracts from the overall look of the track, and 2) With these block/clamps protruding above the track surface, when a car de-slots, there is a potential for the car to have a strong impact with the block/clamp potentially creating serious damage to the car.

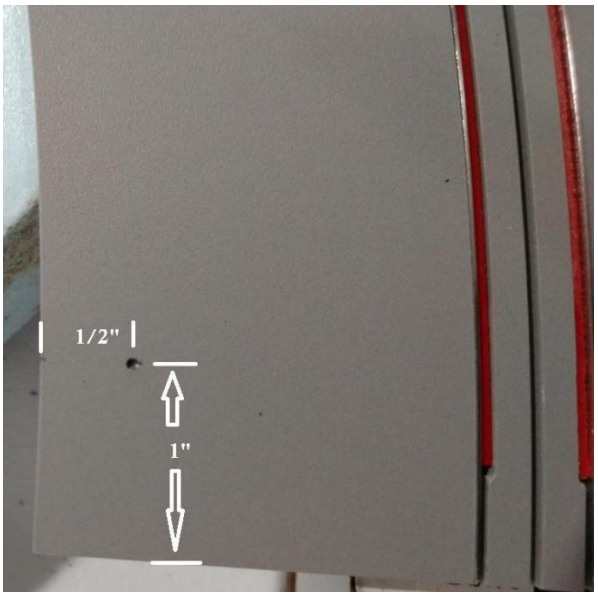
To address these concerns, I decided to drill holes in the track to screw the track directly to the bench top. To begin this process, I took a ride over to Lenjet to look at one of the Max Trax tracks to get an idea of the dimensions for the holes to drill in the track (i.e. how far in from the edge of the track are the holes drilled). Here's a picture, Mount 3, of the measurement I took on the Bear Max Trax track at Lenjet. You can see that the holes are located 1/2" from the edge of the track.

Mount 3 – Location of Track Mounting Hole on Max Trax

I decided to use #6 phillips head machine screws 1" long with a washer, lock washer, and nut to secure the track to the benchwork. Here are some of the tools I used to drill the holes in the track sections, picture Mount 4 below, from left to right: a 9/64" drill bit, a #6 counter sink bit, and a drill block, with 9/64" hole, to ensure drill bit is perpendicular to the track when drilling the hole.

Mount 4 – Tools to Drill Track Mounting Holes

On each track section I would drill at least 4 holes, using the dimensions shown in the Mount 5 picture below. These holes would be 1/2" in from the edge and 1" in from the end of the track section. For some of the larger radius curves, a fifth hole was drilled at the outer edge radius of the track section. On the longer straight section, 36” long, I would drill mounting holes in the center edges of the track. With 42 track sections, I was about to drill at least 168 holes.

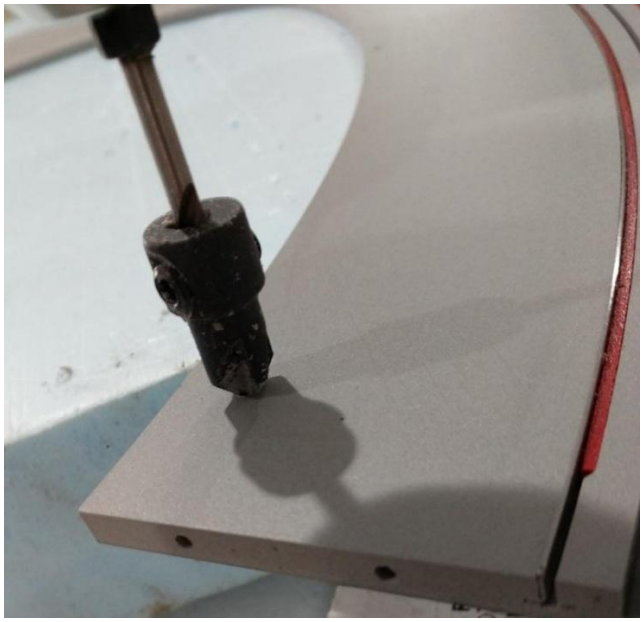


Mount 5 – Location Dimensions of Track Mounting Holes

Once the hole location was marked, I center-punched it to make sure the drill bit would not wander when starting the hole. Here's a picture, Mount 6, of the hole being drilled using the 9/64" drill bit and the Drill Block to ensure the hole is perpendicular to the track surface.

Mount 6 – Drilling Track Mounting Hole using DrillBlock

With the hole drilled, I then needed to counter bore the hole so that the flat head screw would sit flush, or slightly below, the track surface. Here's a picture, Mount 7, of the counter bore bit drilling the counter bore.



Mount 7 – Counter Bore Bit Drilling Counter Bore in Track Mounting Hole

Here's a picture, Mount 8, of the completed counter bore hole with the #6 Phillips head machine screw inserted. You can see that the head of the screw is flush or slightly below the track surface.

Mount 8 - #6 Phillips Head Screw Inserted into Track Mounting Hole

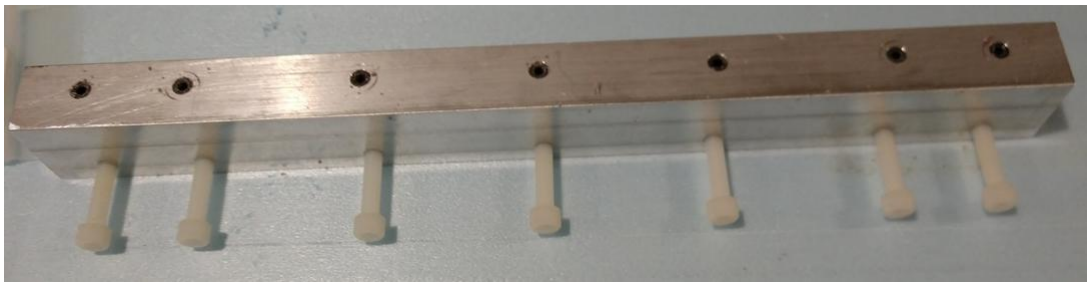
To give you a better idea of how the track will mount to the bench top, once the track is put back together and placed on the bench top (final dry fit), I will then drill 9/64" holes through the bench top, which is 3/8" plywood, using the holes drilled in the track sections as a reference. With these holes drilled, the #6 screw will be inserted into the track from the top and a washer, lock washer, and bolt will be screwed onto the end of the screw under the bottom of the plywood bench top. This will bolt down the track to the plywood bench top. This will be covered in more detail in another section of the document when we go to permanently mount the track to the benchtop.

Pinning

Pinning track sections together is not something new. You may recall the original Aurora Model Motoring track sections from the 1960's used 2 metal joiner pins that slipped into the end of each track section to ensure alignment between the track sections when pushed together. Then a plastic U-shaped roadway lock was inserted into the top of the track sections to lock them together. Below in picture Pin 1, is a section from an old Aurora instruction manual showing the pin and lock method used to join track sections

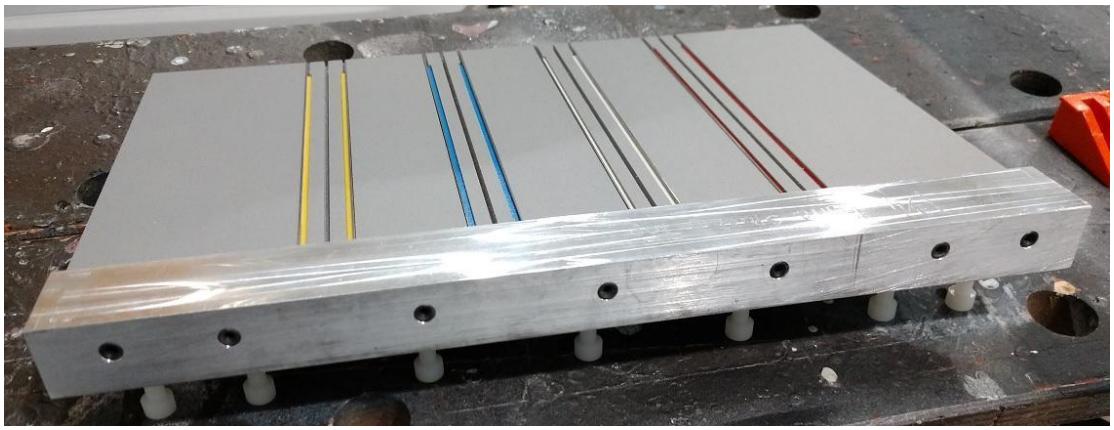
Pin 1 – Aurora Instruction Manual, Joining Track Sections

I would use this same technique to align the Max Trax sections together for my track. However, first I had to drill the joiner pin holes in the ends of each piece of Max Trax. Fortunately, Richard at Modelville Hobbies has a pinning jig for Max Trax that he let me borrow. If you are interested in pinning your track, you should reach out to Richard for a pinning jig, as I believe there are several jigs available for the different makes of routed HO track. Pin 2 picture below is a picture of the Max Trax pinning jig.



Pin 2 – Pinning Jig

The jig itself is a U-channel of aluminum that slips over the end of the track piece. There are seven holes drilled through the end of the jig to align the drill bit for drilling the joiner pin holes in the end of the track. The seven plastic thumb screws align and secure the jig to the end of the track. Pin 3 picture below shows the pinning jig attached to the end of a piece of Max Trax.



Pin 3 – Pinning Jig attached to Max Trax

In addition to the pinning jig, you will need this additional material as shown in Pin 4 picture below, from left to right: drill depth collar for #41 drill bit to drill consistent length holes in track sections, 300 3/8" diameter oversized 3/4" long steel pins (aka dowels) (at $0.80 each, you do the math!), and 2 #41 drill bits. Yeah, that's about $255 of material you are looking at!

Pin 4 – Pinning Material

As you can see from the picture, I purchased all this material from McMaster-Carr. Obviously, your costs will vary based on the number of steel pins you will need for your track. Also, you could save a little by reducing the number of pins you insert into each end of the track. In my case, I decided to use all seven pin locations.

I highly recommend that you purchase the drill depth collar to ensure all the holes for the joiner pins are drilled to the same length. With 588 holes to drill for my track, using the depth

collar was invaluable. Using a piece of masking tape wrapped around the drill bit to mark its depth will easily get worn off or moved after a few holes are drilled.

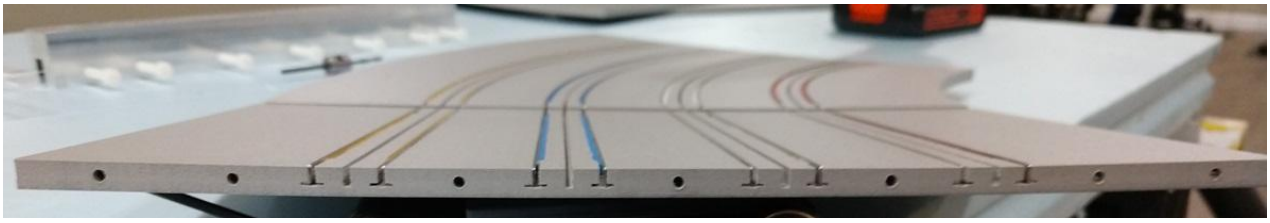
Okay, on with the process of pinning the track.

As previously mentioned, the dowels are ¾" long steel pins. I'll be setting my drilling depth to 7/16" to allow room for any trapped air inside the hole when I insert the oversized dowel. Pin 5 picture below shows the #41 drill bit secured to drill depth collar at the 7/16" depth.

Pin 5 – Drill Depth Collar with #41 Drill Bit Inserted to 7/16" Depth

Mount the pinning jig to the end of the piece of track with the plastic thumb screws towards the bottom of the track. Refer to picture Pin 3 above that shows the jig mounted to the track. The jig is designed such that you can only attach the jig to the track in this orientation.

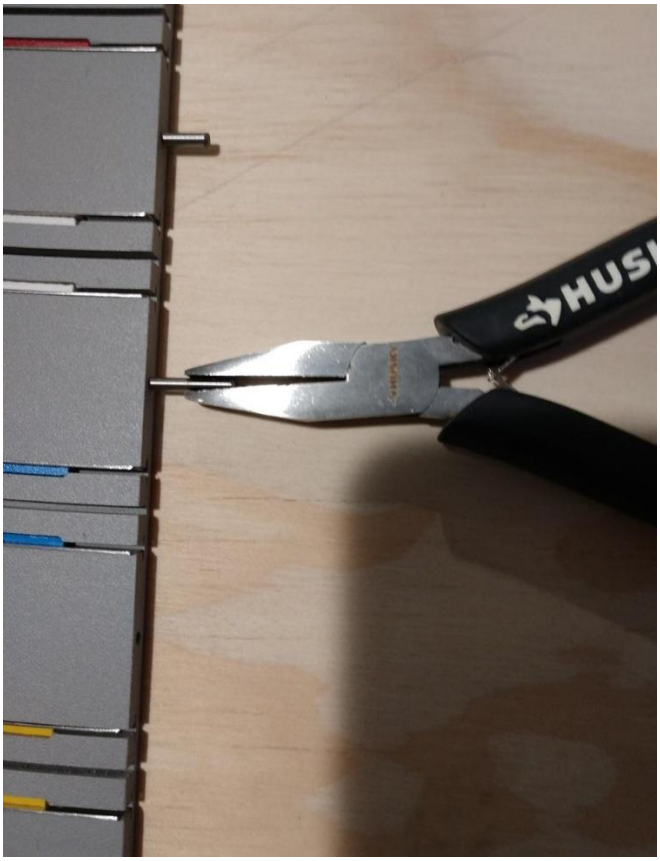
Now using your drill with the #41 drill bit mounted in the drill depth collar, drill out the seven holes in the end of the track**.** ***It is important that you drill slowly as the track is made of plastic material and drilling too fast will melt the plastic resulting in melted plastic remaining in the hole and the hole diameter may be too large.*** I determined that no more than a couple of hundred RPMs speed of the drill worked perfectly. At this speed you should see string like pieces (like angel hair spaghetti) of plastic coming out of your drill bit as it bores the hole. If material is coming out of the drill bit as flat and mushy, you are drilling too fast, generating heat and melting the plastic. Pin 6 is a picture of the end of the track with the dowel pin holes drilled.



Pin 6 – End of Track with Pinning Holes Drilled

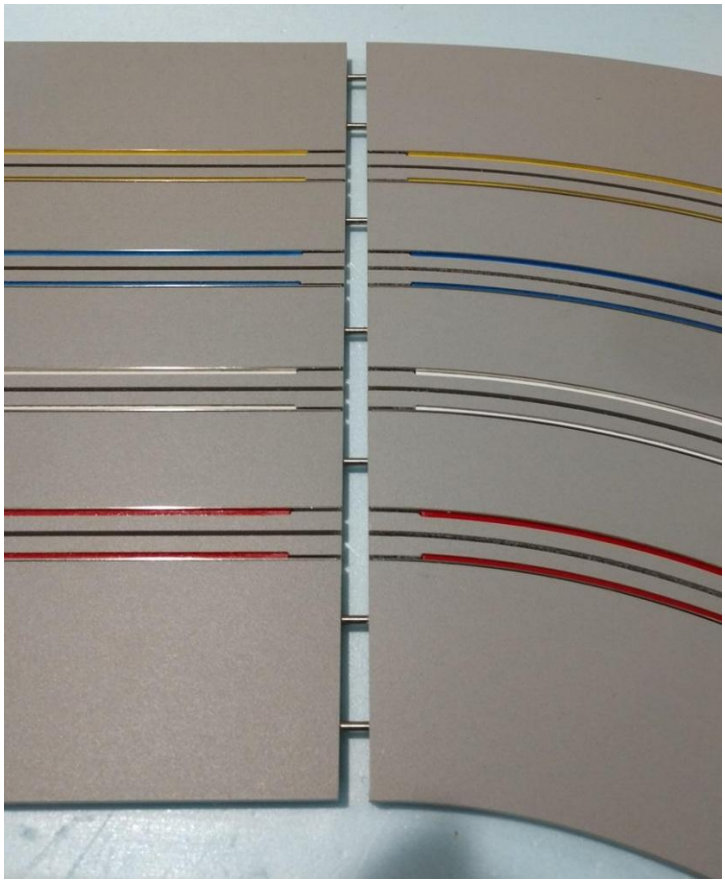
With all the holes drilled, I then began the process of inserting the pins into the track sections together. However, before inserting the pins into the holes, I noticed that the pins had a "sticky" coating on them. Probably some sort of lubricant from the machining process. This coating was making it very difficult to insert the pins into the holes, especially when joining 2 track sections together. To remove this coating, I placed all the pins into 91% isopropyl alcohol, which promptly removed the coating. With the coating removed, I then began

inserting the pins into the track ends using a smooth jawed set of pliers (see picture Pin 7 below) so as not to mar the surface of the dowel pins.



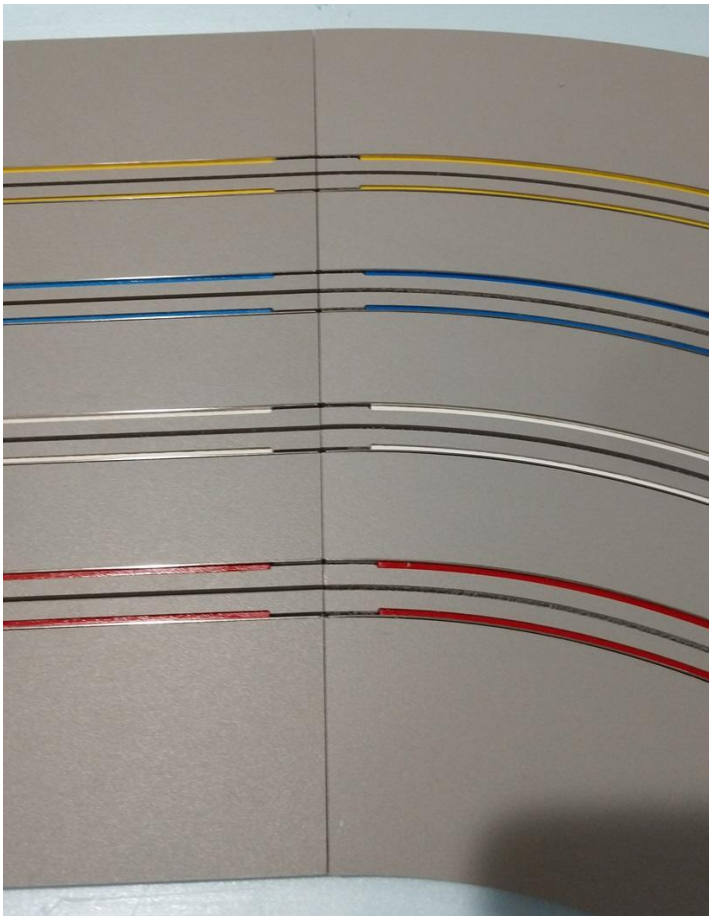
Pin 7 – Inserting Dowel Pins into Track

Here's a couple of pictures, Pin 8 and Pin 9, of assembling two of the track sections together with pins. This picture, Pin 8, is of the track sections partially pushed together to give you an idea of how the pins line up between the track section ends.



Pin 8 – Pinned Track Sections Partially Pushed Together

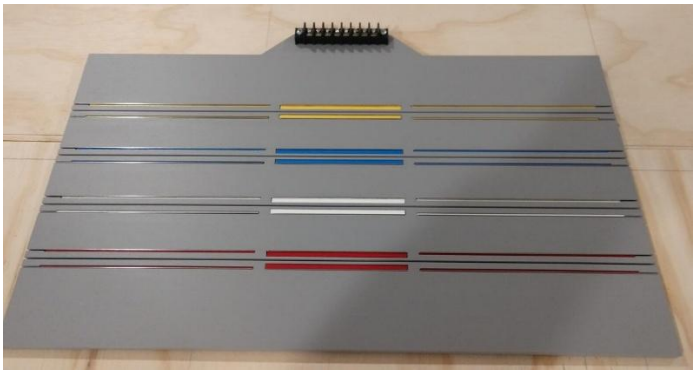
Here's the track sections, picture Pin 9 below, completely pressed together. While the picture does not show it, the joint between the 2 track sections is extremely smooth (like one piece). The lens of my cell phone camera along with the angle of the picture distorts the alignment of the lane slots. They are aligned.



Pin 9 – Pinned Track Sections Joined Together

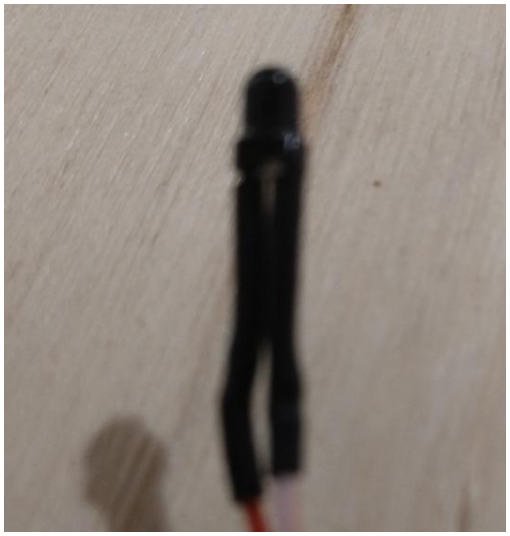
Track Timing Sensor LEDs

The Max Trax layout came with an 18" straight dead strip section of track that could be used as a lap counter, as shown in picture Timing 1 below.



Timing 1 – Max Trax Dead Strip Track

The track also came with an additional 18" straight section that could be used in place of the dead strip track section. Since IMHO dead strips utilizing relays as a lap counter is 1960's technology, not to mention it creates some complexity with a track that will be wired to run in both directions, I decided to use the 18" straight section to implement infra-red LED sensors utilizing a TrackMate lap counter kit specifically sized for Max Trax. To do this I had to mark and drill the holes in the track section for each lane's sensor LED. Drilling the hole was a little more complicated due to the "top hat" shape of the LED sensor as shown in Timing 2 picture below. Notice that the base of the LED (where the wires protrude from has a lip and is slightly wider than the top part of the LED.



Timing 2 – "Top Hat" shaped LED Sensor

To account for the unique shape of the LED and ensure that the LED fit up far enough inside the track, I drilled a 1/8" hole through the track in each lane between one of the rails and the slot. From the bottom of the track, I then enlarged this hole using a 5/32" drill bit, drilling 1/16" into the base of the track. This creates a slightly wider hole at the bottom of the track to allow the entire LED sensor to sit inside the track at a proper depth. Timing 3 picture below shows the top side of the track with the 4 LED sensor holes drilled for each lane.

Timing 3 – LED Sensor Holes drilled in Track Section

We'll come back to installing the LEDs into the track later in the build when we are installing the TrackMate timing hardware.

With the track sections prepared and the base benchwork complete, it is now time to begin installing the track onto the benchwork.

Cookie Cutter Plywood Top

In the previous section we prepared the track pieces by drilling the mounting holes and drilling and installing the metal pins to ensure the track surface is aligned and smooth.

In this section we'll assemble all of the track pieces and dry fit them on top of the plywood benchtop (track pieces not screwed down), trace the outline of the track on the plywood, cut

along these trace lines for the elevated sections of track, build up the elevated sections of the plywood including the crossover, then reinstall the track and mount it to the plywood using the mounting holes already drilled into the track.

Dry Fit Track

I began by joining the track sections together with the pins. I found it easiest to begin with the infield track sections (that part of the track that will be located in the middle of the plywood top). Before inserting the pins into the track sections, I first cleaned the pins using 91% isopropyl alcohol to remove any coating on the pins left over by the machining process. Next using a smooth jaw set of pliers, I pushed the pins into one side of a track section. It is important that the pliers are smooth jawed so they will not mar the surface of the pins when inserting them. Now get the next track section, align it with the pins from the first track section and push the two track sections together. Some force is needed and you may have to apply force from side to side to get the tracks to fully join. When joined, the track sections should look like the Pin 9 picture from the Pinning section.

Continue joining the track sections together, aligning them in the correct position on the plywood bench top. Dry 1 picture below shows the track assembled on the plywood top.

Dry 1 – Track Dry Fit Assembled on Plywood Benchtop

With the track dry fitted (not screwed down) to the plywood benchtop, I then aligned the track so that the track was square to the edges of the plywood top. Once the track was aligned, I then traced around the track edges with a pencil so that the track layout was now marked on

the plywood. Dry 2 picture below is a closeup of the track outline on the plywood (this is the inner portion of the scorpion tail turn) once the track outline was traced and then the track removed.

Dry 2 – Outline of Track Traced onto Plywood

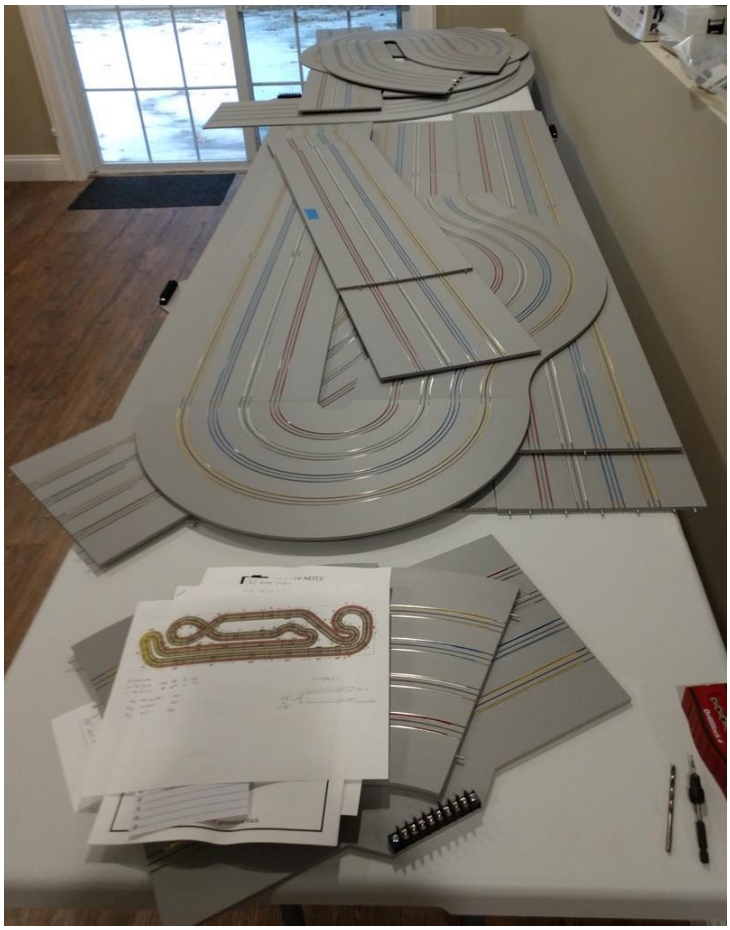
The reason for this dry fit and track outline on the plywood is that I can cut the plywood top pieces for the elevation needed to cross over the corkscrew. As I had previously mentioned, I am using the model railroading "cookie cutter" method of benchtop when plywood is used and cut in different areas for elevation changes. This method creates a smooth, continuous surface for the track to be attached to. The elevation changes are achieved by installing "risers" under the plywood that are attached to the cross braces of the benchwork.

Another thing I measured and marked was the corners of the plywood as I wanted to round them off somewhat based on the curvature of the track in these corners. Here's a picture, Dry 3 below, of one of the corners I will be trimming. The pencil lines toward the bottom of the picture indicate the line I will cut on the plywood.

Dry 3 – Cut Lines Drawn on Plywood for Rounded Corners

A couple of more measurements for cut outs on the plywood were needed for the lap counter/timer LEDs and cut outs at the track power feeder sections to feed the wire from the power supply to the track. I'll cover this in more detail when I explain the track wiring in another section of this document.

With the track outlined on the plywood, I then began removing the track sections and placing them temporarily on some folding tables, as shown in Dry 4 picture below. To save time removing and then when reinstalling the track, I broke the track down into sections that were made up of several track pieces.



Dry 4 – Track Sections in Temporary Storage

Preparing Plywood Top – Mounting Holes, Trimming, Elevation Cuts

With the track removed I then drilled the remaining holes in the plywood top that will be used to screw done the plywood top to the benchwork. All the holes were counter bored to ensure that the drywall screws used to attach the plywood to the benchwork are at or below the plywood top surface so that the screws do not interfere with the track when it is attached to the plywood top. Here's a picture, Prep 1 below, of one of the plywood top pieces with the counter-bore holes. The counter bore holes are aligned with the cross braces of the bench work (denoted by the straight pencil lines on the plywood) and are then drilled every 12" along the cross brace.

Prep 1 – Section of Plywood Top with Counter Bore Holes

With the track pieces removed and in temporary storage, I then removed all of the plywood top pieces so that I could do my cuts on the plywood. Here's a shot of the benchwork with the plywood removed, Prep 2 below. Sometimes you need to take a step (or two) back to move ahead. 😁

Prep 2 – Benchwork after Plywood Top Removed

For those of you with an eagle eye, you may have noticed an additional part of the benchwork (the white legs/shelf, in the center section) in the picture above. I'll get to that in the next section on the power supply.

Two major things I am trying to accomplish in cutting the plywood bench top: 1) rounding of the corners of the bench top to somewhat conform to the corners of the track, and 2) the infamous "cookie cutter" method of elevating the track for the corkscrew.

Here are some pictures, Prep 3 and Prep 4 of the plywood bench top after is has been trimmed, specifically the corners. You'll notice that the benchwork bracing, white 1x3's, have not been trimmed back yet. I am just dry fitting the cut plywood on top of the benchwork at this point after the plywood has been trimmed.

Prep 3 – Bench Corner Short Radius

Prep 4 – Bench Corner Long Radius

Here's an update of the last corner picture, Prep 4 (directly above) corner with the bracing trimmed in Prep 5 picture below.

Prep 5 – Bench Corner Long Radius with Bracing Trimmed

Here's an overall picture, Prep 6 below, of the trimmed plywood bench top. Notice that the corners of the bench top have been rounded as well as a little cut out, I'll call it the "marshal's nook" along the back edge. You'll notice that I have not trimmed back the (white) 1x3 braces at the corners and the nook. You may also notice in the back left corner of the layout a portion of the corkscrew that has been cut and is sitting slightly higher than the rest of the bench top. This is as a result of the cookie-cutter method to elevate the track in the corkscrew.

Prep 6 – Trimmed Plywood Bench Top

Here's a picture of the bench top with the braces trimmed, Prep 7 below. Notice the corkscrew section is elevated at the overpass. Starting to look like a layout. At this point I have permanently attached the plywood bench top to the benchwork (bracing) using construction adhesive and the drywall screws that have been counter sunk into the plywood top. Here's a tip on adhesives: When you go to buy adhesives, whether it is a construction adhesive in a tube, or yellow carpenters glue, when you are in the store (big box or local hardware store) look down on the floor. More specifically look at the adhesives on the lowest shelf. It is this lowest shelf that contains the lowest cost adhesives. For my application, being indoors, I did not need waterproof, weatherproof adhesives which are always located at the waist high shelving and typically cost at least 2x more than the adhesives on the bottom shelf.

Prep 7 – Trimmed Plywood Bench Top with Bracing Trimmed and Corkscrew Elevated

Bridge Abutments and Elevations

Now it is time to focus on the elevated sections for the corkscrew. The critical measurement that all the elevations will be based upon is the clearance between the track as it passes under the overpass of the corkscrew. For this track, I am using 2 1/4" as my clearance. With this number determined, I cut out a couple of "bridge abutments" from some spare pieces of 1x3 lumber and spray painted them black. Here's a couple of pictures of them in place on the bench top, Elevation 1 and Elevation 2 below.

Elevation 1 – Bridge Abutment Left

Elevation 2 – Bridge Abutment Right

With the abutments in place, I could then begin elevating the back straight that leads into the top of the corkscrew using the cookie cutter method. Here's a picture, Elevation 3, of the plywood bench top that was cut to allow it to be elevated using risers (1x2's and 1x3's) attached to the bench work 1x3 bracing. The tops of the risers are then secured to the plywood sub road of the track (the plywood that is elevated) using drywall screws that again have been countersunk to provide a smooth surface for the track to lay on.

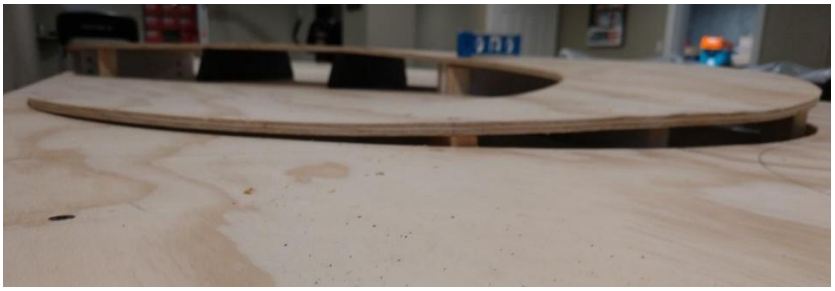
Elevation 3 – Risers Used to Elevate Back Straight

With the back straight sub roadbed elevated it was now time to set the elevation of the corkscrew as it changes elevation at its highest height at the abutments down to ground level at the underpass. Besides the elevation change in the corkscrew, I also added some camber (i.e. banking) to the corkscrew turn by elevating the outer edge slightly.

Here's a picture of the corkscrew, Elevation 4 below. It is hard to see the banking in the picture, but if you look close enough at the back right of the picture where the corkscrew elevated sub roadbed is (plywood) you can just barely notice that the outer edge of the turn is a little higher than the inside edge.

Elevation 4 – Corkscrew with Risers in Place for Elevation and Banking

Here's another picture, Elevation 5.

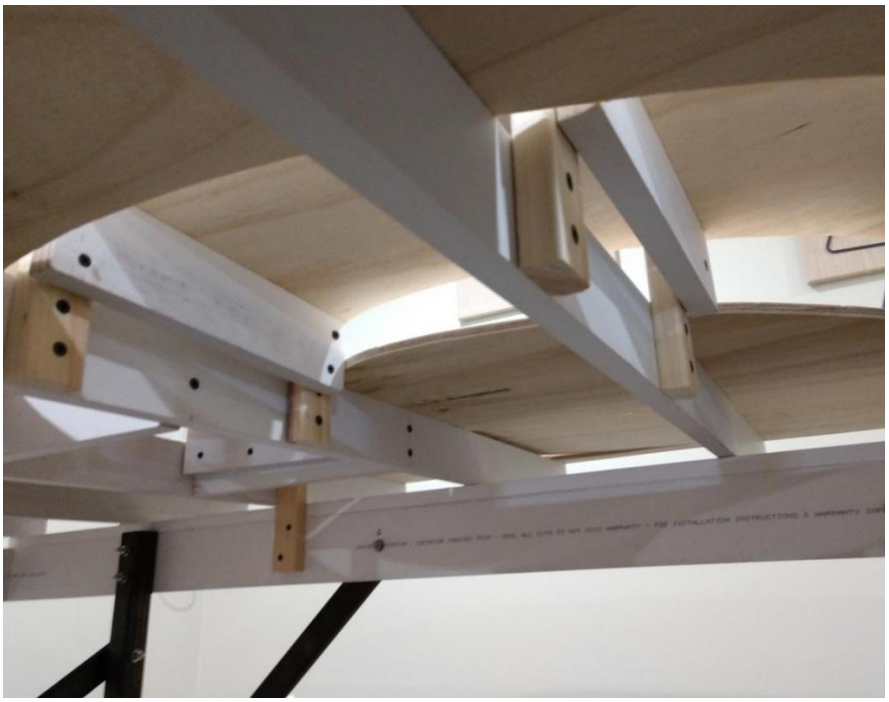


Elevation 5 – Corkscrew Full View

Again, while it is hard to see the banking in the pictures, here's a level I placed across the corkscrew roadbed, Elevation 6 below. Look closely and you will see that the level bubble in the middle gauge is offset such that the plywood is higher in the outside of the turn than the inside.

Elevation 6 – Bubble Level Showing Banking in Corkscrew

Here's a picture, Elevation 7, of the risers underneath the benchwork that are used in the corkscrew.



Elevation 7 – Risers for Corkscrew Viewed Underneath Benchwork

Here's an overall view of the elevated sections of the plywood, Elevation 8, mainly the back straight leading up to the corkscrew and the corkscrew itself. This shot gives a good view of the cookie-cutter method I used to transition the track from the flat sections (plywood base attached directly to the 1x3 cross braces) to the raised track leading into and descending through the corkscrew with risers supporting the plywood base.

Elevation 8 – Overall View of Elevated Section of Plywood Benchtop

Finally, one other piece I had to cut out of the plywood bench top was a slot for the lap counter sensors. In the previous section on prepping the track, I had drilled holes into a section of track to mount the LED sensors used by the TrackMate timing system. These LED sensors are connected to a cable that will connect to the main TrackMate processor board. With that said, I had to cut a slot in the plywood that is directly under the track section along the main straight that will house the sensor LEDs, allowing the wiring from these LEDs to connect to the TrackMate processor board. Elevation 9 picture below shows this slot cut out.

Elevation 9 – Cut Out for LED Track Timing Sensors

That wraps up the major work to be done on the benchwork. There is still some additional work to be done on the benchwork (power supply shelf, fascia supports, etc.) that will be covered in future sections.

Power Supply Shelf and Wiring

Power Supply Shelf

Using some of the left-over lumber from the main benchwork, I built up a shelf for the power supply, TrackMate module, power relay and Arduino board that I attached to the main benchwork. The shelf consists of 1x3's for legs, L-girder sections to support a shelf, and a spare piece of cabinet shelving I cut down for the shelf. I located the shelf in the middle of the bench work, to minimize power lead (wires) length and maximize power distribution and bolted the tops of the 1x3 legs to the cross braces of the benchwork.

Picture Shelf 1 below, is a front view of the power supply shelf.

Shelf 1 – Front view of power supply shelf

Picture Shelf 2 below, is a side view of the shelf, showing how the shelf is attached to the main benchwork using bolts through the top of the 1x3 shelf legs and the main benchwork cross braces.

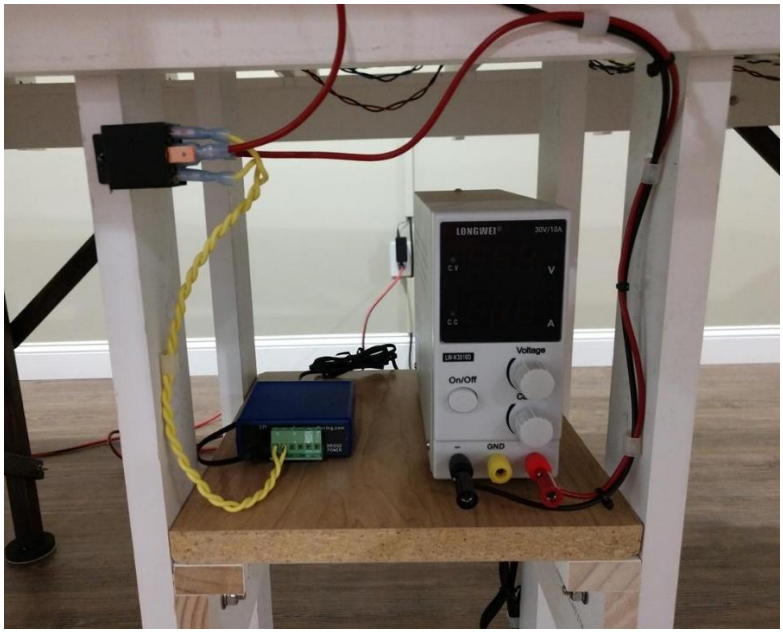
Shelf 2 – Side view of power supply shelf

Base Power Wiring

With the power supply shelf built and installed to the benchwork, I could begin working on the track wiring. What I call the base power wiring, is the wiring that provides the base track voltage from the output of the power supply to the power relay that is controlled by the Trackmate module and then distributed to the input of the driver stations.

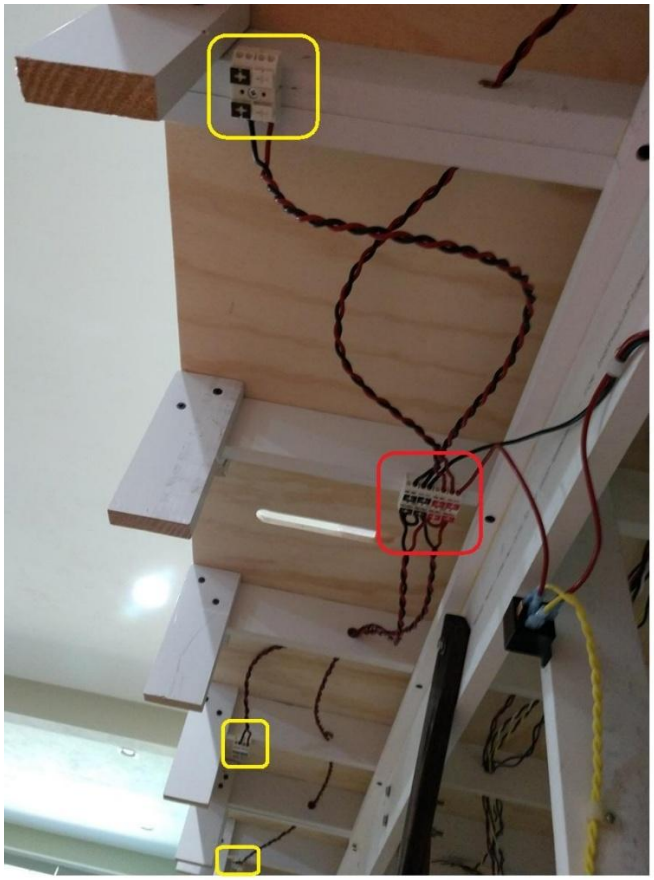
In picture Base Wiring 1 below, shows the base power wiring around the power supply shelf (from left to right): Power Relay, TrackMate module and, power supply. The 2 yellow wires running between the relay and TrackMate module are used to control (open and close) the power relay. The red wire running from the power supply goes to the input of the relay. The other red wire coming out of the relay (goes out of the picture at the center top of the picture) will distribute the voltage to the input of the driver stations. TrackMate provides an excellent,

detailed wiring diagram for this wiring in their documentation, available on their website, so I will not repeat a detailed wiring diagram here.



Base Wiring 1 – Base power wiring around power supply shelf

The next picture below, Base Wiring 2, shows the power distribution to the input of the driver stations. Circled in red is the main power distribution terminal block. Inputs to this block are the red output wire from the power relay (see previous picture) and the black (ground) wire from the power supply. From the main power distribution terminal block red/black cables are connected to the driver station input power terminal blocks, circled in yellow - I could only fit 3 of the driver stations into the picture, the red/black power cable going to the 4th driver station can be seen in the upper right-hand corner of the picture. I drilled holes through the bench framework 1x3's to pass the wire through and help to keep the wiring somewhat neat. I'll go back and dress all of this up to make it look even neater once I have connected the driver stations and completed all testing. Speaking of driver stations, the power input wires from the driver stations will connect to the driver station input power terminal blocks.



Base Wiring 2 – Power distribution wiring to driver station terminal blocks

Electrical Wiring – Track

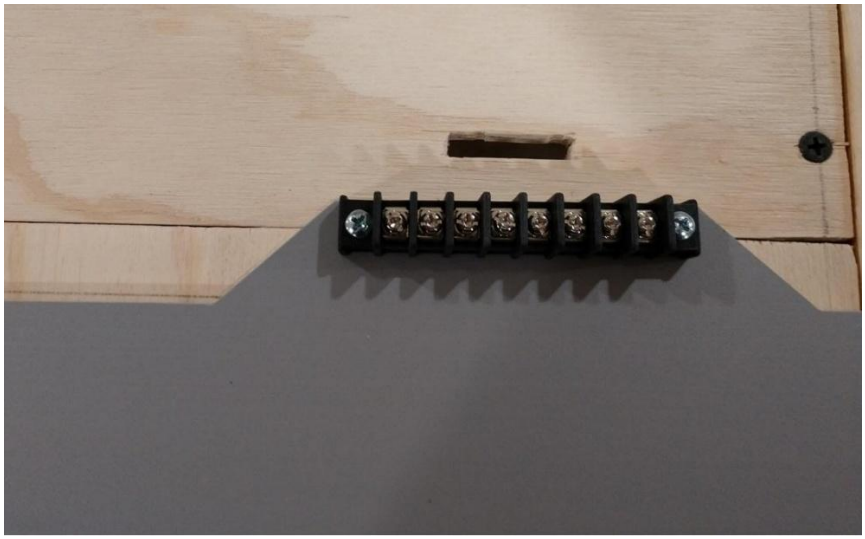
As a retired electrical/software engineer, the wiring of a track is a fun part for me. I know, I'm a geek.🤓

This section will cover the wiring that runs from the output of the driver stations to the track power feeder sections. We'll begin with preparing the wiring for the track power feeder sections, then prepare the underneath of the benchwork for running the wiring and finish up with installing all the wiring.

Track Power Feeder Sections

Going back to the top of the benchwork where I outlined the track, I located the 4 track power feeder sections and then cut out a slot in the plywood top that would allow me to feed the wires from under the benchwork to the screw terminal on the track power feeder sections. Wiring 1 picture below is a picture of the track power feeder track section laid down on the plywood with the slot cut out of the plywood to allow the wires to feed thru. The wires that

feed thru this slot will be screwed to the terminal connectors at the edge of the track power feeder section.

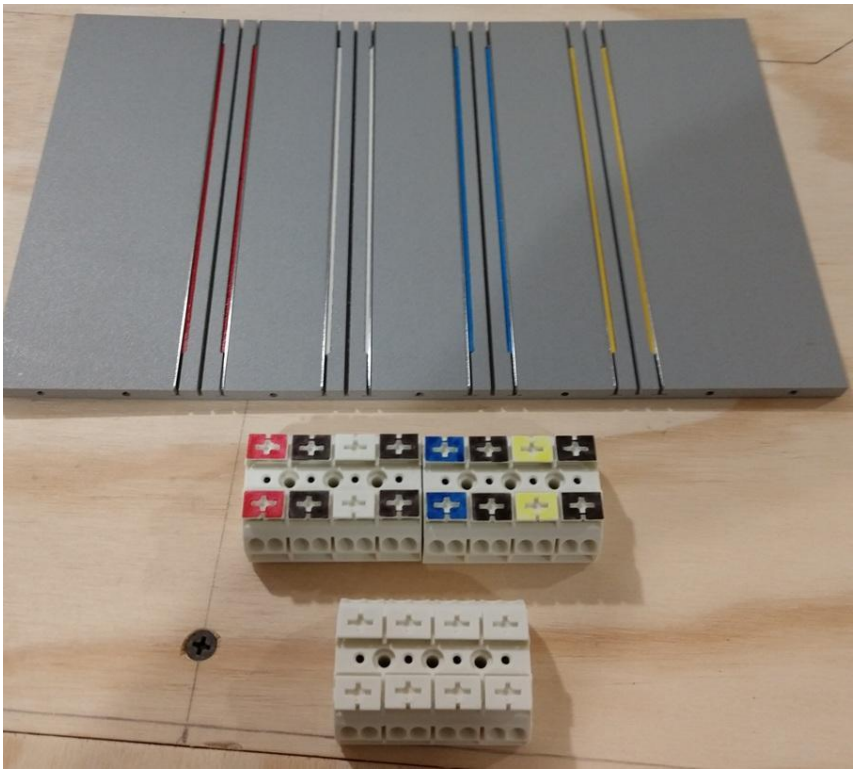


Wiring 1 – Wire feed thru slot for track power feeder section

Terminal Blocks

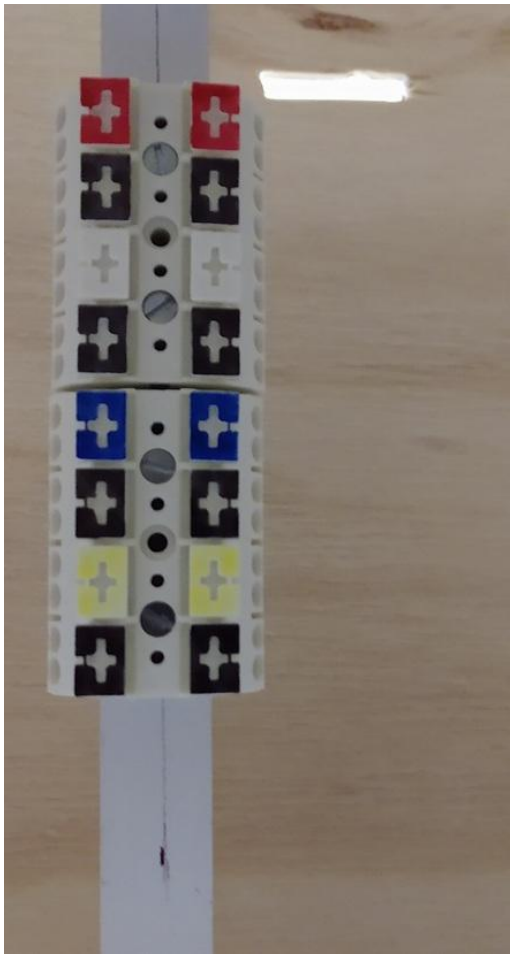
For terminal blocks I am using the Wago Push Lock terminal blocks. I like these as they do not require any tools (i.e. screwdriver) to secure the wire to the terminal block. Instead, you simply push the "+" button on terminal block to insert the wire. Additionally, using colored permanent markers, you can color-code the wires for each lane directly on the terminal block.

Wiring 2 below, is a picture showing the Wago Push Lock as it comes from Wago (bottom). I then use 2 blocks and color code them (middle) for the 4-lane track (top). You can connect up to 4 wires at each location, 2 wires on both sides. In the picture the red/black tabs are for the red lane (positive and ground, respectively), next to them are the white/black tabs for the white lane, blue/black tabs for the blue lane, and yellow/black tabs for the yellow lane.



Wiring 2 – Wago Push Lock terminal blocks

With the slots cut in the plywood top next to each of the track power feeder sections, I crawled under the benchwork and located a set of terminal blocks near these cut outs, attaching the terminal block to the bottom of a 1x3 cross support of the benchwork. I used #4 1" flat head screws to secure the terminal block to the 1x3. Wiring 3 picture below shows the terminal block attached to the 1x3 cross support. You can see the slot cut in the plywood in the upper right corner of the picture for the wire to feed thru to the track power feeder section.



Wiring 3 – Terminal block attached to 1x3 support

Benchwork Wiring Feed Thru Holes

While I was under the benchwork, I punched out (drilled) a number of 5/8" holes at various points in some of the 1x3 cross supports that will allow me to feed the wire through these holes when running them from terminal block to terminal block. Here's a picture, Wiring 4, of a couple of holes (pointed to by red arrow) in a 1x3.

Wiring 4 – Wiring feed thru holes underneath benchwork

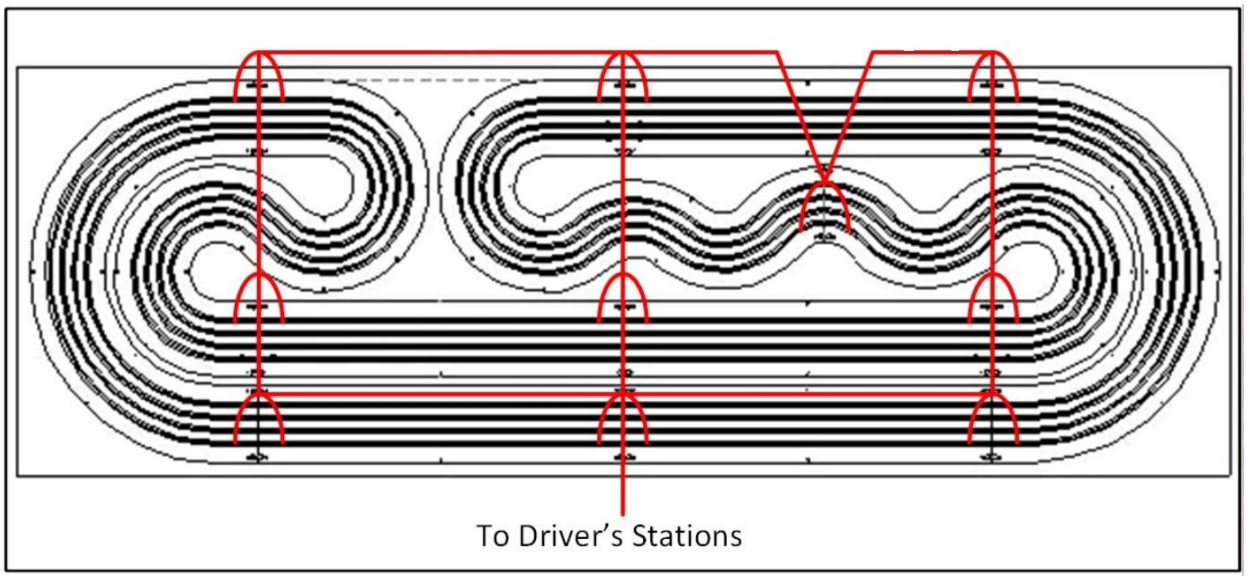
Next to a hobby shop, my second favorite place to visit is Harbor Freight. I bought a right angle drill that fits in between the cross supports (spaced about 11 1/2" a part) to allow me to drill the wire feed thru holes. I bought the corded version of the drill as it was less than half the cost of the battery version once you added in the cost of the battery and charger. Wiring 5 below is a picture of my new toy.

Wiring 5 – Right-Angle drill

With the terminal blocks in place and the holes drilled to feed the wires through, we are ready to start wiring the terminal blocks to one another. The next section will go into the details of this wiring.

Base Ring Wire

There are several ways to wire a slot car track. These methods are called: daisy chain, star, and ring. This website gives a very detailed description of each: New Page 1. For my track I am using the ring wiring method. Wiring 6 picture below is an example diagram of the ring wiring. Notice how every track feeder section (there are 10 of them in this example diagram) is connected to one another via a wire “ring”.

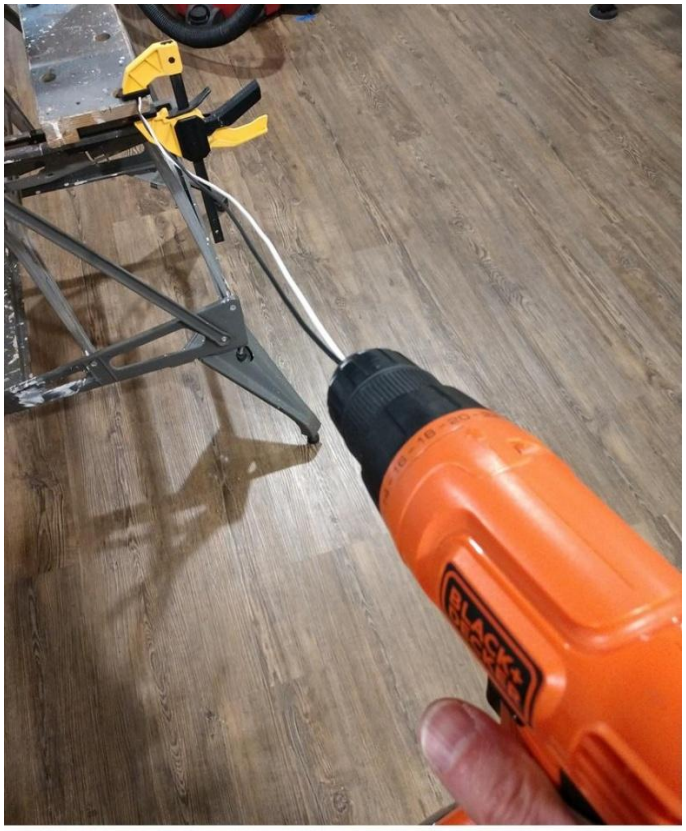


Wiring 6 – Example diagram of ring wiring

The base ring wiring is the wires that will connect all the Wago terminal blocks (described in the last section) to each other. This forms the "ring" wiring configuration. I am using 16 AWG 19 strand "primary" wire in the 4 lane colors (red, white, blue, yellow) and black for all the return (or negative/ground voltage) lines.

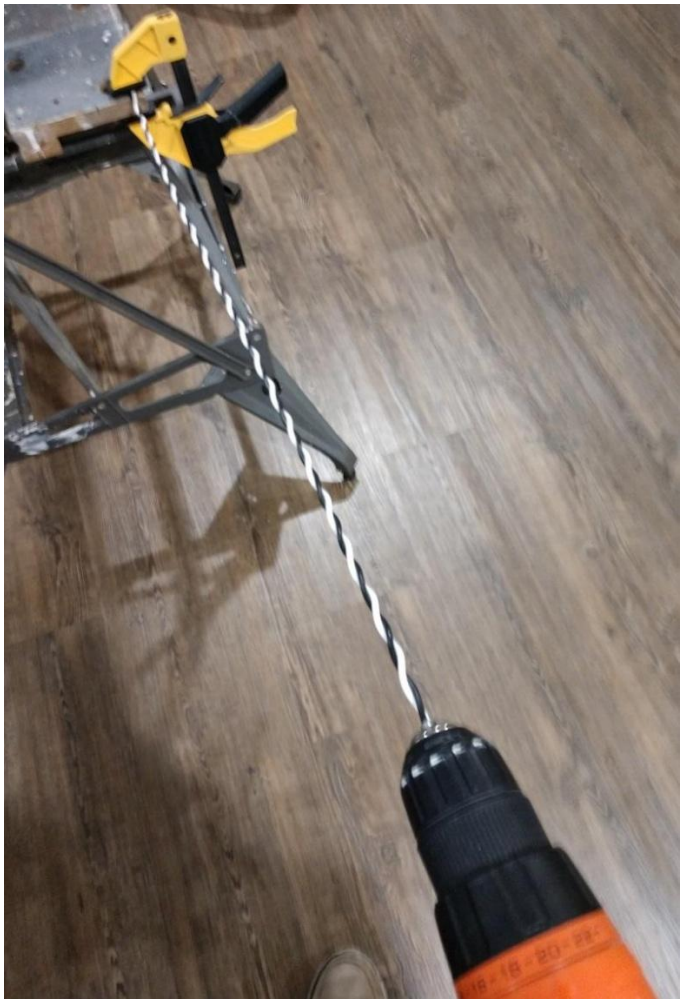
To begin, I crawled under the benchwork and measured the distance between 2 of the terminal blocks. I then cut a pair of wires (one lane color and the other black) 3-4 inches longer to account for slack. I learned a cool trick from one of the technicians I worked with during my electrical/software engineering career about making electrical cables from individual wires. In this case the "cable” consists of 2 wires for the positive and negative feeds to each lane's rails. After taking the measurement, I cut 2 pieces of the 16 AWG wire, one in the track color and the other in black color. I then clamp one end of the 2 wires in a stationary clamp (i.e. vise) and chuck the other 2 ends of the wires into a drill chuck. Then while pulling the wires taught between the drill and stationary clamp, slowly start the drill. As the drill rotates the wires, it causes the wires to wrap (twist) around each other (like a barber shop pole), creating a cable. Here's some pictures showing the process.

Picture Wiring 7 is a cable being made for the white lane. I have white and black wires being held in place on the portable work bench by the yellow pressure clamp. The other ends of the wire are clamped into the drill chuck. I am starting to pull back on the drill to create more tension on the wires before I start twisting them.



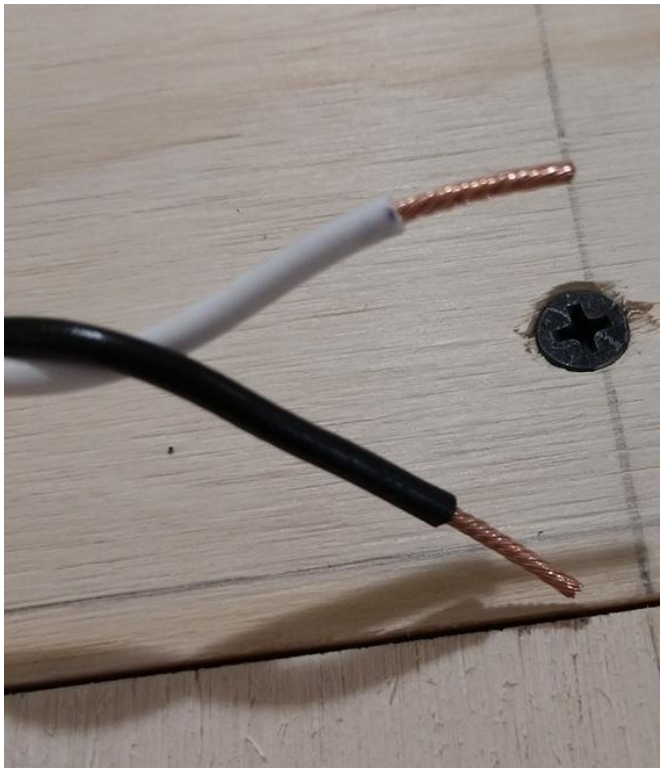
Wiring 7 – Making a cable: wires clamped to stationary bench and other end inserted in to drill chuck

After starting the drill, picture Wiring 8 shows the two wires twisted together to create a cable for the white lane. The white wire will eventually feed power to the positive rail of the white lane, while the black lane will be connected to the ground rail of the white lane.



Wiring 8 – Wires twisted together forming a cable as drill rotates

After creating the cable, I then strip off about 3/4" of insulation from all 4 wire ends. Wiring 9 picture below shows a pair of ends that have been stripped. Notice the multiple small strands of copper wire that make up the 16 AWG wire. These strands have been twisted to keep the wire as small and as clean as possible.



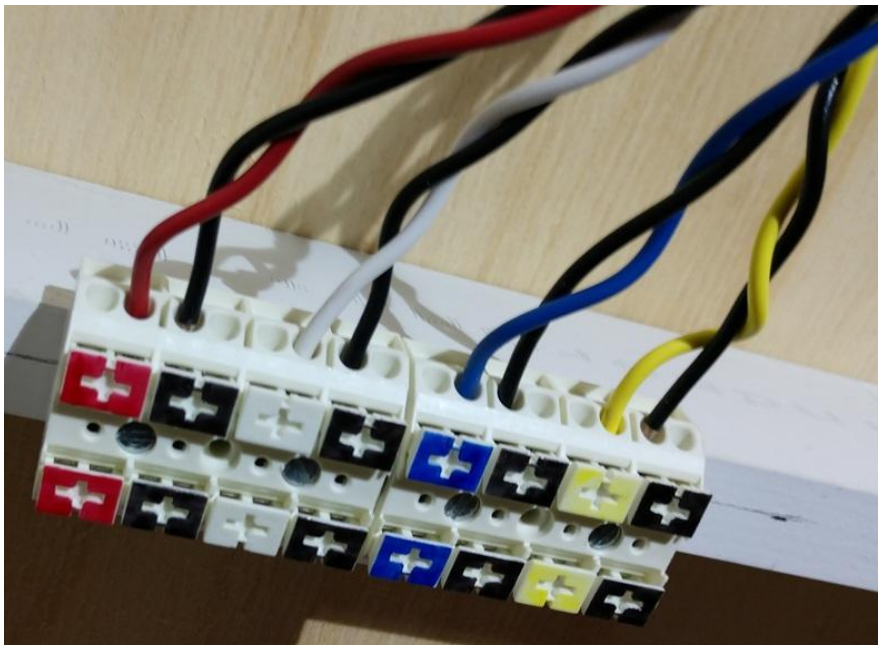
Wiring 9 – Stripped wire ends

Because these wires will be pushed into the locking tab of the terminal block, to eliminate the possibility of the wire strands to begin fraying and making either poor contact with the terminal block or shorting to an adjacent connection on the terminal block, it is best to tin the wire with solder to eliminate the fraying potential.

Wiring 10 picture below shows the wires after they have been tinned with solder. Note the silver color of the wires, as compared to the solid copper color in the previous picture. The silver is the melted solder that has now solidified all the strands into a single wire. Please note that when tinning a wire, you just need to hold the soldering iron on the wire and apply just enough solder to lightly tin the wire so that it has a silver color. You do not want to apply so much solder that the wire appears to be a big silver blob.

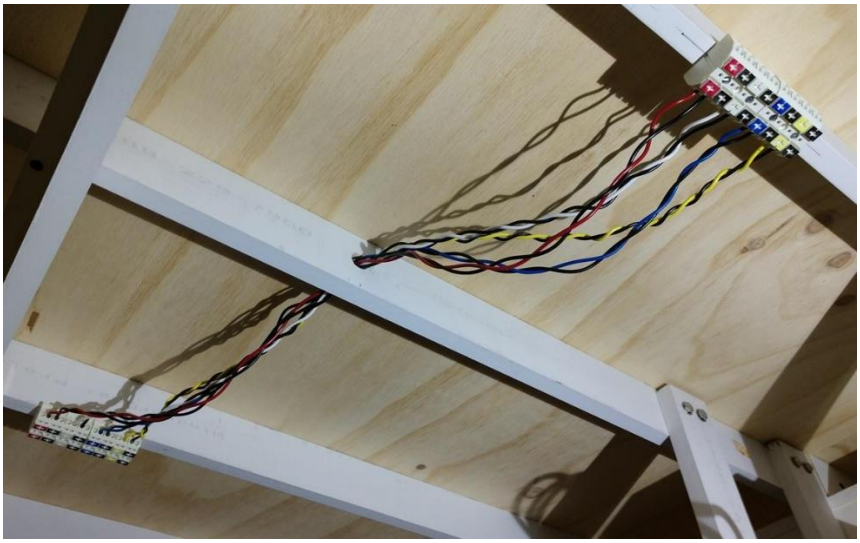
Wiring 10 – Wire ends tinned with solder

With the wires tinned, I then crawled back under the benchwork and inserted the wires into the terminal block. Wiring 11 picture below shows how the colors of the wires align with the tabs on the terminal block. Taking the time to do this sort of detailed work up front will save you many hours if you should need to trouble shoot any electrical issues in the future, as it will be very easy to follow an electrical path just by following the colors.



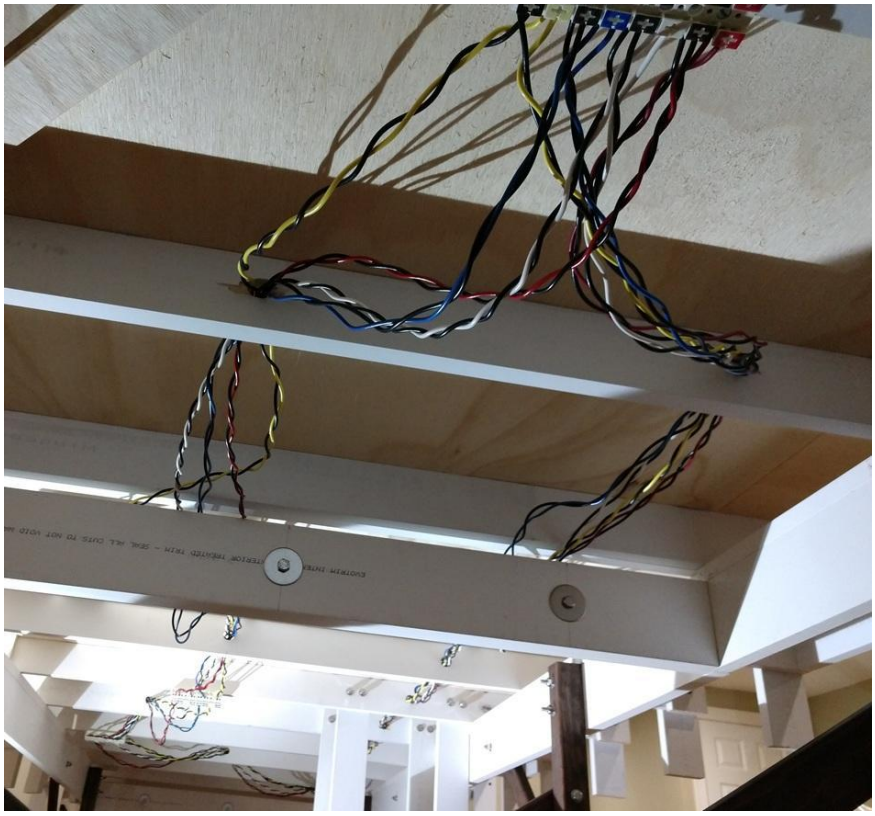
Wiring 11 – Wires inserted into terminal block

Wiring 12 picture below shows 2 terminal blocks that are now connected with wires. Notice how the wires are being fed thru the 5/8” diameter hole that were previously drilled through the 1x3 cross member. This helps to organize the wire and give it a neater look. I’ll come back later after everything is wired up and working to dress up these wires a little neater. For now, I’ll leave them be in the event there is a wiring issue, and I need to undo or move wires around.



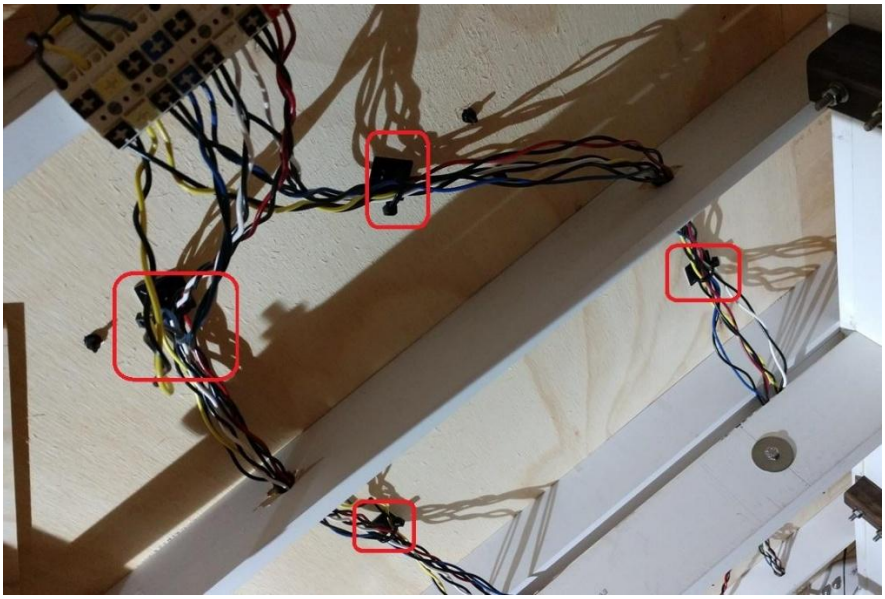
Wiring 12 – Wires connecting terminal blocks

Since there are 4 track sections that contain the power feeds, there are 4 corresponding terminal blocks under the benchwork. Thus, I created cables to connect all 4 of these terminal blocks together so that they conform to the electrical wiring "ring" configuration (see diagram at beginning of this section). Picture Wiring 13 shows all 4 of the terminal blocks and all the wiring in between them. Hopefully this gives you an idea of the base wiring and that you can see how the wire is dressed (fed) through the bench work bracing to keep it somewhat neat.



Wiring 13 – Wiring connecting all 4 terminal blocks

One of the last steps to do with the base wiring is a final cleanup of the wiring. As can be seen in the Wiring 13 picture above, the base wiring is neatly routed under the benchwork through the holes I had drilled in the benchwork cross members, 1x3 lumber. However, the wiring still hung down between the cross members. To clean this up I cable tied the wires to the bottom of the plywood using cable tie holders with double sided tape. Wiring 14 picture below shows the wiring with the cable tie holders circled in red.



Wiring 14 – Wiring secured to benchwork with cable ties and holders

With this base wiring competed, the remaining wiring will consist of running jumper wires from the terminal blocks to the track feeder sections (once I lay the track back down), wire in the driver stations, power supply and TrackMate processor board. There are still a few more things to do before all the wiring can be completed.

Driver Stations

On my previous layout, I used some Harbor Freight magnetic metal tool box shelves that attach to a large tool box, as driver stations that I modified and mounted to the front fascia of the track benchwork. Picture Driver 1 below shows one of these driver stations. I liked this form of driver station at is provides a shelf where a driver could put their car(s), tools, or cleaning tape. What I did not like was that because the shelves are metal, I had to do a lot of insulating of the driver station wiring to eliminate the potential of any electrical shorts against the metal shelf.

Driver 1 – Driver Station built from modified Harbor Freight tool box shelf

3D Design

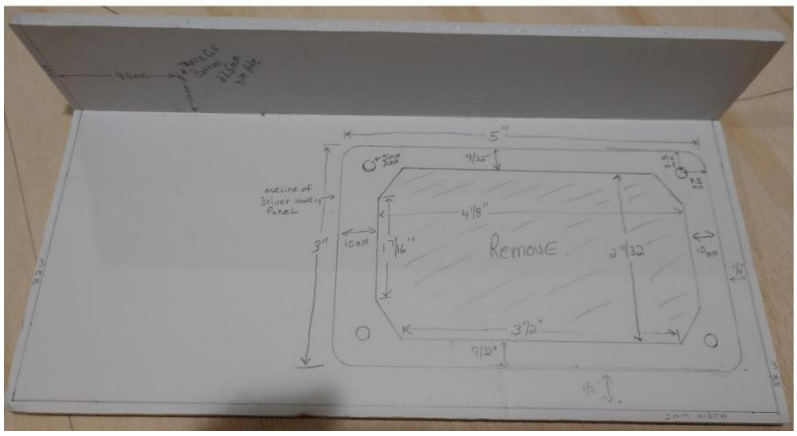
For the Max Trax I am going to do something similar, except I will use a 3D printed driver station that I found online from Greg Gaubb. I had already purchased Slot Car Corner (SCC) driver station kits, with reverse switch (Yes, my Max Trax will operate in both directions), as shown in the Driver 2 picture below.

Driver 2 – Slot Car Corner Driver Station kit assembled

Greg was kind enough to work with me to modify his 3D print of the driver station to accommodate my requests:

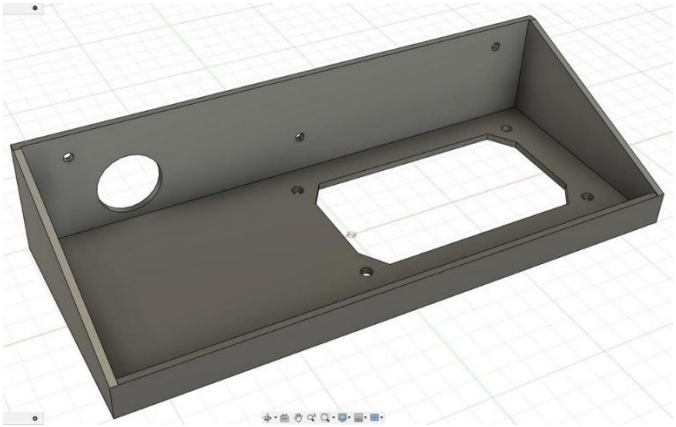
- Use SCC driver station w/ reverse switch
- Accommodate a track call button at each driver station.

With that I was able to mockup a driver station using some foam board and transferring the measurements from the SCC driver panel to the mockup along with locating the track call button in an area that will not be accidentally hit by a driver. Driver 3 picture below shows the mockup.



Driver 3 – Driver Station Mockup

I then emailed Greg the critical measurements and he created a preliminary CAD drawing, as shown in Driver 4 picture below.



Driver 4 – CAD Drawing of driver station

After a few more emails working out the critical measurements for the driver station mounting holes, I sent Greg payment via PayPal and he printed out the 4 driver stations as shown in Driver 5 picture below.

Driver 5 – 3D printed driver stations

That hole in the vertical panel is where the track call button will be located. I've decided to utilize a track call button at each driver session for informal races where we may not have enough corner marshals. I will also be wiring in a switch to disable the driver station track call buttons when a more formal race with plenty of corner marshals is being held.

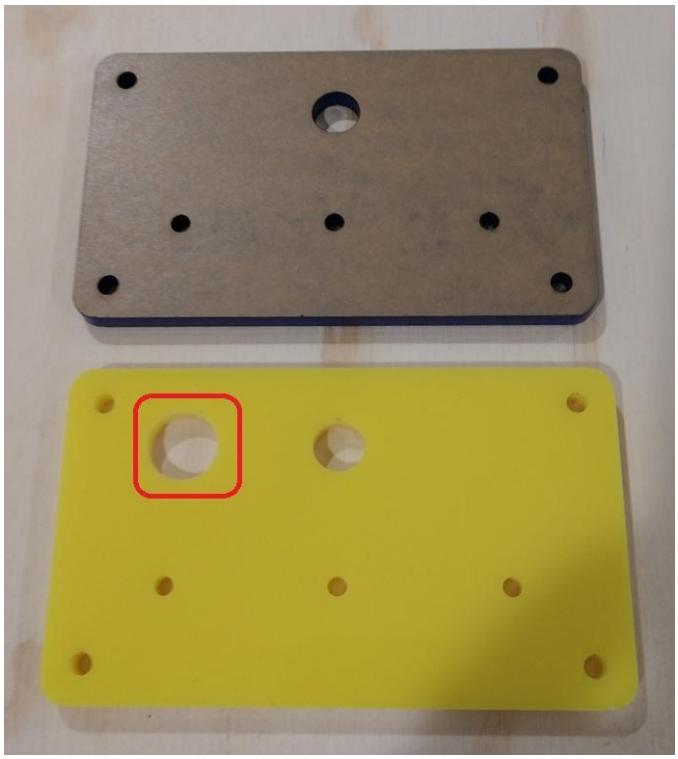
Assembly

As previously mentioned, I am using SCC driver station kits with reverse switch along with a 3D printed driver station housing from Greg Gaub. Driver 6 picture below shows all the components used to build up a driver station.

Driver 6 – Driver station components

Referring to Driver 6 picture above, the components: (top row) Greg Gaub 3D printed driver station housing, (middle row, left to right) SCC driver station wiring kit, 3-amp circuit breaker, mounting hardware (#8 black anodized round head screws 3/4", washers, lock washers, and bolts) to mount driver station panel to housing, SCC driver station kit, (bottom row) track call button switch and button mechanism.

One modification I made to the SCC driver station kit was to add a 3-amp circuit breaker. To do this, I had to drill a 5/8" diameter hole in the thick plastic driver station panel included in the SCC driver station kit. Driver 7 picture below compares the stock SCC panel (top) and the modified panel (bottom). Notice that I have highlighted the 5/8" diameter hole drilled into the SCC panel with a red square. Because of the plastic material, I used a step drill bit to drill out the hole to ensure a clean, accurate hole, and minimize any heat buildup during drilling that might melt or disform the plastic.



Driver 7 – Stock SCC panel (top) and Modified SCC panel (bottom) for circuit breaker

Wiring and Testing

SCC provides an excellent document online providing step-by-step instructions on how to wire their driver station kits. If you have never wired anything before, this document provides all the information you need to be a successful slot car driver station wirer.

Time for another new "toy" from Harbor Freight. Driver 8 picture below shows the wire cutter/crimper/stripper tool I purchased. This tool is critical for track wiring and driver station wiring.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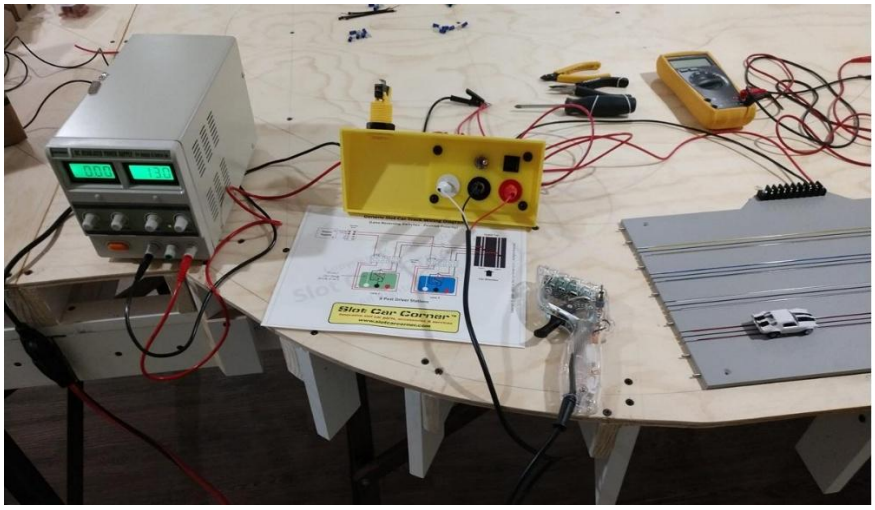
9½ in.
LIFETIME WARRANTY
3-IN-1 MULTI-PURPOSE
STRIPPER, CRIMPER CUTTER
STRIPS 8-20 AWG SOLID WIRE AND 10-22 AWG STRANDED WIRE
CRIMPS INSULATED AND NON-INSULATED TERMINALS
CUTS COMMON SIZED BOLTS AND SCREWS
WIRE CUTTER
INSULATED TERMINALS
22-18
16-14
12-10
WEAR EYE PROTECTION
8-32
4-40
10-24
6-32
10-32
NON-INSULATED TERMINALS
12-10
16-14
22-18
1/4"
1/2"
STRANDED AWG
10
12
14
16
18
20-22
SOLID AWG
8
10
12
14
16
18-20
PITTSBURGH

Driver 8 – Wire stripper/cutter/crimper tool

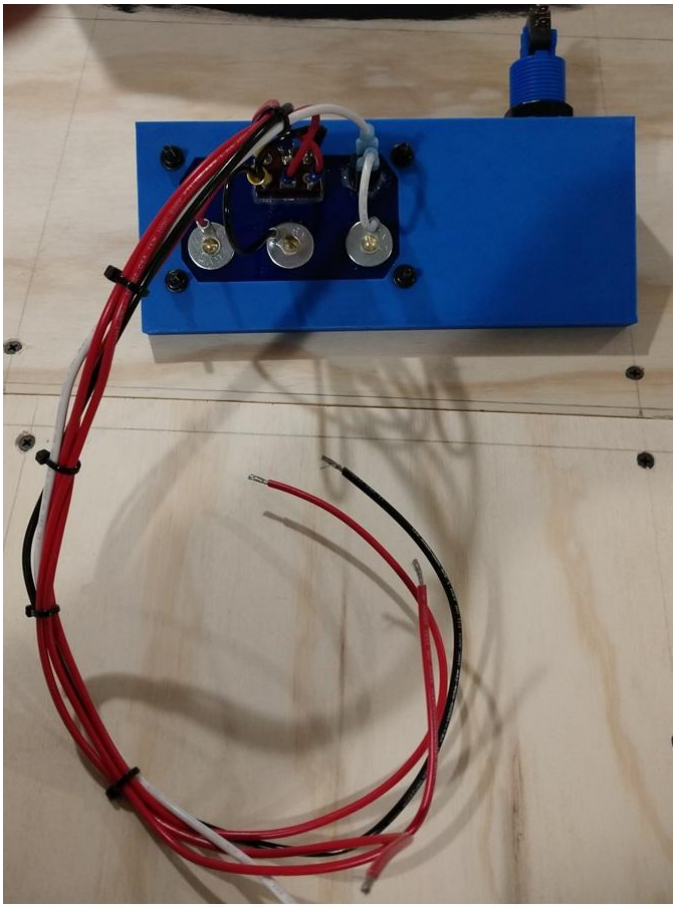
With the driver station wired per SCC's excellent online documentation, I then wanted to test out the driver station, specifically the reverse switch to ensure the switch direction aligned with the direction the car would travel. To do this I set up a small section of the track with a power feeder section, a power supply, controller, and of course a slot car. Driver 9 picture below shows my driver station test setup



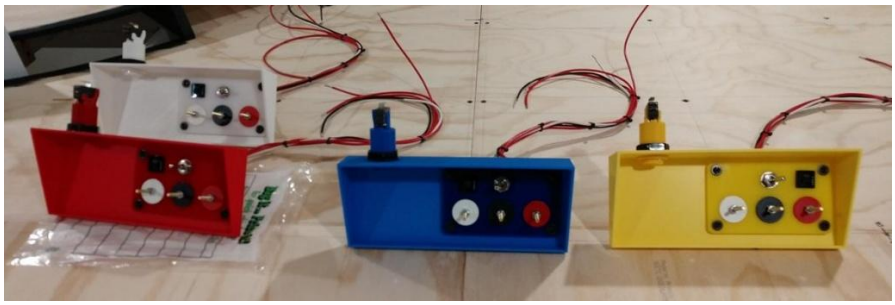
Driver 9 – Driver station test setup

With everything properly connected, I turned on the power supply (set to 12VDC), set the reverse toggle switch, placed the car on the track, pressed the controller, and voila, the car went in the opposite direction it was supposed to. Although I wired the driver station EXACTLY as shown in the SCC wiring document and diagram, I had to reverse the leads on the middle poles of the driver station reverse switch to properly align the polarity of the reverse switch to the car's travel direction. That is if the reverse toggle switch was pointed to the left, the car will travel in a clockwise direction (right to left) around the track, if the toggle is pointed to the right, the car will travel in a counterclockwise direction (left to right). Not sure why this is so (perhaps 1/32 car motors, which is what SCC specializes in, are wired differently - direction wise, then HO slot car motors?). Anyway, I reversed these wires on all 4 driver stations, and everything worked as expected. The important lesson here is that doing this test now saved me significant time later than if I had to fix this once the driver stations were mounted to the track and everything was wired up.

Here's a picture of the back of a wired driver station (Driver 10) and the four completed driver stations (Driver 11) pictures below. Note, I have not wired up the track call button at this time as I will need to wire this into the TrackMate circuit board.



Driver 10 – Wired driver station rear view



Driver 11 – All 4 wired driver stations

Track Installation

With the plywood top trimmed and elevation changes completed and the base wiring completed it was time to do a final installation of the track onto the plywood top. This would consist of several phases:

1. Reconnect all the track sections laying them in the trace lines created during the track preparation phase.
2. Install metal keys between all track joints to provide electrical connection of all track rails between sections.
3. Install FISA borders in corners
4. Install and test the timing light bridge
5. Connect power wiring to track feeder sections.
6. Test and tune the track
7. Screw down the track to the plywood top.
8. Mount Timing light bridge

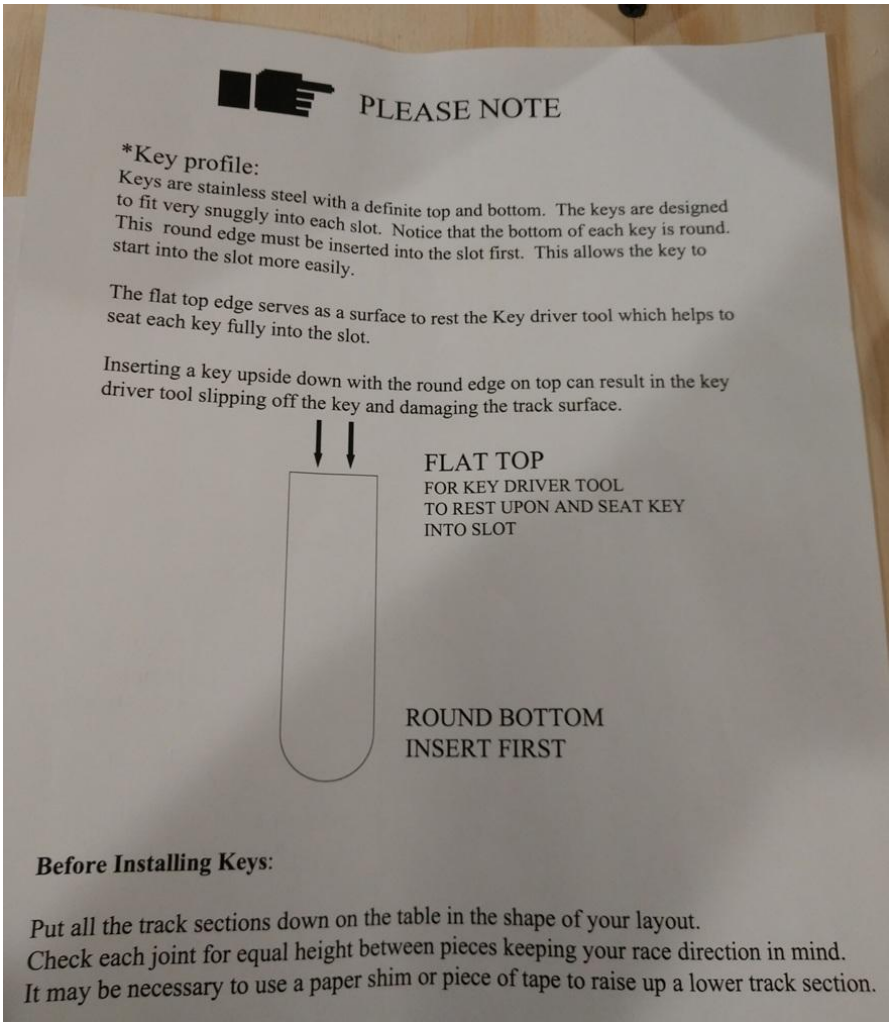
Reconnect All Track Sections

First step is to reassemble the track sections and lay them down on top of the plywood, lining the track up between the lines that were previously traced on the plywood as described in Dry Fit Track section.

Installing Metal Keys

With the power distribution wiring complete, and the track sections back together, we can begin electrically connecting them using the metal keys provided with the Max Trax track.

Install 1, below is a picture of the instructions provided with the Max Trax track on installing the track keys.



PLEASE NOTE

*Key profile:
Keys are stainless steel with a definite top and bottom. The keys are designed to fit very snuggly into each slot. Notice that the bottom of each key is round. This round edge must be inserted into the slot first. This allows the key to start into the slot more easily.

The flat top edge serves as a surface to rest the Key driver tool which helps to seat each key fully into the slot.

Inserting a key upside down with the round edge on top can result in the key driver tool slipping off the key and damaging the track surface.

FLAT TOP
FOR KEY DRIVER TOOL
TO REST UPON AND SEAT KEY
INTO SLOT

ROUND BOTTOM
INSERT FIRST

Before Installing Keys:

Put all the track sections down on the table in the shape of your layout.
Check each joint for equal height between pieces keeping your race direction in mind.
It may be necessary to use a paper shim or piece of tape to raise up a lower track section.

Install 1 – Instructions for installing track keys

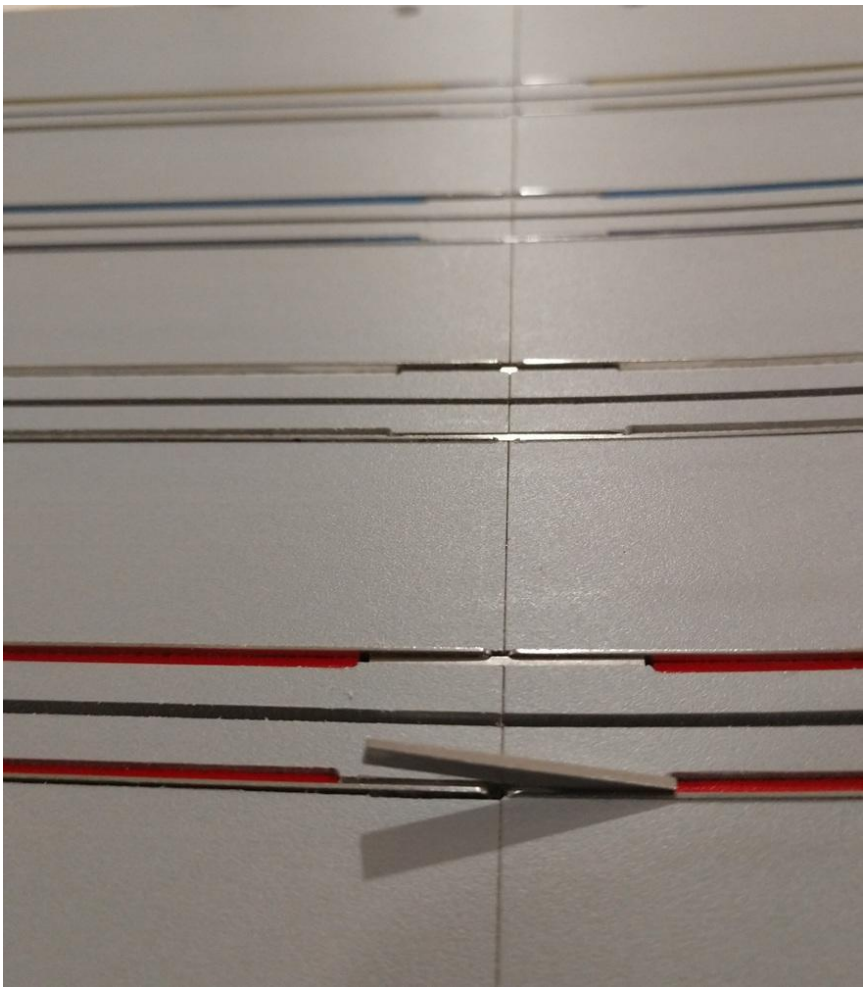
Install 2 is a picture of all the material used to install the track keys (from left to right): plastic bag containing metal keys, container of di-electric grease, digital multi-meter (in back of track), smooth nose pliers (not used), stubby flat blade screwdriver, 70% isopropyl alcohol.

Install 2 – Material used to install track keys

Since the electrical connection is a critical component of the track, I was somewhat anal in my approach to installing these keys. These are the steps I took to install each key:

a) I began by cleaning each key using 70% isopropyl alcohol. This removes any machine grease/oils that might be on the metal key that could affect electrical connectivity.
b) I then applied a light coating of the di-electric grease to the side of the key that will contact the rail. This grease ensures good electrical contact between the 2 metal surfaces (key and rail) and prevents any corrosion if moisture were to get into the joint.
c) With the grease applied to the side of the key that will press against the rail, I then inserted one end of the key into the track joint as shown in Install 3 picture below.
d) I then press down the other side of the key. Once the key is pressed down as far as I can with my fingers, I use the stubby screwdriver to push the key down further (well below the rail head). In picture Install 3, you can see a completely installed key in the other red lane rail, above the red lane rail with the key partially installed. Note how the key sits below the rail head.
e) Once the key is fully inserted, I use the digital multi-meter to test for continuity between the two rail sections on either side of the track joint. It's important to do these continuity tests on each connection as they are joined together to ensure the track key is properly installed and eliminate any issues further on when track power is initially applied.

I repeated this process 336 times for every track key that was installed (42 track joints requiring 8 track keys at each joint)!!!



Install 3 – One end of key inserted into one side of track

Installing FISA Borders

After securing the track sections to the plywood, I also applied vinyl FISA-like corner track borders that came with the Max Trax track. While adding the borders is not necessary, I thought they would add a nice look to the track since I will be adding scenery around the track. Install 4 picture below shows the instructions that came with the borders

MICROSPORT ENGINEERING

Microsport #6410
Die-Cut FISA Curbing

Fits All H.O. Slot Tracks - Installs In Just Minutes!

Congratulations on purchasing Microsport's FISA Curb Set. It's precision construction and universal application is designed for ***all HO race tracks, regardless of manufacturer*** - plastic or commercial, permanent or temporary, Aurora, AFX, Lifelike, Tomy, Tyco, Bucktrax, etc. This unique high-quality product fits them all and will add a great finishing touch to the appearance and realism of your HO race course.

Installation is simple due to the peel-n-stick construction; however, here are some hints to make it even easier. First, make sure your track is really clean - wipe it down with a clean lintless rag and your favorite cleaner (Windex, Fantastic, Formula 409, rubbing alcohol etc. - just don't use lighter fluid or anything similar as it leaves an oily residue that diminishes the vinyl's adhesive.) Next, follow up with a thorough vacuuming and get rid of all those dust particles, track debris, old pickups, etc. as anything trapped under the thin vinyl will be immediately noticeable. Lastly, before handling any of the curbing, wash your hands as any skin oils, sweat, etc. can also impact on the vinyl adhesive.

Start by selecting the easiest or most accessible corner on your track. Pick out a strip of curbing in the appropriate size - this is easy enough as all radiuses are clearly marked. Those of you with routed commercial-type tracks will have to make a guess, but simply placing a plastic track section over the corner will get you close. The vinyl is somewhat flexible and you will have some leeway here, so don't worry about a perfect fit. Gently peel off the appropriate strip and proceed to lay it in place along the inner edge of the curve, using your thumb and index finger on one hand to anchor one of the ends and the other thumb and index finger as a guide. It will seem awkward at first, because the vinyl is both thin and flexible, but use a little patience at first and you will soon pick up confidence (and speed!) In fact, with a little experience, most HO tracks can be trimmed out by a single person in less than an hour!

When you're satisfied with the fit and placement of the first curb, use your thumb to rub it down thoroughly into place and squeeze out any small air bubbles that may have appeared. If it looks good, move on to the next corner. If it's a little out of place, simply lift up the strip and re-apply. If you need to add more curbing, peel off another strip and continue on, remembering to trim the adjacent ends so the sequence of red and white "blocks" remains consistent. Any excess length can be easily trimmed off with a sharp hobby knife, but watch your fingers!

Remember, too, that on most real tracks, the curbing is not restricted to just the turn - it usually starts a bit before and finishes a bit after. ….for our application, this usually looks better, too. Sometimes, too, it looks better when you continue the curbing down the chute between two adjacent corners. We've provided some extra straight pieces for those scenarios. Another trick is to take your hobby knife and trim off the square ends with a curved or angle cut - this will give the curbing a smoother, more finished appearance (See photo).

This curbing is designed solely as a trim/appearance item and intended to be installed only on the inside of the turn. Installed this way, the curbing will enjoy a long and happy life. Some racers may wish to install the curbing on the outside of a turn….keep in mind, though, that the rear tires will be drifting over a bit of a bump (the thickness of the vinyl) and that the curbing will eventually begin to exhibit some wear or possibly lift up. Other than that, install it where you please! This particular type of vinyl is pretty rugged and its longevity may surprise you! It is also pretty much impervious to most chemicals used for cleaning a track. Rubbing alcohol, lighter fluid, Fantastic or Formula 409, *even lacquer thinner* - will not attack the vinyl or the printing. They will, however, affect the adhesive, so you'll want to exercise a little care when cleaning the track after the curbing has been installed. Don't apply any cleaners directly to the track, apply it to the rag instead. If you do have to wipe the curbing, do it lightly and quickly, and you shouldn't have any problems. Enjoy the new look of your track - and good racing!

Above: Three views of a 4-lane Bucktrax outfitted with Microsport's peel-n-stick FISA Curbing. Simply peel the curbing off the sheet and lay in place. It's that simple!

Above: For contrast, here's some more views of Microsport's FISA curbing installed on standard plastic track. As you can see, the improvement in appearance is dramatic.

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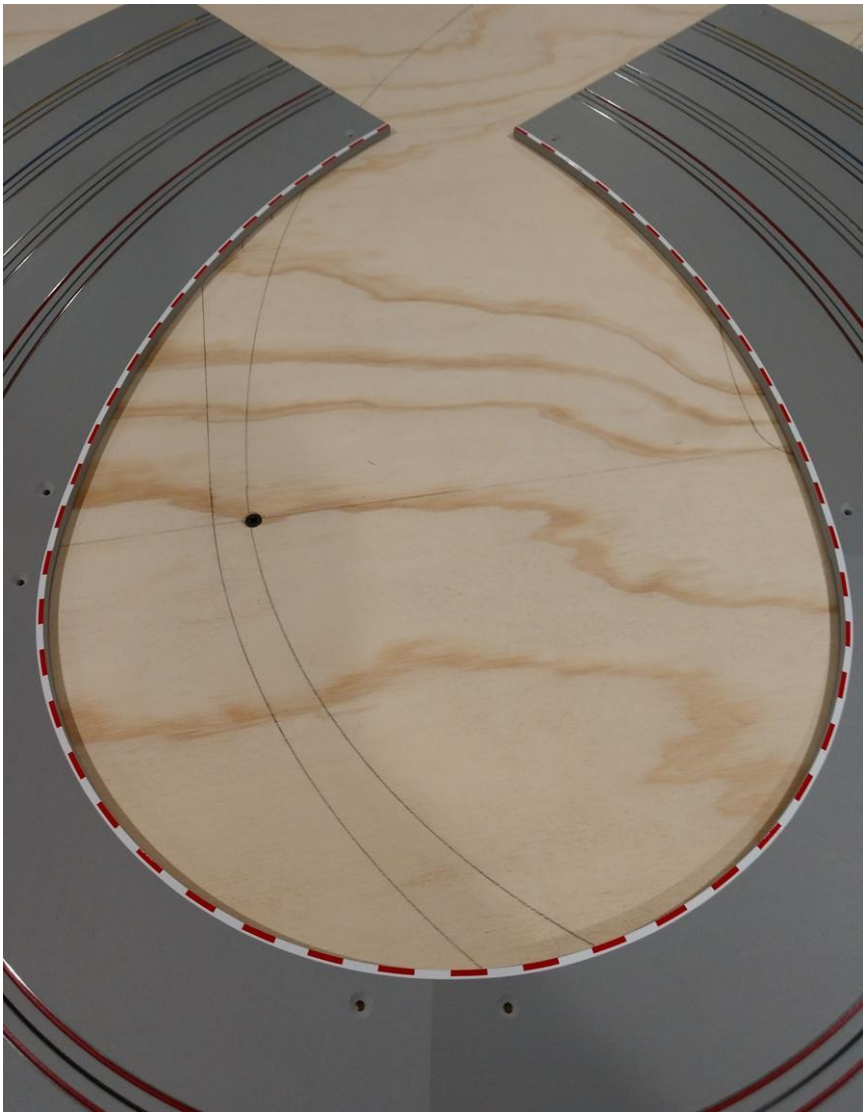
Install 4 – Instructions for FISA borders

Here is a picture of the borders as they come on the vinyl sheet, Install 5 picture below.

Install 5 – FISA border sheet

Install 6 is a picture of the track borders installed on the inside of the carousel turn.

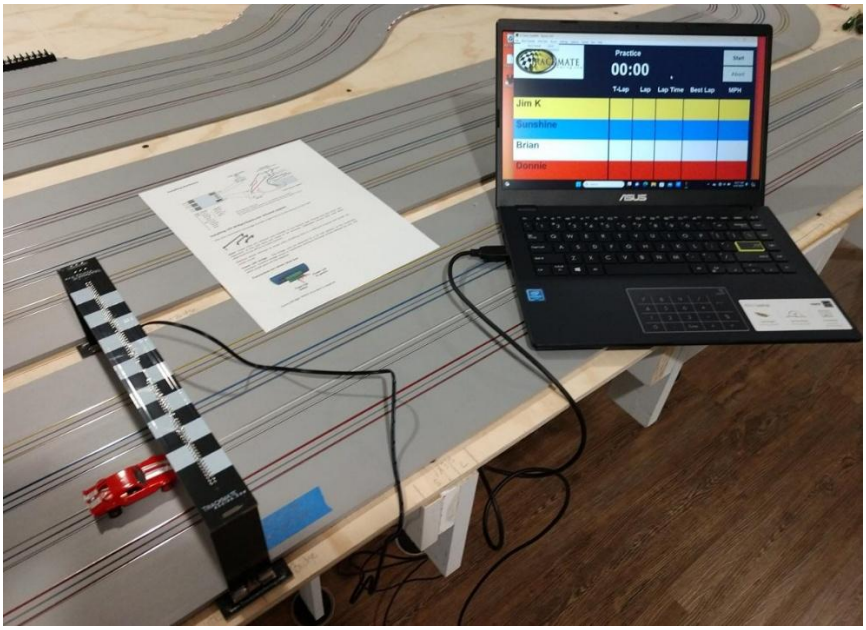


Install 6 – FISA borders installed on inside edge of curved track

Installing and Testing the LED/Light Bridge

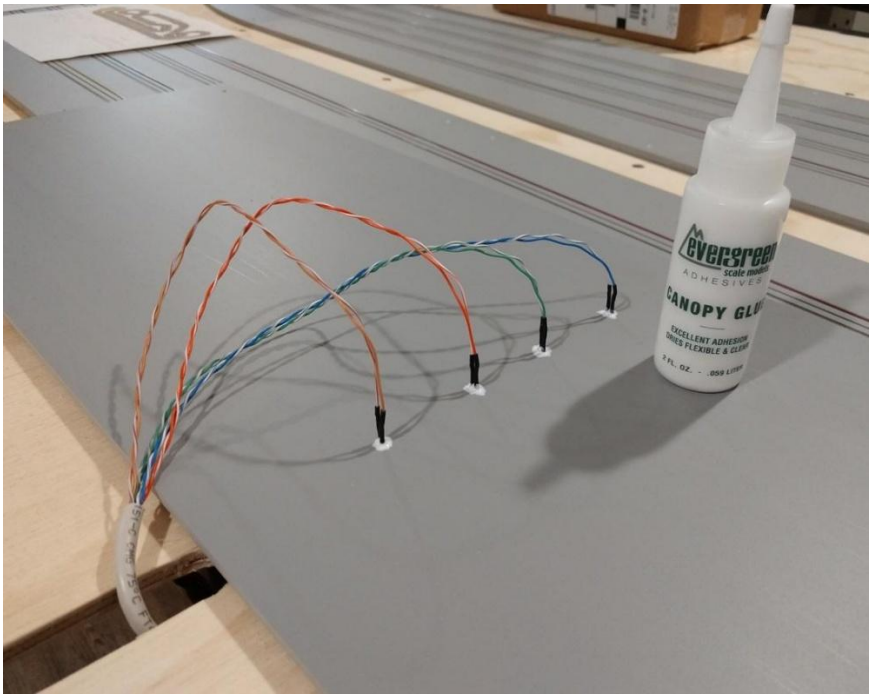
In the previous section, Preparing the Track – Track Timing Sensor LEDs, I had to drill holes in one of the straight track sections so that I could install the sensor LEDs used by the TrackMate hardware/software to keep track of lap count and lap times. Before connecting up the straight track section that would house the LEDs to the rest of the track, I wanted to check the operation of the sensor LEDS and light bridge to ensure everything aligned and worked properly. My main concern here is that the sensor LEDs were mounted at sufficient depth in the track and that the room lighting (ceiling mounted LED lights 4000K) did not impact the ability of the light bridge and sensor to detect a slot car traveling over the sensor LED. Install 7, below, is a picture of the setup I used to test the lap counter. I inserted the sensor LEDs into the straight track section. I then aligned and placed the light bridge over the

sensor LEDs (I temporarily wired the light bridge to the TrackMate module for power). I then connected my laptop with TrackMate software to the TrackMate module and applied power to the TrackMate module. With the TrackMate application running, I moved a slot car over the sensor LED in each lane to make sure the TrackMate software detected the car crossing over the sensor LED. All 4 lanes worked perfectly!



Install 7 – Testing TrackMate light bridge and LED sensors

With the sensor LEDs successfully tested, I flipped the straight track section over and glued the sensor LEDs in place using canopy glue, as shown in Install 8 picture below. The canopy glue dries as a clear flexibly glue that is easy to remove in the event a sensor LED needs to be adjusted/replaced in the future. Note that the sensor LED cable is fed up through the slot I had previously cut out of the plywood bench top.



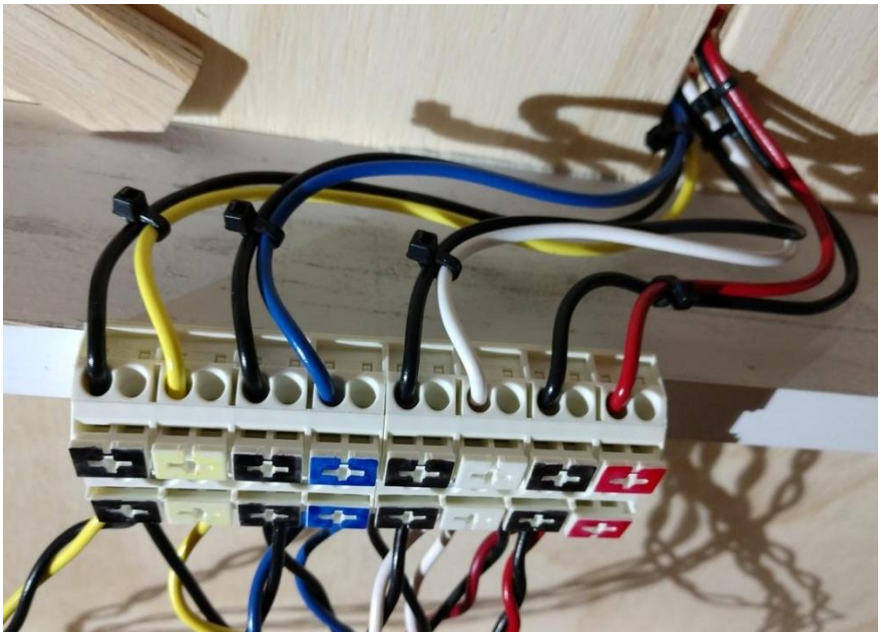
Install 8 – Securing sensor LEDs to track

Connect track power wiring

With the track laid out on top of the benchwork (plywood), it was now time to get some power to the track and begin testing/tuning the track by running some cars.

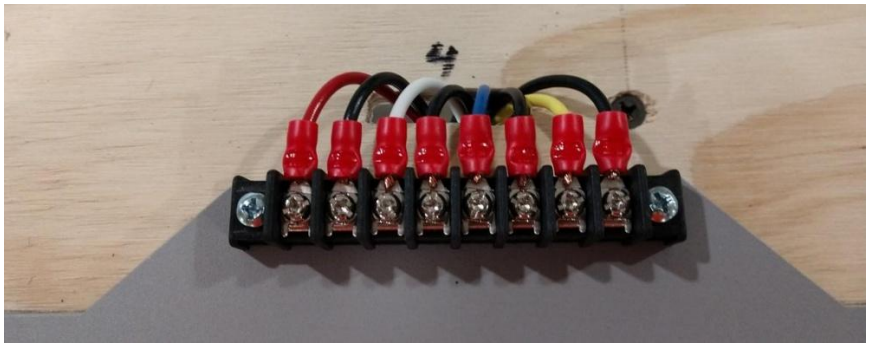
First, I needed to connect the 4 track power feeder sections to the power wiring/terminal blocks I had previously wired up underneath the bench work. Here's some pictures of the wiring.

Power Wiring 1 picture, below, shows the view from underneath the bench work, you can see the 4 sets of wires running from the terminal block (near side) up and through the slot in the plywood, located in the upper right corner of the picture. Please note the wire colors, terminal block tab colors and how all the colors line up. This extra detail will make it so easy to troubleshoot any wiring issues that may occur in the future.



Power Wiring 1 – Track Power Wires running from terminal block to track power feeder section (underneath benchwork view)

Power Wiring 2 picture below, shows one of the track power feeder sections (on top of the plywood base) with the track feeder wires coming up from underneath the benchwork (see previous photo) and connecting to the screw-down connector in the track section. I'm using 16 AWG wire here with crimp-on "C" connectors.



Power Wiring 2 – Track power wires connected to track power feeder section

With all 4 track power feeder sections wired up, and a quick continuity test across all 4 track lanes to make sure nothing is shorted, it was now time to temporarily mount the 4 driver stations to the benchwork.

Power Wiring 3 photo below, shows how I have temporarily bolted the 4 driver stations to their 1x3 mounting panel that is attached to the benchwork. Eventually, the fascia will mount between the driver station and 1x3 mounting panel to cover the benchwork and provide a finished appearance to the track. Also note, at the time this picture was taken, I had not wired

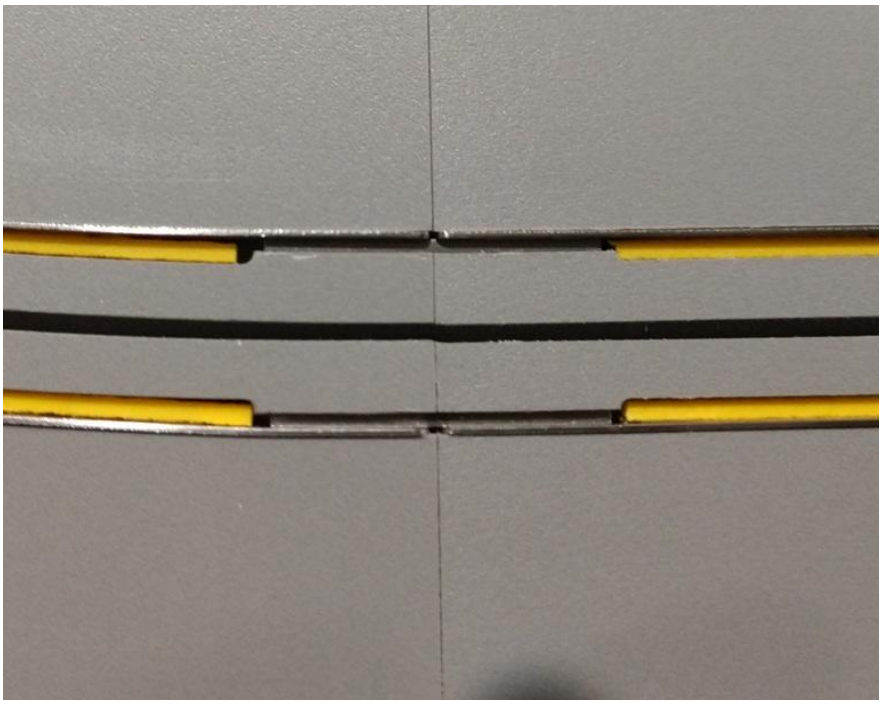
in the driver stations to the rest of the track wiring. You can see the driver station leads (wires) hanging down from the driver stations without any connections to the loose ends.

Power Wiring 3 – Driver stations temporarily mounted in preparation for testing

Drum roll, please…. After 18+ years when this track was manufactured by Max Trax (build date 1-19-2007), power was applied to the track and the first car was run on the track, 5-4-2025! Here's a picture of that historic moment. You may recall that when I purchased the track it was still in its original shipping boxes, still sealed! The car is one of my IROC Corvette C2 Grand Sport set that I detailed (notice the white side exhaust), painted and decaled, and mounted (lowered) on a stock TFX chassis.

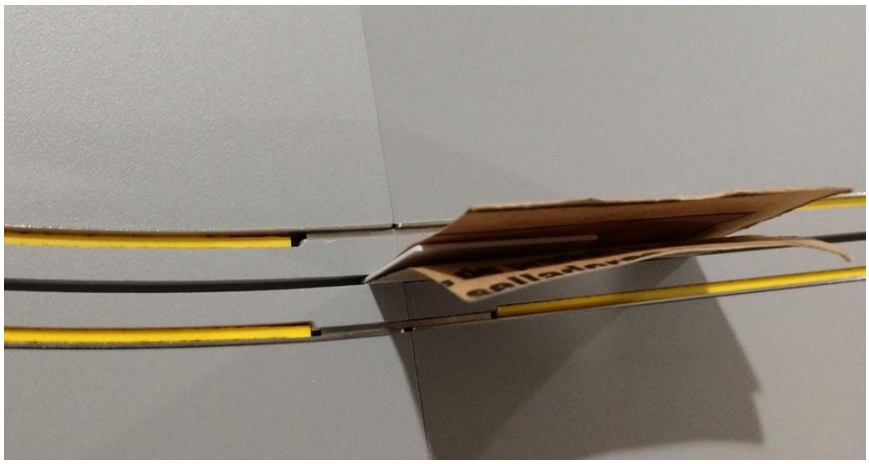
Test and Tune Track

With cars running, it was now time to test and tune the track. As I previously mentioned, the effort to pin the track sections was well worth it as ALL the track sections joints were as flat as if they were a single piece of track. The biggest issue I came across was that a lane connection, the slot portion, sometimes did not align between track sections. When this issue occurred, it would only be with one lane, the other 3 lanes lined up perfectly. Not sure if this was a tolerance issue during the manufacture of the track. Track Tune 1 picture below shows the slot being slightly misaligned in the yellow lane between a couple of track sections. This misalignment was enough to cause a ticking noise every time the car passed over this joint as the car's guide pin passed over this misalignment.



Track Tune 1 – Slot misalignment between track sections

Fortunately, the fix for these misalignments was easy, requiring some 220-grit sandpaper and a piece of .020 thick styrene. Track Tune 2 is a picture of the sanding of the slot to align it. A small piece of 220 grit sandpaper is wrapped around a 1"x1" piece of .020 thick styrene.



Track Tune 2 – Fixing slot misalignment

Since the track is wired to run in both directions, I had to test and tune each lane in both directions. I would estimate that there were 3-5 slot misalignments in each lane in either direction. It was interesting to note that these misalignments were between different track sections, so again because of the randomness of this issue, I can only guess that manufacturing tolerances came in to play here.

Secure Track to Plywood

With the track all tested and tuned, it was time to permanently mount the track to the plywood top. I used #6 hardware, which aligns with the size of the countersink holes I previously drilled into the track sections. Secure 1 picture below, shows the hardware I used. BTW, if you ever need bulk quantities of hardware, Bolt Depot (boltdepot.com) has the best prices, selections and service.

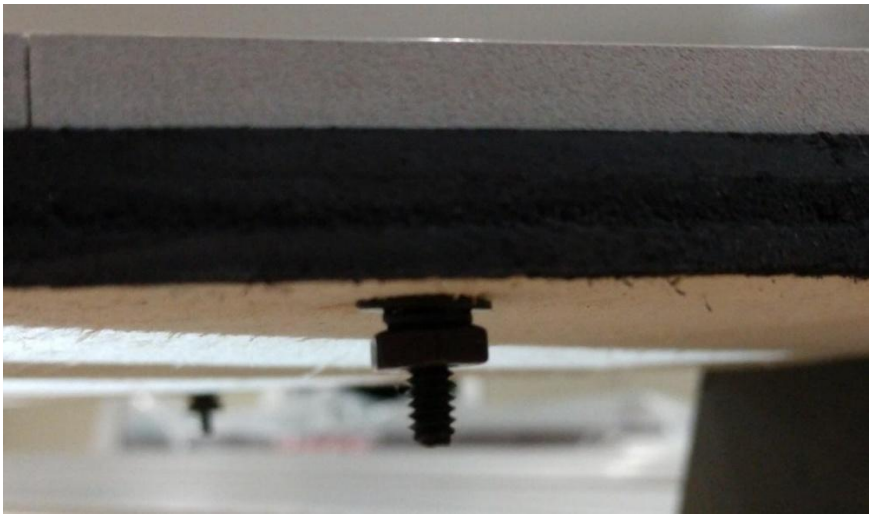
Secure 1 – Hardware used to secure track to plywood top

Using this hardware I inserted the #6-32 1" flat head screw into the countersunk hole in the track. Then, from underneath the plywood I inserted a washer, lock washer, and bolt. This was all very lightly tightened. You don't want to crank this down with a lot of torque. For screw holes that lined up on top of one of the 1x3 bench work joists, the #6 sheet metal screw was screwed directly into the joist.

When drilling the holes into the plywood top for the screws, I used my DrillBlock jig to ensure the 9/64" drill bit was perpendicular to the track surface. Secure 2 picture below shows the DrillBlock and drill as a hole is being drilled.

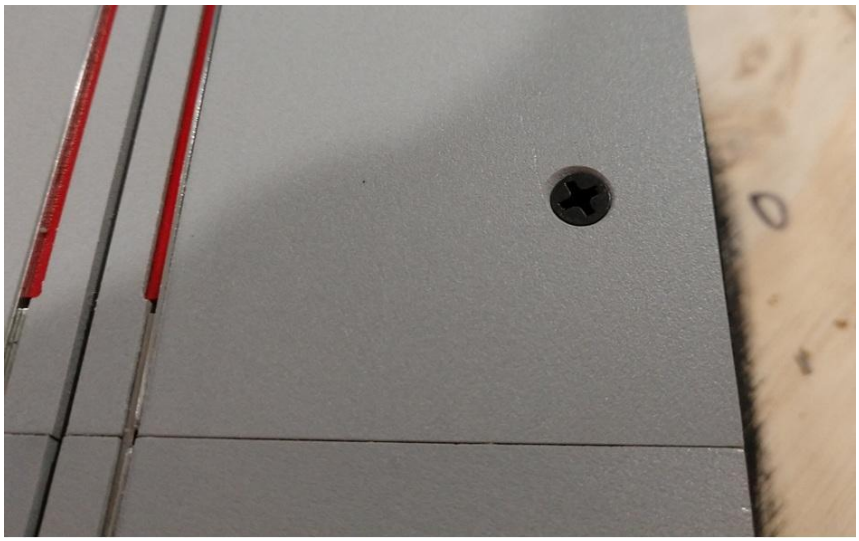
Secure 2 – Using DrillBlock jig to drill track mounting hole

Secure 3 picture below is looking underneath the plywood top where the washer, lock washer and nut are secured to the screw.



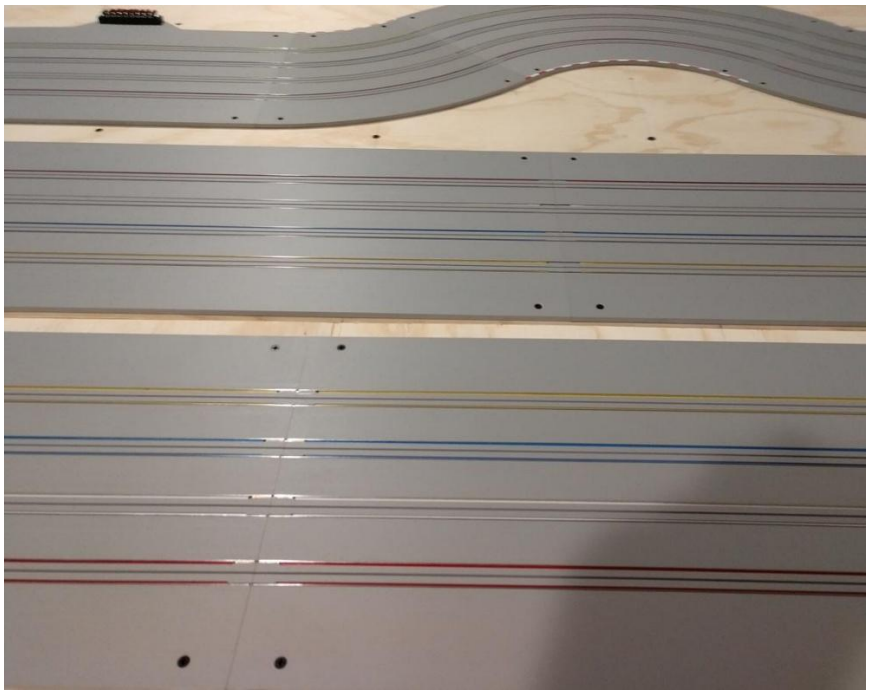
Secure 3 – Hardware used below plywood to secure track section

Secure 4 picture below shows the top of the screw inserted into the countersunk hole of the track.



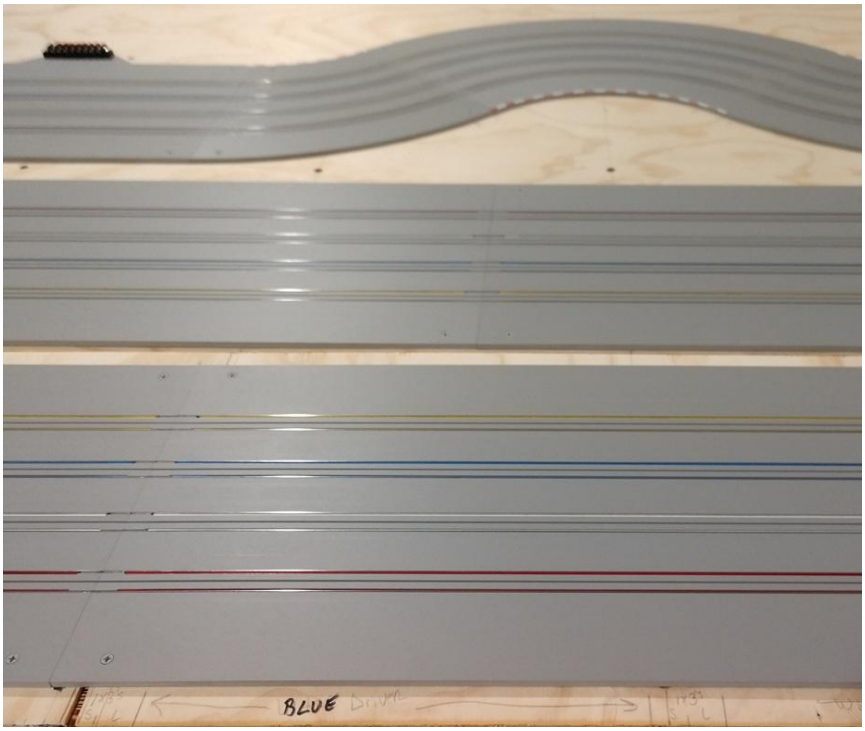
Secure 4 – Screw inserted into countersunk hole of track

Secure 5 picture below shows sections of the track with all the screws installed. You'll notice that the black anodized screw heads at each track joint look like miniature manhole covers. In addition, I felt they would be distracting to a driver when racing. So…



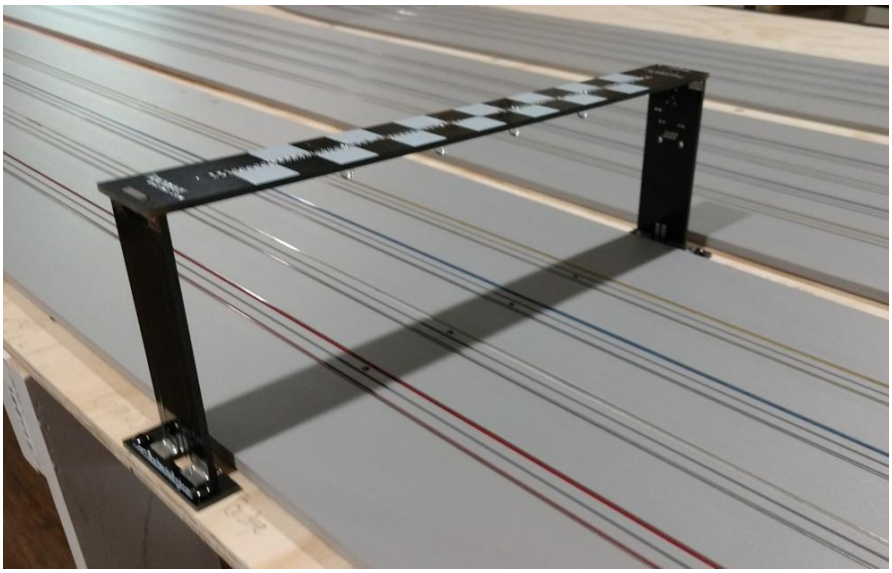
Secure 5 – Sections of track secured to plywood with black anodized screws

I painted the screw heads a shade of Tamiya gray paint (Yes I walked into my local hobby shop with a piece of track (one of the extra sample pieces) so that I could match up the best shade of Tamiya gray paint to the track). Secure 6 picture below shows the same track sections with the screw heads painted. Big difference.



Secure 6 – Black anodized screws painted to match color of track

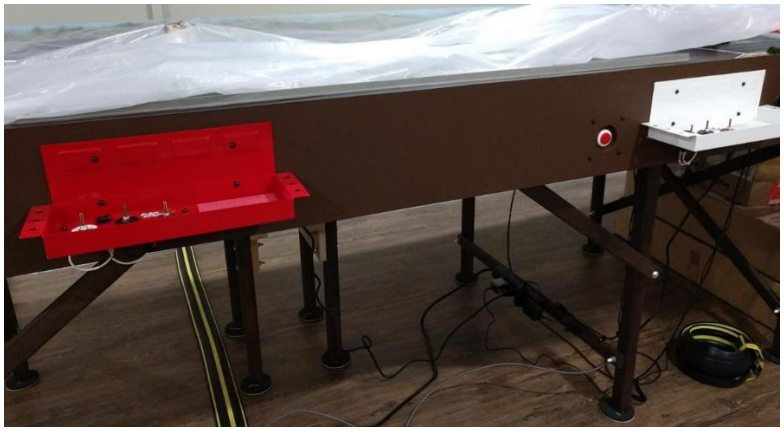
With the track secured to the plywood top, I can now do the final mount for the timing bridge. While I previously tested this, now with the track permanently screwed down, I temporarily clamped down the timing light bridge over the track and ran a car in each lane with the TrackMate software running to make sure the car was being detected. As expected, all 4 lanes worked fine, and I permanently mounted the timing light bridge using 4 #6-32 round head 3/4" long black anodized screws with flat washer, lock washer and bolt. I then did one final test with everything bolted down. Here's a picture, Secure 7 below, of the timing light bridge installed.



Secure 7 – Timing light bridge mounted to plywood

Fascia Installation

I know I am using model railroad lingo when I use the word "fascia". Fascia are the panels placed around the edge of the track benchwork to hide the benchwork and present a finished appearance to the track. Here's a picture, Fascia 1 picture below, of the fascia in my current Viper track. The fascia material itself is 3/16" hardboard (aka masonite) that sits approximately 7" below the bench top (to hide the framing/wiring underneath and anywhere from 1" to 3"-4" above the benchtop, acting as a barrier to prevent cars coming off the track from falling to the floor. I painted the fascia a dark brown on my Viper Track. You can see that the driver stations and track call button are mounted to the fascia.



Fascia 1 – Fascia on my Viper track

Fascia Supports

To mount and support the fascia I attached 6 1/2" long pieces of 1x3's at a 90 degree angle to the 1x3 cross brace ends. You can see these fascia supports extending down from the cross braces below the plywood top in the Fascia 2 picture below. I'm still in the process of mounting the corner fascia braces, which require a little more detail and work. You may also notice in the photo below, which is the front of the track, 4 1x3's mounted horizontally between some of the cross braces. This is where the 4 driver stations will be located and mounted.

Fascia 2 – Fascia support pieces extending down from 1x3 cross braces

Since the fascia material is 3/16" hardwood, which has some flex to it, it is important that all the fascia supports are aligned so that when the fascia is attached to the supports, there is no waviness to the fascia and that it is perpendicular to the bench top. Fascia 3 picture below, shows the aligning and mounting of one of the fascia supports. In this picture I am using my level/straight edge, clamping it to a couple of the fascia supports that have already been mounted (using 2 #5 1 1/4" long dry wall screws). This provides a straight edge to ensure the fascia supports are all aligned.

Fascia 3 – Aligning and mounting of fascia supports

In between the supports that the level is clamped to, I can then mount other fascia supports by making sure they are against the straight edge of the level, as shown in the Fascia 4 picture below. In this picture I have attached the fascia support on the left using wood glue, aligning it with the level and then clamping in place until the glue dries. Once dried, I remove the clamp and install 2 wood screws. It is a tedious process, but the effort is needed and worth it to ensure the fascia is straight and level.

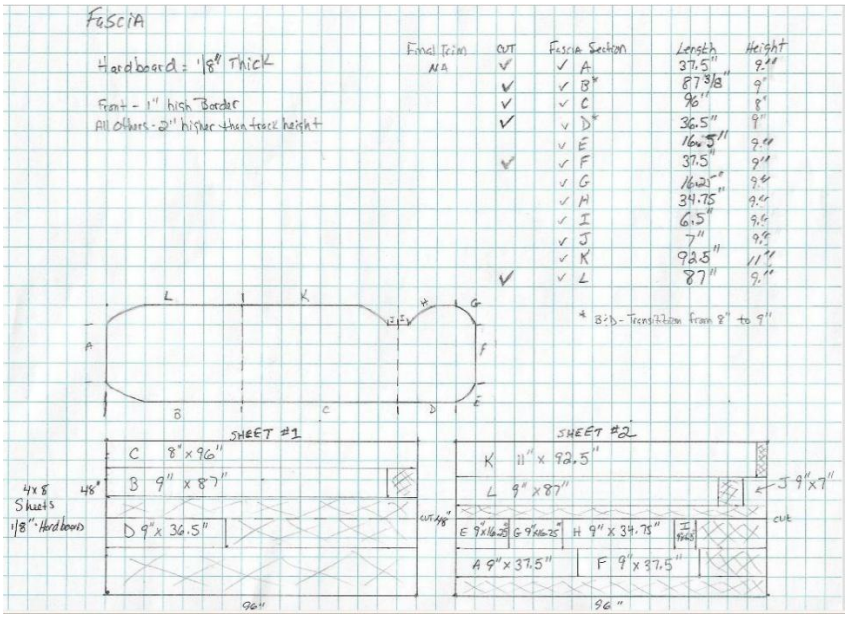
Fascia 4 – Mounting fascia support (white vertical 1x3) to 1x3 cross braces

Cutting Fascia Panels

With all of the fascia supports mounted to the benchwork, we can start cutting the fascia sections that will go around the perimeter of the track benchwork. I am using a material called hardboard that is 1/8" thick. Fascia 5 picture below, shows the product label on the back of one of the 4'x8' sheets. This company uses the trade name "Eucaboard".

Fascia 5 – Fascia material label

I purchased two 4x8 sheets of this material and had my lumber yard rip the sheets lengthwise in half to 2'x8' sheets. This allowed easier handling of the board when I was feeding it into my portable table saw to rip the hardboard to the appropriate height for the fascia. Before cutting the hardboard, I sketched out a diagram of the fascia and how the pieces would fit around the track benchwork. I then determined the height and length of these pieces and even laid out a cutting diagram for the 2 4x8 sheets. Fascia 6 picture below is my sketch of the fascia sections mounted around the perimeter of my track benchwork, fascia sections cutting layout on the 2 4x8 hardboard sheets, and the dimensions, height and length of each fascia section.



Fascia 6 – Sketch of fascia sections

The fascia serves two purposes: 1) to provide a finished look to the track benchwork and 2) act as a barrier to prevent de-slotted cars from crashing to the floor. With that in mind, I designed the height of the fascia to extend 2" above the track level, except along the front straight where I reduced this to 1" to allow easier access to the cars when placing them on the track. Thus, I had 3 different heights of fascia: 8" along the front straight, 11" along the back straight as it rises up to the carousel, and 9" everywhere else.

You'll notice that the fascia is made up of multiple sections (12 in all). There are 2 reasons for this: 1) The track benchwork is designed in 3 sections (this is denoted by the dashed vertical line in my sketch above of the track benchwork outline). Thus, the fascia for these sections are separate pieces to allow easy break down or assembly of the benchwork. 2) There are some sections that are curved that make it easier to cut these as separate pieces to pre-bend them and or easier handling during installation.

Dry Fit and Painting

I began the fascia install by cutting the 8' long, 8" high section along the front straight away. Here's a couple of pictures, Fascia 7 and Fascia 8 of the installation of this section. Fascia 7 picture shows where I have the initial fit using clamps. Once I have the section aligned (level), I then screw it into the 1x3 vertical braces extending down from the benchwork. I used #6 sheet metal screws with #8 fender washers. The screws and washers are only temporary as I do not have enough clamps to hold all the fascia sections in place.

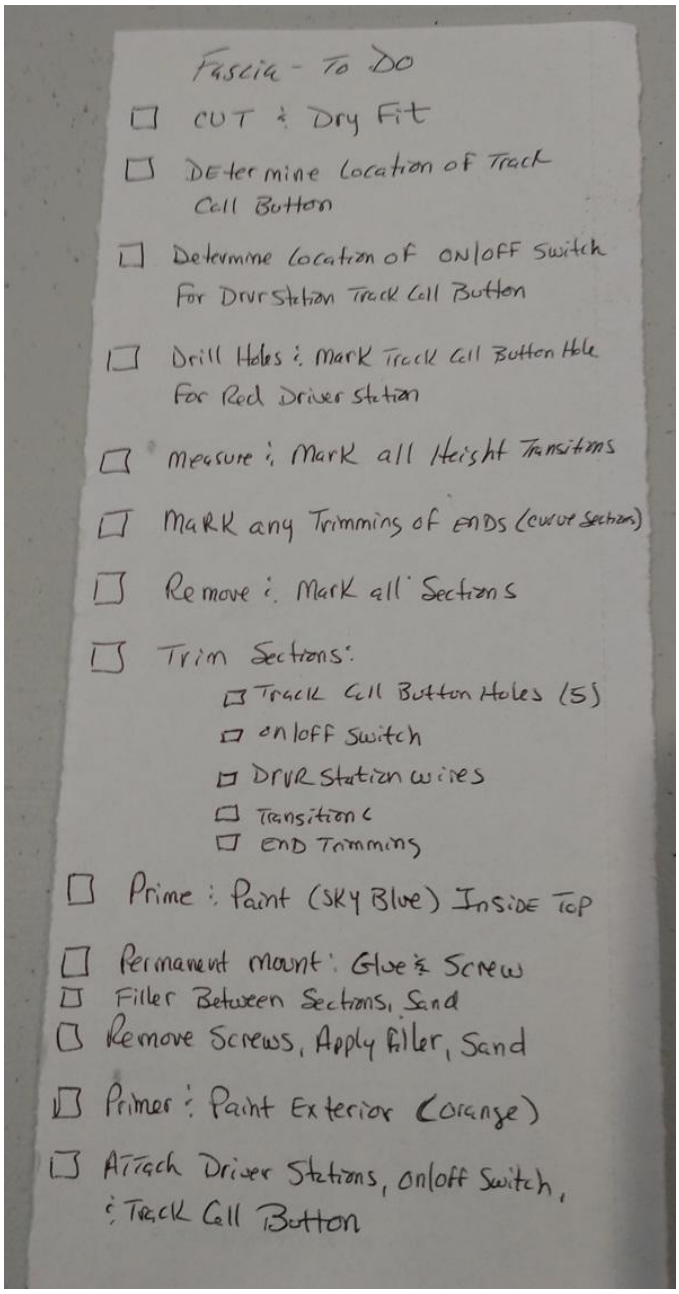
Fascia 7 – Initial fitting of fascia section using clamps

Fascia 8 – Fascia section temporarily mounted using screws and washers

Fascia 9 picture below shows more fascia sections installed. You can see towards the right of the picture the benchwork where the fascia has not been installed yet. This gives you an idea of the vertical 1x3 supports that the fascia is attached to as sort of a before and after shot. Also, you will notice the difference in height between the initial 8' x8" section and the fascia section next to it (to the left), which is 9" high. As part of the final fitting, I will cut a smoother transition between the height of these sections.

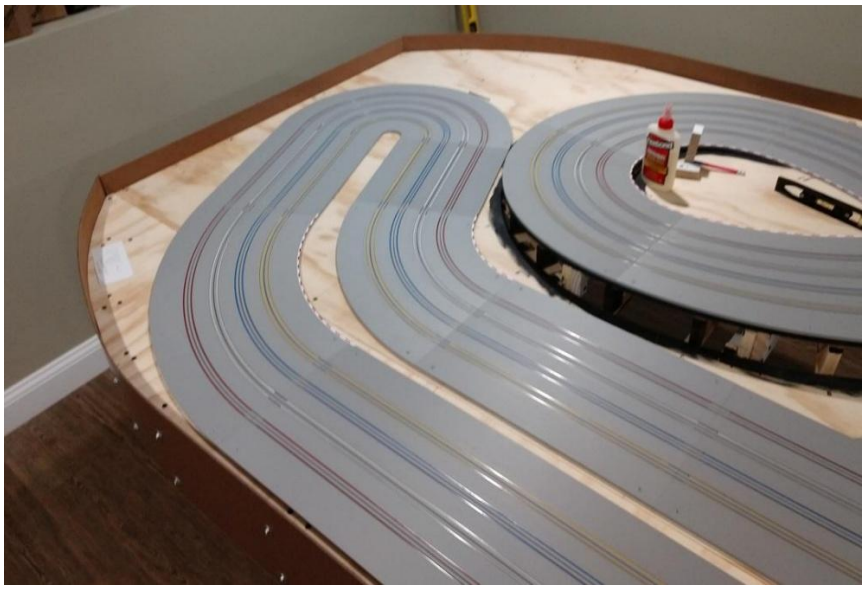
Fascia 9 – Installing more fascia sections

I consider this a dry fit as I temporarily screw the fascia pieces to the benchwork and make any adjustments to the pieces where they attach. Once I am happy with the dry fit, I will remove all of the fascia pieces, drill the holes for mounting the driver stations and track call buttons. Then I will paint the inside top (the portion that extends above the benchwork) a light sky blue. With that done I will then permanently attach the fascia pieces to the benchwork using construction adhesive and the sheet metal screws/washers. Once the glue has dried, I will remove all the screws, fill in the holes with joint compound, and fill in any seams between sections with joint compound, sand, prime and paint the fascia. Fascia 10 picture below is my "to do" list of the fascia installation. Lots of little details. I'm sure there are easier and faster ways, but the end result of my process should produce a clean, professional looking finish to the track.



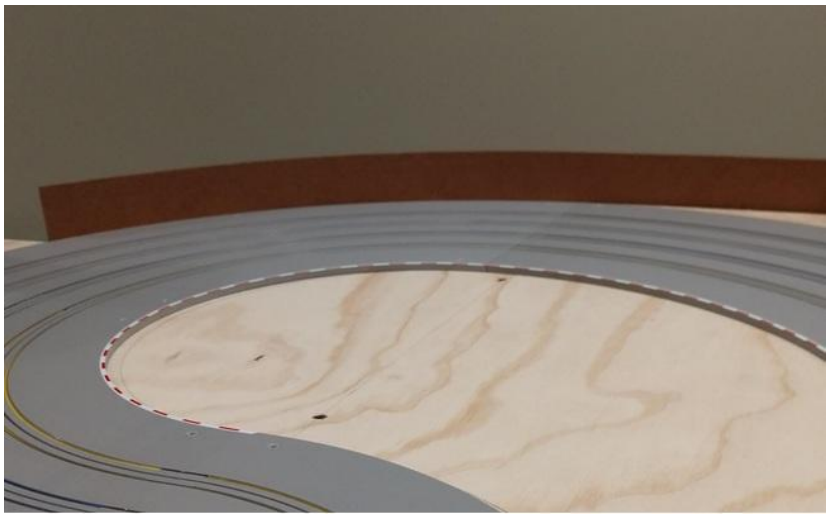
Fascia 10 – Fascia installation "to do" list

One of the things I am trying to accomplish with this fascia is to provide curves at the ends of the track to give the appearance of a slimmer, less bulky look to the track benchwork. Fascia 11 is a picture of the track with some of the curved fascia sections dry fitted in place.



Fascia 11- Curved fascia sections installed

Also, to give you a better idea of the barrier provided by the fascia, Fascia 12 picture below shows the track perspective with a curving fascia section behind it. The fascia is 2" above track level.



Fascia 12 – Fascia height as viewed from track

With all of the fascia pieces dry fitted in place, I then measured and marked all holes for the driver stations' wires and mounting, track call button hole, measure and mark all height transitions across fascia section, and mark any trimming of end (curved sections) where they join straight sections. Once all of this was done, I then removed all the sections so that I could prime and paint the inside top portion of the fascia before permanently mounting the fascia to the benchwork. I am painting the exposed top portion of the inside of the fascia a sky blue to represent a sky in the background as well as being a less distracting color that I

will be using on the outside of the fascia. It is also much easier to paint this portion of the fascia pieces before they are installed. Fascia 13 picture below shows the inside top of the fascia sections that have been painted with primer using Kilz latex primer

Fascia 13 – Inside top portions of fascia sections painted with primer

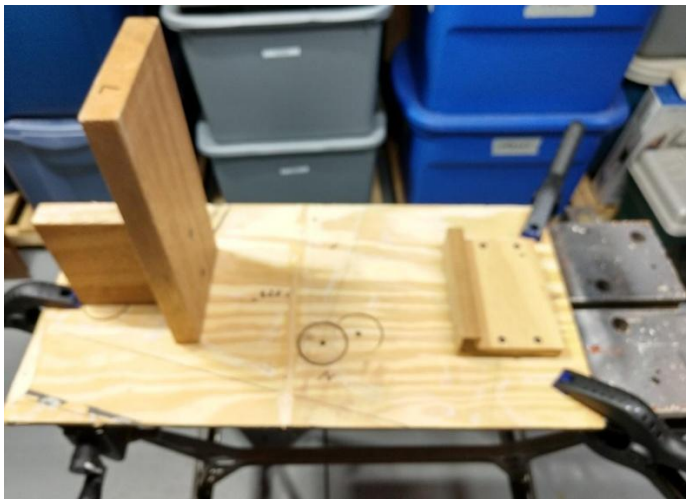
Once the primer dried I applied 2 coats of Behr "Nevada Sky" color to simulate a sky backdrop. Fascia 14 picture below shows the fascia sections painted and ready for final installation.

Fascia 14 – Fascia sections painted and ready for final installation

Bending Fascia Panels

One of the challenges with the fascia were 2 curved corners that have a tight radius. This prevented me from cutting a long piece of fascia material that goes from a straight to a curve as I did with all the other fascia sections where the radius of the curve was much broader. I thought by cutting the fascia in these corners into separate curved sections I could simply bend the section as I attached it to the bench work frame. This was not possible due to the tight radius of the curve, the hardboard was not flexible enough.

To resolve this, I googled "how to bend hardboard" and came across a YouTube video by a model railroader. This person created a jig to hold the hardboard (fascia piece) in place in an arc (curve) and applying Windex to the unfinished side of the hardboard and allowing the piece to dry for 24-48 hours, the hardboard would permanently bend to the shape of the curve. Here are pictures of this process.



Fascia 15 – Jig for bending hardboard

Fascia 15 picture above is the jig I built out of scrap pieces of wood I had laying around. Fun note: The jig is clamped down to an old (original) Black and Decker Workmate portable work bench. I bought this work bench over 50 years ago to use when I built my first HO racetrack as a teenager!

Fascia 16 – Hardboard placed in jig

Fascia 16 picture above shows the jig in use. I have inserted and clamped the hardboard section that needs to be curved. The backside (unfinished side) of the hardboard is facing up and has been sprayed with Windex. The Windex softens the hardboard fibers and when dried will cause the hardboard to take the shape of the curve. I'll keep this clamped for 18-24 hours, applying several sprays of Windex during that time. In the YouTube video I referenced, the creator stated to only use "Original Windex". While he did not explain his reason for this,

I can only guess that the ammonia ingredient used in the original Windex would prevent any mold from forming on the hardboard versus just using water.

Fascia 17 – Curved hardboard section before (left) and after (right)

Fascia 17 picture above shows a before and after shot of the curved section (right) after being placed in the jig and wetted with Windex. The section on the left is the hardboard before being placed in the jig. Just to the right of the curved section, you can see the plywood bench top where this section will be placed. While the curve of the hardboard is not the exact same radius as the plywood edge, it is sufficient to mount the hardboard in place so that it will conform to the radius of the plywood's edge.

Fascia 18 – Applying Liquid Nails construction adhesive to fascia supports

Installation

Time to install the fascia piece. Fascia 18 picture above shows Liquid Nails construction adhesive being applied to the vertical fascia supports of the bench work. This is the first step in attaching the fascia section to the benchwork.

Fascia 19 – Fascia section mounted using screws and washers

Fascia 19 picture above shows the next step in attaching the fascia section to the benchwork. Using #6 screws and #8 fender washers, the fascia section is attached to the benchwork. The screws and washers are temporary as they are used to clamp the fascia piece to the benchwork while the construction adhesive sets up. I'll leave the screws in for 48 hours before removing.

Fascia 20 – View of Fascia attached to benchwork from underneath

Fascia 20 picture above shows a different perspective looking from underneath the benchwork you can see how the fascia butts up against the vertical supports. You can see the construction adhesive oozing out from the side of one of the supports in the middle of the picture.

After the 48 hours to allow complete drying and bonding of the construction adhesive/fascia/benchwork, I began removing the screws and washers. In Fascia 21 picture below you can see the holes in the fascia after I removed several of the screws and washers. There is still one screw/washer in place as a reference for the picture.

Fascia 21 – Removing screws and washers from fascia

Next step is to fill in the screw holes and any gaps between fascia section with spackling paste, as shown in Fascia 22 picture below. Once the spackling paste dries, I will then sand the surface smooth. This process is very time consuming as I may apply up to four applications of spackling past.

Fascia 22 – Using spackling baste to fill in screw holes and gaps in fascia

Some of you may be questioning why I don't just leave the screws in place (or use a better more finished screw/hardware) versus going through all the effort of filling in the holes and sanding everything down. While I know a lot of folks do a nice job of securing their fascia with nice finishing screws and washers, I like the appearance of a clean fascia that appears to float without any apparent hardware connecting it to the benchwork. I can get away with that look here as my fascia is very light weight (only 1/8" thick) versus most folks that use "1 by" lumber for a fascia which is much heavier and will require mechanical fastening.

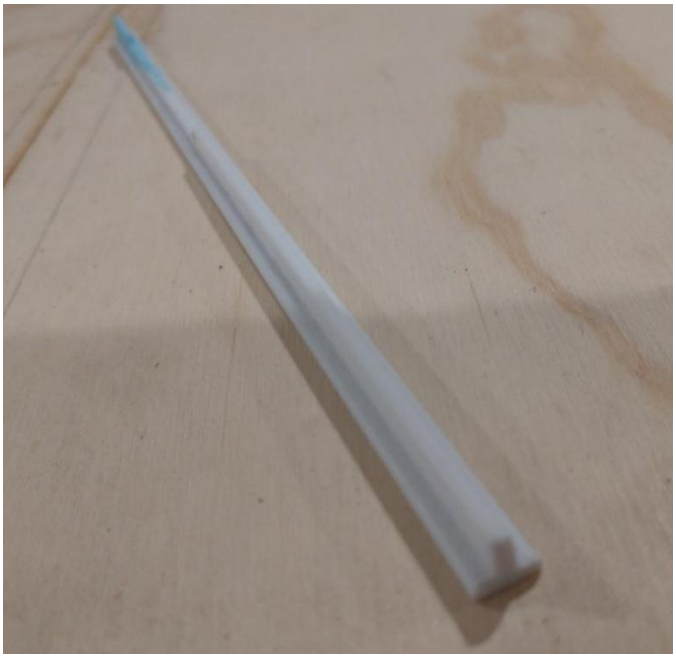
Panel Gap

One fascia panel gap I do not spackle is the gap between sections of the fascia adjacent to one of the 3 benchwork modules. The reason for this is that it will allow easy disassembly and reassembly of the track in the event of a move without any changes/damage to the fascia.

Fascia 24 – Gap between fascia sections of benchwork modules

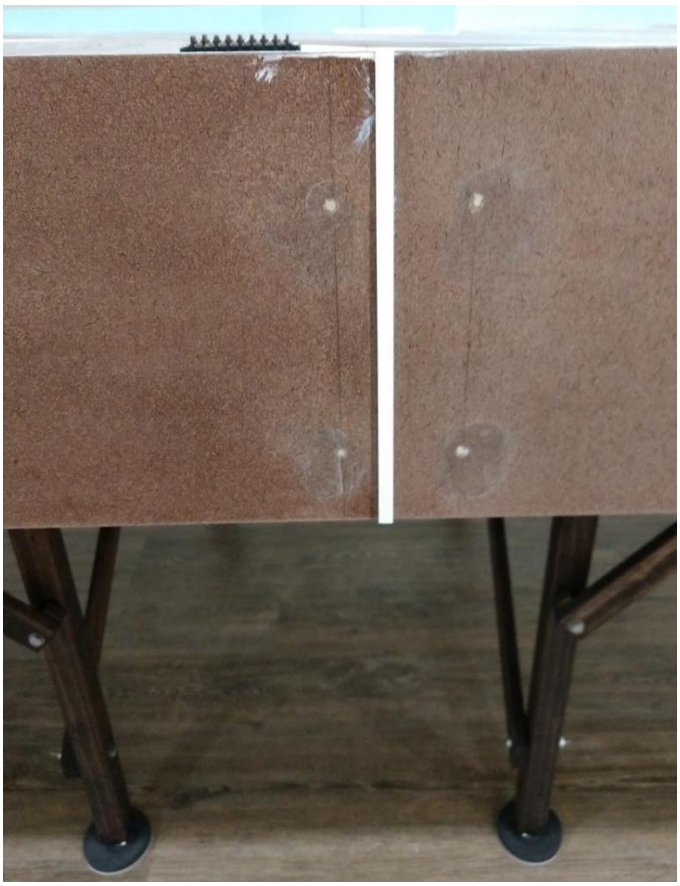
Fascia 24 picture above shows the gap between a couple adjacent sections of the fascia that are attached to the middle track module (left) and an end track module (right). I've purposely created about a 1/8" gap between the fascia panels.

I purchased some Evergreen Plastics "T" styrene pieces (Part no. 768 - width of T is .257" and the vertical portion of the T is 3/32" wide) and cut them to length to for the height of the fascia. Fascia 25 picture below shows one of these T section styrene pieces cut to length. Note: I've painted the top of the inside of the "T" sky blue as it will be exposed above the plywood top and visible as part of the inside of the fascia.



Fascia 25 – Styrene T-section cut to length

Fascia 26 picture below shows the "T" in place on the fascia. I will be painting this the same color as the fascia and will tack it in place using canopy glue that dries to a rubbery consistency and can be easily removed when it comes time to move the track.



Fascia 26 – T styrene section dry fit in fascia gap between benchwork modules

Fascia 27 and 28 pictures below show the fascia sanded and prepped just before I begin to apply primer and paint to the fascia.

Fascia 27 – Fascia sanded and prepped, ready for paint

Fascia 28 – Another view of the sanded and prepped fascia

Prime and Paint

With all the screw holes and fascia section joints spackled and sanded, it was time to apply the paint finish to the fascia. After 3 or 4 layers of spackling and sanding, at which point I determined the fascia was nice and smooth, I applied Kilz primer to the fascia, as shown Fascia 29 picture below.

Fascia 29 – Primer coat applied to fascia

After applying 2 coats of primer and letting it dry for a couple of days, it was now time to apply the finishing coat of paint. I used Behr paint and what I call "McLaren" orange. I applied 2

coats of paint with a foam roller. Fascia 30 picture below shows the finished fascia. I also mounted the driver stations onto the fascia.

Fascia 30 – Fascia painted in "McLaren" orange

I had previously mentioned how I intentionally left a small gap between the fascia sections of adjoining benchwork modules. Here's a picture of where the fascia bench sections join. Fascia 31 picture below shows the 1/8" gap after painting the fascia.

Fascia 31 – Gap in fascia between adjoining benchwork modules

Fascia 32 picture below shows how the joint looks after inserting the plastic T filler, which has been painted the same color as the fascia.

Fascia 32 – Plastic "T" inserted into fascia gap

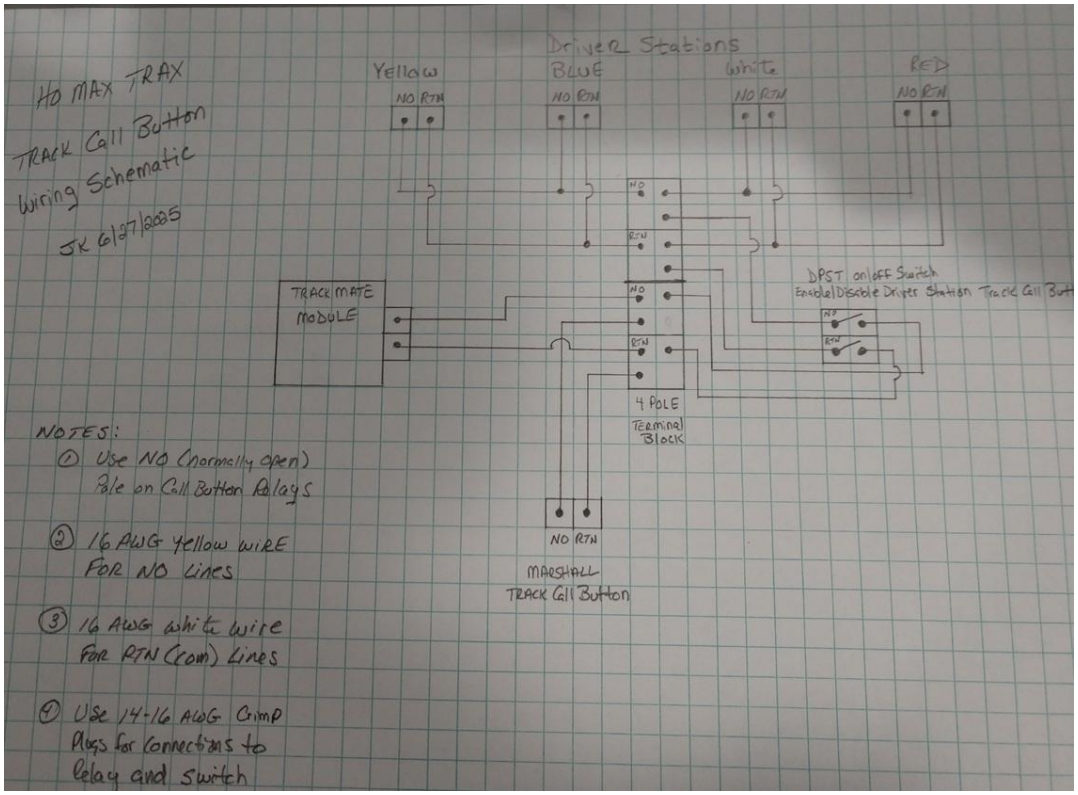
With the fascia painted, there were still several final details to be added to the fascia. The following sections describe the installation of these details.

Track Call Buttons

On the track there are 5 (five) track call buttons: one at each driver's station, and a marshal's track call button located on the back fascia of the track. For times that we do not have the ideal number of racers (9: 4 racing, 4 marshals, and someone manning the computer), we'll use the driver station track call buttons with a track call delay set in the TrackMate software. With the delay, when a driver presses the track call button (because his car came off the track), power will stay on for one second so that the other drivers continue racing. Once the delay expires, power will be turned off for the entire track (like a regular track call), allowing the driver to put their de-slotted car back on the track. Once the driver gets back to their station, they can hit the track call button to resume the race.

Of course, when we do have a full crew (marshals, etc.), we do not want the drivers pressing the track call button, so I have added in a switch to disable/enable the driver station track call buttons.

Button 1 picture below shows a wiring schematic I drew up for the track call button wiring. Basically, the 4 driver stations track call buttons at the top of the schematic feed into the upper half of the terminal block. The output of the upper half of the terminal block feed into a double pole, single throw toggle switch which opens/closes the signal from the driver station track call buttons. The output of the toggle switch, along with the marshal's track call button are fed into the lower half of the terminal block. Finally, the output of the lower half of the terminal block is fed into the Track Mate module.



Button 1 - Wiring diagram of track call buttons

Following are some pictures of the build and installation of the marshal's track call button.

Button 2 – Laminating wood for track call button mount

Button 2 picture above is not some sort of Chinese drone. I am actually laminating a piece of 4"x4" plywood to a similar size piece of hardwood. The track call button is mounted in the

hole in the middle and will be indented when mounted on the fascia (i.e. the track call button is below the surface of the fascia) so it is not accidentally hit, pressed.

Button 3 picture below shows the marshal's track call button mounted in the fascia (back). Note: the 4 mounting screws are symmetrical around the hole for the track call button. The camera and angle of picture distorted the location of these screws.

Button 3 – Marshal's track call button mounted to fascia

Over on the front side of the fascia, as shown in Button 4 picture below, I mounted the toggle switch to enable/disable the driver station track call buttons. Sorry for the blurry picture.

Button 4 – Toggle switch to enable/disable driver station track call buttons

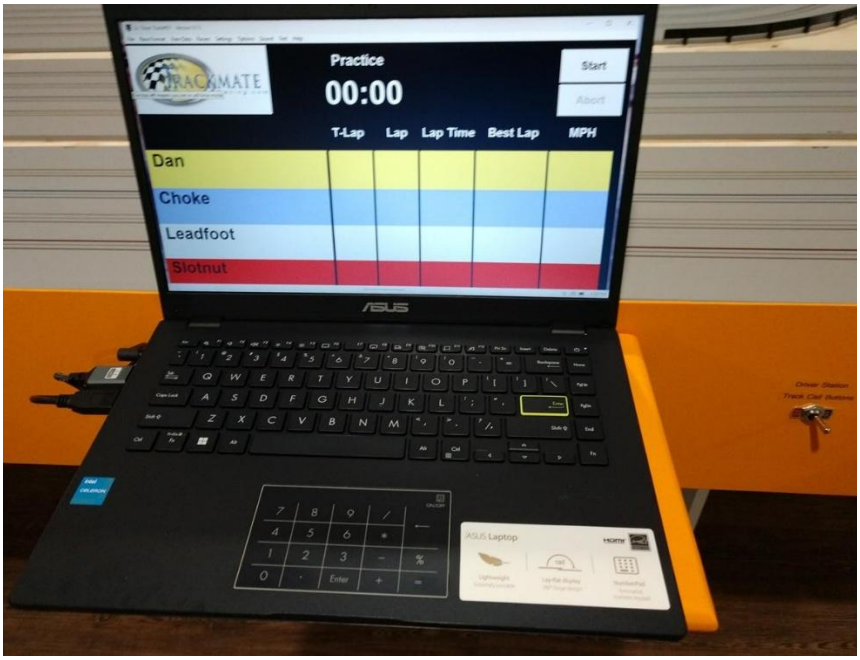
Computer Shelf

With all the wiring now done, it was time to buy a computer, install the TrackMate software, and mount it to the track. I purchased an ASUS laptop from Best Buy on sale for $159 (with Windows 11 installed)! The computer costs less than the TrackMate hardware! The laptop is very basic, but it does have the required USB A port to connect to the TrackMate module and HDMI port for an external monitor.

Using some small L-angle shelf brackets that I painted black, along with a 1" piece of pine board I had laying around, I rounded the edges with a router and painted "McLaren" orange, I mounted the computer shelf to the front fascia at the start/finish line. I punched out a hole in the fascia to feed the power, USB, and HDMI cables to the laptop. I put a rubber grommet around the hole to finish it off. Computer 1 picture below, shows the computer shelf. Note: You can see the track call toggle switch to the right of the shelf

Computer 1 – Computer shelf

Finally, here's the $159 computer running the Track Mate software as shown in Computer 2 picture below.



Computer 2 – Computer running Trackmate software

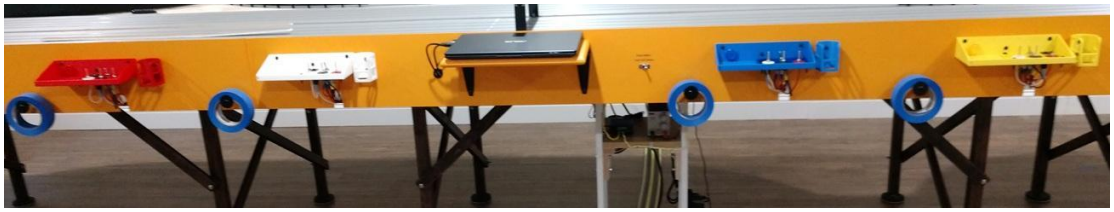
Driver Station Completion

After hosting a shakedown race event and then an actual race event with my Wednesday night race group, I determined that there were a few things needed to complete the driver stations. First was a holder for the controller at each station and second, some sort of holder for tire tape (a roll of masking tape). The controller holder is a 3D printed item I found for sale on eBay. One of my fellow racers uses these controller holders on his racetrack. I really liked the way they held the controller, so I bought an "IROC" set of controller holders. The next item was the individual tape holder at each driver's station. Again, I got this idea from another fellow racer's racetrack. I am using a 1/2" wooden dowel with a large fender washer (I painted the washer and dowel black) and mounted this into the fascia.

Station 1 picture below is a picture of the yellow lane driver station where you can see the tape holder to the left of the driver station hook up shelf and the controller holder to the right of the shelf.

Station 1 – Driver station with tire tape holder (left) and controller holder (right)

Station 2 picture below shows all 4 completed driver stations.



Station 2 – All 4 completed driver stations

Scenery and Details

With the track all wired and tuned, it was now time to start working on the scenery. For scenery, which I previously mentioned was to be very basic, I would be adding retaining walls around the elevated sections of the track, Armco barriers around the outside of the infield corners, scenic grass between the track, start and finish lines on the track, and track section labeling.

Retaining Walls

Up first are the retaining walls around the elevated sections of track. The retaining walls serve two purposes: 1) They add a finished appearance to the elevated sections of the track around the carousel, 2) They act as a guard rail for cars when they de-slot in this section of the track.

I used Evergreen Scale Models 0.060" 8" x 21" Black Colored Polystyrene Sheets (5 of them) for the retaining wall material. There were several reasons I used the black colored styrene versus the typical white colored styrene you see on most tracks: 1) I wanted to be different, 2) the black color will hide any crash marks on the wall, and 3) the black color does not stand out like the white and hopefully minimizes the visual impact of the elevated track

sections. The retaining walls are secured to the track benchwork using #4 Pan Head Black 1/2" screws and some Liquid Nails construction adhesive, as shown in the Walls 1 picture below.

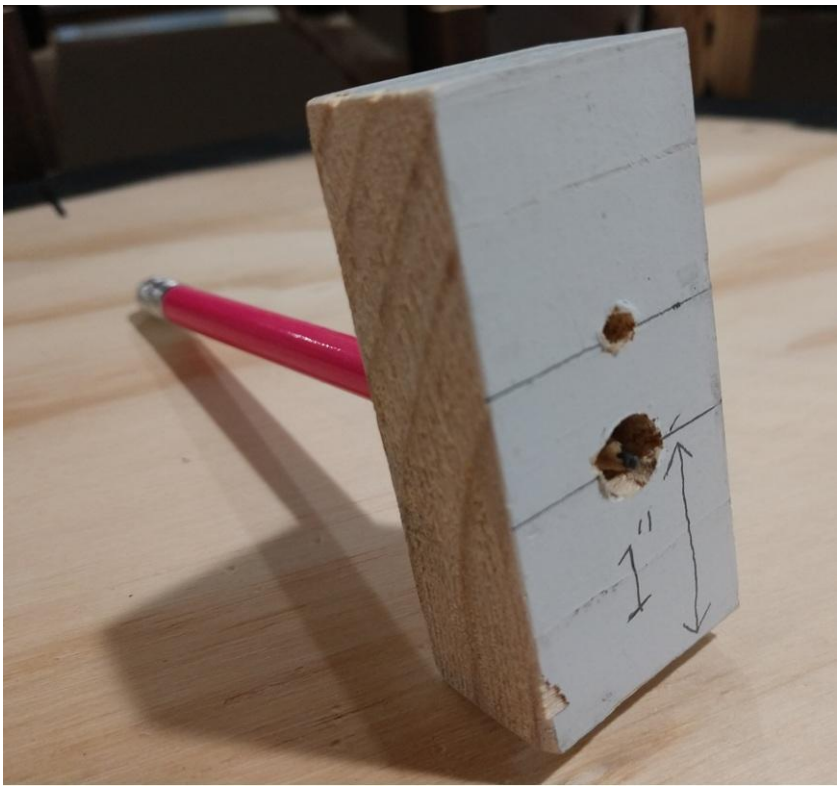
Walls 1 – Retaining wall material: 0.060" black polystyrene sheet, #4 black pan head screws, and Liquid Nails

I set the height of the retaining walls to 2 different heights: 1) 1" above the track on the outside of turns, and 2) 1/2" above the track on the inside of turns or along a straight away. I felt the 1" height provided more protection for cars de-slotting in a turn where they are more likely to travel to the outside of the turn with more force/speed, while the 1/2" height provides a guard rail effect on the inside of a turn and along the straight aways to prevent a car from plunging

off the elevated track sections. Plus, impact against the wall on the inside of a turn should be relatively slower and less forceful than on the outside of a turn.

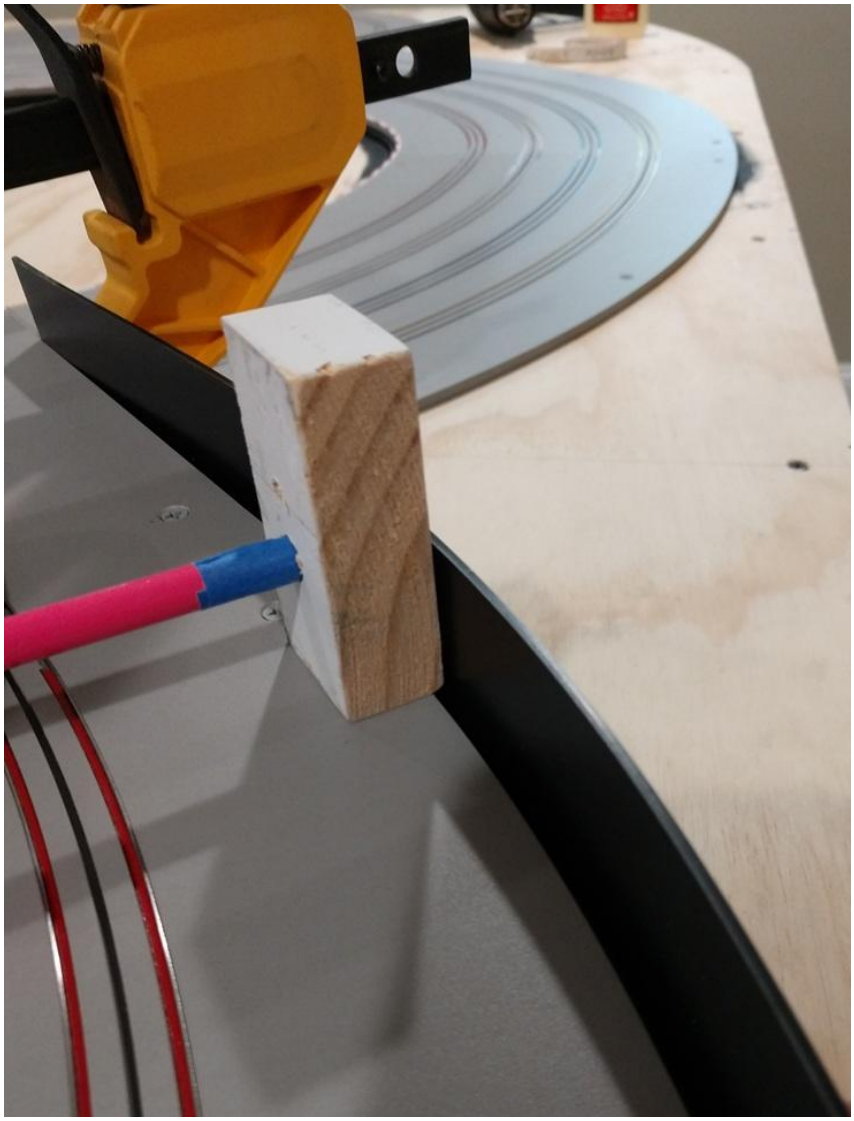
To build the walls I first cut the 8"x 21" sheets in half to 4" x 21" strips knowing that the maximum height of any of the retaining walls would not exceed 4". I then temporarily clamped the 4 x 21 sheets against the track in the carousel section. Using a couple of homemade jigs that I made to allow me to trace a consistent 1" or 1/2" trim line on the 4 x 21 sheets, I would trace the cut line on the sheet, remove the sheet, and use the "score and snap" method to cut the sheet to the correct height. The "score and snap" method is an easy way to cut sheet styrene. Using a sharp utility knife and metal straight edge, cut into the styrene along the cut line, only cutting a third to halfway through the styrene. Next fold back the styrene sheet across the cut line. The styrene should snap (separate) along the cut line in a nice clean, even line. Tip: Using this method, the scored edge of the black styrene will turn a light gray color due to the tension placed on the styrene. Rather than paint the edge with black paint, take an Xacto knife and lightly scrape the edge of the plastic sheet. Eventually you will scrape away the discolored portion and reveal the black color underneath along the edge. No need to paint, just scrape!

Here are some pictures of the build process for the retaining walls:



Walls 2 – Jig to mark 1" height of retaining walls

Wall 2 picture above, shows one of two "jigs" I built to mark a 1" height above the track on the retaining walls (the other jig is set for a 1/2" wall height). It is a scrap piece of 1x3 that I drilled a hole centered 1" from the bottom of the 1x3. The hole diameter allowed a lead pencil to fit snuggly with the point of the pencil centered in the hole.



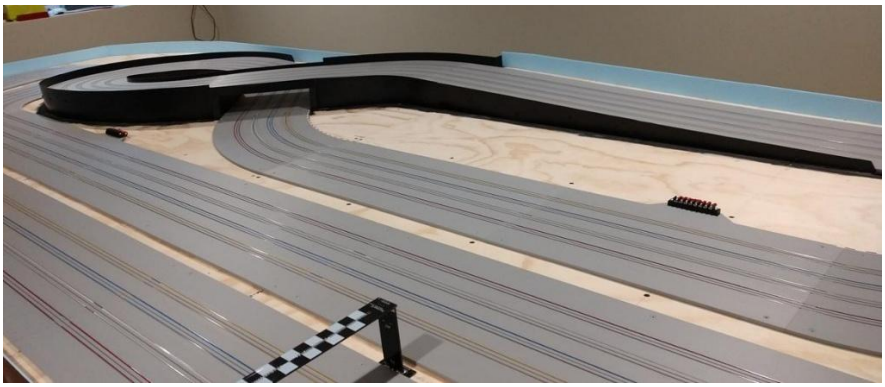
Walls 3 – Tracing 1” height line on retaining walls using jig

Walls 3 picture above shows the jig being used to trace a cut line 1" above track level on the styrene sheet. I've temporarily clamped the styrene sheet along the edge of the track. I am dragging the jig along the top of the track surface while applying pressure to the pencil to create a trace line on the sheet styrene that I will later cut along after the sheet is unclamped.

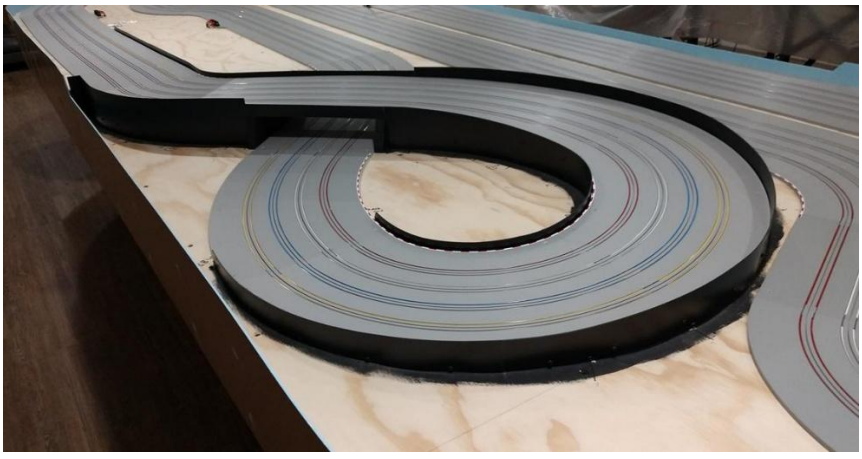
Walls 4 – Section of retaining wall after being trimmed

Walls 4 picture above shows a section of the retaining wall that has been trimmed. This is the wall section that will mount along the outside of the carousel turn, thus the downward slope of the wall. While it is hard to tell in this picture, this piece of the wall is almost 7 feet long. To make a wall this long I bond (glue) several sections of the 4x21 sheets of styrene together using Tamiya styrene liquid cement. This cement actually "welds" the styrene sheets together by softening the plastic (in this case the ends of the styrene sheets) and literally melting them together.

Following are several pictures, Walls 5, Walls 6, and Walls 7, showing the completed and installed wall sections on the track.



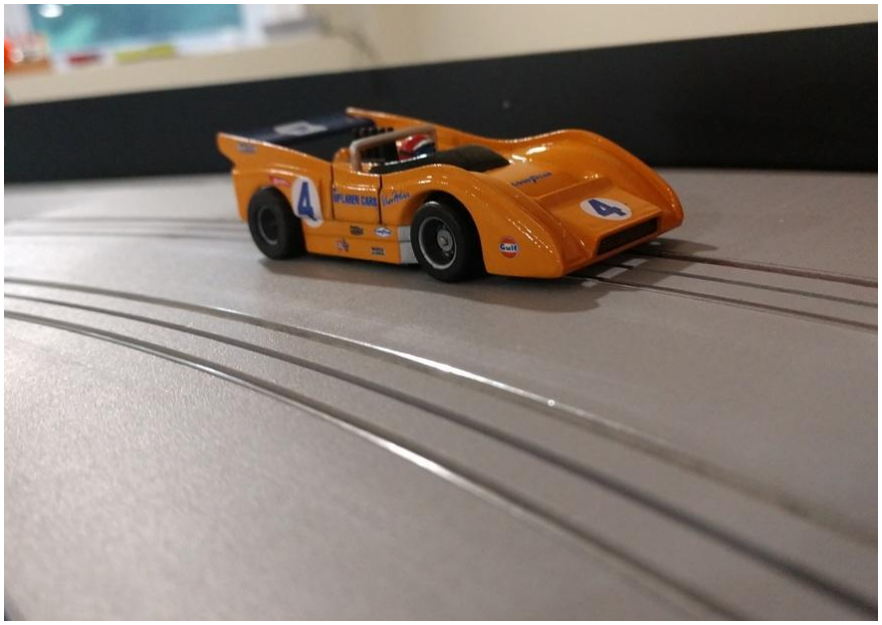
Walls 5 – Completed retaining wall along elevated straight into carousel



Walls 6 – Completed retaining wall inside and outside of carousel

Walls 7 – Another view of the retaining walls from the backside of the track

Walls 8 picture below gives you a perspective of the height of the wall (this is a 1" high wall) as compared to a car on the track.



Walls 8 – Perspective of retaining wall height against car on the track

Overall, I am quite pleased with the results. From a distance the wall looks great as the black #4 pan head screws holding the walls in place blend right into the black styrene plastic. However, upon closer inspection you can see the screw heads so it may distract from the wall a little bit.

Walls 9 picture below is a closeup of one of the walls where you can see the mounting screws (if you look hard enough).

Walls 9 – Retaining wall closeup showing mounting screws

Armco Barriers

I decided to use the "new" AFX Armco barriers versus plexiglass barriers to prevent de-slotted cars from crossing into other sections of the track. Since I will mainly be running T-Jets with an occasional AFX Magnatraction or stock AFX Mega G+ (I love the bodies of the G+ cars. Fantastic detail on everything from mid-60's Mustang fast backs to the latest F1 cars, these are arguably some of the finest bodies ever produced in HO), I feel the use of the Armco barriers will contain the T-Jets and provide a more realistic look to the track.

I am using the AFX Armco barriers that were released several years ago. I modify these barriers to work with the Max Trax and mount onto the plywood top. To do this I am using K&S brass tubing, 1/16" diameter, to act as a stake in the ground to secure the Armco barrier to the plywood top. Barriers 1 picture below shows the material used.

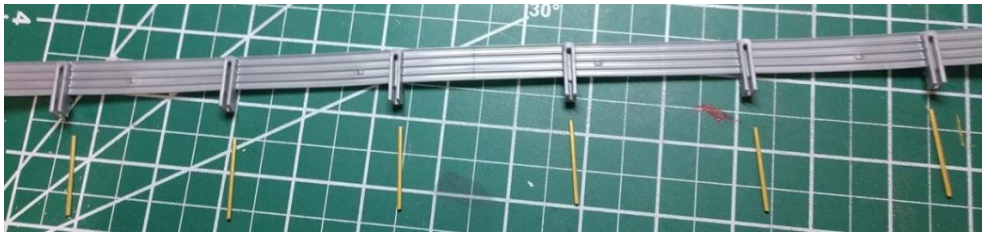
Barriers 1 – Armco barrier material: AFX Armco barriers and K&S 1/16" round brass tubbing

Barriers 2 – Stock AFX Armco barrier (top) and modified Armco barrier (bottom)

First step is to remove the clip at the bottom of each barrier stanchion (6). This clip is used to attach the barrier to the bottom of the AFX track. Since the Max Trax is a solid piece of

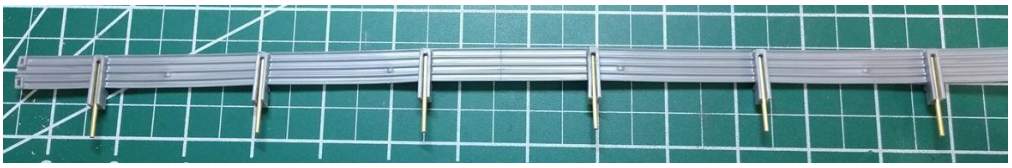
plastic material, this clip is not needed. In Barriers 2 picture above the stock AFX Armco barrier is on top with the modified barrier below it. Notice how the clips have been removed from the bottom of the stanchions on the modified barrier.

Next, I cut 1 1/8" long pieces of the K&S 1/16" brass tubing. Barriers 3 picture below shows the back of the barrier with 6 pieces of the cut brass tubing that will be secured into the slot on the back of the stanchions



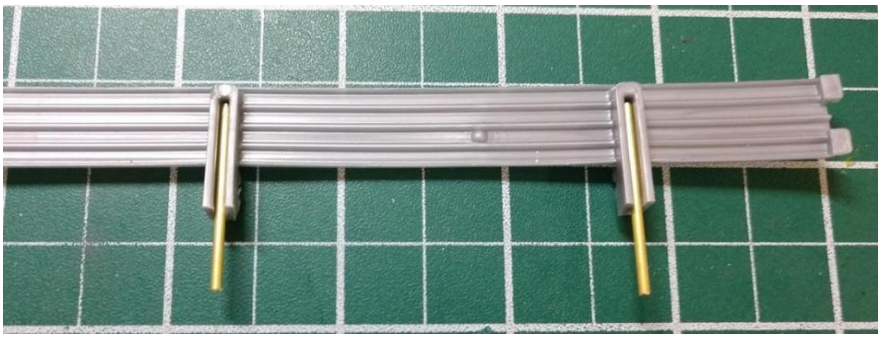
Barriers 3 – Back of modified Armco barrier with cut pieces of 1/16" brass tubbing

Barriers 4 picture below shows the brass tubing inserted into the back of the stanchions. I then use "super glue" to secure the brass tube inside the stanchion. When this dries, I use JB Weld filler epoxy to fill in the channel in the back of the stanchion, covering the top part of the brass tube and giving a squared off look to the stanchion. Sorry I did not grab any pictures with the JB Weld applied



Barriers 4 – Brass tubbing inserted into slots on back or Armco barrier

Barriers 5 picture below is a close up of this assembly.

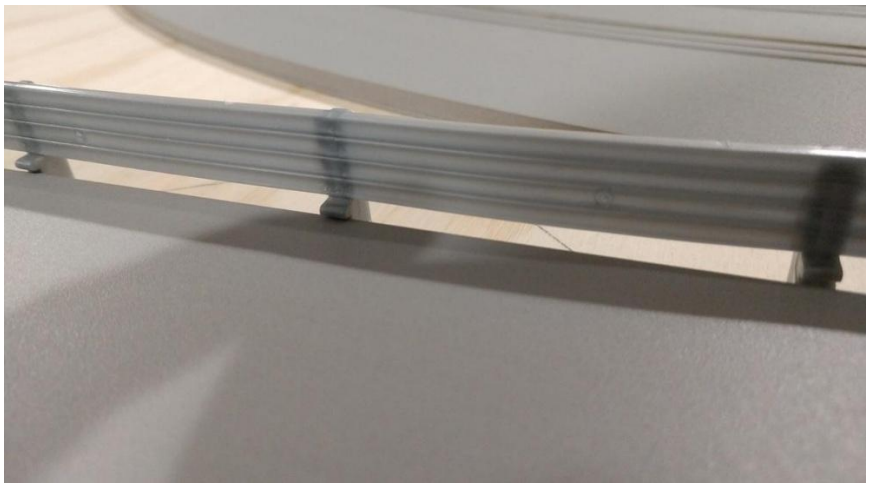


Barriers 5 – Close up of brass tubing glued into back of Armco barrier stanchions

Once the JB Weld epoxy is dry, I sand it smooth. Now it is time to fit the Armco barrier on the track. I place the barrier against the track edge and mark where the brass tubes are contacting the plywood. I then drill a 5/64" hole in the plywood, approximately 3/32" away

from the track edge for each of the holes the brass tube will be inserted into. I'm drilling a slightly oversize hole (5/64") for the 1/16" diameter brass tubing to accommodate any measurement tolerances. I'm also using a 3/32" drill bit as my spacer (gauge) when marking the distance of the hole from the edge of the track.

Barrier 6 picture below shows the Armco barrier inserted into plywood top next to the track. One unexpected, but cool outcome, was that the upper part of the lip on the front of the Armco barrier stanchions aligns perfectly (height wise) with the Max Trax. This ensures that the barrier is horizontally parallel to the track for a nice clean look.



Barrier 6 – Armco barrier mounted next to track

I've decided to paint the Armco barriers a satin black finish using Krylon spray can paint. I feel this compliments the black color of the walls. Besides, if Watkins Glen can have blue Armco barriers, then I think my black Armco barriers are not much of a stretch.

Barrier 7 picture below shows the painted Armco barrier on the track with an old Aurora Porsche 904 T-Jet on the track for perspective.

Barrier 7 – Painted Armco barrier

These barriers will not be permanently mounted until after the scenery is installed.

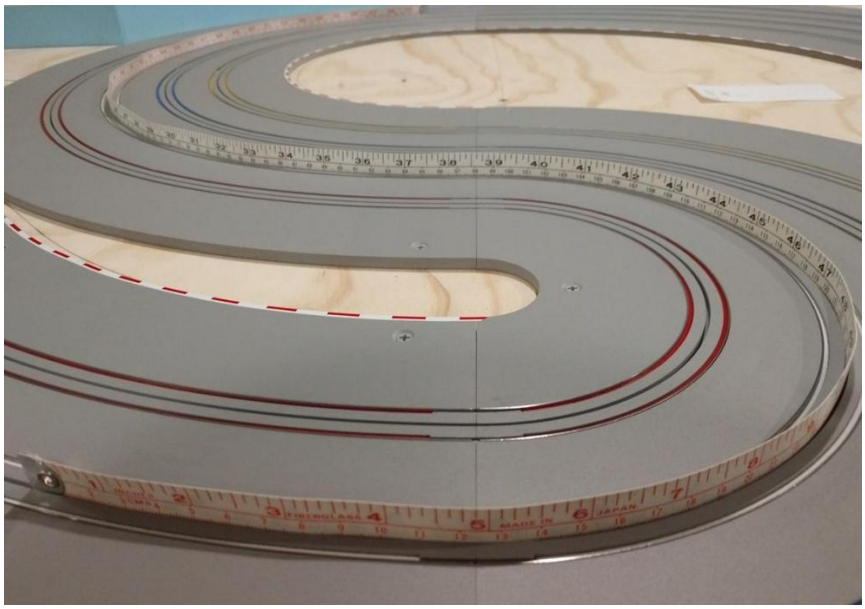
Track Section Labeling

The track section labels denote the different sections of the track. These are typically used when racing to identify what section a car finishes in to help determine the final standings if more than one car finishes on the same lap.

With a lap length of 74', I decided to divide the track into 60 sections with each section having a length of 14 3/4". This resulted in one section being about 1 3/4" longer than all the others. The reason for the 14 3/4" length is that this length aligned perfectly with the underpass of the carousel such that the section of track under the underpass was one section (the section started just before the underpass and ended just after the underpass). This length prevented the section from beginning or ending under the underpass which would have made it extremely difficult to determine which section the car was in if it was close to the section border.

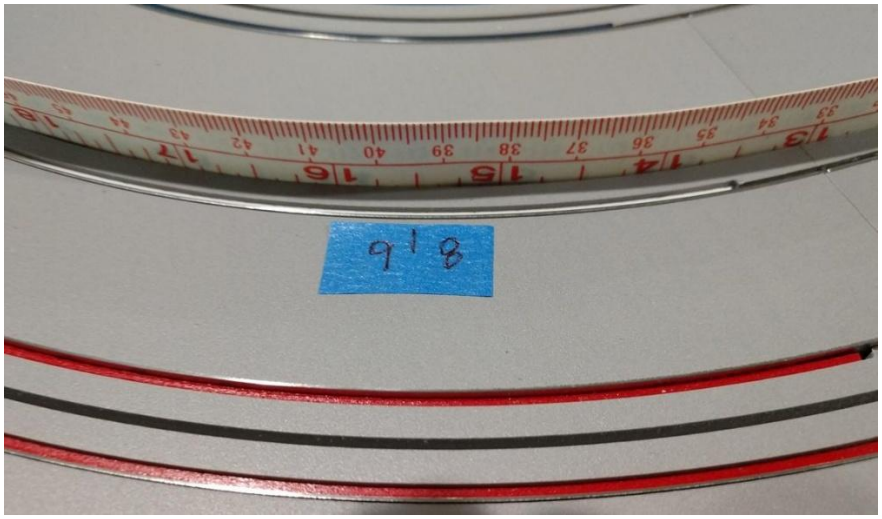
Here are pictures of the process I used to mark my track sections.

I began by measuring the overall lap length using my wife's cloth sewing tape measure (5' long), as shown in Section 1 picture below. This got me the 74' lap length using the white (middle) lane.



Section 1 – Using cloth sewing tape measure to measure track sections

Once the section length was determined, I then used the measuring tape to mark off the 14 3/4" sections using masking tape as shown in Section 2 picture below. Note: In the picture below, I initially was using 15 1/2" sections, but this resulted in 2 track sections in the underpass of the carousel.



Section 2 – Marking off track sections using masking tape

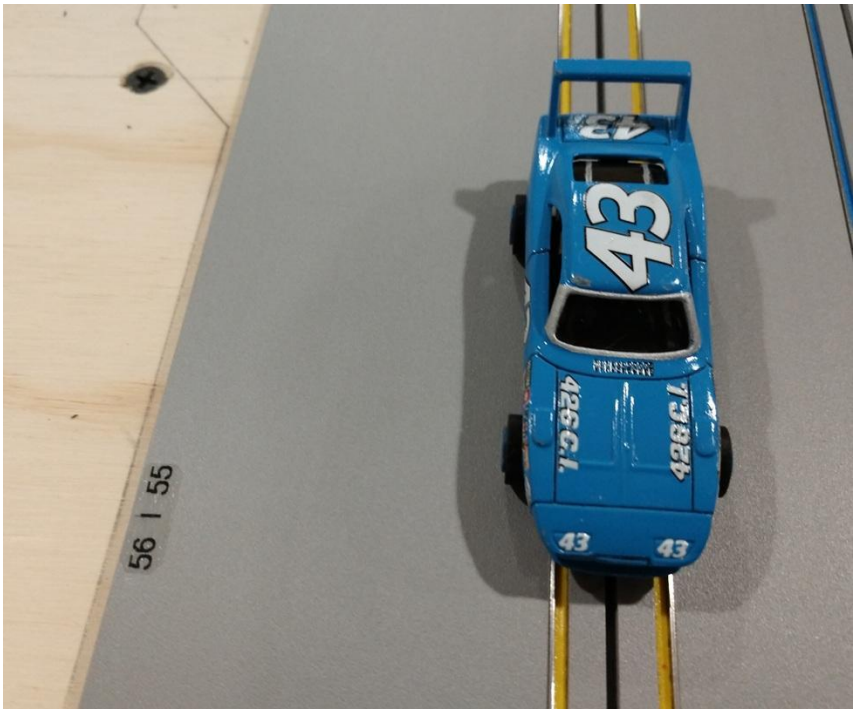
With the 60 sections marked off on the track, it was now time to create the labels. I have a Brother P-Touch Label maker and decided to use this to make my track section labels. Typically, the label maker prints out black lettering on a white background. However, Brother offers different label cartridges that can create labels with different color letters and backgrounds. Since my track can be run in both directions, I would need 2 sets of section labels, ideally in different colors. I chose to use the Brother label cartridges with clear background with one cartridge printing black lettering and the second cartridge printing white lettering. After experimenting with font sizes and spacing, I decided on the following, as shown in the Section 3 picture below.

On the top edge of the track (next to the yellow lane) I used black lettering to denote the track sections when racing in the traditional road course clockwise direction. On the bottom edge of the track (next to the red lane) I used white lettering to denote the track sections when running in the counterclockwise direction.

Section 3 – Track section markers, top black marker for racing in clockwise direction, bottom white marker for racing in counterclockwise direction

To give you a better perspective of the lettering, here are a couple of pictures, Section 4 and Section 5 pictures below, with my Grand National Petty Superbird on the track.

Section 4 – Track section marker size compared to HO slot car

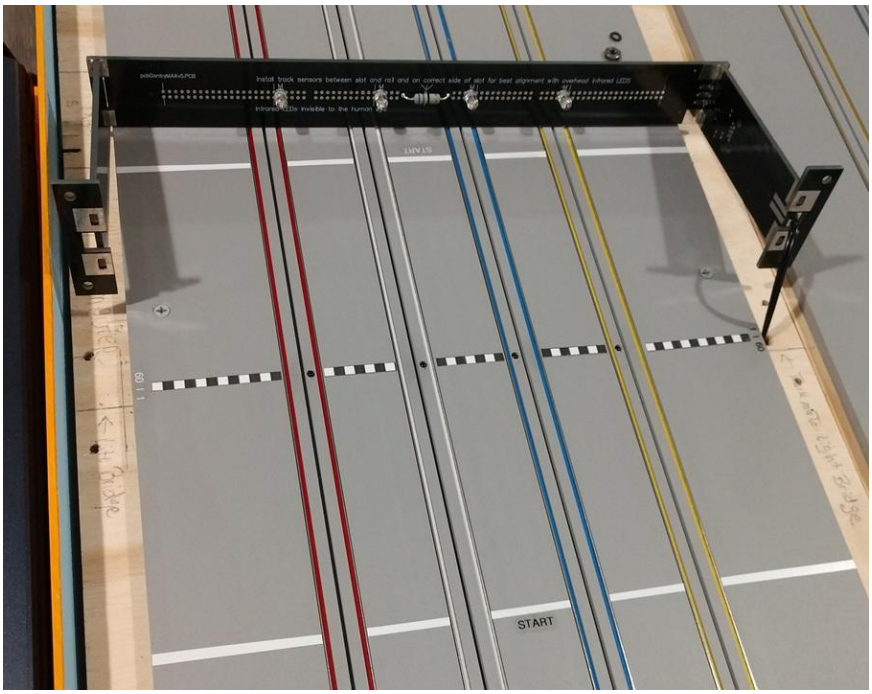


Section 5 – Another view of track section marker next to HO slot car

Adding the start and finish lines

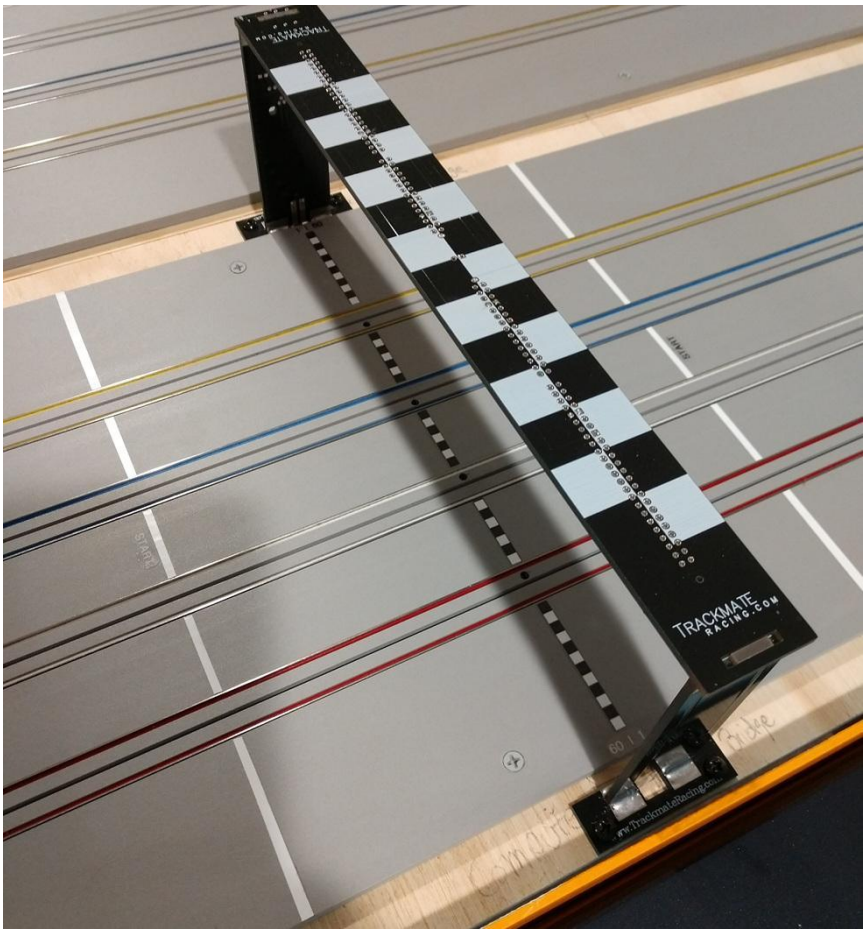
Another important "detail" that needed to be added for racing was the actual start and finish lines. While the track uses one common finish line located directly below the Track Mate light bridge, I added 2 start lines, equidistant on either side of the finish line. Since the track is wired to run in both directions, the need for separate starting lines is necessary.

Lines 1 picture below shows the installation of the common finish line (black and white checkered stripe) located directly under the center of the light bridge. In this picture, I temporarily unbolted the light bridge to allow unobstructed access to the track when installing the finish line. You can also see in the picture the 2 solid white start lines on either side of the finish line. Notice that the word "Start" just below the white start line at the bottom of the picture is printed in the color black. This is the start line used when running in the road race direction (clockwise) and aligns with the black track section labels. At the top of the photo is the second white start line with the word "Start" printed in the color white. This start line is used when running in the oval track direction (counterclockwise) and aligns with the white track section labels when running in this direction. The start lines were made from some white vinyl lane marking tape I had left over from my previous HO layout. The checkered finish line is also a vinyl tape that I cannot remember where I got it from.



Lines 1 – Installing finish line

Lines 2 picture below shows the light bridge in place with the counterclockwise direction start line (left), common finish line (center), and clockwise direction start line (right).



Lines 2 – Start and finish lines

Installing Grass Scenery

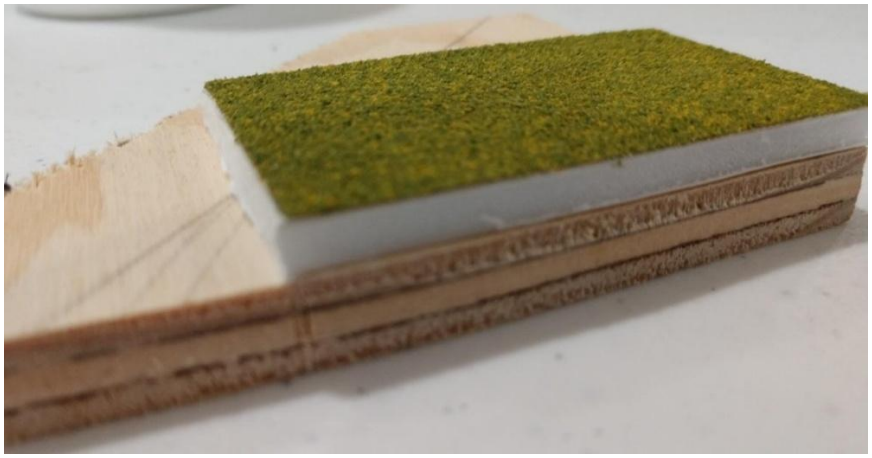
For this part of the build, I ran into a SNAFU. I planned to use Woodland Scenics grass mats as the basis for my scenery. These mats consist of a vinyl sheet where a green grass like material (looks like a very fine ground foam) is glued to one side of the vinyl sheet. These sheets come in several sizes in which I used several of the largest size to complete my track. To attach these sheets to the bench top, Woodland Scenics has their specifically recommended "Mat Adhesive". This is basically a liquid contact cement/glue that you brush on the back of the grass vinyl mat and the benchwork, or surface you are attaching the mat to.

Here's where the SNAFU occurred. While the grass mats were readily available at the 2 local hobby shops I frequent, neither one of them stocked the mat adhesive. Woodland Scenics website showed this product as out of stock. After working with my local hobby shops to see if they could get the adhesive (backorder, etc.), they both told me that their suppliers could not get it and that there was no timeframe on when it would be available. At this point a couple of months had passed to the point where the track was permanently mounted and I

was ready to begin the scenery. Relying on good ole' eBay I was able to find the mat adhesive for sale by a seller at a reasonable price (MSRP), unlike the majority of sellers who were charging well above MSRP. When I finally received the jar of mat adhesive, it was my first time reading the directions and the directions clearly stated that the mating surface the mat was going to be attached to had to have a smooth non-porous surface and that if you were applying it to wood, that the wood must be painted. Since my plywood bench top was not painted (something I planned on NOT doing since it would be covered with the grass mat). It was now too late for me to paint the plywood since the track had been permanently attached and aligned, and I was not going to mask off the track to paint the plywood. What I ended up doing is buying the foam board (purchased from Michael's craft store) that is 20"x30" and 3/16" thick with a glossy paper finish on both sides. Using this material created additional steps with installing the scenery, adding to the amount of time it took me to complete this phase of the build. I would estimate it took me 2 to 3 times longer than if I could have glued the mat directly to the plywood.

However, there was a positive to this SNAFU, the additional layer of foam board raised up the level of the grass mat to the same height of the track, creating a much more realistic appearance once all the scenery was completed.

Scenery 1 picture below shows a sample section I built up before applying this scenery approach to the rest of the track. This picture gives you an idea of the different layers in the scenery. Starting from the bottom is the 3/8" plywood benchtop, above that is the 3/16" foam board (white foam layer), and on top is the Woodland Scenics grass mat.



Scenery 1 – Scenery layers: plywood benchtop (bottom), foam board (middle), grass mat (top)

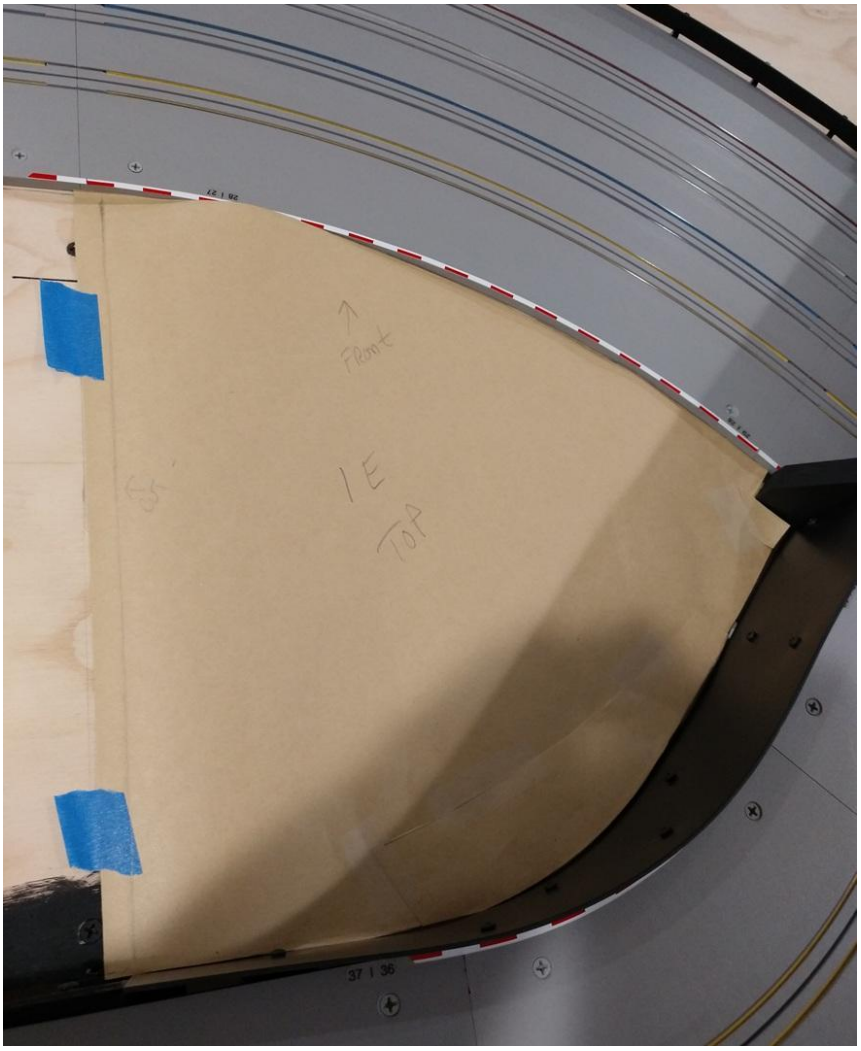
Following are pictures of the process I used to add the scenery (grass mats) to my track.

Scenery 2 picture below shows the material I used. In the background is a roll of the Woodland Scenics grass mat. In front are the 3 adhesives I used to install the scenery. From left to right: the infamous Woodland Scenics Mat Adhesive - this would be used to attach the grass mat to the foam board, Woodland Scenics Scenic Cement is a diluted white glue that I used as an additional layer of glue to hold the grass material to the mat. I would use an eye dropper to apply the glue to the grass surface. The Titebond Wood Glue would be used to secure the foam board to the plywood benchtop. Sorry I did not get a picture of the foam board.

Scenery 2 – Material used for scenery

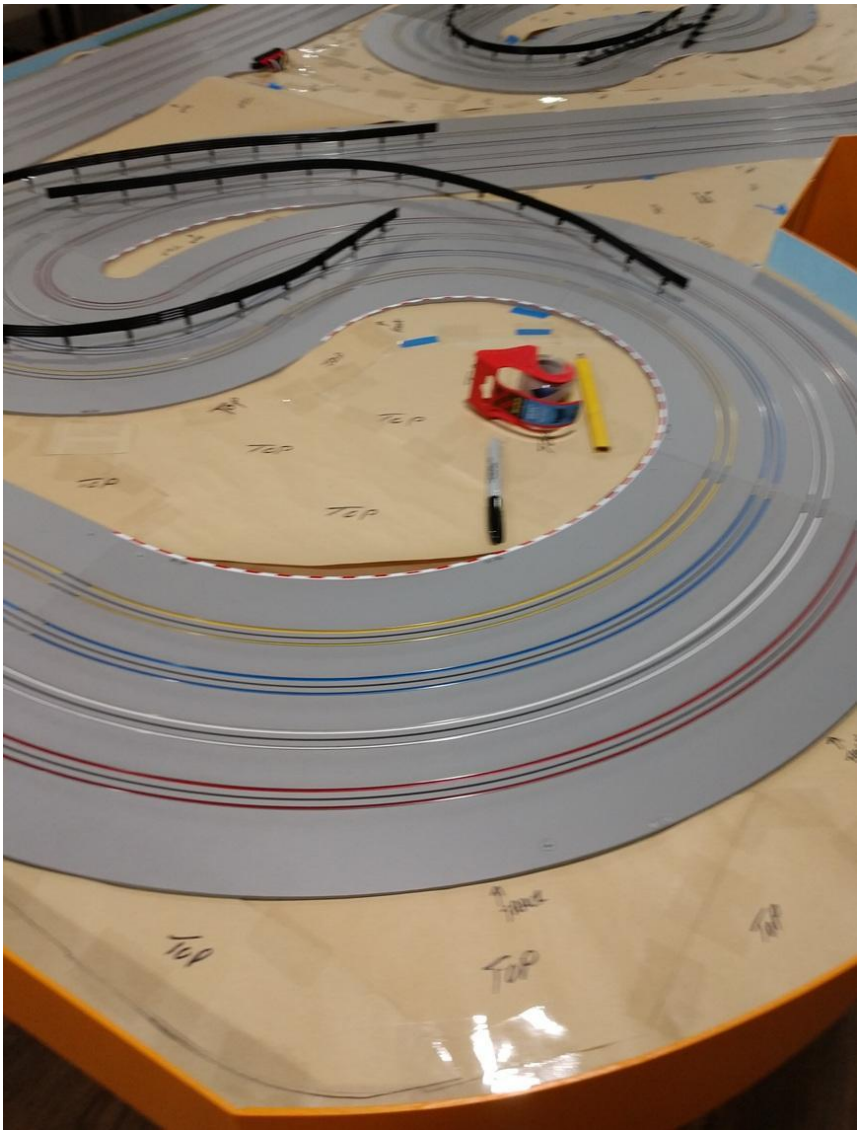
Okay, onto to the installation…

First step, using craft paper, I create a template for the scenery surface around the track. Scenery 3 picture below shows the craft paper template that will be used to create a section of scenery. We'll use this scenery template in the rest of the build photos.



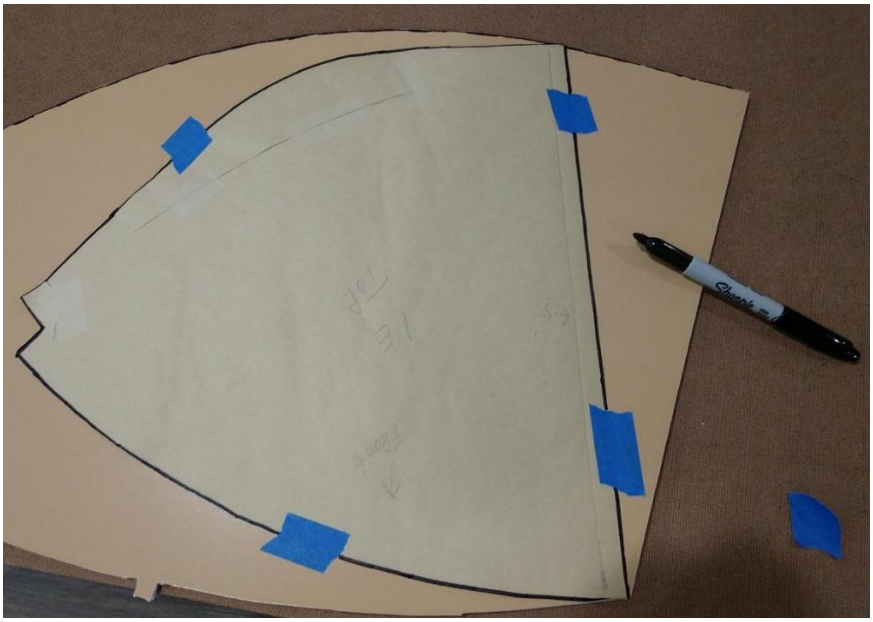
Scenery 3 – Craft paper template traced and cut around track

Before proceeding with the scenery installation for the section picture above, Scenery 4 picture below shows an overall picture of the track with the paper templates in place. Note that I have labeled the paper templates with the words of "top", "front", or "track", to properly orientate the template when it is traced onto the foam board.



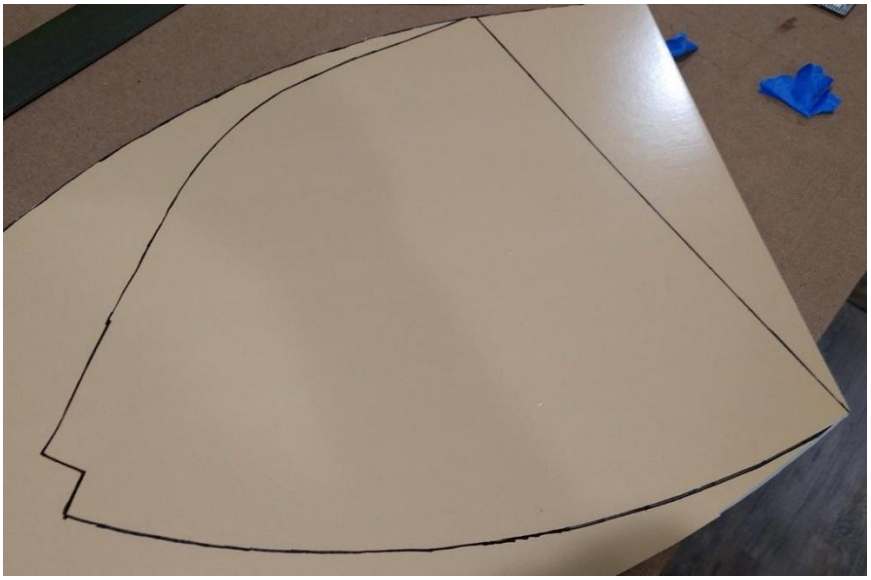
Scenery 4 – Craft paper templates traced and cut around track

Next step is to trace the paper template on the foam board (sand colored). I taped the template to the foam board and then used a permanent marker (Sharpie) to trace the outline of the paper template onto the foam board, as shown in Scenery 5 picture below.



Scenery 5 – Craft paper template taped to foam board and outline traced onto foam board

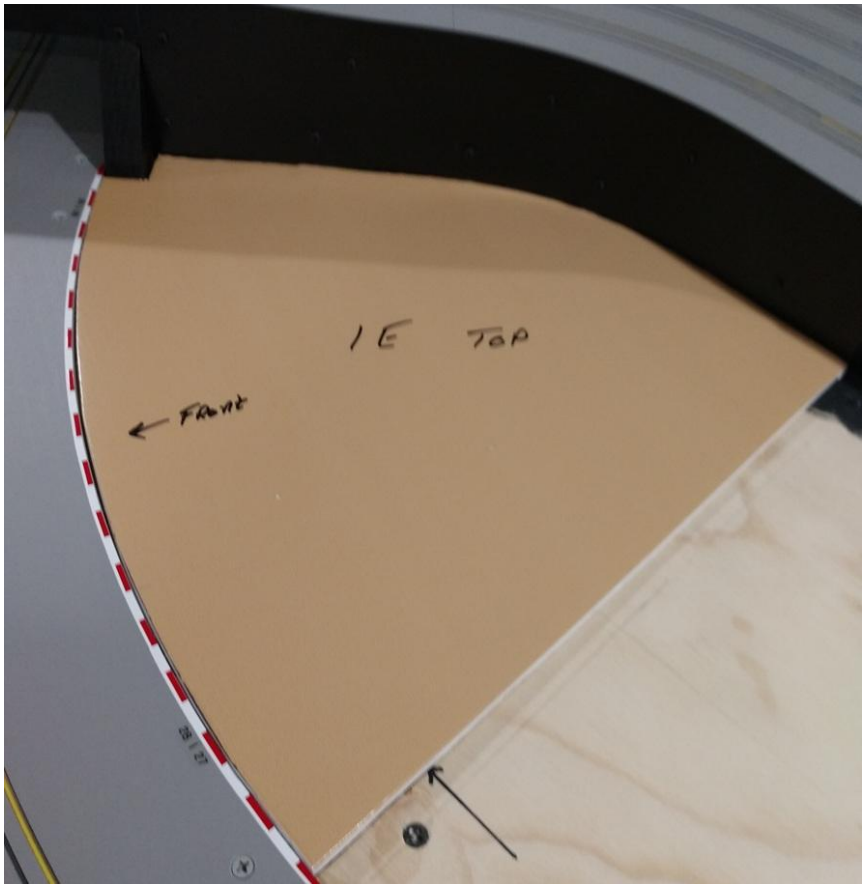
Scenery 6 picture below shows the outline of the paper template on the foam board after the craft paper template has been removed. I will then use a utility knife with a sharp blade to cut out the template of the foam board following the inside of the black Sharpie line. Hint: It is important to always use a sharp blade. I used a Black and Decker utility knife that has a slide out blade that can be broken off (into 8 sections) as a section of the blade gets dull.



Scenery 6 – Outline of scenery section traced onto foam board

With the foam board cut to shape, I then do a dry fit on the layout, as shown in Scenery 7 picture below, to make sure the fit is good and make any adjustments (trim the foam board

edges) if it is not. Note: again, I have labeled the foam board so that I know the top side orientation.

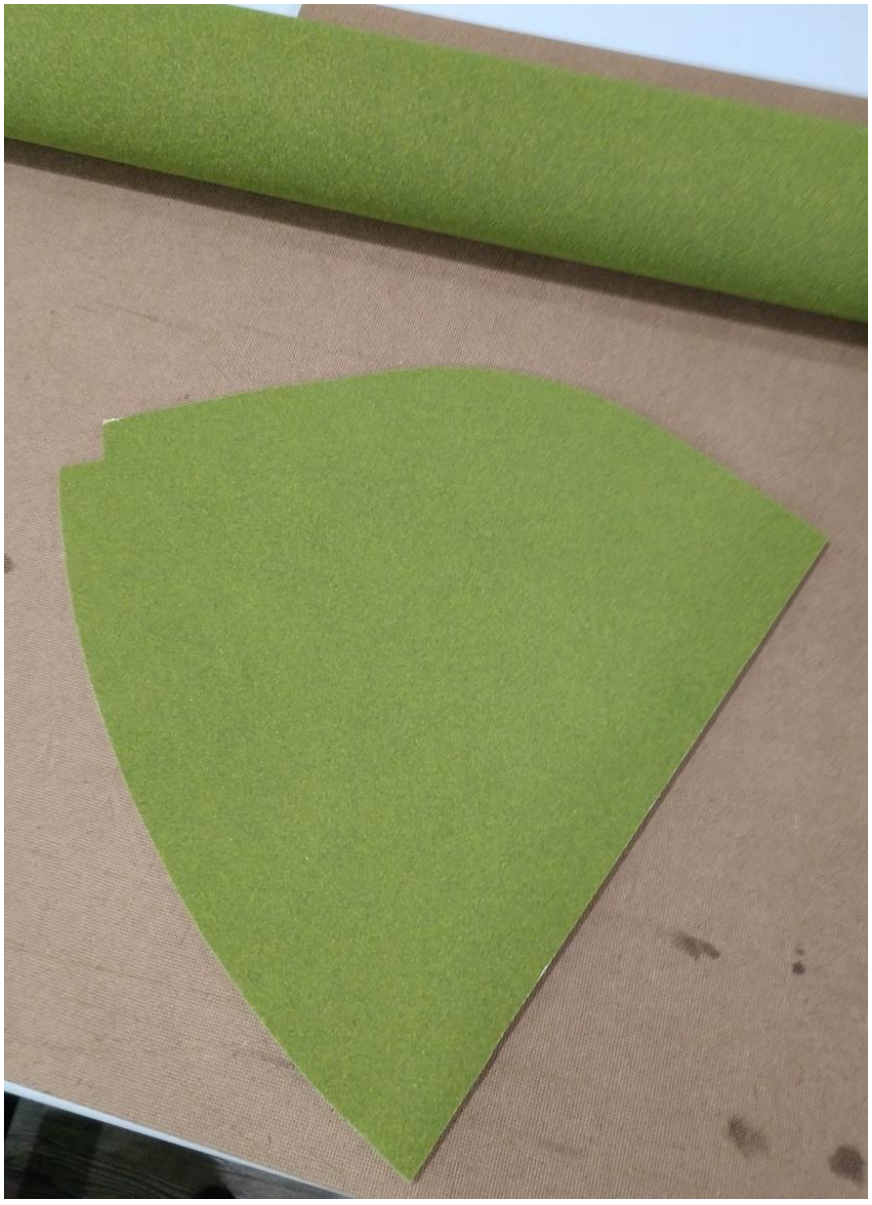


Scenery 7 – Dry fitting trimmed foam board section

After ensuring a proper fit of the foam board to the track, I then trace an outline of the foam board onto the back of the vinyl grass mat (white vinyl surface). I use the utility knife and a metal framing square (as a straight edge) to cut the straight sides of the template and sharp scissors to cut the curved sides, as shown in Scenery 8 picture below.

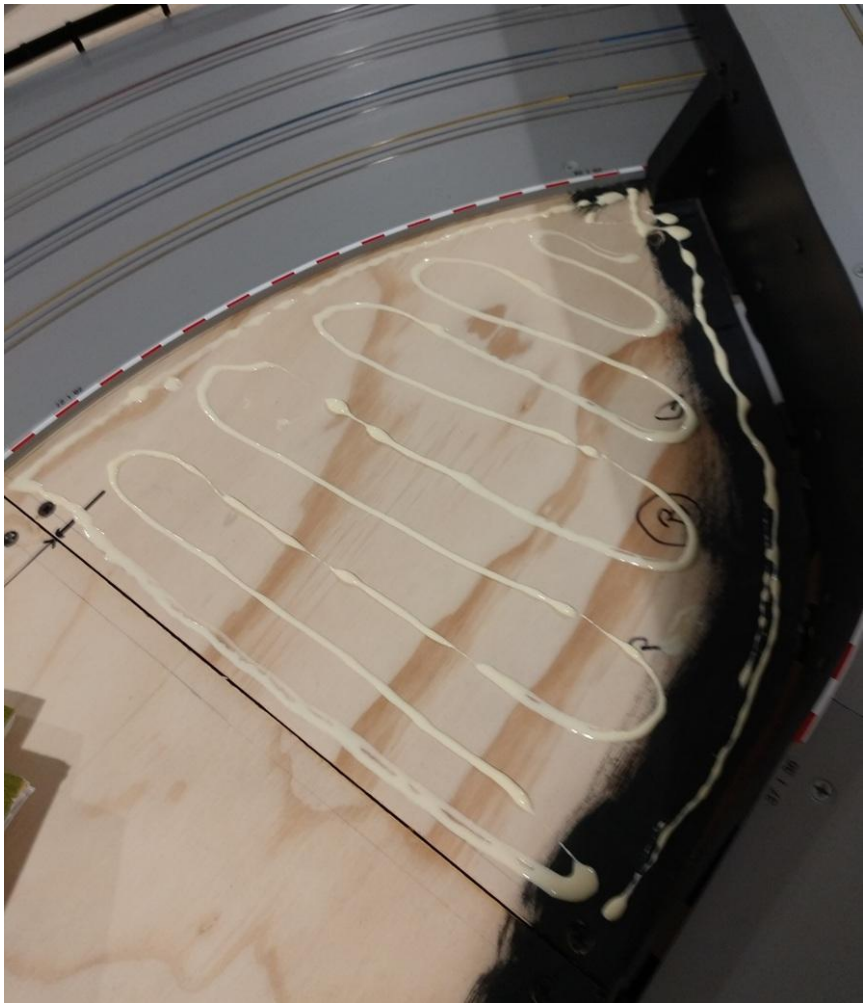
Scenery 8 – Outline of foam board traced onto back of grass mat and trimming grass mat

With the grass mat cut to shape, I then use the Woodland Scenics Mat Adhesive to attach the grass mat to the foam board. I apply the adhesive using a small (1" or 2") foam brush to both surfaces (back of vinyl mat and top of foam board). Hint: The adhesive has up to 2 hours of setting time, so after a few minutes of applying it, it begins to get tacky such that you can glue the 2 pieces together. Also, you need only apply a very thin layer of glue to each surface. With the mat attached to the foam board, I use a rubber roller to smooth out the surface and then apply some weight over the top to ensure proper bonding. Scenery 9 picture below shows the grass mat attached to the foam board.



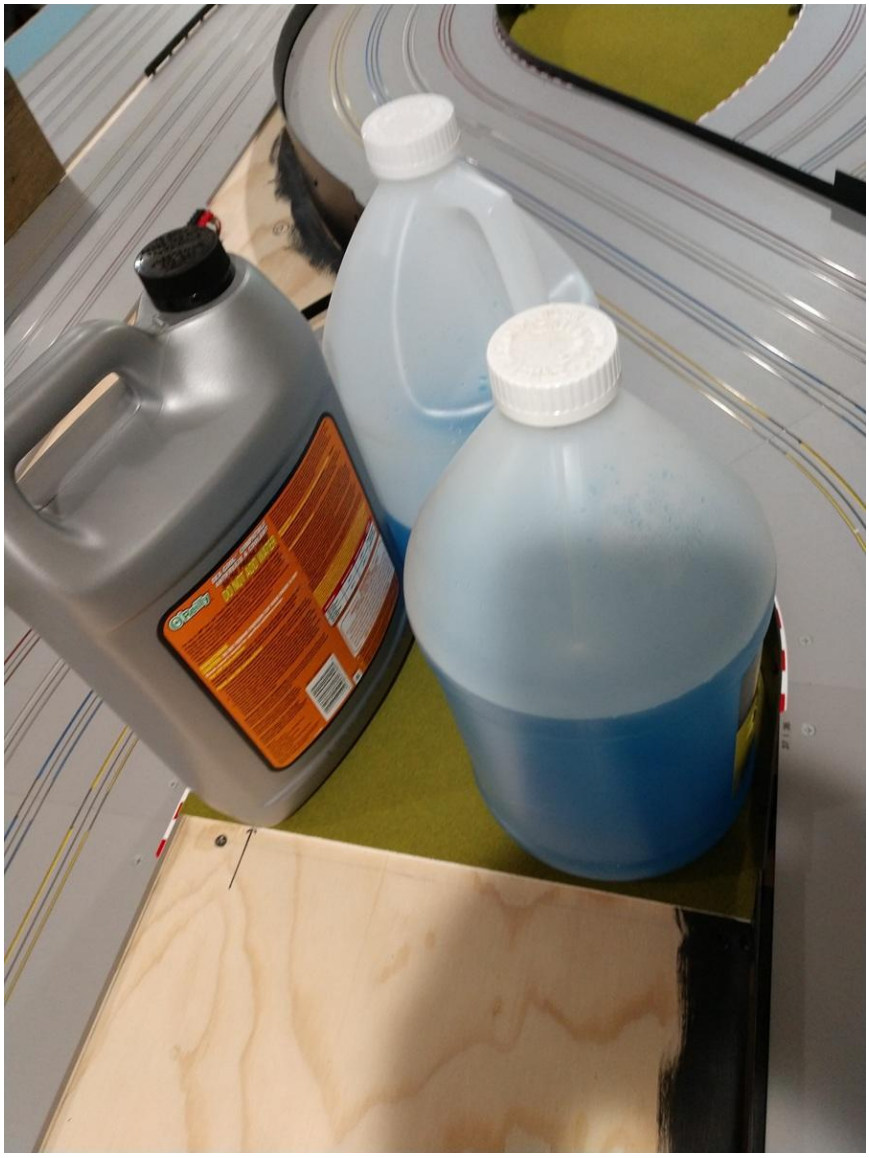
Scenery 9 - Grass mat attached to the foam board

Now we'll attach the grass mat section with foam board to the layout benchtop (plywood). I do this by applying a bead of the Titebond wood glue to the plywood surface, as shown in Scenery 10 picture below.



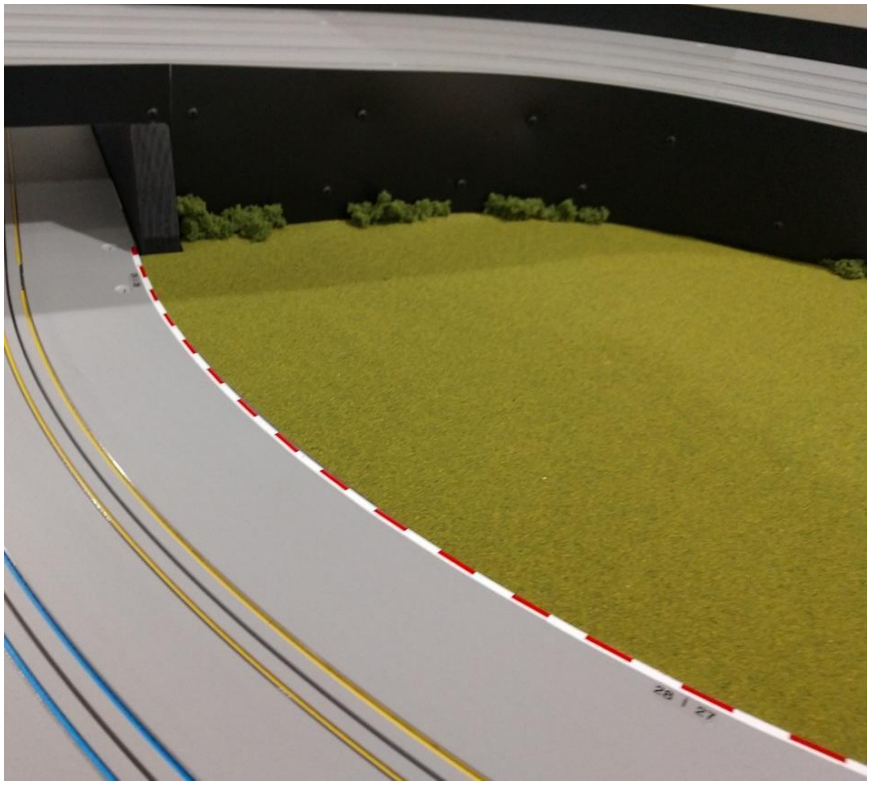
Scenery 10 – Glue applied to plywood service prior to attaching grass mat/foam board scenery section

Next, I lay the grass mat/foam board scenery section onto the plywood and apply weight to the top of the section to ensure a proper bond to the plywood, as shown in Scenery 11 picture below. Liquid jugs are used as weights as they disperse their weight over a larger area. When the glue has bonded and the weights are removed, I'll use an eye dropper to apply the Woodlands Scenic Cement to the grass. While the grass is already glued to the mat when it is purchased, adding this extra layer of glue secures the grass even more and hopefully prevents it from getting into a de-slotted car if it should end up on the grass during a race.



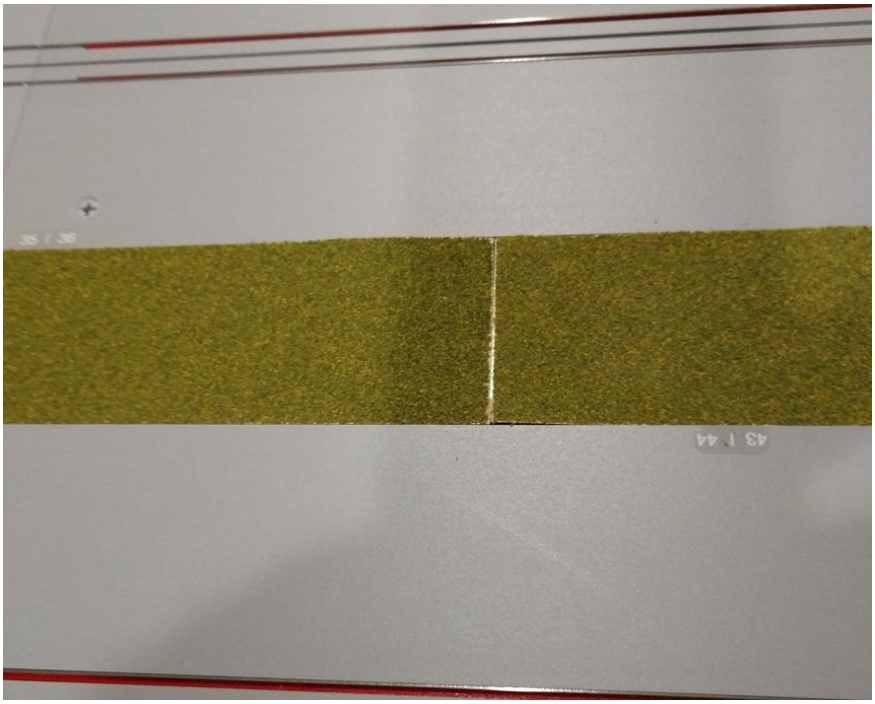
Scenery 11 – Weighing down the scenery section onto the plywood top while the glue sets

Scenery 12 picture below shows the finished section of scenery. Note that I have added some bushes (Woodland Scenics colored foam) to areas of the scenery that might have a flaw. In this case there were some slight gaps between the grass mat/foam board and the black retaining wall.



Scenery 12 – Installed finished section of scenery

Because of limitation in size of the foam board and grass mat material, the scenery grass/foam board was applied in sections. When doing this, the seam between the 2 sections was usually visible, as shown in Scenery 13 picture below.

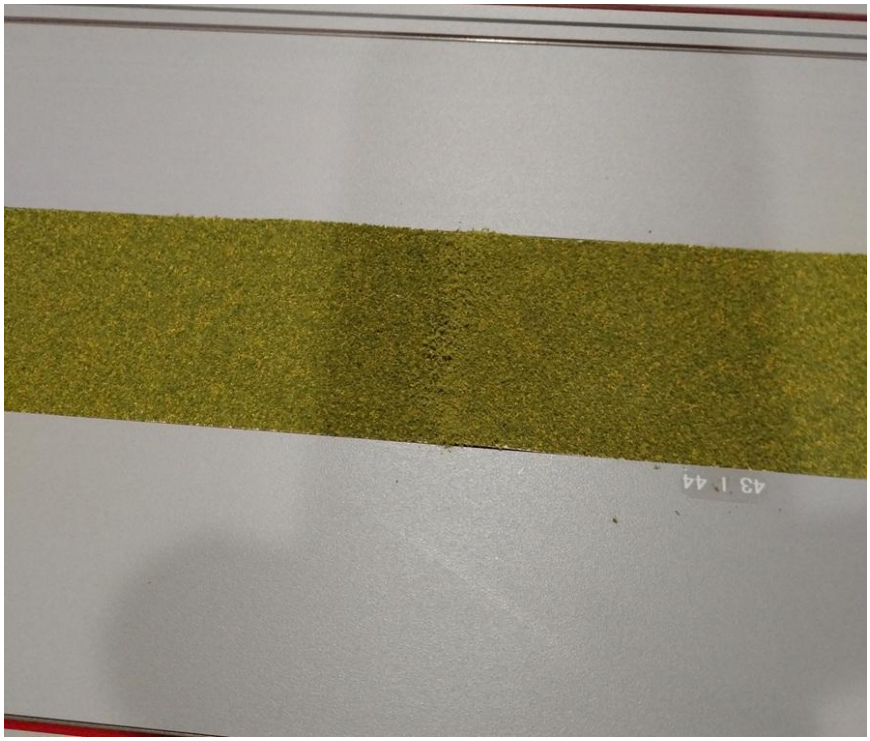


Scenery 13 – Visible seam between scenery sections

To hide the seam, I scraped of the grass from some scrap pieces of grass mat using an Xacto knife, as shown in Scenery 14 picture below.

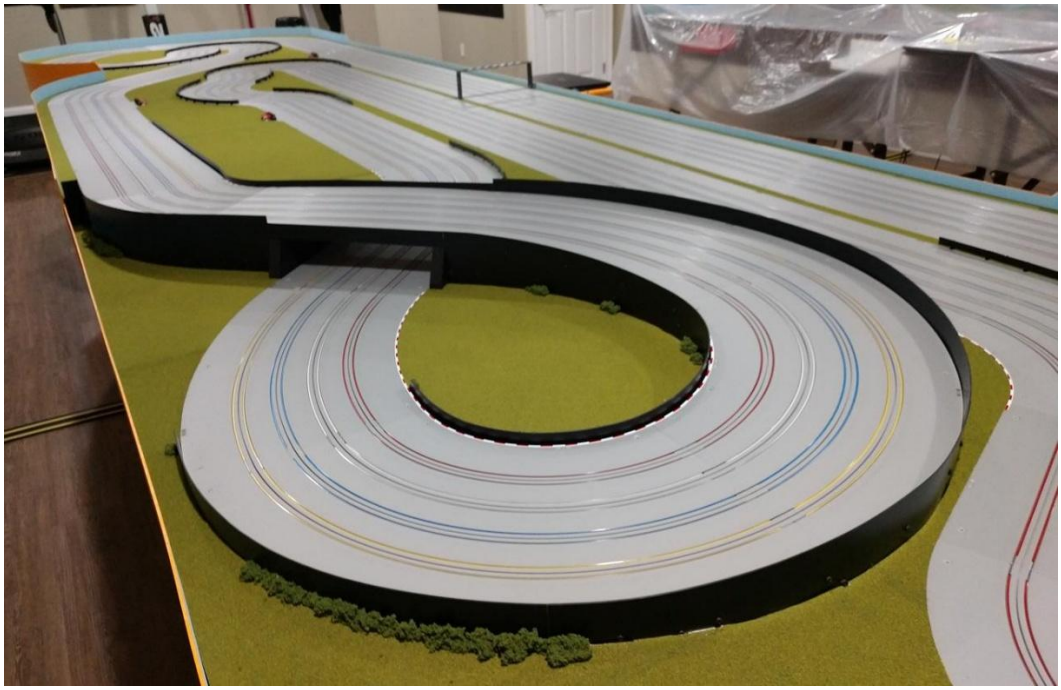
Scenery 14 – Scraping grass material from surface of scrap piece of grass mat

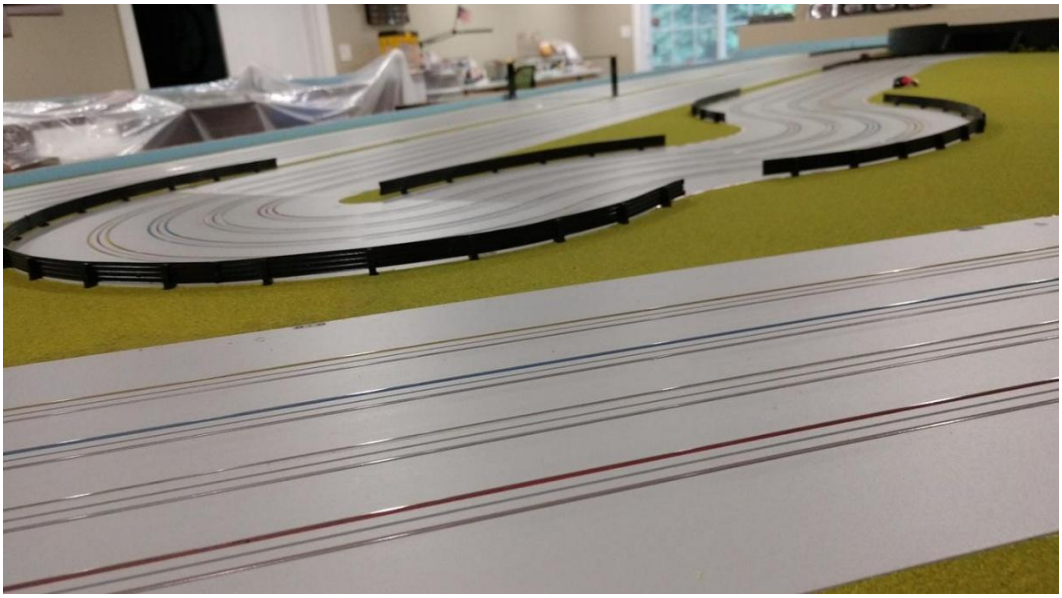
I would then sprinkle this loose grass over the seam and apply the Woodland Scenics Scenic cement. Scenery 14 picture below shows what it looks like when done.



Scenery 14 – Seam between scenery sections filled in with grass material

Okay, with the scenery installation process explanation done, let's look at the final product... Drum roll please!!!





Automation using an Arduino

One of the things I wanted to do to bring this layout to life was to add some automation, by installing track status lights around the track. Track status lights are used on real racetracks to indicate to drivers the status of the track/race where red means the race has stopped, yellow indicates caution, and green means the race is on. Another benefit of adding these lights is that they would be placed where the power feed track sections are, covering up the

terminal connector and wires that are exposed on these track sections. You can see how these track sections stick out in the finished track pictures in the previous section.

To add this automation, there are three major components that make up this automation: 1) Arduino hardware, 2) Arduino software, and 3) The track status lights that I would mount to a track marshal's stand. The following sections will go into more detail on each of these components.

Here's a 40,000 foot view of how this will work. The Arduino hardware and software will monitor the track voltage. Depending on the voltage level read by the Arduino, the Arduino will then turn on the appropriate track status lights (LEDs) at the marshal stands. Green light on means there is power to the track. Red light on means there is no power to the track. One caveat to this approach is that there is no yellow track status light. Measuring the track voltage is a binary state, the track power is either on or off. Thus, this approach can only utilize red or green track status LEDs.

Before taking a deeper dive into the details in the next several sections, here's a picture of the results, Arduino 1 picture below, showing the four marshal stands mounted over the terminal connector on the power feed track sections. In the picture you will notice that the Red LED is on in each of the marshal stands indicating there is no power to the track.

Arduino 1 – Marshal stands with track status LEDs

Arduino Hardware

The Arduino is a low cost and powerful microcontroller. With its open source architecture and under $50 cost, the Arduino is a popular platform from beginners/hobbyists to professional/commercial users. There are many resources available online to learn about the Arduino. One of my favorites is a series of YouTube videos by Paul McWhorter: Arduino Tutorial 1: Setting Up and Programming the Arduino for Absolute Beginners - YouTube. Paul does an outstanding job of taking you from the very basics of what an Arduino is, to writing Arduino software programs, aka sketches, understanding basic electronics, and then combining all of this to use many of the Arduino's capabilities.

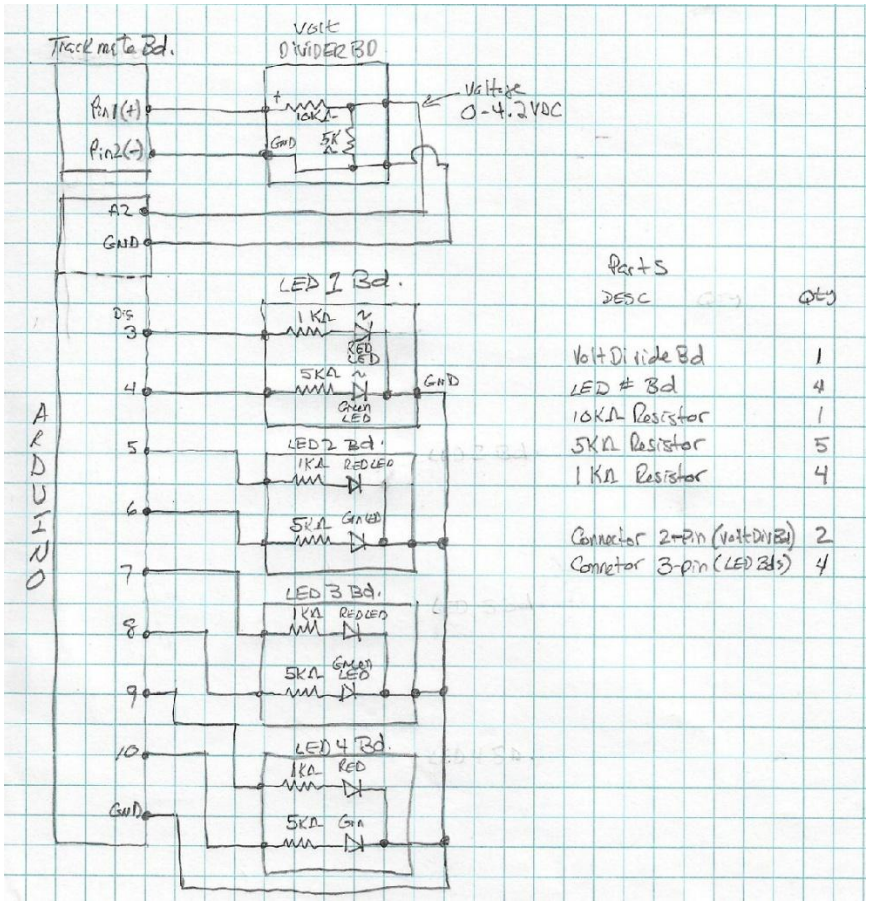
Arduino 2 picture below is a picture of an Arduino board. Looking at the board, the large black square in the middle of the board is the Arduino integrated circuit. Along the top, right, and bottom side of the boards are terminal connectors that access all the Arduino input and output lines as well as access to the boards power and ground lines. On the left side of the board is a large silver connector (top left) that is a USB connector. This connector is used to connect the Arduino board to you PC and allows you to download an Arduino sketch, created on the PC, into the memory of the Arduino board. The black connector on the lower left side is a power connector. The Arduino board requires a 5V DC power source.

There are many companies that manufacture these Arduino boards, so they are readily available online from Amazon, eBay, etc. I purchased the Arduino kit recommended by Paul McWhorter in his YouTube videos. The bonus with buying the kit is that it includes the 5V DC power source, LEDs, and some of the resistors we'll use to build up the track status lights.

Arduino 2 – Arduino board

Because there are so many online resources to learn about the Arduino, I will not go into those specifics here. Instead, if you are new to the Arduino, please learn about the Arduino first (I highly recommend the Paul McWhorter YouTube video series referenced above), then come back here where I will go through the specifics of using the Arduino to create automated track status lights.

Okay, now that you understand the fundamentals about Arduino, here's a schematic diagram, Arduino 3 picture below, showing how the Arduino is wired up to read the track voltage and to control the track status LEDs.



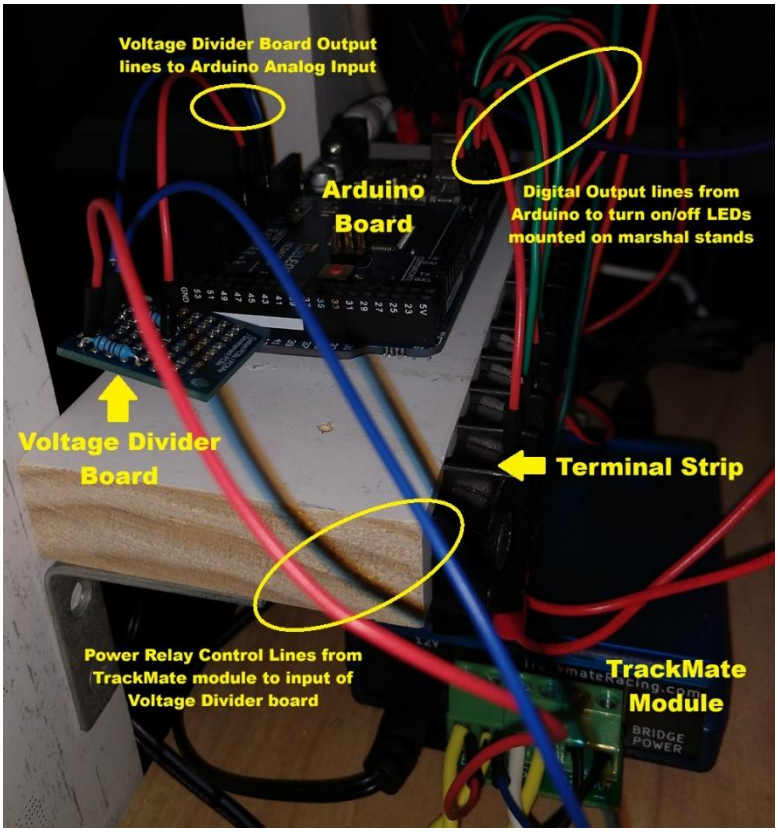
Arduino 3 – Schematic Diagram

Looking at the schematic diagram starting from left to right and top to bottom, you will see the TrackMate module (upper left, below this is the Arduino module. In the center of the schematic are several printed circuit boards. These boards, also known as bread boards or prototyping boards, are low cost 1” square boards that allow us to insert and connect electronic components. In our case, these components are either resistors or the red and green LEDs. On the right side of the diagram is a parts list. These boards can be purchased from online electronic supply houses such as DigiKey, or even bought from eBay.

Starting in the upper left corner is the TrackMate module. We’ll tap into the pins 1 and 2 on the connector of the TrackMate module. These pins are the control lines to the main power relay which turns power on or off to the track. You’ll notice that these 2 lines feed through a Volt(age) Divider board before they go into the Arduino A2 and GND connections. The reason for this voltage divider board is that the Arduino will only read voltage inputs up to 5 Volts DC. The control lines from the TrackMate board can have a voltage as high as 12 volts. By dividing this voltage on the voltage divider board, we can feed a lower voltage to the Arduino, in this case between 0 and 4.2VDC, to meet the Arduino’s voltage input limits and read a scaled down status of the control lines to the power relay.

Continuing with the schematic, you will see that we are using the digital outputs of the Arduino, pins 3 through 10 and a common ground signal, to control the LEDs. I'll cover in the next section, Arduino Software, on how the Arduino takes the input from the TrackMate relay control lines and uses this information to turn on/off the red and green LEDs located in the marshal stands. The digital outputs from the Arduino connect to the second set of printed circuit boards, aka LED 1-4 boards. These LED boards contain the resistors and LEDs used to turn on and off the LEDs. There are four boards , one for each of the four marshal stands on my track. Taking a closer look at LED 1 board, you'll see that digital output pin 3 from the Arduino connects to the Red LED via the 1 Kohm resistor. When the digital output pin 3 is high, an active state, the Red LED will turn on. The 1 Kohm resistor acts as a current limiter to control the brightness of the LED when it is on. Digital Output Pin 4 connects to the Green LED through a 5 Kohm resistor. When this pin is high, it will turn on the Green LED. To complete the circuit, the common GND from the Arduino is connected to the LED boards. This circuit is duplicated for the other 3 remaining LED boards.

Arduino 4 picture below shows how I installed the Arduino module and the wiring connections. I built a small shelf over the TrackMate module to mount the Arduino module on. This shelf also holds the voltage divider board. Along one edge of this shelf I installed a terminal strip. This terminal strip provides connection between the Arduino digital output lines and the longer cables of these lines that connect to the LED boards at the marshal stands. You can see how the Arduino, voltage divider board and TrackMate module are all in close proximity to one another while the terminal strip allows easy connection to the marshal stands located around the track.



Arduino 4 – Arduino mount and wiring

Arduino Software

With the Arduino hardware in place, we can focus on the Arduino software program, aka sketch, we'll create. As previously mentioned, there are plenty of online resources about the Arduino, so I will not go into the details of how to write a sketch for the Arduino. Again, I highly recommend the Paul McWhorter Arduino YouTube series as a great source to learn about Arduino programming.

The Arduino is a microcontroller. As such, we will write the sketch on a PC, download the sketch to the Arduino module, and then every time the Arduino is powered on, it will automatically start up and run the sketch. Thus, once the sketch is created and downloaded to the Arduino, you will not need a PC to run the Arduino.

Being an open-source technology, the Arduino, specifically it's software, is designed to be user friendly yet powerful to accomplish challenging tasks. Based on the "C" programming language, the Arduino software is intuitive with a small learning curve. While I will not go into the specifics of Arduino programming, I'll begin with a 40,000 foot view of the program and then share the actual sketch code and discuss what the sketch is doing.

The 40,000 foot view… The sketch program loaded onto the Arduino is basically running in a loop from the time power is turned on to the Arduino to the time that power is turned off to the Arduino. In this loop the Arduino is reading the control lines voltage level to the Trackmate power relay to determine when power is applied to the track. We are using one of the Arduino's analog input pins to read this voltage. Depending on the voltage level read in, the Arduino will then use its digital outputs to power on/off the red and green LEDs at the four marshal stands. The Arduino will execute this loop every 250 milliseconds (quarter of a second) when performing these functions.

The Arduino 5 picture below shows the actual Arduino sketch (program) to perform the above-mentioned functions. The sketch can be broken down into three major parts: 1) declare program data variables, 2) Setup function, and 3) the Loop function. We'll take a more detailed look at each of these parts.

Declaring Program Data Variables

The first section of the sketch is used to declare all the program data variables that will be used in the program. These data variables store information, typically a numeric value, that will be used by the program. It is good programming practice to give the data variable a descriptive name so when reading through the program you can easily identify what data variable is being used.

As an example of this, you can see in the sketch file that the first data variable we declare is named *AnalogReadPin*. This declares that we will use pin A2 on the Arduino, which is one of the Arduino's analog inputs, as the pin we will use to read the voltage level of the Trackmate relay control lines, an analog input line.

Reviewing the remainder of the data variables, you can see we have a number of data variables declaring the Arduino pins used to control the red and green LEDs. For example, the data variable *LED1RedPin,* declares that we will use Arduino digital output pin 3 to turn on/off the red LED in the first marshal tower.

A couple of important data variables are the and *VoltageThreshold* and *ReadDelay* variables. The VoltageThreshold variable tells the Arduino what voltage level determines whether track power is on or off. In this case, we are setting the value of this variable to 4.0. This value means that if the voltage read in by the Arduino is greater than 4.0 volts, then track power is off. If voltage is less than 4.0 volts, then track power is on. Remember, the TrackMate relay is normally closed relay. This means if the control line voltage which controls whether the relay is open (power off) or closed (power on), is that if there is no voltage on the control lines, i.e. less than 4.0V, then the relay is closed and there is power to the track. The opposite is true if there is voltage on the control lines, greater than 4.0V, then the relay is open and there is no

power to the track. You may need to tweak this value depending on the output of your voltage divider circuit. If you look at my comments in the beginning of the sketch file, you can see that I had initially set this value to 3.8, however when I initially used this value it was too close to the threshold voltage, causing the LEDs to intermittently flash green when power was removed from the track.

The *ReadDelay* variable sets how often the Arduino will read the track voltage and update the status of the LEDs. This data variable is set to 250. As used in this sketch, the 250 value is 250 milliseconds, or a quarter of a second, which is how often the Arduino performs the input voltage read and outputs the control of the LEDs.

The last two data variables, *VoltRelayCtrl* and *ReadValueVoltRelayCtrl*, are data variables used in the calculation of the voltage read in by the Arduino. We declare these variables with a value of 0 to clear them and set them in a known state (value).

Setup Function

The setup function is run one time at the start of the program and configures the various Arduino pins we will be using as either inputs or outputs.

Looking at the Setup section of our sketch, there is only one pin that is configured as an input. That is the AnalogReadPin that will be used to read the voltage on the TrackMate power relay control lines. All of the LED pins are setup as output pins as the Arduino will use these pins to power on/off the LEDs.

Void Loop Function

The void loop function is the heart of the Arduino sketch. After executing the setup function once, the void loop function will execute continuously until the Arduino is either reset (reset push button) or power is turned off to the Arduino.

Looking at the void loop function in our sketch, the first thing the Arduino will do is read the TrackMate power relay control line voltage by calling the analogRead function and reading the voltage on the AnalogReadPin, declared as A2 pin of the Arduino. The voltage value read will be stored in the ReadValueVoltRelayCtrl variable, which is a digitized value in bytes.

The Arduino reads this value as bytes, which is the way the Arduino converts the analog voltage into a digital value, in bytes, that the Arduino understands. For those tech geeks, the Arduino has a 10-bit analog to digital converter (ADC). I won't go into the infinite gory details of analog to digital conversion here. I suggest you Google "analog to digital conversion" for further information.

The next function on the void loop is that we will convert the digitized voltage value (in bytes) that was stored in ReadValueVoltRelayCtrl, into the actual analog voltage value and store this in the VoltRelayCtrl variable. Without going into too much detail, we'll perform this conversion by multiplying the digitized voltage value by a scalar value. This scalar value, 5/1023, represents the maximum voltage the Arduino analog to digital converter supports, 5 volts, divided by the maximum digitized value the Arduino can store, Since the Arduino has a 10-bit ADC this maximum value equate to 2 to the 10^{th} power or 1024 -1 (or 1023 to store a value of 0).

For example, if we have 5 Volts applied to the Arduino A2 input, Arduino will convert this to a digitized value of 1023 and store it in the ReadValueVoltRelayCtrl variable. Looking at the conversion equation in the void loop, when the ReadValueVoltRelayCtrl value of 1023 is multiplied by the scalar value of 5/1023, the 1023 values will simplify to 1, which is then multiplied by 5 to get the analog voltage value of 5 Volts that is stored in the VoltRelayCtrl variable, which is the same voltage input value on the Arduino A2 pin.

Moving on in the void loop function the next grouped lines of code beginning with the "if" statements are what will control turning on and off the red and green LEDs.

The first group of code uses the if statement, if (VoltRelayCtrl < VoltageThreshold). This statement is saying if the voltage value stored in the VoltRelayCtrl variable is LESS THAN the voltage value we set the VoltageThreshold variable to, then this means power is ON to the track and that the Arduino will turn ON the Green LEDs and turn OFF the Red LEDs at the four marshal stands. We do this by using the digitalWrite function and setting its second argument to either HIGH (power On the LED) or LOW (power Off the LED).

If the VoltRelayCtrl value is NOT less than the VoltageThreshold value, then all of the digitalWrite commands are skipped for this group and we move onto the next "if" statement.

The next if statement, if (VoltRelayCtrl >= VoltageThreshold), states that if the voltage value stored in the VoltRelayCtrl variable is GREATER THAN OR EQUAL TO the voltage value we set the VoltageThreshold variable to, then this means power is OFF to the track and that the Arduino will turn OFF the Green LEDs and turn ON the Red LEDs at the four marshal stands. We do this by using the digitalWrite function and setting its second argument to either HIGH (power On the LED) or LOW (power Off the LED).

The final line of code in the void loop function is the delay function. This function adds a delay at the end of the void loop. In our sketch we set the ReadDelay variable to 250. The delay function will pause the void loop 250 milliseconds, before it proceeds back to the first step in the void loop, in our case, read the input voltage from the TrackMate power relay control lines. In simpler terms, with this delay function, the Arduino will sample the input

voltage every 250 milliseconds and set the LEDs to either OFF or ON. Since we set the delay value when we declared the variables at the start of the sketch program, you can change this value and make the delay longer, i.e. 1000 = 1 second. I would not go any lower than 250 milliseconds.

Hopefully this gives you an idea of the power of an Arduino and how relatively simple it is to program the Arduino.

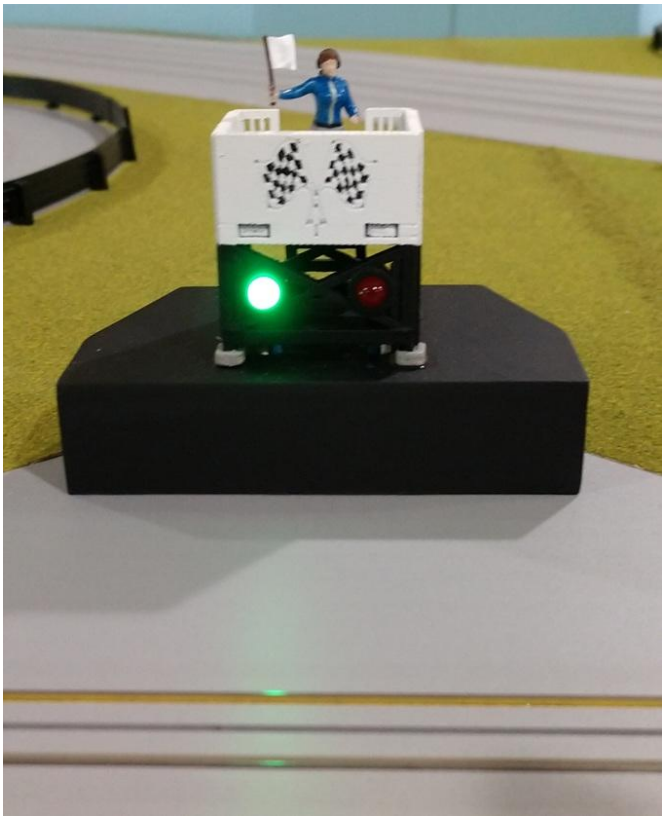
```
/*****************************************************************************
*****************************************************************************/
// Description: This Arduino sketch will use an Analog Input to read the relay
control line voltage of a Trackmate racing power relay to determine when power
// is applied to a slot car track and then using digital outputs drive a couple of
LEDS (red and green) to power on the green LED when power is applied to teh
// slot car track or power on the red LED when there is no power applied to the
track.
// The relay control lines to the Trackmate racing power relay (normally closed
relay) uses 12 VDC to open the relay and remove power from the track.Since the
// Arduino Analog Input can only handle up to 5 VDC maximum, a small voltage divider
circuit is used to bring the realy control line voltage into the range of the
// Arduino.
// Developed by: Jim Kostinden    Date: 08-25-2025 Revision:0
// Modified by: Jim Kostinden     Date: 09-17-2025 Revision:1 - Set VoltageThreshold
float variable from 4.0 to 3.8 to eliminate LEDs intermittent flashing green
//                                                          LED when power is
removed from track.
/*****************************************************************************
*****************************************************************************/

// declare variables
const int AnalogReadPin = A2;
const int LED1RedPin = 3;
const int LED1GreenPin = 4;
const int LED2RedPin = 5;
const int LED2GreenPin = 6;
const int LED3RedPin = 7;
const int LED3GreenPin = 8;
const int LED4RedPin = 9;
const float VoltageThreshold = 3.8;
int LED4GreenPin = 10;
float VoltRelayCtrl = 0;
int ReadValueVoltRelayCtrl = 0;
int ReadDelay = 250;

void setup() {
  // put your setup code here, to run once:
  pinMode (AnalogReadPin, INPUT);

  pinMode (LED1RedPin, OUTPUT);
  pinMode (LED1GreenPin, OUTPUT);

  pinMode (LED2RedPin, OUTPUT);
  pinMode (LED2GreenPin, OUTPUT);

  pinMode (LED3RedPin, OUTPUT);
  pinMode (LED3GreenPin, OUTPUT);

  pinMode (LED4RedPin, OUTPUT);

  pinMode (LED4GreenPin, OUTPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
  // read voltage in bytes on TM power relay control line.
  ReadValueVoltRelayCtrl = analogRead (AnalogReadPin);

  // convert bit read to analog DC voltage value.
  VoltRelayCtrl = (5./1023.) * ReadValueVoltRelayCtrl;

  // turn on/off red/green LEDS based on voltage level.
  // if voltage level less than 4 volts, then power is ON to track and turn green
LEDS ON and red LEDS OFF.
  // if voltage level greater than 4 volts, then power is OFF to track and turn
green LEDS OFF and red LEDS ON.
  if (VoltRelayCtrl < VoltageThreshold) {
    digitalWrite (LED1GreenPin, HIGH);
    digitalWrite (LED1RedPin, LOW);
    digitalWrite (LED2GreenPin, HIGH);
    digitalWrite (LED2RedPin, LOW);
    digitalWrite (LED3GreenPin, HIGH);
    digitalWrite (LED3RedPin, LOW);
    digitalWrite (LED4GreenPin, HIGH);
    digitalWrite (LED4RedPin, LOW);
  }

  if (VoltRelayCtrl >= VoltageThreshold) {
    digitalWrite (LED1GreenPin, LOW);
    digitalWrite (LED1RedPin, HIGH);
    digitalWrite (LED2GreenPin, LOW);
    digitalWrite (LED2RedPin, HIGH);
    digitalWrite (LED3GreenPin, LOW);
    digitalWrite (LED3RedPin, HIGH);
    digitalWrite (LED4GreenPin, LOW);
    digitalWrite (LED4RedPin, HIGH);
  }
  // delay time between reads.
  delay (ReadDelay);
}
```

Track Marshal's Stand

Up to this point we've covered all the behind the scenes work covering the Arduino Hardware connections and the software to automate this hardware. In this final section of the Arduino automation, we'll cover the components that display the results of all the behind the scenes work we have done so far.

While there are many ways to model track status lights for a slot car track, I chose to mount a pair of LEDs, one red and one green, into a model of a marshal's stand and place these at the four power feed track sections around the track. There were two main reasons I chose to model my track status lights this way: 1) Placing the marshal's stands at the power feed track sections would cover the unsightly wires and terminal strips on these track sections, giving the track a more realistic appearance, and 2) the wiring to power and control the LEDs could be fed up through the slot I had already cut in the plywood top to connect the power wires to the power feed track sections.

The model of the marshal stand I chose to use is from Race Track Scenics, their 1/64 scale classic marshal stand. I modified them slightly by removing one tier level of the bracing under the marshal stand. I did this since the marshal stand would be mounted on a raised platform and I did not want the marshal stand to be too tall such that it might obstruct a (real) track marshal when replacing a de-slotted car during a race. I also modified the steps that mount to the back of the marshal stand by reducing their height. The remaining section of steps were mounted to the base that the marshal stand is mounted on. One thing that worked out perfect using these stands was that the 5mm diameter LEDs I used fit perfectly within the bracing under the marshal stand. Arduino 6 picture below shows one of the modified marshals stands located around the track. The 1/64th scale flag person was a 3D printed figure I purchased on eBay.



Arduino 6 – Marshal Stand

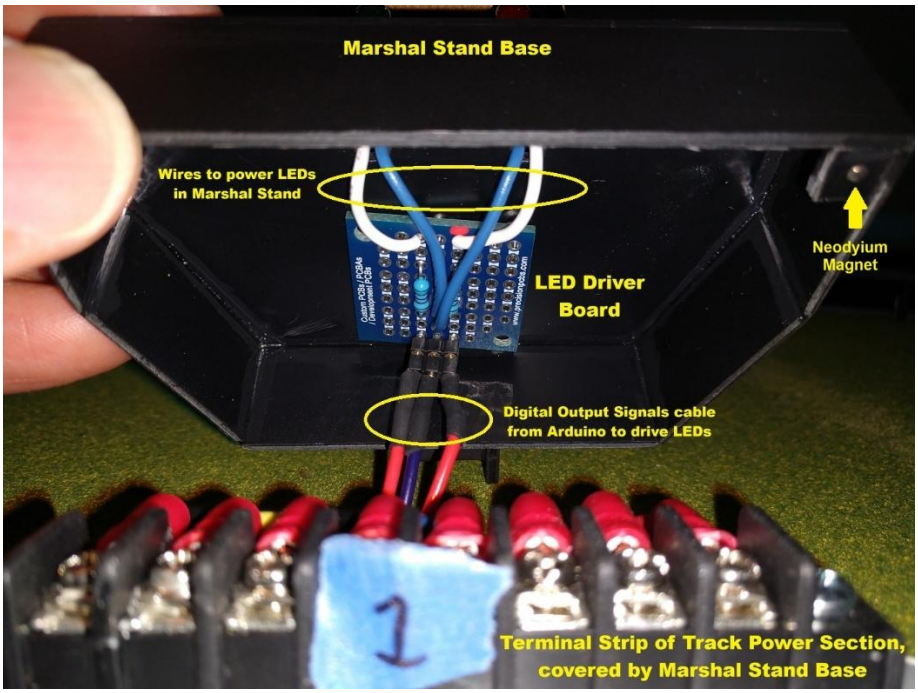
You can see the black styrene base the marshal stand is mounted on in the Arduino 6 picture above. I used some of the left-over pieces of the 0.060 black styrene that was used for the retaining walls around the elevated sections of the track. This base is hollow and serves a couple of purposes: 1) at ¾" tall, it covers the terminal strips and wiring that connect to the power feed track section it is mounted over, and 2) the LED circuit board (see Arduino 3 picture of the schematic diagram) and associated wiring fits inside this base.

The Arduino 7 picture below shows all of the wiring inside the base of the marshal stand. Starting at the bottom of the picture is the terminal strip of the power feed track section. Looking back at Arduino 6 picture, you can see how the base covers the terminal strip and wiring.

The digital output signal cable from the Arduino consists of 3 wires: 1)ground, 2)a control line for the green LED, and 3) a control line for the red LED. This cable is fed up thru the same slot that was cut in the plywood top to feed through the power wires that are connected to the terminal strip of the power feed track section. The other end of this cable connects to the terminal strip next to the Arduino, as previously shown in the Arduino 4 picture. I used a 3 pin connector on the end of the cable and the LED driver board to allow easy removal of the marshal stand for any future maintenance.

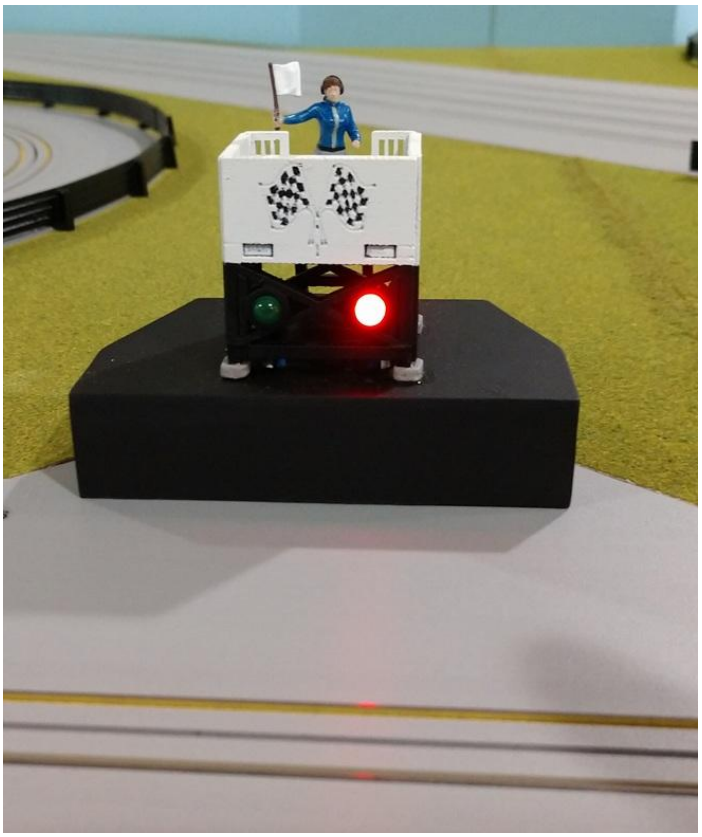
The LED driver board, sits inside the base. It is a 1 inch square “bread board”. These can be purchased at online electronics retailers such as Digikey, or even eBay. As previously mentioned, the bottom end of this board contains a 3-pin connector that allows the digital output signal cable from the Arduino to connect to this board. In the middle of the board are the current limiting resistors for the red and green LEDs. On the top end of the board are the wires that are connected (soldered) directly to the red and green LEDs on the marshal stand. You can refer to schematic diagram in the Arduino 3 picture (above) to see how the LED driver board is wired.

Finally, at the front bottom of the marshal stand base I mounted a pair of neodymium magnets. You can see one of the magnets in the upper right corner of the picture. My thumb is covering the other magnet. I installed a corresponding pair of neodymium magnets in the track section. This “locks” down the marshal stand to the track section and allows easy removal for maintenance or if a marshal should accidentally bump the marshal stand and knock it loose from the track, it can easily be placed back into the correct position by simply aligning the magnets.



Arduino 7 – Marshal stand wiring

Here’s another picture of the completed marshal stand below.



Arduino 8 – Completed marshal stand

Conclusion – Key Takeaways

I estimate that I have about 500 hours of my time into the construction of this track. For me this was more a labor of love, in which I took my time, and thought through every step of the process before execution. I'm not saying that you can build a track like this over a weekend, however, hopefully some of the information I have shared with you in this track build will be helpful and save you the time I spent in experimenting and testing some of the techniques I used.

With so much time spent building this track, I've developed a list of pros and cons or things I like about the track and some things that did not come out as well as I would have hoped.

First the pros…

Since I use this track as a club track, I host numerous races during the year for the HO clubs I belong to. With that said, it is so important to have a smooth-running track. Pinning the track was the key fundamental to accomplishing this. While I had my doubts initially whether all the effort in drilling the 500+ holes at the ends of the track sections would be worth it. There is no doubt in my mind that pinning a track is crucial and I will do this on any future track builds I may take on. Other track fitting steps, such as drilling and counter-boring holes into the track sections to secure them to the plywood top (versus using the old/original Max Trax mounting block) held the track securely in place. Also taking the time to ensure all slot joints between track sections were smooth (had to sand the slot of some sections for proper alignment) is also critical to a smooth track.

Since this track is located in my finished basement, it was important that the track have an almost furniture like look to it and compliment its surroundings. I think the track's appearance met this goal. A key reason for this, I believe, was the rounding of the corners and the smooth finish of the fascia. Also, taking the time to stain the legs and other exposed parts of the benchwork gives the track a finished look.

As a former model railroader, it was important to me that the track had scenery, but at the same time, being a club track that would be raced on, not have the scenery distract (obstruct the view) of the racers. The cars are the stars of this track and I did not want to take away from them with lots of scenery (i.e. buildings, etc.). I think I accomplished this with clean, simple scenery, and unobstructed views of the track.

There are several other positive outcomes, but these 3 are the most important to me.

Now for the cons…

I was a little disappointed with the Woodland Scenics grass mats. There was some variation in color between the several rolls of mats I purchased, which become obvious when you are closer to the track. At first after completing the track this really bothered me. However, as I

write this about one year after the track has been completed, it is not as noticeable. In fact when I host the club races, no one has ever mentioned the grass color variation. I guess real grass is not all the same color, unless you are on a golf course.

Another thing that I was not able to accomplish was with the track lights. I had hoped to have red, green, and yellow track status lights, where yellow would be displayed during a track call. While I am sure there is a way of doing this if I look into the communication signals between the TrackMate board and the computer, I decided to keep it simple and just use red and green to indicate the race has stopped or the race is active, respectively.

Finally, I ran into a little SANFU with the adhesive I used for the grass mat. The adhesive requirements prohibited me from attaching the grass mat directly to the plywood, adding several additional time-consuming steps to install the scenery. While my original intention was to glue the grass mats directly to the plywood base, this would have resulted in the grass surface being 3/16" below the track surface. So, in the end, this SNAFU worked out as I had to add an additional layer, foam board, to secure the grass mat, resulting in the grass mat being at the same elevation as the track. However, this did add a lot of time since the track was already secured to the plywood top and I had to trace paper patterns around the track to cut out the correct size foam board material. Going forward, I would probably use the foam board again but devise a simpler and less time-consuming process for cutting the foam board and grass mats.

As previously mentioned, as I write this document, it has been one year since the track was completed, and we began racing on it. We've run everything from hobby stock (box stock) Aurora T-Jets, Fray cars, stock TFX cars, to Aurora Magnatraction and AFX Mega G+ cars and custom brass chassis with Lexan bodies cars. In every case, these cars are a blast to run on this track. And every time I walk downstairs to the basement and see the track, it brings a smile to my face.

I hope that by sharing my track building experience and some of the techniques I used, will help you when you are building your track, and most importantly, bring a smile to your face when your track is done.