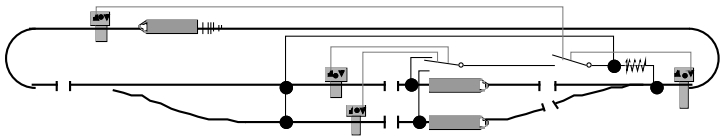
Zellner Yard

4-Track Automatic Switching Block

Assembly and Operating Instructions

Publication #P1653

(this booklet is part of #D8811-165-ZY, 11” x 17” drawing set)



— Ingram Autocontrols —

‘U_BLD_M’ Drawing Series

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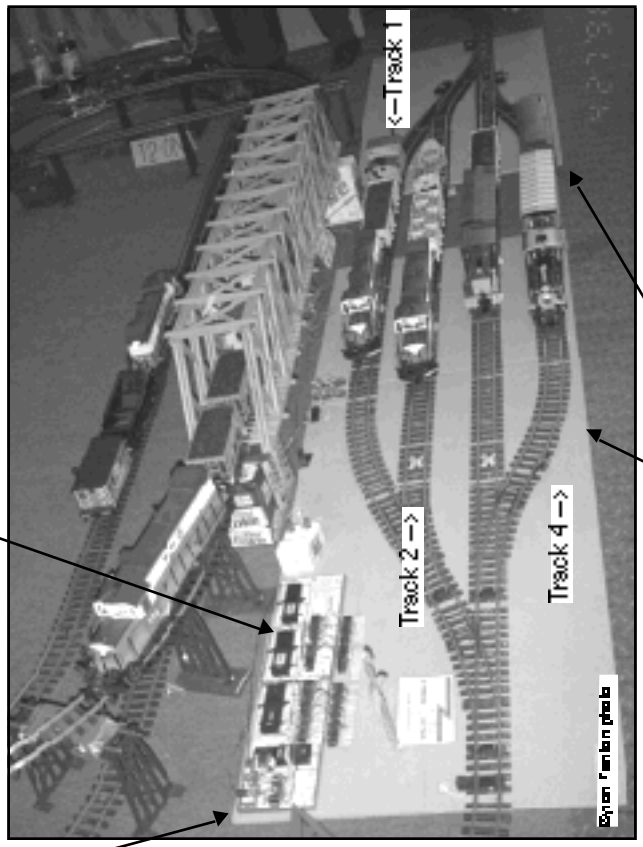
Version Notice

Revisions made to this document are listed below in chronological order.

Revision	Release Date	Description
B	8/15/96	Initial Release

Contents

"Roadmap"



#1653 Helper Control
Chapter 3, Assembly Steps - Helper Control Unit, on page 19

#1651 Main Control
Build From: #D8811-165 Drawings for Model 165 Automatic Switching Block (separate set of drawings)

#1654 Track Unit
Chapter 4, Assembly Steps—Track Unit, on page 25

Figure 70 Roadmap Of Construction Chapters

Chapter 1 Introduction

ABSTRACT: This set of plans (the package of 11” x17” drawings plus this booklet) documents the steps to construct and operate a G-scale model railroad control device, referred to as a “Model 165 Zellner Yard 4-Track Automatic Switching Block”.

This Zellner Yard automatically controls 5 or more multiple trains on the same track, by switching them between the main line and 4 sidings, slowing them down, stopping them, plus controlling a 6-light searchlight signal.

This Zellner Yard Expansion Drawing Set is used to expand the basic Model 165 Switching Block from 2-tracks to a 4-track Zellner Yard. It contains plans for the Helper Control Unit (#1653) and the 4-track Track Unit (#1654).

Publications You Should Have In This Package (Part #D8811-165-ZY)

This drawing set contains:

1. Black and White Drawings, 11” x 17” (#D8811-165-ZY)— approximately 18 sheets numbered 31 thru 48.

   These drawings include photographs, track unit dimensions, track unit wiring, parts lists and costs, *Sheet 39 Full Size Template for Helper Control Unit*, plus check-out and start-up sheets.

2. This instruction booklet, 8-1/2” x 11” (Publication #P1653) — keyed to the drawings — containing the step-by-step written instructions.

If you ordered the colored drawing option, you should also have the following 11” x 17” color sheets:

3. Colored Copies of Key Drawings:
   • *Sheet 38 Track Unit Wiring-4 Tracks*
   • *Sheet 39 Full Size Template for Helper Control Unit*.

4. Template — Colored, plastic-laminated copy of Sheet 39.

   The template is designed to be glued to the wood base of the control unit. For easy assembly, all parts and wires are shown full size in their proper location. You just place the parts and run the wires over top of their outlines.

Note: *Zellner Yard uses the #1653 Helper Control Unit (in this drawing set), plus the #1651 Main Control Unit built per the basic #D8811-165 drawing set.*

Two Drawing Sets

Note that there are two "165 series" drawing sets, the separate basic Model 165 Automatic Switching Block drawing set, and this set, Zellner Yard Expansion drawing set. ***You need both drawing sets.***

1. The basic drawing set— Part #D8811-165 (consisting of 11x17 sheets numbered 1 thru 22 (not continuous)) plus accompanying Assembly Booklet #P1651——contains plans for building:
   - #1651 Main Control Unit (needed for Zellner Yard)
   - #1652 2-track track unit (not needed for Zellner Yard).

   This basic drawing set builds the 2-track Automatic Switching Block you see in Figure 32 d on 11x17 drawing sheet 32.
2. This set, the Zellner Yard Expansion drawing set—Part #D8811-165-ZY plus this accompanying Assembly Booklet #P1653——contains plans for
   - #1653 Helper Control Unit
   - #1654 4-track track unit.

Note that this expansion drawing set has the added designation "ZY" (Zellner Yard) on the end of the number, in order to differentiate it from the original, basic drawing set.

1.1 Overview

Synopsis

The first part of these instructions describe how to construct a Zellner Yard. The second part describes how to operate one.

Zellner Yard has the capability to control a minimum of 5 trains on a single mainline. You can also operate it with either one of the two functions (switching and blocking) turned off, or you can completely depower it so it acts *inert*—that is, acts just like a section of ordinary straight track. Refer to *Sheet 44 Checkout Instructions 4 Tracks* for more detail.

Phone Support

I will be most happy to offer my opinion on any questions you may have concerning operation of these control units. My only request is that I be allowed to return long distance calls collect (continuous negative cashflow=stingy personality). My phone number is at the bottom of each page.

Number of Drawings

Please do not let the number of drawings included here intimidate you into thinking that the control unit is more complicated than it really is. You could construct one from Sheet 39 alone. I built the first unit using early versions of Sheet 39 (the helper control unit) and Sheet 35 (layout for the track unit).

You really don't need all the drawings (various drawings are for check-out, enclosures, schematic reference, operating steps). I have included them all because I think you will find it more efficient to use or start-with dimensions I have developed, rather than "reinventing the wheel" and developing them yourself from scratch.

1.2 History and Comments About Zellner Yard

During the months of Jan/Feb 1996 we developed a design that expands the Model 165 Automatic Switching Block from 2 tracks to 4 tracks. This 4-track unit is named "Zellner Yard"—for the reason that these multi-train megadisplays we have been doing the last 5 or so years, are always dependent on having Ed Zellner and a fleet of his trains available to wear out.

Zellner Yard operates in the normal switching block manner, except instead of holding 2 trains in the yard while the 3rd train is on the mainline, it holds 4 trains in the yard while the 5th train is on the mainline.

It automatically controls the switches, target lights on the Shiloh Signal's signal, plus slowdown, stopping and starting. Trains enter the yard starting on Track 1 on the left, and sequence across to Track 4 on the right.

Zellner Yard uses a standard #1651 Main Control Unit that operates tracks 3 and 4 in the normal manner. The #1653 "Helper Control" is "slaved" to the #1651 control, and operates the two additional tracks 1 and 2.

Parking 2 Tracks

An optional toggle switch "K0", can be used to depower the Helper Control unit when desired. In this mode, the trains on tracks 1 and 2 remain parked and never move. Meanwhile the main control unit continues to operate 3 trains in the normal Model 165 mode—using tracks 3 and 4 via track contacts T3 and T4.

Overall Logic

I refer to this logic as a "cascade logic"—I got it from drawings by Ted Greeno (see next page). If you refer to *Sheet 40 Control Unit Interconnections* that shows the two control units, you see there are 3 relay motors that control the switching, M8, M6, and M2.

Track power comes from block relay M3 when the block is green, into switch relay motor M8 located on the rear end of the rear control unit.

Relay M8 either routes the power to Track 1, or else "cascades" it forward to relay M6.

Relay M6 either routes the power to Track 2, or else "cascades" it forward to relay M2.

The frontmost relay, Relay M2, either routes the power to Track 3 or Track 4.

Thus, the relays M8 and M6 either route power to 1 track, or "cascade" it forward to the rest of the relays. Using this logic, you can construct circuits that **control any number of tracks**; three tracks, four tracks as used in these drawings, five tracks, and so on.

About Ted Greeno

The sequencing logic for this 4-track yard is adapted from drawings made by **Ted Greeno** of Fontana CA sometime around the late eighties. The 5-track automatic passing siding you saw in operation on videotapes 1 and 6 (V9202), built by Tom Flynn of Louisville CO, is based on these Ted Greeno drawings.

Other Ideas From Electrical Guru Ted Greeno
Ted Greeno—creator of the 4-track sequencing logic—may well be the leading creator of designs and drawings for all kinds of G-scale automatic control schemes—multiple trolley systems, reverse loops, switchbacks, mainlines crossing mainlines, etc, etc. An updated copy of his booklet "LGB Electrical Clinic" will be available sometime in the future. If you have any particular design needs, you can contact him at: 8164 Sewell, Fontana, CA 92335. His phone is 909-829-0873, if you don't mind him returning calls collect (same as I do).

1.3 What About Command Control

Before considering building one of these Ingram Autocontrols designs to run multiple trains on the same track, you should first consider the command control systems. The big advantage of the command control systems is

1. You only hook up 2 power wires to the track, instead of hooking up many wires to the track as you need to do with my units.
2. You can control trains independently on the same track.

The reasons why you might want to use an Ingram Autocontrols design instead of (or in addition to) command control are:

1. You want automatic, "hands-off" operation.

   Zellner yard operates the trains, switches, and target light signal automatically. With command control, you have to still control all these components manually.

   Some of our larger displays have run 12 trains (3 mainlines, 4 per mainline (before Zellner Yard)) for 12 hours a day. The task of manually controlling 12 trains and associated switching with command control for this long of a time period, would probably be an exhausting one.

2. You need to run more trains than your loop can handle with command control.

   Usually with command control, you would be putting multiple trains out on the same mainline. Eventually you run out of mainline.

   Zellner Yard, with the 4 sidings, continuously "parks" four different trains on the sidings, so your mainline needs to accommodate only 1 train at a time, and thus is not as crowded.

   Zellner Yard by itself can operate 5 trains. If the loop is bigger than 100 feet, you should be able to add a Model 146 Automatic Block in the middle at the 50 foot point, to add an additional train to the mainline to increase capacity to 6 trains.

3. You don't want to use electronics, or you are using amperages that exceed the current limit of command control power units, or you don't want to modify your engines by adding receivers.

   These Ingram Autocontrols designs use crude, electromechanical parts that tolerate high currents— double pole relays for stopping trains, and rheostats for slowing them down. No electronics are used. You make no modifications to the engines, other than adding a magnet to the bottom.

1.4 Mental Preparation For Building Zellner Yard

I recommend you do the following "chores" before you consider building this 4-Track Zellner Yard.

1. View Ingram Autocontrols Videotapes 1 and 2 (series V9202 Automatic Display Ideas) to get a feel for how these systems operate.
2. Construct a single-track automatic block, such as the Model 146; to get comfortable with the idea of using magnet-actuated relays to control multiple trains on the same track.
3. Use the single-track block to duplicate all the experiments shown on Tape 2.

1.5 AC Control Voltage

This subject of voltages is where I have been negligent in passing on good information. Probably the most important factor in getting reliable operation of these control units, is supplying it with a good "healthy" source of AC control voltage. This AC control voltage is what "powers" the switch motors that operate the relays and also the rear track switch.

LGB's "standard" control voltage is 18 volts AC. An LGB transformer's AC output measures 18 volts. This normally works fairly well for indoor operation where everything is clean, but I think that there is not much margin of error.

There have been occasions when I have been demonstrating my units at shows, where my 110v ac power connection has been on the end of a series of long extension cords, and have I watched in dismay and frustration as the switch motors on my control unit repeatedly failed to reliably change. And this was indoors with everything clean—no dirt to contend with.

- **Increasing AC Control Voltage**

  Increasing the voltage to 20 or 22 or 24 volts, I believe, will improve the reliability of the operation of the switch motors. Blue Streak transformers, which a lot of people seem to have, produce about 20 volts AC. Thus Blue Streaks are a good source of AC power. I currently use a discontinued version of a San-Val pack that supplies 22 volts AC.

  Another way you can increase the voltage to 24 volts, is to get one of the little plastic lawn-sprinkler transformers you can buy in hardware stores.

- **Protecting Bulbs For Use With 24 Volt Power**

  The Shiloh Signals searchlight signal is designed to handle 24 volts. But you have to be careful about overheating any bulbs that may be in the circuit (such as you have if you use the LGB signals 5092, 5094, 5095, etc).

If you use 24 volts and fail to use the resistors to reduce the voltage to the bulbs, you may burn them out and melt the plastic housings.

Byron Fenton (who has built several of these units with Ed Zellner) cautions that if you use 24 volts, you must use a 220 ohm 1/2 watt resistor in series in the wire powering a two bulb unit—such as the semaphore arm. Byron recommends you use a 100 ohm 1/2 watt resistor in series in a wire powering a one bulb unit, such as the 3030 indicator light—the 220 ohm resistor will also work.

- **LGB's 5275 Booster**

  LGB's 5275 EPL booster unit, I believe, uses capacitive-discharge electronic circuitry to increase the AC voltage from 18 volts to some higher voltage. Because LGB's instruction sheet for the 5275 states "Lights may not be connected to the EPL booster", I do not advise using the booster.

  In other words, LGB does not want the booster powering any loads that draw constant current—such as lights or LEDs. They want only momentary loads, such as switch motors. This Model 165 Zellner Yard design has 7 LEDs—1 on the rheostat bracket on the control, and 6 in the target signal.

  You always have 3 of these 7 LED's drawing current at any given time. My guesstimate is that these LED's draw about 20 ma each, for a total of 60 ma. The booster unit may tolerate this small current drain without damage, but I do not know. For this reason, at this time I recommend increasing the voltage above the standard 18 volts (if necessary) rather than using the booster.

1.6 Wiring Color Code

To make it easier to understand how the circuits work, all the wires are color-coded, as per the following Figure 71.

Wiring Color Codes

Where Used	Wire Color	Prefix	Examples
Positive (+) *interrupted* DC controlled by relay switch motors M2, M3, M6, & M8	Black	L	Helper Control: L3, L42, L43, L44, L45 Track Unit: 4, 7, 61, 62
Positive (+) *uninterrupted* DC coming from the positive left rail	Blue	B	Helper Control: None Track Unit: 3, 8
Switched AC (+) to target signal	Gray	A	Helper Control: A46, A47, A48, A49 Track Unit: 13, 14, 15, 16, 51, 52
Intermittent AC coming *from* the 1700 track contacts	Green	G	Helper Control: G38, G39, G40, G41 Track Unit: 1, 5, 9, 12, 53, 54, 56, 59
Negative (-) *uninterrupted* AC (common) going *to* the 1700 track contacts	Red	Y	Helper Control: R31, R32, R33, R34 Track Unit: 2, 55
Positive (+) *uninterrupted* AC	Yellow	R	Helper Control: Y35, Y37 Track Unit: 5, 6, 10, 11, 57, 58

Figure 71 Wiring Color Codes

Note that the color code is also shown on *Sheet 39 Full Size Template for Helper Control Unit*, and also on *Sheet 38 Track Unit Wiring-4 Tracks*.

1.6.1 Obtaining Colored Wire

I recommend using solid, 18 gauge colored wire to construct the control unit. Some people use stranded wire and non-colored wire for the control unit, but I advise against taking this shortcut. The solid wire you can shape better to follow the paths, and the colors make it much easier to understand how the circuits work.

I also prefer the solid wire because it easily screws to the 17000 track contacts and 10153 isolating track terminals, versus having to put the 50131 press cable connectors on the ends of the stranded wire.

You can get the 18 ga solid black, green, and red wire from Radio Shack. The 18 gauge solid blue, yellow, and gray colors is not available from Radio Shack, but is still considered a common product. Two manufacturers that make these colors are Carol Cable and Apex wire. See parts lists Sheet 41 and Sheet 42 for the part numbers.

You might be able to find a distributor close to you by calling these wire companies' headquarters. Carol Cable has several numbers, in Manchester NH at 800-424-5666, and on the west coast 800-372-6374. Apex Wire is in Hauppauge, New York, and their phone number is 516-273-3322.

A distributor here in Denver named Cashway Electric at 303-623-0151 (use the All-Wire part numbers on Sheet 41) handles the Apex wire, and they told me they can ship it to out-of-town customers. All Wire here in Denver at 303-295-0106 may ship it—their policy changes periodically.

For "runs" of longer than 30 feet (connecting to the track), you may want to consider using a heavier wire. Also, you can obtain 15-wire sheathed cables, manufactured by Carol Cable Co.

Chapter 2 Browsing the Drawings

2.1 Helper Control Unit And Photographs

Note that Sheet 39—the full size template—is the key sheet in this drawing set. For that reason, let's start with it first. Remaining drawings will be discussed in numerical order.

Sheet 39 Full Size Template for Helper Control Unit

Note that the drawing set contains two copies of this Sheet 39 (assuming you have the colored set). One copy is colored, but not laminated. The other copy is both colored and plastic-laminated.

You cut the laminated copy down to size to make the template. You then glue this template onto a wood base, attach parts directly on top of their outlines, and finally connect the colored wires following the color coded paths. This Sheet 39 then becomes a permanent part of your final assembly, containing documentation of all wiring connections.

Optional Toggle Switch K0

Note that there is a toggle switch K0 mounted between terminals 58 and 60. This switch is optional. If you install it, it allows you to depower the Helper Control Unit by moving the handle to the rear, which the Main Control Unit continues to operate. Depowering the Helper Control shuts off the "cycling" of tracks 1 and 2, but trains continue to "cycle" on tracks 3 and 4.

Thus, with switch 'K0" shut off, 2 trains can be parked on tracks 1 and 2, and 3 trains can still operate on the layout using tracks 3 and 4 and the "red/green" automatic blocking.

Sheet 31 Cover Sheet

Note this shows the list of drawings that make up this drawing set.

Sheet 32 Photographs

Figure 32 c shows the Model 165 #1651 Main Control Unit. If you look closely, you can see the colored template (sheet 9) and how it shows the wiring paths.

Figure 32 b shows the #1653 Helper Control Unit (sheet 39).

Figure 32 a shows the track unit with the control units mounted on top of it

Figure 32 d shows, for comparison, the standard Model 165 2-track Automatic Switching Block.

2.2 Comments About Building In Phases

The track unit layout has 3 drawings. The idea of having these 3 drawings, is that you may find it easier to build this unit in 3 separate phases, and get familiar with operating each phase, before you build the next one.

There is a drawing for constructing the unit with 1 track (phase 1), a second drawing for adding the 2nd track (phase 2), and a third drawing for adding the 3rd and 4th tracks (phase 3).

Similarly, the track unit wiring has 3 drawings—one drawing for each of the 3 phases.

Starting With 2 Tracks And Expanding To 4 Tracks

If you are building a 2-track block now, but think you may want to later expand it to a 4-track unit, you may want to build the 2 tracks configured like Tracks 3 and 4, which the basic #1651 Main Control unit will operate without the Helper Control. Then you could later add Tracks 1 and 2 and the #1653 Helper Control.

2.3 Track Unit Assembly Drawings

The 3 track unit assembly drawings are Sheet 33, Sheet 34, and Sheet 35.

Most of the dimensions are in centimeters—the metric system. The LGB track is dimensioned in the metric system. The reason I used metric measurements is because when I tried to use inches, the round-off error made it difficult to verify dimensions.

Sheet 33 Track Unit Assembly-1 Track

Sheet 33 shows some suggested dimensions for laying out the first track, which is the mainline track, Track 3.

OPERATION: With the single track, you essentially have a single-track automatic block. You should be able to duplicate all the experiments shown on Videotape 2.

Bases

Note that the drawing shows two front bases (Base 1 and Base 2), and one rear base (Base 3). As mentioned in "Note 1 Base Sizes" in the lower left corner of the drawing, for purposes of reducing the number of wires, I recommend you combine Base 1 and Base 2, if you can handle the length of 7-3".

However, if the front base length of 7'=3" is too long to handle, you can construct the front base in two pieces. I made the front base of the unit I built, as shown in Figure 32 a on *Sheet 32 Photographs*, in 2 pieces so we could transport it in a minivan.

Sheet 34 Track Unit Assembly-2 Tracks

Sheet 34 shows the layout for adding the second track, Track 4. This unit you can operate like the 2-track Model 165 Automatic Switching Block, and control 3 trains.

Videotape 1, about 15 minutes from the beginning, shows the 1992-vintage Model 163 Automatic Switching Block in operation. Your 2-track unit should operate the same way.

Sheet 35 Track Unit Assembly-4 Tracks

This sheet shows all parts for the complete 4-track Zellner Yard.

Notes About Track Positioning:

The track is positioned so the ends of all rails are at least 1 inches away from the edge of the bases.

Track 1 “determines” the location of the rear edge of Base 2 (notice the rear rails of Track 1 on Base 2 are 2.6 cm (1 inch) in from the rear edge of Base 2.

Track 2 “determines” the location of the front edge of Base 3 (notice the front rails of Track 2 on Base 3 are 2.6 cm (1 inch) in from the front edge of Base 3.

2.4 Track Unit Wiring Drawings

Sheet 36 Track Unit Wiring-1 Track

This shows how to wire up the track unit for 1-track operation, after you have completed mounting all the parts per Sheet 33. Note this sheet shows the wiring for when you make Base 1 and Base 2 as one piece.

Sheet 37 Track Unit Wiring-2 Tracks

This shows how to wire up the track unit for 2-track operation, after you have completed mounting all the parts per Sheet 34.

At this point, the only control unit you need is just the #1651 Main Control Unit. You do not need the #1653 Helper Control until you add the last 2 tracks.

Sheet 38 Track Unit Wiring-4 Tracks

This shows how to wire up the track unit for 4-track operation, after you have completed mounting all the parts per Sheet 35.

Sheet 40 Control Unit Interconnections

This sheet shows how you connect the Helper Control Unit to the Main Control Unit. You remove two wires from the Main Unit, and then connect 5 new wires to interconnect the units.

Icons

Note that the small sketch in the upper left corner of the Helper Control, shows in “icon” form how wires 53-62 connect to the track, and how wires 51-52 connect to the searchlight signal.

Similarly, the small sketch in the upper left corner of the Main Control, shows in “icon” form how wires 1-12 connect to the track, and how wires 12-16 connect to the searchlight signal.

Please note that these two sets of icons, the first set from Sheet 9 and the second set from Sheet 39, “overlap”. They both show the same section of track. Each set of icons show the connects that are made for that control unit.

Note: *The icons on Sheets 9 and 39 “overlap”—that is, they both depict same section of track. Each sketch shows connection to the track contacts and switches that the control unit operates. Do not let this confuse you.*

The main control template (upper right Sheet 40) shows wiring connections to track contacts T1, T2, T3,and T4; plus switch motor M1 for switch S1. These components operate what are shown as tracks 3 and 4 on *Sheet 34 Track Unit Assembly-2 Tracks* if you built just a 2-track unit.

The helper control template (upper left Sheet 40) shows wiring connections to track contacts T5, T6, T7,and T8; plus switch motors for switches S5 and S1. This would be tracks 1 and 2 on *Sheet 35 Track Unit Assembly-4 Tracks* when you add the last 2 tracks.

2.5 The Remaining Drawings

Sheet 41 Parts List & Costs-Helper Control Unit

This sheet shows parts for the Helper Control Unit.

Sheet 42 Parts List & Costs-Track Unit

This sheet shows parts for the 4-track track unit.

Sheet 43 Checkout Instructions 1 & 2 Tracks

This sheet shows how to check out Phase 1, the single track; and how to check out Phase 2 with 2 tracks.

Sheet 44 Checkout Instructions 4 Tracks

This sheet shows how to check out Phase 3, when you have installed all 4 tracks.

Sheet 45 Startup Instructions

I tried to condense onto one sheet, all the critical steps required to start this system in normal 5-train operation (top), and also steps to prepare it to operate completely shut down like a piece of straight track (bottom) for 1-train operation.

If you use one of these units where you have different people monitoring it, you may want to laminate one of these sheets and keep it near the controls as a “memory jogger”.

Sheet 46 Searchlight Signal Spec Sheet

This sheet shows specifications for the 6-light Shiloh Signals searchlight signal. You can send this sheet directly to Shiloh Signals to order one.

The addition or lack of this signal does not affect the operation of the control unit.

However, I highly recommend the use of it because you can better tell what the control unit is doing. The 6 lights on the signal show all 6 states of the control unit.

The red and green lights indicate the position of the relay motor M3 that controls the on/off blocks. If the front toggle switch K2 is pushed down (this depowers M3 and turns blocking off), both these lights will be dark.

The four yellow lights indicate the position of the relay motors that control the side-to-side switching. If the rear toggle switch K1 is pushed down (this turns switching power off), all four of these lights will be dark.

Sheet 47 Building Dimensions

This sheet shows dimensions to build a small shed that will conceal the control unit.

Note the building shown on the cover Sheet 31 is significantly larger (the building in the picture was built to conceal an earlier, larger Model 164 control unit).

If you do not want to build your own shed or have someone readily available who can, you can possibly contact Peter Kenneman (303-750-9417) or Jim Siedleman (303-693-8977) here in Denver—they sometimes make custom buildings.

2.6 Alternate Wiring Diagram For 2-Piece Front Base

Sheet 48 Alternate Track Wiring for 2-piece Front Base

This sheet shows the wiring for when you make Base 1 and Base 2 as two separate pieces. **Sheet 38, using the 1-piece front base, is preferred over this sheet.**

This *Sheet 48 Alternate Track Wiring for 2-piece Front Base* is essentially the same as Sheet 38, except it shows the additional terminal blocks TB5 and TB6, which are used to connect Base 1 to Base 2.

Chapter 3 Assembly Steps - Helper Control Unit

Note: *Item numbers for the control unit refer to Sheet 41 Parts List & Costs-Helper Control Unit.*

Before starting assembly, you will probably want to procure parts shown on *Sheet 41 Parts List & Costs-Helper Control Unit*. The laminated template, Sheet 39 (Item 71) is included as part of this instruction package.

3.1 Base Assembly

Drawing Reference for following steps: **Sheet 39**

Per *Sheet 39 "Laminated Template for Helper Control Unit"*, cut a piece of 1/2 inch thick plywood 6-1/4" x 12-7/8" long for the base (Item 27).

120. Sandpaper the base to remove all rough spots.

121. Paint the base using Ace 35A-1A Beechtree (Item 19, brown) or color of your choice.

122. Using scissors and Sheet 9 (make sure you use the plastic-laminated one), trim the template to the 6" x 12-5/8" size. The template shows these dimensions—verify them before you cut.

123. Glue the laminated template Sheet 39 (Item 71) to the wood base, using the adhesive (Item 17).

The base is now ready to attach parts, as shown in the following figure.

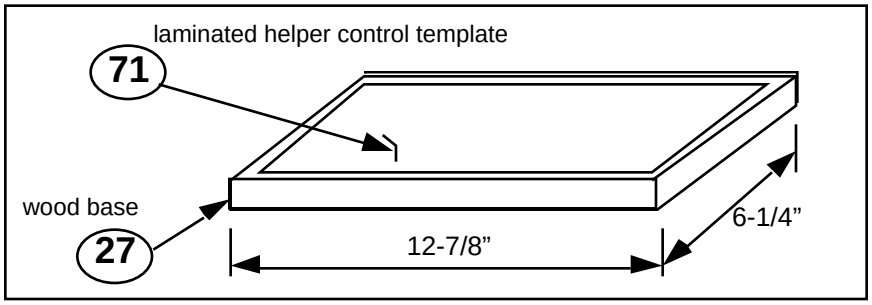
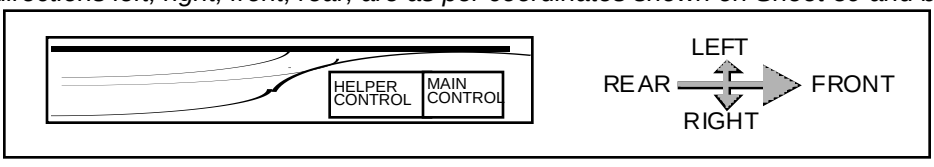


Figure 72 Wood Base With Laminated Template Attached

3.2 Attaching Parts To The Helper Control Unit

Note: *The directions left, right, front, rear; are as per coordinates shown on Sheet 39 and below.*



16-Position Terminal Block TB3

124. Drill four 5/64 pilot holes for 16-position terminal block TB1. The two "crosshairs" on the template show the approximate position. Use the terminal block as a template for drilling the other two holes.

125. Screw the 16-position terminal block (Item 16) to the wood base by using four screws #4 x 1/2" long (Item 29).

Preparing Switch Motors And Relays

Note that the track switches 'S6' and 'S8' have no motors on them—they just slide in whichever direction the engines push the track points as they pass through. Thus you can remove the switch motors from switches 'S6' and 'S8' and use them on the control unit.

126. The 12030 relay points (Item 12) snap into the end of the 12010 switch motors (Item 11). There is a plastic cover plate on the end of the motors. Pry this cover plate off using a screwdriver, and then snap the relay points into the end of the two switch motors.

Attaching Switch Motors M6 & M8

127. Drill four 9/64" holes to attach each switch motor. Note there are two crosshairs at the upper left "foot" of the motor, and two crosshairs at the lower right foot. (I suggest using wire, hence two holes for each foot.)

128. Using two pieces of black 18 gauge solid wire, run the wire through the two holes and twist it at the top, so as to hold the plastic foot of the motor to the wood base, as shown in the following figure.

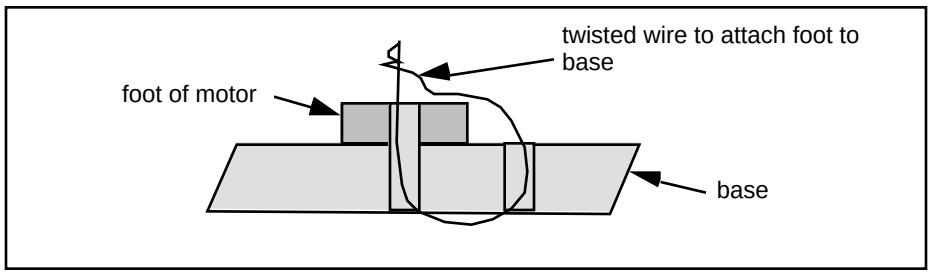


Figure 73 Using Twisted Wire to Attach Foot of Switch Motor to Wood Base

Note you can also just screw the foot to the base, which is neater. But sometimes I prefer to use the wire, since that does not damage the threads in the plastic foot.

Holes for Wing Nuts and Screws

129. Drill two 3/16" holes in the base. These holes are for the screws and wing nuts used to attach the base to the track unit. Note the template shows you a set of crosshairs for each wing nut hole location near the end of the base (11-3/4" apart).

Attaching Jumper Strips

130. Cut a two-terminal-long piece of the jumper (Item 10), in the shape as shown on *Sheet 39* on TB1 at terminals 57 and 58. After cutting it, attach it to the terminal block between terminals 57 and 58. Do not tighten the screws yet.

131. Cut a two-terminal-long piece of the jumper (Item 10), in the shape as shown on *Sheet 39* on TB1 at terminals 63 and 64. After cutting it, attach it to the terminal block between terminals 63 and 64. Do not tighten the screws yet.

3.2.1 Connecting Wires On The Helper Control Unit

Note: *When stripping insulation off the ends of wires that connect to terminals, you can strip off about 1/2".*
You can strip about 1/4" of insulation off the ends of wires that connect to switch motors and relay points.

Note: *Wire A46, L3, L44, R31, and Y35 interconnect between the Main Control Unit and the Helper Control Unit. Thus these 5 wires will not be hooked up until the next section when the control units are connected.*

Black Wires

Connect the following BLACK wires (prefix L=BLACK) using 18 gauge solid wire (Item 20):

132. Connect wire L42, from terminal 62 on terminal block TB1 to terminal 83 on motor M6.
133. Connect wire L43, from terminal 61 on terminal block TB1 to terminal 73 on motor M8.
134. Connect wire L45, from terminal 75 on motor M8, to terminal 84 on motor M6.

Black wire is used for DC + that is "switched"—that is, sometimes the power is on, and sometimes the power is off. (DC "-" (common) on the right rail is not connected to the control unit at all.)

Green Wires

Connect the following GREEN wires (prefix G=GREEN) using 18 gauge solid wire (Item 23):

135. Connect wire G38, from terminal 59 on terminal block TB1, to terminal 81 on motor M6. Do not tighten the screw to terminal 45L yet, as a second wire will be added in the next step.
136. Connect wire G39, from terminal 59 on terminal block TB1, to terminal 53 on terminal block TB1. Note terminal 59 now has 2 wires, and you can tighten the screw.
137. Connect wire G40, from terminal 56 on terminal block TB1, to terminal 54 on terminal block TB1. Do not tighten the screw to terminal 54 yet, as a second wire will be added in the next step.
138. Connect wire G41, from terminal 54 on terminal block TB1, to terminal 71 on motor M8. Note terminal 54 now has 2 wires, and you can tighten the screw.

Green wire is used for AC + that is "switched"—that is, the power is momentarily on if the corresponding track contact is activated, but is normally off.

Red Wires

Connect the following RED wires (prefix R=RED) using 18 gauge solid wire (Item 24):

139. Connect wire R32, from terminal 82 on motor M6, to terminal 63 on terminal block TB1. Do not tighten the screw to terminal 63 yet, as a second wire will be added in the next step.

140. Connect wire R34, from terminal 63 on terminal block TB1, to terminal 72 on motor M6. Do not tighten the screw to terminal 55 yet, as a second wire will be added in the next step. Note terminal 63 now has 2 wires, and you can tighten that screw.
141. Connect wire R33, from terminal 55 on terminal block TB1, to terminal 72 on motor M6. Note terminal 55 now has 2 wires, and you can tighten the screw.

Red wire is used for AC - (common, ground).

Yellow Wires

Connect the following YELLOW wires (prefix Y=YELLOW) using 18 gauge solid wire (Item 25):

142. Connect wire Y37, from terminal 57 on terminal block TB1, to terminal77 on motor M8.

Yellow wire is used for AC + that is "unswitched"—that is, the power is always on.

Gray Wires

Connect the following GRAY wires (prefix A=GRAY) using 18 gauge solid wire (Item 22):

143. Connect wire A47, from terminal 52 on terminal block TB1, to terminal 86 on motor M6
144. Connect wire A48, from terminal 78 on motor M8, to terminal 87 on motor M6.
145. Connect wire A49, from terminal 51 on terminal block TB1, to terminal 76 on motor M8.

Gray wire is used for AC + that is "switched" that powers the lights of the searchlight signal.

3.3 Optional Toggle Switch K0

WHAT IT DOES: Note that there is a toggle switch K0 mounted between terminals 58 and 60. This switch is optional. If you install it, it allows you to depower the Helper Control Unit by moving the handle to the rear, which the Main Control Unit continues to operate. Depowering the Helper Control shuts off the "cycling" of tracks 1 and 2, but trains continue to "cycle" on tracks 3 and 4.

Thus, with switch 'K0" shut off, 2 trains can be parked on tracks 1 and 2, and 3 trains can still operate on the layout using tracks 3 and 4 and the "red/green" automatic blocking.

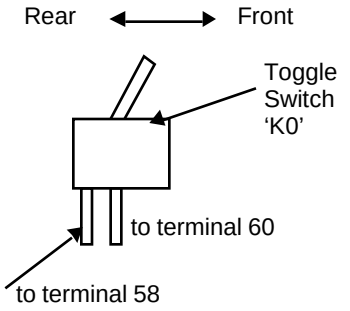
WHAT HAPPENS IF YOU OMIT IT: You can omit this toggle switch, but then you will have to either operate all 4 tracks, or depower the switching totally and operate on just 1 track. That is, you will lose the option of operating 2 tracks and "parking" the other 2 tracks. There is nothing wrong with this, as I find myself rarely using this toggle switch anyway.

Connecting Optional Toggle Switch 'K0'

146. Solder a short piece—about 2 inch long— of yellow wire to one contact of the toggle switch K0 (Item 8). Solder another 2 inch piece of yellow wire to the other contact.
147. Connect the ends of the two wires to terminals 58 and 60. You want the two wires just long enough to support the switch with the stiffness of the wires. Do not tighten the screw to terminal 60 yet, as a second wire will be added later.

Note that you could make a bracket to support this switch more "professionally", but since it will probably be used only occasionally, I mounted it as simple as possible.

ORIENTATION: You want the operation of the handle to be intuitive—so orient the switch as shown in below in Figure 74.



Orient toggle switch 'K0' so that when the handle is in the forward position as shown, the 2 contacts are connected.

With this orientation:
• When the handle is in the forward position, the switch is closed, and the helper control is powered

• When the handle is in the rear position, the switch is open, and the helper control is depowered

Figure 74 Orientation of Toggle Switch K0

Omitting Optional Toggle Switch 'K0'

148. If you decide to omit the toggle switch 'K0', then instead connect a piece of yellow wire between terminals 58 and 60. This wire has the same effect as having a switch that is always in the closed position.

Conclusion

At this point, the assembly of the Helper Control Unit should be complete.

Chapter 4 Assembly Steps—Track Unit

PHASES: As mentioned in *2.2 Comments About Building In Phases , on page 14*, there are 3 sets of track drawings and 3 wiring drawings, so you can build this unit in 3 stages. The steps in this section are for all 3 phases, that is, to build all 4 tracks. However, you will see "skip ahead" notes at the end of each phase, telling you where you can "skip ahead" to the wiring and then the check out.

Note: *Item numbers for the track unit refer to Sheet 42 Parts List & Costs-Track Unit.*

Terminology Note: The tracks are numbered 1 thru 4 from right to left, as this is the order that the yard operates. This booklet describes constructing the tracks in the order that is controlled by the design: Track 3 first (Phase 1), Track 4 second (Phase 2), then Tracks 1 & 2 (Phase 3). So please be aware that the order of construction is not the same as the track number.

Do to the location of the track contacts and resulting logic, Track 3 can operate alone. Tracks 3 & 4 can operate without tracks 1 & 2. Tracks 1 & 2 have to be added at the same time, and cannot operate without Tracks 3 & 4.

4.1 Preparing Bases

Drawing Reference for following steps: **Sheet 33**

As discussed in *Notes About Track Positioning: , on page 15*, the lengths of the bases are designed so the ends of all rails are at least 1 inch away from the edge of the bases.

149. FRONT BASE: Per *Sheet 33 Track Unit Assembly-1 Track* Fig 33b, cut a piece of plywood, 1/2 inch thick, 30" wide x 87-1/4" (7' 3-1/4") long for the front base (Item 76a).

    This assumes you are making the front base in one piece as recommended. If you are making the front base in two smaller pieces, use two smaller pieces as shown.

150. REAR BASE: Cut a piece of plywood, 1/2 inch thick, 30" wide x 56-1/8" (4' 8-1/8") long for the rear base (Item 76c).

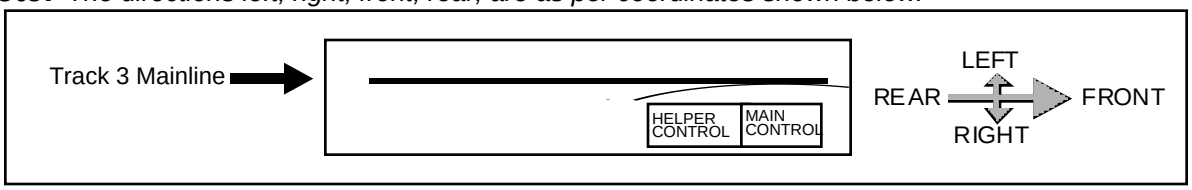
151. Sandpaper the bases to remove all rough spots.

152. Paint the bases using some realistic shade of green, or color of your choice.

    The bases are now ready to attach parts.

4.2 Phase 1—Single Track Assembly—Track 3

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru laying out the mainline track (Track 3) first. Later you add track 4. Still later you add Tracks 1 and 2.

Cutting 3" Special Track Length (Item 45b)

153. From one of the 12" straight sections of track (Item 45), use a razor saw or hack saw to cut a piece 7.5 cm (~3") long. This is the piece (Item 45b) that goes immediately in front of the switch.

    Note that you cannot use a standard 6" long 1015 track, as would seem more logical at first glance, because the tie spacing is too close to fit in the track contact.

154. File the rear of the right rail as necessary to smooth the edges from the cutting.

155. Slide a brass rail joiner (Item 40) onto this rail. You will have to bend the small vertical tab from the vertical up to horizontal to do this.

Putting Plastic Rail Joiners On Track Pieces

Note: *You can use a black magic marker to change the color of the plastic insulated rail joiners (Item 41) from orange to black, so they will be less conspicuous.*

156. From one of the 6" straight tracks (Item 47b), remove the brass rail joiner from the front end as per orientation of Sheet 35. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.

157. From one of the curved tracks (Item 44), remove the brass rail joiner from the front end as per orientation of Sheet 35. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.

Laying Out Track 3 Mainline On The Front Base

158. Lay the pieces loose on top of the wood base, following Sheet 35. Connect the tracks to each other, but do not screw anything down yet.

159. Verify the following per Sheet 35 "Mainline Dimensions":

- The special 3" straight piece (Item 45b) is located approximately 2.6 cm (1") back from the front of the front base.
- The 6" straight piece with the plastic rail joiner (Item 47b) is located approximately 8.65 cm (3-7/16") forward from the rear of the front base
- The plastic insulator of the above 6" straight piece is on the front end, and is on the left rail.
- For the 10153's 6 inch single isolating track (Item 48), the gap is in the left rail.

Note: *The left rail is the (+) rail with the gaps; the right (-) rail has no gaps.)*

- The track contacts T1 and T3 are installed in the track as shown.

Note: *If you are using a 2-piece front base, then you will have a "Gap 1" as shown on Sheet 33. This gap should small, about 5/16"—basically it's just a joint.*

Laying Out Track 3 Mainline On The Rear Base

160. Lay the pieces loose on top of the wood base, following Sheet 33. Connect the tracks to each other, but do not screw anything down yet.

161. Verify the following per *Sheet 33 Track Unit Assembly-1 Track*:
    - The front 12” straight track (Item 45) is located approximately 5.9 cm (2-5/16”) back from the front of the rear base.
    - The rear switch (Item 49b) is located approximately 2.6 cm (1”) forward from the rear of the front base.
    - The gap between the front and rear bases (Gap 2) is approximately 7.25 cm (~2-13/16”)

Attaching Track 3 Mainline To The Bases

Note: *Use a 7/64” drill to drill pilot holes in the plastic ties where the screws will go. In most cases you can use the holes already in the ties.*

Use a 5/64” drill to drill pilot holes in the wood for the screws, under the holes in the ties.

Use a #4 x 5/8 long wood screws (Item 55) to attach the track ties to the wood base.

162. Use a #4 x 5/8 long wood screw (Item 29) to attach the track ties to the wood base in just the following 4 places.
    - The first and last piece on the front base.
    - The first and last piece on the rear base.
    - Verify that when the 6” straight piece that spans the gap between the front and rear bases is inserted, the gap between the front and rear bases (Gap 2) is approximately 7.25 cm (~2-13/16”)

163. Attach the remaining pieces for Track 3 mainline.

Preventing Rails From Sliding In Ties

The pieces of track where you use the insulated rail joiners, the rails will tend to slide out of the ties, since the plastic joiner has no “holding power”. You may want to drill a hole through the outside bottom flange of the rail, and a pair of holes underneath, in the wood base. You can use a short piece of black wire to connect the rail to the base, and prevent it from moving.

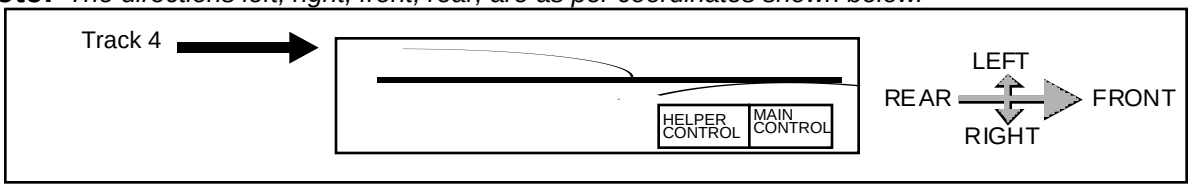
What To Do Next

At this point, you have the mainline, Track 3 assembled. You may want to skip ahead to *5.2, Phase 1—Single Track Wiring—Track 3, on page 34*, to wire up and test this single track, then come back and install the other 3 tracks.

4.3 Phase 2—Constructing 2nd Track—Track 4

Drawing Reference for following steps: **Sheet 34**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru laying out Track 4. Later you add Tracks 1 and 2.

Cutting Track Power Cables Apart

The track power cable (Item 50b) contains a 2-conductor wire and 2 screw-on track power terminals. We will split this wire and use these terminals in separate places.

164. Split the track power cable into two pieces by pulling apart the 2-conductor wire, so that you end up with two separate pieces, each piece having 1 wire and 1 terminal on the end.

165. Attach one terminal to the frontmost curved track of Track 4.

    The other terminal will be used later on Track 1.

Note: *Each of Tracks 4, 1, and 2 have 1 special length piece. The procedure we will use for these 3 tracks, is to position the standard length pieces, verify the required length of the special length piece, cut the special piece, then attach the track*

Putting Plastic Rail Joiner On 6” Piece

166. From one of the 6” straight tracks (Item 47b), remove the brass rail joiner from the front end as per orientation of Sheet 34. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.

Laying Out Track 4 With 1 Missing Piece

167. Lay all the standard pieces loose on top of the wood base. You will have a gap where the special length piece (Item 45c) will fit. Connect the tracks to each other, but do not screw anything down yet.

Cutting Special Length Piece to Complete Track 4 (Item 45c)

168. Fit the front and rear bases together with the mainline Track 3 connected. Measure the gap where the special length piece will fit in Track 4. As shown on the drawing, the gap should be somewhere around 25.4 cm (~10”) long

169. From one of the one-foot long straight sections of track (Item 45), use a razor saw to cut a piece 25.4 cm (~10”) long, or whatever length you have measured. File the rear of the right rail as necessary to smooth the edges from the cutting.

170. Slide a brass rail joiner (Item 40) onto this rail. You will have to bend the small vertical tab from the vertical up to horizontal to do this.

Laying Out Track 4 With All The Pieces

171. Lay the pieces loose on top of the wood base. Connect the tracks to each other, but do not screw anything down yet.

172. Verify the following per Sheet 3x "Track 4 Dimensions":
    - The plastic insulator of the front curved track is on the front end, and is on the left rail.
    - The plastic insulator of the rear 6" straight track is on the front end, and is on the left rail.
    - The track contacts T4, T6, and T8 are installed in the track as shown.

173. Attach all pieces of Track 4 to the wood bases.

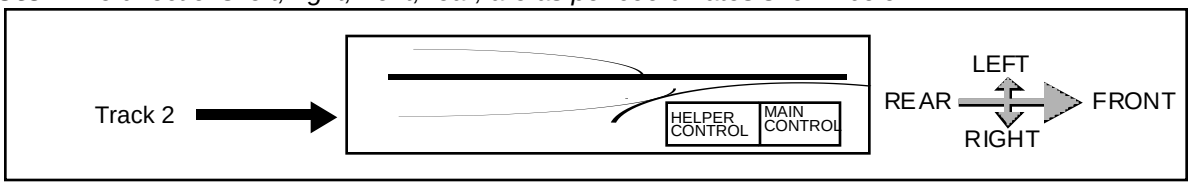
What To Do Next

At this point, you have Tracks 3 and 4 assembled. You may want to skip ahead to Section *5.3, Phase 2—Wiring 2nd Track—Track 4, on page 36* to wire up and test these 2 tracks, then come back and install the other 2 tracks.

4.4 Phase 3a—Constructing 3rd Track—Track 2

Drawing Reference for following steps: **Sheet 35**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru laying out the third track, Track 2. Later you add Track 1.

Putting Plastic Rail Joiner On 6" Piece

174. From one of the 6" straight tracks (Item 47b), remove the brass rail joiner from the front end as per orientation of Sheet 35. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.

Laying Out Track 4 With 1 Missing Piece

175. Lay all the standard pieces loose on top of the wood base. You will have a gap where the special length piece (Item 45d) will fit. Connect the tracks to each other, but do not screw anything down yet.

Cutting Special Length Piece to Complete Track 2 (Item 45d)

176. Fit the front and rear bases together with the mainline Track 3 connected. Measure the gap where the special length piece will fit in Track 2. As shown on the drawing, the gap should be somewhere around 23.4 cm (~9.25") long

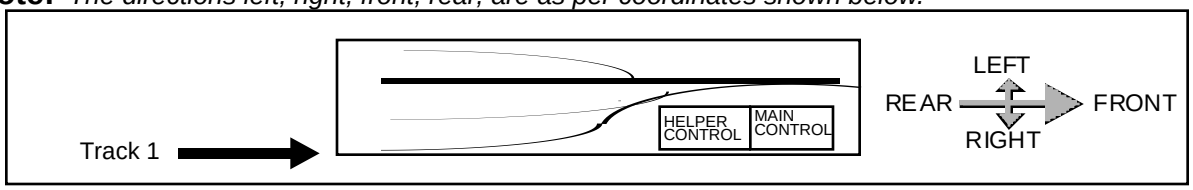
177. From one of the one-foot long straight sections of track (Item 45), use a razor saw to cut a piece 23.4 cm (~9.25”) long, or whatever length you have measured. File the rear of the right rail as necessary to smooth the edges from the cutting.
178. Slide a brass rail joiner (Item 40) onto this rail. You will have to bend the small vertical tab from the vertical up to horizontal to do this.

Laying Out Track 2 With All The Pieces

179. Lay the pieces loose on top of the wood base. Connect the tracks to each other, but do not screw anything down yet.
180. Verify the following per *Sheet 35 Track Unit Assembly-4 Tracks*:
    - The plastic insulator of the rear 6” straight track is on the front end, and is on the left rail.
    - For the 10153 6” single isolating track (Item 48), the gap is in the left rail.
    - The track contact T5 is installed in the track as shown.
181. Attach all pieces of Track 4 to the wood bases.

4.5 Phase 3b—Constructing 4th Track—Track 1

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru laying out the fourth and last track, Track 1.

Cutting Track Power Cables Apart

182. Attach one terminal of the track power cable (that you split in half, back when you attached Track 2) to the frontmost curved track of Track 1.

Putting Plastic Rail Joiners On Track Pieces

183. From one of the 6” straight tracks (Item 47b), remove the brass rail joiner from the front end as per orientation of Sheet 35. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.
184. From one of the curved tracks (Item 44), remove the brass rail joiner from the front end as per orientation of Sheet 34. Slide on one of the plastic insulating rail joiners (Item 41) where you removed the brass one.

Laying Out Track 1 With 1 Missing Piece

185. Lay all the standard pieces loose on top of the wood base. You will have a gap where the special length piece (Item 45e) will fit. Connect the tracks to each other, but do not screw anything down yet.

Cutting Special Length Piece to Complete Track 1 (Item 45e)

186. Fit the front and rear bases together with the mainline Track 3 connected. Measure the gap where the special length piece will fit in Track 1. As shown on the drawing, the gap should be somewhere around 17.1 cm (~6.3/4") long
187. From one of the one-foot long straight sections of track (Item 45), use a razor saw to cut a piece 17.1 cm (~6.3/4") long, or whatever length you have measured. File the rear of the right rail as necessary to smooth the edges from the cutting.
188. Slide a brass rail joiner (Item 40) onto this rail. You will have to bend the small vertical tab from the vertical up to horizontal to do this.

Laying Out Track 1 With All The Pieces

189. Lay the pieces loose on top of the wood base. Connect the tracks to each other, but do not screw anything down yet.
190. Verify the following per *Sheet 35 Track Unit Assembly-4 Tracks*:
    - The plastic insulator of the front curved track is on the front end, and is on the left rail.
    - The plastic insulator of the rear 6" straight track is on the front end, and is on the left rail.
    - For the 10153 6" single isolating track (Item 48), the gap is in the left rail.
    - The track contacts T7 is installed in the track as shown.
191. Attach all pieces of Track 1 to the wood bases.

Chapter 5 Wiring Steps—Track Unit

5.1 Attaching Electrical Parts

Drawing Reference for following steps: **Sheet 36**

Attaching Terminal Blocks

Note: *You can use four #4 x 5/8" long wood screws (Item 29) to attach terminal blocks to the wood bases.*

192. Attach terminal block TB8 (Item 42) to the right front corner of the front base as shown, using four #4 x 5/8" long wood screws (Item 54).
193. Attach terminal block TB2 (Item 42) to the right front corner of the front base as shown.
194. Attach terminal block TB10 (Item 15) to the right front corner of the rear base as shown.
195. If you are using a 2-piece front base (not recommended, as per Sheet 46), then attach terminal blocks TB5 and TB6 as shown on Sheet 46.

    If you are using a 1-piece front base, as recommended, the use a pencil and cross out terminal blocks TB5 and TB6 on Sheet 38, as you do not need these.

Drilling Holes For Wires

Note: *For the following steps, use a 9/64 drill to drill holes as required, in order to run the wires underneath the wood base.*

Find terminal blocks TB2 and TB8 on Sheet 36. About 1/4" to the left of these, you can drill 32 holes next to the 32 terminals, as you will be running wires down through most of these holes.

Mounting Searchlight Signal

Perform these steps if you are using the Shiloh searchlight signal (Item 77).

The use of this signal is optional—it does not affect the operation of the block, but I recommend it because the six lights tell you the "state" of the control unit, plus it is entertaining to watch.

Specifications for this signal are shown on *Sheet 46 Searchlight Signal Spec Sheet.* You can order this signal directly from Shiloh Signals.

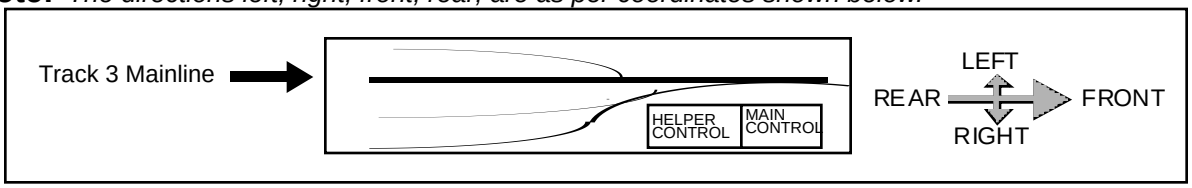
196. Drill a 5/16" hole for the stem of the signal, located about 6" back from the front of the base, and 5" to the right of the track, as shown on Sheet 33. This will position the signal as shown in the photo in Figure 32 a on *Sheet 32 Photographs*.
197. Push the bottom of the signal into the hole, so the wires run underneath.

PHASES: As mentioned in *2.2 Comments About Building In Phases , on page 14*, there are 3 sets of track drawings and 3 wiring drawings, so you can wire this unit in 3 stages. The steps in this section are for all 3 phases, that is, to wire all 4 tracks. However, you will see "skip ahead" notes at the end of each phase, telling you where you can "skip ahead" to the check out.

5.2 Phase 1—Single Track Wiring—Track 3

Drawing Reference for following steps: **Sheet 36**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru wiring the mainline track (Track 3) first, using only the Main Control. Later you wire track 4. Still later you wire Tracks 1 and 2 and the Helper Control.

5.2.1 Connecting Front Track Unit Wires For The Main Control

Note: *For the following steps, use a 9/64 drill to drill holes as required, in order to run the wires underneath the wood base.*

Black Wires

Connect the following BLACK wires using 18 gauge solid wire (Item 20):

198. Connect wire 4 from terminal 4 on terminal block TB8, to the 5th terminal from the front of the front 10153 single isolating track (Item 43) in Track 3.

Note: *Observe the white paths painted on the 10153 isolating track—these show you which rail the screw terminal connects to.*

Black wire is used for DC '+' that is "switched"—that is, sometimes the power is on, and sometimes the power is off.

Note: *DC '-' on the right rail is not connected to the control unit at all. Note that there are no gaps or block in the '-' right rail.*

Blue Wires

Attach the following BLUE wires using 18 gauge solid wire (Item 21):

199. Connect blue wire 3 from terminal 3 on terminal block TB8, to the 5th terminal from the front of the rear 10153 single isolating track (Item 43) in Track 3.

    Note that blue wire 3 carries the current from the rheostat to the slowdown blocks.

200. Connect blue wire 8 from terminal 8 on terminal block TB8, to the 2nd terminal from the front of the front 10153 single isolating track (Item 43) in Track 3.

    Note that blue wire 8 carries the current from the mainline in to the control units.

Blue wire is used for DC + that is "unswitched"—that is, the power is always on.

Green Wires

Attach the following GREEN wires using 18 gauge solid wire (Item 23):

201. Connect green wire 9, from terminal 9 on terminal block TB8, to the rearmost terminal of track contact T1.

Green wire is used for AC + that is "switched"—that is, the power is on if the corresponding track contact is activated, but is normally off.

Yellow Wires

Attach the following YELLOW wires using 18 gauge solid wire (Item 25):

202. Connect yellow wire 10, from terminal 10 on terminal block TB8, to the center terminal of track contact T1.

Yellow wire is used for AC + that is “unswitched”—that is, the power is always on.

Stranded Wires to Contact T2

203. Using the double-conductor stranded wire (Item 61), attach the lighter side to terminal 11 on terminal block TB8. Connect the other end to the center terminal of track contact T2.

204. Using the same double-conductor wire as the previous step, attach the darker side to terminal 12 on terminal block TB8. Connect the other end to the frontmost terminal of track contact T2.

Sheet 36 shows these two wires as green and yellow, but you probably want to use the stranded wire so that track contact T2 can be moved around. If T2 is going to be permanently located in one place, then use the solid yellow and green wire so you have the color coding.

5.2.2 Connecting Rear Track Unit Wires For The Main Control

Blue Wires

Attach the following BLUE wires using 18 gauge solid wire (Item 21):

205. Connect blue wire 8 from terminal 8 on terminal block TB10, to the right terminal on terminal block TB11.

    Note this wire 8 on the on the rear track unit is OPTIONAL. It is a jumper that carries mainline power from the front to the rear of the blocks. If you have good connections around the loop in the other direction and not too much voltage drop, you can omit this wire. I omit it for display layouts.

Blue wire is used for DC + that is “unswitched”—that is, the power is always on.

5.2.3 Connecting Searchlight Signal For The Main Control

206. Connect the red Shiloh wire (wire 2, common) to terminal 2 on terminal block TB8.

207. Connect the white Shiloh wire that has a red stripe on it (wire 15, block red light) to terminal 15 of terminal block TB8.

208. Connect the white Shiloh wire that has a green stripe on it (wire 16, block green light) to terminal 16 of terminal block TB8.

5.2.4 Connecting Main Control Unit to Track Unit

The section describes how to attach the Main Control Unit to the track unit.

Attach Main Control Unit to Track Unit

209. Position the main control unit on the corner of the track unit, such that the 16-position terminal block TB3 is in the corner of the control unit, lines up with the 16-position terminal block TB8 mounted on the track unit.

210. Us**in**g the 2 wing nuts and screws (Item 28), attach the Main Control Unit to the track unit.

Connect Interface Wires

211. Cut 8 short jumper wires, about 3 inches long. Use 18 gauge solid wire (Items 20 thru 25). Make the color the same as shown on Sheet 36, connecting terminal block TB3 to terminal block TB8. For example, jumper 1 is green, jumper 2 is red, jumper 3 is blue, etc

    Attach a spade connectors (Item 51) to each end of these jumper wires (Item 63).

212. Connect the 3" jumper wires (Item 63) between the two 16-position terminal blocks, as shown on Sheet 36, connecting terminal block TB3 to terminal block TB8.

213. Check to verify that you did not accidently cross any of the jumper wires.

5.2.5 Connecting AC Power

Make sure you read the comments about voltage in "Increasing AC Control Voltage" on page 9.

The power input is via the female RCA phono plug that is located on rheostat mounting bracket, identified with the label "18 VAC INPUT POWER".

To plug into the female RCA phono jack on the control unit, you need a wire that terminates with a male RCA type phono jack. You can use a Radio Shack #42-2450 (Item 61c) or similar. This wire has spade terminals on one end to connect to the transformer, and on the other end has a male phono plug that plugs into female jack on the control unit.

214. Using the RCA phono plug to spade terminal wire (Item 61c), connect the RCA male phono plug to the AC power input of the Main Control Unit. Connect the spade terminal end to the AC power supply.

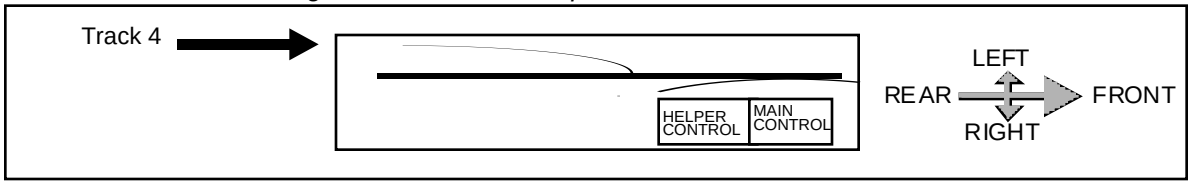
What To Do Next

At this point, you have completed the Main Control Unit and track unit wiring to operate Track 3. You may want to skip ahead to Section *6.1, Phase 1—Checking Out Single Track Assembly—Track 3, on page 43* to test this single track, then come back later and connect the second track, Track 4.

5.3 Phase 2—Wiring 2nd Track—Track 4

Drawing Reference for following steps: **Sheet 37**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru the additional wiring steps to add the left track (Track 4), for 2-Track Automatic Switching Block operation, using only the Main Control. Later you wire Tracks 1 and 2 and the Helper Control.

5.3.1 Connecting Front Track Unit Wires For The Main Control

Black Wires

Connect the following BLACK wires using 18 gauge solid wire (Item 20):

215. Connect wire 7 from terminal 7 on terminal block TB8, to the track power screw terminal (Item 72) you screwed on the front curve track in Track 4.

    You will probably want to make a solder joint to connect black wire 7 to the wire attached to the screw terminal.

Black wire is used for DC '+' that is "switched"—that is, sometimes the power is on, and sometimes the power is off.

Note: *DC '-' on the right rail is not connected to the control unit at all. Note that there are no gaps or block in the '-' right rail.*

Green Wires

Attach the following GREEN wires using 18 gauge solid wire (Item 23):

216. Connect green wire 5A, from terminal 5 on terminal block TB8, to the frontmost terminal of track contact T3.

217. Connect green wire 5B, from terminal 5 on terminal block TB8, to the frontmost terminal of track contact T4.

Green wire is used for AC + that is "switched"—that is, the power is on if the corresponding track contact is activated, but is normally off.

Yellow Wires

Attach the following YELLOW wires using 18 gauge solid wire (Item 25):

218. Connect yellow wire 6A, from terminal 6 on terminal block TB8, to the center terminal of track contact T3.

219. Connect yellow wire 6B, from terminal 6 on terminal block TB8, to the center terminal of track contact T4.

Yellow wire is used for AC + that is "unswitched"—that is, the power is always on.

5.3.2 Connecting Rear Track Unit Wires For The Main Control

Green Wires

Attach the following GREEN wires using 18 gauge solid wire (Item 23):

220. Connect green wire 1, from terminal 1 on terminal block TB10, to the rightmost terminal of switch motor S1.

Green wire is used for AC + that is "switched"—that is, the power is on if the corresponding track contact is activated, but is normally off.

Red Wires

Attach the following RED wires using 18 gauge solid wire (Item 24):

221. Connect red wire 2, from terminal 2 on terminal block TB10, to the leftmost terminal of switch motor S1

Red wire is used for AC - (common, ground).

5.3.3 Connecting Searchlight Signal For The Main Control

222. Connect the white Shiloh wire that has the 4 black stripes on it (wire 13, Track 4 yellow light) to terminal 13 on terminal block TB8.
223. Connect the white Shiloh wire that has the 3 black stripes on it (wire 14, Track 3 yellow light) to terminal 14 on terminal block TB8.

5.3.4 Connecting Main Control Unit Interface Wires

The section describes how to attach the additional 8 short 3 inch wires, to connect the Main Control Unit to the track unit.

Connect Interface Wires

224. Cut 8 short jumper wires, about 3 inches long. Use 18 gauge solid wire (Items 20 thru 25). Make the color the same as shown on Sheet 37, connecting terminal block TB3 to terminal block TB8. For example, jumper 1 is green, jumper 2 is red, jumper 6 is yellow, etc

    Attach a spade connectors (Item 51) to each end of these jumper wires (Item 63).
225. Connect the 3” jumper wires (Item 63) between the two 16-position terminal blocks, as shown on Sheet 37, connecting terminal block TB3 to terminal block TB8.
226. Check to verify that you did not accidently cross any of the jumper wires.

Connect Track Switch S1 on Rear Track Unit to Front Unit

Identify terminals 1 and 2 on terminal block TB8 on the front track unit.
Identify terminals 1 and 2 on terminal block TB10 on the rear track unit.
Find the 2-conductor wire with spade terminals on both ends (Item 82).

227. Use a green magic marker to mark the end of the wire insulation green, for the conductor that has the silver-colored terminals. This will be terminal 1.

    Use a red magic marker to mark the end of the wire’s insulation red, for the conductor that has the brass-colored terminals. This will be terminal 2.

    (Optional) Put labels with the numbers 1 and 2 on each end of these wires for easier identification.
228. Connect terminals 1 and 2, front to rear, using the 2-conductor, spade-terminal wire (Item 82) that you marked in the previous step.

    At terminal TB8, you can either route the wires under the enclosure, our you can cut a slot in the wood base, about 1/4” wide by 3/4” long, for the two wires to come up through from the bottom.

    Sheet 36 shows these two wires as green and red, but you probably want to use the stranded wire so that the rear track unit can be moved around. If the rear track unit is going to be permanently located in one place, then use the solid red and green wire so you have the color coding.

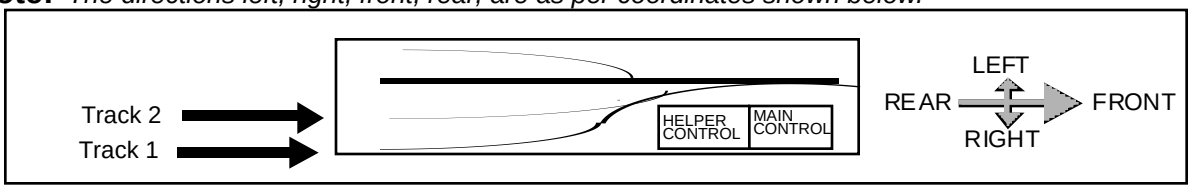
What To Do Next

At this point, you have connected the track unit wiring to operate Tracks 3 and 4. You may want to skip ahead to *6.2, Phase 2—Checking Out 2-Track Unit—Tracks 3 & 4, on page 44* to test these 2 tracks, then come back later and wire the last 2 tracks.

5.4 Phase 3— Wiring 3rd & 4th Tracks—Tracks 2 & 1

Drawing Reference for following steps: **Sheet 38**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru the additional wiring steps to wire Tracks 1 and 2 and the Helper Control, for operating all 4 tracks.

5.4.1 Connecting Front Track Unit Wires For The Helper Control

Black Wires

Connect the following BLACK wires using 18 gauge solid wire (Item 20):

229. Connect wire 61 from terminal 61 on terminal block TB2, to the track power screw terminal (Item 72) you screwed on the front curve track in Track 1.

     You will probably want to make a solder joint to connect black wire 61 to the wire attached to the screw terminal.

230. Connect wire 62 from terminal 621 on terminal block TB2, to the 5th terminal from the front of the front 10153 single isolating track (Item 43) in Track 2.

Black wire is used for DC '+' that is "switched"—that is, sometimes the power is on, and sometimes the power is off.

Green Wires

Attach the following GREEN wires using 18 gauge solid wire (Item 23):

231. Connect green wire 56A, from terminal 56 on terminal block TB2, to the frontmost terminal of track contact T7.
232. Connect green wire 56B, from terminal 56 on terminal block TB2, to the frontmost terminal of track contact T8.
233. Connect green wire 59A, from terminal 59 on terminal block TB2, to the frontmost terminal of track contact T5.
234. Connect green wire 59B, from terminal 59 on terminal block TB2, to the frontmost terminal of track contact T6.

Green wire is used for AC + that is "switched"—that is, the power is on if the corresponding track contact is activated, but is normally off.

Yellow Wires

Attach the following YELLOW wires using 18 gauge solid wire (Item 25):

235. Connect yellow wire 57A, from terminal 57 on terminal block TB2, to the center terminal of track contact T7.
236. Connect yellow wire 57B, from terminal 57 on terminal block TB2, to the center terminal of track contact T8.

237. Connect yellow wire 58A, from terminal 58 on terminal block TB2, to the center terminal of track contact T5.
238. Connect yellow wire 58B, from terminal 58 on terminal block TB2, to the center terminal of track contact T6.

Yellow wire is used for AC + that is "unswitched"—that is, the power is always on.

5.4.2 Connecting Rear Track Unit Wires For The Helper Control

Green Wires

Attach the following GREEN wires using 18 gauge solid wire (Item 23):

239. Connect green wire 53, from terminal 53 on terminal block TB10, to the rightmost terminal of switch motor S5.
240. Connect green wire 54, from terminal 54 on terminal block TB10, to the rightmost terminal of switch motor S7.

Green wire is used for AC + that is "switched"—that is, the power is on if the corresponding track contact is activated, but is normally off.

5.4.3 Connecting Searchlight Signal Wires For The Helper Control

241. Connect the white Shiloh wire that has the 1 black stripe on it (wire 51, Track 1 yellow light) to terminal 51 on terminal block TB8.
242. Connect the white Shiloh wire that has the 2 black stripes on it (wire 52, Track 2 yellow light) to terminal 52 on terminal block TB8.

5.4.4 Connecting the Helper Control Unit to the Track Unit

Attach Helper Control Unit to Track Unit

243. Position the Helper Control Unit on the corner of the track unit, such that the 16-position terminal block TB1 in the corner of the control unit, lines up with the 16-position terminal block TB2 mounted on the track unit.
244. Us**in**g the 2 wing nuts and screws (Item 28), attach the Helper Control Unit to the track unit.

Connecting the Helper Control Unit to the Main Control Unit

Drawing Reference for following steps: **Sheet 40**

For the Helper Control Unit to operate, you must connect it to the Main Control Unit as described below.

The Helper Control Unit connects to the Main Control Unit by 5 wires, after 2 wires are disconnected on the Main Control Unit

245. Follow the seven steps on *Sheet 40 Control Unit Interconnections* to connect the Helper Control Unit to the Main Control Unit.

Connect Interface Wires

Drawing Reference for following steps: **Sheet 38**

246. Cut 9 short jumper wires, about 3 inches long. Use 18 gauge solid wire (Items 20 thru 25). Make the color the same as shown on Sheet 38, connecting terminal block TB1 to terminal block TB2. For example, jumper 53 is green, jumper 57 is yellow, etc.

    Attach a spade connectors (Item 51) to each end of these jumper wires (Item 63).

247. Connect the 3" jumper wires (Item 63) between the two 16-position terminal blocks, as shown on Sheet 38, connecting terminal block TB1 to terminal block TB2.

248. Check to verify that you did not accidently cross any of the jumper wires.

Connect Track Switches S5 & S7 on Rear Track Unit to Front Unit

Identify terminals 53 and 54 on terminal block TB2 on the front track unit.
Identify terminals 53 and 54 on terminal block TB10 on the rear track unit.
Find the 2-conductor wire with spade terminals on both ends (Item 82).

249. Use a green magic marker to mark the end of the wire insulation green, for the conductor that has the silver-colored terminals. This will be terminal 53.

    Use a green magic marker, then a black magic marker to "stripe" the end of the wire insulation with green and black stripes, for the conductor that has the brass-colored terminals. This will be terminal 54.

    (Optional) Put labels with the numbers 53 and 54 on each end of these wires for easier identification.

250. Connect terminals 53 and 54, front to rear, using the 2-conductor, spade-terminal wire (Item 82) that you marked in the previous step.

    At terminal TB2, you can either route the wires under the enclosure, our you can cut a slot in the wood base, about 1/4" wide by 3/4" long, for the two wires to come up through from the bottom.

    Sheet 36 shows these two wires as green, but you probably want to use the stranded wire so that the rear track unit can be moved around. If the rear track unit is going to be permanently located in one place, then use the solid green wire so you have the color coding.

5.5 (Alternate, Option) Track First, Control Units Later

So far this booklet has described the scenario of building the control units first, then building the trackage.

As an alternate way to proceed, you can reverse these steps—that is, design and install the trackage with the proper gaps and insulators as the first step, then build and install the control units as the second step. You simply jumper all the blocks to connect them to the main line, and thus operate without the control units. *Figure 75, Jumpering Tracks To Operate Without Control Units, on page 42* shows the jumper wiring

.

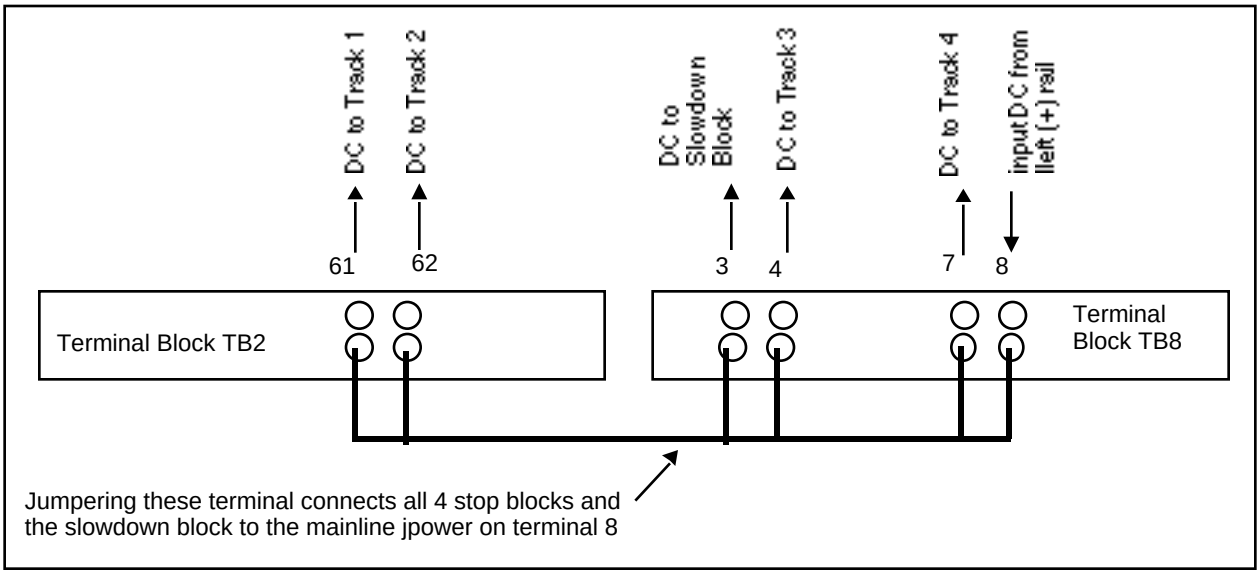


Figure 75 Jumpering Tracks To Operate Without Control Units

Important: *Try to use straight sidings between the front and rear switches, as shown in Sheet 35 Track Unit Assembly-4 Tracks. Curved sidings will work, but it is more difficult to accurately control the speed of the locomotives in the slowdown blocks when they pulling against the increased frictional resistance of the curves.*

Chapter 6 Check-Out and Operating

In normal operation, the control units are doing both automatic switching (motors M2, M6, and M8) and automatic blocking (motor M3) to control 5 trains. For special operation, you can shut down either part of the control unit—that is, you can deactivate the blocking function (operate 4 trains), or you can deactivate the switching function (operate 2 trains). You can also shut the control unit down entirely, so the whole unit acts like a piece of straight track, and operate 1 train on the loop.

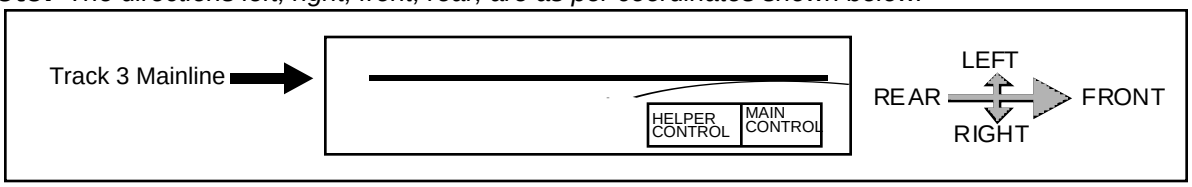
The operating steps in the following section guide you through initializing the unit for all these possible ways to operate it.

Note: *Verify each engine has a magnet on the bottom.*

6.1 Phase 1—Checking Out Single Track Assembly—Track 3

Drawing Reference for following steps: **Sheet 33**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru checking out the mainline track (Track 3) first, using only the Main Control.

Turn on Power

251. Verify AC power source is connected and ON.
252. Verify the power-on indicator light is lighted.
253. Turn on DC track power to about 12 volts.

6.1.1 Checking Out Main Control Unit Red/Green Block Operation

254. Verify toggle switch K2 is in the UP position (block power on).

    Track contacts T1 and T2 operate the block relay M3.

Verify Track Contact T1 Operation

255. Hold a #17001 magnet over top of track contact T1.
256. Relays: Verify the arm of motor M3 on the control unit moves to the REAR (“red” state disconnects track power to all on/off blocks).
257. Verify the RED light on the target signal is lighted.
258. Power: Verify that Block 3 is DEAD.

Verify Track Contact T2 Operation

259. Verify toggle switch K2 is in the UP position.
260. Hold a #17010 magnet over top of track contact T2
261. Relays: Verify the arm of motor M3 on the control unit moves to the FRONT ("green" state-connects track power to on/off blocks B2 or B4).
262. Verify the GREEN light on the target signal is lighted.
263. Leave the arm of motor M3 in the FRONT "green" position for the following steps.

6.1.2 Verify Rheostat Controls Slowdown

264. Adjust rheostat R1 to maximum clockwise position (maximum voltage to on/off blocks, resistance is zero).
265. If possible, place a small engine on the straight slowdown block for Track 3, and put a piece of wood or something in front of it so it will sit in one place and spin its wheels.
266. Adjust rheostat R1 for slower speeds by turning CCW. The engine should run slower.

    This rheostat setting will also control the other 3 on/off blocks when block motor M3 is in the "green" position.

6.1.3 Operating Single-Track Unit

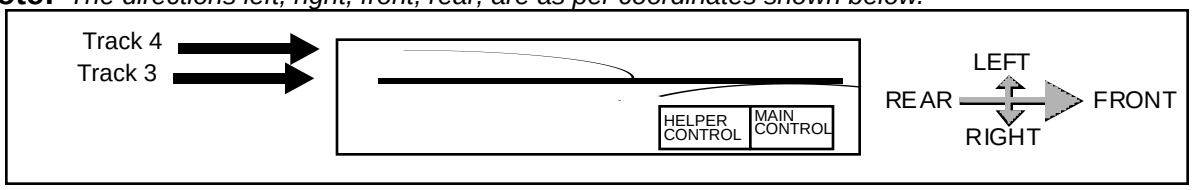
Drawing Reference for following steps: **Sheet 43**

267. Refer to *Sheet 43 Checkout Instructions 1 & 2 Tracks*, and operate the single-track unit in the 3 modes of operation as shown in Figures 43a, 43b, and 43c.

6.2 Phase 2—Checking Out 2-Track Unit—Tracks 3 & 4

Drawing Reference for following steps: **Sheet 34**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru checking out the mainline track (Track 3) and the left track (Track 4) for 2-Track Automatic Switching Block operation, using only the Main Control.

6.2.1 Checking Out Main Control Unit Tracks 3 and 4 Switching

Depowering Helper Control Unit

If the Helper Control is not connected and hooked up, and Tracks 1 and 2 are not yet installed, you can still operate Tracks 3 and 4 with the Main Control Unit only.

However, if the Helper Control is connected, the following 2 steps depower the Helper Control for 2-track operation.

268. If the Helper Control Unit is connected, verify the arms of relay motors M6 and M8 on the helper unit, are pushed to the left position.

    Positioning arms on M6 and M8 to the left, routes DC track power from block relay M3, through relays M8 and M6, and back to relay M2.

269. Set toggle switch K0 on the Helper Control to the rear to depower the helper unit.

Verify Track Contact T3 Operation for Changing Route To Track 4

270. Verify toggle switch K1 is in the UP position (switching power to Main Control Unit on).
271. Hold a #17010 magnet over top of track contact T3.
272. Relays: Verify the arm of motor M2 on the control unit moves to the LEFT (connects track power to block B4 in rightmost Track 4).
273. Verify the track switch S1 changes to CURVED (lines up for Track 4).
274. Verify the upper left YELLOW Track-4 light on the 6 light target signal is lighted.
275. Power: Verify that on/off block B4 in rightmost Track 4 has power, and other 3 on/off blocks are DEAD.

Verify Track Contact T4 Operation for Changing Route To Track 3

276. Verify toggle switch K1 is in the UP position (switching power to Main Control Unit on).
277. Hold a #17010 magnet over top of track contact T4.
278. Relays: Verify the arm of motor M2 on the control unit moves to the RIGHT (connects track power to block B3 in Track 3).
279. Verify the track switch S1 changes to STRAIGHT (lines up for Track 3).
280. Verify the third-from-the-right YELLOW Track-3 light on the 6 light target signal is lighted.
281. Power: Verify that on/off block B3 in rightmost Track 3 has power, and other 3 on/off blocks are DEAD.

6.2.2 Operating Double-Track Unit

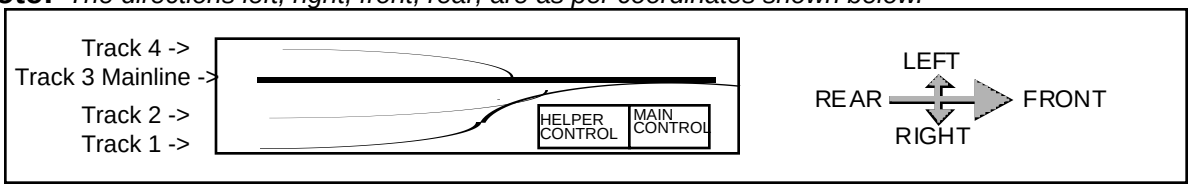
Drawing Reference for following steps: **Sheet 43**

282. Refer to *Sheet 43 Checkout Instructions 1 & 2 Tracks*, and operate the double-track unit in the 2 modes of operation as shown in Figures 43d and 43e.

6.3 Phase 3—Checking Out 4-Track Unit

Drawing Reference for following steps: **Sheet 35**

Note: *The directions left, right, front, rear; are as per coordinates shown below.*



This section guides you thru the additional steps to check out operation for all 4 tracks.

6.3.1 Checking Out Helper Control Unit and Tracks 1 and 2

Turn on Power

283. Verify AC power source is connected and ON.
284. Verify the power-on indicator light is lighted.
285. Verify toggle switch K1 is in the UP position (switching power to Main Control Unit on).
286. Verify toggle switch K0 on the helper unit, is in the FORWARD position (switching power to Helper Control Unit on).
287. Turn on DC track power to about 12 volts.
288. Set the arm of block relay motor M3 in the FRONT “green” position.

Verify Track Contact T8-T6-T4 Operation for Changing Route To Track 1

When an engine pulls in Track 4 and passes over these 3 contacts, it resets all the track switch motors and relay motors back to alignment for Track 1. You can verify this as follows:

289. Hold a #17010 magnet over top of track contact T8, then T6, then T4.
290. Relays: Verify the arms of motor M8, M6, and M2 on the control units move to the RIGHT (connects track power to Block 1 in Track 1).
291. Light: Verify the right YELLOW Track-1 light on the 6 light target signal is lighted.
292. Switch: Verify the track switch S1 changes to STRAIGHT (lines up for Track 3).
293. Switch: Verify the track switch S5 changes to CURVED (lines up for Track 1).
294. Switch: Verify the track switch S7 changes to STRAIGHT (lines up for Track 1).

    The 3 switches should be aligned for Track 1 on the right.

295. Power: Verify that on/off Block 1 in Track 1 has power, and other 3 on/off blocks are DEAD.

Verify Track Contact T7 Operation for Changing Route To Track 2

296. Hold a #17010 magnet over top of track contact T7.
297. Relays: Verify the arm of motor M8 on the control unit moves to the LEFT (connects track power to Block 2 in Track 2).

298. Verify the second-from-the-right YELLOW Track-2 light on the 6 light target signal is lighted.
299. Power: Verify that on/off Block 2 in Track 2 has power, and other 3 on/off blocks are DEAD.

Verify Track Contact T5 Operation for Changing Route To Track 3

300. Relays: Hold a #17010 magnet over top of track contact T5.
301. Verify the arm of motor M6 on the control unit moves to the LEFT (connects track power to Block 3 in Track 3).
302. Verify the third-from-the-right YELLOW Track-3 light on the 6 light target signal is lighted.
303. Power: Verify that on/off Block 3 in Track 3 has power, and other 3 on/off blocks are DEAD.

Verify Track Contact T3 Operation for Changing Route To Track 4

304. Relays: Hold a #17010 magnet over top of track contact T3.
305. Verify the arm of motor M2 on the control unit moves to the LEFT (connects track power to Block 4 in Track 4).
306. Verify the fourth-from-the-right YELLOW Track-4 light on the 6 light target signal is lighted.
307. Power: Verify that on/off Block 4 in Track 4 has power, and other 3 on/off blocks are DEAD.

6.3.2 Operating Four-Track Unit

Drawing Reference for following steps: **Sheet 44**

308. Refer to *Sheet 44 Checkout Instructions 4 Tracks*, and operate the four-track unit in the 6 modes of operation as shown in Figures 44a through 44f.

Drawing Reference for following steps: **Sheet 45**

Sheet 45 Startup Instructions shows 3 of the most common modes you might want to use to operate the unit. Note that Figure 45a initializes the unit for 5-train operation the same as Figure 44f, except it is easier, because (refer Fig 45a) you push Engine 4 backwards over the 3 tracks contacts, and the circuitry sets all the switches and relays, except M2 which you must verify is in the forward 'GREEN' position.

Figure 45b is useful, because it allow you change "on the fly" from using all 4 tracks, to using just 2 tracks.

Chapter 7 Troubleshooting

Possible Malfunctions

You may encounter some of the following problems that can cause the automatic switching block system to malfunction:

- Engine stalls or slows down, upsetting the timing
- Rolling stock uncouples or derails
- Switch motor fails to completely throw
- A Track contact sticks in the closed position.

The first two problems are pretty much self explanatory. The last two are described in more detail as follows:

7.1 Switch Motor Fails to Throw

Mounting the control unit in a clean location is the best way to keep the switch motors working well. Nevertheless, occasionally a switch motor will fail to "throw completely". By this I mean that the arm fails to move all the way to the other position as it should.

If the system suddenly malfunctions, you can check for an "incomplete throw" by doing the following:

- Stop all trains immediately.
- Examine the positions of the arms of motors M2 and M3 on the control unit, and also M1 on track switch S1. Verify that the arms are completely to one side or the other, and not stuck in the middle.
  You should never see the arm in the middle—it should be either all the way to one side or the other.
- If none of the arms are not stuck in the middle—that is, if all of the motor arms are throwing completely, perform the checks in the next section *7.2, Sticking Track Contacts, on page 51*.
- If the arm is stuck in the middle, reposition it per Sheet 42 "Start-up Instructions" and restart the trains.
- If the motor starts sticking on a regular basis, check that the AC control power is not dropping significantly below 18 volts.
  Once when I tried to run 2 trains on the gray 1/2 amp starter set pack, I noticed the automatic block I was using started making incomplete throws, apparently because the AC side of the starter pack was dropping in voltage as a result of my loading the DC side of it to the maximum.

You will occasionally encounter this problem of a motor sticking and not throwing entirely. However, if a motor starts doing this repeatedly, try replacing it with a new one.

7.1.1 "Tuning" The Switch Motors

The motors work most reliably if the rack is centered on the pinion. Occasionally the factory seems to assemble one that is off by a tooth, which is not as reliable for automatic operation. Most of the motors are used for manual operation where you push a button with your finger until the switch throws, in which case the motor can be a trifle weak and it will still work because you will keep pushing the button until it completes its travel. However for automatic operation where the engine crossing the track contact creates a limited-duration pulse, it is critical the motor be "optimally tuned".

I check the centering on the motors I put on units I build, but you can double check by performing the following steps:

- Remove the 1203 relay points if the motor has them.
- Remove the 4 screws holding down the top of the motor, being careful to keep not let the top move.
- Center the arm as much as possible, then hold it in that centered position.
- Remove the lid, being careful to keep the arm in place on the pinion.
- Carefully re-center the arm. The motor housing and arm are symmetrical, so you can visually center them.
- Carefully lift the arm straight up off the pinion, being careful not to let the pinion move.
- You should see a little "tab" on the pinion, and it should be sticking straight up if the rack on the arm was centered on the pinion.
- If the tab on the pinion is not sticking straight up, move it so it does stick straight up.
- Now put the arm with the rack down on top of the pinion, being careful to center the arm with the housing and not to disturb the pinion so that it remains centered.
  Note that you can move the rack to one side or the other a tooth at a time, but carefully letting the teeth slide over the pinion while the position of the pinion remains unchanged.
- Replace the cover and the 4 screws.
- Replace the 1203 relay points if the motor has them.

7.1.2 Checking Voltage Across Switch Motor Terminals

If you suspect that you may be getting a voltage drop to one of the switch motors, such that the motor is not throwing as positively as it should be, you can do a voltage test across the terminals of the motor when the track contact is activated.

- Designate one of the motors to test. You can use any of them.
- Turn off the AC power to the control unit.
- Lay a magnet across one of the track contacts that actuates the motor.

- With a voltage range set to the AC range, hold the two leads of a digital voltmeter down inside the terminals of the motor, as shown in the following Figure 76.

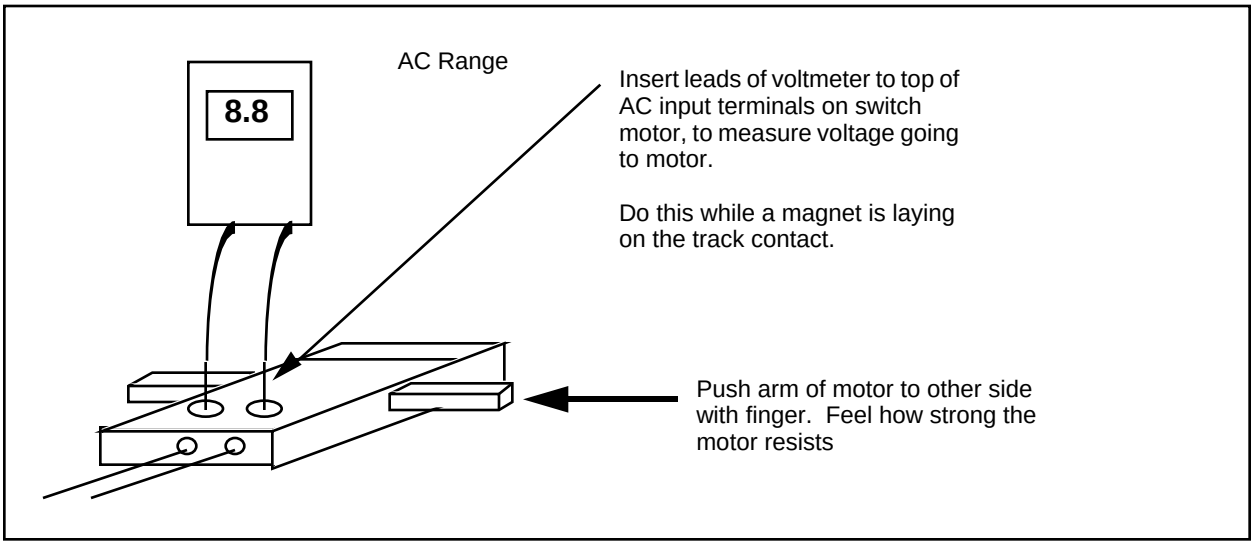


Figure 76 Measuring Voltage Drop Across Switch Motors

- Turn on the AC power.
- Observe and record the AC voltage reading on the meter.
- With your finger, push the arm of the motor to the other side. Feel how strong the resistance is.
  Compare it's strength relative to the other motors. Notice if it catches or has a tendency to hang up anywhere along the length of its travel.
- Turn off the AC power.

Note you can measure the voltage at each motor for each of the two track contacts hooked to it. Expect voltages somewhere in the ballpark around 8.5 volts to 9.6 volts AC for an 18 volt power source.

Note that this voltage measurement you are seeing is not really accurate, as you are measuring a half-wave rectified signal. The main value should be that you can compare the values produced by four track contact to each other, to see if any of readings are significantly lower than the others.

I would advise against leaving the AC power on for very long when the track contact is in the constantly-closed position due to the magnet laying on it. LGB claims that you can apply constant AC voltage to the motors without damaging them, but I notice the motors quickly get hot under this condition.

7.2 Sticking Track Contacts

The 17000 track contact is normally open. It is closed only when a magnet passes over it which causes the contact to momentarily close.

Occasionally a track contact will stick in the closed position, and thus "jam" the system. If the system suddenly malfunctions, you can check for a stuck track contact by doing the following:

- Stop all trains immediately, making sure no engines are parked on top of a track contact.
- Push the arms of the relay motors M2, M3, M6, and M8 to the other position, then return them to the original position. If a track contact is stuck, one of these motors will have power applied to it when it shouldn't, and thus will "fight you" when you try to move it.
- If you find evidence of a sticking track contact, you can identify the sticking track contact as the one that causes the motor to go to the position it is sticking in.
- After identifying the sticking track contact, tap it several times with your finger. This will usually cause it to stop sticking and return to the "open" position.

Often a track contact will stick once in a while, but operate properly for several hundred times before it sticks again. However, you may encounter a track contact that begins to stick repeatedly, in which case you should remove it and replace it with a new one.

Chapter 8 Reference Notes

8.1 Block Lengths

Determining Correct Lengths of Blocks

Note: *The dimensions as shown on Sheet 35 Track Unit Assembly-4 Tracks will work fine for most single-engine trains.*

If you build one of these units in a new layout, you probably want to calculate the lengths of your slowdown and on/off blocks before you lay the track.

The length of the blocks is defined by the lengths between the 10153 gapped tracks. The length of the on/off block must be sufficiently long to stop a moving engine, or else the engine will skid across the block and keep moving. The following figure may help you estimate your lengths.

Determining Block Lengths

Block	Length
B2—Straight On/Off Block	Length of longest engine combination plus *skid* distance of approximately 24 inches
B4—Curved On/Off Block	Same as Block B2—due to geometry of the curve track, it will be slightly longer
B1—Straight Slowdown block	Length of the longest train—noting that end of the caboose should stop about one foot in front of the switch so a train coming through the switch to the other siding will not hit it
B3—Curved Slowdown Block	Same as Block B1—due to geometry of the curve track, it will be slightly longer

Figure 77 Determining Block Lengths

Comments About On/Off Block Length

I use the term *skid* distance to refer to the distance the engine will coast or skid after it enters a dead on/off block. An LGB engine with only a couple of cars and running at a slow speed will stop almost on a dime. In this case the *skid* distance is only about 1/4 inch or so. On the other extreme, I have observed an Aristo Craft Alco diesel with about 10 cars moving at a fast pace skid about two feet or so after entering the dead on/off block, since the engine is relatively light and the cars had a lot of momentum.

Therefore, to be on the safe side, you should probably allow a skid distance of about 24 inches if possible.

If you look at drawing *Sheet 35 Track Unit Assembly-4 Tracks*, you see the length of the on/off block is about 40 inches. This length is sufficient to stop all the LGB engines, or a single "A" unit Aristo Craft diesel if the slowdown rheostat R1 is properly adjusted.

If you plan on operating multiple engine trains, you can increase the 40 inch length of the block by the length of the additional engine.

8.2 Track Contact Position

Positioning 1700 Track Contacts T3 through T8

Track Contacts T3, T4, T5, T6, T7, and T8 control the side-to-side power routing for the two legs of the passing siding. Note that *Sheet 35 Track Unit Assembly-4 Tracks* shows the track contacts about two inches *to the rear* of the on/off blocks. Make sure you locate these contacts to the rear of the on/off blocks. Do not put these track contacts inside the on/off blocks. The reason why you do not want to put these track contacts inside the on/off blocks is that an engine could stop right on top of the track contact, which will hold the circuit closed and jam the operation of the control unit.

Positioning 1700 Track Contact T2

Sheet 45 Startup Instructions shows Track Contract T2 located about two-thirds of way around the loop. This is a good location to begin with. For five trains, this will almost always work.

Often you can operate more than 5 trains on the same track by moving Track Contact T2 back closer to Track Contact T1—this spaces the trains closer together so as to fit more of them on the same track. Module 4D on Tape 2 of the V9202 video demonstrates these spacing variables for the 944 automatic block—the same principles apply for the automatic switching blocks.

Feedback Section

Feedback Form

Name: _____

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Please feel free to use this section for any feedback or comments you might wish to make — just mail it to the address on the bottom of the page. You can also send it **anonymously** if you prefer.

This Product—Part #D8811-165-ZY Zellner Yard U_BLD_M Construction Drawing Set

Any changes to this "product" you would like to see:

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Other Existing Ingram Autocontrols Products

Any changes in the existing line of "products" you would like to see:

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New Products

Any new Ingram Autocontrols non-electronic template-type "products" you would like to see: (such as possible Reverse Loop control template, Automatic Route Selection template, etc)

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Other Comments

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