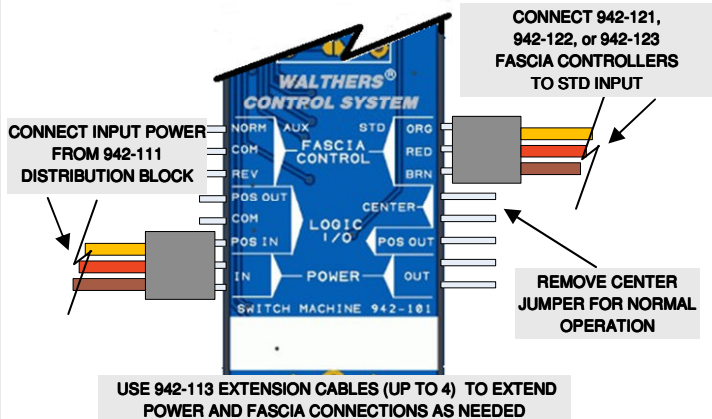


- 1) Temporarily mount turnout using the centering yoke to lock points at center.
- 2) Use #57 bit (from 942-140 Drill Set) and drill hole in center of throwbar through roadbed and benchwork.
- 3) Drill two alignment holes on throwbar centerline. For Walthers Code 83, Shinohara, Atlas Code 83, and Peco Code 83 use the two outer holes in the throwbar as a guide. These holes are used to transfer the throwbar alignment to the bottom of the benchwork and later will be covered with ballast or scenery.
- 4) Remove the turnout, then from under the benchwork, draw a center line between and beyond the alignment holes drilled earlier.
- 5) Using the #57 bit, a small nail or a map pin, poke a hole thru the center point of the supplied mounting template. Peel the backing from the template and use the pin to locate the center point with the center hole drilled in step two. Orient the template so the alignment line matches the center line drawn in step 4 and press into place.
- 6) Use #43 bit (from the 942-140 Drill Set) drill pilot holes for the four mounting screws. You may also drill out the center hole with the 3/16" drill from the drill set to facilitate the next step.
- 7) Drill up from the bottom with the stepped bit from the 942-140 Drill Set to enlarge the center hole to sufficient clearance (3/8" / 9 mm for HO) at the top surface. The hole may be larger on the bottom due to the steps in the bit.
- 8) Clean up the center hole on the top of the benchwork, then reinstall the turnout leaving the centering yoke in place. (Continued on other side)

WALTHERS®

942-101 SWITCH MACHINE ELECTRICAL CONNECTIONS



For complete details on mounting, electrical connections, switch machine adjustments, options and warranty information, see the Switch Machine Reference Guide at waltthers.com/products/waltthers-control-system.

(continued from other side)

- 9) With switch machine in center position, insert actuator wire through subroadbed and up thru the center hole in the throwbar. Center the machine, align with template and secure with screws supplied.
- 10) With power off, connect power input and fascia control cables to the switch machine as shown. Remove the center jumper. See Switch Machine Reference Guide for complete information on electrical connections.
- 11) Remove the centering yoke from the turnout and apply power. Switch machine will stay at center on first power up after center jumper is removed.
- 12) Use the fascia control to cycle the switch machine from Normal to Reverse.
- 13) Check turnout points for proper travel and holding tension. Adjust output arm as detailed in the Switch Machine Reference Guide if required. The actuator travel is infinitely adjustable from 2 mm to 13 mm (1/16" to 1/2") to accommodate a wide variety of scales, turnouts, and roadbed dimensions.
- 14) When satisfied with switch machine operation, finish the turnout mounting. Wear proper eye protection and remove any excess actuator wire above the throwbar with a cut-off disk or hard wire cutting pliers.
- 15) Make electrical connections to aux switches as desired to complete installation.

Switch Machine Reference Guide - Contents

<i>Part 1</i>	<i>Switch Machine Overview</i>	<i>Description of switch machine and accessories</i>
<i>Part 2</i>	<i>Installation</i>	<i>Basic installation instructions</i>
<i>Part 3</i>	<i>Connecting Power</i>	<i>Connecting the Power Distribution Block</i>
<i>Part 4</i>	<i>Options</i>	<i>Setting user configuration options</i>
<i>Part 5</i>	<i>Adjusting Throw</i>	<i>Setting actuator wire movement limits</i>
<i>Part 6</i>	<i>Connecting LEDs</i>	<i>Connections to indicator LEDs</i>
<i>Part 7</i>	<i>Control Overview</i>	<i>Description of switch machine control methods</i>
<i>Part 8</i>	<i>Using Standard Controllers</i>	<i>Connecting WCS standard fascia controllers</i>
<i>Part 9</i>	<i>Using Pushbuttons</i>	<i>Connecting single or dual pushbuttons</i>
<i>Part 10</i>	<i>Using Switches</i>	<i>Connecting SPST or SPDT switches</i>
<i>Part 11</i>	<i>Using Logic I/O</i>	<i>Connecting digital logic devices</i>
<i>Part 12</i>	<i>Using DCC</i>	<i>Setting DCC address and control</i>

Switch Machine Reference Guide - Part 1 - Overview










Walthers Controls offers components for your layout that are high quality, ready to use, and feature plug-in installation. Our products incorporate the latest technology so you can spend less time under your layout, and more time running your trains.

Walthers Control System switch machines and related products bring you a low-cost solution for easy turnout control for HO, N, Z, S, and O Scale layouts. The system is expandable at any time to grow with your layout, and can be used on layouts using both DCC- or DC-power. The system components use servo-style wiring with assembled connectors for plug-and-play easy installation. No soldering is required. Two styles of cables are available separately to expand your wiring as needed. User-friendly instructions are included with all items, and drilling templates for easy mounting on your layout or fascia are included as appropriate. The Reference Guides are an overall reference for the installation and operation of each of the components shown below.

For additional information on new products and updates refer to the link below:

walthers.com/products/walthers-control-system

Switch Machines and Accessories

 <p>942-101 Switch Machine</p> <ul style="list-style-type: none">• Fully assembled servo driven slow motion• Includes integrated DCC accessory decoder• Includes two auxiliary 5A rated switches	 <p>942-121 Turnout Controller</p> <ul style="list-style-type: none">• Single pushbutton and dual bi-color LEDs• Includes drilling template, connecting cable, and spacer adapters for 1/8" or 1/4" panels
 <p>942-110 12V 2A Filtered DC Power Supply</p> <ul style="list-style-type: none">• Powers up to 16 switch machines• Plugs into 942-111 Power Distribution Block	 <p>942-122 Crossover Controller</p> <ul style="list-style-type: none">• Dual pushbuttons and bi-color LED indicators• Includes drilling template, connecting cables, and spacer adapters for 1/8" or 1/4" panels
 <p>942-111 Power Distribution Block</p> <ul style="list-style-type: none">• Matching connector for 942-110 Power Supply• Includes 2 Extension Cables• Terminal block for alternate external power in/out	 <p>942-123 Accessory Controller</p> <ul style="list-style-type: none">• Single pushbutton and bi-color LED indicator• Includes drilling template, connecting cable, and spacer adapters for 1/8" or 1/4" panels
 <p>942-112 Connecting Cable, 48”(1.2 m) pkg (5)</p> <ul style="list-style-type: none">• Fully assembled with servo type connectors• Socket to Socket for connecting extra switches, and external devices to switch machine.	 <p>942-113 Extension Cable, 48”(1.2 m) pkg (5)</p> <ul style="list-style-type: none">• Fully assembled with servo type connectors• Socket to plug used to extend connections to controllers or power distribution block
	 <p>942-140 Drill Set</p> <ul style="list-style-type: none">• Includes 3/16", #43, and #57 drill bits• Includes step drill matching pushbutton and indicator bezels

Switch Machine Reference Guide - Part 1 - Overview**1.0 Switch Machine Overview**

The Walthers Switch Machine is a servo based slow motion device and includes microcontroller based electronics offering a flexible mix of control options allowing easy integration into control panels of virtually any design. The control circuitry may be powered from a 10 to 18 volt filtered DC power supply or from a standard DCC booster output.

Both dual and single LED fascia controllers are available. Each controller features a symmetrical design both mechanically and electrically. The controllers may be installed in either direction and the electrical connection flipped to properly indicate for left and right handed turnouts. The single and dual controllers can also be combined for use with either left or right handed crossovers.

The switch machine may also use existing single or dual momentary pushbuttons, as well as SPST or SPDT toggle or rotary switches to control turnout position. If DC power is used, an option allows the machine to follow the DC power input polarity, allowing emulation of a standard stall motor device controlled via a DPDT reversing switch. When DCC power is used, accessory decoder commands may be used to control the turnout.

Digital logic compatible inputs and outputs are also available allowing integration with other layout control systems.

The switch machine also includes two integrated micro switches which can be dedicated to other functions such as switching frog power, signals or other layout feedback functions. These switches are independent from all switch machine electronics and can be used as a break-before-make circuit as the switch machine transits from the normal and reverse positions.

The design of the switch machine electronics allows any of the control options to be used with no reconfiguration required by the user. In many cases, multiple inputs may be used simultaneously and toggle switch or digital inputs will override the standard fascia controls and provide the ability to remotely disable local turnout control via the pushbutton inputs.

There are several user selectable options available to modify the switch machine behavior if needed:

- **Power Route** — Allows a DPDT switch in the DC power input to determine switch position in lieu of control switches or buttons.

- **Lock Enable** — Changes the POS IN terminal to LOCK IN, disabling local control inputs when active.
- **Color Mode** — Changes colors displayed for each turnout position on standard fascia controllers.
- **Speed** — Changes throw speed from default 1 second to 3 seconds. Optional resistor may be used to set speed to any value between 1/2 and 5 seconds.
- **Swap** — Exchanges switch machine normal and reverse positions, allowing the switch machine to be installed in either orientation to the turnout independent of left or right-handed operation.

The switch machine uses a self-locking mechanism to convert the servo rotation into linear actuator wire motion. Servo rotation is fixed and independent of the throw distance and tension adjustment. In addition the point tension is provided by the actuator wire, not from the servo, so the switch machine may be continuously operated into a jammed point without risk of damage or overload. Strong, self-lubricating Delrin is used for all plastic components allowing the switch machine to provide years of reliable trouble-free operation.

A complete system of fascia controls and indicators can be combined with the switch machines and power supply using pre-made cables and provide easy plug-and-play installation requiring no soldering, cutting or difficult wiring.

The switch machine and controllers include drilling templates and spacers to facilitate the design and construction of layout controls for ease of use and uniform clean appearance.

Each component is complete with connecting cables, mounting and drilling templates for easy installation. Extension cables are available to extend the connections to fascia controls and power supply if needed.

A drill set is available with all sizes needed to mount the switch machine to the layout benchwork and controller buttons and indicators to fascia control panels. The switch machine is designed to integrate seamlessly with other components of the Walthers Control System and provides a versatile system for both control panel design and turnout control.

Switch Machine Reference Guide - Part 2 - Installation

2.0 Installing the Switch Machine

The switch machine package contains the following items:

- 1) Assembled switch machine with centering jumper
- 2) Centering yoke for turnout points
- 3) Peel and stick mounting template
- 4) Mounting screws
- 5) Connecting cable, socket to socket for input power

As packaged, the switch machine is in the centered position which is used when installing to insure proper location under the turnout throwbar. A program jumper is installed as shown in Fig 2.2 to hold the switch machine in the center position when power is applied. This jumper must be removed for normal operation. You may remove the jumper now if you wish and save for future use.

— Do not rotate the servo output arm by hand —

If you need to move the servo arm to center after installation for adjustment of the turnout points or for setting, modifying, or deleting a DCC address, see Section 2.1 for instructions on using the program jumper or the standard fascia button to enter centering mode..

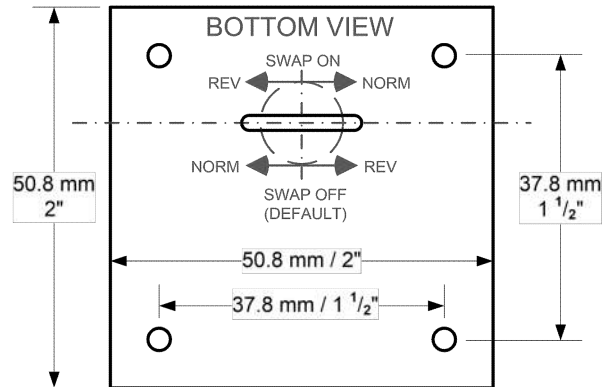


Fig 2.1: Vertical mount template

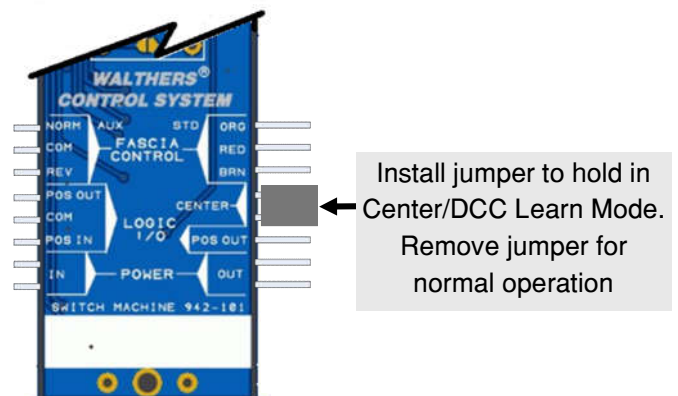


Fig 2.2: Center Program Jumper

Follow these steps to install the switch machine:

- 1) Temporarily mount turnout using the centering yoke to lock points at center.
- 2) Use #57 bit (from 942-140 Drill Set) and drill hole in center of throwbar through roadbed and benchwork.
- 3) Drill two alignment holes on throwbar centerline. For Walthers Code 83, Shinohara, Atlas Code 83, and Peco Code 83 use the two outer holes in the throwbar as a guide. These holes are used to transfer the throwbar alignment to the bottom of the benchwork and later will be covered with ballast or scenery.
- 4) Remove the turnout, then from under the benchwork, draw a center line between and beyond the alignment holes drilled earlier.
- 5) Using the #57 bit, a small nail or a map pin, poke a hole thru the center point of the supplied mounting template. Peel the backing from the template and use the pin to locate the center point with the center hole drilled in step two. Orient the template so the alignment line matches the center line drawn in step 4 and press into place.

Switch Machine Reference Guide - Part 2 - Installation

2.0 Installing the Switch Machine (continued)

- 6) Use #43 bit (from the 942-140 Drill Set) and drill pilot holes for the four mounting screws. You may also drill out the center hole with the 3/16" drill from the drill set to facilitate the next step.
- 7) Drill up from the bottom with the stepped bit from the 942-140 Drill Set to enlarge the center hole to sufficient clearance (3/8" / 9 mm for HO) at the top surface. The hole may be larger on the bottom due to the steps in the bit.
- 8) Clean up the center hole on the top of the benchwork, then reinstall the turnout leaving the centering yoke in place.
- 9) With switch machine in center position, insert actuator wire through subroadbed and up through the center hole in the turnout throwbar. Use the molded alignment mark and align the machine with template centerline and secure with screws supplied.
- 10) With power off, connect power input and fascia control cables to the switch machine as shown. Remove the center jumper. Consult Reference Guide sections on power connections and control inputs for more information on connections to external devices.
- 11) Remove the centering yoke from the turnout and apply power. Switch machine will stay at center on first power up after center jumper is removed.
- 12) Use the fascia control to cycle the switch machine from Normal to Reverse.
- 13) Check turnout points for proper travel and holding tension. Refer to Reference Section on adjustments should the actuator wire require more or less motion than supplied. The actuator travel is infinitely adjustable from 2 mm to 13 mm (1/16" to 1/2") to accommodate a wide variety of scales, turnouts, and roadbed dimensions.
- 14) When satisfied with switch machine operation, finish the turnout mounting. The excess actuator wire above the throwbar may be removed with a cut-off disk or hard wire cutter. Wear proper eye protection when working on the wire trimming.
- 15) Make electrical connections to the auxiliary switches as desired to complete installation. See the Reference Guide section on Auxiliary Wiring for details on the use of the auxiliary switches for frog power, signal systems, or layout feedback to other devices.

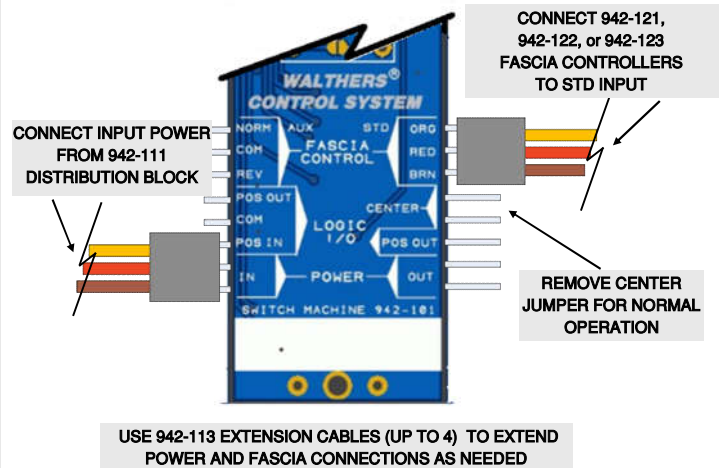


Fig 2.4: Electrical Connections

— Hint —

To make troubleshooting under the layout easier, use a permanent marker or apply a label to the white box area to identify the turnout with a name or number.

Switch Machine Reference Guide - Part 2 - Installation

2.1 Center / Learn Mode

When installing a switch machine on the layout, it is helpful to have the turnout actuator wire in the center of throw, then fasten to the benchwork with the turnout throw bar in its center position. As delivered, the switch machine is in its center position, and a jumper plug is installed as shown. The center jumper must be removed for normal machine operation.

Center / Learn Mode can be entered in one of two ways:

- 1) Install the jumper plug on the Center pins as shown. You may do this with power applied. The servo will rotate to the center position and the fascia indicator LEDs will begin alternately flashing. When done, remove the jumper, and normal operation will be restored.
- 2) Remove power. With the Standard Fascia Controller connected, push and hold the button and apply power. Continue to hold the button until the servo moves to the center position. When the button is released, the LED indicators will flash alternately. The switch machine will remain in the Center / Learn mode until power is removed.

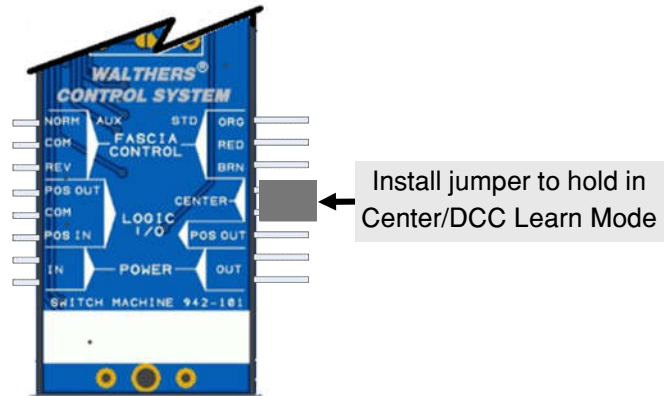


Fig 2.6 Center Program Jumper

Switch Machine Reference Guide - Part 3 - Connecting Power

3.0 Connecting Power

The switch machine requires connection to a filtered DC supply which must be a minimum of 10 volts and a maximum of 18 volts. Supply voltages below 10 VDC may cause the electronics to operate intermittently or reset when trying to operate the turnout. Voltages above 18VDC may damage the control electronics. Use of the Walthers Control System 12 Volt DC supply (942-110) and Power Distribution Block (942-111) is recommended. This power supply will power up to 16 switch machines. The switch machine is supplied with a jumper cable for easy connection to the distribution block.

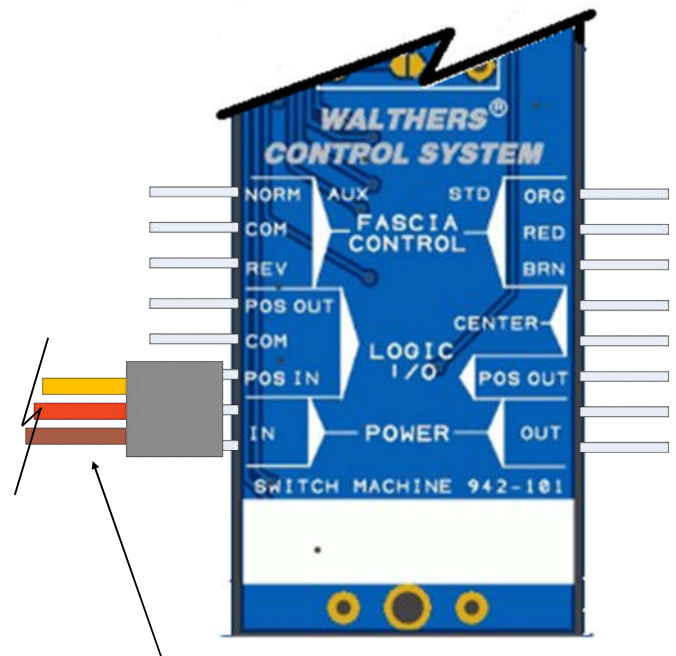
Alternately you may power the switch machine from a standard DCC booster output. The booster output can be connected through the Power Distribution Block by using the terminal strip to connect to the DCC power. See the Power Distribution Block section for more information.

— Note —

While it may be tempting to wire the switch machine to nearby track when using DCC power, it is not recommended to do so. If connected to track power, any short circuit will also interrupt power to the switch machine and cause the circuitry to reset. If the short is caused by a locomotive approaching a turnout thrown against it, you will be unable to move the locomotive due to the short, and also unable to throw the turnout to clear the short circuit. Switch machines and other DCC powered accessories should use a dedicated booster or circuit breaker to avoid disruptions due to track circuit shorts.

Two sets of power connections are available on the switch machine as shown in Fig 3.1. The power in and out pins are bussed together internally and either may be used to connect to control power depending on desired function. The adjacent Position Control input and output may be picked up by the orange wire in the power cable to route it to the Power Distribution Block or to a cascaded machine when needed.

The Power Out connections may be used to daisy-chain multiple switch machines together as shown in the following sections. Two machines used on a crossover may be cascaded together allowing both turnouts to be simultaneously controlled from a single source. The cascaded machines will throw in sequence following the prior machine.

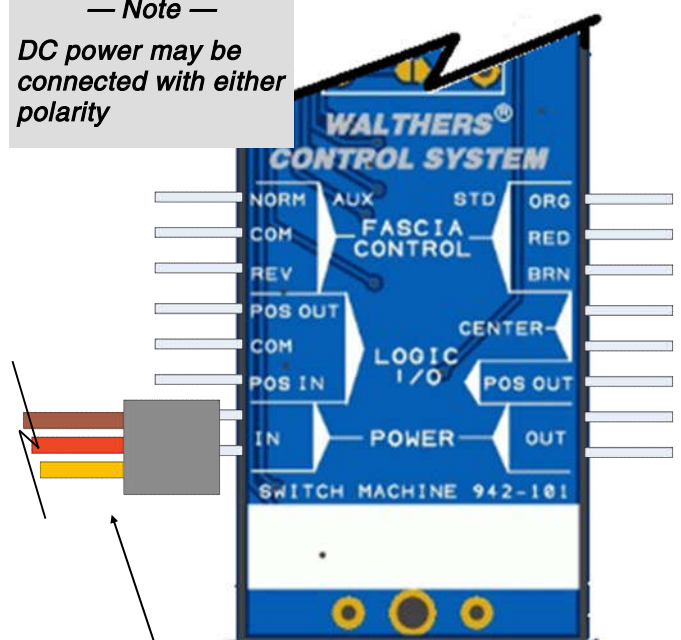


Connect jumper to power distribution block connector. Use extension cables (942-113) if needed

Fig 3.1: Power Input Including Position Input

— Note —

DC power may be connected with either polarity



Flip the connector if access to the logic signal pins is needed

Fig 3.2: Power Input Without Position Input

Switch Machine Reference Guide - Part 3 - Connecting Power

3.1 Distribution Block and Power Supply

The 942-110 Filtered DC Power Supply is designed to connect directly to the 942-111 Power Distribution Block and provide 12 VDC power for up to 16 switch machines. If the full capacity is not used for switch machine power, other layout devices may also connect to the power distribution block pin connectors or terminal strip.

The power distribution block is designed to be mounted using the supplied screws and spacers. Drill pilot holes using the #43 bit from the 942-140 Drill Set if needed. Pick a location central to the switch machines which will connect to it. Note that the switch machines may be connected in daisy-chain fashion as shown in Section 3.2 and also extension cables if needed to reach locations up to 20 feet from the distribution block.

Two 942-113 Extension Cables are included with the distribution block and additional cables are available in packs of five. Each of the extension cables is 48 inches (1.2m) long and up to four cables may be used in each run from the distribution block to the switch machine location.

Plug the power supply into a suitable outlet in a well ventilated location. Route the cable to the barrel connector on the distribution block, securing as needed to prevent accidental disconnection and provide strain relief in the event the cable is accidentally snagged during maintenance.

Connect the switch machine power cables to the distribution block following the color coding as shown. This will allow the corresponding pins on the Position I/O connector to pick up the Position In or Out signals from the switch machines. You may connect the power cable to the Power Out side of the switch machine if you wish to use the Position Out signal on the distribution block connector. The Position I/O connector provides a convenient location to make signal connections to an external digital system or other control circuits such as diode matrixes.

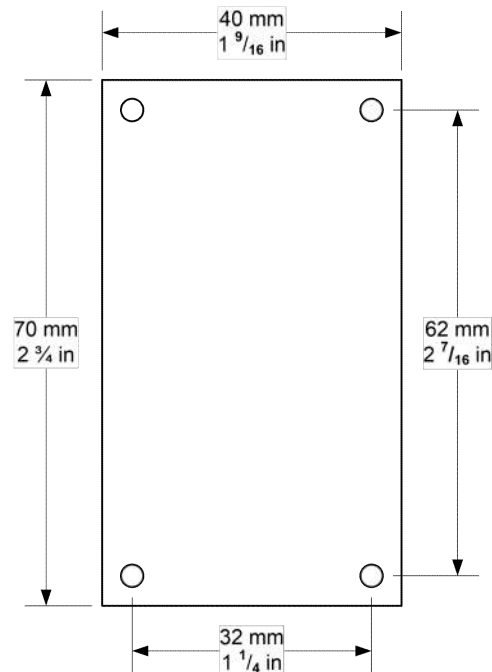
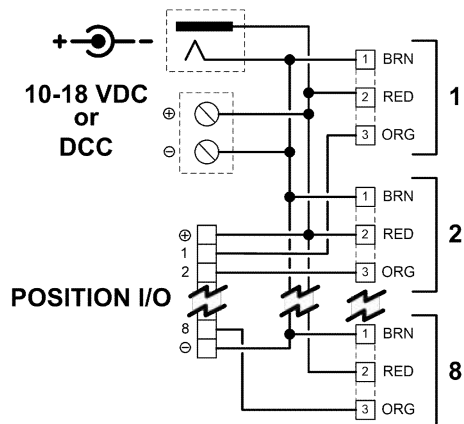
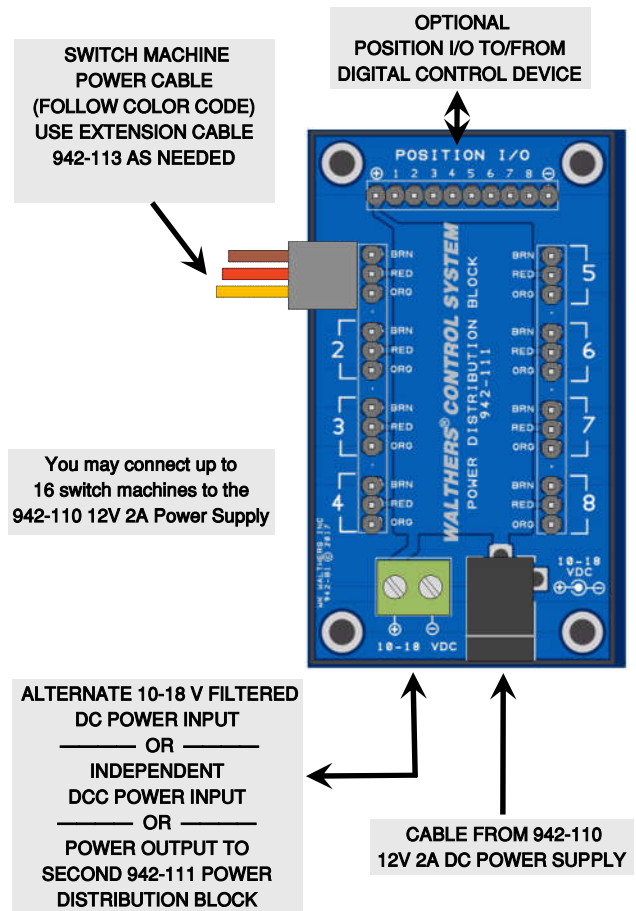


Fig 3.3: Power Distribution Block Template

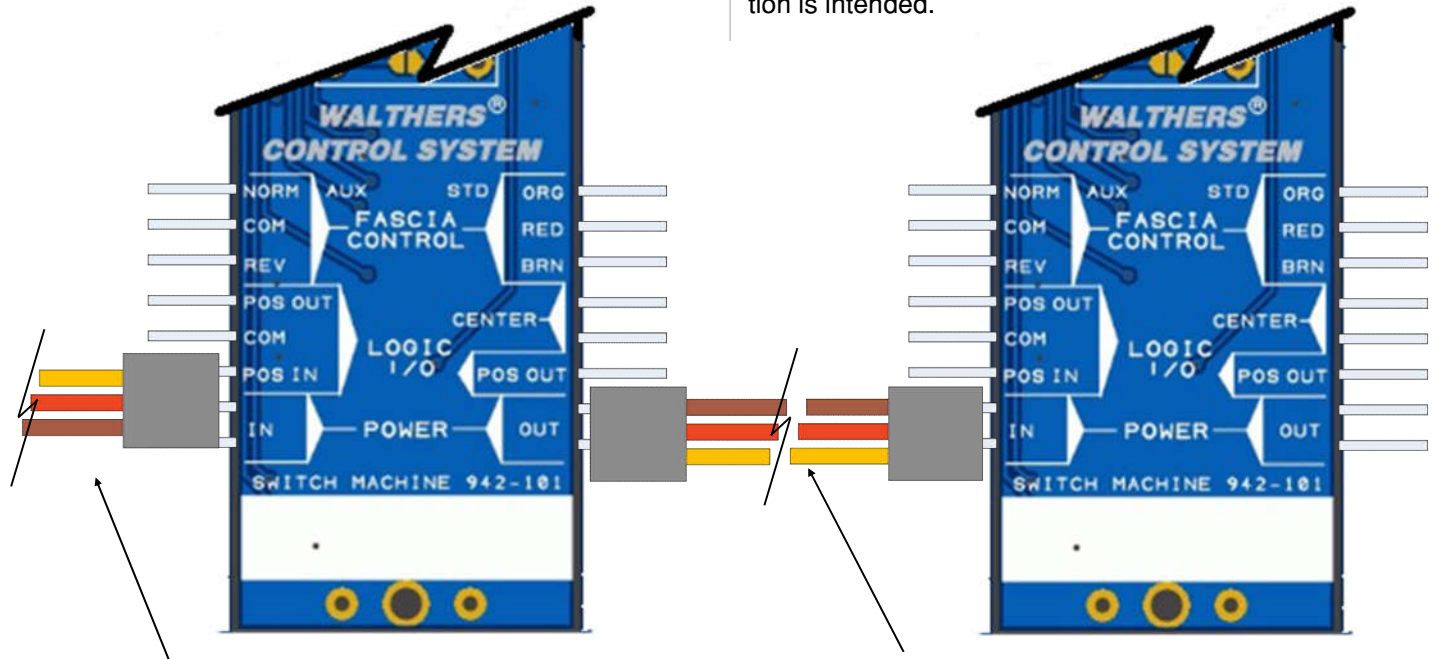


Switch Machine Reference Guide - Part 3 - Connecting Power

3.2 Daisy-Chaining Power Connections

You may jumper power connections through up to four switch machines in daisy-chain fashion when convenient.

On the second and subsequent machines, install the jumpers to connect the power pins only unless crossover operation is intended.



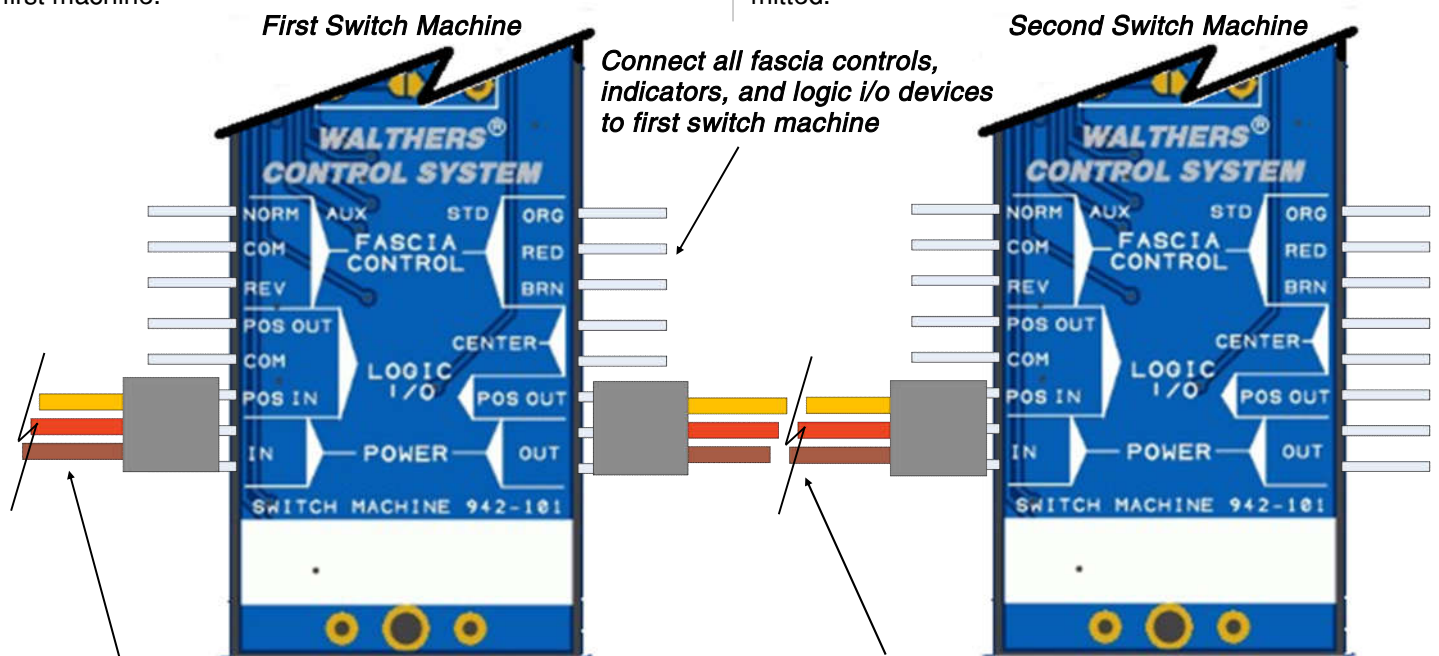
Connect jumper to power distribution block

Connect jumper from second and subsequent machines to previous machine connecting power pins only as shown

3.3 Crossover Operation

Up to four switch machines may be cascade connected allowing a single or double crossover to be controlled from a single fascia controller, digital input, or DCC signal to the first machine.

The second and subsequent machine(s) have only the power connector connected. Mixing cascade crossover connections with single turnouts in the same daisy-chain is permitted.



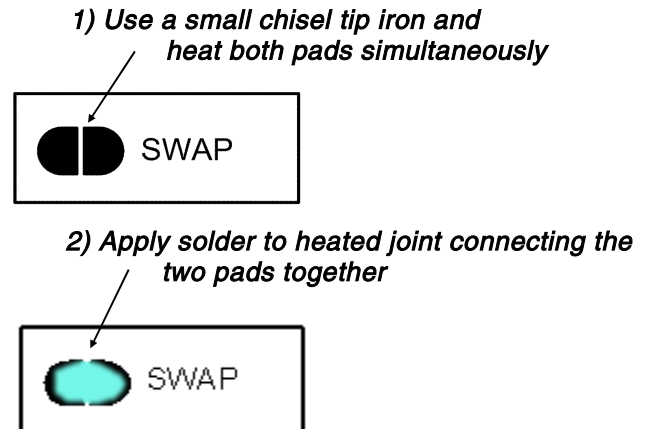
Connect jumper to power distribution block

For cascade operation, connect second machine Power and Pos In pins to Power and Pos Outputs on first machine

Switch Machine Reference Guide - Part 4 - Options

4.0 Switch Machine Options

The following options are available and modify the operation of the switch machine as described below. Each option is enabled by connecting the indicated pads together with a solder jumper. To install a jumper and enable the option follow the steps shown in the diagram. Use only the minimum amount of solder required to make the connection. Only electronic grade rosin core solder should be used. If it is desired to disable the option at a later date, the solder jumper can be removed by reheating the joint and wicking the solder away with solder braid, fine stranded wire, or by using a solder suction device.



4.1 Lock Enable Option

Often it is desired to be able to disable operation of the switch machine from the local fascia controls. This is typically done in CTC controlled territory so that a dispatcher can prevent operation of a main line switch for example. Alternately, you may wish to install a key switch at the turnout location, requiring the crew to use a switch key to activate the turnout.

Lock mode converts the POS IN pin to function as a LOCK on/off input. When on (POS IN pin is low, or connected to COM with a switch), the switch machine will not respond to fascia controls or DCC commands. When off (pin is open, or logic high), the fascia indicators will flash indicating the turnout is unlocked, and fascia controls and DCC commands will operate normally.

4.2 Color Mode Option

The behavior of the LEDs on the standard fascia controllers can be modified by installing one or both of the Color Mode jumpers. Four modes are available as shown in the chart. Alternate color is the manufactured default. Installing the GRN or YEL jumper will cause the switch machine to use the respective color for both switch positions. When both jumpers are installed, both indicators will always be illuminated, and the color positions will reverse when the switch machine reverses position.

Color mode affects only bi-color LEDs on the standard fascia control connector. Indicators on the auxiliary control connector are not affected by the color mode selected.

When using the single LED 942-123 Accessory Controller for switch machine control, the LED will illuminate for both switch positions when Bi-Color Mode is selected.

The chart illustrates all possible indications using the 942-121 Fascia Controller depending on switch machine position and connector orientation used for the connection to the fascia controller. Reversing the connection allows any color to appear in either location as required by the control panel layout.

MODE	PLUG NORMAL		PLUG REVERSED	
	NORM	REV	NORM	REV
ALTERNATE (GRN OFF) (YEL OFF)				
GREEN (GRN ON) (YEL OFF)				
YELLOW (GRN OFF) (YEL ON)				
BI-COLOR (GRN ON) (YEL ON)				

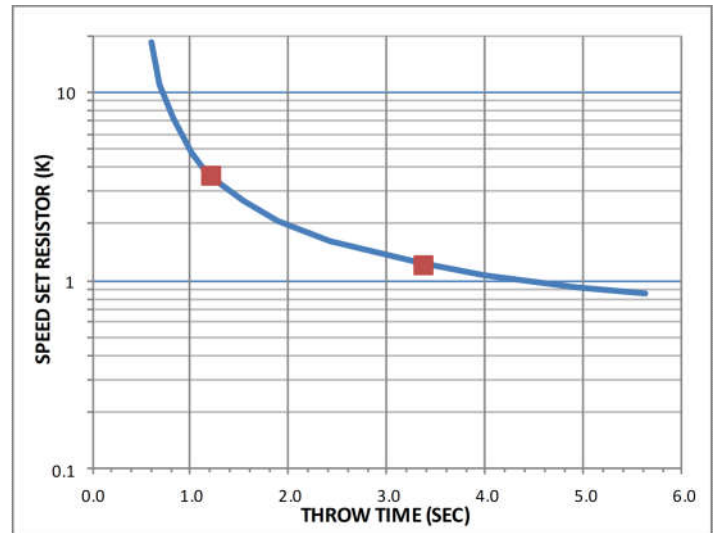
Switch Machine Reference Guide - Part 4 - Options

4.3 Variable Speed Option

The speed the switch machine takes to traverse to the opposite position can be modified with this option. The default speed is about 1 sec, and with the jumper installed, about 3 seconds.

If desired, a resistor may be installed in lieu of the jumper to set the speed to any value from .5 sec to 5 sec as shown on the graph.

The chart shows the relationship between resistor values and throw time. Pick a 1/8 or 1/4 watt resistor with a standard value between 900 and 18000 ohms corresponding to the desired time. Resistor values beyond this range will cause the switch machine to revert to a jumper selected time rather than that shown on the chart. The indicators on the chart show resistor values which will produce times equivalent to the two jumper selected times.



4.4 Swap Option

Swap can be used to reverse the physical orientation of the switch machine wire actuator. With the option jumper installed, Norm will be to the left rather than to the right as shown on the first page diagram.

Since the indicated position can be changed by reversing the cable connection to the fascia controller, this option is generally not needed unless DCC or logic controls are used simultaneously with fascia pushbuttons. Since the

switch machine orientation which corresponds to the desired 'Normal' can be either position, Swap can be used to correct the external remote commands so that 'Normal' to the DCC command is the same as the indicated 'Normal' on the fascia indicators.

This option may also be useful in a crossover configuration where one of switch machines is not in the same orientation relative to the turnout as the other.

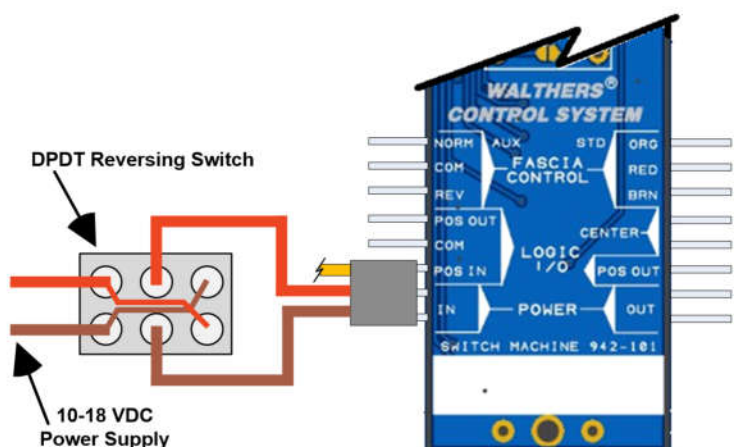
4.5 Polarity Route Option

Polarity Route is used to allow the switch machine position to be set by the polarity of the applied DC supply voltage. Control via fascia switches and logic inputs is disabled when this option is used however LED indicators will function normally. This mode allows the switch machine to either replace a conventional stall motor machine when filtered DC power is used, or be used with the same control panel hardware when added to an existing installation.

When the option is selected, connect the switch machine DC power through a DPDT reversing switch as shown. The throw time of the switch must be less than 50 msec to avoid resetting the control electronics.

If replacing an existing stall motor machine, remove any in-line LEDs in the power circuit and rewire to the fascia control pins as shown in Part 7. Alternately, you can connect LEDs with appropriate current setting resistors across the power input between the DPDT switch and the switch ma-

chine. When running, the current load of the switch machine may damage standard control panel LEDs wired in series with the input power circuit.



Switch Machine Reference Guide - Part 4 - Options

4.6 Center / Learn Mode

When installing a switch machine on the layout, it is helpful to have the turnout actuator wire in the center of throw, then fasten to the benchwork with the turnout throw bar in its center position. As delivered, the switch machine is in its center position, and a jumper plug is installed as shown. The center jumper must be removed for normal machine operation.

Center / Learn Mode can be entered in one of two ways:

- 1) Install the jumper plug on the Center pins as shown. You may do this with power applied. The servo will rotate to the center position and the fascia indicator LEDs will begin alternately flashing. When done, remove the jumper, and normal operation will be restored.
- 2) Remove power. With the Standard Fascia Controller connected, push and hold the button and apply power. Continue to hold the button until the servo moves to the center position. When the button is released, the LED indicators will flash alternately. The switch machine will remain in the Center / Learn mode until power is removed.

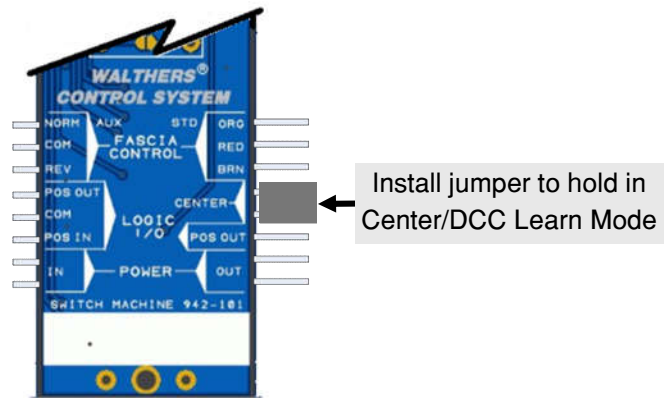


Fig 4.6 Center Program Jumper

4.7 Setting DCC Control Address

The switch machine includes the ability to respond to accessory decoder commands when connected to DCC power. As shipped, the DCC function is disabled. To enable operation via DCC, follow the steps below to set the address you wish to use for turnout control.

Note that while the switch machine can be operated with DCC accessory decoder on/off (sometimes called thrown/closed) commands, it is not itself a decoder, has no DCC address and has no CVs to program.

If you wish to use accessory decoder commands to operate the turnout, follow the steps below to set an address and enable DCC operation. Using DCC to control the turnout requires using DCC booster output for power. Do not use a program track to operate the switch machine.

The DCC address can be set, changed or cleared at any time before, during, or after installation on the layout.

Follow these steps to set or clear a DCC address:

- 1) Enter Center / Learn Mode using one of the two methods described in Section 4.6.

- 2) Issue an accessory decoder 'on' or 'thrown' command using the address you wish to use for the turnout.
- 3) The switch machine will jog toward the REV position acknowledging the stored address.
- 4) Issuing an 'off' or 'closed' command using any address will clear the current address and disable DCC control. The switch machine will acknowledge the reset by a jog toward the NORM position.

If you simply wish to change the address it is not necessary to clear the old address before setting the new one.

If you activate the Center / Learn Mode while the switch machine is on the layout and DCC power is applied, make certain the only accessory decoder commands issued are the ones you wish to use for the turnout.

If you remove power while the switch machine is in Center / Learn Mode, when power is re-applied, the switch machine will remain at the center location until a fascia button is pushed or a DCC, switch or logic command is received.

Switch Machine Reference Guide - Part 5 - Adjusting Throw

5.0 Switch Machine Description

The Walthers Switch Machine uses a microprocessor controlled servo to move an actuator wire connected to a turnout throwbar between normal and reverse positions. The servo's rotary motion is converted to linear motion of the actuator wire by passing the wire through a pivot which rotates in the output arm as the servo rotates from one endpoint to the other. The position of the wire pivot on the output arm relative to the servo output shaft determines amount of distance between the normal and reverse locations. This distance is adjustable and determines the movement of the wire at the turnout throwbar. When the turnout point contacts the stock rail, the amount of excess pivot travel bends the actuator wire and determines the amount of spring tension which holds the points in place. Figure 5.1 illustrates the mechanical principles of this design.

The result is a reliable, durable, self-locking mechanism which has several distinct advantages over traditional servo based designs:

- Servo rotation is a constant and independent of actuator wire travel
- Servo rotation is factory set and never requires adjustment
- Throwbar travel and point tension are infinitely adjustable
- Point tension is provided by the bend of the actuator wire determined by the wire pivot location, not by the servo
- The servo mechanism is isolated from the throwbar by the actuator wire and will maintain throwbar position and tension when power is removed
- The switch machine may be operated into a jammed point without risk of damage or overload
- Throw speed is independent of throw distance and tension
- All moving components are molded in strong self-lubricating Delrin plastic and do not require any routine maintenance

5.1 Adjusting Wire Throw and Tension

Actuator wire throw and tension are controlled by the position of the wire pivot on the servo output arm. Throw can be adjusted from 2 mm to 13 mm (1/16" to 1/2") If adjustment is required, refer to figure 5.2 and follow the steps below:

- 1) Use a small phillips head screwdriver and loosen the short and long screws at the ends of the output arm
- 2) Move the wire pivot closer to the servo shaft to shorten throw or reduce tension, away from the servo shaft to increase throw or tension
- 3) Snug down the short and long screws when done. Do not overtighten.

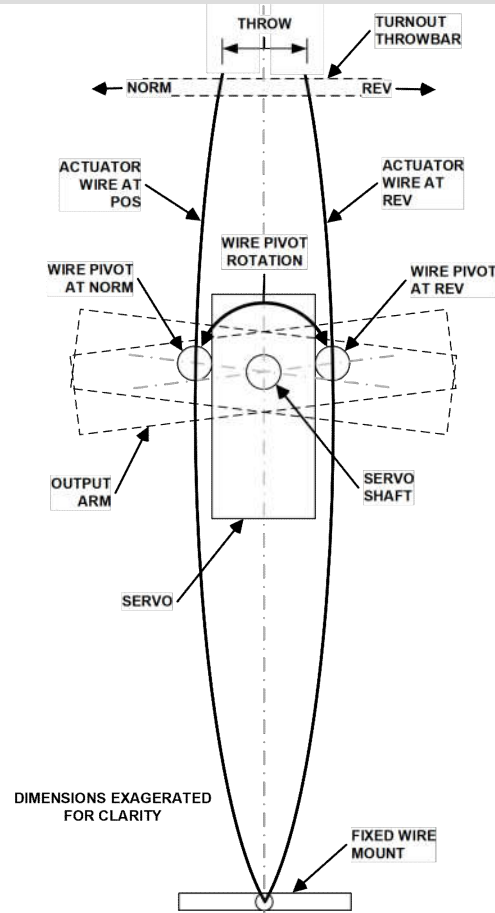


Fig 5.1: Switch Machine Mechanics

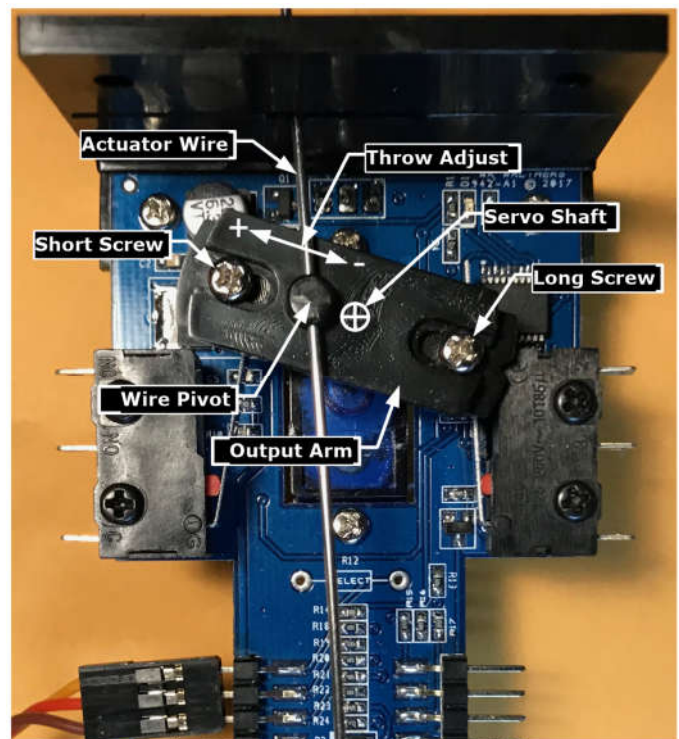


Fig 5.2: Actuator Wire Adjustment

Switch Machine Reference Guide - Part 6 - Connecting LEDs

6.0 Connecting LEDs

The switch machine provides outputs for single color or bi-color LEDs on both the Standard and Auxiliary Fascia Control connectors. You may use both outputs simultaneously if desired. The Color Mode option will modify the behavior of LEDs connected to the Standard Control connector, but has no effect on LEDs connected to the Auxiliary Control connector. LEDs may be directly connected to the switch machine and require no external resistors. You may insert an optional resistor in series with the LED to reduce intensity, however in most cases this will not be required.

The Fascia Control connectors are also inputs for pushbutton or toggle switches. You may connect switches and LEDs simultaneously to the control pins as your need requires

It is convenient to use 942-113 Extension Cables or 942-112 Connecting Cables to wire discreet LEDs to the switch machine. Use the socket end to connect to the Standard or Auxiliary connector and remove the connector on the other end and connect wires to the LEDs as shown on the wiring diagrams. 942-113 Extension Cables can then be used to extend the connection length to the switch machine if needed. Alternately, compatible connectors are available at electronic suppliers who sell parts for Arduino, Raspberry Pi, and similar micro-controller boards.

LEDs connected to the Auxiliary connector will illuminate individually when the switch machine is in position, and be off while the turnout is moving between positions. Operation of LEDs on the Auxiliary connector is not affected by the selected Color Mode Option.

Connect single color normal and reverse LEDs to the Standard Control connector as shown in Fig 6.2 when using the default Alternate Color Mode. You may also connect single color LEDs as shown in Fig 6.4 when GRN Color Mode is used.

Two terminal bi-color LEDs connect to the Standard connector as shown in Fig 6.3. Change the Color Mode to bi-color to illuminate the LED for both turnout positions.

Three terminal bi-color LEDs may be used on the Standard connector as shown in Fig 6.4. Use GRN Color Mode to illuminate the LED for both turnout positions.

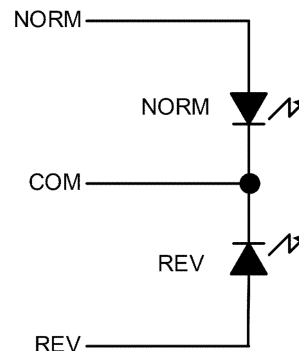


Fig 6.1: Single color or 3 terminal bi-color LEDs on Auxiliary connector

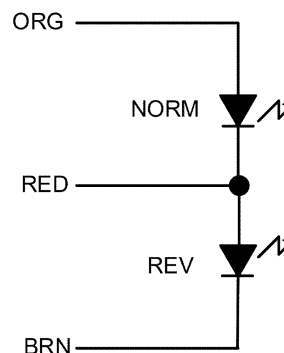


Fig 6.2: Single color LEDs on Standard connector (default Alternate Color Mode)

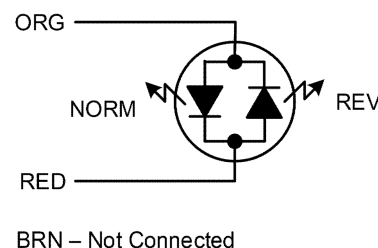


Fig 6.3: Two terminal bi-color LED on Standard connector (use Bi-Color Mode)

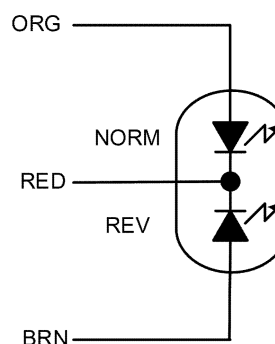


Fig 6.4: Three terminal bi-color LED on Standard connector (use GRN Mode)

Switch Machine Reference Guide - Part 7 - Control Input Overview

7.0 Controlling the Switch Machine

The switch machine may be controlled by single or dual pushbuttons, SPST or SPDT switches, logic signals from layout interface devices, or with accessory decoder commands when powered from a DCC booster output.

In addition, the polarity of the DC supply voltage can be used to control turnout position similar to a stall motor switch machine. See Part 4 section on the Power Route Option for details on implementing this method of control.

The control inputs are segregated into three groups as shown in Fig 7.1. There is no configuration required, and the switch machine will automatically detect the type of input in use. You may connect control devices to more than one of the groups if desired and any conflicting inputs will be resolved as noted below.

The Standard and Auxiliary Fascia connectors interface to pushbutton, toggle, or slide switches and also simultaneously drive LEDs for indicators on your control panel as shown in Part 6. The Logic I/O connector can be used with switch input as shown in Fig 7.3, and may also be used with other logic devices such as microcontrollers, CMRI, LCC, or other DCC accessory decoders when connected as shown in Fig 7.4.

Walthers 942-121 Dual LED and 942-123 Single LED Fascia Controllers are single pushbutton devices equipped with bi-color LEDs for indication and are used with the Standard Fascia Control connector. See Part 8 for details on using the standard controllers.

When more than one control input is used, the switch machine control circuits will resolve conflicting input states as follows:

- Any input held by a switch or logic signal will override any momentary pushbutton input
- The POS IN signal overrides only when held low (REV)
- DCC input is treated as a momentary input and will be overridden by any switch control input

Note that you may implement a de facto lock system by using a toggle switch input to effectively disable a pushbutton input by holding the switch machine in position.

See the Lock Enable section in Part 5 for information on converting the POS IN connection to a LOCK IN function which disables other inputs and provides LED indication of the lock state. See Part 12 for DCC control details.

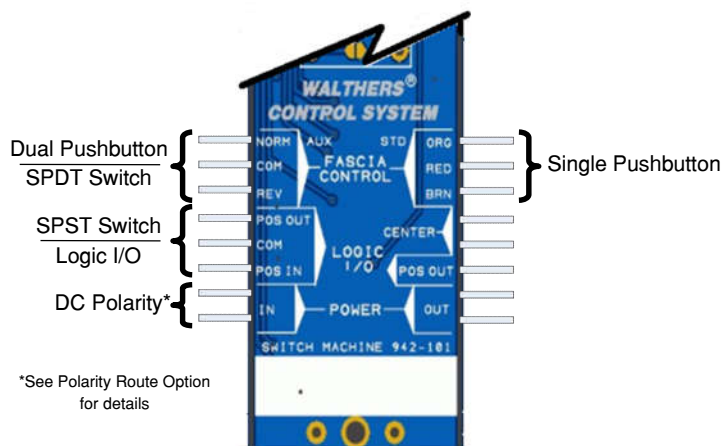


Fig 7.1: Control Inputs

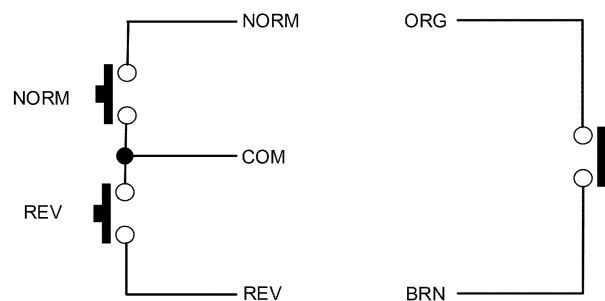


Fig 7.2: Pushbutton Inputs (see Part 9)

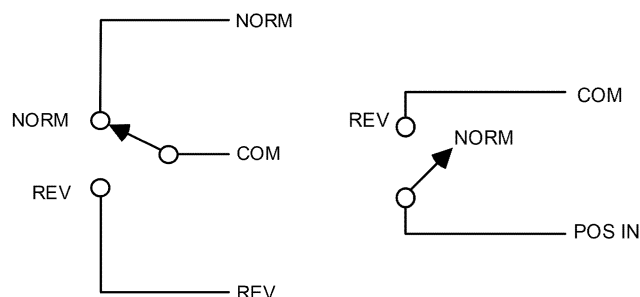


Fig 7.3: Switch Inputs (see Part 10)

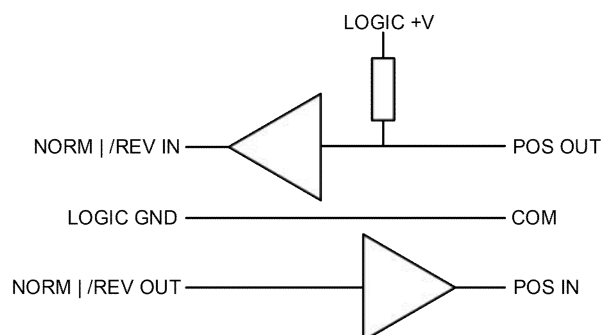


Fig 7.4: Logic Input / Output (see Part 11)

Switch Machine Reference Guide - Part 8— Using Fascia Controllers

8.0 Standard Fascia Controllers

Standard Fascia Controllers are available in both dual LED (942-121) and single LED (942-123) configurations. Controllers are physically and electrical symmetrical, and can be used in either left and right handed orientation as well as indicating the normal route in either turnout direction.

The included spacer allows the controller to be mounted on either 1/8" or 1/4" (3 or 6 mm) thick panels. Controllers also include a mounting template to facilitate proper orientation and spacing when drilling mounting holes. The accessory Turnout Drill Set (942-140) includes all bit sizes required to install the switch machines and fascia controllers.

Each controller also includes a 48" (1.2m) connection cable for easy plug and play installation. Extension cables (942-113) may be used to extend the distance from the control panel to the switch machine up to 20 ft (6m) if required.

A crossover controller (942-122) is also available consisting of one each of the dual and single LED controllers. Both controllers are designed to be mounted together as shown in the following examples and control up to 4 switch machines cascaded together for single button control of left-handed, right-handed or dual crossovers.

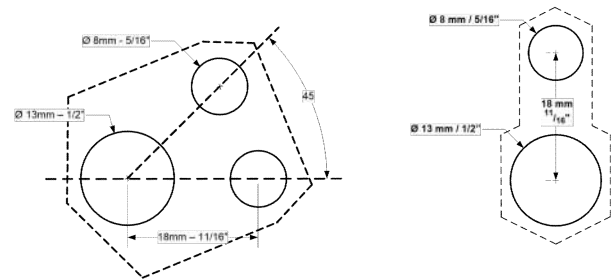


Fig 8.1 : Fascia Controller Dimensions

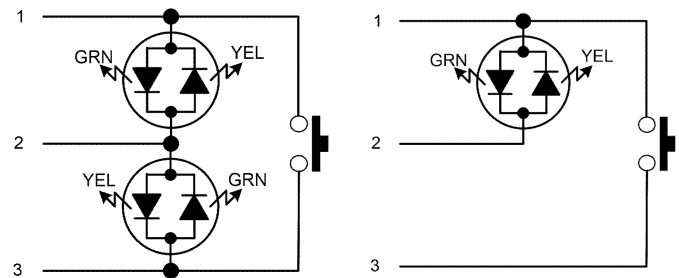


Fig 8.2 : Fascia Controller Equivalent Circuits

8.1 Installation

- 1) Use the template to locate and mark the hole locations. Flip the template as needed to match the turnout directions. The template has multiple locations properly spaced for adjacent controls. For parallel tracks, draw guidelines on your panel on 1" (25.4 mm) centers and use the corresponding lines on the template to position the controllers in the correct locations .
- 2) Use the 3/16" bit from the 942-140 Drill Set and drill a pilot hole at each LED and button location. Mark pushbutton holes to prevent mistakes in next step.
- 3) Using the step drill from the 942-140 Drill Set, enlarge LED holes to 5/16". Make certain which holes are for pushbuttons and enlarge to 1/2". Smooth hole edges on both sides with 150-180 grit sandpaper, reamer, or file.
- 4) Complete the panel painting and marking before mounting the controllers. Chart or stripping tape in 1/8" or 3/16" (3 or 5 mm) width works well to mark tracks on panel.
- 5) Mount controllers from the panel backside using gel or gap-filling CA or fast-acting epoxy adhesive. Avoid excessive adhesive. For 1/8" (3 mm) panels, use the enclosed spacer so the controller LED and pushbutton are flush with panel surface.

- 6) Refer to diagrams on next page and connect controller to the switch machine Standard Fascia Control connector using the enclosed cable.

When using the single LED controller, set the Color Mode Option to Bi-Color to illuminate the LED for both turnout positions as shown in Fig 8.4.

The orientation of the cable connection to the controller connector changes which LED illuminates when the switch machine is in the Normal position. When using manual fascia controls simultaneously with DCC or Logic Control inputs, use the Swap Option if necessary to configure the switch machine so that the indicated fascia position matches the logical position of the turnout for both sets of controls.

When using both single and dual LED controllers on a crossover as shown in Fig 8.5, you may need to use the swap option on one or both turnouts depending on the way they are physically mounted to properly position each turnout with the desired direction indication.

Switch Machine Reference Guide - Part 8— Using Fascia Controllers

8.2 Connection Diagrams

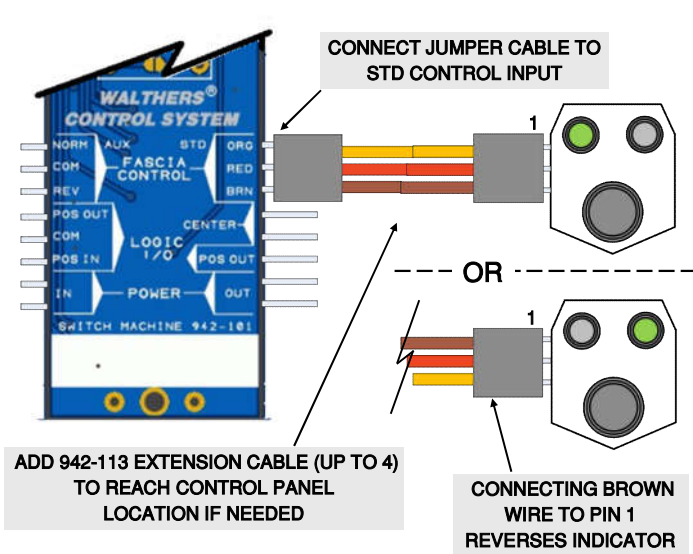


Fig 8.3 : Dual LED Controller Connections

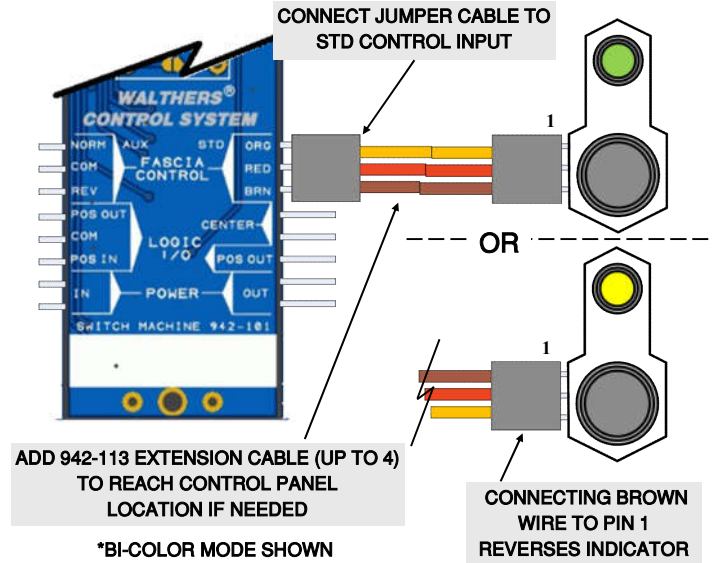


Fig 8.4 : Single LED Controller Connections

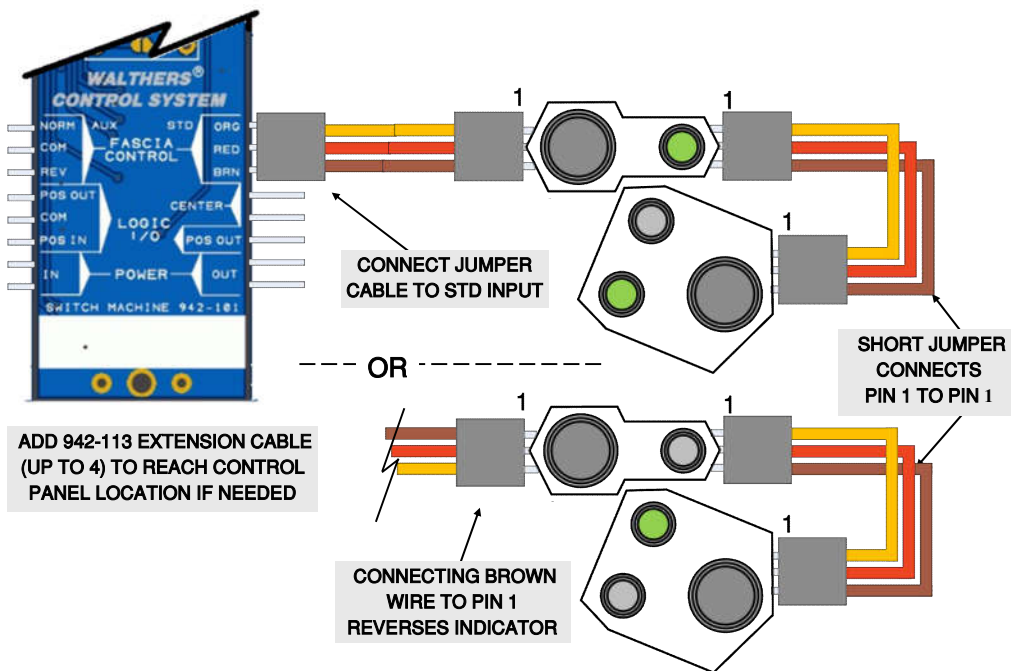


Fig 8.5 : Crossover Controller Connections

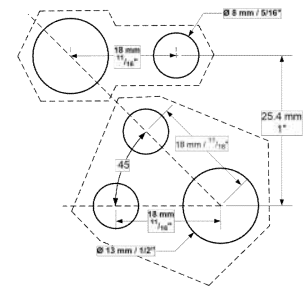
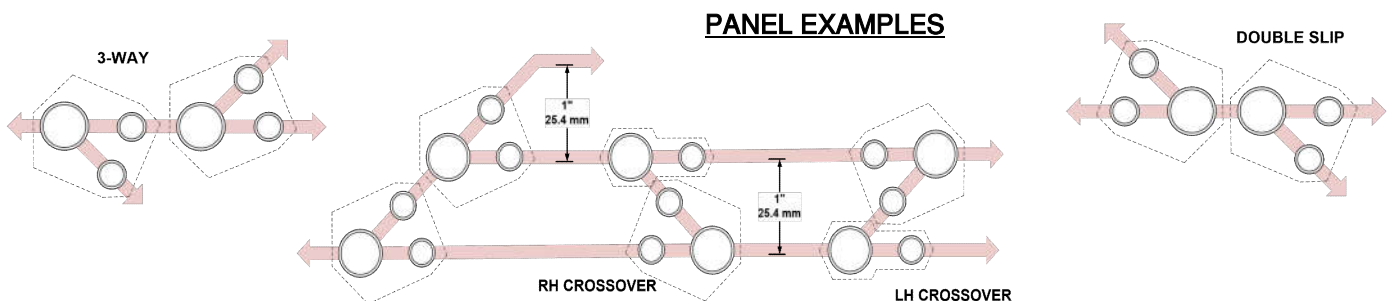


Fig 8.6 : Crossover Controller Dimensions



Switch Machine Reference Guide - Part 9 - Using Pushbuttons

9.0 Pushbutton Control Inputs

The switch machine may be controlled by single or dual pushbuttons connected to the Fascia Control input connectors. Pushbuttons may be used on both inputs if your needs require. Parallel connections to multiple sets of buttons are also permissible.

The Fascia Control connectors are also outputs for LED panel indicators. You may connect switches and LEDs simultaneously to the control pins as your need requires. See Part 6 - Connecting LEDs for more information.

A single pushbutton connected to the Standard Fascia Control input operates in toggle mode reversing the switch machine position each time it is pushed. Standard Fascia Controllers use this type of button control and are available with dual LED (942-121) or single LED (942-123) indicators.

Dual Normal and Reverse pushbuttons are connected to the Auxiliary Fascia Control input. Each button selects the respective switch machine position when pushed.

Connect the selected pushbuttons to the switch machine control inputs as shown in Fig 9.2.

Walthers Connecting Cables (942-112) and Extension cables (942-113) provide a convenient way to connect switches by installing the socket end on the switch machine input connector then removing the connector on the other end and wiring to your switches and optional LEDs. Extension cables can then be used to extend the connection to the fascia switch location up to 20 ft (6m) if needed.

When switch machines are cascaded for crossover operation, fascia controls and indicators are connected to the first machine only. The second and subsequent machines do not have any fascia controls connected. See section 3.3 in Part 3 - Connecting Power for more info on crossover control connections.

Pushbutton control switch operation may be disabled by toggle switches connected to other switch machine control inputs as noted in Part 7 - Control Overview. Fascia controls may also be disabled by using the Lock Enable option as detailed in Part 4.1. When using the Lock Option, fascia indicators will flash when the switch machine is unlocked and fascia controls are enabled. When locked, fascia controls are disabled and LEDs are on steady indicating the switch machine position.

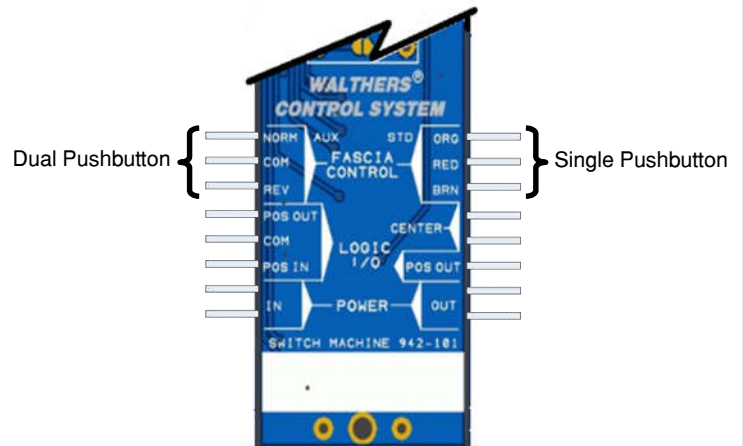


Fig 9.1: Pushbutton Inputs

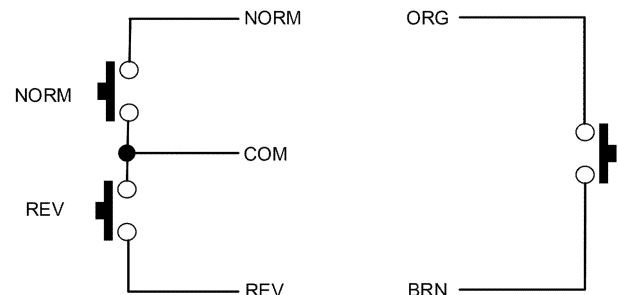


Fig 9.2: Pushbutton Inputs

Diode matrix connections may also be used to set a route through multiple turnouts with a single switch. Route selector pushbuttons are connected through a diode matrix to the Auxiliary Control inputs as shown in Fig 9.3. Isolation diodes connect the Norm or Rev inputs of switch machines relevant to the respective route as shown. Standard small signal 1N914 or equivalent diodes may be used to build the matrix. Connect the COM terminal of each machine in the matrix to the selector pushbutton common as indicated.

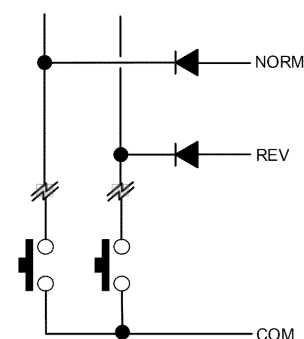


Fig 9.3: Diode Matrix Example

Switch Machine Reference Guide - Part 10 - Using Switches

10.0 Controlling the Switch Machine with Switches

The switch machine may be controlled by a SPDT switch on the Auxiliary Fascia Control connector, a SPST switch connected to the POS IN logic input, or by a DPDT switch in the DC power circuit using the Power Route Option. Refer to the relevant section below for details on wiring connections. Only one of the switch inputs may be used at once. If multi-point control is desired, one of the pushbutton options described in Part 9 must be used.

The Fascia Control connectors are also outputs for LED panel indicators. When connecting a switch to the Auxiliary Control connector, connect indicator LEDs to the Standard Control connector. See Part 6 - Connecting LEDs for more information.

Walthers Connecting Cables (942-112) and Extension cables (942-113) provide a convenient way to connect switches by installing the socket end on the switch machine input connector then removing the connector on the other end and wiring to your switches. Extension cables can then be used to extend the connection to the fascia switch location up to 20 ft (6m) if needed.

When switch machines are cascaded for crossover operation, fascia controls and indicators are connected to the first machine only. The second and subsequent machines do not have any fascia controls connected. See section 3.3 in Part 3 - Connecting Power for more info on crossover control connections.

10.1 Using SPDT Switch on Auxiliary Connector

Connect the SPDT switch to the Auxiliary Fascia Control connector as shown in Fig 10.2. This electrical connection is symmetrical, and the connector may be flipped to align the switch position with the desired turnout position.

You may also use a center-off type SPDT switch or outputs from a DCC accessory decoder to create a lock function such as may be needed in a CTC controlled block. Setting the switch to the center off position allows the switch machine to respond to the pushbutton or DCC input commands, but effectively locks the switch in the selected position when on. The Lock Enable Option can provide a similar locking function using a single switch on the POS IN terminal and also provide visual indication of lock state. See Part 4 - Options for detail on using Lock Enable.

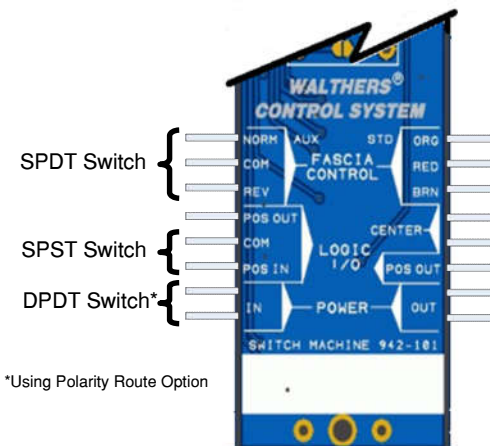


Fig 10.1: Switch Inputs

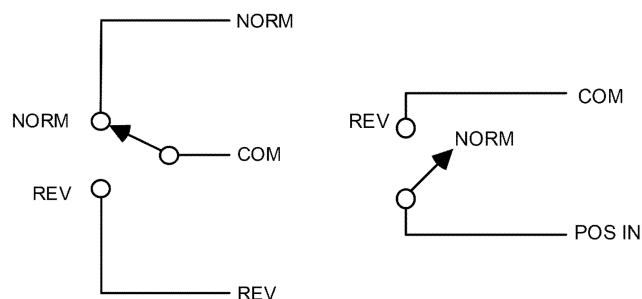


Fig 10.2: Switch Input Wiring

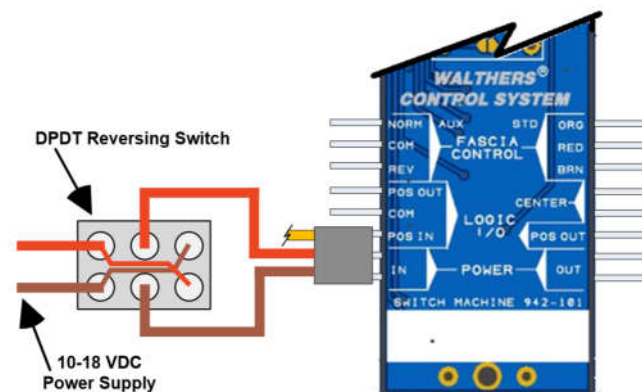


Fig 10.3: Switch Input Wiring Using Power Route Option

Switch Machine Reference Guide - Part 10 - Using Switches

10.2 Using SPST Switch on the Logic IO Connector

Connect the SPST switch to the POS IN and COM terminals of the Logic IO connector as shown in Fig 10.2. When a DC supply is used for switch machine power, the power supply negative terminal may be used in place of the Logic IO COM terminal. The POS IN terminal is also protected from application of high voltages up to the switch machine supply voltage.

The switch machine is held in the reverse position when the switch is closed, and released to normal position when open. Control input from any pushbuttons on the Fascia Control connectors is effectively disabled when the switch is

closed and this can be used to hold the switch machine in reverse position as a form of lock control.

The Logic IO input can also be converted to a Lock Input using the Lock Option. When the Lock Enable Option is on, the switch will enable other control inputs and flash the LEDs to indicate the unlocked controls when off, and disable other controls and stop the flashing indicators when on. See Part 4 - Options for use of the Lock Enable Option.

10.3 Using DPDT Switch on Power Connector

The switch machine may be controlled with a DPDT switch wired into the DC power circuit as shown in Fig 10.3 and the Power Route Option is enabled. In this configuration, the switch machine will behave in a manner similar to a standard stall motor driven machine as the polarity of the supply voltage determines the turnout position.

When the Power Route Option is on, all other control inputs to the switch machine are disabled. LED outputs on the Fascia Control connectors will continue to function.

If replacing an existing stall motor switch machine, remove any resistors and LEDs wired in series with the power connections. If needed, use the Variable Speed Option to change the throw speed from the default values. The Walthers switch machine throw speed is independent of the supply voltage level. Connect existing fascia indicator LEDs to the switch machine Fascia Control connectors as shown in Part 6 - Connecting LEDs, removing any resistors which may be present in the circuit.

10.4 Using Diode Matrix Control

Diode matrix connections are used to set a route through multiple turnouts with a single switch. Route selector switches may be connected through a diode matrix to the Auxiliary Control inputs as shown in Fig 10.4. Isolation diodes connect the Norm or Rev inputs of switch machines relevant to the respective route as shown. Standard small signal 1N914 or equivalent diodes may be used to build the matrix. Connect the COM terminal of each machine in the matrix to the selector pushbutton common as indicated.

A diode matrix may also be connected to the Logic IO connector as shown in Fig 10.5. A diode is connected to each machine required to be in the reverse position for the selected route. Machines not connected will return to normal. The route selector switch common wire may connect to the power supply negative terminal rather than the switch machine COM terminal when DC power is used.

For the matrix in Fig 10.4, the switch machine will be normal for selection 2 and reverse for selection 4. For other selections, the switch machine remains in its last state.

For Fig 10.5, the switch machine is reverse for selections 2 and 4, and normal for all others.

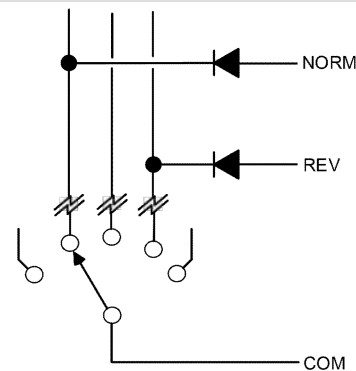


Fig 10.4: Diode Matrix on Auxiliary Control Connector

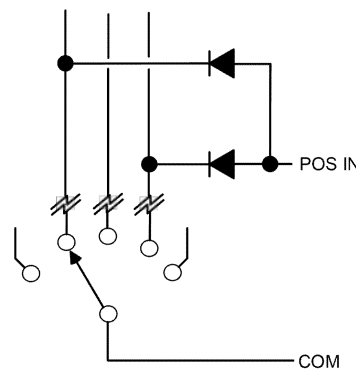


Fig 10.5: Diode Matrix on Logic IO Connector

Switch Machine Reference Guide - Part 11 - Using Logic Inputs & Outputs

11.0 Using Logic Inputs and Outputs

The switch machine may be controlled by devices using digital logic signals such as DCC accessory decoders, LCC nodes, CMRI or other similar layout control devices. Micro-controller based devices such as Arduino and Raspberry PI are also directly supported.

There are two sets of inputs which can be used for logic control of the switch machine as shown in Fig 11.1. If the LOCK ENABLE option is used to convert the POS IN to a lock control as shown in section 4.1, the Alternate Logic Control terminals can be used to control the switch machine when in the unlocked state.

Each set of logic I/O terminals are grouped in a 3-pin configuration allowing the accessory connecting cables (942-112) to be used to connect logic devices using the same pin-type header connectors. Remove the socket connector on the other end if your logic device uses terminal blocks or a different style of connector.

When connecting electronic devices together, a common ground reference must be established to ensure the logic level signals are interpreted correctly. Generally, this is done by connecting the COM terminal on the switch machine to the logic ground of the connected device which usually is the negative terminal of the logic power supply. See Section 11.4 for information on making proper ground connections to your logic device.

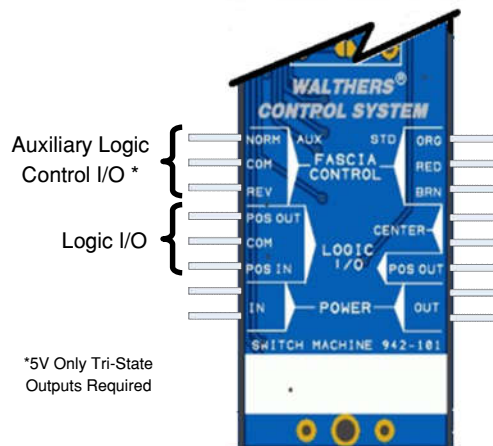


Fig 11.1: Logic Control Inputs

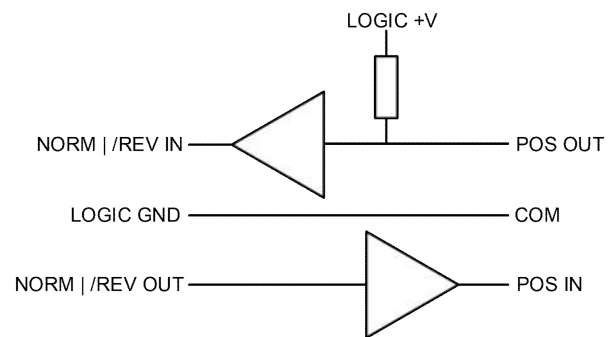


Fig 11.2: Basic Logic Input / Output

11.1 POS IN and POS OUT Logic Control

The POS IN and POS OUT terminals may be used with logic connections as shown in Fig 11.2 and are compatible with standard logic devices operating at levels up to 15V. Logic low (0V) represents reverse position for both input and output signals. Devices using 3.3V logic levels must use outputs designated *5 volt tolerant* or utilize a transistor or FET buffer as shown in Fig 11.4 or 11.5.

The POS OUT terminal is an uncommitted open-drain output and is active low when the switch machine is in the reverse position. This signal also appears on a terminal on the POWER OUT connector for use with the cascade control connection used with crossovers.

The POS OUT signal must be pulled up to the logic supply voltage of the connected device as shown. In most cases a pull-up will be provided on the logic device. If not, connect a resistor of between 1K to 10K ohms to the logic +V power supply.

The POS IN terminal is internally pulled up to the switch machine controller +5V logic supply and diode protected from application of voltages up to 15V. Application of a logic low (0V) will hold the switch machine in the reverse position, overriding other pushbutton inputs. The switch machine will return to normal on the transition of the POS IN from low to high and allow control from other inputs when high.

On power-up the switch machine will remain in its last state unless an Auxiliary Fascia Control input commands otherwise. When using the POS IN for control without benefit of feedback from the POS OUT signal, logic systems which do not retain the turnout position at power-down will need to momentarily cycle (100ms min) POS IN to reverse before setting normal as an initial state to guarantee the proper switch machine position. The position reset must be done after the switch machine controller has completed its own initialization as indicated by the activity LED.

Switch Machine Reference Guide - Part 11 - Using Logic Inputs & Outputs

11.2 Auxiliary Normal/Reverse Logic Control

The Auxiliary Logic Control may be connected to external digital inputs or outputs which conform to the criteria below and with proper programming can provide bi-directional control of the switch machine.

The auxiliary control Norm and Reverse terminals are used by the switch machine microcontroller as outputs to drive the indicator LEDs and as inputs to sense the contact closure of a pushbutton, toggle switch, or a logic low (ie 0V) signal from an external device. The switch machine multiplexes the pin function and any connected device must conform to the following requirements to properly sense the turnout position as well as initiate a change of position.

See Fig 11.3 for basic connections of digital inputs and outputs. External logic control devices may use the Normal and Reverse terminals as inputs for control of the switch machine, outputs for reading the position of the switch machine, or both as the external system requires. Note that since a signal on the Normal or Reverse terminal overrides a pushbutton on the Standard Fascia Input, an external digital device can lock out a local control pushbutton by holding the auxiliary input low and then allow local control by releasing both inputs. See the Lock Enable Option in part 4 for an alternate method of lock control.

A digital input connected to the Normal or Reverse terminal must meet one of the following criteria:

- 1) Must be a 5 Volt powered logic device
- 2) Must be a 3.3 volt powered device with '5V Tolerant' rating
- 3) Must use FET based level translators if using logic levels greater than 5 volts.

When reading the switch machine position, read both inputs simultaneously and resolve the position using the following truth table:

If the input is '11', the read has coincided with the switch

NORM	REV	MACHINE STATE
0	0	Moving to next position
1	0	Normal position
0	1	Reverse position
1	1	Invalid reading

machine scan of the contact state and position is unknown. Your digital system will need to ignore the input, digitally filter, or re-read the input to determine the current position.

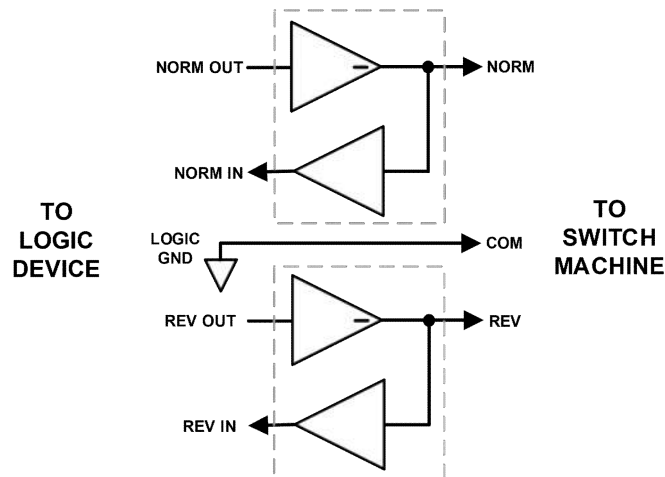


Fig 11.3: Auxiliary Control Logic Connections

A digital output connected to the Normal or Reverse terminal must meet one of the following criteria:

- 1) Must use a 5 volt rated open collector or drain output
- 2) Must be a tri-state output with 5 volt tolerance driven logic low (0 V) only
- 3) Must use a NPN or FET transistor buffer if a standard logic output or using logic levels greater than 5 volts

Digital outputs should be driven to the active low state for 100 ms minimum for momentary commands, and may be held low indefinitely to prevent operation from other pushbutton or DCC inputs.

Arduino, Raspberry Pi, and similar devices can provide bi-directional control of the switch machine when properly programmed to utilize the tri-state capability of the device interface pin. When using these types of devices, make certain that pins defined as outputs are always either tri-stated when off and logic low (0V) when on.

— WARNING —

Never connect a standard digital output to the Auxiliary Logic Control inputs. Attempting to drive the Normal or Reverse inputs to a logic high level may damage the switch machine control circuitry, the connected digital device, or both.

Switch Machine Reference Guide - Part 11 - Using Logic Inputs & Outputs

11.3 Logic Buffer Circuits

The Auxiliary Logic Control terminals require the use of 5 volt logic devices with open collector, open drain, or tri-stateable logic outputs when the Normal or Reverse terminals as used as control inputs. If your logic device does not have this capability, or operates at voltage levels other than 5 volts, you may use a discrete NPN transistor or N-channel FET connected to the logic output as shown in Fig 11.4 or 11.5. The value of the resistor is not critical, and values of 3K to 10K ohms will work well. The value should be sized to prevent excessive loading of the logic device output.

Standard digital logic outputs operating at levels up to 15 volts may be connected directly to the POS IN logic input terminal and do not require a buffer circuit however one may be used if convenient.

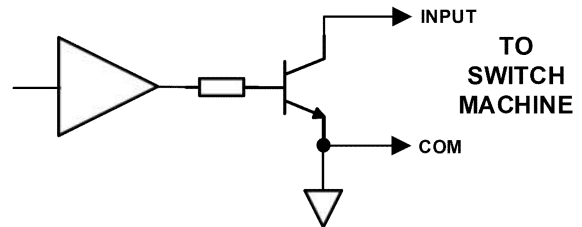


Fig 11.4: NPN Transistor Logic Buffer

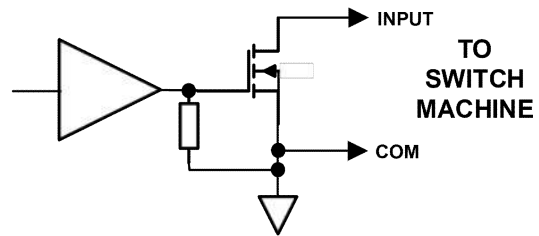


Fig 11.5: FET Transistor Logic Buffer

11.4 Grounding

When the switch machine will be connected an external logic device for readout or control, the recommended configuration is to use a dedicated power supply for the switch machines only, and power the digital logic circuits from a separate supply. Use of the 942-110 12 Volt Filtered DC Power Supply and the 942-111 Power Distribution Block facilitates the separation of the power supply circuits, and the required ground reference between the circuits is created by connecting the switch machine logic ground (COM) to the logic circuit ground as shown in Fig 11.2 and Fig 11.3.

A similar situation occurs when the switch machine is powered from a DCC booster output, and the digital control circuit has a separate supply. In this case, connect to the logic IO terminals as shown in Fig 11.2 and Fig 11.3.

If both the switch machine and the external logic circuit share the same power supply, special consideration in the method of grounding the two circuits may be required to prevent ground loops which may disrupt proper operation.

If using DCC to power both the switch machine and the external device, connect both to the same booster output. Using different boosters will create problems if one is not powered, such as may occur in the presence of a short circuit overload on one of the boosters. Connect the switch machine COM terminal to logic ground on the external device, unless the device documentation specifies otherwise.

When using the same DC supply for both the switch machine and an external logic device, the power supply isolation diodes in the switch machine will cause the switch machine COM terminal to be a diode drop above the external devices logic ground referenced to the power supply negative terminal. It is possible that the external logic device will tolerate the shift in logic levels, however one of the two methods shown below should be used to prevent an inadvertent ground loop through the external logic device and eliminate the shift in logic levels.

First, if possible, insert a diode in the negative supply lead to the external device as shown in Fig 11.6. Just one diode is needed for all devices, and should be sized to accommodate the expected logic circuit load requirement. The diode shifts the voltage supply to the external logic circuits, eliminates the logic level shift, and prevents excessive currents from flowing in the logic COM connection.

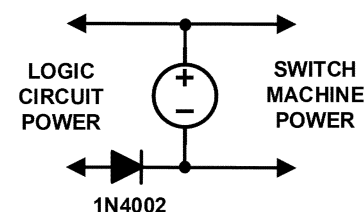


Fig 11.6: Diode Logic Level Shifter

Switch Machine Reference Guide - Part 11 - Using Logic Inputs & Outputs

11.4 Grounding (continued)

The second method involves modifying the DC power connections to the switch machine as shown in Fig 11.7 or 11.8. Using this method to connect DC power to the switch machine bypasses the switch machine isolation diodes and eliminates the logic level shifts which would otherwise be present.

The circuit in Fig 11.7 connects the switch machine logic COM to the power supply negative connection at the switch machine. With this connection in place, it is not necessary to make any additional connection to the logic device ground.

An alternate configuration for DC power is shown in Fig 11.8. In this case a 4 wire connection to the switch machine is made connecting the positive supply lead to one of the POWER IN pins and the negative supply to the COM terminal. The POS IN/OUT or NORM/REV terminals are then connected as required to the external logic device. Note that if only the POS IN logic terminal is required, the standard 3-wire connecting cable may be used.

Due to the myriad of available devices, it is not possible to predict which of the suggested solutions will work in all cases. If operational problems persist, using a separate dedicated supply for the switch machine power will solve even the most difficult control interface problems.

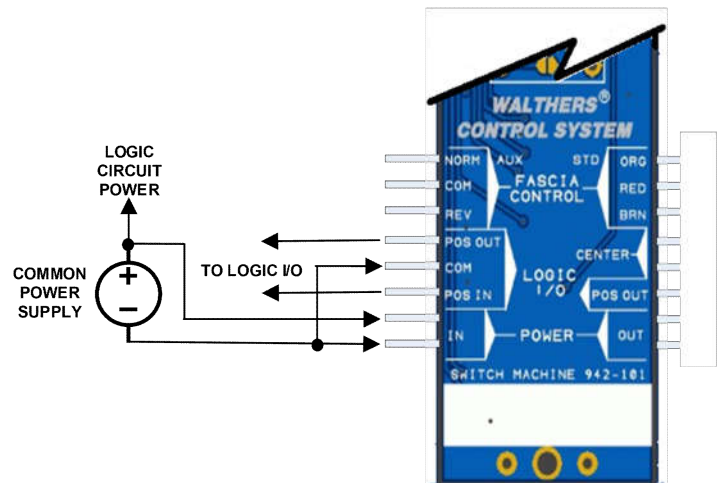


Fig 11.7: Connect COM to negative supply

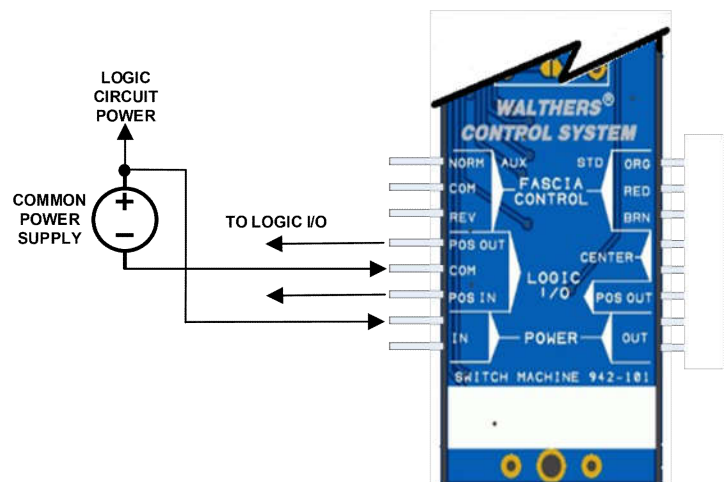


Fig 11.8: Alternate DC power connection

Switch Machine Reference Guide - Part 12 - Using DCC Control

12.0 DCC Control

The switch machine includes the ability to respond to accessory decoder commands when connected to DCC power. As shipped, the DCC function is disabled. To enable operation via DCC, follow the steps below to set the address you wish to use for turnout control.

Note that while the switch machine can be operated with DCC accessory decoder on/off (sometimes called thrown/closed) commands, it is not itself a decoder, has no DCC address and has no CVs to program.

If you wish to use accessory decoder commands to operate the turnout, follow the steps below to set an address and enable DCC operation. Using DCC to control the turnout requires using DCC booster output for power. Do not use a program track to operate the switch machine.

The DCC address can be set, changed or cleared at any time before, during, or after installation on the layout.

Follow these steps to set or clear a DCC address:

- 1) Enter Center / DCC Learn Mode using one of the two methods described below.

- 2) Issue an accessory decoder 'on' or 'thrown' command to the address you wish to use for the turnout. Any accessory address from 1 to 2043 may be used,
- 3) The switch machine will jog toward the REV position acknowledging the stored address.
- 4) Issuing an 'off' or 'closed' command using any address will clear the current address and disable DCC control. The switch machine will acknowledge the reset by a jog toward the NORM position.

If you simply wish to change an existing address it is not necessary to clear the old address before setting the new one.

If you activate the Center / Learn Mode while the switch machine is on the layout and DCC power is applied, make certain the only accessory decoder commands issued are the ones you wish to use for the turnout.

If you remove power while the switch machine is in Center / Learn Mode, when power is re-applied, the switch machine will remain at the center location until a fascia button is pushed or a DCC, switch or logic command is received.

12.1 Center / DCC Learn Mode

When installing a switch machine on the layout, it is helpful to have the turnout actuator wire in the center of throw, then fasten to the benchwork with the turnout throw bar in its center position. As delivered, the switch machine is in its center position, and a jumper plug is installed as shown. The center jumper must be removed for normal machine operation.

Center / Learn Mode can be entered in one of two ways:

- 1) Install the jumper plug on the Center pins as shown. You may do this with power applied. The servo will rotate to the center position and the fascia indicator LEDs will begin alternately flashing. When done, remove the jumper, and normal operation will be restored.
- 2) Remove power. With the Standard Fascia Controller connected, push and hold the button and apply power. Continue to hold the button until the servo moves to the center position. When the button is released, the LED indicators will flash alternately. The switch machine will remain in the Center / DCC Learn mode until power is removed.

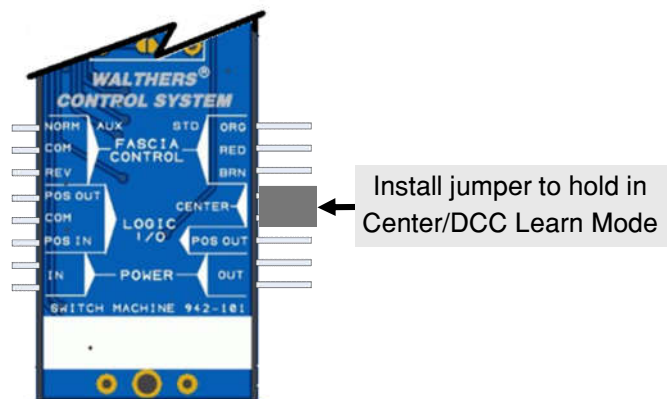


Fig 12.1 Center Program Jumper