Switch Machines
Installation & Wiring
Conventional Twin Coil Switch Machines

- In use since developed by Walthers in early 1930’s
  - Long time standard for remote operation
  - Currently: Rix, Atlas, etc.

Electrically:

- Brief, high current (~2-5 ohm coils) yields brief power pulse, requires heavy wire
- Difficult to fire more than 2 or 3 at the same time
- ? If any available today have reliable electrical contacts
- Bad things happen if power stays on
  - Most capacitive discharge powers supplies are fail safe
Tortoise (Stall Motor) Machines

Electrically:

- 12 VDC
- Stall Motor
- DPDT Switch

✓ Continuous low current (~20 ma) allows light wiring
  ▪ 20 ma ideal to power LED in series with Tortoise
✓ Relatively long throw, continuous force while power on
✓ Slow, realistic turnout motion
✓ Two sets reliable SPDT contacts
  • Carry 4 amps, switch 1 amp
  • Frog power, signals, panel lights, etc
✓ **Tortoise contacts:**

✓ **Tell signals which way Turnout is thrown**

✓ **Control frog & point polarity**

✓ **Can also power LEDs on panel, etc**
“Normal” Installation

Tortoise Directions

1/4” to 3/8” hole

0.024” wire, bent as directed

0.032” wire, ~1/16” “L” at top end

0.030” brass, 3/8” x ½”, drilled 3/32” for screw, 1/16” ID collar soldered on

Modified Installation
10 pos printed circuit edge connector

0.030” brass, 1/16” hole, pivot

0.032” Spring wire

#4 pan head metal screws

0.030” brass, 3/8 x 1/2 “
3/32” drill for SM screw,
1/16” ID collar soldered on

Two 1/16” ID collars soldered together *

Typical “Offset” Installation
0.030” Brass, 3/8”x1/2”, 3/32” Drill for SM screw, 1/16” ID Collar soldered on

SM mounted with #4 pan head screws

Typical offset Tortoise mount

0.032” spring wire

0.030” brass scrap soldered onto wire, 1/16” ID collar

Brass scrap pivot, 1/16” hole
A Tortoise can be mounted in almost any position, along as the motion is approximately at right angles to the track.
**Possible alternative linkage**

*If no hole under turnout:*

*From Feb 2010 RMC*

*Consider 0.032” wire for Lower arm, spring action*
Same Principles work for Twin Coil Machines
Be aware: If you wire your own power supply, you might not get the output voltage you expect!

12 volts in, 16.9 out

12 volts in, 10.8 out
LED’s on panel to show turnout position

✓ The position of a single turnout can be shown with two LED’s in parallel in a wire to the Tortoise.

  ▪ The lighted LED will be dim until the Tortoise motor stalls, then go bright.

  ▪ You can also indicate a single turnout by grounding the LED through a Tortoise contact. Wiring LED’s in line is usually simpler.

✓ This can also be used for a route if you wish to show the position of every turnout.

✓ To show the route selected with a single LED, the LED is powered at the panel and grounded through contacts on the Tortoise machines.

  ▪ This gives a CTC “feel” to the panel. Push the button, hear the switch machines operate, and the LED lights only after all turnouts are aligned to the desired route.
Wiring - Suggestions

- Use PCB edge connectors to wire Tortoise
  - No risk of damage to circuit board, can make layout connections more accessible
- Use two power supplies and common ground
- Wire LEDs for position indication in this order:

  ![LED Circuit Diagram]

  +12 vdc -- 560 ohms

  (LED life 30,000 hours @ 25 ma, about ½ sec @ 12 volts!)
- Make 9 volt battery/330 ohm resistor/LED “tester”
- Get a “multimeter” (reads volts, ohms, ma, more)
  - Magic words are “digital” and “autoranging”
  - About $25 and up (way up!) at Radio Shack or Lowes
Add PCB Edge Connector

- Allows remote (and accessible) layout connections
- 10 Position Connectors were $0.50 at All Electronics
- Easy removal w/o risk of board damage

- Layout connections at more accessible location
Use two power supplies w/ Common ground

- Makes wiring much simpler, only one wire to each Tortoise
  - Common ground not for DCC, but helpful for accessory wiring
  - Common ground wire not shown in wiring diagrams
- Switch can be toggle, rotary, slide, or relay
  - Beware of “make before break” switches!

Diagram:
- 12 vdc
- SPDT switch
- Common ground wire
- LEDs (optional)
- (indicate switch position)

Tortoise
Simple Electrical Tester

Here to ground, check continuity, etc

Here to ground to check LED’s

330 ohm resistor

9 volt battery

Check which contacts are closed on Tortoise, relays, etc

Can also test transistors, on PNP, P to N (emitter and collector to base) should conduct, N to P should not.

NOTE: 3 volt battery, 100 ohm resistor safer, LED’s not rated for 9 volts in reverse
My layouts used rotary switches for twin coil switch machines. Turn knob then push button, knob showed turnout position. This technique worked well for years before changing to Tortoise machines.
Rotary switches for turnout control

LEDs indicate turnout position

Buttons leftover from old twin solenoid machines

Reversing for tail track

Not needed

4 pole 3 pos. Rotary switch Controls turnout and wye tail
Track polarity, center is track off
Control Panel for Hidden Staging Yard

- **Occupancy (Entrance Section)**
- **Track Power**
- **Direction (Reversing Section)**

**Rotary Switch (3 pole 4 Pos)**
- Controls 3 Turnouts

**Green LED’s show turnout alignment**

**Red LEDs show track occupancy**
Staging Yard Tortoise Wiring

Track Layout

- Tk 1
- Tk 2
- Tk 3
- Tk 4

T-A
T-B
T-C

+12 VDC

560 Ohms

LED

3 Pole 4 Pos Rotary Switch
Each Pole shown separately
Simple transistor/relay circuits operated by push buttons on this panel permit controlling Tortoises from several locations and via a diode matrix, route selection. The LED’s show turnout position and/or route selected.
Turnout Control from Multiple Locations and Route Selection

- On following circuits, while one button is shown, any number of buttons can be wired in parallel to control the relay (and Tortoise) from several locations.

- The first three circuits default to the “relay off” turnout position when layout power is turned off or interrupted.

- All Circuits can be used for anything that requires operating a relay from several locations.

- PC relays require care in soldering connections to avoid overheating and damaging relay
Simple Transistor Circuit

✓ Resistor allows transistor to conduct
  ▪ Per Transistor specs, Up to 5000 ohms OK

✓ “On” button powers relay, stick contacts hold it on

✓ “Off” button “shorts” relay coil, so it drops out

-12 volts DC

+12 volts DC

Diode 1N4004 *

On

Relay

Off

Resistor 1500 ohms

To Tortoise

“Stick” contacts

Relay – 12 volt 150 ohm coil *

PNP Transistor 2N3906 (All Elect.) RS 276-1604

* not critical
Two 3 amp Power Supplies

Diode Matrix to select turnouts

Transistor circuits to control turnouts
Control Tortoise with 5 volt Relay
(No personal experience)

✓ “On” Button powers relay, “stick” contact holds it on
✓ “Off” button bypasses relay coil so it drops out
✓ Can have any no. of on & off buttons in parallel
✓ Resistor matched to relay coil so about 7 volt drop, ½ watt at 12 volts
✓ Relays $1 to $1.50 ea. at All Electronics
Hysteresis Circuit
(no personal experience)

-12 volts DC

To Tortoise

+12 volts DC

Relay

On

Off

✓ This relay pulls in at 6 volts, drops out at 3 volts

✓ 300 ohm resistor selected so 4.5 volts on relay coil

✓ Resistor must be matched to relay coil

Beware that if both buttons are pushed at once, a short will result. There should be some sort of current limiter in circuit (eg, an auto taillight bulb.)
• Latching Relays

• A relay an electromechanical switch. It is used to control a large current with a small current. Most relays require a small continuous control current to stay on. A latching relay is different. It uses a voltage pulse to cycle the relay, then stays in this position until the opposite control voltage is applied.

• The latching relay has a small metal strip which can pivot between two terminals. The switch is magnetized, or attached to a small magnet. On either side of that magnet are small coils of wire.

• The two coils are used to control the relay. When electric current flows into one coil, it generates a magnetic field, which moves the switch from one side to the other. When the power is removed from the coil, the strip stays there until it receives a magnetic pulse in the opposite direction. This may come either from the other coil or from a current with the opposite polarity in the original coil, pushing the switch back to the other terminal.
**Latching Relay - Typical**

- Sample from Digikey Catalog
- Use “set” & “reset” coils to reverse
- Permits multiple control locations &
- Route control w/diode matrix
- IE very simple, versatile
- But 10 terminals on 9/16” x 5/16” base

$2.71 ea.
Panel for Latching Relays

Input from Panel Buttons
(Diode matrix under HS tubing)

Power, +, gnd, - 12 vdc

Relay

To Switch Machines

#24 wire relay to pin

Escutcheon Pins
Handy as terminals

Track Schematic
Buttons select track, LED’s show current turnout positions
Further information is available
(or comments, criticism, etc)
Phone, email, or visit Hendersonville

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