How to Wire Commercial Turnouts

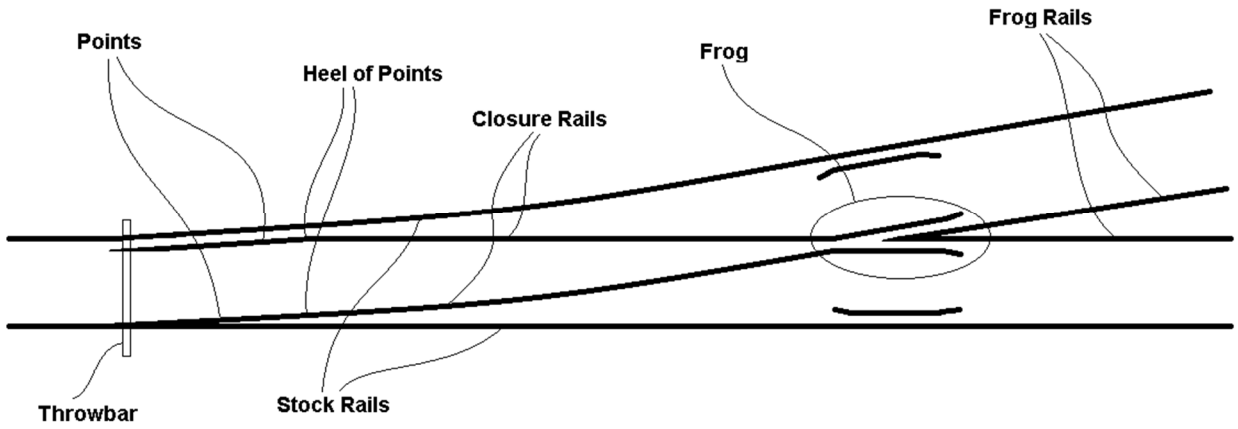
Handout to accompany NMRA North Central Region Division 6 clinic, Bruce Wolff, Friday May 19th 2020

When you install a ready-built "commercial" turnout on your model railroad, it's tempting to think you can just connect it with metal rail joiners to adjacent tracks, solder in a couple feeder wires and you're good to go. But different brands have very different electrical characteristics. If you're not careful, you could end up with a big dead section in your turnout. Or worse yet, a short-circuit!

The aim of this clinic is to familiarize you with the electrical characteristics of some popular brands of turnouts, and how to wire them. But more than that, it's to teach you how to figure out for yourself the characteristics of any turnout and how to decide how to wire it for years of trouble-free operation.

A clinic like this cannot cover every brand of turnout you may come across. It also emphasizes examples in HO scale, though the principles apply to two-rail wiring of turnouts in any scale. You can use these principles to identify how to wire your favorite brand, even if it's not mentioned here.

Before we go on, the diagram below shows the terminology of turnout parts used throughout this clinic:



For the most part, the electrical characteristics of a turnout can be grouped into two categories:

- Both routes live vs. Power Routing
- Frog type

Both Routes Live vs. Power Routing:

Both Routes Live: Point, closure rail and frog rail for each route (other than the frog itself – see "Frog Type" below) are always energized with the opposite polarity to the stock rail for that route – even if the points are set ***against*** that route. A locomotive on either route will always have power.

Power Routing: Track power to both points, both closure rails, the frog and both frog rails changes polarity depending on which way the points are set. The point, closure rail and frog rail for the route the points are set against are ***not*** of the opposite polarity to the stock rail for that route, meaning that a locomotive on that route will have no power.

Frog Type:

Dead Frog: This is a frog which has no track power. It could be a plastic frog, or a metal frog that is insulated from the adjacent closure and frog rails and does not have a separate power supply. For locomotives which have a small number of electrical pickup wheels, and which do not have a capacitor "stay-alive" circuit (or DC locomotives without a large-enough flywheel), a dead frog could cause the locomotive to stall.

Live Frog: This is a metal frog which is either electrically continuous with the points, closure rails and frog rails (in a "power routing" turnout), or is insulated from these other rails but has its own separate power supply.

Insulated Metal Frog: Already mentioned for both types above, this is a metal frog which is unpowered ("dead") by default. It is up to you to solder or otherwise attach a feeder to it, to turn it into a "live" frog.

"Hold on," you ask, "what can I use to separately supply power to the frog?" There are many ways to "feed" a frog:

- In a power routing turnout, the easiest – and least reliable – is to rely on the back of the point touching the stock rail, and drawing power from it. The thinnest layer of paint or slightest bit of ballast or other object can break this electrical contact, resulting in a big dead gap through most of the length of the turnout. Some turnouts have metal tabs under the points or on the throwbar which wipe across the bottom of the stock rail, ***somewhat*** improving the electrical contact. It is always best to add one of the other methods listed below.
- If using manual "ground throws" to move the throwbar and the points, you can use ones with built-in electrical contacts, such as the Caboose Industries model 220S shown on the next page. Follow the manufacturer's directions for the electrical connections.

- Some modelers install an SPDT slide switch (shown below) embedded in the roadbed, with a linkage to move the throwbar. Below the layout surface, solder wires from the switch's terminals to the frog and to the two stock rails (or to the bus wires for each stock rail) so that the frog is electrically connected to either one stock rail or to the other, depending which stock rail has a point closed against it.
- Under-layout linkages are available commercially, which are activated by knobs on the fascia. Examples include the Blue Point Turnout Controller, or the BullFrog from Fast Tracks. These usually include built-in electrical switches to route power from one stock rail or the other to the frog.
- Many electric turnout motors include built-in electric contacts to route power from the correct stock rail to the frog. A popular example is the Tortoise by Circuitron.
- If you are only running DCC, and will never run DC, you can use the Frog Juicer from Tam Valley Depot. This circuit detects a short-circuit when a locomotive enters the frog, and changes the frog's polarity before the circuit breaker that protects your DCC booster can shut down.

Caboose Industries 220S with electrical contacts

SPDT slide switches

When using the methods above to power your frog, be sure to double-check and test to make sure your frog is getting the correct polarity for either route. The last thing you want is to wire in your own short circuit!

- Make sure the frog is connected to the "pole" of the electric switch – usually the center terminal, but not always (e.g. on microswitches).
- If the frog is always the wrong polarity no matter which way the turnout is thrown, try reversing the two wires from the stock rails (or from the bus wires) to the other two terminals on the electric switch.

So far, I haven't mentioned the term "DCC-friendly". A lengthy discussion of that term is at https://dccwiki.com/DCC_Friendly_Turnout (though be careful: That site uses different terminology than this clinic does). Basically, to be "DCC-friendly", a turnout must have:

- Points that are never the opposite polarity to their adjacent stock rail, and
- A metal frog that is isolated from the closure rails and frog rails beyond the frog, and has a separate power supply as described above.

The idea is to avoid the possibility of a short circuit if the back of an out-of-gauge wheel brushes the back of an opposite-polarity point, and to ensure a continuous supply of electricity to sometimes-finicky decoders. If you consistently use "stay-alive" circuits with your decoders, and/or all of your locomotives have many electrical pick-up wheels spread over a long wheelbase (combined with meticulous cleaning of your track and wheels), you may not have to

supply power to the frog. But the frog must stay insulated from the closure rails. For some thoughts about joining the "Dead Frog Society", see https://model-railroad-hobbyist.com/magazine/mrh-2014-09-sep/rr_dead-frog-society (but be sure to read the comments).

How to identify the electrical characteristics of your turnout?

You don't need a degree in electrical engineering. Just remember that metal conducts electricity while plastic insulates it. Then take a close look at your turnout from both above and below. Some things to check:

- Is there a solid electrical contact from the stock rail to the heel of the point and closure rail? Or a metal jumper below the ties from the stock rail to the adjacent closure rail?
- Is the frog plastic or metal?
- If the frog is metal, is it a separate piece from the closure rails? From the frog rails beyond the frog? Or is it fabricated from the frog rails and the closure rails with no gaps?
- Are there gaps in the closure rails and/or frog rails? Are there jumper wires over those gaps?
- If the frog is plastic, or if it's metal but insulated from the closure rails and the frog rails beyond the points, are there metal jumpers visible from below to supply track power to the frog rails beyond the frog?
- If the frog is metal and insulated from the closure rails, is there a tiny metal ring either next to the frog or at the end of a tie, to attach a feeder wire to power the frog? Or is there already a feeder wire folded up under the ties below the frog?
- Do you have a multimeter? If so, set it to the "continuity" setting and touch the leads to various parts of the turnout. It should give a beep if there's electrical continuity, or stay silent if the leads are touching parts of the turnout that are insulated from each other. Parts of the turnout to check:
    - Point or closure rail to the adjacent stock rail, when the other point is closed against its stock rail:
        - Beep: It's a "both routes live" turnout.
        - Silence: It's a "power-routing" turnout.
    - Point or closure rail to the stock rail on the other side of the turnout, when that other stock rail has its point closed against it:
        - Beep: It's a "power routing" turnout. Note that an out-of-gauge wheel might be able to brush against the open point and cause a short circuit, depending on the width of the gap between the point and stock rail.
        - Silence: It's a "both routes live" turnout, unless it was also silent in the previous test. In that case, it's probably a Peco Insulfrog turnout. See the Peco Insulfrog page below for more details.
    - Frog to either point:
        - Beep: It's a "live frog – power routing" turnout.
        - Silence: The turnout has an insulated metal frog – or a dead frog.

Play with your turnout, looking at it from "Both Sides, Now" (sorry Joni Mitchell!), from up and down, and try to picture where the electrons can and can't flow. Then compare that with where you want them to flow and not to flow, and imagine where you may have to add gaps and feeders to wire it correctly.

If you have any questions, please contact me, Bruce Wolff. My contact info is in the Division 6 Board Of Directors section of the Division 6 Newsletter: Download the latest copy at http://div6-ncr-nmra.com/div6---newsletter.html.

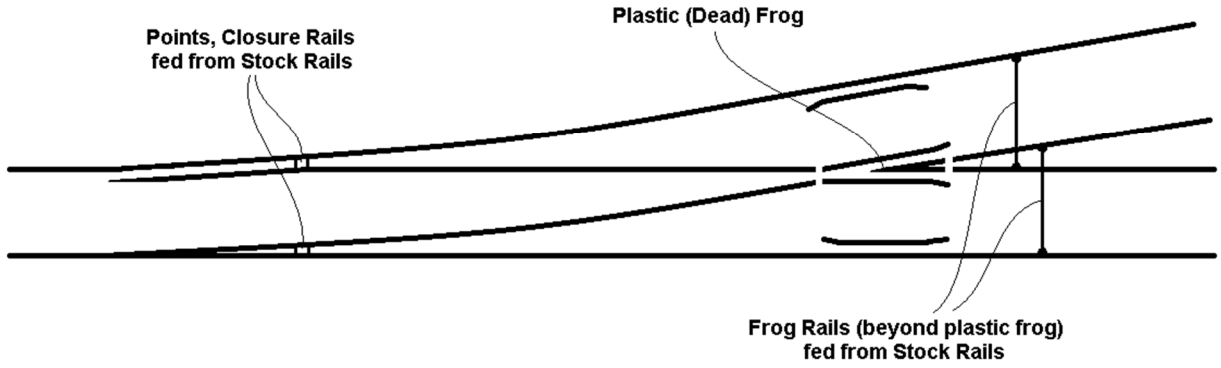
One final note: All commercial turnouts I've seen (except Fast Tracks, which you build yourself) have separate points that are hinged at the heel, rather than being continuous extensions of the closure rails. This means that their electrical contact relies on metal-touching-metal contacts at their pivot points at the heel, and/or where the back of the point closes against the stock rail. When you paint your track to weather it, be sure to protect these areas to keep paint out. Any paint inside these joints will destroy electrical contact to the points, resulting in dead spots and possibly stalling your locomotives.

Over the rest of this handout, we'll take a look at the following examples:

1. Train set
2. Atlas Customline
3. Shinohara
4. Micro Engineering
5. Walthers
6. Fast Tracks
7. Peco Electrofrog
8. Peco Insulfrog
9. Peco Unifrog

We'll conclude with an Epilogue, where we'll look at what you can do with turnouts you already have if they are not ideally wired.

1. Train set turnout



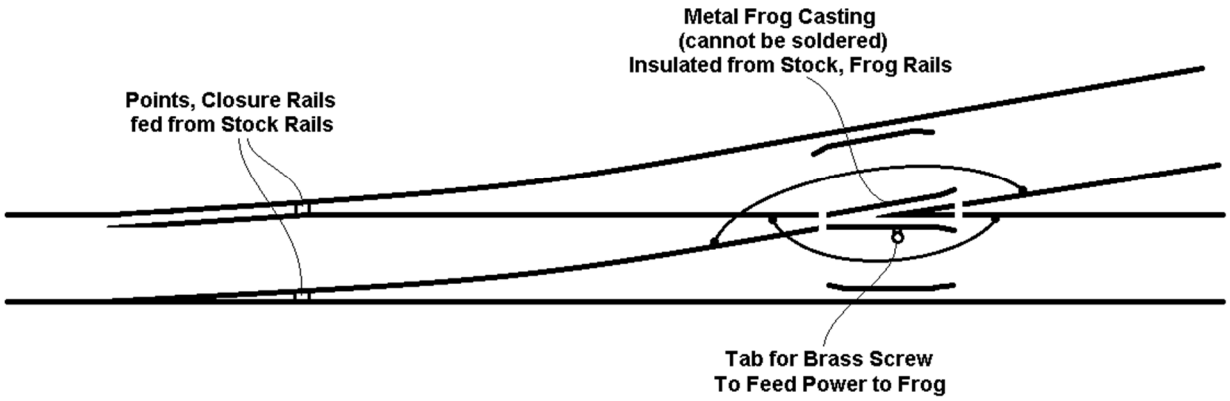
Turnout type: Both routes live
Frog type: Dead (plastic)
DCC-friendly? Almost: The dead frog is so short due to the sharp angle that few if any locomotives will stall.

Electrical characteristics:
Train set turnouts are meant to be so easy you don't have to think about wiring them. Just connect the next lengths of track with metal rail joiners and they will work – so long as the rail joiners still have reliable electrical contact.
The dead frog and both-routes-live design make short circuits impossible*, while the metal jumpers allow the whole turnout to be powered no matter which part of the turnout you wire feeders to.

How to wire:
Do you really want to use a train set turnout in your permanent model railroad?
If you do, then just solder a pair of feeders anywhere that's convenient: Stock rails, closure rails, frog rails or any combination of these.

* Short circuits are still possible if you use the turnout as part of a reversing loop or wye. Those track configurations are beyond the scope of this clinic.

2. Atlas Customline

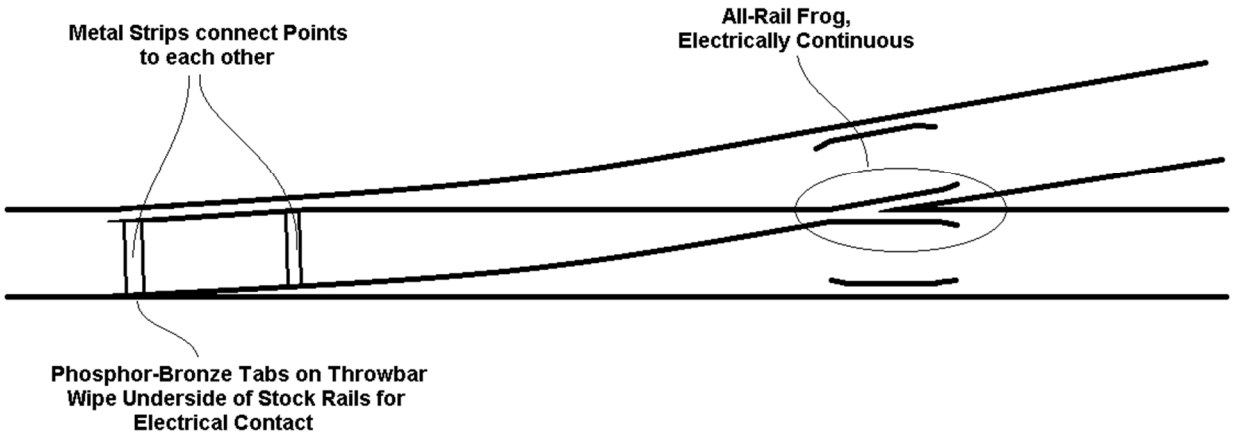


Turnout type: Both routes live
Frog type: Insulated metal frog, with tab to attach feeder
DCC-friendly? Yes

Electrical characteristics:
Just like the train set turnout, but with the option of powering the frog. In a #4 turnout the insulated frog is short enough that it may be worth leaving it dead, though with a #8 the insulated frog is so long that it is much more worthwhile to feed it and make it live.
Atlas makes their frogs from an alloy that can't be soldered. That's why they've thoughtfully provided the small ring for attaching a feeder. (Note: I haven't tried soldering to this ring. If it, too, can't be soldered, you may have to attach a tiny brass screw through the ring into the roadbed, and then solder a feeder wire to the screw.)

How to wire:
Just like a train set turnout, solder a pair of feeder wires anywhere in the turnout. Its internal jumpers will feed the power to the rest of the turnout – except the frog.
Feeding the frog is optional, depending on the frog number / length of the frog. See "Electrical characteristics" above about using the frog feeder ring built into the turnout. Use any of the techniques mentioned earlier in this handout to supply power to the frog.

3. Shinohara



Turnout type: Power routing
Frog type: Live (electrically continuous with closure rails & frog rails beyond the frog)
DCC-friendly? No

Electrical characteristics:
In "Shinohara"-branded turnouts, the points, closure rails, frog and frog rails are all electrically connected to each other. You can tell it's a Shinohara by the pair of metal strips that connect the points to each other at the heel of the points and at the throwbar.
The open point is always the opposite polarity to its adjacent stock rail. In theory this makes it susceptible to causing a short circuit if the back of a wheel brushes the back of the point: That's why it is not "DCC-friendly". But in many years' experience at a local club, I've never seen a short circuit of this type. The gap between the point and the stock rail is large enough to prevent this type of short circuit.
Shinohara turnouts do often cause another type of short circuit at the club: If a Tortoise switch machine is not properly centered side-to-side below the turnout, the Tortoise's electrical contacts can change the frog's polarity before the points start to move, leading to a brief short circuit. Going the other way, the points can swing across and make contact before the Tortoise's contacts change polarity, leading to another brief short circuit. Be sure to center any mechanical or electrical switch machine side-to-side under the turnout.
Shinohara turnouts have phosphor-bronze contacts on the throwbar which wipe the underside of the stock rails. This provides more secure electrical contact than relying on the point touching the stock rail. But these phosphor-bronze contacts are fragile and are often damaged in a club setting.

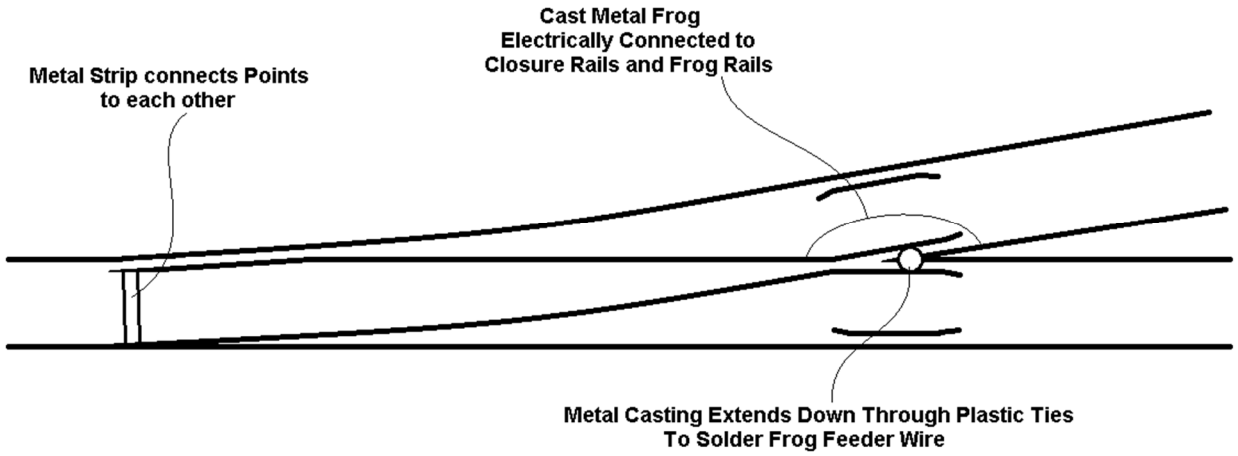
How to wire: (Shinohara)

Solder feeders of opposite polarities to the two stock rails. Due to how fragile the phosphor-bronze wipers are at the throwbar of a Shinohara turnout, it is best to provide a separate power supply to the frog – or to any point on the closure rails, frog or frog rails.

Because this is a power-routing turnout, you need to choose the rail joiners for the frog rails carefully:

- If both routes are spurs without their own power feeders, you can use metal rail joiners on all rails. Whichever route has the points set for it will have power; the other route will be dead.
- But for electrical reliability, you are soldering feeders to each length of rail, aren't you? If you feed power to a power-routing turnout from the frog end, you will create a short circuit – no matter whether there is a locomotive there or not.
- Therefore, always use insulated (plastic) rail joiners on the two frog rails of a power-routing turnout like a Shinohara. Or, if you prefer, use the better-looking metal rail joiners, but use a razor saw or cutoff disk in a motor tool to cut an electrical gap between the frog and the first feeder in the next length of track.

4. Micro Engineering (N scale, year 2000)

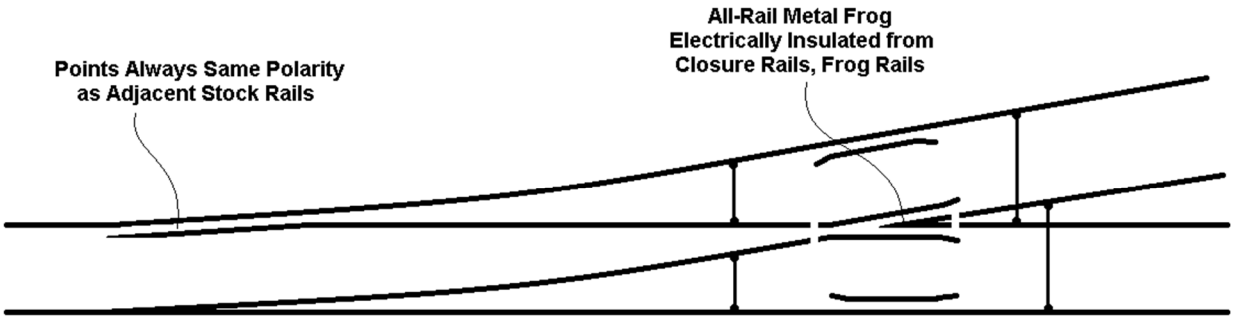


Turnout type: Power routing
Frog type: Live (electrically continuous with closure rails & frog rails beyond the frog)
DCC-friendly? No

Electrical characteristics:
Full disclosure: This turnout was purchased in 2000. I have not inspected more recent Micro Engineering turnouts, nor have I inspected HO turnouts from Micro Engineering.
The N scale Micro Engineering turnout is electrically almost identical to the previously-mentioned Shinohara.
Micro Engineering uses a separate metal casting for the frog, but it is electrically connected to the closure and frog rails. It has a protrusion which extends down through the ties, apparently to be used for soldering a feeder wire before installing the turnout. I don't know whether or not this alloy can be soldered. This is no problem: A feeder soldered to the nickel silver rail anywhere on the closure rails or frog rails will be just as effective.
The throwbar has metal tabs that extend below the stock rail to which a point is closed. I cannot tell whether these tabs touch the bottom of the stock rails, or whether electrical contact is made only through the back of the point touching the stock rail.

How to wire:
Solder feeders of opposite polarities to the two stock rails. It is best to provide a separate supply of power to the frog – or to any point on the closure rails or frog rails.
Because the Micro Engineering N scale turnout is a power routing turnout, like the Shinohara, be sure to use plastic rail joiners on the two frog rails – or cut electrical gaps to insulate the frog from the feeders in the next lengths of rail.

5. Walthers

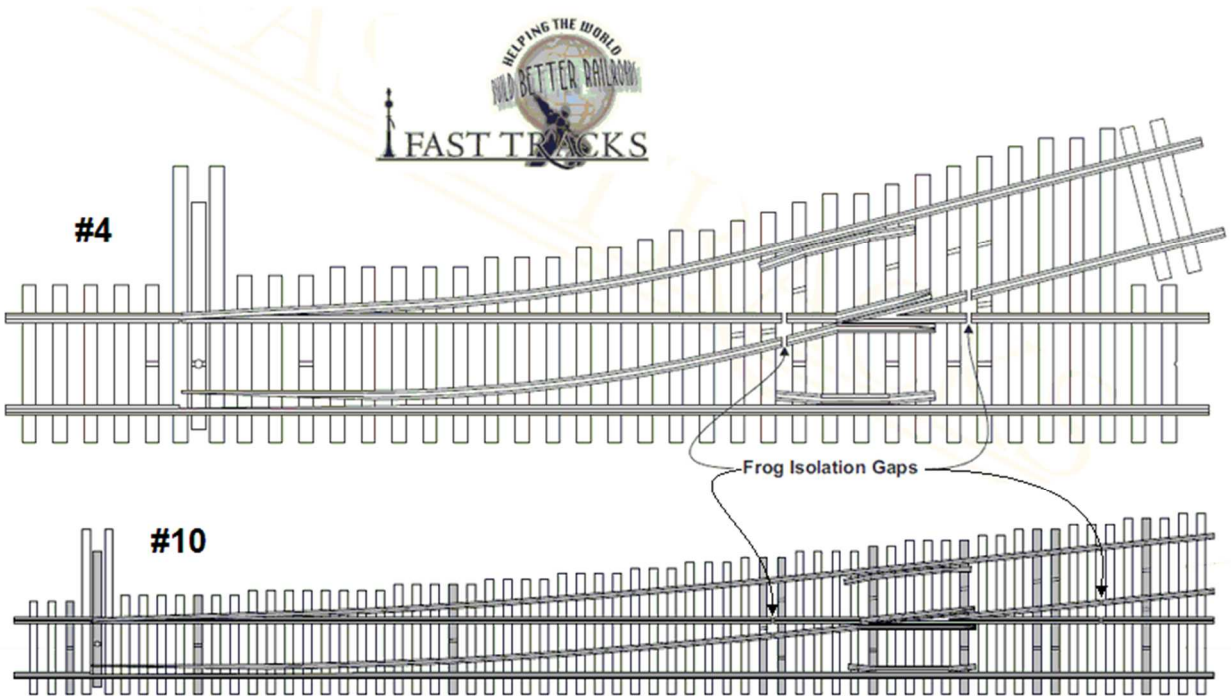


Turnout type: Both routes live
Frog type: Insulated metal frog
DCC-friendly? Yes

Electrical characteristics:
Walthers-branded turnouts are made under contract by Shinohara. They have the same mechanical precision as Shinohara-branded turnouts, and even better looks (without the metal straps connecting the points to each other). They are also fully DCC-friendly.
Metal jumpers under the ties connect each stock rail to its adjacent closure rail (and point) and to the frog rail beyond the frog.
The frog itself is all-metal, but insulated from the rest of the turnout. The insulated portion is as short as possible while still preventing short circuits from wide wheel treads or the back of a wheel brushing one of the frog's wing rails.

How to wire:
Solder a feeder of each polarity anywhere to the respective stock, closure or frog rail.
Depending on the frog number, you may choose to leave the frog dead. If you decide to power it, you can easily solder a feeder to the frog, which is fabricated from nickel-silver rail.

6. Fast Tracks

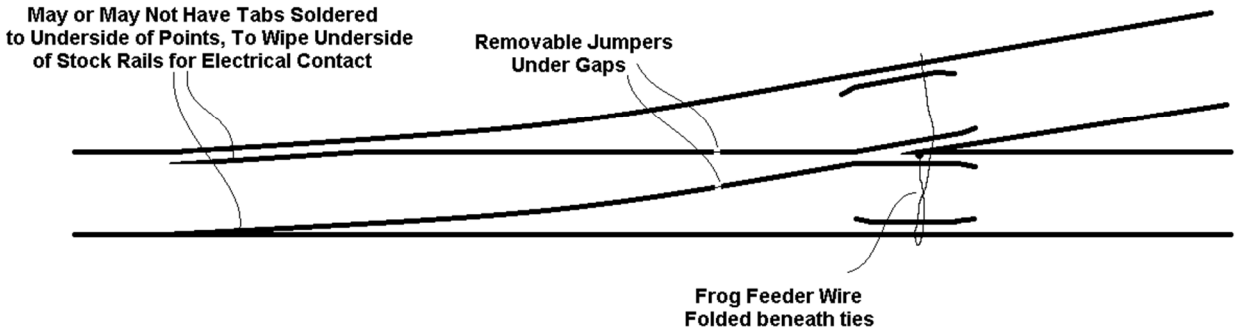


Turnout type: Both routes live (except frog rails beyond the frog)
Frog type: Insulated metal frog
DCC-friendly? Yes

Electrical characteristics:
Fast Tracks turnouts aren't exactly commercially-available: You can't buy them at a store. Instead, you buy jigs, tools and supplies and build the turnouts yourself.
They are designed to be fully DCC-friendly. PC-board ties provide electrical connection between the stock rail and the adjacent closure rails, and you can build most turnouts with the points and the closure rails as the same rail: You can dip these turnouts in a paint can to weather them without affecting electrical continuity (not that I recommend that technique)!
The all-rail metal frog is isolated from all rails around it by electrical gaps in the rails and in the copper cladding of the PC-board ties.
There are no jumpers to the frog rails beyond the frog.

How to wire:
Solder a feeder from each polarity anywhere on the respective stock or closure rail.
Depending on the frog number, you may choose to leave the frog dead. Keep in mind that Fast Tracks turnouts tend to have longer insulated frogs than other brands for the same frog number. You will probably want to separately supply power to the frog through its own feeder.
Be sure to solder feeders from the bus wires to the frog rails beyond the frog: There's no other way for power to reach them.

7. Peco Electrofrog

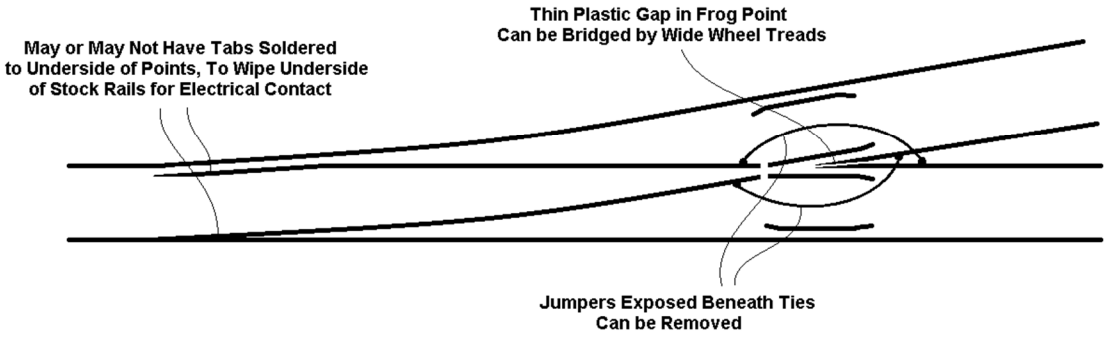


Turnout type: Power routing (but designed to be converted to both routes live)
Frog type: Live metal frog, connected to closure rails and points (but easily modified to be insulated)
DCC-friendly? No (but easily modified to be yes)

Electrical characteristics:
Peco designed an ingenious little turnout! Out of the box it is a power-routing turnout with an all-rail metal frog, just like the Shinohara and Micro Engineering turnouts mentioned earlier. There may or may not be tabs to provide somewhat-reliable electrical contact when a point is closed against its stock rail. But if you want to separately supply power to the frog, there's a feeder wire connected to the frog already folded up under the ties! Just drill a hole in your roadbed below where the frog will sit, and feed the wire through. You can then connect it below the layout to your frog power supply.
If you look carefully, though, there are gaps cut through the closure rails between the frog and the points, with tiny wire jumpers beneath the rails bridging the gaps. You can pry one end of each wire loose with a jeweller's screwdriver, then pull the wires completely away with needlenose pliers. This lets you easily convert the turnout into a DCC-friendly one.

How to wire:
You can wire it just like any other power-routing turnout (Shinohara or Micro Engineering). Don't forget to use plastic rail joiners or cut electrical gaps in the frog rails!
I recommend, though, converting the turnout to DCC-friendly: Remove the jumper wires under the closure rails as described above. Solder feeder wires to <u>both</u> the stock <u>and</u> closure rails: You don't want to rely on the electrical contact between the point and the stock rail. Then use the pre-installed frog feeder wire to feed the frog as described above. You'll still need plastic rail joiners or electrical gaps for the frog rails to insulate the frog from the next lengths of track.

8. Peco Insulfrog



Turnout type: Power routing (but looks deceptively like a "both routes live" type)
Frog type: Dead (plastic) but with risk of short circuit if wired as "both routes live"
DCC-friendly? Not without modification, or using unusual and wasteful wiring

Electrical characteristics:
Peco tried too hard with the Insulfrog, in my opinion. Their goal seems to have been to have the ease of wiring of a plastic frog, while reducing the length of the dead spot by continuing the metal frog rails further into the plastic frog.
The problem is that this makes the plastic gap between the frog rails so narrow that many wheel treads will bridge the gap. If the two frog rails are both powered with the opposite polarity, as they would be in a "both routes live" turnout, this can cause a short circuit each time a wheel crosses the frog.
Later-production Insulfrog turnouts have a wider gap, but even still a wheel conforming with NMRA S-4.2 and RP-25 can bridge this gap.
The Insulfrog's principal characteristics:

- No electrical contact between either stock rail and the adjacent point and closure rail, other than the point touching the stock rail against which it is closed. This defines the Insulfrog as a power-routing turnout.
- The plastic in the frog insulates the closure rail and frog rail of one route from the closure and frog rail of the other route.
- Jumper wires under the frog connect each route's closure rail with its frog rail.

How to wire:
Do NOT wire the Insulfrog as a "both routes live" turnout, with feeders of opposite polarities to the closure or frog rails as well as to the stock rails. Doing this risks causing little blue sparks (and hearing your circuit breaker trip) each time a flat-tread wheel crosses the frog.
It is possible to wire an unmodified Insulfrog turnout as a power-routing turnout, keeping the open point and its closure rail and frog rail dead. In this way, if the gap at the frog is bridged,

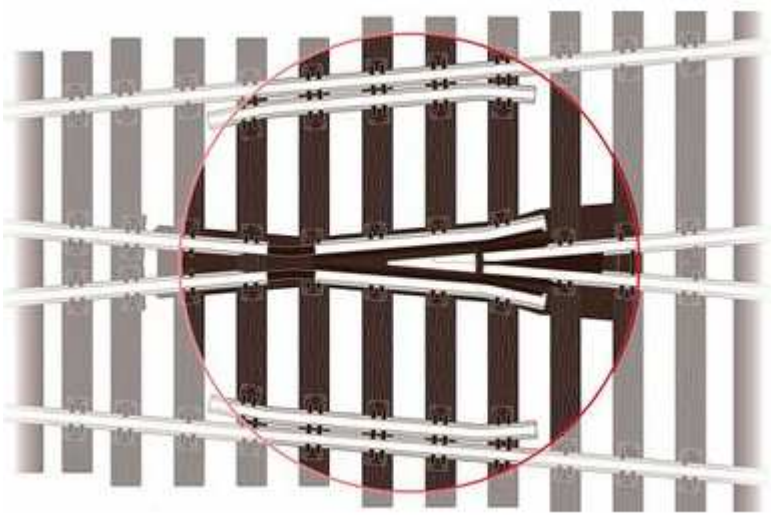
one powered rail is briefly connected to a dead rail, not to a rail powered with the opposite polarity. The Insulfrog thus becomes a DCC-friendly turnout. As with any power-routing turnout, use insulated rail joiners or electrical gaps on the two frog rails. The only problem is that, to apply power to each route's point, closure rail and frog rail only when it is needed, a DPDT switch or two SPST switches are needed. This wiring uses up both sets of contacts within a Tortoise or Blue Point, quite a wasteful use of contacts if you had planned to use the other contact for another purpose like signaling.

Fortunately, only a simple modification allows the Insulfrog to be wired as DCC-friendly using only an SPDT switch, or one of the two sets of contacts in a Tortoise or Blue Point:

1. Turn the turnout upside-down. Using a jeweler's screwdriver, pry up one end of each of the two jumper wires underneath the frog.
2. Using pliers, pull the other end of each jumper wire off the turnout. Discard the jumper wires.
3. Install the turnout. Solder feeders of one polarity to both the appropriate stock rail and to the adjacent closure rail. Solder feeders from of the other polarity to the other stock rail and its adjacent closure rail.
4. Solder feeders from the frog power supply to <u>both</u> frog rails. Now it doesn't matter if a wheel bridges the gap between them, as they always have the same polarity as each other.
5. Don't forget to use insulated joiners (or cut electrical gaps) for both frog rails.

One final note: Don't bother soldering feeders to the frog's wing rails on a Peco Insulfrog. The wing rails are insulated from all other rails.

9. Peco Unifrog



Turnout type: Both routes live
Frog type: See "Electrical characteristics" below
DCC-friendly? Possibly, depending on the width of the gap between the frog rails

Electrical characteristics:
Peco is replacing their Electrofrog and Insulfrog lines with a combined "Unifrog" turnout type. The best information I could find about it comes from the DCCWiki page https://dccwiki.com/PECO_Unifrog. (Note that DCCWiki uses different terminology: What I call the frog rails, they call the point rails. What I call the points, they call the switch rails.)
It seems the Unifrog has an insulated frog like the Insulfrog, but includes a metal frog point that can be powered from your frog power supply, greatly reducing the already-short dead gap in the frog.
Also new for Peco with the Unifrog is that there are feeders connecting the stock rails to their adjacent closure rails. This makes the Unifrog Peco's first "both routes live" turnout.
Judging by the image above (copied from the DCCWiki page), though, it looks like the gap between the frog rails is still too small, easily bridged by a wheel tread – as with the Insulfrog. This is really a problem, now that both frog rails are always energized with opposite polarity to each other.

How to wire:
Not having seen a Unifrog in person, I can only speculate that the jumpers between the closure rails and the frog rails can be removed as easily as in the Insulfrog. If so, do remove the jumpers to isolate the frog rails. (Keep the jumpers between the stock rails and the closure rails.)

Then, solder feeders from your bus wires to the stock or closure rails as with any other “both routes live” turnout. Just don’t solder feeders from the bus wires to the now-isolated frog rails. Instead, connect both frog rails and the frog point to the same source: The separate power supply for the frog. Add insulated rail joiners (or electrical gaps) between the frog rails and the next lengths of rail, and you’ve wired your Peco Unifrog as a DCC-friendly turnout.

Epilogue

What can you do if you already have a number of non-DCC-friendly turnouts, like Shinoharas or Pecos, and you want to modify them to be DCC-friendly?

First, ask yourself why you want to do this:

- Have you been experiencing short circuits?
  - Power-routing Shinohara or Peco Electrofrog turnouts have the theoretical risk of a short circuit between and open point and the back of a wheel on the adjacent stock rail. The gaps at the open points on both turnout types are so wide, though, that this risk is negligible if your wheelsets are all properly in gauge.
  - If you're having short circuits at the frog of a Peco Insulfrog turnout that you've wired in a "both routes live" configuration, and you don't want to lift the turnout off your layout to remove the frog jumper wires, you can use a cutoff disk in a motor tool or a small razor saw to cut electrical gaps in both closure rails and in both frog rails. Solder feeder wires from both closure rails (on the point-side of the gaps) and from both frog rails (on the far side of the gaps) to the respective bus wires. Then solder feeder wires from both closure rails or both frog rails, on the frog-side of the gaps, to your frog power supply. You've just turned your Peco Insulfrog into a DCC-friendly turnout without removing it!
  - If you want to convert a Shinohara turnout to DCC-friendly, you really do need to remove it from the layout. Model Railroader magazine had an article about this conversion in their July 2017 issue ("Upgrading Older Turnouts", page 32). This article glossed over some fairly complex steps, though. I have made this conversion and can give you more detailed illustrated instructions upon request.

- Have you been experiencing dead spots?
  - Most likely, this is due to a power-routing turnout relying on the point touching the stock rail to transmit track power. Add one of the separate frog power supplies mentioned on page 2 and 3 of this handout, and the appropriate feeder wire(s).
  - If you have a Peco Insulfrog, though, you will need to make the modifications described above: Removing the frog jumper wires as described in section 8 above if the turnout has not yet been installed or can easily be removed, or cutting electrical gaps as described above in this Epilogue if the turnout has been installed and can't be removed.

If you have any questions, I'd be glad to hear from you. Again, you can find my contact information (Bruce Wolff) in the Division 6 Board Of Directors section of the Division 6 Newsletter at http://div6-ncr-nmra.com/div6---newsletter.html.