GARDEN RAILWAY BASICS KEVIN STRONG

Automation in the garden: Part 3 — reverse loops

A "reverse loop" is an arrangement of track at the end of a single-track mainline, whereby a train can run around the loop so that it heads back on the single track in the opposite direction (**figure 1**). These features are common on garden railroads, as they allow a single-track mainline over which a train can run back and forth. Sometimes these loops are tucked into garages or other out-of-sight areas, from which the train seems to reappear, magically running in the opposite direction. Other loops are incorporated into the landscape as an integral part of the railroad.

When a railroad has such a loop at both ends of the mainline, this is called a "double reverse loop." With this setup, the train can run back and forth continuously (**figure 2**). For the purposes of this article, I'll refer to the loops as "loops" and the track between them as the "main track."

PHOTOS BY THE AUTHOR

EBT N° 1 brings the daily passenger train around the back of Blacklog on the author's Tuscarora Railroad. Blacklog sits in one of two reverse loops on the railroad. Reverse loops allow trains to run back and forth along an otherwise narrow railroad but they do have some pitfalls for those who run track power. With modern electronics, though, many of those issues are easily resolved.

The catch

Reverse loops are simple until it's time to wire them for track power. While the train reverses, the power in the rails doesn't, which introduces a short circuit (**figure 3**). The "simple" solution to this is to isolate the two loops from the main track, using a toggle switch to change the polarity of the voltage on the main track while the train is in the loop (**figure 4**). This is a great solution—it's been working for decades. All you have to do is remember to throw the switch while the train is in the loop. Simple, right? Well, just ask my dad how many fuses he has replaced on account of yours truly getting distracted and forgetting to throw the switch. (We ultimately solved the problem by switching to battery power, but that's a discussion for another time.) Fortunately, manufacturers have heard similar tales of woe from customers and have produced a bevy of products that control things automatically, saving lots of fuse-swapping, overloads, or other pitfalls.

There are some idiosyncrasies that need to be addressed with automated, track-powered reverse loops. First, it's an electrical necessity with automated reverse loops that the train must always travel in the same direction around each loop. It doesn't matter what the direction is, and it can be different for each loop, but it must be consistent. If the train enters the loop the "wrong" way, it will encounter reversed track polarity and there will be a short.

Second, there's the issue of the switch at the close of each loop. To ensure that the train always travels in the correct direction around each loop, the switch machines (if so equipped) should be wired together, so that both throw the switch the proper direction when the locomotive trips the sensor. That requires powered switch machines.

If you're not using powered switch machines, you can achieve the same thing

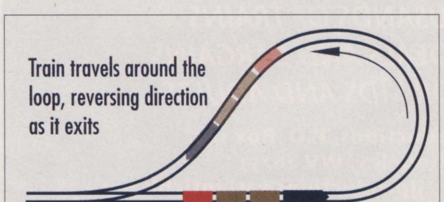


Figure 1: Reverse loop

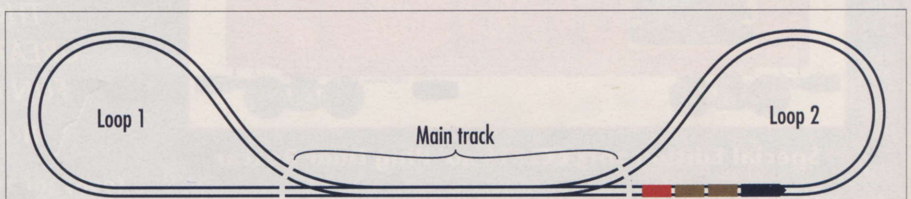


Figure 2: Double reverse loop for continuous running

ILLUSTRATIONS BY MARC HOROVITZ

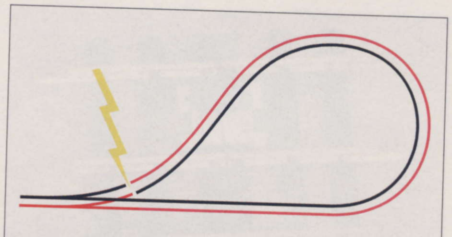


Figure 3: Electrical short caused by reverse loop

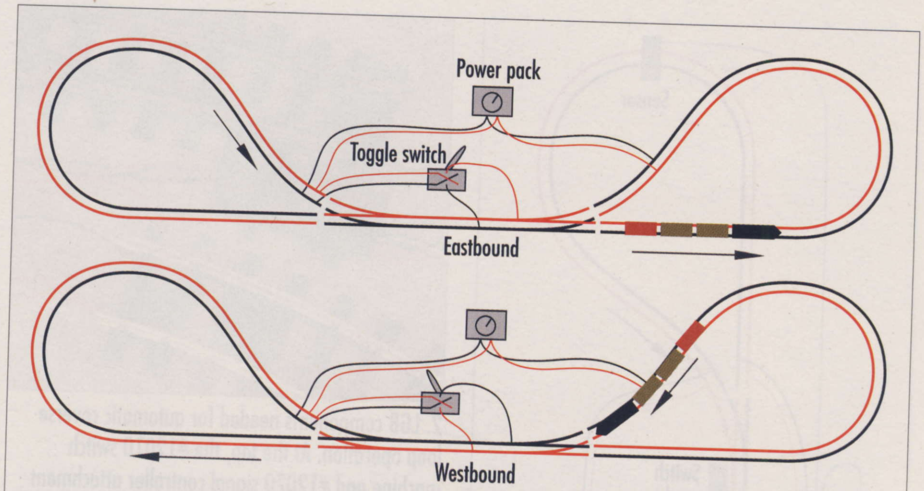


Figure 4: Toggle switch for controlling polarity on main line

by using spring switches. This is a spring-loaded throw that holds the points of the switch against one rail but allows a train coming through the switch in the opposite direction to push the points aside. Once the train has passed, the points spring back to their original position (**figure 5**). It's this last part that's critical. If the points don't return to their former position, the train will try to travel the "wrong" way around the loop the next time it goes by, creating a short at the gap. The drawback to spring switches is that their reliable operation depends upon the train's wheels being able to push the points over. This is problematic with certain locomotives, particularly steam engines with lightweight pilot trucks, which can have a tendency to ride up and over the points instead of pushing them open, leading to derailments.

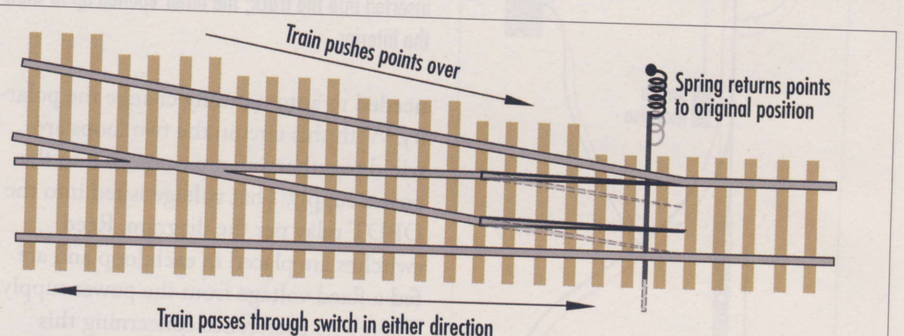
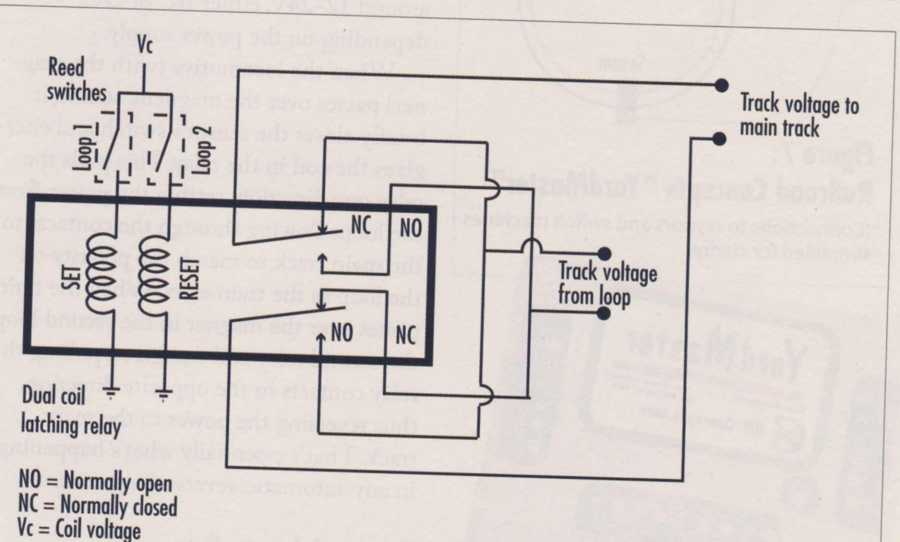


Figure 5: Spring switch

Running a train automatically through a reverse loop

There are a few closely-related ways of accomplishing automatic reverse-loop operation. The trick (as with all automation) is in sensing where the train is so that the electronics can control the direction of the electricity in the track. This is commonly done with magnetic reed switches that sense magnets on the bottom of the locomotive. These reed-switch sensors are placed in each of the loops. When the locomotive passes over the sensor, it triggers the electronics, which reverse the polarity of the voltage on the main track between the loops so that the train can exit the loop without shorting the track.

I've included a circuit diagram for the do-it-yourself crowd, using a dual-coil latching relay, readily available online (**figure 6**). This shows the basic components



Relay coil voltage—Dependent on power supply: typically 5-30V DC or AC
Contact Current - 1 to 10 amps available. Choose a value capable of handling the load of your train.

Relays are available from online retailers

Figure 6:
Dual coil latching relay circuit for automatic reverse-loop control

PHOTOS BY THE AUTHOR

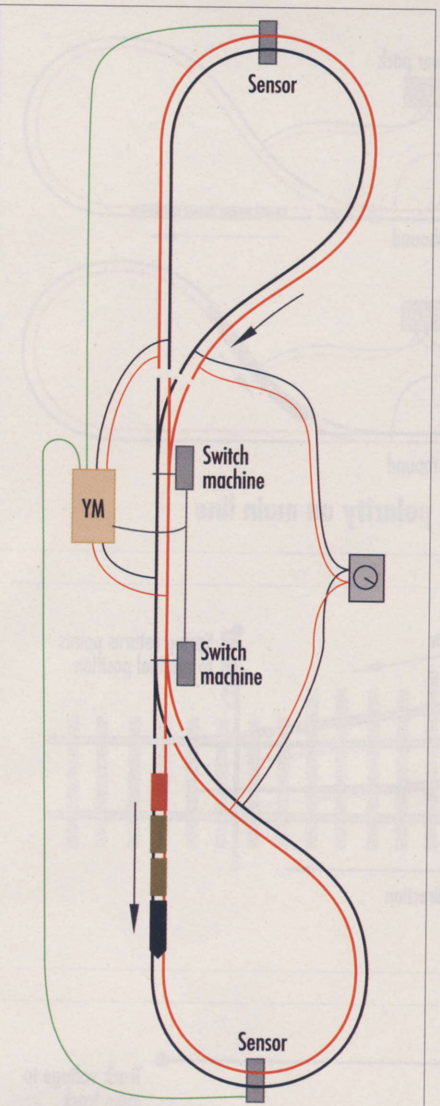
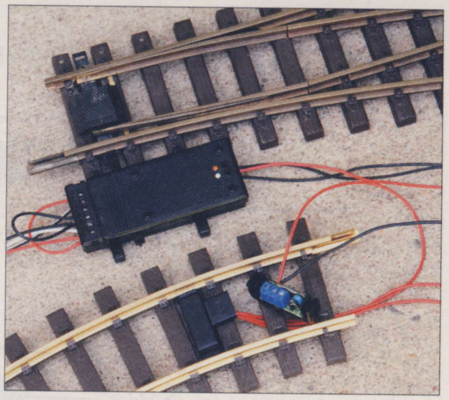


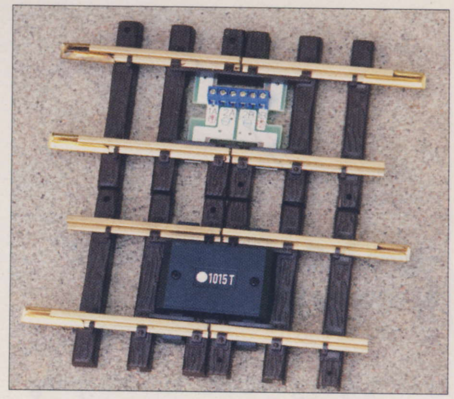
Figure 7: Railroad Concepts "YardMaster"

(Connections to sensors and switch machines simplified for clarity)

1. Railroad Concepts' "YardMaster" offers probably the simplest and most compact means of controlling reverse loops and switches. Everything can get wired into this little box. With the addition of magnets on the underside of the locomotive, reverse-loop operation becomes fully automated.



2. LGB components needed for automatic reverse loop operation. At the top, the #12010 switch machine and #12070 signal controller attachment (at the left end of the switch machine). Also the #17100 track contact, one shown assembled and inserted into the track; the other opened up to show the interior.



3. LGB offers these isolated track sections, which can be used to isolate the reverse loops. As an added feature, they offer screw terminals, making it easy to unobtrusively attach wires to the rails.

needed to automatically change the polarity. With this circuit, the two loops are wired together and are connected to the power supply. That voltage is fed into the DPDT relay per the diagram. Reed switches are placed in each loop and are fed a fixed voltage from the power supply. There's no preference concerning this voltage—just make sure whatever relay you choose matches it. This is usually around 12–24V, either AC or DC, depending on the power supply.

When the locomotive (with the magnet) passes over the magnetic sensor, it briefly closes the sensor's switch and energizes the coil in the relay. This pulls the relay one direction, setting the power from the loops flowing through the contacts to the main track to match the polarity on the loop as the train exits. When the train passes over the magnet in the second loop, the second relay coil energizes, pulling the relay contacts in the opposite direction, thus reversing the power to the main track. That's essentially what's happening in any automatic-reverse-loop control.

Commercial controllers

For those not so electronically inclined, most commercially available systems work on this same principle. Railroad Concepts' "YardMaster" (**photo 1**) uses two magnetic sensors; one in each loop. This is probably the most all-inclusive product available. In addition to the sensors flipping the polarity of the main section of track while the train is in the loop, the YardMaster will also control the direction of the switches at the close of each loop (**figure 7**). In terms of the amount of wiring necessary, it's probably the simplest of all the systems.

LGB offers a number of components that will allow you to control a reverse loop, though their most logically named "Reverse Loop Kit" is, strangely, not the best product for automatic control. As designed, it allows for the control of a single reverse loop but you must physically reverse the polarity of the power supply while the train is in the loop. Its application for automatic control is limited at best, so I'll just mention that they make it.

Having said that, LGB offers a good alternative for automatic control (**photo 2**). The "heart" of this alternative is the LGB switch machine itself, which is designed to accept an accessory that essentially turns it into a big DPDT relay. In addition to physically moving the points on the switch, the relay attachment can be wired to control the polarity of the voltage going to the main track. The switch machine on the second switch does not need this attachment but would be wired together with the first switch machine so they both throw together (**figure 8**). A magnetic sensor placed in each loop triggers the machines, which control the polarity of the main-track voltage to match the position of the switch.

LGB also offers special track sections (**photo 3**) with isolation gaps and screw

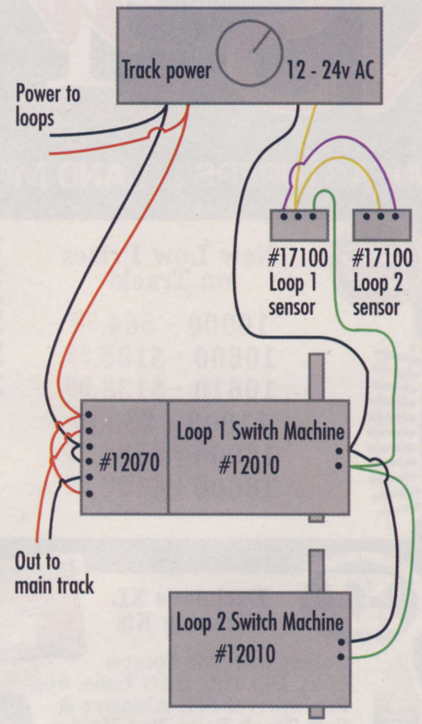


Figure 8: LGB component wiring

Sources and parts list

Manufacturer	Product(s) used	Price
RR Concepts	YardMaster	$55.00
LGB	#12010 Switch Machine *One needed per loop*	$39.98
	#12070 EPL Turnout/Signal controller	$39.98
	#10151 Reverse Loop Track Set *Not necessarily applicable to automatic operation*	$69.98
	#10152 2-rail Insulated Track *Two needed per loop, or just use insulated rail joiners*	$31.98
	#10260 Insulated Rail Joiners 4/pk *Alternative to 10152 and/or 10151*	$9.98
	#17100 Track Contact *One needed per loop*	$20.98
Massoth Elektronik GmbH	DiMax Reverse Loop Module *One needed per loop*	$125.00

Contact information for product sources:

RR Concepts
1357 Hodges Rd.
Oceanside CA 92056
www.rr-concepts.com

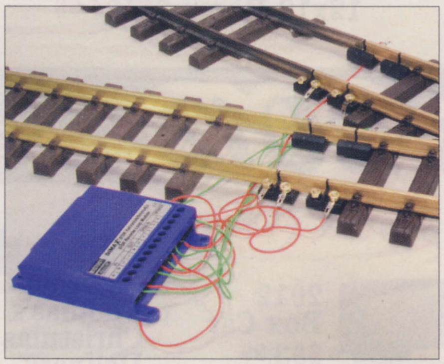
LGB (Wm. K. Walthers Inc., distributor)
5601 W. Florist Ave.
Milwaukee WI 53218
www.walthers.com

Massoth Elektronik GmbH
Frankensteiner Str. 28
64342 Seeheim-Malchen
Germany
www.massoth.com

terminals to attach the various wires, but they're not mandatory. You could also just use insulated rail joiners and attach the wires to the rails through other means.

Massoth Electronics' reverse-loop module uses a different approach to this issue, one that does not require magnets on the locomotive (**photo 4**). It uses short "sensor tracks," which are essentially 1" lengths of rail that are completely isolated from any track power. These short rail sections are connected to the control circuit. When a locomotive's wheel rolls onto the isolated section of track, power flows through the other wheels to this isolated section, energizing it (**figure 9**). The controller reads this and compares the polarity it sees with that on either side of the sensor. If the polarity is reversed, it will throw a relay and set it to the proper polarity. If the polarity's the same, it does nothing. Because it doesn't rely on locomotive magnets, it's great for installations like club railroads, where it's likely that not all of the locomotives would be fitted with magnets. On the downside, this system does not control the switches themselves, so you'd need additional electronics for that. Also, you'll need one control box for each individual loop.

I've always liked double-reverse-loop trackplans for my railroads. Admittedly, my railroad being battery powered means I don't think twice about including such a feature but, from a practical standpoint, the products available today make it nearly as easy to incorporate these loops on track-powered railroads. While it does require some extra wiring, the need to be ever mindful of throwing the switch is gone.



4. Massoth's approach to reverse loops doesn't use magnets on the locomotives. Instead, short, isolated sections of track detect the train's presence and adjust the polarity of the track around it to match what it senses.

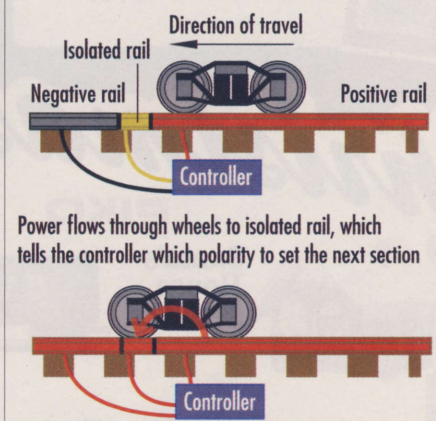


Figure 9: Massoth reverse-loop-module-sensor operation

About this series

August 2012: Auto-reverse systems
October 2012: The station stop
February 2013: Alternating trains in/out of sidings
April 2013: Multiple trains on one loop at one time
June 2013: Combining features and advanced concepts in automation