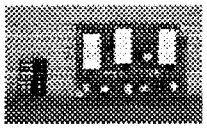
Introduction

Loy's Automatic Reverse Section Controller (ARSC) is designed specifically for NMRA DCC powered model railroads. Except for turntable bridge tracks, it is capable of controlling any type of reverse section - from very simple (including the standard reverse loop) to multiple reverse sections with multiple entry points.

A reverse section is a section of track that connects to opposite polarities at opposite ends. While a reverse loop is a reverse section, not all reverse sections are loops.

Part #/Loy's Order #	Description	Pricing		Purchase
ARSC	Automatic Reverse Section Controller	MSRP	Loy's Price	
			$39.95	1 Add to Your Shopping Cart



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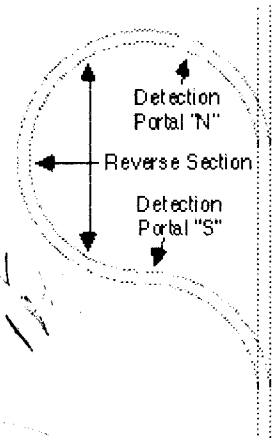
To start with, we'll discuss how Loy's ARSC works. We'll then discuss installation for various types of reverse sections.

These instructions assume you are familiar with under-the-bench track bus and feeder wiring, and understand the importance of using the correct wire size. If not, Kalmbach publishes a book titled "Easy Model Railroad Wiring" that may be of benefit to you - just ignore the part about wiring toggle switches for block control.

How the ARSC Works

There are three parts to a simple reverse section when controlled with an ARSC: two detection portals, and the reverse section itself, as shown at right.



While the reverse section is always powered with one polarity or the other, only one portal is powered at a time - the other portal is in the detection mode.

When a loco enters the north portal, from either direction, polarity in the reverse section is set to match that end, the north portal is powered, and the south portal goes into the detection mode.

When a loco enters the south portal, from either direction, polarity in the reverse section is set to match that end, the south portal is powered, and the north portal goes into the detection mode.

If the loco is within the reverse section when this happens, polarity is switched right under the loco. But, because the decoder is controlling which direction the loco is going, regardless of polarity, the loco doesn't react to this and just keeps going in the same direction.

The requirement for the ARSC to know a loco is present is that two powered wheels must be in the detection portal at the same time at least two powered wheels are outside the portal. With all-wheel power pickup locos, this always happens. With most lighted passenger cars, this doesn't happen because they pickup right rail power from the front truck and left rail power from the rear truck. This is how the ARSC tells a loco from a lighted passenger, or other power pickup, car.

Most older steam locos only pick up right track power from the right drivers and get left track power from the left tender wheels - making it look exactly like a lighted passenger car. This is why power pickup has to be added to these units to make the ARSC work.

While the loco doesn't have to have all-wheel power pickup, it does have to have power pickup on both wheels of the first axle that has power pickup. And if you want to be able to back through the reverse section, it also must also have power pickup on both wheels of the last axle that has power pickup.

You should add power pickup to all-wheels just to have a better running loco. It's fairly easy with Tomar's all-wheel power pickup kit. If you want to see how it's done, check the article about it on page 112 in the March 1995 issue of Model Railroader. The Tomar kit provides all the parts you need to do this installation.

Reverse Section Length

Most people's first thought is to use all the available trackage for the reverse section - probably because that's

the way it's done with analog toggle switch block control.

And with block control, that's OK - simply because engineers are used to being cognizant of where block gaps are, and are always at the ready to flip a toggle or rotary switch. But, with DCC, not only is none of this necessary, long reverse sections can be detrimental and therefore unwanted.

First, keep in mind that other brands of reverse section controllers not only require the reverse section to be longer than the longest power pickup train, but also require that power pickup train to be fully out of the reverse section before the next train can enter at the other end.

Also keep in mind that DCC eliminates the need for engineers to be cognizant of blocks and limit lines, as it should. And with an automatic reverse section controller, engineers will not only forget where the gaps are, but actually forget that the reverse section even exists.

So, with other brands of reverse section controllers the reverse section must be kept long enough for the entire train of power pickup cars (up to 20 or 25 feet), and engineers may forget that there is a reverse section. Any time a train is entering one end of the long reverse section at the same time a power pickup train is still exiting the other end, you will have a short circuit - the booster will shut down and won't fire up again until you clear the short manually.

But, with an ARSC, you can make the reverse section very short - it only needs to be as long as the longest MU lashup that goes through it.

For example, let's say that you run 5-unit diesel MU lashups. Even Dash-9s are only 10 inches long (HO-Scale), and it's a rare sight to see more than three of these lashed up. So, since four feet will easily accommodate any reasonable diesel lashup, four feet is as long as your reverse section needs to be, unless you have some unusual special need.

Even if you wanted to model the UP jockeying 10 locos back south from Los Angeles, it would only need to be seven or eight feet long.

Even if your reverse section has to be as long as eight feet, that's still a good bit shorter than 20' or 25'. But more important, with a Loy's ARSC, a loco can enter one end while a power pickup car is exiting the other end - without any adverse affects. The only requirement is that a loco does not enter a portal at one end while another loco is within the portal at the other end.

How long does the reverse section "need" to be? With the ARSC, it must be long enough to contain the locos in an MU lashup, AND any cars that have all-wheel power pickup.

For example, the Roco DCC operational Crane has all-wheel power pickup. Ergo, it must be counted as a loco when considering the length of your reverse section. If you couple it up right after the last loco in the MU lashup, think of it as just another loco in lashup. But if you couple it six feet back in a cut of cars, you have to accommodate the fact that you'll have a loco entering the reverse section six feet back from the last loco. If your reverse section (including both portals) is shorter than six feet, there's no problem - the crane won't be entering the reverse section until after the locos have exited. As long as the crane isn't crossing one portal

while the locos are crossing the other one, there's no problem.

Most lighted passenger cars, and other cars with power pickup, usually do not have all-wheel power pickup. Most of these cars pick up power from the right rail with the front truck and from the left rail with the rear truck. This is how the ARSC tells a power pickup car (to ignore) from a loco (to switch polarity), and to provide other advantages over other reverse section controllers.

There are some cars that get power from both rails with both trucks (all-wheel power pickup). In this case the ARSC sees them as a locos and therefore has to either be treated like a loco (the reverse section being as long as the longest train with these cars), or disable some of the power pickup to make them look like a car.

Currently, the only cars I'm aware of that come with all-wheel power pickup from the factory are Kato N scale lighted passenger cars, the Roco DCC controlled crane car, and some Roco lighted passenger cars.

So, again, how long does the reverse section need to be? Easy - at least as long as the longest MU lashup that will go through it. It doesn't hurt to make it a little longer than anticipated - just in case you decide to occasionally run a longer than normal lashup through it.

Unless you have special needs, 3 feet is usually more than long enough for N-Scale, 5 feet for HO-Scale, and so on

Portal Length

First, some important things about portal length.

1) Portal length is important for keeping passenger cars from causing a short when the polarity is reversed for that end of the reverse section, and is the only thing controlling portal length.

2) Portal length is irrelevant for locos.

3) Portal length is irrelevant for non-power pickup cars.

4) Lengthening, shortening, staggering, or any other modification to the portal will not help steam locos that don't have all-wheel power pickup to work.

5) Messing with the length and location of the portal rails will not do anything except for passenger car considerations as noted in 1) above. And messing with the configuration of the portal other than what's recommended here will most likely cause lighted passenger cars, or other power pickup cars, to cause short circuits when crossing a portal when it's in the detection mode.

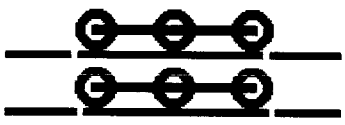
Hopefully, this makes it clear that there's nothing you can do with the portal to keep you from having to add power pickup to some steam locos, and nothing you can do to alleviate any other situation except for the one purpose the portal length is for - keeping lighted passenger cars, and other power pickup cars, from causing a short circuit when the polarity is reversed at that end of the reverse section. So, when might that be?

If you have a passenger train that is seven feet long, but your reverse section is only four feet long, the loco will exit the other end of the reverse section before the train is completely within it. In this situation, the loco will switch the polarity to match the other end while passenger cars are crossing the first portal, with the reverse section polarity opposite that of the track on the other side of the portal.

The portal length being longer than the passenger car truck insures that the truck is fully within the portal before it starts crossing the gaps to exit the portal - thus not causing a short circuit.

The portal length being shorter than length of the shortest car (usually an old time 34' Overton passenger car), insures that the lead truck of one passenger car has fully exited the portal before the lead truck of the next passenger car starts entering the portal.

So, what does all this mean?



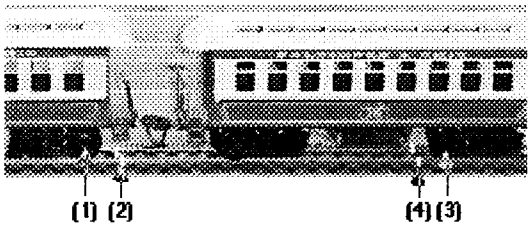
The minimum portal length is directly related to length of your longest power pickup car truck (remember, locos aren't considered for this). For HO-Scale, the minimum is about 1-3/4". The idea is that the entire truck must be able to fit fully within the portal, with staggered gaps, as illustrated at left.

If you don't have three-axle power pickup trucks, the length can be shorter - just as long as it's longer than the longest power pickup truck you will ever have on your layout.

If you will never have cars with power pickup trucks on your layout, the portal can be as short as 1/2". But play it safe an make it at least 1" anyway. However, keep in mind that if you make your portal this short, you will either never be able to have power pickup cars on your layout, or your reverse section will have to be long enough to contain the entire train that has power pickup cars.

Yes, as long as your reverse section is long enough to contain the entire train, portal length is irrelevant. As stated before, the only thing that makes portal length important is to keep power pickup cars from causing a short circuit when crossing the portal when it's in the detection mode (when the loco has switched polarity and power pickup cars are still crossing the first portal).

The maximum portal length is related to the length of your shortest cars power pickup (not locos). For an HO-scale 34' Overton passenger car, that's about 4.5".



As shown above, wheels (1) must clear gaps (2) before wheels (3) cross gaps (4). It doesn't matter if the front truck of tany car crosses the gaps when the rear trucks of any other car are also crossing, only that two front trucks or two rear trucks do not cross gaps at the same time.

If you have power pickup cars shorter than 34' Overtons, your portals will need to be shorter. If you don't have anything as short as a 34' Overton, your portals can be longer.

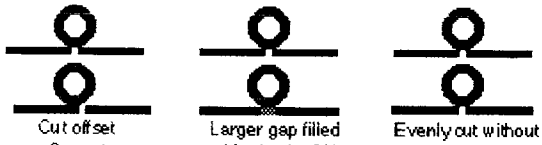
Scale	Ratio	Minimum	Optimum	Maximum
Z	220:1	0.7"	1.2"	1.7"
N	160:1	1"	1.7"	2.4"
TT	120:1	1.3"	2.2"	3.2"
HO	87:1	1.7"	3"	4.5"
S	64:1	2.3"	4.2"	6.1"
O	48:1	3.1"	5.6"	8.1"
G	22.5:1	6.6"	12"	17.4"

In any case, we recommend you stick with the optimum, as shown in the chart at left, unless you have some special reason to do otherwise.

Isolation Gaps

As with any reverse section, it must be electrically isolated from the rest of the layout. Power going to the reverse section and detection portals must be fed only from the ARSC.

Isolation gaps should be offset by about 1/16" to 1/8", as illustrated below (left). If your reverse section is already isolated with even cuts, you can open one of the gaps a little more and fill it with plastic (center). The only purpose for this is to insure that two metal wheels on a freight car do not bridge the two gaps at the exact same time (right), which could incorrectly trigger the ARSC.



A Dremel tool cut-off wheel or Atlas' #400 Super Saw can be used to make isolation gaps.

After cutting the gaps in the rail, confirm that they are in fact cut all the way through, and totally isolated from all other rail parts. You can use an ohmmeter, test light, or any other device capable of testing for continuity. Test each portal rail and both reverse section rails. None of them should have any continuity with each other or with either mainline rail.

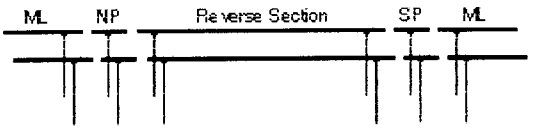
Once you have confirmed that all rail pieces are totally isolated, fill the gaps with something to insure the short portal rails won't slide one way or the other and touch one of the adjacent rails - especially on grades. Following are a couple of ways to accomplish this:

1. Epoxy or White Glue: Fill the gap with 5-minute epoxy or white glue. Even if the gap isn't completely filled, it will be satisfactory if there's enough there to keep the two rails apart. Scrape or file excess epoxy (or glue) away, especially on the inside of the rail.
2. Plastic or Card stock: Fill the gap with a piece of styrene plastic or paper card stock, and glue. Trim with a file or hobby knife, especially on the inside of the rail.

Note: The whole, and only, purpose for staggering the gaps is to keep two metal wheels from bridging the gap at the same time. If this happens, the ARSC will mistake this for a loco and reverse the polarity. Most of the time, this will be irrelevant. If the locos have already exited the other portal, having the reverse section switch to the other polarity won't cause a problem. But, if any loco wheels are still in the exiting portal when this happens, the ARSC will try to do both polarities at the same time. This could cause the booster to shut down due to the short circuit, and could make the ARSC stop between polarities. If this happens, you'll need to reset it with the finger flip method outlined later in the documentation.

Track Feeders

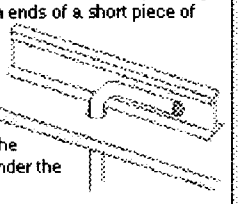
Solder track feeders to both rails in both portals, and to both ends of both rails of the reverse section.



Installing track feeders at both ends of the reverse section makes for the absolute best installation. This insures good solid detection power when a loco is exiting the reverse section. Likewise, installation of track feeders on the mainline rails next to each portal will insure good solid detection power going into the reverse section.

Tip: Installing Track Feeder

Drill a small hole beside the rail for the wire to come up through. Strip about 1/4" of insulation off both ends of a short piece of 22 AWG solid core wire. Bend and install the wire as shown here. Use two different colors of wire. Install one color on all the right rails, and the other color on the left rails. This way it will be easy to tell the right rail from the left when you're under the layout connecting wires.

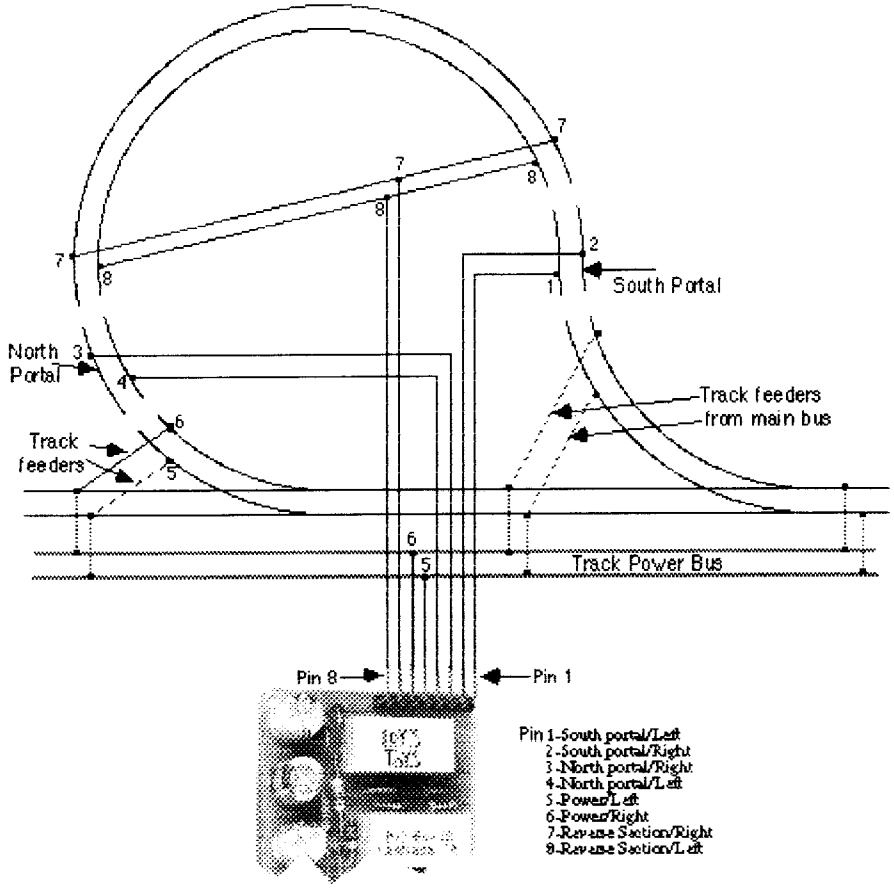


Making the Wire Harness

Find a place under the layout somewhere close to the middle of the reverse section, but don't mount it yet. You just have to know where it will be so you can measure wire lengths to make the wire harness.

The most common reason the ARSC does not work properly the first time is incorrect wiring - mixing up North and South, or left and right. To help alleviate this, it's best to use two colors of wire to make it easier to keep track of left and right, such as white for the right rail and black for the left rail. Zip cord usually has a stripe on one wire, which can be used the same way.

For any scale up to HO, portal wire size can almost always be 20 AWG stranded, even though the wires may be up to three feet long. Even though four or five locos may be occupying the reverse section at one time, only one loco will be drawing power from any given portal at one time



And it will never be drawing more than half of its power from that portal - the other half of the power will be from the adjacent track that the loco's other truck is on.

Compare your ARSC with the illustration above to determine the pin connection sequence. Note that the connector on the ARSC can be unplugged so you can take it to the bench to solder wires to it.

Hopefully the ARSC will be mounted within a foot of the track power bus. And, with the reverse section being only five feet long, the reverse section wires shouldn't be more than 2.5' long. So, 20 AWG (larger for larger scales) stranded should be fine for the reverse section.

If you purchased an ARSH wire harness with your ARSC, the portal wires are about 3' long, the reverse section wire 1' long, and the power connection wire about 2' long, all with 20 AWG stranded wire. The intention is that they will be cut to length as needed when installed.

If making your own, make the harness with wires longer than necessary, then trim them to fit when installing it.

While the 8 metal pieces in the plastic socket housing can be removed for crimping, most people don't have the proper tool. It's easier to solder the wires with the metal pieces left in place in the plastic housing.

Strip about 1/8" of insulation from the wire. Place the wire in position and use a small blade screwdriver to press the wire's insulation down into the last 1/16" of the end of the trough. With wires pushed into place, you can then solder them. You have to use a hot soldering iron, and do it quickly. Otherwise, you stand a chance of melting the plastic.

DO NOT SOLDER WIRES DIRECTLY TO THE ARSC PINS. This will automatically void any warranty and make it exceedingly difficult to troubleshoot. If you screw up the connector that came with the ARSC, call us for another one.

Wiring the Reverse Section

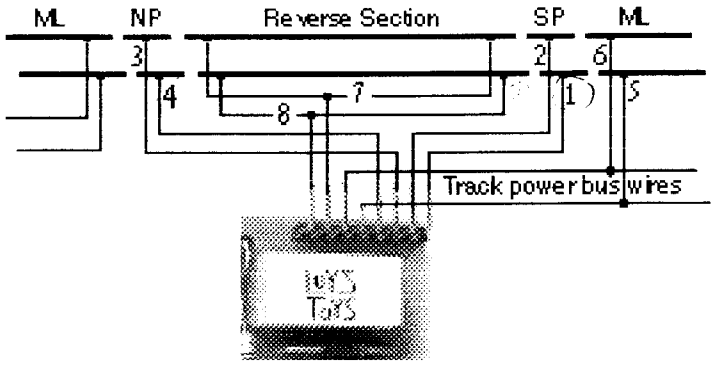
Left rail and right rail are extremely important when wiring your ARSC. There are several ways to keep this straight. If you have used two different colors of wire for your track power bus wires, call one color left and the other right. If you already have your DCC systems, and also have a voltmeter, you can use that to tell left from right. Select address zero, the analog address, and give it full power. This will place DC voltage on the track that you can see with a voltmeter. One rail will be positive, the other negative. If the left rail going into the south portal is negative, all negative rails are left rail.

Regardless of which way you keep track of left and right rail, it's very important to keep that straight - to and including where you connect the power pickup wires (pins 5 and 6) to the track power bus wires.

Looking at the illustration above, notice that pins 1, 4, 5, and 8 are listed as "left" rail. If you're using the color of bus wire to keep track of left and right rail, you might want to substitute "left" for "black", for example. Or, if you're using the DC polarity of the rail as previously discussed, you might want to substitute "left" for "-" (negative). Of course, pins 2, 3, 6, and 7 are right rail, which would then be "white", or "+" (positive), as in our examples.

Here is one very important point: When considering left and right rail for the north portal, it is in relationship to the track entering at the south portal. Don't follow the mainline around to the north portal and match that polarity with left and right rails. Think of it as a reverse section where the polarity is matching the south portal. As such, you will always use the south portal polarity as the reference.

You can actually start wiring anywhere, but I like to start at pin #1 and work up to pin #8. Since the wiring is left - right - right - left - left - right - right - left, it's easy to number the connections right at the rails. Consider the illustration below: ML = Mainline, NP = north portal, and SP = south portal.



Portal Wiring: Since pin #1 is the left rail of the south portal, we start there by numbering that rail #1. Obviously, the other rail is #2. We've now taken care of Left - Right. Next is the north portal, which is Right - Left. Since we finished with right, and the next pin is also right, we just move to the other end of the reverse section on the same rail and number it #3. Obviously, the other rail is #4. That was easy, we're half done.

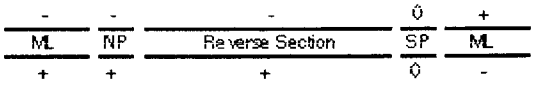
Track Power to the ARSC: Now we move back to the mainline at the south portal. Since the last rail we labeled was the left rail, we stay on the left rail to number that mainline #5. Obviously, the other mainline rail is #6. This is a very important point. If you just continue up to the mainline at the north portal, and stayed on the same rail, you will be wiring it wrong. It's important that you wire #5 to the track power bus wire that feeds the mainline track going into the south portal left rail. If it's unhandy to wire it right at that point, you can wire it into the track power bus wire anywhere, as long as it's to the same color (polarity) as it is at the south portal left rail.

Reverse Section Wiring: Lastly, we move back to the reverse section itself, staying on the same right rail as #6, and mark it #7. Obviously, the other rail is #8. Our illustration shows a short sub-bus so 7 & 8 can have feeders close to 1 and 2, and another pair close to 3 and 4. Note, for reverse sections only 2-1/2 feet long, or shorter, this is not so important as long as there are no rail joiners within the reverse section.

Final Isolation Test: With the wiring done, before you plug the ARSC into the harness socket, check to see that all the rails are still isolated from each other. This eliminates the possibility that you caused a short in the ARSC harness socket, or anywhere else.

Final Polarity Test with a DC Voltmeter: If you have a DCC system, select address "00" (the analog address) and give it full throttle to place DC power on the rail. If you don't have a DCC system, connect a DC power source to the track power bus.

Use a DC voltmeter to check your work. Check to see which portal is powered. Remember, one will be powered, the other will be in the detection mode (no power).



Let's say that the north portal is powered and that the right rail, as going into the reverse section from the north portal mainline, is positive. NOTE: it's OK if your left rail is positive, it doesn't matter which is positive or negative for this test. If you prefer to make yours like the illustration above, all you have to do is reverse the train's direction (or if using a DC power supply for the test, reverse the power wires to the track).

The north portal and Reverse Section should have the same polarity as the main line. Notice that the south portal doesn't have power. Actually, your meter may show a smidgen of power, that's normal. But it won't have full track power.

If any section of track has the wrong polarity, reverse the wires going to it. NOTE: if the mainline polarities are not opposite each other, as shown in the illustration, you don't have a reverse section and shouldn't be installing the ARSC there.

Now short the gaps between the other portal and the mainline - to make the ARSC switch polarities. Both gaps must be shorted at the same time, as if an all-wheel power pickup loco has just crossed the gaps. You should hear the ARSC click, unless you mounted it in a place that could muffle the sound.

If you heard the click, polarity has changed. If you didn't hear it due to its location, polarity still may have changed. To find out, check that portal's voltage. If it has track voltage, polarity changed and is ready to test. If your reverse section matched the polarity in the last test, it should now match the polarity shown below.

+	0	-	-	-
ML	NP	Reverse Section	SP	ML
-	0	+	+	+

If the polarity of the south portal doesn't match the mainline, reverse the wires going to it. NOTE: since you already checked the reverse section's polarity in the previous test, it should also match. If it doesn't, you have something seriously wrong - check to be sure you really need a reverse section controller in this location.

Final Polarity Test with a Test Bulb: With the analog address "00" selected and given full throttle (or with DC voltage connected to the track power bus wires) and using the illustration below as a guide, connect the test bulb leads at the positions indicated below. The test bulb can be a 14-volt GOW, or any other lower voltage bulb with an appropriate resistor.

	3	7	2	
ML	NP	Reverse Section	SP	ML
6	4	8	1	5

If the north portal is powered, the bulb should light with the bulbs leads on 6 and 3, and on 6 and 7.

If it doesn't light at 6 and 3, try 6 and 4. If it lights at 6 and 4, reverse the wires between 3 and 4. If it doesn't light at 6 and 3, or at 6 and 4, something isn't connected properly - check all your wiring.

If it doesn't light at 6 and 7, try 6 and 8. If it lights at 6 and 8, reverse the wires between 7 and 8. If it doesn't light at 6 and 7, or 6 and 8, something isn't connected properly - check all your wiring.

If the south portal is powered, the bulb should light when you place the bulb leads on 5 and 2, and 5 and 7.

If it doesn't light at 5 and 2, try 5 and 1. If it lights at 5 and 1, reverse the wires between 1 and 2. If it doesn't light at 5 and 2, or 5 and 1, something isn't connected properly - check all your wiring.

If it doesn't light at 5 and 7, try 5 and 8. If it lights at 5 and 8, reverse the wires between 7 and 8. If it doesn't light at 5 and 7, or at 5 and 8, something isn't connected properly - check all your wiring.

The Ultimate Polarity Test with a Loco: Use a known good loco that has all-wheel power pickup and a decoder installed (NOTE: Do NOT do this test with an analog loco). This means you must have a DCC system to make this test - the ARSC is NOT designed to work on an analog system, and NO DCC auto-reverse controller will operate properly with an analog loco.

If the north portal is powered, place the loco on the track headed into the reverse section through the north portal. If the south portal is powered, place the loco on the track headed into the reverse section through the south portal.

Select the loco's address and give it throttle to go into the reverse section. If the loco goes through the portal, and gets to the middle of the reverse section without hesitating or shorting the system, you have all the wires connected correctly so far.

If the system shorted out, it's important to know exactly where the loco's wheels were when it shorted out.

If the loco's front wheels just crossed the first set of gaps going into the portal, the portal wires are backward. If the loco wheels just crossed the gaps between the portal and reverse section, the reverse section wires are wrong. In either case, reverse the wires and test it again.

Now run the loco through the other portal. When the front wheels of the loco cross the first set of gaps going into the portal, the ARSC should reverse polarity. If the loco continued on through the portal without problem, wiring is correct. If the system shorted out when polarity reverses, that portal is wired backwards - reverse the wires.

If the loco went into the portal fine, but shorted out when it got to the reverse section, you have a serious problem - check to be sure you really need a reverse section controller in that location.

Note: if a loco won't trigger the ARSC when the leading wheels cross the first gap, check the loco for power pickup. Chances are it needs some service work. When the ARSC is properly wired, the biggest cause of the ARSC not working is locomotive service - something causing power pickup to not be good on one or more wheels. It's a good idea to service your locos on a regular basis, checking for power pickup - not just to keep the ARSC working correctly, but just to have good running locos.

Mounting the ARSC

The Velcro™ on the back of the ARSC will stick to any smooth surface. Remove the protective tape from the Velcro. Hold the ARSC with the exposed sticky tape side facing the mounting surface and let the ARSC find its own orientation according to the natural flow of the wires. When you're satisfied with the positioning, press the ARSC to the surface to make it stick.

Using the ARSC

When the ARSC is properly installed, you can run any DCC-equipped loco through the reverse section in either direction, enter and back out, or do any other type of operation through or within the reverse section without having to think about anything but running your loco. There should be no hesitation as it crosses any gaps, and the system should never be shorted to cause the booster to shut track power off.

However, analog locos (locos without decoders) and locos that do not have all-wheel power pickup pose a slight problem.

Analog Locos: An analog loco will not go through any reverse section without your intervention. Because the polarity on the track dictates the direction of the analog loco, the loco will instantly reverse direction when it hits the exiting portal. It will enter just fine, but will not exit.

However, if you time it just right you can get it to exit. When the analog loco enters the reverse section, get your finger ready to press the direction button. The instant the loco's front wheels hit the first set of gaps (or a split second before), press the direction button to reverse the loco's direction. When the ARSC reverses the polarity to match the exit track, your reversing overall track polarity will counteract it and the loco will continue going forward - two reverses make a forward.

Locos without balanced power pickup: These locos will NOT trigger the ARSC to set proper polarity. The solution is to add power pickup. Many people dread the idea of doing this, but the Tomar all-wheel power pickup kit we carry makes it fairly easy. If you want to see how it's done, check the article about it on page 112 in the March 1995 issue of Model Railroader. Adding power pickup not only will make the ARSC work, but will produce a better running loco to boot.

Problems?

Troubleshooting after initial installation? Click here.

The ARSC should work a good long time for you. We've tested several with over 80,000 reversals without problem. If you run through the reverse section 10 times an hour during a 3 hour operating session, three times a week, this equates to 17 years of operation.

And, there's nothing you can do under normal operating conditions to damage it. Even wiring it wrong won't damage it, it just won't work. But, there is one natural phenomenon with DCC systems and the ARSC.

If you have two locos entering opposite polarities at the same time, the ARSC will try to flip both polarities at the same time, flipping back and forth very quickly. When this happens, the ARSC will buzz.

As long as neither loco crosses the second set of gaps while the other loco is still within the portal, there will be no harm, and everything will continue as normal. However, if one loco spans both gaps while the other loco is still within the other portal, this will cause a dead short (as it would with any reverse section controller).

If this happens, the DCC system's short circuit protection will shut track power off. If this happens at the exact time that the ARSC is using power to flip from one polarity to the other, it could cause the ARSC to stop in the middle of that switching, and render it brain-dead.

There is, however, a quick and easy way to wake it up. Flip it on the head with your finger - sort of like getting it's attention with a 2x4.

Unplug the ARSC from the harness. Hold the ARSC by the connector with the fingers on one hand, and flip the yellow relay on the other end of the ARSC with the middle finger of your other hand. Flip it as hard as you can without hurting yourself.

When you plug it back in, it should work fine. Note that the only time this should happen is when the ARSC is buzzing due to both portals being accessed at the same time, and track power is shut off in the middle of that event.

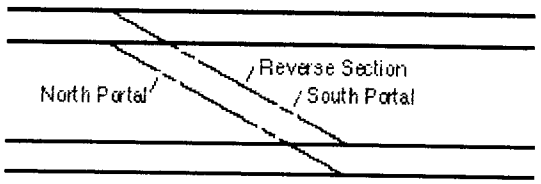
Special installation Note

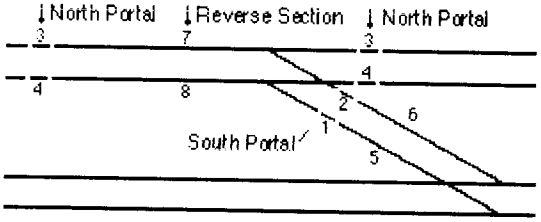
If a portal is right next to a turnout, and the ARSC sometimes doesn't work when entering that portal, check the electrical integrity of the turnout's points. Many turnouts do not have a good solid power connection to the points. And, when the loco runs over it, power can momentarily be lost. This temporary loss of power can cause the ARSC to fail on occasion.

The solution for this is to feed power directly to the points with a short piece of flexible 30 AWG (decoder) wire. For non-power routing turnouts, these wires (using 22 AWG extensions) can be connected directly to the track power bus like track feeders. For power routing turnouts, this power will have to go through a relay that will switch polarities when the turnout is switched. The key is good solid power at all points.

Expanding a Reverse Section

Sometime, a reverse section may be too short, as shown at right. I have one on my layout that would be only 16" long. My two Amtrak FP45s lashed together wouldn't be able to go through it, much less a 5-unit lashup.





The solution, as seen at left, is to move the reverse section out onto the mainline so it can be expanded to whatever length it needs to be.

Wiring it is the same as with a simple reverse section, except for adding two more wires to connect the second north portal (in parallel) to the first one.

Here are a couple of hints to help you figure out which portals are which, and how to wire them:

First, since the mainline itself doesn't have a polarity problem, it's simply straight through with the same polarity all the way, which means that all portals on that mainline will be the same - in our illustration, both north portals.

Second, since the north portal on the right can't be accessed by a train going from the south portal, don't try to figure out which rail is 3 and 4 in the normal way. Treat the north portal on the left and south portal as a simple two-portal reverse section. Once you have those numbered, simply give the right north portal the same numbering as the left north portal.

When trains use the north mainline in the normal manner, in either direction, polarity does not reverse (unless the last train went through from the north mainline to the south mainline). It just stays set to the same polarity as the north mainline, with both north portals having normal track power. Polarity will only change when the crossover is used, and then be changed back, if necessary, when the mainline is used again.

Note that the whole crossover isn't used as part of the reverse section. By keeping the south portal close to the north turnout, a train going from the south mainline to the north can wait closer to the north mainline when it has to wait for a north mainline train to pass. It's not that trains should be waiting closer, but that this reduces the possibility that an errant engineer will enter the south portal pre-maturely.

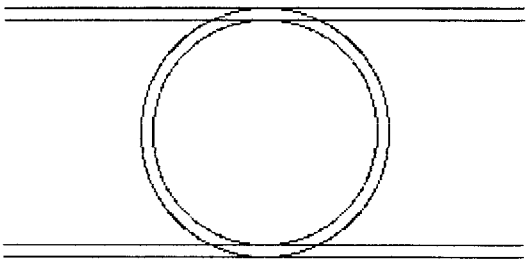
NOTE: When waiting for a train to pass, the waiting train may not enter the portal until the engines of the passing train have completely exited the reverse section.

If the south portal was placed as close to the south mainline as possible, the train going to the north would have to wait completely on the south mainline until the north mainline train has passed. This would be OK, under normal conditions. But after running with DCC for awhile, most people forget that there are still foul lines that have to be accommodated. With the foul lines as close to the real danger as possible, it's less likely

that someone will foul the line and cause a short circuit.

The same holds true for the north portal to the right of the turnout. Keep it as close to the turnout as possible. However, in doing so, you must insure that the points on that turnout have good solid track power as previously discussed.

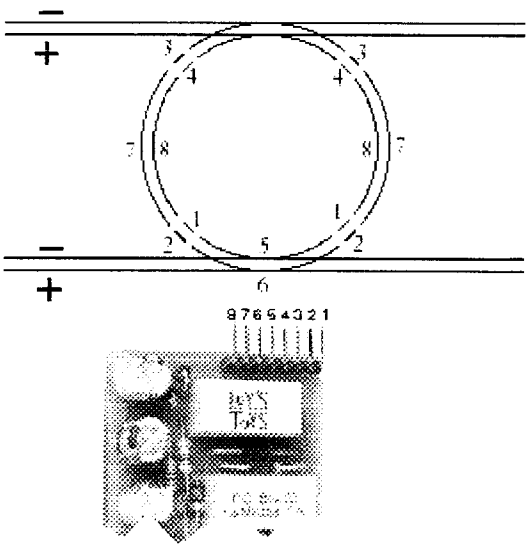
A More Complex Reverse Section



The reverse section shown at right is one we've run into several times over the years. While your's may not be just like this one, it will give you some ideas on how to handle other non-standard reverse sections.

The first inclination is to install two reverse sections, one in each of the circle halves. While one ARSC could control both sections, and is readily doable, it can also be done with just one reverse section. We'll show it first as two reverse sections controlled by one ARSC, then show it as one reverse section.

Controlling Two Reverse Sections with One ARSC



Two or more reverse sections can be controlled with one ARSC, not only in the situation shown to the right, but in any situation. Simply hook all north portals together in parallel, all south portals together in parallel, and all Reverse Sections together in parallel. While this keeps you from having to purchase additional ARSCs, there are limitations when doing this.

1) Opposite polarity portals cannot be used at the same time. For example, if one engine is entering or exiting a south portal at the same time another is entering or exiting the north portal of another reverse section, there will be a short circuit and trains will stop. No damage will be done, but you'll have to push the engines off the gaps manually to correct the problem, and maybe reset the ARSC with a flip.

This restriction only limits the use of opposite polarity portals at the same time. Once a loco lashup is

completely within the reverse Section, other locos may enter or exit any portal at will. Or, one engine can enter or exit one south portal, for example, at the same time another engine is entering or exiting a different south portal. They just can't use opposite polarity portals at the same time.

This is not a restriction only with the ARSC. This restriction applies to all reverse sections that are wired together, no matter how they're controlled.

2) Loy's ARSC is limited to a little more than 3 amps at 15 volts. Ergo, you should limit the number of trains in the reverse sections controlled by one ARSC to 3 amps or less. If you might need to have more trains in multiple reverse sections than that, you should split the reverse sections up into multiple ARSCs.

This should be of concern only to the larger scales, unless you have a large number of reverse sections where lots of engines and/or lighted cars will be on them at the same time.

3) Distance has to be considered. 20 AWG wire is adequate for one HO-scale, or smaller, reverse section. But when controlling two or more reverse section with one controller, you must use larger wire to connect them all together. Otherwise, there could be too much resistance in the wire and keep the reverse section controller from recognizing a loco. The example shown here has the two reverse sections close together so it doesn't require wire much larger than normal. But if the two reverse sections are further apart you should use wire suitable for that distance, such as 14 AWG for 20 to 35 feet.

For clarity, we have left the connection drawings out, in favor of just numbering the connection points - connect all 1s to pin 1, etc.

First, you can see that the two mainlines are wired in parallel. There is no polarity problem with a crossover. But, since each of these sections reverses the direction of the loco, each is a reverse section.

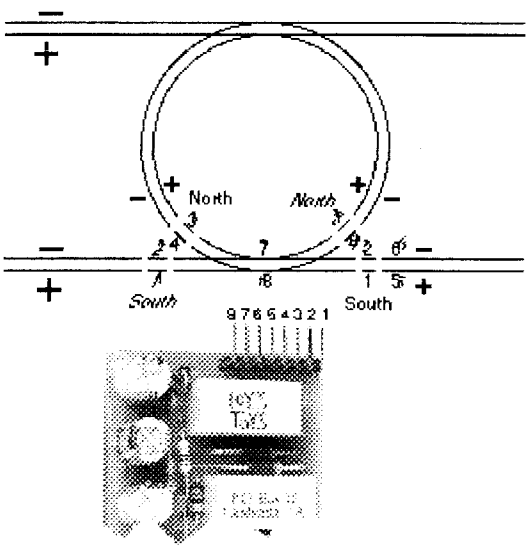
There is one little twist on this wiring that you need to understand. It's sort of like the extra north portal on the previous (reverse section expansion) scenario. But this one shows it in a way that may make you wonder about it.

Start with the reverse section on the right. You can lay it out and number it just like an ordinary simply reverse section, with all the same rules, hints, and tips. But notice that the reverse section on the left starts out with pin one on the right rail of the south portal. This is the point you need to understand.

It really doesn't matter whether you start with the right or left rail, so long as you follow through with the proper pattern - either left - right - right - left - and so on, or right - left - left - right - and so on. In the case of this example, we have one reverse section with the left - right sequence, and the other with the right - left sequence. Why?

The ARSC has only two power inputs, 5 and 6. These pins have to be in the proper sequence the same as all the rest. Since 5 and 6 have already been established by the first reverse section, you can't reverse them so the other reverse section can start out on the left rail. Notice that pin #1 is on the same side of the track as pin 5. So, if you already have pin 5 set to one rail or the other, simply start the numbering sequence on that side.

Combining Two Reverse Sections into One



Note that this is the exact same track plan as the previous example. The only difference is that the reverse section location has been changed. Just because it's obvious that there is a reverse section doesn't mean it has to be where you would first assume. More about that later.

For this one, choose a portal to be the south portal, as you would with any other reverse section. For the illustration, we chose the right mainline portal to be the south portal. As with the "Expanding the Reverse Section" example, the other portal on the mainline (labeled with italics) will be identical to the first mainline portal - both south in this example.

That means that the other two portals must be north portals. You can use the normal "simple reverse section" numbering method for the entire thing. Starting with the left rail of the south portal being #1 and the other rail being #2, then moving to the south portal and number right to left as 3 and 4, then back to the mainline at 1 and 2 to number left to right as 5 and 6, then back to the reverse section to number right to left as 7 and 8.

This only leaves the left mainline portal to number (numbered in italics), which we've already established as being identical to the other mainline portal, and the other loop portal (also numbered in italics) which we can extrapolate as being identical to the other loop portal.

We can prove this by moving the "+/-" signs down closer to the portals. If you look back at the testing portion of the original "simple reverse section" wiring segment, you'll see that the +/- polarity for the mainline at the north portal is reverse that of the mainline at the south portal - as it is in this example.

More Amperage for Large Scales

The contacts in the ARSC's relays are rated at about 3 amps at G-scale voltage. While this is ample for most G-scale locos, it may be inadequate for some, and for MU lashups. To provide more power for G-scale, or

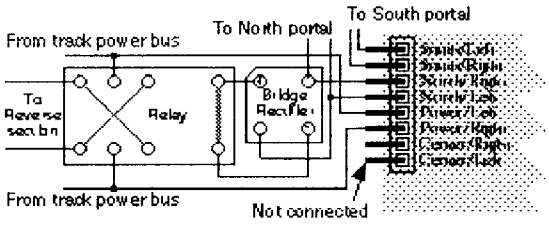
other high current draw scales such as Lionel and American Flyer, another relay needs to be used.

Relays are generally available at most electronic stores, including Radio Shack. Electronic surplus stores have them extremely cheap. When selecting a relay, you have three things to consider:

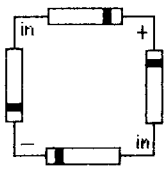
- Contacts rated with adequate amperage for your application
- Coil rated at G-scale voltage
- AC or DC relay coils

Ideally, you'll find something in the range of 5- to 10-amp contacts, with activating coils operating on 20 volts AC. Considering that 12-volt DC relays are more readily available, steps can be taken to accommodate them, or any other relay operating on less than 20 volts.

The wiring schematic here shows using a DC relay. If you've managed to find an AC relay of the proper voltage, you can eliminate the rectifier bridge and hook the portal wires directly to the relay coil.



The bridge rectifier only has to be rated at the relay's power consumption, not the track power consumption. In lieu of a bridge rectifier, you can use a set of four diodes to make the bridge rectifier, as illustrated at right.



Lastly, if you need to reduce the voltage to the relay coil, you can insert a resistor or a series of diodes. Each diode will reduce the voltage by about 0.7 volt. Place them between the rectifier bridge and relay. Resistors vary, so if you opt to use a resistor for voltage drop, you'll have to use trial and error to find the correct resistor.

If the polarity in the reverse section is wrong after you get this connected, simply reverse the reverse section wires.

Block Detection

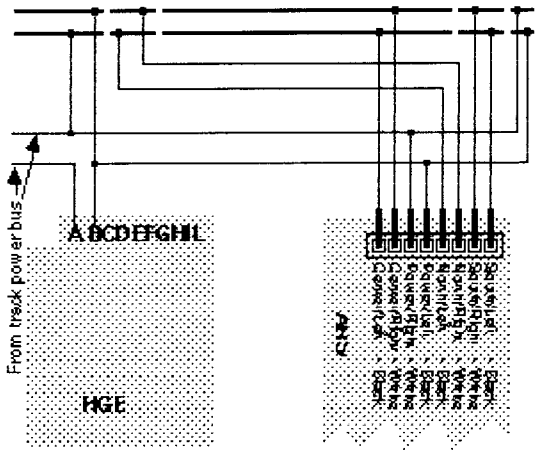
Many people like to have signaling of one kind or another, especially on hidden reverse sections so they know whether or not it is being used.

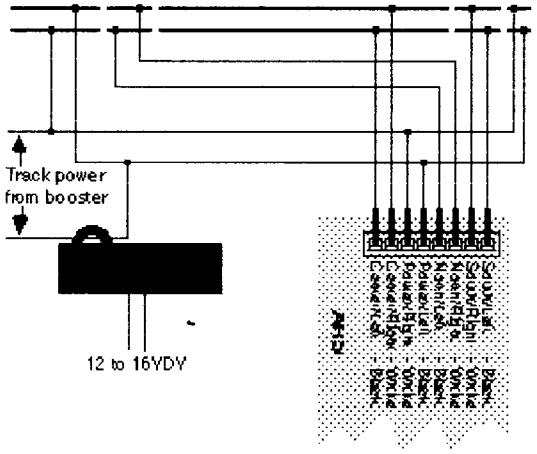
With all other reverse section controllers, power is pulled from the track power bus. Even the Digitrax PM42 that has its own external power source draws some power from the track. This means that none of those reverse section controllers can be used downstream from a block detector. If wired downstream, between the block detector and track, the block detector will see the power being drawn by other reverse section controllers and falsely report a loco as being present. But since the ARSC draws no power from the track

unless a loco is present, it can be safely used with block detection.

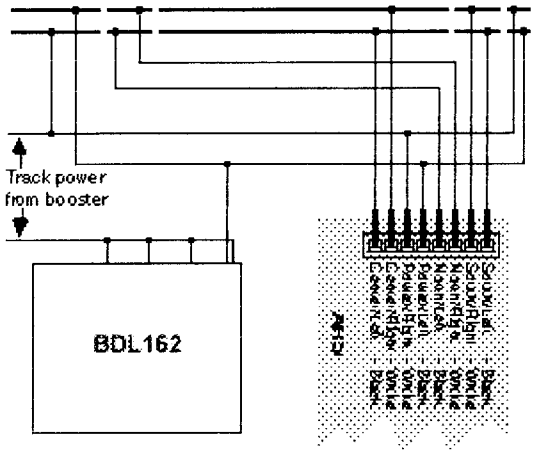
With an HGE block detector, since the reverse section is already isolated from the rest of the layout, simply place the HGE in one of the power lines to the ARSC, as shown below.

This illustration shows an HGE powering the track before and after the reverse section as well as the reverse section - making them all in the same detection block.





Wiring an ARSC with an inductive type block detector is exactly the same.



Wiring the ARSC with a BDL16 is also the same.

NOTE: use of one ARSC for multiple reverse sections becomes exceedingly difficult with signaling, unless the reverse sections are excluded from detection blocks.

Automatic Reverse Loop Turnout Control (ARLTC)

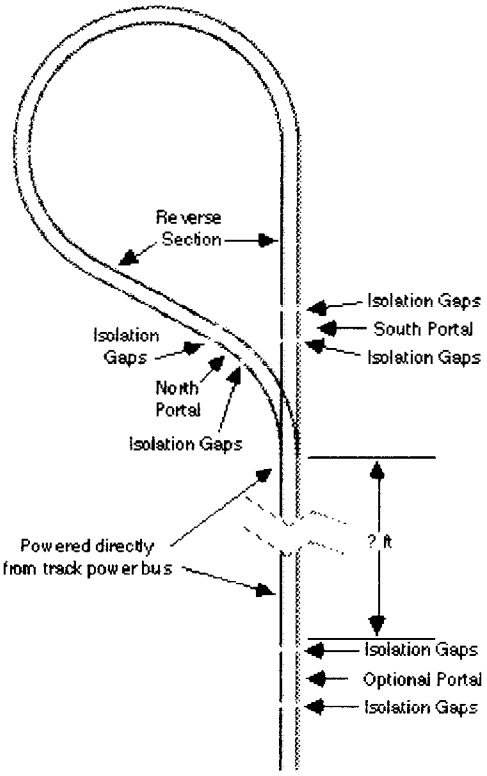
An Automatic Reverse Loop Turnout Controller can be used in conjunction with an ARSC to create a fully automated reverse loop.

When doing a normal ARSC installation, you will have north and south portals in the loop, as shown at right. With the ARLTC wired without an optional portal, the train will enter one way one time, and the other way the next time - continually alternating back and forth.

If you want to control which way the train goes in, you can install a trigger button to the north portal, and another trigger button to the south portal, covered later.

If you want the train to enter the same way each time, you can install an optional portal as illustrated at right. This portal absolutely must be far enough from the turnout to contain any train that will go through the reverse loop - because the tail end of the train has to clear the turnout before the loco crosses that portal when coming out of the loop.

Loy's Toys no longer manufactures ARLTCs, but it's easy to make your own.



Making an ARLTC

To make an ARLTC to control a Tortoise or other stall motor machine, you'll need a DPDT relay, two bridge rectifiers (or 8 diodes), two diodes, and possibly a resistor. Making one for twin-coil machines is more difficult. It would be much easier to switch to a stall motor machine if having an automatic reverse loop is your goal.

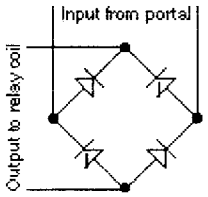
If you can find a DPDT relay that works with AC voltage, you can eliminate the need for one bridge rectifier. However, these are hard to find. And if you can't find a relay that operates with the voltage provided from the track power bus, you'll need an appropriate resistor. The value you'll need will depend on three things: your track voltage, the voltage needed by the relay, and the amount of current drawn by the relay's operating coil.

We'll break the wiring down into two sections: relay actuation, and turnout motor wiring

Relay Actuation

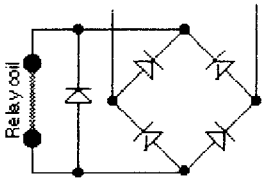
The way this works is based on the fact that only one portal is powered at a time - the other portal is in the detection mode with no power applied. Wire the relay actuating coil to one portal or the other - it doesn't

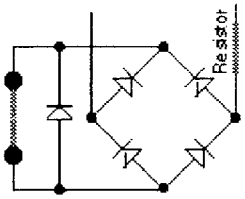
matter which. When polarity of the reverse section is one way, the portal will be powered and the relay will be active. When the polarity is the other way, the portal will not have power and the relay will relax.



If your relay isn't designed for AC voltage, you'll need a bridge rectifier. If you don't have a bridge rectifier, you can make one with four diodes, such as four 1N4001s, as illustrated at left.

Because a collapsing field from the coil will cause Back EMF that needs to be dissipated, another diode needs to be add as shown at right.

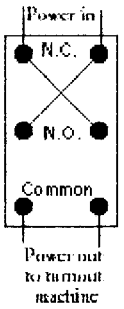




You also have to consider the relay/track voltage difference. Most relays operate on 5 or 12 volts. There are others, but aren't as prevalent. All you have to do to cut the voltage down is add a resistor as shown at left.

The more resistance, the lower the voltage. So if you put a resistor in that keeps the relay from activating, you need a resistor of lower value. The key is to use a resistor of low enough value so the relay will operate reliably, but no more. Allowing too much voltage to the relay coils could damage the coil after some usage.

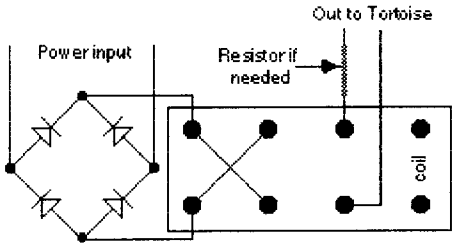
Turnout Motor Wiring



The relay must be a DPDT device. Your relay may or may not have the same pin out as that illustrated here, so you have to go by the pin labels.

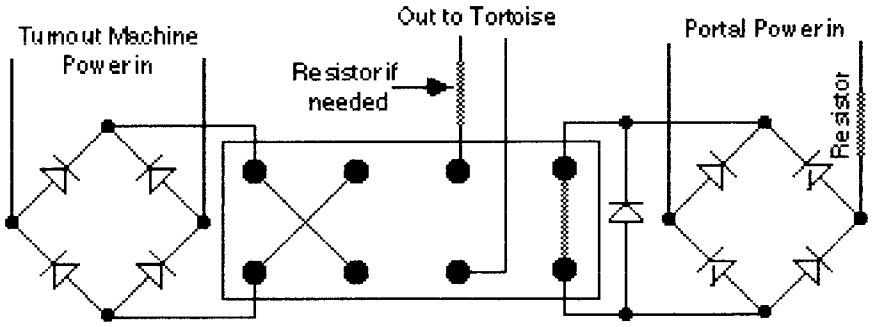
Note the X between the N.C. (normally closed) and N.O. (normally closed) terminals - the X does not connect in the middle where they cross. These wires, which you must install, are what reverses the polarity for the switch motor when the relay operates.

Since a stall motor uses the polarity of the power to know which way to go, you must feed DC power of the voltage needed by the turnout machine you're using. For example, a Tortoise needs about 12 volts, so 12 volts DC must be fed to the power-in pins.



If your power supply provides AC, you can convert it to DC with another bridge rectifier of four diodes, as shown at left. Note that when converting normal AC this way, the voltage will go up - so it's necessary for you to check the voltage. If the voltage is too high, you can reduce it with a resistor as you did on the other circuit.

You can actually get power from the track for this. Because DCC track voltage is AC voltage, you have to use a bridge rectifier, or four diodes. However, because it's "square wave", you won't get an increase in voltage. But you need to check the voltage anyway, and use an appropriate resistor if needed.

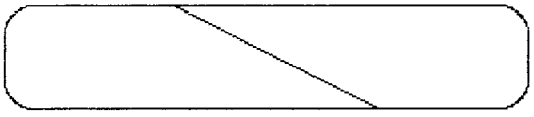


Here we see it all put together, with portal power entering the bridge rectifier (diodes) on the right, controlling the relay's coil on the right, power input for the turnout machine on the left (rectified if needed), and output to the turnout machine in the middle.

Identifying Reverse Sections

If it's not obvious that you have a reverse section, or where it might be, or whether or not it can be moved to a different location, the following information might help.

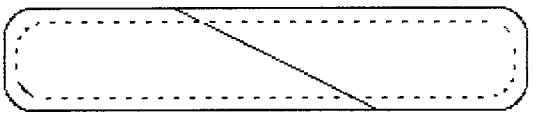
First, you will need a drawing of your track plan. Actually, you may need two, three, or more before you're finished. Ideally, the drawing will only show one line for the track, not both rails. If the one you have already shows both rails, that's OK - it will still work. So, start by making a couple of copies of the track plan before you start - which behooves you to make your drawing on one or more 8.5" x 11" sheets for easy copying. Use the copies to mark on, so you can keep the original pristine for making more copies if you need them.

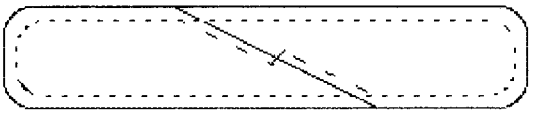


The track plan shown at left is simplistic so it won't get too cluttered while showing you this technique.

The extra lines, for the second rail, will be drawn dotted to be able to tell them apart from the original lines. I suggest you use a red pen to draw the second rail in.

Start anywhere, and draw in the second rail with your red pen. Below you can see that we've draw the second rail in for the complete loop (with our dotted line).

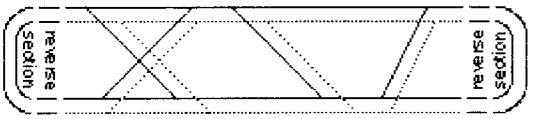




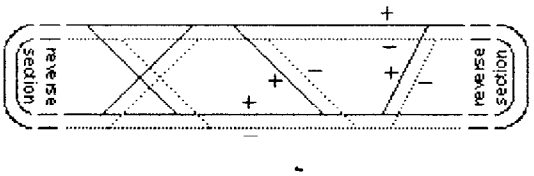
When we try to draw the dotted (red) line in for the crossover, it becomes apparent that there is a polarity problem - because the dotted line has to cross over the solid line in order to come out on the dotted line side at the other end.

This means that there has to be a reverse section somewhere. It's obviously in the crossover. But, as we discussed in the "expanding the reverse section" before, it can be moved if necessary.

For many people with dog-bone designs, the solution is two reverse sections, as shown at right.



This allows them to have as many crossovers (even double crossovers) in the middle as they like, without having to contend with a reverse section at every one of them. Doing so also moves the reverse sections to locations where there is more room to accommodate them.



This allows them to have as many crossovers (even double crossovers) in the middle as they like, without having to contend with a reverse section at every one of them. Doing so also moves the reverse sections to locations where there is more room to accommodate them.

Note that this requires the layout to be wired a little differently to start with. Instead of wiring it as one large loop, the lower section is wired backwards to what it was before, with the dotted (red) line at the bottom like at the top of the loop.

This is why it's important to identify where you will be placing your reverse sections before you start doing your track wiring.

If your layout is as simple as these illustrations, you have no need to draw red rails in to see where the reverse sections are, or see the alternatives. So when you start drawing on your track plan, you may find that you make a mistake or two - crossing the original line when turning at turnouts when you weren't supposed to, for example.

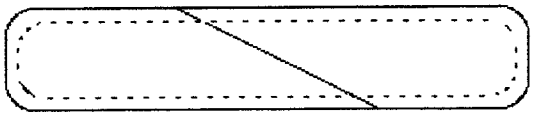
For this reason, it's important that you trace your lines from both directions. Once you do it one way, turn around and do it again, starting from a different point, and do all the loops and crossovers in a different sequence. This is why you will need at least two copies to start with. And when you make a mistake, you'll want to re-do it on yet another fresh copy so you don't get mixed up with erased lines that don't quite get erased.

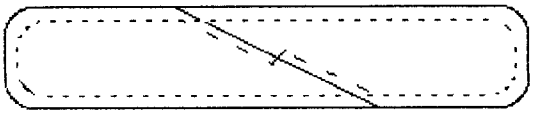
If the place you find that needs a reverse section is in a precarious place, try drawing yet another one, with the idea in mind to force the reverse section elsewhere. Many times you can draw a precarious place in first without the reverse section, which will force the reverse section to another location. Keep trying it until you can get the reverse section into a more suitable location.

Also, if you have two or more reverse sections, you can sometimes draw other plans that can force two reverse sections into one, as was previously shown with a circle between the parallel mainlines.

And if you have trouble nailing this down don't hesitate to mail a copy of your track plan to us so we can figure it out for you.

Start anywhere, and draw in the second rail with your red pen. Below you can see that we've draw the second rail in for the complete loop (with our dotted line).





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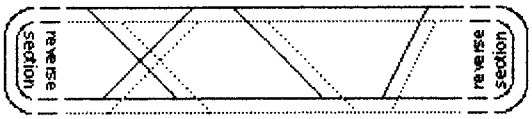

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