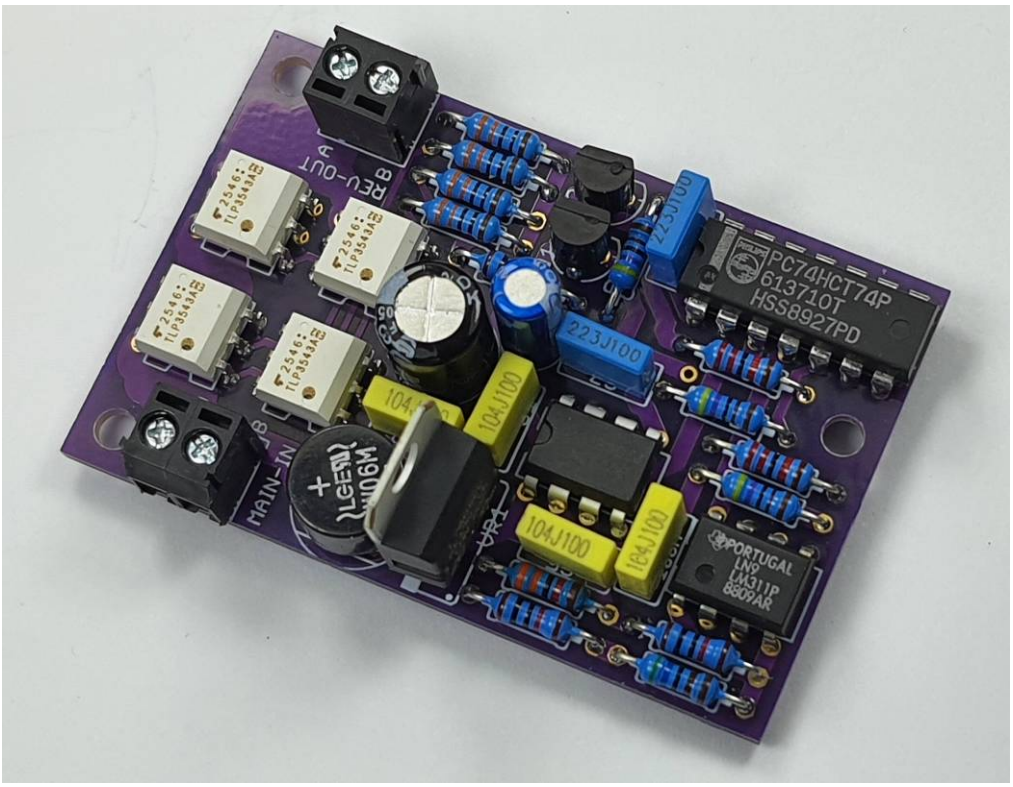
A Simple All-Electronic Auto-Reverser

Introduction

If your DCC layout incorporates a reversing loop or wye, and you would like to run trains through this part of your track without having to stop and fiddle with electrical switches, then you are going to need a unit which automatically swaps over the connections from your DCC booster to the loop or wye sections of track.

The auto-reverser shown in [1] uses readily-available through-hole components, so that, provided you are capable of using a fine-tip soldering iron (and are comfortable assembling electronic components on to a printed-circuit board) you should be able to buy the components easily and build a unit for yourself.

In the interests of long-term reliability, this auto-reverser uses solid-state switching chips rather than an electromechanical relay. And, to keep things simple, there is no microcontroller or software programming involved, nor are there any operating adjustments to make. You can procure the printed-circuit board (PCB) for the unit from a number of suppliers using the standard design files which are provided.



All photographs and diagrams by the author

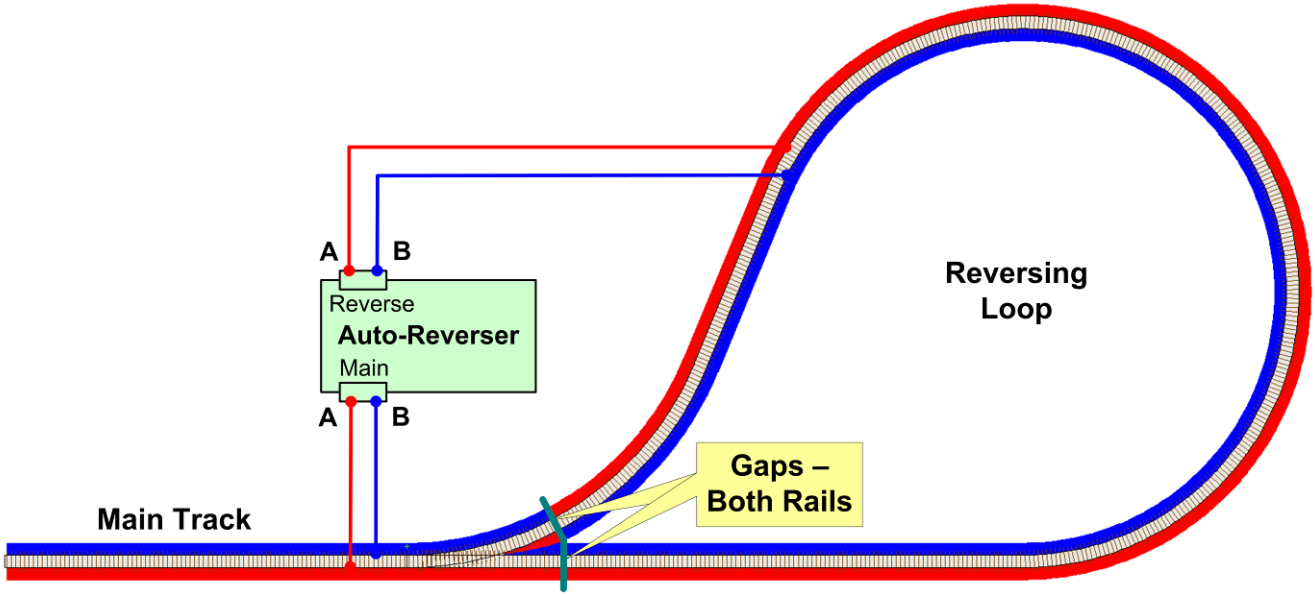
1. Assembled Simple Auto-Reverser

For those of you who are not quite sure how an auto-reverser works, a simple example will (I hope) make things clear. Although the two-wire DCC output from your booster does not,

technically, have a defined polarity since the booster drives each rail alternately positive then negative several thousand times a second, we do have to keep the connections to each section of your track in step (‘in phase’).

So, if we label the booster outputs and the rails as A and B, when connecting the booster to each section of your track, you must ensure that all the A rails go to the booster A output, and all the B rails are connected to the booster B output.

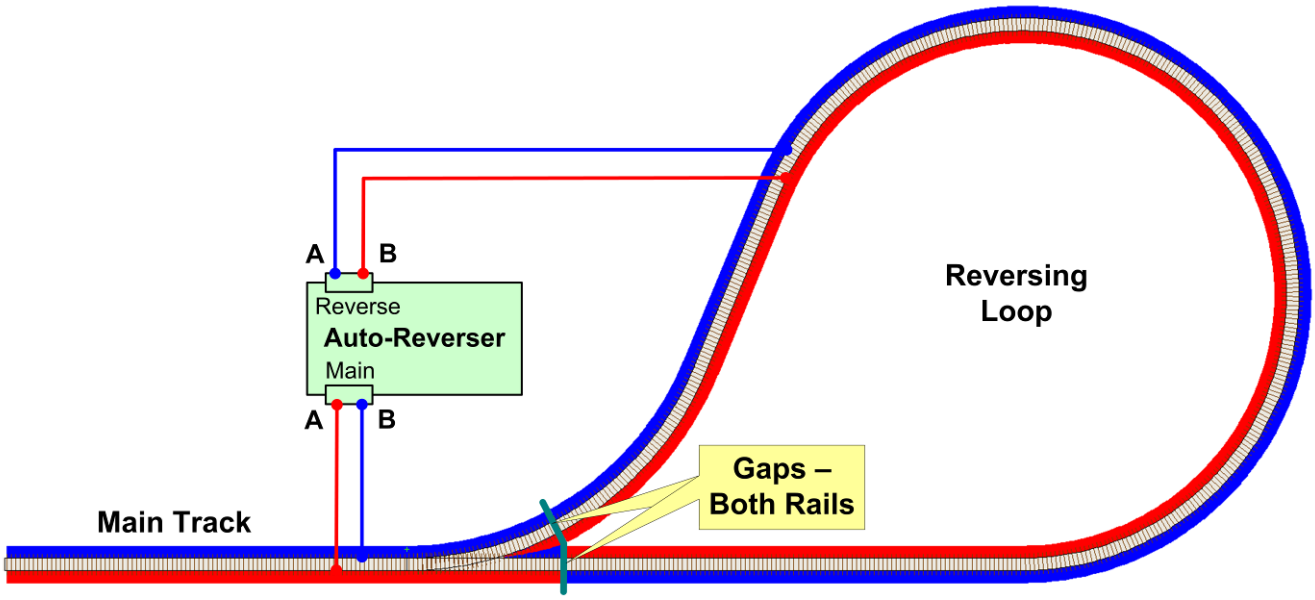
However, when you incorporate a reversing loop in your layout, such as shown in [2], you can see that, as the loop track returns to the diverging exit from the turnout, an A rail (red) potentially gets connected to a B rail (blue) –



2. Example of a Reversing Loop

To prevent an immediate short-circuit between the A and B rails (and booster outputs) gaps are cut in both rails at, or near, each of the turnout exits, as shown. The auto-reverser unit is then connected with its Main inputs connected to the layout main track rails, and with its Reverse outputs supplying DCC power to the rails of the isolated reversing loop track.

With the turnout set to the diverging direction, and with a locomotive approaching the loop from the main track, as soon as the first metal wheel of the locomotive bridges one of the rail gaps, a short-circuit between A and B rails will occur. The auto-reverser unit detects this short-circuit, and immediately swaps the Reverse output connections so that the A output is connected to the B input, and the B output to the A input – eliminating the short-circuit and allowing the locomotive to proceed without any noticeable change in speed. Technically, the unit reverses the ‘DCC phase’ applied to the reversing loop, with the result shown in [3] –



3. Reversing Loop with DCC Phase Reversed

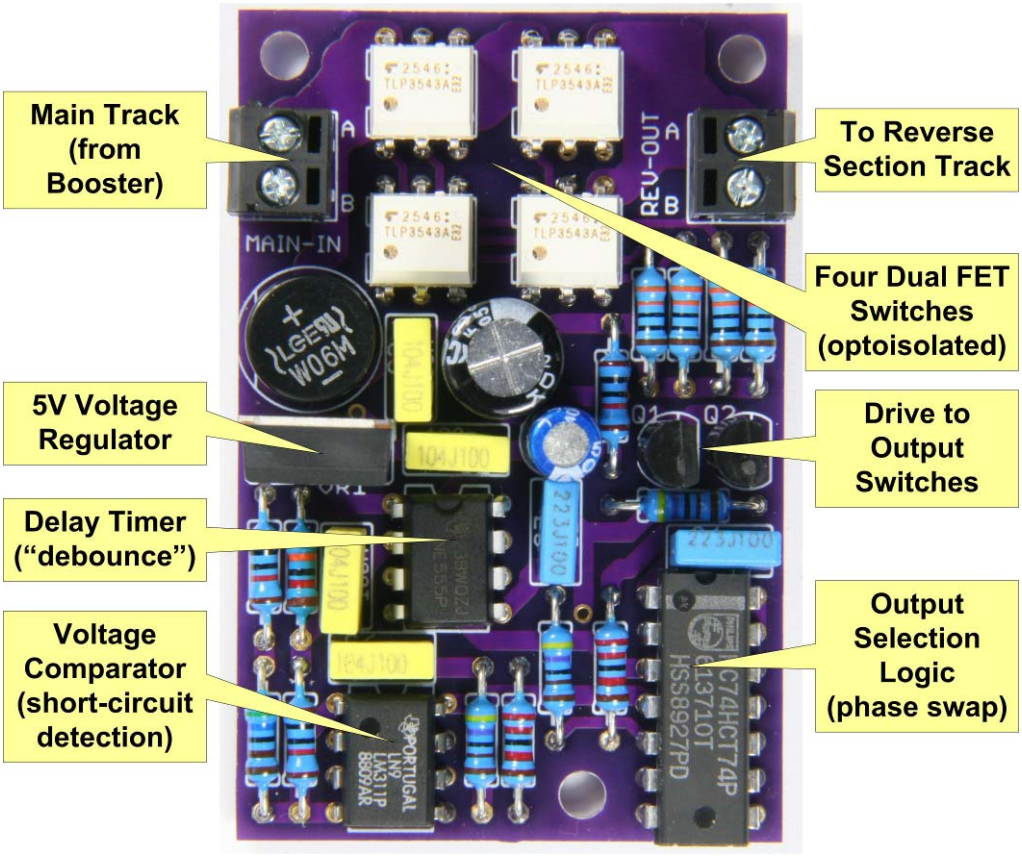
After running around the loop, and with the turnout reset to the straight direction, as soon as a locomotive wheel bridges a track gap at the turnout straight exit it will create another short-circuit. The auto-reverser will then swap the phase of its Reverse A and B outputs back to where they were originally, and so remove the short between A and B rails. The switching within the auto-reverser generally happens so quickly (within milliseconds) that there is no interruption to the locomotive's progress.

For further details of the various track configurations where you might use an auto-reverser on your layout, have a look at Allan Gartner's 'Wiring for DCC' website pages at https://wiringfordcc.com/intro2dcc.htm#a26 and at https://wiringfordcc.com/track_2.htm#reversing .

How does it work ?

All commercial auto-reversers work by sensing the short-circuit current which occurs as soon as the locomotive wheel bridges a track gap. Unfortunately, the electronics required to sense the magnitude of a current is not simple – measuring a voltage change is much easier and, in fact, the commercial auto-reversers generally first convert the current change to an equivalent voltage and then use the detected voltage to operate the auto-reverser.

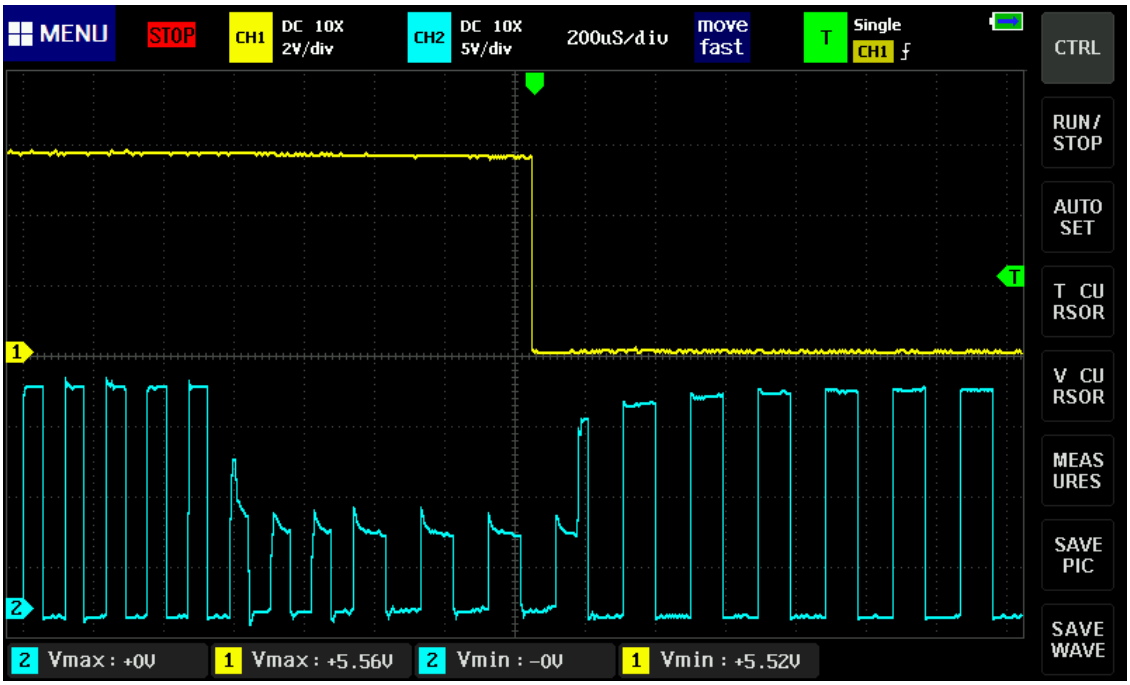
However, as well as generating a current surge, the short-circuit at the track gap also causes the voltage applied to the track to collapse towards zero. The Simple Auto-Reverser (SAR) presented here simply senses this significant dip in track voltage directly and uses this to change the output DCC phase. The unit's structure is outlined in the picture at [4].



4. Simple Auto-Reverser – Internal Structure

The voltage comparator detects the dip in track voltage as the locomotive's wheels cross the track gap and immediately triggers the output selection logic to drive the appropriate pair of dual-FET switch chips and reverse the output DCC phase. The four optically-isolated dual-FET switches replace the double-pole changeover electromechanical relay used in older generations of auto-reverser such as the Digitrax AR1 and provide a faster, much more reliable and longer-lasting implementation of the function.

The oscilloscope traces presented in [5] show the SAR's fast reaction when the locomotive enters the reversing loop. The lower (blue) trace shows the dip in voltage on the mainline DCC input, and the upper (yellow) trace shows the reaction of the output selection logic to swap the DCC phase applied to the reversing section. The phase change occurs in less than 1msec and the track DCC voltage then recovers within a further 0.5msec (500usec).



5. Oscilloscope traces – entry to reversing section

In common with the behaviour of all electromechanical (metal-to-metal) switches, when the locomotive wheel bridges the track gap it 'bounces' against the rail for several milliseconds. This can cause several dips in track voltage in quick succession. If the SAR acted on these transient voltage changes it could flip its output state several times and end up leaving the original short-circuit in effect. This would then trip your power-breaker device (if fitted), or else simply cause your DCC booster to shut down.

The SAR prevents this undesirable behaviour by incorporating a delay timer to prevent any further triggering of the output selection logic for around 100 milliseconds after the initial switchover, which is long enough for any wheel bounces to die away and the track voltage to stabilise.

As designed, the SAR can handle track voltages up to 24 volts and load currents of up to 5 amps. However, in the interests of long-term reliability, I would recommend that you limit operations to maximums of 18 volts and 3 amps which should be more than adequate for normal HO or N scale layouts and equipment.

Important Note 1 : This auto-reverser is **NOT** a power-breaker. It does not measure the current drawn by any locomotive or rolling stock in the reversing section and cannot, therefore, react to any overloads. You should fit an appropriate power-breaker to protect this part of your layout.

Important Note 2 : If you have **two** reversing sections in your layout and fit a SAR to each section then, because the auto-reverser is triggered by sensing a voltage dip on the main track, **both** SARs will flip their outputs as soon as **either** is triggered. As long as only one reversing section is being entered at that time, this will not cause a problem. However, if trains are entering or leaving both reversing sections at the same time, it is likely that the result will be a total track short circuit as the SARs fight each other to flip track phases. You can stop this happening by having each reversing section, and their respective SAR, connected to a separate power district, where each power district is fed from either a separate booster or a separate power-breaker output. A voltage dip in one power district will not then have any effect on the other. The rule is to fit only **one** SAR in any of your layout's power districts.

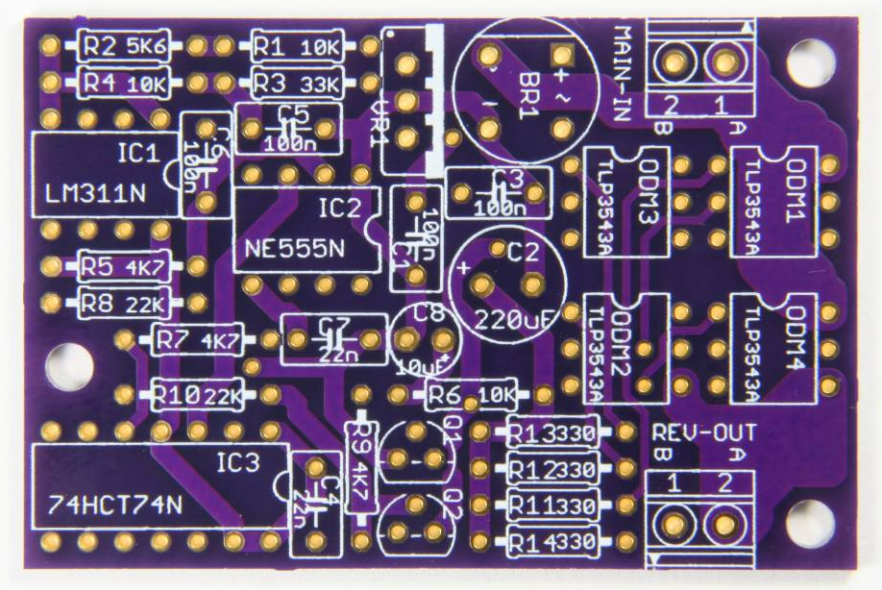
Connections

Connections to the SAR are very simple, as shown in [4]. Just connect from the terminal block labelled MAIN-IN to the mainline track just outside of your reversing section, and then connect from the terminal block labelled REV-OUT to the track of your reversing section.

Ensure that the wire you use for the connections is appropriate to the power you expect to be taken by the locomotives and rolling stock using the reversing section – generally this will be the same guage as your track feeder wires. The specified terminal blocks can accommodate up to 16AWG wires.

Interested in building your own auto-reverser ?

For anyone who would like to build their own SAR, the simplest first step is to order a printed circuit board. This is a double-sided, through-hole-plated PCB, size 1.50 x 2.28 inches (38.1 x 57.8 mm), as shown in [6] –



6. Bare printed-circuit board

The PCB is available from OSH Park, a small company located in Lake Oswego, Oregon. They supply PCBs in multiples of three boards, with the cost based solely on the area of the PCB, including free shipping to any destination worldwide. A set of three Simple Auto-Reverser PCBs will cost you $17.05, as you can see if you follow the link –

https://oshpark.com/shared_projects/NsO6GXCT

On the OSH Park website, if you then want to order a set of PCBs, click the button next to the board labelled “Order Board”, enter your e-mail address, name, and a password of your choice to establish an account with OSH Park, if you don’t already have an account, then follow their ordering process. You can pay either with a credit card or via PayPal. Your boards will be manufactured and delivered within two or three weeks depending on where you are in the world.

You can also obtain your PCBs from PCBWay, a Chinese company which, like OSH Park, allows me to share the uploaded PCB design. PCBWay supply boards in multiples of five so, if you don’t intend to build that many auto-reverser units, you might consider sharing the cost with perhaps a neighbouring model railroader, or a member of your club.

To order a set of boards from PCBWay, follow this link –

https://www.pcbway.com/project/shareproject/Simple_AutoReverser_Version3_f42080b6.html

Unfortunately, at the time of writing, the addition of import duty for customers in the USA makes the cost of PCBs from Chinese suppliers relatively expensive, even when selecting a low-cost delivery option such as Global Standard Shipping. The total cost for five boards for delivery to the USA came to $20.65 compared to delivery to the UK at $10.35.

Please note that neither A-Train Systems nor myself have any connection with OSH Park or PCBWay other than as a very satisfied customer of their services.

If you prefer to use an alternative PCB supplier then, on the OSH Park website instead of clicking "Order Board", just click on "Download" to download a copy of the relevant file in Eagle board (.brd) format which you can then send off to your preferred supplier. Alternatively, you can download the full set of Gerber files from my own website at www.a-train-systems.co.uk/sar-download. This gets you a .zip file which you can pass on directly to your supplier.

Ordering components

The parts required to build a complete SAR, together with sources of supply, are listed in the two tables, [7] and [8].

Part	Reference	Quantity	Value	Notes
Resistor – Metal Film, 0.25 Watt	R11, R12, R13, R14	4	330R	All resistors 0.4" (10mm) pitch on PCB
" "	R5, R7, R9	3	4K7	
" "	R2	1	5K6	
" "	R1, R4, R6	3	10K	
" "	R8, R10	2	22K	
" "	R3	1	33K	
Capacitor – Polyester Film	C1, C3, C5, C6	4	100nF 63V	5mm pitch
" "	C4, C7	2	22nF 63V	5mm pitch
Capacitor – Electrolytic	C2	1	220uF 35V	3.5mm pitch, 8mm diameter
" "	C8	1	10uF 35V	2mm pitch, 5mm diameter
Diode Bridge Rectifier	BR1	1	W01G – W06G	Any voltage rating > 50V acceptable
Transistor NPN	Q1, Q2	2	2N3904	
Voltage Regulator - 5 Volt	VR1	1	L7805CV or LM7805	
Differential Voltage Comparator	IC1	1	LM311P or LM311N	
Precision Timer	IC2	1	NE555P or NE555N	
Dual D-Type Flip-Flop	IC3	1	74HCT74 or 74HC74 (P or N packages)	Either an HCT or HC device can be used
Dual-FET Photorelay	ODM1, ODM2, ODM3, ODM4	4	TLP3543A or TLP3546A	**See notes 6 and 7 following Table 2**
Terminal Block – 2-Way	Main In, Reverse Out	2	Phoenix-350 Series	3.5mm pitch

7. Table 1 – Simple Auto-Reverser – List of components

Suggested suppliers for the parts listed above are RS Components (uk.rs-online.com/web/) or Farnell (uk.farnell.com/) for users in the UK, or Mouser (www.mouser.com/) or Digikey (www.digikey.com/) for users in the USA. Both Mouser and Digikey also have European-based operations, but tend to have higher prices than RS Components or Farnell.

Table 2 [8] gives suggested part numbers for each SAR component from each of the listed suppliers.

Reference	RS Cmps	Farnell	Mouser	Digikey
R11, R12, R13, R14	199-7662	3496925	603-MFR25SFTE52-330R	13-MFR-25FRF52-330RTR-ND
R5, R7, R9	199-1885	3951808	603-MFR-25FBF52-4K7	13-MFR-25FRF52-4K7TR-ND
R2	199-7627	3496939	603-MFR-25FBF52-5K6	13-MFR-25FRF52-5K6TR-ND
R1, R4, R6	199-7658	3496902	603-MFR-25FBF52-10K	13-MFR-25FRF52-10KTR-ND
R8, R10	199-7815	3951799	603-MFR-25FBF52-22K	13-MFR-25FRF52-22KTR-ND
R3	199-7664	3496926	603-MFR-25FBF52-33K	13-MFR-25FRF52-33KTR-ND
C1, C3, C5, C6	241-6571	2763238	80-R82DC3100DQ50J	495-75656-1-ND
C4, C7	312-1447	2763233	R82EC2220SH50J	495-1140-ND
C2	759-040P	4659283	667-ECA-1VM221B	10-ECA-1VM221BCT-ND
C8	759-079P	9451900	667-ECA-1VM100I	732-8937-1-ND
BR1	629-5153	3775028	625-2W04G-E4	4878-B250R-ND
Q1, Q2	843-1575	1574370	512-2N3904TFR	4878-2N3904CT-ND
VR1	298-8514	2849715	863-MC7805CTG	497-1443-5-ND
IC1	428-458	3006909	595-LM311P	296-1389-5-ND
IC2	346-7024	3006909	595-NE555P	296-NE555P-ND
IC3	633-981	3119987	595-CD74HCT74E	296-2132-5-ND
ODM1, ODM2, ODM3, ODM4	NA	3870077	757-TLP3543AF	TLP3543A(F-ND
Terminal Blocks 2-Way	897-1332	3810246	651-1984617	277-1721-ND

8. Table 2 – Simple Auto-Reverser – Component supplier references

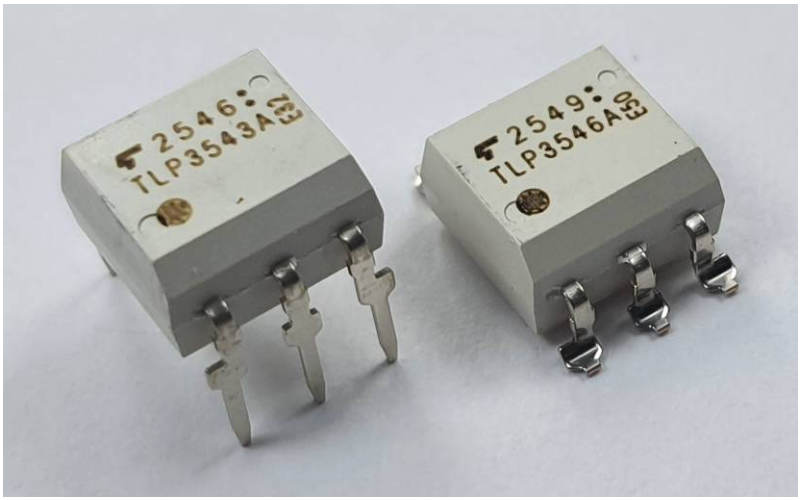
Notes :

1. You may be able to source equivalent parts locally at a lower cost, using the details available for each suggested part in the table above – search the supplier's website using the part number to view the key parameters you are looking to match (assuming that you have sufficient electronics knowledge to understand the specifications).
2. The major suppliers have all increased their delivery charges in the past year, particularly for small orders, where the delivery charge can often exceed the cost of the components.
3. Generally, eBay is a very good source for components, especially for small quantities of passive components, headers, connectors or hardware. Use established suppliers with good feedback ratings, but be wary of very low cost parts, since these are often of low quality or may be manufacturers' substandard rejects.

4. The total cost of parts for a single SAR (when this article was written) should be around $30 (£22 in the UK), including the PCB, but could be much more if all components are ordered in small quantities from the major suppliers.
5. Buying electronics components singly or in small quantities is much more expensive than buying in bulk (in quantities of 10 or more), so it is well worth considering carefully at the outset how many SAR units you might build, possibly jointly with friends, and then procuring all of the required components in a single purchase. This will also minimise any shipping charges.

6. With regard to the dual-FET photorelay chips (ODM1-ODM4), the TLP3543A is the preferred device, rated at 24 volts and 5 amps. However, if not obtainable, you can substitute the TLP3546A device which has a higher voltage rating at 80 volts, but has a current rating of only 3.5 amps. As mentioned earlier, I would recommend that you limit operations to maximums of 18 volts and 3 amps, so that either device should be more than adequate for normal HO or N scale layouts and equipment.

7. Although the SAR PCB is designed to take the dual-FET photorelay chips (ODM1-ODM4) in 6-pin dual-inline packages you may only be able to obtain them in 6-pin gull-wing packages intended for surface mounting. The two package types are shown in [9], and either can be used. Fitting a gull-wing package (on the right) to the PCB is covered later as part of the recommended assembly instructions.



9. Dual-FET photorelay chip packages – dual-inline and gull-wing

Assembling the Simple Auto-Reverser

Assuming you are happy with your soldering technique for electronic components, and have a printed circuit board (PCB) plus a bundle of components ready to be assembled, you should find that putting the auto-reverser together is quite straightforward.

However, if you do not have any experience of soldering electronic components then you should first have a look at one or two of the guides available on the Internet (such as at www.makerspaces.com/how-to-solder/) and some of the multitude of videos available on YouTube, although there is nothing to beat getting some copper stripboard from one of the component suppliers and practising soldering wires (and a few spare components) to it before tackling the real SAR printed circuit board.

Use resin-cored solder in wire form only – never use solder with an acid flux (as sold for plumbing purposes) – and use a fine-tip soldering iron with a maximum power rating of 25 watts (50 watts if it is temperature-controlled). All joints should be made as quickly as possible to avoid damaging the PCB and components. The greatest enemy of electronics is heat.

The position and reference number of each component is printed on the top surface of the PCB. All resistors and capacitors also have their value shown but, where this is not clear, refer back to the component tables to make sure you fit the correct component in each position.

Fit those components with least height to the SAR PCB first. These are the resistors (R1-R14), so that, when you turn the PCB over and lay it down on your bench to solder the component wires on the underside of the board, the components do not fall out of the holes. It does not matter which way round the resistors are placed on the PCB although I generally try to fit them so that the colour code bands are read from either top to bottom or left to right.

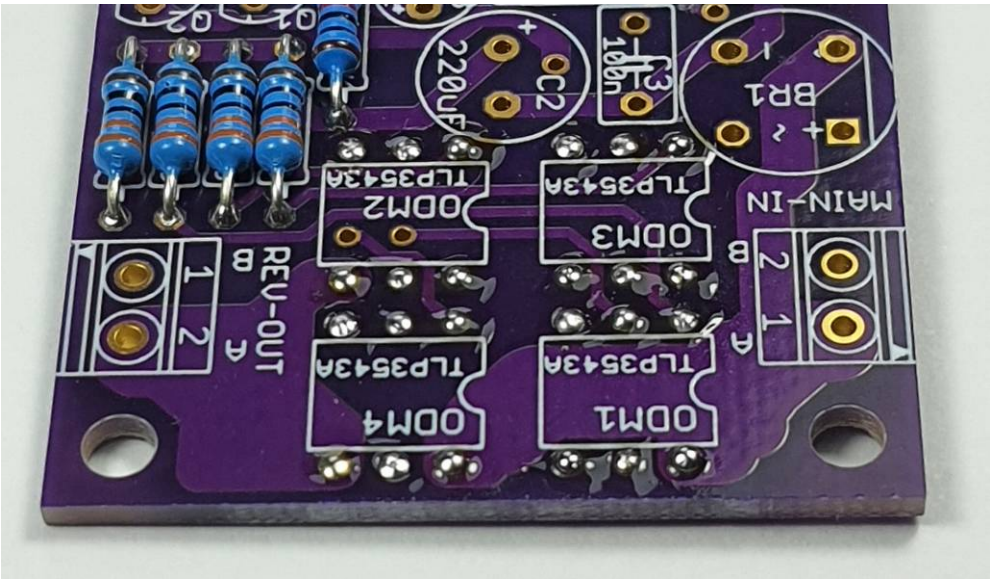
A tip here is to solder just one wire from each component, then turn the PCB over and check that all components are still flush with the PCB. If not, make them so (by briefly melting the one soldered joint while holding the component flat – but watch your fingers – soldered wires are very hot!) before soldering the remaining wire(s) of the component. Clip the excess component wires flush with the soldered joints on the underside of the PCB using a small pair of sidecutters.

The next step is to fit the three integrated circuits (chips) (IC1-IC3) and the four dual-FET photorelays (ODM1-ODM4), as the next tallest components. Ensure that the notch, dimple or dot at one end of each of IC1-IC3 is towards the top edge of the PCB ie. towards the terminal block positions (as seen in [4] and [13]), and that all pins are through the PCB holes, with none having been bent under the devices.

The pins of integrated circuits are generally splayed out so, to make fitting a little easier, I place the pins on one side of the package in their correct PCB holes then use the end of a steel ruler, held vertically, to gently push all pins on the opposite side of the chip inwards until you can gently push the chip down into the other set of PCB holes.

Solder two diagonally-opposite pins on the chips first, and then check that the devices are still flat on the PCB. If not, it is easy to melt the solder on the appropriate corner pin while pushing the device down into the correct position, before soldering the remaining pins.

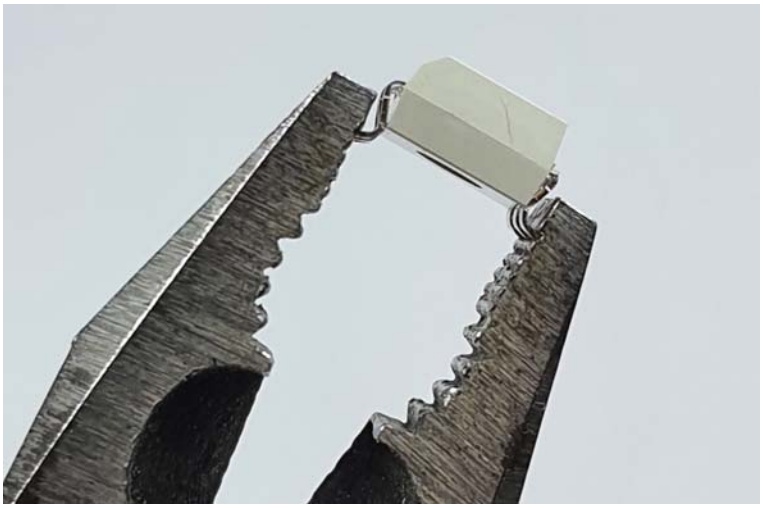
If you have obtained dual-inline versions of the dual-FET photorelay chips (ODM1-ODM4) then they are fitted in the same way as IC1-IC3. However, if you have only managed to source the gull-wing versions, then the first step is to fill the relevant 24 holes in the PCB with solder, to leave 24 ‘solder bumps’ ready for the chips to sit on, as shown in [10] –



10. Filling PCB holes with solder ready to fit the ODM1-4 chips

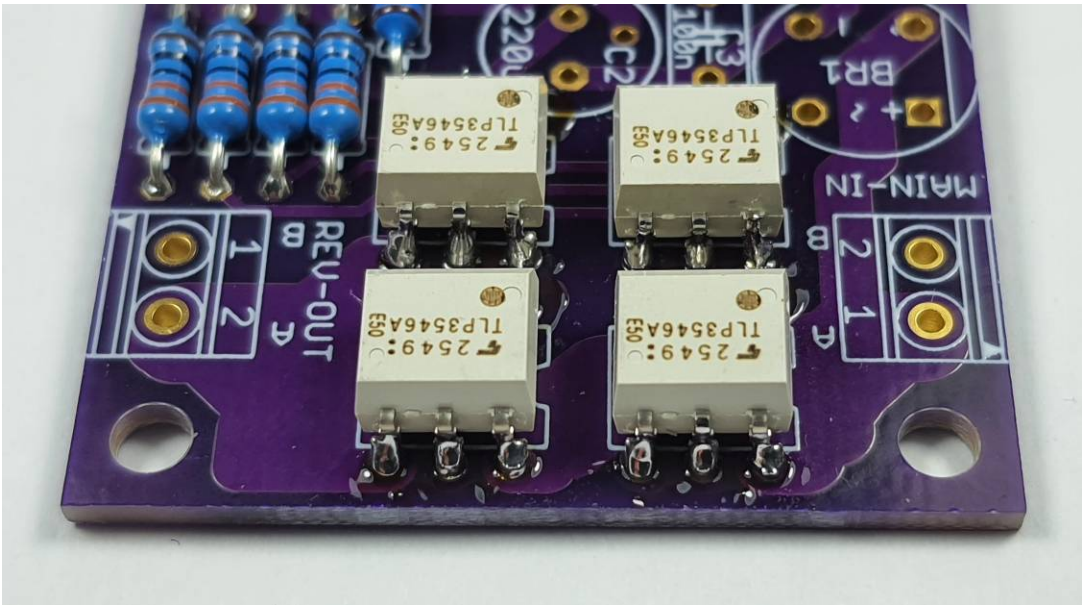
Use the minimum amount of solder to make the ‘bumps’ so that subsequently fitting the chips can be done with the least amount of heat from your soldering iron.

Next, very gently squeeze the pins of each chip inwards so that they lie flush with the package sides using a small pair of combination pliers as shown in [11]. Take care not to distort the pins any more than this –



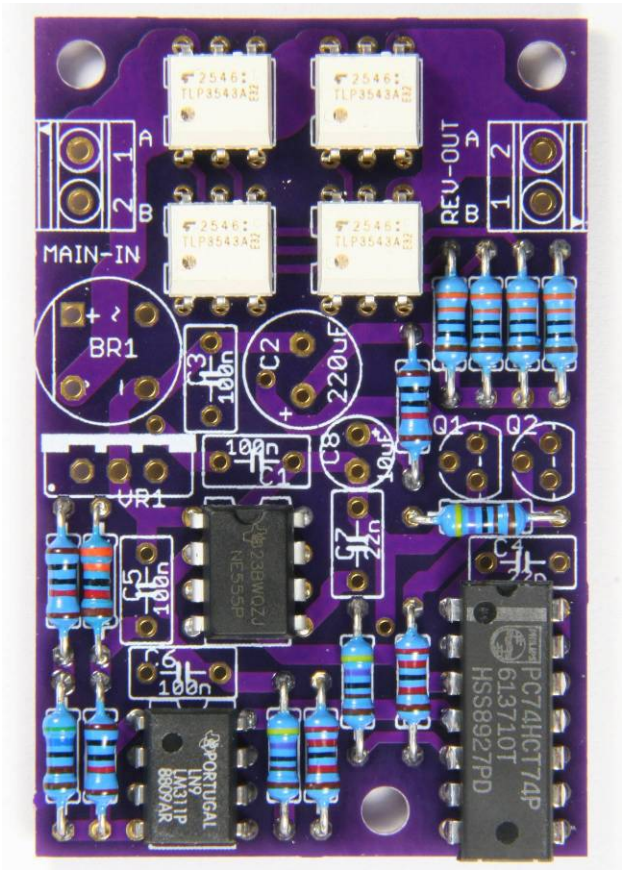
11. Adjust pin spacing of ODM1-4 chips gull-wing packages

Fit the chips one at a time, sitting each chip carefully on its set of ‘bumps’ and then tacking a pair of diagonally-opposite corner pins to the board using a well-tinned soldering iron. Once you have the chip sitting squarely in position, carefully use your iron plus solder to connect each of the other chip pins to the PCB. Finally re-solder the original corner pins so that all pins are in good electrical contact with the PCB tracks, as shown in [12]. Make all joints as quickly as possible, and take care that you do not leave a solder bridge between adjacent pins, or one which shorts pin 3 of ODM2 to the nearby lead of resistor R6.



12. ODM1-4 chips (in gull-wing packages) fitted to PCB

The final result should look like [13] –

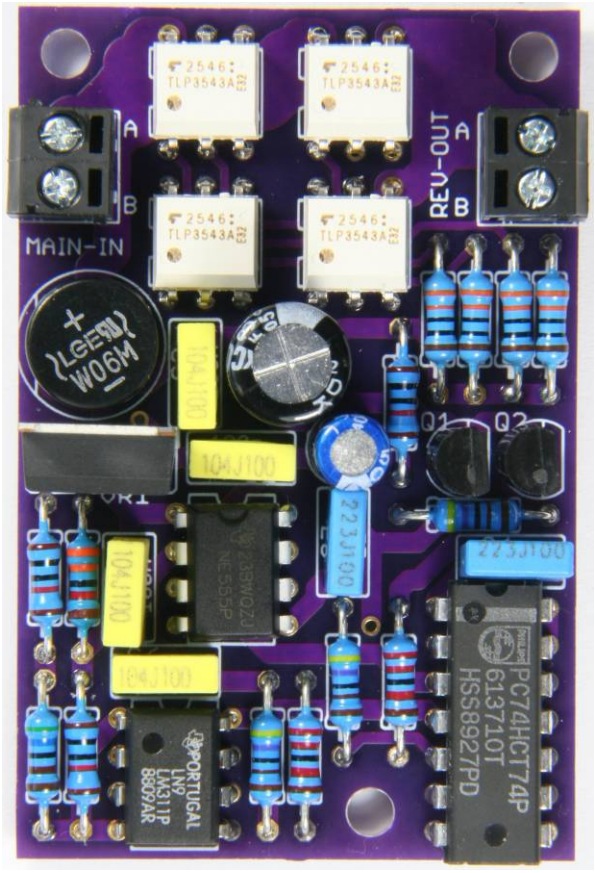


13. First steps completed in assembling the SAR board

Now fit the six small capacitors (C1 and C3-C7), and the bridge rectifier (BR1), ensuring that the positive pin (+) of BR1 goes into the square pad similarly marked (+) on the PCB. The small capacitors are not polarised, so can be fitted either way round. Next, fit the two 2N3904 transistors (Q1 and Q2) ensuring that the flat sides of the transistor packages face outwards towards the edge of the PCB, as indicated by the PCB markings, and then the two 2-way terminal blocks.

The two electrolytic capacitors C2 and C8 are fitted next, observing the correct polarity. Take care to fit them the right way round since a reverse-biased electrolytic capacitor can potentially explode. The negative (-) side of the larger capacitor C2, normally designated by a lighter-coloured stripe down the side of the component, is fitted facing towards the top of the PCB and chips ODM1-4. The smaller capacitor C8 is fitted in the opposite direction, with the negative stripe towards IC2 and IC3. Finally, fit the voltage regulator VR1 with the metal tab towards the top of the PCB, as shown by the broad white marking on the board.

Your PCB should now look like [14] –



14. Simple Auto-Reverser board completely assembled

Check your handiwork

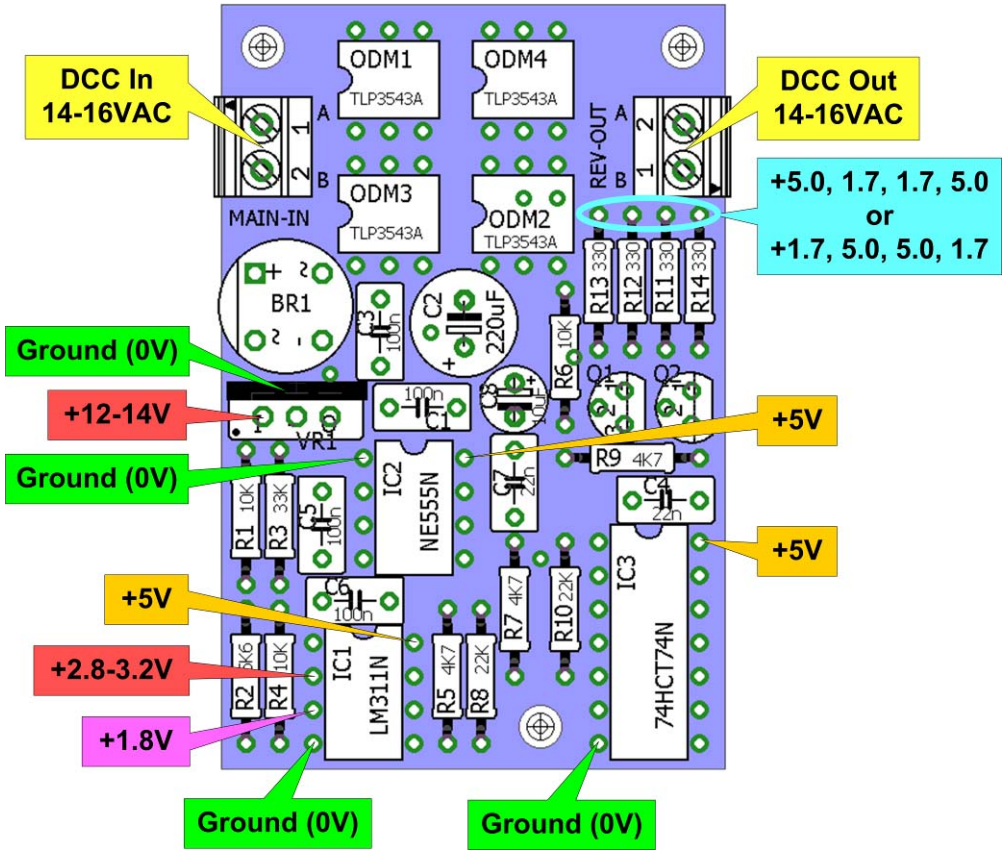
Carefully inspect the completed SAR board to check that all of your soldered joints are bright and shiny, and that the solder has wicked through the PCB holes to the component side of the board. Check also that there are no solder bridges between copper pads or component pins anywhere on either side of the PCB. I highly recommend the use of a x5 or x10 hand lens or jeweller's loupe for this inspection.

Next, before you apply power to your completed SAR you should use your multimeter, set to a resistance range of 20K or so, to check for any short circuits. Between the terminals of both the Main-In and Rev-Out terminal blocks you should see an open circuit (infinite resistance). Take care, if you use the terminal block screwheads as contacts to touch with your meter probes, that the screws are tightened first – loose screws tend to make poor electrical contact and may give you erroneous readings.

Now check the resistance between the metal tab of voltage regulator VRI and the top right pin of any of IC1, IC2 or IC3 (the pins labelled +5V in [15]). The reading should be between 2.5 and 3K. If you see any markedly different value then carefully check your soldered connections, and the fitted component values.

You can now connect the SAR Main-In terminals to the track output of your command station or booster. Using an AC voltage range on your multimeter, check that the voltage at the Rev-Out terminal block is the same as voltage you measure at the Main-In terminal block. For HO and N scale layouts this will generally be in the range of 14 to 16 VAC.

Switching to a DC voltage range on your meter, next check that the right supply voltages are reaching the various integrated circuits on the SAR. The metal tab of voltage regulator VR1 is at ground (0V) so clip one of your multimeter's probes to it as a convenient reference point. Use the other probe to check the voltages on the integrated circuit pins indicated in [15], being very careful not to short any of the pins you are probing to any adjacent pin or to a nearby component.



15. Check the assembled SAR for correct operating voltages

The measured voltages should be within 0.1 volts of the nominal values, since the voltage regulator is not a precision device but, if you see any significantly different values, you should

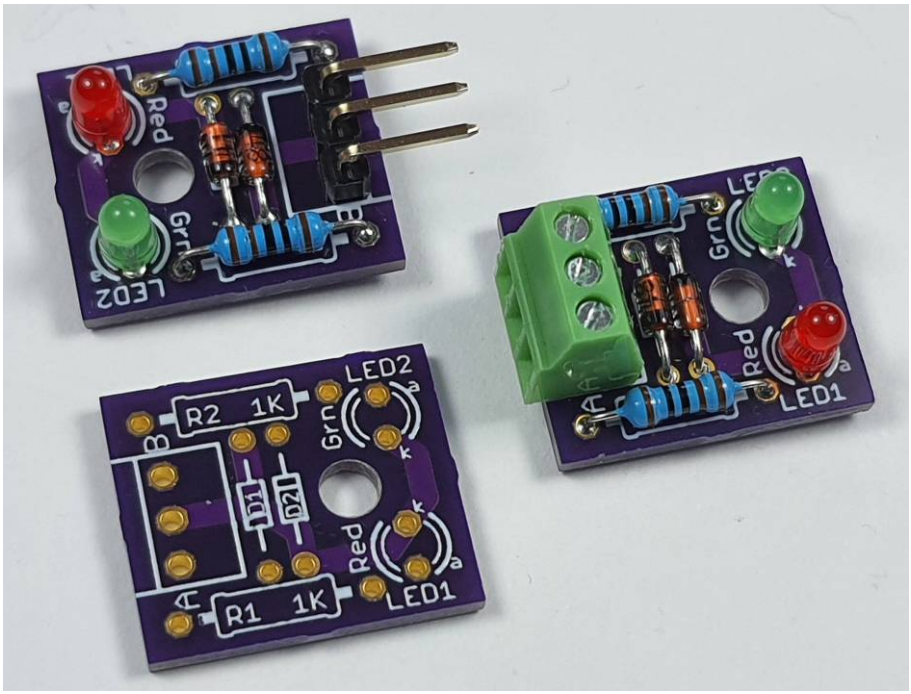
disconnect the SAR from DCC power and carefully check the board for components with the wrong value, or in the wrong place, and recheck the quality of your soldered joints.

The voltage on pin 3 of IC1 (+1.8V) is the fixed reference for the LM311 voltage comparator, whereas that at pin 2 of the chip (+2.8 to 3.2V) depends on your DCC input voltage, as does the voltage at the input to voltage regulator VR1 (+12 to 14V).

The voltages at the top ends of the four resistors R11-R14 control which pair of the dual-FET switches ODM1-ODM4 are conducting at any one time. The measured voltages should be either +5.0V or +1.7V, with the voltage at the top of each pair, R11-R12 and R13-R14, being the same, as indicated in [14]. The initial state of the voltages when you apply power to the SAR depends on various component tolerances. Either combination is acceptable for correct operation of the auto-reverser.

Assuming all is in order, you can now connect your reversing track section to the Rev-Out terminals and check that the SAR operates correctly in practice – just as it does in this short video clip [https://youtu.be/y4TbH57P3zY] of a Simple Auto-Reverser working on my own small test track.

In the video you will probably notice that I use several small units to indicate the states of the SAR and the DCC phase applied to the reversing section of track, as shown in [16] –



16. DCC phase indicator boards

These were originally developed to indicate the state of turnouts with 'live' (power-switched) frogs. The outer pair of terminals (A and B) are connected to the main track and the centre terminal to the turnout frog so that when the turnout is set straight the green LED lights, and when it is set diverging the red LED is lit.

The indicator boards can just as easily be used to indicate the DCC phase of a reversing section, again by connecting the A and B terminals to the main track A and B rails (see [2] and [3]), but this time connecting the centre terminal to the A rail of the reversing section on the other side of the track gap. The green LED lights when the reversing section rails are in-phase with the main

track rails, and the red LED when they are out of phase. Note that, if you leave the centre terminal unconnected, both LEDs will light when you have DCC power applied to the rails.

If you would like to build some phase/turnout indicators for yourself, then you can obtain a set of three PCBs from OSH Park at a cost of $2.10, as you can see if you follow the link –

https://oshpark.com/shared_projects/VnZRD1NU

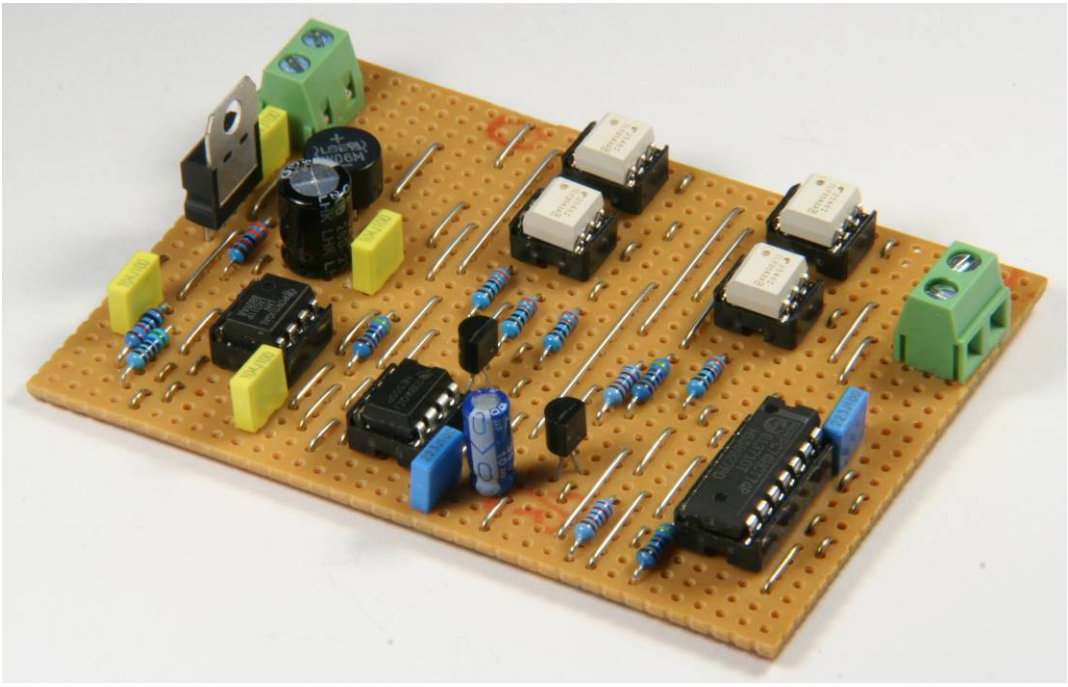
Again, if you would like to use an alternative PCB supplier, you can download a .zip file with the full set of Gerber files from my own website at www.a-train-systems.co.uk/sar-download.

The components required are two 1K resistors (metal film, 0.25 Watt), two diodes such as type 1N4148, and two 3mm LEDs, one red and one green. Fit the diodes with their striped ends as shown on the PCB, and the LEDs with their negative (short) leads towards the centre of the PCB in the holes marked ‘k’, as shown in [16].

You have the choice of fitting either a 3-pin header (for connection using a standard servo connector lead) or a 3-way 0.1” terminal block to use individual wires – or you can simply solder wires directly to the PCB.

An alternative build using stripboard

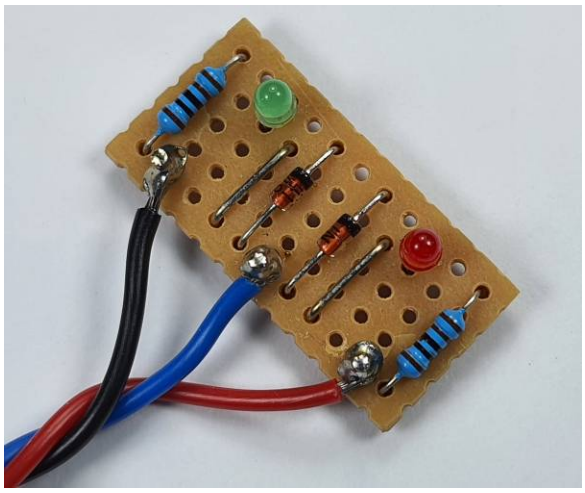
If you would rather not go to the expense of obtaining a PCB, it is perfectly possible to build the Simple Auto-Reverser on a piece of 0.1” pitch stripboard, which is what I used when developing the SAR prototype, as shown below in [17] –



17. Simple Auto-Reverser on stripboard

Here, all the chips are mounted in sockets since I intended to reuse them when a PCB was available. However, there is no reason they cannot be soldered directly in place if you wish to build the auto-reverser in this format. Full details of the stripboard layout can be found as part of the SAR technical details on my website at www.a-train-systems.co.uk/sar-download.

As well as the SAR itself, you can also build the DCC phase indicator unit on stripboard, as shown in [18] and, again, you can find the associated schematic and layout within the SAR technical details.



18. DCC phase indicator on stripboard

Simple Auto-Reverser technical details

For those who are interested, you can download a technical description of the SAR circuitry and that of the phase-indicator boards, including full schematics of both, from a special download section of my A-Train Systems website at www.a-train-systems.co.uk/sar-download.

The folder there also includes copies of the Gerber files for both printed-circuit boards described in the article if you prefer to use an alternative PCB supplier.

Dr Terry Chamberlain

Terry Chamberlain got into model railroading almost by accident in the 1990s when he responded to a request from some modellers in California to build a DCC system based around an Atari personal computer – and he had to build a simple layout to prove that it all worked. Eventually the project evolved into A-Track, a Windows application to provide full computer support for the complete range of NCE DCC systems, with facilities similar to JMRI's Decoder Pro and Panel Pro.

Terry is a professional electronics engineer and spent most of his career in the UK defence industry designing, and managing the development of, large real-time computer systems for the Royal Navy. Now that he is fully retired he has finally managed to build the small logging and mining layout he has been planning for many years (after several visits to Colorado) and is in the slow process of adding buildings and scenery – but keeps getting distracted from completing the details by new computer and electronics projects for model railroading.