



# **CIRCUITS FOR MODEL RAILWAY ENTHUSIASTS**

**MOST OF THESE CIRCUITS WILL WORK ON ANY GAUGE**

## **THE AMAZING MR204**

- 1) Points Indicator
- 2) Points, Signal & Indicator
- 3) Home and Distant Signal Control
- 4) Points, Signal & Control Panel Indication
- 5) Using the MR204 when a CDU is in the system
- 6) Automatic Points Switch
- 7) Automatic Forward / Reverse (Shuttle)
- 8) Automatic Forward / Reverse (Shuttle) & Timer
- 9) Station Stop with Manual Start
- 10) Timer Controlled Station Stop
- 11) Siding Occupied Indication
- 12) Control of Running Lights
- 13) Basic Train Blocking
- 14) Controlling Electro Frog Points
- 15) Controlling Electro Frog Points in a Crossover
- 16) Isolating Sidings
- 17) Semi-automatic Reversing Loop
- 18) Automatic Reversing Loop
- 19) Automatic Level Crossing
- 20) High Power Equipment Switch

These circuits have been developed by either Brimal or submitted by customers using our products. Some circuits have been tested by us, but not all. Please use these circuits as a guide to develop further ideas. Brimal cannot be held responsible for any damage caused by these ideas. Have some fun developing more uses for the MR204

## MR204 2 Coil Latching Relay.

The MR204 is a latching relay circuit which has 2 coils for energising the contacts, or rather one coil to energise them and one coil to de-energise them. This means that a momentary pulse on Coil 2 changes the state of the contacts, and they remain in that state (even if power is completely removed) until Coil 1 receives a momentary pulse.

It also has 2 sets of 'changeover contacts' which mean you can switch 2 separate circuits at the same time, with a rating of 2 amp per set.

**This makes the MR204 the most versatile and usable circuit produced for the Model Railway Industry. It will work equally as well on Z gauge as it will on G gauge. Overall size 40mm x 30mm.**



Contact Arrangement	2 x Changeover
Initial Contact Resistance	50mΩ
Contact Rating	2A at 30vDC / 1A at 125vAC
Maximum Switching Power	60W / 125VA
Maximum Switching Voltage	220vDC / 250vAC
Coil Power	Sensitive 150mW / Standard 200mW
Coil Voltage	Nominal 12vDC / Set Voltage 9vDC
Coil Resistance	720Ω
Maximum Operating Temperature	65°C

### Points Indicator

In this application the MR204 is used to control a Point Motor, and 2 LED's at the Control Panel. The switch is a Momentary action Mini Toggle Switch, (this can be replaced by 2 mini Push Button switches).

Ideally the MR204 should be fixed near the set of points it is controlling.

If you are using a Positive & Negative Bus Bar - the toggle switch and the LED's only require a 6 core back to the control panel.

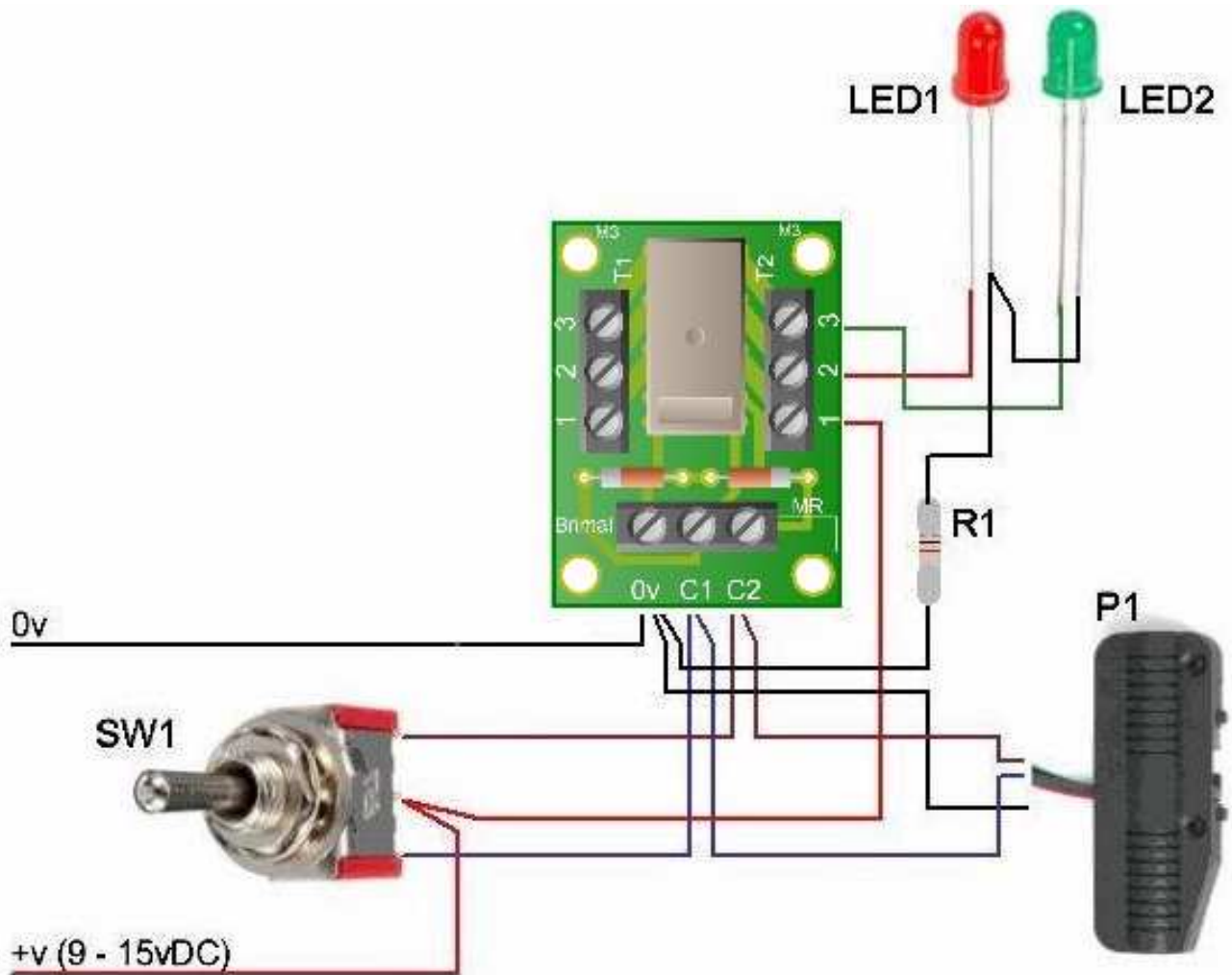
If you are not using Bus Bars then you will require a 8 core cable back to the control panel

The colour code for the wiring is 0v Black, +v Red, please see the individual product instruction sheets to see the colour code they are using.

The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as above, you may find the indicators are back to front, this is due to the state of the relay when you first switch ON. In this case you may have to swap 2 & 3 around.

R1 is a 1K quarter or half watt resistor placed in the negative line to the LED's, to reduce the current drawn by the LED's



### Points, Signal & Indicator

In this application the MR204 is used to control a Point Motor, a Signal, and 2 LED's at the Control Panel. The switch is a Momentary action Mini Toggle Switch, (this can be replaced by 2 mini Push Button switches). Ideally the MR204 should be fixed near the set of points it is controlling, as the Signal will also be in the same area.

If you are using a Positive & Negative Bus Bar - the toggle switch and the LED's only require a 6 core back to the control panel.

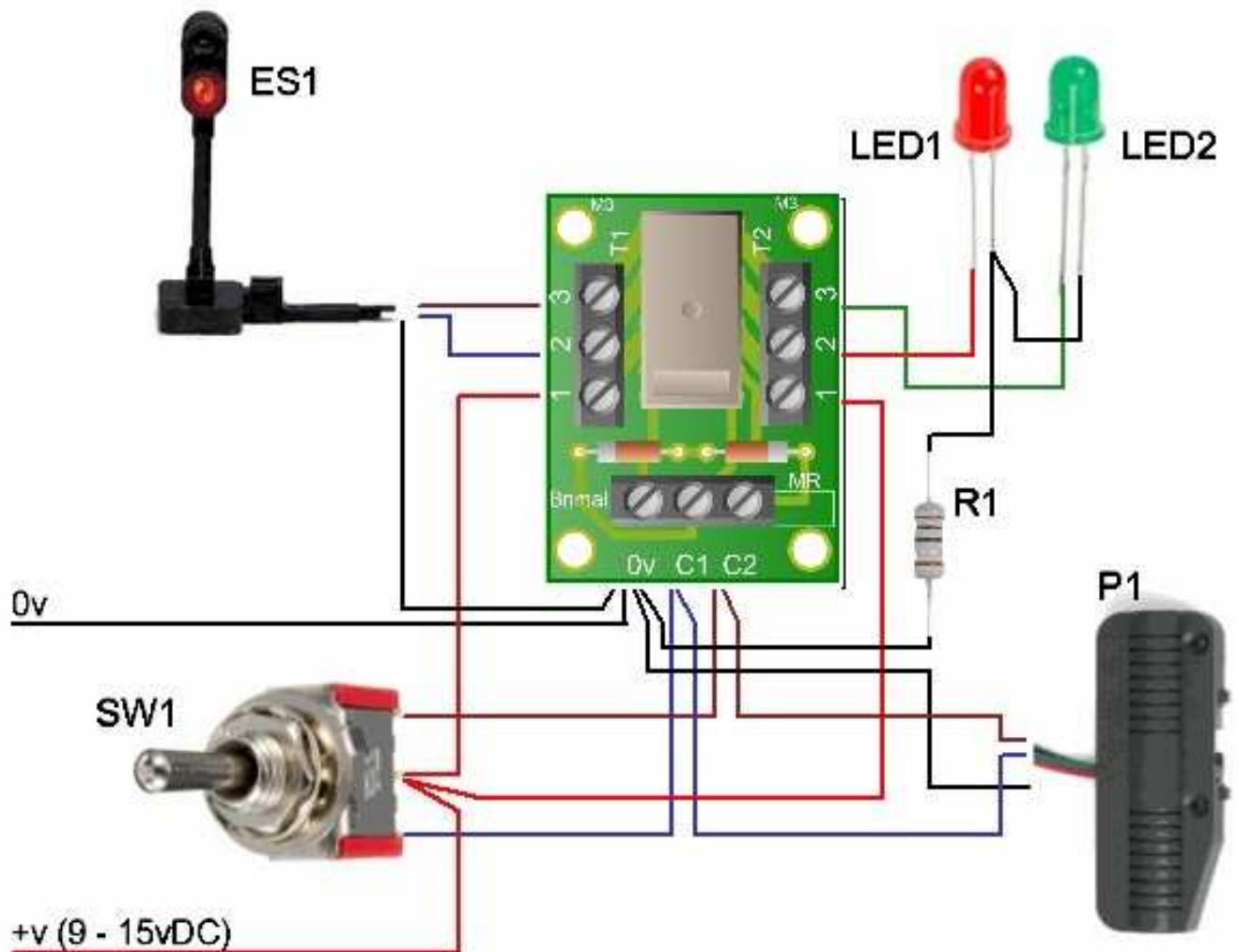
If you are not using Bus Bars then you will require a 8 core cable back to the control panel

The colour code for the wiring is 0v Black, +v Red, please see the individual product instruction sheets to see the colour code they are using.

The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as above, you may find the indicators are back to front, this is due to the state of the relay when you first switch ON. In this case you may have to swap 2 & 3 around.

R1 is a 1K quarter or half watt resistor placed in the negative line to the LED's, to reduce the current drawn by the LED's



## Home & Distant Signal Control

In this application the MR204 is used to control a Point Motor, a Home Signal, and a Distant Signal. The switch is a Momentary action Mini Toggle Switch, (this can be replaced by 2 mini Push Button switches).

Ideally the MR204 should be fixed near the set of points it is controlling, as the Signal will also be in the same area.

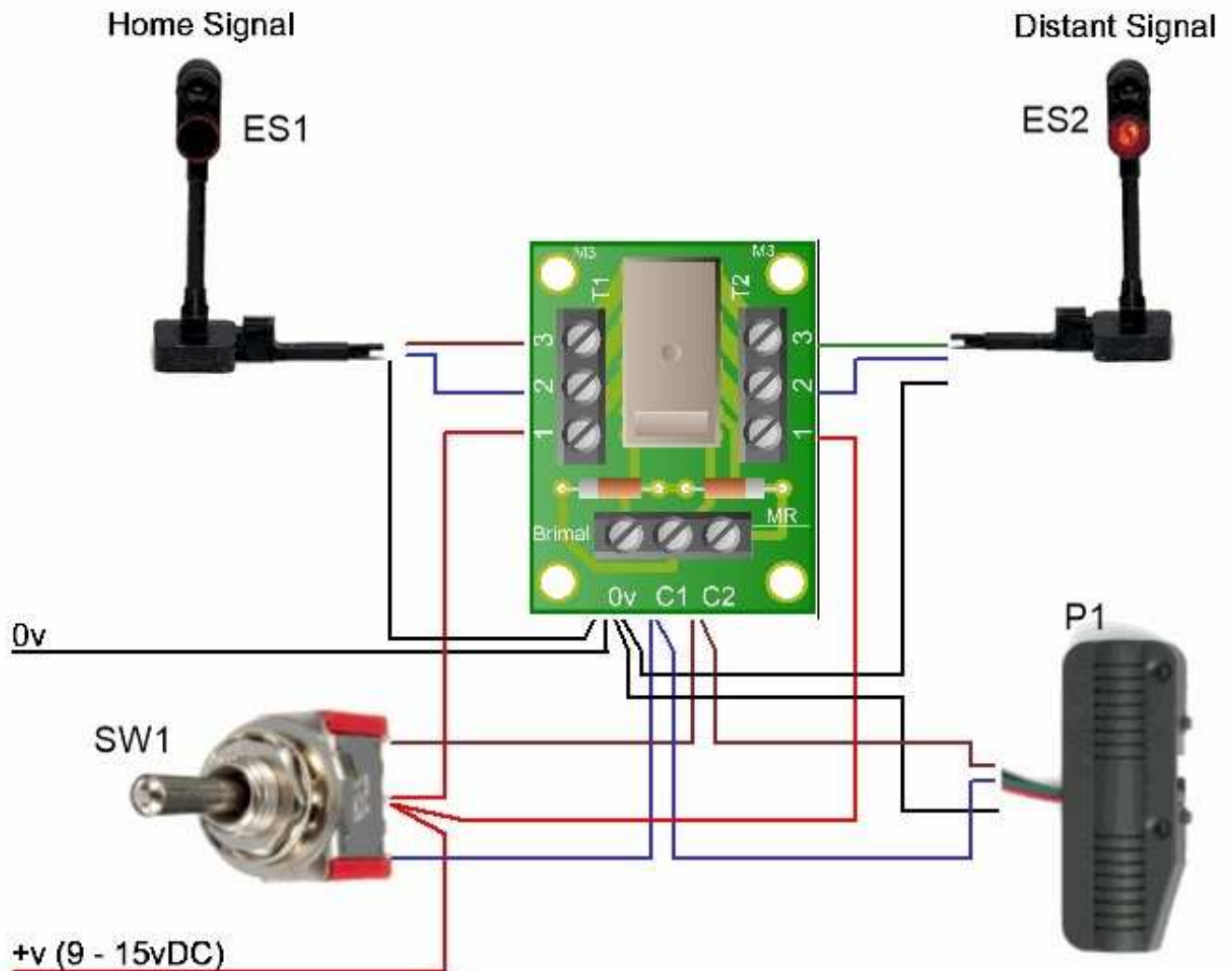
You will require a 2 core cable back to the control panel

The colour code for the wiring is 0v Black, +v Red, please see the individual product instruction sheets to see the colour code they are using.

The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as above, you may find the indicators are back to front, this is due to the state of the relay

when you first switch ON. In this case you may have to swap 2 & 3 around.



**Points, Signal & Control Panel Indication.**

In this application the MR204 is used to control a Point Motor, a Signal, and 2 LED's at the Control Panel. This circuit also has a CDU to help move the points, if required. The switch is a Momentary action Mini Toggle Switch, (this can be replaced by 2 mini Push Button switches).

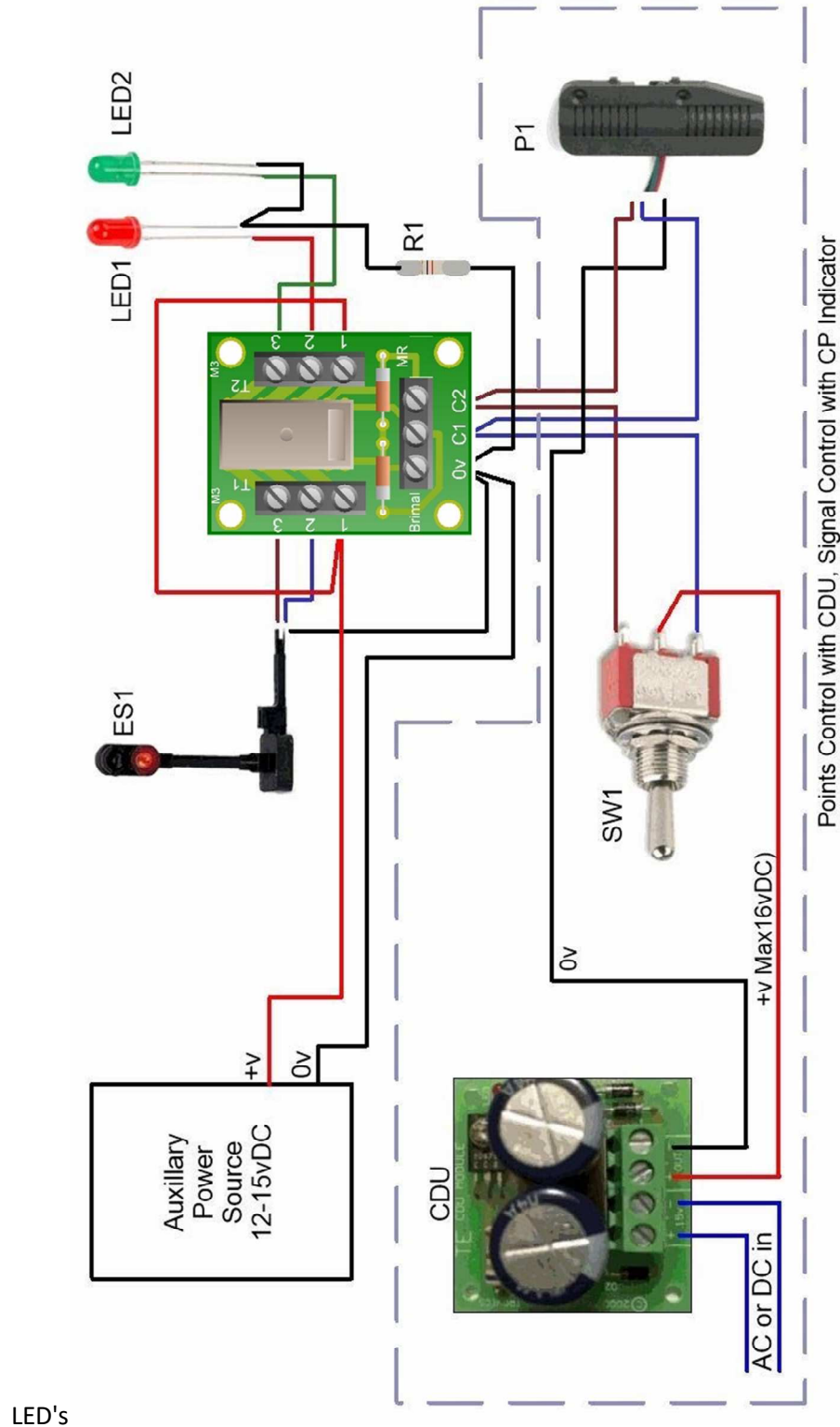
Ideally the MR204 should be fixed near the set of points it is controlling, as the Signal will also be in the same area.

If you are using a Positive & Negative Bus Bar - the toggle switch and the LED's only require a 6 core back to the control panel.

The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as above, you may find the indicators are back to front, this is due to the state of the relay when you first switch ON. In this case you may have to swap 2 & 3 around.

R1 is a 1K quarter or half watt resistor placed in the negative line to the LED's, to reduce the current drawn by the



LED's

## Automatic Points Switch

In this application the MR204 is used to control a Point Motor automatically. The MR204 is controlled by 2 Reed Switches (Sensor 1 & Sensor 2) this means the Locomotive requires a Magnet fixed to the underside of the unit to activate the Sensors.

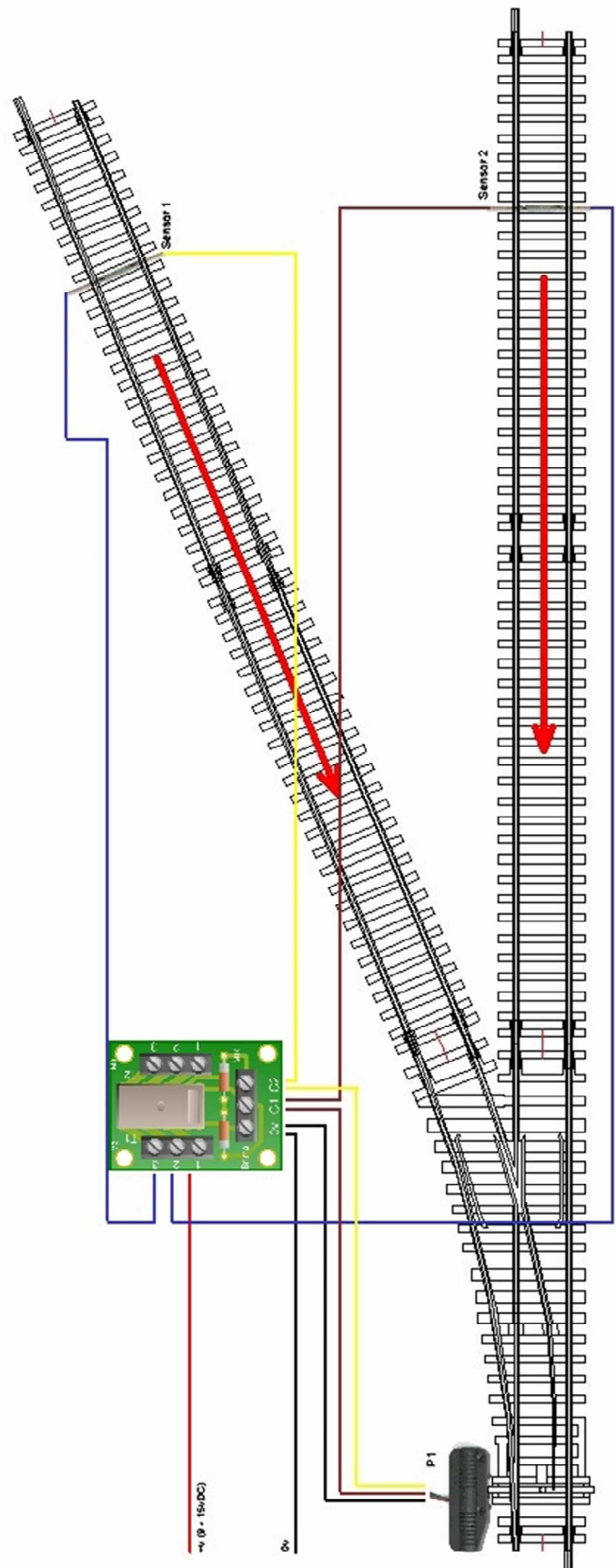
This can be used on systems where the fiddle yard is feeding into a Main Line. The Sensor 2 is activated by the Loco switching the points to straight through, the MR204 now removes power from the sensor so any subsequent passes over the sensor have no effect on the Point Motor. The points will remain in this position until Sensor 1 is activated.

As a Train passes over Sensor 1 the points will change and power will be removed from Sensor 1, and put back on Sensor 2. Further Trains coming from the sidings will have no effect on the points.

With this arrangement there is one spare set of contacts on MR204, this can be used to drive a signal set, isolate the track, give an indication back at the control panel, or block another set of points.

The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as above, you may find the indicators are back to front, this is due to the state of the relay when you first switch ON. In this case you may have to swap 2 & 3 around (you will only have to do this once - after the initial wiring, after this it will always be correct)





### Automatic Forward / Reverse (Shuttle)

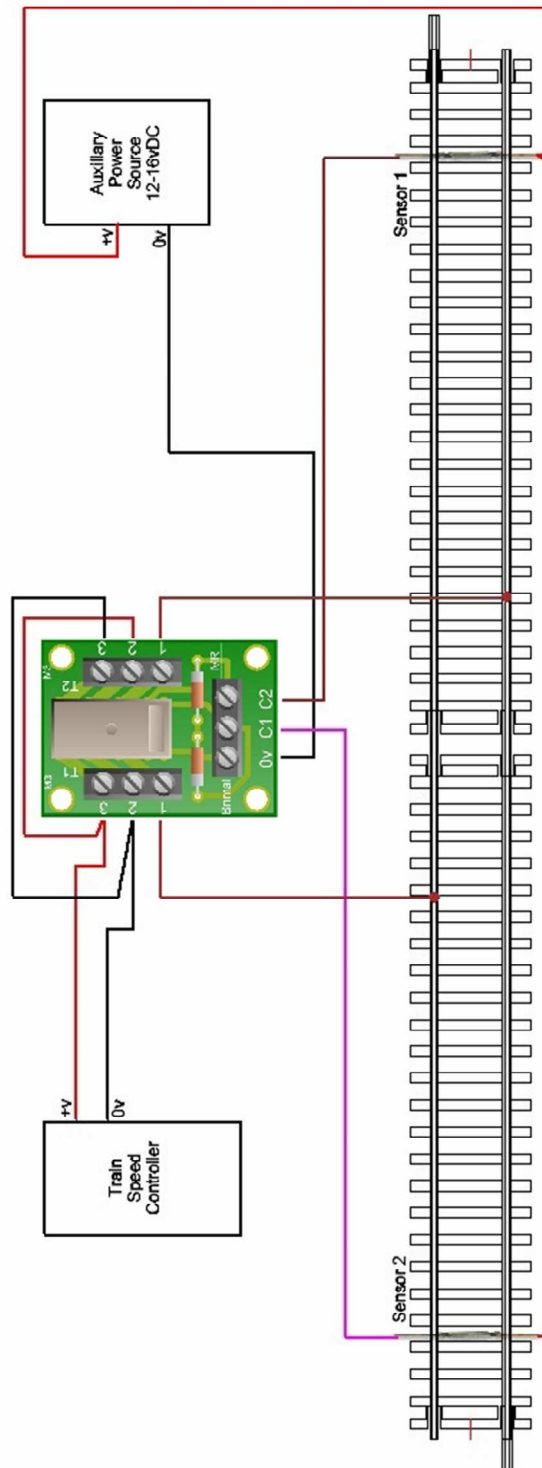
In this application the MR204 is used as a Automatic Forward / Reverse (Shuttle) Control. Sensor 1 and Sensor 2 could be placed anywhere on a loop, or even back to back. The train will run from Sensor 2 to Sensor 1, when it passes sensor 1 the circuit will change the polarity of the tracks putting the train in reverse. The train will now travel in reverse until it passes over sensor 2, at which time the MR204 will again change the polarity of the track putting the Train into forward again.

This will continue until power is removed from the system.

By adding a toggle switch to the 0V line from the Auxiliary Power Source you can disable the MR204 so the polarity remains the same.

Please note there is no slow down or slow start up facility in the MR204, so the train will have it's power Reversed at whatever speed you have set the Train Speed Controller.

Connecting power to the rails can be done in a number of ways, most proprietary manufacturers have their own rail connectors, or you can solder wires directly to the underside of the tracks.

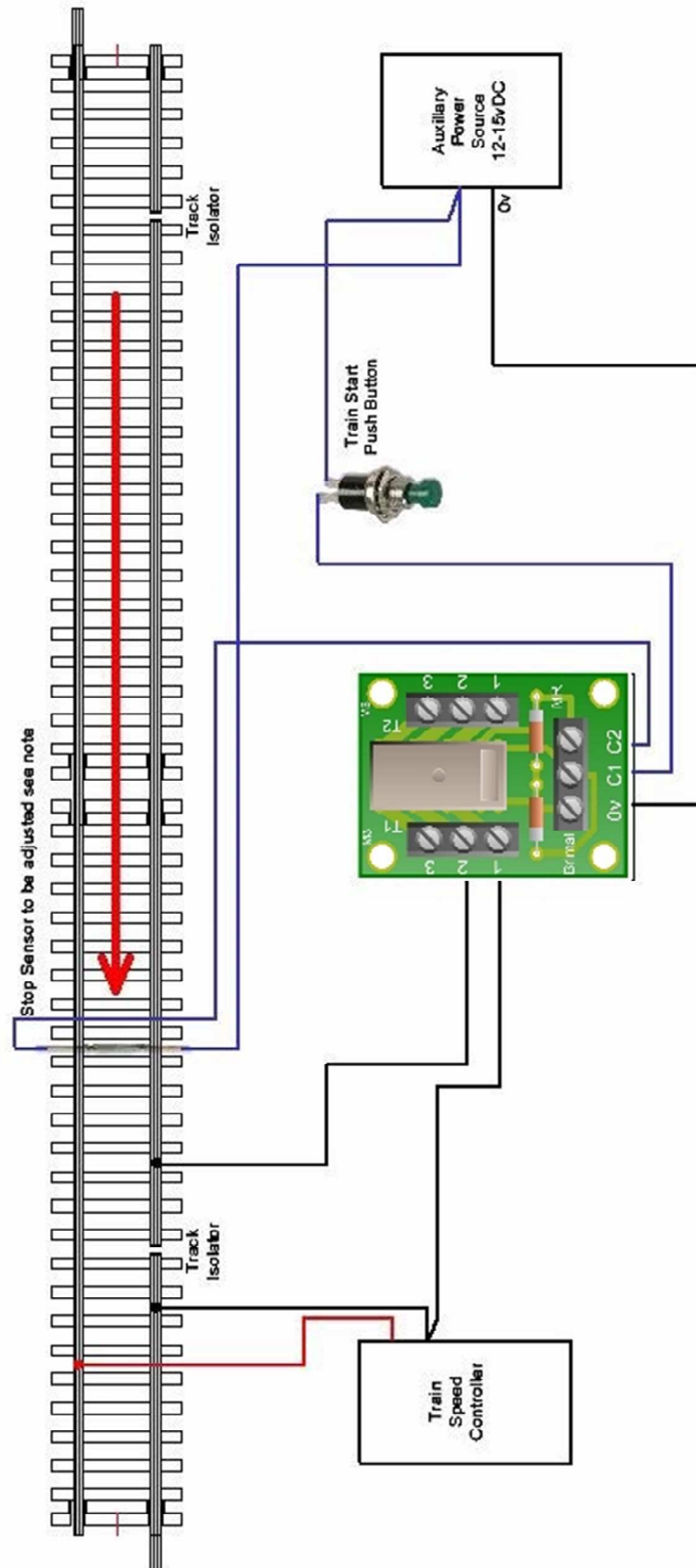


## Station Stop with Manual Start

In this application the MR204 is used as a Station Stop with Manual Override. As the Train passed over the sensor the MR204 cuts power to the rail and the train will stop.

You must insert 2 Isolating points as shown. The critical point is how far from the left Isolator do you place the Sensor. Too close and the train may over run the Isolator and just continue. Too far and the train will not stop at the station. So there is a little trial and error until you find the correct position.

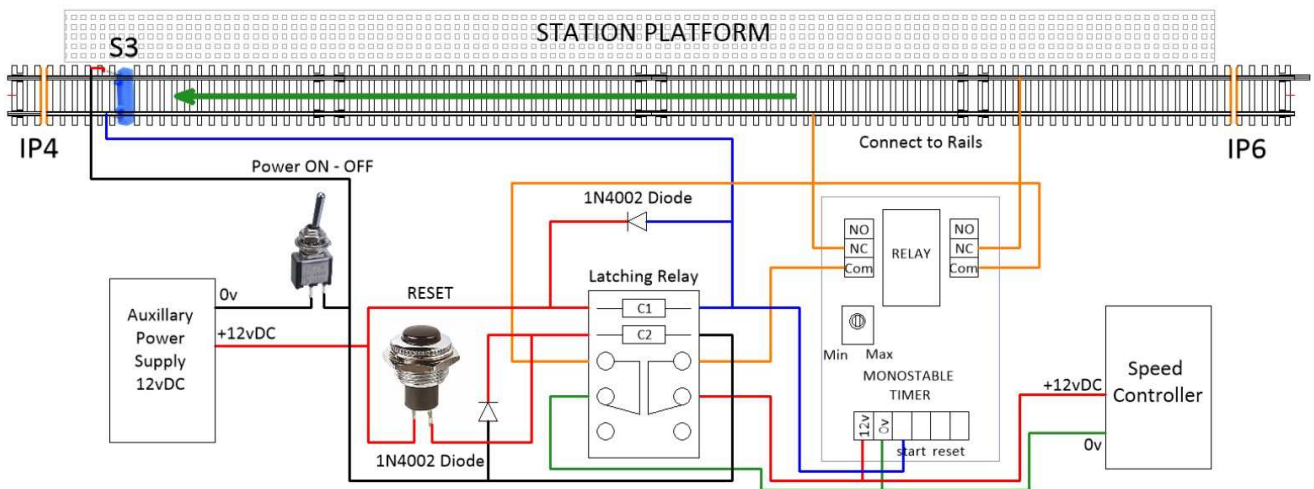
The Push Button changes the state of MR204 and allows power back on the track so the train can move forward. Replacing the Push Button switch with a timer will give an adjustable stop period, see other circuit for the wiring of a timer.



## Fully Automatic Station Stop & Timer

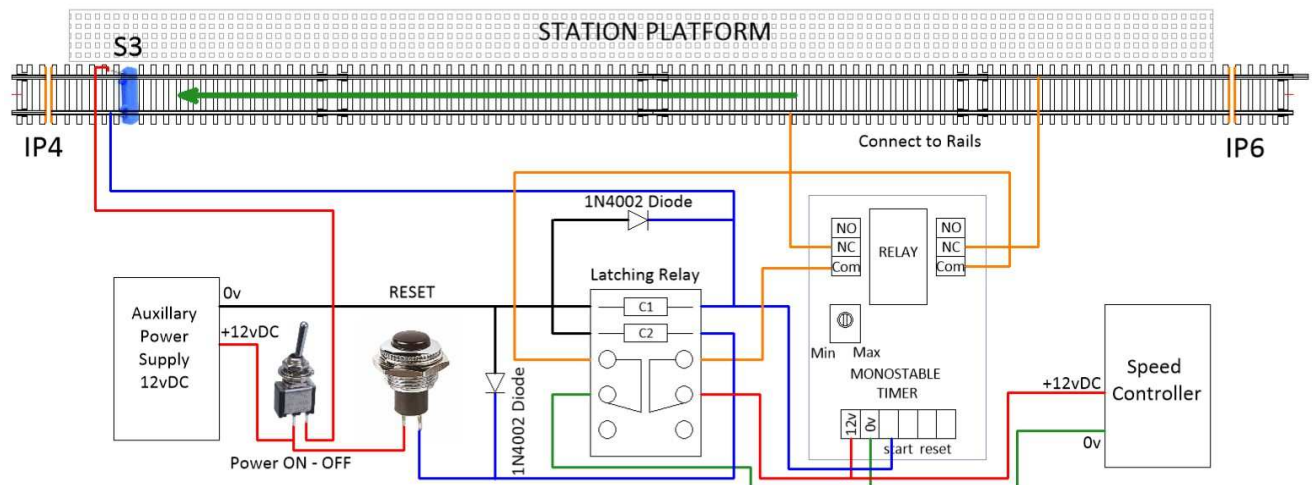
### Negative Switching.

The section within the Station must be isolated using plastic 'Isolation Fishplates' IP4 and IP6. The sensor S3 is positioned near the left side of the platform so that you get the full length of the train in the station, not too close to the Isolation point IP4. Depending on the speed of the train there will be a little over-run so you don't want it to over-run onto the powered section of track past IP4. The Speed Control is fed through the Normally Closed contacts of the Latching Relay. When the Loco passes over S3 the reed will switch ON the first coil on the relay which will disconnect power to the rails, and initiate the Monostable timer. The train will remain in the station until either the Reset button is pressed, or the timer times out. This will energise the second coil in the relay putting power back on the rails and the train will leave the station. If this is on a circular layout, it will happen every time the train comes into the station, unless you switch the power OFF at the On-Off switch. The Layout will work fine with this feature switched OFF, just press the Start switch before switching OFF. This resets the Latching relay to the Normally closed position – Power to the rails.



## Station Stop Timer

### Positive Switching.



### Automatic Forward / Reverse (Shuttle) & Timer

In this application the MR204 is used as a Automatic Forward / Reverse (Shuttle) Control. Sensor 1 and Sensor 2 could be placed anywhere on a loop, or even back to back. The train will run from Sensor 2 to Sensor 1, when it passes sensor 1 the circuit will change the polarity of the tracks putting the train in reverse. The train will now travel in reverse until it passes over sensor 2, at which time the MR204 will again change the polarity of the track putting the Train into forward again.

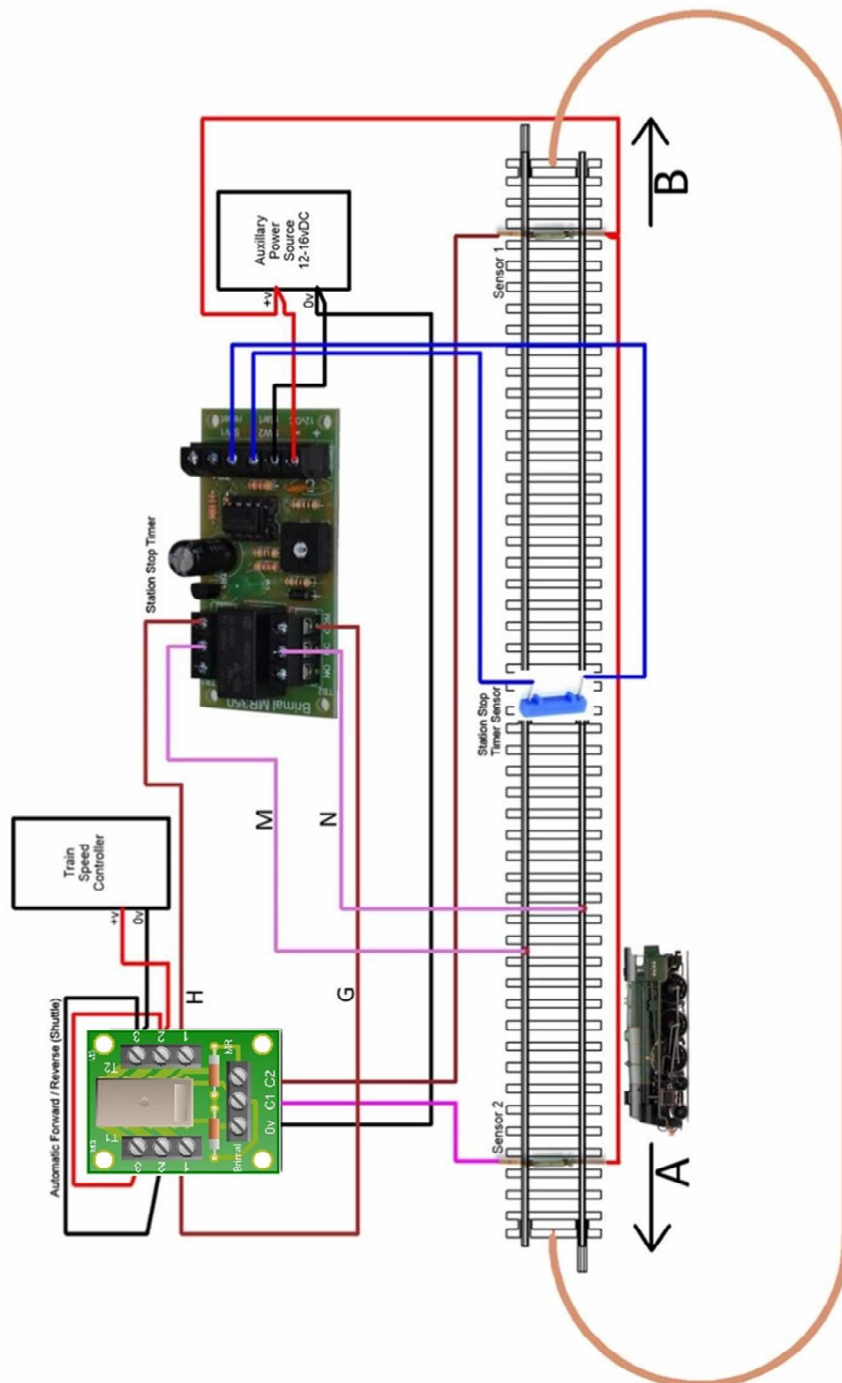
This will continue until power is removed from the system.

You could now add a timer into the system so that the Train stops somewhere for a predetermined period. It can be anywhere, where the sensor is placed.

The Sensor for this is marked 'Station Stop Timer Sensor' this activates a timer which cuts power to the track, thereby stopping the Train at that sensor position.

Wires 'H' & 'G' where going to the track, now they go to the COM on the Timer relay. 'M' & 'N' wires go from the relay back to the track. M&N must be connected to the NC (normally closed) contacts on the relay as shown. The Train Stationary time is adjusted by turning the preset on the timer board. Please see the separate instruction sheet for the MR350.

By adding a toggle switch to the 0V line from the Auxiliary Power Source you can disable the MR204 & the MR350 so the polarity remains the same, and the timer is OFF.

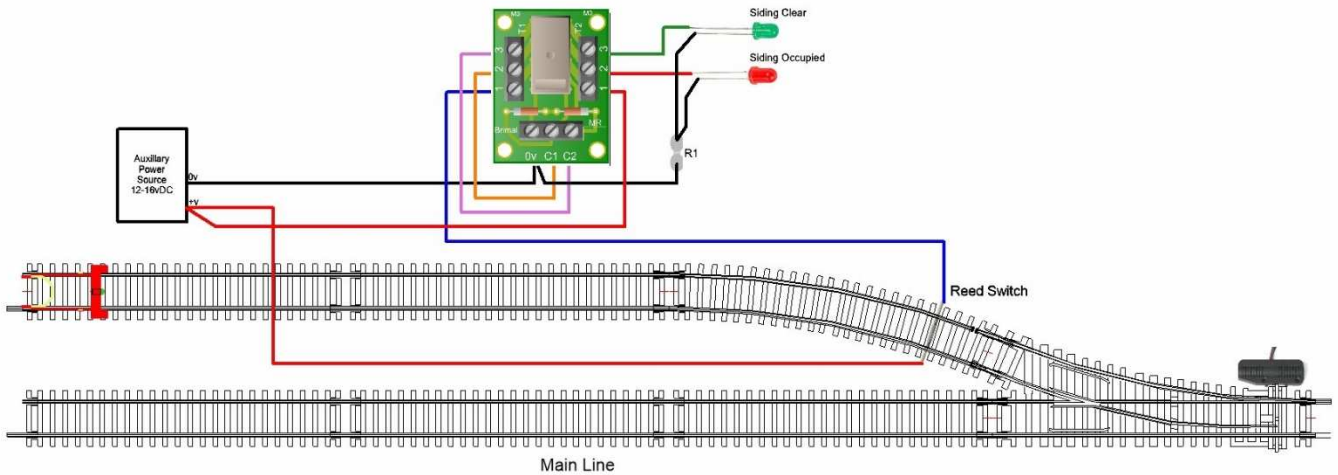


## Siding Occupied Indication

In this application the MR204 is used to indicate back at the Control Panel if a Siding is Occupied or not. As the train passes over the Reed Switch the indication changes from Green (Siding Clear) to Red (Siding Occupied). When the train leaves the siding it passes over the same Reed switch which will change the relay back to Green on (Siding Clear).

The second set of contacts on the relay are used to change the function of the Reed switch, in effect converting it into two separate switches.

A second circuit can be used in conjunction with this first circuit to Isolate the track (so the train enters the siding and then power is removed from the track stopping the train) and controlling the Points with an indication back at the Control Panel as to the status of the points.

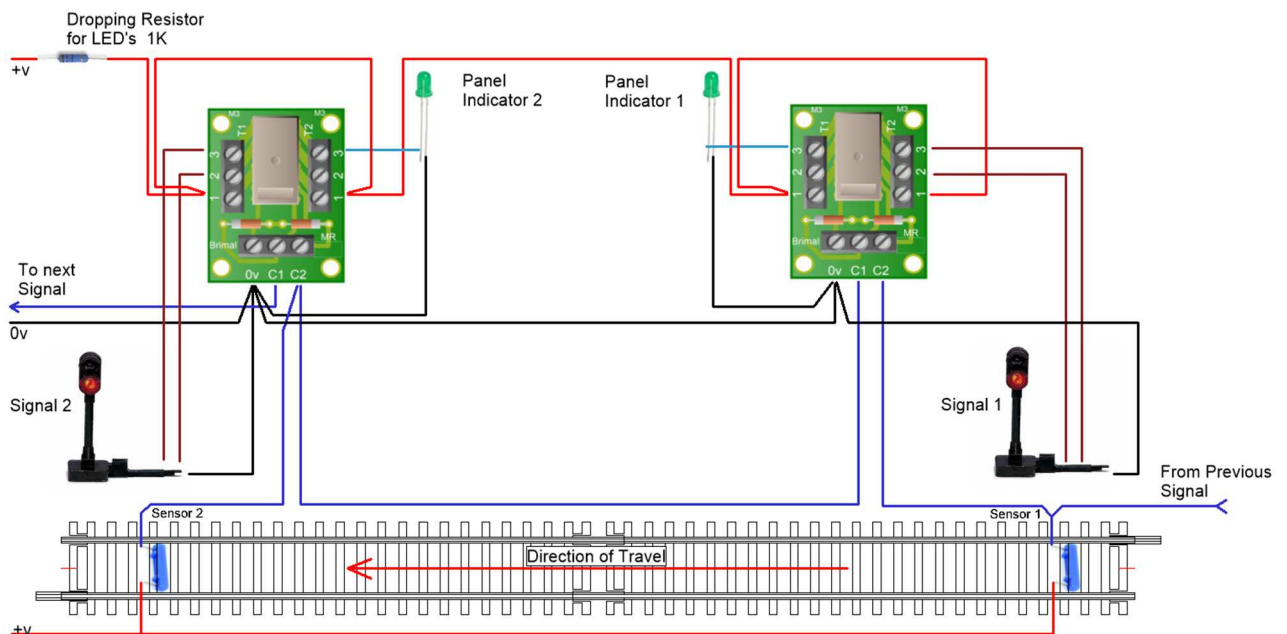


## Control of Running Lights

In this application the MR204 is used to control the signals after a train has passed, each MR204 informs the next MR204 of the status of the last signal. This allows a cascade effect so each signal shows the correct aspect at all times. It is however limited to 2 aspect signals.

As the train passes over Sensor 1 the MR204 will change state which in turn changes the Signal 1 from Green to Red. Also an indicator back at the control panel if required. At this time Signal 2 should be at Green as should all signals left of this. When the train passes over Sensor 2, Signal 2 will change from Green to Red, and Signal 1 will change from Red to Green. This effect will continue as the train passes over the next sensor and so on, until it gets back to Sensor 1 where the cycle will start again.

The distance between Sensor 1 and Sensor 2 will be dependent on the size of your Layout, it could be every 300mm or 500mm and so on



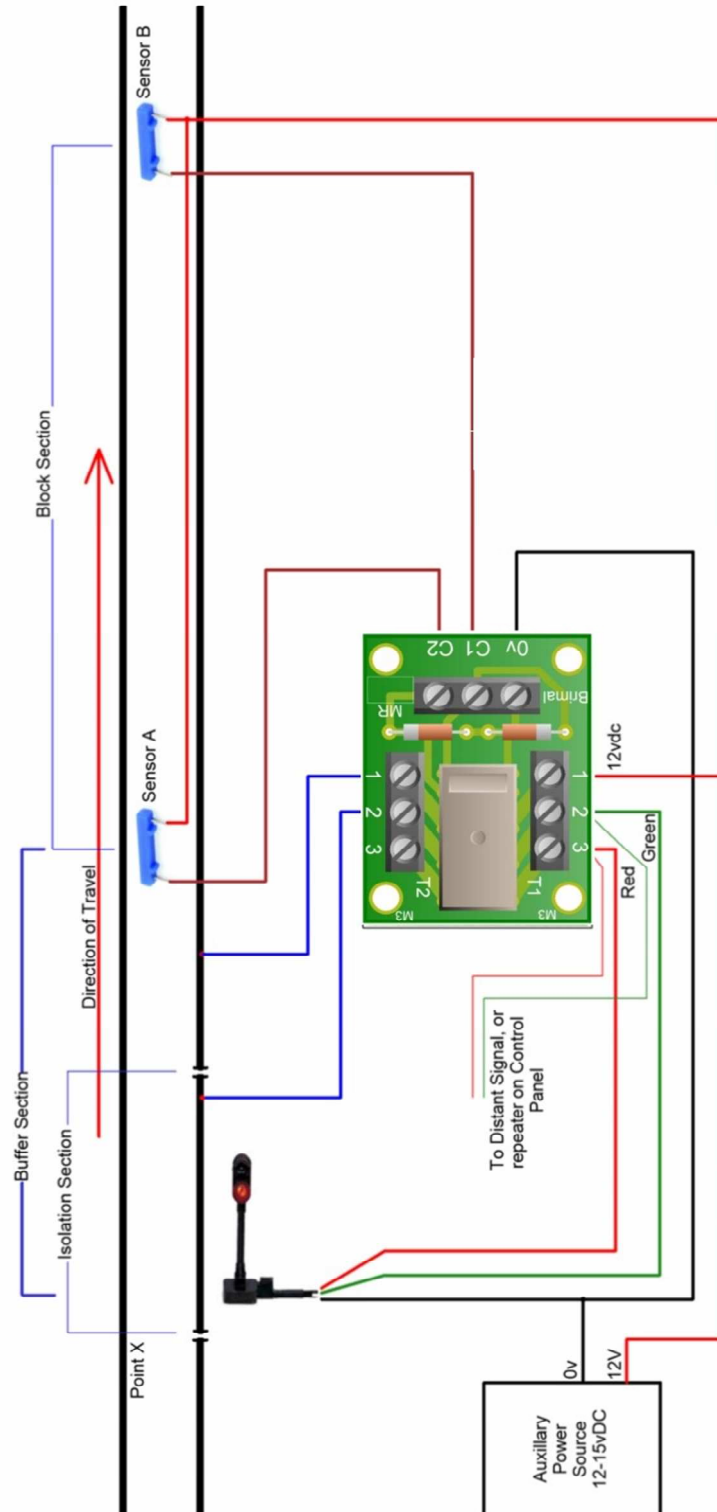
### Basic Train Blocking.

The MR204 can be used to detect the position of a Train in a BLOCK, change the signal behind the train from Green to Red, & stop a following train in the Isolation Section. With 3 or 4 MR204's you could run 3 or 4 Trains on the same track without any collisions.

As the train travels along the track the signal will be at Green. When the Locomotive passes over sensor A the Relay will change over. This puts the signal at Red now, and the other side of the relay removes power from the track in the 'Isolation Section'. When the locomotive reaches Sensor B, the relay will change again. This puts the signal back to Green and restores power in the 'Isolation Section'.

The drawing above has condensed everything onto one page. In real life the distance between Sensor A and Sensor B should be the length of your train plus a little more. The 'Isolation Section' needs to be no more than 300mm, as the Locomotive is not likely to travel that distance without power. The 'Buffer Section' should be a little longer than your train length.

The power for the 'Isolation section' is through the MR204 relay. Pin 1 (T2) picks up power from the track and passes through the relay to Pin 2 (T2), so when sensor A is activated Pin 2 (T2) is deactivated until Sensor B is activated resetting the relay.



## Controlling Electro Frog Points

In this application the MR204 is used to control the polarity of the Frog in a set of Points, also a local Signal or Status indication back at the control panel. The type of motor used in this circuit is a twin coil type with a momentary toggle switch to change the state of the points. As the switch, and therefore power to the motor and the MR204 is only momentary, the MR204 is used to remember the status of the points.

The MR204 is powered from the Power Supply via the Momentary Switch, as shown in the circuit diagram. Positive power is placed on either C1 or C2 depending which way the switch is pushed, this in turn pulls the Point motor Lever Left or Right which changes the state of the Points. Power is then removed from the Points and the MR204, but the contacts on the MR204 remain in the last state they were energised to.

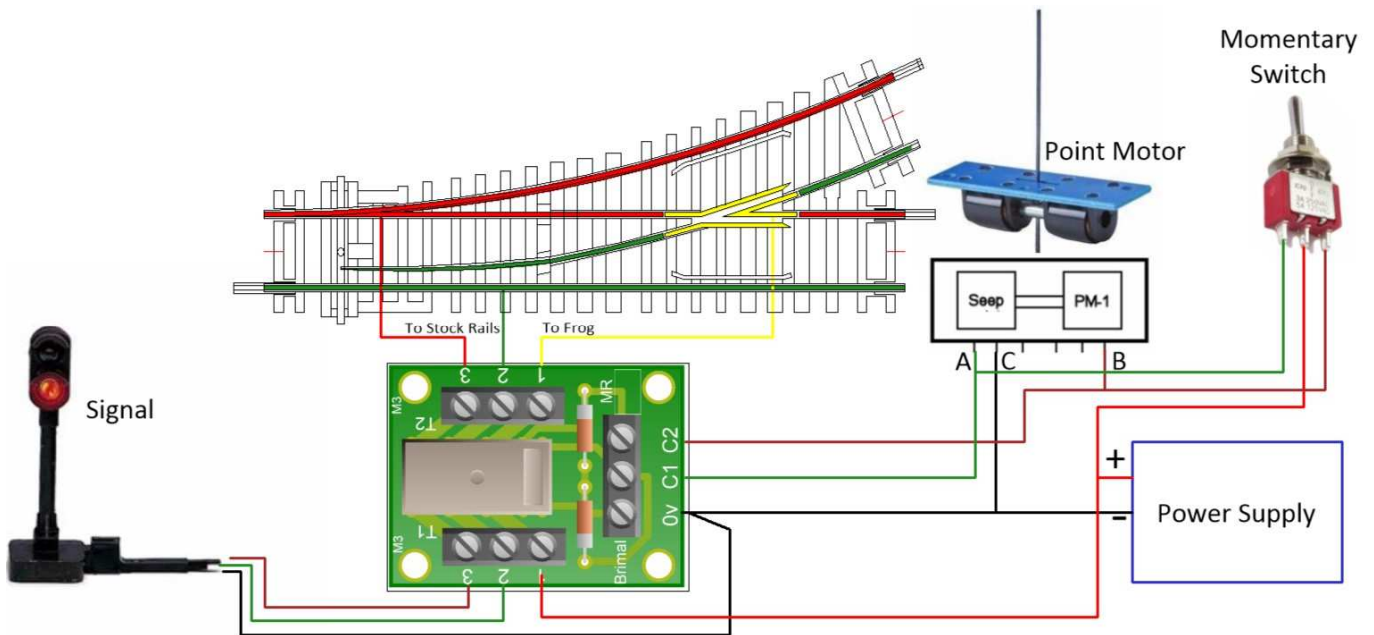
The circuit shows a wire from the RED track going to Terminals 3 of T2, and a wire from the GREEN track going to Terminal 2 of T2. The YELLOW frog has a wire going to Terminal 1 of T2. Because the Contacts in the relay are Changeover the Yellow wire will either be powered from the Red or the Green track. The other terminal set T1 can be used for anything – another set of Points, a Signal, Indication LED's back at control, or to lock out another set of Points.

**IMPORTANT.** The above drawing is powered for Straight Through therefore the power from the RED Track is running through the relay from Terminal 3 to 1 on T2. Because the Relay stays in the last state even when power is removed you must check the flow of power. (It could be that when you receive the MR204 the relay is in 2 to 1 state in which case you would be putting GREEN power onto the Frog, which is not what you want.) There are two ways to solve this.

1) Place a positive pulse on either C1 or C2 to change the relay, independent of the Point motor. You do not want the points to move.

2) Swap the wires around in Terminal T2 (3 to 2) and (2 to 3)

The same as above will apply to anything connected to Terminal T1.



## Controlling Electro-Frog Points in a Crossover

In this application the MR204 is used to control the polarity of the Frogs in two sets of Points. The type of motor used in this circuit is a twin coil type with a momentary toggle switch to change the state of the points. As the switch, and therefore power to the motor and the MR204 is only momentary, the MR204 is used to remember the status of the points.

The MR204 is powered from the Power Supply via the Momentary Switch, as shown in the circuit diagram. Positive power is placed on either C1 or C2 depending which way the switch is pushed, this in turn pulls the Point motor Lever Left or Right which changes the state of the Points. Power is then removed from the Points and the MR204, but the contacts on the MR204 remain in the last state they were energised to.

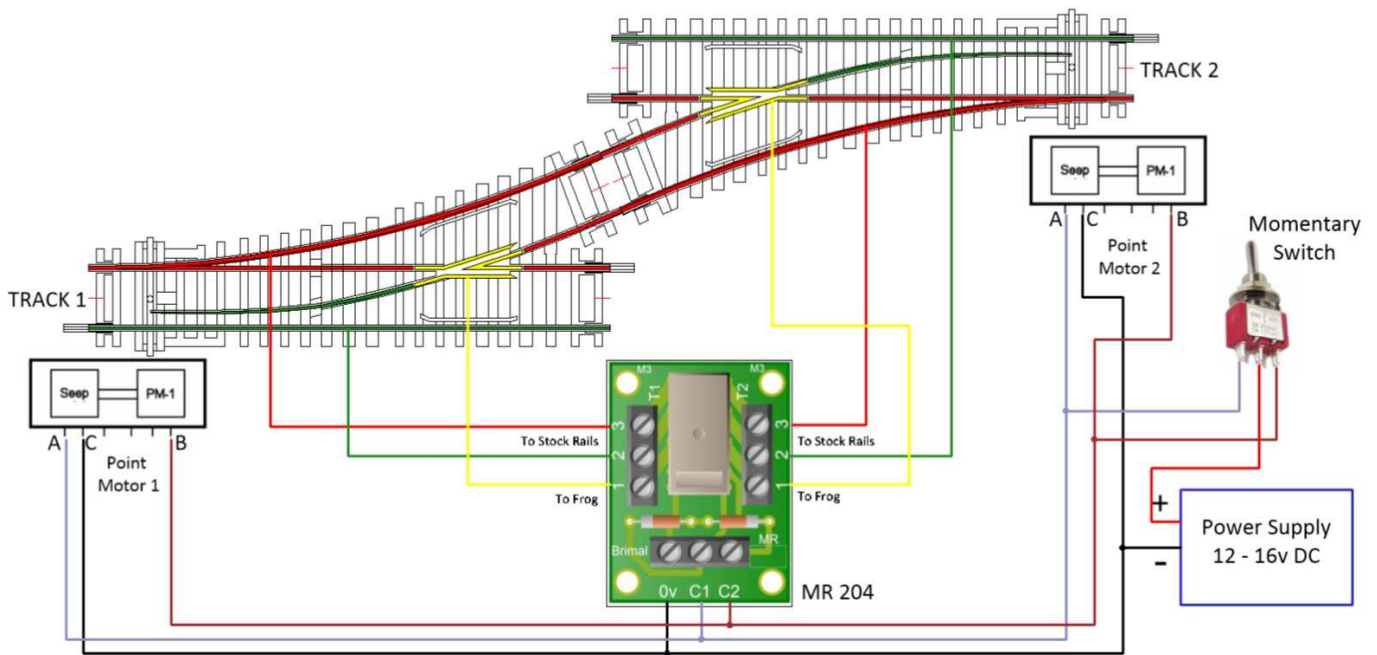
The circuit shows a wire from the RED track going to Terminals 3 of T2 & T1, and a wire from the GREEN track going to Terminal 2 of T2 & T1. The YELLOW frog has a wire going to Terminal 1 of T2 & T1. Because the Contacts in the relay are Changeover the Yellow wire will either be powered from the Red or the Green track. You will see that we are using Terminal set T1 for Track 1 Points and Terminal Set T2 for Track 2 Points. It is important that you use one Momentary switch for this operation, as forgetting to change the points of one set will cause a derailment.

**IMPORTANT.** The above drawing is powered for Straight Through therefore the power from the RED Track is running through the relay from Terminal 3 to 1 on T2. Because the Relay stays in the last state even when power is removed you must check the flow of power. (It could be that when you receive the MR204 the relay is in 2 to 1 state in which case you would be putting GREEN power onto the Frog, which is not what you want.) There are two ways to solve this.

1) Place a positive pulse on either C1 or C2 to change the relay, independent of the Point motor. You do not want the points to move.

2) Swap the wires around in Terminal T2 (3 to 2) and (2 to 3)

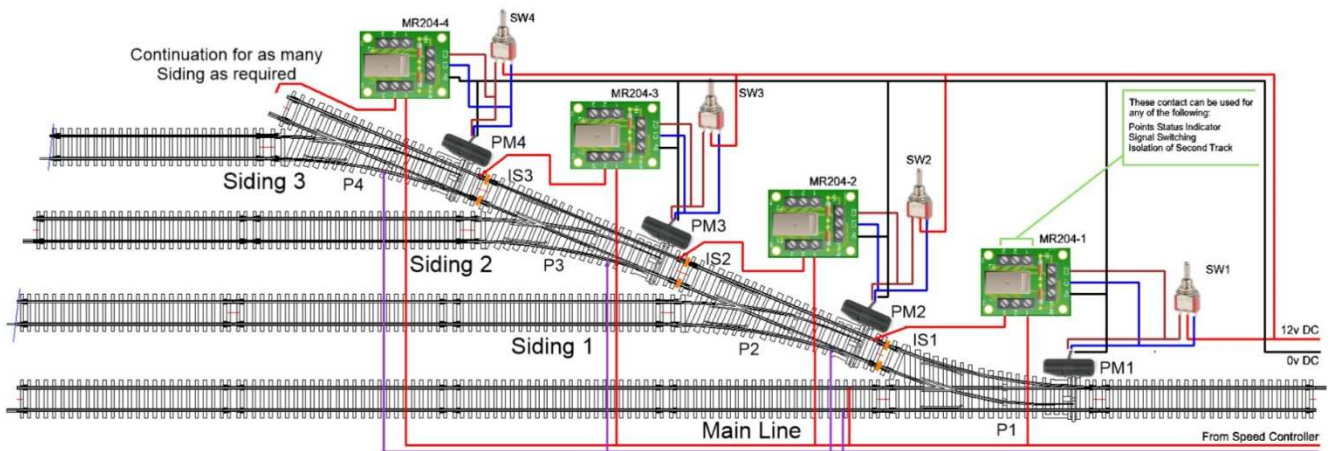
The same as above will apply to anything connected to Terminal T1.





## Controlling & Isolating Sidings

The MR204 can be used to control the Track Power of a complete Siding System. In the diagram below the first MR204 on the right is controlled by the Points switch for PM1, this in turn is switching ON or OFF the power to the Track to all siding above PM1. So with PM1 in the straight through position the MR204 has removed power from the tracks above IS1. When the Points PM1 are changed to Turn Out power is restored to tracks above IS1. If you are removing a Locomotive from Siding 2, then PM3 Points should be in the Turn Out position switching power OFF to the tracks above IS3. This will allow the Loco to move from Siding 2 to the Main Line. Resetting PM1 to Straight Through will switch OFF Power to all the Sidings. (Note 1)

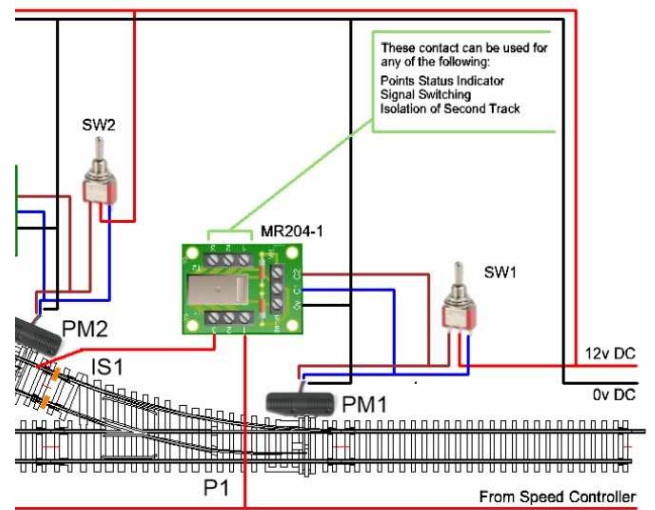


Start by fitting Isolating Fishplates to all the position shown by an orange line. Ensure you have Negative Feed to all the lower tracks of each siding (shown in violet). The positive feed from the Speed Controller goes to Terminal 1 on all the MR204's. As the drawing above shows there is no power on the tracks above the Main Line. PM1 In the position shown the contact on MR204-1 the wiring must come from the Normally open contact (3) to ensure there is no power on the Turn Out at IS1 and above.

To remove a Loco from Siding 2, PM1 must be in the Turn Out position thereby putting power on the Siding Feed Track. PM2 remains the same as the drawing Isolating Siding 1. PM3 is now put in the Turn Out position giving power to Siding 2 and isolating everything above it.

This gives a Speed Control path from Siding 2 to the Main Line with all other sidings are Isolated.

The switch used to activate the points in this case is a Momentary (centre biased) mini toggle switch, this supplies a short pulse to the Point Motor and the MR204. The feed for the Point Motors comes from a separate Power source of a constant 12 – 16v DC.



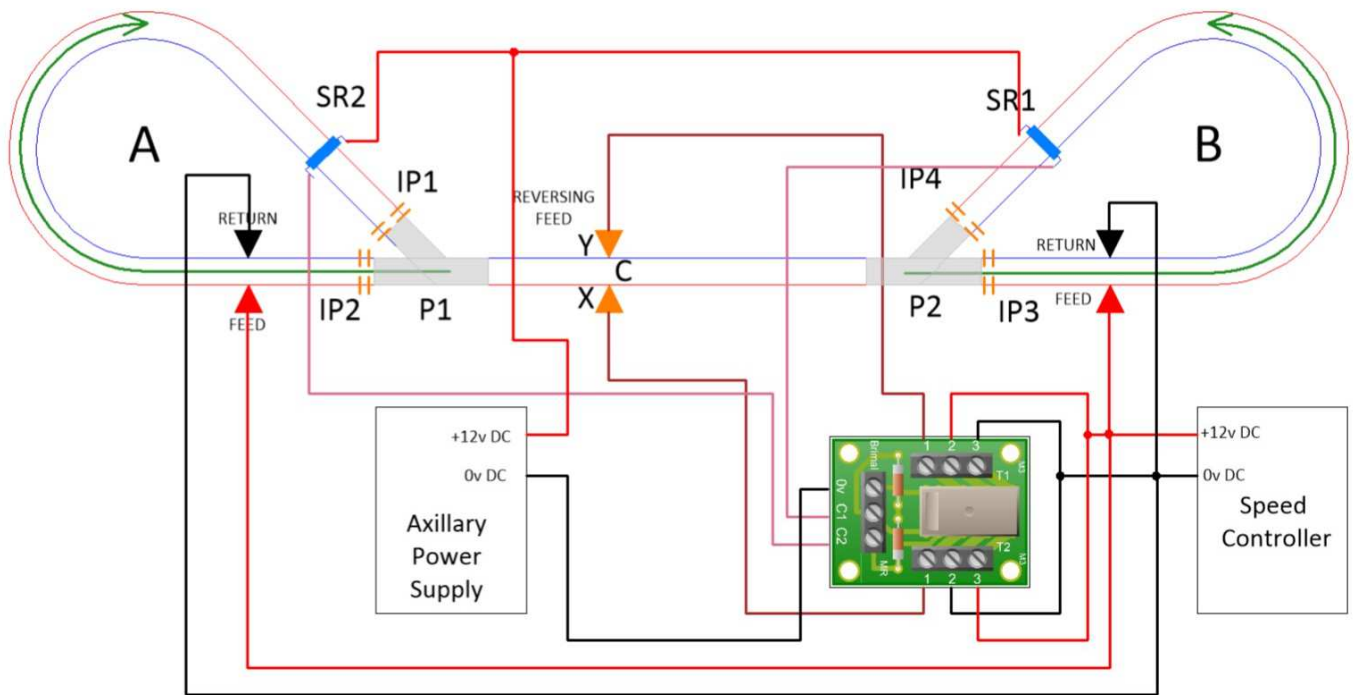
The second set of Change over contacts on the MR204 (T2 Terminals 1 -3) can be used for a number of things.

- 1) A two aspect signal on each siding.
- 2) A 2 aspect indication back at the control Panel
- 3) Isolating the Negative track in each position.
- 4) Isolating a second Speed Controller

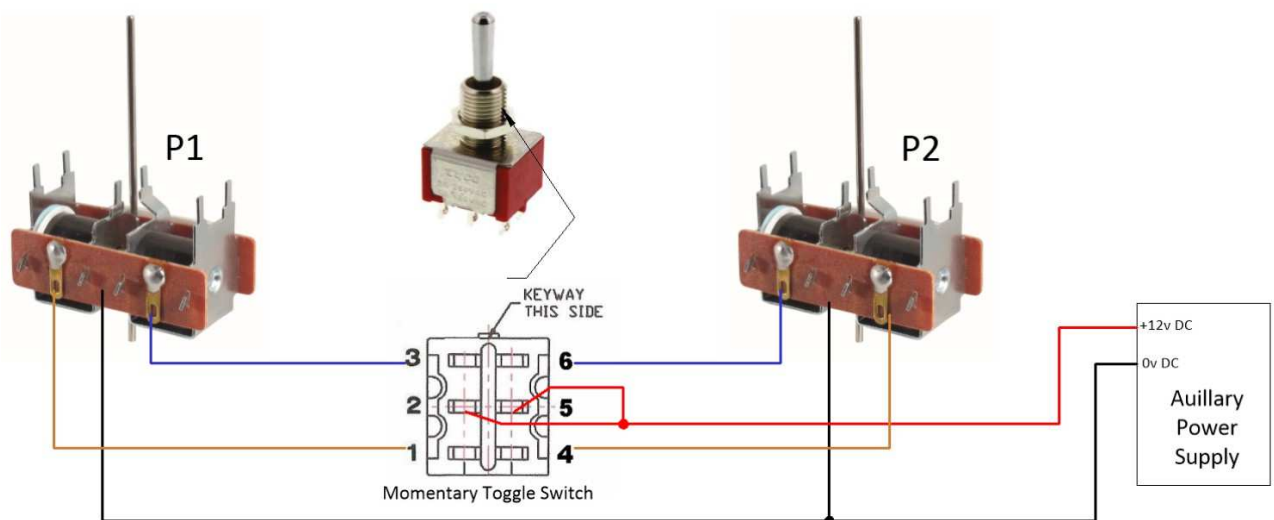
*Note 1:* With PM1 in the Straight Through position, all the Sidings are Isolated, you could therefore have a separate Speed Controller connected to the siding layout so that shunting can be done independently of what is going on elsewhere. However before changing PM1 you need to ensure that the second Speed Controller is Isolated from the Tracks. This can be done by using a second MR204 paralleled to MR204-1, so that both the Positive and Negative Feed of Speed Controller 2 goes through the contacts first before feeding the siding tracks.

## Semi-Automatic Reversing Loop

Below is a complete Layout of a Reversing Loop, the distance between P1 and P2 can be any length to suit your layout. In the Semi-automatic layout, the changing of the points is done manually with a toggle switch, see diagram below, but the power reversing is done automatically via the MR204.



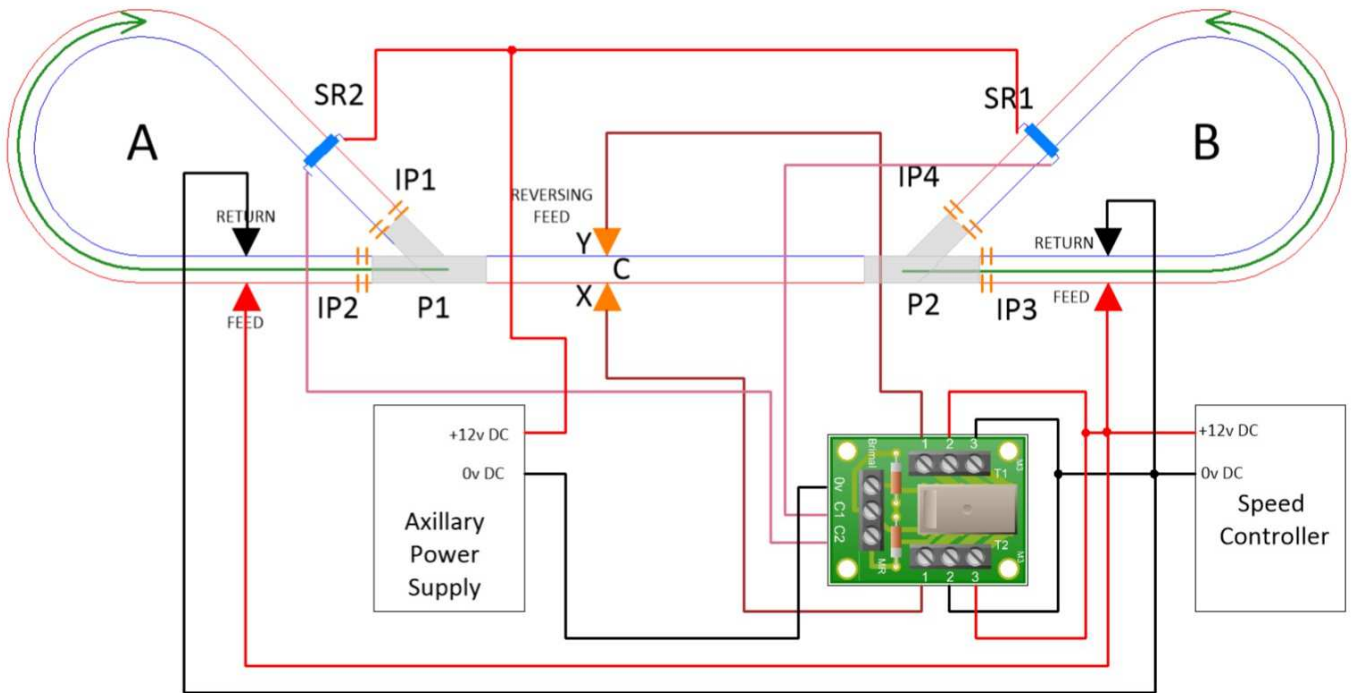
The sequence of operation is as follows: Fit Isolating Fishplates in positions IP1 to IP4. Connect the Speed Control Power to both loops in positions Return (0v) and Feed (+v). Fit magnetic sensors in positions SR1 & SR2. The position of SR1 and SR2 should be far enough away from the points to give you time to change the points. Both sets of points should be controlled by one double pole toggle switch, each set is wired the opposite to the other. In other words when P2 is in Turn Out position P1 will be in Straight Through position. The train travels along the straight from left to right, through P2 around the loop and then passes over SR1 the polarity of the track at X & Y reverses ready to allow the train to proceed onto the straight in the opposite direction. As the train passes over SR1 you will need to ensure the points are in the Turn Out position to allow the train to proceed, this will put P1 in the Straight Through position to allow the train to travel around Loop A



This diagram shows the two Point Motors Connected to a single Momentary Toggle Switch. The Negative (0v) power is connected directly to each point motor (Black). The positive (+12v) power is connected to both sides of the switch at terminals 2 & 5 (Red). The Blue wire, terminals 3 & 6 (up position) are connected to the right-hand coil on P1 and the left-hand coil on P2. The Brown wire, terminals 1 & 4 (down position) are connected to the left-hand coil on P1 and the right-hand coil on P2. *Note 1:* Check the position of the Keyway when wiring the switch is as per the drawing. *Note 2:* Check the orientation when fitted to your layout, as turning one motor through 180 degrees when fitting will make both motors work in the same direction.

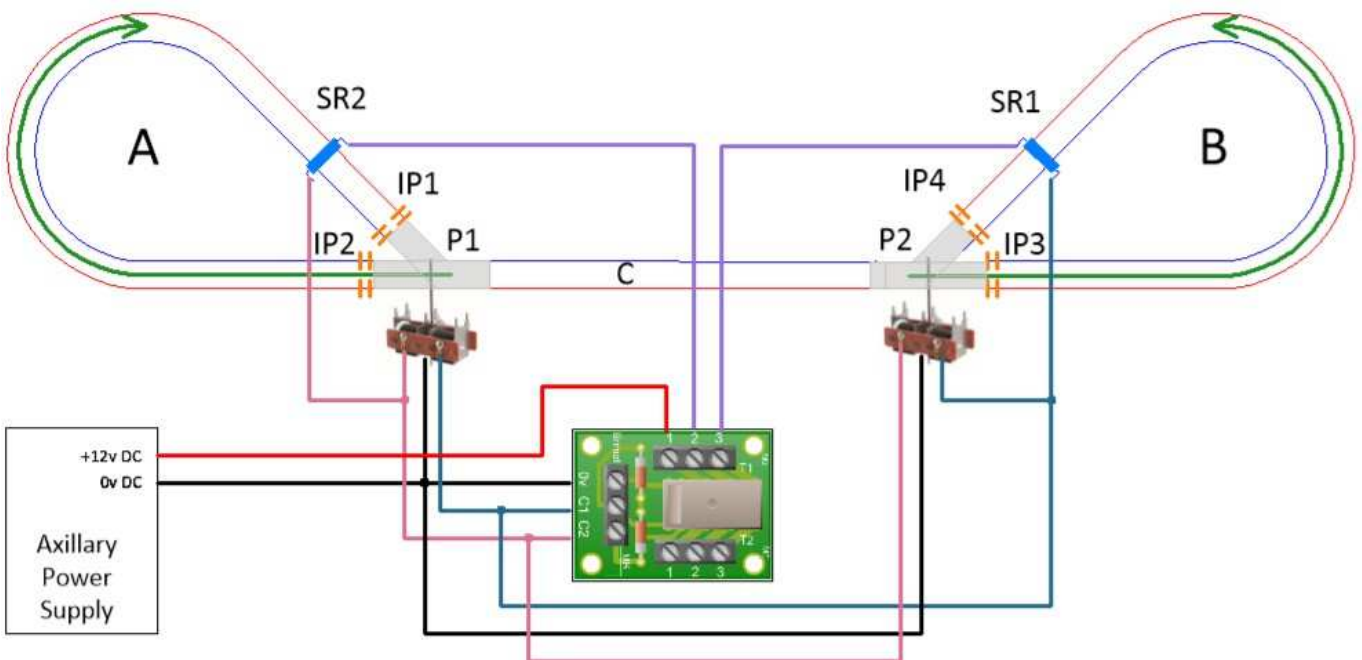
**Automatic Reversing Loop**

Below is a complete Layout of a Reversing Loop, the distance between P1 and P2 can be any length to suit your layout. In the fully Automatic layout, the power from the Speed Controller is reversed automatically with the first MR204 circuit. The changing of the points is done by the second MR204 is show as a separate circuit, below.



The sequence of operation for reversing the polarity is the same as the Semi-automatic system above. As a Train passes over Sensor 1 the points will change and power will be removed from Sensor 1, and put power back on Sensor 2. Sensor 1 cannot be activated again until Sensor 2 has been activated. With this arrangement there is one spare set of contacts on MR204, this can be used to drive a signal set, isolate the track, give an indication back at the control panel, or block another set of points. The relay has latching contacts, this means once energised and power is removed the contacts stay in that state until the second coil is energised.

Once you have the system wired as below, you may find the indicators are back to front, this is due to the state of the relay when you first switch ON. In this case you may have to swap 2 & 3 around (you will only have to do this once - after the initial wiring, after this it will always be correct)



### Equipment Switch Heavy Duty

In this application the MR204 is used to switch ON/OFF a High Power Motor or some other piece of equipment. The ON and OFF push buttons are both momentary Push for ON switches, (these could be magnetic Sensors, Limit switches, timer contacts, pressure switches, etc, as they only need to give a momentary action). The ON/OFF indicators again could be LED's at 2.2v up to filament lamps at 240vAC – the limitation will be the current drawn by the Indicators can not be more than 2 Amps. On the other side of the relay the other changeover contacts can be used to switch ON or OFF a DC or AC appliance, such as a water pump, fan, siren, solenoid, and so on.

By introducing a Timer into T2 contacts the equipment can be switched ON for a specific period irrespective of the switch status, for example an alarm that is only required to be on for a short time.

