

**Northern Line**



# **Switch Types and Circuit Breakers**

**09/08**



This book has been designed to give a basic introduction to the switches that are used to configure the traction current supply to the track. The information is provided as a general guide only. Circumstances and instructions may differ locally. More detailed information can be found in publications elsewhere.

This book deals with the switches that are found at track level. These are the familiar yellow sentry boxes seen in the open sections of the line. The same switches are used in the tunnel section, but they do not have the box

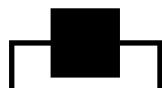
A description of each type of switch is given, and basic diagrams are included to show the effects of the operation of that switch.

There are four types of switch at track level:

- Section Switches
- Section Isolating Switches
- Changeover Switches
- Coupling Switches

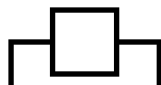
There are also Circuit Breakers

The switches come in pairs - positive and negative, and both have to be operated together. The **positive** switch is identified by a red number plate, the **negative** switch is identified by a blue number plate and the number has the suffix  $\Delta$ .

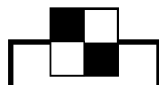


closed

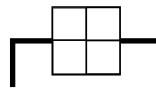
Section, Isolating or Coupling switch



open



Circuit Breaker



Traction Fuse



Changeover switch

## SECTION SWITCHES

A traction current section normally has a double-end feed. This helps to spread the power requirements of the trains in the section between the two substations and to avoid voltage drops in the section. Also, should one substation fail, the section can still be fed from the other substation and the train service continue to run. The section is fed at both ends via a circuit breaker in each substation. If the traction current is switched off (discharged) in that section, then the circuit breakers at both ends open. In the examples below, if section B is discharged, then the circuit breakers at Rannoch Road and Bancom substations will be open.

A section switch divides a double-ended section. It cannot divide a single-ended section (it then becomes a section isolating switch). There may be more than one section switch in a section. A section switch is normally closed.

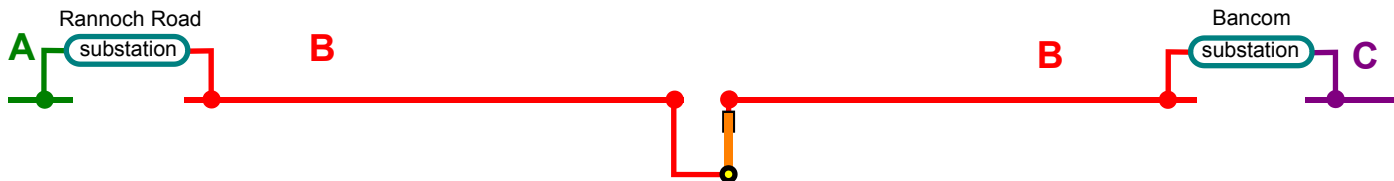
In the simplified diagrams in this book, a section is shown as a single piece of track. In fact a section may comprise several sections of track, such as in a depot, terminus or junction and may include a siding or emergency crossover.

If the section switch is open, the traction current section is divided into two and traction current can be switched back on (recharged) from either end by closing the circuit breaker in the substation at the required end. This would then allow trains to be moved in the live part of the section.

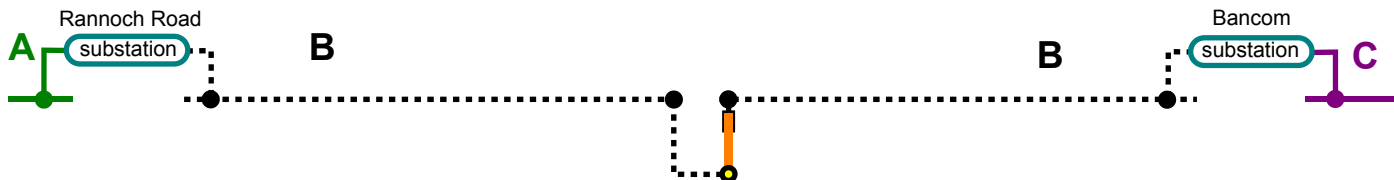
This is useful where traction current has been discharged because of an incident because it may allow trains to reverse via a siding or crossover, or for a train to be brought into a platform for detrainment. Section switches are sometimes opened if it is necessary to carry out engineering work on part of the section with trains running on another part of the same current section.

### some switch plates

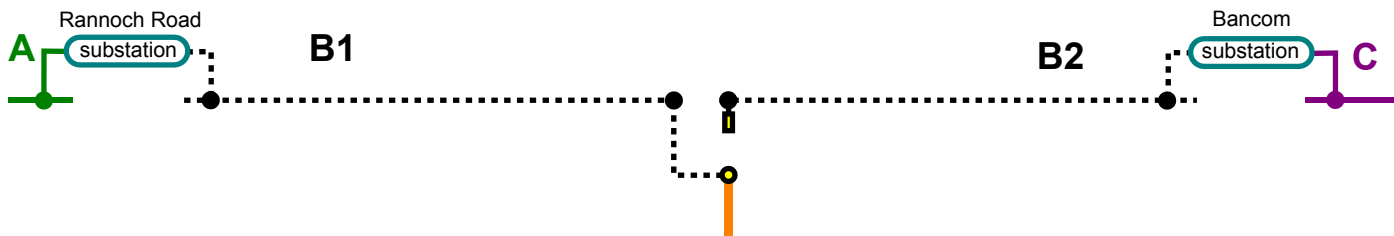




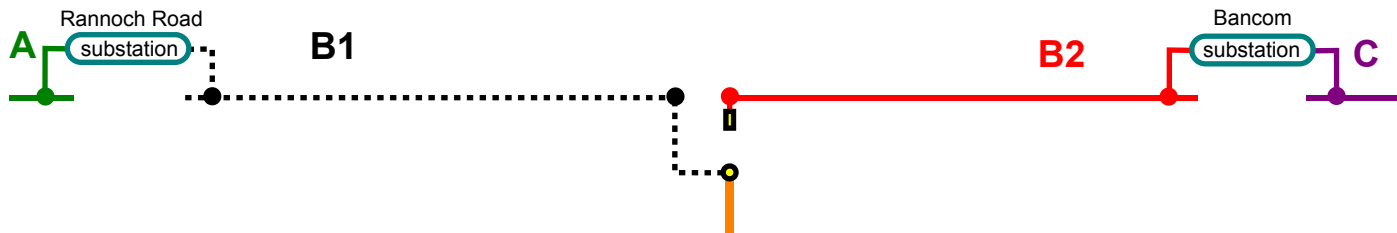
- ① The section switch is closed and current is being fed into section B from both substations



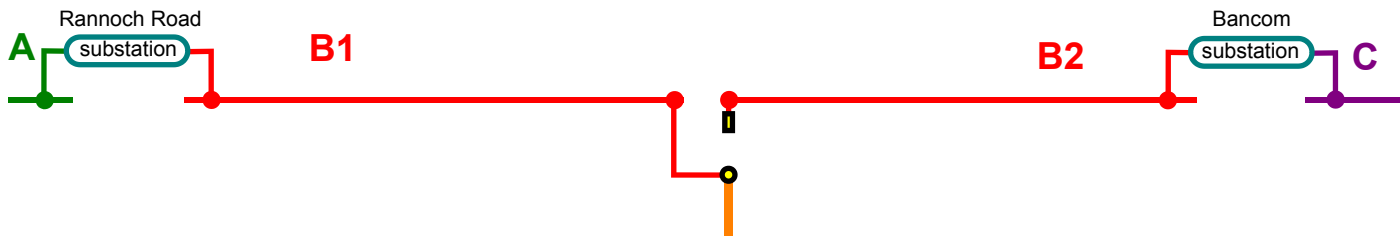
- ② Traction current has been discharged on section B



- ③ The Section Switch has been opened, dividing the traction current section into two - B1 and B2

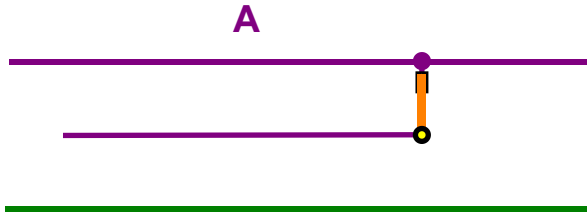


- ④ Traction current has been switched back on from one end - from Bancom substation. Section B2 is live  
Trains can be moved in this area



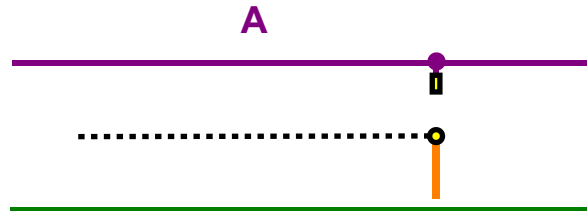
The Section Switch has been left open and traction current switched back on on both sections  
Section B has remained divided into two (B1 and B2). B1 and B2 are both single-end fed  
In normal circumstances, this may have little effect on the service

## SECTION ISOLATING SWITCH



**B**

Section Isolating Switch closed  
- the track is live



**B**

Section Isolating Switch open  
- the track is dead

A section isolating switch is used to isolate a single-end fed section of track.

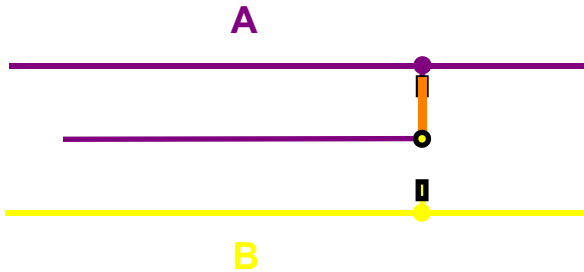
The switch is normally closed and the section of track is live.

Opening the switch switches off current to that section.

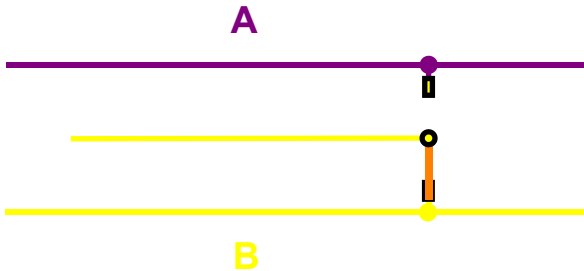
Often used to isolate a siding, a section isolating switch can also be found in some places where a section of running line is single-end fed, such as terminal platforms.

A section isolating switch can be used to isolate a defective train in the siding. It can also be used to isolate a section of track for engineering work during the day when it is necessary to keep the rest of the section live to run trains.

## CHANGEOVER SWITCHES



The Changeover Switch is in the top position  
- the middle track is fed from section A

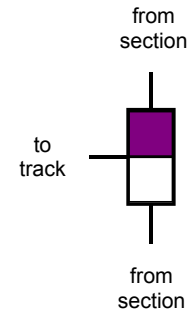


The Changeover Switch is in the bottom position  
- the middle track is fed from section B

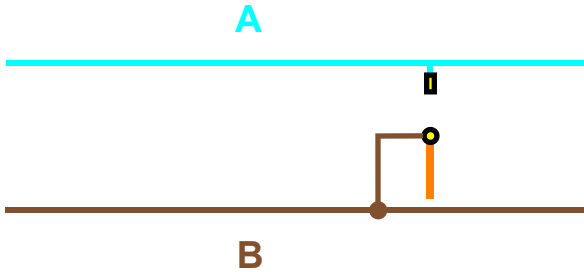
A changeover switch allows a section of track to be fed from different traction current sections. If traction current has been switched off on one section, reversing the switch allows the section of track it feeds to be fed from the other current section.

A changeover switch blade can be in either the top or bottom position, depending on where the feed is being taken from. There is no “normal” position for the blade to be in.

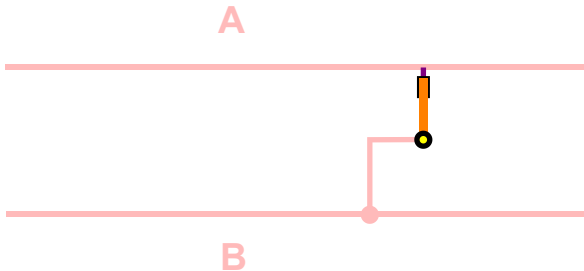
Diagrams normally show the feed with the switch in its usual position, the solid half of the switch showing what section the switch is taking its feed from. The fact that the solid half might be shown at the top, DOES NOT necessarily mean that the switch blade is at the top.



## COUPLING SWITCHES



The Coupling Switch is in the open position  
- the sections are separate



The Coupling Switch is in the closed position  
- the sections are joined

A coupling switch is a switch that joins two traction current sections together.

The switch is normally open.

Closing the coupling switch joins (couples) two separate sections together.

Care has to be taken if the two sections are in different sectionalisation areas (such as when coupling a depot section to a running line section) or a fault, such as an earth, in one sectionalisation area will be transferred to both areas.

Coupling switches are rarely operated, but can be used if there is a loss of a feed from a substation due to a defect or maintenance, or during engineering work. Depending on the requirements, other switches may also be operated at the same time.



## **CIRCUIT BREAKERS**

For what is being covered in this book, circuit breakers can be thought of as another form of a switch. They are usually heavy duty, capable of operating when traction current is being drawn. Their effect on switching traction current is the same. There are circuit breakers in the substations which open and switch off the traction current to the section. At track level, circuit breakers were normally only found in sidings, however they are now being used to replace section and other switches in many locations, usually as part of a line upgrade.

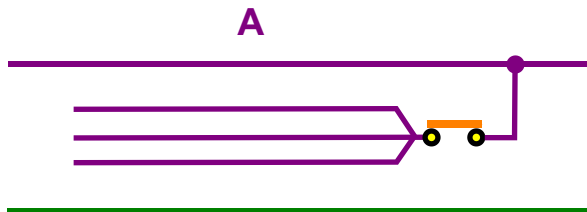
Where circuit breakers have replaced section switches, they are not covered here. However the principle purpose is still the same as for switches when used for dividing a section etc.

When describing a switch operation, the normal terms are open and close. With circuit breakers, the terms trip (open) and reset (close) are normally used. The same goes for Miniature Circuit Breakers.

Track level circuit breakers are usually operated remotely, although there are facilities to manually open and close the circuit breaker if necessary. One circuit breaker will normally switch both positive and negative supplies. Circuit breakers are designed to switch traction current when it is on and even when current is being drawn, such as when the circuit breaker is tripped due to a train moving when the route is not set, or there is an overload. Local instructions will apply as to whether current must normally be discharged before operating the circuit breaker. Traction current **MUST** be discharged if a circuit breaker is being opened or closed manually.

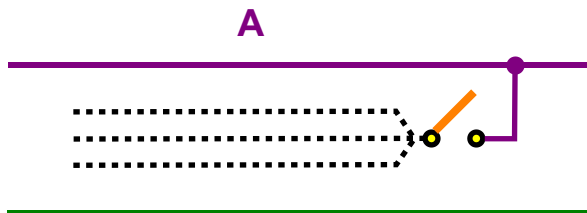
Circuit breakers are normally found in tunnel sidings and are used to switch off traction current if the tunnel telephone wires are operated in the siding. Some will trip and switch off the traction current if a train starts to move and the route is not set. They can also be tripped and reset from a separate panel at the station and manually operated if required.

The circuit breaker in a siding is usually in series with a section isolating switch.



**B**

Circuit breaker closed  
- the tracks are live

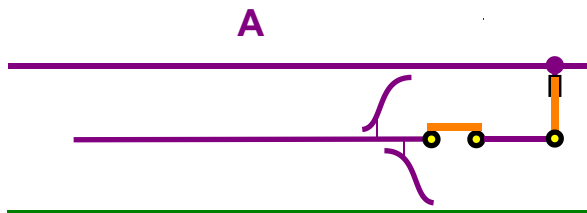


**B**

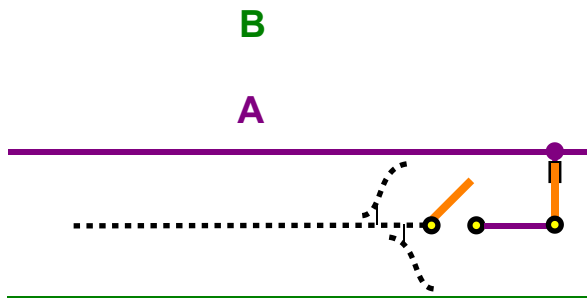
Circuit breaker open  
- the tracks are dead

A circuit breaker is being used to supply or isolate a track. Although only a few tracks are shown here, the circuit breaker could be supplying a wide area consisting of many tracks.

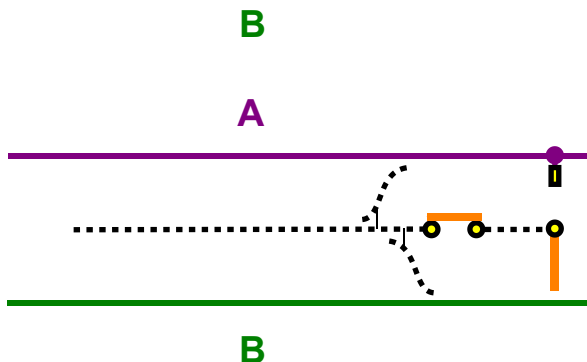
They are often used this way in depots to isolate the main feed to the whole or part of the depot and to isolate overhead shed leads when the nearby plunger is pressed.



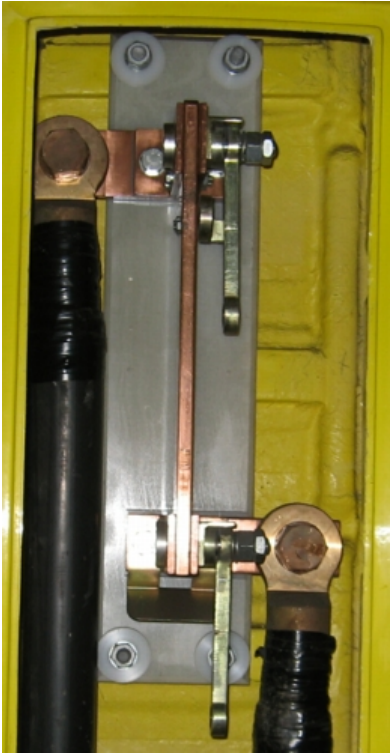
The siding is fed via a section isolating switch and a circuit breaker. Both are closed, and the siding has 630v traction current.



The circuit breaker is opened (tripped). Current is lost to the siding.



The section isolating switch is open. Current is lost to the siding. The circuit breaker is also isolated. By opening the isolating switch, maintenance could be carried out on the circuit breaker even though there is still traction current on section A.



**Section, Isolating or Coupling switch**

In the closed position



In the open position



**Changeover switch**

The top and bottom cables are from the sections  
 The middle cable feeds the track  
 The blade is in the bottom position

## **SIDING TRACTION FUSE PROTECTION**

Traction fuse protection is sometimes used in sidings in the open section and consists of a contactor and a fuse. It is usually provided where there is limited overrun space available and is designed to switch off the positive supply to the siding if the train attempts to move when the route is not set. Together with the raised trainstop at the outlet signal, this limits the movement of the train and is designed to prevent the train fouling an adjacent track.

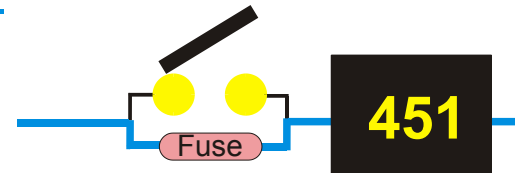
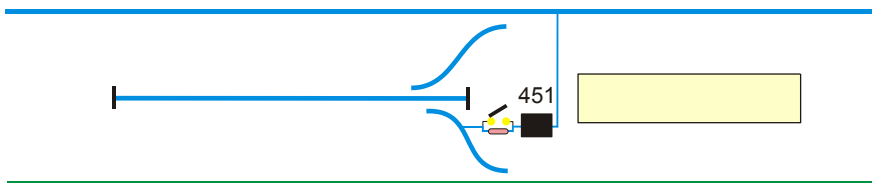
The traction current supply to the siding is protected by a fuse in the positive supply. The contactor is a normally open switch and traction current for the siding passes through the fuse. If the points are set for a train to enter or leave the siding (whether or not the signal is clear), the contactor by-passes the fuse and allows full traction current to the siding. The fuse has a high enough rating to provide all a train's stationary needs. However, if the train attempts to motor when the route is not set, the additional current that is being drawn may blow the fuse.

Traction current will be restored to the siding when the route is set. A remote override switch is usually provided so that the contactor can be closed if required, irrespective of the position of the points.

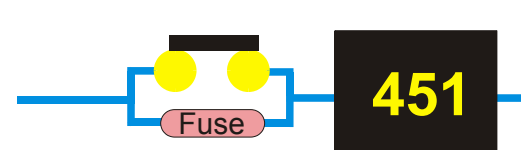
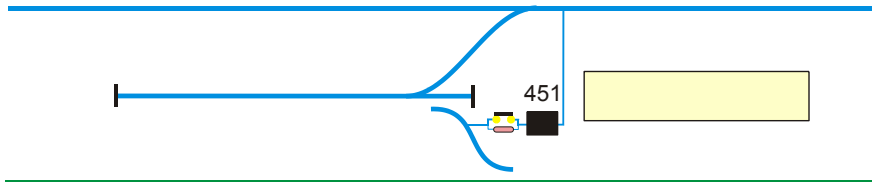
In order for a train to move, it needs air. Amongst other things, the air operates the linebreakers which close to allow the 630v traction current supply to go to the equipment on the train. This 630v equipment includes the compressors which supply the air. When the 630v feed is lost, the compressors will not run and the air could gradually leak off. As the air leaks off, the linebreakers could open. Even though traction current may be restored, the compressors will not start because the linebreakers are open. No air - no movement.

On older stock, the linebreakers are only connected to the motors. The other 630v equipment is fused and fed directly via the traction current shoes. Therefore, when traction current is recharged, the compressors will automatically start and recharge the air.

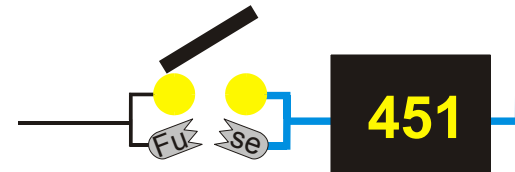
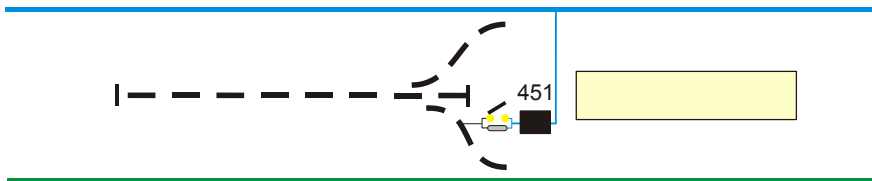
There is usually a section isolating switch in series with the traction fuse / contactor. Opening the switch will also isolate the fuse so that the fuse can be changed.



The points are normal - current is being fed to the siding via the fuse

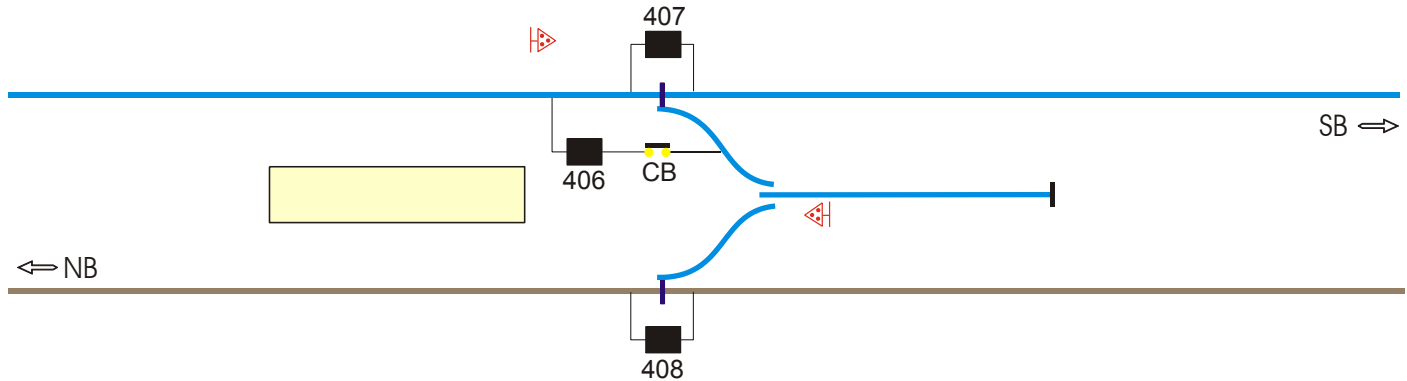


The points are reversed - current is being fed to the siding via the contactor. Current will also flow through the fuse



The points are normal - the fuse has blown. Current is lost to the siding unless the points are reversed

## Typical traction current arrangements at a tunnel siding area



406 are Section Isolating Switches

407 and 408 are Section Switches

CB is the Circuit Breaker

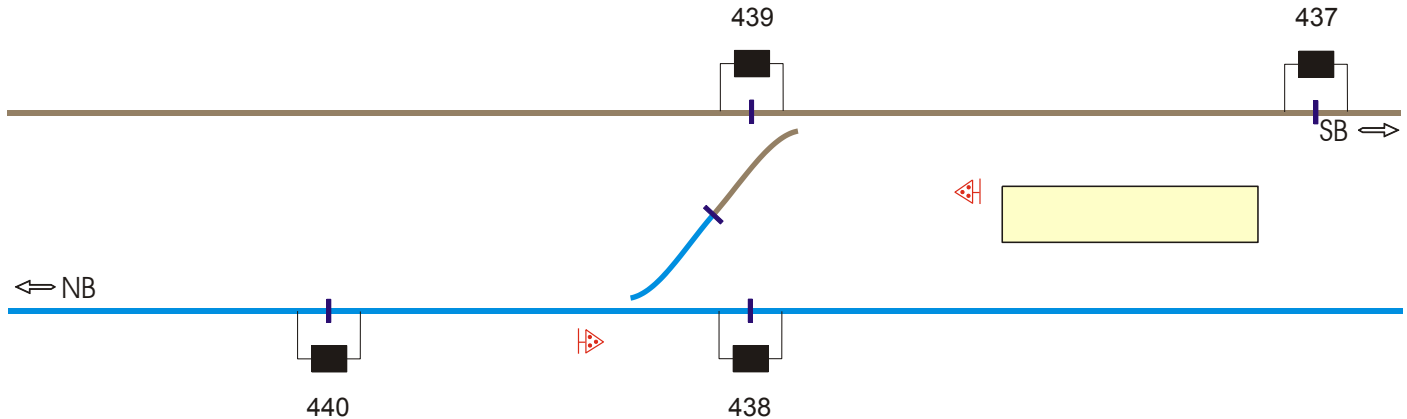
All switches and the circuit breaker are normally closed

406 and the CB can be used to isolate the siding

If there is an incident south of the station on the SB line, opening 407 divides the SB section in two. Switching current back on from the station side allows trains to reverse south to north via the siding

If there is an incident south of the station on the NB line, opening 408 divides the NB section in two. Switching current back on from the station side allows trains to reverse south to north via the siding

## Typical traction current arrangements at an emergency crossover area



All switches are section switches and are normally closed

If there is an incident south of the station on the SB line, opening 437 divides the SB section in two. Switching current back on from the station side allows trains to reverse south to north via the crossover

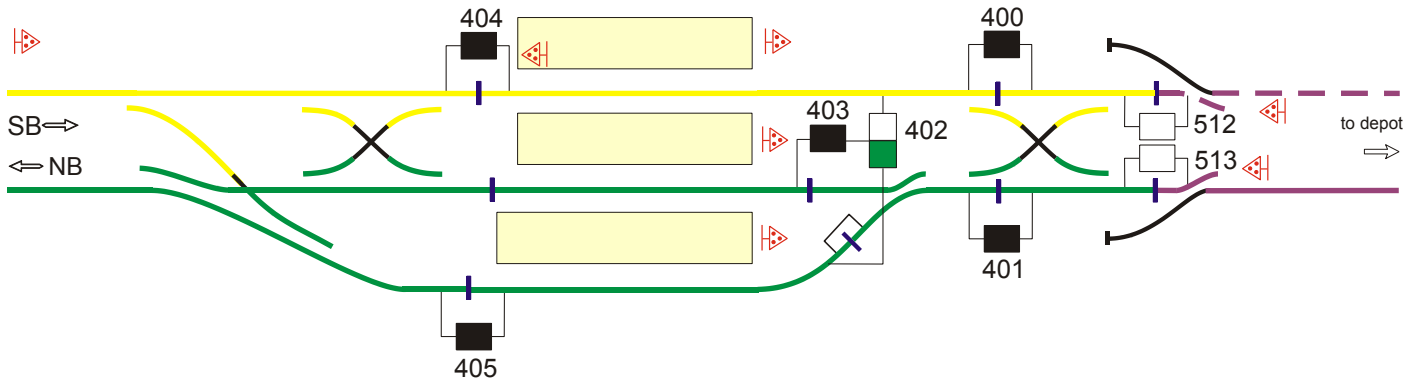
If there is an incident north of 439 on the SB line, opening 439 divides the SB section in two. Switching current back on from the station side allows trains to reverse north to south via the crossover

If there is an incident north of 440, opening 440 divides the NB section in two. Switching current back on from the station side allows trains to reverse north to south via the crossover

If there is an incident in the NB platform, opening 438 divides the NB section in two. Switching current back on from north of 438 allows trains to reverse south to north via the crossover



## Typical traction current arrangements at a terminus with an adjacent depot



400, 401, 404 and 405 are Section Switches - normally closed

402 are Changeover Switches - shown in their usual position

403 are Section Isolating Switches - normally closed

512 and 513 are Coupling Switches - normally open

The section switches can be opened as required to allow train movements after the current has been switched back on to part of the section

402 normally feed the middle platform from the NB (green) section. If they are reversed, the middle platform will be fed from the SB (yellow) section

403 can be opened to isolate a train in the middle platform

512 can be closed to join the SB section with the depot SB section

513 can be closed to join the NB section with the depot NB section