

**Northern Line**

**TRACK CIRCUIT  
INTERRUPTERS**

**POSITION DETECTORS**

**POSITIVE TRAIN  
IDENTIFICATION**

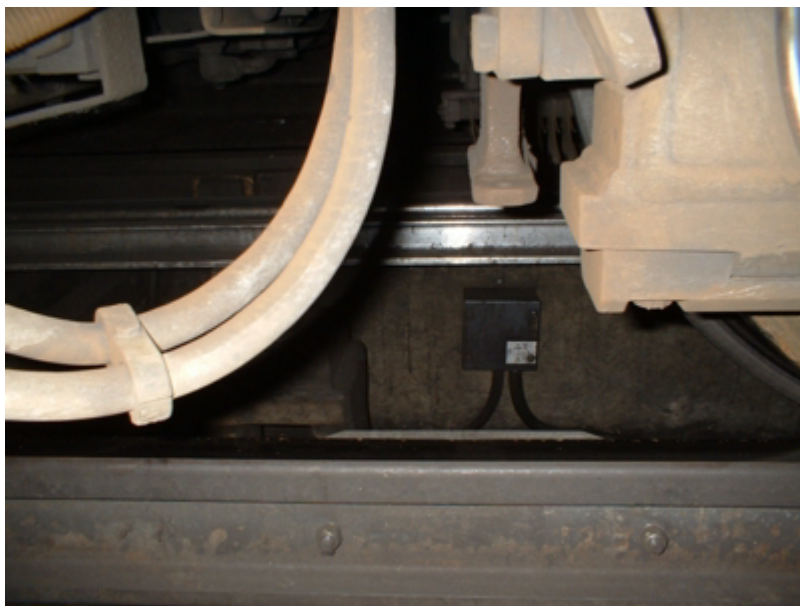
**02/06**



This booklet has been designed to give a brief introduction to three pieces of equipment that affect the working of the Northern Line:

Track Circuit Interrupters  
Position Detectors  
Positive Train Identification

My thanks to David Millard and Kevin Rose for their feedback.



*Position Detector - on inside edge of track - Moorgate SB platform*

## TRACK CIRCUIT INTERRUPTERS

Track Circuit Interrupters (TCI) are used in areas where it is necessary to detect if a train has gone past a certain point. They are usually located at places where it is a dead end – a terminus or siding, or the approach to a sand drag – i.e.. past where a train should stop.

Fitted to the inside of the running rail, the TCI can be thought of as a right angled bracket. This is secured to the inside of the running rail so that the top surface is level with the rail. A cable is taken from the top and side areas of the TCI, the metal of the TCI completing the circuit between the two sets of wires. The TCI is insulated from the running rail.

When the flange of the first wheel passes over the TCI, it breaks it in two, thus breaking the circuit through the cables.

When the TCI is broken, the effect it can have depends on the location: At a terminus road or siding – e.g.. in Edgware platform, this will cause that track to remain down after the train has left. This gives the impression that the track is occupied and therefore another train cannot be signalled into that platform. At a sand drag or buffer, this may cause the signal that the train overran to remain at danger, even though the train may no longer be there.

This is to ensure that overruns are immediately detected and the site can be examined to see how far the train travelled and if there was any damage.

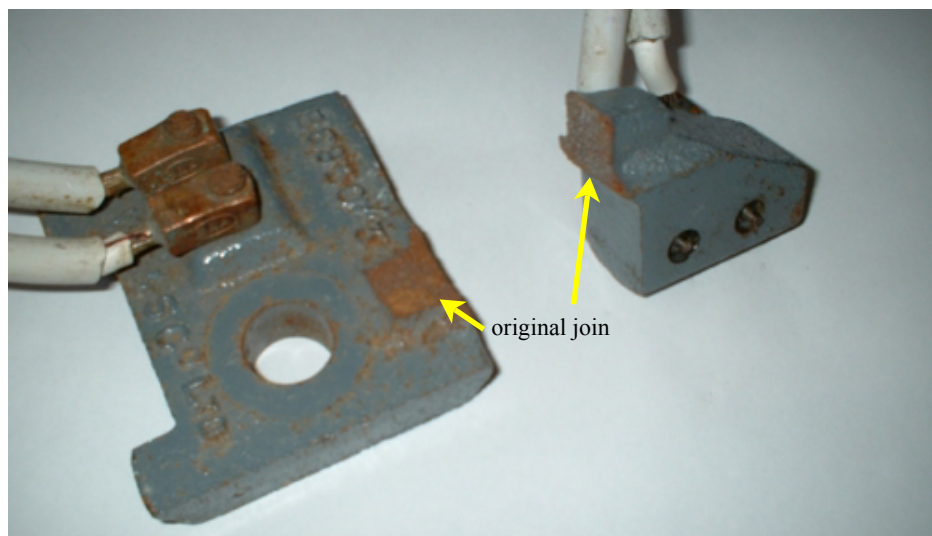
The damaged TCI needs to be replaced before normal service can be resumed.



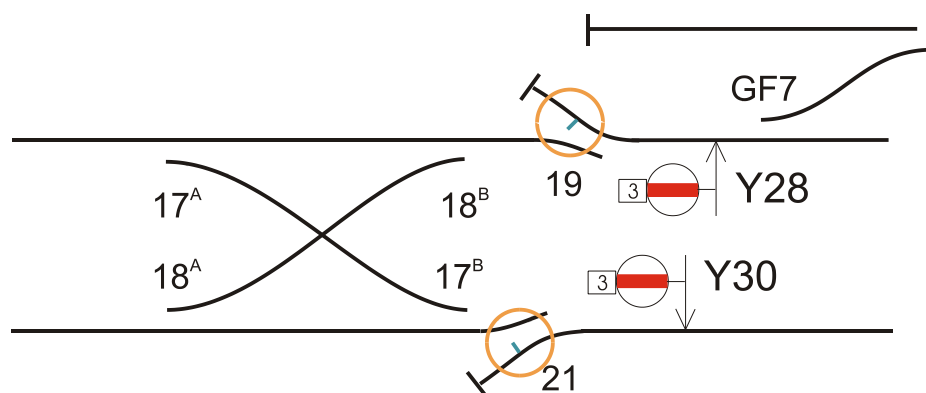
*Track Circuit Interrupter*



*Track Circuit Interrupter in position  
(with white insulator)*



*Track Circuit Interrupter after the passage of a wheel*



*Track Circuit Interrupter locations - Morden depot approach*

## POSITION DETECTORS

Position Detectors (PD) are used to detect the position of a train. They are fixed to the inside of the running rail and act like metal detectors, detecting the train wheel as it passes overhead. There is no physical contact between the detector and the wheel. The PD can be thought of as a switch that is triggered by the passing of the wheel. They can be used for various purposes including:

- detecting a train is correctly berthed
- to release a route after the passage of a train
- operating a timing section / clearing a signal
- to give the exact position of a train – e.g.. for approach control
- lowering the ‘policemen’ trainstops used in the terminal platforms.

In open sections, the junction box for the PD can often be seen, usually adjacent to the cable run. This is the yellow “burger box”.

### Timing sections

It may be necessary for a signal to remain at danger until the speed of the train has been reduced. A draw-up signal is one example of this is and in the Finchley Central area position detectors are associated with NQ100, NQ300, NQ280<sup>A</sup> and NQ280<sup>B</sup>

When a PD is used for slowing a train down. the usual way is like this:

As the first wheel passes over the PD, it triggers a 4.5 second delay. After 4.5 seconds, the signal will clear. If the train is going too fast and reaches the signal in under 4.5 seconds, the signal will still be at danger and the train will be tripped. The actual speed of the train is not measured. The speed that the train is able to do before that signal will clear depends on how far away the PD is from that signal – the nearer the signal, the slower the train has to be going before that signal will clear.

Generally a timing section is positioned to enable the train to be stopped before being tripped, providing the train is not speeding excessively

Examples of the different spacing are:

At J900 in Euston loop, the PD is 57’6” before the signal and the speed of the train has to be reduced to around 5mph.

At AE100, the PD is 216’ before the signal and the speed of the train has to be reduced to around 15mph.

At A4340 (Colindale NB), the PD is 407’ before the signal and the speed of the train has to be reduced to around 25mph.

Some signals have two PDs – AE100 and NU300, for example. Going past the first one will start the 4.5 seconds timer. If the first pair of wheels has not passed the second PD within 4.5 seconds, this proves that the train is at the required speed (15mph) and the signal will clear. If the train is too fast and the first pair of wheels passes the PD within 4.5 seconds, then the signal will not clear. The timing has to start again. This normally means that the train is brought to a halt at the signal. If the train is unable to stop in time, then it will be tripped at the signal.

### **Train detection**

PDs can also be used when it is required to detect that a train has reached a certain position before a signal can be cleared.

At Moorgate SB, there is a PD near the stopping mark. This detects the position of the train. If a train is reversing S-N, it is important that the train is fully berthed so that the PD detects the first pair of wheels. If not, it may not be possible to clear wrong road starter M8.

note

The information given here is a generalisation and actions may vary according to individual circumstances/scenarios. Where it is mentioned that a signal will clear, this assumes that conditions are right for the signal to clear, such as the section ahead clear, lever reversed (where applicable) etc.



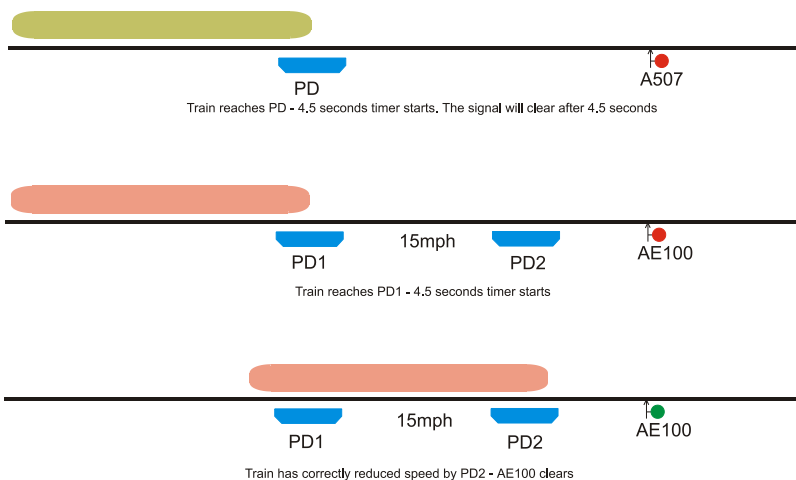
*Position Detector*



*First Position Detector approaching NU300*

## POSITION DETECTOR OPERATION

Single and dual PDs



# POSITIVE TRAIN IDENTIFICATION

PTI information means that the signal operator does not have to set up the train's next destination at each terminus, and that accurate train identity information is maintained as it passes through each junction. PTI is a means of identifying where a train is on the line. This information can also be put to other uses.

There are three main elements of the PTI:

- on-train equipment
- trackside equipment
- computer

## **On-train equipment**

The required PTI information is set up by the driver when they take over the train. On 1995 stock, this information is entered into the train's onboard computer via a keypad. A rotary switch (the 'empty' switch) selects whether the train is in or out of service. A transmitter is located on the right hand side, below the leading car.

## **Trackside equipment**

An interrogator is located on the track between the negative rail and the right hand running rail. This receives the transmitted PTI information. It is called an interrogator because it asks, or interrogates, the train for the PTI information as it passes over it. The information is then passed on to the computer.

## **Computer**

The computer in the Northern Line control centre at Cobourg Street uses the information in different ways:

- to provide a display for the signalman
- to route the train at a junction
- to provide train running information
- to display the train's destination on the station dot matrix displays.

In the control room, the train number, destination and whether the train is in or out of service is displayed on the signalman's wall diagram. The information is displayed in green – three digits for the train number, three letters for the destination, and a "star" if the train is out of service. If the PTI info is not received, usually due to defective equipment on the train, then the display shows three noughts for the train no. and three crosses for the destination.



This is the familiar “you’re showing noughts and crosses here driver” message that is often heard over the train radio.

Depending on what mode the programme machine for that area is operating in, the train may be routed according to what is set up on the PTI. Lack of PTI information may mean that the train is held at a signal. This is why it is important that drivers contact the signalman/Line Controller if they are being held at a signal for no apparent reason. It is also important that the correct PTI information is set up on the train. If the wrong destination is set up and it is not noticed, the driver may be given the wrong route at a junction.

Train running information is provided for display on monitors as required. Depending how the screen is set up, the train no., crew no, destination, location and if the train is on time/how late it is can be displayed for a specific area. There is also the facility to find where a train is on the line or where it was at a particular time. The information can also be used for various other purposes such as train monitoring and providing a real time graphic display of the trains.

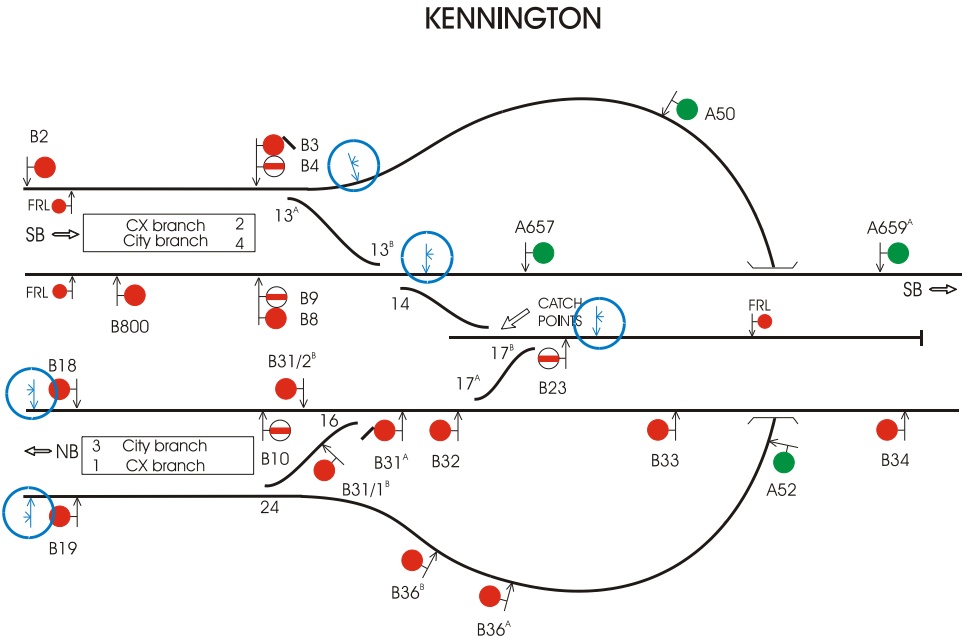
The PTI information is used to set up the train’s destination on the station dot matrix displays. The interrogators are located at key points on the line, especially where a train can leave or join the running line and at the approach to termini.

When the PTI information is set up on the train (1995 stock) the destination will be displayed on the front of the train and in the cars. When the PTI information is picked up at the next interrogator, that information will be displayed from the following station. If the destination is changed between interrogators, the destination will change on the train, but will not change on the station displays until the train has passed the next interrogator. For example, the PTI is set up for Edgware via CX. At Balham, the driver is told that the train will now be diverted to Edgware via Bank. The driver changes the PTI, but the original destination will still be displayed at the stations until Oval because the next interrogator is located north of Stockwell.

If the correct PTI information is not received, because the equipment is faulty or an invalid destination is set up, the station displays will normally show “check destination on front of train”. When a change of information is picked up from the computer, it will amend the station display and flash “correction” to alert the passengers.

The change may not necessarily be a change of destination. For example if three trains are shown, all with Morden as their destination and they become

out of turn – it may be that the train has come off the Charing Cross branch at Kennington rather than the one that was scheduled to depart from the Bank branch first - the computer registers that the sequence has now changed and will update the display. All that the passengers will notice is that the display flashes “correction” and there doesn’t seem to be any change because all three trains will still be shown as going to Morden.



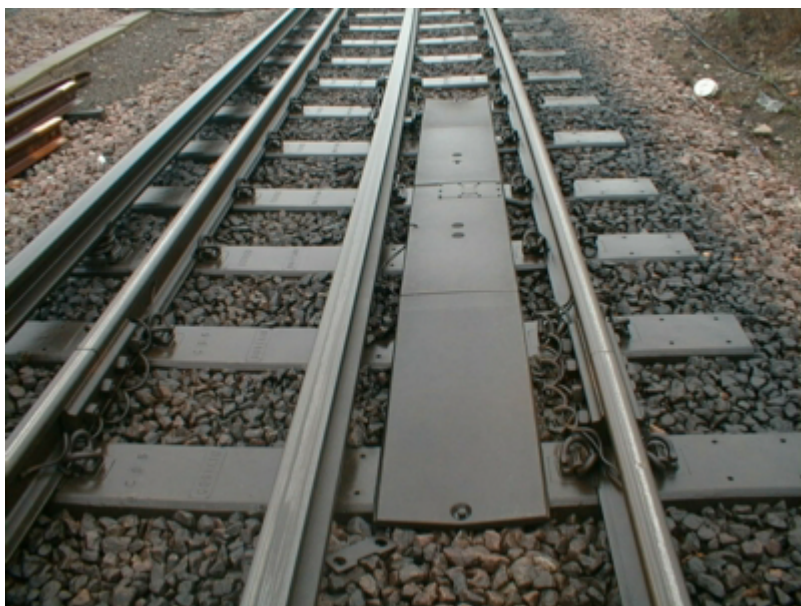
*Interrogator locations at Kennington*

## Interrogator / PTI sections



If the train description is changed in a section, it will not be picked up until the next interrogator is passed.

*Northbound PTI sections - Morden to Stockwell*



*Interrogator*

Archway	NB via CX	006	Hampstead	NB via CX	027
Archway	NB via City	016	Hampstead	NB via City	037
Charing Cross	NB	061	Hampstead then GGDt	NB via CX	026
Charing Cross	SB	125	Hampstead then GGDt	NB via City	036
Clapham Common	NB	065 *	Hampstead	SB	167
Clapham Common	SB via CX	127 *	High Barnet	NB	041
Clapham Common	SB via City	137 *	High Barnet Depot	NB	042
Colindale	NB	053	High Barnet	NB via CX	001
Colindale	NB via CX	023	High Barnet	NB via City	011
Colindale	NB via City	033	High Barnet Depot NB	via CX	002
East Finchley	NB via CX	005	High Barnet Depot NB	via City	012
East Finchley	NB via City	015	Highgate Depot	SB	140
East Finchley	SB	141	Kennington Loop	SB	107
Edgware	NB	051	Kennington Siding	SB via CX	106
Edgware Depot	NB	052	Kennington Siding	SB via City	116
Edgware	NB via CX	021	Kennington plat 1	NB	050 *
Edgware	NB via City	031	Kennington plat 3	NB	062
Edgware Depot	NB via CX	022	Kings Cross	NB	010
Edgware Depot	NB via City	032	Mill Hill East	NB	043
Euston (City)	NB	055	Mill Hill East	NB via CX	003
Euston (City)	SB	134	Mill Hill East	NB via City	013
Finchley Central	NB	044	Moorgate	NB	056
Finchley Central	NB via CX	004	Moorgate	SB	133
Finchley Central	NB via City	014	Morden	SB via CX	101
Finchley Cen 35 sdg	SB	142	Morden	SB via City	111
Finchley Cen plat 1	SB	143	Morden Depot	SB via CX	102
Golders Green	NB via CX	024	Morden Depot	SB via City	112
Golders Green	NB via City	034	Mornington Crescent	NB	060
G Green – then Depot	NB via CX	025	Mornington Crescent	SB	126
G Green – then Depot	NB via City	035	Stockwell	NB	063
Golders Green	SB	170	Stockwell	SB via CX	104
Golders Green Depot	SB	173	Stockwell	SB via City	114
G Green 26rd (4sdg)	NB via CX	027	Tooting Broadway	SB via CX	103
G Green 26rd (4sdg)	NB via City	037	Tooting Broadway	SB via City	113
G Green 26rd (4sdg)	SB	172	Tooting Broadway	NB	064
G Green 24/25rd/loop	SB	171			

\* not used at present

### *Northern Line PTI code listing*