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Issue	I
Date	April 2004

TPWS in areas where control of Trains is by RTEB (formerly RT/E/S/10178)

This temporary front sheet facilitates change to the new Network Rail Standards referencing nomenclature.

The Ref above will be formally allocated to this standard when it is next changed in the meantime the contents, date and issue number of this Network Rail Standard are UNCHANGED and with immediate effect it should be referred to as “(new ref) formerly (old ref)”.

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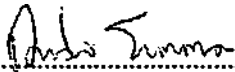
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Network Rail Company Specification

TPWS IN AREAS WHERE THE CONTROL OF TRAIN MOVEMENTS IS BY RETB SIGNALLING

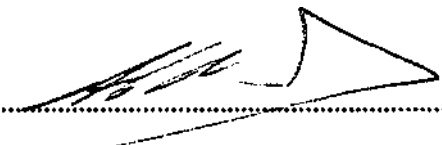
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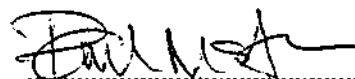
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Issue record

Issue	Date	Comments
I	April 2004	Replaces the Train Protection and Warning System (TPWS) project documents TPWS/TI/034 , TPWS/TI/037 , TPWS/TI/038 , TPWS/TI/039 , TPWS/TI/040 & TPWS/TI/041 .

Implementation

3 April 2004

Compliance

The compliance date is 3 April 2004 and it is mandatory upon Network Rail and Contractors.

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I PURPOSE

This specification mandates the requirements for installing Train Protection and Warning System (TPWS) in areas where the control of movement of trains is by Radio Electronic Token Block (RETB). The specification has a number of sections dealing with the requirements for:

1. describes the overlay of TPWS on routes operated by the RETB system of signalling and outlines the requirements by reference to supporting documentation. It also specifies the following:
 - selection of which Stop Boards require TPWS fitment;
 - the operational (functional and safety) requirements for the overlay of TPWS on the RETB system.
2. the scheme design requirements for the allocation and placement of equipment that is required for the implementation of TPWS within RETB signalled areas.
3. the interface requirements for fitment of TPWS to an RETB signalled line. The document details a suite of standard interface designs that will assist the designer in the production of site-specific designs.
4. the creation and management of Site Configuration Information (SCI) for the programming of the Trackside Radio Control Module (TRCM), which forms part of the TPWS Trackside Radio Control Unit (TRCU) utilised at RETB Token Exchange Points (TEPs).
5. the installation requirements for a TPWS/RETB system, which allows TPWS to be fitted to RETB signalled lines.
6. this document defines the works testing requirements that will provide evidence of the performance of TPWS operating in an RETB signalled site.

2 SCOPE

This Standard applies to the four geographic areas where RETB is installed. These are the far North of Scotland, the West of Scotland, Mid Wales and East Anglia.

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3 REFERENCE DOCUMENTATION

BR1894	Radio Aerial Systems including Towers and Masts
BS 6651	Code of Practice for the Protection of Structures against Lightning
GK/RT0009	Identification of Signalling and Related Equipment
GK/RT0031	Railway Group standard: Lineside signals and indicators
GK/RT0054	Radio Electronic Token Block Areas
GK/RT0054	Radio Electronic Token Block
GK/RT0207	Signal Design Production
PA/05/01609	Certificate of Acceptance – Lineside Status Indicator for use with TPWS on RETB lines
PA05/01610	Certificate of Acceptance – Trackside Radio Control Unit
PA05/1175	External TPWS UPS Product Acceptance certificate
PA05/941	Internal TPWS UPS Product Acceptance certificate
RMDI/TPWS/SPE/405	System Requirements Specification for the TRCU Sub-System
RT/E/C/11210	Signalling Installation
RT/E/C/11213	Signalling Cable Equivalent Sizes
RT/E/C/11724	Signalling Works Test Specifications and Historical Test Value Data
RT/E/C/11821	Siting Requirements for Lineside Apparatus Housings
RT/E/C/19046	Signalling Equipment Technical Advice Note Treadles
RT/E/C/19048	Signalling Equipment Technical Advice Note TPWS
RT/E/C/19052	Signalling Equipment Technical Advice Note RETB
RT/E/G/11720	Signalling Installation Handbook
RT/E/G/11730	Signalling Works Testing
RT/E/P/14002	Signalling Testing Staff Competence Assessment
RT/E/PS/00005	Railway Signalling Cable Specification
RT/E/S/10133	TPWS Signalling Interface Design Requirements
RT/E/S/10135	TPWS Signalling Works Testing
RT/E/S/10137	TPWS Selection of Signals and Other Locations for Provision of Track Sub System
RT/E/S/10138	TPWS Transmitter Loop Requirements and Positioning
RT/E/S/10173	Train Protection and Warning System (TPWS) Track subsystem installation requirements
RT/E/S/10660	Implementation of Signalling Maintenance Work Instruction
RT/E/S/10661	Signalling Maintenance Task Intervals
RT/E/S/11171	Maintenance of circuit signalling installation
RT/E/S/11231	Signalling Maintenance Testing
SSI 8500	SSI Applications Manual
SSI 8503	SSI Applications Manual: Earthing and Bonding of Solid State Interlocking Equipment
T34120	Power Circuits for TPWS Uninterruptible Power Supply
TGEN0121	Procedure for Mast & Tower Climbing

4 DEFINITIONS AND ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
AWG	American Wire Gauge
CDU	Cab Display Unit
Conditional Input	An input to the TRCU required from an external device, such as a Treadle, before TPWS Transmitter Loop suppression is permitted.
COTS	Commercial Off The Shelf
CRC	Cyclic Redundancy Check
DLM	Data Link Module
EMI	Electro-Magnetic Interference
EOF	End Of File
ESD	Electro-Static Discharge
GPS	Global Positioning System
I/O	Input/Output
Intermediate TEP	An intermediate TEP is defined as a TEP at which the Stop Board(s) may be passed with authority by the process of issue of a Long Section Token issued at the previous TEP
IOB	Input Output Blocks
LID	Location Identity Device
LRU	Line Replaceable Unit
LSI	Lineside Status Indicator
MET	Main Earth Terminal
MT	Maintainer's Terminal
NPT	National Project Team
NRS	National Rail Supplies
OSS	Overspeed Sensor System
PC	Personal Computer
PSI	Point Set Indicator
PSL	Park Signalling Limited
PSR	Permanent Speed Restriction
REB	Relocatable Equipment Building
RETB	Radio Electronic Token Block
RF	Radio Frequency
SCI	Site Configuration Information
SCM	Site Configuration for Maintainer's terminal
SIM	Signalling Interface Module
SSI	Solid State Interlocking
SWT	Signalling Works Testing
TAMAR	TPWS Asset Management and Reporting database
TEP	Token Exchange Point
TFM	Trackside Functional Module
TGN	Technical Guidance Note
TI	Technical Instruction

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TIC	Tester In Charge
TPWS	Train Protection and Warning System
TRCM	Trackside Radio Control Module
TRCU	Trackside Radio Control Unit
TSS	Train Stop System
TTU	Transportable Token Unit
UPS	Uninterruptible Power Supply
USB	Universal Serial Bus
ZIF	Zero Insertion Force

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5 TPWS OVERLAY IN RETB AREAS

The RETB signalling method consists of mostly single line sections with 'electronic' tokens issued to the trains via a radio link from a supervising control centre. The process for the issue of the RETB token requires the co-operation of both the Signaller and the Driver via an established radio protocol.

The fitment of TPWS trackside equipment at RETB TEPs is generally as required by the conventional TPWS equipment installation standards with the exception that the RETB Stop Board replaces the signal as the prime reference point for the positioning of TPWS equipment. As the Section Tokens are issued directly to the train, additional equipment is required to control and indicate the status of the TPWS system. This additional equipment consists of the TRCU that is mounted in a housing. Other equipment is mounted at the side of or on the track, consisting of the Lineside Status Indicator (LSI) and in certain circumstances, Treadles to trigger the activation and cancellation of TPWS.

5.1 Current RETB Signalling Operation

5.1.1 General Layout

A typical layout of a TEP with Stop Boards protecting single line sections and a Ground Frame operated siding is included as Appendix A. The RETB system is described in Railway Group Standard [GK/RT0054](#).

Stop Boards are positioned at the entrance to a single line section that must not be entered without the Driver being in possession of a valid token and having received verbal authority from the Signaller. Points Set Indicators (PSIs) are located on the approach side of hydro-pneumatic points at passing loops which are visible to Drivers heading towards the points in the facing direction. The PSIs are provided to indicate that the points are set and detected correctly to allow a facing move and are not stuck in the reverse position or lying open. A Distant Board is located at braking distance from the PSI on the single line on the approach to the TEP. A Station Limits board is located on the departure side of the loop to indicate the limits of the TEP. At certain TEPs, Driver operated Plungers are provided to select the required route or operate Level Crossing equipment.

5.1.2 RETB Train Operation

Trains approaching the TEP pass the Distant Board in possession of a valid token for the single line section that they are on. Before the points are reached, a positive indication of a single yellow light from the PSI gives the Driver authority to drive the train over the facing points. The points into and out of the loops are pneumatically operated, that is they are driven normal automatically by hydro-pneumatic rams to direct trains into the 'normal' platform for that

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direction (they can be manually operated and locked in the reverse position if the other platform is to be used). After operation, the points return to a position such that a facing move will always be diverted into the correct platform. However, the points can be passed through in the trailing direction (i.e. exiting from the passing loops) from either loop line allowing trains to enter into the single line token section from both platforms.

The speed restriction over the hydro-pneumatic points in all directions is 15 mph. The speed restriction over points that are controlled by Ground Frames for movements to and from sidings are generally 5 mph. The speed restriction in the single line sections and within the passing loop between the hydro-pneumatic points are as published in the Regional Sectional Appendix.

After arrival into the passing loop the train stops at or before the Stop Board and the Driver contacts the Signaller to return the electronic Token and request the Token for the next single line section. The Signaller then transmits the electronic Token via the radio system (subject to the Solid State Interlocking (SSI) allowing this) and the Driver is required to verbally acknowledge its receipt. The final authority to enter the single line section is given verbally by radio from the Signaller to the Driver. The Driver proceeds into the single line section and reports when the train passes the Station Limits (loop clear) board. When the loop clear board is passed the Signaller is permitted to issue a token to a following train into the loop that has been vacated by the train. The token exchange process is monitored and interlocked by the SSI, and logged on a printer that is fed with information on the status of the token issue process. The radio traffic is also recorded on a voice recorder.

In some RETB areas it is possible to issue tokens that enable trains to pass through more than one TEP and single line section. These tokens are known as 'Long Section Tokens'.

When engineering work is required to be undertaken, an Engineering Token will typically be issued to an engineer's train or maintenance vehicle.

In addition, a Shunting Token can be issued for unrestricted movements within the TEP either for shunting or engineering purposes.

5.2 Overview of TPWS Overlay in RETB areas

5.2.1 General

Tokens are issued directly from the Signaller to the train via the onboard radio equipment. Apart from locations where trains enter an RETB section from a conventionally signalled section, there is no on-site change of aspect or signalling release within the RETB system that can be used to suppress the TPWS

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equipment. A new system has therefore been developed that will 'eavesdrop' on the radio tokens that are issued by the Signaller to the trains via the radio system. This is the TRCU, which has been developed to meet the requirements of the specification RMDI/TPWS/SPE/505. The TRCU will receive the tokens via its own antennae, decode the tokens, process them and, by reference to SCI, suppress the appropriate TPWS transmitter loops when 'valid tokens' that apply to a particular single line section are recognised. At the heart of the TRCU is the TRCM, which contains the radio modems, processing element and SCI.

Inputs and outputs to/from the TRCM are via standard SSI Trackside Functional Modules (TFM). In addition to the normal trackside/track mounted TPWS equipment (control modules and transmitter loops), the overlay system also comprises of Lineside Status Indicators (LSI) and, in some cases, Treadles and/or Driver operated Plungers. The TRCU is backed up by an Uninterruptible Power Supply (UPS). The TRCU is depicted in Figure I and a brief description of the various elements of the TPWS overlay system in RETB areas is given in the remainder of this section.

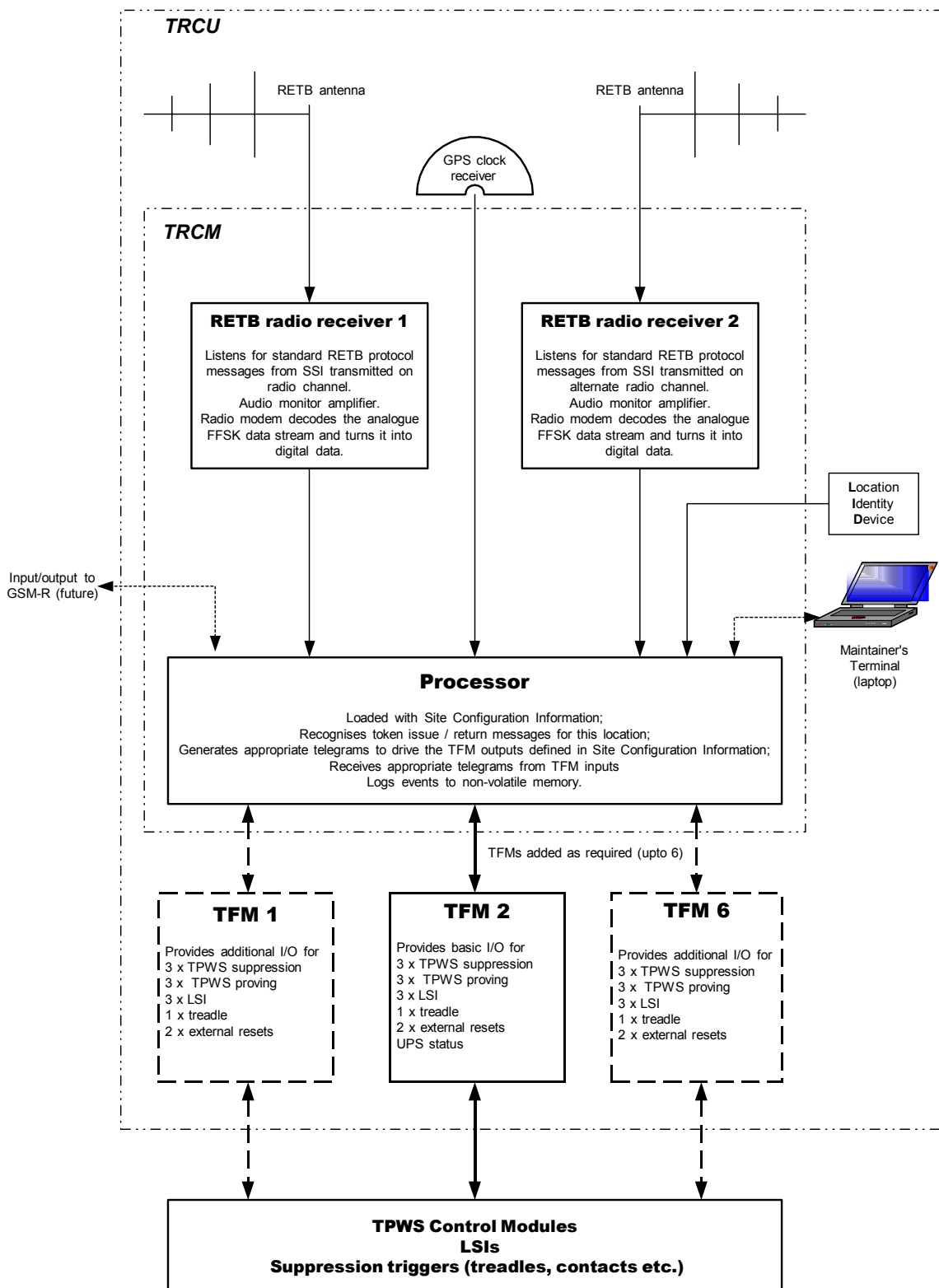


Figure I – TPWS TRCU

5.2.2 Operation of RETB TPWS Equipment

When a Token is issued, it is received by the onboard RETB train system and the trackside TRCU system in parallel. Within the TRCM, the Token is compared with the list of valid Tokens from the TEP over a particular single line section and, if determined to be a valid Token, suppression of the TPWS equipment protecting the single line section is initiated. The initiation of suppression of TPWS equipment will also, in some cases, be dependent on other Conditional Inputs as follows:

- operation of a Treadle on the approach to the Distant Board for Long Section Tokens that pass Stop Boards protecting converging junctions;
- operation of a Treadle on the approach to a TEP passing loop that is within a Long Section Token section;
- operation of route selection equipment where a 'Trainman' operated Plunger must be operated to select a route at a diverging junction;
- operation of Level Crossing equipment where a 'Trainman' operated Plunger must be operated before movements can be made passed the Stop Board;
- operation of a Ground Frame lever to provide 'flank protection'.

When a valid Token for the single line section is recognised and accepted, and any required Conditional Inputs are received, the TPWS is suppressed and LSIs at Stop Boards protecting the particular single line section at the TEP are switched from steady blue to flashing blue indication.

The TPWS Train Stop System (TSS) and Overspeed Sensor System (OSS) equipment will remain suppressed until:

- the TRCU recognises the return of the Token to the Signaller, or
- the TRCU recognises another valid token for that location, e.g. shunting, or
- a pre-set suppression time period has elapsed, or
- the TPWS suppression is cancelled by a Treadle that is mounted on the departure side of the Stop Board (Conditional Input).

When a Shunt Token is recognised and accepted by the TRCU, all TPWS equipment protecting all single line sections from the TEP are simultaneously suppressed subject to any conditional inputs for the direction of movement. All LSIs will change from steady blue to flashing blue indication.

Engineering Tokens are not recognised by the RETB TPWS system. When an Engineering Token is issued to a train, the Driver is required to isolate the

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onboard TPWS equipment in accordance with the existing Rule Book requirements.

Generally, the receipt of a valid Token will suppress the appropriate TPWS equipment for a set time period. This time period will be chosen to suit the expected time taken from receipt of Token to train departure. Too short and the train may not have passed the TPWS Transmitter Loops before they are re-energised, too long and there is a risk of a following train arriving before the Transmitter Loops are re-energised. In some cases it may be necessary to use a Treadle to cancel the suppression after the train has passed clear of the transmitter loops. In other cases, it may be necessary to delay TPWS suppression until a Conditional Input has been received such as from route selection Plungers, Level Crossing Plungers or, in the case of intermediate TEPs in Long Section Tokens, a Treadle input.

5.2.3 Trackside Radio Control Module

The TRCM is a bespoke item of TPWS control equipment, manufactured by Park Signalling Limited. One TRCM is generally required per TEP. The TRCM contains two radio receivers and modems fed by separate antennae as, in certain cases, tokens will be received from two different RETB base stations. However, where the TRCM will receive tokens from only one RETB base station, then both radios will be configured to the same base station providing an element of redundancy. The antennae are mounted on a post and aligned to the particular RETB base station, connected to the TRCM using co-axial cable via a surge arrestor and, in some case, an RF attenuator. Associated with the radio element is a loudspeaker which can be used to listen to radio traffic on either channel.

A processing element within the TRCM contains the processing software which is loaded with Site Configuration Information via a Maintainer's Terminal (MT) to configure the TRCM to the local site requirements. This element controls the suppression/activation of TPWS and the status of the LSI indications, depending on the tokens received together with Conditional Input where required. The TRCM can be linked directly to up to 6 TFM's or up to 10 TFM's via the use of Data Link Modules (DLMs).

The TRCM also has an event logging memory capable of storing a minimum of the last 7 days worth of TRCM events, such as the receipt of tokens and the operation of the various inputs and outputs.

A Global Positioning System (GPS) antenna and receiver provides date and time information to the TRCM event logging memory.

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It is also possible to enter a Test Mode (via the MT) within the TRCM to exercise the various inputs and outputs and simulate the receipt of tokens. The MT also acts to download stored event data and visually see the status of the TRCM inputs and outputs.

The TRCM has been granted a Network Rail Certificate of Acceptance, number PA05/01610.

5.2.4 Trackside Functional Module

Standard Alstom Mark 3 SSI TFMs are utilised as the input/output interface between the TRCM and the TPWS control modules, Treadles, Plungers, LSIs and the UPS fault contact. All TFMs have the same 'system' address code with a unique sub-address coded into the TFM connector plug, hence all TRCMs and TFMs are fully interchangeable.

Normally two TFMs will be required at each site, one controlling Up direction functionality and the other controlling the Down direction. Each TFM can control up to 2 independently configurable TPWS functions and any associated Treadles/Plungers.

5.2.5 Location Identity Device

Although the TRCM and TFMs are fully interchangeable between TEPs, it is necessary to ensure that the correct version of SCI has been loaded into the TRCM. This is achieved by plugging a Location Identity Device (LID) into the TRCM. The version of the SCI in the TRCM must always match the version within the LID. The LID is semi-permanently attached to the TRCM Relocatable Equipment Building (REB) or apparatus case, thus always remaining at site. If an updated version of the SCI is to be loaded at a site then the LID will also require re-programming.

5.2.6 Power Supply Requirements

The power supply to the TRCU is 110V ac and is supplied via a standard External TPWS UPS from a local 230V 'domestic' supply. The TPWS UPS is designed to provide 12 hours standby supply should the domestic supply fail. Where periods of extended domestic power outage are encountered (greater than 12 hours), local arrangements will be required to feed the UPS via a suitable generator.

The TPWS UPS status output (volt-free contact) provides an input to the TRCM and is used to trigger a 'TPWS fault' indication once the UPS has been on standby for a site configurable period. A fault is not immediately indicated to allow for relatively short duration power outages (for which the UPS will provide adequate support) to avoid unnecessary maintenance call outs.

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Further information on the TPWS UPS can be found in RT/E/S/10133 and RT/E/S/10173.

5.2.7 Lineside Status Indicator

The LSI confirms the status of the TPWS transmitter loops and indicates TPWS system failures to the Driver. Failure reporting is escalated from the Driver to the Signaller via the RETB train radio system. There is no automatic reporting of TPWS system faults. LSIs are not required for TPWS associated with PSRs or buffer stops.

An LSI is provided for each Stop Board being fitted with TPWS. The LSI consists of a blue LED-cluster lamp manufactured by Dorman Traffic Products Limited. The LSI is mounted on a matt black backboard.

A Repeater LSI may be required particularly where the TPWS equipment can be approached at high speed, for example at Stop Boards protecting converging routes or where sighting of the Stop Board LSI may be obstructed.

The LSI provides the following indications:

- Confirmation that the system is healthy and the TPWS loop has not been suppressed (steady blue indication).
- Confirmation that the system is healthy and the TPWS loop has been suppressed (flashing blue indication).
- Confirmation that the system is not healthy or the status of the TPWS loops is not determined (no indication, LSI not illuminated).

It should be noted that the LSI may indicate any state when the TRCU is under Test Mode.

The requirements for provision and positioning of LSIs and Repeater LSIs are detailed in sections 6.4.5 to 6.4.7.

The LSI has been granted a Network Rail Certificate of Acceptance, number PA05/01609.

5.2.8 Conditional Inputs

Various Conditional Input may be required to suppress TPWS, or cancel suppression, depending on the site design requirements. These will take the form of rail mounted Treadles, external relay contacts etc, the requirements for which are detailed in section 5.7.

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5.3 General layout of TPWS overlay

5.3.1 System layout

Typical layouts of TPWS fitment with LSIs at an RETB TEP are shown in the example in Appendix C.

5.3.2 Equipment layout

The TRCM and TFM's will normally be mounted together in a pre-wired signalling apparatus case which is connected by a multi-core cable to a second signalling apparatus case containing the TPWS baseplates and control modules. The external TPWS UPS comes in a half signalling apparatus case.

An option exists to mount the TFM(s) and TPWS control modules remote from the apparatus case containing the TRCM. This may be required where the TPWS transmitter loops need to be positioned such that the maximum permitted cable lengths would be exceeded. Depending on the distances involved, this may require the use of a pair of standard SSI Data Link Modules (DLM) manufactured by Alstom or Westinghouse.

The LSI is mounted on the Stop Board post and sighted against agreed sighting criteria. Two sizes of LSI are available, one to fit a 2-post Stop Board mounting arrangement, and one to fit a single post miniature Stop Board mounting arrangement. Repeater LSIs are mounted on the Distant Board on the approach to the TEP, again against agreed sighting criteria.

The two TRCU radio antennae are mounted on a mast adjacent to the apparatus cases.

The GPS smart antenna is mounted on top of the apparatus case housing the TRCM.

5.4 TPWS Selection Criteria

5.4.1 Conventional signals

The 'islands' of conventional signalling in RETB areas shall comply with the requirements of [RT/E/S/10137](#).

5.4.2 Stop Boards

The selection criteria for which Stop Boards to fit with TPWS are defined in the Flow Chart in Appendix B supported by the following clauses.

As for conventional signals, TPWS is only required to be fitted to RETB Stop Boards if they are on or protecting a passenger line and there is an on-coming,

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crossing or converging conflict. Conflicts that are only possible with the rear of train travelling in the same direction shall not be considered for TPWS. In addition, conflicts of any type that are only within the TEP itself, where the permitted speed in the TEP does not exceed 15mph, shall not be considered for TPWS fitment.

TPWS shall not be fitted to a Stop Board if TPWS is already fitted to a worked signal protecting entry to the single line section. If there is a worked signal which is not already fitted with TPWS, then fitting the signal with TPWS shall be the preferred solution.

TPWS shall not be fitted to Stop Boards in sidings 'secured out of use' in accordance with the definition contained in [RT/E/S/10137](#).

TPWS shall not be fitted to Stop Boards where the only assessable conflict is prevented from occurring within the RETB interlocking. This will be the case where it is not possible to issue a token to one train to allow it to be at the conflict point should another train SPAD the Stop Board in question.

All TEP operational exit points leading directly into single line sections shall be considered for fitment with TPWS. This shall include both loop lines/platform exits for the same movement direction even if there is currently no existing Stop Board for the direction not normally used.

TPWS shall not be fitted to a Stop Board if there is a further Stop Board encountered before entering the single line section.

5.4.3 Permanent Speed Restrictions

The selection of which Permanent Speed Restrictions on RETB routes require TPWS shall follow the requirements of [RT/E/S/10137](#).

5.4.4 Buffer Stops

The selection of which Buffer Stops on RETB routes require TPWS shall follow the requirements of [RT/E/S/10137](#).

5.5 Operational Requirements

5.5.1 Provision of Stop Boards

All token section entry points shall be fitted with individual Stop Boards adjacent to the running line where not already provided.

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5.5.2 Provision of TPWS

TSS and OSS equipment shall be provided at Stop Boards in accordance with [RT/E/S/10138](#).

5.6 TPWS Suppression

5.6.1 Section Token and Intermediate Siding Token

On detection of a valid Section Token or Intermediate Siding Token, all TPWS Transmitter Loops protecting entry to a single line section associated with the authority of the particular token where conditional inputs are not required, shall be suppressed at the same time. TPWS Transmitter Loops should be selectively suppressed depending on which line or siding the train is starting from or passing through where it is practicable to do so. However, certain Conditional Inputs may be required, see section 5.7.

5.6.2 Long Section Tokens

The issue of a Long Section Token provides movement authority into 2 or more single line sections. On the receipt of a valid Long Section Token, the relevant TPWS Transmitter Loops at the 'starting' TEP Stop Boards shall be immediately suppressed (subject to any Conditional Input controls as described in section 5.7), but the relevant TPWS Transmitter Loops at the Intermediate TEP(s) Stop Boards shall remain active until triggered by a Conditional Input.

5.6.3 Shunting Token

To allow unrestricted shunting movements within the TEP, all TPWS loops within a TEP shall be suppressed when a valid Shunting Token is issued, subject to any condition inputs for the direction of movement.

5.6.4 Engineering Tokens

When an Engineering Token is issued, all TPWS Transmitter Loops at the TEP shall remain active. Trains required to enter the engineering possession shall follow the requirements of the Rail Safety Standards Board Rule Book and operate the on train Temporary Isolation Switch.

5.7 Conditional Inputs

5.7.1 Suppression Activation

A TRCM Conditional Input is required after the issue of a valid token and before relevant TPWS Transmitter Loops are suppressed under the following circumstances:

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- At Long Section Token Intermediate TEPs where the suppression time period would be dependent on time taken for individual train types to traverse the section. Suppression shall be delayed until the train is detected as being on the immediate approach to the intermediate TEP. The detection point shall be far enough on the approach to the intermediate TEP Stop Boards such that the train can be safely stopped at the Stop Board should the TPWS transmitter loops fail to suppress (as indicated by the LSI remaining with a steady blue indication). Where an Intermediate TEP is passed at or near maximum permissible speed, an LSI Repeater shall be mounted at the Distant Board with a Treadle input sufficiently on the approach to allow the Driver to see the LSI flashing before reaching the Distant Board.
- At diverging junctions where the train Driver is required to operate a route selection Plunger, TPWS Transmitter Loop suppression shall be delayed until the appropriate Driver's route indication has been called by the existing control equipment. The LSI can show steady with the TPWS loops suppressed. This requirement does not apply to shunt tokens.
- At 'Trainman operated' Level Crossing where the Level Crossing red/white light indicator is visible to the Driver at the same time as the LSI is visible to the Driver, TPWS Transmitter Loop suppression shall be delayed until the Level Crossing has been operated and the white light indicator has been called by the existing control equipment. This requirement does not apply to shunt tokens.
- Where there is a Stop Board controlling entry to a siding which is accessed by the operation of a Ground Frame lever, and passing of the Stop Board at danger would lead the train to directly enter a single line section, then TPWS Transmitter Loops shall not be suppressed until the appropriate Ground Frame lever has been reversed, thus providing flank protection.

5.7.2 Suppression Cancellation

A Conditional Input to the TRCU is required to cancel TPWS Transmitter Loop suppression when the minimum TPWS suppression time period (see section 5.8) cannot be supported without undue risk to train operation. It is necessary to cancel suppression when an authorised train has passed clear of the suppressed TPWS Transmitter Loops. Cancellation of suppression is also required for section tokens when conditional inputs from diverging junctions, Level Crossing and Ground Frames are cancelled.

5.7.3 LSI operation

Conditional inputs are required at diverging junctions where the train Driver is required to operate a route selection plunger, ground frames or 'Trainman operated' Level Crossings to ensure that the LSI only flashes when the controls

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for the associated route indicator or drivers level crossing indicator has been called by the existing control equipment. This requirement shall apply to all valid tokens for movements past the LSI.

5.8 TPWS suppression time period

As there is a possibility that the TRCU may not recognise the return of a token, a TPWS suppression timer is used within the TRCU to ensure the TPWS suppression is cancelled when a suitable period has elapsed. To maximise the security of the RETB TPWS system the minimum practical suppression period shall be used in all cases. The preferred time period for TPWS suppression is 5 minutes.

5.8.1 Default suppression time period

The TPWS suppression timer period for individual tokens shall be assessed for each TEP to determine if the preferred suppression period is acceptable to permit duties to be performed and the front of the train to clear the TSS loops. The determination of whether a suppression period longer than 5 minutes is required, should, as a minimum, consider the following normal operating practice at the TEP:

- Train Crew required to operate Level Crossings. The TPWS timeout period should not encourage the Driver to close the crossing before obtaining the token.
- Train Crew required to select the route by an external Plunger.
- Train preparation duties where trains start up.
- Train Crew required to release Ground Frames.

The suppression timer shall always expire before it is possible for a following train having a valid token to arrive at the TEP Stop Board. One exception to this is for the issue of a Shunt token to a train already within the TEP. In this case, the Shunt token can be issued very soon after the first train has departed and hence it is likely that the LSIs will still be flashing blue at this stage. It is not necessary to account for this scenario when determining the suppression time period.

To determine the maximum period of suppression before the arrival of a following train, the token section traversing time shall be calculated based on the length of the token section and the permitted speeds through the section. A section token cannot be issued to a train at a loop until the previous train is notified to have passed the loop clear board of the next TEP. Therefore, the length of the token section shall be the distance from the Stop Board at the previous TEP to the Loop Clear Board on the exit of the next TEP.

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5.8.2 Shunting Tokens

In the case of Shunting Tokens, all relevant TPWS equipment shall be suppressed for a preferred period of 60 minutes.

5.9 Provision of LSIs

An LSI shall be provided for each RETB Stop Board and positioned according to the criteria in section 6.4. This may require an LSI Repeater at certain sites.

As it is normally not possible to detect which line or siding the train is starting from, all TPWS Transmitter Loops will be suppressed at all Stop Boards relevant to the issued Token. The LSIs associated with those Stop Boards shall also display a steady/flashing blue indication together.

The LSI shall indicate to Train Crew when the associated TPWS Transmitter Loops are transmitting by displaying a steady blue indication.

The LSI shall indicate to Train Crew when the associated TPWS Transmitter Loops are suppressed, by displaying a flashing blue indication. The LSI shall not indicate TPWS suppression until any required Conditional Inputs are received.

The LSI shall be returned to a steady blue indication 30 seconds before the suppression timer expires.

The LSI(s) shall indicate to Train Crew failure of TPWS to transmit when required to do so by being extinguished.

5.10 TPWS Fault Reporting

The LSIs shall indicate to Train Crew failure of the TRCU system or of TPWS to transmit when required to do so, by being extinguished. For a failure of any 'Up' direction TPWS to transmit, all LSIs associated with movements in the 'Up' direction shall be extinguished. Similarly, for a failure of any 'Down' direction TPWS to transmit, all LSIs associated with movements in the 'Down' direction shall be extinguished.

Reporting of the failure to the Infrastructure Controller shall then be accomplished by the train Driver contacting the Signaller.

5.11 Local instructions

Network Rail shall ensure that the local RETB operating instructions for Train Crew, Signallers and others concerned with such operations, are amended to cover the required method of operation, the meaning of the LSI and the requirements for Drivers to report faults to the Signaller. In particular the RETB Special Authority card shall be

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up-issued to cater specifically for the requirements to re-instate trainborne TPWS after Temporary Isolation.

5.12 Design requirements

The Scheme Design Requirements are detailed in section 6. This includes what equipment is required, where it should be fitted/positioned, asset identification, radio channel allocation and antennae directional positioning. The scheme design also requires suppression time out and Conditional Input requirements to be determined. From this Control Tables will be produced to enable SCI to be written.

The Interface Design Requirements are detailed in section 7. This includes reference to generic equipment designs and typical circuits, site specific design requirements such as cable length restrictions, cable types etc.

Design requirements for TPWS equipment are contained in [RT/E/S/10133](#) and [RT/E/S/10138](#).

5.13 Site Configuration Information

The TRCM requires SCI to enable it to react correctly to the valid Tokens, control the appropriate TPWS functions and LSIs, and what Conditional Inputs are required. The SCI also configures the radio receivers to the correct channels.

The SCI will be developed from the Control Table produced as part of the scheme design and is produced on a desktop PC. The SCI is uploaded to the TRCM via the TRCM MT and checked for correct version by the LID.

The procedures for producing and uploading the SCI and coding the TFM's and LID are contained in section 8 together with configuration control requirements.

5.14 Installation requirements

The installation requirements for the TRCU and its associated equipment (including the LSI and radio element) are specified in section 9.

The installation requirements for the Thales TPWS equipment and TPWS UPS are detailed in [RT/E/S/10173](#).

Installation requirements for the Treadles are contained in [RT/E/C/19046](#).

5.15 Works testing requirements

Works testing requirements for the TPWS equipment and TPWS UPS are detailed in [RT/E/S/10135](#).

Testing of the Treadles is contained in [RT/E/C/19046](#).

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Works testing requirements for the TRCU and its associated equipment are specified in section 10. Fundamentally, the TRCM, TFMs and their apparatus cases are delivered pre-wired and pre-tested with a certificate of conformity. Once the system has been installed at site and connected to external cabling and powered up, the TRCM can be fitted and loaded with SCI. The TRCM MT will be used to function the equipment on site to prove the external connections. Once loaded with SCI, the TRCU will be 'control table tested' against the applicable Tokens for the site. The radio signal strength shall be tested prior to final commissioning.

5.16 Maintenance requirements

There is no routine maintenance required on the TRCM or TFMs and they are Line Replaceable Units (LRU). However, the TRCM has to be loaded with the SCI and functioned to enable testing to be undertaken. These activities are undertaken using the TRCU MT, a ruggedised, touch screen laptop that is connected directly to the TRCM. Bespoke software on the MT allows the TRCU system to be configured and tested. The MT is also used to interrogate the Event logger within the TRCM. The MT is also used to configure any new GPS smart antennas.

The maintenance requirements for the TRCU and its associated equipment (including the radio element) are specified in [RT/E/C/19052](#).

The maintenance requirements for the Treadles, TPWS equipment and the TPWS UPS are detailed in [RT/E/S/10660](#) and [RT/E/S/10661](#).

Guidance on fault finding the TRCU and its associated equipment is contained in [RT/E/C/19052](#).

Guidance on fault finding the TPWS equipment is contained in [RT/E/C/19048](#).

Guidance on fault finding the Treadles is contained in [RT/E/C/19046](#).

5.17 Training

Appropriate training/briefing shall be provided to all users of the RETB TPWS overlay system.

6 SCHEME DESIGN REQUIREMENTS

6.1 Key Design Requirements

The system must operate without affecting the existing RETB operation, with the exceptions of minor changes to the Signaller/Driver protocol. The system must fail-safe such that the TPWS will revert to the TPWS energised state or indicate to the Driver that the TPWS system is failing or has failed.

6.2 Design Process

The trackside mounted components of the RETB TPWS system will be allocated into the design for the particular TEP. From this initial design a scaled Scheme Plan will be produced as required by section 6 of this specification. When the Scheme Plan is approved, the Control Table that defines the SCI will be produced. The SCI is the control logic for the TEP that is contained within the TRCM.

6.3 TPWS TSS Equipments at Stop Boards

6.3.1 The location of RETB Stop Boards

Within the RETB signalled areas, Stop Boards serve as signalling section entry points. Generally the Stop Boards are positioned at the left side of the line for movements from the normal direction platform or loop line, and at the right hand side of the line for movements from the opposite direction platform or loop line.

In some case there is no existing Stop Board in the opposite direction platform or loop line. At TEPs that are to be fitted with TPWS, a new Stop Board shall be installed at the right hand side of the line for movements from the opposite direction platform or loop line. The new Stop Board shall normally be opposite the existing Stop Board on the normal direction platform or loop line. A Sighting Committee must determine the position of any new Stop Boards in accordance with [GK/RT0031](#).

6.4 RETB TPWS Fitment requirements

At each Stop Board that is selected for fitment of TPWS, TSS/OSS arming and trigger loops shall be positioned with their associated LSIs as required by section 5.9 of this specification.

6.4.1 Train Stop System

The TSS loops shall be positioned as required by [RT/E/S/10138](#) with the position of the loops referenced to the Stop Board. The centre of the TSS arming and trigger loops shall therefore generally be in line with the Stop Board to permit

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maximum length trains operating over the route to be accommodated within the TEP.

6.4.2 Overspeed Sensor Systems for Stop Boards

TPWS OSS will not generally be required for the RETB TPWS system. However, as some speed limits within TEPs exceed 20 mph, TPWS OSSs shall be provided as required by [RT/E/S/10138](#). The OSS loops shall be located relative to the Stop Board.

6.4.3 Overspeed Sensor Systems at Speed Restrictions

OSSs shall also be fitted to Speed Restrictions as required by [RT/E/S/10137](#).

6.4.4 Overspeed Sensor Systems at Buffer Stop Equipment

OSSs shall also be fitted to Buffer Stops as required by [RT/E/S/10137](#).

6.4.5 Fitting and Sighting of RETB TPWS LSI at Stop Boards

One LSI shall be mounted at each Stop Board that is to be fitted with TPWS. The Sighting Committee shall sight each LSI to the requirements contained within this section.

The maximum viewing of the aspect is 200m. The unit cannot be focussed to a particular point but has a beam spread of 25 degrees from the centre horizontal and vertical axis of the unit. The alignment of the LSI is fixed and is dependant on the position of the Stop Board to which it is attached.

At passing loop TEPs the sighting committee shall ensure that the LSI shall be viewed for a minimum distance of 50m. Where this distance cannot be achieved or is considered to be inadequate for the particular conditions at the TEP the sighting committee may recommend the fitting of a repeater for the LSI. The LSI repeater shall be positioned as required by this specification or as otherwise determined by the sighting committee.

Where a TEP protects a converging junction the LSI at the Stop Board and the LSIs at the Distant Board shall be sighted for a maximum view commensurate with the approach line speed.

A typical arrangement for TPWS at TEPs at passing loops is shown in Figure 2.

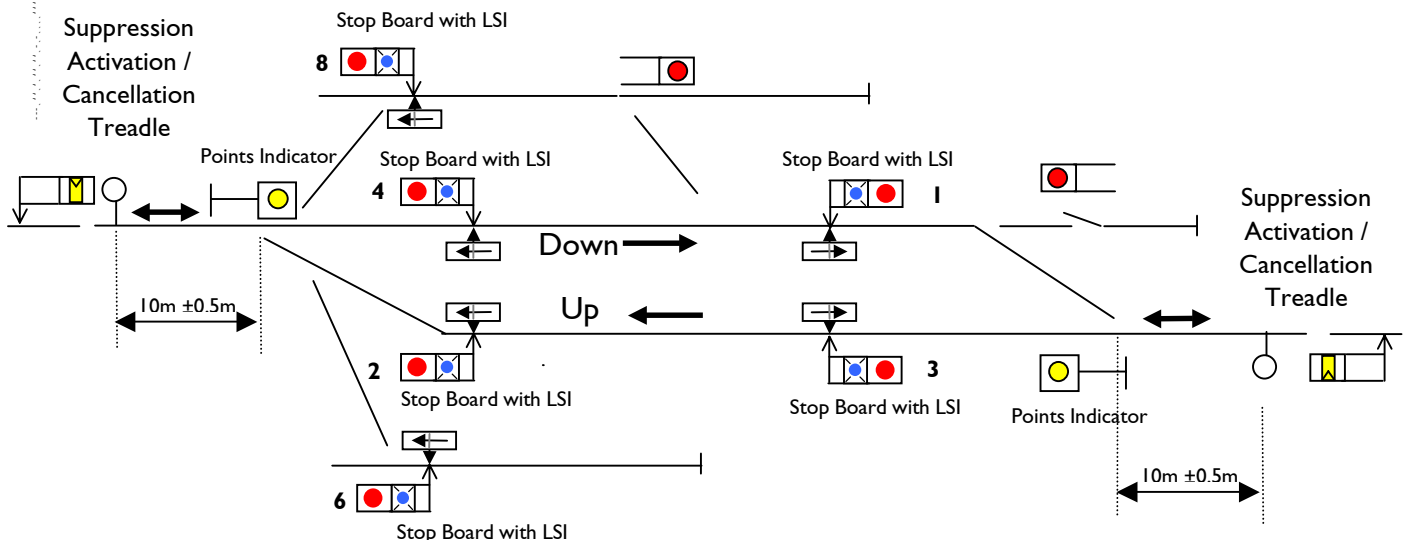


Figure 2 – Typical TPWS fitment at passing loop

6.4.6 Fitting of RETB TPWS LSI at Stop Boards within Passing Loops

LSI Repeaters may be required at some passing loop TEPs that are within Long Section Token sections. These LSI Repeaters shall be installed where it is determined by the Sighting Committee that there is insufficient sighting of the Stop Board LSI at the maximum permitted approach speed. Passing loop LSI repeaters shall be mounted on each line within the passing loop. The LSI repeater shall generally be 50m beyond of the tips of the facing points unless determined otherwise by the Sighting Committee. A general arrangement is shown in Figure 3. The single post mounted LSI shall be used as LSI repeaters in Passing Loops.

Additional LSI Repeaters may be required due to sighting conditions and shall be mounted as determined by the Sighting Committee.

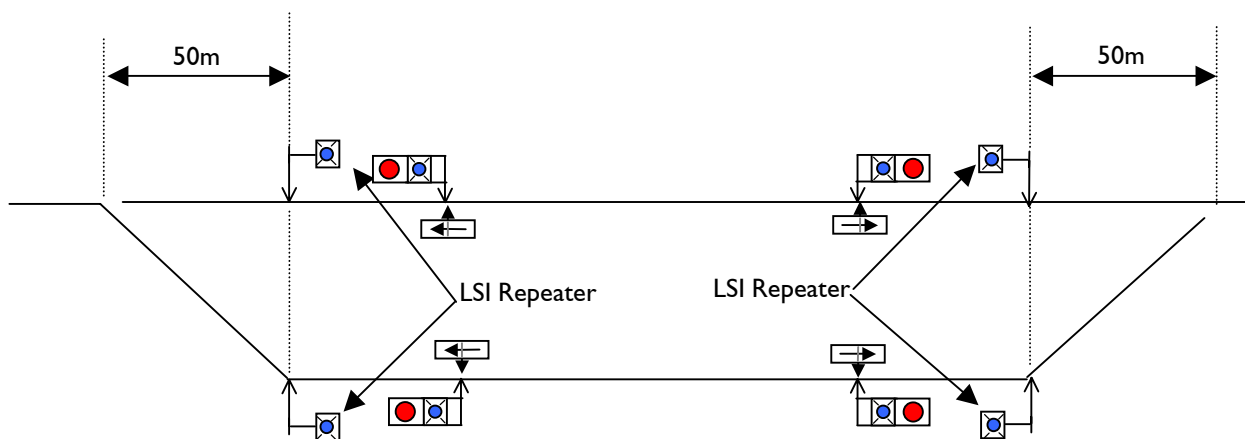


Figure 3 – Fitment of LSI repeaters

6.4.7 Fitting of RETB TPWS LSI Repeaters for Stop Boards Protecting Converging Junctions

At TEPs that protect converging junctions, in addition to the LSI mounted at the Stop Board, an LSI Repeater shall be mounted at the associated Distant Board. The general arrangements for LSIs at RETB controlled converging junctions are as shown on Figure 4.

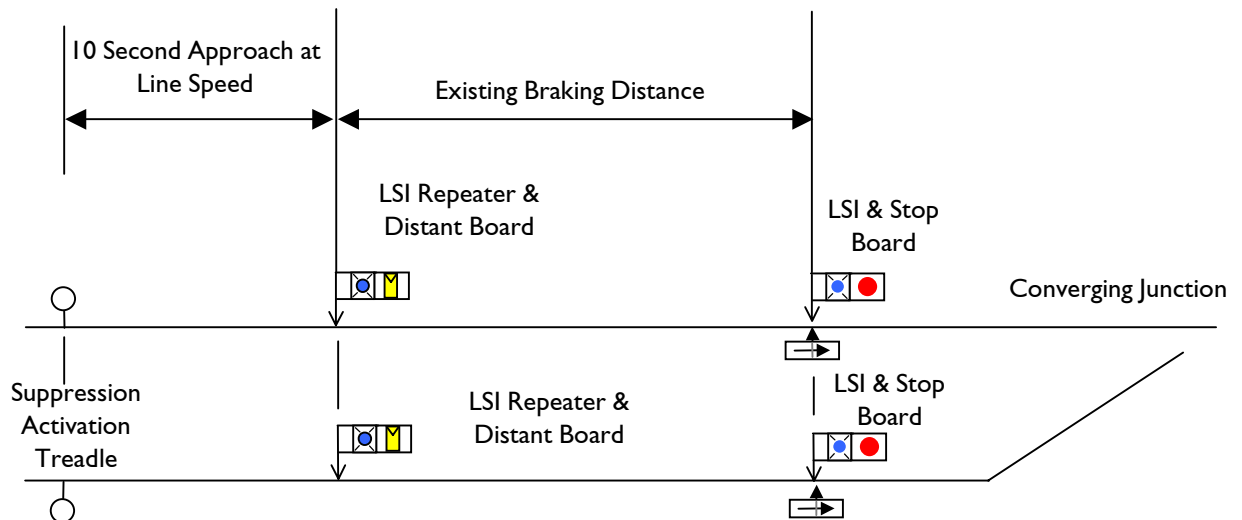


Figure 4 – Fitment at Converging Junctions

6.5 TPWS suppression conditional inputs

The requirements for conditional inputs to the TRCU are defined in section 5.7. The positioning of the equipment that provides the inputs is described below.

6.5.1 TPWS Suppression Activation Conditional Input Treadles

Where required by section 5 for intermediate TEP(s) within Long Section Token sections, a TPWS suppression activation conditional input Treadle shall be provided and shall be mounted 10m (+/- 0.5m) on the approach to the passing loop diverging points as shown in Figure 2.

Where the TPWS activation conditional input Treadle is required to trigger the suppression of TPWS at a Stop Board that provides the protection for a converging junction, the suppression activation Treadle shall be mounted at a point that is calculated to be 10 seconds running time at maximum permissible speed, or as dictated by the sighting committee, on the approach to the associated LSI Repeater. The arrangement is shown in Figure 4.

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6.5.2 TPWS Suppression Cancellation Conditional Input Treadles

Section 5.7 defines the requirements for the application of a conditional Treadle input to cancel the suppression of TPWS loops. Where required by section 5, the TPWS suppression cancellation Treadle shall be mounted in the single line section 10 metres (+/-0.5m) beyond of the tips of the furthest loop exit points. This arrangement will enable one Treadle to cancel all TPWS in a particular direction and thus reduce the infrastructure required at a TEP.

Note: The same Treadle can also be used as a suppression activation Treadle in the opposite direction (as detailed in 6.5.1) where both functions are required as shown in Figure 2.

6.5.3 TPWS suppression at 'Train Crew' Operated Diverging Junctions

At some TEPs a 'Train Crew' operated diverging junction is required to be operated after a valid token is received and before the associated Stop Board may be passed as defined within section 5. Upon selection of the correct route plunger for the Section Token or Long Section valid token for the route authorised, the operation of the diverging junction route indicator shall trigger the suppression of the TPWS loops. Loops for the normal and opposite direction move shall be suppressed, however only the LSI associated with the platform shall operate.

The cancellation (return to the normal position) of the diverging junction route indicator after the issue of the valid token for the route shall cancel the suppression of the TPWS loops. The conditional input shall be derived from the same controls that provide the final output to the route indicator for the diverging junction that applies to the departing train. Where possible in the existing Level Crossing control, only the TPWS loops on the line that the train is standing shall be suppressed. The conditional inputs for TPWS loop suppression and cancellation of TPWS loop suppression derived from the route indicator circuit shall not be applied to the Shunt token that is issued for the TEP.

6.5.4 LSI controls at 'Train Crew' Operated Diverging Junctions

To ensure that the LSI is exhibiting a flashing blue indication only when the associated route indicator is exhibiting a corresponding route indication, the LSI indication shall be controlled by the same controls that operate the diverging junction route indicator. This requirement applies to Section Tokens, Long Section Tokens and Shunt Tokens.

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6.5.5 TPWS suppression at 'Train Crew' Operated Level Crossings

At some TEPs, 'Train Crew' operated Level Crossings are required to be operated after a valid token is received and before the associated Stop Board may be passed as defined by section 5. The correct operation of these Level Crossings against highway traffic after the issue of a valid token shall trigger the suppression of the TPWS loops for valid Section and Long Section Tokens. The cancellation (return to the normal position) of the Drivers' Level Crossing indicator control circuit after the issue of the token for the route shall cancel the suppression of the TPWS loops. The trigger input shall be derived from the same controls that provide the final output to the Drivers' Level Crossing indicator that applies to the departing train. Where possible in the existing Level Crossing control, only the TPWS loops on the line that has requested level crossing operation shall be suppressed. The conditional inputs for TPWS loop suppression and cancellation of TPWS loop suppression derived from the Drivers Level Crossing indicator circuit shall not be applied to the shunt token that is issued to the TEP.

6.5.6 LSI controls at 'Train Crew' Operated Level Crossings

To ensure that the LSI is exhibiting a flashing blue indication only when the associated Driver's Level Crossing indicator is exhibiting a crossing operated indication, the LSI indication shall be controlled by the same controls that operate the Drivers' Level Crossing indicator. This requirement applies to Section Tokens, Long Section Tokens and Shunt Tokens.

6.5.7 Sidings Operated by Ground Frames

The requirements for conditional inputs that are derived from Ground Frames are defined in section 5. Where a conditional input is required, the movement of the Ground Frame points lever from normal locked position to the reverse position shall trigger the suppression of the TPWS and flashing of the LSI. The trigger input shall be derived from a lever circuit controller attached to the points control lever.

6.6 Asset Numbering of LSI

6.6.1 General Requirements for LSI Asset Numbering

Where existing asset numbers have been allocated to Stop Boards the new LSI shall be allocated the same number. Where existing asset numbers are not allocated to Stop Boards each LSI shall be allocated an individual number within the RETB TPWS TRCU system area. The allocation of asset numbers shall be generally as required by Group Standard [GK/RT0009](#) for the identification of Signalling equipment. The Group Standard states that generally the assets shall