

Ref	NR/SP/SIG/10134
Issue	3
Date	April 2004

Train Protection Warning Systems - Track sub-systems equipment (formerly RT/E/S/10134)

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)”.**

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of the Standard Owner.

© Copyright 2004 Network Rail

Uncontrolled copy once printed from its electronic source.

Published & Issued by: Network Rail; 40 Melton Street, London NW1 2EE



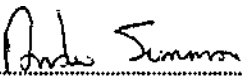
Ref	RT/E/S/10134
Issue	Three
Date	April 2004

Company Specification

TRAIN PROTECTION & WARNING SYSTEM (TPWS) TRACK SUB-SYSTEM EQUIPMENT

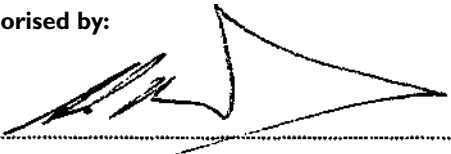
Endorsement & Authorisation

Endorsed by:



A Simmons, Professional Head of Signal Engineering

Authorised by:



A McNaughton, Chief Engineer

Accepted for issue by:



P McAleer, Head of Business Standards

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of the Standard Owner.

©Copyright 2004 Network Rail

Uncontrolled copy once printed from its electronic source.

Published & Issued by: Network Rail 40 Melton Street, London NW1 2EE



Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

Issue record

Issue	Date	Comments
1	September 1999	New Issue
2	October 2000	Updated
3	April 2004	The 24 V d.c. version of the SIM has been removed. The following have been added: the requirement for Self Powered Overspeed Sensor System (SPOSS); the revised requirements for the shape of field; the introduction of a field shape for the buffer stop loops; the inclusion of a section on the management of safety and general up date other requirements in the specification.

Implementation

The implementation date for RT/E/S/10134 shall be 3 April 2004.

Compliance

The compliance date for RT/E/S/10134 shall be 3 April 2004 and is mandatory upon Network Rail. Compliance with this specification is not necessary for equipment that has a product acceptance certificate dated before 3 April 2004.

Disclaimer

Network Rail has used its best endeavours to ensure that the content, layout and text of this document are accurate, complete and suitable for its stated purpose. It makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Network Rail will not be liable to pay compensation in respect of the content or subsequent use of this document for any purpose other than its stated purpose or for any purpose other than that for which it was prepared except where it can be shown to have acted in bad faith or there has been wilful default.

Supply

Copies of documents are available electronically, within Network Rail's organisation. Hard copies of this document will be available to Network Rail staff on request to the Document Controller and to other organisations from Technical Indexes Ltd (01344 404409)

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

Contents

1	Purpose	4
2	Scope	4
3	Reference Documentation	4
4	Definitions	5
5	General Description	7
6	Safety Requirements	7
7	Requirements for TPWS control modules	7
8	Requirements for the Self Powered Overspeed Sensor System (SPOSS)	13
9	Requirements for the TPWS transmitter loops	18
10	Requirements for the TPWS track equipment - general	21
11	Environmental conditions	23
12	Reliability, availability & maintainability	31
13	Management of Safety	32
14	Design method and documentation	33
15	Documentation	33
16	Operational life	33
17	Track sub-system constraints	34
18	Acceptance	34
19	Appendices	35
	APPENDIX A Typical TPWS Track Sub-system Layout	35
	APPENDIX B Field Strength Profiles	36

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

I PURPOSE

This specification defines the detailed requirements for the track sub-system equipment associated with TPWS.

2 SCOPE

This specification refers to the TPWS transmitter loop equipment (track mounted equipment), the control equipment, its' trackside enclosure and the interconnecting cable (trackside equipment) and the Self Powered Overspeed Sensor System (SPOSS) but does not cover the signalling controlling circuitry or the trainborne equipment.

3 REFERENCE DOCUMENTATION

BR 829	Plugboards for Miniature Relay Units for Railway Signalling Purposes
BR 930	Specification for Miniature Tractive Armature DC Neutral Relay (Plug-in Type) for Railway Signalling Purposes
BR 966	Miniature Tractive Armature A.C. Neutral Line Relay (Plug-in Type) for Railway Signalling Purposes
BR 1900	General Specification for Solid State Interlocking Equipment
BS EN 50081-2	Electromagnetic compatibility. Generic emission standard. Industrial environment
BS EN60529	Degrees of Protection Provided by Enclosures (IP code)
BS EN 61000-4-2	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test. Basic EMC publication
BS EN 61000-4-3	Electromagnetic compatibility (EMC). Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test
BS EN 61000-4-4	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrical fast transient/burst immunity test. Basic EMC publication
BS EN 61000-4-5	Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test
BS EN 61000-4-5	Electromagnetic compatibility (EMC). Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields
BS EN 61000-4-8	Electromagnetic compatibility (EMC). Testing and measurement techniques. Power frequency magnetic field immunity test. Basic EMC publication
BS EN 61000-4-9	Electromagnetic compatibility (EMC). Testing and measurement techniques. Pulse magnetic field immunity test. Basic EMC publication

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

BS EN 61000-4-10	Electromagnetic compatibility (EMC). Testing and measurement techniques. Damped oscillatory magnetic field immunity test. Basic EMC publication
BS EN 50121-4	Railway Applications - Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus
GE/RT8005	Fire Safety of Materials at Operational Premises
GE/RT8015	Electromagnetic Compatibility between Railway Infrastructure and Trains
GE/RT8030	Requirements for a Train Protection and Warning System (TPWS)
GK/RT0330	Plug-in and Interchangeable Railway Signalling Equipment
GM/RC1500	Code of Practice for EMC Between the Railway and its Neighbourhood
LUL S&CSE-SE1015-A1	London Underground Limited - Signal & Control Systems Engineering Environmental Requirements for Material and Equipment
RIA13	Generic Specification for Electronic Equipment Used on Traction & Rolling Stock
RIA20	Requirements for Vibration & Shock Testing of Equipment for Railway Vehicles
RT/E/PS/00005	Railway Signalling Cable
RT/E/S/11630	BR930 Series Pin Code Allocations and Contact Arrangements
RT/E/S/11752	Train detection
	Manual Handling Regulations 1994
	Electricity At Work Regulations 1989: SI 1989/635

4 DEFINITIONS

ALARP	As low as reasonably practicable
Arming Frequency	A frequency generated by the track sub-system which, when detected by the vehicle, arms the train sub-system.
MTBF	Mean Time Between Failures
OSS	Overspeed Sensor System
Other Location	Those parts of the infrastructure where an OSS is to be fitted for reasons other than protecting against SPADs.
Overspeed Sensor Transmitter loops	Two transmitter loops mounted in the four foot which generate signals which can be detected by a passing train. The two transmitter loops, one arming loop and one trigger loop, are positioned on the approach to certain signals and other locations to provide two frequencies that may be used by a passing train to determine whether a brake application is necessary.

Overspeed Sensor Module	A module which, when required, produces a pre-determined pair of frequencies which are transmitted via cables to Overspeed Sensor Transmitter loops
Signalling Interface Module (SIM)	A module which operates as the interface between the signalling system and the Overspeed Sensor Module or the Train Stop Module.
SIM	Signalling Interface Module
SPAD	Signal Passed at Danger
SPOSS	Self Powered Overspeed Sensor System
Supplier	The company supplying equipment which meets the requirements of this Line Standard
THD	Total Harmonic Distortion
TPWS	Train Protection & Warning System
TPWS Transmitter loops	Generic term for Overspeed Sensor Transmitter loops and Train Stop Transmitter loops
TPWS track sub-system equipment	Equipment comprising the TPWS control equipment, its' location case, the TPWS transmitter loops and connecting cables
Train Stop Transmitter loops	Two loops mounted in the four foot which generate signals which can be detected by a passing train. The two transmitter loops, one arming loop and one trigger loop, are positioned at certain signals to provide a pair of frequencies that are used by a passing train to determine whether a brake application is necessary.
Train Stop Module	A module which, when required, produces a pre-determined pair of frequencies which are transmitted via cables to Train Stop Transmitter loops
Trigger Frequency	A frequency generated by the track sub-system which, when detected by the vehicle, triggers the train sub-system.
TSS	Train Stop System

5 GENERAL DESCRIPTION

TPWS is designed to reduce the number and the consequences of a SPAD and overspeeding events. Track mounted TPWS transmitter loops emit alternating magnetic fields at defined frequencies which can be detected by trainborne receivers. When the trainborne receiver detects specific combinations of frequencies it will use these to determine whether to initiate an automatic brake application on the train. A typical layout of TPWS track sub-system equipment is shown in Appendix A. The TPWS track sub-system equipment consists of:

- a) TPWS control modules which interface with the signalling system and, dependent upon the status of the signal aspect, generate appropriate frequencies;
- b) the trackside enclosure for the control modules;
- c) the TPWS transmitter loops which emit the generated frequencies to be detected by the train; and,
- d) the interconnecting cables.

6 SAFETY REQUIREMENTS

Although TPWS is a safety related system, it interfaces to vital signalling circuits. Therefore, the integrity and dependability of the TPWS equipment attached to such circuits is vital to the continued safe operation of the railway. In addition, certain requirements are vital to the correct functioning of TPWS as a safety system. The sections within this Specification identified **(S)** are the track equipment Safety Requirements. It shall be necessary for the Supplier to demonstrate through recognised processes that these safety requirements will be met for the trackside equipment under all conditions, including under credible failure modes.

7 REQUIREMENTS FOR TPWS CONTROL MODULES

7.1 TPWS Control Modules: General requirements.

There are three types of TPWS control module, namely the Signalling Interface Module (SIM), the Overspeed Sensor System (OSS) module and the Train Stop System (TSS) module. The TPWS control modules shall:

- a) be isolated from the signalling power supply and the signalling system such that TPWS faults are not transferred to the signalling system and the integrity of the isolation shall not be less than the existing signalling system integrity; **(S)**
- b) fit into non-phenolic plugboards to BR829 and can be held in place by a retaining wire;
- c) be coloured outside in accordance with Table 1 except for the area which fits into the BR829 plugboard;

- d) comply with [GK/RT0330](#) and be provided with pin coding and contact arrangement in accordance with [RT/E/S/11630](#) and shown in Table 1;

TPWS Module Type	Use	Colour (to BS381C)	Pin Code of RMEL modules
SIM	110V a.c. operating voltage	Red (537)	1035
OSS Module	normal direction	Yellow (309)	1036
OSS Module	opposite direction	Blue (107)	1037
TSS Module	normal direction	Green (221)	1038
TSS Module	opposite direction	Brown (410)	1039

Table 1 - Colour coding and pin coding of OSS and TSS modules

- e) be interfaced on a baseplate which has a common wiring interconnection design;
- f) energise or de-energise the TSS or OSS transmitter loops as shown in Table 2.;

Must recognise that input is valid (energised)	Must recognise that the input is invalid (not energised)	Must not cause a TSS or OSS function to change state
Input Voltage between 60V and 121V	Input Voltage <20V	Input voltage between 20V and 60V inclusive

Table 2 - Signal aspect status voltages

- g) have a maximum time of 150 ms between the SIM receiving a request to activate or deactivate the TPWS transmitter loops and the TPWS transmitter loops reaching the corresponding state;
- h) not connect the existing signalling power supply or signalling circuits to earth or to each other; **(S)**
- i) present a 2 wire balanced load to the signalling system;
- j) have inputs which withstand the transients, surges and voltage dips specified in section 11.2; **(S)**
- k) withstand high voltage insulation resistance testing at up to 1kV d.c. pole to pole and pole to earth; **(S)**
- l) ensure that the ECR is not falsely held up when the SIM inputs are directly connected to the signal aspects, the Main and Suppression inputs of the SIM

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

shall draw a maximum current of 7.5 mA a.c. rms for each input, for all input voltages up to a maximum of 121V a.c. rms; **(S)**

- m) be capable of being mounted in a new or existing signalling lineside apparatus case, an existing relay room or in a new trackside enclosures provided by the Supplier.

7.2 Signalling Interface Module (SIM) requirements

7.2.1 SIM inputs

7.2.1.1 SIM power supply interface

The SIM will be connected to a signalling power supply with a voltage of 110V +10/-20%, at 50Hz +4/-6% with a maximum THD @ 13 %. Within this voltage range the TPWS equipment shall function as required in this document. Outside this voltage range the TPWS equipment shall either continue to operate correctly or shall shut down in a controlled manner and annunciate a fault.

7.2.1.2 SIM signalling interface

Two inputs shall be provided on each SIM to interface with the signalling system, one input for the main signal and one input to suppress the associated TSS or OSS function. The inputs are connected to circuits that are derived from the signalling power supply specified in 7.2.1.1. For a TSS, the suppression input will normally be associated with a position light signal or semaphore subsidiary signal. For an OSS, the suppression input will normally be used in complex areas with multiple routes leading up to signals or speed restrictions.

The two input circuits within the SIM shall be isolated from each other, from the power supply and from earth, to a value of at least 10MΩ at 1kV d.c. **(S)**

Each input shall incorporate devices to automatically isolate that circuit of the SIM from the associated signalling circuit under fault conditions. The protective devices shall prevent faults within the SIM, including earth faults of either polarity in the presence of another external earth fault, from affecting the correct operation of a signal aspect to which the input could be directly connected.

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

7.2.2 SIM outputs

7.2.2.1 SIM Fault Reporting

The SIM shall provide a normally open voltage-free proving contact. The contact shall:

- be isolated from all other circuits and earth to a value of at least $10\text{M}\Omega$ at 1kV d.c.; **(S)**
- withstand the transient surges and induced interference as specified in section 11.2; **(S)**
- withstand high voltage insulation resistance testing at up to 1kV d.c. pole to pole and pole to earth. **(S)**

The proving contact shall close within 150ms of the SIM receiving a request to activate the TPWS transmitter loops when all of the following conditions are met:

- the OSS or TSS module is receiving the appropriate power supply operating voltage;
- the OSS or TSS module is receiving the appropriate input indicating that the main signal is required to be at danger;
- the OSS or TSS module is not receiving a sub-signal (TSS) or suppression (OSS) input;
- the correct load impedances of the TPWS transmitter loops are present at the OSS module or TSS module associated with the SIM, implying that the specified fields are being produced.

Once closed, if any of the above conditions are not met, then the proving relay contact shall open within 250ms. The SIM internal proving relay contacts shall be capable of switching a load equivalent to a BR 966 Appendix F7 AC relay over interface cable lengths up to 350 metres or a BR934A 50V DC relay over interface cable lengths up to 2000 metres. **(S)**

7.2.3 SIM constraints

On non -electrified or d.c. only electrified lines the length of cable between the installed SIM and the point of interface (relay contacts or SSI TFM input/output) with the signalling system will not be more than 1500 metres for the power input and the aspect sensing input, but may be up to 2000 metres where the proving contact is driving a BR 934A relay.

Ref:	RT/E/S/10134
Issue:	3
Date:	April 2004

On 25kV a.c. and dual electrified lines the length of cable between the installed SIM and the point of interface (relay contacts or SSI TFM input/output) with the signalling system will not be more than 350 metres but may be up to 2000 metres where the proving contact is driving a BR 934A relay.

7.2.4 SIM Diagnostics

The SIM shall be fitted with a separate means of visibly indicating that:

- a) the power supply is being produced for the associated OSS or TSS module;
- b) the transmitter loops are required to be energised and are currently free of faults.

The indications shall be clearly identifiable and clearly distinguishable from each other.

7.3 OSS and TSS module requirements

7.3.1 OSS and TSS inputs

The inputs for the OSS and TSS shall be derived from the output of their associated SIM. The inputs into the OSS and TSS modules shall be:

- a) the power supply output from the SIM; and,
- b) the output from the SIM which can be used to determine the aspect status of the signal and, where required, aspect status of the associated position light signal or semaphore subsidiary signal for a TSS, or requirement to suppress the OSS in complex areas.

7.3.2 OSS and TSS constraints

It shall be possible to install an OSS or TSS module for a particular use, e.g. 'normal direction' as defined in Table I, in the appropriate position in any BR 930 relay base.

7.3.3 OSS and TSS module diagnostics

The OSS and TSS modules shall be fitted with a separate means of visibly indicating that:

- a) the module is receiving the power input;
- b) the main signal is required to be at stop;
- c) the associated subsidiary signal is required to show a proceed indication or the suppression input is present;

- d) a fault is present on the module or has been registered since the unit was last reset, even if it is not currently present.

The indications shall be clearly identifiable and clearly distinguishable from each other.

7.3.4 OSS and TSS fault detection

After the OSS and TSS module outputs have been activated for 50ms or more they shall be able to detect if the power output to the TPWS transmitter loops is less than the values shown in Appendix B by more than 6 dB (± 1 dB). Detection shall cease when the respective OSS and TSS module outputs are deactivated. **(S)**

7.3.5 SIM fault reporting

If a fault occurs with an OSS or TSS module then the module shall provide an output to the SIM such that the SIM registers the fault while it is present and passes the information on to the signalling system. **(S)**

7.3.6 OSS and TSS outputs

OSS and TSS modules shall provide outputs to the transmitter loops as per the logic in Table 3 such that the fields produced at the transmitter loops conform to those given in Appendix B. **(S)**

Signal State	TSS module outputs to TSS Loop	OSS module outputs to OSS
Signal required to be at proceed	NO	NO
Position light signal or semaphore subsidiary signal required to be at proceed	NO	NO
OSS Suppression required due to positions of points on approach to signal	YES	NO
Signal not required to be at proceed	YES	YES
Warning indicator for speed restrictions	N/A	YES
Buffer stops	N/A	YES

Table 3 - Logic for Output of OSS module/TSS module

The outputs of the OSS and TSS modules shall be such that the field strength produced by the track mounted equipment shall be in accordance with Appendix B of this specification with a cable length up to 500 metres from the OSS or TSS module when installed on any track formation. The cable from the OSS or TSS modules to the OSS or TSS