TS 05260:2.0
T HR SC 01250 SP
Specification

Signalling Interlocking and Traffic Management System Interface

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Issue date: 21 October 2024

Effective date: 21 October 2024

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Document information

Owner: Director Signals and Control Systems Engineering
Asset Management
Planning, Integration and Passenger

Mode: Heavy rail

Discipline: Signals and control systems

Document history

Revision	Effective date	Summary of changes
1.0	12 June 2015	First issued as T HR SC 01250 SP Interfaces Between Signalling and Control Systems
2.0	21 July 2020	Second issue – changes include; change of document title to make it more descriptive and also align with TS 05327 *Traffic Management System*; the addition of Smartlock – SSI Variant and Westrace Mk II interfaces; alignment with new and updated ASA standards.
3.0	19 April 2021	Third issue – changes include; updating reference documents, adding axle counter indications to Appendix A, controls to Appendix B, creating Appendix C for axle counter operation as a guideline
1.0	15 March 2022	First issue as TS 05260. The changes from the previous version include; updating the reference documents; adding indications for two interlockings; adding controls for two interlockings.
2.0	21 October 2024	Second issue – changes include a heartbeat indication for Dupline systems, new standards and requirements including cybersecurity, Kingfisher Modbus over TCP/IP protocol.

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Preface

This is the second issue as TS 05260.

This Specification contains requirements for the interface between Traffic Management Systems (TMS) and various types of signalling interlocking and telemetry systems.

The TMS is designed to manage areas that cover more than one signalling interlocking and should communicate with them to receive indications and send controls safely, securely and with integrity.

This document should be read in conjunction with TS 05327.

The requirements of this document do not reduce the requirements of TS 05333.0.

Changes from the previous version include the following additions:

- a heartbeat indication for Dupline systems
- new standards and requirements including cybersecurity
- Kingfisher Modbus over TCP/IP protocol.

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Table of contents

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1 Scope

This Specification contains requirements for the interface between Traffic Management Systems (TMS) and various types of signalling interlocking and telemetry systems.

The TMS is designed to manage areas that include more than one signalling interlocking and should communicate with them to receive indications and send controls safely, securely and with integrity.

This requirements in this document apply to:

- Communication between the TMS and signalling interlocking. If the signalling interlocking is an RBI, then this interface is between the TMS and the telemetry system.
- Indication and control states presented within the messages between the TMS and signalling interlocking. If the interlocking is the RBI type, then the input or output interface between the telemetry systems and RBI will be defined.
- Naming conventions and the meaning of indications and controls for each trackside object such as track, signals, alarm and monitoring systems.
- Minimum indications and controls for each trackside object so the TMS can monitor and control trackside equipment. These are detailed in Appendix A and Appendix B respectively. If these cannot be provided, the proposed interface is set out in Section 7.6
- Guidelines for the axle counter operations, covered in Appendix C.

2 Application

The requirements in this document apply to interfaces between TMS and signalling interlocking systems across TfNSW's metropolitan rail area.

The interface requirements between trackside objects and interlockings are not covered in this document.

Mechanical interlocking is not part of this document.

This document does not apply to European train control system level 2.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International standards

CLC/TS 50701 *Railway applications – Cybersecurity*

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IEC 62425 *Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling*

IEC 62443 (all parts) *Industrial communication networks – Network and system security*

Transport for NSW standards

TS 00003.1 (T MU MD 00011 ST) *Concessions to Transport Standards, Part 1 – Concession Process*

TS 00031.1 *OT10 Threat-Based Cyber Security Controls, Part 1: Controls and Implementation Requirements*

TS 04981 (T MU MD 20001 ST) *System Safety Standard for New or Altered Assets*

TS 04990 (T MU SY 10010 ST) *Cybersecurity for ICAS – Overview*

TS 04991 (T MU SY 10012 ST) *Cybersecurity for ICAS – Baseline Technical Cybersecurity System Requirements and Countermeasures*

TS 04992 *Surface Transport Fixed Infrastructure Physical Security Standard*

TS 04993 (T MU SY 10013 PR) *Cybersecurity for ICAS – Cyber Risk Management Procedure*

TS 05159 (T HR SC 00001 ST) *Circuit Design Standard – Typical Signalling and Control Systems Circuits*

TS 05257 (T HR SC 00719 SP) *Computer-Based Interlocking Equipment*

TS 05258 (T HR SC 01000 SP) *Common Signals and Control Systems Equipment Requirements*

TS 05327 *Traffic Management Systems*

TS 05333.0 (TS HR SC 10000 ST) *Signalling Design Principle – Introduction*

TS 05333.29 *Signalling Design Principles – Part 29: Naming of Locations, Tracks and Sidings*

TS 05377 *Telecommunication Transmission Systems for Signalling and Control Systems*

TS 06178 (T MU MD 00005 GU) *Type Approval of Products*

TS 06305 (T MU SY 10014 GU) *Application Guide to NSW Cyber Security Policy for Operational Technology*

Other referenced documents

Ansaldo STS, 2019, MVAR–SAD–001 *Mount Victoria Area Remodelling – WSP2G System Architecture & Wayside Interface Design* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

Maximation *ATRICS Kingfisher Enhancements Interface Controls Documents/Design Collaboration* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

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NR BR 1922, British Railways Board, *Message Handling and Data Transmission Requirement Between a Solid State Interlocking and a Train Describer System*

Railtrack PLC, 1999, RT/E/S/17503 *IECC Internal Subsystems Communications Requirements*

Railtrack PLC, 1999, SSI 8003-10A *SSI Data Preparation – Interlocking* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

Siemens, 2017, RFT No. 2017/012 *Sydney Metro City & Southwest: Sydenham Station & Junction Detailed Signalling Designer Services – Contract No. 13/10961 – WESTRACE Modbus Interface Control Document* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

SP S19048 *Mt Victoria Resignalling – Axle Counter Resets* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

SRMP Train Control Systems, Doc. No: 28 862 01 – 004 *SCADA 2000 RTU – Software Design Document – Appendix – 'C', HDLC Design Information* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

Union Switch & Signal, 1996, Service Manual 6700A *Application Logic Programming – GENISYS 2000 – Non-Vital Logic Emulator* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au).

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4 Terms, definitions and abbreviations

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies. Note for signalling related terms and definitions see TS 05366 (Withdrawn).

AMB TfNSW's Asset Management Branch

CBI computer-based interlocking

CSG control system gateway

ELD earth leakage detector

IP internet protocol

metropolitan rail area this is the area bounded by Newcastle (in the north), Richmond (in the northwest), Bowenfels (in the west), Macarthur (in the southwest) and Bomaderry (in the south), and all connection lines and sidings within these areas, but excluding private sidings.

PPM panel processor module

RBI relay-based interlocking

SSI solid state interlocking

SWP sweep function

TAO Technically Assured Organisation

TCP transmission control protocol; a set of standardized rules that allow computers to communicate on a network such as the internet

TfNSW Transport for NSW

TMS traffic management system

UPS uninterruptible power supply

URE unconditional reset enable

5 Overview

The TMS is a key element of automated network management and controls various train operations, such as timetable management, safety and infrastructure management, customer communications, analytics and decision making, and staff service and operational management.

For these functions to perform automatically the TMS needs to receive indications and send controls to trackside objects through signalling interlocking and telemetry systems. The two types of signalling interlocking technologies are CBI and RBI. Figure 1 shows the interfaces between the signalling system and the TMS.

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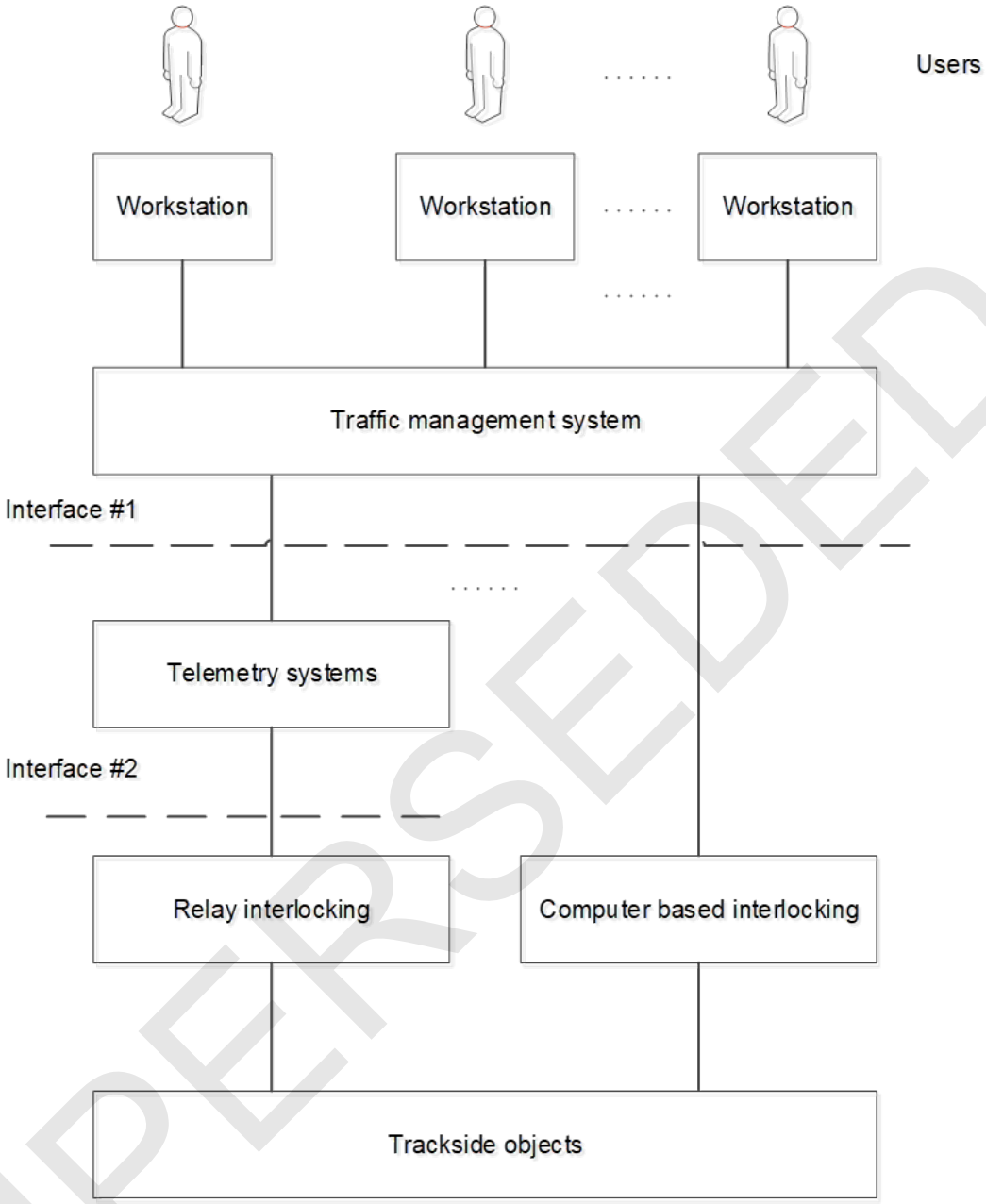

Figure 1 – Interface overview

The interfaces for CBI and RBI technologies are as follows:

- CBI – this interlocking is solid state, where wired networks of relays are replaced by software logic running on special purpose control hardware. It can directly communicate with the TMS, therefore a telemetry system is not required between the CBI and the TMS. This configuration requires only one interface, defined with the communication protocols. Its parameters are shown as ‘Interface #1’ in Figure 1.
- RBI – this type of interlocking consists of complex circuitry made up of relays in an arrangement of relay logic and cannot directly communicate with the TMS. A telemetry system is required between the TMS and the RBI. This configuration requires the following two interfaces:

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- Interface between the TMS and telemetry systems which is defined with the communication protocols and its parameters shown as ‘Interface #1 in Figure 1.
- Interface between the relay interlocking and the telemetry systems which is defined with the relay connection and relay’s binary state shown as ‘Interface #2’ in Figure 1.

6 Design constraints

This section provides requirements for physical interfaces and cybersecurity.

TS 04981 specifies requirements for the whole-of-life of the asset which apply to this document.

The equipment and system requirements in this document are subject to type approval according to TS 06178.

Requirements in TS 00096 shall apply if the interface needs to be updated or upgraded, or if deployment requires staging.

If there is deviation from the requirements as well as indications and controls listed in appendices, the TAO shall apply for a concession in line with TS 00003.1.

6.1 Electrical interface

The signalling interlocking systems shall be electrically isolated from TMS equipment or telemetry systems.

Signalling interlocking systems provide safety functions. The TMS and telemetry systems shall not introduce new hazards or alter existing hazards and their controls. All risks related to the electrical interface shall be identified and mitigated in line with TS 04981.

The electrical interface shall meet the requirements in TS 05257 and TS 05258 as a minimum.

6.2 Communication interface

The TMS provides safety functions as specified in TS 05327 as well as non-safety functions which shall have integrity.

The communication protocol used for interfaces may be serial or IP, which could be converted from serial protocol.

Diversity and redundancy requirements between the TMS and signalling interlocking systems or telemetry systems shall comply with TS 05377.

The communication protocols covered by this document do not have all recommended defences against threats, as required by TS 05377. All transmission systems between the TMS and signalling interlocking or telemetry systems shall be category 1 transmission systems as defined in TS 05377. Failing that, appropriate security mitigations shall be put in place, as detailed in Section 6.3.

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Communication protocol parameters between the TMS and the signalling interlocking or telemetry systems, such as protocol rules, communication parity, speed and bit ordering shall be determined according to the application-specific design, and performance requirements in TS 05327.

All risks related to the communication interface shall be identified and mitigated according to TS 04981.

6.3 Security

All the interface between telemetry systems, signalling interlocking and the TMS shall be able to provide security against physical, personnel and cyber threats. A risk-based analysis shall be done to prevent, detect and respond to any vulnerabilities and threats to the TMS, as required by TS 04992.

6.3.1 Cyber security

Interfaces between telemetry systems, signalling interlocking and the TMS shall comply with all the requirements in CLC/TS 50701, which is based on IEC 62443 (all parts) and IEC 62425.

The interface shall also comply with the following cyber security standards:

- TS 04990
- TS 04991
- TS 04993
- TS 00031.1
- TS 06305.

  Note: In addition to the above standards, requirements concerning protocols in TS 05377 apply, including the use of conduits detailed in TS 04990.

7 Indications and controls

Sections 7.1 to 7.8 set out the generic requirements for indications and controls.

Higher level functions and related interfaces, based on using indications and controls detailed in Appendix A and Appendix B respectively, are specified in TS 05327.

7.1 TMS responsibilities

The TMS shall be capable of the following with respect to indications and controls:

- determining the success of the issued controls by checking appropriate indications within the apportioned response time derived from applicable standards

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- handling invalid combination of an asset's indications during the transition
- generating alarms if unusual conditions are detected and prevent nuisance alarms
- logging all indications, controls and applicable events
- maintaining indication and control integrity
- determining the integrity of the indications according to each signalling interlocking system or requirements of telemetry systems
- processing indications and controls within the apportioned response time derived from applicable standards
- handling the signalling interlocking according to their limitations and constraints, such as processing power, to ensure the signalling interlocking performs its safety and time critical functions
- handling mastership of the signalling interlocking or telemetry systems.

7.2 Indications

The current state of the trackside object shall be determined by one or more indication bits as specified in Appendix A. Each bit can have one of the two states, on or off, depending on:

- the signalling interlocking or telemetry systems described in Sections 8 and 9
- the signalling equipment specified in Appendix A.

7.3 Health indications

The TMS can present the trackside object state differently if it detects the trackside object's indication has lost its integrity, for example if:

- the signalling interlocking or telemetry system providing integrity lost information, such as a ‘Microlok Slave_OK’ indication
- a communication problem exists between the TMS and signalling interlocking or telemetry system based on the communication protocol's rules
- a special health indication bit indicates the integrity of the configured set of indications. For example direct connection to a power supply can be a special health indication bit
- a special heartbeat indication bit continuously toggles at a fixed rate, indicating the telemetry system has not frozen. This may also be referred to as a special watchdog indication bit.

If failure of the signalling equipment or components of the signalling or telemetry systems cannot be established from the communication link status, special health or heartbeat indication

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bits shall be provided. Health or heartbeat indications may either be generated by the telemetry system internally, or provided externally such as through interlocking.

Special health or heartbeat indication bits shall be associated with the set of indications for trackside objects.

The TMS shall process special health or heartbeat indication bits as a priority ahead of other indications to maintain the last known states of the trackside objects correctly.

7.4 Controls

The TMS shall be able to set the new state of the trackside objects using control bits of the trackside object as specified in Appendix B. Each control normally has two states, ‘on’ or ‘off’, which shall be determined according to either:

- the signalling interlocking or telemetry systems in Sections 8 and 9
- signalling equipment in Appendix B.

Some outputs shall be sent as ‘pulsed’ (see Appendix B), achieved with either of the following techniques:

- If the signalling interlocking or telemetry system has the capability to configure their outputs, then the required outputs can be configured as ‘pulsed’ by the TMS.
- Otherwise the TMS shall simulate the ‘pulse on’ and ‘pulse off’ as follows:
    - Pulse on – the output shall be set to ‘on’ and after preconfigured time set to ‘off’ and kept in the off state
    - Pulse off – the output shall be set to ‘off’ and after preconfigured time set to ‘on’ and kept in the ‘on’ state.

The preconfigured time for a pulse shall be determined according to the signalling interlocking requirements.

7.5 Mastership

The signalling interlocking or telemetry systems can be configured as redundant systems to improve the availability of the system. The mastership of the redundant system is determined by the TMS based on the following parameters:

- health of the signalling interlocking or telemetry systems as specified in this document for each type of system
- the TMS user command in TS 05327.

Determination and handling of the mastership of the signalling interlocking or telemetry systems are different for each system and application and are not covered in this document.

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7.6 Minimum operational requirements

The TMS presents the trackside objects according to the operational requirements. Appendix A and Appendix B and in TS 05327 provide guidelines how TfNSW operational requirements can be set based on previous and current applications. To implement these operational requirements, the TMS requires a minimum set of indications and controls of the trackside objects provided by the signalling interlocking or telemetry systems. These are detailed in Appendix A and Appendix B.

Some trackside objects provide more than one independent function based on dedicated inputs and outputs such as axle counters. Depending on the operational requirements of a specific application, it is not necessary to implement all functions of the trackside object. The minimum operational requirements shall apply for each relevant function, not the whole trackside object.

The operational and safety impacts shall be analysed and justified if the minimum set of indications and controls for a function cannot be provided. Outcomes, transferred risks, proposed mitigations and solutions shall be approved by the rail operator and maintainer.

If the trackside object provides more indications or controls than the minimum operational required, they should be marked as ‘no’ in the ‘minimum requirements for TMS’ column in the applicable appendix. Otherwise, it should be marked as ‘yes’.

‘Nil’ indication shall be used when either of the following occurs:

- trackside object is not available for the specific signalling interlocking type
- trackside object’s indication or control is not implemented for the specific signalling interlocking type.

7.7 Maintenance and diagnostic

For some installations a separate maintenance system may be provided to capture diagnostic indications for maintainers. In this case, a reduced set of indications may be provided to the TMS, using the approval process outlined in Section 7.6.

7.8 Design constraints

Sections 7.8.1 to 7.8.5 specify requirements that shall be followed during the interface design.

7.8.1 Spare indications or controls

Controls and indications shall be arranged in order on the serial links’ message structure so that they can be managed and maintained easily. There shall be spare bits within the message structure. If new controls or indications are added, these spare bits shall be used instead of the changing the existing message structure.

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To facilitate this, the listing should where possible nominate an additional 15% to 20% of bits as spare, over and above the required bit listing.

7.8.2 Allocation of indications and controls

All indications and controls related to trackside objects shall be allocated in one signalling interlocking or telemetry system. For example, all the indications and controls of a signal including associated track ‘A’ indications for all routes from the signal. shall be allocated one signalling interlocking or telemetry system.

Indications shall be geographically contiguous in one signal interlocking or telemetry system. So, if the signal and track ‘A’ are indicated from system 1 and track ‘B’ from the next telemetry or interlocking, then subsequent track ‘C’, track ‘D’ and so on shall be indicated from system 2.

7.8.3 Combining of indications

Inputs shall be provided for each indication separately, except where combining of inputs is required for single functions such as:

- route availability indications
- certain alarm indications agreed for a specific project.

7.8.4 Meaning of indications and controls

The minimum indications and controls detailed in Appendix A and Appendix B shall be interpreted as follows:

- Relay, Microlok and WSP2G indications are expressed in terms of relay contacts. For Microlok and WSP2G, interfaces ‘contact’ shall mean the functional equivalent.
- For SSI, Westlock, Smartlock – SSI Variant and Westrace, Table 1 lists the required indications as well as the latches that need to be provided.

Appendix A is based on the standard application. Some installations may vary in the logic required to provide the function. For example, some signals may clear without train stop drive. If there is deviation from the standard, clarification shall be sought from AMB.

Each signalling asset type and its controls and indications shall not be used for different purposes. If the specific site application requires using a signalling asset type other than its general application purposes within the operational rail network, the TAO shall apply for a concession in line with TS 00003.1.

7.8.5 Naming convention

The input and output naming convention for existing interlockings in the TMS shall comply with the function names used in the circuit book or data. An interlocking abbreviation prefix shall be

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added to achieve unique names. This shall be a unique two letter abbreviation of the interlocking name, as specified in TS 05333.29.

The interlocking abbreviation is not required in the interlocking data. The function names shall omit any characters added to identify repeats, according to TS 05159.

Where multiple copies of the same function are provided to the TMS (for example, at the system interfaces) a suffix of '-n' shall be added where 'n' is the copy number starting from one. The suffix for the first copy of the function may be omitted and subsequent copies shall be numbered starting from two.

The naming conventions for SSI, Westlock and Smartlock – SSI Variant shall comply with the SSI source files. The naming convention is defined in SSI 8003-10A.

The naming conventions for Westrace Mk II shall comply with those set out in Siemens RFT No. 2017/012.

The indication names may exclude the 'R' for relay at the end of the function name if it is commonly omitted in usage, such as track circuit indications. This is the case in Microlok data. The naming convention for equipment not included in the documents referenced in Section 7.8.5 shall follow names used in the signalling circuits or CBI data. Or it may be a descriptive word in brackets.

For Microlok and WSP2G interlockings the bit names are often prefixed with their communication port number. In this instance, the prefix shall be removed from the name used by the TMS.

The IO names may contain case sensitive alphanumeric characters as well as the four characters '- _ ( )'. IO names shall not contain any space characters. The asterisk '*' is reserved for use by intermediate terms within the TMS, as are the terms 'true' and 'false'.

7.8.6 Performance

The application that handles interfaces shall be designed to:

- detect and handle all possible and credible failure modes
- detect the compromised communication integrity quickly and accurately
- detect the recovery of the communication integrity shortest possible times based on the protocol parameters
- recover and restore lost or discarded information without compromising the integrity of existing information
- prevent or minimise communication delays, including changeovers.

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8 Interface between the TMS and telemetry systems

Relay interlocking is not able to communicate with the TMS directly. Therefore the following telemetry systems are used to provide the interface:

- SCADA 2000
- Dupline
- iMAC
- Kingfisher.

The wiring connections from the telemetry system to the relay interlocking shall be included in the signalling design circuits.

8.1 SCADA 2000

The SCADA 2000 is a telemetry system that provides an interface between the relay interlocking and the TMS. It can be duplicated to improve availability.

8.1.1 Interface to relay interlocking

The connections to the interlocking shall be through type approved optoisolator boards. The optoisolator can be duplicated to improve availability.

8.1.1.1 Indications

The input circuit may be a single contact or a logic circuit of a number of contacts.

The SCADA 2000 shall detect the following indications:

- On: when the input circuit is closed and the required voltage is applied to the input terminal.
- Off: when the input circuit is open.

Vital indication optoisolators may be used where an intermediate point of a vital circuit is required as an input, such as for route availability indications. A circuit including the vital inputs and outputs then drives an input optoisolator according to conventional inputs.

8.1.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used to determine the integrity of whole or part of the SCADA 2000. The TMS shall determine the integrity of trackside object indications according to the information provided by the SCADA 2000 (refer to SRMP *Train Control Systems, SCADA-2000 RTU, Software Design Document Appendix C*), and from the communication status.

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8.1.1.3 Controls

Controls shall have the following effect on outputs:

- steady ‘on’: current is allowed to flow
- steady ‘off’: no current is allowed to flow.

If the SCADA 2000 is configured as a hot standby system, then it shall send controls to the relay interlocking by the master side of the SCADA 2000. Controls at the standby side of the SCADA 2000 shall be set to ‘high impedance’ so as not to interfere with the master side controls. On a change of mastership there shall be an overlap where both sides are a master to ensure the signalling control outputs do not drop out. The overlap shall not be less than five seconds.

8.1.1.4 Interface to the TMS

The communication protocol used between the SCADA 2000 and the TMS shall comply with SRMP *Train Control Systems, SCADA-2000 RTU, Software Design Document Appendix C*.

The TMS shall be able to determine the health of the SCADA 2000 telemetry system based on the communication status and information it provides. The TMS shall determine the integrity level of indications according to the calculated health status of the SCADA 2000 system specified in TS 05327.

Mastership of the SCADA 2000 shall be set by the TMS according to user commands and the health status determined by the TMS as detailed in TS 05327.

8.2 Dupline

Carlo Gavazzi Automation Component's Dupline is a telemetry system that provides interface between relay interlocking and the TMS. It can be duplicated to improve availability.

8.2.1 Interface to relay interlocking

The connections to the interlocking could be direct.

8.2.1.1 Indications

The input circuit may be a single contact, or a logic circuit of a number of contacts.

The Dupline shall detect indications as follows:

- On: when the input circuit is closed and the required voltage is applied to the input terminal.
- Off: when the input circuit is open.

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8.2.1.2 Indication conditioning

The Dupline has no ability to determine failure of input module. A hardwired ‘special health indication bit’ shall be supplied for each input module and wired directly to the system bus voltage. Therefore, this indication shall be ‘on’ all the time if the module is functioning as required.

The Dupline has two failure modes ‘all on’ and ‘all off’. Only the latter is alarmed.

Dupline systems that include a private line modem also have a failure mode where all indications can freeze, even though they continue to respond to polls from the TMS. For these systems, two 'special heartbeat indication' bits shall be supplied to allow the TMS to detect an indication freeze. Each of these shall be connected to a different Dupline transmitter module, to avoid failure of one transmitter being detected as a heartbeat failure.

8.2.1.3 Controls

No control shall be issued using Dupline telemetry systems.

8.2.2 Interface to the TMS

The communication protocol used between the Dupline master and the TMS shall observe the specifications in the *Modbus Protocol Reference Guide*.

If the TMS detects the ‘special health indication bit’ as ‘off’, the integrity to the Dupline module shall be invalidated and any indications from it ignored. The TMS shall present an ‘integrity lost’ state for any trackside objects affected by this until the health indication recovers and updated indications are received.

8.3 iMAC

AmpControl's iMAC is an integrated monitoring and control telemetry system which can be duplicated to improve availability.

8.3.1 Interface to relay interlocking

The connections to the interlocking could be direct.

8.3.1.1 Indications

iMAC input modules use a sense current to determine if the input circuit is closed. For this reason, one circuit or contact cannot be used for duplicated inputs. Two contacts or duplicated input circuits shall be used for redundant systems. The input circuit may be a single contact, or a logic circuit of a number of contacts.

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Indications shall be detected as follows:

- On: when the input circuit is closed.
- Off: when the input circuit is open.

The iMAC input modules can be configured to invert the logic sense of the inputs using dual in line package (DIP) switches. This feature shall not be used.

8.3.1.2 Indication conditioning

The 'special health indication bit' as specified in Section 7.3 is not required to be used in order to determine the integrity of whole or part of the iMAC. The TMS shall determine the integrity level based on information provided by the iMAC using a register for each module and communication status in TS 05327.

8.3.1.3 Controls

No control shall be issued using the iMAC telemetry systems.

8.3.2 Interface to the TMS

The communication protocol used between the iMAC master and the TMS is detailed in the *Modbus Protocol Reference Guide*.

The TMS shall be able to determine the health of an iMAC telemetry system based on the communication status and information it provides. The TMS shall determine the integrity level of indications according to the calculated health status, as specified in TS 05327.

8.4 Kingfisher

Ovarro Connecting Technologies Kingfisher is a telemetry system that can be duplicated to improve availability.

8.4.1 Interface to relay interlocking

The connections to the interlocking could be direct.

8.4.1.1 Indications

The input circuit may be a single contact, or a logic circuit of a number of contacts. Indications shall be detected as follows:

- On: when the input circuit is closed and the required voltage is applied to the input terminal.
- Off: when the input circuit is open.

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8.4.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used to determine the integrity of whole or part of the Kingfisher. The TMS shall determine the integrity level from information the Kingfisher ‘location OK’ bits provides, as detailed in Appendix A, and its communication status according to TS 05327.

8.4.1.3 Controls

Use of controls through the Kingfisher is permissible, as specified in Section 7.4. However receipt on both sides may be required for the application.

8.4.2 Interface to the TMS

Kingfisher can interface to the TMS in two different ways, either as a serial interface or CP-35 interface, as detailed below.

The TMS shall be able to determine the health of the Kingfisher telemetry system based on the communication status and information it provides. The TMS shall establish the integrity level of indications according to the calculated health status, as specified in TS 05327.

8.4.2.1 Serial interface

This configuration uses the GENISYS protocol over the serial link. The Kingfisher configuration should follow the rules and processes detailed in Union Switch & Signal’s Service Manual 6700A.

8.4.2.2 CP-35 Interface

This configuration uses the Modbus over TCP/IP protocol for the packet switched network. The Kingfisher configuration should follow the rules and processes detailed in the *ATRICS Kingfisher Enhancements Interface Controls Documents/Design Collaboration.*

9 Interface between the TMS and the CBI

The CBI has the ability to perform its functions using executives, rules and site-specific configuration data instead of relays. The CBI is able to communicate directly with the TMS. They do not need another system between the TMS and CBIs.

The CBIs can be used as telemetry systems as detailed in Section 9.

The TMS shall be able to interface with the following CBI technologies:

- SSI
- Westlock
- Smartlock – SSI Variant

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- Westrace Mk II
- Microlok II
- WSP2G.

9.1 SSI

The SSI shall be configured as redundant system and the interface provided by the PPMs.

9.1.1 Interface to the TMS

The SSI interfaces to the TMS directly using the communication protocol set out in Section 9.1.1.4.

9.1.1.1 Indications

Indications are received using the messages detailed in the communication protocol. The indication values shall be:

- On: SSI value of ‘true’ indicated by a ‘1’ in the message.
- Off: SSI value of ‘false’ indicated by a ‘0’ in the message.

9.1.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used in order to determine the integrity of whole or part of the SSI. The TMS shall determine the integrity level from information provided by the SSI (refer to Appendix A), and the communication status, according to TS 05327.

9.1.1.3 Controls

Controls shall only be sent by the master TMS side. On a change of mastership there shall be an overlap where both sides are master for a set period, determined by the SSI performances.

Control values sent using messages are set to the following:

- On: SSI value of ‘true’ indicated by a ‘1’ in the message.
- Off: SSI value of ‘false’ is indicated by a ‘0’ in the message.

9.1.1.4 Communication protocol

The TMS shall interface to the SSI through a serial communication link using the protocols outlined in:

- NR BR1922 – this protocol shall be used if there is no requirement to send controls or monitoring purposes. It is only used by SSI.

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- RT/E/S/17503 – This protocol shall be used when TMS sends controls to the interlocking.

The connection point shall be the RS-422 ports provided by the PPM. Each SSI cubicle has two PPMs with one RS-422 port per PPM for the interface.

9.2 Westlock

Siemens Westlock indication and control interfaces are identical to the SSI indication and control interfaces covered in Section 9.1, except for the following:

- The TMS shall interface to the Westlock interlocking through a serial communication link using RT/E/S/17503.
- The connection point shall be the RS-422 ports provided by CSG. Each Westlock system has two CSGs. Each CSG can have multiple interlocking addresses with one RS-422 port per interlocking address on each CSG.

9.3 Smartlock – SSI variant

All interfaces of Alstom's SmartLock – SSI Variant are identical to the SSI explained in Section 9.1, with the following exceptions:

- PPM is not used in the Smartlock – SSI variant architecture
- Smartlock – SSI variant can be configured as redundant system and the interface shall be provided by the IO groups
- the connection point shall be the RS-422 ports provided by the IO groups. Each Smartlock – SSI variant virtual interlocking uses one RS-422 port per IO group for the interface.

9.4 Westrace Mk II

Siemens' Westrace Mk II has similar interface characteristics as the SSI.

9.4.1 Interface to the TMS

The Westrace Mk II interfaces to the TMS directly using the communication protocol covered in Section 9.4.1.4.

9.4.1.1 Indications

Indications are received using the messages as detailed with the communication protocol. The indication values shall be as follows:

- On: Westrace Mk II value of 'true' indicated by a '1' in the message.
- Off: Westrace Mk II value of 'false' indicated by a '0' in the message.

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9.4.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used to determine the integrity of whole or part of the Westrace Mk II. The TMS shall determine the integrity level from communication status according to TS 05327 and information provided by the Westrace Mk II ‘location OK’ bits detailed in Appendix A,

9.4.1.3 Controls

Controls shall only be sent by the master TMS side. On a change of mastership there shall be an overlap for a set period where both sides are a master.

All controls are sent from the TMS as pulsed controls except points controls, and their duration shall be configurable in the TMS. This is typically set to one second but shall not be greater than five seconds. This means a control is asserted from the TMS to the Westrace Mk II until the control times out, then returns to the logical state ‘off’. When one control is changed, a packet containing all controls in that register is sent to the interlocking. The Westrace Mk II latches controls at the rising edge of the pulse. Points controls are steady state.

9.4.1.4 Communication protocol

The TMS shall interface to the Westrace Mk II interlocking using Modbus over a TCP/IP protocol based communication system using the protocol in RFT No. 2017/012. The interface shall be ‘redundant communication with hot-standby modbus TCP client-server’ compliant with RFT No: 2017/012.

9.5 Microlok II

Hitachi Rail STS’s Microlok II interlocking shall be configured as a redundant system.

9.5.1 Interface to the TMS

The Microlok II interlocking interfaces to the TMS directly using the communication protocol outlined in Section 9.5.1.4.

9.5.1.1 Indications

Indications are received using the messages as detailed with the communication protocol. The indication values shall be as follows:

- On: Microlok II value of ‘true’ indicated by a ‘1’ in the message.
- Off: Microlok II value of ‘false’ indicated by a ‘0’ in the message.

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9.5.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used in order to determine the integrity of whole or part of the Microlok II. The TMS shall determine the integrity level from communication status according to TS 05327 and information provided by the Microlok II detailed in Appendix A.

9.5.1.3 Controls

Controls values sent using the messages are set to the following:

- On: Microlok II value of ‘true’ indicated by a ‘1’ in the message.
- Off: Microlok II value of ‘false’ indicated by a ‘0’ in the message.

Where the Microlok II requires controls to be pulsed ‘on’ or ‘off’, the duration shall be configurable in the TMS. This will typically be set to one second but shall not be greater than two seconds.

The TMS can send controls to either one or both Microlok II masters. If controls are sent to both sides, then the TMS shall ensure a conflict does not exist between requests sent over different links.

9.5.1.4 Communication protocol

The TMS shall interface to the Microlok II interlocking through serial communication links using the GENISYS protocol as detailed in Union Switch & Signal’s Service Manual 6700A.

9.6 WSP2G

Hitachi Rail STS’s WSP2G interlocking shall be configured as a redundant system.

9.6.1 Interface to the TMS

The WSP2G interlocking interfaces to the TMS directly using the communication protocol in Section 9.6.1.4.

9.6.1.1 Indications

Indications are received using the messages as detailed with the communication protocol. The indication values shall be as follows:

- On: WSP2G value of ‘true’ indicated by a ‘1’ in the message.
- Off: WSP2G value of ‘false’ indicated by a ‘0’ in the message.

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9.6.1.2 Indication conditioning

The ‘special health indication bit’ as specified in Section 7.3 is not required to be used to determine the integrity of whole or part of the WSP2G. The TMS shall determine the integrity level from communication status according to TS 05327 and information provided by the WSP2G as detailed in Appendix A.

9.6.1.3 Controls

Controls values sent using the messages are set to the following:

- On: WSP2G value of ‘true’ indicated by a ‘1’ in the message.
- Off: WSP2G value of ‘false’ indicated by a ‘0’ in the message.

Where the WSP2G requires controls to be pulsed ‘on’ or ‘off’, the duration shall be configurable in the TMS and set according to the WSP2G requirements.

The TMS can send controls to either one or both WSP2G masters. If controls are to be sent to both sides, then the TMS shall ensure that a conflict does not exist between requests sent over different links.

9.6.1.4 Communication protocol

The TMS shall interface to the WSP2G interlocking through TCP/IP communication links using the GENISYS TCP/IP protocol described in MVAR–SAD–001.

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Appendix A Indications to the TMS

Minimum indication requirements for TMS interfaces with Relay, Microlok, WSP2G, SSI, Westlock, Smartlock – SSI Variant and Westrace Mk II are listed in Table 1.

Table 1 – Indications to the TMS

Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Air system	Starting of the lag compressor	No	AIR_LAG_KR	Nil	Nil
Air system	Compressor failure	No	AIR_FW_KR	Nil	Nil
Air system	Dryer failure (if provided separate from compressor)	No	AIR_DF_KR	Nil	Nil
Air system	Activation of any low pressure	Yes	AIR_LP_KR	Nil	Nil
Air system	Activation of any high pressure	No	AIR_HHH_KR	Nil	Nil
Air system	Loss of power supply either partially (for example: loss of phase) or completely	No	AIR_PSN_KR AIR_PSE_KR	Nil	Nil
Air system	Activation of low pressure	No	AIR_LLL_KR	Nil	Nil
Air system	Failure of both compressors	Yes	AIR_F_KR	Nil	Nil
Air system	Loss of both power supplies	Yes	AIR_PSR_KR	Nil	Nil
ac power supply	Normal available	Yes	Front contact of _NORM	LnameNORM	[Loc ID]_[Voltage]NORMAL_AVAIL where [voltage] is 120V or 415V
ac power supply	Emergency available	Yes	Front contact of _EMERG	LnameEMERG	[Loc ID]_[Voltage] EMERG_AVAIL where [voltage] is 120V or 415V

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
ac power supply	Load available	Yes	Front contact _PSR	LnamePSR	[Loc ID]_FAIL_PSK
ac power supply	ATS 1 Auto selected	No	ATS_ON_AUTO	Nil	[Loc ID]ATS_ON_AUTO
ac power supply	ATS 1 normal supply available and on line	No	ATS_NOR	Nil	[Loc ID]ATS_NORMAL
ac power supply	ATS 1 emergency supply available	No	ATS_EMERG	Nil	[Loc ID]ATS_EMERG
ac power supply	ATS 1 essential switchboard one supply available	No	ATS_ESS_NOR	Nil	[Loc ID]ATS_ESS_NORMAL
ac power supply	UPS healthy (drops out with any UPS alarm)	No	UPS_NOR	Nil	[Loc ID]A-UPSALMK or [Loc ID]UPS_NORMAL or [Loc ID]UPS_OK
ac power supply	UPS on bypass	No	UPS_BYPASS	Nil	[Loc ID]A-UPSBYPASSK or [Loc ID]UPS_BYPASS
ac power supply	UPS load on battery	No	UPS_BATT	Nil	[Loc ID]UPS_BATT
ac power supply	UPS ON	No	UPS_ON	Nil	[Loc ID]UPS_ON
ac power supply	EC01 supply available and on line	No	EC01_NOR	Nil	[Loc ID]ECO_NORMAL
ac power supply	EC01 bypass supply available	No	EC01_BYPASS	Nil	[Loc ID]ECO_BYPASS
ac power supply	EC01 essential switchboard 2 supply available	No	EC01_ESS_NOR	Nil	[Loc ID]ECO_ESS_NORMAL

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
ac power supply	LOM fail	No	Nil	Nil	[Loc ID]_[Line ID]_LOM_FAIL_PSK
Axle counter	Track section is unoccupied	Yes	Track KR	Nil	Nil
Axle counter	Axle counter cleared	Yes	Track CHK KR	Nil	Nil
Axle counter	Track waiting for a sweep train	Yes	Track WCT KR	Nil	Nil
Axle counter	Preparatory reset is available	Yes	Track Prep Reset Avail KR	Nil	Nil
Axle counter	URE is available	Yes	Track Uncond Reset Avail KR	Nil	Nil
Axle counter	Preparatory reset has been accepted (see Note A8)	Yes	Track RAC KR	Nil	Nil
Axle counter	SWP applied in interlocking	Yes	SWP RLKR	Nil	Nil
Axle counter	No SWP applied in interlocking	Yes	SWP NLKR	Nil	Nil
Axle counter	SWP is free to change state	Yes	SWP ZR KR	Nil	Nil
Axle counter	URE function applied in interlocking	Yes	URE RLKR	Nil	Nil
Axle counter	No URE function applied in interlocking	Yes	URE NLKR	Nil	Nil
Axle counter	URE function is free to change state	Yes	URE ZR KR	Nil	Nil
Axle counter	Axle Counter Communications OK	Yes	Track COMM_OK	Nil	Nil
Axle counter	Communications link OK	Yes	[Loc ID]_COMM_[Link ID]OK	Nil	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Signals	Signal reverse (RGK)	Yes	Combination of front contact of HR or front contact of LsPR and contact of VRR or front contact of RGKR	Combination of: - SnameT.asp0...asp2 LnameVRR – see train stops indications Rname.set logic to perform combination shall be provided by interlocking designer	[Signal ID]_RGK
Signals	Signal normal (NGK)	Yes	Combination of back contact of HR or back contact of LsPR and front contact of VNR or front contact of NGPR	Combination of: - SnameT.asp0...asp2 LnameVNR – see train stops indications latch for train stop suppression where required logic to perform combination shall be provided by interlocking designer	[Signal ID]_NGK
Signals	Up direction indicator (_LUYR)	Yes	_UYR	Nil	[Section ID]UDKR
Signals	Down direction indicator (_DYR)	Yes	_DYR	Nil	[Section ID]DDKR
Signals	Signal key switch (_GZK)	Yes	_GZK	_GZK	Nil
Signals	Emergency replacement	Yes	Front contact of ENR	SnameT.auto	[Signal ID]AUTO
Controlled signal	Auto re-clear (see Note A1)	Yes	Front contact of (A)SR	SnameT.auto	[Signal ID]AUTO or [Signal ID]ASR

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Controlled signal	Approach locked (ALS)	Yes	Front contact of ALSR or ALSR in MLK	SnameT.toal	[Signal ID]_ALSK
Controlled signal	Lever control (_LP)	Yes	Front contact of LPR	Either: SnameT.ascon or LnameLPR latch	[Signal ID]LPR
dc power supply	dc power warning	Yes	Front contact of _WARN	LnameWARN	[Loc ID]_[Voltage]WARN_PSK where [Voltage] is 12V or 24V or 50V
dc power supply	dc power fail	Yes	Front contact of _FAIL	LnameFAIL	[Loc ID]_[Voltage]FAIL_PSK where [Voltage] is 12V or 24V or 50V
Direction indicator	Up direction (UD)	Yes	Front contact of UDKR or UDR	LnameUDKR	Nil
Direction indicator	Down direction (DD)	Yes	Front contact of DDKR or DDR	LnameDDKR	Nil
Direction override	Timer initiation	Yes	'Section and direction identifier' _PBR	Nil	Nil
Direction override	Direction override	Yes	'Section and direction identifier' SECTION_JR	Nil	Nil
Dual controls	Control indicator	Yes	Front contact of _CONTROLK	Latch	Nil
Dual controls	Control repeater	Yes	Front contact of _CONTROLK	Latch	Nil
ELD	Earth leakage	No	Front contact of _ELD	LnameELD	[Loc ID]_[Voltage]_ELD where [Voltage] is 12V or 24V or 50V or 120V or 415V

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Emergency shunt function	ESF enabled (See Note A1)	Yes	Front contact of ESF_ON	LnameESF	Nil
Fire system	Fire	No	Front contact of _FIRE_ALARM	LnameFIREALARM	RFS[RFS ID]A-FIREALMK
Fire system	Fire system fault	No	Front contact of _FIRE_FAULT	LnameFIREFAULT	Nil
Flood detector	Alarm	No	Front contact of _FLOOD_ALARM	Nil	Nil
Flood detector	Warning	No	Front contact of _FLOOD_WARNING	Nil	Nil
Flood detector	Override	No	Front contact of _FLOOD_OVERRIDE	Nil	Nil
Half pilot staff	HPS in lock	Yes	Front contact _HPS	LnamHPS	[HPS ID]HPS
High load detectors	Alarm	Yes	Front contact of _ALARM	Nil	Nil
Health	EquipmentOK	Yes	_OK	Nil	[LOC ID]_OK
Backup Battery	Battery Low Voltage	Yes	BATT_LOW_VOLTAGE	Nil	Nil
Backup Battery	Battery Controller	Yes	BATT_CONTROLLER_OK	Nil	Nil
Backup Battery	Battery Normal	No	Nil	Nil	[Loc ID]BATT_NORMAL
Level crossing (See Note A3)	Warning	Yes	Front contact of _NO_CHARGE	LnameCHARGE	[Level Crossing ID]WARN
Level crossing (See Note A3)	Alarm	Yes	Front contact of _LOW_BATTERY	LnameBATTERY	[Level Crossing ID]FAIL

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Level crossing (See Note A3)	Crossing normal	No	Front contact of XNR	Nil	[Level Crossing ID]XNR
Level crossing (See Note A3)	Crossing control	No	Front contact of XR	Nil	[Level Crossing ID]XR
Local control	Local	Yes	Front contact of LCR	Nil	Nil
Local control	Remote	Yes	Front contact of RCR	Nil	Nil
Local control	Closing	Yes	Front contact of _CLOSING	Nil	Nil
Local control	Override control off	Yes	Front contact of _OVERRIDE_OFF_CONT	Nil	Nil
Local control	Override control auto	Yes	Front contact of _OVERRIDE_AUTO_CONT	Nil	Nil
Local control	Override control forced	Yes	Front contact of _OVERRIDE_FORCED_CONT	Nil	Nil
Local control	Override enabled	Yes	Front contact of OVERRIDE_KR	Nil	Nil
Mastership	Ready	Yes	A_ON_STANDBYK	Nil	Nil
Mastership	Master on line	Yes	A_MASTER_ONLINEK	Nil	Nil
Non-stopping train function	Enabled	Yes	Front contact of non-stopping train function	L-NON-STOP-TRAIN	Nil
Points	Free WZ	Yes	Front contact of WZR	LnameWZ	_WZR

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Points	Normal NWK	Yes	Front contact of NWKR	Combination of: Pname.cn and Pname.dn	[Point ID]_NWKR
Points	Reverse RWK	Yes	Front contact of RWKR	Combination of: Pname.cr and Pname.dr	[Point ID]_RWKR
Points maintenance isolating switch	Points maintenance isolating control off	Yes	Front contact of MTCE_Isolation or [Point ID]_EOLR	Nil	[Point ID]EOL
Releasing switches	Normal detected NK	Yes	Front contact of NKR or NWKR or NR	LnameNKR	Releasing Switch ID]NKR
Releasing switches	Normal locked NL	Yes	Front contact of NLR	LnameNLR	Releasing Switch ID]NLR
Releasing switches	Release reverse RL	Yes	Front contact of RLR	LnameRLR	Releasing Switch ID]RLR
Routes	Normal lock NL	Yes	Front contact of NLR	Rname.set (to be inverted)	[Route ID]NLR
Routes	Available RUZ	Yes	RUZK	Combination of indications	[Route ID]RUZR
Ring circuit (See Note A5)	Machine in use MUR	Yes	Front contact of MuR	Nil	Nil
Ring circuit (See Note A5)	Machine finished FUP	Yes	Front contact of FnPR	Nil	Nil
Security system	Security alarm	No	Front contact of _SEC_ALARM	LnameSECALARM	Nil
Security system	Security fault	No	Front contact of _SEC_FAULT	LameSECFAULT	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Signal filament group	Filament failure FCK	Yes	Front contact of FCKR	Nil	[Signal ID]FCK
Signal lamp group	Lamp failure ECK	Yes	Front contact of ECR, with qualification	SnameT.lp	[Signal ID]_ECK or [Signal ID]_JPECP
Slip (land) detector	Slip detected	Yes	Front contact of SLIP NR	LnameSLIPNR	[Slip Detector ID]NR
Slip (land) detector	Emergency slip override switch	Yes	Front contact of SLIP ALARM R	LnameSLIPALARMR	[Slip Detector ID]ALARM
Tracks	Unoccupied _T	Yes	Front contact of TKR	Combination of: Tname.clear and Tname.bar	[Track ID]
Track timers	Expired _J	Yes	Front contract of TJKR	LTnameJ	[Track ID]JRP
Train stops	Normal VN	See Note A2	Front contact of VNR	LnameVNR	[Trainstop ID]VNR
Train stops	Reverse VR	See Note A2	Front contact of VRR	LnameVRR	[Trainstop ID]VRR
Ventilation lock	Enabled	See Note A4	Front contact of VCKR	Nil	Nil
Track sequencing alarm	Alarm	No	Nil	LALM(line-location)	[Track ID](TSA)ALMK
Treadle	Treadle Fault	Yes	Nil	Nil	Nil
XYZ Switches	See Note A 10	See Note A 10	See Note A 10	See Note A 10	See Note A 10
Miscellaneous (See Note A6)	SSI interlocking critical fault	Yes	Nil	Combination of: - nameStatus.newcrit nameStatus.ackcrit nameStatus.timeout nameStatus.disabled	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Miscellaneous (See Note A6)	SSI interlocking non-critical fault	Yes	Nil	Combination of: - nameStatus.newcrit nameStatus.acknCrit	Nil
Miscellaneous (See Note A6)	SSI interlocking disabled	Yes	Nil	nameStatus.disabled	Nil
Miscellaneous (See Note A6)	Communications OK	Yes	Front contact of Comms_System_OK or COMMS_OK	Nil	Nil
Miscellaneous (See Note A6)	Master on line	Yes	A_MASTER_ONLINE K	Nil	Nil
Miscellaneous (See Note A6)	Dual link health	No	THIS_SIDE_OK	Nil	Nil
Miscellaneous (See Note A6)	Dual link health	No	OTHER_SIDE_OK	Nil	Nil
Miscellaneous (See Note A6)	Dual link health	No	DUAL_LINK_OK	Nil	Nil
Miscellaneous (See Note A6)	LINK A FOMS M1OK_for each location	Yes	<Location>LINK_A_FOMS_M1OK (for each location or card file)	Nil	Nil
Miscellaneous (See Note A6)	LINK B FOMS M1OK_for each location	Yes	<Location>LINK_B_FOMS_M1OK (for each location or card file)	Nil	Nil
Miscellaneous (See Note A6)	LINK A FOMS M3OK_for each location	Yes	<Location>LINK_A_FOMS_M3OK (for each location or card file)	Nil	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Miscellaneous (See Note A6)	LINK B FOMS M3OK_for each location	Yes	<Location>LINK_B_FOMS_M3OK (for each location or card file)	Nil	Nil
Miscellaneous (See Note A6)	Cardfile OK (see Note A7)	Yes	<Location> OK (for each location or cardfile)	Nil	Nil
Miscellaneous (See Note A6)	This cardfile OK (for dual systems)	Yes	This <Location> OK (or A_OK) (for each location or cardfile)	Nil	Nil
Miscellaneous (See Note A6)	Other cardfile OK (for dual systems)	Yes	Other <Location> OK (or B_OK) (for each location or cardfile)	Nil	Nil
Miscellaneous (See Note A6)	On line	Yes	A_ONLINE	Nil	Nil
Miscellaneous (See Note A6)	ON standby	Yes	A_ONSTANDBY (or THIS_MLK_OK_OUT)	Nil	Nil
Miscellaneous (See Note A6)	Dual link OK MP1	Yes	MP1_DUAL_LINK OK	Nil	Nil
Miscellaneous (See Note A6)	Dual link OK MP2	Yes	MP2_DUAL_LINK OK	Nil	Nil
Miscellaneous (See Note A6)	MP1 link <X> OK	Yes	MP1_PORT1LINK OK	Nil	Nil
Miscellaneous (See Note A6)	MP2 link <X> OK	Yes	MP2_PORT1LINK OK	Nil	Nil
Miscellaneous (See Note A6)	Microlok warning	Yes	MLK_WARNING	Nil	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Miscellaneous (See Note A6)	Microlok diversity link in operation	Yes	_DIV_<LOCATION> < LINK>	Nil	Nil
RS400 or RS416	LOC_A1_RS400_OK	No	Nil	Nil	Nil
RS400 or RS416	LOC_A_DIAG_RS416_OK	No	Nil	Nil	Nil
Miscellaneous	RS900 switch OK	No	RS900_[Link]OK	Nil	[Loc ID]RS900_[Link]OK where [Link] is A or B
Miscellaneous	RX1500 router OK	No	Nil	Nil	[Loc ID]RX1500_[Link]OK
Miscellaneous	Interlocking OK	No	Nil	Nil	[Interlocking ID] IXL_WT_OK
Miscellaneous	Interlocking WARNING	No	Nil	Nil	[Interlocking ID] IXL_WT_WARN *Note: OFF indicates WARNING, ON indicates HEALTHY
Miscellaneous	Object Controller OK	No	OC_[N]_OK where [N] is subrack number	Nil	[Loc ID]_[Line ID]WOC_OK
Miscellaneous	Object Controller WARNING	No	Nil	Nil	[Loc ID]_[Line ID]WOC_WARN *Note: OFF indicates WARNING, ON indicates HEALTHY

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Miscellaneous	Westrace Module Healthy	No	Nil	Nil	[Loc ID] _[Westrace Type]_[Westrace Module ID]HLTHY(State) where [Westrace Type] is IXL or OC where [State] is M for master or S for standby
Miscellaneous	Westrace Primary Processor Module Active	No	Nil	Nil	[Interlocking ID]WT_PMPRI_ACTIVE or [Loc ID]_[Westrace Type]PMPRI_ACTIVE where [Westrace Type] is IXL or OC
Miscellaneous	Westrace Secondary Processor Module Active	No	Nil	Nil	[Interlocking ID]WT_PMSEC_ACTIVE or [Loc ID]_[Westrace Type]PMSEC_ACTIVE
Miscellaneous	Link to interlocking event logger, e.g. Moviola maintenance computer, OK.	No	Nil	Nil	[Loc ID]EVENT_LOGGER_LINK_OK
Miscellaneous	Vital Block	Yes	[Signal/Route/Points/Track ID]_BLK	Nil	Nil
Miscellaneous	WSP2G Normal Non-Vital Processor Online	Yes	ART_1_ONLINE	Nil	Nil

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Trackside object	Indication name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Miscellaneous	WSP2G Normal Non-Vital Processor Healthy	Yes	ART_1_HEALTHY	Nil	Nil
Miscellaneous	WSP2G Reserve Non-Vital Processor Online	Yes	ART_2_ONLINE	Nil	Nil
Miscellaneous	WSP2G Reserve Non-Vital Processor Healthy	Yes	ART_2_HEALTHY	Nil	Nil
Miscellaneous	WSP2G interlocking Normal side Healthy	Yes	NORMAL_OK	Nil	Nil
Miscellaneous	WSP2G interlocking Reserve side Healthy	Yes	RESERVE_OK	Nil	Nil
Miscellaneous	Link to Maintenance Panel OK	Yes	MP_LINK_OK	Nil	Nil
Miscellaneous	Dupline flasher (see Note A9)	No	[Loc ID]DUP_FR	Nil	Nil

Notes:

A1. Preferred that these functions are performed wholly within the TMS.

A2. These functions are only for intermediate train stops. Train stops at signals should be combined with the NGK and RGK functions.

A3. Comprehensive level crossing monitoring is performed by the Cerberus Systems.

A4. Only included in TMS if it impacts signals clearing.

A5. Only for exiting RBI entrance – exit interlockings with commence and finish functions performed within the relay interlocking.

A6. Where ethernet switches are used, equivalent indications for the device health are to be substituted.

A7. Different configurations may require variation to these status bits.

A8. Pulsed high for one second.

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A9. Continuously toggling, typically five seconds ‘on’, then five seconds ‘off’.

A10: Its indications are identical to the releasing switches.

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Appendix B Controls from the TMS

Minimum control requirements for TMS interfaces with Relay, Microlok, WSP2G, SSI, Westlock, Smartlock – SSI Variant and Westrace Mk II are listed in Table 2.

Table 2 – Controls from the TMS

Trackside object	Control name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Auto re-clear	Enable (See Note B1)	Yes	A(F)R or [Signal ID]_ARR	See note B1	[Signal ID]AUTO-IP or [Signal ID]AR
Auto re-clear	Disable (See Note B1)	Yes	Normal A(FM)R, or Inverted A(T)R, or [Signal ID]_ARXR	See note B1	[Signal ID]CAUTO-IP or [Signal ID]ARX
Automatic signals with emergency replacement	Set auto	Yes	EM_REP or EMRR	Nil	[Signal ID]RR IP
Automatic signals with emergency replacement	Replace	Yes	Inverted EM(T)REP or Normal EM(FM)REP	Nil	[Signal ID]NR-IP
Axle counter	No Track Prep Reset Request (See Note B3)	Yes	Track Prep Reset (N)	Nil	Nil
Axle counter	Track Prep Reset Request (See Note B4)	Yes	Track Prep Reset (R)	Nil	Nil
Axle counter	URE function request	Yes	URE (R)	Nil	Nil
Axle counter	No URE function request	Yes	URE (N)	Nil	Nil
Axle counter	SWP request	Yes	SWP (R)	Nil	Nil
Axle counter	No SWP request	Yes	SWP (N)	Nil	Nil

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Trackside object	Control name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
Axle counter	No Track Spare Reset Request (See Note B4)	No	Track Spare Reset (N)	Nil	Nil
Axle counter	Track Spare Reset Request (See Note B4)	No	Track Spare Reset (R)	Nil	Nil
Direction override	Set	Yes	SECTION PB	Nil	Nil
Dual controls	Accept	Yes	ACPT_RSR	Nil	Nil
Dual controls	Cancel	Yes	ACPT_UNR	Nil	Nil
Emergency shunt function	ESF request (See Note B1)	Yes	ESF	See Note B1	Nil
Entrance exit routes	Commence	Yes	(F)R	Nil	Nil
Entrance exit routes	Finish	Yes	(F)R	Nil	Nil
Entrance exit routes	Cancel	Yes	(FM)R	Nil	Nil
High load detectors	Test	Yes	_TEST	Nil	Nil
High load detectors	Cancel	Yes	_CANCEL	Nil	Nil
Miscellaneous	Go master	Yes	CTR_SYS_MASTER See Note B1	Nil	Nil
Non-stopping train function	Enable	Yes	NON_STOP_TRAIN_(R)R	Nil	Nil
Non-stopping train function	Disable	Yes	NON_STOP_TRAIN_(N)R	Nil	Nil

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Trackside object	Control name	Minimum requirement for the TMS	Relay, Microlok and WSP2G	SSI, Westlock and Smartlock – SSI Variant	Westrace Mk II
One control routes	Request	Yes	RSR pulsed or [Route ID]_URR	QRname See Note B2	[Signal ID](M)(Route)U1PR-IP1, or [Signal ID](S)(Route)U1PR-IP1, or [Route ID]_UR
One control routes	Cancel	Yes	UNR pulsed	QXSname	[Signal ID]BPULL-IP or [Route ID]_UN
Points	Centre	Yes	(C)R steady or [Point ID]_CZ	QPnameKC	[Point ID]C1PR-IP or [Point ID]_C
Points	Normal	Yes	(N)R steady or [Point ID]_NR	QPnameQN	[Point ID]N1PR-IP or [Point ID]_N
Points	Reverse	Yes	(R)R steady or [Point ID]_RR	QPnameQR	[Point ID]R1PR-IP or [Point ID]_R
Releasing switches	Lock	Yes	(N)R steady	Nil	[GF-ID]GFCAN-IP or [Releasing Switch ID]_N
Releasing switches	Release	Yes	(R)R steady	Nil	[GF-ID]GFREL-IP or [Releasing Switch ID]_R
Track sequencing alarm	Reset	Yes	Nil	QSEQRESET	Nil
XYZ switches	See note B 5	See note B 5	See note B 5	See note B 5	See note B 5
Miscellaneous	Mastership Change Over Request	No	Nil	Nil	[Interlocking ID]WT_PM_COREQ

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Notes:

B1. Preferred that these functions are performed wholly within the TMS.

B2. <name> indicates the location name.

B3. Pulsed low for 1 s.

B4. Pulsed high for 1 s.

B5: Its controls are identical to releasing switches.

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Appendix C Axle counter interface

The axle counter interface provides guidance to use indications and controls in order to provide integrity between interlocking and TMS. The complete axle counter interface requirements between TMS and interlocking are provided in SP S19048.

C.1 Preparatory reset function

The preparatory reset resets the count of an occupied track section to zero, however the track section remains occupied until the passage of a sweep train (running in accordance with the network rules and network procedures) which proves the track section clear. The track section will be restored to an unoccupied state after the sweep train has successfully traversed the track section with the SWP enabled and then returned to normal as detailed in Appendix C.1.1.

The indications and controls listed in Table 3 are provided per track section to manage the axle counter indications and controls for the preparatory reset operation as detailed in Appendix A and Appendix B respectively. TMS can further combine or manipulate these indications for display, log, alarm or other functions. The preparatory reset controls should be ‘single shot’ – that is, controls are not automatically resent if no interlocking response is observed.

Table 3 – List of indications and controls for preparatory reset operation

Name	Type	Characteristic	Description
Track Prep Reset Avail KR	Indication	Continuous	High when a preparatory reset is possible
Track WCT KR	Indication	Continuous	High when track waiting for a sweep train
Track RAC KR	Indication	Pulsed high for 1 s	High when a preparatory reset has been accepted by the axle counter
Track CHK KR	Indication	Continuous	Input high when axle counter cleared (only to be used with sweep indications.)
Track Prep Reset (N)	Control	Pulsed low for 1 s	See Table 4
Track Prep Reset (R)	Control	Pulsed high for 1 s	See Table 4

Before the interlocking accepts any TMS preparatory reset controls it checks to ensure they are valid as shown in Table 4.

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Table 4 – TMS preparatory reset controls

Track prep reset (R)	Track prep reset (N)	Interlocking response
Low	Low	Undefined – no preparatory reset requested Reset availability removed after 1.5 s
Continuous low	Continuous high	No preparatory reset request – normal state
One second pulsed high	1 s pulsed low	Reset is rejected if: Either pulse duration is less than 0.5 s Either pulse duration is greater than 1.5 s Start or end of 'prep reset (N)' and 'prep reset (R)' are out of sync by more than 0.5 s
High	High	Undefined – no preparatory reset requested Reset availability removed after 1.5 s

C.1.1 Sweep function

The SWP is used to maintain track section locking within the interlocking while a preparatory reset is underway, until the signaller can confirm the sweep train has successfully traversed and exited the track section.

The indications and controls listed in Table 5 are provided per track section to manage the SWP as detailed in Appendix A and Appendix B respectively. TMS can further combine or manipulate this indication with other indications for display, log, alarm or other functions.

Table 5 – List of indications and controls for SWP

Name	Type	Characteristic	Description
SWP RLKR	Indication	Continuous	See Table 7
SWP NLKR	Indication	Continuous	See Table 7
SWP ZR KR	Indication	Continuous	High when the SWP is free to change state
SWP (R)	Control	Continuous	See Table 6
SWP (N)	Control	Continuous	See Table 6

Before the interlocking accepts any TMS SWP controls it checks to ensure the TMS SWP controls are valid as shown in Table 6.

Table 6 – TMS SWP controls

SWP (R)	SWP (N)	Interlocking response
Low	Low	Undefined, no change to interlocking sweep status SWP unavailable after 0.5 s
Low	High	Remove SWP

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SWP (R)	SWP (N)	Interlocking response
High	Low	Apply SWP
High	High	Undefined, no change to interlocking sweep status SWP unavailable after 0.5 s

TMS can check the status of the SWP status for each track section as detailed in Table 7.

Table 7 – TMS SWP indications

SWP RLKR	SWP NLKR	Interlocking indication
Low	Low	Undefined
Low	High	SWP normal
High	Low	SWP applied
High	High	Undefined

C.2 Unconditional reset enable function

A URE will immediately reset the count of a track section to zero and restore it to an unoccupied state. A URE is performed by qualified signalling workers from the interlocking technicians terminal and is only available when the signaller has a URE on that track using the URE function.

The indications and controls listed in Table 8 are provided per track section, to manage the URE indications and controls detailed in Appendix A and Appendix B respectively. TMS can further combine or manipulate these indications for display, log, alarm or other functions.

Table 8 – List of indications and controls for URE function

Name	Type	Characteristic	Description
URE RLKR	Indication	Continuous	See Table 10
URE NLKR	Indication	Continuous	See Table 10
URE ZR KR	Indication	Continuous	High when URE function is free to change state
URE (R)	Control	Continuous	See Table 9
URE (N)	Control	Continuous	See Table 9

Before the interlocking accepts a TMS URE control it checks to ensure the TMS URE control is valid as shown in Table 9.

Note: TMS does not initiate the URE operation, it only enables the technician's terminals controls for the URE operation.

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Table 9 – TMS URE controls

URE (R)	URE (N)	Interlocking response
Low	Low	Undefined Reset availability state locked after 0.5 s
Low	High	Remove URE
High	Low	Apply URE
High	High	Undefined Reset availability state locked after 0.5 s

TMS can check the status of the URE status for each track section as detailed in Table 10.

Table 10 – Interlocking URE indications

URE RLKR	URE NLKR	TMS indication
Low	Low	Undefined
Low	High	URE disabled
High	Low	URE enabled
High	High	Undefined

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