Signalling and Safety-Related Telecommunications Power Supplies and Circuits

Synopsis
This document mandates requirements for power supplies and safety protection for signalling and safety-related telecommunications equipment and their enclosures.

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Content approved by

Multifunctional Subject Committee held on 12 May 2004 comprising representatives from the following subject committees:

Train Control and Communications Subject Committee
Plant Subject Committee
Electrification Subject Committee

Authorised by

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Acting Department Head
Railway Group Standards Management
## Signalling and Safety-Related Telecommunications Power Supplies and Circuits

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Part A

A1 Issue record

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<tr>
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This document will be updated when necessary by distribution of a complete replacement.

A2 Implementation of this document

The publication date of this document is 7 August 2004.
This document comes into force on 5 February 2005.
The dates by which compliance with the requirements of this document is to be achieved are set out in Part B2. Where those dates are later than the date on which this document comes into force, this is to give Railway Group members additional time to plan and commence implementation so as to achieve full compliance by the dates set out in Part B2.

This document does not supersede any other Railway Group Standards.

A3 Scope of Railway Group Standards

The overall scope of Railway Group Standards is set out in the Railway Group Standards Code. The specific scope of this document is set out in Part B2.

A4 Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group* and apply to all relevant activities that fall into the scope of each Railway Safety Case. If any of those activities are performed by a contractor, the contractor’s obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

* The Railway Group comprises Network Rail Infrastructure Limited, Rail Safety and Standards Board Limited, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Network Rail Infrastructure Limited.

Network Rail Infrastructure Limited is also known as Network Rail.
Rail Safety and Standards Board Limited is also known as RSSB.

A5 Health and safety responsibilities

Each Railway Group member is reminded of the need to consider its own responsibilities to ensure health and safety at work and its own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

A6 Supply

Controlled and uncontrolled copies of this document may be obtained from the Corporate Communications Dept, Rail Safety and Standards Board, Evergreen House, 160 Euston Road, London NW1 2DX, telephone 020 7904 7518 or e-mail enquiries@rssb.co.uk. Railway Group Standards can also be viewed at www.rssb.co.uk.
Part B

B1 Purpose

This document mandates requirements for power supplies and safety protection for signalling and safety-related telecommunications equipment and their enclosures.

Measures are mandated that minimise the secondary risk that arises from failures of power supplies to signalling and safety-related telecommunications systems. This document also requires the parameters of power supply systems to be defined and distribution systems to be provided to achieve levels of reliability, availability and maintainability consistent with the nature of the project.

B2 Application of this document

B2.1 To whom the requirements apply

This document contains requirements that are applicable to duty holders of the infrastructure controller category of Railway Safety Case.

B2.2 Compliance requirements

B2.2.1 Infrastructure

This document comes into force and shall be complied with from 5 February 2005.

It is permissible for the infrastructure controller to designate specific infrastructure projects, ongoing when this document comes into force, for which compliance with the requirements of this document applicable to the design, construction and commissioning of new or altered infrastructure is not mandatory. When designating such projects, the infrastructure controller shall consider:

a) its responsibilities under its Railway Safety Case

b) the stage reached by the project at the time this document comes into force (for example, approval in principle)

c) whether compliance is necessary to ensure compatibility with other parts of the infrastructure

d) whether compliance is necessary to facilitate safe interworking having regard to changes to related requirements mandated on another Railway Group member

e) the economic impact of compliance, but subject to its Railway Safety Case obligations.

Compliance with the requirements of this document relating to inspection, maintenance and in-service condition of infrastructure is mandatory, whether or not the infrastructure concerned is the subject of a designation, as set out above.

This document mandates compliance on complete new signalling projects where all of the signalling and safety-related telecommunications systems and equipment are being renewed. See clause B2.5 for information regarding situations where modifications are being made to existing systems, or where partial renewal of equipment is to take place.

No action is required for existing installations.

B2.2.2 General compliance requirements

After the compliance date, or after the date by which compliance is achieved, if earlier, Railway Group members shall maintain compliance with the requirements set out in this document.
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Where it is considered not reasonably practicable to comply with the requirements mandated in this document, authorisation not to comply shall be sought in accordance with the Railway Group Standards Code.

B2.3 Application of industry standards and legislation
Railway signalling and safety-related telecommunications equipment is excluded from the scope of the requirements set out in BS 7671 – Requirements for Electrical Installations (IEE Wiring Regulations). Therefore, functional signalling and safety-related telecommunications equipment and associated circuits shall conform to the provisions of this standard.

However, the requirements set out in BS 7671 shall be followed for new installations, where practicable to do so, in respect of a signalling power supply distribution system.

Conflicts can occur between the requirements of system safety and personnel safety. In such situations, Railway Group members are reminded of their responsibilities under the Electricity at Work Regulations 1989, particularly in respect of Regulation 29 (which indicates that a valid defence against prosecution for certain infringements may exist if the duty holder can show that all reasonable steps have been taken and all due diligence exercised to avoid the commission of an offence).

B2.4 Scope with regard to power supply
The scope of this document includes the intake of power supplies from public and private sources and their distribution to signalling and safety-related telecommunications equipment.

In some cases, one or more parameters of what might otherwise be regarded as power supply distribution equipment have the potential to directly affect the integrity or performance of functional circuits, for example, in terms of polarity or phase of supply. In such cases, the relevant equipment associated with the power supply shall be deemed as part of the signalling or safety-related telecommunications functional equipment, rather than part of the power supply distribution system. Examples of possible demarcation between power supply distribution systems and functional circuits are shown in Figures 1 to 4 of Railway Group Guidance Note GI/GN7517 which supports this document.

B2.5 Exclusions from the application of this document
Where existing signalling and safety-related telecommunications power supply arrangements are to be modified, the requirements of this document shall apply only to those systems or sub-systems that are introduced or modified and only to the extent that the interface(s) between the existing and new are compatible with each other. For example, the requirement for the provision of earth fault detection equipment in respect of earth-free circuits fed from outlying housings is waived for modifications to existing signalling installations. Requirements and guidance for the safety of signalling and operational telecommunications systems, including modifications thereto, are set out in GK/RT0206 and GK/GN0806 respectively.

Requirements and guidance for low voltage electrical installations other than for signalling and safety-related telecommunications systems are set out in GI/RT7007 and GI/GN7607 respectively.

B2.6 Supporting documents
This document is supported by Railway Group Guidance Note GI/GN7517 – Guidance on Signalling and Safety-Related Telecommunications Power Supplies and Circuits.
B3 Definitions

Designed load
The maximum load on a distribution main when all functional circuits that can operate simultaneously are in use.

Distribution main
A current-carrying circuit, containing no functional logic, from a source of supply to one or more equipment housings forming part of the power supply distribution system.

Earth
The conductive mass of the earth, whose electric potential at any point is conventionally taken as zero. The impedance to earth from equipment at a particular site may vary due to local ground conditions.

Earth electrode
A conductor, or group of conductors, in intimate contact with, and providing an electrical connection to, earth.

Enclosure
For the purposes of this document the immediate surround of electrical equipment provided for protection against direct contact with live conductors.

Equipotential bond
An electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential. This is sometimes abbreviated to ‘bond’ or ‘bonding’.

Exposed conductive part
A conductive part of equipment which can be touched and which is not a live part but which has the potential to become live under fault conditions.

External circuit
A functional signalling circuit that extends, for example in cable, along the lineside between housings or other signalling or operational telecommunications equipment. Circuits entirely between housings that are located adjacent to each other are included in the definition of ‘internal circuit’.

Fault
A circuit condition in which current flows through an abnormal or unintended path, which may result from an insulation failure or bridging of insulation.

Functional signalling circuit
A circuit containing functional logic that operates signalling equipment or repeats its state to the controlling signalling centre.

Functional supply point
Functional supply point, for the purposes of this document, is the point that the power supply distribution system connects with an item of supplied equipment.

Housing
A building, permanent or relocatable, apparatus case or other structure containing electrical equipment.

Internal circuit
A functional signalling circuit that is contained entirely within a single housing or between housings that are adjacent to each other.

Power supply distribution system
A system consisting of one or more distribution mains conveying power from a connection or connections with public supplies or private supplies to the functional supply point at the supplied equipment.
Private supplies
A power supply derived from a private source such as a generator or railway-owned high voltage distribution system, not subject to the requirements of the Electricity Safety, Quality and Continuity Regulations 2002.

Public supplies
A power supply provided from a network, subject to the regulation imposed by the Electricity Safety, Quality and Continuity Regulations 2002.

Ring main
For the purposes of this document a distribution main connecting a supply to a number of equipment housings by two paths in the form of a ring. The current-carrying conductors are each rated to carry the total load of the whole ring.

Safety management and information system
The safety management and information system (SMIS), also known as the improved safety management and information system (ISMIS), is a national IT system used by all Railway Group members with legislation mandating its use. It is a database of all safety incidents and accidents occurring on Network Rail controlled infrastructure or within the Network Rail Safety Case.

Safety-related telecommunications
Telecommunications equipment or systems in operational use that have the potential to materially reduce the likelihood of risk to the safety of trains or personnel.

Service failure (power supply)
Service failure, for the purposes of this document, is a loss of power supply that results in a signalling failure.

Signalling equipment
Apparatus installed for the control and protection of trains and trackside personnel, including, but not limited to, point operation and proving, signals, train detection equipment, interlockings and signal box equipment.

Signalling failure
An interruption to the normal working of signalling equipment or systems resulting in a loss of, or incorrect, functionality sufficient to warrant an entry in SMIS.

Supplied equipment
For the purposes of this document, supplied equipment includes any piece of signalling equipment or safety-related telecommunications equipment, including power supply equipment where this contains safety-critical functions. (Such functions include polarity or phase of the power supply where this is safety critical.)

Other defined terms are set out in GK/GN0802.

B4 Principles

B4.1 Railway Safety Principles and Guidance
This document supports the following safety principles described in Her Majesty’s Railway Inspectorate Railway Safety Principles and Guidance:

Principle 20: ‘The signalling system should provide for the safe routeing, spacing and control of trains.’

Principle 21: ‘The signalling system should continue to provide for the safe passage of trains permitted to run under degraded conditions.’

B4.2 Statutory instruments
This document supports the following statutory instruments:

a) The Electricity at Work Regulations 1989
B5 Performance requirements

B5.1 Quality
For each functional supply point, the infrastructure controller shall define and document the requirements for the power supply at the designed load. The requirements defined shall ensure the correct and safe operation of that equipment and shall include tolerances on each parameter. Parameters to be defined shall take into account the operational and safety needs of the system and shall include but not be limited to:

a) supply voltage
b) frequency
c) current rating
d) harmonic content
e) the magnitude and duration of any spikes, noise or other perturbations on the power supply
f) power factor
g) inrush current.

The infrastructure controller shall ensure that the power supply distribution system is designed in accordance with the above requirements.

B5.2 Availability
The infrastructure controller shall define and document the required level of availability for the power supply to signalling and safety-related telecommunications at the functional supply point, consistent with the characteristics of the railway and its traffic.

Equipment and systems shall be configured to minimise the effect of interruption of power to the supplied equipment.

The infrastructure controller shall ensure that the power supply distribution system is designed in accordance with the above requirements.

B5.3 Maintainability
Equipment and systems shall be designed to enable maintenance and testing to be undertaken and configured without interruption of power to the supplied equipment unless it is demonstrated that it is not practicable to do so.

The infrastructure controller shall ensure that the allocation of responsibility for maintaining parts of the system does not result in the failure to adequately maintain the complete system.

B5.4 Electrical testing
B5.4.1 Power supply distribution system
Facilities to aid fault-finding and testing of components of the power supply distribution system shall be included in the design. It is permissible for some or all of such testing to be undertaken from a remote location.

The inspection and testing regime set out in BS 7671, or an equivalent standard, shall be applied to the power supply distribution system.
B5.4.2 Extent of testing
When developing the plan for testing of the power supply distribution system, the infrastructure controller shall take account of the effect on train running requirements.

The testing requirements and their periodicity shall be determined, taking account of the following factors:

a) the occupational safety of staff working thereon
b) the operational safety of train movements
c) the diversity of protection systems and equipment.

The extent and periodicity of testing and any supporting assessment results shall be documented. The infrastructure controller shall ensure that this plan is adhered to whenever testing takes place.

B5.5 Environment
The infrastructure controller shall specify the particular environmental requirements set out in BS EN 50125 with which each power supply distribution system shall comply.

B5.6 Security of equipment
The infrastructure controller shall establish the location, construction and security of signalling and safety-related telecommunications power supply equipment, including all associated cabling, to minimise the likelihood of criminal damage or unintentional disturbance to the extent commensurate with the application.

B6 Records
The infrastructure controller shall create and retain design records for new installations and modifications to existing installations that shall include but not be limited to:

a) wiring diagrams
b) cable and equipment ratings
c) protection device ratings and discrimination
d) distribution
e) layout plan
f) supply characteristics of private and public power supplies
g) maintenance and test records.

B7 Protection of signalling and safety-related telecommunications circuits

B7.1 Safety-critical functional signalling circuits
Safety-critical functional signalling circuits shall be resistant to high-risk failures, due to false operation as a result of:

a) power supply interruption and restoration
b) single or double earth faults.
A reduced level of protection from earth faults is permissible where an assessment of possible failure modes of all such interconnected circuits indicates that this does not result in an increased risk to train operations.
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B7.2 Telecommunications circuits
Where telecommunications circuits share a supply with functional signalling circuits that are required to be earth free, the earth reference shall be electrically isolated from the signalling supply.

B7.3 Earth fault detection
Earth fault detection or insulation monitoring systems shall be provided for safety-critical functional circuits, together with arrangements for monitoring on a regular basis, on a scale commensurate with the level of risk involved. (See clause B2.5 for an exclusion for modifications to existing installations.)

B7.4 Surge arrestors
The infrastructure controller shall determine a policy for the application of surge arrestors, taking account of:

a) the environment in which they are used
b) their effect on train operations
c) the effects of equipment failure due to surges (if surge arrestors were not provided).

B8 Power supply restoration
The infrastructure controller shall specify and document measures for the restoration of power supplies following a failure.

B9 Personnel safety

B9.1 Safe system of work
The infrastructure controller shall develop, maintain and document safe systems of work for personnel working on power supply systems and equipment.

The installation shall comply with the accessible and touch voltage limits set out in BS EN 50122.

B9.2 Maximum length of functional circuits
The maximum length of functional circuits shall be as specified by the infrastructure controller, in order to maintain occupational safety. In ac and dual ac/dc electrified areas and elsewhere, for example where the railway is paralleled by high voltage overhead transmission lines, the risk arising from shock due to induced longitudinal voltage in functional circuits shall be taken into account in the determination of functional circuit length.

B9.3 Staff competency
The infrastructure controller shall ensure that personnel who are required to work on signalling power systems or equipment possess the competencies required by GK/RT0101 and GO/RT3260 or a defined and documented equivalent level of competence.

B10 Identification

B10.1 Power supply equipment
In addition to the requirements of the Electrical Equipment (Safety) Regulations 1994, the name and/or function of all items of power supply equipment, including switchgear, shall be clearly and permanently identifiable.

All power sources shall be labelled as such and referenced in information provided for fire brigade personnel.
B10.2 Cable terminations
All power supply cable terminations shall be clearly and permanently identified. Polarity shall be identified at any point where cables can be disconnected for maintenance, fault finding or renewal purposes.

B10.3 Cables
All power supply cables shall be clearly and permanently identified.

B10.4 Busbars
All busbars and each circuit outlet on the busbar shall be clearly and permanently identified.

Where a distribution main conveys power to a number of equipment housings, the direction from which power can be fed shall be clearly indicated at each equipment housing. Busbars associated with reconfigurable feeders and ring mains shall be labelled with a warning that power can be fed in either direction.
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Telecommunications Power Supplies and
Circuits

References
The Railway Group Standards Code
Railway Group Standards and other Railway Group Documents
GE/RT8015 Electromagnetic Compatibility between Railway Infrastructure and Trains
GI/GN7517 Guidance on Signalling and Safety-Related Telecommunications Power Supplies and Circuits
GI/GN7607 Guidance for Low Voltage Electrical Installations
GI/RT7007 Low Voltage Electrical Installations
GK/GN0802 Glossary of Signalling Terms
GK/GN0806 Guidance Note: Signalling and Operational Telecommunications Systems: Safety Requirements
GK/RT0101 Competence Standards for Signalling and Telecommunications Staff
GK/RT0206 Signalling and Operational Telecommunications Systems: Safety Requirements
GO/RT3260 Competence Management for Safety-Critical Staff

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rssb.co.uk.

Other References
BS 7671 Requirements for Electrical Installations (IEE Wiring Regulations)
BS EN 50122 Railway applications – Fixed installations – Electrical supply and earthing systems for public transport
BS EN 50125 Railway applications – Environmental conditions for equipment
Part 2: Fixed electrical installations
Part 3: Equipment for signalling and telecommunications
HSG153 Railway Safety Principles and Guidance
S.I. 1994/3260 The Electrical Equipment (Safety) Regulations 1994
S.I. 1989/635 The Electricity at Work Regulations 1989
S.I. 2002/2665 The Electricity Safety, Quality and Continuity Regulations 2002