

Ref:	NR/L2/TEL/30003
Issue:	3
Date:	6 June 2009
Compliance date:	1 September 2009

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Level 2

Immunity Test Requirements for Lineside Communications Systems

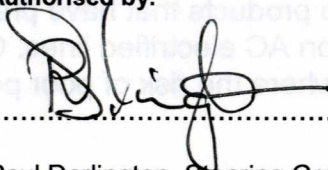
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Published and Issued by Network Rail, Kings Place, 90 York Way, London, NW19AG.

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Issue record

Issue	Date	Comments
1	June 1999	New specification based on old BR 1686
2	April 2006	Document renumbered as part of standards framework process. Railtrack changed to Network Rail.
3	6 June 2009	Test requirements completely revised to suit modern traction systems and telecommunications terminal equipment. Tests for surge protection systems added. Guidance on minimising the risk associated with the use of COTS equipment.

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors from 1 September 2009.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

This standard is not retrospective. It is not mandated that the requirements of this standard are applied to products that have previously been product approved and used without problem on AC electrified lines. Consideration should be given to its application, however, where the risk of poor performance is significant.

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Reference documentation

EN 50121-4	Railway applications - Electromagnetic compatibility. Part 4: Emission and immunity of the signalling and telecommunications apparatus
EN 50121-5	Railway applications - Electromagnetic compatibility. Part 5: Emission and immunity of fixed power supply installations and apparatus
EN 50122-1	Railway applications — Fixed installations — Part 1: Protective provisions relating to electrical safety and earthing
EN 55022	ITE- Radio disturbance characteristics - Limits and methods of measurement
EN 55024	Information technology equipment - Immunity characteristics - Limits and methods of measurement
EN 61000-4-16	Electromagnetic compatibility (EMC). Part 4-16: Testing and measurement techniques — Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz
EN 61000-4-3	Electromagnetic compatibility (EMC). Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrical fast transient/burst immunity test. Basic EMC publication
EN 61000-4-5	Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC). Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-6-1	Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments
EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-3	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
ITU-T Rec. G.117	Transmission aspects of unbalance about earth (definitions and methods)

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ITU-T Rec. K.44	Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic recommendation
ITU-T Rec. K.45	Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents
ITU-T Rec. O.9	Measuring arrangements to assess the degree of unbalance about earth
NR/L1/SIG/30040	EMC strategy for Network Rail
NR/L2/SIG/30041	EMC assurance process for Network Rail
NR/GN/TEL/31106	Overview of coupling between traction systems and signalling & telecommunications cables
NR/L2/SIG/50014	Methodology for the demonstration of compatibility with lineside equipment
NR/L2/SIG/50011	Methodology for the demonstration of compatibility with axle counters
NR/PS/TEL/00015	Unit twin copper telecommunications cable.
NR/SP/TEL/31107	Test method and limits of induced voltages on S&T cables due to electrification systems
NR/SP/TEL/50016	Methodology for the demonstration of compatibility with telecommunications systems
SI 2006 No. 3418	The Electromagnetic Compatibility Regulations 2006

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1 Purpose

This document provides a method for type testing telecommunications equipment and systems to demonstrate the ability of the equipment to survive the levels of interference on lineside copper cables on AC and DC electrified lines on Network Rail controlled infrastructure.

2 Scope

This document applies to equipment which is intended to be connected to lineside copper cables whose parallelism with AC traction systems may exceed 1 km.

It specifies the tests to be applied as part of the product acceptance process to determine the performance of the system when subjected to the normal and fault voltages which may occur on lineside cables. The tests are required in addition to other EMC tests typically carried out by the manufacturer (e.g. EN 50121-4 or EN 61000-6-2).

The tests include:

- Conducted immunity test from 15 Hz to 150 kHz
- Power frequency tests at 50 Hz
- Surge immunity test
- Longitudinal conversion loss test

For certain applications where commercial-off-the-shelf (COTS) equipment is adopted, which has not been subjected to the more onerous immunity requirements of EN 50121-4, applying this standard may be used to provide confidence that the equipment will continue to operate in the railway environment.

Other generic types of lineside system not covered by this document are included within the scope of NR/L2/SIG/50014 and other specific documents (see, for example, NR/L2/SIG/50011 for axle counters, which includes interference effects within the transmission line).

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3 Definitions

AC

Alternating Current

ADSL

Asymmetric Digital Subscriber Line

AE

Auxiliary Equipment

BER

Bit Error Rate

CDN

Coupling/Decoupling Network

CM

Common Mode

DC

Direct Current

DM

Differential Mode (i.e. Transverse Mode)

EMC

Electromagnetic Compatibility

EUT

Equipment Under Test

ITU

International Telecommunications Union

LCL

Line Conversion Loss

Port A

Port of the EUT which is intended to be connected to long lineside cables

Port B

Communications port of the EUT which is used for monitoring the performance of the EUT during the tests specified in this standard

Port C

The output port of any auxiliary equipment used for monitoring performance

POTS

Plain Old Telephony System

SPT

Signal Post Telephone

VDF

Voltage dips and fluctuations

VL

Longitudinal Voltage

VT

Transverse Voltage

xDSL

Any of the versions of Digital Subscriber Line

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4 Responsibility

These tests should normally be carried out by the manufacturer, or supplier, but may be carried out by third parties, or by Network Rail Telecommunications Engineering.

5 Introduction

Section 6 defines the assessment that should be made if the EUT fails to meet the requirements of this standard.

Section 7 defines the applicable tests and monitoring methods for different types of telecommunications terminal systems.

Section 8 defines the test methods used to determine the performance of the equipment under test.

Section 9 defines the generic performance criteria referred to in each test.

Appendix A defines the parameters for a line simulator to emulate copper cable.

Appendix B defines the performance criteria for the equipment under test.

Appendix C defines the method for calibrating the coupling decoupling network.

Appendix D defines the maximum expected voltage on lineside copper

Appendix E outlines a methodology for the acceptance of COTS equipment

Surge protection systems may deteriorate when subjected to the induced voltages on lineside cables during electrical faults. If this occurs, the balance of the protection system may be reduced, resulting in increased transverse voltage at the terminal equipment.

This standard should be used in the product acceptance of surge protection systems so that they may be used with terminal equipment with the assurance that their performance and balance will not deteriorate under lineside conditions. Where surge protection systems which are compliant with this standard are used, there is no requirement to carry out surge tests on the equipment. In this case the use of surge protection systems compliant with this standard shall be specified in the conditions on the product acceptance certificate. If compliant surge protection systems are not intended to be used, then the surge tests should be carried out.

6 Failure during the tests

The tests specified in this standard, in addition to the tests specified in commercial EMC standards, should, in most cases, provide adequate confidence that the system will operate satisfactorily in the railway environment with suitable protection measures are adopted (see Appendix D).

If the relevant performance criterion is not achieved for a specific test, it is recommended that the affected part of the test is repeated at a lower amplitude of interfering signal to determine the threshold of susceptibility.

The product acceptance specialist should review the test results and determine whether the equipment has demonstrated an adequate level of immunity taking into account: safety criticality, performance risk, length of cables, location, etc. Any

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limitations of use that are deemed necessary to control the risk of interference or damage shall be included on the product acceptance certificate.

7 Applicable Tests and Monitoring Methods

Table 1 provides a summary of the tests that should normally be applied for different types of systems which connect to lineside copper cables. It is not possible to provide an exhaustive list of product types and system functionality, so the test engineer should determine a suitable suite of tests which adequately demonstrates the ability of the system to operate as intended in the working environment. Consideration should be given to testing the system in its various modes (e.g. on hook and off-hook).

	Conducted Immunity Normal Conditions	Conducted Immunity Fault Conditions	Surge [†]	LCL
Paragraph	8.1 & 0	8.3	8.4	8.5
Analogue voice		✓	✓	✓
Analogue data	✓	✓	✓	
Digital audio	✓	✓	✓	
Digital video	✓	✓	✓	
Digital data	✓	✓	✓	
Surge protection systems		✓	✓	✓

[†] Applied if compliant external protection is not provided

Table 1 – Applicable tests

7.1 Analogue Voice Systems

The following tests shall be applied to analogue voice systems.

If external surge protection compliant with this standard is specified, the LCL test of 8.5 shall be applied. The transverse voltage shall be measured across the terminals of the system under test.

If external surge protection compliant with this standard is not specified, the following tests shall be applied:

- The LCL test of 8.5.
- The surge test of 8.4
- The conducted immunity test for fault conditions of 8.3. This may be applied without any auxiliary equipment, line simulator, or performance monitoring during the test.
- The LCL test shall be repeated.

Note: For analogue voice systems, e.g. plain old telephone systems (POTS), such as signal post telephones (SPTs), the failure mechanism under interference is predominantly a loss of clarity in the received signal. This can range from being annoying to causing a risk of the recipient making an error

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because the message was misheard. This problem is mitigated through formal information transfer protocols, including use of the phonetic alphabet.

7.2 Audio systems excluding analogue telephones

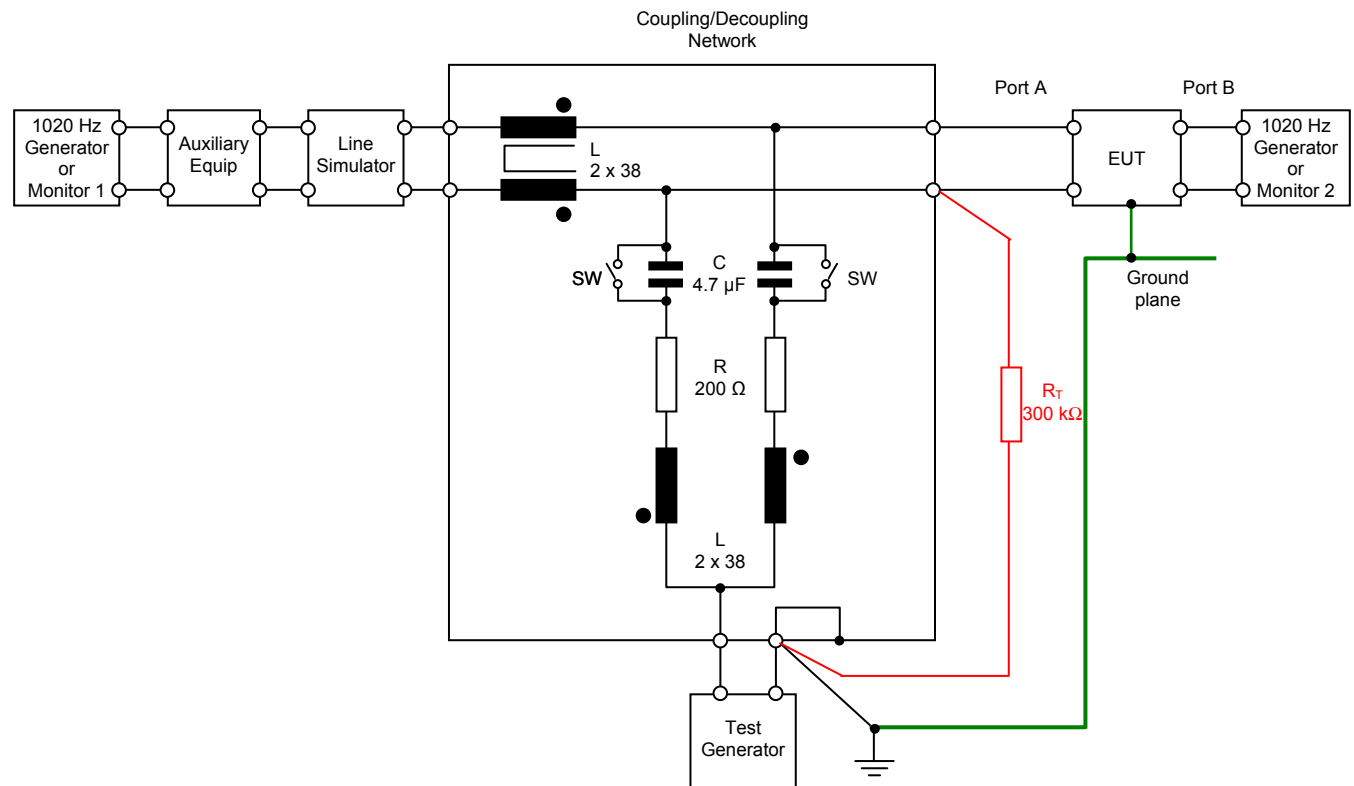


Figure 1 - Test Set-Up for Audio Systems

The equipment shall be set up as shown in Figure 1.

The line simulator may be omitted for this test, provided the signal levels at the EUT which are representative of lineside conditions are applied. Similarly, the auxiliary equipment may be omitted if the required audio signal can be generated and/or measured effectively from a tone generator/monitor.

Where the performance criteria specified in the following tests are not met, the level of the interferer shall be reduced and the test repeated over the frequency range concerned to determine the threshold of immunity.

The test sequence in Table 2 shall be applied, in no particular order. The tests shall be applied when transmission is enabled. Suitable test equipment shall be used to establish transmission.

It may be advisable to carry out the 1000 V tests at the end in case of failure.

At the end of the test sequence, the surge test of 7.2.5 shall be applied.