

INTERNATIONAL STANDARD

NORME INTERNATIONALE



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

Electromagnetic compatibility of multimedia equipment – Immunity requirements

Compatibilité électromagnétique des équipements multimédia – Exigences d'immunité



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE
COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

**Electromagnetic compatibility of multimedia equipment – Immunity
requirements**

**Compatibilité électromagnétique des équipements multimédia – Exigences
d'immunité**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.100.20

ISBN 978-2-8322-3591-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references.....	9
3 Terms, definitions and abbreviations	10
3.1 Terms and definitions	10
3.2 Abbreviations	15
4 Requirements	18
4.1 General requirements.....	18
4.2 Particular requirements	19
4.2.1 Electrostatic discharges (ESD)	19
4.2.2 Continuous RF disturbances.....	19
4.2.3 Power frequency magnetic field.....	21
4.2.4 Electrical fast transients/burst (EFT/B).....	21
4.2.5 Surges.....	21
4.2.6 Voltage dips and interruptions	21
4.2.7 Broadband impulsive conducted disturbances	21
5 Immunity requirements	23
6 Documentation	28
6.1 Test report	28
6.2 Advice to end-users	28
7 Test configuration	28
8 General performance criteria.....	29
8.1 General.....	29
8.2 Performance criterion A.....	29
8.3 Performance criterion B.....	30
8.4 Performance criterion C.....	30
9 Compliance with this document.....	30
10 Test uncertainty.....	30
Annex A (normative) Broadcast reception function	31
A.1 General.....	31
A.2 Applicability	31
A.3 Mode of operation	31
A.4 Modified test levels and performance criteria	33
Annex B (normative) Print function	35
B.1 Applicability	35
B.2 Mode of operation	35
B.3 Performance criteria.....	35
B.3.1 Performance criterion A.....	35
B.3.2 Performance criterion B.....	36
B.3.3 Performance criterion C	36
Annex C (normative) Scan function	37
C.1 Applicability	37
C.2 Mode of operation	37
C.3 Performance criteria.....	37

C.3.1	Performance criterion A.....	37
C.3.2	Performance criterion B.....	37
C.3.3	Performance criterion C	38
Annex D (normative)	Display and display output functions	39
D.1	Applicability	39
D.2	Mode of operation	39
D.2.1	Test signals and conditions	39
D.2.2	Display evaluation, for continuous disturbances	41
D.2.3	Display evaluation for power frequency magnetic field testing	43
D.3	Performance criteria.....	44
D.3.1	Performance criterion A for continuous radiated and conducted disturbances tests.....	44
D.3.2	Performance criterion A for the power frequency magnetic field tests	44
D.3.3	Performance criterion B.....	44
D.3.4	Performance criterion C	44
Annex E (normative)	Musical tone generating function.....	45
E.1	Applicability	45
E.2	Mode of operation	45
E.3	Performance criteria.....	45
E.3.1	General	45
E.3.2	Performance criterion A.....	45
E.3.3	Performance criterion B.....	46
E.3.4	Performance criterion C	46
Annex F (normative)	Networking functions.....	47
F.1	Applicability	47
F.1.1	General	47
F.1.2	Switching and routing function.....	47
F.1.3	Data transmission function	47
F.1.4	Supervisory function	47
F.2	Specific terminology for use within Annex F	47
F.3	General requirements for network functions	48
F.3.1	General	48
F.3.2	Configuration	48
F.3.3	Performance criteria.....	48
F.4	Requirements for CPE containing xDSL ports	50
F.4.1	Configuration and mode of operation	50
F.4.2	Performance criterion A.....	51
F.4.3	Performance criterion B.....	52
F.4.4	Performance criterion C	53
Annex G (normative)	Audio output function.....	54
G.1	Applicability	54
G.2	Specific terminology for use within this annex	54
G.2.1	acoustic interference ratio	54
G.2.2	acoustic reference level	54
G.2.3	audio output port.....	54
G.2.4	dBm0.....	54
G.2.5	demodulated audio level.....	54
G.2.6	electrical interference ratio	55
G.2.7	electrical reference level	55

G.2.8	loudspeaker	55
G.2.9	on-ear device	55
G.3	Overview	55
G.3.1	General	55
G.3.2	Ports to be tested	55
G.4	Reference level	56
G.5	Mode of operation	57
G.5.1	General	57
G.5.2	Gain setting	57
G.5.3	Audio frequency-response adjustments	57
G.5.4	Non-linear processing	57
G.6	Method of measurement	57
G.6.1	General	57
G.6.2	Electrical measurements	58
G.6.3	Acoustic measurements	58
G.6.4	Processes (not applicable to direct measurements)	59
G.7	Performance criteria	60
G.7.1	Performance criterion A	60
G.7.2	Performance criterion B	60
G.7.3	Performance criterion C	61
G.8	Test setup examples	61
Annex H (normative)	Telephony function	65
H.1	Applicability	65
H.2	General	65
H.3	Mode of operation	65
H.4	Performance criteria	66
Annex I (informative)	Immunity to specific radio technologies operating at frequencies of 800 MHz and above	67
Annex J (informative)	Examples of how to apply this document	69
J.1	Purpose	69
J.2	Developing the test plan	69
J.3	Specific examples	70
J.3.1	General	70
J.3.2	Example 1: A multifunction printer	70
J.3.3	Example 2: Flat panel television	72
J.3.4	Example 3: Notebook computer	74
J.3.5	Example 4: Small key telephone systems or PABXs	76
Bibliography		79
Figure 1	– Examples of ports	14
Figure 2	– Example schematic of the broadband impulsive conducted disturbances test setup	21
Figure 3	– Graphical representation of the continuous induced RF disturbances levels defined in table clause 2.1	23
Figure D.1	– Example colour bar image	41
Figure D.2	– Example test setup with a video camera system for use with a display	42
Figure D.3	– Example test setup for capturing the image directly from a display port	43
Figure F.1	– xDSL access system configuration	44

Figure G.1 – Example basic test setup for electrical measurements (direct connection to EUT).....	61
Figure G.2 – Example basic test setup for acoustic measurements	61
Figure G.3 – Example test setup for acoustic measurements on loudspeakers	61
Figure G.4 – Example test setup for on-ear acoustic measurements.....	62
Figure G.5 – Example test setup for on-ear acoustic measurements, microphone located away from earpiece transducer	62
Figure G.6 – Example test setup for measuring the sound pressure level from the acoustic output device of a telephone handset.....	63
Figure G.7 – Example test setups for measuring the demodulation on analogue wired network lines	64
Figure J.1 – Examples of different types of functions	70
Figure J.2 – Example of a typical small key telephone system or PABX.....	77
Table 1 – Immunity requirements for enclosure ports	24
Table 2 – Immunity requirements for analogue/digital data ports	25
Table 3 – Immunity requirements for DC network power ports	26
Table 4 – Immunity requirements for AC mains power ports	27
Table 5 – Test arrangements of EUT	29
Table A.1 – Examples of specifications of digital broadcast signals.....	32
Table A.2 – Modified test levels for performance criterion A for the broadcast reception function	34
Table D.1 – Prioritised list of display images	40
Table D.2 – Characteristics of a measurement video camera monitor system	43
Table E.1 – Subgroups and performance criteria A for the musical tone generating function	45
Table E.2 – Performance criteria for different subgroups given in Table E.1	46
Table F.1 – ITU-T recommendations for xDSL systems.....	51
Table F.2 – Attenuation values representing cable lengths.....	51
Table F.3 – Performance criteria against impulse duration	52
Table G.1 – Test requirements for various MME	56
Table G.2 – Measurement method and reference level setting	56
Table G.3 – Performance criterion A – Limits for devices supporting telephony	60
Table H.1 – Telephony functions, performance criteria.....	66
Table I.1 – Guidance on the selection of immunity levels to common wireless communication devices	68
Table J.1 – Test requirements for example 1: a multifunction printer	71
Table J.2 – Test details for example 1: a multifunction printer	72
Table J.3 – Test requirements for example 2: flat panel television.....	73
Table J.4 – Test details for example 2: flat panel television.....	74
Table J.5 – Test requirements for example 3: notebook computer	75
Table J.6 – Test details for example 3: notebook computer	76
Table J.7 – Example test configurations and performance assessment methods applicable to a PABX and associated terminals for continuous induced RF disturbance tests	78

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

ELECTROMAGNETIC COMPATIBILITY OF MULTIMEDIA EQUIPMENT – IMMUNITY REQUIREMENTS

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard CISPR 35 has been prepared by CISPR subcommittee 1: Electromagnetic compatibility of information technology equipment, multimedia equipment and receivers.

The text of this standard is based on the following documents:

FDIS	Report on voting
CISPR/II/522/FDIS	CISPR/II/527/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This CISPR document establishes uniform requirements for the electromagnetic immunity of multimedia equipment. The test methods are given within this document or in referenced basic EMC immunity standards. This document specifies applicable tests, test levels, product operating conditions and assessment criteria.

ELECTROMAGNETIC COMPATIBILITY OF MULTIMEDIA EQUIPMENT – IMMUNITY REQUIREMENTS

1 Scope

NOTE Blue coloured text within this document indicates text aligned with CISPR 32. CISPR 32 contains the appropriate emission requirements above 150 kHz for the equipment within the scope of this document.

This document applies to multimedia equipment (MME) as defined in 3.1.24 and having a rated AC or DC supply voltage not exceeding 600 V.

MME within the scope of CISPR 20 or CISPR 24 is within the scope of this document.

MME with a broadcast reception function is within the scope of this document, see Annex A. MME with non-broadcast wireless interfaces is also within the scope of this document, however, compliance with this document does not require the assessment of the performance of these interfaces.

MME intended primarily for professional use is within the scope of this document.

MME for which immunity requirements in the frequency range covered by this document are explicitly formulated in other CISPR documents (except CISPR 20 and CISPR 24) are excluded from the scope of this document.

The objectives of this document are:

- to establish requirements which provide an adequate level of intrinsic immunity so that the MME will operate as intended in its environment in the frequency range 0 kHz to 400 GHz;
- to specify procedures to ensure the reproducibility of tests and the repeatability of results.

Due to technology convergence of the functions of MME, the performance criteria have been determined on a function-orientated basis rather than on an equipment-orientated basis.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-3:2006/AMD 1:2007

IEC 61000-4-3:2006/AMD 2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*¹

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*²

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-20: 2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-4-21:2011, *Electromagnetic compatibility (EMC) – Part 4-21: Testing and measurement techniques – Reverberation chamber test methods*

ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) – Part 3: Visual display requirements*

IEEE Standard 802.3, *IEEE Standard for Ethernet, Section Three*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Terms and definitions related to EMC and to relevant phenomena are given in IEC 60050-161. Attention is drawn to the fact that a common set of definitions has been written for both CISPR 32 and CISPR 35. It is noted that some terms and definitions will only be used in one of these two documents but for purposes of consistency they are intentionally included in both.

3.1.1

AC mains power port

port used to connect to the mains supply network

Note 1 to entry: Equipment with a DC power port which is powered by a dedicated AC/DC power converter is defined as AC mains powered equipment.

¹ 2nd edition (2005). This 2nd edition has been replaced in 2014 by a 3rd Edition IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*.

² 3rd edition (2008). This 3rd edition has been replaced in 2013 by a 4th Edition IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*.

3.1.2**analogue/digital data port**

signal/control port (3.1.32), antenna port (3.1.3), wired network port (3.1.34), broadcast receiver tuner port (3.1.8), or optical fibre port (3.1.25) with metallic shielding and/or metallic strain relief member(s)

3.1.3**antenna port**

port, other than a broadcast receiver tuner port (3.1.8), for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

3.1.4**arrangement**

physical layout and orientation of all the parts of the EUT, AE and any associated cabling, located within the test area

3.1.5**associated equipment****AE**

equipment needed to exercise and/or monitor the operation of the EUT

Note 1 to entry: The AE may be either local (within the measurement or test area) or remote.

3.1.6**audio equipment**

equipment which has a primary function of either (or a combination of) generation, input, storage, play, retrieval, transmission, reception, amplification, processing, switching or control of audio signals

3.1.7**broadcast receiver equipment**

equipment containing a tuner that is intended for the reception of broadcast services

Note 1 to entry: These broadcast services are typically television and radio services, including terrestrial broadcast, satellite broadcast and/or cable transmission.

3.1.8**broadcast receiver tuner port**

port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services

Note 1 to entry: This port may be connected to an antenna, a cable distribution system, an RF modulator output port (3.1.31) or similar device.

3.1.9**common mode impedance**

asymmetrical mode (see CISPR 16-2-1:2014) impedance between a cable attached to a port and the Reference Ground Plane (RGP)

Note 1 to entry: The complete cable is seen as one wire of the circuit, and the RGP is seen as the other wire of the circuit. The common mode current flowing around this circuit can lead to the emission of radiated energy from the EUT.

3.1.10**configuration**

operational conditions of the EUT and AE, consisting of the set of hardware elements selected to comprise the EUT and AE, the mode of operation (3.1.23) used to exercise the EUT and arrangement (3.1.4) of the EUT and AE

3.1.11

converted common mode current

asymmetrical mode current converted from differential mode current by the unbalance of an attached cable and/or network

3.1.12

DC network power port

port, not powered by a dedicated AC/DC power converter and not supporting communication, that connects to a DC supply network

Note 1 to entry: Equipment with a DC power port which is powered by a dedicated AC/DC power converter is defined as AC mains powered equipment.

Note 2 to entry: DC power ports supporting communication are considered to be wired network ports (3.1.34), for example Ethernet ports which include power over Ethernet (POE).

3.1.13

enclosure port

physical boundary of the EUT through which electromagnetic fields may radiate or may enter

3.1.14

entertainment lighting control equipment

equipment generating or processing electrical signals for controlling the intensity, colour, nature or direction of the light from a luminaire, where the intention is to create artistic effects in theatrical, televisual or musical productions and visual presentations

3.1.15

Equipment Under Test

EUT

multimedia equipment (MME) being evaluated for compliance with the requirements of this document

3.1.16

formal measurement

measurement used to determine compliance

Note 1 to entry: This is often the final measurement performed. It may be carried out following a prescan measurement. It is the measurement recorded in the test report.

3.1.17

function

operation carried out by an MME

Note 1 to entry: Functions are related to basic technologies incorporated in the MME such as: displaying, recording, processing, controlling (including control of lighting operations, see 3.1.14), reproducing, transmitting, or receiving single medium or multimedia content. Where relevant the content may be data, audio or video, either individually or in combination.

3.1.18

highest internal frequency

F_x

highest fundamental frequency generated or used within the EUT, or highest frequency at which it operates

Note 1 to entry: This includes frequencies which are solely used within an integrated circuit.

3.1.19

information technology equipment

ITE

equipment having a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication

messages and which may be equipped with one or more ports typically for information transfer

Note 1 to entry: Examples include data processing equipment, office machines, electronic business equipment and telecommunication equipment.

3.1.20

launched common mode current

asymmetric mode current produced by internal circuitry and appearing at a wired network port of the EUT

Note 1 to entry: Measurement of the launched common mode current requires the EUT port to be loaded by a perfectly balanced termination.

3.1.21

LNB

low noise block converter which amplifies and converts broadcast satellite frequencies to frequencies usable by a satellite receiver

3.1.22

local AE

AE located within the measurement or test area

3.1.23

mode of operation

set of operational states of all functions of an EUT during a test or measurement

3.1.24

multimedia equipment

MME

equipment that is information technology equipment (3.1.19), audio equipment (3.1.6), video equipment (3.1.33), broadcast receiver equipment (3.1.7), entertainment lighting control equipment (3.1.14) or a combinations of these

3.1.25

optical fibre port

port at which an optical fibre is connected to an equipment

3.1.26

outdoor unit of home satellite receiving systems

outdoor unit which typically consists of a reflecting surface (or antenna) and an LNB

Note 1 to entry: This excludes the intermediate frequency amplifier and the demodulator included in the indoor receiver.

3.1.27

port

physical interface through which electromagnetic energy enters or leaves the EUT

Note 1 to entry: See Figure 1.

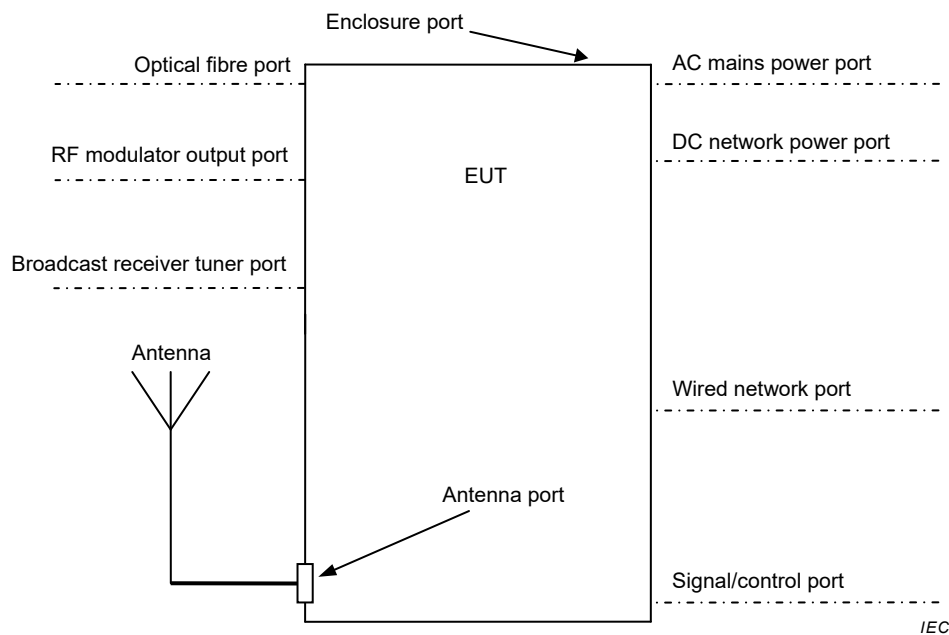


Figure 1 – Examples of ports

3.1.28

primary function

any function of an MME considered essential for the user or for the majority of users

Note 1 to entry: An MME may have more than one primary function. For example the primary functions of a basic television set include broadcast reception, audio reproduction and display.

3.1.29

primary protection

means by which the majority of surge stress is prevented from propagating beyond a designated location (preferably the building entrance point)

3.1.30

primary protector

surge protection device used for the primary protection of analogue/digital ports that may connect to cables that leave the building structure

Note 1 to entry: Aligned with ITU-T, K series recommendations.

3.1.31

RF modulator output port

port intended to be connected to a broadcast receiver tuner port (3.1.8) in order to transmit a signal to the broadcast receiver

3.1.32

signal/control port

port intended for the interconnection of components of an EUT, or between an EUT and AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it)

Note 1 to entry: Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE Standard 1394 ("FireWire").

3.1.33**video equipment**

equipment which has a primary function of either (or a combination of) generation, input, storage, display, play, retrieval, transmission, reception, amplification, processing, switching, or control of video signals

3.1.34**wired network port**

port for the connection of voice, data and signalling transfers intended to interconnect widely-dispersed systems by direct connection to a single-user or multi-user communication network

Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks.

Note 2 to entry: These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

AAN	Asymmetric Artificial Network
AC	Alternating Current
AC-3	ATSC standard: digital Audio Compression (AC-3)
AE	Associated Equipment, see 3.1.5
AGC	Automatic gain control
AM	Amplitude Modulation
ANSI	American National Standards Institute
ARIB	Association of Radio Industries and Businesses
ATM	Asynchronous transmission mode
ATSC	Advanced Television Systems Committee
AV	Audio Visual
BPSK	Binary Phase Shift Keying
CATV	Cable TV network
CCD	Charge coupled device
CDN	Coupling/decoupling network
CISPR	International Special Committee on Radio Interference
CM	Common mode
CMAD	Common Mode Absorbing Device
CPE	Customer premise equipment
CRC	Cyclic redundancy check
CRT	Cathode ray tube, a type of visual display device
CVP	Capacitive Voltage Probe
DAB	Digital audio broadcasting
DC	Direct current
DMB	Digital multimedia broadcast
DMB-T	Digital multimedia broadcast – Terrestrial
DOCSIS	Data Over Cable Service Interface Specification
DQPSK	Differential Quadrature Phase Shift Keying
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer

DVB	Digital Video Broadcast
DVB-C/C2	Digital Video Broadcast – Cable
DVB-S/S2	Digital Video Broadcast – Satellite
DVB-T/T2	Digital Video Broadcast – Terrestrial
DVD	Digital Versatile Disk (an optical disc format also known as a digital video disc)
DVR	Digital Video Recorder
EFT/B	Electrical Fast Transient/Burst
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
ERP	Effective Radiated Power
ETN	External Telecommunications Network
ETSI	European Telecommunications Standards Institute
EUT	Equipment under test, see 3.1.15
FEXT	Far End cross Talk
FM	Frequency Modulation
FSOATS	Free Space Open Area Test Site
F/UTP	Foil screened/Unscreened Twisted Pair
GSM	Global System of Mobile communication radio service
GTEM	Gigahertz Transverse ElectroMagnetic
HDD	Hard Disk Drive
HDMI	High-Definition Multimedia Interface
HID	Human Interface Device
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
INP	Impulsive noise protection
IP	Internet Protocol
ISDB	Integrated Services Digital Broadcasting
ISDB-C	Integrated Services Digital Broadcasting – Cable
ISDB-S	Integrated Services Digital Broadcasting – Satellite
ISDB-T	Integrated Services Digital Broadcasting – Terrestrial
ISDN	Integrated Services Digital Networks
ISDN-NT	Integrated Services Digital Networks – Network Termination
ISO	International Standardisation Organisation
ITE	Information Technology Equipment, see 3.1.19
ITN	Internal Telecommunications Network
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union – Radio Communication sector
ITU-T	International Telecommunications Union – Telecommunication sector
JCTEA	Japan Cable Television Engineering Association
LAN	Local Area Network
LCL	Longitudinal Conversion Loss
LO	Local Oscillator

LNB	Low-Noise Block converter
LTE	Long term evolution, a type of radio service
lx	Lux
MIDI	Musical instrument digital interface
MME	Multimedia Equipment, see 3.1.24
MPEG	Moving Picture Experts Group
NSA	Normalized Site Attenuation
NTSC	National Television Systems Committee (a composite colour video coding format)
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
PABX	Private automatic branch exchange
PAL	Phase alternating line, a composite colour video coding format
PC	Personal Computer
PCM	Pulse code modulation
PDH	Plesiochronous digital hierarchy
POE	Power Over Ethernet
POS	Point Of Sale
POTS	Plain Old Telephone Service
PSTN	Public Switched Telecommunications Networks
PSU	Power Supply Unit (including a AC/DC power converter)
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
REIN	Repetitive Electrical Impulsive Noise
RF	Radio Frequency
RGP	Reference Ground Plane
rms	root mean square
RVC	ReVerberation Chamber
SAC	Semi Anechoic Chamber
SCTE	Society of Cable Telecommunications Engineers
SDH	Synchronous Digital Hierarchy
SECAM	Sequential Colour with Memory, a composite colour video coding format
SES	SIP Enable Services
SIP	Session Initiation Protocol
SPL	Sound Pressure Level
STP	Screened Twisted Pair
TC8PSK	a type of Trellis coding
TEM	Transverse ElectroMagnetic
T_r/T_h	Rise time (or front time) / time to half value
TTE	Telecommunication Terminal Equipment
TV	Television
UFA	Uniform Field Area
UHF	Ultra High Frequency

UMTS	Universal Mobile Telecommunication System
USB	Universal Serial Bus
U/UTP	Unscreened/Unscreened Twisted Pair
VCR	Video Cassette Recorder
VHF	Very High Frequency
VOIP	Voice Over IP
VSB	Vestigial Side Band
WAN	Wide Area Network
Wi-Fi	Wireless Fidelity digital radio network
WiMAX	Worldwide Interoperability for microwave access digital radio network
xBase-T	Where x is 10, 100, 1 000, 10 000 as defined in the IEEE 802.3 series of Ethernet standards
xDSL	Generic term for all types of DSL technology

4 Requirements

4.1 General requirements

This document contains requirements for immunity testing of MME including: selection of applicable tests; disturbance levels to be applied during testing; configuration; performance criteria; and other necessary details. These requirements are contained in the main body of the document and in various annexes.

In this document, the word “testing” means the application of an EM phenomenon to a port of the EUT and the assessment of its impact on the primary function(s).

In this document, table clauses are referenced using an x.y format, where x denotes the table and y denotes that actual clause (or row) within the table. For example, table clause 1.3 is Table 1, clause (or row) 3.

All aspects of testing the EUT shall be defined and documented by the manufacturer prior to testing in a test plan. This requirement includes, but is not limited to, the following details: selection of the primary function(s), the specific performance criteria relevant to these primary functions, and the mode(s) of operation to be used. These details as a minimum shall be included in the test report.

During testing of ports as specified in Table 1 to Table 4, the primary function(s) shall be monitored and assessed against the relevant performance criteria.

For primary functions covered within the normative annexes (Annex A through Annex H), the particular requirements within each of the relevant annexes take precedence over the general performance criteria given in Clause 8. For primary function(s) not covered by one of these annexes, the general performance criteria given in Clause 8 apply. Examples of the application of these annexes are given in Annex J.

Signal processing and data storage functions shall be assessed according to the general performance criteria given in Clause 8.

There are two types of functions:

- Direct functions that can be observed or monitored.

An example of a direct function is the measurement of demodulated tone within a telephone handset in accordance with Annex H.

- Indirect functions that can only be observed by monitoring direct functions.

An example of an indirect function is the ability of a DVD recorder to store video which may be assessed for accuracy using the play back function at the completion of the test. In this case, the video recorded during the entire test would need to be observed and checked for performance degradation.

The evaluation of indirect functions is achieved by operating the equipment as intended and monitoring the direct functions to ascertain the performance of the indirect functions. When direct and indirect functions operate in this way, and the two functions have different performance criteria, the least stringent of these criteria shall be applied.

To reduce the amount of testing, it is recommended to select one or more modes of operation that exercise multiple primary functions during the application of each test. As an example, the evaluation of the data reception, print and display functions of an EUT may be performed while receiving data from a LAN port. This allows the functions to be exercised in parallel during a single test, thus reducing test time.

Where a port supports both screened and unscreened cables, unless otherwise specified by the manufacturer, unscreened cables shall be used during testing.

The immunity tests required by this document shall be carried out individually, in any sequence. The same sample shall be used for all tests relating to a particular EM phenomenon, however other samples of the EUT may be used to test against different EM phenomena. These other samples shall be of the same type, including construction, software, firmware and other elements which may impact the result of the tests.

The description of the test, the test equipment (for example, generators, amplifiers, transducers and cables), the test methods, the calibration and/or verification methods and the test setups are given in the relevant basic EMC publications referenced in Table 1 to Table 4. The content of these documents is not repeated here; however, modifications or additional information needed for the practical application of the tests are given in this document.

4.2 Particular requirements

4.2.1 Electrostatic discharges (ESD)

The test procedure shall be in accordance with IEC 61000-4-2:2008. Electrostatic discharges shall be applied only to points and surfaces of the EUT which are expected to be touched during normal operation, including user access operations specified in the user manual, for example cleaning or adding consumables when the EUT is powered. The application of discharges to the contacts of open connectors is not required.

The number of test points is EUT dependent. Subclause 8.3.1 and Clause A.5 of IEC 61000-4-2:2008 shall be taken into consideration when selecting test points, paying particular attention to keyboards, dialling pads, power switches, mice, drive slots, card slots, the areas around communication ports, etc.

When applying direct discharges to a portable or handheld battery-powered EUT with a display screen, it may not be possible to observe the screen for a given EUT orientation. If observation of the screen is necessary during this test, the EUT may be mounted vertically using non-metallic supports.

4.2.2 Continuous RF disturbances

4.2.2.1 General

The following tests are applied:

- Swept frequency tests across the specified ranges as defined in Table 1 to Table 4.

- Spot frequency tests at a limited number of selected frequencies as defined in Table 1.
- Additional spot frequency tests applicable only for functions where this requirement is specified in the relevant annex. The required frequencies are given in Clause 5.

Recognising that a 1 % step size is preferred, the frequency range can be swept incrementally with a step size not exceeding 4 % of the previous frequency with a test level of twice the value of the specified test level in order to reduce the testing time for equipment requiring testing in multiple configurations and/or long cycle times. The step size and test level used shall be recorded in the test report.

The test level specified is the rms voltage level of the unmodulated signal.

The disturbance test signal shall be 80 % amplitude modulated by a sine wave, preferably having a frequency of 1 kHz. A frequency other than 1 kHz may be used where permitted within this document (for example Clause G.3). The reason for this selection shall be included in the test report.

The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond. However, the dwell time should not exceed 5 s at each of the frequencies during the scan.

When testing an EUT with a radio reception function, the radio reception function is not expected to operate normally when the test frequency is within the band where the radio reception function is designed to operate. For broadcast reception functions see Annex A.

4.2.2.2 Continuous RF electromagnetic field disturbances

The test procedure shall be in accordance with IEC 61000-4-3:2006/AMD1:2007/AMD2:2010, IEC 61000-4-20:2010 or IEC 61000-4-21:2011.

When testing using IEC 61000-4-3:2006/AMD1:2007/AMD2:2010 or IEC 61000-4-20:2010, if the most sensitive face (or side) of the EUT is known throughout the frequency range (for example, via preliminary tests), testing may be restricted to that side only.

The dwell time requirements at each frequency as defined in 4.2.2.1 shall be applied for each face (or side) of the EUT, antenna position and polarization, or layout of the stirrer.

When testing to the requirements defined in table clause 1.3 (spot frequency testing above 1 GHz), the radiated field illumination of the EUT using the 'independent windows method' specified in IEC 61000-4-3:2006/AMD1:2007/AMD2:2010, Annex H may be used.

Partial illumination as defined in IEC 61000-4-3:2006/AMD1:2007/AMD2:2010 may be used:

- if the EUT is too large to fit within the UFA;
- if the EUT consists of separate modules which cannot be tested separately and is too large to fit within the UFA.

When testing in a TEM cell the EUT shall meet the definition of 'small equipment' specified in IEC 61000-4-20:2010.

NOTE Further information is given in Annex I for specific radio technologies. See Table I.1 for more specific details.

4.2.2.3 Continuous induced RF disturbances

The test procedure shall be in accordance with IEC 61000-4-6:2008.

Multi-conductor cables shall be tested as a single cable. Cables shall not be split or divided into groups of conductors for this test. Where an appropriate CDN is not available for the single cable including all the conductors, use Figure 1 from IEC 61000-4-6:2008 to determine the suitable injection method.

When using injection clamps (including EM clamps and current probes) an additional isolation device may be required to protect the AE.

4.2.3 Power frequency magnetic field

The test procedure shall be in accordance with IEC 61000-4-8:2009. The proximity method may be used.

4.2.4 Electrical fast transients/burst (EFT/B)

The test procedure shall be in accordance with IEC 61000-4-4:2012.

Multi-conductor cables shall be tested as a single cable. Cables shall not be split or divided into groups of conductors for this test.

4.2.5 Surges

The test procedure shall be in accordance with IEC 61000-4-5:2005.

Further guidance for surge testing wired network ports is also found in the ITU recommendations, for example, ITU-T K.20, ITU-T K.21, ITU-T K.43 (including test setup information) and ITU-T K.48:2006 (including Clause 7 for operational condition and Clause 8 for specific performance criteria).

The requirement in the basic standard to test a previously unstressed EUT is not applicable. Therefore a stressed or unstressed EUT may be tested or the protection devices may be replaced before the test, as specified by the manufacturer.

4.2.6 Voltage dips and interruptions

The test procedure shall be in accordance with IEC 61000-4-11:2004.

4.2.7 Broadband impulsive conducted disturbances

Repetitive noise impulses and isolated noise impulses are applied to xDSL ports of the EUT. The requirements for the test level, burst duration and burst period for the two tests are given in Table 2.

This test procedure is based upon the CDN method defined in IEC 61000-4-6:2008, but with the signal generator replaced by a generator capable of producing bursts of white noise. See Figure 2.

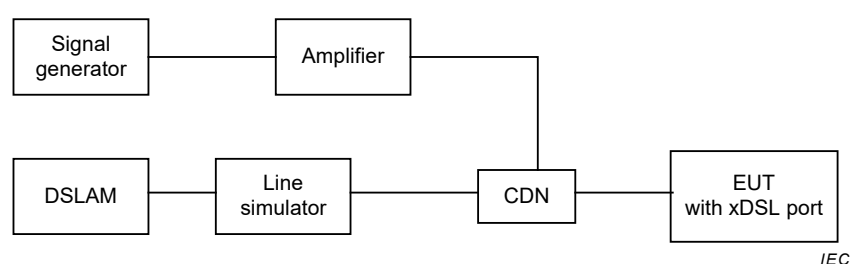


Figure 2 – Example schematic of the broadband impulsive conducted disturbances test setup

The white noise burst should be derived from a longer sequence pseudo-random near-Gaussian white noise generator that may be band-limited to the highest frequency used by the xDSL technology or 30 MHz, whichever is the lowest. This may be generated from an arbitrary waveform source. The length of the sequence from which the noise bursts are generated shall be at least 128 K samples.

The amplifier and CDN used shall have a uniform frequency response that does not change by more than 3 dB over the frequency range that extends from 150 kHz to the highest frequency used by the xDSL technology or 30 MHz, whichever is the lowest. It is recommended that the CDN should have an LCL of at least 60 dB over the relevant frequency range. Equipment that satisfies the performance criteria when tested using a CDN with a lower LCL value shall be deemed to meet the requirements.

NOTE 1 A CDN with an LCL of less than 60 dB is more likely to cause failures due to the differential mode signal generated by the lower LCL value of the CDN.

The LCL of the CDN shall be measured in accordance with CISPR 16-1-2:2014.

The ratio of the peak value to the rms value of the signal at the CDN input port shall be at least 4,0.

A level setting procedure similar to that in IEC 61000-4-6:2008 shall be used. The specified test level is established using a spectrum analyser in peak detection mode with a resolution bandwidth of 10 kHz, and a video bandwidth of less than or equal to 10 Hz. The EUT port of the coupling device is connected in common mode through a 150 Ω to 50 Ω adapter to a spectrum analyser having a 50 Ω input impedance.

The test generator shall be adjusted to give the level specified in table clause 2.2 at the EUT port of the coupling device, using the setup shown in Figure 8c of the basic standard IEC 61000-4-6:2008.

For the repetitive impulse test the disturbance shall be applied for a period of at least 2 min for each port under test.

For the isolated impulse test a minimum of 5 isolated impulses shall be applied with an interval of at least 60 s between successive impulses.

NOTE 2 The relationship between the measured level (M) in dBμV and the test level (T) in dBμV as defined in table clause 2.2 or 2.3 is given by:

$$M = T - 27,6 \text{ dB}$$

where:

$$27,6 \text{ dB} = A_1 + A_2 + A_3$$

$$A_1 = 9,6 \text{ dB (150 } \Omega \text{ to 50 } \Omega \text{ converter loss)}$$

$$A_2 = 6 \text{ dB (e.m.f. correction, 50 } \Omega \text{ termination of signal generator output)}$$

$$A_3 = 12 \text{ dB for the averaging caused by the video bandwidth reduction}$$

NOTE 3 For xDSL lines the test levels were derived from a spectral power density (dBm/Hz) of -43 dBm/Hz where

$$\text{Test level (dB(}\mu\text{V))} = \text{Spectral power density (dBm/Hz)} + 150 \text{ dB}$$

where:

$$150 \text{ dB} = A_1 + A_2 + A_3$$

$$A_1 = 40 \text{ dB (10 kHz bandwidth factor)}$$

$$A_2 = -10 \text{ dB (mW to V conversion for 100 } \Omega \text{ impedance)}$$

$A_3 = 120$ dB (V to μ V conversion)

5 Immunity requirements

Tests shall be applied to the EUT according to Table 1 to Table 4 and 4.1.

Where a manufacturer determines from the electrical characteristics and intended usage of the EUT that one or more of the tests are unnecessary, the decision and justification not to perform these tests shall be recorded in the test report.

Throughout Clause 5:

- Where the amplitude of a test level varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency. For example, a graphical representation of the continuous induced RF disturbances levels defined in table clause 2.1 is presented in Figure 3.

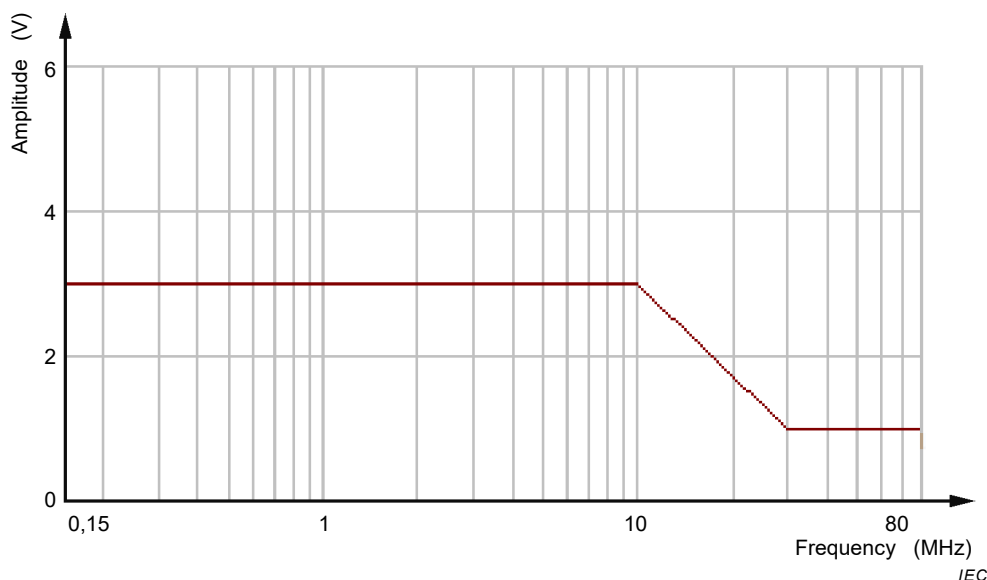


Figure 3 – Graphical representation of the continuous induced RF disturbances levels defined in table clause 2.1

- Where there is a step in the relevant test level, the higher value shall be applied at the transition frequency.
- Combination surge waveforms are defined in the format of open circuit voltage (short circuit current) T_r/T_h μ s, for example 1,2/50 (8/20) μ s where 1,2/50 relates to voltage and (8/20) to current.
- The test conditions shall be within:
 - the operating ranges of voltage and frequency as specified for the EUT, having regard to the supply voltage and frequency for the intended market of the EUT.
Testing at nominal voltage(s) of 230 V (± 10 V) and/or 110 V (± 10 V), using a frequency of 50 Hz or 60 Hz, is normally sufficient for an EUT intended for worldwide use.
 - the environmental parameters (temperature, humidity and atmospheric pressure) specified for the EUT.
 - the environmental parameters specified within the relevant basic standard.

No additional environmental parameters are defined. It is not necessary to repeat measurements at more than one set of environmental parameters.

- During continuous induced RF disturbances testing, where equipment operates upon or processes chrominance or similar signals modulated on a subcarrier (for example, PAL,

NTSC or SECAM composite systems), the performance criterion B shall be used when testing within $\pm 1,5$ MHz of the relevant subcarrier frequency.

- During continuous RF disturbance testing, additional spot frequency tests are required for equipment with a primary function of telephony, subject to the limitations specified in Table H.1. The additional spot frequencies are:
 - 0,2 MHz; 1 MHz; 7,1 MHz; 13,56 MHz; 21 MHz; 27,12 MHz and 40,68 MHz (± 1 %) for continuous induced RF disturbances; and,
 - 80 MHz; 120 MHz; 160 MHz; 230 MHz; 434 MHz; 460 MHz; 600 MHz; 863 MHz and 900 MHz (± 1 %) for continuous RF radiated electromagnetic field disturbances.
- Continuous RF electromagnetic field disturbance testing is not applicable to broadcast receivers with no coaxial antenna connector (see Annex A) and not applicable to battery powered music players with no external power or charging capability.

Table 1 – Immunity requirements for enclosure ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
1.1	Power frequency magnetic field	Frequency	50 or 60	Hz	IEC 61000-4-8	See ^a	A
		Field strength	1	A/m			
1.2	Continuous RF electromagnetic field disturbances, swept test	Frequency range	80 to 1 000	MHz	IEC 61000-4-3 or IEC 61000-4-20 or IEC 61000-4-21	For modulation details see 4.2.2.1	A
		Field strength	3	V/m			
1.3	Continuous RF electromagnetic field disturbances, spot test	Frequency (± 1 %)	1 800, 2 600, 3 500, 5 000	MHz	IEC 61000-4-3 or IEC 61000-4-20 or IEC 61000-4-21	For modulation details see 4.2.2.1	A
		Field strength	3	V/m			
1.4	ESD	Contact discharge	4	kV	IEC 61000-4-2		B
		Air discharge	8				

^a Applicable only to equipment containing devices intrinsically susceptible to magnetic fields, such as CRT monitors, Hall effect elements, electro-dynamic microphones, magnetic field sensors or audio frequency transformers. Refer to D.3.2 for determining the test level when the EUT contains a CRT display.

NOTE The applicable versions of the basic standards are IEC 61000-4-2:2008, IEC 61000-4-3:2006/AMD1:2007/AMD2:2010, IEC 61000-4-8:2009, IEC 61000-4-20:2010 and IEC 61000-4-21:2011. See Clause 2.

Table 2 – Immunity requirements for analogue/digital data ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
2.1	Continuous induced RF disturbances	Frequency ranges Test level See Figure 3	0,15 to 10 3	MHz V	IEC 61000-4-6	For modulation details see 4.2.2.1.	A
			10 to 30 3 to 1	MHz V			
			30 to 80 1	MHz V			
2.2	Broadband impulse noise disturbances, repetitive	Impulse frequency Test level	0,15 to 0,5 107	MHz dBμV	4.2.7	Applicable only to CPE xDSL ports. For operating conditions see F.4.1. Apply period based on the AC mains frequency.	A See F.4.2.2
			0,5 to 10 107 to 36	MHz dBμV			
			10 to 30 36 to 30	MHz dBμV			
		Burst duration Burst period	0,70 8,3 (for 60 Hz) 10 (for 50 Hz)	ms ms ms			
2.3	Broadband impulse noise disturbances, isolated	Impulse frequency	0,15 to 30	MHz	4.2.7	Applicable only to CPE xDSL ports. Apply all burst durations.	B See F.4.3.1
		Test Level	110	dBμV			
		Burst duration	0,24 10 300	ms ms ms			
2.4	Surges	Port type: unshielded symmetrical Apply: lines to ground			IEC 61000-4-5	See ^c	C
		Apply where primary protection is intended					
		Test level	1 and 4, See ^a , _b	kV			
		T_r/T_h	10/700 (5/320)	μs			
		Apply where primary protection is not intended					
		Test level T_r/T_h	1 See ^b 10/700 (5/320)	kV μs			
	Surges	Port type: coaxial or shielded Apply: shield to ground			IEC 61000-4-5	See ^c	B
		Test level T_r/T_h	0,5 1,2/50 (8/20)	kV μs			
2.5	Electrical fast transients / burst	Test level T_r/T_h Repetition frequency	0,5 5/50 5	kV ns kHz	IEC 61000-4-4	For CPE xDSL ports repetition frequency is 100 kHz.	B, xDSL function. See F.4.3.2 B, other functions

Applicable only to ports which, according to the manufacturer's specification, support cable lengths greater than 3 m.

^a Surges are applied with primary protection fitted. Where possible, use the actual primary protector intended to be used in the installation.

^b Where the surge coupling network for the 10/700 (5/320) μ s waveform affects the functioning of high speed data ports, the test shall be carried out using a 1,2/50 (8/20) μ s waveform and appropriate coupling network.

^c Surges are applicable to ports which satisfy all the following conditions:

- may connect directly to cables that leave the building structure,
- defined as an antenna port (3.1.3), a wired network port (3.1.34), or a broadcast receiver tuner port (3.1.8).

Typical ports covered include xDSL, PSTN, CATV, antenna and similar. Excluded ports are LAN and similar.

NOTE The applicable versions of the basic standards are IEC 61000-4-4:2012, IEC 61000-4-5:2005, IEC 61000-4-6:2008. See Clause 2.

Table 3 – Immunity requirements for DC network power ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
3.1	Continuous induced RF disturbances	Frequency ranges	0,15 to 10 3	MHz V	IEC 61000-4-6	For modulation details see 4.2.2.1.	A
		Test level	10 to 30 3 to 1	MHz V			
		See Figure 3	30 to 80 1	MHz V			
3.2	Surges	Surges are applied line to reference ground for each individual line			IEC 61000-4-5	Applicable only to ports which, according to the manufacturer's specification, may connect directly to outdoor cables.	B
		Test level T_r/T_h	0,5 1,2/50 (8/20)	kV μ s			
3.3	Electrical fast transients/burst	Test level T_r/T_h Repetition frequency	0,5 5/50 5	kV ns kHz	IEC 61000-4-4		B
Applicable only to ports which, according to the manufacturer's specification, support cable lengths greater than 3 m.							
NOTE The applicable versions of the basic standards are IEC 61000-4-4:2012, IEC 61000-4-5:2005, IEC 61000-4-6:2008. See Clause 2.							

Table 4 – Immunity requirements for AC mains power ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
4.1	Continuous induced RF disturbance	Frequency ranges	0,15 to 10 3	MHz V	IEC 61000-4-6	For modulation details see 4.2.2.1.	A
		Test level	10 to 30 3 to 1	MHz V			
		See Figure 3	30 to 80 1	MHz V			
4.2	Voltage dips	Residual voltage	< 5	%	IEC 61000-4-11	See ^a Apply at only one supply frequency of the MME.	B
		Number of cycles	0,5				C
		Residual voltage	70	%			
		Number of cycles	25 for 50 Hz 30 for 60 Hz				
4.3	Voltage interruptions	Residual voltage	< 5	%	IEC 61000-4-11	See ^a Apply at only one supply frequency of the MME.	C
4.4	Surges	Apply between line and line			IEC 61000-4-5	See ^b Test shall be performed with protection measures in place, if specified by the manufacturer.	B
		Test level T_r/T_h	1 1,2/50 (8/20)	kV μ s			
		Apply between line and earth (ground)					
		Test level T_r/T_h	2 1,2/50 (8/20)	kV μ s			
4.5	Electrical fast transients/burst	Test level T_r/T_h Repetition frequency	1 5/50 5	kV ns kHz	IEC 61000-4-4		B, xDSL function. See F.4.3.2 B, other functions

^a Changes to occur at 0 degree crossover point of the voltage waveform. If the EUT does not demonstrate compliance when tested with 0 degree switching, the test shall be repeated with the switching occurring at both 90 degrees and 270 degrees. If the EUT satisfies these alternative requirements, then it fulfils the requirements. This condition shall be recorded in the test report.

^b The number of pulses applied shall be as follows:

- Five positive pulses line-to-neutral at 90° phase
- Five negative pulses line-to-neutral at 270° phase

The following additional pulses are required only if the EUT has an earth connection or if the EUT is earthed via any AE.

- Five positive pulses line-to-earth at 90° phase
- Five negative pulses line-to-earth at 270° phase
- Five negative pulses neutral-to-earth at 90° phase
- Five positive pulses neutral-to-earth at 270° phase

For multiple-phase systems, where a neutral conductor is present, the test is applied (as defined above) to a single phase unless the other phases are connected to significantly different circuit arrangements.

For multiple-phase systems, where a neutral conductor is not present, the test is applied as defined in the basic standard.

NOTE The applicable versions of the basic standards are IEC 61000-4-4:2012, IEC 61000-4-5:2005, IEC 61000-4-6:2008, IEC 61000-4-11:2004. See Clause 2.

6 Documentation

6.1 Test report

General guidance for compiling a test report can be found in ISO/IEC 17025:2005, 5.10. Sufficient details, including, where appropriate, photographs of the test configuration, shall be provided to facilitate reproducibility.

The test report shall describe any special measures that were required to ensure EMC compliant operation of the EUT. One example would be the need to use shielded or special cables.

6.2 Advice to end-users

The user documentation shall describe any special measures required to be taken by the user or installer to ensure EMC compliance of the EUT with the requirements of this document. One example would be the need to use shielded or special cables.

7 Test configuration

The intention of this document is to assess the immunity of the EUT in a manner that is consistent with its typical arrangement and use. Other arrangements may be used, for example to reduce test time, as long as these arrangements can be shown not to have a significant effect on the performance of the EUT. The EUT arrangement shall be noted in the test report.

If the equipment is part of a system or can be connected to AE, then the equipment shall be tested while connected to at least the minimum representative arrangement of AE necessary to exercise the primary functions of the EUT.

Where the EUT has a set of similar ports or modules and engineering judgement indicates that these have similar immunity characteristics, the minimum representative configuration may use a subset of those ports or modules. The representative configuration of port(s) or modules(s) shall be clearly identified in the test report.

A cable shall be connected to at least one port of each type and this port shall be exercised.

Table 5 describes the preferred EUT arrangement. When applying the requirements of Table 5, refer to the text of each basic standard or test method to determine whether the test arrangement identified as 'table-top' requires a support table during a particular test.

Table 5 – Test arrangements of EUT

Intended operational arrangement(s) of MME	Test arrangement (See Basic Standard)	Remarks
Table-top only	Table-top	
Floor-standing only	Floor-standing	
Can be floor-standing or table-top	Table-top	
Rack mounted	In a rack or table-top	
Other, for example wall mounted, ceiling mounted, handheld, body worn	Table-top	With normal orientation If the equipment is designed to be mounted on a ceiling, the downward-facing portion of the EUT may be oriented facing upward.
If a physical hazard would be caused by testing the device on a table-top, then it can be tested as floor standing and the test report shall document the decision and justification.		

In cases where the manufacturer's specification or user documentation includes a clear requirement for external protection devices or special measures to achieve EMC compliance (such as additional earthing), the test requirements of this document shall be applied with these devices or measures in place.

Where the manufacturer provides cables with the EUT, these cables shall be used during testing. If cables are not supplied, suitable cables of the type appropriate for the signals processed, and conforming to any special requirements clearly stated in the user documentation or manual, shall be used. Coil cables (such as keyboard cables) shall not be intentionally stretched during testing. For such cables, the length specified in the table notes is the unstretched length.

If an earth connection independent of the power supply cable is provided, this earth connection shall be installed according to the specifications of the manufacturer during all tests.

Equipment with a dedicated AC/DC power converter shall be tested as AC mains powered equipment. If available, the power converter provided from the manufacturer shall be used.

8 General performance criteria

8.1 General

General performance criteria are defined in 8.2, 8.3 and 8.4. These criteria shall be used during the testing of primary functions where no relevant annex is applicable.

When assessing the impact of a disturbance on a function, the assessment should take into consideration the function's performance prior to the application of the disturbance and only identify as failures those changes in performance that are a result of the disturbance.

8.2 Performance criterion A

The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

8.3 Performance criterion B

During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test.

After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.

If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

8.4 Performance criterion C

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed.

Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

9 Compliance with this document

Compliance with this document requires the EUT to satisfy the requirements defined in Table 1 to Table 4 as appropriate. An EUT which fulfils these requirements is deemed to fulfil the requirements in the entire frequency range from 0 Hz to 400 GHz. No tests need be performed at frequencies where no requirement is specified.

Where this document gives options for testing particular requirements with a choice of test methods, compliance can be shown against any of the test methods using the appropriate performance criterion. In any situation where it is necessary to re-test the equipment to show compliance with this document, the test method, configuration and parameters (for example, the reference levels according to Annex G) originally chosen shall be used in order to guarantee consistency of the results, unless it is agreed by the manufacturer to do otherwise.

Equipment is considered to be non-compliant where any primary function fails to meet the specified performance criteria. These failures may have been observed directly or indirectly. See 4.1.

The determination of compliance shall be based solely on the immunity performance of the EUT and not be affected by the lack of immunity of any AE.

Compliance can be shown by testing the EUT operating all primary functions simultaneously, individually, or any combination thereof.

10 Test uncertainty

Tests are performed using equipment and facilities as specified in the relevant basic standards. The uncertainty related to test instrument calibration and test levels need not be recorded in the test report and shall not be taken into account.

In particular the test parameters specified in Table 1 to Table 4 shall not be changed to take test uncertainty into account.

Annex A (normative)

Broadcast reception function

A.1 General

A broadcast receiver is designed to receive very weak RF signals in specific broadcast bands. Most commercial broadcast receivers will show a degradation of performance when an immunity test signal defined in table clause 1.2 is applied in the broadcast band for which the receiver is designed.

These receivers may have antennas attached, or be connected to complicated cable distribution systems, and hence the effective immunity protection required to pass the tests given in Table 1 to Table 4 is not achievable. In addition, the use of the broadcast reception bands is strictly controlled under various national and international regulations. Some of these regulations limit the interfering signals which would be apparent in these bands and others allow additional services to be operated. Hence different approaches may be required based upon the region in which the device is intended to operate.

Annex A defines:

- the function to be tested,
- the mode(s) of operation of the broadcast receiver during the test(s),
- any deviations from the test levels defined in Table 1 to Table 4,
- any deviations from the general immunity criteria defined in Clause 8.

A.2 Applicability

Annex A applies to MME with a broadcast reception function. This function enables the EUT to receive analogue or digitally modulated sound or television broadcast signals via an integral or external antenna or cable.

MME with a broadcast reception function, and no port for external signal connection, is excluded from tests requiring performance criterion A.

For the purpose of Annex A broadcast reception equipment is classified as follows:

Group 1: equipment in which the desired RF broadcast signal enters the equipment through a coaxial broadcast receiver tuner port. See 3.1.8. These coaxial ports are intended to be connected via a coaxial cable to an antenna or a cable distribution system.

Group 2: broadcast reception equipment which is not included in Group 1.

AM/FM/DAB equipment with a coaxial broadcast receiver tuner port is classified as Group 2 equipment if the manufacturer declares that the equipment is not intended to be connected to a CATV or other cable distribution network.

A.3 Mode of operation

The broadcast reception function shall be tested in each reception mode for which the receiver is designed, for example analogue reception, DVB-T, DVB-T2, DVB-C, DVB-C2, DVB-S, DVB-S2. The receiver shall be tuned to one channel and provided with an appropriate wanted signal on that channel as described in Table A.1 or other input typical of normal use.

Preliminary tests may be performed to determine the worst case mode of operation and tuned channel, which will be used for formal testing. The conclusions shall be recorded in the test report.

Table A.1 – Examples of specifications of digital broadcast signals

Digital broadcasting	DVB	ISDB	ATSC	DMB-T
Standard	TR 101 154	-	ATSC standard A/65	System-A (DAB/Eureka-147)
Source coding	MPEG-2 video MPEG-2 audio	MPEG-2 video MPEG-2 audio	MPEG-2 video AC-3 audio	H.264/MPEG-4 AVC
Data coding	Optional	Optional	Optional	Optional
Video elementary stream	Colour bar, with small moving element	Colour bar, with small moving element	Colour bar, with small moving element	Colour bar, with small moving element
Video bit rate	6 MBit/s	6 MBit/s	6 MBit/s	(1 ~ 11) Mbit/s
Audio elementary stream for reference measurement	1 kHz/full range – 6 dB	1 kHz/full range – 6 dB	1 kHz/full range – 6 dB	1 kHz/full range – 6 dB
Audio elementary stream for noise measurement	1 kHz/silence	1 kHz/silence	1 kHz/silence	1 kHz/silence
Audio bit rate	192 kbit/s	192 kbit/s	192 kbit/s	192 kbit/s
Terrestrial TV	DVB-T	ISDB-T	ATSC	DMB-T
Standard	EN 300 744	ARIB STD-B21 ARIB STD-B31	ATSC 8VSB	System-A (DAB/Eureka-147)
Level	50 dB(μV)/75 Ω-VHF B III 54 dB(μV)/75 Ω-UHF B IV/V	34 dB(μV) to 89 dB(μV)/75 Ω	54 dB(μV) (using ATSC 64/B)	18 dB(μV) ~ 97 dB(μV)
Channel	6 to 69	-	2 to 69	-
Frequency	-	470 MHz to 770 MHz, 5,7 MHz bandwidth		174 MHz ~ 216 MHz
Modulation	OFDM	OFDM	8 VSB or 16 VSB	DQPSK, transmission: OFDM
Mode	2 k or 8 k	8 k, 4 k, 2 k	-	-
Modulation scheme	16 or 64QAM or QPSK	QPSK, DQPSK, 16 QAM, 64QAM	-	-
Guard interval	1/4, 1/8, 1/16, 1/32	1/4, 1/8, 1/16, 1/32	-	-
Code rate	1/2, 2/3, 3/4, 5/6, 7/8	1/2, 2/3, 3/4, 5/6, 7/8	2/3	-
Useful bit rate	Variable MBits	-	19,39 MBit/s	-
Information bit rate: max	31,668 MBit/s	23,234 MBit/s	-	-
Satellite TV	DVB-S	DVB-S (communication satellite)	ISDB-S (broadcasting satellite)	None
Specification	EN 300 421	ARIB STD-B1	ARIB STD-B20 ARIB STD-B21	-
Level	60 dB(μV)/75 Ω	48 dB(μV) to 81 dB(μV)/75 Ω	48 dB(μV) to 81 dB(μV)/75 Ω	-

Frequency	0,95 GHz to 2,15 GHz	12,2 GHz to 12,75 GHz	11,7 GHz to 12,2 GHz	-
Frequency 1 st IF	-	1 000 MHz to 1 550 MHz, 27 MHz bandwidth	1 032 MHz to 1 489 MHz, 34,5 MHz bandwidth	-
	-	12,5 GHz to 12,75 GHz	11,7 GHz to 12,2 GHz	-
Modulation	QPSK	QPSK	TC8PSK, QPSK, BPSK	-
Code rate	3/4	1/2, 2/3, 3/4, 5/6, 7/8	2/3 (TC8PSK), 1/2, 2/3, 3/4, 5/6, 7/8 (QPSK, BPSK)	-
Useful bit rate	38,015 MBit/s	29,2 MBits/s ($r = 3/4$)	-	-
Information bit rate	-	19,4 MBits/s to 34,0 MBits/s	-	-
Information bit rate: max	-	34,0 MBits/s	52,17 MBits/s	-
Cable TV	DVB-C	ISDB-C	ATSC	None
Specification	EN 300 429 ES 201 488 ES 202 488-1 EN 302 878 (DOCSIS)	JCTEA STD-002 JCTEA STD-007	ANSI/SCTE 07	-
Level	67 dB(μV) at 75 Ω for 256 QAM 60 dB(μV) at 75 Ω for 64 QAM	49 dB(μV) to 81 dB(μV)/75 Ω (64 QAM) TDB (256 QAM)	60 dB(μV)/75 Ω	-
Frequency	110 MHz to 862 MHz	90 MHz to 770 MHz, 6 MHz bandwidth	88 MHz to 860 MHz	-
Modulation	16/32/64/128/256 QAM	64 QAM or 256 QAM	64 QAM or 256 QAM	-
Useful bit rate	38,44 MBits/s (64 QAM) and 51,25 MBits/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	-	26,97 MBits/s (64 QAM), 38,81 MBits/s (256 QAM)	-
Transmission bit rate	41,71 MBits/s (64 QAM) 55,62 MBits/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	31,644 MBits/s (64 QAM) 42,192 MBits/s (256 QAM)	-	-
Information bit rate max	51,25 MBits/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	29,162 MBits/s 38,883 MBits/s (256 QAM)	-	-
Return path	-	-	5 MHz to 40 MHz, QPSK	-

A.4 Modified test levels and performance criteria

The broadcast reception function shall comply with the general performance criteria given in Clause 8 and any relevant annex with the deviations defined in Table A.2.

NOTE For the continuous RF electromagnetic field immunity test specified in the table clauses 1.2 and 1.3, deviations apply for in-band frequencies. The deviations depend on the class of the broadcast receiver (Group 1 or 2) and are defined in Table A.2.

**Table A.2 – Modified test levels for performance criterion A
for the broadcast reception function**

Performance criteria	Test type table clause	Group 1	Group 2
A	1.2 1.3	The disturbance level is reduced to 1 V/m for in-band frequencies.	No test requirements apply
	2.1 3.1 4.1	The disturbance level is reduced to 1 V for in-band frequencies.	
In-band is defined as the entire tuneable operating range of the selected broadcast reception function.			
The tuned channel $\pm 0,5$ MHz (lower edge frequency – 0,5 MHz up to the upper edge frequency + 0,5 MHz of the tuned channel) is excluded from testing.			
NOTE In some countries, there is a requirement to test the tuned channels. Refer to the relevant regional requirements for guidance.			

Annex B (normative)

Print function

B.1 Applicability

The print function is the rendering of patterns on to media, to create patterns that are readable by humans or machines by sensing the reflection or transmission of light, and that are retained on the media after the print function has ended. The patterns may include text, photographs, drawings, bar codes, or other patterns.

The image content exists as analogue or digital electrical signals during or immediately prior to printing. The print function may render the image on various types of media such as paper, cloth, ceramic, or film. The image may be rendered onto the media using a number of materials such as dyes, pigments, inks, thermoplastic toners, or waxes. The image may also be rendered onto the media by a variety of processes such as exposing the media to heat or light.

Functions designed to store large amounts of data for magneto-optical retrieval, such as in a DVD recorder, are not covered by Annex B.

B.2 Mode of operation

Printing shall be performed in the presence of the EM disturbance, and the results shall be compared with results in undisturbed operation.

A particular test pattern is not specified, but a suitable image and conditions shall be selected so as to evaluate the performance specified by the manufacturer. The following are examples of features for a test pattern:

- text with three or more font types or sizes;
- one or more grids of lines, to aid in detecting any stretch or compression of the printed image;
- some regions of the image should include the highest possible detail resolution (dots per centimetre or per square centimetre);
- various levels of shading or half-toning;
- multiple colours, where available.

B.3 Performance criteria

B.3.1 Performance criterion A

Apply criterion A as defined in 8.2. Additionally, the following shall not occur as a consequence of the application of the disturbance:

- change of operating state;
- unintended pausing of the print operation;
- a change of print quality or legibility, as appropriate to the test pattern;
- change of character font;
- unintended line feed;
- unintended page feed;

- paper feed failure.

B.3.2 Performance criterion B

Apply criterion B as defined in 8.3 with the following specifics and additional limitations.

Paper feed failures are allowed only if, after removal of the jammed sheets, the job is automatically recovered and there is no loss of printed information.

Any low-quality print output caused by the application of the disturbance shall not continue beyond the sheet of media being printed, or beyond the typical length of a finished page or sheet printed from continuous roll media.

False indicators are permitted during the test provided that a normal operator response to that false indicator is simple (such as pressing a button). False indicators are not acceptable if they would cause the user to discard printing supplies such as ink, toner or paper, when those supplies are actually not empty or faulty. Any false indicator shall either clear automatically or after the operator's response.

After the disturbance, the print function may print the remainder of the print job at a quality level within the manufacturer's specifications. Alternately, the print function may halt processing of a print job as a result of the disturbance, but only if the operator is capable of reprinting the job (for example, a fax printing job where the image to be printed still resides in local memory). Automatically restarting the print job from the beginning is also acceptable. In any scenario, the pairing of front and back images during double-sided printing shall be correct.

B.3.3 Performance criterion C

Apply criterion C as defined in 8.4.

Annex C (normative)

Scan function

C.1 Applicability

The scan function illuminates an object, or part of an object, and creates an electronic representation of an image of the object. Flat bed scanners, bar code scanners, finger print readers and copying machines typically have functions within the scope of Annex C.

Functions designed to record images of complex 3-dimensional shapes, distant objects, or moving action, such as those in most digital cameras or video cameras, are outside the scope of Annex C.

C.2 Mode of operation

Scanning shall be performed during the test, and the results of the scanning shall be compared with the results generated when not subject to interfering signals.

The object scanned shall be appropriate for the type of scanner and shall be sufficiently complex to allow the performance of the EUT to be evaluated.

The test object for a document scanner should include the following features:

- text with three or more font types;
- one or more grids of lines, to aid in detecting any stretch or compression of scanned images;
- image content in various parts of the scanned area that has fine detail, to aid in detecting changes to scan resolution (pixels per centimetre or per square centimetre);
- various levels of shading or half-toning;
- multiple colours, if the scan function is designed to detect colour variations.

C.3 Performance criteria

C.3.1 Performance criterion A

Apply criterion A as defined in 8.2. Additionally, the following shall not occur as a consequence of the application of the test:

- change of settings, such as which side(s) of the page to be scanned, colour or monochrome, and resolution;
- corruption of the image, for example stretching, compressing or change in colour;
- paper feed failures;
- errors in the reading of bar codes.

C.3.2 Performance criterion B

Apply criterion B as defined in 8.3 with the following specifics and additional limitations:

- Document feed failures are allowed only if the original documents are undamaged and, after removal of the jammed sheets, the job is automatically recovered and there is no loss of scanned information.

- During the test, the representation of the image shall not be degraded such that reading mistakes occur.

C.3.3 Performance criterion C

Apply criterion C as defined in 8.4.

Annex D (normative)

Display and display output functions

D.1 Applicability

A display function is the presentation of an image or sequence of images to a viewer. It does not include images presented on removable media, such as sheets of paper. Examples of equipment with a display function are: TV set; notebook computer; computer monitor; calculator; telephone; electronic musical instrument.

A display output function creates a set of signals representing visual information, and presents those signals at a port intended by the manufacturer for direct connection to external equipment having a display function. Examples of equipment with display output functions are DVD player; set-top box; DVR; HDD player; personal computer.

Video outputs intended for further processing (and that are not intended to be directly connected to a display) are outside the scope of Annex D.

D.2 Mode of operation

D.2.1 Test signals and conditions

The EUT shall be exercised with the most complex image from Table D.1 that it is capable of displaying. Where the user can select different spatial resolutions or field/frame rates, the highest number of pixels and field/frame rates that are typical of normal use shall be selected. When there is more than one display or display output, each display or display output shall be configured using this requirement and taking into account the maximum performance of each display or display output.

Where an input signal to the EUT is required to provide the displayed image, the characteristics of that input signal (for example, its amplitude) shall be typical of normal use.

The display images may be modified, when necessary to monitor primary functions of the EUT. Where possible, these modifications should be restricted to the bottom or top half of the display area so that the image defined in Table D.1 fills the majority of the display.

Table D.1 – Prioritised list of display images

Complexity	Display image	Description	Examples of appropriate equipment
4 (Most)	Colour bars with moving picture element	Standard colour bar image with a small moving element.	Digital television set, set-top box, personal computer, DVD player, video game player, video camera.
3	Colour bars	Standard colour bar image.	Analogue television set, display on a still camera, display on photo printer.
2	Text image	A pattern consisting of all H characters shall be displayed. If the H character is not available, another character of similar complexity shall be selected. The character size and number of characters per line shall be set so that typically the greatest number of characters per screen is displayed. If text scrolling is supported on the display, the text shall scroll (except during power frequency magnetic field testing of a CRT).	POS terminal, telephone, computer terminal without graphic capability.
1 (Least)	Typical display	Whatever display can be generated by the EUT.	Equipment with proprietary displays and/or not capable of displaying any of the above images, for example electronic music instrument, indicator light

These requirements are also applicable to monochrome displays, for example displaying grey scale bars.

With complexity 4, the additional small moving element, such as a square that moves back and forth, or a geometric pattern that continually rotates, indicates that the display is not frozen.

The display controls, such as brightness, contrast, backlight should be left at the factory default setting established by the manufacturer.

The text display image, complexity 2, shall be used when the power frequency magnetic field test (table clause 1.1) is applied to a CRT display.

Examples of colour bars required in complexity 3 and 4 are specified in ITU-R Recommendation BT.471-1, See Figure D.1.

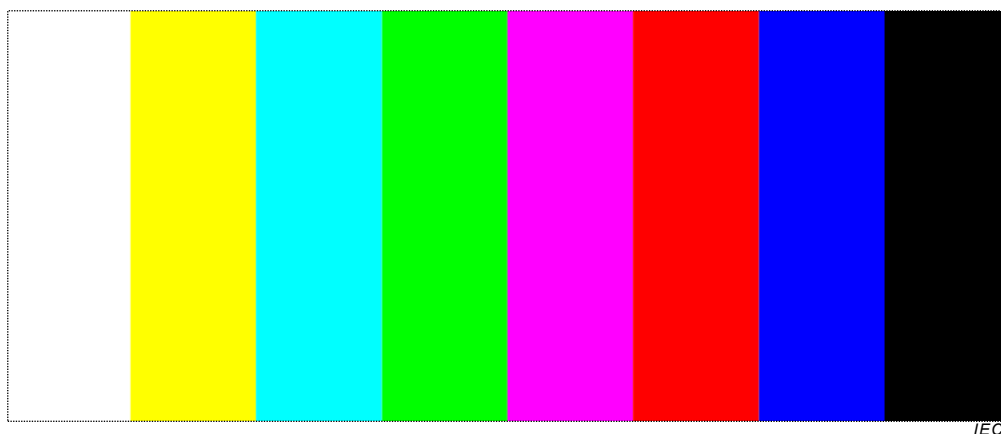


Figure D.1 – Example colour bar image

D.2.2 Display evaluation, for continuous disturbances

D.2.2.1 General

The display quality or signal quality of a display output shall be evaluated by using a subjective or automated method as defined below.

D.2.2.2 Subjective display evaluation

The display quality can be evaluated either by means of a video camera monitoring system as defined in D.2.2.4 or by direct observation.

For display output function evaluation, a suitable display device shall be connected. This device shall meet the immunity requirements for displays specified in this document. The screen size shall be typical for the display output. If the output is intended for display complexities 3 or 4 (in Table D.1) the diagonal screen size shall be at least 0,50 m.

The display shall be observed under normal viewing conditions including viewing distance using a reduced ambient light level preferably in the range 15 lx to 20 lx. The viewing distance or settings of the video camera monitoring system shall be sufficient to provide visibility of the whole display. In the case of direct observation the selected viewing distance shall be recorded in the test report.

D.2.2.3 Automated display evaluation

D.2.2.3.1 General

It should be noted that the automated method described here may not be suitable for all types of displays. Other automated methods of image evaluation may be used.

Devices that are used to capture or display the image shall have sufficient EMC immunity to allow assessment of the EUT performance.

If the output image from the video camera system is degraded by alias patterns due to the re-sampling of the displayed image by the video camera, the video camera should be slightly de-focussed so as to reduce the alias patterns to a level that will not influence the measurement result.

D.2.2.3.2 Measurement method

The automated display evaluation is a comparison of a reference image (captured while not subjected to the RF disturbance) and the image from the display during the immunity test. The

display image may be viewed directly from the EUT, or indirectly from an external device attached to a display output of the EUT. As an alternative, the image may be analysed electronically by coupling the display output to an image evaluation tool.

The image evaluation algorithm calculates the reference for the subsequent quality assessment. The display image is captured from the EUT by a video camera system or, for a display output, directly from the output signal. The image evaluation algorithm (for example in accordance with CISPR TR 29) calculates the maximum deviation and compares the result with the reference.

An example test setup for using a video camera system is shown in Figure D.2. The test setup for capturing the image directly from the display output of the EUT is shown in Figure D.3.

For the video camera capture method the following apply:

- It is necessary to ensure a precise alignment of the optical axis of the video camera system with the perpendicular axis of the EUT display to avoid geometric distortions and systematic error.
- If the video generator provides a reference synchronisation signal output, the video camera system and the video generator should be operated in synchronism.

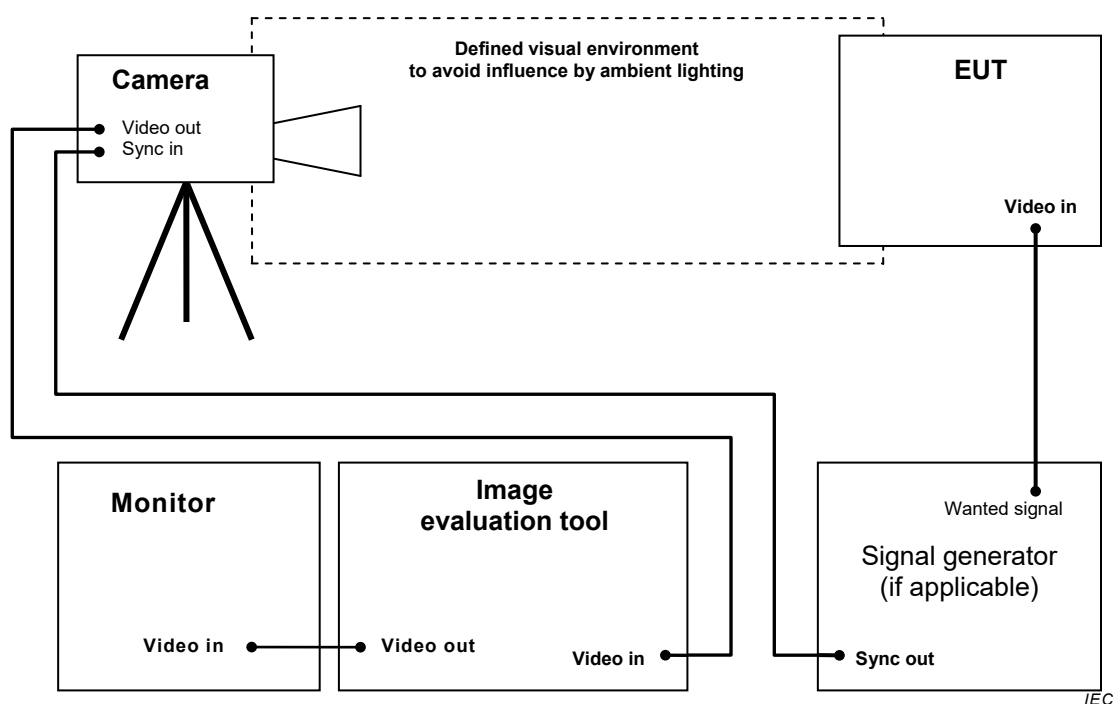


Figure D.2 – Example test setup with a video camera system for use with a display

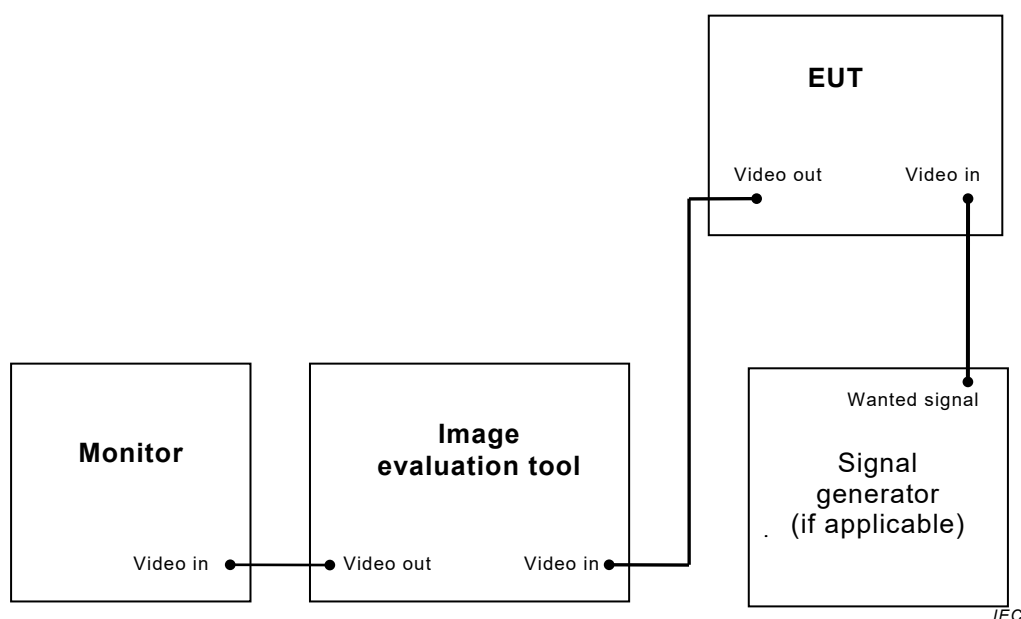


Figure D.3 – Example test setup for capturing the image directly from a display port

D.2.2.4 Characteristics of a measurement video monitor camera system

The video camera monitoring system shall be capable of reproducing the image created by the EUT well enough to allow detection of image defects. In particular, the quality of the camera's resolution and lens needs to be adequate for transmitting various kinds of picture disturbances correctly, and the settings of the camera have to be chosen carefully in order to ensure an accurate picture transmission. The camera system shall not introduce picture errors. See Table D.2 for specific characteristics.

Table D.2 – Characteristics of a measurement video camera monitor system

Specification	Remarks
Number of CCD: 3 or 1	A 3-CCD camera has high fidelity for reproduction of picture and less deviation among cameras. A 1-CCD camera has colour filters to generate the colour signal. The filter characteristic is product dependent. These cameras have a reduced colour resolution.
Gamma correction: OFF	This sets the input-output characteristic linear and reduces the deviation of output level among cameras.
Aperture correction: OFF	The value of compensation is product dependent.
Gain: 0 dB	This should not be in AGC mode because AGC response is product dependent.
Iris: f/5,6	The camera's output should not exceed its nominal white level for a peak white display on the EUT.
White balance: Auto	Set with a 100 % white signal after setting the iris.
For display images with complexity 1 or 2 (for example indicator lights, seven-segment display) a 1-CCD camera is sufficient.	
If necessary, the iris should be adjusted by monitoring the camera output with a suitable video measurement instrument when the EUT screen is displaying 100% white. The measurement should be made at the centre of the image. For example, a measurement at the midpoint of line 160 is appropriate for a 625-line camera.	

D.2.3 Display evaluation for power frequency magnetic field testing

The peak-to-peak positional disturbance (jitter) due to the disturbance shall be measured, for example by means of a measuring microscope as specified in 6.6.14 of ISO 9241-3:1992.

D.3 Performance criteria

D.3.1 Performance criterion A for continuous radiated and conducted disturbances tests

Apply criterion A as defined in 8.2. Additionally, an increase in any degradation greater than just perceptible by observation of the image shall not occur as a consequence of the application of the test. Examples of such degradations are:

- superimposed patterning;
- positional disturbances due to synchronisation errors;
- geometric distortion;
- change of contrast or brightness;
- picture artefacts;
- freezing or disturbance of motion;
- image loss;
- video data or decoding errors.

D.3.2 Performance criterion A for the power frequency magnetic field tests

Alternative 1: A continuous magnetic field of 1 A/m:

The jitter (in mm) shall not exceed the value $\frac{(\text{character height in mm} + 0,3) \times 2,5}{33,3}$

Alternative 2: An increased power frequency magnetic field ≤ 50 A/m:

The amplitude of the disturbing field shall be increased by a factor K , where $1 \leq K \leq 50$. The jitter shall not exceed K times the value given in alternative 1. The value of K should be chosen to avoid saturation of any magnetic screening materials.

When the EUT is subjected to fields above $K = 1$ and the performance criteria are satisfied for all relevant functions of the EUT, the EUT shall be deemed to satisfy the requirement. When the EUT is subjected to fields above $K = 1$ and the display function is shown to meet these performance criteria, but the performance criteria for other relevant functions are NOT satisfied, the EUT shall be retested at $K = 1$ (the field level required in table clause 1.1) to assess compliance for those other functions.

D.3.3 Performance criterion B

Apply criterion B as defined in 8.3.

D.3.4 Performance criterion C

Apply criterion C as defined in 8.4.

Annex E (normative)

Musical tone generating function

E.1 Applicability

The musical tone generating function is the reproduction of musical tones having pitch, loudness and sound type, which are individually and independently altered and controlled in accordance with control data from a keyboard controller or other control device. Examples of equipment having a musical tone generating function include:

- electronic piano,
- electronic organ,
- synthesizer,
- musical tone generator without keyboard.

Annex E does not apply to simple tones for alarms, warnings, time markers or simple feedback 'beeps' and that are typically output from equipment such as clocks, microwave ovens, and timers.

E.2 Mode of operation

To generate musical tones, auto-play or demonstration modes shall be used. Tone generation shall be performed during the test and the sound generated shall be compared with the sound generated when not subject to interfering signals.

The sequence of tones used for test may be a combination of simple musical phrases (a group of musical notes) for example repeated playing of 'sol-fa'.

E.3 Performance criteria

E.3.1 General

The particular performance criteria for evaluating the musical tone generating function are defined in E.3.2, E.3.3 and E.3.4.

E.3.2 Performance criterion A

Performance criterion A is subdivided according to the type of equipment and its use. Three subgroups corresponding to different equipment types are defined in Table E.1 and have corresponding performance criteria A1, A2 and A3. The relevant subgroup shall be selected by the manufacturer in accordance with the product specification. The description of criteria A1, A2 and A3 are presented in Table E.2.

Table E.1 – Subgroups and performance criteria A for the musical tone generating function

Equipment type and use	Subgroup	Performance Criteria
High-end quality suitable for professional use or studio recording	1	A1
Middle grade quality suitable for amateur use or home use	2	A2
Entry grade quality for practice or exercise use	3	A3

Table E.2 – Performance criteria for different subgroups given in Table E.1

Description of degradation in performance	Performance Criteria		
	A1	A2	A3
Specific unintended change in the characteristic of the tone generated 1. interruption 2. stopping (or ceasing) 3. holding 4. sudden change in amplification	Not acceptable	Not acceptable	Not acceptable
Specific unintended change in the characteristic of the tone generated 1. frequency 2. harmonic distortion	Not acceptable	Not acceptable if the degradation is beyond the level specified by the manufacturer	Not acceptable if the manufacturer judges such degradations interfere with the continuation of playing music
Other changes in the type of tone generated	Not acceptable	Not acceptable	Not acceptable if the manufacturer judges such degradations interfere with the continuation of playing music
The specified degradations shall be perceptible to a listener. During the test no performance degradation other than that permitted by this table is allowed. After the test the EUT shall operate without performance degradation.			

E.3.3 Performance criterion B

During the test, degradation of performance beyond that defined in criterion A1 of Table E.2 is allowed. However, sudden amplification of tone to a level that exceeds the expected level by more than 6 dB is not allowed.

After the test, normal operation of the EUT shall be self-recovered.

In the case of unintended tone holding caused by a MIDI protocol communication error, the EUT can be re-initialised by the operation of the controls by the user controls in accordance with the manufacturer's instructions.

Due to the nature of the MIDI protocol, it is necessary to modify the performance criterion B to allow user intervention when the unintended tone holding is caused by a missing MIDI communication error (for example missing a 'NOTE OFF' message).

E.3.4 Performance criterion C

Degradation of the performance beyond that defined in criterion A1 of Table E.2 is permitted provided that the normal operation of the EUT can be restored after the test by operator intervention. However, sudden amplification of tone to a level that exceeds the expected level by more than 6 dB is not allowed.

Annex F (normative)

Networking functions

F.1 Applicability

F.1.1 General

Annex F contains specific performance criteria and operational conditions related to networking functions. Equipment that provides these functions transmits and receives data through ports such as an analogue/digital data port. Networking functions are described further in the following subgroups:

- network switching and routing, F.1.2,
- data transmission, F.1.3,
- supervisory, F.1.4.

F.1.2 Switching and routing function

The network switching and routing function connects multiple networks or network segments together, to enable data flow between different networks or network segments. Network segments may be analogue or digital. Equipment with a network switching function includes but is not limited to: local telephone exchanges, remote network switching concentrators, international switches, telex switches, network packet switches, base station controllers, radio network controllers, and, network servers and gateways. Equipment with a routing function includes, but is not limited to gateways, network servers and network routers.

Packet-based routing and network switching functions are very similar; the differences include, but are not limited to, minor changes in data format, and addressing instructions. Based on these similarities, these functions should be treated in a similar manner.

F.1.3 Data transmission function

The data transmission function is the sending and receiving of data over long distances through an analogue/digital data port. Equipment with a transmission function includes but is not limited to analogue modems, ISDN terminals, xDSL systems, routers, multiplexers, line equipment and repeaters (SDH, PDH, ATM), digital cross connect systems, network terminations and other access network, WAN or LAN equipment.

F.1.4 Supervisory function

The supervisory function provides several network management capabilities including network efficiency, alarm monitoring, fault detection and recovery, test and diagnostics, or network maintenance. Equipment with a supervisory function includes but is not limited to network management equipment, operator access maintenance equipment, traffic measurement systems, line test units and functional test units.

F.2 Specific terminology for use within Annex F

dBm

power P in W of a signal expressed as a ratio x dB to 1 mW, calculated as

$$x = 10 \lg P + 30$$

where $P = V^2/R$ for an rms voltage V (V) across a resistance R (Ω)

NOTE In access telecommunication systems which are 600 Ω systems, 0 dBm corresponds to approximately 775 mV.

F.3 General requirements for network functions

F.3.1 General

Subclauses F.1.2 to F.3.3.3 give general requirements for network functions. More specific requirements for certain network functions or technologies are defined in Clause F.4 and shall be applied in addition to the general requirements of Clause F.3.

F.3.2 Configuration

The configuration shall:

- include a representative system with end-to-end functionality employing suitable network elements, simulators or call generators;
- provide a stable method to monitor the signal quality during testing.

Traffic passing through the switch, modem, terminal, router or transmission system shall simulate the various types of supported protocols. The loading of the system (the amount of traffic or number of calls established/re-established) shall be representative of normal operation. Where possible, signal levels transmitted and received at analogue/digital data ports shall be at a level representative of a typical installation. It may be determined by the manufacturer that one data rate (or type of transmission) represents a worst-case. In such a case, the test may be performed in only that worst-case operating mode.

Equipment used to develop this representative configuration may include, but is not limited to:

- simulators,
- dummy loads,
- loopback cables,
- line attenuators,
- other network equipment,
- software emulators,
- call traffic generators.

Where loopback cables are used to interconnect systems and ports, they should simulate normal impedance, network insertion loss, grounding and connection practices. Further guidance is given in ITU-T recommendations K.48 and K.43.

All supervisory functions shall be monitored.

F.3.3 Performance criteria

F.3.3.1 Performance criterion A

Where relevant, during the application of the test the network function shall, as a minimum, operate ensuring that:

- established connections shall be maintained throughout the application of the test;
- no change of operational state or corruption of stored data occurs;
- no increase in error rate above the figure defined by the manufacturer occurs. The manufacturer should select the most appropriate performance measurement criteria for the product or system, for example bit error rate, block error rate;
- no request for retry above the figure defined by the manufacturer;