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**Telecommunication network equipment;
Harmonised Standard for
ElectroMagnetic Compatibility (EMC) requirements**

Reference

REN/ERM-EMC-422

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Contents

Intellectual Property Rights	7
Foreword.....	7
Modal verbs terminology.....	8
1 Scope	9
2 References	10
2.1 Normative references	10
2.2 Informative references.....	12
3 Definition of terms, symbols and abbreviations.....	15
3.1 Terms.....	15
3.2 Symbols.....	17
3.3 Abbreviations	18
4 Installation environment.....	19
5 Immunity: test methods	19
5.0 General requirements	19
5.1 Electrostatic discharge.....	19
5.2 Electrical fast transients/burst.....	19
5.3 Surges	20
5.3.1 Signal line ports	20
5.3.2 AC power ports.....	20
5.4 Immunity to continuous conducted signals	20
5.4.1 Radio frequency (> 150 kHz)	20
5.4.1.1 AC power port.....	20
5.4.1.2 DC power port.....	20
5.4.1.3 Signal line port	20
5.5 Immunity to radiated electromagnetic fields	21
5.6 Voltage dips and short interruptions: AC power port.....	21
6 Emission: test methods.....	21
6.0 General	21
6.1 AC power port.....	21
6.2 DC power port.....	21
6.3 Wired network Ports.....	22
6.4 Antenna Port.....	22
6.5 Radiated emission.....	22
7 Test levels and limits.....	22
7.0 General requirements	22
7.1 Emission	22
7.1.1 Enclosure port, Radiated electromagnetic field emissions.....	22
7.1.2 AC ports.....	23
7.1.2.1 Conducted emissions.....	23
7.1.3 DC ports, Conducted emissions	23
7.1.4 Wired network ports, Conducted emissions	23
7.2 Immunity	23
7.2.0 General.....	23
7.2.1 Equipment operating in telecommunication centres	24
7.2.1.1 Telecommunication centres equipment, immunity requirement of enclosure port	24
7.2.1.2 Telecommunication centres equipment, immunity requirement of ports for outdoor signal lines and antenna ports	25
7.2.1.3 Telecommunication centres equipment, immunity requirements of ports for indoor signal lines	25
7.2.1.4 Telecommunication centres equipment, immunity requirements of AC power ports	26
7.2.1.5 Telecommunication centres equipment, immunity requirements of DC power ports	27
7.2.2 Equipment operating in locations other than telecommunication centres.....	27
7.2.2.1 Other than telecommunication centres equipment, immunity requirements of enclosure port	27

7.2.2.2	Other than telecommunication centres equipment, immunity requirements of ports for outdoor signal lines and antenna ports.....	28
7.2.2.3	Other than telecommunication centres equipment, immunity requirements of ports for indoor signal lines.....	29
7.2.2.4	Other than telecommunication centres equipment, immunity requirements of AC power ports	30
7.2.2.5	Other than telecommunication centres equipment, immunity requirements of DC power ports	30
8	General test configuration	31
9	General operational conditions during testing.....	31
9.0	General requirements	31
9.1	Equipment configuration.....	31
9.2	Operation of multimedia network equipment.....	32
10	General immunity conditions	32
10.1	General performance criteria	32
11	Switching equipment specific requirements.....	33
11.1	Test configuration.....	33
11.2	Operational conditions	34
11.2.0	General.....	34
11.2.1	Emission	34
11.2.2	Immunity	34
11.3	Specific immunity performance criteria	34
11.3.0	General.....	34
11.3.1	Digital port performance criteria	34
11.3.1.1	Performance criterion A (continuous phenomena).....	34
11.3.1.2	Performance criterion B (transient phenomena).....	34
11.3.1.3	Performance criterion C (interruptions)	35
11.3.2	Analogue port performance criteria	35
11.3.2.1	Performance criterion A (continuous phenomena).....	35
11.3.2.2	Performance criterion B (transient phenomena).....	35
11.3.2.3	Performance criterion C (interruptions)	35
12	Transmission equipment specific requirements	35
12.1	Test configuration.....	35
12.2	Operational conditions	36
12.2.0	General.....	36
12.2.1	Emission	36
12.2.2	Immunity	36
12.3	Specific immunity performance criteria	36
12.3.1	Digital signal ports.....	36
12.3.1.0	General	36
12.3.1.1	Performance criterion A (continuous phenomena).....	37
12.3.1.2	Performance criterion B (transient phenomena).....	37
12.3.1.3	Performance criterion C (interruptions)	37
12.3.2	Analogue voice frequency signal ports	37
12.3.2.0	General	37
12.3.2.1	Performance criterion A (continuous phenomena).....	37
12.3.2.2	Performance criterion B (transient phenomena).....	37
12.3.3	SDH and PDH interfaces	38
12.3.3.1	Tributary and aggregate interfaces.....	38
12.3.4	ISDN interfaces	38
12.3.4.1	Primary rate access ISDN interfaces	38
12.3.4.2	Network termination NT1 for ISDN "U" interfaces.....	38
12.3.4.3	Basic access ISDN interfaces	38
12.3.5	Analogue interfaces	38
12.3.5.1	Trunk interfaces and leased line interfaces	38
12.3.5.2	Subscriber interfaces	38
12.3.6	V.10, V.11, V.24, V.28, V.36, X.24 and similar V.- and X.- series interfaces	38
12.3.7	Ethernet and packet-data interfaces	38
12.3.7.0	General	38
12.3.7.1	Performance criterion A (continuous phenomena).....	38
12.3.7.2	Performance criterion B (transient phenomena).....	39

12.3.8	Service and maintenance interfaces	39
12.3.9	Synchronization interfaces	39
12.3.9.0	General	39
12.3.9.1	Performance criterion A (continuous phenomena)	39
12.3.9.2	Performance criterion B (transient phenomena)	39
12.3.10	Remote alarm interfaces	39
12.3.10.0	General	39
12.3.10.1	Performance criterion A (continuous phenomena)	39
12.3.10.2	Performance criterion B (transient phenomena)	39
12.4	Digital Subscriber Line (DSL) Access Systems	39
12.4.1	Test configuration	39
12.4.2	Operational conditions	40
12.4.3	Immunity	41
12.4.4	Specific Immunity performance criteria	41
12.4.4.0	General	41
12.4.4.1	Performance Criterion A (continuous phenomena)	41
12.4.4.2	Performance Criterion B (transient phenomena)	41
12.4.4.3	Performance Criterion C (interruptions)	41
13	Power supply equipment specific conditions	42
13.0	Applicability	42
13.1	Test configuration	42
13.2	Operational conditions	43
13.2.1	Emission	43
13.2.2	Immunity	43
13.3	Specific immunity performance criteria	43
13.3.0	General	43
13.3.1	Alternating current secondary interface	43
13.3.1.1	Performance criterion A (continuous phenomena)	43
13.3.1.2	Performance criterion B (transient phenomena)	43
13.3.2	Direct current secondary interface	44
13.3.2.1	Performance criterion A (continuous phenomena)	44
13.3.2.2	Performance criterion B (transient phenomena)	44
13.3.3	Control/signal interface	44
13.3.4	Tertiary supply interface	44
14	Supervisory equipment specific conditions	45
14.1	Test configuration	45
14.2	Operational conditions	45
14.3	Specific immunity performance criteria	46
14.3.1	Performance criterion A (continuous phenomena)	46
14.3.2	Performance criterion B (transient phenomena)	46
Annex A (informative):	Relationship between the present document and the essential requirements of Directives 2014/30/EU and 2014/53/EU	47
A.1	Relationship between the present document and the essential requirements of Directive 2014/30/EU	47
A.2	Relationship between the present document and the essential requirements of Directive 2014/53/EU	49
Annex B (informative):	Evaluation of test results	51
Annex C (informative):	Guidance on EMC performance requirements and methods of measurement for RF ports (also covered by EN 50083-2) of multimedia network equipment	53
Annex D (normative):	Requirements of radio functions	54
D.1	Applicability	54
D.2	Exclusion bands	54
D.2.1	General	54

D.2.2	Calculation for exclusion bands	55
D.2.2.1	Exclusion bands for receivers	55
D.2.2.1.1	For channelized systems	55
D.2.2.1.2	For non-channelized systems	55
D.2.2.2	Exclusion bands for transmitters.....	55
D.2.2.2.1	For channelized systems	55
D.2.2.2.2	For Non-Channelized Equipment.....	55
D.2.3	Example of exclusion Bands	56
D.3	Mode of operation	56
D.3.1	General	56
D.3.2	Standby Mode	56
D.3.3	Receivers	56
D.3.4	Transmitters.....	57
D.3.5	Performance criteria	57
D.3.5.1	Performance criterion A.....	57
D.3.5.2	Performance criterion B	57
D.3.5.3	Performance criterion C.....	57
Annex E (informative):	Why testing on cables shorter than 3 m in length is not required.....	58
E.1	Background	58
E.2	Emission requirements	58
E.3	Immunity requirements	58
E.3.1	Common rationale	58
E.3.2	For EN 61000-4-6 tests	58
E.3.3	For EN 61000-4-4 tests	59
E.4	Interactive aspects in EMC Tests	59
E.4.1	Introduction	59
E.4.2	For EN 61000-4-6 tests	59
E.4.3	For EN 61000-4-4 tests	61
E.5	Conclusion.....	61
Annex F (informative):	Bibliography.....	62
Annex G (informative):	Change history	63
History		64

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Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been prepared:

- under the Commission's standardisation request C(2016) 7641 final of 30.11.2016 [i.43] ('M/552'), to provide one voluntary means of conforming to the essential requirements of Directive 2014/30/EU on the harmonisation of the laws of the Member States relating to electromagnetic compatibility [i.31];
- under the Commission's standardisation request C(2015) 5376 final of 4.8.2015 [i.7] ('M/536'), to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.6].

Once the present document is cited in the Official Journal of the European Union under the Directives, compliance with the normative clauses of the present document given in tables A.1 and A.2 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of the relevant Directives and associated EFTA regulations.

National transposition dates	
Date of adoption of this EN:	12 November 2025
Date of latest announcement of this EN (doa):	28 February 2026
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2026
Date of withdrawal of any conflicting National Standard (dow):	31 August 2027

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document specifies the EMC requirements for telecommunication equipment intended to be used within a telecommunications network, which provides telecommunications between Network Termination Points (NTPs) (i.e. excluding terminal equipment beyond the NTPs). Radio functionality (e.g. Bluetooth®, Wi-Fi®, GPS) incorporated in telecommunication network equipment is also within the scope of the present document. Examples (non-exhaustive list) of such equipment are:

- 1) Switching equipment. Such equipment includes:
 - local telephone exchanges;
 - remote switching concentrators;
 - international switches;
 - telex switches;
 - network packet switches;
 - base station controllers, radio network controllers;
 - network servers and gateways.
- 2) Non-radio transmission equipment and ancillary equipment. Such equipment includes:
 - multiplexers;
 - line equipment and repeaters, e.g. equipment for:
 - Synchronous Digital Hierarchy (SDH);
 - Plesiochronous Digital Hierarchy (PDH);
 - Asynchronous Transfer Mode (ATM);such as:
 - Digital Cross Connect systems;
 - network terminations;
 - transmission equipment used in the access network like xDSL.
- 3) Power supply equipment. Such equipment includes:
 - central power plant;
 - end of suite power supplies;
 - uninterruptible power supplies;
 - stabilized AC power supplies; and
 - other dedicated telecommunication network power suppliesbut excludes equipment which is uniquely associated with or integrated in other equipment.
- 4) Supervisory equipment. Such equipment includes:
 - network management equipment;
 - operator access maintenance equipment;
 - traffic measurement systems;
 - line test units;

- functional test units.

NOTE 1: The function of *supervision* may either be performed by independent equipment or form part of other telecommunication network equipment. If the function of supervision forms part of a telecommunication network equipment, the performance may be evaluated simultaneously with other functions (such as switching and transmission) during EMC testing.

- 5) Telecommunication network equipment incorporating radio equipment.
- 6) Data centre equipment which is intended to be used within telecommunication network infrastructure:
 - Storage.
 - Processor.
 - Server.

The requirements applicable to radio interfaces of Telecommunication network equipment within the scope of the present document (e.g. Bluetooth®, Wi-Fi®, GPS) are defined in clause 7 and annex D.

The environmental classification locations used in the present document refer to ETSI TR 101 651 [i.22].

The emission requirements of the present document refer to EN 55032 [31] that have been selected to ensure an adequate level of protection to radio services.

The immunity requirements of the present document have been selected to ensure an adequate level of immunity for the apparatus covered by the scope of the present document.

General purpose equipment, which is used as a part of a telecommunication network, may be covered by the scope of other standards. Equipment which also fall within the scope of EN 50083-2 [3] may require additional testing on the relevant RF ports. See clause 9.2 and annex C.

Equipment may provide different functions, i.e. switching equipment may also provide transmission functions and transmission equipment may provide storage capabilities, etc. All available functions of the EUT are to be tested.

Technical requirements related to conducted emission EMC requirements below 9 kHz on the AC mains port of telecommunication network equipment are not included in the present document.

NOTE 2: Such technical requirements are normally found in the relevant product family standards for AC mains powered equipment (e.g. EN 61000-3-2 [i.48] and EN 61000-3-3 [i.49]).

NOTE 3: The relationship between the present document and essential requirements of annex I.1 of Directive 2014/30/EU [i.31] and/or article 3.1(b) of Directive 2014/53/EU [i.6] is given in annex A.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] [EN 55016-1-2 \(2014 + Amendment 1: 2018\)](#): "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" (produced by CENELEC).

- [2] Void.
- [3] [EN 50083-2 \(2012 + Amendment 1: 2015\)](#): "Cable networks for television signals, sound signals and interactive services - Part 2: Electromagnetic compatibility for equipment" (produced by CENELEC).
- [4] Void.
- [5] Void.
- [6] Void.
- [7] Void.
- [8] Void.
- [9] [EN 61000-4-2 \(2009\)](#): "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test", (produced by CENELEC).
- [10] [EN 61000-4-3 \(2020\)](#): "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test", (produced by CENELEC).
- [11] [EN 61000-4-4 \(2012\)](#): "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test", (produced by CENELEC).
- [12] [EN 61000-4-5 \(2014 + Amendment 1: 2017\)](#): "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test", (produced by CENELEC).
- [13] [EN 61000-4-6 \(2023\)](#): "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields", (produced by CENELEC).
- [14] [EN 61000-4-11 \(2020\)](#): "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase", (produced by CENELEC).
- [15] [ETSI EN 300 132-1 \(V2.2.1\) \(11-2022\)](#): "Environmental Engineering (EE); Power supply interface at the input to Information and Communication Technology (ICT) equipment; Part 1: Alternating Current (AC)".
- [16] [ETSI EN 300 132-2 \(V2.8.1\) \(10-2024\)](#): "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 2: -48 V Direct Current (DC)".
- [17] [IEC 60050-161 \(1990\)](#): "International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility".
- [18] [IEC 60050-714 \(1992\)](#): "International Electrotechnical Vocabulary - Chapter 714: Switching and signalling in telecommunications".
- [19] [ETSI EN 301 489-1 \(V2.2.3\) \(11-2019\)](#): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility".
- [20] [Recommendation ITU-T O.41 \(1994\)](#): "Psophometer for use on telephone-type circuits".
- [21] [ETSI EN 301 489-17 \(V3.3.1\) \(10-2024\)](#): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband and Wideband Data Transmission Systems; Harmonised Standard for ElectroMagnetic Compatibility".
- [22] Void.

- [23] [ETSI EN 301 489-19 \(V2.2.1\) \(09-2022\)](#): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band providing positioning, navigation, and timing data; Harmonised Standard for ElectroMagnetic Compatibility".
- [24] [EN 61000-4-34 \(2007 + Amendment A1: 2009\)](#): "Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase", (produced by CENELEC).
- [25] Void.
- [26] Void.
- [27] Void.
- [28] [ETSI EN 300 132-3 \(V2.3.1\) \(01-2023\)](#): "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 3: Up to 400 V Direct Current (DC)".
- [29] [Recommendation ITU-T G.812 \(2004 + Erratum 1: 2005\)](#): "Timing requirements of slave clocks suitable for use as node clocks in synchronization networks".
- [30] [Recommendation ITU-T G.813 \(2003 + Corrigendum 1: 2005 + Corrigendum 2: 2016\)](#): "Timing characteristics of SDH equipment slave clocks (SEC)".
- [31] [EN 55032 \(2015 + Amendment A11: 2020 + Amendment A1: 2020\)](#): "Electromagnetic compatibility of multimedia equipment - Emission requirements", (produced by CENELEC).

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

- [i.1] ETSI EN 300 011-1 (V1.2.2): "Integrated Services Digital Network (ISDN); Primary rate User Network Interface (UNI); Part 1: Layer 1 specification".
- [i.2] ETSI EN 300 012-1 (V1.2.2): "Integrated Services Digital Network (ISDN); Basic User-Network Interface (UNI); Part 1: Layer 1 specification".
- [i.3] ETSI EN 300 166 (V1.2.1): "Transmission and Multiplexing (TM); Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s - based plesiochronous or synchronous digital hierarchies".
- [i.4] ETSI ETS 300 232 (1993 + Amendment 1: 1996): "Transmission and Multiplexing (TM); Optical interfaces for equipments and systems relating to the Synchronous Digital Hierarchy [ITU-T Recommendation G.957 (1993), modified]".
- [i.5] ISO/IEC/IEEE 8802-3 (2014): "Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications".
- [i.6] [Directive 2014/53/EU](#) of the European Parliament and of the council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

- [i.7] [Commission Implementing Decision C\(2015\) 5376 final of 4.8.2015](#), ('M/536'), on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.
- [i.8] Recommendation ITU-T G.712 (2001): "Transmission performance characteristics of pulse code modulation channels".
- [i.9] Void.
- [i.10] Void.
- [i.11] ITU Radio Regulations (Article 1, Section VI).
- [i.12] Recommendation ITU-T G.961 (1993 + Erratum 1: 2000): "Digital transmission system on metallic local lines for ISDN basic rate access".
- [i.13] Recommendation ITU-T O.150 (1996 + Corrigendum 1: 2002): "General requirements for instrumentation for performance measurements on digital transmission equipment".
- [i.14] Recommendation ITU-T Q.552 (2001): "Transmission characteristics at 2-wire analogue interfaces of digital exchanges".
- [i.15] Recommendation ITU-T V.10 (1993): "Electrical characteristics for unbalanced double-current interchange circuits operating at data signalling rates nominally up to 100 kbit/s".
- [i.16] Recommendation ITU-T V.11 (1996): "Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s".
- [i.17] Recommendation ITU-T V.24 (2000): "List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE)".
- [i.18] Recommendation ITU-T V.28 (1993): "Electrical characteristics for unbalanced double-current interchange circuits".
- [i.19] Recommendation ITU-T V.36 (1988): "Modems for synchronous data transmission using 60-108 kHz group band circuits".
- [i.20] Recommendation ITU-T X.24 (1988): "List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) on public data networks".
- [i.21] Recommendation ITU-T X.25 (1996 + Corrigendum 1: 1998): "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".
- [i.22] ETSI TR 101 651 (V2.1.1): "Classification of the electromagnetic environment conditions for equipment in telecommunication networks".
- [i.23] EN 61000-6-1 (2019): "Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments", (produced by CENELEC).
- [i.24] Void.
- [i.25] Recommendation ITU-T G.783 (2006 + Erratum 1: 2006 + Amendment 1: 2008 + Amendment 2: 2010): "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".
- [i.26] Recommendation ITU-T G.798 (2017 + Corrigendum 1: 2018 + Amendment 1: 2018): "Characteristics of optical transport network hierarchy equipment functional blocks".
- [i.27] Void.
- [i.28] IEEE 1284™ (2000): "IEEE Standard Signalling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers".

- [i.29] IEEE 1394™ (2008): "IEEE Standard for High Performance Serial Bus Bridges".
- [i.30] Void.
- [i.31] [Directive 2014/30/EU](#) of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast).
- [i.32] Recommendation ITU-T G.996.1 (2001 + Amendment 1: 2003): "Test procedures for digital subscriber line (DSL) transceivers".
- [i.33] ETSI TS 101 135 (V1.5.3): "Transmission and Multiplexing (TM); High bit-rate Digital Subscriber Line (HDSL) transmission systems on metallic local lines; HDSL core specification and applications for combined ISDN-BA and 2 048 kbit/s transmission".
- [i.34] ETSI TS 101 524-1 (V1.1.1): "Transmission and Multiplexing (TM); Access transmission system on metallic access cables; Symmetrical single pair high bitrate Digital Subscriber Line (SDSL); Part 1: Functional requirements".
- [i.35] ETSI TS 101 270-1 (V1.4.1): "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements".
- [i.36] Recommendation ITU-T G.992.1 (1999 + Annex H: 2000 + Corrigendum 1: 2001 + Corrigendum 2: 2002 + Amendment 1: 2003 + Corrigendum of Amendment 1: 2003): "Asymmetric digital subscriber line (ADSL) transceivers".
- [i.37] Recommendation ITU-T G.992.3 (2009 + Corrigendum 1: 2009 + Amendment 1: 2010 + Amendment 2: 2010 + Amendment 3: 2010 + Corrigendum 2: 2011 + Amendment 4: 2011 + Amendment 5: 2012 + Corrigendum 3: 2013): "Asymmetric digital subscriber line transceivers 2 (ADSL2)".
- [i.38] Recommendation ITU-T G.992.5 (2009 + Corrigendum 1: 2010): "Asymmetric digital subscriber line 2 transceivers (ADSL2) - Extended bandwidth ADSL2 (ADSL2plus)".
- [i.39] Recommendation ITU-T G.993.1 (2004): "Very high speed digital subscriber line transceivers (VDSL)".
- [i.40] Recommendation ITU-T G.993.2 (2015): "Very high speed digital subscriber line transceivers 2 (VDSL2)".
- [i.41] Recommendation ITU-T G.991.1 (1998): "High bit rate digital subscriber line (HDSL) transceivers".
- [i.42] Recommendation ITU-T G.991.2 (2013 + Amendment 1: 2004 + Amendment 2: 2005 + Amendment 2 Erratum 1: 2005 + Amendment 3: 2005): "Single-pair high-speed digital subscriber line (SHDSL) transceivers".
- [i.43] [Commission implementing Decision C\(2016\) 7641](#) final of 30.11.2016, ('M/552'), on a standardisation request to the European Committee for Standardisation, to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards harmonised standards in support of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.
- [i.44] EN 50083 series: "Cable networks for television signals, sound signals and interactive services" (produced by CENELEC).
- [i.45] Void.
- [i.46] Void.
- [i.47] Void.
- [i.48] EN 61000-3-2 (2019) + Amendement 1 (2021): "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤16 A per phase)" (produced by CENELEC).

- [i.49] EN 61000-3-3 (2013) + Amendement 2 (2021): "Electromagnetic compatibility (EMC) - Part 3-3: Limits -Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection" (produced by CENELEC).
- [i.50] EN 55022:2010 "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" (produced by CENELEC).
- [i.51] EN IEC 61000-6-3:2021 "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments" (produced by CENELEC).
- [i.52] IEC TR 61000-2-5:2017 "Electromagnetic compatibility (EMC) - Part 2-5: Environment - Description and classification of electromagnetic environments" (produced by CENELEC).

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in IEC 60050-161 [17] and the following apply:

NOTE: The definitions taken from IEC 60050-161 [17] have reference in parentheses.

AC secondary interface: output port of an AC power supply

AC secondary voltage: output of the AC power supply at the AC secondary interface

NOTE: The AC secondary voltage may be either:

- a stabilized AC supply derived from a DC primary supply (e.g. where the power supply is an inverter); or
- derived from the AC primary supply (e.g. a stabilized power supply used where the quality of the primary supply is not sufficient to feed telecommunication equipment).

antenna port: port for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

burst (161-02-07): sequence of a limited number of distinct pulses or an oscillation of limited duration

channel width: bandwidth between the two frequencies f_{low} and f_{high} defined as the operating channel within ITU-R

connection: temporary association of transmission channels or telecommunication circuits, switching or other functional units set up to provide for the transfer of information between two or more points in a telecommunication network (IEC 60050-714 [18])

continuous disturbance (161-02-11): electromagnetic disturbance the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects

critical stored data: data that is essential for an EUT to operate

data centre: structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services.

NOTE: In this definition are included all facilities and infrastructures for power distribution and environmental control together with the necessary levels of resilience and security required to provide the desired service availability.

DC secondary interface: output port of a DC power supply

DC secondary voltage: output of the DC power supply at the DC secondary interface

NOTE: The DC secondary voltage may be derived from the AC primary supply with or without a buffer battery.

duration (of a pulse): interval of time between the instants at which the instantaneous value of a pulse reaches 50 % of the pulse magnitude for the first and last time

duration (of a voltage change) (161-08-03): interval of time for the voltage to increase or decrease from the initial value to the final value

enclosure port: physical boundary of the Equipment Under Test (EUT) through which electromagnetic fields may emanate or on which they may impinge

environment, environmental conditions: electromagnetic conditions external to the equipment, to which it is subjected at a certain time

NOTE: The environmental conditions comprise a combination of single environmental parameters and their severity.

environmental parameters: present one or more properties of the electromagnetic environment

exclusion band(s): frequency range(s) where the emissions are not assessed, and where during immunity test(s) the radio functionality is not required to meet the performance criteria

NOTE: Further information on exclusion bands can be found in annex D.

immunity (to a disturbance) (161-01-20): ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

impulsive disturbance (161-02-09): electromagnetic disturbance which, when incident on a particular device or equipment, manifests itself as a succession of distinct pulses or transients

integrated equipment: equipment which cannot be separated into radio and non-radio constituent products that can be assessed individually

interface "A": terminals at which a power supply is connected to the telecommunications equipment

interface A3: interface, physical point, at which power supply is connected in order to operate the telecommunications and datacom (ICT) equipment with input DC voltage between 260 V and 400 V

multimedia network equipment: network containing broadcast and telecommunication functions

Network Termination Point (NTP): physical point at the boundary of the Telecommunications Networks intended to accept the connection of a Terminal Equipment

nominal voltage: nominal value of voltage that designates the type of supply

normal service: service mode where telecommunications equipment operates within its specification

occupied bandwidth: combined bandwidth (β) of a carrier and its sidebands, below the lower, and above the upper frequency limits, the respective mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of that carrier

operating frequency: operating frequency range of the wireless technology as defined in ITU-R

performance criterion: limits of acceptable behaviour of the equipment during and after the application of the electromagnetic phenomenon

NOTE: Performance criteria A apply for continuous phenomena; performance criteria B and C apply for transient phenomena; and performance criteria R apply for resistibility phenomena.

port: particular interface of the EUT with the external electromagnetic environment

power supply: power source (within the scope of the present document) to which telecommunications equipment is intended to be connected

primary supply: public mains or a locally generated AC or DC supply

pulse (161-02-02): abrupt variation of short duration of a physical quantity followed by a rapid return to the initial value

quiescent level: steady state performance of the equipment operating as intended when configured for EMC immunity testing prior to the application of any disturbance signal

radio equipment: *"An electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radio determination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radio determination"*, definition from Directive 2014/53/EU [i.6].

Radio Frequencies (RF): frequency range above 150 kHz

radio module: piece of a radio equipment allowing the radio function of this equipment

rise time (of a pulse) (161-02-05): interval of time between the instants at which the instantaneous value of a pulse first reaches a specified lower value and then a specified upper value

NOTE: Unless otherwise specified, the lower and upper values are fixed at 10 % and 90 % of the pulse magnitude.

secondary supply: supply to the telecommunications equipment (e.g. racks or system blocks), derived from the primary supply

signal line ports: include wired network ports, RF ports or ports intended for the interconnection of components of an EUT, or between an EUT and AE and used in accordance with relevant functional specifications

NOTE: E.g. for the maximum length of cable connected to it.

surge (voltage) (161-08-11): transient voltage wave propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease of the voltage

system block: functional group of equipment depending for its operation and performance upon the secondary power supply

telecommunications network: network operated under a licence granted by a national telecommunications authority, which provides telecommunications between Network Termination Points (NTPs)

NOTE: I.e. excluding terminal equipment beyond the NTPs.

tertiary supply: supply to the telecommunications equipment derived from the secondary supply

transient (adjective or noun) (161-02-01): pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval which is short compared with the timescale of interest

wired network ports: point of connection for 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: E.g. PSTN, ISDN, xDSL, LAN and similar networks.

NOTE 2: A port generally intended for interconnection of components of the EUT (e.g. RS-232, IEEE 1284 [i.28] (parallel printer), Universal Serial Bus (USB), IEEE 1394 [i.29] ("Fire Wire"), etc.) and used in accordance with its functional specifications (e.g. for the maximum length of cable connected to it), is not considered to be a wired network port under this definition.

NOTE 3: See EN 55032 [31].

NOTE 4: These ports may support screened or unscreened cables and may also carry AC or DC power, e.g. PoE, where this is an integral part of the communication specification.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternated Current
ADSL	Asymmetric Digital Subscriber Line
AE	Auxiliary Equipment
AM	Amplitude Modulation
ATM	Asynchronous Transfer Mode
BSC	Base Station Controller
BW	BandWidth
CATV	CABLE TeleVision
CDN	Coupling Decoupling Network
CHW	CHannel Width
CPU	Central Processing Unit
DBS	Digit Broadcast Satellite
DC	Direct Current
DLU	Digital Line Unit
DSL	Digital Subscriber Line
EC	European Commission
EFT	Electrical Fast Transients
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
EN	European Norm
ESD	ElectroStatic Discharge
ETSI	European Telecommunications Standards Institute
EUT	Equipment Under Test
GLONASS	GLObal NAVigation Satellite System
GPS	Global Positioning System
HDSL	High bit-rate Digital Subscriber Line
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union - Telecommunication sector
LAN	Local Area Network
LTE	Long Term Evolution
LTG	Line Trunk Group
MATV	Master Antenna TeleVision (system)
NT	Network Termination
NTP	Network Termination Point
OBw	Occupied Bandwidth
PDH	Plesiochronous Digital Hierarchy
PoE	Power over Ethernet
POTS	Plain Old Telephone Service
PRBS	Pseudo Random Bit Sequence
PSTN	Public Switched Telecommunication Network
RF	Radio Frequency
rms	root-mean-square
RNC	Radio Network Controller
ROMES	Receive Only Mobile Earth Station
RSL	Receiver Signal Level
RX	Radio Receiver
SAT-IF	SATellite-Intermediate Frequency
SDH	Synchronous Digital Hierarchy
SDSL	Symmetrical single pair high bit rate Digital Subscriber Line
SN	Switching Network
SPL	Sound Pressure Level
TLS	Test Load Simulator
T _r /T _h	Rise time and hold time of transient signal

TS	Traffic Simulator
Tx	Radio Transmitter
Upso	Psofometric Voltage
USB	Universal Serial Bus
VDSL	Very high speed Digital Subscriber Line
xDSL	As such ADSL, HDSL, VDSL or SDSL

4 Installation environment

ETSI TR 101 651 [i.22] defines four installation environments for the equipment covered by the present document. For the purposes of the present document, these environments are classified as either:

- the telecommunication centre (major and minor); this includes Data centres, see clauses 5.1.1 and 5.1.2 of ETSI TR 101 651 [i.22];
- locations other than telecommunication centre; this includes: outdoor locations (see clause 5.2 of ETSI TR 101 651 [i.22]) and customers' premises locations (see clause 5.3 of ETSI TR 101 651 [i.22]).

5 Immunity: test methods

5.0 General requirements

Immunity requirements are defined according to the phenomena defined in EN 61000-6-1 [i.23].

Conducted immunity tests shall be applied to one port at a time.

Single EUT with multiple power ports intended to be connected to the same power source, conducted immunity tests may be applied to all these ports at the same time.

Conducted immunity test shall not be applied to the ports that, according to the product documentation, are not permanently connected but just used to setup or perform a maintenance activity of the equipment; these maintenance activities are not intended operating conditions because such connections are not present in the normal operating conditions.

Only performance criteria specified in the present document shall apply.

For equipment with a radio function, the exclusion band(s) defined in annex D shall apply.

5.1 Electrostatic discharge

The immunity test method and laboratory conditions shall be in accordance with EN 61000-4-2 [9], clauses 6 for test generator, 7.1 for test equipment, 7.2 for test setup performed in laboratories and 8 for test procedure.

The testing shall be performed by direct and indirect application of discharges to the EUT. Direct discharges shall be applied only to those points and surfaces of the EUT that are expected to be touched during normal operation including users access parts that can be touched in normal operation.

The application of discharges to any point of the EUT which are accessible only for maintenance purposes, are not required. The application of ESD to the contacts of open connectors is not required.

The selected test points shall be defined in the test plan and recorded in the test report.

5.2 Electrical fast transients/burst

The immunity test method and laboratory conditions shall be in accordance with EN 61000-4-4 [11], clauses 6 and 7.2 for test equipment, 7.3 for test setup in laboratory and 8 for test procedure.

5.3 Surges

5.3.1 Signal line ports

This requirement shall apply to both indoor and outdoor signal line ports.

The immunity test method to be used for signal line ports shall be in accordance with EN 61000-4-5 [12], clauses 6, 7.1 and 7.2 for test instrumentation, 7.4 for test on unshielded unsymmetrical lines, 7.5 for test on unshielded symmetrical lines, 7.6 for test on shielded lines and 8 for test procedure and laboratory conditions.

For ports connected to multi-conductor lines, the networks according to EN 61000-4-5 [12], clause 6.3.3, shall be used.

5.3.2 AC power ports

The immunity test method for AC power line ports shall be in accordance with EN 61000-4-5 [12], clauses 6, 7.1 and 7.2 for test instrumentation, 7.3 for test on power ports and 8 for test procedure and laboratory conditions.

This test applies to AC power input ports. It also applies to output ports of Power Supply equipment defined in clause 13 of the present document if, according to the EUT's specifications, they support cable lengths greater than 10 m.

5.4 Immunity to continuous conducted signals

5.4.1 Radio frequency (> 150 kHz)

5.4.1.1 AC power port

The test method shall be in accordance with EN 61000-4-6 [13], clauses 6 for test equipment and level adjusting, 7 for test setup and injection method and 8 for test procedure. The selection of injecting method shall be according to clause 7.4, figure 20 of EN 61000-4-6 [13].

This test applies to AC power input ports. It also applies to output ports of Power Supply equipment defined in clause 13 of the present document if, according to the EUT's specifications, they support cable lengths greater than 0,5 m.

5.4.1.2 DC power port

The test method shall be in accordance with EN 61000-4-6 [13], clauses 6 for test equipment and level adjusting, 7 for test setup and injection method and 8 for test procedure. The selection of injecting method shall be according to clause 7.4, figure 20 of EN 61000-4-6 [13].

The coupling/decoupling network type M1 as given in EN 61000-4-6 [13], annex D, shall be used when the DC return lead at the EUT side is to be connected to the equipment protective earth. If the DC return lead is not connected to the equipment protective earth then the coupling/decoupling network M2 as given in EN 61000-4-6 [13], annex D, shall be used.

This test applies to DC power input ports. It also applies to output ports of Power Supply equipment defined in clause 13 of the present document if, according to the EUT's specifications, they support cable lengths greater than 0,5 m.

5.4.1.3 Signal line port

The test method shall be in accordance with EN 61000-4-6 [13], clauses 6, for test equipment and level adjusting, 7 for test setup and injection method and 8 for test procedure. The selection of injecting method shall be according to clause 7.4, figure 20 of EN 61000-4-6 [13].

It only applies when the overall cable length between the EUT and another item of active equipment is capable of being greater than 3 m.

5.5 Immunity to radiated electromagnetic fields

The test method shall be in accordance with EN 61000-4-3 [10], clauses 6 for test instrumentation, test facility and Uniform Field Area, 7 for test setup and 8 for test procedure. The test method using the anechoic chamber, defined in annex C of EN 61000-4-3 [10] shall apply.

5.6 Voltage dips and short interruptions: AC power port

For EUT with rated input current not exceeding 16 A per phase, test method shall be in accordance with EN 61000-4-11 [14], clauses 6 for test instrumentation, 7 for test setup and 8 for test procedure.

For EUT with rated input current exceeding 16 A per phase, test method shall be in accordance with EN 61000-4-34 [24], clauses 6 for test instrumentation, 7 for test setup and 8 for test procedure.

6 Emission: test methods

6.0 General

Where not specified here, the EUT shall be configured, installed, arranged and operated in a manner consistent with the intended use of the EUT.

All emission tests defined in the present document shall be considered by the test plan.

All emission tests defined in the present document and required by the test plan shall be applied to the EUT.

For equipment with a radio function, the exclusion band(s) defined in annex D shall apply.

In the case where non compliances can be attributed to the transmission of the wanted radio signal from the EUT, these shall be disregarded.

6.1 AC power port

For conducted emission on AC power port in the frequency range 0,15 MHz to 30 MHz, the test method specified in EN 55032 [31] clause A3, table A.8 and clause A8.1, shall apply.

This test applies to AC power input ports. It also applies to output ports of Power Supply equipment defined in clause 13 of the present document if, according to the EUT's specifications, they support cable lengths greater than 3 m.

6.2 DC power port

The measuring methods shall be those specified for the AC mains interface in EN 55032 [31], clause A3, table A.8 and clause A8.1.

This test applies to DC power input ports. It also applies to output ports of Power Supply equipment defined in clause 13 of the present document if, according to the EUT's specifications, they support cable lengths greater than 3 m.

For an EUT that has several modules, each with its own power cable (however terminated) and for which the manufacturer provides a power strip (multi-socket mains splitter) with a single power cable for connection to the external power source, a single measurement shall be performed at the mains input to that power cable.

The artificial network shall be the one described in EN 55016-1-2 [1], clause 4:

- 0,15 MHz to 30 MHz: (50 Ω // 50 μ H).

The DC return lead at the EUT side shall be connected to the protective earth if this is required by the equipment installation specification.

When the use of the artificial network is not suitable (e.g. when the EUT has a current absorption higher than 200 A) the method described in EN 55016-1-2 [1], clause 5.2, for the voltage probe (1 500 Ω) may be used.

6.3 Wired network Ports

For conducted emissions on wired network ports in the frequency range 0,15 MHz to 30 MHz, the test method specified in EN 55032 [31], clause A3, table A.8 and clauses A8.2, A8.3 or A8.4, shall apply.

6.4 Antenna Port

Where the EUT has a port intended for the connection of an external antenna, the requirements of EN 55032 [31], clause A3, table A.8 and clauses A8.2, A8.3 or A8.4 for antenna ports shall apply.

6.5 Radiated emission

For radiated emission in the frequency range 30 MHz to 6 000 MHz the test method specified in EN 55032 [31], table A.1, clauses A1.1, A1.2, A1.3 and A1.4, shall apply.

7 Test levels and limits

7.0 General requirements

The EMC properties of the radio function of the EUT shall be tested against the requirements defined in annex D of the present document and, for radio technologies not covered in annex D, the applicable radio EMC standard(s) for the specific technology shall also be used. Where there are conflicts between the EMC requirements of the radio standard and the present document, the requirements of the present document shall apply.

Conducted immunity test shall not be applied to the ports that, according to the product documentation, are not permanently connected but just used to setup or perform a maintenance activity of the equipment; these maintenance activities are not intended operating conditions because such connections are not present in the normal operating conditions.

The non-radio function of the EUT shall be tested against the requirements of the present document.

7.1 Emission

7.1.1 Enclosure port, Radiated electromagnetic field emissions

For radiated emissions, the EUT with the radio function in receive mode shall comply with the limits defined in EN 55032 [31], annex A:

- for the frequency range up to 1 GHz: table A.2, clauses A2.1, A.2.2, A2.3, A2.4 or table A.4, clauses A4.1, A.4.2, A4.3, A4.4;
- for the frequency range above 1 GHz and up to 6 GHz: table A.3, clauses A3.1 and A3.2 or clauses A5.1 and A5.2.

The determination of the applicable limits shall be according to the equipment classification defined in EN 55032 [31], clause 4.

If the EUT has no receiver but just a transmitter the EUT transmitter shall be set to standby-mode.

7.1.2 AC ports

7.1.2.1 Conducted emissions

The limits defined in EN 55032 [31], annex A, table A.9, clauses A9.1 and A9.2 or table A.10, clauses A10.1 and A10.2. shall apply.

The determination of the applicable limits shall be according to the equipment classification defined in EN 55032 [31], clause 4.

7.1.3 DC ports, Conducted emissions

The limits defined in EN 55032 [31], annex A, table A.9, clauses A9.1 and A9.2 shall apply.

The limits above apply to DC power ports in any environment defined in clause 4 of the present document.

NOTE: DC power cables of telecommunication network equipment in residential environment are either shorter than 3 m or running underground.

7.1.4 Wired network ports, Conducted emissions

The limits defined in EN 55032 [31], annex A, table A.11, clauses A11.1, A11.2 and A11.3 or table A.12, clauses A12.1, A12.2 and A12.3. shall apply.

The determination of the applicable limits shall be according to the equipment classification defined in EN 55032 [31], clause 4.

7.2 Immunity

7.2.0 General

Immunity requirements are defined in clause 7.2.1 for equipment operating in telecommunication centres and clause 7.2.2 for equipment operating in other than telecommunication centre.

If no restrictions are specified in the product documentation for the installation environment; i.e. telecommunication centres or other than telecommunication centre as described in clause 4 of the present document, the equipment shall comply with the requirements of both environments.

NOTE: Surge test on DC ports is not defined in the present document because in the environment of "telecommunication centres" the DC power distribution is an indoor network in a controlled environment. Whereas in the environment "other than telecommunication centres" the DC power line is derived from an AC/DC converter with a cable shorter than 10 m and then surge test is performed on the AC port only.

7.2.1 Equipment operating in telecommunication centres

7.2.1.1 Telecommunication centres equipment, immunity requirement of enclosure port

Table 1: Telecommunication centres equipment, immunity requirement of enclosure port

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.1.1.1	Electrostatic discharge	kV kV	4 Contact Discharge 4 Air Discharge	EN 61000-4-2 [9]	B	See note 1
7.2.1.1.2	Electrostatic discharge	kV kV	4 Contact Discharge 8 Air Discharge	EN 61000-4-2 [9]	B	See note 2
7.2.1.1.3	Radio frequency electromagnetic field amplitude modulated	MHz V/m % AM (1 kHz)	80 to 690 3 80	EN 61000-4-3 [10]	A	See note 3
		MHz V/m % AM (1 kHz)	690 to 6 000 10 80			
NOTE 1: This requirement applies to telecommunication centres where ESD control practice are in place.						
NOTE 2: This requirement applies to telecommunication centres where no ESD control practice are in place.						
NOTE 3: These test levels have been selected in accordance with the radiated disturbances classified in table 6 of ETSI TR 101 651 [i.22].						

7.2.1.2 Telecommunication centres equipment, immunity requirement of ports for outdoor signal lines and antenna ports

Table 2: Telecommunication centres equipment, immunity requirement of ports for outdoor signal lines and antenna ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.1.2.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	0,5 5/50 5	EN 61000-4-4 [11]	B	For xDSL ports, repetition frequency is 100 kHz
7.2.1.2.2	Surges, port type: symmetrical unscreened Line to Ground	T_r/T_h μ s kV	10/700 (5/320) 1	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 2, 3 and 5
7.2.1.2.3	Surges, port type: asymmetrical unscreened Line to Ground Line to Line	T_r/T_h μ s kV kV	1,2/50 (8/20) 1 0,5	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 2 and 3
7.2.1.2.4	Surges, port type: coaxial or screened Shield to Ground	T_r/T_h μ s kV	1,2/50 (8/20) 1	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 3 and 4
7.2.1.2.5	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	
<p>NOTE 1: Outdoor lines carrying DC power with superimposed signals shall be treated as outdoor signal lines.</p> <p>NOTE 2: As a result of the surge, loss of function of the port under test is allowed. The function of the port under test shall be self-recoverable or restored by the intervention of the user. For the whole system, performance degradations are allowed during the application of surge and self-recovery to normal condition is required after the cessation of the test. System Software reboot is not allowed.</p> <p>NOTE 3: Primary protections shall not be in place for this test.</p> <p>NOTE 4: No surge test is required on antenna ports. Currently EN 61000-4-5 [12] does not have an effective surge test method and does not apply this test to antenna ports.</p> <p>NOTE 5: Where the presence of the surge coupling network for the 10/700 (5/320) μs waveform negatively impact the functioning of a data port (e.g. data is corrupted or insufficient data flow), the test shall be carried out using a 1,2/50 (8/20) μs waveform and the appropriate coupling network.</p>						

7.2.1.3 Telecommunication centres equipment, immunity requirements of ports for indoor signal lines

Only ports connected to inter-system cables are to be tested. Testing of ports for intra-system cabling, e.g. local alarm and control, are to be tested if according to the EUT's specifications these cables may be longer than 3 m (see "Remarks" for test applicability).

Table 3: Telecommunication centres equipment, immunity requirements of ports for indoor signal lines

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.1.3.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	0,5 5/50 5	EN 61000-4-4 [11]	B	See note 2 For xDSL ports Repetition frequency is 100 kHz
7.2.1.3.2	Surges Line to Ground	T_r/T_h μ s kV	1,2/50 (8/20) 0,5	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See note 3
7.2.1.3.3	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	See note 2
NOTE 1: Indoor lines carrying DC power with superimposed signals shall be treated as indoor signal lines.						
NOTE 2: This test applies when the overall cable length between the EUT and another item of active equipment is capable of being greater than 3 m as defined in Generic Immunity standards EN 61000-6-1 [i.23].						
NOTE 3: This test applies when the overall cable length between the EUT and another item of active equipment may be greater than 10 m as defined in EN 61000-4-5 [12].						

7.2.1.4 Telecommunication centres equipment, immunity requirements of AC power ports

Table 4: Telecommunication centres equipment, immunity requirements of AC power ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.1.4.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	1 5/50 5	EN 61000-4-4 [11]	B	
7.2.1.4.2	Surges Line to Line Line to Ground	T_r/T_h μ s kV kV	1,2/50 (8/20) 0,5 1	EN 61000-4-5 [12]	B B	
7.2.1.4.3	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	

7.2.1.5 Telecommunication centres equipment, immunity requirements of DC power ports

Table 5: Telecommunication centres equipment, immunity requirements of DC power ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.1.5.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	0,5 5/50 5	EN 61000-4-4 [11]	B	See note
7.2.1.5.2	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	See note
NOTE: This test applies when the overall cable length between the EUT and another item of active equipment is capable of being greater than 3 m as defined in Generic Immunity standards EN 61000-6-1 [i.23].						

7.2.2 Equipment operating in locations other than telecommunication centres

7.2.2.1 Other than telecommunication centres equipment, immunity requirements of enclosure port

Table 6: Other than telecommunication centres equipment, immunity requirements of enclosure port

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.2.1.1	Electrostatic discharge	kV kV	6 contact discharge 8 air discharge	EN 61000-4-2 [9]	B	
7.2.2.1.2	Radio frequency electromagnetic field amplitude modulated	MHz V/m % AM (1 kHz)	80 to 690 3 80	EN 61000-4-3 [10]	A	See note
		MHz V/m % AM (1 kHz)	690 to 6 000 10 80			
NOTE: These test levels have been selected in accordance with the radiated disturbances classified in table 6 of ETSI TR 101 651 [i.22].						

7.2.2.2 Other than telecommunication centres equipment, immunity requirements of ports for outdoor signal lines and antenna ports

Table 7: Other than telecommunication centres equipment, immunity requirements of ports for outdoor signal lines and antenna ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.2.2.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	0,5 5/50 5	EN 61000-4-4 [11]	B	For xDSL ports repetition frequency is 100 kHz
7.2.2.2.2	Surges, port type: symmetrical unscreened Line to Ground	T_r/T_h μ s kV	10/700 (5/320) 1	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 2, 3 and 5
7.2.2.2.3	Surges, port type: unsymmetrical unscreened Line to Ground Line to Line	T_r/T_h μ s kV kV	1,2/50 (8/20) 1 0,5	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 2 and 3
7.2.2.2.4	Surges, port type: coaxial or screened Shield to Ground	T_r/T_h μ s kV	1,2/50 (8/20) 1	EN 61000-4-5 [12] and clause 5.3.1 of the present document	B	See notes 2 and 4
7.2.2.2.5	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	
<p>NOTE 1: Outdoor lines carrying DC power with superimposed signals shall be treated as outdoor signal lines.</p> <p>NOTE 2: As a result of the surge, loss of function of the port under test is allowed. The function of the port under test shall be self-recoverable or restored by the intervention of the user. For the whole system, performance degradations are allowed during the application of surge and self-recovery to normal condition is required after the cessation of the test. System Software reboot is not allowed.</p> <p>NOTE 3: Primary protections shall not be in place for this test.</p> <p>NOTE 4: No surge test is required on antenna ports. Currently EN 61000-4-5 [12] does not have an effective surge test method and does not apply this test to antenna ports.</p> <p>NOTE 5: Where the presence of the surge coupling network for the 10/700 (5/320) μs waveform negatively impact the functioning of a data port (e.g. data is corrupted or insufficient data flow), the test shall be carried out using a 1,2/50 (8/20) μs waveform and the appropriate coupling network.</p>						

7.2.2.3 Other than telecommunication centres equipment, immunity requirements of ports for indoor signal lines

Only ports connected to inter-system cables are to be tested. Testing of ports for intra-system cabling, e.g. local alarm and control are to be tested if according to the EUT's specifications these cables may be longer than 3 m (see "Remarks" for test applicability).

Table 8: Other than telecommunication centres equipment, immunity requirements of ports for indoor signal lines

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.2.3.1	Fast transients	kV T_r/T_h ns Repetition frequency kHz	0,5 5/50 5	EN 61000-4-4 [11]	B	See note 2 For xDSL ports Repetition frequency is 100 kHz
7.2.2.3.2	Surges Line to Ground	T_r/T_h μ s kV	1,2/50 (8/20) 0,5	EN 61000-4-5 [12], and clause 5.3.1 of the present document	B	See note 3
7.2.2.3.3	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	See note 2
NOTE 1: Indoor lines carrying DC power with superimposed signals shall be treated as indoor signal lines.						
NOTE 2: This test applies when the overall cable length between the EUT and another item of active equipment is capable of being greater than 3 m as defined in Generic Immunity standards EN 61000-6-1 [i.23].						
NOTE 3: This test applies when the overall cable length between the EUT and another item of active equipment may be greater than 10 m as defined in EN 61000-4-5 [12].						

7.2.2.4 Other than telecommunication centres equipment, immunity requirements of AC power ports

Table 9: Other than telecommunication centres equipment, immunity requirements of AC power ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.2.4.1	Fast transients	kV T _r /T _h ns Repetition frequency kHz	1 5/50 5	EN 61000-4-4 [11]	B	
7.2.2.4.2	Surges Line to Line Line to Ground	T _r /T _h µs kV kV	1,2/50 (8/20) 1 2	EN 61000-4-5 [12]	B B	
7.2.2.4.3	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	
7.2.2.4.4	Voltage dips and short interruptions	Residual voltage % Cycle Residual voltage % Cycle Residual voltage % Cycle	0 1 70 25 0 250	EN 61000-4-11 [14] or EN 61000-4-34 [24]	B B C	

7.2.2.5 Other than telecommunication centres equipment, immunity requirements of DC power ports

Table 10: Other than telecommunication centres equipment, immunity requirements of DC power ports

	Environmental phenomenon	Unit	Test level and characteristic	Reference	Performance criterion	Remarks
Immunity						
7.2.2.5.1	Fast transients	kV T _r /T _h ns Repetition frequency kHz	1 5/50 5	EN 61000-4-4 [11]	B	See note
7.2.2.5.2	Radio frequency, conducted continuous	MHz V % AM (1 kHz) Source impedance Ω	0,15 to 80 3 80 150	EN 61000-4-6 [13]	A	See note
NOTE: This test applies when the overall cable length between the EUT and another item of active equipment may be greater than 3 m as defined in Generic Immunity standards EN 61000-6-1 [i.23].						

8 General test configuration

The EUT shall be configured and operated in accordance with its intended use.

The signal or control ports shall be correctly terminated either by auxiliary equipment necessary to exercise the ports or by their nominal impedance. These terminations (e.g. auxiliary equipment or nominal impedance) shall be connected by cables at least 3 m long within the test volume if the EUT ports can support cables length up to 3 m or more. If EUT ports cannot support cables length of 3 m, then the termination shall be connected with cables of the maximum length supported by that specific port.

Measures shall be taken to avoid any effects of unwanted signals on the measuring equipment used to monitor the performance of the EUT.

The test conditions shall be within operating ranges voltage and frequency as defined in the EUT's specifications, having regard to the supply voltage and frequency for the intended market of the EUT.

The equipment test conditions shall be as close as possible to the installed conditions, as defined in the EUT's specifications. Wiring shall be consistent with the EUT's specifications, and the equipment shall be in its housing with all covers and access panels in place as in normal operation, unless otherwise stated. If the equipment is designed to be mounted in a rack or cabinet, it should be tested in this configuration. The justification of the selected test configurations shall be included in the test plan and recorded in the test report.

The earth connections of the EUT shall be connected to a reference earth according to the EUT's specifications.

Only cables that are permanently connected shall be included.

The types of the cables connected to the EUT and port terminations shall be indicated in the test report.

9 General operational conditions during testing

9.0 General requirements

The general operational conditions shall be in accordance to the present document. Special exercising equipment and/or software may be used with the object of reducing the test time and to simulate traffic conditions.

The tests described shall be performed with the Equipment Under Test (EUT) powered up (i.e. connected to an appropriate power supply), and operating in a manner which is as representative of the EUT intended use.

9.1 Equipment configuration

Power and signal distribution, grounding, interconnecting cabling and physical placement of equipment of a test system shall simulate the application and usage in so far as is practicable and shall be in accordance with the relevant EUT's specifications.

Where equipment may be connected with cables routed either overhead or from beneath (i.e. equipment mounted on a raised floor) the equipment shall be tested in a manner representative of an installation using overhead cable routing.

EXAMPLE: Interface cables may be moved or equipment re-orientated during initial stages of testing and the effects on the results observed.

Only configurations within the range of positions likely to occur in normal use need to be considered.

The configuration selected shall be fully detailed and documented in the test report, together with the justification for selecting that particular configuration.

9.2 Operation of multimedia network equipment

Multimedia network equipment which is subjected simultaneously to different clauses of the present document and/or other standards (e.g. EN 50083-2 [3]) shall be tested with each function operating in isolation, if this can be achieved without modifying the equipment internally.

For equipment for which it is not practical to test with each function operating in isolation, or where the isolation of a particular function would result in the equipment being unable to fulfil its primary function, the equipment shall be deemed to have complied if the relevant provisions of each clause/standard are taken into account, with the necessary functions operative.

In case of emission requirements, if the limits for the different functions are not identical, the highest limits for the functions in operation apply, taking into account the specific measurement conditions related to those (highest) limits.

EXAMPLE 1: For telecommunication equipment provided with an RF port for CATV distribution, this would mean that the emission requirements at the RF port is in accordance with EN 50083-2 [3].

In case of immunity requirements, if the test levels for the different functions are not identical, the level for the function under test applies, taking into account the performance criteria for this function.

EXAMPLE 2: For telecommunication equipment provided with an RF port for CATV distribution, this would mean that the RF port is in accordance with EN 50083-2 [3].

10 General immunity conditions

10.1 General performance criteria

The general performance criteria apply for those ports for which no specific performance criteria are defined (e.g. auxiliary ports) in the present document.

Where the specific immunity criteria are not relevant or inappropriate, relevant justification shall be included in the test report highlighting how the EUT was fully exercised and met the general immunity criteria defined in this clause.

Performance criterion A:

The EUT shall continue to operate as intended. No change of operational state is allowed. No loss or unintentional change in critical stored data shall occur and no more than a 5 % degradation in transmission performance or 5 % additional errored frames above the quiescent level is allowed during the test.

For instance, in a transmission interface of 10 000 frames, it is not allowed a number of errored frames higher than 5 % of 10 000.

Performance criterion B:

Degradation of the performance below the level described in criterion A is permitted, provided the EUT self-recovers to the condition established prior to the application of the test. The EUT shall operate as intended after the test. No change of actual operating state or critical stored data is allowed.

Performance criterion C:

Degradation of performance as described in criteria A and B is permitted provided that the EUT self-recovers to the condition established prior to the application of the test, or can be restored after the test by the operator.

11 Switching equipment specific requirements

11.1 Test configuration

For network switching equipment, two separate processes are monitored simultaneously, see figure 1. The first is the continuous process of establishing and clearing connections and the second is the stable situation of monitoring signal quality during testing. It is to be considered that at least a part of the set-up for both processes covers the full signal path from subscriber to the network. The signal loop at the network end can either be established by test equipment or by a simple cable loop. In the latter case the simulation of normal grounding and connection practice is required.

The test equipment may be digital or analogue signal analyser as required. The test equipment may also loop back the test signal.

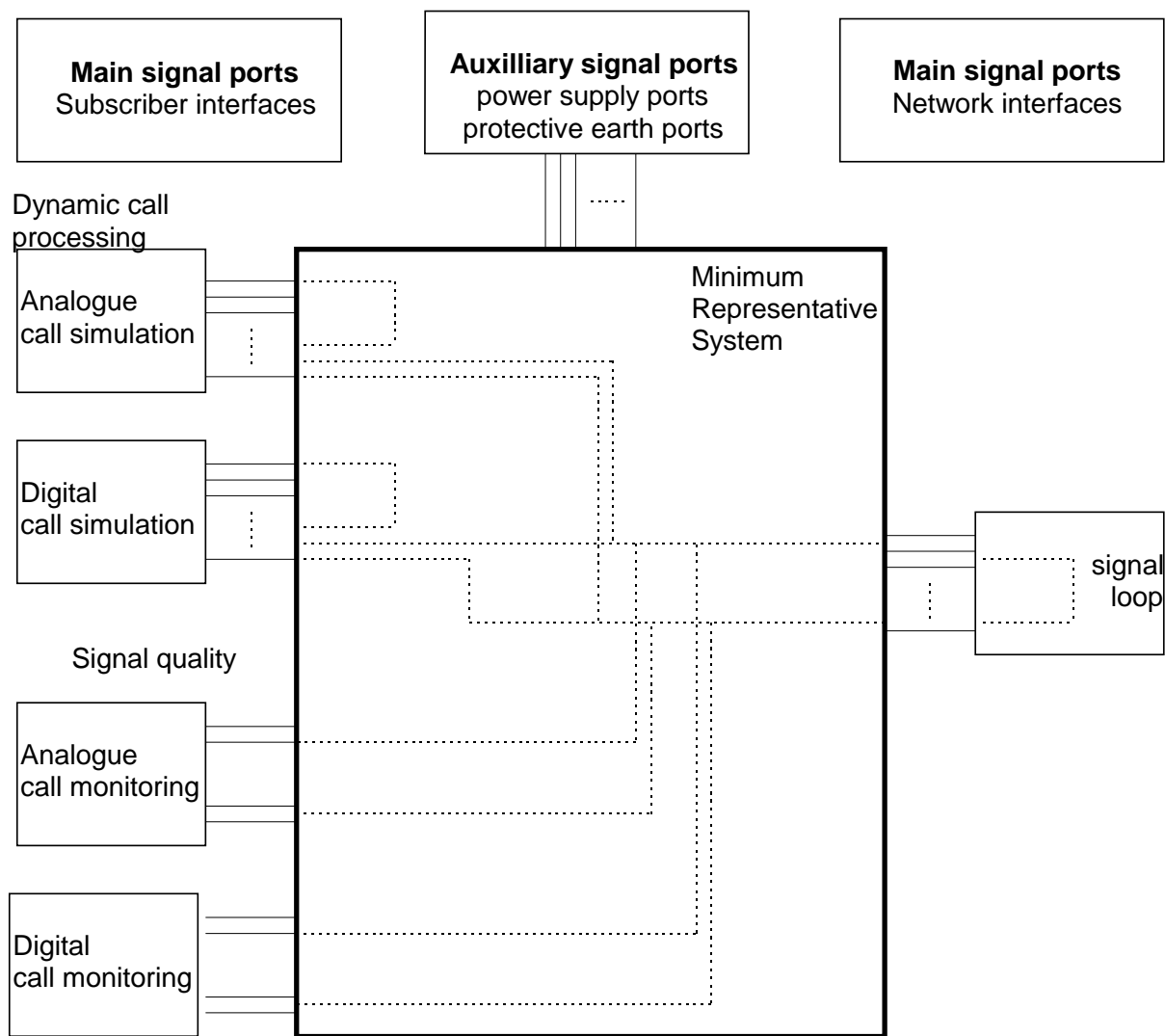


Figure 1: Schematic test configuration, switching equipment

If possible, cable harnesses shall be separated and the cables tested individually.

For Base Station Controller (BSC) and Radio Network Controller (RNC) equipment it is not necessary to exercise the continuous process of establishing and clearing connections; a representative configuration with End to End system functionality employing either core network and base station or core network and base station simulators may be tested.

11.2 Operational conditions

11.2.0 General

The general conditions of clause 9 apply.

For switching equipment with less than 32 subscriber lines (analogue or digital), all the lines shall be driven. For switching equipment with more than 32 subscriber lines (analogue or digital) a choice of at least 32 lines shall be made among the available lines. In this case, as it is impossible to do tests at all ports, single ports of each type shall be selected for the testing. At least one port of each type shall be tested.

The ports shall be configured with their nominal impedance for a connection to another port. Auxiliary equipment or loopback may be used to simulate the functional termination of the ports.

Connections have to be provided which shall be established before the start of the tests and then maintained.

11.2.1 Emission

The general requirements for test methods are described in clause 6 of the present document.

11.2.2 Immunity

The general requirements for test methods are described in clause 5 of the present document.

11.3 Specific immunity performance criteria

11.3.0 General

For the switching equipment the following main signal ports are recognized:

- analogue ports (e.g. analogue subscribers' lines, analogue interfaces to transmission equipment);
- digital ports (e.g. digital subscribers' lines (ISDN), digital connections to transmission equipment).

The interfaces shall operate as described in clauses 11.3.1 and 11.3.2.

11.3.1 Digital port performance criteria

11.3.1.1 Performance criterion A (continuous phenomena)

During the sweep:

- the established connections shall be maintained throughout testing and the transfer of information shall be within the limits of the EUT's specifications;
- loss of frame alignment or loss of synchronization is not allowed during each individual exposure (if applicable);
- no more than 5 % additional errored frames above the quiescent level shall be permitted during the exposure;

For instance, in a transmission interface of 10 000 frames, it is not allowed a number of errored frames higher than 5 % of 10 000.

11.3.1.2 Performance criterion B (transient phenomena)

The established connections shall be maintained throughout testing except in the case of surge immunity testing at 1 kV where disconnection is allowed on the port being tested:

- it shall be possible to establish a connection between two ports after the end of the transient disturbances;

- it shall be possible to clear a connection in a controlled manner after the end of the transient disturbances.

11.3.1.3 Performance criterion C (interruptions)

The general performance criterion C applies.

11.3.2 Analogue port performance criteria

11.3.2.1 Performance criterion A (continuous phenomena)

During the sweep:

- the established connections shall be maintained throughout testing;
- the noise level at a two wire analogue interface shall be less than -40 dBm at 600 Ω (ignoring the nominal impedance of the port for practical reasons) if not otherwise stated in the EUT's specifications. The measurement shall be done selectively with a bandwidth ≤ 100 Hz at 1 kHz;
- dialling tones shall be available (if applicable).

11.3.2.2 Performance criterion B (transient phenomena)

Established connections shall be maintained throughout testing except in the case of surge immunity testing at 1 kV where disconnection is allowed on the port being tested:

- it shall be possible to establish a connection between two ports after the end of the transient disturbances;
- it shall be possible to clear a connection in a controlled manner after the end of the transient disturbance.

11.3.2.3 Performance criterion C (interruptions)

The general performance criterion C of clause 10.1 applies.

12 Transmission equipment specific requirements

12.1 Test configuration

Typically the EUT will be configured as shown in figure 2. The EMC test equipment is not shown.

The test configuration shall cover a representative set up of tributary signals within the aggregate interface signals.

In figure 2 a test signal is derived from a signal generator and looped through EUT. If the EUT supports several identical channels, these may be connected in series and the test signal may be looped through all the channels.

The test equipment may be digital or analogue signal analyser as required. The test equipment may also loop-back the test signal.

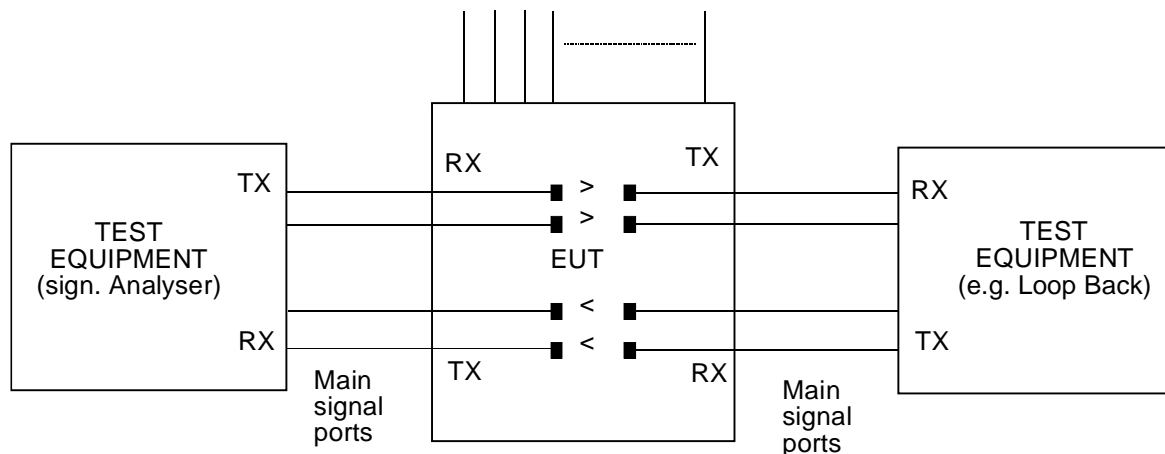


Figure 2: Schematic test configuration for transmission equipment

12.2 Operational conditions

12.2.0 General

The general conditions of clause 9 apply.

A test signal suitable for each type of port shall be used. The test signal shall be stated in the test report. The preferred test signal is the Pseudo Random Bit Sequence (PRBS) appropriate for the bit rate of the channel (Recommendation ITU-T O.150 [i.13]).

The modes of operation during testing shall be recorded in the test report.

12.2.1 Emission

The measurements shall be made in the operating mode, with the EUT producing the maximum emission, consistent with the EUT's intended use. The EUT load shall be adjusted within the range defined in the EUT's specification in order to maximize the emission.

Conducted emission shall be measured on the power input and output ports, signal ports and wired network ports.

12.2.2 Immunity

Immunity tests shall be performed at nominal values of all signal conditions and with a typical value of line attenuation as defined in the EUT's specifications.

Conducted immunity testing shall be performed on power input and output ports, signal ports and wired network ports.

For surge testing the conducted immunity tests shall be performed on auxiliary (signal) ports that are permanently connected in the normal installation.

12.3 Specific immunity performance criteria

12.3.1 Digital signal ports

12.3.1.0 General

The performance of the equipment shall be verified for digital signal ports:

- by measuring the number of induced bit errors on the main signal port during all exposures;
- by testing the functionality of the main signal port and the other signal ports after the exposure;

- by verifying that corruption of software and data held in memory has not occurred.

12.3.1.1 Performance criterion A (continuous phenomena)

The performance of the equipment shall be verified by measuring the additional errors induced due to the application of any electromagnetic phenomena. During the test sweep the established connection shall be maintained throughout the testing and the transfer of information shall be without any additional reproducible bit errors or loss of synchronization. If a degradation in performance is observed and the system is adaptive i.e. has the capability to automatically re-train in the presence of an interfering signal, then for conducted immunity tests only the following procedure shall be followed:

- 1) For each range of interfering frequencies where a degradation in performance is observed, three frequencies (beginning, middle and end) shall be identified.
- 2) At each of the frequencies identified in step 1, the interfering signal shall be turned on and the system allowed to re-train. If the system is able to re-train and then function without any additional reproducible bit errors or loss of synchronization then the system's performance is considered acceptable.

The frequencies identified in 1) and the data rates achieved in 2) shall be recorded in the test report.

12.3.1.2 Performance criterion B (transient phenomena)

Loss of frame alignment is not allowed during each individual exposure. No alarms shall be generated as a result of the electromagnetic stress.

The above does not apply to surge testing where some loss of frame alignment may be expected. For this test, the EUT shall operate as intended following the cessation of the exposure.

12.3.1.3 Performance criterion C (interruptions)

The general performance criterion C in clause 10.1 applies.

12.3.2 Analogue voice frequency signal ports

12.3.2.0 General

The performance of the equipment shall be verified for analogue voice frequency signal ports:

- by measuring the audio signal break-through (demodulated 1 kHz) on the signal port during continuous exposures in both signal path directions covering both analogue to digital conversion and digital to analogue conversion;
- by testing the functionality of the main signal port and the other signal ports after the transient exposures;
- by verifying that corruption of software and data held in memory has not occurred.

12.3.2.1 Performance criterion A (continuous phenomena)

The noise signal level received from the EUT measured in an impedance of 600 Ω shall not be greater than -40 dBm. The measurement shall be done selectively with a bandwidth ≤ 100 Hz at the exact frequency of modulation used during the radiated/conducted immunity test (i.e. 1 kHz).

Connections shall be maintained throughout the test.

12.3.2.2 Performance criterion B (transient phenomena)

The established connections shall be maintained throughout testing except in the case of surge immunity testing at 1 kV where disconnection is allowed on the port being tested.

The EUT shall return automatically to normal performance after the cessation of the exposure.

12.3.3 SDH and PDH interfaces

12.3.3.1 Tributary and aggregate interfaces

The criteria specified in clause 12.3.1 apply to the interfaces specified in ETSI EN 300 166 [i.3] (electrical interface) and ETSI ETS 300 232 [i.4], Recommendations ITU-T G.783 [i.25] and G.798 [i.26] (optical interfaces).

12.3.4 ISDN interfaces

12.3.4.1 Primary rate access ISDN interfaces

The criteria specified in clause 12.3.1 apply to the interfaces specified in ETSI EN 300 011-1 [i.1].

12.3.4.2 Network termination NT1 for ISDN "U" interfaces

The criteria specified in clause 12.3.1 apply to the interfaces specified in Recommendation ITU-T G.961 [i.12].

12.3.4.3 Basic access ISDN interfaces

The criteria specified in clause 12.3.1 apply to the interfaces specified in ETSI EN 300 012-1 [i.2].

12.3.5 Analogue interfaces

12.3.5.1 Trunk interfaces and leased line interfaces

The criteria specified in clause 12.3.2 apply to the interfaces specified in Recommendation ITU-T G.712 [i.8].

12.3.5.2 Subscriber interfaces

The criteria specified in clause 12.3.2 apply to the interfaces specified in Recommendation ITU-T Q.552 [i.14].

12.3.6 V.10, V.11, V.24, V.28, V.36, X.24 and similar V.- and X.- series interfaces

The criteria specified in clause 12.3.1 apply to the interfaces specified in Recommendations ITU-T V.10 [i.15], V.11 [i.16], V.24 [i.17], V.28 [i.18], V.36 [i.19] and X.24 [i.20].

12.3.7 Ethernet and packet-data interfaces

12.3.7.0 General

To the interfaces specified in ISO/IEC/IEEE 8802-3 [i.5] and Recommendation ITU-T X.25 [i.21], the criteria defined in clauses 12.3.7.1 and 12.3.7.2 apply.

12.3.7.1 Performance criterion A (continuous phenomena)

For interfaces which are intended for the transmission of third party data traffic, a selected port shall be connected to test equipment (e.g. a data communications analyser) as a single point-to-point data link. This will avoid excessive failed transmission attempts caused by data collisions and bus contention problems.

The interface shall be suitably exercised and monitored throughout the test period for errored frames.

No more than 5 % additional errored frames above the quiescent level shall be permitted during the exposure.

For instance, in a transmission interface of 10 000 frames, it is not allowed a number of errored frames higher than 5 % of 10 000.

12.3.7.2 Performance criterion B (transient phenomena)

The established connections shall be maintained throughout testing except in the case of surge immunity testing at 1 kV where disconnection is allowed on the port being tested.

12.3.8 Service and maintenance interfaces

The functional performance of ports of this type not intended to be permanently connected and therefore not subjected to immunity testing shall be verified according to the EUT's specifications following cessation of the electromagnetic exposure on other ports.

12.3.9 Synchronization interfaces

12.3.9.0 General

The performance of slave clocks specified in Recommendations ITU-T G.812 [29] and G.813 [30] shall be checked with the equipment synchronized with an external source.

12.3.9.1 Performance criterion A (continuous phenomena)

During the exposure, synchronization shall not be lost.

12.3.9.2 Performance criterion B (transient phenomena)

No alarm indications shall persist after the exposure.

The functional performance according to the EUT's specifications shall be verified following cessation of the exposure.

12.3.10 Remote alarm interfaces

12.3.10.0 General

These interfaces are defined in the EUT's specifications.

12.3.10.1 Performance criterion A (continuous phenomena)

No false alarms shall occur during continuous exposures.

12.3.10.2 Performance criterion B (transient phenomena)

No false alarm indications shall persist after the exposure.

12.4 Digital Subscriber Line (DSL) Access Systems

12.4.1 Test configuration

Typically the equipment shall be configured as shown in figure 3. The EMC test Equipment is not shown.

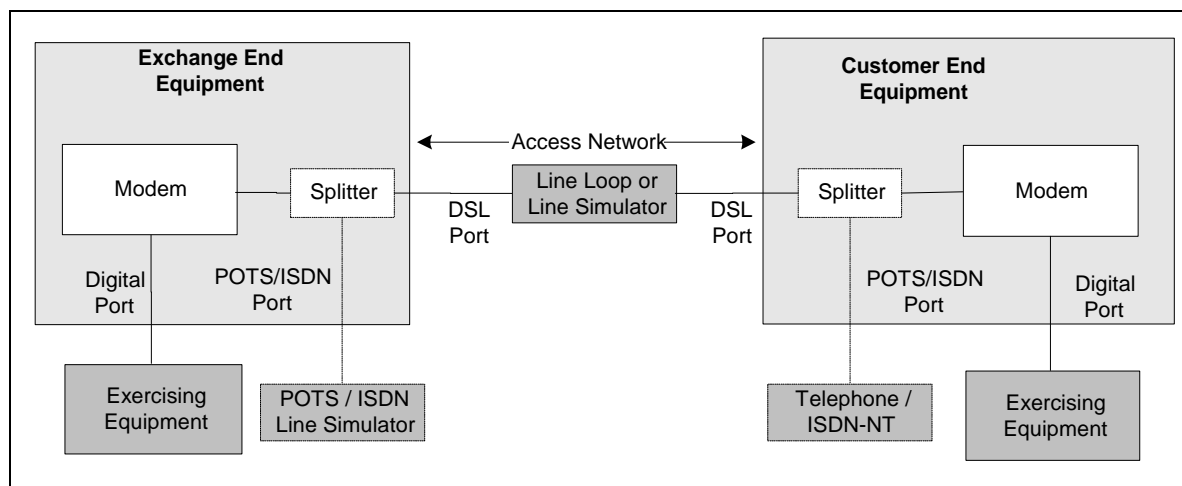


Figure 3: DSL Access System Configuration

For passband systems such as ADSL and VDSL both ends of the equipment under test typically comprise a DSL modem and splitter/filter via which the POTS/ISDN port is presented. The modem and splitter may be separate units or combined into one unit.

For baseband systems such as HDSL and SDSL or passband systems where the DSL modem does not include the splitter then the equipment under test as shown in figure 3 will not include the parts denoted with a dotted line and hence measurements at the analogue port do not apply.

For the test setup, test loops shall be configured using a line simulator or real cable lengths.

12.4.2 Operational conditions

The general conditions of clause 9 shall apply.

The measurements shall be made with the digital transmission system trained up and operating at its nominal transmission rate such that the full frequency spectrum used by the system is utilized. If the system can be operated in asymmetric and symmetric modes then the testing shall be carried out for each of these modes of operation.

Immunity testing shall be performed at nominal values of all signal conditions and with a value of the line attenuation (i.e. using real cable or line simulator) such that the system will be operating at its minimum acceptable noise margin. (E.g. 6 dB noise margin relative to the system's nominal bit error ratio of 1E-7).

Further details on the noise margin can be found in the following documents:

ADSL	Recommendation ITU-T G.996.1 [i.32] Recommendation ITU-T G.992.1 [i.36] Recommendation ITU-T G.992.3 [i.37] Recommendation ITU-T G.992.5 [i.38]
HDSL	ETSI TS 101 135 [i.33] Recommendation ITU-T G.991.1 [i.41]
SDSL	ETSI TS 101 524-1 [i.34] Recommendation ITU-T G.991.2 [i.42]
VDSL	ETSI TS 101 270-1 [i.35] Recommendation ITU-T G.993.1 [i.39] Recommendation ITU-T G.993.2 [i.40]

Ports should be either terminated in their nominal impedance or connected to auxiliary equipment that simulates the functional termination of the port. These terminations (e.g. auxiliary equipment or nominal impedance) shall be connected by cables at least 3 m long within the test volume if the EUT ports can support cables length up to 3 m or more. If EUT ports cannot support cables length of 3 m, then the termination shall be connected with cables of the maximum length supported by that specific port.

12.4.3 Immunity

The test methods are given in clause 5 of the present document. Conducted immunity testing shall be performed on all power input ports, DSL port and POTS/ISDN port.

12.4.4 Specific Immunity performance criteria

12.4.4.0 General

The performance of the equipment shall be verified by:

- Measuring the additional errors induced due to the application of any electromagnetic phenomena.
- Measuring the audio signal break-through (demodulated 1 kHz) at any POTS port whilst continuous interference phenomena are applied.
- Testing the functionality of the system at the cessation of test.
- Ensuring that any software or stored data corruption has not occurred.
- For ISDN ports the performance requirements of clause 12.3.4 shall apply.

12.4.4.1 Performance Criterion A (continuous phenomena)

During the test sweep the established connection shall be maintained throughout the testing and the transfer of information shall be without any additional reproducible bit errors or loss of synchronization. If a degradation in performance is observed and the system is adaptive i.e. has the capability to automatically re-train in the presence of an interfering signal, then for conducted immunity tests only the following procedure shall be followed:

- 1) For each range of interfering frequencies where a degradation in performance is observed, three frequencies (beginning, middle and end) shall be identified.
- 2) At each of the frequencies identified in step 1, the interfering signal shall be turned on and the system is allowed to re-train. If the system is able to re-train and then function without any additional reproducible bit errors or loss of synchronization then the system's performance is considered acceptable.

The frequencies identified in 1) and the data rates achieved in 2) shall be recorded in the test report.

During the test sweep the demodulated noise level at the POTS port shall be less than -40 dBm at 600 Ω (ignoring the nominal port impedance for practical reasons) if not otherwise stated in the EUT's specifications. The measurement shall be done selectively with a bandwidth ≤ 100 Hz at 1 kHz. As an alternative method the acoustic Sound Pressure Level (SPL) at the receiver of a telephone connected to the two-wire analogue interface shall not exceed 55 dB (SPL) when measured in a bandwidth ≤ 100 Hz at 1 kHz.

12.4.4.2 Performance Criterion B (transient phenomena)

The general performance criteria B shall apply when errors are acceptable during the application of the test. However the application of the test shall not cause the system to lose the established connection or delay function (e.g. by re-train). At the cessation of the test the system shall continue to function in the state established prior to the application of the test, without user intervention.

The above performance criterion does not apply to surge testing. For this test, the EUT shall not lose the established connection and shall operate as intended following the cessation of the exposure.

12.4.4.3 Performance Criterion C (interruptions)

The general performance criterion C in clause 10.1 applies.

13 Power supply equipment specific conditions

13.0 Applicability

This is applicable to power supplies aimed at the generation of power for distribution within telecom centres. It is not applicable to power supplies i.e. DC/DC converters, AC/DC adapters and supplies incorporated within network equipment..

13.1 Test configuration

Typically the EUT will be configured as shown in figures 4 and 5. The EMC test equipment is not shown.

The earth connections of the EUT shall be connected to a reference earth according to the EUT's specifications.

The EUT load shall be resistive unless otherwise specified in the EUT's specifications.

For EUT with DC output and battery back-up, EMC tests shall be performed without the battery unless otherwise specified.

Uninterruptible power supplies shall be tested with AC mains supply and also in the configuration when it is fed by the battery only without AC mains.

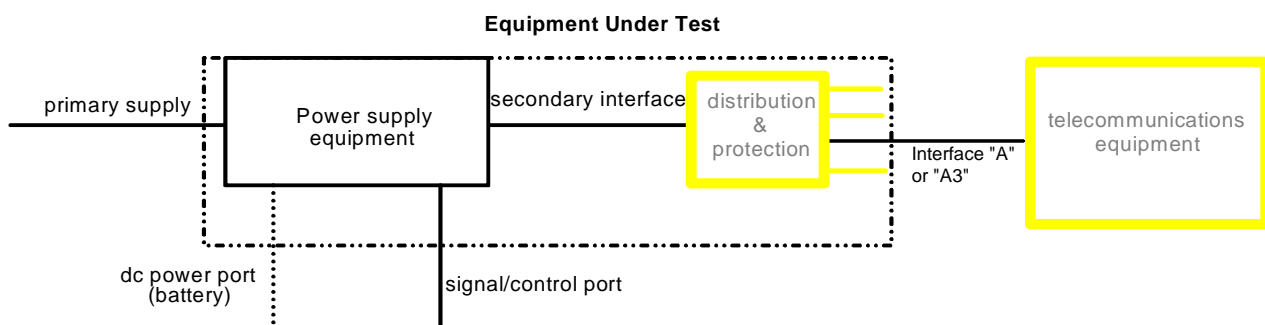


Figure 4: General identification of a power supply and its ports

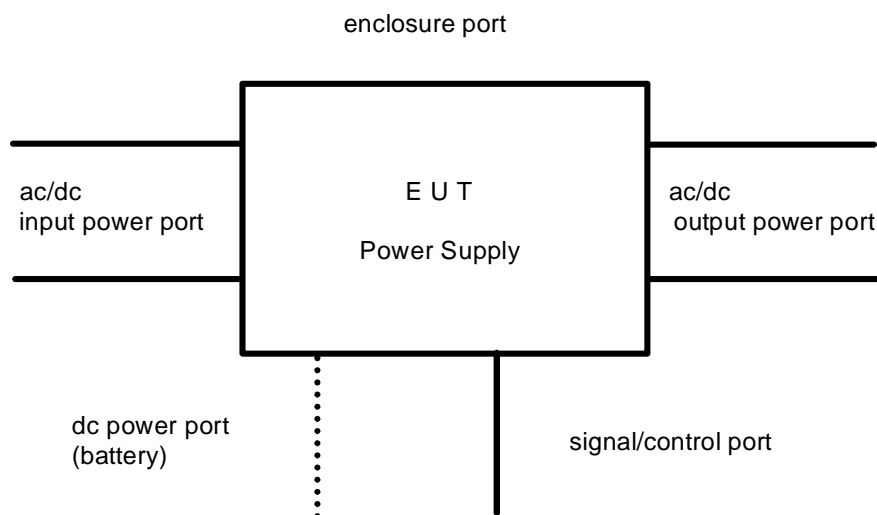


Figure 5: Port identifications of the EUT

13.2 Operational conditions

13.2.1 Emission

The measurements shall be made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load shall be adjusted within the range defined in the EUT's specifications in order to maximize the emission.

Conducted emission shall be measured on the power input and output ports.

The conducted emission tests shall only be performed on ports that are permanently connected in the normal installation.

13.2.2 Immunity

Immunity tests may be performed with the EUT operating at reduced output power but not less than 50 %. The actual output power level for each test shall be stated in the test report.

Conducted immunity tests shall be performed on the power input and output ports, and on one signal/control interface of each type found on the equipment.

The conducted immunity tests need only be performed on ports that are permanently connected in the normal installation.

13.3 Specific immunity performance criteria

13.3.0 General

The ports of the power supply equipment (figure 6) that shall be monitored during the tests can be categorized as one of:

- DC secondary interface;
- AC secondary interface; or
- control/signal interface.

13.3.1 Alternating current secondary interface

13.3.1.1 Performance criterion A (continuous phenomena)

During the exposure, the AC secondary range shall be in accordance with the normal service condition defined in ETSI EN 300 132-1 [15], clause 5.2.

The long-term voltage fluctuations at the AC secondary interface shall be within ± 10 % of the nominal voltage.

During and after the exposure, the EUT shall operate without alarms, false alarm indications (power supply failure, protection failure, etc.) and false display indications.

13.3.1.2 Performance criterion B (transient phenomena)

Voltage interruptions at the AC secondary interface shall last no longer than 20 ms. The time between two voltage interruptions shall be no less than 10 s.

The voltage fluctuations at the AC secondary interface shall be in accordance with the following requirements:

- for < 500 ms with respect to rms value: no worse than ± 15 % of nominal value defined in ETSI EN 300 132-1 [15], clause 5.1;
- for < 2 ms with respect to actual value: no worse than ± 40 % of nominal value defined in ETSI EN 300 132-1 [15], clause 5.1.

The frequency at the AC secondary interface shall not vary by more than ± 3 Hz and shall return to the nominal value within 5 s.

Peaks with a duration shorter than 0,25 of one period (5 ms for a 50 Hz system), which appear during the exposure, are permissible.

After the exposure, the EUT shall operate without alarms or false alarm indications (power supply failure, protection failure, etc.) or false display indications.

Self-recovery to normal performance shall occur at the cessation of the exposure.

13.3.2 Direct current secondary interface

13.3.2.1 Performance criterion A (continuous phenomena)

During the exposure, the DC secondary voltage range shall be in accordance with the normal service conditions defined in ETSI EN 300 132-2 [16], clause 4.2 for 48 V DC or ETSI EN 300 132-3 [28], clause 5.3 for 260 V DC to 400 V DC.

The maximum level of wide band noise at the DC secondary interface shall not exceed the limits specified in table 11.

Note: This requirement is taken from the ETSI EN 300 132-2 [16].

Table 11: Level of wide band noise

Frequency	Voltages
25 Hz to 5 kHz	10 mV U_{ps0rms} (measured over a 50 Ω impedance)

The reference method of measurement is with a psophometer that shall conform to Recommendation ITU-T O.41 [20].

During and after the exposure, the EUT shall operate without alarms or false alarm indications (power supply failure, protection failure, etc.) and false display indications.

13.3.2.2 Performance criterion B (transient phenomena)

After the exposure, the EUT shall operate without alarms or false alarm indications (power supply failure, protection failure, etc.) and false display indications:

- the DC secondary voltage during the exposure shall not exceed the following value:
 - for -48 V DC nominal value: -60 V;
 - for -60 V DC nominal value: -75 V;
 - for 365 V DC ± 15 V nominal value: 410 V;
- peaks originated from the test phenomena that appear in the secondary voltage, during the application of the tests, shall be ignored.

13.3.3 Control/signal interface

The control and signal ports need not be monitoring during the tests, because they are not considered to be primary functions.

13.3.4 Tertiary supply interface

To be considered only for special cases. Performance criteria should be derived from the product specifications.

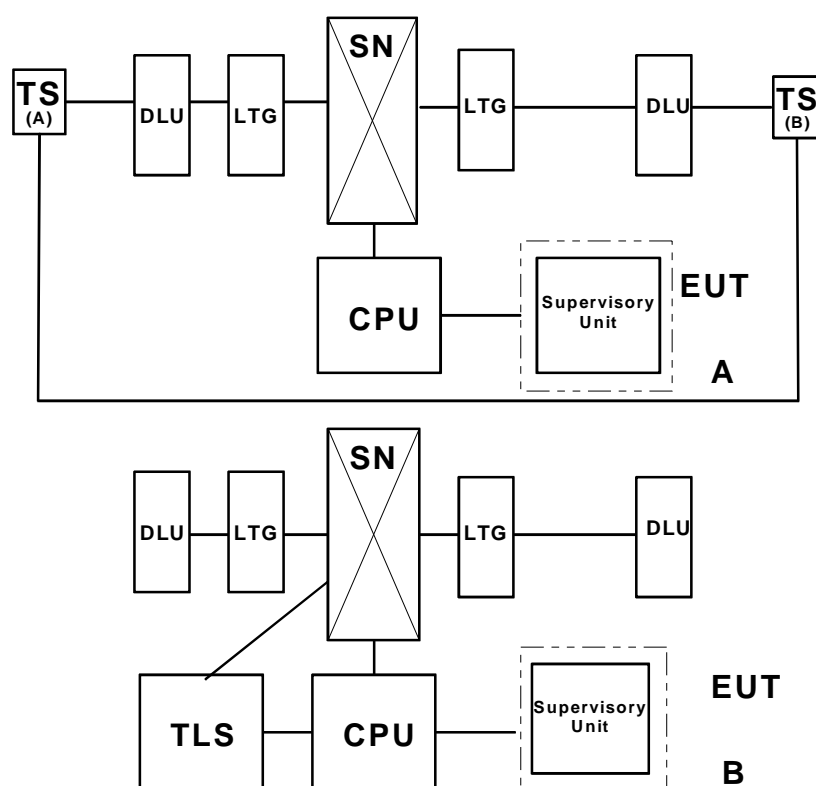
14 Supervisory equipment specific conditions

14.1 Test configuration

Exercising equipment e.g. a traffic simulator used for testing of other functions and equipment e.g. switching equipment can also be used as exercising equipment for supervisory equipment. Figure 6 shows two examples for a possible test configuration. The EMC test equipment is not shown.

Parts of the supervisory equipment (e.g. terminals) may be connected together but installed at locations other than the supervised equipment. For the purpose of EMC testing, these parts may be tested simultaneously and at the same location as the supervised equipment.

Example A shows a configuration with an external traffic simulator. In example B a test load simulator software is used. The use of either or both configurations is possible. The EMC tests shall be carried out during normal operation of supervisory equipment.



Legend: CPU = Central Processing Unit
 DLU = Digital Line Unit
 LTG = Line Trunk Group
 SN = Switching Network
 TLS = Test Load Simulator
 TS = Traffic Simulator

Figure 6: Two examples for the configuration of the EUT and exercising equipment

14.2 Operational conditions

The general conditions of clause 9 apply.

14.3 Specific immunity performance criteria

14.3.1 Performance criterion A (continuous phenomena)

The connection between the supervising and supervised equipment shall be maintained.

Supervisory functions shall continue to operate during and after the EMC testing.

No false alarms, such as signal lamps or printer misprints shall occur.

14.3.2 Performance criterion B (transient phenomena)

The supervisory equipment shall not affect the normal operation of the equipment being supervised.

The operating speed of the supervising equipment may be reduced.

Any minor priority supervisory function may be affected during EMC testing. These functions shall resume normal performance at cessation of the exposure. For example, false alarms shall reset.

Annex A (informative): Relationship between the present document and the essential requirements of Directives 2014/30/EU and 2014/53/EU

A.1 Relationship between the present document and the essential requirements of Directive 2014/30/EU

The present document has been prepared under the Commission's standardisation request C(2016) 7641 final of 30.11.2016 [i.43] ('M/552') to provide one voluntary means of conforming to the essential requirements of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility [i.31].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

**Table A.1: Relationship between the present document and
the essential requirements of Directive 2014/30/EU**

Harmonised Standard ETSI EN 300 386					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Enclosure port	Annex I. 1(a) (electromagnetic disturbances)	7.1.1	U	
2	AC ports	Annex I. 1(a) (electromagnetic disturbances)	7.1.2	C	Only applicable where equipment has AC mains power input ports. For power supply equipment as defined in clause 13, this requirement applies to AC output port in addition.
3	DC ports	Annex I. 1(a) (electromagnetic disturbances)	7.1.3	C	Only applicable where equipment has DC power input ports. For power supply equipment as defined in clause 13, this requirement applies to DC output port in addition.
4	Wired network ports	Annex I. 1(a) (electromagnetic disturbances)	7.1.4	C	Only applicable where equipment has wired network ports.
5	Enclosure port	Annex I. 1(b) (electromagnetic immunity)	7.2.1.1, 7.2.2.1	U	
6	Signal line ports	Annex I. 1(b) (electromagnetic immunity)	7.2.1.2, 7.2.1.3, 7.2.2.2, 7.2.2.3	C	Only applicable where equipment has signal line ports.
7	AC power ports	Annex I. 1(b) (electromagnetic immunity)	7.2.1.4, 7.2.2.4	C	Only applicable where equipment has AC mains power input ports. For power supply equipment as defined in clause 13, this requirement applies to AC output port in addition.
8	DC power ports	Annex I. 1(b) (electromagnetic immunity)	7.2.1.5, 7.2.2.5	C	Only applicable where equipment has DC power input ports. For power supply equipment as defined in clause 13, this requirement applies to DC output port in addition.

Key to columns:**Requirement:**

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

A.2 Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.7] ('M/536') to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.6].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.2 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table A.2: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 300 386					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Enclosure port	3.1(b)	7.1.1	U	
2	AC ports	3.1(b)	7.1.2	C	Only applicable where equipment has AC mains power input ports. For power supply equipment as defined in clause 13, this requirement applies to AC output port in addition.
3	DC ports	3.1(b)	7.1.3	C	Only applicable where equipment has DC power input ports. For power supply equipment as defined in clause 13, this requirement applies to DC output port in addition.
4	Wired network ports	3.1(b)	7.1.4	C	Only applicable where equipment has wired network ports.
5	Enclosure port	3.1(b)	7.2.1.1, 7.2.2.1	U	
6	Antenna port	3.1(b)	7.2.1.2, 7.2.2.2	C	Only applicable where equipment has an antenna port.
7	Signal line ports	3.1(b)	7.2.1.2, 7.2.1.3, 7.2.2.2, 7.2.2.3	C	Only applicable where equipment has signal line ports.
8	AC power ports	3.1(b)	7.2.1.4, 7.2.2.4	C	Only applicable where equipment has AC mains power input ports. For power supply equipment as defined in clause 13, this requirement applies to AC output port in addition.
9	DC power ports	3.1(b)	7.2.1.5, 7.2.2.5	C	Only applicable where equipment has DC power input ports. For power supply equipment as defined in clause 13, this requirement applies to DC output port in addition.

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

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Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative): Evaluation of test results

The test report will comprise:

- a) a detailed description of the EUT, the physical aspects of the set-up and of the earthing conditions;
- b) a list (and description) of the auxiliary equipment;
- c) a detailed description of the operation modes and operational status of the EUT during emission testing;
- d) the response of the EUT to the immunity test levels should be expressed in terms of the compliance criteria detailed in the present document;
- e) a description of the test conditions (including temperature and relative humidity) and test results together with the method of test. If the method used differs from the preferred method, then the deviations should be recorded and justification made in the test report;
- f) a statement of measurement uncertainty;
- g) the calibration status of all test equipment used;
- h) if an unrepeatable response occurs, this should be noted in the test report, but the response should not be taken into account in the assessment of the EUT.

Test reports

The work carried out by the testing laboratory will be covered by a report which accurately, clearly and unambiguously presents the test results and all other relevant information.

Each test report should include at least the following information:

- a) name and address of testing laboratory and location where the test was carried out when different from the address of the testing laboratory;
- b) unique identification of report (such as serial number) and of each page, and total number of pages of the report;
- c) name and address of client;
- d) description and identification of the test item;
- e) date of receipt of test item and date(s) of performance of test;
- f) identification of the test specification or description of the method or procedure;
- g) description of sampling procedure, where relevant;
- h) any deviations, additions to or exclusions from the test specification, and any other information relevant to a specific test;
- i) identification of any non-standard test method or procedure utilized;
- j) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified;
- k) a statement on measurement uncertainty (where relevant);
- l) a signature and title or an equivalent marking of person(s) accepting technical responsibility for the test report and date of issue;
- m) a statement to the effect that the test results relate only to the items tested;
- n) a statement that the report cannot be reproduced except in full without the written approval of the testing laboratory.

Particular care and attention need to be paid to the arrangement of the test report, especially with regard to presentation of the test data and ease of assimilation by the reader. The format should be carefully and specifically designed for each type of test carried out, but the headings should be standardized as far as possible.

Corrections or additions to a test report after issue can be made only by a further document suitably marked, e.g. "Amendment/Addendum to test report serial number XXX (or as otherwise identified)", and should meet the relevant requirements of the preceding clauses.

A test report should not include any advice or Recommendation arising from the test results.

Test results should be presented accurately, clearly, completely and unambiguously in accordance with instructions that may be part of the test methods.

Quantitative results should be given together with calculated or estimated uncertainty.

Test results obtained on items, which have been statistically selected from a larger lot, batch or production quantity, are frequently used to infer the properties of the lot, batch or production quantity. Any extrapolation of the test results to the properties of the lot, batch or production quantity should be contained in a separate document.

NOTE: Test results could be measured values, findings from the visual examination or practical use of the test item, derived results or any other type of observation from the testing activities. Test results may be supported by tables, photographs or graphical information of any kind appropriately identified.

Annex C (informative): Guidance on EMC performance requirements and methods of measurement for RF ports (also covered by EN 50083-2) of multimedia network equipment

This annex provides guidance on additional testing to be performed on network equipment, that is intended to be included in cable distribution systems. This type of equipment is known as "multimedia network equipment".

The rationale behind this annex is that cable distribution systems for television and sound signals are being used for many more interactive services, some network equipment can include both RF ports as defined in the EN 50083 series [i.44] and network ports, as defined in the present document (including EN 55032 [31]). Hence these additional requirements will provide a single standard for the EMC assessment of "multimedia network equipment".

RF ports of multimedia network equipment should comply with the requirements of the following clauses of EN 50083-2 [3] presented in table C.1.

Table C.1: Additional RF Port test requirements defined in EN 50083-2 [3]

Clause in EN 50083-2 [3]	Test	Specifics	Limits/ Criteria in EN 50083-2 [3] clause
4.2.3	Measurement of input terminal disturbance voltage 30 MHz to 3 GHz	This measurement is relevant for equipment directly connected to receiving antennas or to satellite outdoor units (e.g. channel converter, DBS tuner, etc.).	5.2.2
4.4.3.2	External immunity to ambient fields: In-band immunity 790 MHz to 862 MHz	This is included to state that within the LTE band the test level is 1 V/m.	
4.4.4.2	Internal immunity in the frequency range: 47 MHz to 862 MHz	Only applicable to equipment directly connected to receiving antennas (from EN 50083-2 [3], clause 4.4.4) and is an RF amplifier and converter (from EN 50083-2 [3], table 16).	5.4.2
4.4.4.3	Internal immunity in the frequency range: 10,95 GHz to 12,75 GHz	Applicable to satellite receiving outdoor units for CATV and MATV headend application.	5.4.2
4.4.4.4	Immunity of outdoor units to image frequency signals	The immunity to image frequency signals is given by the image frequency rejection ratio. This is measured for outdoor units used for the reception and conversion of TV-signals with output frequencies in the SAT-IF range.	5.4.3

Table C.2 defines which equipment falls within the scope of this annex.

Table C.2: Port structure of different network equipment

Port	Cable network equipment	Telecommunication network equipment	Multimedia network equipment
Enclosure	X	X	X
Power	X	X	X
Signal and Control	X	X	X
Earth	X	X	X
RF	X	See note	X
Telecommunication/Wired Network		X	X
NOTE: Telecommunication Network Equipment may have RF ports which are not covered by EN 50083-2 [3].			

In table C.2, cable network equipment and telecommunication network equipment have four common ports and one individual port each. Multimedia network equipment has an addition RF port as well as a telecom port.

The EMC requirements for these systems should be common, since they operate in similar environments.

Annex D (normative): Requirements of radio functions

D.1 Applicability

The present annex establishes the particular modes of operation, performance criteria and exclusion bands to be applied to the EUT radio function during emissions and immunity tests defined in clause 7.

Where the EUT contains two or more radio technologies which are intended to operate simultaneously then it shall be tested with all radio technologies operational. Where the EUT contains more than one radio technology which are intended to operate independently, each radio technology may be tested separately.

D.2 Exclusion bands

D.2.1 General

For each active wireless technology within the EUT, the exclusion band for that active technology is applicable.

Exclusion band(s) associated with the transmitter are not applicable when transmitters are in standby mode.

The exclusion band(s) for channelized and non-channelized systems are shown in figures D.1 and D.2 and determined according to clause D.2.2.

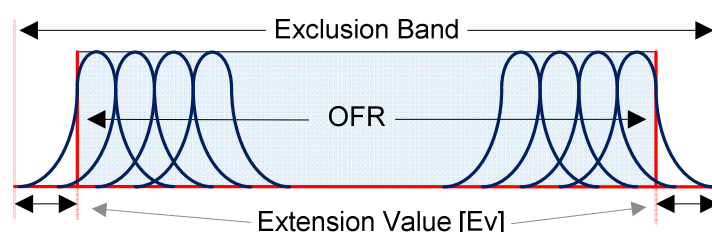


Figure D.1: Exclusion band for channelized systems

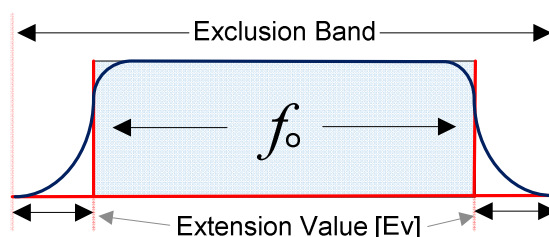


Figure D.2: Exclusion band for non-channelized systems

D.2.2 Calculation for exclusion bands

D.2.2.1 Exclusion bands for receivers

D.2.2.1.1 For channelized systems

For channelized equipment the exclusion band shall be calculated by using the following formulae:

For the lower edge for the exclusion band:

$$\text{EXband(lower)} = \text{Band}_{\text{RX}}(\text{lower}) - n\text{ChW}_{\text{RX}}$$

and for the upper edge of the exclusion band:

$$\text{EXband(upper)} = \text{Band}_{\text{RX}}(\text{upper}) + n\text{ChW}_{\text{RX}}$$

Where n = number of channel widths required for exclusion band.

The value of n shall be 1 in the absence of any blocking tests in the relevant standard for article 3.2 of reference [i.7].

NOTE: For equipment that support multiple channel widths the Channel Width used is the widest supported by the EUT.

D.2.2.1.2 For non-channelized systems

For non-channelized equipment the exclusion band shall be calculated by using the following formulae:

For the lower edge for the exclusion band:

$$\text{EXband(lower)} = \text{Band}_{\text{RX}}(\text{lower}) - n\text{BW}_{\text{RX}}$$

and for the upper edge of the exclusion band:

$$\text{EXband(upper)} = \text{Band}_{\text{RX}}(\text{upper}) + n\text{BW}_{\text{RX}}$$

Where n = multiple of whole bandwidths required to define exclusion band.

The value of n shall be 1 in the absence of any blocking tests in the relevant standard for article 3.2 of reference [i.7].

Bandwidth of Receiver is the occupied bandwidth of the corresponding transmitter signal.

NOTE: For radio technologies which include a blocking requirement, the exclusion band does not need to cover the range defined within the blocking requirement.

D.2.2.2 Exclusion bands for transmitters

D.2.2.2.1 For channelized systems

The exclusion band shall extend 250 % of the CHW either side of the transmitter centre frequency.

D.2.2.2.2 For Non-Channelized Equipment

The exclusion band shall extend 250 % of the OBw either side of the transmitter centre frequency.

NOTE: The exclusion band of 250 % is based on the ITU Radio Regulations [i.11], 1.146, 1.146A and 1.146B.

D.2.3 Example of exclusion Bands

Exclusion bands are defined in specific technology standards. Example of such standards are:

- ETSI EN 301 489-17 [21], clause 4.3 for Broadband Data Transmission Systems (e.g. Wireless LAN, Bluetooth®, Bluetooth® Low Energy, ZigBee®, Wi-Fi®).
- ETSI EN 301 489-19 [23], clause 4.3 for Receive Only Mobile Earth Stations (ROMES) (e.g. GPS).
- ETSI EN 301 489-1 [19], clause 4.3 for radio functions where no technology standards are available.

D.3 Mode of operation

D.3.1 General

The requirements of clause 7 apply. In addition, the tests shall be applied with the EUT in standby mode, if supported by the EUT.

Where external signals are required to exercise the EUT, the signal source should be located outside the test environment, this is to prevent:

- unintended interactions between the EUT and other radio equipment operating nearby;
- transmitting signals over the air which would not be allowed by country regulations.

The EUT may be exercised by connecting an appropriate signal source to the coaxial antenna port, when available, or by connecting the signal source to an antenna located within the test environment. Where the EUT has multiple coaxial antenna ports, it is recommended to connect all of these ports to coaxial cables to minimize any unwanted interactions.

Alternative to using a radio test set, a local Wi-Fi® (or cellular) network may be used provided that the correct signalling levels defined in table D.1 can be established and that an established link to the network can support the necessary traffic.

D.3.2 Standby Mode

Standby mode shall be considered as a mode of operation, where these modes may be defined as follows:

- Standby Mode 1, a condition in which the EUT is able to resume a function by way of a remotely initiated trigger from a wireless connection.
- Standby Mode 2, the EUT is powered on and active but the wireless function is off (or disabled).

NOTE: This may also be known as idle, listening or power save mode.

D.3.3 Receivers

The wanted RF signal level at the input of the EUT shall be set to value defined in table D.1 to provide a stable communication link. For radiated immunity testing this input level is measured while the power amplifiers generating the EM disturbance are switched on, but without the interfering signal source output power turned on.

Table D.1: Receiver Signal Level Input

Clause	Radio Technology	Value above RSL (see note)
D.2.1	Wireless LAN, Bluetooth® Low Energy, ZigBee®, Wi-Fi®	≤ 30 dB
D.2.2	GPS, GLONASS, GALILEO	≤ 40 dB
D.2.3	Other	≤ 40 dB
NOTE: RSL is also known as maximum useable sensitivity.		

NOTE 1: If the radiated immunity test is performed within the exclusion band(s), some additional measures may be necessary to avoid damage of the radio receiver.

NOTE 2: Be aware of the harmonics of the power amplifier which may appear in the radio receiver band and produce false failures.

NOTE 3: Where possible use a power amplifier with a low noise floor so to limit the impact on communication of the wireless function.

NOTE 4: To establish the RSL for a given test arrangement the following process may be used:

- introduce a variable attenuator into the Tx path to allow the Tx levels to be changed;
- for a given configuration, find the minimum attenuation at which the radio receiver stops working;
- decrease the attenuation by the appropriate value given in table D.1.

D.3.4 Transmitters

The RF output shall be set to the maximum transmit power level for the selected EUT operating mode.

D.3.5 Performance criteria

D.3.5.1 Performance criterion A

The following performance criteria shall apply to radio function:

- ETSI EN 301 489-17 [21], clauses 6.3 and 6.5 for Broadband Data Transmission Systems (e.g. Wireless LAN, Bluetooth®, Bluetooth® Low Energy, ZigBee®, Wi-Fi®).
- ETSI EN 301 489-19 [23], clauses 6.1 or 6.2 or 6.4 for Receive Only Mobile Earth Stations (ROMES) (e.g. GPS).
- ETSI EN 301 489-1 [19], clause 6.1 for radio functions where no technology standards are available.

No monitoring of performance is required if the disturbance is applied within an exclusion band.

D.3.5.2 Performance criterion B

The following performance criteria shall apply to radio function:

- ETSI EN 301 489-17 [21], clauses 6.4 and 6.6 for Broadband Data Transmission Systems (e.g. Wireless LAN, Bluetooth®, Bluetooth® Low Energy, ZigBee®, Wi-Fi®).
- ETSI EN 301 489-19 [23], clauses 6.1 or 6.3 or 6.4 for Receive Only Mobile Earth Stations (ROMES) (e.g. GPS).
- ETSI EN 301 489-1 [19], clause 6.2 for radio functions where no technology standards are available.

D.3.5.3 Performance criterion C

Apply the general performance criterion C defined in clause 10.1.

Annex E (informative): Why testing on cables shorter than 3 m in length is not required

E.1 Background

Historically most EMC standards, including European Norms, have exempted short cables (usually less than 3 m in length) from testing on the basis that testing such cables has no discernible impact on the EMC performance of the EUT.

Investigations were performed to support this approach and justifications are in this annex.

E.2 Emission requirements

Technically, the measurement range for conducted emissions is from 150 kHz to 30 MHz and that a quarter wavelength cable makes an effective radiator. From this, it is assumed that a 3 m cable might be an effective radiator at 25 MHz, however, this can only occur in extremely rare situations outside of the test laboratory. The reason it does not occur in the field is because the above assumption is very simplified. Indeed, the typical use of such long cable is not a straight radiator in free space comparable to a rod antenna. In use, cables are typically laid out in a random manner (not in a straight position) and generally terminated, both of which significantly reduces their effectiveness as an antenna. It is also typically positioned mainly horizontally and relatively close to the ground or other conductive parts. When the cable is curved, the effective length is reduced, causing a lower gain.

All EMC assessment and testing specifications are based on experience from around the world which is gathered by the relevant standardisation organisations (IEC). The exemption of testing is in place since the first publication of Generic Emission standards (e.g. EN 61000-6-3 [i.51]) and EMC product standards (e.g. EN 55022 [i.50] or EN 55032 [31]).

E.3 Immunity requirements

E.3.1 Common rationale

The coupling path to consider from the source to the potential victim is the capacitive coupling from cables to cables installed longitudinally. In this situation, the length of the cable has a significant impact on the coupling factor: only long cables are able to provide a significant coupling factor allowing the transfer of energy from the source to the victim.

In addition, the immunity testing methods requires a minimum length of the cable for inserting coupling devices considering some standardised distances allowing for reproducibility of the test result.

E.3.2 For EN 61000-4-6 tests

The 3 V test level defined is extremely large and would not appear in the typical installation. These levels will only occur close to radio broadcast transmitters or next to a radio amateur station.

For example, without any obstacle (e.g. walls), 3 V/m occurs at 100 m from a 1,5 kW radio amateur station, for lower power ones this drops to just over 20 m. See IEC TR 61000-2-5:2017 [i.52], table 17. Similarly, 3 V/m occurs at 1,5 km from a 500 kW radio transmitter. See IEC TR 61000-2-5:2017 [i.52], table 19. Obstacles are likely to reduce the field strength at the victim.

E.3.3 For EN 61000-4-4 tests

For the Electrical Fast Transients (EFT), the threat is noise from the AC mains due to the switching of inductive load. For short cables connected to the EUT, the EFT injection from AC mains cables, being transferred to short signal cable, is covered by the test on the AC main port (see clause E.4.3). There is an additional threat from coupling between the signal cables and an adjacent power cable. This occurs when long cables are very closely coupled, this threat is covered by an additional test on cables longer than 3 m.

E.4 Interactive aspects in EMC Tests

E.4.1 Introduction

EMC tests are interactive, when an Equipment Under Test (EUT) is being tested, so are all the cables and all the Associated Equipment (AE). For example, a Coupling Decoupling Network (CDN) is designed to isolate the AE from the EUT, so when an EFT burst is applied, for example, the voltage should only be applied to EUT, however some of the voltage is always applied to the AE.

E.4.2 For EN 61000-4-6 tests

During conducted RF immunity testing to EN 61000-4-6 [13], the EUT, AE and associated cables are within the same test loop ($300\ \Omega$), see figure E.1.

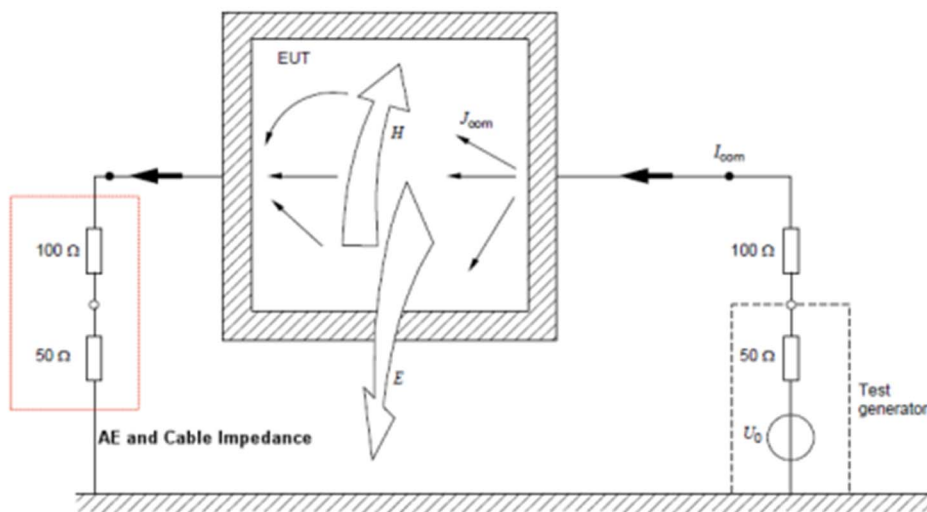


Figure E.1

In all cases cables are terminated using CDN, this includes any earth cables.

Hence effectively the same voltage/current is applied to the AE and EUT, hence independent of the cable length during the mains testing any associated cabling are also tested. The following are examples of the measured current during a test; see Figure E.2



Measuring the field from an EUT during a conducted immunity test based on the requirements of EN 61000-4-6

The diagram illustrates the test setup for measuring the field from an EUT during a conducted immunity test. The setup includes a Signal Generator connected to a CDN (Common Mode Network) via a 3V signal. The CDN is connected to the EUT (Equipment Under Test) via an AC Power line. The EUT is placed on a Ground plane. An Isotropic field Probe is positioned at a distance of 0,3m from the EUT. A Fiber Optic Cable is connected to the EUT. The probe is positioned at a distance of 0,1m from the EUT. The probe is also positioned at a distance of 1,0m from the EUT. The probe is also positioned at a distance of 0,3m from the EUT. The probe is also positioned at a distance of 0,1m from the EUT.

Figure 1 – Set up 1

The graph shows the Voltage from probe (Amplitude : V/m) versus Frequency : MHz. The graph displays four curves representing different probe distances: 0,0m (blue), 0,1m (orange), 0,3m (grey), and 1,0m (yellow). The 0,0m curve shows the highest amplitude, starting around 15 V/m and decreasing to about 5 V/m at 80,00 MHz. The 0,1m curve starts around 12 V/m and decreases to about 2 V/m at 80,00 MHz. The 0,3m curve starts around 4 V/m and decreases to about 1 V/m at 80,00 MHz. The 1,0m curve remains relatively flat around 1 V/m across the frequency range.

Frequency : MHz	0,0m (V/m)	0,1m (V/m)	0,3m (V/m)	1,0m (V/m)
0,15	15,0	12,0	4,0	1,0
0,20	15,0	11,0	4,0	1,0
0,27	15,0	10,0	4,0	1,0
0,35	14,0	10,0	4,0	1,0
0,47	13,0	10,0	4,0	1,0
0,63	12,0	10,0	4,0	1,0
0,83	11,0	10,0	4,0	1,0
1,11	11,0	10,0	4,0	1,0
1,48	11,0	10,0	4,0	1,0
1,97	11,0	10,0	4,0	1,0
2,62	11,0	10,0	4,0	1,0
3,48	11,0	10,0	4,0	1,0
4,64	11,0	10,0	4,0	1,0
6,17	11,0	10,0	4,0	1,0
8,21	11,0	10,0	4,0	1,0
10,93	11,0	10,0	4,0	1,0
14,55	11,0	10,0	4,0	1,0
19,37	11,0	10,0	4,0	1,0
25,78	11,0	10,0	4,0	1,0
34,31	11,0	10,0	4,0	1,0
45,67	11,0	10,0	4,0	1,0
60,79	11,0	10,0	4,0	1,0
80,00	5,0	2,0	1,0	1,0

Figure E.3

E.4.3 For EN 61000-4-4 tests

During EFT testing, the voltage is applied to power ports via coupling networks or via a clamp to signal lines. These tests are applied independently. However, because of the close proximity of the power ports with the signal cables and because the signal cables are attached to the same EUT enclosure, the two separate tests become interactive and hence are not independent. When the test is applied to the power port, the signal ports are also tested and vice versa.

The following examples show the voltages which appear on the signal ports when the test is applied to the AC mains port.

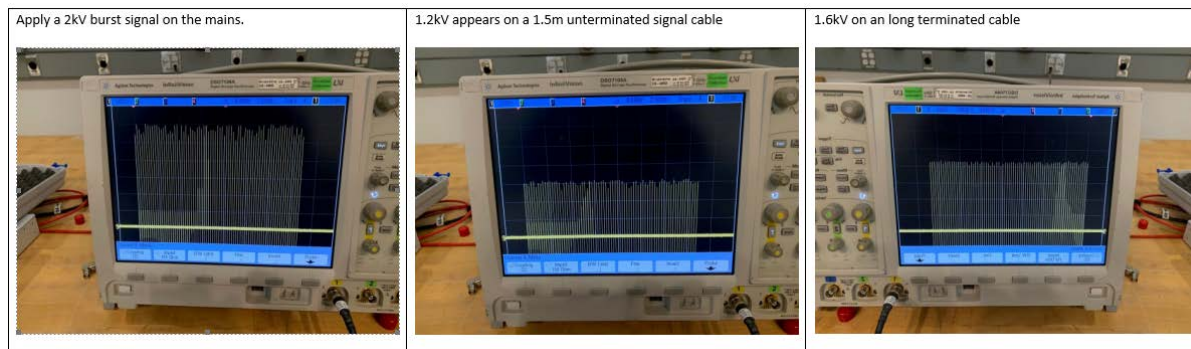


Figure E.4

Typically the voltage applied is for the mains test is 1 kV and for signal cables 500 V, as defined in the present document. In this context, that would be 600 V and 800 V respectively.

E.5 Conclusion

The examples from testing to EN 61000-4-6 [13] and EN 61000-4-4 [11] clearly show that during mains testing, significant signals appear on the signal and control lines. Therefore, because of the limited direct threat from the environment on short cables, the test which is applied during testing of the main ports are considered adequate and do not need to be tested separately.

Annex F (informative): Bibliography

[Council Directive 89/336/EEC](#) of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

Recommendation ITU-T G.661 (2007): "Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems".

Recommendation ITU-T G.662 (2005): "Generic characteristics of optical amplifier devices and subsystems".

[Directive 98/34/EC](#) of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations (EMC Directive).

[Directive 98/48/EC](#) of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

Annex G (informative): Change history

Version	Information about changes
2.1.1	Scope revised to remove the exclusion of Optical amplifiers, references have been updated and the reference to EN 55032 has been added, radiated immunity requirements have been extended in frequency range up to 6 GHz to cover the immunity requirements of radio services in the frequency range 2,7-6 GHz, EFT pulse repetition rate on signal ports of 100 kHz frequency has been adopted for xDLS ports.
2.2.1	Alignment with HS ETSI template, update of references, revision of general performance criteria, reference to specific clauses of the reference standards have been added about test methods, changed the definition of NTP, changes in surge tests on signal lines, inclusion of requirements of radio technologies when present as secondary function in telecommunication network equipment.
3.2.1	References to specific clauses of basic standards have been added. Annex E on justification of 3 m cable exclusion was added.

History

Document history		
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Corrigendum 1	April 1997	Corrigendum 1 to 1 st Edition of ETSI ETS 300 386-1
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V1.3.1	September 2001	Publication
V1.3.2	May 2003	Publication
V1.3.3	April 2005	Publication
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V1.6.1	September 2012	Publication
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V3.0.0	August 2025	SRdAP Process EV 20251112: 2025-08-14 to 2025-11-12
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