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ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

Contents

Foreword

This European Telecommunication Standard (ETS) has been produced by the Equipment Engineering (EE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS is Part 1 of a 2 part ETS. Part 2 of this ETS is currently being drafted and is further divided into 5 parts as follows:

Part 1: "Product family overview, compliance criteria and test levels".

Part 2-1: "Product specific compliance criteria and operating conditions - Switching equipment" (DE/EE-04003-2-1).

Part 2-2: "Product specific compliance criteria and operating conditions - Transmission equipment" (DE/EE-04003-2-2).

Part 2-3: "Product specific compliance criteria and operating conditions - Power supply equipment" (DE/EE-04003-2-3).

Part 2-4: "Product specific compliance criteria and operating conditions - Supervisory equipment" (DE/EE-04003-2-4).

Part 2-5: "Product specific compliance criteria and operating conditions - Tariff and billing equipment" (DE/EE-04003-2-5).

Transposition dates	
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Introduction

The purpose of testing is to ascertain whether the equipment will perform satisfactorily in its electromagnetic environment. Hence, testing requirements need to relate to actual electromagnetic environmental conditions. The statistical nature of the environment as well as the equipment's response to stress needs to be taken into account.

This is done by introducing the concepts of "environmental classes", "priorities of service", and graded "compliance criteria" described in more detail below.

Part 1 of this ETS specifies all parameters that are not specific to a particular equipment. These are:

- general operating conditions;

- test levels for immunity (tables 2, 3, 4 and 5) and associated general compliance criteria. Test levels are specified according to environmental class and according to priority of service;

- emission limits related to an environmental class.

Dedicated product-specific EMC requirements are being developed in the planned part 2 of this ETS (i.e. parts 2-1 to 2-5).

Environmental classes

The electromagnetic environment varies from time to time and from place to place in a very complicated manner. The concept of environmental classes introduced by the IEC, (IEC Publication No. 721 [2]) and also implemented by ETSI, (ETS 300 019 [11]) for climatic and mechanical environments takes these aspects into account.

An environmental class is an envelope of the environments encountered in a group of locations with similar properties. This ETS defines environmental classes for public telecommunication equipment:

- telecommunication centres, classes 1 and 2;

- locations other than telecommunication centres, classes 3 and 4.

The characteristics of the environmental classes are given in annex B.

Determination of limits

Immunity limits have been set considering that:

- the purpose of testing is to reveal potential failure mechanisms by means of well-defined exposures under controlled laboratory conditions;

- the test does not attempt to reproduce the exposures experienced in practice, but to reproduce the effects of real life exposure;

- the test needs to be conclusive even though it is normally based on only a few samples;

- there is a finite probability that equipment in practice will experience more severe stresses than those considered as being characteristic of the environmental class; it would mean over specification if 100 % performance was required in all cases;

- a safety margin between full performance and loss of function can be established.

A graded test is introduced which operates with three levels of performance. In order of increasing exposure, these levels are designated:

- normal performance (within specified limits);
- reduced performance;
- loss of function.

Each level of performance corresponds to a certain accepted degradation, i.e. an immunity threshold.

The compliance criteria are precisely defined in each individual equipment specification (being developed in part 2 of this ETS).

Finally, considering that all kinds of equipment are not equally important, it is recommended that the equipment is rated and tested according to the priority of the service performed, i.e. according to its main purpose.

The priority of service may be assessed by evaluating the consequences of:

- loss of service;
- loss of equipment;
- loss of revenue;
- loss of reputation.

Two equipment categories and associated EMC requirements are introduced which, in order of increasing requirements, are designated:

- normal priority of service (see tables 2 and 4);
- high priority of service (see tables 3 and 5).

Which requirements apply to a specific piece of equipment are defined in part 2 of this ETS (under development).

Emission limits are set considering that:

- emissions should not disturb the normal performance of co-located electronic equipment for communications or other purposes;
- emissions shall not interfere with the licensed use of the radio spectrum.

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1 Scope

This European Telecommunication Standard (ETS) specifies the essential Electro-Magnetic Compatibility (EMC) requirements for non-radio equipment used within the **public** telecommunications network. It covers both the emission and immunity requirements of the equipment.

This ETS is applicable to all equipment types, examples of which are listed below. The test methods to be used are also described together with the failure criteria:

- switching equipment which includes trunk and local telephone exchanges, remote switching concentrators, international switches, telex switches and network packet switches;

- transmission equipment which includes multiplexers, line equipment and repeaters, Synchronous Digital Hierarchy (SDH), Digital Cross Connect (DXC), Asynchronous Transfer Mode (ATM) and network terminations;

- power supply equipment which includes central power plant, end of suite power supplies, power management systems and other dedicated telecommunications network power supplies;

- supervisory equipment and dedicated Operation And Maintenance (OAM) equipment;

- tariff and billing equipment.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] EN 55022: "Limits and methods of measurement of radio interference characteristics of information technology equipment".

[2] IEC Publication No. 721 (Series): "Classification of environmental conditions".

[3] EN 60801-2: "Electromagnetic compatibility of industrial-process measurement and control equipment; Part 2: Electrostatic discharge requirements".

[4] ENV 50140: "Electromagnetic compatibility - Basic Immunity standard; Radiated, radio-frequency electromagnetic field - Immunity test".

[5] IEC 801-4 (1988): "Electromagnetic compatibility for industrial-process measurement and control equipment; Part 4: Electrical fast transient/burst requirements".

[6] ENV 50142: "Electromagnetic compatibility - Basic immunity standard; Surge immunity test".

[7] ENV 50141: "Electromagnetic compatibility - Basic immunity standard; Conducted disturbances induced by radio-frequency fields; Immunity test".

[8] CCITT Recommendation K.20 (1991): "Resistibility of telecommunication switching equipment to overvoltages and overcurrents".

[9] CCITT Recommendation K.21 (1988): "Resistibility of subscribers' terminals to overvoltages and overcurrents".

[10] CCITT Recommendation K.22 (1988): "Overvoltage Resistibility of Equipment connected to an ISDN T/S bus".

[11] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[12] ETS 300 127: "Equipment Engineering (EE); Radiated emission testing of physically large telecommunication systems".

[13] ETS 300 132: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment"; Part 1 - Interface operated by alternating current (AC) Part 2 - Interface operated by direct current (DC).

[14] CISPR Publication No. 16 : "Specifications for radio interference measuring apparatus and measurements methods".

[15] ENV 55102-1: "Electromagnetic Compatibility requirements for ISDN Terminal Equipment - Part 1: Emission requirements".

[16] ETS 300 046-1 (1992): "Integrated Services Digital Network (ISDN) primary rate access; Safety and protection; Part 1: general".

[17] EN 61000-4-11: "Electromagnetic compatibility (EMC), Part 4 Testing and measurement techniques, Section 11: Voltage dips and short interruptions and voltage variations".

[18] EN 60555-2: "Disturbances in supply systems caused by household appliances and similar electrical equipment; Part 2: Harmonics".

[19] EN 60555-3: "Disturbances in supply systems caused by household appliances and similar electrical equipment; Part 3: Voltage fluctuations".

[20] IEC Publication No. 50 (161): "International Electrotechnical Vocabulary; Chapter 161: Electromagnetic compatibility".

3 Definitions and abbreviations

3.1 Definitions

For the purpose of this ETS, the definitions in IEC Publication No. 50 (161) [20] apply. In addition, the following definitions apply:

priority of service: Measures on a relative scale how important it is that the equipment operates as specified.

Two levels of priority are standardized: They are designated as **normal** and **high**.

Normal priority of service should be assumed unless special circumstances are indicated.

The priority is **normal** if the equipment has **moderate failure consequences**. An equipment has moderate failure consequences when:

- a failure causes limited inconvenience;

- repairs may be made without compromising the responsibilities of the network operator.

The priority is **high** if the equipment has **severe failure consequences**. An equipment has severe failure consequences when:

- failure compromizes the function of vital, centralized systems, or services of commercially sensitive or security related nature;

- repair or restoration costs are high, or the time the equipment is out of service is unacceptably long;

- corruption of charging or billing information occurs.

The following definitions apply only in the context of this ETS, except where the reference to the IEC Publication No. 50 (161) [20] is given adjacent to the subclause title, in parentheses:

Audio (low) Frequency (AF): The frequency interval from 0 Hz to 20 kHz. It may sometimes be convenient to extend the use of this term to include the range of frequencies up to 150 kHz.

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

characteristic severity: The characteristic severity for a certain detail parameter in an environmental class states a severity which has only a low probability (generally less than 1 %) of being exceeded. The term relates to duration, rate of occurrence or location. It applies to requirements on the environment and to immunity requirements.

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.

Discontinuous interference (161-02-13): Electromagnetic interference occurring during certain time intervals separated by interference-free intervals.

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.

duration (of a pulse): The 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.

environment, environmental conditions: The electromagnetic conditions external to the equipment, to which it is subjected at a certain time. The environmental conditions comprise a combination of single environmental parameters and their severities.

environmental class: A representation of the environment on locations with similar properties. They are specified and standardized to provide an operational frame of reference for:

- requirements on the environment;

- immunity requirements.

The class is described using an envelope of environmental conditions expressed in terms of a number of environmental parameters and their characteristic severities or other characteristics. The environmental parameters specified for the class are limited to those which may affect equipment performance.

environmental parameters: Present one or more properties of the electromagnetic environment.

immunity (to a disturbance) (161-01-20): The 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.

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

Radio Frequencies (RF): The frequency range above 150 kHz.

rise time (of a pulse) (161-02-05): The 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.

shielding effectiveness: For a given external source, the ratio of electric or magnetic field strength at a point before and after the placement of the shield in question.

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

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.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AC	Alternating Current
ATM	Asynchronous Transfer Mode
CRC	Cyclic Redundancy Check
DC	Direct Current
DXC	Digital Cross Connect
EMC	Electro-Magnetic Compatibility
ESD	Electrostatic Discharge
EUT	Equipment Under Test
LFC	Loss of Function (Customer reset)
LFO	Loss of Function (Operator reset)
LFS	Loss of Function (Self recovery)
NP	Normal Performance
RF	Radio Frequency
RP	Reduced Performance
SDH	Synchronous Digital Hierarchy

4 General operational conditions

This clause gives the general operational conditions. The product-specific operating conditions will be specified in part 2 of this ETS (under development).

The general operational conditions shall allow for appropriate measuring of the emission and for testing of immunity.

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 normal operation as possible.

Details on the evaluation of test results are given in annex C.

4.1 Equipment configuration

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

The configuration that tends to maximize the EUT's emission or minimize its immunity is not usually intuitively obvious and in most instances selection will involve some trial and error testing. For 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.

4.2 Exercising equipment

The exercising equipment and other auxiliary equipment shall be sufficiently decoupled from the EUT so that the performance of such equipment does not significantly influence the test results.

4.3 Laboratory environment

For all the tests, the test laboratory environment shall be the one defined in the corresponding basic standards EN 60801-2 [3], ENV 50140 [4], IEC 801-4 [5], ENV 50142 [6] and ENV 50141 [7].

The electromagnetic environment of the test laboratory shall not influence the results.

The laboratory environment shall not exceed the limits specified by the manufacturer for normal operation of the EUT.

5 General compliance criteria for immunity tests

In this clause, general compliance criteria are defined and equipment shall meet these criteria when tested according to the requirements of clause 8.

The detailed product-specific compliance criteria, associated to the respective general compliance criteria given in subclauses 5.1 to 5.5, will be given in part 2 of this ETS (under development) for each type of equipment.

Interpretation of compliance

The equipment is deemed to comply with the EMC requirements, if it meets the compliance criteria given in tables 2 to 5 and the associated product specific criteria, according to part 2 of this ETS (under development), while:

- it is operated according to the general and product specific operating conditions, given in clause 4 and in part 2 of this ETS (under development);

- the performance items, as given in part 2 of this ETS (under development) being monitored.

5.1 Normal Performance (NP)

For NP:

- the EUT shall withstand the applied test without damage;

- the EUT shall operate correctly within relevant limits, specified by the manufacturer, during and after the application of the test;

- corruption of any software or data associated with the EUT shall not occur. This includes data stored in memory or data in process within the EUT;

- the EUT shall withstand the applied test indefinitely.

5.2 Reduced Performance (RP)

For RP:

- the EUT shall withstand the applied test without damage;

- corruption of software or data held in memory shall not occur;

- reduced performance is permitted within specified relaxed limits;

- resumption to normal performance shall occur at the cessation of the test.

5.3 Loss of Function (Self recovery) (LFS)

For LFS:

- the EUT shall withstand the applied test without damage;
- corruption of software or data held in memory shall not occur;
- temporary loss of function following application of test is permitted;
- self recovery to normal performance shall occur at the cessation of the test.

5.4 Loss of Function (Customer reset) (LFC)

For LFC:

- the EUT shall withstand the applied test without damage;
- corruption of software or data held in memory shall not occur;
- temporary loss of function following application of test is permitted;
- recovery requires simple customer action to restore normal performance. For example, for switching functions redialling may be required.

  NOTE: The "customer" in this context is the subscriber to the service.

5.5 Loss of Function (Operator reset) (LFO)

For LFO:

- the EUT shall withstand the applied test without damage;
- corruption of system operating software is not permitted;
- temporary loss of function following application of test is permitted;
- recovery requires network operator action to restore normal performance.

6 Immunity: test methods

6.1 General

Where reference is made in this ETS to specific "test levels" to be used for the tests, it is implicitly required that the EUT shall also fulfil the compliance criteria when tested at "test levels" lower than those specified. This requirement does not apply, however, to tests for immunity to continuous phenomena.

6.2 Electrostatic discharge

The test method and laboratory conditions are described in EN 60801-2 [3].

6.3 Electrical fast transients/burst

The test method to be used is described in IEC 801-4 [5].

6.4 Surges

6.4.1 Outdoor signal line ports

The test method to be used for signal line ports is described in CCITT Recommendations K.20 [8], K.21 [9] and K.22 [10], respectively.

The test generator shall be connected via the coupling network to one signal port. This port shall only be connected to the surge generator. During the test, the EUT and all ports (other than the one connected to the generator) shall comply with the given compliance criteria. After the surge has been applied the generator shall be disconnected from the port and the port checked against the compliance criteria. The compliance criteria shall contain functional aspects. Therefore, the test serves two purposes:

a) the EMC test of the EUT;

b) a test of resistibility of the port to which the generator is connected.

6.4.2 Indoor signal line ports

Ports of signal lines remaining within the building shall not be subjected to the method in subclause 6.4.1. Annex A specifies an appropriate test method, dedicated to unshielded 4-wire balanced interface types with phantom DC power feeding and operating at bit rates up to and including 2 Mbit/s.

The test set up for shielded interface cables is specified in ENV 50142 [6].

For ports connected to multi-conductor lines, for which the network according to annex A is not applicable, the networks according to subclause 6.3.2.2 of ENV 50142 [6] shall be used.

No other types of signal lines which remain within the building shall be tested.

Signal lines, which according to the manufacturer's specification, shall not be longer than 10 m, shall not be subjected to this test.

6.4.3 AC power line ports

The test method to be used for AC power line ports is described in ENV 50142 [6].

6.5 Immunity to continuous conducted signals

6.5.1 Low frequency (≤ 150 kHz)

6.5.1.1 AC power supply port

No requirements.

6.5.1.2 DC power supply interface port

No requirements.

6.5.1.3 Signal line port

No requirements.

6.5.2 Radio frequency (> 150 kHz)

6.5.2.1 AC power supply port

The test method to be used is described in ENV 50141 [7].

Power cables, which according to the manufacturer's specification shall not be longer than 3 m, shall not be subjected to these tests.

6.5.2.2 DC power supply interface port

The test method to be used is described in ENV 50141 [7].

Power cables, which according to the manufacturer's specification shall not be longer than 3 m, shall not be subjected to these tests.

The coupling/decoupling network type M1 (see ENV 50141 [7]) 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 shall be used.

6.5.2.3 Signal line port

The test method to be used is described in ENV 50141 [7].

Signal cables, which according to the manufacturer's specification shall not be longer than 3 m, shall not be subjected to these tests.

6.6 Immunity to radiated electromagnetic fields

The test method to be used is described in ENV 50140 [4].

6.7 Immunity to power supply disturbances: AC and DC ports

6.7.1 Test of immunity to low frequency disturbances: AC ports

Immunity to low frequency disturbances on the AC line ports, test methods are defined below.

Public telecommunication equipment in telecommunication centres, normal and high priority of service:

- these phenomena are addressed in ETS 300 132-1 [13].

Public telecommunication equipment, locations other than telecommunication centres, normal and high priority of service:

- the test method to be used is described in EN 61000-4-11 [17].

6.7.2 Test of immunity to low frequency disturbances: DC ports

Immunity to low frequency disturbances on the DC line ports, test methods are defined below.

Public telecommunication equipment in telecommunication centres, normal and high priority of service:

- these phenomena are addressed in ETS 300 132-2 [13].

7 Emission: test methods and limits

7.1 General

This clause specifies requirements for the measurement of emissions from public telecommunications network equipment.

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

7.2 Conducted emission

7.2.1 Signal line ports: test method and limits

For conducted emission on signal lines in the frequency range 0,15 - 30 MHz, the EUT shall meet the requirements given in ENV 55102-1 [15].

7.2.2 Mains interface: test method and limits

For conducted emission on mains interface lines in the frequency range 0,15 - 30 MHz, the EUT shall meet the requirements specified in EN 55022 [1].

Equipment shall meet the emission requirements at low frequencies, according to EN 60555-2 [18] and EN 60555-3 [19].

NOTE: The scopes of EN 60555-2 [18] and EN 60555-3 [19] do not cover telecommunications equipment, however, they may be used for the purposes of this ETS.

7.2.3 DC power interfaces: test methods and limits

The measuring methods shall be those specified for the mains interface in EN 55022 [1] but shall be used in the frequency range 0,02 MHz - 30 MHz.

The EUT shall be connected to the DC power supply through an artificial network to provide a defined impedance across EUT at the point of measurement and to provide isolation from the noise on the DC power supply lines.

The artificial networks to be used are the ones described in CISPR Publication No. 16 [14], section 2:

0,02 - 0,15 MHz subclause 8.2.1 (50 Ω // 50 μH + 5 Ω);

0,15 - 30 MHz subclause 8.2.2 (50 Ω // 50 μH).

Figure 1 shows the general form for the measurement of interference voltages between each conductor and the reference ground plane. The DC return lead at the EUT side shall be connected to the protective earth if this is required by the equipment installation specification.

The limits for the conducted emission are as given in table 1.

Table 1

Frequency range	**Limits in dB μV**	
	Average detector	Quasi-peak detector
0,02 - 0,15 MHz	-	79
0,15 - 0,5 MHz	66	79
0,50 - 30 MHz	60	73

When the use of the artificial network is not suitable (e.g. when the artificial mains network with the current capacity of the EUT is not commercially available) the method described in CISPR Publication No. 16 [14] for the voltage probe (1 500 Ω) shall be used.

Radio Frequency (RF) noise not produced by the device under test shall be at least 6 dB below the appropriate test limit level.

NOTE: The limits in the frequency range 0,15 - 30 MHz are Class A limits as specified in EN 55022 [1].

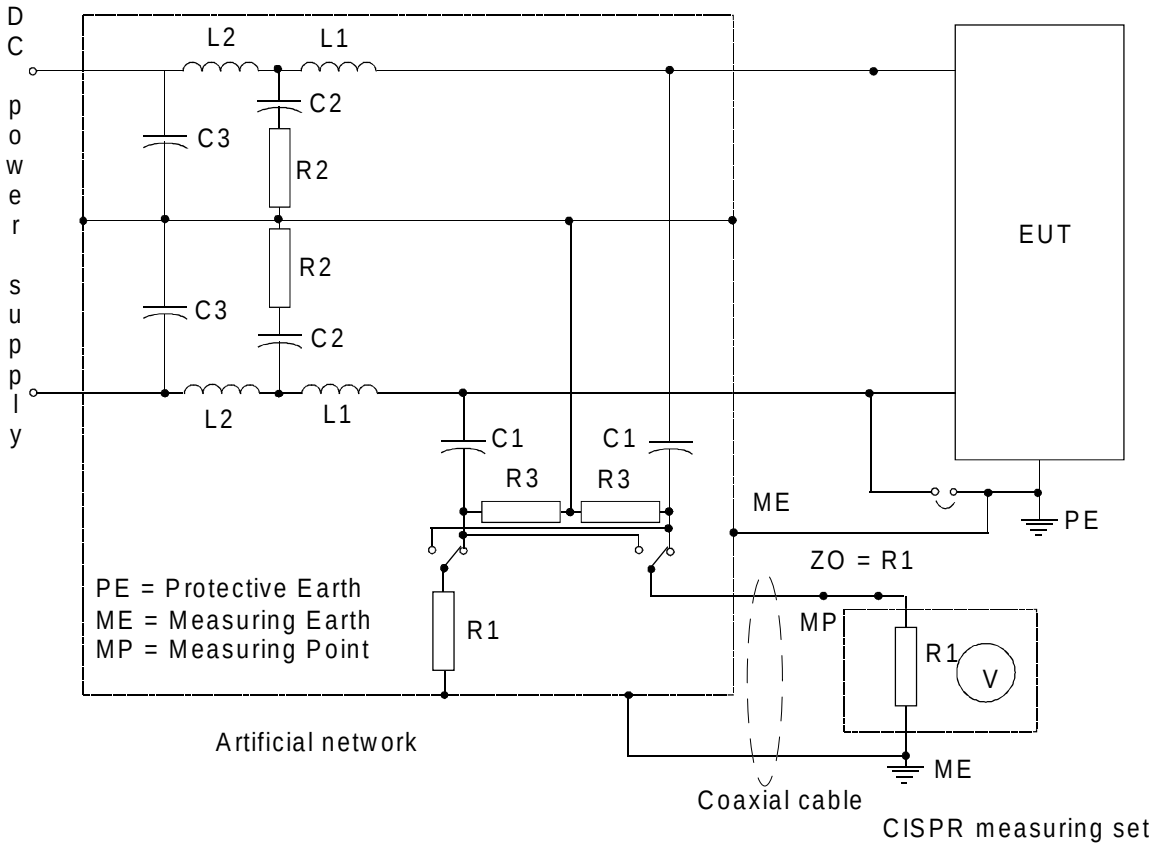


Figure 1: Measurement set-up for conducted emission on DC power interface

7.3 Radiated emission: test method and limits

For radiated emission in the frequency range 30 MHz - 1 000 MHz the EUT shall meet the requirements as specified in EN 55022 [1].

Where the EUT is considered to be physically large, the test methods and requirements prescribed by ETS 300 127 [12] shall apply.

8 Requirements

Tables 2 to 5 shall be used in the process of selection of appropriate tests to be applied to the EUT.

Table 2 shall be used for equipment which is intended to be installed in telecommunication centres, and which has a normal priority of service.

Table 3 shall be used for equipment which is intended to be installed in telecommunication centres, and which has a high priority of service.

Table 4 shall be used for equipment which is intended to be installed in locations other than telecommunication centres, and which has a normal priority of service.

Table 5 shall be used for equipment which is intended to be installed in locations other than telecommunication centres, and which has a high priority of service.

Test levels have been selected from the recommended levels defined in the relevant "basic standards" (IEC Publications and ENs), and using the environmental conditions as described in annex B.

The test specifications for equipment in telecommunication centres cover environmental classes 1 and 2.

The test specifications for equipment in locations other than telecommunication centres cover environmental classes 3 and 4.

Test levels have been selected taking into account:

- that different installation sites can have different environmental conditions;

- that environmental characteristic severity levels may be exceeded with a finite probability;

- that the required safety margin shall reflect the "**priority of service**".

NOTE: In case that a certain equipment type may be installed in several, different environments, it is recommended that test levels are selected such that the more severe conditions are covered.

Annex B quantifies environmental levels having in view the characteristics which are relevant from a testing point of view. The classification provides background information on which the EMC requirements have been based. It is emphasized that the environmental levels in annex B are not to be confused with test levels.

Table 2: Public telecommunications equipment in telecommunication centres, normal priority of service

PHENOMENON	COUPLING (PORT)	REFERENCE (subclause)	TEST LEVEL (note 3)	COMPLIANCE CRITERION (subclause)
IMMUNITY				
ESD (transient phenomenon)	ENCLOSURE	6.2	2 (4 kV Cont) (4 kV Air)	5.1 (NP)
		6.2	3 (6 kV Cont) (8 kV Air)	5.3 (LFS) (note 2)
EFT (transient phenomenon)	AC POWER	6.3	2 (1 kV)	5.1 (NP)
		6.3	3 (2 kV)	5.3 (LFS)
	DC POWER	6.3	1 (500 V)	5.1 (NP)
	SIGNAL	6.3	2 (500 V)	5.1 (NP)
		6.3	3 (1 kV)	5.3 (LFS)
RADIATED FIELD (CONTINUOUS)	ENCLOSURE	6.6	2 (3 V/m)	5.1 (NP)
		6.6	3 (10 V/m)	5.3 (LFS)
SURGES (transient phenomenon)	AC POWER	6.4.3	2 (0,5 kV line to line) (1 kV line to ground)	5.1 (NP)
		6.4.3	3 (1 kV line to line) (2 kV line to ground)	5.3 (LFS) (note 2)
	OUTDOOR SIGNAL	6.4.1 table 1/K.20 No1 table 2/K.20 No2	 1 kV 4 kV (note 1)	 5.3 (LFS) (note 2) 5.3 (LFS) (note 2)
	INDOOR SIGNAL	6.4.2	500 V	5.2 (RP) (note 4)
CONDUCTED (CONTINUOUS)	AC POWER	6.5	2 (3 V)	5.1 (NP)
	DC POWER	6.5	2 (3 V)	5.1 (NP)
	SIGNAL	6.5	2 (3 V)	5.1 (NP)
EMISSION	**COUPLING (PORT)**	**REFERENCE (subclause)**	**LIMITS**	**COMPLIANCE CRITERION**
CONDUCTED EMISSIONS	AC POWER	7.2.2	Class A	
	DC POWER	7.2.3	See subclause 7.2.3	
	SIGNAL	7.2.1	Class A	
RADIATED EMISSION	ENCLOSURE	7.3	Class A	

NOTE 1: Only to be applied when primary protection is fitted.

NOTE 2: Compliance criteria 5.4 (LFC) or 5.5 (LFO) may be more appropriate for some product types.

NOTE 3: Values given in parentheses are for information only.

NOTE 4: When using coupling/decoupling networks with surge arrestors, the compliance criterion 5.3 may be specified.

Table 3: Public telecommunications equipment in telecommunication centres, high priority of service

PHENOMENON	COUPLING (PORT)	REFERENCE (subclause)	TEST LEVEL (note 3)	COMPLIANCE CRITERION (subclause)
IMMUNITY				
ESD (transient phenomenon)	ENCLOSURE	6.2	2 (4 kV Cont) (4 kV Air)	5.1 (NP)
		6.2	3 (6 kV Cont) (8 kV Air)	5.2 (RP)
EFT (transient phenomenon)	AC POWER	6.3	3 (2 kV)	5.1 (NP)
		6.3	4 (4 kV)	5.3 (LFS)
	DC POWER	6.3	2 (1 kV)	5.1 (NP)
	SIGNAL	6.3	3 (1 kV)	5.1 (NP)
		6.3	4 (2 kV)	5.3 (LFS)
RADIATED FIELD (CONTINUOUS)	ENCLOSURE	6.6	2 (3 V/m)	5.1 (NP)
		6.6	3 (10 V/m)	5.2 (RP)
SURGES (transient phenomenon)	AC POWER	6.4.3	2 (0,5 kV line to line) (1 kV line to ground)	5.1 (NP)
		6.4.3	3 (1 kV line to line) (2 kV line to ground)	5.2 (RP)
		6.4	4 (2 kV line to line) (4 kV line to ground)	5.3 (LFS) (note 2)
	OUTDOOR SIGNAL	6.4.1 table 1/K.20 No1 table 2/K.20 No2	 1 kV 4 kV (note 1)	 5.3 (LFS) (note 2) 5.3 (LFS) (note 2)
	INDOOR SIGNAL	6.4.2	500 V	5.2 (RP) (note 4)
CONDUCTED (CONTINUOUS)	AC POWER	6.5	2 (3 V)	5.1 (NP)
		6.5	3 (10 V)	5.2 (RP)
	DC POWER	6.5	2(3 V) 3 (10 V)	5.1 (NP) 5.2 (RP)
	SIGNAL CM	6.5	2 (3 V)	5.1 (NP)
		6.5	3 (10 V)	5.2 (RP)
EMISSION	**COUPLING (PORT)**	**REFERENCE (subclause)**	**LIMITS**	**COMPLIANCE CRITERION**
CONDUCTED EMISSIONS	AC POWER	7.2.2	Class A	
	DC POWER	7.2.3	See subclause 7.2.3	
	SIGNAL	7.2.1	Class A	
RADIATED EMISSIONS	ENCLOSURE	7.3	Class A	

NOTE 1: Only to be applied when primary protection is fitted.

NOTE 2: Compliance criteria 5.4 (LFC) or 5.5 (LFO) may be more appropriate for some product types.

NOTE 3: Values given in parentheses are for information only.

NOTE 4: When using coupling/decoupling networks with surge arrestors, the compliance criterion 5.3 may be specified.

Table 4: Public telecommunications equipment, locations other than telecommunication centres. Normal priority of service

PHENOMENON	COUPLING (PORT)	REFERENCE (subclause)	TEST LEVEL (note 4)	COMPLIANCE CRITERION (subclause)
IMMUNITY				
ESD (transient phenomenon)	ENCLOSURE	6.2	3 (6 kV Cont) (8 kV Air)	5.1 (NP)
		6.2	4 (8 kV Cont) (15 kV Air)	5.3 (LFS) (note 3)
EFT (transient phenomenon)	AC AND DC	6.3	2 (1 kV)	5.1 (NP)
	POWER	6.3	3 (2 kV)	5.3 (LFS)
	SIGNAL	6.3	2 (500 V)	5.1 (NP)
		6.3	3 (1 kV)	5.3 (LFS)
RADIATED FIELD (CONTINUOUS)	ENCLOSURE	6.6	2 (3 V/m)	5.1 (NP)
		6.6	3 (10 V/m)	5.2 (RP)
SURGES (transient phenomenon)	AC POWER	6.4.3	3 (1 kV line to line) (2 kV line to ground)	5.2 (RP)
		6.4.3	4 (2 kV line to line) (4 kV line to ground)	5.3 (LFS) (note 3)
	OUTDOOR SIGNAL	6.4.1 K.21/table 1 No1	1,0/1,5 kV 4 kV (note 1)	5.3 (LFS) (note 3) 5.3 (LFS) (note 3)
	INDOOR SIGNAL	6.4.2	500 V	5.2 (RP) (note 5)
CONDUCTED (CONTINUOUS)	AC AND DC	6.5	2 (3 V)	5.1 (NP)
	POWER	6.5	3 (10 V)	5.2 (RP)
	SIGNAL	6.5	2 (3 V)	5.1 (NP)
		6.5	3 (10 V)	5.2 (RP)
EMISSION	**COUPLING (PORT)**	**REFERENCE (subclause)**	**LIMITS**	**COMPLIANCE CRITERION**
CONDUCTED EMISSION	AC POWER	7.2.2	Class B (note 2)	
	DC POWER	7.2.3	see subclause 7.2.3	
	SIGNAL	7.2.1	Class B (note 2)	
RADIATED EMISSION	ENCLOSURE	7.3	Class B (note 2)	

NOTE 1: Only to be applied when primary protection is fitted.

NOTE 2: Equipment not intended for use in residential, commercial and light-industrial environment may meet Class A limits.

NOTE 3: Compliance criteria 5.4 (LFC) or 5.5 (LFO) may be more appropriate for some product types.

NOTE 4: Values given in parentheses are for information only.

NOTE 5: When using coupling/decoupling networks with surge arrestors, the compliance criterion 5.3 may be specified.

Table 5: Public telecommunications equipment, locations other than telecommunication centres. High priority of service

PHENOMENON	COUPLING (PORT)	REFERENCE (subclause)	TEST LEVEL (note 4)	COMPLIANCE CRITERION (subclause)
IMMUNITY				
ESD (transient phenomenon)	ENCLOSURE	6.2	3 (6 kV Cont) (8 kV Air)	5.1 (NP)
		6.2	4 (8 kV Cont) (15 kV Air)	5.2 (RP)
EFT (transient phenomenon)	AC AND DC POWER	6.3	3 (2 kV)	5.1 (NP)
		6.3	4 (4 kV)	5.3 (LFS)
	SIGNAL	6.3	3 (1 kV)	5.1 (NP)
		6.3	4 (2 kV)	5.3 (LFS)
RADIATED FIELD (CONTINUOUS)	ENCLOSURE	6.6	3 (10 V/m)	5.1 (NP)
SURGES (transient phenomenon)	AC POWER	6.4.3	3 (1 kV line to line) (2 kV line to ground)	5.1 (NP)
		6.4.3	4 (2 kV line to line) (4 kV line to ground)	5.2 (RP)
	OUTDOOR SIGNAL	6.4.1 K.21/table 1 No1	1,0/1,5 kV 4 kV (note 1)	5.3 (LFS) (note 3) 5.3 (LFS) (note 3)
	INDOOR SIGNAL	6.4.2	500 V	5.2 (RP) (note 5)
CONDUCTED (CONTINUOUS)	AC AND DC POWER	6.5	3 (10 V)	5.1 (NP)
	SIGNAL	6.5	3 (10 V)	5.1 (NP)
EMISSION	**COUPLING (PORT)**	**REFERENCE (subclause)**	**LIMITS**	**COMPLIANCE CRITERION**
CONDUCTED EMISSION	AC POWER	7.2.2	Class B (note 2)	
	DC POWER	7.2.3	See subclause 7.2.3	
	SIGNAL	7.2.1	Class B (note 2)	
RADIATED EMISSION	ENCLOSURE	7.3	Class B (note 2)	

NOTE 1: Only to be applied when primary protection is fitted.

NOTE 2: Equipment not intended for use in residential, commercial and light-industrial environment may meet Class A limits.

NOTE 3: Compliance criteria 5.4 (LFC) or 5.5 (LFO) may be more appropriate for some product types.

NOTE 4: Values given in parentheses are for information only.

NOTE 5: When using coupling/decoupling networks with surge arrestors, the compliance criterion 5.3 may be specified.

Annex A (normative): Surges: test method for ports of signal lines remaining within the building

Ports of signal lines remaining within the building, e.g. of ISDN-equipment with interfaces at basic and primary rate shall be tested with the surge test set-up as described in figure A.1.

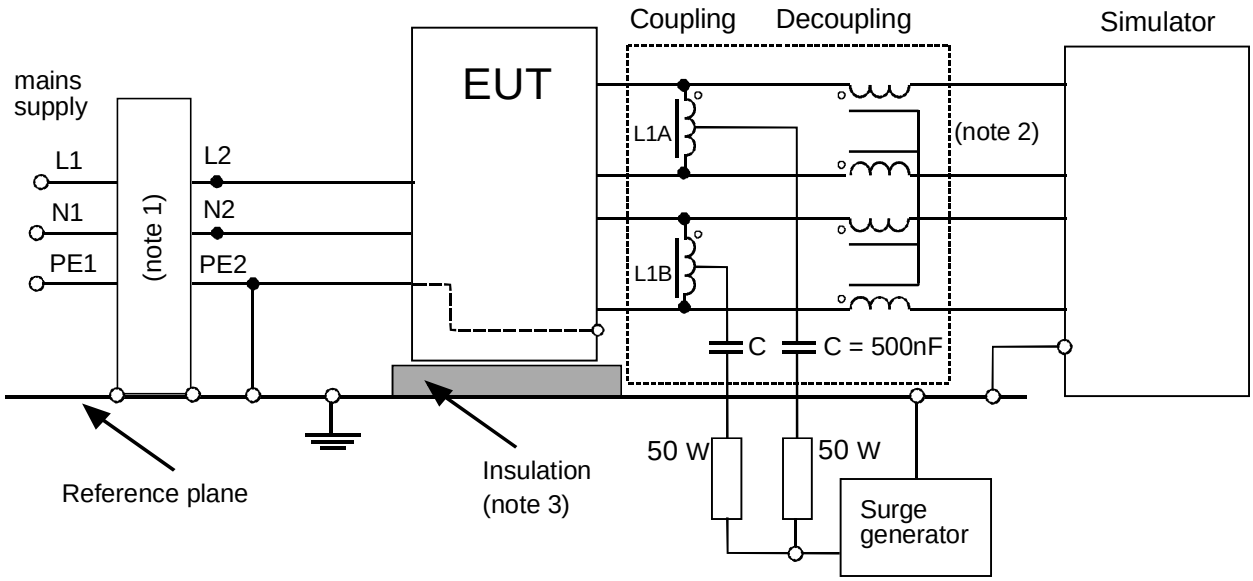
An example of a coupling/decoupling network for an unshielded interface cable is described in figure A.2

The test generator to produce the test pulses 1,2/50 µs shall conform to CCITT Recommendation K.22 [10]. The total source impedance (generator plus external resistor) shall be 40 Ω.

At least 5 positive and 5 negative pulses with alternating polarity shall be applied to the EUT. The time interval between two pulses shall be at least 10 s.

A.1 Test set-up for ports with ISDN interface

Figures A.1 and A.2 show the test set-up for ports with ISDN interface.



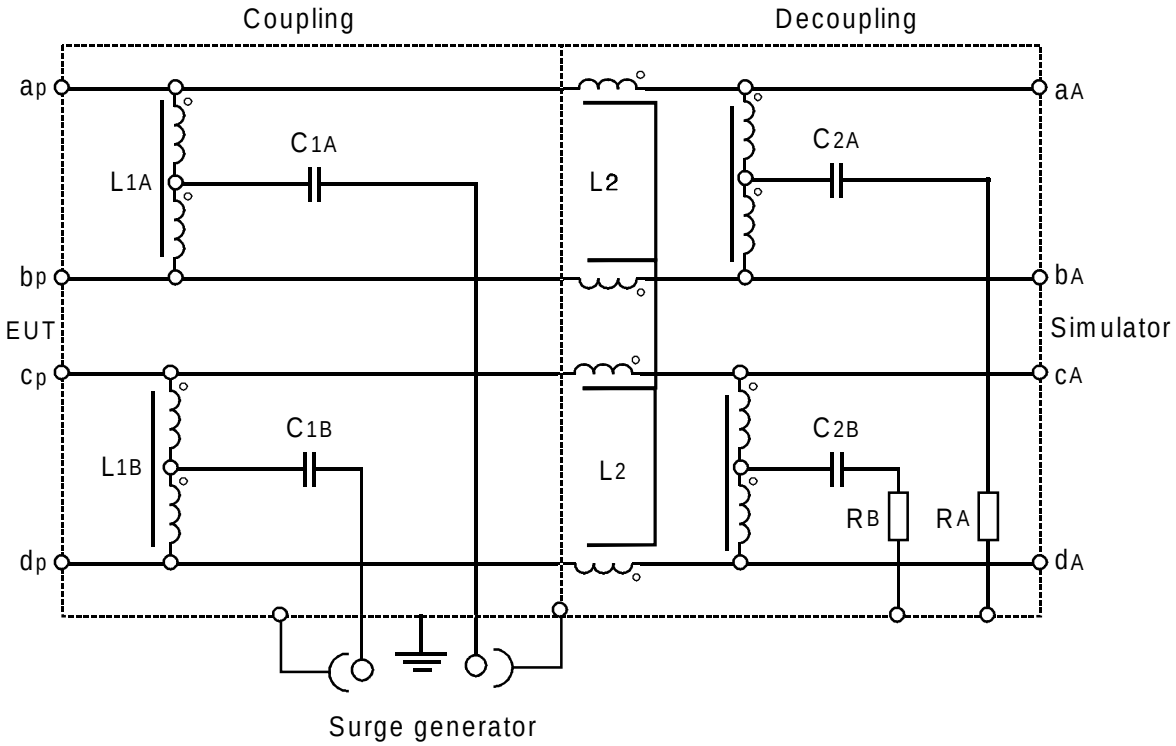
NOTE 1: The impedance matching network is used to decouple the mains and to provide low impedance to reference plane at EUT side. See ETS 300 046-1 [16], figure C.2.

NOTE 2: The coupling/decoupling network is described in figure A.2.

NOTE 3: Insulation thickness: 0,1 m for floor standing EUT; 0,5 mm for table top EUT.

NOTE 4: Interface wiring shall be placed 0,1 m above reference plane.

Figure A.1: Surge test set-up for basic rate and primary rate interface ports (using unshielded interface cable)



$C_{1A} = C_{1B} = 500$ nF
$L_{1A} = L_{1B} = 2 * 38$ mH
$L_{3A} = L_{3B} = 2 * 38$ mH

$C_{2A} = C_{2B} = 1$ µF
$L_2 = 4 * 100$ mH

$R_A = R_B = 50\ \Omega$

NOTE: L2 shall be a 4-coil current compensated choke to avoid saturation of coils due to phantom power feeding.

Figure A.2: Example of a coupling/decoupling network for two symmetrical pairs for surge testing

Annex B (informative): Classification of the electromagnetic environmental conditions

B.1 Introduction

This annex provides information on the electromagnetic environmental conditions encountered where public telecommunications network equipment is installed and is a compilation of data concerning electromagnetic environmental conditions.

Only some of the data is based on comprehensive environmental surveys. Such surveys are rarely reported in available literature. Consequently, estimated values are often used when the electromagnetic environmental conditions are stated. In order to characterize the electromagnetic environment, it is necessary to make certain assumptions on the installation practice. If these assumptions are not satisfied in a particular case, the environmental characteristic may not apply.

Each environment is characterized in two ways:

- by a short verbal description of its assumed attributes;

- by a quantitative statement of the characteristic severities of the crucial environmental phenomena.

It is only possible to specify the appropriate EMC requirements following the assessment of the severity of the electromagnetic environment. This in turn will be helpful in ensuring that the public telecommunications network equipment has the sufficient intrinsic immunity to enable it to operate as intended in its environment.

B.2 Application area

This annex applies to public telecommunication network equipment installed and controlled by the network operator which is installed in telecommunications centres, outdoor locations and customer's premises. It does not make references to equipment dependent details.

B.3 Characteristics of environments

B.3.1 Telecommunication centres (common features class 1 and class 2)

The internal electrical power distribution is a 48 V DC nominal (alternatively 60 V DC) and a 230 V/400 V AC nominal 50 Hz (according to ETS 300 132 [13]). It is assumed that switching of loads on the DC supply seldom occurs, and therefore, has not been taken into account.

Battery back-up is available at 48 V DC (alternatively 60 V DC).

NOTE 1: Local emergency generators are not assumed.

Primary protection on incoming cables is not assumed.

NOTE 2: If primary protection is present, differential mode transients could occur.

Internal AC power cables are kept separate at some distance to DC power cables and signal cables in order to reduce mutual coupling. No separation is assumed between DC power cables and signal cables. Normal practice is to use grounded, metallic cable supports.

Cables from telecommunication centres to customers' premises are assumed to be unshielded.

Some Electrostatic Discharge (ESD) preventive measures are either incorporated in the building installation (e.g. charge dissipating floors) or through guidelines for handling and operation of the equipment (e.g. use of wrist-straps, charge dissipating shoes). Some distance to high power broadcast transmitters is assumed. In cases where radio communication transmitters are present on the premises, it is assumed that special precautions are taken in order to prevent exposure to the emitted field.

Restriction on the use of mobile radio equipment is assumed in telecommunication centres.

NOTE 3: The telecommunication operator cannot control the external radio frequency environment.

It is assumed that the building has no external lightning protection system.

NOTE 4: The effects of direct lightning strike to the building are not considered here.

B.3.1.1 Class 1 - major telecommunication centres

This environmental class applies to major telecommunication centres in dedicated, separate buildings, which are controlled by the network operator. These would typically be located in urban areas.

The telecommunication centre has its own electricity power transformed from the public distribution network.

The AC power distribution inside the building is of the type TN-S, or IT (defined in IEC Standard 364-3).

External signal lines may be of any type, size or length normally entering via underground routes. There exists a risk of coupling to high voltage electricity lines or electric traction lines. A dedicated earthing and bonding network is implemented according to ETS 300 253 (or CCITT Recommendation K.27).

The shielding effectiveness from the building structure may give a frequency dependent attenuation of about 10 dB provided that the structural reinforcement elements of the building are adequately bonded together to form an integral mesh.

B.3.1.2 Class 2 - minor telecommunication centres

This environmental class applies to telecommunication centres in dedicated, separate buildings, which are controlled by the network operator. These would typically be located in rural areas serving the local community, and may often be unmanned.

The telecommunication centre may draw its electrical power from the public supply network either via a dedicated transformer or from a transformer shared with the local community.

The AC power distribution inside the building may be of the type TN-S, TN-C, TT or IT (defined in IEC Standard 364-3).

External signal lines may be overhead cables of considerable length. There is a high risk of coupling to high voltage electricity lines or electric traction lines.

A dedicated earthing and bonding network is implemented according to ETS 300 253 (or CCITT Recommendation K.27).

No shielding effectiveness from the building structure can be assumed.

B.3.2 Class 3 - outdoor locations

This environmental class applies to an unattended telecommunications site such as street furniture, telephone boxes, repeaters and amplifiers on trunk cables, or to concentrators and cable distribution boxes.

This environmental class may apply to equipment buried below ground level.

Repeaters on submarine cables are not covered by this class.

DC power may also be supplied from the telecommunication centre 48 V DC, (alternatively 60 V DC) or higher voltages. Voltages up to 120 V DC can be expected for ISDN basic rate remote supply systems. Only the 48 V DC (alternatively 60 V DC) systems are included at present.

Remote supplies of digital transmission systems using ± 110 V DC, of carrier frequency systems using 270 V DC or even ± 600 V DC are considered as being intrinsic to the systems and are not considered as being environmental parameters.

External signal lines may be of any type, size or length. There is a high risk of coupling to high voltage electricity lines and to electric traction lines.

Remote repeaters in rural areas are equipped with overvoltage protection devices. A local ground electrode might not be present in all cases. Other outdoor locations may not be protected.

The class does not apply to installations in areas of high keraunic levels. An external lightning protection system cannot be assumed.

NOTE: The effects of direct lightning strike to the building are not considered here.

The outdoor locations are considered as being low risk areas in terms of electrostatic charges.

The distance to electricity distribution transformers may be small and the mains frequency related magnetic field exposure may be high.

Some distance to high power broadcasting transmitters and amateur radio transmitters are assumed. However, mobile and portable radio transmitters may come very close.

The installation is enclosed in some housing or cabinet for weather protection purposes. The enclosure is not assumed to shield against electromagnetic fields.

B.3.3 Class 4 - customers' premises

This environmental class (location) encompasses the locations "residential, rural", "residential urban", "commercial" and "light industrial" as defined in the document IEC TC 77 (Secretariat) 108.

As a first approach to a quantitative characteristic an attempt has been made to fit the "disturbance levels" specified by IEC TC 77 into tables B.2 to B.7. There rarely exists a one-to-one correspondence between the environmental parameters given in this ETS and the "phenomena" introduced by IEC. Disturbances neglected by the IEC have been included and vice versa, and even in cases where a certain phenomenon has been included in both places, differences remain in the attributes chosen to characterize the disturbance.

In tables B.2 to B.7, values given in brackets means that they are not specified by the IEC.

It is emphasized that all four types of customers' premises are covered by the specification.

B.4 Attributes of customers' premises

Table B.1

Media	Attributes
Radiated:	- no amateur radio closer than 20 m; - no broadcast transmitter closer than 1 km; - paging and portable communication systems; - high concentration of ITE; - possible presence of diathermy therapy equipment; - possible proximity of local substation; - possible presence of audio/hearing aid systems.
AC power:	- relatively high network impedance; - cables or overhead lines; - high harmonic levels (ITE, lighting, ASD); - roof-top mounted equipment (lightning exposure); - significant lightning exposure.
DC power:	- not applicable.
Signal/control:	- overhead telecom cables or lines; - cables or short overhead spans; - close coupling between signal systems and switched power systems; - significant lightning exposure; - control lines are usually short, less than 10 m.
Reference:	- abundant metallic structures which may or may not be bonded, earthed or grounded; - frequent interfaces of power and telecom (including local) systems; - local ground can be absent or present high impedance; - multiple local grounds might not be coordinated.
Additional notes:	- interfaces with customer systems; - HV lines might be routed over buildings.

B.5 Notation to tables B.2 to B.7

In tables B.2 to B.7, the following notation has been used:

Correlated parameters: correlated parameter values are arranged vertically and separated by ";" e.g.

A ; B ; C ; ...
a ; b ; c ; ...

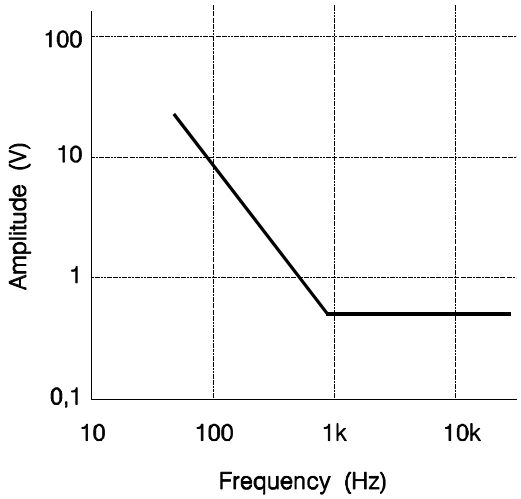
Functional relations: functional relations are always piecemeal linear and defined by their break-points. A discontinuity where a parameter changes from a to b is written "a/b" e.g.

f1 - f2 - f3
a1 - a2 - a3

or f1 - f2 - f3
a1 - a2/b1 - b2

Such relations state the frequency dependence of a parameter, and in that case, the linear interpolation between break-points is made using logarithmic scales on both axes.

Figure B.1 shows an example of frequency dependence.



Audio frequency voltage Common mode	Frequency (kHz) Amplitude (V)	0,05 - 1 - 20 20 - 0,5 - 0,5

Figure B.1

Universal values: if a single parameter value applies over the whole range, only a single number is stated.

Intervals: where a detail parameter Q may assume any value in an interval, and where it is impossible to state which value constitutes the most severe condition, the parameter is specified by the interval: q1 to q2.

B.6 Characteristic severities of the environmental parameters

In tables B.2 to B.7, the characteristic severities and other characteristics of the relevant environmental parameters are stated for the environmental class for public telecommunication network equipment.

It is often not feasible to model the disturbances/parameters in every detail. For instance the temporal evolution of transients is much too complex to be described realistically. In such cases, simplified models are used which select the characteristic details as appropriate to the standardized test pulses. This approach presumes that the test pulses do emphasize the crucial features.

In case of continuous disturbances, the postulated frequency dependence and modulation mode are gross simplifications of reality. A frequency analysis will show that the disturbances are confined within narrow frequency bands separated by "silent" intervals. This complicated (and time dependent) pattern is replaced by a smooth frequency variation using few levels of amplitude.

The environmental parameters are arranged in tables according to the coupling path. Six coupling-paths are included:

1) **signal lines entering the building**, which includes all telecommunications lines of the extended networks where metallic conductors are used;

2) **signal lines remaining within the building**, which includes all signal lines in the local installation using metallic conductors. They are of relatively short lengths, and are confined to the local premises;

3) **AC power mains** is the low voltage distribution network (230 V/400 V, 50 Hz);

4) **DC power** distribution is the local power distribution system at 48 V (alternatively 60 V). DC supplies integrated in the equipment are not included;

5) **radiation** covers coupling to the internal wiring of the equipment via electromagnetic fields. Radiation picked up by the connected wires or cables is included in the conducted coupling-paths stated above;

6) **discharge of static electricity (ESD)** may take place directly to the equipment or to other metallic objects in its vicinity. ESD is taken into account as a separate parameter.

Table B.2: Conducted disturbances on signal lines entering the building

Environmental parameter		Class 1	Class 2	Class 3	Class 4
DC Voltage Common mode (note 1)	Amplitude V Impedance MΩ	500 > 1			(500) (> 1)
16 2/3 Hz voltage common mode (note 2)	Amplitude V rms Impedance Ω	20 100	50 100		(50) (100)
50 Hz voltage differential mode	Amplitude V rms Impedance Ω Duration min	240 10 to 600 about 10			(240) (10 to 600) (about 10)
50 Hz voltage common mode	Amplitude V rms Impedance Ω Duration s	(note 3)	300 100 0,5		(300) (100) (0,5)
Audio frequency voltage common mode	Frequency kHz Amplitude V rms	0,05 - 1 - 20 20 - 0,5 - 0,5	0,05 - 1 - 20 30 - 0,75 - 0,75		
	Impedance Ω	100	100		300
Radio frequency voltage common mode, amplitude modulated (note 4)	Frequency MHz Amplitude V rms	0,15 to 100 1	0,15 to 100 3		0,01 to 0,15 1
	Frequency MHz Amplitude V rms				0,1 to 30 10
	Frequency MHz Amplitude V rms				30 to 150 3
Electrical fast transients	Amplitude V peak	250		500	1 000 (note 5)
Common mode (high frequency, low energy)	Rate of occurrence events/week	Several		Several	Several
	Rise time ns	1 to 100		1 to 100	5
	Impedance Ω	40 to 80		40 to 80	50
Surge common mode (Low frequency, high energy)	Amplitude V peak Rise time µs	300 ; 1 000 1 to 1 000	300; 1 000; 3 000 1 to 1 000	300; 1 000; 3 000 1 to 1 000	500 ; 1 000 10 ; 1
	Duration µs	< 3 000	< 3 000	< 3 000	1 000 ; 50
	Rate of occurrence events/year	6 ; 0,5	6 ; 0,5 ; 0,2	30 ; 3 ; 1	Multiple
	Impedance Ω	20 to 40	20 to 40	20 to 40	20 to 300; 1 to 10

NOTE 1: 1MΩ source impedance included in order to take into account e.g. cable fault location equipment. We do not take into account DC power plants for traction systems causing DC potential differences on the telecommunication lines. Also not included are the induced voltages from geomagnetic activity.
NOTE 2: Only applicable in Austria, Germany, Norway, Sweden and Switzerland.
NOTE 3: For Major Telecommunications Centres (Class 1), 50 Hz Common Mode Voltage due to earth faults in nearby high voltage electricity systems is not taken into account. The probability of this phenomena occurring is extremely low.
NOTE 4: As the primary coupling occurs in the last few metres of the signal line, we take advantage of the shielding effects in the building (e.g. metallic framework) of the Major Telecommunications Centre (Class 1). Hence, 1V can be assumed. For environmental classes 1, 2 and 3, disturbance in the frequency range 20 kHz to 150 kHz is unlikely.
NOTE 5: Only specified for "Commercial Locations".

Table B.3: Conducted disturbances on signal lines remaining within the building

Environmental parameter		Class 1	Class 2	Class 3	Class 4
Audio Frequency Voltage Common mode	Frequency kHz	0,05 - 1 - 20		Not Applicable	0,05 - 1 - 20
	Amplitude V rms	5 - 0,2 - 0,2			10 - 0,5 - 0,5
	Impedance Ω	100			300
Radio frequency Voltage Common mode, Amplitude modulated (note 1)	Frequency MHz Amplitude V rms	0,15 to 100 1	0,15 to 100 < 3 (note 2)	Not Applicable	0,01 to 0,15 1
	Frequency MHz Amplitude V rms				0,1 to 30 10
	Frequency MHz Amplitude V rms				30 to 150 3
Electrical fast transients Common mode (high Frequency, Low energy)	Amplitude V peak	250		Not Applicable	1 000 (note 3)
	Rate of occurrence events/week	Several			Several
	Rise time ns	1 to 100			5
	Impedance Ω				50

NOTE 1: For environmental classes 1, 2 and 3, disturbance in the frequency range 20 kHz to 150 kHz is unlikely.
NOTE 2: Value depending on length of cable.
NOTE 3: Only specified for "commercial locations".

Table B.4: Conducted disturbances on AC power units

Environmental parameter		Class 1	Class 2	Class 3	Class 4
Voltage variation	Voltage change %	± 10	+ 10/-15	+ 10/-15	± 8
Voltage fluctuation	Voltage change %	-50 to -20 ; +20			10 to 99
	Duration ms	10 to 1500			< 3 000
	Rate of occurrence events/day	100 to 0,01			unspecified
Voltage interruption	Duration ms	10 ; 20 ; 40 ; 100 to 700			< 6 000
	Rate of occurrence events/day	10 ; 1 ; 0,1 ; 0,05			unspecified
Radio frequency Voltage Common mode, Amplitude modulated (note 1)	Frequency MHz Amplitude V rms	0,15 to 100 1 (note 2)	0,15 to 100 3		0,01 to 0,15 1
	Frequency MHz Amplitude V rms				0,1 to 30 10
	Frequency MHz Amplitude V rms				30 to 150 3
Electrical fast transients Common mode and differential mode (High frequency, Low energy)	Amplitude V peak	1 000			(1 000)
	Rate of occurrence events/day	1			(1)
	Rise time ns	1 to 100			(1 to 100)
Surge line/neutral (Low frequency, High energy)	Amplitude kV peak	2	2 ; 4	2 ; 4	(2 ; 4)
	Rise time µs	0,5 to 10	0,5 to 10	0,5 to 10	(0,5 to 10)
	Duration µs	< 100	< 100 ; < 100	< 100	(< 100)
	Rate of occurrence events/year	20	100 ; 3	100 ; 3	(100 ; 3)
Surge line/ground (Low frequency, High energy)	Amplitude kV peak	(note 3)	2 ; 4	2 ; 4	(1 ; 4)
	Rise time µs		0,5 to 10	0,5 to 10	10 ; 1
	Duration µs		< 100 ; < 100	< 100	1 000 ; 50
	Rate of occurrence events/year		100 ; 3	100 ; 3	Multiple
	Impedance Ω	10 - 20			20 to 300 ; 1 to 10

NOTE 1: For environmental classes 1, 2 and 3, disturbance in the frequency range 20 kHz to 150 kHz is unlikely.
NOTE 2: We take advantage of the shielding effects in the building (e.g. metallic framework) of the major telecommunications centre (class 1). Hence, 1 V can be assumed.
NOTE 3: Not applicable because major telecommunications centres (class 1) have their own electricity power transformers.

Table B.5: Conducted disturbances on the DC power distribution (48 V nominal assumed)

Environmental parameter		Class 1	Class 2	Class 3	Class 4
Voltage variation	Voltage V	40,5/57			(40,5/57)
Voltage fluctuation and interruption	Voltage V	0 to 40,5 ; 57 to 60			(0 to 40,5;57 to 60)
	Duration ms	< 50			(< 50)
	Rate of occurrence events/year	3			(3)
Audio frequency Voltage Differential mode	Frequency kHz Amplitude mV rms	0,025 - 0,3 - 1 - 20 - 150 50 - 50 - 7 - 7/50 - 50			(0,025-0,3-1-20-150) (50-50-7-7/50-50)
Radio frequency Voltage Common mode, Amplitude modulated	Frequency MHz Amplitude V rms	0,15 to 100 1	0,15 to 100 < 3 (note 1)	0,15 to 100 1	(0,15 to 100) < 3 (note 1)
Electrical fast transients	Amplitude V peak	250			(250)
Common mode (High frequency, Low energy)	Rate of occurrence events/week	Several			(Several)
	Rise time ns	1 to 100			(1 to 100)
Surge	Amplitude V	200		Not applicable	(200)
Common mode and	Rise time µs	5			(5)
Differential mode	Duration µs	50			(50)
(note 2)	Rate of occurrence events/year	3			(3)

NOTE 1: Value depending on length of cable.
NOTE 2: From fuse blowing.
NOTE 3: Class 3 does not apply to remote 48 V DC supplies via the signal lines. In such cases, the appropriate classification for "Signal lines entering from outside" (under development in part 2 of this ETS) are to be used.
NOTE 4: Not considered by the IEC.

Table B.6: Radiated disturbances

Environmental parameter		Class 1	Class 2	Class 3 (note 3)	Class 4 (note 4)
Audio frequency Magnetic Field	Frequency Hz Amplitude A/m rms	50 to 20 000 10 to 0,025	50 to 20 000 3 to 0,008	50 to 20 000 10 to 0,025	16⅔;50 to 20 000 1 ; 0,015
	Frequency Hz Amplitude A/m rms				50 ; 100 to 3 000 10 ; 1,8 to 0,6
Radio frequency Electromagnetic field	Frequency MHz Amplitude V/m rms	0,15 to 1 000 1	0,15 to 1 000 3	0,15 to 1 000 10	0,09 to 1 000 3 (note 2)
Amplitude modulated (note 1)	Frequency MHz Amplitude V/m rms				27 10
Radio frequency Electromagnetic field Pulse modulated (note 1)	Frequency GHz Amplitude V/m peak	1 to 20 1	1 to 20 3	1 to 20 10	1 to 40 unspecified
Pulse Electromagnetic field	Frequency MHz Amplitude mV/m/kHz	0,01 to 300 100 to 1		Not applicable	
	Frequency MHz Amplitude dB ref kTB				0,01 to 1 117
	Frequency MHz Amplitude dB ref kTB Frequency MHz Amplitude dB ref kTB Frequency MHz Amplitude dB ref kTB				1 to 10 77 10 to 100 57 100 to 1 000 37
Lightning Electromagnetic pulse	Amplitude A/m Rise time µs	Not applicable	500 0,2	Not applicable	Specified by the slew rate 100 V/m/ns
	Duration µs		100		
	Rate of occurrence events/year		0,1		

NOTE 1: In cases where mobile communications are permitted, field strengths in the range from 3 to 10 V/m may be experienced at communication frequencies.
NOTE 2: In the vicinity of amateur radio transmitters the field strength may reach 10 V/m at the transmitter frequencies.

Table B.7: Electrostatic charge

Environmental Parameter		Class 1	Class 2	Class 3	Class 4
Electrostatic Voltage	Amplitude kV peak	4		2	Specified by the slew rate (40 A/ns, 8 A/m/ns, or 1 000 V/m/ns)

Annex C (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 clause 5 of this ETS;

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.

The following additional items have been extracted from EN 45001.

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 needs 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 ... (or as otherwise identified)", and should meet the relevant requirements of the preceding paragraphs.

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 D (informative): Guidance for the preparation of product specific operational conditions and compliance criteria

D.1 General

Dedicated product EMC specifications should contain the following clauses:

a) a "Scope" clause,

"This EMC specification applies to <product definition>.";

NOTE 1: The scope should define the product type and its main functions.

b) a "Priority of service" clause,

"The priority of service for <product> is <normal/high> due to the <main function> performed by <product>.";

NOTE 2: For most equipment "normal priority of service" applies. "High priority of service" only applies in exceptional cases when equipment has severe failure consequences (see also clause 3).

EXAMPLE: Normal priority of service applies for high bit rate transmission equipment (2 Gbit/s) under normal circumstances.

c) an "Installation environment" clause,

"The <product> tested according to the present EMC specification is designed to be installed in <telecommunication centres/locations other than telecommunication centres>.".

NOTE: If installed in a different environment than specified, a performance degradation cannot be excluded. If no restrictions are put on the installation environment the product needs to comply with both cases (telecommunication centre/other than telecommunication centre), implying that the more severe test level is to be used when the test is performed.

D.2 Operational conditions and compliance criteria during EMC tests

D.2.1 General considerations

It should be observed that EMC immunity tests are time consuming and expensive to perform.

To illustrate this, one example is given: test of immunity to radiated RF fields involves a slow sweep through the total frequency range specified. This slow sweep (often realized by increasing the frequency in small increments) needs, in general, to be repeated eight times (2 antenna polarizations, 4 sides of the EUT facing the antenna) it is, therefore, preferred that the compliance criteria are defined such that:

- repetition of time consuming tests is avoided;

- they are rapidly verified;

and further, such that:

- transportable monitoring equipment can be used.

D.2.2 Operational conditions during EMC tests

The following advice is given on the selection of operational conditions:

- operational conditions needs to be selected such that compliance criteria can be employed;

- modes of operation where all relevant units/functions are excited at short intervals are required;

  NOTE 1: Special software may be necessary in order to test appropriate system operations.

- only one mode of operation should be selected in order to limit test time;

- at least one power supply or signal port of each type found on the equipment needs to be exposed to disturbances during conducted immunity testing;

- at least one power supply or signal port of each type found on the equipment needs to be measured for conducted emission.

  NOTE 2: Some tests do not apply to short cables.

D.2.3 Compliance criteria during EMC tests

The following advice is given on the selection of compliance criteria:

- compliance criteria should be simple to verify;

- compliance criteria should be specific to the main functions of the equipment (i.e. the main functions are those which determine the priority of service). Only main functions should be monitored during the test. After the test, the auxiliary functions should be tested for loss of function (self recovery).

Compliance criteria may be specified for the performance parameters listed below. The list suggests examples and is not exhaustive (there are no distinctions made between different equipment categories):

- acceptable bit error rate (mainly for higher bit rates; test time should not be too long);

- alarm indications;

- analogue signal/noise ratio;

- bit errors (mainly for lower bit rates);

- busy hour call attempts;

- call misrouteing;

- corruption of data in process/transit;

- corruption of stored data;

- Cyclic Redundancy Check (CRC) in case of protocols with frames;

- false alarms;

- false tripping/non-tripping;

- inability to access stored data;

- incorrect allocation of charging rates;

- incorrect digits;

- jitter rate;

- loss of established calls;
- loss of frame synchronization;
- output spikes, drop-outs, ripple and noise;
- reduced input sensitivity;
- spurious responses;
- voltage/current tolerance;
- wrong allocation of frames/rates.

Normally, three different criteria are needed:

- normal performance within specified limits;
- a specified acceptable reduced performance; and
- loss of function with self recovery.

Annex E (informative): Bibliography

The following references are provided for informative purposes.

1) NORDTEL Publication NT/ENV-SPEC-CE series (1990): "Classification of environmental conditions - Electromagnetic environment".

2) IEC TC 77 (Secretariat) 108: "Classification of electromagnetic environments".

3) IEC Standard 364-3: "Electrical installations of buildings; Part 3: Assessment of general characteristics".

4) ETR 127: "Equipment Engineering (EE); Electrostatic environment and mitigation measures for Public Telecommunications Network (PTN)".

5) ETS 300 253: "Equipment Engineering (EE); Earthing and bonding of telecommunications equipment in telecommunications centres".

6) CCITT Recommendation K.27 (1991): "Bonding configurations and earthing inside a telecommunication building".

7) EN 45001: "General operating conditions for testing laboratories".

History

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