ITU Training on C&I for Americas Electromagnetic Compatibility EMC

TRANSFORMANDO
EN REALIDAD

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Resumen Summary

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Ambiente Electromagnético
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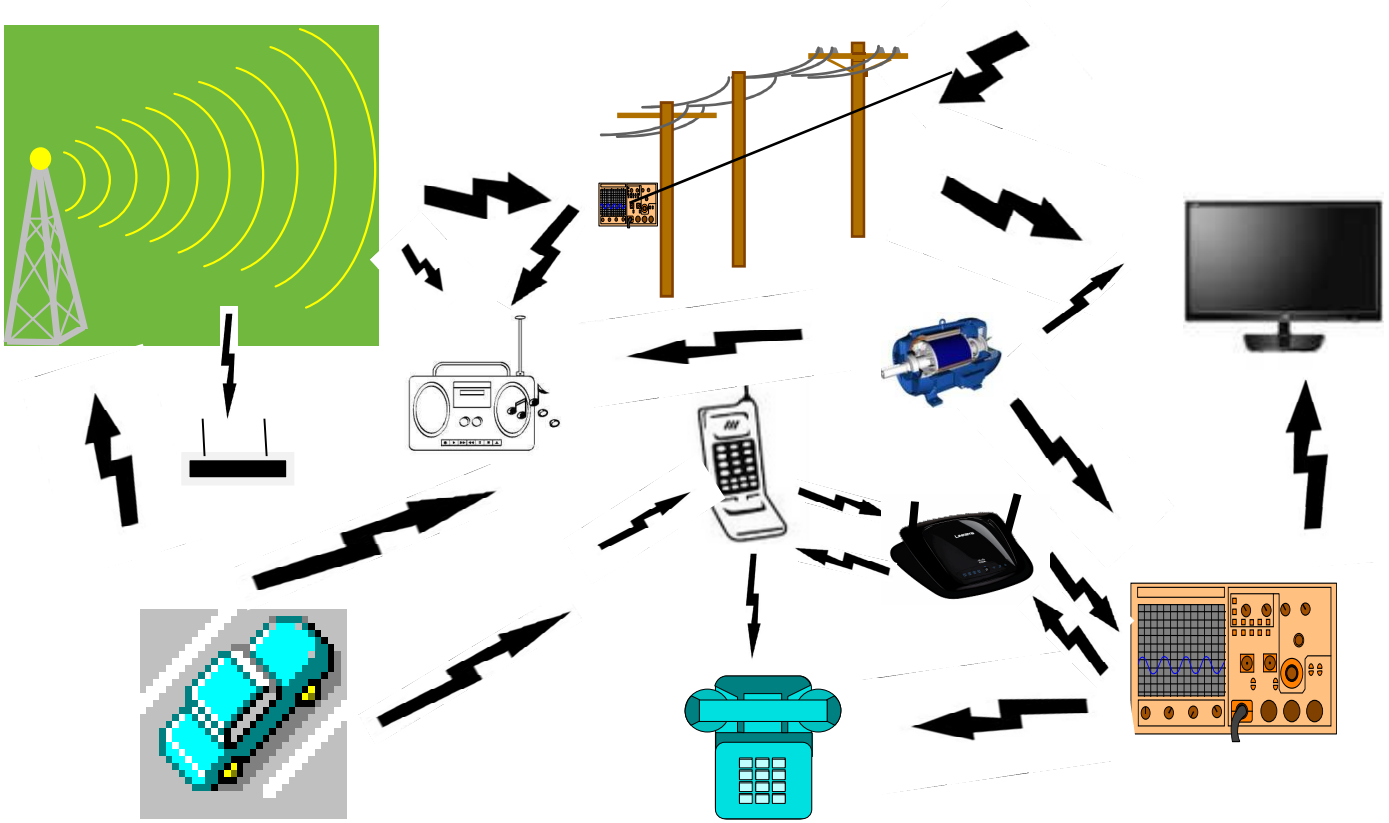


Introducción – Introduction

Objetivo de la normalización de CEM

(EMC standard objective)

- Garantizar la protección de los servicios de telecomunicaciones y radiodifusión (protección del espectro radioeléctrico)

  (Guarantee the protection of radiofrequency spectrum)

- Garantizar el funcionamiento adecuado del equipo en su ambiente electromagnético de operación

  (Guarantee the normal operation of equipment at the installation site)

Introducción – Introduction

Terminología – Terminology

Compatibilidad electromagnética (CEM) – capacidad de un dispositivo, equipo o sistema de funcionar satisfactoriamente en su ambiente electromagnético sin producir perturbación electromagnética intolerable para otras materias, equipos o sistemas contenidos en este ambiente

Electromagnetic compatibility – ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

IEV161-01-07

International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

Introducción – Introduction

Terminología – Terminology

Interferencia electromagnética (IEM) – es la degradación del desempeño de un equipo, canal de transmisión o de un sistema causada por una perturbación electromagnética

Electromagnetic interference (EMI) – degradation of the performance of an equipment, transmission channel system caused by an electromagnetic disturbance

IEV161-01-06

International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

Introducción – Introduction

Terminología – Terminology

Perturbación electromagnética – es un fenómeno electromagnético capaz de degradar el desempeño de un dispositivo, equipo o sistema y puede ser un ruido electromagnético, una señal indeseable o una modificación del medio de transmisión

Electromagnetic disturbance – any electromagnetic phenomenon which may degrade the performance of device, equipment or system, or adversely affect living or inert matter

IEV161-01-05

International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

Introducción – Introduction

Terminología – Terminology

Inmunidad (a una perturbación) – capacidad de un dispositivo, equipo o sistema de no sufrir degradación de desempeño cuando en la presencia de una perturbación electromagnética

Immunity (to a disturbance) – ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

IEV161-01-20

International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

Introducción – Introduction

Terminología – Terminology

Interferencia de radiofrecuencia – degradación de la recepción de una señal deseada causada por una perturbación de radiofrecuencia

Radio frequency interference – degradation of the reception of a wanted signal caused by radio frequency disturbance

IEV161-01-14

International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

Introducción – Introduction

ISO – International Organization for Standardization

ITU – International Telecommunication Union

IEC – International Electrotechnical Commission

CISPR – Comité International Spécial des Perturbations Radioélectriques

CENELEC – Comité Européen de Normalisation Electrotechnique

CIGRE – Conseil International Des Grands Réseaux Électriques

Introducción – Introduction

Normalización en Europa

CEN – Comité Europeo de Normalización

ETSI – European Telecommunication Standardization Institute

Normalización en Europa – Standardization in Europe

Las llamadas **Directivas de nuevo enfoque** establecen los requisitos esenciales que deben cumplir las mercancías para venderse en toda la UE

The EU legislation, referred to as **new approach directives**, sets the essential requirements that products have to meet to be sold across the EU

http://europa.eu/youreurope/business/profiting-from-eu-market/selling-goods/index_es.htm

Normalización en Europa – Standardization in Europe

Para ayudarlos se han publicado unas **20.000 normas europeas**.

Los productos que las cumplen se consideran conformes a las directivas de la UE. Pero las normas no son obligatorias: los fabricantes pueden optar por otras soluciones técnicas para cumplir los requisitos

To help them do so, some **20 000 European standards** have been published to date.

Goods that comply with European standards are taken to comply with the essential requirements laid down by EU directives. It is however voluntary and, if they prefer, manufacturers may choose other technical solutions to meet these requirements.

http://europa.eu/youreurope/business/profiting-from-eu-market/selling-goods/index_es.htm

Electrical Engineering Electromagnetic Compatibility (EMC)

Todos los aparatos eléctricos o instalaciones pueden influir en los demás cuando interconectado o cerca uno del otro.

La Directiva primero limita las EMC emisiones electromagnéticas .

La Directiva también regula la inmunidad de equipos.

All electric devices or installations can influence each other when interconnected or close to each other.

The EMC Directive first limits electromagnetic emissions of equipment.

The Directive also governs the immunity of such equipment.

http://ec.europa.eu/enterprise/sectors/electrical/emc/index_en.htm

Electromagnetic Compatibility (EMC) – Directive 2004/108/EC

Directive 2004/108/EC relating to electromagnetic compatibility and repealing Directive 89/336/EEC
OJ L 390 of 31 December 2004

Directive repealed:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to Electromagnetic Compatibility
OJ L 139 of 23 May 1989

http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/electromagnetic-compatibility/index_en.htm

Directiva 2004/108/CE – EMC

Articulo 3

Los Estados miembros adoptarán todas las medidas adecuadas para garantizar que sólo se comercialicen y/o pongan en servicio los equipos que cumplan los requisitos de la presente Directiva cuando estén instalados, mantenidos y utilizados correctamente para los fines previstos.

Article 3

Member States shall take all appropriate measures to ensure that equipment is placed on the market and/or put into service only if it complies with the requirements of this Directive when properly installed, maintained and used for its intended purposes.

Directiva 2004/108/CE – EMC

Artículo 4

2. Los requisitos de la presente Directiva no impedirán la aplicación en cualquier Estado miembro de las siguientes medidas especiales, relativas a la puesta en servicio o uso de Equipos:

(a) medidas para superar un problema existente o previsto de compatibilidad electromagnética en un lugar específico;

(b) medidas adoptadas por motivos de seguridad para proteger las redes públicas de telecomunicaciones o las estaciones receptoras o transmisoras cuando se utilicen con fines de seguridad en situaciones de espectro bien definidas.

Article 4

2. The requirements of this Directive shall not prevent the application in any Member State of the following special measures concerning the putting into service or use of equipment:

(a) measures to overcome an existing or predicted electromagnetic compatibility problem at a specific site;

(b) measures taken for safety reasons to protect public telecommunications networks or receiving or transmitting stations when used for safety purposes in well-defined spectrum situations.

Directiva 2004/108/CE – EMC

Artículo 6

2. El cumplimiento por parte de los equipos de las normas armonizadas pertinentes, cuyas referencias se hayan publicado en el *Diario Oficial de la Unión Europea, creará la presunción,* por parte de los Estados miembros, de conformidad con los requisitos esenciales mencionados en el Anexo I a los que dichas normas hagan referencia. Esta presunción de conformidad se limitará al ámbito de las normas armonizadas aplicadas y a los requisitos esenciales pertinentes cubiertos por tales normas armonizadas.

Article 6

2. The compliance of equipment with the relevant harmonised standards whose references have been published in the Official Journal of the European Union shall raise a presumption, on the part of the Member States, of conformity with the essential requirements referred to in Annex I to which such standards relate. This presumption of conformity is limited to the scope of the harmonized standard(s) applied and the relevant essential requirements covered by such harmonized standard(s).

Normas Armonizadas – Directiva 2004/108/EC
Harmonized Standards – Directive 2004/108/EC

ORG	Reference	Superseded	Date of cessation
Cenelec	EN55022:2010 CISPR 22:2008 modified (ITE – emission)	EN 55022:2006 and Amend	1.12.2013
Cenelec	EN 55024:2010 CISPR 24:2010 (ITE – immunity)	EN55024:1998 and Amend	1.12.2013

http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/electromagnetic-compatibility/index_en.htm

European standards Radio and Telecommunications Terminal Equipment (RTTE) Directive 1999/5/EC

Directive of 9 March 1999 of the European Parliament and of the Council on Radio Equipment and Telecommunications Terminal Equipment and the mutual recognition of their conformity
OJ L 91 of 7 April 1999

Modification:

Directives repealed:

Directive 98/13/EC is repealed by Directive 1999/5/EC as from 8 April 2000

Directive 1999/5/EC – RTTE

Artículo 3. Requisitos esenciales

1. Se aplicaran a todos los aparatos los requisitos esenciales siguientes:

a) la protección de la salud y la seguridad del usuario o de cualquier otra persona, incluidos los objetivos respecto de los requisitos en materia de seguridad que figuran en la Directiva 73/23/CEE, salvo en lo relativo al limite de tensión;

b) los requisitos de protección que figuran en la Directiva 89/336/CEE, respecto de la compatibilidad electromagnética.

2. Los equipos radioeléctricos se construirán de forma que utilicen de forma eficaz el espectro asignado a las radiocomunicaciones terrenas/espaciales y los recursos orbitales para impedir las interferencias perjudiciales.

Directive 1999/5/EC – RTTE

Article 3. Essential requirements

1. The following essential requirements are applicable to all apparatus:

(a) the protection of the health and the safety of the user and any other person, including the objectives with respect to safety requirements contained in Directive 73/23/EEC, but with no voltage limit applying;

(b) the protection requirements with respect to electromagnetic compatibility contained in Directive 89/336/EEC.

2. In addition, radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communication and orbital resources so as to avoid harmful interference.

Harmonized Standards
Directive 1999/5/EC – RTTE

ORG	REFERENCE	SUPERSEDED	DATE. OF CESSATION	ITEM
CEN	EN55022:2010 CISPR 22:2008 Modified (ITE – emission)	EN55022:2006	1.12.2013	3.1 (b)
CEN	EN 55024:2010 CISPR 24:2010 (ITE – immunity)	EN55024:1998 and Amend	1.12.2013	3.1 (b)
ETSI	EN 301 489-1 v1.9.2 EMC and Radio Spectrum Matters (ERM): Electromagnetic Compatibility standard for radio equimen and services;Part 1: Commom technical	EN 301 489-1 v1.8.1	30/06/2013	3.1 (b)
ETSI	EN 301 489-10 v1.3.1 EMC and Radio Spectrum Matters (ERM): Electromagnetic Compatibility standard for radio equipment and services; Part 10: Specific conditions for First (CT1 and CT1+) and Second Generation Cordless Telephone (CT2) equipment	EN 301 489-10 v1.2.1	Date expired (30/11/2007)	3.1 (b)

http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/rtte/index_en.htm

Harmonized Standards
Directive 1999/5/EC – RTTE

ETSI EN 300 386 – Electromagnetic compatibility and Radio Spectrum Matters (ERM);Telecommunication Network Equipment; Electromagnetic Compatibility (EMC) requirements

- Condiciones de ensayo
- Evaluación de calidad de funcionamiento
- Aplicabilidad de los requisitos de emisión y inmunidad
- Aspectos específicos relativos a los métodos de ensayo
- Utiliza como referencia normas de la CEI y CISPR

- Test conditions
- Performance analysis
- Applicability of emission and immunity requirements
- Particular aspects related to Test method for each piece of equipment
- Use of IEC and CISPR standards as reference

http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/rtte/index_en.htm

Organismos Internacionales relacionados con CEM
International Organisms related to EMC

- **International Telecommunication Union – Standards (ITU)**
- International Electrotechnical Commission (IEC)
- Comité International Spécial des Perturbations Radioelectriquès (CISPR)

Some ITU-T Recommendations related to EMC

- ITU-T K38: Radiated emission test procedure for physically large systems
- ITU-T K42: Preparation of emission and immunity requirements for telecommunication equipment – General principles
- ITU-T K43: Immunity requirements for telecommunication equipment
- ITU-T K48: Product family EMC requirements for each telecommunication network equipment
- ITU-T K49: Test condition and performance criteria for voice terminal subject to interference from digital mobile phone
- ITU-T K60: Emission levels and test methods for wireline telecommunication networks to minimize electromagnetic disturbance of radio services

http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=5

Some ITU-T Recommendations related to EMC

- ITU-T K74: EMC, resistibility and safety requirements for home network devices
- ITU-T K76: EMC requirements for telecommunication network equipment (9 kHz – 150 kHz)
- ITU-T K80: EMC requirements for telecommunication network equipment (1 GHz – 6 GHz)
- ITU-T K81: High power electromagnetic immunity guide for telecommunication systems
- ITU-T K88: EMC requirements for next generation network equipment
- ITU-T K92: Conducted and radiated electromagnetic environment in home networking
- ITU-T K93: Immunity of home networking devices to electromagnetic disturbances

http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=5

UIT-T K48 / ITU-T K48

UIT-T K48 – Requisitos de compatibilidad electromagnética de la familia de productos para cada equipo de la red de telecomunicaciones
ITU-T K48 – Product family EMC requirements for each telecommunication network equipment

Esta Recomendación especifica los requisitos de emisión e inmunidad de equipos de conmutación, transmisión, potencia, estación radio base de telefonía móvil digital, LAN inalámbrica, sistema de transmisión digital de radio, línea de abonado digital (xDSL) y los equipos de supervisión. También se describen las condiciones operativas para la emisión y las pruebas de inmunidad. También se especifican los criterios de funcionamiento de los ensayos de inmunidad.

This Recommendation specifies the emission and immunity requirements for switching, transmission, power, digital mobile base station, wireless LAN, digital radio relay system, digital subscriber line (xDSL) and supervisory equipment. It also describes operational conditions for emission and immunity testing. Performance criteria for immunity tests are also specified.

UIT-T K48 / ITU-T K48

UIT-T K48 – Requisitos de compatibilidad electromagnética de la familia de productos para cada equipo de la red de telecomunicaciones
ITU-T K48 – Product family EMC requirements for each telecommunication network equipment

Requisitos de emisión

- Los métodos de prueba e sus limites están de acuerdo con CISPR 22. El limite depende del local de instalación: centro de telecomunicaciones o en el exterior.
- Los equipos de radiocomunicaciones excluyendo las estaciones de base móviles digitales se clasifican como:
  - Categoría 1: equipos con antena integrada
    - Categoría 1.1 equipos cuya frecuencia es inferior a 1 GHz
    - Categoría 1.2 equipos cuya frecuencia es superior a 1 GHz
  - Categoría 2 equipos con antena no integrada
- Para las categorías 1.2 y 2 se aplican CISPR 22. Considerar la banda de exclusión
- Para las categorías 1.1 e estaciones de base móviles digitales se aplican la Rec. UIT-R SM 329-10 limites de las emisiones en el dominio no esencial.

UIT-T K48 / ITU-T K48

Emission requirements

- Test methods and their limits are in accordance with CISPR 22. The limit depends on the place of installation: telecommunications center or outside.
- Radio communication equipment excluding digital mobile base stations are classified as:
  - Category 1 equipment with integrated antenna
    - Category 1.1 equipment whose frequency is below 1 GHz
    - Category 1.2 equipment whose frequency is above 1 GHz
  - Category 2 devices with integrated antenna
- For categories 1.2 and 2 apply CISPR 22. Consider exclusion band
- For categories 1.1 and digital mobile base stations apply

  ITU-R SM 329-10 emissions limits in the spurious domain

  (ITU-R Recommendation SM.329-10 (2003), *Unwanted emissions in the spurious domain. At present SM 329-12 – 2012)*

UIT-T K48 / ITU-T K48

Requisitos de inmunidad

- Se aplican los métodos y niveles de pruebas generales señalados en la Rec. UIT-T K43.
- La prueba de inmunidad por conducción se efectuarán en los puertos de entrada y salida de energía y en los puertos de señales.
- Se aplicará a un puerto a la vez.
- Si la longitud máxima especificada de la línea es inferior a 3 m, no será necesaria una prueba de inmunidad por conducción.
- No es necesaria ninguna prueba de sobretensión en la línea de señal si la longitud máxima especificada es inferior a 10 m.
- Se probará un puerto de señales de cada tipo encontrado en el equipo.
- Cables de pares múltiples y/o compuestos se probarán como si fuera un cable único, pero cables agrupados en haces por cuestiones estéticas deben ser probados individualmente.
- En caso de cables apantallados, la sobretensión se aplica directamente a la pantalla.

UIT-T K48 / ITU-T K48

Requisitos de inmunidad

- Apply the methods and general test levels specified in ITU-T K43.
- The conductive immunity test shall be made in the input and output ports power and signal ports.
- Test shall be applied to one port at a time.
- If the specified maximum length connected line is less than 3 m, it is not necessary to test.
- It is not required to test lines which the specified maximum length is less than 10 m.
- Shall be tested signal port of each type found in the equipment.
- Multi-pair cables and / or compounds shall be tested as a single cable, but wires grouped into bundles for aesthetic reasons must be tested individually.
- For the shielded cables, the voltage is applied directly to the screen.

UIT-T K48 / ITU-T K48

- Condiciones de funcionamiento generales y configuración de la prueba
  - Configuración máximo
  - Condiciones de funcionamiento normales y representativas
  - Prueba únicamente puertas con cables conectados permanentemente
  - Se aplicará a un puerto a la vez.
- Condiciones de funcionamiento especificas
  - Equipo de conmutación
    - Puertos sometidos a prueba deben establecer la conexión a otro puerto y se pueden utilizar equipos auxiliares
    - Uso de simulador de tráfico para someter a prueba ciertas funciones
    - Limitar ejercicio en 32 líneas de abonado (analógicas o digitales)

UIT-T K48 / ITU-T K48

- Equipo de transmisión / Transmission Equipment
- Equipo de suministro de energía / Power Supply Equipment
- Equipo de supervisión / Supervisory Equipment.
- LAN inalámbricas / Wireless LAN
- Estación de base móvil digital (BS)/ Digital Mobile Base Station
- Sistemas de radioenlace digital / Digital Radio Relay System
- Equipos xDSL / xDSL equipment

UIT-T K48 / ITU-T K48

Table 4/K.48 – Wireless LAN performance criteria

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance (Note 1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance (Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance (Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance (Note 2)

NOTE 1 – Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases, the specified minimum performance level may be replaced by a permissible degradation of performance.

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

NOTE 2 – No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases, the specified minimum performance level may be replaced by a permissible degradation of performance. After the test, no change of actual operating data or user retrievable data is allowed.

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

UIT-T K48 / ITU-T K48

Immunity test levels

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
Enclosure port					
Radio-frequency electro-magnetic field	3 10 3 10	V/m	IEC 61000-4-3 [36]	A	80-800 MHz 800-960 MHz 960-1000 MHz 1400-2000 MHz (Note 1)
Electrostatic discharge	4	kV	IEC 61000-4-2 [35]	B	Contact and air discharge
Outdoor telecommunication ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2, 3 and 5)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5 [38]	B	10/700 µs (Notes 4 and 13)
Fast transients	0.5	kV	IEC 61000-4-4 [37]	B	(Note 12)
Indoor telecommunication ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2, 3 and 5)
Surges	0.5 (line to ground)	kV	IEC 61000-4-5 [38]	B	1.2/50 (8/20) µs (Note 4)
Fast transients	0.5	kV	IEC 61000-4-4 [37]	B	(Note 12)
DC power ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2, 3 and 5)
Fast transients	0.5	kV	IEC 61000-4-4 [37]	B	(Note 12)

UIT-T K48 / ITU-T K48

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
DC power ports (continued)					
Voltage dips	0 0.01 and 0.1	% of nominal voltage s	IEC 61000-4-29 [41]	C (Notes 7, 8 and 11)	
Abnormal Voltage	0 to 90 1	% of nominal voltage s		C (Notes 9, 10 and 11)	
	110 to 125 1	% of nominal voltage s		C (Notes 9, 10 and 11)	
Voltage Variation	From 100 to 90 2	% of nominal voltage s		A	The test simulates a change in the DC voltage from the nominal value to a lower value
	From 100 to 110 2	% of nominal voltage s		A	The test simulates a change in the DC voltage from the nominal value to a higher value
AC power ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Note 5)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5 [38]	B	1.2/50 (8/20) µs
Fast transients	1.0	kV	IEC 61000-4-4 [37]	B	(Note 12)

UIT-T K48 / ITU-T K48

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
Voltage dips	>95 0.5	% reduction period	IEC 61000-4-11 [40]	B	(Note 6)
	30 25	% reduction period	IEC 61000-4-11 [40]	C	(Note 6)
Voltage interruption	95 250	% reduction period	IEC 61000-4-11 [40]	C	(Note 6)

NOTE 1 – The test may be performed with a start frequency lower than 80 MHz, but not less than 27 MHz.

NOTE 2 – A lower test level above 10 MHz can be applied. The specific level is under study.

NOTE 3 – The test level can be defined as equivalent current into 150 Ω.

NOTE 4 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 5 – It is recognized that radio-frequency electromagnetic fields and conducted continuous voltages are 1 V/m and 1 V respectively in major telecommunication centres.

NOTE 6 – This test applies to equipment having a rated input current not exceeding 16 A per phase.

UIT-T K48 / ITU-T K48

Table A.2/K.48 – Equipment for outdoor locations

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
Enclosure port					
Radio-frequency electro-magnetic field	3 10 3 10	V/m	IEC 61000-4-3 [36]	A	80-800 MHz 800-960 MHz 960-1000 MHz 1400-2000 MHz (Notes 1 and 5)
Electrostatic discharge	4	kV	IEC 61000-4-2 [35]	B	Contact and air discharge
Telecommunication ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2 and 3)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5 [38]	B	10/700 µs (Notes 4 and 13)
Fast transients	0.5	kV	IEC 61000-4-4 [37]	B	(Note 12)
DC power ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2 and 3)

UIT-T K48 / ITU-T K48

Table A.2 continued except voltage variation on DC power supply ref. IEC 61000-4-29

Fast transients	0.5	kV	IEC 61000-4-4 [37]	B	(Note 12)
AC power ports					
Radio-frequency conducted continuous	3	V	IEC 61000-4-6 [39]	A	0.15-80 MHz (Notes 2 and 3)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5 [38]	B	1.2/50 (8/20) µs
Fast transients	1.0	kV	IEC 61000-4-4 [37]	B	(Note 12)
Voltage dips	>95 0.5	% reduction period	IEC 61000-4-11 [40]	B	(Note 6)
	30 25	% reduction period	IEC 61000-4-11 [40]	C	(Note 6)
Voltage interruption	95 250	% reduction period	IEC 61000-4-11 [40]	C	(Note 6)
	30 25	% reduction period	IEC 61000-4-11 [40]	C	(Note 6)

NOTE 1 – The test may be performed with a start frequency lower than 80 MHz, but not less than 27 MHz.

NOTE 2 – A lower test level above 10 MHz can be applied. The specific level is under study.

NOTE 3 – The test level can be defined as equivalent current into 150 Ω.

NOTE 4 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 5 – In cases where mobile communications are permitted, radio field immunity higher than 10 V/m may be requested at communication frequencies.

NOTE 6 – This test applies to equipment having a rated input current not exceeding 16 A per phase.

UIT-T K48 / ITU-T K48

Table A.3/K.48 – Equipment for telecommunication centre (Emission)

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electromagnetic field	30 to 230 MHz	40 dB(µV/m)	N/A	CISPR 22 [30]	Physically large systems should be tested according to ITU-T Rec. K.38 [15] (Note 3)
	230 to 1000 MHz	47 dB(µV/m)			
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	97 to 87 dB(µV)	84 to 74 dB(µV)	CISPR 22 [30]	(Notes 1 and 2)
	0.5 to 30 MHz	87 dB(µV)	74 dB(µV)		
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(µV)	66 dB(µV)	CISPR 22 [30]	(Note 2)
	0.5 to 30 MHz	73 dB(µV)	60 dB(µV)		
DC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(µV)	66 dB(µV)	CISPR 22 [30]	(Note 2)
	0.5 to 30 MHz	73 dB(µV)	60 dB(µV)		

NOTE 1 – The limits decrease linearly with the logarithm of the frequency.

NOTE 2 – Equivalent current limit can be applied.

NOTE 3 – The limits are given for 10 metres measurement distance.

UIT-T K48 / ITU-T K48

Table A.4/K.48 – Equipment for outdoor location (Emission)

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electro-magnetic field	30 to 230 MHz	30 dB(µV/m)	N/A	CISPR 22 [30]	Physically large systems should be tested according to ITU-T Rec. K.38 (Note 3)
	230 to 1000 MHz	37 dB(µV/m)			
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	84 to 74 dB(µV)	74 to 64 dB(µV)	CISPR 22 [30]	(Notes 1 and 2)
	0.5 to 30 MHz	74 dB(µV)	64 dB(µV)		
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	66 to 56 dB(µV)	56 to 46 dB(µV)	CISPR 22 [30]	(Notes 1 and 2)
	0.5 to 5 MHz	56 dB(µV)	46 dB(µV)		
	5 to 30 MHz	60 dB(mV)	50 dB(µV)		
DC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	66 to 56 dB(µV)	56 to 46 dB(µV)	CISPR 22 [30]	(Notes 1 and 2)
	0.5 to 5 MHz	56 dB(µV)	46 dB(µV)		
	5 to 30 MHz	60 dB(µV)	50 dB(µV)		

NOTE 1 – The limits decrease linearly with the logarithm of the frequency.

NOTE 2 – Equivalent current limit can be applied.

NOTE 3 – The limits are given for 10 metres measurement distance.

Recomendaciones internacionales de CISPR utilizadas como referencias

- CISPR 22 – Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement

- ITU-R SM.329-10 (2003) – Unwanted emissions in the spurious domain (emisiones no deseadas en el dominio no esencial)

- These publication establishes requirements in order to prevent radio interference.

- Estas publicaciones establecen requisitos con el fin de evitar interferencias de radio.

Recomendaciones internacionales básicas de la IEC sobre inmunidad electromagnética

International IEC standards on electromagnetic immunity

- CISPR 24 – Características de inmunidad de ETI
  ITE immunity characteristics
- IEC 61000-4-2 – Relativas a las descargas electrostáticas
  Immunity related to electrostatic discharge
- IEC 61000-4-3 – Relativas a radiaciones electromagnéticas
  Immunity related to RF electromagnetic fields
- IEC 61000-4-4 – Relativa a transitorios rápidos y salvas de impulsos
  Immunity related to EFT/B
- IEC 61000-4-5 – Relativa a ondas de choque (impulsos eléctricos)
  Immunity related to surges

Recomendaciones internacionales básicas de la IEC sobre inmunidad electromagnética

International IEC standards on electromagnetic immunity

- IEC 61000-4-6 – Relativa a señales de radiofrecuencia conducidos

  Immunity related to conducted RF signals

- IEC 61000-4-11 – Relativa a interrupciones y variaciones de la tensión de alimentación de corriente alternada

  Immunity related to variations and interruptions of the a.c. mains power

Resolution 442 – ANATEL - 2006

Capitulo II - REFERENCES

- I - Anatel - Regulamento para Certificação e Homologação de Produtos para Telecomunicações.

  II - IEC 61000-4-2(2001) - Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques. Section 2 Electrostatic discharge immunity test.

  III - IEC 61000-4-3 (2002) - Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques. Section 3 Radiated electromagnetic field requirements.

  IV - IEC 61000-4-4 (2004) - Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques. Section 4 Electrical fast transient.

  V - IEC 61000-4-5 (2001) - Electromagnetic Compatibility (EMC) - Part 4: Test and Measurement Techniques - Section 5: Surge Immunity Test.

  VI - IEC 61000-4-6 (2004) - Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques. Section 6 Immunity to conducted disturbances induced by radio-frequency fields.

Resolution 442 – ANATEL - 2006

VII - IEC 61000-4-11 (2004) - Electromagnetic Compatibility (EMC): Part 4: Testing and Measurement Techniques; Section 11: Voltage dips, short interruptions and voltage variations; Immunity tests.

VIII - CISPR 11 (2003) - Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristic - Limits and methods of measurement.

IX - CISPR 22 (2005) - Limits and methods of measurement of radio disturbance characteristics of information technology equipment.

X - CISPR 24 (1997), Amend 1 (2001) e Amend 2 (2002) - Information technology equipment - Immunity characteristics - Limits and methods of measurement

Resolution 442 – ANATEL - 2006

VII - IEC 61000-4-11 (2004) - Electromagnetic Compatibility (EMC): Part 4: Testing and Measurement Techniques; Section 11: Voltage dips, short interruptions and voltage variations; Immunity tests.

VIII - CISPR 11 (2003) - Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristic - Limits and methods of measurement.

IX - CISPR 22 (2005) - Limits and methods of measurement of radio disturbance characteristics of information technology equipment.

X - CISPR 24 (1997), Amend 1 (2001) e Amend 2 (2002) - Information technology equipment - Immunity characteristics - Limits and methods of measurement

Resolución 442 – ANATEL - 2006

Capítulo III – Alcance

Art. 3º : Las siguientes disposiciones se aplican a los equipos de telecomunicaciones. Los demás equipos que pueden desempeñar funciones de telecomunicaciones u ofrecer accesos a servicios de valor añadido, incluso Internet, serán objeto de regulación específica.

I - Los requisitos de emisión de perturbaciones electromagnéticas se aplican a los equipos sometidos a certificación obligatoria, tal como se define en las normas específicas contenidas en la sección I, del Art. 2

En el caso de los equipos que utilizan el espectro radioeléctrico, los requisitos de emisión perturbaciones electromagnéticas radiadas descritas en el presente Reglamento se aplicará únicamente a la ausencia de requisitos de emisiones intencional de radiofrecuencia o emisión de señales non esenciales dispuestos en reglamentación específica sobre el producto.

Resolución 442 – Anatel

Capítulo III – Alcance

II - Los requisitos de inmunidad a las perturbaciones electromagnéticas se aplican a los equipos clasificados como Productos de Telecomunicaciones de Categoría I y Categoría II, según definido en reglamentación específica mencionada en sección I de lo Art. 2, desde que destinado al uso previsto del público general (véase el anexo II).

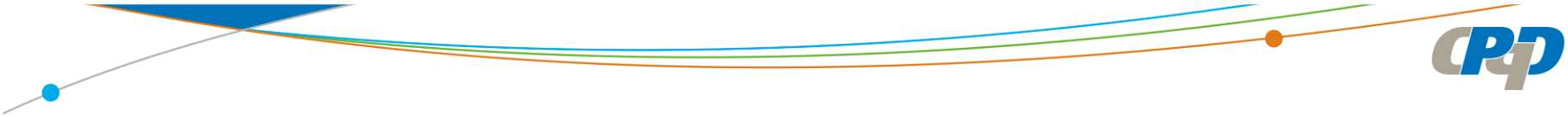
III - El Requisitos de Resistibilidad a las perturbaciones electromagnéticas se aplican a los productos de telecomunicaciones Categoría I y Categoría II, según definido en la reglamentación mencionada en la sección I del artículo. 2, desde que destinados al uso por el público en general (véase el anexo II).

Resolución 442 – Anatel

Productos de Telecomunicaciones de Categoría I: equipo terminal diseñado para su uso por el público en general para acceder al servicio de telecomunicaciones de interés colectivo.

Productos de Telecomunicaciones de Categoría II: equipos no incluidos en la definición de Categoría I, pero que hace el uso del espectro radioeléctrico, incluyendo antenas y los caracterizados en la regulación específica, como equipos de radiocomunicaciones de radiación Estricta;

Productos de Telecomunicaciones de Categoría III: cualquier producto o equipo, que no lo son, cubiertos por las categorías I y II, para lo cual es necesaria la regulación;



Conceptos Básicos
Basic Concepts

Conceptos Básicos / Basic Concepts

Decibelio para expresar la medida de magnitudes utilizadas en EMC

$$X_{dBm} = 10 \log \frac{x\ mW}{1\ mW}$$

dBm ↔ 1 mW como referencia. 0 dBm = 1 mW

$$X_{dB\mu A} = 20 \log \frac{x \mu A}{1 \mu A}$$

dBµA ↔ 1 µA como referencia. 0 dBµA = 1 µA

$$X_{dB\mu V} = 20 \log \frac{x\ \mu V}{1\ \mu V}$$

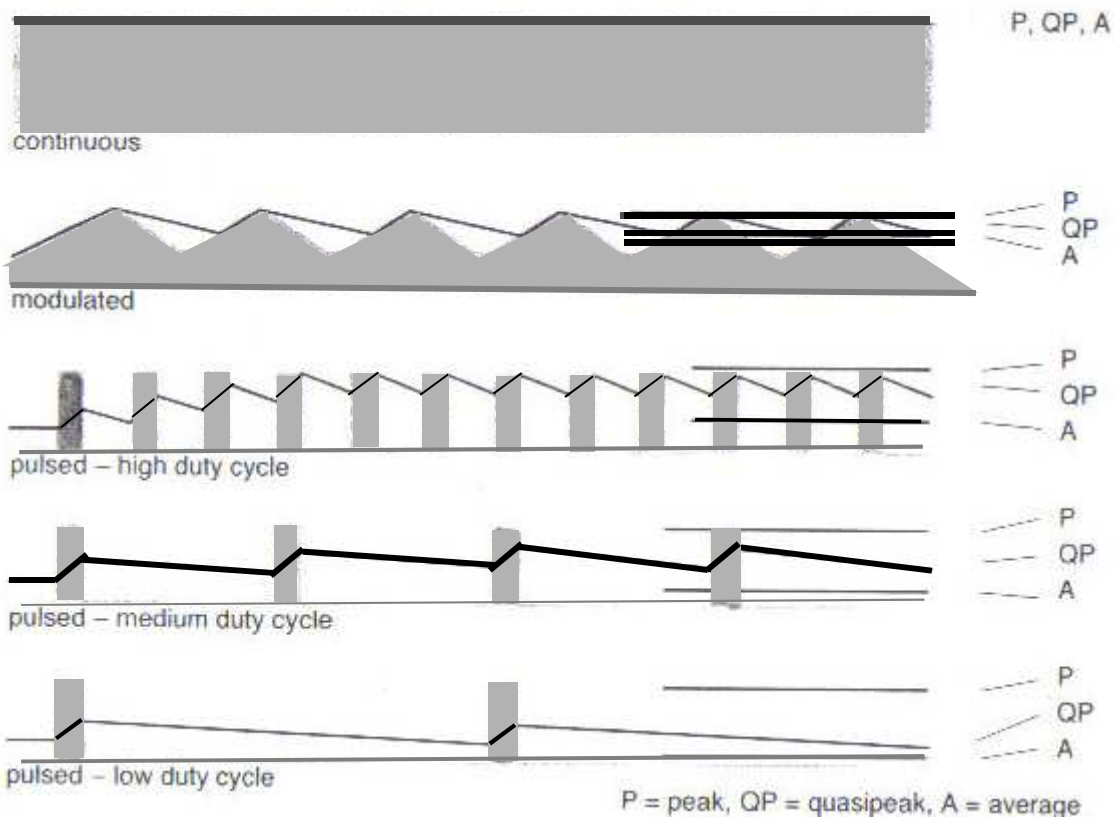
dBµV ↔ 1 µV como referencia. 0 dBµV = 1 µV

$$X_{dB\mu V/m} = 20 \log \frac{x\ \mu V/m}{1\ \mu V/m}$$

dB µV/m ↔ 1 µV/m como referencia

Conceptos Básicos / Basic Concepts

Detección de pico, valor medio e cuasi-pico



Conceptos Básicos / Basic Concepts

La medición de intensidad de campo
Electric field strength measurement

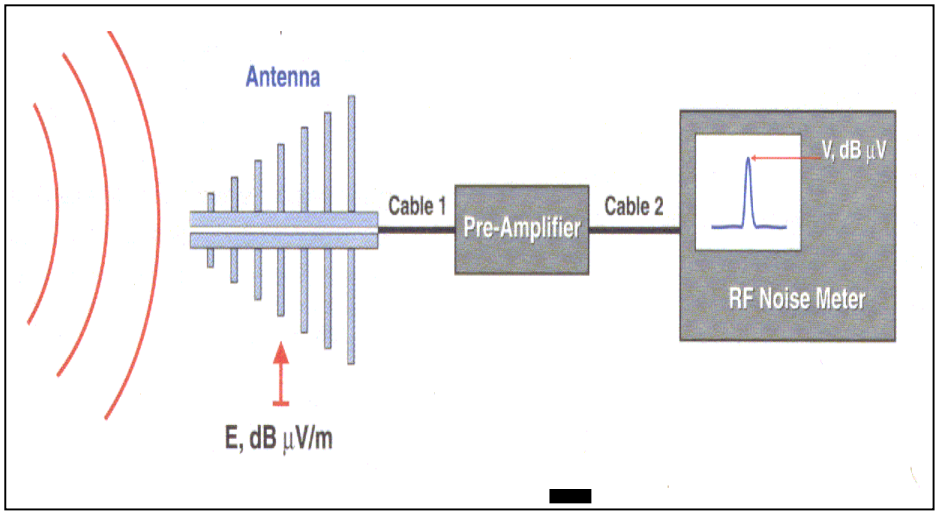
Los componentes

1 – Antena / antenna

2 – Línea de transmisión / transmission line

3 – Atenuador o pré-amplificador/ attenuator or amplifier

4 – Receptor / receiver



Conceptos Básicos / Basic Concepts

Antenas de medición utilizadas en EMC / EMC measuring antennas

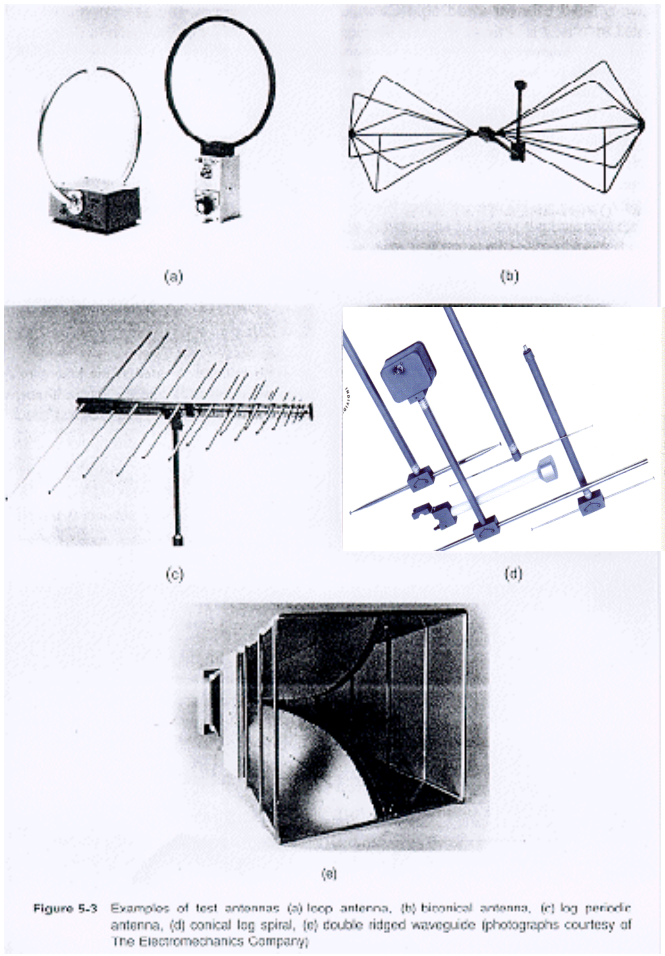


Figure 5-3 Examples of test antennas (a) loop antenna, (b) biconical antenna, (c) log periodic antenna, (d) conical log spiral, (e) double ridged waveguide (photographs courtesy of The Electromechanics Company)

- **ANTENA TIPO BUCLE**

  9 kHz – 30 MHz

- **ANTENA BICÓNICA**

  30 MHz – 200 MHz

- **ANTENA LOG PERIÓDICA**

  200 MHz – 1000 MHz

- **ANTENA DIPOLO SINTONIZADO**

  30 MHz – 1000 MHz

- **ANTENA *DOBLE RIDGE***

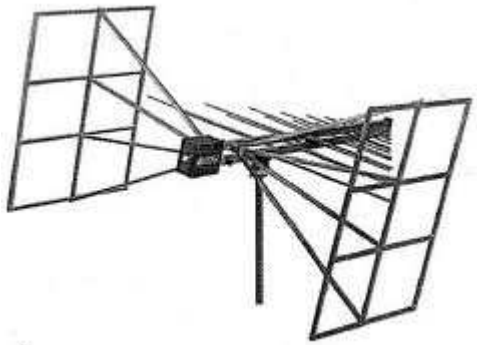
  1 GHz – 18 GHz

Conceptos Básicos / Basic Concepts

Antenas de medición utilizadas en EMC

ANTENA BICONILOG

30 MHz – 2000 MHz

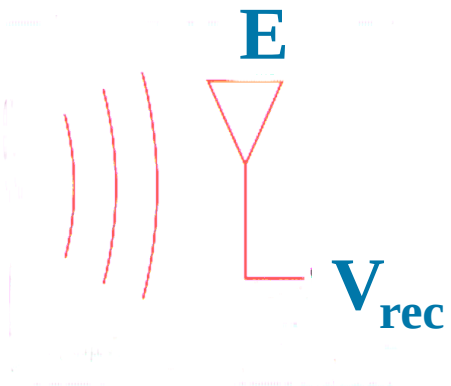


Conceptos Básicos / Basic Concepts

FACTOR DE ANTENA AF

("ANTENNA FACTOR - AF")

Relación del campo eléctrico con la tensión en el terminal de la antena



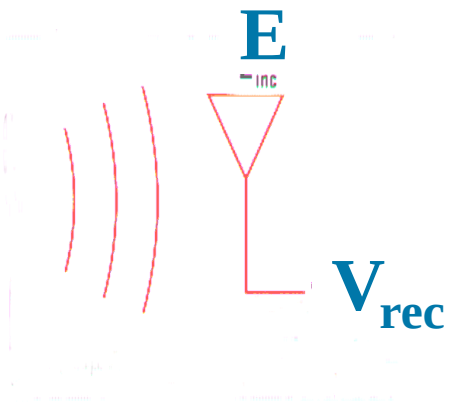
$$AF\ \ (1/\mathrm{m}) \ = \frac{E\ \ (\mathrm{V/m})}{V_{\mathrm{rec}}\ \ \ (\mathrm{V})}$$

Conceptos Básicos / Basic Concepts

FACTOR DE ANTENA AF
("ANTENNA FACTOR - AF")

En decibelios:

$$E_{dB(\mu V/m)} = V_{[dB(\mu V)]} + AF_{[dB(m^{-1})]}$$



$$E_{\mu V/m} = 10^{\frac{E_{dB\mu V/m}}{20}} \quad \mu V/m$$

Conceptos Básicos / Basic Concepts

FACTOR DE ANTENA x GANANCIA DE LA ANTENA

ANTENNA FACTOR x ANTENNA GAIN

$$AF = \frac{9{,}73}{\lambda\sqrt{G_i}}$$

$$AF_{dB(1/m)} = 20 \log f_{MHz} - 29{,}78 - Gi_{dB}$$

Donde:

G_i = Ganancia de la antena con relación a antena de referencia isotrópica/gain related to an isotropic antenna

λ = longitud de onda / wavelength = c/f

Conceptos Básicos / Basic Concepts

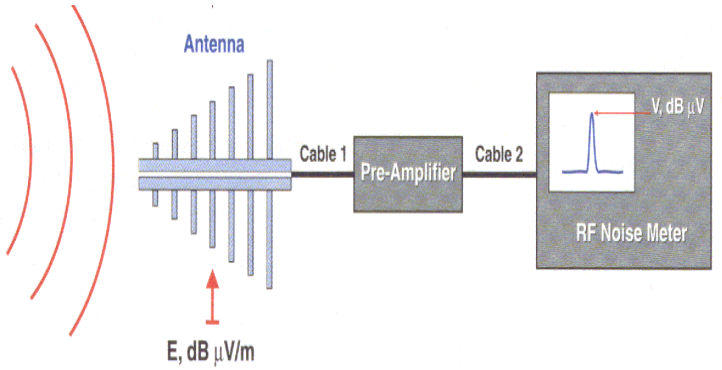
Considerando el factor AF de la antena, las pérdidas en los cabos de RF y eventuales atenuaciones y amplificaciones, resulta:
Considering the antenna factor, cable loss and possible attenuation and amplification, the result is:

$$E_{dB(\mu V/m)} = V_{[dB(\mu V)]} + AF_{[dB(m^{-1})]} + Ca_{dB} + A_{dB}$$

Donde / where:

Ca = Perdida total de los cables / cable loss

A_{dB}
- **> 0 Atenuación / attenuation**
- **< 0 Ganancia del amplificador / amplifier gain**



ASPECTOS SOBRE LOS ENSAYOS DE CEM

ASPECTS REGARDING EMC TEST

Publication CISPR 22

- **CISPR 22 (2008) – Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement**

- This publication establishes requirements for the radio disturbance emission and methods of measurement in order to prevent radio interference.

- Esta publicación establece requisitos para la emisión de perturbaciones radioeléctricas y de los métodos de medición con el fin de evitar interferencias de radio.

Publication CISPR 22

Information Technology Equipment (ITE)

any equipment:

- **which has a primary function of (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer;**
- **It includes, for example, data processing equipment, office machines, electronic business equipment and telecommunication equipment.**

Equipos de tecnología de información (ITE)

cualquiera equipo

- que tiene una función primaria de (o una combinación de) entrada, almacenamiento, visualización, recuperación, transmisión, transformación, distribución, o el control de los datos y mensaje de telecomunicaciones que puede estar equipado con uno o más puertos terminales habilitados para la transmisión de la información;
- Incluye, por ejemplo, equipos de procesamiento de datos, máquinas de oficina, equipo de presentación electrónica y equipos de telecomunicaciones.

Publication CISPR 22

Classification of ITE

Class B ITE is intended primarily for use in the domestic environment and may include:

– includes equipment with no fixed place of use; portable equipment and telecommunication terminal, personal computers and auxiliary connected equipment.

NOTE: The domestic environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m of the apparatus concerned.

Class A ITE is a category of all other ITE which satisfies the class A ITE limits but not the class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use.

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Publication CISPR 22

- **Importante aspecto de la CISPR 22 a mencionar es el uso de los detectores de valor medio, pico y cuasi-pico / Important aspect of CISPR 22 to be mentioned is the use average peak and quasi-peak detectors**

  - **Emisión conducida – uso dos detectores de valor medio e do cuasi-pico / conducted emission – use of average and quasi-peak detectors**

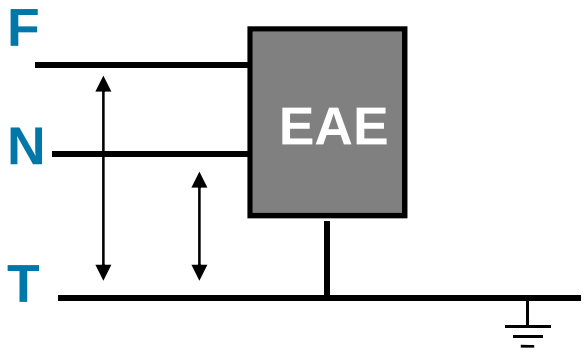
  - **En emisión radiada hasta 1 GHz – uso del detector de cuasi-pico / radiated emission up to 1 GHz – use of quasi-peak detector**

  - **En emisión radiada superior a 1 GHz - ¨6 GHz – uso del detector de valor medio / radiated emission higher than 1 GHz – use of average and peak detectors**

Publication CISPR 22

- Emisiones a partir de los terminales de energía eléctrica y de los terminales de telecomunicaciones

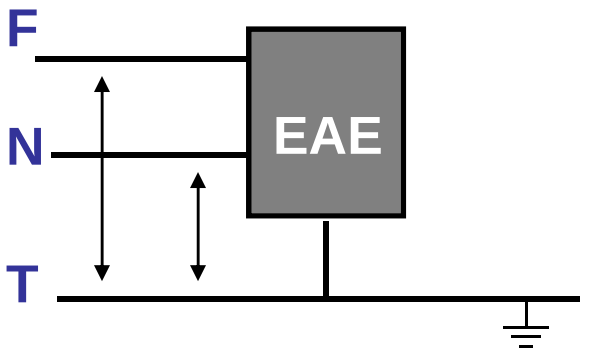
- Uso de detectores de valor medio y valor cuasi-pico / usage of average and quasi peak detectors
- Red fictícia (AMN – Artificial mains network)
- Red estabilizada de impedancia (ISN – Impedance Stabilization Network)
- Faja de frecuencia de 150 kHz a 30 MHz / frequency range of 150 kHz to 30 MHz
- Perturbación ambiente 6 dB abajo del limite (uso de cámara blindada) / Ambient disturbances 6 dB below the limit (usage of shielded chamber)



Publication CISPR 22

Limites de emisión a partir de las líneas de alimentación

FRECUENCIA MHz	LIMITES en dB (µV) CLASE B	
	Cuasi-pico	Valor medio
0,15 - 0,50	66 a 56	56 a 46
0,5 - 5	56	46
5 - 30	60	50



OBS.: Medición con red artificial tipo " V "

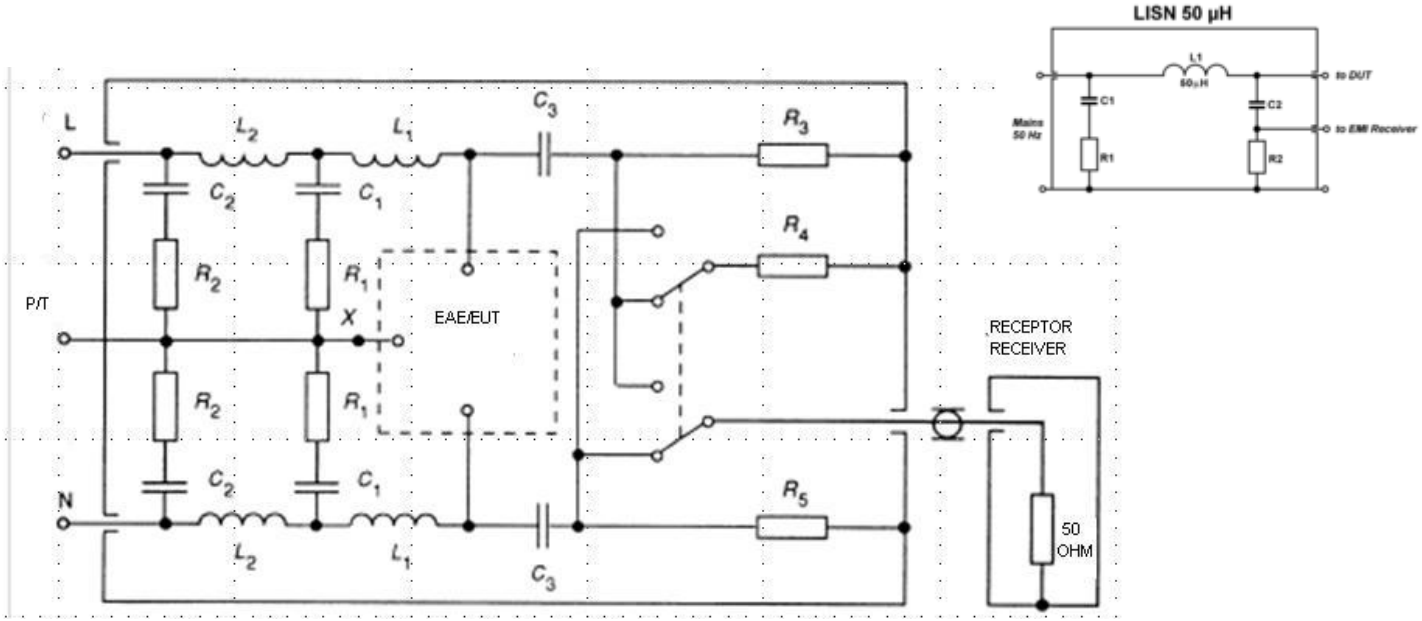
Según UIT-T K48 puede ser utilizada corriente equivalente

According to ITU-T K48 can be used equivalent current

Publication CISPR 22

Red artificial / Artificial mains network – AMN

Line impedance stabilization network - LISN

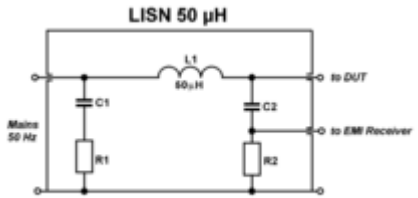


Circuito según la CISPR / Circuit according CISPR

Publication CISPR 22

Red artificial / Artificial mains network – AMN

Line impedance stabilization network - LISN



Garantiza una impedancia normalizada en la entrada del EAE (50 Ω) independiente del valor de impedancia de la red de alimentación local

Ensures normalized impedance at the input of EAE (50 Ω) regardless the actual value of the local mains impedance

Circuito simplificado / simplified circuit

Publication CISPR 22

Red artificial / Artificial mains network – AMN

Line impedance stabilization network - LISN

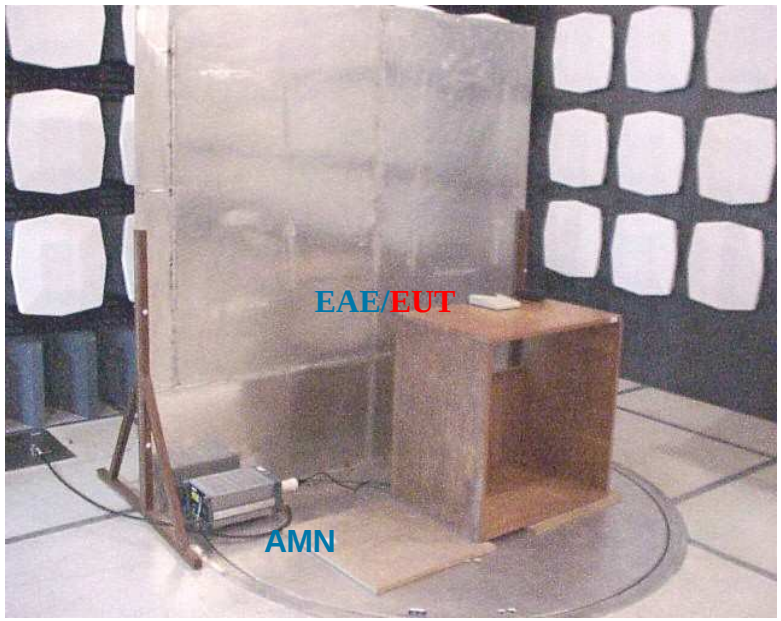
Reduce la presencia de perturbación del ambiente sobre los niveles de emisión que serán medidos

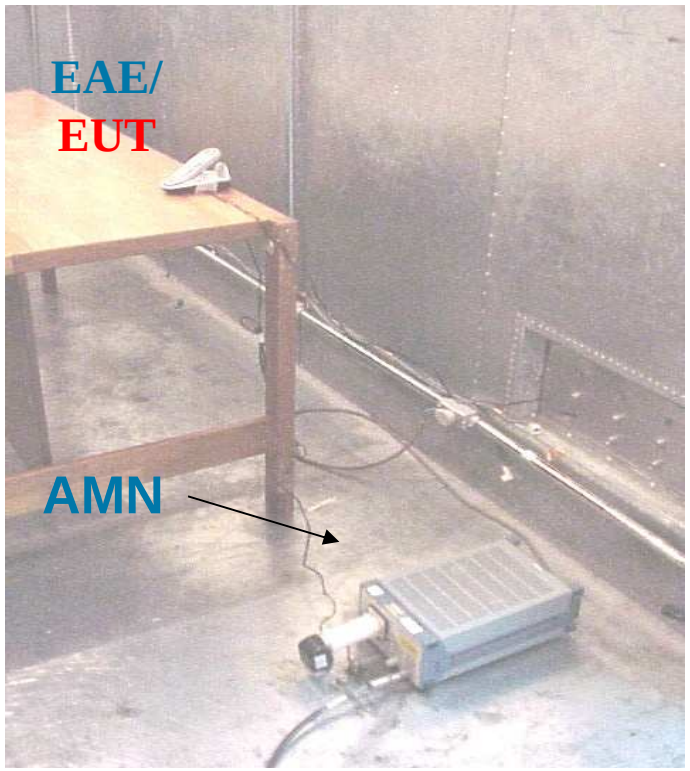
Reduce the presence of disturbance of the environment on the emission levels to be measured

Publication CISPR 22

Ensayo de emisión conducida – línea de alimentación

- Ejemplo de montaje de ensayo / **test setup**





Publication CISPR 22

Limites de emisión de las líneas de telecomunicaciones

Frecuencia MHz	LIMITES EN dB (μV) CLASE B		LIMITES EN dB (μA) CLASE B	
	Cuasi-pico	Valor medio	Cuasi-pico	Valor medio
0,15 - 0,50	84 a 74	74 a 64	40 a 30	30 a 20
0,5 - 30	74	64	30	20

Nota:

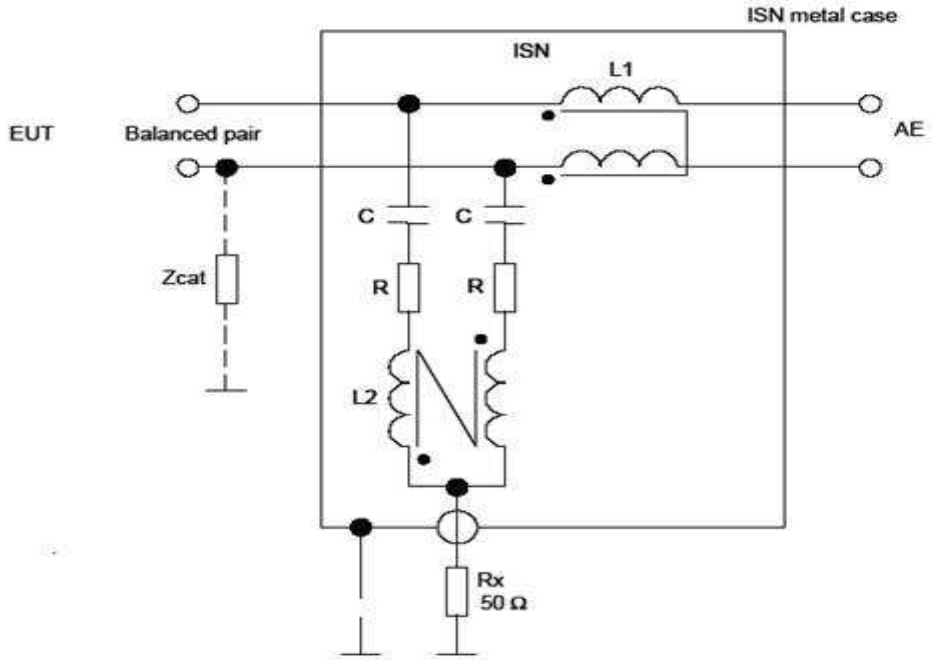
Los límites decrecen con el logaritmo de la frecuencia en la banda 0,15 MHz a 0,50 MHz / the limits increase with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz

La corriente y tensión son derivadas del uso do ISN (150 Ω)
Current and voltage are derived from the usage of ISN (150 Ω)

Red de estabilización de impedancia
Impedance Stabilization Network – ISN

Para ensayo de emisión conducida en línea de telecom

For telecom line conducted emission test

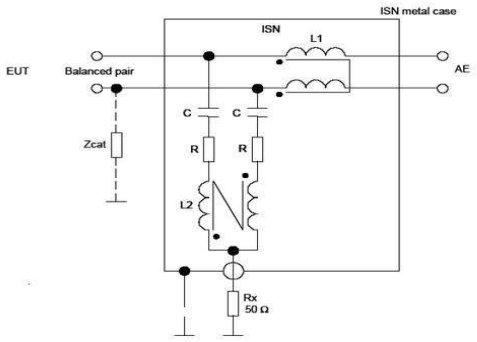


Publication CISPR 22

Red de estabilización de impedancia
Impedance stabilization network – ISN

Garantiza una impedancia asimétrica normalizada en la línea de telecomunicación del EAE (150 Ω)

Ensures a normalized asymmetric impedance to the telecom line of the EUT (150 Ω)

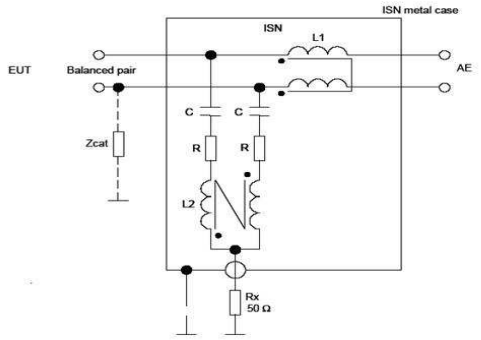


Publication CISPR 22

Red de estabilización de impedancia
Impedance stabilization network – ISN

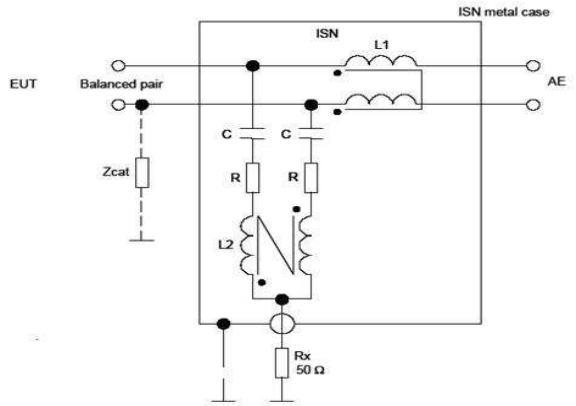
Reduce la presencia de perturbación del ambiente sobre los niveles de emisión que serán medidos

Reduce the presence of environment disturbance on the emission levels to be measured



Publication CISPR 22

Red de estabilización de impedancia
Impedance stabilization network – ISN

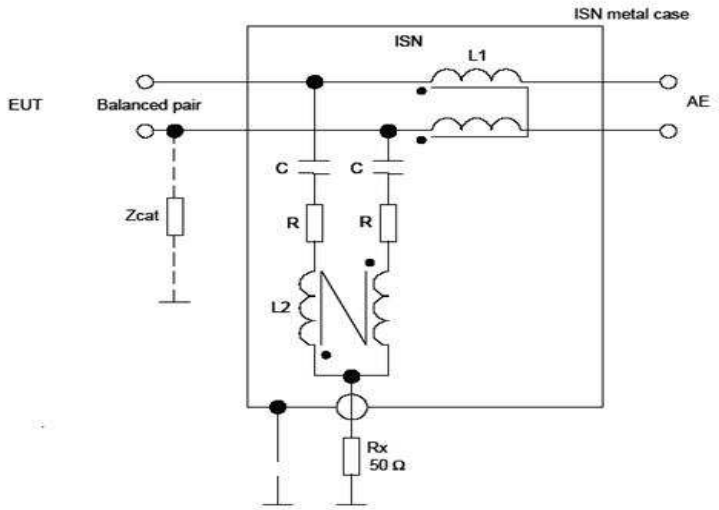


Impedancia del punto de conexión del medidor debe ser 50 Ω./ Impedance meter connection point should be 50 Ω

LCL del ISN debe ser compatible con la red de telecomunicación normalmente utilizada con el EAE/ LCL must be compatible with the telecommunication network normally used with EAE

Publication CISPR 22

Red de estabilización de impedancia
Impedance stabilization network – ISN



$$LCL = 20LOG\frac{U_C}{U_D}$$

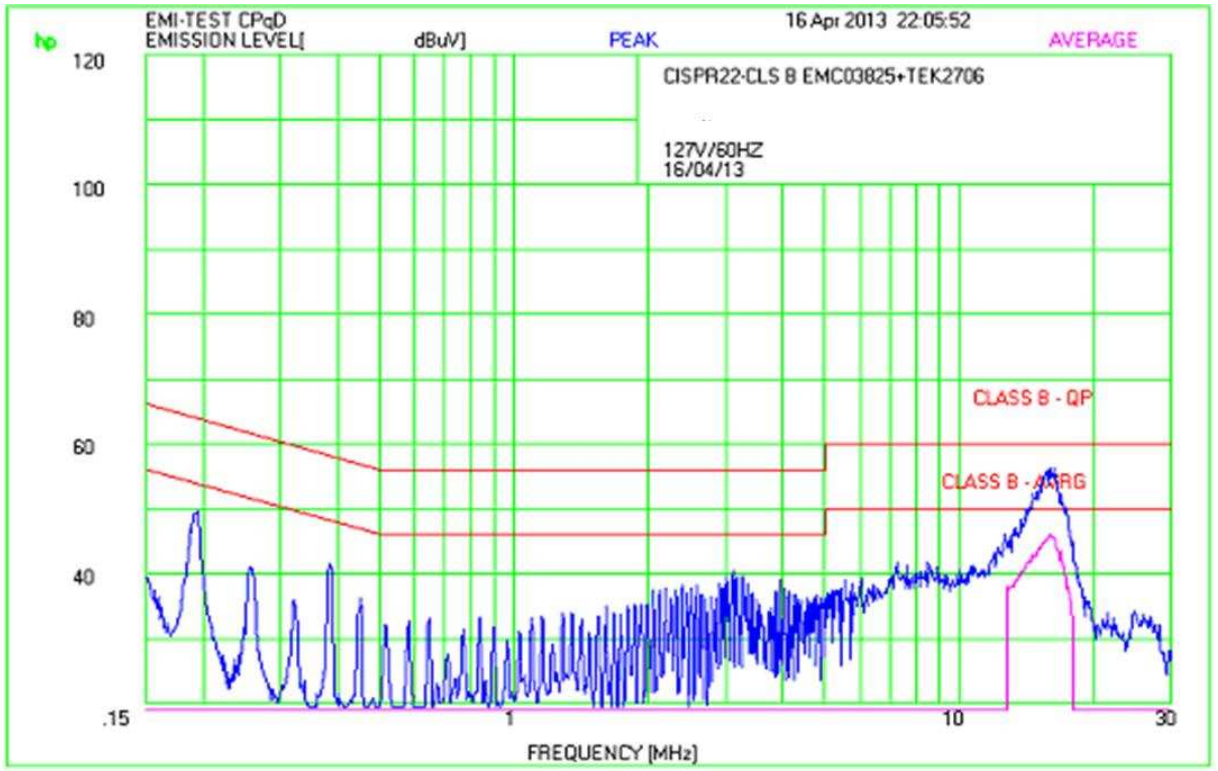
U_C – tensión en modo común (fuerza electro-motriz) / common mode voltage

U_D – tensión en modo diferencial / differential mode voltage

Publication CISPR 22

Ejemplo de resultado de ensayo de emisión conducida

Example of conducted emission test result



Publication CISPR 22

Ejemplo de montaje de ensayo de emisión conducida

Example of conducted emission test setup

Equipo X

Publication CISPR 22

➢ Ensayo de emisión de perturbaciones radiadas

- Detector de valor cuasi-pico para el rango de 30 MHz a 1000 MHz
- Quasi-peak detector for 30 MHz to 1000 MHz frequency range

- Detector de valor medio e pico para el rango 1 GHz a 6 GHz
- Average and peak detector for 1 GHz to 6 GHz frequency range

- Ruido ambiental deberá ser de al menos 6 dB por debajo del limite (uso de cámara semi-anecóica)
- Ambient disturbances at least 6 dB below the limit (usage of semianechoic chamber)

Publication CISPR 22

Para frecuencias superiores a 1 GHz, la decisión a respecto de la máxima frecuencia a ser medida es indicada en la tabla abajo

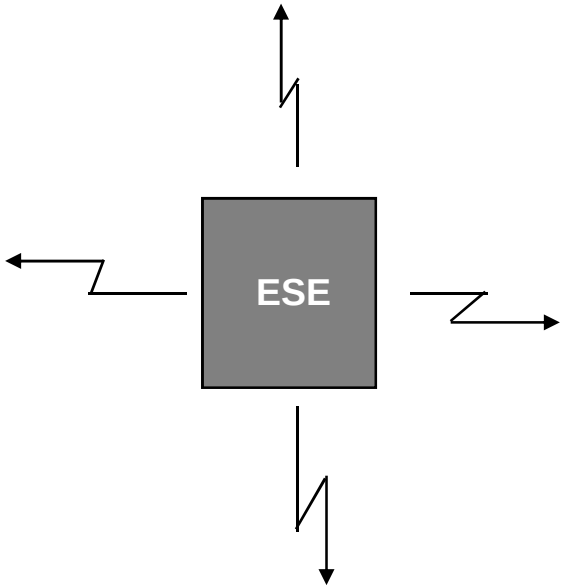
For frequencies above 1 GHz, the decision regarding the maximum frequency to be measured is given in the table below

Highest internal frequency (MHz)	Maximum frequency to measure (MHz)
< 108	1000
108 < $f_{highest}$ < 500	5000
f >1 000	6000

Publication CISPR 22

Limites de emisión de perturbación radiada
Limits of radiated disturbance emission

Frequency range (MHz)	Class B limits quasi-peak value dB(uV/m)
30 - 230	30 (40)
230 - 1 000	37 (47)



OBS.: Limites para niveles de emisión medidos a 10 (3) metros
Limit levels for emissions measured at 10 (3) meters

Publication CISPR 22

Limites de clase A para frecuencias superiores a 1 GHz
Class B limits for frequencies higher than 1 GHz

Frequency range GHz	**Average limit** dB(µV/m)	**Peak limit** dB(µV/m)
1 to 3	56	76
3 to 6	60	80
NOTE: The lower limit applies at the transition frequency.		

OBS.: Limites para niveles de emisión medidos a 3 m
Limit levels for emission measured at 3 meters

Publication CISPR 22

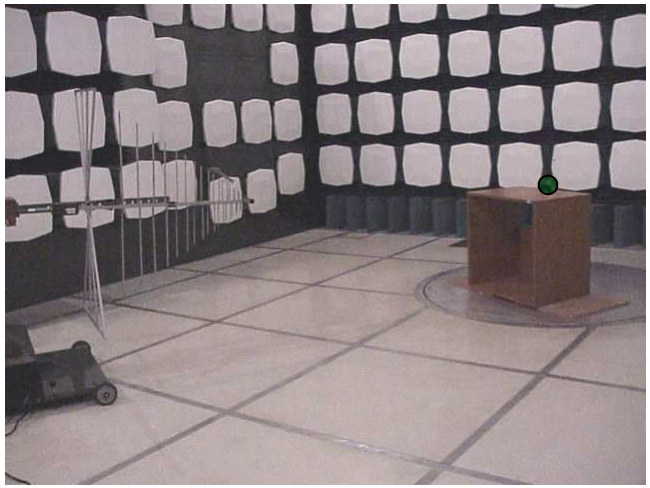
Limites de clase B para frecuencias superiores a 1 GHz
Class B limits for frequencies higher than 1 GHz

Frequency range GHz	**Average limit** dB(µV/m)	**Peak limit** dB(µV/m)
1 to 3	50	70
3 to 6	54	74
NOTE The lower limit applies at the transition frequency.		

OBS.: Limites para niveles de emisión medidos a 3 m
Limit levels for emission measured at 3 meters

Publication CISPR 22

Ejemplo de montaje de ensayo de emisión radiada
Example of setup for radiated emission test



Ensayo de inmunidad a perturbaciones electromagnéticas

Electromagnetic disturbances immunity test

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Performance criteria (ITU-T K.43)

Criterion A – The equipment shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. In some cases, the performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

(for continuous phenomenon)

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Performance criteria (ITU-T K.43)

Criterion B – After the test, the equipment shall continue to operate as intended. No degradation of performance is allowed after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. In some cases, the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance or loss of function is, however, allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

(for no continuous phenomenon)

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Performance criteria (ITU-T K.43)

Criterion C – Loss of function is allowed, provided the function is automatically recoverable or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. Functions and information protected by a battery backup shall not be lost.

(for no continuous phenomenon)

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ensayo de inmunidad a descargas electrostáticas (ESD) según la norma IEC 61000-4-2

Electrostatic Discharge (ESD) immunity test according to IEC 61000-4-2

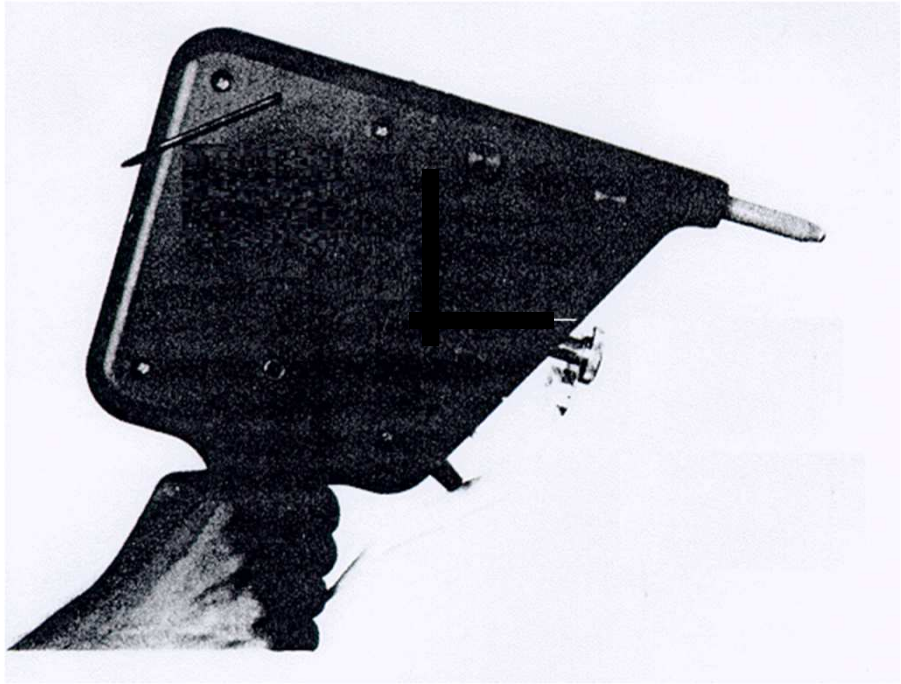
Severity level		
Test level		
Sev.	Contact (kV)	Air (kV)
1	2	2
2	4	4
3	**6**	**8**
4	8	15

Criterio de desempeño B

Performance criterion B

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo de generador de ensayo
Example of test generator
(IEC 61000-4-2)

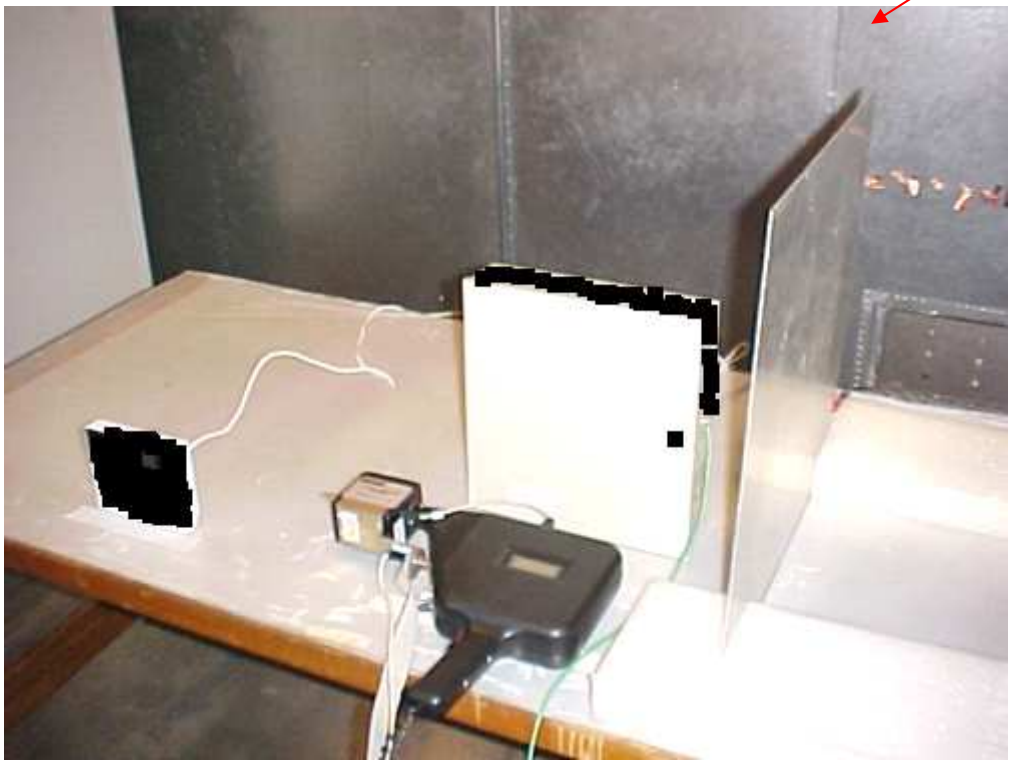


Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-2)

plan vertical

plan horizontal



Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ensayo de inmunidad a perturbación de RF radiada de acuerdo con la norma IEC 61000-4-3

Radiated radio frequency immunity test according IEC 61000-4-3

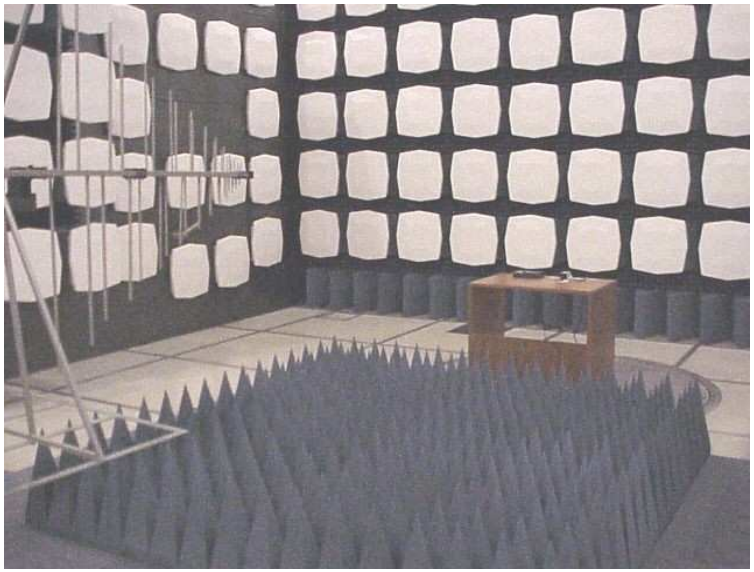
Severity level	
Frequency range: 80 MHz - 1 GHz e 1,4 a 2 GHz Modulation *AM* 80% - 1 kHz	
Severity	Field strength without modulation (V/m)
1	1
2	3
3	10

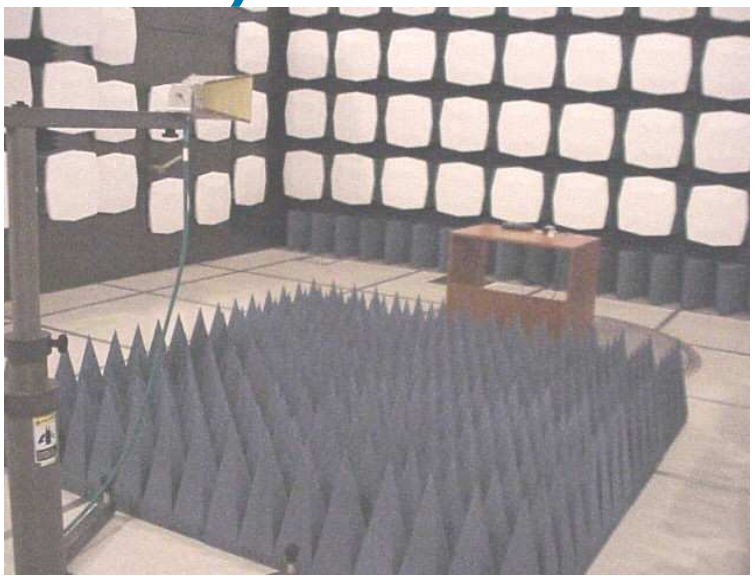
Criterio de desempeño A

Performance criterion A

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-3)





Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ensayos de inmunidad a transitorios eléctricos rápidos y salvas de impulsos

Electrical fast transient and burst immunity test

IEC 61000-4-4

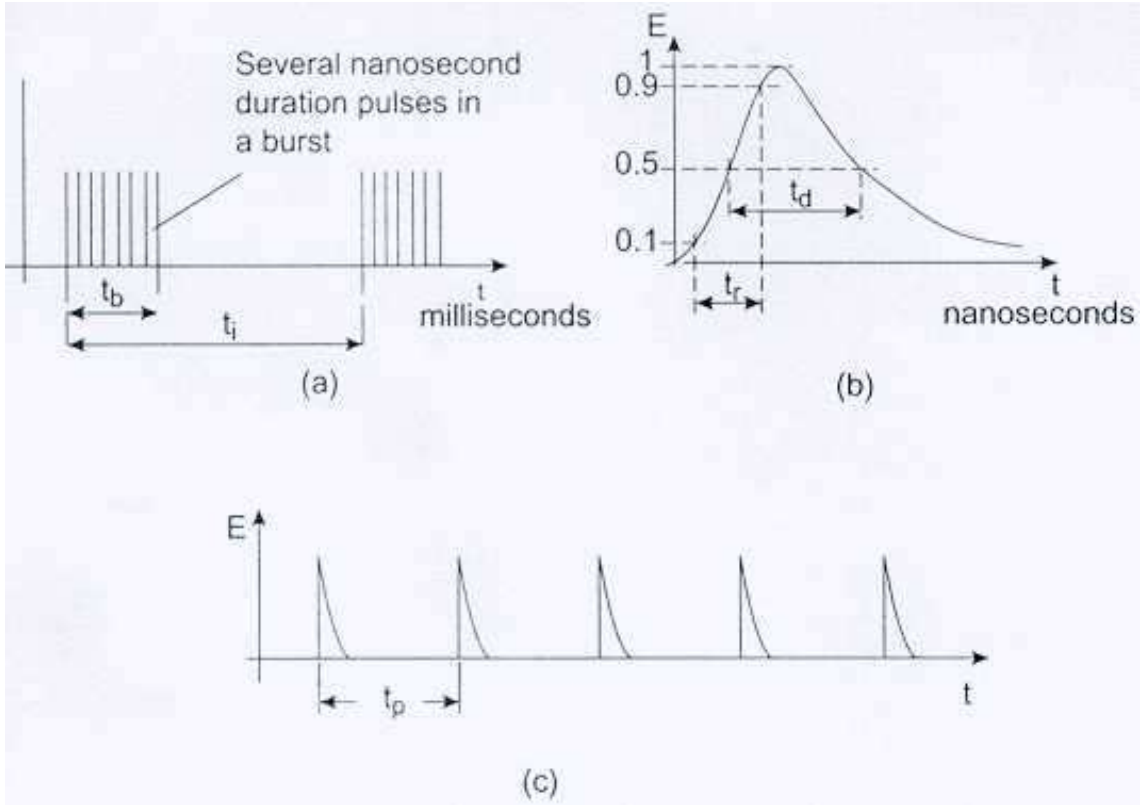
Severity level		
tr/td: 5 ns/50 ns BURST: 15 ms/300 ms		
Open circuit output voltage		
Sev.	**Power supply lines (kV)**	**Signal lines (kV)**
1	0,5	0,25
2	**1**	**0,5**
3	2	1
4	4	2

Criterio de desempeño B

Performance criterion B

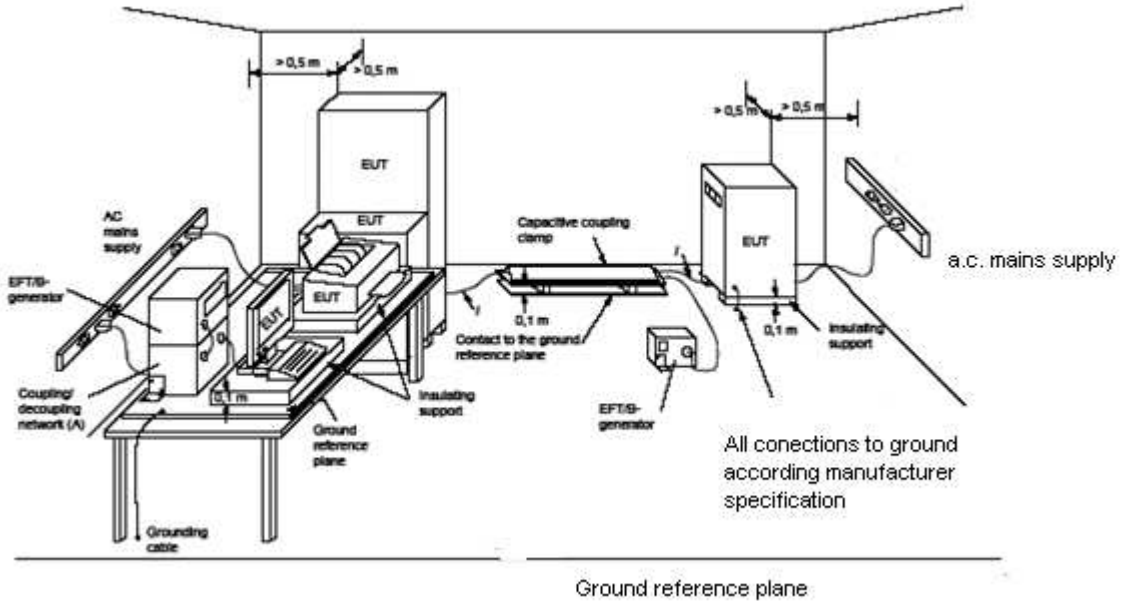
Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Waveform according the IEC 61000-4-4



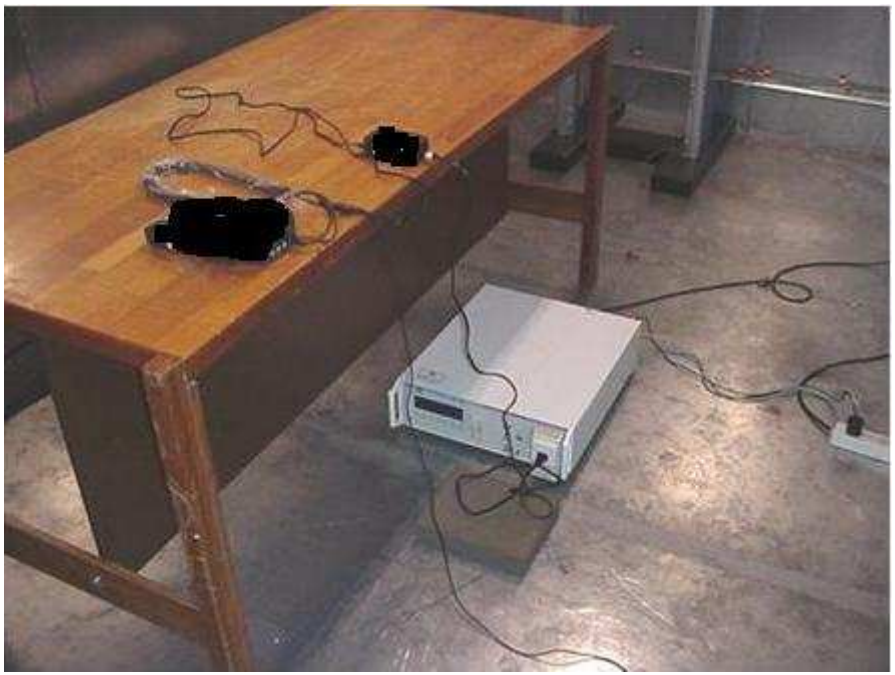
Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-4)



Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-4)



Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

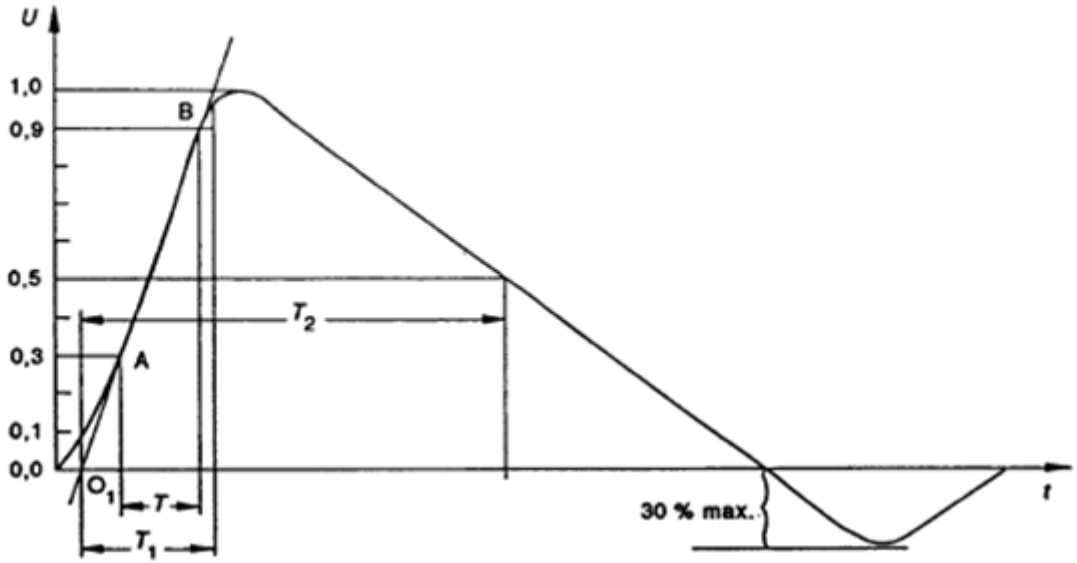
Ensayo de inmunidad a las ondas de choque
Surge immunity test
IEC61000-4-5

- **Algunas características del generador de ondas combinadas**/ Some combined wave generator characteristics
  - **Tensión de salida en circuito abierto and corriente de salida en corto circuito son de acuerdo con especificaciones** / output voltage with open circuit and output current with short circuit shall be according the specification
  - **Niveles de ensayo** / test levels: **0.5; 1.0, 2.0, y 4 kV**
  - **Polaridad: positiva y negativa** / polarity: positive and negative
  - **Línea-línea (modo diferencial) y de línea para tierra /** line to line (differential mode) and line to ground

- **Criterio de desempeño B / performance criterion B**

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

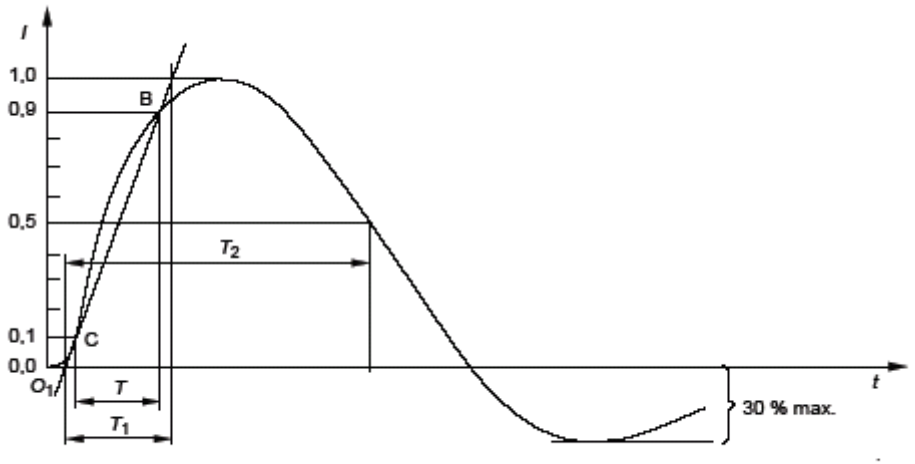
Forma de onda de tensión con salida en abierto
Waveform of open-circuit voltage (1,2/50 µs)
(IEC 61000-4-5)



$T_{1=}$ 1,2 µs ± 30 % and T_2=50 µs ± 20 %

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

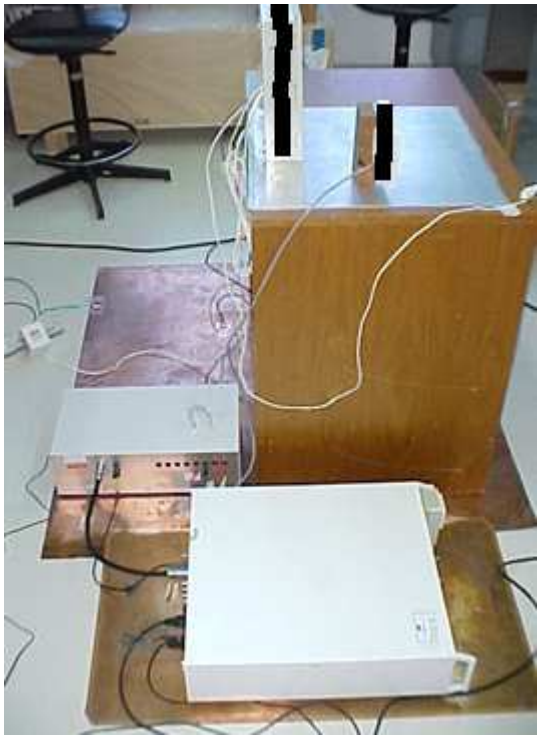
Forma de onda de corriente con salida en corto circuito
Waveform of short-circuit current (8/20 µs)
(IEC 61000-4-5)



T_1 = 8 µs ± 30 % and T_2= 20 µs ± 20 %

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-5)



Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

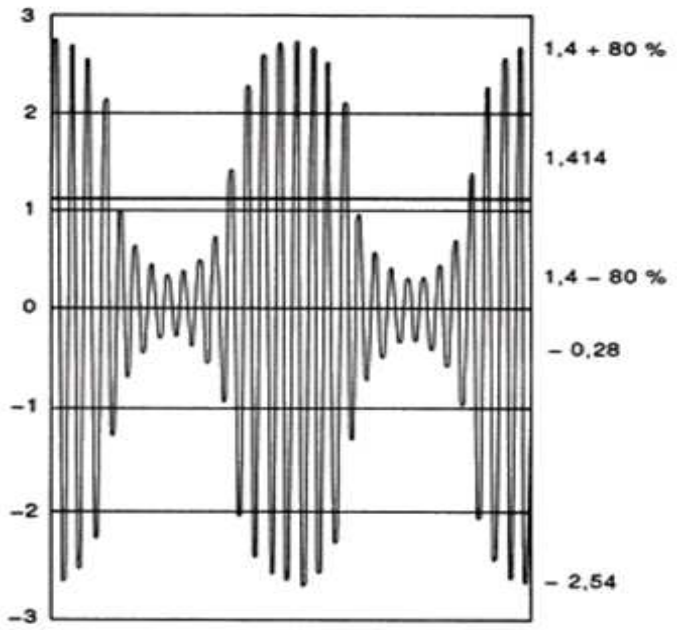
Inmunidad a perturbaciones de RF conducidas
Immunity to conducted RF disturbances
IEC 61000-4-6

Test Levels
Frequency range: 0.15 - 80 MHz
RMS Value without Modulation (V)
1 **3** 10

Criterio de desempeño A
Performance criterion A

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

La forma de onda de acuerdo con la IEC 61000-4-6
Waveform according to IEC 61000-4-6



Tests are done with modulated RF signal 80% AM
Urms (s/mod) = 1 V Upp = 5,09 V Urms = 1,12 V

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-6)

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Dispositivos de acoplamiento
Coupling devices

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Inmunidad a reducciones y interrupciones de tensión c.a.
Voltage dips, short interruptions and voltage variations immunity on a.c.
(IEC 61000-4-11)

Severity level	Reduction	Duration periods/cicles
1	**> 95 %**	**0,5**
2	**30 %**	**25**
3	**> 95 %**	**250**

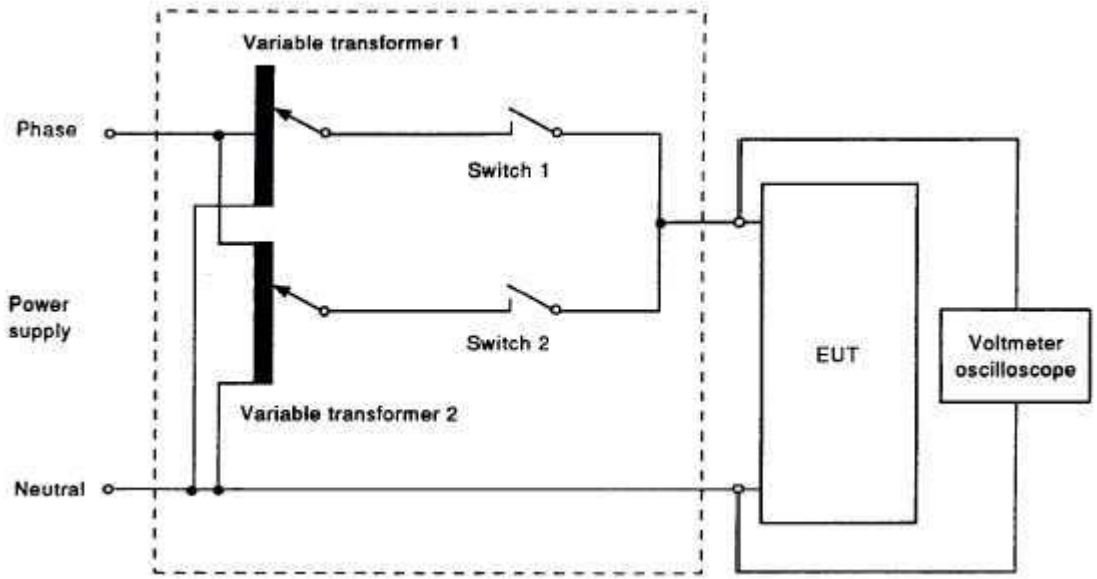
Limites de acuerdo con resolución 442 2 ANATEL

Limits according to Resolution 442 ANATEL

Critério B para nivel 1 y Critério C para los niveles 2 y 3

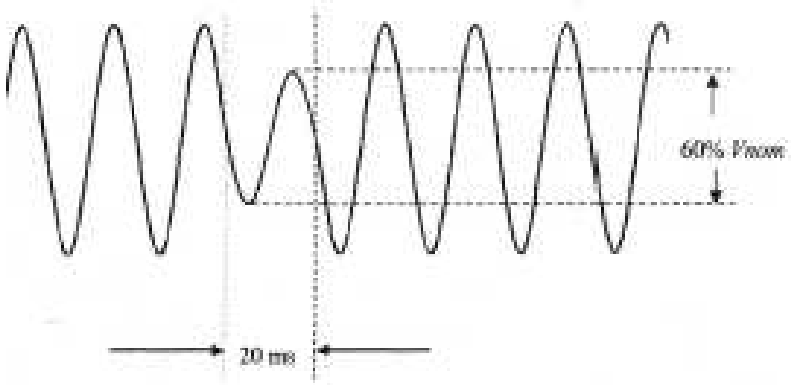
Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11)

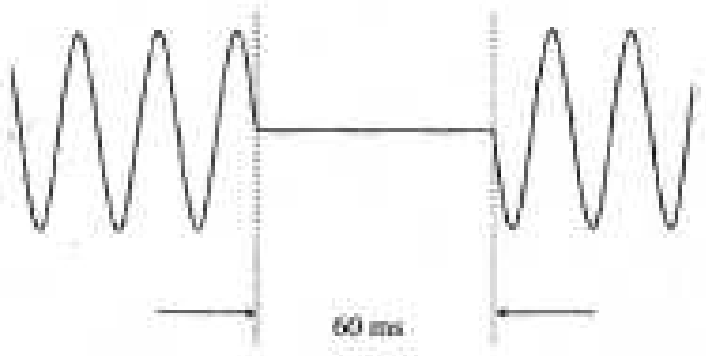


Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11)



Caídas de tensión
Voltage Dip



Interrupciones de tensión
Voltage Interruption

Ensayos de inmunidad electromagnética
Electromagnetic immunity tests

Ejemplo del montaje de ensayo
Example of Test setup
(IEC 61000-4-11)

Uncertainty in Standardized EMC Tests

Incertidumbre en las pruebas normalizadas de EMC

Uncertainty in Standardized EMC Tests

Measurand

Particular quantity (magnitud) subject to measurement

IEV 161-03-01

Uncertainty in Standardized EMC Tests

Measurement Instrumentation Uncertainty – MIU

Incertidumbre de Instrumentación Medida - MIU

parameter, associated with the result of a measurement that characterizes the dispersion of the values that can reasonably be attributed to the **measurand, induced by all relevant** influence quantities that are related to the measurement instrumentation.

Measuring chain (cadena de medida)

series of elements of a measuring instrument or system that constitutes the path of the measuring signal from input to the output.

Uncertainty in Standardized EMC Tests

Standards Compliance Uncertainty – SCU

Incertidumbre de conformidad de normas - SCU

parameter, associated with the result of a compliance measurement as described in a standard, that characterizes the dispersion of the values that could reasonably be attributed to the **measurand.**

Tolerance (tolerancia)

maximum variation of a value permitted by specifications, regulations, etc. for a given specified **influence quantity (magnitud de influencia).**

Uncertainty in Standardized EMC Tests

true value (of a quantity) valor verdadero (de una magnitud)

value consistent with the definition of a particular quantity

[adapted from ISO/IEC Guide 98-3, B.2.3, IEV 311-01-04].

uncertainty source (fuente de incertidumbre)

source (descriptive, not quantitative) that contributes to the uncertainty of the value of a measurand, and that shall be divided into one or more relevant **influence quantities.**

Uncertainty in Standardized EMC Tests

Emission Test

Uncertainty is related always to a quantity to be measured, so for conducted emission and radiated emission requirements the uncertainty is related to the quantify measured and the compliance status.

Immunity tests

For immunity the uncertainty is related to the disturbances be applicable to the test. Waveform and levels of the generated disturbance can have an uncertainty associated to their characteristics and associated to how they applied to the EUT.

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

The MIU for a test laboratory shall be evaluated for the disturbances emission measurement, taking into consideration each of the input quantities (magnitudes de entrada). The standard uncertainty u(xi) in dB, and the sensitivity coefficient c_i, shall be evaluated for the estimate xi of each quantity. The combined standard uncertainty $u_c(y)$ of the estimate y of the Measurand shall be calculated using

$$u_c(y) = \sqrt{\sum_i c_i^2 \, u^2(x_i)}$$

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

$$U_{lab} = U(y) = 2\,u_c(y)$$

If *Ulab is less than or equal to Ucispr, then the test report may either state the value* of *Ulab or state that Ulab is less than Ucispr.*
If *Ulab exceeds Ucispr, then the test report shall contain the value of Ulab (in dB) for* the measurement instrumentation actually used for the measurements.

**NOTE: The equation above means that a coverage factor *k = 2 is applied that yields approximately a 95 % level of*
confidence for the near-normal distribution typical of most measurement results.**

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

CISPR uncertainty – CISPR 16-4-2

Measurement		U_{cispr}
Conducted disturbance at mains port using AMN	(9 kHz to 150 kHz)	3,8 dB
	(150 kHz to 30 MHz)	3,4 dB
Conducted disturbance at mains port using voltage probe	(9 kHz to 30 MHz)	2,9 dB
Conducted disturbance at telecommunication port using AAN	(150 kHz to 30 MHz)	5,0 dB
Conducted disturbance at telecommunication port using CVP	(150 kHz to 30 MHz)	3,9 dB
Conducted disturbance at telecommunication port using CP	(150 kHz to 30 MHz)	2,9 dB
Disturbance power	(30 MHz to 300 MHz)	4,5 dB
Radiated disturbance (electric field strength at an OATS or in a SAC)	(30 MHz to 1 000 MHz)	6,3 dB

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

Conducted disturbance measurement from 150 kHz a 30 MHz using a 50 Ω / 50 µH AMN

Mediciones de perturbaciones conducidas de 150 kHz a 30 MHz utilizando una AMN de 50 Ω / 50 µH

Input quantity / Magnitud de entrada Xi	Uncertainty of Xi / Incertidumbre de x_i		$u(x_i)$	c_i	$c_i\ u(x_i)$
	dB	Distribución de probabilidad	dB	1	dB
Receiver reading/Lectura del receptor	± 0,1	k =1	0,1	1	0,1
Attenuation AMN-receiver/Atenuación: AMN-receptor	± 0,1	k = 2	0,05	1	0,05
AMN voltage divison factor/Factor de división de tensión de la AMN	± 0,2	k = 2	0,1	1	0,10
Sine wave voltage/tensión de onda sinusoidal	± 1,0	k = 2	0,5	1	0,5
Pulse amplitude response/respuesta de la amplitud de pulso	± 1,5	retangular	0,87	1	0,87
Pulse repetition rate response/respuesta a la frecuencia de repetición de pulsos	± 1,5	retangular	0,87	1	0,87
Noies floor proximity/proximidad del ruído de fondo	± 0,0		0,00	1	0,00
AMN frequency interolation/interpolation em frecuencia del VDF de la AMN	±0,1	retangular	0,06		0,06
Mismatch AMN-receiver/esadaptación AMN-receptor	±0,07	formato U	0,53	1	0,05
AMN impedance/impedancia de la AMN	+2,6/-2,7	triangular	1,08	1	1,08
Efeito of mains disturbance/efecto de las perturbaciones de la red de alimentación	0,0				0,0
Effect of the environment / efecto del entorno	0,0				0,0

Hence, expanded uncertainty $u_c(V)$ = 1,72 dB **$u_E(V)$ = 3,44 dB**

Horizontally polarized radiated disturbances from 30 MHz to 200 MHz using a biconical antenna at a distance of 3 m, 10 m/Perturbaciones radiadas en polarización horizontal de 30 MHz a 200 MHz utilizando una antena bicônica a distancias de 3 m, 10 m

Input quantity **Xi**	**Uncertainty de x_i**		**$u(x_i)$**	**c_i**	**c_i $u(x_i)$**
	dB	Probability distribution	dB	1	dB
Receiver reading/Lectura del receptor	± 0,1	k =1	0,1	1	0,1
Attenuation antenna-receiver/Atenuación: antena-receptor	± 0,2	k = 2	0,1	1	0,1
Fator de antena	± 2,0	k = 2	1,0	1	1,0
Receiver correction/Correcciones para el receptor Sine wave voltagey/tensión de onda sinusoidal	± 1,0	k = 2	0,5	1	0,5
Pulse amplitude response/respuesta de la amplitud de pulso	**± 1,5**	**rectangular**	**0,87**	**1**	**0,87**
Pulse repetition rate response/respuesta a la frecuencia de repetición de pulsos	**± 1,5**	**rectangular**	**0,87**	**1**	**0,87**
Noies floor proximity/proximidad del ruído de fondo	**± 0,5**	**rectangular**	**0,29**	**1**	**0,29**
Mismatch antenna-receiver/desadaptación antena-receptor	**+0,9/-1,0**	U-shaped	**0,67**	**1**	**0,67**
Antenna corrections/Correcciones para la antena bicónica AF frequency interpolation/Interpolación en frecuencia del AF	**± 0,3**	**rectangular**	**0,17**	**1**	**0,17**

Horizontally polarized radiated disturbances from 30 MHz to 200 MHz using a biconical antenna at a distance of 3 m, 10 m/Perturbaciones radiadas en polarización horizontal de 30 MHz a 200 MHz utilizando una antena bicônica a distancias de 3 m, 10 m

AF variation with height/Variación del AF con la altura		**± 1,0**	**rectangular**	**0,58**	**1**	**0,58**
Directivity difference/Diferencia en directividad **– d = 3 m**		**± 0,0**		**0,0**	**1**	**0,0**
Directivity difference/Diferencia en directividad **– d = 10 m**		**± 0,0**		**0,0**	**1**	**0,0**
Directivity difference/Diferencia en directividad – **d = 30 m**		**± 0,0**		**0,0**	**1**	**0,0**
Cross-polarization/Polarización cruzada		**± 0,0**		**0,0**	**1**	**0,0**
Balance/balanceo		**± 0,3**	**rectangular**	**0,17**	**1**	**0,17**
Site imperfections/Imperfecciones del emplazamiento		**± 4,0**	**triangular**	**1,63**	**1**	**1,63**
Separation distance/Distancia de separación	**d=3 m**	**± 0,3**	**rectangular**	**0,17**	**1**	**0,17**
Separation distance/Distancia de separación	**d=10 m**	**± 0,1**	**rectangular**	**0,06**	**1**	**0,06**
Table height/Altura de la mesa	**d=3 m**	**± 0,1**	**k = 2**	**0,05**	**1**	**0,05**
Table heightAltura de la mesa	**d=10 m**	**± 0,1**	**k = 2**	**0,05**	**1**	**0,05**

Hence, expanded uncertainty $U(E) = 2u_c(E) = \begin{cases} 5{,}06 \text{ dB, at a separation of 3 m} \\ 5{,}05 \text{ dB, at a separation of 10 m} \end{cases}$

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

Horizontally polarized radiated disturbances from 30 MHz to 200 MHz

Input quantity [a]	X_i	Uncertainty of x_i		$c_i\, u(x_i)$ [b]
		dB	Probability distribution function	dB
Receiver reading A1)	V_r	± 0,1	k = 1	0,10
Attenuation: antenna-receiver A2)	a_c	± 0,2	k = 2	0,10
Biconical antenna factor D1)	F_a	± 2,0	k = 2	1,00
Receiver corrections:				
Sine wave voltage A3)	δV_{sw}	± 1,0	k = 2	0,50
Pulse amplitude response A4)	δV_{pa}	± 1,5	Rectangular	0,87
Pulse repetition rate response A4)	δV_{pr}	± 1,5	Rectangular	0,87
Noise floor proximity A5)	δV_{nf}	+0,5/0,0	Rectangular	0,29
Mismatch: antenna-receiver A7)	δM	+0,9/□1,0	U-shaped	0,67

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

Biconical antenna corrections:					
AF frequency interpolation [A6]		δF_{af}	± 0,3	Rectangular	0,17
AF variation with height [D2]		δF_{ah}	± 1,0	Rectangular	0,58
Directivity difference [D3] at	3 m	δF_{adir}	± 0,0		0,00
	or 10 m	δF_{adir}	± 0,0		0,00
	or 30 m	δF_{adir}	± 0,0		0,00
Phase centre location [D4] at	3 m	δF_{aph}	± 0,0		0,00
	or 10 m	δF_{aph}	± 0,0		0,00
	or 30 m	δF_{aph}	± 0,0		0,00
Cross-polarization [D5]		δF_{acp}	± 0,0		0,00
Balance [D6]		δF_{abal}	± 0,3	Rectangular	0,17

Uncertainty in Standardized EMC Tests – CISPR 16-4-2

Site corrections:					
Site imperfections [D7]		δH_N	± 4,0	Triangular	1,63
Separation distance [D8] at	3 m	δd	± 0,3	Rectangular	0,17
	or 10 m	δd	± 0,1	Rectangular	0,06
	or 30 m	δd	± 0,0		0,00
Effect of setup table material [D10]		δH_{NT}	± 0,0		0,00
Table height [D9] at	3 m	δh	± 0,1	$k = 2$	0,05
	or 10 m	δh	± 0,1	$k = 2$	0,05
	or 30 m	δh	± 0,1	$k = 2$	0,05
Effect of ambient noise on OATS [D13]		δE_{amb}	± 0,0		0,00

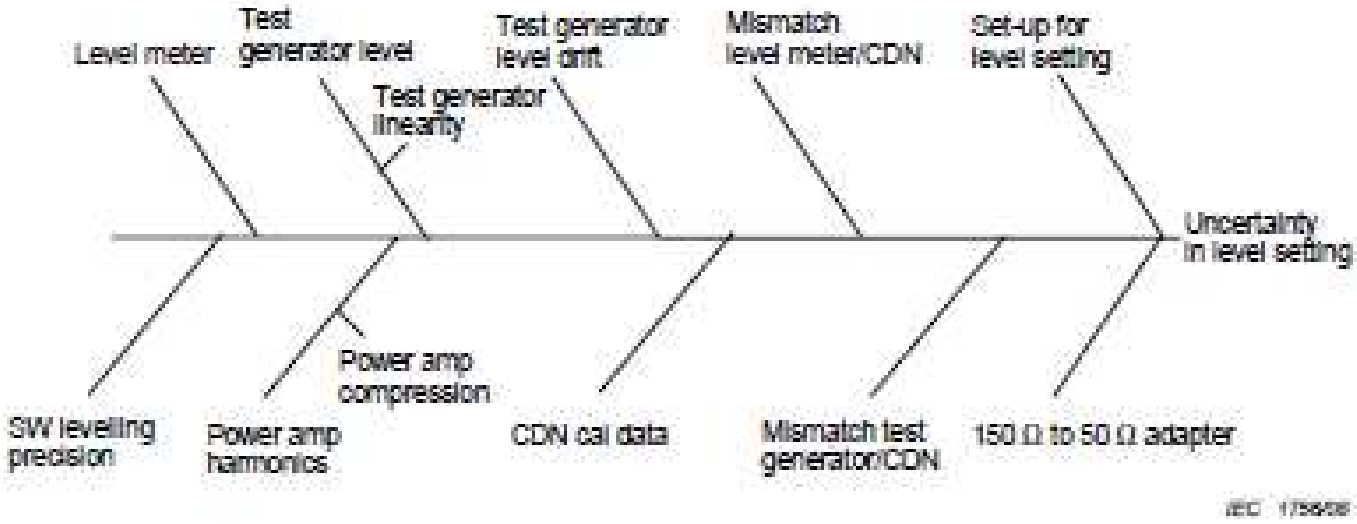
a Superscripts [e.g. [A1)]] correspond to numbered comments in the annexes (see A.2 and D.3).

b All $c_i = 1$ (see A.1).

Hence, expanded uncertainty $U(E) = 2u_c(E) =$ 5,06 dB, at a separation of 3 m; 5,05 dB, at a separation of 10 m; 5,05 dB, at a separation of 30 m

Uncertainty in Inmunity Test

Related to the disturbance and its aplication



AMBIENTE DE ENSAYO

TEST SITE

Ambientes de ensayo

- **Ensayo de emisión de perturbaciones electromagnéticas de acuerdo con la publicación CISPR 22**

En estos ensayos se desea medir perturbaciones generadas por el equipamiento a ensayar, así siendo perturbaciones electromagnéticas debido al ambiente de ensayo así como reflexiones en paredes y cobertura no pueden afectar las mediciones.

En la ausencia de un local abierto de ensayo libre de señales de radiodifusión y otros ruidos, el uso de cámara semi anecóica se hace fundamental.

Ambientes de ensayo

- **Ensayo de inmunidad a perturbaciones electromagnéticas de acuerdo con la publicación IEC 61000-4-3**.

En estos ensayos debe evitarse la emisión de perturbaciones electromagnéticas para el ambiente y equipos prójimos (emisión radiada/inducida y conducida). Además debe garantizarse la uniformidad de campo prescrita en la norma.

Para este ensayo es esencial el uso de la cámara semi anecóica.

Ambientes de ensayo

- **Ensayo de inmunidad a perturbaciones electromagnéticas conducidas de acuerdo con las publicaciones IEC 61000-4-x**.

En estos ensayos debe evitarse o minimizarse la emisión de perturbaciones electromagnéticas para el ambiente y otros equipos (emisión radiada/inducida y conducida).

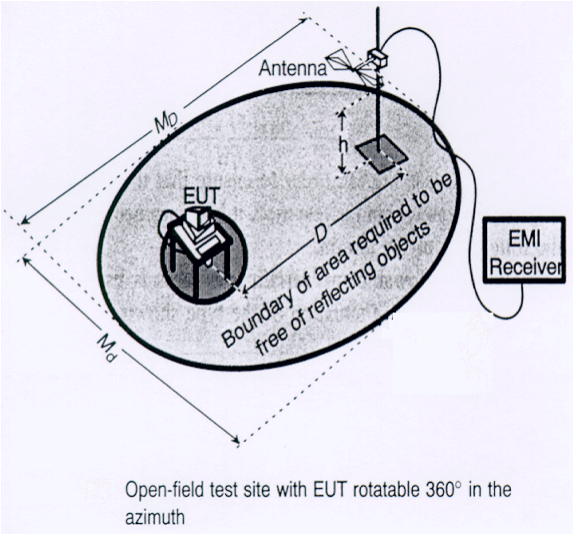
Normalmente en estos ensayos se tiene equipos auxiliares para que ejerciten los EAE. O aún otros equipos en operación en las proximidad.

Una cámara blindada es recomendada en estos casos (Excepto IEC 61000-4-3)

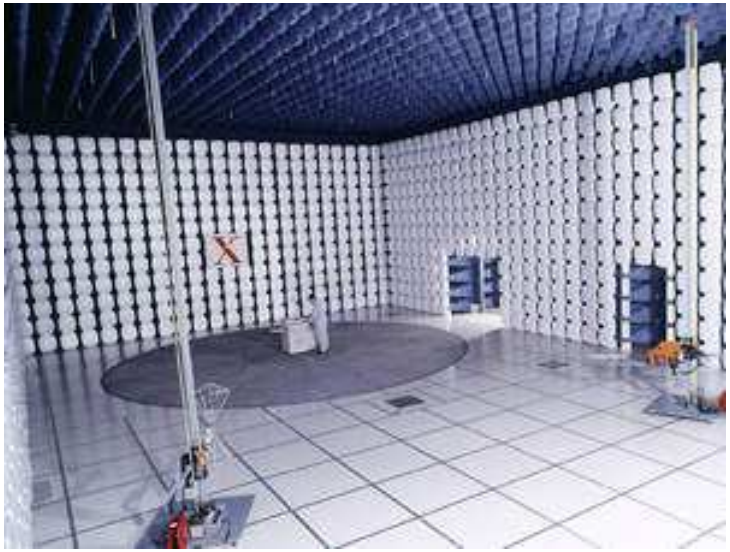
Local de medición de emisión radiada

OATS (OPEN AREA TEST SITE)

LOCAL DE ENSAYO EN CAMPO ABIERTO (referencia)



Open-field test site with EUT rotatable 360° in the azimuth



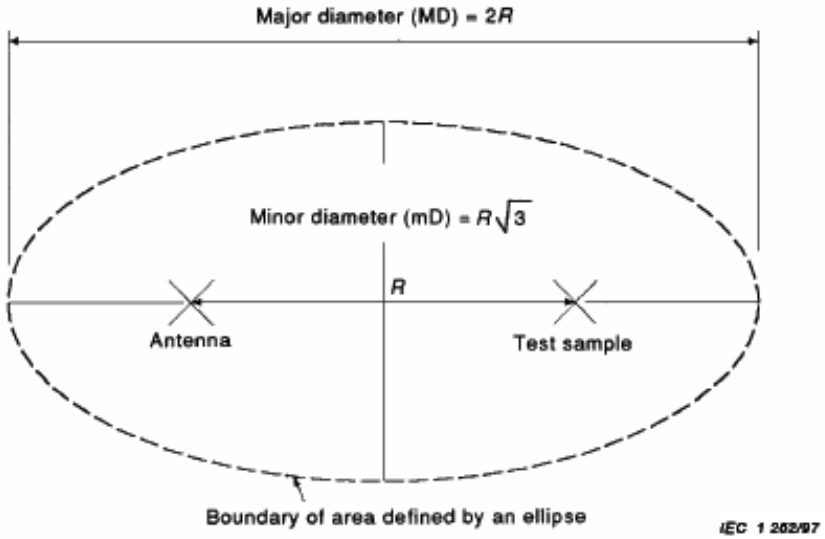
LOCAL ALTERNATIVO DE ENSAYO

CÁMARA SEMI ANECÓICA

SEMI ANECHOIC CHAMBER

Local de medición de emisión radiada

Local de medición en campo abierto: el local de medición debe ser plano, libre de cables o estructuras que reflejen los campos, suficientemente grande para permitir la colocación de la antena de medición la una dada distancia del EAE.



Volume above earth to be free of reflecting objects.

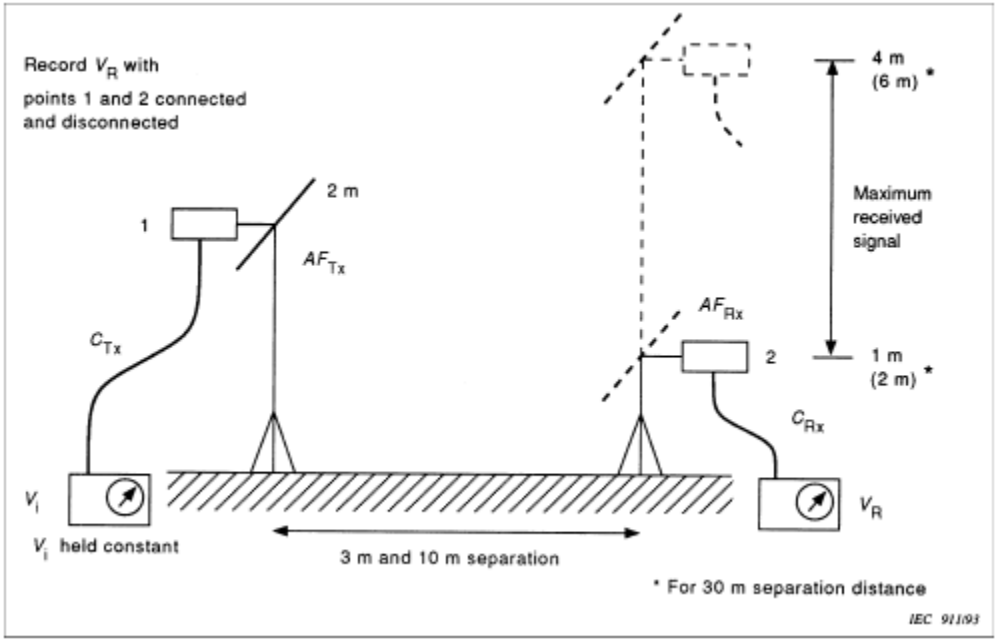
Local de medición de emisión radiada

La atenuación del local de medición de emisión electromagnética radiada no debe diferir de más de ±4dB del valor teórico de la atenuación para un local ideal de medición.

Tanto el local abierto de medición como la cámara semi anecóica deben atender al requisito de ±4dB de atenuación del local.

Medición de “normalized site attenuation”

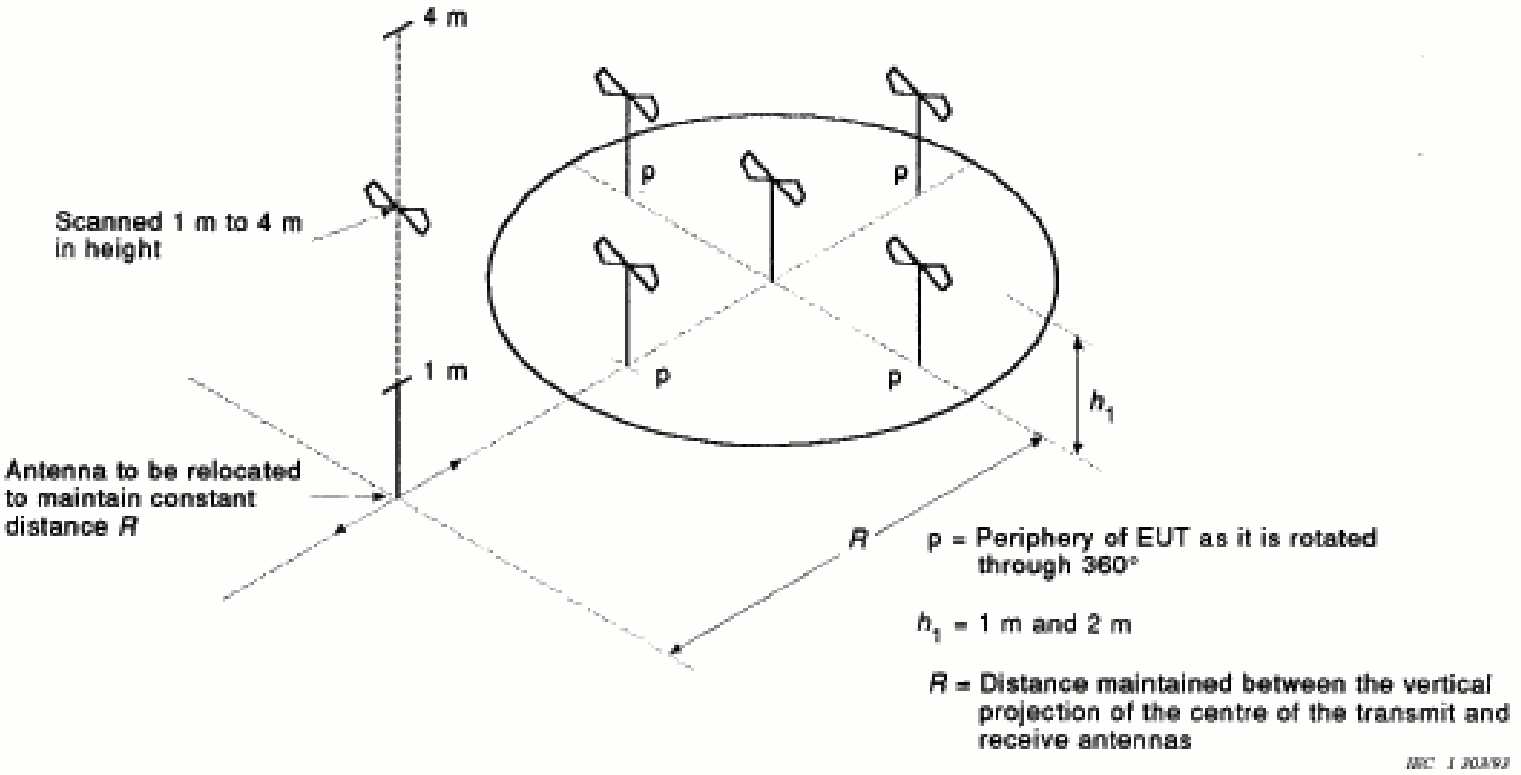
Configuraciones de las antenas para polarización horizontal



V_{direct} = puntos 1 e 2 dos cables conectados diretamente

Medición de “normalized site attenuation”

Configuraciones de las antenas para polarización horizontal



Medición de “normalized site attenuation”

Normalized site attenuation

Atenuación del local normalizada

$$A_N = V_{direct} - V_{site} - AF_T - AF_R$$

AF_T **= factor de la antena transmisora**

AF_R **= factor de la antena receptora**

V_{direct} **= medida obtenida con los cabos conectados directamente**

V_{site} **= medida obtenida cuando los cabos del generador y receptor están conectados en la antena transmisora y antena receptora, respectivamente.**

(Los cables y atenuadores no son considerados desde que utilizados tanto para medir V_{direct} como V_{site})

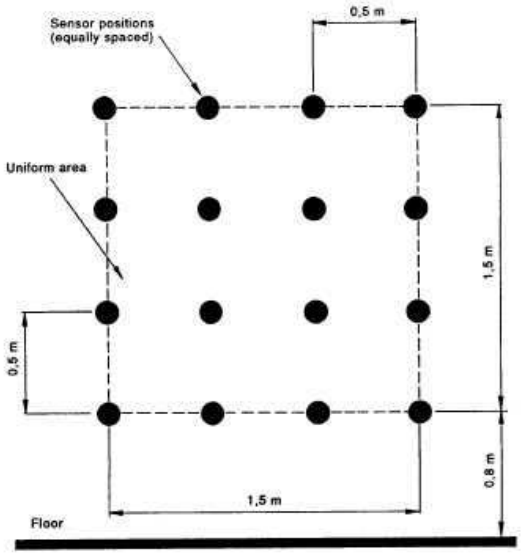
Ensayos de inmunidad electromagnética

Uniformidad del campo eléctrico

La norma prescribe para el local de ensayo la necesidad de uniformidad de campo.

El campo es considerado uniforme si el nivel del mismo esté en la banda de 0 dB a +6 dB del valor nominal, en por lo menos 75% de la superficie, o sea en 12 de los

16 puntos medidos.



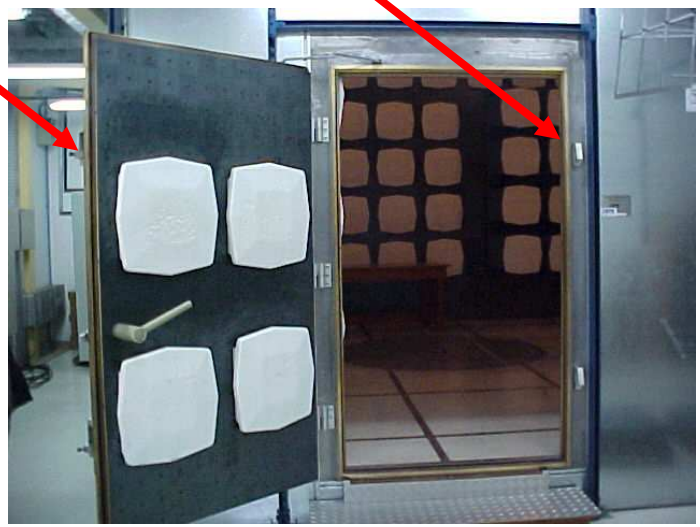
Cámara semi anecóica

SOBRE EL MANTENIMIENTO

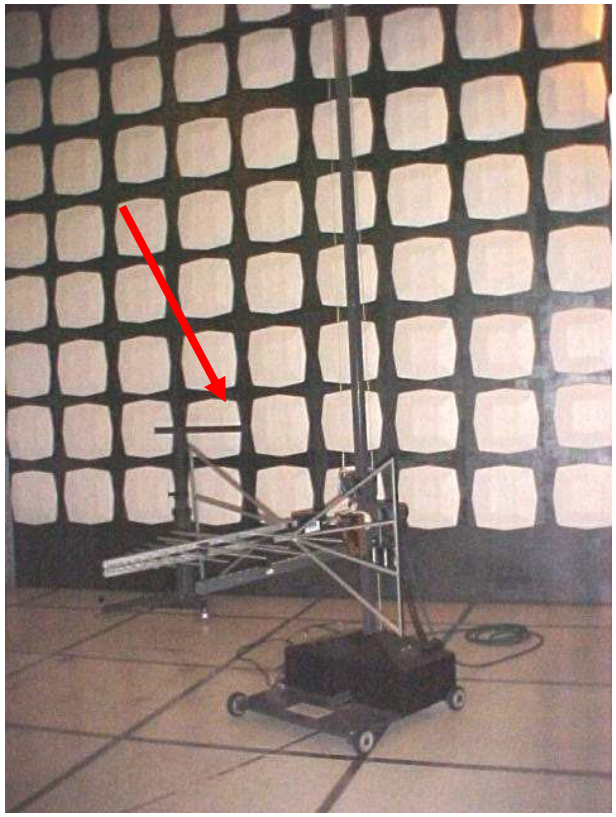
- ✓ **Limpieza de los contactos conductores de la puerta**
- ✓ **Si hubo quiebra de los contactos, los mismos deben ser sustituidos**
- ✓ **Limpieza de los contactos conductores de la mesa giratoria**
- ✓ **Verificación de los materiales absorbentes de RF**
- ✓ **Verificación continua del control de humedad y temperatura**

Cámara semi anecóica

Limpieza de los contactos



Ensayos de emisión de perturbaciones radiadas



Antenas biconilog

ISO IEC 1705 – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

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5.9 Assuring the quality of test and calibration results

5.10 Reporting the results

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.2 Management system

- The laboratory shall establish, implement and maintain a management system appropriate to the scope of its activities.
- The laboratory shall document its policies, systems, programs, procedures and instructions to the extent necessary to assure the quality of the test.
- The system’s documentation shall be communicated to, understood by, available to, and implemented by the appropriate personnel.
- The laboratory's management system policies related to quality, including a quality policy statement, shall be defined in a quality manual.
- The quality policy statement shall be issued under the authority of top management. It shall include at least the following:
  - commitment to good professional practice.
  - quality of its testing in servicing its customers.
  - the purpose of the management system related to quality.
  - the laboratory management's commitment to comply with this ISO IEC 17025.
- The quality manual shall include or make reference to the supporting procedures including technical procedures. It shall outline the structure of the documentation used in the management system.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.2 Management system (cont.)

- The roles and responsibilities of technical management and the quality manager
- Top management shall ensure that the integrity of the management system is maintained when changes to the management system are planned and implemented.

4.3 Document control

- The laboratory shall establish and maintain procedures to control all documents
- Invalid or obsolete documents are promptly removed from all points of issue or use
  - Management system documents generated by the laboratory shall be uniquely identified. Such identification shall include the date of issue and/or revision identification, page numbering, the total number of pages or a mark to signify the end of the document, and the issuing authority(ies).
  - Where practicable, the altered or new text shall be identified in the document or the appropriate attachments.
  - Procedures shall be established to describe how changes in documents maintained in
  - computerized systems are made and controlled.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.4 Review of requests, tenders and contracts

- The laboratory shall establish and maintain procedures for the review of requests, tenders and contracts.
- Records of reviews, including any significant changes, shall be maintained.
- The customer shall be informed of any deviation from the contract.
- If a contract needs to be amended after work has commenced, the same contract review process shall be repeated and any amendments shall be communicated to all affected personnel.

4.5 Subcontracting of tests and calibrations

- The laboratory is responsible to the customer for the subcontractor's work, except in the case where the customer or a regulatory authority specifies which subcontractor is to be used.
- The laboratory shall maintain a register of all subcontractors that it uses for tests and/or calibrations and a record of the evidence of compliance with this International Standard for the work in question.

4.6 Purchasing services and supplies

- The laboratory shall have a policy and procedure(s) for the selection and purchasing of services and supplies it uses that affect the quality of the tests and/or calibrations.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.7 Service to the customer

- The laboratory shall be willing to cooperate with customers or their representatives in clarifying the customer's request and in monitoring the laboratory's performance in relation to the work performed, provided that the laboratory ensures confidentiality to other customers.
- The laboratory shall seek feedback, both positive and negative, from its customers.

4.8 Complaints

- The laboratory shall have a policy and procedure for the resolution of complaints.

4.9 Control of nonconforming testing and/or calibration work

- The laboratory shall have a policy and procedures that shall be implemented when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its own procedures or the agreed requirements of the customer.

4.10 Improvement

- The laboratory shall continually improve the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.11 Corrective action

- The laboratory shall establish a policy and a procedure and shall designate appropriate authorities for implementing corrective action when nonconforming work or departures from the policies and procedures in the management system or technical operations have been identified.
- A problem with the management system or with the technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feedback from customers and from staff observations.
- The procedure for corrective action shall start with an investigation to determine the root cause(s) of the problem.
- Cause analysis is the key and sometimes the most difficult part in the corrective action procedure.
- The laboratory shall monitor the results to ensure that the corrective actions taken have been effective.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.12 Preventive action

- Needed improvements and potential sources of nonconformities, either technical or concerning the management system, shall be identified.

4.13 Control of records

- The laboratory shall establish and maintain procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical record.
- All records shall be legible and shall be stored and retained such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.
- The laboratory shall retain records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each test report or calibration certificate issued, for a defined period.

4.14 Internal audits

The laboratory shall periodically, and in accordance with a predetermined schedule and procedure, conduct internal audits of its activities.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

4.15 Management reviews

- In accordance with a predetermined schedule and procedure, the laboratory’s top management shall periodically conduct a review of the laboratory's management system and testing and/or calibration activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvement.

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.1 General

Factors contributing to the reliability of the results

- Human Factors
- Accommodation and environmental conditions
- Test and calibration methods and method validation
- Team
- Measurement traceability
- Sampling
- Handling of test and calibration

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.2 Personal

- Having competent people to:
  - Operate measuring equipment
  - Testing
  - Evaluate the results
  - Sign test reports
  - Supervise trainees
  - The laboratory needs: Education, training, skills assessment, targets set through training programs.
  - Having the training certificates of all technical staff
  - Having described the roles of people: managerial, technical
  - Authorizations for activities people perform them

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.3 Accommodation conditions

- Environmental Measures and accommodation conditions should not invalidate the results or adversely affect the required quality.
- special care to control and monitoring of environmental conditions
- maintain separate laboratories neighbors with incompatible activities
- control access of people
- ensure cleanliness

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.4 Test and calibration methods and method validation

- Standardized method and non-standard method
- The methods should be appropriate and should meet the needs
  - Use of non-standard method
    - Subject to agreement with the customer
    - Include customer requirements
    - Include the purpose of the test
    - Validating before use
    - Inform the customer if the methods proposed is inadequate or outdated

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.5 Equipment

- with the required accuracy
- that meet the specifications of the methods
- be operated by authorized personnel
- have instructions on use and maintenance up to date and available
- be uniquely identified
- have identified the calibration status
- manufacturer name, model unique identification, and location
- adjustments, acceptance criteria, date of next calibration
- procedures to ensure proper operation, handling, transport, usage, storage
- planned maintenance

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.6 Measurement traceability

- Calibrate and verify before placing equipment in use
- Program and procedure for calibration of equipment, reference standards and labor (for values and key values) that have significant effect on the results
- Use of competent calibration laboratories or recognized by INMETRO/CGCRE
- The certificates shall have all the information needed to check its traceability
- Intermediate checks
- Verification procedure for intermediate checks of equipment,
- Maintain a schedule for date a program of intermediated

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.7 Sampling

- plan and procedures available at the sampling site
- plans based on statistical methods
- process - cover factors to be controlled
- record deviations, additions or deletions in the procedure.
- sampling procedure
- identification sampler
- environment conditions
- sampling site

- Usually not applicable to EMC Laboratory

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.8 Handling of test and calibration items

- transport
- receipt handling, storage
- protecting the integrity of the item
- removal or retention and
- protecting the interests of the laboratory and the client
- keep the item identification during their stay in the same laboratories
- ensure that the items are not confused,
- allow subdivision of groups of items and their transfer into and out of the laboratory
- keep records of: abnormalities, deviations from normal or specified
- customer queries
- maintain, monitor and register the specified environmental conditions

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.9 Assuring the quality of test and calibration results

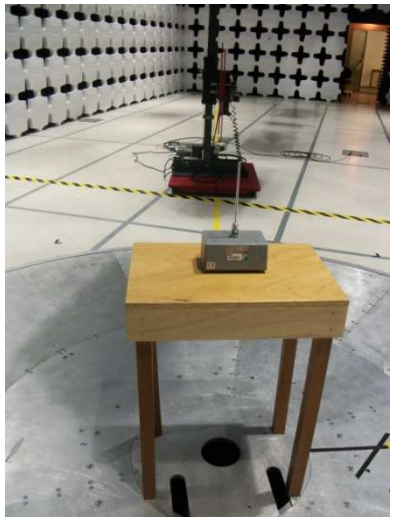
- Proficiency testing
- Interlaboratorial comparisons
- Application of statistical techniques to critically analyze the results
- Record the resulting data so that trends are identifiable
- Preliminary tests with known sources of disturbances

ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.9 Assuring the quality of test and calibration results

For emission: preliminary test with a known field source



ISO IEC 1705 (2005) – GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES

Technical requirements

5.10 Reporting the results

- Accurately and clearly unambiguously
- Title
- Name and address of the laboratory
- Where these tests were done
- Univocal identification of the report
- Each page with an identification to ensure that the page is recognized as part of the report.
- Clear identification of the end of the report
- Name and address of the customer
- Identification of the method utilized
- Description, condition and identification not ambiguous of the item tested
- Date of receipt
- Shall include all the information needed to interpret the result

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Gracias!
Thank you!

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