EUROPEAN STANDARD **EN 55020**

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ICS 33.100.20 Supersedes EN 55020:1994 + A11:1996 + A12:1999 + A13:1999 + A14:1999

English version

Sound and television broadcast receivers and associated equipment - Immunity characteristics - Limits and methods of measurement

(CISPR 20:2002)

Récepteurs de radiodiffusion et de télévision et équipements associés - Caractéristiques d'immunité - Limites et méthodes de mesure (CISPR 20:2002)

Ton- und Fernseh-Rundfunkempfänger und verwandte Geräte der Unterhaltungselektronik - Störfestigkeitseigenschaften - Grenzwerte und Prüfverfahren (CISPR 20:2002)

This European Standard was approved by CENELEC on 2002-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 55020:2002 E

Foreword

The text of document CISPR/I/15/FDIS, future edition 5 of CISPR 20, prepared CISPR SC I, Electromagnetic compatibility of information technology equipment, multimedia equipment and receivers, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 55020 on 2002-04-01.

This European Standard supersedes EN 55020:1994 (+ corrigendum December 1997) + A11:1996 + A12:1999 (+ corrigendum January 2001) + A13:1999 + A14:1999.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2003-01-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes A, B, C, D, E, F, G and ZA are normative and annex H is informative.
Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard CISPR 20:2002 was approved by CENELEC as a European Standard without any modification.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
CISPR 16-1	- [1)]	Specification for radio disturbance and immunity measuring apparatus and methods Part 1: Radio disturbance and immunity measuring apparatus	-	-
CISPR 16-3	- [1)]	Part 3: Reports and recommendations of CISPR	-	-
CISPR 22 (mod)	- [1)]	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022 + corr. July	1998 [2)] 2001
CISPR 24 (mod)	- [1)]	Information technology equipment - Immunity characteristics - Limits and methods of measurement	EN 55024	1998 [2)]
IEC 60050-161	- [1)]	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 60268-1	- [1)]	Sound system equipment Part 1: General	HD 483.1 S2	1989 [2)]
IEC 60651	- [1)]	Sound level meters	EN 60651	1994 [2)]
IEC 60728-2	- [3)]	Cabled distribution systems for television and sound signals Part 2: Electromagnetic compatibility of equipment	-	-

[1)] Undated reference.

[2)] Valid edition at date of issue.

[3)] To be published.

Publication	Year	Title	EN/HD	Year
IEC 61000-4-2	- [1)]	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995 [2)]
IEC 61000-4-3	- [1)]	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2002 [2)]
IEC 61000-4-4	- [1)]	Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	1995 [2)]
ETS 300 158	1992	Satellite Earth Stations and Systems (SES) - Television Receive Only (TVRO-FSS) Satellite Earth Stations operating in the 11/12 GHz FSS bands	-	-
ETS 300 249	1993	Satellite Earth Stations and Systems (SES) - Television Receive-Only (TVRO) equipment used in the Broadcasting Satellite Service (BSS)	-	-
ITU-R Recommendation BS.468-4	- [1)]	Measurement of audio-frequency noise voltage level in sound broadcasting	-	-
ITU-R Recommendation BT.471-1	1986	Nomenclature and description of colour bar signals	-	-
ITU-R Recommendation BT.500-10	- [1)]	Methodology for the subjective assessment of the quality of television pictures	-	-
ITU-T Recommendation J.61	- [1)]	Transmission performance of television circuits designed for use in international connections	-	-

COMMISSION
ELECTROTECHNIQUE
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CISPR 20

Cinquième édition
Fifth edition
2002-02

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

Récepteurs de radiodiffusion et de télévision et équipements associés – Caractéristiques d'immunité – Limites et méthodes de mesure

Sound and television broadcast receivers and associated equipment – Immunity characteristics – Limits and methods of measurement

Numéro de référence
Reference number
CISPR 20:2002

Révision de la présente publication

Le contenu technique des publications de la CEI et du CISPR est constamment revu par la Commission et par le CISPR afin qu'il reflète bien l'état actuel de la technique.

Les renseignements relatifs à des questions à l'étude et des travaux en cours entrepris par le comité technique qui a établi cette publication, ainsi que la liste des publications établies, se trouvent dans les documents ci-dessous:

- **Site web de la CEI***
- **Catalogue des publications de la CEI**
  Publié annuellement et mis à jour mensuellement
  (Catalogue en ligne)*
- **iec e-tech**
  Disponible à la fois sur le site web de la CEI* et comme périodique imprimé

Revision of this publication

The technical content of IEC and CISPR publications is kept under constant review by the IEC and CISPR, thus ensuring that the content reflects current technology.

Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is to be found at the following IEC sources:

- **IEC web site***
- **Catalogue of IEC publications**
  Published yearly with monthly updates
  (On-line catalogue)*
- **iec e-tech**
  Available both at the IEC web site* and as a printed periodical

Terminologie utilisée dans la présente publication

Seuls sont définis ici les termes spéciaux se rapportant à la présente publication.

En ce qui concerne la terminologie générale, le lecteur se reportera à la CEI 60050: *Vocabulaire Electrotechnique International* (VEI), qui est établie sous forme de chapitres séparés traitant chacun d'un sujet défini, l'Index général étant publié séparément. Des détails complets sur le VEI peuvent être obtenus sur demande.

Pour les termes concernant les perturbations radioélectriques, voir le chapitre 902.

Terminology used in this publication

Only special terms required for the purpose of this publication are defined herein.

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV), which is issued in the form of separate chapters each dealing with a specific field, the General Index being published as a separate booklet. Full details of the IEV will be supplied on request.

For terms on radio interference, see Chapter 902.

Symboles graphiques et littéraux

Pour les symboles graphiques, les symboles littéraux et les signes d'usage général approuvés par la CEI, le lecteur consultera la CEI 60027*: Symboles littéraux à utiliser en électrotechnique* et la CEI 60617: *Symboles graphiques pour schémas*;

Les symboles et signes contenus dans la présente publication ont été soit tirés de la CEI 60027 ou CEI 60617, soit spécifiquement approuvés aux fins de cette publication.

Graphical and letter symbols

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to IEC 60027: *Letter symbols to be used in electrical technology* and IEC 60617: *Graphical symbols for diagrams*;

The symbols and signs contained in the present publication have either been taken from IEC 60027 or IEC 60617, or have been specifically approved for the purpose of this publication.

* Voir adresse du site web sur la page de titre.

* See web site address on title page.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

SOUND AND TELEVISION BROADCAST RECEIVERS AND ASSOCIATED EQUIPMENT – IMMUNITY CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT

FOREWORD

1) The formal decisions or agreements of the CISPR on technical matters, prepared by sub-committees on which all the National Committees and other member organizations of the CISPR having a special interest therein are represented, express, as nearly as possible, an international consensus on the subject dealt with.
2) They have the form of recommendations for international use and they are accepted by the National Committees and other member organizations of the CISPR in that sense.
3) In order to promote international unification, the CISPR expresses the wish that all National Committees should adopt the text of the CISPR recommendation for their national rules in so far as national conditions will permit. Any divergence between the CISPR recommendations and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

This International Standard CISPR 20 has been prepared by CISPR, subcommittee I: Electromagnetic compatibility of information technology equipment, multimedia equipment and receivers.

This fifth edition of CISPR 20 cancels and replaces the fourth edition published in 1998. This fifth edition constitutes a technical revision.

The text of this CISPR publication is based on the fourth edition and the following documents:

FDIS	Report on voting
CISPR/I/15/FDIS	CISPR/I/27/RVD

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

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

Annexes A, B, C, D, E, F and G form an integral part of this standard.

Annex H is for information only.

The committee has decided that the contents of this publication will remain unchanged until 2002-12. At this date, the publication will be

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

SOUND AND TELEVISION BROADCAST RECEIVERS AND ASSOCIATED EQUIPMENT – IMMUNITY CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT

1 Scope and object

This standard for immunity requirements applies to television broadcast receivers, sound broadcast receivers and associated equipment intended for use in the residential, commercial and light industrial environment.

This standard describes the methods of measurement and specified limits applicable to sound and television receivers and to associated equipment with regard to their immunity characteristics to disturbing signals.

This standard is also applicable to the immunity of outdoor units of direct to home (DTH) satellite receiving systems for individual reception.

NOTE Receiving systems for collective reception, in particular cable distribution head ends (Community Antenna Television, CATV) and community reception systems (Master Antenna Television, MATV) are covered by IEC 60728-2.

Immunity requirements are given in the frequency range 0 Hz to 400 GHz. Radio-frequency tests outside the specified frequency bands or concerning other phenomena than given in this standard are not required.

The objective of this standard is to define the immunity test requirements for equipment defined in the scope in relation to continuous and transient, conducted and radiated disturbances including electrostatic discharges.

These test requirements represent essential electromagnetic immunity requirements.

Test requirements are specified for each port (enclosure or connector) considered.

NOTE 1 This standard does not specify electrical safety requirements for equipment such as protection against electric shocks, unsafe operation, insulation co-ordination and related dielectric tests.

NOTE 2 In special cases, situations will arise where the level of disturbances may exceed the levels specified in this standard e.g. where a hand-held transmitter is used in proximity to an equipment. In these instances special mitigation measures may have to be employed.

The environments encompassed by this standard are residential, commercial and light-industrial locations, both indoor and outdoor. The following list, although not comprehensive, gives an indication of locations which are included:

– residential properties, e.g. houses, apartments, etc.;
– retail outlets, e.g. shops, supermarkets, etc.;
– business premises, e.g. offices, banks, etc.;
– areas of public entertainment, e.g. cinemas, public bars, dance halls, etc.;
– outdoor locations, e.g. petrol stations, car parks, amusement and sports centres, etc.;

– light-industrial locations e.g. workshops, laboratories, service centres, etc.;

– car and boat.

Locations which are characterized by their mains power being supplied directly at low voltage from the public mains are considered to be residential, commercial or light industrial.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR 16-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 16-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: Reports and recommendations of CISPR*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

CISPR 24, *Information technology equipment – Immunity characteristics – Limits and methods of measurements*

IEC 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60268-1, *Sound system equipment – Part 1: General*

IEC 60651, *Sound level meters*

IEC 60728-2: _, *Cabled distribution systems for television, sound and interactive multimedia signals – Part 2: Electromagnetic compatibility of equipment* [1]

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

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

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

ETS 300 158:1992, *Satellite Earth Stations and Systems (SES) – Television Receive Only (TVRO-FSS) Satellite Earth Stations operating in the 11/12 GHz FSS bands*

ETS 300 249:1993, *Satellite Earth Stations and Systems (SES) – Television Receive-Only (TVRO) equipment used in the Broadcasting Satellite Service (BSS)*

[1] To be published.

ITU-R BS.468-4, *Measurement of audio-frequency noise voltage level in sound broadcasting*

ITU-R BT.471-1:1986, *Nomenclature and description of colour bar signals*

ITU-R BT.500-10, *Methodology for the subjective assessment of the quality of television pictures*

ITU-T J.61, *Transmission performance of television circuits designed for use in international connections*

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this standard, the definitions contained in IEC 60050(161) as well as the following apply.

A non-exhaustive overview of equipment to which the standard is applicable is given in table 1. The terminology and abbreviations of table 1 are also used in other tables.

Table 1 – Survey (non exhaustive) of receiver and associated equipment types, including the appropriate parts of multifunction equipment

<table>
<tr><th colspan="3" rowspan="2">Equipment</th><th colspan="2">Intended for mains powering and portable with external power connection facility</th><th rowspan="2">Battery powered portable, without external power connection facility (portable)</th><th rowspan="2">Car radio</th></tr>
<tr><th>With a connection facility for an external antenna</th><th>Without a connection facility for an external antenna</th></tr>
<tr><td rowspan="2">Sound broadcast receivers (radio) (including satellite receivers)</td><td colspan="2">FM</td><td>FM radio ant.
PC FM tuner card</td><td>FM radio</td><td rowspan="2">Portable radio</td><td>Car radio FM</td></tr>
<tr><td colspan="2">LW, MW, SW (AM)</td><td>AM radio ant.
PC AM tuner card</td><td>AM radio</td><td>Car radio AM</td></tr>
<tr><td colspan="3">Television broadcast receivers (TV) (including satellite receivers)</td><td>TV antenna
PC TV tuner card</td><td>TV</td><td>Portable TV</td><td>Car TV</td></tr>
<tr><td rowspan="4">Associated equipment (ass.)</td><td rowspan="2">Video tape/disc equipment (recording and/ or play-back)</td><td>With tuner</td><td>Ass. video tuner antenna</td><td>Ass. video Tuner</td><td rowspan="2">Portable ass. video</td><td rowspan="4"></td></tr>
<tr><td>Without tuner</td><td colspan="2">Ass. video</td></tr>
<tr><td colspan="2">Audio tape/disc equipment</td><td colspan="2">Ass. audio</td><td>Portable ass. audio</td></tr>
<tr><td colspan="2">Other, e.g. audio amplifiers, decoders, electronic organs</td><td colspan="2">Ass. other</td><td>Portable ass. other, e.g. infrared devices</td></tr>
</table>

3.1.1
sound receivers
appliances intended for the reception of sound broadcast and similar services for terrestrial, cable and satellite transmissions; these sound receivers can be digital receivers with digital incoming signals or receivers with digital processing of digital or analogue incoming signals

3.1.2
television receivers
appliances intended for the reception of television broadcast and similar services for terrestrial, cable and satellite transmissions; these TV receivers can be digital receivers with digital incoming signals or receivers with digital processing of digital or analogue incoming signals

NOTE 1 Modular units which are part of sound or television receiving systems, like tuners, frequency converters, modulators, etc. are considered to be sound or television receivers respectively.

NOTE 2 Tuners may be provided with a broadcast-satellite-receiving stage and with demodulators, decoders, demultiplexers, D/A converters, encoders (e.g. NTSC, PAL or SECAM encoders) etc.

NOTE 3 Frequency converters may be provided with a broadcast-satellite-receiving stage and with devices which convert the signals to other frequency bands.

NOTE 4 Receivers, tuners, or frequency converters may be tuneable or may only be able to receive a fixed frequency.

3.1.3
associated equipment
appliance either intended to be connected directly to sound or television receivers, or to generate or to reproduce audio or visual information; excluded are information technology equipment even if they are intended to be connected to a television broadcast receiver

NOTE Information technology equipment is defined in CISPR 22.

3.1.4
multifunction equipment
appliances in which two or more functions are provided in the same unit, for instance television reception, radio reception, digital clock, tape-recorder or disc player etc.

3.1.5
disturbance signal
an unwanted signal which may degrade radio reception or cause malfunction in equipment; specific unwanted signals are simulating disturbance signals, generated under laboratory conditions

3.1.6
immunity
ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels

NOTE In this standard the specified performance is:

– a specified sound signal-to-interference ratio and/or

– no greater than just perceptible degradation of the picture when a wanted signal and an unwanted signal occur simultaneously.

3.1.7
input immunity
immunity from unwanted signal voltages present at the antenna input terminal

3.1.8
immunity from conducted voltages
immunity from unwanted signal voltages present at the equipment terminals for audio and mains input and audio output

3.1.9
immunity from conducted currents
immunity from unwanted signal (common mode) currents present in cables connected to the equipment

3.1.10
immunity from radiated fields
immunity from unwanted electromagnetic fields present at the equipment

3.1.11
screening effectiveness
characteristic of a coaxial connector terminal to attenuate the transfer of external currents into internal voltages

3.1.12
port
particular interface of the specified apparatus with the external electromagnetic environment (see figure 1)

3.1.13
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

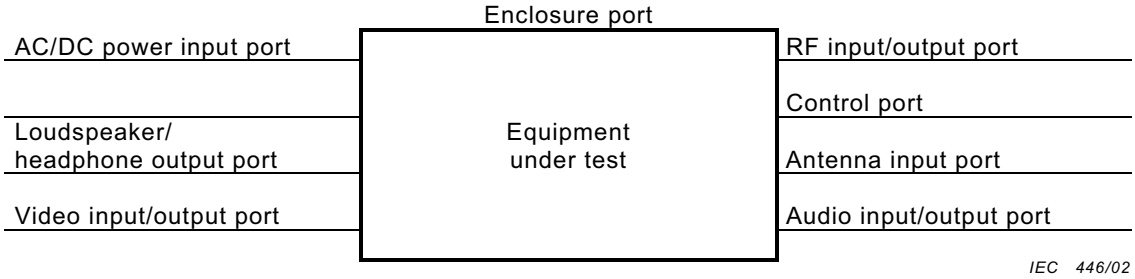


Figure 1 – Examples of ports

3.2 Abbreviations

AC/DC	Alternate Current/Direct Current
AFC	Automatic Frequency Control
AM	Amplitude Modulation
BSS	Broadcast Satellite System
CATV	Community Antenna Television
CD	Compact Disc
DTH	Direct To Home (satellite receiving systems)
e.m.	Electromagnetic (field)
e.m.f.	Electro-motive-force
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FM	Frequency Modulation
FSS	Fixed Satellite System
GSM	Global System for Mobile Communications
ITU-R	International Telecommunication Union - Radiocommunications

LW, MW and SW	Long Wave, Medium Wave and Short Wave
MATV	Master Antenna Television
PC	Personal Computer
RF	Radio Frequency
r.m.s.	Root-mean-square
TEM	Transverse Electromagnetic (cell)

4 Immunity requirements

4.1 Performance criteria

4.1.1 Performance criterion A

The equipment shall continue to operate as intended during the test.

No change of actual operating state (for example change of channel) is allowed as a result of the application of the test.

Multifunction equipment shall for each function meet the relevant requirements.

Evaluation is carried out for audio and video functions.

The equipment is supposed to operate as intended if the criteria of 4.1.1.1 and/or 4.1.1.2 are fulfilled.

4.1.1.1 Evaluation of audio quality

Unless otherwise specified in this standard, the criterion of compliance with the requirement is a wanted to unwanted audio signal ratio of ≥40 dB at a wanted audio signal level of 50 mW, or at another audio signal level specified by the manufacturer.

If the S/N ratio is less than 43 dB, the performance criterion for audio assessment is the actual S/N ratio minus 3 dB.

In this case, at the beginning of the audio quality evaluation the actual S/N ratio is measured and noted in the test report as reference value.

For AM sound receivers the criterion is ≥26 dB at 50 mW.

For AM and FM car radios and for broadcast receiver cards for computers the criterion is ≥26 dB at 500 mW.

4.1.1.2 Evaluation of picture quality

In the evaluation of picture interference the wanted test signal produces a standard picture (in the case of video tape equipment on the screen of the test-tv-set) and the unwanted signal produces a degradation of the picture. The degradation may be in a number of forms, such as a superposed pattern, disturbance of synchronization, geometrical distortion, loss of picture contrast, of colour, etc.

The criterion of compliance with the requirement is just perceptible degradation by observation of the picture. The screen shall be observed under normal viewing conditions (brightness 15 lx to 20 lx), at a viewing distance of six times the height of the screen.

In the case of video tape equipment the test criteria relate to the picture, assessed on a test-tv-set, which is connected to the video output terminal of the equipment.

4.1.2 Performance criterion B

The equipment shall continue to operate as intended after the test. No loss of function is allowed after the test when the apparatus is used as intended, but failures which are recovered automatically but which cause temporary delay in processing, are permissible. No change of actual operating state for example change of channel or stored data and settings is allowed as a result of the application of the test. During the test, degradation of performance is allowed.

4.2 Applicability

Tests are applied at the relevant connectors and enclosure port of the equipment according to 4.3 through 4.7. Tests shall only be carried out where the relevant port(s) or function exist. If more than one specific function exists, for example audio functions, then all these functions shall be tested.

It may be determined from consideration of the electrical characteristics and usage of a particular equipment that some of the tests are inappropriate and therefore unnecessary. In such a case it is required that the decision not to test and the rationale leading to this decision shall be recorded in the test report.

4.2.1 Multifunction equipment

Multifunction equipment which is subjected simultaneously to different clauses of this standard and/or other standards shall be tested with each function operating in isolation, if this can be achieved without modifying the equipment internally. The equipment thus tested shall be deemed to have complied with the requirements of all clauses/standards when each function has satisfied the requirements of the relevant clause/standard.

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

If the test levels for the different functions are not identical, the level for the function under test applies, taking into account the performance criteria for this function.

Example: For a TV receiver provided with a telecommunication function, the requirements for the telecommunication port are verified in accordance with CISPR 24.

4.2.2 PC tuner cards

For PC tuner cards immunity requirements for the antenna input connector are applicable according to table 2. PC tuner cards which are separately marketed for incorporation in diverse host units shall be tested in at least one appropriate representative host unit (e.g. PC) of the choice of the card manufacturer.

4.2.3 IR units

An IR remote control unit shall be tested together with the main unit.

4.3 Immunity requirements for the antenna input connector

Measurements apply to equipment and with the performance criteria according to table 2.

Table 2 – Antenna port

Parameter	Test specification	Test set-up	Applicability	Performance criteria
RF voltage Differential mode	See 4.3.1 Tables 3 and 4 and 4.3.2 Tables 5, 5a, 5b, 5c, 5d and 6	See 5.3 (input immunity)	FM radio antenna PC tuner cards for FM and TV Car radio FM Satellite radio TV antenna Satellite TV Ass. video tun. antenna	A
RF voltage Common mode AM modulate carrier	See 4.3.3, Table 8 1 kHz, 80 % depth	See 5.4	FM radio antenna PC tuner cards for FM and TV Car radio FM Satellite radio TV antenna Satellite TV Ass. video tun. antenna AM radio antenna Car radio AM	A
Screening effectiveness	See 4.3.4, Table 8a	See 5.5	FM radio antenna TV antenna	see Table 8a

4.3.1 Requirements for input immunity to RF voltages (differential mode) of the FM part of sound receivers

Sound receivers with a FM part shall meet the sound criterion of 4.1.1.1 They shall be tested at a tuned frequency f_n and subjected to an unwanted signal of frequency f_f and level n_f as specified in tables 3 and 4. Receivers with mono/stereo facility shall be tested in stereo mode.

Table 3 – Limits of input immunity from unwanted signals outside the FM range
(see also 5.3.1.2 for the wanted signal)

Wanted signal frequency f_n	Unwanted signal frequency f_f	Level n_f dB(µV) 1 kHz AM at 80 % depth	
MHz	MHz	Mono	Stereo
87,6	66,2 [a]	80	80
	76,9	80	80
	87,1	80	80
	87,2	80	80
	87,25	80	80
	87,30	72,4	69,2
	87,35	64,8	58,4
	87,40	57,2	47,6
	87,45	49,6	36,8
	87,50	42,0	26,0
107,9	129,3 [b]	80	80
	118,6	80	80
	108,4	80	80
	108,3	80	80
	108,25	80	80
	108,20	72,4	69,2
	108,15	64,8	58,4
	108,10	57,2	47,6
	108,05	49,6	36,8
	108,00	42,0	26,0

[a] Only applicable for receivers with the local oscillator frequency below the tuned frequency.

[b] Only applicable for receivers with the local oscillator frequency above the tuned frequency.

Table 4 – Limits of input immunity from unwanted signals inside the FM range
(see also 5.3.1.3 for the wanted signal)

Wanted signal frequency f_n MHz	**Unwanted signal frequency f_f** MHz	**Level n_f** dB(μV) **1 kHz FM 40 kHz deviation**	
		Mono	**Stereo**
98	97,5 and 98,5	85	85
	97,6 and 98,4	85	85
	97,65 and 98,35	80	80
	97,7 and 98,3	72	72
	97,75 and 98,25	63	63
	97,8 and 98,2	59	58
	97,85 and 98,15	57	47
	97,9 and 98,1	53	32
	97,925 and 98,075	49	20
	97,95 and 98,05	41	14
	97,975 and 98,025	34	14
	98	29	20

4.3.2 Requirements for input immunity to RF voltages (differential mode) of television receivers and associated video equipment with tuner (including satellite television receivers)

Television receivers, video tape equipment with built-in television broadcast receiving facility in the RF recording mode and other associated video equipment with tuner shall be tested at a tuned television channel N and subjected to an unwanted signal in channel M, level n_f, and of the following types. The wanted input signals are specified in 5.3.2.2.

Unwanted signal types:

A: an unmodulated signal at the picture carrier frequency of the relevant channel M;

B: two unmodulated signals each at the level as given in the tables, one at the relevant picture carrier frequency +0,5 MHz and the other at the picture carrier frequency –0,5 MHz;

C: a modulated signal at the relevant sound carrier frequency, 1 kHz FM at 30 kHz deviation;

C shall be applied to receivers for countries in which mono-sound television signals of the systems B and G can be received.

For television receivers for countries, in which also two-sound-channel-television-signals of the systems B and G with two frequency modulated sound carriers can be received (even for one-sound-channel-television-receivers)

– C1: a frequency modulated signal at the relevant frequency of the first sound carrier, 1 kHz FM at 30 kHz deviation, and

– C2: a frequency modulated signal at the relevant frequency of the second sound carrier, 1 kHz FM at 30 kHz deviation

are applied simultaneously.

D: an amplitude modulated signal at the relevant picture carrier frequency, 1 kHz AM at 80 % depth.

E: an amplitude modulated signal, 1 kHz AM at 80 % depth.

Table 5 – Limits of input immunity of television receivers for systems B, G and I

Wanted channel	Unwanted signal in channel M						
	Level dB(μV)						Type
N	M = N – 5	N – 1	N + 1	N + 5 [a]	N + 9 [a]	N + 11	
	–	73	73	–	68 [b]	–	A
N_I and	–	61	61	–	56 [b]	–	B
N_{III} and	70	73 – *x*	73 – *x*	70	68 – *x* [b]	68	C or C1
N_H	63	73 – *y*	73 – *y*	63	68 – *y* [b]	61	C2
	70	–	–	70	–	68	D
	–	77	77	80	68	–	A
	–	65	65	68	56	–	B
N_{IV}	74	77 – *x*	77 – *x*	80 – *x*	68 – *x*	–	C or C1
	67	77 – *y*	77 – *y*	80 – *y*	68 – *y*	–	C2
	74	–	–	–	–	–	D
	80	77	77	80	–	–	A
	68	65	65	68	–	–	B
N_V	80 – x	77 – *x*	77 – *x*	80 – *x*	62	–	C or C1
	80 – y	77 – *y*	77 – *y*	80 – *y*	55	–	C2
	–	–	–	–	62	–	D
For systems B and G: *x* = 13 dB, *y* = 20 dB For system I (monophonic only): *x* = 10 dB							

NOTE 1 "*x*" is the relative level (dB) of the first sound carrier (mono sound channel) with respect to the picture carrier. "*y* " is the relative level (dB) of the second sound carrier (stereo sound channel) with respect to the picture carrier.

NOTE 2 (For China only). For systems D-PAL and K-PAL, Table 5 applies with the addition of channels (M) N – 4 and N + 4, with the same limits of channels N – 5 and N + 5 and *x* = 10 dB.

NOTE 3 N ± *m* indicates the frequency of the picture carrier of the tuned television channel, plus or minus *m* times the channel frequency bandwidth. The test signal shall be applied at this frequency if a limit value is tabulated.

[a] These levels only apply for television systems with a channel spacing of 8 MHz and an IF of 38,9 MHz. For other channel spacing and IF frequencies different image channel or local oscillator interference constraints may apply.

[b] Only for hyperband N_H.

For the purpose of this standard, a television receiver shall meet the limits of tables 5, or 5a to 5d and 6 as appropriate for all channels for which it is designed.

For tests for conformity of appliances in series production (see clause 6) a television receiver shall be tested on one channel in each band for which it is designed, using the channel N for which the picture carrier frequency is nearest to the middle frequency of each TV band. For Europe:

Channel N_I in Band I nearest to 55 MHz

Channel N_{III} in Band III nearest to 203 MHz

Channel N_{IV} in Band IV nearest to 503 MHz

Channel N_V in Band V nearest to 743 MHz

Channel N_H in Hyperband nearest to 375 MHz

See also annex H.

Table 5a – Limits of input immunity of television receivers for system L

Wanted channel N	Unwanted signal in channel M				
	Level dB(μV) n_f (75 Ω)				Type
	M ≤ N – 2	N – 1	N + 1	M ≥ N + 2	
04	68	–	-	–	D
08	71	68	68	71	D
25	75	72	72	75	D
55	75	72	72	75	D
NOTE For channel N = 04 (f_v = 63,75 MHz), the unwanted signal shall only be applied in channel M = 02 (f_v = 55,75 MHz).					

For system L, signal D is an amplitude modulated signal at the relevant picture carrier frequency, 1 kHz at 80 % depth. This signal is also used in a second measurement for simulating the unwanted signal at the sound carrier frequency. In that case the limits indicated in table 5a have to be reduced by 5 dB.

Table 5b – Limits of input immunity of television receivers for systems D-SECAM, K-SECAM (used in Russia)

Wanted channel N	Unwanted signal in channel M						
	Level dB(μV)						Type
	M = N – 4	N – 1	N + 1	N + 4	N + 8	N + 9	
N_I (Channel 2)	– –	73 61	73 61	– –	– –	– –	A B
N_{II} (Channel 4)	– –	73 61	73 61	– –	– –	– –	A B
N_{III} (Channel 10)	– – – 70	73 61 63 –	73 61 – 73	– – 70 –	– – – –	– – – 68	A B C D
N_{IV} (Channel 25)	– – – 74	77 65 67 –	77 65 – 70	– – 70 –	– – 66 –	68 56 – –	A B C D
N_V (Channel 55)	80 68 – –	77 65 67 –	77 65 – 67	– – 70 –	– – 62 –	– – – 62	A B C D
NOTE The wanted channels in brackets are recommended for measurements within each television band.							

Table 5c – Limits of input immunity of television receivers for systems PAL D/K (used in central Europe)

Wanted channel and signal	Unwanted signal in channel M						
	Level dB(μV)						Type
N	M = N – 4	N – 1	N + 1	N + 4	N + 8	N + 9	
Channel 3	–	73	73	–	–	–	A
Signal level:	–	61	61	–	–	–	B
77,25 MHz	–	–	–	–	–	–	C
70 dB(μV)	–	–	–	–	–	–	D
Channel 9	–	73	73	–	–	–	A
Signal level:	–	61	61	–	–	–	B
199,25 MHz	–	63	–	70	–	–	C
70 dB(μV)	70	–	73	–	–	68	D
Channel 26	–	77	77	–	–	68	A
Signal level:	–	65	65	–	–	56	B
511,25 MHz	–	67	–	70	66	–	C
74 dB(μV)	74	–	70	–	–	–	D
Channel 55	80	77	77	–	–	–	A
Signal level:	68	65	65	–	–	–	B
743,25 MHz	–	67	–	70	62	–	C
74 dB(μV)	–	–	67	–	–	62	D

Table 5d – Limits of input immunity of television receivers for system M-NTSC with a 58,75 MHz IF video carrier (used in Japan)

Wanted channel N	Unwanted signal in channel M					
	Level dB(μV)					Type
	M = N – 2	N – 1	N + 1	N + 2	N + 19	
N_{II}, N_{III}	–	–	60	–	70	A
	–	49	–	–	–	C1
	70	–	–	70	–	D
N_{IV}	–	–	64	–	74	A
	–	53	–	–	–	C1
	70	–	–	74	–	D

NOTE 1 Wanted signal: a standard TV signal with vertical colour bar pattern with modulated sound carrier, level 70 dB(μV) in band II and band III or 74 dB(μV) in band IV 1 kHz FM at 15 kHz deviation.

NOTE 2 Sound carrier level: 64 dB(μV) in band II and band III or 68 dB(μV) in band IV.

NOTE 3 C1: a modulated signal at the relevant sound carrier frequency, 1 kHz FM at 15 kHz deviation.

For tests for conformity of appliances in series production (see clause 6) a television receiver shall be tested on one channel in each band for which it is designed, using the channel N for which the picture carrier frequency is nearest to the following frequencies:

Channel N_{II} in Band II nearest to 98 MHz

Channel N_{III} in Band III nearest to 203 MHz

Channel N_{IV} in Band IV nearest to 623 MHz

See also annex H.

Table 6 – Limits of input immunity of television receivers

Wanted channel N	Unwanted signal		
	Frequency MHz	**Level** dB(μV) n_f (75 Ω)	**Type**
N_I	26 to 30	89	E
N_{III}	26 to 30	104	E
NOTE 1 The limits for the wanted channel N_I apply also to the wanted channel N_{III} when band II is used for systems D-SECAM, K-SECAM. NOTE 2 For the wanted audio signal see 5.3.2.2.			

For all input immunity measurements on television receivers equipped with a "fine tuning" adjustment, easily accessible to the user, readjustment of the receiver oscillator is allowed (up to ±250 kHz) referred to its nominal frequency, in order to minimize the interference, while maintaining the quality of picture and sound.

Table 7 – Limits of input immunity of satellite television receivers

Wanted channel N	Unwanted signal in channel M				Wanted and unwanted signal type
	Level dB(μV)				
	N – 2	N – 1	N + 1	N + 2	
N_{min} + 3	70	66	66	70	A1 or A2 or A3
N_{mid}	70	66	66	70	
N_{max} – 3	70	66	66	70	
NOTE 1 N_{min} = lowest channel of the receiver in the relevant band. NOTE 2 N_{mid} = middle channel of the receiver in the relevant band. NOTE 3 N_{max} = highest channel of the receiver in the relevant band.					

Satellite television receivers shall meet the sound criterion of 4.1.1.1 and the picture criterion of 4.1.1.2. The levels of the unwanted signals are specified in table 7.

For satellite television receivers the wanted and unwanted signals shall be of the same type and have the same modulation as described in 5.3.2.3. The characteristics are:

A1: Channel distance 29,5 MHz with a deviation sensitivity of 16 MHz/V and a dispersal of 2 MHz for PAL receivers.

A2: Channel distance 42 MHz with a deviation sensitivity of 22 MHz/V and a dispersal of 2 MHz for receivers able to receive wide band (33 MHz) signals. A2 type signal applies to SECAM receivers.

A3: Channel distance 50 MHz with a deviation sensitivity of 22,5 MHz/V and a dispersal of 2 MHz for PAL receivers able to receive this wide band signal.

NOTE The deviation sensitivity is defined for the zero dB point of the pre-emphasis network.

Measurements with type A3 need not be carried out if measurements with type A1 have been performed.

Table 7a – Limits of input immunity of satellite television receivers (Used in Japan, Korea)

Wanted Channel N	Unwanted signal in channel M Level dB(μV)		Wanted and unwanted signal type
	N – 2	N + 2	
N_{min} + 2	70	70	B1 or B2
N_{mid}	70	70	
N_{max} – 2	70	70	

B1: Channel distance 19,18 MHz with a deviation sensitivity of 17 MHz/V and a dispersal of 0,6 MHz for NTSC receivers.

B2: Channel distance 19,18 MHz with a deviation sensitivity of 17 MHz/V and a dispersal of 0,6 MHz for high vision (MUSE) receivers.

4.3.3 Requirements for immunity to RF voltages (common mode) at antenna terminals

The requirements for receivers, (including car radios and AM receivers), multifunction equipment and video tape equipment concerning the immunity to RF voltages in common mode are restricted to the antenna terminals and to the frequency range from 26 MHz to 30 MHz.

Requirements are applied to equipment operating in the receiving mode.

Receivers and multi-function equipment shall meet the sound criterion of 4.1.1.1 and the picture criterion of 4.1.1.2 as appropriate for unwanted signals of frequencies and levels as specified in table 8 applied to the antenna terminal.

Video tape equipment with built in television broadcast receiving facility shall meet in the RF recording mode the sound criterion of 4.1.1.1 at the audio output terminal of the equipment and the picture criterion of 4.1.1.2 on a test-TV-set under the same test conditions as receivers and multifunction equipment.

Table 8 – Limits of immunity to RF voltages (common mode) of antenna terminals

Frequency MHz	Level dB(μV) (e.m.f.)
26 to 30	126
NOTE 1 For system L the test level in the frequency range 28 MHz to 30 MHz is 116 dB (μV) (e.m.f.). NOTE 2 According to the measuring procedure the immunity from conducted current is expressed by the e.m.f. level of the unwanted signal generator (figures 5 and 6).	

4.3.4 Requirements for screening effectiveness

Requirements for screening effectiveness apply to the coaxial antenna terminals, if any.

Measurements shall be made in accordance with 5.5.

Table 8a – Limits of screening effectiveness of the coaxial antenna terminals

Equipment	Wanted signal frequency or channel MHz or N	Unwanted signal frequency MHz	Level dB
FM sound receivers	f_m [a]	f_m [a] ± 0,001	≥20
Television receivers Videotape equipment [b]	Middle channel of each TV band 04, 08, 25, 55 [c]	f_V ± 1 [d]	≥50

[a] The middle frequency of the FM band.
[b] With built-in television broadcast receiving facility in the RF recording mode.
[c] For system L.
[d] Each one falls inside the wanted channel (f_v = wanted channel video carrier).

4.4 Immunity requirements for audio connectors

4.4.1 Immunity requirements at loudspeaker and headphone output connector

Measurements apply to equipment and with the performance criteria according to table 9.

Table 9 – Loudspeakers/headphone output port

Parameter	Test specification	Test set-up	Applicability [a]	Performance criteria
RF voltage Differential mode AM modulated signal	See 4.6 Table 12 1 kHz, 80 % depth	See 5.7	Mains powered: – FM radio ant. – TV ant. – Ass. video Tuner. Ant. – Ass. video – Ass. radio – Ass. audio – Ass. other (e.g. audio amplifier) – Camcorders, in playback mode, – Satellite TV – Satellite radio	A

[a] The requirements shall not apply to:
– the equipment functions in the interference frequency ranges listed in table 14;
– AM sound receivers and car radios.

4.4.2 Immunity requirements for audio input and output connectors (excluding loudspeaker and headphone)

Measurements apply to equipment and with the performance criteria according to table 10.

Table 10 - Audio input/output port (excluding loudspeaker and headphone)

Parameter	Test specification	Test set-up	Applicability [a]	Performance criteria
RF voltage Differential mode AM modulated signal	See 4.6 Table 13 1 kHz, 80 % depth	See 5.7	Mains powered: – FM radio antenna – TV antenna – Ass. video tun. ant. – Ass. video – Ass. radio – Ass. audio, – Ass. other (e.g. audio amplifier) – Camcorders, in playback-mode – Satellite TV – Satellite radio	A
[a] The requirements shall not apply to: – the equipment functions in the interference frequency ranges listed in table 14; – AM sound receivers and car radios.				

4.5 Immunity requirements for AC mains power connectors

Measurements apply to equipment and with the performance criteria according to table 11.

Table 11 - Power input port

Parameter	Test specification	Test set-up	Applicability [a]	Performance criteria
RF voltage Common mode AM modulated signal	See 4.6 Table 12 1 kHz, 80 % depth	See 5.7	Mains powered: – FM radio antenna – TV antenna – Ass. video tun. ant. – Ass. video – Ass. radio – Ass. audio, – Ass. other (e.g. audio amplifier) – Camcorders, in playback-mode, – Satellite TV – Satellite radio	A
Electrical fast transients Common mode	1 kV(peak) Tr/Th: 5/50 ns 5 kHz repetition frequency	IEC 61000-4-4 Direct injection Coupling/decoupling network		B
[a] The requirements shall not apply to: – the equipment functions in the interference frequency ranges listed in table 14; – AM sound receivers and car radios. The requirements shall apply to: – AC/DC adaptors, when marketed with the host as one commercial unit.				

4.6 Requirements for immunity to RF voltages

4.6.1 Limits of immunity to RF voltages of mains supply terminal and loudspeaker and headphone terminals

Equipment as listed in tables 9 and 11 shall meet, except as stated in 4.6.3 for each function, the sound criterion of 4.1.1.1 and the picture criterion of 4.1.1.2 as appropriate. They shall be tested using unwanted signals of frequencies and levels specified in table 12 applied to the mains (in common mode) and loudspeaker and headphone terminals (in differential mode).

Table 12 – Limits of immunity to RF voltages of mains, loudspeaker and headphone terminals

Frequency MHz	**Level** dB(μV) (e.m.f.)
0,15 to 30	130
30 to 100	120
100 to 150	120 – 110 [a]
[a] Decreasing linearly with the logarithm of the frequency.	

4.6.2 Limits of immunity to RF voltages of audio input and output terminals (except loudspeaker and headphone terminals)

Equipment as listed in table 10 shall meet, except as stated in 4.6.3 for each function, the sound criterion of 4.1.1.1 and the picture criterion of 4.1.1.2 as appropriate. They shall be tested using unwanted signals of frequencies and levels specified in table 13 applied to the corresponding terminal.

Table 13 – Limits of immunity to RF voltages of audio input and output terminals (except loudspeaker and headphone terminals)

Frequency MHz	**Level** dB(μV) (e.m.f.)
0,15 to 1,6	80 – 90 [a]
1,6 to 20	90 – 120 [a]
20 to 100	120
100 to 150	120 – 110 [b]
[a] Increasing linearly with the logarithm of the frequency.	
[b] Decreasing linearly with the logarithm of the frequency.	

4.6.3 Exceptions to the limits

The requirements in 4.6.1 and 4.6.2 shall not apply to:

– the equipment functions in the interference frequency ranges listed in table 14;

– television receivers and associated equipment in the frequency range $f_c \pm 1{,}5$ MHz, in which f_c is the colour sub-carrier frequency.

Table 14 – Additional unwanted signal frequencies to be excluded in tests on sound and television reception functions.

Function	Frequency range	
	The tuned channel in all cases, plus	
	the IF channel MHz	other frequencies MHz
FM sound receivers	$f_i \pm 0,5$	None
Television receivers	$f_i - 2$ to $f_v + 2$ (for systems B, G, I, L, D, K, M) $f_v - 2$ to $f_i + 2$ (for system L')	$f_s \pm 0,5$
NOTE f_i is the sound intermediate frequency; f_v is the vision intermediate frequency; f_s is the intercarrier sound frequency.		

4.7 Immunity requirements for the enclosure port

Measurements apply to equipment and with the performance criteria according to table 15.

Table 15 – Enclosure port

Parameter	Test specification	Test set-up	Applicability	Performance criteria
RF e.m. field AM modulated carrier	See 4.7.1 1 kHz, at 80 % depth	See 4.7.1 and 5.8	Mains powered: – FM radio antenna – TV antenna – Ass. video tun. ant. – Ass. video – Ass. radio – Ass. audio – Ass. other (e.g. audio amplifier) – Camcorders, in playback-mode, – Satellite TV – Satellite radio	A
RF e.m. field Keyed carrier [a]	900 MHz, 3 V/m, duty cycle 1/8, 217 Hz repetition frequency	IEC 61000-4-3 With measurement conditions of 5.8.4. and table 23. Filter B.2 replaced by B.4.		
Electrostatic discharge	8 kV air discharge 4 kV contact discharge	IEC 61000-4-2	All equipment covered by the scope	B

[a] As an alternative method, a non-homogeneous field strength ≥3 V/m of similar characteristics as the test specification (e.g. generated by a dummy GSM portable telephone) may be applied in a shielded room.

The dummy shall be placed on a non-metallic stand with a height of 80 cm, at a distance of 1 m to the EUT (see figure 11). The front side of the EUT shall be placed in parallel to the antenna line of sight. The position shall be described in the measurement report.

In case of dispute, measurements shall be carried out in accordance with IEC 61000-4-3, with measurement conditions given in 5.8.4 and table 23, and filter B.2 replaced by filter B.4.

4.7.1 Requirements for immunity to ambient electromagnetic fields

Requirements apply for immunity from radiated fields for equipment providing audio, video, FM sound, and television functions and associated equipment.

4.7.1.1 FM sound broadcast receivers

For equipment with a FM sound broadcast reception table 16 applies.

Table 16 – Limits of immunity to ambient electromagnetic fields of FM reception functions of sound receivers

Frequency MHz	**Level** dB(μV/m)
0,15 to 150	125
Except frequency bands:	
$(f_i - 0,5)$ to $(f_i + 0,5)$	101
$(f_o - 0,5)$ to $(f_o + 0,5)$	109
$(f_{im} - 0,5)$ to $(f_{im} + 0,5)$	109
87,5 to 108 [a]	109
Except the tuned channel ± 0,15	
NOTE f_i is the intermediate frequency (= 10,7 MHz) $f_o = f_t \pm f_i$ is local oscillator frequency $f_{im} = f_t \pm 2f_i$ is the image frequency f_t is the tuned frequency where sign "+" applies when $f_o > f_t$ sign "–" applies when $f_o < f_t$	
[a] The frequency range 87,5 MHz to 108 MHz can be varied depending on the use of the FM frequency band on a national basis.	

4.7.1.2 Television broadcast receivers

For equipment with a broadcast television receiver function table 17 applies.

Table 17 – Limits of immunity to ambient electromagnetic fields of television receivers operating in the reception function

Frequency MHz	**Level** dB(μV/m)
0,15 to 47	125
Except frequency bands:	
(f_c – 1,5) to (f_c + 1,5)	101
(f_s – 0,5) to (f_s + 0,5)	101
(f_i – 2) to (f_v + 2) [a]	101
(f_v – 2) to (f_i + 2) [b]	101
For non-European countries and Russia	
47 to 150 [c]	109 [d]
Except the tuned channel ± 0,5	
For European countries	
47 to 87	109
87 to 108	125
108 to 144	109
144 to 150	125
Except the tuned channel ± 0,5	
NOTE f_i is the sound intermediate frequency f_v is the vision intermediate frequency f_s is the intercarrier sound frequency f_c is the colour subcarrier frequency	
[a] For systems B, D, G, K, I, L, M. [b] Only for system L'. [c] The frequency 47 MHz can be varied on a national basis depending on the use of this frequency range. [d] For television receivers with reception function in this frequency range. For television receivers without reception function in this frequency range a level of 125 dB(μV/m) shall apply.	

Receivers and multifunction equipment operating in the monitor mode shall also meet the requirement of 125 dB(μV/m) in the frequency range 150 kHz to 150 MHz. For the frequency range f_c ± 1,5 MHz the limit of 101 dB(μV/m) applies.

4.7.1.3 Associated video tape equipment

Video tape equipment in both recording and playback mode as appropriate shall meet the requirement of:

– table 17 for equipment with built-in television broadcast receiving facility in the RF recording mode;

– table 18 for all equipment in the playback mode;

– table 19 for all equipment in the video recording mode (except for f_c ± 1,5 MHz, for which the limit 101 dB(μV/m) applies).

Table 18 – Limits of immunity to ambient electromagnetic fields of video tape equipment in the playback mode

Frequency MHz	Level dB(μV/m)
0,15 to 2,5	125
2,5 to 4,25	120
4,25 to 6,25	115
6,25 to 10	120
10 to 150	125

4.7.1.4 Other associated equipment

For equipment with audio or video functions other than related to broadcast reception, for instance infrared headphones, table 19 applies. For infrared headphones the frequency band $f_{mod} \pm f_{diff}$ is exempted (f_{mod} = internal frequency for the modulation of the IR carrier, f_{diff} = sidebands depending on the kind of modulation).

Table 19 – Limits of immunity to ambient electromagnetic fields of equipment with audio or video functions

Frequency MHz	Level dB(μV/m)
0,15 to 150	125

For disc equipment in both recording or playback mode the requirements of table 19 shall be met.

For video disc equipment the limit of 101 dB(μV/m) applies in the frequency range $f_c \pm 1{,}5$ MHz.

For outdoor units of Direct to Home satellite receiving systems (FSS and BSS) table 19 is applicable (see also 5.5.2 of ETS 300 158 and 5.5.2 of ETS 300 249).

Infrared remote controls shall be tested against the same field strength limit as defined for the equipment to which it is intended to signal.

During the test the infrared remote control shall not generate a control signal unintentionally and shall maintain its functions.

For camcorders in playback mode, when powered via the external power connection facility, the requirements of table 20 shall be met.

Table 20 – Limits of immunity to ambient electromagnetic fields of camcorders in the playback mode

Frequency MHz	Level dB(μV/m)
0,15 to 45	115
45 to 150	125

4.7.2 Requirements for immunity to electrostatic discharge

Requirements for immunity to electrostatic discharge apply to the enclosure port and the housing of plugs and sockets.

Connector pins and receptors are excluded from ESD tests. See table 15.

5 Immunity measurements

5.1 General conditions during testing

For equipment for which the wanted signals are not explicitly described in this standard, the nominal signals as specified by the manufacturer shall be applied during the tests. In case a sound signal other than 1 kHz is used as a wanted signal, an appropriate band pass filter shall be used, instead of the filter specified in B.2. The input signal applied during the test shall be included in the technical report.

Immunity measurements are performed by the application of a wanted test signal and an unwanted signal to the equipment under test. These signals and methods of application are specified in 5.3, 5.7 and 5.8.

NOTE For compliance testing it is not necessary to measure the actual immunity level.

For the vision component of the wanted TV signal the level refers to the r.m.s. value of the carrier at the peak of the modulation.

The signal level refers in all other cases to the r.m.s. level of the unmodulated carrier.

At transition frequencies the more stringent limit shall apply.

The limit values for the wanted and unwanted signals specified for the input immunity correspond to a nominal antenna impedance of 75 Ω. For receivers with nominal antenna impedance other than 75 Ω, these limit values on the antenna terminals are modified, according to the following formula:

$$L_z = L + 10 \lg (Z/75) \text{ dB}(\mu\text{V})$$

where

L_z is the limit in dB(μV) for receivers with a nominal input impedance Z;

L is the limit in dB(μV) given in Tables 3 to 7a for Z = 75 Ω;

Z is the nominal input impedance in ohms of the receiver under test.

In case of video tape (or similar) equipment without a built-in display and/or internal loudspeakers, the equipment under test has no audio and/or video output terminals in the relevant operating mode. In this case the test-TV-set shall be connected to the RF modulator output terminal and the sound criterion relates to the audio output terminal of the test-TV-set.

The picture quality is assessed as in 4.1.1.2.

The specification of the test-TV-set is given in annex A.

NOTE The modulator of the equipment under test should be tuned to the centre channel of its tuning range and the test-TV-set tuned to this channel. Care should be taken that the modulator channel is not equal to the tuned input channel of the equipment under test or to the unwanted channels M as specified in tables 5 to 7a.

The modulator output level shall be within the limits 60 dB(μV) to 76 dB(μV) at 75 Ω.

Equipment under test with switchable or adjustable gain at the antenna input (e.g. High/Low-switch) shall be tested in the expected most sensitive position.

5.2 Performance assessment

5.2.1 Measurement procedure for audio assessment

First the wanted test signal is applied to the equipment under test. This produces a wanted audio signal which is measured.

The volume control of the equipment under test or test set-up is adjusted to set this audio signal at the required level. The wanted audio signal is then removed by switching off the modulation or the audio test signal.

The "unwanted" disturbance signal is applied in addition and its frequency is swept through the test range; its level is kept at the relevant limit value.

The evaluation of the interference is made by measuring the level of the unwanted output signal and comparing this to the wanted output signal level.

NOTE Concerning the measurement procedure for the criterion of sound interference of television receivers the frequency of the unwanted signal is adjusted to the relevant values.

Concerning the measurement procedure for the criterion of sound interference of video tape equipment with automatic modulation control, the modulation of the sound carriers of the wanted test signal or the wanted audio test signal shall not be switched off continuously but switched off and on at an appropriate low rate (e.g. 10 s off and 1 s on).

The equipment under test is considered to meet the requirements if the conditions of 4.1.1.1 are fulfilled.

5.2.2 Audio power-output measurement

The measurements shall be performed with the flattest possible audio-frequency response. If this flat response is not clearly marked at the controls, the control setting shall be as prescribed by the manufacturer and recorded in the test report.

The audio power at the output of the equipment under test shall be measured as follows:

a) For equipment under test with audio power output available through an external loudspeaker connector, the levels of the wanted and the unwanted audio signals are measured at the external loudspeaker terminals across the load impedance specified by the manufacturer. See figure 2a.

b) For equipment under test without an audio power output, such as a radio tuner, tape or record deck, an audio amplifier can be provided and connected to the audio output under test. Level measurements are made at the output of the amplifier. The volume control, if any, of the equipment under test shall be set at the mid-position. See figure 2b. The volume control of the audio amplifier provided shall then be adjusted to obtain the required level of the wanted audio signal. The amplifier noise shall be at least 50 dB below the level of the wanted signal. Care shall be taken to ensure that the amplifier is not subjected to the effects of the unwanted signal. As an alternative method, measurements can be made directly at the audio output connector of the EUT. The reference level is in this case related to the output level caused by the wanted input signal. The volume control of the EUT, if any, shall be set at the mid-position.

c) For equipment under test with audio power output fed to a built-in loudspeaker having no external loudspeaker connector, the audio signal levels are measured by placing a small high quality microphone (a directional type may be required) close to the front of the built-in loudspeaker under test. The microphone output is fed through a screened cable (ferrite loaded as required) to an external amplifier, filter and audio voltmeter to measure the audio output power (see figure 2c). The microphone-audio voltmeter measurement chain shall be calibrated by the use of a loudspeaker of a type similar to the one in the equipment under test, placed at the same distance as that used in the measurement, and supplied with a 1 kHz tone at the required levels.

NOTE Care should be taken that ambient noise does not adversely influence the measurement results.

As an alternative method, avoiding the use of a microphone, the speaker leads are taken out from the internal speaker of the EUT and are connected through a relevant filter to the audio voltmeter across the rated load impedance, specified by the manufacturer (see figure 2a).

For the measurement of input immunity, filter FR shall be of a 15 kHz low-pass type (see annex B). The audio frequency voltmeter shall be provided with a weighting filter according to ITU-R BS.468-4. The quasi-peak value shall be measured.

For the measurement of immunity from conducted voltages, radiated fields and conducted currents, filter FR shall be of a 0,5 kHz to 3 kHz band-pass type (see annex B). The audio frequency voltmeter shall be applied without weighting filter. The r.m.s. value shall be measured.

In case of dispute, the measurement method mentioned in the test report shall be verified.

5.2.3 Measurement procedure for video assessment

The standard picture is a pattern consisting of vertical colour bars in accordance with ITU-R BT.471-1, 100/0/75/0 (see figure A1b of the ITU-R Recommendation).

First the wanted signal only is applied to the equipment under test. The controls of the equipment under test are set to obtain a picture of normal brightness, contrast, and colour saturation. This is obtained with the following luminance values:

– black part of the test pattern 2 cd/m^2

– magenta part of the test pattern 30 cd/m^2

– white part of the test pattern 80 cd/m^2

NOTE The luminance of the magenta bar is set to 30 cd/m^2. If this level cannot be reached, the luminance is set as close as possible to 30 cd/m^2. If a value different from 30 cd/m^2 is used, this is stated together with the results.

The unwanted signal is then applied in addition, its frequency adjusted to the relevant values (an accuracy of $\pm f_{line}/2$ may be necessary, where f_{line} = 15 625 Hz, horizontal scan frequency). The level of the unwanted signal shall be maintained at the relevant limit value at each frequency. The equipment under test is considered to meet the requirement if the conditions of 4.1.1.2 are fulfilled (see ITU-R BT.500-10).

The degradation is more rapidly discerned and the variation of results due to individuals is reduced, if the unwanted signal is switched on and off at a low rate (about 0,5 Hz) during the test. This can be done manually or automatically by an electronic timer.

5.3 Measurement of input immunity

5.3.1 Measurement of sound receivers

For these measurements the wanted and the unwanted signal frequencies shall be adjusted with an accuracy of ±1 kHz.

5.3.1.1 Measuring set-up

The measuring set-up is shown in figure 3. The unwanted signal generator and the wanted signal generator are interconnected by means of the coupling network. To avoid mutual interference between the two generators the coupling loss can be increased with the attenuators. The output of the coupling network, the source impedance of which shall be 75 Ω shall be matched to the antenna terminal of the equipment under test by the network, if necessary.

The audio output power is measured according to 5.2.1 and 5.2.2.

5.3.1.2 Measurement with unwanted signals outside the FM band range

The wanted input signal at the antenna terminal shall be at a level of 60 dB(μV) referred to 75 Ω (see 5.1), frequency modulated with 1 kHz at a frequency deviation of 40 kHz. For the measurement of receivers in the stereo mode the wanted signal shall have additionally a 19 kHz pilot tone with a frequency deviation of 7,5 kHz.

The unwanted signal shall be amplitude modulated with 1 kHz at 80 % depth.

Measurements shall be made according to 5.2.1 at the wanted signal frequencies and the unwanted signal frequencies given in table 3.

5.3.1.3 Measurement with unwanted signals inside the FM band range

The wanted input signal at the antenna terminal shall be at a level of 60 dB(μV) referred to 75 Ω (see 5.1), frequency modulated with 1 kHz at a frequency deviation of 75 kHz (40 kHz for car radios). For the measurement of receivers in the stereo mode the wanted signal shall have additionally a 19 kHz pilot tone with a frequency deviation of 7,5 kHz.

The unwanted signal shall be frequency modulated with 1 kHz at a frequency deviation of 40 kHz.

Measurements shall be made according to 5.2.1 at the wanted signal frequency and the unwanted signal frequencies given in table 4.

5.3.2 Measurement of television receivers and video tape equipment

5.3.2.1 Measuring set-up

The measuring set-up is shown in figure 4. The principle of operation is similar to the measuring set-up of figure 3 and the remarks in 5.3.1.1 apply. The low-pass filter is added to prevent influence of the measuring results by harmonics of the unwanted signal generators.

5.3.2.2 Measurement procedure

The wanted input signal at the antenna terminal shall be a standard television signal with the picture carrier level of 70 dB(μV) referred to 75 Ω within the VHF range or 74 dB(μV) referred to 75 Ω within the UHF range. The picture modulation shall be a vertical colour bar pattern. For systems B, G and I the sound carrier is frequency modulated with 1 kHz at a frequency deviation of 30 kHz. For system L the sound carrier is amplitude modulated with 1 kHz at

54 % depth. The sound carrier level is 70 – *x* dB(μV) within the VHF range or 74 – *x* dB(μV) within the UHF range where *x* = 13 for systems B and G and *x* = 10 for systems I and L.

For the measurement of television receivers and video tape equipment for countries, in which also two-sound-channel television-signals of the systems B and G with two frequency modulated sound carriers can be received, (even for one-sound-channel-equipment) the wanted input signal shall be a two-sound-channel-signal.

The second sound carrier with the level 70 – *y* dB(μV) or 74 – *y* dB(μV) with *y* = 20 dB is also frequency modulated with 1 kHz at a frequency deviation of 30 kHz and additionally with the 54,6875 kHz pilot-tone and with the identification for two independent sound channels at a frequency deviation of 2,5 kHz.

The unwanted signals shall be as described in 4.3.2.

Measurements shall be made according to 5.2.1 and 5.2.3 at the wanted signal frequencies and the unwanted signal frequencies given in tables 5, 5a to 5d and 6.

5.3.2.3 Measurement of satellite television receivers

For satellite television receivers the measuring set-up is the same as shown in figure 4, but the signal generators G1 and G2 are both frequency-modulated with a colour bar signal as specified in 5.2.3.

The level of the wanted signal at the terminals for the 1st satellite IF band shall be 60 dB(μV) at 75 Ω.

Measurements shall be made with the wanted signal at the frequencies given in column N of tables 7 and 7a, the unwanted signals in the channels listed in column M of tables 7 and 7a.

Only the signal type shall be used for which the receiver is designed.

5.4 Measurement of immunity to RF voltage (common mode) at antenna terminal

The general principle of the measurement is illustrated in figure 5. The effects of interference signals induced onto a lead of an equipment in an actual situation are simulated by the injection of an unwanted signal current on the lead through a suitable coupling unit. In the case of unshielded leads the unwanted current is injected in common mode onto the conductors. In the case of coaxial or shielded cables the unwanted current is injected onto the outer conductor or the shield of the cable. The current flows through the equipment under test returning to the generator through the earth capacitance of the equipment under test and through the load impedances of the other terminals provided by coupling units.

5.4.1 Coupling units

The coupling units contain RF chokes and resistive networks for the injection of unwanted signal currents. The impedance of the unwanted signal voltage source and the load impedances are standardized at 150 Ω and the coupling units are designed to provide this impedance. They also permit the passage of the wanted test signal, other signals, and mains supply.

Four types of coupling units have been found to be required to provide for frequency, connector, and cable variations.

Constructional details and performance checks of coupling units are contained in annex C.

5.4.2 Measurement set-up

The equipment under test is placed 0,1 m above a metallic ground plane of dimensions 2 m by 1 m. The coupling units are inserted into the various cables respectively. The cables linking the coupling units to the equipment under test shall be as short as possible, in particular the lead to the antenna input of the equipment under test shall be not longer than 0,3 m. Where applicable, these cables shall be of a coaxial type with a transfer impedance of maximally 50 mΩ/m at 30 MHz.

The mains lead, if not cut, shall be bundled to give a length of less than 0,3 m. The distance between the leads and the ground plane shall be 30 mm to 50 mm. The mains lead shall be fixed in a well-defined lay out which shall be recorded with the test results.

For each type of terminal (input/output/ power ports) at least for one port a coupling unit shall be used (independent of the number of ports).

5.4.3 Measurement circuit

The measurement circuit is given in figure 6.

The wanted radio- or television signal including the sound part is supplied by a generator G1, followed by a channel filter F_c and an attenuator T3.

The unwanted signal current is supplied by a generator G2, followed by a switch S1, an attenuator T1, a wide-band amplifier Am, a low-pass filter F and an attenuator T2.

For immunity tests on receivers or video tape equipment in frequency ranges other than the reception bands, a low-pass filter F is required to attenuate the harmonics of the unwanted signal source which could otherwise interfere directly with the IF and RF channels of the equipment under test. For the same reason the power amplifier Am is, if necessary, placed in a shielded box Sh to prevent direct radiation.

NOTE Annex C describes the performance requirement of the low-pass filter F (see C.3).

The attenuator T2 (6 dB to 10 dB) provides a matched 50 Ω load to the power amplifier output and defines the source impedance.

If an equipment under test requires another apparatus in order to function properly that additional apparatus shall be considered as part of the measuring equipment and precautions shall be taken to ensure that the additional apparatus is not subject to the unwanted signal. These precautions may include additional earthing of coaxial shields, shielding, and insertion of RF filter on or application of ferrite rings to the connecting cables.

Ground terminals of equipment under test shall be connected to the ground plane through a 150 Ω resistor.

The audio output power levels shall be measured according to 5.2.2.

5.4.4 Measurement procedure

The wanted television signal shall be at a picture carrier level of 70 dB(μV) referred to 75 Ω modulated with a vertical colour bar pattern

– at the picture carrier frequency of the middle channel of the lowest band available in the equipment under test for system B, G. I, D, K, M, as appropriate;
– at the picture carrier frequency in the lowest of the channels 04, 08, 25, 55 available in the equipment under test for system L as appropriate.

For systems B, G, I, D, K the sound carrier is frequency modulated with 1 kHz at a frequency deviation of 30 kHz.

For system M see table 5a.

For system L the sound carrier is amplitude modulated with 1 kHz at 54 % depth. The sound carrier level is 70 – *x* dB(μV) where *x* = 13 for systems B and G and *x* = 10 for systems I, L and D, K.

The unwanted signal is amplitude modulated at 1 kHz at 80 % depth.

Measurements shall be carried out according to 5.2.2 and 5.2.3.

The wanted AM radio signal shall be at a level of 46 dB(μV), referred to 75 Ω, amplitude modulated with 1 kHz at 30 % depth at the frequencies nearest to 250 kHz for LW band, nearest to 1 MHz for MW band and 16 MHz for SW band.

The wanted FM radio signal shall be tuned at 98 MHz (for Europe) and shall be at a level of 60 dB(μV), referred to 75 Ω, frequency modulated with 1 kHz, 40 kHz deviation.

5.5 Measurement of screening effectiveness

The screening effectiveness of the antenna terminal of a receiver is given by its immunity to the in-channel disturbance signal, injected into the screen of the antenna coaxial cable.

5.5.1 Measuring set-up for receivers

The measuring set-up is shown in figure 7.

The receiver under test is placed on a non-metallic table, the height of which shall be 0,8 m. At the side of the receiver antenna terminal, a non-metallic table 4 m long shall be placed at the same height to provide for movement of the absorbing clamp. An RF signal generator, a coaxial transfer switch and a variable attenuator are placed on a third table.

The wanted signal generator is connected, via the signal combiner, to the antenna terminals of the receiver by a measurement cable (a high grade coaxial cable) with a high-grade connector. The measurement cable is positioned in a straight line. The height of the receiver shall be adjusted as necessary to bring the antenna terminals to the correct position. The characteristic impedance of the measurement cable shall have the same value as the nominal impedance of the receiver. If the output impedance of the wanted signal generator, signal combiner and/or measurement cable are different, they shall be matched to each other by means of matching networks.

The absorbing clamp is placed around the measurement cable with its coupling transformer towards the receiver. It shall be suitable for use at the test frequency as specified in CISPR 16-1.

The disturbance signal generator shall be connected to the coaxial transfer switch which in turn is connected to either the absorbing clamp, or the receiver under test via the variable attenuator, matching network, signal combiner and measurement cable.

A load having the same impedance as the disturbance generator and absorbing clamp shall be connected to the coaxial transfer switch to terminate the non-selected disturbance signal path.

All reflecting or absorbing objects shall not be closer than 0,8 m to the measuring set-up.

The quality of the measurement cable and its connector shall be checked by using the measuring set up shown in figure 7.

The receiver under test shall be replaced by a selective voltmeter and the pattern generator by a screened matched load. The disturbance signal generator shall be connected via the coaxial transfer switch to the absorbing clamp.

Let S_c be the value determined by the formula:

$$S_c = U_g - A - U$$

where

U_g is the output level of the generator expressed in dB(μV);

A is the insertion loss of the clamp expressed in dB;

U is the maximum voltage measured by the selective voltmeter when moving the clamp expressed in dB(μV).

The quality of the measurement cable and its connector is considered satisfactory if at all frequencies S_c is 10 dB greater than the immunity limit specified for the receiver under test.

5.5.2 Measurement procedure for television receivers

Measurements shall be carried out at the frequency of the centre channel of each television band available in the receiver under test.

The television receiver is fed by a pattern generator providing a signal level of 70 dB(μV) at the antenna terminals, and shall be tuned and adjusted to produce a normal picture successively in the middle channel of each TV band (channels 04, 08, 25 and 55 for system L).

An unmodulated disturbance signal, 1 MHz from the vision carrier and inside the wanted channel, shall be injected via the coaxial transfer switch and absorbing clamp.

The interference can either be observed at the television receiver screen or, in case the receiver has a video output connector, measured at this connector with a selective measuring instrument, e.g. a spectrum analyser tuned to the 1 MHz interfering video component.

In case the interference is observed at the screen, the disturbance signal frequency shall be adjusted within the range of ±8 kHz for maximum interference and the level shall be adjusted to produce a just perceptible degradation of the picture quality.

In case the interference is measured, the disturbance signal level shall be adjusted to provide a convenient level of the interfering video component, e.g. 20 dB below the black to white level.

NOTE When connecting a measuring instrument to the video output of the receiver under test, it may be necessary to apply suitable ferrite rings to this connection or to make use of an optical connection with suitable adaptors.

Starting from a position close to the antenna terminals of the television receiver, the absorbing clamp shall be moved along the measurement cable to the position of the first maximum of interference.

The variable attenuator shall be adjusted so that the picture degradation or the measured interfering video component remains constant when the coaxial transfer switch is operated.

The screening effectiveness S_e is given by the formula:

$$S_e = A_a + A_c - A$$

where

A_a is the setting of the variable attenuator expressed in dB;

A_c is the insertion loss of the signal combiner and matching network expressed in dB;

A is the insertion loss of the absorbing clamp expressed in dB.

5.5.3 Measurement procedure for FM sound receivers

Measurements shall be carried out at the frequency of the centre channel of the FM band available in the receiver under test.

If an FM sound receiver has a 300 Ω balanced input, then a 75 Ω/300 Ω balun shall be inserted to carry out the measurements on that actual input.

NOTE 1 The balun should not influence measuring results.

The FM sound receiver is fed by a generator providing a wanted signal with a level of 60 dB(μV) at the antenna terminals at the tuned frequency of the receiver.

The receiver shall be adjusted to produce a reference audio output of 50 mW (see 4.1.1.1) measured at the loudspeaker load terminals.

After having adjusted the reference audio output level, the 1 kHz audio modulation of the wanted signal shall be removed.

An unmodulated signal at a frequency 1 kHz higher or lower than the centre frequency of the wanted channel shall be injected via the coaxial transfer switch and absorbing clamp.

The interference is measured at the loudspeaker load terminals with a frequency selective voltmeter or a spectrum analyser tuned at a frequency of 1 kHz.

The disturbance level shall be adjusted to provide a convenient level of the interfering audio component, e.g. 40 dB below the reference level.

NOTE 2 When connecting a measuring instrument to the audio output of the receiver under test. It may be necessary to apply suitable ferrite rings to this connection or make use of an optical connection with suitable adaptors.

Starting from a position close to the antenna terminal of the receiver under test, the absorbing clamp shall be moved along the measurement cable to the position of the first maximum of interference.

The variable attenuator shall be adjusted so that the measured interfering audio output level remains constant when the coaxial transfer switch is operated.

The screening effectiveness S_e is given by the formula:

$$S_e = A_a + A_c - A$$

where

A_a is the setting of the variable attenuator expressed in dB;

A_c is the insertion loss of the signal combiner and matching network expressed in dB;

A is the insertion loss of the absorbing clamp expressed in dB.

5.6 Measurement of electrical transients

Test equipment, test set-up and test procedure shall be according to IEC 61000-4-4, based on the use of a coupling/decoupling network (see table 11).

5.7 Measurement of immunity to induced voltages

5.7.1 Measuring circuit and set-up

Figure 8 shows the measuring circuit and set-up for receivers, video tape and audio equipment.

The wanted test signal is supplied via the respective connections A or V or S or T (see table 21) by generators G1, G2, G3 and G4 (see table 22). The unwanted signal is supplied by generator G5. Network RC_i matches the RF disturbance source to the input impedance of the relevant audio terminal and a similar network RC_o is used to match the output terminals. A mains stopfilter MSF is used to inject the unwanted signal at the mains terminal and acts as a stopfilter for unwanted signals from the mains network.

Annex D (see figures D.1 to D.3) shows the circuits of the networks RC_i and RC_o and the mains stopfilter of figure 8.

The equipment under test is placed 0,1 m above the centre of a metal ground plane of dimensions 2 m by 1 m. The mains lead shall be bundled to a length less than 0,3 m and connected in the shortest possible way to the mains stop filter MSF.

The cable supplying the RF voltage to the audio input and output terminals of the equipment under test shall be of a coaxial type with a transfer impedance of 50 mΩ/m at a maximum at 30 MHz.

In case the terminals of the equipment under test are non-shielded (e.g. loudspeaker terminals) the connection from the coaxial cable to the terminals shall be kept as short as possible. The shield of the coaxial cable shall be connected to the metal plate, as close as possible to the terminals of the coupling unit and by a connection as short as possible.

To avoid ground loop problems (e.g. hum, RF coupling) it is recommended that measuring instruments such as audio power meter and signal generators are of the ungrounded type. Alternatively the instruments may each be powered via individual mains isolation transformers.

For connection to the phono or tape input, care shall be taken to ensure an efficient shielding against mains pick-up. The earth conductors of the cable at the signal generator output and of the networks RC_o, RC_i and MSF are connected to the metal plate.

As a rule the connecting cables shall be of the 50 Ω coaxial type, up to the terminal under test (e.g. also for loudspeaker and headphone ports).

The unused input terminals and the loudspeaker and/or headphone or any other audio output terminals are terminated with appropriate load resistors as specified by the manufacturer or in the relevant standard.

For stereo or two channel sound television equipment respectively the unwanted signal is simultaneously fed to the two audio input channels. The output terminals of the channels are fed as well as measured separately.

Prior to measurements a check shall be carried out to see that no interference signal penetrates directly into the measuring equipment.

The audio output power levels are measured according to 5.2.2.

In table 22 the conditions for the measurement are given for receivers, video tape and audio equipment. The wanted signals are specified according to the operating mode of the equipment under test and provided by generators G3 and G1, or G4 and G2 and G1 or G1 or G2.

The unwanted signal shall be amplitude modulated with 1 kHz at 80 % depth, supplied by generator G5.

Table 21 – Function of the connections in figure 8

A	1 kHz (G1) at the audio inputs
V	video signal (G2) at the video input
S	modulated wanted signal for sound receivers (G3 and G1) at the antenna input
T	modulated wanted signal for television receivers and video tape equipment (G4 and G2 and G1) at the antenna input
A_i	unwanted signal at the audio inputs
M	unwanted signal at the mains lead
A_o	unwanted signal at the audio outputs
	L_o: at the left channel
	R_o: at the right channel
L	adjustment or measurement of channel L
R	adjustment or measurement of channel R

Table 22 – Measurement conditions for the test of immunity from conducted voltages

Operating mode of the EUT	Wanted signal for adjustment of reference output power/ reference picture	Unwanted signal injected into EUT connector
FM broadcast reception	60 dB(μV) at 75 Ω at a frequency of 98 MHz, 1 kHz freq. mod. 40 kHz deviation	Audio input terminals or Power supply or Loudspeaker or Headphones or Audio output terminals
TV broadcast reception and recording	70 dB(μV) at 75 Ω at the frequency of the middle channel of the lowest band available in the EUT (the lowest of the available channels for system L: 04, 08, 25 or 55) and ITU-R BT.471-1 standard colour bar and frequency modulated at 1 kHz with 30 kHz deviation (or 54 % amplitude modulation for system L)	
Video recording (other than TV broadcast signals)	1 kHz, 500 mV (e.m.f.) sound signal and ITU-R BT.471-1 standard colour bar video signal, with 1 V between white and synchronism level	
Video playback	A signal from a recorded standard colour bar on a tape or disc, with 0 dB sound level or a level specified by the manufacturer. For audio immunity measurement this may be a blank tape or disc	
Audio amplifier	1 kHz, 500 mV (e.m.f.)	

5.7.2 Measurement procedure

For adjusting, the wanted signals are set, dependent on the type of equipment under test and its operating mode, by making the connections of figure 8 as follows:

A for audio terminals,

V for video terminals (simultaneously audio signal at audio terminals),

S for antenna terminals (sound broadcast signal) and

T for antenna terminals (television broadcast signal).

The audio controls of the equipment under test, other than the volume control, are set at normal position. The volume control is adjusted to obtain an audio output power of 50 mW (or 500 mW) (see 5.2.2 for audio power measuring arrangements).

For stereo equipment the balance control shall be adjusted to obtain 50 mW (or 500 mW) from both channels. The video controls of the equipment under test are set to obtain a picture as described in 5.2.3.

For the measurement the unwanted signal is applied to the terminal under test by making the connections of figure 8 as follows:

A_i for audio input terminals,

M for the mains lead and

A_o for audio output terminals.

The connections L, R, respectively L_o, R_o, are for adjusting and/or measurement of the adequate output channels.

For television receivers and video tape equipment in the RF recording mode, measurements are carried out with the wanted signal at the frequency of the middle channel of the lowest band available in the equipment under test (or the lowest of the available channels 04, 08, 25 or 55 for system L).

5.8 Measurement of immunity from radiated fields

A homogeneous, electromagnetic wave under free space conditions can be simulated by a guided wave of the TEM (transverse electromagnetic) mode travelling between two flat conducting surfaces. In this case the electric field component is perpendicular, and the magnetic field component parallel, to the conductors. The open TEM stripline is specified in this standard.

5.8.1 The open stripline

The constructional details of a suitable open stripline are shown in annex E. The open stripline has a frequency range usable up to 150 MHz and may be used for equipment under test up to 0,7 m high. The characteristic impedance of the stripline is 150 Ω.

The calibration and testing of the measuring set-up is performed as in annex F.

The input voltage of the stripline is set to produce the correct voltage at the measuring plate, corresponding with the required field strength; at a frequency of 15 MHz.

The correction factor K1, established by the calibration, is taken into account during the further measurement procedure.

The use of TEM devices of other dimensions or types is acceptable if it is shown that in the relevant frequency range the results do not differ by more than 2 dB from the values measured in the recommended stripline.

5.8.2 Measurement set-up

The stripline shall be placed on non-metallic supports at least 0,8 m from the floor, and the top conductor plate shall be no closer than 0,8 m from the ceiling.

When used in a room, the stripline shall be spaced at least 0,8 m from its open longitudinal sides to walls or other objects. When used inside a screened room, RF absorbing plates shall be placed in the space between the sides of the stripline and the walls of the screened room. Figure 9 shows the arrangement.

The equipment under test is placed on a non-metallic support, 0,1 m high, in the centre of the stripline in the same position as for normal home usage (e.g. in the case of portable equipment), see figure 10.

Connecting leads to the equipment under test are inserted through holes in the base conductor plate of the stripline, the lengths of the leads inside the stripline shall be as short as possible and completely surrounded by ferrite rings to attenuate induced currents. The transfer impedance of coaxial cables used shall be no higher than 50 mΩ/m at 30 MHz.

The mains lead shall be bundled to a length less than 0,3 m.

Any balanced-to-unbalanced transformer used shall be connected to the equipment under test with leads as short as possible.

Terminals of the equipment under test not used during the measurement shall be terminated with shielded resistors matching the nominal terminal impedance.

If an equipment under test requires another apparatus in order to function properly, that additional apparatus shall be considered as part of the measuring equipment and precautions shall be taken to ensure that the additional apparatus is not subject to the unwanted signal. This requires generally the placing of the other apparatus outside the stripline.

For the connections to the antenna terminal or to the video input terminal of the equipment under test, a high-grade coaxial cable with a high-grade connector at the antenna or video input terminal side shall be used. These precautions may include additional earthing of coaxial shields, shielding, and insertion of an RF filter on or application of ferrite rings to the connecting cables.

5.8.3 Measurement procedure

Figure 10 shows the circuit used. For adjusting the wanted signals the audio or video controls of the equipment under test are set as described in 5.2.2 and 5.2.3. During the adjustment procedure the unwanted signal (generator G2) is switched off. The wanted signals are specified in table 23.

The required field strength is adjusted with the equipment under test inside the set-up as described in 5.8.2. The equipment however is switched off during the adjustment.

For the measurement, the unwanted signal is supplied by generators G1 and G2 which is connected through wide-band amplifier Am, and low-pass filter F to matching network MN of the stripline. The wide-band amplifier Am may be required to provide the necessary field strength. The stripline is loaded with a terminating impedance TI.

Care shall be taken with respect to the harmonic level of the RF output of the generator G2 and in particular the output of the wide-band amplifier Am. Harmonics may influence the measurement if they coincide with the tuned channel or the IF channel of the equipment under test. In some cases provisions shall be made to reduce the harmonic level adequately by inserting a suitable low-pass filter F. Annex C describes the checking procedure for low-pass filters.

The audio output power levels shall be measured according to 5.2.2.

The unwanted signal shall be amplitude modulated with 1 kHz at 80 % depth, supplied by generator G2 and amplifier Am.

Measurements shall be performed while taking into account 4.1 and 5.1.

Table 23 – Measurement conditions for the test of immunity from radiated fields

Operating mode of receiver/video tape equipment	Wanted signal for adjustment of reference output power/ reference picture
FM broadcast reception	60 dB(μV) at 75 Ω at a frequency of 98 MHz, 1 kHz freq. mod. with 40 kHz deviation
Phono	1 kHz, 500 mV (e.m.f.) for crystal 1 kHz, 5 mV (e.m.f.) for moving magnet 1 kHz, 0,5 mV (e.m.f.) for moving coil
CD, audio tape, audio amplifier, auxiliary	1 kHz, 500 mV (e.m.f.)
Audio playback	A signal from a tape or disc, which has a recorded signal of 1 kHz, 500 mV (e.m.f.), with 0 dB sound level or a sound level specified by the manufacturer. For audio immunity measurement this may be a blank tape or disc
TV broadcast reception and recording	70 dB(μV) at 75 Ω at the frequency of the middle channel of the lowest band (the lowest of the available channels for system L: 04, 08, 25 or 55) and ITU-R BT.471-1 standard colour bar and frequency modulated at 1 kHz with 30 kHz deviation (or 54 % amplitude modulation for system L)
Video recording (other than TV broadcast signals)	1 kHz, 500 mV (e.m.f.) sound signal and ITU-R BT.471-1 standard colour bar video signal, with 1 V between white and synchronism level
Video playback	A signal from a recorded standard colour bar on a tape or disc, with 0 dB sound level or a level specified by the manufacturer. For audio immunity measurement this may be a blank tape or disc

5.8.4 Field immunity for large equipment not fitting in the open strip line

Equipment not fitting inside the open strip line shall be measured according to IEC 61000-4-3 in the frequency range 80 MHz to 150 MHz with limits as in table 17. The recommended step size of 1 % shall be replaced by a scanning, which allows for an adequate observation time of the possible interference.

The equipment shall be placed on a non-conducting table with a height of 80 cm. Testing shall be done with a vertical polarised field with the equipment in one position. Picture quality can be inspected by means of a video camera or by direct observation. The arrangements concerning cables and filters are the same as for measurements in the open strip line.

The front side of the EUT shall be positioned parallel to the antenna line of sight. The position shall be described in the measurement report.

5.9 Measurement of electrostatic discharge

Test generator, test set-up and test procedure shall be according to IEC 61000-4-2.

For double and reinforced insulated equipment, for non-grounded metallic parts of Class II equipment and for portable equipment, repetitive tests may be more onerous when the EUT cannot discharge sufficiently before the next ESD pulse is applied. Therefore sufficient time shall be allowed between the applied pulses.

6 Interpretation of CISPR immunity limits

6.1 Significance of a CISPR limit

The significance of the immunity limits in this standard for type approved equipment shall be that on a statistical basis at least 80 % of the mass produced equipment comply with the limits with at least 80 % confidence.

Tests shall be made:

a) either on a sample of equipment of the type using the statistical method of evaluation set out in item 6.2,

b) or for simplicity's sake, on one equipment only.

Subsequent tests are necessary from time to time on equipment taken at random from production, especially in the case referred to in 6.1b).

The banning of sales or the withdrawal of a type approval, as a result of a dispute, shall be considered only after tests have been carried out in accordance with 6.1a).

6.2 Compliance with limits on a statistical basis

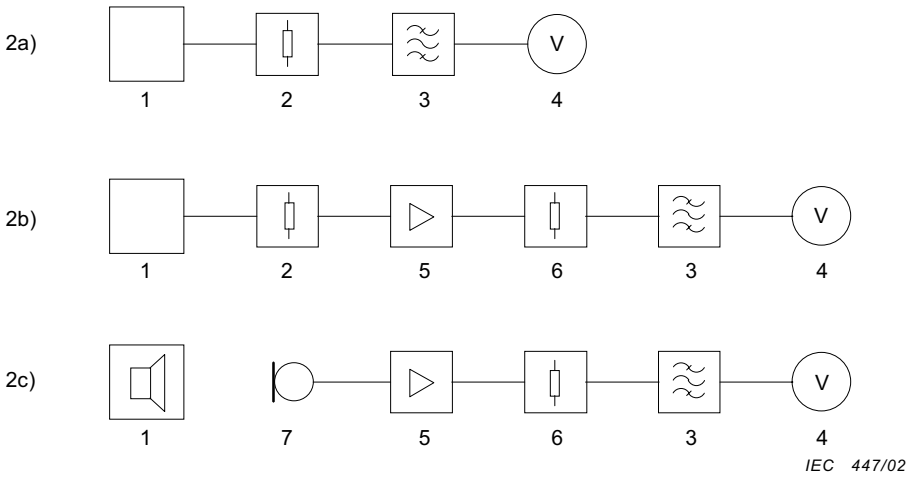
Statistical assessment of compliance, based on the binomial distribution, shall be made as follows.

This test shall be performed on a sample of not less than seven items. Compliance is judged from the condition that the number of equipment, which do not meet the immunity limits, does not exceed *c* in a sample of size *n*.

n	7	14	20	26	32
c	0	1	2	3	4

Should the test on the sample result in non-compliance with the requirements in 6.1a), then a second sample may be tested and the results combined with those from the first sample and compliance checked for the larger sample.

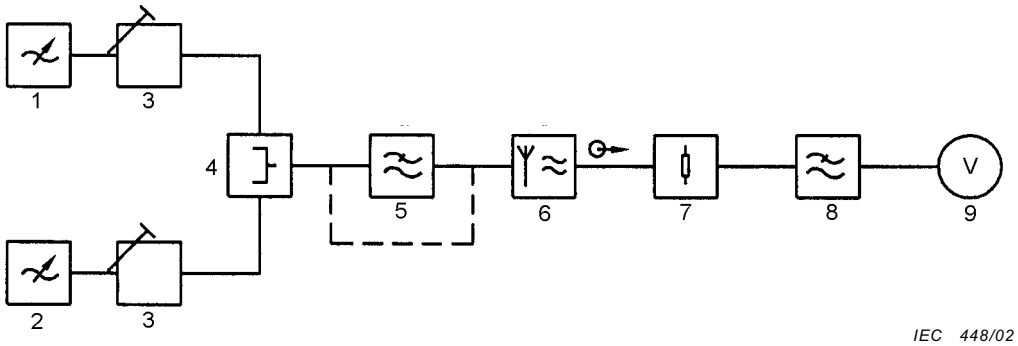
For general information, see CISPR 16-3.



Key

1 Equipment under test
2 Rated load impedance RL of the audio output
3 Filter, FR (see annex B) low-pass or bandpass
4 Audio frequency voltmeter V
5 Amplifier A
6 Rated load impedance Ra of the amplifier output
7 Microphone M

Figure 2 – Audio power output measurement

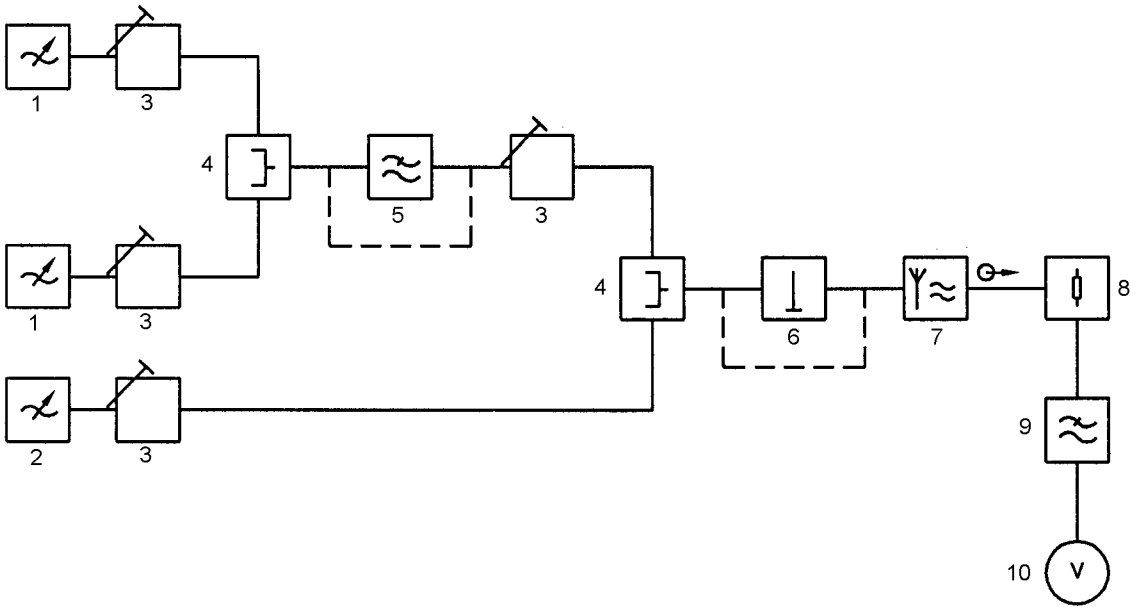


Key

1 Unwanted signal generator G1
2 Wanted signal generator G2
3 Attenuators
4 Coupling network
5 Matching and/or balancing network
6 Equipment under test
7 Load resistor RL
8 Low-pass filter (see annex B)
9 Audio frequency voltmeter (with weighting network according to ITU-R BS.468-4)

(7, 8 and 9 may be replaced by figure 2b or 2c if appropriate)

Figure 3 – Measuring set-up for input immunity measurement of sound broadcast receivers



IEC 449/02

Key

1 Unwanted signal generators G1
2 Wanted signal generator G2
3 Attenuators
4 Coupling networks
5 Low-pass filter [a]
6 Matching and/or balancing network
7 Equipment under test [b]
8 Load resistor
9 Low-pass filter (see annex B)
10 Audio frequency voltmeter (with weighting network according to ITU-R BS.468-4)

[a] To prevent influence of the measuring results by harmonics of the unwanted signal generator, the cut-off frequency of the filter shall be specified depending on the adequate unwanted signal frequencies.

[b] If video tape equipment, then in connection with the test-TV-set

(8, 9 and 10 may be replaced by figure 2b or 2c if appropriate or in the case of video tape equipment under test connected to the audio output terminal of the test-TV-set).

Figure 4 – Measuring set-up for input immunity measurement of television receivers and video tape equipment

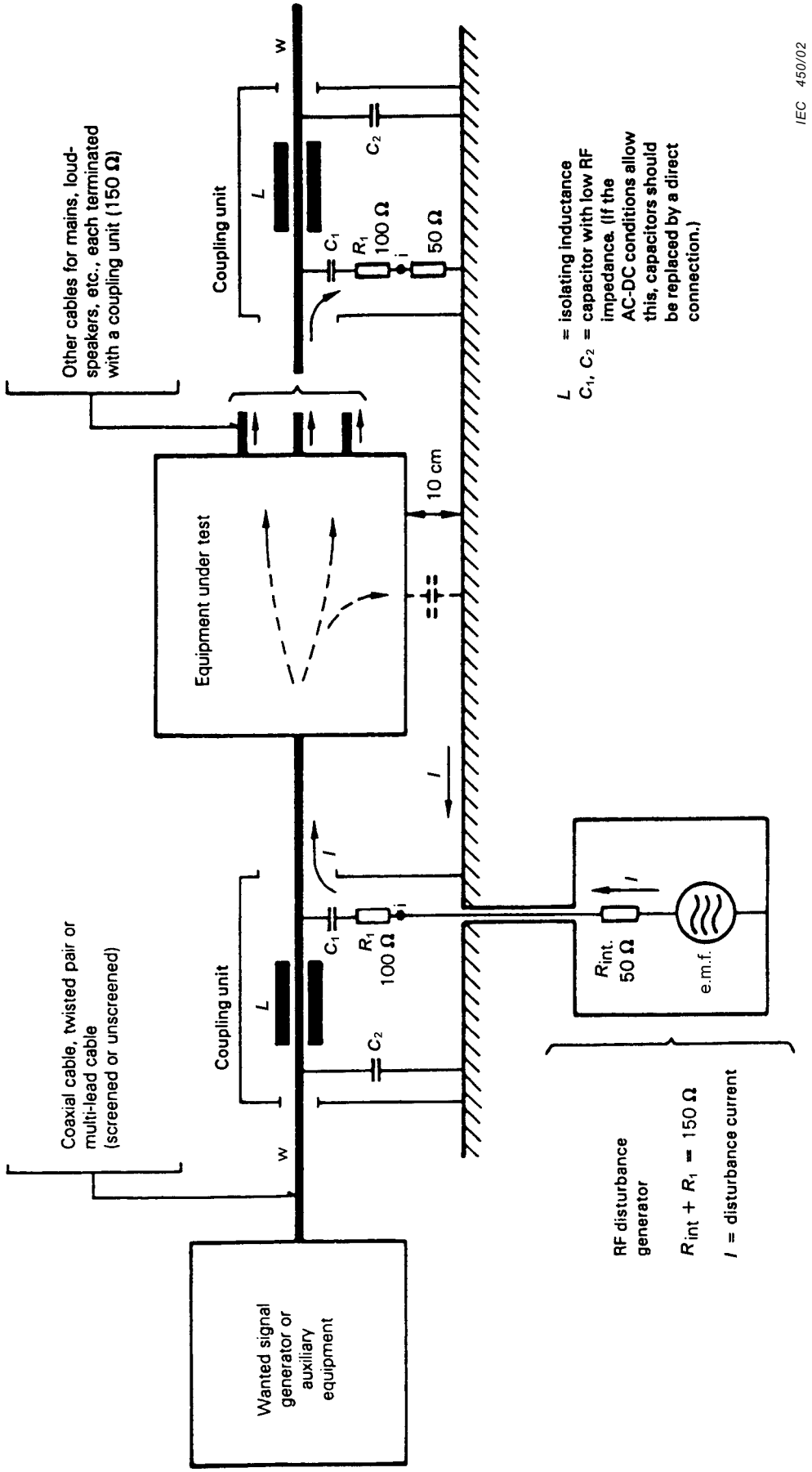
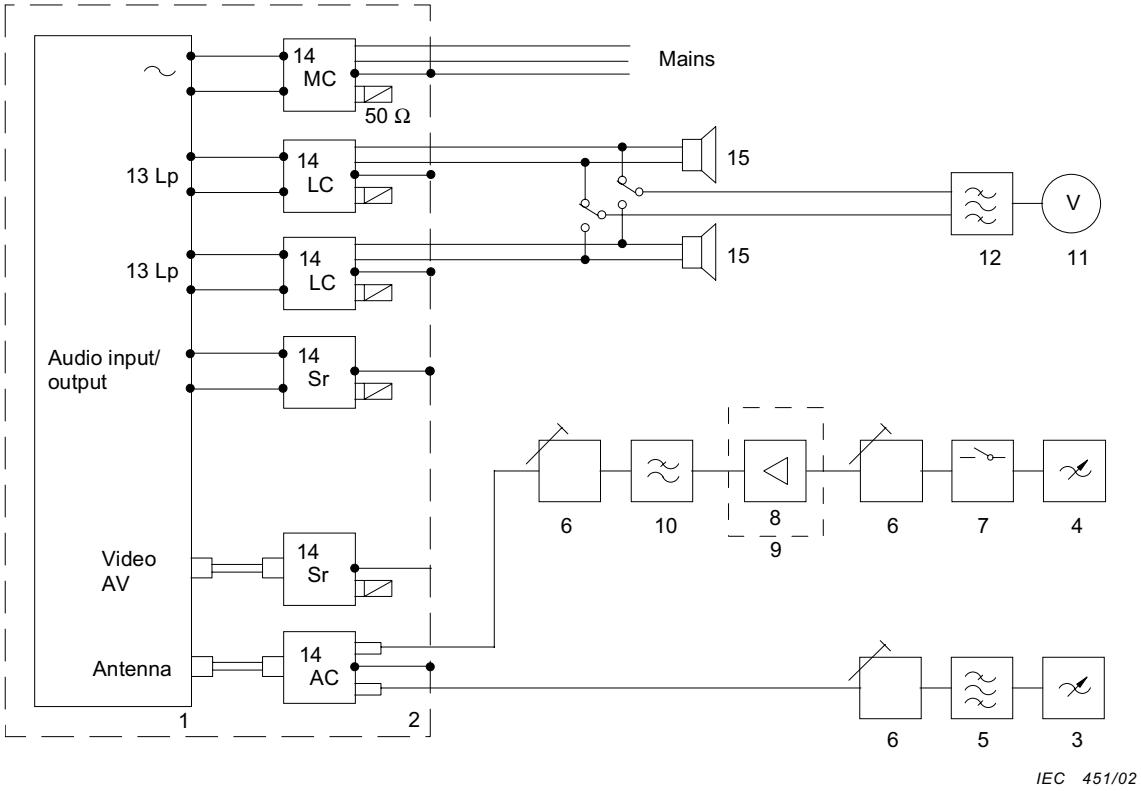


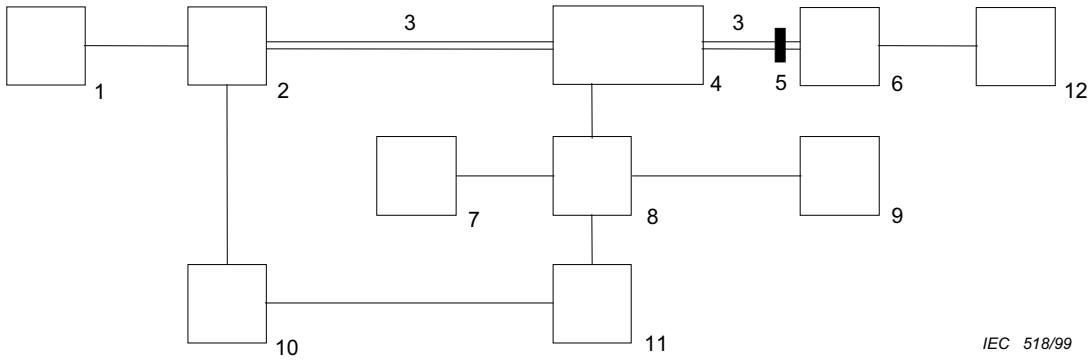
Figure 5 – General principle of the current injection method



Key

1 Equipment under test
2 Metal plate P = 2 m × 1 m
3 Generator of wanted signal G1
4 Generator of unwanted signal G2
5 Channel filter Fc
6 Attenuators T1, T2, T3
7 Switch S1
8 Amplifier Am
9 Shielded box Sh
10 Low-pass filter F
11 Audio frequency voltmeter V
12 Band-pass filter 0,5 kHz to 3 kHz (see annex B)
13 Loudspeaker connectors Lp
14 Coupling units MC, LC, Sr, AC (see annex C) of the loudspeaker
15 Dummy load simulating the nominal impedance of the loudspeaker

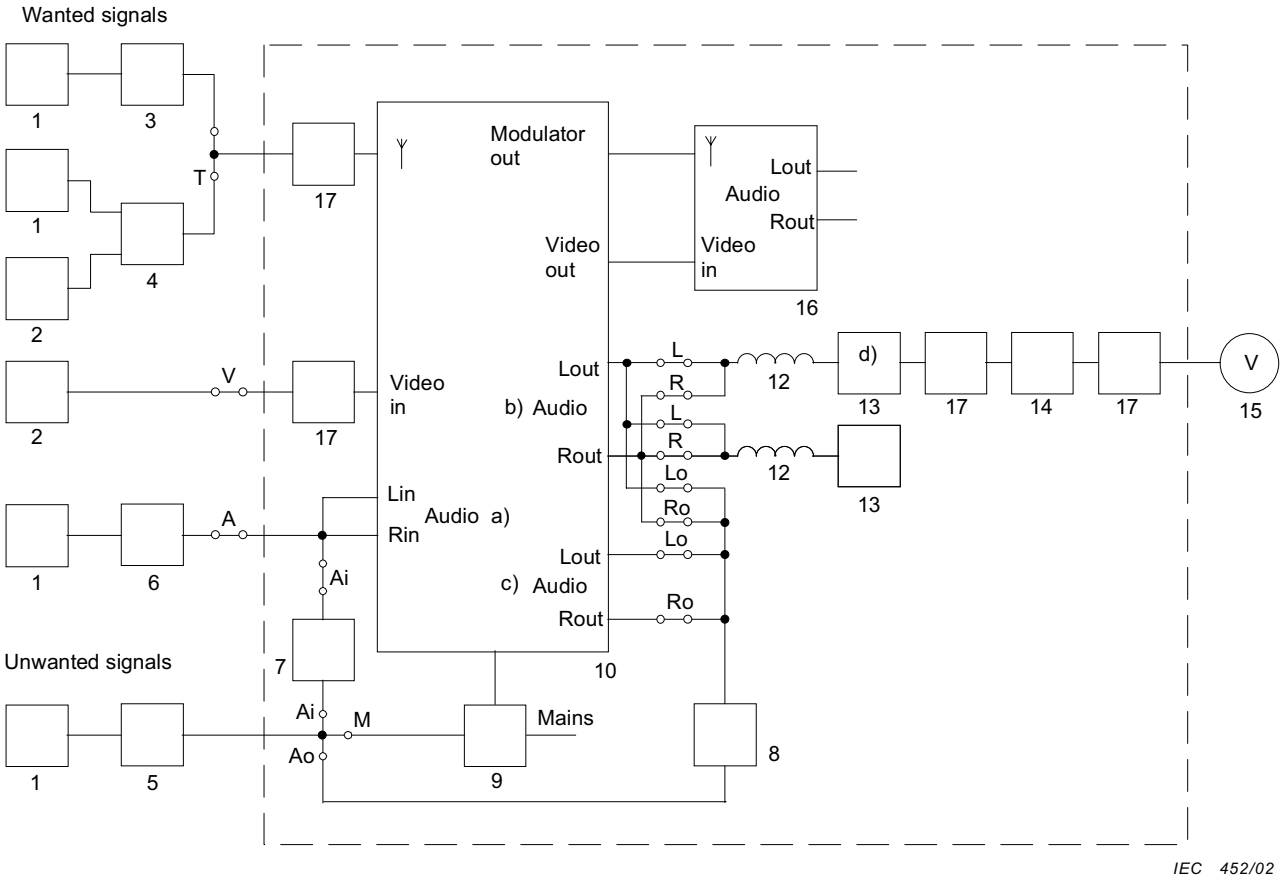
Figure 6 – Measurement principle for the immunity from conducted currents



Key

1 Pattern or wanted signal generator
2 Signal combiner
3 Measurement cable
4 Absorbing clamp
5 High grade connector
6 Receiver under test
7 Matching load
8 Coaxial transfer switch
9 Disturbance generator
10 Matching network
11 Variable attenuator
12 Spectrum analyzer or audio-frequency voltmeter

Figure 7 – Measuring set-up for the screening effectiveness of the antenna terminals of a television receiver



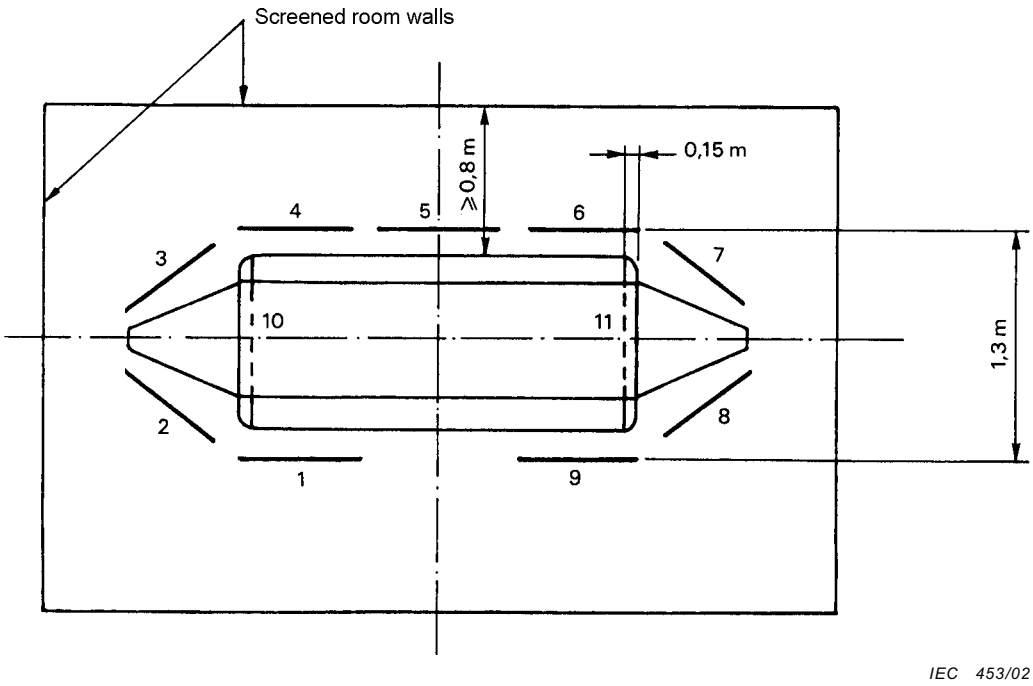
a) Channels 1 and 2 in the case of two channel sound television equipment.
b) Audio power output provided for adjusting and measurement.
c) Other audio outputs.
d) To be left out in case of high-resistance (>10 kΩ) audio output impedance.

Key

1 AF generator 1 kHz G1
2 Video generator G2
3 RF generator G3 for FM
4 RF generator G4 for TV
5 RF generator G5 for unwanted signal
6 Impedance (Rs to RG1)
7 RC network for audio inputs RC_i
8 RC network for audio outputs RC_o
9 Mains stop filter MSF
10 Equipment under test
11 Metal plate P = 2 m × 1 m
12 RF choke L = 100 µH
13 Rated load impedance of the audio output RL
14 Band-pass filter BP (input impedance 10 kΩ)
15 Audio frequency voltmeter V
16 Test-TV-set TTS
17 Sheath current choke Sh (ferrite cores)

(12, 13, 14 and 15 may be replaced by figure 2b or 2c if appropriate.)
Rs rated source impedance of the audio input (1 kΩ in the case of video tape equipment).

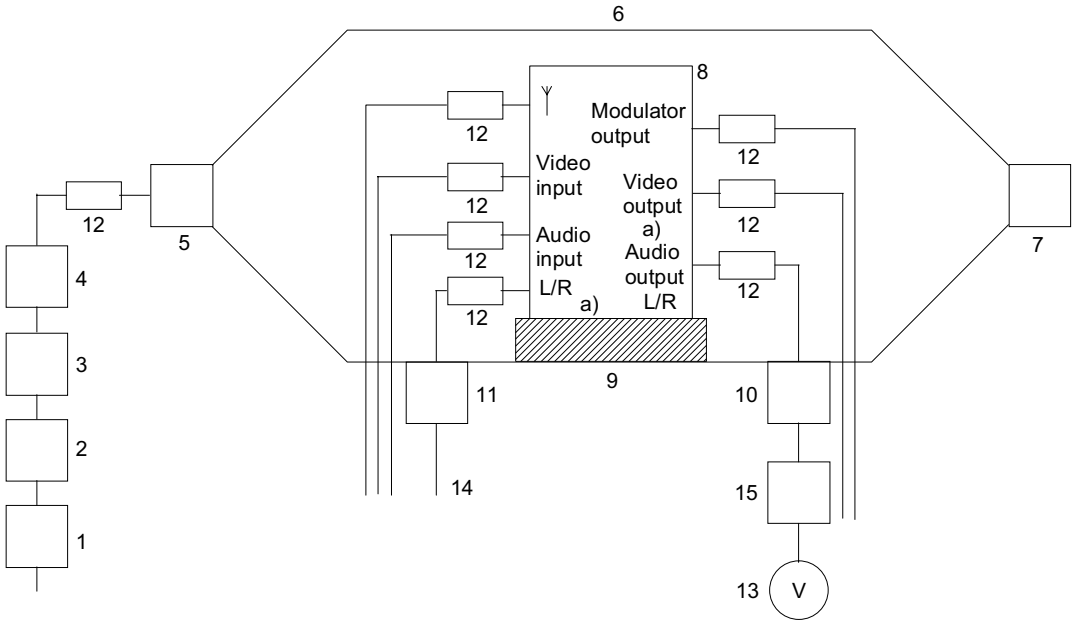
Figure 8 – Measurement of immunity from induced voltages at mains input, headphones, speakers, audio output, audio input



Key

1-11 Absorbing panels with dimensions of approximately 0,8 m × 0,6 m.

Figure 9 – Example of the arrangement of an open stripline TEM device in combination with absorbing plates inside a screened room with dimensions of 3 m x 3,5 m

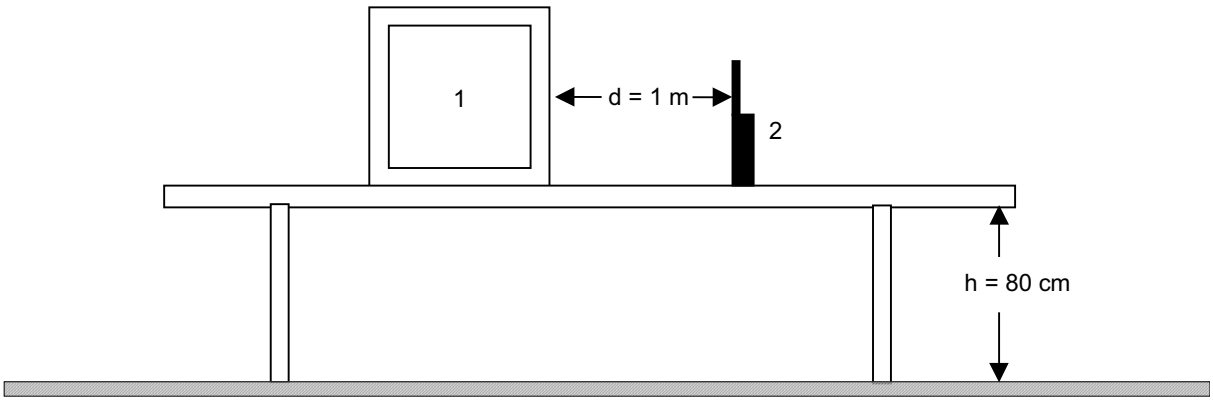


Key

1 AF generator 1 kHz G1
2 RF generator G2 for unwanted signal
3 Wideband power amplifier Am 0,15 MHz to 150 MHz
4 Low-pass filter F
5 Matching network MN (see figure E.5)
6 Open stripline device TEM
7 Terminating impedance 150 Ω (see figure E.6)
8 Equipment under test
9 Non-metallic support
10 Loudspeaker bandstop filter LBS (see figure E.8)
11 Mains bandstop filter MBS (see figure E.7)
12 Sheath current chokes Sh (ferrite cores)
13 Audio frequency voltmeter V
14 Mains cable
15 Band pass filter (see figure B.1)

a) Channels 1 and 2 in the case of two-channel sound television equipment.

Figure 10 – Measurement of the immunity of broadcast receivers from radiated fields in the frequency range 0,15 MHz to 150 MHz in an open stripline



Key

1 Front of EUT
2 Dummy GSM portable telephone

Figure 11 – Measurement of the immunity from RF e.m. field, keyed carrier, using a dummy GSM portable telephone

Annex A
(normative)

Specification of the test-TV-set

For systems B, G, I, D, K, and M the test-TV-set shall be a two-channel-sound television broadcast receiver with an automatic frequency control facility (AFC) and with appropriate video input terminals for connection with the video output terminals of video tape equipment, but without a sound muting circuit.

For system L, the test-TV-set shall be an AM sound television broadcast receiver, with an automatic frequency control facility (AFC) and with appropriate video and audio terminals for connection with video tape equipment.

The test-TV-set shall at least meet the immunity requirements for television receivers specified in this standard in 4.3.2, 4.3.3, 4.3.4 and 4.7.1, when measured according to the relevant methods of measurement of this standard and the input immunity shall overstep the limits of table 5 (or table 5a to table 7a, as appropriate) for at least 3 dB.

Additional requirements:

– Screen diagonal size: ≥50 cm.
– Picture definition, measured at the picture tube electrode by using a multiburst test pattern: 4 MHz, level –6 dB related to 1 MHz.
– Focusing: optimum.
– Video-signal-to-noise-ratio, weighted by weighting network according to ITU-T J.61, noise voltage level as r.m.s.-value, related to the video output level of the receiver, when monochrome picture with colour-burst and for the antenna signal level of 70 dB(μV) at 75 Ω: ≥ 50 dB.
– Audio-signal-to-noise-ratio, weighted by weighting network according to ITU-R BS.468-4, noise voltage level as quasi-peak value, related to the 1 kHz audio output level of the receiver of 50 mW for antenna signal level of 70 dB(μV) at 75 Ω and frequency deviation of the sound carrier 30 kHz: ≥43 dB.
– Suppression of the line-frequency at the audio output terminals, relation equal to audio-signal-to-noise-ratio, measured selective with bandwidth ≤150 Hz as r.m.s.-value: ≥43 dB.

Annex B
(normative)

Specification of filters and weighting network

B.1 Low-pass filter 15 kHz

The low pass filter shall comply with the following characteristics:

– cut-off frequency (3 dB) at 15 kHz
– attenuation for operating frequencies up to 10 kHz ≤ 0,5 dB
– attenuation at 15 kHz ≤ 3 dB
– attenuation at 19 kHz ≥ 50 dB

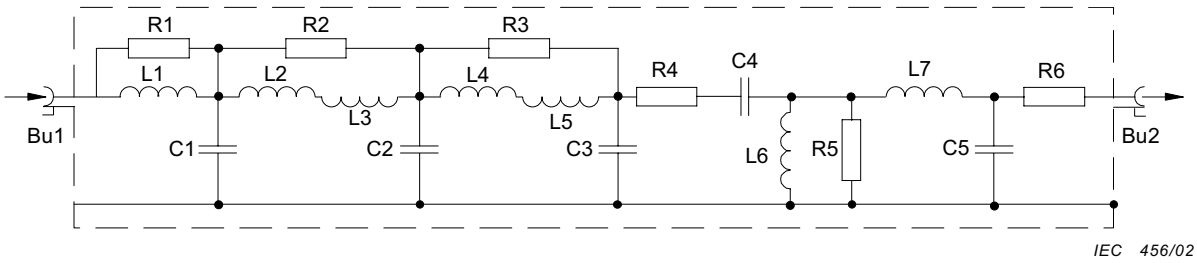
The low-pass filter shall be terminated with its characteristic impedance.

B.2 Band-pass filter 0,5 kHz to 3 kHz

The band-pass filter shall comply with the following characteristics:

– attenuation at 0,1 kHz ≥ 25 dB
– attenuation at 0,5 kHz ≤ 5 dB
– attenuation at 1 kHz ≤ 0,5 dB (reference point)
– attenuation at 3 kHz ≤ 5 dB
– attenuation at 10 kHz ≥ 25 dB

An example of a 0,5 kHz to 3 kHz band-pass filter is given in figure B.1.



Components

L1 to L5	=	33 mH	Inductance		
*L6	=	650 mH	Four-slit-core		
L7			Broad-band-choke		
R1 to R3	=	4,7 kΩ	C1 to C3	=	22 nF
R4	=	100 Ω	C4	=	0,1 µF
R5	=	8,2 kΩ	C5	=	2,2 nF
R6	=	820 Ω			

*1 450 turns, copper wire, diameter 0,115 mm, solderable
Bu1, Bu2 BNC-F 50 Ω

Figure B.1 – Band-pass filter 0,5 kHz to 3 kHz

B.3 Psophometric filter

For some audio-output measurements a psophometric filter shall be placed in front of the audiofrequency voltmeter. The psophometric filter shall comply with ITU-R BS.468-4 (see 4.6.1.3 of CISPR 16-1, 1999).

B.4 A-weighting network

See 6.2.1 of IEC 60268-1 and clause 6 of IEC 60651.

Annex C
(normative)

Specification of coupling units and of low-pass filter

These devices are used for the measurement of immunity from conducted currents in the frequency range 0,15 MHz to 150 MHz.

C.1 Construction of the coupling units

The coupling units are designed to inject the unwanted signal current onto a lead connected to the terminal under test and to isolate the other leads and apparatus connected to the equipment under test from the effect of the unwanted signal current. The units are used also to define the asymmetric impedance to earth of leads connected to equipment under test terminals which are not under test.

The principle of operation is illustrated in figure 5. The inductance L presents a high RF impedance to the injected current. The filter L/C_2 isolates the terminal under test. The unwanted signal from an RF generator with 50 Ω source impedance is injected via a 100 Ω resistor and a blocking capacitor C_1 onto the leads or the shield of a coaxial cable.

The coupling units shall have a resulting resistive source impedance of 150 Ω. With this source impedance it has been found that there is a good correlation between the RF interference fieldstrength acting on an installation and the e.m.f. applied in the conducted current measurement to produce the same degradation. Therefore the immunity of an apparatus is expressed in terms of this e.m.f. level.

There are four types of coupling units:

Type AC: For use with coaxial cables carrying wanted RF signals. The construction details are shown in figure C.1.

Type MC: For use with mains leads. The construction details are shown in figure C.2.

Type LC: For use with loudspeaker leads. The construction details are shown in figure C.3.

Type Sr: For use where there is no requirement to provide a through path for a wanted signal. All leads of the cable are terminated with a matched load resistance. The construction details are shown in figure C.4.

In the layout of all coupling units precautions have to be taken to keep the parasitic capacitance as low as possible for the output terminals which conduct the injected current. Those terminals are to be mounted on an insulating plate. It should be noted that the metal cases of the units are to be grounded carefully to the ground plane using large size copper braid and unpainted cases.

The following general requirements apply.

a) All types of coupling units have a resulting resistive source impedance of 150 Ω. The value of the series resistor included in the unit is adjusted according to the source impedance of the unwanted signal generator (combination of G2 + Am + T2 in figure 6).

When the generator impedance is 50 Ω the resistor has a value of 100 Ω. In the type AC antenna line coupling unit this 100 Ω resistor is bonded to the shield of the coaxial output connector in the unit. In the mains coupling unit type MC the unwanted current is injected asymmetrically on both mains leads through an equivalent resistance of 100 Ω. This unit has been designed as a delta artificial mains network and presents a symmetrical and asymmetrical equivalent resistive impedance of 150 Ω to the equipment under test.

b) The RF chokes shall present a sufficiently high RF impedance (with respect to 150 Ω) over the whole frequency range.

c) The shielding effectiveness of the coaxial cable (including the 0,3 m cable length between the unit and the equipment under test) and coaxial connector used for the type AC antenna coupling unit shall be at least 10 dB better than the shielding effectiveness of the elements used in the antenna input circuit of the equipment under test (input connector, cable and tuner).

NOTE For the coupling units described in figures C.1 to C.4, with coils of 30 µH or 2 × 60 µH in parallel, the above requirements a) and b) are met within the frequency range 1,5 MHz to 150 MHz. These coupling units can also be used in the frequency range 0,5 MHz to 1,5 MHz for provisional tests. Coupling units to cover 0,15 MHz to 30 MHz are in preparation.

C.2 Performance checks for coupling units

In the frequency range up to 30 MHz the total asymmetric impedance (RF choke in parallel with the 150 Ω resistor) measured between the shield of the coupling unit type AC output connector and the ground plane as well as between the joint terminals of the mains coupling unit type MC and the ground plane shall have a modulus of 150 Ω ± 20 Ω and a phase angle less than 20°.

In the frequency range of 30 MHz to 150 MHz the insertion loss of two identical coupling units in tandem shall be measured in a 50 Ω system. The method and the requirements are given in figure C.5.

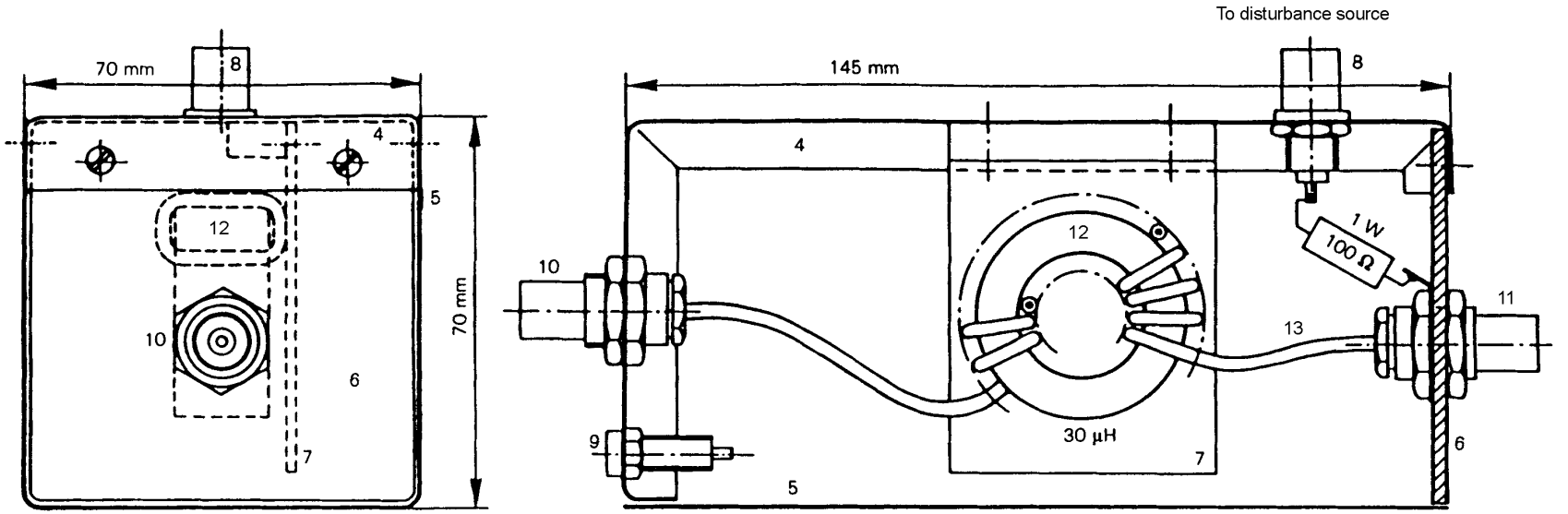
C.3 Performance checks for the low-pass filter F

The purpose of this filter is to attenuate the harmonics of the unwanted signal source. The frequency response of the filter F shall have a sharp cut off at a frequency of a few megahertz below the frequency band to be protected (IF and reception band) and shall have a high attenuation in this frequency band. The requirements for this filter depend on the spectral purity of the signal generator and power amplifier. The overall generator-amplifier-filter chain is tested in the following way (the example being the test for TV receivers).

A calibrated RF signal generator with 50 Ω output impedance is directly connected to the disturbance source input of coupling unit AC in figure 6 replacing the generator-amplifier-filter chain. The frequency is swept through the IF and RF reception channels of the TV receiver and the RF voltages required to cause just perceptible interference are noted.

Then the levels of the harmonics generated in the above frequency ranges by the combined set-up (G2 + Am + F) are measured at the output of attenuator T2, setting the highest levels used during the immunity tests.

The attenuation of the filter F is considered adequate if the levels of the harmonics are at least 10 dB below the voltages noted in the preceding test.

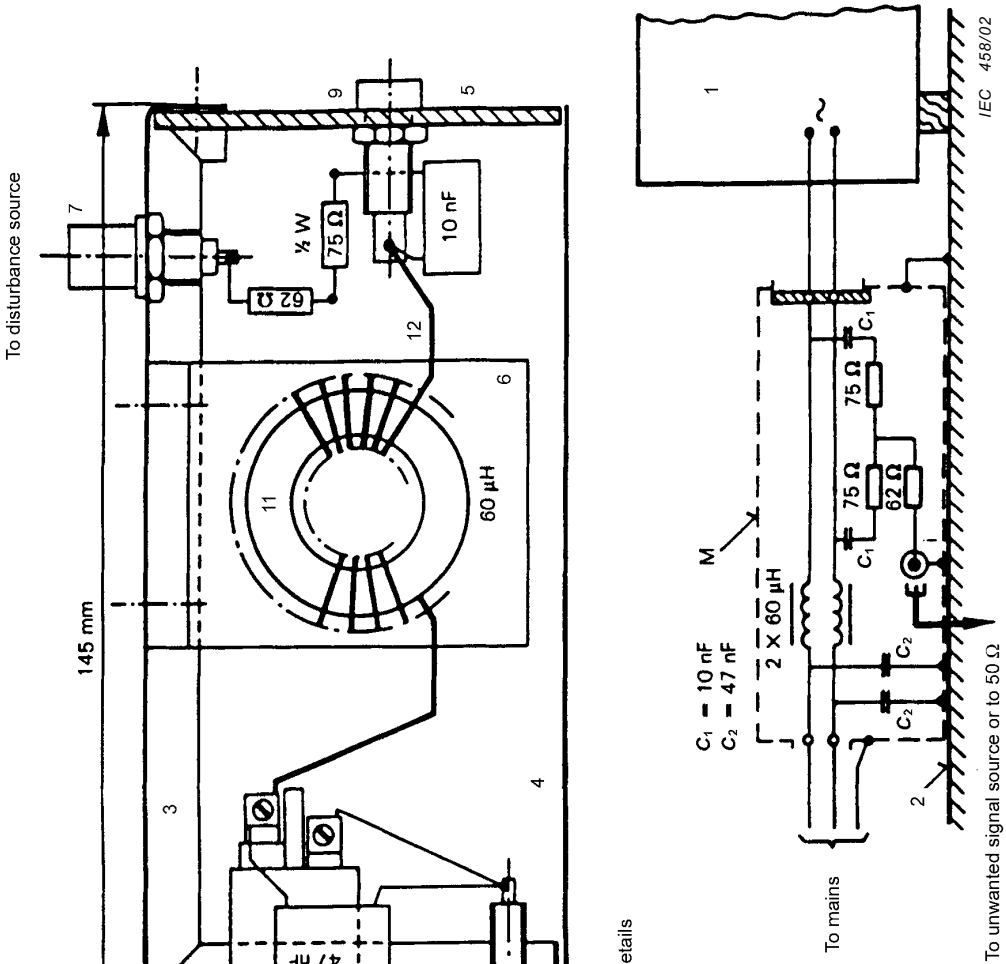


Schematic diagram and construction details

Key

1 Equipment under test
2 Coaxial antenna cable
3 Metal ground plane PL0
4 Metallic case 145 mm × 70 mm × 70 mm
5 Part 4 placed on the ground plane PL
6 Front plate (insulating material)
7 Supporting plate for chokes (insulating material)
8 Coaxial connector, BNC
9 Ground jack
10 Coaxial connector, BNC (for coaxial cable to the wanted signal generator)
11 Coaxial connector, BNC (for coaxial cable to the EUT)
12 Ferrite ring type C (see annex G) with *N* turns of 2,4 mm outer diameter coaxial cable to produce 30 µH
13 Coaxial cable type RG-188 A/U, 50 Ω, 2,4 mm outer diameter

Figure C.1 – Coupling unit type AC (for coaxial antenna input)

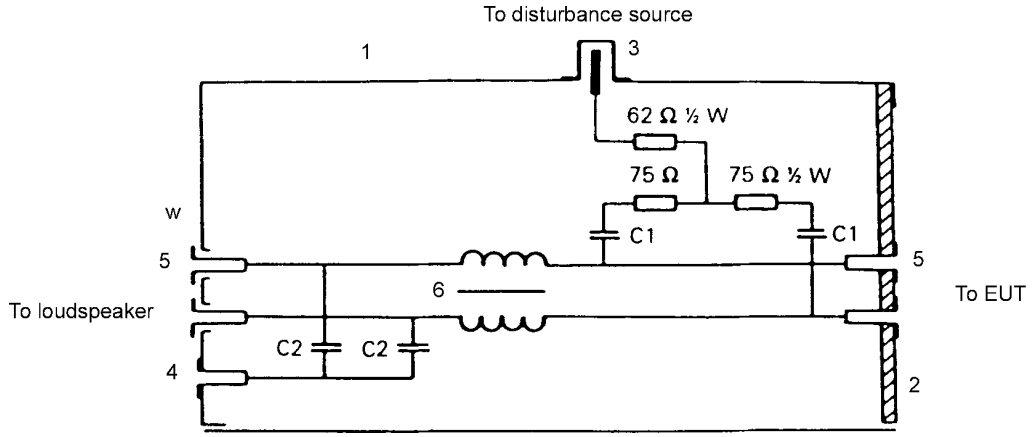


Schematic diagram and construction details

Key

1 Equipment under test
2 Metal ground plane PL
3 Metallic case 145 mm × 70 mm × 70 mm
4 Part placed on the ground plane PL
5 Front plate (insulating material)
6 Supporting plate for chokes (insulating material)
7 Coaxial connector, BNC
8 Ground jack
9 Mains socket for equipment under test (2 insulated banana jacks)
10 Mains plug (2Pin + ground)
11 Two ferrite rings type C (see annex G) including *N* turns each of insulated copper wire to produce 60 µH each
12 Copper wire 0,8 mm, insulated, 1,8 mm outer diameter

Figure C.2 – Coupling unit type MC (for mains lead)

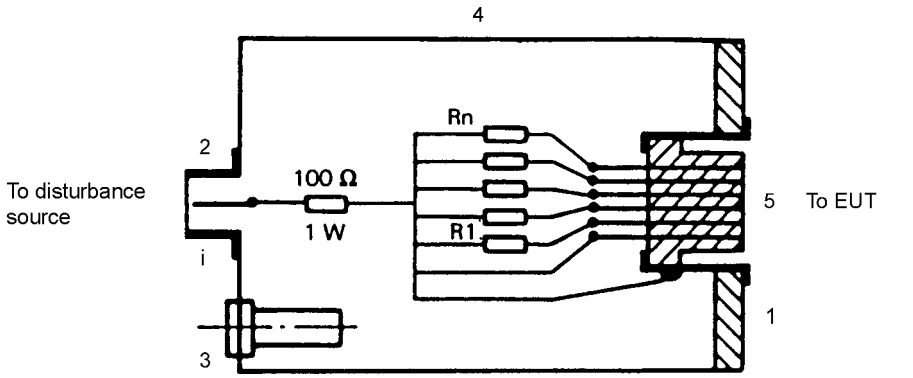


IEC 459/02

Key

1 Metallic case 145 mm × 70 mm ×70 mm
2 Front plate (insulating material)
3 Coaxial connector, BNC
4 Ground jack
5 Insulated banana jacks
6 Inductance 30 µH asymmetrical
Core: 1 ferrite ring, type C (see annex G).
Winding: *N* turns with a twisted pair (2 leads, copper wire 0,6 mm diameter, insulated, 1,2 mm outer diameter to produce 30 µH).
Mounting of the inductance similar to figure C.1.
Capacitors: C1 = 10 nF; C2 = 47 nF.

Figure C.3 – Coupling unit type LC (for loudspeaker leads)



IEC 460/02

Key

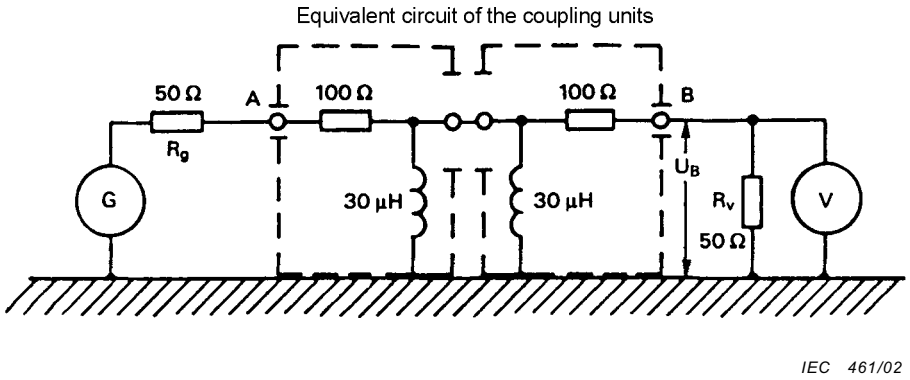
1 Front plate (insulating material)
2 Coaxial connector, BNC
3 Ground jack
4 Metallic case 100 mm × 55 mm × 55 mm
5 Multiple pins connector or DIN-socket

R1 to Rn matched load resistance

Example: Coupling units Sr for audio equipment:

Phono magn.: 2 × 2,2 kΩ
Phono crystal: 2 × 470 kΩ
Microphone: 2 × 600 Ω
Tuner: 2 × 47 kΩ
Tape in/out: 4 × 47 kΩ
Audio in/out: 4 × 47 kΩ

Figure C.4 – Coupling unit type Sr with load resistances



Components

R_g = internal resistance of generator
R_v = internal resistance of voltmeter

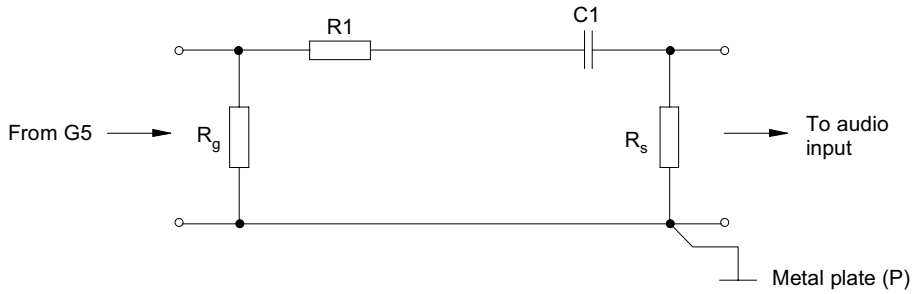
Figure C.5 – Measuring set-up to check the insertion loss of the coupling units in the frequency range 30 MHz to 150 MHz

The insertion loss U_G/U_B of two identical coupling units measured according to figure C.5 should be within 9,6 dB and 12,6 dB in the frequency range 30 MHz to 150 MHz. U_G is the reading of the voltmeter, when the generator and the voltmeter are directly connected together.

NOTE The two units shall be connected together with very short wires (shorter than 10 mm).

Annex D
(normative)

Matching networks and mains stop filter



Components

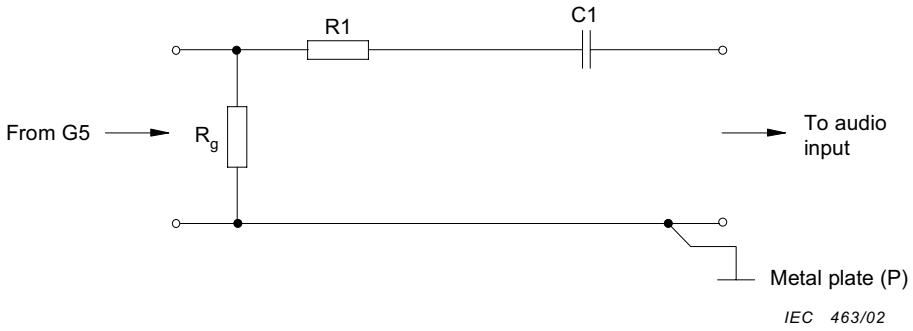
R1 = 100 Ω – R_g/2

C1 = 470 pF

R_g equal to the rated output impedance of generator G5 or high-pass filter HP as appropriate

R_s equal to the rated source impedance of the audio input

Figure D.1 - RC network for audio inputs (RC_i)



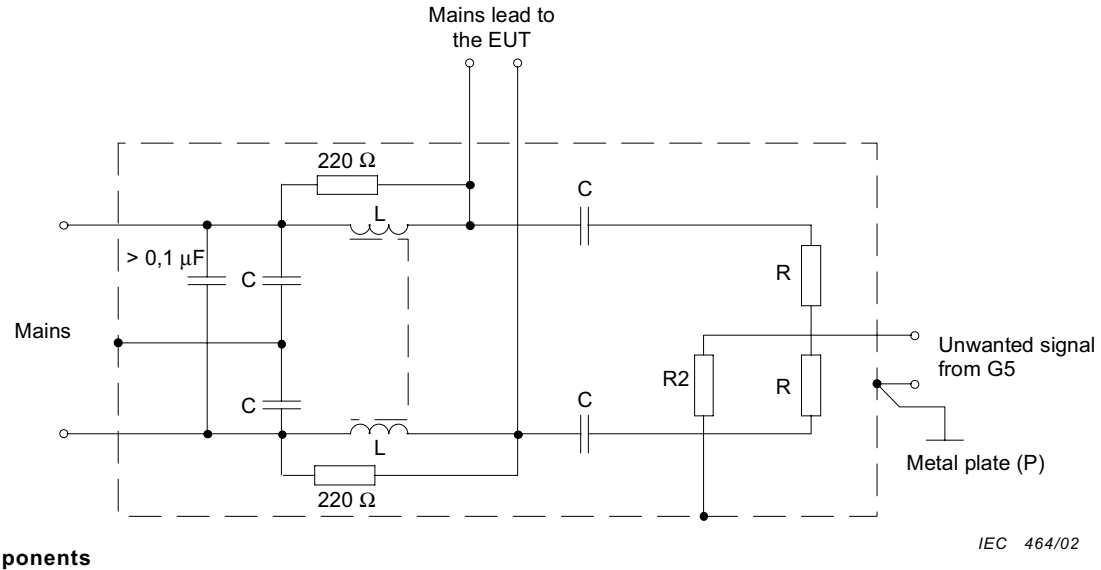
Components

R1 = 100 Ω – R_g/2

C1 = 470 pF

R_g equal to the rated output impedance of generator G5 or high-pass filter HP as appropriate

Figure D.2 – RC network for audio outputs (RC_o)



Components

L = 100 µH

C = 3,3 nF

R = 200 Ω – R2

R2 equal to the rated output impedance of generator G5 or high-pass filter HP as appropriate

Figure D.3 – Mains stop filter (MSF)

Annex E
(normative)

Construction information for the open stripline and for the mains and loudspeaker band-stop filter

The basic configuration of the open stripline TEM device is given in figure E.1, an overview is given in figure E.2.

The nominal dimensions of the metal plates are given in figure E.3.

The construction details of both ends are given in figure E.4 together with the dimensions of the matching network MN and the terminating impedance TI (figures E.5 and E.6 respectively).

A circuit of the mains band-stop filter MBS is given in figure E.7. The filter used shall have a minimum attenuation of 20 dB between 150 kHz and 30 MHz, and 50 dB between 30 MHz and 150 MHz, when measured with a 50 Ω source and load.

A circuit for the loudspeaker band-stop filter LBS is given in figure E.8. The filter used shall have a minimum attenuation of 20 dB between 150 kHz and 30 MHz, and 50 dB between 30 MHz and 150 MHz, when measured with a 50 Ω source and load.

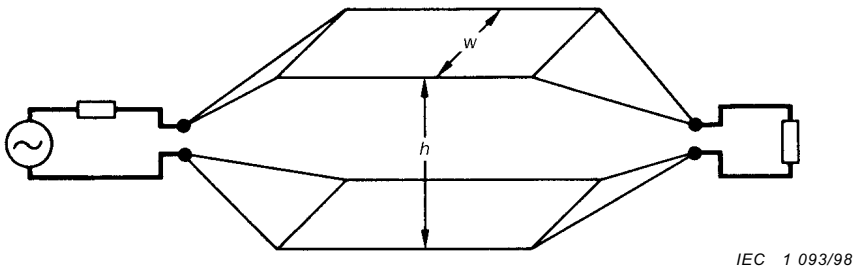
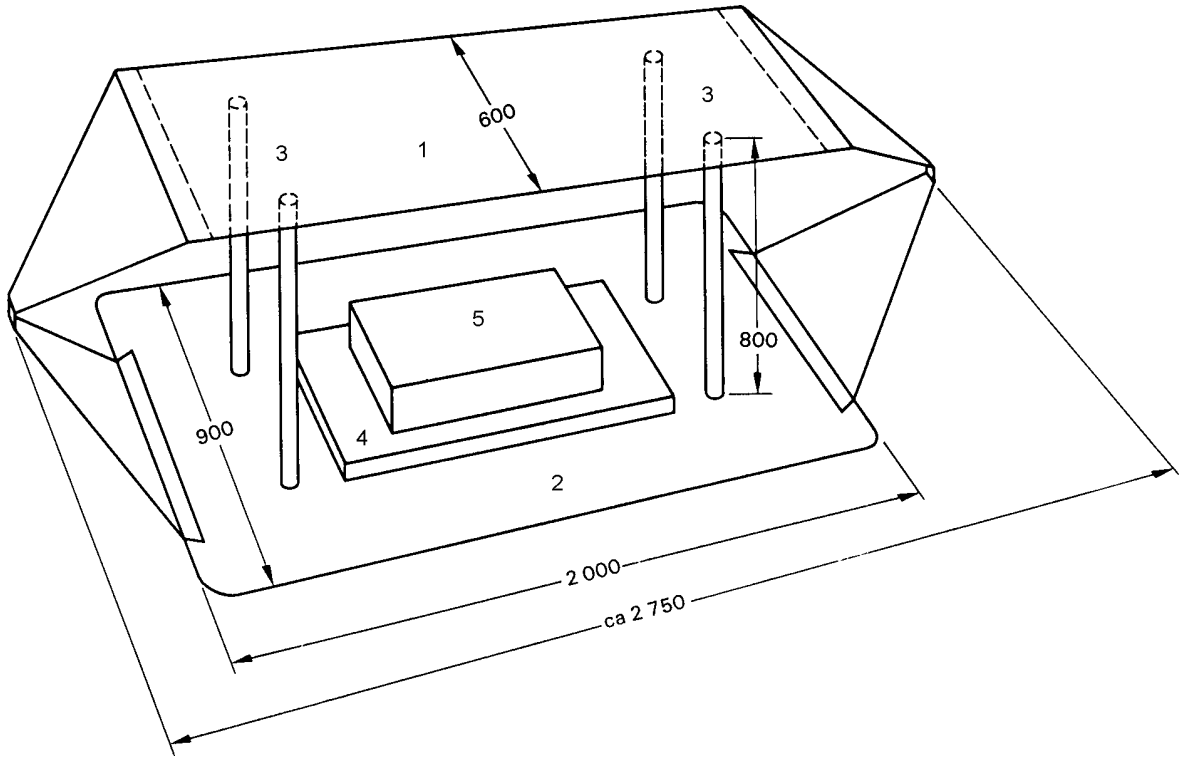


Figure E.1 – Open stripline TEM device, basic configuration with matching network and terminating impedance



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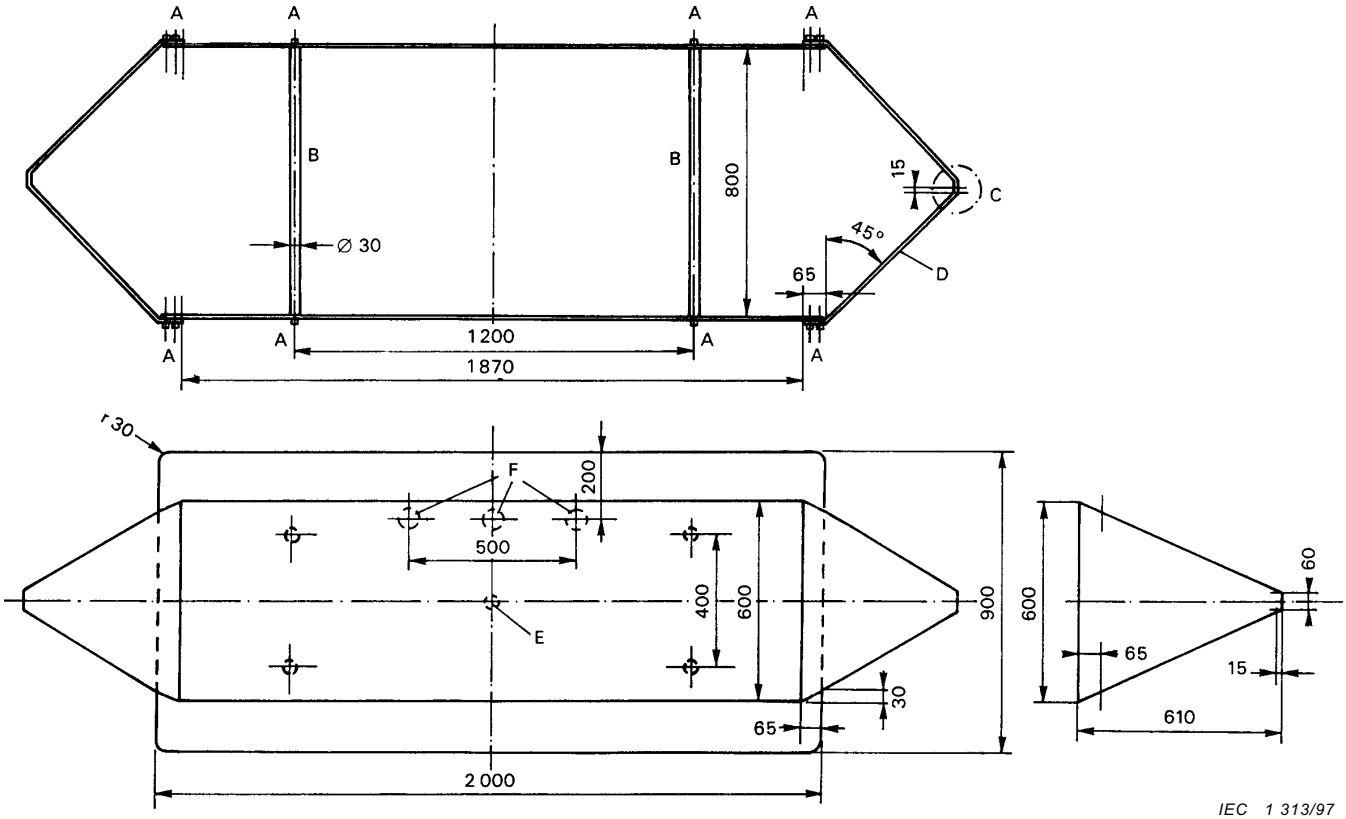
Dimensions in millimetres

Key

1 Metal top-plate (2 m × 0,6 m) parallel to base-plate
2 Metal base-plate (2 m × 0,9 m)
3 Plastic bracing (0,8 m) 4×
4 Non-metallic support
5 Equipment under test

Figure E.2 – Overview of an open stripline TEM device



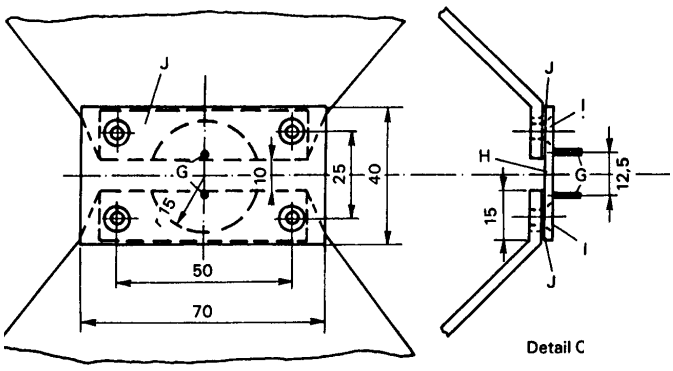
Dimensions in millimetres

Material metal thickness 3 mm to 5 mm

Components

A Threaded screws M 5 x 15, maximum length 30 mm
B Plastic bracing
C Detail see figure E.5
D Blank at contacts (good electrical contact required with A and C)
E Hole 25 mm in base plate for measuring probe
F Holes, 50 mm in base plate for mains cable passage

Figure E.3 – Constructional details of an open stripline, TEM device



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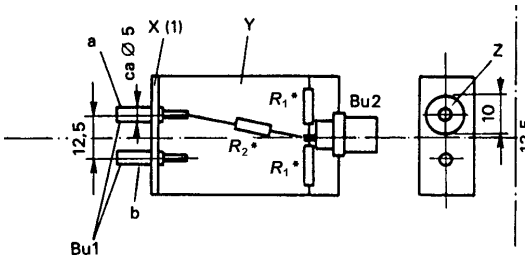
Dimensions in millimetres

Components

G Connection pins diameter 1,3 mm to 1,5 mm, conductively connected to J
H Insulating plate 4 mm thick
I Threaded screws M 5 mm x 10 mm (countersunk head)
J Contact intermediate plate made of tinplate 0,5 mm thick

Figure E.4 – Supplementary constructional details of the open stripline TEM device



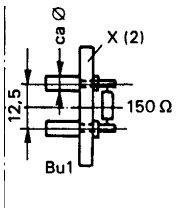
Dimensions in millimetres

IEC 467/02

Components	
Bu1	Plug sockets for pins, suited to G
Plug socket a	insulated
Plug socket b	connected to casing
Bu2	Coaxial socket 50 Ω
X(1)	Plastic plate approx. 3 mm thick
Y	Metal casing, approx. 40 mm × 30 mm × 15 mm, shown open
Z	Opening in metal casing
R_1 – 122,4 Ω (2×)	* soldered-in as close as possible
R_2 – 122,5 Ω	* soldered-in as close as possible

The matching network is suitable for a signal generator output impedance Z_o = 50 Ω.

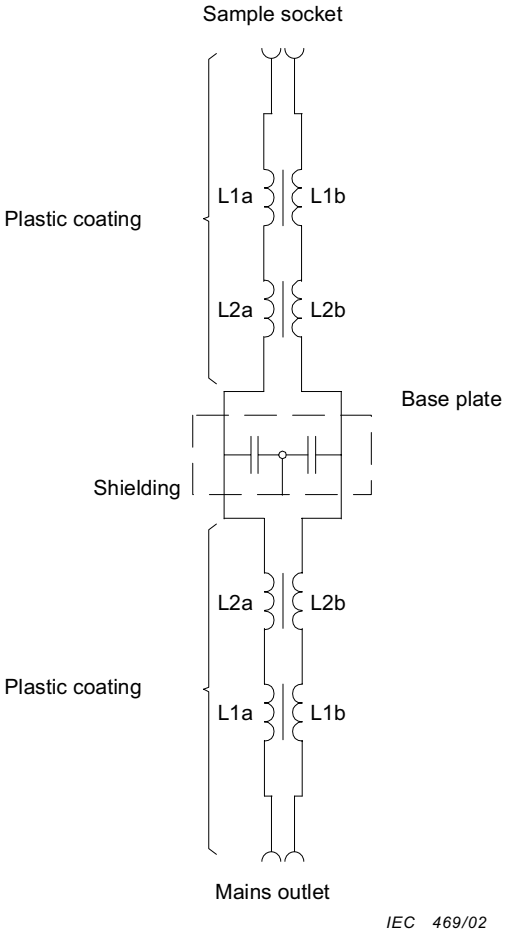
Figure E.5 – Matching network MN



IEC 468/02

X(2) Plastic plate approx. 3 mm thick.

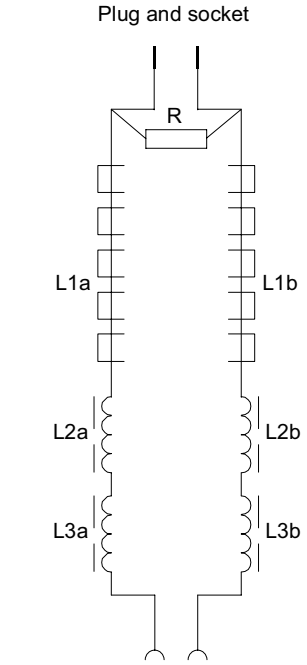
Figure E.6 – Terminating impedance TI



Components

L1a, L1b	Inductance approximately 30 µH in between 1 MHz and 50 MHz core 1 ferrite ring type A (see annex G); winding *N* turns to produce 30 µH.
L2a, L2b	Inductance approximately 300 µH, up to 1 MHz core 1 ferrite ring type B (see annex G); winding *N* turns to produce 300 µH.
C1a, C1b	Coupling capacitors of 3,3 nF.

Figure E.7 – Band-stop filter type MBS circuit (for mains connection)



Components

R	Nominal terminating impedance
L1a, L1b	5 ferrite beads each
L2a, L2b	Inductance approximately 70 µH, in between 1 MHz and 60 MHz core 1 ferrite ring type A (see Annex G) winding N turns 0,6 mm diameter enamelled copper wire to produce 70 µH.
L3a, L3b	Inductance approximately 2 mH, up to 1 MHz core 1 ferrite ring type B (see annex G) winding N turns 0,6 mm diameter enamelled copper wire to produce 2 mH.

Non conductive materials shall be used for mounting and casing

Figure E.8 – Band-stop filter type LBS (for loudspeaker connection)

Annex F
(normative)

Calibration of the open stripline

An empty stripline with plates at distance h, should, for an input voltage U_{in}, furnish a field strength E given by

$$E = \frac{U_{in}}{h}$$

where

E is the field strength in volts/meter

U_{in} is the input voltage in volts

h is the distance between the plates, in meters

In practice deviation from this relationship may be caused by mechanical tolerances, material losses, internal reflections causing standing waves, radiation, etc. These deviations are in general dependent on frequency. For this reason it is necessary to calibrate a transfer factor, for each stripline, given by

$$T = E - U_{in}$$

where

T is the transfer factor in dB(m^{-1});

U_{in} is the input voltage measured at the input to the adapting network of the stripline in dB(V);

E is the field strength of the TEM wave in dB(V/m).

For testing the field strength within the stripline according to Figure F.1 a metal-plate with the dimensions 200 mm x 200 mm is positioned 10 mm above the base-plate of the stripline. The RF voltage of the measuring-plate related to the base-plate of the stripline is measured by using a RF millivoltmeter or an appropriate measuring apparatus. The termination by the measuring apparatus should be 3 pF parallel to ≥100 kΩ. The capacity of the measuring-plate related to the base-plate of the stripline is 35 pF. Above 10 MHz the termination resistance may decrease depending on the frequency (e.g. to 10 kΩ for 100 MHz). An example for the arrangement of the measuring apparatus is shown in figure F.2.

The voltage value at the measuring-plate for an unmodulated signal from the unwanted signal generator of 10 V (e.m.f.) shall comply with the calibration curve of Figure F.3. The field strength within the stripline is then 3 V/m. This test shall be done for the measuring frequency range. Deviations greater than the limited deviations of ±2 dB shall be taken into account, depending on the frequency, by the correction factor K_1:

$$K_1 = \frac{U_{mes}}{U_{nom}}$$

where

K_1 is the correction factor;

U_{mes} is the measured voltage value at the measuring-plate;

U_{nom} is the nominal voltage value.

Narrowband deviations are excepted beginning at a level for which the relative bandwidth, given by the following formula, is less than 10 %:

$$\Delta NBr = \frac{2(f_2 - f_1)}{f_2 + f_1} \times 100 \quad (\%)$$

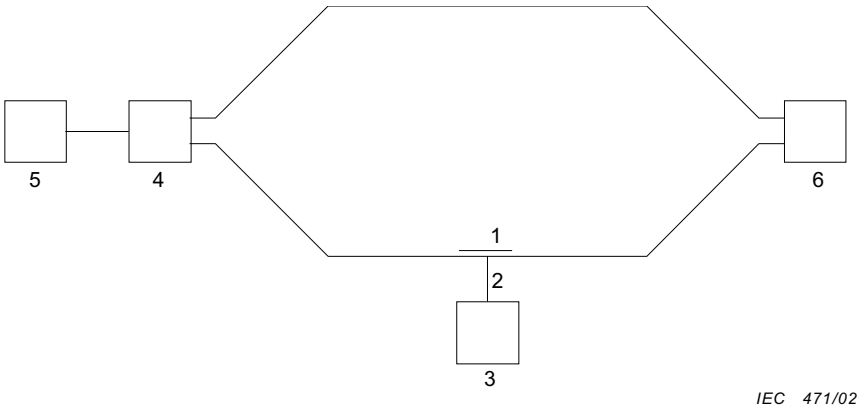
where

ΔNBr is the relative narrow-band deviation in percentage;

f_1 and f_2 are the cut-off frequencies (–3 dB) of the considered narrow-band in megahertz.

It shall be verified whether spurious influence interferes the measuring result during the calibration procedure. With switched on or switched off unwanted signal generator and RF matched shortening of the measuring-plate, the basic voltage indication of the RF millivoltmeter shall be negligible.

The earth side of the measuring-probe shall be direct and the RF matched connected to the base-plate of the stripline at the feed through point. If appropriate the RF millivoltmeter is to be placed in a one-side-open metal-box under the measuring point or beside it. Care shall be taken to perfect the RF matched (large-sized) connection of the metal-box with the base-plate and with the millivoltmeter (see figure F.2).



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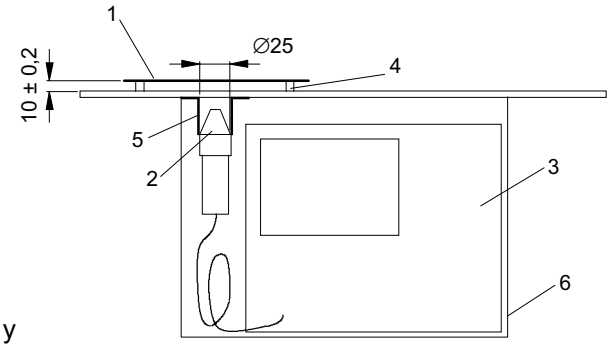
Key

1 Measuring-plate of metal (200 ± 0,5) mm × (200 ± 0,5) mm × 1 mm
2 Measuring-probe
3 RF millivoltmeter
4 Matching network
5 Unwanted signal generator
6 Termination resistor 150 Ω

Figure F.1. – Circuit arrangement for calibration of the measuring set-up

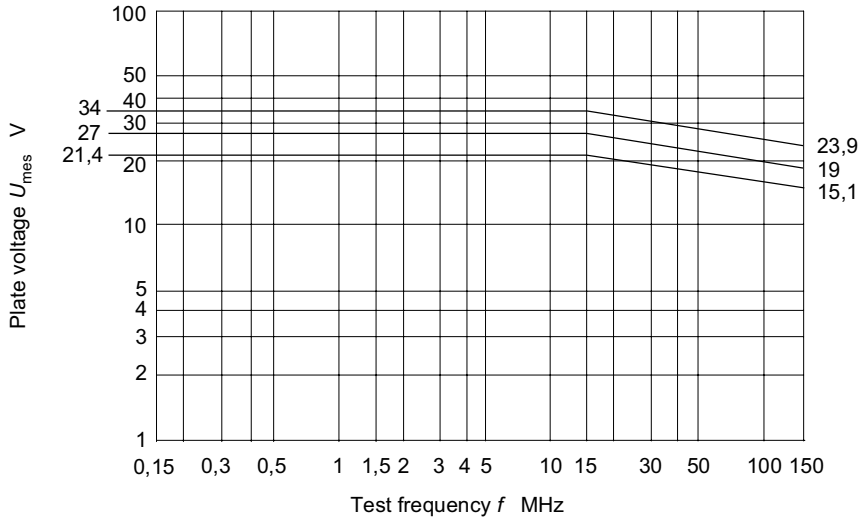


IEC 472/02

Key

1 Measuring-plate of metal (200 ± 0,5) mm ×(200 ± 0,5) mm × 1 mm
2 Measuring-probe
3 RF millivoltmeter
4 Plastic distance pieces, total cross-area of all plastic distance pieces max. 1 % of the plane of item 1
5 Connection to the base-plate of the stripline, total min. 25 mm wide
6 Metal-box (350 ± 1,2) mm × (250 ± 1,2) mm × (250 ± 1,2) mm, closed at the back, with the base-plate of the stripline several times tightly contacted

Figure F.2 – Example of additional arrangement for enquiry of the calibration curve



Voltage at the measuring plate depends on the measuring frequency for 10 V e.m.f. volta*IEC 473/02* the unwanted signal generator and the ranges of the limited deviations of ±2 dB for the measuring set-up. The field strength within the stripline is then 3 V/m.

Figure F.3 – Calibration curve

Annex G
(normative)

Ferrite core sizes and materials

The following table provides ferrite core sizes and materials.

Table G.1 – Ferrite core sizes and materials

Core	Type		
	A	B	C
Material	Nickel/Zinc	Manganese/Zinc	Nickel/Zinc
Outside diameter	13 mm to 17 mm	15 mm to 25 mm	30 mm to 50 mm
Cross sectional area	40 mm^2 to 60 mm^2	100 mm^2 to 140 mm^2	170 mm^2 to 230 mm^2
Initial permeability	50 to 200	2 000 to 7 500	50 to 200
Reduction in permeability permitted at high frequencies	50 % at 60 MHz 75 % at 100 MHz	75 % at 1,0 MHz 50 % at 0,6 MHz	50 % at 60 MHz 75 % at 100 MHz
Saturation flux density	>300 mT	>300 mT	>300 mT

NOTE The number of turns to produce the required inductance can be calculated from the inductance factor of the specific core selected by the following equation:

$$N = \sqrt{L / A_L}$$

where

L is the inductance (μH);
N is the number of turns;
A_L is the inductance factor (μH/N²).

Annex H
(informative)

Frequency bands

H.1 FM bands

– For the European region: 87,5 MHz to 108 MHz
– For Japan: 76 MHz to 90 MHz.
– For eastern Europe and other regions outside Europe: to be specified.

H.2 Frequency bands defined for the European region

For the European region, the following frequency bands are defined:

Band	Frequency MHz
I	47 to 68
III	174 to 230
IV	470 to 598
V	598 to 862
Hyper	302 to 470

NOTE In practice not all television receivers are tunable over all of these frequency ranges. On the other hand many television receivers are tuneable over additional channels, exclusively used in cable distribution networks.

H.3 Channel frequencies for system D (VHF) (used in Russia)

Channel N	Vision carrier MHz	Sound carrier MHz
1	49,75	56,25
2	59,25	65,75
3	77,25	83,75
4	85,25	91,75
5	93,25	99,75
6	175,25	181,75
7	183,25	189,75
8	191,25	197,25
9	199,25	205,75
10	207,25	213,75
11	215,25	221,75
12	223,25	229,75

H.4 Frequency bands defined for Japan

For Japan, the following frequency bands are defined:

Band	Frequency MHz
II	90 to 108
III	170 to 222
IV	470 to 770

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