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Australian/New Zealand Standard™

**Limits and methods of measurement of
immunity characteristics of sound and
television broadcast receivers and
associated equipment**



Standards Australia



AS/NZS 4053:1997

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee TE/3, Electromagnetic Interference. It was approved on behalf of the Council of Standards Australia on 19 November 1996 and on behalf of the Council of Standards New Zealand on 30 October 1996. It was published on 5 February 1997.

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Australian Electrical and Electronic Manufacturers Association
Australian Information Industry Association
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Australian/New Zealand Standard™

Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TE/3 on Electromagnetic Interference. It is identical with and has been reproduced from IEC/CISPR 20:1996, *Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment*, prepared by CISPR Sub-Committee E. This Standard supersedes AS/NZS 4053:1992 of the same title.

This Standard incorporates Amendment No. 1 (May 2000). The changes arising from the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure, or part thereof affected.

The objective of this Standard is to provide the manufacturers and designers of television receivers and associated equipment with methods of measurement and limits with regard to their immunity characteristics to interfering signals.

This Standard contains clarification of Australian and New Zealand broadcasting requirements with respect to tables and test method applications. Where the text of CISPR 20:1996 has been varied technically to accommodate Australian and New Zealand different or additional requirements, it is indicated by double vertical lines in the left-hand margin against the clause affected. Australian and New Zealand variations to CISPR 20:1996 are given in Annex ZZ at the end of this publication.

Statements expressed in mandatory terms in notes and figures are deemed to be requirements of this Standard.

The term ‘normative’ has been used in this Standard to define the application of the annex to which it applies. A ‘normative’ annex is an integral part of a Standard.

As this Standard is reproduced from an international Standard the following applies:

- (a) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (b) In the source text ‘this International Standard’ should read ‘this Australian/New Zealand Standard’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

References to international Standards should be replaced by equivalent Australian or Joint Australian/New Zealand Standards as follows:

<i>Reference to International Standard or other Publication</i>		<i>Australian/New Zealand Standard</i>	
CISPR		AS/NZS	
13	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment	1053	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment
16	CISPR specification for radio interference measuring apparatus and measurement methods	1052	CISPR specification for radio interference measuring apparatus and measurement methods
16	Specification for radio disturbance and immunity measuring apparatus and methods	1052	Specification for radio disturbance and immunity measuring apparatus and methods
16.1	Radio disturbance and immunity measuring apparatus	1052.1	Radio disturbance and immunity measuring apparatus
50	International Electrotechnical Vocabulary	1852	International Electrotechnical Vocabulary
50(161)	Electromagnetic compatibility	—	
CISPR		AS/NZS	
94	Magnetic tape sound recording and reproducing systems	3871	Magnetic tape sound recording and reproducing systems
94-2	Part 2: Calibration tapes	3871.2	Calibration tapes

IEC		AS	
96	Radio-frequency cables	—	
96-1	Part 1: General requirements and measuring methods (including Amendment No. 2 (1993))		
98	Analogue audio disk records and reproducing equipment	1127.8	Analogue audio disk records and reproducing equipment
CCIR	Recommendation 471	—	
	Nomenclature and description of colour bar signals		
	Recommendation 500	—	
	Methods for the subjective assessment of the quality of television pictures		

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AUSTRALIAN/NEW ZEALAND STANDARD

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

1 Scope and object

This publication is applicable to the immunity of sound and television broadcast receivers and associated equipment to ambient electromagnetic fields, induced currents and voltages. The frequency range covered extends from 150 KHz to 1 GHz.

- A1 | This publication is also applicable to the immunity of outdoor units of direct to home (DTH) satellite receiving systems for individual reception.

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

This publication 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 interfering signals.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

CISPR 13:1990, *Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment*

CISPR 16:1987, *CISPR specification for radio interference measuring apparatus and measurement methods*

CISPR 16-1:1993, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

IEC 50(161): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 94-2:1994, *Magnetic tape sound recording and reproducing systems – Part 2: Calibration tapes*

IEC 96-1:1986, *Radio-frequency cables – Part 1: General requirements and measuring methods*
Amendment 2 (1993)

IEC 98:1987, *Analogue audio disk records and reproducing equipment*

- A1 | IEC 60728-2: *Cabled distribution systems for television and sound systems — Part 2: Electromagnetic compatibility of equipment*¹⁾

CCIR Recommendation 471: *Nomenclature and description of colour bar signals*

CCIR Recommendation 500: *Method for the subjective assessment of the quality of television pictures*

A1 | ¹⁾ To be published.

3 Definitions

For the purpose of this publication, the definitions contained in IEC 50(161) apply.

3.1 external immunity: Ability of a receiver or associated equipment to perform without degradation in the presence of electromagnetic disturbances entering other than via its antenna input terminals.

3.2 Internal immunity: Ability of a receiver or associated equipment to perform without degradation in the presence of electromagnetic disturbances entering via its antenna input terminals.

The immunity of a receiver or associated equipment is characterized by the level of an interfering signal that under specified conditions produces a specified degradation of the picture or of the sound of the receiver.

A1 **3.3 sound receivers:** Appliances intended for the reception of sound broadcast and similar services for terrestrial, cable and satellite transmissions.

3.4 television receivers: Appliances intended for the reception of television broadcast and similar services for terrestrial, cable and satellite transmissions.

NOTES

- 1 Modular units which perform a part of the functions of a sound or television receiving system (such as tuners, frequency converters, amplifiers, equalizers, monitors, etc.) are considered to be sound or television receivers respectively.
- 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.
- 3 Frequency converters may be provided with a broadcast-satellite-receiving stage and with devices which convert the signals to other frequency bands.
- 4 Receivers, tuners, or frequency converters may be tunable or may only be able to receive a fixed frequency.

screening effectiveness (the definition is under consideration).

For practical reasons the specified degradation of the picture in this publication is a just perceptible interference and the specified degradation of the sound is a measured signal-to-disturbance ratio. For these reasons and for normal operation of the equipment it is generally necessary to supply the receiver with a standard input signal.

The external immunity can be distinguished as:

- immunity to ambient fields;
- immunity to induced currents;
- immunity to induced voltages.

4 Limits of immunity

4.1 External immunity

NOTE – Limits for associated equipment are under consideration.

4.1.1 *Limits of immunity to ambient electromagnetic field in the frequency range 0,15 MHz to 150 MHz*

Measurements shall be made in accordance with 5.2.

Table 1 – Limits of immunity to ambient electromagnetic fields of audio functions of sound and television receivers

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

Table 2 – Limits of immunity to ambient electromagnetic fields of VHF band II 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 ¹⁾	109
The tuned channel	Under consideration

¹⁾ 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.

NOTE – f_i is the intermediate frequency (= 10,7 MHz)
 $f_o = f_t \pm f_i$ is the 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 $f_o < f_t$.

Table 3 – Limits of immunity to ambient electromagnetic fields reception functions of television receivers

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 $(f_v + 2)$ ¹⁾	101
$(f_v - 2)$ to $(f_i + 2)$ ²⁾	101
47 to 150 ³⁾	109 ⁴⁾ 125 ⁵⁾
Except the tuned channel	Under consideration

¹⁾ For systems B, D, G, K, I, L, M.
²⁾ Only for system L.
³⁾ The frequency 47 MHz can be varied depending on the use of this frequency range on a national basis.
⁴⁾ For television receivers with reception function in this frequency range.
⁵⁾ For television receivers without reception function in this frequency range.

NOTE – f_i sound intermediate frequency
 f_v vision intermediate frequency
 f_s intercarrier sound frequency
 f_c colour sub-carrier frequency

4.1.2 Limits of immunity to ambient electromagnetic field in the frequency range 150 MHz to 1 GHz

Measurements shall be made in accordance with 5.3.

Table 4 – Limits of immunity to ambient electromagnetic fields of audio functions of sound and television receivers

Frequency MHz	Level dB(μ V/m)
150 to 1 000	Under consideration

Table 5 – Limits of immunity to ambient electromagnetic fields of VHF Band II reception functions of sound receivers

Frequency MHz	Level dB(μ V/m)
150 to 1 000	Under consideration

Table 6 – Limits of immunity to ambient electromagnetic fields reception functions of television receivers

Frequency MHz	Level dB(μ V/m)
150 to 1 000	Under consideration

4.1.3 Limits of immunity to RF induced currents in the frequency range 0,15 MHz to 150 MHz

Measurements shall be made in accordance with 5.4.

Table 7 – Limits of immunity to RF induced currents of mains, loudspeaker, and headphone terminals for sound and television receivers

Frequency MHz	Level dB(μ V/m) (e.m.f.)
0,15 to 1,6	Under consideration
1,6 to 30	Under consideration
30 to 85	Under consideration
85 to 150	Under consideration

Table 8 – Limits of immunity to RF induced currents of antenna terminals for sound and television receivers

Frequency MHz	Level dB(μV/m) (e.m.f.)
0,15 to 26	Under consideration
26 to 30	126
30 to 150	Under consideration

4.1.4 Limits of immunity to RF induced currents in the frequency range 0,15 MHz to 150 MHz

Measurements shall be made in accordance with 5.5, excluding the tuned channel and the frequency bands indicated under "Except" in table 2 or table 3, as appropriate.

Table 9 – Limits of immunity to RF induced currents of audio Input and output terminals (except loudspeaker and headphone terminals) for sound and television receivers

Frequency MHz	Level dB(μV/m) (e.m.f.)
0,15 to 1,6	Under consideration
1,6 to 30	Under consideration
30 to 150	Under consideration

Table 10 – Limits of immunity to RF induced voltage of mains loudspeaker and headphone terminals for sound and television receivers

Frequency MHz	Level dB(μV/m) (e.m.f.)
0,15 to 30	130
30 to 100	120
100 to 150 ¹⁾	120-110
¹⁾ Decreasing linearly with the logarithm of the frequency.	

Table 11 – Limits of immunity to RF induced voltage of audio input and output terminals (except loudspeaker and headphone terminals) for sound and television receivers

Frequency MHz	Level dB(μV/m) (e.m.f.)
0,15 to 1,6 ¹⁾	80-90
1,6 to 20 ¹⁾	90-120
20 to 100	120
100 to 150 ²⁾	120-110
¹⁾ Increasing linearly with the logarithm of the frequency.	
²⁾ Decreasing linearly with the logarithm of the frequency.	

4.2 Internal immunity

The immunity of tested equipment shall be equal to or better than the specified limits given in 4.2.1 to 4.2.4 when measured using the methods given in 5.6.

At transition frequencies the more stringent limit shall apply.

The limits values correspond to a nominal antenna impedance of 75 Ω . For receivers with nominal antenna impedance other than 75 Ω , these limits values and the level of the wanted signals on the antenna terminals are modified, according to the following formula:

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

where

L_z is the limits for receivers with a nominal input impedance Z ;

L is the limits given in tables 12 to 16 ($Z = 75 \Omega$);

Z is the nominal input impedance (Ω) of the receiver under test.

NOTE – The level of the unwanted signal refers to the level at the antenna terminal when this is matched to the unwanted signal generator, i.e. half the e.m.f. value.

4.2.1 Television receivers

Television receivers shall be tested according to 5.6.2 at a tuned frequency of the wanted television channel N and subjected to an unwanted signal in channel M and of the following type (A, B, C, D), as specified in tables 12 and 13, and an unwanted signal of type E outside the television bands as specified in table 14 ... or to an unwanted signal in channel M and of the following type (A, B₁, F and G) as specified in tables 12a and 13b:

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 table, one at the relevant picture carrier frequency +0,5 MHz and the other at the picture carrier frequency –0,5 MHz;

B₁: two unmodulated signals, one at the relevant picture carrier frequency $f_N - 0,25$ MHz and level –19 dB, the other at the relevant picture carrier frequency $f_N + 0,25$ MHz and level –9,5 dB, as given in table 13b;

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

For television receivers for countries in which the systems B and G with two frequency modulated sound carriers can be received;

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

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

D: a modulated signal at the relevant picture carrier frequency, 1 kHz AM at 80 % depth;

E: a modulated signal 1 kHz AM at 80 % depth.

F: See notes below table 12a.

G: one pulsed unmodulated signal at the relevant picture carrier frequency $f_N + 10,125$ MHz, pulse width $t_d = 60 \mu\text{s}$, pulse frequency 200 Hz ($T = 5$ ms), and if possible synchronized with the field frequency of the wanted signal generator (see figure D.1), level as given in table 13b.

For signal types C, C1, C2, D and E, the level refers to the r.m.s. value of the unmodulated carrier.

NOTE – Limits for television receivers for systems different from those shown in the following tables are under consideration.

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Table 12 – Limits of internal immunity of television receivers for systems B, G and I to unwanted signals inside the television bands

Wanted channel N	Unwanted signal in channel M						Type
	Level dB (μV)						
	M = N – 5	N – 1	N + 1	N + 5 ²⁾	N + 9 ²⁾	N + 11	
N _i , and N _{iii} and N _{H1}	—	73	73	—	68 ¹⁾	—	A
	—	61	61	—	56 ¹⁾	—	B
	70	73 – x	73 – x	70	68 – x ¹⁾	68	C or C ₁
	—	73 – y	73 – y	—	68 – y ¹⁾	—	C ₂
	70	—	—	70	—	68	D
N _{iv}	—	77	77	80	68	—	A
	—	65	65	68	56	—	B
	74	77 – x	77 – x	80 – x	68 – x	—	C or C ₁
	—	77 – y	77 – y	80 – y	68 – y	—	C ₂
	74	—	—	—	—	—	D
N _v	80	77	77	80	—	—	A
	68	65	65	68	—	—	B
	80 – x	77 – x	77 – x	80 – x	62	—	C or C ₁
	80 – y	77 – y	77 – y	80 – y	—	—	C ₂
	—	—	—	—	62	—	D
For systems B and G				x = 13 dB, y = 20 dB			
For system I (monophonic only)				x = 10 dB			
1) Only for hyperband N _H .							
2) 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.							

NOTES

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.

2 (For China only). For systems D-PAL and K-PAL, table 12 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.

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_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_{H1} in hyperband nearest to 375 MHz (table 12)

Channel N_{H2} in hyperband nearest to 363 MHz and

Channel N_{H3} in hyperband nearest to 423 MHz (table 13b)

where:

– band I from 47 MHz to 68 MHz

– band III from 174 MHz to 230 MHz

– band IV from 470 MHz to 598 MHz

– band V from 598 MHz to 862 MHz

– hyperband from 302 MHz to 470 MHz

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

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**Table 12a – Limits of internal 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					Type
	Level dB(μV)					
	M = N – 2	N – 1	N + 1	N + 2	Other	
N _{ii} , N _{iii}	70	60	65	70	70	F
N _{iv} , N _v	74	64	69	74	74	F

NOTES

- 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 and band V, 1 kHz FM at 15 kHz deviation.
- 2 Sound carrier level: 64 dB(μV) in band II and band III or 68 dB(μV) in band IV and band V.
- 3 Unwanted signal type F: a standard TV signal with vertical colour bar pattern with unmodulated sound carrier.

**Table 13 – Limits of internal immunity of television receivers for system L
to unwanted signals inside the television bands**

Wanted channel N	Unwanted signal in channel M				
	Level dB(μV)				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

For system L, signal D is a modulated signal at the relevant picture carrier frequency (r.m.s. value) 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 the table have to be reduced by 5 dB.

Table 13a – Limits of internal immunity of television receivers for systems D-SECAM, K-SECAM (used in Russia)

Wanted channel	Unwanted signal in channel M						Type
	Level dB(μV)						
	M = N – 4	N – 1	N + 1	N + 4	N + 8	N + 9	
N _i (Channel 2)	–	73	73	–	–	–	A
	–	61	61	–	–	–	B
N _{ii} (Channel 4)	–	73	73	–	–	–	A
	–	61	61	–	–	–	B
N _{iii} (Channel 10)	–	73	73	–	–	–	A
	–	61	61	–	–	–	B
	–	63	–	70	–	–	C
	70	–	73	–	–	68	D
N _{iv} (Channel 25)	–	77	77	–	–	68	A
	–	65	65	–	–	56	B
	–	67	–	70	66	–	C
	74	–	70	–	–	–	D
N _v (Channel 55)	80	77	77	–	–	–	A
	68	65	65	–	–	–	B
	–	67	–	70	62	–	C
	–	–	67	–	–	62	D

NOTE – The wanted channels in brackets are recommended for measurements within each television band.

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Table 13b — Limits of internal immunity of television receivers for system D2-MAC to unwanted signals inside the television band

Wanted channel N	Unwanted signal in channel M					Type
	Level dB (μV)					
	M = N – 3	N – 1	N + 1	N + 3	N + 6	
N _{H2} ¹⁾	54/63,5					B1
N _{H3} ¹⁾	—	62	62	—	—	G

¹⁾ Channel spacing of 12 MHz is assumed.

¹⁾ Channel spacing of 12 MHz is assumed.

Table 14 – Limits of internal immunity of television receivers to unwanted signals outside the television bands

Wanted channel N	Unwanted signal		
	Frequency MHz	Level dB(μV)	Type
N _i	0,15 to 26 26 to 30	Under consideration 89	– E
N _{iii}	0,15 to 26 26 to 30	Under consideration 104	– E

NOTE – The limits for the wanted channel N_i apply also to the wanted channel N_{ii} when band II is used for systems D-SECAM, K-SECAM.

4.2.2 FM sound receivers

Sound receivers shall be tested according to 5.6.3 at a tuned frequency of the wanted signal and subjected to an unwanted signal of frequency specified in tables 15 and 16.

Receivers with mono/stereo facility shall be tested in stereo mode.

NOTE – Limits for sound receivers for an FM band different from band II(87,5 MHz to 108 MHz) are under consideration.

Table 15 – Limits of internal immunity to unwanted signals outside the VHF Band II range

Wanted signal MHz	Unwanted signal MHz	Level dB(μV)	
		Mono	Stereo
87,6	66,2 ¹⁾	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 ¹⁾	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
1) Only applicable for receivers with the local oscillator frequency below the tuned frequency. 2) Only applicable for receivers with the local oscillator frequency above the tuned frequency.			

Table 16 – Limits of internal immunity to unwanted signals inside the VHF Band II range

Wanted signal MHz	Unwanted signal MHz	Level dB(μV)	
		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

4.2.3 Multi-function equipment

Multi-function equipment, which performs one or more of the functions for which limits are given in 4.2.1 and 4.2.2, shall meet the relevant limits.

4.2.4 Associated equipment

Under consideration.

A1 4.2.5 Satellite television receivers

Satellite television receivers shall be tested according to 5.6.4 at a turned channel N and subject to an unwanted signal in channel M, as specified in table 17 and of signal type selected from A₁, A₂, A₃ or A₄ as appropriate.

Table 17 — Limits of internal immunity of satellite receivers

Wanted channel N	Unwanted signal in channel M				Type
	Level dB(μV)				
	N – 2	N – 1	N + 1	N + 2	
N _{min} + 3	70	66	66	70	A ₁ or A ₂ or A ₃ or A ₄
N _{mid}	70	66	66	70	
N _{max} – 3	70	66	66	70	
NOTES					
1 N _{min} = lowest channel of the receiver in the relevant band					
2 N _{mid} = middle channel of the receiver in the relevant band					
3 N _{max} = highest channel of the receiver in the relevant band					

For satellite television receivers the wanted and unwanted signals shall be of the same type and shall have the same modulation as described in 5.1.3. Their characteristics are as follows:

- A₁: channel spacing 38,36 MHz with a deviation sensitivity of 13,5 MHz/V and an energy dispersal of 0,6 MHz for MAC/packet receivers;
- A₂: channel spacing 29,5 MHz with a deviation sensitivity of 16 MHz/V and an energy dispersal of 2 MHz for PAL receivers;
- A₃: channel spacing 42 MHz with a deviation sensitivity of 22 MHz/V and an energy dispersal of 2 MHz for MAC/packet and SECAM receivers able to receive wide-band (33 MHz) signals;
- A₄: channel spacing 50 MHz with a deviation sensitivity of 22,5 MHz/V and an energy dispersal of 2 MHz for PAL receivers able to receive wideband (33 MHz) signals.

NOTE — The deviation sensitivity is defined for the zero decibel point of the pre-emphasis network and expressed in megahertz/volts.

Measurements with signal type A₄ do not need to be carried out if measurements with signal type A₂ are carried out.

A1 4.2.6 *Satellite sound receivers*

Satellite sound receivers shall be tested according to 5.6.5 at a tuned channel N and subject to an unwanted signal in channel M, as specified in table 17 and of signal type selected from A_1 , A_2 , A_3 or A_4 as appropriate.

The unwanted signal and the limits are the same as for satellite television receivers (see also 5.6.5).

4.3 *Screening effectiveness*

4.3.1 *Television receivers*

4.3.1.1 *Terrestrial receivers*

For terrestrial television receivers the screening effectiveness is measured according to 5.7 and the limit is 50 dB.

4.3.1.2 *Satellite receivers*

Under consideration.

4.3.2 *Sound receivers*

For terrestrial sound receivers the screening effectiveness is measured according to 5.7 and the limit is 20 dB at 98 MHz.

5 **Methods of measurement**

5.1 *General*

5.1.1 *Introduction*

In 5.2, 5.3, 5.4, 5.5 and 5.6, methods of immunity measurement are described for various interfering signals. Such an interfering signal may be in the form of an ambient field, a conducted current or a voltage present on a lead to one of the equipment terminals.

In practical situations, the equipment may be subject to a combination of these effects. An ambient field not only radiates into the equipment itself, but also induces current into connected cables to the equipment.

These currents enter the equipment at the connecting point of the cables and circulate through the chassis; therefore they may disturb various functions of the equipment. The currents in the connecting cables may further induce voltages at the input and output terminals of the equipment.

In order to measure the immunity characteristics of the equipment individually, instead of a complex combination of various equipment connected by cabling (installation), these immunity characteristics are described by separate measurements of the immunity to fields, currents and voltages respectively.

The methods described are applicable for certain ranges of frequency and equipment size. To cover the frequency range 150 kHz to 1 GHz, for ambient field methods, such fields can be generated in the lower part of the frequency range (up to one or a few hundred megahertz depending on the dimensions) by a TEM device (transverse electromagnetic device). For the upper part of the frequency range a radiating antenna is used, the size of which limits the lower end of the frequency range to a practical value just below 100 MHz.

The injected current and voltage methods are applicable to equipment with size and connected cable lengths which are small compared with the wavelength. Moreover, the input and output matching circuits also have a limited frequency range.

For the reasons mentioned above the following frequency ranges are to be considered:

External immunity:

Ambient field method:

- TEM device: 150 kHz to 150 MHz
- radiating antenna 150 MHz to 1 GHz

Current injection method: 150 kHz to 150 MHz

Voltage injection method: 150 kHz to 150 MHz

Internal immunity (under consideration).

Screening effectiveness (under consideration).

NOTE – In the case of equipment the size of which exceeds maximum dimensions, so that it is not compatible with the available TEM device, the radiating antenna method can be extended downwards to 80 MHz.

5.1.2 *Determination of the immunity characteristics*

In the measuring methods described in 5.2, 5.3, 5.4, 5.5 and 5.6, the interference in a picture channel is displayed on the picture tube. This avoids the connection of external measurement leads, which may influence the immunity characteristics.

The picture is disturbed by the interfering signal for which the immunity is to be determined and the immunity is defined by the level that causes just perceptible degradation of the test picture with respect to interference patterns, colour degradation and synchronization distortion.

The picture degradation is evaluated in a subjective way and the viewing distance shall be equal to six times the height of the screen (see CCIR Recommendation 500).

If there is any doubt as to whether the degradation is just perceptible, the interfering signal can be switched on and off a few times in order that its occurrence can be more readily determined.

This procedure is much simpler than a complicated objective measurement of picture quality and easier to reproduce than the subjective assessment according to picture quality scales (EBU or CCIR scales).

The sound degradation, however, is determined according to objective measures, because a subjective indication is not so easy as in a picture.

Immunity of sound receivers or of the sound channel of television receivers is defined by the interfering signal level that produces a specified signal-to-disturbance ratio, namely 40 dB for FM sound receivers and television receivers with AM or FM sound channel, 26 dB for AM sound receivers of the sound output signal, measured at the sound output terminals.

The audio output signal of the receiver under test is measured by a selective audio voltmeter (or an audio voltmeter following a suitable band-pass filter) connected directly to the receiver output terminals through a screened cable (ferrite-loaded if necessary).

In the case of receivers which are not equipped with output connectors it is particularly important to avoid the connection of external output meters or indicators. The picture tube or the built-in loudspeaker is used as the output instrument.

In this last case a small high quality microphone is placed close to the front of the loudspeaker. A directional type may be required.

The microphone output is fed through a screened cable (ferrite-loaded if necessary) to an external amplifier and a selective audio voltmeter to measure the sound output of the receiver under test.

5.1.3 *Standard input and interfering signals*

For a meaningful evaluation of the immunity characteristics, the receiver under test should operate under normal standardized conditions. In the case of television receivers particularly, the time-base and synchronization circuits shall function properly and the automatic frequency and gain controls shall also be active under normal operating conditions, therefore a standard input signal is required during the test.

The standard input signal causes the receiver to operate under normal conditions as far as time-base synchronization, automatic frequency and gain control circuits are concerned and produces a standardized picture for evaluating the degradation.

The standard input signal is supplied by a television signal generator producing a pattern consisting of vertical colour bars together with an unmodulated sound carrier (the sound carrier is modulated only for the calibration of the audio output, but not for the immunity test itself).

The colour bars shall be in accordance with CCIR Recommendation 471, the specific patterns used being stated with the results of measurements. For both video and audio components the signal furnished by the pattern generator shall be in accordance with the system relevant to the receiver under test.

The normal picture is obtained by setting the brightness, contrast and colour saturation controls for the following luminance values:

black bar	2 cd/m ²
magenta bar	30 cd/m ²
white bar	80 cd/m ² .

NOTE – The luminance of the magenta bar should be set to 30 cd/m². If this level cannot be reached, the luminance should be set to the maximum possible. If a value different from 30 cd/m² is used, it should be stated together with the results.

For calibration only, the sound carrier of the pattern generator is modulated with a 1 kHz audio signal according to the system for which the receiver under test is manufactured. In case of FM sound, the sound carrier is modulated with a frequency deviation which is 30 kHz.

In case of AM sound, the sound carrier is modulated to a depth of 30 %.

The same criteria apply for sound receivers.

Another aspect which influences the signal-to-disturbance ratio at the output is the modulation of the interfering signal. Therefore reproducible measurements require standardized signal modulation. For the measurements 80 % amplitude modulated interfering signals are used.

The standard input television signal of the receiver is adjusted to a level of 70 dB(μ V) referred to an impedance of 75 Ω to obtain a noise-free picture.

For receivers equipped with a telescopic antenna and measured according to figure 6 or 7, the level of the wanted field shall be: 60 dB(μ V/m) band I; 66 dB(μ V/m) band III; 72 dB(μ V/m) bands IV and V.

In the case of receivers provided with antenna input terminals, the standard wanted signal of 46 dB(μ V) e.m.f. shall be supplied directly to the antenna terminals (see figure 5).

For receivers provided with a telescopic or a ferrite built-in antenna, the wanted signal shall be supplied via a combiner at the input of the TEM device (see figure 6). In this case the output level of the wanted signal generator shall be adjusted to a field intensity inside the TEM device of 60 dB(μ V/m). The ferrite antenna of the receiver is orientated for the maximum signal.

5.1.4 *Reference audio output signal level*

The immunity of sound receivers or of the sound channel of television receivers is measured after calibration of the measuring set-up. For this purpose the modulated sound carrier at a specific level (see 5.1.3) is fed to the input of the receiver under test and the audio volume control is set for 50 mW output power, the other controls being in normal position. The 1 kHz output voltage thus noted is the reference audio output signal level.

5.2 *Measurement of the immunity to ambient electromagnetic fields in the frequency range 150 kHz to 150 MHz*

5.2.1 *Introduction*

Ambient electromagnetic fields may induce unwanted voltages or currents within the equipment, which can interfere with the wanted signal. Generally, either the magnetic or the electric component of an ambient electromagnetic field dominates at frequencies at the lower end of the spectrum ($f < 30$ MHz), depending on the source and on the standing wave patterns caused by nearby reflections.

At frequencies above 30 MHz, fields are usually characterized by free field conditions, i.e. with a constant wave impedance of $120 \pi \Omega$.

For the sake of reproducibility during the test of immunity to ambient fields, homogeneous fields with a specified relation between electric and magnetic components are necessary. In the frequency range up to 150 MHz the use of guided waves of the TEM mode is recommended. By matching the waveguide circuits properly, standing waves in the direction of propagation are small and a homogenous field of constant impedance results in the space through which the waves propagate when obstacles (equipment under test) are absent.

At frequencies above 150 MHz, the TEM devices are small and therefore not generally suitable for immunity measurements. In the frequency range 150 MHz to 1 GHz use is made of antenna radiated fields under standardized conditions.

It should be noted that, when the disturbance field is obtained by a radiating antenna, a horizontal polarization is generated, whereas when a TEM device is used, a vertical polarization is generated.

NOTE – In the case of equipment the size of which exceeds maximum dimensions compatible with the available TEM device or for comparison purposes, measurements on the radiation test site can be carried out in the frequency range 80 MHz to 1 GHz as described in 5.3.

Accurate and reproducible measurements require a standardized lay-out of input, output, auxiliary, and mains cabling and precautions to reduce their influence on the measurements as far as possible. In particular, in order to measure the influence of ambient fields on single electronic equipment, the interaction of the connected elements (cables, generators, output indicators, etc.) should be eliminated or, if this is not possible for practical reasons, the effect should be taken into account by means of a reproducible test set-up.

Terminals not used during the measurement are terminated with shielded resistors matching the nominal load impedance.

External unwanted fields can induce signals which coincide with wanted signal frequencies (tuned RF band, IF band, VF or AF range) and interfere with them at levels at which the circuits operate in a linear mode. In these cases the interfering signal is of the same order of magnitude as the wanted signal. Unwanted signals at different frequencies and at much higher levels, however, may generate intermodulation signals because of non-linear operation of the circuits which results in higher immunity levels for these frequencies.

5.2.2 Systems for guided waves (TEM devices)

A homogeneous electromagnetic wave under free space conditions can be generated by a guided wave of the TEM mode travelling between two flat conductors. In this case the electric field component is perpendicular to the conductors, the magnetic field component is parallel to the conductors and both components are perpendicular to the longitudinal direction of propagation. The simplest system is formed by an open stripline (figure 1). Although the wave impedance is constant ($E/H = 120 \pi \Omega$) the characteristic impedance between the conductors is dependent on the height-to-width ratio h/w . A stripline, with constructional details, is shown in figures 2a, 2b and 2c.

An alternative system is the closed TEM device shown in figures 3a, 3b and 3c, which is actually a coaxial system with a rectangular outer conductor and a plate-shaped inner conductor.

To avoid standing waves in the longitudinal direction the empty TEM devices should be matched to the load and generator impedances by means of appropriate tapered transitions. The voltage standing wave ratio of the unloaded TEM device should be less than 1,2.

The frequency range of the TEM device is restricted by its vertical dimensions. At frequencies equal to or higher than the frequency at which the height h equals $\lambda/2$, higher order modes can occur which give rise to reflections and therefore to non-uniform field distributions.

Moreover, the radiation outwards of the open TEM device will increase considerably. Therefore the frequency range of a TEM device with $h = 1$ m is restricted to frequencies up to 150 MHz. By loading part of the device internally with absorbing material the frequency range can be extended by 25 % to 50 %.

During the measurement the equipment under test should not disturb the field configuration substantially. If an apparatus containing metal parts is placed inside the TEM device, this reduces the effective distance between the plates and increases the field strength accordingly. It also results in a standing wave pattern in the longitudinal direction. The overall effect depends on the height of the equipment and the percentage of metal in contains. As a rule, the vertical dimension of the test item should not be higher than two-thirds of the height h , especially if the equipment contains metallic parts of large vertical size.

The transfer factor h_t of a TEM device is the ratio between input voltage U_{in} and field strength E :

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

This transfer factor should be calibrated as a function of frequency for each individual TEM device. As a guide, the transfer factor approximate the actual distance h between the plates of the TEM device.

In the open stripline device as well as in the closed TEM device, a TEM field is generated between the conductor plates. The field is substantially homogeneous in the centre part of the device with some distortion of the field configuration at the edges of the plates. In this respect the two types of TEM device do not differ essentially.

In the upper part of the frequency range ($h \approx \lambda/2$) higher modes are generated. This causes a standing wave pattern inside the device, whereas in the open stripline device part of the energy is radiated outwards. Nearby objects may reflect this radiated energy and distort the internal field configuration which results in frequency dependent variations in the calibration curve of the open stripline device. It has been found, however, that such field distortions can be suppressed adequately by placing some absorbing panels around the stripline device. If outward radiation is not permitted the open stripline device should be placed in a screened room. In this case absorbing panels around the stripline device are required (for example panels with resistive material $200\Omega/\square$).

Important practical advantages of the open stripline device are: easy accessibility for the equipment to be tested, visual control of the apparatus under test (observation of the picture screen), the total height is half of the height of an equivalent closed TEM device, the construction is simple.

For this reason the use of an open stripline device, with a height of 0,8 m between the plates and a construction according to figures 2a, 2b and 2c, is recommended as a standard device for field measurements. The use of a closed TEM device according to figures 3a, 3b and 3c is accepted as an alternative.

The calibration procedure of a TEM device is given in annex A.

5.2.3 *Measurement of the immunity of television receivers*

5.2.3.1 *General*

Although measurements according to the procedure laid down in 5.2.3 are restricted to the interfering signal frequency range below 150 MHz, this procedure also applies to receivers with tuning frequencies above 150 MHz in which case 5.2.3.3 does not apply as far as the measurement in the tuned channel is concerned.

In the following measuring procedures the television receiver is used during the measurements as an indicating instrument which displays a standard picture.

5.2.3.2 *Measuring set-up*

For an open TEM device a space equal to at least 0,8 m shall be left between the longitudinal side of the open TEM device and walls, ceiling, floor and other objects. In an open device reflected disturbance fields may influence the calibration of the device and the measurements. If such a device is placed inside a screened room the distance between the base-plate of the device and the metal floor of the shielded room should be approximately 0,8 m. In order to suppress the influence of reflections, absorbing material shall be placed in the space between the stripline device and the walls of the screened room. Figure 4 shows the arrangement of the stripline device in a screened room.

The equipment under test is placed on a non-metallic support in the centre of the TEM device (see figure 5). The distance to the bottom plate (earth plate) is 0,10 m. The side of the equipment containing the screen of the tube is parallel to the axis of the TEM device so that it can be observed by the operator.

The mains or other power supply lead is inserted through a hole in the bottom plate, the length inside the TEM device is as short as possible and completely surrounded by ferrite toroids in order to attenuate induced currents. In the same way a coaxial cable, having a transfer impedance of maximally 50 mΩ/m at 30 MHz and loaded with ferrites, is connected through the bottom to the input connectors. In case of receivers equipped with a balance input only, the balance-to-unbalance transformer is connected to the receiver antenna terminals with leads as short as possible.

In case of receivers equipped with a telescopic antenna and without an antenna input terminal, the wanted signal shall be transmitted by means of an appropriate RF field. Such a field should be fed to the TEM device combined with the interfering signal according to the circuit of figure 6. If an open TEM device is used, it is also possible to generate externally a radiated field according to figure 7, which case supplementary equipment for signal radiation is placed outside the open TEM device.

NOTE – In the case of receivers with a telescopic antenna and without an antenna input terminal, this method is only suitable for measuring the immunity in the IF frequency range.

Terminals not used during the measurement are terminated with shielded resistors matching the nominal terminal impedance.

The input of the receiver under test and the input of the TEM device are fed with signals from the circuit of figure 8.

In figure 8 the wanted signal is supplied by a television signal generator (P) producing a pattern together with a tone, produced by the generator (Ga), in accordance with 5.1.3.

The RF output of the pattern generator (P) is connected to the input of the receiver.

A second RF generator (G1) simulates the disturbance source and is connected via the switch S1 to the TEM device. This generator shall supply a modulated signal in accordance with 5.1.3.

NOTE – The disturbance effect is often in the form of horizontal bars. The modulation frequency shall be adjusted in order to obtain horizontal bars slowly rolling over the screen of the television receiver.

The switch S1 can be operated manually or automatically by an electronic timer at a low switching speed. This facilitates the adjustment of the level which produces a just perceptible degradation in the picture (see 5.1.2).

It may be necessary to insert an RF wideband amplifier (Am) at the input of the TEM device in order to raise the disturbance field strength to an adequate level for the immunity measurements. Care should be taken with respect to the harmonic level of the RF output of the generator and particularly of the output of the wideband amplifier. Harmonics might influence the measurement if they coincide with the tuned channel or the IF channel of the receiver under test. In some cases provision should be made to reduce the harmonic level adequately by inserting suitable low-pass filters at the input of the TEM device. This can be checked according to the procedure described in B.3.

5.2.3.3 *Measurement of the immunity in the tuned RF channel and IF frequency band*

The circuit of figure 8 is used.

The television receiver and the wanted signal generator (P) are tuned to the relevant television channel, which should be the channel in band I which is nearest to the centre of the band and additionally, for those receivers which can be tuned to non-standard channels between band I and band III, the channel of that special band which is nearest to the centre of that band.

Television receivers capable of tuning only to Bands IV and V (e.g. television receivers for system I) are tuned on the channel nearest to the centre of Bands IV-V.

The measurement procedure is the following.

All controls are in the normal or average position.

The frequency of the disturbance generator (G1) is set at a frequency about 1 MHz from the wanted picture carrier towards the sound carrier. The disturbance output level should be sufficiently high to produce a clearly noticeable interference in the picture. Then the frequency of the generator is adjusted to obtain a pattern consisting of lines at 45° with respect to the scanning lines to obtain a maximum disturbance effect. The generator frequency should be sufficiently stable to produce a stationary pattern. Subsequently the output level is reduced to give a just perceptible degradation in the picture (see 5.1.2).

The corresponding field strength level E is assumed as the level of immunity to ambient fields.

Then the procedure is repeated with the wanted signal generator tuned to the centre channel in Band I and the disturbance generator adjusted at a frequency about 1 MHz from the IF picture carrier towards the sound carrier, producing a similar interference pattern.

NOTE – The immunity in the tuned RF channel frequency range does not apply to receivers without antenna terminals.

5.2.3.4 *Measurement of the immunity outside the tuned RF channel and IF frequency band*

Contrary to the measurement as performed according to 5.2.3.3 in which the interfering signal falls in the tuned RF or IF channel (linear operation), interfering signals outside these channels may generate VF or AF components by non-linear operation (inter-modulation and detection).

In principle these interfering signals can be produced at any point in the receiver (tuner, IF, VF, AF stages, etc.). In particular amplitude-modulated signals have a high disturbing potential when the demodulated signal falls in the video or audio range.

The frequency of the disturbance generator is swept manually and slowly through the desired frequency ranges, as given for example in table C.1, test Nos. 4 to 7 (annex C). The output level should be sufficiently high to locate frequencies of minimum immunity by observing the picture and the audio output signal.

The tests may be performed by automatic frequency sweeping in order to find the range of weak immunity in a fast manner. It shall be established, however, that the fast sweeping technique gives the same results as the slow manual sweep.

Suitable sweeping techniques are under consideration.

For the immunity measurement of the video circuits of the television receiver outside the RF and IF frequency bands the measuring circuit as shown in figure 8 is to be used.

For this measurement the television receiver and the pattern generator are tuned to the same VHF channel for which the measurements according to 5.2.3.3 are carried out. The interfering signal should be tuned between 150 kHz and 150 MHz with the exclusion of the IF band and the VHF reception band.

The output of the disturbance generator (G1) is adjusted to the level which causes a just perceptible degradation in the picture according to 5.1.2 and the corresponding field strength level E is the level of immunity to ambient fields of the video circuits of the receiver.

For the immunity measurement of the sound circuits of the receiver, the measuring circuit shown in figure 8 is to be used.

The sound carrier is modulated according to 5.1.3 and the input standard signal frequency is adjusted for normal operation in the channel indicated in 5.2.3.3. The set-up is calibrated in accordance with 5.1.4.

Then the modulation signal generator (Ga) is disconnected from the wanted signal generator (P) and connected to the disturbance generator (G1). The interfering signal is swept through the frequency range 150 kHz to 150 MHz with the exclusion of the IF band and the VHF reception band.

The output level of the disturbance generator is adjusted for a signal-to-disturbance ratio measured at the audio output as specified in 5.1.2 and the corresponding field strength level E is the level of immunity to ambient fields of the sound circuits of the receiver.

The lower of the two measured field strength levels (video and sound circuits respectively) is the level of immunity to ambient fields outside the RF tuned channel and IF frequency range.

These tests have to be performed in several steps using suitable low-pass filters (see table C.1, annex C).

5.2.4 *Measurement of the immunity of sound receivers*

5.2.4.1 *General*

Lack of immunity of the RF stages of AM and FM receivers to co-channel RF interfering signals does not produce the same effect as in the case of television receivers where ghost signals may appear on the picture screen. For this reason no recommendation for the measurement of RF stages of sound receivers is made, but the method is similar to the measurement as described in 5.2.4.3.

However, in the case of FM receivers that are connected to large wired distribution systems, the FM tuner immunity in the reception channels is an important topic that should be taken into consideration (utilization of the channels in the distribution system that are occupied by local or powerful regional transmitters). A test procedure is under consideration.

The immunity of IF stages of FM receivers to radio frequency disturbances is also of little significance because of the limiter action of such receivers which results in favourable immunity characteristics.

In the case of AM receivers, however, the immunity to penetrating IF signals is very important. A measuring method for the immunity of IF stages of AM receivers to interfering signals is described in 5.2.4.2.

5.2.4.2 *Measurement of the immunity of AM receivers in the IF band*

The measuring set-up is similar to that of figure 5 used for the measurement of television receivers (see 5.2.3.2), and the circuit is shown in figure 9. The receiver shall be positioned with its front side parallel to the longitudinal axis of the TEM device.

The receiver is tuned to a frequency in the centre of the medium waveband. All controls, except for the volume control, are set in normal or average position.

The wanted standard input signal is fed to the receiver from an RF generator amplitude modulated according to 5.1.3.

The receiver audio output signal is measured according to 5.1.2 and the set-up is calibrated as indicated in 5.1.4.

The volume control is kept in this position during the test.

The interfering signal, modulated according to 5.1.3, is fed to the TEM device. In the case of receivers with built-in ferrite antennas this interfering signal is combined with the wanted signal.

The disturbance generator is tuned at the nominal IF frequency. Care should be taken that both the wanted and unwanted signal generators are sufficiently stable and tuned in such a way that the two carriers do not produce a beat frequency during the measurement which falls into the pass-band of the selective audio voltmeter or of the 1 kHz band-pass filter. The output of the disturbance generator is adjusted to a level for an audio output signal-to-disturbance ratio according to 5.1.2. The corresponding field strength level E is the level of immunity to ambient fields.

5.2.4.3 *Measurement of the immunity of sound receivers outside the IF band*

The test set-up for AM and FM receivers is the same as described in 5.2.3.2 and shown in figure 5. The circuit is shown in figure 9.

The receiver is tuned to a frequency in the centre of the MW and/or FM band, depending on the type of receiver under test. The wanted input signal is adjusted at the standard level (see 5.1.3) and tuned to the same frequency at which the receiver is set. The receiver audio output signal is measured according to 5.1.2 and the set-up is calibrated as indicated in 5.1.4.

The disturbance generator is swept through the frequency range 150 kHz to 150 MHz with the exclusion of the IF band and the tuned RF channel. The output level shall be sufficiently high to locate frequencies of minimum immunity by observing the audio output signal.

Then the output level of the disturbance generator is adjusted according to 5.2.4.2 and the corresponding field strength level E is the level of immunity to ambient fields.

NOTE – It may be necessary to insert appropriate band-pass filters at the input of the TEM device. For instance, FM receivers should be tested in the frequency range 150 kHz to 150 MHz in two steps:

- from 150 kHz to 87.5 MHz (frequencies below the FM band) through a filter with a cut-off frequency of 87.5 MHz;
- above 87.5 MHz without any filter.

5.2.5 *Measurement of the immunity of equipment associated with sound and television receivers*

5.2.5.1 *General*

This sub-clause relates to equipment such as audio amplifiers, audio tape recorders, record players and video recorders. Equipment which is designed to fulfil a number of purposes is known as multi-function equipment and is dealt with in 5.2.5.7.

The equipment covered by this sub-clause is often designed to interface with other units to operate as a system, although each equipment may be sold separately. Each equipment shall be assessed as a single item. The assembly of a system does not need to be assessed as a single entity.

The test set-up and circuit for various types of equipment shall be as described in 5.2.3.2 and as shown in figure 10. Any input and output terminals not in use during the measurement shall be terminated with appropriate load resistors as specified by the manufacturer or in the relevant standard.

The volume control of the equipment shall be adjusted as explained in the following measurement procedure. The other controls shall be set in normal or average position.

Measurement of immunity shall be carried out in the 150 kHz to 150 MHz frequency range at those specific frequencies at which the immunity has minimum values. The audio output signal is measured in accordance with 5.1.2.