

Specification for radio disturbance and immunity measuring apparatus and methods —

Part 1-1: Radio disturbance and immunity measuring apparatus — Measuring apparatus

The European Standard EN 55016-1-1:2004, with the incorporation of amendment A1:2005, has the status of a British Standard

ICS 33.100.10; 33.100.20

National foreword

This British Standard is the official English language version of EN 55016-1-1:2004, including amendment A1:2005. It is identical with CISPR 16-1-1:2003, including amendment 1:2005. Together with BS EN 55016-1-2:2004, BS EN 55016-1-3:2004, BS EN 55016-1-4:2004 and BS EN 55016-1-5:2004 it supersedes BS CISPR 16-1:1999 which will be withdrawn on 2007-09-01.

The standards in the new BS EN 55016 series referred to above have been produced following the publication by CISPR of a new multi-part edition of CISPR 16 and constitute an editorial reorganization of CISPR 16 without technical changes. This has resulted in the BS CISPR 16 series being replaced as follows:

BS CISPR 16-1:1999 replaced by BS EN 55016-1-1:2004, BS EN 55016-1-2:2004, BS EN 55016-1-3:2004, BS EN 55016-1-4:2004 and BS EN 55016-1-5:2004.

BS CISPR 16-2:1996 replaced by BS EN 55016-2-1:2004, BS EN 55016-2-2:2004, BS EN 55016-2-3:2004 and BS EN 55016-2-4:2004.

BS CISPR 16-3:2000 replaced by PD CISPR/TR 16-3:2003, PD CISPR/TR 16-4-1:2003, PD CISPR/TR 16-4-3:2003 and PD CISPR/TR 16-4-4:2003.

BS CISPR 16-4:2002 replaced by BS EN 55016-4-2:2004.

The start and finish of text introduced or altered by IEC amendment is indicated in the text by tags A1 A1. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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English version

**Specification for radio disturbance and immunity
measuring apparatus and methods
Part 1-1: Radio disturbance and immunity measuring apparatus -
Measuring apparatus
(CISPR 16-1-1:2003)**

Spécifications des méthodes et des appareils
de mesure des perturbations radioélectriques
et de l'immunité aux perturbations
radioélectriques
Partie 1-1: Appareils de mesure
des perturbations radioélectriques
et de l'immunité aux perturbations
radioélectriques –
Appareils de mesure
(CISPR 16-1-1:2003)

Anforderungen an Geräte und Einrichtungen
sowie Festlegung der Verfahren zur Messung
der hochfrequenten Störaussendung
(Funkstörungen) und Störfestigkeit
Teil 1-1: Geräte und Einrichtungen
zur Messung der hochfrequenten
Störaussendung (Funkstörungen)
und Störfestigkeit –
Messgeräte
(CISPR 16-1-1:2003)

This European Standard was approved by CENELEC on 2004-09-01. 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.

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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

Foreword

The text of the International Standard CISPR 16-1-1:2003, prepared by CISPR SCA, Radio-interference measurements and statistical methods, was submitted to the formal vote and was approved by CENELEC as EN 55016-1-1 on 2004-09-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard CISPR 16-1-1:2003 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of document CISPR/A/579/FDIS, future amendment 1 to CISPR 16-1-1:2003, prepared by CISPR SC A, Radio-interference measurements and statistical methods, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 55016-1-1:2004 on 2005-07-01.

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at national level by publication of an identical
national standard or by endorsement (dop) 2006-04-01
- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2008-07-01

Endorsement notice

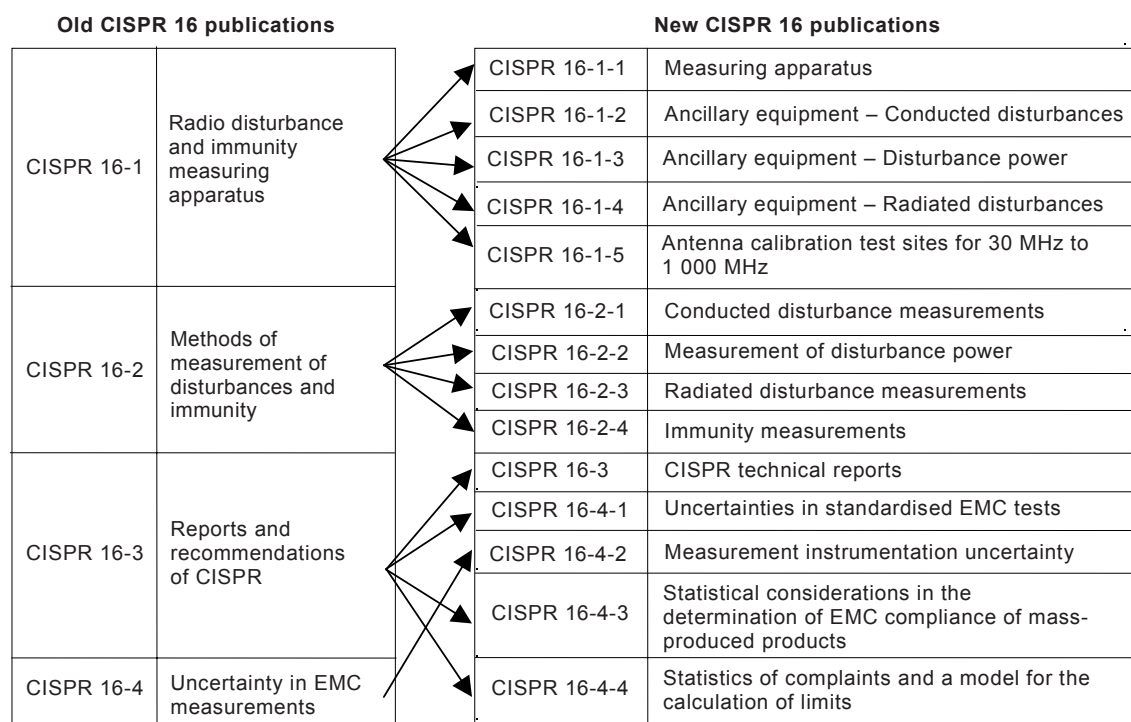
The text of amendment 1:2005 to the International Standard CISPR 16-1-1:2003 was approved by CENELEC as an amendment to the European Standard without any modification.

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INTRODUCTION

CISPR 16-1, CISPR 16-2, CISPR 16-3 and CISPR 16-4 have been reorganised into 14 parts, to accommodate growth and easier maintenance. The new parts have also been renumbered. See the list given below.



More specific information on the relation between the 'old' CISPR 16-1 and the present 'new' CISPR 16-1-1 is given in the table after this introduction (TABLE RECAPITULATING CROSS REFERENCES).

Measurement instrumentation specifications are given in five new parts of CISPR 16-1, while the methods of measurement are covered now in four new parts of CISPR 16-2. Various reports with further information and background on CISPR and radio disturbances in general are given in CISPR 16-3. CISPR 16-4 contains information related to uncertainties, statistics and limit modelling.

CISPR 16-1 consists of the following parts, under the general title *Specification for radio disturbance and immunity measuring apparatus and methods – Radio disturbance and immunity measuring apparatus*:

Part 1-1: Measuring apparatus,

Part 1-2: Ancillary equipment – Conducted disturbances,

Part 1-3: Ancillary equipment – Disturbance power,

Part 1-4: Ancillary equipment – Radiated disturbances,

Part 1-5: Antenna calibration test sites for 30 MHz to 1 000 MHz.

TABLE RECAPITULATING CROSS-REFERENCES

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SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY MEASURING APPARATUS AND METHODS –

Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus

1 Scope

This part of CISPR 16 is designated a basic standard, which specifies the characteristics and performance of equipment for the measurement of radio disturbance voltages, currents and fields in the frequency range 9 kHz to 18 GHz. In addition, requirements are specified for specialized equipment for discontinuous disturbance measurements. The requirements include the measurement of broadband and narrowband types of radio disturbance.

The receiver types covered include the following:

- a) the quasi-peak measuring receiver,
- b) the peak measuring receiver,
- c) the average measuring receiver,
- d) the r.m.s. measuring receiver.

In addition there are specifications for spectrum analyzers, scanning receivers and audio-frequency voltmeters.

The requirements of this publication shall be complied with at all frequencies and for all levels of radio disturbance voltages, currents, power or field strengths within the CISPR indicating range of the measuring equipment.

Methods of measurement are covered in Part 2, and further information on radio disturbance is given in Part 3 of CISPR 16. Uncertainties, statistics and limit modelling are covered in Part 4 of CISPR 16.

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 11:2003, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 14-1:2000, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 16-1-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-1-3:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-3: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Disturbance power*

CISPR 16-1-4:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment - Radiated disturbances*

CISPR 16-1-5:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-5: Radio disturbance and immunity measuring apparatus – Antenna calibration test sites for 30 MHz to 1 000 MHz*

CISPR 16-2-1:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of immunity and disturbance – Conducted disturbance measurements*

CISPR 16-2-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-2: Methods of measurement of immunity and disturbance – Measurement of disturbance power*

CISPR 16-2-3:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of immunity and disturbance – Radiated disturbance measurements*

CISPR 16-2-4:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-4: Methods of measurement of immunity and disturbance – Immunity measurements*

CISPR 16-3:2003, *Specification for radio disturbance and Immunity measuring apparatus and methods – Part 3: CISPR technical reports*

CISPR 16-4-1:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-1: Uncertainties, statistics and limit modelling – Uncertainties in standardized EMC tests*

CISPR 16-4-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty*

CISPR 16-4-3:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-3: Uncertainties, statistics and limit modelling – Statistical considerations in the determination of EMC compliance of mass-produced products*

CISPR 16-4-4:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-4: Uncertainties, statistics and limit modelling – Statistics of complaints and a model for the calculation of limits*

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*
Amendment 1:1997 and Amendment 2:1998

IEC 60315-3:1999, *Methods of measurement or radio receivers for various classes of emissions – Part 3: Receivers for amplitude-modulated sound-broadcasting emissions*

IEC 60315-4:1997, *Methods of measurement or radio receivers for various classes of emissions – Part 4: Radio-frequency measurements on receivers for frequency modulated sound-broadcasting emissions*

ITU-R Recommendation BS.468-4:1986, *Measurement of audio-frequency noise voltage level in sound broadcasting*

ITU-T Recommendation P. 53 of *Blue Book* (1989), Volume V – *Psophometers (apparatus for the objective measurement of circuit noise)*. See also ITU-R Rec. O.41 (10/94).

3 Definitions

For the purpose of this part of CISPR 16, the following definitions apply. Also see IEC 60050(161).

3.1

bandwidth (B_n)

the width of the overall selectivity curve of the receiver between two points at a stated attenuation, below the midband response. The bandwidth is represented by the symbol B_n , where n is the stated attenuation in decibels.

3.2

impulse bandwidth (B_{imp})

$$B_{\text{imp}} = A(t)_{\text{max}} / (2 G_o \times IS)$$

where

$A(t)_{\text{max}}$ is the peak of the envelope at the IF output of the receiver with an impulse area IS applied at the receiver input;

G_o is the gain of the circuit at the centre frequency.

Specifically for two critically-coupled tuned transformers,

$$B_{\text{imp}} = 1,05 \times B_6 = 1,31 \times B_3$$

where

B_6 and B_3 are respectively the bandwidths at the -6 dB and -3 dB points (see clause A.2 in annex A for further information).

3.3

impulse area (IS)

the impulse area (sometimes called impulse strength, IS) is the voltage-time area of a pulse defined by the integral:

$$IS = \int_{-\infty}^{+\infty} V(t) dt \text{ (expressed in } \mu\text{Vs or dB}(\mu\text{Vs))}$$

NOTE Spectral density (D) is related to impulse area and expressed in $\mu\text{V/MHz}$ or $\text{dB}(\mu\text{V/MHz})$. For rectangular impulses of pulse duration T at frequencies $f \ll 1/T$, the relationship $D (\mu\text{V/MHz}) = 2 \times 10^6 IS (\mu\text{Vs})$ applies.

3.4

electrical charge time constant (T_C)

the time needed after the instantaneous application of a constant sine-wave voltage to the stage immediately preceding the input of the detector for the output voltage of the detector to reach 63 % of its final value

NOTE This time constant is determined as follows: A sine-wave signal of constant amplitude and having a frequency equal to the mid-band frequency of the i.f. amplifier is applied to the input of the stage immediately preceding the detector. The indication, D , of an instrument having no inertia (e.g., a cathode-ray oscilloscope) connected to a terminal in the d.c. amplifier circuit so as not to affect the behaviour of the detector, is noted. The level of the signal is chosen such that the response of the stages concerned remains within the linear operating range. A sine-wave signal of this level, applied for a limited time only and having a wave train of rectangular envelope is gated such that the deflection registered is 0,63D. The duration of this signal is equal to the charge time of the detector.

3.5 electrical discharge time constant (T_D)

the time needed after the instantaneous removal of a constant sine-wave voltage applied to the stage immediately preceding the input of the detector for the output of the detector to fall to 37 % of its initial value

NOTE The method of measurement is analogous to that for the charge time constant, but instead of a signal being applied for a limited time, the signal is interrupted for a definite time. The time taken for the deflection to fall to 0,37D is the discharge time constant of the detector.

3.6 mechanical time constant (T_M) of a critically damped indicating instrument

$$T_M = T_L / 2\pi$$

where

T_L is the period of free oscillation of the instrument with all damping removed.

NOTE 1 For a critically damped instrument, the equation of motion of the system may be written as:

$$T_M^2 (d^2\alpha / dt^2) + 2T_M (d\alpha / dt) + \alpha = ki$$

where

α is the deflection;

i is the current through the instrument;

k is a constant.

It can be deduced from this relation that this time constant is also equal to the duration of a rectangular pulse (of constant amplitude) that produces a deflection equal to 35 % of the steady deflection produced by a continuous current having the same amplitude as that of the rectangular pulse.

NOTE 2 The methods of measurement and adjustment are deduced from one of the following:

- The period of free oscillation having been adjusted to $2\pi T_M$, damping is added so that $\alpha T = 0,35\alpha_{\max}$.
- When the period of oscillation cannot be measured, the damping is adjusted to be just below critical such that the overshoot is not greater than 5 % and the moment of inertia of the movement is such that $\alpha T = 0,35\alpha_{\max}$.

3.7 overload factor

the ratio of the level that corresponds to the range of practical linear function of a circuit (or a group of circuits) to the level that corresponds to full-scale deflection of the indicating instrument

The maximum level at which the steady-state response of a circuit (or group of circuits) does not depart by more than 1 dB from ideal linearity defines the range of practical linear function of the circuit (or group of circuits).

3.8 symmetric voltage

in a two-wire circuit, such as a single-phase mains supply, the symmetric voltage is the radio-frequency disturbance voltage appearing between the two wires. This is sometimes called the differential mode voltage. If V_a is the vector voltage between one of the mains terminals and earth and V_b is the vector voltage between the other mains terminal and earth, the symmetric voltage is the vector difference ($V_a - V_b$)

3.9 CISPR indicating range

it is the range specified by the manufacturer which gives the maximum and the minimum meter indications within which the receiver meets the requirements of this section of CISPR 16

4 Quasi-peak measuring receivers for the frequency range 9 kHz to 1 000 MHz

The receiver specification depends on the frequency of operation. There is one receiver specification covering the frequency range 9 kHz to 150 kHz (band A), one covering 150 kHz to 30 MHz (band B), one covering 30 MHz to 300 MHz (band C), and one covering 300 MHz to 1 000 MHz (band D).

4.1 Input impedance

The input circuit of measuring receivers shall be unbalanced. For receiver control settings within the CISPR indicating range, the input impedance shall be nominally 50 Ω with a v.s.w.r. not to exceed 2,0 to 1 when the RF attenuation is 0 and 1,2 to 1 when the RF attenuation is 10 dB or greater.

Symmetric input impedance in the frequency range 9 kHz to 30 MHz: to permit symmetrical measurements a balanced input transformer is used. The preferred input impedance for the frequency range 9 kHz to 150 kHz is 600 Ω . This symmetric input impedance may be incorporated either in the relevant symmetrical artificial network necessary to couple to the receiver or optionally in the measuring receiver.

4.2 Fundamental characteristics

The responses to pulses as specified in 4.4 are calculated on the basis of the measuring receivers having the following fundamental characteristics.

Table 1 – Fundamental characteristics of quasi-peak receivers

Characteristics	Frequency band		
	Band A 9 kHz to 150 kHz	Band B 0,15 MHz to 30 MHz	Bands C and D 30 MHz to 1 000 MHz
Bandwidth at the –6 dB points, B_6 in kHz	0,20	9	120
Detector electrical charge time constant, in ms	45	1	1
Detector electrical discharge time constant, in ms	500	160	550
Mechanical time constant of critically damped indicating instrument, in ms	160	160	100
Overload factor of circuits preceding the detector, in dB	24	30	43,5
Overload factor of the d.c. amplifier between detector and indicating instrument, in dB	6	12	6
NOTE 1 The definition of mechanical time constant (see 3.6) assumes that the indicating instrument is linear, i.e., equal increments of current produce equal increments of deflection. An indicating instrument having a different relation between current and deflection may be used provided that the instrument satisfies the requirements of this subclause. In an electronic instrument, the mechanical time-constant may be simulated by a circuit.			
NOTE 2 No tolerance is given for the electrical and mechanical time constants. The actual values used in a specific receiver will be determined by the design to meet the requirements in 4.4			

4.3 Sine-wave voltage accuracy

The accuracy of measurement of sine-wave voltages shall be better than ± 2 dB when supplied with a sine-wave signal at 50 Ω resistance source impedance.

4.4 Response to pulses

NOTE Annexes B and C describe methods for determining the output characteristics of a pulse generator for use in testing the requirements of this subclause.

4.4.1 Amplitude relationship (absolute calibration)

The response of the measuring receiver to pulses of impulse area of a) μVs (microvolt second) e.m.f. at 50 Ω source impedance, having a uniform spectrum up to at least b) MHz, repeated at a frequency of c) Hz shall, for all frequencies of tuning, be equal to the response to an unmodulated sine-wave signal at the tuned frequency having an e.m.f. of r.m.s. value 2 mV (66 dB(μV)). The source impedances of the pulse generator and the signal generator shall both be the same. A tolerance of $\pm 1,5$ dB shall be permitted on the sine-wave voltage level.

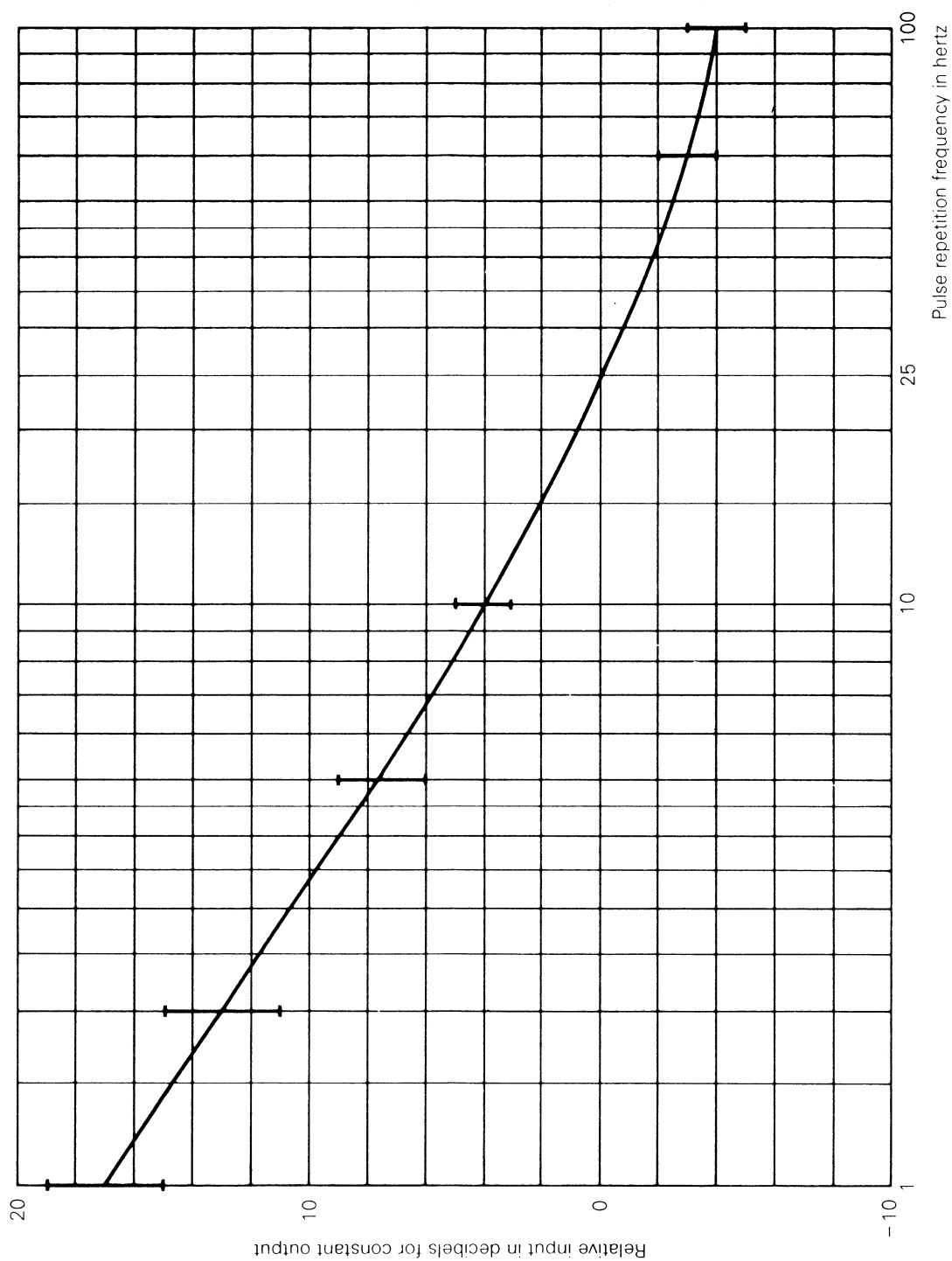
NOTE A lower impulse area may be used together with a proportionally lower amplitude for the unmodulated sinewave input, provided sufficient signal-to-noise ratio is maintained.

Table 2 – Test pulse characteristics for quasi-peak measuring receivers

Frequency range	a) μVs	b) MHz	c) Hz
9 kHz to 150 kHz	13,5	0,15	25
0,15 MHz to 30 MHz	0,316	30	100
30 MHz to 300 MHz	0,044	300	100
300 MHz to 1 000 MHz	0,044	1 000	100

4.4.2 Variation with repetition frequency (relative calibration)

The response of the measuring receiver to repeated pulses shall be such that for a constant indication on the measuring receiver, the relationship between amplitude and repetition frequency is in accordance with figures 1a, 1b or 1c.



IEC 1290/99

Figure 1a – Pulse response curve (Band A)

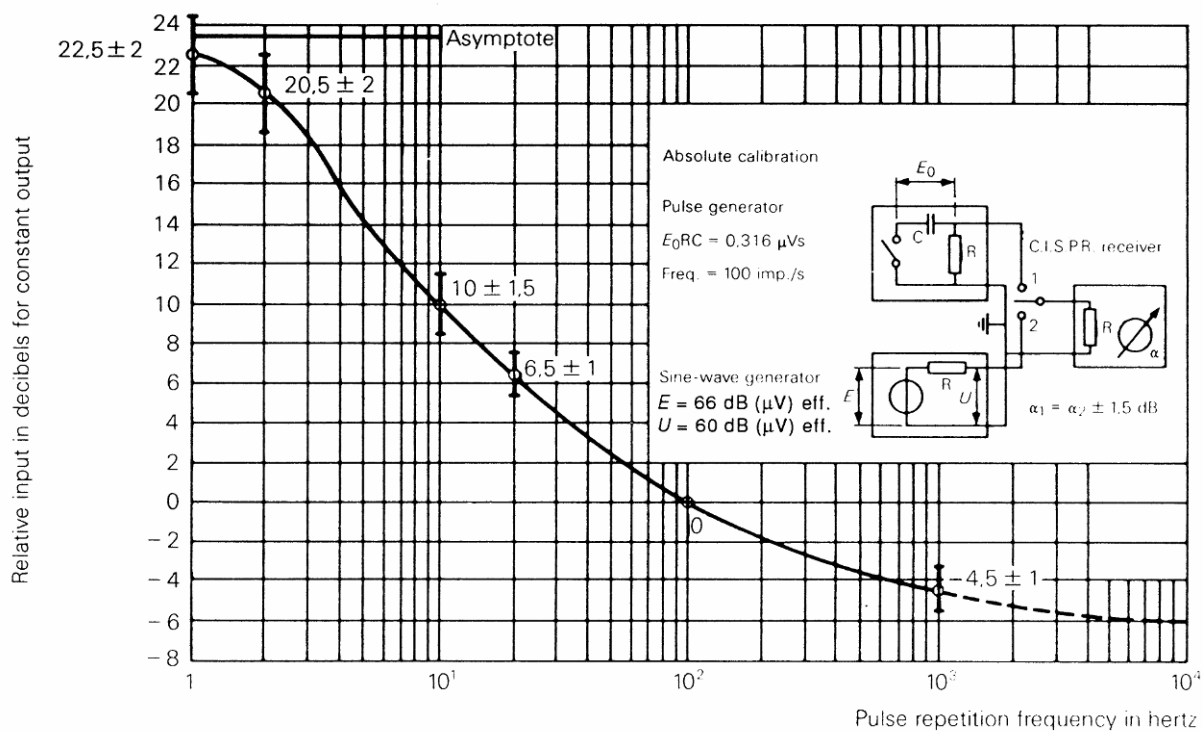


Figure 1b – Pulse response curve (Band B)

IEC 1291/99

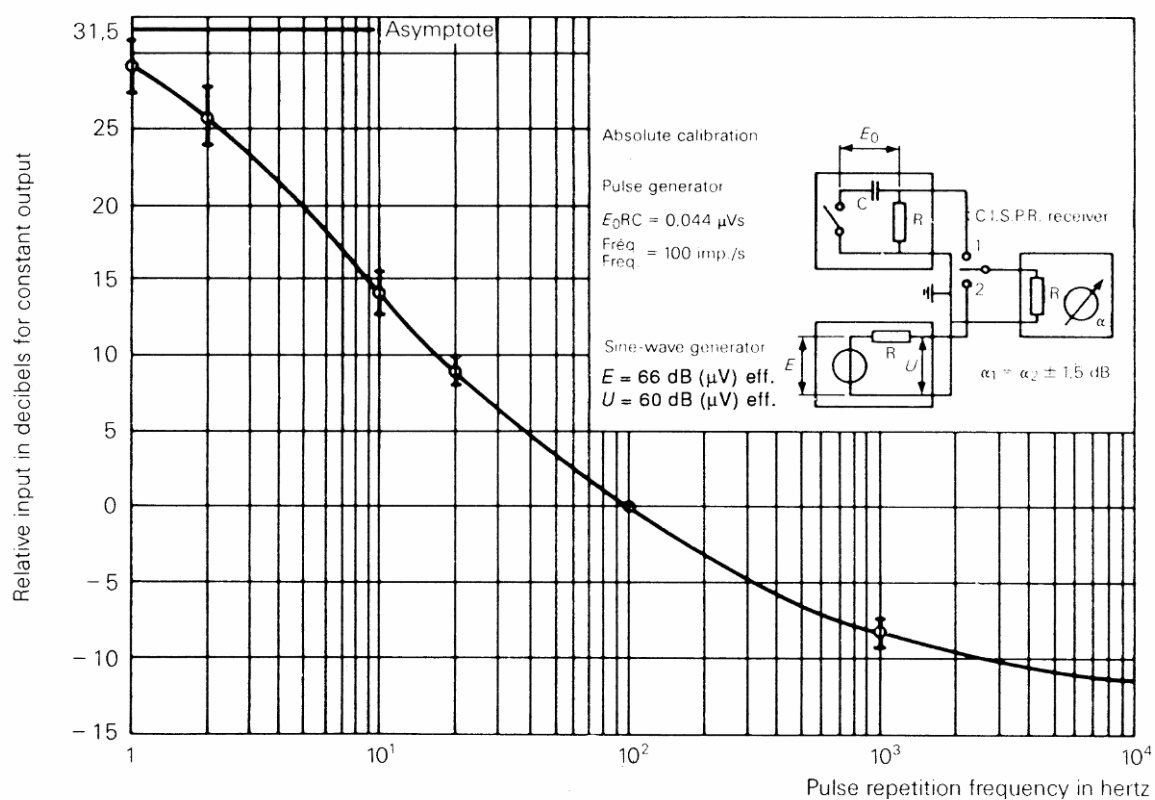


Figure 1c – Pulse response curve (Bands C and D)

The response curve for a particular measuring receiver shall lie between the limits defined in the appropriate figure and quantified in table 3.

Table 3 – Pulse response of quasi-peak receivers

Repetition frequency Hz	Relative equivalent level in dB of pulse for stated band			
	Band A 9 kHz to 150 kHz	Band B 0,15 MHz to 30 MHz	Band C 30 MHz to 300 MHz	Band D 300 MHz to 1 000 MHz
1 000	Note 4	$-4,5 \pm 1,0$	$-8,0 \pm 1,0$	$-8,0 \pm 1,0$
100	$-4,0 \pm 1,0$	0 (ref.)	0 (ref.)	0 (ref.)
60	$-0,3 \pm 1,0$	–	–	–
25	0 (ref.)	–	–	–
20	–	$+6,5 \pm 1,0$	$+9,0 \pm 1,0$	$+9,0 \pm 1,0$
10	$+4,0 \pm 1,0$	$+10,0 \pm 1,5$	$+14,0 \pm 1,5$	$+14,0 \pm 1,5$
5	$+7,5 \pm 1,0$	–	–	–
2	$+13,0 \pm 2,0$	$+20,5 \pm 2,0$	$+26,0 \pm 2,0$	$+26,0 \pm 2,0^*$
1	$+17,0 \pm 2,0$	$+22,5 \pm 2,0$	$+28,5 \pm 2,0$	$+28,5 \pm 2,0^*$
Isolated pulse	$+19,0 \pm 2,0$	$+23,5 \pm 2,0$	$+31,5 \pm 2,0$	$+31,5 \pm 2,0^*$

NOTE 1 The influence of the receiver characteristics upon its pulse response is considered in annex D.

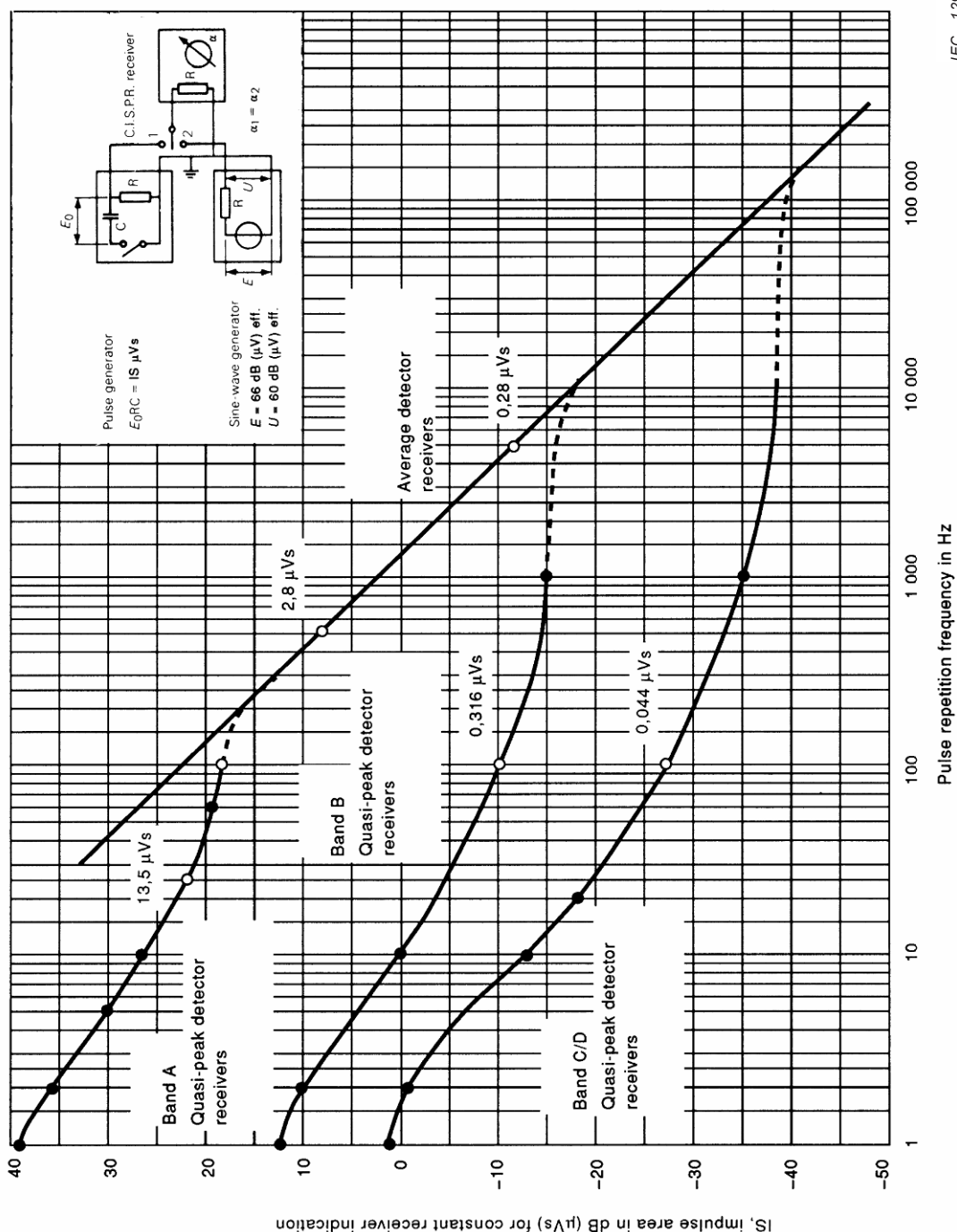
NOTE 2 The relationships between the pulse responses of a quasi-peak receiver and receivers with other detector types are given in 5.4, 6.4.1 and 7.4.1.

NOTE 3 The theoretical pulse response curves of quasi-peak and average detector receivers combined on an absolute scale are shown in figure 1d. The ordinate of figure 1d shows the open-circuit impulse areas in dB(μ Vs) corresponding to the open-circuit sine-wave voltage of 66 dB(μ V) r.m.s. The indication on a measuring receiver with an input matched to the calibrating generators will then be 60 dB(μ V). Where the measuring bandwidth is less than the pulse repetition frequency, the curves of figure 1d are valid when the receiver is tuned to a discrete line of the spectrum.

NOTE 4 It is not possible to specify a response above 100 Hz in the frequency range 9 kHz to 150 kHz because of the overlapping of pulses in the i.f. amplifier.

NOTE 5 Annex A deals with the determination of the curve of response to repeated pulses.

NOTE 6 The pulse response is restricted due to overload at the input to the receiver at frequencies above 300 MHz. The values marked with an asterisk (*) in the table are optional and are not essential.



IEC 1293/99

Figure 1d – Theoretical pulse response curve of quasi-peak detector receivers and average detector receiver (see 6.4.2)

4.5 Selectivity

4.5.1 Overall selectivity (passband)

The curve representing the overall selectivity of the measuring receiver shall lie within the limits shown in figures 2a, 2b or 2c.

Selectivity shall be described by the variation with frequency of the amplitude of the input sine-wave voltage that produces a constant indication on the measuring receiver.

NOTE For the measurement of equipment that requires higher selectivity at the transition between 130 kHz and 150 kHz (e.g. mains signalling equipment as defined in EN 50065-1/A2), a highpass filter may be added in front of the measuring receiver to achieve the following combined selectivity of CISPR measuring receiver and highpass filter:

Frequency kHz	Relative attenuation dB
150	≤ 1
146	≤ 6
145	≥ 6
140	≥ 34
130	≥ 81

The measuring receiver in conjunction with the highpass filter should fulfil the requirements of this standard.

4.5.2 Intermediate frequency rejection ratio

The ratio of the input sine-wave voltage at the intermediate frequency to that at the tuned frequency that produces the same indication of the measuring receiver shall be not less than 40 dB. Where more than one intermediate frequency is used, this requirement shall be met at each intermediate frequency.

4.5.3 Image frequency rejection ratio

The ratio of the input sine-wave voltage at the image frequency to that at the tuned frequency that produces the same indication on the measuring receiver shall be not less than 40 dB. Where more than one intermediate frequency is used, this requirement shall be met at the image frequencies corresponding to each intermediate frequency.

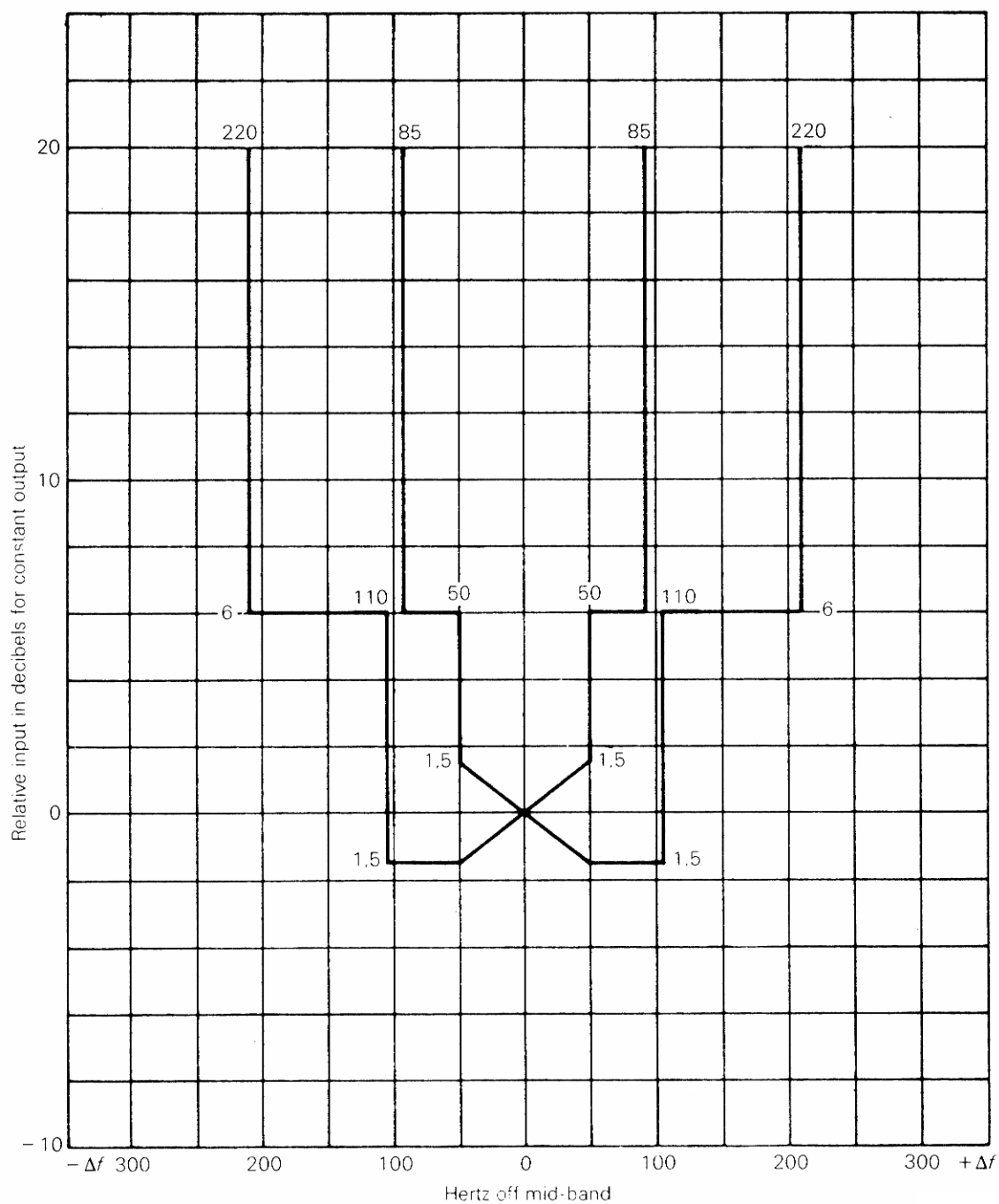


Figure 2a – Limits of overall selectivity – pass-band
(see 4.5.1, 5.5, 6.5, 7.5) (Band A)

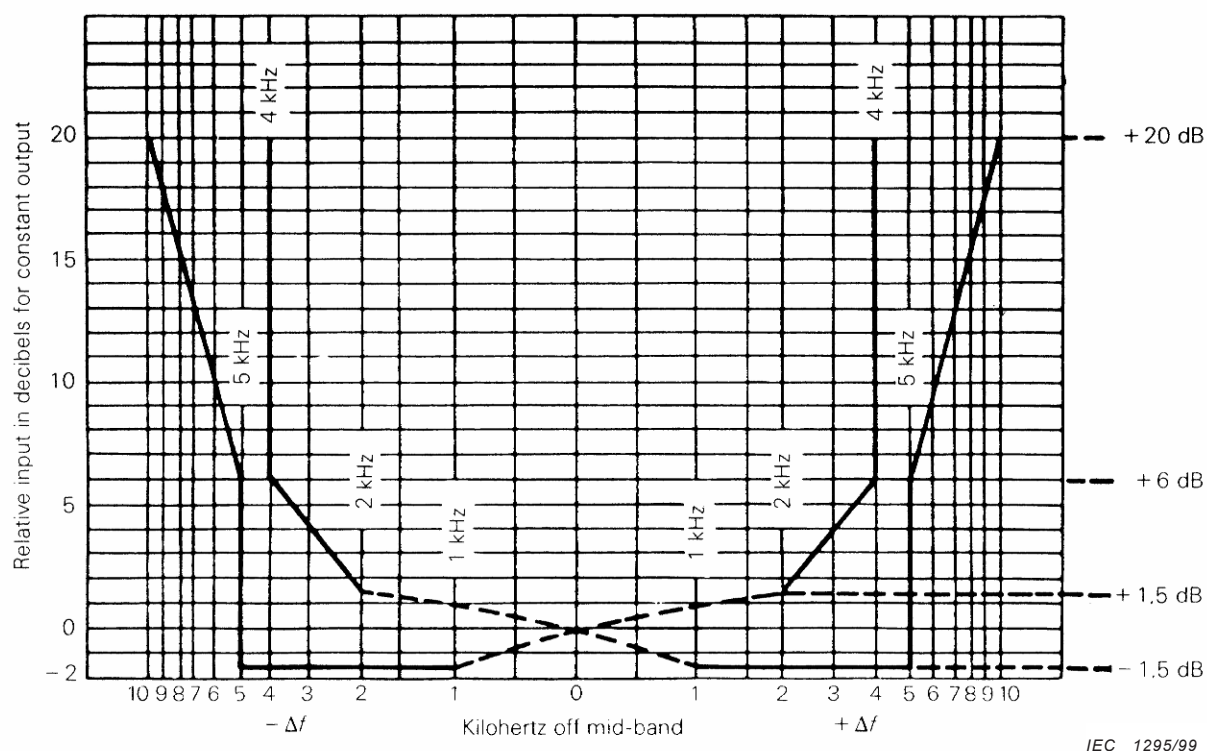


Figure 2b – Limits of overall selectivity – pass-band (see 4.5.1, 5.5, 6.5) (Band B)

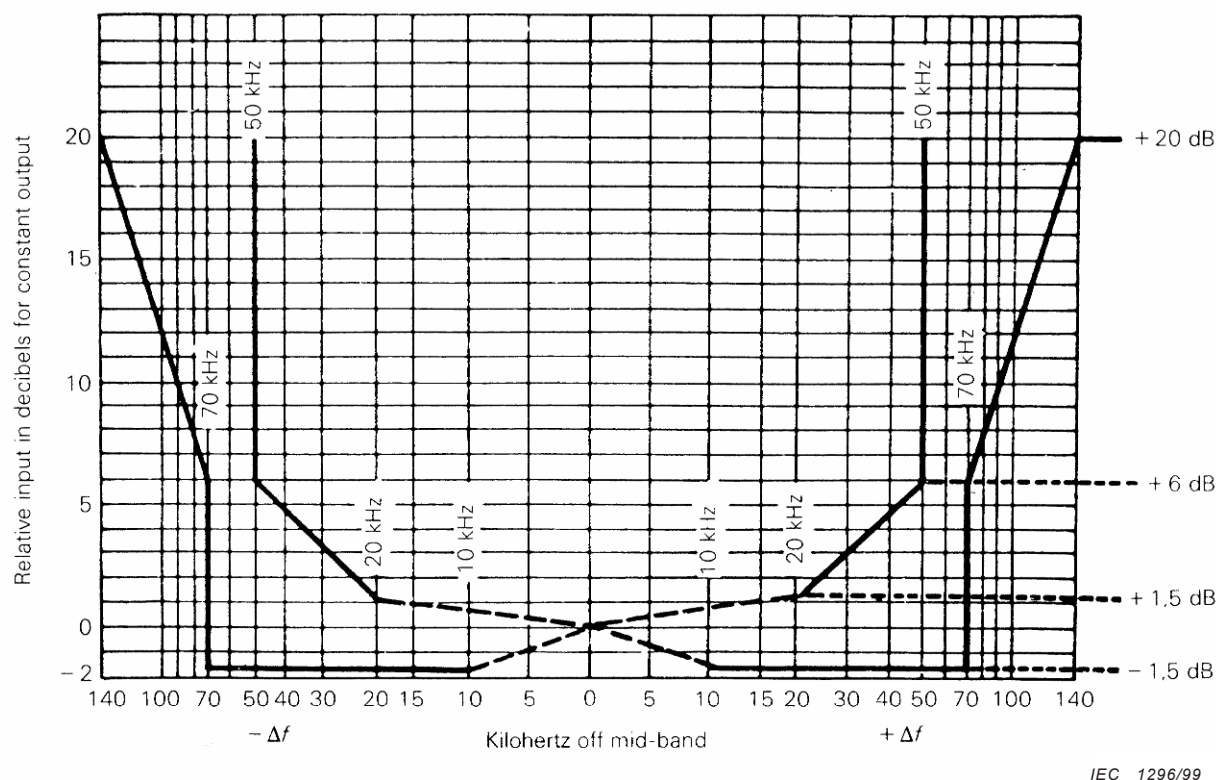


Figure 2c – Limits of overall selectivity – pass-band (see 4.5.1, 5.5, 6.5, 7.5) (Bands C and D)

4.5.4 Other spurious responses

The ratio of the input sine-wave voltage at frequencies other than those specified in 4.5.2 and 4.5.3 to that at the tuned frequency that produces the same indication on the measuring receiver shall be not less than 40 dB. Examples of the frequencies from which such spurious responses may occur are as follows:

$$(1/m) (nf_L \pm f_i) \text{ and } (1/k) (f_o)$$

where

m, n, k are integers;

f_L is the local oscillator frequency;

f_i is the intermediate frequency;

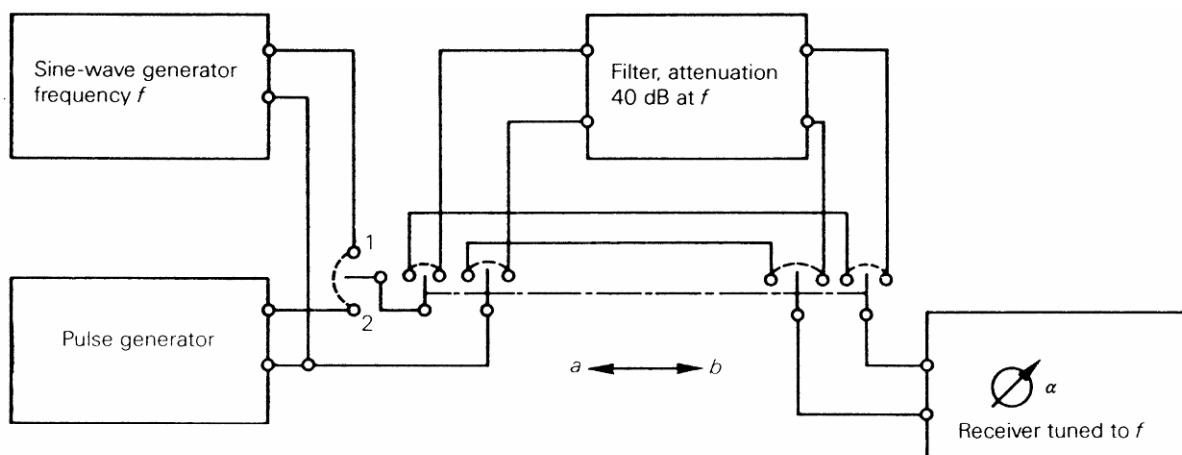
f_o is the tuned frequency.

NOTE Where more than one intermediate frequency is used, the frequencies f_L and f_i may refer to each of the local oscillator and intermediate frequencies used. In addition, spurious responses may occur when no input signal is applied to the measuring receiver; for example, when harmonics of the local oscillators differ in frequency by one of the intermediate frequencies. The requirements under this heading therefore cannot apply in these latter cases. The effect of these spurious responses is dealt with in 4.7.2.

4.6 Limitation of intermodulation effects

The response of the measuring receiver shall not be influenced by intermodulation effects when tested as follows.

Arrange the apparatus as shown in figure 3. The pulse generator has a spectrum substantially uniform up to frequency 3) but at least 10 dB down at frequency 4) of the frequencies given in table 4. The band-stop filter has an attenuation at the test frequency of at least 40 dB. Its bandwidth, B_6 , relative to the maximum attenuation of the filter shall lie between the frequencies 1) and 2) given in table 4.



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Responses:

$$\alpha_{1a} = \alpha_{2a}$$

$$\alpha_{1b} = \alpha_{1a} - 40 \text{ dB}$$

$$\alpha_{2b} = \alpha_{2a} - 36 \text{ dB}$$

Figure 3 – Arrangement for testing intermodulation effects

Table 4 – Bandwidth characteristics for inter-modulation test of quasi-peak measuring receivers

Frequency range	1) kHz	2) kHz	3) MHz	4) MHz
9 kHz to 150 kHz (band A)	0,4	4	0,15	0,3
0,15 MHz to 30 MHz (band B)	20	200	30	60
30 MHz to 300 MHz (band C)	500	2 000	300	600
300 MHz to 1 000 MHz (band D)	500	6 000	1 000	2 000

Connect the sine-wave generator output direct to the measuring receiver input and adjust for a convenient reading. Substitute the pulse generator for the sine-wave generator and adjust for the same reading. The pulse repetition frequency shall be 100 Hz for band A and 1 000 Hz for the other bands.

With the pulse generator connected as described above, switching the filter into circuit shall introduce attenuation of not less than 36 dB.

4.7 Limitation of receiver noise and internally generated spurious signals

4.7.1 Random noise

The background noise shall not introduce an error in excess of 1 dB.

NOTE For a measuring apparatus incorporating attenuation in the intermediate frequency amplifier, this condition will be regarded as being satisfied if the apparatus complies with the following test:

A sine-wave signal is applied to the input of the measuring apparatus and adjusted to a value S_1 , such that the output meter shows a reference deflection θ . An attenuation of 10 dB is introduced in the intermediate-frequency stages. The level of the input signal is increased to S_2 so as to restore the output meter to the deflection θ . The increase of the level of the input signal ($S_2 - S_1$) shall be between 10 dB and 11 dB.

4.7.2 Continuous wave

Where more than one intermediate frequency is used, the existence of spurious responses as described in the note to 4.5.4 shall not introduce a measurement error in excess of 1 dB for any signal input to the measuring receiver. For a measuring receiver incorporating attenuation in the i.f. amplifier, this requirement shall be regarded as satisfied if the receiver complies with 4.7.1 when tested as described in 4.7.1, except that the attenuation in the intermediate stages shall be introduced after the last mixer stage.

4.8 Screening effectiveness

Screening effectiveness is a measure of the ability of the measuring receiver to operate in an electromagnetic field without degradation. The requirement applies to receivers operating within the "CISPR indication range" specified by the manufacturer as described in 3.9.

The screening of the receiver shall be such that when it is immersed in an ambient electromagnetic field of 3 V/m (unmodulated) at any frequency in the range 9 kHz to 1 000 MHz, an error of not greater than 1 dB is produced at the maximum and minimum of the CISPR indicating range as specified by the manufacturer of the receiver. In cases where a measuring receiver is not immune to the requirement of 3 V/m, the field strength and frequency at which the error exceeds 1 dB shall be stated by the manufacturer. The test shall be performed as described below.

The receiver is placed inside a screened enclosure. An input signal is applied to the receiver via a 2 m long well-screened cable (e.g. semi-rigid), through a feedthrough in the enclosure wall, to a signal generator placed outside the enclosure. The level of the input signal shall be at the maximum and the minimum of the CISPR indication range as specified by the manufacturer of the receiver. All other coaxial terminals of the receiver shall be terminated in their characteristic impedance.

Only essential leads (e.g. mains and input cables) for the normal use of the measuring receiver in its minimum configuration (excluding options such as headphones) shall be connected during the test. The leads shall have the lengths and be arranged as in typical use.

The strength of the ambient field in the vicinity of the measuring receiver shall be measured by a field strength monitor.

The receiver meter indication in the presence of the ambient electromagnetic field shall differ by not more than 1 dB from the meter indication when the field is absent.

4.8.1 Limitation of radio-frequency emissions from the measuring receiver

4.8.1.1 Conducted emissions

The radio disturbance voltage at any connecting pin of external lines (not only the mains terminals) shall not exceed the limits for class B equipment given in 5.1 of CISPR 11. The measurement of the radio disturbance voltage is however not required on the inner conductors of screened connections to screened equipment. The local oscillator injection power at the measuring receiver input terminated with its characteristic impedance shall not exceed 34 dB(pW) which is equivalent to 50 μ V across 50 Ω .

4.8.1.2 Radiated emissions

The radio disturbance field strength emitted by the measuring receiver shall not exceed the limits for class B equipment given in 5.2 of CISPR 11, for the frequency range of 9 kHz to 1 000 MHz. The limits shall also apply for frequency bands (ISM frequencies) listed in table 1 of the same publication. In the frequency range of 1 GHz to 18 GHz, a limit of 45 dB(pW) shall apply.

Before performing radiated and conducted emission measurements, it is essential that the noise contributions of the test equipment do not affect the measured results (e.g. computer control).

4.9 Facilities for connection to a discontinuous disturbance analyzer

For all bands the disturbance measuring receiver shall have both an intermediate-frequency output and an output from the quasi-peak detector for the measurement of discontinuous disturbance. The loading of these outputs shall have no influence on the indicating instrument.