
British Standard Specification for
**Radio-interference
measuring apparatus**

Les appareils de mesure des perturbations radioélectriques — Spécifications

Bestimmungen für Geräte zur Messung von Funkstörungen

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**Amendment No. 1
published and effective from 29 July 1985
to BS 727 : 1983**

Specification for radio-interference measuring apparatus

NOTE. This amendment has been issued to implement Statutory Instruments 1985 Nos. 807 *Telegraphs. The Wireless Telegraphy (Control of interference from fluorescent lighting apparatus) (Amendment) Regulations 1985* and 808. *Telegraphs. The Wireless Telegraphy (Control of interference from household appliances, portable tools etc.) (Amendment) Regulations 1985* as far as references to BS 727 are concerned.

Revised text

**AMD 4954
July 1985**

Foreword

At the end of the foreword (but before the statement beginning 'Compliance with . . .') insert the following:

'The Statutory Instruments requiring compliance with BS 5394 : Part 1 : 1976 and BS 800 : 1977 and referred to in an earlier paragraph have themselves been amended by SI 1985 Nos. 807 and 808. The amended SIs require compliance with BS 5394 : 1983 and BS 800 : 1983 and these standards make detailed reference to BS 727 : 1983.

BS 727 : 1983 is effective from 29 July 1985 and supersedes BS 727 : 1967 which is now withdrawn.'

**AMD 4954
July 1985**

Outside back cover

In paragraph 1 delete line 4 and substitute the following:

'It comes into effect on 29 July 1985 (see foreword).'

Foreword

This British Standard has been prepared under the direction of the General Electrotechnical Engineering Standards Committee. It is a revision of BS 727 : 1967, but it will become effective only from a date to be announced later by amendment. The reasons for this are explained in the following paragraphs of this foreword. It should be noted that, since some measurements now extend beyond the upper limit of 1000 MHz covered by the earlier edition, reference to the frequency range has been omitted from the title in this revision.

Withdrawal of BS 727 : 1967 will be announced at the appropriate time. It is at present specifically referred to in BS 800 : 1977 and BS 5394 : Part 1 : 1976. These standards have themselves also been revised at the same time, by the issue of 1983 editions, but the earlier editions have to remain effective for a time because they are referred to in Statutory Instruments, which await appropriate action by HM Government in an undertaking to adopt nationally the provisions of EEC Directives, with which the technical content of BS 800 and BS 5394 are identical.

Since the earlier editions of BS 800 and BS 5394 make detailed reference to BS 727 : 1967 and the 1983 revisions

to this edition, the situation described above affects the effective date of BS 727 : 1983 and the subsequent withdrawal of the 1967 edition.

NOTE. Upon publication of this revision, BSI Sales Department will respond to purchase orders for BS 727 by supplying copies of the 1983 edition. Copies of the 1967 edition may be obtained by quoting the number 'BS 727/67'.

This revision introduces new material dealing with average measuring receivers for the measurement of narrow-band signals, ferrite clamps and current probes. It also specifies requirements for disturbance analysers for the measurement of discontinuous interference. The apparatus specified and the methods of measurement given are in line with current international agreement as set out in CISPR Publication 16, published by the International Electrotechnical Commission (IEC). Some of the material and some of the figures are taken from that publication.

This standard is intended for use as a specific reference for the legal implementation of regulations on the permissible limits of radio interference.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

British Standard Specification for Radio-interference measuring apparatus

Section one. General

1. Scope

This British Standard specifies the characteristics and performance of equipment for the measurement of radio interference voltages, currents and fields in the frequency range 9 kHz to 1000 MHz. In addition, requirements are specified for spectrum analysers in the frequency range 1 GHz to 18 GHz. The requirements cover the capability of measurement of most forms of disturbance including broadband continuous noise, harmonics and other narrowband signals, and specialized apparatus for discontinuous noise measurement.

The detector types covered in the standard include the following:

- (a) the quasi-peak detector (which remains the preferred form of detector in the determination of compliance with national and international standards and legal regulations);
- (b) the peak detector (which is employed extensively in dealing with military interference problems);
- (c) the average detector (which has application in the measurement of narrowband signals).

This standard also specifies requirements for artificial mains networks, ferrite clamps and current probes, and appendix H makes recommendations on the use of aerials with measuring receivers.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2. Definitions

For the purposes of this British Standard, the following definitions apply.

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

2.2 impulse bandwidth (B_{imp})

$$B_{\text{imp}} = \frac{A(t)_{\text{max}}}{2G_0}$$

where

$A(t)_{\text{max}}$ is the peak envelope output of the intermediate frequency stages with a unit impulse applied;

G_0 is the gain of the circuit at the centre frequency.

In general, $B_{\text{imp}} = 1.05B_6 = 1.31B_3$, where B_6 and B_3 are respectively the bandwidths at the -6 dB and -3 dB points.

2.3 electrical charge time constant. The time needed after the instantaneous application of a constant sine-wave voltage to the input of the apparatus for the output voltage of the voltmeter to reach 63 % of its final value.

NOTE. This time constant is that 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 last stage of the i.f. amplified. The indication, D , of an instrument having no inertia (e.g. a cathode-ray oscilloscope) connected at a point 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 found such that the deflection registered is $0.63D$. The duration of this signal is equal to the charge time constant of the measuring apparatus.

2.4 electrical discharge time constant. The time needed after the instantaneous removal of a constant sine-wave voltage applied to the input of the apparatus for the output of the voltmeter 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 measuring apparatus.

2.5 mechanical time constant (T) of a critically damped indicating instrument

$$T = T_L / 2\pi$$

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:

$$T^2 \frac{d^2 \alpha}{dt^2} + 2T \frac{d\alpha}{dt} + \alpha = ki$$

where

α is the deflection;

i is the current through the instrument;

T is the time constant of 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.

(a) The period of free oscillation having been adjusted to 0.63 s, damping is added so that $\alpha T = 0.35\alpha_{\text{max}}$.

(b) 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 $\alpha T = 0.35\alpha_{\text{max}}$.

2.6 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.

NOTE. 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).

Section two. Measuring apparatus

3. General

The input circuit of measuring receivers shall be unbalanced. The modulus of the input impedance for r.f. attenuator settings greater than 10 dB shall have a value of $50 \pm 10 \Omega$ with a phase-angle not exceeding 20° .

NOTE. Appendices B and C describe methods for determining the output characteristics of pulse generators for use in testing the requirements of 4.2, 5.3 and 6.2.

Appendix H makes recommendations for the use of aerials with measuring receivers.

4. Quasi-peak measuring receiver for the frequency range 9 kHz to 1000 MHz

4.1 Fundamental characteristics. Quasi-peak measuring receivers shall have the fundamental characteristics given in table 1.

4.2 Response to pulses

4.2.1 Amplitude relationship. The response of the measuring apparatus to pulses of amplitude (1) having a uniform spectrum up to at least (2), repeated at a frequency of (3), all as shown in table 2, shall, for all frequencies of tuning, be equal to the response to an unmodulated sine-wave signal at the tuned frequency having a value at the input of the measuring receiver of 1 mV r.m.s. (60 dB(μ V)).

A tolerance of ± 1.5 dB shall be permitted on the sine-wave voltage level.

4.2.2 Variation with repetition frequency. The response of the measuring apparatus 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 1(a), 1(b) or 1(c).

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

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

NOTE 2. The relationship between the indications of a quasi-peak meter and a peak meter at a repetition rate of 100 Hz is given in table 5.

Table 1. Fundamental characteristics of quasi-peak measuring receivers

Characteristics	Frequency band		
	9 kHz to 150 kHz	0.15 MHz to 30 MHz	30 MHz to 1000 MHz
Bandwidth at the -6 dB points, (B_6), in kHz	0.200	9	120
Electrical charge time constant of quasi-peak receiver, in ms	45	1	1
Electrical discharge time constant of quasi-peak receiver, in ms	500	160	550
Mechanical time constant (T) of critically damped indicating instrument, in ms	160	160	100
Overload factor of circuits preceding the detector (above the level of sine-wave signal that produces the maximum deflection of the indicating instrument), in dB	24	30	43.5
Overload factor of the d.c. amplifier inserted between the detector and the indicating instrument (above the d.c. voltage level corresponding to full-scale deflection of the indicating instrument), in dB	6	12	6

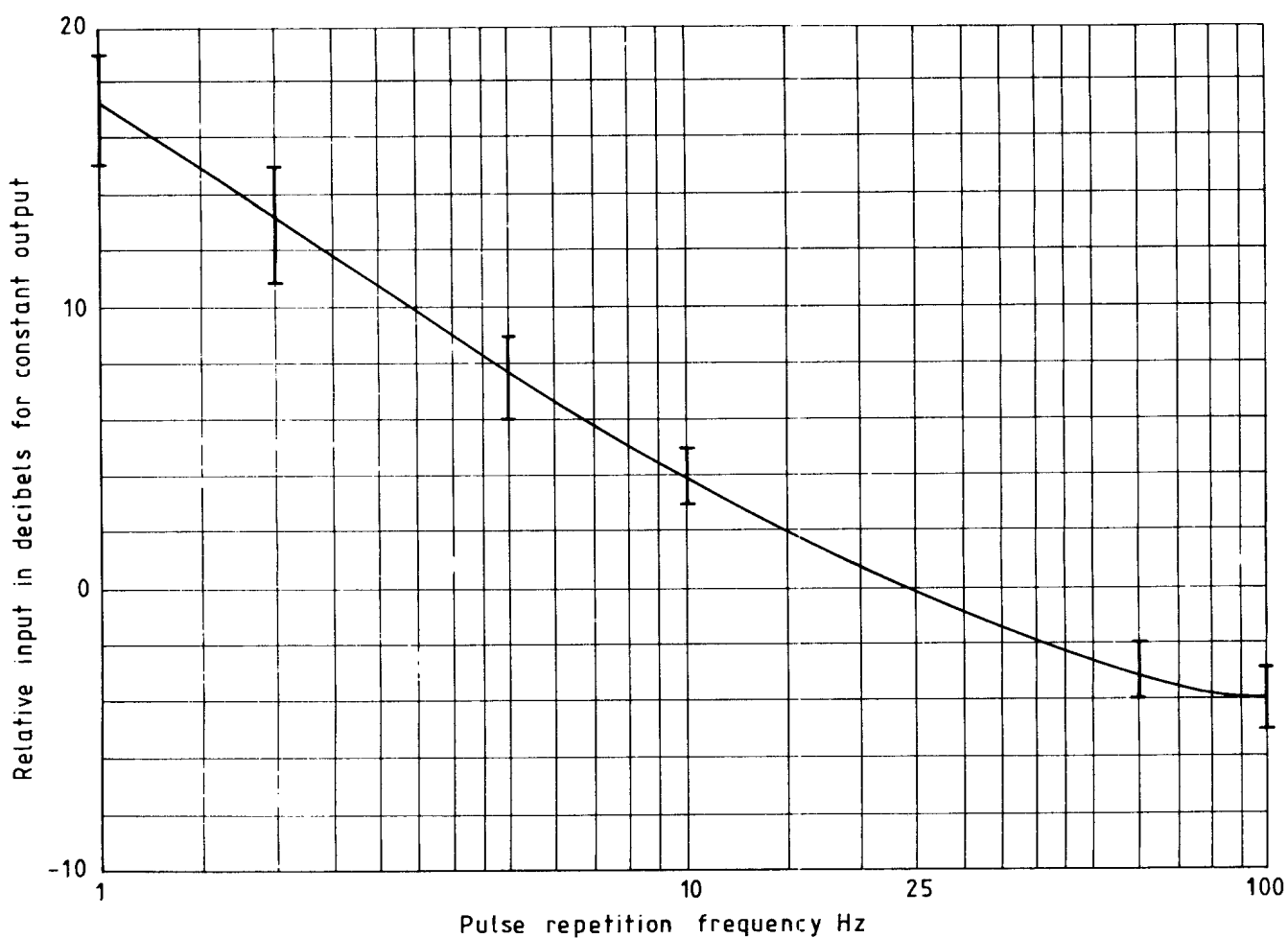
NOTE 1. The definition of mechanical time constant (see 2.5) assumes that the indicating instrument is linear, i.e. equal increments of current produce equal increments of deflection. An indicating instrument having a different relation between current and deflection may be used provided that the apparatus satisfies the requirements of this section.

NOTE 2. To permit symmetrical measurements a balanced input transformer is necessary. In the frequency range 9 kHz to 150 kHz the preferred input impedance is 600Ω .

NOTE 3. For all bands, the interference measuring receiver should have both an i.f. output and a high impedance output from the detector for the measurement of clicks. The loading of these outputs should have no influence on the indicating instrument.

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

Frequency range	(1)	(2)	(3)
	$\mu\text{V}\cdot\text{s}$	MHz	Hz
9 kHz to 150 kHz	13.5	0.15	25
0.15 MHz to 30 MHz	0.316	30	100
30 MHz to 1000 MHz	0.044	1000	100

**Figure 1(a). Pulse response curve (see 4.2.2) for frequency range 9 kHz to 150 kHz**

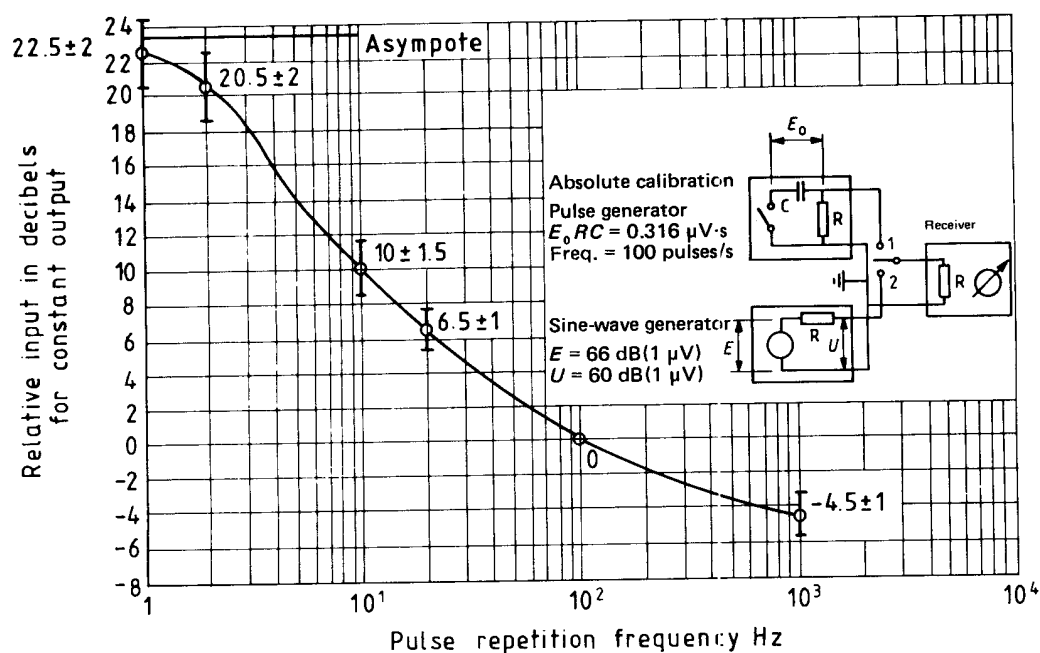


Figure 1(b). Pulse response curve (see 4.2.2) for frequency range 0.15 MHz to 30 MHz

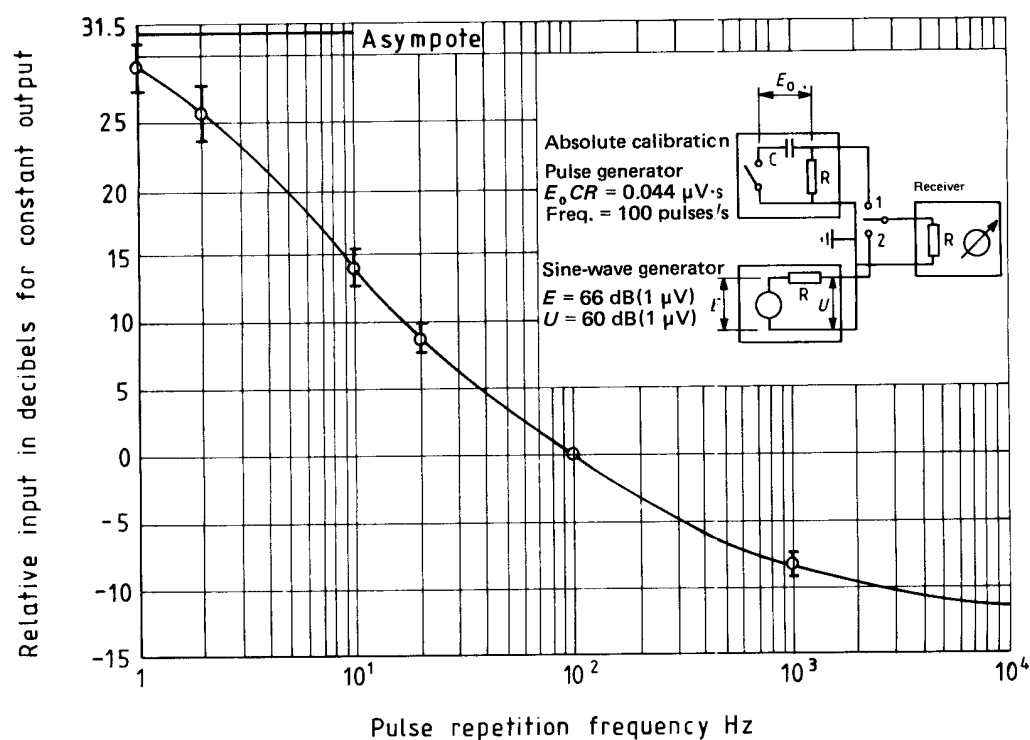


Figure 1(c). Pulse response curve (see 4.2.2) for frequency range 30 MHz to 1000 MHz

Table 3. Pulse response of quasi-peak measuring receivers

Repetition frequency	Relative equivalent level of pulse for stated waveband			
	9 kHz to 150 kHz	0.15 MHz to 30 MHz	30 MHz to 300 MHz	300 MHz to 1000 MHz
Hz	dB	dB	dB	dB
1000	—	-4.5 ± 1.0	-8.0 ± 1.0	-8.0 ± 1.0
100	-4.0 ± 1.0	0 (reference)	0 (reference)	0 (reference)
60	-3.0 ± 1.0	—	—	—
25	0 (reference)	—	—	—
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	$+7.5 \pm 1.5$	—	—	—
2	$+13.0 \pm 2.0$	$+20.5 \pm 2.0$	$+26.0 \pm 2.0$	—
1	$+17.0 \pm 2.0$	$+22.5 \pm 2.0$	$+28.5 \pm 2.0$	—
Isolated pulse	$+19.0 \pm 2.0$	$+23.5 \pm 2.0$	$+31.5 \pm 2.0$	—

NOTE 1. 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 2. Appendix A deals with the determination of the curve of response to repeated pulses.

NOTE 3. Notes on the pulse generator required for the tests and on the determination of the pulse spectrum are given in appendix B.

NOTE 4. The pulse response is restricted for practical reasons at frequencies above 300 MHz.

4.3 Selectivity

4.3.1 Overall selectivity (pass-band). The curve representing the overall selectivity of the measuring apparatus shall lie within the limits shown in figures 2(a), 2(b) or 2(c).

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.

4.3.2 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 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 each intermediate frequency.

4.3.3 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.

4.3.4 Other spurious responses. The ratio of the input sine-wave voltage at frequencies other than those specified in 4.3.2 and 4.3.3 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:

$$\frac{1}{m} (nf_L \pm f_i) \text{ and } \frac{1}{k} f_0$$

where

m, n and k are integers;

f_L is the oscillator frequency;

f_i is the intermediate frequency;

f_0 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 4.5.2.

4.4 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 but not exceeding 50 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.

Connect the sine-wave generator direct to the measuring receiver and adjust for a convenient reading. Substitute the pulse generator for the sine-wave generator and adjust for the same reading.

Switching the filter into circuit shall introduce attenuation of not less than 36 dB.