



BS 9045 : 1981

UDC 621.373.084.842

Specification for
Microwave noise generators:
Generic data and methods of test

Spécification pour les générateurs de bruit à micro-ondes:
Données génériques et méthodes d'essai

Spezifikation für Mikrowellen-Rauschgeneratoren:
Fachgrunddaten und Prüfverfahren

BS 9045 : 1981

Contents

Foreword

Cooperating organizations

Section one. General matters

- 1.1 Scope
- 1.2 Related documents
- 1.3 Terminology
- 1.4 Letter symbols, signs and abbreviations
- 1.5 Graphical symbols
- 1.6 Marking of the microwave noise generator and packing
- 1.7 Eligibility for qualification approval
- 1.8 Structurally similar devices
- 1.9 Delayed delivery
- 1.10 Qualification approval
- 1.11 Certified test records
- 1.12 Standard ratings and characteristics

1.13 Unchecked parameters

1.14 Procedure to be followed in the event of failures in group C or D inspection

1.15 Ordering information

1.16 Release prior to completion of group B tests

1.17 Inspection procedures for low rates of production

1.18 Inspection procedure for continuous production

Section two. Test procedures

2.1 Test and measurement conditions

2.2 Visual inspection

2.3 Dimensioning and gauging procedures

2.4 Electrical test procedures

2.5 Mechanical test procedures

2.6 Environmental test procedures

2.7 Endurance test procedures

Foreword

This British Standard, which has been prepared under the direction of the Electronic Components Standards Committee, is the generic specification for microwave noise generators in the system of standards for electronic parts of assessed quality.

Particular attention is drawn to 2.1.2, which warns of the health and safety hazards associated with the manufacture and use of this type of component.

British Standard Specification for

Microwave noise generators : Generic data and methods of test

Section one. General matters

1.1 Scope

This British Standard forms part of the system of common standard specifications for electronic parts of assessed quality and should be read in conjunction with the standards in the BS 9000 series.

It specifies the terms, definitions, symbols, test methods and other material for solid state and gas discharge microwave noise generators used for reference purposes.

1.2 Related documents

BS 308	Engineering drawing practice
BS 448	Dimensions of electronic tubes and valves
BS 1991	Letter symbols, signs and abbreviations
BS 2011	Basic environmental testing procedures
BS 3939	Graphical symbols for electrical power, telecommunications and electronics diagrams (IEC Publication 117)
BS 4727	Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms
BS 6001	Sampling procedures and tables for inspection by attributes
BS 9000	General requirements for electronic parts of assessed quality
IEC 50(531)	International electrotechnical vocabulary Chapter 531 Electronic tubes
IEC 235-2A	Chapter V Measurement of the electrical properties of microwave tubes Part 2 General measurements Chapter V Methods of measuring parasitic noise

1.3 Terminology

For the purposes of this British Standard, the following definitions apply, in addition to those in BS 4727 and IEC 50(531).

1.3.1 microwave noise generator. A device that generates noise over a stated band of frequencies.

NOTE. For the purposes of this British Standard, a microwave noise generator may be either of the gas discharge type or solid state.

1.3.2 ionization. In this standard, 'ionization' is referred to as 'partial local ionization'.

1.3.3 local ionization. The phenomenon produced by subjecting a gas discharge type noise generator to incident r.f. energy, either from the radar system's own transmitter or from an external source. The resulting ionic discharge is generally confined to that portion of the noise generator contained within the active (r.f.) section of the mount.

NOTE. The phenomenon may occur without the cathode of the noise generator being activated.

1.4 Letter symbols, signs and abbreviations

1.4.1 Letter symbols. For the purposes of this British Standard, the following letter symbol applies, in addition to those in BS 1991:

excess noise ratio (above 290 K): N_{or}

1.4.2 Abbreviations. For the purposes of this British Standard, the following abbreviations apply:

excess noise ratio:	ENR
device under test:	DUT
voltage standing wave ratio:	vswr

1.5 Graphical symbols

For the purposes of this British Standard, graphical symbols shall be in accordance with BS 3939.

1.6 Marking of the microwave noise generator and packing

The following symbols or codes shall be clearly and durably marked on the device in the following order of preference as space permits. All symbols and codes except terminal marking and operating conditions shall also appear on the primary pack, e.g. carton, box or plastics envelope, used as initial wrapping for delivery:

- manufacturer's part designation number and special marking relating to hazard and special operating conditions;
- manufacturer's factory identification code;
- date code;
- number of the detail specification.

1.7 Eligibility for qualification approval

A microwave noise generator shall be eligible for submission for qualification approval to BS 9000 : Part I : 1971 only when the construction of frequency-determining elements, the joining together of all piece parts and the processes of sealing and pumping have been carried out by an approved manufacturer. 2.3.2(3) (ii) of BS 9000 : Part I : 1971 shall not be used.

1.8 Structurally similar devices

When simultaneous or successive production is proceeding on several types of microwave noise generators having common features, those common features may be sampled from the complete range of types instead of from each lot of each type. Some examples of admissible common features and associated tests are as follows.

Common method of mounting	Visual inspection Terminal inspection Dimensions Robustness of terminations
Common processing and assembly techniques	Endurance tests

1.9 Delayed delivery

Microwave noise generators held by the manufacturer or approved distributor for a period exceeding twelve months following acceptance inspection shall be re-examined prior to release for all sub-group A0 and A2 requirements.

1.10 Qualification approval

1.10.1 Supplementary procedure for qualification approval.

The following table supersedes the sample size requirements of 2.3.1 of BS 9000 : Part 1 : 1971, for production lot sizes below 280 devices. When using the table a second sample, as shown, shall be taken when the quantity of defectives exceeds the acceptance quantity but is less than the reject quantity.

1.10.2 Release prior to qualification approval.

Where production rates are 12 devices per month or less, permission to release prior to approval may be granted on successful completion of the specified tests on two devices for groups A and B and one device for groups C and D. On receipt of such permission the manufacturer may commence to release devices meeting the specification.

Qualification approval will be granted when the number of devices quoted in the table have satisfied the specified requirements, provided that during this period no inspection lots have been rejected.

Permission to release devices will be withdrawn:

- (a) in the event of the rejection of an inspection lot prior to the granting of qualification approval;
- (b) in the event of qualification approval not being granted within 18 months of the date of permission to release.

All release documentation, including the certificate of conformity, shall be prominently marked 'This device is released in advance of qualification approval', and the

reference of the document granting permission to release shall be quoted.

NOTE to 1.10.1 and 1.10.2. Defective devices may be used for those tests where the validity of the result is not affected by the particular defect(s).

Results obtained on development devices that have been produced using substantially final production techniques and tested by approved methods may be included in the test report to cover part of the requirements for qualification approval with the agreement of the National Supervising Inspectorate.

1.11 Certified test records

The requirements of 2.8 and appendix C of BS 9000 : Part 1 : 1971 shall apply.

1.12 Standard ratings and characteristics

Not applicable.

1.13 Unchecked parameters

Not applicable.

1.14 Procedure to be followed in the event of failures in group C or D inspection

The procedures described in 2.6.4.1 and 2.6.4.2 of BS 9000 : Part 1 : 1971 shall be used.

1.15 Ordering information

This shall be stated in the appropriate detail specification.

1.16 Release prior to completion of group B tests

Not applicable.

1.17 Inspection procedures for low rates of production

Where production rates are low, with the result that lots are accepted on zero rejects, 2.5.1.2 of BS 9000 : Part 1 : 1971 allows a larger sample to be taken with consequent lot acceptance on one reject. Alternatively, the manufacturer may elect to perform tests on a 100 % basis.

1.18 Inspection procedure for continuous production

2.5.1.1(5) of BS 9000 : Part 1 : 1971 shall apply, except that the period shall be increased to six months.

Section two. Test procedures

2.1 Test and measurement conditions

2.1.1 General. All tests shall be carried out under the standard atmospheric conditions for testing as specified in 5.3 of BS 2011 : Part 1.1 : 1980, unless otherwise stated.

Group	Lot size	Sample size	Accept	Reject	Second sample	Total sample	Accept	Reject
A and B	2 to 7	100 %*	0	1				
	8 to 280	6	0	2	2	8	1	2
C and D	Any	2	0	2	2	4	1	2

*Qualification approval is dependent on at least six devices being tested.

The limits quoted in detail specifications are absolute. The test limits used for quality conformance inspection shall be inset from the absolute limits by the amount necessary to allow for measurement uncertainty.

Difficulties may be encountered in assessing measurement uncertainties in the test methods marked with an asterisk in 2.4.12. In such cases at the manufacturer's discretion the device shall meet the limits given in the detail specification, when the measurement is carried out using identified test equipment and monitoring procedures approved by the National Supervising Inspectorate.

2.1.2 Health and safety hazards

2.1.2.1 General. This standard calls for the use of substances and test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations relating to health and safety at any stage of manufacture or use according to the Health and Safety at Work, etc. Act 1974. Particular attention is drawn to the hazards described in 2.1.2.2 to 2.1.2.7, although the list is not necessarily exhaustive.

2.1.2.2 High voltage. Equipment shall be so designed that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals shall be enclosed and fail-safe interlock switches shall be fitted to disconnect the primary power supply and discharge all high voltage capacitors and stored charges in the electronic devices before allowing access. Interlock switches shall not be bypassed to allow operation with access doors open.

2.1.2.3 R.F. radiation. Personnel shall not be exposed to strong r.f. fields, even at relatively low frequencies. Absorption of r.f. energy by the human body is dependent on frequency and, although at frequencies below 30 MHz most energy passes straight through the body with little heating effect, it still presents a hazard.

To minimize leakage of r.f. energy, all r.f. connectors, waveguide coupling flanges and cavities shall be correctly fitted and the transmission line efficiently coupled to a load before the device is operated.

2.1.2.4 X-ray radiation. All high voltage devices operating at voltages above 5 kV produce progressively more dangerous X-rays as the voltage is increased. The device envelope usually provides only limited protection and further shielding may be required.

NOTE. The X-rays emitted by some microwave tubes may correspond to a voltage approximately two to three times higher than the applied anode voltage.

2.1.2.5 Radioactive materials. Radioactive materials are incorporated in certain electronic devices. Appropriate precautions against harmful radiation shall be taken as required by current legislation.

2.1.2.6 Beryllium oxide ceramics. Beryllium oxide ceramics are used in some devices (usually marked with a blue band). Beryllium oxide dust or fumes are highly toxic if inhaled, or if particles enter a cut or abrasion.

Avoid handling the beryllium oxide ceramics; if they are touched, wash the hands before smoking or eating.

Do nothing to the beryllium oxide ceramics that may produce dust or fumes. Cleaning information is available from the manufacturer. Information on the procedure to follow if a beryllium oxide ceramic is broken is provided with the device.

2.1.2.7 Implosion. All high vacuum tubes store potential energy by virtue of their vacuum. The energy level is low in small tubes, but it represents a significant hazard in larger tubes such as cathode ray tubes, particularly if the tube is dropped or subjected to violent impact.

Such tubes shall be stored and transported in their approved packs. During installation or replacement, the tube shall not be scratched or damaged in any way likely to reduce the strength of the glass envelope. No stresses shall be imposed on the glass envelope, particularly the neck, and the tube shall be adequately supported. Free-standing cathode ray tubes shall be placed faceplate down on a soft surface free from abrasive particles. The user shall be protected against implosion of the tube in the equipment.

2.2 Visual inspection

Unless otherwise specified, visual inspection shall be performed under normal factory lighting conditions and without visual aids.

Visual inspection shall be carried out for good appearance and workmanship, and shall include the following items where applicable:

- (a) shape;
- (b) quality of seals;
- (c) straightness of pins, leads, etc.;
- (d) freedom of loose elements;
- (e) correctness of marking;
- (f) correctness of terminal identification;
- (g) finish;
- (h) materials (the materials and finish for external parts shall be seen to conform with the requirements of the detail specification and/or the quality of the qualification approval samples);
- (i) absence of blow holes or defects in the surface of metal castings forming mating surfaces of r.f. connections.

2.3 Dimensioning and gauging procedures

Dimensional measurements shall be carried out either by use of conventional measuring instruments (vernier calipers, rules, micrometers, etc.) or by gauges. Gauges shall be in accordance with BS 448 where applicable or shall have dimensions which comply with the requirements given on the dimensional drawing of the part. All drawings shall state whether first or third angle projection applies.

2.4 Electrical test procedures

2.4.1 Alternative methods of test. See 2.4.2 of BS 9000 : Part 1 : 1971.

2.4.2 Measuring equipment. All microwave measuring equipment shall be verified to ensure satisfactory operation over the required frequency band. This shall be carried out using swept frequency techniques.

The measuring equipment shall be such that the time constants or pulse response characteristics shall not significantly affect the measurement results.

NOTE. Care should be taken to ensure that any stray electromagnetic fields do not significantly affect the measurement results.

2.4.3 Temperature conditions. Where the measurement of temperature is required for operating conditions or temperature coefficients, the temperature at a stated part of the device rather than the ambient temperature shall be measured. This is because of the large variation in cooling efficiency with the rate of flow and turbulence of the cooling medium.

Steady conditions shall be maintained for a sufficient time to ensure that all parts of the device have reached their equilibrium temperature.

2.4.4 Pressurizing. Where pressurizing is required, the following requirements shall be complied with before and during operation of the device.

(a) The system shall be clean and free from condensation and be capable of adequate sealing to maintain gas purity.

(b) The minimum or maximum limits of gas pressure to which the microwave components can be subjected without damage or mechanical distortion shall be observed.

(c) The nature, purity, dryness and temperature of the gas shall be within stated limits.

2.4.5 Reference point. The polarity of all voltages applied to the electrodes of microwave noise generators shall be specified relative to the cathode in the case of gas discharge types and relative to the body in the case of solid state noise sources.

2.4.6 Pre-test holding period. All gas discharge type noise generators shall be stored for a minimum period of 168 h after pumping prior to being subjected to the specified tests. Completion of manufacture, such as plating and marking, may be carried out during this period.

2.4.7 Reference frequency tolerances. For general measurements the allowable tolerance for the reference frequency shall be $\pm 1\%$.

2.4.8 Symmetry. Microwave noise generators having structural symmetry about the axis of insertion shall be tested in such a manner as to ensure compliance with the specified limits for all mounting positions.

2.4.9 Microwave noise generators under test (device under test). In the absence of any indication to the contrary the symbol 'DUT' includes the mount.

2.4.10 Power supplies. These shall be adequately current stabilized, unless otherwise specified.

2.4.11 Conversion of noise temperature to excess noise ratio. When the noise temperature exceeds 3000 K, the noise output shall be expressed in terms of the ENR according to the equation

$$N_{\text{er}} = 10 \log_{10} \left\{ \frac{T - 290}{290} \right\},$$

where

N_{er} is the ENR expressed in dB above 290 K, and

T is the noise temperature in K.

2.4.12 Index of test methods. For convenience of identification in detail specifications, the following numbering system for measurement methods has been used.

Title	Method
Heater (filament) voltage or current	1001
Voltage standing wave ratio	1002
Insertion loss	1003*
Rise and fall of the noise output pulse	1004

Ignition characteristics	1005
Maintaining/operating voltage	1006
Maintaining/operating current	1007
Excess noise ratio	1008*
Critical current for noise output stability	1009
Maximum incident power for ionization	1010*
Effect of incident power on excess noise ratio (ENR)	1011*
Exposure to r.f. power	1012*

*See 2.1.1.

2.5 Mechanical test procedures

Not applicable.

2.6 Environmental test procedures

The following tests (from BS 2011 : Part 2.1 : 1977) shall be performed as required by the detail specification.

2.6.1 Test N: change of temperature. The test shall be either test Na or test Nc, except that the device shall be non-operating and the duration at each temperature extreme shall be as given in the following table.

Mass of tube	Minimum period
kg	h
0.15 and less	0.5
Over 0.15 up to 1.5	1.0
Over 1.5 up to 15	2.0
Over 15 up to 150	4.0

Where the required changes in temperature can be achieved with one chamber using test Nb, this is permissible and in this case the rate of change of temperature shall also be specified.

The preferred temperatures are -5°C and $+85^{\circ}\text{C}$.

2.6.2 Test Ea: shock. The acceleration of the shock pulse shall be 147 m/s^2 and its duration shall be 3 ms.

NOTE. Devices having structural symmetry in two of the three axes need be subjected to shock in the two dissimilar axes only.

2.6.3 Test U: robustness of termination. The purpose of this test is to assess the ability of a termination to withstand the mechanical strains likely to be applied during normal assembly of the device into equipment, the following tests being applied as appropriate.

(a) Test Ud: torque. The value of the torque shall be as follows:

caps of diameter less than 15 mm: 0.17 N m;
caps of diameter greater than 15 mm: 0.34 N m.

(b) Test Ua: tensile.

(c) Test Ub: bending.

2.6.4 Test Fc: vibration (sinusoidal). Devices shall be vibrated to the specified procedure (B1, B2, B3 or B4) under the specified conditions.

Devices having structural symmetry about one of the three axes shall be subjected to vibration in two directions instead of three.

The preferred frequency range and acceleration are 55 Hz to 2000 Hz and 49 m/s^2 .

2.6.5 Test Eb: bump. Devices having structural symmetry about one of the three axes shall be subjected to bump in two directions instead of three.

The preferred peak acceleration and duration are 245 m/s^2 and 6 ms. The preferred number of bumps is 4000.

2.6.6 Test Db: damp heat, cyclic (12 + 12-hour cycle).

This test shall be used for durability of marking.
Marking shall be legible at the conclusion of the test.

2.6.7 Increased air pressure. The device shall be subjected to an increase of atmospheric pressure to the specified level and maintained at this condition for not less than one minute. The specified pressure shall be obtained within one minute.

The preferred severity is 200 kN/m² gauge pressure.

2.6.8 Test M: low air pressure. No arcing shall occur when the device is operated at the specified pressure.

The preferred pressure is 30 kN/m² gauge pressure.

2.6.9 Test A: cold. The preferred temperature is -55 °C.

2.7 Endurance test procedures**2.7.1 Non-operating endurance test (storage).**

Noise generators shall initially be tested to the requirements of the detail specification. They shall then be stored, either without a container or in an open container, in such a way that they are exposed to standard testing conditions (see 5.3.1 of BS 2011 : Part 1.1 : 1980) but protected from direct sunlight.

Unless otherwise specified, the period of storage shall be twelve months. Devices shall be removed for testing at intervals of three, six, nine and twelve months.

2.7.2 Operating endurance test. Noise generators shall be operated under the specified conditions for the required number of hours.

NOTE 1. It is permissible to connect the DUTs in either series or shunt multiple mounts.

Unless otherwise specified, devices undergoing endurance tests shall be measured at intervals of 0, 160, 500 and 1000 h, and thereafter at 1000 +48 -24 hours.

NOTE 2. These time intervals (up to 1000 hours) may be extended to allow the manufacturer to perform the required tests during normal factory working hours. At the discretion of the manufacturer, tests may be performed at more frequent intervals.

Where there is a break in production (see 1.18) of the particular noise generator and other types of similar design for which structural similarity is claimed, the group C and D tests shall be performed before delivery commences against any further contracts.

NOTE 3. Noise generators that are rejected for mechanical defects may be used for operating endurance tests.

2.7.3 Cathode endurance. Gas discharge type microwave noise generators shall be operated under the specified conditions for the specified duration.

2.7.4 Heater cycling endurance. When specified, gas discharge type microwave noise generators shall undergo a heater cycling endurance test. The device shall be non-operating except that the specified heater voltage shall be applied for the specified number of cycles. Each cycle shall consist of 3 min with heater on and 3 min with heater off.

2.7.5 R.F. power endurance. When specified, solid state noise generators shall be subjected to an r.f. power endurance test under the specified conditions, which shall include a minimum ambient temperature. The duration of the test shall be the sum of both the operating endurance and the passive endurance. Other requirements shall be in accordance with 2.7.2.

NOTE. Passive endurance is the duration for which the device is installed in functioning equipment but is not itself operating.