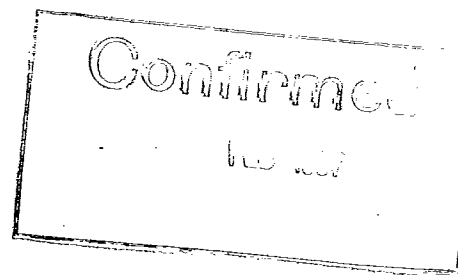


BS 9014 : 1974

UDC 621.387.132.223 : 621.376.5

**Specification for
Pulse modulator hydrogen
thyatron tubes
of assessed quality:
Generic data and
methods of test**



**Gr 8
British Standards Institution**

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Committee reference TLE/5/2 Draft for comment 71/29131

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*British Radio Equipment Manufacturers' Association	Department of Employment (HM Factory Inspectorate)
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FOREWORD

This British Standard has been prepared under the authority of the Telecommunications Industry Standards Committee and is the generic specification for pulse modulator hydrogen thyratron tubes in the system of standards for electronic components of assessed quality.



BRITISH STANDARD SPECIFICATION FOR
PULSE MODULATOR HYDROGEN THYRATRON TUBES
OF ASSESSED QUALITY : GENERIC DATA AND
METHODS OF TEST

1. GENERAL MATTERS

1.1 SCOPE

This standard forms part of the system of common standard specifications for electronic components of assessed quality and should be read in conjunction with the standards in the series BS 9000 to BS 9009. It applies to pulse modulator hydrogen thyatron tubes as defined in 1.3 and gives the terms, definitions, symbols, test methods and other material required for implementing the detail specifications for these tubes.

The material herein shall be applicable only when called up by the detail specification, except for 1.6 to 1.18 which are mandatory requirements.

1.2 RELATED DOCUMENTS

- | | |
|------------|--|
| 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, telecommunication and electronics diagrams (IEC Publication 117). |
| BS 4727 | Glossary of electrotechnical, power, telecommunications, electronics, lighting and colour terms. |
| BS 6001 | Sampling procedures and tables for inspection by attributes. |
| BS 9000 | General requirements for electronic components of assessed quality. Part 1. General description and basic rules. |
| IEC 134 | Rating system for electronic tubes and valves and analogous semiconductor devices. |
| IEC 151-20 | Methods of measurement of thyatron pulse modulators |

1.3 TERMINOLOGY

For the purpose of this British Standard, the following terms and definitions apply, in addition to those from BS 4727: Part 1: Group 06.

NOTE. A number of the following definitions are identical with those given in IEC publications; these are indicated by the inclusion of the relevant IEC reference in parentheses at the end of the definition.

1.3.1 *Pulse modulator hydrogen thyatron tube.* A thyatron, as defined in 3401 of BS 4727: Part 1: Group 06, but which switches energy from a storing circuit to another tube, usually a magnetron, in pulses of short duration.

1.3.2 *Pulse and other relevant characteristics* are defined below and in Fig. 1.

(1) *Pulse amplitude.* The maximum value of a smooth curve through the average of the variations on the top of the pulse, exclusive of spike.

* The tests referred to in this document are to BS 2011: 1967. These will be reviewed where necessary in the next amendment.



- (2) *Pulse duration*. The time interval between the instants at which the value of the parameter equals 70 % of the pulse amplitude unless otherwise stated (151-20 2.3)
 - (3) *Pulse rise time*. The time required for the pulse to rise from 26 % to 70 % of the pulse amplitude. (151-20 2.4)
 - (4) *Pulse fall time*. The time required for the pulse to fall from 70 % to 26 % of the pulse amplitude. (151-20 2.5)
 - (5) *Spike*. A surge above the pulse amplitude of duration less than 10 % of the pulse duration.
 - (6) *Spike duration*. The time interval between the instants when the spike departs from and returns to the pulse amplitude level. (151-20 2.7)
 - (7) *Spike amplitude*. The maximum excursion of the spike above the pulse amplitude. (151-20 2.8)
 - (8) *Pulse repetition rate*. The average quantity of pulses in unit time. (Unless otherwise stated, unit time is one second.) (151-20 2.10)
 - (9) *Average rate of rise of anode pulse current*. The quotient of the change of current during the pulse rise time to the period of the rise time. (See Fig. 2.) (151-20 2.17)
 - (10) *Critical d.c. anode-voltage for conduction*. The minimum d.c. voltage at the anode which causes conduction under specified conditions. (151-20 2.21)
 - (11) *Unloaded grid pulse voltage*. The pulse amplitude at the grid terminal with respect to cathode with the tube removed from the socket and the grid drive supply set to the operating conditions.
 - (12) *Anode delay time*. The time interval between the instant at which the unloaded grid pulse reaches 26 % of the pulse amplitude and the instant when anode conduction takes place. In multi-grid tubes the reference grid pulse should be stated. (151-20 2.37)
 - (13) *Anode delay time drift*. The change in anode delay time after a specified duration of operation.
 - (14) *Jitter (pulse jitter time)*. Pulse to pulse variation of the anode delay time.
 - (15) *Peak forward anode voltage*. The maximum positive voltage applied to the anode with respect to the cathode.
 - (16) *Peak inverse anode voltage*. The maximum negative voltage applied to the anode with respect to the cathode.
 - (17) *Anode heating factor*. The product of peak forward anode voltage, anode pulse current and pulse repetition rate.
 - (18) *Unloaded grid bias voltage*. The negative d.c. voltage at the grid terminal with respect to cathode with the tube removed from the socket and the grid bias supply set to the operating conditions.
 - (19) *Loaded grid bias voltage*. The inter-pulse negative d.c. voltage at the grid with respect to the cathode, when the tube is operating.
 - (20) *Average rate of rise of unloaded grid pulse voltage*. The quotient of the change of voltage during the pulse rise time to the period of the pulse rise time. (151-20 2.30)
 - (21) *Priming*. The initiation of a local discharge between cathode and grid 1 of the tetrode thyatron tube.
- NOTE. Priming may be achieved either by the application of a d.c. voltage to grid 1 so maintaining a continuous discharge current or by the application to grid 1 of a pre-pulse. The purpose of priming is to reduce pulse jitter and anode delay time.
- (22) *Unloaded grid 1 d.c. priming voltage*. The d.c. voltage measured at the grid 1 socket terminal with the tube removed from its socket and the grid 1 d.c. priming voltage supply set to the operating conditions.



(23) *Grid 2 pulse delay.* In a pulse primed tube, the time interval between the voltage pulses on grid 1 and grid 2 terminals with the tube removed from its socket, measured at 26 % of the pulse amplitude, on the leading edge of each pulse.

(24) *Grid firing time.* The time interval between the instant of simultaneous application of cathode heater, reservoir heater and specified grid voltages, and the instant when the grid-cathode gap breaks down.

(25) *Forward grid circuit impedance.* The output impedance of the grid drive and bias circuit. (51-20 2.33)

(26) *Recovery.* The re-establishment of grid control following interruption of forward anode current.

(27) *Recovery impedance, Z_R .* The impedance through which the decaying ion-recombination grid current flows during the recovery period. Recovery impedance can be calculated from the following formula:

$$Z_R = \frac{(\text{Instantaneous grid voltage}) - (\text{Loaded bias voltage})}{(\text{Instantaneous ion-recombination grid current})}$$

(28) *Recovery time.* The time required after cessation of forward anode current for the grid to regain control, under specified operating conditions.

(29) *Reservoir.* A device inside the tube for controlling the gas pressure.

(30) *D.C. resistance between grid and cathode.* The resistance measured between the grid and cathode terminals with the tube removed from its circuit.

(31) *Tube heating time.* The time required for all essential parts of the tube to attain temperatures such that the tube will operate satisfactorily.

(32) *Resonant charging.* The condition achieved when the pulse repetition frequency is equal to twice the natural resonance frequency of the charging inductance with the capacitance of the pulse-forming-network, so that the firing pulse occurs when the voltage on the capacitance is maximum; the network is discharged and recharges to attain the maximum voltage of the moment of incidence of the next successive firing pulse.

(33) *Charging diode.* A diode inserted between the supply and the pulse forming network to prevent any current from the network flowing back into the supply.

(34) *Inverse diode.* A diode in series with a resistance placed in parallel with the modulator tube to dissipate the negative charge of the pulse-forming-network and in addition to limit the peak inverse voltage after it has discharged through the tube.

(35) *Surface temperature (envelope temperature).* The temperature measured at specified point(s) on the surface of the tube. (BS 2011: Part 1: 4.5)

(36) *Trip.* Interruption of the power supply by an operation of an overload relay.

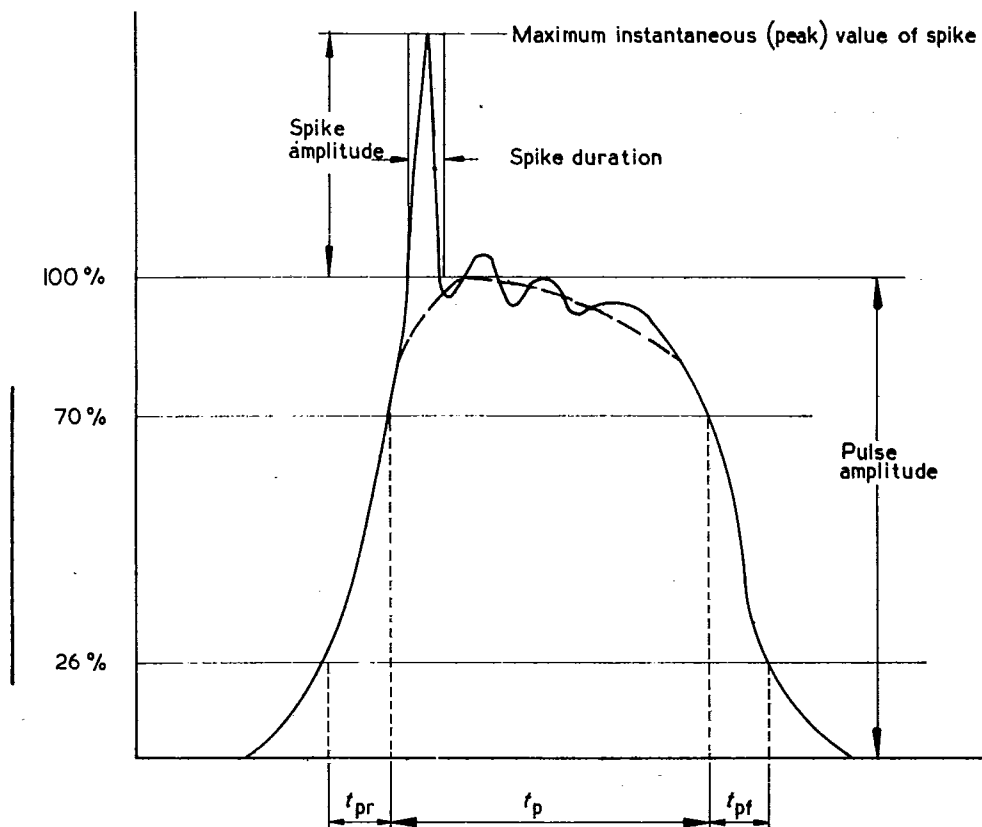


Fig. 1. General pulse characteristics

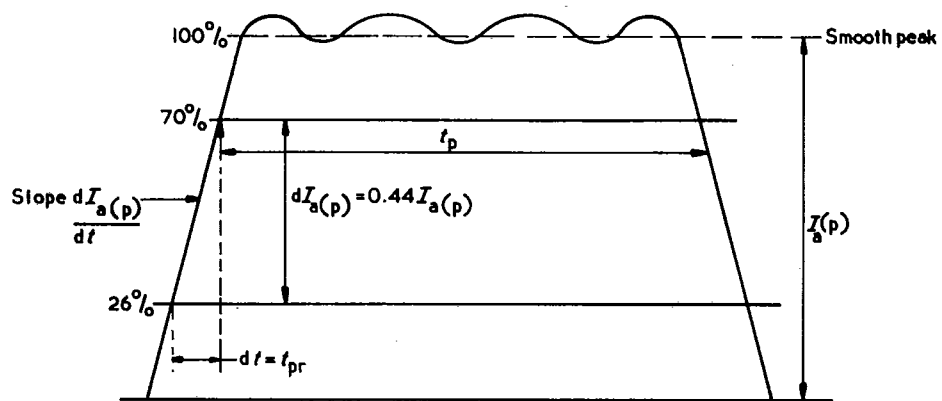


Fig. 2. Anode current pulse

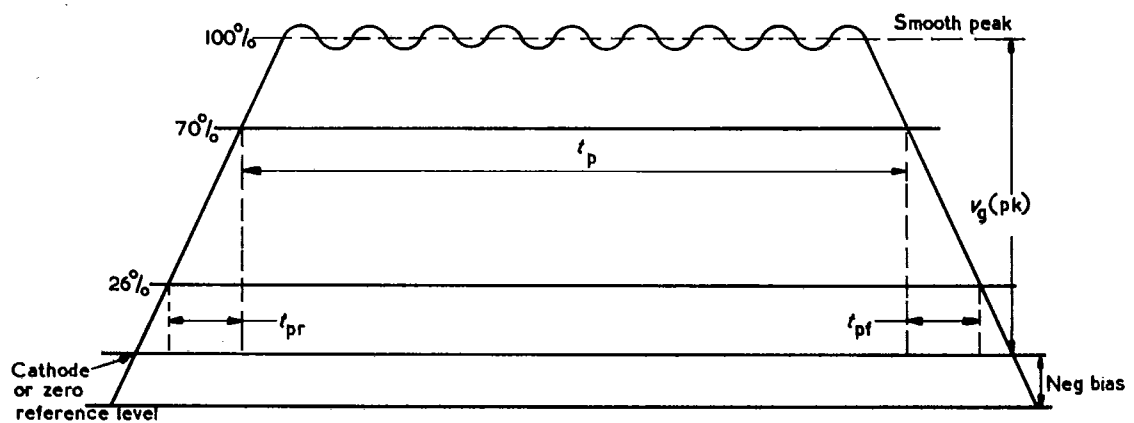


Fig. 3. Unloaded grid voltage pulse



1.4 LETTER SYMBOLS, SIGNS AND ABBREVIATIONS

For the purpose of this British Standard, the following letter symbols apply:

$\frac{dI_{a(p)}}{dt}$	average rate of rise of anode pulse current
$V_{a(crit)}$	critical d.c. anode voltage for conduction
$V_{g(pk)}$	peak forward grid voltage
$V_{a(pk)inv}$	peak inverse anode voltage
$V_{a(pk)}$	peak forward anode voltage
$I_{a(p)}$	anode pulse current
I_a	average anode current
$i_{a(pk)}$	peak anode current
F_{ah}	anode heating factor
<i>Text deleted</i>	
p.r.r.	pulse repetition rate
t_{ad}	anode delay time
Δt_{ad}	anode delay time drift
t_{pf}	pulse fall time
t_{pj}	pulse jitter time
t_p	pulse duration
t_R	recovery time
t_{pr}	pulse rise time
Z_R	recovery impedance
TUT	tube under test
$V_{a(p)}$	anode pulse voltage
V_a	anode d.c. voltage
$-V_{g1}$	grid 1 negative d.c. voltage
$-V_{g2}$	grid 2 negative d.c. voltage

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1.5 GRAPHICAL SYMBOLS

Unless stated otherwise the graphical symbols in this standard imply the definitions given in BS 3939 (IEC Publication 117).

1.6 MARKING OF THE TUBE AND PACKING

The following symbols or codes shall be clearly and durably marked on the tube 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, plastics envelope, etc, used as initial protection or wrapping for delivery:

- (1) Manufacturer's tube designation number and special marking relating to hazard and special operating conditions.
- (2) Manufacturer's factory identification code.
- (3) Date code.
- (4) BS number of the detail specification.

1.7 ELIGIBILITY FOR QUALIFICATION APPROVAL

The first stage of processing in accordance with 2.3.2(3) of BS 9000 is:

The joining together of all piece parts.

The use of the procedure specified in 2.3.2(3)(ii) of BS 9000 is excluded.

1.8 STRUCTURALLY SIMILAR TUBES

When simultaneous or successive production is proceeding on several types of hydrogen thyratron tubes having common features, those common features may be sampled from the complete range of types instead of from each lot of each type.

Admissible common features and associated tests include the following:

Envelope assembly, finish and labels	Damp heat, BS 2011 Test Ca
Bases and caps	Dimensions and adhesion, BS 2011 Test 2.6.9.
Terminations	BS 2011, Test U
Cathode heater	Current, Method 1004
Reservoir heater	Current, Method 1004

1.9 DELAYED DELIVERY

Tubes held by the manufacturer for a period exceeding one year following acceptance inspection shall be re-examined before release for all subgroup AO requirements except holding.

1.10 SUPPLEMENTARY PROCEDURE FOR QUALIFICATION APPROVAL

The following table supersedes the sample size requirements of 2.3.1 of BS 9000: Part 1, for production lot sizes below 280 specimens. The samples may be drawn from one production lot. 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.



Group	Lot size	Sample size	Accept	Reject	2nd sample	Total sample	Accept	Reject
A and B	2 - 7	100 % See note	0	1				
	8 - 280	6	0	2	2	8	1	2
C and D	Any	2	0	2	2	4	1	2

NOTE. Qualification approval is dependent on at least six samples being tested.

Where production rates are 12 tubes per month or less permission to release prior to approval may be granted on successful completion of the specified tests on two specimens for Groups A and B and one specimen for Groups C and D.

On receipt of such permission the manufacturer may commence to release components meeting the specification.

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

Permission to release tubes 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.

When permission to release is granted, the specification number will be shown in Part 4 of PD 9002 but there will be no entry in Part 1 until qualification approval is granted.

All release documentation including the certificate of conformity shall be prominently marked 'This tube is released in advance of qualification approval' and the reference of the document granting permission to release shall be quoted.

Defective tubes may be used for those tests where the validity of the result is not affected by the particular defect(s).

Results obtained on development samples which have been produced using substantially final production techniques and tested by approval methods may be included in the test report to cover part of the requirements for qualification approval with the agreement of the NSI.

1.11 CERTIFIED TEST RECORDS

Generally not applicable, but when the detail specification requires attributes information on the results of tests, this may be given as percentage acceptance without declaring actual quantities.

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 AT GROUP C OR D INSPECTION

The procedures of 2.6.4.1 and 2.6.4.2 of BS 9000 shall apply.