engineering data for CBS®

BULLETIN T-1014

WIDEBAND PENTODE AMPLIFIER

7733

CBS Type 7733 is a wideband pentode amplifier which is especially designed and tested for use in measurement test equipment, instrumentation, and other applications where extreme reliability, stable characteristics, and long life are required. The 7733 is a replacement for types 12BY7 and 12BY7A. Superior performance is assured because of its improved construction, special tests, and tight minimum-maximum limits.

This electron tube has a continuous-wound coil heater which is superior to ordinary heaters both electrically and mechanically. Burn-outs are virtually eliminated, heater-cathode leakage is lower, and hum is lower. Further insurance of quality is provided by heater cycle testing.

Stable characteristics throughout life is a result of meticulous processing and selection of cathode sleeve material. Also each tube is subjected to a 48 hour burn-in period to obtain a more uniform level of performance when they are put into operational service.

An elaborate testing procedure is carried out on these tubes for confidence in their ultimate operation. There is a 100-hour early life assurance test, a special 1000-hour life test, and a 5000-hour informational life test.

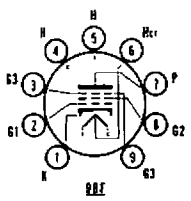
Additional mechanical features offered by CBS type 7733 include: gold plated base pins which prevent oxidation and improve base pin contact; precisely made and fitted parts in stronger structures for lower noise and microphonism; and electrical features include: grid current test, knee test, reduced heater voltage plate current test, and life tested plate current.

MECHANICAL DATA

Cathode, coated unipotential	
Bulb	T-6 1/2
Outline	JEDEC 6-3
Base	Miniature 9-pin (E9-1)
Basing	9BF
Mounting position	Any

PIN CONNECTIONS

Pin 1: Cathode
Pin 2: Grid 1
Pin 3: Grid 3, I.S.
Pin 4: Heater
Pin 5: Heater
Pin 6: Heater Center Tap
Pin 7: Plate
Pin 8: Grid 2
Pin 9: Grid 3, I.S.



ELECTRICAL DATA

HEATER CHARACTERISTICS

Voltage, a-c or d-c	12.6/6.3±10%	volts
Current	300/600	ma
Peak heater-cathode voltage		
Heater negative to cathode	200	volts
Heater positive to cathode*	200	volts

*D-c component must not exceed 100 volts.

DIRECT INTERELECTRODE CAPACITANCES

Grid to plate: g1 to p, max.	.063	uuf
Input: g1 to k+h+g2+g3+i.s.	10.7	uuf
Output: p to k+h+g2+g3+i.s.	4.0	uuf

MAXIMUM RATINGS (Design maximum values)

Plate voltage	330	volts
Grid 2 voltage	190	volts
Grid 1 voltage, negative d-c	-55	volts
Grid 1 voltage, positive d-c	0	volts
Plate dissipation	6.5	watts
Grid 2 dissipation	1.2	watts
Grid 1 circuit resistance		
Fixed bias	0.25	meg
Self bias	1.0	meg
Bulb temperature	165	°C

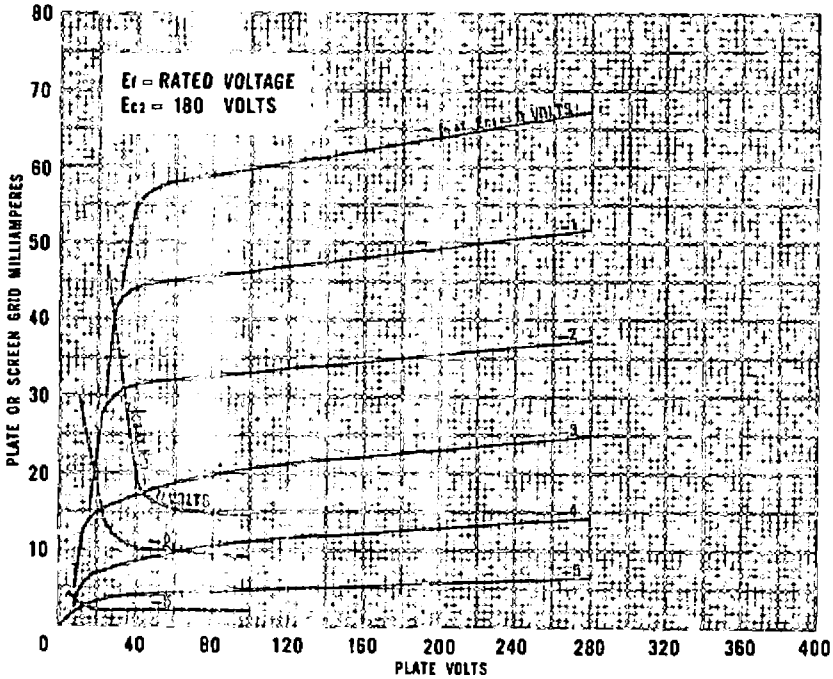
CHARACTERISTICS AND TYPICAL OPERATION

Class A Amplifier

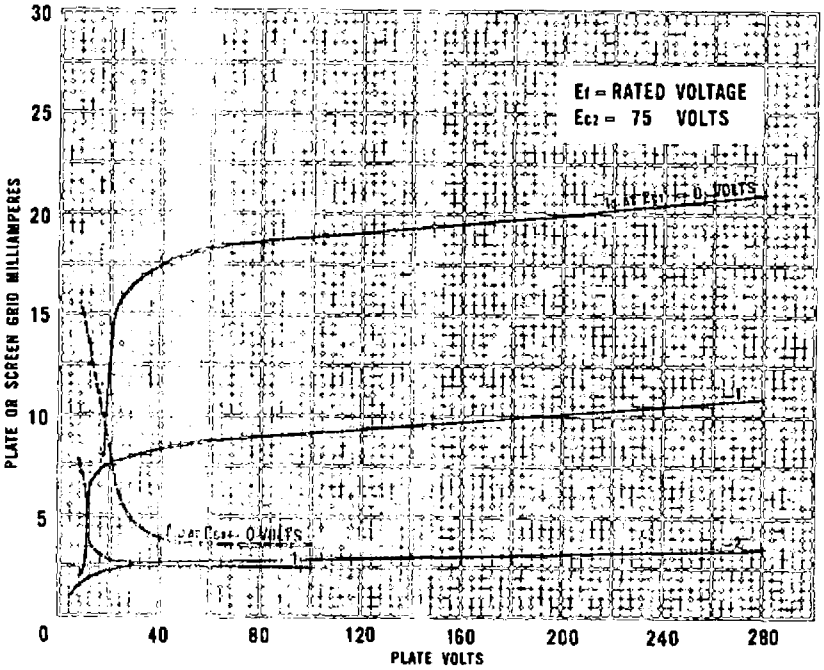
Plate voltage	250	volts
Grid 3 (suppressor) connected to cathode at socket		
Grid 2 (screen voltage)	180	volts
Cathode bias resistor	100	ohms
Plate resistance (approx.)	90000	ohms
Transconductance	12000	umhos
Plate current	24	ma
Grid 2 current	5.0	ma
Grid 1 voltage (approx.) for Ib=20ua	-8	volts
Amplification factor (g1 to g2)	31.5	

from JEDEC release #2870, July 4, 1960

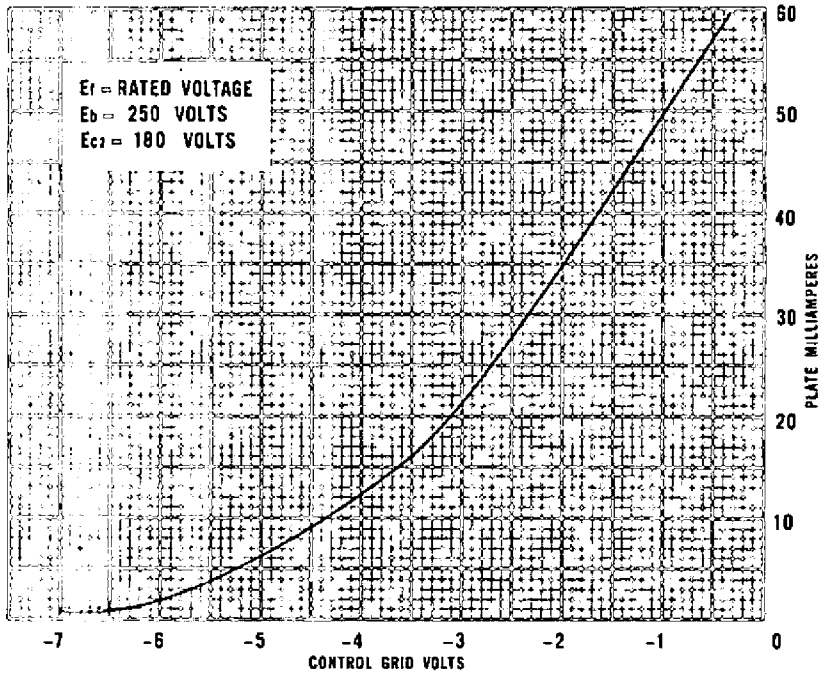
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



CUSTOMER ACCEPTANCE SPECIFICATION

Test Conditions

12.6 series connection or 6.3 parallel connection — Eb = 250 Vdc, Ec2 = 180Vdc
Ec1= 0 Vdc, Rk = 100 ohms

Reference Note 2	AQL Note 1	Test	Conditions	Sym.	Min.	Max.	Unit
4.7.5	0.4	Continuity & Short		---	---	---	---
4.10.8	2.5*	Heater Current	Ef = 12.6V	If	275	325	mA
			Ef = 6.3 V	If	570	630	mA
4.10.15	1.0	Heater Cathode Leakage	Ehk = +200 Vdc	Ihk	---	10	uAdc
			Ehk = -200 Vdc	Ihk	---	10	uAdc
4.10.6.1	1.0	Grid Current (1)		Ic(1)	0	-0.5	uAdc
4.10.4.1	1.0	Plate Current (1)		Ib(1)	19	31	mAdc
4.10.4.3	[redacted] 2.5	Screen Grid Current		Ic2	3.5	8.5	mAdc
4.10.9	[redacted] 2.5	Transconductance (1)		Sm(1)	8500	13500	umhos
---	[redacted] 2.5	Knee Determination	Ebb vary, Ecc_2=150Vdc Rg_1=2.2meg, Ecc_1=0	Kn	---	50	Vdc
4.8	2.5	Insulation of Electrodes	E(g1-all)=100 Vdc, g1 negative	R(g1-all)	100	---	Meg
			E(p-all)=300 Vdc, p Negative	R(p-all)	100	---	Meg
4.10.4.1	2.5	Plate Current (2)	Rk=0, Ec1= -16 Vdc	Ib(2)	---	40	uAdc
4.10.9	2.5	Plate Current (2)	Ef = 5.7V or 11.4	Δ Ib	---	15	%
4.10.6.1	2.5	Grid Current (2)	Ef=7.0V or 13.8, Rg1=0.1 Meg Note 3	Ic(2)	0	-1.5	uAdc
4.10.3.4	2.5	Noise & Microphonics	Rg_1=50K, Ebb=300V, Rp=10K Ecc_2=180Vdc, Rk=0; Ecc= -5V Ecal=30mVac, Notes 4[redacted]	M	---	---	---
4.10.4.1	2.5*	Plate Current (3)	Eb=65Vdc, Ec2=150Vdc Ec_1=0; Rk=0, Note 7	Ib(3)	30	70	mAdc
4.9.19.1	2.5*	Vibration	Rp=2000 ohms	Ep	---	100	mVac
4.10.14	2.5*	Capacitance	No Shield	Cgp	---	0.063	uuf
			No Shield	Cin	8.0	12.4	uuf
			No Shield	Cout	2.5	4.5	uuf
LIFE TESTS							
---	1.0 Code K	Early Life Assurance Test	Ef=6.3V or 12.6V Eb=250Vdc Ec2=180Vdc Rk=100 ohms, Ehk= -200Vdc, Rg1=1.0 Meg, Note 5	---	---	---	---

Reference	AQL	Test	Conditions	Sym.	Min.	Max.	Unit
---	---	Early Life Assurance Test End Points	Shorts and Continuity	---	---	---	---
			Change in Plate Current of Individual Tubes	$\Delta \frac{Ib}{t}$	---	10	%
4.11.5	---	Intermittent Life Test 1000 Hours	Early Life Assurance Test Conditions, Note 6	---	---	---	---
4.11.4	---	Intermittent Life Test End Points - 1000 hours	Inoperatives	---	---	---	---
			Grid Current (1)	Ic(1)	0	-1.5	uAdc
			Change in Plate Current (1) of individual tubes	$\Delta \frac{Ib(1)}{t}$	0	20	%
			Heater Cathode Leakage				
			Ehk= +200Vdc	Ihk	0	20	uAdc
			Ehk= -200 Vdc	Ihk	0	20	uAdc
			Insulation of Electrodes				
			E(g1-all)	R(g1-all)	50	---	Meg
			E(p1-all)	R(P-all)	50	---	Meg
4.11.7	---	Heater Cycling Life Test	Ef=7.0V or 13.8V Ehk= -200V Cycle 1.0 Min. on 4.0 Min. off	---	---	48	hours
4.11.4	---	Heater Cycling Life Test End Points	Shorts & Opens Heater Cathode Leakage	---	---	---	---
			Ehk = +200 Vdc	Ihk	---	15	uAdc
			Ehk = -200 Vdc	Ihk	---	15	uAdc

TEST NOTES

Note 1: Lots of CBS Electronics tubes may be sampled using MIL-STD-105A sampling tables for the specified AQL. All characteristics, having similar AQL's, shall be combined for sampling purposes with the exception of control test. Control test is indicated by an asterisk (*). The term AQL, as used on the specification, is defined in MIL-STD-105A, paragraph 4.1.

Note 2: References are paragraphs in MIL-E-1D specification, dated 31 March 1958.

Note 3: Prior to this test, tubes to be preheated five (5) minutes at conditions indicated below. Test immediately after preheating:

Ef V	Ec1 Vdc	Rk ohms	Rg1 Meg	Eb Vdc	Ec2 Vdc
7.0 or 13.8	0	100	0.1	250	180

Note 4: Rejection point shall be VU reading obtained during calibration.

Note 5: Early Life Assurance Test

a. Life test samples shall be selected from a lot at random in such a manner as to be representative of the lot. If such selection results in a sample containing tubes which are outside the initial specification limits for the relevant life test endpoint characteristics, such tubes shall be replaced by randomly selected acceptable tubes.

b. Serially mark all tubes of the sample.

c. Record reference characteristic measurements on the entire sample after a maximum operation of 15 minutes under specified voltage and current conditions.

d. The Early Life Assurance Test sample shall be operated at specified conditions or equivalent for 100 hours (± 4 hours) with the intermediate down period reading point at 20 hours (± 4 hours) and 2 hours ± 30 minutes. Intermittent or continuous operation may be employed.

e. A defective shall be defined as a tube having failed the shorts and continuity test or a tube having a change in referenced characteristic greater than that specified.

Note 6: 1000 Hour Intermittent Life Test

a. The sample size shall be 10 tubes and shall be selected from the first 10 lowest number tubes which have successfully passed the Early Life Assurance Test and meet the initial test endpoint characteristic.

b. Record the reference characteristic.

c. Place the sample on life test with the specified operating conditions for 1000 hours with the intermediate down period reading points at 250 ± 24 hours, 500 ± 24 hours and 750 ± 24 hours. The 100 hours of Early Life Assurance Test — shall be part of the 1000 hours.

d. Acceptance criteria - The sample is acceptable if it has earned a total of 9000 tube hours. The total number of tube hours is the sum of the successful operating hours of each tube.

e. Quarterly, the life test sample shall be continued to 5000 hours with interim reading points at each 1000 hours. This test will be run to determine long life capabilities.

Note 7: Plate current Ib(3) reading shall be an instantaneous reading.

Note 8: The rejection level shall be set at the VU meter reading obtained during calibration.

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Printed in U.S.A.