4037

High-Mu Triode

GLASS-METAL PENCIL TYPE HAVING OCTAL BASE

For RF-Power-Amplifier, Oscillator, and Frequency-Multiplier Applications at Altitudes up to 100,000 Feet

Replaces Type 2C40 in Most Applications

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	0.140	amp
Cathode Warm-Up Time to reach 90 per cent of:		
Typical oscillator power output	10 max.	sec
Operating dc plate current.	15 max.	sec
Amplification Factor.	56	
Transconductance for dc plate volts = 250 and dc plate ma. = 18	6500	μmhos
Direct Interelectrode Capacitances:[a]		
Grid to plate	1.4	μμf
Grid to cathode	2.4	μμf
Plate to cathode.	0.035 max.	μμf
Cathode to rf cathode terminal.	100	μμf

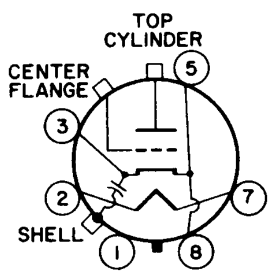
Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. . . . . 3.125"
Maximum Diameter. . . . . 1.312"
Base. . . . . Small H-Wafer Octal 6-Pin (JEDEC Group 1, No.B6-108)

Terminal Connections:

BOTTOM VIEW

Pin 1 - Do Not Use
Pin 2 - Heater
Pin 3 - Cathode
Pin 5 - Cathode
Pin 7 - Heater
Pin 8 - Cathode



SHELL - Cathode RF Terminal
CENTER FLANGE - Grid Terminal
TOP CYLINDER - Plate

Thermal:

Plate-Seal Temperature (Measured on plate seal).	175 max.	°C

RF AMPLIFIER — Class A1

Maximum CCS[b] Ratings, *Absolute-Maximum Values:*

For altitudes up to 100,000 feet and frequencies up to 1700 Mc

DC PLATE VOLTAGE	300 max.	volts
DC GRID VOLTAGE	-100 max.	volts
DC PLATE CURRENT	25 max.	ma
PLATE DISSIPATION[c]	6.25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	90 max.	volts
Heater positive with respect to cathode	90 max.	volts

Maximum Circuit Values:

Grid-Circuit Resistance	0.5 max.	megohm

RF POWER AMPLIFIER AND OSCILLATOR — Class C Telegraphy

Key-down conditions per tube without amplitude modulation[d]

Maximum CCS[b] Ratings, *Absolute-Maximum Values:*

For altitudes up to 100,000 feet and frequencies up to 1700 Mc

DC PLATE VOLTAGE	360 max.	volts
DC GRID VOLTAGE	-100 max.	volts
DC PLATE CURRENT	25 max.	ma
DC GRID CURRENT	8 max.	ma
PLATE INPUT	9 max.	watts
PLATE DISSIPATION[c]	6.25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	90 max.	volts
Heater positive with respect to cathode	90 max.	volts

Typical CCS Operation:

As oscillator in cathode-drive circuit

	At 500 Mc	*At 2000 Mc*	*At 3000 Mc*	
DC Plate-to-Grid Voltage	262	252	252	volts
DC Cathode-to-Grid Voltage[e]	12	2	2	volts
DC Plate Current	23	23	25	ma
DC Grid Current (Approx.)	6	3	4	ma
Useful Power Output (Approx.)	3	0.5	0.1	watts

As rf power amplifier in cathode-drive circuit

	At 500 Mc	
DC Plate-to-Grid Voltage	326	volts
DC Cathode-to-Grid Voltage[e]	51	volts
DC Plate Current	23	ma
DC Grid Current (Approx.)	7	ma

Driver Power Output (Approx.)	2		watts
Useful Power Output (Approx.)	5		watts

Maximum Circuit Values:

Grid-Circuit Resistance	0.1	max.	megohm

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1

Maximum CCS[b] Ratings, *Absolute-Maximum Values:*

For altitudes up to 100,000 feet and frequencies up to 1700 Mc

DC PLATE VOLTAGE	275	max.	volts
DC GRID VOLTAGE	-100	max.	volts
DC PLATE CURRENT	22	max.	ma
DC GRID CURRENT	8	max.	ma
PLATE INPUT	6	max.	watts
PLATE DISSIPATION[c]	4.25	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	90	max.	volts
Heater positive with respect to cathode	90	max.	volts

Maximum Circuit Values:

Grid-Circuit Resistance	0.1	max.	megohm

FREQUENCY MULTIPLIER

Maximum CCS[b] Ratings, *Absolute-Maximum Values:*

For altitudes up to 100,000 feet and frequencies up to 1700 Mc

DC PLATE VOLTAGE	330	max.	volts
DC GRID VOLTAGE	-100	max.	volts
DC PLATE CURRENT	22	max.	ma
DC GRID CURRENT	8	max.	ma
PLATE INPUT	7.5	max.	watts
PLATE DISSIPATION[c]	6.25	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	90	max.	volts
Heater positive with respect to cathode	90	max.	volts

Typical CCS Operation:

In cathode-drive circuit

	Tripler to 480 Mc	*Doubler to 960 Mc*	
DC Plate-to-Grid Voltage	390	370	volts
DC Cathode-to-Grid Voltage[e]	90	70	volts
DC Plate Current	18	17.3	ma
DC Grid Current (Approx.)	6	7	ma

	Tripler to 480 Mc	Doubler to 960 Mc	
Driver Power Output (Approx.) . .	2.1	2	watts
Useful Power Output (Approx.) . .	2.1	2	watts

Maximum Circuit Values:

Grid-Circuit Resistance	0.1 max.	megohm

[a] Without external shield.

[b] Continuous Commercial Service.

[c] In applications where the plate dissipation exceeds 2.5 watts, it is important that a large area of contact be provided between the plate cylinder and the plate-circuit connection to provide adequate heat conduction.

[d] Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

[e] Obtained from grid resistor.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current.	1	0.125	0.155	amp
Direct Interelectrode Capacitances:				
Grid to plate	-	1.2	1.6	μμf
Grid to cathode	-	2.1	2.7	μμf
Plate to cathode.	-	-	0.035	μμf
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode.	1,2	-	50	μa
Heater positive with respect to cathode.	1,2	-	50	μa
Reverse Grid Current.	1,3	-	1	μa
Amplification Factor.	1,4	41	71	
Transconductance.	1,4	5150	7850	μmhos
Plate Current (1)	1,4	12.5	23.5	ma
Plate Current (2)	1,5	-	55	μa
Plate Current (3)	1,6	0.5	-	ma
Power Output.	1,7	0.2	-	watt

Note 1: With 6.3 volts ac or dc on heater.

Note 2: With 100 volts dc between heater and cathode.

Note 3: With dc plate voltage of 250 volts, dc grid voltage of -2.5 volts, grid resistor of 0.5 megohm.

Note 4: With dc plate-supply voltage of 250 volts, cathode resistor of 75 ohms, and cathode bypass capacitor of 1000 μf.

Note 5: With dc plate voltage of 250 volts and dc grid voltage of -12 volts.

Note 6: With dc plate voltage of 250 volts and dc grid voltage of -5 volts.

Note 7: With dc plate voltage of 250 volts, grid resistor adjusted to give a dc plate current of 23 milliamperes in a cavity-type oscillator operating at 2000 ± 25 Mc.

SPECIAL TESTS & PERFORMANCE DATA

Low-Pressure Voltage Breakdown Test:

This test (similar to MIL-E-1D, paragraph 4.9.12.1) is periodically performed on a sample lot of tubes. Tubes are tested in a chamber at an air pressure equivalent to an altitude of 100,000 feet. Breakdown will not occur when a 60-cycle rms voltage of 500 volts is applied between the plate cylinder and grid flange.

Low-Frequency Vibration Performance:

This test (MIL-E-1D, paragraph 4.9.19.1) is performed on a sample lot of tubes from each production run under the following conditions:

Heater voltage of 6.3 volts, dc plate-supply voltage of 250 volts, grid voltage of -2.5 volts, and plate load resistor of 10,000 ohms. The tubes are vibrated in a plane perpendicular to the tube axis at 25 cycles per second at an acceleration of 2.5 g. The rms output voltage across the plate load resistor as a result of vibration of the tube will not exceed 100 millivolts.

High-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.19.2) is performed on a sample lot of tubes from each production run. The tube is vibrated perpendicular to its axis, with no voltages applied to the tube. Vibration frequency is 40 to 60 cps and acceleration is 10 g. At the end of this test, tubes will not show temporary or permanent shorts or open circuits and will meet the following limits:

Heater-Cathode Leakage Current. . . . . . . 50 max. μa

For conditions shown under *Characteristics Range Values Notes 1,2.*

Low-Frequency Vibration (rms) . . . . 100 max. mv

For conditions shown above under *Low-Frequency Vibration Performance.*

Transconductance. . . . . 5150 min. μmhos

For conditions shown under *Characteristics Range Values Notes 1,4.*

Plate Current (2) . . . . 55 max. μa

For conditions shown under *Characteristics Range Values Notes 1,5.*

Shorts and Continuity Test:

This test (similar to MIL-E-1D, paragraph 4.7.3) is performed on all tubes from each production run. Voltage applied between adjacent elements of the tube under test will be between 20 and 70 volts dc or peak ac. Plate and cathode terminals are tied together and connected to the grid terminal through the shorts test equipment. Tubes are tapped with a rubber tapper three times in each of three mutually perpendicular directions. If a short indication is obtained, the tapping cycle is repeated two times for verification. Acceptance criteria is based on the "Resistance vs. Time Duration" curve shown in paragraph 4.7.7 of MIL-I-D, Amendment 5.

Glass-Seal Fracture Tests:

Fracture tests are performed on sample lots of subassemblies during manufacture.

1. Tubes (prior to final assembly) are placed on supports spaced 15/16" ± 1/64" apart with the grid flange centered between these supports. Tubes will withstand gradual application, perpendicular to the tube axis, of a force of 30 pounds upon the grid flange without causing fracture of the glass insulation.

2. Tubes (prior to final assembly) are held by clamping to the cathode cylinder. Tubes will withstand gradual application of atorque of 12.5 inch-pounds upon the plate terminal without causing fracture of the glass insulation.

Intermittent Dynamic Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.2) is performed on a sample lot of tubes from each production run to insure high quality of rf performance. Each tube is life-tested in a cavity-type oscillator at 500 ± 15 Mc under the following conditions:

Heater voltage of 6.3 volts, plate-supply voltage of 300 volts, grid resistor is adjusted to give a dc plate current of 25 ma and value is recorded, cathode resistor of zero ohms, heater positive with respect to cathode by 100 volts, and plate-seal temperature of 175° C min. Heater voltage is cycled at a rate of 110 minutes on and 10 minutes off.

At the end of 500 hours, the tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to meet the following limits:

Power Output. . . . . 0.2 min. watts

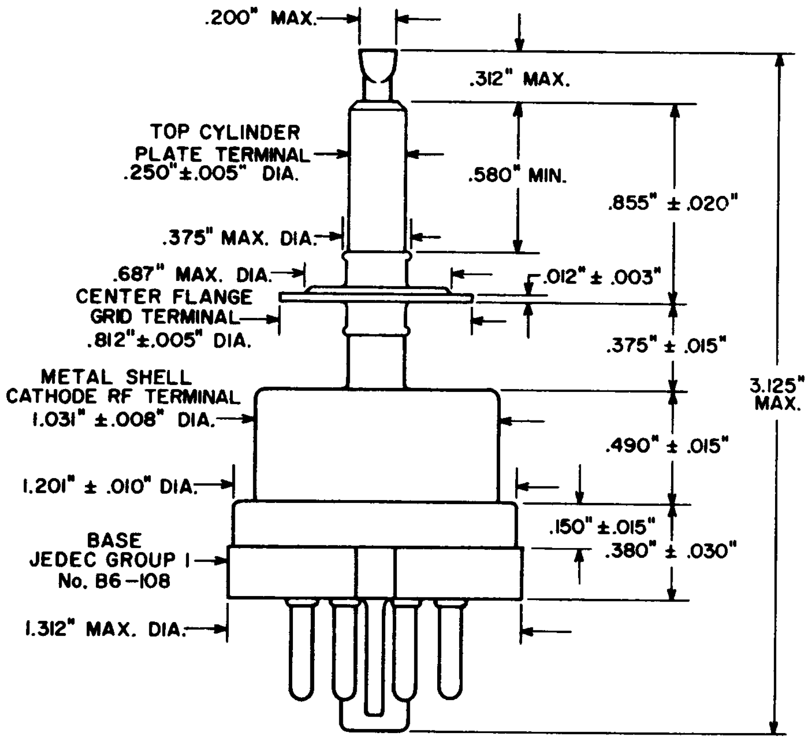
For conditions shown under *Characteristics Range Values Notes 1,7*.

OPERATING CONSIDERATIONS

Mechanically, the 4037 differs from the comparable lighthouse type primarily in the plate-cylinder length. In most applications this dimensional difference presents no problem, and the 4037 can be substituted directly. Electrically, the 4037 is interchangeable with the comparable lighthouse type providing the maximum plate-voltage rating of the 4037 is not exceeded. A slight re-tuning of the cavity may be required in some cases to compensate for the minor differences in the interelectrode capacitances between the two types.

The *mounting* for the 4037 in cavity-type circuits should support the tube by the cathode cylinder which should make firm contact to the cavity surface. Connections to the grid flange and plate cylinder must be made by contacts with flexible leads to allow for variations in tube dimensions and eccentricities of the tube structure. In addition the plate connector should make firm, large-surface contact and be capable of conducting heat so that the plate-seal temperature will not exceed 175° C under any operating conditions.

The *cathode* should preferably be connected to one side of the heater. When, in some circuit designs, the heater is not connected directly to the cathode, precautions must be taken to hold the peak heater-cathode voltage to the maximum rated values shown in the tabulated data.



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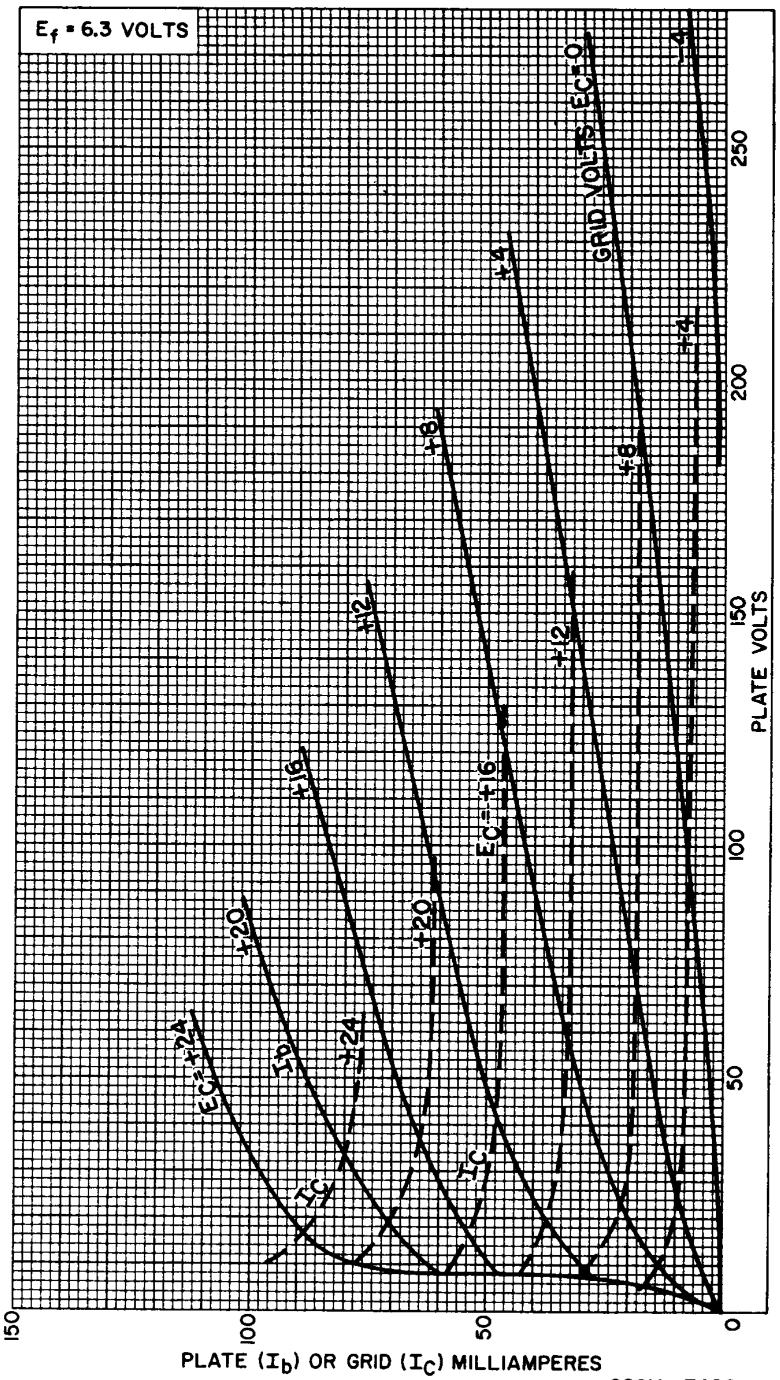
AVERAGE CHARACTERISTICS



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