4028A

High-Mu Triode

CERAMIC-METAL PENCIL TYPE
FAST WARM-UP TIME **FAST HEAT DISSIPATION**

For use in plate-pulsed operation as a power amplifier, oscillator, and frequency multiplier in compact mobile and aircraft equipment at frequencies up to 4 Gc/s and above and at altitudes up to 25,000 feet without pressurization.

ELECTRICAL

Heater, for Unipotential Cathode		
Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 V	0.300	A
Cathode Warmup Time (Average) to reach 80% of operating plate current	10	s
DC plate supply volts = 80, grid volts = 0, cathode resistor = 0 Ω, load resistor = 10 Ω, heater volts = 6.3		
Amplification Factor	70	
Transconductance	22500	μmhos
DC plate mA = 14, dc plate volts = 125, cathode resistor = 50 Ω		
Direct Interelectrode Capacitances		
Grid to plate	2.0	pF
Grid to cathode and heater	5.8	pF
Plate to cathode and heater	0.08 max	pF

MECHANICAL

Operating Position . . . . . Any
Dimensions and Terminal Connections . . . . . See accompanying *Dimensional Outline*
Weight (Approx.) . . . . . 0.3 oz
Sockets
Heater-Terminals Connector Socket for operation up to about 550 Mc/s (Including heater-terminals connector) . . . . . **Grayhill[a] No. 22-5, or equivalent**
Jettron[b] No. CD7010, or equivalent
Cavities (Including heater-terminals connector) . . . **J-V-M[c] No. D-7980 Series, Resdel[d] No. 10 Series, AML, Inc,[e] MCL, Inc,[f] or equivalent**

Terminal Connections (see *Dimensional Outline*):

H – Heater Pin
K – Cathode Cylinder (Adjacent to Heater Pins)
G – Grid Flange
P – Plate Cylinder (Adjacent to pinch-off)

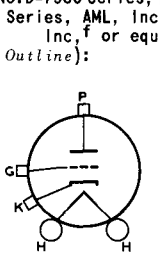

PLATE PULSED SERVICE—CLASS C

Absolute Maximum Ratings (Up to 4 Gc/s)

For a maximum "ON" time[g] of 5 microseconds in any 5000-microsecond interval.

Peak Positive-Pulse Plate-Supply Voltage	2000	V
Peak Plate Current from Pulse Supply	3.0	A
DC Plate Current	3.0	mA
DC Grid Current	1.5	mA
Pulse Duration	1.5	μs
Duty Factor	0.001	
Plate-Seal Temperature[h]	225	°C

Typical Operation as Oscillator with Rectangular Wave Shape in Cathode-Drive Circuit at 3.3 Gc/s

With duty factor[j] of 0.001 and pulse duration of 1 microsecond

Peak Positive-Pulse Plate-Supply Voltage	1750	V
DC Plate Current	2.5	mA
DC Grid Current	1.0	mA
Grid Resistor	50	Ω
Useful Power Output at Peak of Pulse (Approx.)	1000	W

Typical Operation as Frequency Doubler to 1 Gc/s with Rectangular Wave Shape in Cathode-Drive Circuit

Peak Positive-Pulse Plate-Supply Voltage	1200	V
DC Plate Current	0.4	mA
DC Grid Current	0.2	mA
Grid Resistor	2000	Ω
Driver Power Output (Approx.)	50	W
Useful Power Output (Approx.)	100	W

RF POWER AMPLIFIER AND OSCILLATOR—CLASS C TELEGRAPHY[k]

RF POWER AMPLIFIER—CLASS C FM TELEPHONY

Absolute Maximum Ratings (Up to 4 Gc/s)

DC Plate Voltage	300	V
DC Grid Voltage	-50	V
DC Plate Current	35	mA
DC Cathode Current	45	mA
DC Grid Current	15	mA
Plate-Seal Temperature[h]	225	°C
Peak Heater-Cathode Voltage		
Heater negative with respect to cathode	50	V
Heater positive with respect to cathode	50	V

Typical Operation as RF Power Amplifier in Cathode-Drive Circuit at 550 Mc/s

DC Plate Voltage	250	300	V
DC Grid Voltage	-6.5	-9	V
Grid Resistor	500	700	Ω
DC Plate Current	31	35	mA
DC Grid Current	13	13	mA
Driver Power Output (Approx.)	0.2	0.2	W
Useful Power Output (Approx.)	4.8	6	W

Maximum Circuit Value

Grid-Circuit Resistance	0.25	MΩ

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CHARACTERISTICS RANGE VALUES

	Note	Min	Max	
Heater Current	1	0.270	0.330	A
Direct Interelectrode Capacitances				
Grid to plate	-	1.7	2.4	pF
Grid to cathode	-	5.0	6.5	pF
Plate to cathode	-	-	0.08	pF
Heater-Cathode Leakage Current				
Heater negative with respect to cathode	1,2	-	30	μA
Heater positive with respect to cathode	1,3	-	30	μA
Reverse Grid Current	1,4	-	0.3	μA
Transconductance	1,5	18000	27000	μmhos
Plate Current (1)	1,5	13	25	mA

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

Note 2: With 60 volts dc between heater and cathode, heater negative with respect to cathode.

Note 3: With 60 volts dc between heater and cathode, heater positive with respect to cathode.

Note 4: With dc plate voltage of 200 volts, dc grid voltage of -2 volts, grid resistor of 0.5 megohm.

Note 5: With dc plate-supply voltage of 125 volts, cathode resistor of 50 ohms, and cathode bypass capacitor of 1000 μf.

[a] Grayhill, Inc., 561 Hillgrove Ave., LaGrange, Ill.

[b] Jettron Products, Inc., 56 Route 10, Hanover, N.J.

[c] Fidelitone Microwave, Inc., JVM Division, 6415 N. Ravenswood Ave., Chicago, Ill. Indicated No. applies to a series of cavities covering the range from 220 to 3500 Mc/s.

[d] Resdal Engineering Corp., 330 South Fair Oaks Ave., Pasadena, Calif. This series of cavities covers the range from 215 to 2325 Mc/s.

[e] Applied Microwave Laboratory, Inc., 106 Albion St., Wakefield, Mass.

[f] Microwave Cavity Laboratory, Inc., 10 Beach Ave., LaGrange, Ill.

[g] *"ON"* time is defined as the sum of the duration of all individual pulses which occur during the indicated interval. *Pulse duration* is defined as the time interval between the two points on the pulse at which the instantaneous value is 70% of the peak power value. The *peak value* is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

[h] 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 terminal to provide adequate heat conduction.

[j] Duty factor is the product of pulse duration and repetition rate. For variable pulse durations and pulse repetition rates, the duty factor is defined as the ratio of time "ON" to total elapsed time in any 5000-microsecond interval.

[k] Key-down conditions per tube without amplitude modulation. 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.

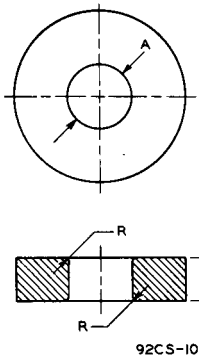
OPERATING CONSIDERATIONS

Connections to the cathode cylinder, grid flange, and plate cylinder should be made by flexible spring contacts. The connectors should make firm, large-surface contact, yet must be sufficiently flexible to insure that no part of the tube is subjected to excessive strain.

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.

GAUGES

Gauge	Type	Dimension		
		Diameter A	Thickness B	Radius R
G_1-1	Go	0.25200" +0.00000" -0.00007"	0.320" +0.001" -0.000"	0.003" Max
G_1-2	No-Go	0.24500" +0.00007" -0.00000"	-	-
G_3-1	Go	0.55700" +0.00000" -0.00007"	-	-
G_3-2	No-Go	0.54700" +0.00007" -0.00000"	-	-



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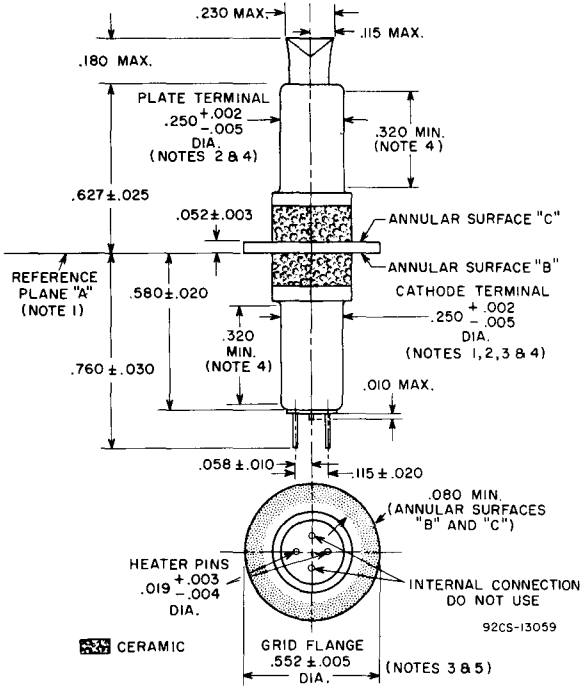
DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Reference Plane "A" is defined as that plane against which annular surface "B" of the grid flange abuts.

Annular Surface "B" is on the side of the grid flange toward the cathode cylinder.

Annular Surface "C" is on the side of the grid flange toward the plate cylinder.

Note 1: With annular surface "B" resting on reference plane "A". The axis of the cathode cylinder will be within 2° of a line perpendicular to reference plane "A".

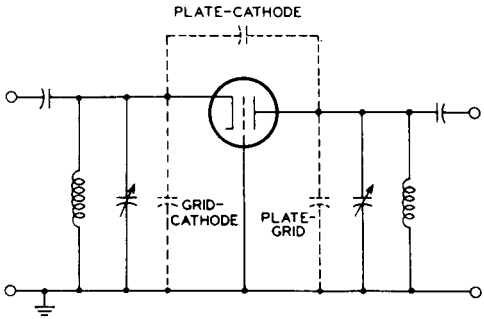
Note 2: The axes of the plate cylinder and cathode cylinder will coincide within 0.010 inch.

Note 3: The axes of the cathode cylinder and grid flange will coincide within 0.005 inch.

Note 4: The diameter along the 0.320 inch minimum length is measured with "GO" and "NO-GO" ring gauges G1-1 and G1-2, respectively.

Note 5: This diameter is measured with "GO" and "NO-GO" gauges G3-1 and G3-2, respectively.

TYPICAL CATHODE-DRIVE POWER AMPLIFIER CIRCUIT



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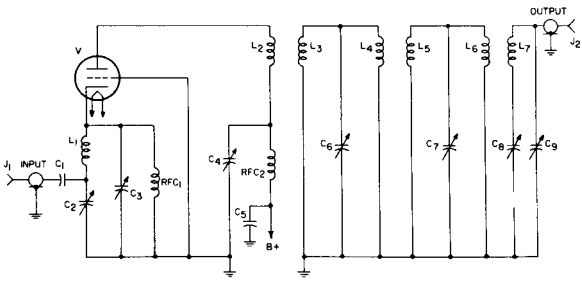
TYPICAL BROADBAND AMPLIFIER CIRCUIT



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C_1: 100 to 500 pF.
C_2, C_3, C_4, C_6, C_7, C_8, C_9: 0.8-8.5 pF
Glass Dielectric Trimmers—JFD VC 20G or equivalent.
C_5: 500 pF.
J_1, J_2: BNC Connectors.
L_1, L_2, L_3, L_4, L_5, L_6, L_7:
For Frequency Range of:
200-500 Mc/s—Two Turns, 1/2 inch Dia., Spaced 3/8 inch, Silver-Plated #14 Wire.
500-1000 Mc/s—One Turn, 1/2 inch Dia., Silver-Plated #14 Wire.
RFC_1, RFC_2: Ohmite Z-450 RF Chokes, or equivalent.
V: RCA-4028A

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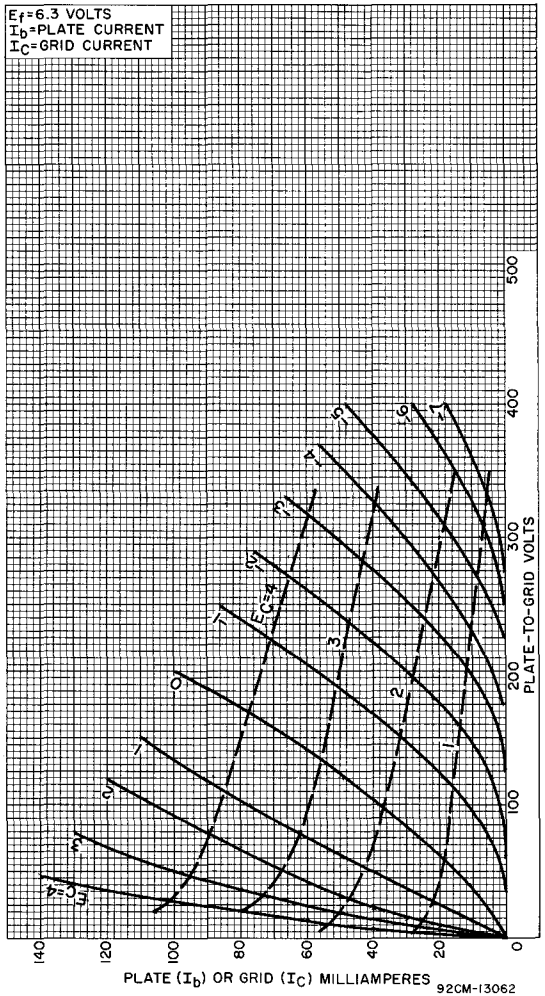
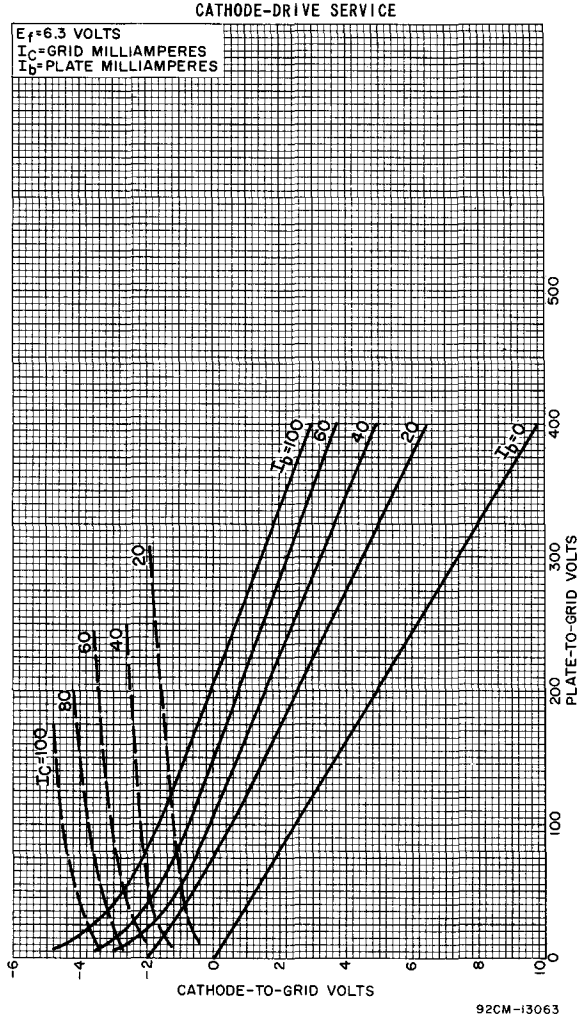
Average Characteristics

CATHODE-DRIVE SERVICE



Average Constant-Current Characteristics



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Typical Oscillator Power Output as a Function of Variations in Heater Voltage

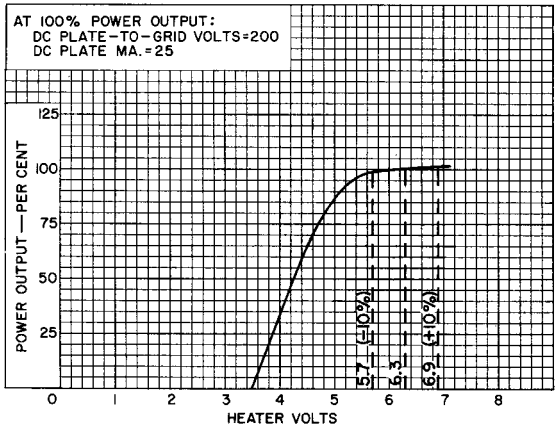

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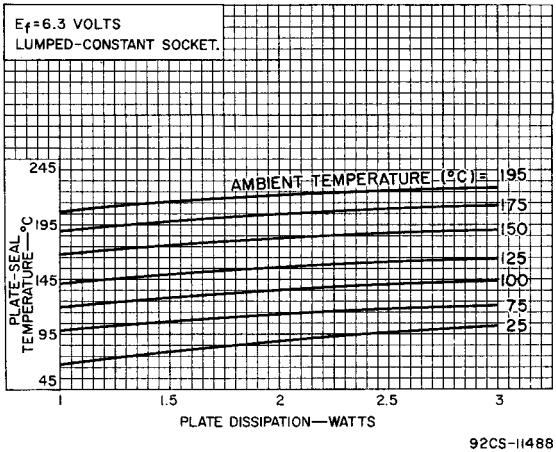
Plate-Seal Temperature as a Function of Ambient Temperature With Lumped-Constant Circuit



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