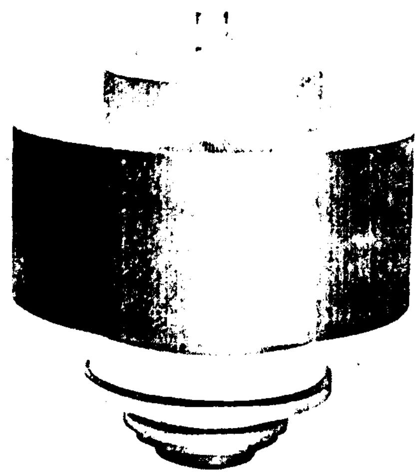
TENTATIVE TECHNICAL DATA

4CX40,000G

VHF RADIAL BEAM POWER TETRODE



The EIMAC 4CX40,000G is a ceramic/metal power tetrode intended for use in audio or radio-frequency applications. It features a high-stability pyrolytic graphite grid and a type of internal mechanical structure which results in high rf operating efficiency. Low rf losses in this structure permit operation of the tube at full ratings up to 220 MHz.

The 4CX40,000G is recommended for FM broadcast service, rf linear power amplifier service, and for VHF-TV linear amplifier service. The anode is rated for 40 kW of dissipation with orced-air cooling, and incorporates a highly efficient cooler of new design.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

lament: Thoriated-tungsten Mesh		
Voltage	15.0 ± 0.75	V
Current, @ 15.0 volts	170	A
Warmup: see FILAMENT WARMUP RECOMMENDATION		
plification Factor, average at Ib = 10 Adc		
Grid to screen	8	
Direct Interelectrode Capacitances (cathode grounded)		
Cin	447	pF
Cout	33	pF
Cgp	1.8	pF
Direct Interelectrode Capacitances (grid & screen grounded)		
Cin	155	pF
Cout	35	pF
Cfp	0.15	pF
Frequency of Maximum Ratings (CW)	220	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

Effective: September 1979

MECHANICAL

Maximum Length	11.85 In; 30.10 Cm
Maximum Diameter	10.08 In; 25.60 Cm
Net Weight (approximate)	55 lbs ; 25 kg
Operating Position	Axis Vertical, Base Up or Down
Cooling	Forced Air
Operating Temperature, Maximum	
Ceramic/Metal Seals and Anode Core	250 °C
Base	Special, Coaxial
Recommended Air-System Socket	EIMAC SK-2400
Recommended Air-System Chimney	EIMAC SK-2406

RADIO FREQUENCY POWER AMPLIFIER
OR OSCILLATOR

Class C Telegraph or FM

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	14.	KILOVOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC GRID VOLTAGE	-1000	VOLTS
DC PLATE CURRENT	10	AMPERES
PLATE DISSIPATION	40	KILOWATTS
SCREEN DISSIPATION	1500	WATTS
GRID DISSIPATION	1000	WATTS

TYPICAL OPERATION

Class C rf Amplifier

Plate Voltage	10.6	kVdc
Screen Voltage	800	Vdc
Grid Voltage	-300	Vdc
Plate Current	7.0	Adc
Screen Current [1]	440	mAdc
Grid Current [1]	700	mAdc
Load Impedance	800	Ω
Driving Power [1]	250	W
Useful Power Output [2]	60	kW

1 Approximate value

2 Measured at the load

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

A P P L I C A T I O N

MECHANICAL

MOUNTING - The tube must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the designer.

SOCKET & CHIMNEY - The EIMAC air-system socket SK-2400 and air chimney SK-2406 are designed especially for use with the 4CX40,000G. The use of the recommended air flow through this socket provides effective forced-air cooling of the base, with air then guided through the anode cooling fins by the air chimney.

COOLING - The maximum temperature rating for the external surfaces of the tube is 250°C, and sufficient forced-air cooling must be used in all applications to keep the temperature of the anode (at the base of the cooling fins) and the temperature of the ceramic/metal seals comfortably below the rated maximum.

The cooling characteristics of the anode are shown in the attached graphs, for power levels (anode dissipation) from 20 to 40 kW and for sea level, 5000 feet, and 10,000 feet. The designer is cautioned to keep in mind this is ABSOLUTE data, with pure dc power, with no safety factors added, and the pressure drop figures make no allowance for losses in filters, ducting, and the like.

It is considered good engineering practice to design for a maximum anode core temperature of 225 °C, and temperature-sensitive paints are available for checking base and seal temperatures before any design is finalized. It is also considered good practice to add a 15% safety factor to the indicated air flow, and allow for variables such as dirty air filters, rf seal heating at VHF, and the fact that the anode cooling fins may not be clean if the tube has been in service for some length of time. Special attention may be required in cooling the center of the stem (base), by means of special directors or some other provision. An air interlock system should be incorporated into the design to automatically remove all voltages from the tube in case of even partial failure of the tube cooling air.

Air flow must be applied before or simultaneously with the application of power, including the tube filament, and should normally be maintained for a short period of time after all power is removed to allow for tube cooldown.

ELECTRICAL

FILAMENT WARMUP RECOMMENDATION - Filament inrush surge current must be limited to two times rated current. The filament should be brought to rated voltage over a two-minute period. If a step-start sequence is used the initial voltage applied should be 1/3 to 1/2 the nominal rated filament voltage. After two minutes the voltage may then be increased to the rated value. In the event of power failure which does not exceed 60 seconds the full filament voltage may be applied to the tube instantaneously. If the power failure exceeds 60 seconds, the programmed warmup procedure should be used.

FILAMENT OPERATION - The rated nominal filament voltage for the tube is 15.0 volts, as measured at the socket or tube base. Variation in voltage should be maintained within plus or minus five percent, and the filament warmup procedure should be adhered to.

The peak emission capability at nominal filament voltage is normally more than that required for communication service. A small decrease in filament temperature due to a reduction in filament voltage can increase tube life by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance (such as plate current, power output, or distortion) while filament voltage is reduced. At some point in filament voltage there will be a noticeable change in the operating parameter being monitored, and the operating filament voltage must be slightly higher than the level at which deterioration was noted. When filament voltage is to be reduced in this manner it should be regulated and held to plus or minus one percent, and the actual operating value should be checked periodically to maintain proper operation.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings of the tube must be respected to avoid damage. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods (10 seconds maximum) such as may occur during tuning.

GRID OPERATION - The control grid has a maximum dissipation rating of 1000 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should normally be kept near the values shown in the TYPICAL OPERATION section of the data sheet whenever possible.

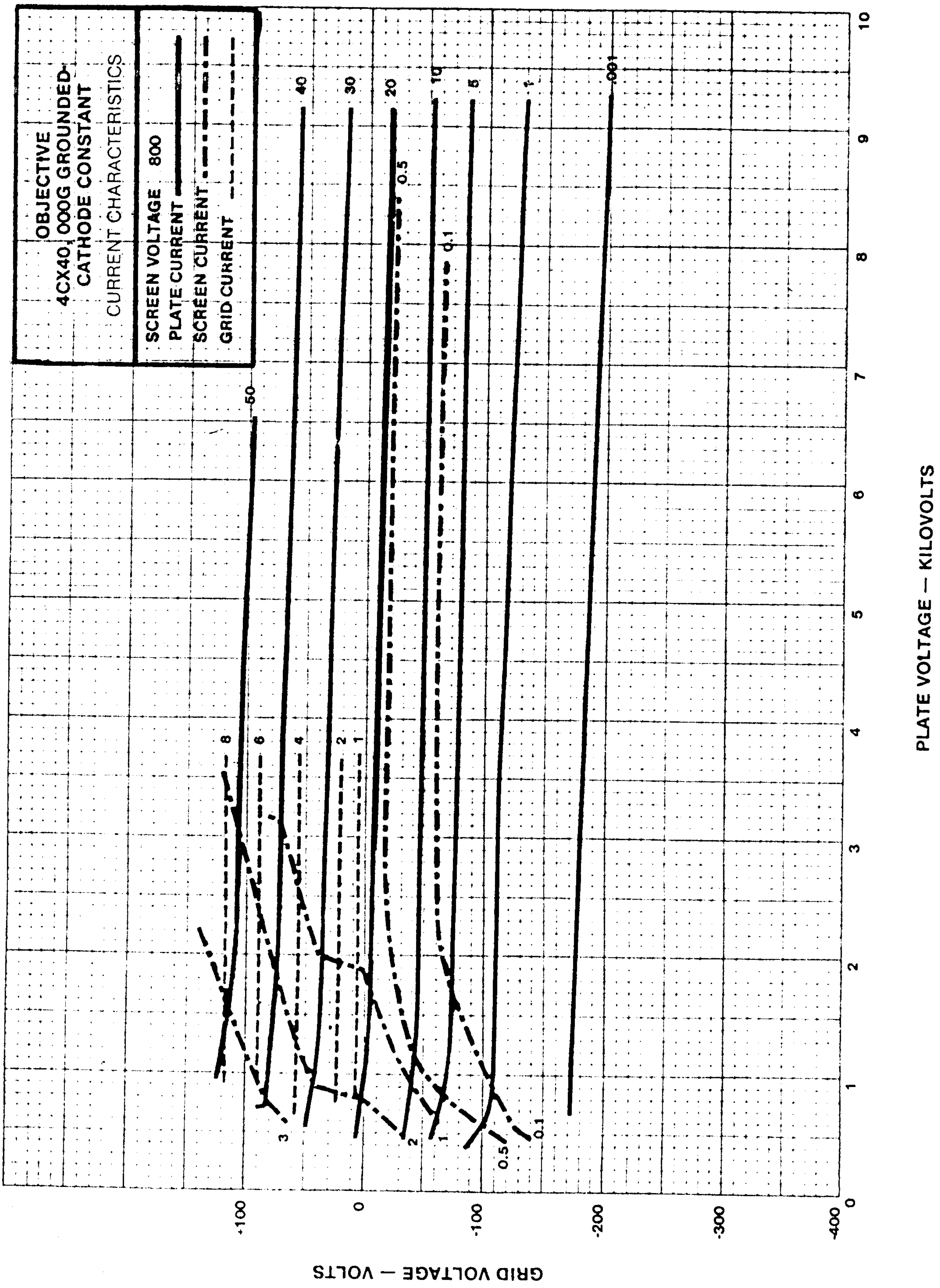
SCREEN OPERATION - The power dissipated by the screen grid must not exceed 1500 watts. Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

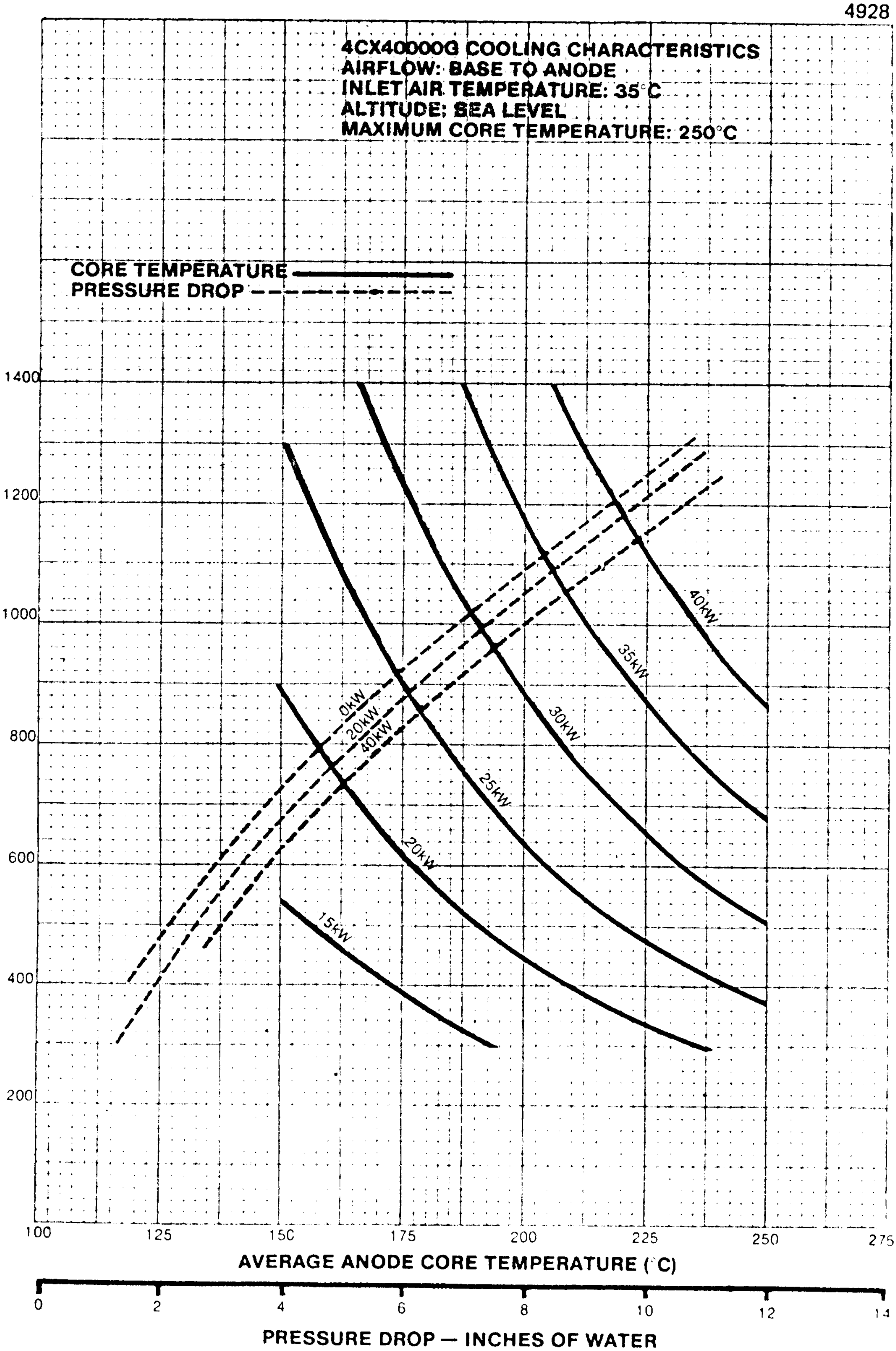
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with the filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation in the event of circuit failure. Energy limiting circuitry (which will activate if there is a fault condiition) and spark gap over-voltage protection are recommended as good engineering proactice.

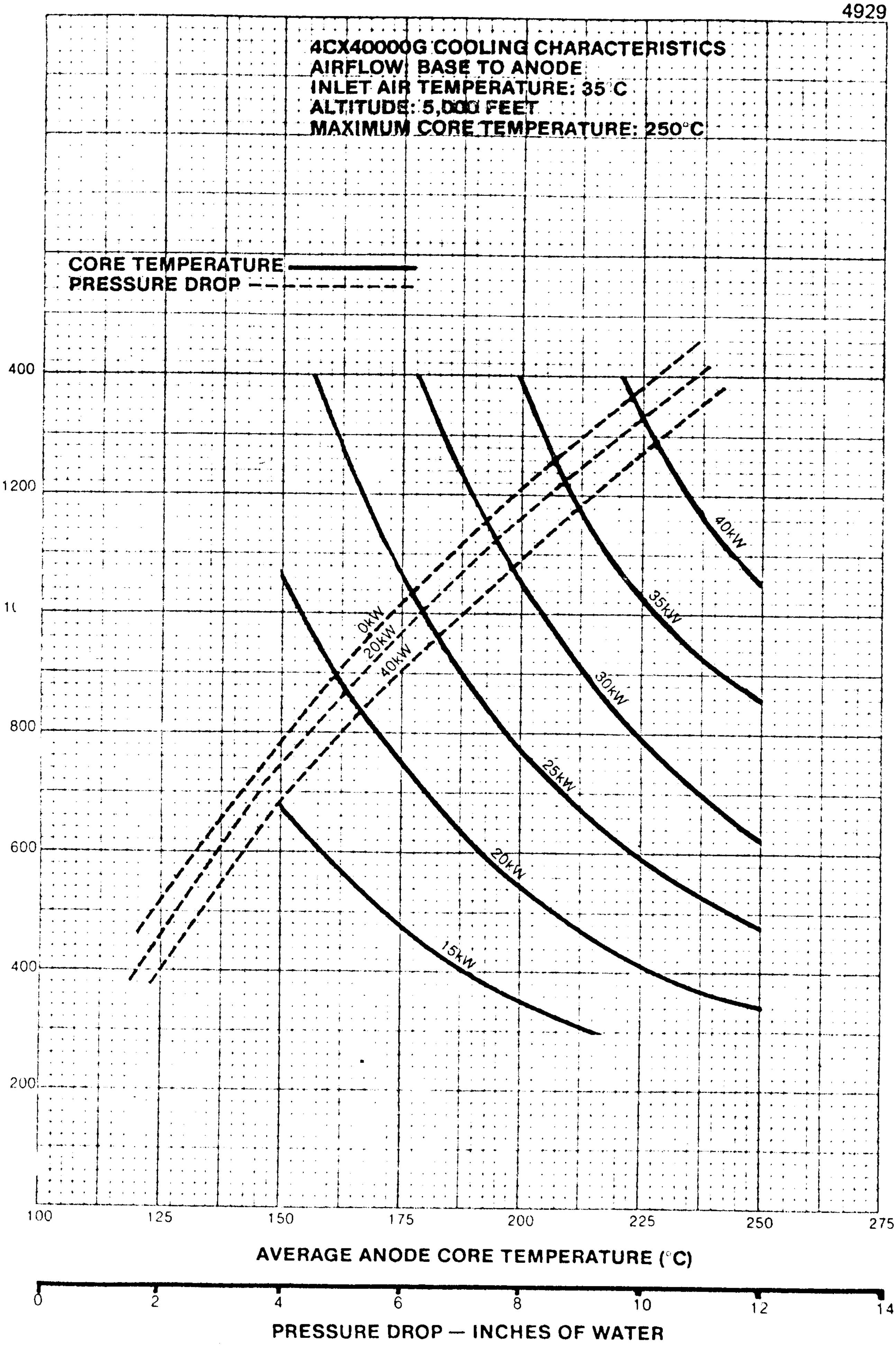
HIGH VOLTAGE - Normal operating voltages used with the 4CX40,000G are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

FAULT PROTECTION - In addition to normal cooling airflow interlock and plate and screen over-current interlocks, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high voltage.

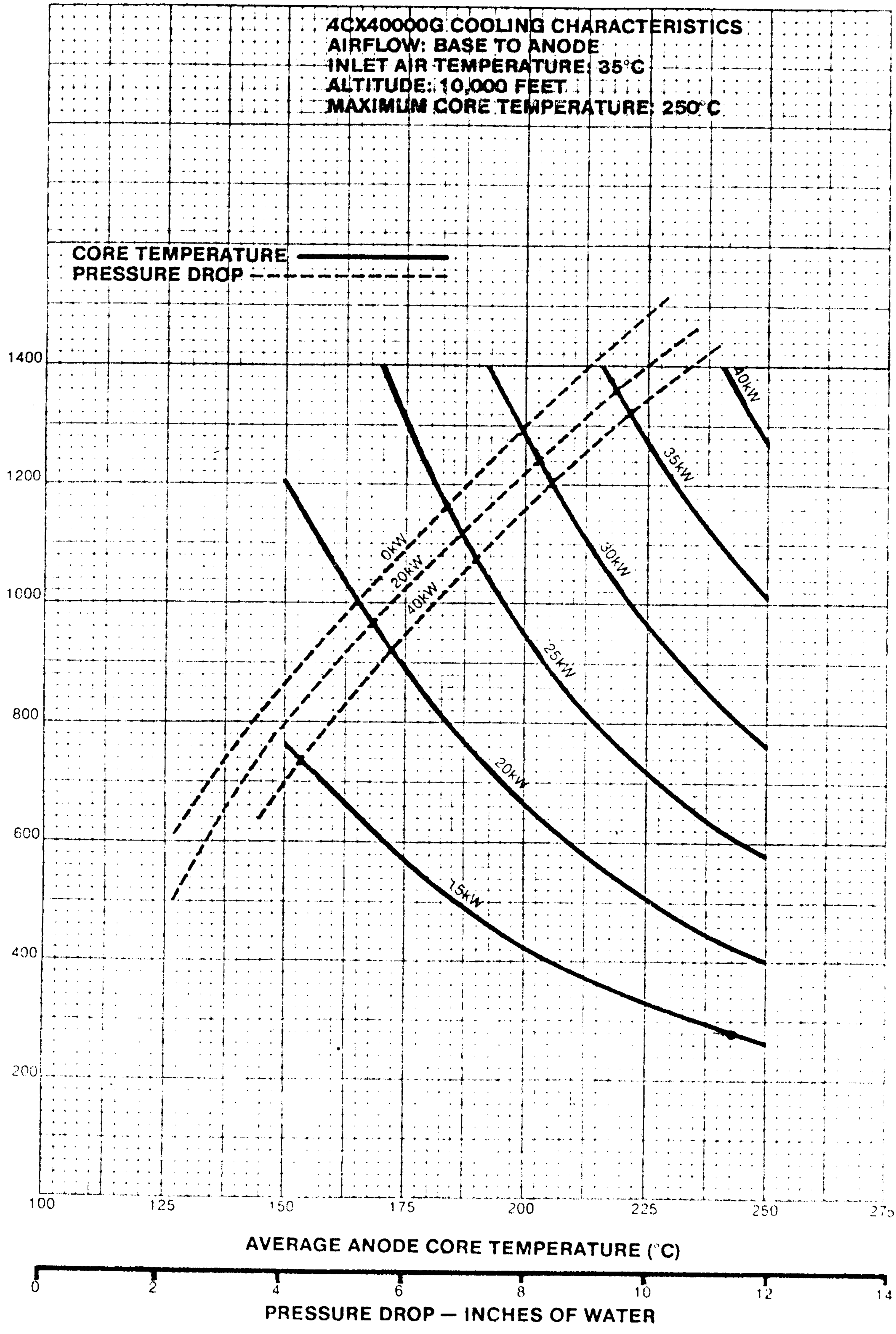
In all cases some protective resistance, at least one or two ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. When stored energy is high, it is recommended that some form of electronic crowbar be used which will discharge power supply capacitors in as short a time as possible following indication of start of a plate arc.


OBJECTIVE
4CX40,000G GROUNDED-CATHODE CONSTANT
CURRENT CHARACTERISTICS
SCREEN VOLTAGE 800
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
PLATE VOLTAGE — KILOVOLTS
GRID VOLTAGE — VOLTS

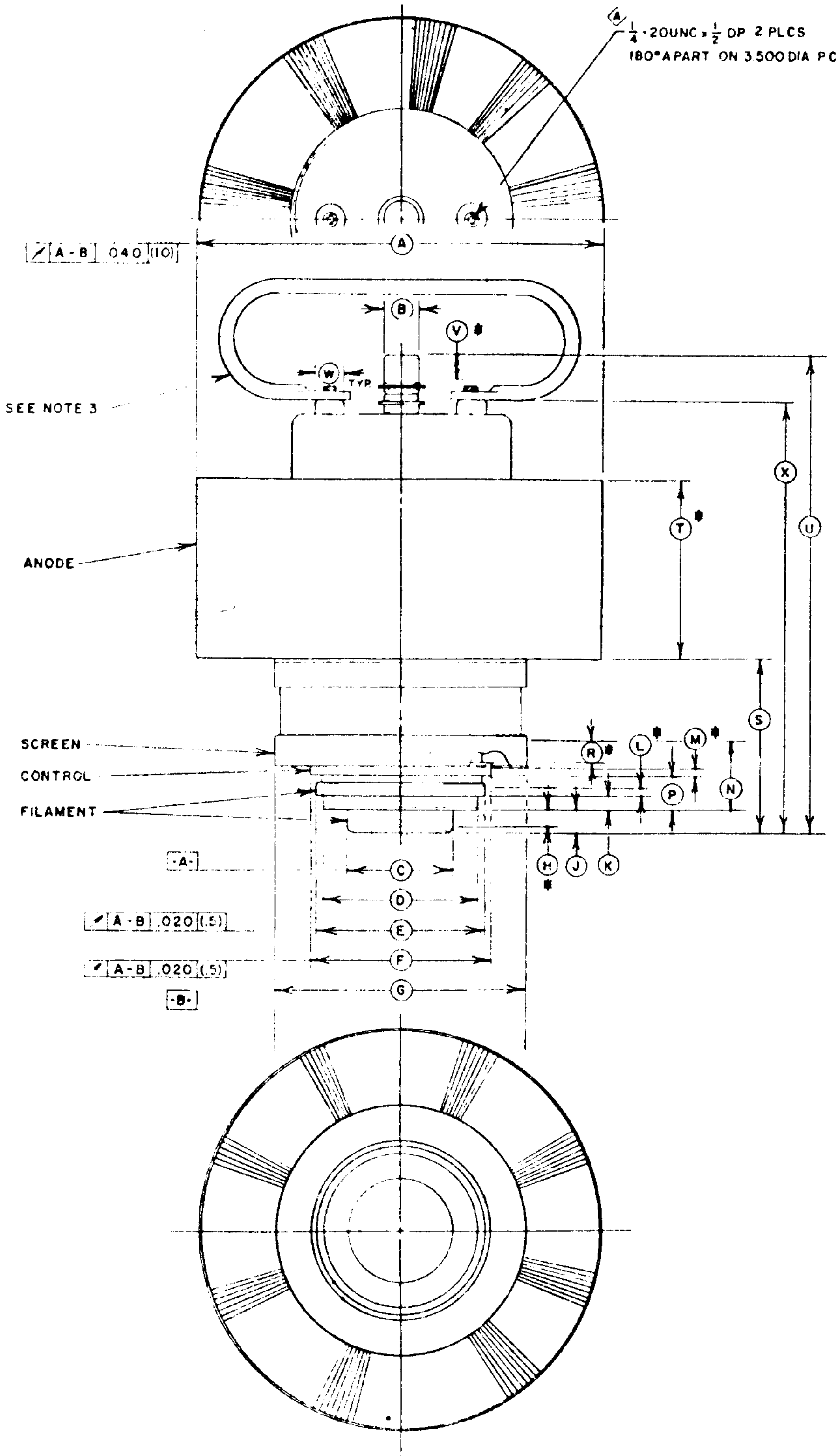

4928
4CX40000G COOLING CHARACTERISTICS
AIRFLOW: BASE TO ANODE
INLET AIR TEMPERATURE: 35°C
ALTITUDE: SEA LEVEL
MAXIMUM CORE TEMPERATURE: 250°C
CORE TEMPERATURE
PRESSURE DROP
1400
1200
1000
800
600
400
200
0kW
20kW
40kW
15kW
20kW
25kW
30kW
35kW
40kW
100
125
150
175
200
225
250
275
AVERAGE ANODE CORE TEMPERATURE (°C)
0
2
4
6
8
10
12
14
PRESSURE DROP — INCHES OF WATER


4929
4CX40000G COOLING CHARACTERISTICS
AIRFLOW: BASE TO ANODE
INLET AIR TEMPERATURE: 35°C
ALTITUDE: 5,000 FEET
MAXIMUM CORE TEMPERATURE: 250°C
CORE TEMPERATURE
PRESSURE DROP
0kW
20kW
40kW
15kW
20kW
25kW
30kW
35kW
40kW
400
1200
800
600
400
200
100
125
150
175
200
225
250
275
AVERAGE ANODE CORE TEMPERATURE (°C)
0
2
4
6
8
10
12
14
PRESSURE DROP — INCHES OF WATER

4930


4CX40000G COOLING CHARACTERISTICS
AIRFLOW: BASE TO ANODE
INLET AIR TEMPERATURE: 35°C
ALTITUDE: 10,000 FEET
MAXIMUM CORE TEMPERATURE: 250°C
CORE TEMPERATURE
PRESSURE DROP
0kW
20kW
40kW
15kW
20kW
25kW
30kW
35kW
40kW
1400
1200
1000
800
600
400
200
100
125
150
175
200
225
250
275
AVERAGE ANODE CORE TEMPERATURE (°C)
0
2
4
6
8
10
12
14
PRESSURE DROP — INCHES OF WATER

4CX40,000G



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF	MIN	MAX	REF
A	9.960	10.080		253.0	256.0	
B	.860	.890		21.8	22.6	
C	2.615	2.625		66.42	66.68	
D			3.825			97.2
E	4.245	4.265		107.80	108.30	
F	4.490	4.520		114.05	114.81	
G	6.360	6.405		161.5	162.7	
H	.440			11.2		
J	.640	.680		16.2	17.3	
K	.260	.290		6.6	7.4	
L	.250			6.3		
M	.150			3.8		
N	1.600			40.6		
P	.790	.830		20.1	21.1	
R	.350			8.9		
S	4.170	4.400		106.0	111.8	
T	4.400	4.600		112.0	117.0	
U	11.550	11.850		293.0	301.0	
V	.500			12.7		
W			.750			19.1
X	10.500	10.850		267.0	276.0	

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE
3. SHIPPED WITH HANDLE ATTACHED. REMOVE BEFORE OPERATION

2nd Draft 17 Aug 83

Varian EIMAC
San Carlos, California

Issue Date Here

TEST SPECIFICATION

ELECTRON TUBE, TRANSMITTING TETRODE
EXTERNAL ANODE, FORCED-AIR COOLED

TYPE 4CX40,000GM

F1 = 110 MHz

ABSOLUTE MAXIMUM RATINGS: (See Note 1)

Parameter:	Ef	Eb	Ec2	Ec1	Ib	Pg1	Pg2	Pp	Anode Core & Seal T	Cooling	Alt.
Units:	Vac	kVdc	kVdc	kVdc	Adc	W	W	kW	°C	---	Ft.
	Note 2								Note 3	Note 4	Note 5
Class AB1 (audio or rf) :	15.0±5%	14.0	2.0	-1.0	10	500	1500	40	250	---	10,000
TEST COND :	15.0	---	1.4	---	---	---	---	---	---	Note 6	---

METHOD OR PAR. references: MIL-E-1 or MIL-STD-1311

Mounting: See Note 7

Recommended Air-System Socket: EIMAC SK-2400

Envelope: Ceramic & Metal

Fault Protection: See Note 8

rf Radiation Hazard: See Note 9

METHOD OR PAR.	REQUIREMENT OR TEST	CONDITIONS	AQL%	INSP. LEVEL	SYMB.	LIMITS Min	LIMITS Max	UNITS
	General							
---	Cathode	Thoriated-tungsten filament	---	---	---	---	---	---
4.8.5	Holding Period		---	---	t:	72	---	hrs

METHOD OR PAR.	REQUIREMENT OR TEST	CONDITIONS	AQL%	INSP. LEVEL	SYMB.	LIMITS Min	LIMITS Max	UNITS
	Quality Conformance Inspection - Part 1 (Production) Note 10							
D-30(a), 40, 60	Visual & Mechanical Inspection Criteria		---	---	---	---	---	---
1301	Filament Current	t = 5 minutes minimum; See Note 11	0.65	II	If:	168	182	Aac
1261	Grid Voltage (1)	Eb = 10.5 ± 0.5 kVdc; Ec1/Ib = 2.5 Adc	0.65	II	-Ec1:	160	230	Vdc
					-Ic1:	---	1.0	mAdc
1266	Primary Grid Emission (control)	Pg1 = 500 W; t = 120 minimum; Ec2 = 0 Vdc; anode = -500 to -1000 Vdc	0.65	II	-Isg1:	---	1.0	mAdc
1266	Primary Grid Emission (screen)	Ec1 = 0 Vdc; t = 120 minimum; Pg2 = 2000 W; anode = -500 to -1000 Vdc	0.65	II	-Isg2:	---	6.0	mAdc
---	Ion Current	Ec1 = 0 Vdc; Ec2 = 75 Vdc; Eb = -45 Vdc; t = 180; Ef/Ic2 = 25 mAdc	0.65	II	Iz:	---	1.0	uAdc
1261	Grid Voltage (2) (cut-off)	Eb = 16 kVdc; Eco = Ec1/Ib = 20 mAdc	0.65	II	-Eco:	---	350	Vdc
1372	Current Division (1)	Eb = 5000 Vdc; Ec1 = -400 Vdc; egk/Ib = 17 a; See Note 12	0.65	II	egk:	---	0	v
					ic2:	---	2.0	a
1372	Current Division (2)	Eb = Ec2 = 2000 Vdc; Ec1 = -400 Vdc; egk/Ib = 27 a; See Note 12	0.65	II	egk:	---	0	v
					Ic2:	---	5.0	a
1231	Pulsing Emission	eb = ec2 = ec1 = 1000 v etd/Ib = 100 a	0.65	II	Is:	200	---	a
---	rf Operation	To Be Specified	0.65	II	---	---	---	---

METHOD OR PAR.	REQUIREMENT OR TEST	CONDITIONS	AQL%	INSP. LEVEL	SYMB.	LIMITS Min	Max	UNITS
	Quality Conformance Inspection - Part 2 (Design) - Note 13							
D-30(b)	Dimensions	Per Outline Drawing	6.5	S3	---	---	---	---
1331	Direct Interelectrode Capacitance (gnd.cath.connection)		6.5	S3	Cin:	420	480	pF
					Cout:	33	43	pF
					Cgp:	---	2.0	pF
1331	Direct Interelectrode Capacitance (gnd.grid connection)		6.5	S3	Cin:	150	180	pF
					Cout:	35	45	pF
					Cpk:	---	0.5	pF

NOTES

1. The values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

2. Filament inrush surge current must be limited to 300 amperes. For best reliability experience has shown that the filament and its internal supporting structure should be raised to operating temperature over a two-minute period. This should be accomplished by a linear increase in voltage to the operating value over 120 seconds. This can be accomplished by a motor-driven variable transformer or an equivalent solid-state device. A step-start sequence can be used with equivalent reliability, as follow:

   1) Turn on at 40% to 50% of operating voltage and maintain this value for 120 seconds.
   2) Increase voltage to full operating value.

   In the event of a power failure not exceeding 60 seconds the full operating voltage may be reapplied instantaneously. If the power failure exceeds 60 seconds, the programmed warmup procedure should be used. In case of emergency the turn-on program may be bypassed with no serious effect on reliability but normal startup should be programmed.

   Filament voltage should be measured at the tube base or socket, using an known-accurate rms-responding meter.

3. Under all operating conditions the specified maximum temperature should not be exceeded for the anode core or surface, the seals, and the envelope. Where long life and consistent performance are factors, maintaing temperature well below the rated maximum is normally beneficial.

4. In all cases of operation forced-air cooling of the anode and base is required. Minimum air flow requirements for the anode are shown, based on a maximum tube temperature of 225°C and a cooling air temperature of 35°C, with air flow through the anode cooler in a base-to-anode direction. The pressure drop values shown are in inches of water for the anode cooler and are approximate.

	SEA LEVEL		10,000 FEET	
Anode Diss. (kW)	Air Flow (cfm)	Press. Drop	Air Flow (cfm)	Press. Drop
20	340	1.6	510	2.2
30	660	4.2	970	6.3
40	1110	9.4	1600	13.6

Cooling of the base requires a minimum of 100 cfm of air (at a maximum temperature of 35°C) be directed horizontally through the socket from the sides. It is preferable to direct this air through three equally-spaced ducts.

Particular care should be taken to insure that the blower selected for anode cooling is capable of supplying the desired air flow at a back pressure equal to the pressure drop shown in the table plus any drop built up in ducts and/or filters. At higher altitudes or ambient temperatures the amount of cooling air must be modified to obtain equivalent cooling. Both base and anode cooling must be applied before or simultaneously with the application of electrode voltages (including the filament) and should normally be maintained for approximately 2 minutes after all electrode voltages are removed.

5. Operation at altitudes significantly above sea level may require that electrode voltages be set lower than the maximum values shown. Normally only the anode would require reduction.

6. In all electrical tests involving the application of filament voltage, the use of an air-system socket is permissible and forced-air cooling of the anode and base is permissible.

7. The tube must be mounted vertically, base up or down.

8. In addition to the normal plate over-current interlock, screen current interlock, and air-flow interlock, the tube must be protected from internal damage caused by an internal plate arc which may occur at high plate voltage. A protective resistance should always be connected in series with each tube anode, to absorb power supply stored energy if an internal arc should occur. An electronic crowbar, which will discharge power supply capacitors in a few microseconds after the start of an arc, is recommended. The protection criteria for each electrode supply is to short each electrode to ground, one at a time, through a vacuum relay switch and a section of #30 AWG copper wire. The wire will remain intact if the criteria is met.

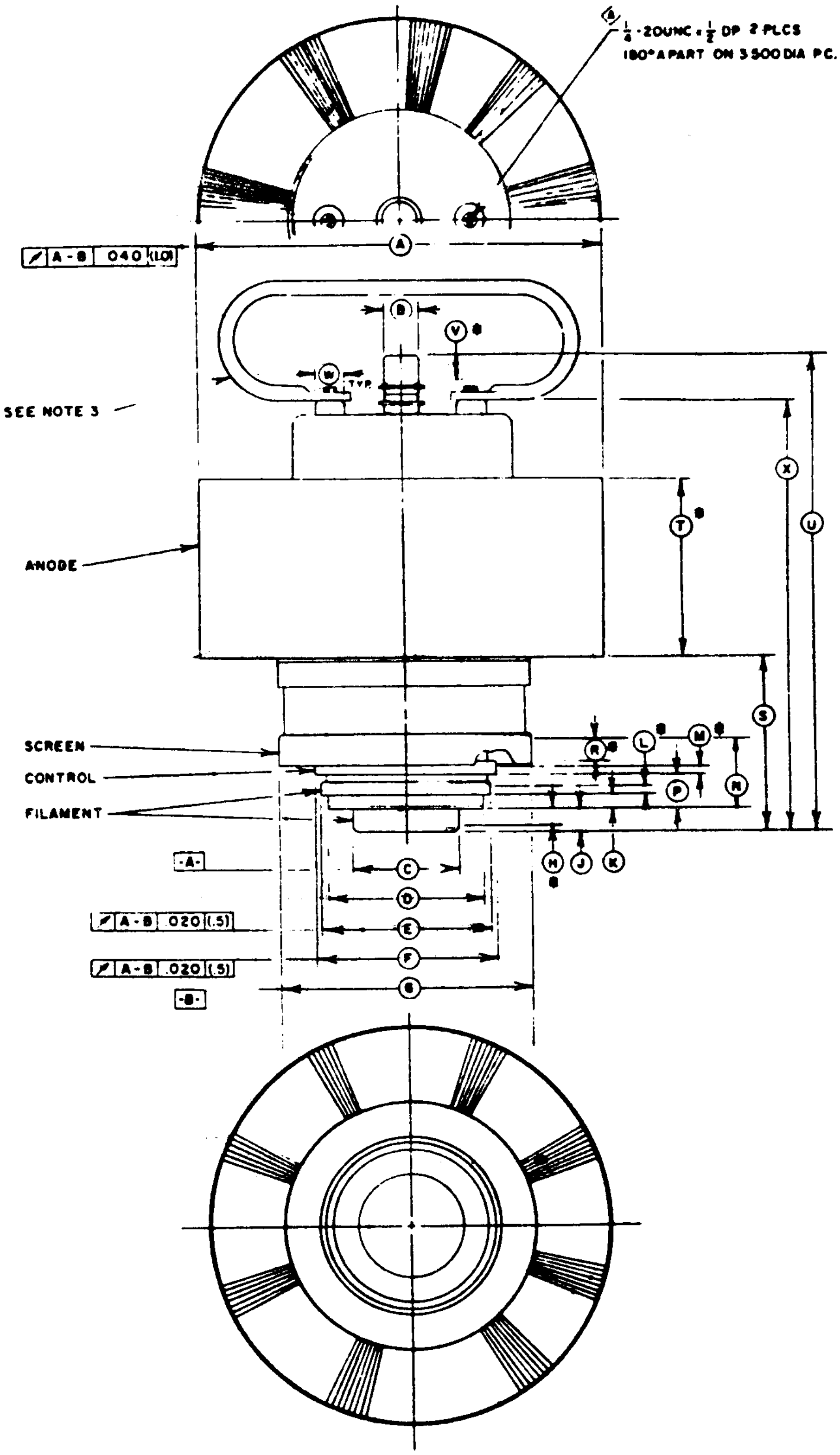
9. Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with the hazard even at these frequencies. A widely accepted standard is that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

10. These tests are carried out 100% by the manufacturer as standard production tests. On final acceptance testing, sampling in accord with MIL-STD-105 may be used. The AQL for the combined defectives for attributes, excluding mechanical, shall be 1%. A tube having 1 or more defects shall be counted as 1 defective.

11. Filament voltage shall be maintained at the specified value for a minimum of 5 minutes before the filament current is read.

12. The symbol egk represents peak positive voltage between the control grid and the cathode.

13. Sampling shall be in accord with MIL-STD-105.



DIMENSIONAL DATA						
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D			3.825			97.2
E	4.245	4.265		107.80	108.30	
F	4.490	4.520		114.05	114.81	
G	6.360	6.405		161.5	162.7	
H	.440			11.2		
J	.640	.680		16.2	17.3	
K	.250	.290		6.4	7.4	
L	.250			6.3		
M	.150			3.8		
N	1.600			40.6		
P	.790	.830		20.1	21.1	
R	.350			8.9		
S	4.170	4.400		106.0	111.8	
T	4.400	4.600		112.0	117.0	
U	11.550	11.850		293.0	301.0	
V	.500			12.7		
W			.750			19.1
X	10.500	10.850		267.0	276.0	

NOTES
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2. ⊠ CONTACT SURFACE
3. SHIPPED WITH HANDLE ATTACHED. REMOVE BEFORE OPERATION

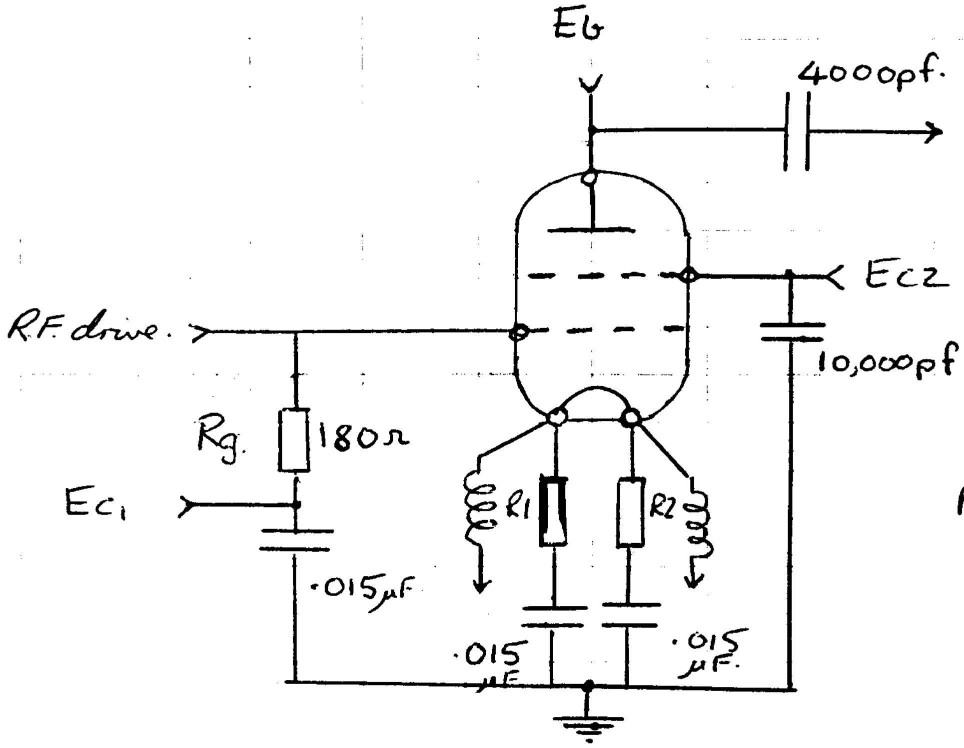
EIMAC TEST SPECIFICATION.

RE 2ND DRAFT 17/8/83 15/3/84.

4CX 40,000 G M.

RF operation

1. Test circuit



R1 = R2 = 6·5Ω.

2. Class AB Amplifier.

3. E_b = 10·5 KV d.c.

4. E_{c2} = 1400V d.c.

5. R_L = 650Ω ± 5%

Anode loaded tank Q = 10 to 15

6. R_g = 180Ω ± 5%

7. I_{BO} < 2·5A d.c. (after adjustment for optimum I.M.D.)

8. Power Out and Intermodulation distortion.

8.1 The power out measured at the anode to be at least 56 KW PEP at 3 MHZ with two equal tones spaced at 600 HZ.

8.2. Peak R.F. grid voltage < 260V at 56KW PEP

8.3 I_{C2} < 400ma dc. at 56KW PEP.

8.4. I.M.D. - measured relative to each tone at any level up to 56KW P.E.P.

3RD I.M.D. < -41db.

5TH IMD < -46db.

The drive signal I.M.D and Harmonics < -55db.

COMPARISON OF I.M.D. PERFORMANCE OF V1, V3, V4 &V5

WITH TEST CIRCUIT AS SHOWN.

0dB = 56 KW PEP. AT ANODE.

Bk1/95

V1	I_{BO} = 2.0A				I_{BO} = 2.2A				I_{BO} = 2.6A			
dB	5th	3rd	3rd	5th	5th	3rd	3rd	5th	5th	3rd	3rd	5th
0	45	49	45	45	47	53	46	48	50	41	39	50
−1	50	42	42	50	53	47	46	53	60	47	45	60
−3	60	41	41	60	60	46	46	60	54	52	52	54
−6	58	50	50	58	57	59	59	57	53	48	47	53
−10	60	60	60	60	60	53	53	60	58	46	46	58

Bk2/164

V3	I_{BO} = 2.8A				I_{BO} = 3.2A				I_{BO} =			
dB	5	3	3	5	5	3	3	5	5	3	3	5
0	48	39	39	47	52	47	46	51				
−1	56	38	38	56	57	43	43	57				
−3	57	40	40	56	53	45	45	53				
−6	54	51	52	56	55	56	56	57				
−10	60	54	54	60	60	52	53	60				

V4

	dB	I_{BO} = 1·7A				I_{BO} = 2·0A				I_{BO} = 2·6A			
		5	3	3	5	5	3	3	5	5	3	3	5
	0	49	39	38	49	58	47	43	58	51	44	42	52
BK2/213	−1	54	39	38	54	53	44	44	54	46	44	43	46
	−3	56	42	42	54	50	56	56	50	46	40	40	46
	−6	56	58	58	56	52	45	45	52	50	38	38	52
	−10	60	49	49	60	60	44	46	60	60	42	42	60

V5

	dB	I_{BO} = 1·8 A				I_{BO} = 2·0A				I_{BO} = 2·4A			
		5	3	3	5	5	3	3	5	5	3	3	5
	0	58	38	38	58	52	42	41	52	46	51	46	46
BK3/51	−1	56	38	38	58	48	44	43	48	44	50	46	44
	−3	52	44	44	52	48	52	50	48	46	42	42	46
	−6	52	54	52	50	52	44	43	52	52	38	38	52
	−10	55	44	44	55	58	43	43	56	62	42	42	62