EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

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VOLUME II

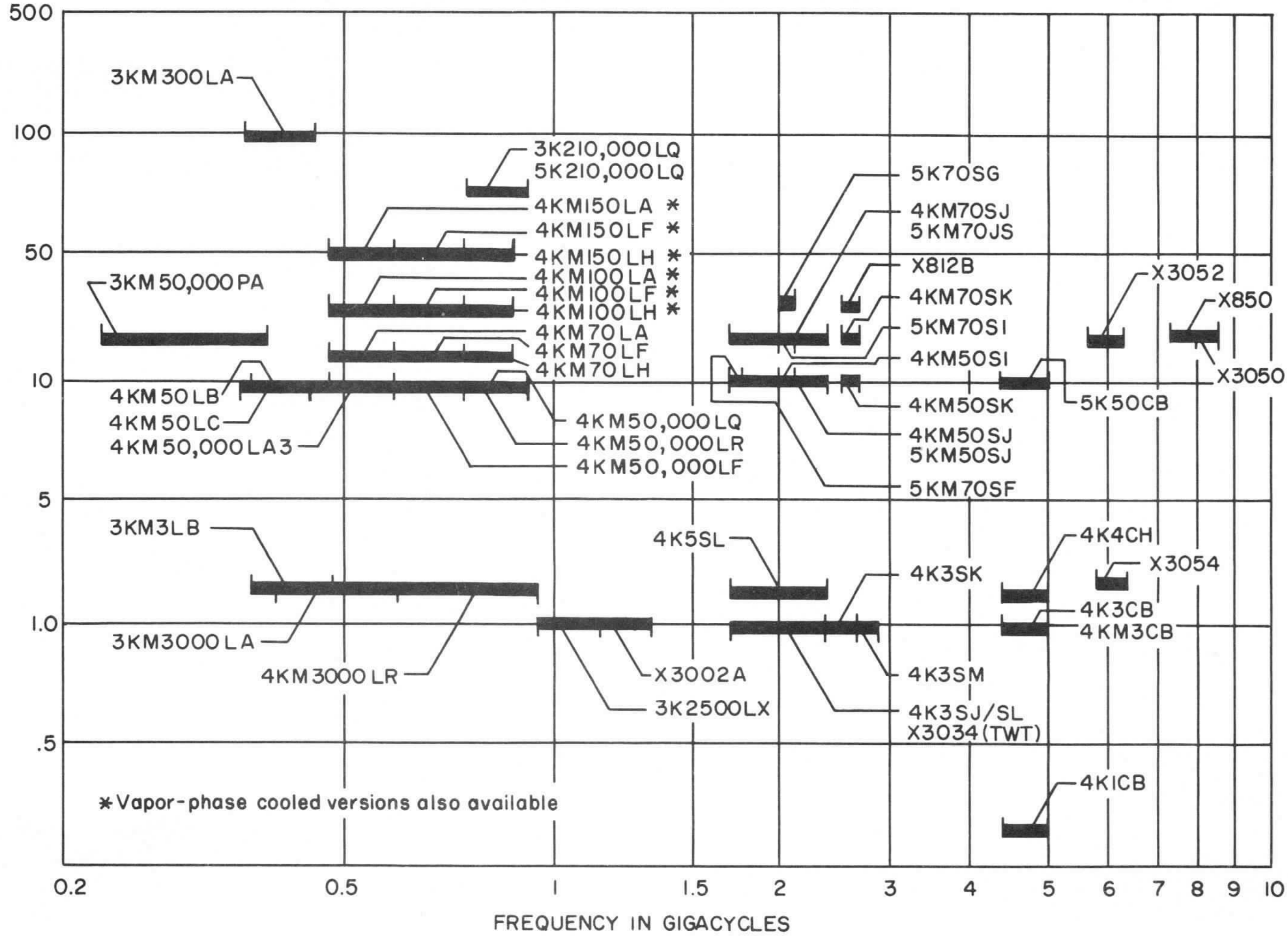
*Divider Sheets Not Available

Effective Date 9-1-66

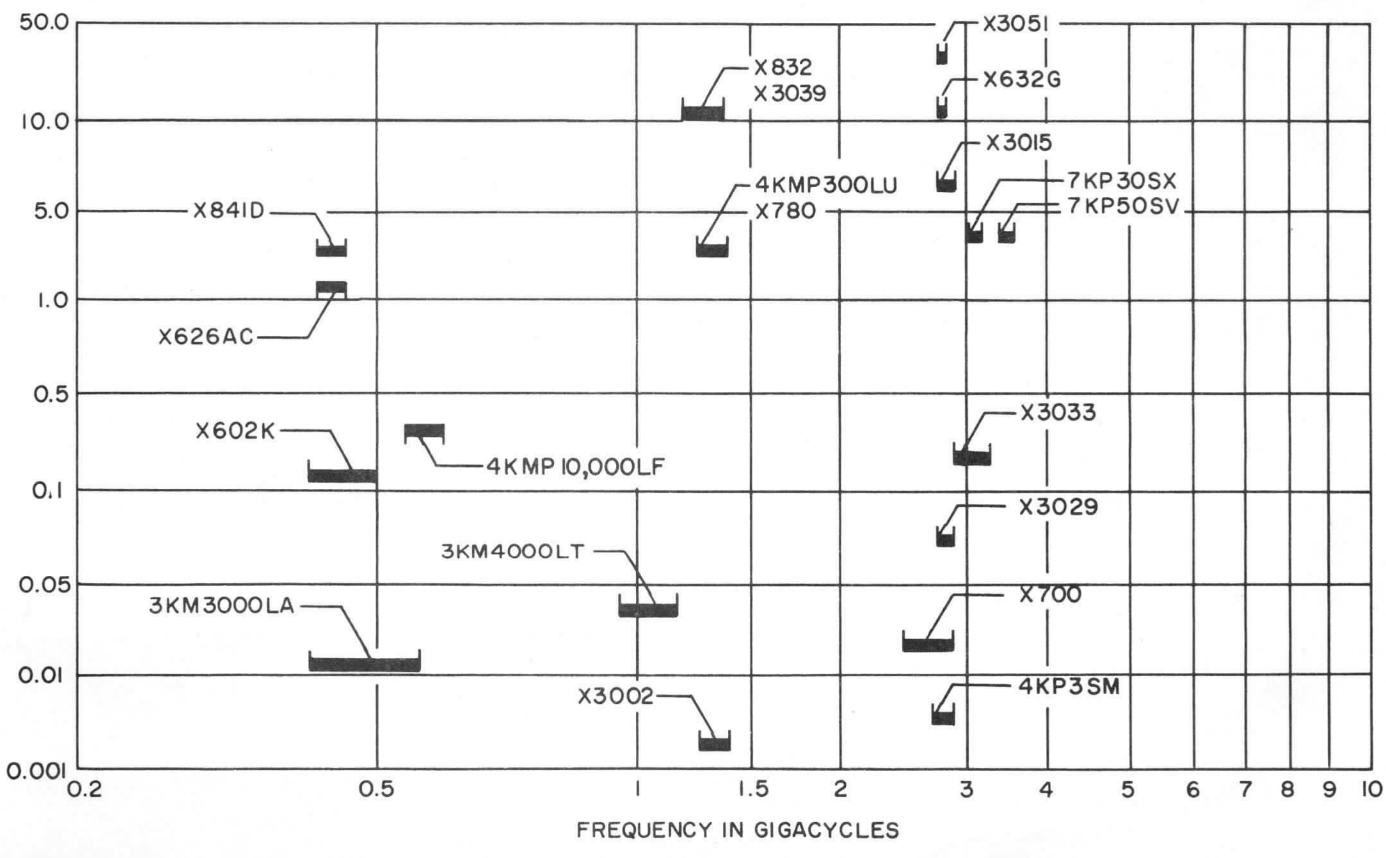
EIMAC HIGH POWER MICROWAVE TUBES

11/20/64

CW MICROWAVE TUBES RECOMMENDED FOR NEW EQUIPMENT DESIGN



PULSE MICROWAVE TUBES RECOMMENDED FOR NEW EQUIPMENT DESIGN



klystrons

Look in the general section for---

- Your nearest distributor of modern, fully guaranteed Eimac electron tubes and electron tube accessories.
- Your nearest Eimac Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or provide other information not found in the catalog.
- Eimac tube type numbering system.
- Tube Replacement Chart.
- Prices on Eimac products.

IMPORTANT EIMAC "EXTRAS"

Application Engineering. The Eimac Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proved by Eimac engineers, whose combined knowledge and experience are at your service. Additional contributions by this Eimac department are its Application Bulletins, a service which you receive without obligation.

Field Engineering. Serving as an extension of the Application Engineering Department outside the Eimac plant, Eimac Field Engineers cover the United States, operating out of offices in major cities. They will help you personally with experimental work, problems of technique, etc. Engineers from Eitel-McCullough, Inc. are available, too, for field consultation throughout the country. As Eimac tubes are world renowned, the same services extend to various countries overseas through the Eimac Export Department.

klystrons

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

3K2500LX

POWER-AMPLIFIER

L-BAND KLYSTRON

The Eimac 3K2500LX is a ceramic and metal, three cavity, magnetically focused, power-amplifier klystron designed for use at frequencies between 980 and 1200 megacycles. It will deliver a minimum CW output power of one kilowatt with a power gain of more than 25 db.

The resonant cavities of the 3K2500LX have cylindrical ceramic windows and are completed by tuning boxes external to the tube. This design permits a wide tuning range, and allows repeated tuning cycling without damage to vacuum seals.

An Eimac Klystron Amplifier Circuit Assembly (Catalog Number H-114) has been designed for use with this tube. The klystron must not be operated in any other circuit assembly without design guidance and final approval by Eitel-McCullough, Inc.

CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, Oxide Coated	
	Minimum Heating Time	5 minutes
Heater:	Voltage	7.5 volts
	Current	5.8 amperes
	Maximum Starting Current	15 amperes
Power Gain		25 db
Output Power		1000 watts
Frequency Range		980 to 1200 mc

MECHANICAL

Operating Position*		Axis vertical
R-F Coupling:		
	Input	Type "N" coaxial fitting
	Output	1 5/8-inch 50-ohm air line
Cooling (See Application)		Forced air
Net Weight		22 pounds
Shipping Weight (Approximate)		80 pounds
Maximum Over-All Dimensions:		
	Length	25 7/8 inches
	Diameter	5 1/8 inches

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS (Using H-114 Coils)

Prefocus-Coil Voltage	0 to 35 volts
Prefocus-Coil Current	0 to 1.0 ampere
Body-Coil Voltage	0 to 165 volts
Body-Coil Current	0 to 2.5 amperes

*Cathode end up when installed in the Eimac H-114 circuit assembly.

MAXIMUM RATINGS

D-C BEAM VOLTAGE	7000 MAX.	VOLTS
D-C BEAM CURRENT	600 MAX.	MA
D-C BODY CURRENT (CONTINUOUS)	60 MAX.	MA
D-C BODY CURRENT (TUNING ONLY)	90 MAX.	MA
D-C FOCUS-ELECTRODE VOLTAGE	-100 MAX.	VOLTS
COLLECTOR DISSIPATION	2500 MAX.	WATTS

TYPICAL OPERATION

NARROW-BAND CW AMPLIFIER (In H-114 Circuit Assembly)

Frequency	1000	1000	megacycles
Output Power	830	1320	watts
Driving Power	2	2	watts
Power Gain	26.1	28.2	db
D-C Beam Voltage	6000	7000	volts
D-C Beam Current	350	455	milliamperes
Beam Input Power	2100	3180	watts
Beam Power Efficiency	39.5	41.4	percent
D-C Body Current	40	30	milliamperes
D-C Collector Current	310	425	milliamperes
Collector Dissipation*	1030	1650	watts
Focus-Electrode Voltage	-100	-100	volts
Heater Voltage	7.5	7.5	volts
Heater Current	5.8	5.8	amperes
Magnetic-Coil Currents:*			
Prefocus	0.5	0.5	ampere
Body	2.0	2.0	amperes

*Approximate values.

APPLICATION

Cooling--When the 3K2500LX is operated at sea level, with an ambient air temperature of less than 30° C (86°F), the cathode will normally require only convection air cooling. At higher altitudes or temperatures, forced-air cooling must be used to maintain the temperature of the metal button at the cathode end of the tube below 150°C.

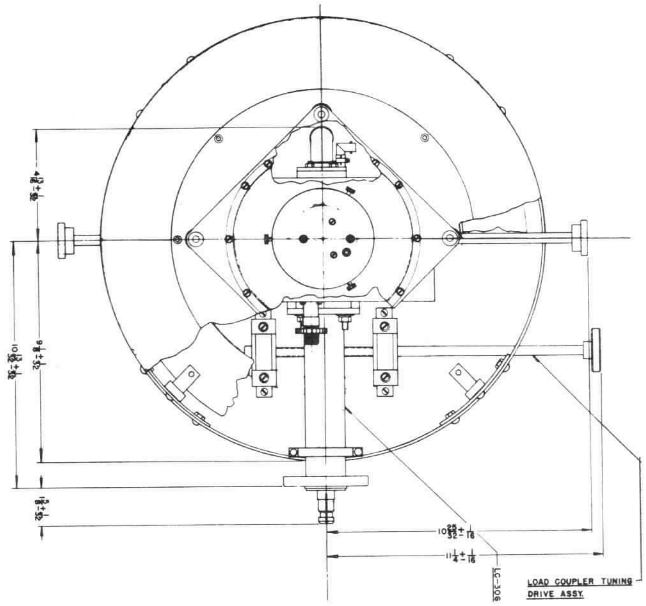
With a maximum ambient temperature of 25° C (77° F) and at sea level, the air-flow rates tabulated below are sufficient for operation at maximum ratings.

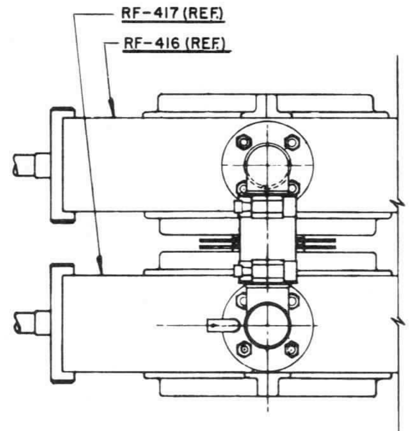
Output and Middle Cavities (Combined)	50 cfm
Collector	150 cfm

At higher temperatures or altitudes, the air-flow rate must be increased to obtain equivalent cooling.

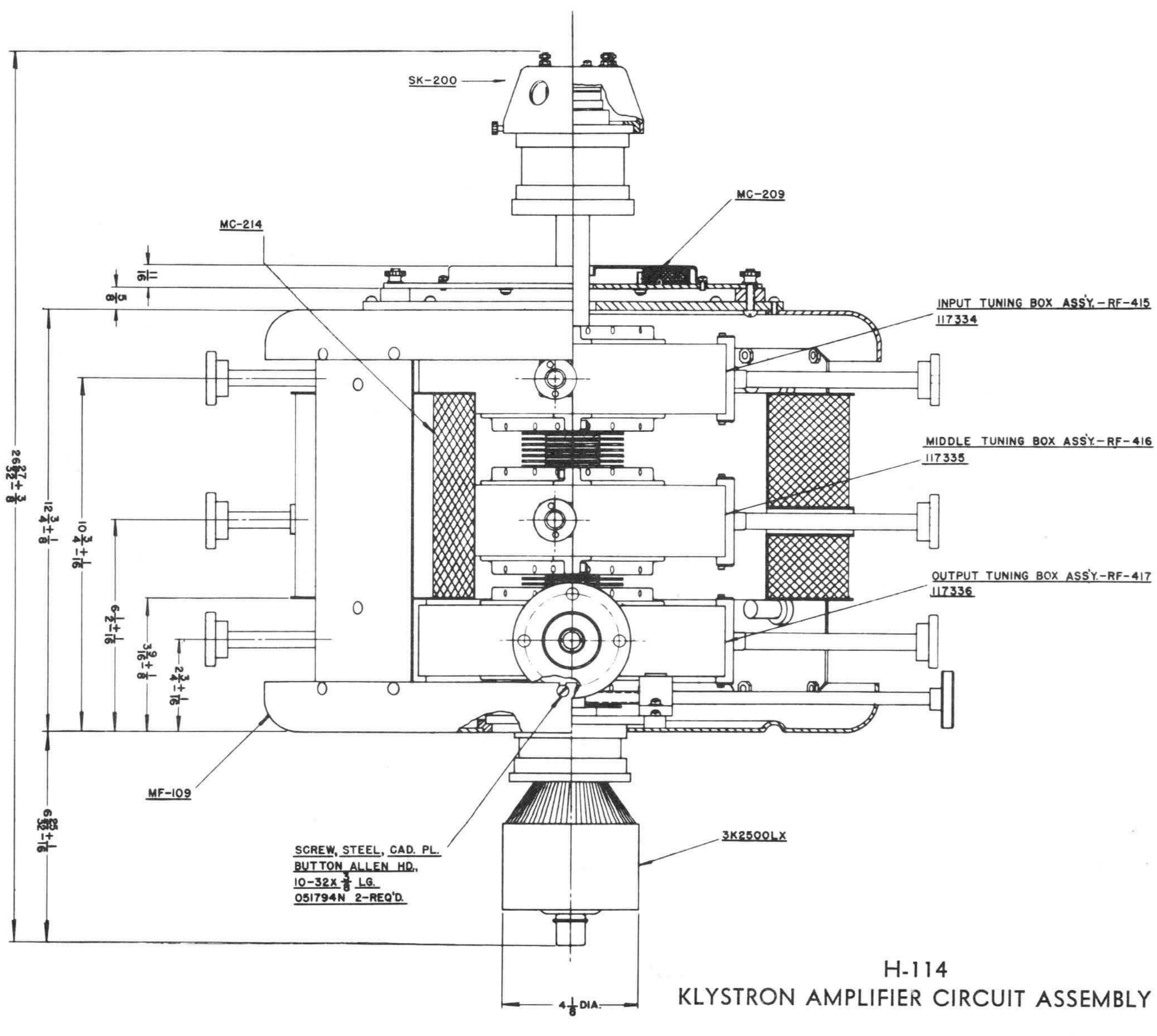
Body cooling is normally provided by the escaping air from the tuning boxes. However, if the ambient air temperature exceeds 30° C, forced air will also be required on the body cooling fins.

Special Applications--If it is desired to operate this tube under conditions not covered by this data sheet or if more information is required, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California.



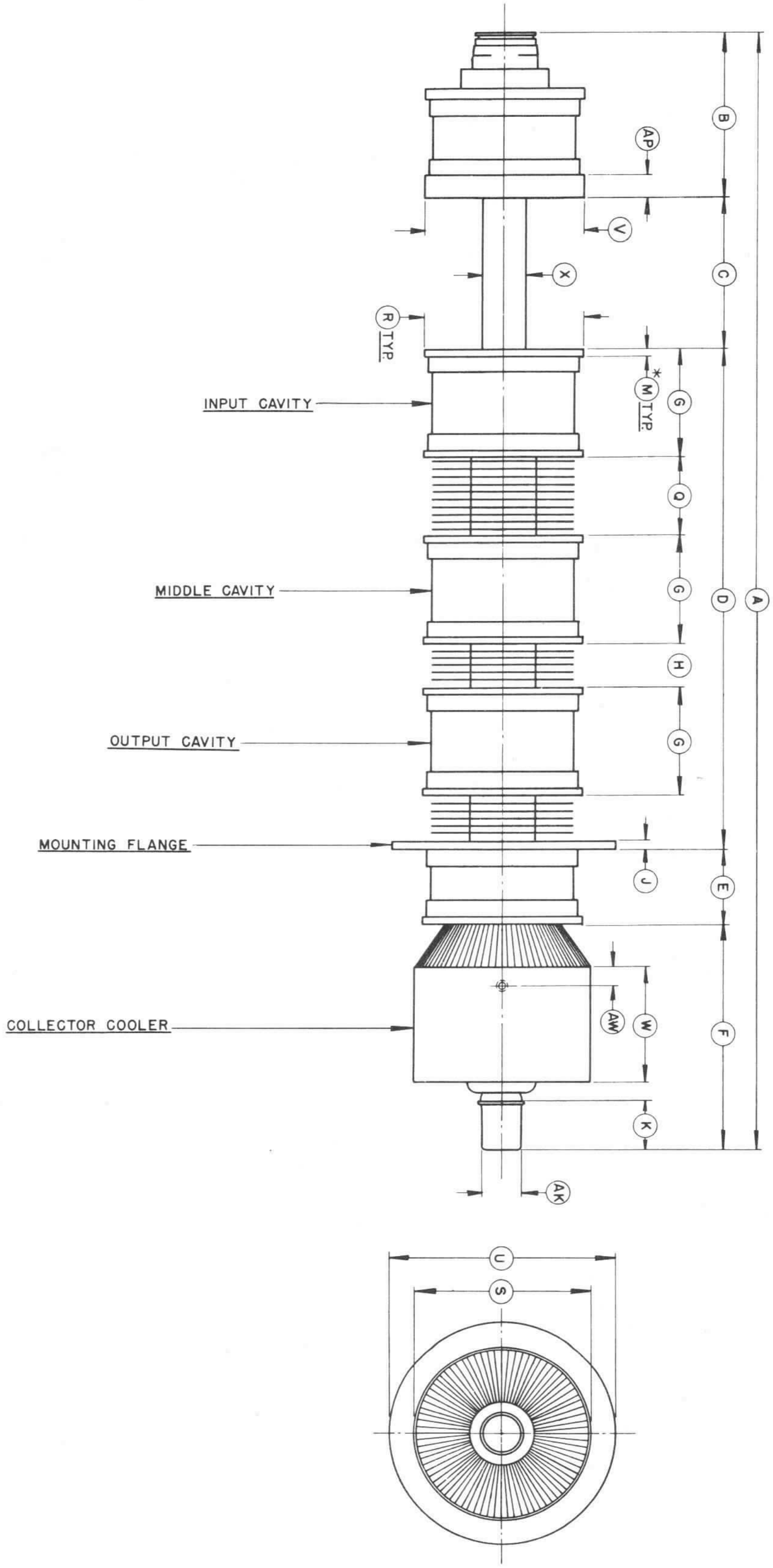


DETAIL SHOWING COOLING TUBE ASSY.



H-114
KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		25.438	26.188
B		3.730	3.980
C		3.406	3.470
D		11.107	11.357
E	1.976		
F		5.187	5.437
G		2.464	2.528
H		.971	1.033
J		.220	.240
K		1.115	1.135
M		.187	
Q		1.710	1.774
R		3.615 DIA.	3.635 DIA.
S		3.985 DIA.	4.015 DIA.
U		5.118 DIA.	5.148 DIA.
V		3.615 DIA.	3.635 DIA.
W	2.625		
X		.992 DIA.	1.008 DIA.
AK		.865 DIA.	.885 DIA.
AP		.490	.510
AW		.428	.448



NOTES:

1. *MINIMUM CONTACT SURFACES.
2. DIMENSIONS IN INCHES

3K2500LX
OUTLINE DRAWING

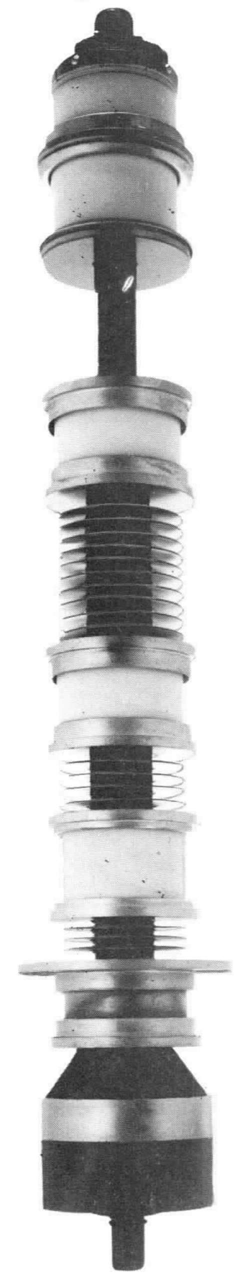
Printed in U.S.A. 54405

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

3KM4000LT

PULSE AMPLIFIER
L-BAND KLYSTRON



The Eimac 3KM4000LT is a three-cavity, magnetically focused, pulse-amplifier klystron. It will deliver a peak output power of 40 kilowatts with an average power of one kilowatt at frequencies between 960 and 1215 megacycles. Nominal power gain is 33 db.

This klystron employs the Eimac Modulating Anode which provides an effective means of pulse modulating the output power without changing the beam voltage. A modulating anode voltage of approximately one half the beam voltage is sufficient to realize full rated pulse output power.

All tuning is accomplished outside of the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. This design affords a wide tuning range and permits external cavity loading for broadband applications. For spares or replacements, only the basic vacuum tube, without cavities, need be purchased.

Eimac Klystron Amplifier Circuit Assembly H-116 has been designed for use with the 3KM4000LT to cover the frequency range of 960 to 1215 megacycles. This assembly includes a klystron supporting structure, focus coils, tuning cavities and an adjustable output load coupler.

CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, Oxide-Coated		
	Minimum Heating Time	5	minutes
Heater:	Voltage	7.5	volts
	Current	5.5	amperes
	Maximum Starting Current	11	amperes
Modulating Anode Capacitance (To all other electrodes)		22	uuf
Power Gain (Nominal)		33	db
Average Output Power		1	kilowatt
Peak Output Power		40	kilowatts
Frequency Range (In H-116 Assembly)		960 to 1215	megacycles

MECHANICAL

Operating Position	Vertical, cathode end up
RF Input Coupling	50-ohm Type "N"
RF Output Coupling	1-5/8 inch, 50-ohm line
Weight (Tube Only)	21 pounds
Approximate Shipping Weight (Klystron only)	120 pounds
Weight (H-116 Circuit Assembly)	240 pounds

MECHANICAL (Cont'd)

Maximum Dimensions (Tube):

Length	31	inches
Diameter	5.3	inches

Maximum Dimensions (Tube and Circuit Assembly):

Length	31	inches
Diameter	19	inches

Cooling:

Cathode and Drift Tubes - Convection air cooling is adequate at sea level up to 25° C ambient air temperature. Forced-air cooling may be required at higher altitudes or higher temperatures.

Collector - - - - - - 150 cfm air with pressure drop of 1.85 inches H_2O (25° C inlet air at sea level).

FOCUS COIL POWER-SUPPLY REQUIREMENTS

Prefocus-Coil Voltage	0 to 25	volts
Prefocus-Coil Current	0 to 1.5	amperes
Body-Coil Voltage	0 to 25	volts
Body-Coil Current	0 to 10	amperes
Collector-Coil Voltage	0 to 50	volts
Collector-Coil Current	0 to 2.5	amperes

MAXIMUM RATINGS

DC BEAM VOLTAGE	28	KILOVOLTS
PEAK MODULATING-ANODE VOLTAGE	14	KILOVOLTS
PEAK BEAM CURRENT	6	AMPERES
AVERAGE BEAM CURRENT	500	MILLIAMPERES
DC BODY CURRENT (CONTINUOUS)	20	MILLIAMPERES
DC BODY CURRENT (TUNING ONLY)	40	MILLIAMPERES
DC FOCUS ELECTRODE VOLTAGE	-400	VOLTS
COLLECTOR DISSIPATION	4	KILOWATTS
SEAL TEMPERATURE	175	DEGREES C

TYPICAL OPERATION

(In H-116 Circuit Assembly)

NARROW-BAND PULSE AMPLIFIER, SQUARE PULSE, 0.025 DUTY, MODULATING ANODE PULSED

DC Beam Voltage	24	26	28	kilovolts
Peak Output Power	30	36	40	kilowatts
Peak Driving Power	5	5	5	watts
Power Gain	37.7	38.5	39	db
Peak Beam Current	2.8	3.3	3.7	amperes
Average Beam Current	71	82	90	milliamperes
DC Body Current	13	14	15	milliamperes
Peak Modulating-Anode Voltage	12	13	14	kilovolts
Focus-Electrode Voltage	-75	-75	-75	volts
Focus Coil Currents:				
Prefocus	0.92	1.1	1.2	amperes
Body	6.8	7	7	amperes
Collector	0.95	1.0	1.0	ampere

For additional information or information regarding any specific application, write to Eitel-McCullough, Inc., San Carlos, California.

Eimac

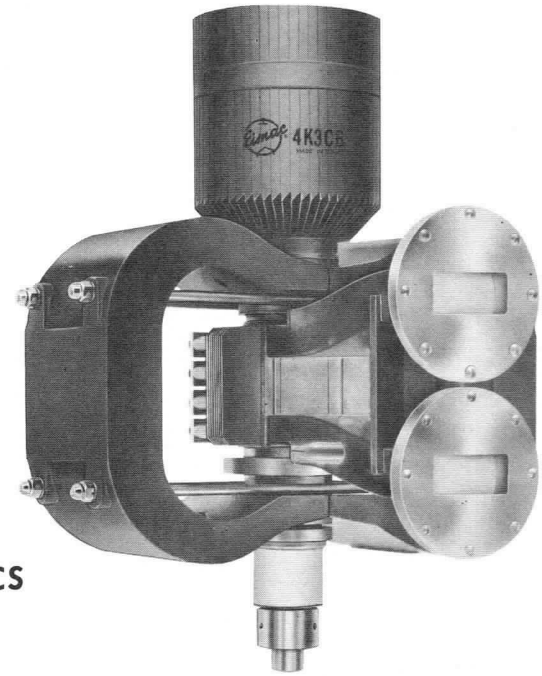
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4K3CB

POWER AMPLIFIER C-BAND KLYSTRON

The Eimac 4K3CB is an air cooled, permanent magnet focused, power amplifier klystron. It will deliver a minimum CW output power of one kilowatt at frequencies from 4.4 to 5.0 kMc, with a minimum power gain of 43 db. The 4K3CB is designed for use in transmitters where compactness and light weight are essential.



FEATURES

FREQUENCY.	4.4-5.0	kMc
MINIMUM OUTPUT POWER	1	kW
HALF POWER BANDWIDTH	7.5	Mc
MINIMUM POWER GAIN. .	43	db

AIR COOLING

PERMANENT MAGNET FOCUSING

FOUR INTEGRAL CAVITIES

FIXED INPUT AND OUTPUT COUPLING

INSTANT FAULT RECYCLING

CHARACTERISTICS

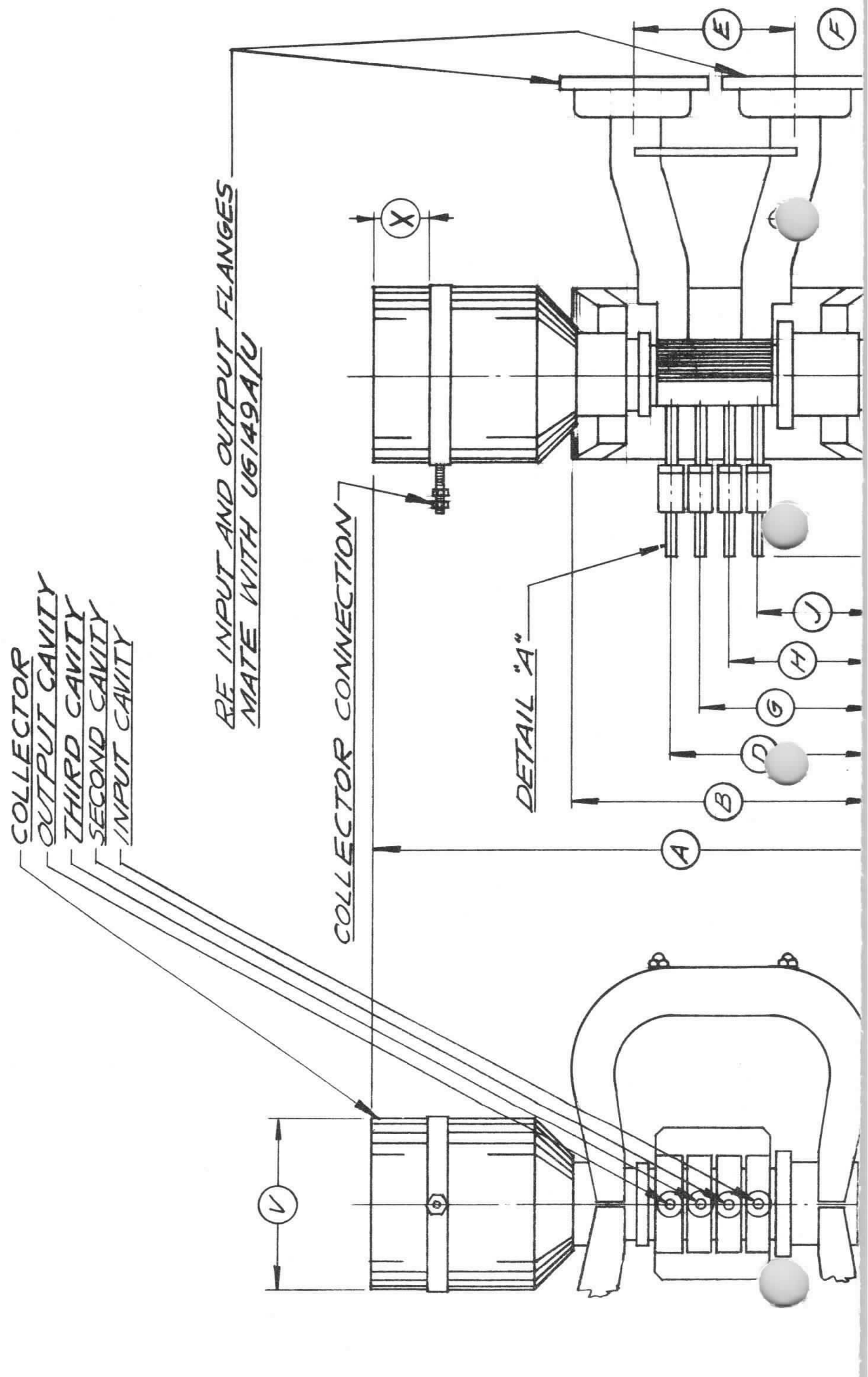
ELECTRICAL

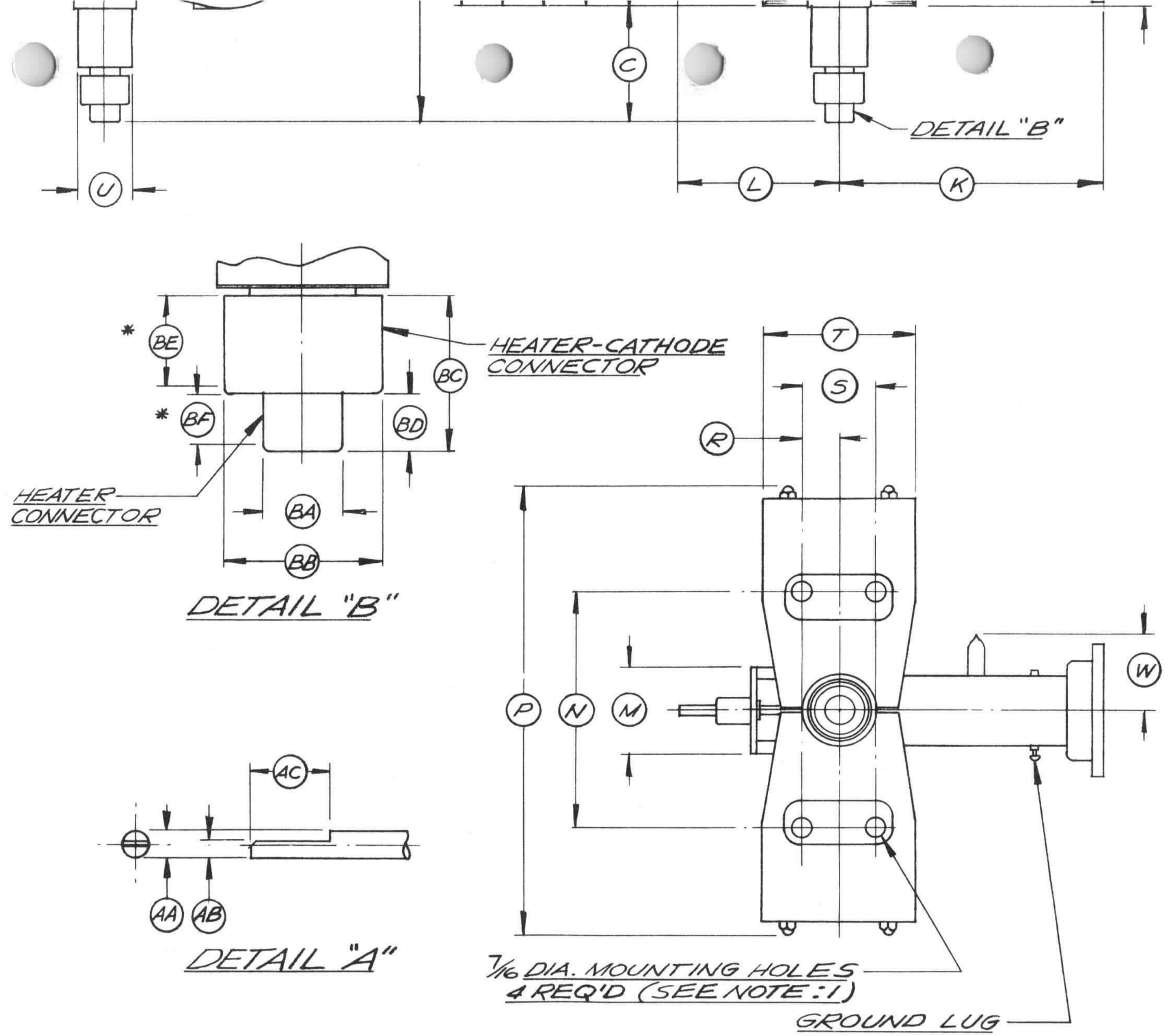
Cathode:	Impregnated, Unipotential		
	Heating Time.	3	minutes
Heater:	Voltage.	6.5	volts
	Current	7.5	amperes
	Maximum Starting Current	15	amperes

MECHANICAL

Maximum Dimensions:		
Length	15-1/2	inches
Width	12-13/16	inches
Depth	11-15/16	inches
Maximum Weight (Tube and Magnet)	60	pounds
Input Coupling.	UG149A/U	waveguide
Output Coupling	UG149A/U	waveguide
Maximum Tuner Torque	30	in-oz
Mounting Position Preferred	Vertical, cathode down	

DIMENSIONAL DATA			
REF.	NOM.	MIN.	MAX.
A			15.500
B			7.500
C	2.723		
D	5.104		
E		3.629	3.879
F	2.281		
G	4.409		
H	3.714		
J	3.019		
K		7.038	7.288
L		4.481	4.605
M		2.328	2.359
N		6.500	6.625
P			12.812
R		.937	1.000
S		1.969	2.031
T			4.600
U			1.627
V		4.333	4.433
W			2.750
X		.875	1.125
AA		.248	.250
AB		.170	.180
AC		.740	.760
BA		.740	.760
BB		1.485	1.505
BC		1.450	1.490
BD		.530	
BE		.830	
BF		.450	





NOTES:
1. KEEP MAGNETIC MATERIAL AT LEAST SIX INCHES AWAY FROM MAGNET; OTHER MAGNETS SHOULD BE AT LEAST TWELVE INCHES DISTANT.
2. DIMENSIONS ARE IN INCHES.
3. (*) MINIMUM CONTACT SURFACES.

4K3CB KLYSTRON

MECHANICAL (continued)

Cooling: Forced Air (20° C at Sea Level)

	Flow Rate	Pressure Drop
Tuner (Ducted)	60 cfm	0.25 inches H_2O
Body	60 cfm	free
Collecter (Ducted)	200 cfm	2 inches H_2O

MAXIMUM RATINGS

DC BEAM VOLTAGE	8.0	KILOVOLTS
DC BEAM CURRENT	0.6	AMPERE
DC BEAM INPUT POWER	4	KILOWATTS
DC BODY CURRENT	60	MILLIAMPS
COLLECTOR DISSIPATION	4	KILOWATTS
LOAD VSWR	2:1	
TEMPERATURE OF COLLECTOR, BODY AND TUNER FINS	150° C	

TYPICAL OPERATION - TUNED FOR MAXIMUM EFFICIENCY

Frequency	4.4	4.7	5.0	kilomegacycles
Output Power	1.42	1.32	1.22	kilowatts
Driving Power	40	40	40	milliwatts
Gain	45.5	45	44.8	decibels
DC Beam Voltage	7.5	7.5	7.5	kilovolts
DC Beam Current	0.465	0.465	0.465	ampere
Beam Power Efficiency	40.7	37.8	35	percent
Half Power Bandwidth	7.5	8	9	megacycles
DC Body Current	21	21	18	milliamperes

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.

EIMAC
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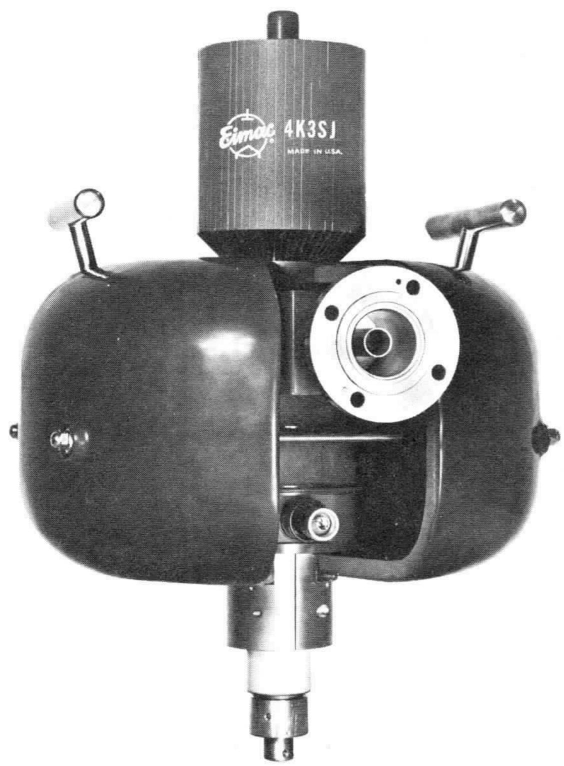
SAN CARLOS
CALIFORNIA

4K3SJ

POWER AMPLIFIER S-BAND KLYSTRON

The EIMAC 4K3SJ is an air cooled, permanent magnet focused, power-amplifier klystron designed to operate at frequencies from 1700 to 2400 MHz. It will deliver a minimum output power of 1 kilowatt with minimum power gain of 40 decibels. The 4K3SJ is intended for use in applications where light weight and compactness are essential.



FEATURES

- PERMANENT MAGNET FOCUSING
- FOUR INTEGRAL CAVITIES
- LOW NOISE LEVEL
- FIXED INPUT AND OUTPUT COUPLING
- TWO LIFTING HANDLES FOR EASE OF HANDLING
- INSTANT FAULT RECYCLING

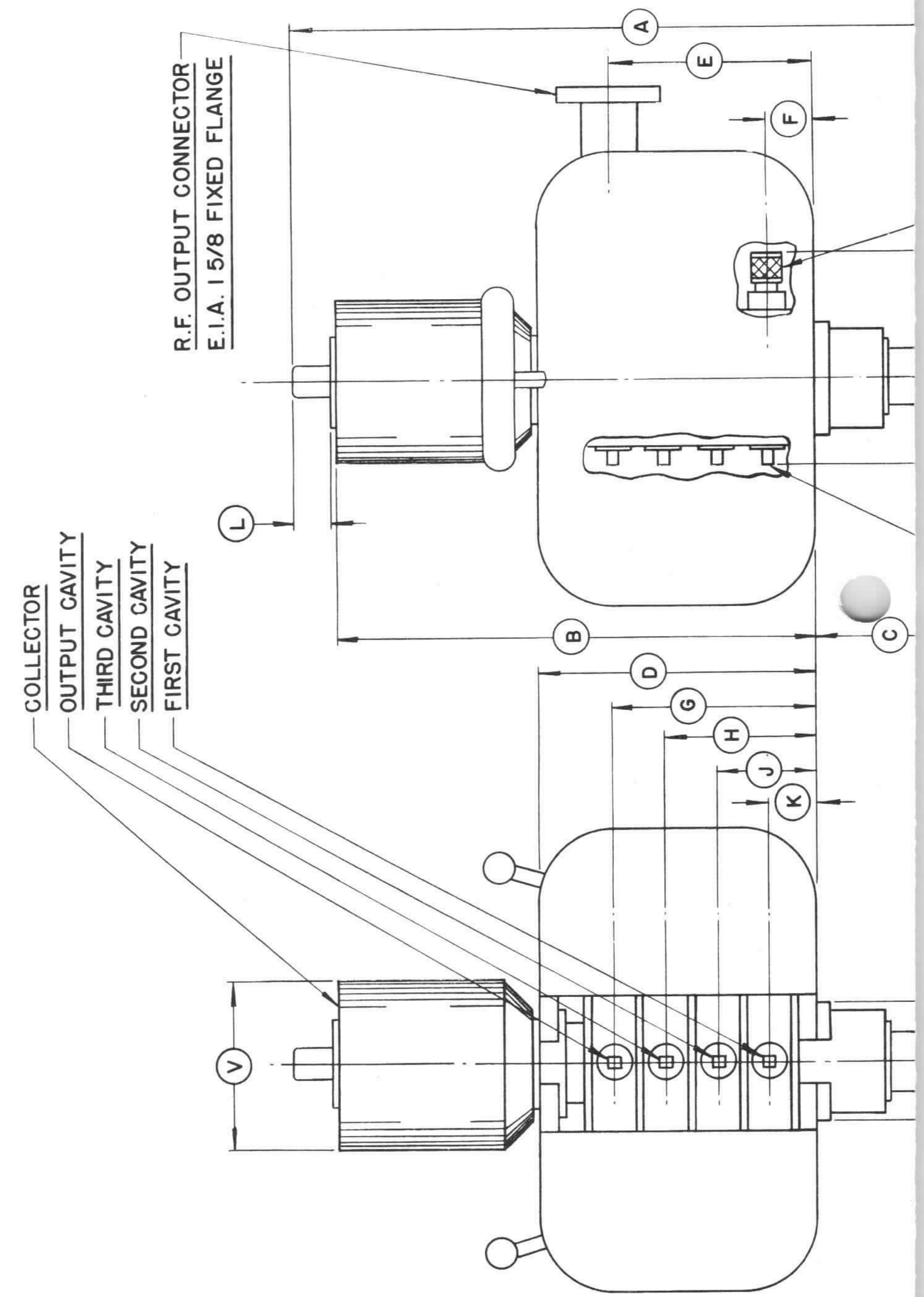
CHARACTERISTICS

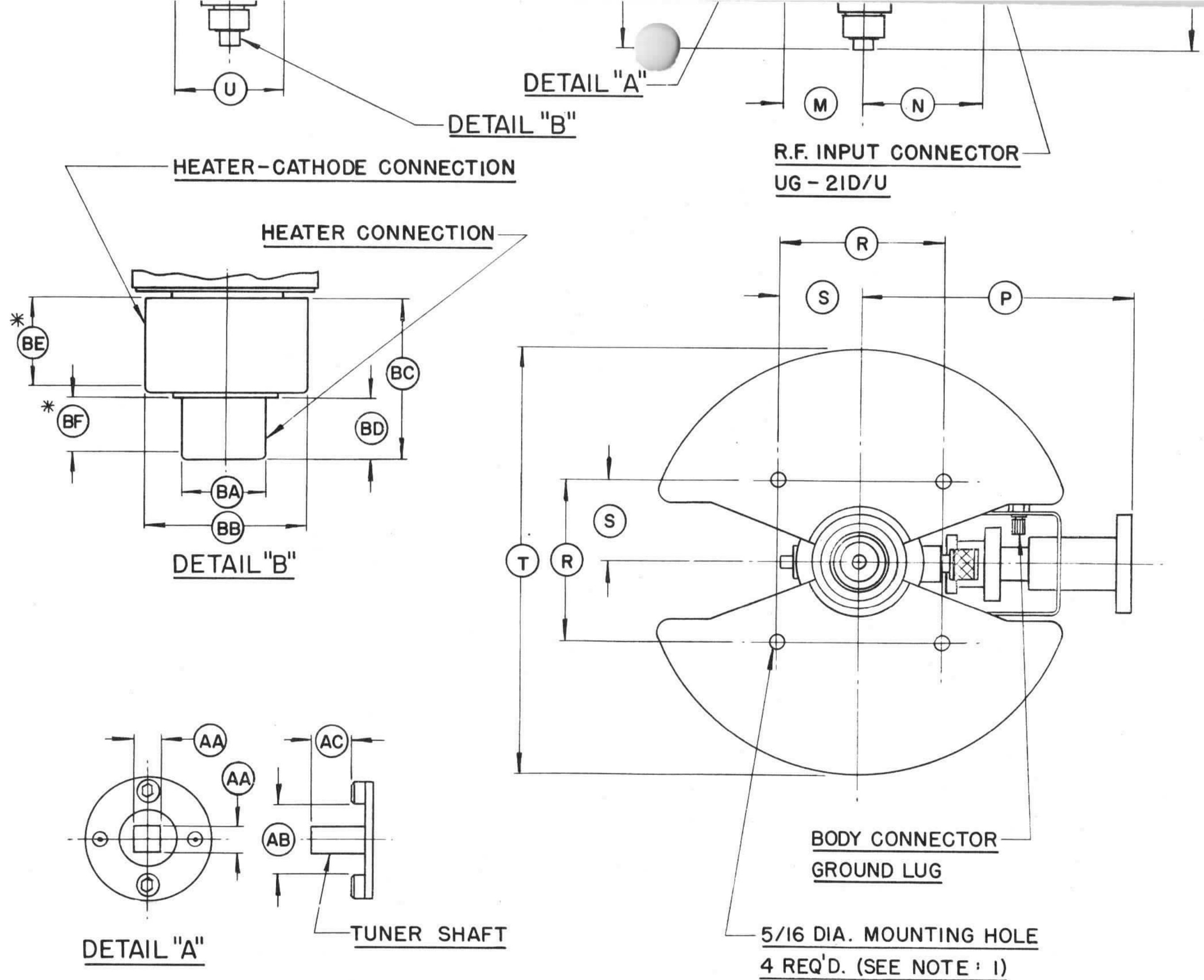
ELECTRICAL

Frequency	1700-2400 MHz
Minimum Output Power	1 kW
Minimum Power Gain	40 db
Cathode: Impregnated Unipotential	
Starting Time	3 minutes
Heater: Voltage	6 volts
Current	4.5 amperes
Maximum Starting Current	9 amperes

Printed in U.S.A.

DIMENSIONAL DATA			
REF.	NOM.	MIN.	MAX.
A			19.000
B	13.475		
C	4.544		
D			7.874
E	5.820		
F	1.470		
G	5.820		
H	4.370		
J	2.920		
K	1.470		
L			.750
M	2.472		
N	3.475		
P	7.910		
R		4.888	5.012
S		2.444	2.506
T			13.196
U			3.042
V	4.383		
AA		.248	.252
AB		.647	
AC		.340	
BA		.740	.760
BB		1.485	1.505
BC		1.450	1.490
BD		.530	
BE		.830	
BF		.450	





NOTES:

1. KEEP MAGNETIC MATERIALS AT LEAST SIX INCHES AWAY FROM MAGNET: OTHER MAGNETS SHOULD BE AT LEAST TWELVE INCHES DISTANT.
2. DIMENSIONS ARE IN INCHES.
3. (*) MINIMUM CONTACT.

4K3SJ KLYSTRON

MECHANICAL

Operating Position (preferred)	Vertical, cathode down
Cavity Tuning Torque (maximum)	12 inch pounds
Cooling	Forced Air (20°C at sea level)
Collector Flow	200 cfm
Collector Pressure Drop	1.5 inches H_2O

Body and cathode seals require cooling only at higher temperatures or lower pressures.

Maximum Dimensions:	
Length	18.4 inches
Width	13.25 inches
Depth	14 inches
RF Input Coupling	UG-21 D/U Connector
RF Output Coupling	1⅝ inch, 50-ohm line
Weight (Klystron and Magnet)	85 pounds

MAXIMUM RATINGS

DC BEAM VOLTAGE	7.0 KILOVOLTS
DC BEAM CURRENT	0.6 AMPERE
DC BEAM INPUT POWER	4 KILOWATTS
COLLECTOR DISSIPATION	4 KILOWATTS
CATHODE SEAL TEMPERATURE	150 DEGREES C
LOAD VSWR	2:1

TYPICAL OPERATION — TUNED FOR MAXIMUM EFFICIENCY

Frequency	1700	2000	2400	megahertz
Output Power	1.17	1.08	1.03	kilowatts
Driving Power	20	25	30	milliwatts
Gain	47.6	46.3	45.3	decibels
DC Beam Voltage	6	6	6.2	kilovolts
DC Beam Current	0.54	0.54	0.56	ampere
Beam Power Efficiency	36.2	33.4	31.8	percent
3 db Bandwidth	4	4.5	6	megahertz

For additional data or information regarding a specific application, write to EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California.

Eimac®

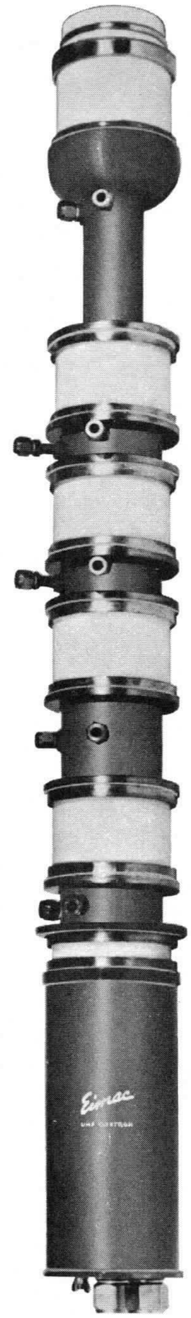
EITEL-McCULLOUGH, INC.
SAN BRUNO · CALIFORNIA

TENTATIVE DATA
4K50,000LQ
POWER AMPLIFIER
L-BAND KLYSTRON

The Eimac 4K50,000LQ is a ceramic and metal, four-cavity, magnetically focused, power-amplifier klystron designed for use at frequencies between 600 and 985 megacycles. It will deliver a minimum CW output power of 10 kilowatts with a power gain of more than 55 db. In applications requiring a 6-megacycle bandwidth at the 0.5-db power points, the 4K50,000LQ will deliver 10 kilowatts output power with a power gain of 30 db.

The resonant cavities for the 4K50,000LQ are completed through the cylindrical ceramic windows of the klystron and all tuning is accomplished outside the vacuum envelope. This design permits a wide tuning range and allows repeated tuning cycling without damage to vacuum seals.

An Eimac Klystron Amplifier Circuit Assembly (Catalog Number H-101A) has been designed for use with this tube and covers the frequency range of 720 to 985 megacycles. Other frequency ranges can be provided if required. This assembly includes an electromagnetic frame and coils, external tuning boxes, an adjustable output coupler, and an Eimac SK-110 Air-System Socket.



CHARACTERISTICS

ELECTRICAL

Filament: Pure Tungsten			
	Voltage	8.0	volts
	Current	40	amperes
	Maximum Starting Current	80	amperes
Cathode: Unipotential, Bombardment Heated			
	Voltage	2250	volts
	Current	0.71	ampere
	Power	1600	watts
Power Gain:			
	Narrow Band	55	db
	Broad Band (6 mc at 0.5-db points)*	30	db
Output Power		10,000	watts
Frequency Range (In H-101A Assembly)		720 to 985	mc

*(9 mc at 3-db points)

MECHANICAL

Operating Position	Vertical, cathode end up
R-F Input Coupling	Type "N" coaxial fitting
R-F Output Coupling	3 1/8-inch 50-ohm air line
Net Weight	53 pounds
Shipping Weight (approximate)	135 pounds

Cooling: Water and Forced Air	Flow Rate	Pressure Drop
Cathode (With SK-110)	52 cfm air	5 inches H_2O
Output Cavity	50 cfm air	1.5 inches H_2O
Body	1 gpm water	8 psi
Collector	25 gpm water	28 psi

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Prefocus-Coil Voltage	0 to 25	volts
Prefocus-Coil Current	0 to 1	ampere
Each of Three Body Coils:		
Voltage	0 to 175	volts
Current	0 to 3	amperes
Collector-Coil Voltage	0 to 50	volts
Collector-Coil Current	0 to 1.5	amperes

MAXIMUM RATINGS

D-C BEAM VOLTAGE	20 MAX.	KILOVOLTS
D-C BEAM CURRENT	2.5 MAX.	AMPERES
D-C BODY CURRENT (CONTINUOUS)	0.1 MAX.	AMPERE
D-C BODY CURRENT (TUNING ONLY)	0.15 MAX.	AMPERE
FOCUS-ELECTRODE VOLTAGE	-500 MAX.	VOLTS
BOMBARDED CATHODE:		
D-C VOLTAGE	2.4 MAX.	KILOVOLTS
D-C CURRENT	0.75 MAX.	AMPERE
D-C POWER	1.6 MAX.	KILOWATTS
COLLECTOR DISSIPATION	50 MAX.	KILOWATTS

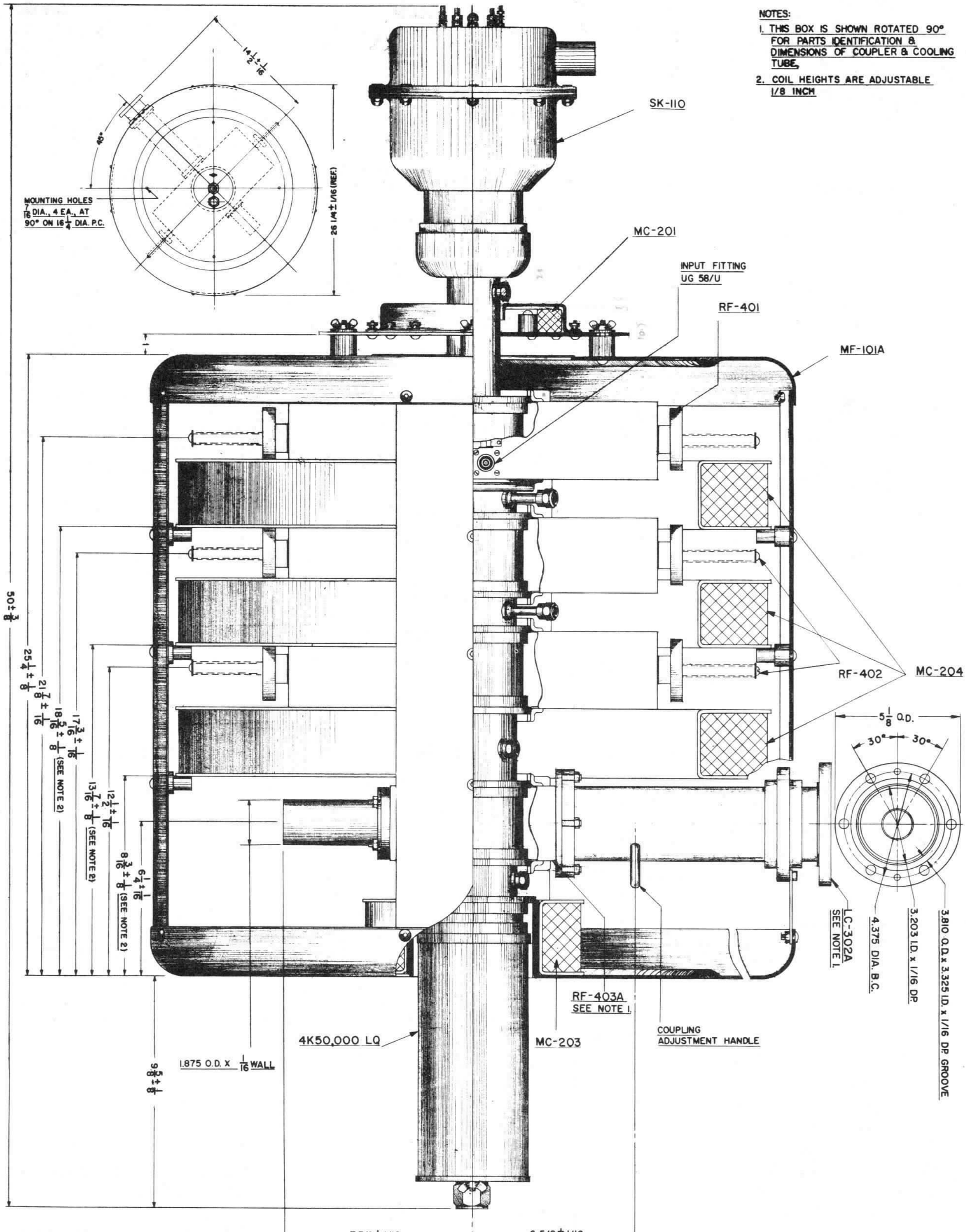
TYPICAL OPERATION

Frequency	900	900	megacycles
Output Power	10.15	11.2	kilowatts
Bandwidth (0.5-db power points)	6.85	1.05	megacycles
Driving Power	5	0.02	watts
Power Gain	33	57.5	db
D-C Beam Voltage	17	16	kilovolts
D-C Beam Current	1.78	1.59	amperes
Beam Input Power	30.2	25.4	kilowatts
Beam Power Efficiency	33.6	44.1	percent
D-C Body Current	80	80	milliamperes
D-C Collector Current	1.7	1.51	amperes
Collector Dissipation*	11.51	12.92	kilowatts
Focus-Electrode Voltage	-200	-200	volts
Filament Voltage	8.0	8.0	volts
Filament Current	40	40	amperes
Bombarded Cathode:			
Voltage*	2250	2250	volts
Current*	0.71	0.71	ampere
Power	1600	1600	watts
Magnetic-Coil Currents:* (Using H-101A Components)			
Prefocus	0.8	0.75	ampere
First Body	1.2	1.2	amperes
Second Body	1.9	1.8	amperes
Third Body	2.5	2.3	amperes
Collector	0.85	0.85	ampere

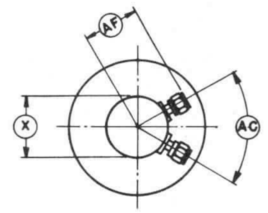
*Approximate values.

APPLICATION

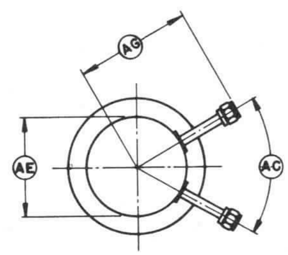
For additional information or information regarding any specific application, write to the Application Engineering Department, Eitel-McCullough, Inc., San Bruno, California. All such requests will be handled confidentially and without charge.



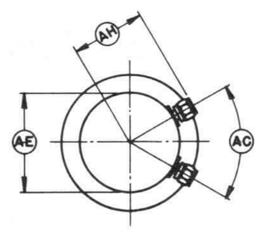
H-101A
KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY



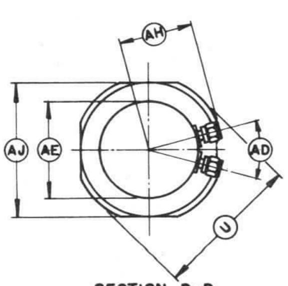
SECTION A-A



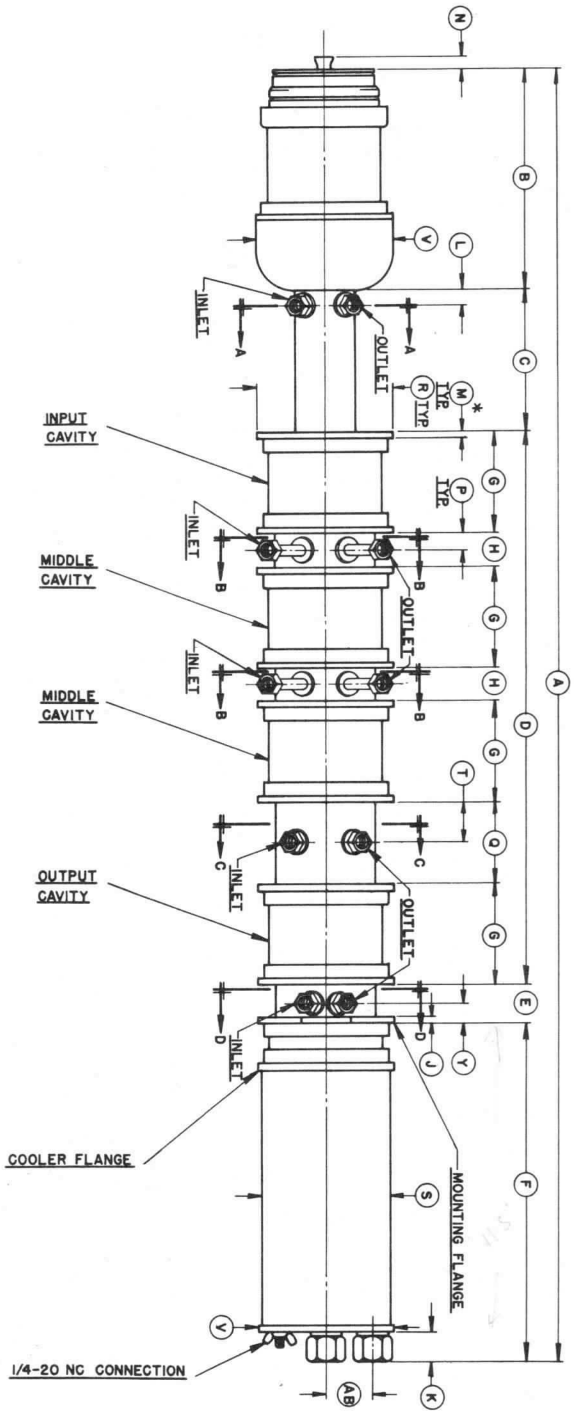
SECTION B-B



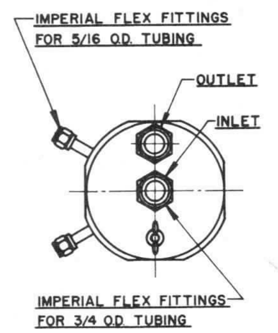
SECTION C-C



SECTION D-D



DIMENSION DATA			
REF	NOM.	MIN.	MAX.
A		44.560	44.690
B		7.470	7.510
C		4.985	5.040
D		19.994	20.064
E	.626		
F		12.515	12.620
G		3.495	3.530
H		1.170	1.205
J		.230	.255
K		1.030	1.100
L		.515	.645
M		.187	
N		.750	
P		.560	.650
Q		2.735	2.770
R		4.610 D	4.630 D
S		4.490 D	4.510 D
T		1.320	1.425
U		5.115 D	5.130 D
V		4.610 D	4.640 D
X		2.120	2 140
Y		.645	.705
AB		1.585	1.630
AC	60°		
AD	30°		
AE		3.485	3.510
AF	1.875		
AG	4.000		
AH	2.563		
AJ		4.615	4.635



4K50,000LQ
OUTLINE DRAWING

NOTES:

1. *MINIMUM CONTACT SURFACES FOR ALL CAVITY PLATES.
2. DIMENSIONS IN INCHES.
3. FOR ELECTRICAL CONTACT SURFACE DIMENSIONS SEE GUN NO. 2 OUTLINE, DRWG. NO. GUN NO. 2-6001.

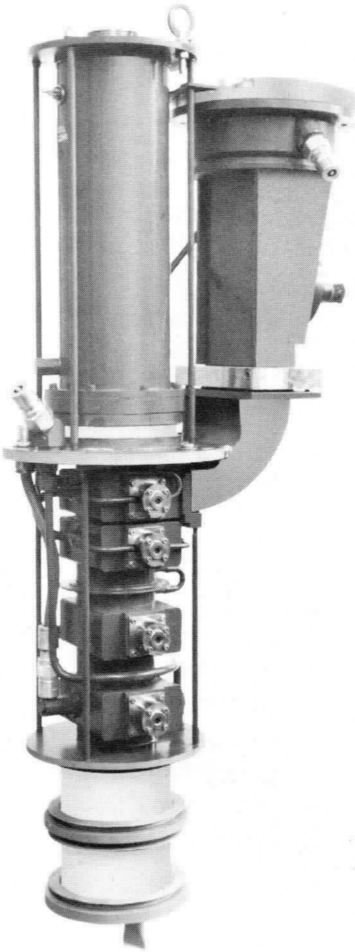
Printed in U.S.A. 46915

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

4KM50SJ

POWER AMPLIFIER KLYSTRON

12 kW
1.7 - 2.4 Gc



The 4KM50SJ is a four-cavity, power amplifier klystron intended primarily for use in tropospheric scatter communications systems. When tuned for maximum efficiency, it produces a minimum output power of 12 kilowatts, at frequencies from 1.7 to 2.4 gigacycles, with a minimum gain of 40 decibels.

The electron gun of this klystron has a confined flow configuration which minimizes focusing adjustments and produces a stable beam. The current of the focusing electromagnet can be varied over a wide range without appreciably affecting rf output or body current. Only one electromagnet power supply is required. Cathode current loading is less than 200 milliamperes per square centimeter. This light cathode loading contributes to long life.

Both input and output couplings of the 4KM50SJ are fixed. The only adjustments required are therefore the tuning of the four integral cavities. The output window is a thick beryllium oxide disc which is protected by a photo-cell arc detector.

The 4KM50SJ incorporates a built-in vacuum pump in the form of a titanium getter which should be energized whenever heater power is applied. Effective protection against internal arcs is provided by the Eimac Modulating Anode.

A focusing electromagnet and klystron supporting structure, Catalog Number H-158, has been designed for use with the 4KM50SJ.

Eimac Water Load WL-202 is recommended for use with the 4KM50SJ.

CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential		
	Heating time	5 minutes
Heater:	Voltage (±5%)	7.5 volts
	Current	12 amperes
Getter:	Voltage	4 volts ac
	Amperes	24 amperes ac
Power Gain		40 decibels
Output Power		12 kilowatts
Frequency Range		1.7-2.4 gigacycles
Phase sensitivity to beam voltage		0.058 degrees/volt

MECHANICAL

Maximum Dimensions (4KM50SJ and H-158 Electromagnet)		
Length	33 inches	
Diameter	18 inches	
Weight (4KM50SJ)	90 pounds	
Weight (H-158 Electromagnet)	170 pounds	
Input Coupling (rf)	Type N Coaxial	
Output Coupling (rf)	UG435A/U Flange	
Maximum Tuner Start Torque	70 in-oz	
Maximum Tuner Stop Torque	30 in-lbs	
Mounting Position Preferred	vertical, cathode down	
Cooling: Water and Forced Air		
	Flow Rate	*Pressure Drop*
Cathode	20 cfm	free
Body	1.2 gpm	50 psi
Collector	18 gpm	30 psi
Electromagnet	1.5 gpm	15 psi

ELECTROMAGNET POWER SUPPLY REQUIREMENTS

Voltage	150 volts
Current	15 amperes

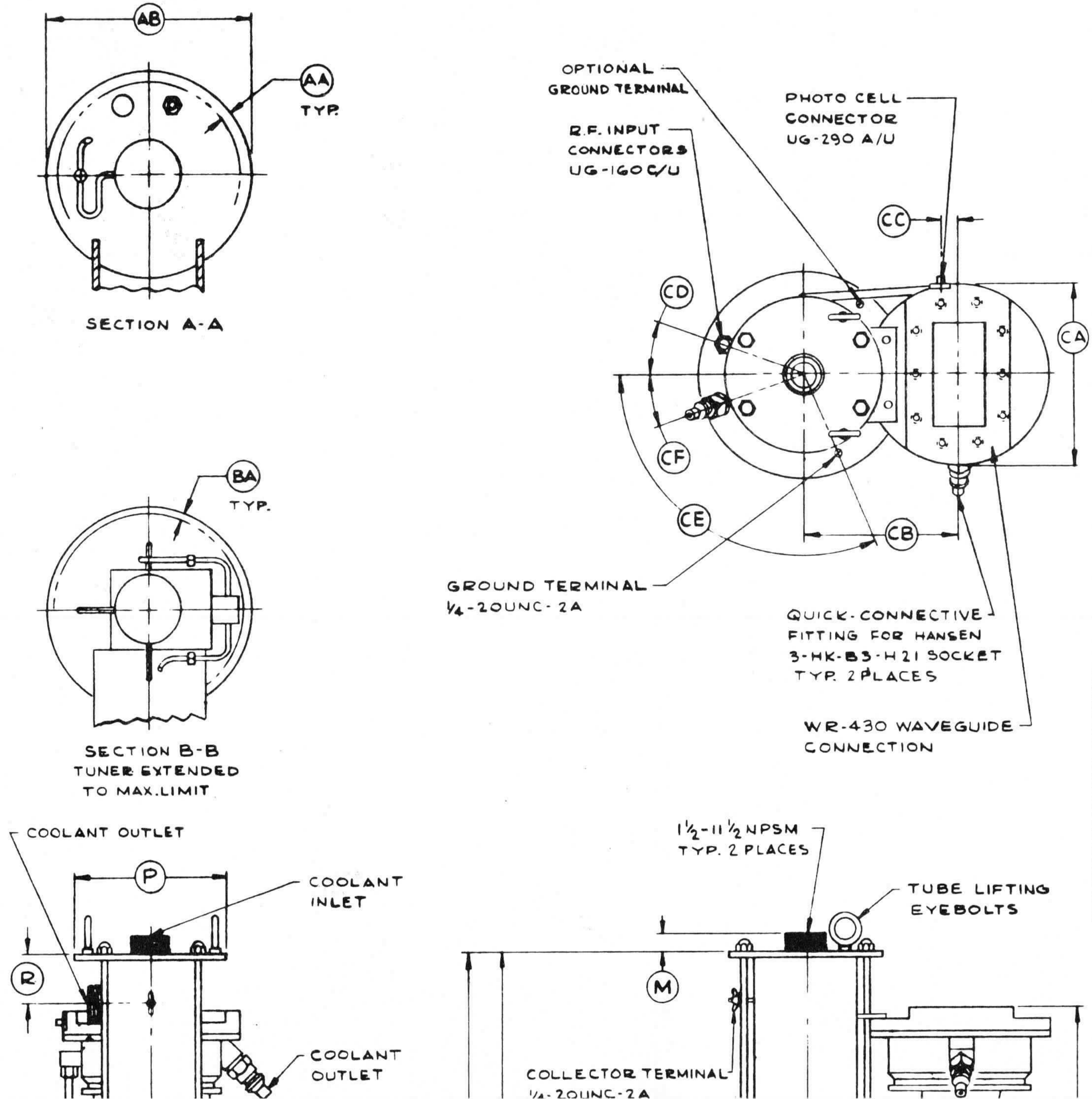
MAXIMUM RATINGS

BEAM VOLTAGE (dc)	20 KILOVOLTS
BEAM CURRENT (dc)	3 AMPERES
BEAM INPUT POWER	50 KILOWATTS
BODY CURRENT (dc)	75 MILLIAMPERES
COLLECTOR DISSIPATION	50 KILOWATTS
LOAD VSWR	1.5:1
INLET WATER PRESSURE	80 PSIG
OUTLET WATER TEMPERATURE	80 DEGREES C

TYPICAL OPERATION

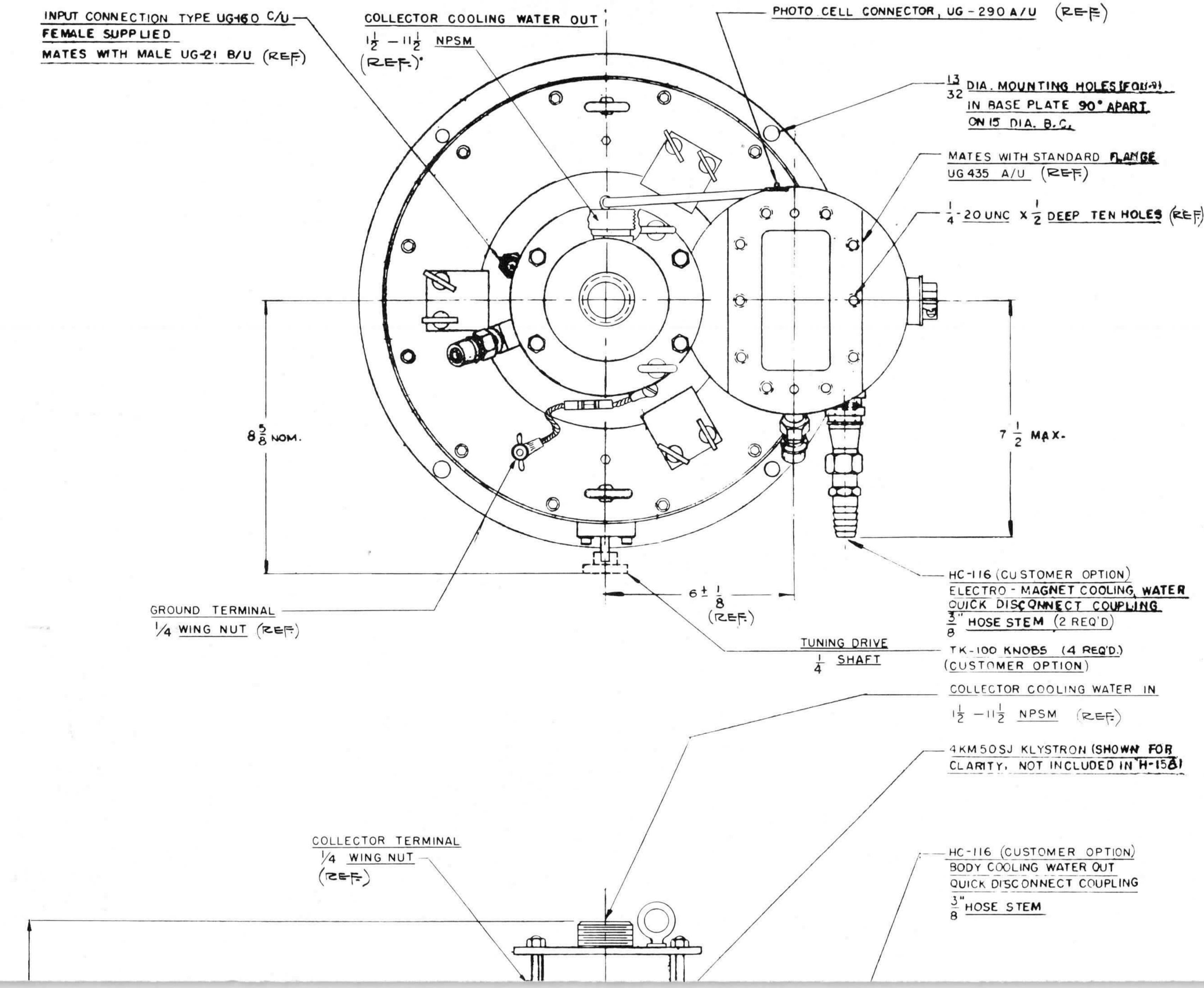
	High Eff. Tuned		*Broadband Tuned*		
Frequency	1.7	2.4	1.7	2.4	gigacycles
Output Power	14.5	12.3	12.1	10.5	kilowatts
Driving Power	1	1	1	1	watt
Gain	41.6	40.9	40.8	40.2	decibels
Beam Voltage	18	18	18	18	kilovolts dc
Beam Current	1.8	1.8	1.8	1.8	amperes dc
Modulating Anode Voltage (to cathode)	10.4	10.4	10.4	10.4	kilovolts dc
Beam Power Efficiency	44.5	38.0	37.2	32.4	percent
Half Power Bandwidth	5	8	10	12	megacycles
Body Current	65	50	55	35	milliamperes dc
Electromagnet Current	12.5	12.5	12.5	12.5	amperes

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.

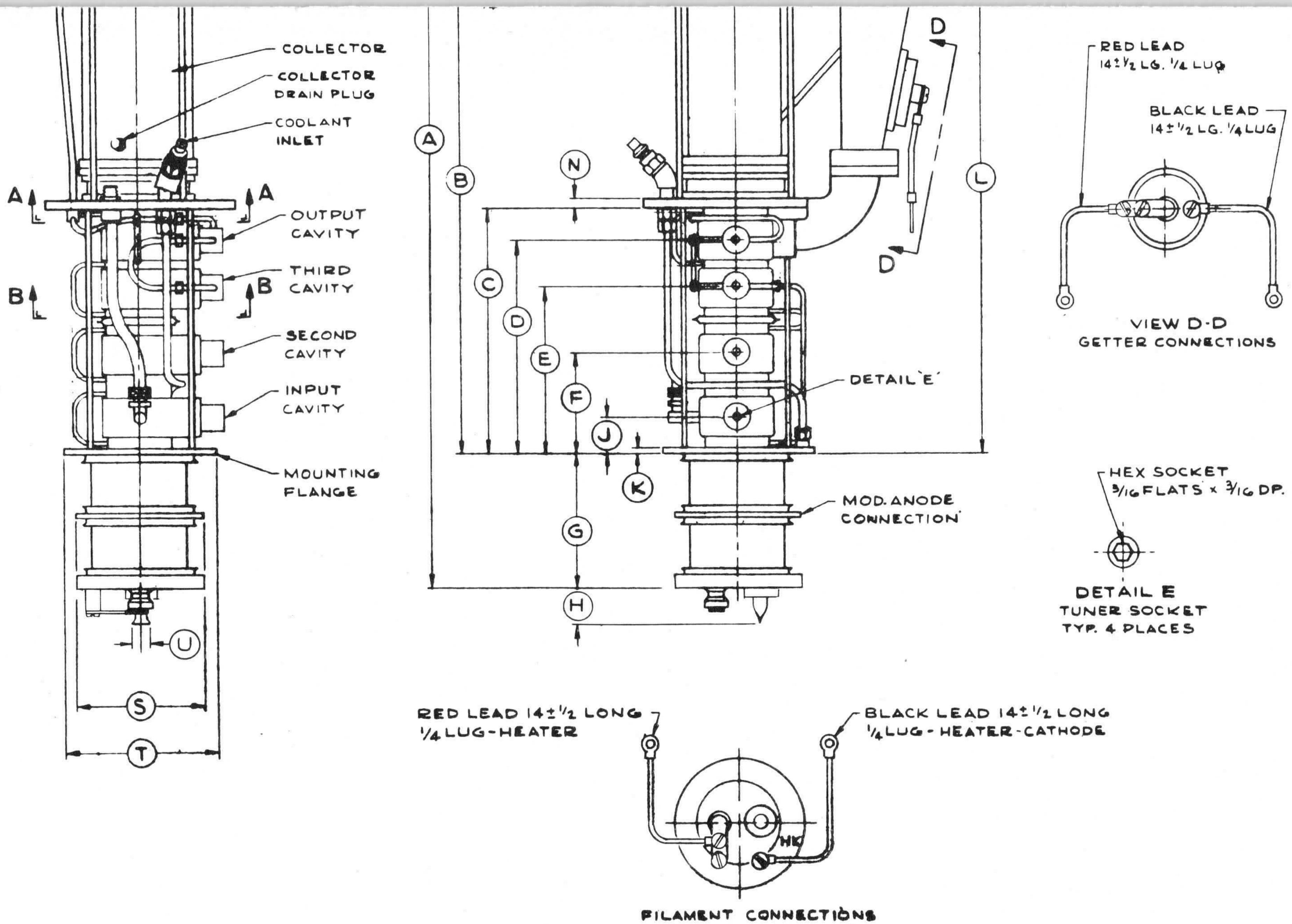


DIMENSIONAL DATA

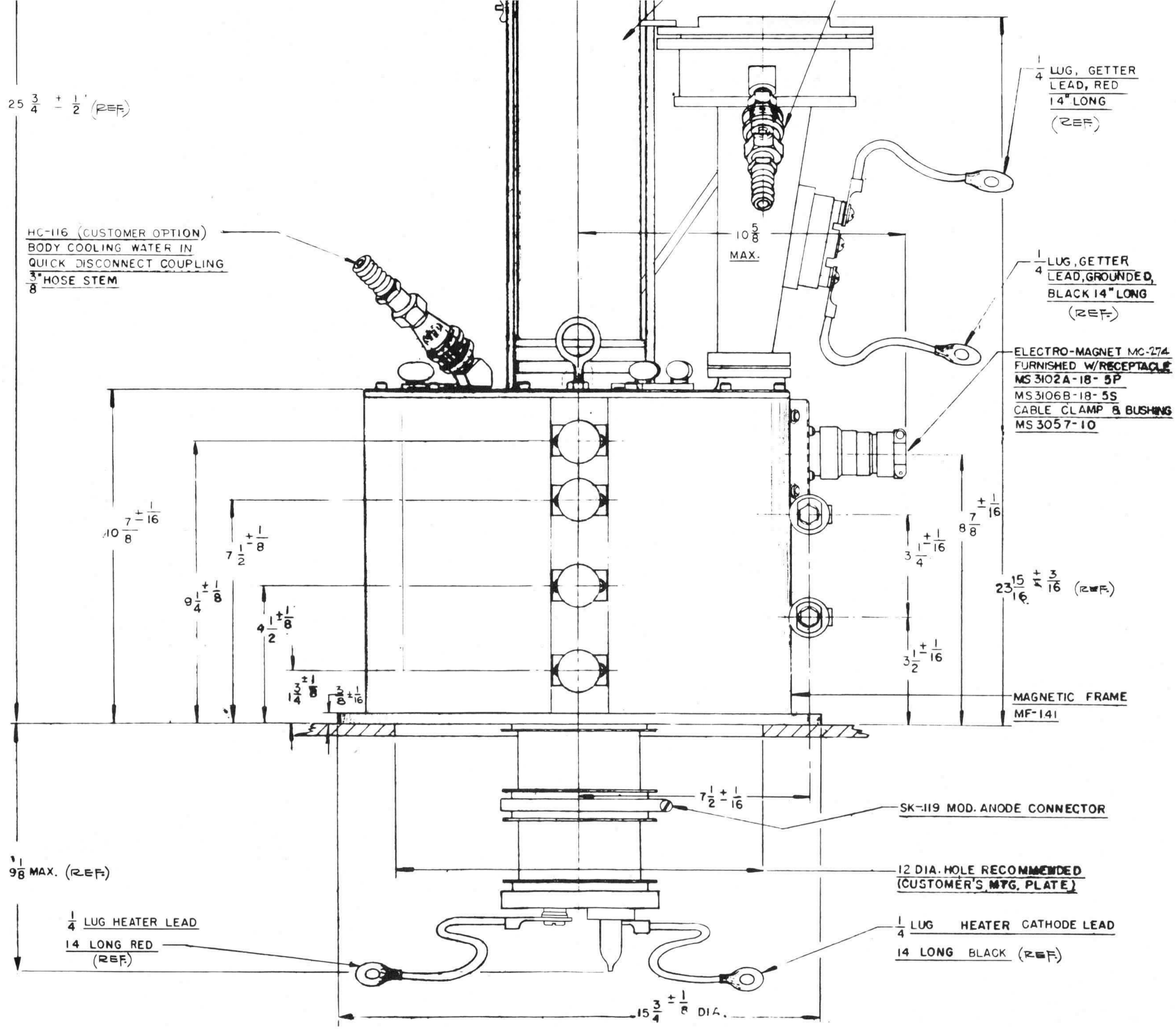
REF	NOM.	MIN.	MAX.
A	30.366		
B	24.670		
C		10.325	10.525
D	9.125		
E	7.375		
F	4.388		
G	5.696		
H	2.188		
J	1.638		
K		.230	.270
L		23.600	24.000
M			1.000
N		.345	.405
P		5.950	6.050
R		1.470	1.720
S			5.280
T		6.490	6.500
U			1.188
AA		.437	
AB		7.990	8.000
BA		.380	
CA		6.970	7.030
CB		5.750	6.250
CC		.510	.610
CD		15°	25°
CE		110°	120°
CF		15°	25°



INPUT CONNECTION TYPE UG-160 C/U
FEMALE SUPPLIED
MATES WITH MALE UG-21 B/U (REF)
COLLECTOR COOLING WATER OUT
1½ — 11½ NPSM
(REF)
PHOTO CELL CONNECTOR, UG-290 A/U (REF)
13/32 DIA. MOUNTING HOLES (FOUR) IN BASE PLATE 90° APART ON 15 DIA. B.C.
MATES WITH STANDARD FLANGE UG 435 A/U (REF)
1/4-20 UNC X 1/2 DEEP TEN HOLES (REF)
8 5/8 NOM.
7 1/2 MAX.
6 ± 1/8 (REF)
GROUND TERMINAL
1/4 WING NUT (REF)
TUNING DRIVE
1/4 SHAFT
HC-116 (CUSTOMER OPTION)
ELECTRO-MAGNET COOLING WATER QUICK DISCONNECT COUPLING
3/8" HOSE STEM (2 REQ'D)
TK-100 KNOBS (4 REQ'D.)
(CUSTOMER OPTION)
COLLECTOR COOLING WATER IN
1½ — 11½ NPSM (REF)
4KM50SJ KLYSTRON (SHOWN FOR CLARITY, NOT INCLUDED IN H-158)
COLLECTOR TERMINAL
1/4 WING NUT
(REF)
HC-116 (CUSTOMER OPTION)
BODY COOLING WATER OUT
QUICK DISCONNECT COUPLING
3/8" HOSE STEM



4KM50SJ KLYSTRON



H-158 ELECTROMAGNET AND KLYSTRON SUPPORTING STRUCTURE

Eimac®

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

TENTATIVE DATA

4KM100LA

POWER AMPLIFIER

L-BAND KLYSTRON

The Eimac 4KM100LA is a four-cavity, magnetically focused, power-amplifier klystron designed for use at frequencies from 470 to 610 megacycles. Intended primarily for television visual service, it is also suitable for aural TV, or for tropospheric-scatter communications service.

When adjusted for narrow-band CW operation the 4KM100LA will deliver a minimum output power of 35 kilowatts with a power gain of 45 decibels. In television visual service it will provide more than 25 kilowatts of peak synchronizing power, with a power gain of 30 decibels, and 1db bandwidth of 8 megacycles. Random AM noise is more than 60db below black level.

The electron gun of this klystron utilizes a semi-confined flow field which minimizes focusing adjustments and produces a very stable beam. The cathode loading of only 100 milliamperes per square centimeter, at a beam voltage of 18 kilovolts, is ultra conservative in the interest of long life. Effective protection from internal arcs is provided by the Eimac Modulating Anode.

All tuning is accomplished outside of the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. Load couplers are provided to permit external loading of these cavities for extreme wide-band operation. However, external cavity loading is not ordinarily required in TV visual service.

The 4KM100LA incorporates a built-in vacuum pump in the form of a titanium getter. This getter should be energized whenever heater power is applied. Its normal operating voltage is 3.7 volts at approximately 20 amperes. When a new tube is first placed in operation the getter should be flashed for 5 minutes at a voltage of 7.5 volts (±5%) which produces a current of approximately 33 amperes. The getter should also be flashed whenever a tube exhibits symptoms of high gas pressure.

Eimac Klystron Amplifier Circuit Assembly H133 has been designed for use with the 4KM100LA to cover the specified frequency range. This assembly includes a klystron supporting structure, magnetic focusing coils, tuning cavities, and adjustable load couplers for each cavity.

CHARACTERISTICS

ELECTRICAL

Heater:	Voltage	26.0	volts
	Current	11.5	amperes
	Maximum Starting Current	23	amperes
Cathode:	EMA, Unipotential		
	Heating Time	5	minutes
Getter (Operating):			
	A-C Voltage (±5%)	3.7	volts
	A-C Current	20	amperes
Getter (Flash):			
	A-C Voltage (±5%)	7.5	volts
	A-C Current	33	amperes
Power Gain:	Narrow Band	45	decibels
	Television Visual Service	30	decibels
Output Power:	Narrow Band	35	kilowatts
	Television Visual Service	25	kilowatts
Frequency Range (H133 Assembly)		470 to 610	megacycles

MECHANICAL

Operating Position		Axis vertical, cathode up
RF Coupling:		
Input		Type "N" coaxial fitting
Output		3-1/8 inch, 50-ohm line
Input and 2nd Cavity Loading		Type "N" coaxial fitting
3rd Cavity Loading		1-5/8 inch, 50-ohm line
Shipping Weights:		
Klystron Only		119 lbs (Net)
H-133 RF Circuit Assembly		1188 lbs (Net)

Cooling: Water and Forced Air

	Flow Rate	Pressure Drop
Cathode	*5 cfm	-------
Cavity	50 cfm	TBS
Klystron Body (5 drift-tube sections, in series)	2 gpm	35 psi
Klystron Collector	30 gpm	7.5 psi

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Each of Four Body Coils and Collector Coil:

Voltage	0 to 50	volts
Current	0 to 10	amperes

MAXIMUM RATINGS

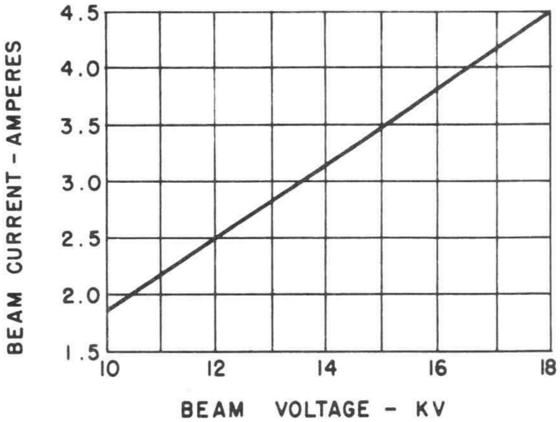
D-C BEAM VOLTAGE	20	KILOVOLTS
D-C BEAM CURRENT	6.0	AMPERES
D-C BODY CURRENT	150	MILLIAMPERES
COLLECTOR DISSIPATION	100	KILOWATTS
INLET WATER PRESSURE	100	PSI

TYPICAL OPERATION

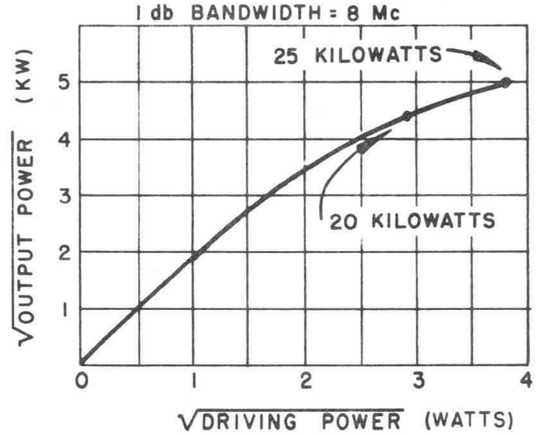
	TV Visual Amplifier	Narrow Band CW	
Frequency	550	550	megacycles
Output Power	26.4 (peak sync.)	35.4	kilowatts
Driving Power	20 " "	1.0	watts
Power Gain	31 " "	45	decibels
D-C Beam Voltage	16	18	kilovolts
D-C Beam Current	3.82	4.54	amperes
Beam Power Efficiency	43 (peak sync.)	43.3	percent
D-C Body Current	--	90	milliamperes
1 db Bandwidth	8	--	megacycles
Magnetic Coil Currents:			
First Body Coil	9.0	9.0	amperes
Second Body Coil	9.0	9.2	amperes
Third Body Coil	8.6	9.8	amperes
Fourth Body Coil	7.1	6.0	amperes
Collector Coil	3.3	6.3	amperes

* Required only if ambient air temperature exceeds 25° C.

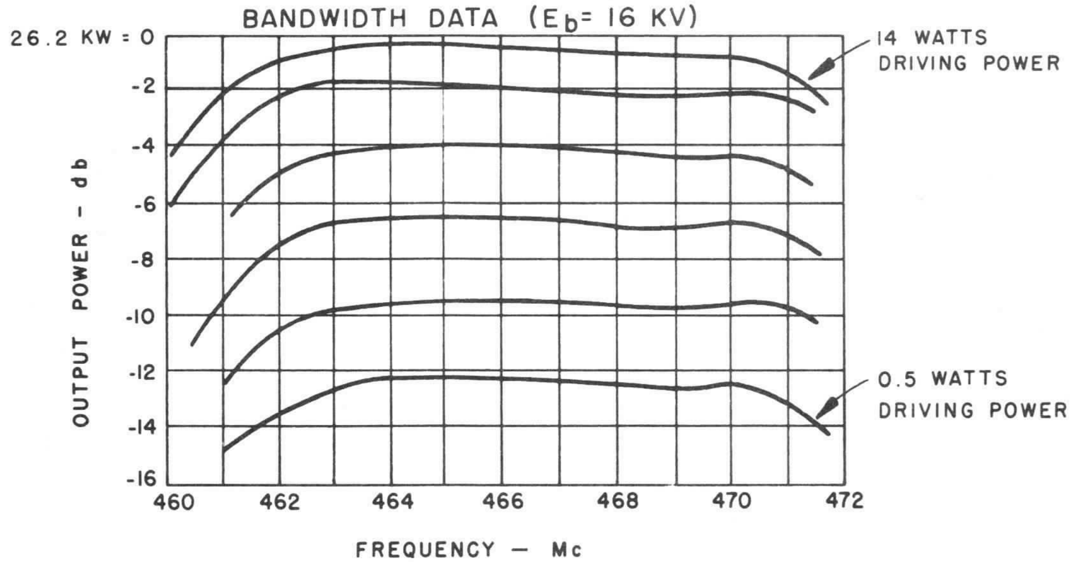
For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., San Bruno, California.



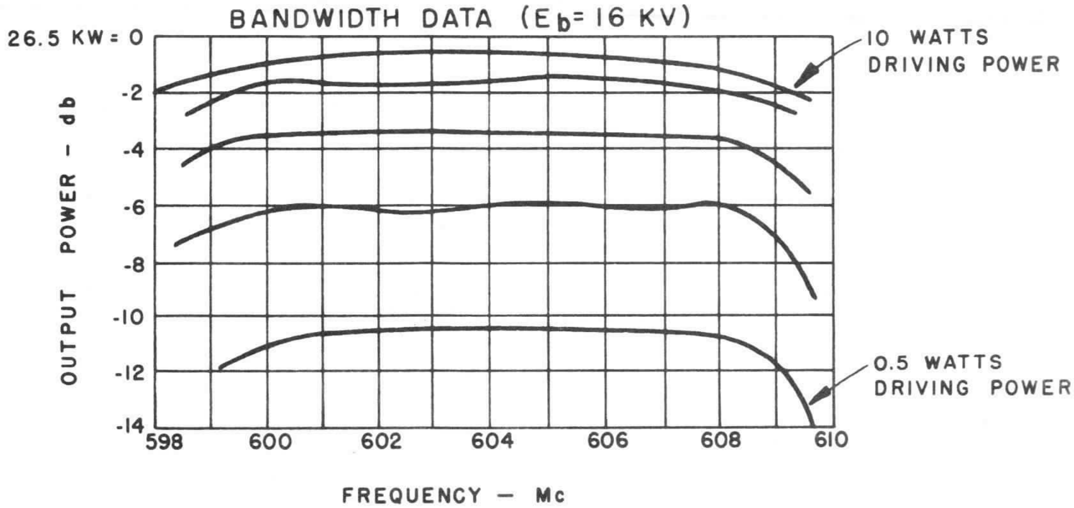
LINEARITY DATA
E_b = 16 KV F = 470 Mc
1 db BANDWIDTH = 8 Mc

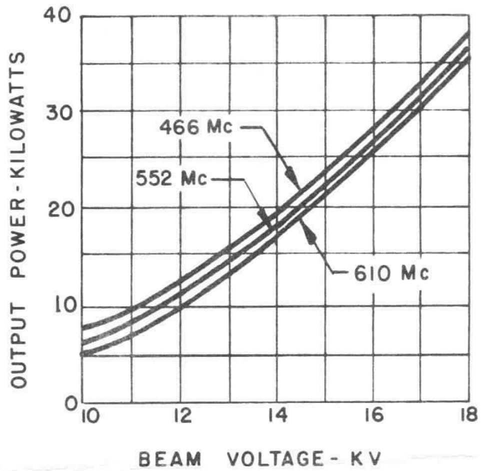


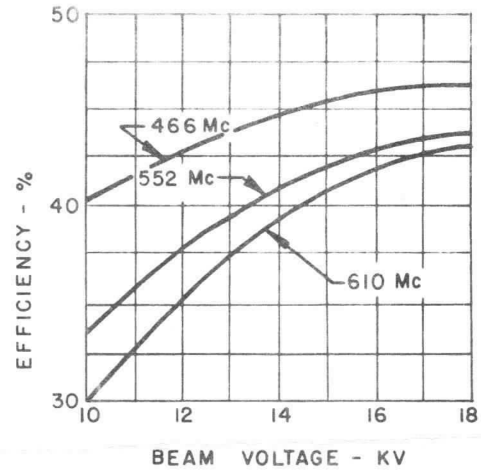
BANDWIDTH DATA (E_b = 16 KV)

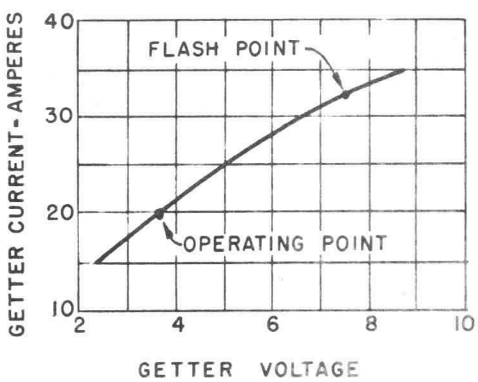


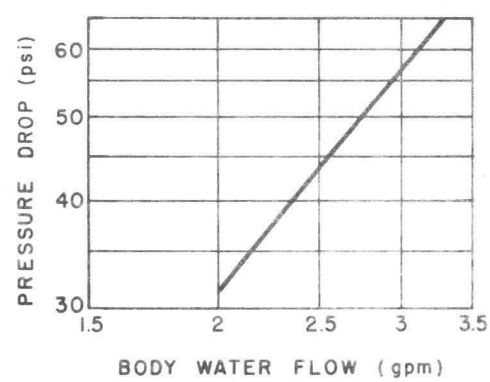
BANDWIDTH DATA (E_b = 16 KV)

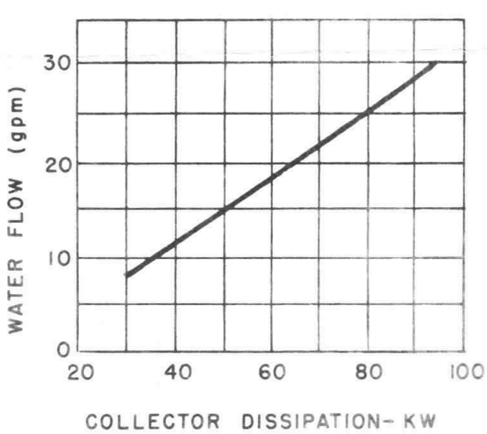


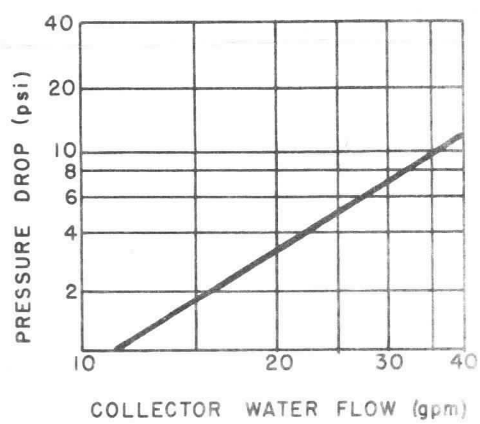

OUTPUT POWER - KILOWATTS
BEAM VOLTAGE - KV
466 Mc
552 Mc
610 Mc
0
10
20
30
40
10
12
14
16
18

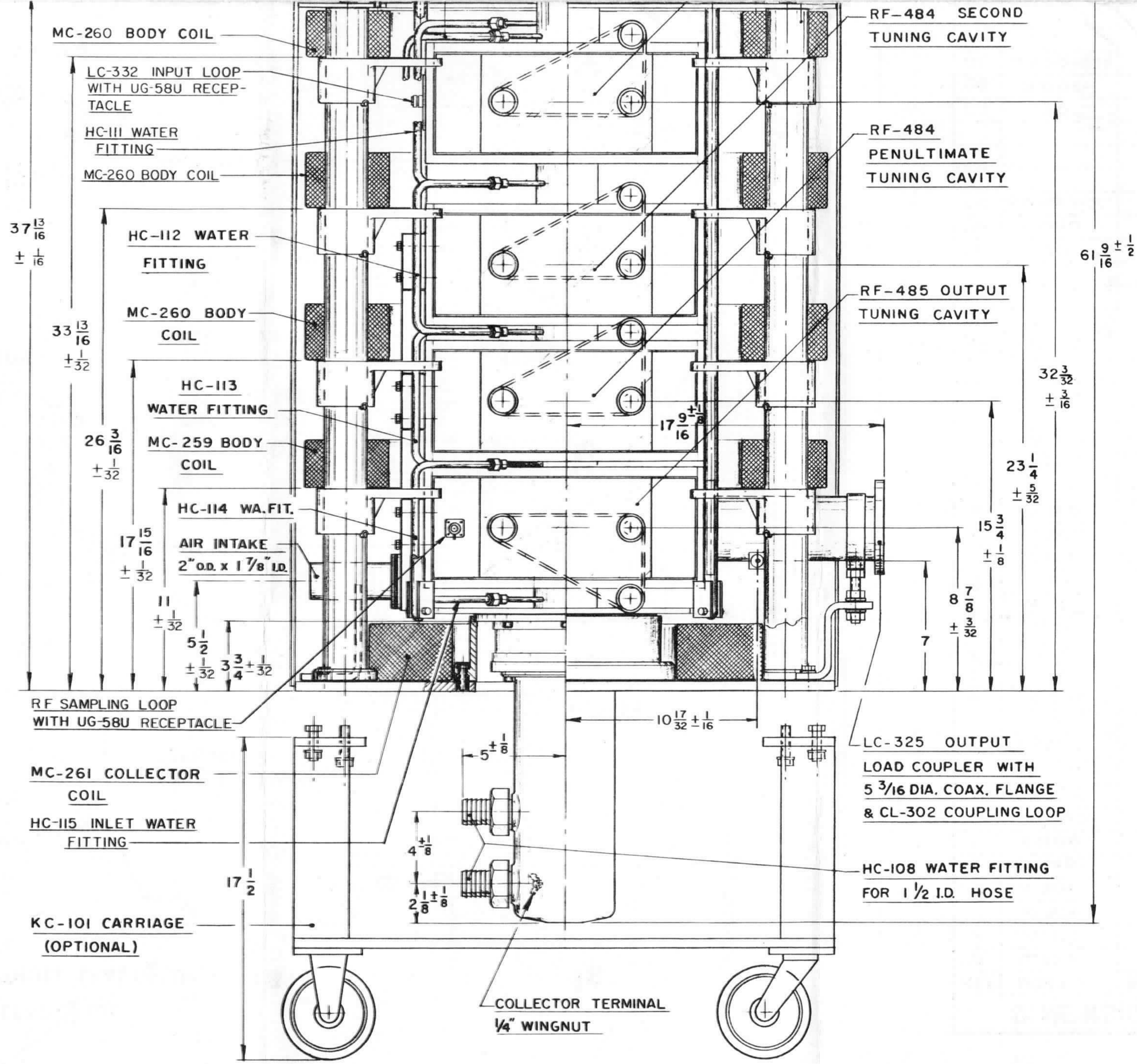

EFFICIENCY - %
BEAM VOLTAGE - KV
466 Mc
552 Mc
610 Mc
30
40
50
10
12
14
16
18


GETTER CURRENT - AMPERES
GETTER VOLTAGE
FLASH POINT
OPERATING POINT
10
20
30
40
2
4
6
8
10

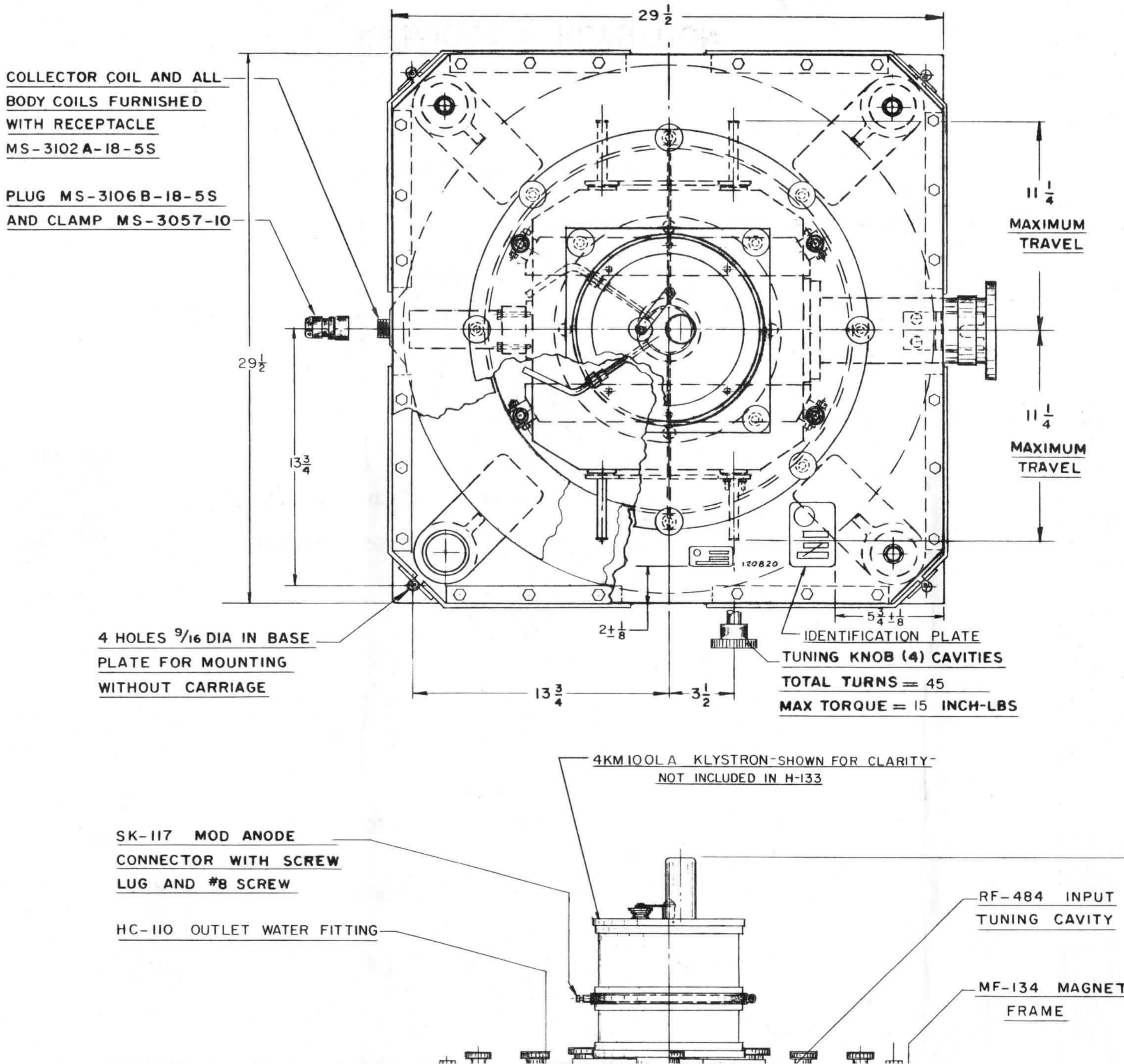

PRESSURE DROP (psi)
BODY WATER FLOW (gpm)
30
40
50
60
1.5
2
2.5
3
3.5


WATER FLOW (gpm)
COLLECTOR DISSIPATION - KW
0
10
20
30
20
40
60
80
100


PRESSURE DROP (psi)
COLLECTOR WATER FLOW (gpm)
2
4
6
8
10
20
40
10
20
30
40



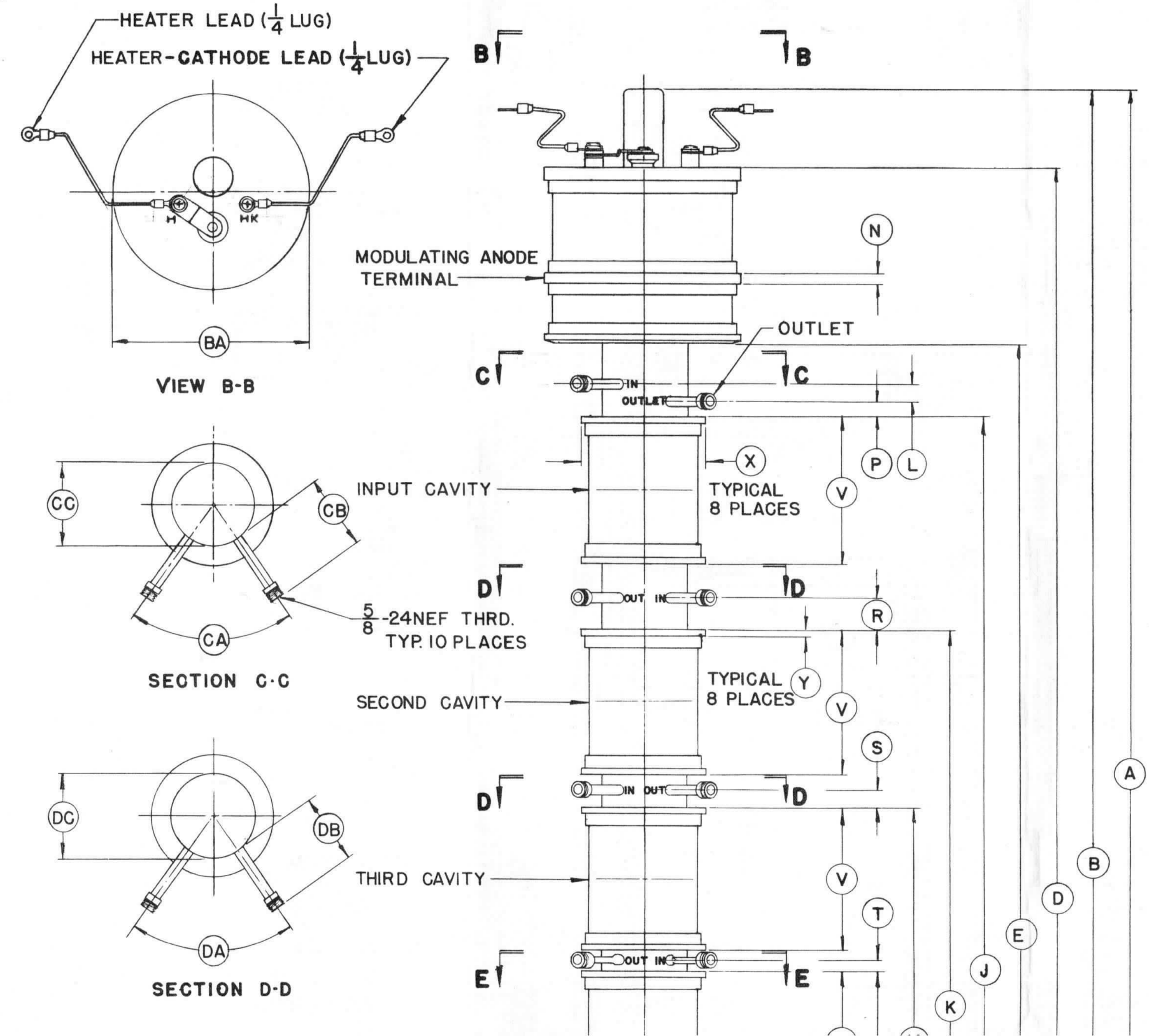
H-133 KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY



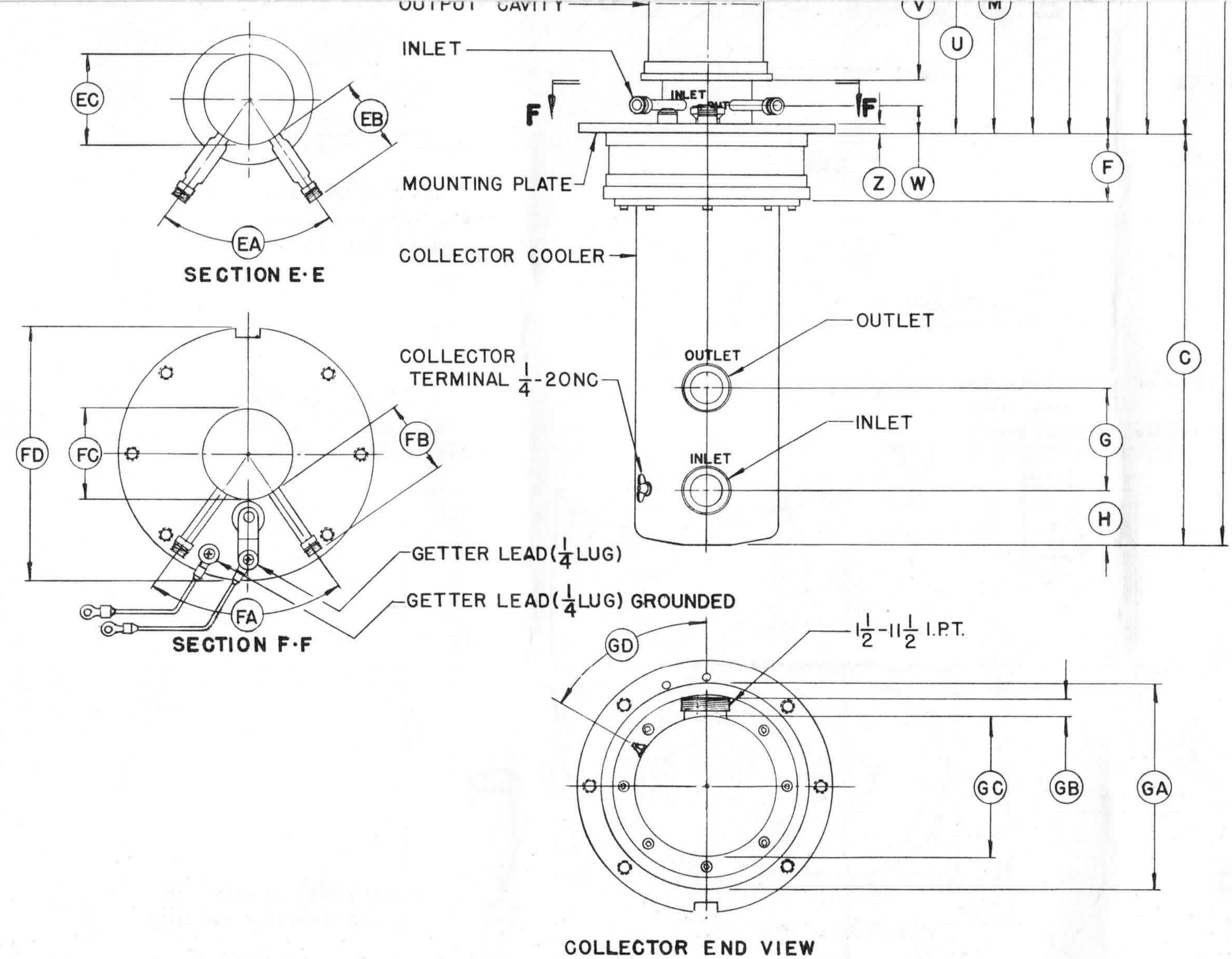
NOTES

PARTS NOT SHOWN

1. CP-100 (3) COVER PLATES
2. TL-103 (ONE) TUBE LIFT
3. HT-101 (ONE) WRENCH
4. HT-104 (ONE) WRENCH
5. LC-313A (ONE) LOAD COUPLER (OPTIONAL-USED ON PENULTIMATE TUNING CAVITY)
6. LC-333 (TWO) COUPLING LOOPS (OPTIONAL-USED ON INPUT & SECOND TUNING CAVITIES)



DIMENSION DATA			
REF.	NOMINAL	MINIMUM	MAXIMUM
A	61.625		
B	45.150		
C	16.475		
D	41.900		
E	34.467		
F	2.600		
G	4.000		
H	2.125		
J	31.341		
K	22.499		
L	.625		
M	14.999		
N	.375		
P	.636		
R	1.433		
S	.875		
T	.453		
U	8.124		
V	6.000		
W	1.124		
X	5.125		
Y	.250		
Z	.375		
BA	8.125 DIA		
CA	70°		
CB	3.000		
CC	3.500 DIA		
DA	70°		
DB	3.000		
DC	3.500 DIA		



EA	70°		
EB	3.000		
EC	3.500 DIA		
FA	70°		
FB	3.000		
FC	3.500 DIA		
FD	10.000 DIA		
GA	8.125 DIA		
GB	.843		
GC	5.500 DIA		
GD	60°		

4KM100LA KLYSTRON

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4KM100LA

POWER-AMPLIFIER L-BAND KLYSTRON

The Eimac 4KM100LA is a four-cavity, magnetically focused, power-amplifier klystron designed for use at frequencies from 470 to 610 megacycles. Intended primarily for television visual service, it is also suitable for aural TV, or for tropospheric-scatter communications service.

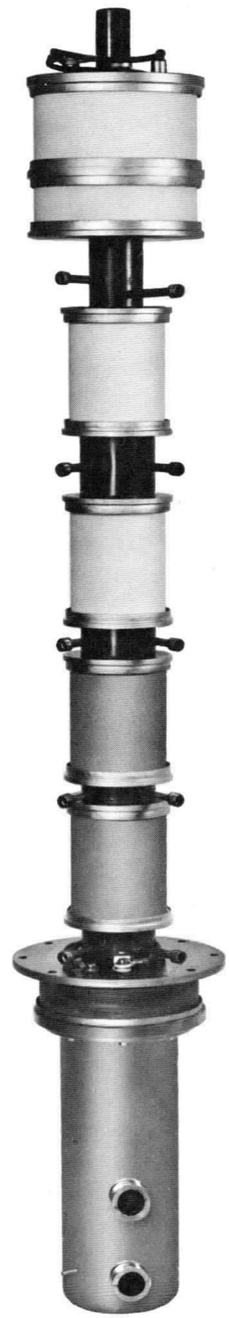
When adjusted for narrow-band CW operation the 4KM100LA will deliver a minimum output power of 35 kilowatts with a power gain of 45 decibels. In television visual service it will provide more than 25 kilowatts of peak synchronizing power, with a power gain of 30 decibels, and 1db bandwidth of 8 megacycles. Random AM noise is more than 60db below black level.

The electron gun of this klystron utilizes a semi-confined flow field which minimizes focusing adjustments and produces a very stable beam. The cathode loading of only 100 milliamperes per square centimeter, at a beam voltage of 18 kilovolts, is ultra conservative in the interest of long life. Effective protection from internal arcs is provided by the Eimac Modulating Anode.

All tuning is accomplished outside of the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. Load couplers are provided to permit external loading of these cavities for extreme wideband operation. However, external cavity loading is not ordinarily required in TV visual service.

The 4KM100LA incorporates a built-in vacuum pump in the form of a titanium getter. This getter should be energized whenever heater power is applied. Its normal operating voltage is 3.7 volts at approximately 20 amperes. When a new tube is first placed in operation the getter should be flashed for 5 minutes at a voltage of 7.5 volts (±5%) which produces a current of approximately 33 amperes. The getter should also be flashed whenever a tube exhibits symptoms of high gas pressure.

Eimac Klystron Amplifier Circuit Assembly H-133 has been designed for use with the 4KM100LA to cover the specified frequency range. This assembly includes a klystron supporting structure, magnetic focusing coils, tuning cavities, and adjustable load couplers for each cavity.



CHARACTERISTICS

ELECTRICAL

Heater:	Voltage - - - -	26.0	volts
	Current - - - -	11.5	amperes
	Maximum Starting Current	23	amperes
Cathode:	EMA, Unipotential		
	Heating Time - - -	5	minutes
Getter (Operating):			
	A-C Voltage (±5%) - -	3.7	volts
	A-C Current - - -	20	amperes
Getter (Flash):			
	A-C Voltage (±5%) - -	7.5	volts
	A-C Current - - -	33	amperes
Power Gain:	Narrow Band - -	45	decibels
	Television Visual Service	30	decibels
Output Power:	Narrow Band - -	35	kilowatts
	Television Visual Service	25	kilowatts
Frequency Range (H-133 Assembly)		470 to 610	megacycles

MECHANICAL

Maximum Height of Klystron and H-133 Assembly including KC-101 Carriage		67 inches
Operating Position	- - - - - -	Axis vertical, cathode up
R-F Coupling:		
Input	- - - - - -	Type "N" coaxial fitting
Output	- - - - - -	3-1/8 inch, 50-ohm line
Input and 2nd Cavity Loading	- - - -	Type "N" coaxial fitting
3rd Cavity Loading	- - - - - -	1-5/8 inch, 50-ohm line
Weights:		
Klystron Only	- - - - - -	119 pounds
H-133 RF Circuit Assembly	- - - -	1188 pounds

Cooling: Water and Forced Air

		Flow Rate	Pressure Drop
Cathode	- - - -	*5 cfm	-------
Cavity	- - - -	50 cfm	TBS
Klystron Body (5 drift-tube sections, in series)		2 gpm	35 psi
Klystron Collector	- - - -	30 gpm	7.5 psi

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Each of Four Body Coils and Collector Coil:

Voltage	- - - -	0 to 50	volts
Current	- - - -	0 to 10	amperes

MAXIMUM RATINGS

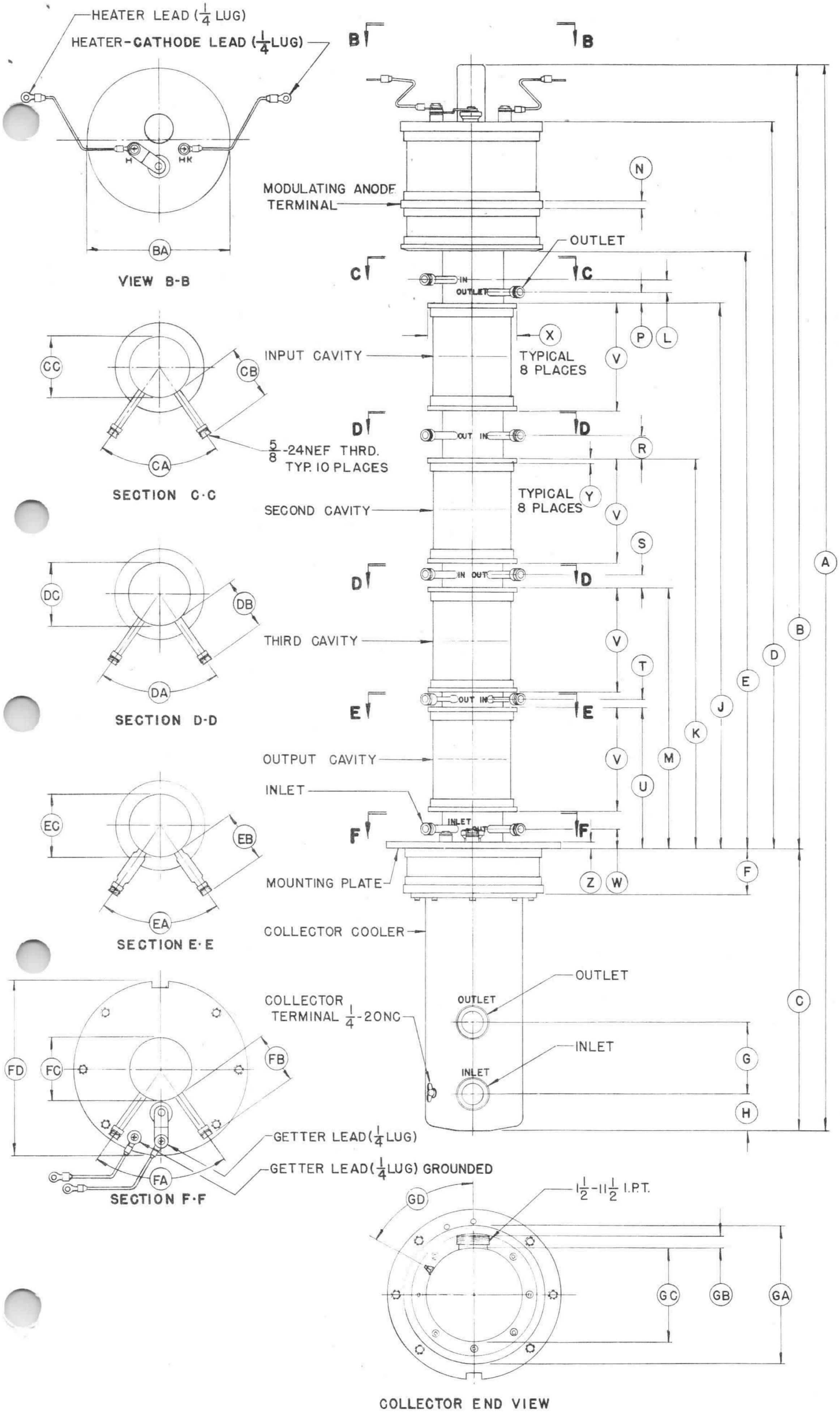
D-C BEAM VOLTAGE	- - - -	20	KILOVOLTS
D-C BEAM CURRENT	- - - -	6.0	AMPERES
D-C BODY CURRENT	- - - -	150	MILLIAMPERES
COLLECTOR DISSIPATION	- - - -	100	KILOWATTS
INLET WATER PRESSURE	- - - -	100	PSI

TYPICAL OPERATION

		TV Visual Amplifier	Narrow Band CW	
Frequency	- -	550	550	megacycles
Output Power	- -	26.4(peak sync.)	35.4	kilowatts
Driving Power	- -	20 " "	1.0	watts
Power Gain	- -	31 " "	45	decibels
D-C Beam Voltage	- -	16	18	kilovolts
D-C Beam Current	- -	3.82	4.54	amperes
Beam Power Efficiency	- -	43(peak sync.)	43.3	percent
D-C Body Current	- -	--	90	milliamperes
1 db Bandwidth	- -	8	--	megacycles
Magnetic-Coil Currents:				
First Body Coil	- -	9.0	9.0	amperes
Second Body Coil	- -	9.0	9.2	amperes
Third Body Coil	- -	8.6	9.8	amperes
Fourth Body Coil	- -	7.1	6.0	amperes
Collector Coil	- -	3.3	6.3	amperes

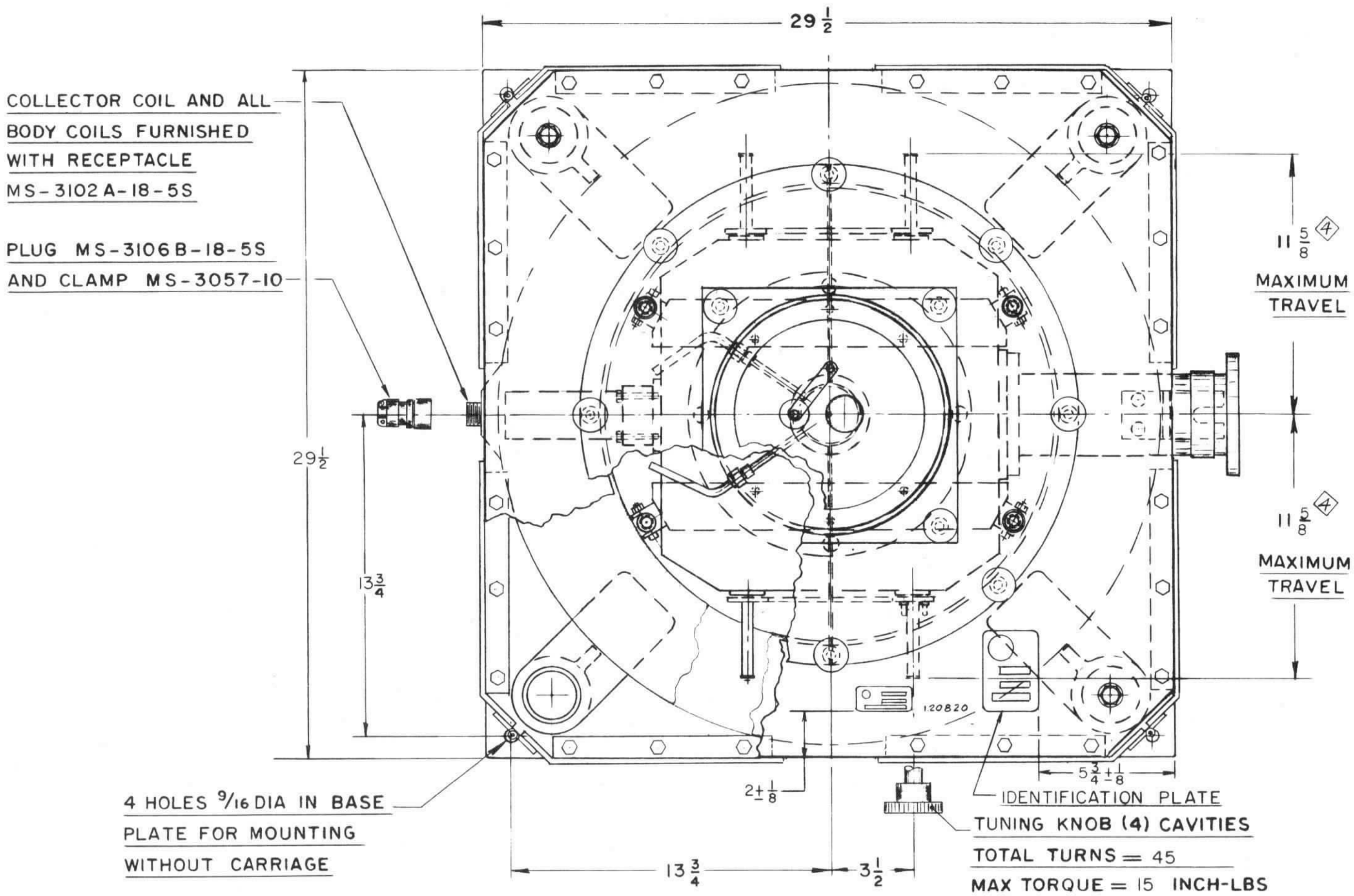
* Required only if ambient air temperature exceeds 25°C.

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., San Carlos, California.



DIMENSION DATA			
REF.	NOMINAL	MINIMUM	MAXIMUM
A	61.625		
B	45.150		
C	16.475		
D	41.900		
E	34.467		
F	2.600		
G	4.000		
H	2.125		
J	31.341		
K	22.499		
L	.625		
M	14.999		
N	.375		
P	.636		
R	1.433		
S	.875		
T	.453		
U	8.124		
V	6.000		
W	1.124		
X	5.125		
Y	.250		
Z	.375		
BA	8.125 DIA		
CA	70°		
CB	3.000		
CC	3.500 DIA		
DA	70°		
DB	3.000		
DC	3.500 DIA		
EA	70°		
EB	3.000		
EC	3.500 DIA		
FA	70°		
FB	3.000		
FC	3.500 DIA		
FD	10.000 DIA		
GA	8.125 DIA		
GB	.843		
GC	5.500 DIA		
GD	60°		

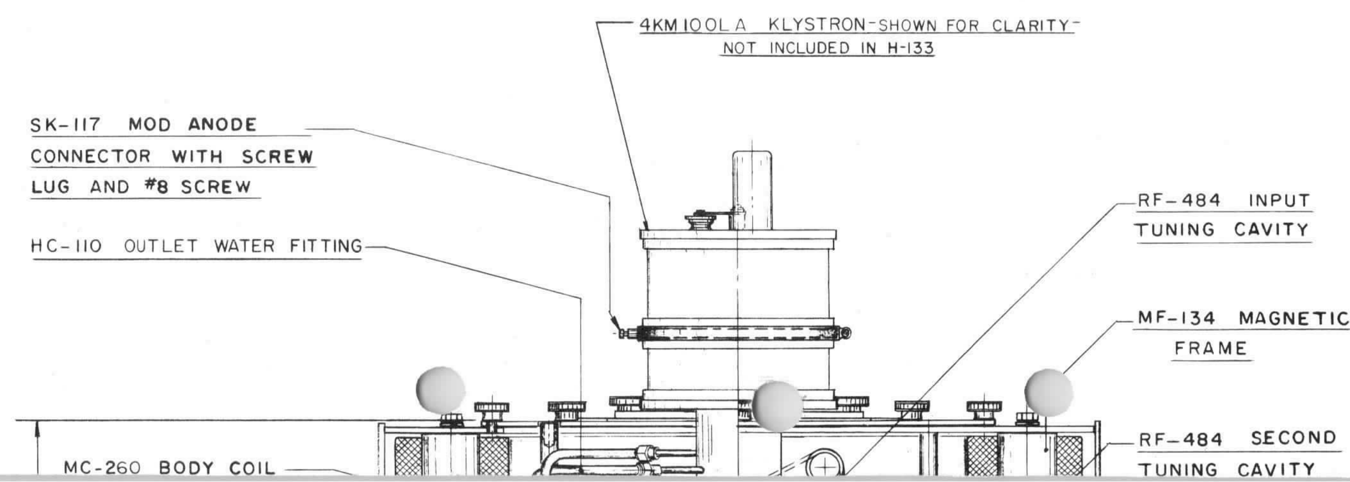
4KM100LA KLYSTRON

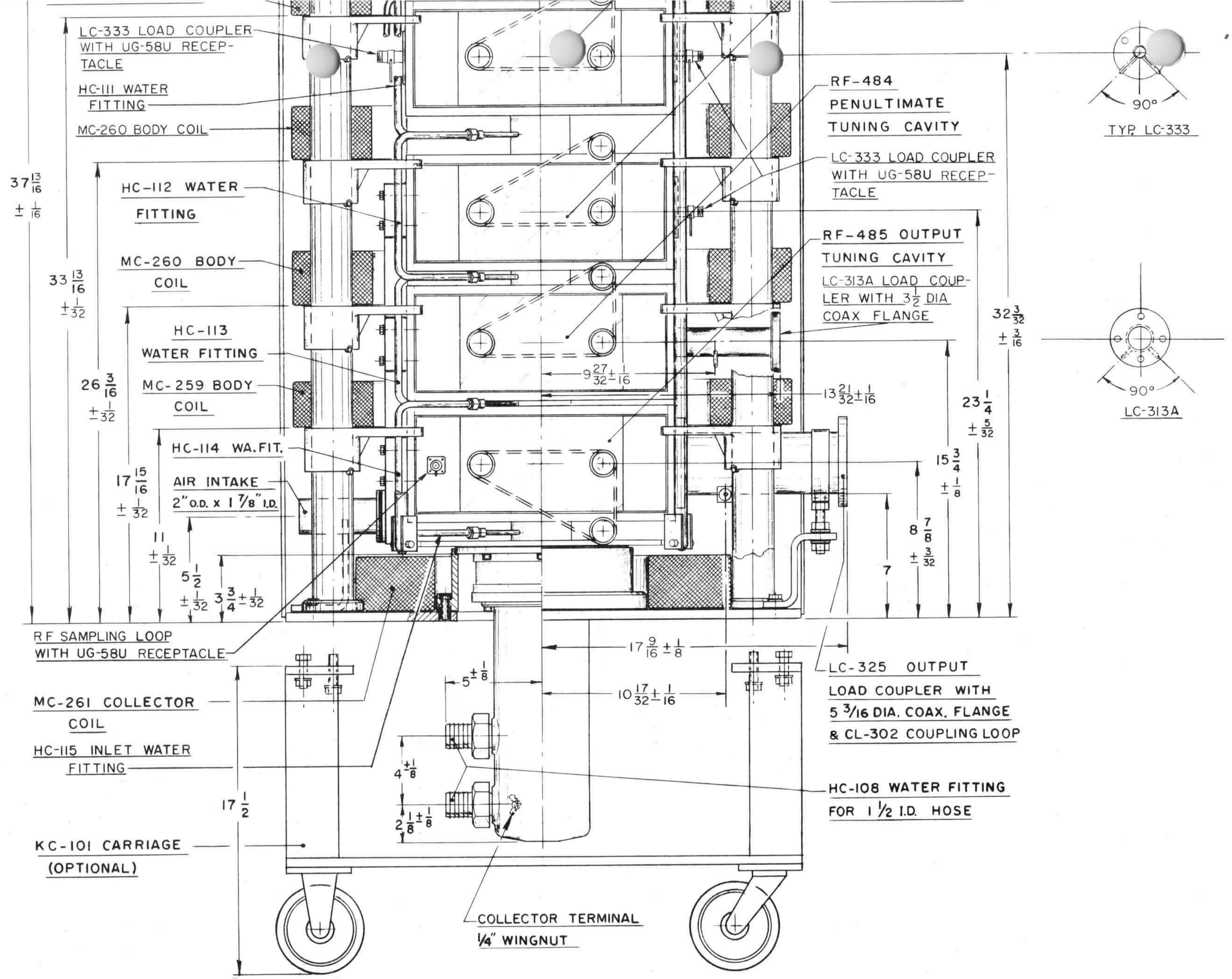


NOTES

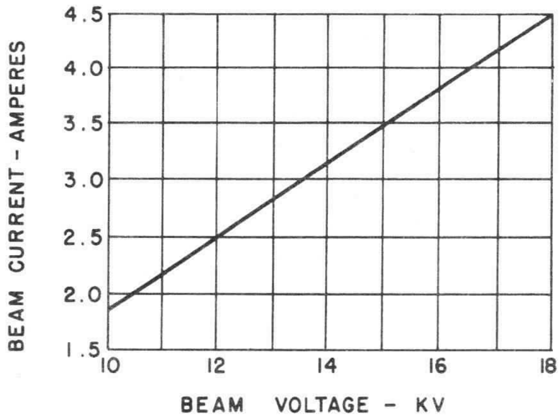
PARTS NOT SHOWN

1. CP-100 (3) COVER PLATES — TO REPLACE LC-313A OR LC-333 IF NOT USED
2. TL-103 (ONE) TUBE LIFT
3. HT-101 (ONE) WRENCH
4. HT-104 (ONE) WRENCH

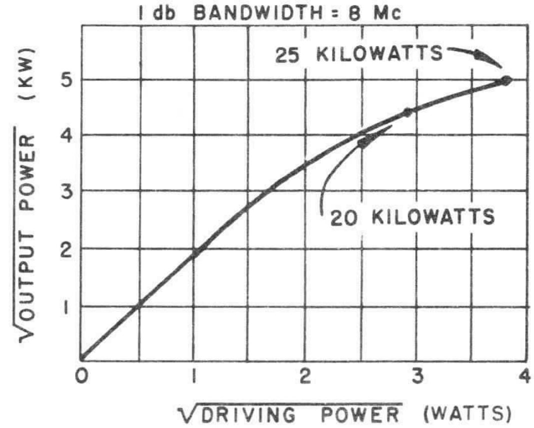




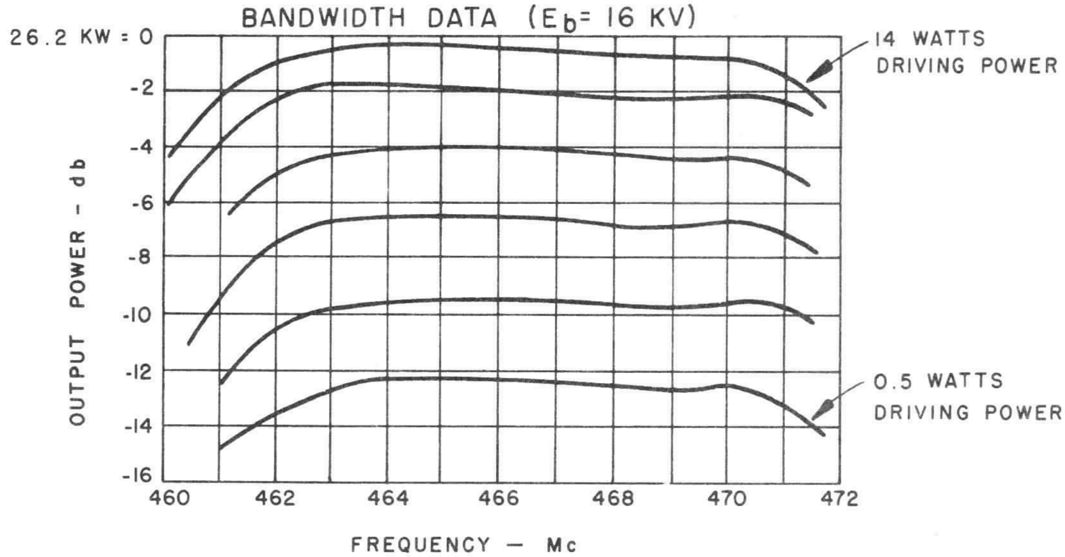
H-133 KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY



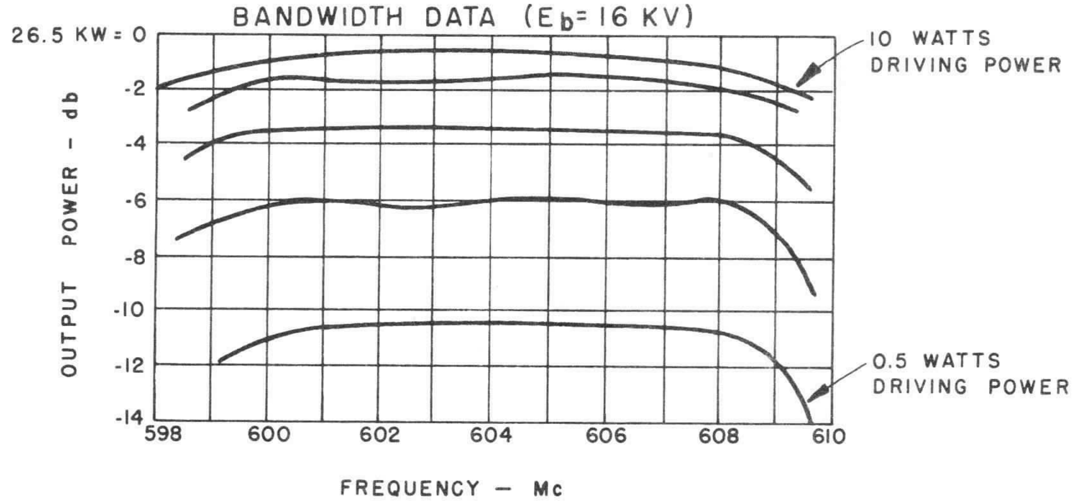
LINEARITY DATA
E_b = 16 KV F = 470 Mc
1 db BANDWIDTH = 8 Mc

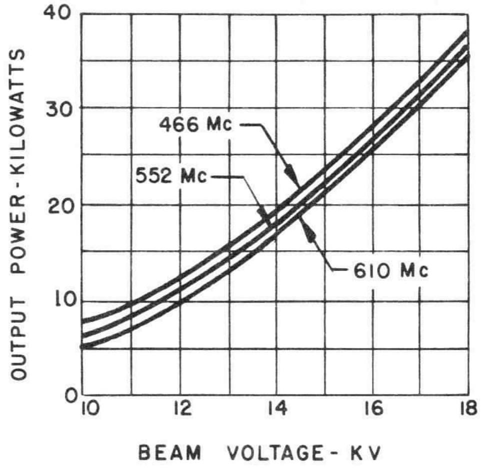


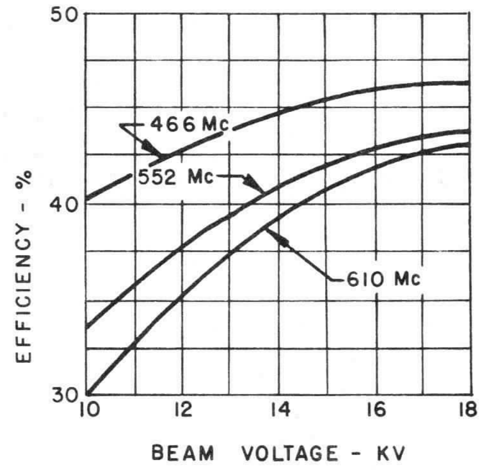
BANDWIDTH DATA (E_b = 16 KV)

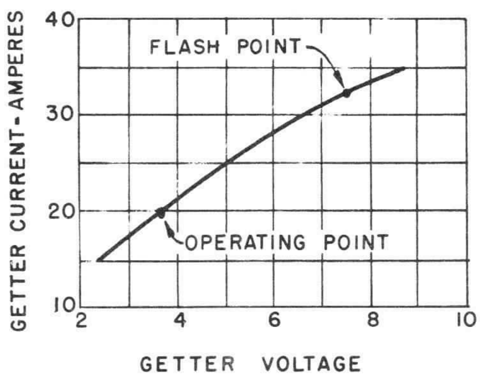


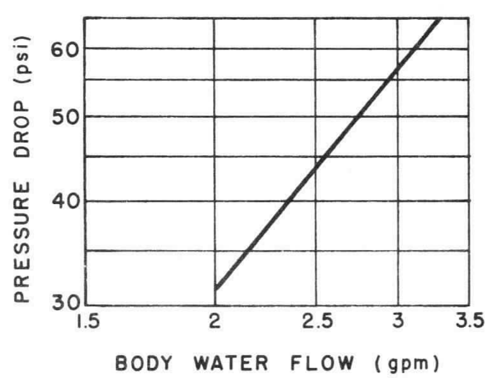
BANDWIDTH DATA (E_b = 16 KV)

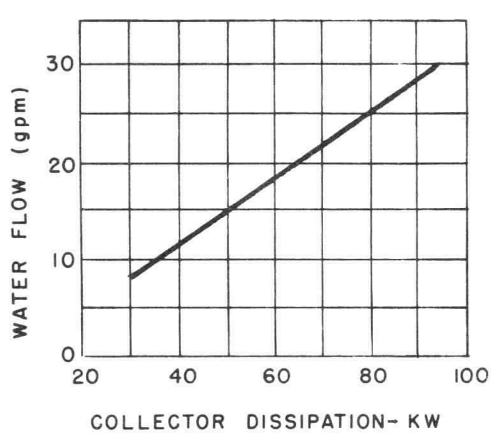


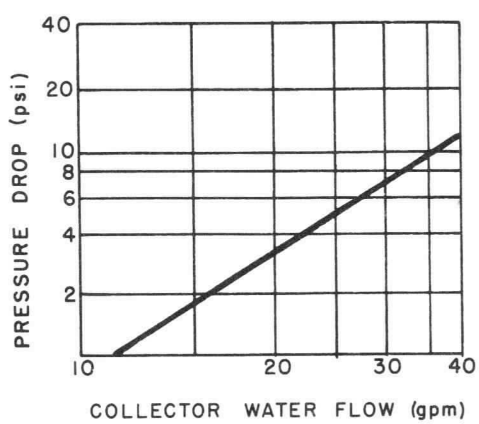

OUTPUT POWER - KILOWATTS
BEAM VOLTAGE - KV
466 Mc
552 Mc
610 Mc


EFFICIENCY - %
BEAM VOLTAGE - KV
466 Mc
552 Mc
610 Mc


GETTER CURRENT - AMPERES
GETTER VOLTAGE
FLASH POINT
OPERATING POINT


PRESSURE DROP (psi)
BODY WATER FLOW (gpm)


WATER FLOW (gpm)
COLLECTOR DISSIPATION - KW


PRESSURE DROP (psi)
COLLECTOR WATER FLOW (gpm)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4KM100LA 25KW

POWER-AMPLIFIER L-BAND KLYSTRON

The Eimac 4KM100LA is a four-cavity, magnetically focused, power-amplifier klystron designed for use at frequencies from 470 to 610 megacycles. Intended primarily for television visual service, it is also suitable for aural TV, or for tropospheric-scatter communications service.

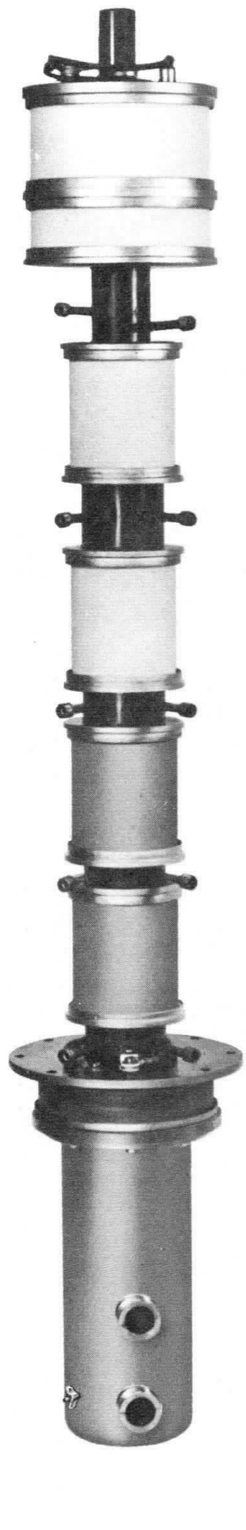
In television visual service the 4KM100LA will provide more than 25 kilowatts of peak synchronizing power, with a power gain of 30 decibels, and 1db bandwidth of 8 megacycles. Random AM noise is more than 60db below black level.

The electron gun of this klystron utilizes a semi-confined flow field which minimizes focusing adjustments and produces a very stable beam. The cathode loading of only 100 milliamperes per square centimeter, at a beam voltage of 18 kilovolts, is ultra conservative in the interest of long life. Effective protection from internal arcs is provided by the Eimac Modulating Anode.

All tuning is accomplished outside of the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. Load couplers are provided to permit external loading of these cavities for extreme wideband operation.

The 4KM100LA incorporates a built-in vacuum pump in the form of a titanium getter. This getter should be energized whenever heater power is applied. Its normal operating voltage is 3.7 volts at approximately 20 amperes.

Eimac Klystron Amplifier Circuit Assembly H-163 has been designed for use with the 4KM100LA to cover the specified frequency range. This assembly includes a klystron supporting structure, focusing electromagnet, tuning cavities, and adjustable load couplers for each cavity.



CHARACTERISTICS

ELECTRICAL

Heater:	DC Voltage	26.0	volts
	DC Current	11.5	amperes
	Maximum Starting Current	23	amperes
Cathode:	EMA, Unipotential		
	Heating Time	5	minutes
Getter (Operating):			
	AC Voltage (±5%)	3.7	volts
	AC Current	20	amperes
Power Gain:			
	Television Visual Service	30	decibels
Output Power:			
	Television Visual Service	25	kilowatts
Frequency Range (H-163 Assembly)		470 to 610	megacycles

MECHANICAL

Maximum Height of Klystron and H-163 Assembly including KC-102 Carriage	67 inches
Operating Position	Axis vertical, cathode up
R-F Coupling:	
Input	Type "N" coaxial fitting
Output	3-1/8 inch, 50-ohm line
Input and 2nd Cavity Loading	Type "N" coaxial fitting
3rd Cavity Loading	1-5/8 inch, 50-ohm line
Weights:	
Klystron Only	119 pounds
H-163 RF Circuit Assembly	1800 pounds

Cooling: Water and Forced Air

	Flow Rate	Pressure Drop
Cathode	*5 cfm	-------
Cavity	50 cfm	TBS
Klystron Body and Electromagnet in Series	2 gpm	45 psi
Klystron Collector	30 gpm	7.5 psi

ELECTROMAGNET POWER-SUPPLY REQUIREMENTS

Voltage	0 to 150	volts
Current	0 to 12	amperes

MAXIMUM RATINGS

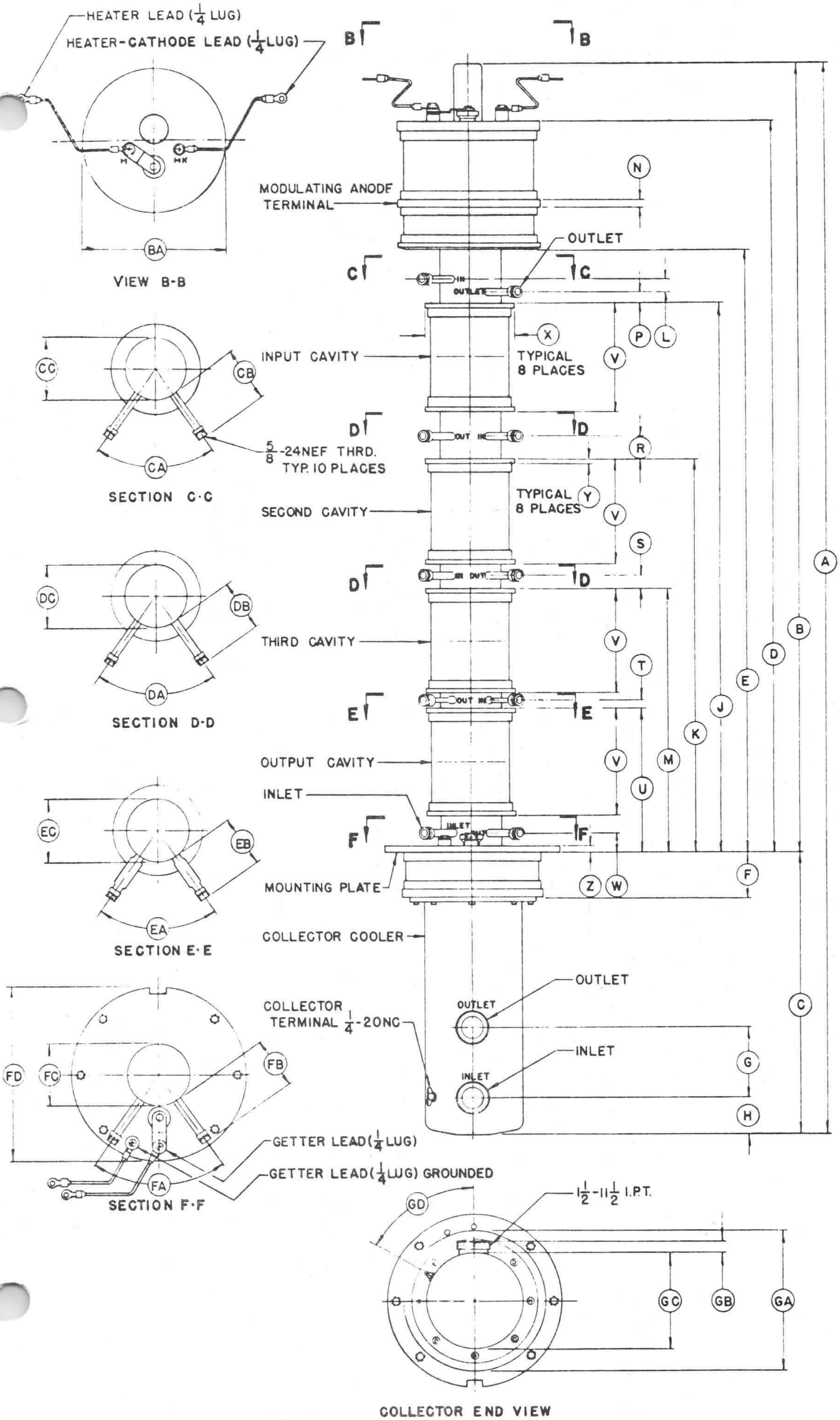
DC BEAM VOLTAGE	20	KILOVOLTS
DC BEAM CURRENT	6.0	AMPERES
DC BODY CURRENT	150	MILLIAMPERES
COLLECTOR DISSIPATION	100	KILOWATTS
INLET WATER PRESSURE	100	PSI

TYPICAL OPERATION

	TV Visual Amplifier	
Frequency	550	megacycles
Output Power	26.4 (peak sync.)	kilowatts
Driving Power	20 " "	watts
Power Gain	31 " "	decibels
DC Beam Voltage	16	kilovolts
DC Beam Current	3.82	amperes
Beam Power Efficiency	43 (peak sync.)	percent
1 db Bandwidth	8	megacycles
Electromagnet Current	8.9	amperes

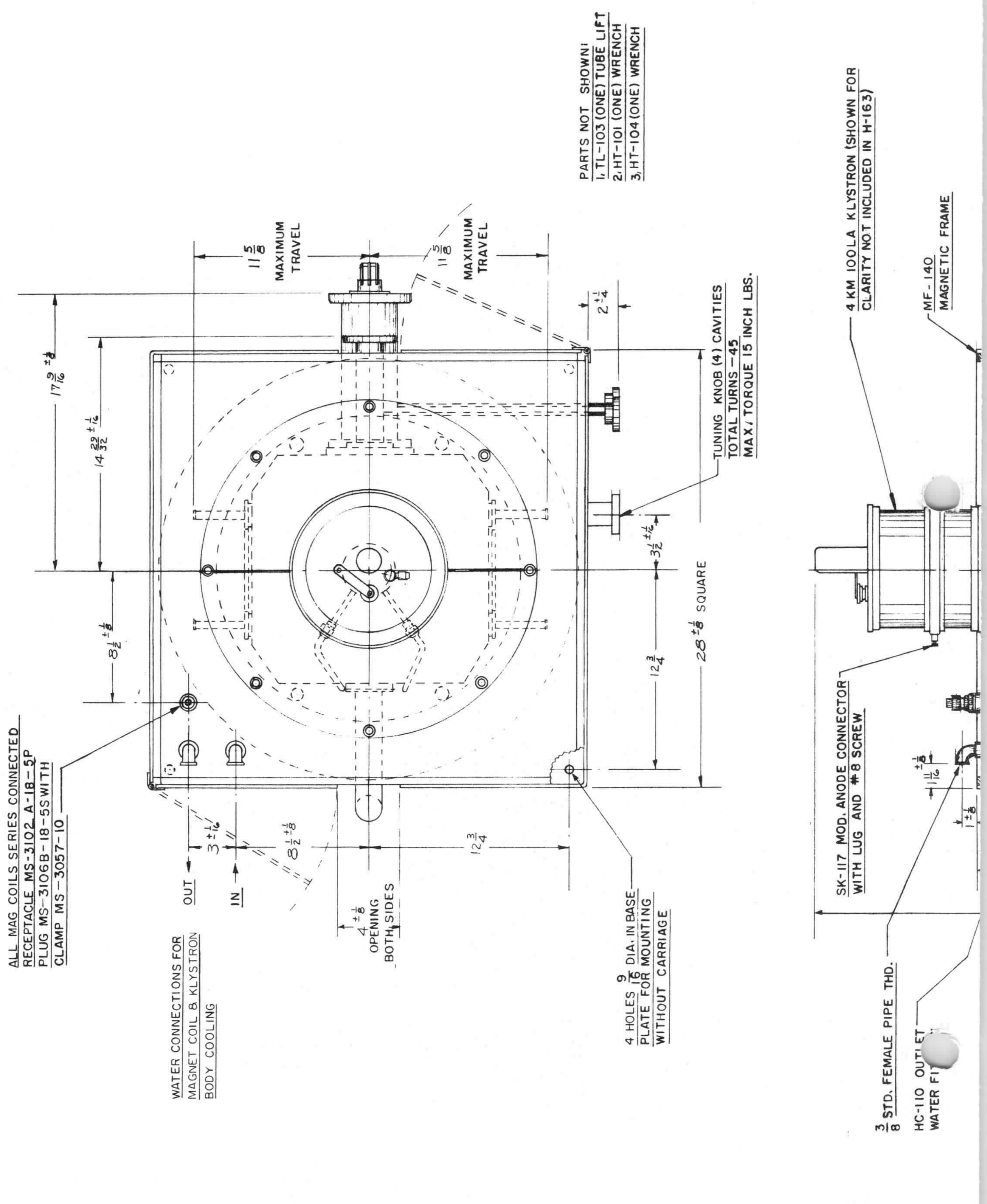
* Required only if ambient air temperature exceeds 25° C.

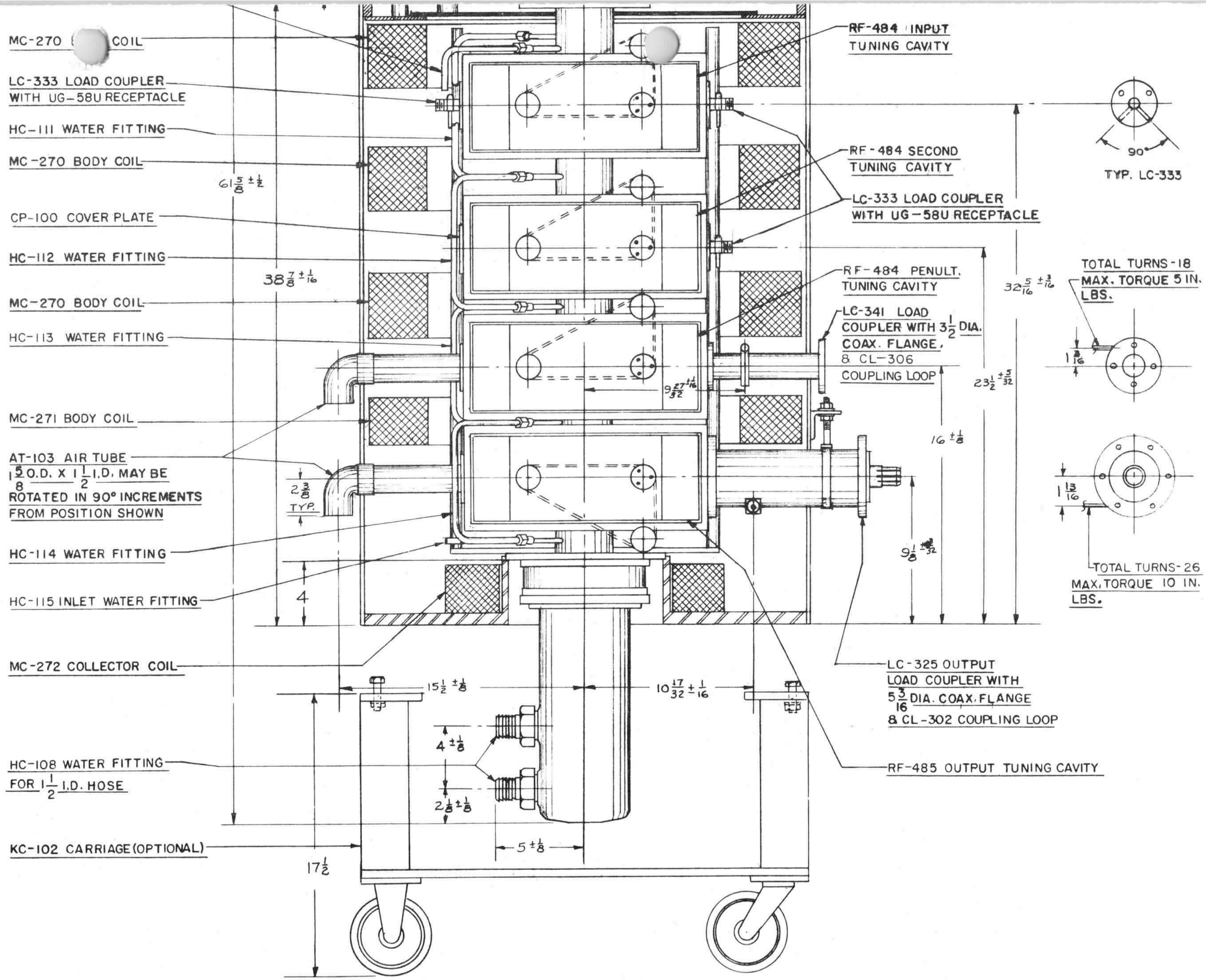
For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.



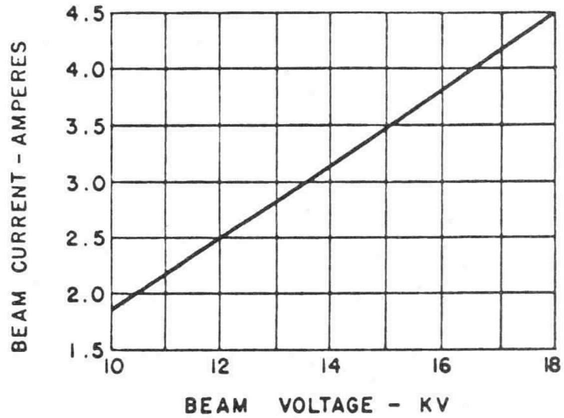
DIMENSION DATA			
REF.	NOMINAL	MINIMUM	MAXIMUM
A	61.625		
B	45.150		
C	16.475		
D	41.900		
E	34.467		
F	2.600		
G	4.000		
H	2.125		
J	31.341		
K	22.499		
L	.625		
M	14.999		
N	.375		
P	.636		
R	1.433		
S	.875		
T	.453		
U	8.124		
V	6.000		
W	1.124		
X	5.125		
Y	.250		
Z	.375		
BA	8.125 DIA		
CA	70°		
CB	3.000		
CC	3.500 DIA		
DA	70°		
DB	3.000		
DC	3.500 DIA		
EA	70°		
EB	3.000		
EC	3.500 DIA		
FA	70°		
FB	3.000		
FC	3.500 DIA		
FD	10.000 DIA		
GA	8.125 DIA		
GB	.843		
GC	5.500 DIA		
GD	60°		

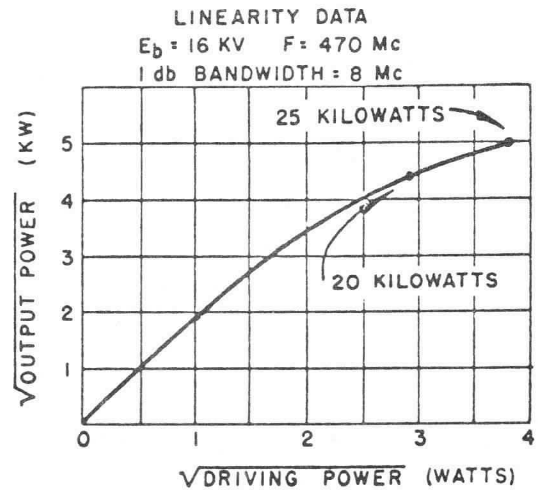
4KM100LA KLYSTRON

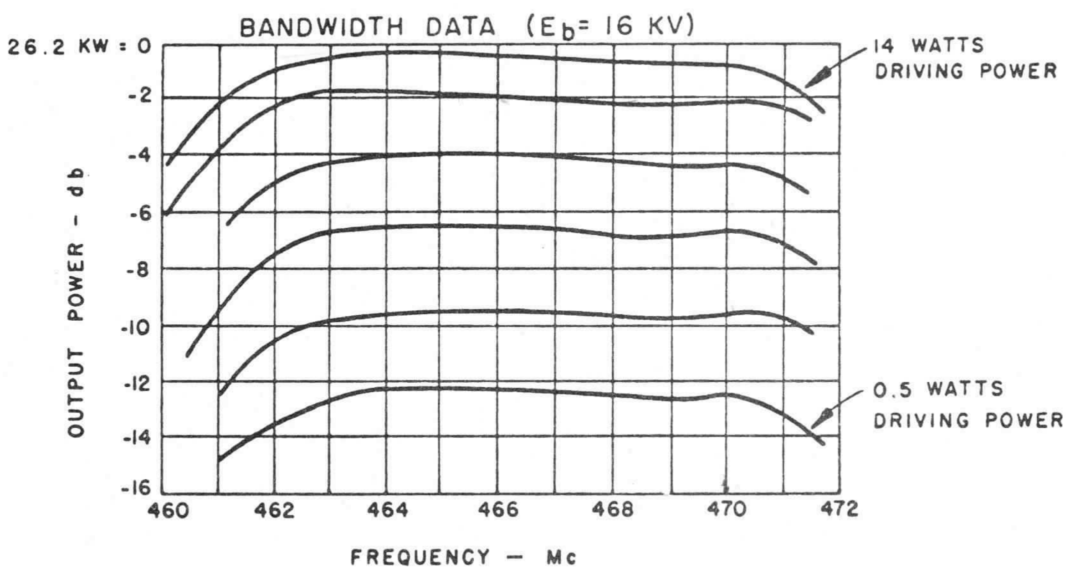

ALL MAG COILS SERIES CONNECTED
RECEPTACLE MS-3102 A-18-5P
PLUG MS-3106B-18-5S WITH
CLAMP MS-3057-10
WATER CONNECTIONS FOR
MAGNET COIL & KLYSTRON
BODY COOLING
OUT
IN
OPENING
BOTH SIDES
4 HOLES 9/16 DIA. IN BASE
PLATE FOR MOUNTING
WITHOUT CARRIAGE
SQUARE
MAXIMUM
TRAVEL
MAXIMUM
TRAVEL
TUNING KNOB (4) CAVITIES
TOTAL TURNS -45
MAX. TORQUE 15 INCH LBS.
PARTS NOT SHOWN:
1. TL-103 (ONE) TUBE LIFT
2. HT-101 (ONE) WRENCH
3. HT-104 (ONE) WRENCH
4 KM 100LA KLYSTRON (SHOWN FOR
CLARITY NOT INCLUDED IN H-163)
MF-140
MAGNETIC FRAME
SK-117 MOD. ANODE CONNECTOR
WITH LUG AND #8 SCREW
3/8 STD. FEMALE PIPE THD.
HC-110 OUTLET
WATER FI

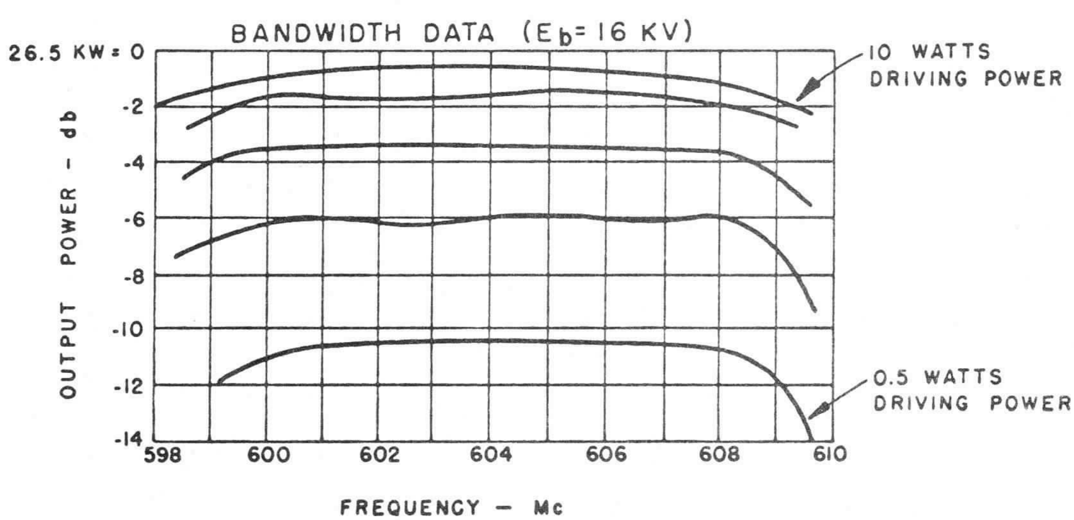


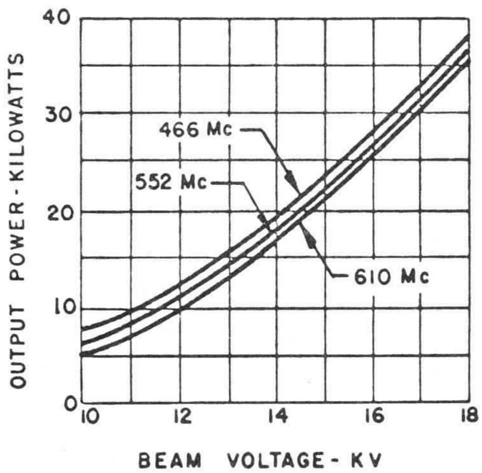
H-163 KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY

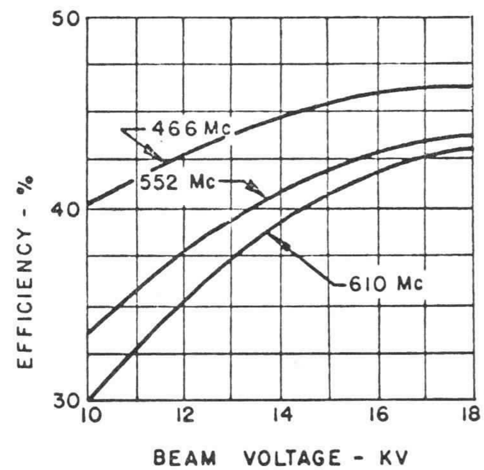

BEAM CURRENT - AMPERES
4.5
4.0
3.5
3.0
2.5
2.0
1.5
10
12
14
16
18
BEAM VOLTAGE - KV

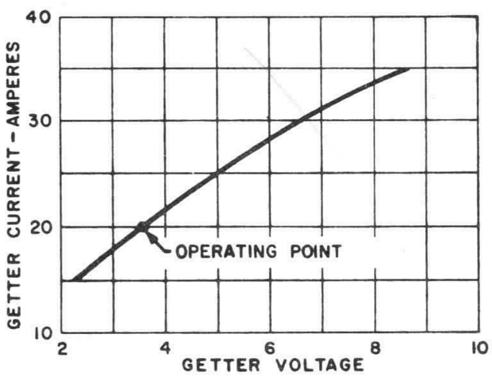

LINEARITY DATA
Eb = 16 KV F = 470 Mc
1 db BANDWIDTH = 8 Mc
25 KILOWATTS
20 KILOWATTS
√OUTPUT POWER (KW)
1
2
3
4
5
0
1
2
3
4
√DRIVING POWER (WATTS)

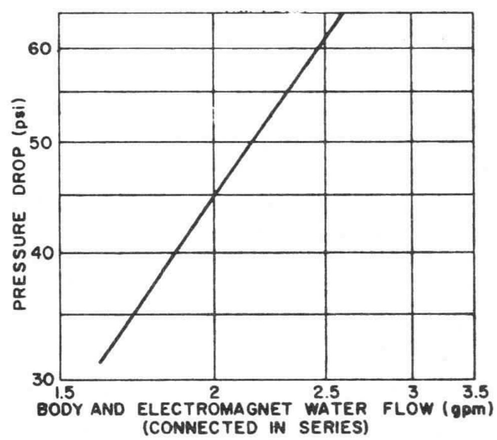

BANDWIDTH DATA (Eb = 16 KV)
26.2 KW = 0
-2
-4
-6
-8
-10
-12
-14
-16
OUTPUT POWER - db
14 WATTS DRIVING POWER
0.5 WATTS DRIVING POWER
460
462
464
466
468
470
472
FREQUENCY — Mc

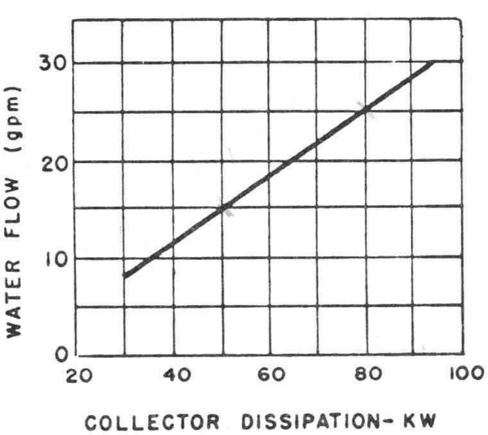

BANDWIDTH DATA (Eb = 16 KV)
26.5 KW = 0
-2
-4
-6
-8
-10
-12
-14
OUTPUT POWER - db
10 WATTS DRIVING POWER
0.5 WATTS DRIVING POWER
598
600
602
604
606
608
610
FREQUENCY — Mc

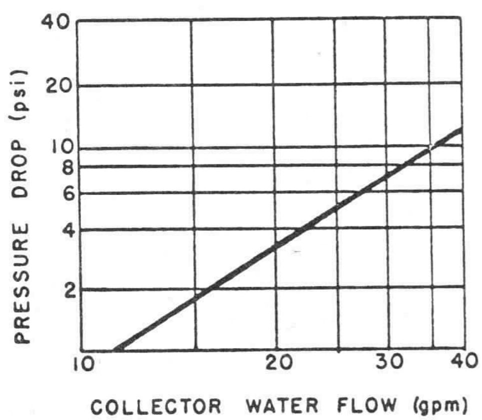

OUTPUT POWER - KILOWATTS
0
10
20
30
40
10
12
14
16
18
466 Mc
552 Mc
610 Mc
BEAM VOLTAGE - KV


EFFICIENCY - %
30
40
50
10
12
14
16
18
466 Mc
552 Mc
610 Mc
BEAM VOLTAGE - KV


GETTER CURRENT - AMPERES
10
20
30
40
2
4
6
8
10
OPERATING POINT
GETTER VOLTAGE


PRESSURE DROP (psi)
30
40
50
60
1.5
2
2.5
3
3.5
BODY AND ELECTROMAGNET WATER FLOW (gpm)
(CONNECTED IN SERIES)


WATER FLOW (gpm)
0
10
20
30
20
40
60
80
100
COLLECTOR DISSIPATION - KW

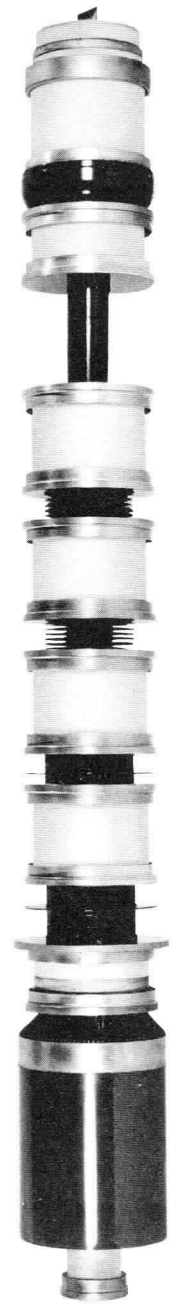

PRESSURE DROP (psi)
2
4
6
8
10
20
40
10
20
30
40
COLLECTOR WATER FLOW (gpm)

TENTATIVE DATA

4KM3000LQ

POWER-AMPLIFIER L-BAND KLYSTRON

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA



The Eimac 4KM3000LQ is a four-cavity, magnetically focused, power-amplifier klystron of ceramic and metal. It is designed for use at frequencies between 710 and 985 megacycles and will deliver a minimum CW output power of two kilowatts with a minimum power gain of 25 decibels when operated at 50% collector depression.

The collector is designed to operate at less than the cathode to anode voltage, thereby realizing an improvement in efficiency.

This klystron employs the Eimac Modulating Anode which provides an effective means of amplitude or pulse modulating the output power without changing the beam voltage. It is also useful as a protective device, either in conjunction with external circuits, or when grounded through a resistor.

The resonant cavities for the 4KM3000LQ are completed by tuning boxes which enclose the cylindrical ceramic windows of the klystron and all tuning is accomplished outside the vacuum envelope. This design permits a wide tuning range and allows external cavity loading for broad-band applications. It also permits an unlimited number of tuning cycles without risk of damage to the vacuum seals.

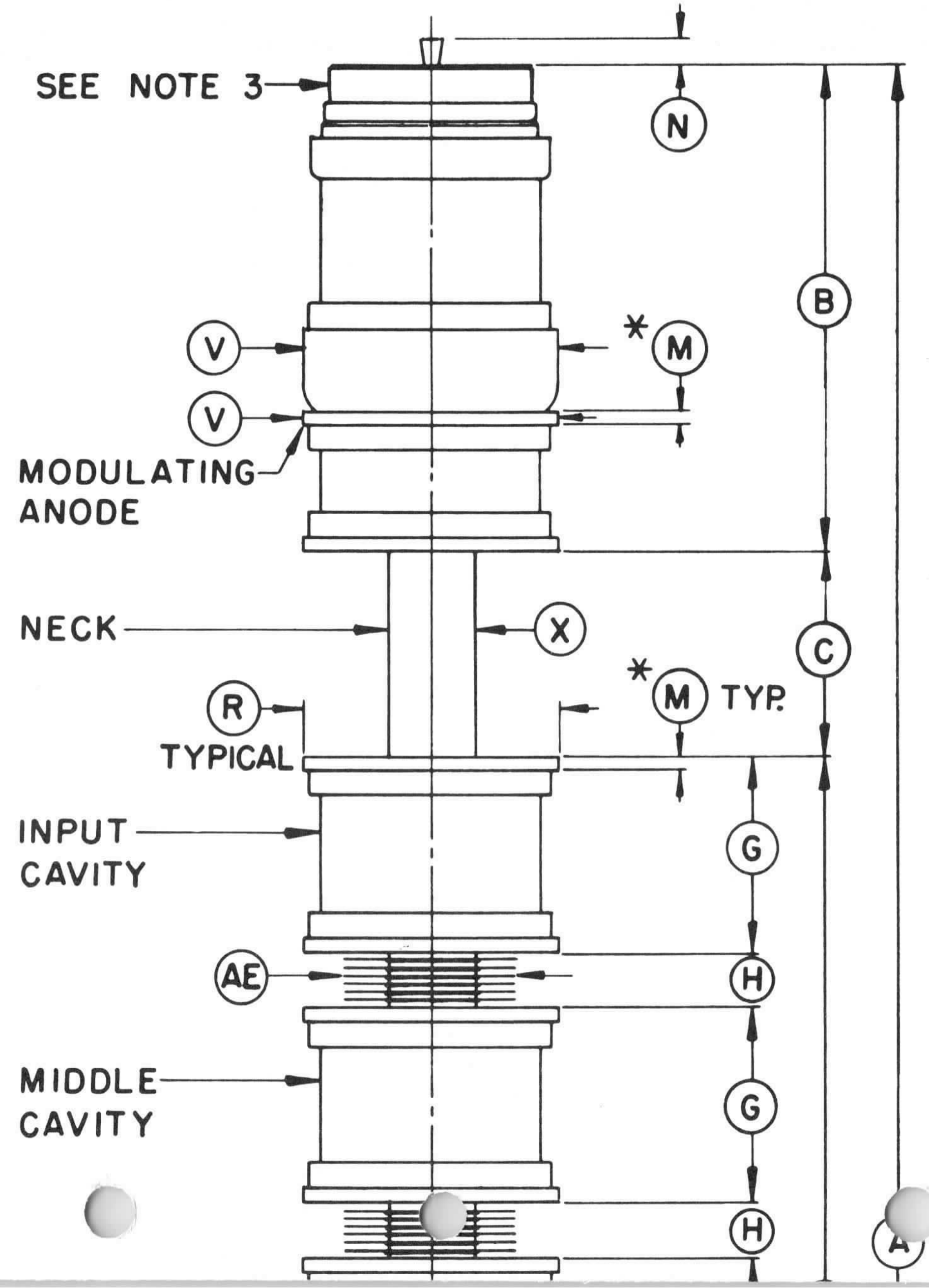
Eimac Klystron Amplifier Circuit Assembly H-118, for use with the 4KM3000LQ, covers the frequency range of 710 to 985 megacycles. This assembly includes a klystron supporting structure, electromagnetic focusing coils, tuning boxes, output r-f load coupler and an Eimac SK-100 Air-System Socket.

CHARACTERISTICS

ELECTRICAL

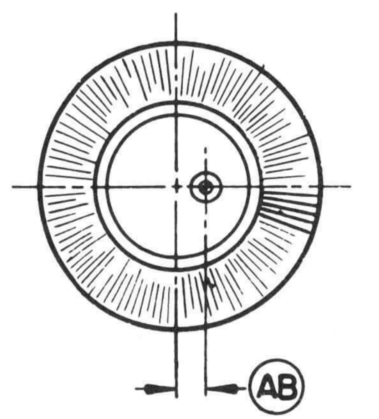
Cathode, Unipotential, Oxide Coated		
Minimum Heating Time	5	minutes
Heater: Voltage	5	volts
Current	33	amperes
Maximum Starting Current	65	amperes
Modulating Anode Capacitance (To other electrodes)	21	uuf
Power Gain (Narrow Band CW)	25	decibels
Output Power (Narrow Band CW)	2000	watts
Frequency Range (In H-118 Circuit Assembly)	710 to 985	megacycles

DIMENSIONS			
REF.	NOM.	MIN.	MAX.
A	44.187		
B	8.781		
C	3.750		
D	19.250		
E	2.125		
F	10.265		
G	3.500		
H	1.000		
J	.250		
K	2.578		
M		.187	
N		.650	1.000
R	4.625 DIA.		
S	5.135 DIA.		
U	5.375 DIA.		
V	4.625 DIA.		
W	6.937		
X	1.500 DIA.		
Z	4.625 DIA.		
AB	.500		
AE	3.078 DIA.		
AK	2.500 DIA.		

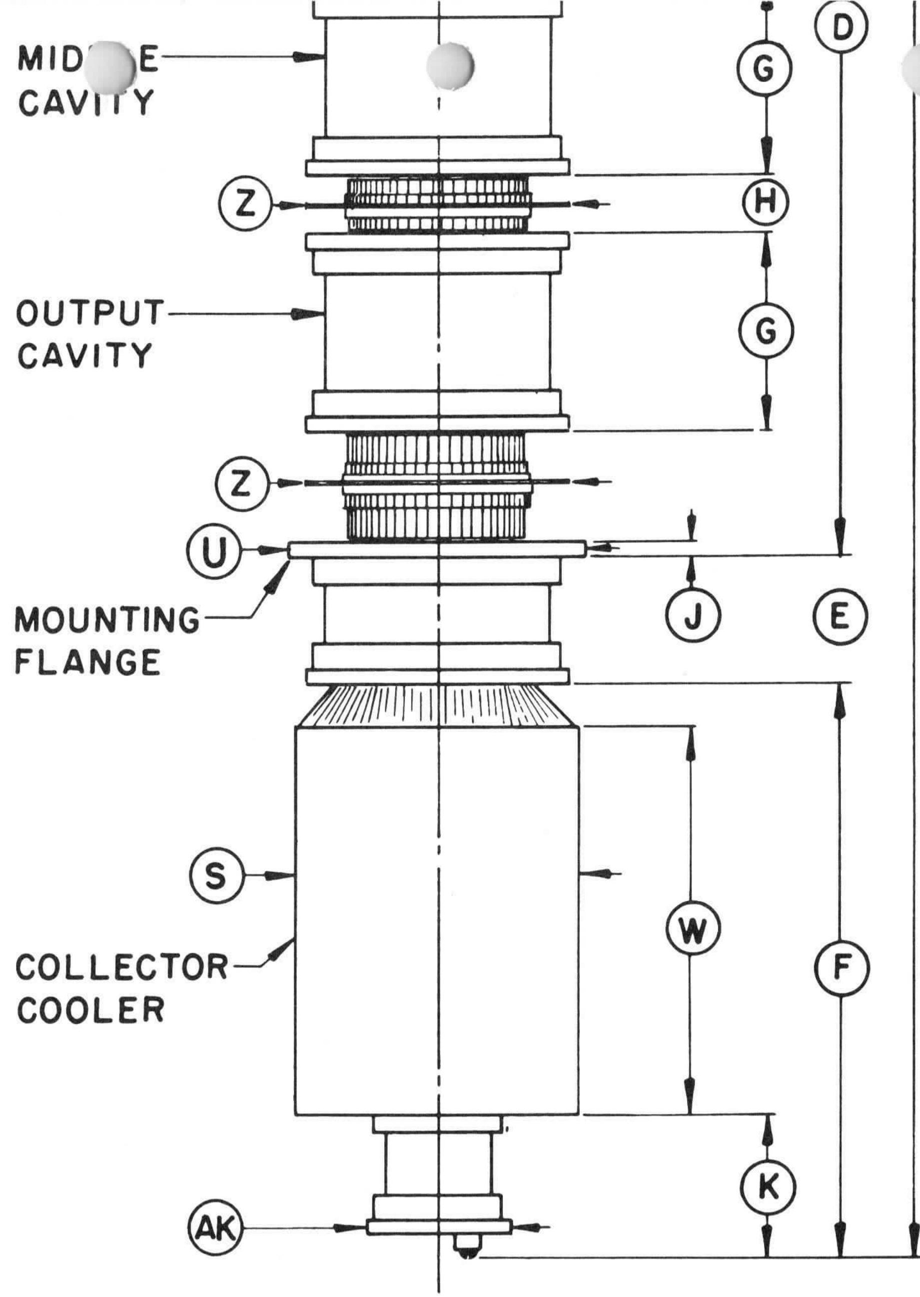


NOTES

1. *MINUMUM CONTACT SURFACE.
2. DIMENSIONS IN INCHES.
3. FOR ELECTRICAL CONTACT SURFACE DIMENSIONS SEE GUN NO. 1 OUTLINE, DRWG. NO. GUN NO. 1 – 6001.



COLLECTOR COOLER
END VIEW



4KM3000LQ OUTLINE DRAWING

MECHANICAL

Operating Position	Axis vertical, cathode up
R-F Coupling	
Input	Type "N" coaxial fitting
Output	1-5/8 inch 50-ohm line
Shipping Weights:	
Klystron Only	49 lbs (Net); 138 lbs (Gross)
H-118 R-F Amplifier Circuit Assembly	327 lbs (Net); 473 lbs (Gross)

Cooling:

The 4KM3000LQ is cooled by forced air. At sea level and with inlet air temperature of 20°C (68°F) the flow rates tabulated below are sufficient for operation at maximum ratings and at maximum collector depression of 50%.

Cathode (with SK-100 Air-System Socket)	5 cfm
Penultimate Cavity	50 cfm
Output Cavity	75 cfm
Collector	150 cfm

Operation at higher altitudes or with higher inlet temperatures requires increased volumes of air flow to obtain equivalent cooling.

MAGNETIC-COIL POWER SUPPLY-REQUIREMENTS

Prefocus Coil Voltage	0 to 50	volts
Prefocus Coil Current	2.0	amperes
Each of Three Body Coils		
Voltage	0 to 100	volts
Current	3.0	amperes
Collector Coil Voltage	0 to 50	volts
Collector Coil Current	0 to 1.5	amperes

MAXIMUM RATINGS

D-C BEAM VOLTAGE	10,000	VOLTS
D-C BEAM CURRENT	0.750	AMPERE
D-C FOCUS ELECTRODE VOLTAGE	-500	VOLTS
COLLECTOR DISSIPATION	3000	WATTS
SEAL TEMPERATURES	175	DEGREES C

TYPICAL OPERATION - NARROW BAND CW AMPLIFIER - COLLECTOR DEPRESSED

Frequency	900	megacycles
Output Power	2150	watts
Driving Power	4.0	watts
Power Gain	27	decibels
D-C Beam Voltage	9000	volts
D-C Beam Current	0.580	amperes
D-C Collector Voltage (from Cathode)	4500	volts
D-C Collector Current	0.210	amperes
D-C Body Current	0.370	amperes
Focus Electrode Voltage	-200	volts
Efficiency	50.0	percent

For additional information or information regarding any specific application, write to Eitel-McCullough, Inc., San Carlos, California. All such requests will be handled confidentially.

Printed in U.S.A. 890

Eimac®

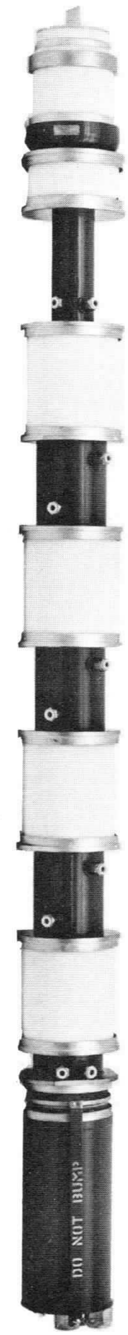
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4KM50,000LA

POWER-AMPLIFIER

L-BAND KLYSTRON



The Eimac 4KM50,000LA is a four-cavity, magnetically focused, power-amplifier klystron of ceramic and metal. It is designed for use at frequencies between 400 and 610 megacycles and will deliver a minimum CW output power of 10 kilowatts with a minimum power gain of 50 decibels.

This klystron employs the Eimac Modulating Anode which provides an effective means of amplitude or pulse modulating the output power without changing the beam voltage. It is also useful as a protective device, either in conjunction with external circuits or when grounded through a resistor.

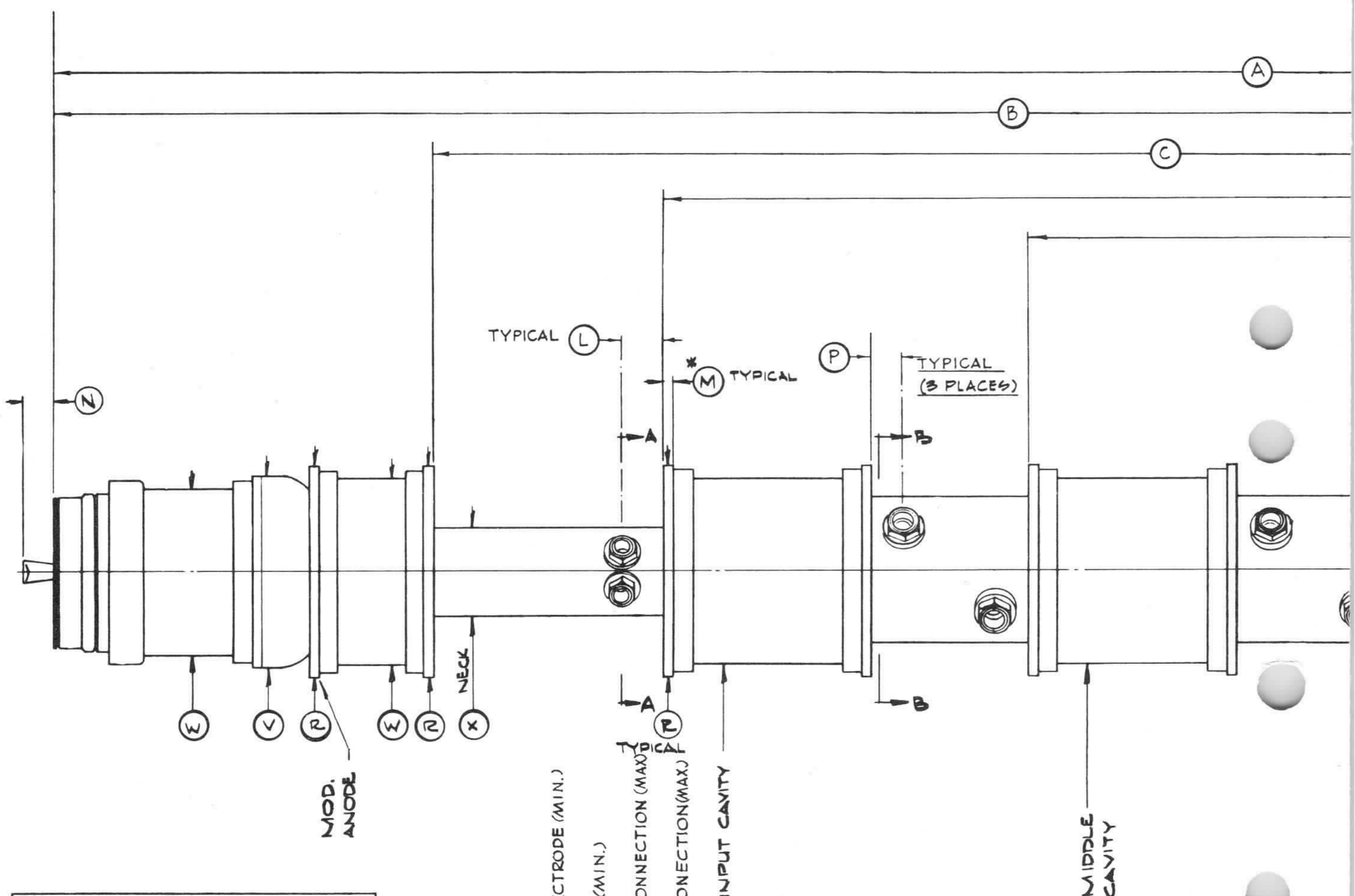
The resonant cavities for the 4KM50,000LA are completed by tuning boxes which enclose the cylindrical ceramic windows of the klystron and all tuning is accomplished outside the vacuum envelope. This design permits a wide tuning range and allows external cavity loading for broad-band applications. It also permits an unlimited number of tuning cycles without risk of damage to the vacuum seals.

Eimac Klystron Amplifier Circuit Assembly H-121, for use with the 4KM50,000LA, covers the frequency range of 400 to 610 megacycles. This assembly includes a klystron supporting structure, electro-magnetic focusing coils, tuning boxes, adjustable load couplers for the second, third and output cavities, and an Eimac SK-110 Air-System Socket.

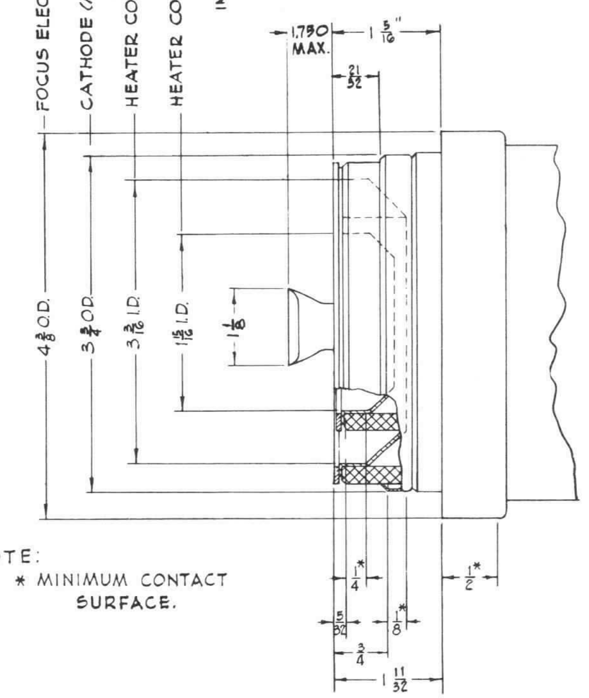
CHARACTERISTICS

ELECTRICAL

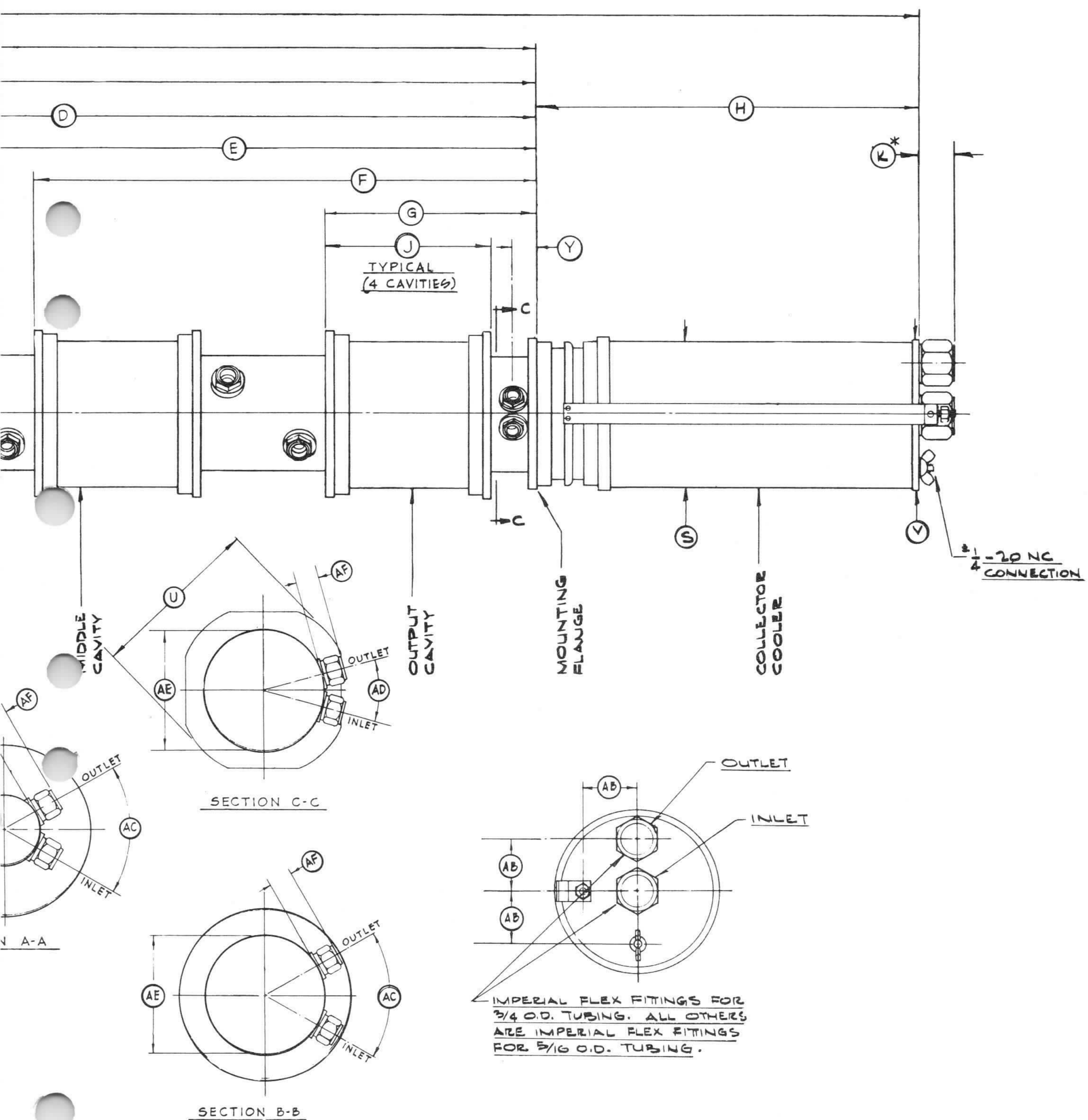
Heater:	Voltage - - -	7.5	volts
	Current - - -	40.0	amperes
	Maximum Starting Current	80.0	amperes
Cathode:	EMA, Unipotential		
	Heating Time - -	5	minutes
Getter (Operating):			
	Voltage - - -	2.0	volts
	Current - - -	36.0	amperes
Power Gain:	(Narrow Band) - -	50	decibels
Output Power	- - - -	10	kilowatts
Frequency Range	(H-121 Assembly)	400 to 610	megacycles



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		63.901	64.409
B		52.447	52.863
C		43.251	43.597
D		37.798	38.104
E		27.679	27.917
F		17.561	17.731
G		7.444	7.544
H		11.429	11.569
J		5.987	6.045
K		1.000	1.150
L		.977	.997
M		.245	.255
N			1.750
P		.832	.862
R		5.120	5.130
S		4.495	4.505
U		5.120	5.130
V		4.610	4.640
W		3.998	4.002
X		2.115	2.125
Y		.395	.469
AB		1.610	1.640
AC		50°	70°
AD		20°	40°
AE		3.495	3.505
AF		.839	.879



NOTE:
* MINIMUM CONTACT SURFACE.



4KM50,000LA OUTLINE DRAWING

MECHANICAL

Operating Position			Axis vertical, cathode up
R-F Coupling:			
Input			Type "N" coaxial fitting
Output			3 1/8 inch 50 ohm line
Input Cavity Loading			Type "N" coaxial fitting
2nd and 3rd Cavity Loading			1 5/8 inch 50 ohm line
Shipping Weights:			
4KM50,000LA Klystron Only			64 lbs (Net)
			155 lbs (Gross)
H-121 R-F Circuit Assembly			767 lbs (Net)
			1084 lbs (Gross)
Cooling: Water and Forced Air			
		Flow Rate	Pressure Drop
Cathode (with SK-110 Air-System Socket)		*25 cfm	1 inch H_2O
Output Cavity		*50 cfm	1.5 inches H_2O
Klystron Body (5 drift-tube sections, in series)		1 gpm	28 psia
Klystron Collector		25 gpm	28 psia

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Prefocus-Coil:	Voltage	0 to 50	volts
	Current	0 to 1.5	amperes
Three Body Coils and Collector Coil in Series:			
	Voltage	0 to 500	volts
	Current	0 to 2.5	amperes

MAXIMUM RATINGS

D-C BEAM VOLTAGE	20	KILOVOLTS
D-C Beam Current	2.5	AMPERES
D-C BODY CURRENT (CONTINUOUS)	100	MILLIAMPERES
D-C BODY CURRENT (TUNING ONLY)	150	MILLIAMPERES
A-C GETTER CURRENT	50	AMPERES
FOCUS ELECTRODE VOLTAGE	-500	VOLTS
COLLECTOR DISSIPATION	50	KILOWATTS

TYPICAL OPERATION, NARROW BAND, CW AMPLIFIER

Frequency	400	610	megacycles
Output Power	13.1	12.0	kilowatts
Driving Power	.050	.050	watts
Power Gain	54	53.8	decibels
D-C Beam Voltage	17	17	kilovolts
D-C Beam Current	1.8	1.8	amperes
Beam Power Efficiency	42.8	39.2	percent
D-C Body Current	90	80	milliamperes
D-C Collector Current	1.71	1.72	amperes
Focus-Electrode Voltage	-201	-211	volts
Magnetic-Coil Currents (H-121 Components):			
Prefocus Coil	1.0	0.97	ampere
Three Body Coils and Collector Coil in Series	2.0	2.0	amperes

* At Sea level with 20^{o} C inlet air temperature.

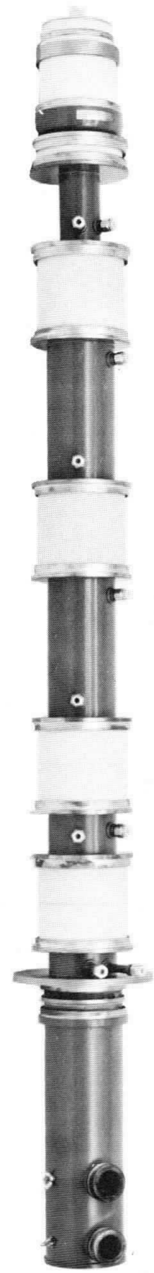
For additional information or information regarding any specific application, write to Eitel-McCullough, Inc., San Carlos, California. All such requests will be handled confidentially.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4KM50,000LF

POWER-AMPLIFIER L-BAND KLYSTRON



The Eimac 4KM50,000LF is a four-cavity, magnetically focused, power-amplifier klystron designed for use at frequencies from 610 to 790 megacycles. Although intended primarily for UHF television visual service this klystron may also be used for FM, for aural TV, or for tropospheric-scatter communications service.

When tuned for narrow band CW operation this klystron will deliver a minimum output power of 10 kilowatts with a power gain of 45 db. In television visual service it will provide more than 10 kilowatts of peak synchronizing output power with a power gain of 30 db. The AM random noise is more than 50 db below black level. Minimum bandwidth at the 3 db power level is 8 megacycles with a minimum of 7 megacycles at the 1 db level.

The 4KM50,000LF employs the Eimac Modulating Anode which provides an effective means of protecting the tube from internal arcs.

All tuning is accomplished outside of the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. This design permits a wide tuning range and allows external cavity loading for broadband applications. For spares or replacements, only the basic vacuum tube, without cavities, need be purchased.

Eimac Klystron Amplifier Circuit Assembly H-139 has been designed for use with the 4KM50,000LF to cover the specified frequency range. This assembly includes a klystron supporting structure, magnetic focusing coils, tuning cavities, adjustable load couplers for the second, third and output cavities and an Eimac SK-110 Air System Socket.

CHARACTERISTICS

ELECTRICAL

Heater:	Voltage	- - - -	7.5	volts
	Current	- - - -	40.0	amperes
	Maximum Starting Current	- -	80.0	amperes
Cathode:	EMA, Unipotential			
	Heating Time	- - - -	5	minutes
Getter (Operating):				
	Voltage	- - - -	2.0	volts
	Current	- - - -	36.0	amperes
Power Gain:	Narrow Band	- - -	45	decibels
	Television Visual Service	-	30	decibels
Output Power:	Television Visual Service	-	10	kilowatts
Frequency Range (H-139 Assembly)			610 to 790	megacycles

MECHANICAL

Operating Position	- - - - -	Axis vertical, cathode up
R-F Coupling:		
Input	- - - - -	Type "N" coaxial fitting
Output	- - - - -	3 1/8 inch, 50-ohm line
Input Cavity Loading	- - - - -	Type "N" coaxial fitting
2nd and 3rd Cavity Loading	- - - - -	1 5/8 inch, 50-ohm line

MECHANICAL (cont'd)

Shipping Weights:

4KM50,000LF Klystron only	64	pounds
H-139 RF Circuit Assembly	767	pounds

Cooling: Water and Forced Air

	Flow Rate	Pressure Drop
Cathode (with SK-110 Air System Socket)	*25 cfm	1 inch H_2O
Output Cavity	*50 cfm	1.5 inches H_2O
Klystron Body (5 drift-tube sections, in series)	1 gpm	28 psi
Klystron Collector	(See collector cooling curves)	

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Prefocus Coil: Voltage	0 to 50	volts
Current	0 to 1.5	amperes
Three Body Coils and Collector Coil in Series:		
Voltage	0 to 500	volts
Current	0 to 2.5	amperes

MAXIMUM RATINGS

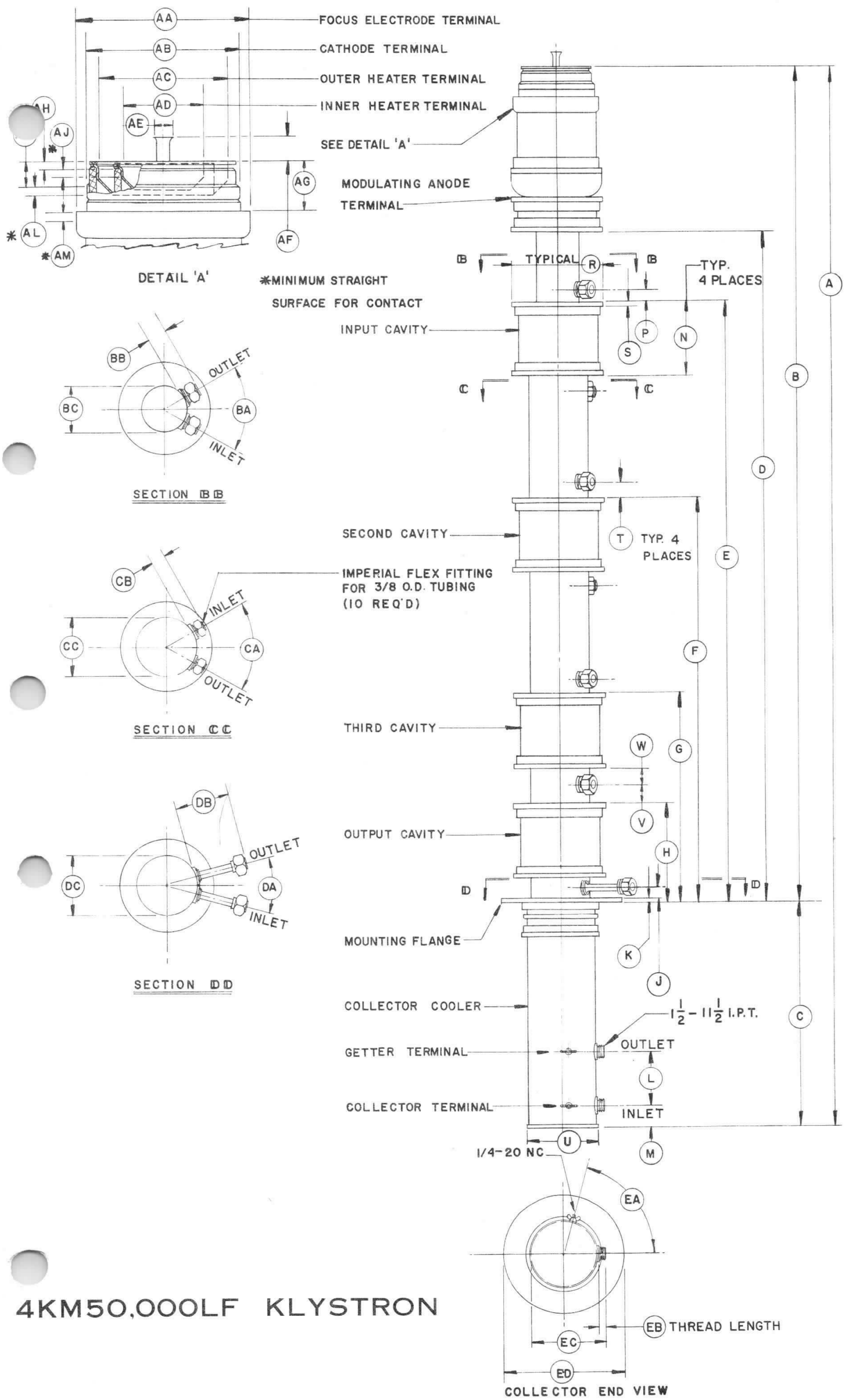
D-C BEAM VOLTAGE	20	KILOVOLTS
D-C BEAM CURRENT	2.5	AMPERES
D-C BODY CURRENT	150	MILLIAMPERES
A-C GETTER CURRENT	50	AMPERES
FOCUS-ELECTRODE VOLTAGE	-500	VOLTS
COLLECTOR DISSIPATION	60	KILOWATTS
INLET WATER PRESSURE	50	PSI

TYPICAL OPERATION

	TV Visual Service	Narrow Band	
Frequency	610	735	megacycles
Output Power	12.6	15.6	kilowatts
Driving Power	10	0.30	watts
Power Gain	30.3	47.2	decibels
D-C Beam Voltage	18	18	kilovolts
D-C Beam Current	2.03	2.03	amperes
Beam Power Efficiency	34.5	43	percent
D-C Body Current	75	45	milliamperes
Focus-Electrode Voltage	-200	-200	volts
Cavity Loading:			
1st Cavity	0.47	--	watts
2nd Cavity	116	--	watts
3rd Cavity	390	--	watts
Magnetic-Coil Currents:			
Prefocus Coil	1.15	1.15	amperes
Three Body Coils and Collector Coil in Series	2.3	2.3	amperes

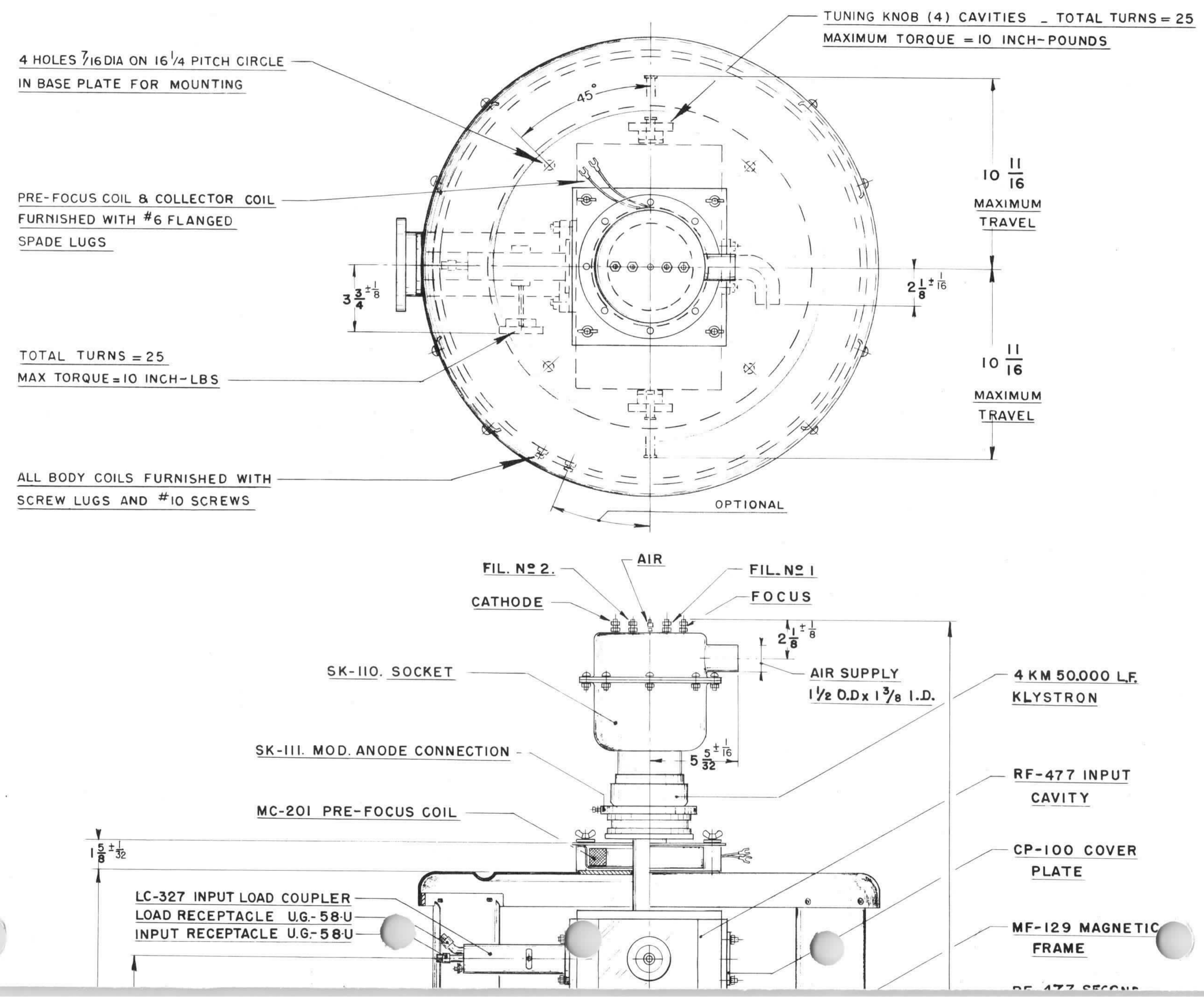
* At sea level with 20° C inlet air temperature.

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., San Carlos, California.

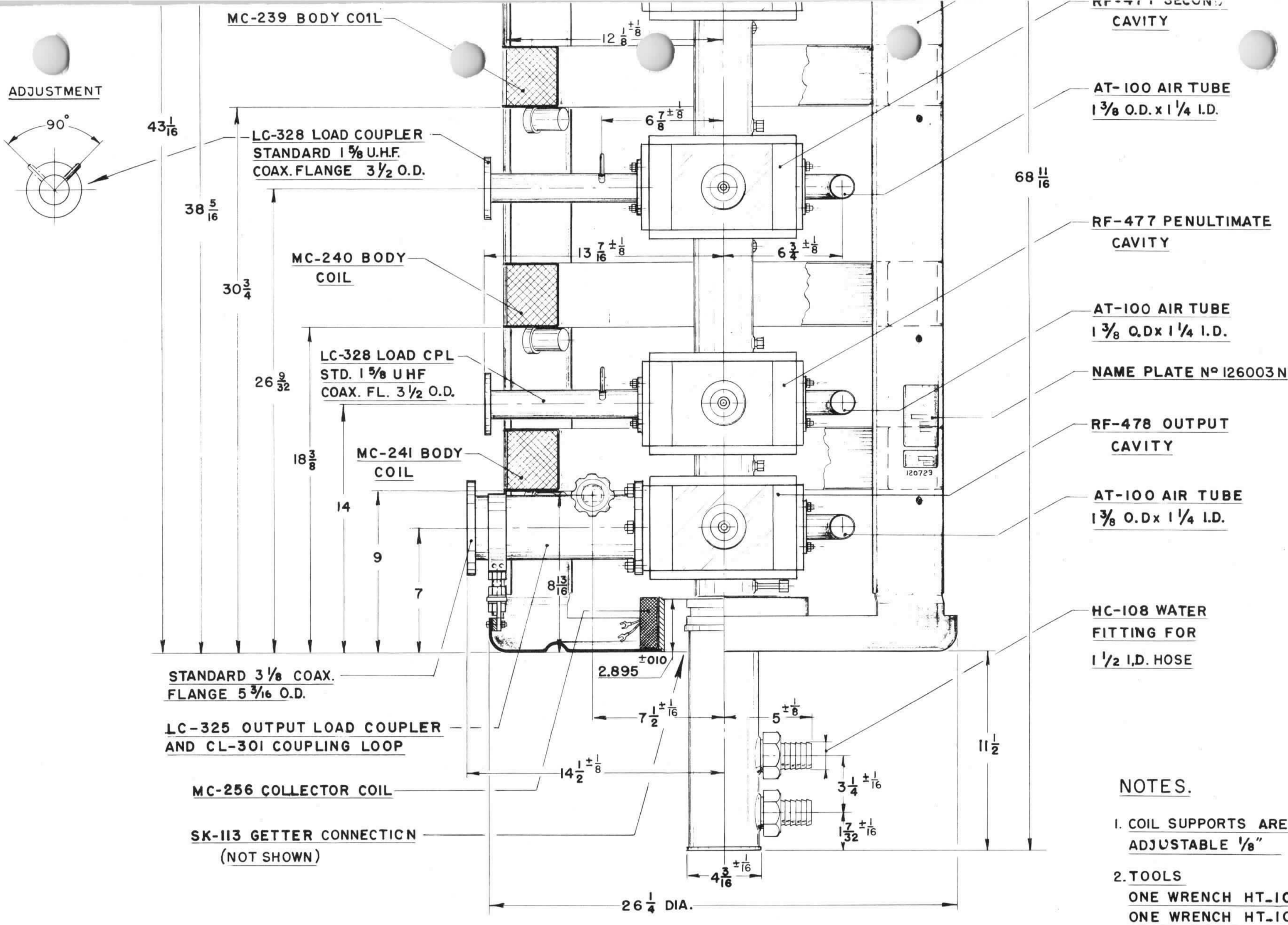


4KM50,000LF KLYSTRON

ITEM	NOM.	MIN.	MAX.
		DIMENSION DATA	
A		63.700	65.200
B		49.600	50.300
C		14.250	14.750
D		41.600	42.100
E		37.800	38.325
F		25.600	26.000
G		13.400	13.700
H		6.490	6.650
J		0.400	0.500
K		0.335	0.365
L		3.200	3.300
M		1.100	1.300
N		4.950	5.040
P		0.840	1.100
R		5.105	5.145
S		0.230	0.270
T		0.840	
U		4.165	4.215
V		0.840	
W		0.840	
AA		4.300 DIA.	4.450 DIA.
AB		3.750 "	3.835 "
AC		3.100 "	3.200 "
AD		1.865 "	1.950 "
AE			1.188
AF			1.750
AG		1.000	1.500
AH		.125	.175
AJ		.100	
AK		.670	.775
AL		.100	
AM		.500	
BA		55°	65°
BB		0.800	1.000
BC		2.100	2.140
CA		55°	65°
CB		0.800	1.000
CC		3.480	3.520
DA		25°	35°
DB		2.430	2.630
DC		3.480	3.520
EA		75°	85°
EB		0.600	
EC		4.875	5.125
ED		7.140	7.165



TUNING KNOB (4) CAVITIES _ TOTAL TURNS = 25
MAXIMUM TORQUE = 10 INCH-POUNDS
4 HOLES 7/16 DIA ON 16 1/4 PITCH CIRCLE
IN BASE PLATE FOR MOUNTING
45°
PRE-FOCUS COIL & COLLECTOR COIL
FURNISHED WITH #6 FLANGED
SPADE LUGS
10 11/16
MAXIMUM
TRAVEL
3 3/4 ± 1/8
2 1/8 ± 1/16
TOTAL TURNS = 25
MAX TORQUE = 10 INCH-LBS
10 11/16
MAXIMUM
TRAVEL
ALL BODY COILS FURNISHED WITH
SCREW LUGS AND #10 SCREWS
OPTIONAL
FIL. Nº 2.
AIR
FIL. Nº 1
CATHODE
FOCUS
2 1/8 ± 1/8
SK-110. SOCKET
AIR SUPPLY
1 1/2 O.D x 1 3/8 I.D.
4 KM 50,000 L.F.
KLYSTRON
SK-111. MOD. ANODE CONNECTION
5 5/32 ± 1/16
RF-477 INPUT
CAVITY
MC-201 PRE-FOCUS COIL
1 5/8 ± 1/32
CP-100 COVER
PLATE
LC-327 INPUT LOAD COUPLER
LOAD RECEPTACLE U.G.-58-U
INPUT RECEPTACLE U.G.-58-U
MF-129 MAGNETIC
FRAME



NOTES.

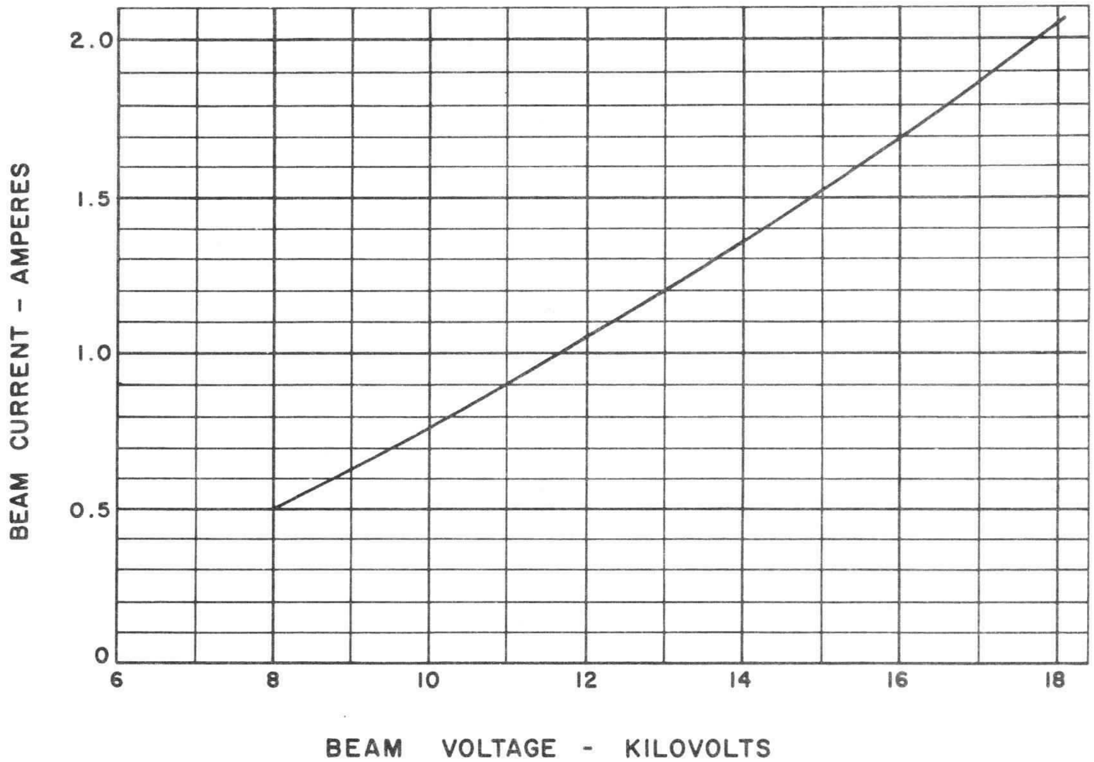
1. COIL SUPPORTS ARE ADJUSTABLE 1/8"
2. TOOLS
   ONE WRENCH HT-101
   ONE WRENCH HT-104

H-139 KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY

EIMAC 4KM50,000LF

BEAM VOLTAGE vs BEAM CURRENT

E_{foc} = -200 VOLTS



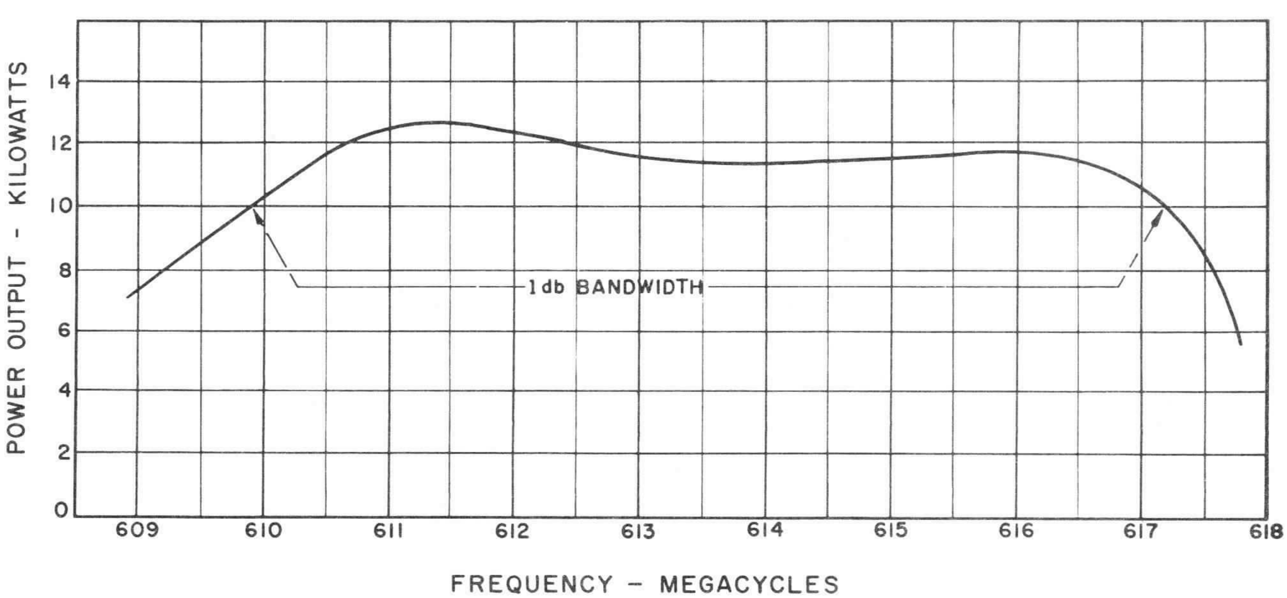
EIMAC 4KM50,000LF

BANDWIDTH DATA

E_b = 18 KILOVOLTS

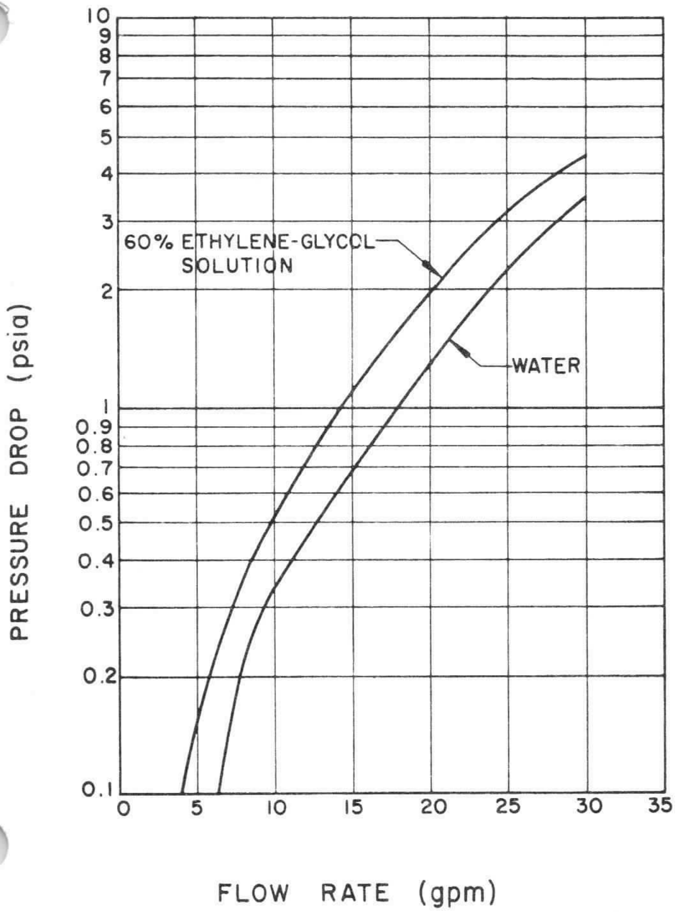
I_b = 2.03 AMPERES

P_D = 10 WATTS



EIMAC 4KM50,000LF

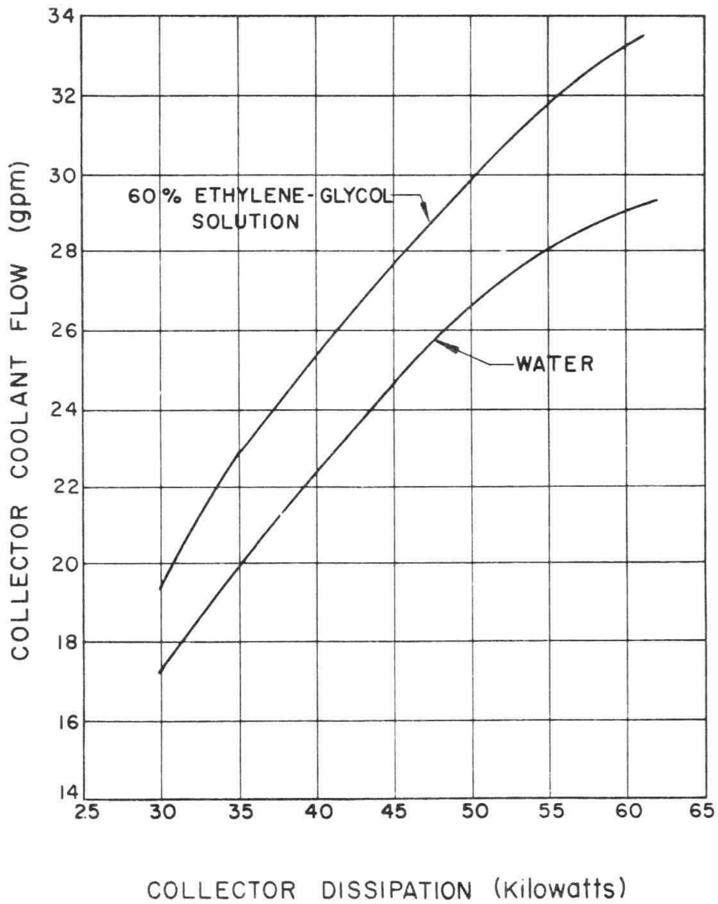
PRESSURE DROP vs COOLANT FLOW RATE ACROSS COLLECTOR



EIMAC 4KM50,000LF

COLLECTOR DISSIPATION vs COOLANT FLOW

COOLANT INLET TEMPERATURE 25°C



EIMAC 4KM50,000LF

POWER OUTPUT vs FREQUENCY

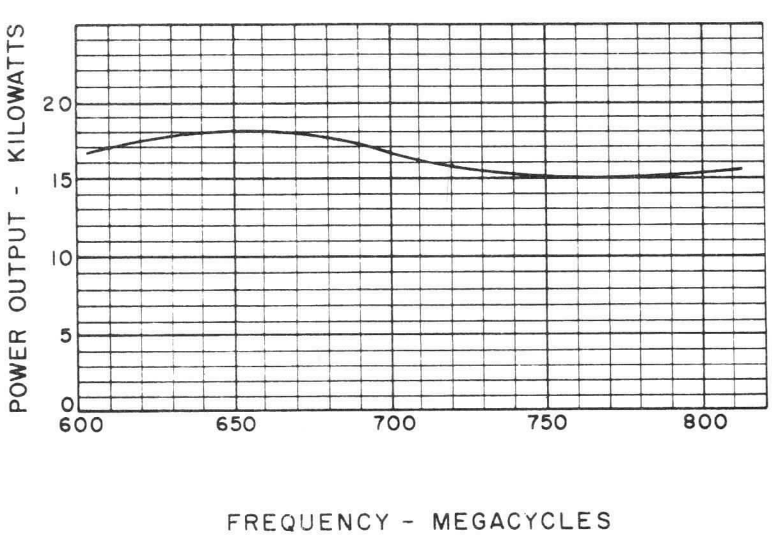
NARROW BAND

I_b = 2.03 AMPERES

P_d = 0.3 WATTS

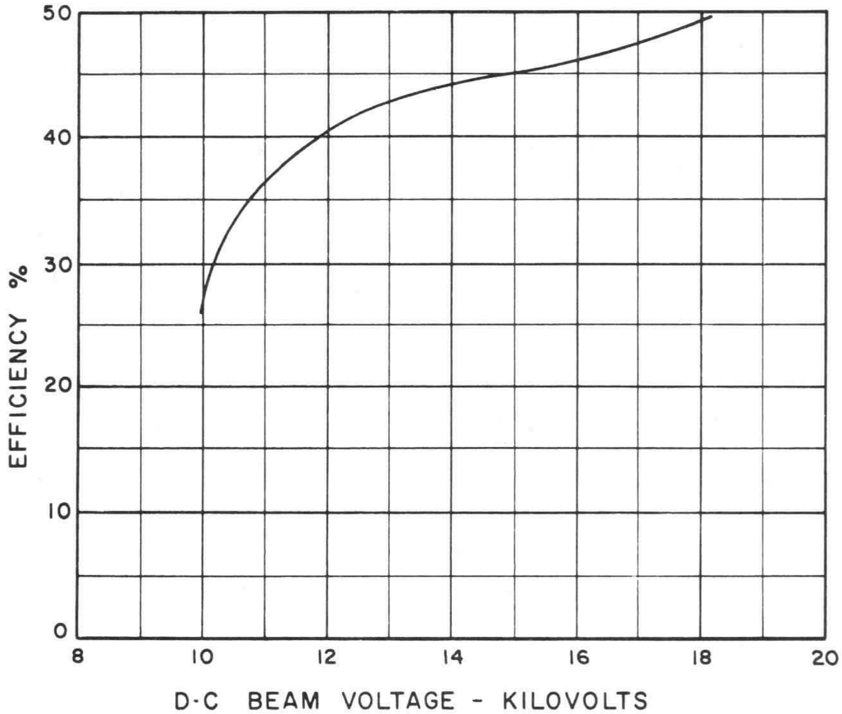
E_{foc} = -200 VOLTS

E_b = 18 KILOVOLTS



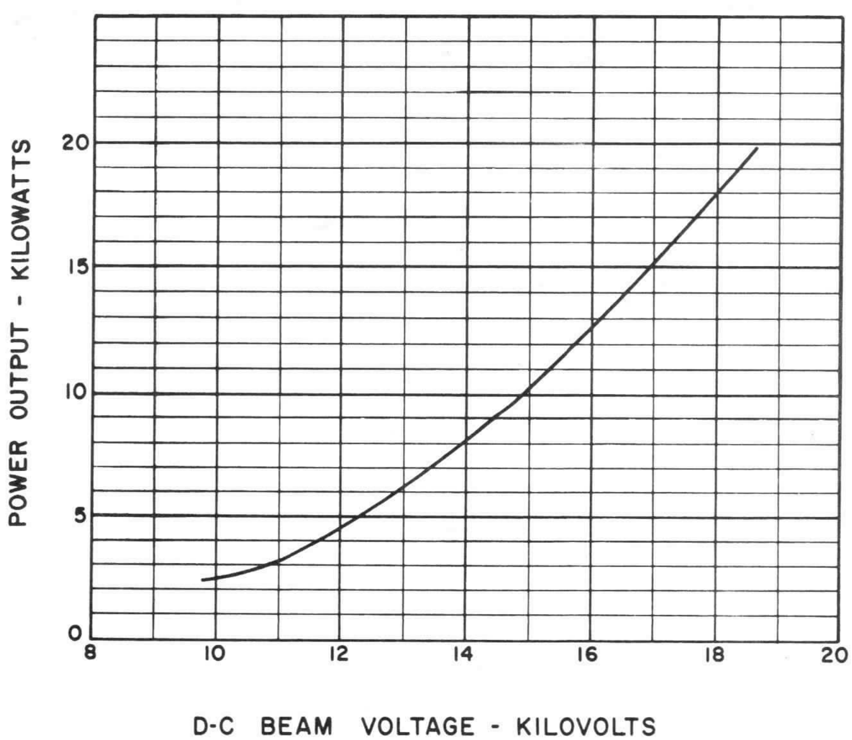
EIMAC 4KM50,000LF

EFFICIENCY vs BEAM VOLTAGE
NARROW BAND
FREQUENCY = 700 MEGACYCLES



EIMAC 4KM50,000LF

POWER OUTPUT vs BEAM VOLTAGE
NARROW BAND
FREQUENCY = 700 MEGACYCLES



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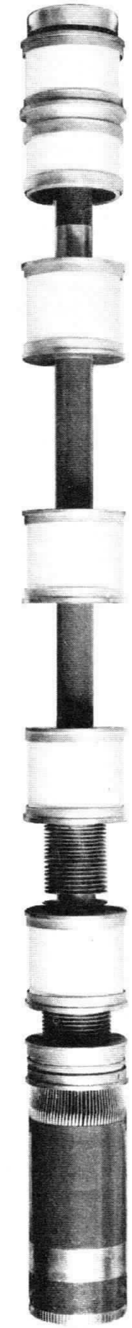
SAN BRUNO · CALIFORNIA

TENTATIVE DATA

4KMP10,000LF

PULSE AMPLIFIER

L-BAND KLYSTRON



The Eimac 4KMP10,000LF is a four-cavity, magnetically focused, pulse-amplifier klystron of ceramic and metal. It is designed for use at frequencies between 570 and 630 megacycles and will deliver a minimum pulse output power of 200 kilowatts at two percent duty, or 400 kilowatts at one percent duty, with an average power of four kilowatts. Nominal power gain is 57 db.

This klystron employs the Eimac Modulating Anode which provides an effective means of pulse modulating the output power without changing the beam voltage. A modulating anode voltage of approximately one half the beam voltage is sufficient to realize full rated pulse output power.

The resonant cavities for the 4KMP10,000LF are completed through tuning boxes which enclose the cylindrical ceramic windows of the klystron and all tuning is accomplished outside the vacuum envelope. This design permits a wide tuning range, and allows external cavity loading for broad-band operation. It also permits an unlimited number of tuning cycles without risk of damage to the vacuum seals.

Eimac Klystron Amplifier Circuit Assembly H-127, for use with the 4KMP10,000LF, covers the frequency range of 570 to 630 megacycles. This assembly includes a klystron supporting structure, electromagnetic focusing coils, tuning boxes, adjustable output load coupler, and an Eimac SK-1200 socket.

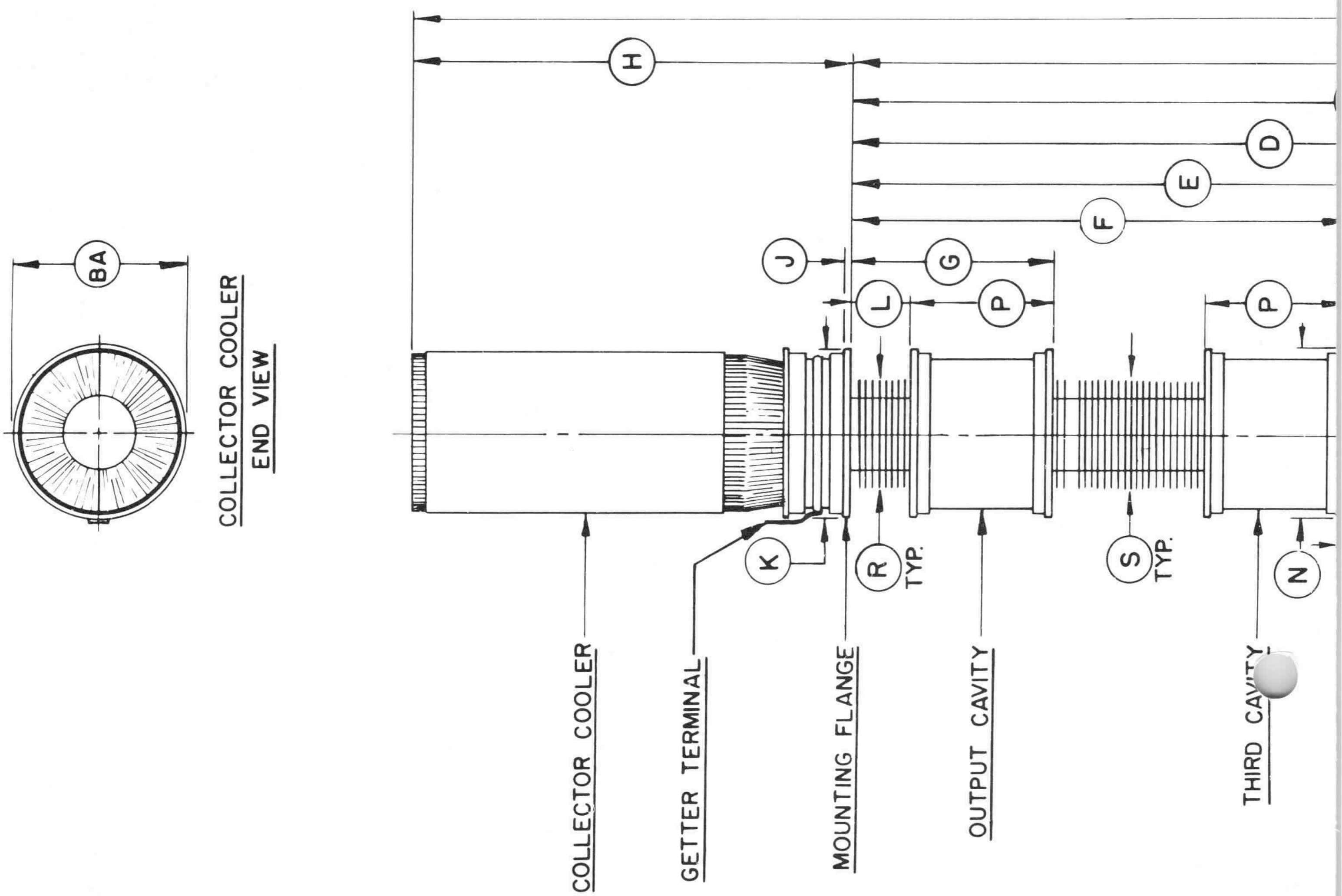
CHARACTERISTICS

ELECTRICAL

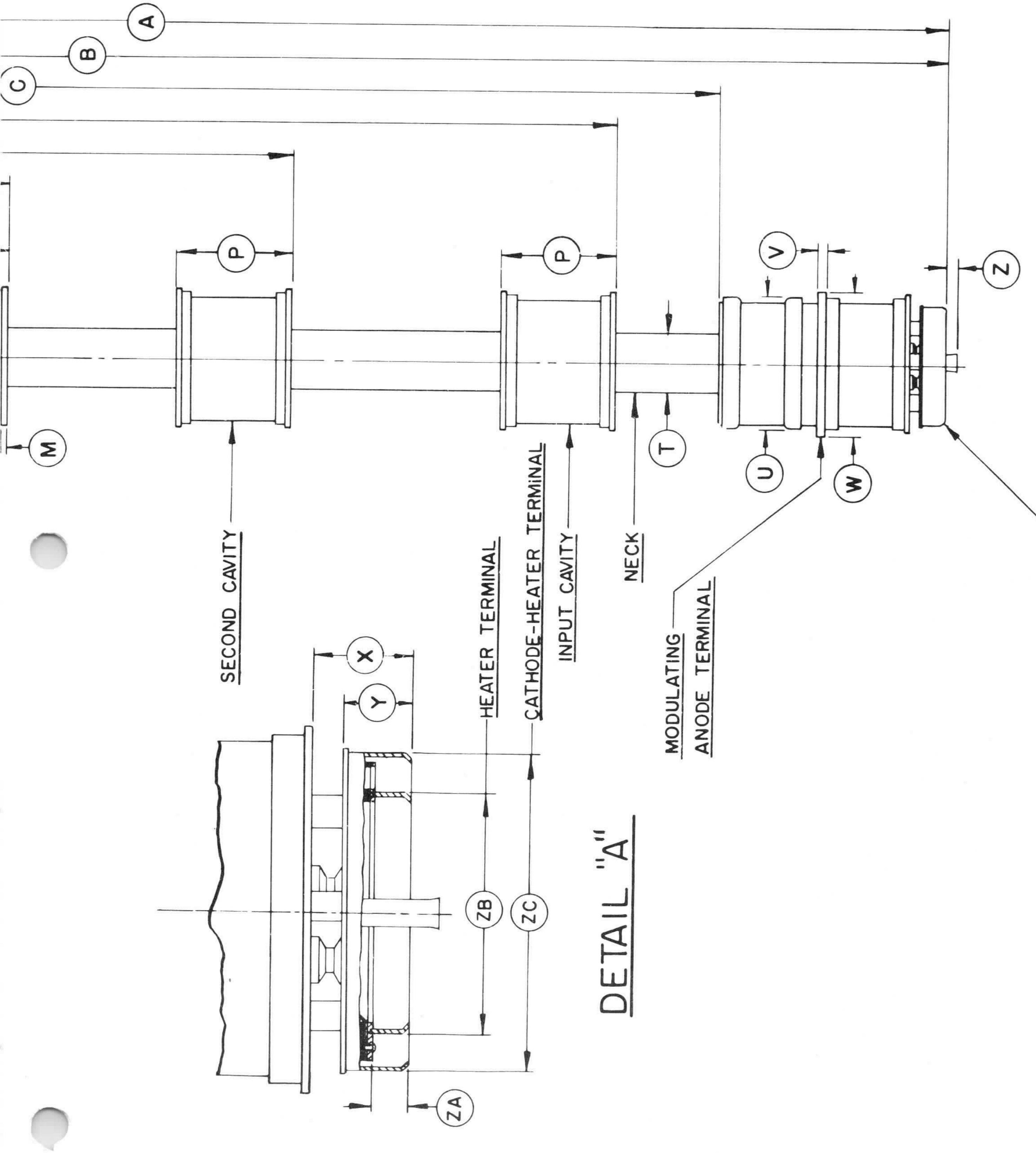
Heater:	Voltage (±5%)	11	volts
	Current (Normal)	22	amperes
	Maximum Starting Current	50	amperes
Cathode:	Unipotential, Oxide Coated		
	Heating Time	10	minutes
Getter (Operating):	Voltage (Nominal)	5.1	volts
	Current	36	amperes
	Maximum Starting Current	50	amperes
Power Gain:	(Narrow Band)	57	decibels
Output Power:			
2% Duty		200	kilowatts
1% Duty		400	kilowatts
Average		4	kilowatts
Frequency Range		570 to 630	megacycles

Capacitance between Modulating Anode and all other Tube Elements:

Maximum	60	micromicrofarads
Typical	37	micromicrofarads



DIMENSIONAL DATA	
REF.	NOM.
A	84
B	66 1/4
C	54 7/8
D	50 5/32
E	34 3/16
F	20 1/4
G	10 1/2
H	17 13/16
J	1/4
K	6 5/8
L	2 1/4
M	1/4
N	6 5/8
P	6 1/64
R	4 7/16
S	4
T	2 1/2
U	6 5/8
V	3/8
W	6 7/8
X	1 3/4
Y	1 9/32
Z	1
ZA	1/2
ZB	4 3/8
ZC	5 3/4
BA	6 11/32



4KMP10,000LF OUTLINE DRAWING

MECHANICAL

Operating Position	Axis Vertical Cathode down (in oil)	
R-F Input Coupling	Type N Coaxial Fitting	
R-F Output Coupling	WR1500 Waveguide	
Weight (Tube only)	140 pounds	

Cooling: Forced Air and Oil

Cathode (With SK-1200 socket) - oil

	Flow Rate	Pressure Drop
Body	*100 cfm air	1 inch H_2O
Output Cavity	*50 cfm air	1 inch H_2O
Collector	*400 cfm air	2.5 inches H_2O

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS
(Eimac H-127 Klystron Amplifier Circuit Assembly)

		Min.	Max.	
Prefocus Coil:	Voltage (dc)	0	40	volts
	Current (dc)	0	2.5	amperes
Each of Five Body Coils:				
	Voltage (dc)	0	40	volts
	Current (dc)	0	12.5	amperes

MAXIMUM RATINGS

D-C BEAM VOLTAGE	70	KILOVOLTS
PEAK D-C BEAM CURRENT	22.5	AMPERES
PEAK MODULATING ANODE VOLTAGE	44	KILOVOLTS
AVERAGE D-C BODY CURRENT	15	MILLIAMPERES
COLLECTOR DISSIPATION	10	KILOWATTS
PULSE LENGTH	60	MICROSECONDS
SEAL TEMPERATURES	175	DEGREES C
A-C GETTER CURRENT	50	AMPERES

TYPICAL OPERATION, NARROW BAND PULSE AMPLIFIER

Frequency	600	megacycles
Peak Output Power	466	kilowatts
Average Output Power	4.66	kilowatts
Peak Driving Power	0.8	watts
Power Gain	57.4	decibels
D-C Beam Voltage	65	kilovolts
Average D-C Beam Current	165	milliamperes
Peak D-C Beam Current	16.5	amperes
Peak Modulating Anode Voltage	32	kilovolts
D-C Body Current (Average)	9.5	milliamperes
D-C Collector Current (Average)	156	milliamperes
Beam Input Efficiency (Average)	43.4	percent

MAGNETIC-COIL CURRENTS (H-127 Circuit Assembly)

Prefocus Coil	1.9	amperes
First Body Coil	6.3	amperes
Second Body Coil	7.5	amperes
Third Body Coil	7.5	amperes
Fourth Body Coil	8.5	amperes
Fifth Body Coil	8.5	amperes

*At Sea Level with 20° C inlet air temperature.

For additional information or information regarding any specific application, write to Eitel-McCullough, Inc., San Bruno, California. All such requests will be handled confidentially.

Printed in U.S.A. 585

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

Tentative Data

5K50CB

10 KW CW
POWER AMPLIFIER
C-BAND KLYSTRON

The Eimac 5K50CB power-amplifier klystron operates at frequencies from 4.4-5.0 kilomegacycles with a rated output power of 10 kilowatts and a minimum gain of 60 decibels. This klystron is intended primarily for use in tropospheric scatter communications systems.

A confined flow configuration is used in the electron gun of the 5K50CB to minimize focusing adjustments and to provide a thoroughly stable beam.

This electron gun is completely enclosed in a metal shield with integral shielded connecting leads to reduce the high voltage hazard to a minimum.

The small size and light weight of the 5K50CB make it suitable, where necessary, for mounting on the antenna structure of the system in which it is used.

Five integral cavities are used in the 5K50CB. Both input and output couplings are fixed. Unusual stability, for this power and frequency, is achieved through the use of improved body cooling.

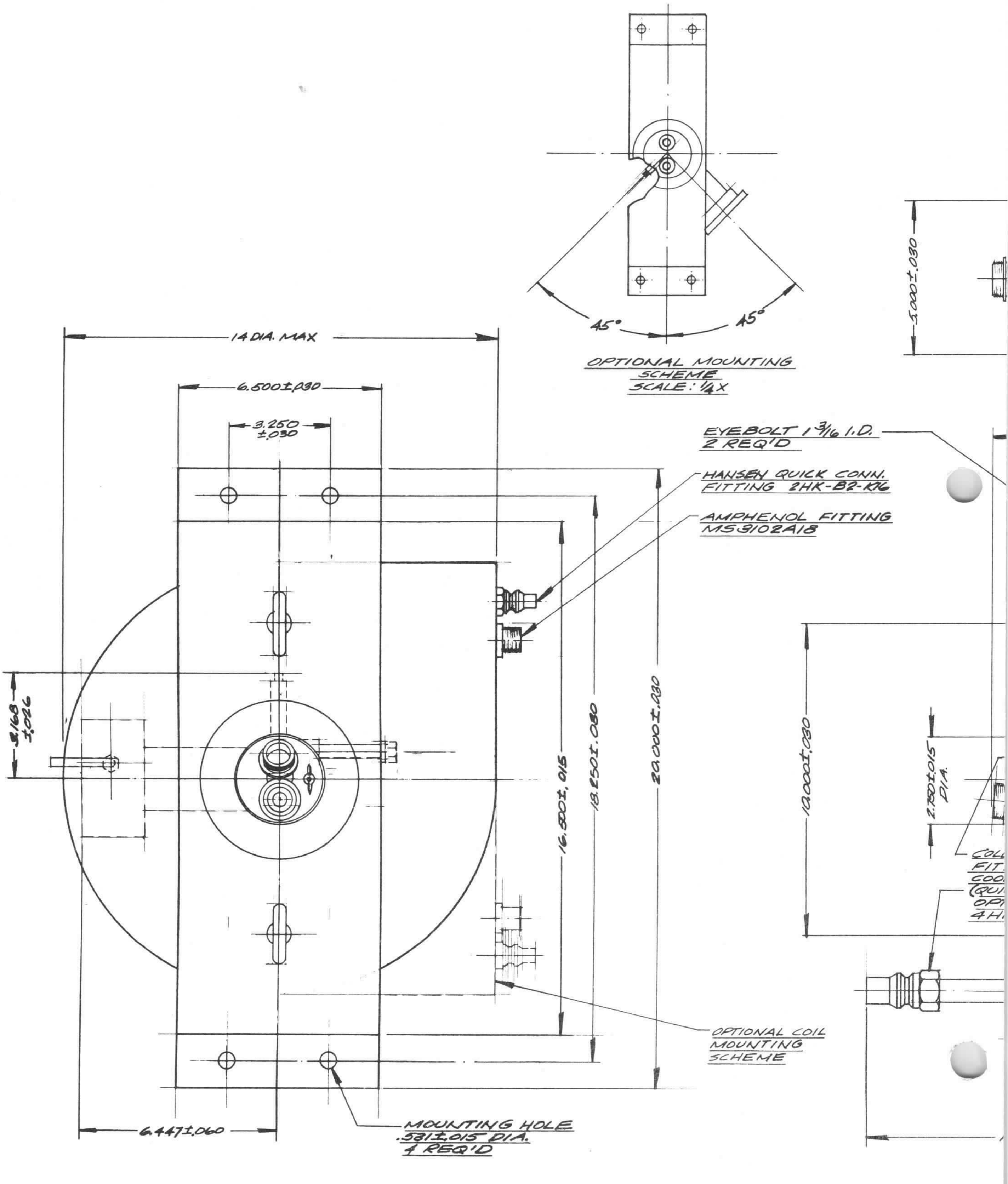
The 5K50CB incorporates a built-in vacuum pump in the form of a titanium getter which should be energized whenever heater power is applied.

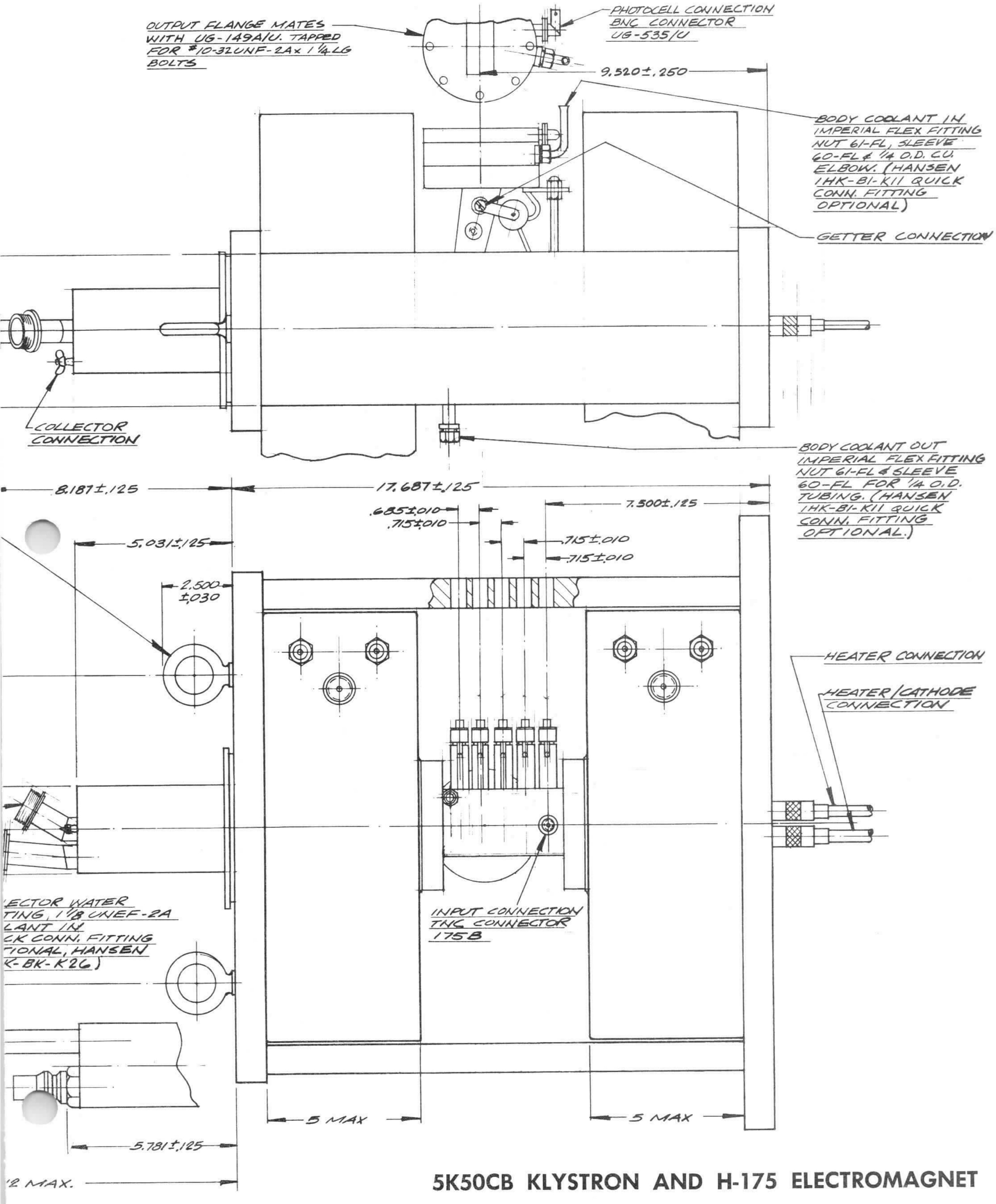
A focusing electromagnet and klystron supporting structure, Catalog Number H-175, has been designed for use with the 5K50CB.

CHARACTERISTICS

ELECTRICAL

Heater: Voltage	10 volts
Current	3.0 amperes
Cathode: Impregnated, Unipotential	
Heating Time	5 minutes
Getter: Voltage	4.0 volts
Current	25 amperes
Power Gain	60 decibels
Output Power	10 kilowatts
Frequency Range	4.4-5.0 kilomegacycles
Phase sensitivity to beam voltage	0.06 degrees/volt


OPTIONAL MOUNTING
SCHEME
SCALE: 1/4X
45°
45°
14 DIA. MAX
6.500±.030
3.250
±.030
EYEBOLT 1 3/16 I.D.
2 REQ'D
HANSEN QUICK CONN.
FITTING 2HK-B2-K16
AMPHENOL FITTING
MS3102A18
3.168
±.026
16.500±.015
18.250±.030
20.000±.030
10.000±.030
5.000±.030
2.750±.015
DIA.
OPTIONAL COIL
MOUNTING
SCHEME
6.447±.060
MOUNTING HOLE
.531±.015 DIA.
4 REQ'D



5K50CB KLYSTRON AND H-175 ELECTROMAGNET

MECHANICAL

Operating Position		Axis Vertical, Cathode Down
Output rf Coupling		RG49/U Waveguide
Input rf Coupling		TNC
Dimensions: Klystron only		6 x 7 x 26½ inches
Electromagnet:		
Height		18.5 inches
Width		15.5 inches
Depth		20 inches
Weight: Klystron only		30 lbs
Electromagnet		270 lbs
Cooling: 52.5/47.5 Solution, Ethylene Glycol and Water	*Flow Rate*	*Pressure Drop*
Body	1.5 gpm	50 psi
Collector	9 gpm	50 psi
Electromagnet	2 gpm	50 psi

ELECTROMAGNET POWER-SUPPLY REQUIREMENTS

Voltage	170 volts
Current	10 amperes

MAXIMUM RATINGS

DC BEAM VOLTAGE	17.5 KILOVOLTS
DC BEAM CURRENT	2.5 AMPERES
DC BEAM INPUT POWER	50 KILOWATTS
DC BODY CURRENT (with rf drive)	80 MILLIAMPERES
COLLECTOR DISSIPATION	50 KILOWATTS
INLET WATER PRESSURE	120 PSI
OUTLET WATER TEMPERATURE	80 DEGREES C
LOAD VSWR	1.2:1

TYPICAL OPERATION — TUNED FOR HIGH EFFICIENCY

Frequency	4700 megacycles
Output Power	10 kilowatts
Driving Power	10 milliwatts
Power Gain	60 decibels
DC Beam Voltage	15 kilovolts
DC Beam Current	2.0 amperes
Beam Power Efficiency	33 percent
DC Body Current	40 milliamperes
3 db Bandwidth	15 megacycles
Electromagnet Current	9.5 amperes

For additional information or information regarding a specific application, write to Eimac Division, Varian Associates, 301 Industrial Way, San Carlos, California

Eimac®

E I M A C
Division of Varian
SAN CARLOS
CALIFORNIA

5K70SH

S-BAND

30 KW CW

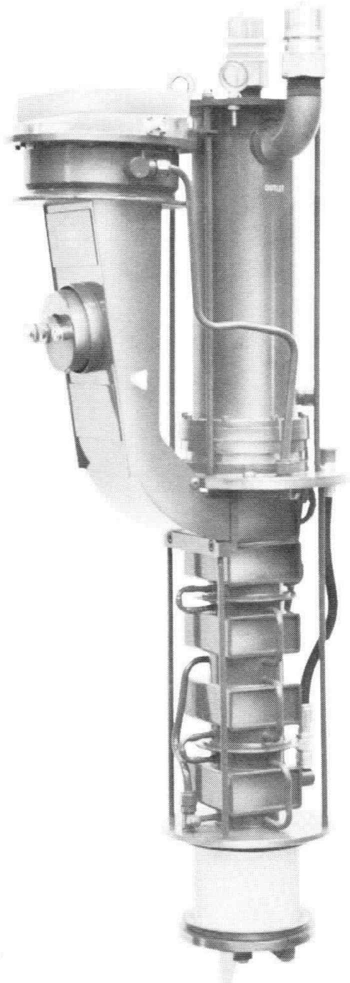
POWER AMPLIFIER KLYSTRON

The EIMAC 5K70SH power amplifier klystron was designed specifically for industrial heating applications. The outstanding characteristic of this klystron is its high efficiency at full power. The 5K70SH delivers 30 kilowatts output power at better than 50% efficiency at 2450 MHz with a minimum gain of 50 db.

An extra large cathode is used in the 5K70SH to assure long life. Five integral cavities are employed for high gain, and all are pre-tuned at the factory. Also, input and output couplings are factory adjusted. In short, no tuning of any kind is required.

The output "window," where microwave power is transferred from the vacuum within the klystron to the external waveguide, is made of beryllium oxide. This insulating material has extremely good heat-transfer and mechanical characteristics. It is virtually indestructible in this application.

A focusing electromagnet, Catalog Number H-226, has been designed for use with the 5K70SH. EIMAC Water Load WL-204 is recommended for use with this klystron.



CHARACTERISTICS

ELECTRICAL

Heater: Voltage (±5%)	7.5 Vac
Current (nominal)	11.5 Aac
Cathode: Oxide Coated	
Heating Time	5 Min
Getter: Voltage	4 Vac
Current	24 Aac
Power Gain	50 db
Output Power	30 kW
Frequency	2450 MHz
Phase Shift as a Function of Beam Voltage	0.0935 °/V

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MECHANICAL

Operating Position		Any
Input rf Coupling		Type N Coaxial Fitting
Output rf Coupling		UG435A/U Flange
Weights: 5K70SH		100 lbs
H-226 Electromagnet		186 lbs
Cooling: Forced Air and Water	*Flow Rate*	*Pressure Drop*
Cathode	20 cfm	Free
Klystron Body	0.8 gpm	50 psi
Klystron Collector	18 gpm	30 psi
Electromagnet	2 gpm	30 psi

ELECTROMAGNET POWER SUPPLY REQUIREMENTS

Voltage, Adjustable to	150 Vdc
Current, Adjustable to	25 Adc

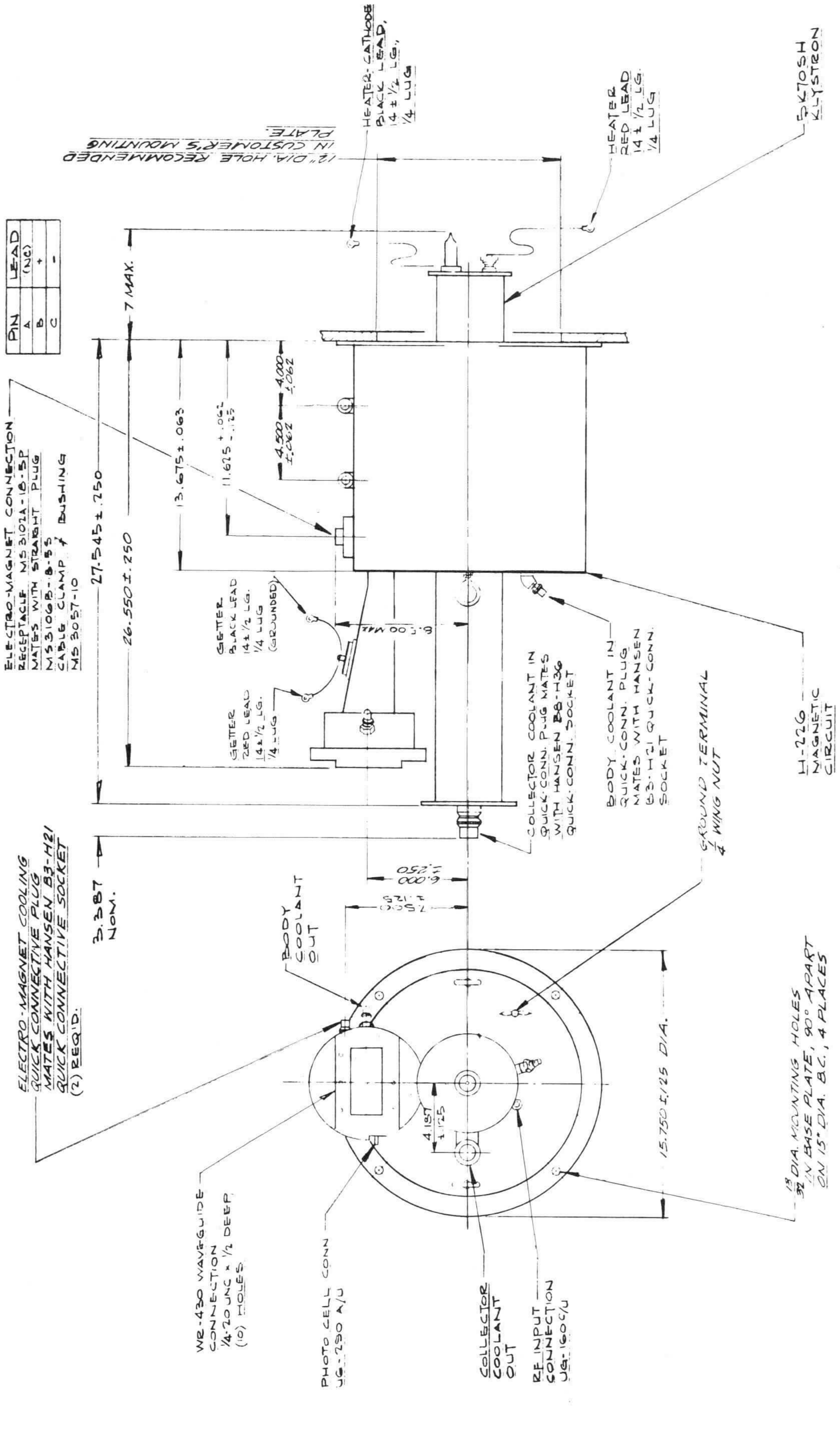
MAXIMUM RATINGS

BEAM VOLTAGE	23 kVdc
BEAM CURRENT	3 Adc
BEAM INPUT POWER	70 kW
BODY CURRENT	100 mAdc
COLLECTOR DISSIPATION	70 kW
INLET COOLANT PRESSURE	125 psig
COOLANT OUTLET TEMPERATURE	80 °C
LOAD VSWR (NON DESTRUCTIVE)	3:1

TYPICAL OPERATION

Frequency	2450 MHz
Output Power	31.5 kW
Driving Power	100 mW
Power Gain	55 db
Beam Voltage	22.5 kVdc
Beam Current	2.66 Adc
Body Current	50 mAdc
Efficiency	52.5 %
Electromagnet Current	16.5 Adc

For additional data or information regarding a specific application, write to EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California.



5K70SH and H-226

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

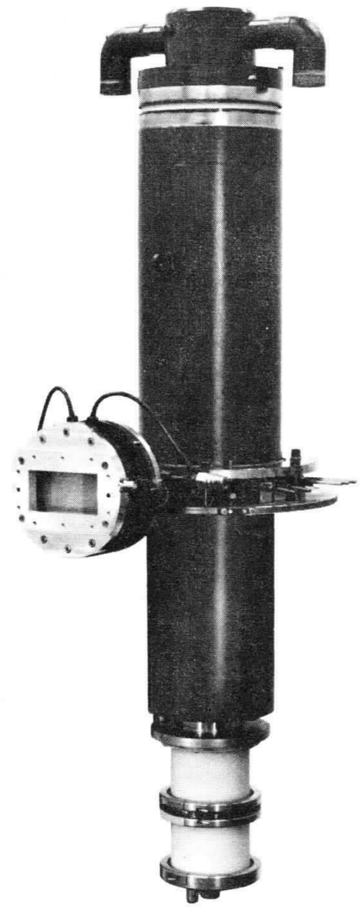
Tentative Data

5KM300SI

S-BAND

100 KW CW

POWER AMPLIFIER KLYSTRON



The Eimac 5KM300SI power amplifier klystron was designed specifically for use in the ground transmitters of spacecraft communications systems. The 5KM300SI has a rated output power of 100 kilowatts at frequencies from 2100 to 2400 megacycles with a 3 db bandwidth of 15 megacycles and a minimum gain of 55 decibels.

Five integral cavities are used in the 5KM300SI. Both input and output couplings are fixed. The output window is a thick beryllium oxide disc which will withstand severe abuse. An arc detector is provided to protect this window.

The electron gun of this klystron provides an exceptionally uniform beam which contributes greatly to stability and high efficiency. This gun incorporates the Eimac Modulating Anode which provides a versatile means for controlling the beam.

The 5KM300SI incorporates an ion pump which maintains a low gas pressure in the klystron and also provides a continuous indication of this pressure during operation.

A focusing electromagnet, Catalog Number H-225, has been designed for use with the 5KM300SI.

CHARACTERISTICS

ELECTRICAL

Heater: Voltage (±5%)	13 Vac
Current (Nominal)	5.4 Aac
Cathode: Impregnated, Unipotential	
Heating Time	5 Min
Ion Pump Supply	
Voltage	3 to 4 kVdc
Current	1 mAdc
Power Gain	55 db
Output Power	100 kW
Frequency Range	2100 to 2400 Mc
Phase shift as a function of beam voltage	0.026 °/V

MECHANICAL

Operating Position	any
Input Coupling (rf)	UG-23 D/U
Output Coupling (rf)	WR-430 Waveguide
Weights: 5KM300SI	235 lbs
H-225 Electromagnet	180 lbs
Tuner Starting Torque (max)	50 in-oz
Tuner Stop Torque	6 in-lbs

Cooling: Forced Air and Water	*Flow Rate*	*Pressure Drop*
Cathode	25 cfm	Free
Klystron Body	2.3 gpm	60 psi
Klystron Collector	65 gpm	23 psi
Electromagnet	2.5 gpm	45 psi

Printed in U.S.A.

ELECTROMAGNET POWER SUPPLY REQUIREMENTS

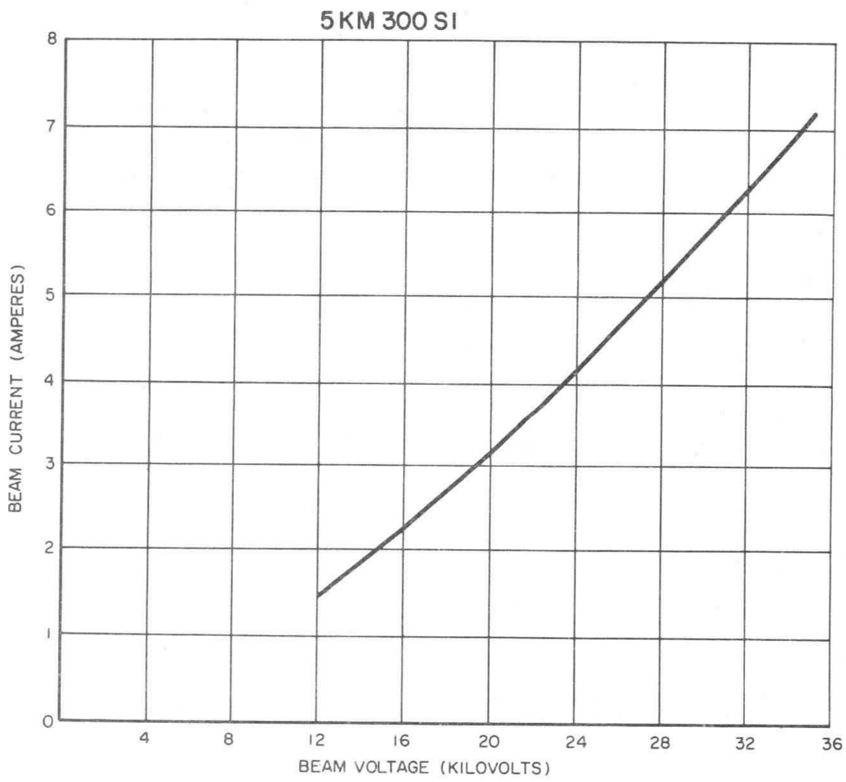
Voltage, adjustable to	160 Vdc
Current, adjustable to	20 Adc

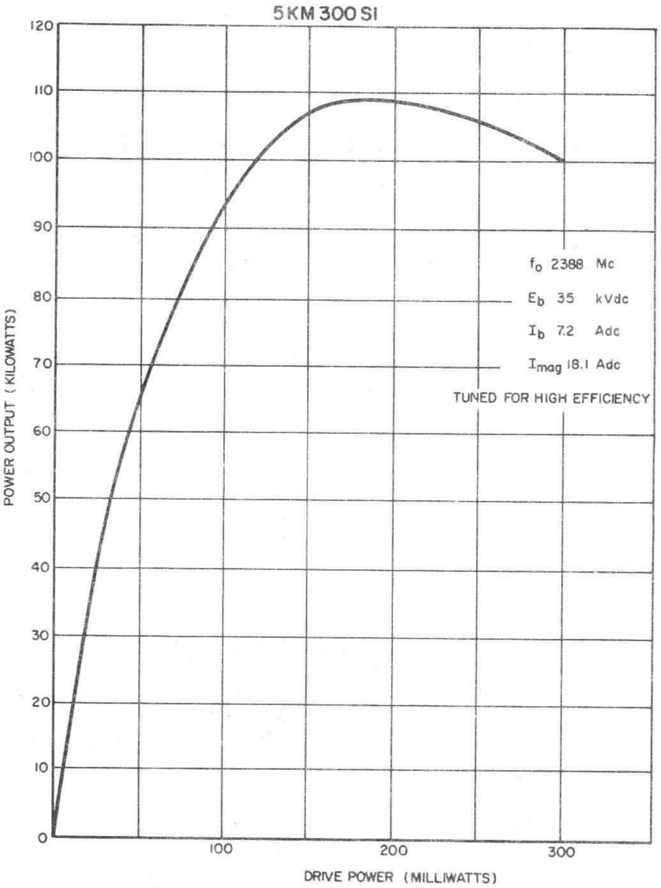
MAXIMUM RATINGS

BEAM VOLTAGE	38 kVdc
BEAM CURRENT	7.9 Adc
BEAM INPUT POWER	300 kW
BODY CURRENT (WITHOUT DRIVE)	50 mAdc
BODY CURRENT (WITH DRIVE)	350 mAdc
COLLECTOR DISSIPATION	300 kW
INLET COOLANT PRESSURE	125 psig
COOLANT OUTLET TEMPERATURE	80 °C
LOAD VSWR	1.2:1

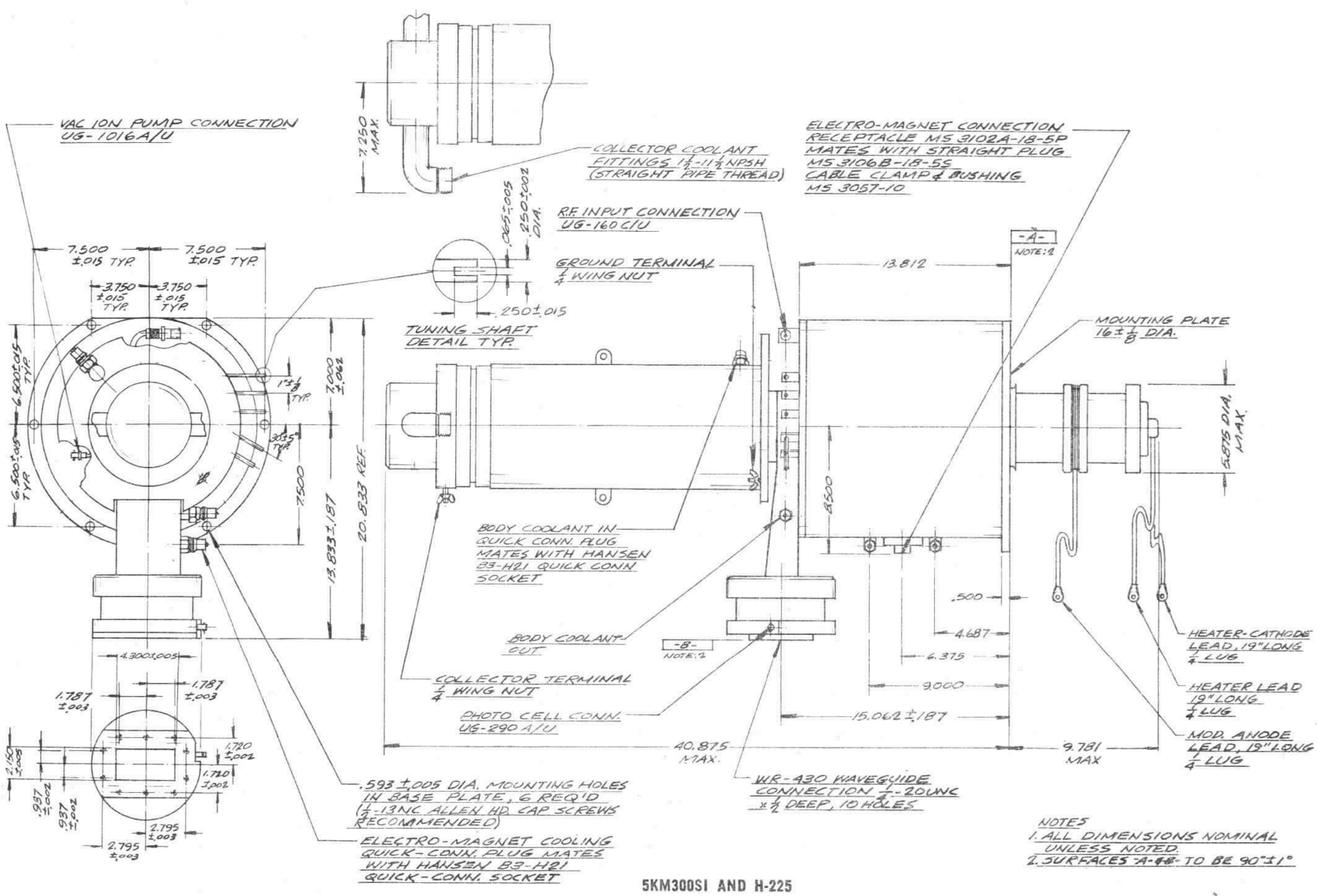
TYPICAL OPERATION

	Synchronously Tuned		*High Efficiency Tuned*		
Frequency	2115	2388	2115	2388	Mc
Output Power	74	79	104	109	kW
Driving Power	1	1.15	215	190	mW
Power Gain	78	78	57	57.3	db
Beam Voltage	35	35	35	35	kVdc
Beam Current	7.2	7.2	7.2	7.2	Adc
Body Current	135	85	340	190	mAdc
Modulating Anode Voltage (with respect to cathode)	35	35	35	35	kVdc
3 db Bandwidth	3.5	4	15	15	Mc
Efficiency	29.4	31.5	41.3	45.3	%
Electromagnet Current	18.1	18.1	18.1	18.1	Adc
Load VSWR	1.1:1	1.1:1	1.1:1	1.1:1	

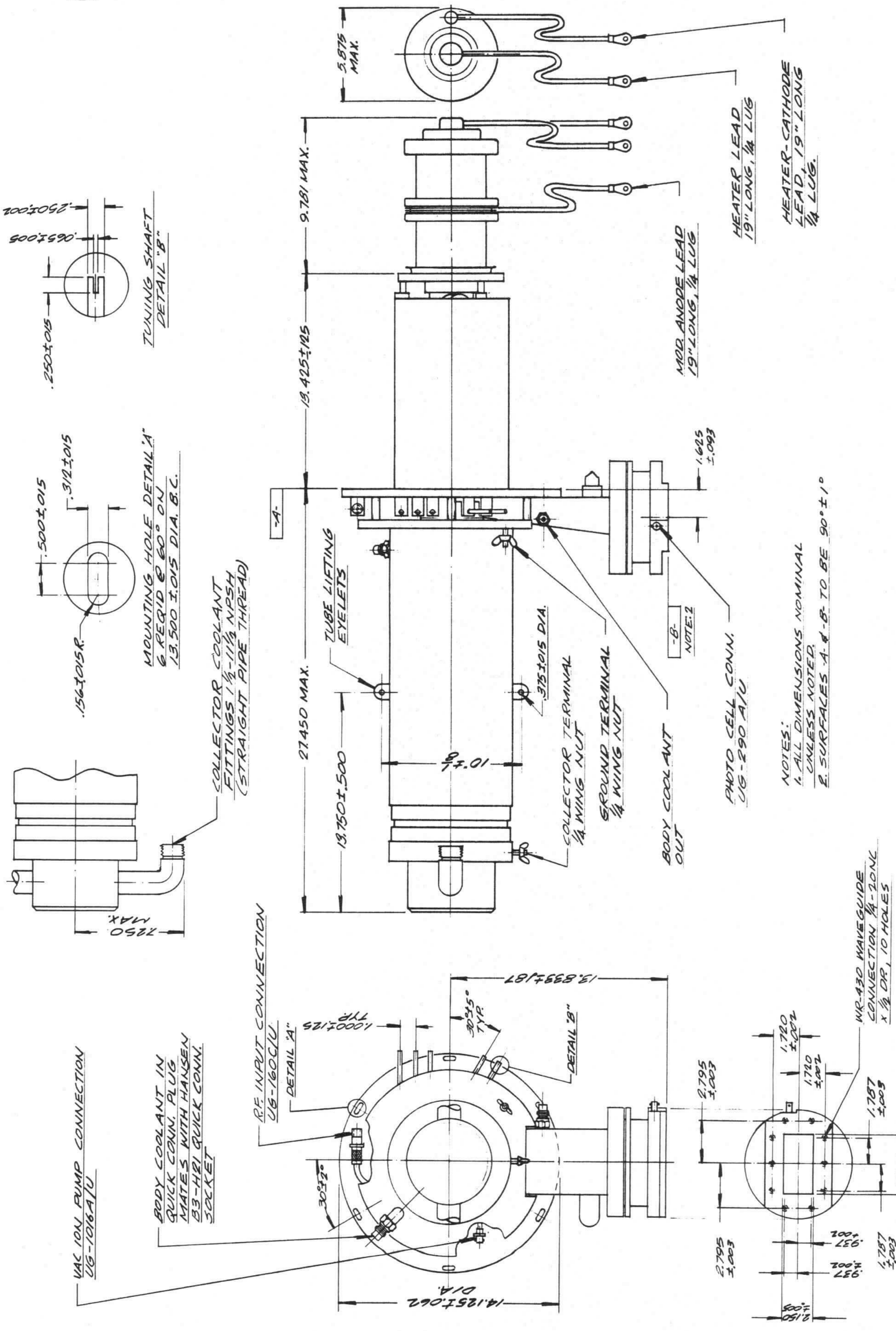




5KM300SI
POWER OUTPUT (KILOWATTS)
DRIVE POWER (MILLIWATTS)
f_o 2388 Mc
E_b 35 kVdc
I_b 7.2 Adc
I_{mag} 18.1 Adc
TUNED FOR HIGH EFFICIENCY



VAC ION PUMP CONNECTION UG-1016A/U
COLLECTOR COOLANT FITTINGS 1½-11½ NPSH (STRAIGHT PIPE THREAD)
ELECTRO-MAGNET CONNECTION RECEPTACLE MS 3102A-18-5P MATES WITH STRAIGHT PLUG MS 3106B-18-5S CABLE CLAMP & BUSHING MS 3057-10
R.F. INPUT CONNECTION UG-160 C/U
GROUND TERMINAL ¼ WING NUT
TUNING SHAFT DETAIL TYP.
MOUNTING PLATE 16±⅛ DIA.
BODY COOLANT IN-QUICK CONN. PLUG MATES WITH HANSEN 83-H21 QUICK CONN SOCKET
BODY COOLANT OUT
COLLECTOR TERMINAL ¼ WING NUT
PHOTO CELL CONN. UG-290 A/U
.593±.005 DIA. MOUNTING HOLES IN BASE PLATE, 6 REQ'D (½-13NC ALLEN HD. CAP SCREWS RECOMMENDED)
ELECTRO-MAGNET COOLING QUICK-CONN. PLUG MATES WITH HANSEN 83-H21 QUICK-CONN. SOCKET
WR-430 WAVEGUIDE CONNECTION ¼-20UNC x ½ DEEP, 10 HOLES
HEATER-CATHODE LEAD, 19" LONG ¼ LUG
HEATER LEAD 19" LONG ¼ LUG
MOD. ANODE LEAD, 19" LONG ¼ LUG
40.875 MAX.
9.781 MAX
15.062±.187
13.812
20.833 REF.
NOTES
1. ALL DIMENSIONS NOMINAL UNLESS NOTED.
2. SURFACES "A-B" TO BE 90°±1°



5KM 300 SI KLYSTRON

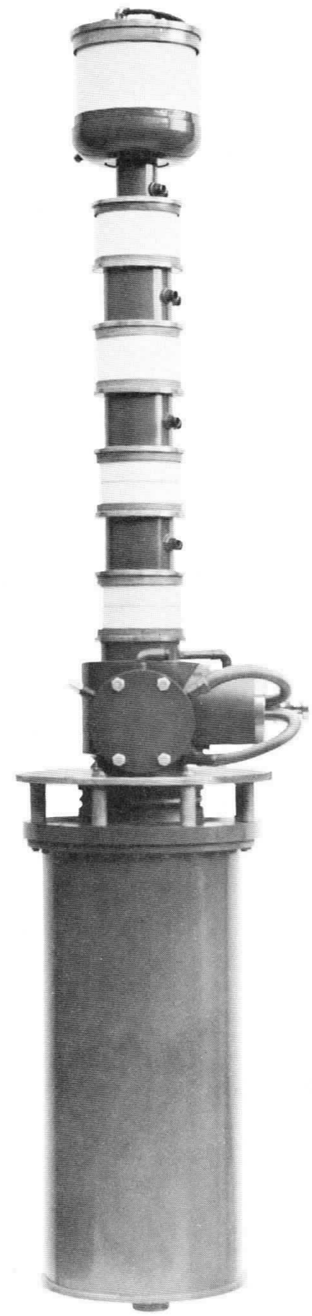
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

5K210,000LQ

POWER-AMPLIFIER L-BAND KLYSTRON



The Eimac 5K210,000LQ is a high-gain, power-amplifier klystron designed for wide-band, tropospheric-scatter, communications service at frequencies from 755 to 985 megacycles. This klystron will deliver a CW output power of 75 kilowatts, with a minimum power gain of 42 decibels, and half-power band-width of 10 megacycles.

Five resonant cavities are used in the 5K210,000LQ. Four are external and one, the output cavity, is integral. Output coupling is achieved by means of a fixed loop and a quarter-wave, variable-impedance, coaxial coupling section which terminates in a waveguide transition.

The 5K210,000LQ has a beam microperveance of 2 which makes it possible to achieve adequate bandwidth for tropo-scatter applications without external loading of the intermediate cavities.

Eimac Klystron Amplifier Circuit Assembly H-132 has been designed for use with the 5K210,000LQ to cover the specified frequency range. This assembly includes a supporting structure, magnetic focusing coils, tuning cavities, adjustable load couplers for the input and output cavities, and a coaxial-to-waveguide transition.

CHARACTERISTICS

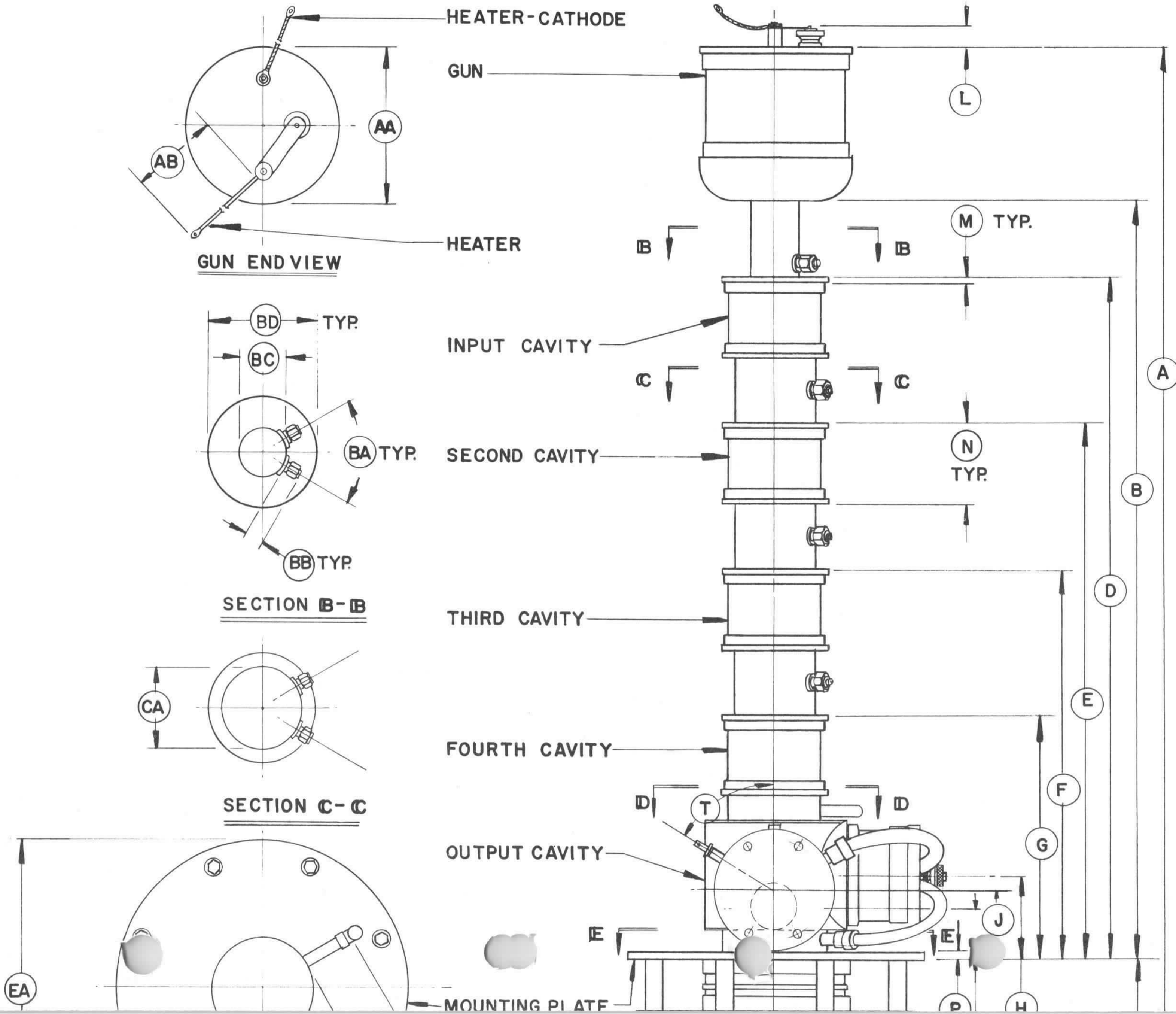
ELECTRICAL

Heater:	Voltage	15	volts
	Current	18	amperes
	Maximum Starting Current	36	amperes
Cathode:	EMA, Unipotential		
	Heating Time	5	minutes
Getter:	Voltage	5.2	volts
	Current	36	amperes
Power Gain (Wide Band)		42	decibels
Output Power		75	kilowatts
Frequency Range (H-132 Circuit Assembly)		755 to 985	megacycles

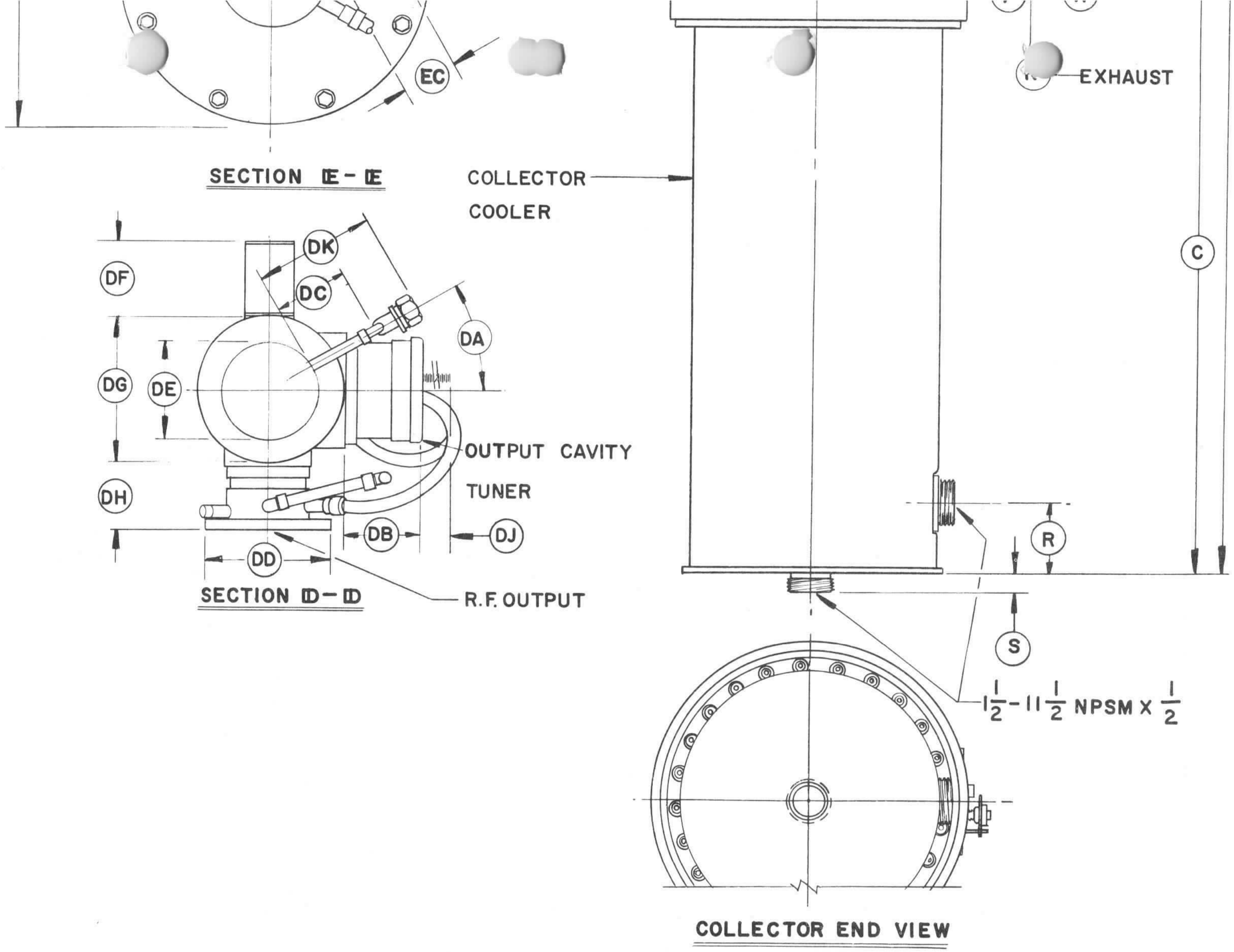
MECHANICAL

Operating Position	Axis vertical, cathode up	
R-F Coupling:		
Input	Type "N" coaxial fitting	
Output	WR-975 Waveguide	
Weight (5K210,000LQ Klystron)	380	pounds
Weight (H-132 Circuit Assembly)	1530	pounds
Cooling:	Water and Forced Air	

	Flow Rate	Pressure Drop
Second, Third and Penultimate Cavities (each)	25 cfm	1 inch H_2O
Body and Output Section	6 gpm	25 psi
Collector	50 gpm	25 psi



DIMENSIONAL DATA			
ITEM	NOM.	MIN.	MAX.
A	64.787		
B		32.244	32.786
C		25.361	25.613
D		29.066	29.544
E		22.854	23.252
F		16.642	16.960
G		10.430	10.668
H		3.576	3.728
J		2.951	3.103
K		2.206	2.348
L		29/32	1 3/32
M		.245	.255
N		3.481	3.523
P		23/64	25/64
R		2 53/64	2 59/64
S		21/32	23/32
T			
AA		6.620 DIA.	6.630 DIA.
AB		8	9
BA	60°		
BB	39/64		
BC	2.125 DIA.		
BD		4.620 DIA.	4.630 DIA.
CA	3.500 DIA.		
DA	30°		
DB		3	3 5/32
DC	2 15/32		
DD		5 11/64 DIA.	5 13/64 DIA.
DE	4.000 DIA.		
DF	4		
DG		6.000 DIA.	6.010 DIA.



DH		2 [illegible]/64	2 45/64
DJ		1.152	1.222
DK			
EA		12.748 DIA.	12.752 DIA.
EB			
EC			
ED			

5K210,000LQ KLYSTRON

MECHANICAL cont.

Maximum Dimensions of Klystron:		
Length	66.6	inches
Diameter	14	inches
Maximum Dimensions (Klystron and Circuit Assembly):		
Height	75	inches
Width	32	inches
Depth	47	inches

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Prefocus Coil:	Voltage	0 to 25	volts
	Current	0 to 2	amperes
Each of Four Body Coils:			
	Voltage	0 to 100	volts
	Current	0 to 12	amperes
Collector Coil:	Voltage	0 to 40	volts
	Current	0 to 5	amperes

MAXIMUM RATINGS

D-C BEAM VOLTAGE	30	KILOVOLTS
D-C BEAM CURRENT	10	AMPERES
D-C BODY CURRENT	300	MILLIAMPERES
A-C GETTER CURRENT	50	AMPERES
COLLECTOR DISSIPATION	210	KILOWATTS

TYPICAL OPERATION, WIDE-BAND, CW AMPLIFIER

RF Frequency	860	megacycles
Output Power	81	kilowatts
Driving Power	3	watts
Power Gain	44.3	decibels
D-C Beam Voltage	25	kilovolts
D-C Beam Current	7.52	amperes
Efficiency	43	percent
D-C Body Current	120	milliamperes
Half-Power Bandwidth	10.9	megacycles
Magnetic-Coil Currents:		
Prefocus coil	0.97	ampere
Body Coil #1	8.7	amperes
Body Coil #2	8.2	amperes
Body Coil #3	8.5	amperes
Body Coil #4	7.6	amperes
Collector Coil	3.6	amperes

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., San Carlos, California.

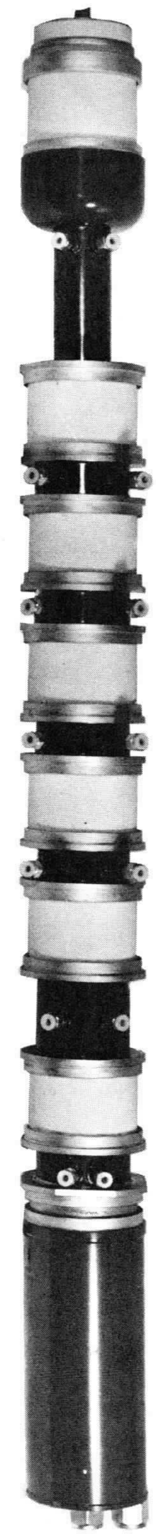
Eimac®

EITEL-McCULLOUGH, INC.
SAN BRUNO · CALIFORNIA

TENTATIVE DATA

6K50,000LQ

POWER-AMPLIFIER L-BAND KLYSTRON



The Eimac 6K50,000LQ is a six-resonant-cavity, magnetically focused, cascade amplifier klystron designed primarily for CW high-power, broad-band communication service in the frequency range of 720 to 980 megacycles.

When tuned for narrow-band operation, this tube type will provide 10 kilowatts of CW r-f output power with a power gain of more than 50 db. When tuned for broad-band operation, this tube type will provide more than 6 kilowatts of CW r-f output power with a power gain of more than 30 db and bandwidths of 15 to 20 megacycles between the 3-db power points

The resonant cavities of the Eimac 6K50,000LQ have cylindrical ceramic windows and are completed by tuning boxes external to the tube. Klystron amplifier circuit assemblies designed for use with this tube provide the required external tuning boxes, magnetic focusing frame, and magnetic focusing coils. Such circuit assemblies also provide both input and output coaxial-type radio-frequency fittings. In addition, these circuit assemblies include an air-system socket which provides for cooling and making connections to the electron-gun portion of the tube.

CHARACTERISTICS

ELECTRICAL

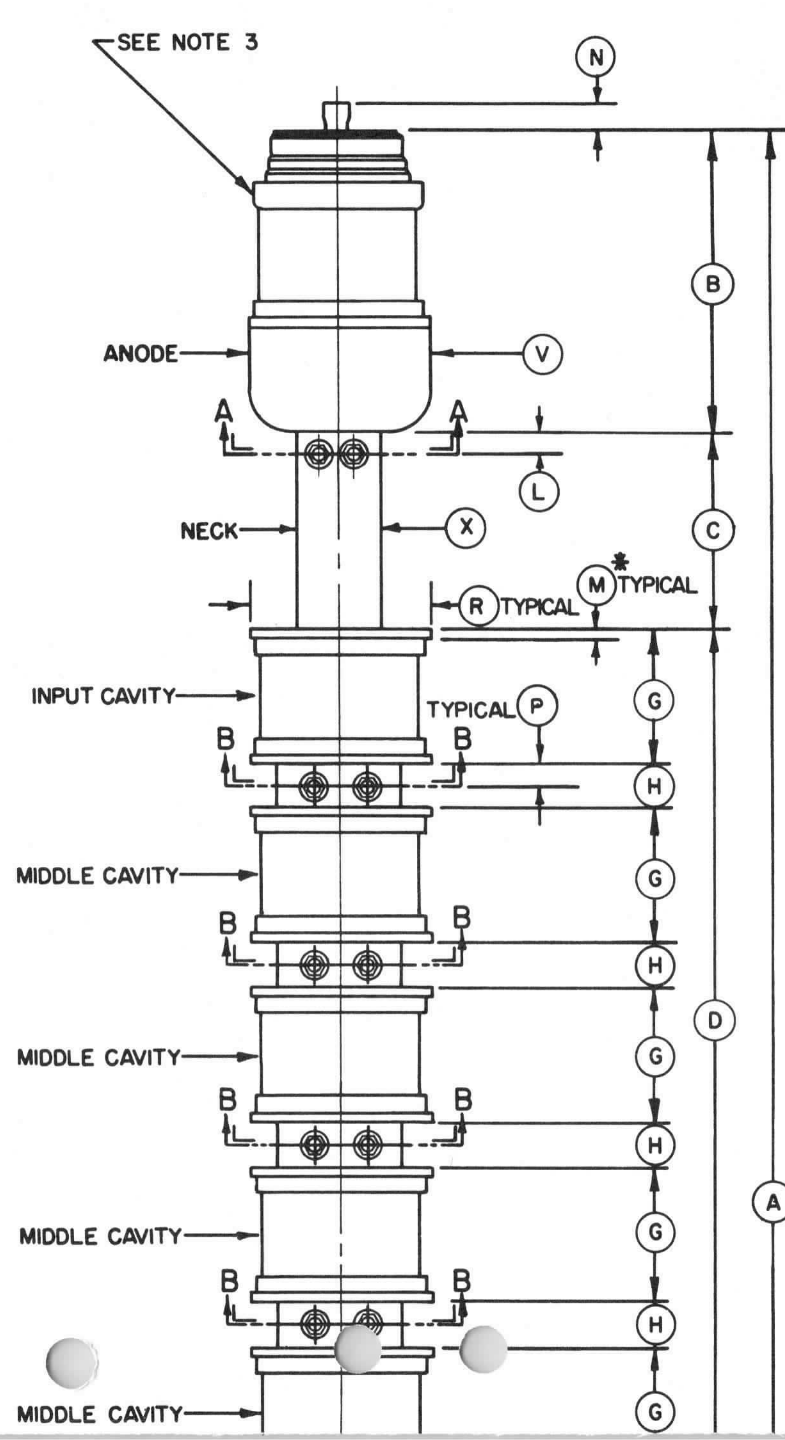
Filament:	Tungsten					
	Voltage	-	-	-	8.0	volts
	Current	-	-	-	40	amperes
	Maximum Starting Current			-	80	amperes
	Minimum Warm-Up Time		-	-	30	seconds
Cathode:	Unipotential, Bombardment Heated					
	Voltage	-	-	-	2280	volts
	Current	-	-	-	0.7	ampere
	Power -	-	-	-	1596	watts
▶ Frequency	Range -	-	-		720 to 985	mc

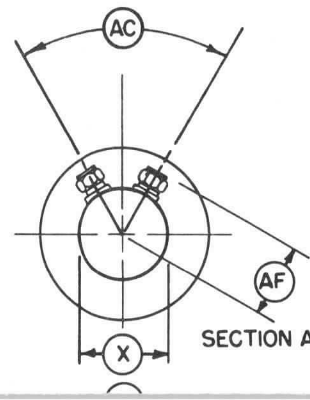
MECHANICAL

Operating Position		-	Vertical, cathode end up
Recommended Socket		- - -	Eimac SK-110
R-F Coupling:			
	Input -	-	Type "N" coaxial fitting
	Output -	-	3 1/8-inch coaxial line
Approximate Weights:			
	Net -	- - -	63 pounds
	Shipping	- - -	390 pounds

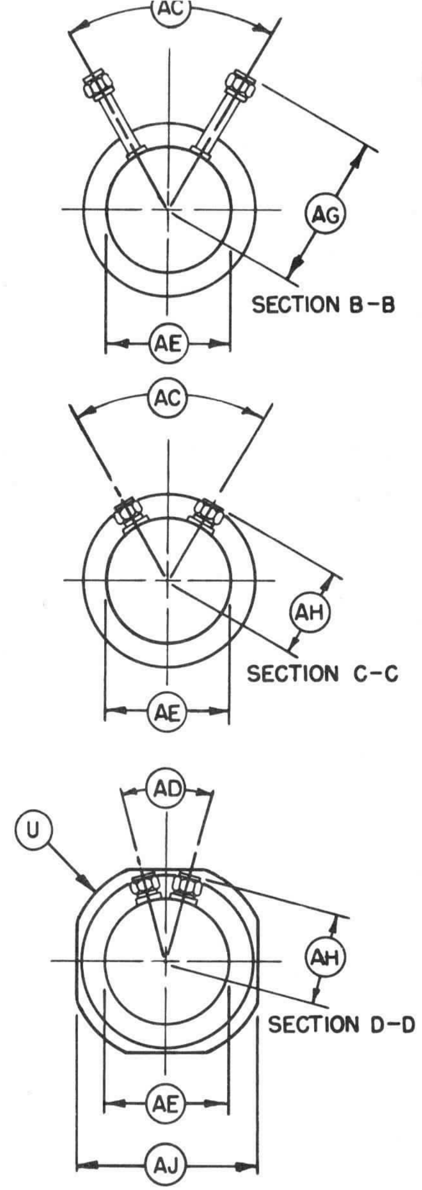
▶ Indicates change from sheet dated 2-10-58

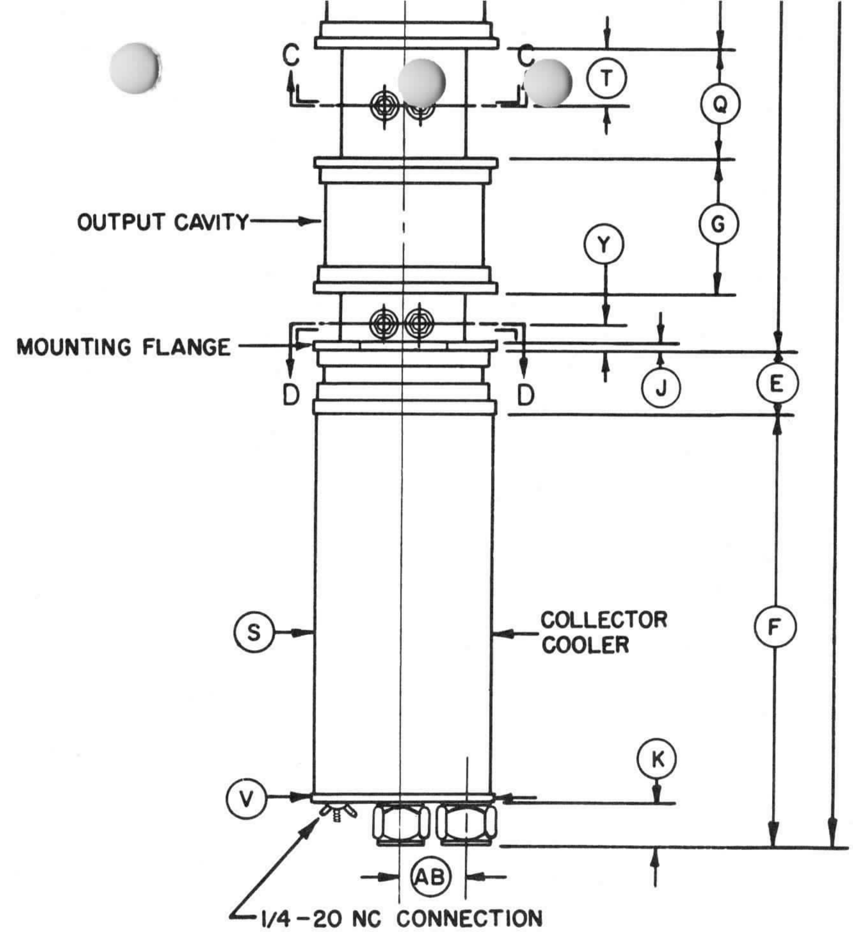
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		54.750	55.500
B		7.437	7.687
C		4.968	5.031
D		29.875	30.125
E	1.625		
F		10.812	11.062
G		3.468	3.531
H		1.156	1.218
J	.250		
K	1.062		
L	.562		
M		.187	
N	.500		
P	.593		
Q		2.718	2.781
R		4.615 DIA.	4.635 DIA.
S	4.500 DIA.		
T	1.375		
U	5.125 DIA.		
V	4.625 DIA.		
X	2.125 DIA.		
Y	.687		
AB	1.625		
AC	60°		
AD	30°		
AE	3.500 DIA.		
AF	1.875		
AG	4.000		
AH	2.565		
AJ	4.625		

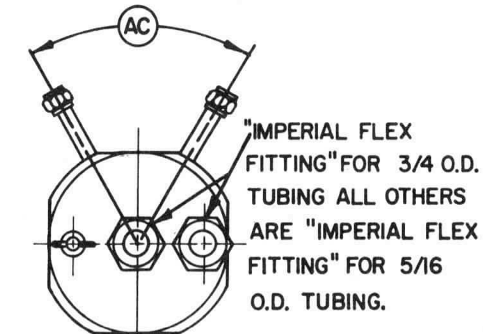




SECTION A-A







COLLECTOR END VIEW

NOTES:

1. * MINIMUM CONTACT SURFACES FOR ALL CAVITY PLATES.
2. DIMENSIONS IN INCHES.
3. FOR ELECTRICAL CONTACT SURFACE DIMENSIONS SEE GUN NO. 2 OUTLINE, DRWG. NO. GUN NO. 2 -6001.

▶COOLING REQUIREMENTS

	Volume	Pressure Drop
Cathode (With Eimac SK-110)	52 cfm air	5 inches H_2O
Fifth Cavity (Broad-Band Applications Only)	50 cfm air	1.5 inches H_2O
Output Cavity	50 cfm air	1.5 inches H_2O
Drift-Tube Jackets (Series Connected)	1 gpm water	11 psi
Collector Assembly	25 gpm water	28 psi

MAXIMUM RATINGS

D-C BEAM VOLTAGE	20 MAX. KILOVOLTS
D-C BEAM CURRENT	2.5 MAX. AMPERES
D-C BODY CURRENT (CONTINUOUS)	0.1 MAX. AMPERE
D-C BODY CURRENT (TUNING ONLY)	0.15 MAX. AMPERE
D-C FOCUS-ELECTRODE VOLTAGE	-500 MAX. VOLTS
BOMBARDED CATHODE:	
▶ VOLTAGE	2400 MAX. VOLTS
CURRENT	0.75 MAX. AMPERE
POWER	1600 MAX. WATTS
COLLECTOR DISSIPATION	50 MAX. KILOWATTS

TYPICAL OPERATION

Frequency	880	880	megacycles
Output Power	6.4	9	kilowatts
Bandwidth (3-db power points)	20	15	megacycles
Driving Power	1.7	2.3	watts
Power Gain	35.6	35.9	db
D-C Beam Voltage	17	19.5	kilovolts
D-C Beam Current	1.88	2.30	amperes
Beam Input Power	31.96	44.85	kilowatts
Beam-Power Efficiency	20	20	percent
D-C Body Current	50	50	milliamperes
D-C Collector Current	1.83	2.25	amperes
D-C Focus-Electrode Voltage	-175	-200	volts
Filament Voltage	8	8	volts
Filament Current	40	40	amperes
Bombarded Cathode:			
Voltage	2280	2280	volts
Current	0.7	0.7	ampere
Power	1596	1596	watts
▶ Collector Dissipation	24.71	34.88	kilowatts

APPLICATION

For additional information or information regarding a specific application, write to the Application Engineering Department, Eitel-McCullough, Inc., San Bruno, California. All such requests will be handled confidentially and without charge.

▶ Indicates change from sheet dated 2-10-58

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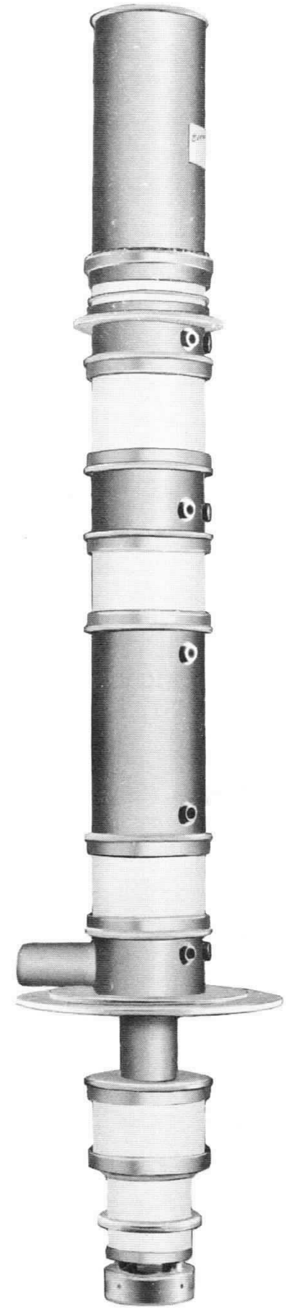
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X626AC

PULSE-AMPLIFIER L-BAND KLYSTRON



The Eimac X626AC is a three-cavity, pulse-amplifier klystron designed for high-average-power pulse service at frequencies from 400 to 450 megacycles. This klystron will deliver a peak output power of 1.25 megawatts, at 75 kilowatts average power, with a narrow-band power gain of 30 decibels.

All tuning is accomplished outside the vacuum envelope by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. This design permits external cavity loading for wide-band applications. For spares or replacements, only the basic klystron, without cavities, need be purchased.

This klystron employs the Eimac Modulating Anode which provides a convenient means for pulse modulating the output power without changing the beam voltage. The electron-gun geometry is such that the required beam current is obtained with a peak modulating-anode voltage of only 52 kilovolts, at the rated beam voltage of 100 kilovolts.

Waveguide output coupling for the X626AC is achieved by means of an adjustable iris in the output cavity.

Eimac Klystron Amplifier Circuit Assembly H-123B has been designed for use with the X626AC to cover the specified frequency range. This assembly includes a supporting structure, magnetic focusing coils, tuning cavities, input load coupler, output waveguide transition, and a klystron socket.

CHARACTERISTICS

ELECTRICAL

Cathode:	EMA, Unipotential		
	Minimum Heating Time - - - -	10	minutes
Heater:	Voltage (±5%) - - - - -	7.5	volts
	Current - - - - - -	90 to 100	amperes
	Maximum Starting Current - -	200	amperes
Getter:	Voltage - - - - - - -	15.6	volts
	Current - - - - - - -	36	amperes
Modulating Anode Capacitance (to all other electodes):			
	Dry - - - - - - -	45	$\mu\mu f$
	In Typical Circuit (oil immersed)	125 to 150	$\mu\mu f$
Power Gain (Narrow Band)		30	decibels
Peak Output Power - - - - - -		1.25	megawatts
Average Output Power - - - - -		75	kilowatts
Frequency Range (H-123B Circuit Assembly)		400 to 450	megacycles

MECHANICAL

Operating Position - - - - - - - - - -	Vertical, Cathode Down
R-F Input Coupling - - - - - - - - - -	1 5/8 inch, 50-ohm line
R-F Output Coupling - - - - - - - - - -	WR-2100 Waveguide
Weight (X626AC only) - - - - - - - - -	590 pounds

MECHANICAL cont.

Weight (H-123B Circuit Assembly)	1780	pounds
Maximum Dimensions (X626AC)		
Length	118	inches
Diameter	18	inches
Maximum Dimensions (X626AC and H-123B Circuit Assembly)		
Height	120	inches
Width	38	inches
Depth	38	inches

Cooling: Oil, Water and Forced Air
Electron Gun: Immersed in Oil

	Flow Rate	Pressure Drop
Penultimate and Output Cavities	250 cfm	3 inches H_2O
Four Drift-Tube Sections in Series	5 gpm	5.5 psi
Collector	50 gpm	26 psi

MAGNETIC COIL POWER-SUPPLY REQUIREMENTS

Prefocus Coil:	Voltage	0 to 60	volts
	Current	0 to 2	amperes
First Body Coil:	Voltage	0 to 100	volts
	Current	0 to 2	amperes
Each of Three Body Coils and Collector Coil:	Voltage	0 to 150	volts
	Current	0 to 6	amperes

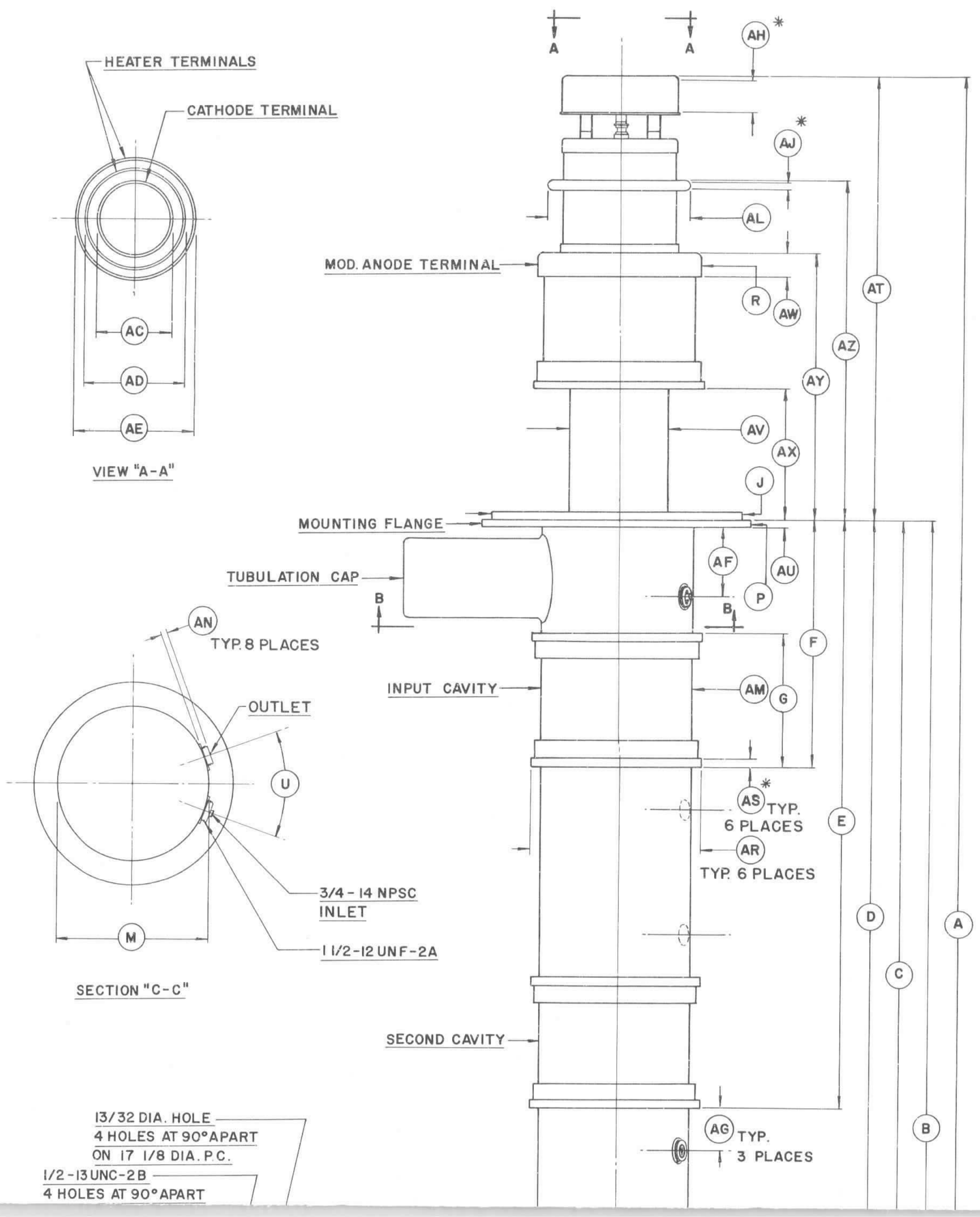
MAXIMUM RATINGS

D-C BEAM VOLTAGE	110	KILOVOLTS
PEAK BEAM CURRENT	36.5	AMPERES
PEAK MODULATING-ANODE VOLTAGE	66	KILOVOLTS
AVERAGE D-C BODY CURRENT	150	MILLIAMPERES
A-C GETTER CURRENT	50	AMPERES
COLLECTOR DISSIPATION	240	KILOWATTS
SEAL TEMPERATURES	175	DEGREES C
D-C FOCUS-ELECTRODE VOLTAGE	-500	VOLTS

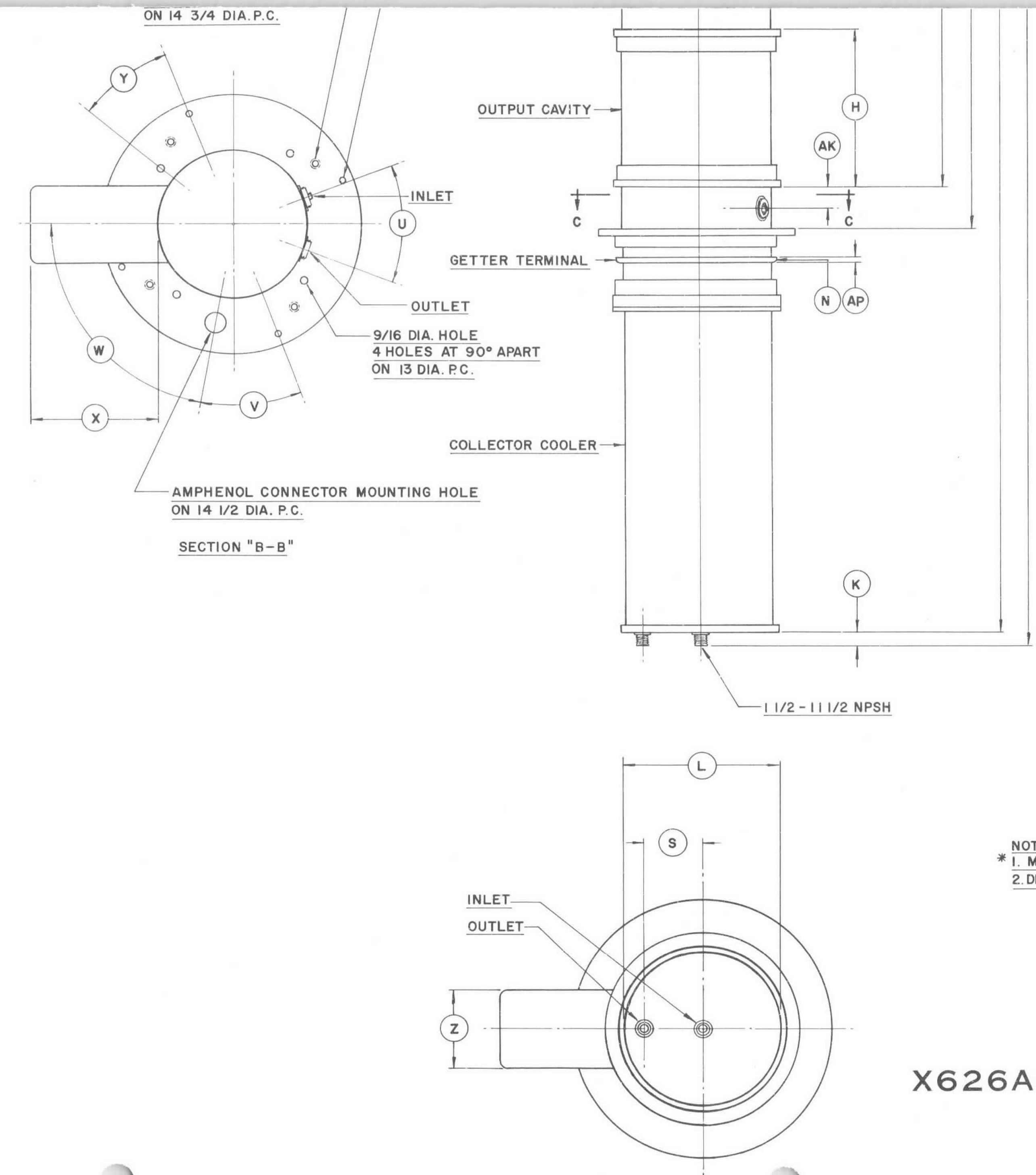
TYPICAL OPERATION, NARROW-BAND, PULSE AMPLIFIER

Frequency	425	megacycles
D-C Beam Voltage	100	kilovolts
Peak Modulating-Anode Voltage	52	kilovolts
Peak Beam Current	32.5	amperes
Average D-C Body Current	130	milliamperes
Peak Output Power	1.25	megawatts
Average Output Power	75	kilowatts
Peak Drive Power	1.25	kilowatts
Power Gain	30	decibels
Peak Beam Power Efficiency	38.4	percent
Focus-Electrode Voltage	-50	volts
Pulse Width	2000	microseconds
Pulse Repetition Rate	30	pulses/second
Duty	0.06	
Electron-Gun Microperveance	2.6	
Beam Microperveance	0.98	
Magnetic-Coil Currents		
Prefocus Coil	1.4	amperes
First Body Coil	1.0	ampere
Second, Third & Fourth Body Coil and Collector Coil (each)	4.0	amperes

For additional information or information regarding a specific application write to Eitel-McCullough, Inc., San Carlos, California.

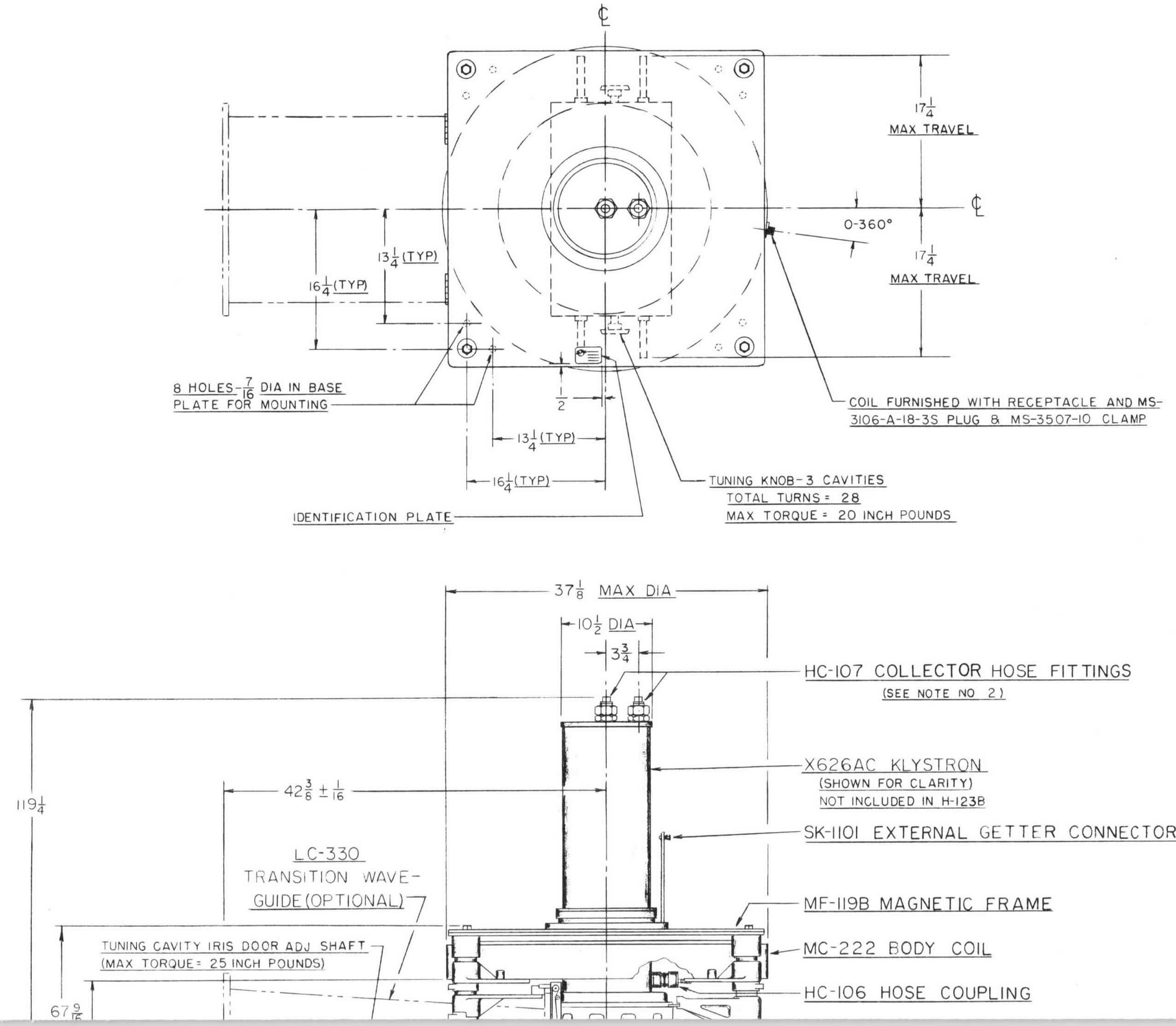


DIMENSIONAL DATA			
REF	NOM	MIN	MAX
A	117.5		
B	89.3		
C		60.78	61.20
D	58.0		
E	42.0		
F	14.6		
G		8.790	8.842
H		10.429	10.481
J		16.375	16.500
K		.600	
L	10.5		
M	10.0		
N	10.8		
P		17.875	18.030
R	10.9		
S	3.7		
T			
U	40°		
V	32°		
W	91.5°		
X	6.750		
Y	30°		
Z	4.0		
AA			
AB			
AC		33.970	4.090
AD		6.165	6.285
AE		7.910	8.030
AF	3.75		
AG	2.0		
AH		2.375	
AJ		.5	
AK		1.460	1.560
AL		9.281	9.343
AM	10.045		
AN		.375	
AP		.250	.500
AR		11.490	11.510
AS		.375	
AT		27.290	27.790
AU		.437	
AV	5.0		
AW			
AX	7.5		
AY	15.6		
AZ	20.7		

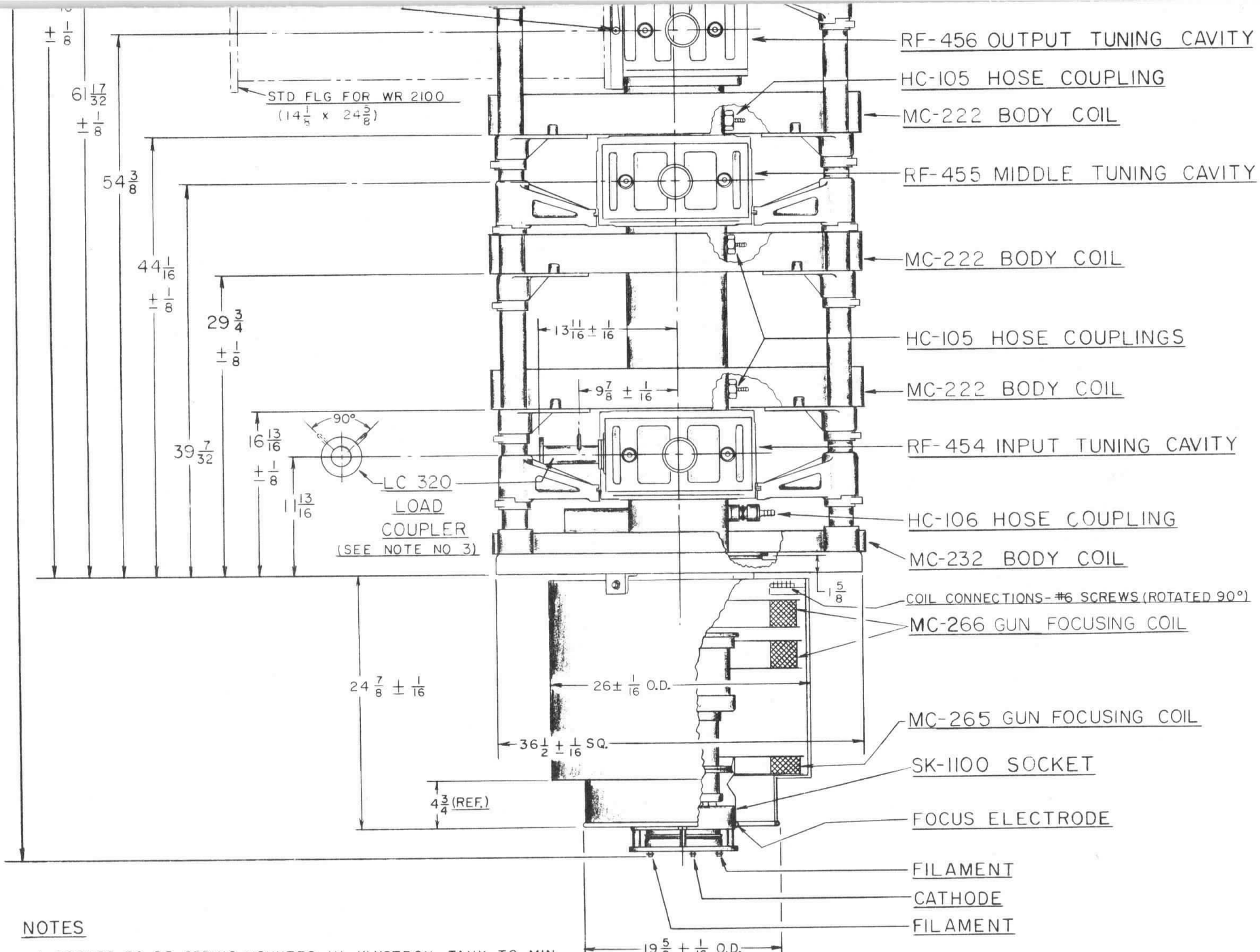


NOTES:
* 1. MIN. STRAIGHT SURFACE FOR CONTACT.
2. DIMENSIONS ARE INCHES.

X626AC KLYSTRON



17 1/4 MAX TRAVEL
17 1/4 MAX TRAVEL
0-360°
13 1/4 (TYP)
16 1/4 (TYP)
8 HOLES-7/16 DIA IN BASE PLATE FOR MOUNTING
1/2
13 1/4 (TYP)
16 1/4 (TYP)
COIL FURNISHED WITH RECEPTACLE AND MS-3106-A-18-3S PLUG & MS-3507-10 CLAMP
TUNING KNOB-3 CAVITIES
TOTAL TURNS = 28
MAX TORQUE = 20 INCH POUNDS
IDENTIFICATION PLATE
37 1/8 MAX DIA
10 1/2 DIA
3 3/4
HC-107 COLLECTOR HOSE FITTINGS
(SEE NOTE NO 2)
X626AC KLYSTRON
(SHOWN FOR CLARITY)
NOT INCLUDED IN H-123B
42 3/8 ± 1/16
119 1/4
SK-1101 EXTERNAL GETTER CONNECTOR
LC-330
TRANSITION WAVE-GUIDE (OPTIONAL)
MF-119B MAGNETIC FRAME
TUNING CAVITY IRIS DOOR ADJ SHAFT
(MAX TORQUE = 25 INCH POUNDS)
MC-222 BODY COIL
HC-106 HOSE COUPLING
67 9/16



NOTES

1 SOCKET TO BE SPRING MOUNTED IN KLYSTRON TANK TO MIN DIMENSION MIN SPRING COMPRESSION TO BE $\frac{3}{4}$ INCH

2 MATING PART (BY CUSTOMER) SNAP-TITE COUPLER HALF NO H24-2009-38

3 STD $1\frac{5}{8}$ UHF COAX FLANGE ON LOAD COUPLER

PARTS NOT SHOWN

HT-105 EXTENSION WRENCH
HT-106 COUPLING WRENCH
HT-107 WATER FITTING WRENCH

H-123B KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY

Eimac®

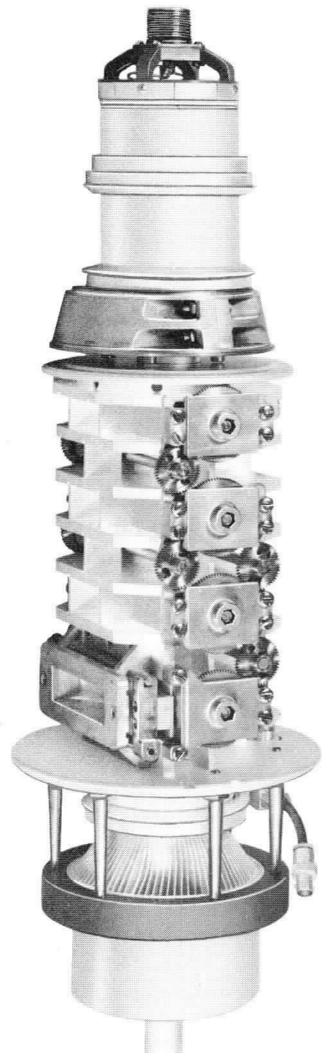
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X700

PULSE AMPLIFIER

S-BAND KLYSTRON



The Eimac X700 is a four cavity, magnetically focused, pulse amplifier klystron designed for use under severe environmental conditions. This klystron will deliver a peak output power of 20 kilowatts, at 1 kilowatt average power, at frequencies from 2400 to 2900 megacycles. Typical power gain is 40 decibels.

This klystron employs the Eimac Modulating Anode which provides an effective means of pulse modulating the output power without changing the beam voltage. The electron-gun geometry is such that the modulating anode voltage is only 50% as great as the beam voltage.

The resonant cavities of the X700 are an integral part of the klystron but are completed and tuned outside the vacuum envelope.

Waveguide output coupling for the X700 is achieved by means of an adjustable iris in the output cavity.

The associated magnetic circuitry for the X700 includes a supporting structure, focusing coils, extension tuning controls, and a waveguide transition.

CHARACTERISTICS

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Minimum Heating Time	5	minutes
Heater: Voltage (±5%)	7.5	volts
Current	5.5	amperes
Maximum Starting Current	11	amperes
Typical Power Gain	40	decibels
Peak Output Power	20	kilowatts
Average Output Power	1.0	kilowatt
Frequency Range	2400 to 2900	megacycles

MECHANICAL

Operating Position	Vertical, Cathode up	
RF Input Coupling	50-ohm TNC	
RF Output Coupling	WR-284 Waveguide	
Weight (X700)	39	pounds
Weight (Circuit Assembly)	160	pounds
Maximum Dimensions (X700)		
Length	24	inches
Diameter	7	inches
Maxmum Dimensions (X700 and circuit assembly)		
Length	24	inches
Diameter	17	inches

Cooling: Forced Air	Flow Rate	Pressure Drop
Body	100 cfm	1.5 inches H_2O
Collector	100 cfm	1.5 inches H_2O

MAGNETIC-COIL POWER-SUPPLY REQUIREMENTS

Prefocus Coil: Voltage	0 to 40	volts
Current	0 to 2	amperes
Each of Two Body Coils:		
Voltage	0 to 40	volts
Current	0 to 10	amperes
Collector Coil: Voltage	0 to 50	volts
Current	0 to 5	amperes

MAXIMUM RATINGS

DC BEAM VOLTAGE	28	KILOVOLTS
PEAK BEAM CURRENT	36.5	AMPERES
PEAK MODULATING-ANODE VOLTAGE	14	KILOVOLTS
AVERAGE DC BODY CURRENT	50	MILLIAMPERES
COLLECTOR DISSIPATION	2500	WATTS
DC FOCUS-ELECTRODE VOLTAGE	−500	VOLTS

TYPICAL OPERATION, NARROW-BAND, PULSE AMPLIFIER

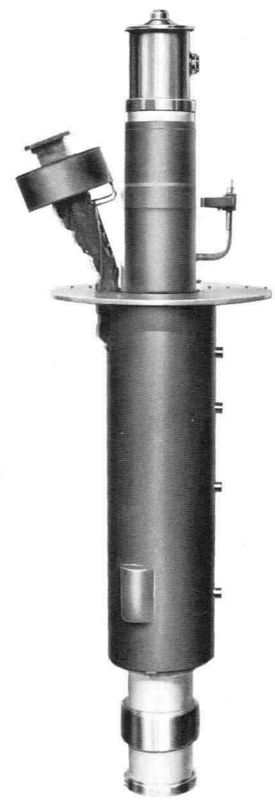
Frequency	2500	megacycles
DC Beam Voltage	21	kilovolts
Peak Modulating-Anode Voltage	10.5	kilovolts
Peak Beam Current	2.77	amperes
Average DC Beam Current	0.138	ampere
Average DC Body Current	25	milliamperes
Peak Output Power	21.5	kilowatts
Average Output Power	1.07	kilowatts
Peak Drive Power	2	watts
Power Gain	40.2	decibels
Peak Beam Power Efficiency	37	percent
Focus-Electrode Voltage	−100	volts
Pulse Width	50	microseconds
Pulse Repetition Rate	1000	pulses/second
Duty	0.05	
Magnetic Coil Currents:		
Prefocus Coil	1.2	amperes
First Body Coil	7.0	amperes
Second Body Coil	7.0	amperes
Collector Coil	3.2	amperes

For additional information or information regarding a specific application write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X780

**PULSE AMPLIFIER
L-BAND KLYSTRON**



The Eimac X780 is a pulse-amplifier klystron designed to operate at frequencies from 1235-1365 megacycles. This klystron will deliver a peak output power of 2.5 megawatts at 75 kilowatts average power, with a minimum saturated gain of 35 decibels. The small signal gain is in excess of 50 decibels.

Four integral cavities are used in the X780. The RF input and output coupling circuits are of the fixed broad-band type, optimized at maximum power. The output window is a thick beryllium oxide disc which will withstand severe abuse. The electron gun utilizes a confined flow configuration which results in a stable beam and non-critical focusing adjustments.

This klystron employs the Eimac Modulating Anode which provides a convenient means for pulse modulating the output power without changing the beam voltage. Also incorporated are two built-in vacuum pumps. One consists of an active titanium getter. The other is an ion pump which maintains a low vacuum pressure and provides for continuous monitoring of this pressure.

A focusing electromagnet and klystron supporting structure, Catalog Number H-145, has been designed for use with the X780.

CHARACTERISTICS

ELECTRICAL

Cathode: EMA, Unipotential		
Minimum Heating Time	10	minutes
Heater: Voltage (±5%)	7	volts
Current	90	amperes
Maximum Starting Current	180	amperes
Getter: Voltage (AC nominal)	4	volts
Current	20	amperes
Power Gain (minimum narrow band)	35	decibels
Peak Power Output	2.5	megawatts
Average Power Output	75	kilowatts
Frequency Range	1235-1365	megacycles
Phase: Beam Voltage Sensitivity	0.006	degree/volt
Ion Pump:		
Voltage DC	4000	volts
Current (0.1 megohm limiting resistor)	10	milliamperes
Beam Microperveance	1.5	
Electron Gun Microperveance	2.5	
Input VSWR (maximum)	1.5:1	

MECHANICAL

Operating Position	Vertical, Cathode End Down	
RF Input Coupling	EIA standard RS 225, ⅞" rigid coaxial fitting	
RF Output Coupling	RG69/U Flange	
Approximate Weight (tube only)	400	pounds
Approximate Weight (H-145 Magnetic Circuit)	1500	pounds

Cooling: Oil and Water

Cathode — Immersed in Oil

	Flow Rate	Pressure Drop
Collector	60 gpm	40 psi
Klystron Body	5 gpm	25 psi
Electromagnet	2 gpm	30 psi

Fittings: Collector — Hansen B12 HK
Body — Hansen B4-K26
Electromagnet — Hansen B4-H26

Maximum Overall Dimensions (Klystron & Electromagnet):

Length	71	inches
Diameter	24	inches
Electromagnet Power Supply Requirements	2.5	kilowatts

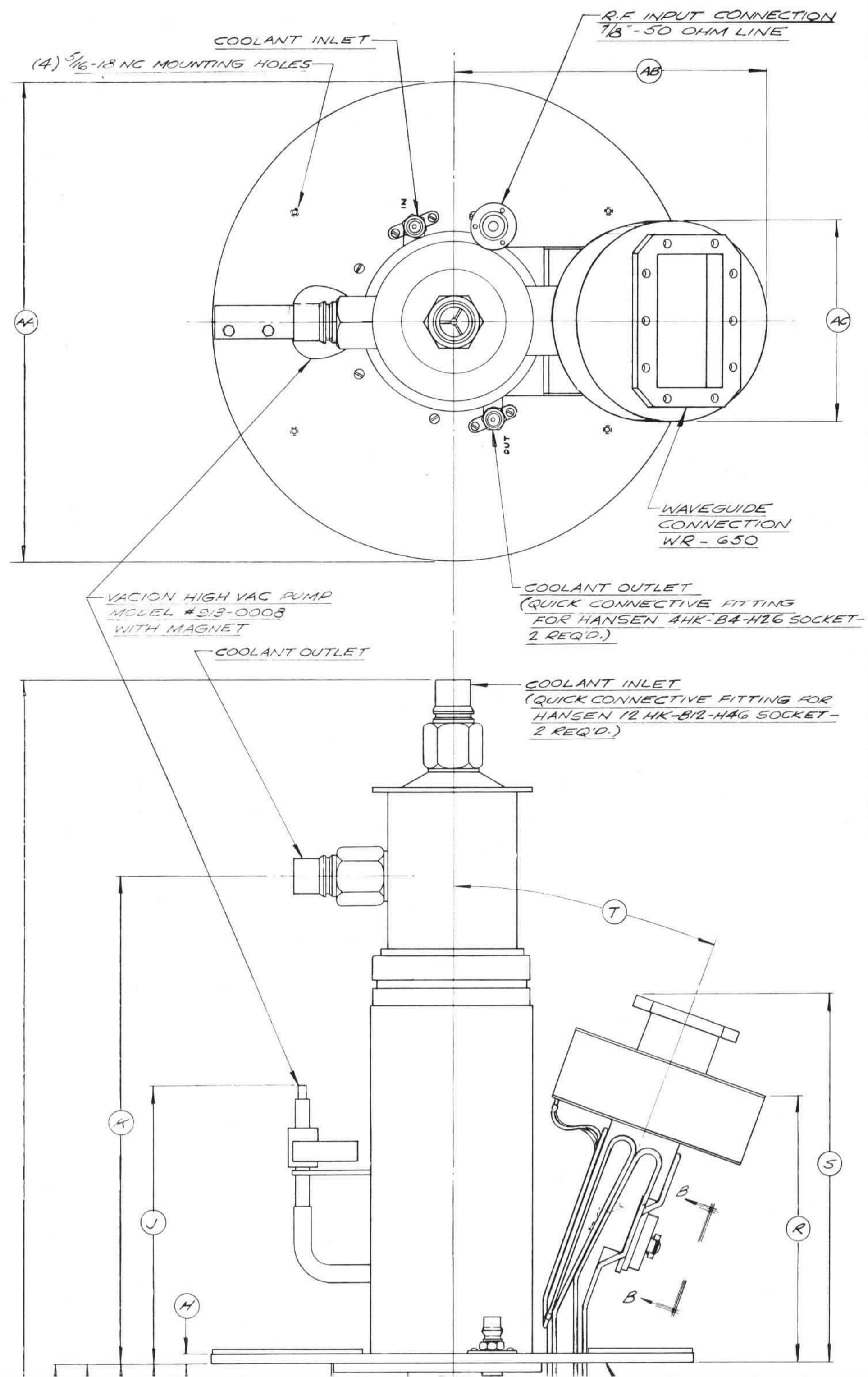
MAXIMUM RATINGS

DC BEAM VOLTAGE	120	kilovolts
PEAK BEAM CURRENT	62.5	amperes
PEAK MODULATING ANODE VOLTAGE	88	kilovolts
AVERAGE DC BODY CURRENT	150	milliamperes
AC GETTER CURRENT	45	amperes
COLLECTOR DISSIPATION	250	kilowatts
SEAL TEMPERATURES	175	degrees C
LOAD VSWR	1.5:1	

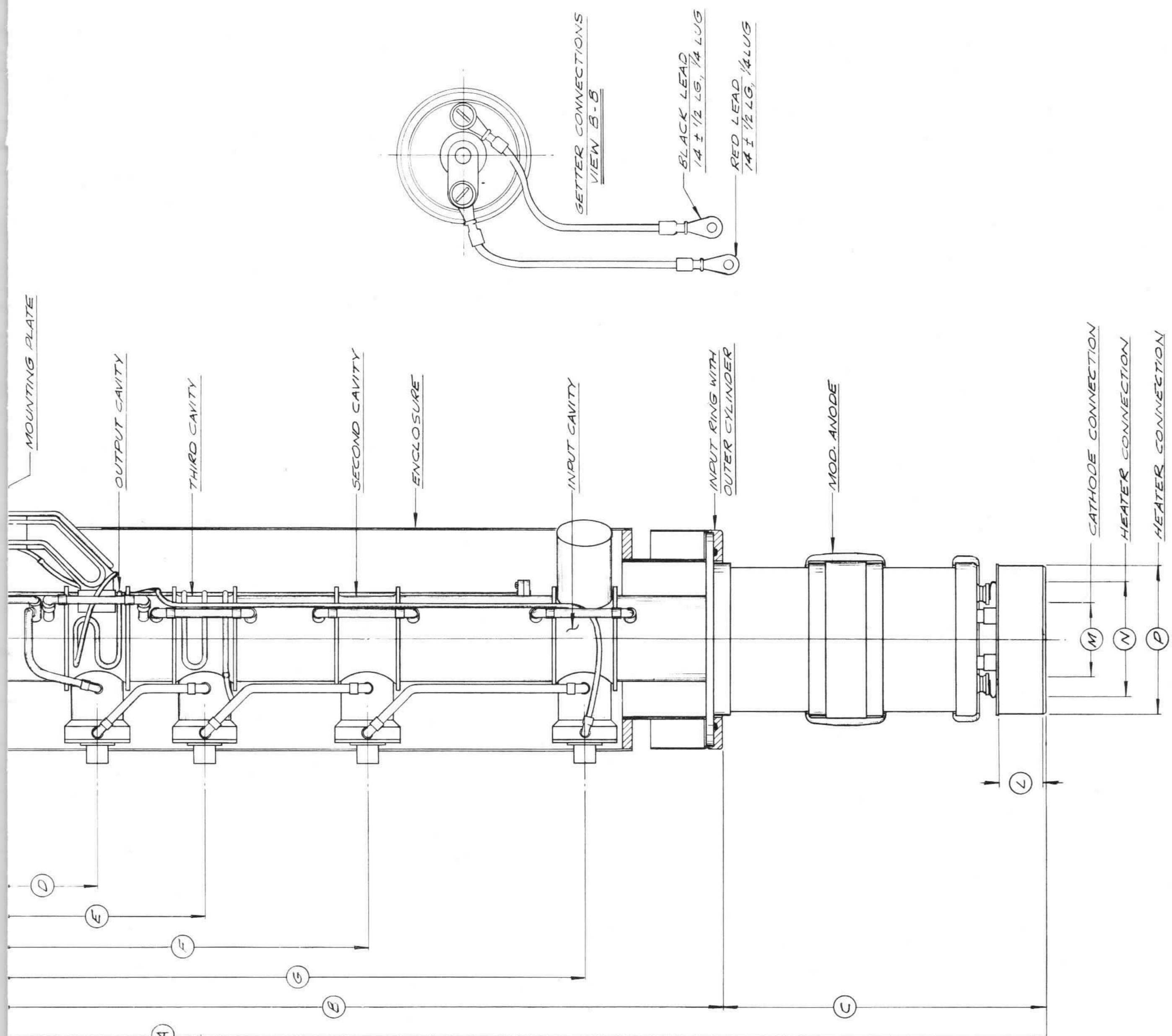
TYPICAL OPERATION, NARROW-BAND PULSE AMPLIFIER

Frequency	1295	1295	megacycles
DC Beam Voltage	100	115	kilovolts
Peak Modulating-Anode Voltage	73.5	83.5	kilovolts
Peak Beam Current	41.8	58.6	amperes
Average DC Body Current	90	100	milliamperes
Peak Output Power	1.485	2.515	megawatts
Average Output Power	89	75.5	kilowatts
Peak Drive Power	0.475	0.790	kilowatts
Power Gain	35	35	decibels
Peak Beam Power Efficiency	35.6	36.8	percent
Pulse Width	2	1	millisecond
Pulse Repetition Rate	30	30	pulses/second
Duty	0.06	0.03	percent

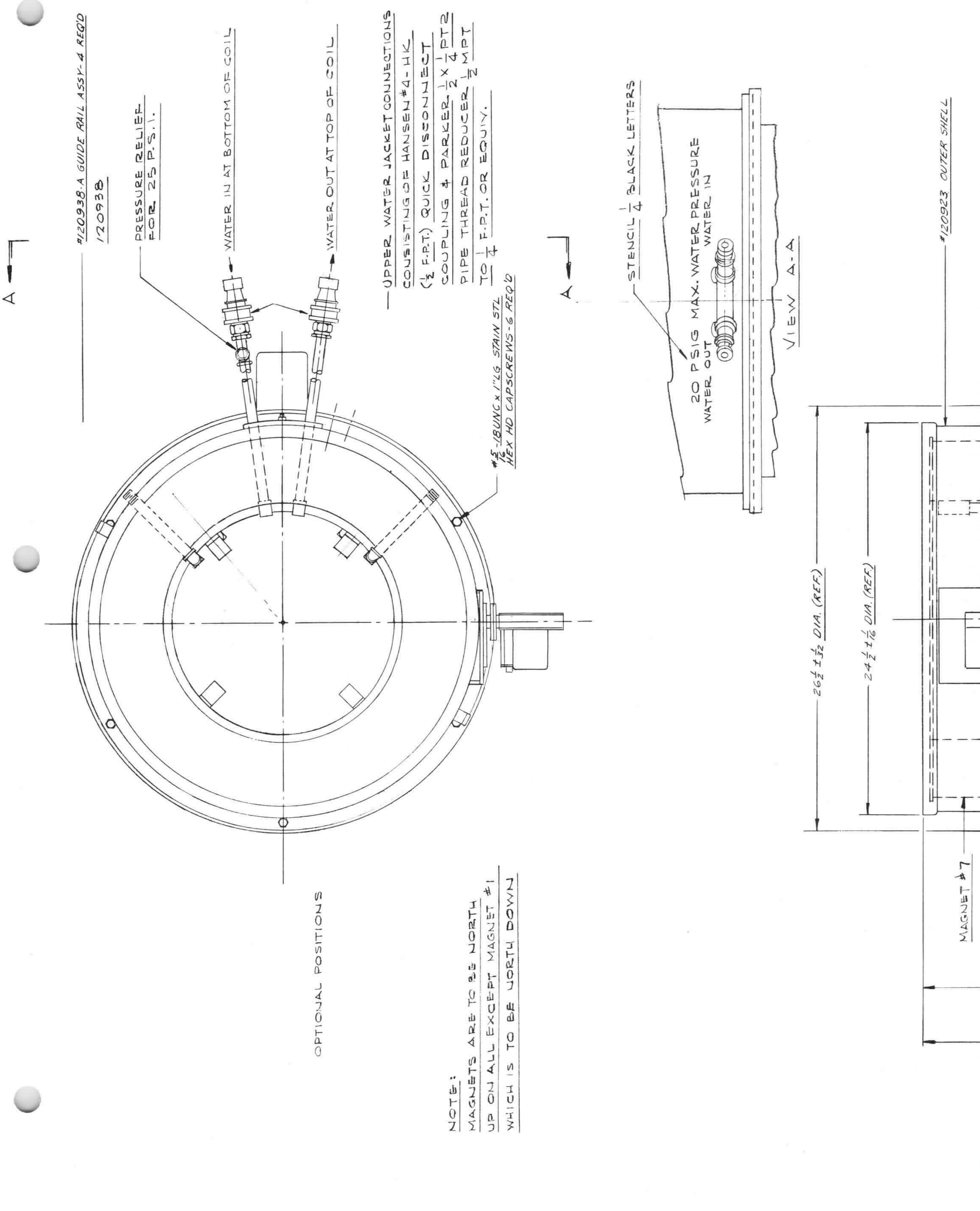
For additional information regarding a specific application,
write to Eitel-McCullough, Inc., San Carlos, California.

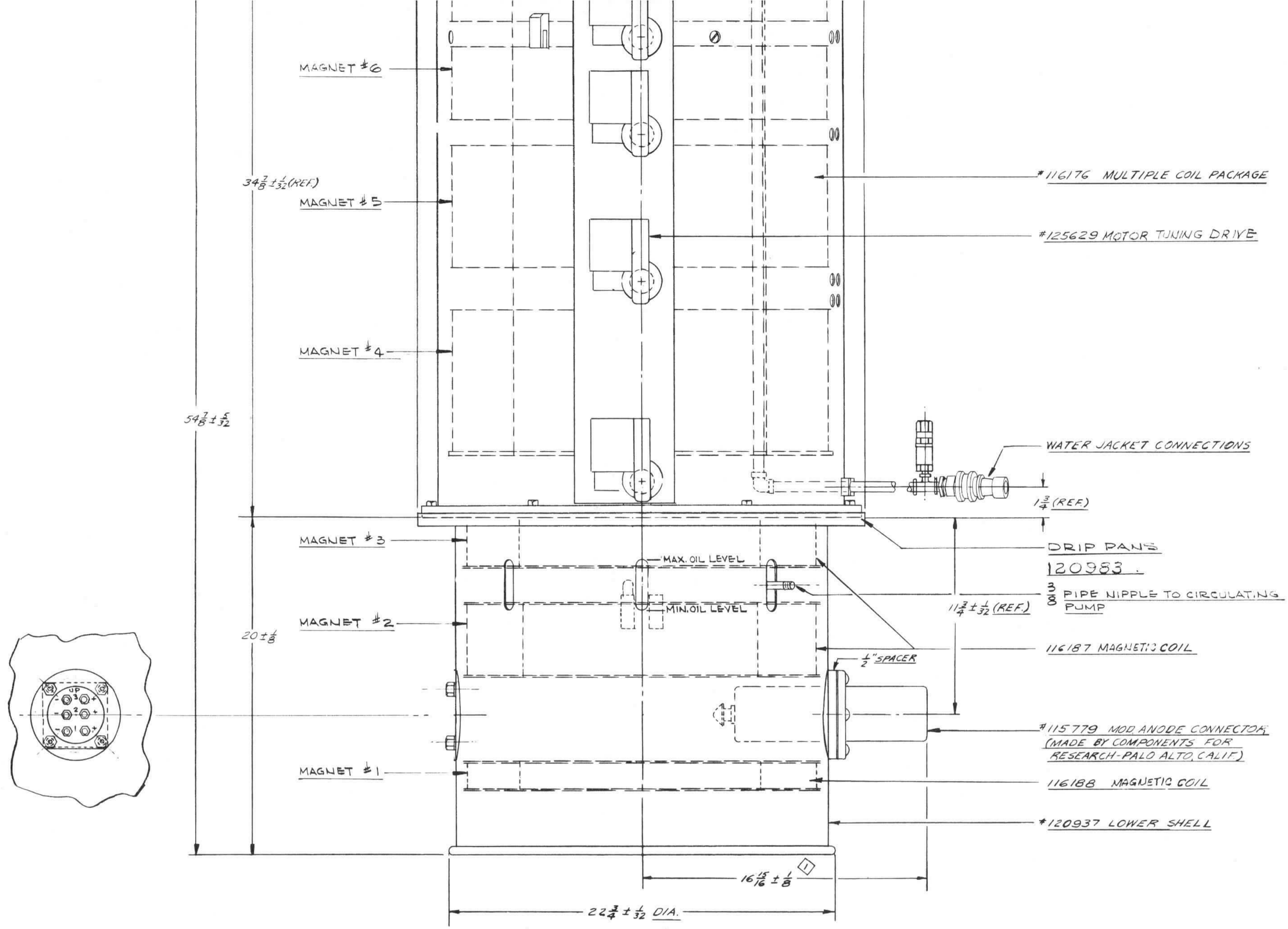


DIMENSIONAL DATA			
REF.	NOM.	MIN.	MAX.
A	92.625		
B	40.250		
C	17.125		
D	6.000		
E	11.812		
F	20.562		
G	32.312		
H	.500		
J	12.625		
K	24.750		
L	2.375		
M	4.000		
N	6.250		
P	8.000		
R	12.500		
S	17.750		
T	20°		
AA	24.000		
AB	15.000		
AC	10.000		



X780 KLYSTRON


#120938-A GUIDE RAIL ASSY-4 REQ'D
120938
PRESSURE RELIEF
FOR 25 P.S.I.
WATER IN AT BOTTOM OF COIL
WATER OUT AT TOP OF COIL
UPPER WATER JACKET CONNECTIONS
CONSISTING OF HANSEN #4-HK
(1/2 F.P.T.) QUICK DISCONNECT
COUPLING & PARKER 1/2 x 1/4 PT2
PIPE THREAD REDUCER 1/2 MPT
TO 1/4 F.P.T. OR EQUIV.
A
A
STENCIL 1/4 BLACK LETTERS
20 PSIG MAX. WATER PRESSURE
WATER IN
WATER OUT
VIEW A-A
#5/16-18UNC x 1"LG STAIN STL
HEX HD CAPSCREWS-6 REQ'D
#120923 OUTER SHELL
26 1/2 ± 1/32 DIA. (REF.)
24 1/2 ± 1/16 DIA. (REF.)
MAGNET #7
OPTIONAL POSITIONS
NOTE:
MAGNETS ARE TO BE NORTH
UP ON ALL EXCEPT MAGNET #1
WHICH IS TO BE NORTH DOWN



H-145 KLYSTRON AMPLIFIER CIRCUIT ASSEMBLY

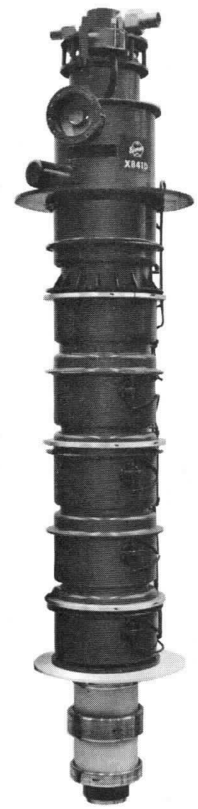
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

Tentative Data

X841D

PULSE AMPLIFIER
UHF KLYSTRON

The EIMAC X841D is a pulse amplifier klystron designed for broadband high average power pulse service at frequencies from 400-450 megacycles. This klystron will have a 5%, fixed-tuned band-width anywhere within this frequency range and will deliver a minimum peak output power of 2.5 megawatts, at 150 kilowatts average power, with a minimum power gain of 33 decibels.



Six integral cavities are used in the klystron. The output circuit mates to a 6⅛ inch transmission line.

This klystron employs the EIMAC Modulating Anode which provides a convenient means for pulse modulating the output power without changing the beam voltage. The electron-gun geometry is such that a typical switching voltage of 75 kilovolts is required for the modulating anode to provide the specified beam current, at the rated beam voltage of 115 kilovolts. The equivalent modulating anode impedance is approximately one megohm.

The tube incorporates a built-in ion pump and gauge which maintains a low gas pressure, and also provides a means for continuously monitoring this pressure.

Catalog Number H-150 has been assigned to the magnetic circuitry for this tube.

CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	15 minutes
Heater: Voltage (maximum)	30 volts
Current (maximum)	35 amperes
Power Gain (minimum)	33 decibels
Peak Power Output	2.5 megawatts
Average Power Output	150 kilowatts
Phase shift as a function of beam voltage	0.006 degree/volt
Ion Pump: Voltage	3,000-4,000 volts dc
Current (0.1 megohm limiting resistor)	10 milliamperes
Beam Microperveance	1.6
Electron Gun Microperveance	3.0

MECHANICAL

Operating Position		Vertical, Cathode End Down
Input Coupling (rf)		UG 22/U, Type N
Output Coupling (rf)		6⅛" Coax
Approximate Weight (tube only)		1,000 Pounds
Approximate Weight (H-150 Magnetic Circuit)		1,200 Pounds

Cooling: Oil and Water (Max Water Inlet Temp of 45°C)

	Flow Rate	*Pressure Drop*
Cathode — Immersed in Oil		
Collector	120 gpm	65 psi
Klystron Body	10 gpm	65 psi
Electromagnet	5 gpm	65 psi

Maximum Overall Dimensions (Klystron and Electromagnet):

Length	130 inches
Diameter	26 inches
Greatest Extending Radius	16-5/16 inches

ELECTROMAGNET POWER SUPPLY REQUIREMENTS

Each of 3 supplies	75 volts at 10 amperes
Each of 2 supplies	150 volts at 10 amperes
Each of 3 supplies	300 volts at 10 amperes

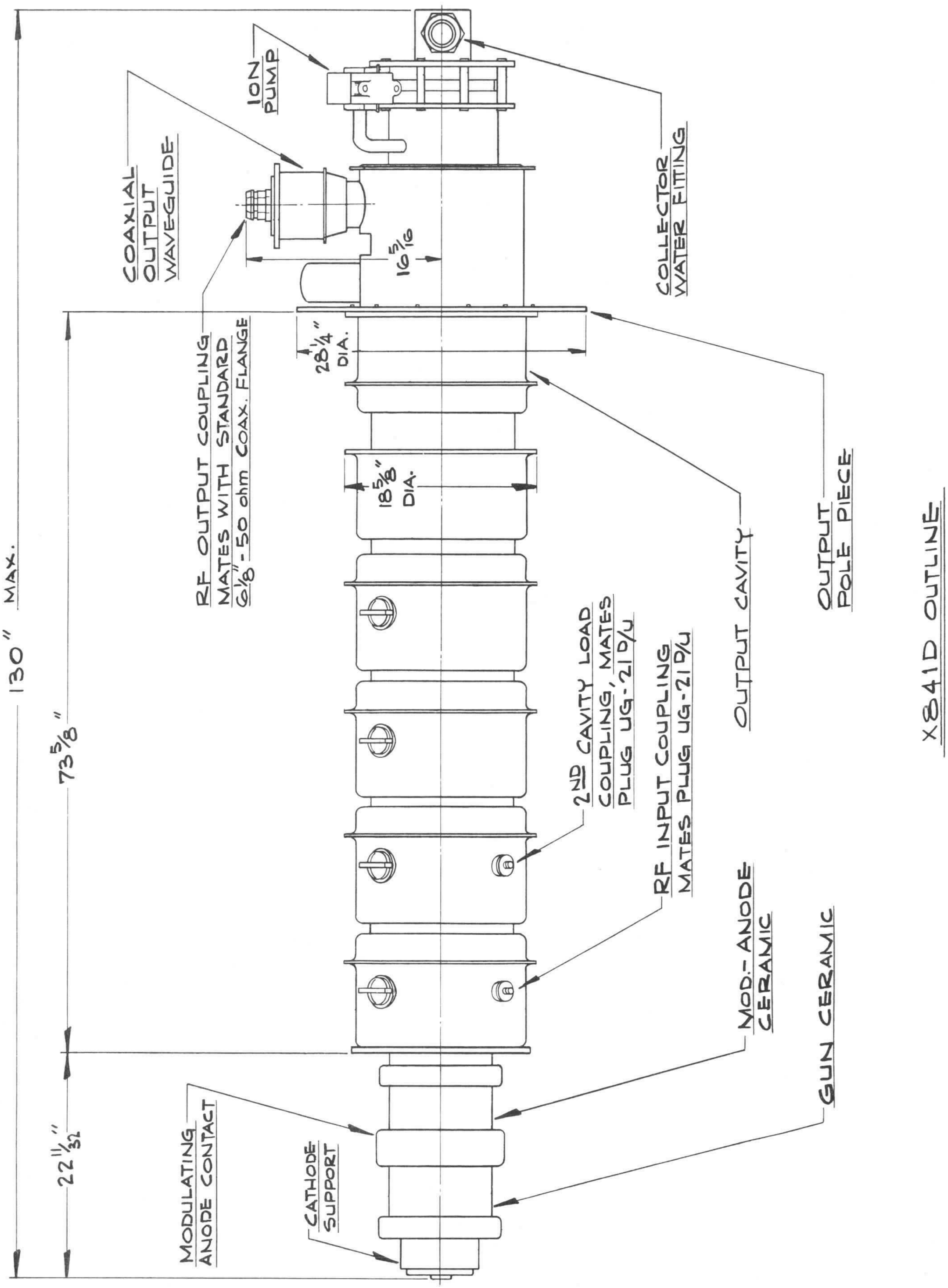
MAXIMUM RATINGS

BEAM VOLTAGE (dc)	115 Kilovolts
PEAK BEAM CURRENT	66 Amperes
PEAK MODULATING ANODE VOLTAGE	78 Kilovolts
AVERAGE MODULATING ANODE CURRENT	20 Milliamperes
AVERAGE BODY CURRENT	200 Milliamperes
PULSE WIDTH	2000 Microseconds
COLLECTOR DISSIPATION	450 Kilowatts
DUTY CYCLE	.06
SEAL TEMPERATURES	150 Degrees C
LOAD VSWR	1.5:1
INLET WATER PRESSURE	100 PSIG

TYPICAL OPERATION, BROAD-BAND PULSE AMPLIFIER

Center Frequency	425 Megacycles
Beam Voltage	112 Kilovolts dc
Peak Modulating-Anode Voltage	74 Kilovolts
Peak Beam Current	60 Amperes
Average Body Current	60 Milliamperes dc
Peak Output Power	2.5 Megawatts
Average Output Power	150 Kilowatts
Peak Drive Power	500 Watts
Power Gain	37 Decibels
Peak Beam Power Efficiency	40 Percent
Pulse Width	2000 Microseconds
Pulse Repetition Rate	30 Pulses per second
Duty	.06
Bandwidth (1 db)	25 Megacycles
Load VSWR	1.2:1

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.



X841D OUTLINE

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

OBJECTIVE DATA

X850 X-BAND 20 KW CW POWER AMPLIFIER KLYSTRON

The X850 is the most recent product of the Eimac High Power Microwave Tube Laboratory. It is the first of a series of Eimac X-band power klystrons which will ultimately include tubes at all commonly used power levels.

Four integral cavities are used in the X850. Each tube is pretuned at the laboratory to the frequency chosen by the user, within the 7.125 to 8.5 kMc band.

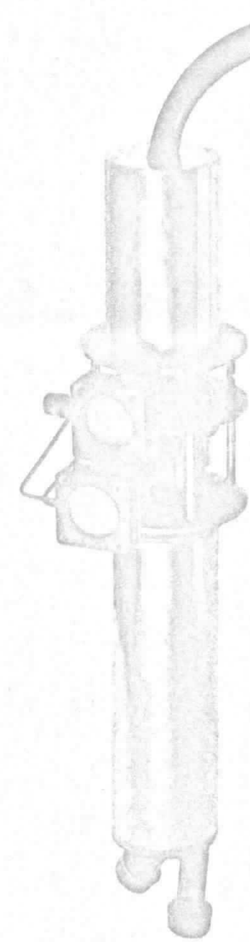
The X850 is intended especially for use in space age applications including missile and satellite tracking systems, radar astronomy, and space communications.

The electron gun of the X850 utilizes a convergent confined flow field which results in non-critical focusing adjustments and produces a stable, quiet beam. This electron gun is rugged in structure and completely enclosed in a metal shield with integral, shielded, connecting leads, to reduce the high-voltage hazard to a minimum.

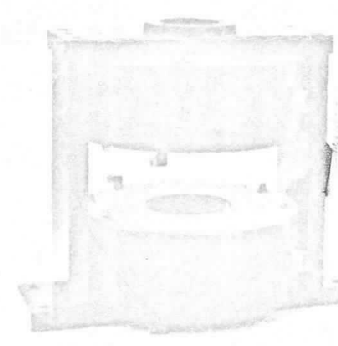
Fixed input and output couplings are used in the X850. The output window is a thick beryllium oxide disc. Unusual stability, for this power and frequency, is achieved through the use of improved body cooling.

The superior bandwidth of this klystron, 35 Mc minimum, and low beam voltage are due to high perveance design. Exceptionally high convergence of the electron gun, 50:1, means very low cathode emission density resulting in long life expectancy.

A focusing electromagnet and klystron supporting structure, Catalog Number H-160, has been designed for use with the X850. Only one power supply is required for the electromagnet.



X-850



H-160

CHARACTERISTICS

ELECTRICAL

Heater:	Voltage - - -	10	volts
	Current - - -	3.0	amperes
	Maximum Starting Current	6.0	amperes
Cathode:	Impregnated, Unipotential		
	Heating Time - -	5	minutes
Power Gain	- - - -	43	decibels
Output Power	- - - -	20	kilowatts
Frequency Range	- - -	7.125 to 8.5	kilomegacycles

MECHANICAL (continued)

Operating Position		Any
RF Coupling:		
Input		WR-112 Waveguide
Output		WR-112 Waveguide
Dimensions:		
Klystron only	6x7x25	inches
H-160 Electromagnet:		
Length	17	inches
Width	18	inches
Depth	12	inches
Weight:		
Klystron only	20	lbs
H-160 Electromagnet	200	lbs

Cooling: Water and Forced Air

	Flow Rate	Pressure Drop
Cathode	5 cfm	free
Klystron Body and Electromagnet	2 gpm	100 psi
Klystron Collector	8.5 gpm	45 psi

ELECTROMAGNET POWER-SUPPLY REQUIREMENTS

Voltage	50	volts
Current	25	amperes

MAXIMUM RATINGS

DC BEAM VOLTAGE	22	KILOVOLTS
DC BEAM CURRENT	3.5	AMPERES
DC BODY CURRENT (with RF drive)	80	MILLIAMPERES
COLLECTOR DISSIPATION	70	KILOWATTS
INLET WATER PRESSURE	120	PSI

TYPICAL OPERATION

Frequency	7.6	kilomegacycles
Output Power	22	kilowatts
Driving Power	1	watt
Power Gain	43	decibels
DC Beam Voltage	20	kilovolts
DC Beam Current	3.1	amperes
Beam Power Efficiency	35.5	percent
DC Body Current	40	milliamperes
3 db bandwidth	35	megacycles

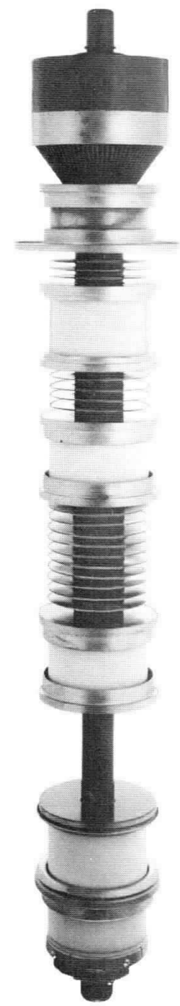
The Eimac EM778 Traveling Wave Tube in recommended as a driver for this klystron.

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., San Carlos, California.

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

X3002

PULSE AMPLIFIER
L-BAND KLYSTRON



The Eimac X3002 is a three-cavity, magnetically focused, pulse amplifier klystron. Designed for use at frequencies between 1235 and 1365 megacycles, this klystron will deliver a minimum peak output power of 4 kilowatts with a power gain of at least 23 decibels during long-pulse service.

Tuning for the X3002 is accomplished by means of external resonant cavities which enclose the cylindrical ceramic windows of the klystron. This design permits an unlimited number of tuning cycles without risk of damage to the vacuum seals.

Eimac Klystron Amplifier Circuit Assembly H-147 is provided for use with the X3002 to cover the frequency range of 1235 to 1365 megacycles. This assembly includes a klystron supporting structure, focusing coils, external cavities, and adjustable load couplers for the input and output cavities.

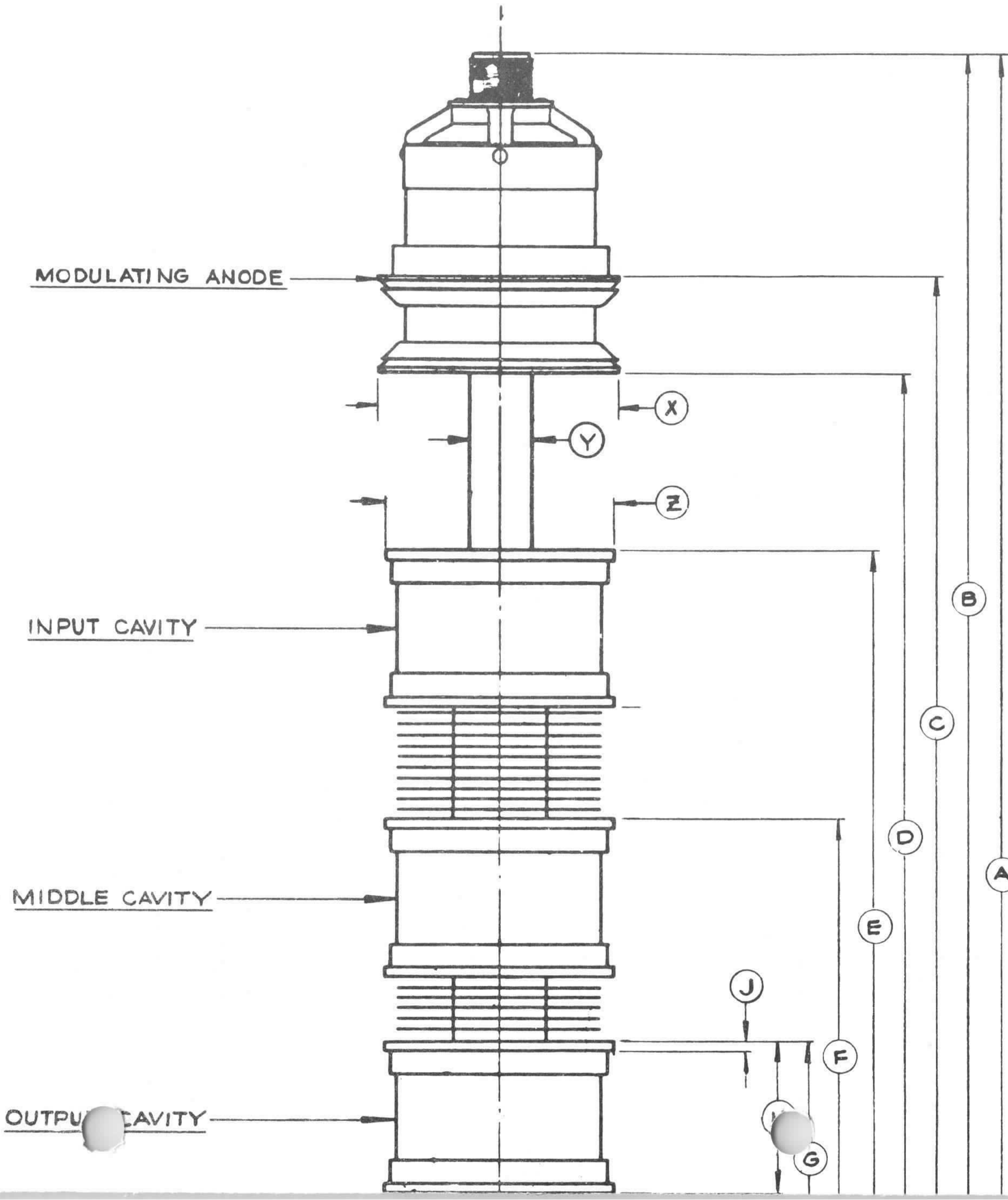
CHARACTERISTICS

ELECTRICAL

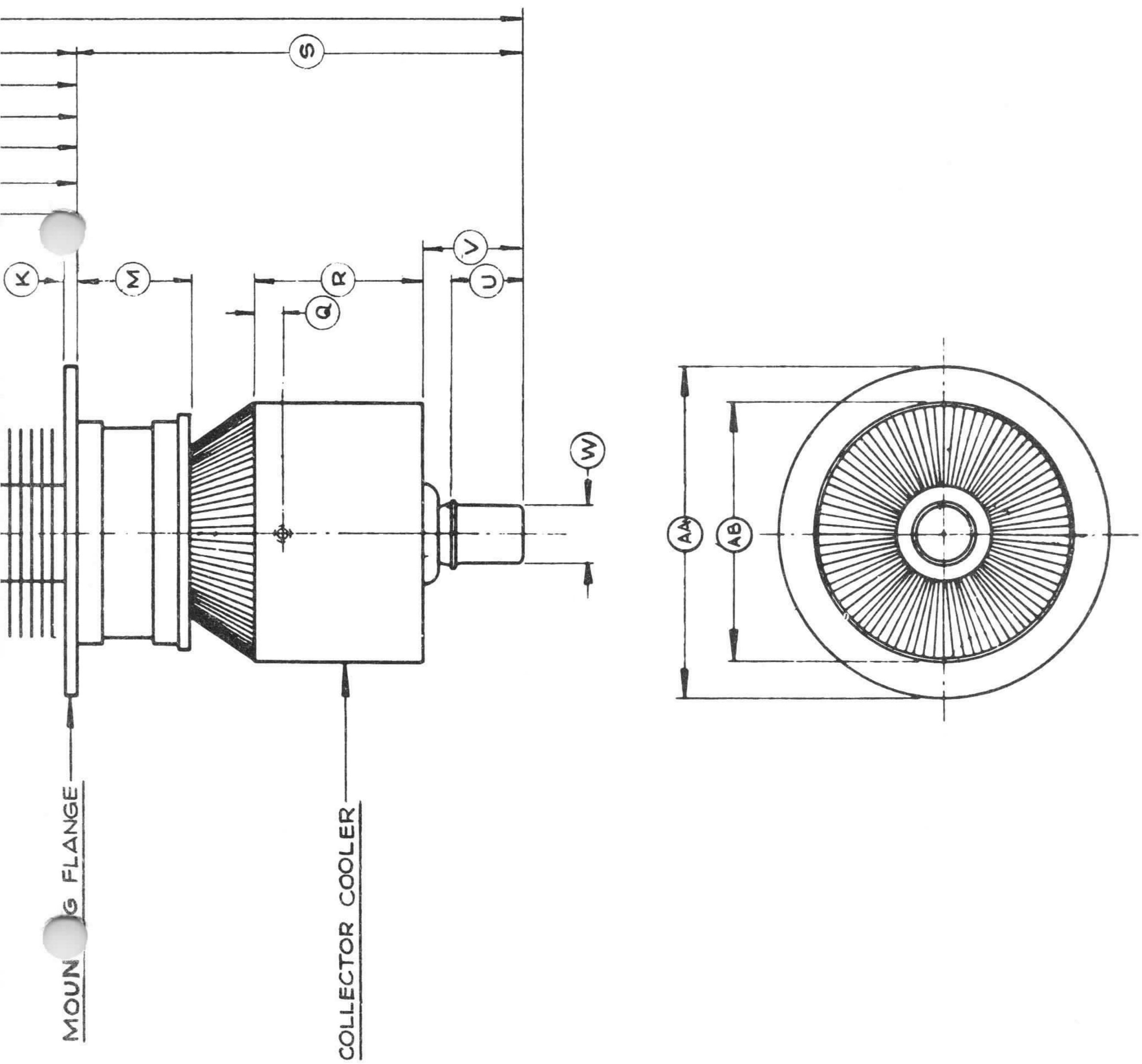
Cathode: Unipotential		
Minimum Heating Time	5	minutes
Heater: Voltage (±5%)	7.5	volts
Current	5.5	amperes
Minimum Power Gain	23	decibels
Minimum Output Power	4	kilowatts
Frequency Range	1235 to 1365	megacycles
Phase Shift as a Function of Beam Voltage	0.0005	degrees/volt

MECHANICAL

Operating Position	Vertical, cathode end up	
Coupling (rf): Input	Type "N", Coaxial Fitting	
Output	⅞ inch, 50-ohm coaxial	
Cooling: (20 degrees C inlet air at sea level)	*Flow Rate*	*Pressure Drop*
Body	100 cfm	1.5" H_2O
Collector	150 cfm	1.6" H_2O
X3002 Length		27 inches
X3002 Diameter		5.3 inches
X3002 Weight		23 pounds
H-147 Height		15 inches
H-147 Diameter		18 inches
H-147 Weight		155 pounds



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A	26.718		
B	19.750		
C	15.812		
D	14.312		
E	11.500		
F	7.250		
G	3.750		
H	2.500		
J	.250		
K	.250		
M	1.687		
Q	.437		
R	2.625		
S	6.968		
U	1.125		
V	1.812		
W	.875		
X	3.812		
Y	1.500		
Z	3.625		
AA	5.125		
AB	4.125		



X3002 OUTLINE DRAWING

FOCUS COIL POWER SUPPLY REQUIREMENTS

Body Coil	Variable to 200 volts, 3 amperes maximum
Prefocus Coil	Variable to 25 volts, 1.5 amperes maximum

TYPICAL OPERATION

Pulse Amplifier

Frequency	1300	1300	megacycles
Peak Output Power	5	3.2	kilowatts
Power Gain	23	23	decibels
Beam Voltage	13	10	kilovolts dc
Peak Beam Current	1.12	0.91	amperes
Peak Modulating Anode Voltage	5.0	4.0	kilovolts
Focus Electrode Voltage	—50	—50	volts
Pulse Length	2000	2000	microseconds
Duty	3	3	percent
Efficiency	35	40	percent

For additional information or information regarding a specific application, write to Eimac Division, Varian Associates, 301 Industrial Way, San Carlos, California

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

Tentative Data

X3034

POWER AMPLIFIER S-BAND (1.1 KW CW) TWT

The Eimac X3034 is a power-amplifier TWT intended for use in broadband communications systems. It is designed to operate at frequencies from 1.7 to 2.1 gigacycles with a minimum output power of 1.1 kilowatts. The electron gun of this TWT has a confined flow configuration which makes focusing adjustments unnecessary and produces a stable beam. Excellent isolation between input and output is assured through the use of terminated severed circuits. This TWT incorporates the Eimac Modulating Anode which provides a versatile means for controlling the beam.

Eimac electromagnet assembly Type Number H-199 has been designed for use with the X3034.

CHARACTERISTICS

ELECTRICAL

Cathode: Impregnated, Unipotential	
Heating Time	5 Min
Heater: Voltage (±5%)	5.6 Vac or Vdc
Current (Nominal)	3.8 Aac or Adc
Power Gain (Saturated)	20 db
Power Gain (Small Signal)	25 db
Output Power	1.1 kW
Frequency Range	1.7-2.1 Gc
Maximum Power Variation in any 50 Mc band (Note 1)	1 db

MECHANICAL

Maximum Dimensions:	
Length	34⅝ inches
Width	7⅛ inches
Depth	7½ inches
Weight (Including Electromagnet)	160 pounds
Input Coupling (rf)	Type N Coaxial
Output Coupling (rf)	⅞" coaxial, EIA STD RS-225
Mounting Position	Any

Cooling: Forced Air and Water	*Flow Rate*	*Pressure Drop*
Cathode	20 cfm	free
Body	1 gpm	50 psi
Collector	5 gpm	10 psi
Electromagnet	1.5 gpm	40 psi

ELECTROMAGNET POWER SUPPLY REQUIREMENTS

Upper Coil	Adjustable to 50 Vdc at 10 Adc
Lower Coil	Adjustable to 35 Vdc at 7 Adc

MAXIMUM RATINGS

BEAM VOLTAGE	13 kVdc
BEAM CURRENT	1 Adc
BEAM INPUT POWER	11 kW
BODY CURRENT	25 mAdc
COLLECTOR DISSIPATION	11 kW
LOAD VSWR	1.2:1
WATER INLET TEMPERATURE	50 °C

TYPICAL OPERATION

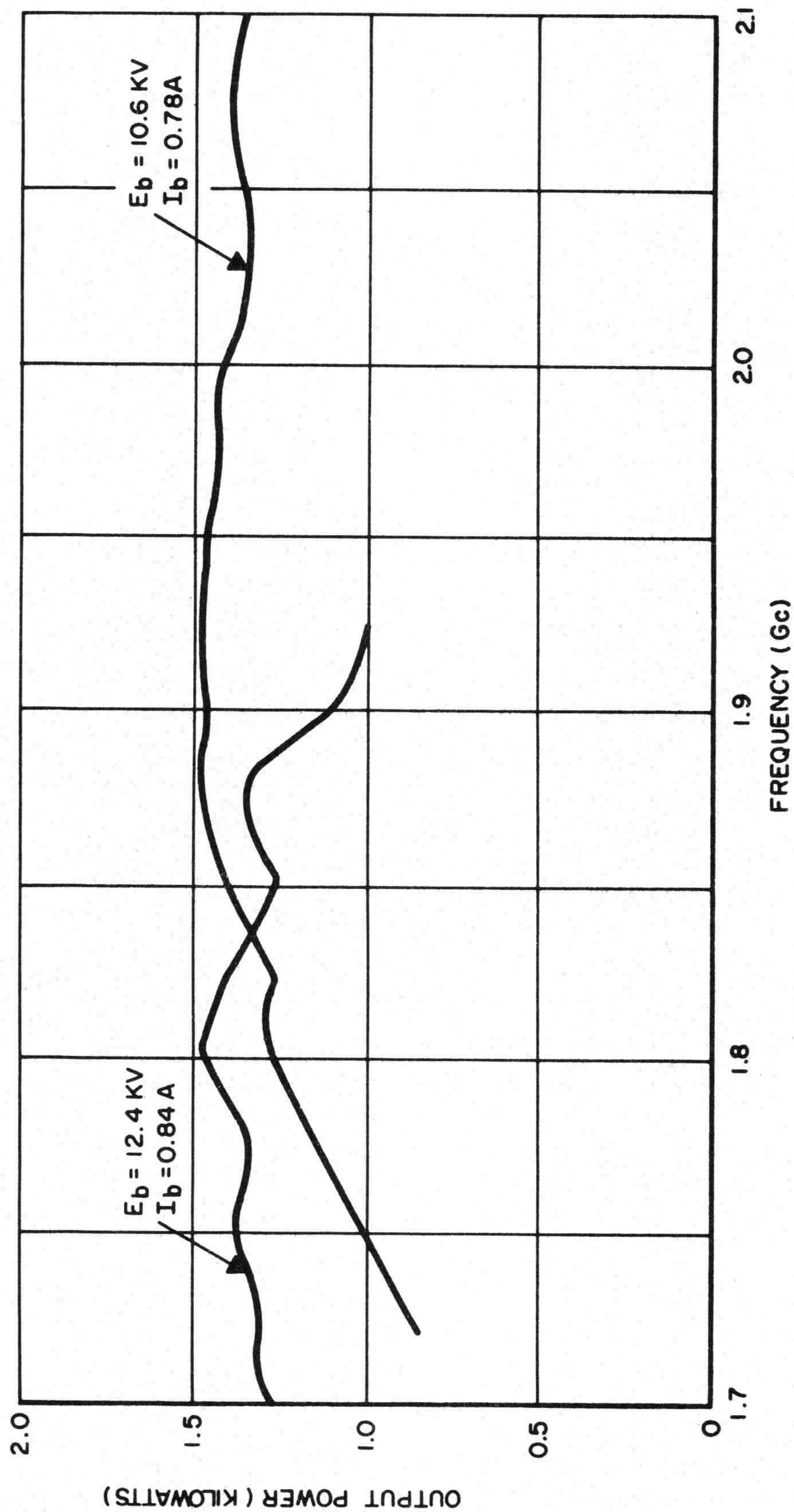
Frequency	1.7	1.8	1.9	2.0	2.1	Gc
Beam Voltage	12.4	12.4	10.6	10.6	10.6	kVdc
Beam Current	0.84	0.84	0.78	0.78	0.78	Adc
Mod Anode Voltage (with respect to cathode)	10.0	10.0	9.7	9.7	9.7	kVdc
Body Current	13	13	17	17	17	mAdc
Drive Power	10	10	10	10	10	W
Output Power	1.25	1.47	1.47	1.43	1.36	kW
Gain	20.9	21.6	21.6	21.5	21.3	db
Electromagnet Currents						
Upper Coil	9.5	9.5	9.5	9.5	9.5	Adc
Lower Coil	6	6	6	6	6	Adc

NOTE:

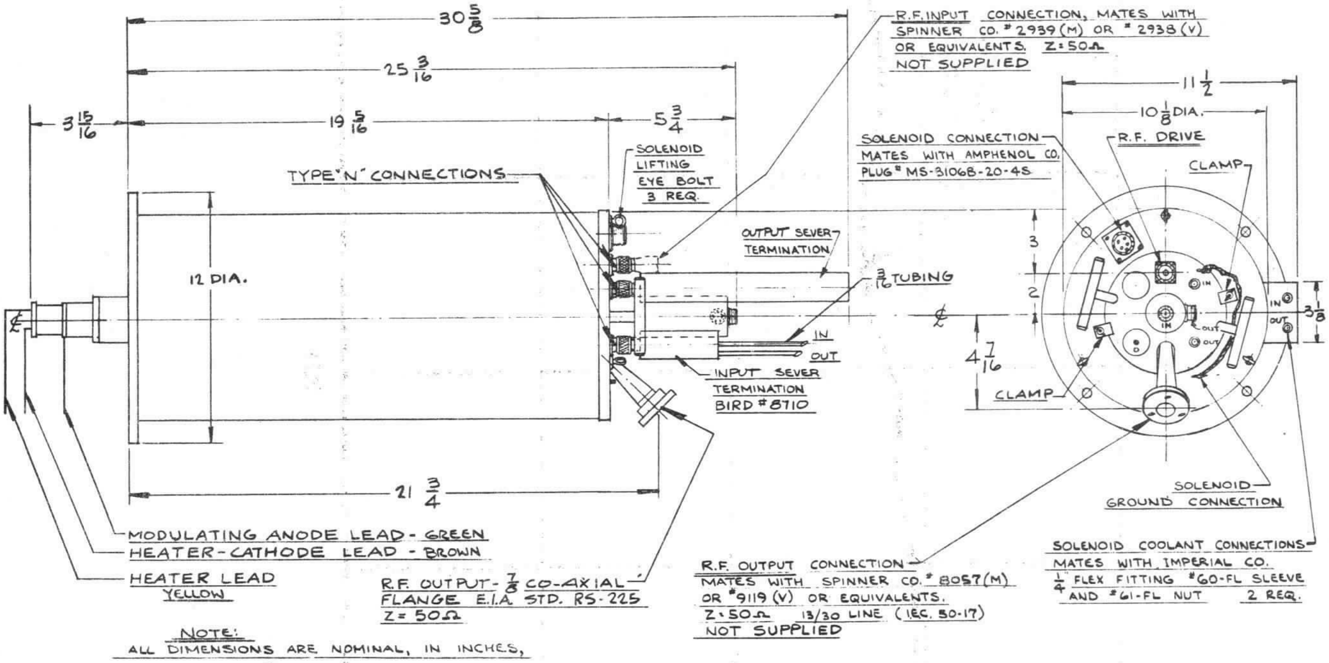
(1) Beam Voltage may be optimized for each 50 Mc segment.

(2) In the event of rapid change in VSWR such as caused by a transmission line arc, the rf drive must be removed in 20 milliseconds. It is recommended that an isolator be inserted in the output line between a re-active filter and the TWT.

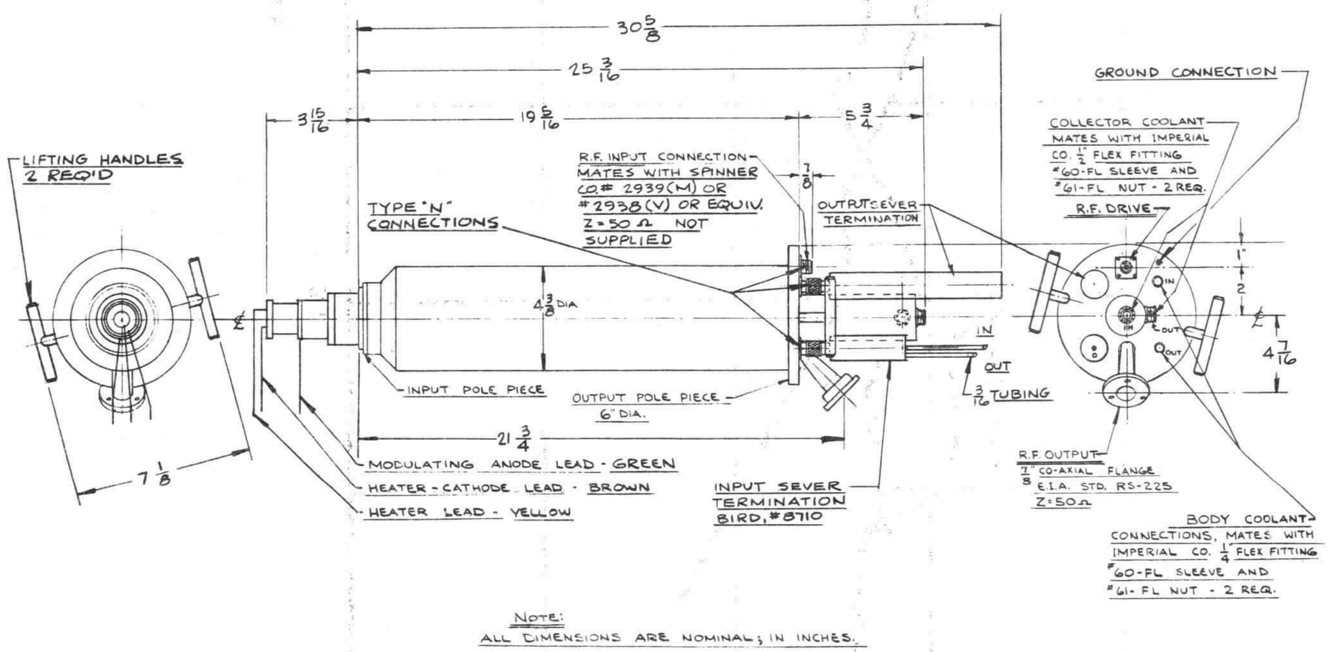
(3) The nominal input and output impedances are designed to work into 50 ohm transmission lines.


E_b = 10.6 KV
I_b = 0.78A
E_b = 12.4 KV
I_b = 0.84 A
2.0
1.5
1.0
0.5
0
OUTPUT POWER (KILOWATTS)
1.7
1.8
1.9
2.0
2.1
FREQUENCY (Gc)

X-3034



X-3034 AND H-199



X-3034 TWT

EIMAC

A Division of Varian Associates

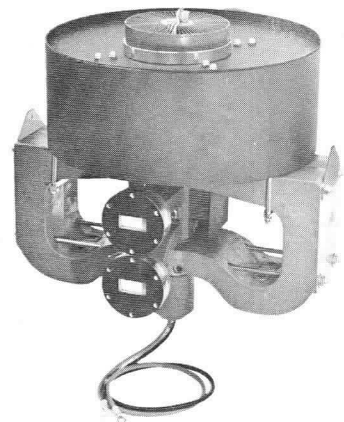
SAN CARLOS, CALIFORNIA

Tentative Data

X3054

2.5 KW
POWER AMPLIFIER
C-BAND KLYSTRON

The Eimac X3054 is a five-cavity, air-cooled power amplifier klystron tunable over the frequency range of 5.925 to 6.425 gigacycles. It will deliver a minimum CW output power of 2.5 kilowatts with a minimum power gain of 50 decibels and a minimum 1 db bandwidth of 20 megacycles.



The very high gain and efficiency of this klystron make it particularly attractive for transportable equipment.

A common air inlet is used for collector and body cooling. Improved collector cooling is achieved through use of an integral plenum chamber which encloses the collector.

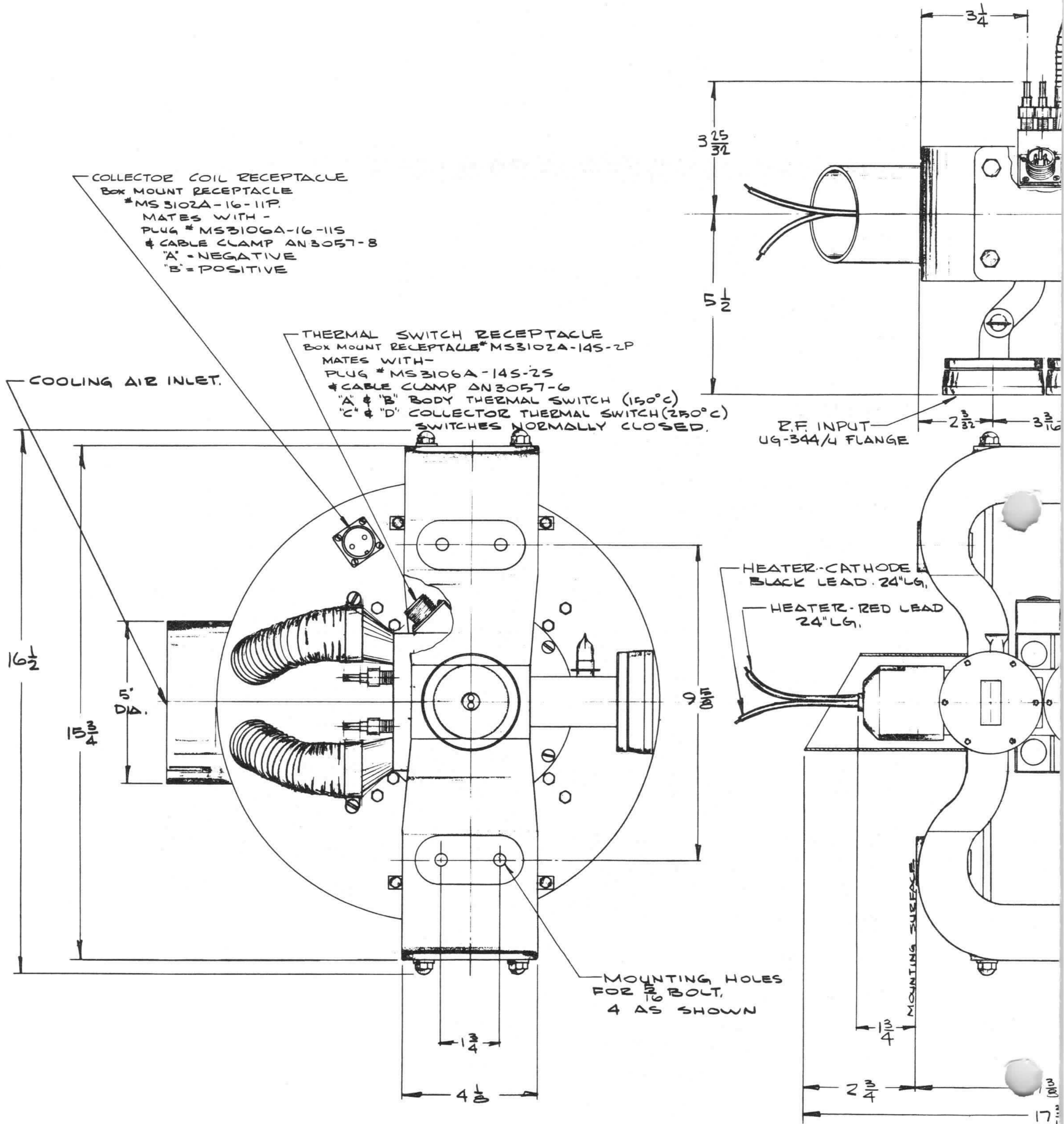
This klystron is focused with a permanent magnet and an auxiliary low voltage collector coil.

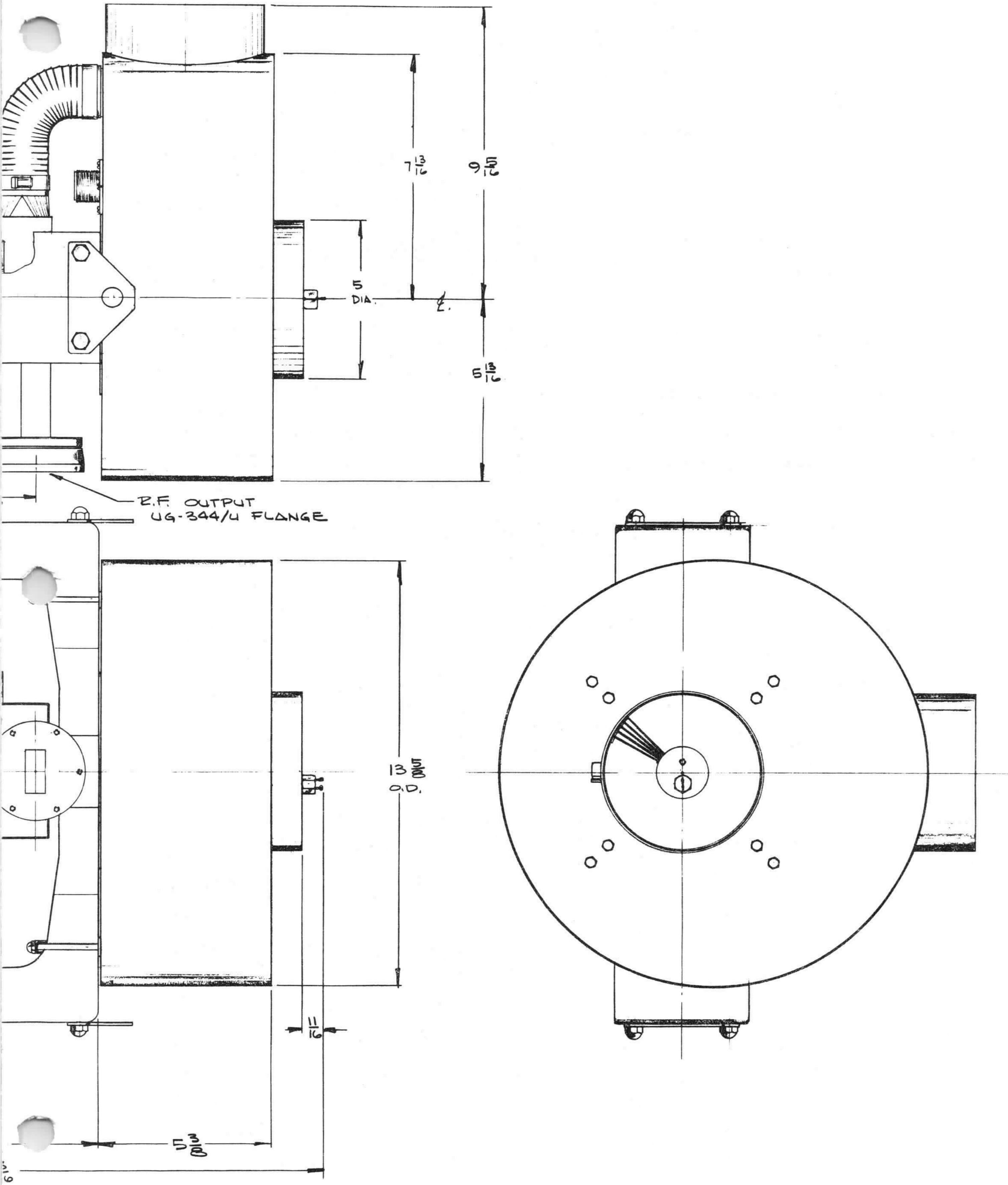
Both input and output rf couplings of the X3054 are fixed. The only adjustments required are the tuning of the cavities.

CHARACTERISTICS

ELECTRICAL

Cathode: Impregnated, Unipotential		
Heating Time	5	minutes
Heater:		
Voltage (±5%)	5.75	volts
Current (nominal)	3.7	amperes
Power Gain	50	decibels
Output Power	2.5	kilowatts
Frequency Range	5.925-6.425	gigacycles


COLLECTOR COIL RECEPTACLE
BOX MOUNT RECEPTACLE
#MS3102A-16-11P.
MATES WITH -
PLUG #MS3106A-16-11S
& CABLE CLAMP AN3057-8
"A" - NEGATIVE
"B" = POSITIVE
THERMAL SWITCH RECEPTACLE
BOX MOUNT RECEPTACLE #MS3102A-14S-2P
MATES WITH -
PLUG #MS3106A-14S-2S
& CABLE CLAMP AN3057-6
"A" & "B" BODY THERMAL SWITCH (150°C)
"C" & "D" COLLECTOR THERMAL SWITCH (250°C)
SWITCHES NORMALLY CLOSED.
COOLING AIR INLET.
5" DIA.
16 1/2
15 3/4
9 5/8
MOUNTING HOLES FOR 5/16 BOLT, 4 AS SHOWN
1 3/4
4 1/8
3 1/4
3 25/32
5 1/2
R.F. INPUT
UG-344/U FLANGE
2 3/32
HEATER-CATHODE BLACK LEAD. 24" LG.
HEATER-RED LEAD 24" LG.
MOUNTING SURFACE
2 3/4
17



7 13/16
9 5/16
5 DIA.
5 13/16
R.F. OUTPUT
UG-344/U FLANGE
13 5/8 O.D.
11/16
5 3/8

MECHANICAL

Maximum Dimensions

Length	$17\frac{1}{2}$	inches
Width	$16\frac{1}{2}$	inches
Depth	$15\frac{1}{2}$	inches
Weight	120	pounds
Input Coupling (rf)	UG-344/U	flange
Output Coupling (rf)	UG-344/U	flange
Maximum Tuner Start Torque	30	in-oz
Maximum Tuner Stop Torque	100	in-oz
Mounting Position		any

Cooling: Forced Air (25°C at sea level)

	Flow Rate	*Pressure Drop*
Body and Collector	175 cfm	1.2 in. H_2O

Collector Coil Power Supply Requirements - - - - - - - - - 40 volts at 9 amperes

MAXIMUM RATINGS

BEAM VOLTAGE (dc)	8.5	kilovolts
BEAM CURRENT (dc)	0.85	ampere
BEAM INPUT POWER	6.5	kilowatts
BODY CURRENT WITH RF DRIVE (dc)	70	milliamperes
COLLECTOR DISSIPATION	6.5	kilowatts
LOAD VSWR	1.5:1	
TEMPERATURE OF BODY AND TUNER FINS	150°C	
TEMPERATURE OF COLLECTOR	250°C	

TYPICAL OPERATION — TUNED FOR BROADBAND OPERATION

Frequency	6175	megacycles
Output Power	2.7	kilowatts
Driving Power	8	milliwatts
Gain	56	decibels
Beam Voltage	8.2	kilovolts dc
Beam Current	0.74	ampere dc
Beam Power Efficiency	44	percent
1 db Bandwidth	24	megacycles
Body Current	40	milliamperes dc
Collector Coil Current	7	amperes dc

For additional information or information regarding a specific application, write to Eimac, a Division of Varian Associates, 301 Industrial Way, San Carlos, California

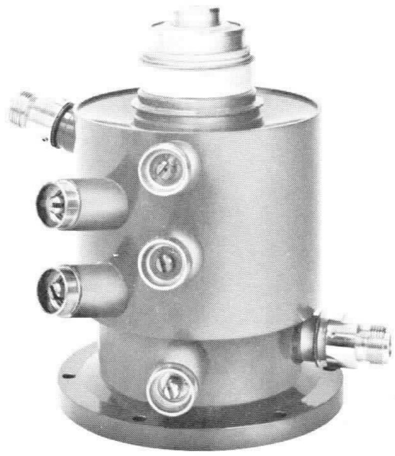
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

Tentative Data

X3065

**POWER AMPLIFIER
S-BAND KLYSTRON**

The EIMAC X3065 is a conduction cooled, electrostatically focused, power-amplifier klystron designed to operate at frequencies from 2100 to 2110 megahertz. It will deliver a minimum output power of 200 watts with a minimum power gain of 40 decibels. The X3065 is intended for use in applications where light weight and compactness are essential.



FEATURES

- ELECTROSTATIC FOCUSING
- FIVE INTEGRAL CAVITIES
- LOW NOISE LEVEL
- FIXED INPUT AND OUTPUT COUPLING
- INSTANT FAULT RECYCLING

CHARACTERISTICS

ELECTRICAL

Frequency	2100-2110 MHz
Minimum Output Power	200 W
Minimum Power Gain	40 db
Cathode: Oxide, Unipotential	
Starting Time	1 minute
Heater: Voltage	7 Vac
Current	1.0 Aac
Maximum Starting Current	2 Aac

MECHANICAL

Operating Position	Any
Cavity Tuning Torque (maximum)	1 inch pounds
Cooling	By Conduction
Maximum Dimensions:	
Length	6.5 inches
Width	6.50 inches
Depth	5.5 inches
Input rf coupling	Connector TNC
Output rf coupling	Type N
Weight	5 pounds

Printed in U.S.A.

MAXIMUM RATINGS

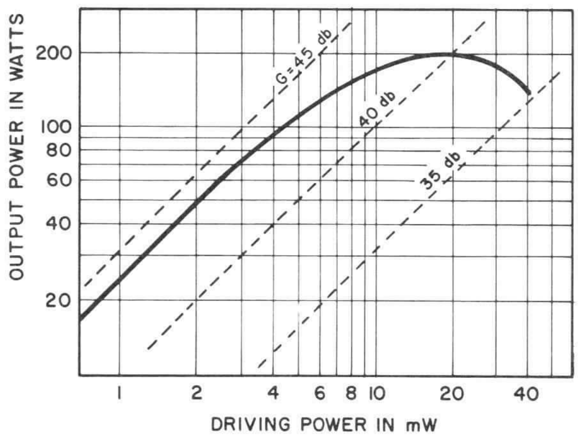
BEAM VOLTAGE	4.0 kVdc
BEAM CURRENT	180 mAdc
BEAM INPUT POWER	720 W
COLLECTOR DISSIPATION	720 W
CATHODE SEAL TEMPERATURE	150 °C
LOAD VSWR	2:1

TYPICAL OPERATION
A — Tuned For Maximum Efficiency

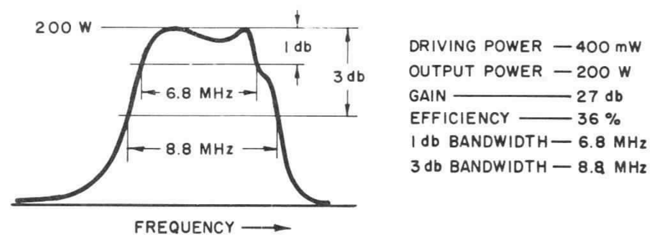
Frequency	2105	2105	MHz
DC Beam Voltage	2.2	3.5	kVdc
DC Beam Current	73	145	mAdc
Driving Power	5	20	mW
Output Power	50	200	W
Gain	40	40	db
Beam Power Efficiency (without collector depression)	31	39.5	%
Beam Power Efficiency (with collector depression)	39	42	%
3 db Bandwidth	2.0	2.2	MHz

TYPICAL OPERATION
B — Tuned For Bandwidth

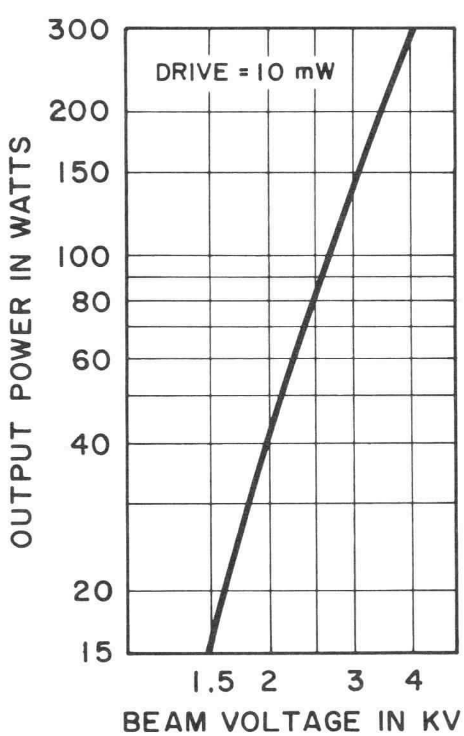
Frequency	2105 MHz
DC Beam Voltage	3.6 kVdc
DC Beam Current	151 mAdc
Driving Power	400 mW
Output Power	196 W
Gain	27 db
Beam Power Efficiency	36 %
1 db Bandwidth	6.8 MHz
3 db Bandwidth	8.8 MHz

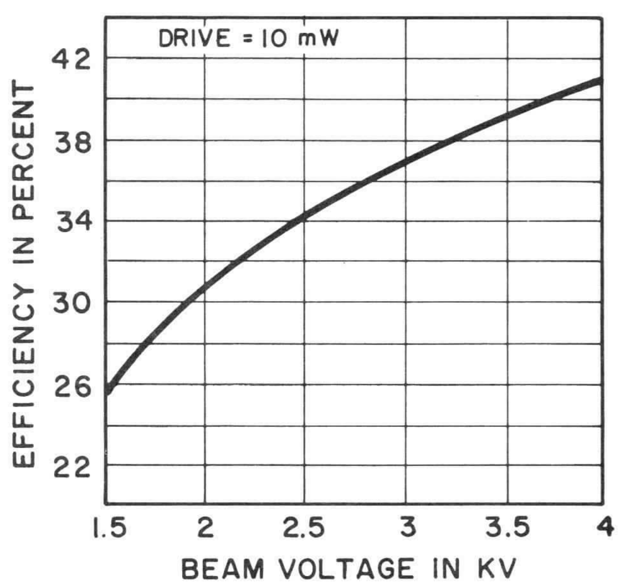


OUTPUT POWER vs DRIVING POWER AT 3.5 KV BEAM VOLTAGE.

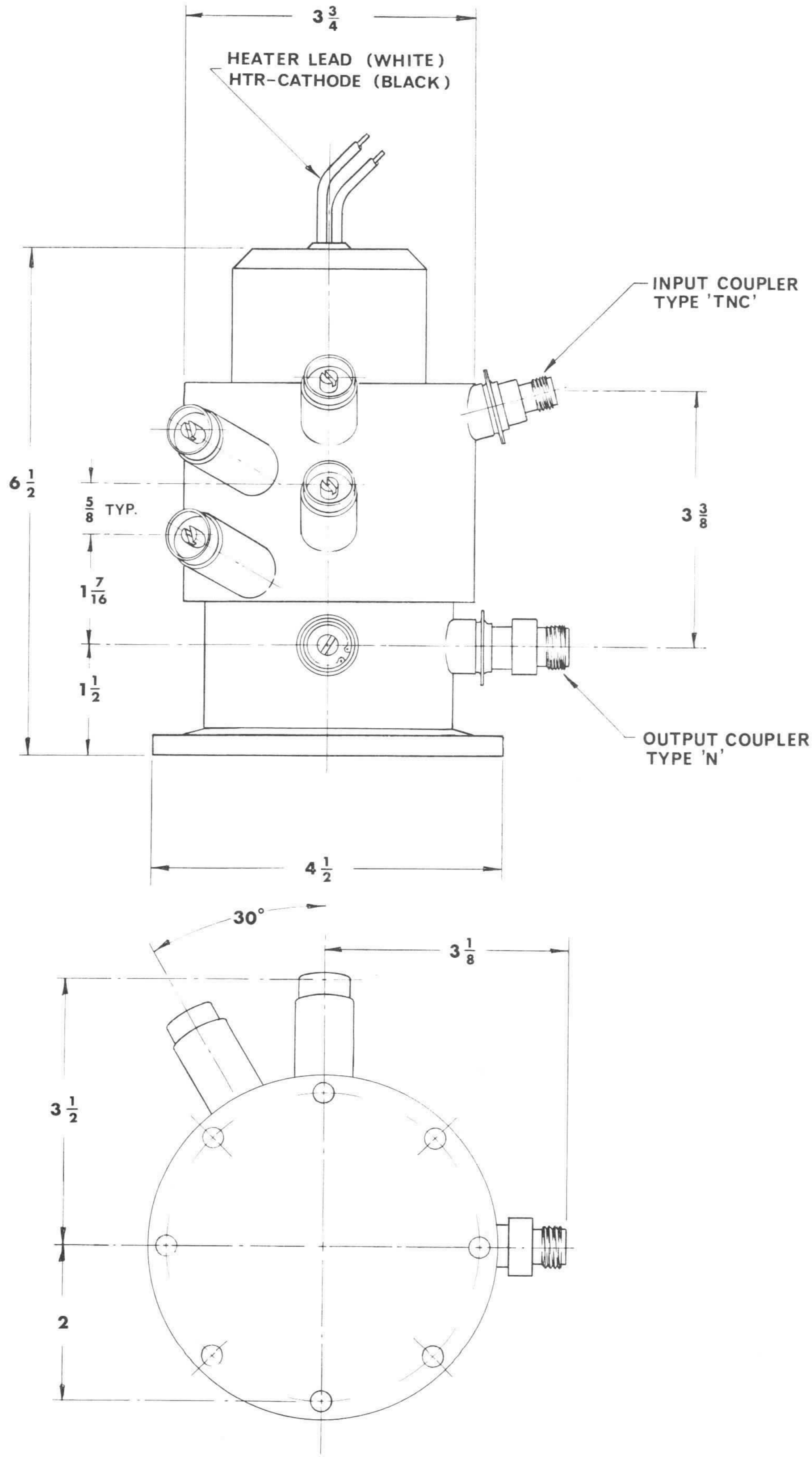


RF-OUTPUT POWER vs FREQUENCY. THE CAVITIES ARE TUNED FOR BANDWIDTH





BEAM POWER EFFICIENCY, WITHOUT COLLECTOR DEPRESSION, vs BEAM VOLTAGE.


3 3/4
HEATER LEAD (WHITE)
HTR-CATHODE (BLACK)
INPUT COUPLER
TYPE 'TNC'
6 1/2
5/8 TYP.
3 3/8
1 7/16
1 1/2
OUTPUT COUPLER
TYPE 'N'
4 1/2
30°
3 1/8
3 1/2
2

EIMAC

Division of Varian

SAN CARLOS

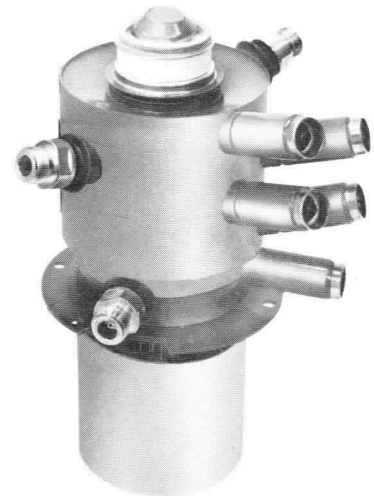
CALIFORNIA

Tentative Data

X3065A

POWER AMPLIFIER
S-BAND KLYSTRON

The EIMAC X3065A is an air cooled, electrostatically focused, power-amplifier klystron designed to operate at frequencies from 2100 to 2110 megahertz. It will deliver a minimum output power of 500 watts with a minimum power gain of 40 decibels. The X3065A is intended for use in applications where light weight and compactness are essential.



FEATURES

- ELECTROSTATIC FOCUSING
- FIVE INTEGRAL CAVITIES
- LOW NOISE LEVEL
- FIXED INPUT AND OUTPUT COUPLING
- INSTANT FAULT RECYCLING

CHARACTERISTICS

ELECTRICAL

Frequency	2100-2110 MHz
Minimum Output Power	500 W
Minimum Power Gain	30 db
Cathode: Oxide, Unipotential	
Starting Time	1 minute
Heater: Voltage	7 Vac
Current	1 Aac
Maximum Starting Current	2 Aac

MECHANICAL

Operating Position	Any
Cavity Tuning Torque (maximum)	1 inch pounds
Cooling	Forced Air (20°C at sea level)
Collector Flow	100 cfm
Collector Pressure Drop	1 inches H_2O
Maximum Dimensions:	
Length	9.0 inches
Width	6.5 inches
Depth	5.5 inches
Rf Input Coupling	Connector TNC
Rf Output Coupling	7/8 inch, 50-ohm line
Weight	5 pounds

Printed in U.S.A.

MAXIMUM RATINGS

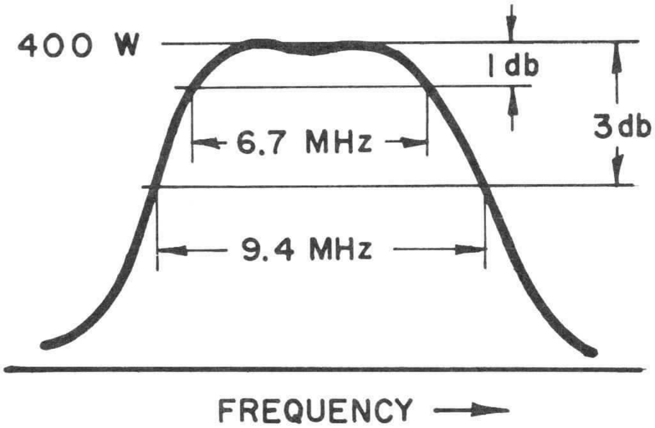
DC BEAM VOLTAGE	6.0 kVdc
DC BEAM CURRENT	0.325 mAdc
DC BEAM INPUT POWER	1.95 kW
COLLECTOR DISSIPATION	1.95 kW
CATHODE SEAL TEMPERATURE	150 °C
LOAD VSWR	2:1

TYPICAL OPERATION
A — Tuned For Maximum Output Power

Frequency	2105	2105	MHz
DC Beam Voltage	4.75	4.9	kVdc
DC Beam Current	230	250	Madc
Driving Power	500	50	mW
Output Power	500	500	W
Gain	30	40	db
Beam Power Efficiency	46	41	%
3 db Bandwidth	7.5	3.7	MHz

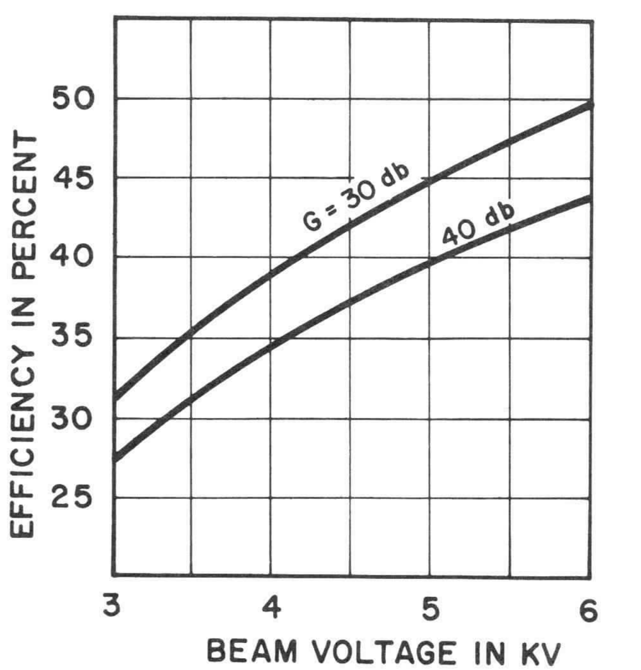
TYPICAL OPERATION
B — Tuned For Bandwidth

Frequency	2105 MHz
DC Beam Voltage	5.3 kVdc
DC Beam Current	270 mAdc
Driving Power	500 mW
Output Power	500 W
Gain	30 db
Beam Power Efficiency	35 %
1 db Bandwidth	6.7 MHz
3 db Bandwidth	9.4 MHz

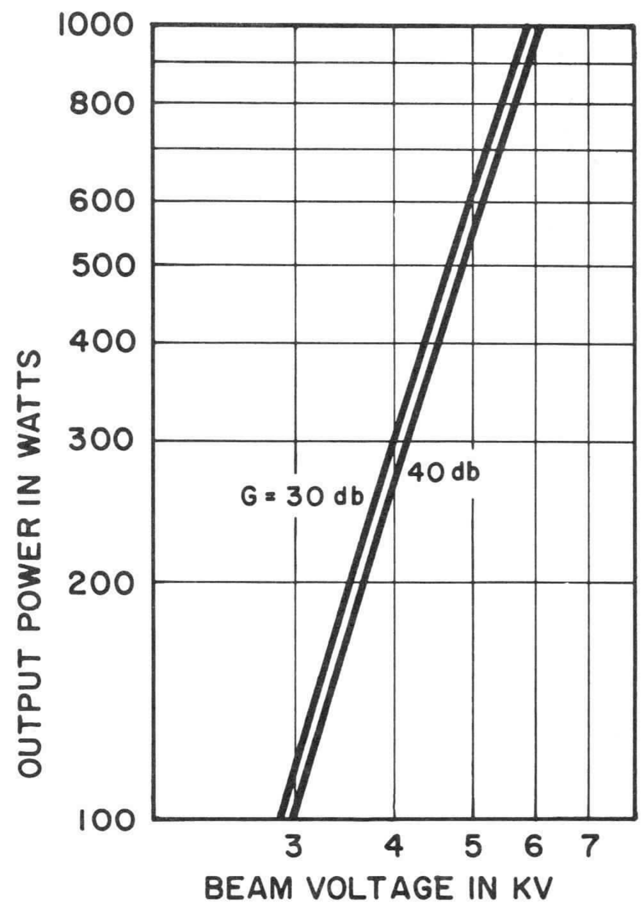


DRIVING POWER — 500 mW
OUTPUT POWER — 400 W
GAIN — 29 db
EFFICIENCY — 35 %
1 db BANDWIDTH — 6.7 MHz
3 db BANDWIDTH — 9.4 MHz

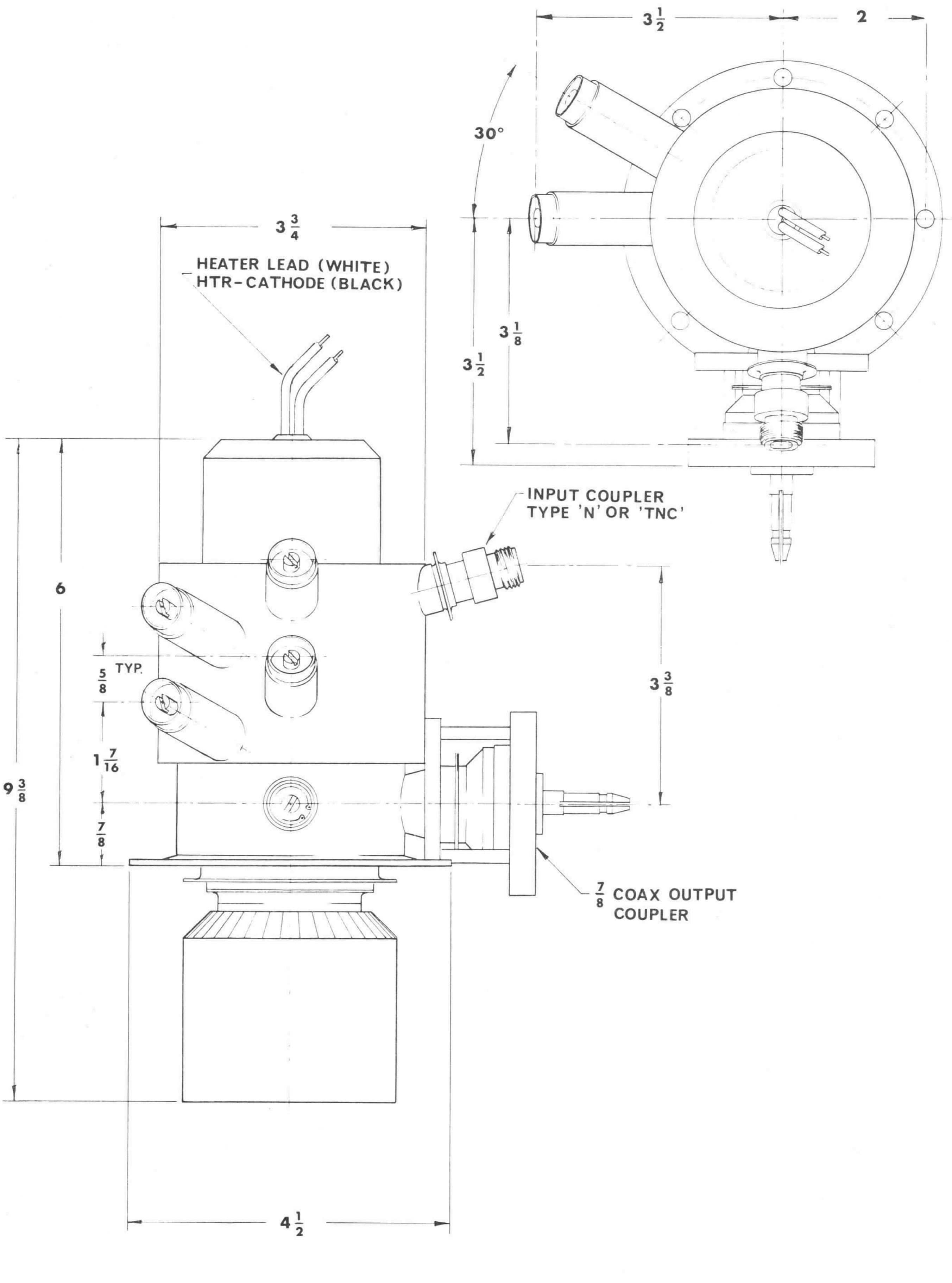
RF-OUTPUT POWER vs FREQUENCY. THE CAVITIES ARE TUNED FOR BANDWIDTH.



CAVITIES TUNED FOR MAXIMUM EFFICIENCY



CAVITIES TUNED FOR MAXIMUM EFFICIENCY


3 1/2
2
30°
3 1/8
3 1/2
3 3/4
HEATER LEAD (WHITE)
HTR-CATHODE (BLACK)
INPUT COUPLER
TYPE 'N' OR 'TNC'
6
5/8 TYP.
1 7/16
7/8
9 3/8
3 3/8
7/8 COAX OUTPUT
COUPLER
4 1/2

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM15LS

INDUSTRIAL MAGNETRON

25 kW
915 Mc.

The Eimac EM15LS is a rugged power magnetron designed specifically for industrial processing. It is designed to operate in the industrial and scientific frequency allocation of 915 ±15 Mc. A power output of 25 kW can be obtained into a matched load at an efficiency of approximately 80%. Long operating life in severe industrial environment is assured through use of a directly heated pure tungsten spiral cathode. Further, ruggedness is assured through exclusive use of metal-ceramic construction. Every effort has been made in the design of this tube to keep water cooling pressure and purity requirements down to minimize cooling cost. The magnetic field is provided by an electromagnet which is an integral part of waveguide coupler Type H-195. This coupler mates with 9¾" x 4⅞" waveguide.

The magnetron may be operated with a fixed magnetic field or with the electromagnet connected in series with the anode. The latter mode of operation greatly reduces the variation in output power due to supply voltage changes.

Anode voltage for the EM15LS is normally supplied from a full wave three-phase rectifier with or without filter choke. The degree of filtering in any particular application is dictated by the permissible amplitude and frequency modulation of the rf output power. These are mainly determined by the anode current ripple.

CHARACTERISTICS

ELECTRICAL

Filament:	
Heating Time	10 seconds
Starting Voltage (±5%)	13 volts ac
Starting Current	115 amperes ac
Maximum Inrush Current	250 amperes
Cold Resistance	0.03 ohms
Output Power	25 kilowatts
Frequency	915 ±15 Mc

MECHANICAL

Maximum Dimensions:	
Length	17 inches
Diameter	7 inches
Weight	25 pounds
Output Coupling (rf)	(See outline drawing)
Mounting Position Preferred	Vertical

Cooling: Water and Forced Air	*Flow Rate*	*Pressure Drop*
Anode	3 gpm	30 psi
Electromagnet	0.25 gpm	30 psi
Output Window	20 cfm	2" H_2O
Stem	5 cfm	2" H_2O

POWER SUPPLY REQUIREMENTS

Electromagnet Voltage, dc	50 volts
Electromagnet Current, dc	4 amperes
Filament Voltage, ac	14 volts
Filament Current, ac	120 amperes

MAXIMUM RATINGS

Anode Voltage (dc)	14 kilovolts
Anode Current (dc)	3 Amperes
Anode Dissipation	15 Kilowatts
Load VSWR	2.5:1
Seal Temperature	175°C
Water Outlet Temperature	70°C

TYPICAL OPERATION

Frequency	915	915	megacycles
Output Power	20	25	kilowatts
Anode Voltage	11.5	12.5	kilovolts dc
Anode Current	2.1	2.4	amperes dc
Efficiency	83	83	percent
Filament Voltage	11	10.8	volts ac
Filament Current	106	103	amperes ac
VSWR	3:1*	2.5:1*	
Electromagnet Current	3.3	3.6	amperes dc

*Efficiency with mismatched load depends upon phase angle of the load. Efficiencies listed can be obtained with matched load or at selected phase angles.

NOTES

1. COOLING

Both air and water cooling must be applied before anode voltage is applied.

2. FILAMENT ADJUSTMENTS

Before the anode voltage is applied, the filament current must be set for 115 amperes and held there for 10 seconds. When the magnetron begins operating, the heater current should be reduced immediately to compensate for back bombardment. The filament current given above is for a matched rf load. Maximum life of this magnetron will be obtained if the filament voltage is decreased during operation until the filament resistance V_f/I_f is the same as that when the magnetron is not oscillating; i.e., V_{fo}/I_{fo}. When the rf load is reasonably constant in magnitude and phase, filament voltage and current can be reduced a fixed amount using manual switch control. However, when the variation of the load mis-match and phase is considerable, more accurate compensation should be provided by automatic control.

3. POWER SUPPLY

The short circuit characteristics of the anode supply must be such that the peak anode current is limited to 25 amperes in case of an arc in the magnetron. If the leakage reactance of the transformer, plus the resistance of the rectifiers, transformer and filter choke do not provide this degree of current limiting, a series resistor is recommended in the anode supply to achieve the additional current limiting required.

4. OPERATION WITH SERIES FIELD

With the coil of the electromagnet connected in series with the anode as shown in Fig. 4, the magnetron threshold voltage V_T (approx. equal to the anode voltage at zero anode current, see Fig. 3) becomes proportional to the anode current and curve of V_a against I_a for steady currents, and is obtained as given in Fig. 5. The slope of this characteristic, which depends upon the number of turns in the coil, is much greater than that with fixed field (compare with Fig. 3), and hence the power changes with supply voltage variations are correspondingly reduced. This is one advantage of the series field mode of operation.

Operating points to the left of the line can be reached by supplying a biasing current through the coil. Assuming an initial biasing current, the behavior is then as follows: as the anode voltage, and hence current, rises from zero, the increasing voltage drop across the magnet coil causes a decrease in the biasing current, and a V_aI_a characteristic of reduced slope* is obtained. Beyond the branch point shown in Fig. 5, the biasing current is zero and full series field behavior is obtained. The characteristic is raised or lowered in accordance with the biasing current and threshold voltage V_T, and with a fixed supply voltage this enables the power output to be controlled in an economical way by varying the magnet current. Since the slope of the characteristic depends upon the magnet coil resistance, there is a slight drift of the operating point as the coil warms up. This can be minimized by making R_b large compared with R_m or by using a bias supply which behaves as a constant current source.

With series field, anode voltage cannot be applied instantaneously without biasing field current, because a transient voltage approximately equal to the anode supply voltage is developed across the magnet coil. A recommended method of starting is therefore to increase the biasing current to raise V_T above the no load voltage of the anode supply, switch on the anode voltage, and then reduce the biasing current until the required operating point is reached.

With series field, the stability against load mismatch remains the same as that with fixed field, but the variation in anode impedance V_a/I_a, with phase of load VSWR is reduced by a self-regulating action. This leads to a power variation (see Fig. 2 for example) which is mainly determined by efficiency changes.

Precautions should be taken to prevent excessive load reflection as stipulated in the maximum ratings, since operation in unwanted modes is always possible with series field, following a cessation of oscillation in the proper mode.

5. INSTALLATION

The EM15LS is constructed from metal and ceramic. Reasonable care should be taken to protect the tube from excessive shocks when handling and after installation. The mounting position is with axis vertical, either up or down.

Connection between the magnetron and the H-195 is made by a copper washer retained on a flange on the tube at the base of the dome window. The tube must be seated squarely in the electromagnet, and the retaining screws tightened up uniformly to ensure proper contact at the washer. A new washer should be used each time the magnetron is inserted. A new washer is supplied with each new tube purchased.

The magnetron dome window is forced-cooled by air ducted over the dome by a flanged insulating cylinder. To obtain proper cooling it is necessary to ensure a uniform gap between the cylinder and dome.

The cathode terminals must be securely clamped to make proper contact and avoid overheating. Cooling is by forced air through a duct attached to the small cathode terminal. The terminal temperature should not exceed 175°C.

*In proportion to $\frac{R_b}{R_b+R_m}$, where R_b is the effective internal impedance of the biasing supply, and R_m the magnet resistance.

For additional information or information regarding a specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.

ELECTROMAGNET CHARACTERISTIC

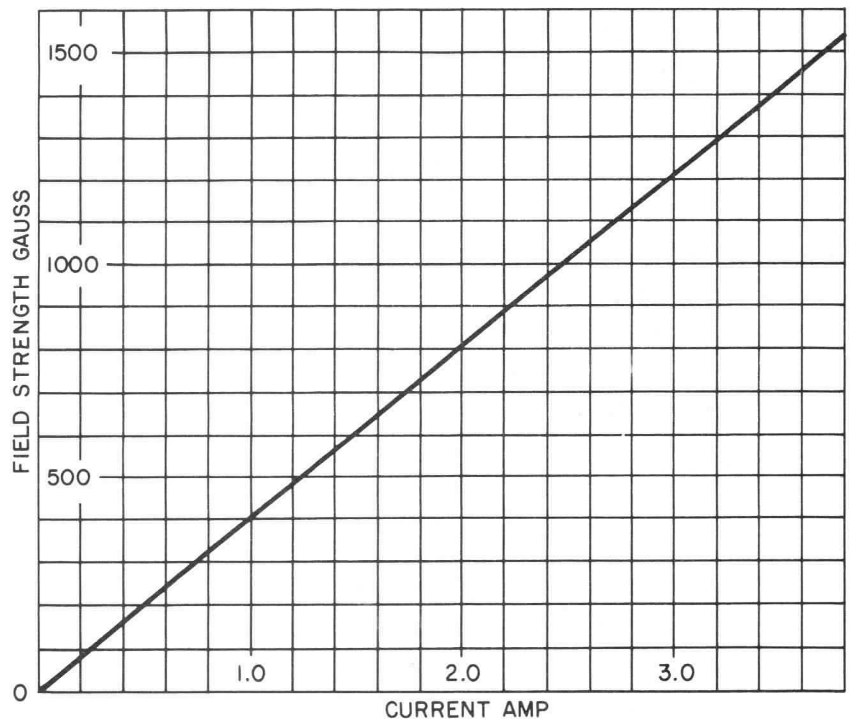
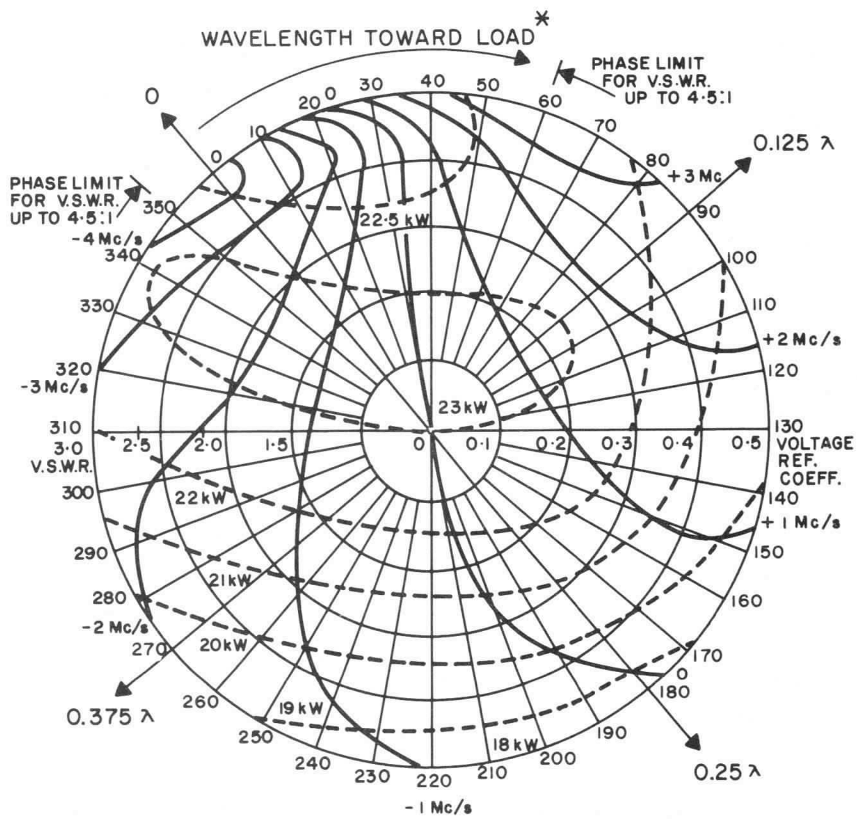


fig. 1



TYPICAL RIEKE DIAGRAM

fig. 2

Va = 12.5 kv
Ia = 2.4 a
f = 915 Mc

*ZERO WAVELENGTH IS AT FLANGE OF LAUNCHER AND INDICATES VOLTAGE MINIMUM AT THE FLANGE.

PERFORMANCE CHART

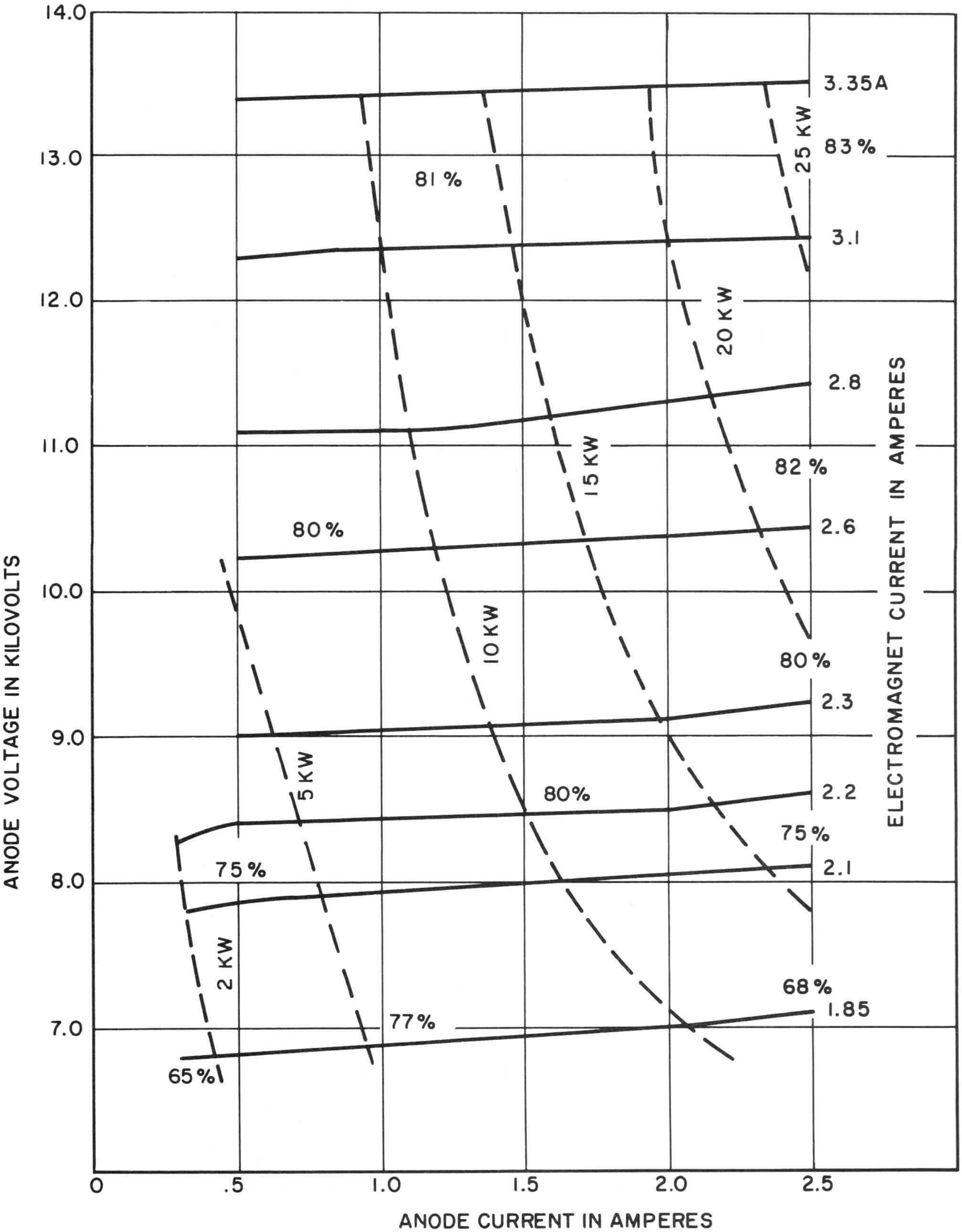
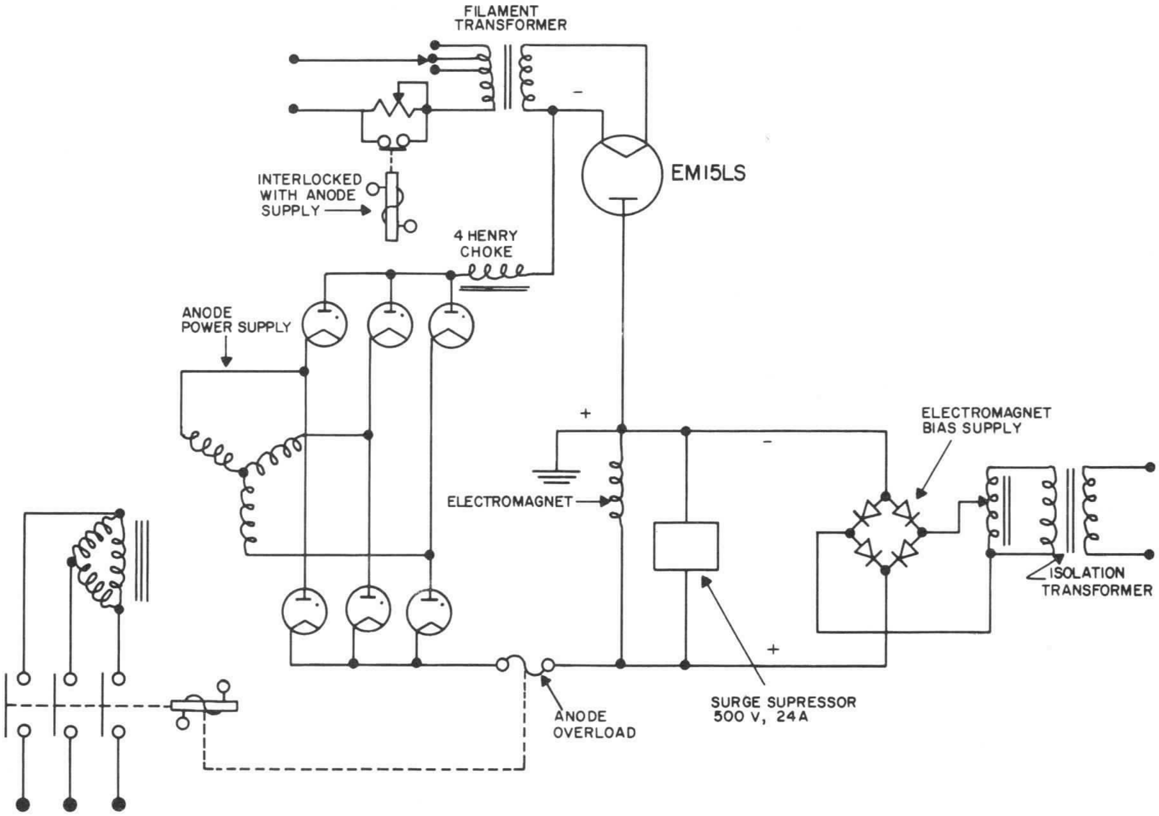


fig. 3



ELEMENTARY CIRCUIT FOR OPERATION WITH SERIES FIELD

fig. 4

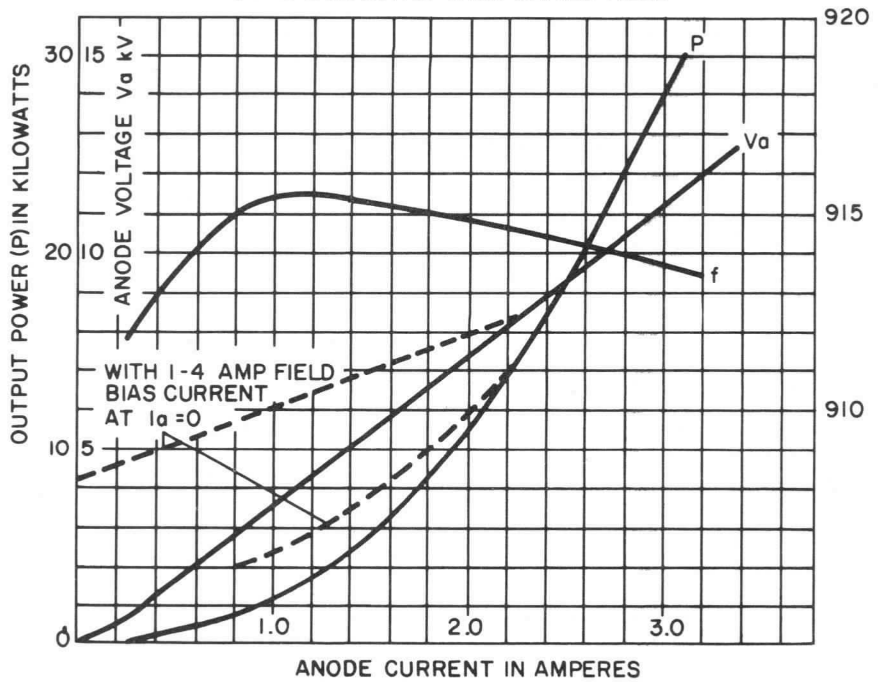
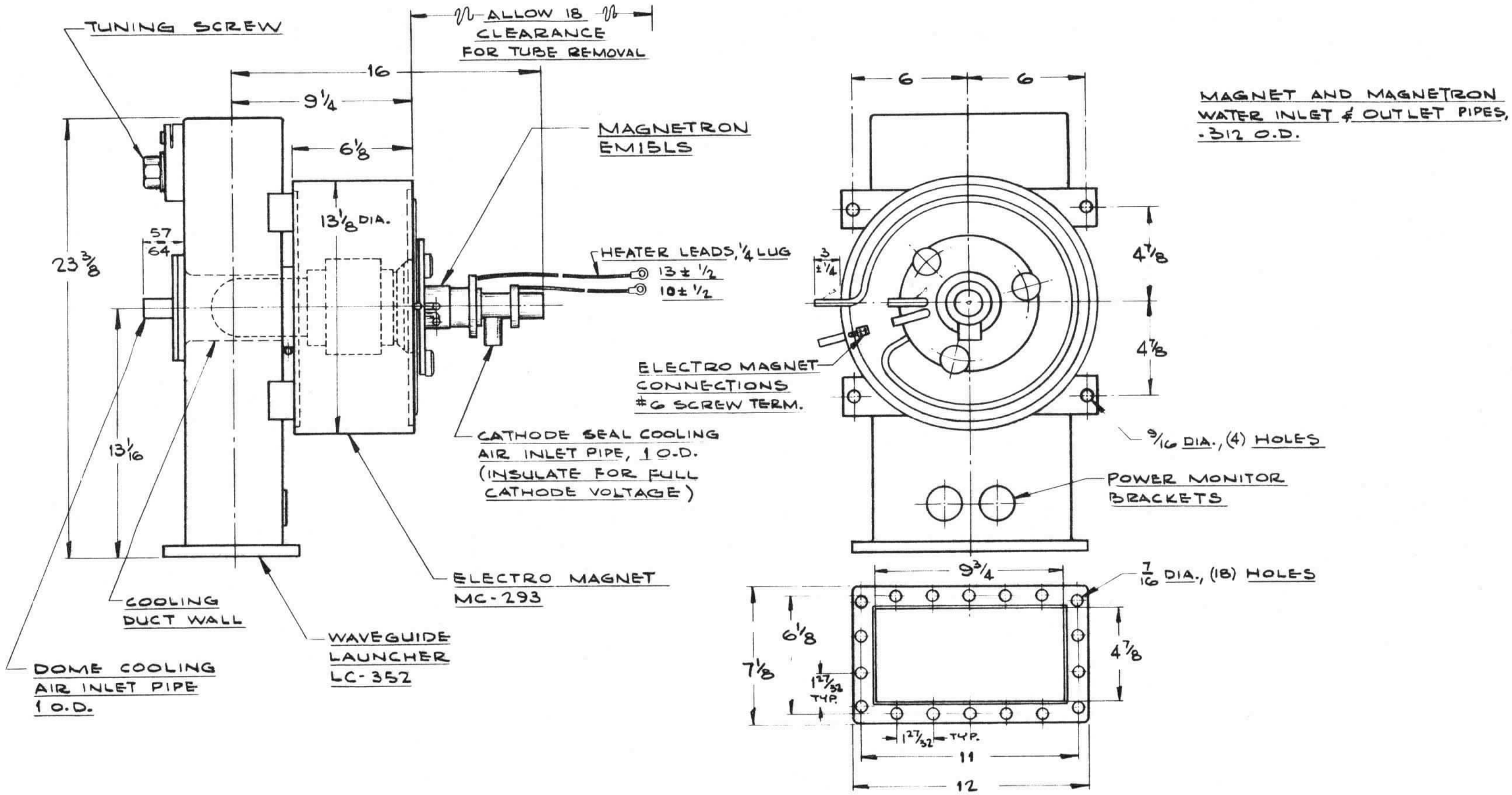
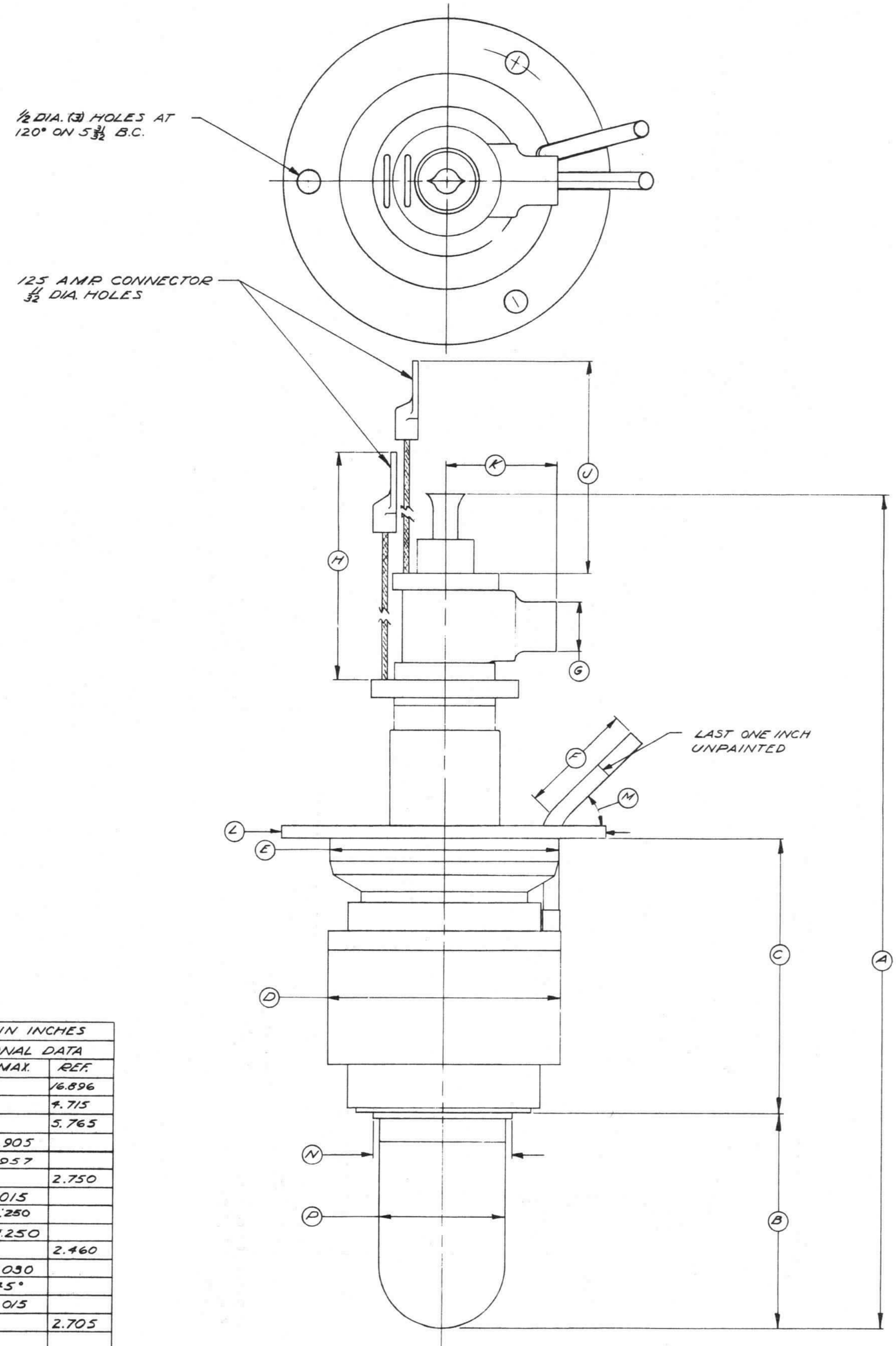


fig. 5



EM-15LS MAGNETRON AND H-195 WAVEGUIDE COUPLER



DIMINSIONS IN INCHES			
	DIMINSIONAL DATA		
DIM.	MIN.	MAX.	REF.
A			16.896
B			4.715
C			5.765
D	4.855	4.905	
E	4.917	4.957	
F			2.750
G	.985	1.015	
H	10.500	11.250	
J	12.500	13.250	
K			2.460
L	6.970	7.030	
M	25°	45°	
N	2.985	3.015	
P			2.705

EM15LS MAGNETRON

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

WL-120
WL-130
WL-140

WATER LOADS

Eimac WL-120, WL-130 and WL-140 are 3-1/8" coaxial water loads covering the frequency range of 200 to 1200 megacycles. These loads will dissipate up to 50 kilowatts average power and three megawatts peak power.

Each of these loads is equipped with a sampling loop which provides a convenient rf monitoring source. Measurement of rf power by calorimetric methods* can be accomplished through the use of auxiliary temperature and flow measuring devices. Thermometer wells are available as accessories.

Because the rf power is dissipated directly into the fluid in these loads the resistivity of the fluid affects the VSWR which the loads present. Fluids having specific resistances of 5000 ohm centimeters or less produce excellent results. Tap water and 50% to 60% solutions of ethylene glycol and distilled water are ordinarily acceptable. Because the resistivity of the fluid changes with temperature the outlet temperature should be kept as low as possible.

These loads can be furnished equipped to withstand pressurization if required. The peak power ratings listed in this data sheet are with pressurization. If pressurization is employed provision must be made to prevent application of gas pressure without adequate fluid pressure. The gas pressure must not exceed the fluid pressure by more than 5 psi.

*When the fluid is water the power formula is:

Power (kw) = 0.264 x Flow-rate (gpm) x Temperature Rise (°C)

Typical values of the constant in this formula for the 60% ethylene glycol solution are: 0.208 at 15°C, 0.215 at 40°C, and 0.226 at 70°C.

CHARACTERISTICS

ELECTRICAL

	WL-120	WL-130	WL-140	
Frequency Range (Inlet Water Temperature 25° C, VSWR<1.2:1)	500-1200	320-1200	200-1200	megacycles
Frequency Range (Inlet Water Temperature 60°C, VSWR<1.2:1)	800-1200	600-1200	400-1200	megacycles
Average Power	50	50	50	kilowatts
Peak Power	3	3	3	megawatts
Impedance	50	50	50	ohms

Coupling (rf): EIA Standard RS-225

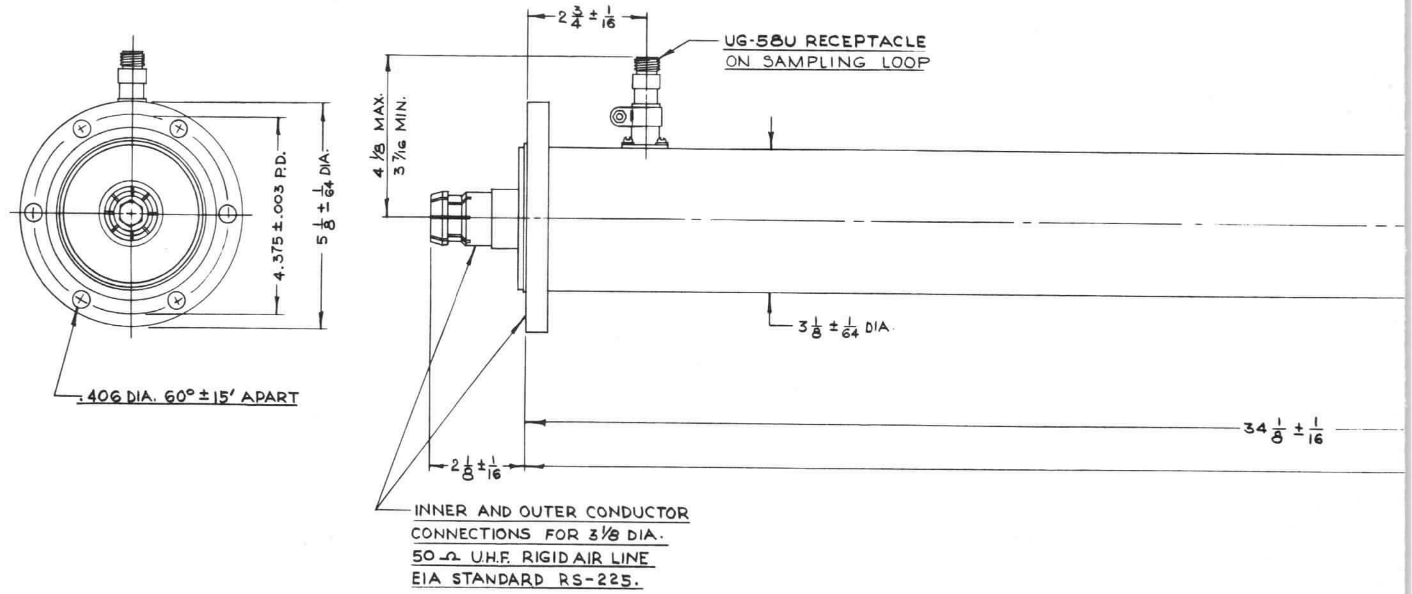
MECHANICAL

Operating Position: Horizontal or rf connection down

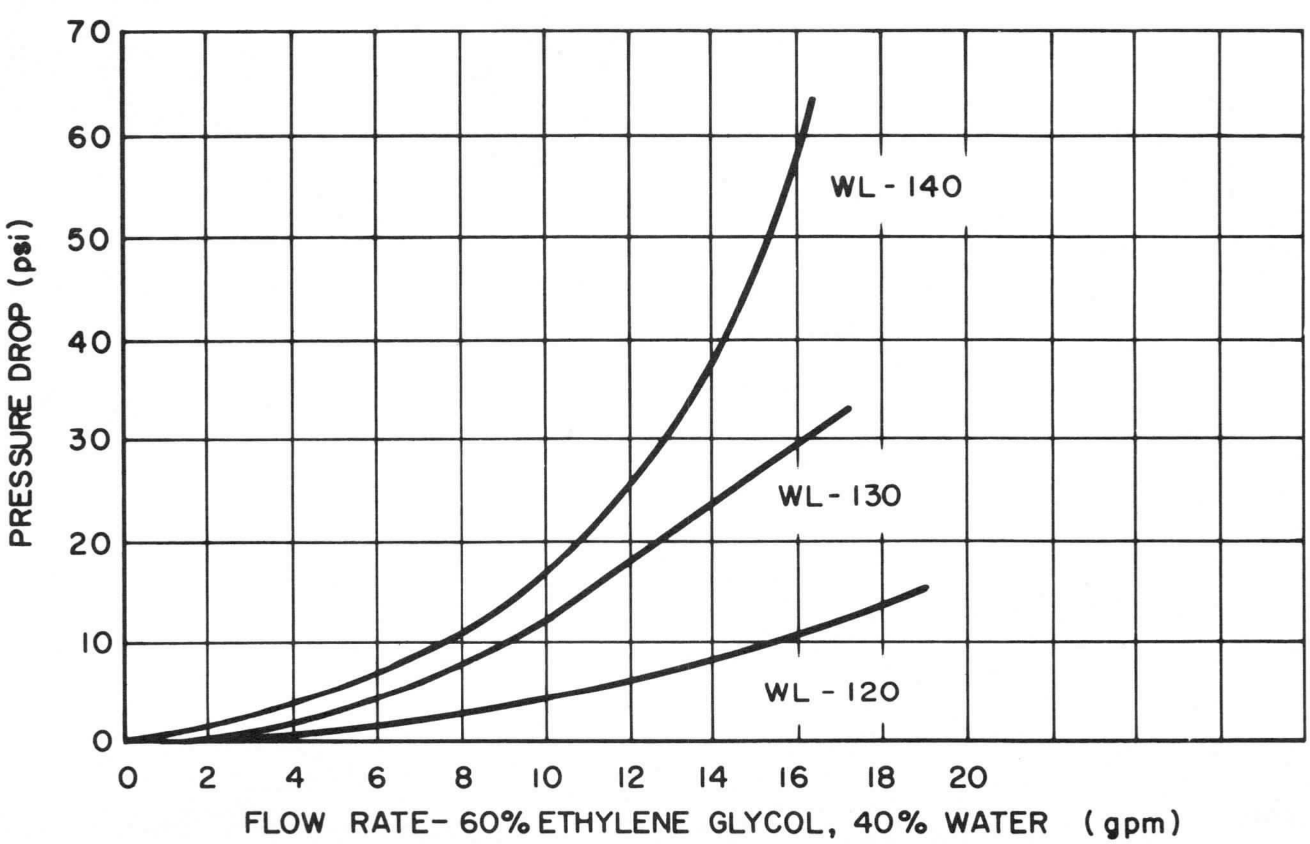
Length	38	80	152	inches
Weight (Empty)	13-1/2	25	38-1/2	pounds
Water Capacity	0.43	1.72	3.96	gallons
Maximum Static Water Pressure	90	90	90	psig
Maximum Outlet Water Temperature	70	70	70	degrees C
Maximum Gas Pressure relative to water pressure	5	5	5	psi

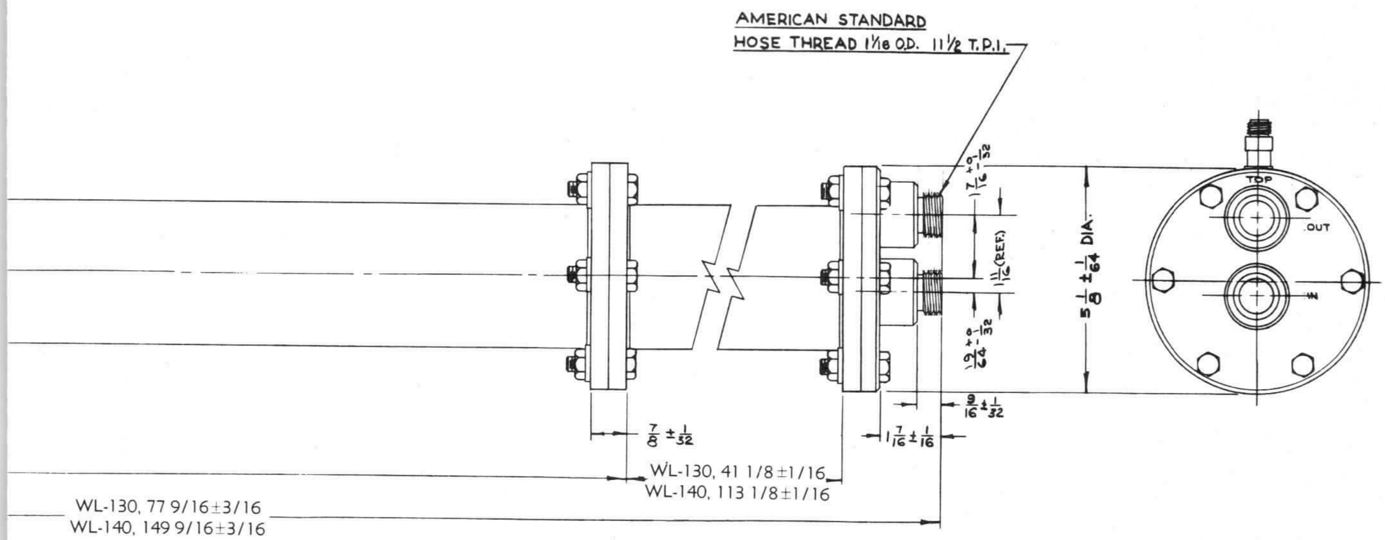
Water Connections: American Standard Hose thread, 1-1/6" O.D., 11-1/2 T.P.I.

For additional information or information regarding a specific application, write to Eitel-McCullough, San Carlos, California.

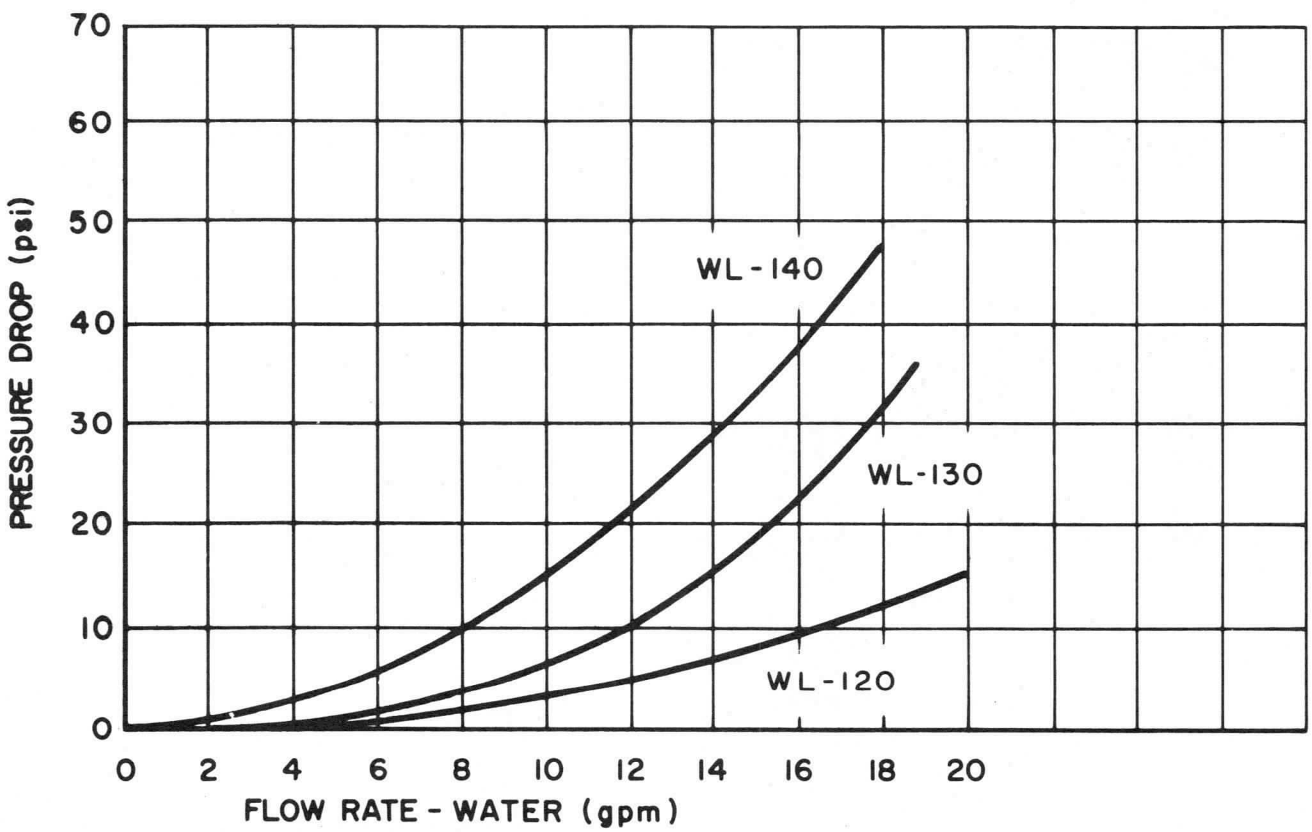

4.375 ± .003 P.D.
5 1/8 ± 1/64 DIA.
.406 DIA. 60° ± 15' APART
2 3/4 ± 1/16
UG-58U RECEPTACLE ON SAMPLING LOOP
4 1/8 MAX.
3 7/16 MIN.
3 1/8 ± 1/64 DIA.
34 1/8 ± 1/16
2 1/8 ± 1/16
INNER AND OUTER CONDUCTOR CONNECTIONS FOR 3 1/8 DIA. 50 Ω U.H.F. RIGID AIR LINE EIA STANDARD RS-225.

WL-130 & WL

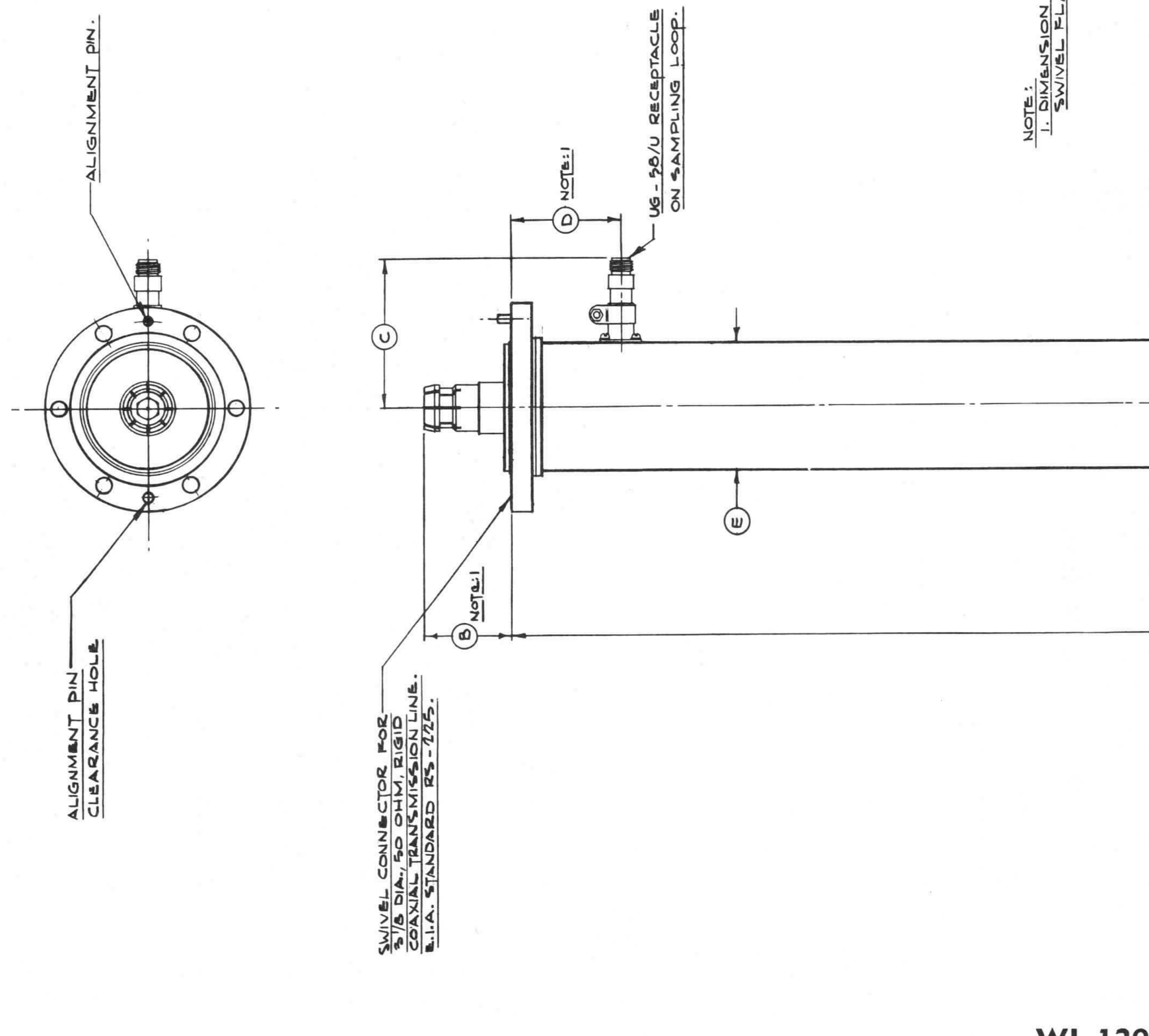

PRESSURE DROP (psi)
70
60
50
40
30
20
10
0
WL - 140
WL - 130
WL - 120
0
2
4
6
8
10
12
14
16
18
20
FLOW RATE– 60% ETHYLENE GLYCOL, 40% WATER (gpm)


AMERICAN STANDARD
HOSE THREAD 1 1/16 O.D. 11 1/2 T.P.I.
TOP
OUT
IN
DIA.
WL-130, 41 1/8±1/16
WL-140, 113 1/8±1/16
WL-130, 77 9/16±3/16
WL-140, 149 9/16±3/16

-140 OUTLINE

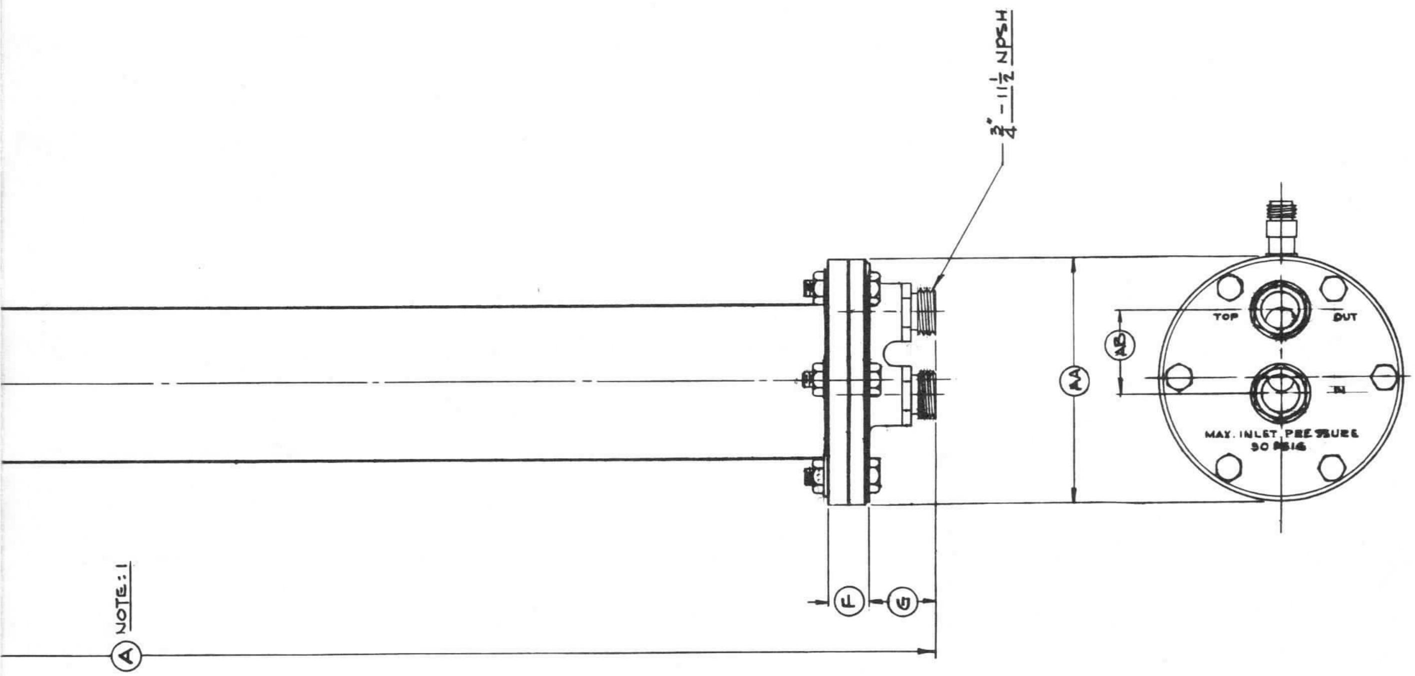

PRESSURE DROP (psi)
FLOW RATE - WATER (gpm)
WL-140
WL-130
WL-120
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60
70

DIMENSIONAL DATA			
REF.	NOM.	MIN.	MAX.
A		35.437	35.688
B		1.062	2.188
C		3.438	4.125
D		2.687	2.813
E		3.109	3.141
F		.781	.844
G		1.400	1.600
AA		5.094	5.156
AB		1.687	1.813



NOTE:
1. DIMENSION INDICATED WITH SWIVEL FLANGE SEATED.

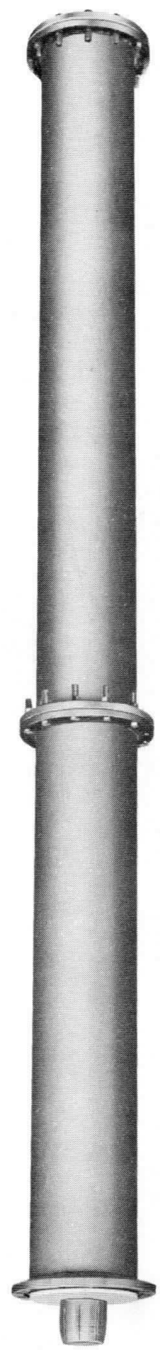
WL-120


$\frac{3}{4}$" - 11$\frac{1}{2}$ NPSH
TOP
OUT
IN
MAX. INLET PRESSURE 30 PSIG
AA
AB
F
G
A
NOTE: 1

OUTLINE

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

WL-150
WL-151
WL-160
WL-161
WATER LOADS
300 kW
200-750 Mc



Eimac WL-150, WL-151, WL-160, and WL-161 are 6⅛" coaxial water loads covering the frequency range of 200 to 750 megacycles. These loads will each dissipate up to 300 kilowatts average power. The WL-151 and WL-161 will also dissipate up to 5 megawatts peak power.

Water Loads WL-150 and WL-160 are equipped with sampling loops which provide convenient rf monitoring sources. Measurement of rf power by calorimetric methods* can be accomplished through the use of auxiliary temperature and flow measuring devices. Thermometer wells are available as accessories.

Because the rf power is dissipated directly into the fluid in these loads, the resistivity of the fluid affects the VSWR which the loads present. Fluids having specific resistances of 5000 ohm centimeters or less produce excellent results. Tap water and 50% to 60% solutions of ethylene glycol and distilled water are ordinarily acceptable. Because the resistivity of the fluid changes with temperature the outlet temperature should be kept as low as possible.

Water Loads WL-151 and WL-161 are equipped to withstand pressurization. The peak power ratings listed in this data sheet are with pressurization. If pressurization is employed provision must be made to prevent application of gas pressure without adequate fluid pressure. The gas pressure must not exceed the fluid pressure by more than 5 psi.

*Power dissipated in the load is determined calorimetrically as follows:

Power (kW) = K x Flow-rate (gpm) x Temperature Rise (°C).

For water, the constant (K) is 0.264.

Typical values of the constant (K) for a 60% ethylene glycol solution are: 0.208 at 15°C, 0.215 at 40°C, and 0.226 at 70°C.

CHARACTERISTICS

ELECTRICAL

	WL-150 WL-151	WL-160 WL-161
Frequency Range (Inlet Water Temperature 25°C, VSWR < 1.2:1)	250-750	200-750 megacycles
Frequency Range (Inlet Water Temperature 60°C, VSWR < 1.2:1)	390-750	340-750 megacycles
Average Power	300	300 kilowatts
Peak Power (WL-151 or WL-161, Pressurized)	5	5 megawatts
Impedance	50	50 ohms

Coupling (rf): EIA Standard RS-235

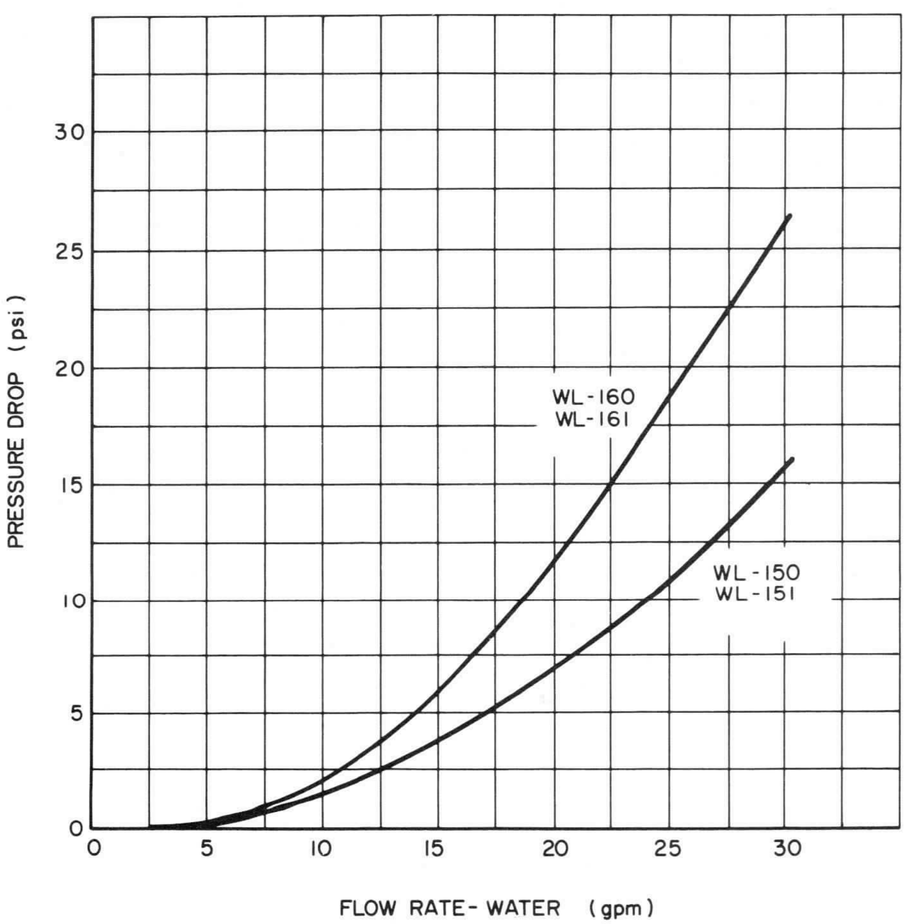
MECHANICAL

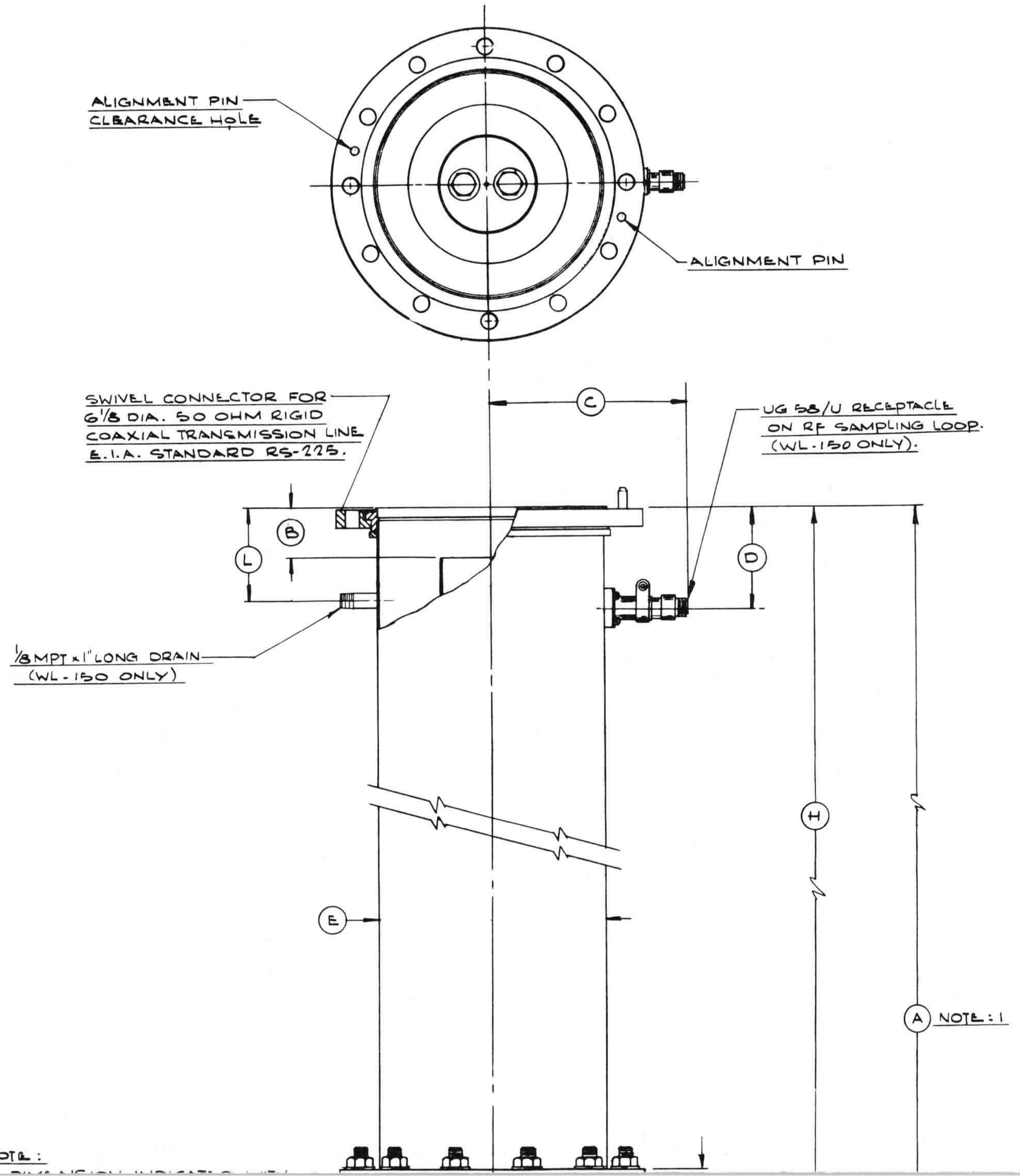
Operating Position: Horizontal or rf connection down

	WL-150 WL-151	WL-160 WL-161
Length	86.75	152.75 inches
Weight (Empty)	78	112 pounds
Water Capacity	7.5	17 gallons
Maximum Static Water Pressure	60	60 psig
Maximum Outlet Water Temperature	70	70 degrees C
Maximum Gas Pressure relative to water pressure	5	5 psi

Water Connections: ¾" F.P.T.

For additional information or information regarding a specific application, write to Eitel-McCullough, San Carlos, California



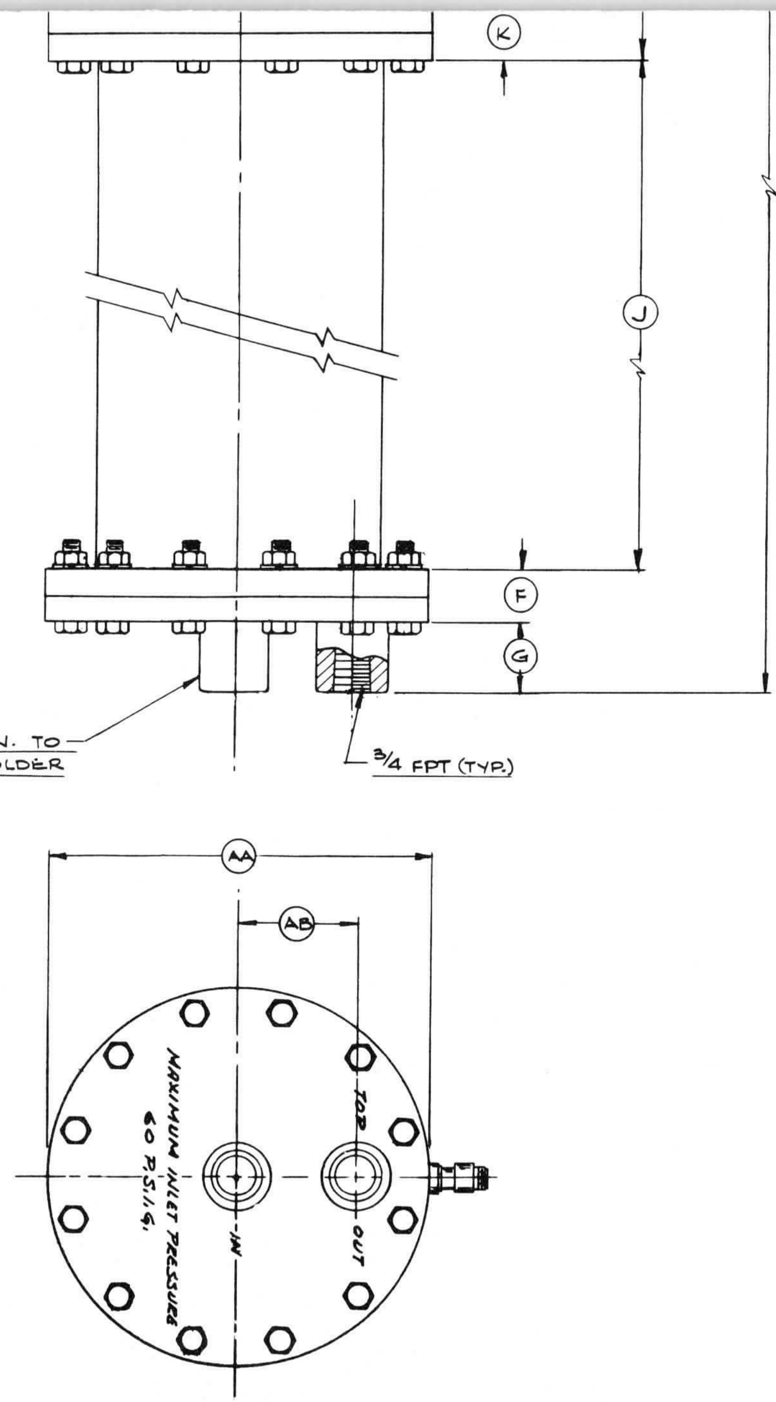


ALIGNMENT PIN
CLEARANCE HOLE
ALIGNMENT PIN
SWIVEL CONNECTOR FOR
6 1/8 DIA. 50 OHM RIGID
COAXIAL TRANSMISSION LINE
E.I.A. STANDARD RS-225.
C
UG 58/U RECEPTACLE
ON RF SAMPLING LOOP.
(WL-150 ONLY).
B
L
D
1/8 MPT x 1" LONG DRAIN
(WL-150 ONLY)
H
E
A
NOTE: 1

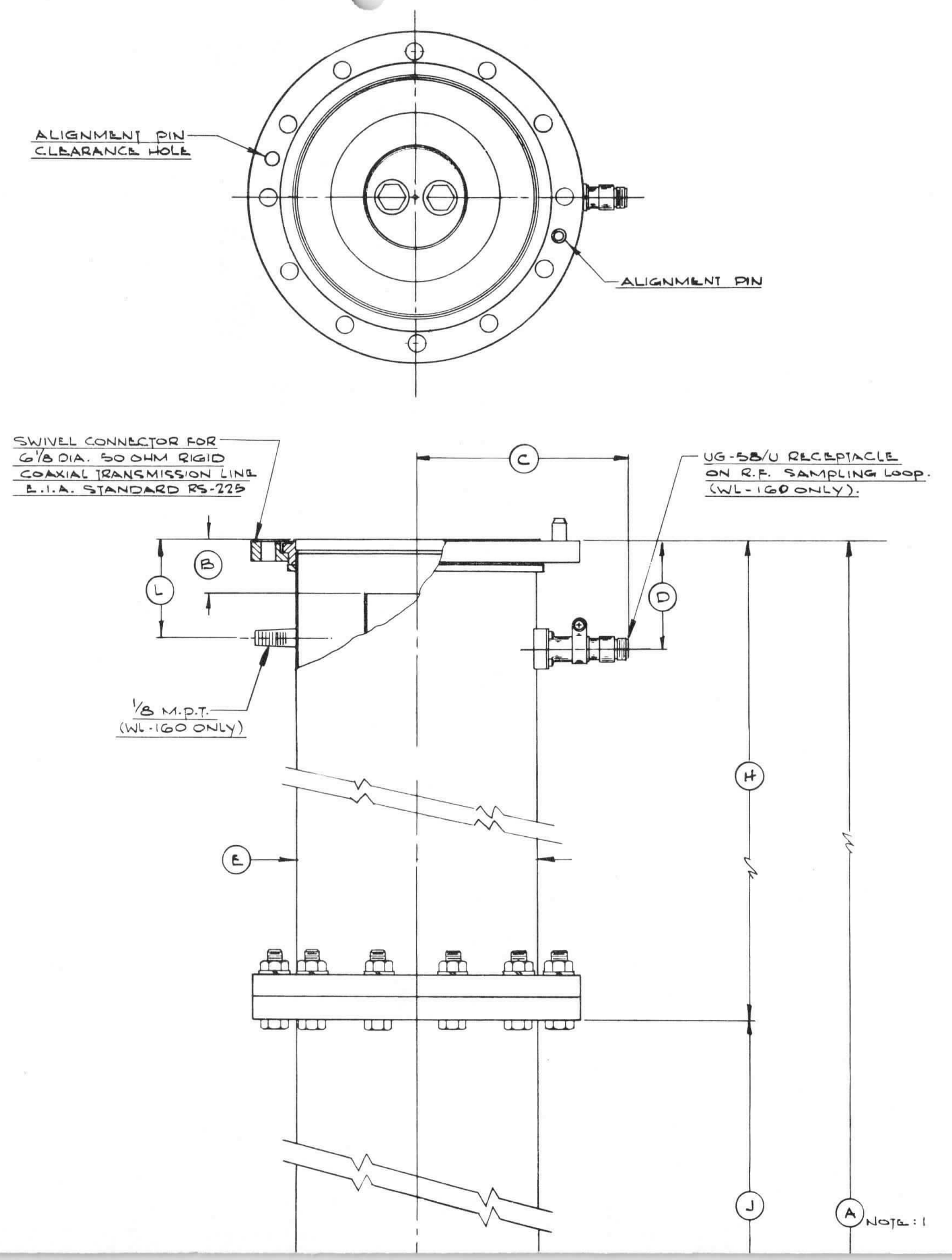
NOTE:

1. DIMENSION INDICATED WITH
SWIVEL FLANGE SEATED.

DIMENSIONAL DATA			
REF.	NOM.	MIN.	MAX.
A		83.969	84.281
B		1.250	1.281
C		4.937	5.625
D		2.687	2.813
E		6.109	6.141
F		1.094	1.156
G		1.531	1.594
H		34.625	34.750
J		46.687	46.813
K		1.219	1.281
L		2.375	2.625
AA		8.156	8.219
AB		2.468	2.531

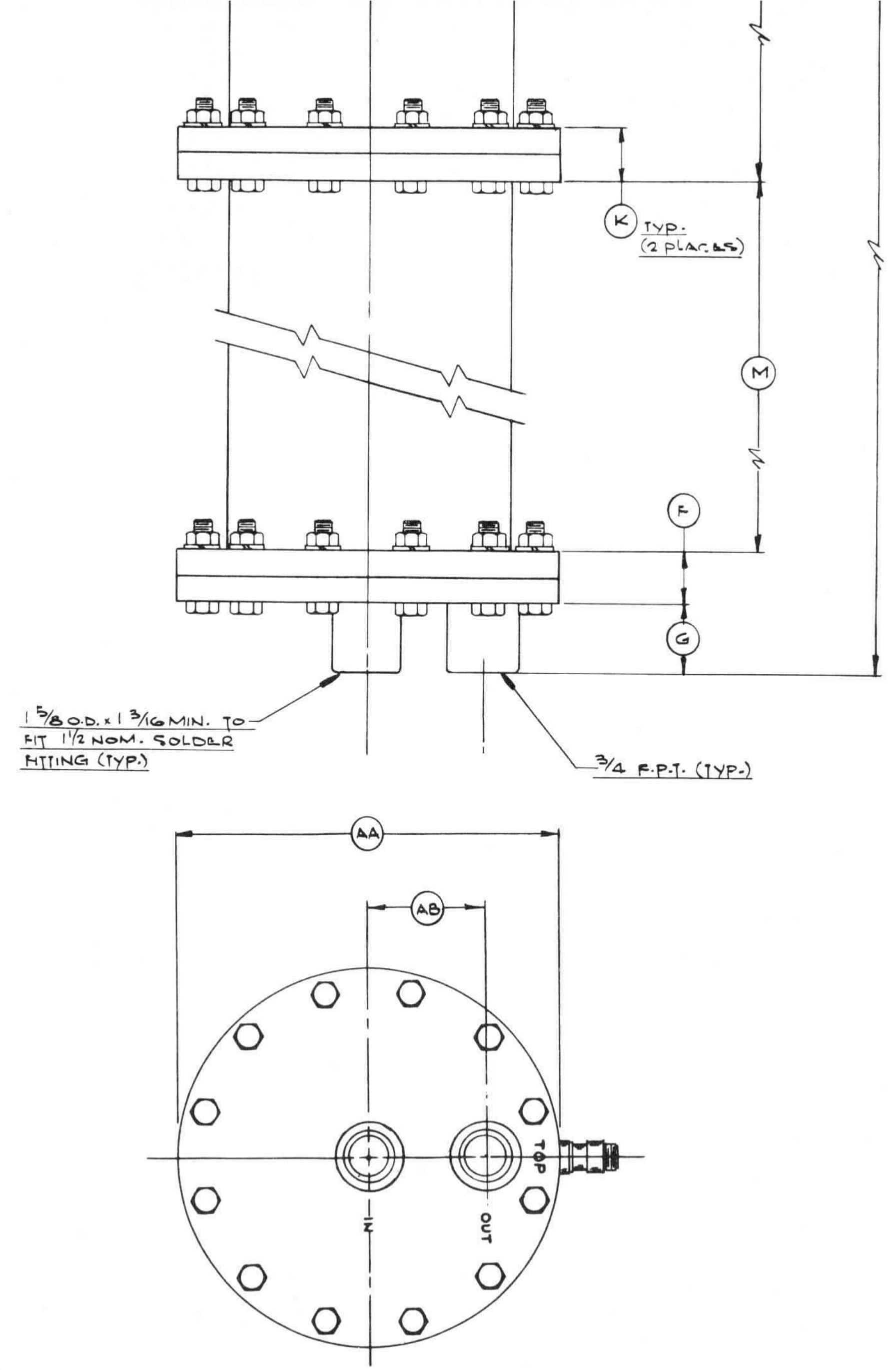


WL-150, WL-151 OUTLINE

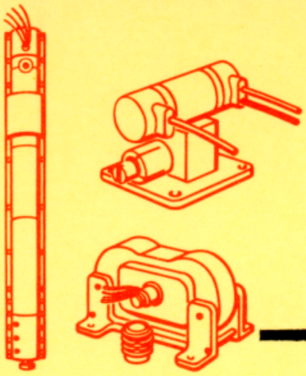

ALIGNMENT PIN
CLEARANCE HOLE
ALIGNMENT PIN
SWIVEL CONNECTOR FOR
6 1/8 DIA. 50 OHM RIGID
COAXIAL TRANSMISSION LINE
E.I.A. STANDARD RS-225
UG-58/U RECEPTACLE
ON R.F. SAMPLING LOOP.
(WL-160 ONLY).
1/8 M.P.T.
(WL-160 ONLY)
C
B
L
D
H
E
J
A
NOTE: 1

NOTE:
1. DIMENSION INDICATED WITH SWIVEL FLANGE SEATED.

DIMENSIONAL DATA			
REF.	NOM.	MIN:	MAX.
A		149.906	150.282
B		1.250	1.280
C		4.937	5.625
D		2.687	2.813
E		6.109	6.141
F		1.094	1.156
G		1.531	1.594
H		34.625	34.750
J		47.937	48.063
K		1.219	1.281
L		2.375	2.625
M		64.687	64.813
AA		8.156	8.219
AB		2.468	2.531



WL-160, WL-161 OUTLINE



reflex klystrons · twt · vtm

Look in the general section for---

- Your nearest distributor of modern, fully guaranteed Eimac electron tubes and electron tube accessories.
- Your nearest Eimac Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or provide other information not found in the catalog.
- Eimac tube type numbering system.
- Tube Replacement Chart.
- Prices on Eimac products.

IMPORTANT EIMAC "EXTRAS"

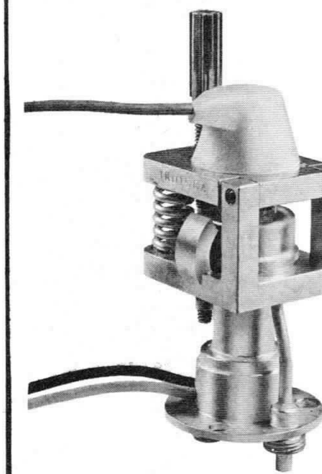
Application Engineering. The Eimac Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proved by Eimac engineers, whose combined knowledge and experience are at your service. Additional contributions by this Eimac department are its Application Bulletins, a service which you receive without obligation.

Field Engineering. Serving as an extension of the Application Engineering Department outside the Eimac plant, Eimac Field Engineers cover the United States, operating out of offices in major cities. They will help you personally with experimental work, problems of technique, etc. Engineers from Eitel-McCullough, Inc. are available, too, for field consultation throughout the country. As Eimac tubes are world renowned, the same services extend to various countries overseas through the Eimac Export Department.

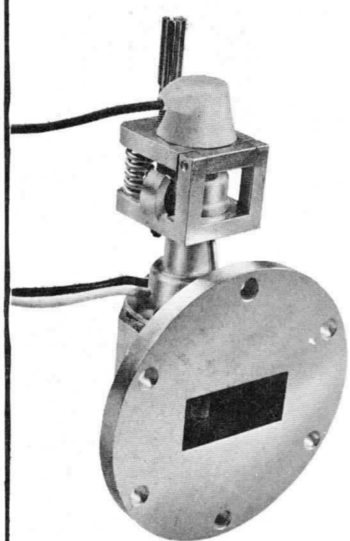
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

PRELIMINARY DATA
1K015CA
1K015CG
C-BAND
REFLEX KLYSTRONS

The Eimac 1K015CA and 1K015CG are ceramic and metal, ruggedized, internal-cavity reflex klystrons designed for local oscillator service in the frequency range of 5350 to 5950 megacycles. These tubes are capable of delivering a minimum output power of 70 milliwatts into a load VSWR of 1.5 to 1 under conditions of shock, vibration or sustained acceleration.



1K015CA



1K015CG

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated.		
	Warm-up time - -	60	seconds
Heater:	Voltage - - -	6.3	volts
	Current - - -	1.0	ampere
Minimum Output Power	(Load VSWR=1.5:1)	70	milliwatts
Frequency Range	- -	5350 to 5950	megacycles

MECHANICAL

Operating Position - - - -	Any		
Mounting:			
1K015CA - - -	Three hole flange		
1K015CG - -	UG-344/U waveguide flange		
R-F Output Coupling:			
1K015CA - -	Miniature coaxial fitting		
1K015CG - -	RG-50/U waveguide		
Electrical Connections - -	Flexible leads		
Cooling - - -	Convection and conduction		
Maximum Overall Dimensions:	1K015CA	1K015CG	
Length - -	3.4	5.3	inches
Width - -	1.3	3.1	inches
Depth - -	1.2	1.5	inches
Net Weight - - -	4.2	17.5	ounces
Shipping Weight (Approximate)	2	6	pounds

ENVIRONMENTAL

Maximum Ambient Temperature - - - -	100° C
Maximum Altitude - - - - -	No limit
Maximum Operating Shock (11 ms duration)* - -	40 g
Maximum Operating Vibration (20-2000 cps)** - -	10 g

*Based on a maximum permanent frequency shift after drop of 1.5 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 1.0 megacycle.

MAXIMUM RATINGS

D-C RESONATOR VOLTAGE*	350	MAX. VOLTS
D-C CATHODE CURRENT	55	MAX. MA.
RESONATOR DISSIPATION	20	MAX. WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0	MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500	MAX. VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

D-C Resonator Voltage*	300	350	volts
Mode	4-3/4	3-3/4	
Frequency	5650	5650	megacycles
D-C Cathode Current	35	49	milliamperes
D-C Repeller Voltage*	-135	-240	volts
D-C Repeller Current	1	1	microampere
Power Output	35	130	milliwatts
Electronic Tuning Range (3 db-bandwidth)	45	45	megacycles
Modulation Sensitivity	1600	900	Kc/volt
Peak-to-peak FM Deviation (10g, 20-2000 cps)	75	75	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level, these tubes will not require forced air cooling when operated at their maximum rated dissipation with an ambient temperature less than 100° Centigrade. The mounting flange or waveguide flange will normally provide the required heat sink connection for conduction cooling.

If an insulator is used between the tube and waveguide or chassis, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 200° Centigrade.

Resonator: The resonator of the 1K015CA and 1K015CG is integral with the body of the tube. For this reason, it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ± 5% of the rated value of 6.3 volts if variation in performance is to be minimized and best tube life obtained.

The heater and cathode of the 1K015CA and 1K015CG are internally connected. When the resonator of these tubes is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: Mechanical tuning is accomplished by a single screw tuner with a differential thread. A tuning rate of approximately 100 megacycles per turn and a maximum tuner torque of four inch-pounds is provided by this design. Mechanical stops, capable of withstanding a maximum torque of 10 inch-pounds, are provided at the extremes of the tuning range. Tuner cycling in excess of 100 cycles will not damage the vacuum seals.

A clockwise rotation of the tuner will produce an increase in frequency.

Mounting: The 1K015CA should be mounted by the three-hole tube flange provided. The 1K015CG is mounted by the UG-344/U waveguide flange to the appropriate waveguide connector.

Electrical connections are made to both tubes by means of the flexible leads provided.

Output Coupling: The R-F terminal of the 1K015CA is a miniature coaxial connector described in detail in the outline drawing. For waveguide coupling, the 1K015CG utilizes the Eimac transition section and mates with standard RG-50/U waveguide. An adapter is available on special order to adapt the 1K015CA to standard BNC type coaxial output.

Special Applications: For additional information regarding any specific application, write to Eitel-McCullough, Inc., San Carlos, California. All such requests will be handled confidentially.

Eitel-McCullough, Inc.
February 16, 1960
AE245

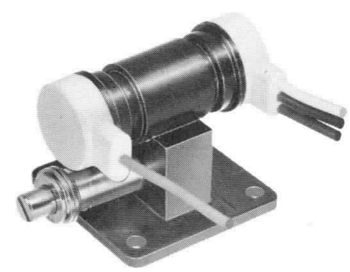
Eimac

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K20XD-A

X-BAND REFLEX KLYSTRON



The Eimac 1K20XD-A is a ceramic and metal, conduction-cooled reflex klystron designed for local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 75 milliwatts over the frequency range of 10,000 to 10,700 megacycles.

The stacked-ceramic construction results in an extremely rugged design and low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up time	30	seconds
Heater:	Voltage	6.3	volts
	Current	0.8	ampere
Typical Output Power (Load VSWR = 1.15:1)		75	milliwatts
Frequency Range		10,000 to 10,700	megacycles

MECHANICAL

Operating Position		Any
Mounting		UG-39/U waveguide flange
Cooling		Conduction
Electrical Connections		Flexible leads
RF Output Coupling		RG-52/U waveguide
Net Weight	4	ounces
Shipping Weight (approximate)	2	pounds
Maximum Overall Dimensions:		
Height	1.50	inches
Width	1.63	inches
Length	2.50	inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-Operating Shock* (11 ms Duration)	40 g
Maximum Operating Vibration** (20 to 2,000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 200 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	350 MAX.	VOLTS
DC CATHODE CURRENT	55 MAX.	MA
RESONATOR DISSIPATION	20 MAX.	WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0 MAX.	VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX.	VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

DC Resonator Voltage*	300	350	volts
Mode	5-3/4	5-3/4	
Frequency	10,350	10,350	megacycles
DC Cathode Current	26	35	milliamperes
DC Repeller Voltage*	-165	-150	volts
DC Repeller Current	1	1	microampere
Power Output	50	75	milliwatts
Electronic Tuning (3db bandwidth)	30	30	megacycles
Modulation Sensitivity ($\Delta E_r = \pm 3$ volts)	2.0	2.0	Mc/volt
Peak-to-Peak FM Deviation (10g, 20-2000 cps)	200	200	kilocycles
Residual FM	50	50	kilocycles

*All voltages referred to cathode.

APPLICATION

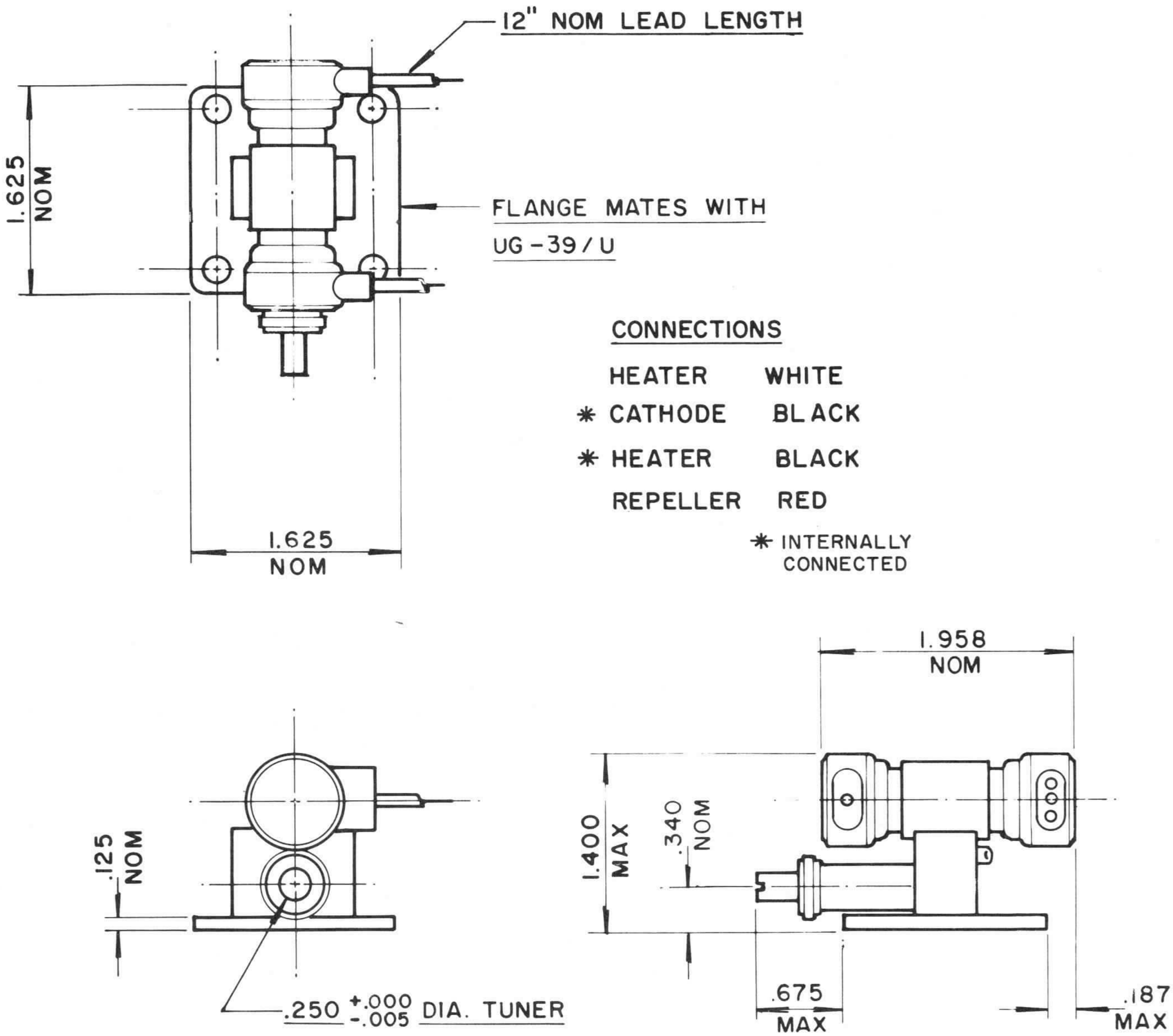
Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 150° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the body temperature below the maximum rating of 175° Centigrade.

Resonator: The resonator of the 1K20XD-A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.
The heater and cathode of the 1K20XD-A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the 1K20XD-A a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.
A clockwise rotation of the tuner will produce a decrease in frequency.

1K20XD-A



CONNECTIONS

HEATER	WHITE
* CATHODE	BLACK
* HEATER	BLACK
REPELLER	RED

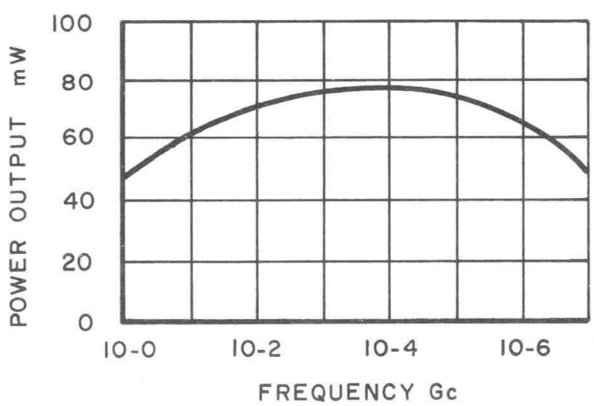
* INTERNALLY CONNECTED

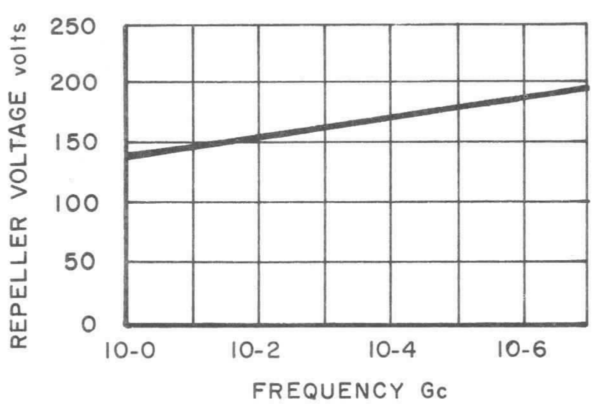
1K20XD-A TYPICAL OPERATING CHARACTERISTICS

Ers = 300 Vdc

Ik = 26 mAdc

$5\frac{3}{4}$ MODE

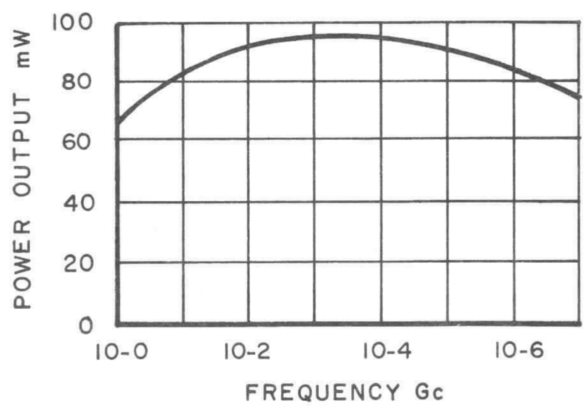


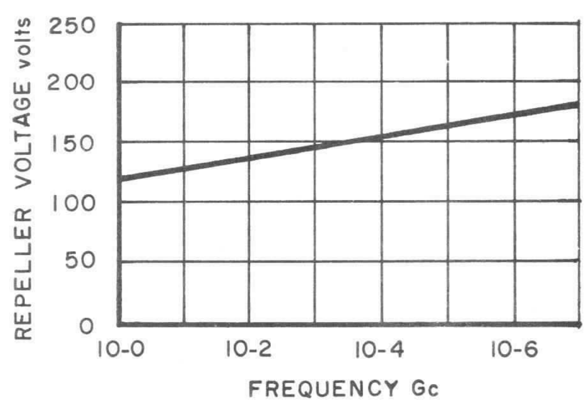


Ers = 350 Vdc

Ik = 35 mAdc

$5\frac{3}{4}$ MODE





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

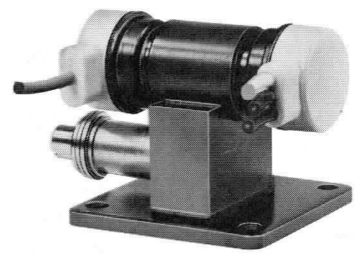
1K20XD-S

X-BAND REFLEX KLYSTRON

The Eimac 1K20XD-S is a ceramic and metal, conduction-cooled reflex klystron designed for transmitter or local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 120 milliwatts over the frequency range of 10,500 to 11,000 megacycles.

The stacked-ceramic construction results in an extremely rugged design and a low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.



GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up time	30	seconds
Heater:	Voltage	6.3	volts
	Current	1.0	ampere
Minimum Output Power (Load VSWR 1.15:1)		100	milliwatts
Frequency Range		10,500 to 11,000	megacycles

MECHANICAL

Operating Position	any
Mounting	UG-39/U waveguide flange
Cooling	conduction
Electrical Connections	flexible leads
RF Output Coupling	RG-52/U waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.50 inches
Width	1.63 inches
Length	2.50 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-Operating Shock* (11 ms Duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g
Maximum Operating Shock* (11 ms Duration)	40 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 200 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	450 MAX.	VOLTS
DC CATHODE CURRENT	45 MAX.	MA
RESONATOR DISSIPATION	25 MAX.	WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0 MAX.	VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX.	VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15:1)

DC Resonator Voltage*	400	volts
Mode		5-3/4
Frequency	10,750	megacycles
DC Cathode Current	40	milliamperes
DC Repeller Voltage*	-175	volts
DC Repeller Current	1	microampere
Power Output	120	milliwatts
Electronic Tuning (3 db bandwidth)	30	megacycles
Modulation Sensitivity ($\Delta E_r = \pm 3$ volts)	1.7	Mc/volt
Peak-to-Peak FM Deviation (10g, 20-2000 cps)	200	kilocycles
Residual FM	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 150° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-ceramic seal temperatures below the maximum rating of 250° Centigrade.

Resonator: The resonator of the 1K20XD-S is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

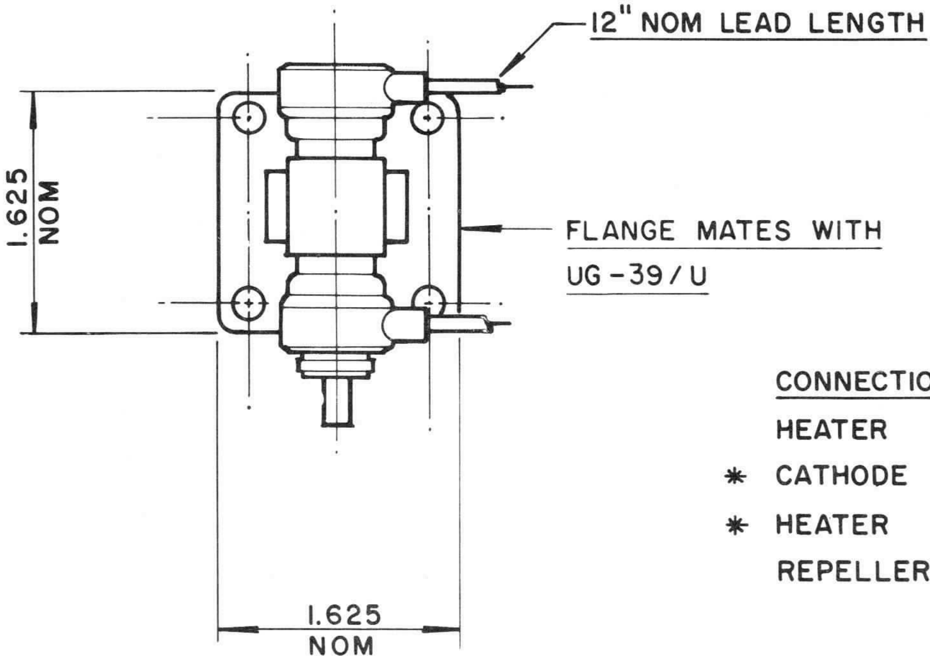
Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the 1K20XD-S are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the 1K20XD-S a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.

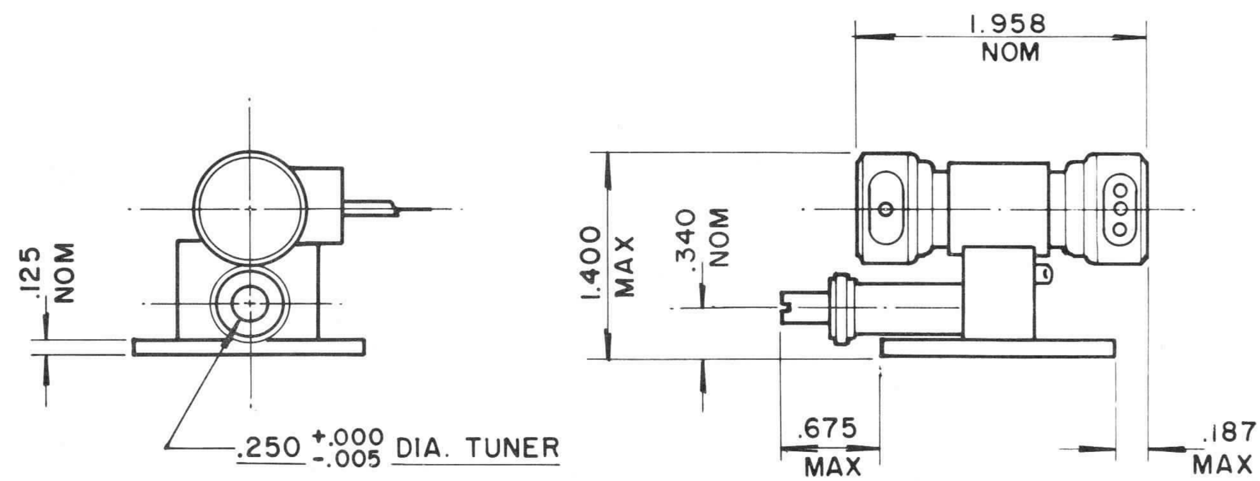
1K20XD-S



CONNECTIONS

HEATER
* CATHODE
* HEATER
REPELLER

* INTERNALLY CONNECTED

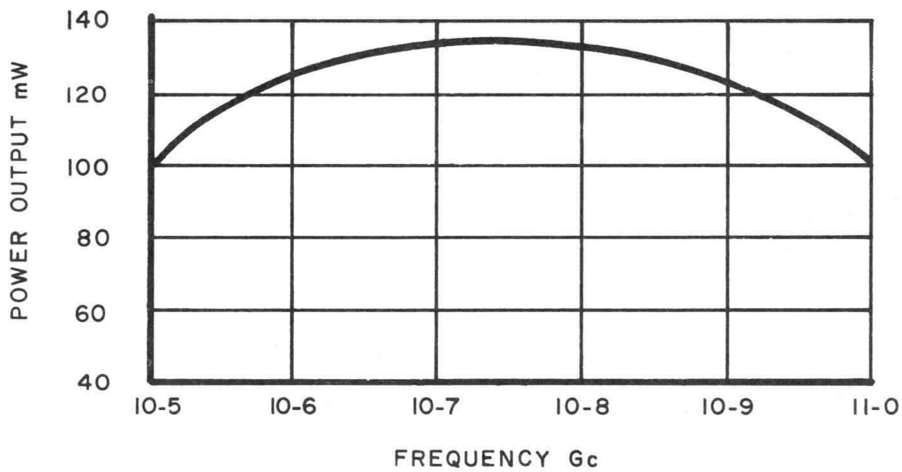


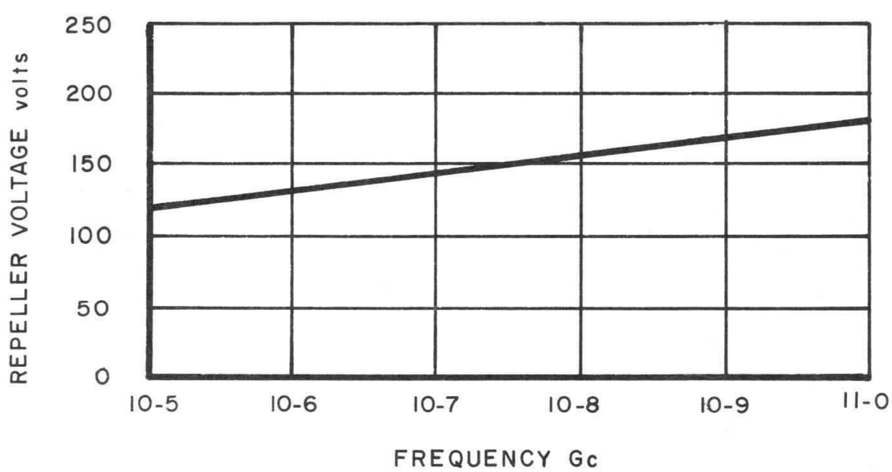
1K20XD-S TYPICAL OPERATING CHARACTERISTICS

Ers = 400 Vdc

Ik = 40 mAdc

$5\frac{3}{4}$ MODE





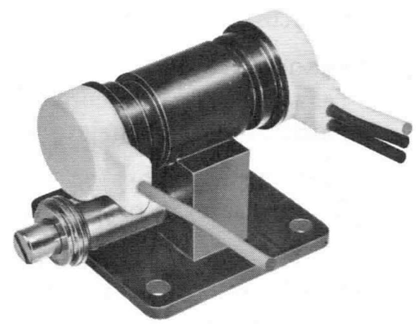
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K20XF-B

X BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	10.061 to 10.452 Gc
Mechanically tunable	391 Mc
Power output	40 mW min.
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	300 Vdc
Cathode current	25 mA
Repeller voltage	−80 to −120 Vdc
Modulation sensitivity	3.0 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	0.7 A max.
Mode	5¾
VSWR of load	1.1:1
Temperature coefficient	−200 +100 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	400 Vdc
Cathode current	50 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	RG-52U wave-guide flange
Cooling required	conduction
Net weight	5 oz. max.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100° C
Altitude	100,000 ft.
Vibration*	10G, 20 to 2000 cps
Shock*	40G, 11 ms

*As required

OUTLINE DIMENSIONS

Height	1.400 in.
Width	1.625 in.
Length	2.570 in.

APPLICATION

NOTE: All voltages are referred to the cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at less than 20 watts resonator dissipation and an ambient temperature of less than 150° C. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If the tube is operated at a resonator dissipation of greater than 20 watts or if an insulator is used between the tube and waveguide for DC isolation, forced air cooling will be required to maintain the body temperature below the maximum rating of 175° Centigrade.

Resonator: The resonator of the 1K20XF-B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

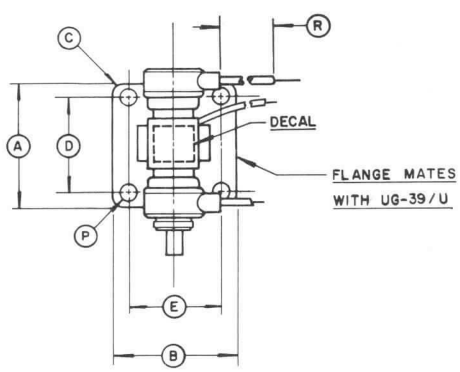
Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the 1K20XF-B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2,000 cps) or shock of up to 40g (11 milliseconds duration).

With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 200 kilocycles.

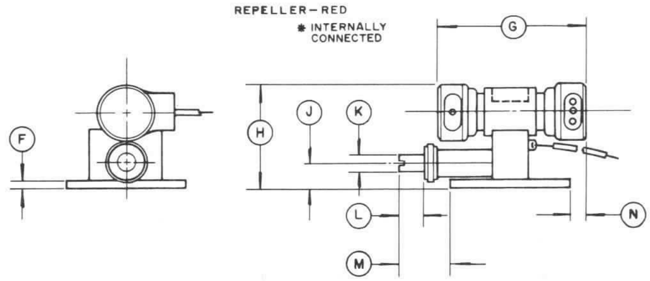
Special Applications: For additional information regarding any specific application, write to Microwave Division, Eitel-McCullough, Inc., San Carlos, California, telephone Lytell 1-1451, Cable EIMAC.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF	MIN	MAX	NOM
A			1.625
B			1.625
C			.125 R.
D	1.276	1.284	
E	1.216	1.224	
F			.125
G			1.958
H		1.400	
J			.340
K	.245	.250	
L	.290		
M		.800	
N		.187	
P	.169	.174	
R	12±1 TYP LEAD LENGTH		

CONNECTIONS
BODY – BROWN
HEATER – WHITE
* CATHODE – BLACK
* HEATER – BLACK
REPELLER – RED
* INTERNALLY CONNECTED



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K20XK

X-BAND
REFLEX KLYSTRON

The Eimac 1K20XK is a ceramic and metal, conduction-cooled reflex klystron designed for local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 75 milliwatts over the frequency range of 9200 to 10,000 megacycles.

The stacked-ceramic construction results in an extremely rugged design and a low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated.	
Warm-up time	30 seconds
Heater: Voltage	6.3 volts
Current	0.8 ampere
Typical Output Power (Load VSWR = 1.15:1)	75 milliwatts
Frequency Range	9200 to 10,000 megacycles

MECHANICAL

Operating Position	Any
Mounting	UG-39/U waveguide flange
Cooling	Conduction
Electrical Connections	Flexible leads
R-F Output Coupling	RG-52/U waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.40 inches
Width	1.63 inches
Length	2.28 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-Operating Shock (11 ms Duration)	40 g
Maximum Operating Shock* (11 ms Duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 100 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	350 MAX. VOLTS
D-C CATHODE CURRENT	55 MAX. MA.
RESONATOR DISSIPATION	20 MAX. WATTS
PEAK REPELLER VOLTAGE*	
POSITIVE WITH RESPECT TO CATHODE	0 MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX. VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

D-C Resonator Voltage*	300	350	volts
Mode	5¾	5¾	
Frequency	9600	9600	megacycles
D-C Cathode Current	40	50	milliamperes
D-C Repeller Voltage*	−170	−155	volts
D-C Repeller Current	1	1	microampere
Power Output	70	90	milliwatts
Electronic Tuning (3 db bandwidth)	35	35	megacycles
Modulation Sensitivity ($\Delta E_r = \pm 3$ volts)	1.7	1.7	Mc/volt
Peak-to-Peak FM Deviation (10g, 20-2000 cps)	50	50	kilocycles
Residual FM	50	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced-air cooling when operated at its maximum rated dissipation with an ambient temperature less than 150° Centigrade. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for D-C isolation, forced-air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 250° Centigrade.

Resonator: The resonator of the 1K20XK is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

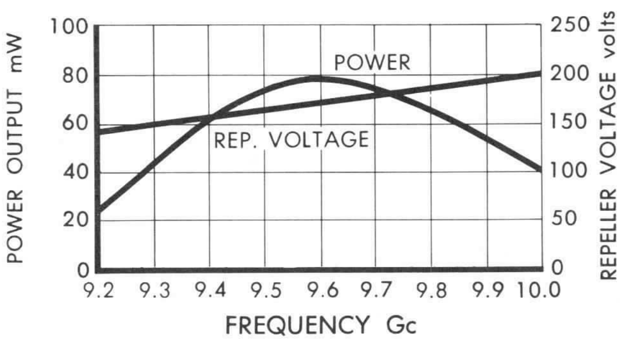
The heater and cathode of the 1K20XK are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

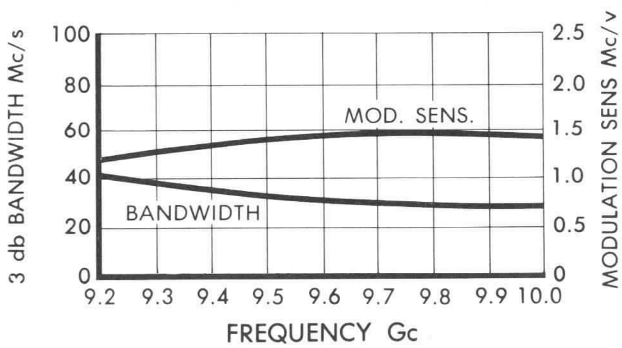
Mechanical Tuning: In the 1K20XK a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.

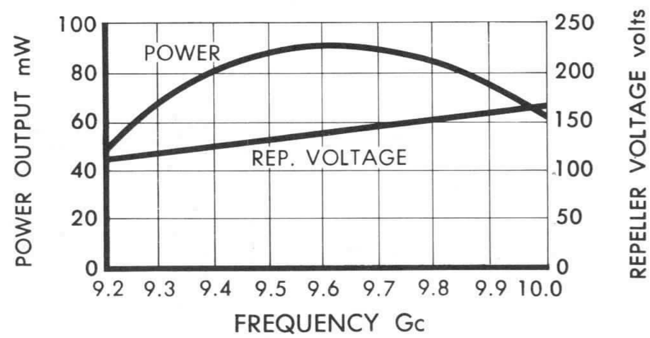
IK20XK TYPICAL OPERATING CHARACTERISTICS

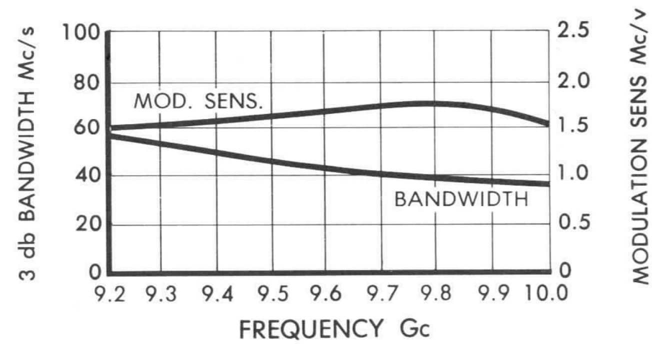
$E_{RS} = 350$ Vdc
$I_K = 50$ mAdc
5¾ MODE



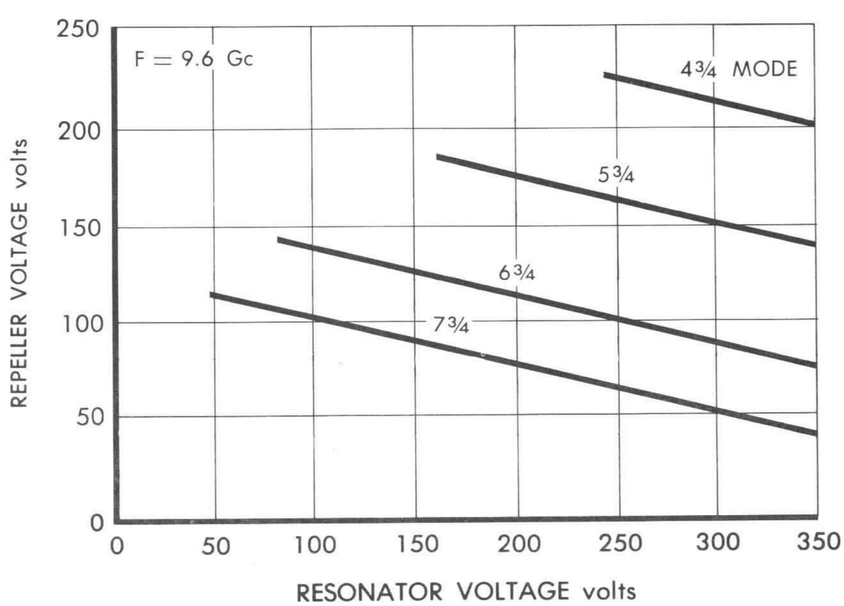


$E_{RS} = 300$ Vdc
$I_K = 40$ mAdc
5¾ MODE

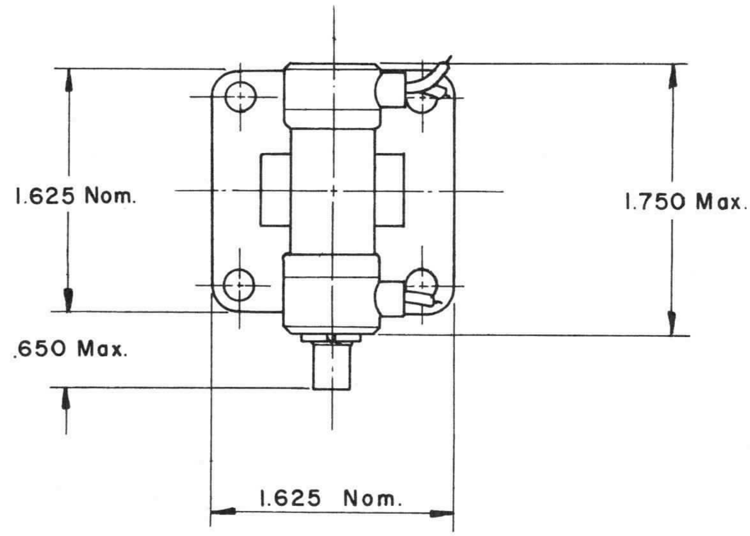




MODE CHARACTERISTICS



IK20 XK

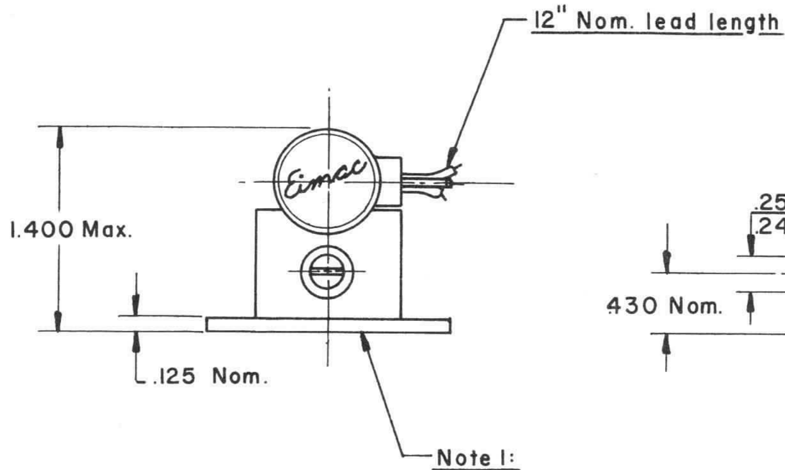


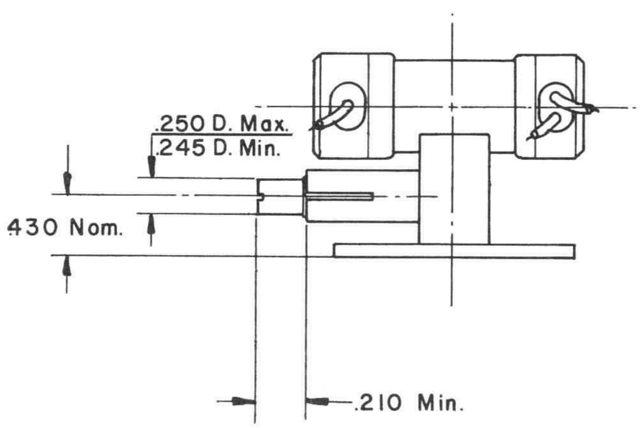
NOTE:

1. Mates with UG-39/U flange for RG-52/U waveguide

CONNECTIONS

1. REPELLER - RED
2. CATHODE - BLACK
3. HEATER - WHITE



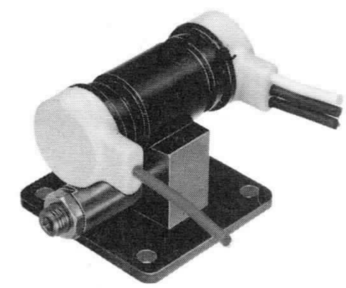


EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K20XN-A

X-BAND REFLEX KLYSTRON



The Eimac 1K20XN-A is a ceramic and metal reflex klystron which is especially well-suited for parametric amplifier pump applications. This tube is available at any factory pre-set frequency between 8.5 and 11.0 Gc, and the lock-tuner can be trimmed ± 50 Mc. for fine tuning adjustments.

The 1K20XN-A provides a minimum output power of 150 milliwatts and is conservatively warranteed for 1,000 hours.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, Oxide Coated		
	Warm-up Time	30	seconds
Heater:	Voltage	6.3	volts
	Current	0.8	ampere
Connections			flexible leads

MECHANICAL

Operating Position		any
Mounting		UG-39/U Waveguide flange
RF Output Coupling		RG-52/U Waveguide
Net Weight	4	ounces
Shipping Weight (approximate)	2	pounds
Maximum Overall Dimensions:		
Height	1.50	inches
Width	1.63	inches
Length	2.50	inches

ENVIRONMENTAL

Maximum Ambient Temperature	150°	C
Maximum Altitude		no limit
Maximum Shock* (11 ms duration)	40	g
Maximum Operating Vibration** (20-2,000 cps)	10	g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 200 kilocycles.

TYPICAL OPERATION

Mode		4-3/4
Frequency	10.6	Gc
Resonator Voltage	400	Vdc
Output Power	200	MW
Cathode Current	40	mAdc

TYPICAL OPERATION (continued)

Repeller Voltage*	-290	Vdc
3 db Bandwidth	25	Mc
Modulation Sensitivity	0.8	Mc/V

*All voltages referred to cathode.

MAXIMUM RATINGS

Resonator Voltage	450	Vdc
Cathode Current	50	mAdc
Repeller Voltage	500	Vdc
Ambient Temperature	150°	C
Resonator Dissipation with conduction cooling	20	watts
Resonator Dissipation with forced air cooling	30	watts

APPLICATION

Cooling: At sea level this tube will not require forced air cooling when operated at less than 20 watts resonator dissipation and an ambient temperature of less than 150° C. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If the tube is operated at a resonator dissipation of greater than 20 watts or if an insulator is used between the tube and waveguide for DC isolation, forced air cooling will be required to maintain the body temperature below the maximum rating of 175° Centigrade.

Resonator: The resonator of the 1K20XN-A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the 1K20XN-A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

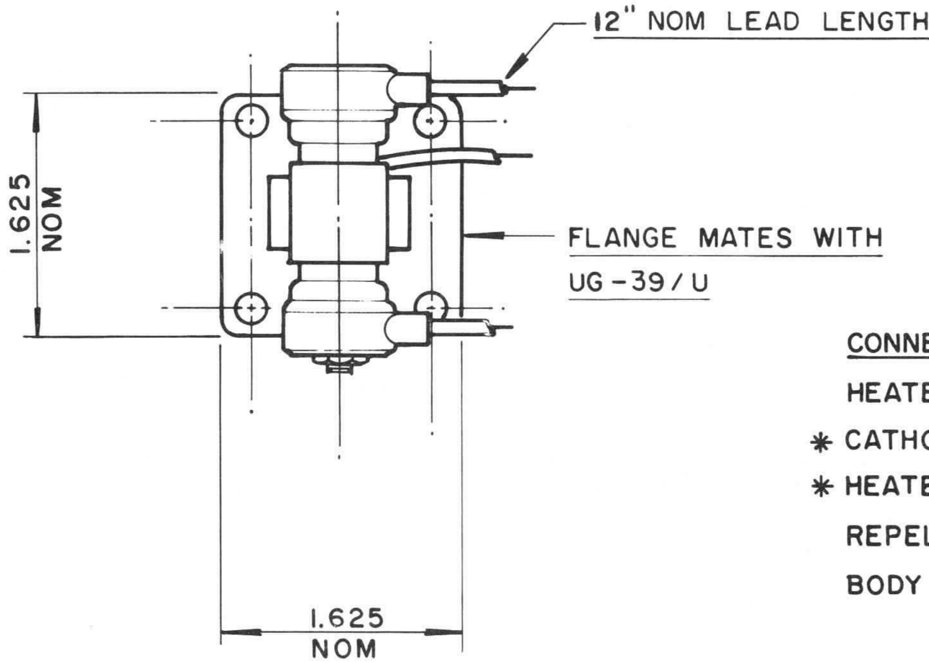
Mechanical Trimming: The 1K20XN-A is fitted with a locking tuner that allows ±50 mc trimming. The center frequency is factory pre-set to your specification.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20-2,000 cps) or shock of up to 40g (11 milliseconds duration).

With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 200 kilocycles.

Special Applications: For additional information regarding any specific application, write to Microwave Division, Eitel-McCullough, Inc., San Carlos, California, telephone Lytell 1-1451, Cable EIMAC.

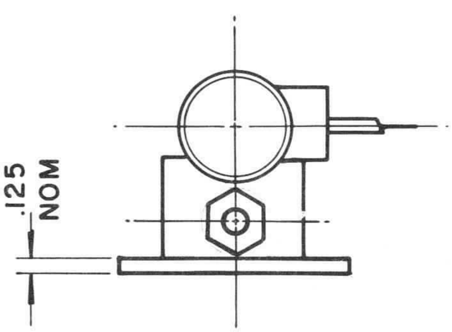
1K20XN-A

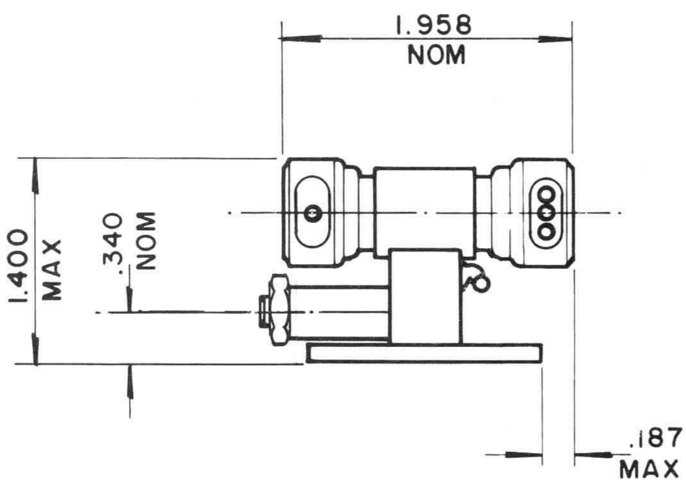


CONNECTIONS

HEATER - WHITE
* CATHODE - BLACK
* HEATER - BLACK
REPELLER - RED
BODY — BLACK - WHITE

* INTERNALLY CONNECTED





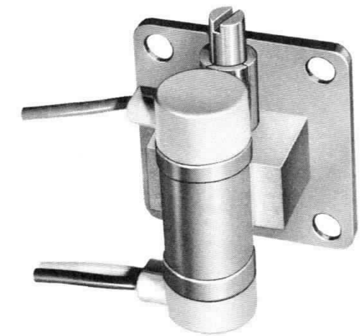
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K20XS

X-BAND
REFLEX KLYSTRON



The Eimac 1K20XS is a ceramic and metal, conduction-cooled reflex klystron designed for local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 75 milliwatts over the frequency range of 8500 to 9200 megacycles.

The stacked-ceramic construction results in an extremely rugged design and a low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated.	
	Warm-up time	30 seconds
Heater:	Voltage	6.3 volts
	Current	0.8 ampere
Typical Output Power (Load VSWR = 1.15:1)		75 milliwatts
Frequency Range		8500 to 9200 megacycles

MECHANICAL

Operating Position	Any
Mounting	UG-39/U waveguide flange
Cooling	Conduction
Electrical Connections	Flexible leads
R-F Output Coupling	RG-52/U waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.40 inches
Width	1.63 inches
Length	2.28 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-Operating Shock (11 ms Duration)	40 g
Maximum Operating Shock* (11 ms Duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.

**Based on a maximum peak-to-peak frequency deviation of 100 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	350 MAX. VOLTS
D-C CATHODE CURRENT	55 MAX. MA.
RESONATOR DISSIPATION	20 MAX. WATTS
PEAK REPELLER VOLTAGE*	
POSITIVE WITH RESPECT TO CATHODE	0 MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX. VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

D-C Resonator Voltage	350	300	volts
Mode	5¾	5¾	
Frequency	8850	8850	megacycles
D-C Cathode Current	50	40	milliamperes
D-C Repeller Voltage*	135	150	volts
D-C Repeller Current	1	1	microampere
Power Output	90	70	milliwatts
Electronic Tuning (3 db bandwidth)	40	40	megacycles
Modulation Sensitivity ($\Delta E_r = \pm 3$ volts)	1.5	1.5	Mc/volt
Peak-to-Peak FM Deviation (10g, 20-2000 cps)	50	50	kilocycles
Residual FM	50	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced-air cooling when operated at its maximum rated dissipation with an ambient temperature less than 150° Centigrade. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for D-C isolation, forced-air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 250° Centigrade.

Resonator: The resonator of the 1K20XS is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

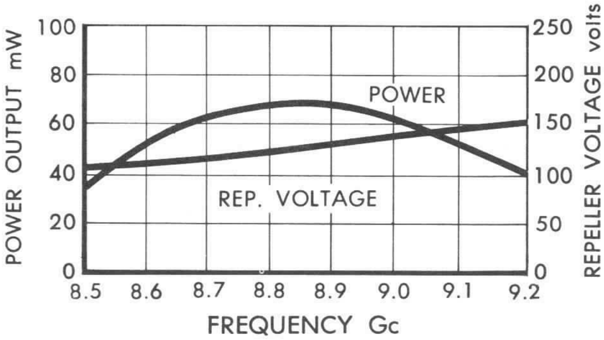
The heater and cathode of the 1K20XS are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

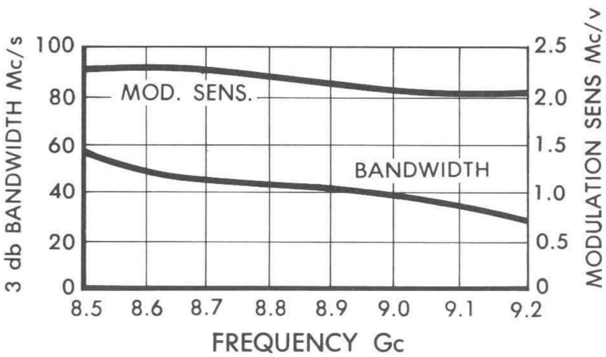
Mechanical Tuning: In the 1K20XS a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.

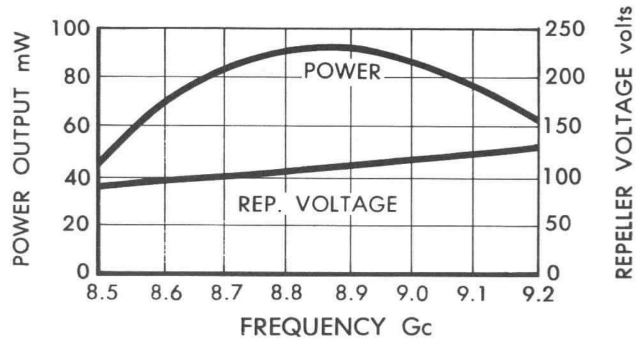
IK20XS TYPICAL OPERATING CHARACTERISTICS

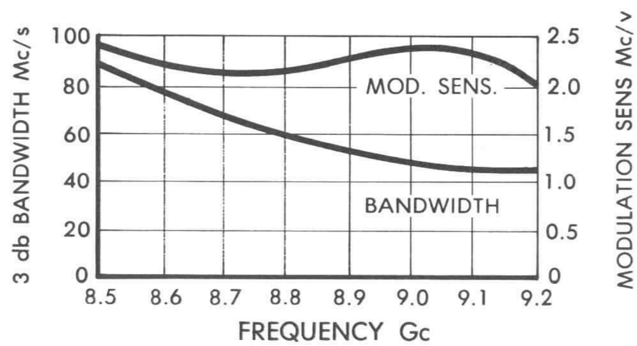
E_{RS} = 300 Vdc
I_K = 40 mAdc
5¾ MODE



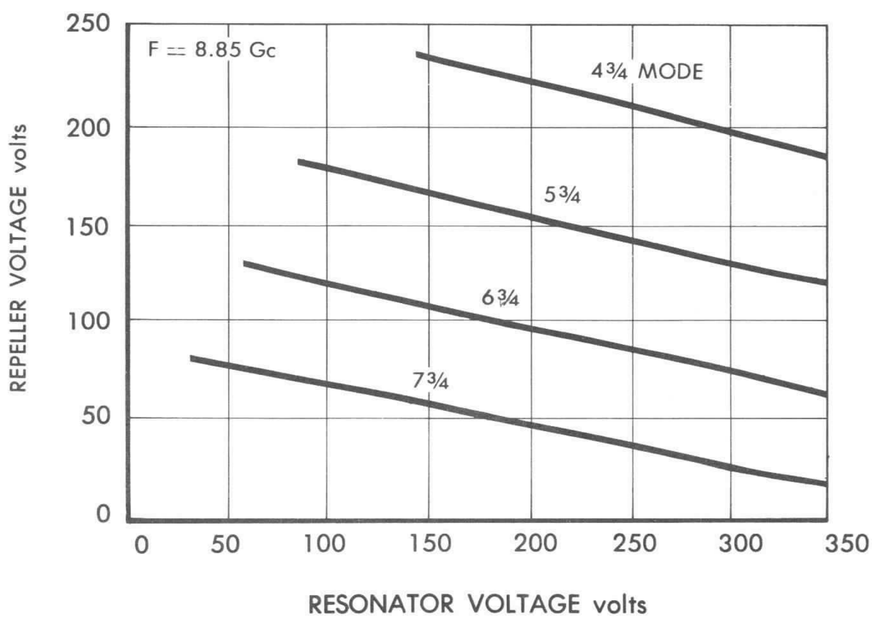


E_{RS} = 350 Vdc
I_K = 50 mAdc
5¾ MODE



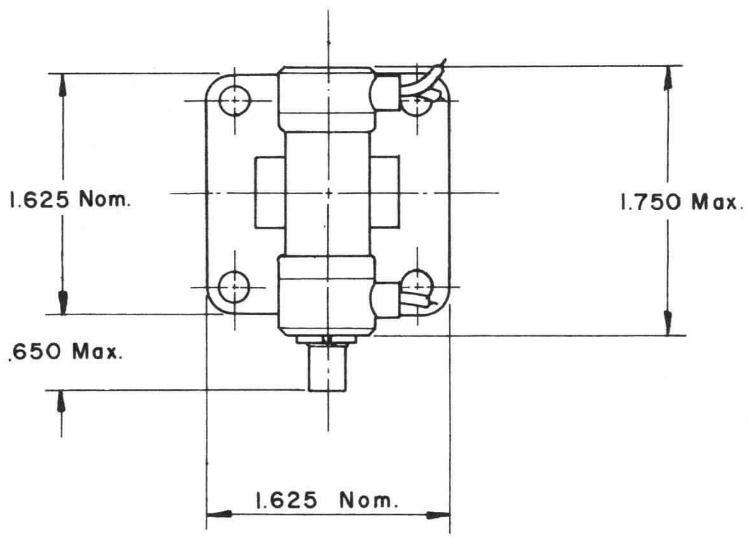


MODE CHARACTERISTICS



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

1K20XS

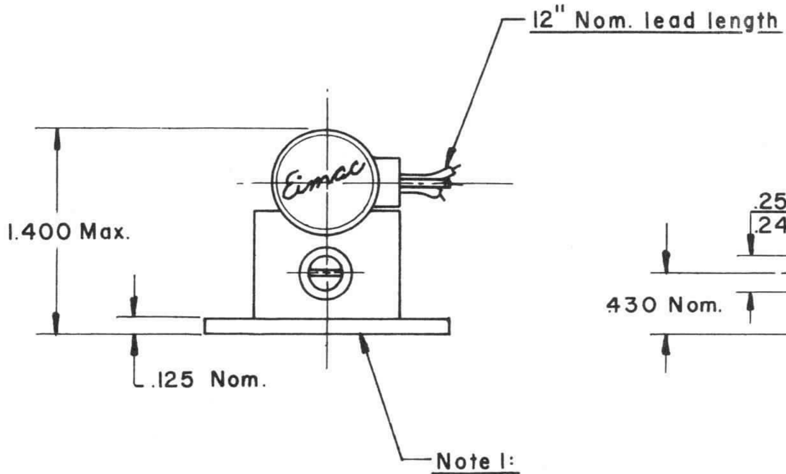


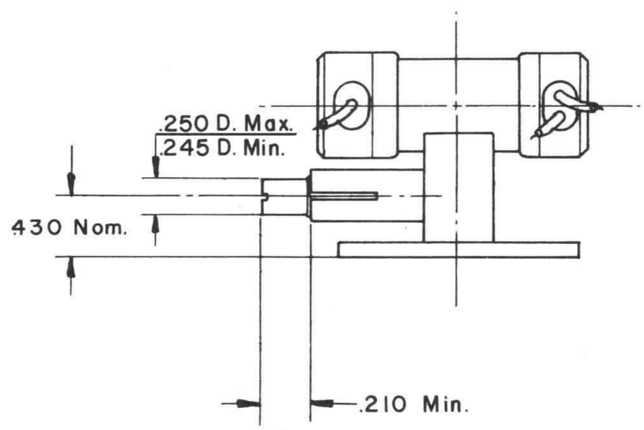
NOTE:

1. Mates with UG-39/U flange for RG-52/U waveguide

CONNECTIONS

1. REPELLER - RED
2. CATHODE - BLACK
3. HEATER - WHITE





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

1K75CLA

REFLEX

KLYSTRON

TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency Setting	4.300 to 4.375 Gc
Power Output	240 mW
Electronic Tuning Range (3 db bandwidth)	50 Mc
Resonator Voltage	550 Vdc
Cathode Current	38 mA
Repeller Voltage	−93 Vdc
Modulation Sensitivity	1.0 to 2.0 Mc/V
Heater Voltage	6.3 V(ac or dc)±5%
Heater Current	1.5 A max
Mode	4-3/4
VSWR of Load	1.05:1
Temperature Coefficient	±150 Kc/°C max
Warm-up Time	120 seconds max
[redacted]	[redacted]

*MAXIMUM RATINGS

Resonator Voltage	900 Vdc
Cathode Current	85 mA
Repeller Voltage (negative with respect to the cathode)	−50 to −500 Vdc

*Note: Damage to the tube may occur if the maximum ratings are exceeded.

MECHANICAL

Operating Position	Any
Electrical Connection	Flexible Leads
RF Output Coupling	1/2 height, RG 49 A/U waveguide flange
Cooling Required	Conduction
Net Weight	10 ounces
Shipping Weight (approximate)	4 Pounds

ENVIRONMENTAL PERFORMANCE

Temperature Range	−55 to +90° C
Altitude	50,000 ft. max
Vibration	10 G, 20-2000 cps
Shock	30 G, 11 ms

OUTLINE DIMENSIONS

Height	2-1/32 inches
Width	2-49/64 inches
Length	1-9/16 inches

APPLICATION NOTES

NOTE: All voltages referred to the cathode.

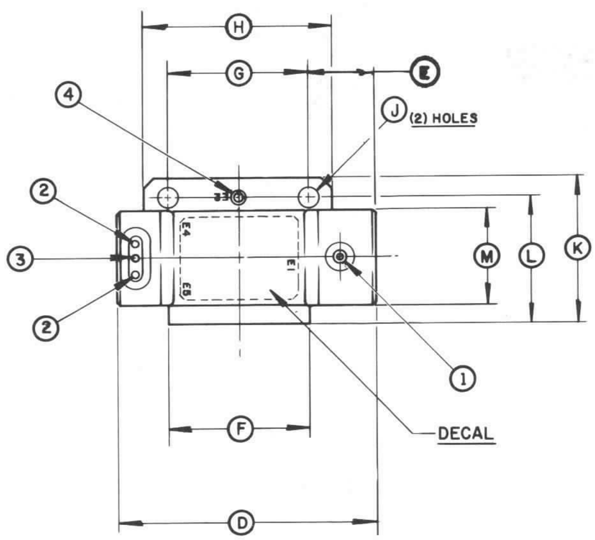
COOLING: At sea level, these tubes will not require forced-air cooling when operated at their maximum rated dissipation with heat-sink and ambient temperatures less than 125° Centigrade. The mounting flange or waveguide flange will normally provide the heat sink connection required for conduction cooling.

If an insulator is used between the tube and waveguide or chassis, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 175° Centigrade.

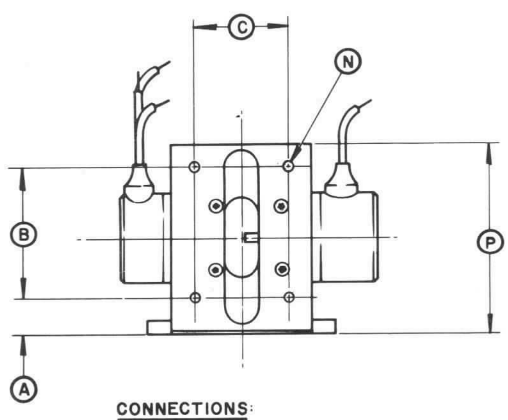
RESONATOR: The resonator of the 1K75C series tube is integral with the body of the tube. For this reason, it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

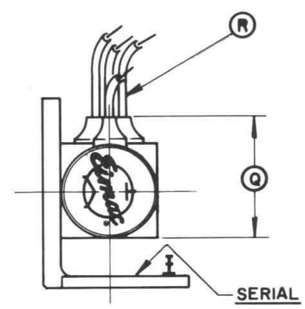
CATHODE: The heater voltage should be maintained with ± 5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of these tubes are not internally connected and the heater-to-cathode voltage should not exceed ±45 volts. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	.365	.385	
B	1.396	1.416	
C	.990	1.010	
D		2.730	
E		.684	
F		1.520	
G	1.495	1.505	
H		1.968	
J	.215 DIA.	.225 DIA.	
K		1.593	
L	1.339	1.349	
M		1.010	
N	#6-32 UNC-2B (4) HOLES		
P		2.030	
Q		1.345	
R	18" MIN. INSULATION		





CONNECTIONS:

1. REPELLER — RED
2. HEATER — WHITE
3. CATHODE — BLACK
4. RESONATOR — TERMINAL

FINISH:

TUBE BODY — PAINTED
TUBE FLANGE — GOLD PLATED

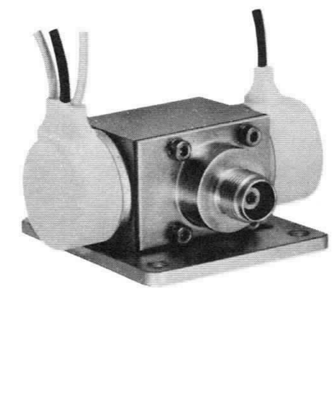
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

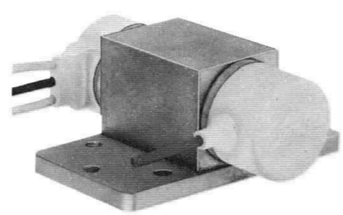
1K75CH
1K75CK

C-BAND REFLEX KLYSTRONS

The Eimac 1K75CH and 1K75CK are low noise, ceramic and metal, ruggedized, internal cavity, reflex klystrons designed for use in altimeter applications at a fixed frequency of 4300 ± 50 megacycles. These conduction-cooled tubes are capable of delivering a minimum output power of one watt into a load VSWR of 1.15 to 1 under conditions of severe shock, vibration or acceleration extremes.



1K75CH



1K75CK

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up Time - -	60	seconds
Heater:	Voltage - - -	6.3	volts
	Current - -	1.0 to 1.5	amperes
Minimum Output Power (Load VSWR=1.15:1)		1.0	watts
Operating Frequency - -		4300 ± 50	megacycles

MECHANICAL

Operating Position - - -			Any
Mounting:			
	1K75CH - - -		Heat sink flange
	1K75CK - -		Special waveguide flange
R-F Output Coupling:			
	1K75CH - - -		Insulated TNC jack
	1K75CK -		Special half-height waveguide
Electrical Connections - -			Flexible leads
Cooling - - -			Convection and conduction

Maximum Overall Dimensions:	1K75CH	1K75CK	
Depth - -	1.13	1.19	inches
Width - -	2.50	2.76	inches
Length - -	2.51	2.73	inches
Net Weight - -	8.5	8.0	ounces
Shipping Weight (Approximate)	2	2	pounds

ENVIRONMENTAL

Maximum Heat-Sink or Ambient Temperature - -	125° Centigrade
Maximum Altitude (1K75CK, and 1K75CH with TNC jack at body potential) - - - -	No Limit
Maximum Altitude (1K75CH with TNC jack at cathode potential)	40,000 Feet
Maximum Non-Operating Shock (11 ms duration) (1K75CH) -	15 g
Maximum Non-Operating Shock (11 ms duration) (1K75CK) -	30 g
Maximum Operating Vibration (20-2000 cps)* - - -	10 g

*Based on a maximum peak-to-peak frequency deviation of 100 kilocycles.

MAXIMUM RATINGS

D-C RESONATOR VOLTAGE*	850	MAX. VOLTS
D-C CATHODE CURRENT	100	MAX. MA.
RESONATOR DISSIPATION	75	MAX. WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0	MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500	MAX. VOLTS
PEAK HEATER TO CATHODE VOLTAGE	±45	MAX. VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

D-C Resonator Voltage*	550	750	volts
Mode	4-3/4	2-3/4	
Frequency	4300	4300	megacycles
D-C Cathode Current	35	60	milliamperes
D-C Repeller Voltage*	-150	-350	volts
D-C Repeller Current	1	1	microampere
Power Output	0.25	1.0	watt
Electronic Tuning (3 db bandwidth)	60	30	megacycles
Modulation Sensitivity ($\Delta E_r = \pm 5$ volts)	1600	160	Kc/volt
Residual FM	40	40	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level, these tubes will not require forced-air cooling when operated at their maximum rated dissipation with heat-sink and ambient temperatures less than 125° Centigrade. The mounting flange or waveguide flange will normally provide the heat sink connection required for conduction cooling.

If an insulator is used between the tube and waveguide or chassis, forced-air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 175° Centigrade.

Resonator: The resonator of the 1K75C series tubes is integral with the body of the tube. For this reason, it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

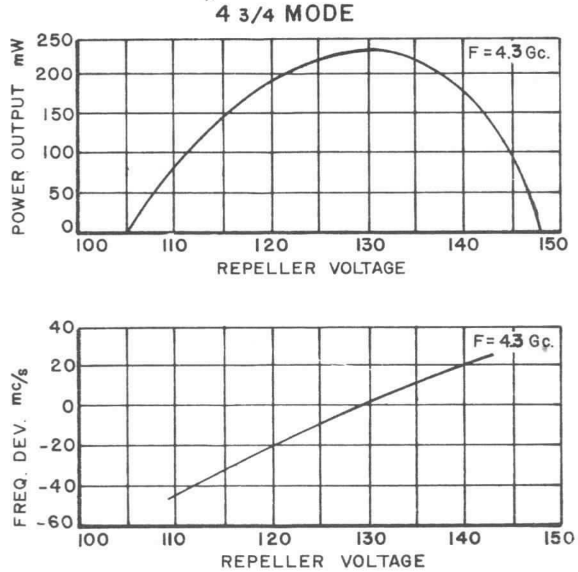
Cathode: The heater voltage should be maintained within ± 5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of these tubes are not internally connected and the heater-to-cathode voltage should not exceed ± 45 volts. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

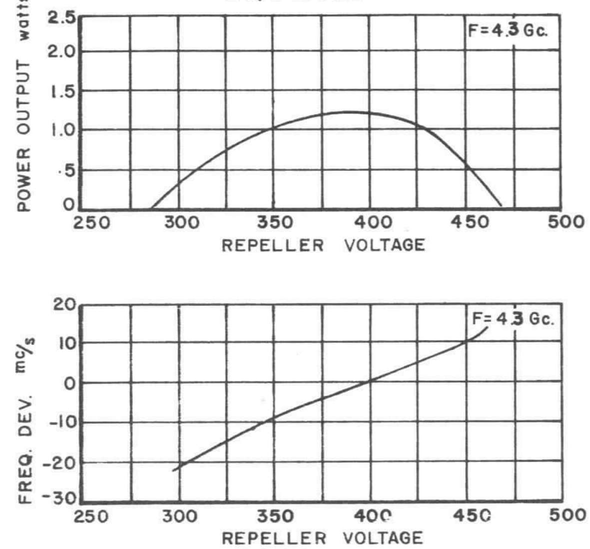
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

IK75CH/CK TYPICAL OPERATING CHARACTERISTICS

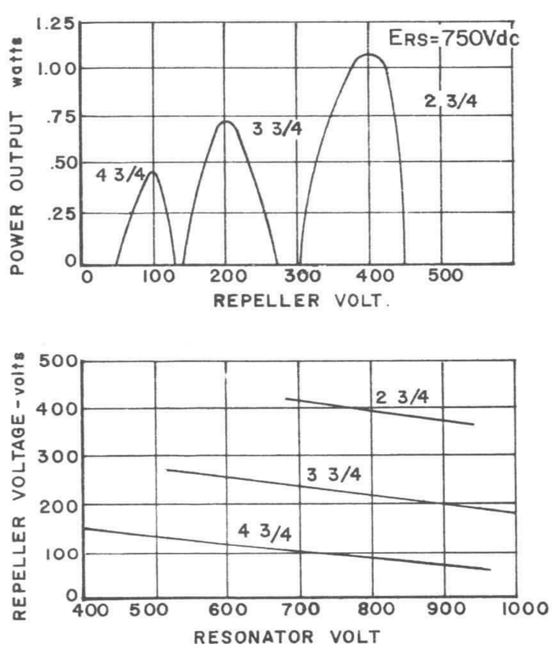
ERS = 500 Vdc
IK = 35 mAdc
4 3/4 MODE



ERS = 750 Vdc
IK = 60 mAdc
2 3/4 MODE

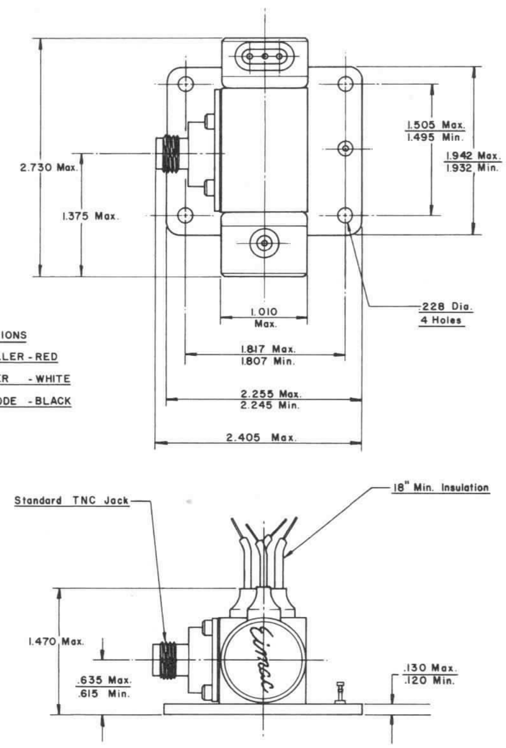


MODE CHARACTERISTICS



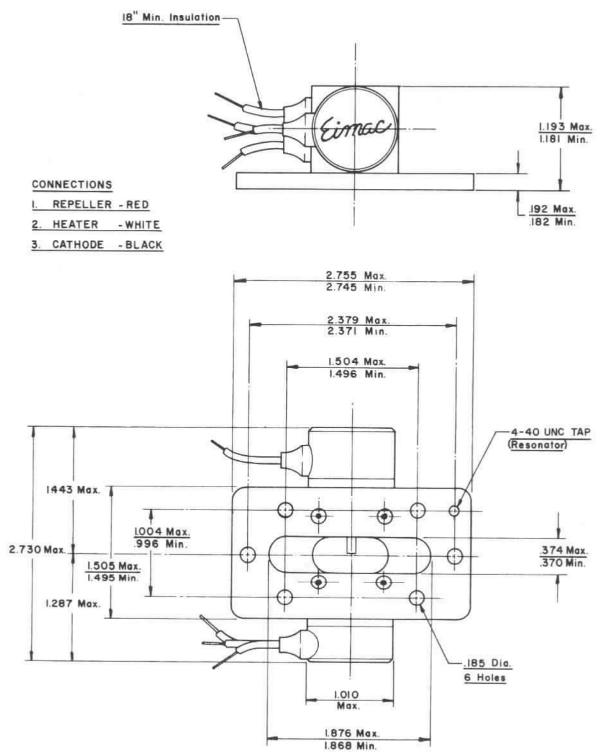
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

IK75 CH



CONNECTIONS
1. REPELLER - RED
2. HEATER - WHITE
3. CATHODE - BLACK

IK75 CK



CONNECTIONS
1. REPELLER - RED
2. HEATER - WHITE
3. CATHODE - BLACK

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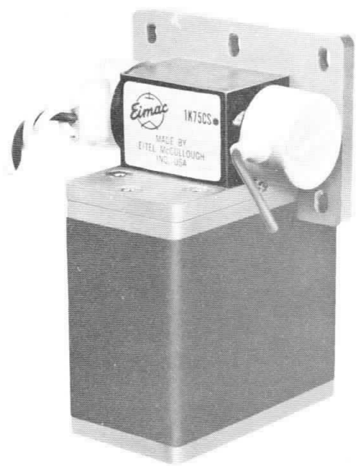
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

1K75CS

C-BAND REFLEX KLYSTRON



The Eimac 1K75CS is intended to ease the system designers' logistics and performance problems by providing a ruggedized, load-insensitive reflex klystron/isolator package for the 4200-4400 Mc. radio-altimeter band. Combining these two components into one integral package allows them to be matched for optimum performance. Operating in the 4-3/4 mode, the 1K75CS provides more than 300 mW and 100 Mc. electronic tuning range into a load VSWR of 2:1 with only 8 Mc. maximum frequency pulling. Alternately, this tube can be factory pre-set to provide approximately 1 watt and 30 Mc. electronic tuning range.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up Time	60	seconds
Heater:	Voltage	6.3	volts
	Current	1.0 to 1.5	amperes
Minimum Output Power (4-3/4 mode)		0.3	watts
Operating Frequency (Fixed)		4300 ± 50	megacycles

MECHANICAL

Operating Position		Any
Mounting		Heat Sink Flange
RF Output Coupling		Special Half-Height Waveguide
Electrical Connections		Flexible Leads
Maximum Overall Dimensions:		
Depth	4.16	Inches
Width	2.81	Inches
Length	2.76	Inches
Net Weight	1.5	Pounds Max.
Shipping Weight (Approximate)	3	Pounds

ENVIRONMENTAL

Maximum Heat-Sink Temperature	125°C
Maximum Non-Operating Shock (11 ms Duration)	15 g
Maximum Operating Vibration (20 - 1500 cps)*	10 g

*Based on a maximum peak-to-peak frequency deviation of 100 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE	900 MAX. VOLTS
DC CATHODE CURRENT	85 MAX. MA
RESONATOR DISSIPATION	75 MAX. WATTS
PEAK REPELLER VOLTAGE*	
POSITIVE WITH RESPECT TO CATHODE	0 MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX. VOLTS

TYPICAL OPERATION

Mode	4-3/4	
Frequency	4300	megacycles
DC Resonator Voltage*	700	volts
DC Cathode Current	55	milliamperes
DC Repeller Voltage	-85	
DC Repeller Current	1	microampere
Output Power	325	milliwatts
Electronic Tuning (3 db bandwidth)	110	megacycles
Modulation Sensitivity	3	Mc/volt
Residual FM	40	kilocycles
Temperature Coefficient (-55 to +125 C)	±75	Kc/°C

*Based on a maximum peak-to-peak frequency deviation of 100 kilocycles.

APPLICATION

Cooling: At sea level, these tubes will not require forced-air cooling when operated at their maximum rated dissipation with heat-sink and ambient temperatures less than 125° Centigrade. The mounting flange or waveguide flange will normally provide the heat sink connection required for conduction cooling.

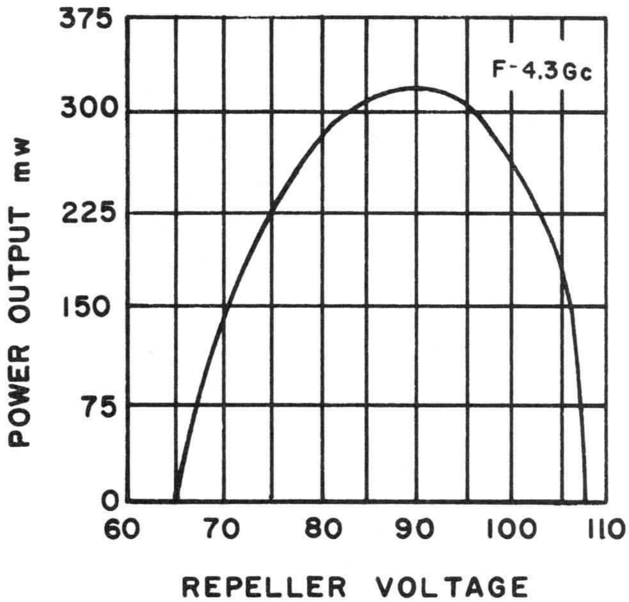
Resonator: The resonator of the 1K75CS is integral with the body of the tube. For this reason, it is convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

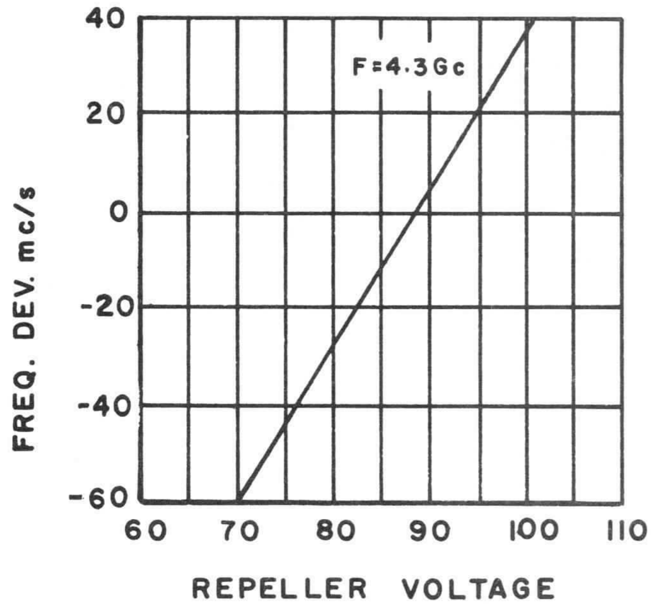
Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of these tubes are not internally connected and the heater-to-cathode voltage should not exceed ±45 volts. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

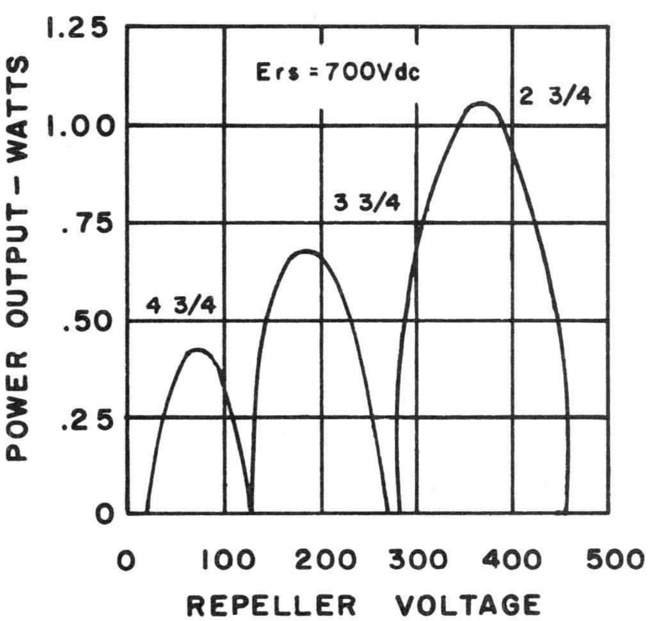
1K75CS TYPICAL OPERATING CHARACTERISTICS

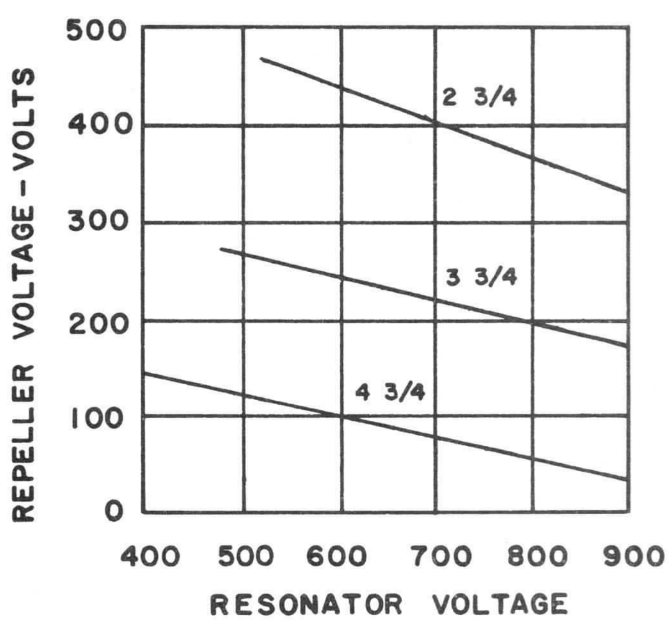
Ers = 700 Vdc
Ik = 55 mAdc
4 3/4 MODE



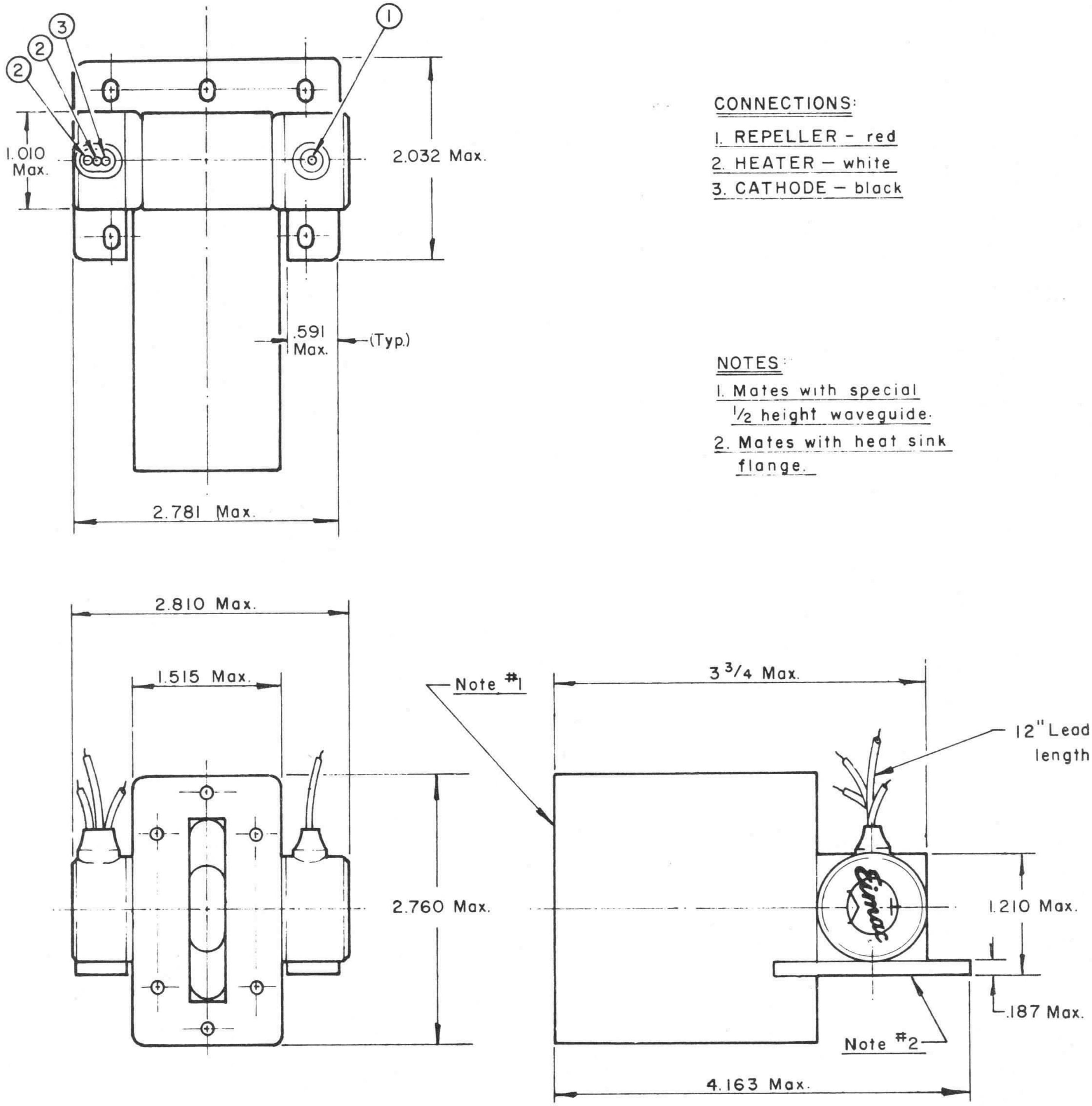


MODE CHARACTERISTICS





1K75 CS



CONNECTIONS:

1. REPELLER – red
2. HEATER – white
3. CATHODE – black

NOTES:

1. Mates with special 1/2 height waveguide.
2. Mates with heat sink flange.

Eimac®

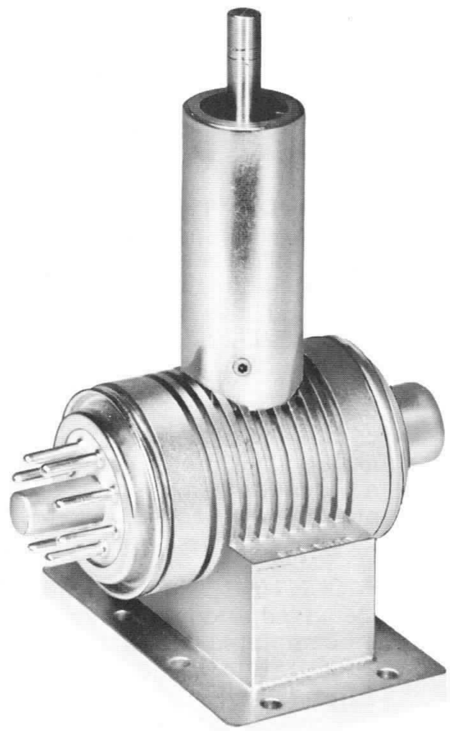
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

PRELIMINARY DATA

1K125CA

C-BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency Range - -	3.7 to 4.4 Gc
Mechanically Tunable	700 Mc
Power Output - - -	1.25 W min
Electronic Tuning Range (3 db bandwidth) -	25 Mc min
Resonator Voltage -	1000 Vdc
Cathode Current - -	80 mAdc
Repeller Voltage - -	—400 Vdc
Modulation Sensitivity	250 to 550 Kc/v
Heater Voltage - -	6.3 V(ac or dc)±5%
Heater Current - -	1.5 A max
Mode - - - - - -	2-3/4
VSWR of Load - - -	1.15:1
Temperature Coefficient	±75 Kc/°C
Warm-up Time - -	120 seconds
[redacted] - - - - - - -	[redacted]

MAXIMUM RATINGS

Resonator Voltage - - - - - -	1200 Vdc
Cathode Current - - - - - -	110 mA
Repeller Voltage (negative with respect to the cathode) - - -	—100 to —750 Vdc

Note: Damage to the tube may occur if the maximum ratings are exceeded.

MECHANICAL

Operating Position - - - - -	any
Electrical Connection - - - -	Octal Socket
RF Output Coupling -	-CMR 187 waveguide flange
Cooling Required - - - - -	10 cfm @ sea level
Net Weight - - - - - - - - -	19 ounces
Shipping Weight (approximate) - -	5 pounds

ENVIRONMENTAL PERFORMANCE

Temperature Range (Ambient) -	—25 to +65 C
Altitude - - - - - - -	10,000 ft. max
Vibration - - - - - - -	10 G, 40 cps
Shock - - - - - - - -	10 G, 1 ms

OUTLINE DIMENSIONS

Height - - - - - - - - - - - -	4.700 max
Width - - - - - - - - - - - -	2.797 max
Length - - - - - - - - - - - -	3.450 max

APPLICATION NOTES

NOTE: All voltages are referred to the cathode.

COOLING: At sea level, with an ambient temperature of 50° Centigrade, a minimum air-flow rate of 10 CFM, directed over the klystron body, is required to adequately cool the tube when operated at maximum ratings.

For conditions other than the above, the criterion for proper cooling is to maintain the klystron ceramic-to-metal seal temperatures below 175° Centigrade. Cooling in excess of the minimum recommended flow rate will result in longer tube life and more stable operation. If extended tube life is of primary concern, the body temperature should not exceed 100° Centigrade.

RESONATOR: The resonator of the 1K125CA is integral with the body of the tube. For this reason, it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

CATHODE: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the 1K125CA are not internally connected and the heater-to-cathode voltage should not exceed ±45 volts. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

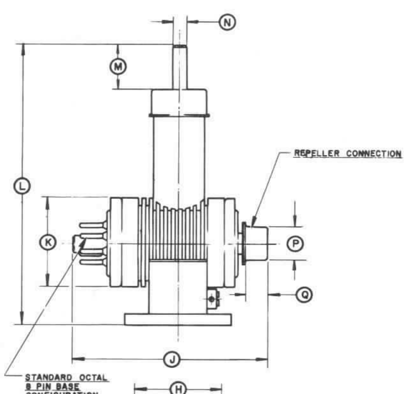
Electrical connection to the cathode of this tube should be completed by utilizing all four of the cathode base pins.

MECHANICAL TUNING: A screw-driven bellows, coupled to a ceramic-slug tuner, allows tuning cycling in excess of 1000 cycles without damage to the vacuum seals. The tuning rate of approximately 100 megacycles per turn and the low tuner starting-torque permits the use of miniature motors for remote tuning. Mechanical stops, capable of withstanding a maximum torque of 10 inch-ounces, are provided at the extremes of the tuning range to prevent damage to the tube.

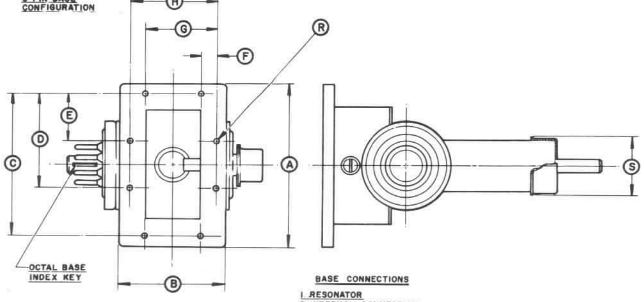
Clockwise rotation of the tuner-shaft produces an increase in frequency.

MOUNTING: The 1K125CA should be mounted by the output-waveguide flange. An octal socket is required to complete the electrical connections to the heater and cathode. The repeller connection is completed with a standard medium cap connector.

SPECIAL APPLICATIONS: For additional information regarding any specific application, write to Eitel-McCullough, Inc., San Carlos, California. All such requests will be handled confidentially.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.765	2.797	
B	1.765	1.797	
C	2.426	2.434	
D	1.616	1.624	
E	.806	.814	
F	.243	.251	
G	1.179	1.187	
H	1.426	1.434	
J		3.450	
K			1.500 DIA.
⟨9⟩ L		4.700	
M	.400		
N	.248 DIA.	.250 DIA.	
P	.559 DIA.	.573 DIA.	
Q	.370		
R	.147 DIA. TYP.		
⟨9⟩ S		1.050	



BASE CONNECTIONS
1. RESONATOR
2. INTERNAL CONNECTION
3. CATHODE
4. CATHODE
5. HEATER
6. HEATER
7. CATHODE
8. CATHODE

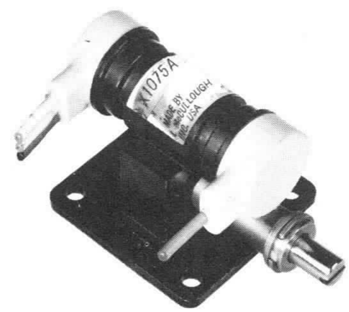
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X-1075A

X-BAND REFLEX KLYSTRON



The Eimac X-1075A is a ceramic and metal, conduction cooled reflex klystron designed for local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 100 milliwatts over the frequency range of 8500 to 9600 megacycles.

The stacked-ceramic construction results in an extremely rugged design and a low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.

FEATURES: This tube features Eimac's new long-life tuner which renders excellent torque control under extreme environmental conditions over as many as 10,000 cycles.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up Time	30	seconds
Heater:	Voltage	6.3	volts
	Current	1.0	ampere
Typical Output Power (Load VSWR = 1.15:1)		100	milliwatts
Frequency Range		8500 to 9600	megacycles

MECHANICAL

Operating Position		Any
Mounting		UG-39/U Waveguide Flange
Cooling		Conduction
Electrical Connections		Flexible Leads
RF Output Coupling		RG-52/U Waveguide
Net Weight	4	Ounces
Shipping Weight (Approximate)	2	Pounds
Maximum Overall Dimensions:		
Height	1.40	Inches
Width	1.63	Inches
Length	2.28	Inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No Limit
Maximum Non-Operating Shock (11 ms Duration)	40 g
Maximum Operating Shock (11 ms Duration)	40 g
Maximum Operating Vibration (20 to 2000 cps)	10 g

(Effective 8-10-62)

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	500 MAX.	VOLTS
DC CATHODE CURRENT	50 MAX.	MA
RESONATOR DISSIPATION	25 MAX.	WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0 MAX.	VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX.	VOLTS

OPERATION

	MIN.	AVE.	MAX.	UNIT
Mode	---	5-3/4	---	
Frequency	8.5	---	9.6	Gc.
DC Resonator Voltage	---	400	---	Volts
DC Cathode Current	---	40	---	ma
DC Repeller Current	---	---	1	μamp
Power Output	100	130	200	mW
Electronic Tuning (3 db bandwidth)	---	30	---	mc
Modulation Sensitivity	---	---	2	Mc/Volt
Peak-to-Peak FM Deviation (10g, 20 - 2000 cps)			250	kc
Residual FM	---	---	50	kc

*All voltages referred to cathode.

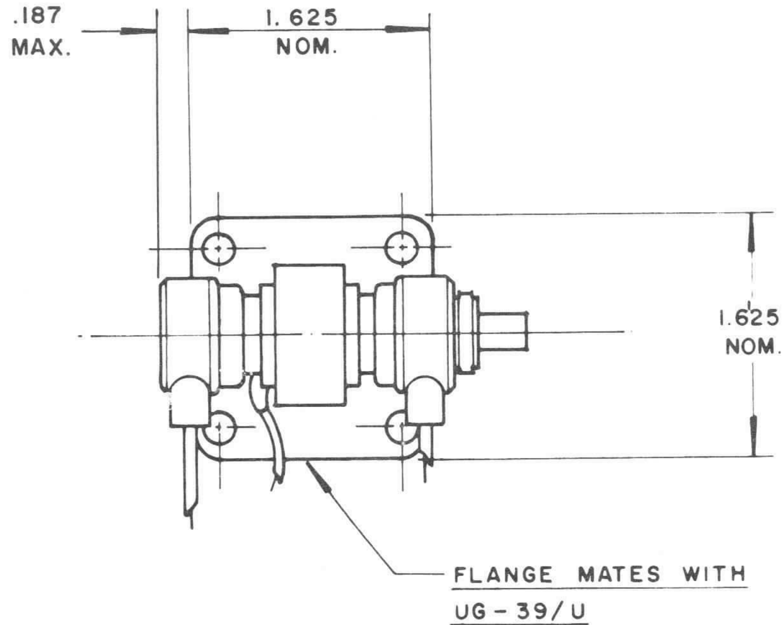
APPLICATION

Cooling: At sea level this tube will not require forced-air cooling when operated at its maximum rated dissipation with an ambient temperature less than 150° Centigrade. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced-air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 175° Centigrade. Maximum life will be obtained if the tube is maintained at 150° C or less.

Resonator: The resonator of the X-1075A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ± 5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

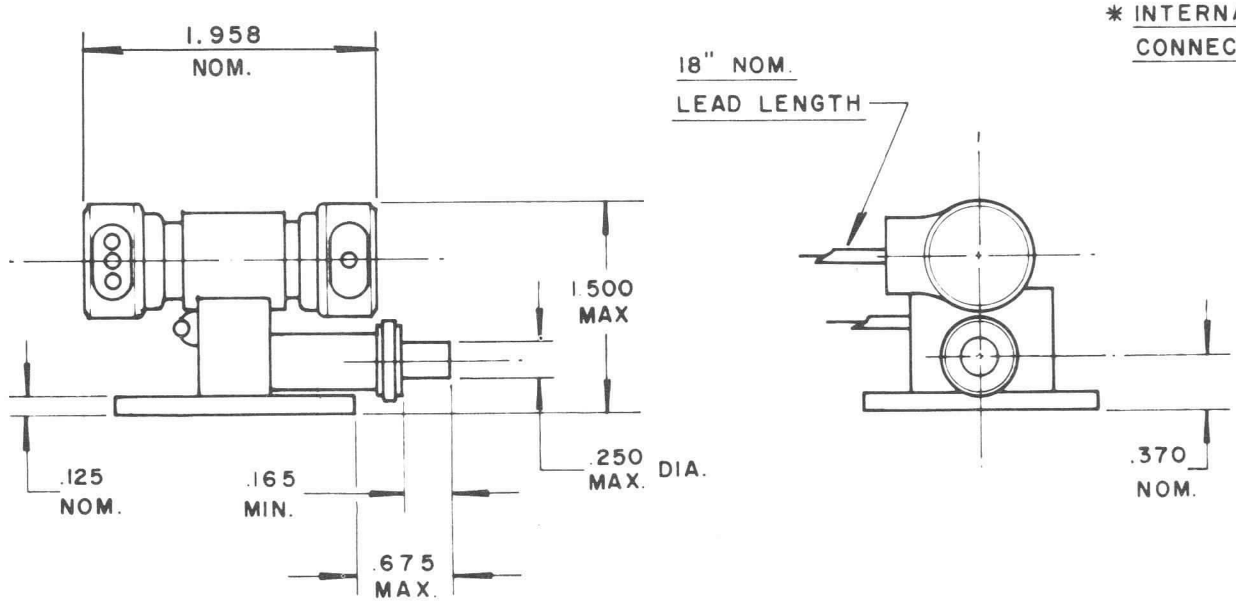
The heater and cathode of the X-1075A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.



LEAD CONNECTIONS

YELLOW	HEATER
* GREEN	CATHODE
* WHITE	HEATER
GRAY	REFLECTOR
BROWN	BODY

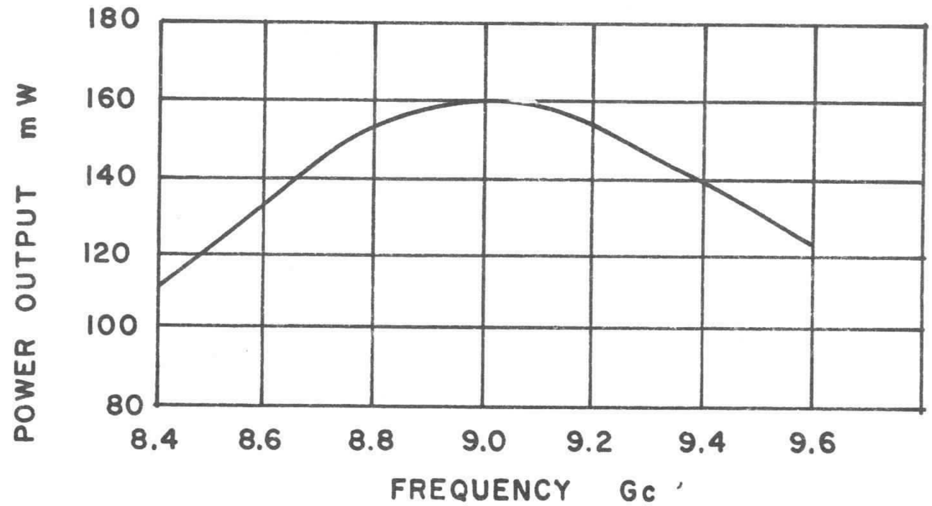
* INTERNALLY CONNECTED

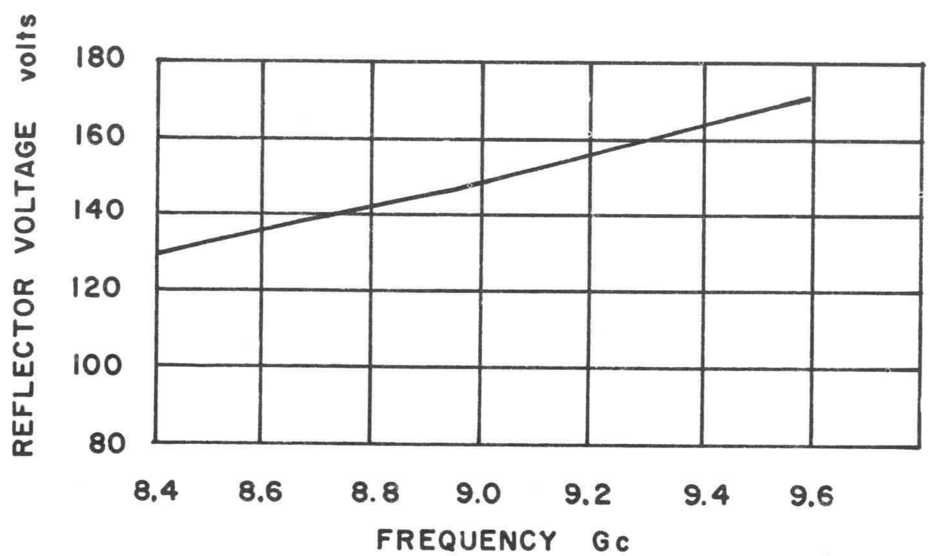


X 1075 A

X 1075A OPERATING CHARACTERISTICS

E rs = 400 V dc
I k = 40 mA dc
5 3/4 MODE





Tech Pub

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

EM-1114

X-BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency Setting - - - - -	13.90 Gc
Mechanically Trimmable -	±20 Mc
Power Output - - - - - -	200 mW
Electronic Tuning Range (3 db bandwidth) - - -	25 Mc min
Resonator Voltage - - -	400 Vdc
Cathode Current - - - -	40 mA
Repeller Voltage - - - - -	−280 Vdc
Modulation Sensitivity - -	0.8 Mc/v max
Heater Voltage - - - -	6.3 V(ac or dc)±5%
Heater Current - - - -	1.3 A max
Mode - - - - - - - -	3-3/4
VSWR of Load - - - - -	1.10:1
Temperature Coefficient -	−150 Kc/°C
Warm-up Time - - - - -	30 seconds
[redacted] - - - - - - - - -	[redacted]

MAXIMUM RATINGS

Resonator Voltage - - -	500 Vdc
Cathode Current - - - -	55 mA
Repeller Voltage (negative with respect to the cathode) -	(-50 to -500) Vdc

Note: Damage to the tube may occur if the maximum ratings are exceeded.

MECHANICAL

Operating Position - - -	Any
Electrical Connections - -	Flexible Lead
RF Output Coupling - - -	RG-91/U waveguide
Cooling Required - - - -	Conduction
Net Weight - - - - -	6 ounces
Shipping Weight (approximate)	4 pounds

ENVIRONMENTAL PERFORMANCE

Temperature Range (Max Ambient)	150°C
Altitude - - - - - - -	100,000 ft. max
Vibration - - - - - - -	10 G, (20-2000 cps)
Shock - - - - - - - -	40 G, (11 ms)

OUTLINE DIMENSIONS

Height - - - - - - - -	1.40 inches
Width - - - - - - - -	1.50 inches
Length - - - - - - - -	2.10 inches

APPLICATION NOTES

COOLING: At sea level this tube will not require forced air cooling when operated at less than 20 watts resonator dissipation and an ambient temperature of less than 150° C. The waveguide flange connection will normally provide the required heat-sink for conduction cooling. If the tube is operated at a resonator dissipation of greater than 20 watts or if an insulator is used between the tube and waveguide for DC isolation, forced air cooling will be required to maintain the body temperature below the maximum rating of 175° Centigrade.

RESONATOR: The resonator of the EM-1114 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

CATHODE: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

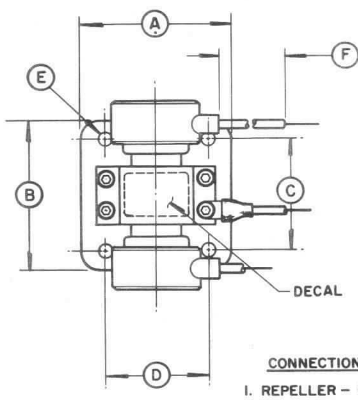
The heater and cathode of the EM-1114 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

MECHANICAL TRIMMING: The EM-1114 is fitted with a locking tuner that allows ±20 mc trimming. The center frequency is factory pre-set to your specification.

SHOCK AND VIBRATION: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20-2,000 cps) or shock of up to 40g (11 milliseconds duration).

With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 200 kilocycles.

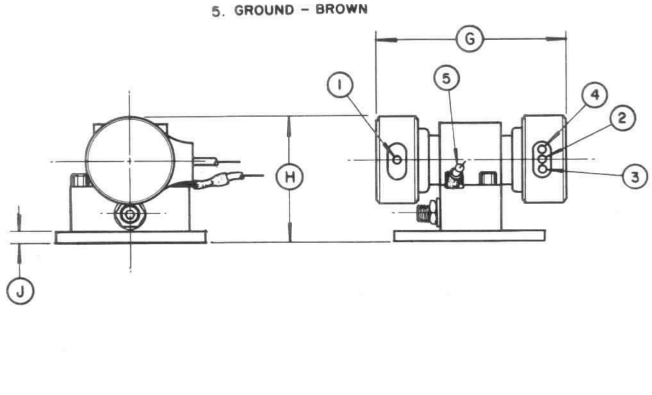
SPECIAL APPLICATIONS: For additional information regarding any specific application, write to Microwave Division, Eitel-McCullough, Inc., San Carlos, California, telephone Lytell 1-1451, Cable EIMAC.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.100	
H		1.400	
J			.125

CONNECTIONS

1. REPELLER – GREY
2. HEATER – YELLOW
3. CATHODE – GREEN
4. HEATER CATHODE – WHITE
5. GROUND – BROWN



TENTATIVE DATA

X-1075

X-BAND REFLEX KLYSTRON

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

The Eimac X-1075 is a ceramic and metal, conduction cooled reflex klystron designed for local oscillator service in applications encountering severe vibration, shock or temperature extremes. This tube will deliver a typical output power of 30 milliwatts over the frequency range of 8500 to 9600 megacycles.

The stacked-ceramic construction results in an extremely rugged design and a low sensitivity to vibration.

Leads to the tube are permanently attached and protected by molded silastic rubber caps which permit operation at any altitude without flashover.

FEATURES: This tube features Eimac's new long-life tuner which renders excellent torque control under extreme environmental conditions over as many as 10,000 cycles.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up Time	30	seconds
Heater:	Voltage	6.3	volts
	Current	1.0	ampere
Typical Output Power (Load VSWR = 1.15:1)		30	milliwatts
Frequency Range		8500 to 9600	megacycles

MECHANICAL

Operating Position		Any	
Mounting		UG-39/U Waveguide Flange	
Cooling		Conduction	
Electrical Connections		Flexible Leads	
RF Output Coupling		RG-52/U Waveguide	
Net Weight		4	Ounces
Shipping Weight (Approximate)		2	Pounds
Maximum Overall Dimensions:			
	Height	1.40	Inches
	Width	1.63	Inches
	Length	2.28	Inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C	
Maximum Altitude	No Limit	
Maximum Non-Operating Shock (11 ms Duration)	40	g
Maximum Operating Shock (11 ms Duration)	40	g
Maximum Operating Vibration (20 to 2000 cps)	10	g

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	400 MAX.	VOLTS
DC CATHODE CURRENT	40 MAX.	MA
RESONATOR DISSIPATION	20 MAX.	WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0 MAX.	VOLTS
NEGATIVE WITH RESPECT TO CATHODE	500 MAX.	VOLTS

OPERATION

	MIN.	AVE.	MAX.	UNIT
Mode	---	6-3/4	---	
Frequency	8.5	---	9.6	Gc.
DC Resonator Voltage	---	250	---	Volts
DC Cathode Current	20	---	30	ma
DC Repeller Voltage	---	65	---	Volts
DC Repeller Current	---	---	1	μamp
Power Output	20	30	50	mW
Electronic Tuning (3 db bandwidth)	---	35	---	mc
Modulation Sensitivity	---	---	2	mc
Peak-to-Peak FM Deviation (10g, 20 - 2000 cps)			250	kc
Residual FM	---	---	50	kc

*All voltages referred to cathode.

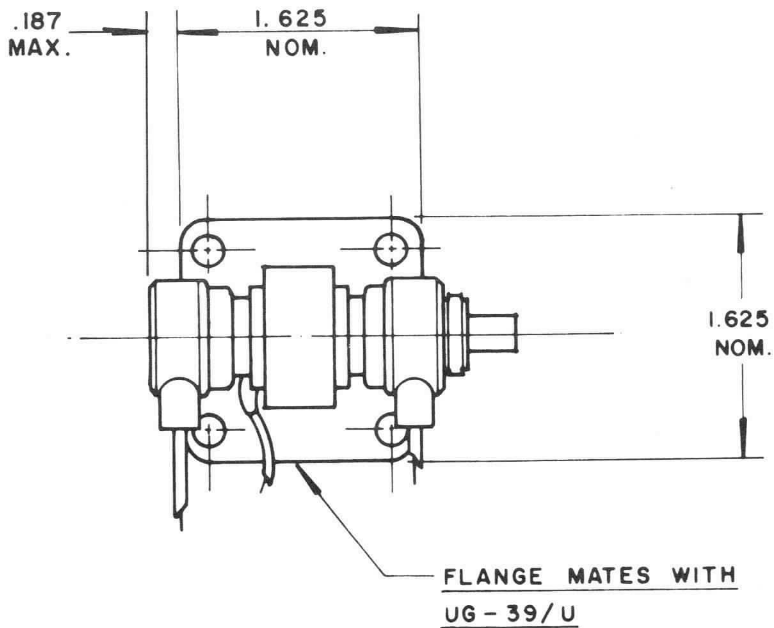
APPLICATION

Cooling: At sea level this tube will not require forced-air cooling when operated at its maximum rated dissipation with am ambient temperature less than 150° Centigrade. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced-air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 175° Centigrade. Maximum life will be obtained if the tube is maintained at 150° C or less.

Resonator: The resonator of the X-1075 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ± 5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

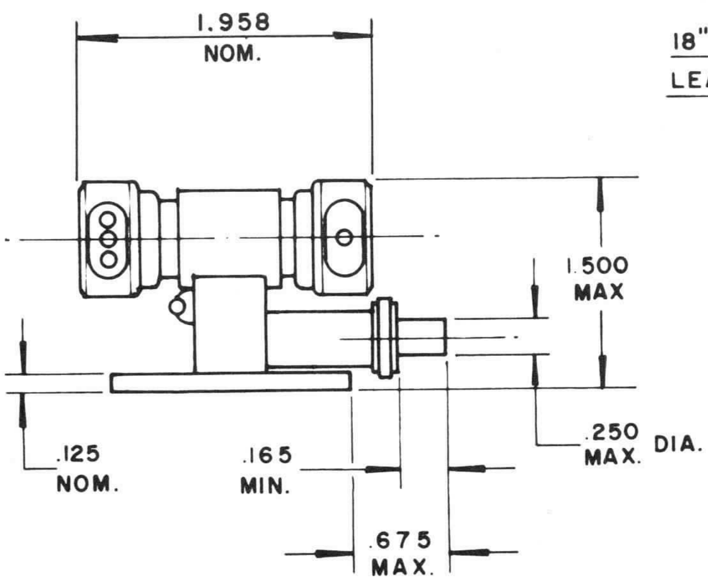
The heater and cathode of the X-1075 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

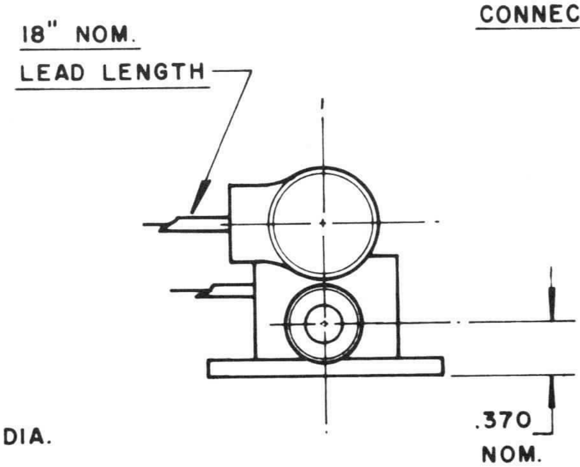


LEAD CONNECTIONS

YELLOW	HEATER
* GREEN	CATHODE
* WHITE	HEATER
GRAY	REFLECTOR
BROWN	BODY

* INTERNALLY CONNECTED

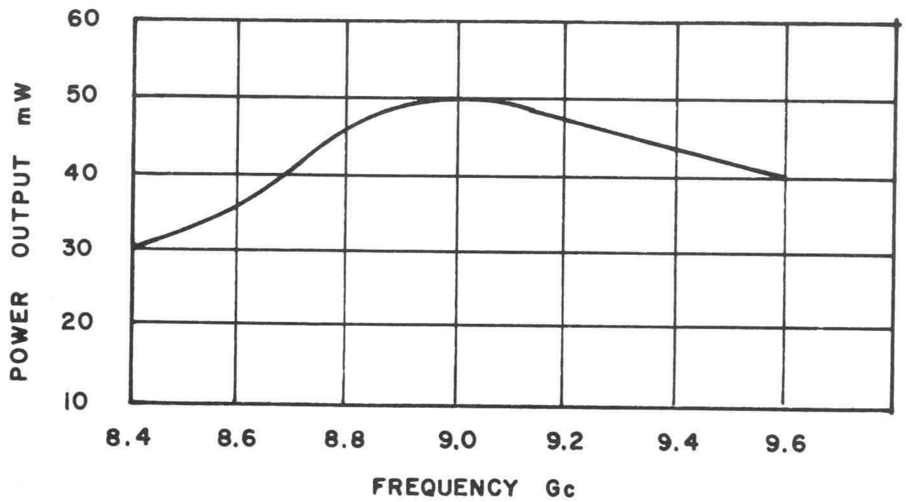


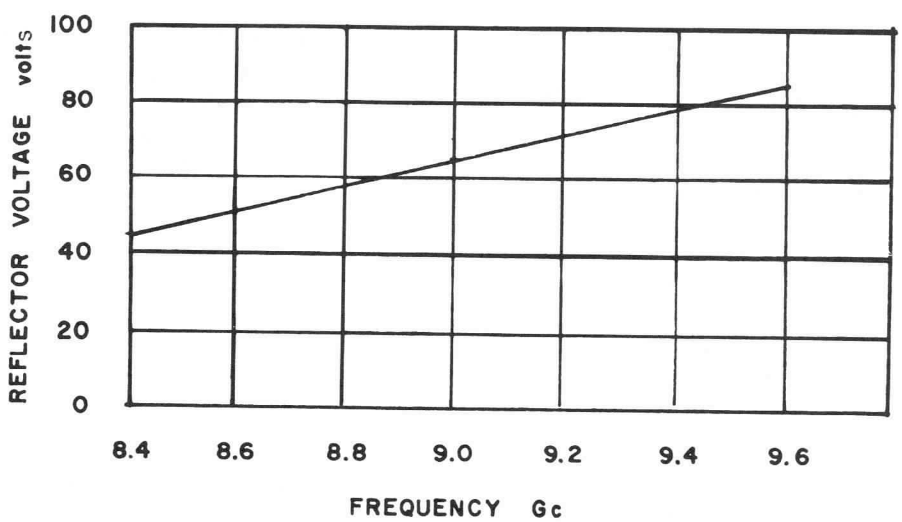


X 1075

X1075 OPERATING CHARACTERISTICS

Ers = 250 Vdc
Ik = 22 mA dc
6 3/4 MODE





EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

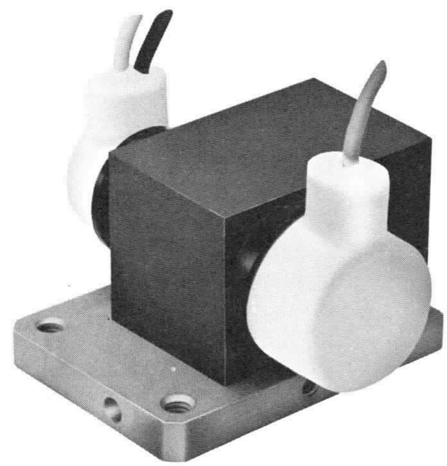
X-1095

REFLEX KLYSTRON

TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency Setting	factory preset at frequency between 5.9 & 6.7 Gc
Power Output	400 mW
Electronic Tuning Range (3 db bandwidth)	100 Mc
Resonator Voltage	600 Vdc
Cathode Current	45 mA
Repeller Voltage	—100 to —200 Vdc
Modulation Sensitivity	2.0 to 3.0 Mc/V
Heater Voltage	6.3 V (ac or dc)
Heater Current	0.7 A
Mode	4¾
VSWR of Load	1.2:1 max
Temperature Coefficient	±50 kc/°C
Warm-up Time	30 seconds



MAXIMUM RATINGS

Resonator Voltage	700 Vdc
Cathode Current	60 mA
Repeller Voltage (negative with respect to the cathode)	—50 to —500 Vdc

Note: Damage to the tube may occur if the maximum ratings are exceeded.

MECHANICAL

Operating Position	Any
Electrical Connection	Flexible Leads
RF Output Coupling	See Outline Drawing
Cooling Required	Conduction
Net Weight	6 ounces
Shipping Weight (approximate)	4 Pounds

ENVIRONMENTAL PERFORMANCE

Temperature	—55°C to +125°C
Altitude	70,000 feet max
Vibration	10 G, 5 to 2000 cps
Shock	100 G, 11 ms

OUTLINE DIMENSIONS

Height	1.42 inches
Width	2.00 inches
Length	2.45 inches

APPLICATION NOTES

NOTE: All voltages referred to the cathode.

COOLING: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat-sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

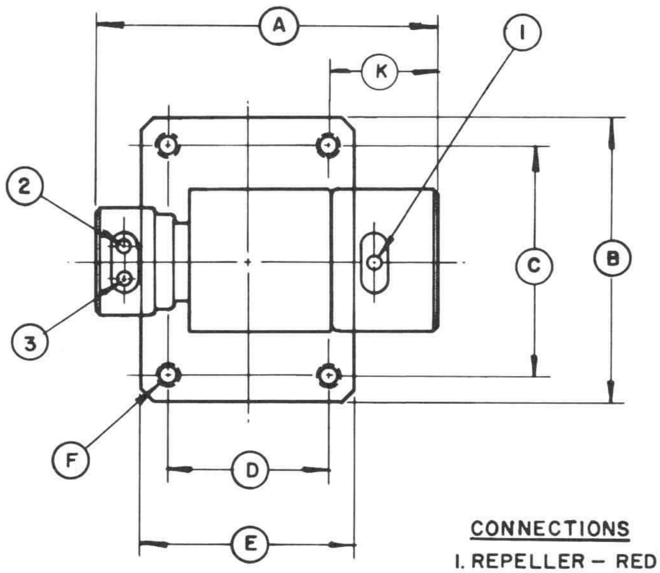
RESONATOR: The resonator of the X1095 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

CATHODE: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

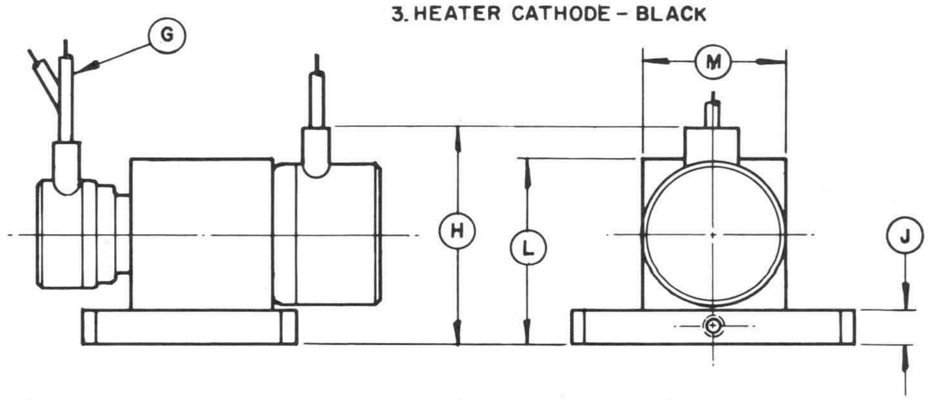
The heater and cathode of the X1095 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

VSWR OF LOAD: To obtain the typical performance listed, the load VSWR should be less than 1.2:1.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		2.520	
B		2.015	
C	1.620	1.630	
D	1.120	1.130	
E		1.515	
F	#8-32 TAP		
G	12±1 TYP LEAD LENGTH		
H			1.500
J		.260	
K	.800	.880	
L		1.325	
M		1.015	



CONNECTIONS
1. REPELLER – RED
2. HEATER – WHITE
3. HEATER CATHODE – BLACK



Eimac® EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1111

TWO-CAVITY KLYSTRON

TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency Setting - -	13.3±.005 Gc
Power Output - - -	2.0 W min
Electronic Tuning Range (3 db bandwidth) -	10 Mc
Resonator Voltage -	2150±75 Vdc
Cathode Curent - -	15-25 mA
Modulation Sensitivity	100 kc/V
Heater Voltage - -	6.3 V(ac or dc)±5%
Heater Current - -	0-70 A
VSWR of Load - -	1.2:1
Temperature Coefficient	±100 kc/°C
Warm-up Time - -	35 seconds
[redacted] - - - - - -	[redacted]

MAXIMUM RATINGS

Resonator Voltage - - - - - - - -	2500 Vdc
Cathode Current - - - - - - - - -	30 mA

Note: Damage to the tube may occur if the maximum ratings are exceeded.

MECHANICAL

Operating Position -	Any
Electrical Connection	Flexible Leads
RF Output Coupling -	RG—91/V waveguide flange
Cooling Required - -	Conduction
Net Weight - - - -	8 ounces
Shipping Weight (approximate)	4 Pounds

ENVIRONMENTAL PERFORMANCE

Temperature Range - - -	−20 to +75° C
Altitude - - - - - - -	100,000 feet max
Vibration - - - - - - -	10 G, 20 to 2000 cps
Shock - - - - - - - -	60 G, 11 ms

OUTLINE DIMENSIONS

Height - - - - - - - - - -	.90 inches
Width - - - - - - - - - -	1.35 inches
Length - - - - - - - - - -	2.80 inches

APPLICATION NOTES

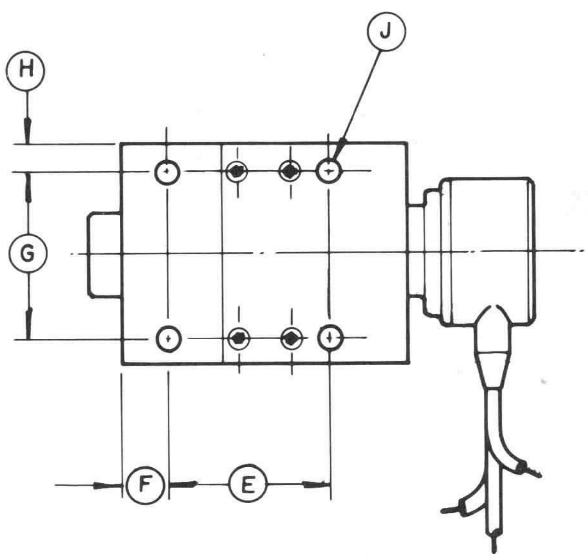
1. NOTE: All voltages are referred to the cathode.

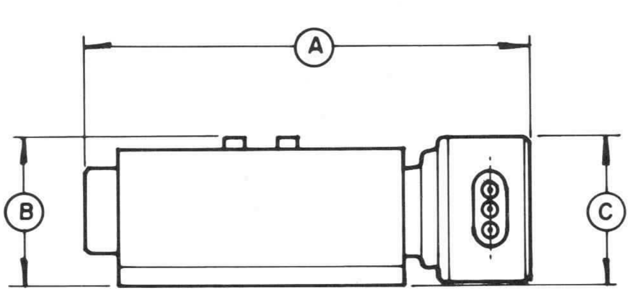
2. RESONATOR: The resonator of the X-1111 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

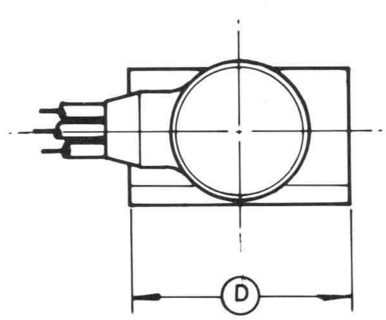
3. CATHODE: The heater voltage should be maintained with $\pm 5\%$ of the rated value of 6.3 volts if variations in performance are to be mimimized and best tube life obtained.

   The heater and cathode of the X-1111 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		2.660	
B			.920
C			.905
D		1.325	
E	.946	.966	
F			.250
G	.984	1.004	
H			.159
J	.144D	.150 D	







Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1113

TWO-CAVITY KLYSTRON

TENTATIVE DATA

ELECTRICAL PERFORMANCE

Frequency Setting - -	35 Gc
Power Output - - -	2.0 W min
Electronic Tuning Range (3 db bandwidth) -	40 Mc
Resonator Voltage -	2500±150 Vdc
Cathode Current - -	25-40 mAdc
Modulation Sensitivity	100 Kc/V.
Heater Voltage - -	6.3 V(ac or dc)±5%
Heater Current - -	2.0 A
VSWR of Load - -	1.2:1
Warm-up Time - -	35 seconds
[redacted] - - - - - -	[redacted]

MAXIMUM RATINGS

Resonator Voltage - - - - - - - - 3100 Vdc

Note: Damage to the tube may occur if the maximum rating is exceeded.

MECHANICAL

Operating Position -	Any
Electrical Connection	Flexible Leads
RF Output Coupling -	RG-96/V waveguide flange
Cooling Required - -	Blower or Conduction
Net Weight - - - -	17 ounces
Shipping Weight (approximate)	5 Pounds

ENVIRONMENTAL PERFORMANCE

Temperature - - - - -	−20 to +75°C
Altitude - - - - - -	100, 000 feet max
Vibration - - - - - -	2 G, 20 to 2000 cps
Shock - - - - - - -	15 G, 11 ms

OUTLINE DIMENSIONS

Height - - - - - - - - - -	2.0 inches
Width - - - - - - - - - -	1.9 inches
Length - - - - - - - - - -	3.5 inches

APPLICATION NOTES

NOTE: All voltages are referred to the cathode.

1. RESONATOR: The resonator of the X-1113 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

2. CATHODE: The heater voltage should be maintained with $\pm$5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

   The heater and cathode of the X-1113 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

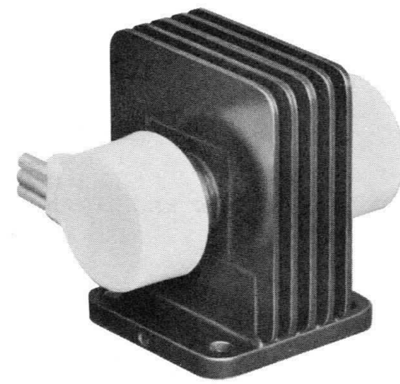
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1115

KU BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	12.2 to 12.7 Gc
Mechanically tunable	500 Mc
Power output	1 W min.
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	750 Vdc
Cathode current	90 mA max.
Repeller voltage	−300 Vdc
Modulation sensitivity	1.5 Mc/V max.
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.3 A max.
Mode	3¾
VSWR of load	1.2:1 max.
Temperature coefficient	±100 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	900 Vdc
Cathode current	110 mA
Repeller voltage:	
Negative with respect to cathode	−50 to −1000 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction & convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.6 in.
Width	1.6 in.
Length	2.1 in.

APPLICATION

NOTE: All voltages referred to cathode.

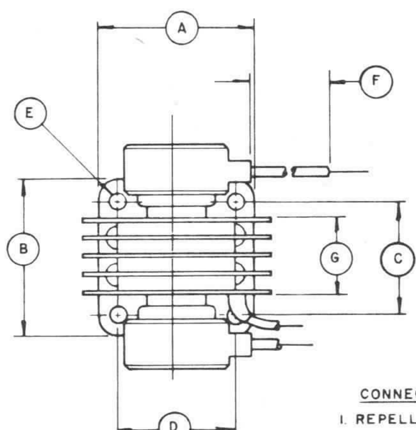
Cooling: The X1115 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1115 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1115 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.

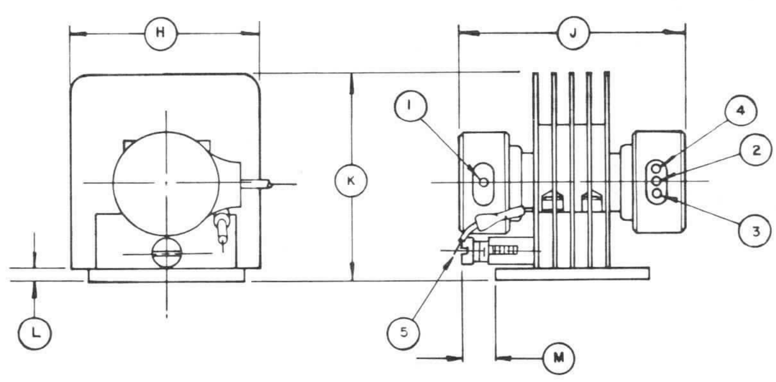


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D	.148D.	
F	12±1 TYP. LEAD LENGTH		
G			.650
H			1.600
J		2.100	
K		1.600	
L			.125
M		.532	

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN

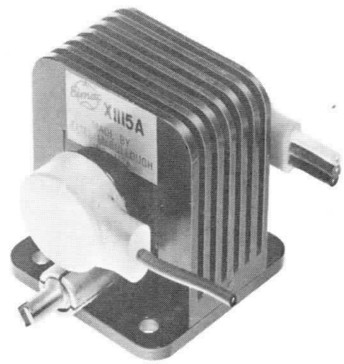


EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1115A

REFLEX KLYSTRON



The Eimac X1115A is a ceramic and metal, conduction-cooled reflex klystron designed for transmitter/local oscillator service in 12.2 - 12.7 Gc. microwave relay equipments. This tube provides a minimum output power of 100 mW and is tunable across the entire 500 Mc. band. High power output and good power/frequency stability also make the X1115A a good choice for parametric amplifier pump applications.

The X1115A features low-noise gridless gun optics and is warranteed for 1000 hours life.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up time	30	seconds
Heater:	Voltage	6.3	volts
	Current	0.8	ampere
Typical Output Power (Load VSWR 1.15:1)		100	milliwatts
Frequency Range		12.200 to 12.700	megacycles

MECHANICAL

Operating Position	Any
Mounting	WR-75 Waveguide Flange
Cooling	Conduction
Electrical Connections	Flexible Leads
RF Output Coupling	WR-75 Waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.8 inches
Width	1.5 inches
Length	2.5 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-operating Shock (11 ms duration)	40 g
Maximum Operating Shock* (11 ms duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 250 kilocycles.

(Effective 3-5-63)

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	500	MAX. VOLTS
DC CATHODE CURRENT	60	MAX. MA
RESONATOR DISSIPATION	30	MAX. WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	(25	MAX. VOLTS)
NEGATIVE WITH RESPECT TO CATHODE	(500	MAX. VOLTS)

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

DC Resonator Voltage*	400	volts
Mode		4-3/4
Frequency	12,450	megacycles
DC Cathode Current	40	milliamperes
DC Repeller Voltage*	-200	volts
DC Repeller Current	1	microampere
Power Output	150	milliwatts
Electronic Tuning (3 db bandwidth)	30	megacycles
Modulation Sensitivity ($E_r = \pm 3$ volts)	2.0	Mc/volt
Peak-to-peak FM Deviation (10 g, 20 - 2000 cps)	250	kilocycles
Residual FM	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

Resonator: The resonator of the X1115A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

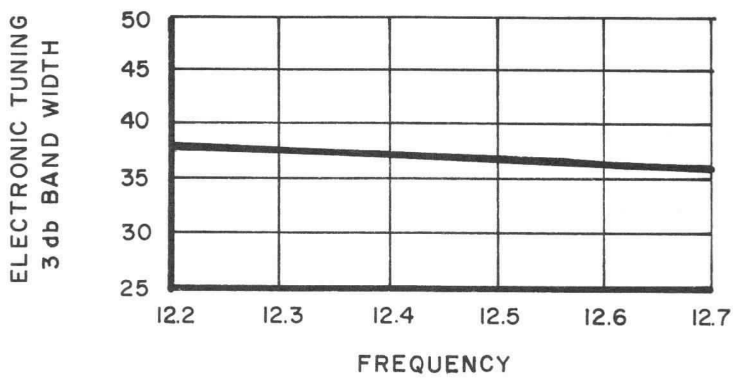
The heater and cathode of the X1115A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

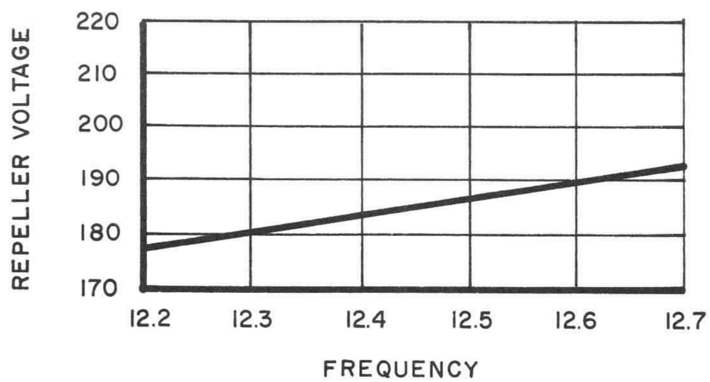
Mechanical Tuning: In the X1115A a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

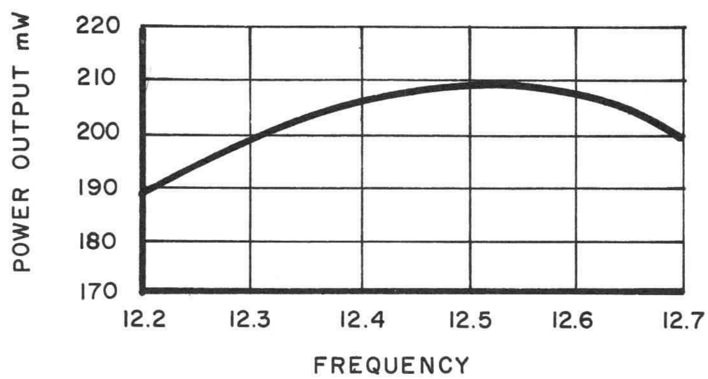
A clockwise rotation of the tuner will produce a decrease in frequency.

X1115A OPERATING CHARACTERISTICS

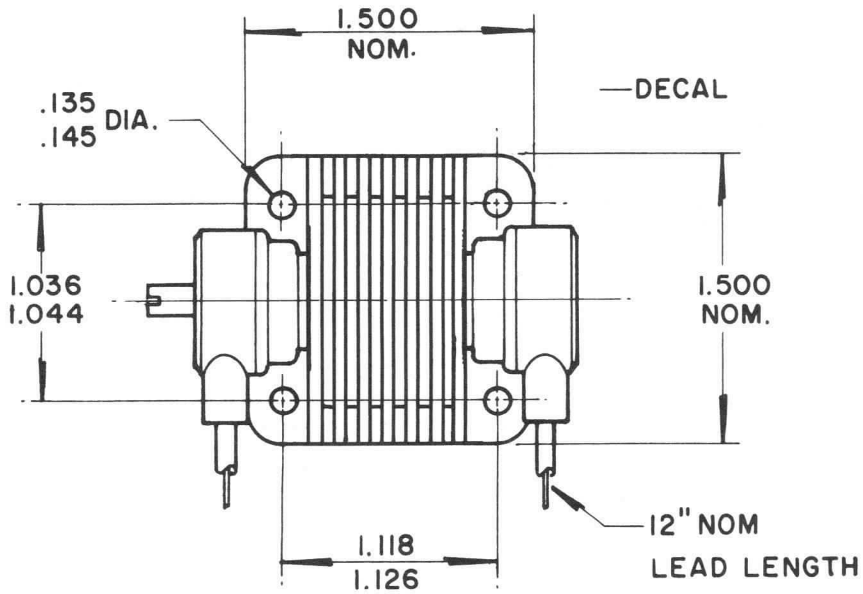
Ers = 400 V.
$5\frac{3}{4}$ MODE

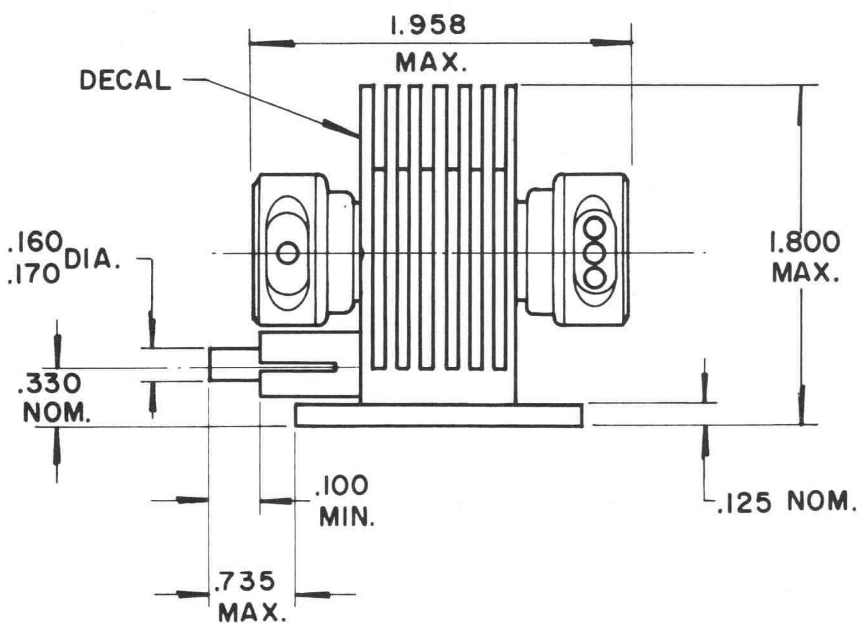






X1115A





CONNECTIONS

REPELLER - RED

HEATER - WHITE

* CATHODE - BLACK

* HEATER - BLACK

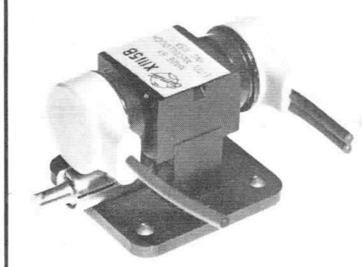
* INTERNALLY CONNECTED

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1115B

REFLEX KLYSTRON



The Eimac X1115B is a ceramic and metal, conduction-cooled reflex klystron designed for local oscillator service in 12.2 - 12.7 Gc. microwave relay equipments. The tube provides a minimum power output of 30 mW and is tunable across the entire 500 Mc. band.

The X1115B features low-noise gridless gun construction, good power and frequency stability and is conservatively warranteed for 1000 hours life.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated		
	Warm-up time	30	seconds
Heater:	Voltage	6.3	volts
	Current	0.8	ampere
Typical Output Power (Load VSWR 1.15:1)		30	milliwatts
Frequency Range		12,200 to 12,700	megacycles

MECHANICAL

Operating Position	Any
Mounting	WR-75 Waveguide Flange
Cooling	Conduction
Electrical Connections	Flexible Leads
RF Output Coupling	WR-75 Waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.4 inches
Width	1.5 inches
Length	2.5 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-operating Shock (11 ms duration)	40 g
Maximum Operating Shock* (11 ms duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 250 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	425	MAX. VOLTS
DC CATHODE CURRENT	45	MAX. MA
RESONATOR DISSIPATION	20	MAX. WATTS
PEAK REPELLER VOLTAGE*		
POSITIVE WITH RESPECT TO CATHODE	0	MAX. VOLTS
NEGATIVE WITH RESPECT TO CATHODE	400	MAX. VOLTS

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

DC Resonator Voltage*	300	volts
Mode		6-3/4
Frequency	12,450	megacycles
DC Cathode Current	26	milliamperes
DC Repeller Voltage*	-130	volts
DC Repeller Current	1	microampere
Power Output	40	milliwatts
Electronic Tuning (3 db bandwidth)	35	megacycles
Modulation Sensitivity ($E_r = \pm 3$ volts)	2.5	Mc/volt
Peak-to-peak FM Deviation (10 g, 20 - 2000 cps)	250	kilocycles
Residual FM	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

Resonator: The resonator of the X1115B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

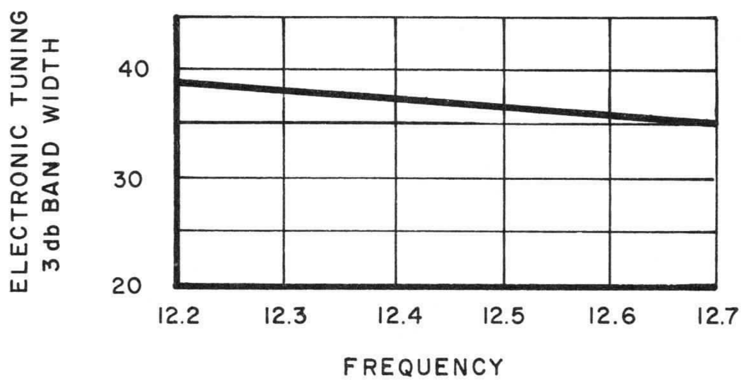
The heater and cathode of the X1115B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

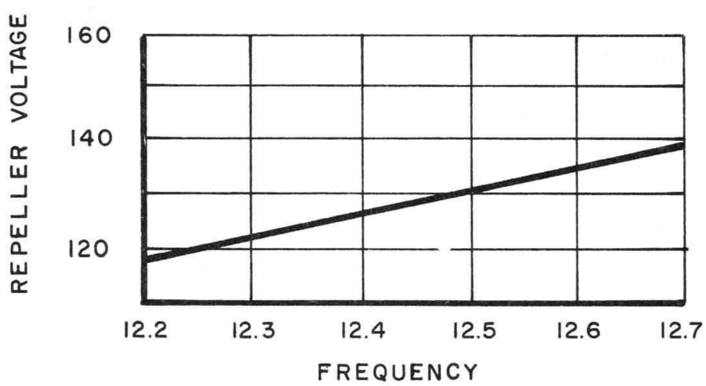
Mechanical Tuning: In the X1115B a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

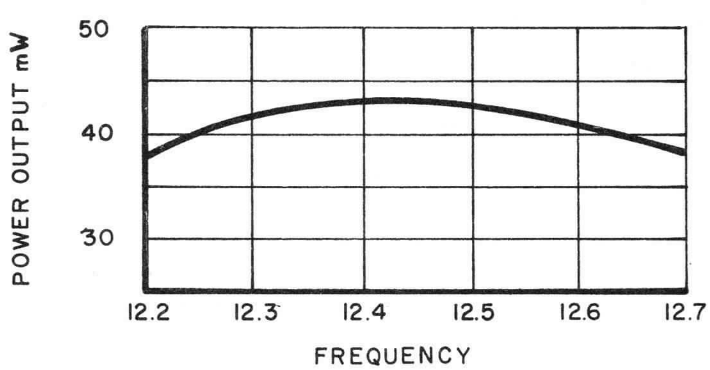
A clockwise rotation of the tuner will produce a decrease in frequency.

X1115B OPERATING CHARACTERISTICS

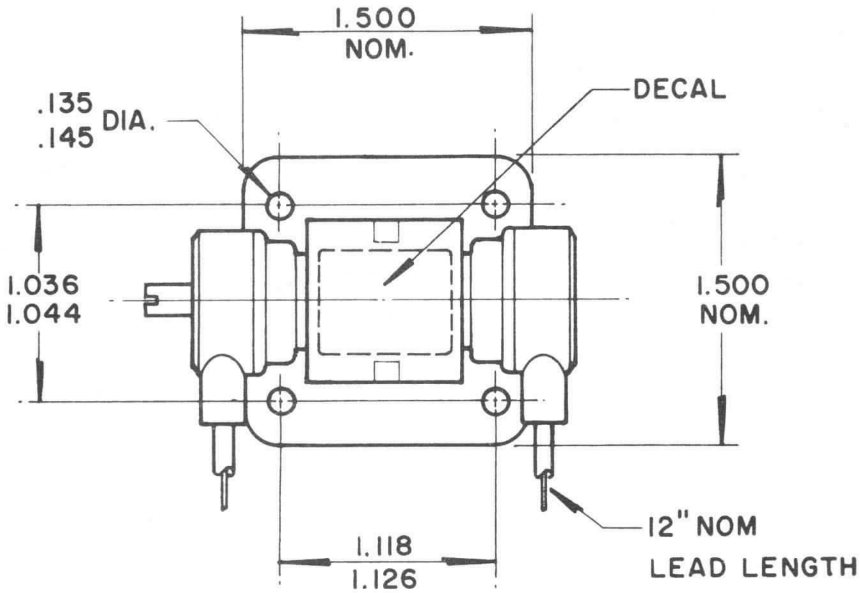
Ers = 300 V.
$6\frac{3}{4}$ MODE







X1115B



CONNECTIONS

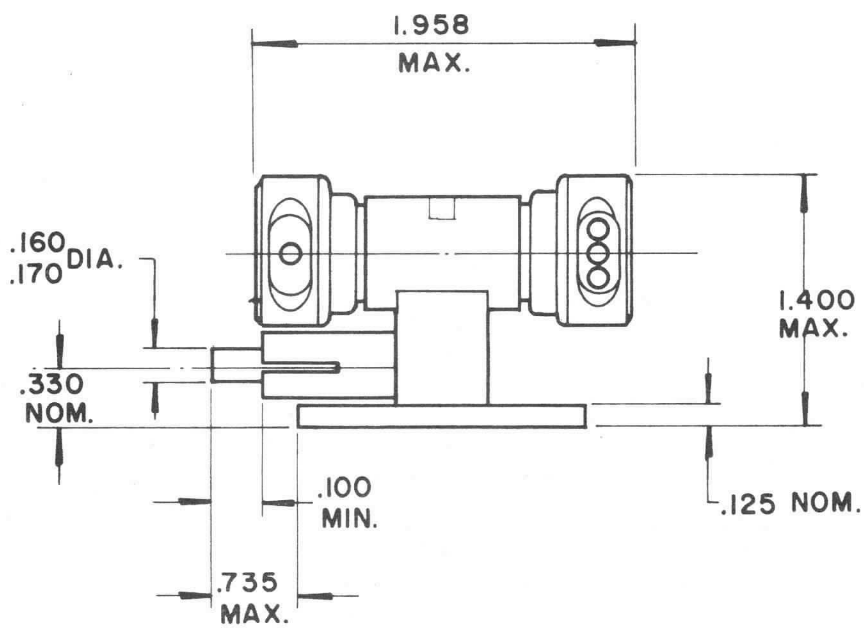
REPELLER - RED

HEATER - WHITE

* CATHODE - BLACK

* HEATER - BLACK

* INTERNALLY CONNECTED

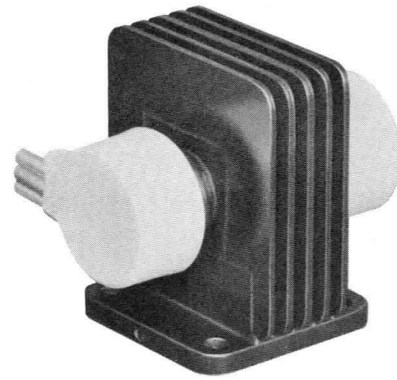


EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1116

X BAND REFLEX KLYSTRON



TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency range	11.7 to 12.2 Gc
Mechanically tunable	500 Mc
Power output	1 W min.
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	750 Vdc
Cathode current	90 mA max.
Repeller voltage	−300 Vdc
Modulation sensitivity	1.5 Mc/V max.
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.3 A max.
Mode	3¾
VSWR of load	1.2:1 max.
Temperature coefficient	±100 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	900 Vdc
Cathode current	110 mA
Repeller voltage:	
Negative with respect to cathode	−50 to −1000 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction & convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.6 in.
Width	1.6 in.
Length	2.1 in.

APPLICATION

NOTE: All voltages referred to cathode.

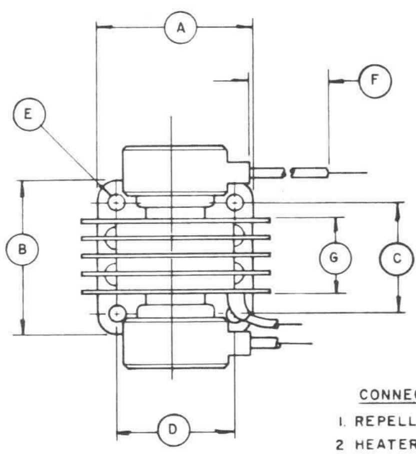
Cooling: The X1116 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1116 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with $\pm 5\%$ of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1116 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.

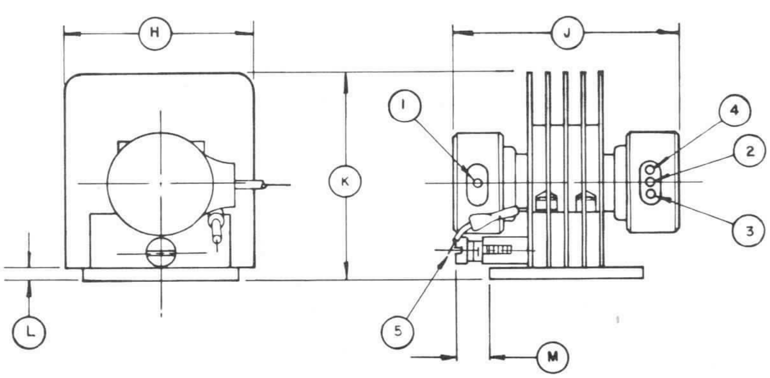


CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D	.148D.	
F	12±1 TYP. LEAD LENGTH		
G			.650
H			1.600
J		2.100	
K		1.600	
L			.125
M		.532	



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

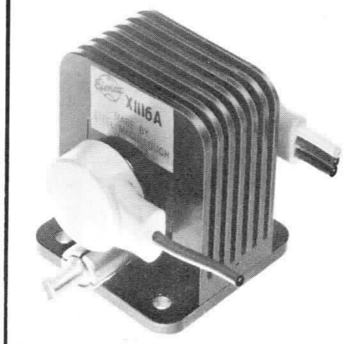
TENTATIVE DATA

X1116A

REFLEX KLYSTRON

The Eimac X1116A is a ceramic and metal. conduction-cooled reflex klystron designed for transmitter/local oscillator service in 11.7 - 12.2 Gc. microwave relay equipments. This tube provides a minimum output power of 100 mW and is tunable across the entire 500 Mc. band. High power output and good power/frequency stability also make the X1116A a good choice for parametric amplifier pump applications.

The X1116A features low-noise gridless gun optics and is warranteed for 1000 hours life.



GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential. oxide coated		
	Warm-up time	30	seconds
Heater:	Voltage	6.3	volts
	Current	0.8	ampere
Typical Output Power (Load VSWR 1.15:1)		100	milliwatts
Frequency Range		11,700 to 12,200	megacycles

MECHANICAL

Operating Position	Any
Mounting	WR-75 Waveguide Flange
Cooling	Conduction
Electrical Connections	Flexible Leads
RF Output Coupling	WR-75 Waveguide
Net Weight	4 ounces
Shipping Weight (Approximate)	2 pounds
Maximum Overall Dimensions:	
Height	1.8 inches
Width	1.5 inches
Length	2.5 inches

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	No limit
Maximum Non-operating Shock (11 ms duration)	40 g
Maximum Operating Shock* (11 ms duration)	40 g
Maximum Operating Vibration** (20 to 2000 cps)	10 g

*Based on a permanent frequency shift after drop of 2 megacycles.
**Based on a maximum peak-to-peak frequency deviation of 250 kilocycles.

MAXIMUM RATINGS

DC RESONATOR VOLTAGE*	500	MAX. VOLTS
DC CATHODE CURRENT	60	MAX. MA
RESONATOR DISSIPATION	30	MAX. WATTS
PEAK REPELLER VOLTAGE*		
NEGATIVE WITH RESPECT TO CATHODE	(25	MAX. VOLTS)
	(500	MAX. VOLTS)

TYPICAL OPERATION (Load VSWR less than 1.15 to 1)

DC Resonator Voltage*	400	volts
Mode		4-3/4
Frequency	11.950	megacycles
DC Cathode Current	40	milliamperes
DC Repeller Voltage*	-200	volts
DC Repeller Current	1	microampere
Power Output	150	milliwatts
Electronic Tuning (3 db bandwidth)	30	megacycles
Modulation Sensitivity ($E_r = \pm 3$ volts)	2.0	Mc/volt
Peak-to-peak FM Deviation (10 g. 20 - 2000 cps)	250	kilocycles
Residual FM	50	kilocycles

*All voltages referred to cathode.

APPLICATION

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation. forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

Resonator: The resonator of the X1116A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential. with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

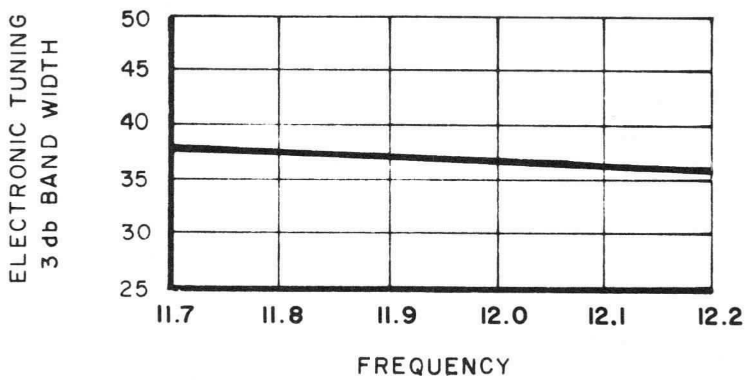
The heater and cathode of the X1116A are internally connected. When the resonator of this tube is operated at chassis potential. the heater transformer must be insulated for the cathode-to-resonator voltage.

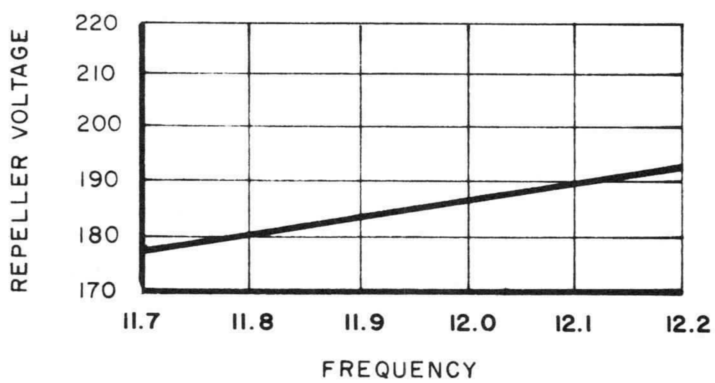
Mechanical Tuning: In the X1116A a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

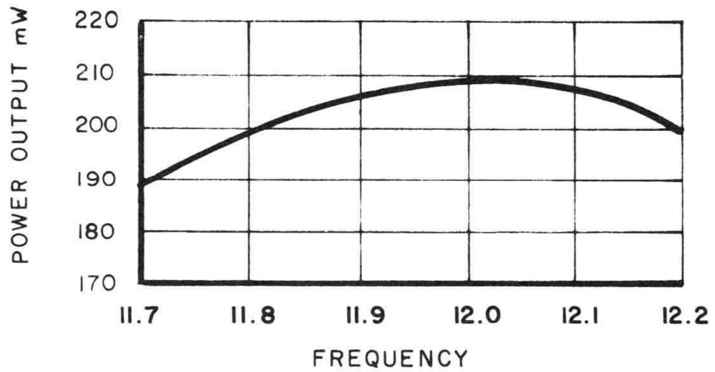
A clockwise rotation of the tuner will produce a decrease in frequency.

X1116A OPERATING CHARACTERISTICS

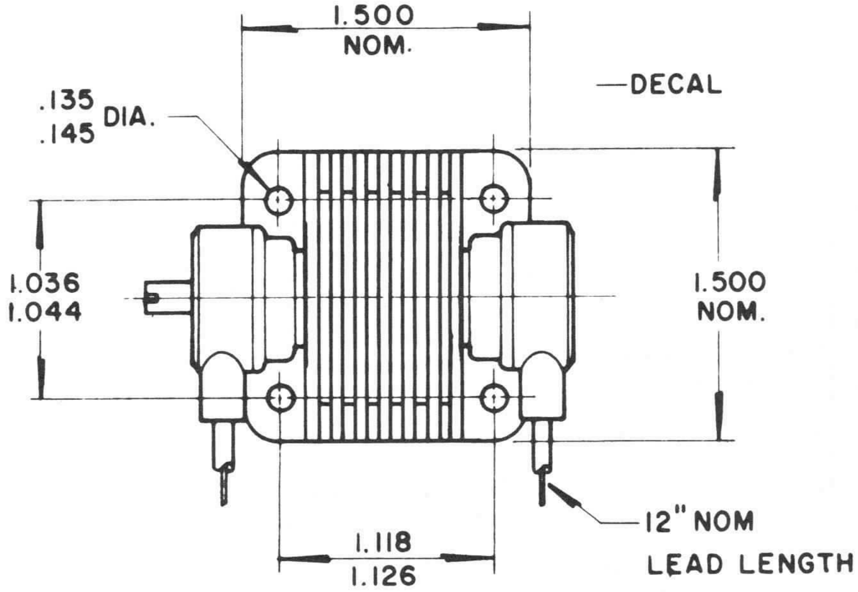
Ers = 400 V.
$5\frac{3}{4}$ MODE

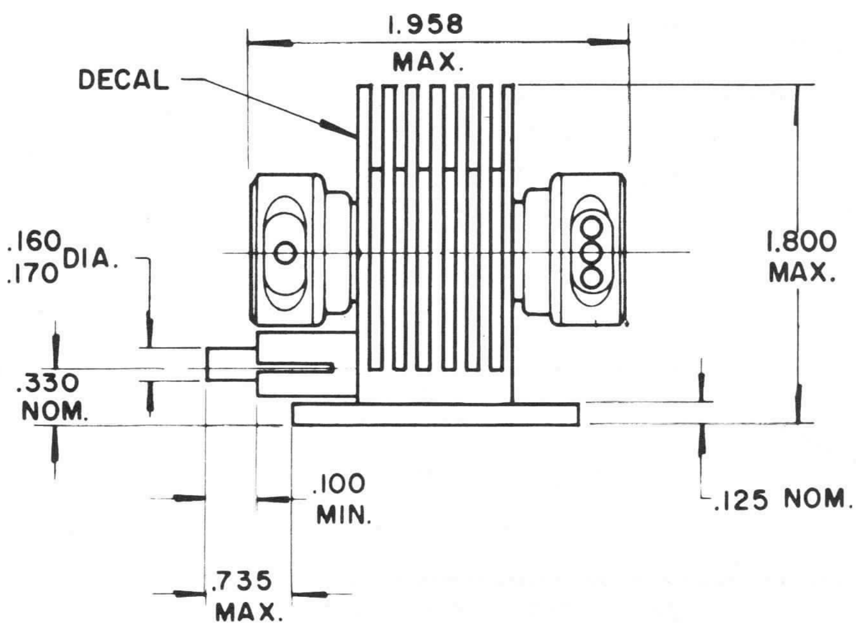






X1116A





CONNECTIONS

REPELLER - RED
HEATER - WHITE
* CATHODE - BLACK
* HEATER - BLACK

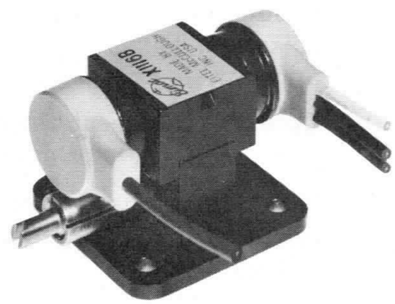
* INTERNALLY CONNECTED

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1116B

X BAND REFLEX KLYSTRON



TYPICAL PERFORMANCE

ELECTRICAL PERFORMANCE

Frequency range	11.7 to 12.2 Gc
Mechanically tunable	500 Mc
Power output	30 mW
Electronic tuning range (3 db bandwidth)	40 Mc
Resonator voltage	300 Vdc
Cathode current	25 mAdc
Repeller voltage	−100 Vdc
Modulation sensitivity	2.5 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.0 A max.
Mode	6¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	425 Vdc
Cathode current	45 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −400 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction or convection
Net weight	4½ oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.5 in.
Length	2.5 in.

(EFFECTIVE 4-1-64)

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

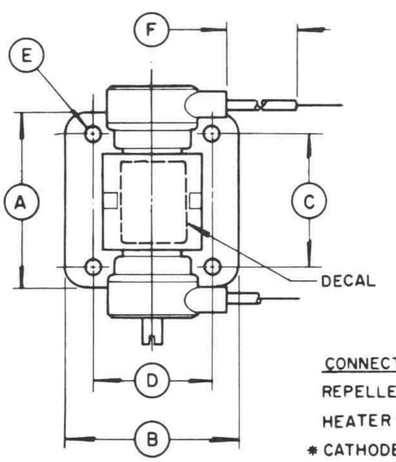
Resonator: The resonator of the X1116B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1116B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the X1116B a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.



CONNECTIONS

REPELLER - RED

HEATER - WHITE

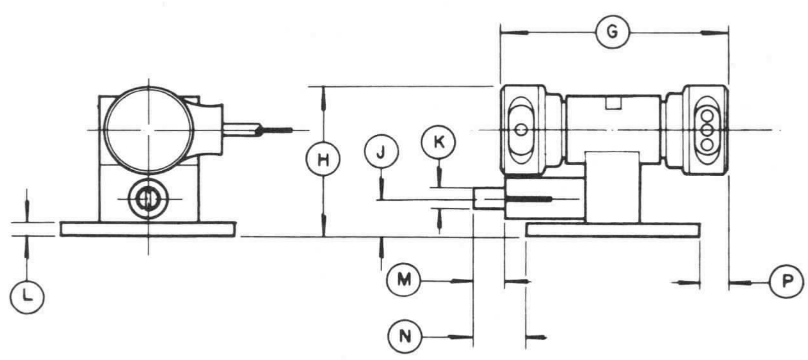
* CATHODE - BLACK

* HEATER - BLACK

*INTERNALLY CONNECTED

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		1.958	
H		1.400	
J			.330
K	.160	.170	
L			.125
M	.100		
N		.735	
P		.250	



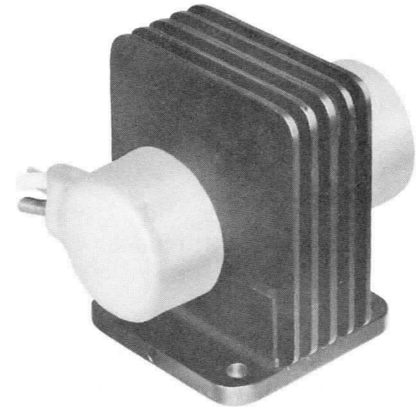
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1117

X BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	11.2 to 11.7 Gc
Mechanically tunable	500 Mc
Power output	1 W min.
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	750 Vdc
Cathode current	90 mA max.
Repeller voltage	−300 Vdc
Modulation sensitivity	1.5 Mc/V max.
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.3 A max.
Mode	3¾
VSWR of load	1.2:1 max.
Temperature coefficient	±100 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	900 Vdc
Cathode current	110 mA
Repeller voltage:	
Negative with respect to cathode	−50 to −1000 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction & convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.6 in.
Width	1.6 in.
Length	2.1 in.

APPLICATION

NOTE: All voltages referred to cathode.

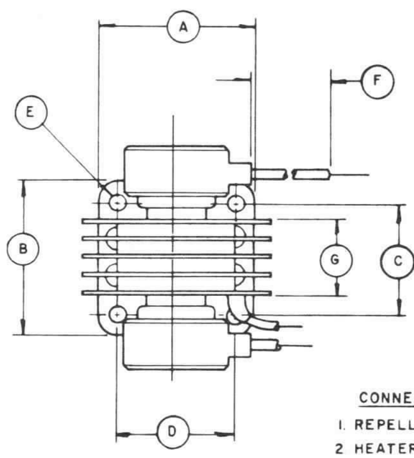
Cooling: The X1117 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1117 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1117 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

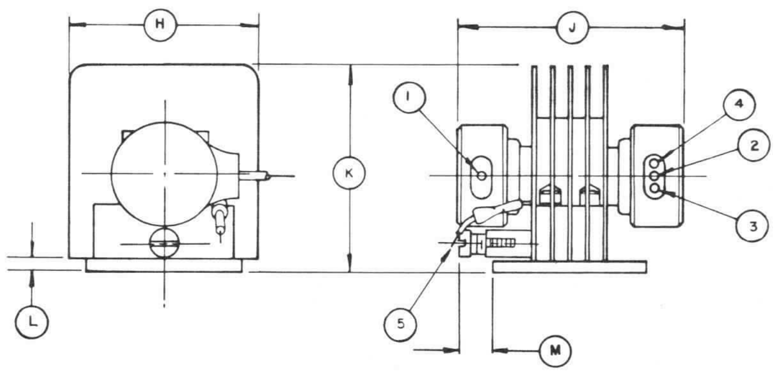
Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.



CONNECTIONS
1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D	.148 D.	
F	12±1 TYP. LEAD LENGTH		
G			.650
H			1.600
J		2.100	
K		1.600	
L			.125
M		.532	



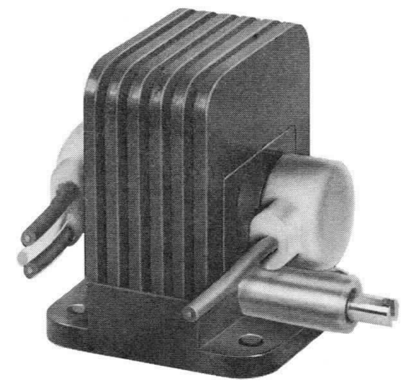
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1117A

X BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	11.2 to 11.7 Gc
Mechanically tunable	500 Mc
Power output	100 mW
Electronic tuning range (3 db bandwidth)	40 Mc
Resonator voltage	400 Vdc
Cathode current	40 mAdc
Repeller voltage	−150 Vdc
Modulation sensitivity	2.0 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.0 A max.
Mode	4¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	500 Vdc
Cathode current	60 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction or convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.8 in.
Width	1.5 in.
Length	2.5 in.

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

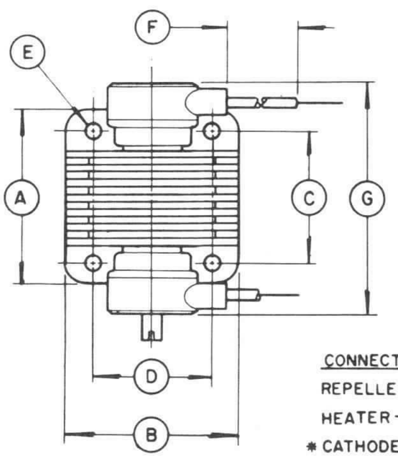
Resonator: The resonator of the X1117A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1117A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the X1117A a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.



CONNECTIONS

REPELLER - RED

HEATER - WHITE

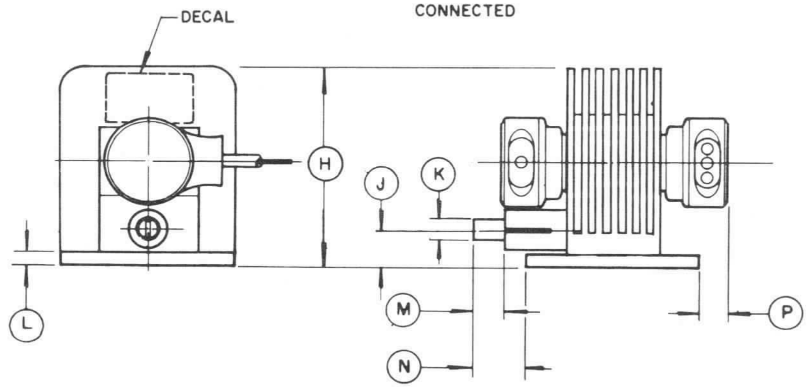
* CATHODE - BLACK

* HEATER - BLACK

*INTERNALLY CONNECTED

DIMENSIONS IN INCHES

DIMENSIONAL DATA •			
REF.	MIN.	MAX.	NOM.
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		1.958	
H		1.800	
J			.330
K	.160	.170	
L			.125
M	.100		
N		.735	
P		.250	



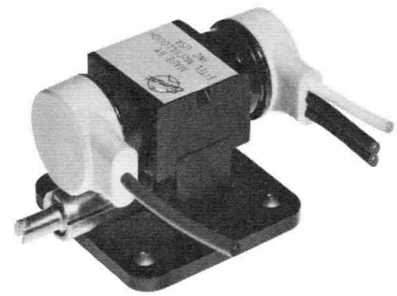
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1117B

X BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	11.2 to 11.7 Gc
Mechanically tunable	500 Mc
Power output	30 mW
Electronic tuning range (3 db bandwidth)	60 Mc
Resonator voltage	300 Vdc
Cathode current	25 mAdc
Repeller voltage	−100 Vdc
Modulation sensitivity	2.5 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.0 A max.
Mode	6¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	425 Vdc
Cathode current	45 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −400 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction or convection
Net weight	4½ oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.5 in.
Length	2.5 in.

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

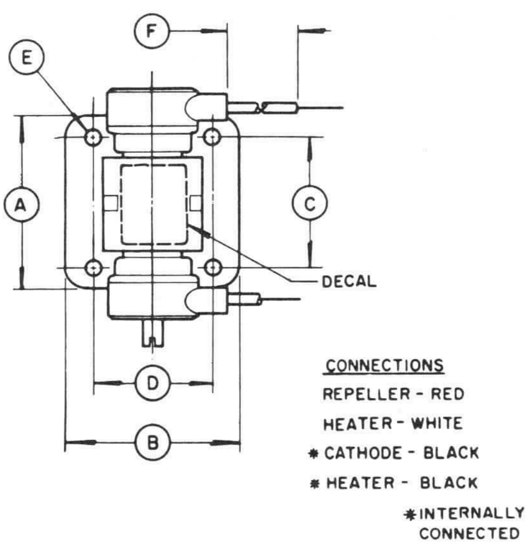
Resonator: The resonator of the X1117B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1117B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

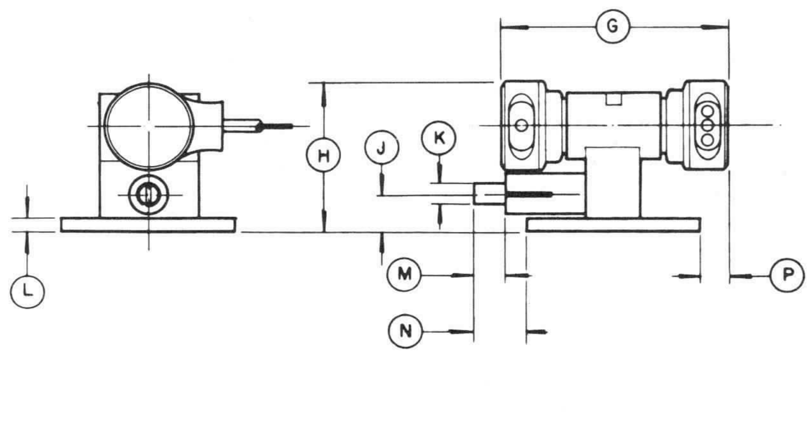
Mechanical Tuning: In the X1117B a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		1.958	
H		1.400	
J			.330
K	.160	.170	
L			.125
M	.100		
N		.735	
P		.250	



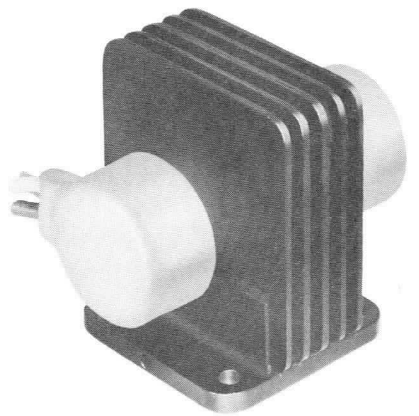
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1118

X BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	10.7 to 11.2 Gc
Mechanically tunable	500 Mc
Power output	1 W min.
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	750 Vdc
Cathode current	90 mA max.
Repeller voltage	−300 Vdc
Modulation sensitivity	1.5 Mc/V max.
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.3 A max.
Mode	3¾
VSWR of load	1.2:1 max.
Temperature coefficient	±100 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	900 Vdc
Cathode current	110 mA
Repeller voltage:	
Negative with respect to cathode	−50 to −1000 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction & convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.6 in.
Width	1.6 in.
Length	2.1 in.

APPLICATION

NOTE: All voltages referred to cathode.

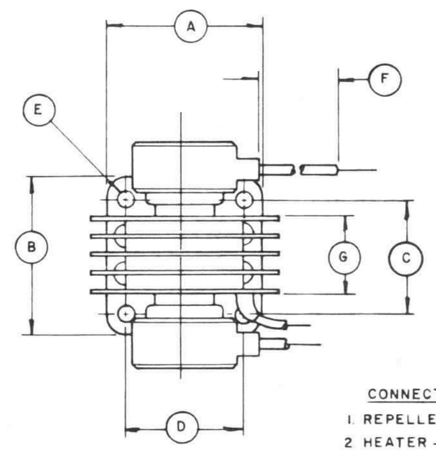
Cooling: The X1118 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1118 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1118 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.

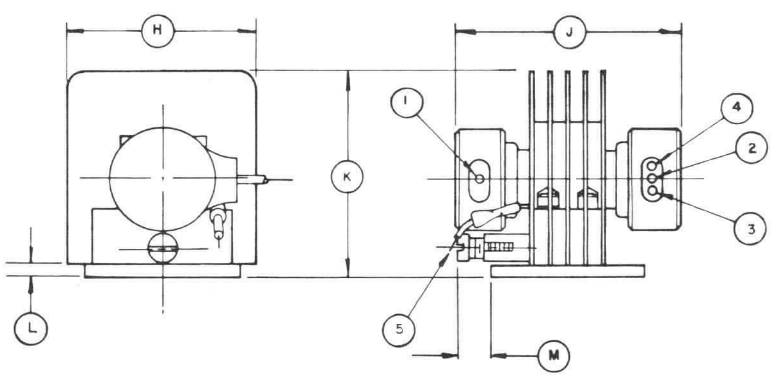


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D	.148 D.	
F	12±1 TYP. LEAD LENGTH		
G			.650
H			1.600
J		2.100	
K		1.600	
L			.125
M		.532	

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



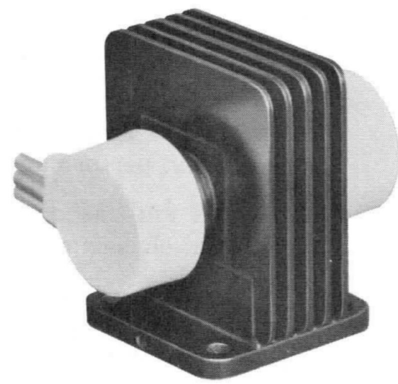
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1118A

X BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	10.7 to 11.2 Gc
Mechanically tunable	500 Mc
Power output	100 mW
Electronic tuning range (3 db bandwidth)	40 Mc
Resonator voltage	400 Vdc
Cathode current	40 mAdc
Repeller voltage	−150 Vdc
Modulation sensitivity	2.0 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.0 A max.
Mode	4¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	500 Vdc
Cathode current	60 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction or convection
Net weight	6 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps.
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.8 in.
Width	1.5 in.
Length	2.5 in.

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

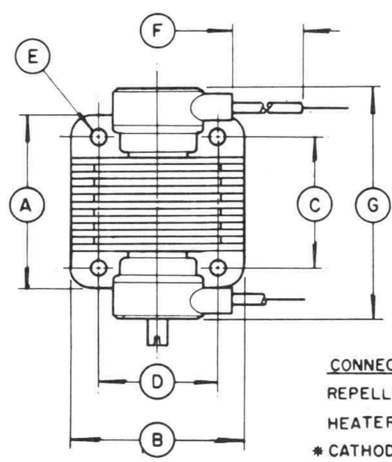
Resonator: The resonator of the X1118A is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1118A are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the X1118A a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.



CONNECTIONS

REPELLER - RED

HEATER - WHITE

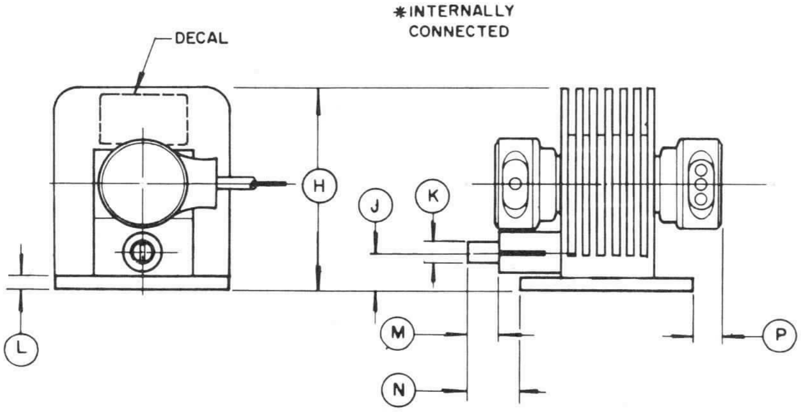
* CATHODE - BLACK

* HEATER - BLACK

*INTERNALLY CONNECTED

DIMENSIONS IN INCHES

REF.	MIN.	MAX.	NOM.
	DIMENSIONAL DATA •		
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		1.958	
H		1.800	
J			.330
K	.160	.170	
L			.125
M	.100		
N		.735	
P		.250	



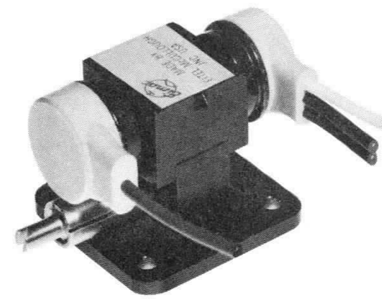
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1118B

X BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	10.7 to 11.2 Gc
Mechanically tunable	500 Mc
Power output	30 mW
Electronic tuning range (3 db bandwidth)	40 Mc min.
Resonator voltage	30 Vdc
Cathode current	25 mAdc
Repeller voltage	−100 Vdc
Modulation sensitivity	2.5 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.0 A max.
Mode	6¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	30 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	425 Vdc
Cathode current	45 mA
Repeller voltage:	
Negative with respect to cathode	−50 to −1000 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	WR-75 wave-guide flange
Cooling required	conduction & convection
Net weight	4½ oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40G, 11 mc

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.5 in.
Length	2.5 in.

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

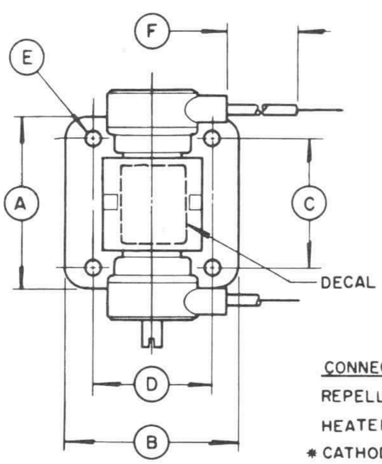
Resonator: The resonator of the X1118B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within $\pm 5\%$ of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1118B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Mechanical Tuning: In the X1118B a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.



CONNECTIONS

REPELLER - RED

HEATER - WHITE

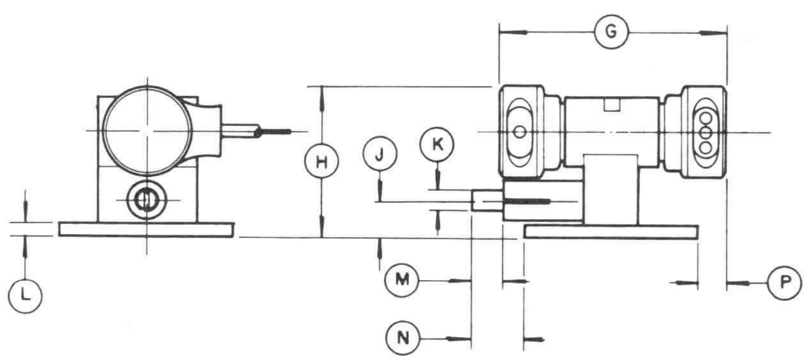
* CATHODE - BLACK

* HEATER - BLACK

*INTERNALLY CONNECTED

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.500
B			1.500
C	1.118	1.126	
D	1.036	1.044	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		1.958	
H		1.400	
J			.330
K	.160	.170	
L			.125
M	.100		
N		.735	
P		.250	



X-1120

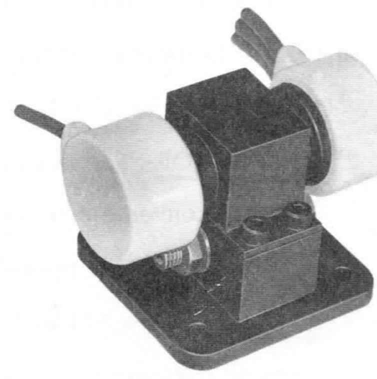
REFLEX KLYSTRON
OPERATING-FREQUENCY
12.5 to 15Gc
TRIMMABLE ± 50 Mc
MINIMUM OUTPUT POWER
200 mW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

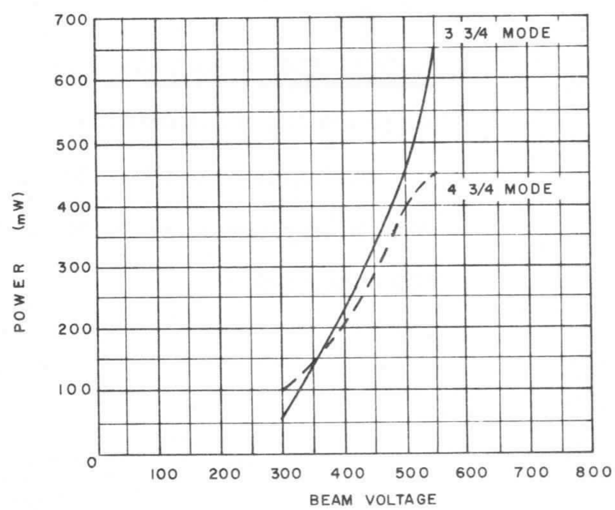
TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	12.5 to 15 Gc (preset)
Resonator Voltage[2]	400 V
Output Power	225 mW
Cathode Current	38 mAdc
Repeller Voltage	−300 v
3db Bandwidth	35 Mc
Modulation Sensitivity	0.7 Mc/V
Temperature Coefficient	±100 Kc/°C
Heater Voltage (AC)[3]	6.3 v
Heater Current (AC)	1.25 A
VSWR	1.2:1 max
Mode	3-3/4



KU-BAND



MECHANICAL

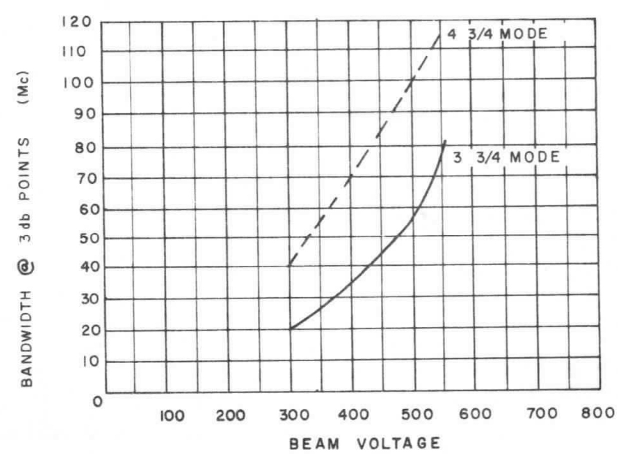
Operating Position	Any
Mounting	Waveguide Flange
RF Output Coupling	RG/91U Waveguide
Net Weight	6 ounces
Cooling[1]	(See note 1)

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	NO LIMIT
Maximum Shock (11ms duration)[4]	40g
Maximum Operating Vibration[4] (20-2000cps)	10g

OUTLINE DIMENSIONS

Height	1.400 inches
Width	1.312 inches
Length	2.100 inches



APPLICATION NOTES

1. COOLING: At sea level this tube will not require forced air cooling when operated at less than 20 watts resonator dissipation and an ambient temperature of less than 150°C. The waveguide-flange connection will normally provide the required heat sink for conduction cooling. If the tube is operated at a resonator dissipation of greater than 20 watts or if an insulator is used between the tube and waveguide for DC isolation, forced air cooling will be required to maintain the body temperature below the maximum rating of 175°C. For maximum tube life, the operating temperature should be less than 100°C.

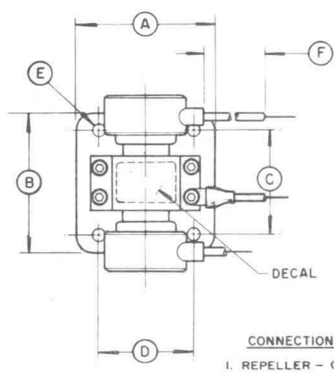
2. RESONATOR: The resonator of the X 1120 is integral with the body of the kylstron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

3. CATHODE: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

   The heater and catholde of the X 1120 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

4. SHOCK AND VIBRATION: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20 - 2000 cps) or shock of up to 40g (11 milliseconds duration).

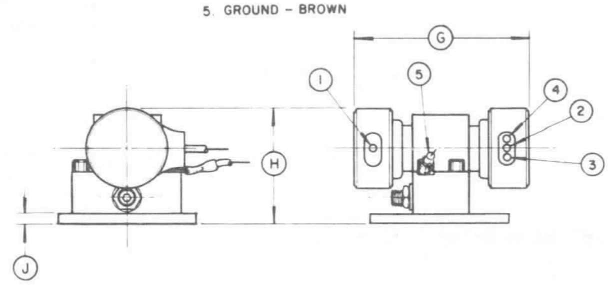
   With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.100	
H		1.400	
J			.125

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



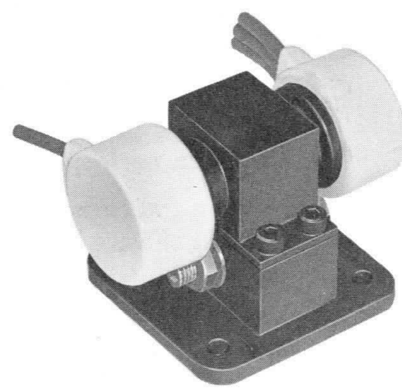
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1123

KU BAND
REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency setting	13.395 Gc
Mechanically trimmable	±50 Mc
Power output	20 mW
Electronic tuning range (3 db bandwidth)	30 Mc
Resonator voltage	300 Vdc
Cathode current	30 mAdc max.
Repeller voltage	−80 to −100 Vdc
Modulation sensitivity	3.0 Mc/V max.
Heater voltage	6.3 V (ac or dc)
Heater current	0.8 A max.
Mode	5¾
VSWR of load	1.2:1 max.
Temperature coefficient	0 to −200 Kc/°C
Warm-up time	20 sec
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	500 Vdc
Cathode current	55 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	RG-91/U waveguide flange
Cooling required	conduction
Net weight	5 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−55 to +125 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40G, 11 ms

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.3 in.
Length	2.1 in.

(EFFECTIVE 4-1-64) PRINTED IN U.S.A.

APPLICATION

NOTE: All voltages referred to cathode.

Cooling: At sea level this tube will not require forced air cooling when operated at its maximum rated dissipation with an ambient temperature less than 125° Centigrade. The waveguide flange connection will normally provide the required heat sink for conduction cooling. If an insulator is used between the tube and waveguide for DC isolation, forced air cooling may be required to maintain the ceramic-to-metal seal temperatures below the maximum rating of 150° Centigrade.

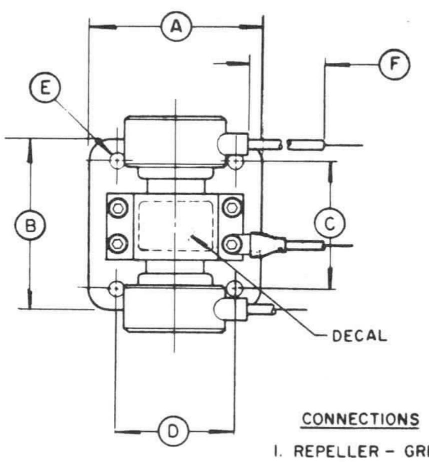
Resonator: The resonator of the X1123 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained.

The heater and cathode of the X1123 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: In the X1123 a fixed-tuned inner cavity is closely coupled through a ceramic window to a secondary cavity outside the vacuum. Mechanical tuning is accomplished by a capacitive slug in the secondary cavity with a tuning rate of approximately 150 megacycles per turn. This design allows repeated tuner cycling without damaging the vacuum seals. The maximum tuner torque is 40 inch-ounces.

A clockwise rotation of the tuner will produce a decrease in frequency.

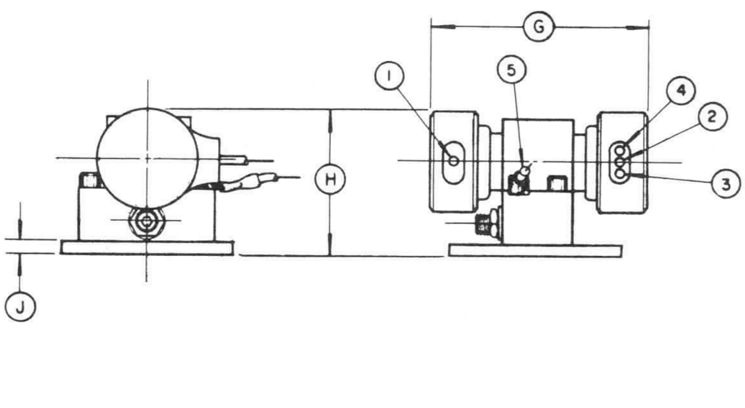


DIMENSIONS IN INCHES

REF.	DIMENSIONAL DATA MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.100	
H		1.400	
J			.125

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN

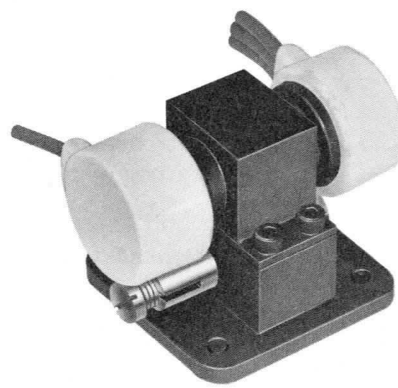


TENTATIVE DATA

X1126

KU BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	16.0 to 17.0 Gc
Mechanically tunable	1000 Mc
Power output	20 mW
Electronic tuning range (3 db bandwidth)	50 Mc
Resonator voltage	300 Vdc
Cathode current	30 mAdc max.
Repeller voltage	−80 to −100 Vdc
Modulation sensitivity	5.0 Mc/V max.
Heater voltage	6.3 V [redacted] (ac or dc) ±5%
Heater current	1.3 A max.
Mode	6¾
VSWR of load	1.2:1 max.
Temperature coefficient	±150 Kc/°C
Warm-up time	20 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	500 Vdc
Cathode current	55 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	RG-91/U wave-guide flange
Cooling required	conduction
Net weight	5 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−50 to +100 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40 G, 11 ms

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.3 in.
Length	2.1 in.

(EFFECTIVE 4-1-64)

APPLICATION

NOTE: All voltages referred to cathode.

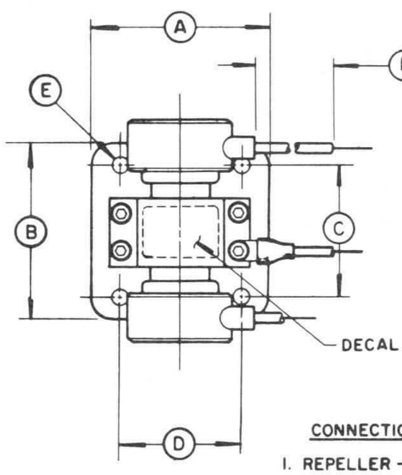
Cooling: The X1126 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1126 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1126 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.

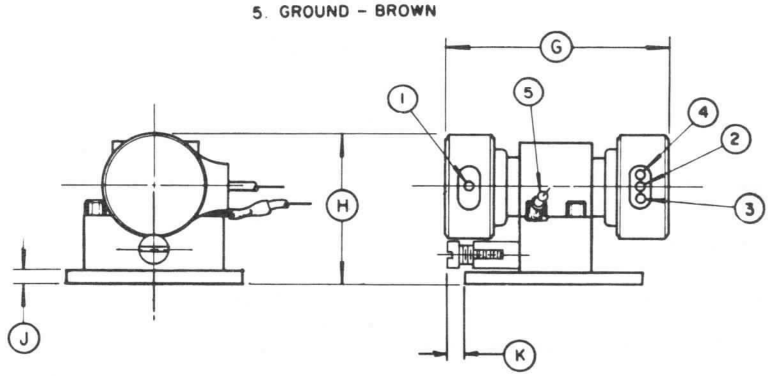


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.700	
H		1.400	
J			.125
K		.437	

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



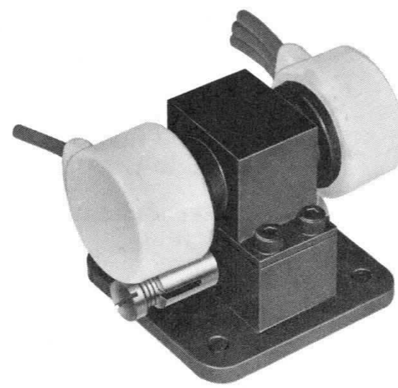
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X1126B

KU BAND REFLEX KLYSTRON

TYPICAL PERFORMANCE



ELECTRICAL PERFORMANCE

Frequency range	16.5 to 17.2 Gc
Mechanically tunable	700 Mc
Power output	20 mW
Electronic tuning range (3 db bandwidth)	40 Mc
Resonator voltage	300 Vdc
Cathode current	30 mAdc max.
Repeller voltage	−40 to −150 Vdc
Modulation sensitivity	1.3 to 3.5 Mc/V
Heater voltage	6.3 V (ac or dc) ±5%
Heater current	1.3 A max.
Mode	5¾
VSWR of load	1.2:1 max.
Temperature coefficient	−200 to −400 Kc/°C
Warm-up time	20 sec.
[redacted]	[redacted]

MAXIMUM RATINGS

Resonator voltage	500 Vdc
Cathode current	55 mA
Repeller voltage:	
Negative with respect to cathode	−25 to −500 Vdc

NOTE: Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating position	any
Electrical connections	flexible leads
RF output coupling	RG-91/U wave-guide flange
Cooling required	conduction
Net weight	5 oz.
Shipping weight (approximate)	4 lbs.

ENVIRONMENTAL PERFORMANCE

Temperature range	−55 to +120 °C
Altitude	100,000 ft. max.
Vibration	10G, 20 to 2000 cps
Shock	40 G, 11 ms

OUTLINE DIMENSIONS

Height	1.4 in.
Width	1.3 in.
Length	2.1 in.

APPLICATION

NOTE: All voltages referred to cathode.

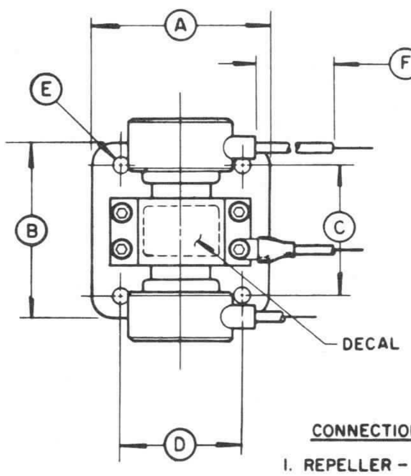
Cooling: The X1126B may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

Resonator: The resonator of the X1126B is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

Cathode: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

The heater and cathode of the X1126B are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

Shock and Vibration: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20–2000 cps) or shock of up to 40g (11 milliseconds duration.) With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.

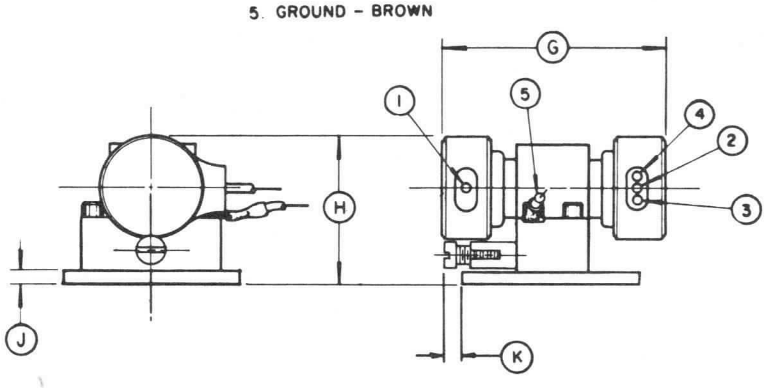


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.700	
H		1.400	
J			.125
K		.437	

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1130

REFLEX KLYSTRON

OPERATING FREQUENCY
15-18 Gc
TRIMMABLE ±50 Mc

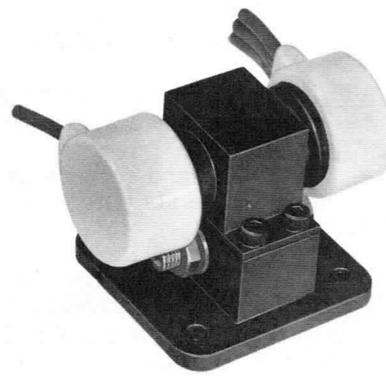
MINIMUM OUTPUT POWER
200 mW

TYPICAL PERFORMANCE

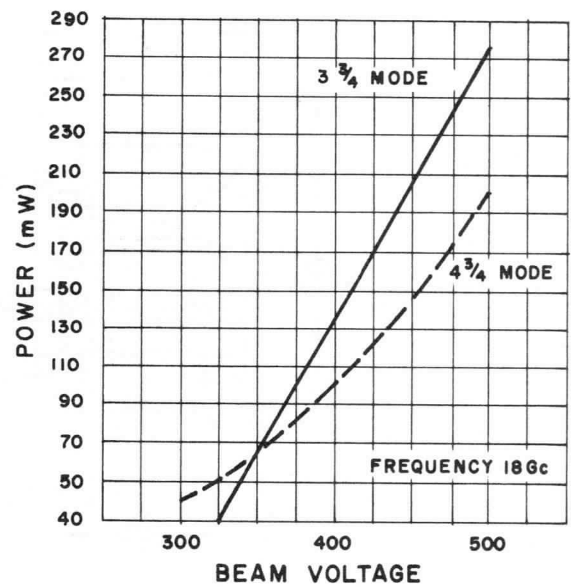
ELECTRICAL

Frequency Range 15.0 to 18 Gc (preset)

Resonator Voltage[2]	500 V
Output Power	250 mW
Cathode Current	52 mAdc
Repeller Voltage	-300 V
3db Bandwidth	35 Mc
Modulation Sensitivity	0.7 Mc/V
Temperature Coefficient	±150 Kc/°C
Heater Voltage (AC)[3]	6.3 V
Heater Current(AC)	1.25 A
VSWR	1.2:1 max
Mode	3-3/4



KU-BAND



MECHANICAL

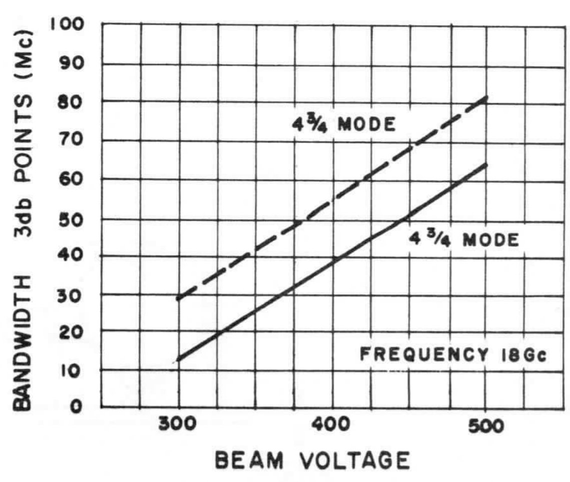
Operating Position	Any
Mounting	Waveguide Flange
RF Output Coupling	RG-91/U waveguide
Net Weight	6 ounces
Cooling[1]	(See note 1)

ENVIRONMENTAL

Maximum Ambient Temperature	150° C
Maximum Altitude	NO LIMIT
Maximum Shock (Hms duration)[4]	40 g
Maximu Operating Vibration (20-2000cps)[4]	10 g

OUTLINE DIMENSION

Height	1.40 inches
Width	1.312 inches
Length	2.100 inches



APPLICATION NOTES

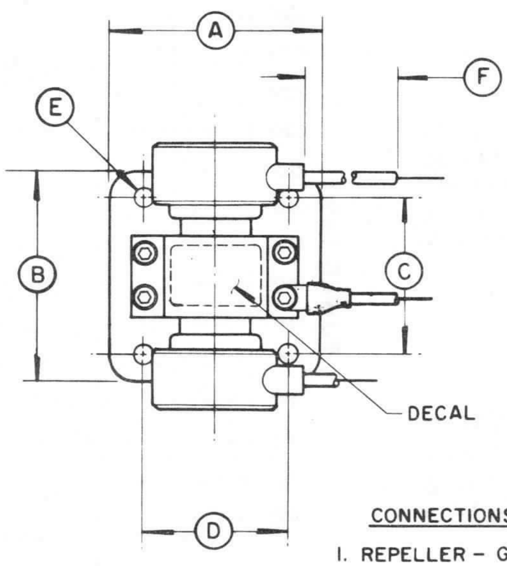
1. COOLING: The X 1130 may be cooled by conduction if the connecting waveguide flange provides an adequate heat sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade.

2. RESONATOR: The resonator of the X 1130 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

3. CATHODE: The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

   The heater and cathode of the X 1130 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

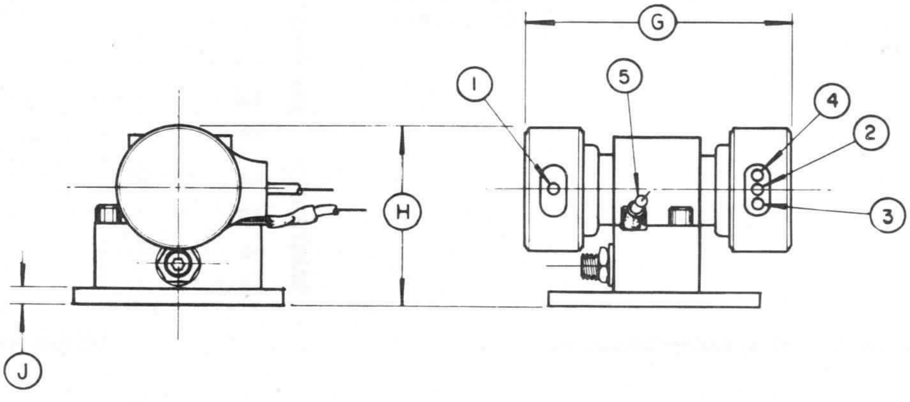
4. SHOCK AND VIBRATION: This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20-2000 cps) or shock of up to 40g (11 milliseconds duration).
   With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP LEAD LENGTH		
G		2.100	
H		1.400	
J			.125

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM 108
TRAVELING WAVE TUBE

The EM108 is an octave bandwidth pulse PPM focused TWT capable of delivering 1.0 kw of power from 2.0–4.0 Gc. This tube is of metal-ceramic construction designed for operation in severe environments. This tube contains a grid for modulating purposes.

ELECTRICAL SPECIFICATIONS

Absolute Ratings	Maximum
Filament Voltage	7.0 Volts
Cathode Voltage	−8000 vdc
Peak Cathode Current	2.0 adc
Pulse Grid Voltage	+400 to −150 vdc
Duty Cycle	2%

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	3.0 Amperes
Cathode Voltage	−7500 Vdc
Peak Cathode Current	1.3 Adc
Grid Voltage (Beam off)	−90 Vdc
Grid Voltage (Beam on)	+200 Vdc
Duty Cycle	2%
Frequency Range	2.0–4.0 Gc
Small Signal Gain—Minimum	36 db
Peak Saturated Power Out—Minimum	1.0 kw
Saturated Gain—Minimum	30 db
Grid Capacitance (to all other elements)	15 picofds.

ENVIRONMENTAL SPECIFICATIONS

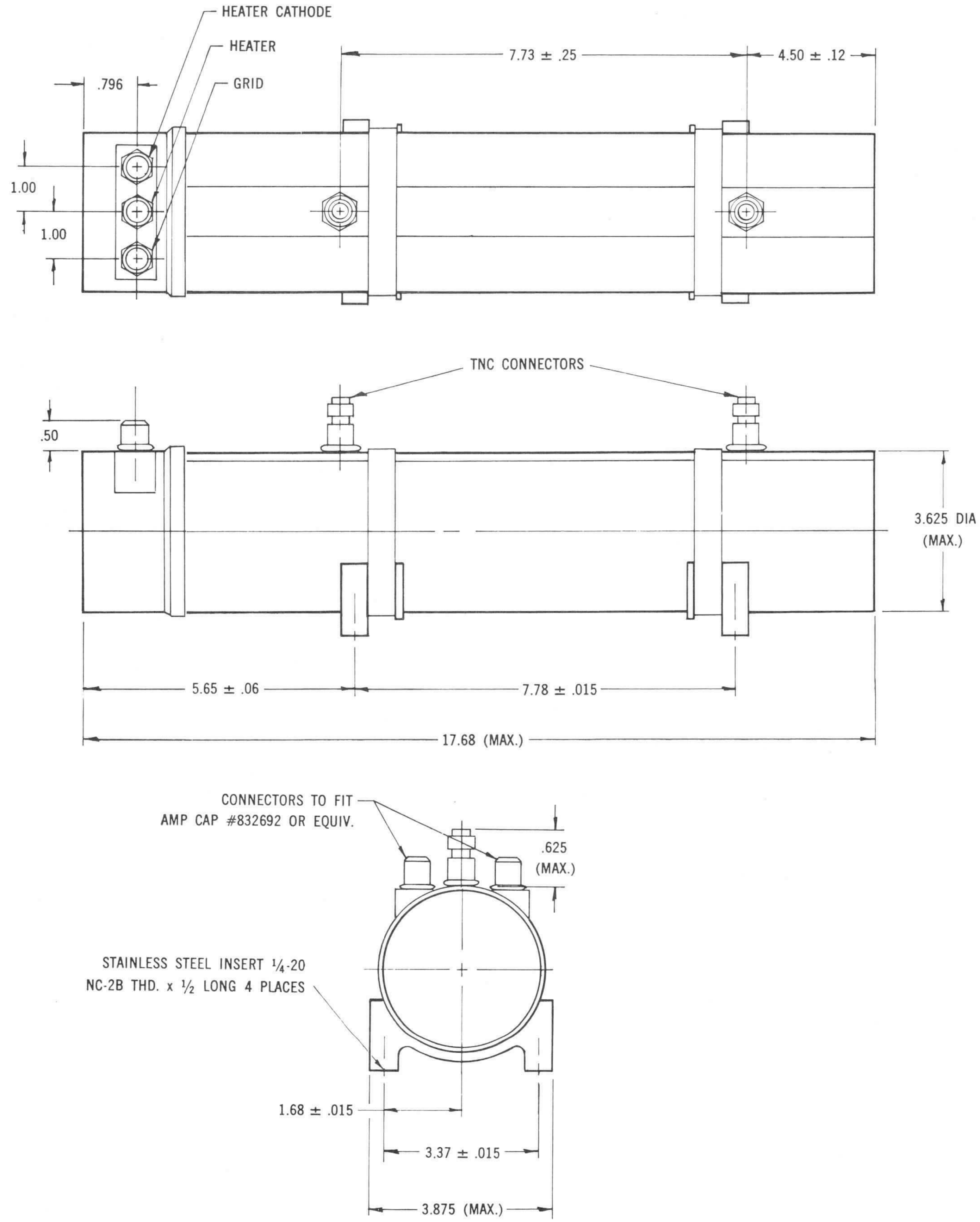
Complies with MIL-5400 Class II Equipment

Temperature	−65° C to +125° C

MECHANICAL SPECIFICATIONS

Operating Position	Any
Input Coupling, rf	TNC
Output Coupling, rf	TNC
Focusing	PPM
Cooling	75 CFM forced air
Dimensions	See outline drawing
Weight	9 lbs.
Supply Connections	Cathode—yellow Filament—brown Grid—green

NOTE: Electrode Voltages are with respect to cathode; tube shell at ground potential.

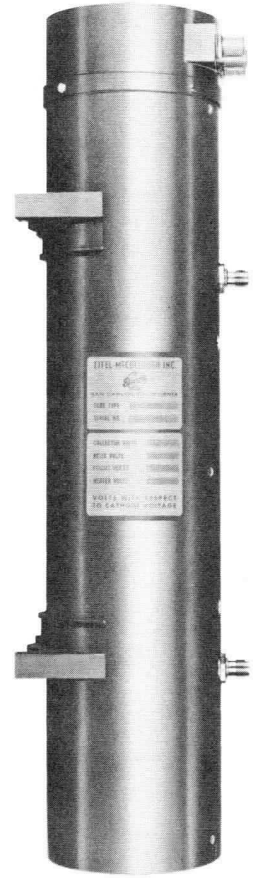

HEATER CATHODE
HEATER
GRID
.796
7.73 ± .25
4.50 ± .12
1.00
1.00
TNC CONNECTORS
.50
3.625 DIA
(MAX.)
5.65 ± .06
7.78 ± .015
17.68 (MAX.)
CONNECTORS TO FIT
AMP CAP #832692 OR EQUIV.
.625
(MAX.)
STAINLESS STEEL INSERT 1/4-20
NC-2B THD. x 1/2 LONG 4 PLACES
1.68 ± .015
3.37 ± .015
3.875 (MAX.)

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM 113

TRAVELING WAVE TUBE



The EM113 delivers 1 kw of pulse power from 2.0–4.0 Gc. It is of metal-ceramic construction and is suitable for airborne and missile applications. The focusing is accomplished by periodic permanent magnet and compensated for operation over the temperature range —65° C to +125° C.

ELECTRICAL SPECIFICATIONS

Absolute Ratings

Absolute Ratings	Maximum
Filament Voltage	7.0 Volts
Pulse Cathode Voltage	—8000 vdc
Peak Cathode Current	2.0 adc
Duty Cycle	2%

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	3.0 Amperes
Cathode Voltage	—7500 Vdc
Peak Cathode Current	1.3 adc
Duty Cycle	2%
Frequency Range	2.0–4.0 Gc
Small Signal Gain—Minimum	36 db
Peak Saturated Power Out—Minimum	1.0 kw
Saturated Gain—Minimum	30 db

ENVIRONMENTAL SPECIFICATIONS

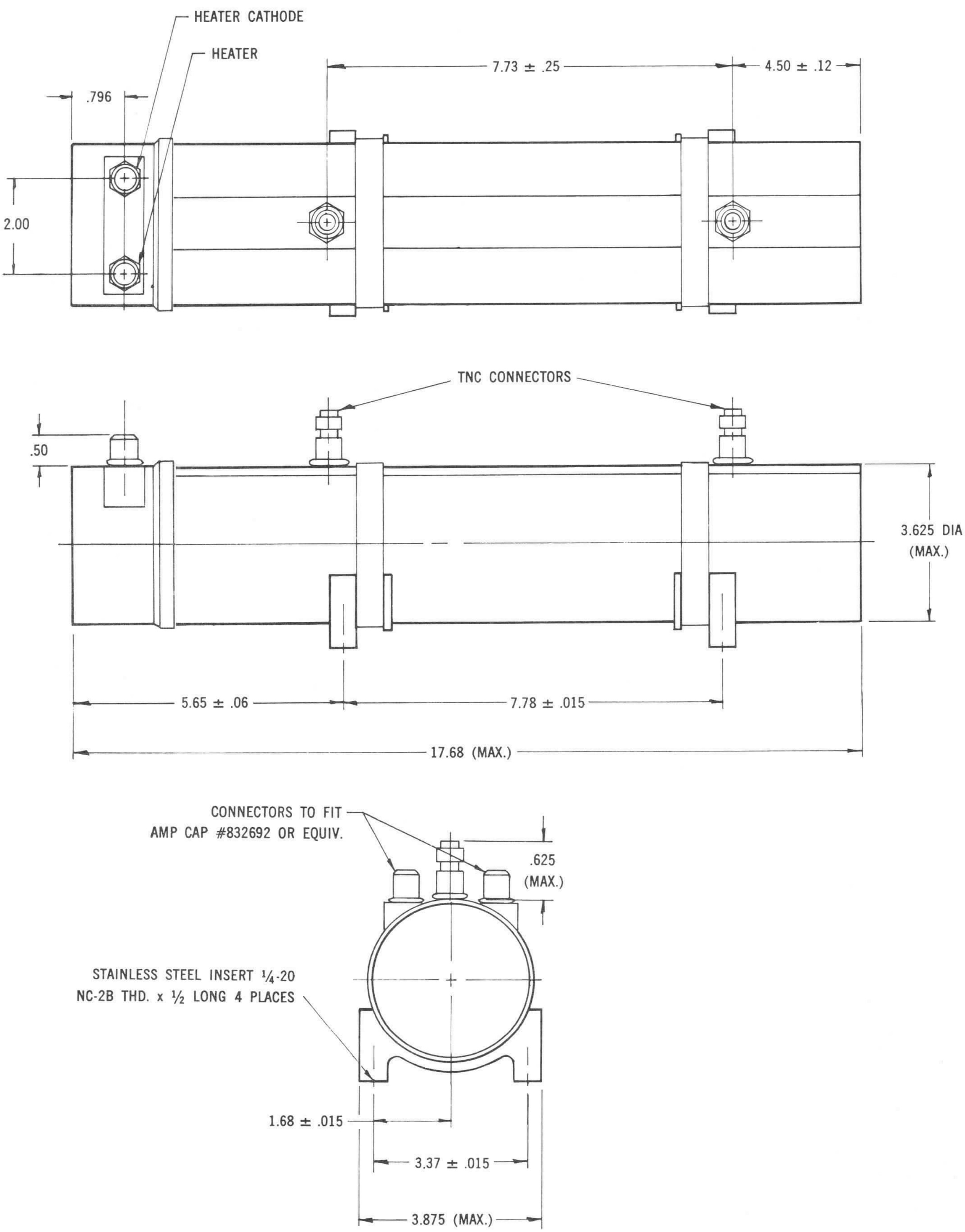
Complies with MIL-5400 Class II Equipment

Temperature	—65° C to +125° C

MECHANICAL SPECIFICATIONS

Operating Position	Any
Input Coupling, rf	TNC
Output Coupling, rf	TNC
Focusing	PPM
Cooling	75 CFM forced air
Dimensions	See outline drawing
Weight	9 lbs.
Supply Connections	Cathode—yellow Filament—brown Grid—green

NOTE: Electrode Voltages are with respect to cathode; tube shell at ground potential.


HEATER CATHODE
HEATER
.796
7.73 ± .25
4.50 ± .12
2.00
TNC CONNECTORS
.50
3.625 DIA
(MAX.)
5.65 ± .06
7.78 ± .015
17.68 (MAX.)
CONNECTORS TO FIT
AMP CAP #832692 OR EQUIV.
.625
(MAX.)
STAINLESS STEEL INSERT 1/4-20
NC-2B THD. x 1/2 LONG 4 PLACES
1.68 ± .015
3.37 ± .015
3.875 (MAX.)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM 114

TRAVELING WAVE TUBE

The EM114 is a grid modulated pulse TWT covering the frequency range of 2.8–3.5 Gc with a peak power output of 2.0 kw. This tube is designed for use in airborne and missile environments.

ELECTRICAL SPECIFICATIONS

Absolute Ratings	Maximum
Filament Voltage	7.0 Volts
Cathode Voltage	−8000 vdc
Peak Cathode Current	2.0 adc
Grid Voltage	+400 to −150 vdc
Duty Cycle	2%

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	3.0 Amperes
Cathode Voltage	−7800 Vdc
Peak Cathode Current	1.5 adc
Grid Voltage (Beam on)	200 Vdc
Grid Voltage (Beam off)	−90 Vdc
Duty Cycle	2%
Frequency Range	2.8–3.5 Gc
Small Signal Gain—Minimum	36 db
Saturated Power Out—Minimum	2.0 kw
Saturated Gain—Minimum	30 db
Grid Capacitance (to all other elements)	15 picofds.

ENVIRONMENTAL SPECIFICATIONS

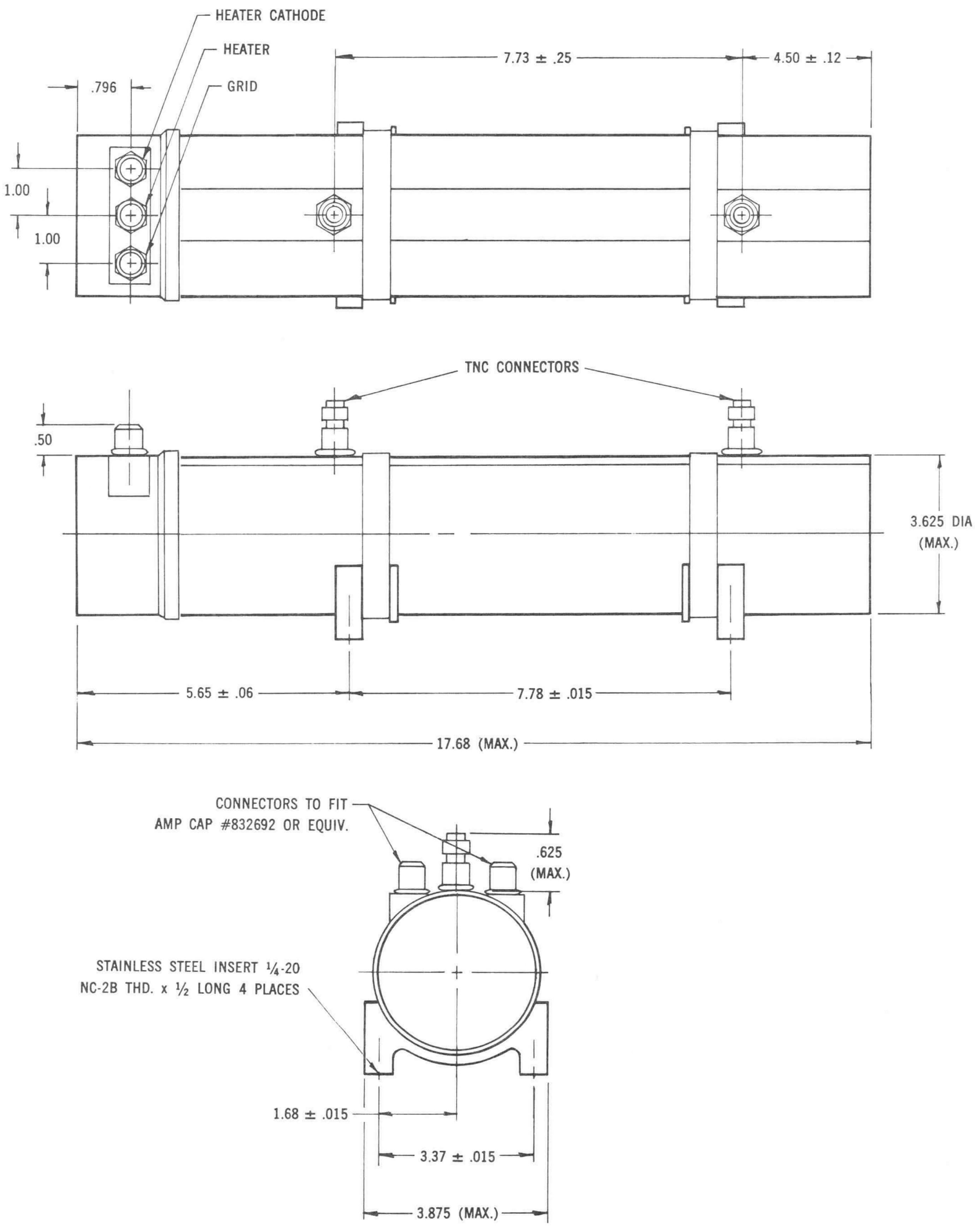
Complies with MIL-5400 Class II Equipment

Temperature	−65° C to +125° C

MECHANICAL SPECIFICATIONS

Operating Position	Any
Input Coupling, rf	TNC
Output Coupling, rf	TNC
Focusing	PPM
Cooling	75 CFM forced air
Dimensions	See outline drawing
Weight	9 lbs.
Supply Connections	Cathode—yellow Filament—brown Grid—green

NOTE: Electrode Voltages are with respect to cathode; tube shell at ground potential.

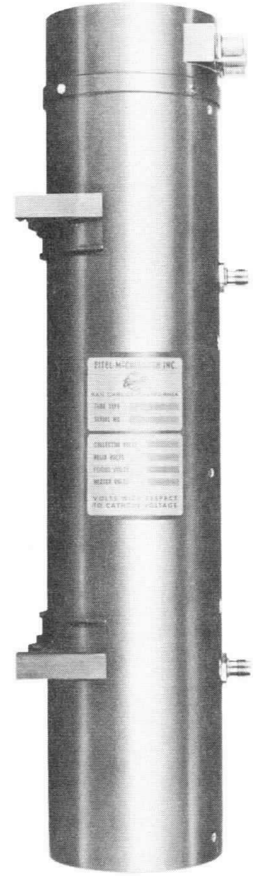

HEATER CATHODE
HEATER
GRID
.796
7.73 ± .25
4.50 ± .12
1.00
1.00
TNC CONNECTORS
.50
3.625 DIA
(MAX.)
5.65 ± .06
7.78 ± .015
17.68 (MAX.)
CONNECTORS TO FIT
AMP CAP #832692 OR EQUIV.
.625
(MAX.)
STAINLESS STEEL INSERT 1/4-20
NC-2B THD. x 1/2 LONG 4 PLACES
1.68 ± .015
3.37 ± .015
3.875 (MAX.)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM 116

TRAVELING WAVE TUBE

The EM116 is a 2% duty cycle TWT providing 1.6 kw of power over the frequency range of 2.9–3.1 Gc. This tube is PPM focused and of metal-ceramic construction for use in stringent environments.



ELECTRICAL SPECIFICATIONS

Absolute Ratings	Maximum
Filament Voltage	7.0 Volts
Pulse Cathode Voltage	−8000 vdc
Peak Cathode Current	2.0 adc
Duty Cycle	2%

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	3.0 Amperes
Cathode Voltage	−7500 Vdc
Peak Cathode Current	1.3 adc
Duty Cycle	2%
Frequency Range	2.9–3.1 Gc
Small Signal Gain—Minimum	36 db
Saturated Power Out—Minimum	1.6 kw
Saturated Gain—Minimum	30 db

ENVIRONMENTAL SPECIFICATIONS

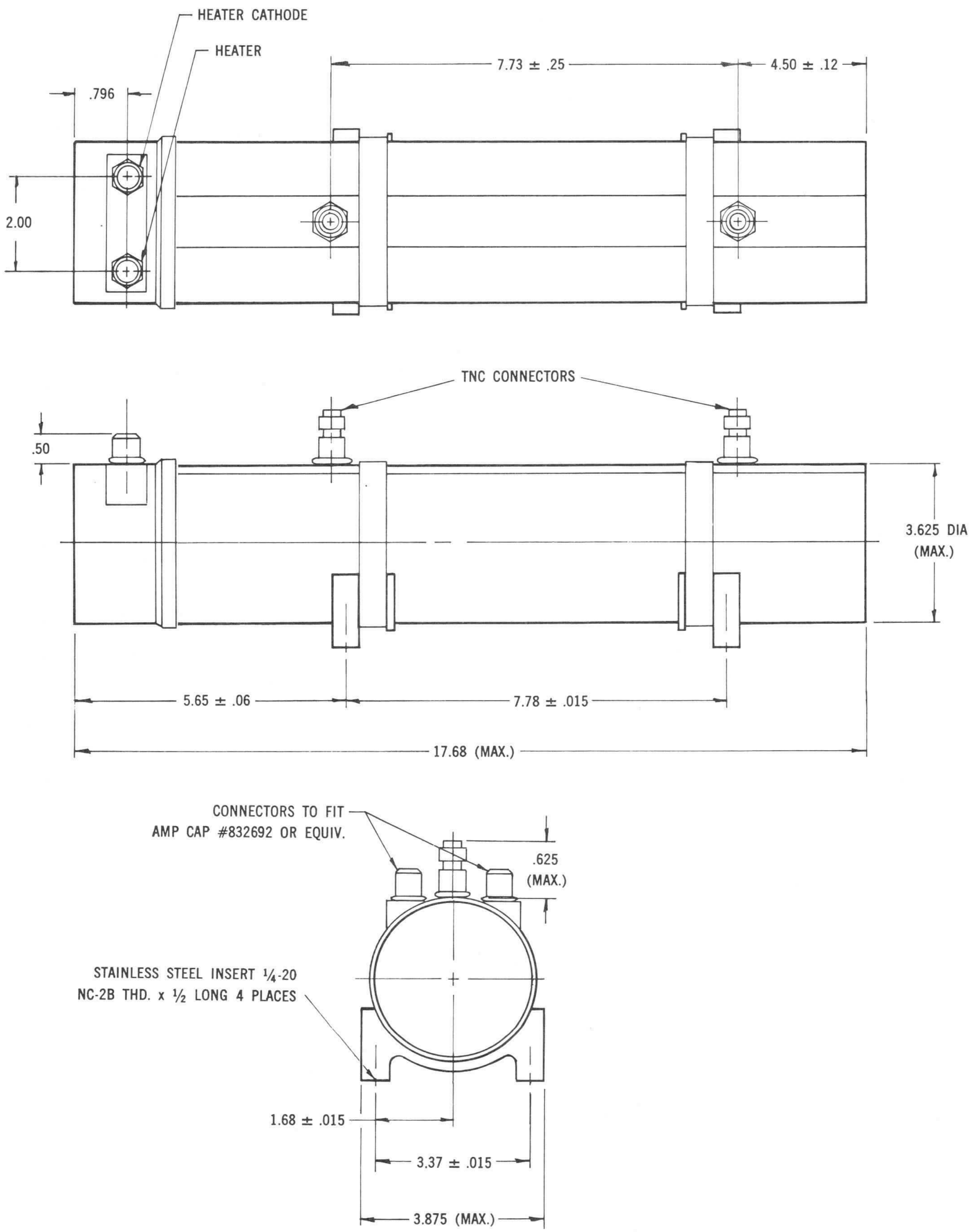
Complies with MIL-5400 Class II Equipment

Temperature	−65° C to +125° C

MECHANICAL SPECIFICATIONS

Operating Position	Any
Input Coupling, rf	TNC
Output Coupling, rf	TNC
Focusing	PPM
Cooling	75 CFM forced air
Dimensions	See outline drawing
Weight	9 lbs.
Supply Connections	Cathode—yellow Filament—brown Grid—green

NOTE: Electrode Voltages are with respect to cathode; tube shell at ground potential.


HEATER CATHODE
HEATER
.796
7.73 ± .25
4.50 ± .12
2.00
TNC CONNECTORS
.50
3.625 DIA
(MAX.)
5.65 ± .06
7.78 ± .015
17.68 (MAX.)
CONNECTORS TO FIT
AMP CAP #832692 OR EQUIV.
.625
(MAX.)
STAINLESS STEEL INSERT 1/4-20
NC-2B THD. x 1/2 LONG 4 PLACES
1.68 ± .015
3.37 ± .015
3.875 (MAX.)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM 118

TRAVELING WAVE TUBE

The EM118 is a medium-power grid pulse TWT suitable for operation in extreme environments. Rated power output of 500 watts is obtained over the frequency range of 2.7–2.9 Gc.

ELECTRICAL SPECIFICATIONS

Absolute Ratings	Maximum
Filament Voltage	7.0 Volts
Cathode Voltage	−5000 Vdc
Peak Cathode Current	1.0 adc
Pulse Grid Voltage	+400, to −150 vdc
Duty Cycle	2%

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	3.0 Amperes
Cathode Voltage	−4700 Vdc
Peak Cathode Current	0.8 adc
Pulse Grid Voltage (Beam on)	+200 Vdc
Pulse Grid Voltage (Beam off)	−90 Vdc
Duty Cycle	2%
Frequency Range	2.7–2.9 Gc
Small Signal Gain—Minimum	46 db
Peak Saturated Power Out—Minimum	500 w
Saturated Gain—Minimum	40 db
Grid Capacitance (to all other elements)	15 picofds.

ENVIRONMENTAL SPECIFICATIONS

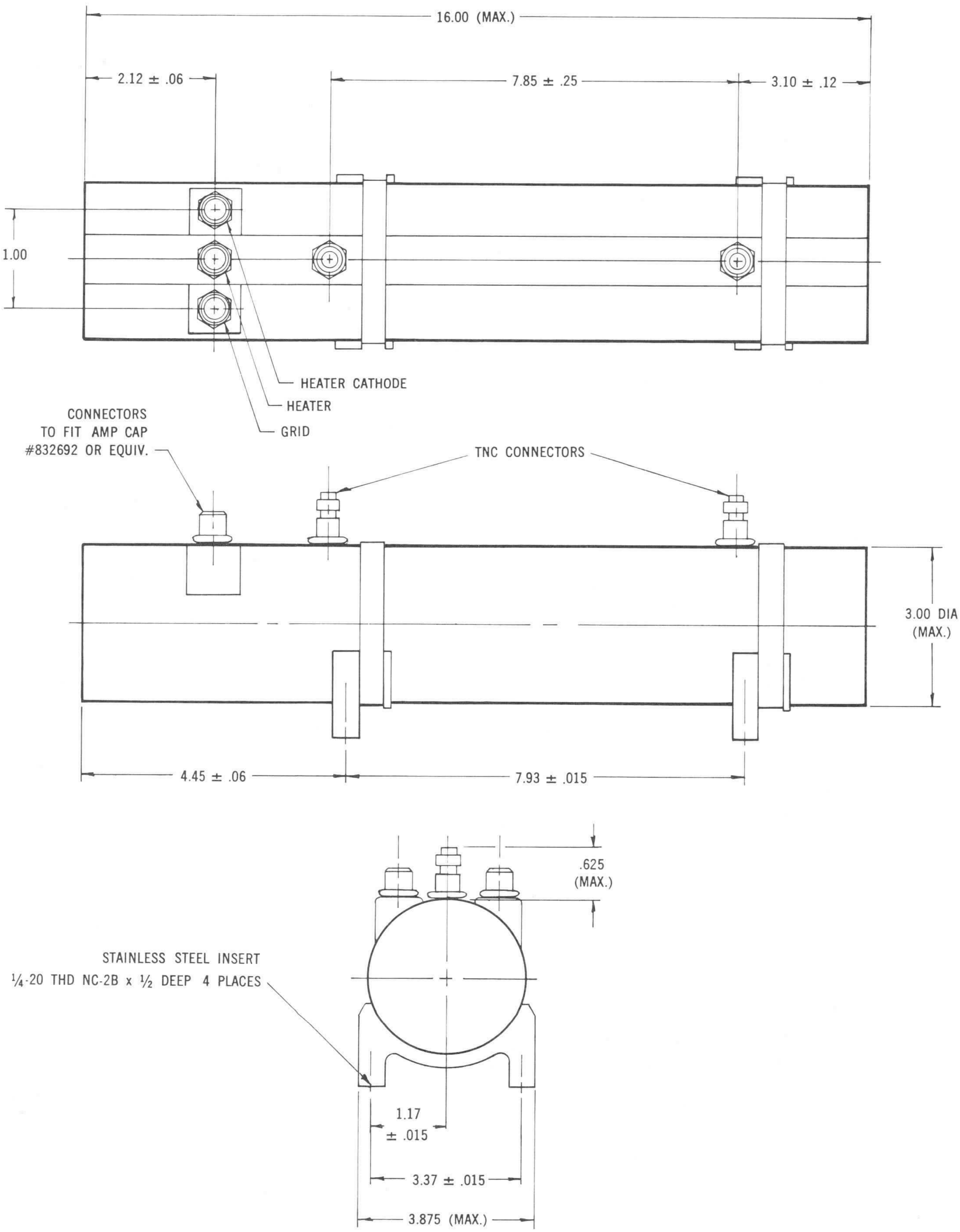
Complies with MIL-5400 Class II Equipment

Temperature	−65° C to +125° C

MECHANICAL SPECIFICATIONS

Operating Position	Any
Input Coupling, rf	TNC
Output Coupling, rf	TNC
Focusing	PPM
Cooling	75 CFM forced air
Dimensions	See outline drawing
Weight	9 lbs.
Supply Connections	Cathode—yellow Filament—brown Grid—green

NOTE: Electrode Voltages are with respect to cathode; tube shell at ground potential.


16.00 (MAX.)
2.12 ± .06
7.85 ± .25
3.10 ± .12
1.00
HEATER CATHODE
HEATER
GRID
CONNECTORS
TO FIT AMP CAP
#832692 OR EQUIV.
TNC CONNECTORS
3.00 DIA
(MAX.)
4.45 ± .06
7.93 ± .015
.625
(MAX.)
STAINLESS STEEL INSERT
¼-20 THD NC-2B x ½ DEEP 4 PLACES
1.17
± .015
3.37 ± .015
3.875 (MAX.)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

8198
EM-778

TRAVELING WAVE TUBE
5.0 to 11.0 Gc.
1 Watt Min.
60 db Gain

TENTATIVE DATA FOR EIMAC EM-778 TRAVELING WAVE TUBE

The Eimac 8198/EM-778 is a ruggedized, ceramic and metal, periodic permanent magnet focused, power-amplifier traveling wave tube. It is capable of delivering a minimum CW output power of one watt throughout the frequency range of 5.0 to 11.0 gigacycles with a nominal small signal gain of 60 decibels. The 8198/EM-778 is designed to operate under severe environmental extremes of shock, vibration, temperature and altitude such as encountered in airborne applications.

The use of temperature compensated permanent magnets allows the 8198/EM-778 to be operated over a wide temperature range without degradation of performance. Flexible leads provide electrical connections to the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	−50 dbm
Minimum Saturated Output Power	1 watt
Frequency Range	5.0 to 11.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	4.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	3000 VOLTS
D-C FOCUS ELECTRODE VOLTAGE*: NEGATIVE WITH RESPECT TO CATHODE	40 VOLTS
D-C CATHODE CURRENT	25 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	5.0 to 11.0 gigacycles
Minimum Output Power	1.0 watt
Small Signal Gain	60 decibels
D-C Beam Voltage*	2900 volts
D-C Cathode Current	23 milliamperes
D-C Focus Electrode Voltage*	–30 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-778 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-778 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

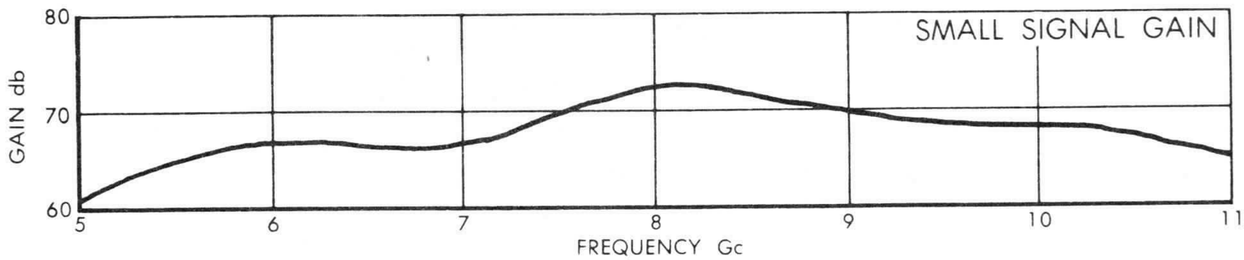
Temperature: –54°C to + 85°C

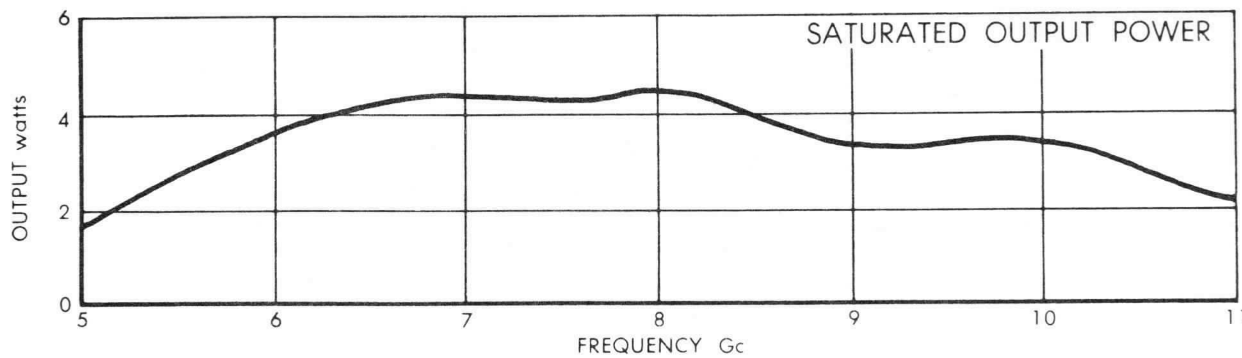
Altitude: 70,000 ft.

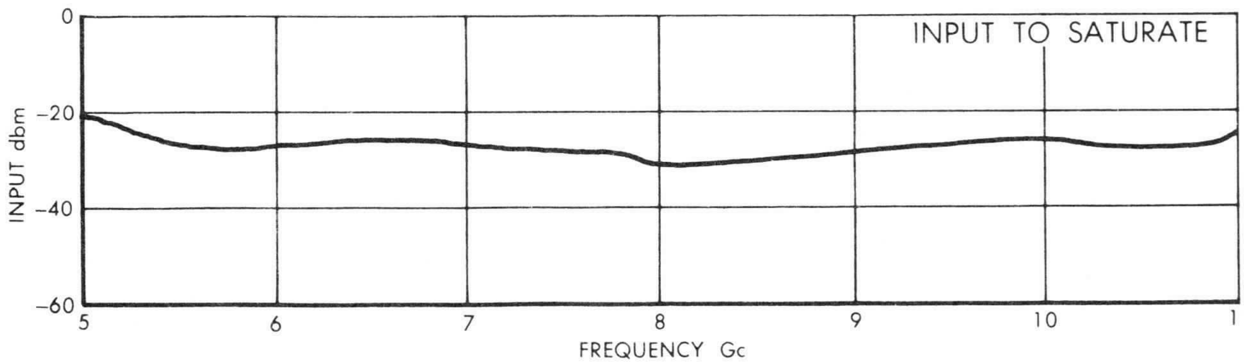
NOTE: This data should not be used for final equipment design.

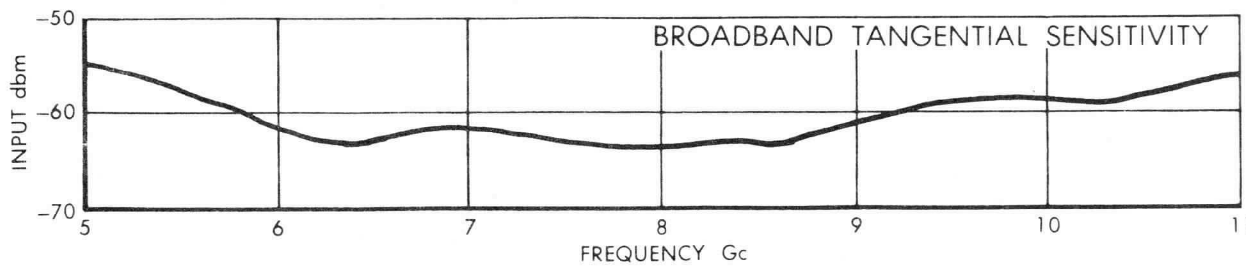
EM-778 TYPICAL OPERATING CHARACTERISTICS

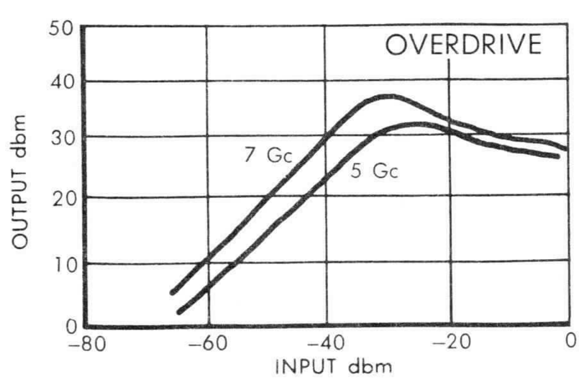
ANODE VOLTAGE	2900 Vdc	FOCUS VOLTAGE	−30 V dc
CATHODE CURRENT	23 mAdc	FILAMENT VOLTAGE	6.3 Vac

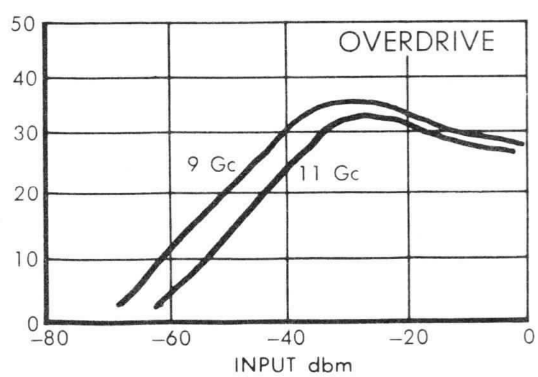








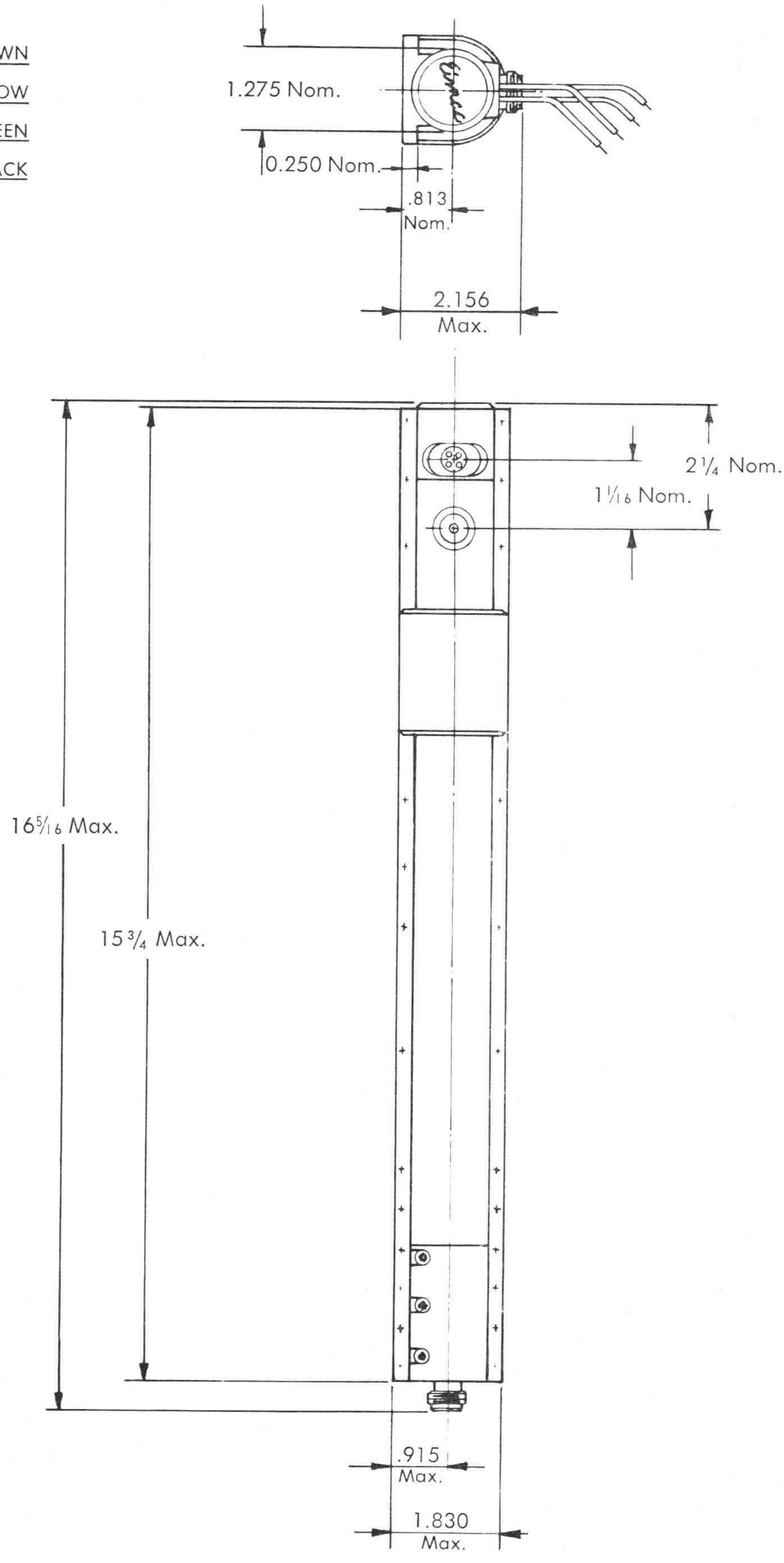




EM-778

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

EM-779

TRAVELING WAVE TUBE
5.0 to 11.0 Gc.
1 Watt Minimum
30 db Gain

TENTATIVE DATA FOR EIMAC EM-779 TRAVELING WAVE TUBE

The Eimac EM-779 is a ruggedized, ceramic and metal, periodic permanent magnet focused, power-amplifier traveling wave tube. It is capable of delivering a minimum CW output power of one watt throughout the frequency range of 5.0 to 11.0 Gigacycles with a nominal small signal gain of 30 decibels. The EM-779 is designed to operate under severe environmental extremes of shock, vibration, temperature and altitude such as encountered in airborne applications.

The use of temperature compensated permanent magnets allows the EM-779 to be operated over a wide temperature range without degradation of performance. Flexible leads provide electrical connections to the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Saturated Output Power	1 watt
Frequency Range	5.0 to 11.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	2.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	3000 VOLTS
D-C FOCUS ELECTRODE VOLTAGE*: NEGATIVE WITH RESPECT TO CATHODE	40 VOLTS
D-C CATHODE CURRENT	25 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	5.0 to 11.0 gigacycles
Minimum Output Power	1.0 watts
Small Signal Gain	30 decibels
D-C Beam Voltage*	2950 volts
D-C Cathode Current	23 milliamperes
D-C Focus Electrode Voltage*	–30 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-779 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-779 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

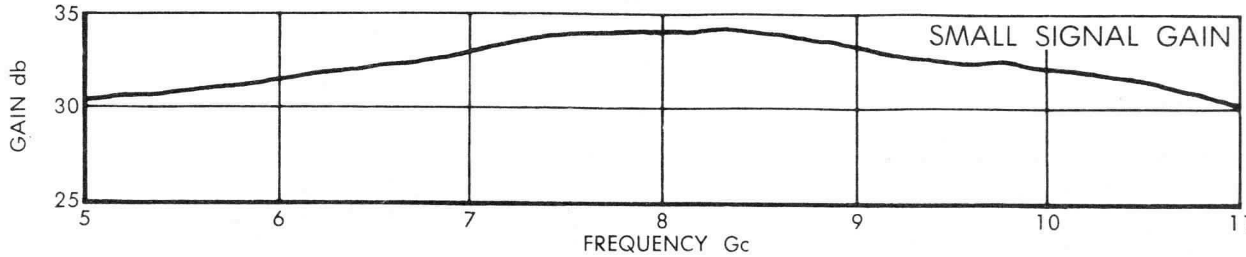
Temperature: –54°C to + 85°C

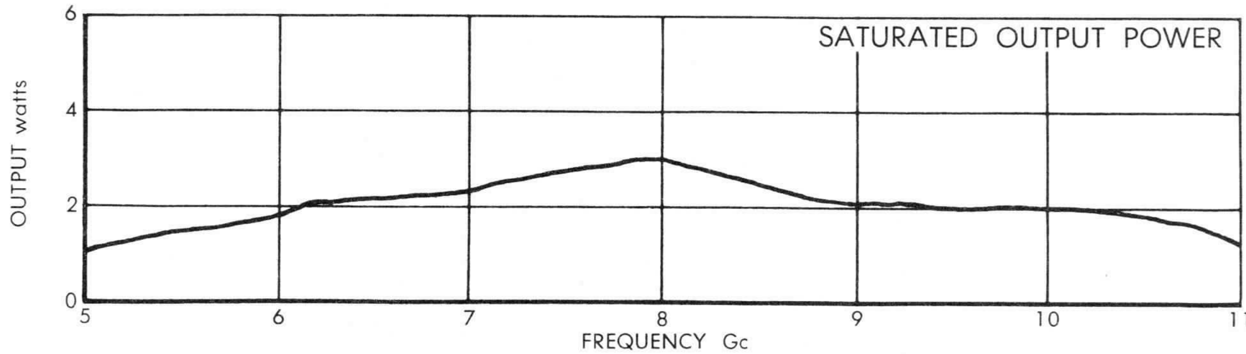
Altitude: 70,000 ft.

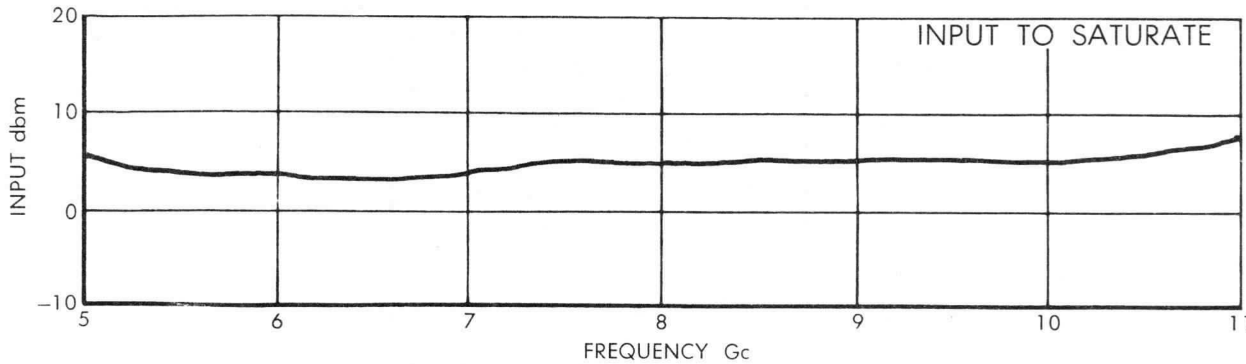
NOTE: This data should not be used for final equipment design.

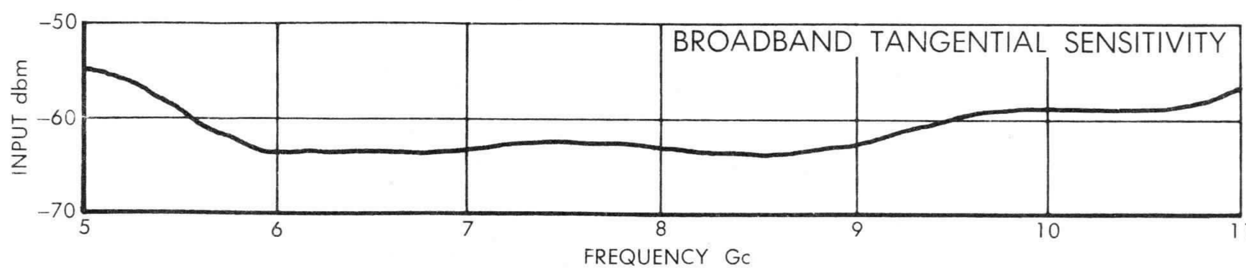
EM-779 TYPICAL OPERATING CHARACTERISTICS

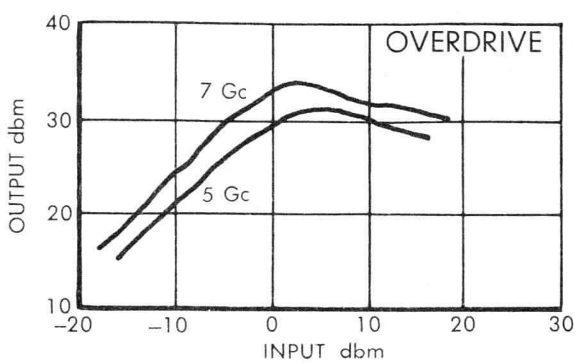
ANODE VOLTAGE	2950 Vdc	FOCUS VOLTAGE	−30 Vdc
CATHODE CURRENT	23 mAdc	FILAMENT VOLTAGE	6.3 Vac

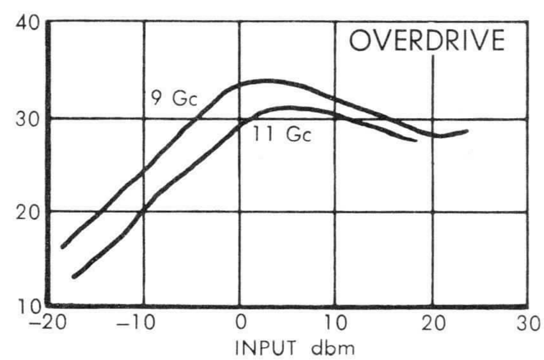








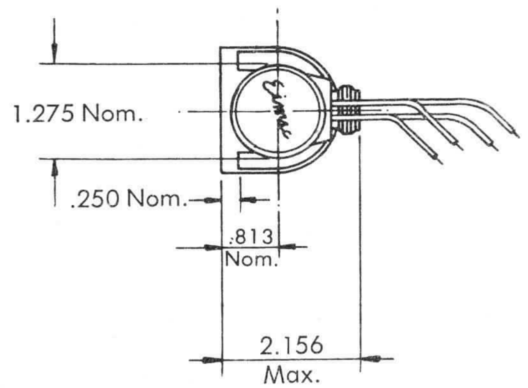


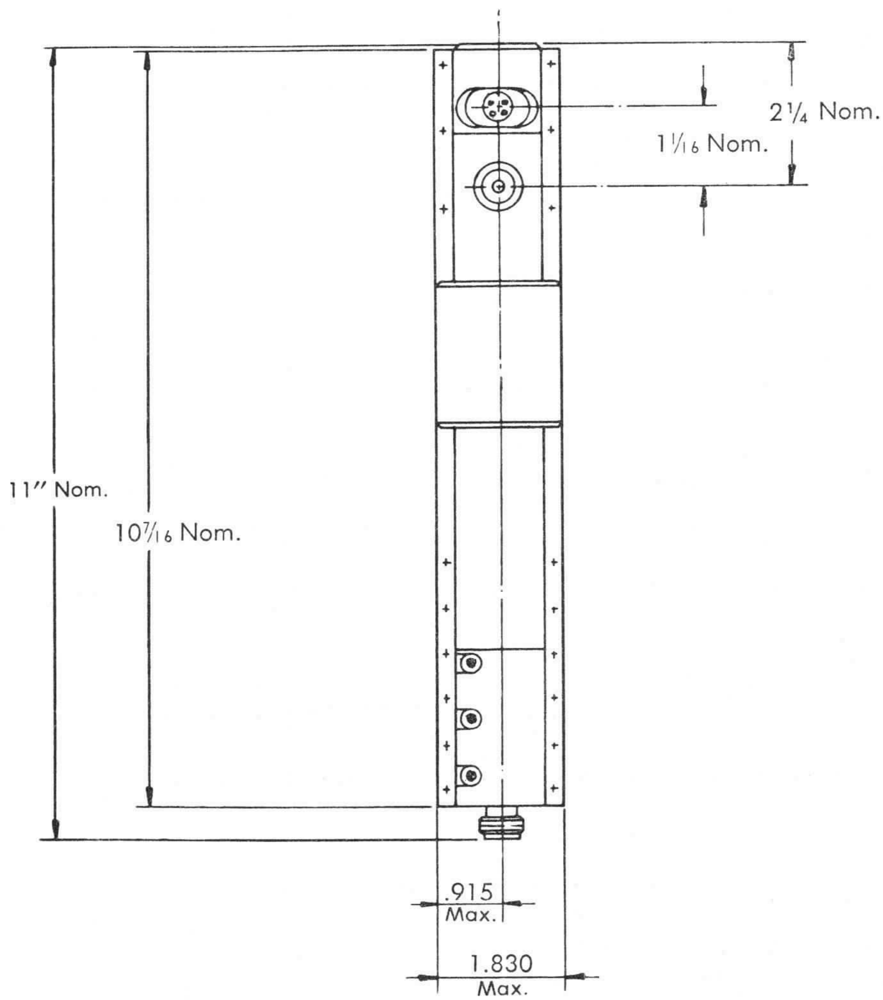


EM-779

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA
EM-1011
TRAVELING WAVE TUBE
4.0 to 8.0 Gc.
1 Watt Min.
30 db Gain

TENTATIVE DATA FOR EIMAC EM-1011 TRAVELING WAVE TUBE

The Eimac EM-1011 is an intermediate-power traveling wave tube amplifier designed to operate in the 4.0 to 8.0 Gc frequency range. The EM-1011 will provide a minimum saturated power output of 1 watt over this frequency range with a nominal small signal gain of 30 db.

The EM-1011 features rugged ceramic and metal construction and focusing is provided by built-in periodic permanent magnets. These magnets are fully temperature compensated to allow operation from −55°C to + 85°C. No additional cooling is required at these temperatures due to the integral heat sink/mounting flange supplied with the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Saturated Output Power	1 watt
Frequency Range	4.0 to 8.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	2.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	2600 VOLTS
D-C FOCUS ELECTRODE VOLTAGE*: NEGATIVE WITH RESPECT TO CATHODE	40 VOLTS
D-C CATHODE CURRENT	30 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	4.0 to 8.0 gigacycles
Minimum Output Power	1.0 watt
Small Signal Gain	30 decibels
D-C Beam Voltage*	2550 volts
D-C Cathode Current	28 milliamperes
D-C Focus Electrode Voltage*	–30 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-1011 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-1011 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

Temperature: –54°C to + 85°C

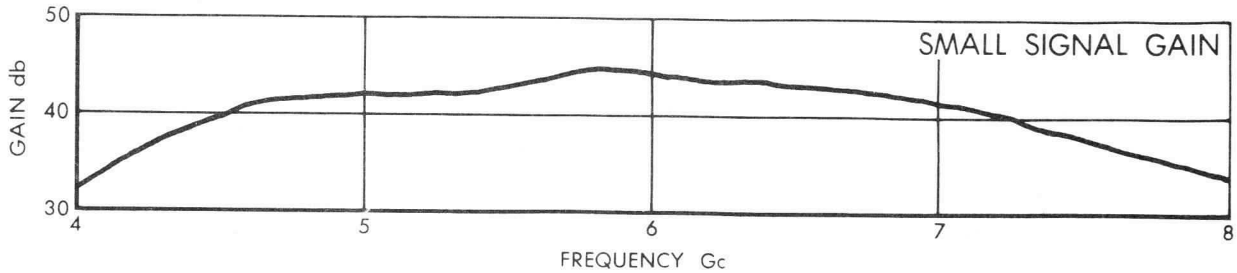
Altitude: 70,000 ft.

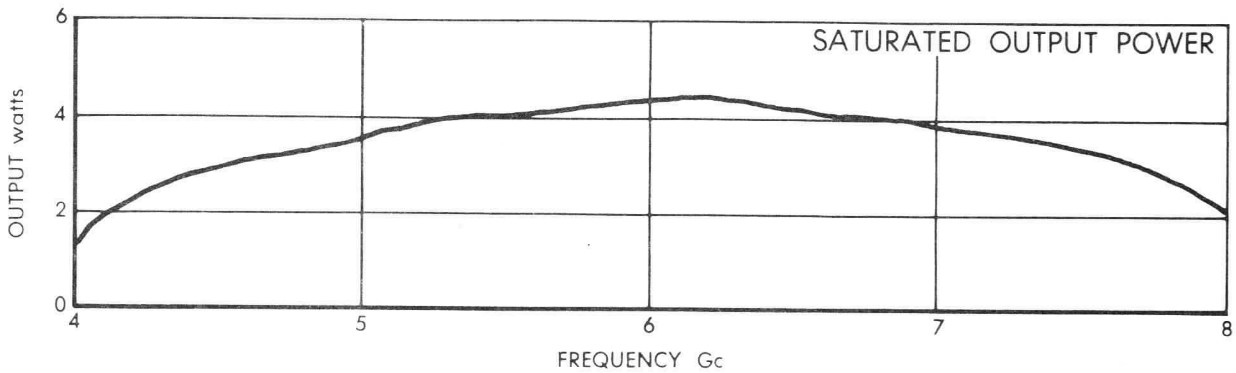
NOTE: This data should not be used for final equipment design.

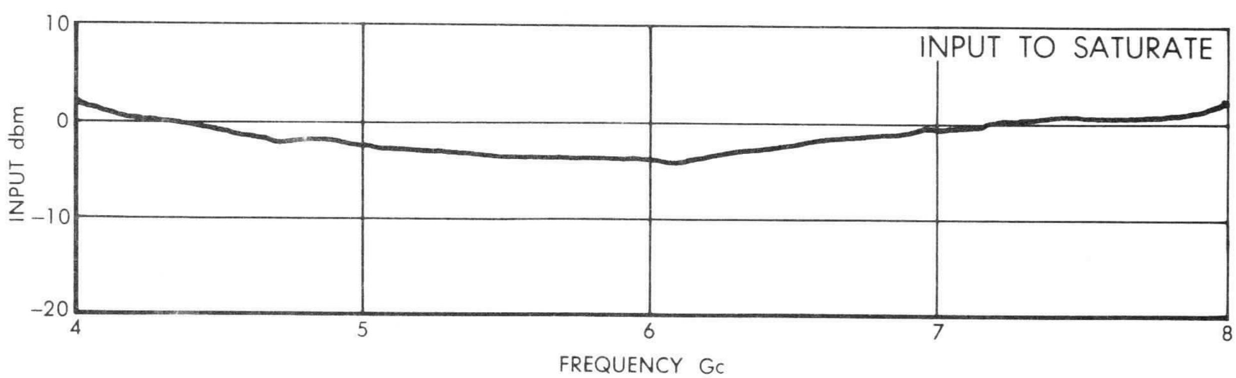
EM-1011 TYPICAL OPERATING CHARACTERISTICS

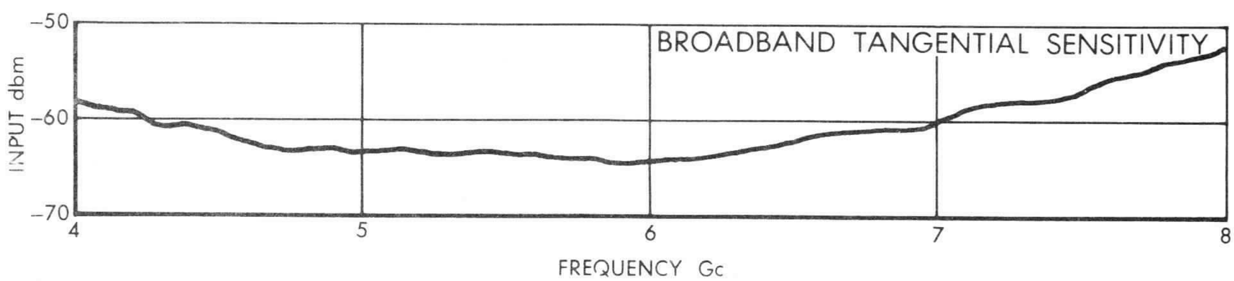
ANODE VOLTAGE 2550 Vdc   FOCUS VOLTAGE −30 Vdc

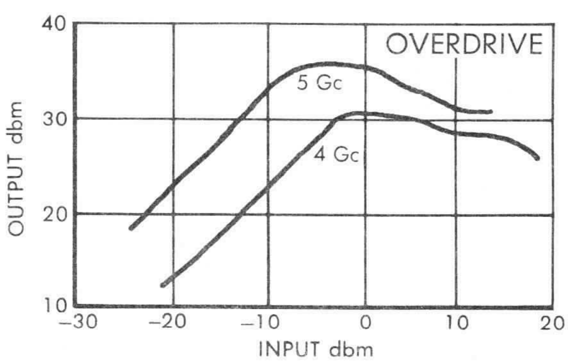
CATHODE CURRENT 28 mAdc   FILAMENT VOLTAGE 6.3 Vac

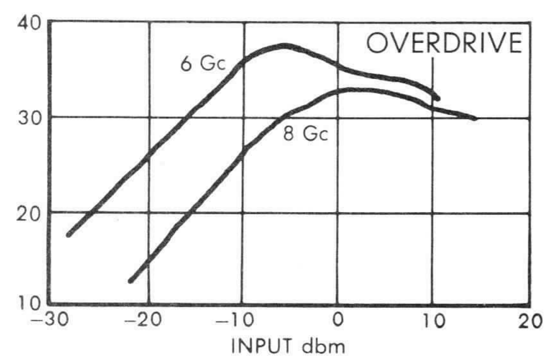








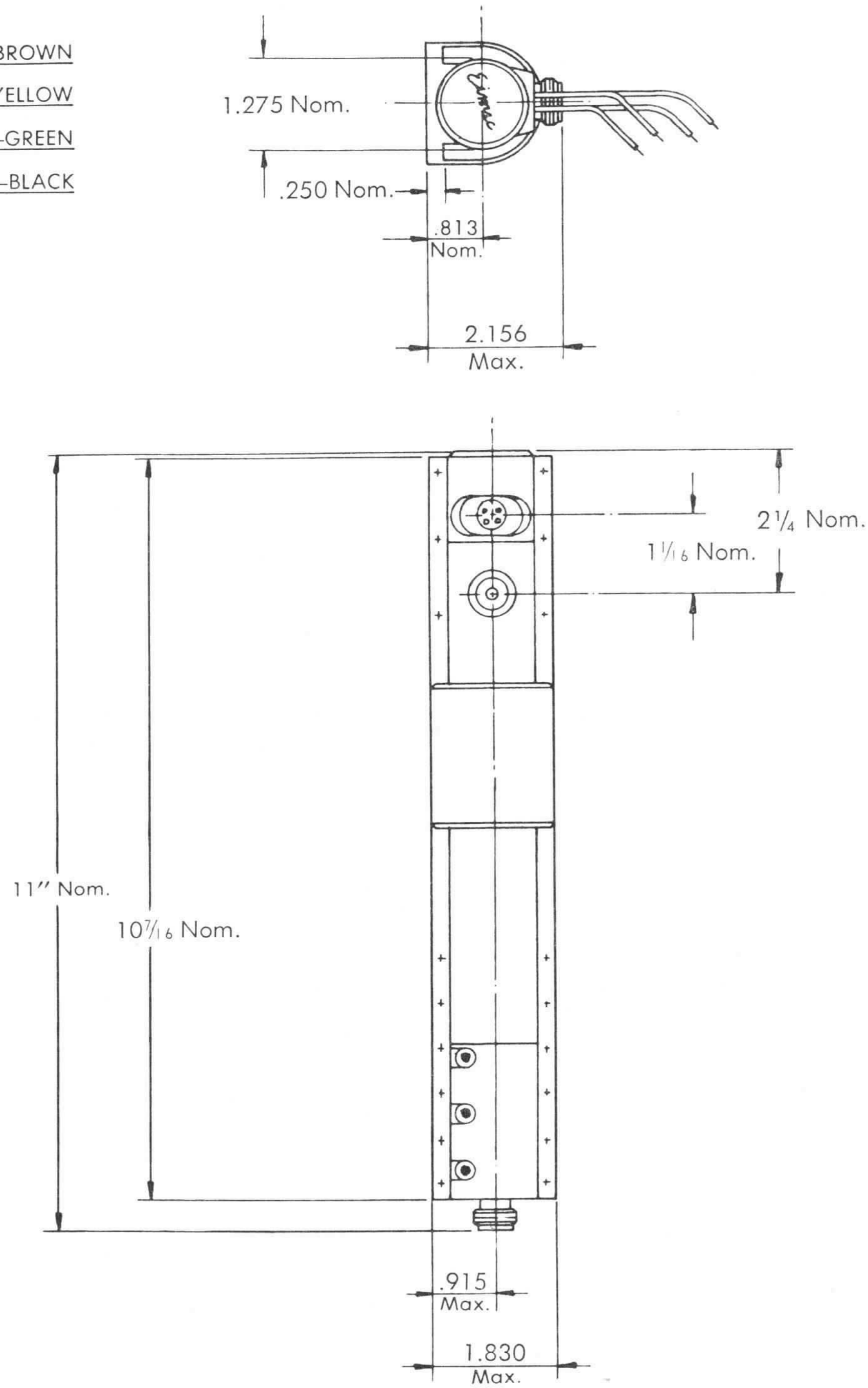




EM-1011

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

EM-1016

TRAVELING WAVE TUBE
4.0 to 8.0 Gc.
3 Watts Min.
30 db Gain

TENTATIVE DATA FOR EIMAC EM-1016 TRAVELING WAVE TUBE

The Eimac EM-1016 is an intermediate-power traveling wave tube amplifier designed to operate in the 4.0 to 8.0 Gc frequency range. The EM-1016 will provide a minimum saturated power output of 3 watts over this frequency range with a nominal small signal gain of 30 db.

The EM-1016 features rugged ceramic and metal construction and focusing is provided by built-in periodic permanent magnets. These magnets are fully temperature compensated to allow operation from –55°C to + 85°C. No additional cooling is required at these temperatures due to the integral heat sink/mounting flange supplied with the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	–50 dbm
Minimum Saturated Output Power	3 watts
Frequency Range	4.0 to 8.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	2.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	2600 VOLTS
D-C FOCUS ELECTRODE VOLTAGE:*	
NEGATIVE WITH RESPECT TO CATHODE	50 VOLTS
D-C CATHODE CURRENT	40 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	4.0 to 8.0 gigacycles
Minimum Output Power	3.0 watts
Small Signal Gain	30 decibels
D-C Beam Voltage*	2550 volts
D-C Cathode Current	35 milliamperes
D-C Focus Electrode Voltage*	–40 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-1016 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-1016 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

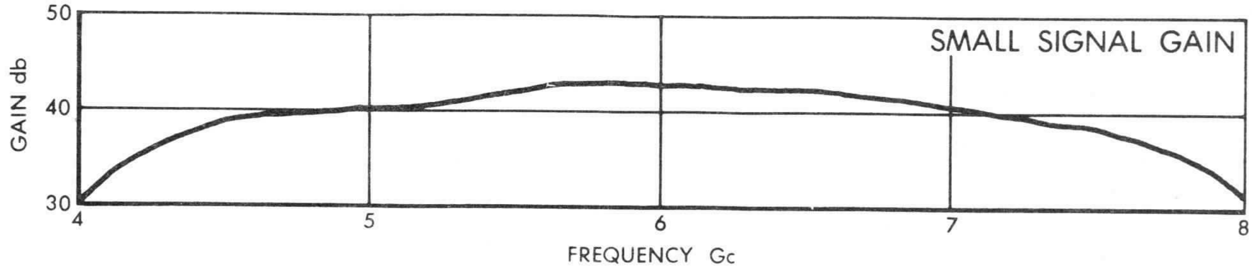
Temperature: –54°C to + 85°C

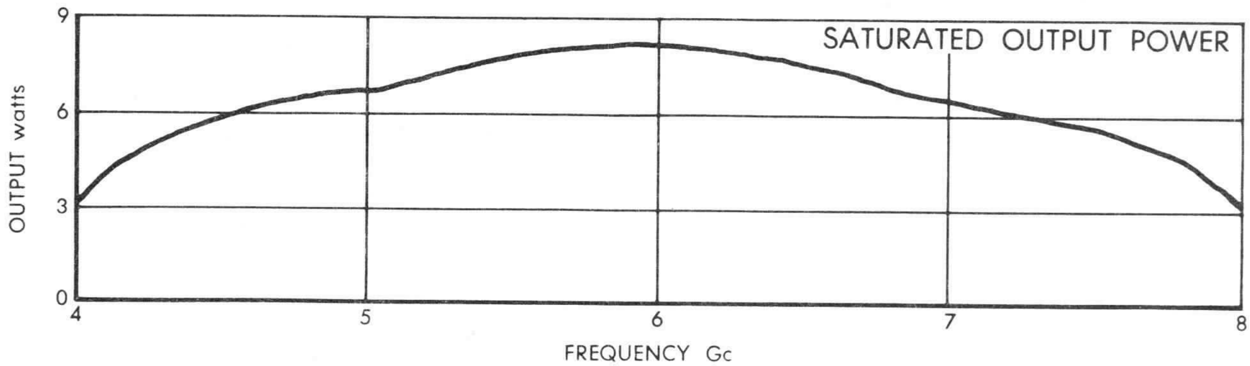
Altitude: 70,000 ft.

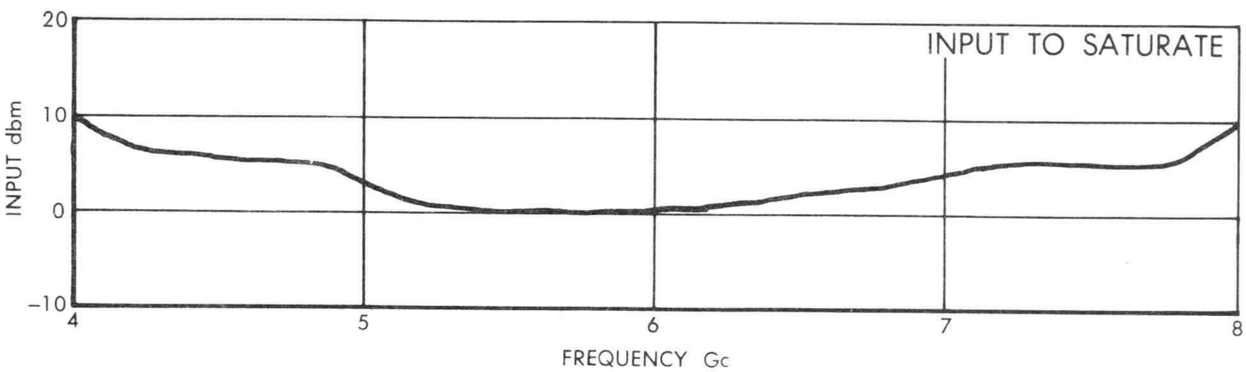
NOTE: This data should not be used for final equipment design.

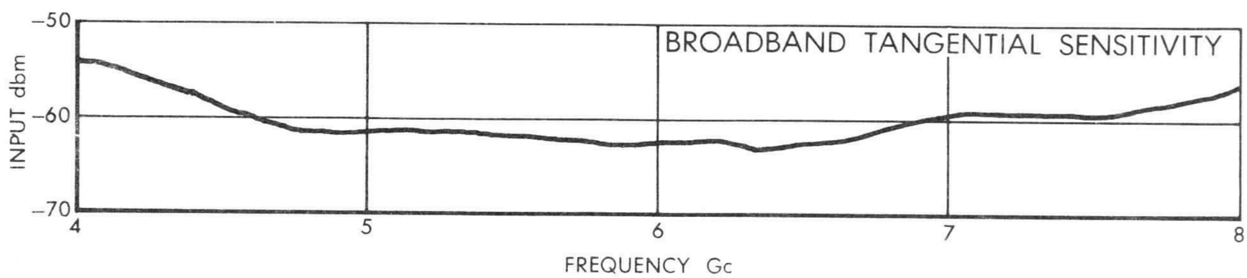
EM-1016 TYPICAL OPERATING CHARACTERISTICS

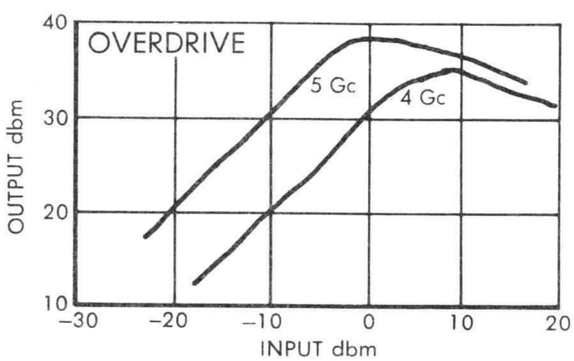
ANODE VOLTAGE	2550 Vdc	FOCUS VOLTAGE	−40 Vdc
CATHODE CURRENT	35 mAdc	FILAMENT VOLTAGE	6.3 V

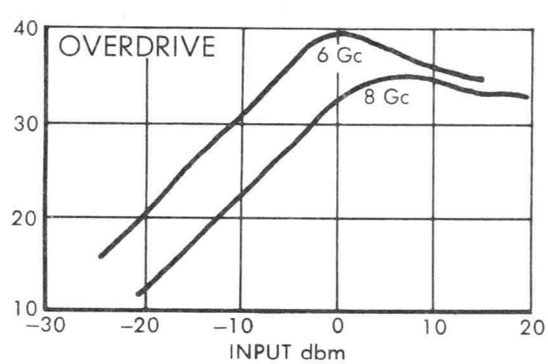








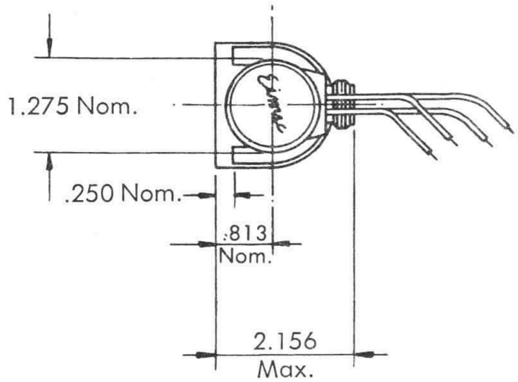


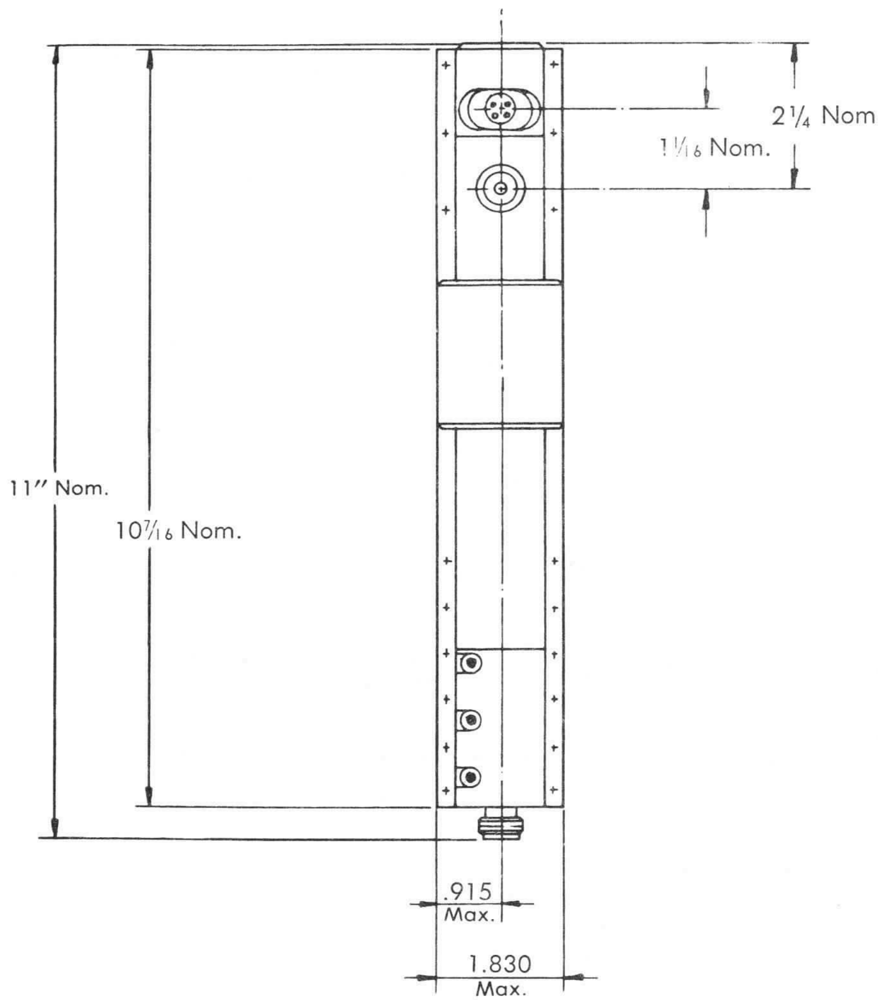


EM-1016

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

EM-1025

TRAVELING WAVE TUBE
4.0 to 12.0 Gc.
1 Watt Min.
40 db Gain

TENTATIVE DATA FOR EIMAC EM-1025 TRAVELING WAVE TUBE

The Eimac EM-1025 now offers performance over a frequency range that previously required **two or more** tubes to duplicate, providing 1 watt saturated power output from 4.0 to 12.0 gigacycles with 40 db gain! This tube is focused by light weight, periodic permanent magnets and utilizes proven ceramic and metal construction to insure reliable operation over a wide range of environments. The integral heat sink/mounting flange allows operation to + 85°C without additional cooling.

APPLICATIONS:

Wide bandwidth, high power output and high gain make the EM-1025 ideally suited for signal generators, power amplifier units or any application where these characteristics are required. In addition, the tube can be adapted to frequency-multiplier applications.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	–50 dbm
Minimum Saturated Output Power	1 watt
Frequency Range	4.0 to 12.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	4.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	3000 VOLTS
D-C FOCUS ELECTRODE VOLTAGE:* NEGATIVE WITH RESPECT TO CATHODE	40 VOLTS
D-C CATHODE CURRENT	25 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	4.0 to 12.0 gigacycles
Minimum Output Power	1.0 watt
Small Signal Gain	40 decibels
D-C Beam Voltage*	2900 volts
D-C Cathode Current	23 milliamperes
D-C Focus Electrode Voltage*	–30 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-1025 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-1025 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

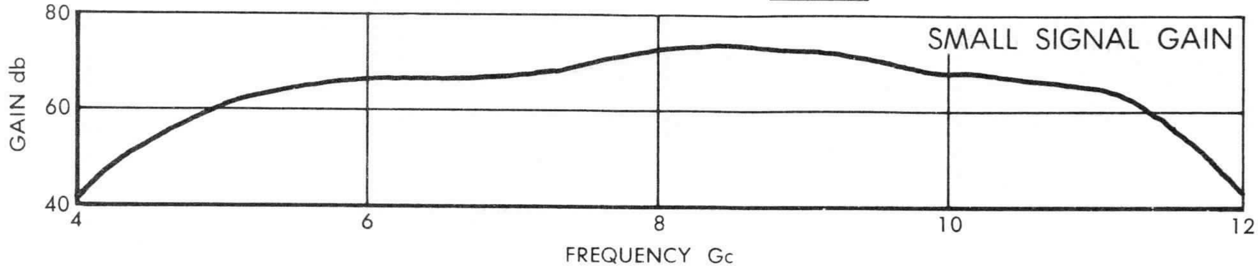
Temperature: –54°C to + 85°C

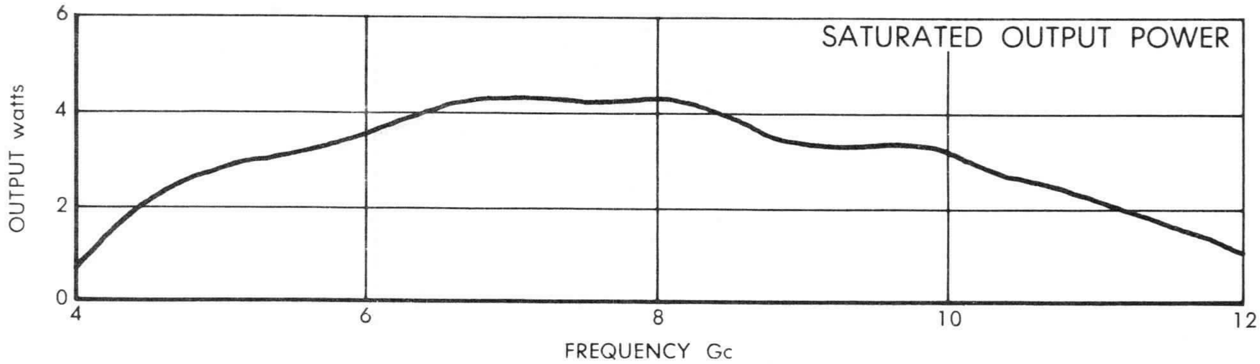
Altitude: 70,000 ft.

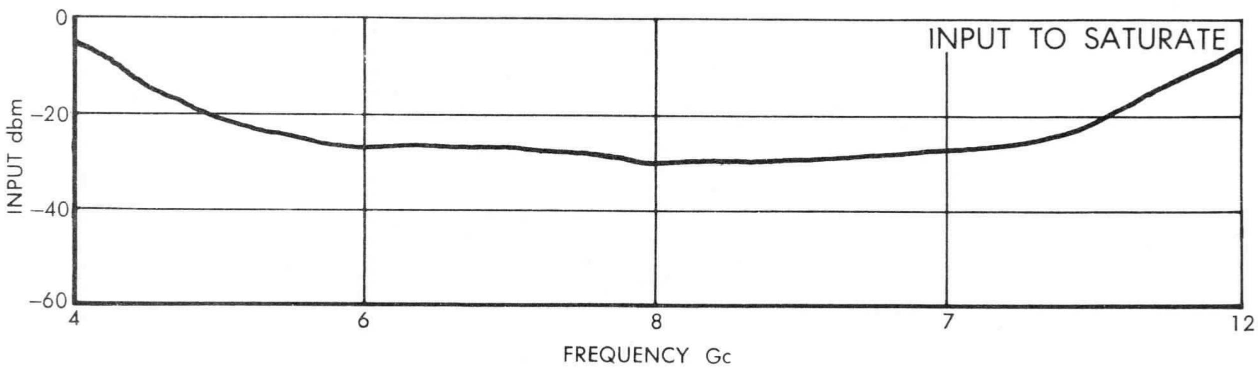
NOTE: This data should not be used for final equipment design.

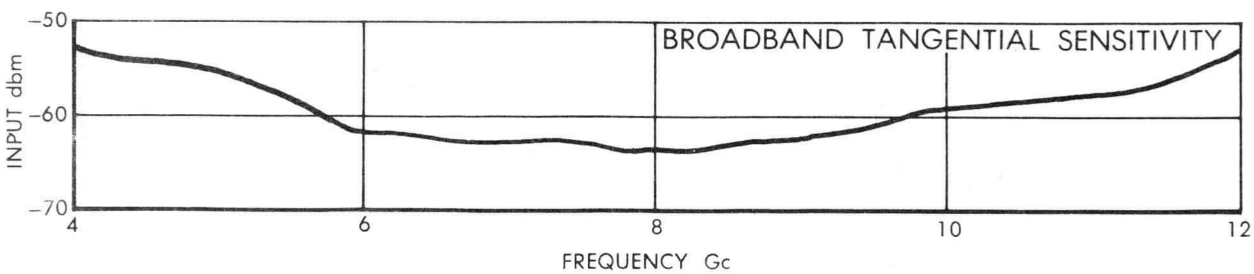
EM-1025 TYPICAL OPERATING CHARACTERISTICS

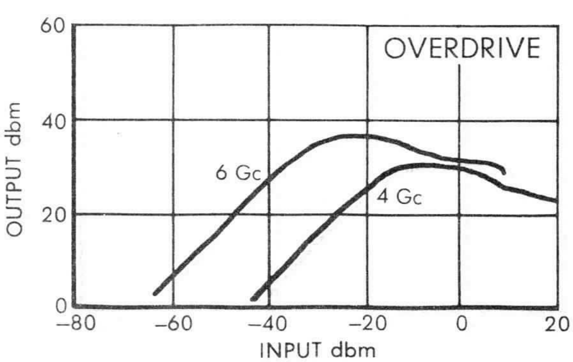
ANODE VOLTAGE	2900 Vdc	FOCUS VOLTAGE	−30 Vdc
CATHODE CURRENT	23 mAdc	FILAMENT VOLTAGE	6.3 V

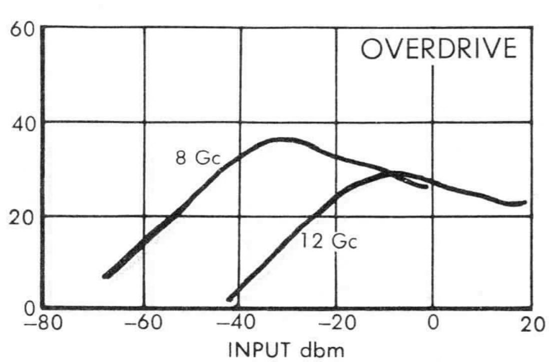








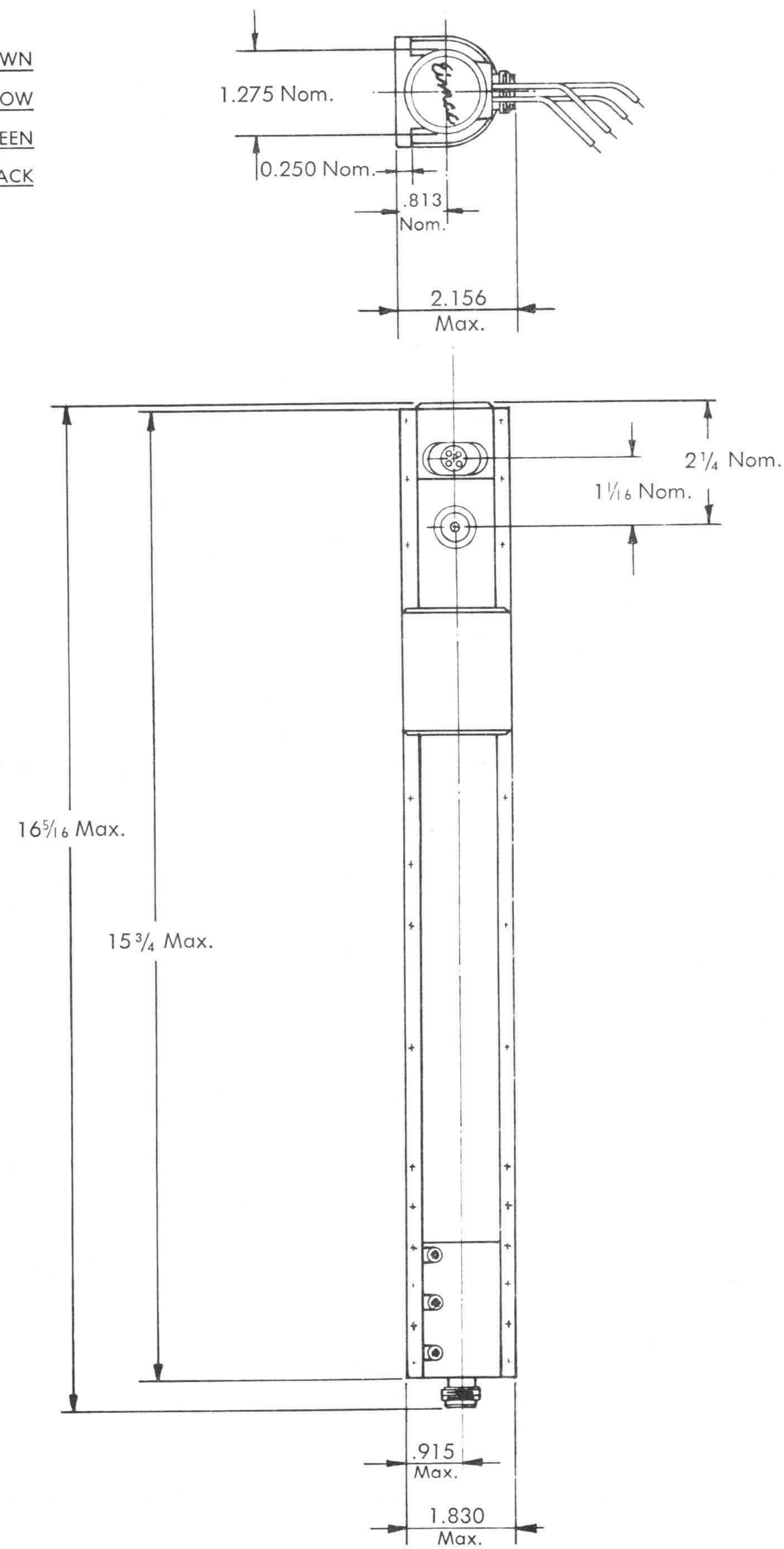




EM-1025

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA
EM-1031
TRAVELING WAVE TUBE
7.0 to 11.0 Gc.
5 Watts Min.
30 db Gain

TENTATIVE DATA FOR EIMAC EM-1031 TRAVELING WAVE TUBE

The Eimac EM-1031 is a very rugged, light weight power-amplifier traveling wave tube designed to operate under severe environmental extremes of shock, vibration, altitude and temperature. The EM-1031 utilizes ceramic and metal construction and is focused by a fully temperature-compensated periodic permanent magnet array. This tube will provide a minimum output power of 5 watts CW over the frequency range of 7.0 to 11.0 Gc with a nominal small signal gain of 30 db.

The integral heat sink/mounting flange allows operation to ambient temperatures of + 85°C without additional cooling. Flexible leads provide electrical connections to the tube. The integral heat sink/mounting flange permits this high temperature operation without additional cooling required for most applications.

APPLICATIONS:

Wide bandwidth, high power output and high gain make the EM-1031 ideally suited for radar augmentation or ECM applications in high performance aircraft or missile systems.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	−50 dbm
Minimum Saturated Output Power	5 watts
Frequency Range	7.0 to 11.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	4.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	3400 VOLTS
D-C FOCUS ELECTRODE VOLTAGE:* NEGATIVE WITH RESPECT TO CATHODE	40 VOLTS
D-C CATHODE CURRENT	40 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	7.0 to 11.0 gigacycles
Minimum Output Power	5.0 watts
Small Signal Gain	30 decibels
D-C Beam Voltage*	3350 volts
D-C Cathode Current	34 milliamperes
D-C Focus Electrode Voltage*	–30 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-1031 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

The EM-1031 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

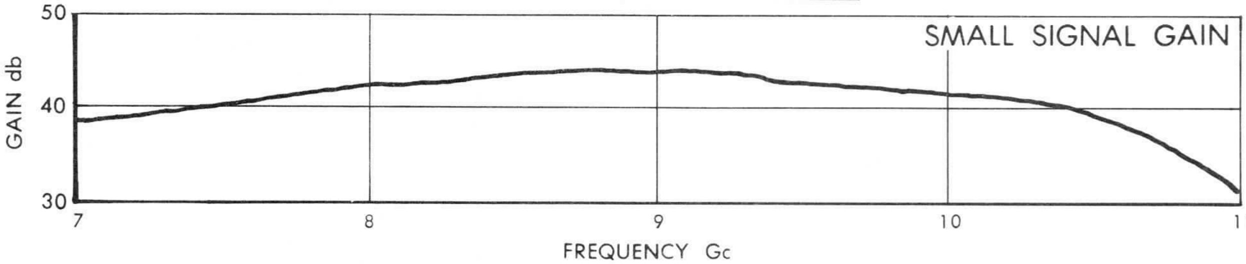
Temperature: –54°C to + 85°C

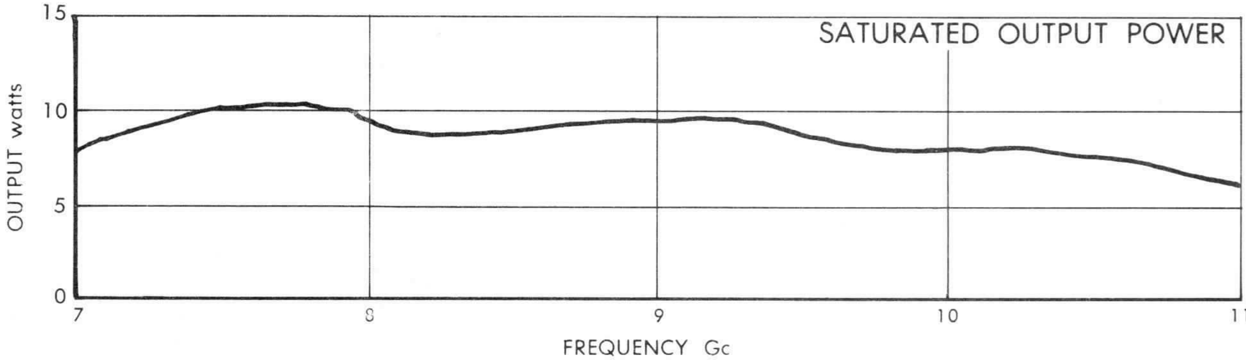
Altitude: 70,000 ft.

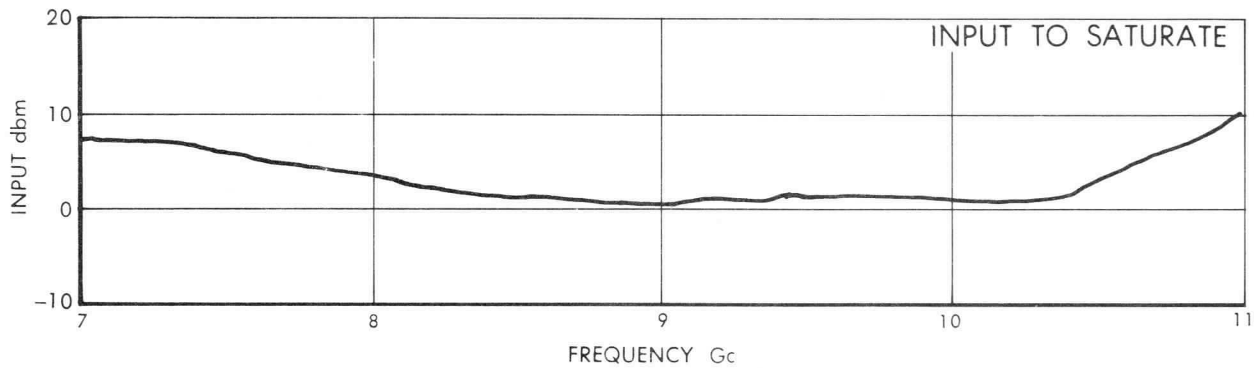
NOTE: This data should not be used for final equipment design.

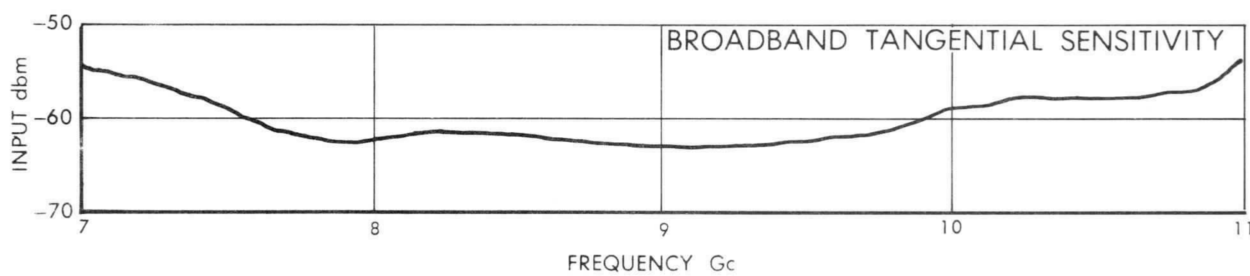
EM-1031 TYPICAL OPERATING CHARACTERISTICS

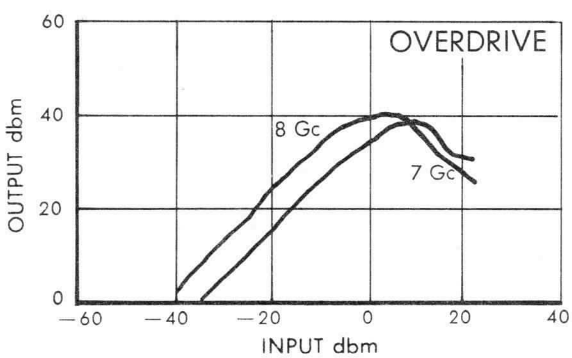
ANODE VOLTAGE 3350 Vdc
CATHODE CURRENT 34 mAdc
FOCUS VOLTAGE −30 Vdc
FILAMENT VOLTAGE 6.3 V

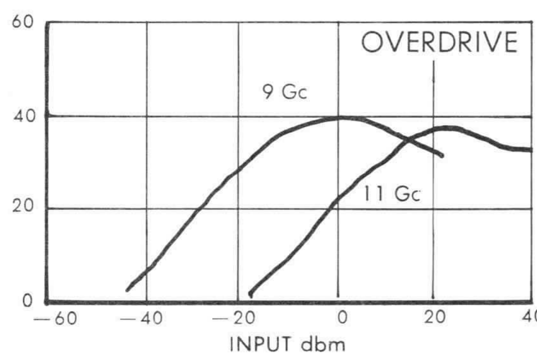








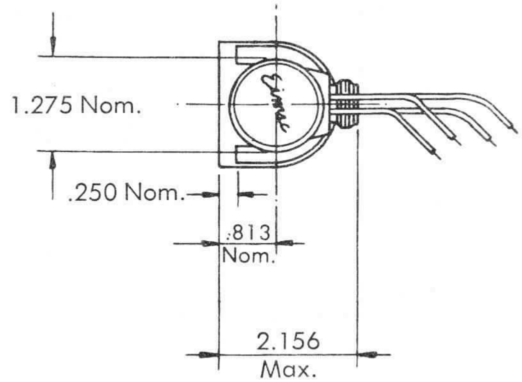


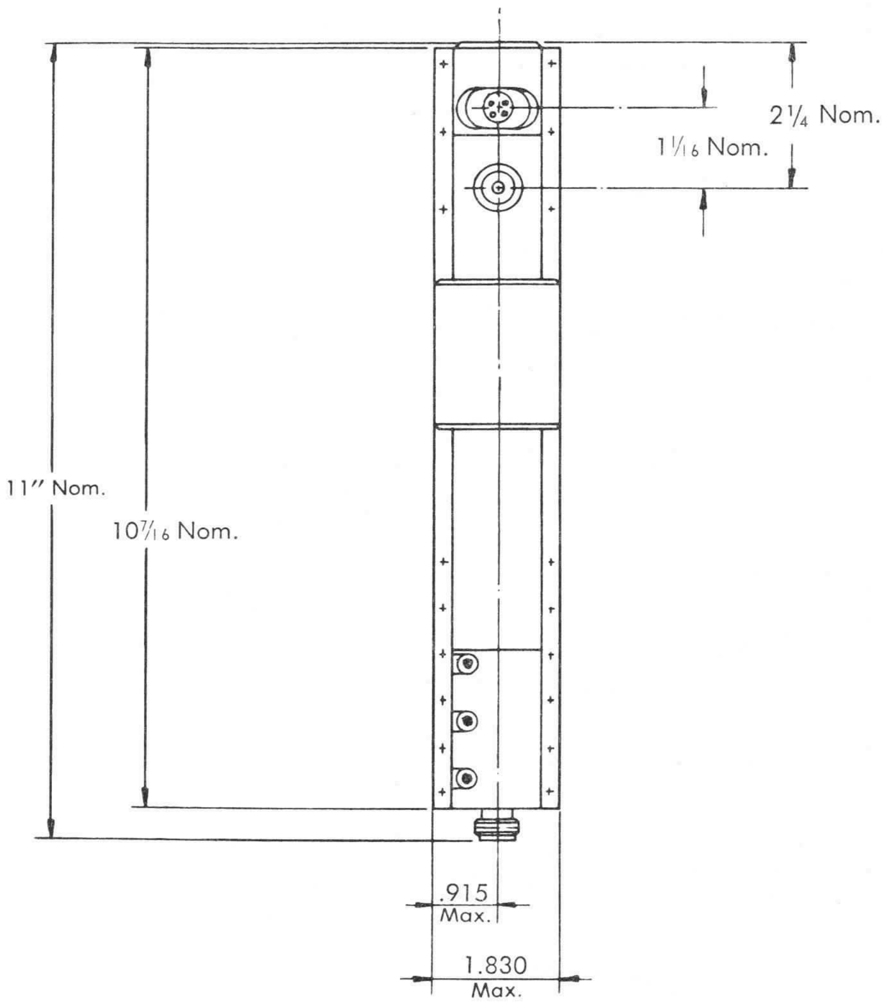


EM-1031

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK





Eimac®

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

Tentative Data

EM1046

TRAVELING WAVE TUBE

8.0 to 12.0 GHz
1 Watt Min.
30 db Gain

TENTATIVE DATA FOR EIMAC EM1046 TRAVELING WAVE TUBE

The EIMAC EM1046 is a ruggedized, ceramic and metal, periodic permanent magnet focused, power-amplifier traveling wave tube. It is capable of delivering a minimum CW output power of 1 watt throughout the frequency range of 8.0 to 12.0 gigahertz with a nominal small signal gain of 30 decibels. The EM1046 is designed to operate under severe environmental extremes of shock, vibration, temperature and altitude such as encountered in airborne applications.

The use of temperature compensated permanent magnets allows the EM1046 to be operated over a wide temperature range without degradation of performance. Flexible leads provide electrical connections to the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater: Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	—50 dbm
Minimum Saturated Output Power	1 watt
Frequency Range	8.0 to 12.0 gigahertz
Input and Output Impedence	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	2.5 Pounds

MAXIMUM RATINGS

DC Beam Voltage*	3000 volts
DC Focus Electrode Voltage*: Negative with respect to Cathode	40 volts
DC Cathode Current	25 milliamperes

Printed in U.S.A.

TYPICAL OPERATING CHARACTERISTICS

Frequency	8.0 to 12.0 gigahertz
Minimum Output Power	1.0 watt
Small Signal Gain	30 decibels
DC Beam Voltage*	2950 volts
DC Cathode Current	23 milliamperes
DC Focus Electrode Voltage*	—30 volts
DC Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM1046 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ±5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ±1 per cent to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ±2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, Calif.

ENVIRONMENTAL

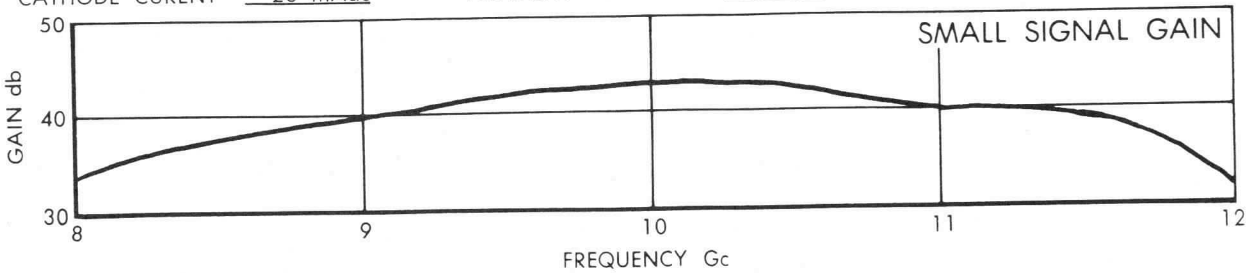
The EM1046 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

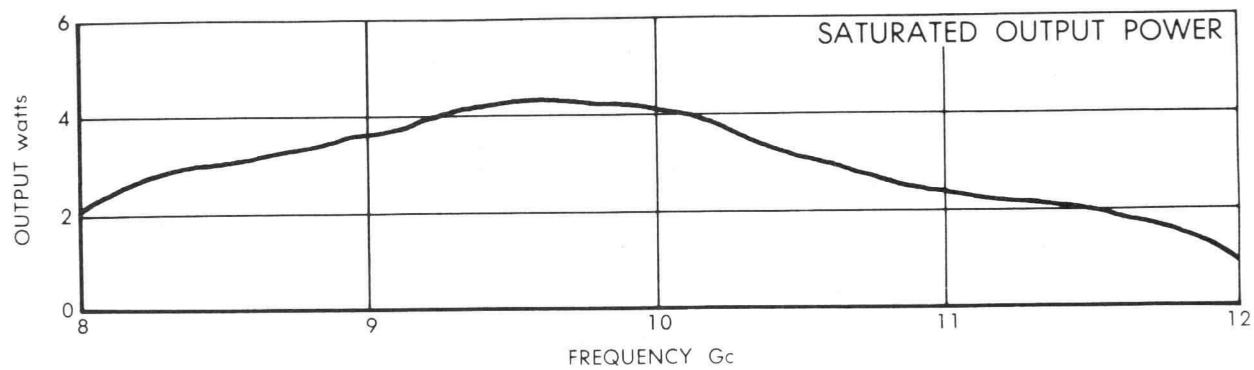
Vibration	10 g to 2000 Hz (Curve A of Proc. XII, MIL-E-5272C)
Shock	25 g, 11 ±1 ms
Acceleration	Sustained, 25 g's
Temperature	–54°C to +85°C
Altitude	70,000 ft.

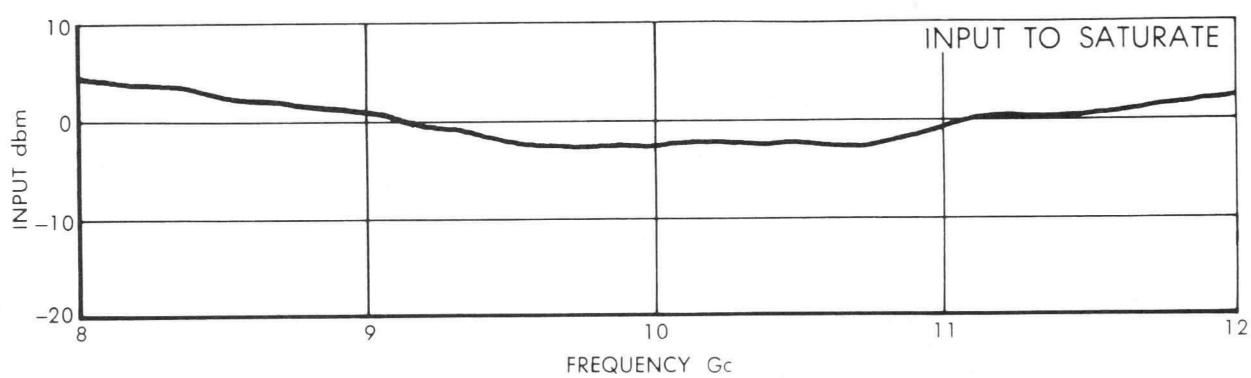
Note: This data should not be used for final equipment design.

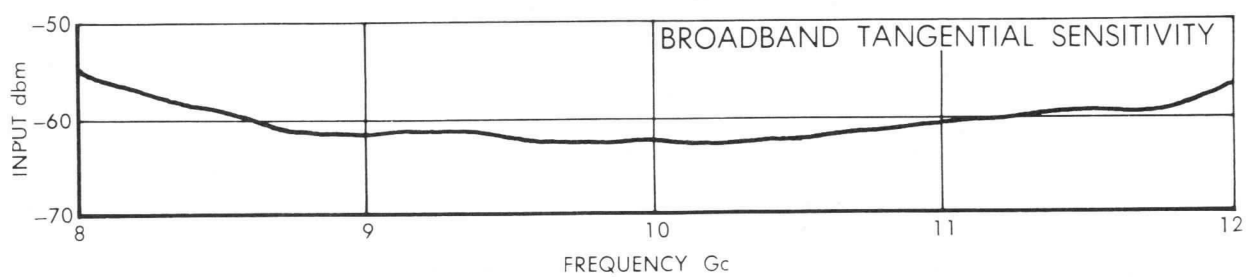
EM-1046 TYPICAL OPERATING CHARACTERISTICS

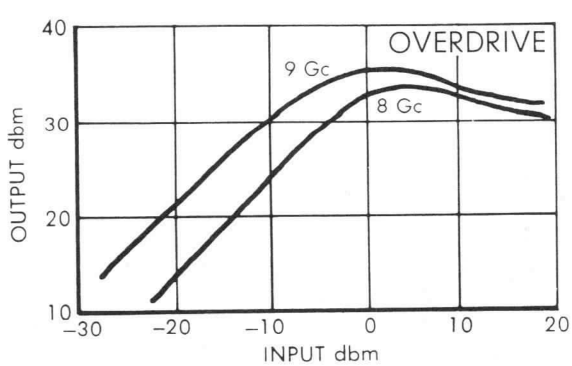
ANODE VOLTAGE	2950 Vdc	FOCUS VOLTAGE	−30 Vdc
CATHODE CURENT	23 mAdc	FILAMENT VOLTAGE	6.3 Vac

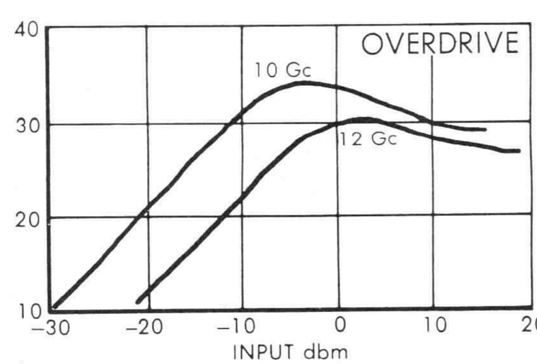








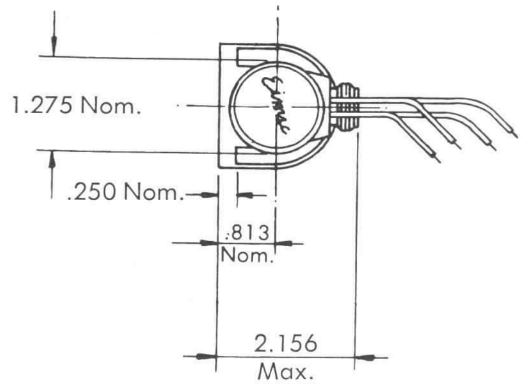


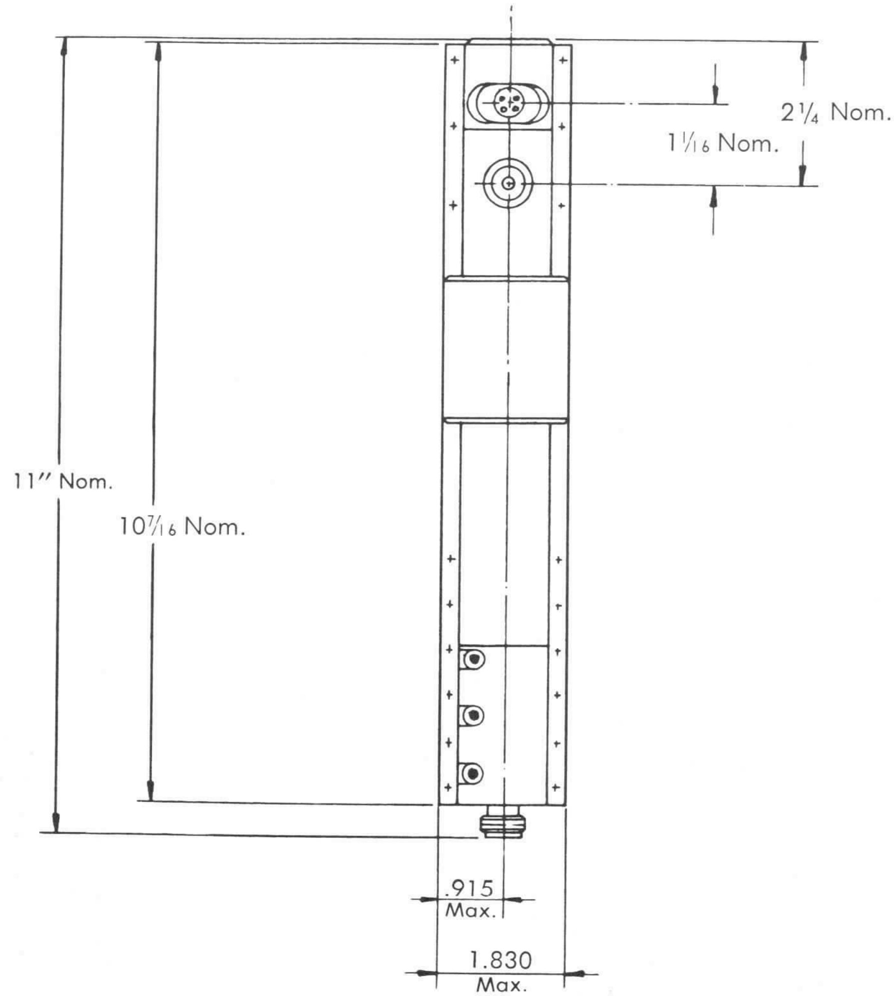


EM-1046

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

EM-1050

TRAVELING WAVE TUBE

8.0 to 12.0 Gc.

3 Watts Min.

60 db Gain

TENTATIVE DATA FOR EIMAC EM-1050 TRAVELING WAVE TUBE

The Eimac EM-1050 is an intermediate-power traveling wave tube amplifier designed to operate in the 8.0 to 12.0 Gc frequency range. The EM-1050 will provide a minimum saturated power output of 3 watts over this frequency range with a nominal small signal gain of 60 db.

The EM-1050 features rugged ceramic and metal construction and focusing is provided by built-in periodic permanent magnets. These magnets are fully temperature compensated to allow operation from −55 to + 85°C. No additional cooling is required at these temperatures due to the integral heat sink/mounting flange supplied with the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, oxide coated	
Minimum Heating Time	60 seconds
Heater Voltage	6.3 volts
Current	0.6 amperes
Noise Figure	25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)	−50 dbm
Minimum Saturated Output Power	3 watts
Frequency Range	8.0 to 12.0 gigacycles
Input and Output Impedance	50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	4.5 Pounds

MAXIMUM RATINGS

D-C BEAM VOLTAGE*	3500 VOLTS
D-C FOCUS ELECTRODE VOLTAGE* NEGATIVE WITH RESPECT TO CATHODE	50 VOLTS
D-C CATHODE CURRENT	30 MILLIAMPERES

TYPICAL OPERATING CHARACTERISTICS

Frequency	8.0 to 12.0 gigacycles
Minimum Output Power	3.0 watts
Small Signal Gain	60 decibels
D-C Beam Voltage*	3300 volts
D-C Cathode Current	28 milliamperes
D-C Focus Electrode Voltage*	−40 volts
D-C Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM-1050 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ± 5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ± 1% to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ± 2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California.

ENVIRONMENTAL

The EM-1050 conforms generally with MIL-E-5272C, "Environmental Testing, Areonautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

Vibration: 10 g to 2000 cps (Curve A of Proc. XII, MIL-E-5272C)

Shock: 25 g, 11 ± 1 ms

Acceleration: Sustained, 25 g's

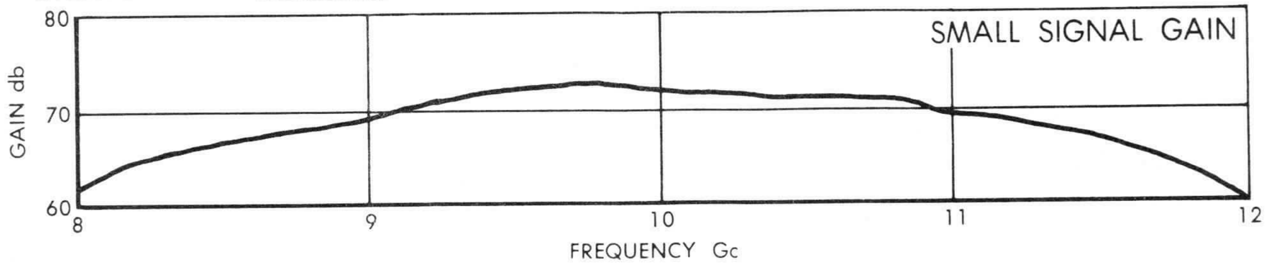
Temperature: −54°C to + 85°C

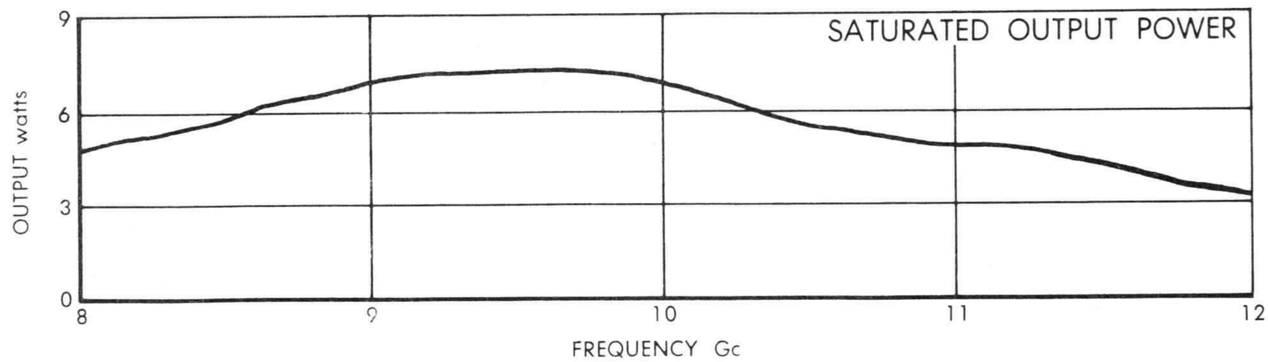
Altitude: 70,000 ft.

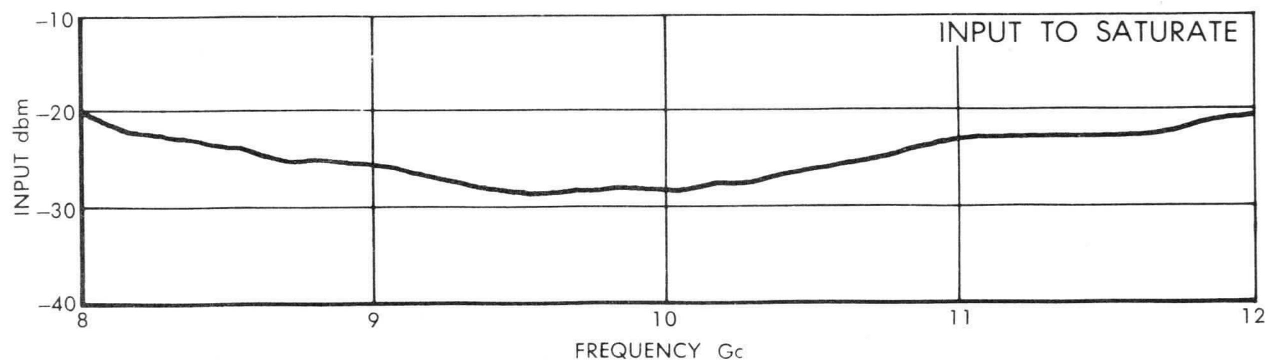
NOTE: This data should not be used for final equipment design.

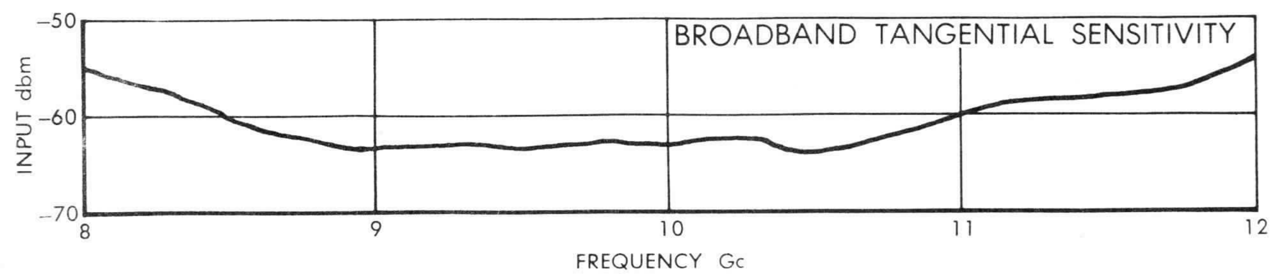
EM-1050 TYPICAL OPERATING CHARACTERISTICS

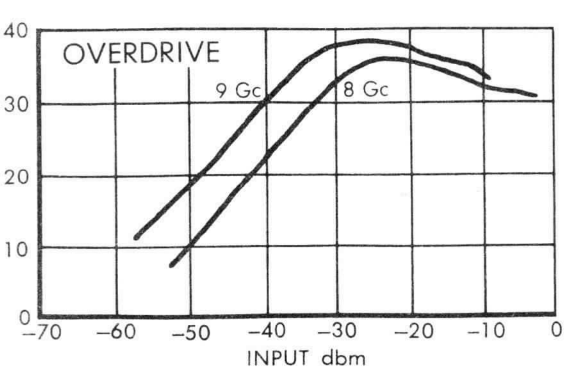
ANODE VOLTAGE 3300 Vdc
CATHODE CURRENT 28 mAdc
FOCUS VOLTAGE −40 Vdc
FILAMENT VOLTAGE 6.3 Vac

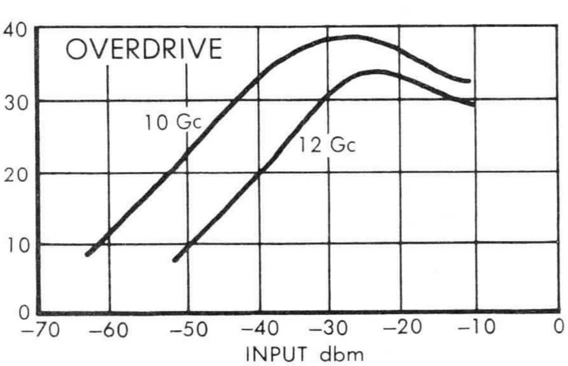








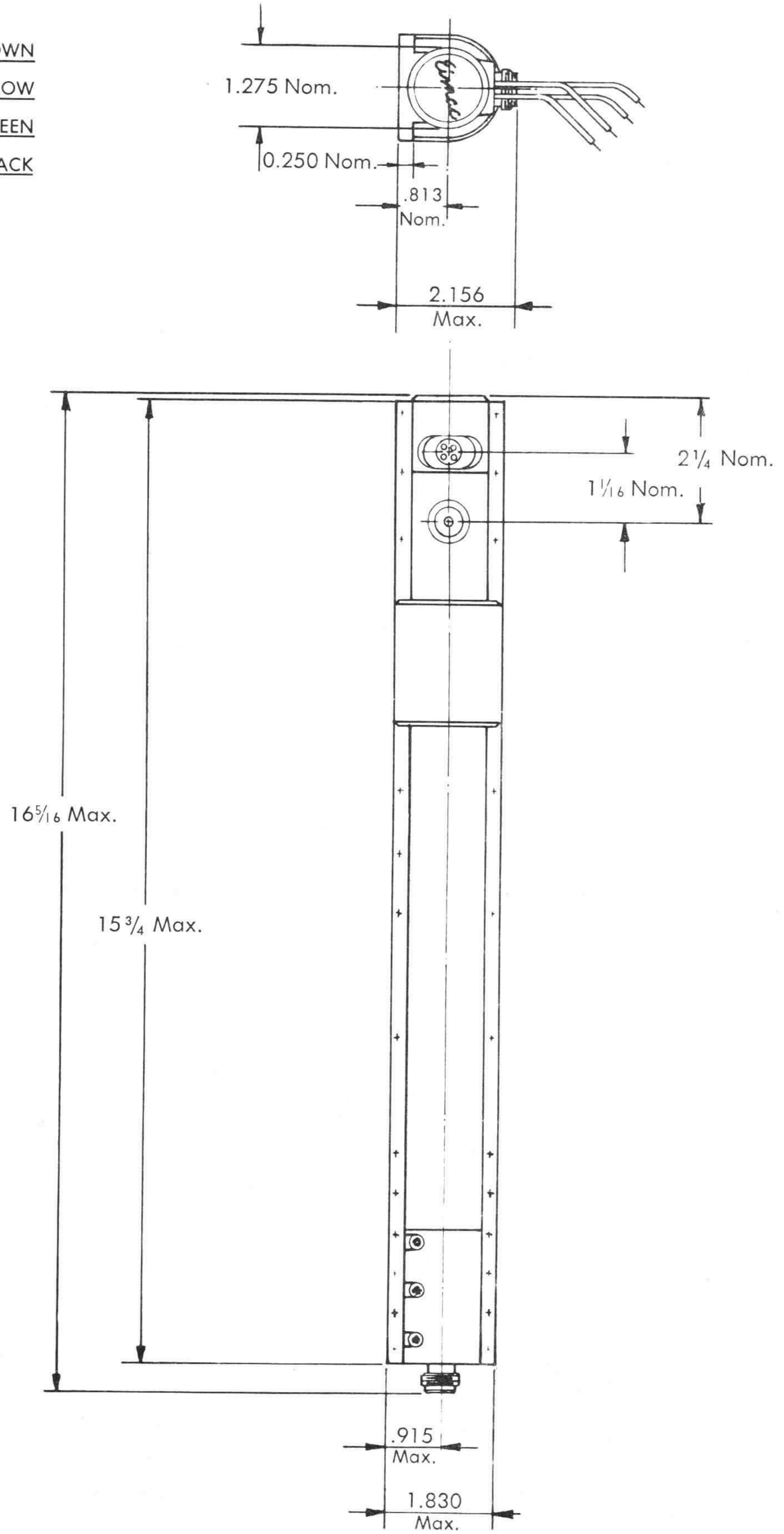




EM-1050

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK



EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

Tentative Data

EM1051

TRAVELING WAVE TUBE

8.0 to 12.0 GHz
3 Watts Min.
30 db Gain

TENTATIVE DATA FOR EIMAC EM1051 TRAVELING WAVE TUBE

The EIMAC EM1051 is a very rugged, light weight power-amplifier traveling wave tube designed to operate under severe environmental extremes of shock, vibration, altitude and temperature. The EM1051 utilizes ceramic and metal construction and is focused by a fully temperature-compensated periodic permanent magnet array. This tube will provide a minimum output power of 3 watts CW over the frequency range of 8.0 to 12.0 GHz with a nominal small signal gain of 30 db.

The integral heat sink/mounting flange allows operation to ambient temperatures of +85°C without additional cooling. Flexible leads provide electrical connections to the tube.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, oxide coated	
	Minimum Heating Time	60 seconds
Heater:	Voltage	6.3 volts
	Current	0.6 amperes
Noise Figure		25 to 34 decibels
Minimum Tangential Sensitivity (Broadband)		—50 dbm
Minimum Saturated Output Power		3 watts
Frequency Range		8.0 to 12.0 gigahertz
Input and Output Impedence		50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Passive Heat Sink
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	2.5 Pounds

MAXIMUM RATINGS

DC Beam Voltage*	3500 volts
DC Focus Electrode Voltage*: Negative with respect to Cathode	50 volts
DC Cathode Current	30 milliamperes

TYPICAL OPERATING CHARACTERISTICS

Frequency	8.0 to 12.0 gigahertz
Minimum Output Power	3.0 watts
Small Signal Gain	30 decibels
DC Beam Voltage*	3300 volts
DC Cathode Current	28 milliamperes
DC Focus Electrode Voltage*	—40 volts
DC Focus Electrode Current	0 milliamperes

*All voltages referred to cathode.

APPLICATION

Cooling: The EM1051 is designed to be heat sink cooled by means of the mounting available and integral with the tube and PPM structure. Under environmental conditions normally encountered in military equipments, additional cooling will not be required.

Cathode: The heater voltage should be maintained within ±5 per cent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

Helix: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials. The cathode potential should be maintained within ±1 per cent to insure proper operation.

Focus Electrode: The focus electrode power supply must be regulated within ±2 per cent to minimize variations in performance.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, Calif.

ENVIRONMENTAL

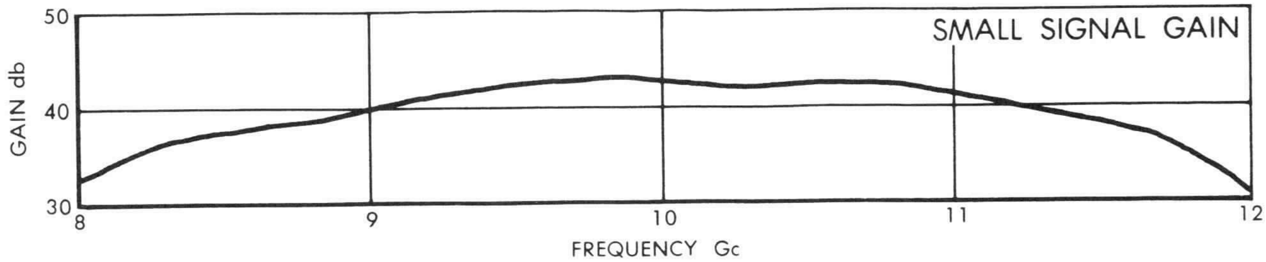
The EM1051 conforms generally with MIL-E-5272C, "Environmental Testing, Aeronautical and Associated Equipment, General Specification for," and MIL-E-5400, "Electronic Equipment, Aircraft, General Specification for," Class II.

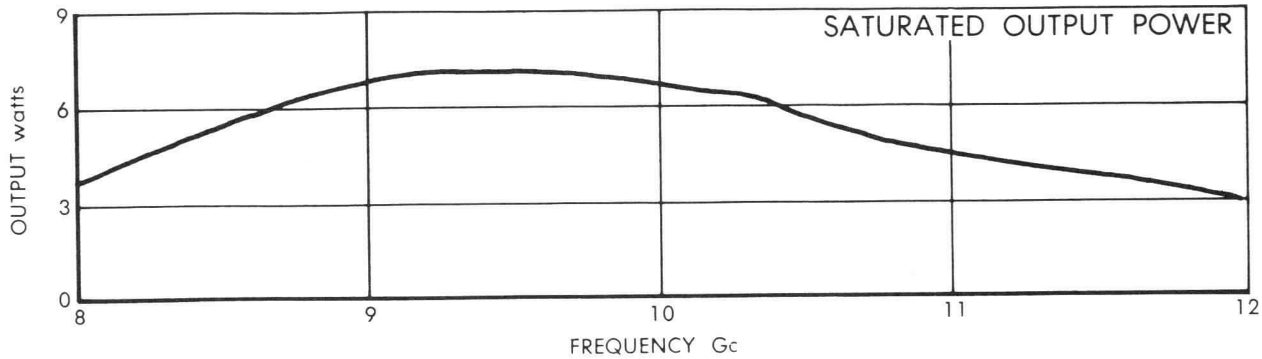
Vibration	10 g to 2000 Hz (Curve A of Proc. XII, MIL-E-5272C)
Shock	25 g, 11 ±1 ms
Acceleration	Sustained, 25 g's
Temperature	–54°C to +85°C
Altitude	70,000 ft.

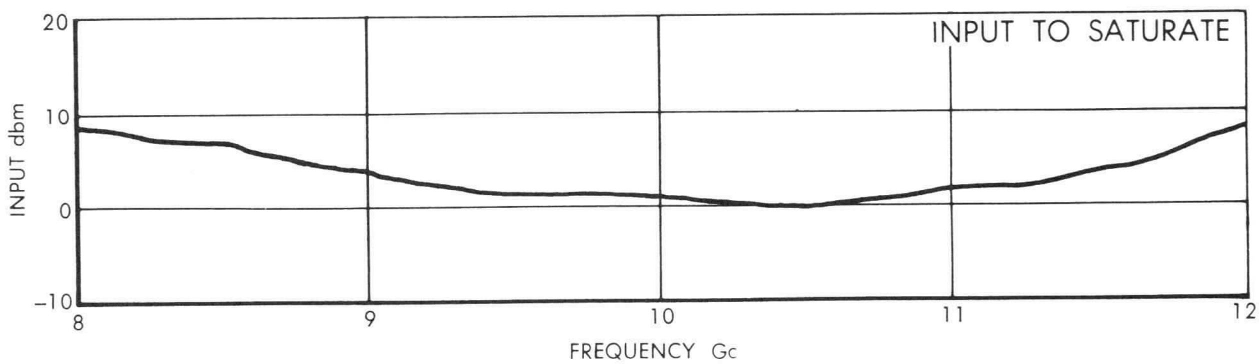
Note: This data should not be used for final equipment design.

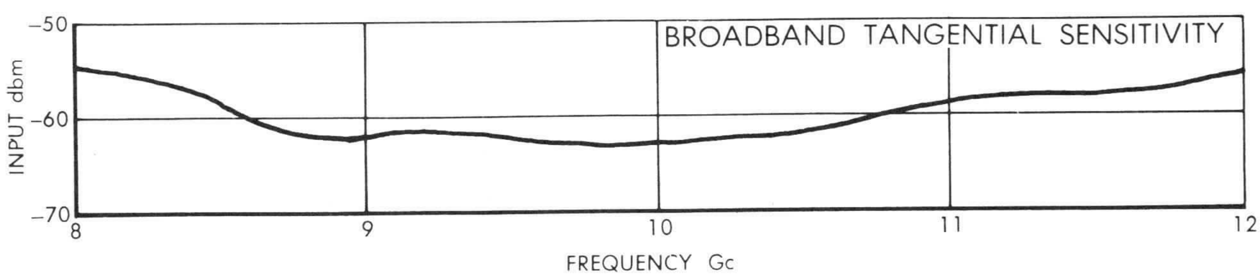
EM-1051 TYPICAL OPERATING CHARACTERISTICS

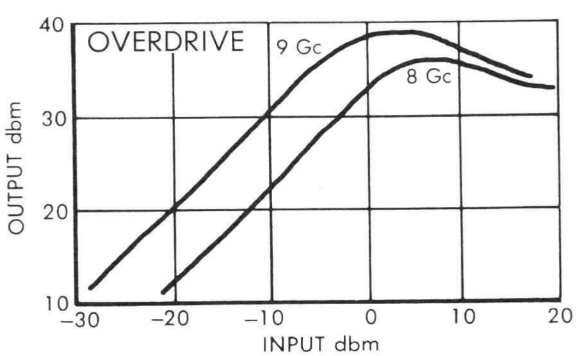
ANODE VOLTAGE	3300 Vdc	FOCUS VOLTAGE	−40 Vdc
CATHODE CURRENT	28 mAdc	FILAMENT VOLTAGE	6.3 Vac

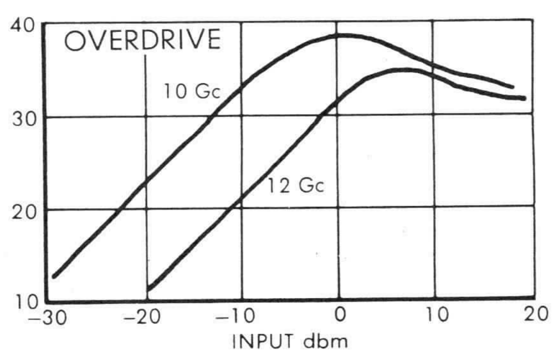








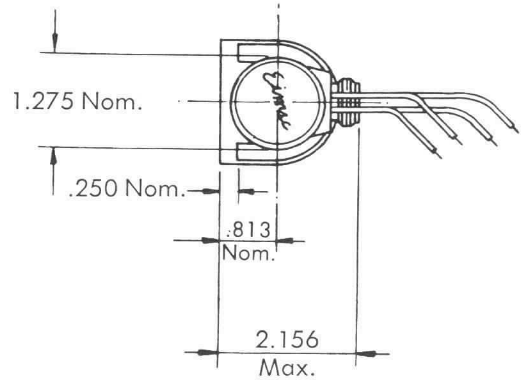


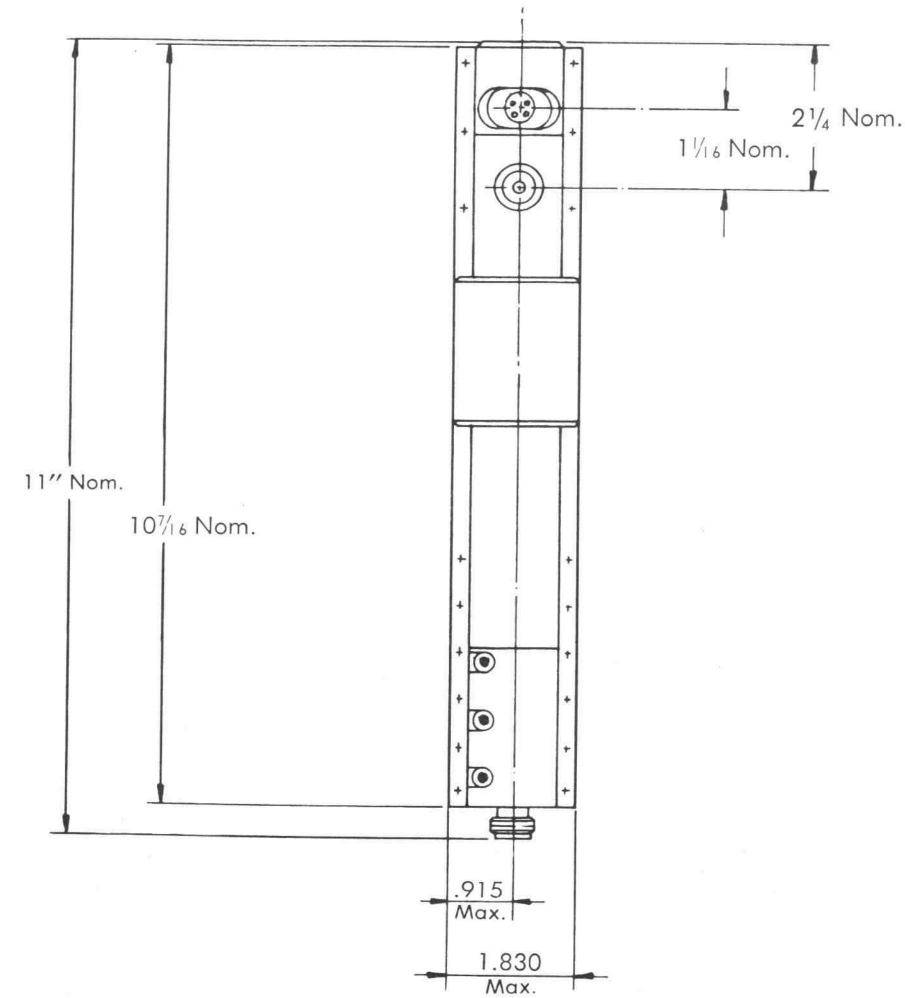


EM-1051

CONNECTIONS

1. HEATER —BROWN
2. CATHODE HEATER—YELLOW
3. FOCUS ELECTRODE —GREEN
4. BODY GROUND —BLACK





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X-1021 TWT

4.0-8.0 GC

40 db Gain

TENTATIVE DATA FOR EIMAC X-1021 TRAVELING WAVE TUBE

The Eimac X-1021 is a C-Band, ruggedized, light weight power amplifier traveling wave tube designed to operate under severe environmental extremes of shock, vibration, altitude and temperatures. The X-1021 utilizes ceramic and metal construction and is focused by a fully temperature-compensated periodic permanent magnet array. This tube will provide a minimum output power of 10 watts and 40 db gain over the frequency range of 4.0 to 8.0 Gc.

APPLICATIONS

The all ceramic-metal design coupled with a temperature compensated periodic permanent magnet array enables the X-1021 to perform under adverse environmental conditions while heat sink cooling provides an improved form factor for equipment design, making it an excellent choice for power amplification in augmentation or ECM systems in high performance aircraft, rocket or missile applications.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode.	Unipotential, dispenser type	
	Minimum Heating Time	120 seconds
Heater:	Voltage	6.3 volts
	Current	1.2 amperes
Noise Figure		35 decibels
Minimum Saturated Output Power		10 watts
Minimum Saturated Gain		40 db
Frequency Range		4.0 to 8.0 gigacycles
Input and Output Impedance		50 ohms nominal

MECHANICAL

Operating Position	Any
RF Input Coupling	Type N Female Coaxial Fitting
RF Output Coupling	Type N Female Coaxial Fitting
Focusing	Periodic Permanent Magnet
Cooling	Heat Sink and/or Forced Air
Maximum Overall Dimensions	See Outline Drawing
Net Weight (Including Magnets)	3.5 Pounds

Effective 1 August 1962

MAXIMUM RATINGS

D-C Beam Voltage*	2900 volts
D-C Focus Electrode Voltage*:	
Negative with respect to cathode	
(a) For CW Operation	40 volts
(b) For maximum current control	400 volts
D-C Cathode Current	90 milliamperes

TYPICAL OPERATING CHARACTERISTICS

Frequency	4.0 to 8.0 gigacycles
Minimum Output Power	10 watts
Minimum Saturated Gain	40 decibels
D-C Beam Voltage*	2850 volts
D-C Cathode Current	80 milliamperes
D-C Focus Electrode Voltage*	—30 volts
D-C Focus Electrode Current	1.0 milliamperes

*All voltages referred to cathode

APPLICATION

Cooling: The X-1021 is designed to be cooled by means of conduction to the mounting flange integral with the tube and PPM structure, or by forced air directed across the collector. Adequate cooling is determined when the envelope temperature is maintained below 250°F by thermocouple measurements at monitoring point indicated.

Cathode: The heater voltage should be maintained within ±5 percent of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

HELIX: The helix, collector and anode are internally connected to the tube body and are operated at the same potential. Therefore, it is often convenient to operate these elements at chassis potential, with the cathode and focus electrode at appropriate negative potentials.

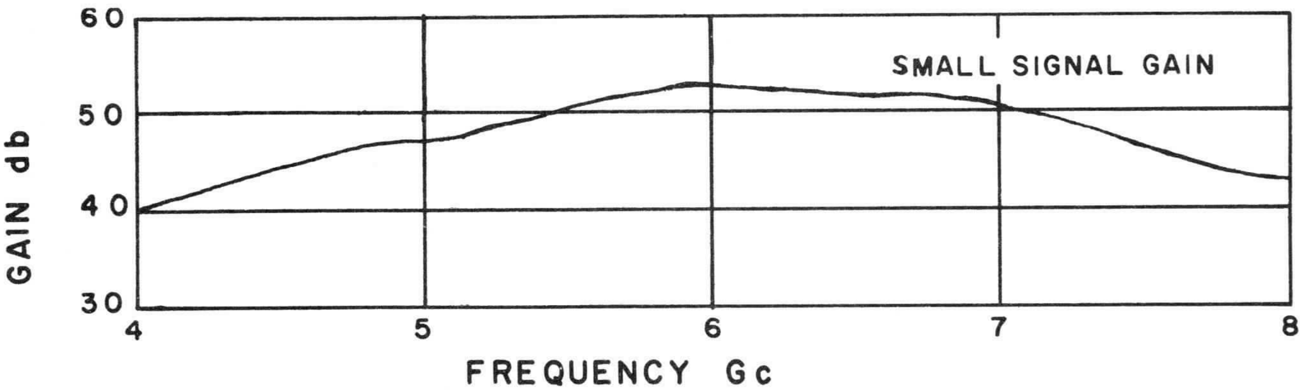
Focus Electrode: The focus electrode power supply must be regulated within ±2 percent to minimize variations in performance. This electrode may be used as a cathode current control electrode, within the limits of the maximum ratings listed above.

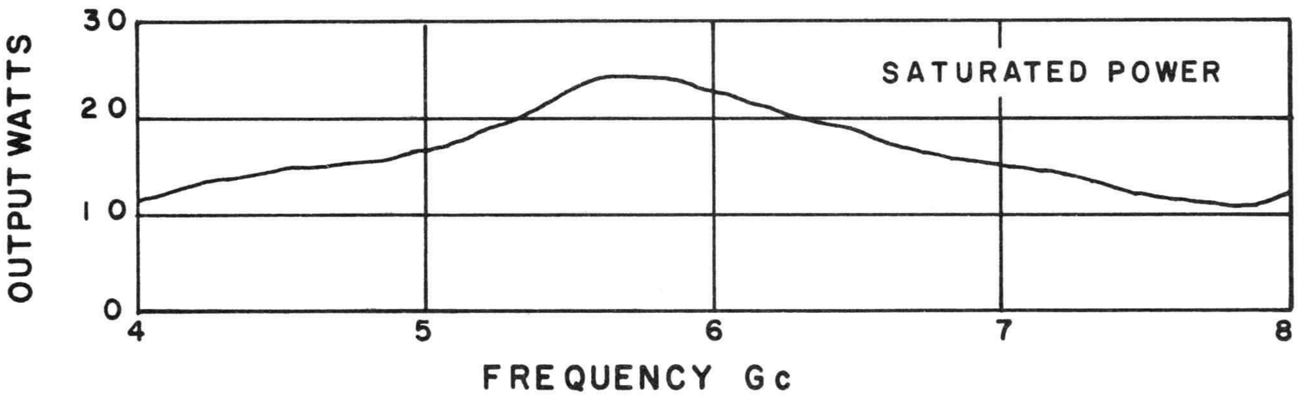
Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, Telephone LYtell 1-1451, Cable: EIMAC.

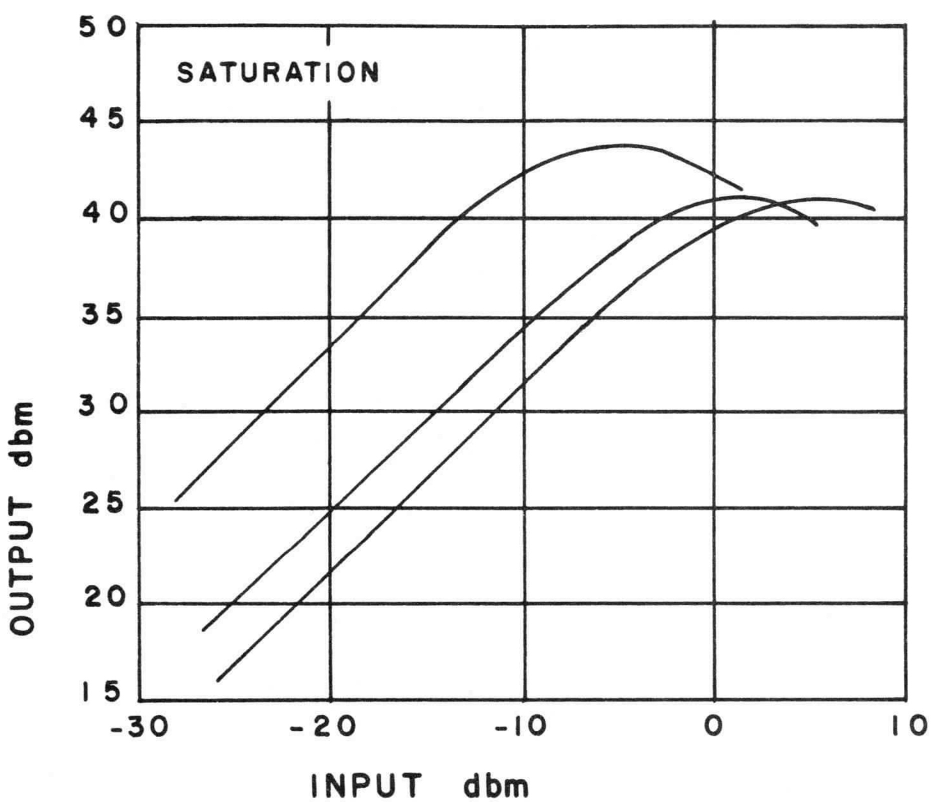
EM 1021 TYPICAL OPERATING CHARACTERISTICS

HELIX VOLTAGE 2850 Vdc FOCUS VOLTAGE -30 Vdc

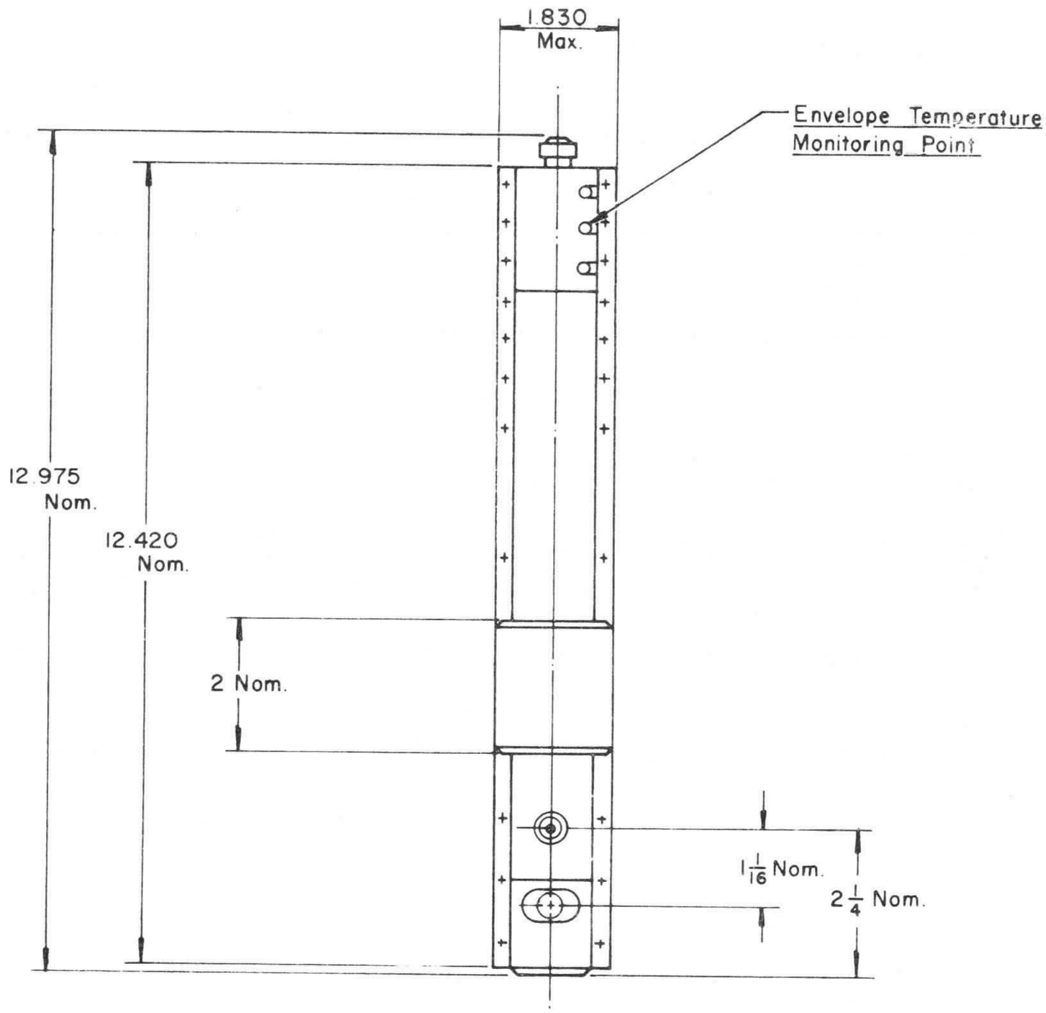
CATHODE CURRENT 80 mAdc FILAMENT 6.3V





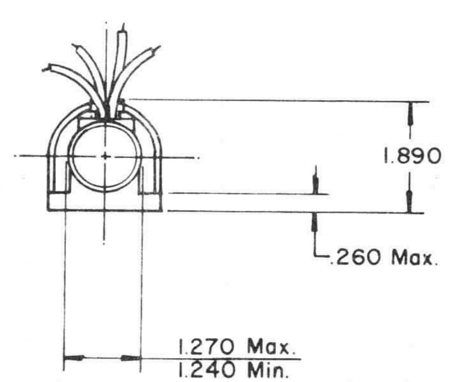


X1021



CONNECTIONS

1. HEATER -BROWN
2. CATHODE HEATER -YELLOW
3. FOCUS ELECTRODE -GREEN
4. BODY GROUND -BLACK



Eimac® EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X1059

TRAVELING WAVE TUBE
4.0-8.0 Gc
2 WATT MIN.
38 db SMALL SIGNAL GAIN

TENTATIVE DATA SHEET TRAVELING WAVE TUBE X1059

DESCRIPTION

The X1059 is a ruggedized, C-Band, octave bandwidth Travleing Wave Tube with metal-ceramic construction capable of operation under severe environments. Focusing is accomplished by a fully temperature compensated magnet array. This tube may be used in serrodyning applications.

ELECTRICAL SPECIFICATIONS:

Absolute Ratings

Absolute Ratings	Maximum	Minimum
Filament Voltage	6.7	5.9 V
Filament Current	1.5	- A
Helix Current	7.0	- mAdc
Helix Voltage	+2600	- Vdc
Cathode Current	30.0	- mAdc
Control Grid Voltage	—150	0 Vdc
Anode Voltage	+200	0 Vdc
Anode Current	0.250	- mAdc
Duty Cycle	CW	
Beam Power Output	78	- W
Input Power, rf	20	- dbm
Power Reflected From Load	5	- W
Temperature, Body	+175	° C
Temperature, Collector	+175	° C
Ambient Temperature	+120	-54° C
Cathode Warm-Up	-	60 Seconds
Altitude	70,000	- ft

Operating and Performance Data

Filament Voltage	6.3 V
Filament Current	0.9 A
Helix Voltage	+2500 Vdc
Cathode Current	30 mAdc
Control Grid Voltage	0 Vdc
Control Grid Current	0 mAdc
Anode Voltage	0 to 200 Vdc
Anode Current	0.250 mAdc
Serrodyne Voltage	105-115 Vdc
Duty Cycle	CW
Frequency Range	4.0-8.0 Gc
Small Signal Gain --Minimum	33 db
--Typical	38 db
Saturated Power Out--Minimum	2 W
--Typical	3 W
Output VSWR (Cold)	2.5:1
Input VSWR (Cold)	2.0:1
Input and Output Impedance	50 ohms

ENVIRONMENTAL SPECIFICATIONS:

The X1059 conforms to MIL-E-5400

Vibration	10 g's to 2000 cps
Shock	15 g's (11 ± 1 msec)
Temperature	−54°C to +120°C
Altitude	70,000 Ft.

MECHANICAL SPECIFICATIONS:

Operating Position	Any
Input Coupling, rf	Type TNC Coaxial Fitting
Output Coupling, rf	Type TNC Coaxial Fitting
Focusing	PPM
Cooling	Passive Heat Sink
Dimensions	See Outline Drawing
Weight	4 Pounds
H. V. Leads	#22 AWG Teflon Ins. Flying Leads

APPLICATION NOTES:

ALL VOLTAGES ARE WITH RESPECT TO CATHODE.

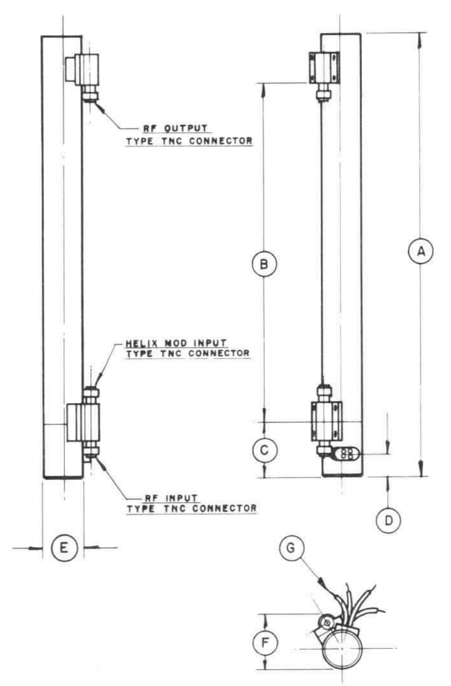
COOLING: The X1059 is designed to be heat sink cooled. Under environmental conditions normally encountered in military equipments, additional cooling is not required.

FILAMENT: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations of performance are to be minimized and best tube life obtained.

CONTROL GRID: The control grid is a high mu control electrode. Normal operation is obtained at zero volts, eliminating the need for an additional control power supply. However, in pulse applications the grid may be used to gate the tube on and off.

SERRODYNE: The helix is isolated from the tube body allowing serrodyne operation for frequency translation applications. The cathode voltage should be maintained within ±1% to insure rated performance.

THIS DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN.



DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	13.940	14.060	
B	10.625	10.875	
C	1.690	2.810	
D	.630	.870	
E	1.230	1.270	
F		1.700	
G	24"	26"	LEAD LENGTH

CONNECTIONS

1. HEATER - BROWN
2. HEATER CATHODE - YELLOW
3. GRID - GREEN
4. ANODE - BLUE

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

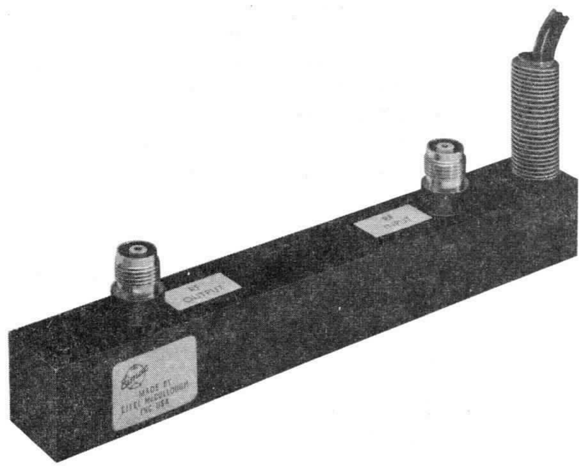
X1131

TRAVELING WAVE TUBE

7.0 - 8.0 Gc
3.0 WATTS
36 db GAIN

TENTATIVE DATA SHEET TRAVELING WAVE TUBE X1131

The X1131 is a highly reliable light weight miniaturized Traveling Wave Tube Amplifier designed for long life in space applications. The tube is of metal-ceramic construction utilizing periodic permanent magnets as the focusing array. From 7.0 to 8.0 Gc, 2.5 Watts of rf power at 36 db gain is provided. Electronic efficiency with collector depression is typically 33%.



ELECTRICAL SPECIFICATIONS:

Absolute Ratings	Maximum	Minimum
Filament Voltage	10	- volts
Filament Current	0.30	- Ampere
Helix Voltage	1600	1200 Vdc
Body and Helix Current	1.0	- mAdc
Collector Voltage	1600	550 Vdc
Collector Current	16	- mAdc
Focus Electrode Voltage	−100	- Vdc
Focus Electrode Current	1.0	- mAdc
Anode Voltage	1800	1650 Vdc
Anode Current	0.2	- mAdc
Duty Cycle	100	- %
Beam Power Input	25	- W
Input Power, rf	100	- mW
Power Reflected From Load	3.0	- W
Temperature, Body	+100	-60° C
Temperature, Collector	+200	-60° C
Ambient Temperature	+100	-50° C
Cathode Warm-Up	-	120 Seconds

Operating and Performance Data

Filament Voltage	6.3 Volts
Filament Current	0.20 A
Helix Voltage	1450 Vdc
Body and Helix Current	0.50 mAdc
Collector Voltage	575 Vdc
Collector Current	14.5 mAdc
Focus Electrode Voltage	0 Vdc
Focus Electrode Current	0 mAdc
Anode Voltage	1550 Vdc
Anode Current	0.2 mAdc
Duty Cycle	100 %
Frequency Range	7.0-8.0 Gc
Small Signal Gain-Minimum	40 db
-Typical	43 db
Saturated Power Out-Minimum	2.5 W
-Typical	3.0 W
Saturated Gain-Minimum	36 db
-Typical	38 db
Output VSWR (Cold)	1.5:1
Input VSWR (Cold)	1.5:1
Input and Output Impedance	50 ohms
Noise Figure, Typical	28 db

ENVIRONMENTAL SPECIFICATIONS:

Applicable military specifications:	MIL-E- 5400
	MIL-E- 5272
Vibration - - - - - -	20 g's at 5000 cps
Shock - - - - - - -	100 g's
Acceleration - - - -	20 g's
Temperature - - - -	$-50°$ C to $+100°$ C

Altitude--Any, when used in conjunction with hermetically sealed capsule

MECHANICAL SPECIFICATIONS:

Operating Position -	Any
Input Coupling, rf - -	TNC
Output Coupling, rf -	TNC
Focusing - - - -	PPM, magnetically shielded
Cooling - - - - - -	Heat Sink conduction
Dimensions - - -	See outline drawing
Weight - - - - - -	9 ounces, encapsulated
H.V. Leads - - - -	Flying

APPLICATION NOTES

VOLTAGES REFERENCE: ALL VOLTAGES ARE WITH RESPECT TO CATHODE.

COOLING: Tube is cooled by conduction through base. With depressed collector and rf output at saturation, 6.0 watts are dissipated.

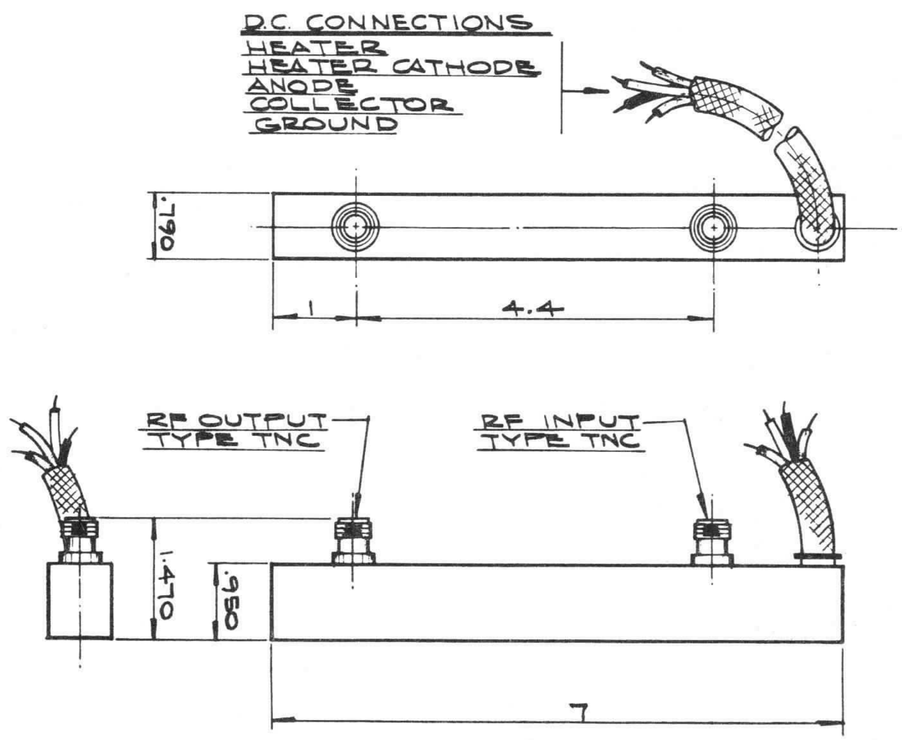
COLLECTOR: Depressed up to 65% for full rf output. Collector is completely encapsulated and insulated.

HELIX: Grounded. Can be supplied floating for modulation capability.

FOCUS ELECTRODE: Used to gate off the tube in certain applications.

MISSION: This is a high reliability tube with a design "wearout" of 100,000 hours. Reliability coupled with high efficiency and light weight makes this tube ideal for long mission space applications.

DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

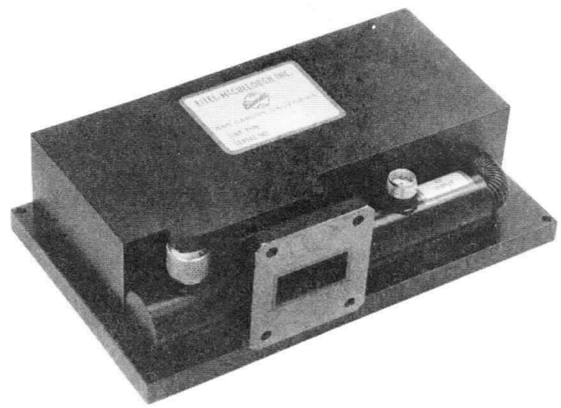
X1132

TRAVELING WAVE TUBE - POWER SUPPLY PACKAGE

7.0 - 8.0 Gc
3.0 WATTS
36 db GAIN

TENTATIVE DATA SHEET
TRAVELING WAVE TUBE AMPLIFIER POWER SUPPLY PACKAGE X1132

The X1132 is a long life, highly reliable amplifier package consisting of a PPM focused ceramic-metal TWT amplifier (X1131) and integral solid state power supply designed for space applications. Over the frequency range of 7.0 to 8.0 Gc, 2.5 Watts of rf power are produced at a saturated gain of 36 db.



ELECTRICAL SPECIFICATIONS:

Absolute Ratings	Maximum	Minimum
Power Supply Voltage - - - -	40	20 V
Power Supply Power - - - -	16	- W
Duty Cycle - - - - - - - -	100	- %
Input Power, rf - - - - - -	100	0 mw
Power Reflected From Load - -	3.0	- W
Temperature, Collector - - -	+150	- 40° C
Ambient Temperature - - -	+80	- 40° C
Altitude - - - - - - - -	Any	

Operating and Performance Data		
Power Supply Voltage - - -	28	V
Power Supply Current - - -	0.48	A
Duty Cycle - - - - - - - -	100	%
Frequency Range - - - - - -	7.0-8.0	Gc
Small Signal Gain-Minimum -	40	db
-Typical - -	43	db
Saturated Power-Minimum - -	2.5	W
-Typical - - -	3.0	W
Saturated Gain-Minimum - - -	36	db
-Typical - - -	38	db
Output VSWR (Cold) - - -	1.5:1	
Input VSWR (Cold) - - - - -	1.5:1	
Input and Output Impedance - -	50	ohms
Noise Figure-Maximum - - -	30	db
-Typical - - - -	28	db

ENVIRONMENTAL SPECIFICATIONS:

Vibration - - - - - - - -	20 g's to 2000 cps
Shock - - - - - - - - -	100 g's
Acceleration - - - - - - -	20 g's, sustained
Temperature - - - - - - -	−20° C to +50° C
Altitude - - - - - - - -	Any

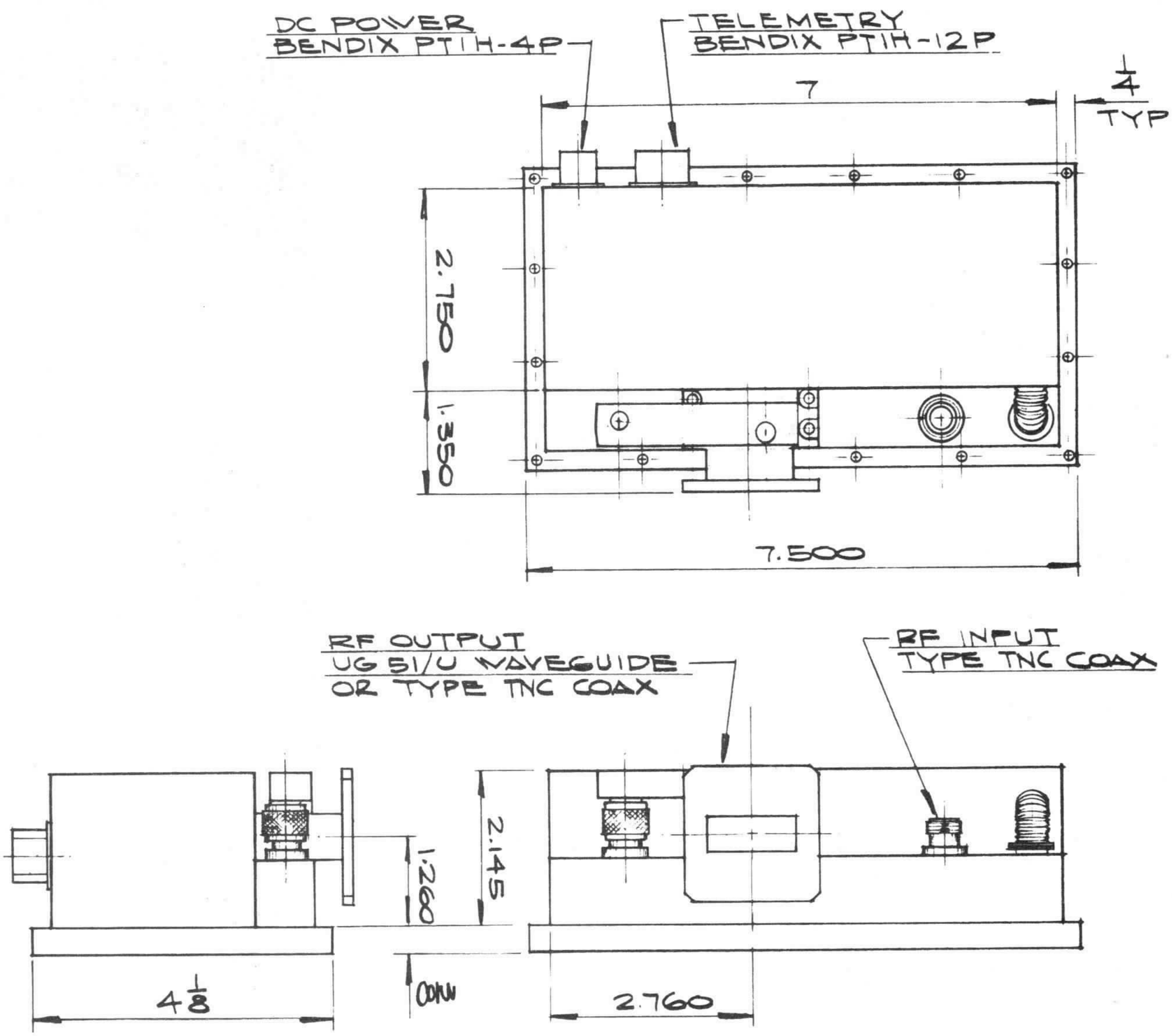
MECHANICAL SPECIFICATIONS:

Operating Position	Any
Input Coupling, rf	TNC Coax Fitting
Output Coupling, rf	TNC Coax or UG 51/U Waveguide
Focusing - - -	PPM, shielded
Cooling - - -	Conduction through heat sink
Dimensions - -	See outline drawing
Weight - - - -	4.0 lbs
Power Supply Connections	Bendix PTIH - 3P

APPLICATION NOTES:

1. Full rf performance will be obtained for input voltages between 24 and 30 volts dc.
2. Six telemetry outputs are available for monitoring of TWTA performance.
3. DC operation may be programmed by use of 20 V control signal (draws 10 mW).
4. Especially useful in long unattended mission applications, MTTFF 50,000 hours, rated.
5. Magnetic shield minimizes interference with sensitive components, permits dense packing. Two units may be mounted and operated as close as mechanical outline permits.

DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN



Eimac

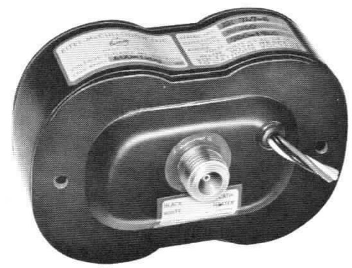
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM-747

Voltage Tunable Magnetron

Frequency 400—1200 Mc

Minimum Output Power 50 mW Min.

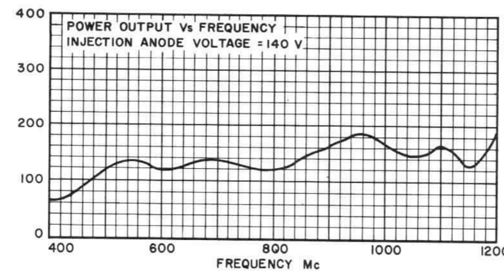


L-BAND OSCILLATOR

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range - - - - - - -	0.4-1.2 kMc
Anode Voltage - - - - - - - -	660-1980 V
Cathode Current - - - - - - -	2-8 mA
Typical Output Power - - - - - -	75-250 mW
Anode FM Sensitivity - - - - - -	.65 Mc/V
Injection Anode Voltage - - - - -	200 V
Injection Anode Current - - - - -	0 mA
Heater Voltage (AC or DC) - - -	6.3 V
Heater Current (AC or DC) - - -	0.8 A
Load Impedance - - - - - - -	50 ohms
Service - - - - - - - - - -	cw



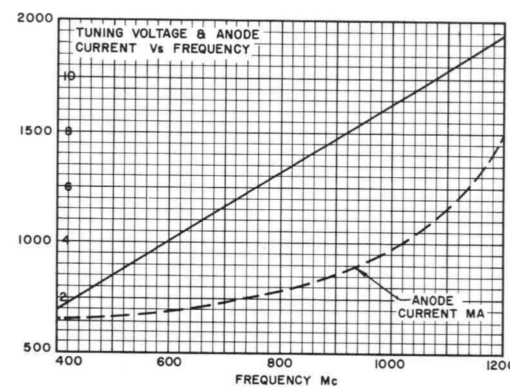
*MAXIMUM RATINGS

Anode Voltage - - - - - - - - - - -	2000 V
Cathode Current - - - - - - - - - -	20 mA
Injection Anode Voltage - - - - - - -	500 V
Injection Anode Current - - - - - - -	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating Position - - - - -	Any
Cooling - - - - - - - - - -	Conduction
Electrical Connection - - - -	Flexible Leads
RF Output Coupling - - - - -	Type N Jack
Weight - - - - - - - - - -	3.0 Pounds



ENVIRONMENTAL

Vibration - - - - - - - - - -	10G-(to 2kc)
Shock - - - - - - - - - - -	100G-(11ms)
Altitude - - - - - - - - - -	70,000 ft.

OUTLINE DIMENSIONS

Height - - - - - - - - - - - -	3 inches
Width - - - - - - - - - - - -	1.6 inches
Length - - - - - - - - - - - -	4.5 inches

APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

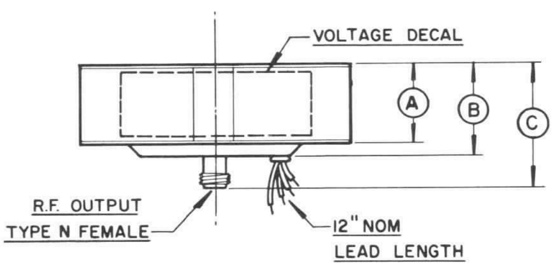
3. TEMPERATURE STABILITY: The permanent magnet for the EM-747 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the EM-747 package is typically .02% of the operating frequency per degree Centrigrade. Thus, for an operating frequency of 1000 megacycles, the temperature/frequency coefficient is typically 200 kilocycles per degree Centrigrade. A positive change in temperature will always produce a positive change in frequency. On special order, temperature compensation of .008% of the operating frequency per degree Centigrade can be provided.

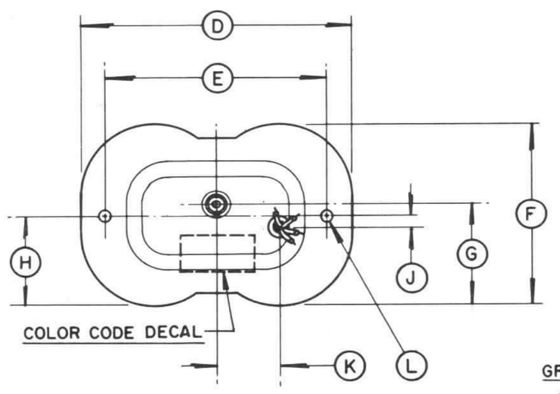
4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.312
D		4.515	
E	3.640	3.671	
F		3.031	
G			1.656
H			1.500
J			.375
K			1.062
L			.187 D.





CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

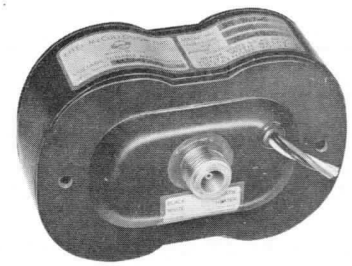
EM-1080

VOLTAGE TUNABLE MAGNETRON

FREQUENCY
1.2-2.2 kMc

MINIMUM OUTPUT POWER
100 mW

TYPICAL PERFORMANCE



S-BAND OSCILLATOR

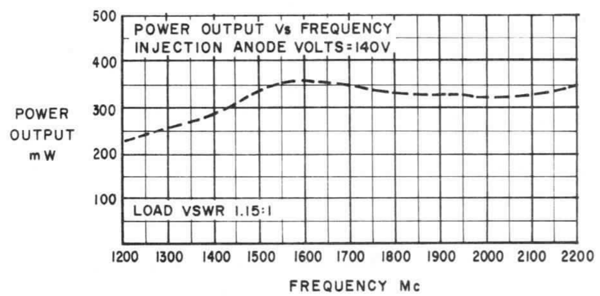
ELECTRICAL

Frequency Range	1.2-2.2 kMc
Anode Voltage	800-1400 V
Cathode Current	2-15 mA
Typical Output Power	140-300 mW
Anode FM Sensitivity	1.68 Mc/V
Injection Anode Voltage	200 V
Injection Anode Current	0.1 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw

*MAXIMUM RATINGS

Anode Voltage	1500 V
Cathode Current	25 mA
Injection Anode Voltage	+700 V
Injection Anode Current	1 mA

* Damage to the tube may occur if maximum ratings are exceeded.

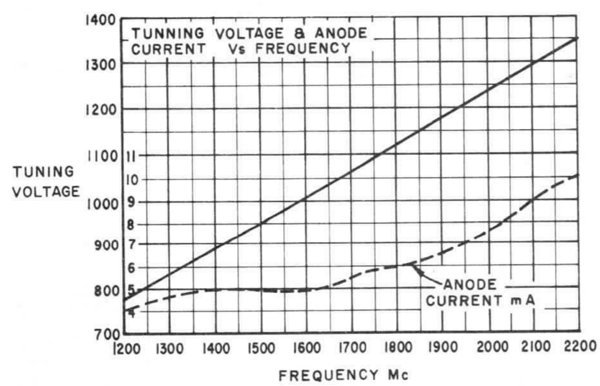


MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type N. Jack
Weight	3.5 Pounds

ENVIRONMENTAL

Vibration	10G-(to 2kc)
Shock	100G-(11ms)
Altitude	70,000 ft.

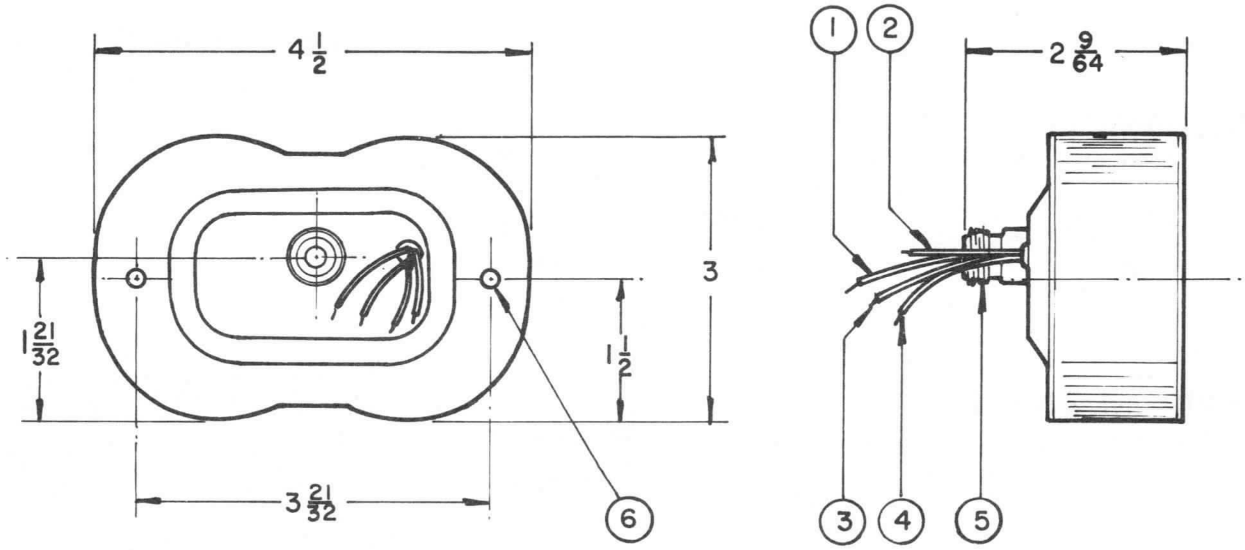


OUTLINE DIMENSIONS

Height	3 inches
Width	2.1 inches
Length	4.5 inches

APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.
2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.
3. TEMPERATURE STABILITY: The permanent magnet for the X-1080 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1080 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1500 megacycles, the temperature/frequency coefficient is typically 300 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.
4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



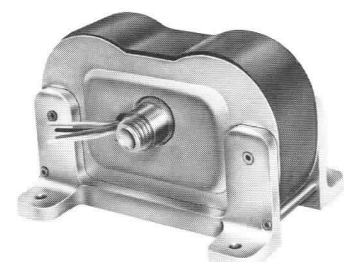
6	3/16 DIA. MOUNTING HOLES (2) REQ'D
5	FEMALE TYPE "N" CONNECTOR
4	GROUND LEAD (GREEN)
3	HEATER LEAD (WHITE)
2	HEATER CATHODE LEAD (BLACK)
1	INJECTION ANODE LEAD (YELLOW)

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X-1081

L-BAND PACKAGED VOLTAGE TUNABLE MAGNETRON



The Eimac X-1081 is a ruggedized, ceramic and metal, packaged voltage-tunable magnetron capable of delivering a minimum output power of 10 watts into a 50-ohm termination over the frequency range of 900-1200 megacycles.

Eimac's three terminal VTM circuit has been used in this tube to give a more uniform output circuit with the added advantage of one third more heat dissipating area extending out of the VTM envelope.

The electron injection design incorporated in this magnetron minimizes back-bombardment of the indirectly heated EMA cathode with resultant long life. This design also reduces output power variation across the tuning range by limiting the cathode current variation resulting from anode voltage changes.

The extremely linear tuning characteristing of this magnetron simplifies programming the frequency sweep, by eliminating the complicated compensating networks required by other voltage tunable oscillators.

The X-1081 Circuit Assembly has been designed for use with this tube to cover the specified frequency range and includes the permanent magnet and rf circuitry. Electrical connections to the tube are completed by means of flexible leads.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, EMA		
	Warm-up time	30	seconds
Heater:	Voltage (AC or DC)	6.3	volts
	Current	1.0	ampere
Minimum Output Power		10	watts
Frequency Range		900 to 1200	megacycles

MECHANICAL

Operating Position		any
Cooling		forced air
Electrical Connections		flexible leads
RF Output Coupling		Type N, or TNC female
Net Weight, including magnet and circuit:		3.2 pounds
Shipping Weight		10 pounds
Maximum Overall Dimensions (Magnet and Circuit):		
	Height	3 inches
	Width	3-3/8 inches
	Length	4-1/2 inches

MAXIMUM RATINGS

Anode Voltage*	2400	volts
Cathode Current	30	milliamperes
Injection Anode Voltage*	800	volts
Injection Anode Current	1	milliampere

TYPICAL OPERATION (X-1081 Circuit Asssembly, Load VSWR = 1.15:1)

Frequency Range	900	1200	megacycles
Anode Voltage* (Note 1)	1800	2380	volts
Cathode Current	15	18	milliamperes
Typical Power Output	10	12	watts
Anode FM Sensitivity		.55	Mc/volt
Injection Anode Voltage		400	volts
Injection Anode Current		0.5	milliampere
Heater Voltage (AC)		6.3	volts
Heater Current (AC)		0.8	ampere

*All voltages referred to the cathode.
Note 1. The operating frequency is determined by the Anode Voltage.

APPLICATION

Cooling: To insure long life and best operation, sufficient cooling air is required to maintain the magnet temperature below 70° C.

Anode: The operating frequency is determined by the anode voltage. The anode is mounted in direct electrical contact with the external circuit. Therefore, it is often convenient to operate the anode at chassis potential, with the cathode and injection anode at appropriate negative potentials.

Cathode: The cathode and one leg of the heater are internally connected. Therefore, the heater supply must be insulated for the maximum tuning voltage.

The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained. Either alternating or direct current may be used to energize the X-1081 heater in most applications as a result of the advanced counter-wound helical heater package. In applications where residual FM at the power supply frequency must be held to an absolute minimum, it is recommended that direct current be used for the heater.

Proximity of Ferrous Materials: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

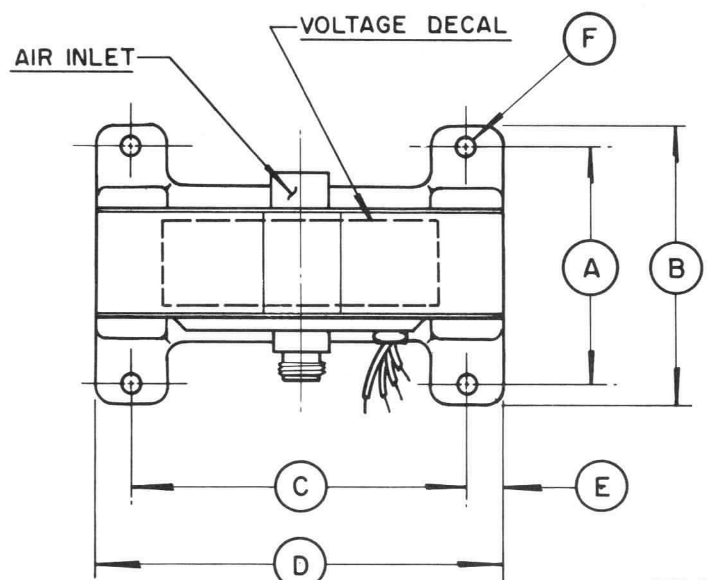
Temperature Stability: The permanent magnet for the X-1081 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1081 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1000 megacycles, the temperature/frequency coefficient is typically 200 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

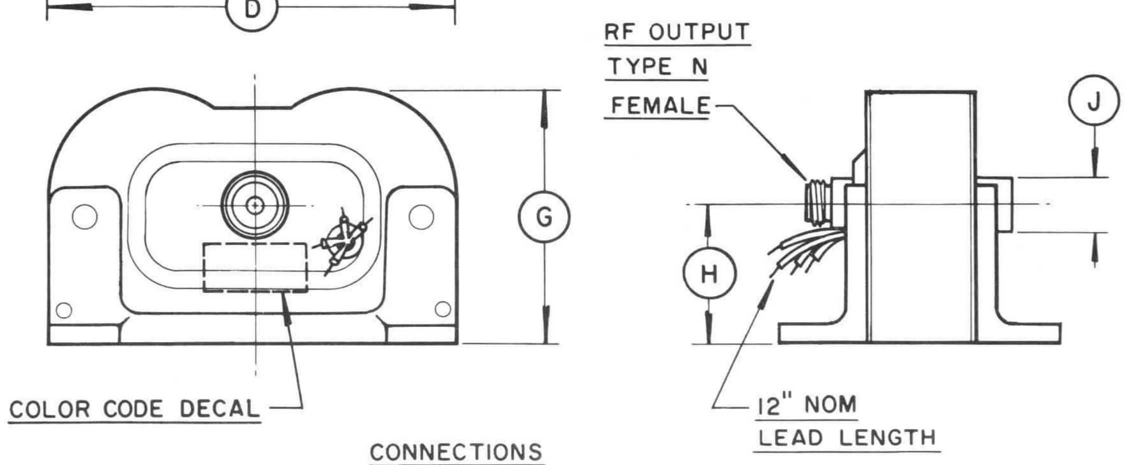
Linearity: The voltage/magnetic-field/frequency relationship of a magnetron is theoretically linear and this linearity is observed in practical tube. The frequency versus tuning voltage curve for the X-1081 is a straight line with a positive slope and may be easily programmed for the desired frequency sweep. Tests of the fine grain linearity curve show a deviation from a straight line of approximately 3-5 parts per thousand over a 20 megacycle bandwidth.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, telephone LYtell 1-1451, Cable: EIMAC.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			2.875
B			3.375
C	3.980	4.010	
D			4.875
E			.437
F			.196 D.
G		3.031	
H			1.656
J			.680 D.





CONNECTIONS

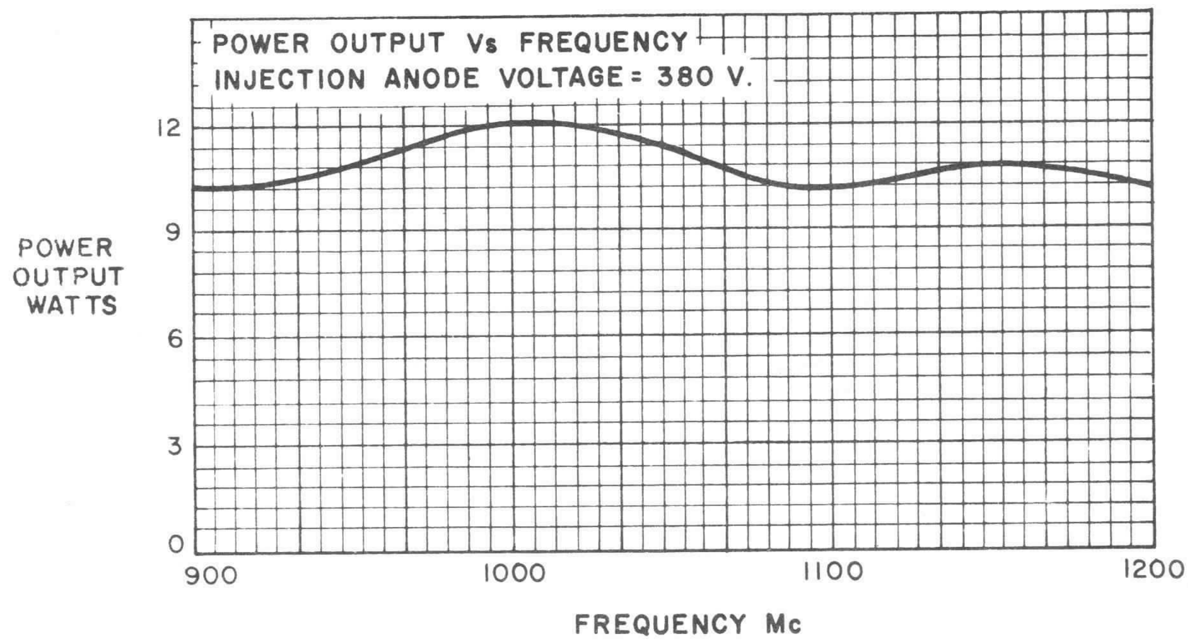
GROUND — GREEN

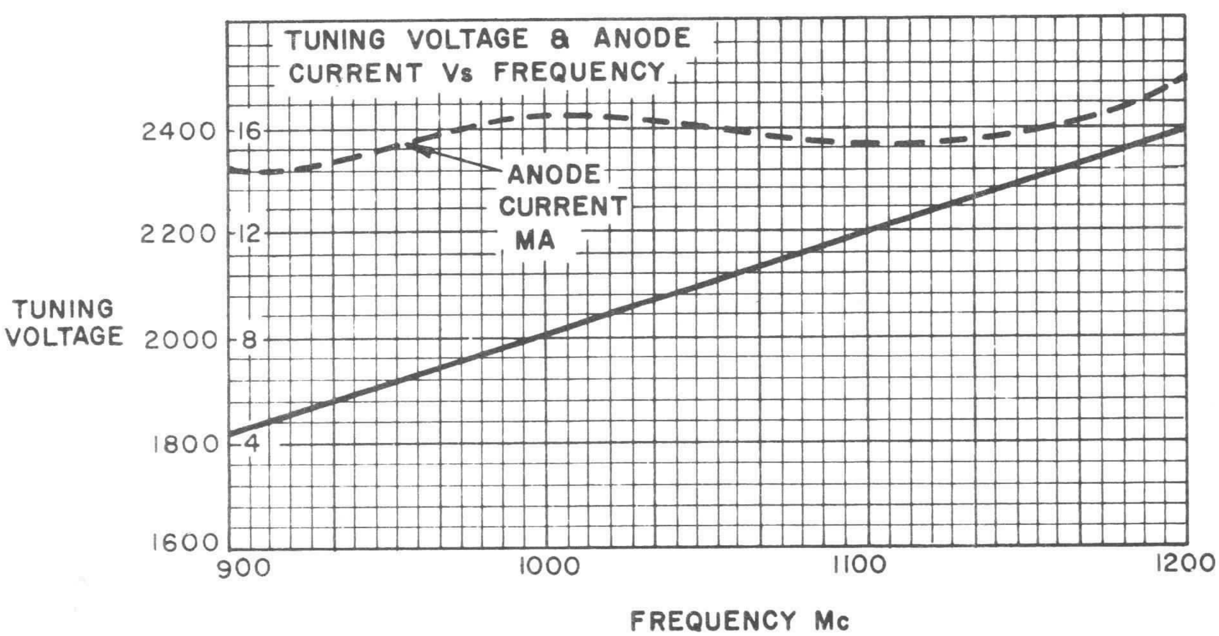
HEATER — WHITE

HEATER CATHODE — BLACK

INJECTION ANODE — YELLOW

X1081 VTM


POWER OUTPUT Vs FREQUENCY
INJECTION ANODE VOLTAGE = 380 V.
12
9
6
3
0
POWER
OUTPUT
WATTS
900
1000
1100
1200
FREQUENCY Mc

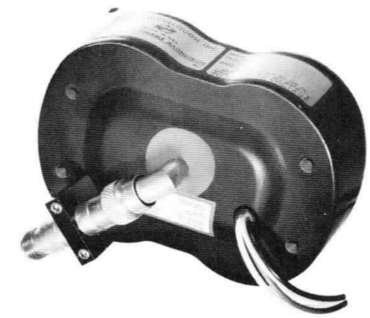

TUNING VOLTAGE & ANODE
CURRENT Vs FREQUENCY
2400
16
2200
12
2000
8
1800
4
1600
TUNING
VOLTAGE
ANODE
CURRENT
MA
900
1000
1100
1200
FREQUENCY Mc

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1083B

Low Noise Voltage Tunable Magnetron
Frequency 320 - 525 Mc
Minimum Power Output 32 mW

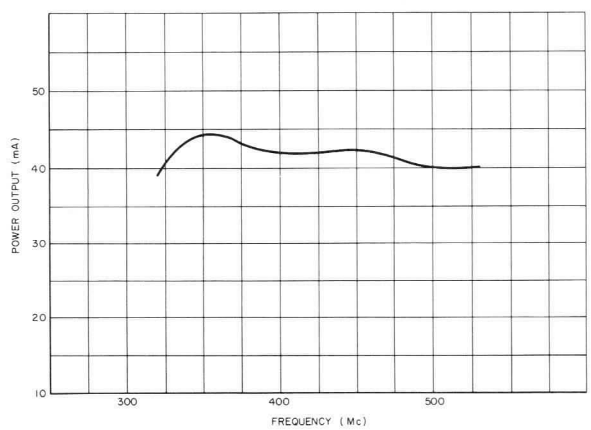
TYPICAL PERFORMANCE



P-BAND OSCILLATOR

ELECTRICAL

Frequency Range	320-525 Mc
Anode Voltage	1230-2000 V
Cathode Current	0.5-1.5 mA
Typical Output Power	30-50 mW
Anode FM Sensitivity	.26 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.02 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw
Noise	--85 db (See Note 5)
VSWR (max)	2:1



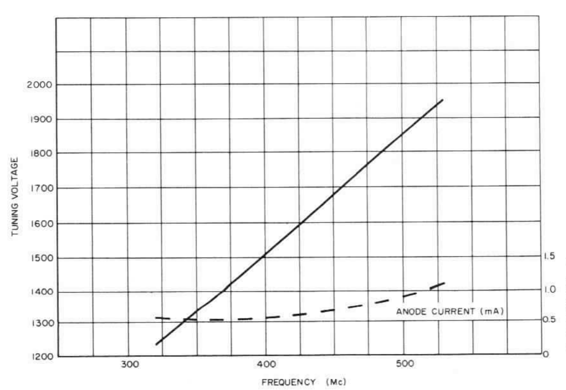
MAXIMUM RATINGS*

Anode Voltage	2300 V
Cathode Current	10 mA
Injection Anode Voltage	+300 V
Injection Anode Current	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type TNC Jack (See Outline Drawing)
Weight	3.5 Pounds



ENVIRONMENTAL

Vibration	10G-(to 2kc)
Shock	100G-(11ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3.1 inches
Width	2.5 inches
Length	4.6 inches

APPLICATION NOTES

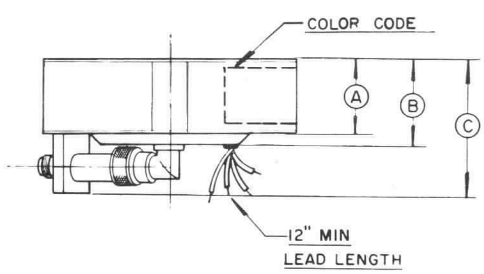
1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

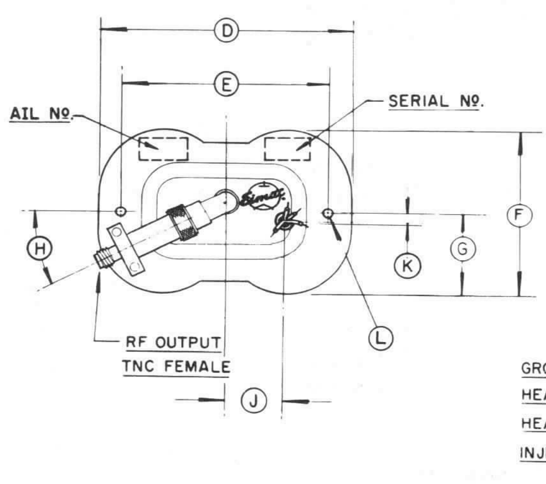
3. TEMPERATURE STABILITY: The permanent magnet for the X-1083-B has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficent for the X-1083-B package is typically .008% of the operating frequency per degree Centrigrade. Thus, for an operating frequency of 400 megacycles, the temperature/frequency coefficient is typically 32 kilocycles per degree Centrigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

5. NOISE: 5 points as measured using a 60 Mc If, both sidebands and a 2 Mc bandpass (this measuring technique is one of many methods available. Other methods will be entertained.)



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.500
D		4.600	
E	3.640	3.671	
F		3.100	
G			1.500
H			27°
J			1.062
K			.375
L			.173 D.



CONNECTIONS
GROUND - GREEN
HEATER - WHITE
HEATER CATHODE - BLACK
INJECTION ANODE - YELLOW

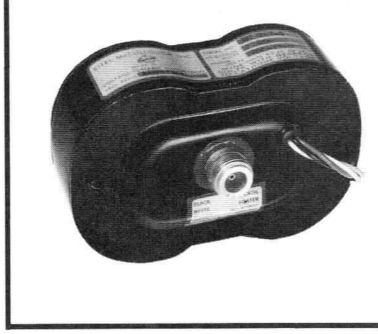
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X-1084

UHF
PACKAGED

VOLTAGE TUNABLE
MAGNETRON



The Eimac X-1084 is a ruggedized, ceramic and metal packaged voltage-tunable magnetron capable of delivering a minimum output power of 30 milliwatts into a 50-ohm termination over the frequency range of 300 to 600 megacycles.

The electron injection design incorporated in this magnetron minimizes back-bombardment of the indirectly heated EMA cathode with resultant long life. This design also reduces output power variation across the tuning range by limiting the cathode current variation resulting from anode voltage changes.

The extremely linear tuning characteristic of this magnetron simplifies programming and frequency sweep, by eliminating the complicated compensating networks required by other voltage tunable oscillators. In addition, the injection anode may be programmed to provide some leveling action on the output power during the frequency sweep.

The X-1084 circuit assembly has been designed for use with this tube to cover the specified frequency range and includes the permanent magnet and rf circuitry. Electrical connections to the tube are completed by means of flexible leads.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, EMA	
	Warm-up time	60 seconds
Heater:	Voltage (AC or DC)	6.3 volts
	Current	.8 ampere
Minimum Output Power		30 milliwatts
Frequency Range		300 to 600 megacycles

MECHANICAL

Operating Position	any
Cooling	conduction
Electrical Connections	flexible leads
RF Output Coupling	TNC Female
Net Weight, including magnet and circuit	3.2
Shipping Weight	10 lbs.
Maximum Overall Dimensions (Magnet and Circuit):	
Height	3 inches
Width	2 inches
Length	4½ inches

Effective 1 August 1962
Printed in U.S.A.

MAXIMUM RATINGS

Anode Voltage*	1800 volts
Cathode Current	10 milliamperes
Dissipation	18 watts
Injection Anode Voltage*	+500 volts
Injection Anode Current	.5 milliamperes

TYPICAL OPERATION (Load VSWR = 1.15:1)

Frequency Range	300	600 megacycles
Anode Voltage* (Note 1)	800	1550 volts
Cathode Current	1	3 milliamperes
Typical Power Output	50	200 milliwatts
Anode FM Sensitivity		.40 Mc/volt
Injection Anode Voltage		200 volts
Injection Anode Current		0.05 milliamperes
Heater Voltage (AC)		6.3 volts
Heater Current (AC)		0.8 amperes

*All voltages referred to the cathode.

Note 1. The operating frequency is determined by the Anode Voltage.

Anode: The operating frequency is determined by the anode voltage. The anode is mounted in direct electrical contact with the external circuit. Therefore, it is often convenient to operate the anode at chassis potential, with the cathode and the injection anode at appropriate negative potentials.

Cathode: The cathode and one leg of the heater are internally connected. Therefore, the heater supply must be insulated for the maximum tuning voltage.

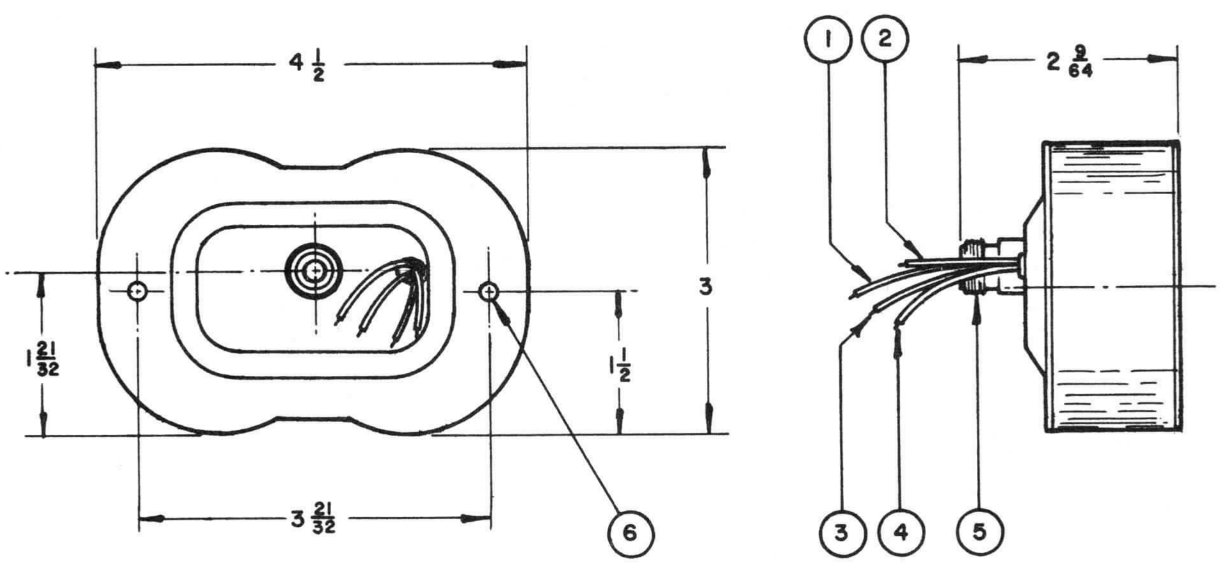
The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained. Either alternating or direct current may be used to energize the X-1084 heater in most applications as a result of the advanced counter-wound helical heater package. In applications where residual FM at the power supply frequency must be held to an absolute minimum, it is recommended that direct current be used for the heater.

Proximity of Ferrous Materials: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

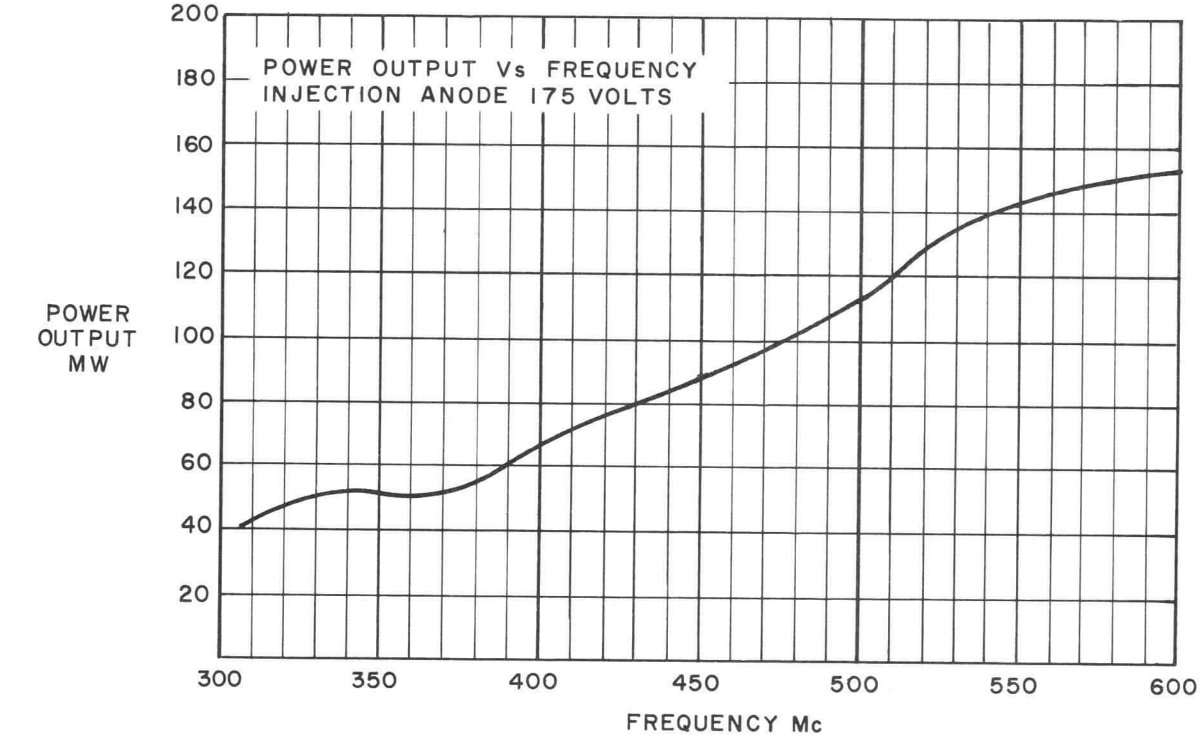
Temperature Stability: The permanent magnet for the X-1084 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1084 package is typically .008 of the operating frequency per degree Centigrade. Thus, for an operating frequency of 500 megacycles, the temperature/frequency coefficient is typically 40 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

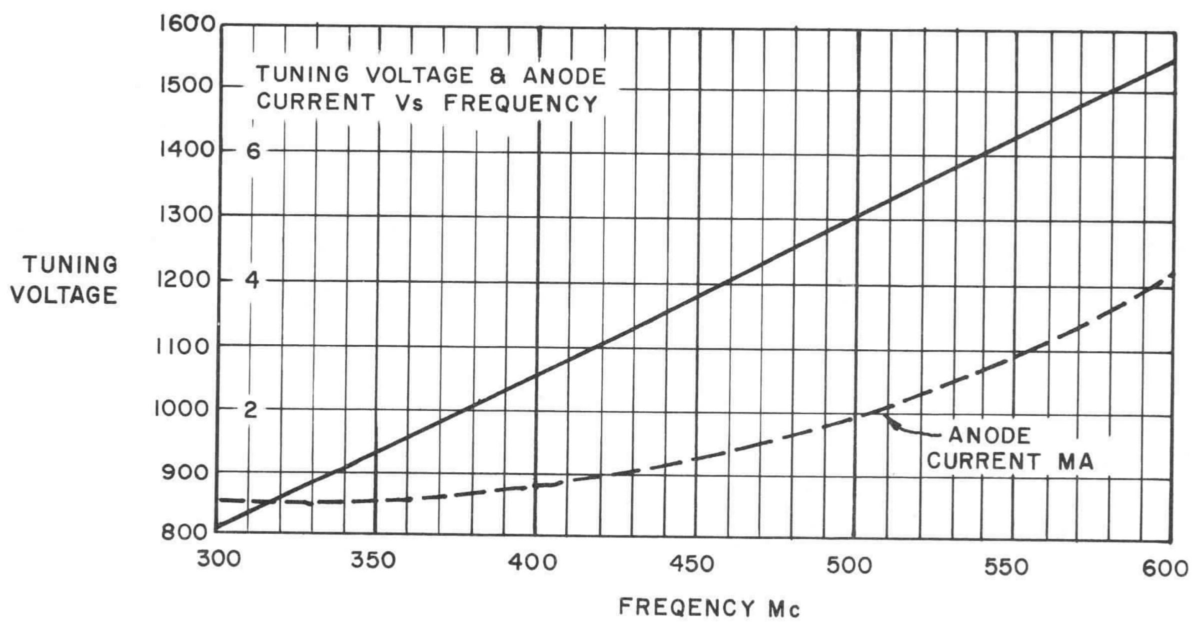
Linearity: The voltage/magnetic-field/frequency relationship of a magnetron is theoretically linear and this linearity is observed in practical tubes. The frequency versus tuning voltage curve for the X-1084 is a straight line with a positive slope and maye be easily programmed for the desired frequency sweep. Tests of the fine grain linearity curve show a deviation from a straight line of approximately 3-5 parts per thousand over a 20 megacycle bandwidth.

Special Applications: For any aditional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, telephone LYtell 1-1451, Cable: EIMAC.



6	3/16 DIA. MOUNTING HOLES (2) REQ'D
5	FEMALE TNC CONNECTOR
4	GROUND LEAD (GREEN)
3	HEATER LEAD (WHITE)
2	HEATER CATHODE LEAD (BLACK)
1	INJECTION ANODE LEAD (YELLOW)


POWER OUTPUT Vs FREQUENCY
INJECTION ANODE 175 VOLTS
POWER OUTPUT MW
200
180
160
140
120
100
80
60
40
20
300
350
400
450
500
550
600
FREQUENCY Mc


TUNING VOLTAGE & ANODE
CURRENT Vs FREQUENCY
TUNING VOLTAGE
1600
1500
1400
1300
1200
1100
1000
900
800
6
4
2
ANODE
CURRENT MA
300
350
400
450
500
550
600
FREQENCY Mc

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM-1086

L-BAND PACKAGED VOLTAGE TUNABLE MAGNETRON

The Eimac EM-1086 is a ruggedized, ceramic and metal packaged voltage-tunable magnetron capable of delivering a minimum output power of 15 watts into a 50 ohm termination over the frequency range of 940-1060 megacycles.

Eimac's three terminal VTM circuit has been used in this tube to give a more uniform output circuit with the added advantage of one-third more heat dissipating area extending out of the VTM envelope.

The electron injection design incorporated in this magnetron minimizes back-bombardment of the indirectly heated EMA cathode with resultant long life. This design also reduced output power variation across the tuning range by limiting the cathode current variation resulting from anode voltage changes.

The linear tuning characteristics of this magnetron simplifies programming the frequency sweep, by eliminating the complicated compensating networks required by other voltage tunable oscillators.

The EM-1086 Circuit Assembly has been designed for use with this tube to cover the specified frequency range and includes the permanent magnet and rf circuitry. Electrical connections to the tube are completed by means of flexible leads.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, EMA	
Warm-up Time	30 seconds
Heater: Voltage (AC or DC)	6.3 volts
Current	1.0 ampere
Minimum Output Power	15 watts
Frequency Range	940 to 1060 megacycles

MECHANICAL

Operating Position	any
Cooling	see note
Electrical Connections	flexible leads
RF Output Coupling	TNC male (6" flexible Rf connector)
Net Weight, including magnet and circuit	3.5 pounds
Shipping Weight	10 pounds
Maximum Overall Dimensions (Magnet and Circuit):	
Height	3 inches
Width	1.575 inches
Length	4.556 inches

MAXIMUM RATINGS

Anode Voltage*	2500 volts
Cathode Current	35 milliamperes
Injection Anode Voltage*	750 volts
Injection Anode Current	1 milliampere

TYPICAL OPERATION (EM-1086 Circuit Assembly, Load VSWR=1.15:1)

Frequency Range	940-1060	megacycles
Anode Voltage* (Note 1)	1840-2075	volts
Cathode Current	21 - 25	milliamperes
Typical Power Output	16 - 16	watts
Anode FM Sensitivity	.50	Mc/volt
Injection Anode Voltage	500	volts
Injection Anode Current	.02	milliamperes
Heater Voltage (AC)	6.3	volts
Heater Current (AC)	0.8	amperes

*All voltages referred to the cathode.

Note 1. The operating frequency is determined by the Anode Voltage.

APPLICATION

Cooling: To insure normal operation over prolonged periods, sufficient cooling is required so that the EM-1086 magnet temperature does not exceed 70°C.

Anode: The operating frequency is determined by the anode voltage. The anode is mounted in direct electrical contact with the external circuit. Therefore, it is often convenient to operate the anode at chassis potential with the cathode and injection anode at appropriate negative potentials.

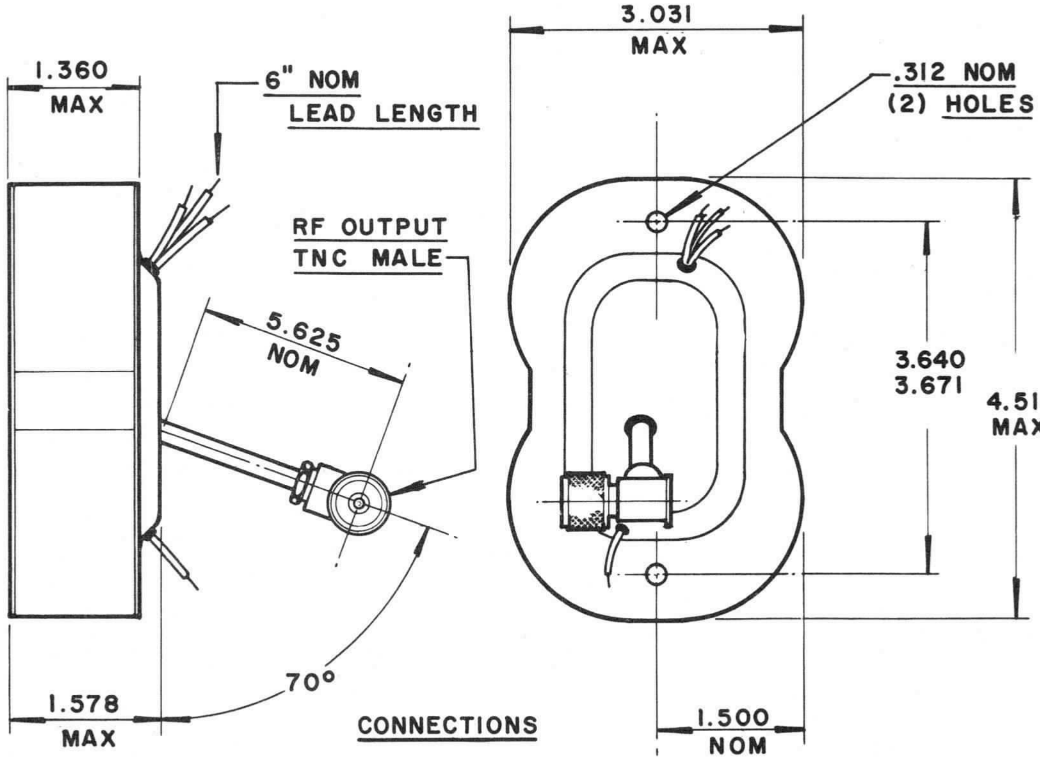
Cathode: The cathode and one leg of the heater are internally connected. Therefore, the heater supply must be insulated for the maximum tuning voltage.

The heater voltage should be maintained within $\pm 5\%$ of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained. Either alternating or direct current may be used to energize the EM-1086 heater in most applications as a result of the advanced counterwound helical heater package. In applications where residual FM at the power supply frequency must be held to an absolute minimum, it is recommended that direct current be used for the heater.

Proximity of Ferrous Materials: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

Temperature Stability: The permanent magnet for the EM-1086 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the EM-1086 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1,000 megacycles, the temperature/frequency coefficient is typically 200 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, telephone LYtell 1-1451.
Cable: EIMAC.



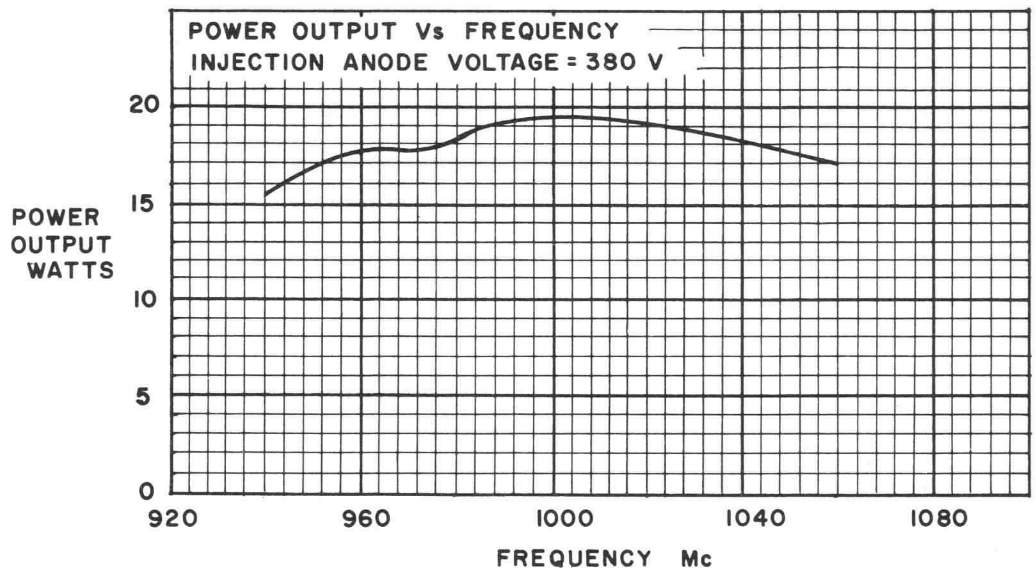
CONNECTIONS

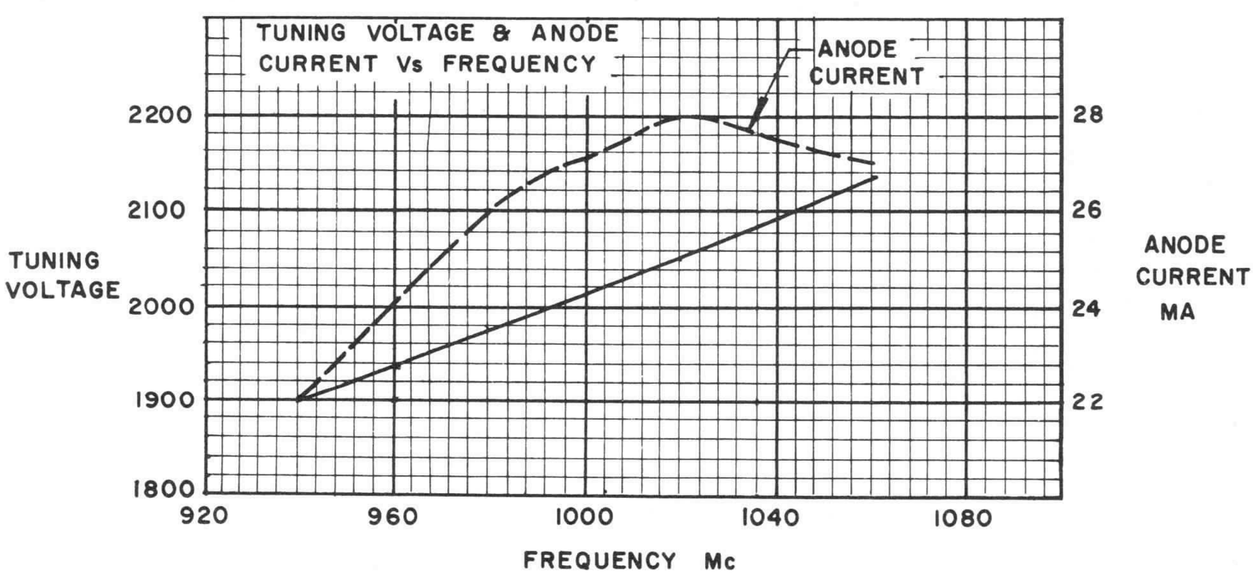
GROUND – BLACK

HEATER – BLUE

HEATER CATHODE – RED

INJECTION ANODE – WHITE


POWER OUTPUT Vs FREQUENCY
INJECTION ANODE VOLTAGE = 380 V
POWER OUTPUT WATTS
0
5
10
15
20
920
960
1000
1040
1080
FREQUENCY Mc


TUNING VOLTAGE & ANODE CURRENT Vs FREQUENCY
ANODE CURRENT
TUNING VOLTAGE
1800
1900
2000
2100
2200
ANODE CURRENT MA
22
24
26
28
920
960
1000
1040
1080
FREQUENCY Mc

X-1088-B

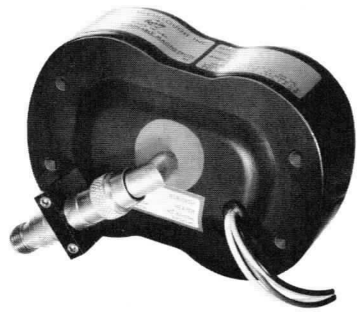
Low Noise Voltage Tunable Magnetron

Frequency 520 - 925 Mc

Minimum Output Power 32 mW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

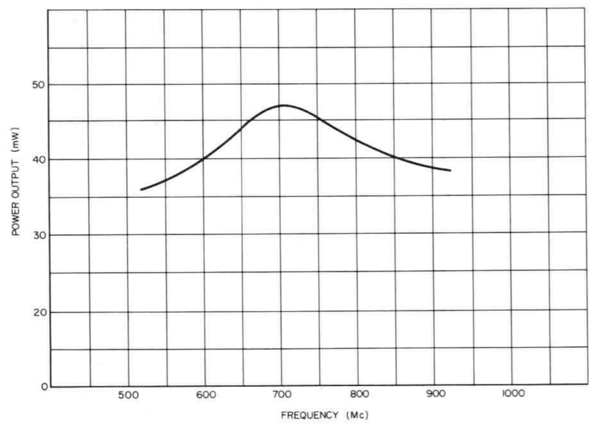
TYPICAL PERFORMANCE



P-BAND OSCILLATOR

ELECTRICAL

Frequency Range	520-925 Mc
Anode Voltage	1000-2000 V
Cathode Current	2-4 mA
Typical Output Power	30-50 mW
Anode FM Sensitivity	.55 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.02 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw
Noise	−85 db (See Note 5)
VSWR (max)	2:1



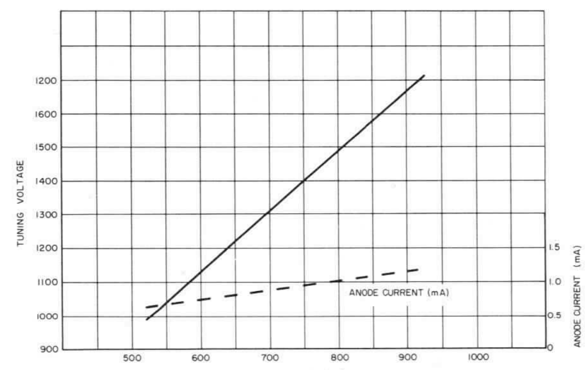
*MAXIMUM RATINGS

Anode Voltage	2300 V
Cathode Current	10 mA
Injection Anode Voltage	+300 V
Injection Anode Current	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type TNC Jack (See Outline Drawing)
Weight	3.5 Pounds



ENVIRONMENTAL

Vibration	10G-(to 2 kc)
Shock	100G-(11 ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3.1 inches
Width	2.5 inches
Length	4.6 inches

APPLICATION NOTES

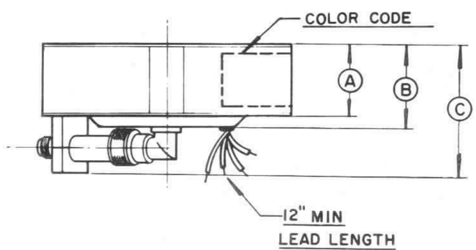
1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the X-1088-B has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1088-B package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 700 megacycles, the temperature/frequency coefficient is typically 56 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

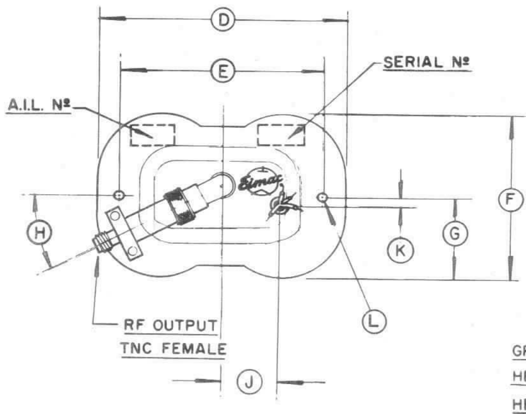
4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

5. NOISE: 5 points as measured using a 60 Mc If, both sidebands and a 2 Mc bandpass (This measuring technique is one of many methods available. Other methods will be entertained.)



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.500
D		4.600	
E	3.640	3.671	
F		3.100	
G			1.500
H			27°
J			1.062
K			.375
L			.173 D.



CONNECTIONS
GROUND - GREEN
HEATER - WHITE
HEATER CATHODE - BLACK
INJECTION ANODE - YELLOW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

OBJECTIVE DATA

X-1091

S-BAND PACKAGED VOLTAGE TUNABLE MAGNETRON

The Eimac X-1091 is a ruggedized, ceramic and metal packaged voltage-tunable magnetron capable of delivering a minimum output power of 35 watts into a 50 ohm termination over the frequency range of 2.2 to 2.3 Kmc.

The electron injection design incorporated in this magentron minimizes back-bombardment of the indirectly heated EMA cathode with resultant long life. This design also reduces output power variation across the tuning range by limiting the cathode current variation resulting from anode voltage changes.

The extremely linear tuning characteristic of this magnetron simplifies programming the frequency sweep, by eliminating the complicated compensating networks required by other voltage tunable oscillators.

The X-1091 Circuit Assembly has been designed for use with this tube to cover the specified frequency range and includes the permanent magnet and rf circuitry. Electrical connections to the tube are completed by means of flexible leads.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, Matrix	
Warm-up Time	60 seconds
Heater: Voltage (AC or DC)	6.3 volts
Current	1.0 ampere
Minimum Output Power	35 watts
Frequency Range	2200 to 2300 megacycles

MECHANICAL

Operating Position	Any
Cooling	Forced Air
Electrical Connections	Flexible leads
RF Output Coupling	Type N or TNC Female
Net weight, including magnet and circuit	3.2 pounds
Shipping Weight	10 pounds
Maximum Overall Dimensions (Magnet and Circuit):	
Height	3 inches
Width	2 5/16 inches
Length	4 1/2 inches

MAXIMUM RATINGS

Anode Voltage*	2500 volts
Cathode Current	60 milliamperes
Injection Anode Voltage*	600 volts
Injection Anode Current	1 milliampere

TYPICAL OPERATION (In X-1091 Circuit Assembly, Load VSWR=1.15:1)

Frequency Range	2200-2300	megacycles
Anode Voltage* (Note 1)	1800-1940	volts
Cathode Current	35 - 40	milliamperes
Typical Power Output	35 - 35	watts
Anode FM Sensitivity	1.4	Mc/volt
Injection Anode Voltage	300	volts
Injection Anode Current	0.5	milliampere
Heater Voltage (AC)	6.3	volts
Heater Current	0.8	amperes

*All voltages referred to the cathode.

Note 1. The operating frequency is determined by the anode voltage.

APPLICATION

Cooling: The X-1091 is designed to be cooled by forced air. To insure normal operation over long periods, sufficient cooling is required to maintain the magnet temperature below 70°C.

Anode: The operating frequency is determined by the anode voltage. The anode is mounted in direct electrical contact with the external circuit. Therefore, it is often convenient to operate the anode at chassis potential, with the cathode and injection anode at appropriate negative potentials.

Cathode: The cathode and one leg of the heater are internally connected. Therefore, the heater supply must be insulated for the maximum tuning voltage.

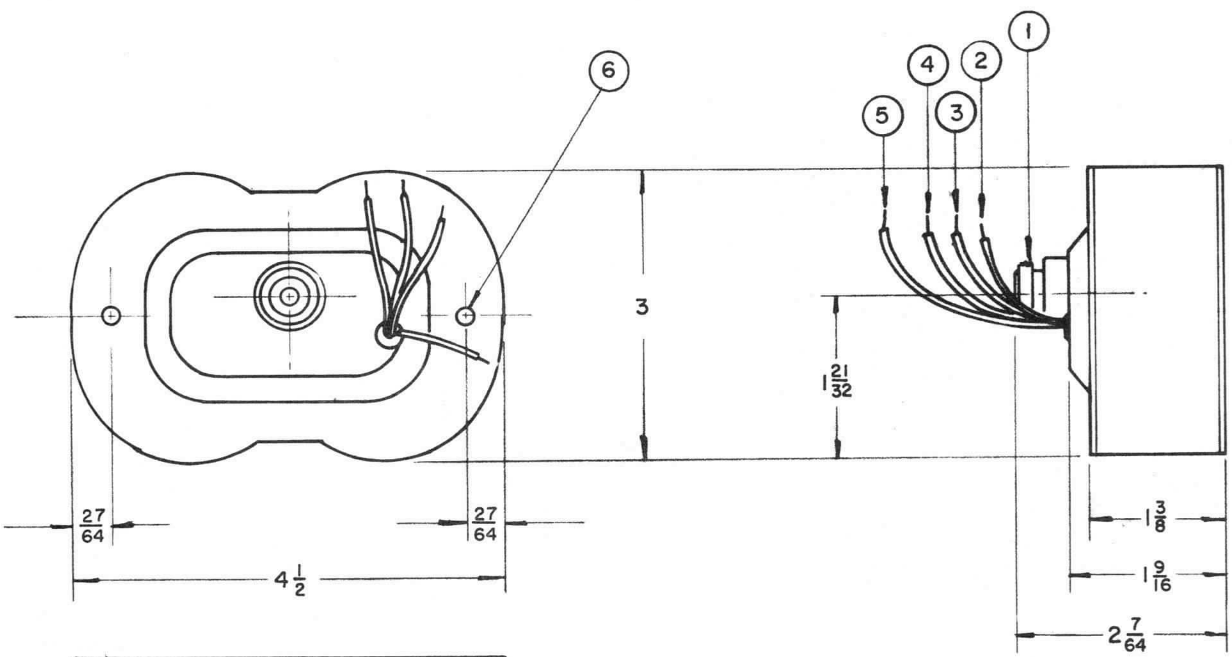
The heater voltage should be maintained within $\pm 5\%$ of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained. Either alternating or direct current may be used to energize the X-1091 heater in most applications as a result of the advanced counter-wound helical heater package. In applications where residual FM at the power supply frequency must be held to an absolute minimum, it is recommended that direct current be used for the heater.

Proximity of Ferrous Materials: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

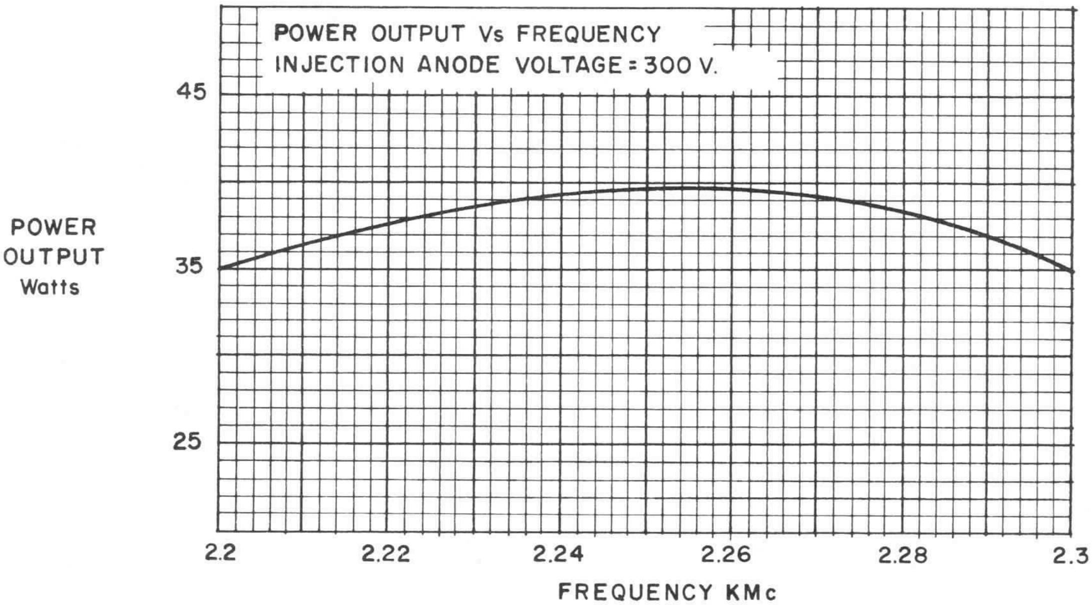
Temperature Stability: The permanent magnet for the X-1091 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1091 package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 2250 megacycles, the temperature/frequency coefficient is typically 180 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

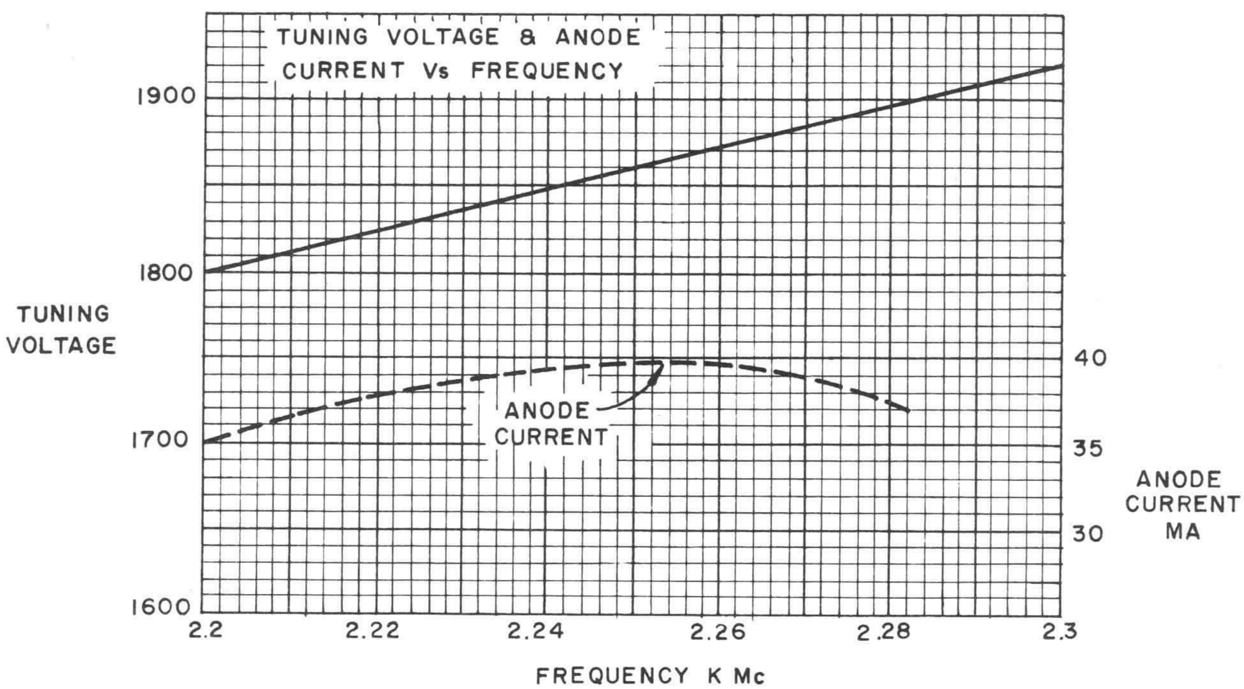
Linearity: The voltage/magnetic-field/frequency relationship of a magnetron is theoretically linear and this linearity is observed in practical tubes. The frequency versus tuning voltage curve for the X-1091 is a straight line with a positive slope and may be easily programmed for the desired frequency sweep. Tests of the fine grain linearity curve show a deviation from a straight line of approximately 3-5 parts per thousand over a 20 megacycle bandwidth.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, telephone LYtell 1-1451.
Cable: EIMAC.



6	3/16 DIA. MOUNTING HOLES
5	GROUND LEAD – Green
4	HEATER LEAD – White
3	INJECTION ANODE LEAD – Yellow
2	HEATER CATHODE LEAD – Brown
1	FEMALE TNC CONNECTOR


POWER OUTPUT Vs FREQUENCY
INJECTION ANODE VOLTAGE = 300 V.
POWER OUTPUT Watts
45
35
25
2.2
2.22
2.24
2.26
2.28
2.3
FREQUENCY KMc

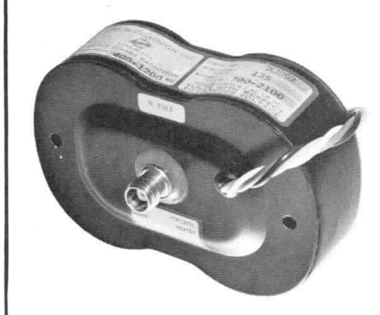

TUNING VOLTAGE & ANODE CURRENT Vs FREQUENCY
TUNING VOLTAGE
1900
1800
1700
1600
ANODE CURRENT
40
35
30
ANODE CURRENT MA
2.2
2.22
2.24
2.26
2.28
2.3
FREQUENCY K Mc

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

OBJECTIVE DATA

X-1092

L-BAND PACKAGED VOLTAGE TUNABLE MAGNETRON



The Eimac X-1092 is a ruggedized, ceramic and metal packaged voltage-tunable magnetron capable of delivering a minimum output power of 750 milliwatts into a 50-ohm termination over the frequency range of 800 to 1450 megacycles.

The electron injection design incorporated in this magnetron minimizes back-bombardment of the indirectly heated EMA cathode with resultant long life. This design also reduces output power variation across the tuning range by limiting the cathode current variation resulting from anode voltage changes.

The extremely linear tuning characteristic of this magnetron simplifies programming the frequency sweep, by eliminating the complicated compensating networks required by other voltage tunable oscillators.

The X-1092 Circuit Assembly has been designed for use with this tube to cover the specified frequency range and includes the permanent magnet and rf circuitry. Electrical connections to the tube are completed by means of flexible leads.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, EMA		
	Warm-up time	60	seconds
Heater:	Voltage (AC or DC)	6.3	volts
	Current	0.8	ampere
Minimum Output Power		750	milliwatts
Frequency Range		800 to 1450	megacycles

MECHANICAL

Operating Position	any
Cooling	forced air
Electrical Connections	flexible leads
RF Output Coupling	TNC female
Net Weight, including magnet and circuit	3.5 pounds
Shipping Weight	10 pounds
Maximum Overall Dimensions (Magnet and Circuit):	
Height	3 inches
Width	2 inches
Length	4-1/2 inches

MAXIMUM RATINGS

Anode Voltage*	2500	volts
Cathode Current	25	milliamperes
Injection Anode Voltage*	+500	volts

TYPICAL OPERATION (In X-1092 Circuit Assembly, Load VSWR = 1.15:1)

Frequency Range	800	1450	megacycles
Anode Voltage* (Note 1)	1175	2070	volts
Cathode Current	7	15	milliamperes
Typical Power Output	0.9	3	watts
Anode FM Sensitivity		.75	Mc/volt
Injection Anode Voltage*		200	volts
Injection Anode Current		.05	milliampere
Heater Voltage (AC)		6.3	volts
Heater Current (AC)		0.8	ampere

*All voltages referred to the cathode.

Note 1. The operating frequency is determined by the Anode Voltage.

APPLICATION

Anode: The operating frequency is determined by the anode voltage. The anode is mounted in direct electrical contact with the external circuit. Therefore, it is often convenient to operate the anode at chassis potential, with the cathode and injection anode at appropriate negative potentials.

Cathode: The cathode and one leg of the heater are internally connected. Therefore, the heater supply must be insulated for the maximum tuning voltage.

The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and the best tube life obtained. Either alternating or direct current may be used to energize the X-1092 heater in most applications as a result of the advanced counter-wound helical heater package. In applications where residual FM at the power supply frequency must be held to an absolute minimum, it is recommended that direct current be used for the heater.

Proximity of Ferrous Materials: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

Cooling: To insure long life and best operation, the magnet temperature should not exceed 70° C.

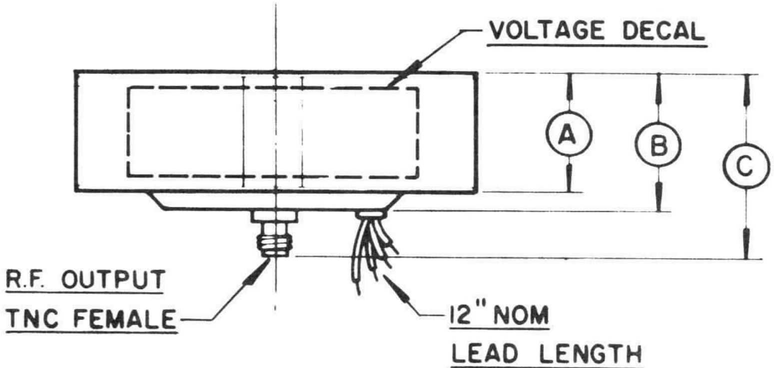
Temperature Stability: The permanent magnet for the X-1092 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1092 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1000 megacycles, the temperature/frequency coefficient is typically 200 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

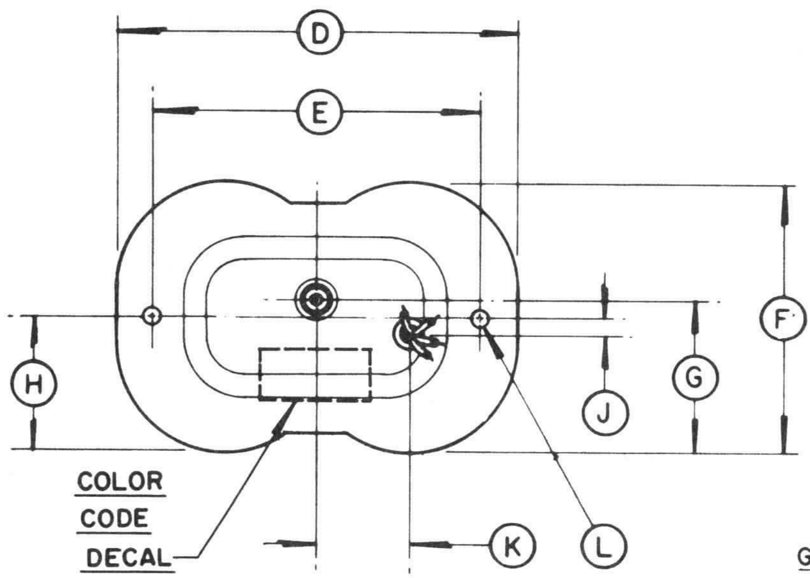
Linearity: The voltage/magnetic-field/frequency relationship of a magnetron is theoretically linear and this linearity is observed in practical tubes. The frequency versus tuning voltage curve for the X-1092 is a straight line with a positive slope and may be easily programmed for the desired frequency sweep.

Special Applications: For any additional information concerning this tube or its application, write to Microwave Product Manager, Eitel-McCullough, Inc., San Carlos, California, telephone LYtell 1-1451, Cable: EIMAC.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.312
D		4.515	
E	3.640	3.671	
F		3.031	
G			1.656
H			1.500
J			.375
K			1.062
L			.187 D.





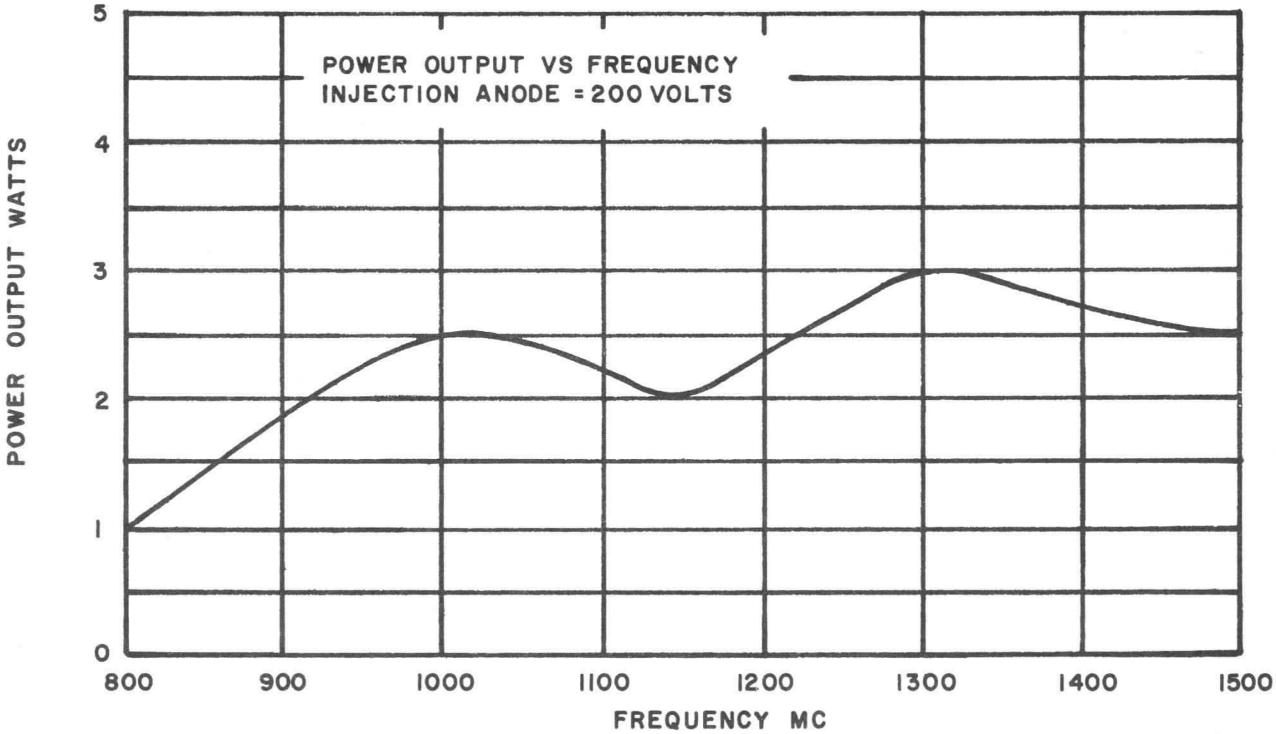
CONNECTIONS

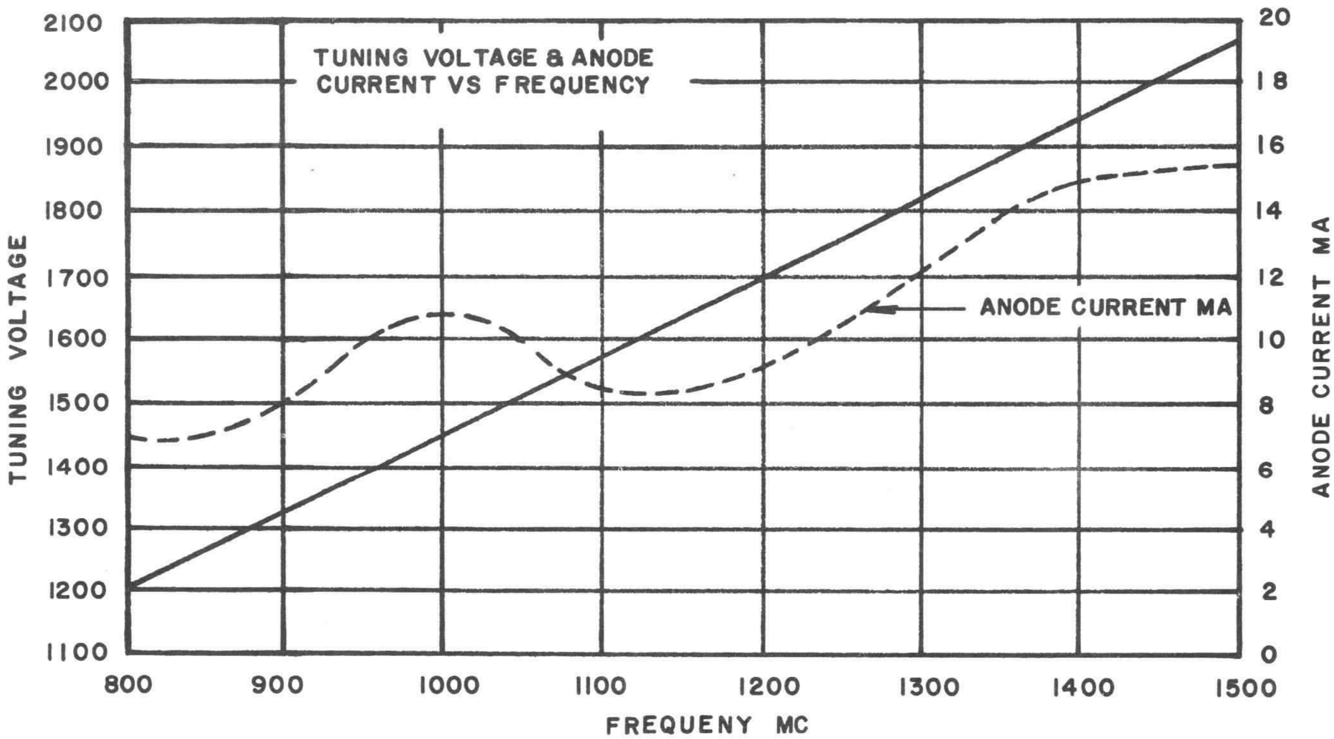
GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW


POWER OUTPUT VS FREQUENCY
INJECTION ANODE = 200 VOLTS
POWER OUTPUT WATTS
0
1
2
3
4
5
800
900
1000
1100
1200
1300
1400
1500
FREQUENCY MC


TUNING VOLTAGE & ANODE
CURRENT VS FREQUENCY
ANODE CURRENT MA
TUNING VOLTAGE
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
ANODE CURRENT MA
0
2
4
6
8
10
12
14
16
18
20
800
900
1000
1100
1200
1300
1400
1500
FREQUENY MC

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM-1093

VOLTAGE TUNABLE MAGNETRON

FREQUENCY 2.475 - 2.725

MINIMUM OUTPUT POWER 1.75 W

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range - - - - -	2475-2725 Mc
Anode Voltage - - - - - -	1100-1200 V
Cathode Current - - - - - -	12-20 mA
Typical Output Power - - - -	2-3 W
Anode FM Sensitivity - - - -	2.5 Mc/volt
Injection Anode Voltage - - -	300 V
Injection Anode Current - - -	0.0 mA
Heater Voltage (AC) (DC) - - -	6.3 V
Heater Current (AC) (DC) - - -	.65 A
Load Impedance - - - - - -	50 ohms
Service - - - - - - - - -	cw

*MAXIMUM RATINGS

Anode Voltage - - - - - - - - - -	1500 V
Cathode Current - - - - - - - - - -	25 mA
Injection Anode Voltage - - - - - - -	400 V
Injection Anode Current - - - - - - -	0.5 mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

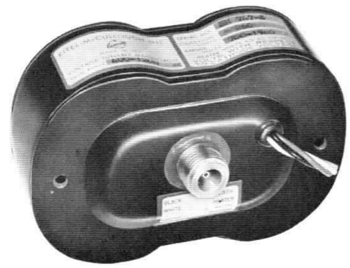
Operating Position - - - - - -	Any
Cooling - - - - - - - - - -	Conduction
Electrical Connection - - - - -	Flexible Leads
RF Output Coupling - - - - - -	Type N Jack
Weight - - - - - - - - - -	3.5 Pounds

ENVIRONMENTAL

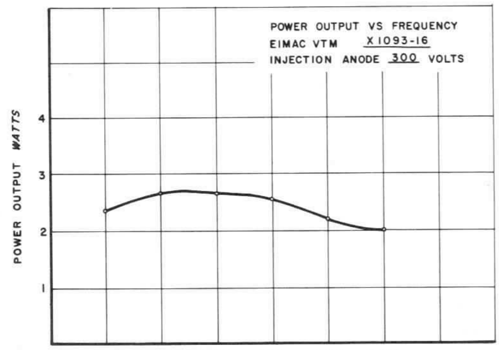
Vibration - - - - - - - - - - -	10 G-(to 2kc)
Shock - - - - - - - - - - -	100 G-(11 ms)
Altitude - - - - - - - - - - -	70,000 ft.

OUTLINE DIMENSIONS

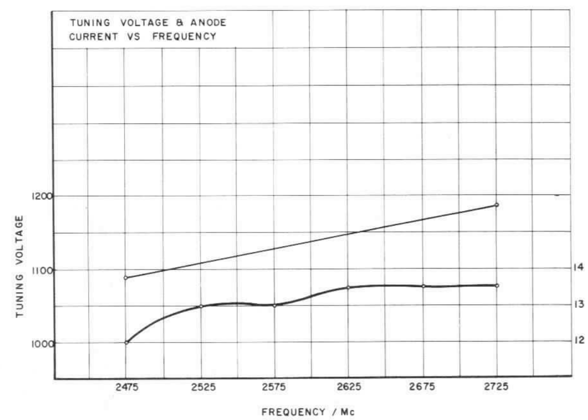
Height - - - - - - - - - - - - -	3 inches
Width - - - - - - - - - - - - -	2.1 inches
Length - - - - - - - - - - - - -	4.5 inches



S-BAND OSCILLATOR



FREQUENCY MC	2475	2525	2575	2625	2675	2725
ANODE VOLTAGE	1080	1100	1120	1140	1160	1180
ANODE CURRENT MA	12.0	13.0	13.0	13.5	13.5	13.5



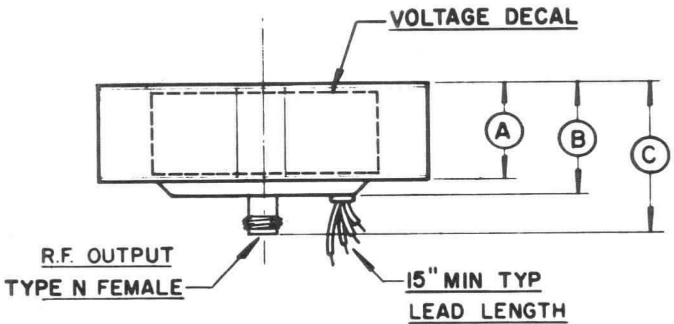
APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70°C.

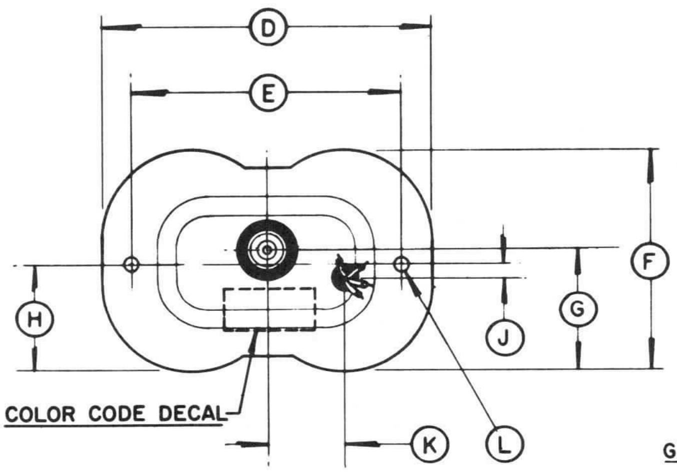
2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the EM-1093 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the EM-1093 package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 2600 megacycles, the temperature/frequency coefficient is typically 520 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.172
D		4.600	
E	3.640	3.671	
F		3.100	3.000
G			1.656
H			1.500
J			.375
K			1.000
L			.187 D.



CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1087

VOLTAGE TUNABLE MAGNETRON

FREQUENCY
515-605 Mc

MINIMUM POWER OUTPUT
10 WATTS

TYPICAL PERFORMANCE

P-BAND
OSCILLATOR

ELECTRICAL

Frequency Range	515	605	Mc
Anode Voltage	1480	1790	V
Cathode Current	13	15	mA
Typical Output Power		10	W
Anode FM Sensitivity		0.3	Mc/V
Injection Anode Voltage		500	V
Injection Anode Current		0.1	mA
Heater Voltage (AC)		6.3	V
Heater Current (AC)		0.8	A
Load Impedance		50	ohms
Service			cw

*MAXIMUM RATINGS

Anode Voltage	2500	V
Cathode Current	25	mA
Injection Anode Voltage	+700	V
Injection Anode Current	1	mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical	Flexible Leads
RF Output Coupling	Type TNC Female
Weight	3.5 Pounds

ENVIRONMENTAL

Vibration	10 G-(to 2 kc)
Shock	100 G-(11 ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3	inches
Width	2.1	inches
Length	4.5	inches

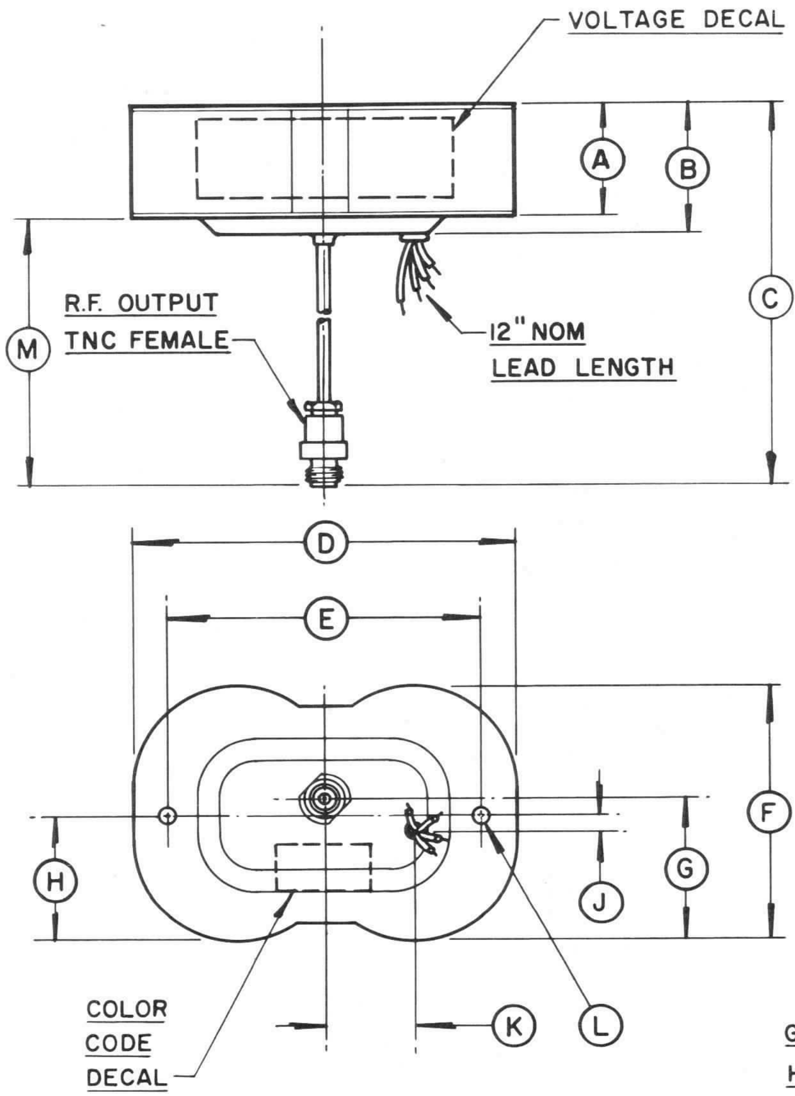
APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70°C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the X-1087 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficent for the X-1087 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 600 megacycles, the temperature/frequency coefficient is typically 120 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			9.375
D		4.515	
E	3.640	3.671	
F		3.031	
G			1.656
H			1.500
J			.375
K			1.062
L			.187 D.
M			8"

CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1094

Voltage Tunable Magnetron

Frequency 375 - 481 Mc

Minimum Output Power 50 mW

TYPICAL PERFORMANCE

ELECTRICAL

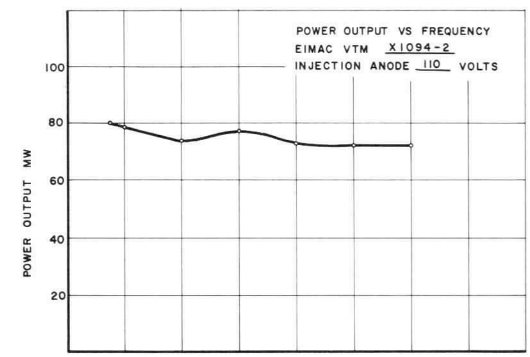
Frequency Range	375-480 Mc
Anode Voltage	1355-1700 V
Cathode Current	.45 to .55 mA
Typical Output Power	75 mW
Anode FM Sensitivity	.3 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.0 mA
Heater Voltage (AC or DC)	6.3 V
Heater Current (AC or DC)	0.8 A
Load Impedance	50 ohms
Service	cw

P-BAND OSCILLATOR

*MAXIMUM RATINGS

Anode Voltage	2000 V
Cathode Current	10 mA
Injection Anode Voltage	250 V
Injection Anode Current	1 mA

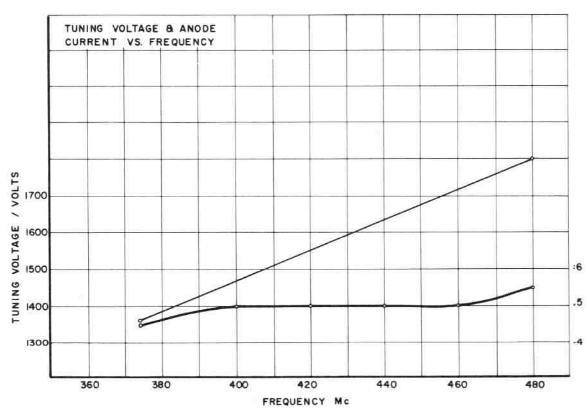
*Damage to the tube may occur if maximum ratings are exceeded.



FREQUENCY MC	360	380	400	420	440	460	480	500
ANODE VOLTAGE		1355	1420	1488	1567	1630	1695	
ANODE CURRENT MA		.45	.5	.5	.5	.5	.55	

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type N Jack
Weight	3.5 Pounds



ENVIRONMENTAL

Vibration	10G-(to 2kc)
Shock	100G-(11ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3 inches
Width	2.1 inches
Length	4.5 inches

(Effective 3-15-94)

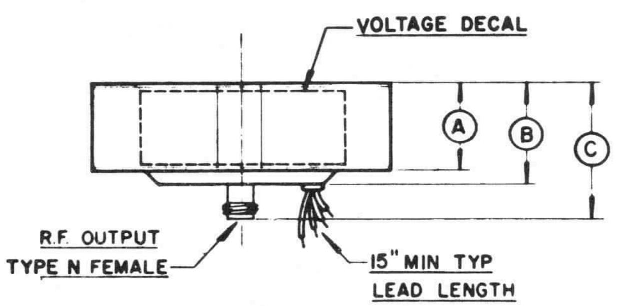
APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70°C.

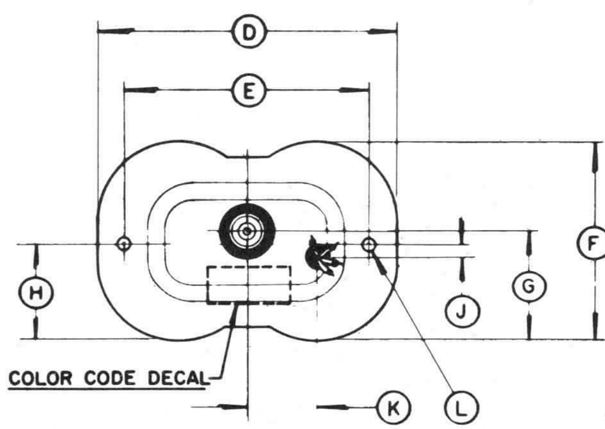
2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray megnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the X-1094 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1094 package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 400 megacycles, the temperature/frequency coefficient is typically 32 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF	MIN	MAX	NOM
A			1.375
B			1.562
C			2.172
D		4.600	
E	3.640	3.671	
F		3.100	3.000
G			1.656
H			1.500
J			.375
K			1.000
L			.187 D.



CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

TENTATIVE DATA

X1097

VOLTAGE TUNABLE MAGNETRON

FREQUENCY 600-1200 Mc

MINIMUM OUTPUT POWER 5 WATTS

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TYPICAL PERFORMANCE

L-BAND OSCILLATOR

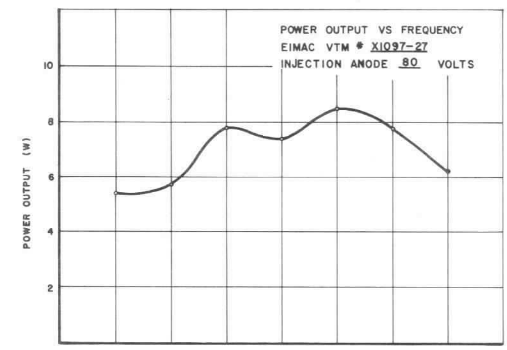
ELECTRICAL

Frequency Range	600-1200 Mc
Anode Voltage	1250-2450 V
Cathode Current	9-25 mA
Typical Output Power	5.5 watts
Anode FM Sensitivity	0.48 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw

*MAXIMUM RATINGS

Anode Voltage	3000 V
Cathode Current	35 mA
Injection Anode Voltage	+500 V
Injection Anode Current	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.



FREQUENCY MC	600	700	800	900	1000	1100	1200
ANODE VOLTAGE	1250	1470	1680	1900	2100	2260	2450
ANODE CURRENT MA	9.5	11	14	16	18	21	25

MECHANICAL

Operating Position	Any
Cooling	Forced Air
Electrical Connection	Flexible Leads
RF Output Coupling	TNC Jack
Weight	1.5 Pounds

ENVIRONMENTAL

Vibration	10 G-(to 2kc)
Shock	100 G-(11 ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	2 inches
Width	1-1/4 inches
Length	3.5 inches

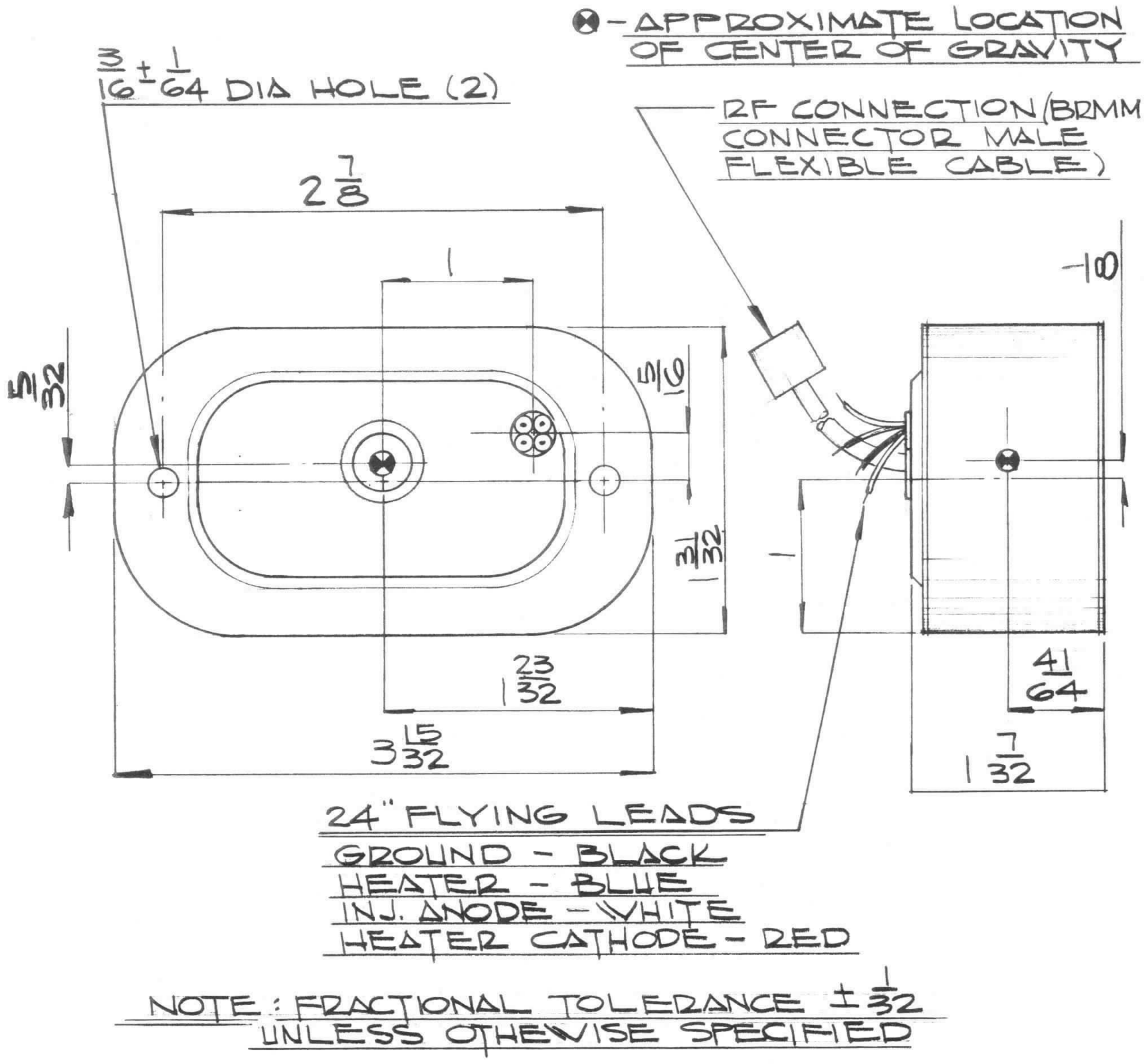
APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. This tube was designed for operation in missile environments and can be operated for short periods of time without any cooling.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X-1098

VOLTAGE TUNABLE MAGNETRON

FREQUENCY
885-1460 Mc

MINIMUM OUTPUT POWER
32 mW

TYPICAL PERFORMANCE

ELECTRICAL

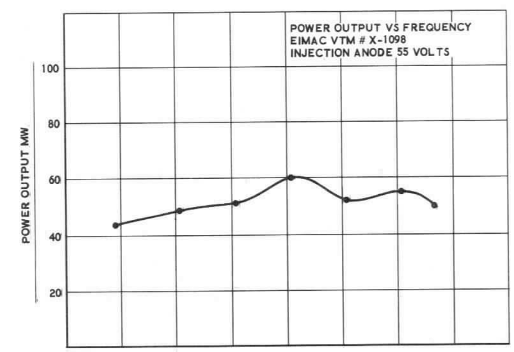
Frequency Range	885-1460 kMc
Anode Voltage	900-1420 V
Cathode Current	2-6 mA
Typical Output Power	45-80 mW
Anode FM Sensitivity	1.1 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.0 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw

LOW NOISE L-BAND OSCILLATOR

*MAXIMUM RATINGS

Anode Voltage	1800 V
Cathode Current	20 mA
Injection Anode Voltage	300 V
Injection Anode Current	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.



FREQUENCY MC	800	900	1000	1100	1200	1300	1400	1500
ANODE VOLTAGE		900	1005	1095	1190	1280	1370	1425
ANODE CURRENT MA		2	2	2.5	3	4	5	6

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type N Jack
Weight	3.5 Pounds

ENVIRONMENTAL

Vibration	10 G-(to 2 kc)
Shock	100 G-(11 ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3 inches
Width	2.1 inches
Length	4.5 inches

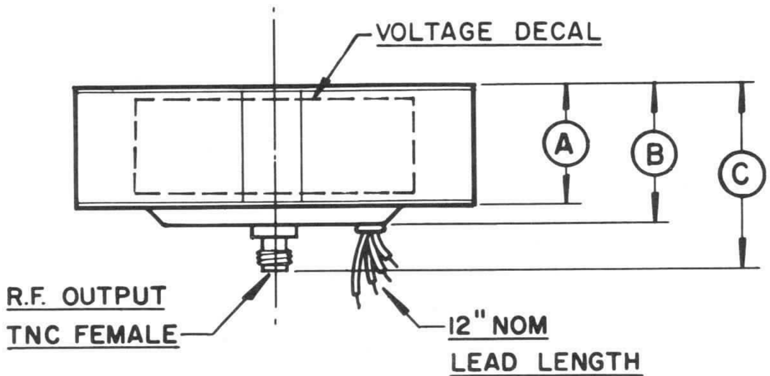
APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70°C.

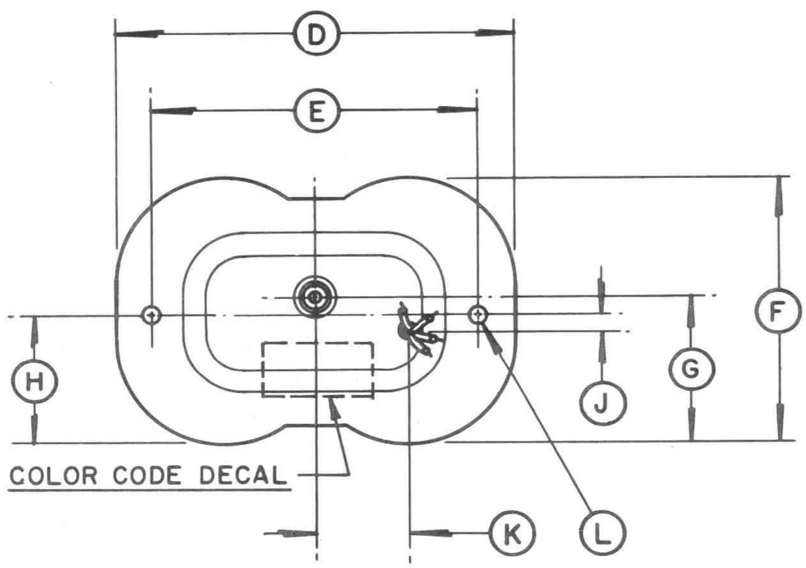
2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the X-1098 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1098 package is typically .006% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1450 megacycles, the temperature/frequency coefficient is typically 300 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.312
D		4.515	
E	3.640	3.671	
F		3.031	
G			1.656
H			1.500
J			.375
K			1.062
L			.187 D.



CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1099

VOLTAGE TUNABLE MAGNETRON

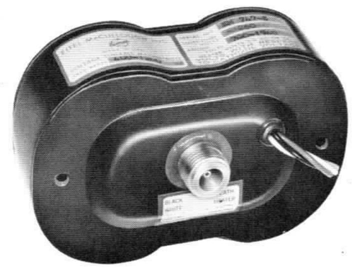
FREQUENCY 530 - 655 Mc

MINIMUM OUTPUT POWER 8 mW

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	530-655 Mc
Anode Voltage	925-1150 V
Cathode Current	0.5 mA
Typical Output Power	20-25 mW
Anode FM Sensitivity	.55 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.0 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw
AM Noise (See Note #5)	—75 db

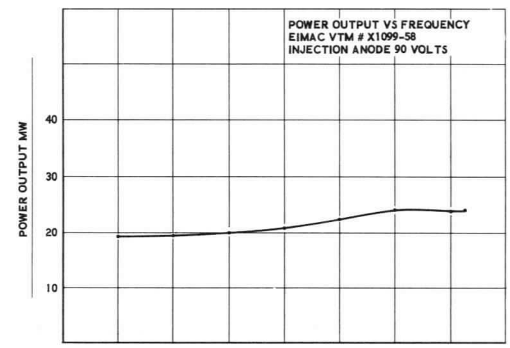


P-BAND OSCILLATOR

*MAXIMUM RATINGS

Anode Voltage	1500 V
Cathode Current	10 mA
Injection Anode Voltage	500 V
Injection Anode Current	1 mA

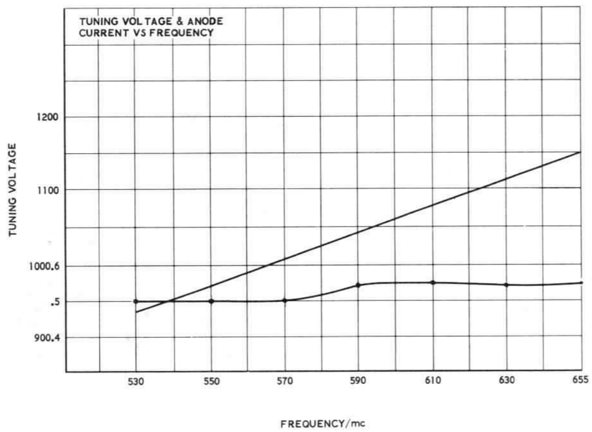
*Damage to the tube may occur if maximum ratings are exceeded.



FREQUENCY MC	530	550	570	590	610	630	650	655
ANODE VOLTAGE	935	965	1000	1040	1070	1105	1145	1150
ANODE CURRENT MA	.50	.50	.50	.55	.55	.55	.55	.55
NOISE LEVEL	-77	-75.9	-77	80.2	-81.7	-79	-78.8	-79.2

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type N Jack
Weight	3.5 Pounds



ENVIRONMENTAL

Vibration	10G-(to 2kc)
Shock	100G-(11ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3 inches
Width	2.1 inches
Length	4.5 inches

APPLICATION NOTES

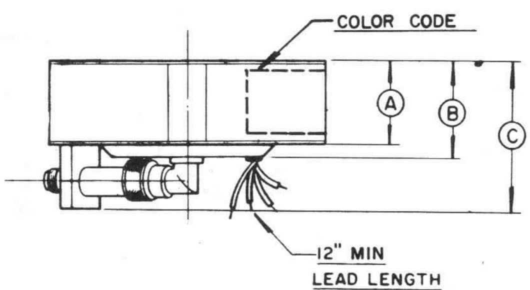
1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

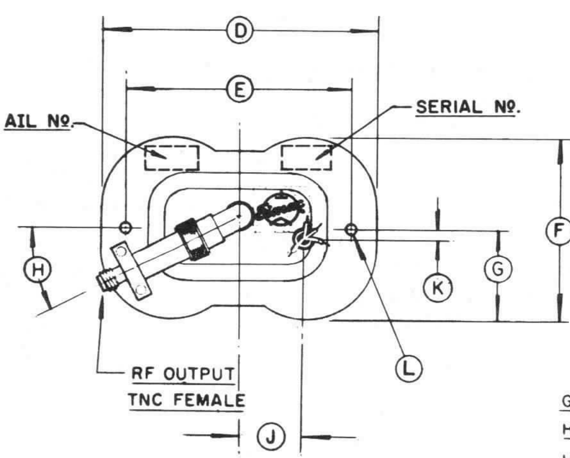
3. TEMPERATURE STABILITY: The permanent magnet for the X-1099 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1099 package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 600 megacycles, the temperature/frequency coefficient is typically 48 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

5. AM NOISE: AM noise is defined as noise in db below the carrier using a 6 omc IF Strip with 2 Mc band pass and includes power in both side bands. Other measurement techniques can be utilized as the application requires.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN	MAX.	NOM.
A			1.375
B			1.562
C			2.500
D		4.600	
E	3.640	3.671	
F		3.100	
G			1.500
H			27°
J			1.062
K			.375
L			.173 D.



CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

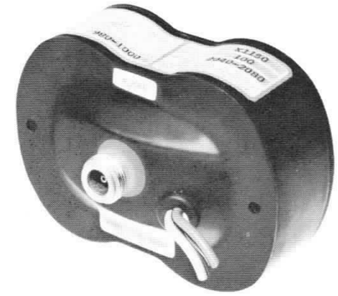
INJECTION ANODE - YELLOW

X-1150

VOLTAGE TUNABLE MAGNETRON

FREQUENCY
980 - Mc 1020

MINIMUM OUTPUT POWER 40 W



L-BAND OSCILLATOR

TYPICAL PERFORMANCE

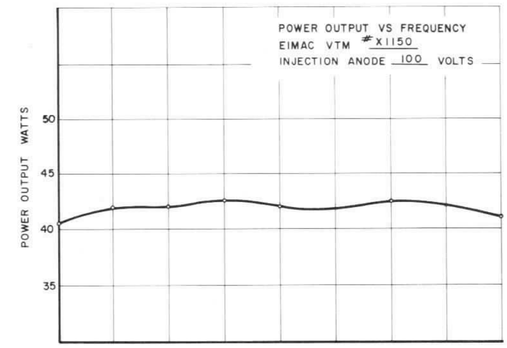
ELECTRICAL

Frequency Range - - - - - - -	980 Mc 1020
Anode Voltage - - - - - - - -	2040 V 2120
Cathode Current - - - - - - -	45-50 mA
Typical Output Power - - - - -	45 W
Anode FM Sensitivity - - - - -	.45 Mc/V
Injection Anode Voltage - - - -	200 V
Injection Anode Current - - - -	0.0 mA
Heater Voltage (AC) - - - - -	6.3 V
Heater Current (AC) - - - - -	0.8 A
Load Impedance - - - - - - -	50 ohms
Service - - - - - - - - - -	cw

*MAXIMUM RATINGS

Anode Voltage - - - - - - - - - - -	2500 V
Cathode Current - - - - - - - - - -	60 mA
Injection Anode Voltage - - - - - - -	500 V
Injection Anode Current - - - - - - -	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.



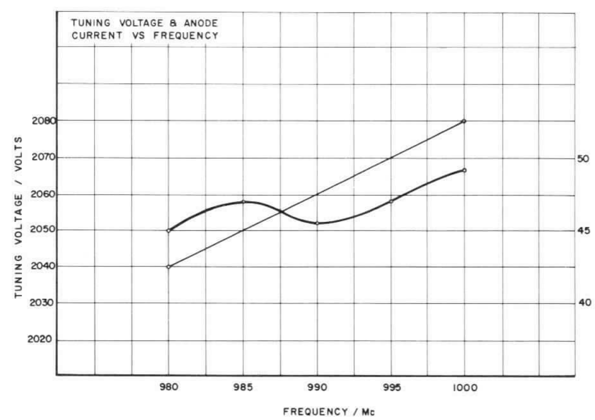
FREQUENCY MC	980	985	990	995	1000	1010	1020
ANODE VOLTAGE	2040	2047	2058	2064	2080	2100	2120
ANODE CURRENT MA	45	47	46	47	49	51	52

MECHANICAL

Operating Position - - - - - -	Any
Cooling - - - - - - - - - - - -	Forced Air
Electrical Connection - - - -	Flexible Leads
RF Output Coupling - - - - - -	Type N Jack
Weight - - - - - - - - - - -	3.5 Pounds

ENVIRONMENTAL

Vibration - - - - - - - - - - -	10G (to 2kc)
Shock - - - - - - - - - - - - -	100G (11ms)
Altitude - - - - - - - - - - -	70,000 ft.



OUTLINE DIMENSIONS

Height - - - - - - - - - - - - -	35 inches
Width - - - - - - - - - - - - -	2.5 inches
Length - - - - - - - - - - - - -	4.5 inches

APPLICATION NOTES

1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70° C.

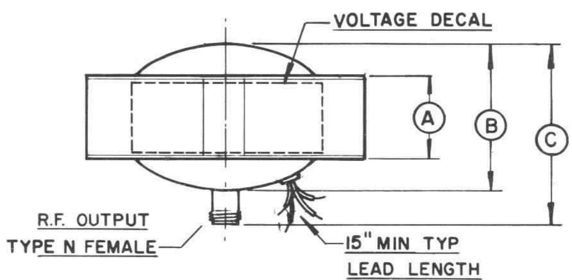
2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

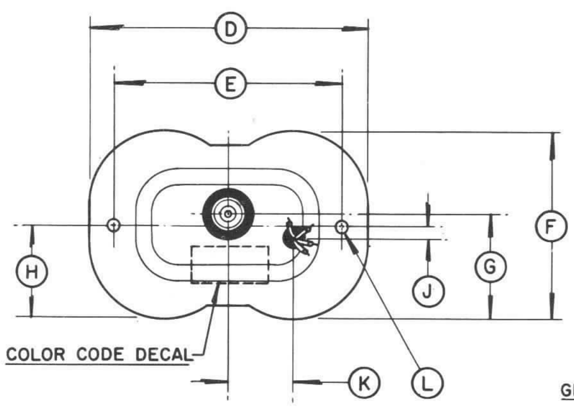
3. TEMPERATURE STABILITY: The permanent magnet for the X-1150 has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. The temperature/frequency coefficient for the X-1150 package is typically .02% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 1000 megacycles, the temperature/frequency coefficient is typically 200 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			1.375
B			2.300
C			2.910
D		4.600	
E	3.640	3.671	
F		3.100	3.000
G			1.656
H			1.500
J			.375
K			1.000
L			.187 D.





CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X-1153-C

LOW NOISE VOLTAGE TUNABLE MAGNETRON

Frequency 0.6 - 1.2 Gc

Minimum Output Power 20 mW

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	0.6-1.2 Gc
Anode Voltage	1000-2000 V
Cathode Current	2-4 mA
Typical Output Power	30-50 mW
Anode FM Sensitivity	.66 Mc/V
Injection Anode Voltage	100 V
Injection Anode Current	0.02 mA
Heater Voltage (AC)	6.3 V
Heater Current (AC)	0.8 A
Load Impedance	50 ohms
Service	cw
Noise	—85 db (See Note 5)
VSWR (max)	2:1

*MAXIMUM RATINGS

Anode Voltage	2300 V
Cathode	10 mA
Injection Anode Voltage	+300 V
Injection Anode Current	1 mA

*Damage to the tube may occur if maximum ratings are exceeded.

MECHANICAL

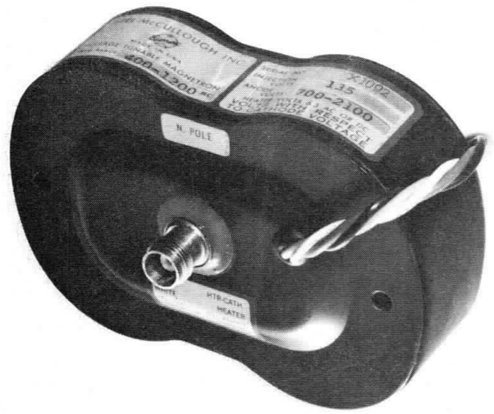
Operating Position	Any
Cooling	Conduction
Electrical Connection	Flexible Leads
RF Output Coupling	Type TNC Jack (See Outline Drawing)
Weight	3.5 Pounds

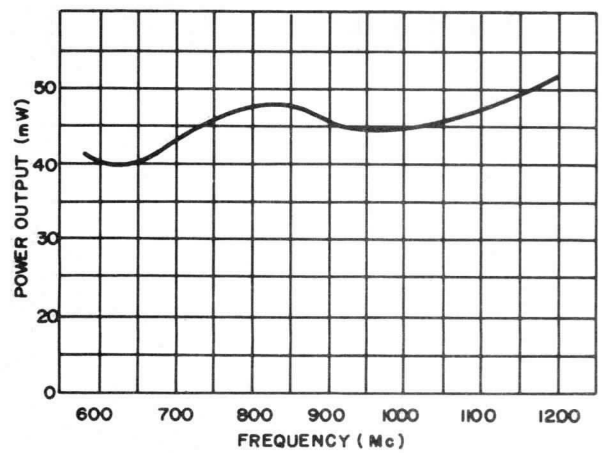
ENVIRONMENTAL

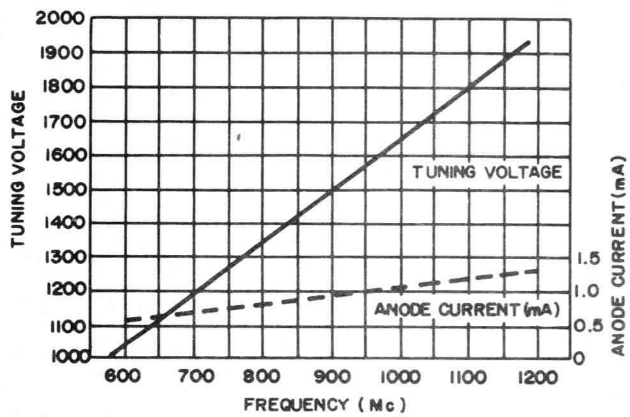
Vibration	10G-(to 2 kc)
Shock	100G-(11 ms)
Altitude	70,000 ft.

OUTLINE DIMENSIONS

Height	3.1 inches
Width	2.5 inches
Length	4.6 inches







APPLICATION NOTES

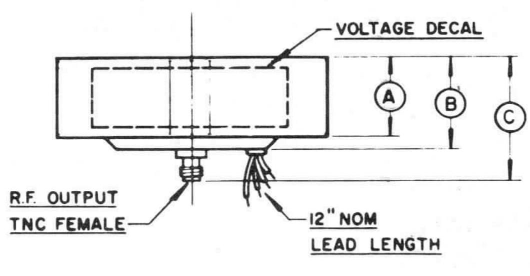
1. COOLING: To insure optimum tube performance the magnet temperature should be maintained below 70°C.

2. PROXIMITY OF FERROUS MATERIALS: To minimize variations in performance, ferrous materials should be kept at least 6 inches from the magnetron package. Modulation of the tube may be produced by rotating ferrous materials and such parts as fans, shafts and couplings should be placed as far from the magnetron package as possible. Transformers and chokes should not be placed in such close proximity to the tube that their stray magnetic fields will interfere with the magnetron operation.

3. TEMPERATURE STABILITY: The permanent magnet for the X-1153-C has been temperature stabilized to minimize frequency changes caused by variations in the ambient temperature. This temperature/frequency coefficient for the X-1153-C package is typically .008% of the operating frequency per degree Centigrade. Thus, for an operating frequency of 700 megacycles, the temperature/frequency coefficient is typically 56 kilocycles per degree Centigrade. A positive change in temperature will always produce a positive change in frequency.

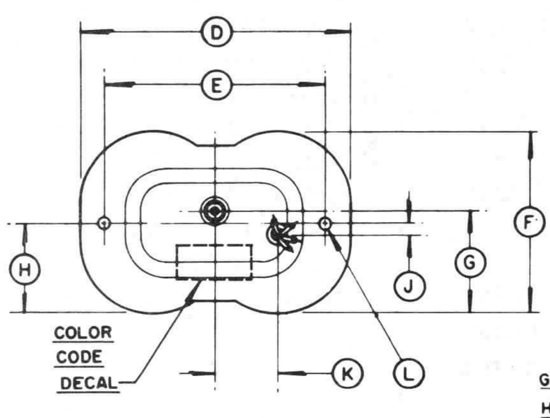
4. ANODE VOLTAGE: The operating frequency is a function of the anode voltage; therefore, any voltage ripple on the anode supply will appear as frequency modulation on the RF output signal.

5. NOISE: Noise power, in db below carrier, is measured using a 60 Mc I_f which has a bandpass of 2 Mc. Both sidebands are included in the measurement. (This measuring technique is one of many methods available. Other methods will be entertained.)



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF	MIN.	MAX.	NOM.
A			1.375
B			1.562
C			2.312
D		4.515	
E	3.640	3.671	
F		3.031	
G			1.656
H			1.500
J			.375
K			1.062
L			.187 D.



CONNECTIONS

GROUND - GREEN

HEATER - WHITE

HEATER CATHODE - BLACK

INJECTION ANODE - YELLOW

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

EM1300

MAGNETICALLY SHIELDED VOLTAGE TUNABLE MAGNETRON

250 - 500 Mc

100 mw

DESCRIPTION

The EM1300 Voltage Tunable Magnetron Oscillator delivers at least 100 mw over the frequency range of 250-500 mc. This miniature magnetically shielded oscillator is ideally suited for applications requiring compact lightweight packaging. Its unique magnetic circuit results in negligible external magnetic field and permits the tube to contact other ferromagnetic materials with no degradation in performance.

FEATURES

- Magnetically Shielded
- Light Weight
- Linear Voltage Tuning
- Small Size
- Rugged
- Flat Power Output

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	250-500 Mc
Anode Voltage	920-1840 V
Cathode Current	0.5-2 mA
Typical Power Output	140 mw
Anode FM Sensitivity	0.3 Mc/V
Injection Anode Voltage	200 Volts
Injection Anode Current	0.0 mA
Heater Voltage (AC or DC)	6.3 Volts
Heater Current (AC or DC)	0.9 Amp
Load Impedance	50 Ohm
Load VSWR	1.1:1
Power Variation	±1 db

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flying Leads
RF Output Coupling	TNC Female
Weight	1.8 lbs.

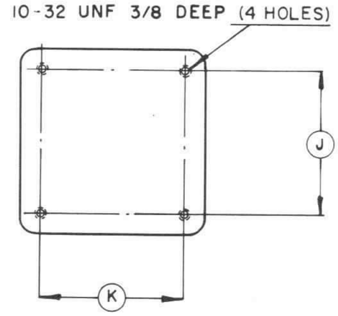
MAXIMUM RATINGS*

Anode Voltage	2200 Volts
Cathode Current	10 mA
Injection Anode Voltage	500 Volts
Injection Anode Current	0.5 mA
Load VSWR	3:1

*Damage to the tube may occur if maximum ratings are exceeded.

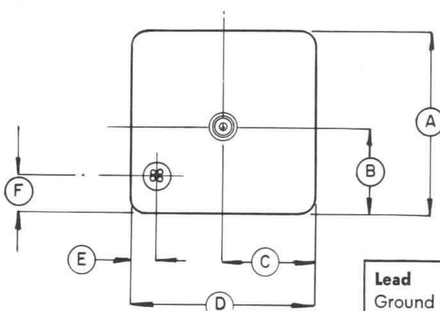
NOTES:

1. The operating frequency is a function of the anode voltage; therefore any voltage ripple on the anode supply appears as frequency modulation on the RF output.
2. The heater supply may be either alternating or direct current. If direct current is used, the heater connections *must* be connected to the negative terminal of the heater supply.
3. Cooling—To insure optimum tube performance, the magnet shell should be maintained below 70° C.
4. Temperature Stability — The permanent magnet of the shielded VTM has been temperature stabilized to minimize frequency changes caused by variations in the magnet temperature. The temperature/frequency coefficient for the shielded VTM is 0.008% of the operating frequency per degree centigrade. A positive change in temperature will always produce a positive change in frequency.

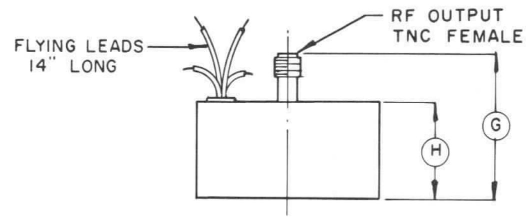


DIMENSIONS IN INCHES

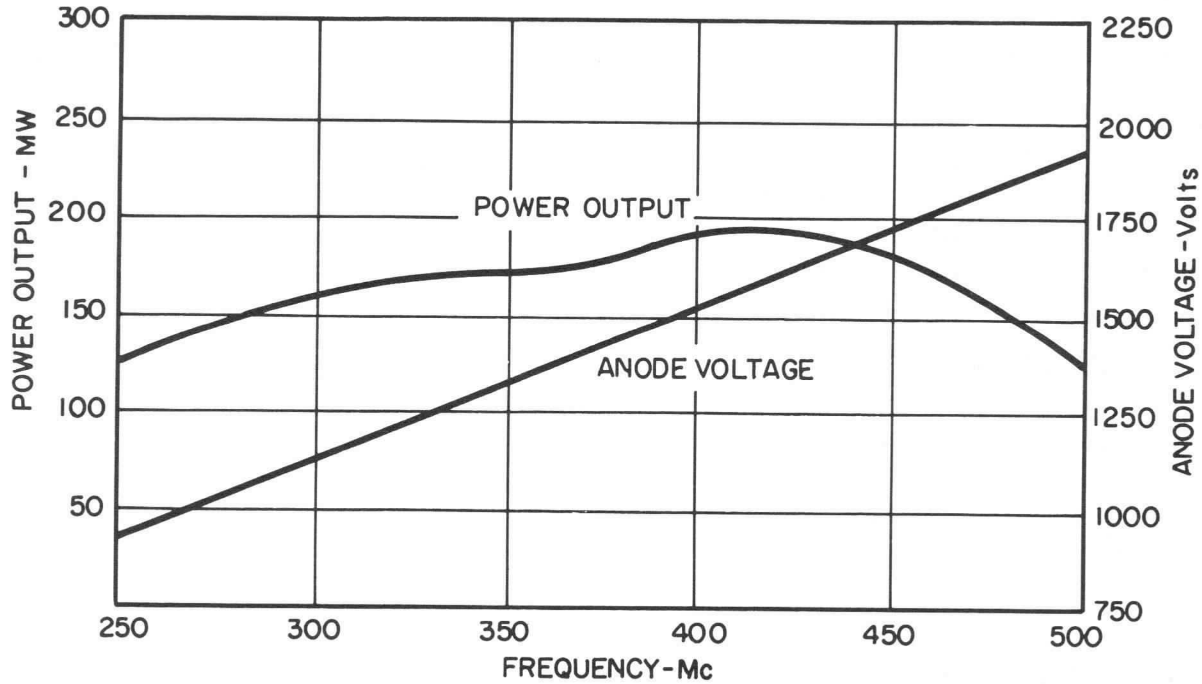
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3.050	
B	1.200	1.800	
C	1.300	1.700	
D		3.050	
E	.300	.500	
F	.700	.900	
G		2.300	
H		1.525	
J	2.320	2.380	
K	2.320	2.380	



Lead	Color Code
Ground	Black
Heater	Blue
Heater Cathode	Red
Injection Anode	White



CHARACTERISTIC CURVES
Typical Performance Values



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SAN CARLOS, CALIFORNIA

EM1310

MAGNETICALLY SHIELDED VOLTAGE TUNABLE MAGNETRON

500 -1000 Mc

100 mw

DESCRIPTION

The EM1310 Voltage Tunable Magnetron Oscillator delivers at least 100 mw over the frequency range of 500-1000 Mc. This miniature magnetically shielded oscillator is ideally suited for applications requiring compact lightweight packaging. Its unique magnetic circuit results in negligible external magnetic field and permits the tube to contact other ferromagnetic materials with no degradation in performance.

FEATURES

- Magnetically Shielded
- Light Weight
- Linear Voltage Tuning
- Small Size
- Flat Power Output
- Rugged

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	500-1000 Mc
Anode Voltage	920-1840 V
Cathode Current	0.5-2 mA
Typical Power Output	150 mw
Anode FM Sensitivity	0.55 Mc/V
Injection Anode Voltage	150 Volts
Injection Anode Current	0.0 mA
Heater Voltage (AC or DC)	6.3 Volts
Heater Current (AC or DC)	0.86 Amp
Load Impedance	50 Ohm
Load VSWR	1.1:1
Power Variation	±1 db

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flying Leads
RF Output Coupling	TNC Female
Weight	1.5 lbs. max.

MAXIMUM RATINGS*

Anode Voltage	2200 Volts
Cathode Current	10 mA
Injection Anode Voltage	500 Volts
Injection Anode Current	1 mA
Load VSWR	3:1

*Damage to the tube may occur if maximum ratings are exceeded.

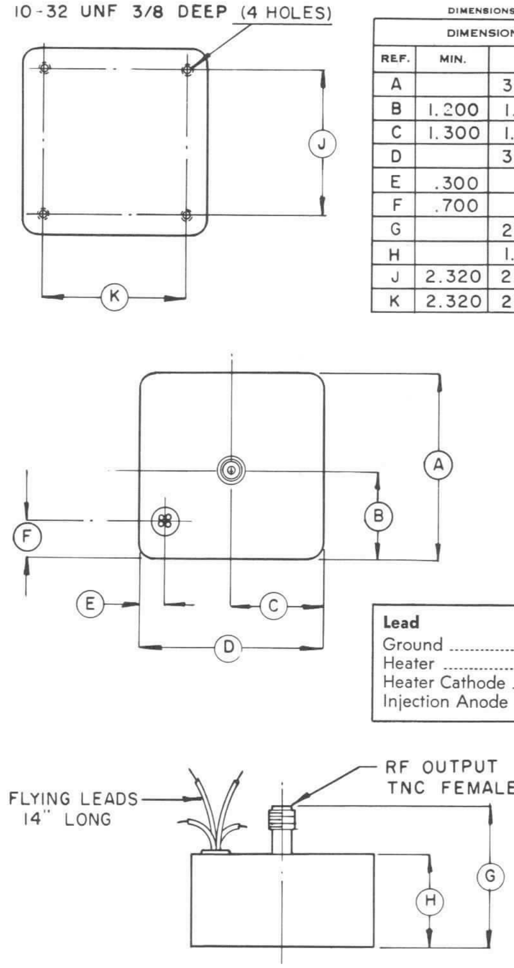
NOTES:

1. The operating frequency is a function of the anode voltage; therefore any voltage ripple on the anode supply appears as frequency modulation on the RF output.

2. The heater supply may be either alternating or direct current. If direct current is used, the heater connections *must* be connected to the negative terminal of the heater supply.

3. Cooling—To insure optimum tube performance, the magnet shell should be maintained below 70° C.

4. Temperature Stability — The permanent magnet of the shielded VTM has been temperature stabilized to minimize frequency changes caused by variations in the magnet temperature. The temperature/frequency coefficient for the shielded VTM is 0.008% of the operating frequency per degree centigrade. A positive change in temperature will always produce a positive change in frequency.

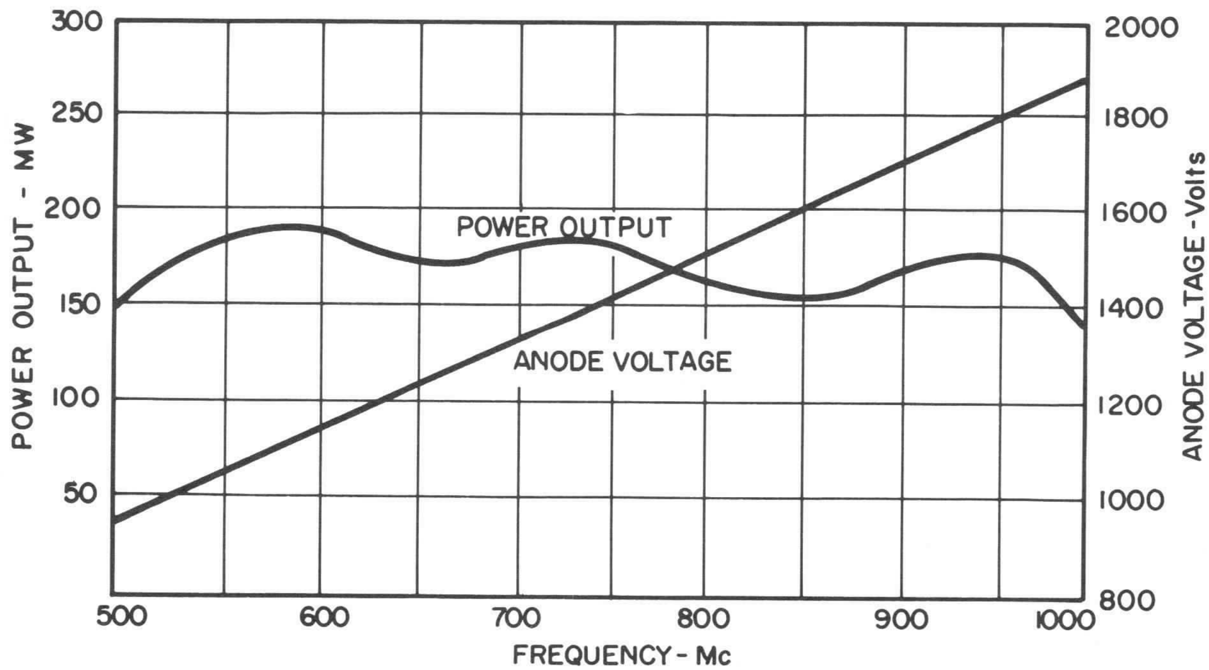


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3.050	
B	1.200	1.800	
C	1.300	1.700	
D		3.050	
E	.300	.500	
F	.700	.900	
G		2.300	
H		1.525	
J	2.320	2.380	
K	2.320	2.380	

Lead	Color Code
Ground	Black
Heater	Blue
Heater Cathode	Red
Injection Anode	White

CHARACTERISTIC CURVES
Typical Performance Values



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SAN CARLOS, CALIFORNIA

EM1320

MAGNETICALLY SHIELDED VOLTAGE TUNABLE MAGNETRON

1000 - 2000 Mc

100 mw

DESCRIPTION

The EM1320 Voltage Tunable Magnetron Oscillator delivers at least 100 mw over the frequency range of 1000-2000 mc. This miniature magnetically shielded oscillator is ideally suited for applications requiring compact lightweight packaging. Its unique magnetic circuit results in negligible external magnetic field and permits the tube to contact other ferromagnetic materials with no degradation in performance.

FEATURES

- Magnetically Shielded
- Light Weight
- Linear Voltage Tuning
- Small Size
- Flat Power Output
- Rugged

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	1000-2000 Mc
Anode Voltage	920-1840 V
Cathode Current	1-6 mA
Typical Power Output	200 mw
Anode FM Sensitivity	1 Mc/Volt
Injection Anode Voltage	200 Volts
Injection Anode Current	0.0 mA
Heater Voltage (AC or DC)	6.3 Volts
Heater Current (AC or DC)	0.9 Amp
Load Impedance	50 Ohm
Load VSWR	1.1:1
Power Variation	±1 db

MECHANICAL

Operating Position	Any
Cooling	Conduction
Electrical Connection	Flying Leads
RF Output Coupling	TNC Female
Weight	1.5 lbs.

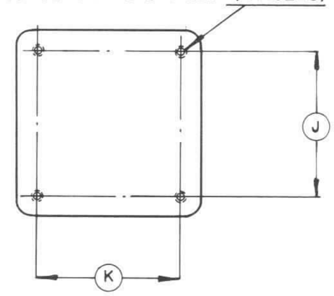
MAXIMUM RATINGS*

Anode Voltage	2200 Volts
Cathode Current	12 mA
Injection Anode Voltage	500 Volts
Injection Anode Current	1 mA
Load VSWR	3:1

*Damage to the tube may occur if maximum ratings are exceeded.

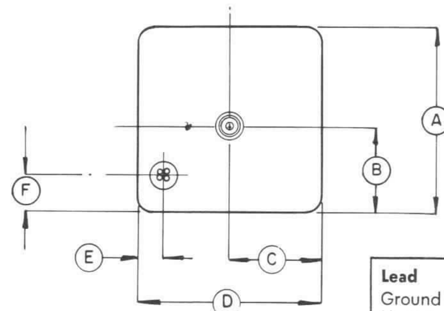
NOTES:

1. The operating frequency is a function of the anode voltage; therefore any voltage ripple on the anode supply appears as frequency modulation on the RF output.
2. The heater supply may be either alternating or direct current. If direct current is used, the heater connections *must* be connected to the negative terminal of the heater supply.
3. Cooling—To insure optimum tube performance, the magnet shell should be maintained below 70° C.
4. Temperature Stability — The permanent magnet of the shielded VTM has been temperature stabilized to minimize frequency changes caused by variations in the magnet temperature. The temperature/frequency coefficient for the shielded VTM is 0.008% of the operating frequency per degree centigrade. A positive change in temperature will always produce a positive change in frequency.

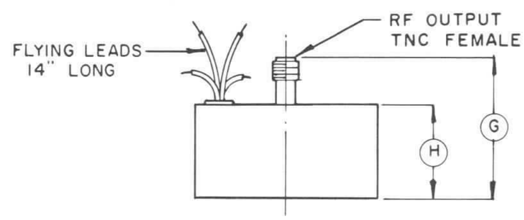


DIMENSIONS IN INCHES

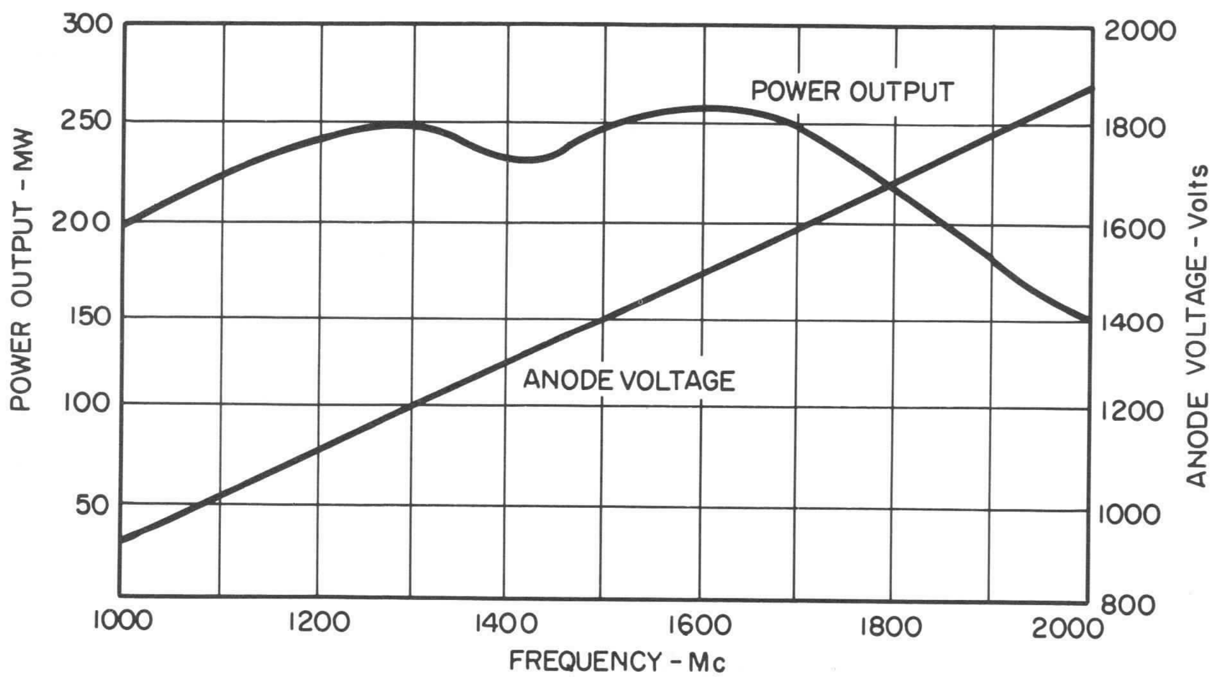
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3.050	
B	1.200	1.800	
C	1.300	1.700	
D		3.050	
E	.300	.500	
F	.700	.900	
G		2.300	
H		1.525	
J	2.320	2.380	
K	2.320	2.380	



Lead	Color Code
Ground	Black
Heater	Blue
Heater Cathode	Red
Injection Anode	White



CHARACTERISTIC CURVES
Typical Performance Values



EIMAC

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S A N   C A R L O S ,   C A L I F O R N I A

EM1331

MAGNETICALLY SHIELDED VOLTAGE TUNABLE MAGNETRON

2200 - 2300 Mc

35 Watts

DESCRIPTION

The EM1331 Voltage Tunable Magnetron Oscillator delivers at least 35 watts over the frequency range of 2200-2300 Mc. This miniature magnetically shielded oscillator is ideally suited for applications requiring compact lightweight packaging. Its unique magnetic circuit results in negligible external magnetic field and permits the tube to contact other ferromagnetic materials with no degradation in performance.

FEATURES

- Magnetically Shielded
- Light Weight
- Linear Voltage Tuning
- Small Size
- Flat Power Output

TYPICAL PERFORMANCE

ELECTRICAL

Frequency Range	2200-2300 Mc
Anode Voltage	2060-2160 V
Cathode Current	41-44 mA
Typical Power Output	40-42 W
Anode FM Sensitivity	1 Mc/Volt
Injection Anode Voltage	500 Volts
Injection Anode Current	0.0 mA
Heater Voltage (AC or DC)	6.3 Volts
Heater Current (AC or DC)	1.0 Amp
Load Impedance	50 Ohm
Load VSWR	1.1:1
Power Variation	1 db

MECHANICAL

Operating Position	Any
Cooling	Forced Air
Electrical Connection	Flying Leads
RF Output Coupling	TNC Female
Weight	3.5 lbs. max.

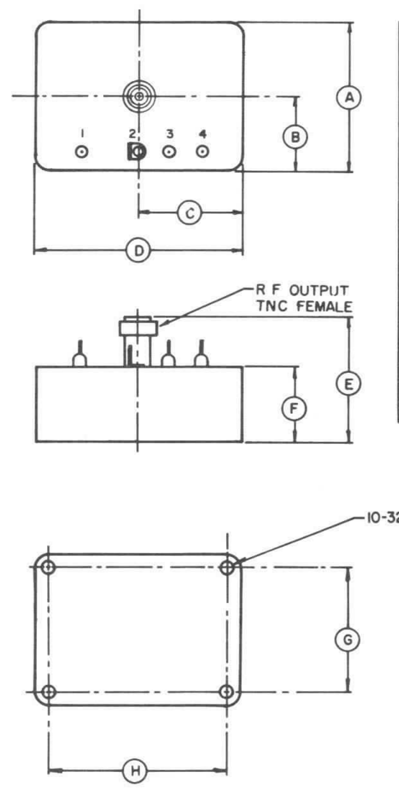
MAXIMUM RATINGS*

Anode Voltage	2500 Volts
Cathode Current	60 mA
Injection Anode Voltage	750 Volts
Injection Anode Current	1 mA
Load VSWR	1.2:1

*Damage to the tube may occur if maximum ratings are exceeded.

NOTES:

1. The operating frequency is a function of the anode voltage; therefore any voltage ripple on the anode supply appears as frequency modulation on the RF output.
2. The heater supply may be either alternating or direct current. If direct current is used, the heater connections *must* be connected to the negative terminal of the heater supply.
3. Cooling—To insure optimum tube performance, the magnet shell should be maintained below 70° C.
4. Temperature Stability — The permanent magnet of the shielded VTM has been temperature stabilized to minimize frequency changes caused by variations in the magnet temperature. The temperature/frequency coefficient for the shielded VTM is 0.008% of the operating frequency per degree centigrade. A positive change in temperature will always produce a positive change in frequency.

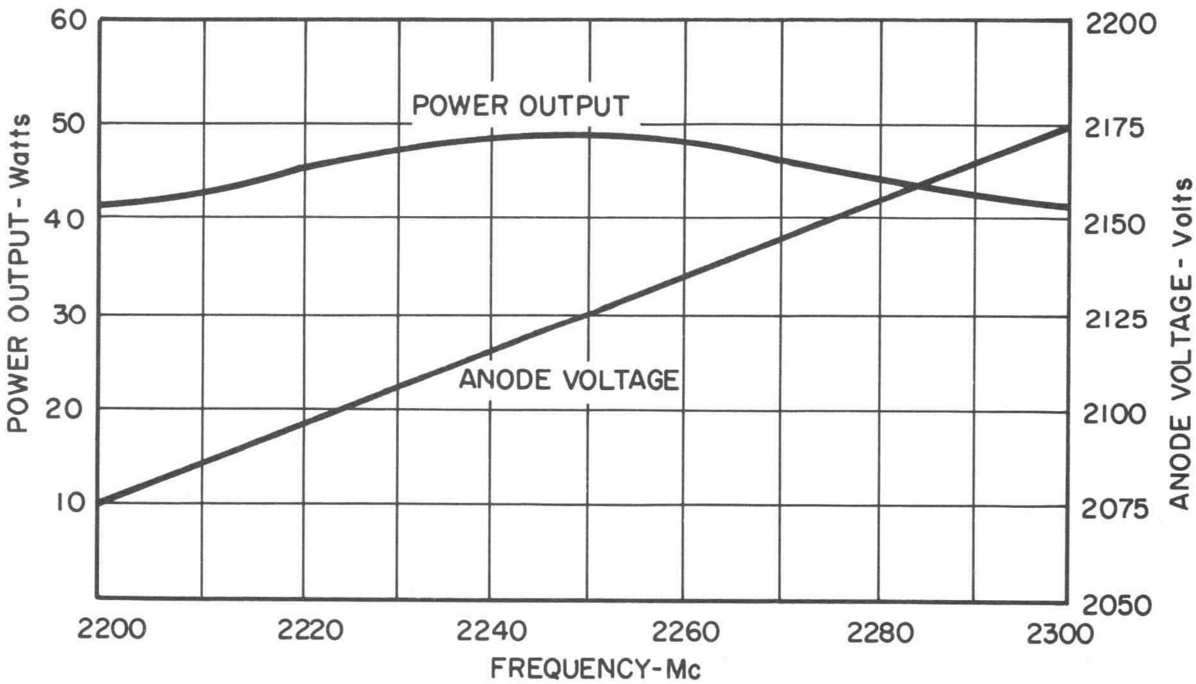


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3.015	
B	1.200	1.800	
C	1.450	2.050	
D		3.515	
E		2.300	
F		1.525	
G	2.220	2.280	
H	2.720	2.780	

D C CONNECTIONS	
1	INJECTION ANODE
2	GROUND
3	HEATER CATHODE
4	HEATER

CHARACTERISTIC CURVES
Typical Performance Values

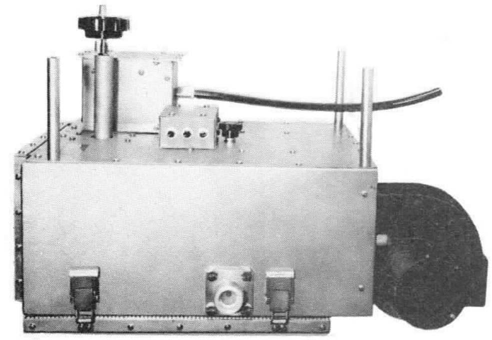


Eimac

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4500

CAVITY AMPLIFIER
145-150 Mc



The Eimac EM4500 is a cavity amplifier incorporating the Eimac 4CX1000K tetrode. It is designed for use as a linear amplifier in a transmitter output stage. Front panel tuning controls are provided.

CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable	145-150 Mc	
RF Power Output	300 watts*CW	
RF Drive Power Required	3W*	
Power Supply Requirements (Typical):	Voltage	Current
Anode, maximum	3000 V	500 mA*
Grid	-10 to -100 V	-0.25 to 0.75 mA
Heater	6.0 V	20 A
Tube Type	Eimac 4CX1000K	
Load Impedance	50 ohms	
Bandwidth	20 KC minimum at 3 db	
Modulation	0-100% AM, 0-10,000 CPS	

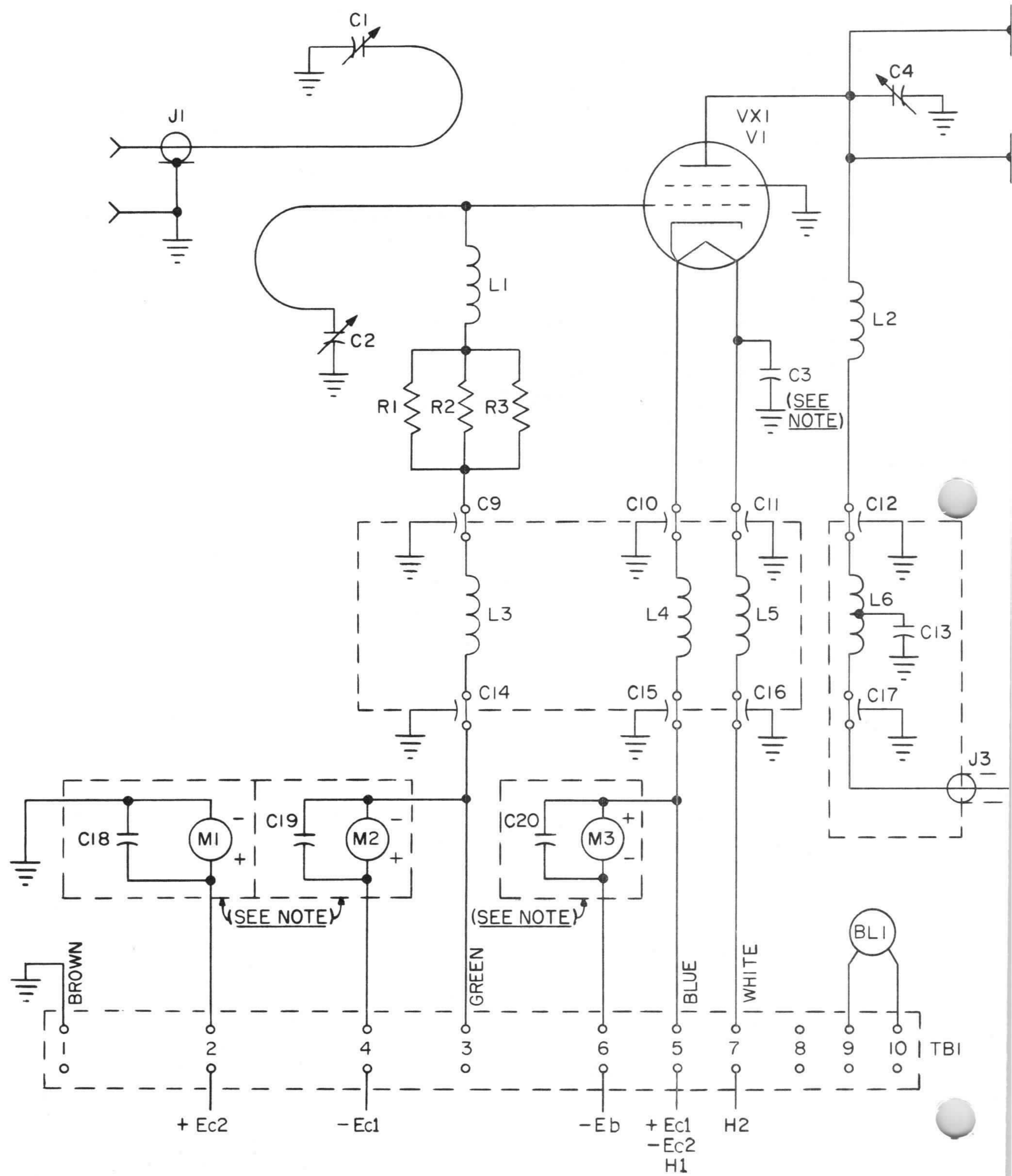
MECHANICAL

Mounting	Standard 19" relay rack Panel
Size	height -- 16 inches width -- 14 inches depth -- 12 inches
Operating controls	Tuning knobs provided
Cooling required	50 CFM at 0.5" water
Connectors	Input - - Type N Female Output - Type LC Female

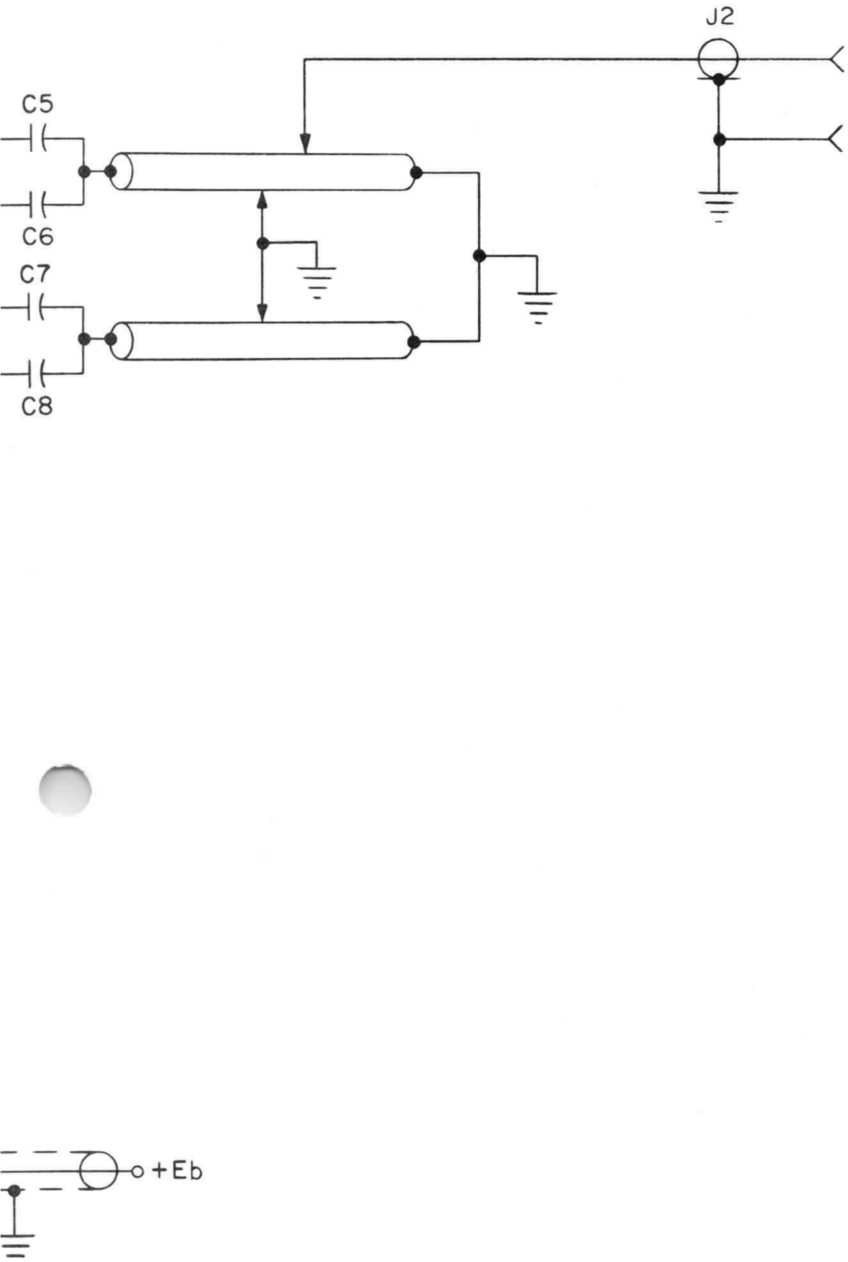
ENVIRONMENTAL

Temperature	-10 to +50°C (+14 to +122°F)
Altitude	to 12,000 feet

*Up to 1 KW output can be provided with 15 watts drive and 600 mA anode current.



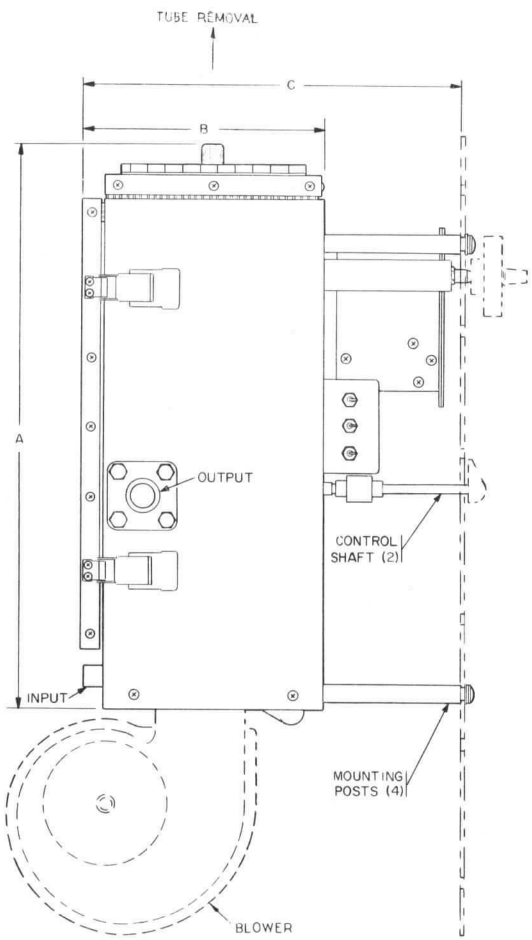
REFERENCE SCHEMATIC ONLY



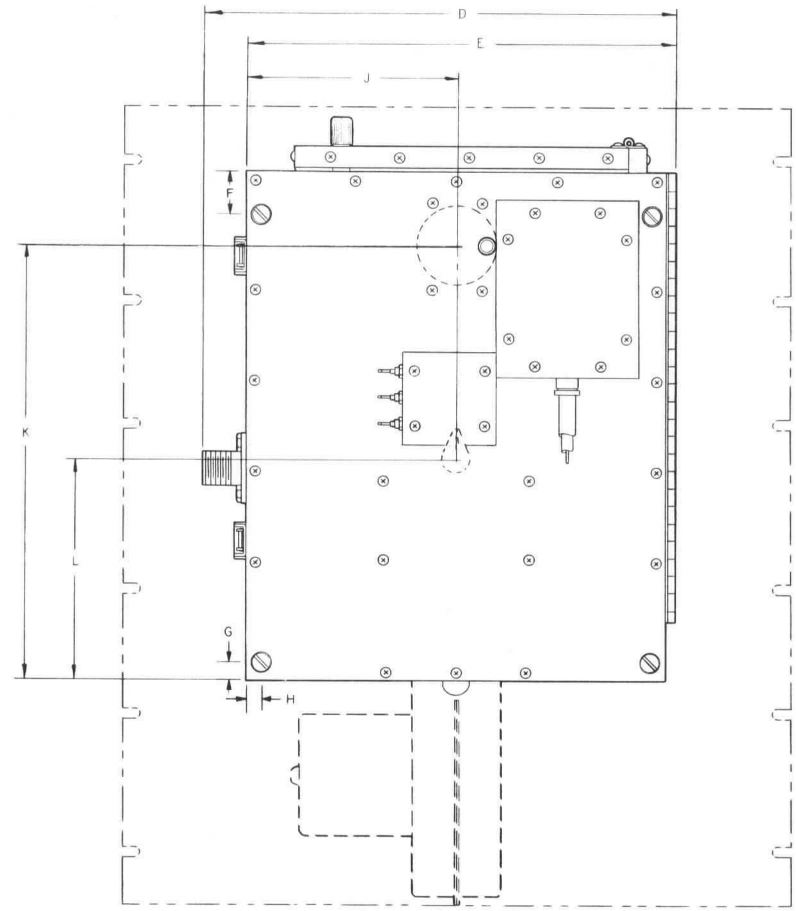
NOTES:

1. C18, C19, C20, M1, M2, M3, NOT SUPPLIED WITH UNIT
2. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED
3. ALL CAPACITOR VALUES ARE IN MICRO-MICRO FARADS UNLESS OTHERWISE SPECIFIED.

REF	DIMENSION DATA MIN	MAX
A	15.875	16.125
B	7.110	7.140
C	11.093	11.157
D	13.454	13.546
E	12.220	12.280
F	1.202	1.298
G	.484	.516
H	.359	.391
J	5.953	5.984
K	11.922	11.953
L	6.234	6.266



SIDE VIEW



FRONT VIEW

Eimac

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4501

CAVITY AMPLIFIER
145-150 Mc

The Eimac EM4501 is a cavity amplifier incorporating the Eimac 4CX3000A tetrode. It is designed for use as a power amplifier in a transmitter output stage.

CHARACTERISTICS

ELECTRICAL

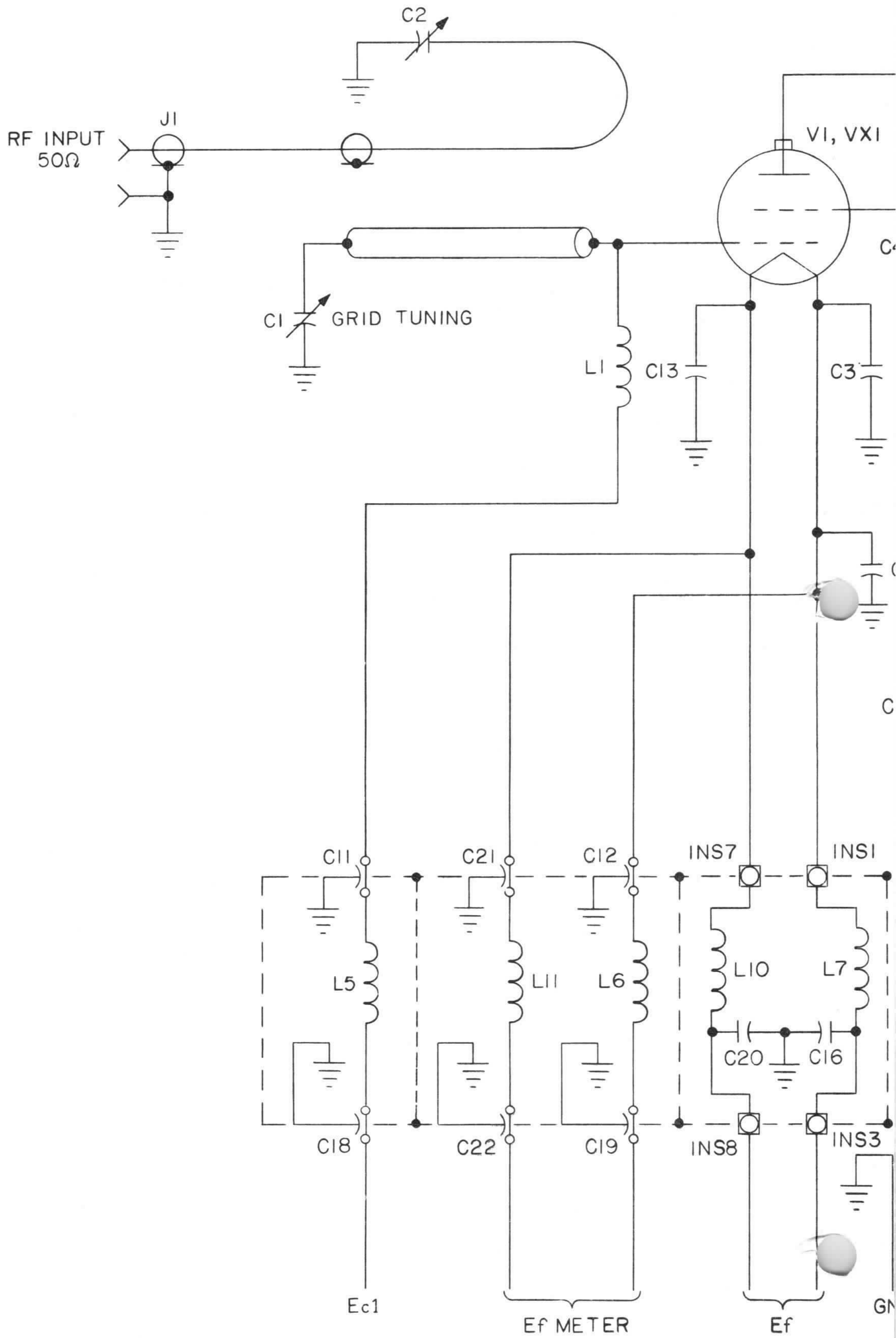
Frequency		145-150 Mc
RF Power Output		3 kW CW
RF Drive Power Required		175 W
Power Supply Requirements (Typical):	Voltage	Current
Anode, Maximum	4500 V	1.1A
Screen Grid, Maximum	300 V	125 mA
Control Grid, Maximum	150 V	55 mA
Heater	9.0 V	45 A
Tube Type		Eimac 4CX3000A
Load Impedance		50 ohms
Load VSWR, Maximum		1.5:1, any phase
Bandwidth		20 KC Minimum at 3 db
Modulation		0-100% AM, 0-10,000 CPS

MECHANICAL

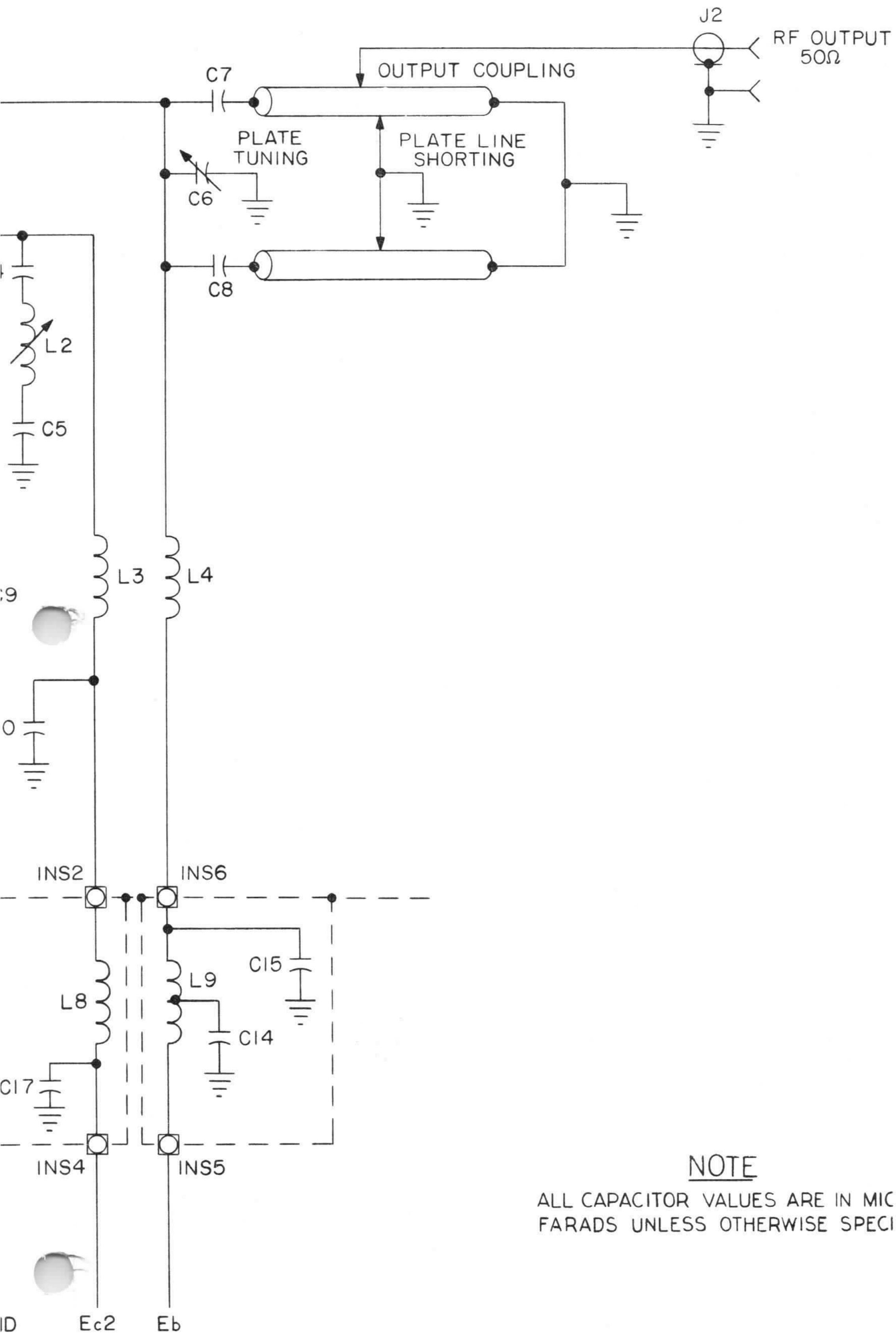
Mounting	Standard 19" relay rack panel
Size	Height - 18 inches
	Width - 15-3/4 inches
	Depth - 14-7/8 inches
Cooling Required	170 CFM at 1.6" water
Connectors	Input - - Type N Female
	Output -- Type LC Female

ENVIRONMENTAL

Temperature	-10 to +50°C (+14 to+122° F)
Altitude	to 12,000 feet

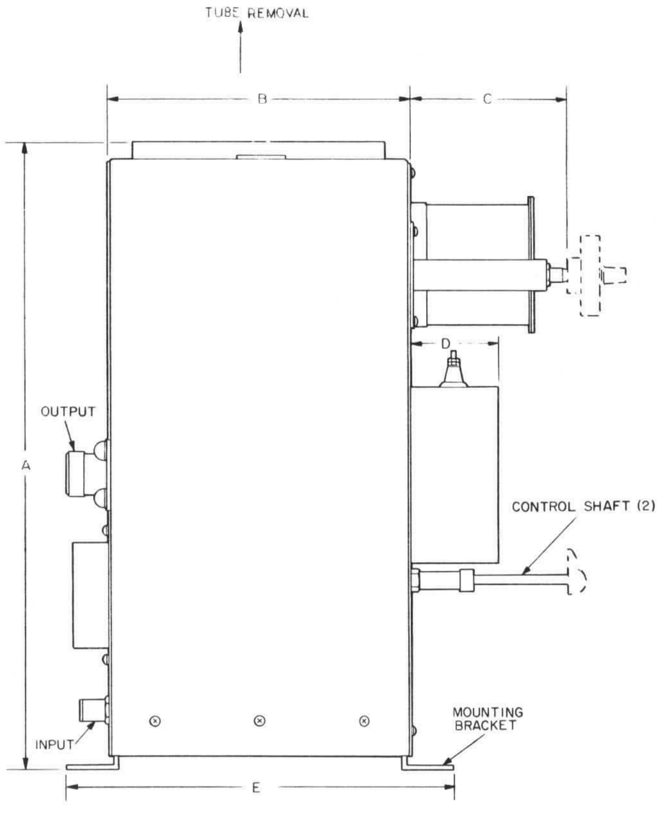


REFERENCE SCHEMATIC ONLY

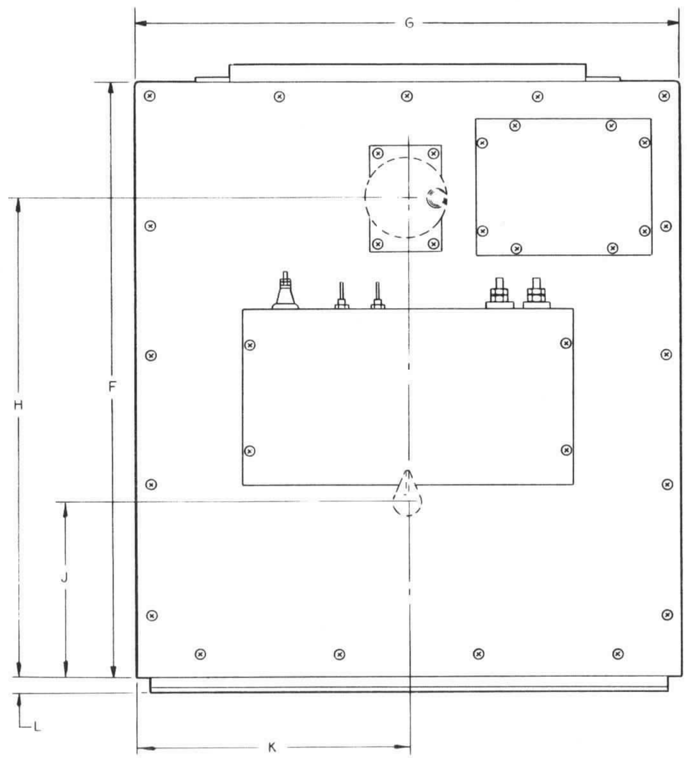


NOTE

ALL CAPACITOR VALUES ARE IN MICRO-MICRO FARADS UNLESS OTHERWISE SPECIFIED



SIDE VIEW



FRONT VIEW

DIMENSION DATA		
REF	MIN	MAX
A	18.110	18.140
B	8.606	8.650
C	4.953	5.047
D	2.484	2.516
E	11.110	11.140
F	16.921	16.953
G	15.359	15.391
H	13.671	13.691
J	4.984	5.016
K	7.672	7.703
L	.359	.391

EIMAC

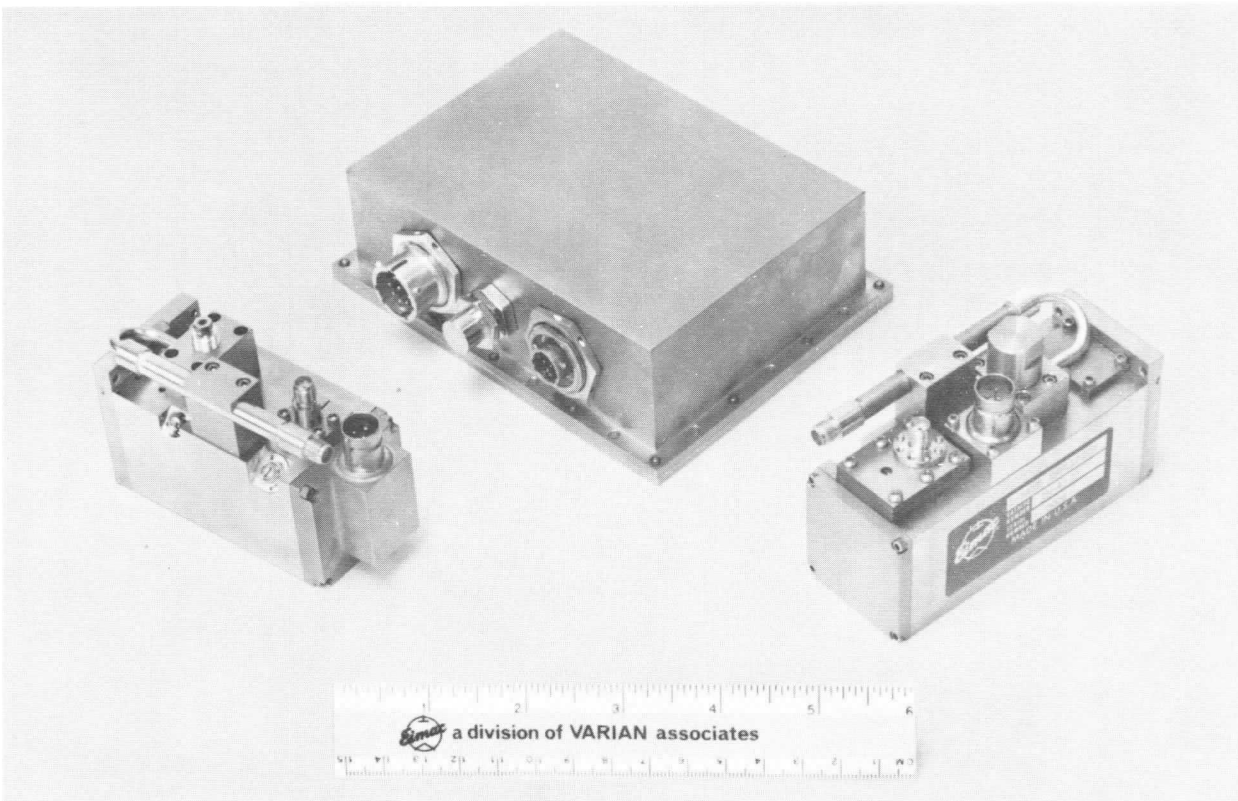
A Division of Varian Associates

SAN CARLOS, CALIFORNIA

EM4504
EM4537

AMPLIFIER SYSTEM

2200 - 2300 MHz
1435 - 1600 MHz



These modular amplifier systems are recommended for medium power aerospace telemetry transmission. They provide at least 10 db gain in the 2200-2300 MHz or 1435-1535 MHz telemetry bands, when driven by a 1-2 watt exciter. The system includes an EM4590 power supply, plus an L-band (EM4539) or S-band (EM4596) cavity amplifier. Full power output is provided, even in the severe environment of missile launch. These modular units provide maximum flexibility in system packaging. A single package containing both the amplifier and the power supply is also available, on special order. All modules are conduction cooled, and can be operated continuously at heat sink temperatures from −54°C to +95°C. They are hermetically sealed, for operation at any altitude.

AMPLIFER MODULE

Model EM4596 is used for 2200-2300 MHz; EM4539 is used for 1435-1600 MHz. These cavity amplifiers provide at least 10 db gain, using a rugged, frequency-stable ceramic planar triode. All connectors and tuners are accessible on one surface. A low pass filter, for harmonic suppression, is included. EM4596 is 3¾″ x 2½″ x 1½″ and weighs 0.95 lbs.; EM 4593 is 4″ x 2½″ x 1½″ and weighs 1.1 lbs. (dimensions include all protusions). For further details, refer to the data sheets for these units.

POWER SUPPLY

The dc-dc converter, included in the amplifier system, is Model EM4590. This is a solid state unit which provides regulated plate and heater voltages, operating from a 28 Vdc primary source. All components are used well below their maximum ratings. Size is 1.7″ x 4.2″ x 5.5″; weight is 2.5 lbs. For further details, refer to the EM4590 data sheet.

CHARACTERISTICS

ELECTRICAL

Frequency,[1] continuously tunable, EM4504	2200-2300 MHz
EM4537	1435-1600 MHz
RF power[2] output (with 2 watts drive), minimum	20 Watts
RF power[2] output (with 1 watt drive), minimum	12 Watts
Input Signals	All standard FM telemetry signal formats, per IRIG 106-65
Bandwidth, Minimum, 3 db points	10 MHz
Gain, Minimum	10 db
Load Impedance, Nominal	50 Ohms
VSWR, Maximum, for full rated output	1.5:1
without damage	3:1
Harmonic Suppression, Minimum (2nd, 3rd & 4th)	60 db
Warm-up Time	3 Minutes
Input Voltage[3]	28^{+8}_{-4} Vdc
Overvoltage, Maximum	43 Vdc
Input Transients, Maximum	80 Volts for 20 Microseconds
Input Ripple, Maximum	3 V rms, DC-20 KHz, superimposed on 24-32 Vdc input
Interference	Meets MIL-I-6181D
Efficiency, DC-RF Conversion, Minimum	17.5%

MECHANICAL

	Size	*Weight*
Power Supply Module	1.7″ x 4.2″ x 5.5″	2.5 lbs.
S-band Cavity Amplifier Module	3.75″ x 2.5″ x 1.5″	0.95 lbs.
L-band Cavity Amplifier Module	4″ x 2.5″ x 1.5″	1.1 lbs.
Mounting	To Heat Sink (not included)	
Cooling	Conduction	
Connectors: RF input and output	OSM Female	
Primary power input	Bendix JT07H-8-3P	
Power supply module output	Deutsch DTK07H-12-8P	
Cavity Amplifier module input	Deutsch DM5300-3P-643	

ENVIRONMENTAL

Temperature, Heat Sink (for continuous operation)	–54°C to +95°C
Altitude (3 hour duration)	Any
Vibration 20 g peak to 2 KHz, Curve E, Fig. 514-3	MIL-STD-810
0.3 G^2/Hz Random, Curve F, Fig. 514-4	MIL-STD-810
20 g peak to 2 KHz, Category II	MIL-E-5400
Other	Per MIL-E-5400

FOOTNOTES

[1]Also available with similar performance characteristics for other frequencies in the 500-2500 MHz range.

[2]Under worst combination of specified environmental conditions. Output and efficiency are higher under optimum conditions. See EM4539 and EM4596 data sheets for typical performance curves.

[3]Power supplies for operation from other primary sources are also available.

EM4522-5
EM4522-6
EM4538-2
EM4538-5
EM4591

CAVITY OSCILLATORS

1435 - 1540 MHz
1700 - 1850 MHz
2200 - 2300 MHz

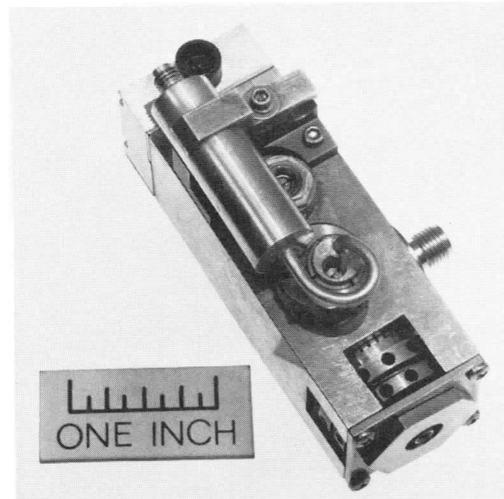
Eimac®

EIMAC

A Division of Varian Associates
SAN CARLOS, CALIFORNIA

These oscillators are recommended for use in UHF/microwave telemetry transmitters and aerospace television transmitters. They are precisely tuned over the specified ranges by three easy adjustments. Power output and frequency are highly stable under severe environmental conditions, including shock and vibration of missile launch. Modulation is achieved by varying the voltage applied to a varactor diode in the anode cavity. Modulation is linear over a wide range of frequency deviation. High rf efficiency is another important advantage of these oscillators. These are very compact units, shaped for maximum packaging efficiency. Cooling is by conduction to the transmitter case. All models use rugged ceramic-metal planar triodes.

Dc-dc converters are available from EIMAC to operate these oscillators from 28Vdc.



EM4522-5 OSCILLATOR

CHARACTERISTICS

ELECTRICAL	**EM4522-5**	**EM4522-6**	**EM4538-2**	**EM4538-5**	**EM4591**
Tuning Range, MHz[1]	2200-2300	2200-2300	1435-1540	1435-1540	1700-1850
rf Power Output,[3] Watts, CW	2	10	13	3	2.5
Frequency Stability, MHz	±2.5	±2.5	±2.5	±2	±2
Power Supply Requirements:					
Anode Voltage, Volts, Max.	165	240	240	165	165
Anode Current, mA, Max.	70	130	130	70	70
Control Grid	← Self Bias →				
Heater Voltage, Volts	6.0	5.6	5.6	6.0	6.0
Heater Current, mA, Max.	400	540	540	400	400
Suggested EIMAC Power Supply Model	EM4589	PS4700	PS4700	EM4589	EM4589
Load Impedance, Ohms, Nominal	← 50 →				
Modulation	← Any IRIG 106-65 Format →				
Modulation Linearity:					
500 KHz peak-to-peak deviation, %	← 1 →				
3 MHz peak-to-peak deviation, %	← 2.5 →				
6 MHz peak-to-peak deviation, %	← 5 →				
Modulation Frequency Response, 0-2 MHz, db	← 0.5 →				
VSWR, Maximum for rated output	← 1.2:1 →				
Maximum without damage	← 3:1 →				
Warm-up time	← 90 Seconds →				
MECHANICAL					
Mounting	← Bolts to Heat Sink →				
Dimensions	← See Drawing →				
Weight, pounds	← 0.4 →				
Cooling	← Conduction to Heat Sink →				
Connector, rf output	← OSM →				
Modulation Input	← OSSM →				

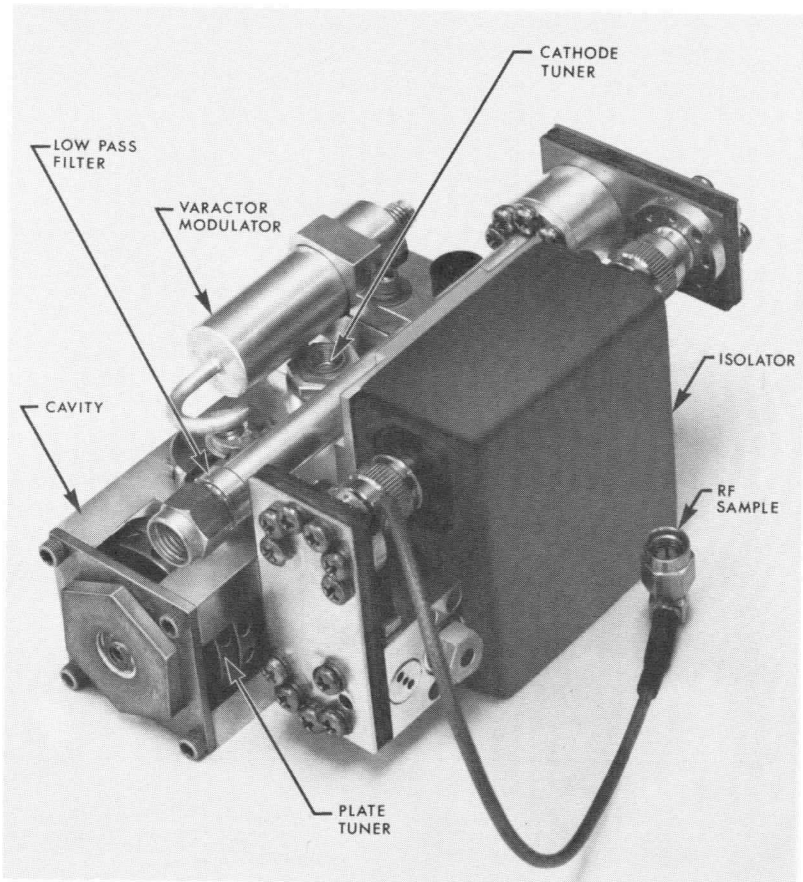
THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Printed in U.S.A.

ENVIRONMENTAL

Temperature (Heat Sink)	−54° to +85°C
Vibration[2] (MIL-STD-810, Fig. 514-3 Curve D)	15 g Peak to 2 KHz
Shock[2] (MIL-STD-810 Method 516, Procedures I and V, half sine)	15 g for 11 milliseconds
Sustained Acceleration	30 g for 5 minutes

[1]Other ranges available on special order.
[2]Electrical performance is as specified, under these environmental conditions. More severe conditions can be withstood without damage.
[3]Higher power oscillators available on special order.



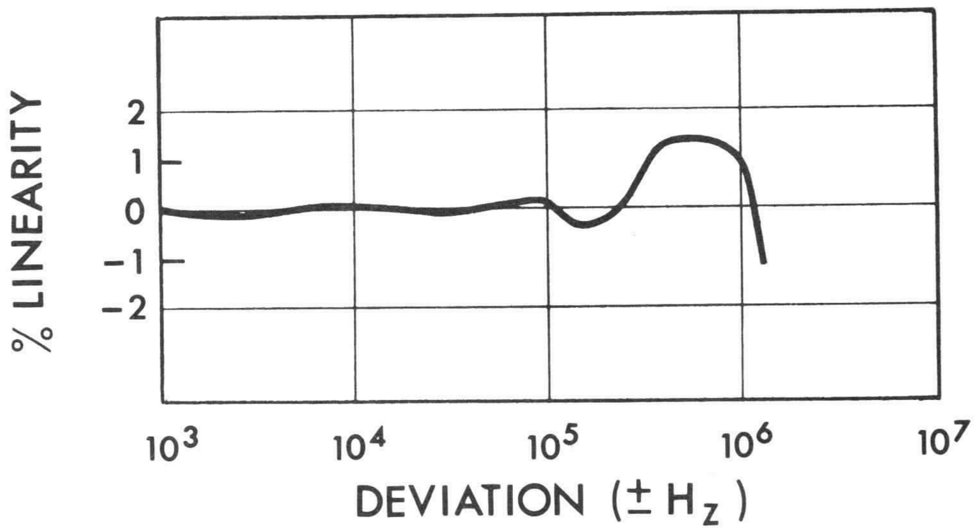
MODEL EM4522-5 OSCILLATOR WITH ACCESSORIES

Complete rf power source packages are also available from EIMAC. The package shown here includes a three-port terminated circulator, low pass filter, modulation input choke and cabling.

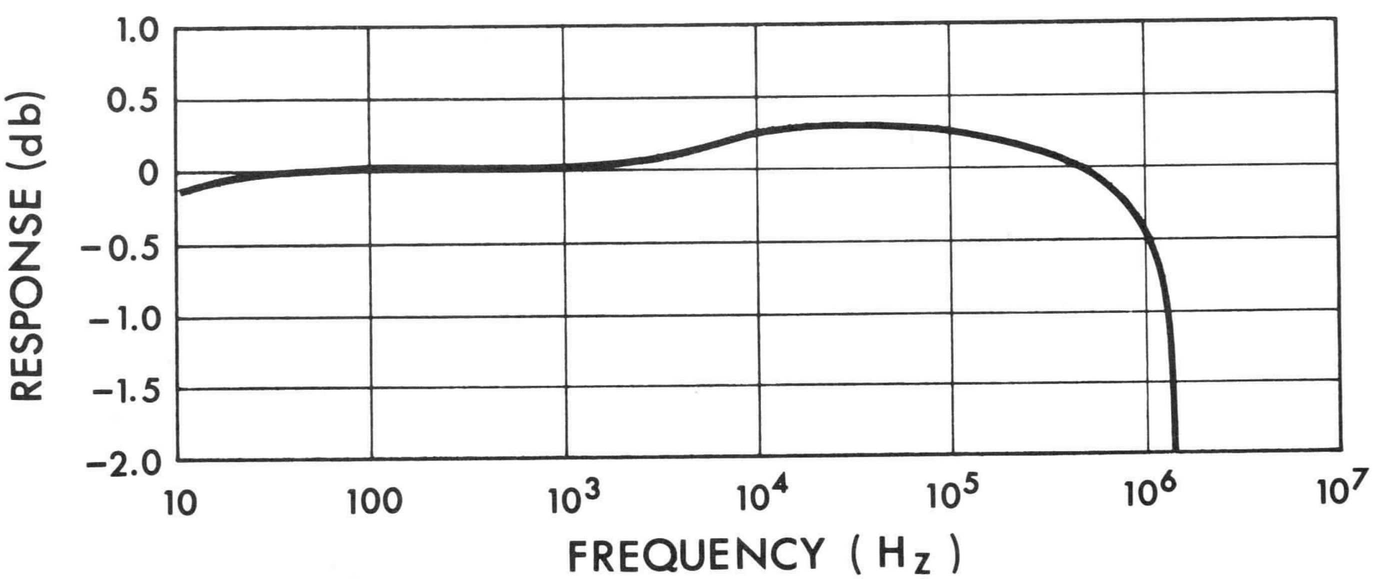
Dc-dc converters are available from EIMAC to operate any EIMAC oscillator or amplifier from 28 Vdc. These power supplies feature compact, light weight design, particularly suited for use in aerospace systems. All components are solid state. The package is conduction cooled. Operation during the shock and vibration of missile launch is satisfactory. RF interference is within limits of the applicable MIL specifications.

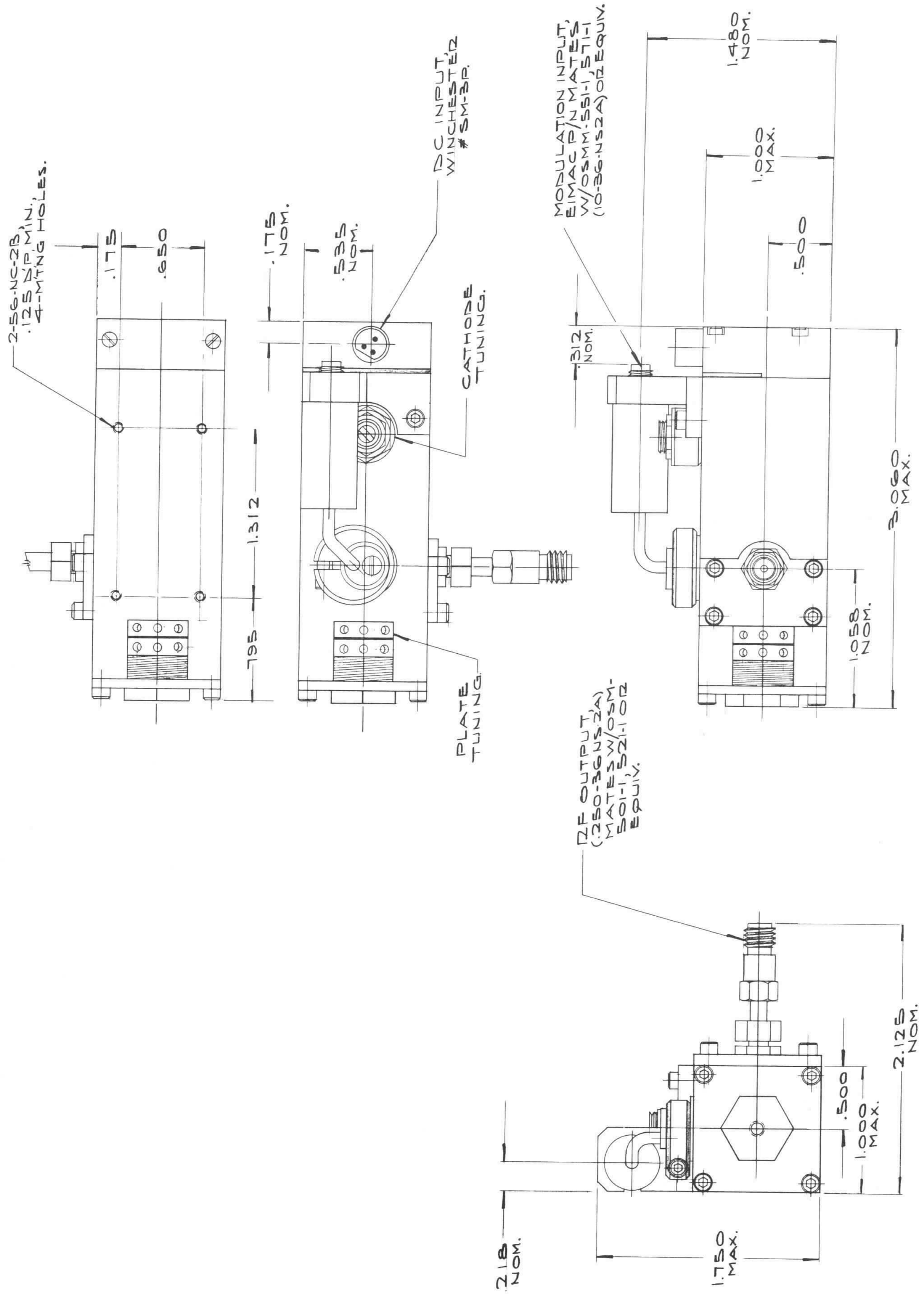
Power supplies for operation from 400 CPS primary supply are available on special order.

TYPICAL MEASURED MODULATION LINEARITY
MODEL EM4522-5 OSCILLATOR



TYPICAL MEASURED MODULATION FREQUENCY RESPONSE
MODEL EM4522-5 OSCILLATOR

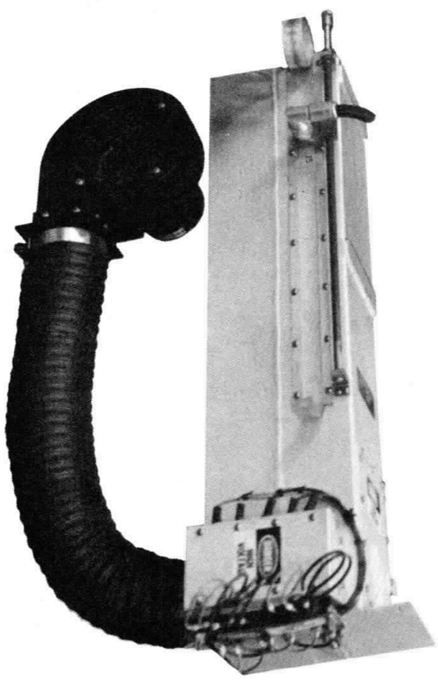



2-56-NC-2B, .125 DP MIN, 4-MTNG HOLES.
.175
.650
1.312
.795
.175 NOM.
.535 NOM.
DC INPUT, WINCHESTER #SM-3P.
CATHODE TUNING.
PLATE TUNING.
MODULATION INPUT, EIMAC P/N MATES W/OSMM-551-1, 5711-1 (10-36-NS2A) OR EQUIV.
1.480 NOM.
1.000 MAX.
.500
.312 NOM.
3.060 MAX.
1.058 NOM.
RF OUTPUT (.250-36NS-2A) MATES W/OSM-501-1, 521-1 OR EQUIV.
2.125 NOM.
.500
1.000 MAX.
1.750 MAX.
.218 NOM.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4505
CAVITY AMPLIFIER
122-150 Mc

The Eimac EM4505 is a cavity amplifier incorporating the Eimac 4CX250R ruggedized ceramic tetrode. It is designed for use as an intermediate stage in an FM transmitter. Tuning controls are provided.



CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable		122-150 Mc
RF Power Output		30 watts* CW
RF Drive Power Required		1W*
Power Supply Requirements (Typical):	Voltage	Current
Anode, maximum	400 to 800 V*	150-250 mA*
Screen Grid, maximum	80 to 175 V	±25 mA
Control Grid, maximum	—35 to —60 V	±25 mA
Heater	6.0 V	2.6 A
Tube Type		Eimac 4CX250R
Load Impedance		50 ohms
Bandwidth		2 Mc minimum at 1.5 db
Modulation		FM

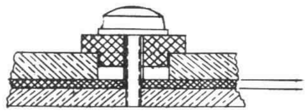
MECHANICAL

Mounting	Standard 19" relay rack Panel
Size	height — 13 inches width — 8½ inches depth — 26 inches
Operating controls	Tuning knobs provided
Cooling required	Blower included
Connectors	Type N Female

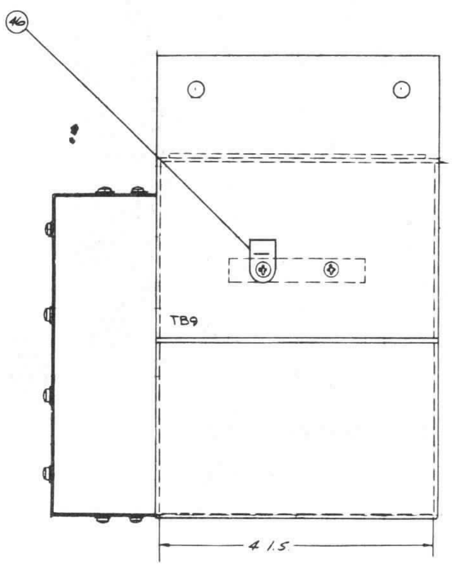
ENVIRONMENTAL

Temperature	—10 to +50°C (+14 to +122°F)
Altitude	to 12,000 feet

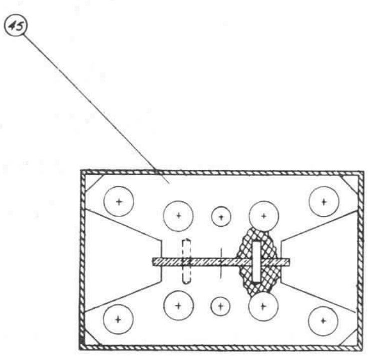
*Up to 200 watts output can be provided with higher anode voltage and drive.



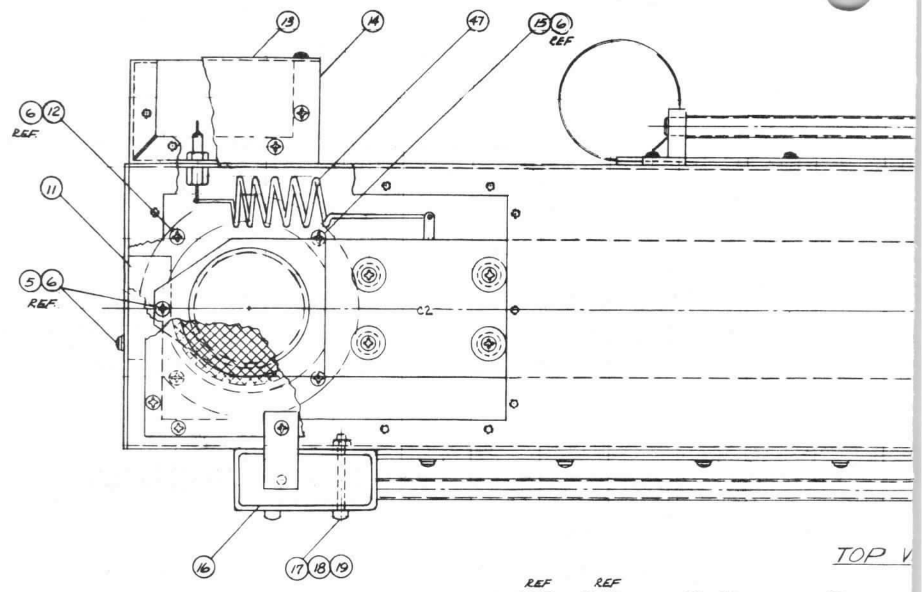
SECTION B-B (TYP.)
NOT TO SCALE



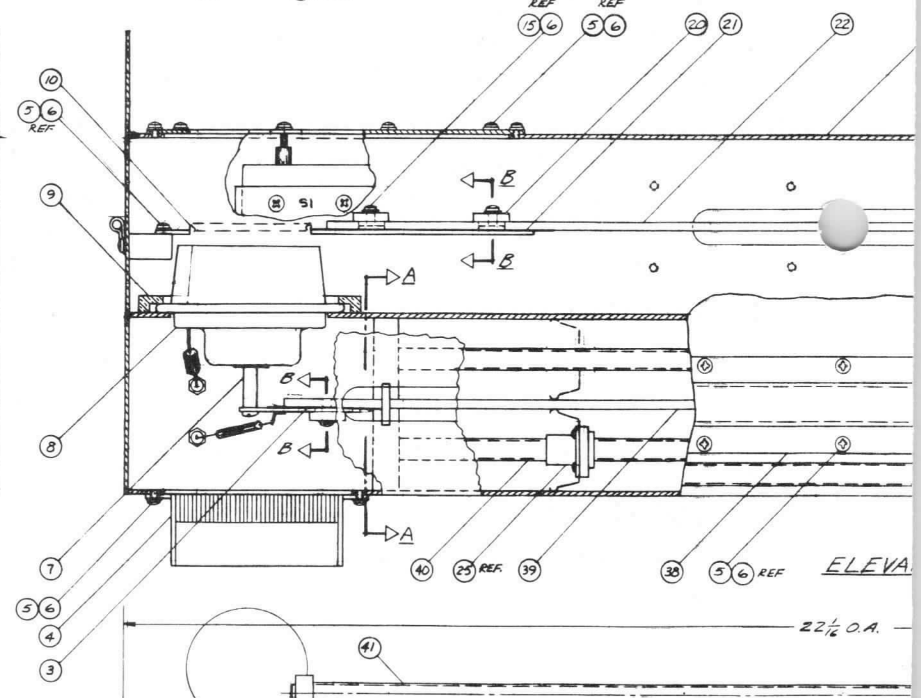
BACK END



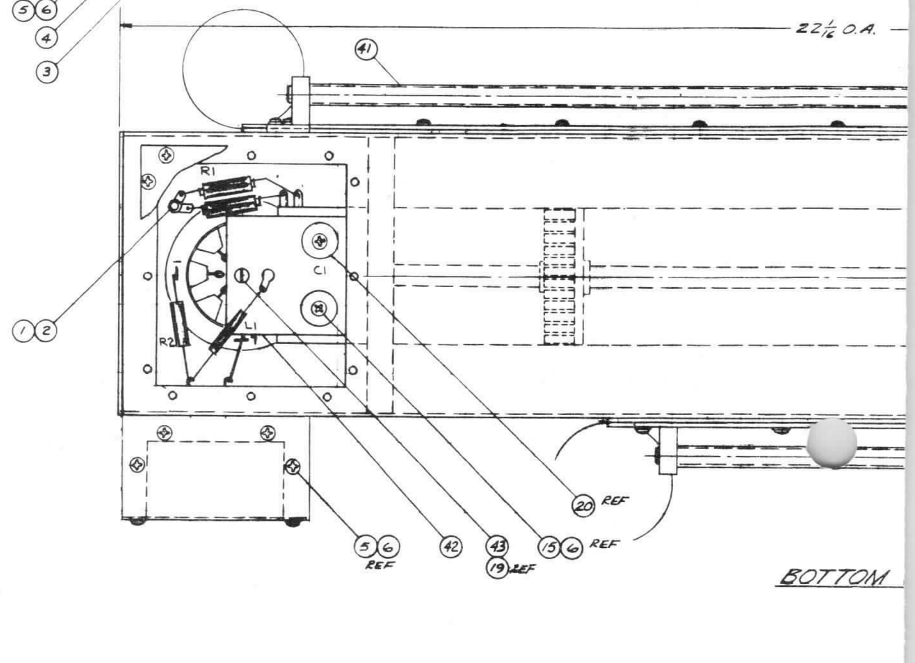
SECTION A-A (TYP.)



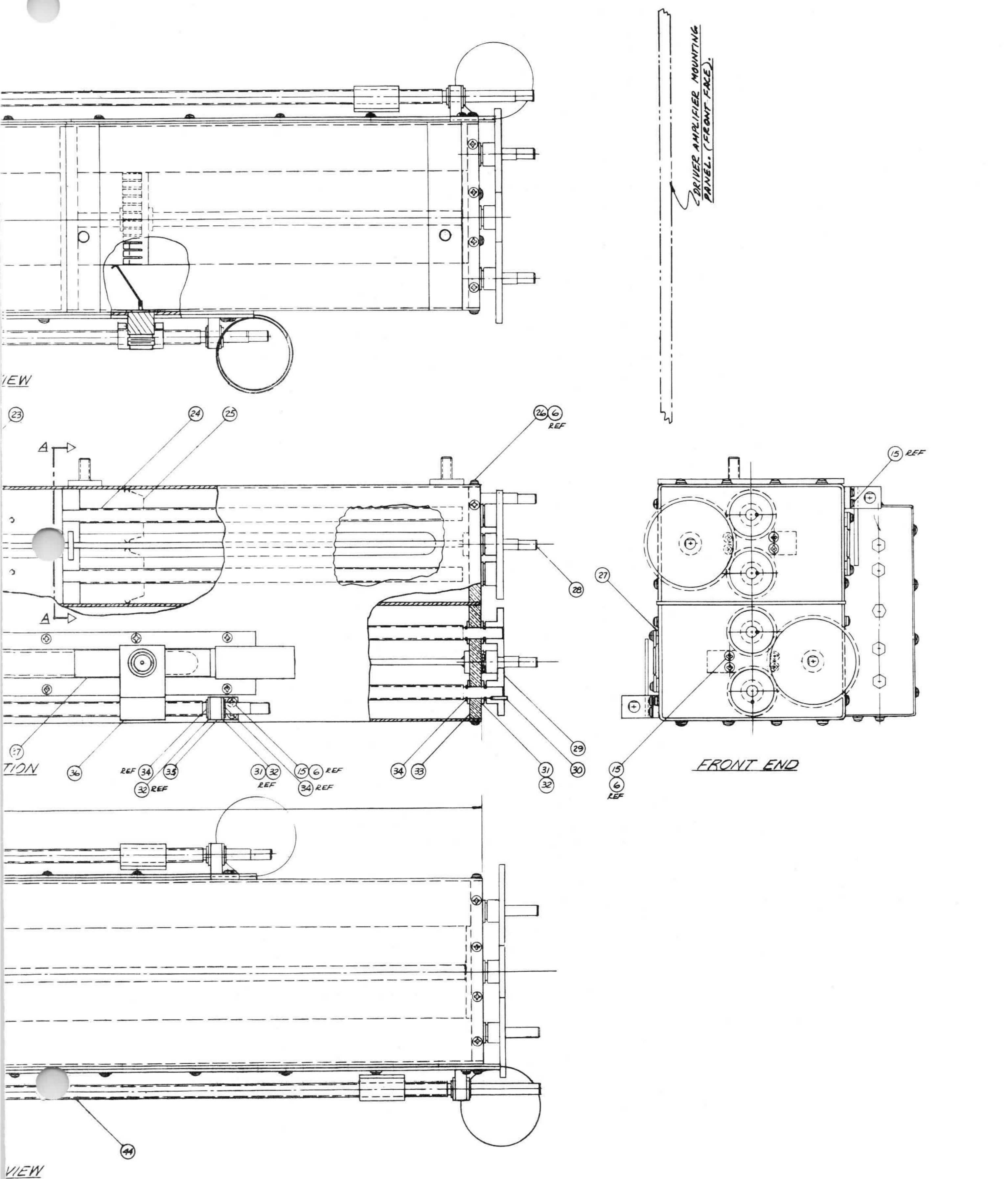
TOP V

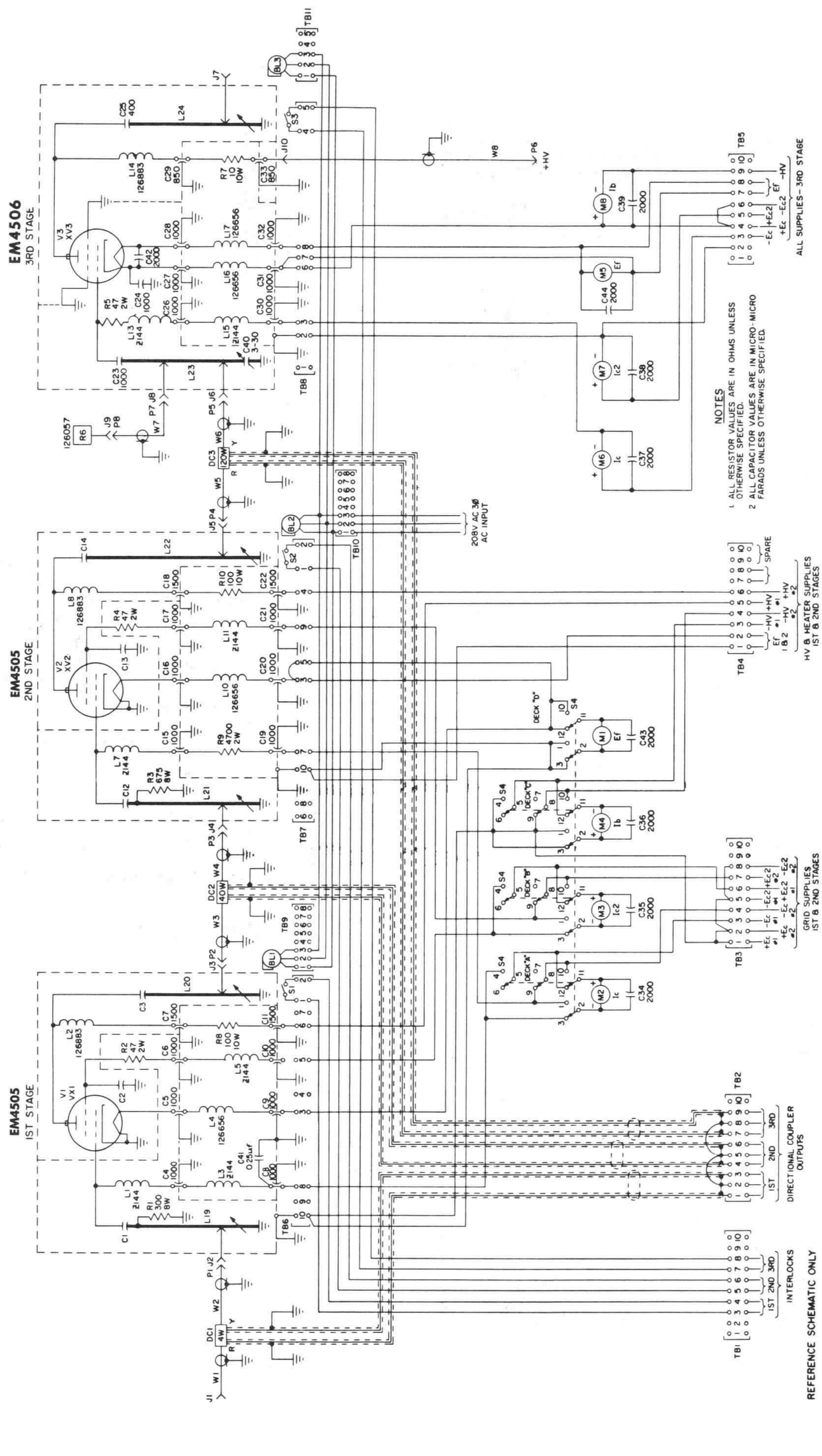


ELEVA



BOTTOM

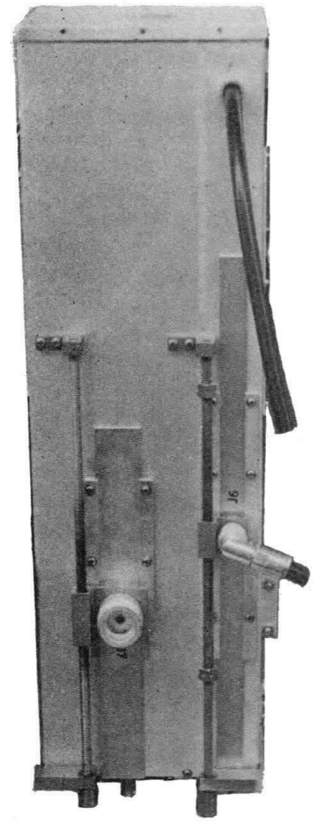

DRIVER AMPLIFIER MOUNTING PANEL. (FRONT FACE).
VIEW
23
24
25
26 6 REF
A
A
28
27
15 REF
29
TION
36
REF 34 35
32 REF
31 32 REF
15 6 REF
34 REF
34 33
31 32
30
15 6 REF
FRONT END
44
VIEW


EM4505
IST STAGE
EM4505
2ND STAGE
EM4506
3RD STAGE
208V AC 3Ø
AC INPUT
NOTES
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICRO-MICRO FARADS UNLESS OTHERWISE SPECIFIED.
ALL SUPPLIES - 3RD STAGE
HV & HEATER SUPPLIES
IST & 2ND STAGES
GRID SUPPLIES
IST & 2ND STAGES
DIRECTIONAL COUPLER
OUTPUTS
INTERLOCKS
REFERENCE SCHEMATIC ONLY

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4506

CAVITY AMPLIFIER
122-150 Mc



The Eimac EM4506 is a cavity amplifier incorporating the Eimac 4CX1000K tetrode. It is designed for use as an intermediate stage or the output stage of an FM transmitter.

CHARACTERISTICS

ELECTRICAL

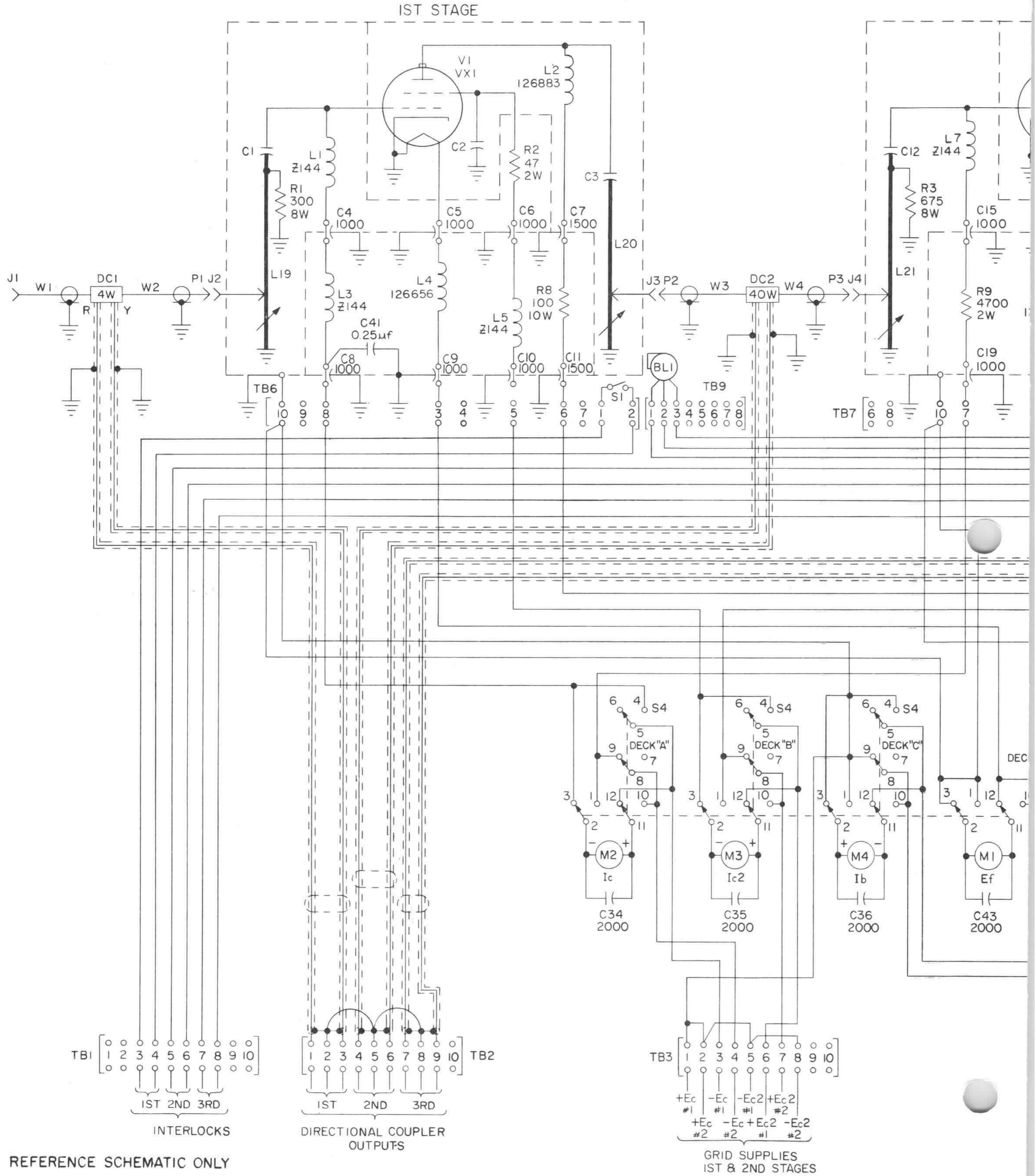
Frequency		122-150 Mc
RF Power Output		1 kW CW
RF Drive Power Required		30 Watts
Power Supply Requirements (Typical):	Voltage	Current
Anode, Maximum	3 KV	1 A
Screen Grid, Maximum	250-350 V	-100 to+125 mA
Control Grid, Maximum	-90 to -120 V	-50 to+0.75 mA
Tube Type		Eimac 4CX1000K
Load Impedance		50 ohms
Bandwidth		2 Mc at 1.5 db
Modulation		FM

MECHANICAL

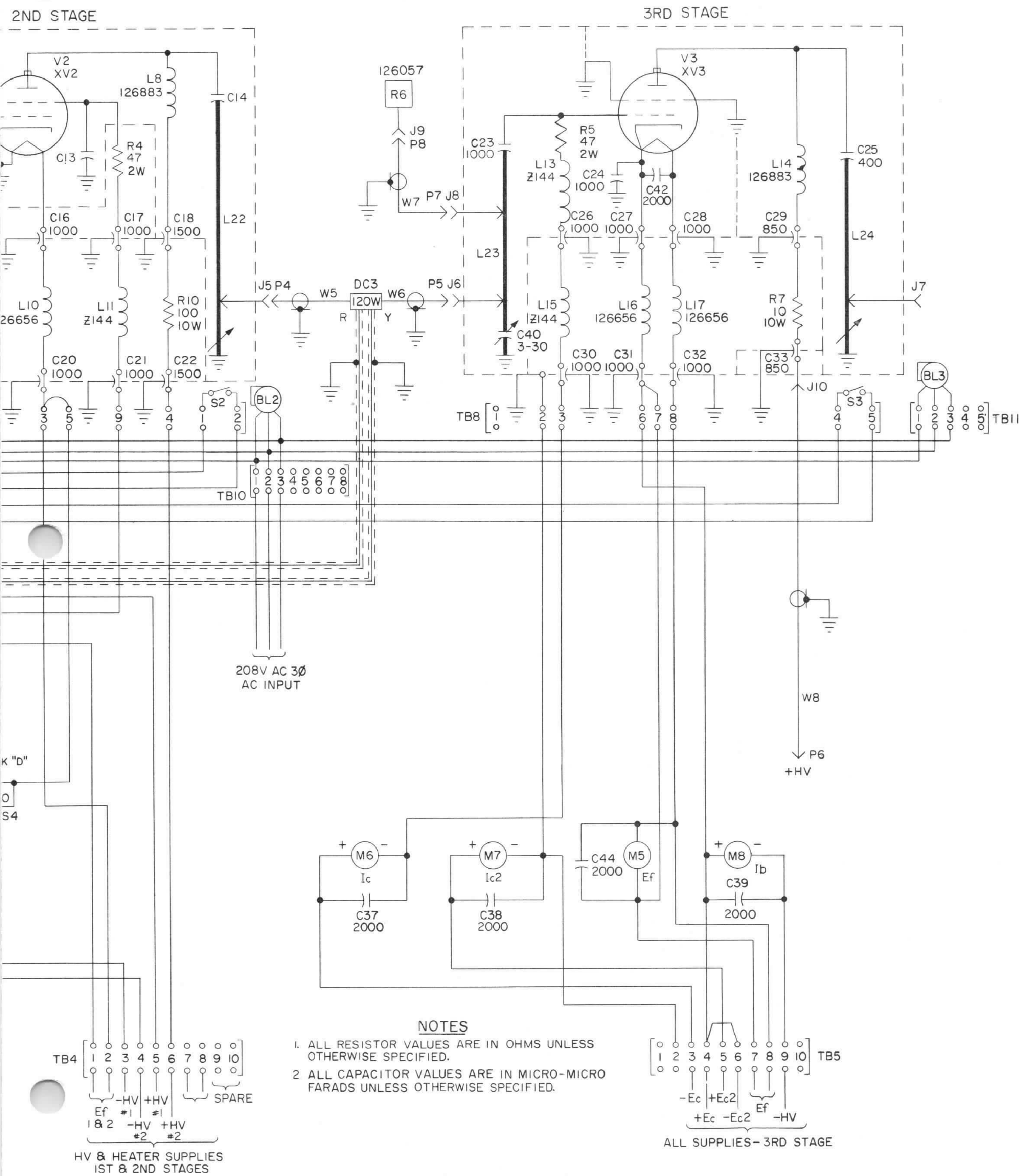
Mounting	Standard 19" relay rack panel
Size	Height - 24 inches Width - 15 inches Depth - 12 1/2 inches
Cooling	Blower included
Connectors	Input -- Type N Female Output -- Type LC Female

ENVIRONMENTAL

Temperature	-10 to+50°C (+14 to+122°F)
Altitude	to 12,000 feet

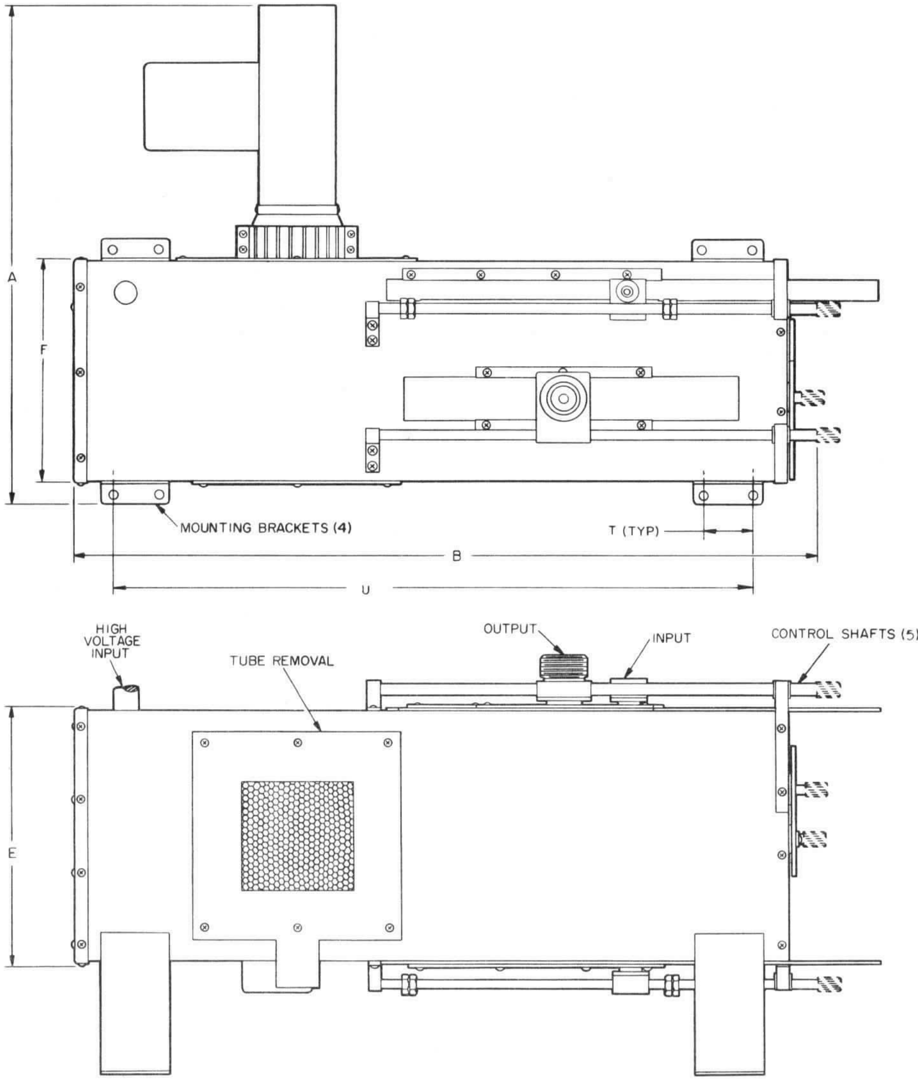


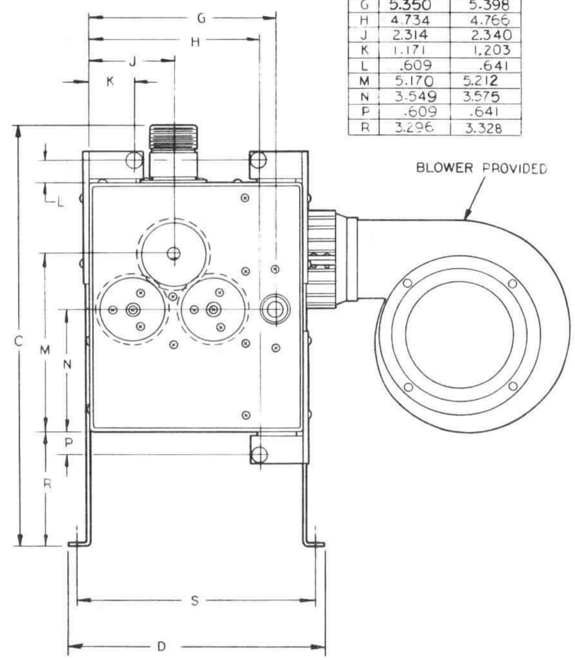
REFERENCE SCHEMATIC ONLY



NOTES

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICRO-MICRO FARADS UNLESS OTHERWISE SPECIFIED.





DIMENSION DATA		
REF	MIN	MAX
A	8.268	8.434
B	21.844	21.875
C	11.719	11.843
D	7.389	7.485
E	7.171	7.203
F	6.266	6.234
G	5.350	5.398
H	4.734	4.766
J	2.314	2.340
K	1.171	1.203
L	.609	.641
M	5.170	5.212
N	3.549	3.575
P	.609	.641
R	3.296	3.328

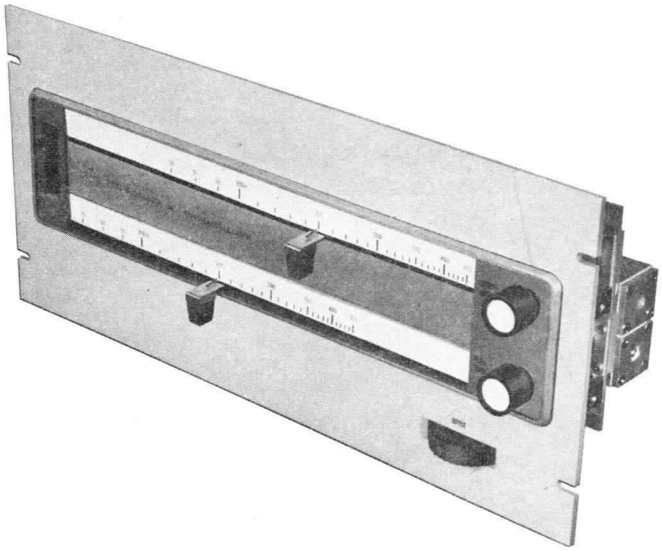
DIMENSION DATA			
REF	MIN	MAX	NOM
S			6.937
T			1.500
U			18.500

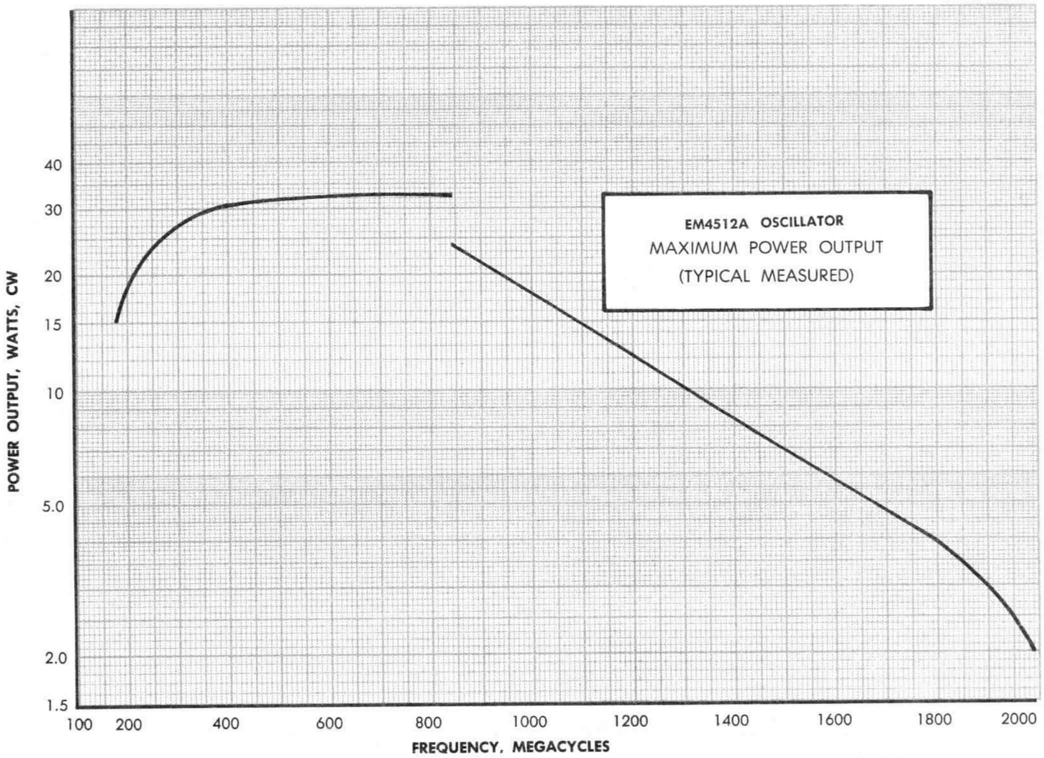
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4512A

BROAD TUNING OSCILLATOR 170-2000 Mc

The Eimac EM4512A is a broad-tuning cavity power oscillator incorporating the Eimac Y-319 ceramic-metal planar triode. It is intended for use in test equipment consoles and special transmitters. This oscillator has front-panel tuning knobs and frequency scales for tuning across the 170-2000 Mc band with power output from 25 to 2 watts.





CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable		170-2000 Mc
RF Power Output, minimum	Frequency, Mc	Power output, watts, CW
	170- 300	15
	300- 800	25
	800-1200	10
	1200-1600	5
	1600-2000	2
Frequency Drift,[1] percent of operating frequency		±0.05%
Power Supply Requirements:		Voltage Current
Anode, maximum		1 KV 100 mA
Grid		Bias through variable cathode resistor, 200-1000 ohms
Heater		6.0 V 1 A
Ground		Positive terminal of anode supply
Cathode Current		125 mA
Tube Type		Eimac Y-319
Load Impedance		50 ohms nominal
Load VSWR, maximum		2.0:1 any phase, without damage

MECHANICAL

Mounting	Standard 19" relay rack
Size	height — 8¾ inches depth — 4½ inches
Weight	10 pounds
Operating Controls	Tuning knobs and frequency scales provided[2]
Cooling	Conduction — Convection[3]
Connector	Type TNC Female

ENVIRONMENTAL

Temperature	—10 to +50°C (+14 to +122°F)[3]
Altitude	to 12,000 feet

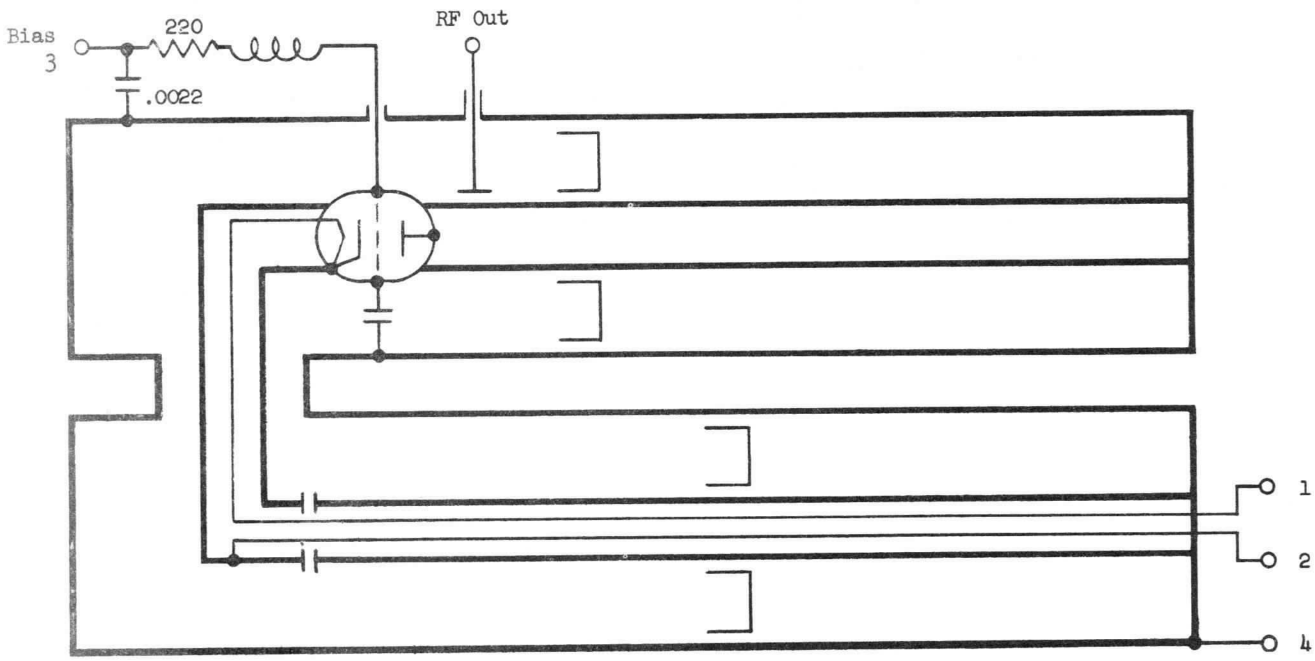
NOTES:

(1) Frequency drift is specified over a period of 2 hours, following a warm-up period of ½ hour minimum.

(2) Knobs are provided on the front panel for fine tuning the plate and cathode cavities and for adjusting output coupling. Frequency scales are provided for each cavity. Tuning is accomplished by sliding the pointers to the desired frequency, then adjusting the fine tuning and output coupling. Access to the interior of the amplifier is not required for tuning. Four sets of scales are provided, covering four sections of the tuning range. The desired set of scales is selectable by a knob on the front panel.

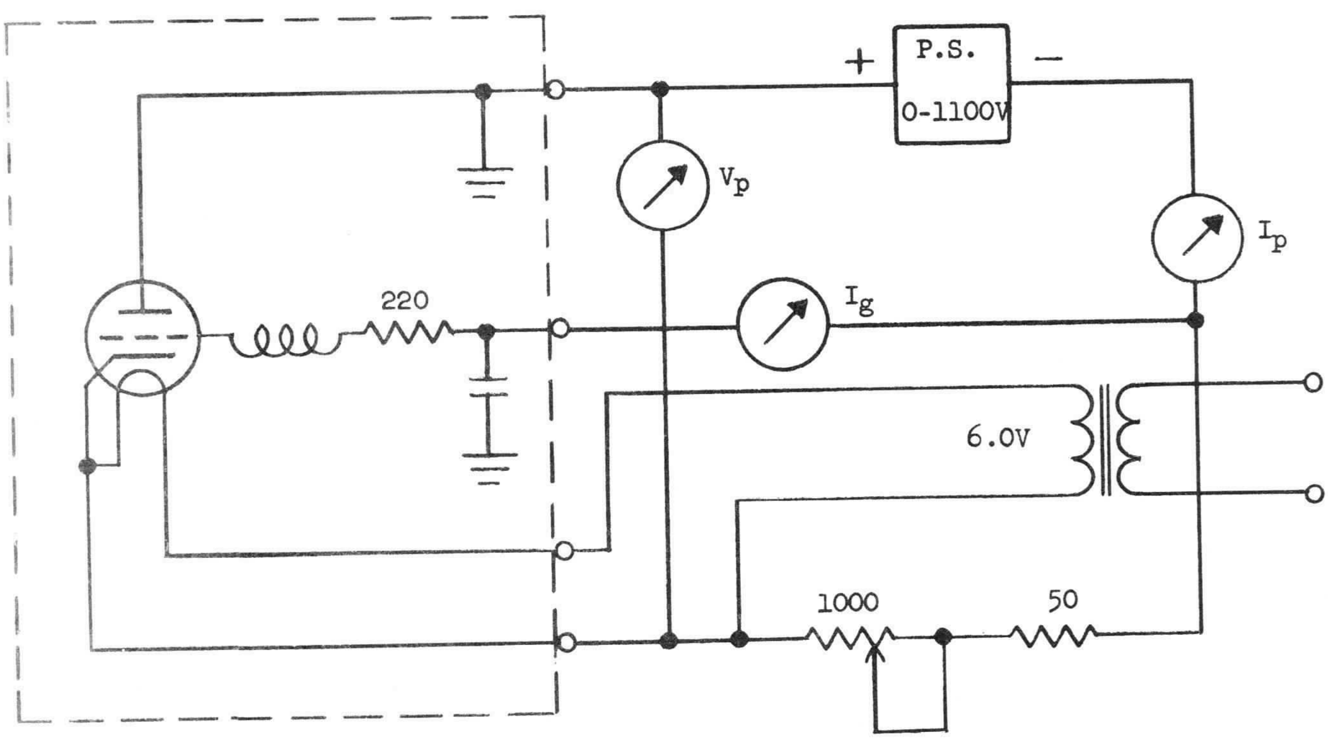
(3) If ambient temperature exceeds 90°F, the cavity body will become quite hot (up to 250°F), and forced air cooling is recommended.

For personnel protection, high voltage circuits above 500 volts are enclosed and identified. Interlocks are not provided.



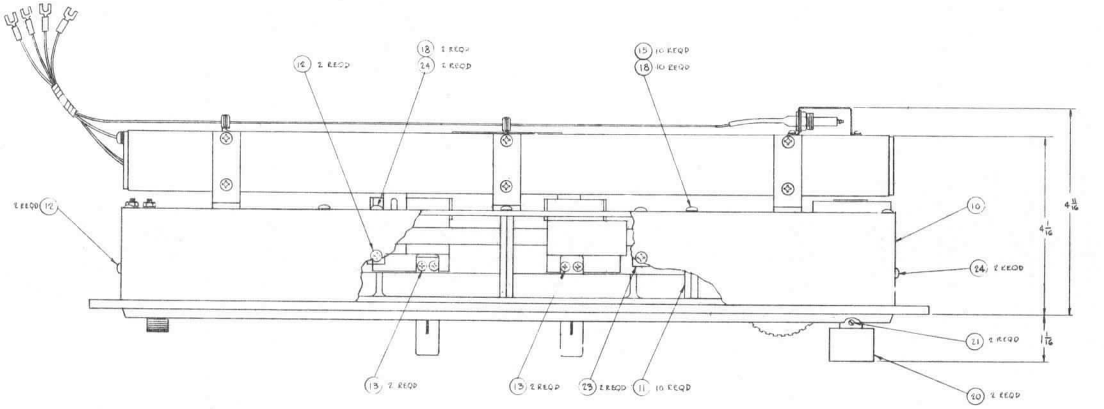
EM4512A CAVITY OSCILLATOR

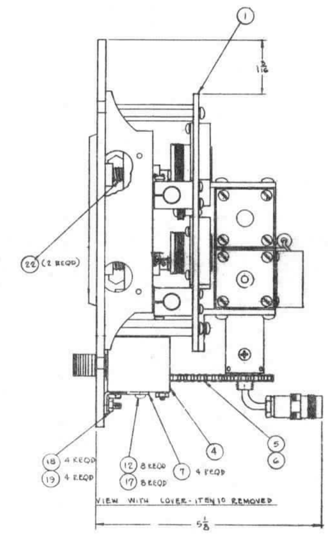
Figure 2



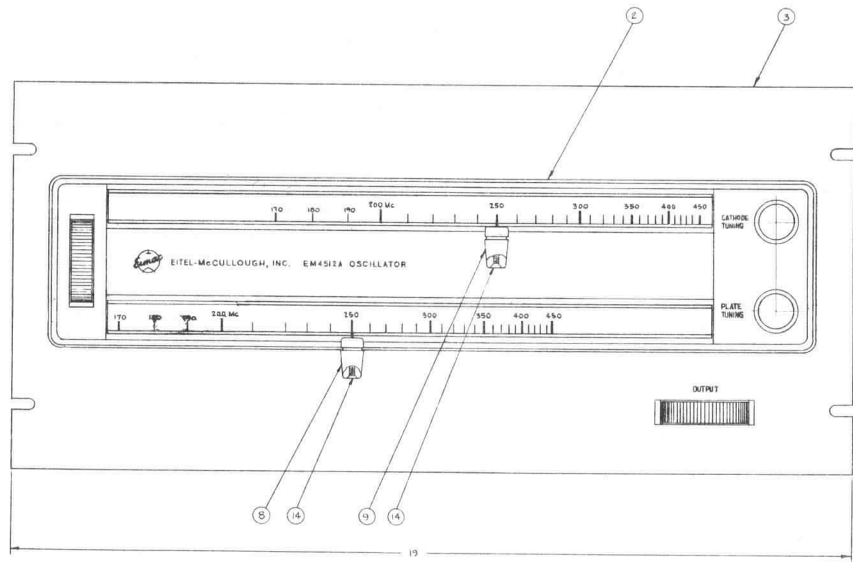
EM4512A POWER SUPPLY CONNECTIONS

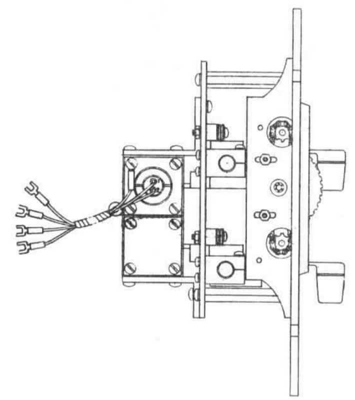
Figure 3





VIEW WITH COVER-ITEM 10 REMOVED





VIEW WITH COVER-ITEM 10 REMOVED

NOTE:

1. DIMENSIONS ARE NOMINAL AND ARE FOR REFERENCE ONLY.

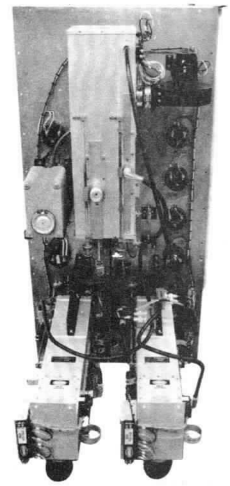
ITEM	QTY	PART NUMBER	DESCRIPTION
24	6		SCREW, PAN HD, PH DR #6-32 x 1/4 LG
23	2	PR-14563	BRACKET- COVER
22	2		SPRING-LEE #LC-022D-5 (SST)
21	2		SCREW, SET-HEX SKT HD, #4-40 x 1/8 LG
20	2	PR-14143	KNOB ASSY
19	4		NUT, HEX - #6-32
18	16		LOCKWASHER, SPLIT #6
17	8		LOCKWASHER, SPLIT #4
16	4		SCREW PAN HD, PH DR-#8-32 x 3/16 LG
15	10		SCREW, PAN HD, PH DR-#6-32 x 1/2 LG
14	2		SCREW, FLAT HD-82°, PH DR-#4 40 x 3/8 LG
13	4		SCREW, BDG HD, PH DR-#4-40 x 1/4 LG
12	12		SCREW, BDG HD, PH DR-#4-40 x 3/16 LG
11	10	PR-14121	SPACER- MTG
10	1	PR-14431	COVER
9	1	PR-14214	SLIDER ASSY- CATHODE CAVITY
8	1	PR-14149	SLIDER ASSY- PLATE CAVITY
7	4	PR-14102	BRACKET, DRIVE
6	1	S18043N	DISCONNECT ASSY
5	A/R		CHAIN - SIERRA 1475 P - SST
4	1	PR-11998	DRIVE ASSY-OUTPUT COUPLER
3	1	PR-14248	PANEL ASSY
2	1	PR-14397	BEZEL ASSY
1	1	PR-14351	CAVITIES & DRIVE ASSY

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4516

CAVITY AMPLIFIER CHAIN

122-150 Mc



The Eimac EM4516 is a three stage amplifier chain designed for use as the driver amplifier section in FM transmitters. The first two stages are Eimac EM4505 cavity amplifiers incorporating the 4CX250R ruggedized tetrode. The final stage is Eimac cavity amplifier EM4506 which uses the 4CX1000K tetrode. The three stages are mounted on a panel which fits a standard 19" rack.

CHARACTERISTICS

ELECTRICAL

Frequency	122-150 Mc
RF Power Output	1 kW CW
RF Drive Power Required	1 Watt

Power Supply Requirements (Typical):

	Stage 1 Voltage	Stage 1 Current	Stage 2 Voltage	Stage 2 Current	Stage 3 Voltage	Stage 3 Current
Anode	400 V	150 mA	750 V	250 mA	3000 V	800 mA
Screen	100 to 200 V	−25 to +25 mA	150 to 250 V	−10 to +40 mA	250 to 350 V	−75 to +75 mA
Grid	−20 to −70 V	−10 mA	−50 to −100 V	−15 mA	−50 to −125 V	−10 mA
Heater/Filament	6.0 V	2.6 A	6.0 V	2.6 A	6.0 V	12.0 A

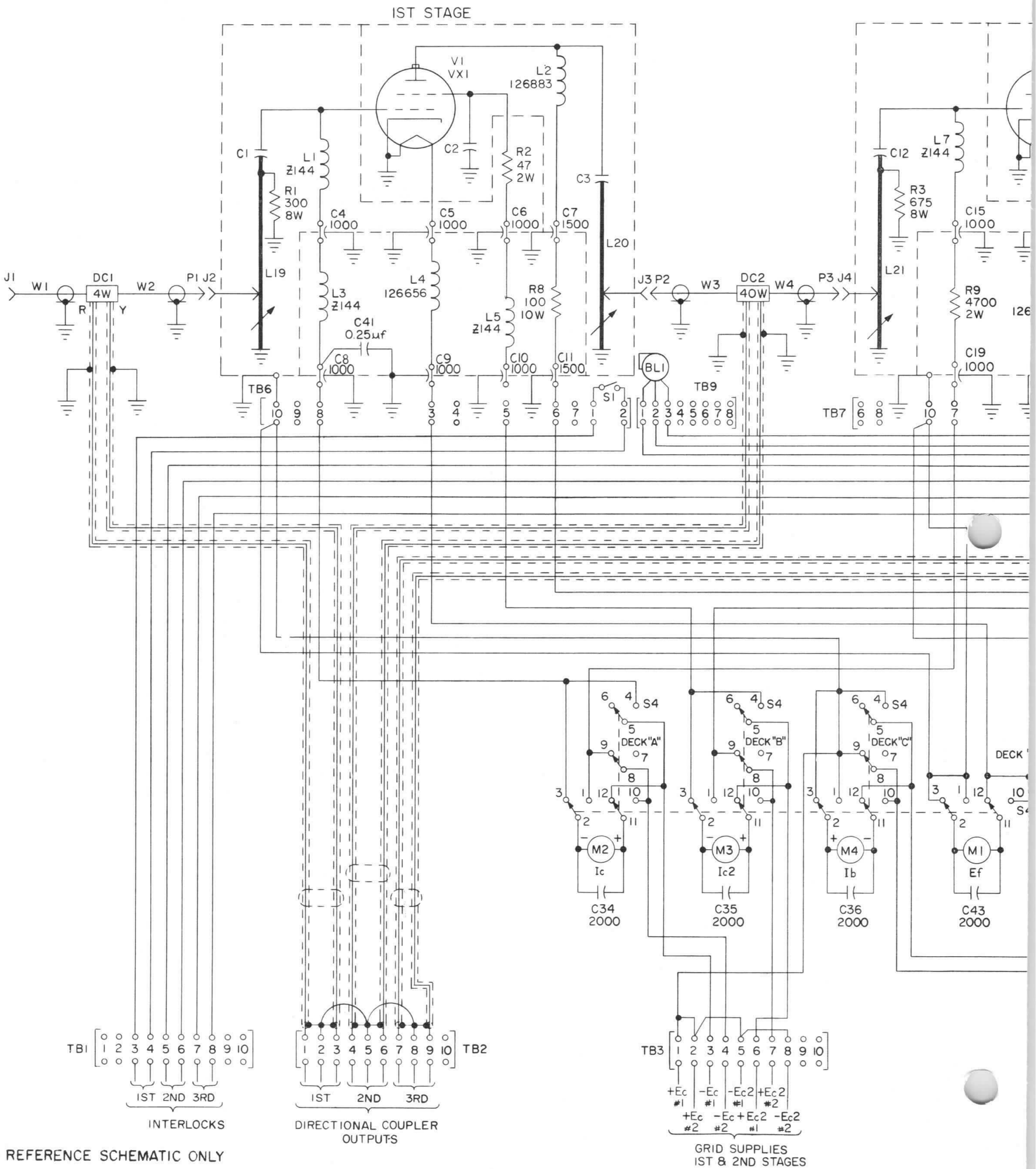
Tube Type	Eimac 4CX250R and 4CX1000K
Load Impedance	50 ohms
Bandwidth	2 Mc at 1.5 db
Modulation	FM-CW

MECHANICAL

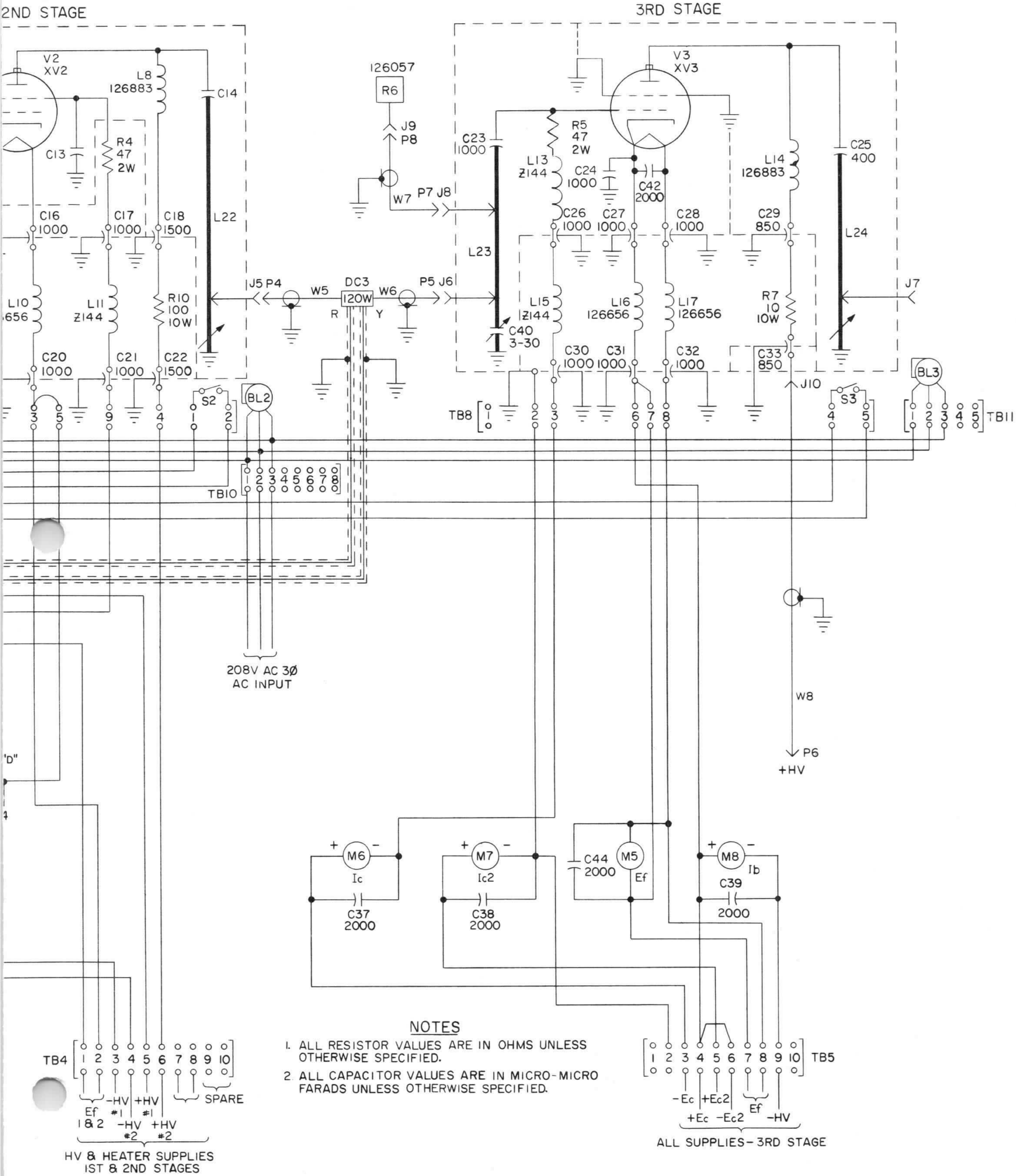
Mounting	Standard 19" relay rack
Size	Height - 60 inches Depth - 28 inches
Cooling	Blowers provided
Connectors	Input - Type N Female Output - Type LC Female

ENVIRONMENTAL

Temperature	-10 to +50° C (+14 to +122° F)
Altitude	to 12,000 feet

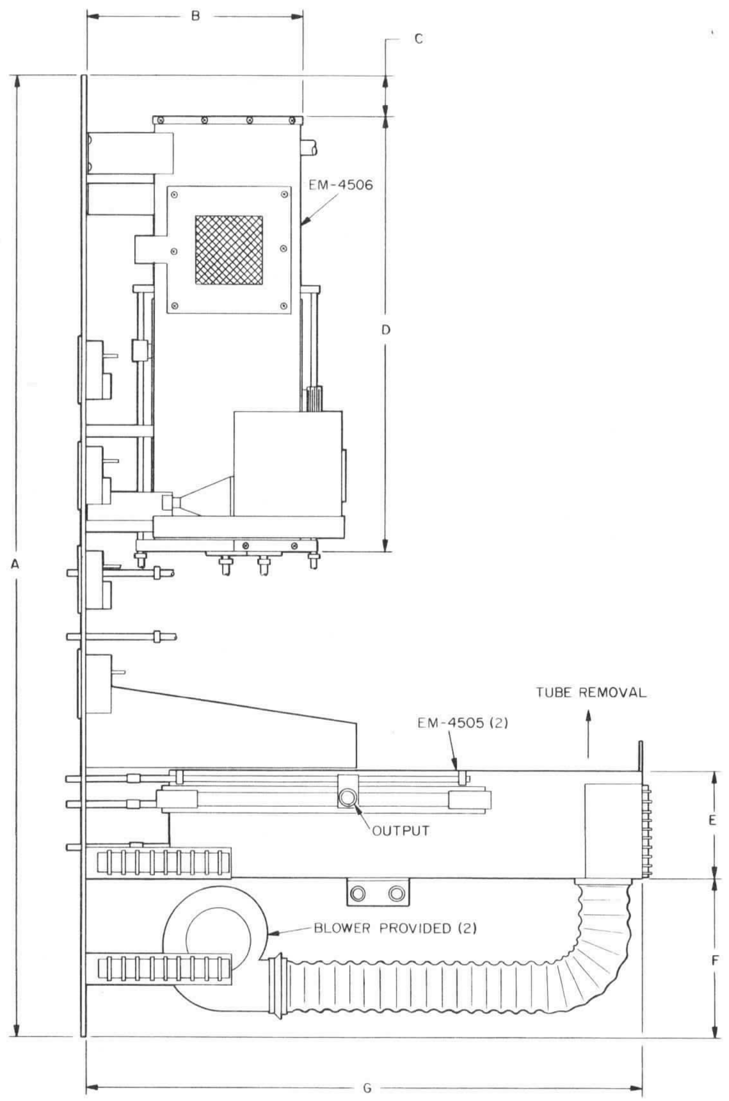


REFERENCE SCHEMATIC ONLY

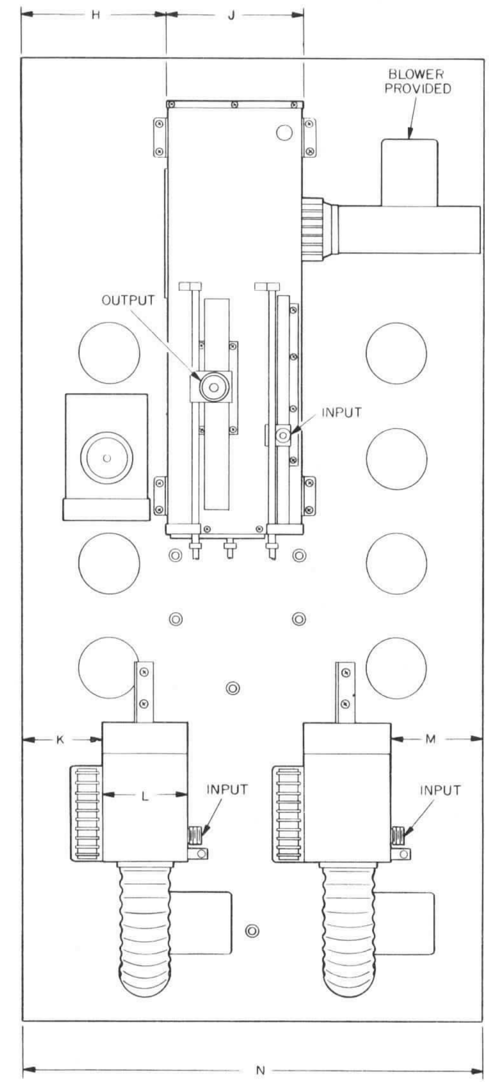


NOTES

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICRO-MICRO FARADS UNLESS OTHERWISE SPECIFIED.



SIDE VIEW



BACK VIEW

DIMENSION		DATA
REF	MIN	MAX
A	45.940	46.060
B	10.484	10.516
C	1.922	1.954
D	20.530	20.594
E	5.109	5.141
F	7.734	7.766
G	25.938	26.062
H	6.812	6.876
J	6.234	6.266
K	4.406	4.470
L	4.109	4.141
M	3.906	3.960
N	21.940	22.060

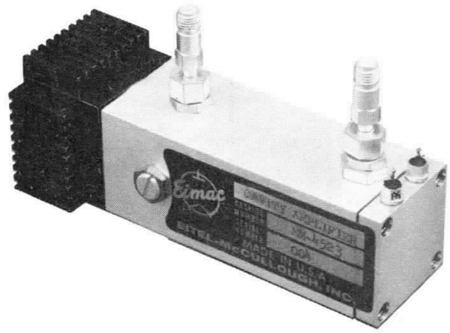
NOTE:
FOR CONTROL SHAFT LOCATING DIMENSIONS SEE INDIVIDUAL CAVITY AMPLIFIER SPEC SHEET.

EM4523

CAVITY AMPLIFIER

2200-2300 Mc
20 Watts CW

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA



The Model EM4523 cavity amplifier is a compact modular amplifier readily adaptable to airborne or ground support telemetry and communications systems. It is an optimum combination of the tube configuration with the associated rf circuit. Maximum efficiency and rf output from a very small package are outstanding features offered by this amplifier. Tuning can be accomplished with a minimum of test equipment.

CHARACTERISTICS

ELECTRICAL

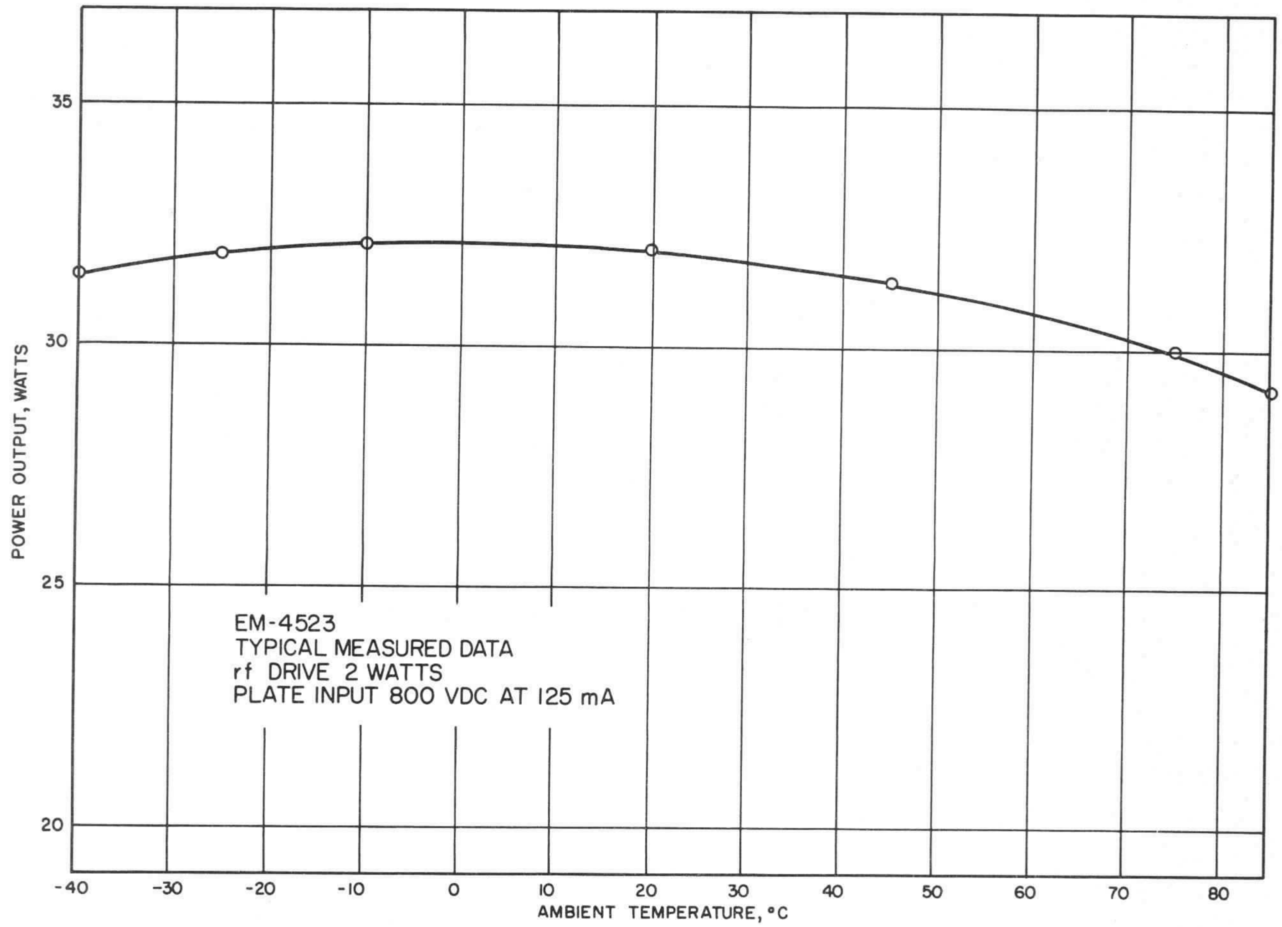
Tuning Range		2200-2300 Mc
Tube Type		Eimac A126066
Power Supply Requirements:		
Anode Voltage	800	V
Current	125	mA
Heater Voltage	6.0	V
Current	1.0	A
Operating Characteristics:		
Power Input	2.0	W
Power Output, Minimum	20	W
Modulation		CW/FM
Bandwidth, 3 db points	5	Mc
Frequency Stability	20	PPM/°C
Load Impedance	50	ohms nominal
Load VSWR	1.5:1	Any Constant Phase

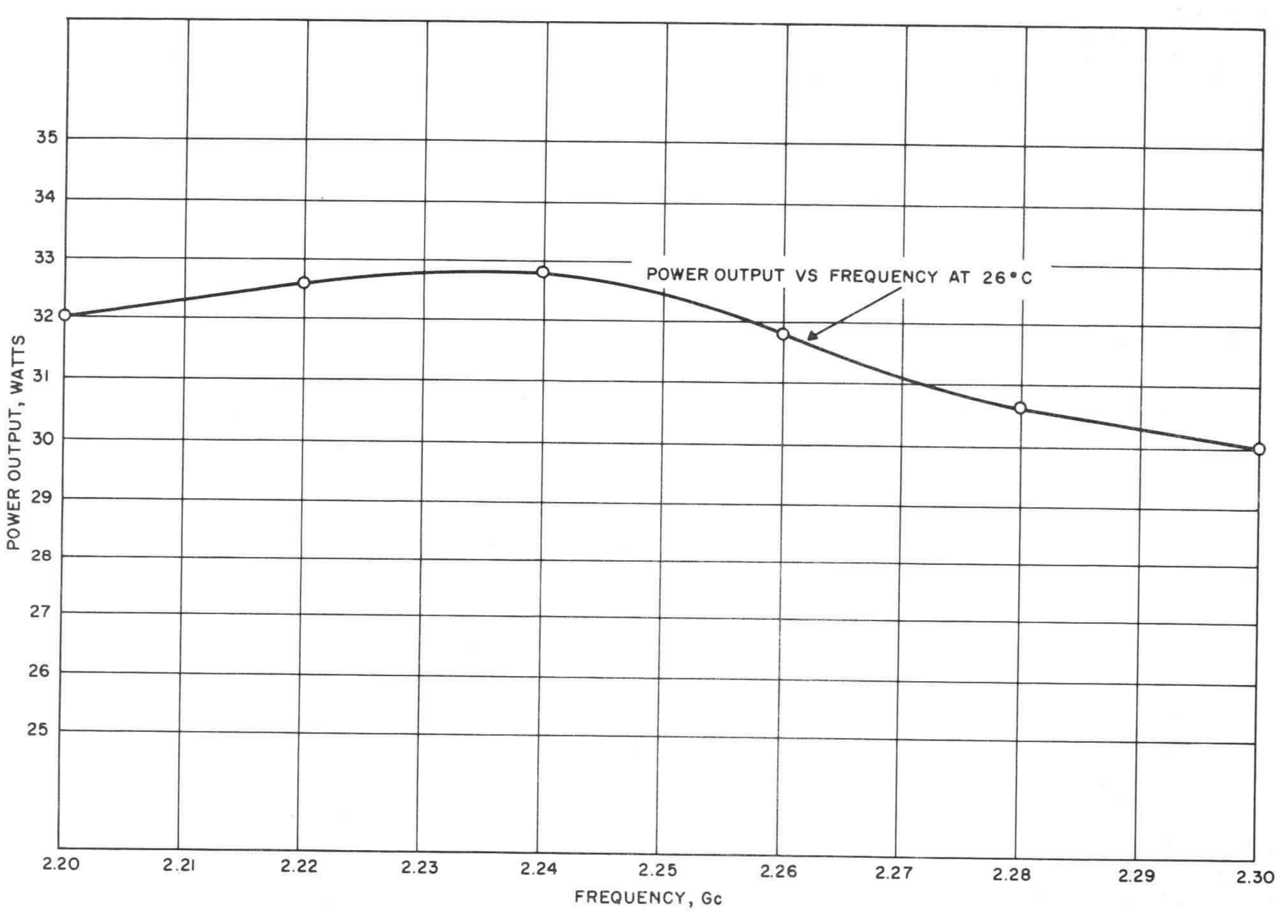
MECHANICAL

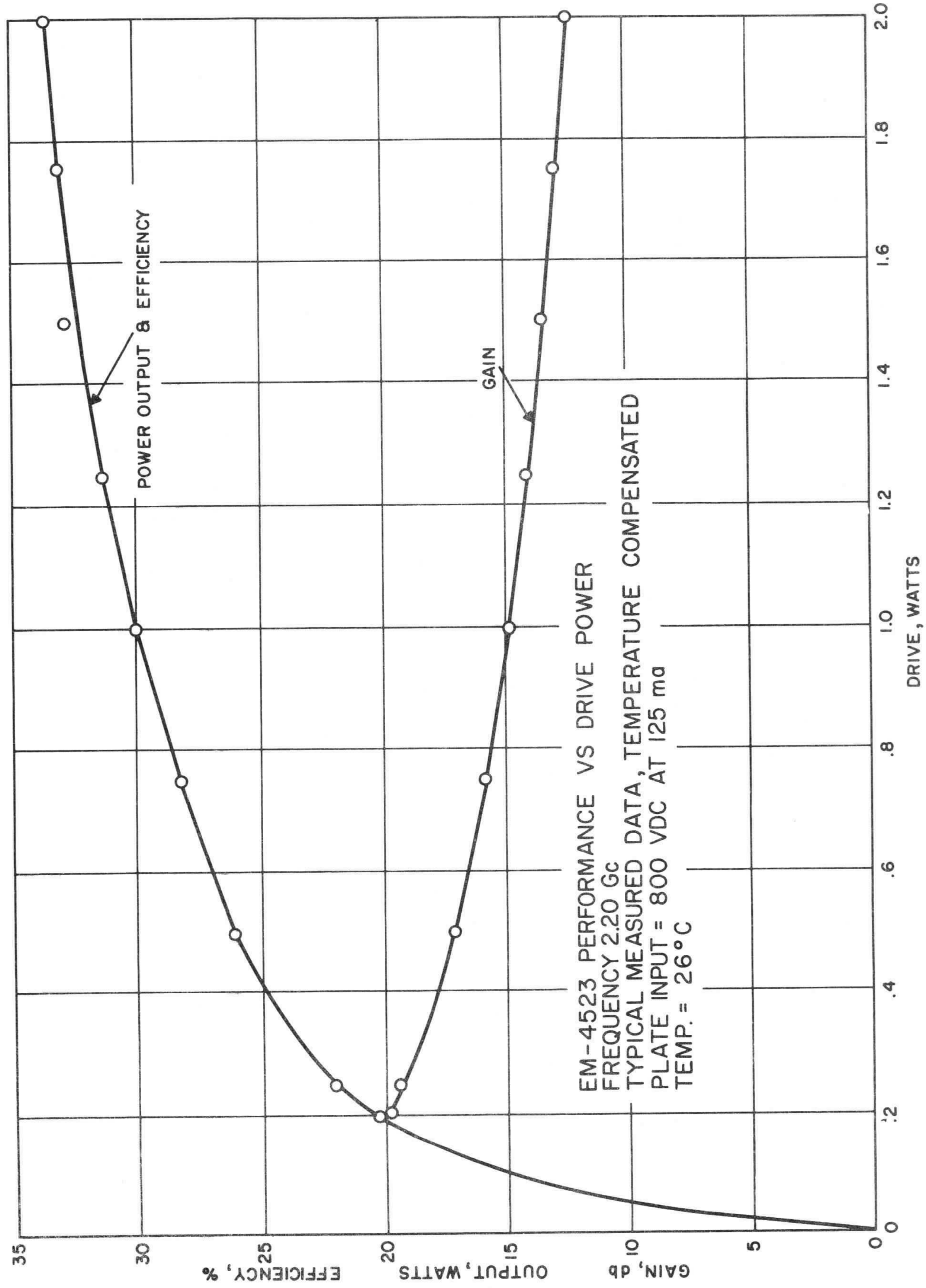
Connectors	Type OSM
Cooling	Conduction to heat sink
Maximum Overall Dimensions	1.25" x 1.25" x 4⅜"
Net Weight	1.2 pounds

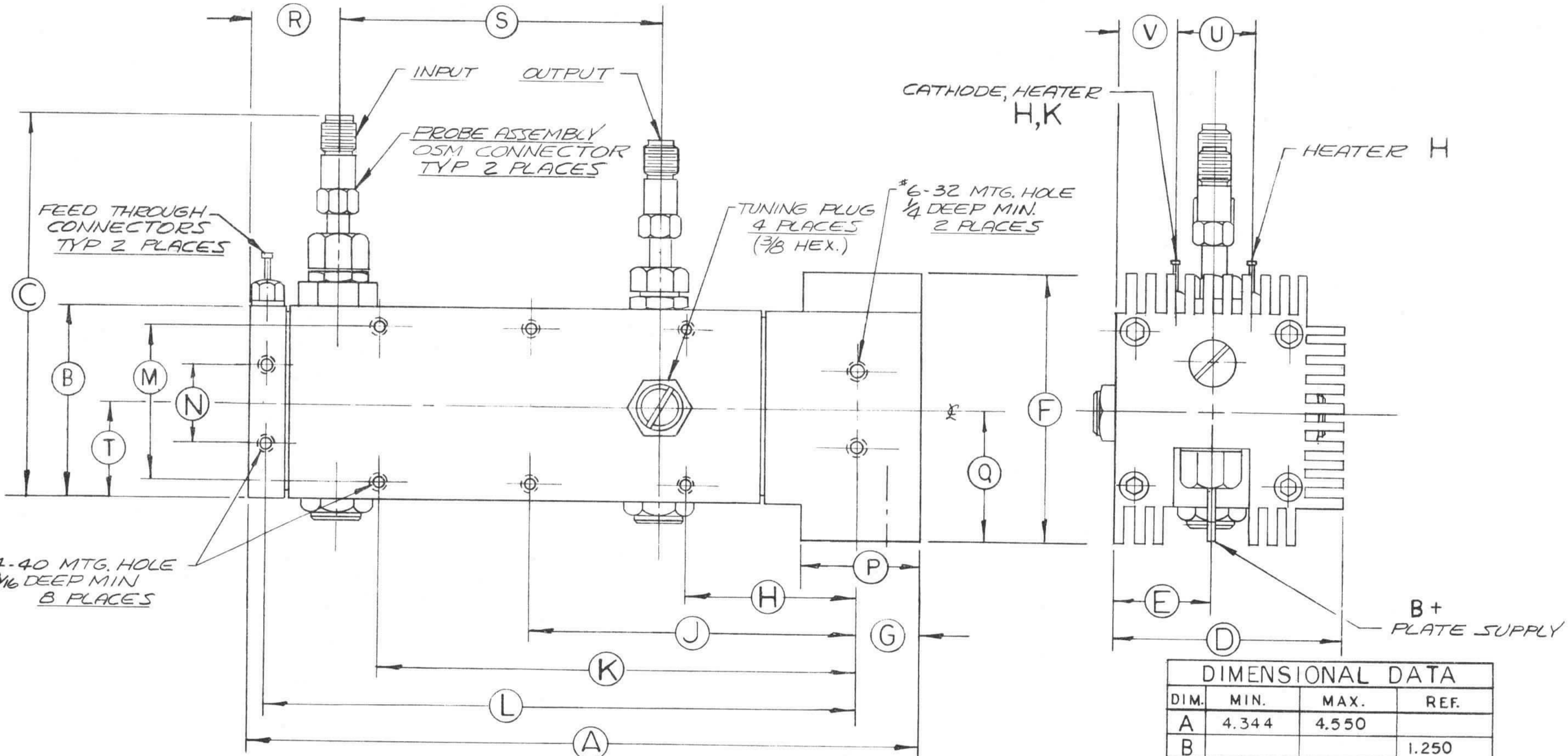
ENVIRONMENTAL

Mounting Surface Temperature	–40° to +85°C
Vibration	10g, 5-500 cycles, 15 minutes in 3 mutually perpendicular planes
Shock	15g for 11 milliseconds in 3 mutually perpendicular planes


35
30
25
20
POWER OUTPUT, WATTS
EM-4523
TYPICAL MEASURED DATA
rf DRIVE 2 WATTS
PLATE INPUT 800 VDC AT 125 mA
-40 -30 -20 -10 0 10 20 30 40 50 60 70 80
AMBIENT TEMPERATURE, °C


35
34
33
32
31
30
29
28
27
26
25
POWER OUTPUT, WATTS
POWER OUTPUT VS FREQUENCY AT 26°C
2.20 2.21 2.22 2.23 2.24 2.25 2.26 2.27 2.28 2.29 2.30
FREQUENCY, Gc


EM-4523 PERFORMANCE VS DRIVE POWER
FREQUENCY 2.20 Gc
TYPICAL MEASURED DATA, TEMPERATURE COMPENSATED
PLATE INPUT = 800 VDC AT 125 ma
TEMP. = 26°C
POWER OUTPUT & EFFICIENCY
GAIN
DRIVE, WATTS
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
GAIN, db
OUTPUT, WATTS
EFFICIENCY, %
0
5
10
15
20
25
30
35



DIM.	MIN.	MAX.	REF.
A	4.344	4.550	
B			1.250
C			2.500
D			1 1/2 IN.
E			.625
F	1.735	1.765	
G			.302
H	1.130	1.170	
J	2.130	2.170	
K	3.130	3.170	
L	3.860	3.890	
M	1.045	1.055	
N	.495	.505	
P			.750
Q			.875
R	.560	.590	
S			2.106
T			.625
U	.458	.478	
V	.375	.406	

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

EM4524A

CAVITY AMPLIFIER

2200-2300 Mc

100 WATTS CW

Tentative Data

The Model EM4524A cavity amplifier is a compact modular amplifier readily adaptable to airborne or ground support telemetry and communications systems. The Model EM4524A is an optimum combination of the tube configuration with the associated RF circuit. Maximum efficiency and rf output from a very small package are outstanding features offered by this amplifier. Tuning can be accomplished with a minimum of test equipment.

CHARACTERISTICS

ELECTRICAL

Tuning Range		2200-2300 Mc
Tube Type		Eimac X843G
Power Supply Requirements:		
Anode Voltage	1000	V
Current	350	mA
Heater Voltage	6.0	V
Current	2.7	A
Operating Characteristics:		
Power Input	10	W
Power Output	100	W
Modulation		CW/FM
Bandwidth, 3db points	7	Mc
Frequency Stability	20	PPM/°C
Load Impedance	50	ohms nominal
Load VSWR	1.5:1	Any Constant Phase
Gain	10	DB

MECHANICAL

Connectors	OSM Input, Type N Output
Cooling	Conduction
Maximum Overall Dimensions	2" x 2" x 6"
Net Weight	3 pounds

ENVIRONMENTAL

Mounting Surface Temperature	–40 to +100°C
Vibration	Shall meet the requirements of Method 514, MIL-Standard-810, Class 1 through 4 and mounting Type A.
Shock	Shall meet the requirements of Procedure 1, Method 516 of MIL-Standard-810.

Printed in U.S.A.

EIMAC

A Division of Varian Associates

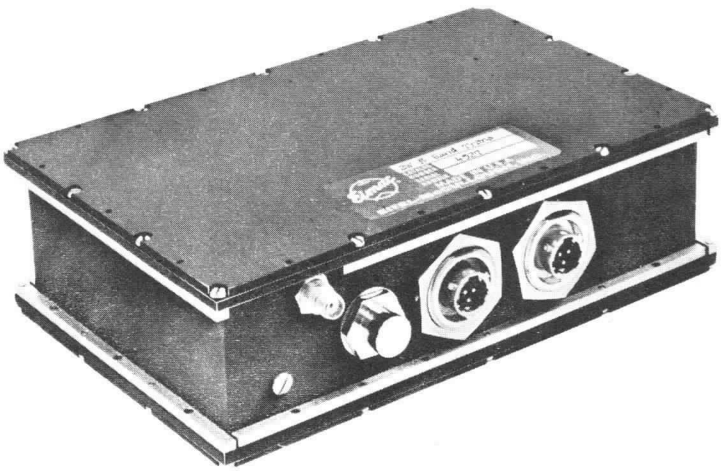
SAN CARLOS, CALIFORNIA

EM4527

TELEMETRY TRANSMITTER

2200 - 2300 MHz
2 Watts

This EIMAC S-Band transmitter provides over 2 watts rf output with over 10% overall efficiency, under all combinations of worst specified environmental extremes and primary power variation. Frequency change, if desired, is easily accomplished in the field. It is designed to operate during the severe shock and vibration of missile launch.



Model EM 4527 is a complete transmitter, including a pre-regulated DC-DC converter. All circuits are solid state, except the rf power oscillator, which is a single stage rugged ceramic planar triode. RF is generated at the output frequency. The complete transmitter package displaces less than 50 cubic inches, and weighs 4 pounds. Major features of this transmitter include:

Easy Tuning: A simple crystal change will allow the output to be tuned to any frequency in the 2.2-2.3 GHz band. Test points are provided. A minimum of test equipment is required. Adjustment of temperature compensation is not required.

High Reliability: Since the rf power output is produced by a single stage, this transmitter has a minimum number of components, tuning adjustments and connections. All components are used well below maximum ratings, and circuits are epoxy encapsulated for environmental protection.

Wide Temperature Range: This transmitter will meet full performance specifications over the range —40°C to +85°C.

Modulation Bandwidth and Linearity: Deviation of ±1.5 MHz is accomplished at ±2.5% linearity, and ±300 KHz at ±0.5% linearity.

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

CHARACTERISTICS

ELECTRICAL

Frequency, Tunable	2200-2300 MHz
Power Output, CW Minimum	2 Watts
Frequency Accuracy	±0.001%
Frequency Stability[7]	±0.0025%
Carrier Deviation, Adjustable, peak-to-peak	2Mc/Volt to 30Kc/Volt
Modulation Bandwidth,[1] Flat within ±0.5 db	100 Hz to 500 KHz
Flat within ±1 db	5 Hz to 800 KHz
Modulation Linearity, Deviation from B.S.L.,	
For ±300 KHz peak Deviation	±0.5%
For ±1.5 MHz peak Deviation	±2.5%
Incidental Frequency Modulation, Maximum	5 KHz rms deviation
AM, Maximum, due to environmental conditions	1%
due to ±300 KHz carrier deviation	1%
due to ±1.5 MHz carrier deviation	5%
Modulation Input Impedance, Minimum, 5 Hz to 800 KHz	10,000 Ohms
Primary Voltage required[2]	$28 \pm^{8}_{4}$ Vdc
Primary current required, maximum, at 28 Vdc	700 mA
Primary Ripple, maximum, peak-to-peak from Dc to 20 KHz	8 volts
Transients, Maximum positive	80 volts for 20 microseconds
Input current rise above nominal, due to fault,[3] maximum	130%
VSWR Maximum, any phase, for 2 watts output	1.5:1
for 1 watt output	5.5:1
Load Impedance required	50 ohms
Warm-up time to meet all specifications	120 seconds
Interference	All applicable requirements of MIL-I-26600 and MIL-I-6181D are met
Life (95% probability, 60% confidence factor)	500 hours

PACKAGING

Volume displaced	48 cubic inches
Dimensions, including mounting flanges	6.5"x 4.4"x 1.9"
Weight	4 pounds
Pressurization	30 psia
Cooling	Conduction through bottom plate to heat sink

ENVIRONMENTAL SPECIFICATIONS[4]

Temperature[5] at heat sink (Continuous Operation)	—40°C to +85°C
Altitude	Any
Vibration (MIL-STD-810, Figure 514-3, Curve D)	15G peak to 2KHz
(MIL-STD-810, Figure 514-4, Curve E)	0.2 G^2/Hz
Air Induced Vibration	150 db above 2×10^{-4} dynes/CM^2 from 150 to 2000 Hz, 30 minutes
Explosive Atmosphere	Capable of operation without igniting an explosion
Sustained Acceleration	30G for 5 minutes, three axes
Shock, per MIL-STD-810 Method 516, Procedures I and V,	
half-sine shocks	15G for 11 milliseconds
sawtooth shocks[6]	100G

[7]±0.001% available on special order.

[6]Out-of-tolerance operation may occur during 100G shock.

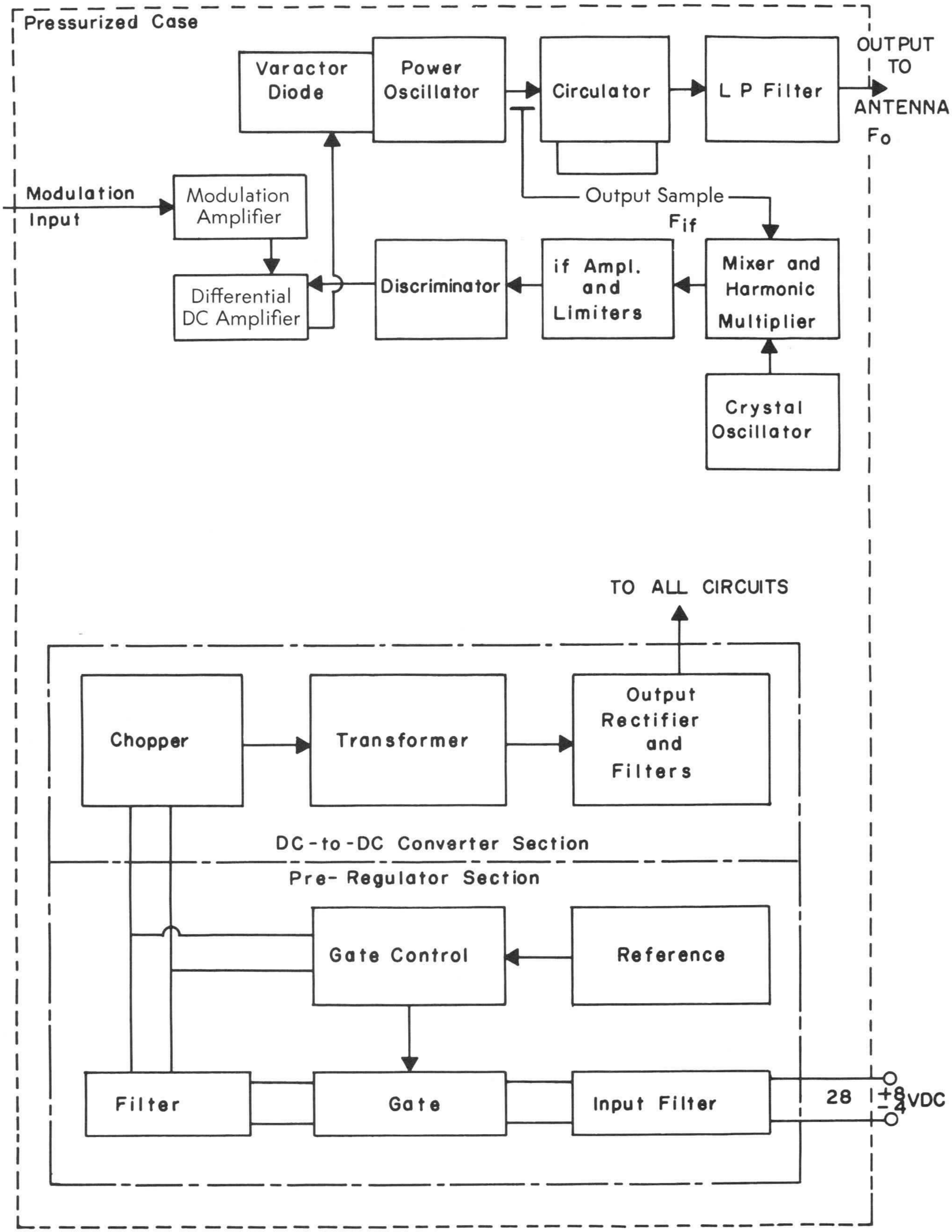
[5]Other ranges available on special order.

[4]Transmitter performs as specified, under any combination of environmental conditions.

[3]Any failure of transmitter (except at input terminals.)

[2]Under emergency conditions, full rf output is provided with primary power as low as 22 Vdc, but increased IFM and AM will occur.

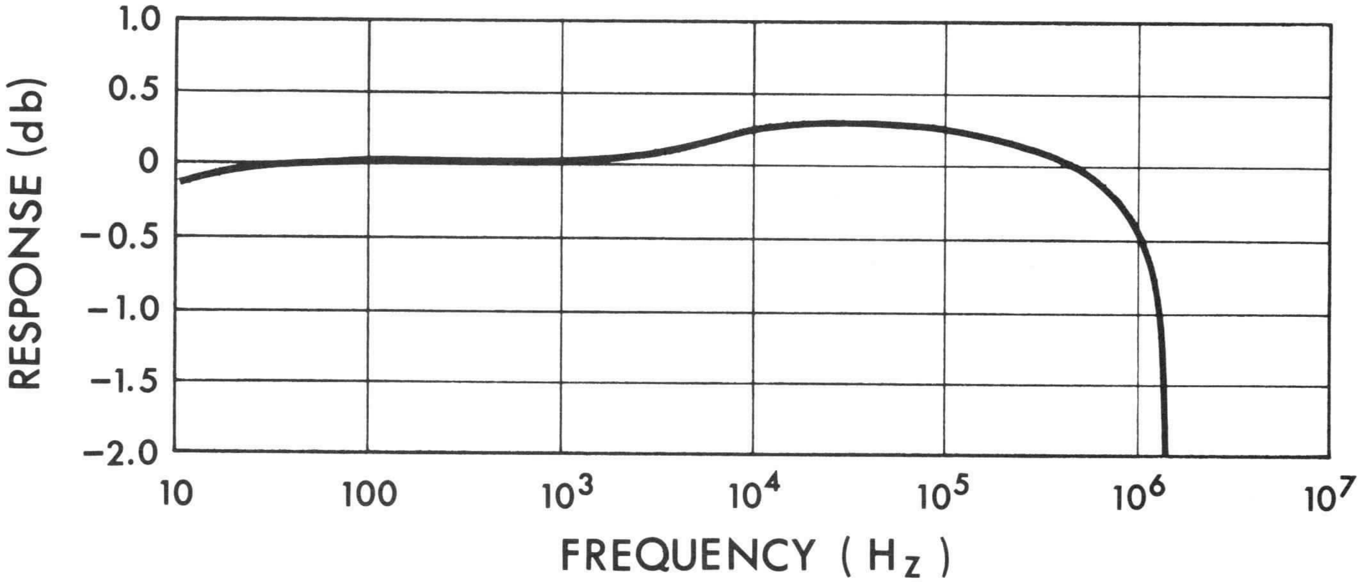
[1]Also available modified for modulation down to DC; and up to 2MHz.



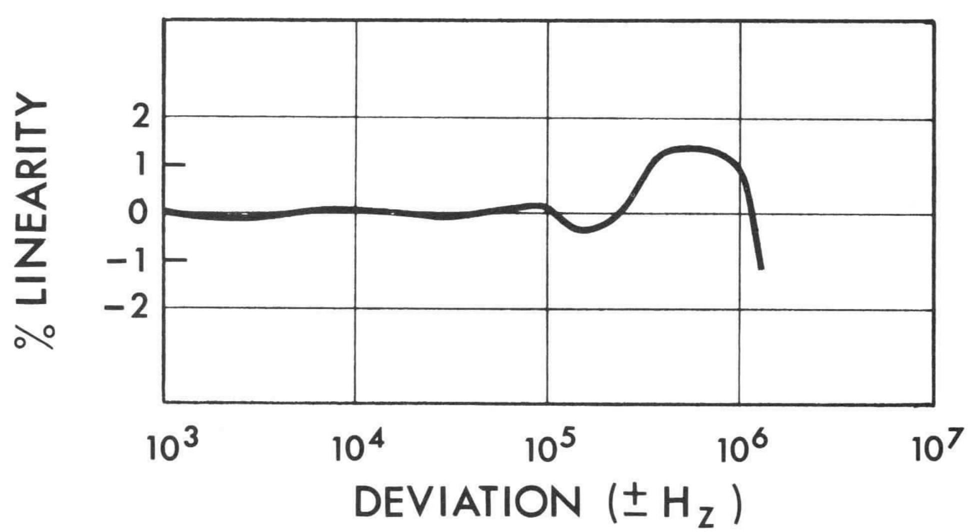
BLOCK DIAGRAM

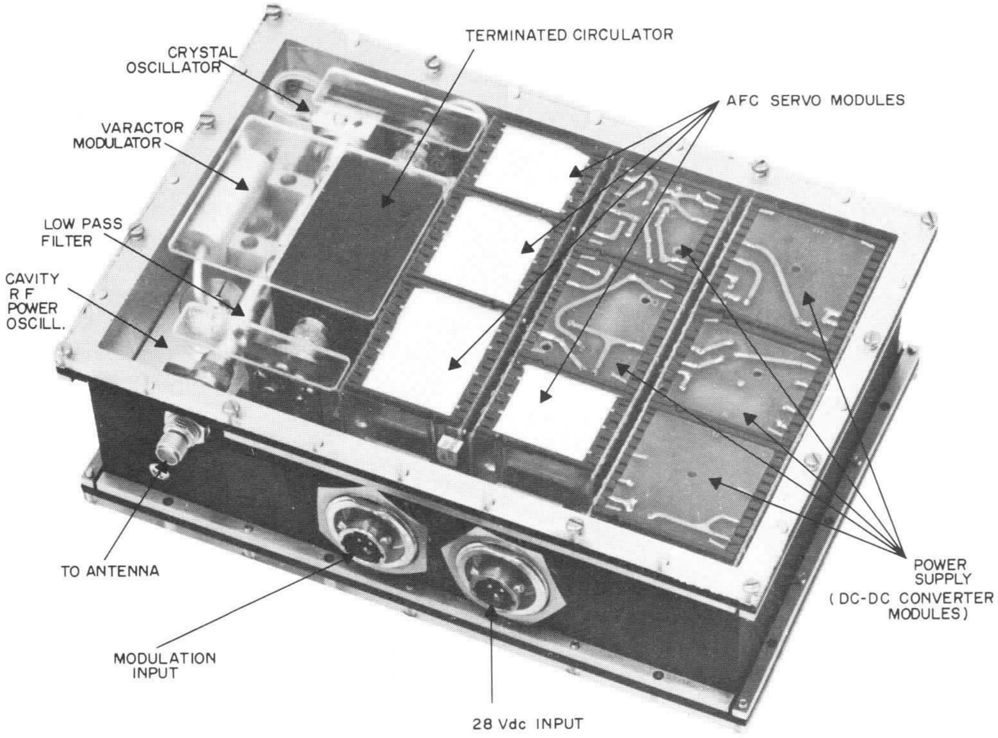
MODEL EM4527 2W S-BAND TELEMETRY TRANSMITTER

MODULATION FREQUENCY RESPONSE OF TRANSMITTER
EM4527, (TYPICAL)



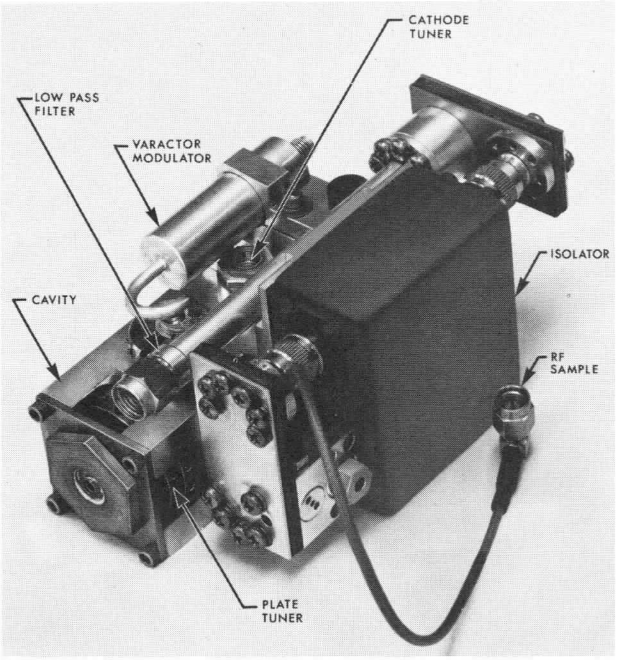
DEVIATION LINEARITY OF TRANSMITTER
EM4527, (TYPICAL)





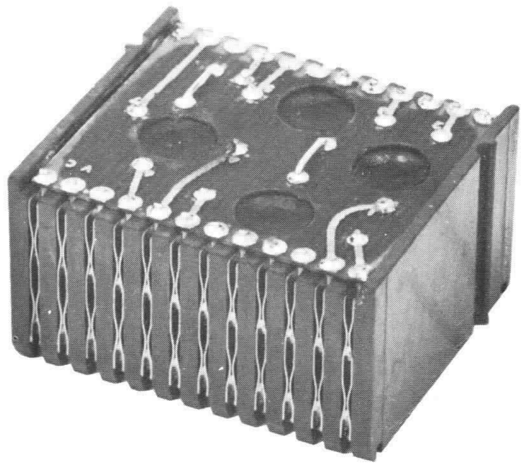
EM4527 TELEMETRY TRANSMITTER ASSEMBLY

Packaging of this transmitter is compact, yet all modules are easily accessible by removing top and bottom covers. The covers incorporate pressure seals and rfi gaskets.



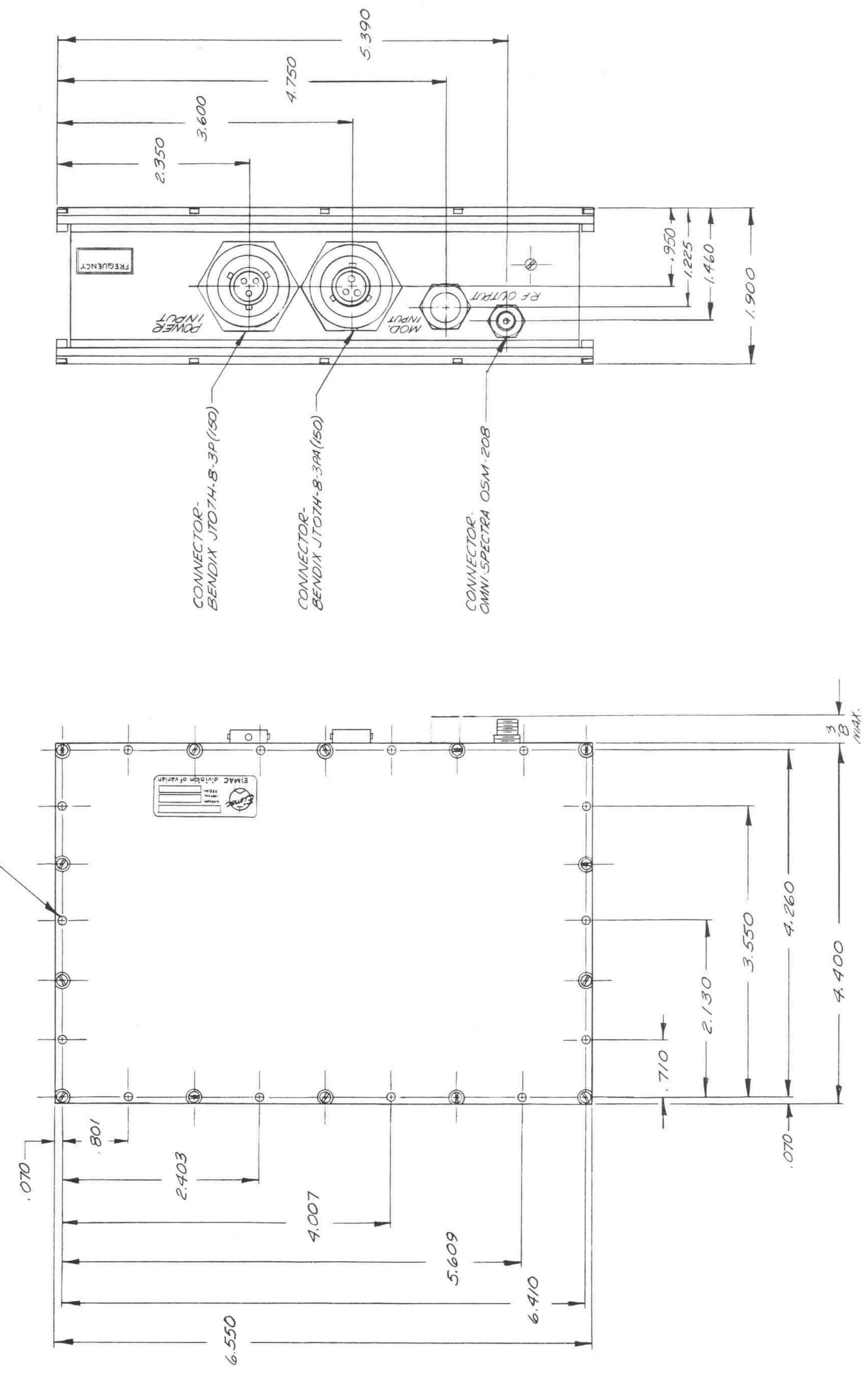
RF SECTION, EM4527 TRANSMITTER

The rf power oscillator provides over 2 watts, tunable 2.2-2.3 GHz. There is no output below 2.2 GHz. Harmonics are removed by a low pass filter. The ceramic planar triode in the oscillator is conduction cooled to the transmitter case.



TYPICAL PLUG-IN MODULE

Circuits use only high reliability components such as silicon planar transistors and are packaged in modular form. The modules are easily removable, and offer flexibility for future modification. The connector system provides four redundant contacts at each connection. Modules are encapsulated with a rigid high thermal conductivity compound for heat conduction and vibration protection.



5.390
4.750
3.600
2.350
FREQUENCY
POWER INPUT
MOD. INPUT
RF OUTPUT
.950
1.225
1.460
1.900
CONNECTOR-BENDIX JT07H-8-3P(150)
CONNECTOR-BENDIX JT07H-8-3PA(150)
CONNECTOR: OMNI-SPECTRA OSM-208
14 MOUNTING HOLES FOR #2-56 SCREWS
EIMAC division of varian
3/8 MAX.
4.400
4.260
3.550
2.130
.710
.070
.070
.801
2.403
4.007
5.609
6.410
6.550

EIMAC

A Division of Varian Associates

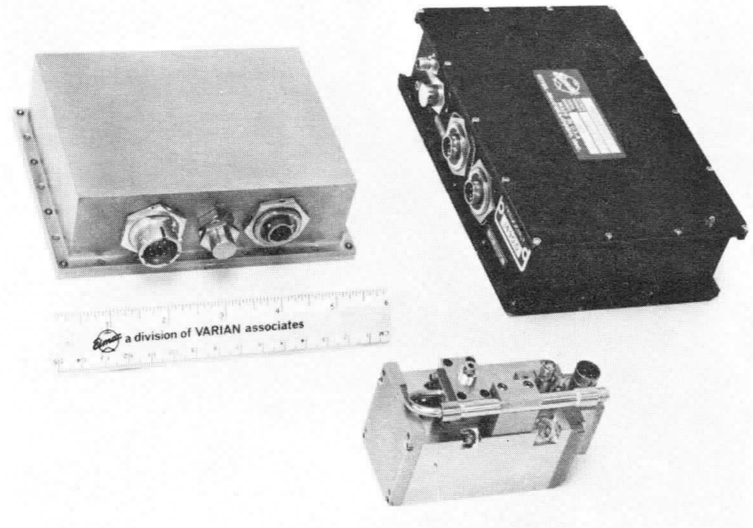
SAN CARLOS, CALIFORNIA

X4528

TELEMETRY TRANSMITTER

2200 - 2300 MHz
20 Watts

The EIMAC X4528 S-band transmitter is packaged in three modules, for maximum flexibility in system packaging. Output is over 20 watts, with over 13% overall efficiency, under all combinations of worst specified extremes of environment and primary power. X4528 operates satisfactorily in the severe environment of missile launch. Frequency change, if desired, is easily accomplished in the field.



Model X4528 is a complete transmitter. It includes an exciter, a power amplifier and a pre-regulated dc-dc converter. All circuits are solid state, except the rf power oscillator and the power amplifier; these use rugged ceramic planar triodes. RF is generated at the output frequency, and stabilized by a crystal-referenced AFC servo circuit. Major features of this transmitter include:

Easy Tuning: A simple crystal change will allow the output to be tuned to any frequency in the the 2.2-2.3 GHz band. Test points are provided. A minimum of test equipment is required. Adjustment of temperature compensation is not required.

High Reliability: Since the rf power output is produced by only two rf stages, this transmitter has a minimum number of components, tuning adjustments and connections. All components are used well below maximum ratings, and circuits are epoxy encapsulated for environmental protection.

Wide Temperature Range: This transmitter will meet full performance specifications over the range —40°C to +85°C.

Modulation Bandwidth and Linearity: Deviation of ±1.5 Mc is accomplished at ±2.5% linearity, and ±300 Kc at ±0.5% linearity.

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

CHARACTERISTICS

ELECTRICAL

Frequency, Tunable	2200-2300 MHz
Power Output, CW Minimum	20 Watts
Frequency Accuracy	$\pm 0.001\%$
Frequency Stability[6]	$\pm 0.0025\%$
Carrier Deviation, Adjustable, peak-to-peak	2 MHz Volt to 30 KHz Volt
Modulation Bandwidth,[1] Flat within ± 0.5 db	100 Hz to 500 KHz
Flat within ± 1 db	5 Hz to 800 KHz
Flat within ± 2 db	5 Hz to 2 MHz
Modulation Linearity, Deviation from B.S.L.,	
For ± 300 KHz peak Deviation	$\pm 0.5\%$
For ± 1.5 MHz peak Deviation	$\pm 2.5\%$
Incidental Frequency Modulation, Maximum	5 KHz rms
AM, Maximum, due to environmental conditions	1%
due to ± 300 KHz carrier deviation	1%
due to ± 1.5 MHz carrier deviation	5%
Modulation Input Impedance, Minimum, 5 Hz to 800 KHz	10,000 Ohms
Primary Voltage required[2]	$28 \pm^{8}_{4}$ Vdc
Primary current required, maximum, at 28 Vdc	5.5 Amperes
Primary Ripple, maximum, peak-to-peak from DC to 20 KHz	8 volts
Transients, Maximum positive	80 volts for 20 microseconds
VSWR Maximum, any constant phase, for full output	1.5:1
Load Impedance required	50 ohms
Warm-up time to meet all specifications	120 seconds
Interference	All applicable requirements of MIL-I-26600 and MIL-I-6181D are met
Life (95% probability, 60% confidence factor)	500 hours

PACKAGING

Volume displaced	110 cubic inches
Dimensions	See Drawings, page 6
Weight	7.8 pounds
Pressurization	30 psia
Cooling	Conduction to heat sink

ENVIRONMENTAL SPECIFICATIONS[3]

Temperature[4] at heat sink (Continuous Operation)	$-40°C$ to $+85°C$
Altitude	Any
Vibration (MIL-STD-810, Figure 514-3, Curve D)	15G peak to 2 KHz
(MIL-STD-810, Figure 514-4, Curve E)	0.2 G^2/Hz
Air Induced Vibration	150 db above $2x10^{-4}$dynes/CM^2 from 150 to 2000 Hz, 30 minutes
Explosive Atmosphere	Capable of operation without igniting an explosion
Sustained Acceleration	30G for 5 minutes, three axes
Shock, per MIL-STD-810 Method 516, Procedures I and V,	
half-sine shocks	15G for 11 milliseconds
sawtooth shocks[5]	100G

[6] $\pm 0.001\%$ available on special order.

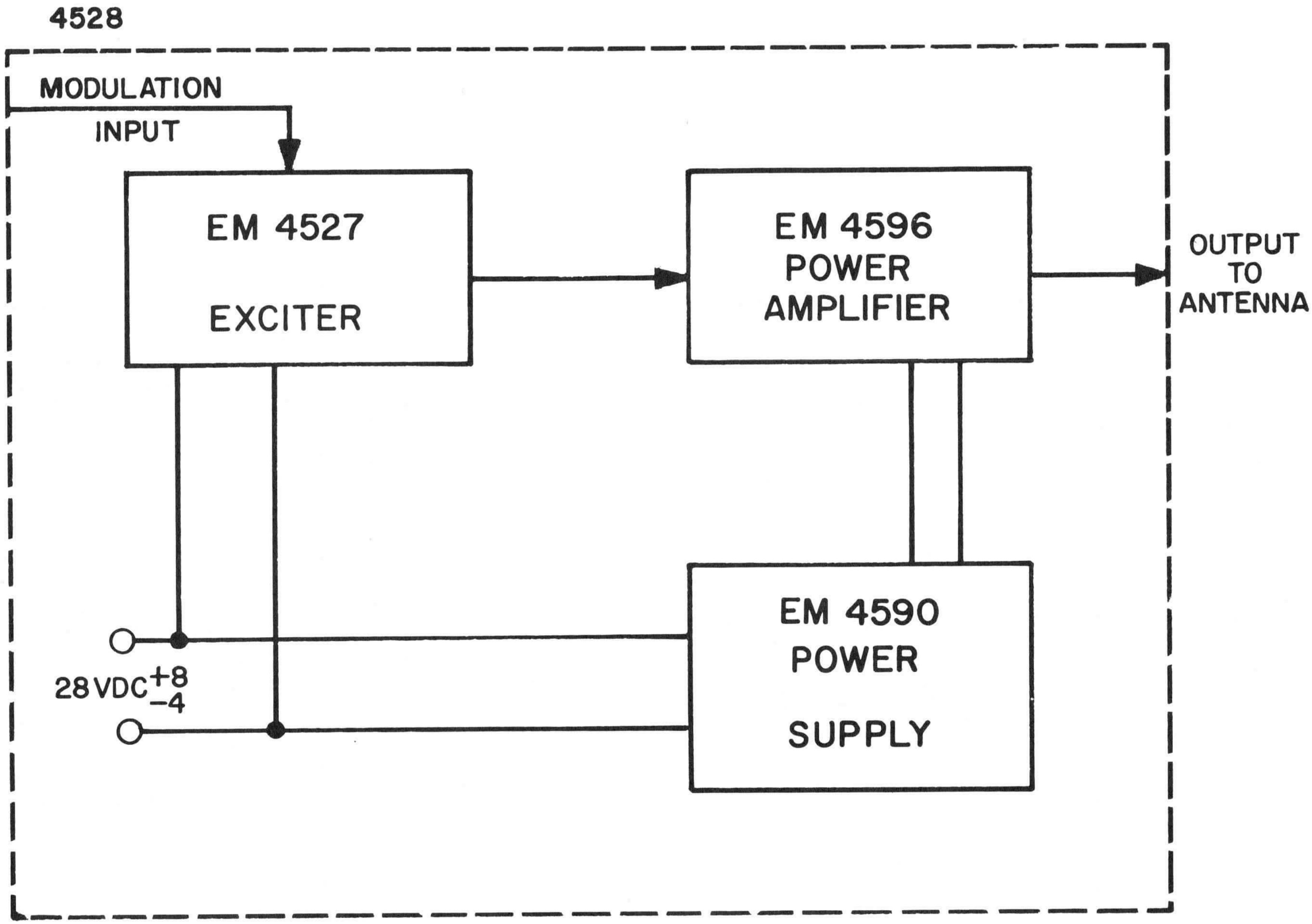
[5] Out-of-tolerance operation may occur during 100G shock.

[4] Other ranges available on special order.

[3] Transmitter performs as specified, under any combination of environmental conditions.

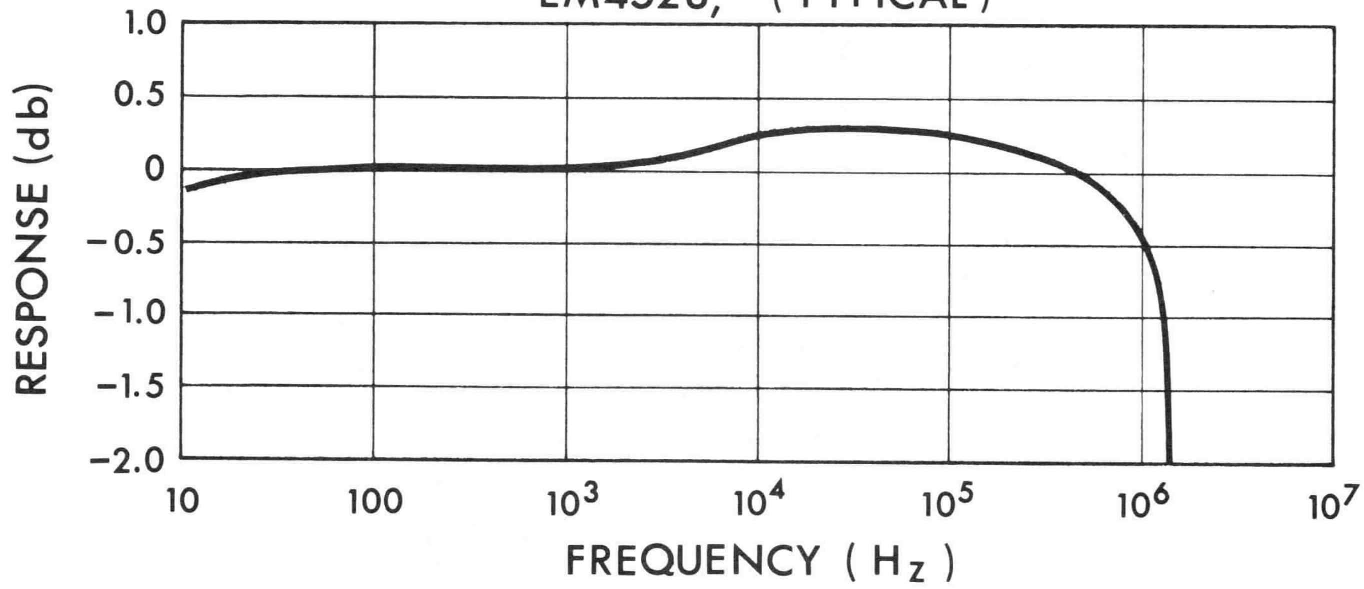
[2] Under emergency conditions, full rf output is provided with primary power as low as 20 Vdc, but increased IFM and AM will occur.

[1] Also available modified for modulation down to DC.

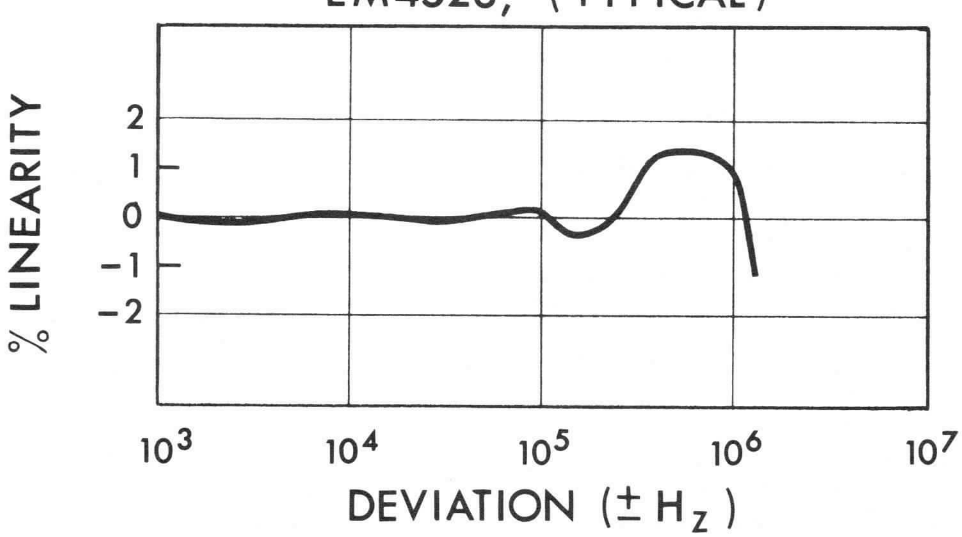


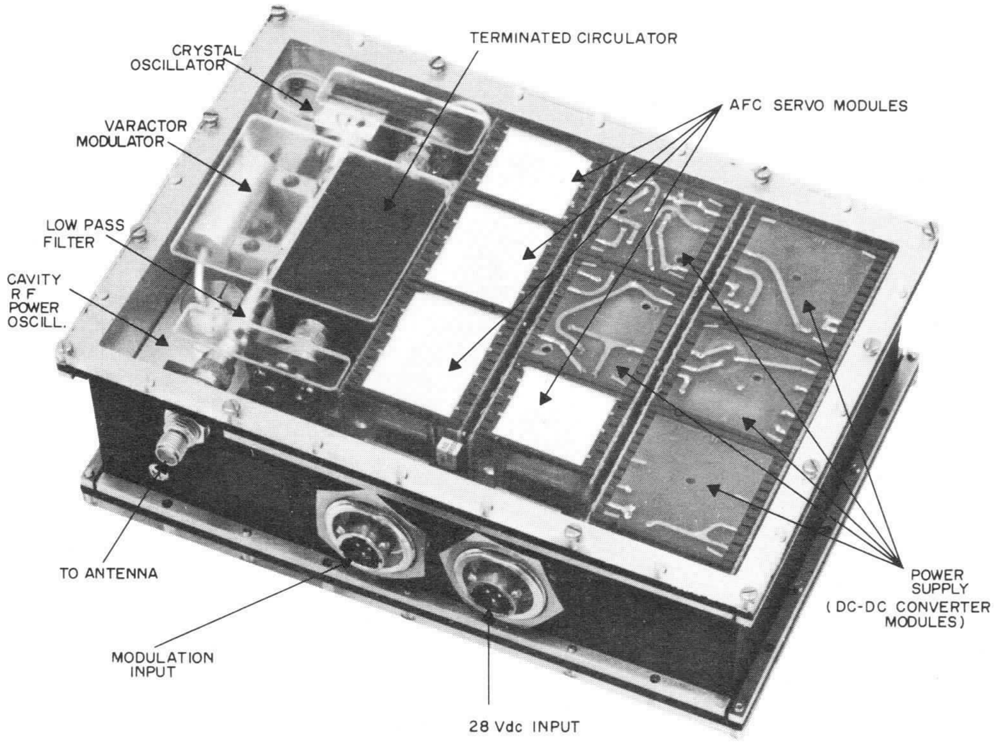
BLOCK DIAGRAM
4528 20 WATT S-BAND
TELEMETRY TRANSMITTER

MODULATION FREQUENCY RESPONSE OF TRANSMITTER EM4528, (TYPICAL)



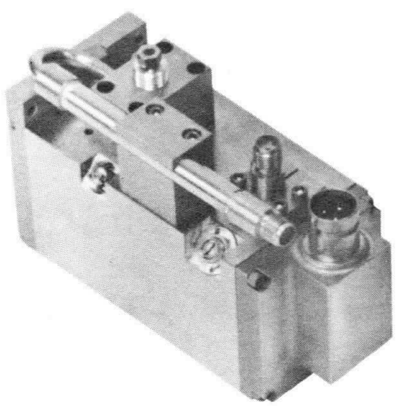
DEVIATION LINEARITY OF TRANSMITTER EM4528, (TYPICAL)





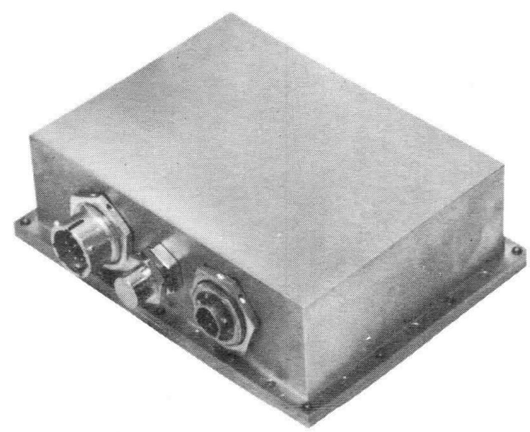
EM4527 EXCITER ASSEMBLY

EM4527 is a complete 2 watt transmitter, including a dc-dc converter. RF power is generated in a stable triode cavity oscillator. Frequency is stabilized by a crystal-referenced AFC servo loop. Power output and frequency remain stable under worst combinations of extremes of environment and primary power. Displaced volume is 50 cubic inches; weight is 4.3 lbs.



EM4596 RF POWER AMPLIFIER

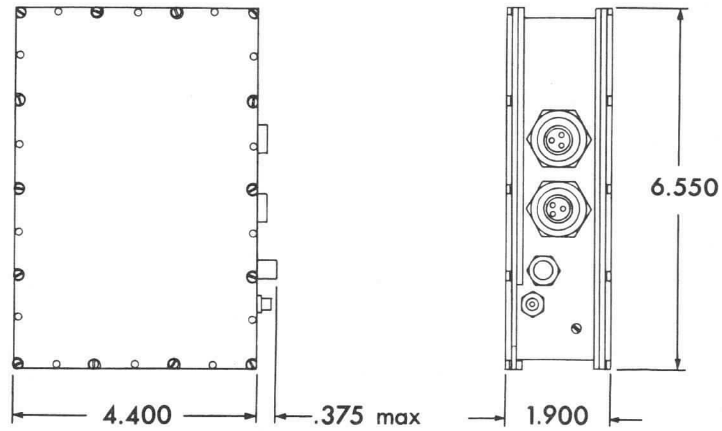
The EM4596 is a miniaturized 20 W cavity amplifier using a frequency-stable ceramic planar triode. It is hermetically sealed, for operation at any altitude. All connectors and tuners are accessible on one surface. A low pass filter, for harmonic suppression, is included. By mounting this amplifier close to the transmitting antenna, rf transmission line loss can be significantly reduced. This amplifier can operate continuously at heat sink temperatures of —54°C to +95°C, and for short periods without damage at higher temperatures. Weight is 0.95 lbs; volume is less than 14 cubic inches.



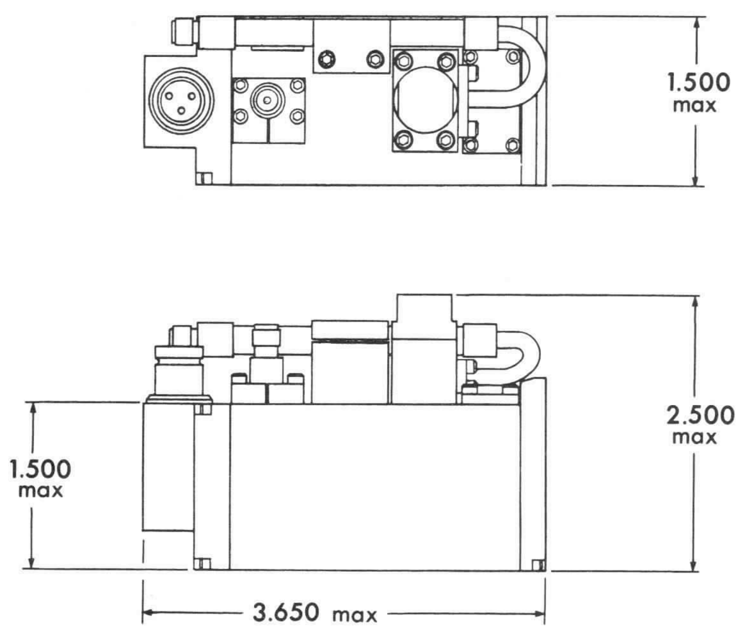
EM4590 POWER SUPPLY

EM4590 is a solid state dc-dc converter, miniaturized, conduction cooled, hermetically sealed. It meets operating specifications over a primary voltage range of 24-36 volts and heat sink temperature range of —54°C to +95°C. Volume is less than 39 cubic inches, weight 2.5 lbs.

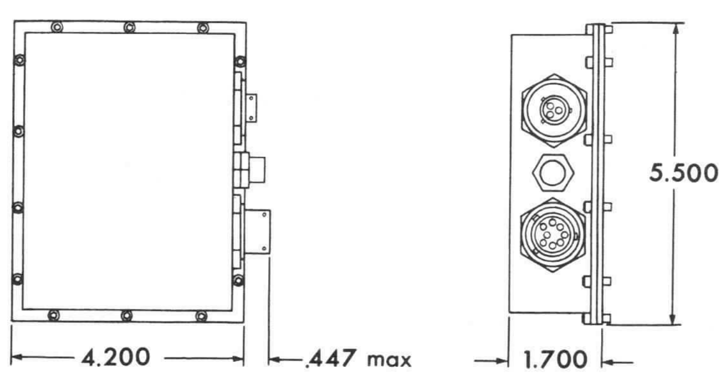
EM 4527 - EXCITER



EM 4596 - AMPLIFIER



EM 4590 - POWER SUPPLY



Eimac®

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

EM4529
EM4581
EM4582
EM4583
LOW PASS FILTERS

EM4582

These low pass filters are recommended for use with UHF/Microwave telemetry transmitters, aerospace television transmitters and command/control transmitter exciters. Because of their small size and light weight, however, they are excellent for use in many other low-to-medium power transmitters. Their rugged construction results in reliable performance under the shock and vibration of missile launch. All models are coaxial, multiple-section reactive type filters. Silver plating is used to minimize insertion loss.

CHARACTERISTICS

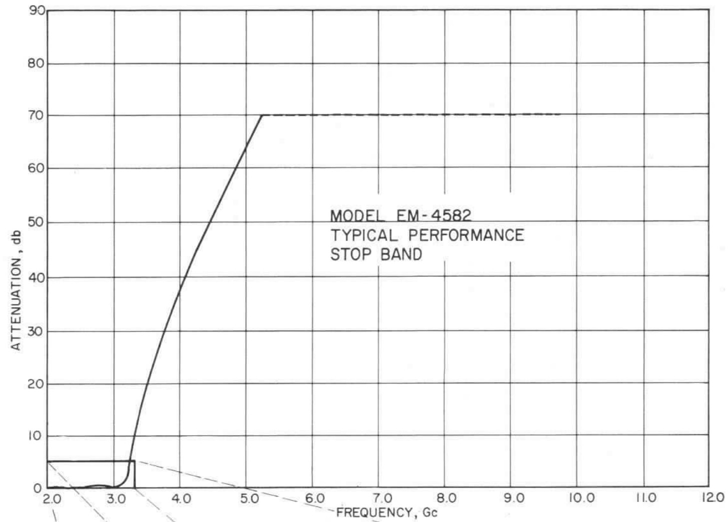
MODEL	EM4581	EM4529	EM4582	EM4583
Pass Band, MHz - -	1435-1735	1435-1735	2200-2500	4400-5000
Power Rating, Watts, Avg.	100	50	100	50
Insertion Loss, DB, Max.	0.2	0.3	0.2	0.2
Attenuation, Second Harmonic, DB Min. -	45	45	45	45
Attenuation, Third and Fourth Harmonic, DB, Min. - - -	60	60	60	60
VSWR, Maximum - -	1.2	1.2	1.2	1.2
Impedance, Ohms, Nominal - - -	50	50	50	50
Connectors (male)[1] -	OSM	([2])	OSM	OSM

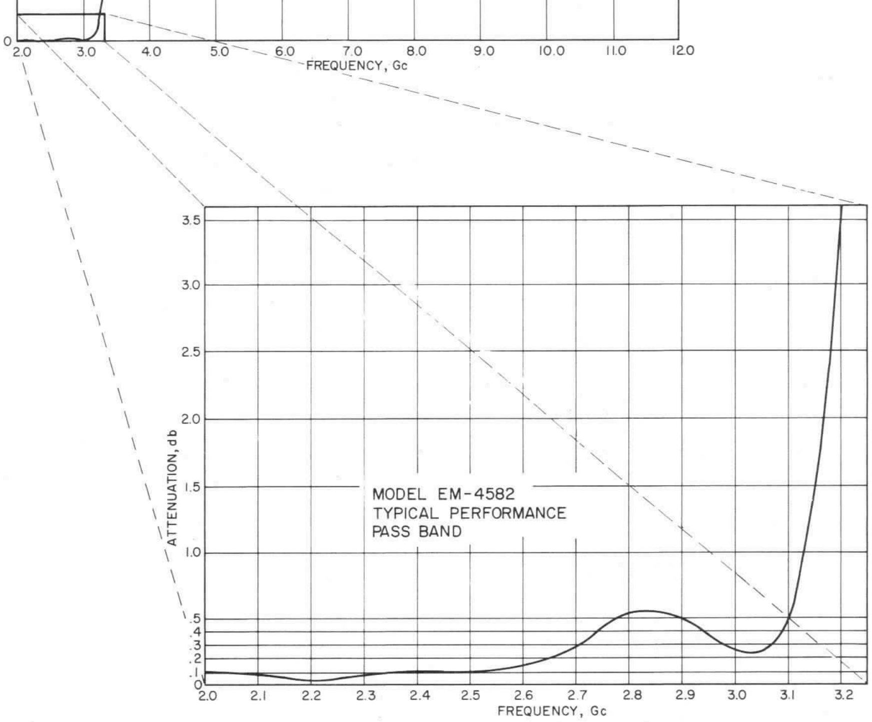
[1]Strip-line connectors also available.

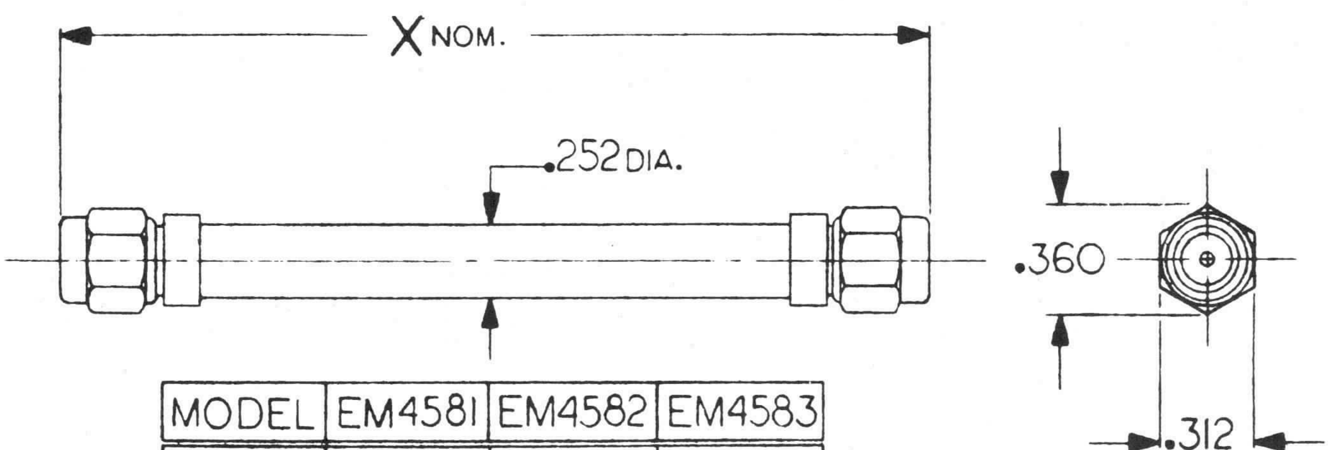
[2]OSM female panel-mount connector one end, OSM male connector with flexible cable other end.

EM4529

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.







MODEL	EM4581	EM4582	EM4583
X	3.340	2.953	3.279

EIMAC

A Division of Varian Associates

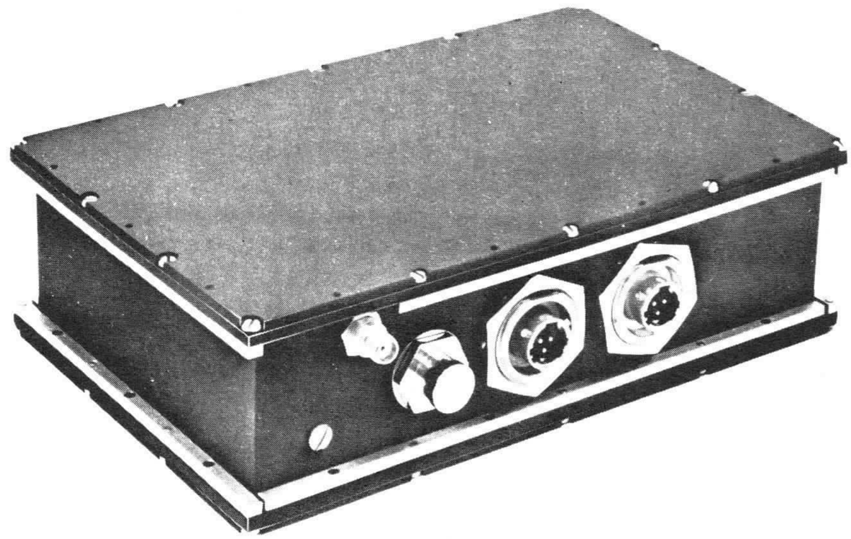
SAN CARLOS, CALIFORNIA

EM4534

TELEMETRY TRANSMITTER

1435 - 1540 MHz
3 Watts

This EIMAC L-Band transmitter provides over 3 watts rf output with over 13% overall efficiency, under all combinations of worst specified environmental extremes and primary power variation. Frequency change, if desired, is easily accomplished in the field. It is designed to operate during the severe shock and vibration of missile launch.



Model EM4534 is a complete transmitter, including a pre-regulated DC-DC converter. All circuits are solid state, except the rf power oscillator, which is a single stage rugged ceramic planar triode. RF is generated at the output frequency. The complete transmitter package displaces less than 50 cubic inches, and weighs 4.5 pounds. Major features of this transmitter include:

Easy Tuning: A simple crystal change will allow the output to be tuned to any frequency in the 1435-1540 MHz band. Test points are provided. A minimum of test equipment is required. Adjustment of temperature compensation is not required.

High Reliability: Since the rf power output is produced by a single stage, this transmitter has a minimum number of components, tuning adjustments and connections. All components are used well below maximum ratings, and circuits are epoxy encapsulated for environmental protection.

Wide Temperature Range: This transmitter will meet full performance specifications over the range $-40°C$ to $+85°C$.

Modulation Bandwidth and Linearity: Deviation of ± 1.5 MHz is accomplished at $\pm 2.5\%$ linearity, and ± 300 KHz at $\pm 0.5\%$ linearity.

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Printed in U.S.A.

CHARACTERISTICS

ELECTRICAL	
Frequency, Tunable	1435-1540 MHz
Power Output, CW Minimum	3 Watts
Frequency Accuracy	±0.001%
Frequency Stability[7]	±0.0025%
Carrier Deviation, Adjustable, peak-to-peak	2MHz/Volt to 30KHz/Volt
Modulation Bandwidth,[1] Flat within ±0.5 db	100 Hz to 500 KHz
Flat within ±1 db	5 Hz to 800 KHz
Modulation Linearity, Deviation from B.S.L.,	
For ±300 KHz peak Deviation	±0.5%
For ±1.5 MHz peak Deviation	±2.5%
Incidental Frequency Modulation, Maximum	5 KHz rms deviation
AM, Maximum, due to environmental conditions	1%
due to ±300 KHz carrier deviation	1%
due to ±1.5 MHz carrier deviation	5%
Modulation Input Impedance, Minimum, 5 Hz to 800 KHz	10,000 Ohms
Primary Voltage required[2]	$28 \pm^{8}_{4}$ Vdc
Primary current required, maximum, at 28 Vdc	825 mA
Primary Ripple, maximum, peak-to-peak from DC to 20 KHz	8 volts
Transients, Maximum positive	80 volts for 20 microseconds
Input current rise above nominal, due to fault,[3] maximum	130%
VSWR Maximum, any phase, for 3 watts output	1.5:1
for 1.5 watts output	5.5:1
Load Impedance required	50 ohms
Warm-up time to meet all specifications	120 seconds
Interference	All applicable requirements of MIL-I-26600 and MIL-I-6181D are met
Life (95% probability, 60% confidence factor)	500 hours
PACKAGING	
Volume displaced	48 cubic inches
Dimensions, including mounting flanges	6.5″ x 4.4″ x 1.9″
Weight	4.5 pounds
Pressurization	30 psia
Cooling	Conduction through bottom plate to heat sink
ENVIRONMENTAL SPECIFICATIONS[4]	
Temperature[5] at heat sink (Continuous Operation)	—40°C to +85°C
Altitude	Any
Vibration (MIL-STD-810, Figure 514-3, Curve D)	15G peak to 2 KHz
(MIL-STD-810, Figure 514-4, Curve E)	0.2 G^2/Hz
Air Induced Vibration	150 db above $2x10^{-4}$/dynes/CM^2 from 150 to 2000 Hz, 30 minutes
Explosive Atmosphere	Capable of operation without igniting an explosion
Sustained Acceleration	30G for 5 minutes, three axes
Shock, per MIL-STD-810 Method 516, Procedures I and V	
half-sine shocks	15G for 11 milliseconds
sawtooth shocks[6]	100G

[7] ±0.001% available on special order.

[6] Out-of-tolerance operation may occur during 100G shock.

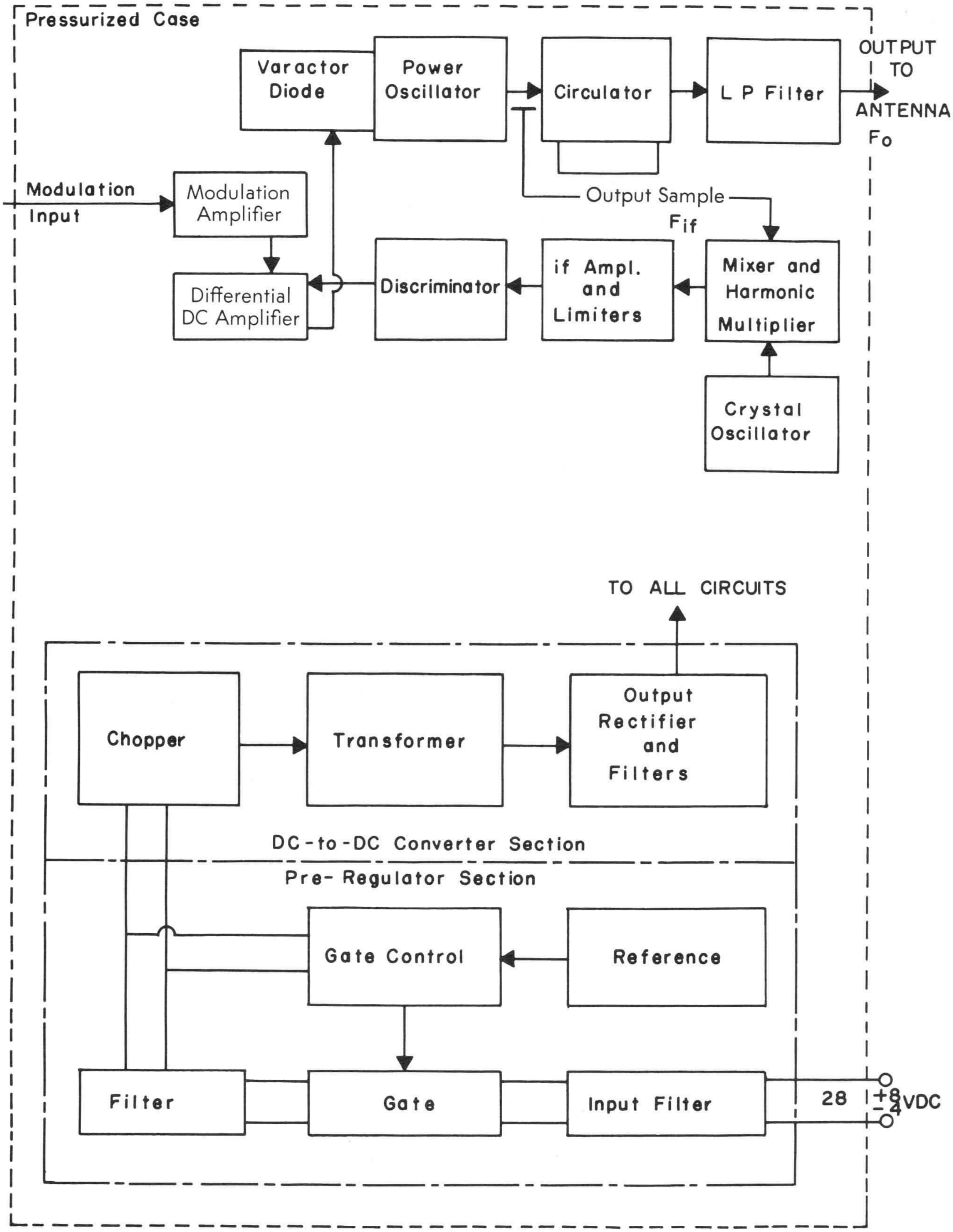
[5] Other ranges available on special order.

[4] Transmitter performs as specified, under any combination of environmental conditions.

[3] Any failure of transmitter (except at input terminals.)

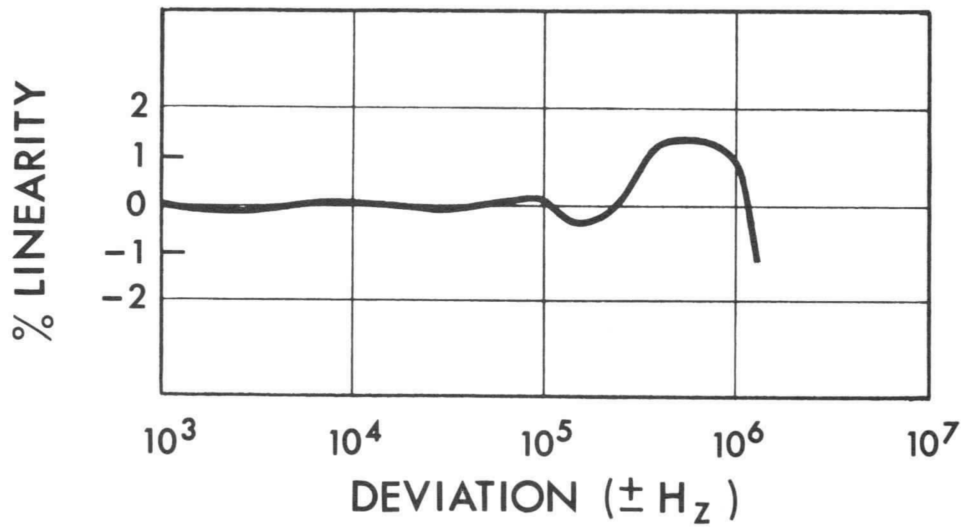
[2] Under emergency conditions, full rf output is provided with primary power as low as 22 Vdc, but increased IFM and AM will occur.

[1] Also available modified for modulation down to DC; and up to 2 MHz

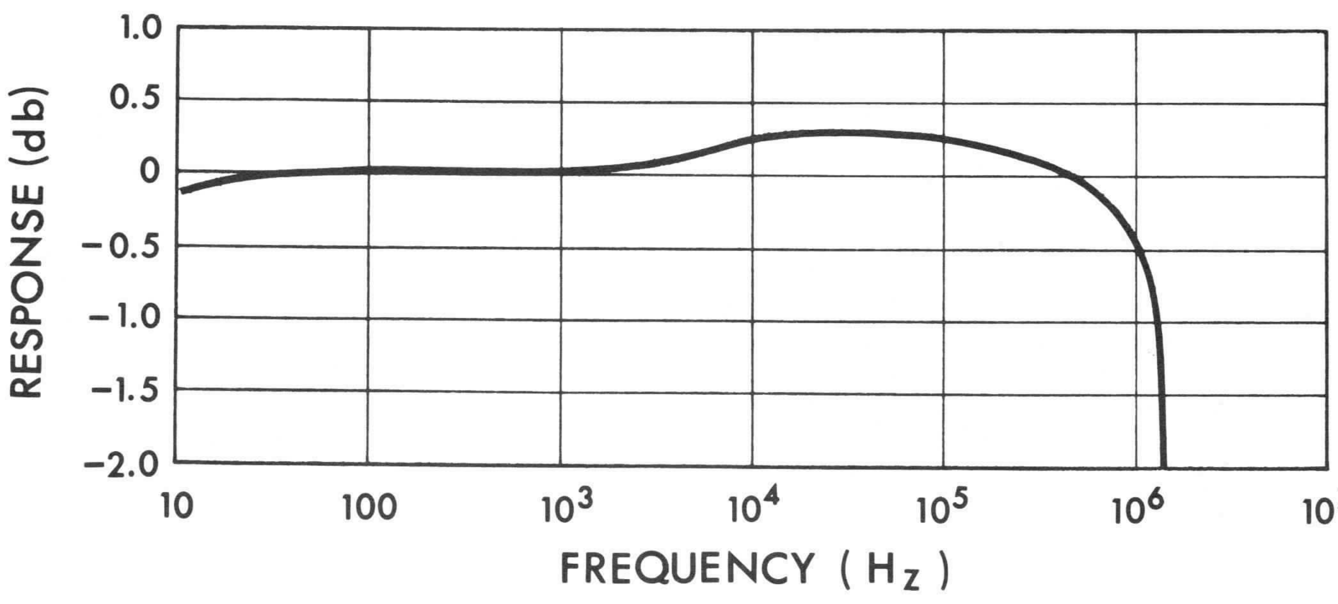


BLOCK DIAGRAM

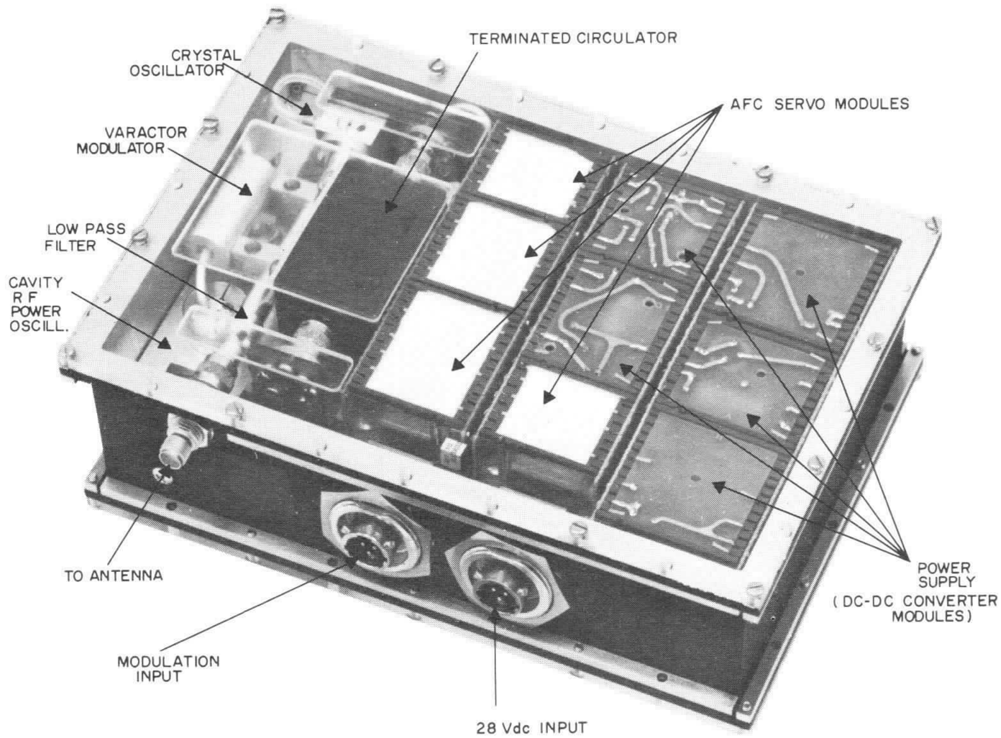
MODEL EM4534 3W S-BAND TELEMETRY TRANSMITTER



TYPICAL DEVIATION LINEARITY OF TRANSMITTER

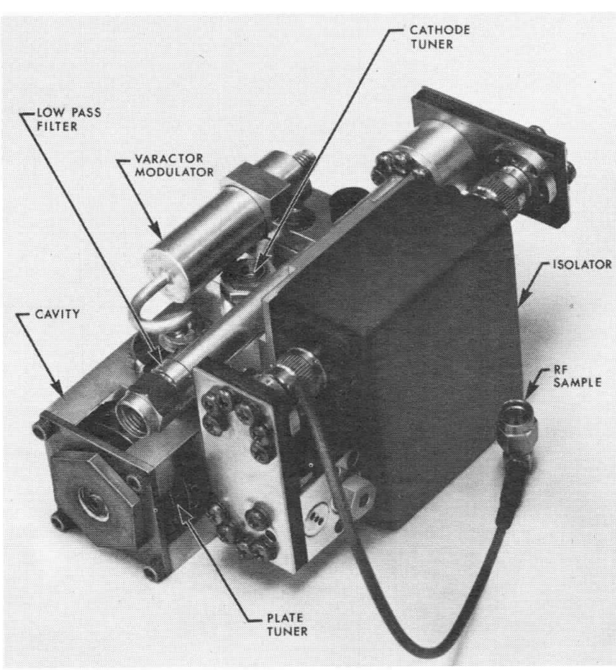


TYPICAL MODULATION FREQUENCY RESPONSE OF TRANSMITTER



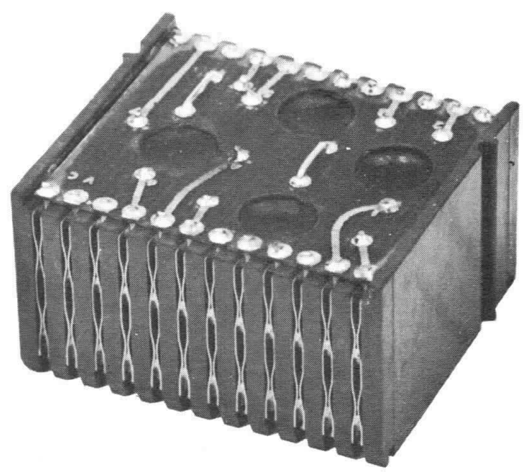
EM4534 TELEMETRY TRANSMITTER ASSEMBLY

Packaging of this transmitter is compact, yet all modules are easily accessible by removing top and bottom covers. The covers incorporate pressure seals and rfi gaskets.



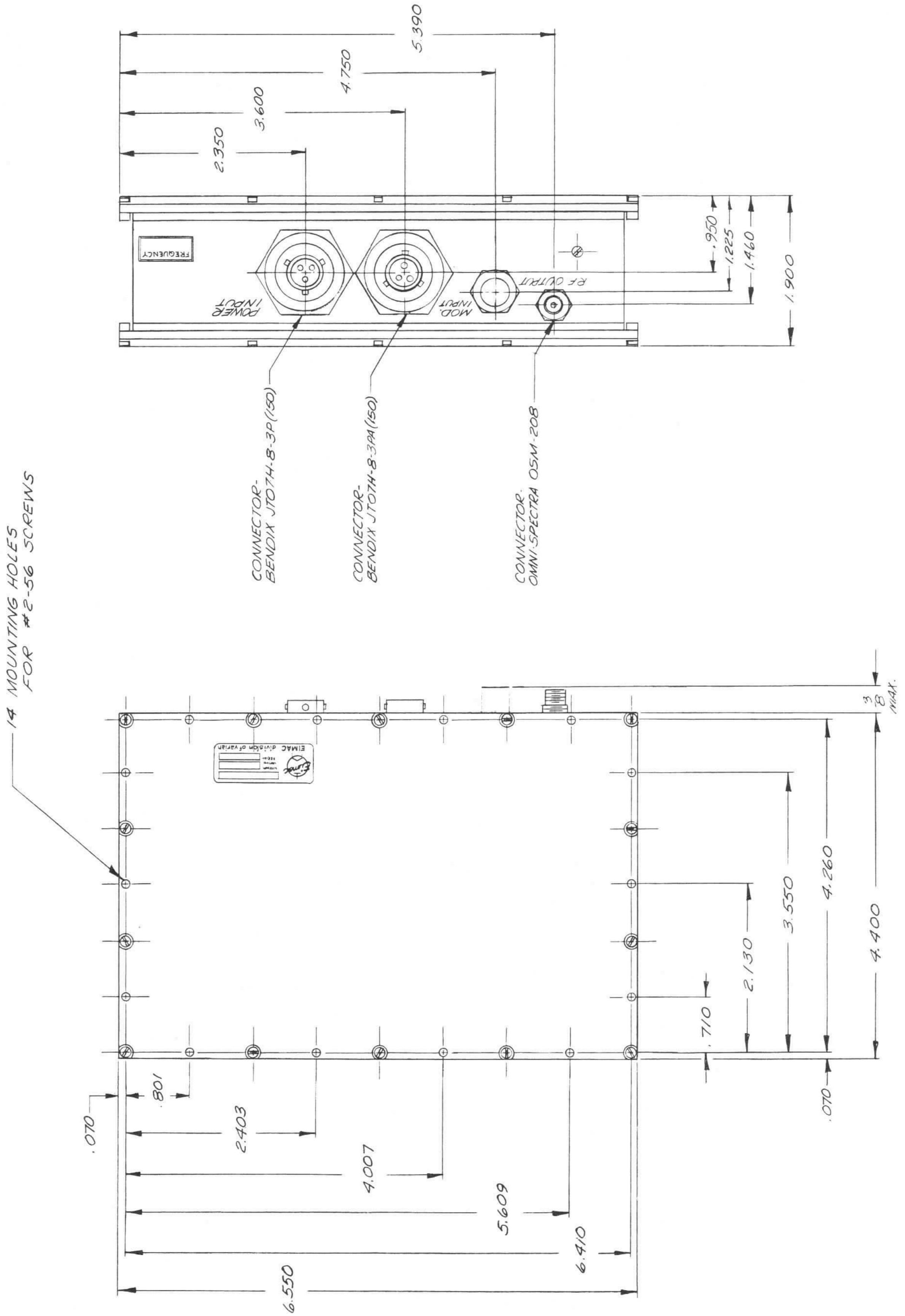
RF SECTION, EM4534 TRANSMITTER

The rf power oscillator provides over 3 watts, tunable 1435-1540 MHz. There is no output below 1435 MHz. Harmonics are removed by a low pass filter. The ceramic planar triode in the oscillator is conduction cooled to the transmitter case.



TYPICAL PLUG-IN MODULE

Circuits use only high reliability components such as silicon planar transistors and are packaged in modular form. The modules are easily removable, and offer flexibility for future modification. The connector system provides four redundant contacts at each connection. Modules are encapsulated with a rigid high thermal conductivity compound for heat conduction and vibration protection.



5.390
4.750
3.600
2.350
FREQUENCY
POWER INPUT
MOD. INPUT
RF OUTPUT
.950
1.225
1.460
1.900
CONNECTOR-BENDIX JT07H-8-3P(150)
CONNECTOR-BENDIX JT07H-8-3PA(150)
CONNECTOR-OMNI-SPECTRA OSM-208
14 MOUNTING HOLES FOR #2-56 SCREWS
EIMAC division of varian
3/8 MAX.
4.260
4.400
3.550
2.130
.710
.070
.801
2.403
4.007
5.609
6.410
6.550

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

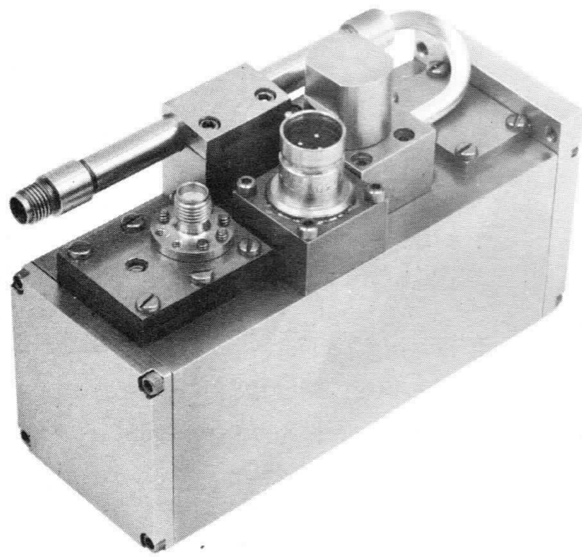
EM4539

CAVITY AMPLIFIER

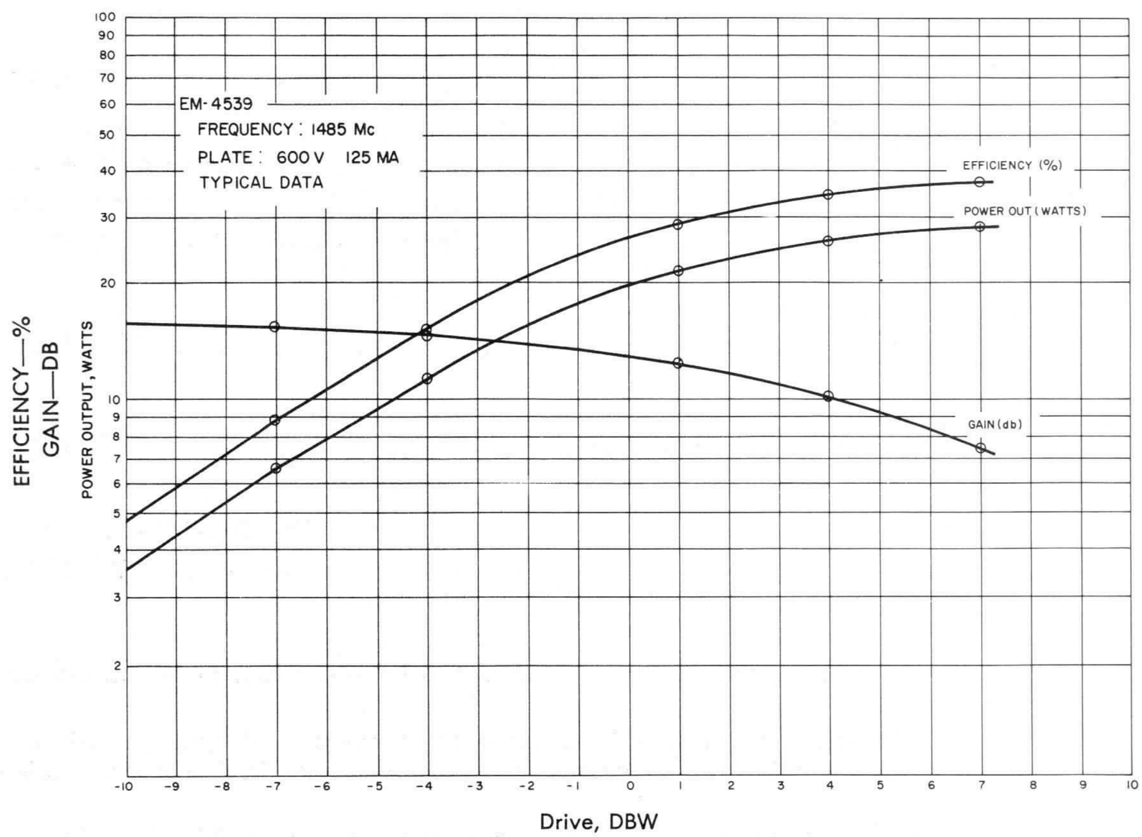
1420-1600 Mc

The Eimac EM4539 is a miniaturized 20 watt cavity amplifier incorporating a ceramic-metal planar triode. It is intended for use in aerospace telemetry transmitters and special aerospace transmitters.

A recommended DC-DC converter for use with this amplifier is Eimac Model EM4590.



EM4539 CAVITY AMPLIFIER



EM4539 AMPLIFIER

CHARACTERISTICS

ELECTRICAL

Frequency,[1] continuously tunable		1420-1600 Mc
Rf power[2] output (with 2 watts drive)	Frequency, Mc	Power output, Watts, CW
	1420-1435	15
	1435-1535	20
	1535-1600	15
Input Signals		All standard FM telemetry signal formats, per IRIG 106-60
Bandwidth, Minimum, 3 db points		10 Mc
Gain, Minimum, 1435-1535 Mc		10 db
Load Impedance, nominal		50 ohms
VSWR, Maximum, for full rated output		1.5:1
without damage		3:1
Efficiency,[2] Overall, Minimum		25%
Phase jitter, Maximum, between input and output		5° peak
Power Supply Requirements[3]		
Anode voltage		600 Volts
Current		125 mA
Heater voltage		6.0 Volts
Current		1.0 Amperes
Harmonic Suppression (2nd, 3rd and 4th of 1435-1535 Mc)		60 db
Warm-up Time		3 Minutes

MECHANICAL

Size, Overall (including protrusions)	4" x 2½" x 1½"
Weight	1.1 pounds
Mounting	To Heat Sink (not included)
Tuning Controls	Three (all on same surface)
Cooling	Conduction to Heat Sink at –54°C to +95°C
Connectors: rf input	OSM
rf output	OSM
Power	Deutsch #DM 5300-3P-643

ENVIRONMENTAL

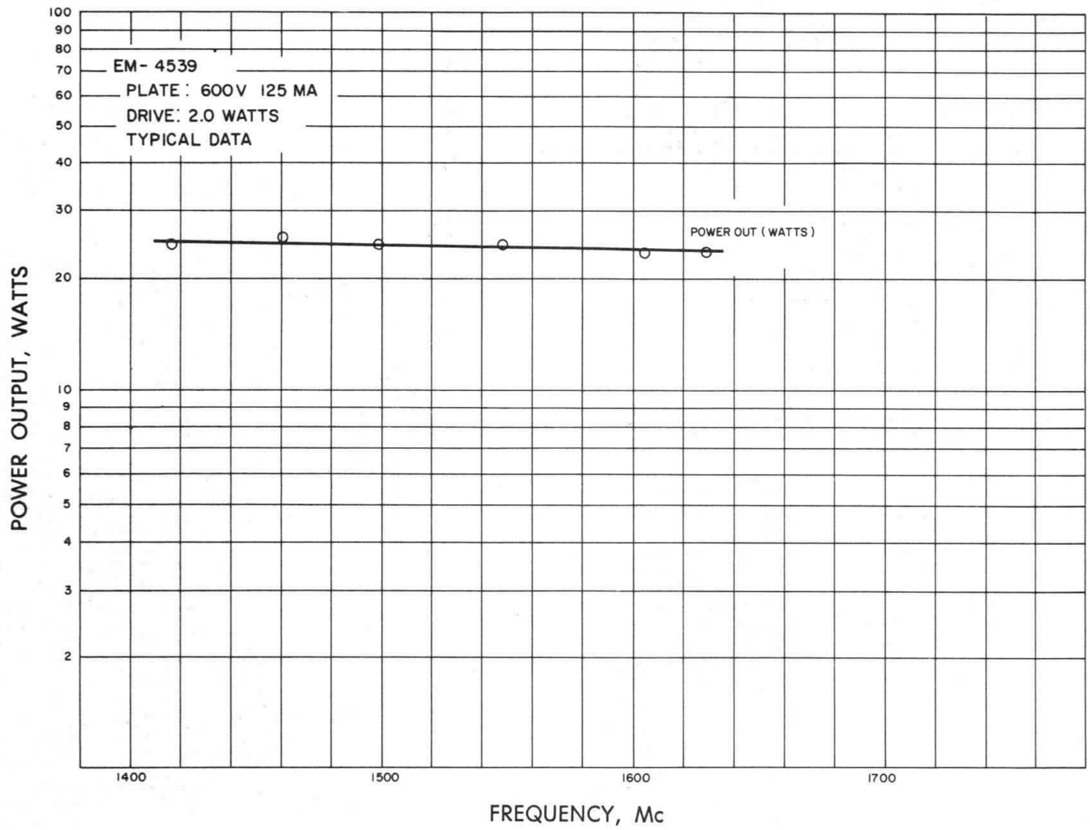
Temperature, heat sink, for continuous operation	–54°C to +95°C
Altitude	Any
Vibration	20g, 20-2000 cps, 3 major axes
Other	Per MIL-E-5400

FOOTNOTES:

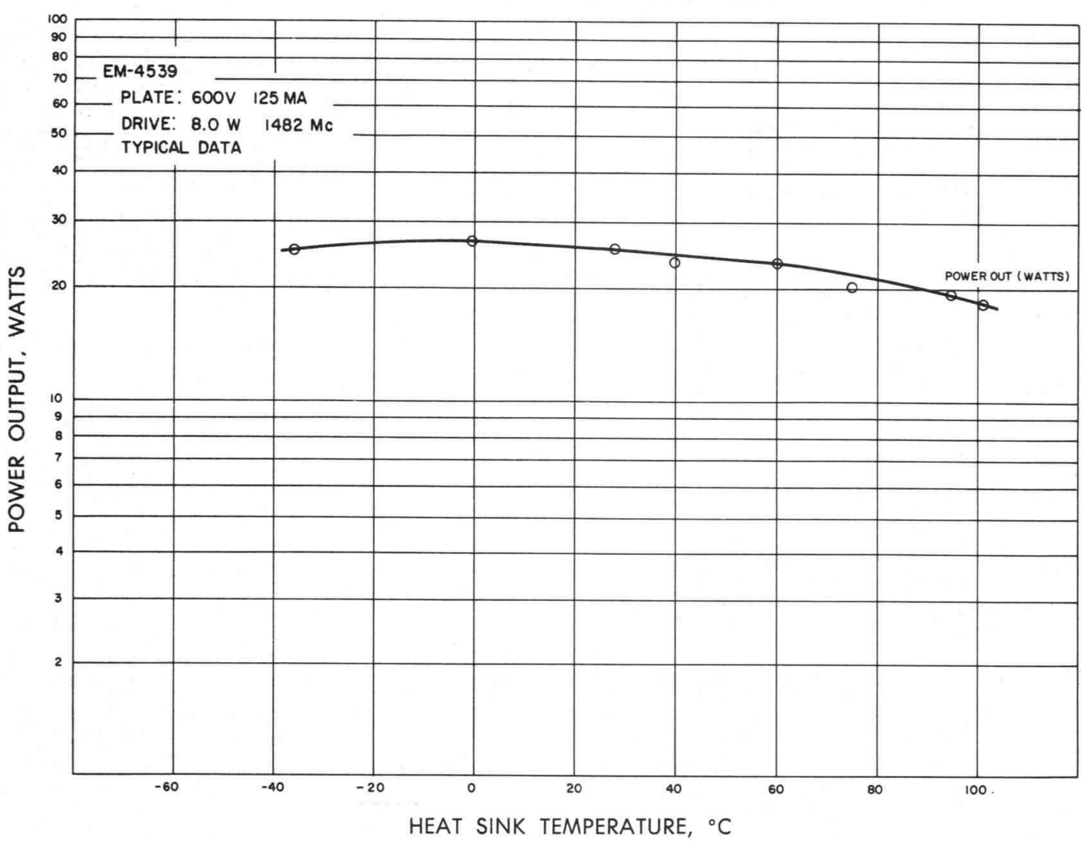
(1) Also available with similar performance characteristics for other frequencies in the 900-2500 Mc range.

(2) Under worst combination of specified environmental conditions. Output and efficiency are higher under optimum conditions. See curves for typical output and efficiency with other drive levels.

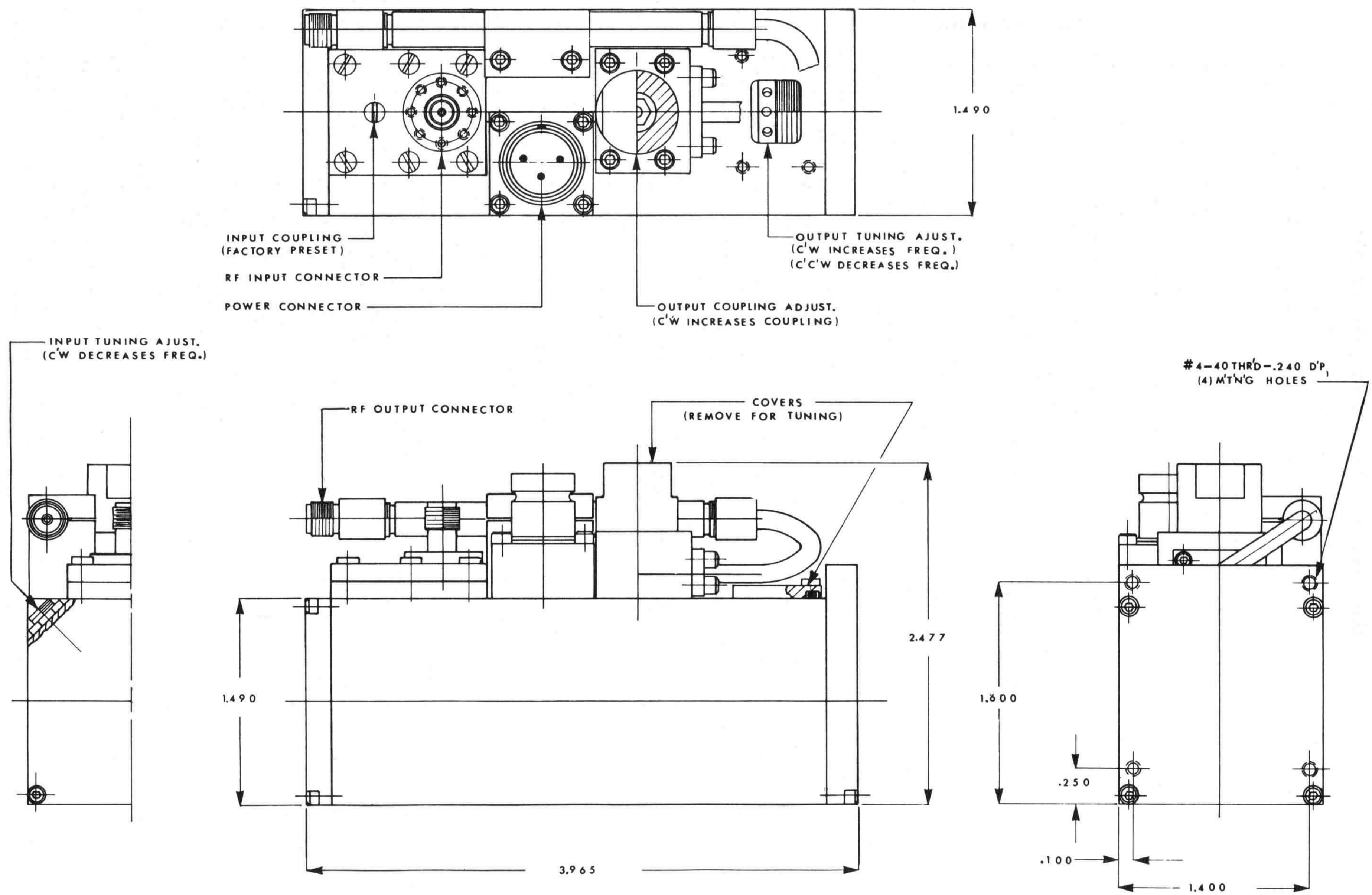
(3) A separate DC-DC converter package, Model EM4590, operating from 28 +8/–4 Vdc, is available from Eimac. Power supplies for operation from other primary sources are available on special order.



TUNING RANGE, EM4539 AMPLIFIER



TEMPERATURE EFFECT, EM4539 AMPLIFIER



OUTLINE DIMENSIONS, EM4539 AMPLIFIER

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

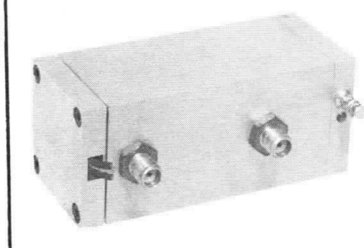
X4539

CAVITY AMPLIFIER

FREQUENCY
1.435-1.535 kMc

Power Output
20 Watts CW

The Eitel-McCullough Model X4539 cavity amplifier is a compact modular amplifier readily adaptable to airborne or ground support telemetry systems. The Model X4539 is a result of combined tube and circuit technology that serves to optimize the tube configuration with the associated RF circuit. Maximum efficiency and RF output from a very small package are salient features offered by this amplifier. Tuning can be accomplished with a minimum of test equipment.



CHARACTERISTICS

FREQUENCY 1.435-1.535 kMc

ELECTRICAL

Tube Type		Eimac Y-319
Power Supply Requirements:		
Anode	1000	V
Current	63	mA
Heater	6.0	V
Current	1.0	A
Operating Characteristics:		
Power Input	2.0	W
Power Output	20	W
Service		CW/FM
Bandwidth	10	Mc
Frequency Stability	20	PPM/°C
Load Impedance	50	ohms
Load VSWR	1.5:1	Any Ø

MECHANICAL

Connectors	Type BRM Bendix
Cooling	Conduction
Maximum Overall Dimensions	1.25" x1.25" x4.5"
Net Weight	0.84 pounds

ENVIRONMENTAL

Mounting Surface Temperature	-40 to +100°C
Vibration	Shall meet the requirements of Method 514, MIL-Standard-810, Class 1 through 4 and mounting Type A.
Shock	Shall meet the requirements of Procedure 1, Method 516 of MIL-Standard-810.

Eimac®

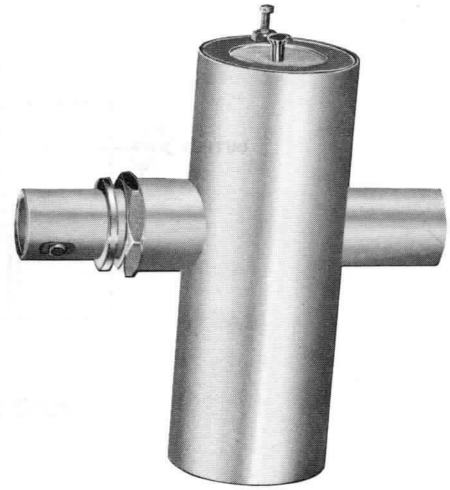
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4543

CAVITY OSCILLATOR

1700-1850 Mc

The Eimac EM4543 is an ultra-stable low noise cavity oscillator designed for use in microwave transmitters where compactness and ruggedness is required. Excellent frequency stability over a wide temperature range is a major advantage of this oscillator. It incorporates the Eimac 128613 ceramic-metal planar triode. Operating life, without tube change, is over 5000 hours average.



CHARACTERISTICS

ELECTRICAL

Tuning Range	1700-1850* Mc	
rf Power Output	1.6** Watts CW	
Frequency Stability	±0.15% from —40°C to +75°C	
Power Supply Requirements:	Voltage	Current
Anode, Maximum	140 V	50 mA
Control Grid, Maximum		Self Bias
Heater	6.0 V	400 mA
Tube Type	Eimac 128613	
Load Impedance	50 ohms nominal	
Modulation	CW	
VSWR, maximum	1.3:1, any phase	
rf Noise, maximum	0.2 percent	

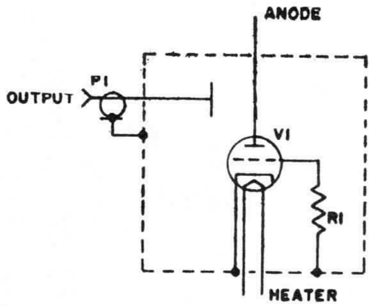
MECHANICAL

Mounting	Clamps to heat sink cradle
Size	Length: 2.25 inches Diameter: 0.85 inches
Weight	0.25 pounds
Cooling	Conduction
Connector	Type TNC Female

ENVIRONMENTAL

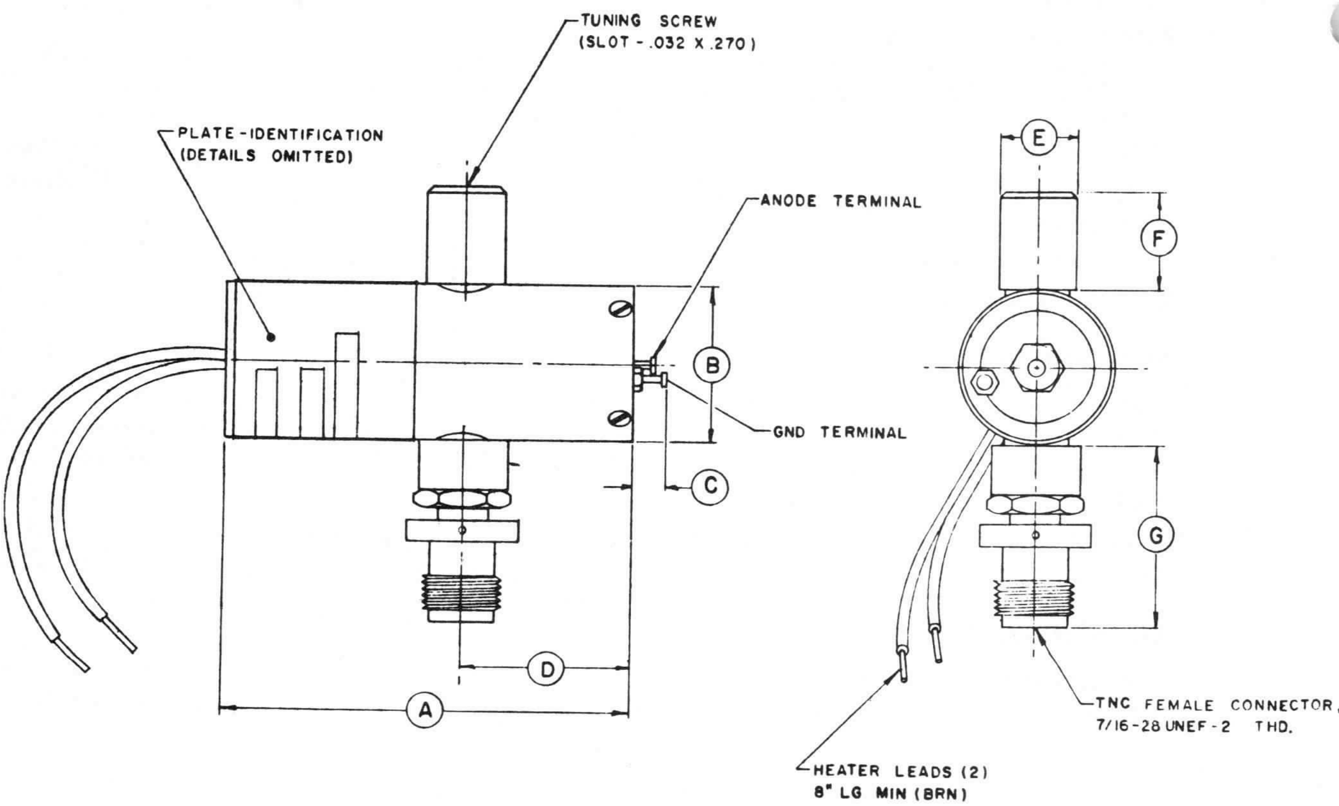
Temperature	—40°C to +75°C
Altitude	0 to 12,000 feet

*Factory adjusted for any 48 Mc Segment of the 1700-1850 Mc band.
**Can provide up to 3 watts output with higher anode voltage and current and special cooling.



SCHEMATIC

DIMENSIONAL DATA			
REF	MAX	MIN	NOM
A	2.300	2.255	
B	.860 DIA	.850 DIA	
C	—	—	.181
D	.973	.930	
E	.437 DIA	.429 DIA	
F	.535	.525	
G	1.000	.935	



Eimac®

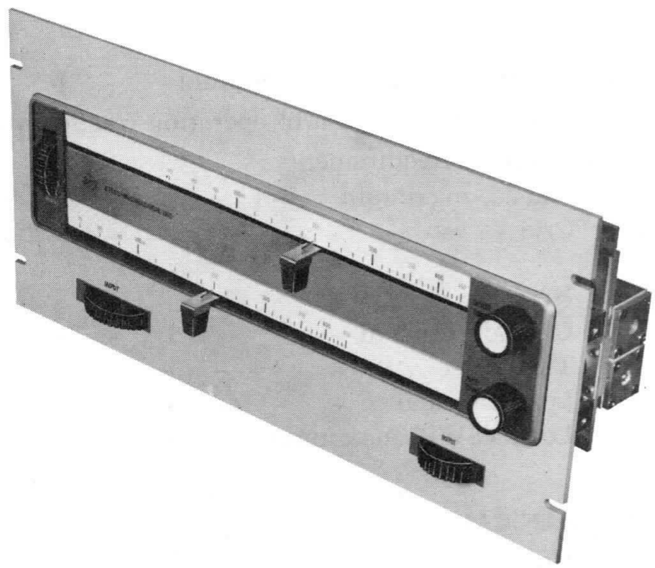
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

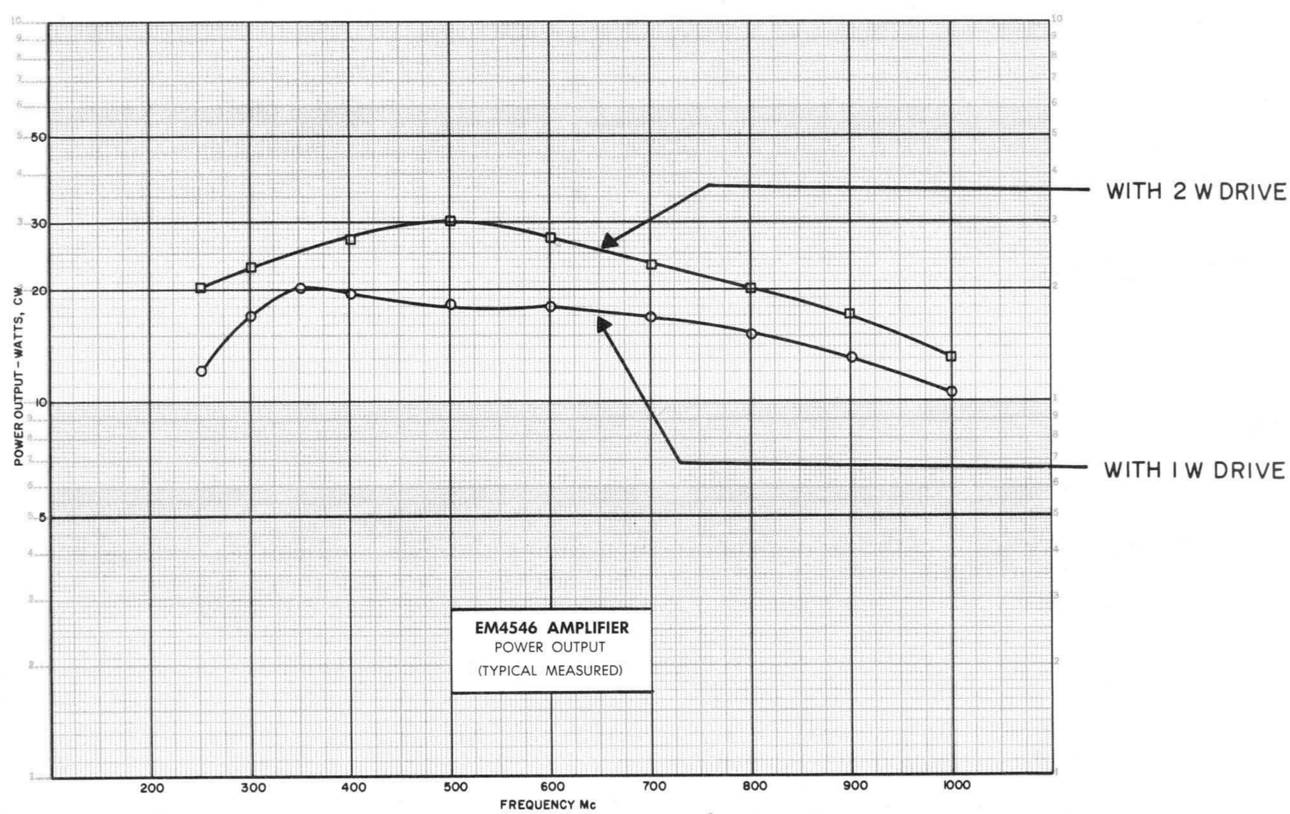
EM4546

BROAD TUNING AMPLIFIER

250-1000 Mc

The Eimac EM4546 is a broad-tuning cavity power amplifier incorporating the Eimac Y-319 ceramic-metal planar triode. It is intended for use in test equipment consoles and special transmitters. This Amplifier has front-panel tuning knobs and frequency scales for tuning across the 250-1000 Mc band. Power output is 20 to 10 watts with 1 watt rf drive and 30 to 10 watts with 2 watts rf drive.





CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable	250-1000 Mc

RF Power Output, minimum (1 watt drive)

Frequency, Mc	Power output, watts, CW
250- 300	10
300- 800	15
800-1000	10

Gain (with 1 watt drive), minimum	10 db
Frequency Drift,[1] percent of operating frequency	±0.05%

Power Supply Requirements:

	Voltage	Current
Anode, maximum	1 KV	100 mA
Grid	Bias through variable cathode resistor, 200-1000 ohms	
Heater	6.0 v	1A
Cathode Current		125 mA
Tube Type	Eimac Y-319	
Load Impedance	50 ohms nominal	
Load VSWR, maximum	2.0:1 any phase, without damage	

MECHANICAL

Mounting	Standard 19" relay rack
Size	height — 8¾ inches depth — 4½ inches
Weight	10 pounds
Operating Controls	Tuning knobs and frequency scales provided[2]
Cooling	Conduction — Convection[3]
Connectors	Type TNC Female

ENVIRONMENTAL

Temperature	—10 to +50°C (+14 to +122°F)[3]
Altitude	to 12,000 feet

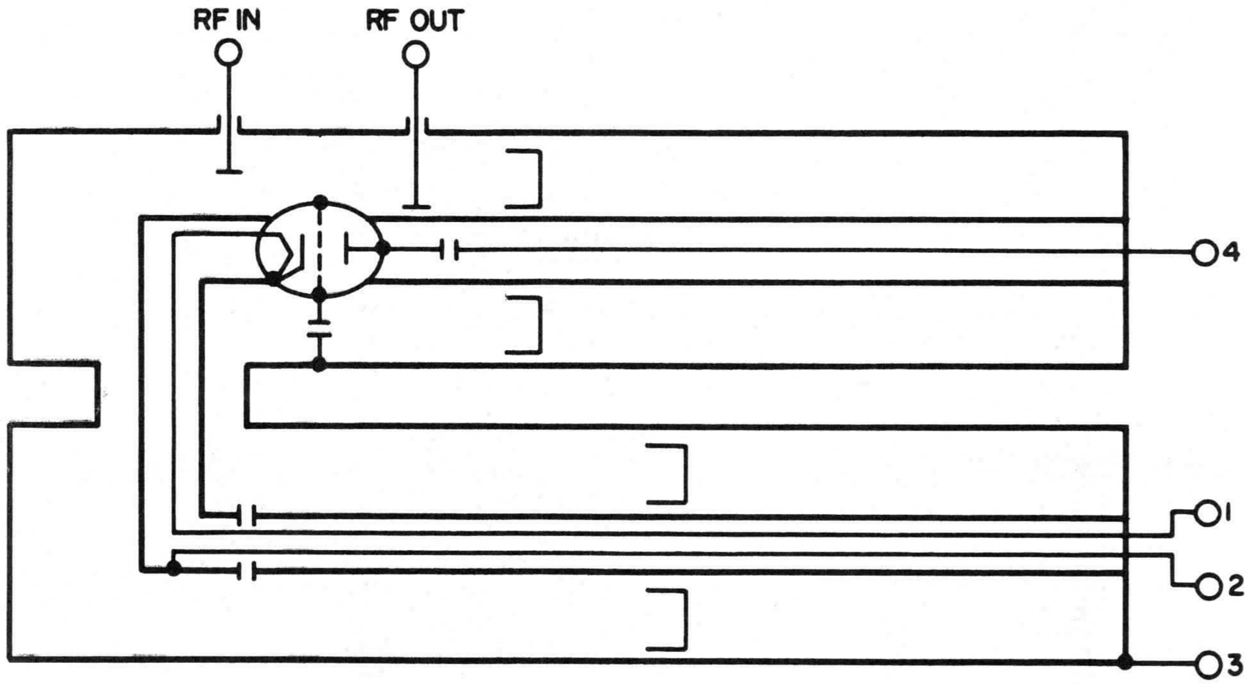
NOTES:

(1) Frequency drift is specified over a period of 2 hours, following a warm-up period of ½ hour minimum.

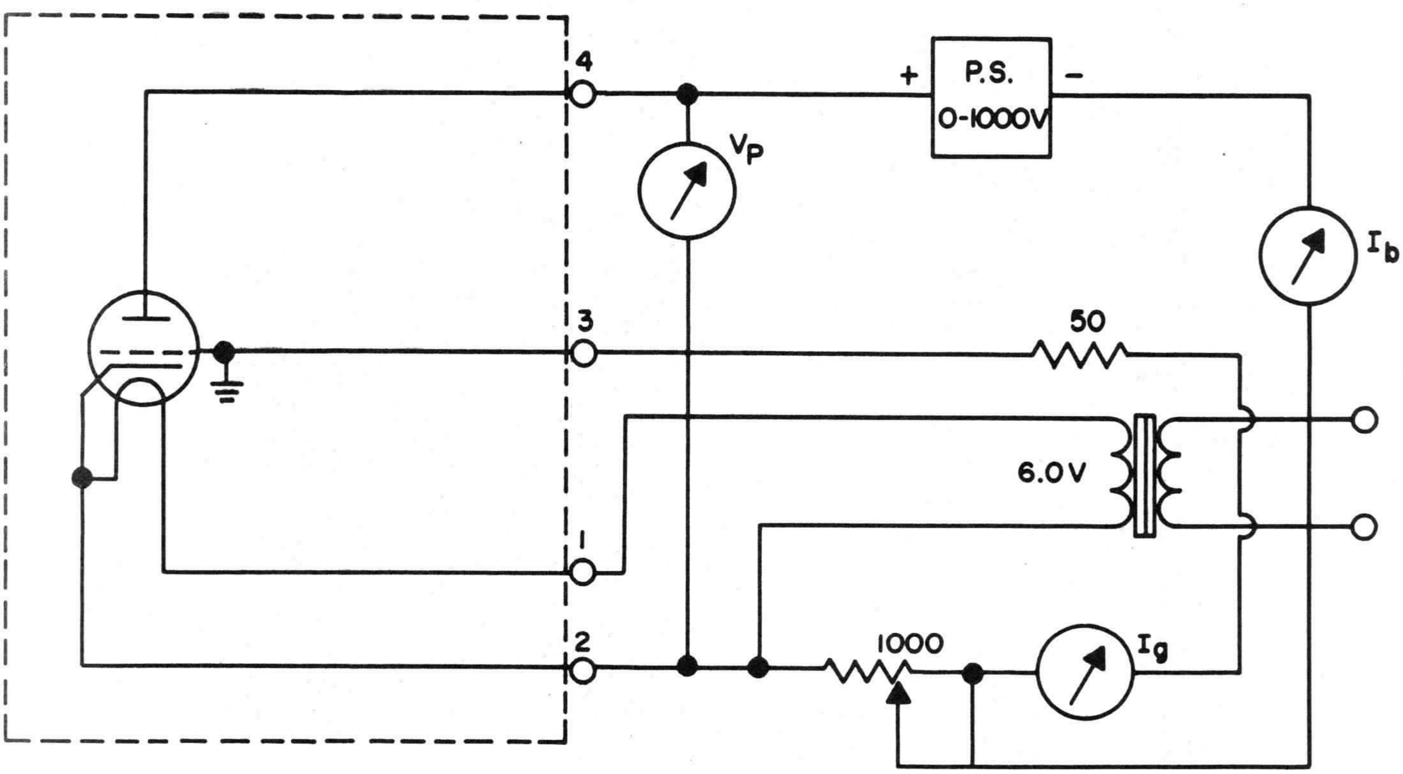
(2) Knobs are provided on the front panel for fine tuning the plate and cathode cavities and for adjusting input and output coupling. Frequency scales are provided for each cavity. Tuning is accomplished by sliding the pointers to the desired frequency, then adjusting the fine tuning and coupling. Access to the interior of the amplifier is not required for tuning. Four sets of scales are provided, covering four sections of the tuning range. The desired set of scales is selectable by a knob on the front panel.

(3) If ambient temperature exceeds 90°F, the cavity body will become quite hot (up to 250°F), and forced air cooling is recommended.

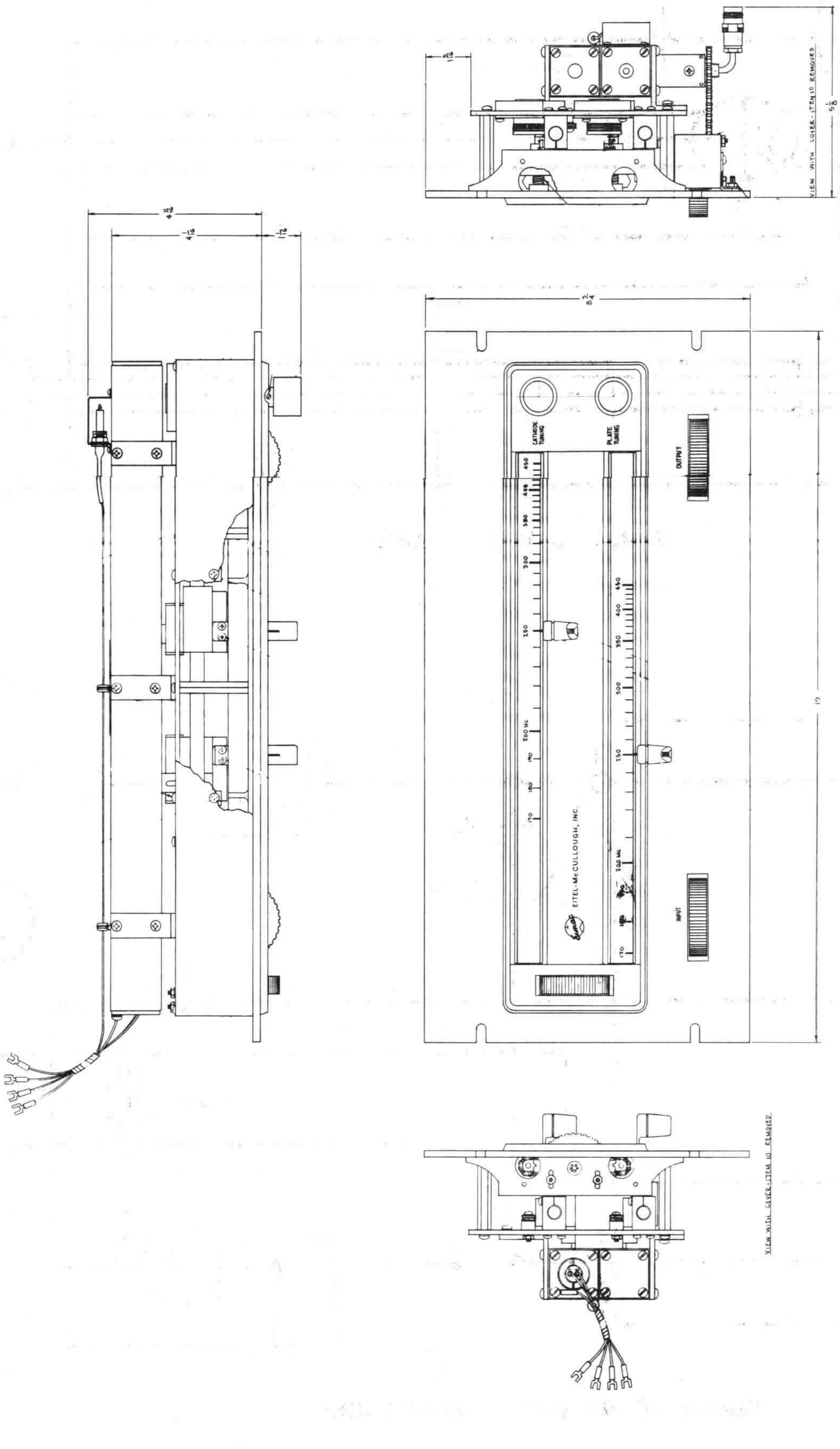
For personnel protection, high voltage circuits above 500 volts are enclosed and identified. Interlocks are not provided.



EM4546 CAVITY AMPLIFIER



EM4546 POWER SUPPLY CONNECTIONS


VIEW WITH COVER-ITEM 10 REMOVED
CATHODE TUNING
PLATE TUNING
OUTPUT
INPUT
EITEL-McCULLOUGH, INC.
19
VIEW WITH COVER-ITEM 10 REMOVED

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X4546

CAVITY AMPLIFIER
150-2000 Mc

The Eimac X4546 is a broad-tuning cavity amplifier incorporating the Eimac Y-319 ceramic metal planar triode. It is intended for use in test equipment consoles and special transmitters. This amplifier has front-panel tuning knobs and frequency scales for tuning across the 150-2000 Mc band with power output from 25 to 5 watts.

CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable - 150-2000 Mc

RF Power Output -

Frequency, Mc	Power output, watts, CW
150- 900	40
900-1400	30
1400-1800	20
1800-2000	10

RF Drive Power Required - 2W

Frequency Stability - within $\pm$200 PPM/°C

Power Supply Requirements:

	Voltage	Current
Anode, maximum	1 KV	100 mA
Grid	Bias through variable cathode resistor, 200-1000 ohms	
Heater	6.0 V	1 A
Ground	Negative terminal of anode supply	

Tube Type - Eimac Y-319

Load Impedance - 50 ohms

Load VSWR, maximum - 1.5:1, any phase

MECHANICAL

Mounting - Standard 19'' relay rack

Size - height--8-3/4 inches
depth--6 inches

Weight - 5 pounds

Operating controls - Tuning knobs and frequency scales provided

Cooling - Conduction to heat sink (included)

Connector - Type N

ENVIRONMENTAL

Temperature -10 to +50° C (+14 to +122° F)

Altitude - to 12,000 feet

NOTES:

(1) Knobs are provided on the front panel for fine tuning and for adjusting output coupling. Frequency scales are provided for each cavity. Tuning is accomplished by moving the scale pointers until scales indicate the desired frequency, then adjusting the output coupling. Access to the interior of the amplifier is not required for tuning.

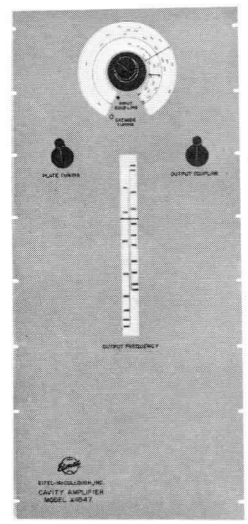
(2) For personnel protection, high voltage circuits above 500 volts are enclosed and identified. Interlocks are not provided.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4547

CAVITY AMPLIFIER

150-1000 Mc
100 WATTS CW



This is a broad-tuning cavity amplifier, incorporating the Eimac X843D ceramic-metal planar triode. It is intended for use in test equipment consoles and special transmitters. High power output and wide tuning range are outstanding features of this amplifier.

A recommended driver for use with this amplifier is Eimac EM4555 oscillator.

CHARACTERISTICS

ELECTRICAL

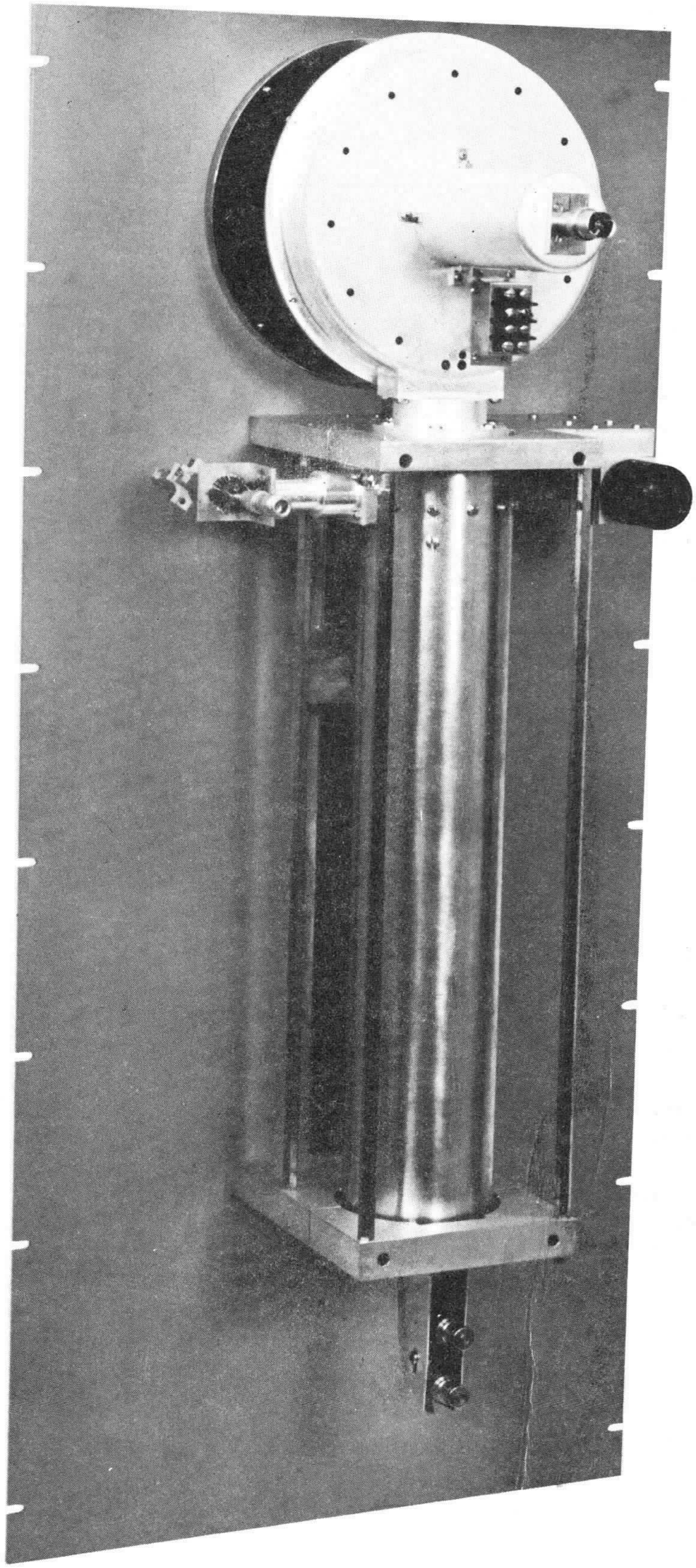
Tuning Range	150-1000 Mc	
Tube Type	Eimac X843D	
Power Supply Requirements:		
Anode Voltage	1000	V
Current	250	mA
Heater Voltage	5.5	V
Current	2.7	A
Grid Current, Maximum	100	mA
Cathode Current, Maximum	300	mA
Operating Characteristics:		
rf Drive Power Required (nominal)	10	W
Power Output, minimum	100	W
Bandwidth, 3 db points	5	Mc
Load Impedance	50 ohms nominal	
Load VSWR, Maximum	1.5:1	Any Phase
Gain, Minimum	10	db

MECHANICAL

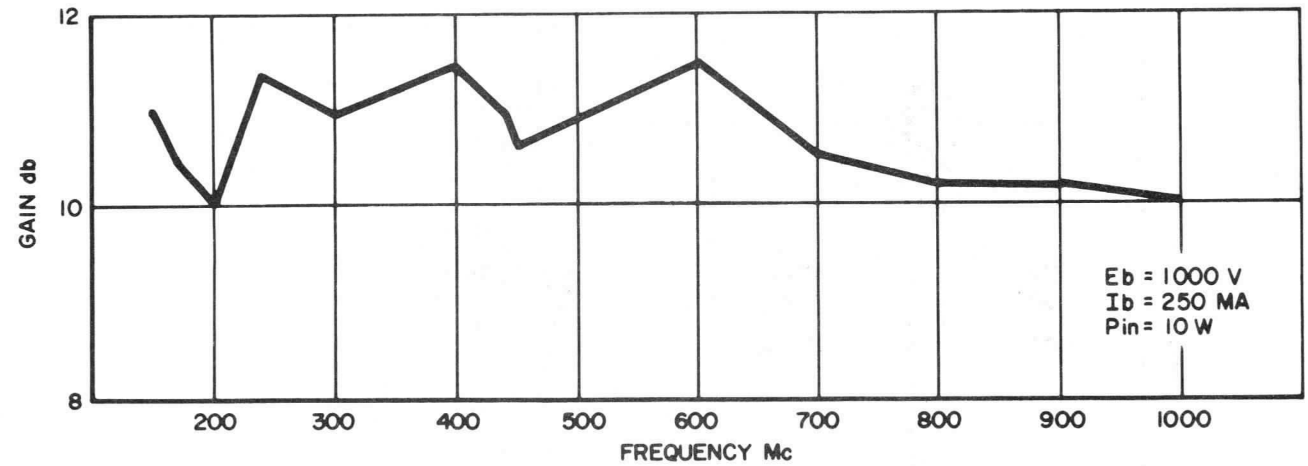
Connectors	Type N Female
Cooling	Liquid (self-contained)
Maximum Overall Dimensions	11"x 19"x 55"
Net Weight	50 pounds
Mounting	19" Relay Rack

ENVIRONMENTAL

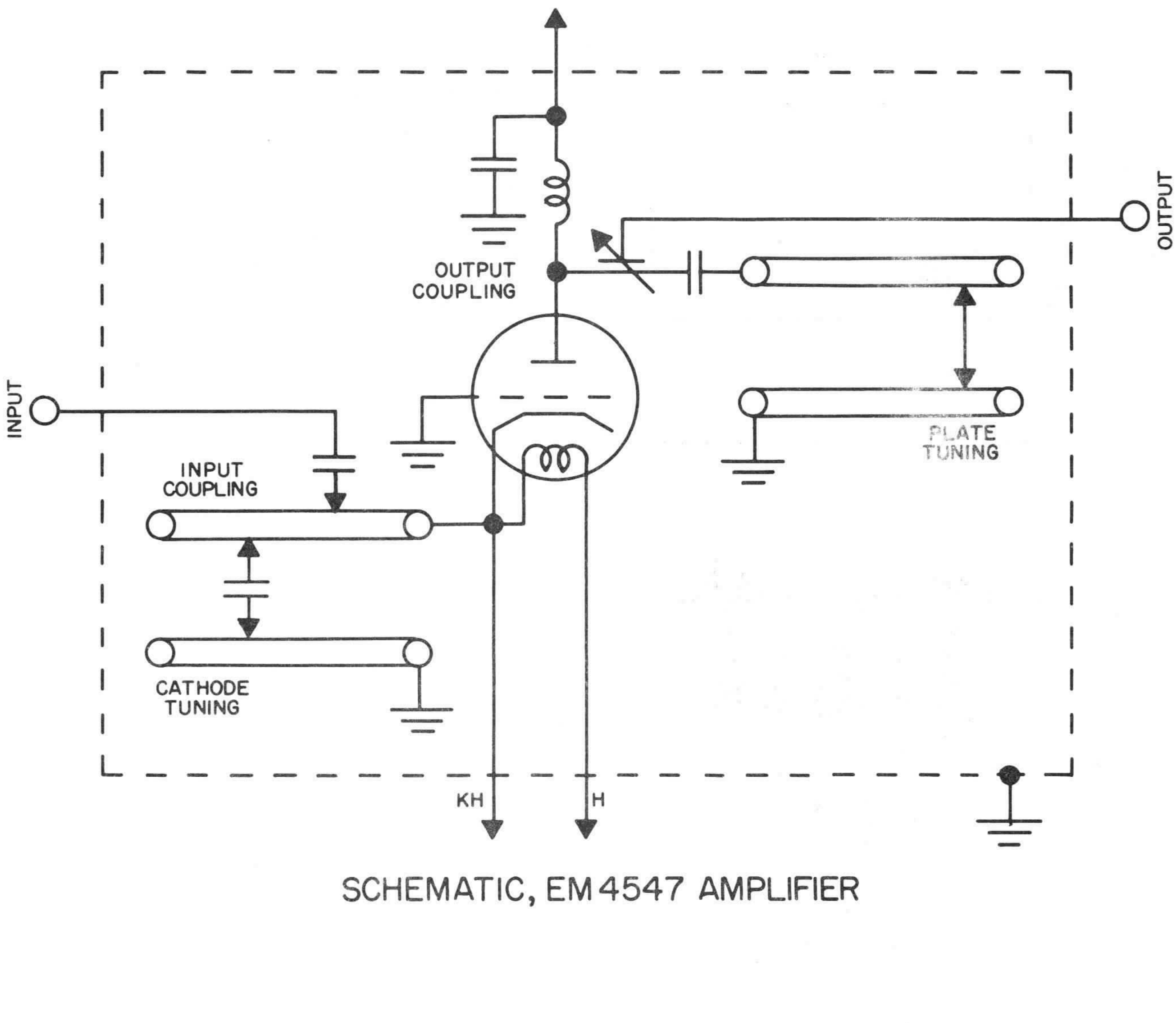
Operating Temperature	—10 to +50°C
Altitude	0 to 12,000 feet



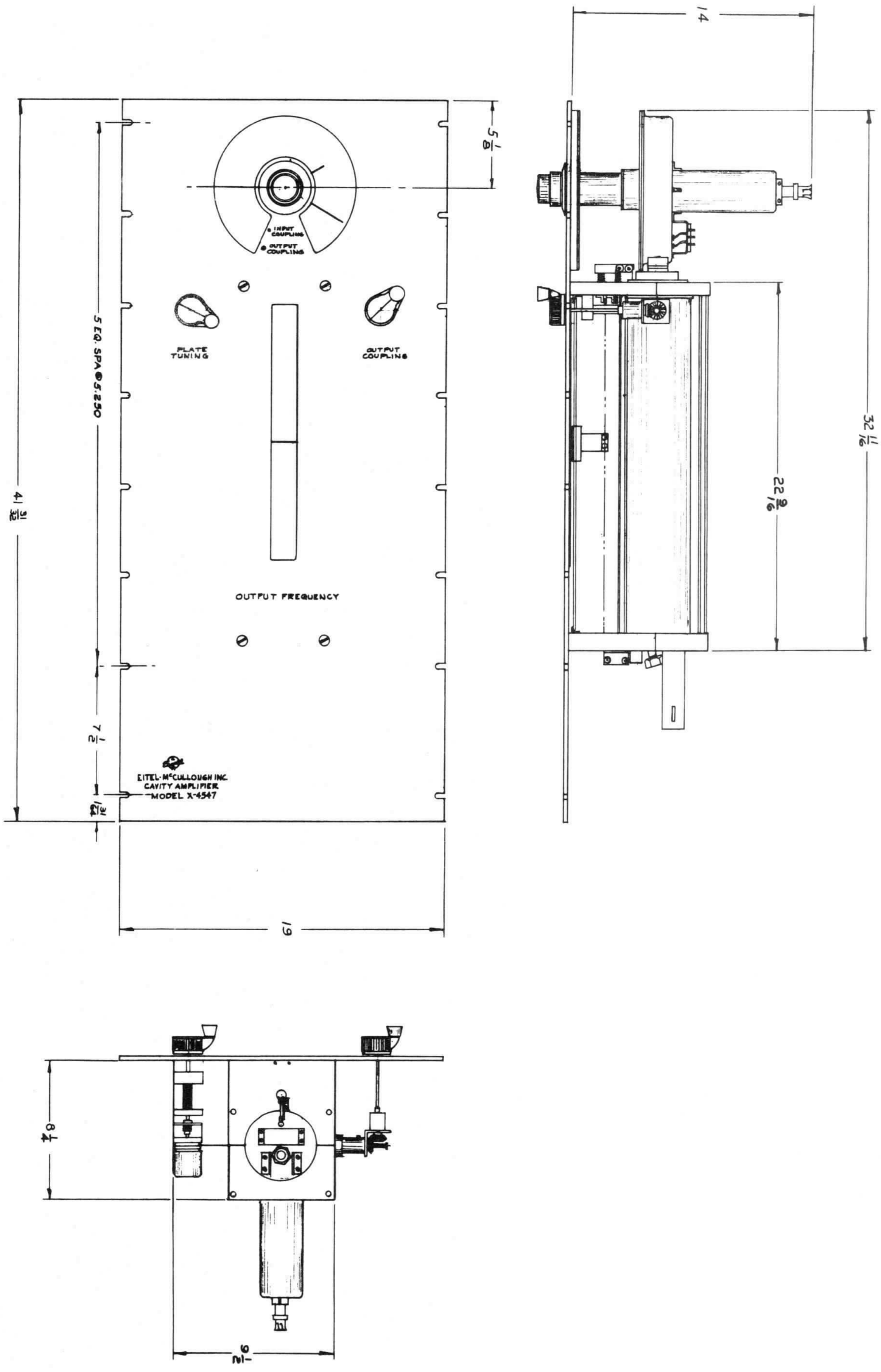
REAR VIEW, EM4547 AMPLIFIER



GAIN OF EM 4547 AMPLIFIER



SCHEMATIC, EM 4547 AMPLIFIER



14
5 1/8
INPUT COUPLING
OUTPUT COUPLING
PLATE TUNING
OUTPUT COUPLING
OUTPUT FREQUENCY
5 EQ. SPA @ 5.250
41 31/32
7 1/2
31/32
EITEL-McCULLOUGH INC.
CAVITY AMPLIFIER
MODEL X-4547
19
32 11/16
22 9/16
8 1/4
9 1/2

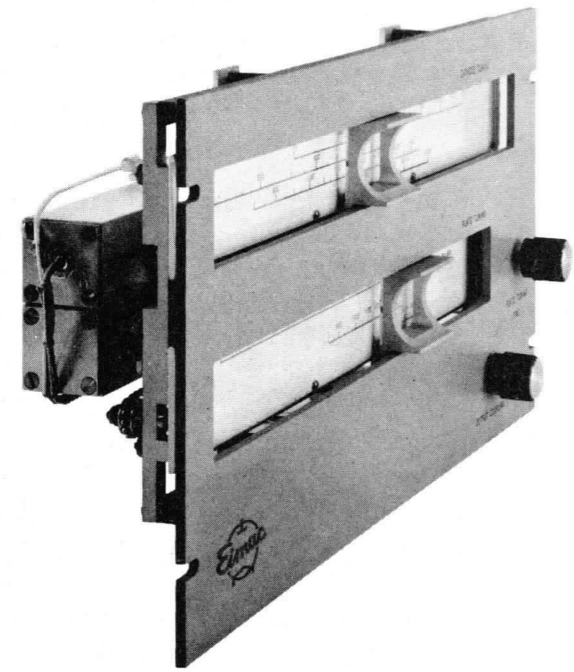
Eimac®

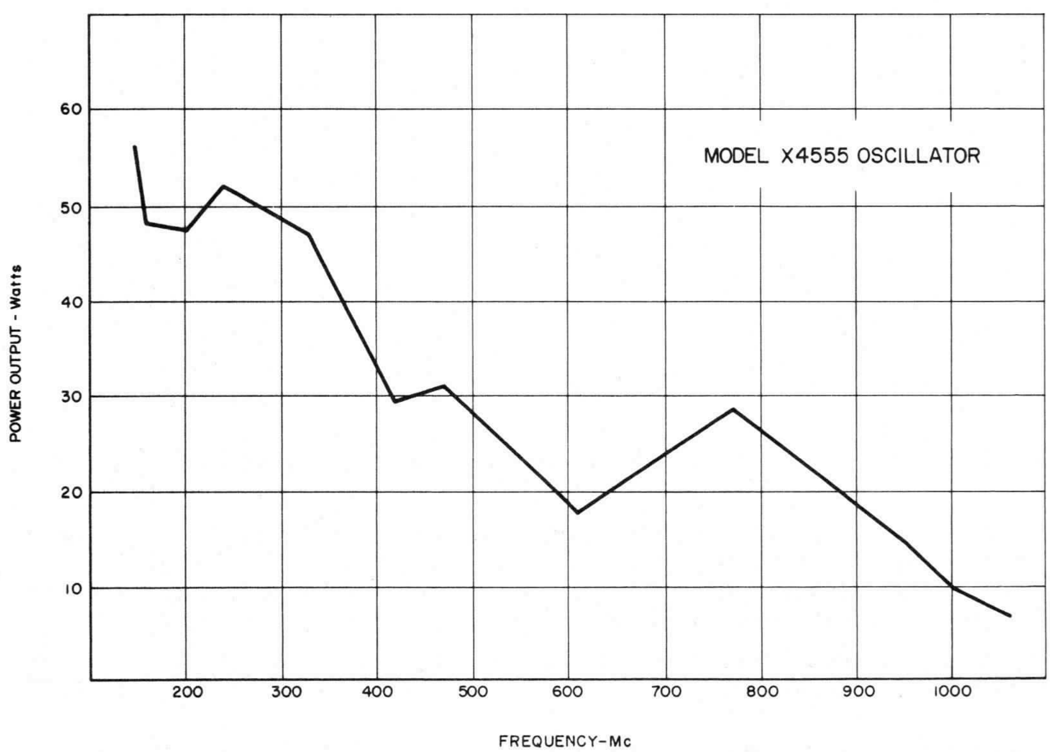
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4555

BROAD TUNING OSCILLATOR 150-1050 Mc

The Eimac EM4555 is a broad-tuning cavity power oscillator incorporating the Eimac Y-319 ceramic-metal planar triode. It is intended for use in test equipment consoles and special transmitters. This oscillator has front-panel tuning knobs and frequency scales for tuning across the 150-1050 Mc band with power output from 40 to 5 watts.





CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable		150-1050 Mc
RF Power Output	Frequency, Mc	Power output, watts, CW
	150- 300	40
	300- 500	20
	500- 900	15
	900-1050	5
Frequency Drift,[1] percent of operating frequency		±0.05%
Power Supply Requirements:	Voltage	Current
Anode, maximum	1 KV	100 mA
Grid Current, maximum		50 mA
Heater	6.0 V	1 A
Ground		Positive terminal of anode supply
Cathode Current, maximum		125 mA
Tube Type		Eimac Y-319
Load Impedance		50 ohms nominal
Load VSWR, maximum		2.0:1 any phase, without damage

MECHANICAL

Mounting	Standard 19" relay rack
Size	height — 8¾ inches depth — 4½ inches
Weight	10 pounds
Operating Controls	Tuning knobs and frequency scales provided[2]
Cooling	Conduction — Convection[3]
Connector	Rear Mounted Type TNC Female

ENVIRONMENTAL

Temperature	—10 to +50°C (+14 to +122°F)[3]
Altitude	0 to 12,000 feet

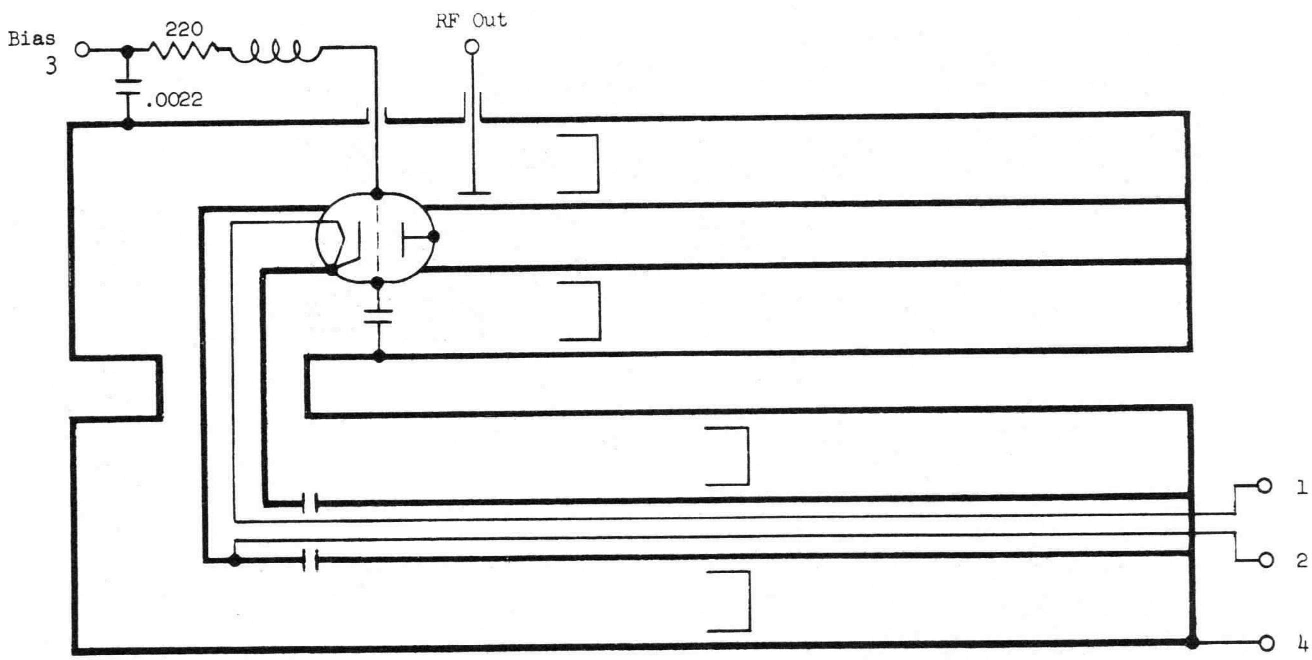
NOTES:

(1) Frequency drift is specified over a period of 2 hours, following a warm-up period of ½ hour minimum.

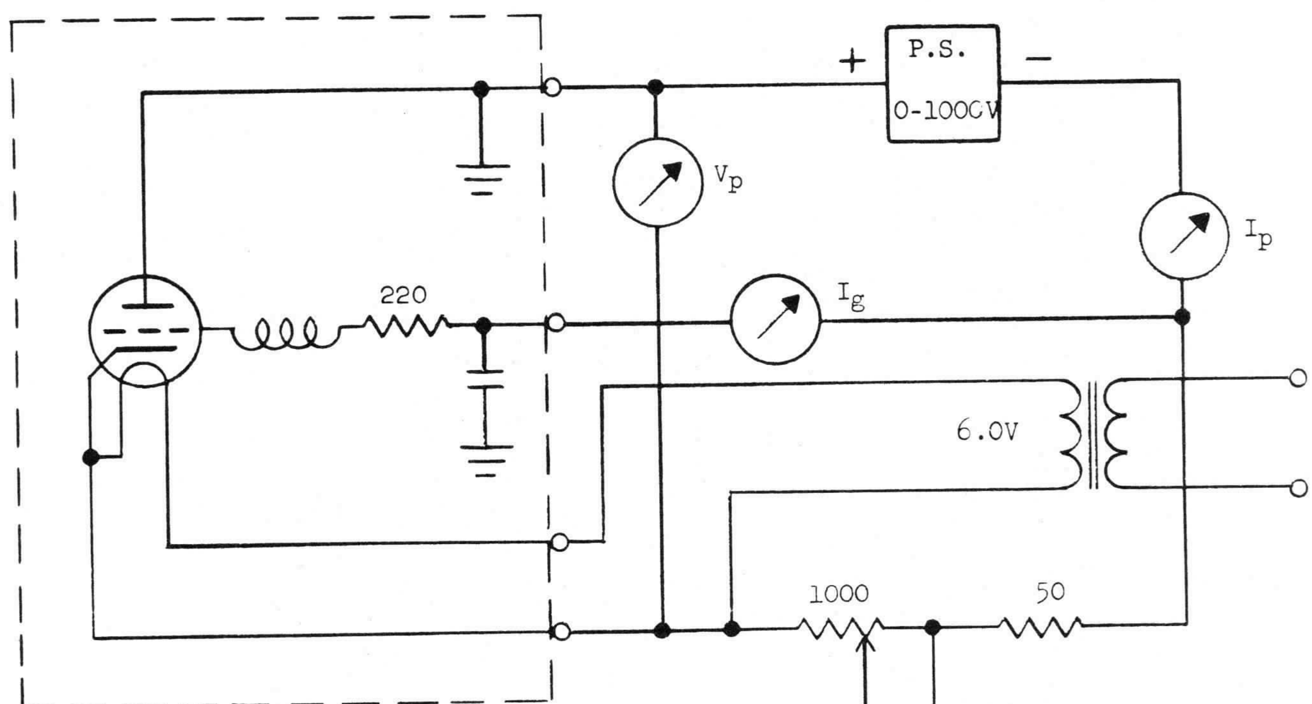
(2) Knobs are provided on the front panel for fine tuning the plate and cathode cavities and for adjusting output coupling. Direct-reading frequency scales are provided for each cavity. Tuning is accomplished by sliding the hairline windows to the desired frequency, then adjusting the fine tuning and output coupling. Access to the interior of the amplifier is not required for tuning.

(3) If ambient temperature exceeds 90°F, the cavity body will become quite hot (up to 250°F), and forced air cooling is recommended.

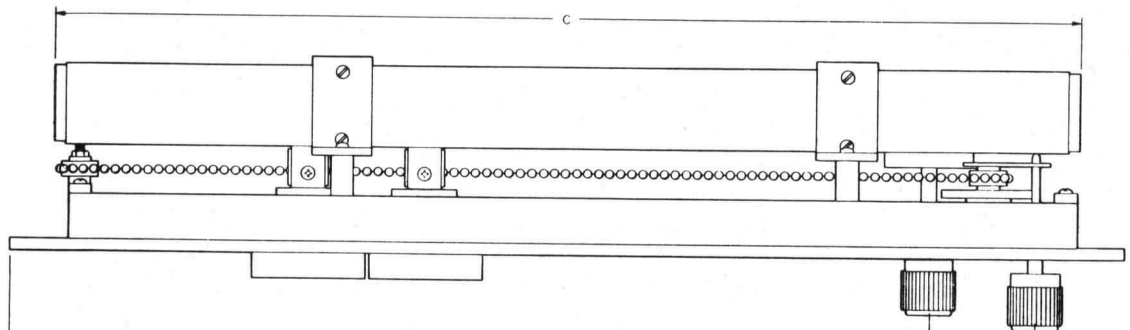
For personnel protection, high voltage circuits above 500 volts are enclosed and identified. Interlocks are not provided.



EM4555 CAVITY OSCILLATOR
Figure 2

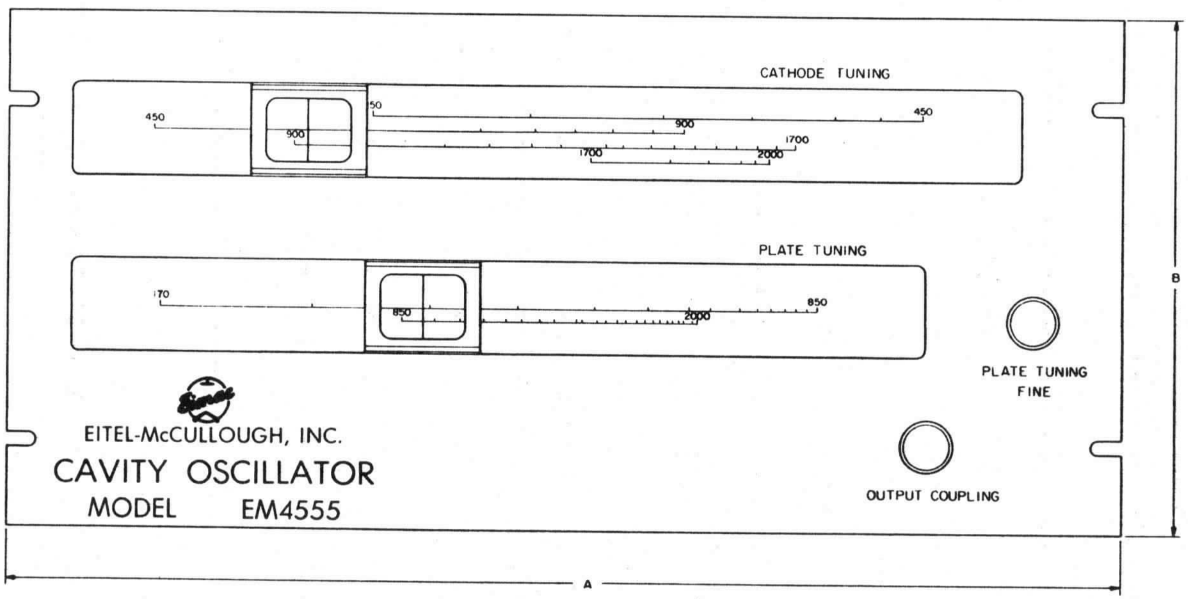


EM4555 POWER SUPPLY CONNECTIONS
Figure 3

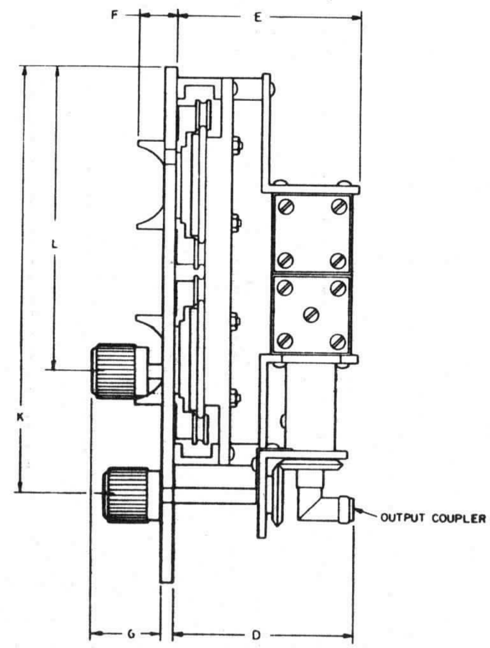


TOP VIEW

DIMENSION DATA		
REF	MIN	MAX
A	18.969	19.000
B	8.719	8.750
C	17.417	17.521
D	2.863	3.091
E	3.025	3.099
F	.589	.598
G	1.182	1.214
H	15.583	15.635
J	17.474	17.526
K	7.245	7.287
L	5.167	5.209



FRONT VIEW

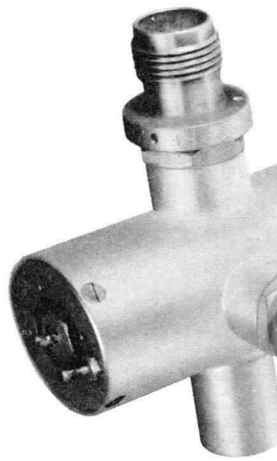


SIDE VIEW

06890	EM4555
CODE IDENT	PART NO

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4564
CAVITY OSCILLATOR
1700-1850* Mc



The Eimac EM4564 is an ultra-stable low noise cavity oscillator designed for use in microwave transmitters where compactness and ruggedness is required. Excellent frequency stability over a wide temperature range is a major advantage of this oscillator. It incorporates the Eimac 128631 ceramic-metal planar triode. Operating life, without tube change, is over 5000 hours average.

A connector inlet port is provided in the plate cavity for insertion of a modulator.

CHARACTERISTICS

ELECTRICAL

Tuning Range		1700-1850* Mc
rf Power Output		1.6** Watts CW
Frequency Stability		±0.15% from —40°C to +75°C
Power Supply Requirements:	Voltage	Current
Anode, Maximum	140 V	50 mA
Control Grid, Maximum		Self Bias
Heater	6.0 V	400 mA
Tube Type		Eimac 128631
Load Impedance		50 ohms nominal
Modulation		CW
VSWR, maximum		1.3:1, any phase
rf Noise, maximum		0.2 percent

MECHANICAL

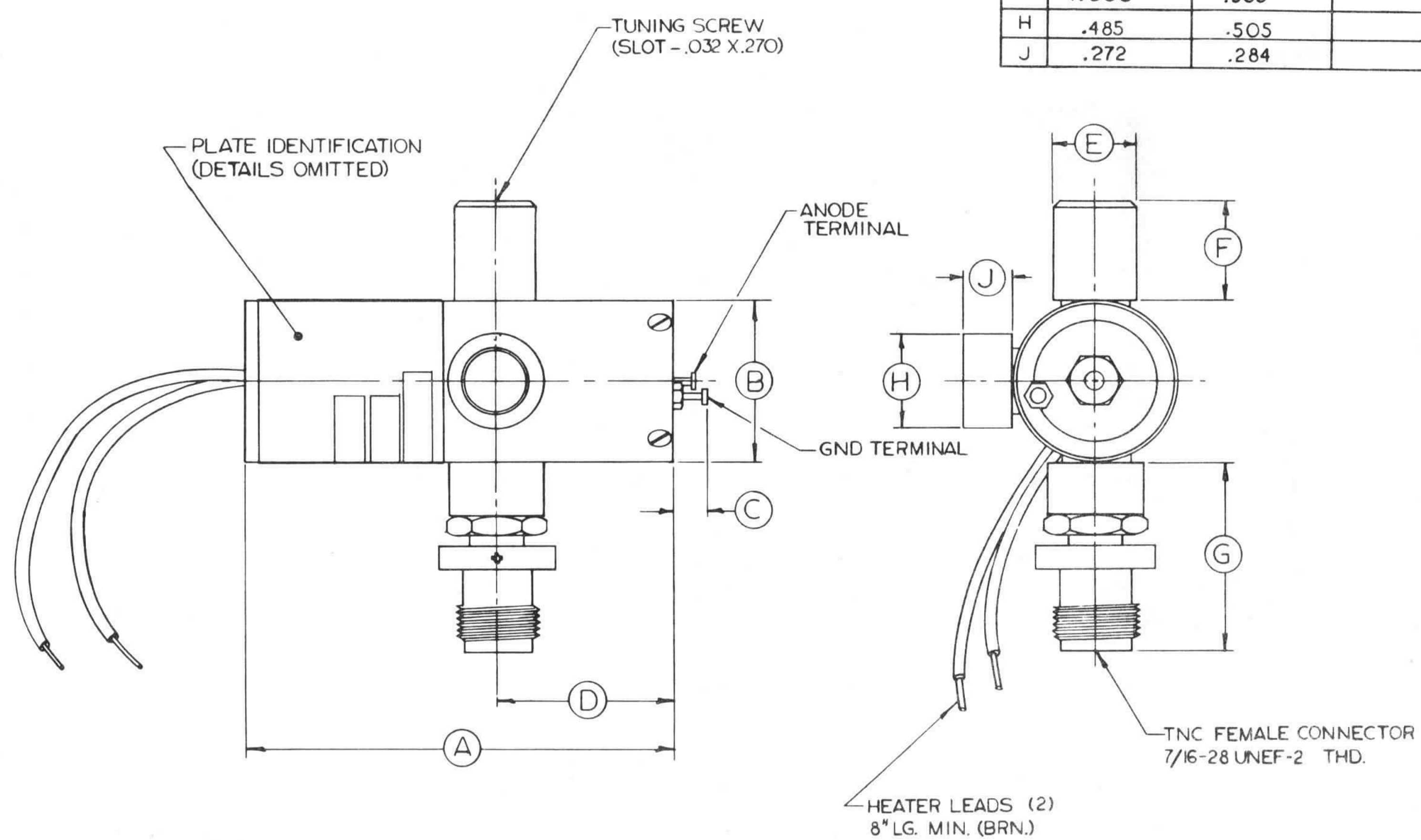
Mounting	Clamps to heat sink cradle
Size	Length: 2.25 inches Diameter: 0.85 inches
Weight	0.3 pounds
Cooling	Conduction
Connectors	Type TNC Female

ENVIRONMENTAL

Temperature	—40°C to +75°C
Altitude	0 to 12,000 feet

*Factory adjusted for any 48 Mc Segment of the 1700-1850 Mc band.
**Can provide up to 3 watts output with higher anode voltage and current and special cooling.

DIMENSIONAL DATA			
DIM	MIN	MAX	REF
A	2.255	2.300	
B	.850 DIA.	.860 DIA.	
C	—	—	.181
D	.930	.973	
E	.429 DIA.	.437 DIA.	
F	.525	.535	
G	1.000	.935	
H	.485	.505	
J	.272	.284	



Eimac®

EIMAC

A Division of Varian Associates

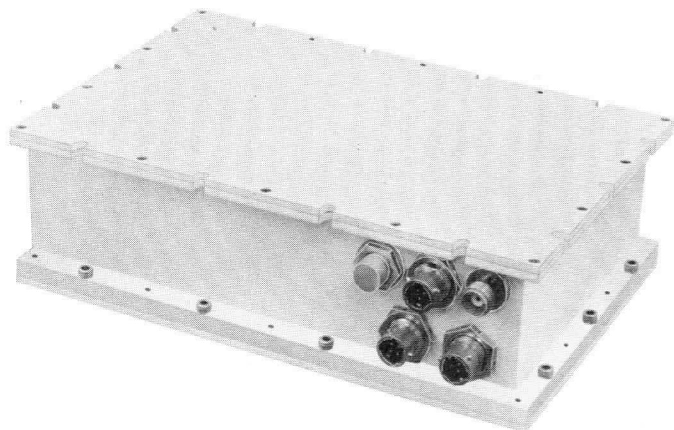
SAN CARLOS, CALIFORNIA

EM4567

TELEMETRY TRANSMITTER

2200 - 2300 MHz
10 Watts

This Eimac S-Band transmitter provides over 10 watts rf output with over 15% overall efficiency, under all combinations of worst specified environmental extremes and primary power variation. Frequency change, if desired, is easily accomplished in the field. It is designed to operate during the severe shock and vibration of missile launch.



Model EM4567 is a complete transmitter, including a pre-regulated DC-DC converter. All circuits are solid state, except the rf power oscillator, which is a single stage rugged ceramic planar triode. RF is generated at the output frequency. The complete transmitter is packaged in less than 110 cubic inches, and weighs less than 8 pounds. Modulation is true FM. Major features of this transmitter include:

Easy Tuning: A simple crystal change will allow the output to be tuned to any frequency in the 2.2-2.3 GHz band. Test points are provided. A minimum of test equipment is required. Adjustment of temperature compensation is not required.

High Reliability: Since the rf power output is produced by a single stage, this transmitter has a minimum number of components, tuning adjustments and connections. All components are used well below maximum ratings, and circuits are epoxy encapsulated for environmental protection.

Wide Temperature Range: This transmitter will meet full performance specifications over the range −40°C to +85°C.

Modulation Bandwidth and Linearity: Deviation of ±1.5 MHz is accomplithed at ±2.5% linearity, and ±300KHz at ±0.5% linearity.

CHARACTERISTICS

ELECTRICAL

Frequency, Tunable	2200-2300 MHz
Power Output, CW Minimum[7]	10 Watts
Frequency Accuracy	±0.001%
Frequency Stability[8]	±0.0025%
Carrier Deviation, Adjustable, peak-to-peak	2MHz/Volt to 30KHz/Volt
Modulation Bandwidth,[1] Flat within ±0.5 db	100 Hz to 500 KHz
Flat within ±1 db	5 Hz to 800 KHz
Flat within ±2 db	5 Hz to 2 MHz
Modulation Linearity, Deviation from B.S.L.,	
For ±300 KHz peak Deviation	±0.5%
For ±1.5 MHz peak Deviation	±2.5%
Incidental Frequency Modulation, Maximum	5 KHz rms
AM, Maximum, due to environmental conditions	1%
due to ±300 KHz carrier deviation	1%
due to ±1.5 MHz carrier deviation	5%
Modulation Input Impedance, Minimum, 5 Hz to 800 KHz	10,000 Ohms
Primary Voltage required[2]	$28\ {}^{+8}_{-4}$ Vdc
Primary current required, maximum, at 28 Vdc	2.4A
Primary Ripple, maximum, peak-to-peak from Dc to 20 KHz	8 volts
Transients, Maximum positive	80 volts for 20 microseconds
Input current rise above nominal, due to fault,[3] maximum	30%
VSWR Maximum, any phase, for 10 watts output[7]	1.5:1
for 5 watt output	5.5:1
Load Impedance required	50 ohms
Warm-up time to meet all specifications	120 seconds
Interference	All applicable requirements of MIL-I-26600 and MIL-I-6181D are met
Life (95% probability, 60% confidence factor)	500 hours

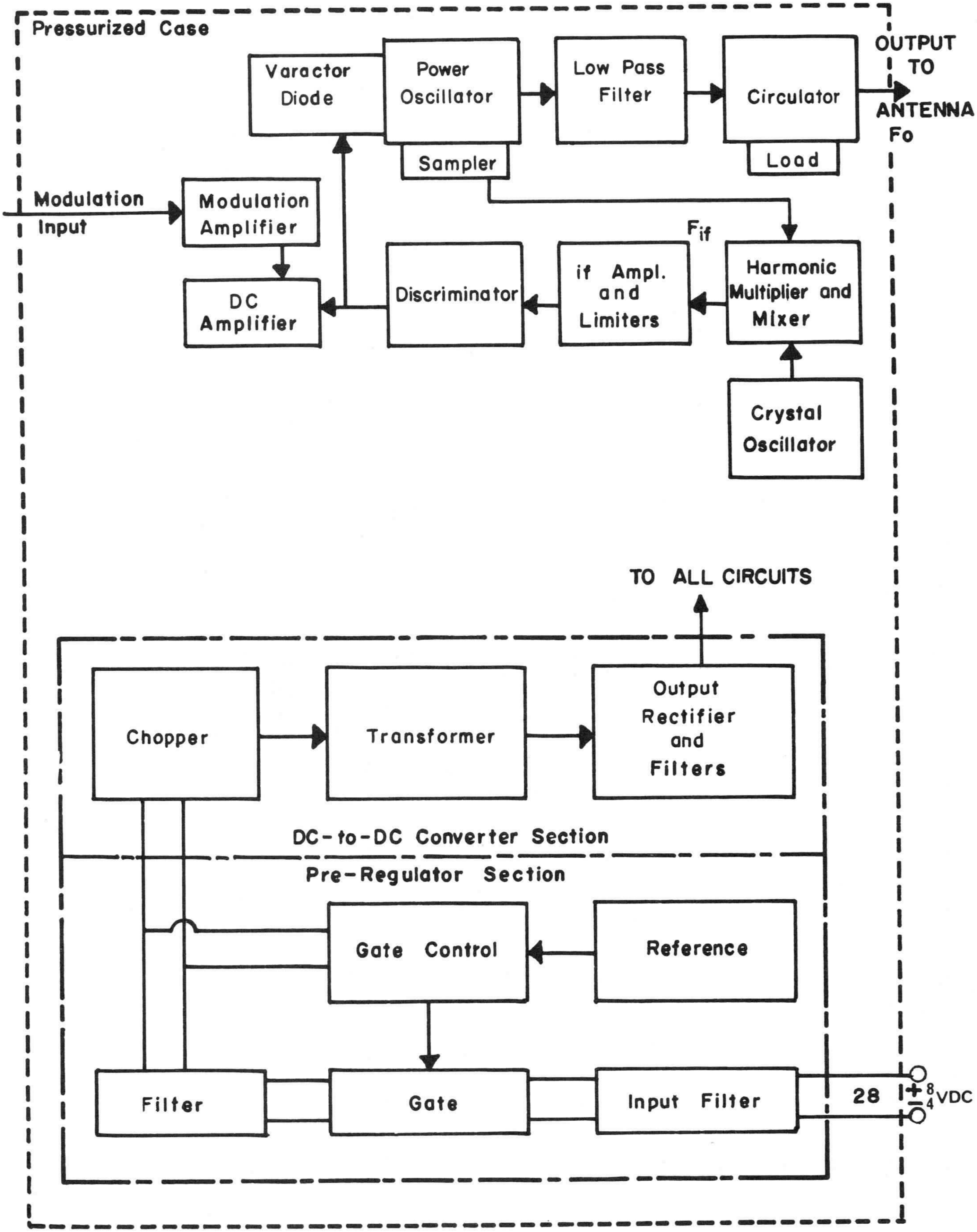
PACKAGING

Volume displaced	98 cubic inches
Dimensions, including mounting flanges	8.3″ x 5.5″ x 2.525″
Weight	8 pounds
Pressurization	30 psia
Cooling	Conduction to heat sink
Connectors, rf	TNC Female
Power and Modulation	Bendix PTO7 Male

ENVIRONMENTAL SPECIFICATIONS[4]

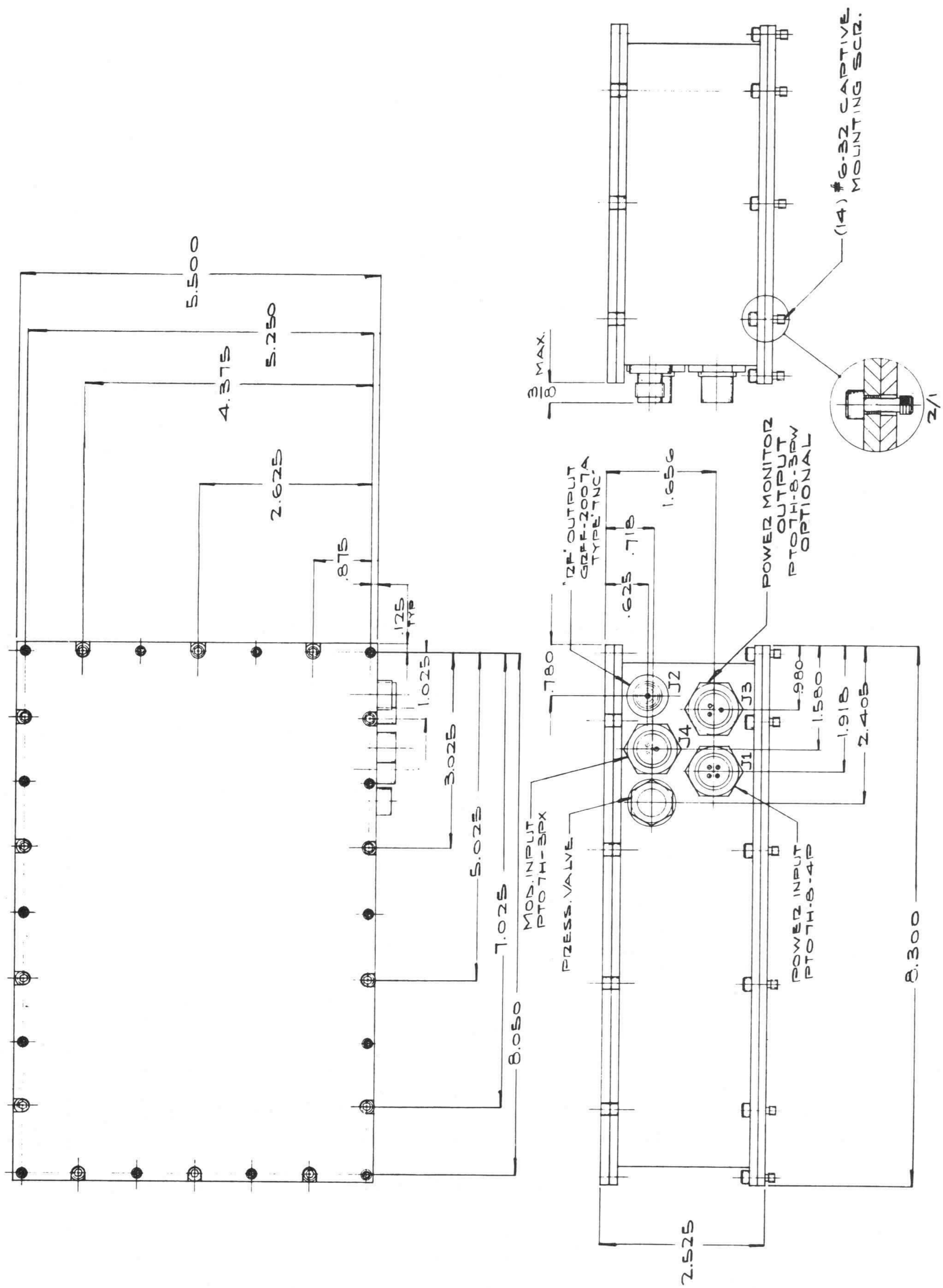
Temperature[5] at heat sink (Continuous Operation)	—40°C to +85°C
Altitude	Any
Vibration[9] (MIL-STD-810, Figure 514-3, Curve D)	15G peak to 2 KHz
(MIL-STD-810, Figure 514-4, Curve E)	0.2 G^2/Hz
Air Induced Vibration	150 db above $2\times10^{-4}/CM^2$ from 150 to 2000 Hz, 30 minutes
Explosive Atmosphere	Capable of operation without igniting an explosion
Sustained Acceleration	30G for 5 minutes, three axes
Shock[9], per MIL-STD-810 Method 516, Procedures I and V,	
half-sine shocks	15G for 11 milliseconds
sawtooth shocks[6]	100G

[9]Available for use in more severe environment, on special order.
[8]Stability of ±0.001% from —40°C to +85°C is available on special order.
[7]Over temperature range —20°C to +70°C. Minimum power output for —40°C to +85°C is 8 watts.
[6]Out-of-tolerance operation may occur during 100G shock.
[5]Other ranges available on special order.
[4]Transmitter performs as specified, under any combination of environmental conditions.
[3]Any failure of transmitter (except at input terminals).
[2]Under emergency conditions, full rf output is provided with primary power as low as 20 Vdc, but increased IFM and AM will occur.
[1]Also available modified for modulation down to DC.



BLOCK DIAGRAM

EM4567 10 Watts 2200 - 2300 MHz TELEMETRY TRANSMITTER


5.500
5.250
4.375
2.625
.875
.125 TYP
1.025
3.025
5.025
7.025
8.050
.780
.625
.718
1.656
'ZF' OUTPUT GRFF-2007A TYPE 'TNC'
POWER MONITOR OUTPUT PT07H-8-3PW OPTIONAL
J2
J3
J4
J1
.980
1.580
1.918
2.405
MOD. INPUT PT07H-3PX
PRESS. VALVE
POWER INPUT PT07H-8-4P
8.300
2.525
3/8 MAX.
(14) #6-32 CAPTIVE MOUNTING SCR.
2/1

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

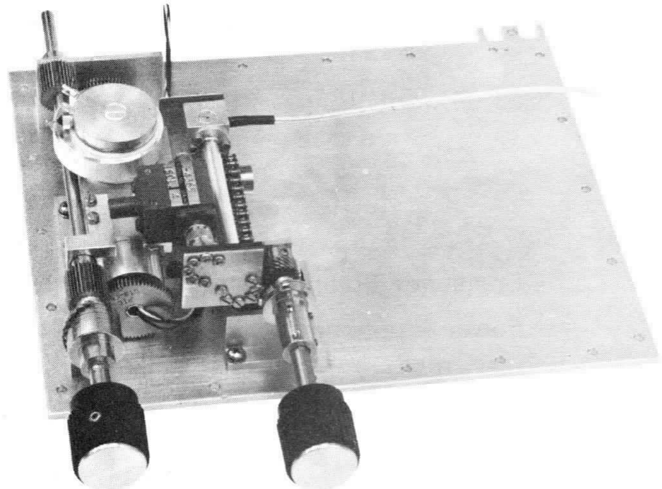
EM4574
EM4585
EM4586

CW OSCILLATOR

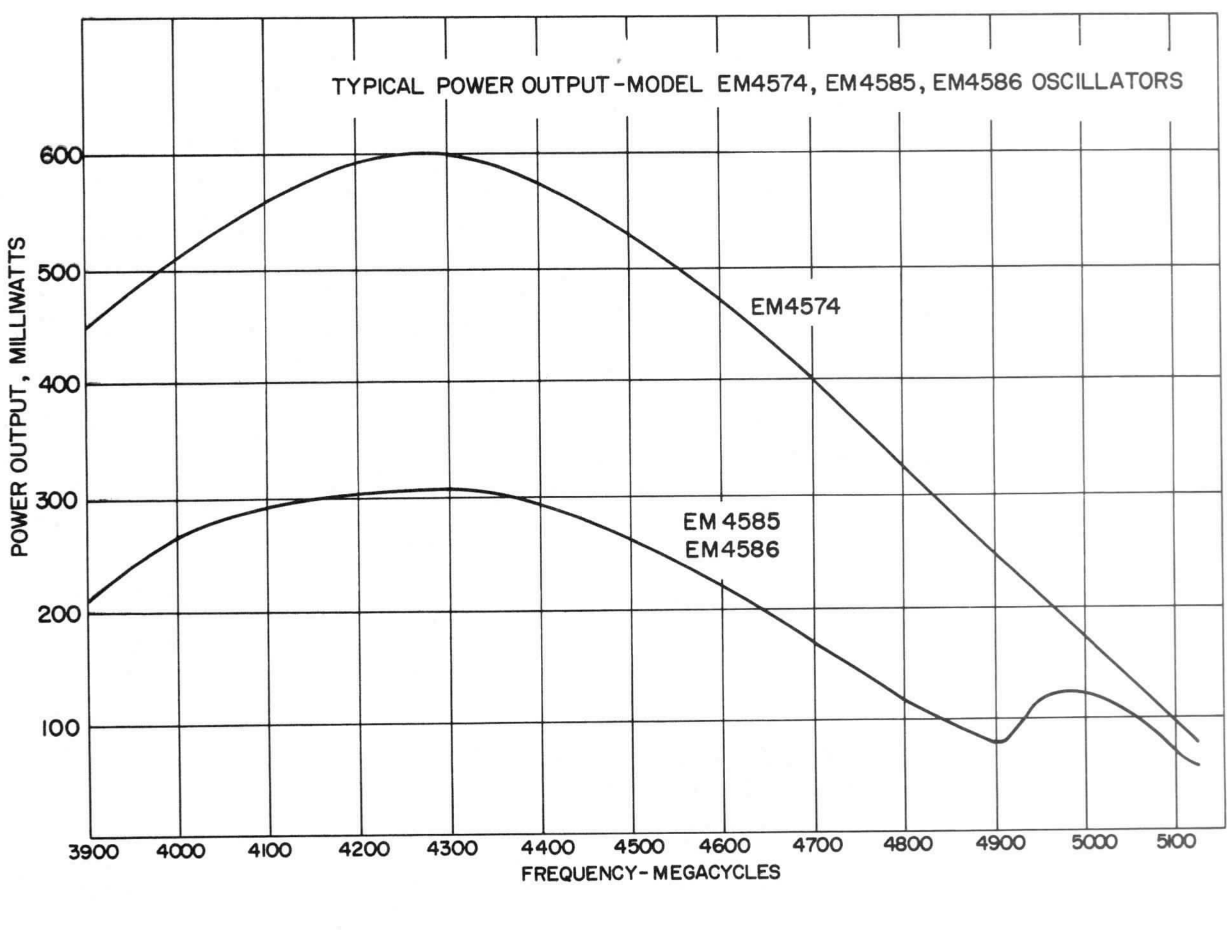
3900-5100 Mc

The Eimac EM4574 is a CW oscillator providing up to 600 milliwatts output, tunable 3.9-5.1 Gc. It is also available as an electronically tunable oscillator, EM 4585, including a varactor diode modulator. A complete package of the EM4585 electronically tunable oscillator with low pass filter, terminated circulator and tuning mechanism for single knob front panel tuning is available, Model EM4586. This oscillator is recommended for use in aerospace and ground system transmitters.

A DC-DC converter, EM4589, is available to operate this oscillator from a 28 V DC primary power supply.



EM4586 OSCILLATOR



CHARACTERISTICS

ELECTRICAL

Frequency, Manual Tuning Range	3900-5100 Mc
Electronic Tuning Range	±15 Mc

RF Power Output

Frequency, Mc	Power output, Milliwatts, CW EM4574	EM4585/EM4586
3900	400	200
4300	550	300
4700	350	150
5100	75	50

Frequency Stability, Parts/million/°C - ±10

Power Supply Requirements:

	Voltage	Current
Anode, maximum	150	35 mA
Grid Current, maximum		5 mA
Heater	6.0 V	0.3A

Ground	Positive terminal of anode supply
Tube Type	Eimac 128676
Load Impedance	50 ohms nominal
Load VSWR, maximum	1.5:1, any phase (5:1 without damage)
Modulation	CW/FM

MECHANICAL

Mounting	To Heat Sink (See photograph)
Size, EM4574	Length 4.5 in.; Width 1.0 in.; Depth 1.0 in.
Weight, EM4574	0.5 pounds
EM4586	1.9 pounds
Cooling	Conduction
Connector	Type TNC Female

ENVIRONMENTAL (Operational)

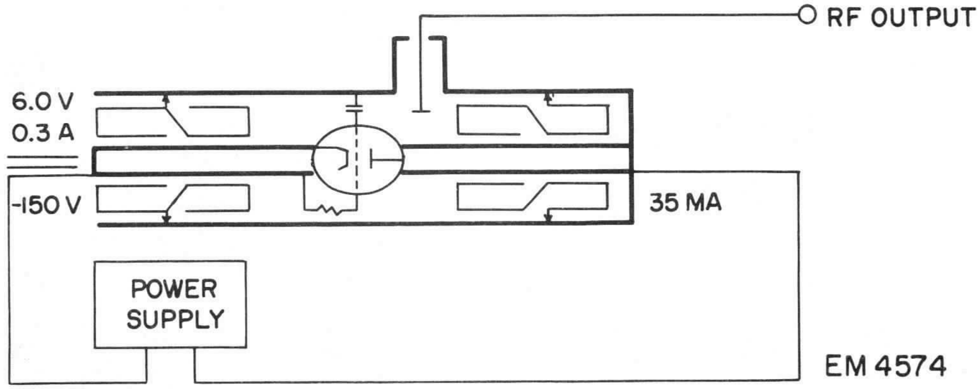
Temperature	—40 to +100°C
Altitude	0 to 5,000 feet
Vibration	5 to 33 CPS at 0.3 inches amplitude
Shock Withstood	300 g sawtooth for 1 millisecond

NOTES:

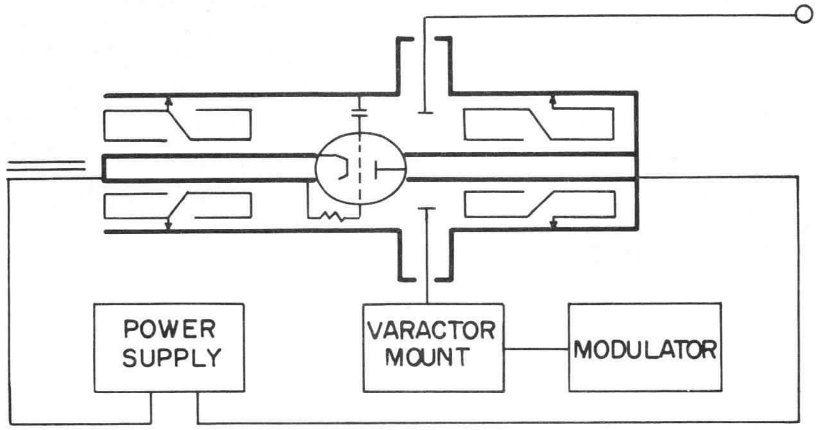
(1) *Carrier Deviation* of EM4585 and EM4586 is adjustable from ±3 Kc to ±300 Kc with 0.2 to 1.0 volts peak-to-peak modulating input voltage.

(2) *Modulation Bandwidth* of EM4585 and EM4586 is flat within 1 db, 500 CPS to 150 Kc.

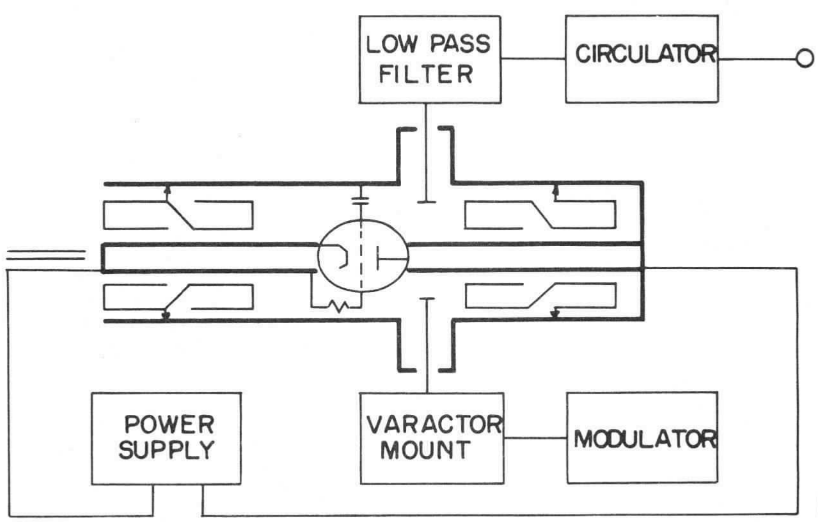
(3) *Modulation Linearity* of EM4585 and EM4586: deviation from BSL less than ±0.5%, ±6 Kc to 300 Kc.



EM 4574



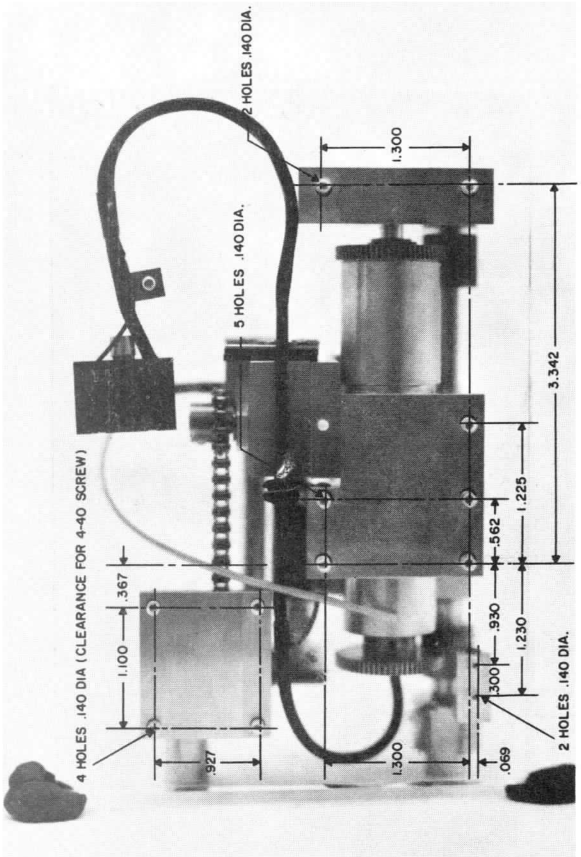
EM 4585

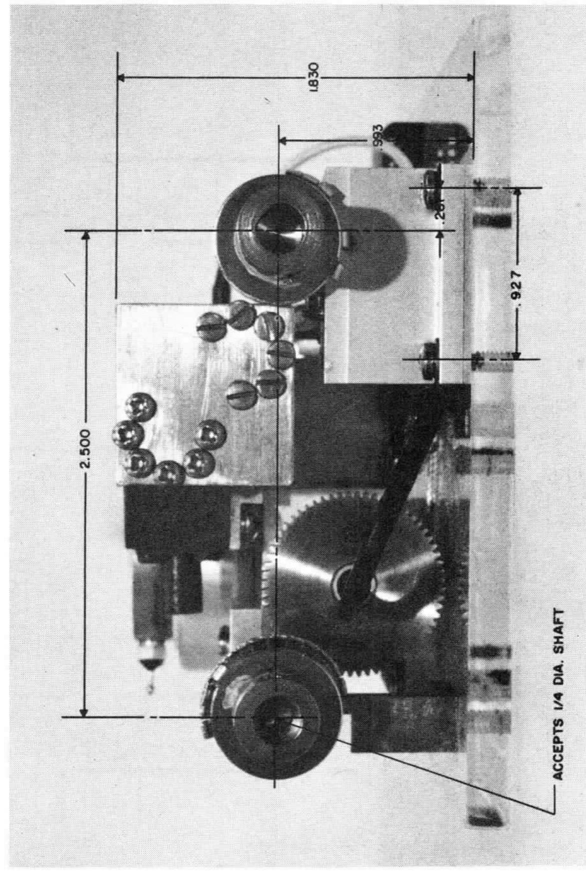


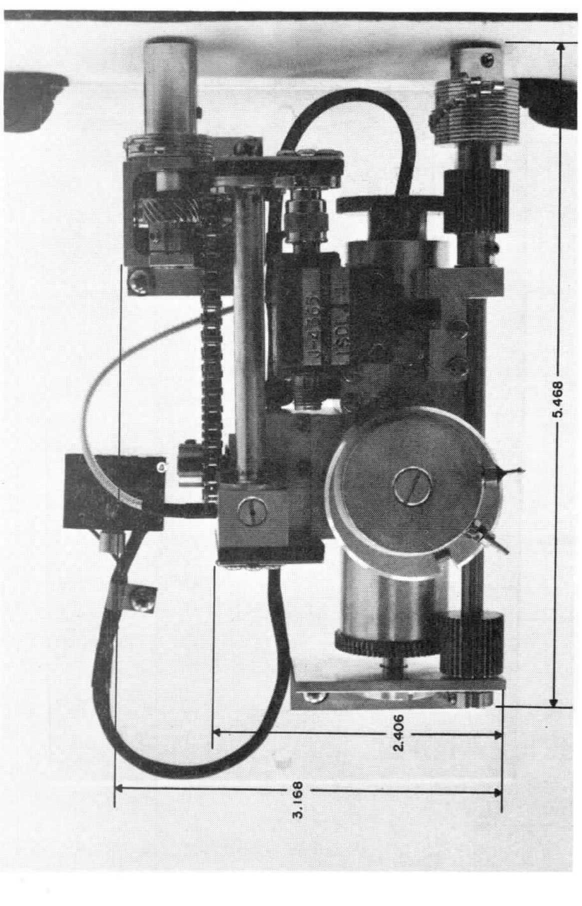
EM 4586

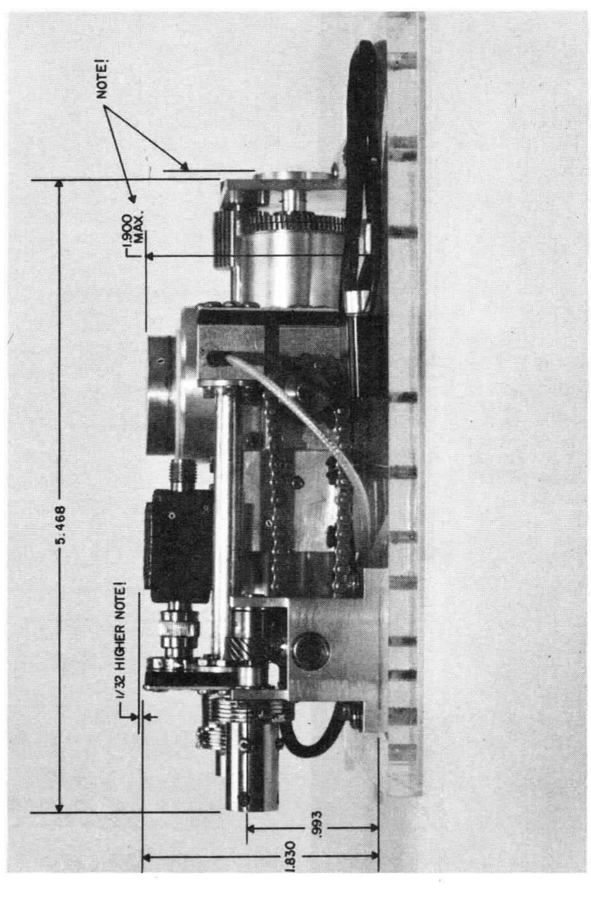
EIMAC C-BAND CW POWER OSCILLATORS

POWER SUPPLY MUST BE PURCHASED SEPERATELY.


4 HOLES .140 DIA (CLEARANCE FOR 4-40 SCREW)
2 HOLES .140 DIA.
5 HOLES .140 DIA.
1.300
3.342
1.225
.562
.930
1.230
.300
2 HOLES .140 DIA.
.069
1.300
.927
1.100
.367


1.830
.993
.927
2.500
ACCEPTS 1/4 DIA. SHAFT


5.468
2.406
3.168


NOTE!
1.900 MAX.
5.468
1/32 HIGHER NOTE!
1.830
.993

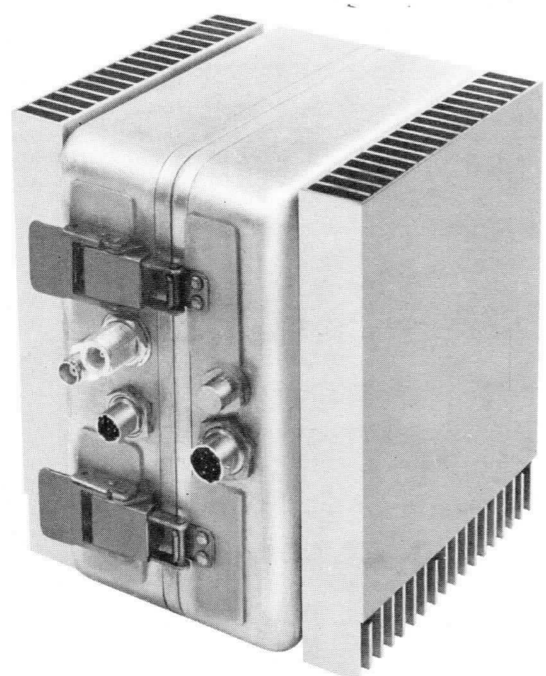
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

Tentative Data

EM4575
TELEMETRY TRANSMITTER

2200 - 2300 Mc
4 Watts



This Eitel-McCullough S-Band transmitter provides over 4 watts rf output with over 10% overall efficiency, under all combinations of worst specified environmental extremes and primary power variation. Frequency change, if desired, is easily accomplished in the field. It is designed to operate during the severe shock and vibration of aircraft operations. Operation is from nominal 400 CPS 115V single phase primary power. No heat sink or supplementary cooling required.

Model EM4575 is a complete transmitter, including a 400 CPS 115V power supply. All circuits are solid state, except the rf power oscillator, which is a single stage cavity using a rugged ceramic planar triode. RF is generated at the output frequency. The complete transmitter is packaged in less than 300 cubic inches, and weighs less than 11 pounds. Major features of this transmitter include:

Easy Tuning: A simple crystal change will allow the output to be tuned to any frequency in the 2.2-2.3 Gc band. Test points are provided. A minimum of test equipment is required. Adjustment of temperature compensation is not required.

High Reliability: Since the rf power output is produced by a single stage, this transmitter has a minimum number of components, tuning adjustments and connections. All components are used well below maximum ratings, and circuits are epoxy encapsulated for environmental protection.

Wide Temperature Range: This transmitter will meet full performance specifications over the range —54°C to +55°C, without a heat sink or supplementary cooling.

Modulation Bandwidth and Linearity: Deviation of ±1.5 Mc is accomplished at ±2.5% linearity, ±500Kc at ±1% linearity, and ±300KC at ±0.5% linearity.

High Frequency Stability: Frequency drift does not exceed ±0.0025% of the operating carrier frequency, under all combinations of specified operating conditions.

CHARACTERISTICS

ELECTRICAL

Frequency, Tunable	2200-2300 Mc
Power Output, CW Minimum	4 Watts
Frequency Accuracy[4]	±0.0025%
Frequency Stability[4]	±0.0025%
Carrier Deviation, Adjustable, peak-to-peak	2Mc/Volt to 30Kc/Volt
Modulation Bandwidth,[1] Flat within ±0.5 db	100 cps to 500 Kc
Flat within ±1 db	5 cps to 800 Kc
Modulation Linearity, Deviation from B.S.L.,	
For ±300 Kc peak Deviation	±0.5%
For ±1.5 Mc peak Deviation	±2.5%
Incidental Frequency Modulation, Maximum	±5 Kc
AM, Maximum, due to environmental conditions	1%
due to ±300 Kc carrier deviation	1%
due to ±1.5 Mc carrier deviation	5%
Modulation Input Impedance, Minimum, 5 cps to 800 Kc	50,000 Ohms shunted by 50 picofarads
Primary Voltage required[2]	100-150V, 350-450 cps, single phase
Primary power required, maximum	40 VA
Transients, Maximum positive withstood	300 volts for 1 microsecond —10 milliseconds
VSWR Maximum, any phase, for 4 watts output	2:1
for 2 watts output	5:1
Load Impedance required	50 ohms
Warm-up time to meet all specifications	120 seconds
Interference	All applicable requirements of MIL-I-6181D are met
Life (without adjustment of controls), minimum	172 hours
(with servicing and maintenance), minimum	5000 hours

PACKAGING

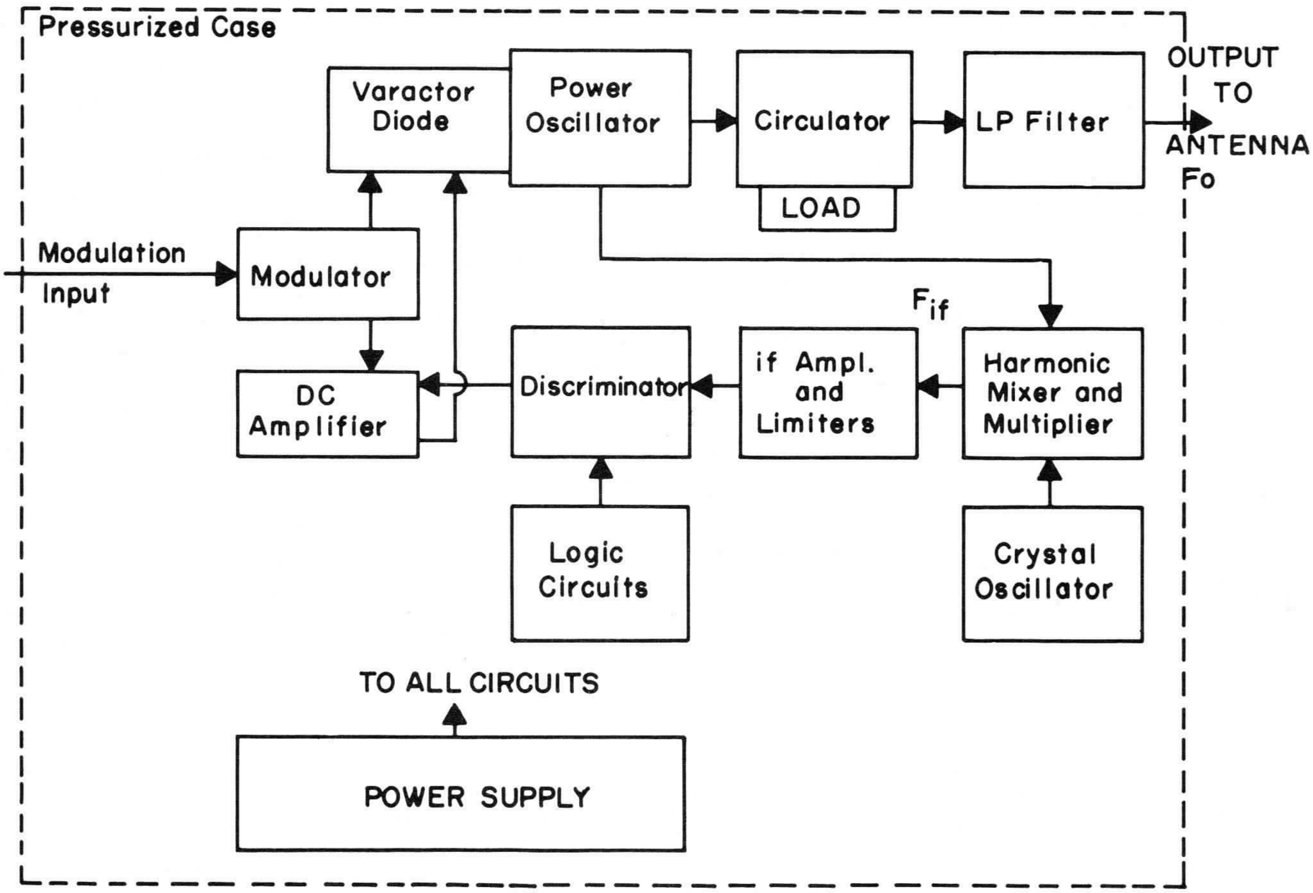
Volume displaced	280 cubic inches
Dimensions, including mounting flanges	7.5" x 6.063" x 8.0"
Weight	11 pounds
Pressurization	30 psia
Cooling	Convection
Connector, rf Output	Automatic Metals 100-N3001-85
Modulation Input	General RF 2007A
Power Input	Bendix PT07H-8-4P
Test Points	Bendix PT06H-10-6S

ENVIRONMENTAL SPECIFICATIONS[2]

Temperature,[3] ambient (Continuous Operation)	—54°C to +55°C (MIL-T-21200, Class 1)
Altitude	30,000' with 30 psia internal pressure, any altitude with 20 psia pressure
Vibration	Per MIL-T-5422 Curve IV
Shock	Per MIL-T-5422
Salt spray, humidity	Per MIL-T-5422

[4]Available with frequency accuracy and stability of ±0.001% on special order.
[3]Other ranges available on special order.

[1]Also available modified for modulation down to DC.
[2]Transmitter performs as specified, under any combination of environmental conditions.



BLOCK DIAGRAM
MODEL EM4575 4W S-BAND TELEMETRY TRANSMITTER

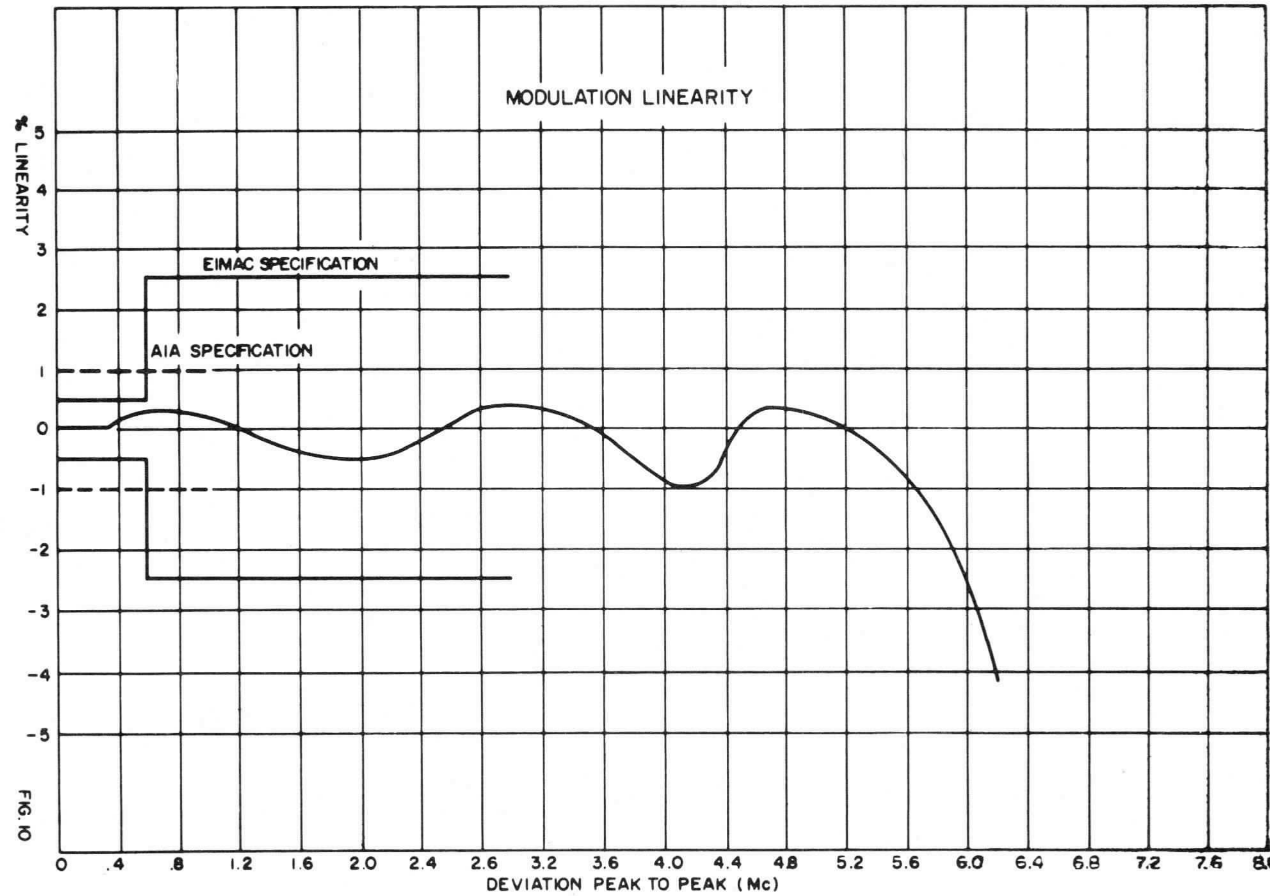
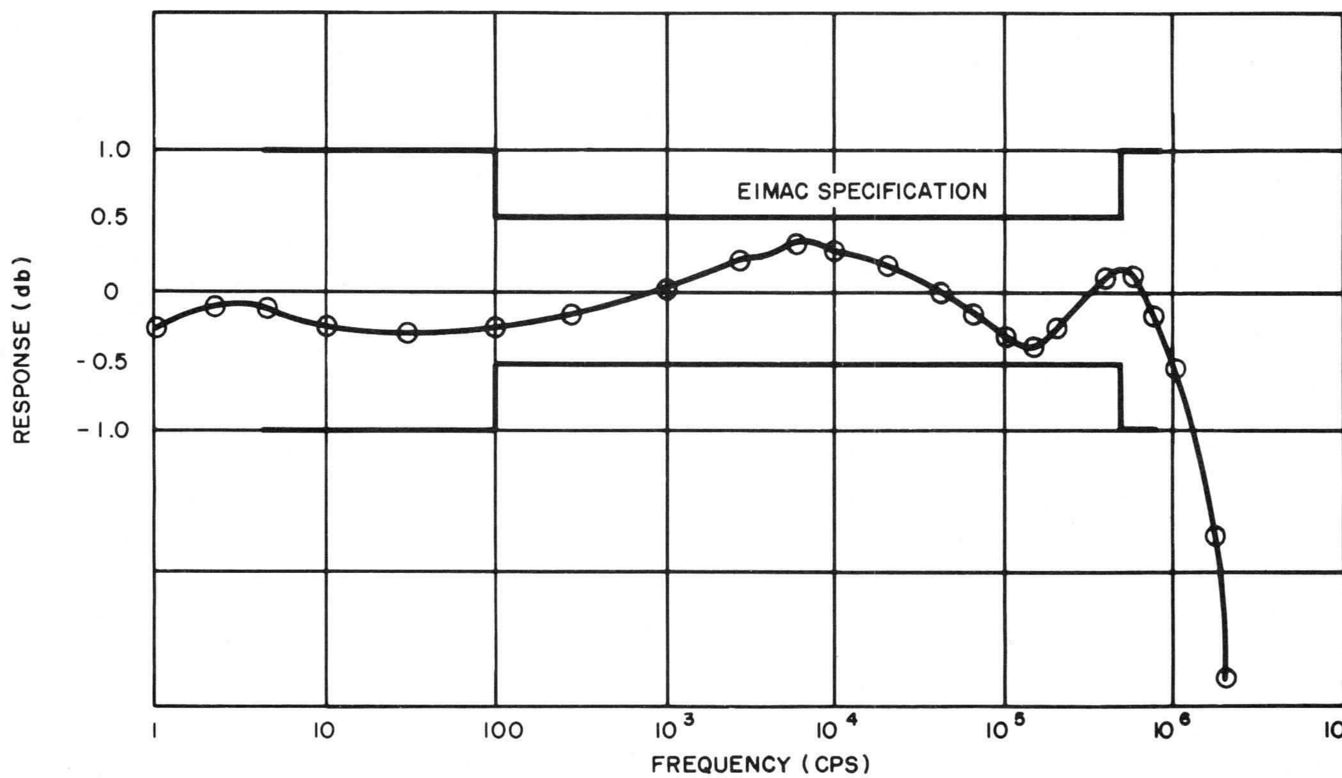
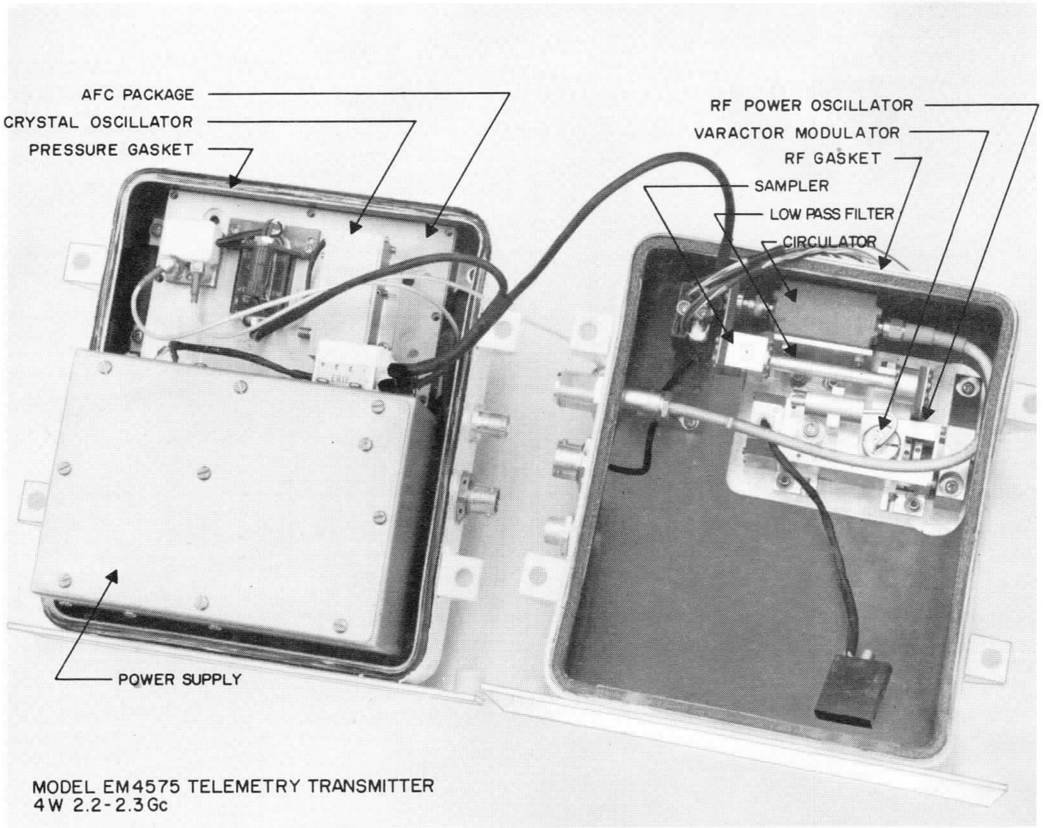


FIG. 10

MODULATION LINEARITY OF EM4575 TRANSMITTER

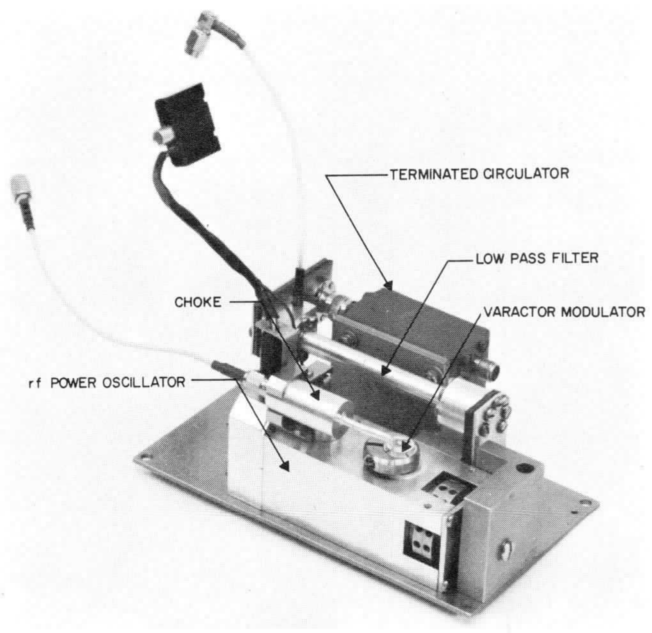


MODULATION FREQUENCY RESPONSE OF EM4575 TRANSMITTER



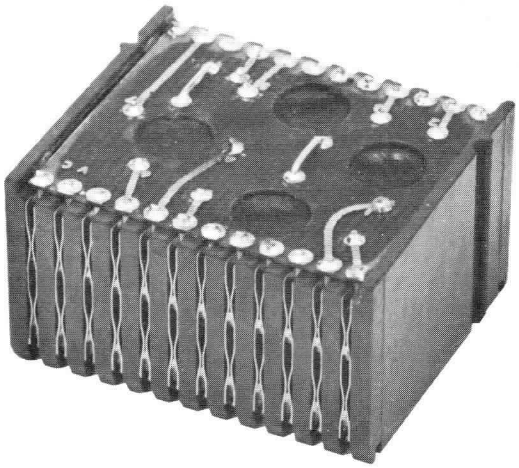
EM4575 TELEMETRY TRANSMITTER ASSEMBLY

Packaging of this transmitter is compact, yet all modules are easily accessible. The covers incorporate pressure seals and rfi gaskets.



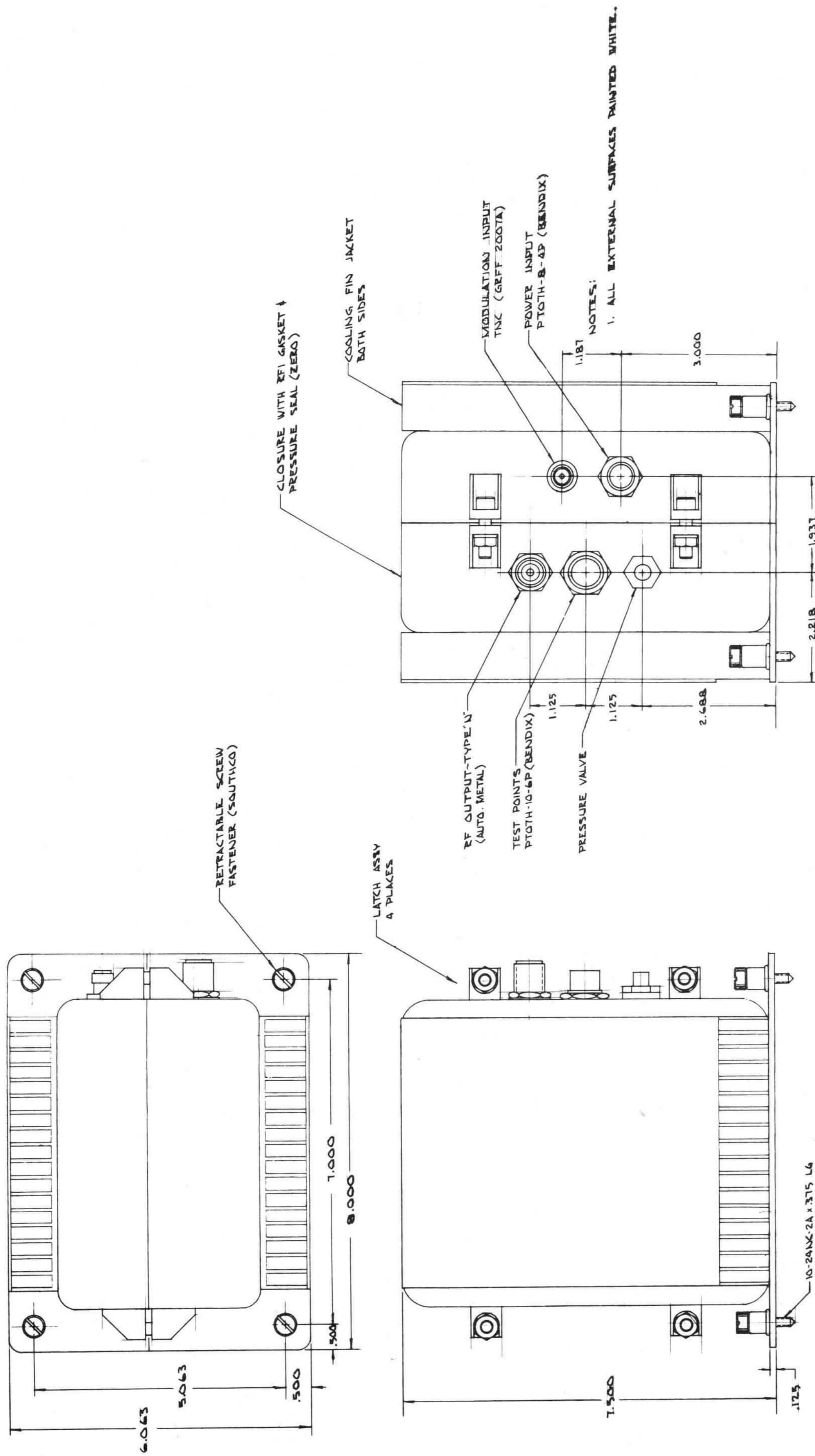
RF SECTION, EM4575 TRANSMITTER

The rf power oscillator provides over 4 watts, tunable 2.2-2.3 Gc. There is no output below 2.2 Gc. Harmonics are removed by a low pass filter. The ceramic planar triode in the oscillator is conduction cooled to the transmitter case.



TYPICAL PLUG-IN MODULE

AFC servo circuits use only high reliability components such as silicon planar transistors and are packaged in modular form. The modules are easily removable, and offer flexibility for future modification. The connector system provides four redundant contacts at each connection. All modules are encapsulated with a rigid high thermal conductivity compound for heat conduction and vibration protection.


CLOSURE WITH RFI GASKET & PRESSURE SEAL (ZERO)
COOLING FIN JACKET BOTH SIDES
MODULATION INPUT TNC (GRFF 2007A)
POWER INPUT PTO7H-8-4P (BENDIX)
NOTES:
1. ALL EXTERNAL SURFACES PAINTED WHITE.
1.187
3.000
1.937
2.218
RF OUTPUT-TYPE 'N' (AUTO. METAL)
TEST POINTS PTO7H-10-6P (BENDIX)
PRESSURE VALVE
1.125
1.125
2.688
RETRACTABLE SCREW FASTENER (SOUTHCO)
LATCH ASSY 4 PLACES
7.000
8.000
.500
5.063
.500
6.063
7.500
.125
10-24UNC-2A x .375 LG 4 PLACES (MOUNTING)

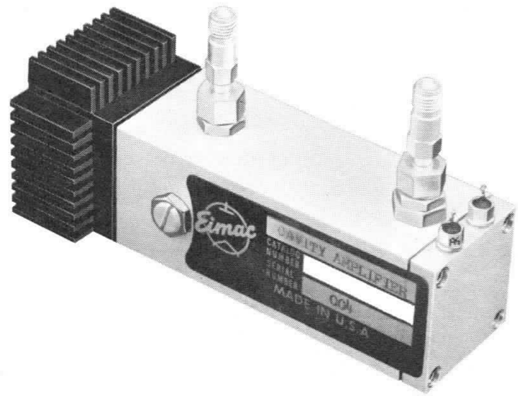
Tentative Data

X4576

CAVITY AMPLIFIER

2300-2600* MHz
20 Watts CW

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA



The X4576 cavity amplifier is recommended for use in airborne and ground transmitters. It is a compact, lightweight, high efficiency amplifier using a ceramic-metal planar triode. It will withstand the severe environmental conditions of missile and aircraft operation. Field tuning is simple.

A recommended dc-dc converter for use with this unit is EIMAC Model EM4590.

CHARACTERISTICS

ELECTRICAL

Frequency,* continuously tunable	2300-2450 MHz 2450-2600 MHz
rf Power Output (2 watts drive), at 2300 MHz	20 watts
2450 MHz	18 watts
2600 MHz	15 watts
Bandwidth, Minimum, 3 db points	5 MHz
Gain, Minimum, 2300 MHz	10 db
2600 MHz	8 db
Load Impedance, Nominal	50 Ohms
VSWR, Maximum, for full rated output (fixed phase)	1.5:1
without damage	3:1
Power Supply Requirements	
Anode Voltage, Maximum	800 Volts
Current, Maximum	125 mA
Heater Voltage	6.0 Volts
Current	1.0 Amperes
Warm-up Time	3 minutes

MECHANICAL

Size (excluding protrusions), maximum	1¼″ x 1¼″ x 4⅜″
Weight	1.2 Pounds
Mounting	To heat sink (not included)
Tuning Controls	Four (two for coupling, two for frequency)
Cooling	Conduction to heat sink at —40°C to +85°C
Connectors	Type OSM, Female

ENVIRONMENTAL

Temperature, heat sink, for continuous operation	—40°C to +85°C
Altitude	0 to 20,000 feet
Vibration	10 g, 5-500 cps, 15 minutes in 3 mutually perpendicular planes
Shock	15g for 11 milliseconds in 3 mutually perpendicular planes

*Factory-adjusted for tuning range of 2.3-2.45 GHz or 2.45-2.6 GHz.

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Printed in U.S.A.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4577

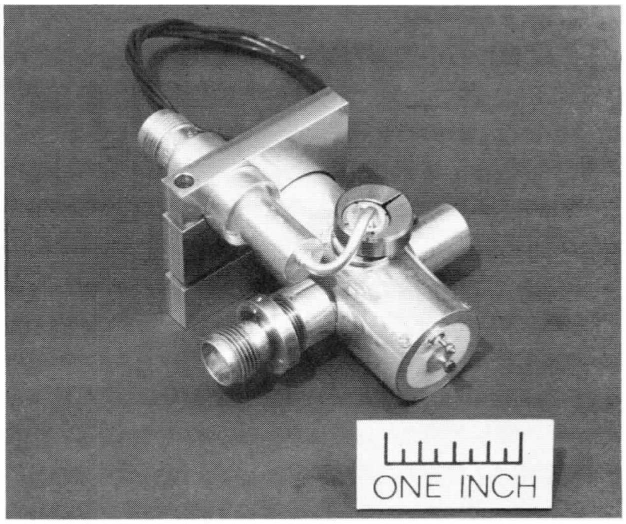
CAVITY OSCILLATOR

1700-1850* Mc

The Eimac EM4577 is an ultra-stable low noise cavity oscillator designed for use in microwave transmitters. It is unusually compact and rugged. Its high frequency stability over a wide temperature range is a major advantage. This unit uses a ceramic-metal planar triode. Operating life, without tube change, averages over 5000 hours.

Electronic tuning range of ±7.5 Mc is achieved by the varactor diode in the plate circuit. A choke is provided to keep rf off the modulation input lead.

The EM4577 is also offered as part of a complete modulated system, EM4584. The modulator is solid state. It pulses the oscillator at 100 pps to achieve a frequency time output of symmetrical triangular form.



CHARACTERISTICS

ELECTRICAL

Tuning Range, Manual		1700-1850* Mc
Tuning Range, Electronic		±7.5 Mc
rf Power Output		2 watts CW
Frequency Stability		±0.15% from —40°C to +75°C
Power Supply Requirements**	*Voltage*	*Current*
Anode, Maximum	170 V	50 mA
Heater	6.0 V	400 mA
Control Grid	Self Bias	
Linearity, for ±1 Mc Deviation		±1%
for ±2.5 Mc Deviation		±5%
for ±5 Mc Deviation		±10%
for ±7.5 Mc Deviation		±15%
Deviation Sensitivity, Nominal		1 Mc/Volt
Modulation		CW/FM
Load Impedance, Nominal		50 Ohms
Load VSWR, Maximum		1.3:1, Any Phase
Tube Type		Eimac 128631

MECHANICAL

Mounting	Clamps to heat sink cradle
Size	Length: 2.25 inches; Diameter: 0.85 inches
Weight	0.5 pounds
Cooling	Conduction to Heat Sink
Connectors	Type TNC, Female

ENVIRONMENTAL

Temperature (Mounting Surface)	—40°C to +75°C
Altitude	0 to 12,000 ft.

*Factory adjusted for any 50 Mc segment of the 1700-1850 Mc band. Other frequencies available on special order.
**A compact solid state dc-dc converter, Model EM4589, is available for use with this oscillator.

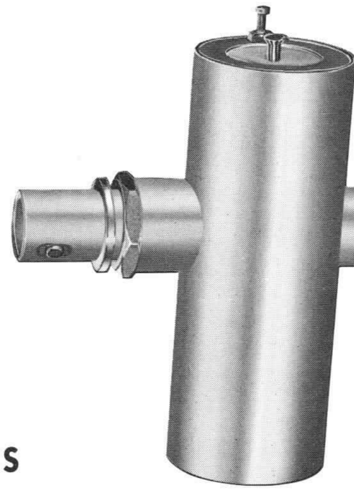
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4578

CAVITY OSCILLATOR

1000-2000* Mc



The EM4578 is a CW oscillator providing 2 watts rf output at any frequency in the 1-2 Gc band. Specify the required frequency when ordering; we will adjust the EM4578 to this frequency, with field tuning capability of ±10 Mc. This unit is small, lightweight and rugged, using a ceramic-metal planar triode. It is recommended for use in both airborne and ground transmitters.

CHARACTERISTICS

ELECTRICAL

Frequency Range		1000-2000* Mc
rf Power Output		2** Watts CW
Frequency Stability		±0.2% from –40°C to +75°C
Power Supply Requirements:	*Voltage*	*Current*
Anode, Maximum	140 V	50 mA
Control Grid, Maximum		Self Bias
Heater	6.0 V	400 mA
Tube Type		Eimac 128613
Load Impedance		50 ohms nominal
Modulation		CW
VSWR, Maximum		1.3:1, any phase

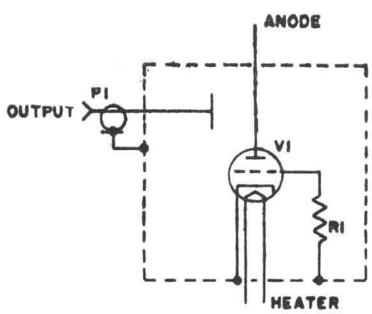
MECHANICAL

Mounting	Clamps to heat sink cradle
Size	Length: 2 to 4 inches, depending on frequency Diameter: 0.85 inches
Weight	0.2 to 0.5 pounds, depending on frequency
Cooling	Conduction
Connector	Type TNC Female

ENVIRONMENTAL

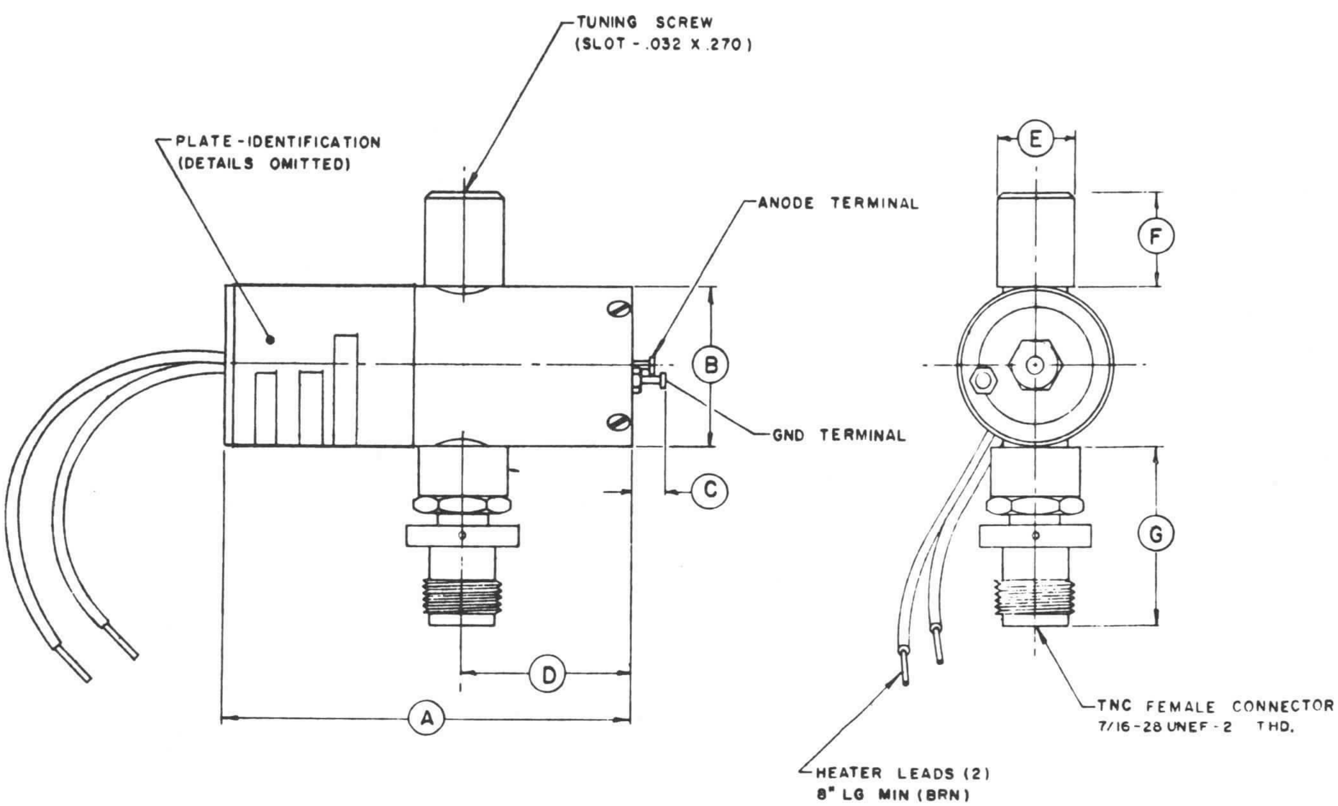
Temperature	–40°C to +75°C
Altitude	0 to 12,000 feet

*Factory adjusted for any 20 Mc Segment of the 1000-2000 Mc band.
**Can provide up to 3 watts output with higher anode voltage and current and special cooling.



SCHEMATIC

FREQUENCY	1000 Mc	1500 Mc	2000 Mc
A (nom.)	4	3	2
D (nom.)	1.75	1.2	.9



Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EM4580

POWER SUPPLY

0-1000V

The Eimac Model EM4580 is a rack-mounted, regulated power supply for laboratory use. Output voltage is continuously variable 0-1000 V at 0.5 Amps; a vernier control permits precise selection of output with less than one volt deviation from the desired value. A 300 Vdc reference output and 6.3 Vac output are also provided. A voltmeter and ammeter are included, accuracy ±2% at full scale. Forced air cooling is provided by the included fan.

CHARACTERISTICS

Output Impedance, Maximum,	0-1000 cps	0.01 Ohm
	1-10 Kc	0.1 Ohm
	10-100 Kc	1 Ohm
Transient Response		For Full Load/No Load or No Load/Full Load step change, output recovers to within dc regulation limits within 2 milliseconds
Vernier Range		3 Volts
AC Input		105 to 125 Vac rms, 50 to 60 cps, Single Phase
Output Polarity		Swinging link for positive or negative output with respect to ground, or floating output
Overload Protection		Line and HV circuits fused; time delay relay included
Mounting		Fits standard 19" rack. Also has rubber feet for table mounting
Weight		80 pounds
Dimensions		10½" high x 19" x 15"

OUTPUTS:

VOLTS	CURRENT	REGULATION				MAXIMUM RIPPLE mV rms
		Line		No Load/Full Load		
		%	V	%	V	
0-1000 Vdc	0-500 mA	0.02	0.05	0.01	0.02	1
6.3 Vac (CT)	10 A	—	—	—	—	—
300 Vdc	5 mA	0.02	0.05	0.01	0.02	1

EM4581
EM4582
EM4583

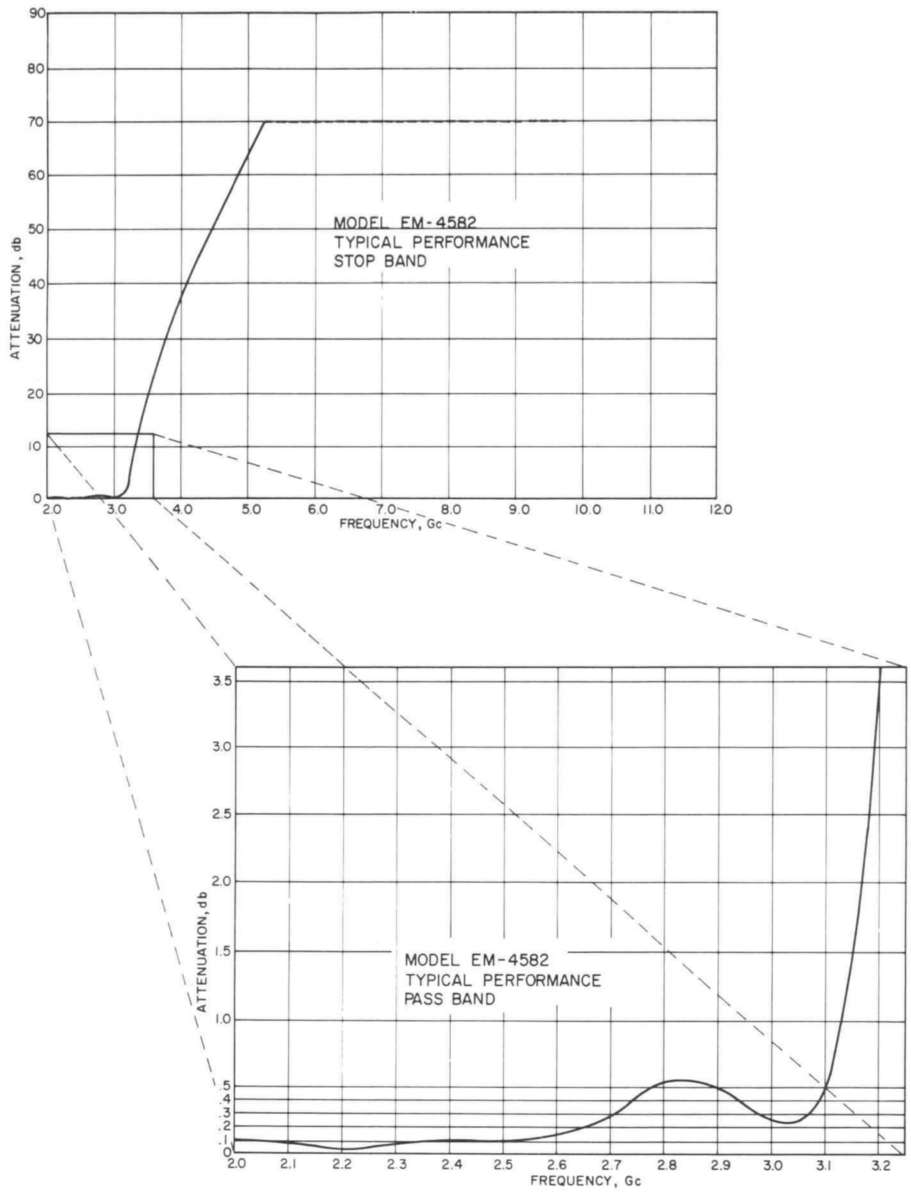
LOW PASS FILTERS

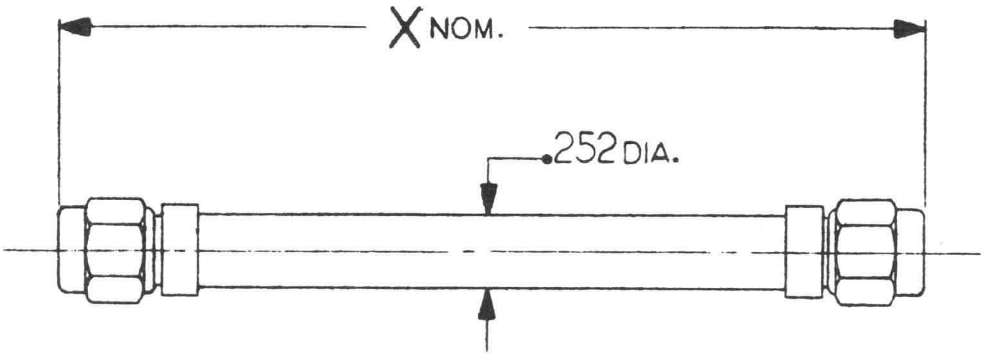
These low pass filters are recommended for use with UHF/Microwave telemetry transmitters, aerospace television transmitters and command/control transmitter exciters. Because of their small size and light weight, however, they are excellent for use in many other low-to-medium power transmitters. Their rugged construction results in reliable performance under the shock and vibration of missile launch. All models are coaxial, multiple-section reactive type filters. Silver plating is used to minimize insertion loss.

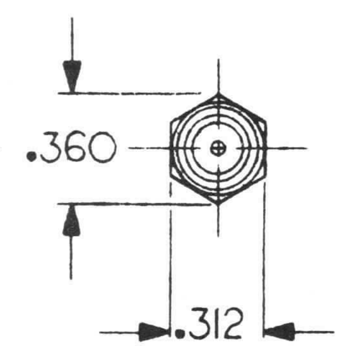
CHARACTERISTICS

MODEL	EM4581	EM4582	EM4583
Pass Band, Mc - - - - -	1435-1735	2200-2500	4400-5000
Power Rating, Watts, Avg. - -	100	100	50
Insertion Loss, DB, Max. - -	0.2	0.2	0.2
Attentuation, First Harmonic, DB, Min. - - -	45	45	45
Attenuation, Second and Third Harmonic, DB, Min. -	60	60	60
VSWR, Maximum - - - -	1.2	1.2	1.2
Impedance, Ohms, Nominal -	50	50	50
Connectors (male)[1] - - -	OSM	OSM	OSM

[1]Strip-line connectors also available.







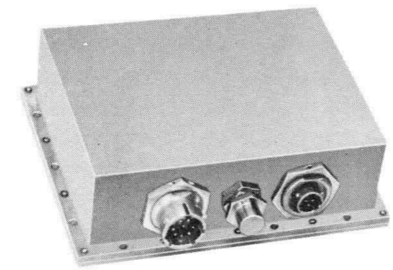
MODEL	EM4581	EM4582	EM4583
X	3.340	2.953	3.279

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

EM4590

POWER SUPPLY

The EIMAC Model EM4590 is a solid state dc-dc converter, recommended for use with 10-30 watt output rf cavity amplifiers and oscillators. It provides regulated plate and heater voltages, operating from 28 Vdc primary source. This is a compact, light weight, high efficiency, conduction-cooled unit. It operates satisfactorily during the shock and vibration of missile launch. It is hermetically sealed, for operation at any altitude.



CHARACTERISTICS

ELECTRICAL

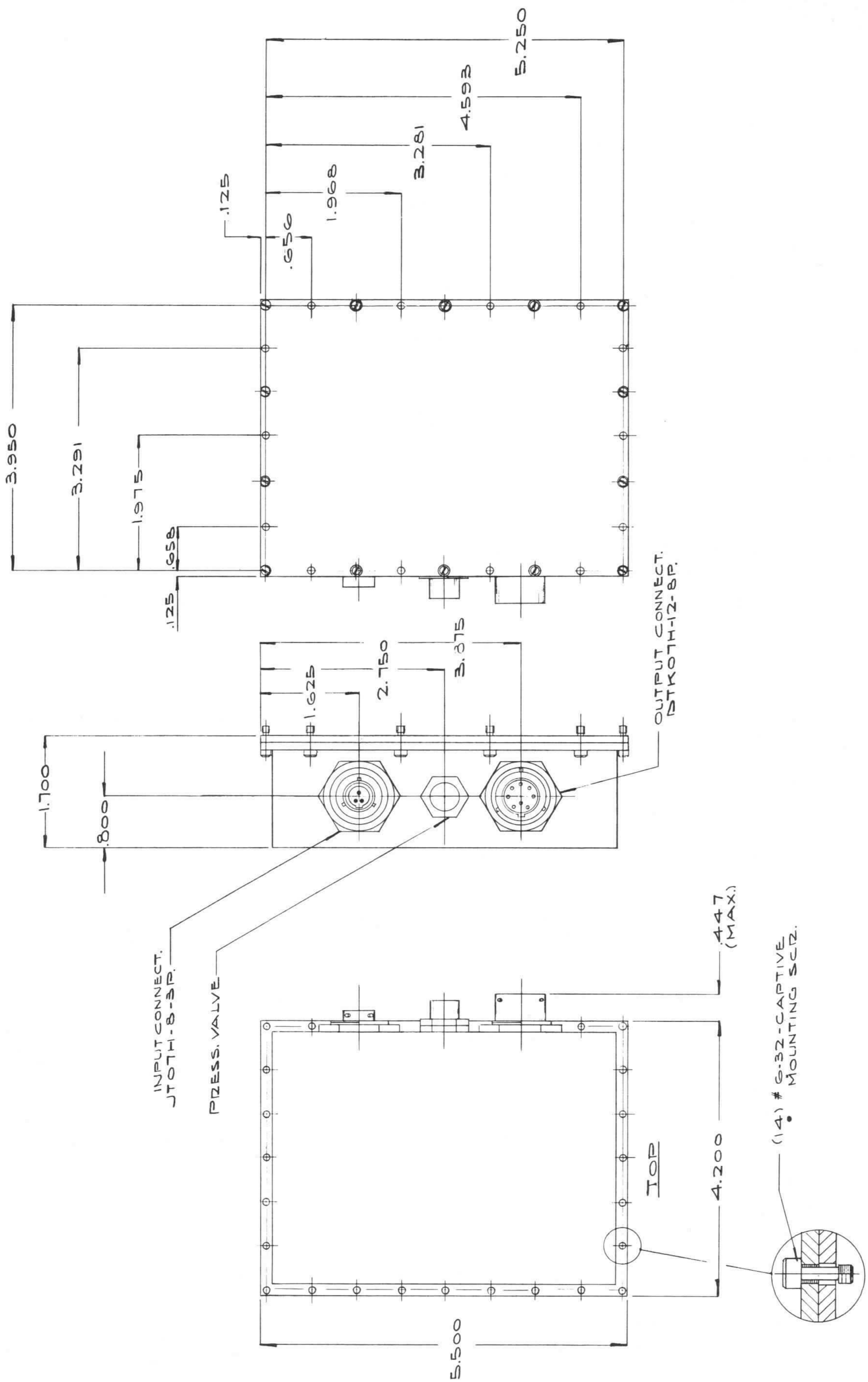
Plate Voltage	600, 650 or 700 Vdc, selectable by internal wiring, at 90 to 150 mA
Accuracy, (at nominal input, 125 mA)	±5%
Line Regulation	±5%
Load Regulation	±5%
Ripple (including spikes), maximum	3%
Heater Voltage	6.0 Volts, 1.0 Amperes
Line Regulation	±3%
Ripple (including spikes), maximum	10%
Bias Voltage	A constant-current, adjustable bias voltage is provided for operation of Eimac EM4539, EM4596 and similar amplifiers.
Input Voltage	28 $^{+8}_{-4}$ Volts dc
Overvoltage, maximum	43 Vdc
Input Transients, maximum	80 volts for 20 microseconds
Input Ripple, Maximum	3V rms, DC — 20 Kc, superimposed on 24-32 Vdc input
Input reversal is withstood without damage.	
Interference	Meets MIL-I-6181D
Efficiency, Minimum	70%
Life, Continuous or intermittent operation, 95% probability, 60% confidence	1000 hours

MECHANICAL

Size, Overall (excluding connectors)	1.7″ x 4.2″ x 5.5″
Weight	2.5 pounds
Mounting	on 4″ x 5″ surface, to heat sink (not included)
Cooling	Conduction
Pressurization	30 Psia
Connectors: Input	Bendix JT07H-8-3P
Output	Deutsch DTK07H-12—8-P

ENVIRONMENTAL

Temperature (at mounting surface)	—54°C to +95°C
Altitude (3 hour duration)	Any
Vibration	20 g peak to 2 KHz, Curve E, Fig. 514-3, MIL-STD-810 0.3 G²/cps Random, Curve F, Fig. 514-4, MIL-STD-810 20 g peak, to 2 KHz, Category II, MIL-E-5400
Acceleration (Sustained)	-30 g, 5 minutes, three mutually perpendicular axes
Shock	50 g, Method 516, Proc. I, MIL-STD-810 100 g, Sawtooth, Proc. V, MIL-STD-810 Three mutually perpendicular axes


5.250
4.593
3.281
1.968
.656
.125
3.950
3.291
1.975
.658
.125
1.625
2.750
3.875
OUTPUT CONNECT.
BTKO7H-12-8P.
1.700
.800
INPUT CONNECT.
JTO7H-8-3P.
PRESS. VALVE
.447
(MAX.)
TOP
4.200
5.500
(14) # 6-32-CAPTIVE
MOUNTING SCR.

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

Tentative Data

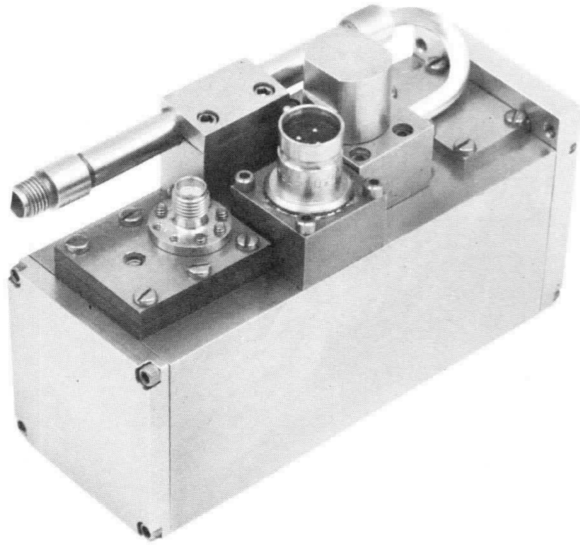
X4592

CAVITY AMPLIFIER

1700-1850 MHz
25 Watts CW

The X4592 cavity amplifier is recommended for use in aerospace telemetry, television and general-purpose transmitters. It may be used with transmitters having wide modulation bandwidth. Its small size and light weight are major advantages for aerospace use. This unit is hermetically sealed; it may be used at any altitude. It uses a ceramic-metal planar triode. Operation is satisfactory during the severe environmental conditions of missile launch.

A recommended dc-dc converter for use with this amplifier is EIMAC Model EM4590.



CHARACTERISTICS

ELECTRICAL

Frequency,[1] continuously tunable	1700-1850 MHz
Rf power[2] output (with 2 watts drive)	see table below

Frequency (MHz)	Power Output (Watts) CW
1700-1750	20
1750-1800	25
1800-1850	20

Input Signals	All standard FM telemetry signal formats, per IRIG 106-65
Bandwidth, Minimum, 3 db points	10 MHz
Gain, Minimum, 1700-1850 MHz	10 db
Load Impedance, nominal	50 ohms
VSWR, Maximum, for full rated output	1.5:1
without damage	3:1
Efficiency,[2] Overall, Minimum	25%
Phase jitter, Maximum, between input and output	5° peak
Power Supply Requirements[3]:	
Anode voltage	600 Volts
Current	125 mA
Heater voltage	5.5 Volts
Current	1.2 Amperes
Warm-up Time	3 Minutes

(Revised 5-15-66) © 1965 Varian

Printed in U.S.A.

MECHANICAL

Size, Overall (including protrusions)	4″ x 2½″ x 1½″
Weight	1.1 pounds
Mounting	To Heat Sink (not included)
Tuning Controls	Three (all on same surface)
Cooling	Conduction to Heat Sink at —54°C to +95°C
Connectors: rf input	OSM Female
rf output	OSM Female
Power	Deutsch #DM 5300-3P-643

ENVIRONMENTAL

Temperature, heat sink, for continuous operation	—54°C to +95°C
Altitude	Any
Vibration	20g, 20-2000 cps, 3 major axes
Other	Per MIL-E-5400

FOOTNOTES:

(1) Also available with similar performance characteristics for other frequencies in the 900-2500 MHz range.

(2) Under worst combination of specified environmental conditions. Output and efficiency are higher under optimum conditions.

(3) A separate DC-DC converter package, Model EM4590, operating from 28 +8/—4 Vdc, is available from EIMAC. Power supplies for operation from other primary sources are available on special order.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

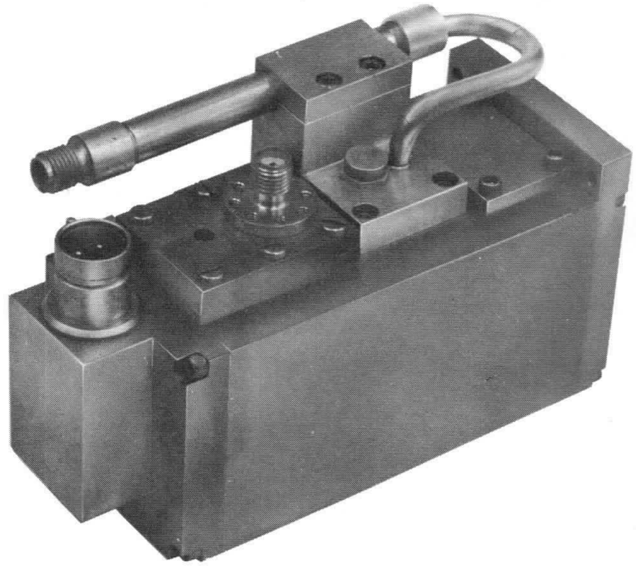
EM4596

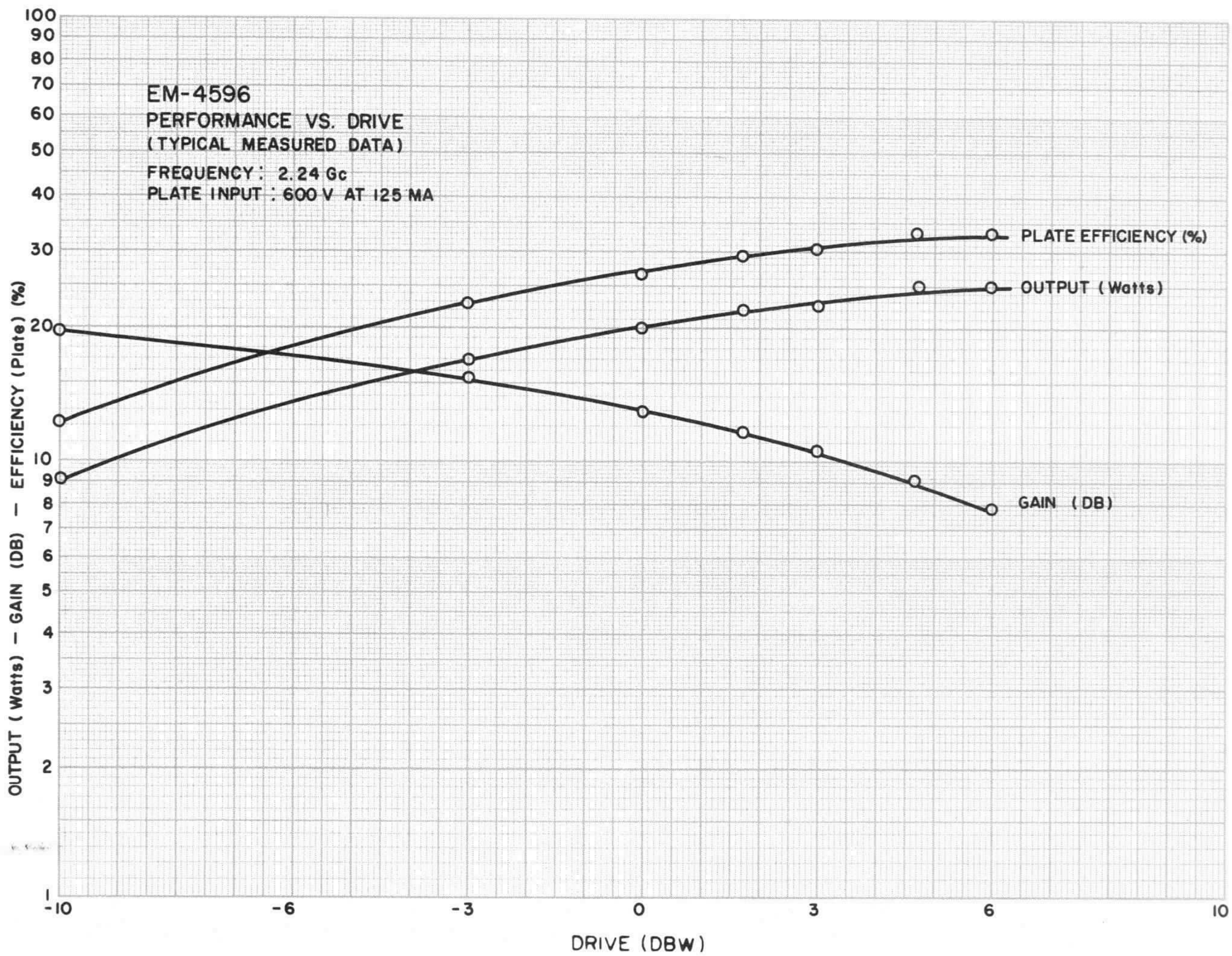
CAVITY AMPLIFIER

2200-2300 Mc

The Eimac EM4596 is a miniaturized 20 watt cavity amplifier incorporating a ceramic-metal planar triode. It is intended for use in aerospace telemetry transmitters and special aerospace transmitters. It is hermetically sealed, for operation at any altitude. All connectors and tuners are accessible on one surface. A low pass filter, for harmonic suppression is included.

A recommended DC-DC converter for use with this amplifier is Eimac Model EM4590.





EM4596 AMPLIFIER

CHARACTERISTICS

ELECTRICAL

Frequency,[1] continuously tunable	2200-2300 Mc
Rf power[2] output (with 2 watts drive)	17 Watts
Input Signals	All standard FM telemetry signal formats, per IRIG 106-60
Bandwidth, Minimum, 3 db points	10 Mc
Gain, Minimum	10 db
Load Impedance, nominal	50 ohms
VSWR, Maximum, for full rated output	1.5:1
without damage	3:1
Efficiency,[2] Overall, Minimum	25%
Power Supply Requirements[3]	
Anode voltage	600 Volts
Current	125 mA
Heater voltage	6.0 Volts
Current	1.0 Amperes
Harmonic Suppression (2nd, 3rd and 4th of 2200-2300 Mc)	60 db
Warm-up Time	3 Minutes

MECHANICAL

Size, Overall (including protrusions)	3¾" x 2½" x 1½"
Weight	0.95 pounds
Mounting	To Heat Sink (not included)
Tuning Controls	Three (all on same surface)
Cooling	Conduction to Heat Sink at −54°C to +95°C
Connectors: rf input	OSM Female
rf output	OSM Female
Power	Deutsch #DM 5300-3P-643

ENVIRONMENTAL

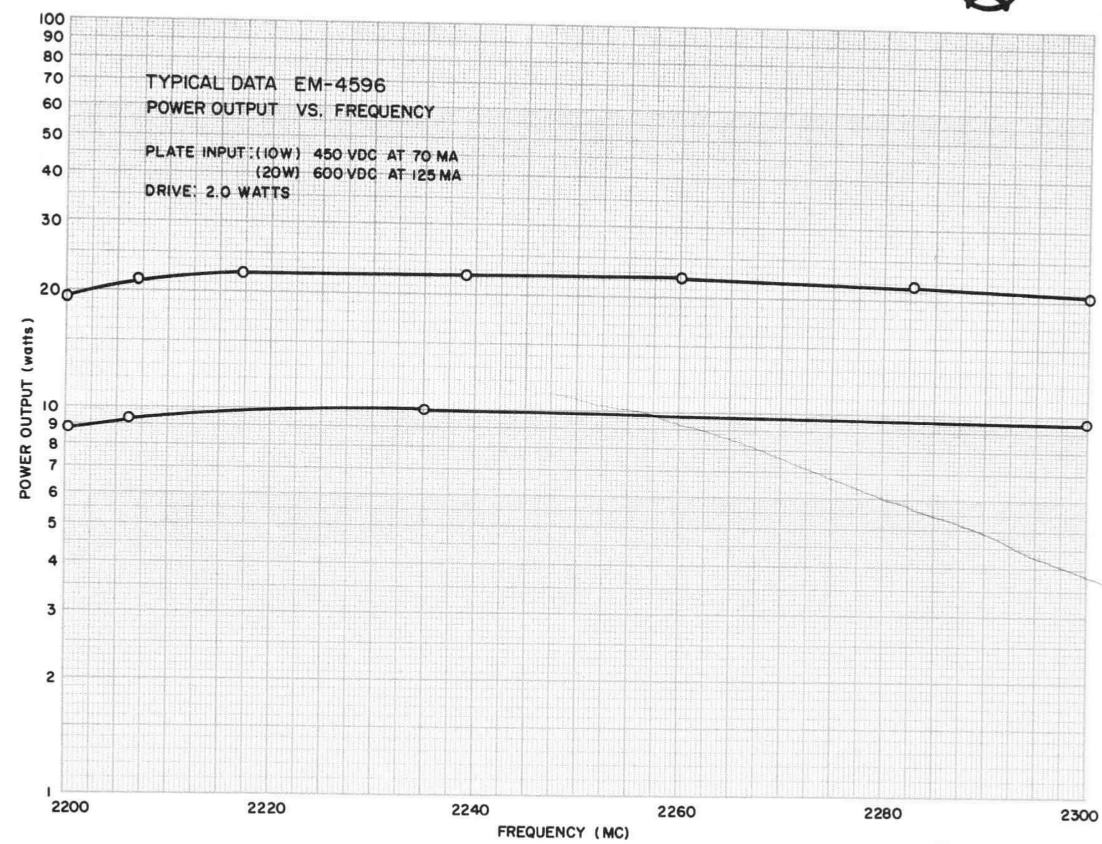
Temperature, heat sink, for continuous operation	−54°C to +95°C
Altitude	Any
Vibration	20g, 20-2000 cps, 3 major axes
Other	Per MIL-E-5400

FOOTNOTES:

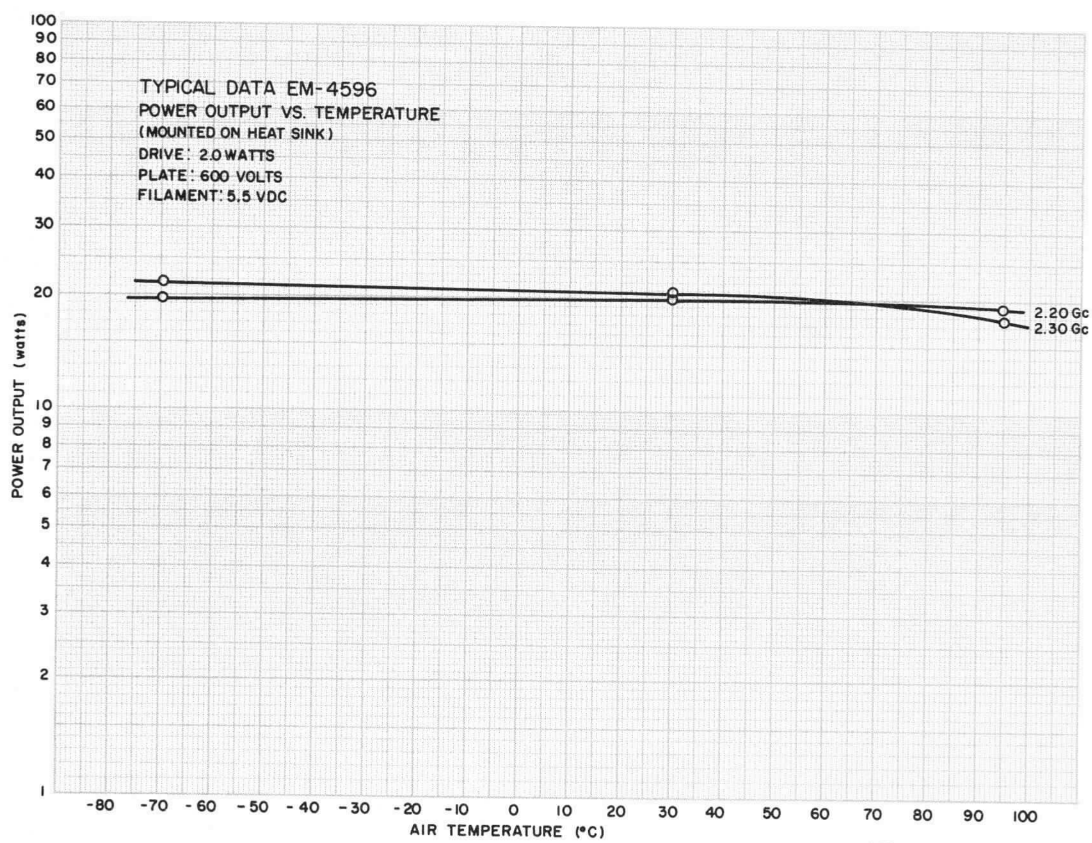
(1) Also available with similar performance characteristics for other frequencies in the 900-2500 Mc range. Model EM4539 covers 1420-1600 Mc, Model EM4592 covers 1700-1850 Mc.

(2) Under worst combination of specified environmental conditions. Output and efficiency are higher under optimum conditions. See curves for typical output and efficiency with other drive levels. Power output is 20 watts minimum, −54°C to +75°C.

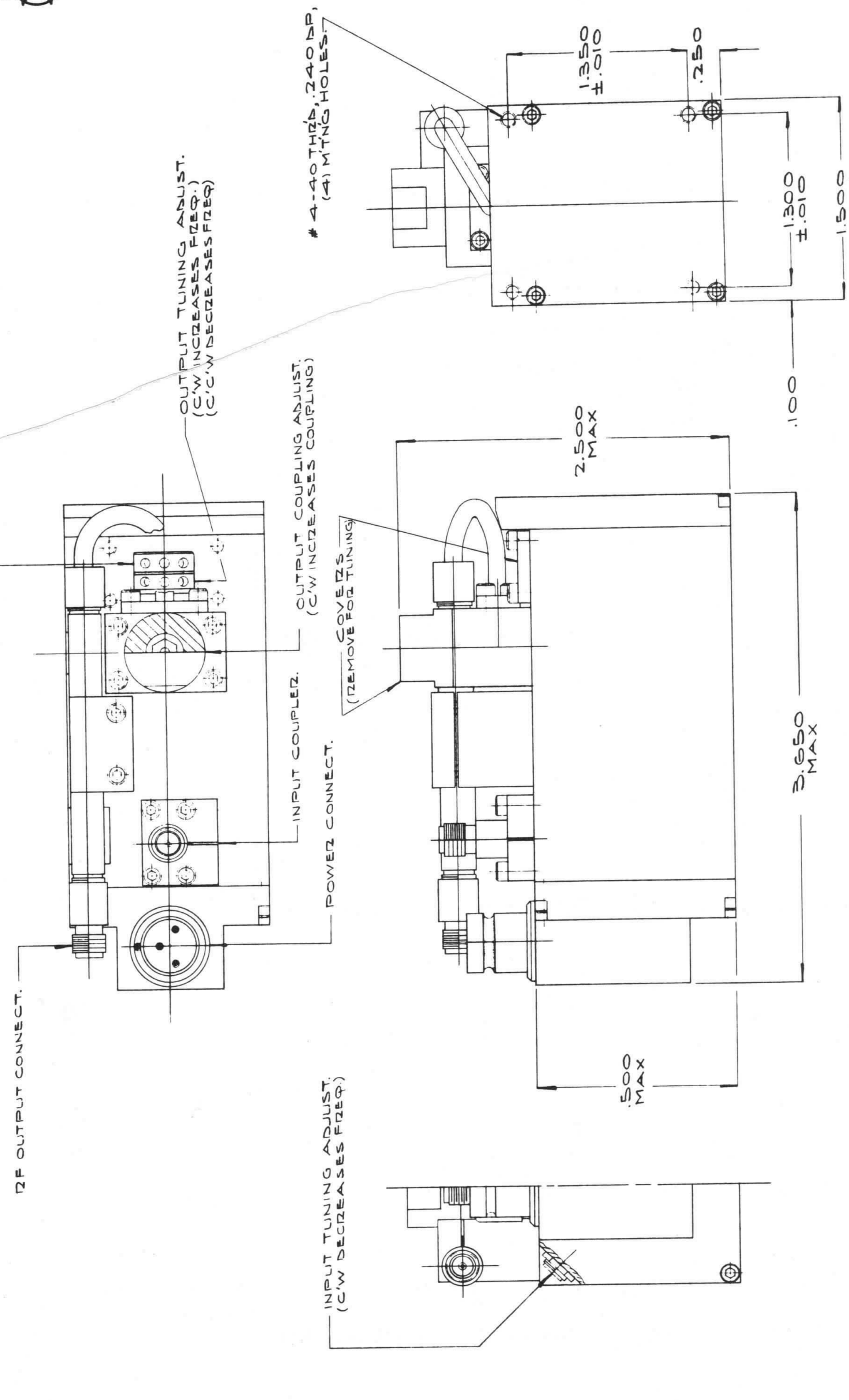
(3) A separate DC-DC converter package, Model EM4590, operating from 28 +8/−4 Vdc, is available from Eimac. Power supplies for operation from other primary sources are available on special order.



TUNING RANGE, EM4596 AMPLIFIER



TEMPERATURE EFFECT, EM4596 AMPLIFIER

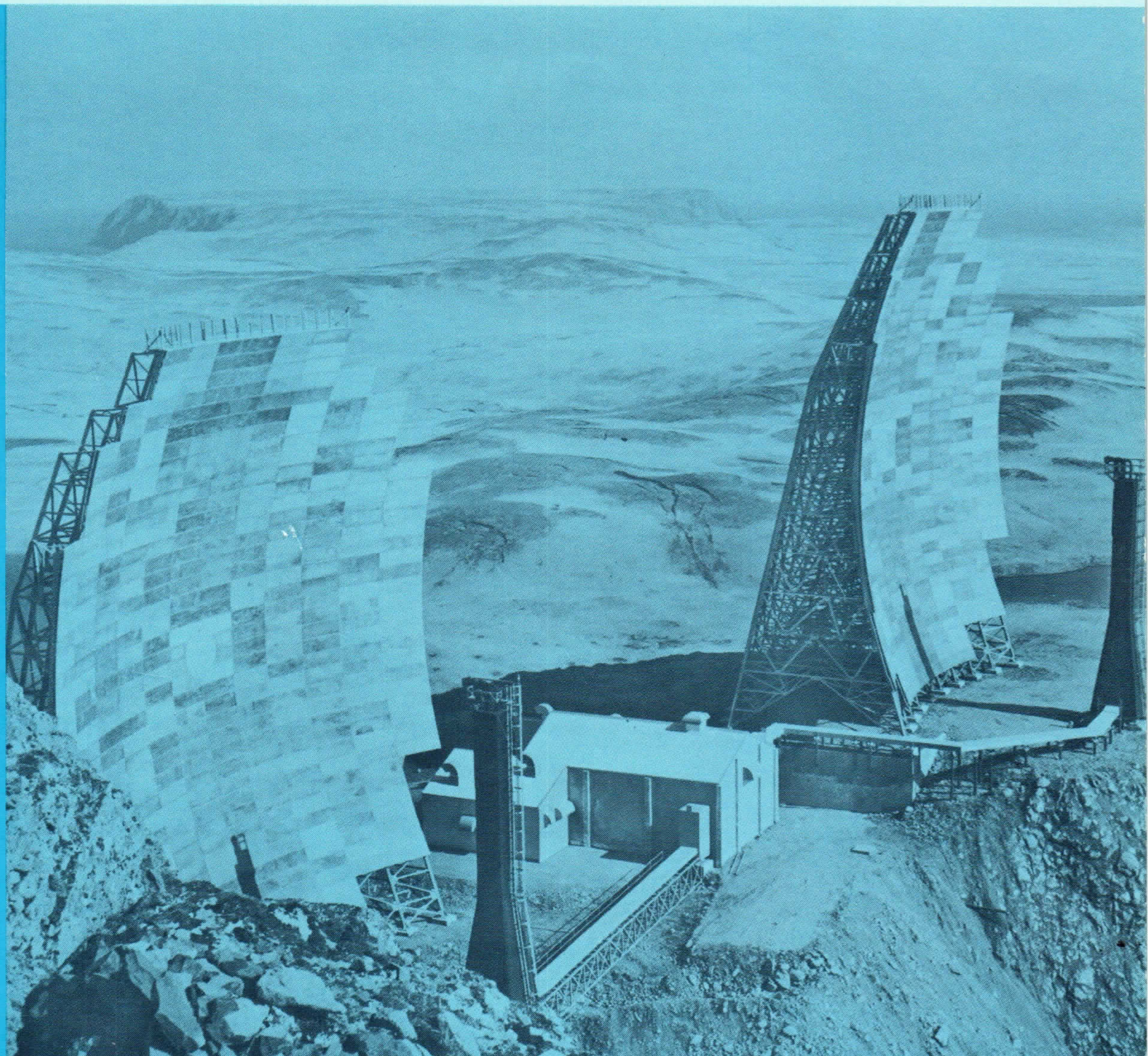


OUTLINE DIMENSIONS, EM4596 AMPLIFIER

The Care and Feeding of

EIMAC EXTERNAL CAVITY

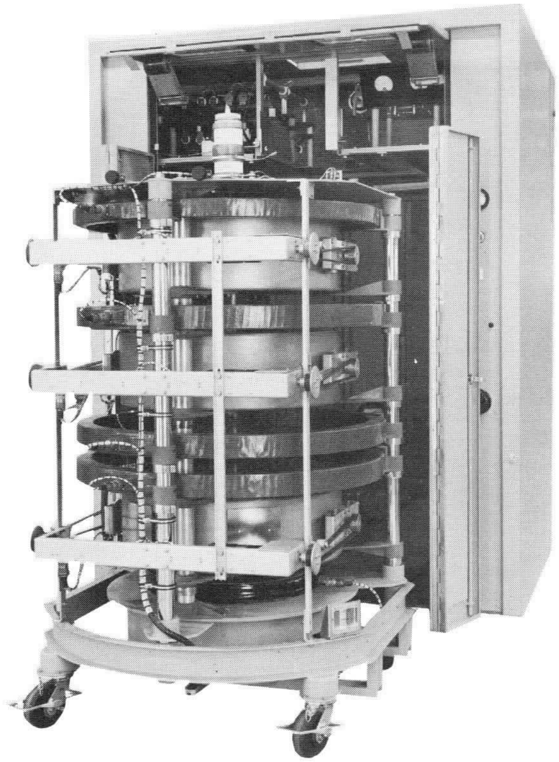
POWER KLYSTRONS



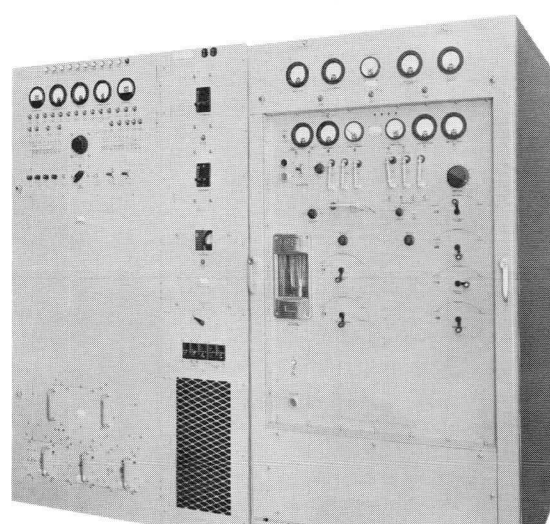
APPLICATION BULLETIN 10

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

20 kW power amplifier built by ITT Federal Laboratories. This amplifier, using the Eimac 3KM50,000PA klystron, operates from 225 to 400 Mc. The klystron carriage is shown removed from the amplifier cabinet.



Collins Radio Company's 240D-2 amplifier, which uses an Eimac 10 kW power klystron. These power amplifiers are part of the ground command control network used for control of Project Mercury manned space capsules. Additional 240D-2 amplifiers will be used to control Project Gemini two-man space flights.



REL 10 kW power amplifier using the Eimac 4KM50,000LR klystron. This amplifier covers the frequency range of 755 to 985 Mc.

CONTENTS

On the Cover—120-foot antennas used at one of the tropospheric scatter sites in the Aleutian Islands. This is one of the many tropospheric scatter installations using Eimac power amplifier klystrons. The transmitters at this site were manufactured by Radio Engineering Laboratories, and the installation was engineered and directed by Western Electric Company.

PUBLISHED BY EITEL-McCULLOUGH, INC.

PRINTED IN U.S.A.

FOREWORD

Eimac 3K210,000LQ. This 75 kW klystron is used in many tropo-scatter systems spanning distances up to 440 miles. This klystron is unique in that its input and penultimate cavities are external but its output cavity is integral.

Eimac external cavity power klystrons, operating at frequencies from 225 to 985 megacycles, have earned a unique position in high power radio communications. They were used in the very first tropospheric scatter communications systems and proved to be so successful that they are now found in approximately 90% of all such systems in the free world. They are also used extensively in fixed radar installations and in UHF television.

Because external cavity klystrons are so generally used, almost everyone associated with high power radio communications will at some time be concerned with equipment using these tubes. For this reason Eitel-McCullough, Inc. believes that an application bulletin dealing exclusively with external cavity power klystrons will serve a useful purpose.

Eitel-McCullough, Inc. also manufactures a complete line of integral cavity power klystrons operating throughout the UHF and microwave spectrum. Information on these Eimac integral cavity klystrons will be found in other publications.

The information in this bulletin is arranged in six sections:

1. Introduction to the Klystron.
2. Mechanical Considerations.
3. Electrical Considerations.
4. Operating and Tuning.
5. Application of the Power Klystron.
6. Miscellaneous.

This application bulletin is intended to be a practical handbook for persons designing and operating equipment using external cavity power klystrons. For a more theoretical approach the reader should consult one of the many excellent textbooks available on the subject.

The information in this bulletin is based on data believed to be accurate, but no responsibility is accepted for the successful application of the systems or principles discussed. Likewise, no responsibility is accepted for patent infringement, if any, resulting from the application of this information.

The Care and Feeding of EIMAC External Cavity POWER KLYSTRONS

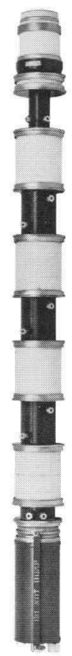


Figure 1

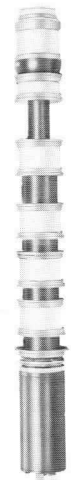


Figure 2

Figure 3

Section 1.0

INTRODUCTION TO THE KLYSTRON

The klystron is not as mysterious as it may seem to persons accustomed to using conventional tubes, even though it has no grid and no plate, and no lumped tuned circuits are connected to it by means of wires leading out of the tube. Actually the klystron is a simple device which exists for the same reason that conventional negative-grid tubes exist—it controls the behavior of electron streams flowing in a vacuum. The great difference between the klystron and the conventional tube lies not in *what* it does, but in *how* it does it.

Conventional triode or multigrid tubes, in which the electron flow is controlled by potential fields surrounding the grids, have upper usable frequency limits beyond which the electrons can not respond efficiently to the alternating control voltages applied to the grids. This occurs when the time required by the electrons for the transit of their paths becomes a substantial part of the period of one cycle at the operating frequency.

As a result of transit time effects, efforts to obtain satisfactory operation of conventional tubes at the higher frequencies have resulted in the development of extremely small tubes in which the lengths of the electron paths are reduced to the practical minimum. Such tubes are extensively used in low-power applications, but they are simply too small to control great amounts of power.

On the other hand, klystrons must be made relatively large in order to take advantage of transit time effects, which are essential to their operation. As a result, a klystron for operation near 500 megacycles, such as the 4KM50,000LA3 (Fig. 1), can be nearly $5\frac{1}{2}$ feet long and produce more than ten kilowatts of useful CW output power. The 4KM50,000LR (Fig. 2), is a smaller klystron for operation at higher frequencies, and can deliver ten kilowatts output power at frequencies from 755-985 megacycles. The Eimac 3KM50,000PA (Fig. 3), for operation from

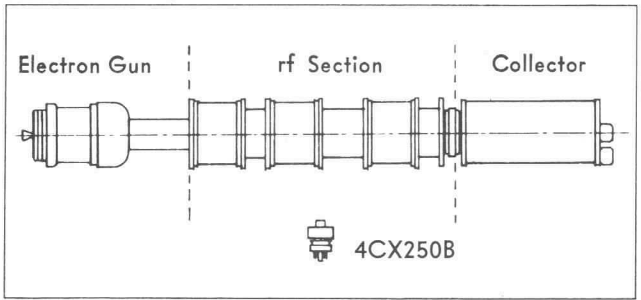


Figure 4—Typical Eimac Externally Tuned Klystron, Compared to a 250-Watt UHF Tetrode Tube.

225-400 megacycles, is nearly seven feet long and can develop over 20 kilowatts of CW power output.

A typical Eimac externally-tuned klystron is illustrated in Figure 4. It is apparent from the form of a klystron that it can be divided into three functional sections: the electron gun, the rf section, and the collector. In the following paragraphs, these parts of the klystron will be described in detail and their operation explained in simple terms.

1.1 The Electron Gun

The electron gun is the source of the electron beam upon which the operation of the klystron depends. The electron beam is simply a fast-moving stream of electrons expelled from the electron gun into the drift space of a klystron in somewhat the same manner that a jet of water is expelled in a solid stream from a nozzle.

A sectional schematic drawing of an electron gun of the kind used in Eimac klystrons is presented in Figure 5. The electrons destined to form the beam are emitted from a heated cathode and they flow away from the cathode along converging paths because of the specially shaped electric field set up by the electrodes.

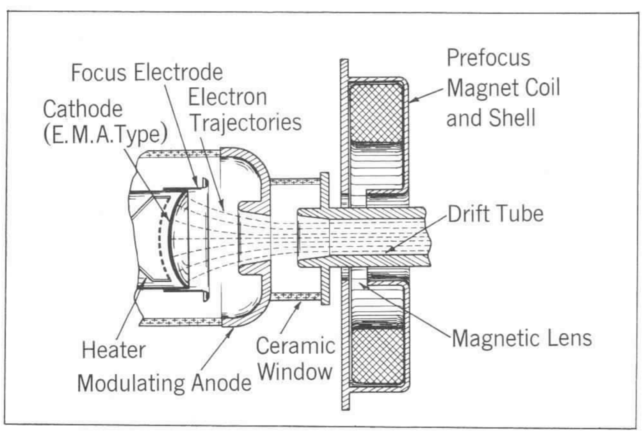


Figure 5—Simplified View of Electron Gun, Prefocus Magnet Coil and Entrance to Drift Tube.

The cathode is a concave section of an ellipsoid located inside one end of a cylindrical metal piece called the "focus electrode." Just beyond the opposite end of the focus electrode the modulating anode and first drift tube section are located. The focus electrode is maintained at cathode potential or at some negative potential with respect to the cathode. The modulating anode potential is positive with respect to the cathode. The positive charge applied to the modulating anode causes the electrons to flow away from the cathode toward the anode, and the negative or zero charge applied to the focus electrode tends to force them toward the axis. As a result of the two forces acting on the electrons, they form a converging beam, which focuses inside the first drift tube section. In klystrons which have no modulating anode, the end of the drift tube is formed into a cup which partially surrounds the cathode and serves as an anode.

Modern Eimac klystrons use oxide-coated cathodes at power levels up to and including 2 kilowatts. At higher power levels the Eimac Matrix Cathode Type A (EMA) is used. This cathode is made by pressing a mixture of powdered nickel and various earth carbonates under great pressure onto a nickel backing. Oxide-coated and EMA cathodes are easily heated by radiation from a filament or heater since they operate at relatively low temperatures.

Some of the older Eimac power klystrons use solid metal cathodes operating at relatively high temperatures. Radiation heating cannot be used in this case and the metallic cathodes must be heated by electron bombardment. This is accomplished by placing a filament behind the cathode and applying approximately 2000 volts dc between the filament and the cathode structure. Electrons emitted from the filament will travel at high velocities to the rear of the cathode, where they will release all their kinetic energy in the form of heat when they strike the cathode. By this means, the cathode can be heated to the operating temperature.

1.2 The rf Section

The rf section of a klystron is made up of the drift tube and the several resonant cavities which surround it at intervals along its length. The drift tube is an axial, interrupted tube with a length about twenty times its diameter. There may be from two to six interruptions, called "gaps," along the length of the drift tube.

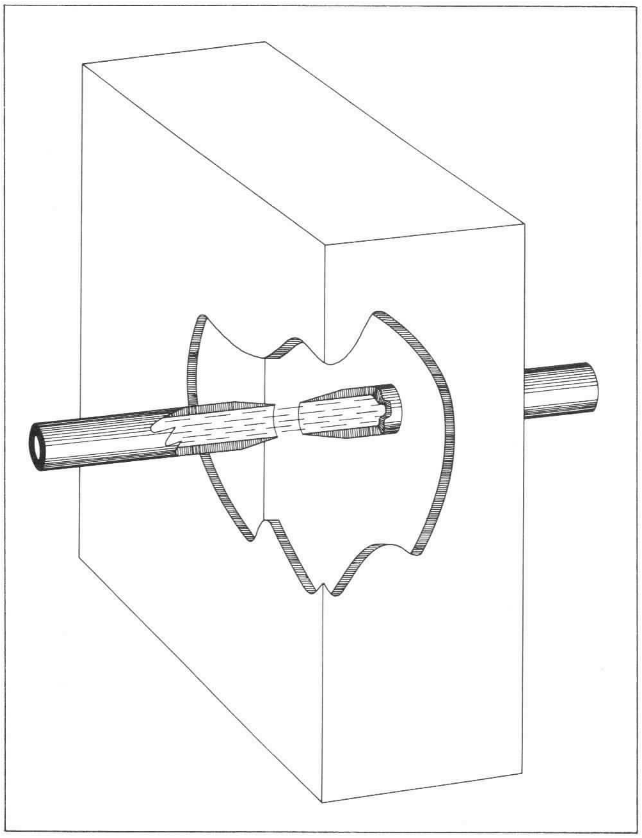


Figure 6—Simplified View of Resonant Cavity. Note Drift Tube Tips. Electron Trajectories Represented by Broken Lines.

A resonant cavity is constructed around each drift tube gap, as shown in Figure 6, and arranged so that the ends of the drift tube sections protrude into the cavity at opposing high-voltage points on the cavity wall. Thus, the drift tube tips become the capacitive loading elements in the cavity, and large rf voltages will be induced across them when the cavity is excited at resonance.

In Eimac external cavity klystrons, the drift tube gaps are surrounded by cylindrical ceramic envelope sections, and external demountable tuning cavities are assembled around the ceramic sections to form the complete cavities. The construction of the ceramic envelope and gap assembly, and the method of assembling a typical tuned cavity on the klystron body can be seen in Figure 7. In this type of resonator, only the drift tube gap is in the evacuated space, and the tuning mechanism remains entirely outside the vacuum. This permits a few klystron types of simple design to cover a relatively large frequency range.

1.3 The Collector

The electron beam transfers some of its energy to the rf circuits as it flows through the rf section of the klystron, and it carries the balance of its energy out of the rf section into an electrode called the "collector." The collector gathers the electrons and passes them out of the klystron into the external circuits leading to the positive terminal of the beam power supply.

The large energy content of the partially spent beam must be dissipated by the collector. When the electrons collide with the collector surface all their kinetic energy is transformed into thermal energy which heats the collector. The thermal energy is then transferred to the surroundings by cooling the collector with air or a liquid coolant such as water, or water in combination with antifreeze fluids like ethylene glycol.

1.4 The Axial Magnetic Field

The klystron requires a strong axial magnetic field to maintain and direct the electron beam throughout the length of the drift tube. The electron beam is a concentration of negative charges which tend to disperse because of the mutual repulsion existing between like charges. The axial magnetic field overcomes this tendency of the beam to disperse by exerting restoring forces on any electrons which try to move in directions not parallel to the axis. Thus, electrons attempting to move away from the axis of the beam are constrained to remain within the confines of the beam by the magnetic field.

The magnetic field is usually established by several individual electromagnet coils forming part of the magnetic assembly in which the klystron is mounted. The direct currents used to energize the electromagnet coils are sometimes made individually adjustable, to permit variation of the field strength along the length of the klystron if necessary. In many cases, however, the focus coils are so designed that they can be operated in series from a single power supply.

The proper use of the magnetic field is imperative to the long life and satisfactory performance of a klystron, and this matter will be discussed in detail in Section 4.

1.5 The Electron Beam

At the beginning of its passage through the drift tube the electron beam is a continuous stream of electrons moving at constant velocity. Although it is not confined to a wire, it is nevertheless a direct

Figure 7—Typical Eimac Klystron and One of Its External Cavities Before and After Assembly.

current of electricity, flowing through the free space enclosed by the drift tube. Ideally the beam would never touch the drift tube, but in practice there are always some electrons which stray far enough from the center of the beam to be caught by the drift tube walls.

Just as a direct current produces no sound as it flows through a headphone, so a direct current electron beam can produce no rf power as it flows through a klystron. It must be *modulated* in some manner before it can be useful and in the klystron this is accomplished at the drift tube gaps, which modulate the velocity of the electrons in the moving beam.

In Section 1.2 it was explained how a drift tube gap is formed by the ends of drift tube sections, which enter the cavity axially, from opposite ends. The cavity is designed so that the drift tube tips then become its highest voltage points, in order to build up strong radio frequency fields in the gap. This construction is clearly illustrated in Figure 6.

Velocity modulation occurs when the dc beam passes through the radio frequency alternating field established in the first drift tube gap by the rf driver. Following is how velocity modulation is accomplished, and how it transforms itself into density modulation as the beam passes down the drift tube.

Those electrons in the parts of the beam passing the first gap when it is "positively polarized" experience an increase of velocity because they will flow from a region of negative charge toward a region of positive charge. The negative region repels the electrons and the positive region attracts them, with the result that the velocity and the energy content of that part of the beam are increased. The energy gained by the faster parts of the beam is provided by the driving power furnished to the input cavity.

Conversely, the electrons in that part of the beam passing through the first drift tube gap during the half cycles of "negative polarity" will be forced to travel from a positive to a negative region. As a result they will lose velocity and surrender some of their energy to the input cavity.

The beam leaving the first gap is continuous and of uniform density, but alternate parts along its length will contain electrons having higher or lower velocities than they had before entering the gap. The faster electrons begin to overtake the slower electrons as the beam travels freely down the axis of the drift tube, until at some point a few inches from the gap, the fastest electrons will be traveling in company with the slowest electrons for a brief period. At that point, optimum "bunching" has occurred, and the density of the beam will vary periodically at signal frequency, when seen from a fixed point. In other words, the beam will have become a density-modulated beam. If a gap is located at the point of optimum bunching or "density modulation" the beam can be made to surrender many times as much energy as was originally required for velocity modulation. In other words, the klystron will have acted as a radio frequency amplifier.

Energy is extracted from the bunched beam by the same mechanism used to velocity-modulate it in the first gap. As the beam travels through the output gap, the gap polarity will vary in such a way that the denser portions of the beam will be decelerated while the less dense parts of the beam will be accelerated. As a result, there are many more electrons being made to give up energy to the circuit than there are electrons which take energy, and the net effect is to transfer power from the electron beam into the external circuits of the klystron.

The preceding paragraphs have described the action of a two-cavity klystron, in which rf power is used to velocity-modulate an electron beam, so that it can be made to surrender energy to another cavity after traveling a short distance down the drift tube. Experience has shown that klystrons having more than two cavities offer advantages in higher gain and higher efficiency; as a result, three-cavity and four-cavity klystrons are in common use and klystrons with as many as six cavities have been used for special applications.

There is little or no reverse flow of electrons in the drift tube. The fields in the drift tube which are not due to the presence of the beam are so small that great isolation between the output cavity and the input cavity can be obtained. As a result it is possible to obtain stable operation with power gains of up to 50 db, in the case of four-cavity klystrons.

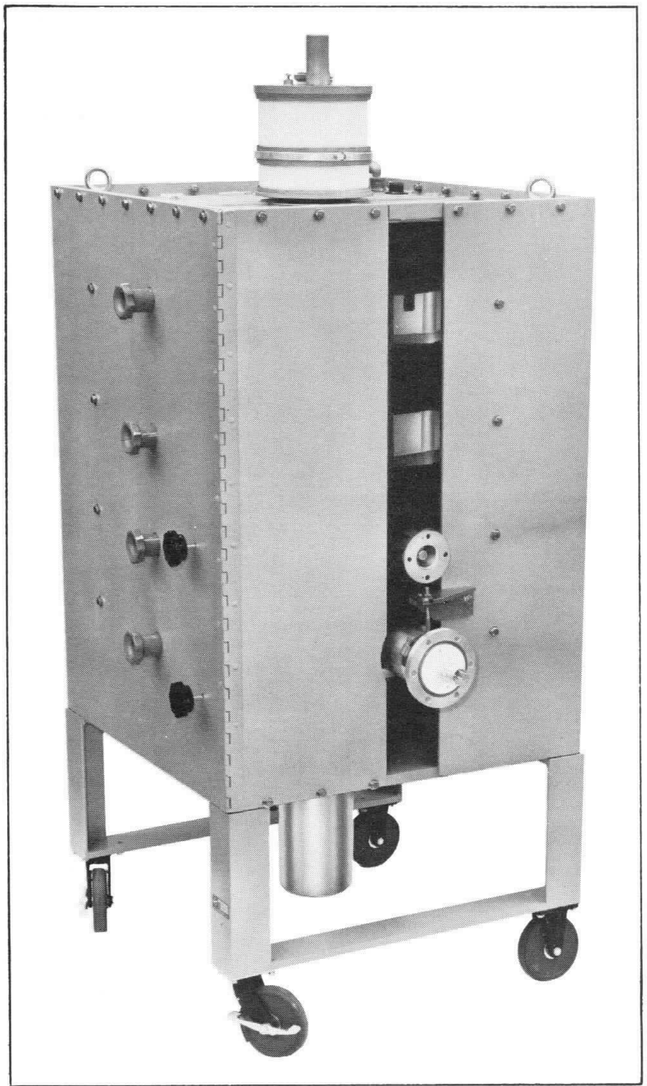


Figure 8—4KM100LA Klystron and H-163 Circuit Assembly. Designed for UHF Television, This Tube Develops 25 Kilowatts of Peak Synchronizing Power at Frequencies from 470 to 610 Megacycles.

1.6 Modulating Anode Klystrons

The klystron is a velocity-modulated device, and the velocity of the electron beam entering the drift tube must be maintained within certain limits if the klystron is to function well. Therefore, attempts to amplitude-modulate the klystron beam voltage with modulation factors larger than 0.3 have been unsatisfactory because the velocity depends entirely upon the beam voltage. Some means must be provided to modulate the beam intensity without varying the beam velocity if satisfactory amplitude modulation is to be obtained.

Certain Eimac klystrons, as shown in Figure 9, are designated by the letters "KM" in their type numbers, and are equipped with "modulating anodes." The electrode configuration of these klystrons is identical to that of standard klystrons, except that the anode of the electron gun is insulated from the rest of the klystron. As a result, the total accelerating potential difference between the klystron body and the cathode can remain constant, while the anode of the electron gun can assume any voltage between zero and the body voltage, with the result that the intensity of the electron beam can be varied at will while the total acceleration and the velocity remain constant.

The modulating anode makes possible amplitude modulation of the klystron with low distortion and high modulation factors. It also provides an excellent means for pulse modulating the klystron with minimum modulating power. In CW applications the modulating anode may be connected to the beam supply through a resistor to provide protection against internal arcs.

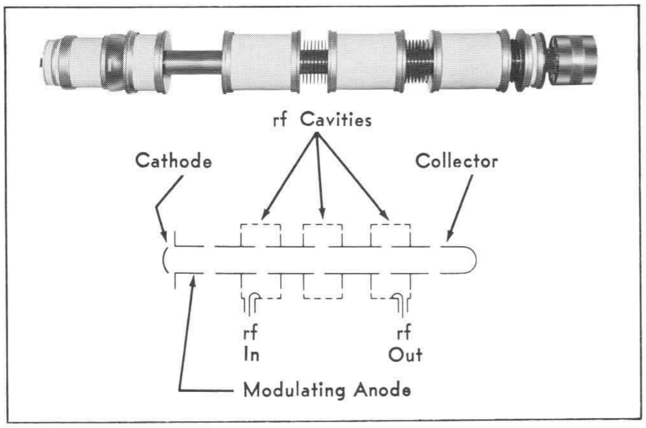


Figure 9—Eimac's Modulating Anode Klystrons Employ an Insulated Anode Placed Between the Cathode and Drift Tube Section.

1.7 Titanium Getter

Most Eimac external cavity power klystrons, rated at or above 10 kilowatts, employ a titanium getter which is designed to be energized simultaneously with the heater. The getter, which consists of a tungsten or molybdenum heater around which is wound a smaller titanium wire, is generally located near the upper end of the collector. One end of the getter is connected to the collector, the other to an insulated terminal.

Getter power supply requirements for Eimac external cavity klystrons range from 2 to 9 volts ac, at 20 to 33 amperes. Provision must be made to limit starting current to twice operating value. The purpose of the getter is to adsorb the small amounts of gas which may be released during operation from the normally hot or accidentally overheated surfaces of the klystron. The getter functions in two ways. The hot titanium adsorbs the common gases directly, and in addition a slow evaporation of titanium takes place which condenses on the walls of the collector to form a cooler layer of titanium to adsorb hydrogen and the inert molecules. In addition to its use during normal operation, the getter can be valuable in conditioning tubes which are unused for long periods of time. For example, site or warehouse spares can be maintained in good condition through periodic energizing of the getter.

Section 2.0

MECHANICAL CONSIDERATIONS

2.1 Shipping Klystrons

Eimac power amplifier klystrons are shipped in strong wooden boxes designed to protect the tube against damage during shipment. Special rubberized hair packs molded to completely fill the space between the tube and the shipping crate, or shock-mounted aluminum cradles, are used to protect and support the klystrons during shipment. These packs support the entire length of the klystron, and prevent accidental bending of the long body section.

Klystrons should be unpacked immediately upon receipt and inspected carefully. If possible they should be installed and operated in a klystron amplifier for a sufficient time to insure that they have arrived in usable condition.

2.2 Storing Klystrons

Klystrons may be stored vertically or horizontally until they are to be used. If vertical storage is preferred, they should be kept in racks, with the weight of the tubes supported by the mounting flanges. Horizontal storage requires the use of the shipping crates and their rubberized hair packing or cradle which provide support for the entire length of the tube body (Fig. 10).

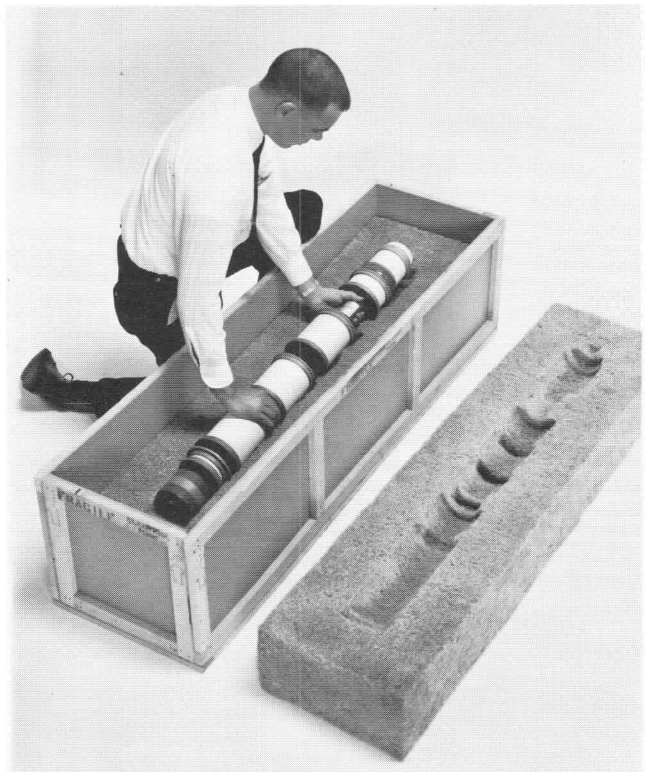


Figure 10—Storage of Klystron in Shipping Crate.

2.3 Handling Klystrons

Eimac power amplifier klystrons of the externally tuned cavity type are among the sturdiest electron tubes being built today. However, they must be handled with the same care accorded to other types of tubes of the same weight and size if maximum tube life and satisfactory performance are to be obtained. The handling precautions which follow are simple and easily remembered.

The shape of the klystron makes it especially susceptible to bending near the center; therefore, the klystron should always be supported at two or more points when picked up in a horizontal position. (Fig. 11).

Water-cooled klystrons are equipped with heavy water-jacketed collectors in order to dissipate large amounts of power when necessary. The collectors of Eimac klystrons are insulated from the rf sections

Figure 11—Recommended Method of Hand Carrying Eimac Klystrons.

by ceramic envelope rings, and the ceramic-to-metal seals can be broken by rough handling, or lack of proper support. Therefore, when a klystron is picked up in a horizontal position the collector should be supported about one-third of its length from the inner end of the water jacket to balance the forces acting on the collector.

The larger Eimac klystrons are shipped in aluminum cradles which facilitate handling. These cradles are so designed that the klystron may be lifted to a vertical position while still strapped in its cradle, the collector end of the cradle may be removed, and the tube mounted in operating position prior to removal of the main cradle.

2.4 Acceleration Forces

Forces exerted on the tube structure as the result of sudden accelerations, such as occur when the klystron is dropped or set down roughly, can be destructively great. In the larger tubes, the structure is such that acceleration, such as could occur when the tube is picked up roughly by the center section, can bend the klystron body.

Some of the larger klystrons can be handled safely only when two persons move them, or when a hoisting device is used.

2.5 At the Bench

Occasionally it becomes necessary to place a klystron in a horizontal position for inspection and cleaning. Experience has shown that the safest and most convenient way is to use wooden V-blocks as supports. For short tubes, two blocks are usually sufficient, but long klystrons require three. When three blocks are used, they should offer uniform support to the tube, and one block should always support the full weight of the collector directly. (Fig. 12).

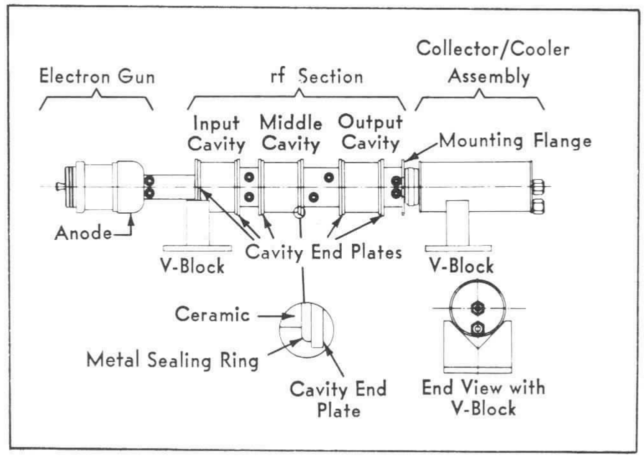


Figure 12—View of Klystron Mounted Correctly on V-Blocks.

V-blocks should be placed so that they touch the rims of the metal ends of the ceramic envelope sections. These metal surfaces are the contact surfaces which connect to the tuning cavities through spring finger contacts. Great care should be exercised to avoid marring or scratching these contacts, because the rf losses which can result are capable of destroying the contact fingers in the tuning cavities.

The massive metal end plates connected to the ceramic envelope sections of the klystron are not sufficiently flexible to be attached directly to the ceramic envelope cylinders. The vacuum-tight attachment between these parts is made by soft metal sealing rings, shown circled in Figure 12, which are intentionally made thin and flexible. In any handling or cleaning operation, care should be taken to protect these thin metal sealing rings against accidental damage.

2.6 Cleaning the Ceramic

Klystron ceramics are best cleaned with an abrasive household cleanser. A cleanser which does not contain bleaches or dyes is preferred. Scrubbing with a small stiff brush will help to remove baked-on deposits. The cleanser must be completely removed by rinsing with clean water before the klystron is restored to service or placed in storage.

2.7 Care of the External Tuning Cavities

The adjustable tuning cavities, which are assembled around the body of the klystron to form resonant circuits in conjunction with the drift tube gaps and their metallic end plates, must be maintained with care. The contact fingers should be protected against accidental deformation, because every individual finger must make effective contact with its opposing metal surface. The walls or metal parts against which the fingers bear must be kept clean and free of oxidation for the same reason. The tuning cavities may be cleaned by wiping them with a dust rag, but should not be left oily. A few drops of mineral lubricating oil or light application of grease should be applied to the adjusting screws if necessary, and all the excess lubricant wiped off.

2.8 Air and Liquid Coolant Supplies

All Eimac klystrons require air cooling, and some of them require water cooling of the collectors and drift tubes. Air circulated for cooling should be thoroughly filtered to avoid undue collection of dirt on the klystron. Accumulation of air-borne dirt on the ceramic envelope sections can cause local heating or voltage flash-over on the surface of the ceramic, and must be avoided.

The air filters should be inspected at suitable intervals to insure the free passage of air through them.

Water or other liquid used for cooling collectors and drift tubes of the larger klystrons must be free of minerals capable of encrusting the water passages and the metal surfaces being cooled. The use of a closed water-cooling system employing heat exchangers is the most satisfactory way to cool the large klystron. Aeration of coolant liquids containing water should be avoided in closed systems to keep oxidation effects to a minimum and derive the greatest benefit from closed-system operation.

In cold climates, where the coolant will be subjected to temperatures below 32°F, mixtures of water and ethylene glycol can be used in closed systems. The heat capacity of such mixtures is lower than the heat capacity of water, and the use of such mixtures will require some readjustment of the flow rates if equivalent cooling is to be obtained with them.

Aqueous solutions of ethylene glycol will freeze at temperatures which depend on the concentration of the ethylene glycol as follows: 25% ethylene glycol, 75% water, freezing point = 10° F (−12.2° C); 52.5% ethylene glycol, 47.5% water, freezing point = −40°F (−40°C).

Water mixed with ethylene glycol has greatly increased viscosities depending upon the temperature of the solution. This may change the indicated pressure drops in various parts of the cooling system as compared to the pressure drops observed when pure water is circulated.

2.9 Coolant Connections

The insulated envelope section interposed between the klystron body and the collector should be protected against unnecessary lateral forces tending to break the ceramic or its seals. The collector should be supported while the nuts on the water hose fittings are tightened, and the hoses should be sufficiently flexible to avoid exerting lateral forces against the end of the collector during operation. For the same reason, air ducts leading to air-cooled collectors should be flexible enough to avoid stresses resulting from poorly fitting duct work. The air connections to the air system socket and to the air-cooled cavities must also be made through flexible hose to avoid deforming the contact fingers in these devices.

Section 3.0

ELECTRICAL CONSIDERATIONS

3.1 High Voltage Protection

It is convenient to operate klystrons with their rf sections and collectors at or near ground potential. When this is done, the electron gun end of the tube, the focus electrode voltage supply, the cathode-heating supply, and the instruments associated with these must all be operated at high potentials with respect to ground.

Adequate interlocking devices must be provided to protect operating personnel against accidental contact with these high-voltage circuits, and any effort to defeat the purpose of these safety devices should not be tolerated.

Measuring instruments connected to the cathode end of the tube must be adequately insulated from ground and located behind glass or plastic windows to protect operating personnel.

The filament transformers and cathode-heating power supply transformers must be adequately insulated to withstand the total beam voltage (plus the bombarding voltage in certain klystron types).

3.2 Equipment Protection

Protective devices should be installed to avoid damage to the klystron as a result of malfunctioning of the associated equipment. A minimum complement of such devices would include:

(1) Air-flow and water-flow interlocks arranged to remove all electrical power supplied to the klystron in the event of failure in either or both of the cooling systems.

(2) Current overload relays to remove the beam power and the cathode heating power in the event that excessive current should flow in either of those circuits.

(3) Body current overload relay, arranged to remove the beam power upon the rise of body current beyond the maximum permissible value.

(4) Water-temperature or air-temperature interlock switches to remove the beam power in the event of collector overheating.

(5) Low power output interlock, or VSWR interlock to remove the beam power in case the output cavity becomes unloaded due to output line or antenna defects.

(6) Focus coil current failure interlocks to remove the beam power in the event of focus coil power supply failure.

3.3 Focus Coils

Klystron equipment must incorporate means for producing a controllable magnetic field, arranged so the flux is parallel to the axis of the klystron. The field is usually produced by two or more large electromagnet coils carrying direct current.

Each individual klystron may require slightly different magnetic field strengths to control and direct the electron beam, and these may change slightly each time the tuning is changed. Unless designed for series operation each individual coil should be furnished with an independent control for the current supplied to it, and each control must be capable of smooth, continuous adjustment. In addition, it is recommended that each coil be provided with an individual ammeter, permanently connected to its supply circuit. With series-connected coils, of course, only one ammeter is used.

All the electromagnet coils must establish their fields in the same direction. In equipment where all the terminals and the tops of the coils are marked, careful observance of polarity should assure correct field polarities. The polarity can be tested by means of a fluxmeter or by use of the galvanometer-and-loop method, in case doubt exists that the coils are correctly connected.

The direct current provided by the electromagnet power supplies should be filtered to 5% ripple, or less if minimum noise output is desirable. The design values should be stated so the operator can see that the filter circuits continue to function effectively.

The magnetic field will not remain parallel to the axis of the klystron if there are large steel or iron objects in or near the klystron amplifier frame. The magnetic frame of the amplifier should be located away from unsymmetrical cabinet work and in a place free of strong ac fields. Before operation is started, care should be taken that no tools or other magnetic materials are permitted to remain in the magnetic frame.

3.4 Instrumentation

The equipment associated with a power klystron should be provided with instruments to indicate the filament voltage, filament current, bombarder power (if used), beam power input, focus coil currents, body current and relative power output. The relative power indicator should be a sensitive instrument, arranged so that its coupling to the load can be varied to provide on-scale indications at any power level. The relative power indicator and the body current meter are the fundamental tuning tools available to the operator, and they must be located conveniently close to the tuning position. If this provision is not made by the equipment manufacturer, it should be done in the field before any attempt is made to tune the klystron.

It is convenient to operate a klystron with the rf section and the collector at or near ground potential. As a result, the instruments connected to the electron gun end of the klystron are necessarily at high potential with respect to ground. These instruments must be isolated from accidental contact with personnel, as outlined in Section 3.1.

It sometimes happens that instruments connected to circuits at high potentials with respect to ground may experience electrostatic forces exerted by fields set up between them and their surroundings. Errors resulting from this effect can be eliminated by the use of electrostatic shielding or guard circuits in the vicinity of the instruments.

Section 4.0

OPERATING AND TUNING

4.1 Test Data Cards

Every Eimac klystron is operated and tested individually in a standard Eimac Klystron Amplifier

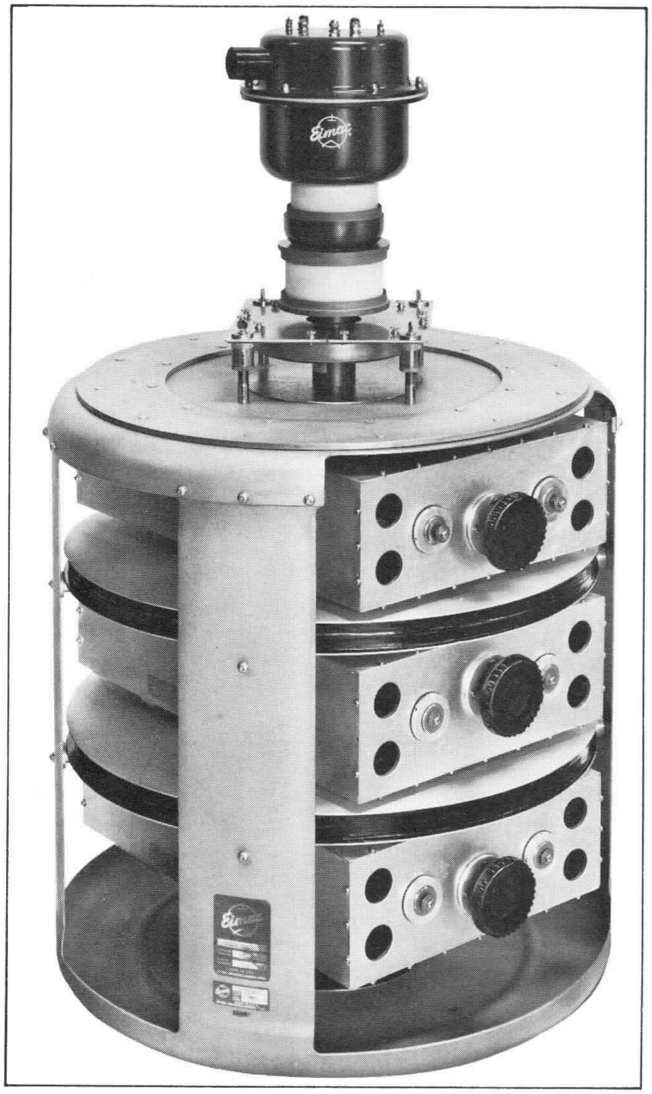


Figure 13—Typical Eimac UHF Klystron Amplifier Assembly.

Circuit Assembly (Fig. 13) before it is shipped to the customer. The complete tuning data and the conditions under which the klystron was operated are recorded in duplicate on test cards. One of these test cards is kept on permanent file at the factory, and the other is shipped in the same package with the klystron to which it belongs. This copy of the test card is one of the most important tools required by the transmitter operator, especially when the klystron is being operated for the first time in the field. A sample is shown in Figure 14.

TEST DATA

TYPE 4KM50,000LR POWER AMPLIFIER KLYSTRON EITEL-McCULLOUGH, INC.

SERIAL NO. A3-79-B E_f 7.5 I_f 39.6 GAS CHECK / DATE 2-1-63

F_o	E_b	I_b	I_{by}	E_{foc}	P_o	P_d	Eff	Im_1	Im_{2a}	Im_{2b}	Im_{2c}	Im_{2d}	Im_3		
985	12	1.06	10	-200	4.32	.025		1.0	3.0	3.0	3.0	-	3.0		
"	14	1.36	15	"	7.12	"		1.04	"	"	"	-	"		
"	17	1.89	30	"	12.1	"		1.10	"	"	"	-	"		
755	12	1.06	10	-200	5.18	.025		1.03	3.0	3.0	3.0	-	3.0		
"	14	1.36	15	"	7.78	"		1.05	"	"	"	-	"		
"	17	1.89	30	"	12.4	"		1.08	"	"	"	-	"		

E_f - AC FILAMENT VOLTAGE
I_f - AC FILAMENT CURRENT
F_o - FREQUENCY IN MEGACYCLES
E_b - BEAM VOLTAGE IN KILOVOLTS
I_b - BEAM CURRENT IN AMPERES
I_{by} - BODY CURRENT IN MILLIAMPERES
E_{foc} - FOCUS ELECTRODE VOLTAGE
P_o - OUTPUT POWER IN KILOWATTS
P_d - DRIVING POWER IN WATTS
Eff - EFFICIENCY IN PERCENT
Im_1 - PREFOCUS COIL CURRENT IN AMPERES
Im_{2a} - FIRST BODY COIL CURRENT IN AMPERES
Im_{2b} - SECOND BODY COIL CURRENT IN AMPERES
Im_{2c} - THIRD BODY COIL CURRENT IN AMPERES
Im_{2d} - FOURTH BODY COIL CURRENT IN AMPERES
Im_3 - COLLECTOR COIL CURRENT IN AMPERES

PLEASE USE REVERSE SIDE FOR SERVICE LIFE RECORDS

Figure 14—Test Data Card. (front)

SERVICE LIFE RECORD SERIAL NO.

DATE RECEIVED CONDITION

SITE INITIAL GAS CHECK: ION , ELECTRON

GAS CHECKS - RECOMMENDED EACH MONTH WHEN KLYSTRON IS NOT IN SERVICE

DATE																
ION CURRENT																
ELECTRON CURRENT																

DATE IN SERVICE	TRANS-MITTER	CARRIAGE	FILAMENT HOUR METER	BEAM HOUR METER	DATE OUT OF SERVICE	FILAMENT HOUR METER	BEAM HOUR METER	REASON FOR REMOVAL	TOTAL FILAMENT HOURS

Test Data Card. (back)

When a klystron is operated in several individual transmitters of the same type, its performance can be expected to vary slightly from one installation to another. Variations up to five percent are not usually cause for concern, but variations greater than ten percent often indicate maladjustment or trouble with the equipment.

4.2 Preliminary Focus Coil Adjustment

In new equipment, or in equipment in which the focus coils or their wiring may have been disturbed for any reason, the procedure outlined here and in Section 3.3 should be followed before the electron beam is started.

The prefocus coil should be centered physically around the neck of the drift tube and lightly held by the four locknuts at its corners. This preliminary adjustment is made visually, and it will be of aid in final centering later when the klystron is energized.

Before the beam is energized, the currents specified for operation at the lowest recorded beam voltage on the test data card must be established in the focus coils. These preliminary current values will change slightly during tuning, according to the requirements of the individual circuit, after the klystron is placed in dynamic operation.

4.3 Starting the Electron Gun

The cooling system must be placed in operation and its functioning checked before power is applied to the klystron. Large klystrons have electron guns which must dissipate considerable amounts of power, and they can be seriously damaged by operation without adequate cooling.

The magnetic field must be established in the klystron before any attempt is made to energize the beam. Although very low beam voltages will not usually damage a klystron operating without its magnetic field, damage can occur and it is not good practice to start the beam without first establishing the magnetic field. The electromagnet currents should be adjusted to the values corresponding to the lowest beam voltage shown on the test data card, and initial operation should not exceed that beam voltage.

Attention should be paid to the recommended focus electrode bias voltage. The correct value for normal operation of the klystron is recorded on the test card and should be used during all preliminary tuning operations. Small adjustments in the beam current obtained at any fixed beam voltage can be obtained by variation of the focus electrode voltage around the recommended value, which is not critical.

Two distinct methods of heating cathodes in Eimac klystrons are in general use: direct radiation heating, and electron bombardment heating. The starting instructions for electron guns using each of these methods are given in the following sections:

4.3.1 Starting the Electron Gun, Radiation-heated Cathode Type:

1. Start cooling system, check its operation.
2. Establish recommended currents in focus coils.
3. Increase heater voltage gradually to the rated value, holding the heater current to the specified value.
4. Apply the focus electrode voltage if this is obtained from a power supply. If the focus electrode voltage is obtained from a cathode series resistor, this should be set to approximately its operating resistance.
5. Permit the cathode to heat as specified.
6. Beam voltage may now be applied to the klystron in accordance with Section 4.4.

4.3.2 Starting the Electron Gun, Bombarded Cathode Type:

1. Start cooling system, check its operation.
2. Establish recommended currents in focus coils.
3. Increase filament voltage gradually to the rated value, keeping filament current to the specified value.
4. Apply bombarder voltage, increasing it gradually until rated bombarding power is obtained.
5. Apply focus electrode voltage specified for the type klystron in use if this is obtained from a power supply. If the focus electrode voltage is obtained from a voltage divider across the bombarder supply, it should be pre-set to approximately the correct value.
6. Beam voltage may now be applied to the klystron in accordance with Section 4.4.

4.4 Applying Beam Voltage

Initial adjustment and operation of the klystron must be done at the lowest voltage specified on the test card provided with each tube. Failure to observe this rule can result in the destruction of the klystron.

The beam voltage may be applied only after the recommended magnetic field has been established in the equipment, the prefocus coil centered visually, and the electron gun started.

4.5 Magnetic Field Coils

The magnetic field which guides the electron beam in an Eimac klystron is created by controlled amounts of direct current flowing in electromagnet coils surrounding the klystron (Fig. 15).

The number of coils required is not the same for all types of klystrons, but operators will find four or five coils in most transmitters. These are the prefocus coil, several body coils and the collector coil.

The purpose of the magnetic field is to control the diameter and direction of the electron beam as it flows through the klystron, so that as little beam current as possible will strike the drift tube walls and be wasted. It follows that the best adjustment of the focus coil currents is the setting for minimum

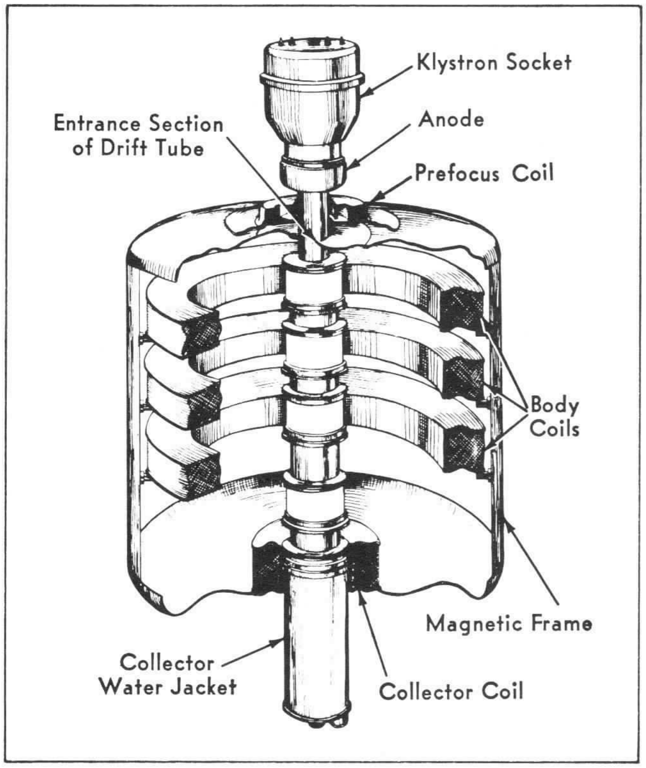


Figure 15—Simplified View of a Klystron and Its Magnetic Circuit with the Tuning Cavities Removed.

body current, consistent with good output. Sometimes slight changes in the coil current settings will produce large changes in power output without correspondingly great body current changes. In such cases, if the body current is not too near the permissible maximum, it is wise to adjust for a compromise body current setting which permits the larger power output to be obtained.

Each time the rf circuits are tuned, some changes will take place in the velocity and bunch density of the beam, which may increase the body current. As a result, each readjustment of the rf tuning will usually make it necessary to trim the focus coil currents slightly to obtain minimum body current again. This behavior is normal, and the adjustment is not critical despite its importance.

Focus coil resistances undergo considerable variation as the coils heat up after being turned on. The effects of this resistance variation on the coil current must be corrected by some means, and in transmitters where the currents are controlled manually, the operator should make frequent checks on the coil currents and over-all klystron operation during the warm-up period.

4.5.1 Prefocus Coil (Not Required for Some Klystrons)

The prefocus coil is much smaller than the body coils used with the klystron, and it is enclosed in a special magnetic shell containing an annular air gap. The flux outside of the air gap forms a magnetic lens located on the axis of the klystron at the approximate point where the convergent paths of the electrons would focus. This magnetic lens overcomes the tendency of the electron paths in the beam to diverge and strike the drift tube wall before the beam enters the main magnetic field, and it directs the beam down the center line of the drift tube. To accomplish these two ends, the prefocus coil requires two separate adjustments: the current must be correctly set, and the correct position of the coil around the axis of the drift tube must be found.

The initial current settings should be those shown on the test data card, for the lowest operating beam voltage specified. After the magnetic field has been established and the beam energized, the locknuts on the prefocus coil mounting pillars can be loosened and the coil carefully positioned to obtain the lowest possible body current (Fig. 16). When the optimum position has been located, the coil may be locked in place again.

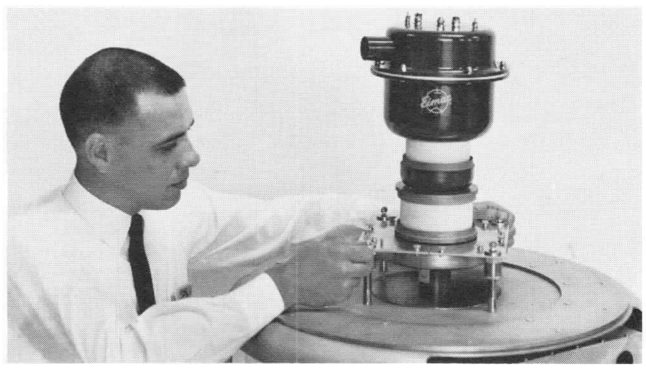


Figure 16—Adjustment of Prefocus Coil.

The prefocus coil mount should *never* be unlocked at beam voltages higher than the low beam voltage used during the position adjustment just described. To move the prefocus coil at higher beam voltages is to invite destruction of the klystron and, although it can be done in some instances by experienced personnel, moving the prefocus coil during high-voltage operation is NOT recommended.

Some of the newer Eimac external cavity klystrons do not require prefocus coils. This is because they use confined flow electron gun designs which make prefocus coils unnecessary. In the confined flow principle the main magnetic field is permitted to extend through the cathode and is so shaped that the electrons are confined by the field from the instant they leave the cathode. This minimizes focusing adjustments and provides a more stable beam.

4.5.2 Body Coils

Many body coils are supported in the klystron amplifier frame by small mounting pillars, which are secured to the side bars by single machine bolts running in tapped eccentric holes in the support pillar base. By this means, the support pillars can be rotated to provide four-point suspension of the coil, and the body coils can be levelled within small limits. The coils are positioned on the axis by small shoulders turned on the bodies of the mounting pillars.

Once the coils have been correctly set on the mounting pillars, it only remains to adjust the currents during the process of tuning the klystron amplifier. The original current values required are given by the test data card for each beam voltage. The test values should be used as starting points, and the final currents should not deviate greatly from them. In most cases, deviation from the test values of more than ten percent will result only when an error has been made in setting up the adjustments, or in assembly of the equipment.

4.5.3 Collector Coil

The collector coil is located around the soft steel sleeve in the bottom of the magnetic frame which supports the mounting flange of the klystron. The mounting flange is also made of magnetic material, and it serves to establish the magnetic field needed near the collector end of the drift tube whenever the collector coil is energized. The collector coil current adjustments are made in the same manner as the body coil current adjustments, and with the object of reducing the body current as much as is consistent with good power output.

4.5.4 Results of Improper Adjustment of Focus Coils

If the focus coils are improperly adjusted so that the electron beam is not centered in the drift tubes or if the beam is too large in diameter, it will graze the drift tube tips and evaporate copper which will raise the gas pressure in the tube and possibly poison the cathode. In extreme cases the drift tube tips may be partially melted by the beam. On the other hand, if the beam is over-focused by using an excessively strong magnetic field, the beam size is too small as it leaves the field and therefore it will not spread properly before it strikes the collector, with resulting damage. It is quite possible to burn a hole in the collector if the beam is overfocused.

Correct focusing of the electron beam is accomplished by keeping the body current well below the maximum limit at all times using focus coil currents that do not deviate more than 10% from those shown on the Eimac test data card. Adjustment of the focus coil currents should be made carefully so that the body current overload relay is seldom, if ever, called upon to operate. If the beam is thrown considerably out of focus it is quite possible for the tube to be damaged before the body current overload relay can operate.

4.6 Beam Transmission and Beam Loss

Some of the electrons in the klystron beam will inevitably strike the drift tube walls, instead of passing on through the klystron to the collector. Captured by the wall of the drift tube and returned to the external electrical circuits (through the body current milliammeter), these electrons are totally wasted as far as the production of rf power is concerned. The electrons lost in this manner are called the "body current," and the rest of the electron beam, which reaches the collector, is called the "collector current." The sum of the collector current and the body current is equal to the total beam current emitted from the cathode.

The collector current, expressed as a percentage of the total cathode current, is called "beam transmission."

The body current, expressed as a percentage of the total cathode current, is called "beam loss."

4.7 Tuning the Klystron

It has been noted that klystrons may have any number of cavities, but those most common in the field have either three or four. The nomenclature for klystron cavities has arisen from the functions they perform, and it is natural that the first cavity be called the "input cavity," no matter how many cavities may follow it.

Similarly, the last cavity transfers power from the electron beam to the output transmission line, and it is logically referred to as the "output cavity."

The cavity preceding the output cavity is tuned by the same rules regardless of whether the klystron has three, four, or more cavities. Therefore, it is convenient to refer to this next-to-the-last cavity by some descriptive word independent of the number of cavities which precede it, so it will be referred to as the "penultimate cavity."

The remaining cavities, not given descriptive names according to the scheme outlined above, are referred to by their position on the drift tube as the "second cavity," "third cavity," and so on. Most Eimac external cavity klystrons use either three or four cavities and the following tuning instructions will therefore be chiefly concerned with these tubes.

Before driving power is applied to the input cavity of a klystron, the tuning cavities should all be adjusted to the highest possible frequency. This is done by moving the tuning doors as far as possible toward the centers of the cavities. The output load coupler should also be adjusted for maximum coupling (loop vertical). After this is done, beam power and rf drive can be applied to the klystron and tuning may begin.

The tuning procedures which follow will apply particularly to narrow-band, maximum-gain amplifier operation. The procedures for broad-band klystron operation are ordinarily evolved for each individual application, and therefore cannot be treated as generally as can the narrow-band case. (See Section 5.3 for broad-band application information.)

The operator should not permit his familiarity with conventional electron tube behavior to confuse him when he tunes a klystron amplifier. In some respects a klystron behaves like a linear amplifier using conventional electron tubes, because the "plate current" does not change during tuning and the best indicator of correct tuning is the power output. Furthermore, when the driving power level is increased to a point above "saturation" the power output will start to fall with increasing driving power, which is similar in some respects to "overloading" a conventional amplifier circuit (Fig. 17).

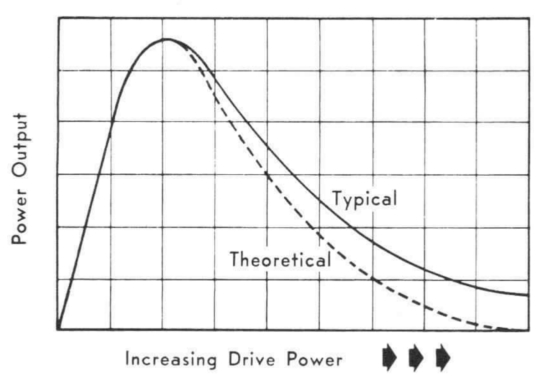


Figure 17—Overdriving a Klystron Reduces Output.

The klystron offers the operator the advantage that he can be guided in his actions by the variations in body current resulting from changes in the rf tuning adjustments. As each cavity is tuned, the body current may vary, and it is often necessary to trim the focus currents after each readjustment of the rf tuning, especially when the klystron is operating near its highest efficiency at any given power level.

Many Eimac klystrons carry dual body current ratings. One of these is intended for use during long periods of continuous operation and is usually half the absolute maximum rating. The absolute maximum rated body current is established for observance during tuning operations, to free the operator from the necessity of stopping frequently to trim the focus currents and to avoid tripping overload current relays frequently during tuning.

4.7.1 Input Cavity Tuning

The input cavity is tuned to resonance at the driving frequency. A beam voltage equal to 50% of that required for full rated power is applied to the klystron during this adjustment. Resonance is usually indicated by tuning for minimum VSWR at the input cavity. A directional coupler is ordinarily inserted in the driving line for this purpose. The two tuning doors of the cavity should always be equally spaced from the ceramic cylinder. The input cavity coupling loop should be adjusted to the position giving lowest reflected power as indicated by the directional coupler in the drive line. This is the condition of best match for the drive line. The input cavity must be resonated after each coupling adjustment. After the coupling is adjusted for best match, the driving power should be set at the value specified for the particular klystron. This power can be measured with a bolometer at the incident power terminals of the input directional coupler. After the input cavity is tuned, the second cavity (if applicable) and output cavity tuning doors should be adjusted to approximately the same positions as those of the input cavity. Since the cavities are similar, this will approximate resonance. The penultimate cavity tuning doors should next be set at positions midway between those of the input cavity and the maximum high frequency setting (tuning doors nearest to klystron).

4.7.2 Second Cavity Tuning
(Ignore for 3 cavity klystrons)

The second cavity is also tuned to resonance at the driving frequency (unless stagger tuning is employed for broad-band operation). This is accomplished by tuning for maximum output power. It will probably be necessary to adjust the output cavity to resonance at this time in order to obtain adequate output power for tuning purposes. The relative power output indicator must be sufficiently sensitive to detect the low power output during this tuning procedure.

4.7.3 Penultimate Cavity Tuning

After the input and second cavities are resonated, the beam voltage can be increased to the lowest value shown on the Eimac test data card. (Adjust focus coil currents for minimum body current). The input and second cavities should then be rechecked for resonance because their tuning may change as the beam current changes. The penultimate cavity can then be slowly tuned toward a lower frequency as the output power is carefully observed. As the cavity is tuned, the output power will increase to a maximum and then start to decrease. Return the tuning to the point which gave maximum power output and then detune on the high frequency side until the output power drops 10%. This is the correct tuning point for the penultimate cavity. See Fig. 18.

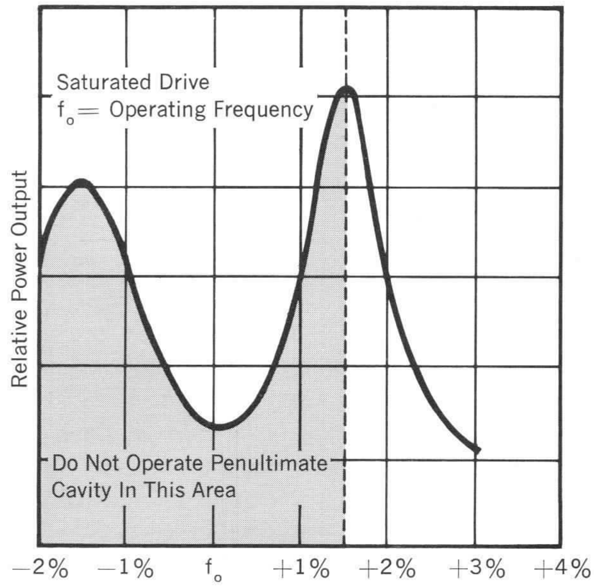


Figure 18—Penultimate Cavity Tuning

4.7.4 Output Cavity Tuning

After the penultimate cavity is tuned, the output cavity is retuned for maximum output power. Next the output coupling is adjusted. Starting in a vertical position the coupling loop is moved in 5° steps toward a horizontal position. The output cavity must be retuned at each step because its resonant frequency will change as the coupling is adjusted. As the output coupling is reduced the output power will increase. Eventually optimum coupling (maximum power) will be reached and if the coupling is further reduced the output power will start to decrease. *Do not reduce the coupling past the point of optimum coupling.* Instead, increase the coupling until the output power drops to 95% of its value at optimum coupling (see Fig. 19). The klystron is now correctly tuned at the lowest beam voltage shown on the Eimac test data card and the output power should be near the value shown on the test data card. If it is not, the tuning procedure should be repeated until the reason for the discrepancy is discovered.

At the lowest beam voltage shown on the Eimac test data card mistakes in tuning will not ordinarily injure the klystron and it is suggested that the operator take this opportunity to practice tuning the klystron and familiarize himself with its behavior before increasing power.

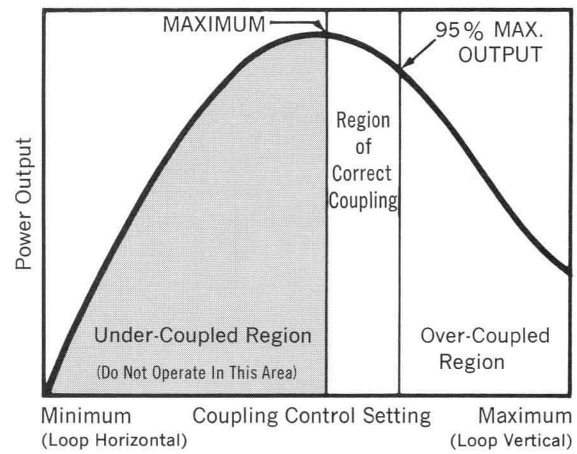


Figure 19—Adjustment of Output Coupling Control.

4.7.5 Load VSWR Check

After the klystron has been tuned at the lowest beam voltage shown on the Eimac test data card, the load VSWR should be determined by comparing the incident and reflected power measured at the directional coupler in the output transmission line. Most Eimac external cavity power klystrons will deliver rated output power with any load VSWR up to 1.5:1. This is equivalent to 4.2% reflected power with respect to forward power. If the reflected power exceeds this value the load must be adjusted to reduce the VSWR to 1.5:1 or less before the beam voltage is increased.

4.7.6 Trimming

When the tuning procedure has been completed and the operation appears reasonably satisfactory, each adjustment in turn should be trimmed to assure the operator that optimum performance has been obtained. When satisfactory operation at any given power level has been obtained, operation at the next higher power level may be started.

4.8 Increasing Power

Before increasing power the following precautions must always be taken.

1. Increase the frequency of the penultimate cavity until the output power decreases by 50%. (Move tuning doors toward the center of the cavity.)

2. Increase the output coupling to maximum. (Coupling loop vertical.)

The beam voltage may then be increased in steps to the desired value. Observe the body current during each voltage increase and adjust the focus coil currents as required to keep the body current at minimum. After the desired beam voltage is reached, the input cavity and second cavity (where applicable) are again checked for resonance. Next the penultimate cavity is tuned exactly as described in Section 4.7.3 and finally the output coupling and output cavity tuning are adjusted exactly as described in Section 4.7.4. If the output power obtained in this way is greater than required, the output coupling should be increased until the desired output is obtained.

Section 5.0

APPLICATION OF THE POWER KLYSTRON

Figure 20 shows the filament and beam supplies, protective circuitry and instrumentation for a klystron amplifier. Focus coils and their power supplies have been omitted for simplicity. Commonly used abbreviations for klystron electrical characteristics are shown in Figure 21. Heater voltage and current (E_f, I_f) are typically supplied from a transformer, insulated for high voltage, and a variable autotransformer. The heater transformer is often designed to be short circuit limited to twice the normal heater current rating. The heater voltmeter should be connected directly to the klystron socket to minimize measurement errors due to voltage drop in the connecting cable.

Resistor R_{surg} is the current limiting resistor for the beam supply. Its value should be chosen to limit short circuit current to 25 to 100 times nominal beam current. A value of 100 ohms is typical for 10 kW power amplifiers.

Focus electrode voltage is most conveniently and reliably obtained from a cathode resistor (R_c). Focus electrode voltage is developed across this resistor by the beam current. R_c should have ample power dissipating capability. A voltmeter should be provided to monitor the focus electrode voltage (E_{foc}) and this meter should be protected by a thyrite element.

At least two overload circuits are required, one for the beam current and one for body current. These overloads are set to trip at the values of maximum beam current and body current specified for the klystron. Meter relays are often used in these circuits and have been found to be satisfactory. The thyrite at T is desirable to protect the metering circuits and the klystron collector insulator in the event of power supply shorts. Every effort should be made to keep the total impedance between the klystron body (ground) and the positive terminal of the high voltage supply at a minimum. This resistance should be less than 5 ohms and one ohm is desirable.

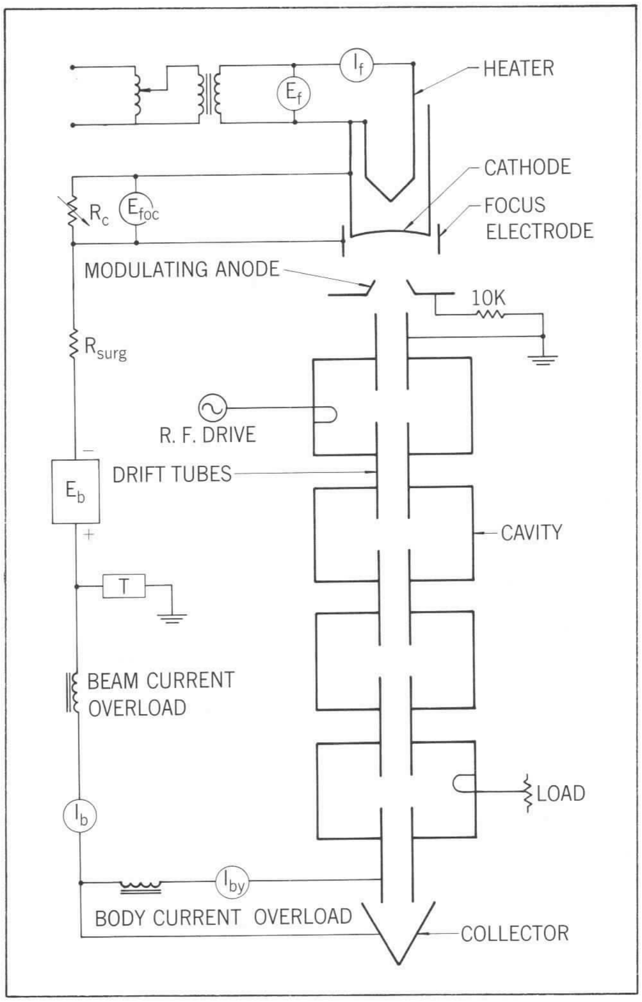


Figure 20—Klystron Power Supply Connections

Beam current and heater current should never be carried in the same conductor. Amplitude modulated random noise can be reduced several decibels if this rule is observed.

Beam supply ripple should be less than 1% for systems requiring incidental FM and AM noise down 40 db or more from the carrier. For noise down 60 db, 0.1% or less ripple is required. The supply should be variable or adjustable to at least four equally spaced voltage levels between 50% and 100% E_b.

Focus coil power supplies (not shown in Fig. 20) should be filtered to 5% ripple. In most cases three phase full wave supplies may be used unfiltered. The focus coils have enough inductance to reduce the ripple adequately. Means must be provided to adjust the focus coil power supply voltages over wide limits. In many cases a variable autotransformer is used with each supply to provide continuous voltage variation from zero to the maximum specified on the klystron data sheet. An ammeter must be supplied to measure the current in each focus coil. An under-current relay is often provided in each power supply, interlocked so that the beam power supply cannot be energized unless the focus coils are energized. The body and collector coils of many modern klystrons are operated in series from a single power supply but the prefocus coil always has a separate supply.

5.1 Modulating Anode—CW Applications

Most modern klystrons are equipped with modulating anodes. For CW applications the modulating anode is connected as shown in Fig. 20. The 10,000 ohm resistor is usually wire-wound and rated for 200 W. If the power supply and its filter capacitors stored with energy were connected directly from cathode to anode and should the slightest surface arc, gas burst or interelectrode arc take place, the full energy of the power supply would be dissipated in the tube. This energy would pass through the cathode with disastrous results. The tube would have to withstand the energy supplied and stored by the power supply until the mechanical inertia of the primary breaker and the filter capacitor shorting switch could be overcome. This situation can be somewhat improved by the use of current limiting resistors but the power loss is prohibitive if the resistance is high enough to be fully effective.

COMMONLY USED ABBREVIATIONS FOR POWER KLYSTRON CHARACTERISTICS:

E_f	—Heater Voltage
I_f	—Heater Current
f_o	—Carrier Frequency
E_b	—Beam Voltage
I_b	—Beam Current
I_{by}	—Body Current
E_{foc}	—Focus Electrode Voltage
P_o	—Output Power
P_{in}	—Beam Input Power (dc)
P_d	—Driving Power
Im_1	—Prefocus Coil Current
Im_{2a}	—First Body Coil Current
Im_{2b}	—Second Body Coil Current
Im_{2c}	—Third Body Coil Current
Im_{2d}	—Fourth Body Coil Current
Im_3	—Collector Coil Current

Figure 21

The problem is solved by connecting the modulating anode as shown in Figure 20. It is clear that the normal condition of negligible current to the anode does not exist at the time of the arc. When the arc occurs, a large current tends to flow to the anode. With the modulating anode connected as shown, this current is limited to a small value and has the further advantage of removing the off-cathode gradient. This extinguishes the arc and cuts off the beam current automatically in an extremely short period of time. Application of this technique at power output levels of 10 kW and above may well make the difference between a successful system and an unreliable system plagued by occasional arcs costing valuable down time.

5.2 Modulating Anode—Pulse Applications

The use of the modulating anode is very advantageous in many pulse applications. By use of this additional element it is possible to switch the tube directly across the beam power supply without the use of conventional storage networks which impose severe restrictions on the switching tubes. However, in order to take full advantage of this desirable modulation property, it is necessary to build a modulator which can efficiently drive this high impedance electrode with high voltage pulses. A new type of circuit has been developed to meet this need.

The pulse voltage can be applied to the modulating anode with a pulse transformer. However, for high voltage long pulse applications, variations of the circuit shown in Figure 22 are used. These circuits use two hard switching tubes. One tube is used to switch the anode up to operating potential, and the other to pull the anode back to cathode potential thus cutting off the beam. Rise and fall times of less than 1 microsecond through 60 kv have been achieved with jitter down in excess of 40 db.

The circuit shown in Figure 22 consists essentially of two switch tubes in series. The lower switch tube drives the modulating anode positive with respect to the klystron cathode, causing beam current to flow. The current supplied by the switch tube is only the charging current to the anode and associated circuit capacitance. This tube usually conducts during the full length of the pulse, but the dissipation is negligible because the voltage drop across the switch tube is small and the conduction current consists of only the leakage current and the intercepted beam current both of which are small. The upper

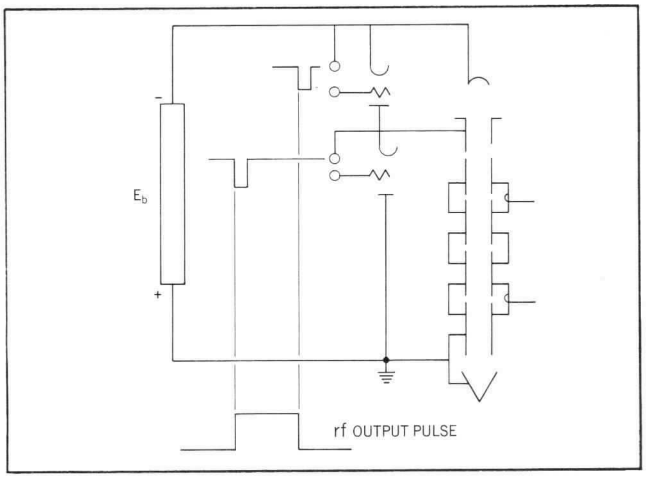


Figure 22

tube is triggered at the end of the pulse, shorting the modulating anode back to the cathode and cutting off the beam. This arrangement is known as the floating deck circuit because the circuitry which drives the lower tube must float with the modulating anode.

This circuit arrangement is particularly useful in long pulse applications because the switching tubes must work only during the rise and fall time of the pulse.

In addition, this circuit is desirable where adjustable pulse length is required. Pulsers have been made which generate a continuously variable pulse length from a few microseconds to several milliseconds.

5.3 Broad-Band Applications

External cavity klystrons are well suited to broad-band applications because the cavities can be loaded with external resistive loads to increase the bandwidth of the klystron. The circuit assemblies for many Eimac external cavity klystrons include provisions for coupling external loads to the cavities and, in other cases, coupling loops or load couplers for this purpose can be supplied on special order. The input cavity, second cavity and penultimate cavity are ordinarily loaded for broad-band operation. For extreme bandwidth, stagger tuning in addition to cavity loading is sometimes employed. The klystron is best adjusted for broad-band operation by using a sweep frequency source for the drive signal and adjusting the tuning and loading of the cavities while observing the output response curve on an oscilloscope. Such adjustments can also be made by the point-by-point method but this becomes very time consuming.

Driving power requirements for the klystron under broad-band conditions are greatly increased with respect to narrow-band operation. The gain of a three-cavity klystron under maximum broad-band conditions will be in the order of 20 decibels. The gain of a four-cavity klystron under these conditions will be from 30 to 35 decibels. The beam power efficiency of the klystron is also reduced in broad-band operation. Efficiencies of 30% to 40% can be expected.

The 3 db bandwidth of a properly loaded and adjusted three-cavity klystron is approximately 0.4% of the operating frequency. A four-cavity klystron under these conditions can provide bandwidths up to 1% of the operating frequency.

Section 6.0
MISCELLANEOUS

6.1 Eimac Power Klystron Catalog Numbering System

The catalog numbers for Eimac power klystrons have been designed to convey maximum information regarding the klystron. Here is an example:

4KMP10,000LF

The first number indicates number of cavities (4). The first letter is always K, indicating klystron.

The second letter, M, indicates that the tube has a modulating anode. If no modulating anode is used, the M is omitted.

The third letter, P, indicates that this is a pulse klystron. In the case of CW klystrons the P is omitted.

The second number, 10,000, indicates the maximum collector dissipation of the klystron. In catalog numbers assigned prior to May 1, 1961, this was expressed in watts, but in those assigned after that date it is expressed in kilowatts in the interest of brevity.

The next to last letter, L, indicates the general frequency band in which the klystron operates.

The last letter, F, indicates the frequency sub-band in which the klystron operates. Since no standard system of sub-band assignments exists, Eimac uses its own.

Eimac klystrons described by the letter X followed by three or four numerals are usually newly developed tubes which have not yet been assigned catalog numbers. In a few cases klystrons become so well known by their developmental designations that these are used permanently.

6.2 Klystron Gas Check

The power amplifier klystron can be used as an ion gauge to check relative gas pressure and thus indicate the condition of its own vacuum. This technique is used in the Eimac factory and can be used to advantage in the field. The gas check is performed by applying +150 volts dc to the electrode nearest the cathode (usually the focus electrode) and −45 volts dc to the electrode next closest to the cathode (usually the modulating anode or anode). These voltages are with respect to the cathode. The heater voltage is then applied. As the cathode heats, electrons are attracted from it to the positively charged electrode and some of the electrons collide with gas molecules, dislodging electrons from these molecules and forming positive ions. These ions are attracted to the negatively charged electrode causing a current to flow in this circuit which is proportional to the density of the gas molecules in the klystron and hence to its gas pressure. With most external cavity klystrons the ion current in the −45 volt circuit is read when the electron current in the +150 volt circuit increases through 20 milliamperes. The heater voltage is usually maintained at approximately 75% of rated value so that the electron current rises slowly enough to permit accurate readings. The heater voltage should be removed immediately after measurement. If a klystron is found to have an ion current reading greater than five microamperes it should be aged in the transmitter at the lowest available beam voltage or with other aging equipment as described in Section 6.3.

The gas check circuit is shown in Figure 23. Because ion currents in the order of one microampere or less are involved, it is convenient to measure them by inserting resistors in the ion current circuit and measuring the voltage across these resistors with a sensitive vacuum tube voltmeter. With the voltmeter and resistor combination shown in Figure 23, equivalent full scale readings of 0.1, 1, 10 and 100 microamperes are available.

Because of the small currents involved, the leakage resistance across the tube elements involved in the gas check must be very high. This can be checked by watching for current indication in the ion circuit before heater power is applied.

Specific information on gas checking any particular Eimac klystron is available by writing to Eitel-McCullough, Inc., San Carlos, California.

6.3 Klystron Reconditioning or "Aging"

It is often inconvenient to recondition a klystron which exhibits excessive gas current by operating it in a transmitter. Equally satisfactory results can be obtained with the following procedure.

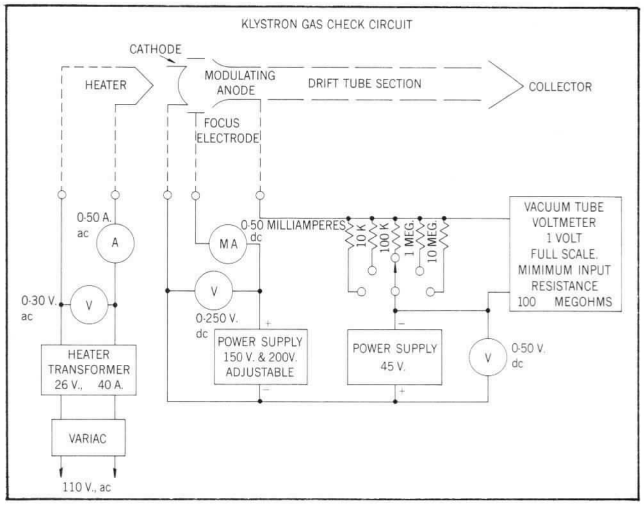


Figure 23

1. Support the klystron in a position permitting free circulation of air around the gun structure. Klystrons which are shipped in a metal frame may be aged in this frame, but those shipped in hair pack must be removed from the shipping container.
2. Apply forced air cooling to the gun structure in the amount specified in the data sheet.
3. Apply rated heater voltage to the klystron, limiting starting current to the specified value. Allow five minutes to warm up.
4. Short the focus electrode to the cathode.
5. Short the anode, drift tubes and collector together and ground.
6. Apply 500 volts ac or dc from the anode to the cathode. If dc is used the positive terminal must be connected to the anode. Cathode current will be approximately 15 to 30 milliamperes.
7. Energize the klystron in this manner for 12 hours or until the ion current, as indicated by the gas check, decreases to one microampere or less.

If the klystron has a titanium getter, it will be advantageous to energize the getter during the aging process.

6.4 Technical Assistance

Eitel-McCullough, Inc. will gladly assist users in the choice of klystrons best suited to their particular applications. This cooperation is especially important when a prototype design, which will later be manufactured in quantity, is being contemplated. Such assistance makes use of accumulated, detailed experience with the Eimac klystron types involved, and is handled confidentially and without charge.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

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