GATES

HARRIS
COMMUNICATION
TECHNOLOGY

MW-50

50,000 Watt
Medium Wave
AM Broadcast
Transmitter

MODEL MW-50

Features:

- High level plate modulated, using a Pulse Duration Modulator (PDM)*
- High overall efficiency . . . exceeds 60%
- Minimum power consumption . . . only 87 kW at 30% modulation
- Only five tubes, with three tube types
- Only one power amplifier tube and one modulator tube
- Quiet, air-cooled operation
- Compact design
- High level design with no modulation transformer or reactor
- Power level is adjusted in low level PDM stage. No loading adjustment is required
- Switches smoothly from high to low power with carrier on
- Automatic return to operation after a power failure
- Easily remote controlled

*Patented

The most advanced 50 Kilowatt Medium Wave Transmitter in the world. Gates' MW-50 provides an overall performance superior to that of any other AM broadcast transmitter in the same power range, at lower operating costs. With Gates' exclusive high level plate modulation, using a Pulse Duration Modulator (PDM), this transmitter represents the latest state of the art in high power broadcast equipment.

High Efficiency—Exceeds 60%. The Pulse Duration Modulator employed in the MW-50 is nearly 90% efficient (instead of the usual 50% or 60%), enabling the transmitter to achieve an unusually high overall efficiency of greater than 60%. This means less power consumption than that of the other 50 kilowatt medium wave transmitters currently available.

Only Five Tubes. The entire transmitter employs just five tubes—with modern ceramic 4CX35,000C tetrode power tubes operating well below manufacturer's dissipation ratings. Only three tube types are used, which simplifies the stocking of spares. All power supplies use long-life solid state silicon rectifiers. Highest quality components, conservatively rated, are used throughout the MW-50 to assure a maximum degree of reliability.

Continuous 100% Modulation Rating. This continuous sine wave modulation capability permits a higher average modulation to boost signal strength without increasing transmitted carrier power. The MW-50 provides 130% positive peak capability when operating at full 50 kilowatt RF power output. Another feature of this high efficiency series type modulator is that the carrier power may be adjusted from the front panel without changing the loading.

Maximum Carrier Power 60 Kilowatts. The Gates MW-50 provides a maximum carrier power of 60 kilowatts, which allows more reserve for driving directional arrays than any other 50 kilowatt medium wave broadcast transmitter. The MW-50 uses DC feedback for power output stability, which insures a minimum RF power output change with a change of the power line voltage. The MW-50 can be switched smoothly from high to low power with the carrier on.

Easy Tuning. Output network tuning is accomplished by PA plate tune and loading control of the power amplifier stage, which operates as a standard Class C amplifier. Automatic gain control on the power amplifier screen allows tuning of the Type 4CX35,000C tetrode as if it were a triode, without any risk of over-dissipating the screen. After PA tuning and loading controls are optimized, power output is controlled in the low level PDM stage. In case of a power line failure, the MW-50 is equipped to automatically return to full power operation.

MW-50

50KW AM TRANSMITTER

FEATURES OF THE MW-50

1. Only Five Tubes
2. Only Eleven Transistors in Audio and RF (PDM and Osc.)
3. Two Transistors and Two Op Amps in Control and Metering
4. Field Proven by the VP-100
5. Greater Reliability (Uses Mostly VP-100 Parts)
6. Quiet
7. Step-Start on All Filaments and the High Voltage
8. No Modulation Transformer or Reactor
9. Type Accepted, Three Power Levels
10. AGC in PA Screen
11. Dual Osc/Buffer/AGC/Solid State Driver
12. Low Distortion
13. Good Frequency Response
14. Great Accessibility
15. No HV Voltage Regulator Required
16. Automatic Return After Power Failure
17. Automatic Re-Cycling
18. VSWR Protection
19. Output Network Arc Protection
20. Highest Positive Peak Capability (130%)
21. 60 kW Output Capability at 100% Modulation
22. Redundant HV Shorting Switches (One in Each Cabinet)
23. Very Easy to Install
24. Lowest Power Consumption

MW-50, 50KW AM TRANSMITTER

The Gates MW-50 provides an overall performance superior to that of any other AM broadcast transmitter in the same power range at lower operating costs. With Gates' exclusive high level plate modulation (PDM), this transmitter represents the latest state of the art in high power broadcast transmitters. Here are some typical performance measurements that we have run on this transmitter in the factory:

1. Distortion - rated 3% at 100% modulation (typical less than 2%)
2. Response - rated ±1.5 dB 20-10,000 Hz. (typical ±1.0 dB 20-10,000 Hz.)
3. Noise - 60 dB
4. 70 kHz. Suppression - better than -77 dB (must meet -35 dB)
5. Harmonics - greater than -80 dB
6. Power Consumption - 0% modulation 80kW, average 85kW; 100% modulation 110kW
7. Type Accepted at 3 Power Levels - 10kW, 25kW, and 50kW

The above tests are required for FCC acceptance. We could have stopped there, but we didn't. Here are eleven additional tests we performed:

8. Heat run for 24 hours at 125 degrees F - full power and 140% positive peak programming
9. 16 hours per day running, unattended for a week
10. Operated into a very narrow band load to check for oscillation
11. Power failure tests
12. Single phase power failure test
13. High VSWR (The output was shorted creating a very high VSWR; the VSWR overload protection was disabled; transmitter was still protected.)
14. Feedback failure
15. Output Arc
16. Open damper diode
17. Shorted modulator
18. Crystal turned off with tone on at 100% modulation

Next feature is the high efficiency. The transmitter exceeds overall efficiency of better than 60%. The pulse duration modulator employed in the MW-50 is almost 90% efficient, instead of the usual 50% to 60%. This enables the transmitter to achieve an unusual high overall efficiency of greater than the 60%. This means less power consumption than that of any other 50kW medium wave transmitter currently available. Not only is this low power consumption of 80kW's important, but where it really counts is up in the average modulation or close -0 the 100% modulation where our overall power consumption is way below any other transmitter. The MW-50 actual measurement is 107kW at 100% modulation.

Third feature - only 5 tubes! The entire MW-50 employs just 5 tubes and 11 transistors. The 4CX35000C is used in the PA and the modulator, and the 4CX1500A is used in the RF and the modulator drivers. The only other tube used in the transmitter is the damper diode, a F1099. Please note there are only 3 tube types used which simplifies the stocking of spares. All power supplies use long life solid state silicon rectifiers. The highest quality components (those used in the field proven VP-100) conservatively rated are used throughout the MW-50 to assure a maximum degree of reliability. The output circuit of this transmitter has been tested to handle 100kW.

The 4CX35000C is the air cooled version of the 4CV100000, the PA and the modulator tube used in the VP-100. The 4CX35000C is capable of 100kW at 100% modulation when used Class D as in the MW-50.

The MW-50 is rated at continuous 100% modulation. This continuous sign wave modulation capability permits a higher average modulation to boost signal strength of that increasing transmitter carrier power. The MW-50 provides at least 130% to 140% positive peak capability when operating at full 50kW RF power output.

Another feature of this high efficiency series type modulator is that the carrier power may be adjusted from the front panel without changing the loading. The new MW-50 has a maximum carrier power of 60kW. This transmitter has been tested at 75kW to 80kW cW on the output without modulation, but we know that this will modulate at 60kW to 65kW at 100% modulation. This allows more reserve for driving directional rays than any other 50kW medium wave broadcast transmitter manufactured today.

The MW-50 uses DC feedback for power output stability which ensures a minimum RF power output change with a change of the power line voltage. In other words, the power line could drop 20-30 volts and the transmitter would be within FCC limits.

The MW-50 can be switched smoothly from high power to low power with the carrier on. When the low power is pressed, it decreases in a very smooth fashion - just slowly drops to the output power which you are seeking. Also, the HV is <u>not</u> turned off when the unit is switched in a directional system. The PDM is turned off during the switch and on again when completed--silent, smooth, and <u>fast</u>!

Easy tuning - The output network is adjusted by the PA plate tuning and loading controls on the power amplifier stage which operates as a standard Class C amplifier. Automatic gain control on the power amplifier screen allows tuning of the 4CX35000C tetrode as if it were a triode, without any risk of over dissipating

the screen. After PA tuning and loading controls are optimized, power output is controlled in the low level PDM stage.

In case of power line failure, the MW-50 is equipped to return automatically to full power output. This is very important - the MW-50 remembers where it was if you were to lose power, regardless of how long it is between the power interruptions. The MW-50 will recycle and will come back on the air at full power. If it has been off for some time, it will go through the normal start-up procedures with filaments on, then the time delays will allow plate power to be applied, and it will come up to full power.

The Gates' exclusive PDM system produces conventional high level plate modulation. The difference is simply the matter in which the audio signal is amplified and applied in series with the RF amplifier plate supply. This one difference provides several distinct advantages - particularly, a much higher efficiency and the elimination of large iron core components. In other words, you do not have a modulation transformer or a modulation reactor.

The duty cycle of the pulse determines the voltage at the plate of the PA. For instance, a 50% duty cycle will produce 50% of the supply voltage at the PA. A 100% duty cycle will place 100% of the supply voltage on the PA. A 0% duty cycle will produce 0 voltage at the PA or the 100% negative modulation tip. The rate of variation of the pulse width is the audio signal, hence a pulse duration modulator.

We operate at about a 40% duty cycle at 50kW carrier. This means the duty is 80% at the positive 100% modulation peak. The other 20% duty goes into the 130% positive peak capability.

The RF section is conventional using a transistorized oscillator, buffer, emittor follower, and a 4CX1500A tetrode tube amplifier to drive a single 4CX35000C tetrode Class C power output stage.

An automatic drive control limits the PA screen current to 1.8 amps, eliminating the usual problem of over-dissipating of the screen of a tetrode during tune-up. In other words, we have an automatic control on the PA screen so you cannot destroy the tube during the tune-up or severe faults.

Control of the transmitter power output over a wide range is accomplished in a low level stage of the modulator by means of a convenient front panel vernier control. No adjustment is necessary in any high power RF circuit, including the loading capacitor.

Protective circuits - All major components of the MW-50 are protected by circuit breakers. Tubes and transistors are protected by overload relays or current limiting devices.

Protection against voltage standing wave ratios of greater than 1.2 to 1 is provided. Both forward and reflected power is metered at the front panel. In the case of momentary RF overloads, the MW-50 will recycle automatically. Should a repeated overload occur within a thirty second period, the transmitter will remain off until manually reset; however, if the time between overloads is greater than thirty seconds, continuous recycling will occur.

We have the status light panel which has the VSWR trip and the arc suppression which no other transmitter has.

The new MW-50 has quiet air cooling. Cooling of the MW-50 tubes is accomplished by a 3 horsepower, 2,000 cfm blower located in the modulator cabinet. The transmitter cabinet air is flushed with a 4,000 cfm fan which also operates at a very low noise level. Provisions are made at the top of the transmitter for ducting the exhaust air to the outside of the transmitter building.

The MW-50 is capable of operating at altitudes up to 10,000 feet by changing the blower speed.

All transformers and similar components are hermetically sealed, encased, or vacuum impregnated.

Easy access - All components are readily accessible through the four rear doors and one front access door. Meter panels are hinged for easy inspection and maintenance.

Transmitter layout - The MW-50 consists of two cabinets and an external high voltage power transformer. External connections to the transmitter are made through either the top or the bottom of the unit as desired for greater installation flexibility.

The new MW-50 has been field tested. The first VP-100 was shipped to Thailand and went on the air in August, 1967. This transmitter uses the same circuits as this MW-50, except it is vapor cooled. As mentioned before, the tube that is used in the VP-100, the medium wave transmitter is the same identical tube as the 4CX35000, except for cooling. So this transmitter has been in operation really since 1967. We shipped another VP-100 to Saigon in March, 1970. Before we shipped the one to Saigon, we shipped two to Oporto, Portugal (in 1968). We shipped one to Bissau, Portuguese Guinea, in April, 1970. We know that this transmitter is great because we have had no problems with the VP-100, medium wave transmitter. The Malaysian government bought six SW-100's which use PDM, after they saw the Thailand VP-100. This will make a total of eleven PDM transmitters shipped since 1967. Five of these transmitters were VP-100's, medium wave 100,000 watt transmitters, and six of them are on the short wave band in Malaysia.

Gates Radio Company
June 26, 1972

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GATES' MW-50 -- THE WORLD'S FINEST 50KW MEDIUM

RF Section

The RF chain is conventional, using a transistorized oscillator, buffer, emitter follower, and a 4CX1500A tetrode tube amplifier to drive a single 4CX35,000C tetrode Class C power output stage.

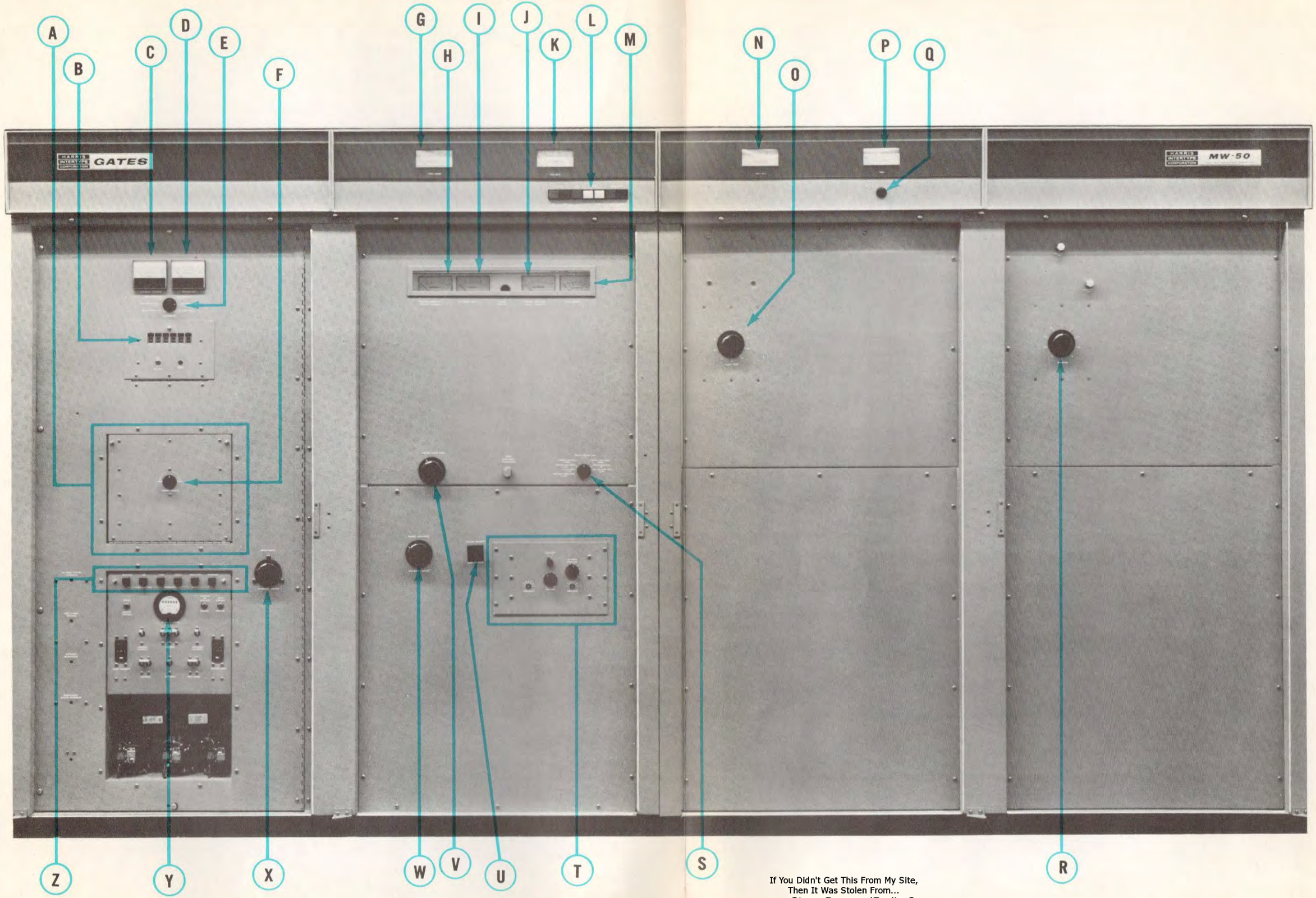
An automatic drive control limits the PA screen current to 1.8 amps, eliminating the usual problem of over-dissipating the screen of a tetrode during tune-up.

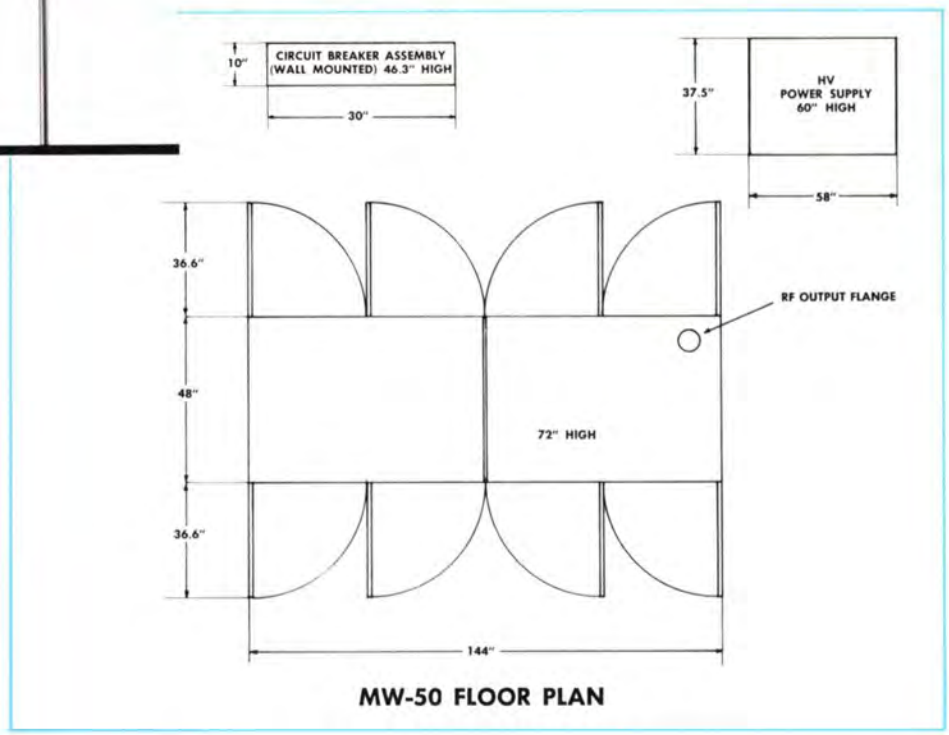
The Modulation System

Gates' Pulse Duration Modulator is characterized by low plate dissipation and low tube peak currents. Peak cathode currents are about one-half that of other 50 kilowatt transmitters. Average plate dissipation runs substantially below rated levels, and all peak voltages are maintained well below component ratings. In addition, the PDM design allows continuous 100% sine wave modulation.

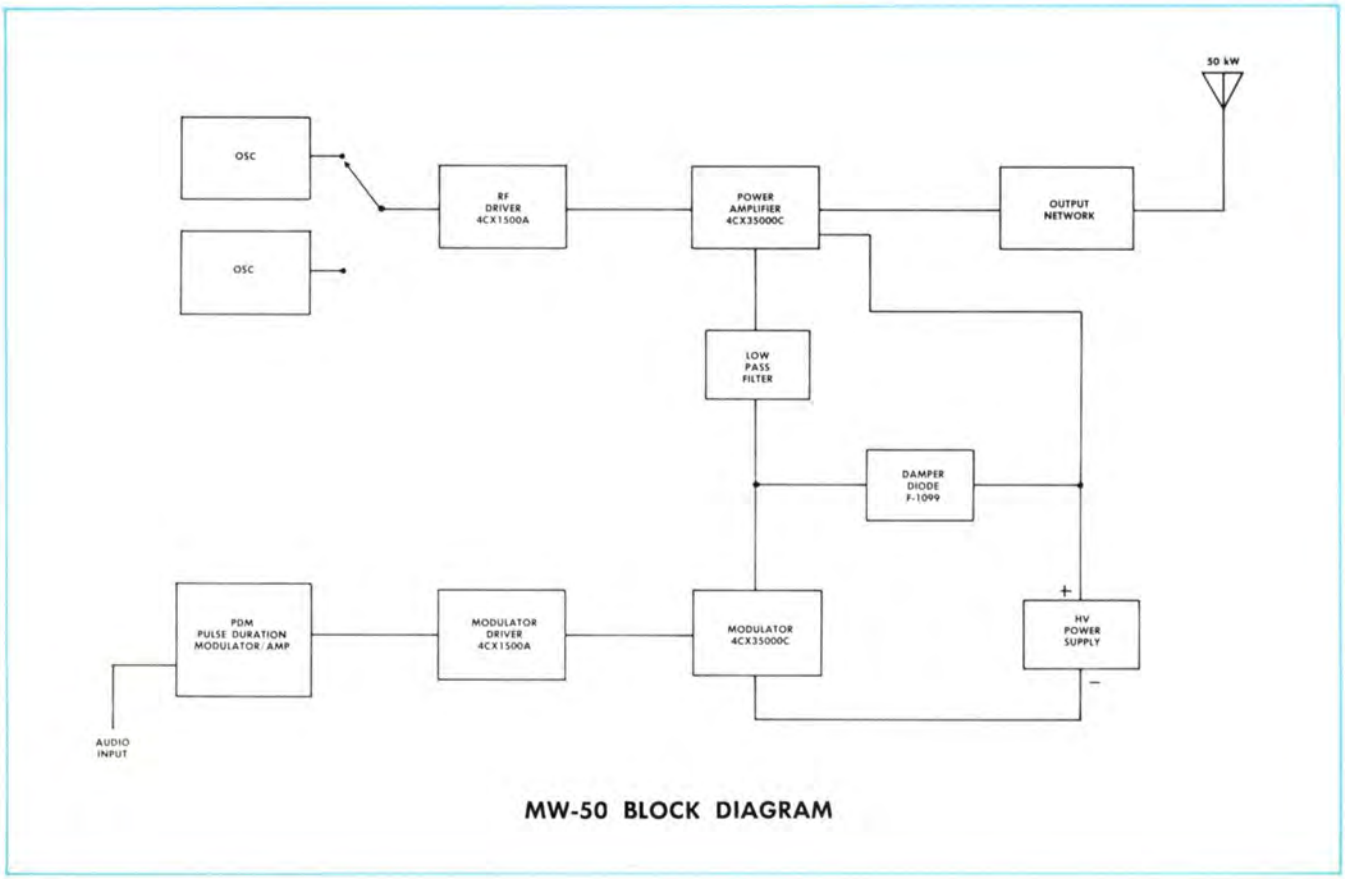
The modulator efficiency is about 90%, and a wide frequency response is possible, as large reactive components are not used in the modulation system.

The MW-50 offers full rear accessibility





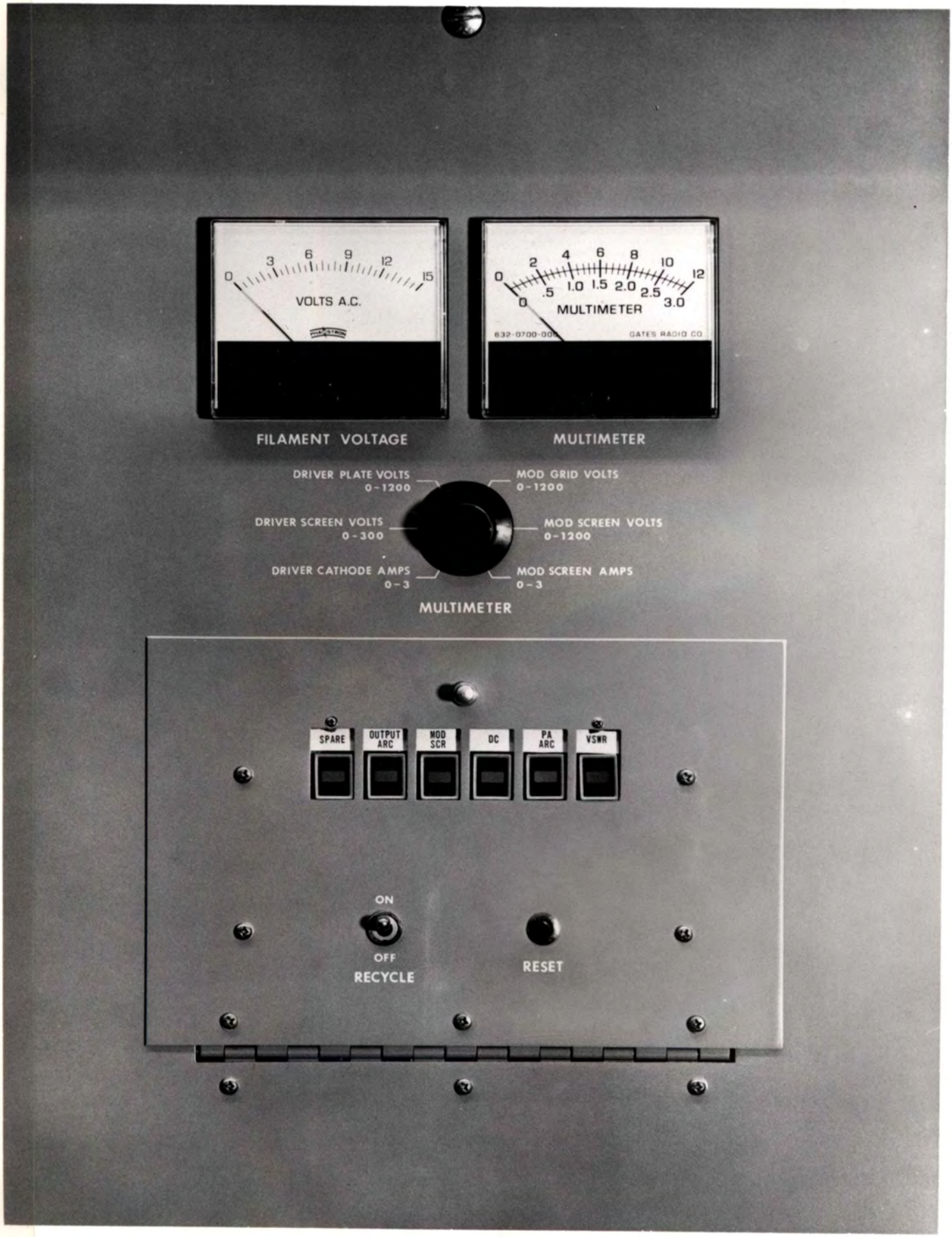
MW-50 FLOOR PLAN



MW-50 BLOCK DIAGRAM

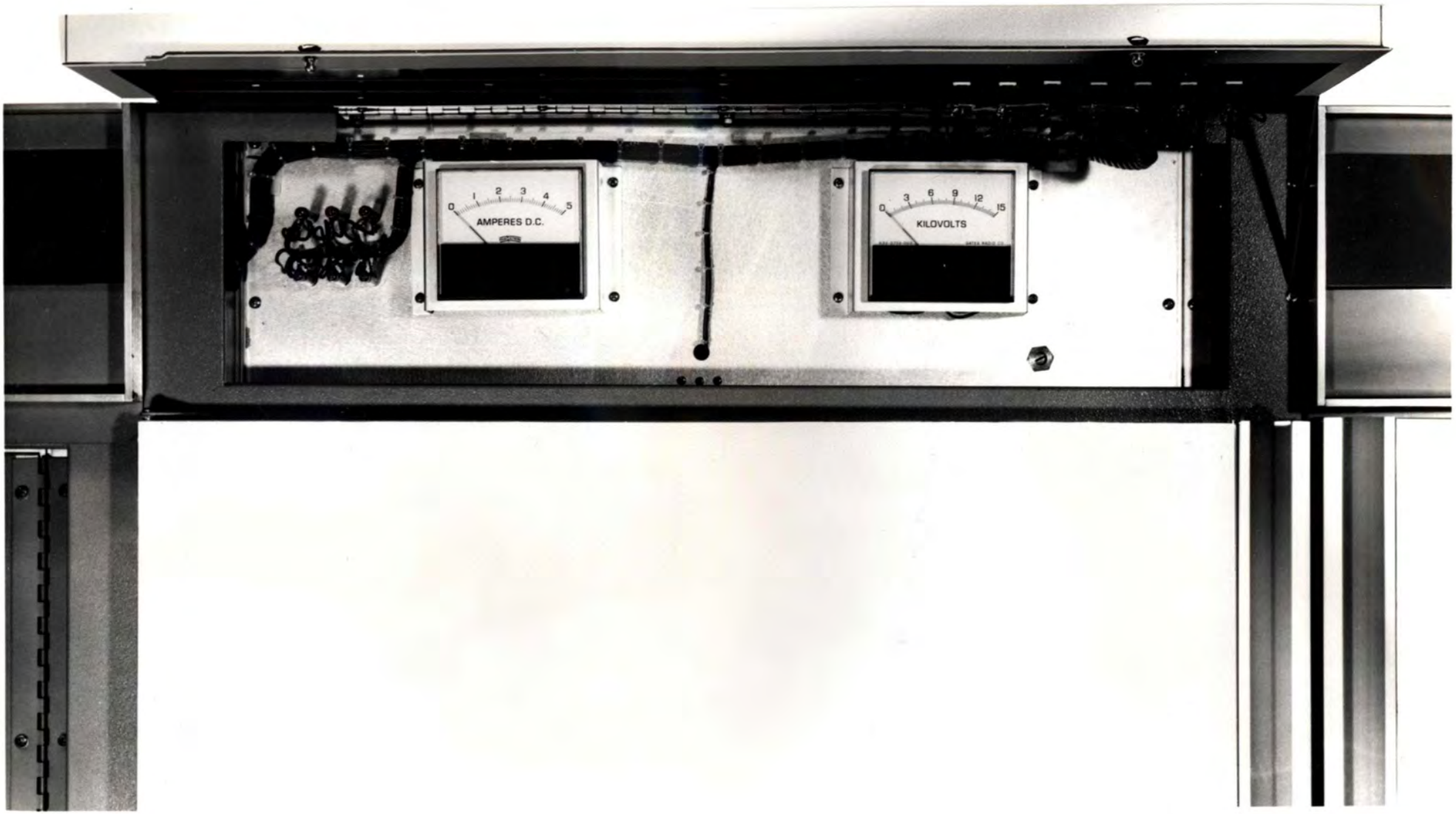
GATES' MW-50, 50,000-WATT MEDIUM WAVE AM TRANSMITTER. 1883

MW-50, REAR VIEW, DOORS OFF. 1886

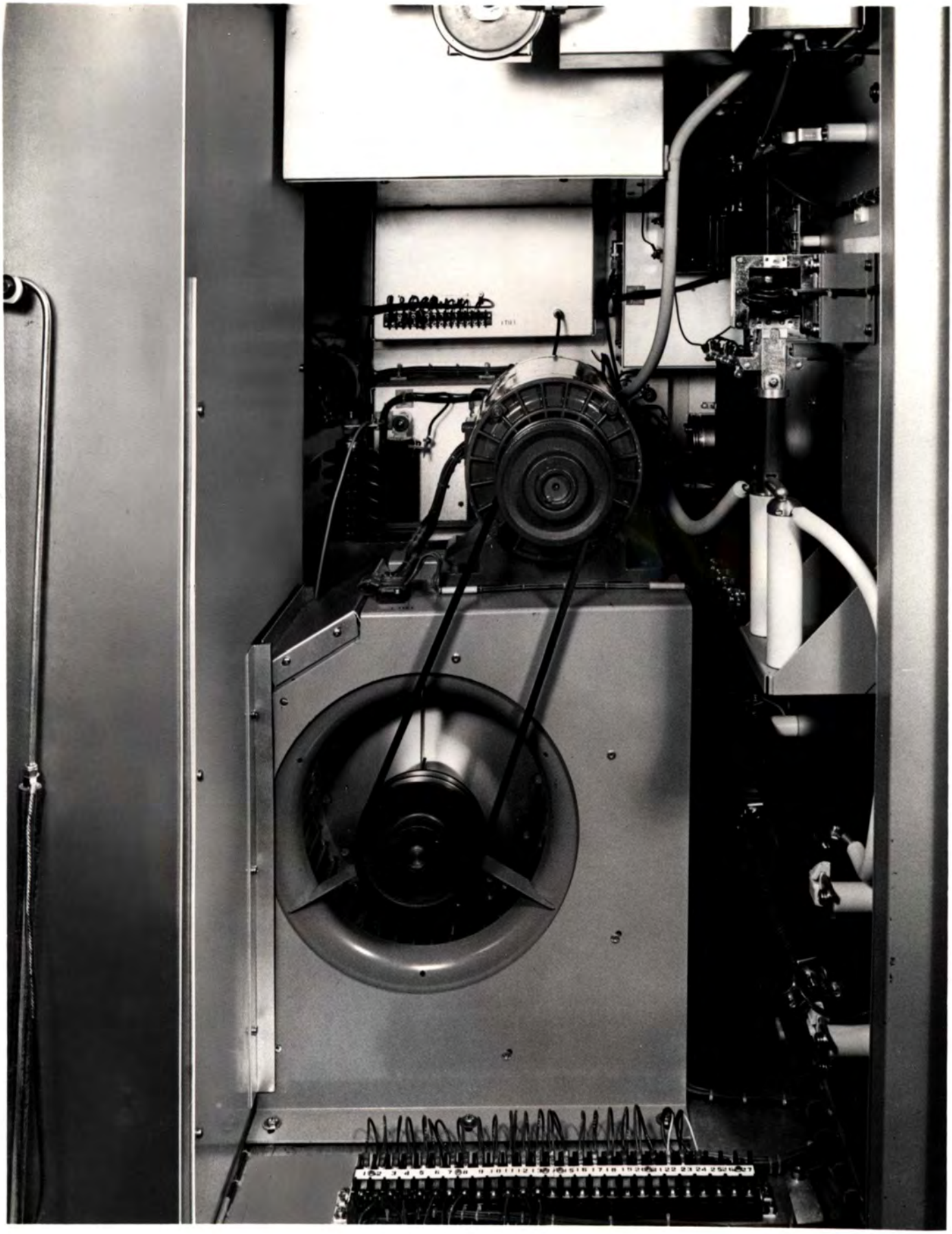


MW-50 MULTIMETER, FILAMENT VOLT METER AND TARGET OVERLOAD PANEL. 1894

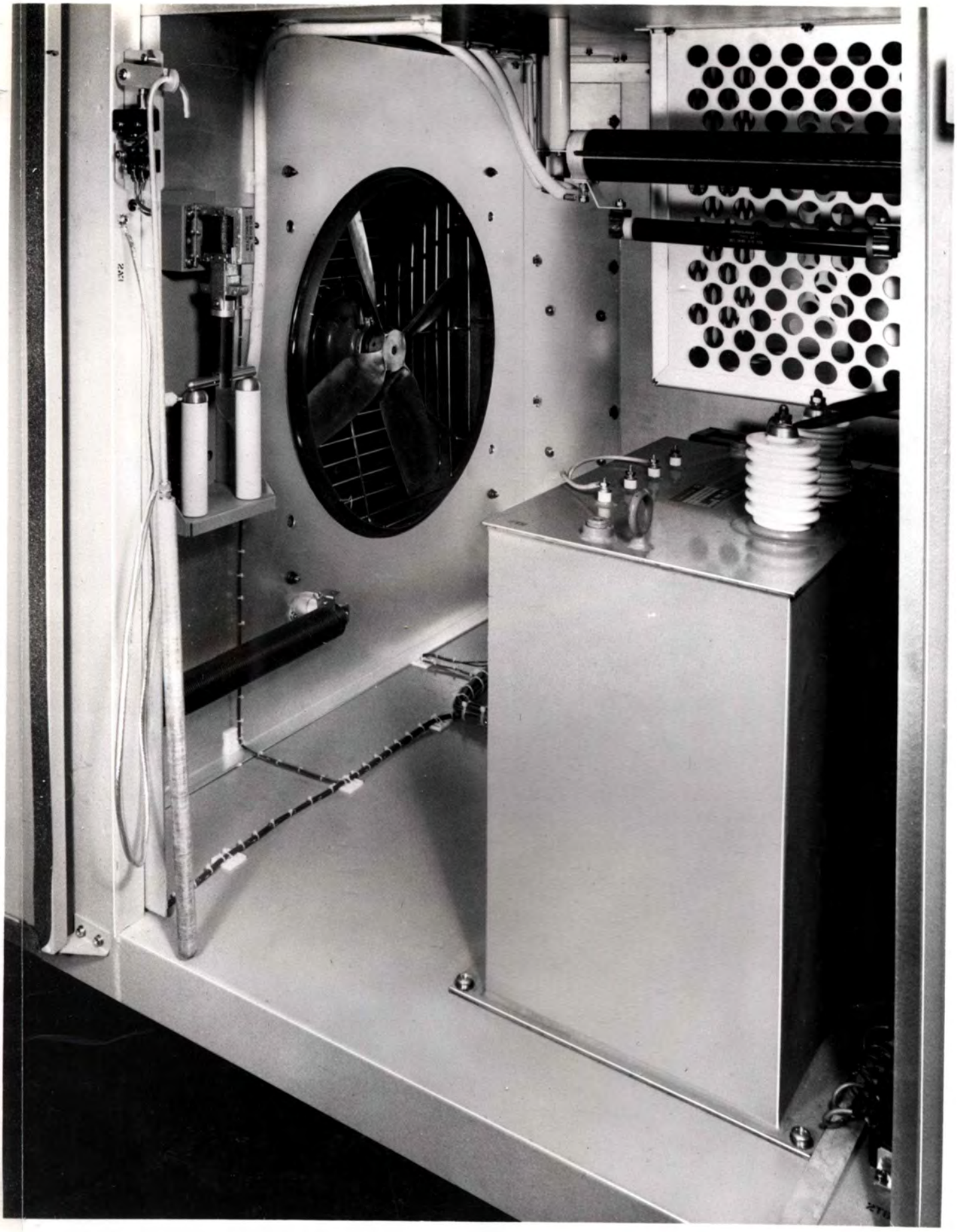
FRONT VIEW OF GATES' MW-50 RF CUBICLE, SHOWING DUAL OSCILLATOR CONTROLS AND ISOLATED METERING. 1891



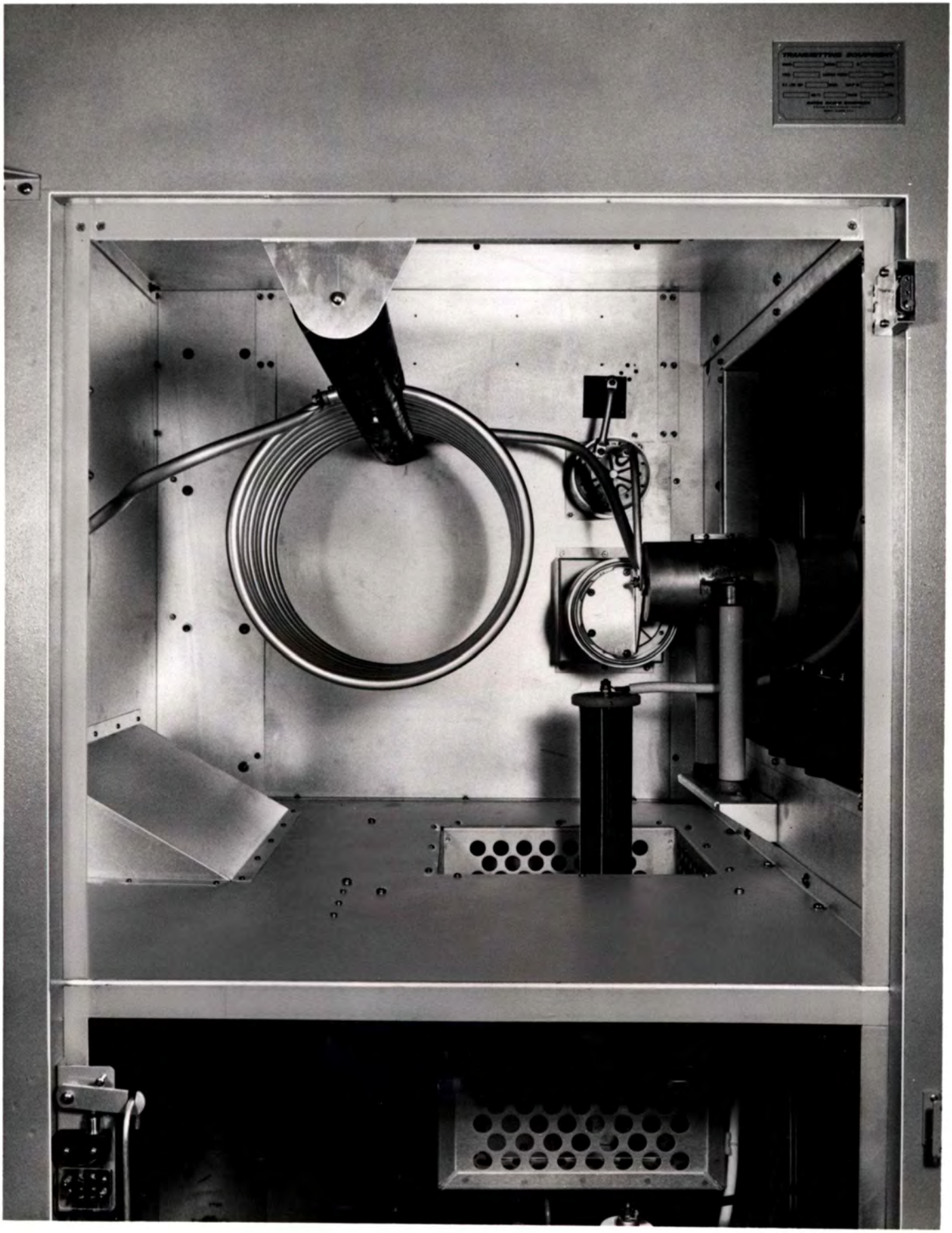
HINGED METER PANELS ON GATES' MW-50 ALLOW EASY ACCESS FOR INSPECTION AND MAINTENANCE. 1888



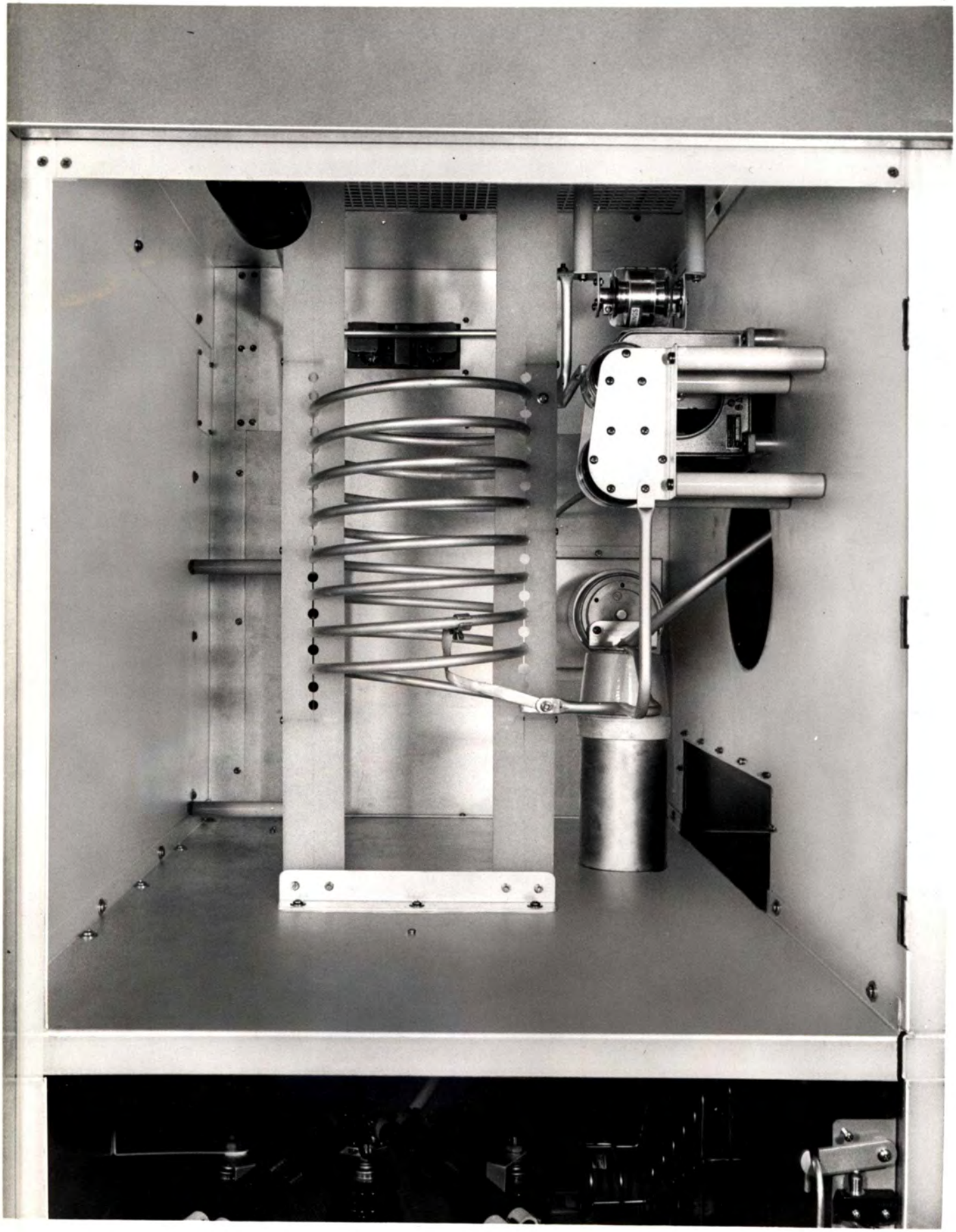
LOW-SPEED BLOWER USED FOR COOLING POWER AMPLIFIER AND PULSE DURATION MODULATOR TUBES IN GATES' MW-50, 50 kW MEDIUM WAVE TRANSMITTER. 1908



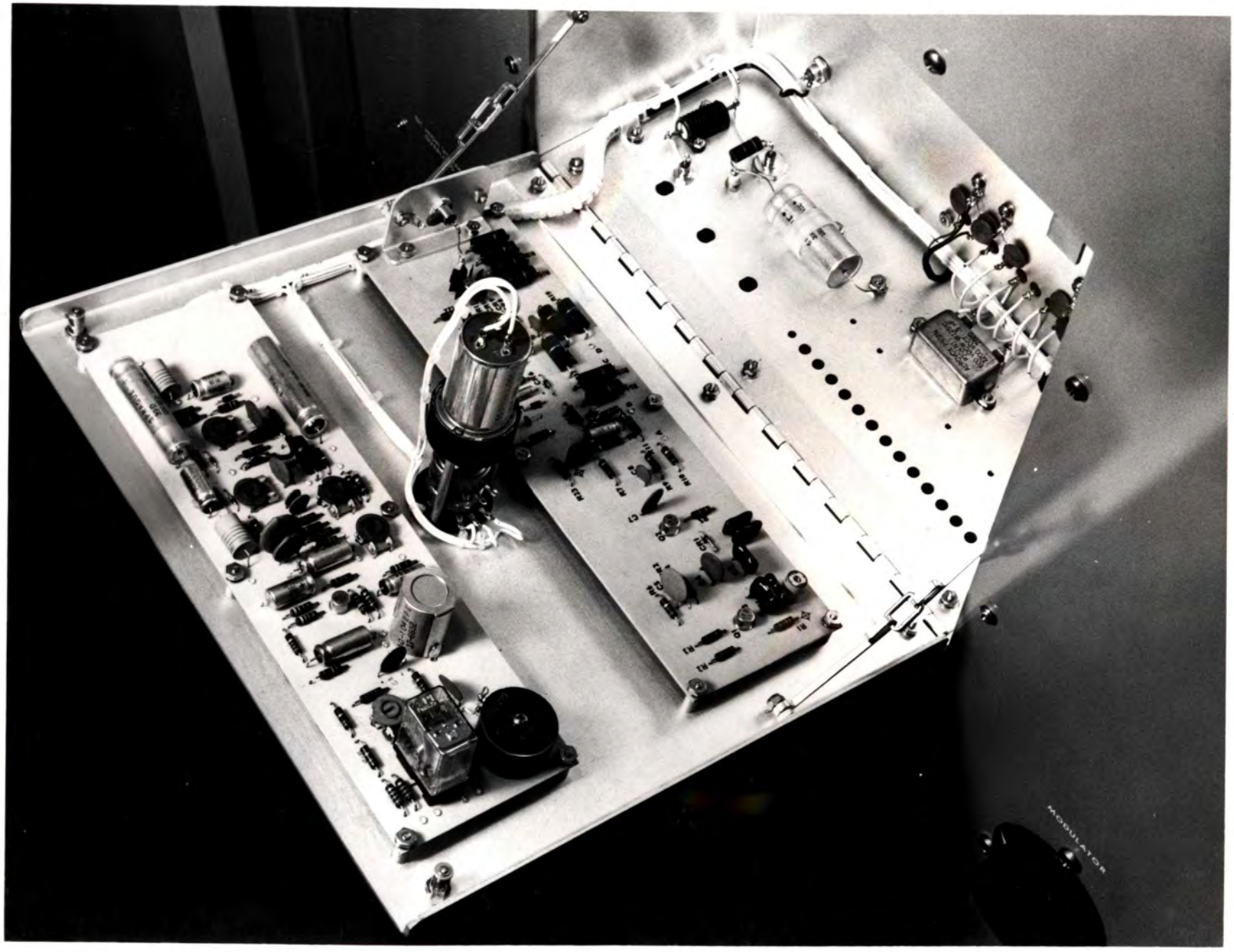
AC ISOLATION TRANSFORMER AND CIRCULATOR FAN USED FOR FLUSHING TRANSMITTER AIR IN GATES' MW-50, 50 kW MEDIUM WAVE TRANSMITTER. 1906



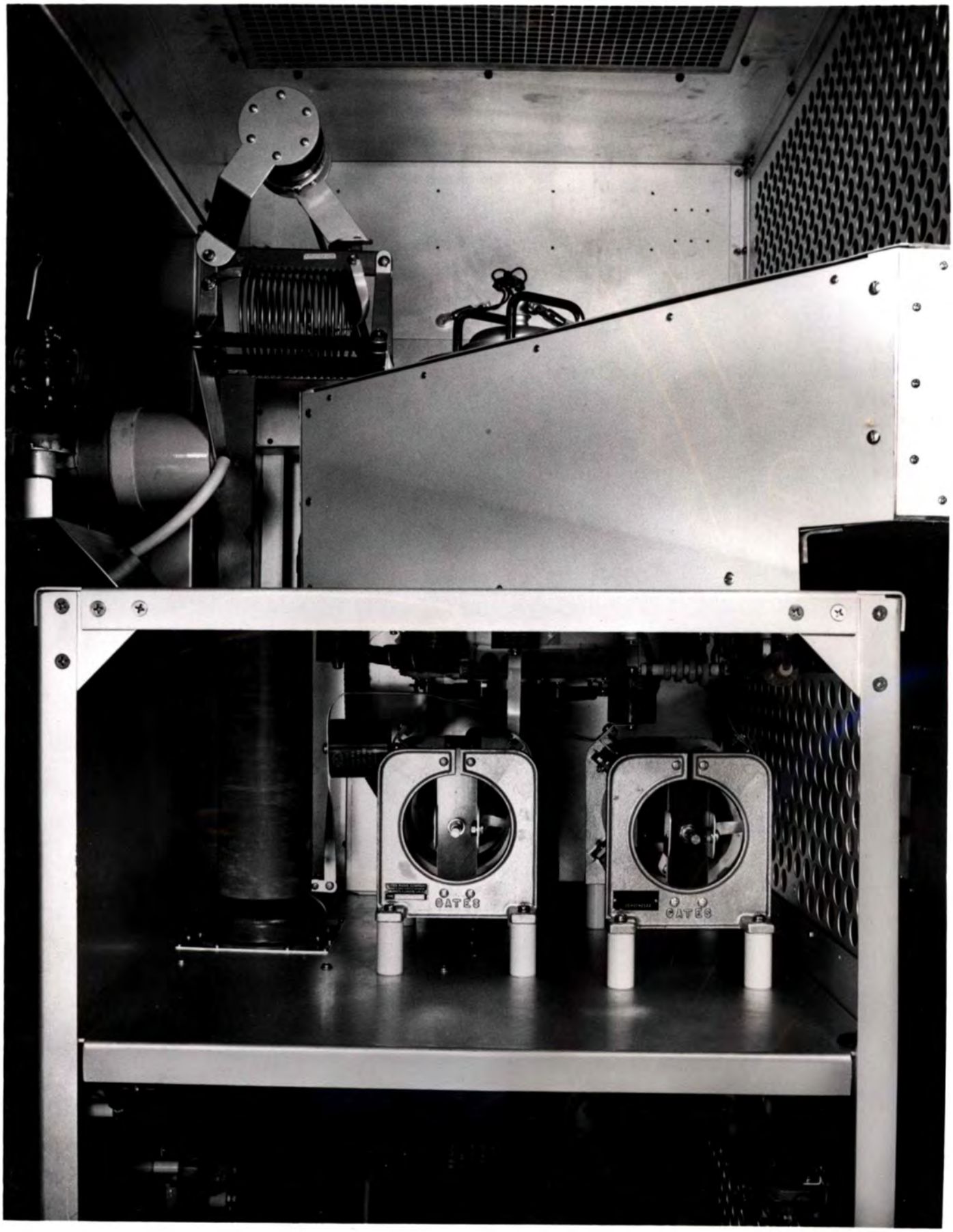
POWER AMPLIFIER TUNING COMPONENTS OF GATES' MW-50, 50 kW MEDIUM WAVE TRANSMITTER. 1900



POWER AMPLIFIER OUTPUT COMPONENTS IN GATES' MW-50, 50 kW MEDIUM WAVE TRANSMITTER. 1907



LOW LEVEL PULSE DURATION MODULATOR CHASSIS, SHOWING POWER CONTROL, LOW LEVEL PULSE DURATION MODULATOR AND AUDIO INPUT/CONTROL BOARD. 1897



RF DRIVER TUBE (4CX1500A) AND TUNING COMPONENTS, GATES' MW-50, 50 kW MEDIUM WAVE TRANSMITTER. 1899

FCC Form 723-A
July 1971

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

March 17, 1972

IN REPLY REFER TO:
6110/TD 85.1.1/
EQU-17

Gates Radio Company
Division of Harris-Intertype Corp.
Attention: Mr. C. Brian Cox
123 Hampshire Street
Quincy, Illinois 62301

Re: Application dated February 14, 1972
for type acceptance of the following equipment:
Name of Applicant Gates Radio Company
Equipment Type No. MM-50
Application Acct. Class 080

Gentlemen:

Pursuant to the above referenced application, type acceptance of the equipment specified is hereby granted for use under Part(s) 73 of the Commission's Rules and Regulations, subject to payment and receipt of the grant fee required by §1.1120 of the Commission's rules within 45 days from the date of this letter.

You are hereby requested to remit the following amount appropriate to this application for type acceptance:

Amount due: $ 75.00 Date due: May 1, 1972

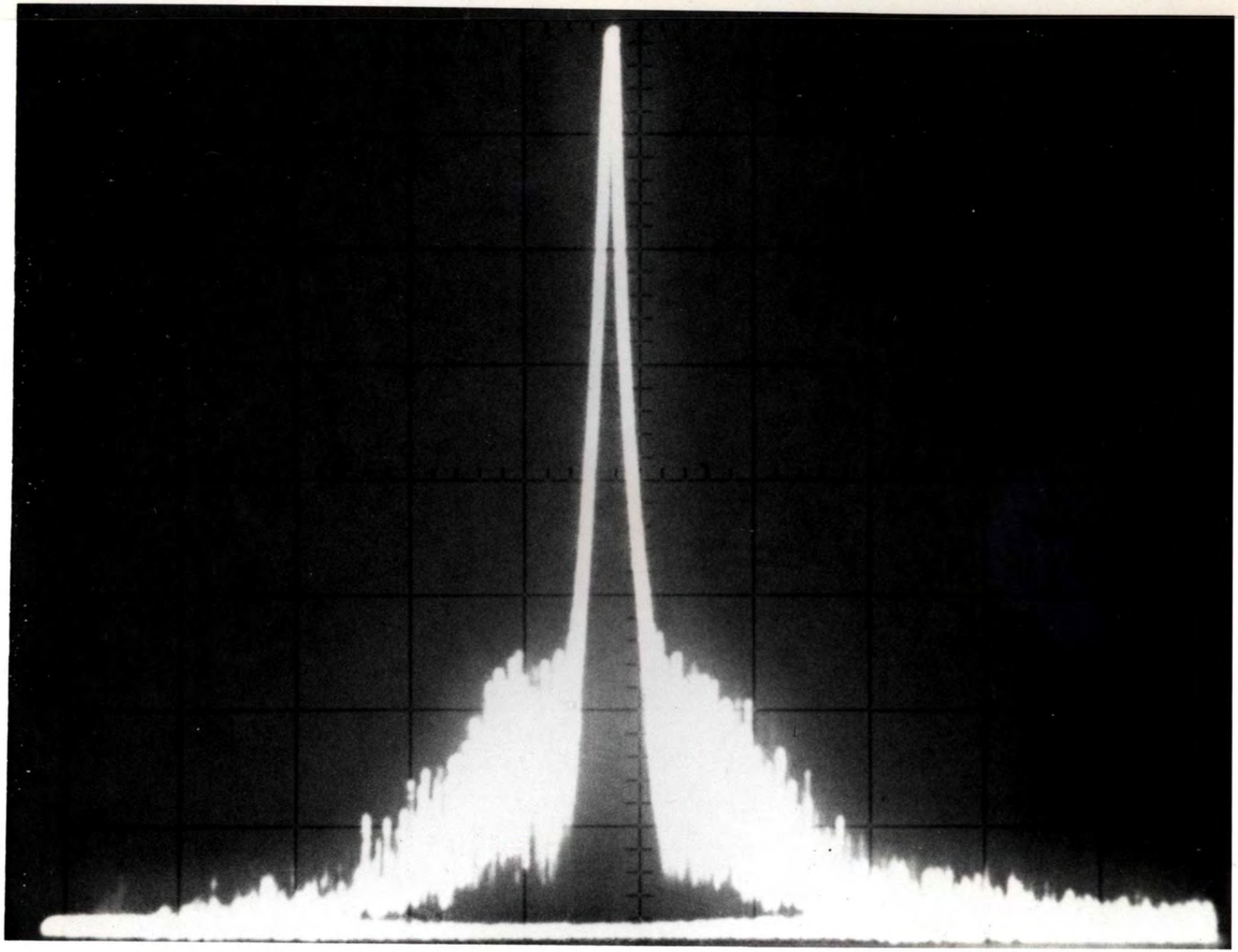
Failure to make payment of the grant fee to the Commission by the required date shall result in the grant becoming null and void and ineffective after that date, pursuant to §1.1102(d) of the Commission's Rules.

Checks or money orders should be made payable to Federal Communications Commission. It is important that you enclose the duplicate copy of this form with your remittance in order to ensure that your payment is identified with the appropriate application. Please use the enclosed envelope.

Sincerely yours,

John T. Robinson
Chief, Technical Standards Branch

enclosures



SPECTRUM ANALYSIS OF GATES' MW-50, ±100 kHz OF CARRIER FREQUENCY. 1942

AUDIO FREQUENCY DATA & CURVES

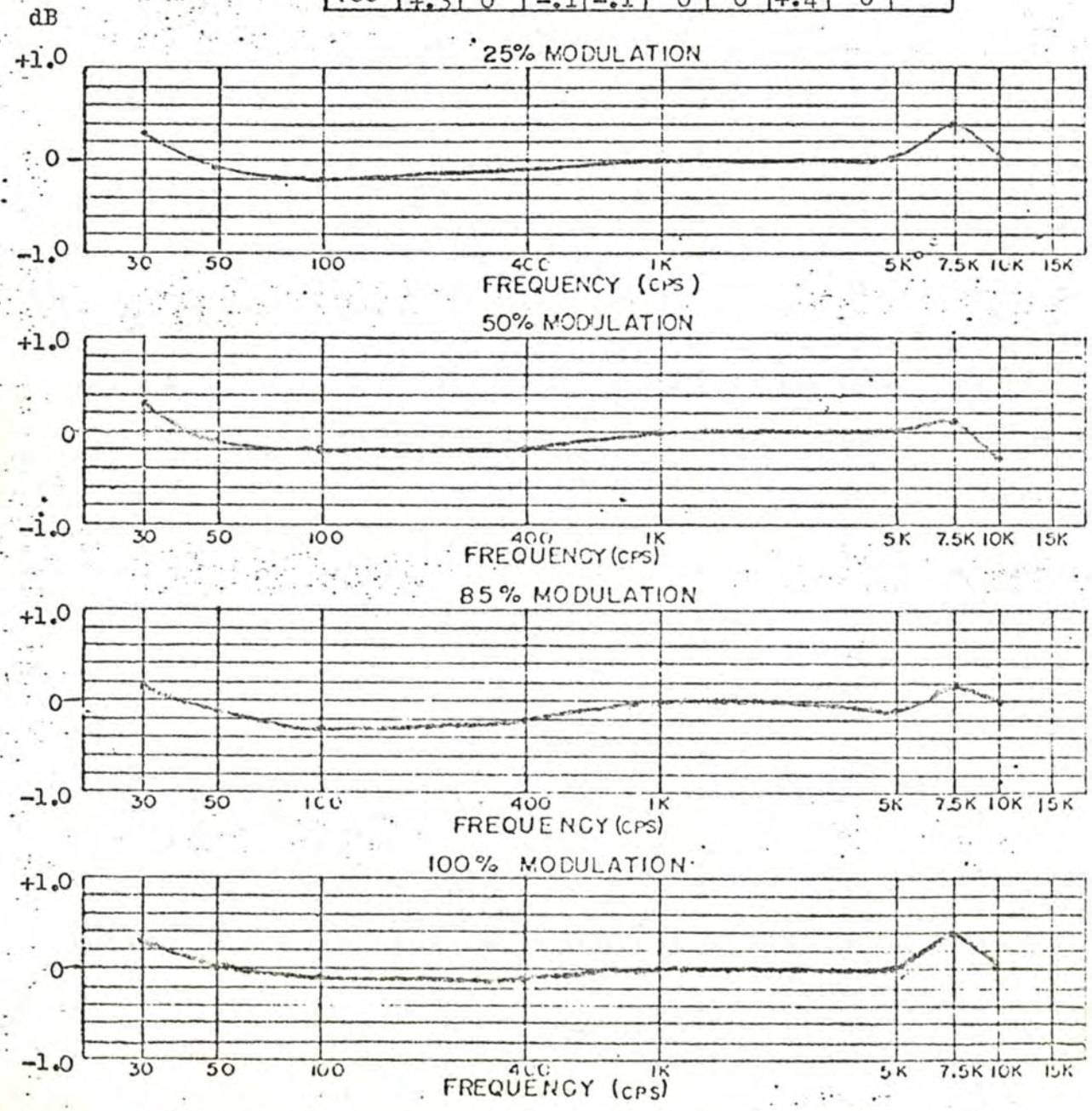
MW-50 BROADCAST TRANSMITTER

FCC Rule 2.579(b)(1)

Response Operating at 50 KW

Reference to 1 KHz

% MOD. CPS	30	50	100	400	1K	5K	7.5K	10K	15K
25	+.3	-.1	-.2	-.1	0	0	+.4	0	
50	+.3	-.1	-.2	-.2	0	0	+.1	-.3	
85	+.2	-.1	-.3	-.2	0	-.1	+.2	0	
100	+.3	0	-.1	-.1	0	0	+.4	0	



C. E. COX
ENGINEER

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M-6994

FORM GFCC

AUDIO FREQUENCY DATA & CURVES

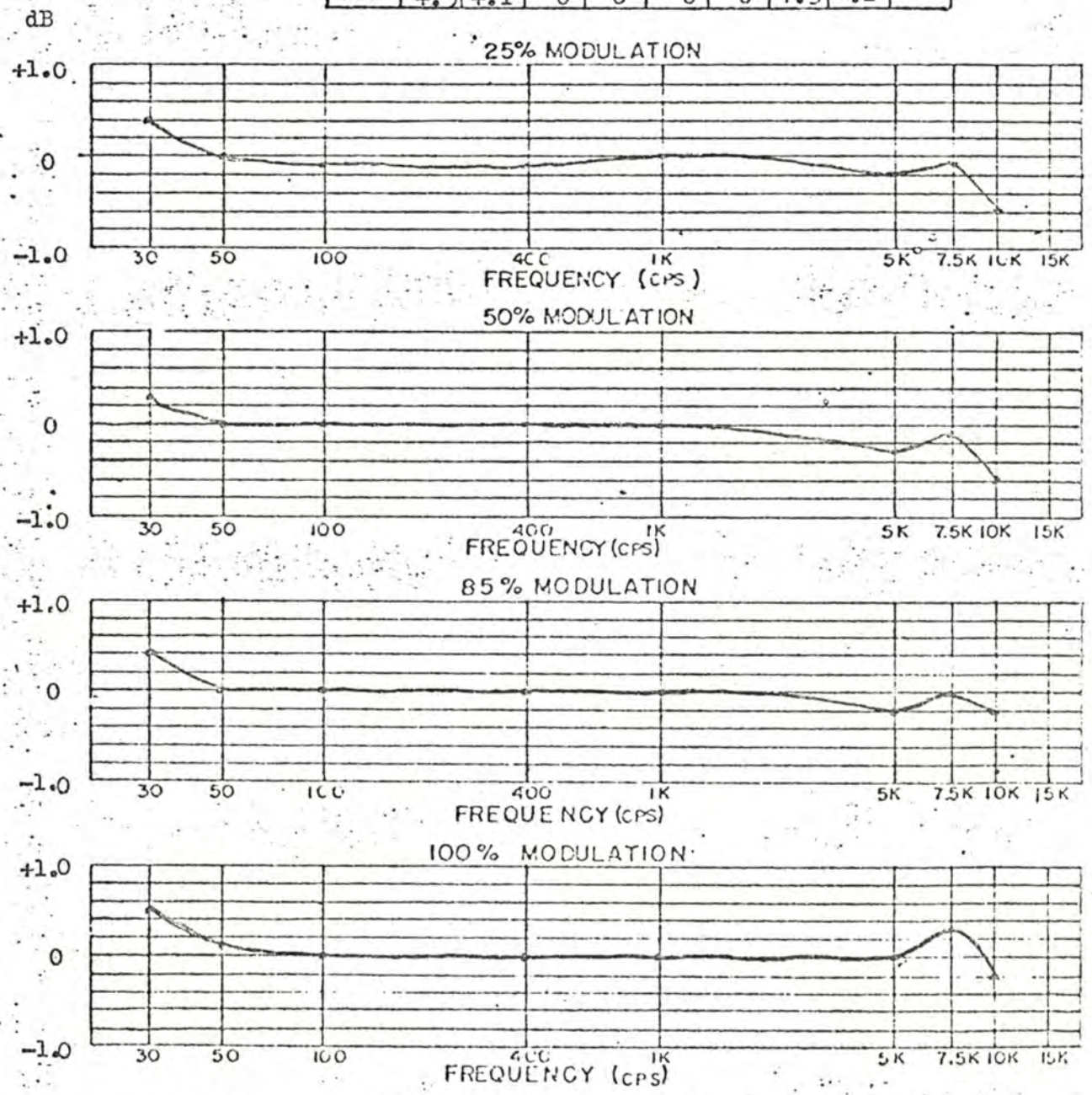
MW-50 BROADCAST TRANSMITTER

FCC Rule 2.579(b)(1)

Response Operating at 25 KW

Reference to 1 KHz

% MOD. \ CPS	30	50	100	400	1K	5K	7.5K	10K	15K
25	+.4	0	-.1	-.1	0	-.2	-.1	-.6	
50	+.3	0	0	0	0	-.3	-.1	-.6	
85	+.4	0	0	0	0	-.2	0	-.2	
100	+.5	+.1	0	0	0	0	+.3	-.2	



C. B. COX. 27JAN 1972 M 6994

ENGINEER

FORM GFCC

AUDIO FREQUENCY DATA & CURVES

MW-50 BROADCAST TRANSMITTER

FCC Rule 2.579(b)(1)

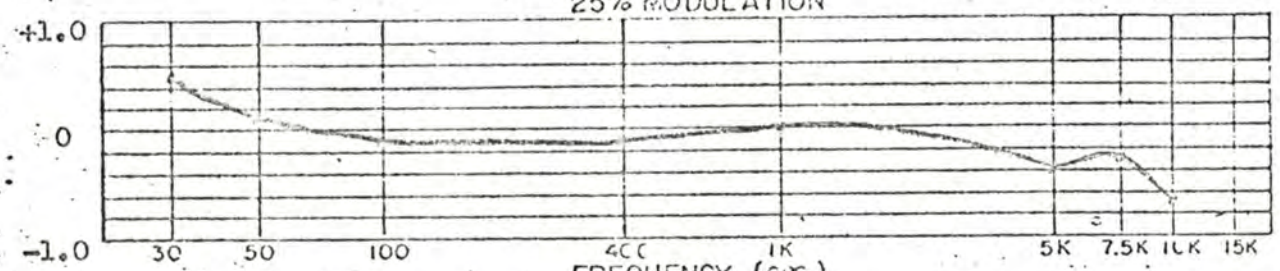
Response Operating at 10 KW

Reference to 1 KHz

% MOD.	CPS	30	50	100	400	1K	5K	7.5K	10K	15K
	25	+.5	+.1	-.1	-.1	0	-.4	-.3	-.7	
	50	+.5	+.1	0	0	0	-.3	0	-.5	
	85	+.4	+.1	-.1	-.1	0	-.1	+.1	-.4	
	100	+.4	0	-.2	-.1	0	-.2	+.1	-.6	

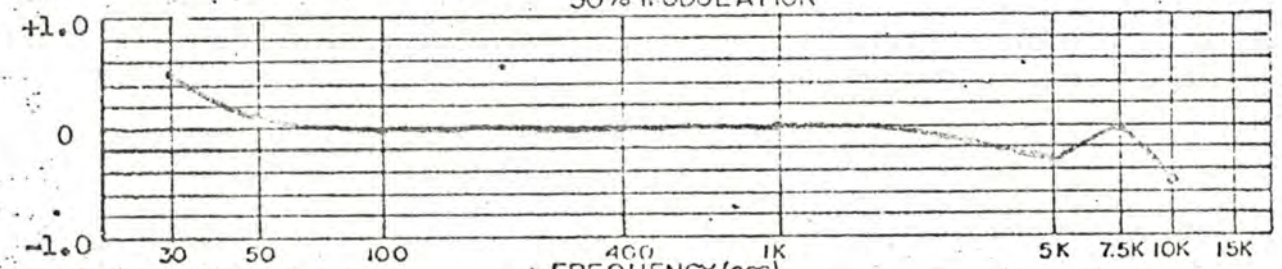
dB

25% MODULATION



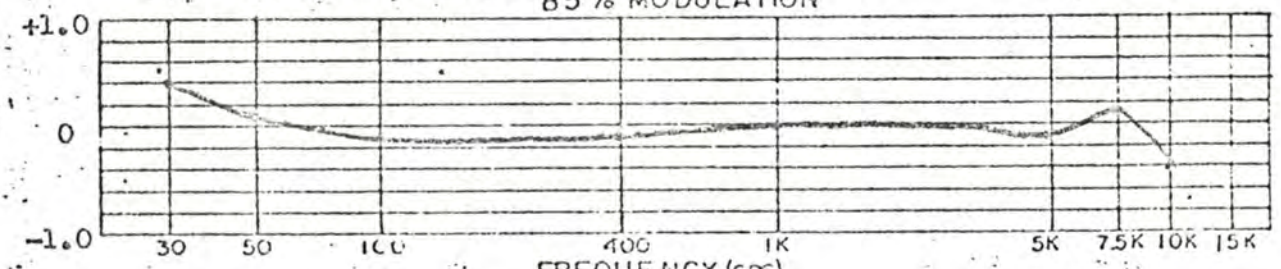
FREQUENCY (CPS)

50% MODULATION



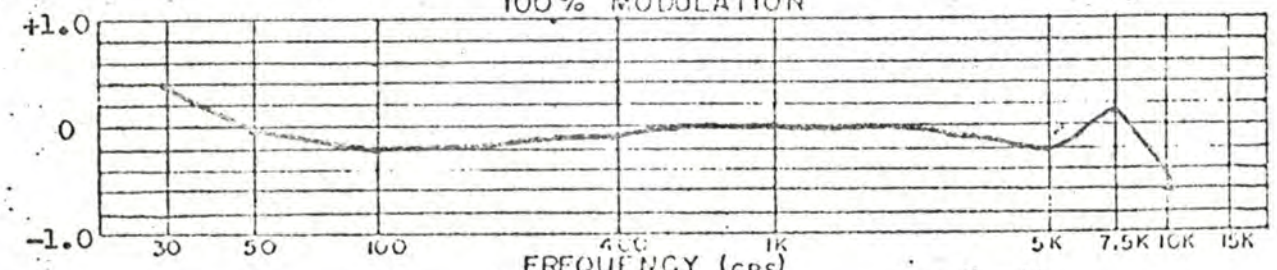
FREQUENCY (CPS)

85% MODULATION



FREQUENCY (CPS)

100% MODULATION



FREQUENCY (CPS)

C. B. COX ENGINEER 27JAN 19 72 M-6994

FORM GFCC

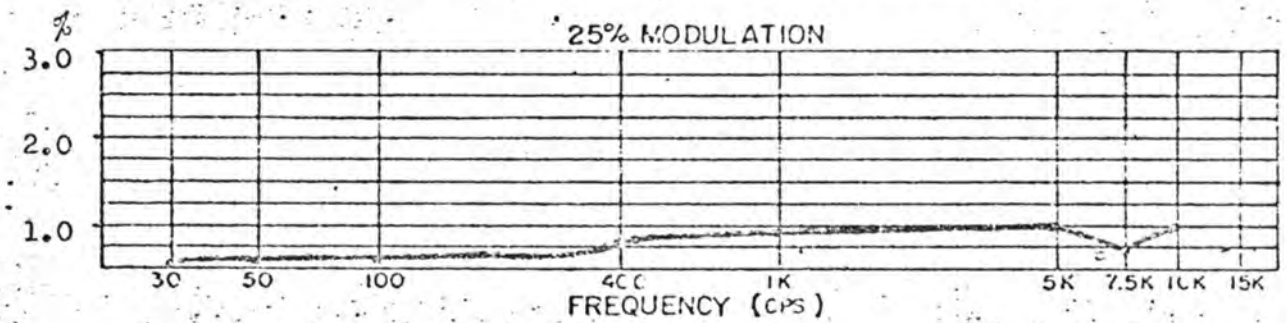
AUDIO FREQUENCY DATA & CURVES

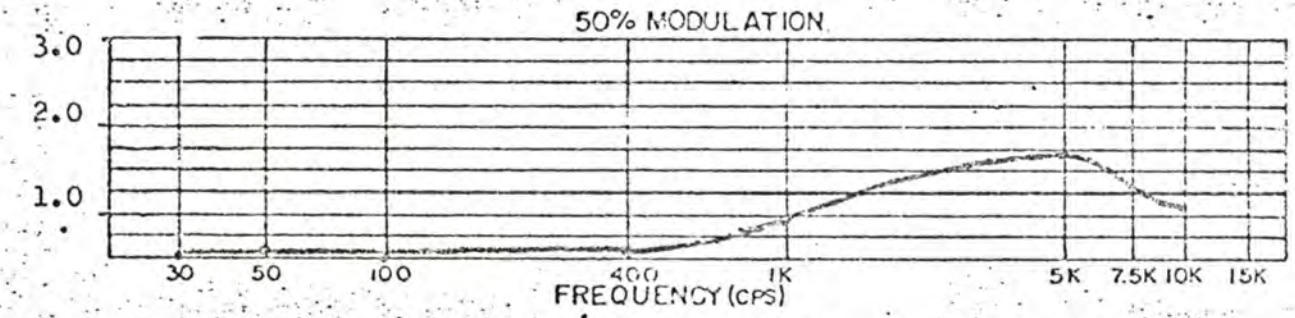
MW-50 BROADCAST TRANSMITTER

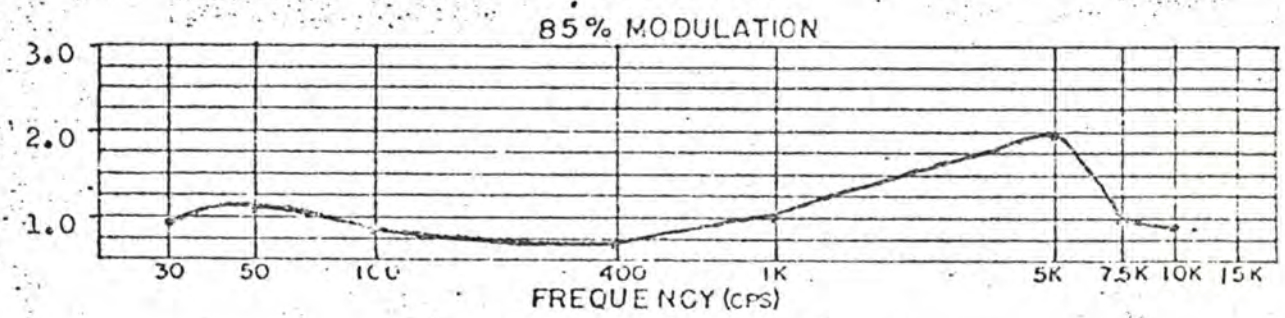
FCC Rule 2.579(b)(2)

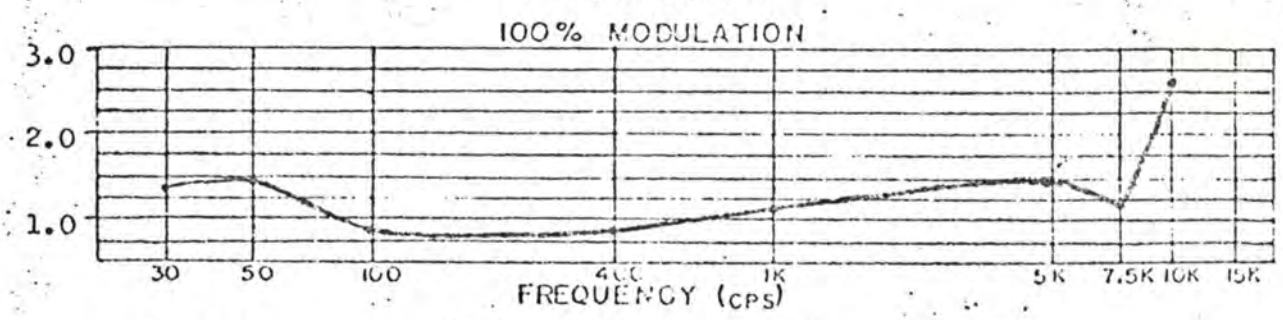
Percent Distortion Operating at 50 KW

% MOD.	CPS	30	50	100	400	1K	5K	7.5K	10K	15K
	25	0.6	0.6	0.6	0.8	0.9	1.0	0.7	1.0	
	50	0.5	0.6	0.5	0.6	0.9	1.7	1.3	1.1	
	85	0.9	1.1	0.8	0.7	1.0	2.0	1.0	0.9	
	100	1.3	1.4	0.8	0.8	1.1	1.5	1.2	2.6	









C. B. COX 27JAN 1972 M-6994

ENGINEER

FORM GFCC

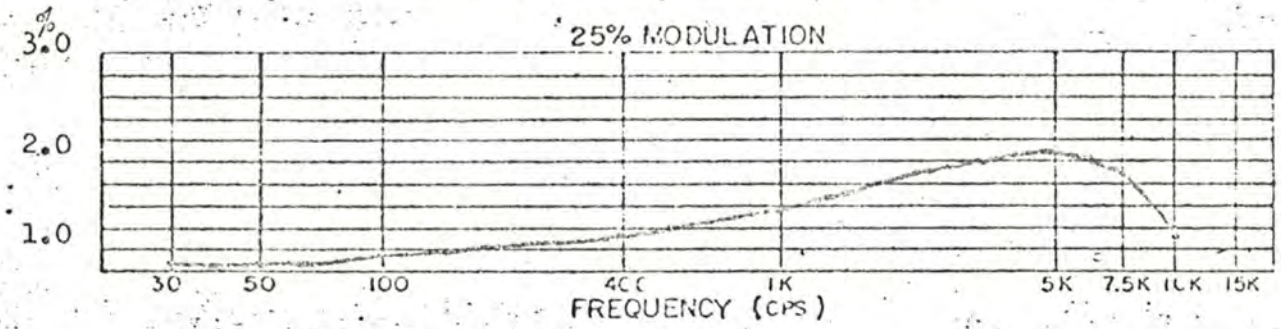
AUDIO FREQUENCY DATA & CURVES

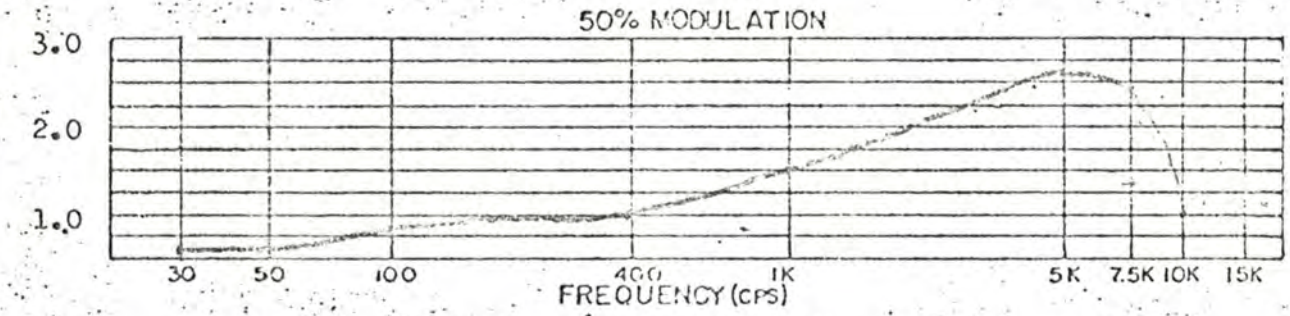
MW-50 BROADCAST TRANSMITTER

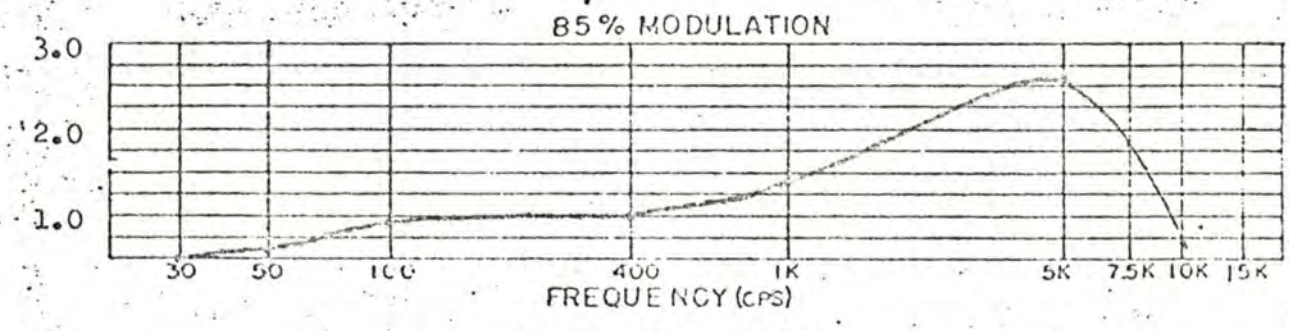
FCC Rule 2.579(b)(2)

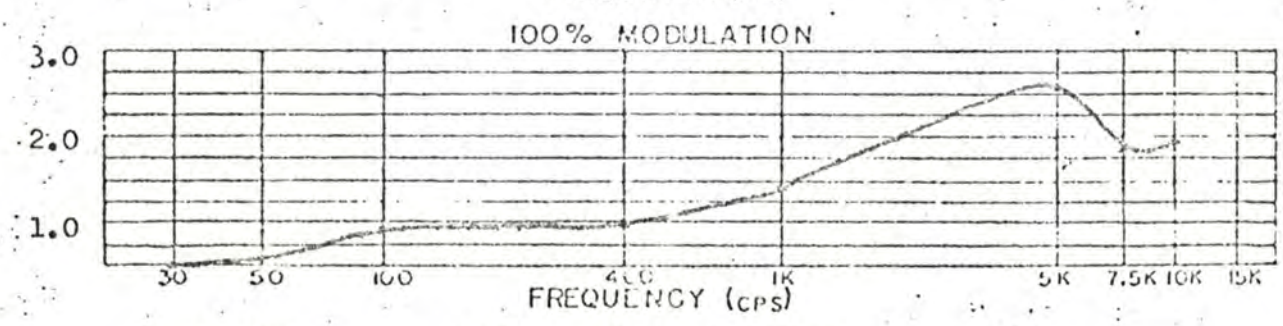
Percent Distortion Operating at 25 KW

% MOD.	CPS	30	50	100	400	1K	5K	7.5K	10K	15K
	25	0.6	0.6	0.7	0.9	1.2	1.8	1.6	0.9	
	50	0.6	0.6	0.8	1.0	1.5	2.6	2.4	1.0	
	85	0.5	0.6	0.8	0.9	1.2	2.5	1.8	0.7	
	100	0.5	0.6	0.9	1.0	1.4	2.6	1.8	1.9	









C. B. COX 27JAN 19 72 M-6994

ENGINEER

FORM GFCC

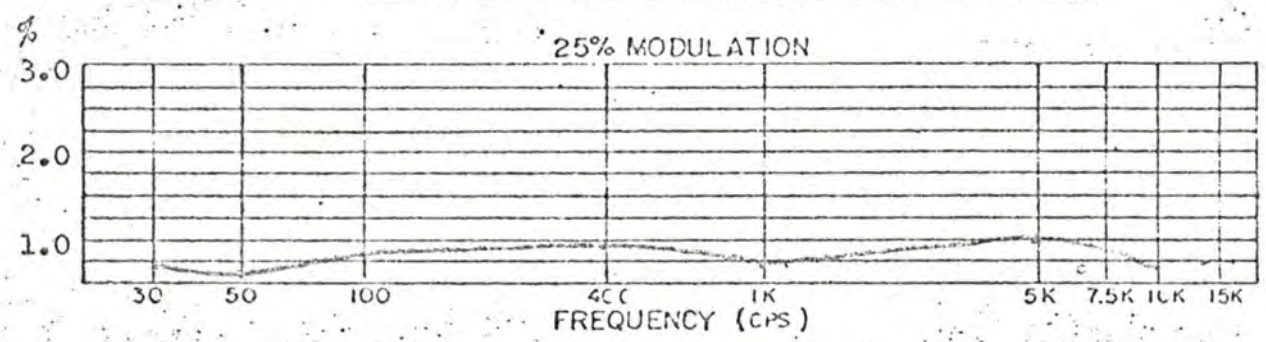
AUDIO FREQUENCY DATA & CURVES

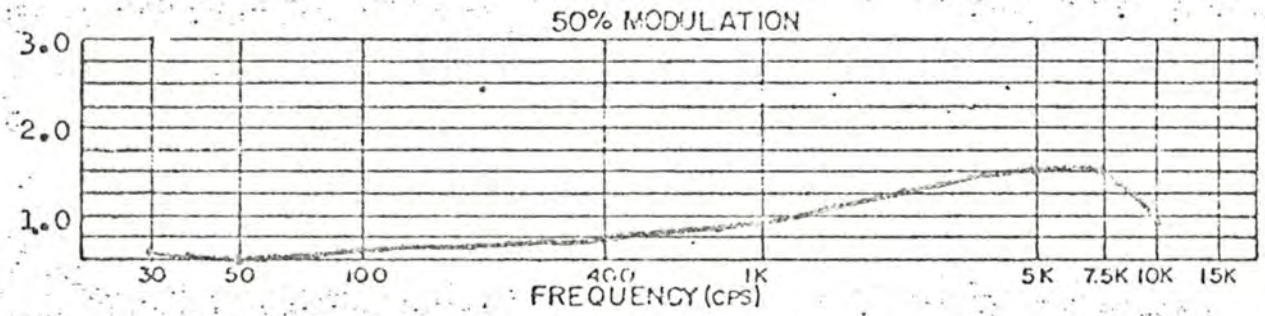
MW-50 BROADCAST TRANSMITTER

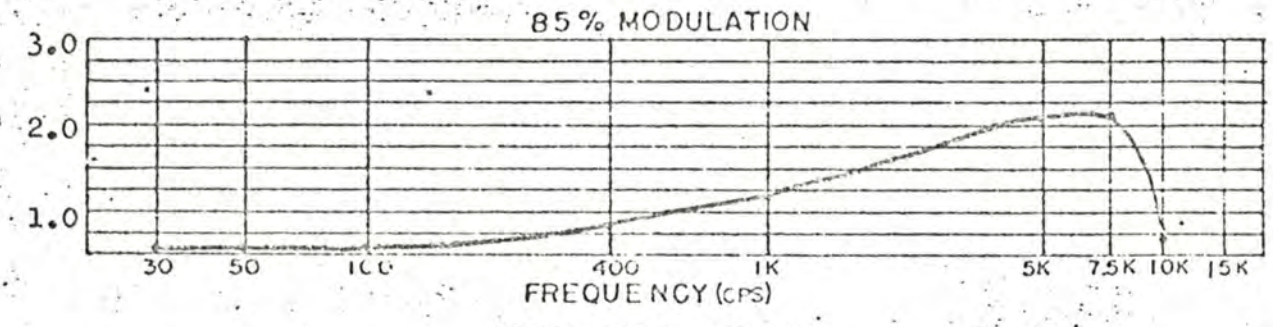
FCC Rule 2.579(b)(2)

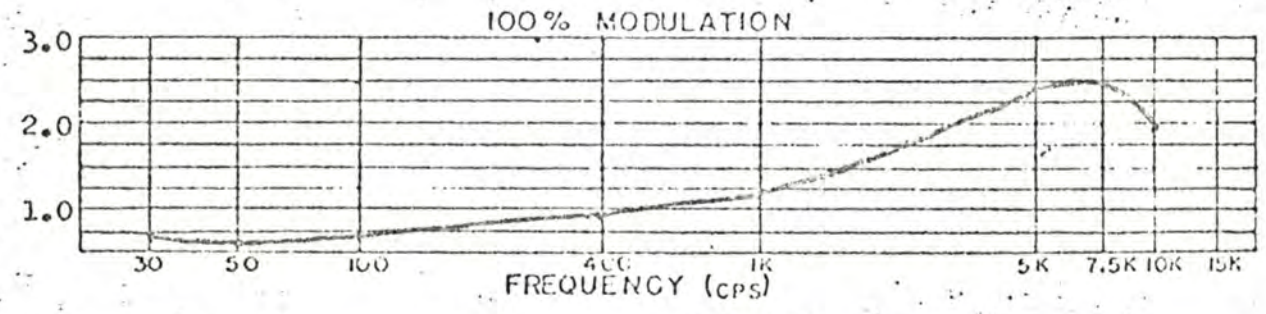
Percent Distortion Operating at 10 KW

% MOD.	CPS	30	50	100	400	1K	5K	7.5K	10K	15K
	25	0.7	0.6	0.8	0.9	0.7	1.0	0.8	0.7	
	50	0.6	0.5	0.6	0.7	0.9	1.5	1.5	0.9	
	85	0.6	0.6	0.6	0.8	1.2	2.1	2.1	0.7	
	100	0.7	0.6	0.7	0.9	1.2	2.4	2.4	1.9	









C. B. COX
ENGINEER

27JAN 1972

M-6994

FORM GFCC

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CX1500A

RADIAL BEAM TETRODE

PRELIMINARY DATA SHEET

The EIMAC 4CX1500A is a general purpose tetrode for use up to and through VHF, insulation is ceramic, the thoriated tungsten filament is a rugged mesh design. The screen terminal is a continuous ring which allows good isolation between the plate circuit and the control grid circuit.

The 4CX1500A is recommended for use as a Class C Power Amplifier, Class B, or Class AB_1 Linear Amplifier, as a Regulator, and in Pulse Modulator service.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament Voltage	5.0	volts
Filament Current	40.5	amps
Amplification Factor (Grid Screen)	5.5	
Transconductance (Ib = 1 amp		
E_{c2} = 500 volts, Eb = 200 volts)	26,000	μmho
Frequency for Maximum Ratings	150	MHz
Direct Interelectrode Capacitances, Grounded Cathode		
Input	80	pF
Output	9.5	pF
Feedback	Not over .4	pF

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Recommended Socket	EIMAC SK-831
Recommended Air Chimney	EIMAC SK-806
Operating Position	Axis Vertical
Maximum Anode Core Temperature	250°C
Maximum Seal Temperature	250°C
Cooling	Forced Air
Maximum Dimensions	
Height	4.8 inches
Diameter	3.4 inches
Net Weight	30 ounces
Shipping Weight (Approximately)	3 pounds

(Effective 3-15-70) Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Continuous Operating Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

TYPICAL OPERATION

	Low Freq. Calculated		220 MHz Measured	
DC Plate Voltage	3000	4000	3000	volts
DC Screen Voltage	500	500	500	volts
DC Grid Voltage	-200	-200	-116	volts
DC Plate Current	800	800	1000	mA
DC Screen Current	36	37	35	mA
DC Grid Current	17	15	0	mA
Peak RF Grid Voltage	240	240	---	volts
Driving Power	4.1	3.6	31.5	watts
Resonant Load Resistance	1720	2570	---	ohms
Plate Dissipation	600	700	---	watts
Power Output	1800	2500	1500[1]	watts

1. Useful Power Output

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class C Telephony
(Carrier Conditions unless noted)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC SCREEN VOLTAGE	550	VOLTS
DC PLATE CURRENT	.8	AMPERE
PLATE DISSIPATION [1]	1000	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

1. Corresponds to 1500 watts at 100% sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	2500	3400 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	-300	-300 volts
Peak Audio Screen Voltage (For 100% mod. approx.)	500	500 volts
DC Plate Current	800	900 mA
DC Screen Current	46	28 mA
DC Grid Current	27	28 mA
Peak RF Grid Voltage	365	365 volts
Grid Driving Power	10	10 watts
Resonant Load Resistance	3200	1940 ohms
Plate Dissipation	620	780 watts
Plate Power Out	1600	2320 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Two Tubes) Class AB_1

DC Plate Voltage	2500	3900 volts
DC Screen Voltage	600	600 volts
DC Grid Voltage	-105	-110 volts
Zero-Signal Plate Current	500	400 mA
Max-Signal Plate Current	1.530	1.500 amp
Max-Signal Screen Current	90	80 mA
Peak AF Driving Voltage	95	100 volts
Load Resistance Plate to Plate	3340	5800 ohms
Max-Signal Plate Dissipation[1]	820	1070 watts
Max-Signal Plate Power Out	2160	3700 watts

1. Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

TYPICAL OPERATION Class AB_1

DC Plate Voltage	2500	3900 volts
DC Screen Voltage	600	600 volts
DC Grid Voltage	-105	-110 volts
Zero-Signal Plate Current	250	200 mA
Max-Signal Plate Current	765	750 mA
Max-Signal Screen Current	46	40 mA
Peak RF Driving Voltage	95	100 volts
Resonant Plate Load Resistance	1670	2900 ohms
Max-Signal Plate Power Out	1080	1850 watts

APPLICATION

CHARACTERISTIC RANGE VALUES

Filament Current, E_F = 5.0 V	38.0	43.0	AMPS
Interelectrode Capacitance			
Grounded Cathode Circuit			
Input	75.0	85.0	pF
Output	7.5	11.5	pF
Feedback	---	.4	pF

MECHANICAL

MOUNTING - The 4CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-831 socket and SK-806 chimney have been designed especially for the 4CX1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and through the anode cooling fins.

COOLING - The maximum temperature rating for the anode core of the 4CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

	SEA LEVEL		6000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	27	.33	33	.40
1500	47	.76	58	.95

*Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen dissipation can, under some conditions, represent another 100 watts, allowance has been made in preparing this tabulation for an additional 300 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value or below to obtain maximum tube life.

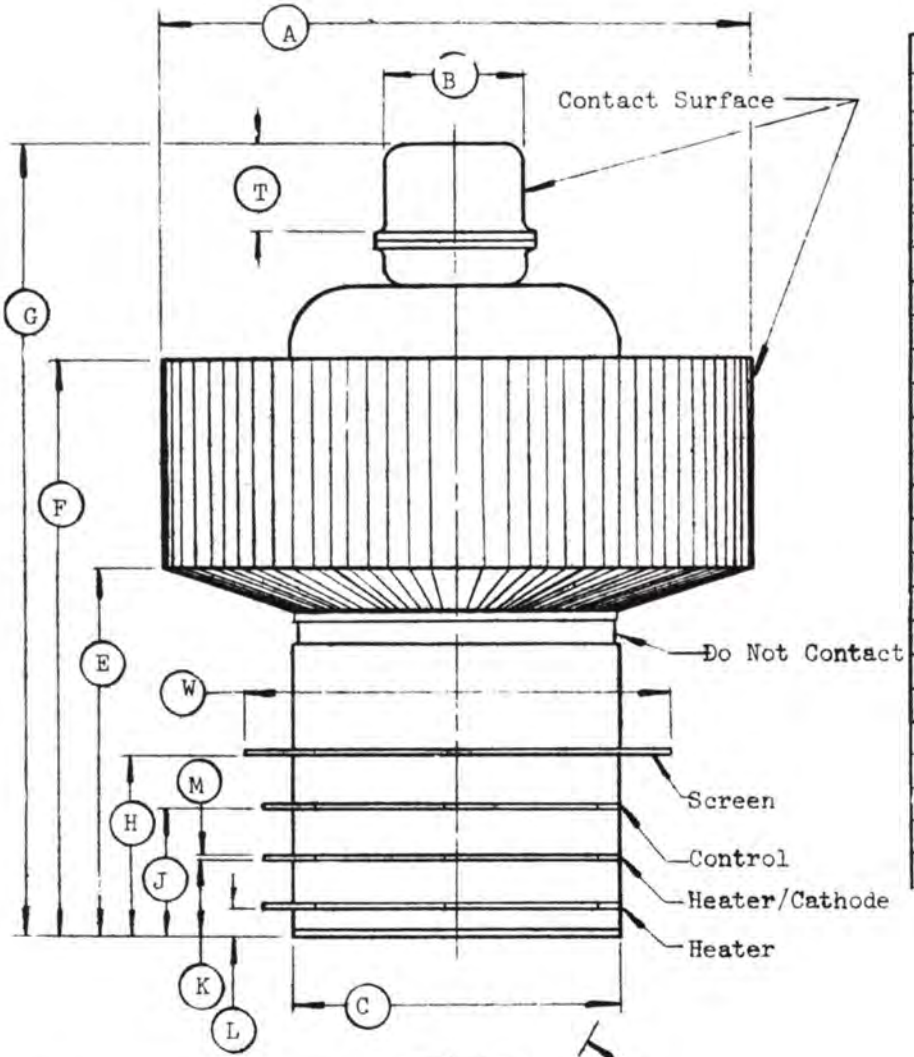
CONTROL GRID OPERATION - The rated dissipation of the grid is 25 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

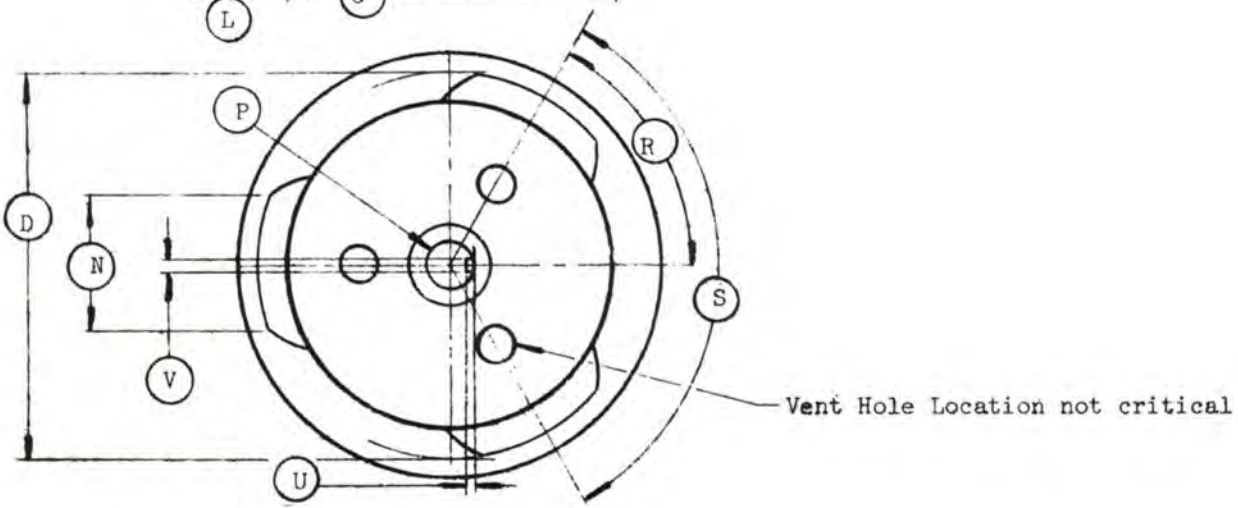
SCREEN GRID OPERATION - The power dissipated by the screen of the 4CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon RMS screen current and voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

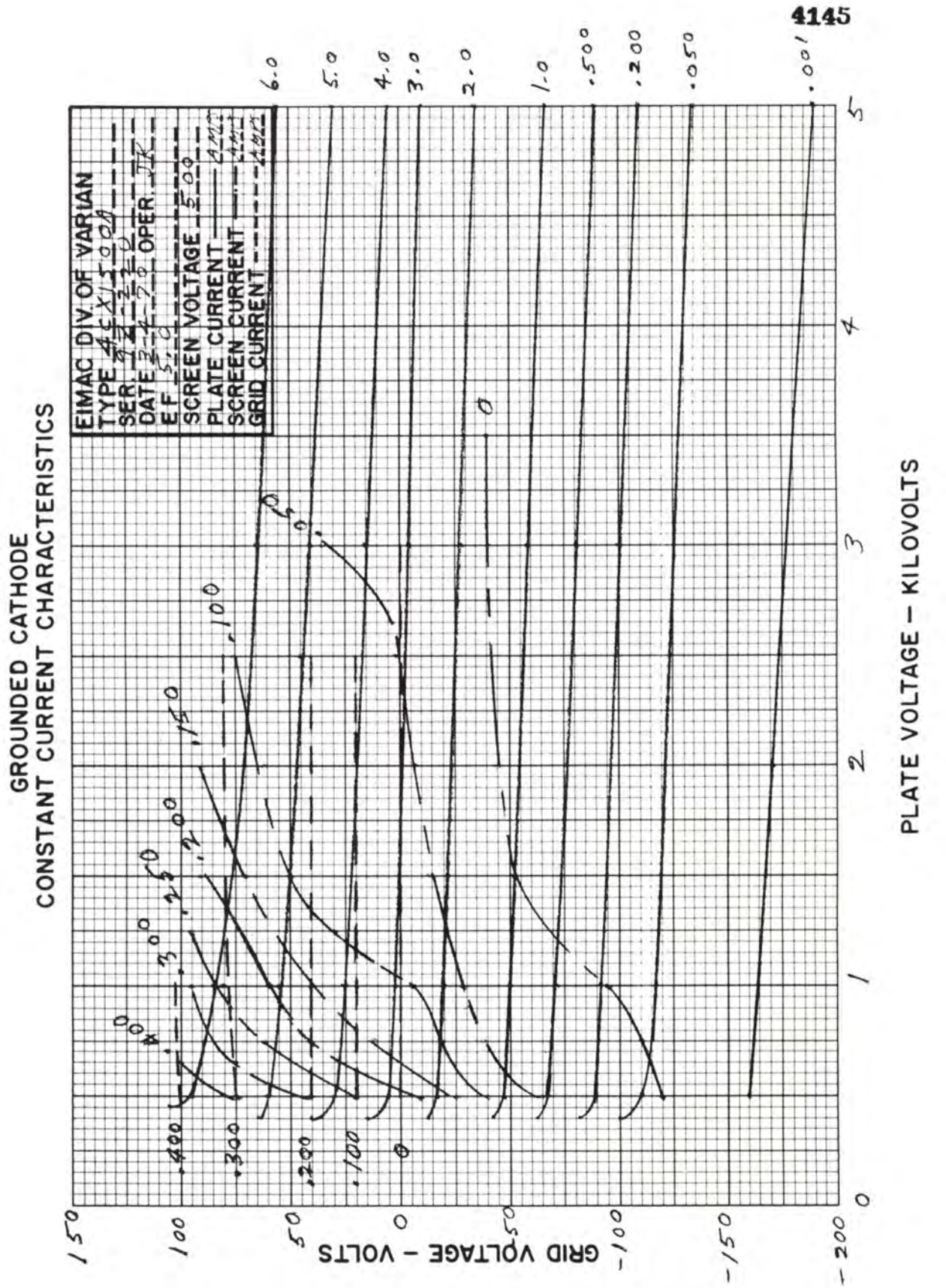


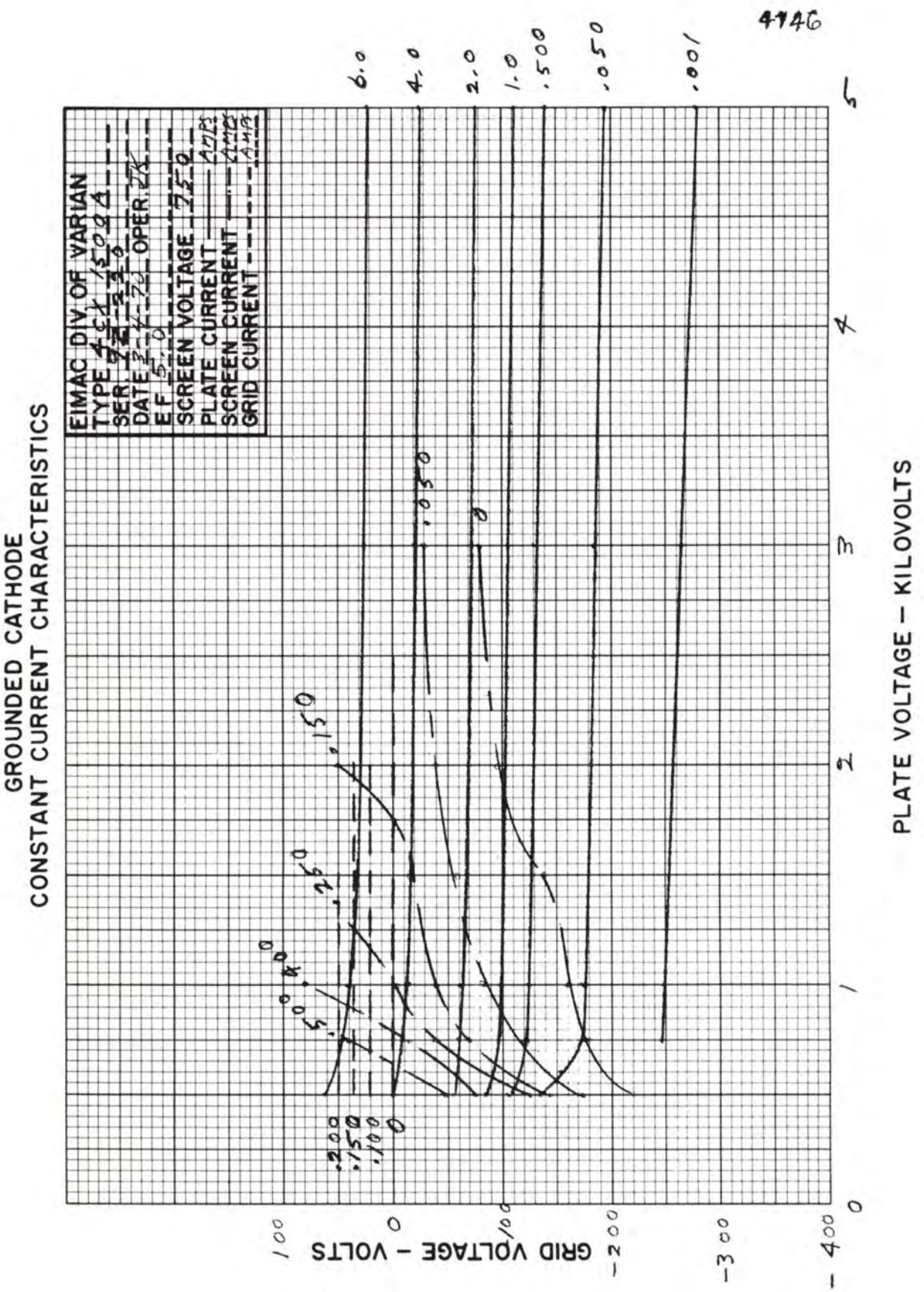


DIMENSIONS IN INCHES

DIMENSIONAL DATA

Dim.	MIN.	MAX.	Ref.
A	3.335	3.370	
B	.807	.820	
C	1.870	1.900	
D	2.250	2.300	
E	2.185	2.385	
F	3.385	3.585	
G	4.675	4.825	
H	.965	.988	
J	.690	.710	
K	.415	.435	
L	.140	.165	
M	.020	.030	
N	.700	.800	
P	.314	.326	
R	55°	65°	
S	115°	125°	
T	.470	.530	
U	.025	.048	
V	.045	.070	
W	2.468	2.531	





TENTATIVE SPECIFICATION

DESCRIPTION

The F-1099 is a high power vacuum diode designed for use in charging shunt or rectifying circuits. The cathode is a thoriated tungsten filament. The anode is of heavy wall construction capable of handling high momentary overloads. The anode is forced air cooled and is capable of dissipating up to 12 KW under CW conditions.

ELECTRICAL

Filament Voltage	7.0 volts
Filament Current	110 amperes
Filament Starting Current	165 max. amper
Filament Cold Resistance	.010 ohms

Rectifier Ratings

Maximum Peak Inverse Voltage	50 kilovolts
Maximum Peak Plate Current	25 amperes
Average Plate Current	8 amperes

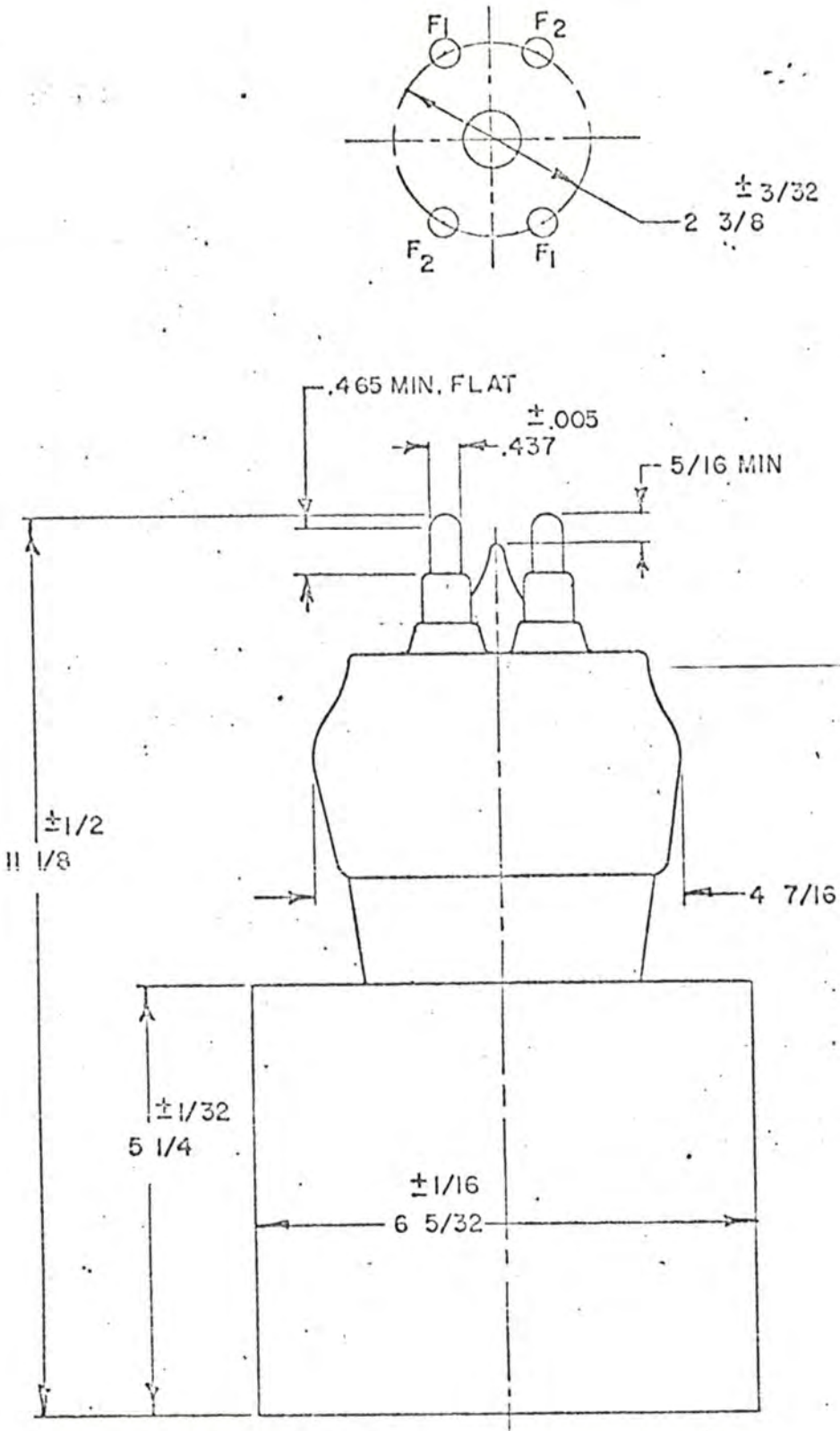
MECHANICAL

Mounting Position	Vertical, Anode Down
Maximum Incoming Air Temperature	45 °C

Required Air Flow on Anode

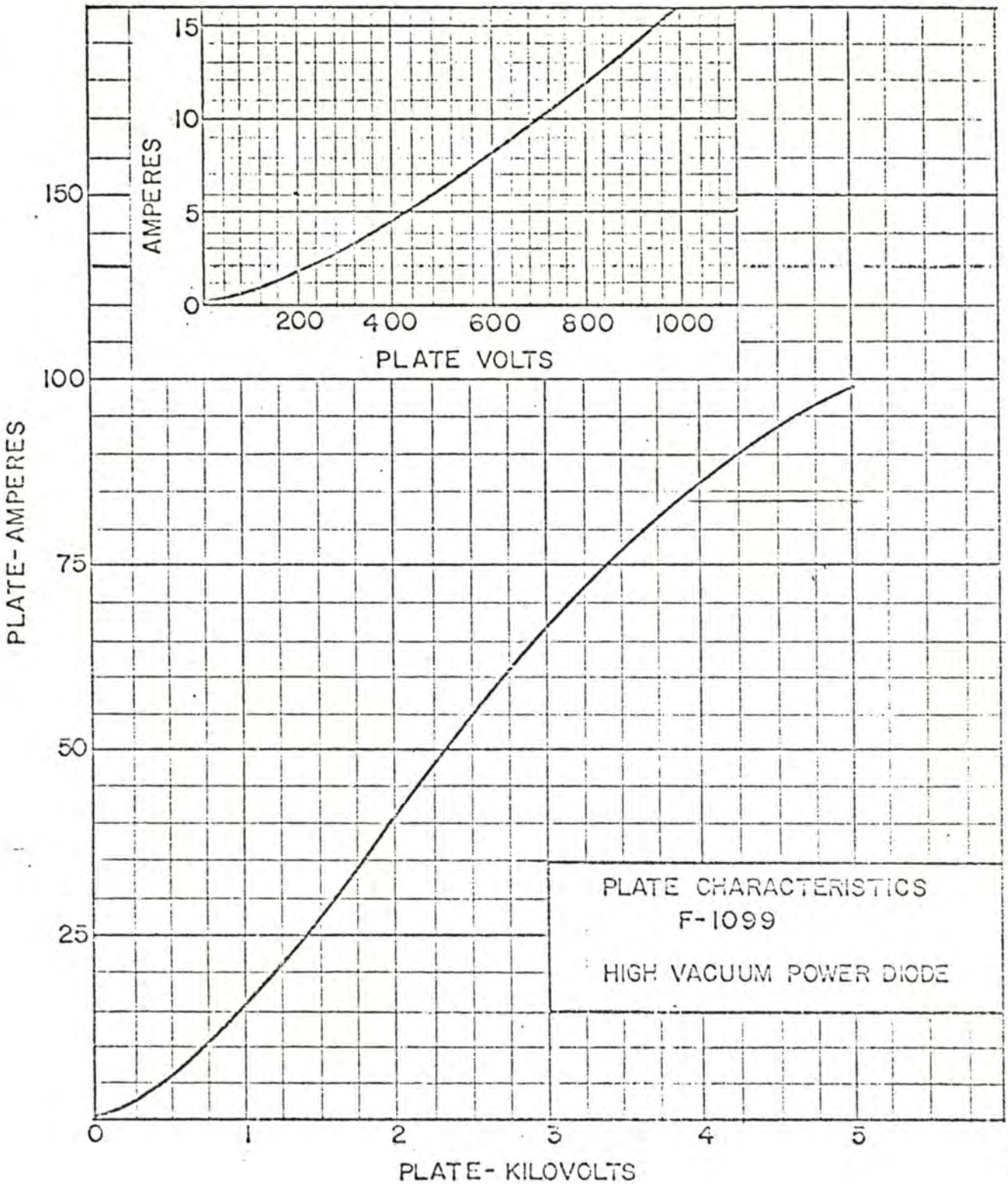
Plate Dissipation - kw	12	9.5	7
Air Flow - cfm	400	287	200
Pressure - inches of water	3.5	2.0	1.0

Glass Temperature 180 °C max.



OUTLINE F-1099 POWER DIODE

11-67



1-2-63

8349
4CX35,000C

TECHNICAL DATA

RADIAL-BEAM
POWER TETRODE

The EIMAC 8349/4CX35,000C is a ceramic/metal, forced-air cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB rf linear amplifier, or a Class-AB push-pull af amplifier or modulator. The 8349/4CX35,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The forced-air cooled anode is rated at 35 kilowatts maximum dissipation.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 V
Current, at 10.0 volts	295 A
Amplification Factor (Average):	
Grid to Screen	4.5
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	440 pF
Cout	55 pF
Cgp	2.3 pF
Frequency of Maximum Rating:	
CW	30 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	17.34 in; 440.4 mm
Diameter	9.75 in; 247.7 mm
Net Weight	50 lb; 22.7 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Base	Special, graduated rings
Recommended Socket	EIMAC SK-1500

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	15.0	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage [1]	-400	Vdc
Zero-Signal Plate Current	1.0	Adc
Single Tone Plate Current	5.7	Adc
Single-Tone Screen Current [2]	0.9	Adc
Peak rf Grid Voltage [2]	250	v
Peak Driving Power [2]	0	w
Plate Dissipation	30	kW
Plate Output Power	55	kW
Resonant Load Impedance	1280	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	10.0	15.0	19.0	kVdc
Screen Voltage	750	750	750	Vdc
Grid Voltage	-425	-480	-550	Vdc
Plate Current	7.5	6.8	6.96	Adc
Screen Current [1]	0.84	0.51	0.80	Adc
Grid Current [1]	0.29	0.23	0.35	Adc
Peak rf Grid Voltage [1]	600	660	730	v
Calculated Driving Power [1]	180	150	258	W
Plate Dissipation	19.3	19.0	21.0	kW
Plate Output Power	55.5	82.5	110	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	14,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION [1]	23,000	WATTS
SCREEN DISSIPATION [2]	1750	WATTS
GRID DISSIPATION [2]	500	WATTS

1. Corresponds to 35,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	12.0	kVdc
Screen Voltage	750	Vdc
Grid Voltage	-600	Vdc
Plate Current	5.4	Adc
Screen Current [1]	0.52	Adc
Grid Current [1]	0.16	Adc
Peak af Screen Voltage [2] (100% modulation)	500	v
Peak rf Grid Voltage [1]	740	v
Calculated Driving Power	125	W
Plate Dissipation	13.2	kW
Plate Output Power	55.0	kW
Resonant Load Impedance	1120	Ω

1. Approximate value.
2. Approximate value, depending upon degree of driver modulation.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	12.0 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage[1/3]	-400 Vdc
Zero-Signal Plate Current	3.0 Adc
Max Signal Plate Current	9.2 Adc
Max Signal Screen Current[1]	1.8 Adc
Peak af Grid Voltage[2]	280 v
Max Signal Plate Dissipation[2]	20 kW
Plate Output Power	70 kW
Load Resistance (plate to plate)	2860 Ω

2. Per Tube
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 10.0 volts	280	310	A
Interelectrode Capacitances (grounded cathode connection)[2]			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX35,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC sockets, type SK-1500, and SK-1510 have been designed especially for the concentric base terminals of the 4CX35,000C.

COOLING - The maximum temperature rating for the external surfaces of the 4CX35,000C is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C.

Air-flow requirements to maintain core temperature at 225°C in 40° ambient air are tabulated below (for operation below 30 megahertz.) These data are for air flowing in the base-to-anode direction.

	Base-to-Anode Air Flow			
	Sea Level		10,000 Feet	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
15,000	554	1.2	795	1.7
20,000	820	2.1	1100	3.0
25,000	1140	3.6	1665	5.2
30,000	1465	5.0	2140	7.4
35,000	1800	7.2	2630	10.3

* Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 CFM of air directed through the center of the socket is sufficient for this purpose.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CX35,000C is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CX35,000C by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CX35,000C. At some point in filament voltage there will be a noticeable reduction in plate current, or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appears to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked to maintain proper operation.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of tube and SK-1500 socket, must not exceed 100 volts.

GRID OPERATION - The 4CX35,000C grid has a maximum dissipation rating of 500 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX35,000C must not exceed 1750 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX35,000C is 35,000 watts. When the 4CX35,000C is operated as a plate-modulated rf amplifier, under carrier conditions, the maximum plate dissipation is 23,000 watts.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capaci-

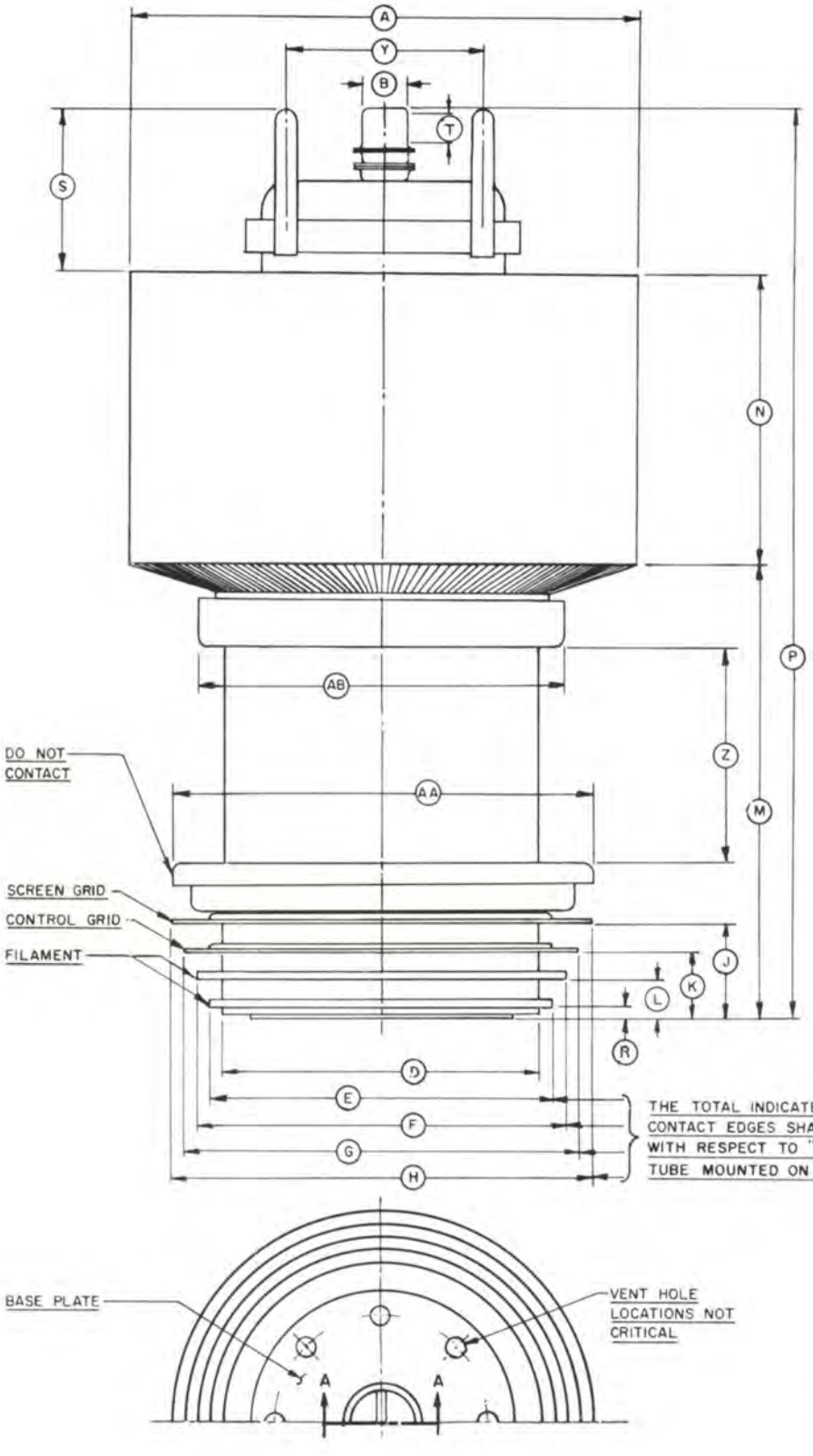
tance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

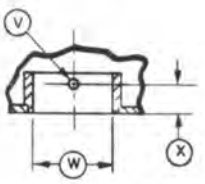
HIGH VOLTAGE - Normal operating voltages used with the 4CX35,000C are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX35,000C, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

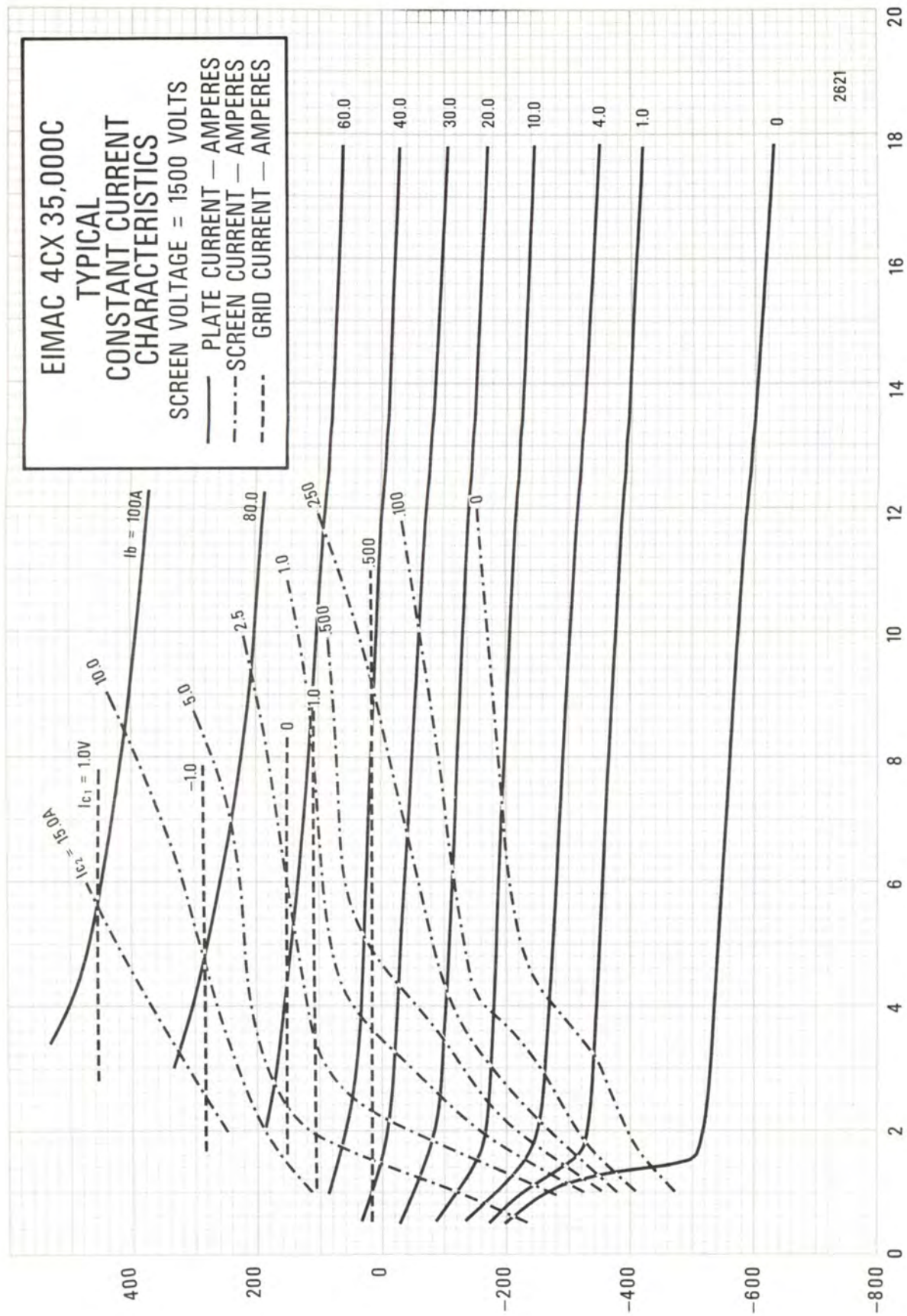
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

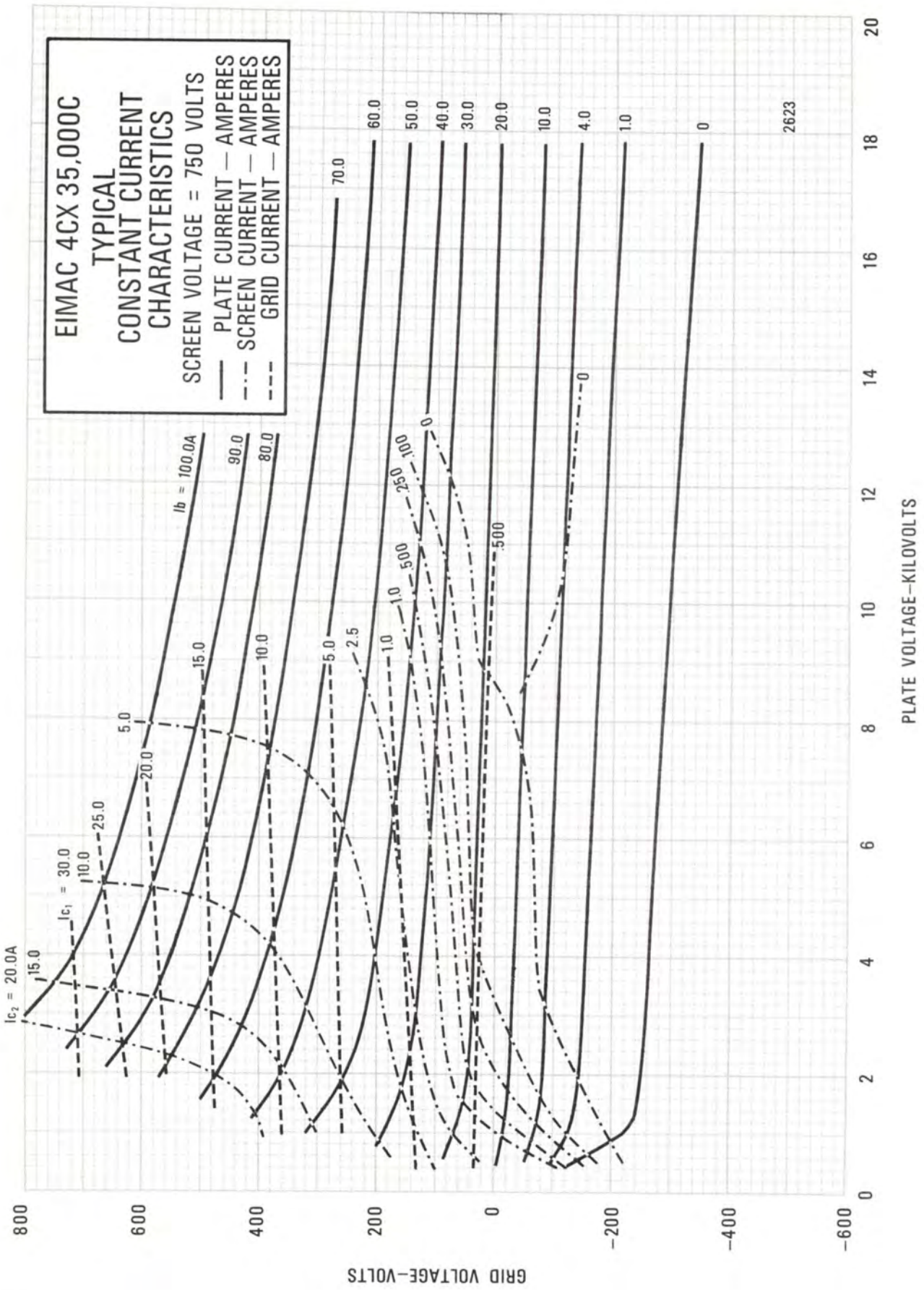




SECTION A–A
ROTATED 180°

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	9.500	9.750	241.30	247.65
B	0.860	0.890	21.84	22.60
D	5.980	6.020	151.89	152.91
E	6.510	6.560	165.35	166.62
F	6.980	7.020	177.29	178.31
G	7.480	7.520	189.99	191.01
H	7.975	8.015	202.57	203.58
J	1.750	1.800	44.45	45.72
K	1.220	1.270	30.99	32.26
L	0.690	0.740	17.53	18.80
M	8.442	8.692	214.43	220.78
N	5.375	5.625	136.52	142.88
P	17.070	17.340	433.58	440.44
R	0.173	0.213	4.40	5.41
S	3.062 (1)		77.77 (1)	
T	0.485	0.515	12.32	13.08
V	— —	0.135	— —	3.43
W	1.250	1.270	31.75	32.26
X	0.490	0.530	12.45	13.46
Y	4.500 (1)		114.30 (1)	
Z	3.750 (1)		95.25 (1)	
AA	8.000 (1)		203.20 (1)	
AB	6.875 (1)		174.63 (1)	





A COMPARISON OF 50 KW AM TRANSMITTERS

	Gates MW-50	Continental 317C	RCA BTA-50J	CCA AM-50,000D
Size	63 sq. ft.	62 sq. ft.	80 sq. ft.	48 sq. ft.
External Components	Plate Transformer Cubicle	Plate Transformer Cubicle	2 Plate Transformers & Switch Gear	None
Weight (Unpacked)	6,370 lbs.	6,600 lbs.	12,000 lbs.	15,000 lbs.
Power Line Requirements	380/460V 3 Phase 50/60 Hz	460V 3 Phase 50/60 Hz	460V 3 Phase 50/60 Hz	380/460V 3 Phase 50/60 Hz
Power Consumption:				
0% Modulation	80kW	82kW	94kW	95kW
Average	85kW	92kW	100kW	103kW
100% Modulation	110kW	120kW	130kW	140kW
Type of Modulation	High Level Plate	Screen	Ampliphase	High Level Plate
Carrier Shift	Less Than 2%	Less Than 3%	5%	3%
Noise	-60dB	-60dB	-60dB	-55dB
Power Factor	95%	90%	90%	90%
Number of Tubes	5	9	10	10
100% Tube Cost	$4,996.00	$4,405.00	$3,504.00	$3,160.00
PA Tube	4CX35000C	4CX35000C	(2) 6697	4CX35000C
Are Same Tube Types Used in PA as in Modulator?	Yes	No -- (2) 3X3000A1	No Modulator	(2) 4CX15000A

A COMPARISON OF 50 KW AM TRANSMITTERS

	Gates MW-50	Continental 317C	RCA BTA-50J	CCA AM-50,000D
Distortion	3% 20-10,000 Hz	3% 50-7,500 Hz	3% 50-7,500 Hz	3% 50-7,500 Hz
Response	±1.5dB 20-10,000 Hz	±1.5dB 30-10,000 Hz	±1.5dB 30-10,000 Hz	±1.5dB 50-10,000 Hz
Frequency Stability	±5 Hz	±5 Hz	±5 Hz	±5 Hz
Power Output Capability	60kW	53kW	56kW	55kW
Positive Peak Capability	130%	Not Specified	110%	Not Specified
Cooling	Air	Air	Air	Air
Dual Oscillators, Driver, and Buffer (Redundancy)	Yes	No	No	No
Altitude	10,000 ft.	7,500 ft.	7,500 ft.	8,500 ft.
Automatic Return After Prolonged Power Failure	Yes	No	No	No
VSWR Sensing	Yes	Yes	No	No
Output Arc Sensing	Yes	No	No	No

Gates Radio Company
March 30, 1972

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