RCA TUBE
HANDBOOK
HB-3

RECEIVING-TYPE INDUSTRIAL TUBE SECTION

This Section contains data on "special red" tubes; premium tubes; tubes for computer and "on-off" control applications; low-microphonic amplifier tubes; and similar special types.

For further Technical Information, write to Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J.

Receiving-Type Industrial Tubes

RECEIVING-TYPE INDUSTRIAL TUBE CLASSIFICATION CHART

When choosing tube types, the equipment designer should refer to the RCA PREFERRED TYPES LIST and its companion list - TYPES NOT RECOMMENDED FOR NEW EQUIPMENT DESIGN - both of which appear in the General Section.

SPECIAL-RED TUBES

Name	Prototype	TUBE TYPE
Full-Wave Vacuum Rectifier	-	5690
High-Mu Twin Triode	6SL7-GT	5691
Medium-Mu Twin Triode	6SN7-GT	5692
Sharp-Cutoff Pentode	6SJ7	5693†

PREMIUM TUBES

Name	Prototype	TUBE TYPE
Sharp-Cutoff Pentode	6AK5	5654□
Medium-Mu Triode	-	5718●
High-Mu Triode	-	5719●
Twin Diode	6AL5	5726□
High-Mu Twin Triode	12AX7	5751□
Medium-Mu Twin Triode	12AU7	5814-A□
Sharp-Cutoff Pentode	-	5840●
Voltage Regulator	0A2	6073□▲
Voltage Regulator	0B2	6074□▲
Medium-Mu Twin Triode	6J6	6101□
High-Mu Twin Triode	12AT7	6201□

TUBES FOR LOW-MICROPHONIC APPLICATIONS

Name	Prototype	TUBE TYPE
Medium-Mu Twin Triode	-	12AY7□
Sharp-Cutoff Pentode	-	1609
Pentagrid Mixer	6L7	1612†
Sharp-Cutoff Pentode	6J7	1620†
Sharp-Cutoff Pentode	-	5879□

TUBES FOR COMPUTER & OTHER "ON-OFF" CONTROL APPLICATIONS

Name	Use	TUBE TYPE
Pentagrid Amplifier	Gated Amplifier	5915□
Medium-Mu Twin Triode	Frequency Divider	5963□
Medium-Mu Twin Triode	Frequency Divider	5964□
Medium-Mu Twin Triode	Frequency Divider	5965□
Power Pentode	Frequency Divider	6197□
Medium-Mu Twin Triode	Frequency Divider	6211□

† Metal-shell type.
□ Miniature type.
▲ For data on this type, see *THYRATRON, IGNITRON, & GLOW-DISCHARGE TUBE SECTION.*
● Subminiature type having flexible leads.

RECEIVING-TYPE INDUSTRIAL TUBE CLASSIFICATION CHART

TUBES HAVING 26.5-VOLT HEATERS		
Name	**Use**	**TUBE TYPE**
Remote-Cutoff Pentode	Aircraft receivers where operating voltages are obtained from 12-cell storage batteries.	26A6□
Twin Beam Power Tube		26A7-GT
Twin Diode—Medium-Mu Triode		26C6□
Pentagrid Converter		26D6□
Low-Mu Twin Triode		6082

TUBES FOR SPECIAL APPLICATIONS		
Name	**Features**	**TUBE TYPE**
Power Pentode	Delivers 1.2 watts power output at 10 Mc in rf power amplifier service.	3A4□
Medium-Mu Twin Triode	Delivers 2 watts power output at 40 Mc in push-pull class C service.	3A5□
Full-Wave Vacuum Rectifier	Useful at altitudes up to 40,000 feet.	5R4-GY
Sharp-Cutoff Pentode	Useful in gated-amplifier circuits, delay circuits, and gain-controlled amplifier circuits.	6AS6□
Low-Mu Twin Triode	Useful as regulator tube in dc power supplies, and in projection-television booster-scanning applications.	6AS7-G
Beam Power Tube	-	12A6†
Twin Power Pentode	-	12L8-GT
Twin Diode—Medium-Mu Triode	Similar to 6SR7 except for heater rating.	12SW7†
Medium-Mu Twin Triode	Similar to 6SN6-GT except for heater rating.	12SX7-GT
Pentagrid Converter	Similar to 6SA7 except for heater rating.	12SY7†

□ Miniature type.
† Metal-shell type.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RECEIVING-TYPE INDUSTRIAL TUBE CLASSIFICATION CHART

TUBES FOR SPECIAL APPLICATIONS (Cont'd)		
Name	Features	TUBE TYPE
Power Pentode	Similar to 6F6. For applications requiring continuity of service.	1621
Beam Power Tube	Similar to 6L6. For applications requiring continuity of service.	1622
Electron-Ray Tube	Similar to 6E5 except for 12.6-volt heater. Useful as voltage indicator in aircraft equipment.	1629
Beam Power Tube	Similar to 6L6 except for 12.6-volt heater and dissipation ratings. For applications critical as to uniformity of characteristics.	1631
Beam Power Tube	Similar to 25L6 except for 12.6-volt heater and dissipation ratings. For applications critical as to uniformity of characteristics.	1632
High-Mu Twin Triode	Similar to 12SC7. For applications critical as to matching of the two triode units.	1634
High-Mu Twin Triode	For audio-frequency amplifier applications.	1635
Beam Power Tube	For audio-frequency amplifier applications. Similar in electrical characteristics to the 6L6-G except for higher dissipation ratings.	5881
Low-Mu Twin Triode	Similar to 6AS7-G but smaller. For applications critical as to shock and vibration, and requiring reduced susceptibility to electrolysis.	6080

3FH5

High-Mu Triode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 3FH5 is the same as the 6FH5 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	3.0	volts
Warm-up time (Average)	11	sec

3GK5

High-Mu Triode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 3GK5 is the same as the 6GK5 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	2.8	volts
Warm-up time (Average)	11	sec

3GS8/3BU8

Sharp-Cutoff Twin Pentode

With Common Cathode, Grid No.1, and Grid No.2

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 3GS8/3BU8 is the same as the 4GS8/4BU8 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater amperes = 0.600	3.15	volts

4AU6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4AU6 is the same as the 6AU6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current.	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450.	4.2	volts
Warm-up time (Average)	11	sec

4AV6

Twin Diode—High-Mu Triode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4AV6 is the same as the 6AV6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current.	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450.	4.2	volts
Warm-up time (Average)	11	sec

4BC5

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BC5 is the same as the 6BC5 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current.	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450.	4.2	volts
Warm-up time (Average)	11	sec
Peak heater-cathode voltage:		
Heater negative with respect to cathode	200 max.	volts
Heater positive with respect to cathode	200[a] max.	volts

[a] The dc component must not exceed 100 volts.

4BC8

Medium-Mu Twin Triode

With Semiremote-Cutoff Characteristic

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BC8 is the same as the 6BC8 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater amperes = 0.600	4.2	volts
Warm-up time (Average)	11	sec

4BL8

Medium-Mu Triode— Sharp-Cutoff Pentode

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BL8 is the same as the 6BL8 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater amperes = 0.600	4.6	volts

4BN6

Beam Tube

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BN6 is the same as the 6BN6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.2	volts
Warm-up time (Average)	11	sec

4AU6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4AU6 is the same as the 6AU6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average)	11	sec

4AV6

Twin Diode—High-Mu Triode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4AV6 is the same as the 6AV6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average)	11	sec

4BC5

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BC5 is the same as the 6BC5 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average)	11	sec
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	200 max.	volts
Heater positive with respect to cathode	200▲ max.	volts

▲ The dc component must not exceed 100 volts.

4BC8

Medium-Mu Twin Triode

With Semiremote-Cutoff Characteristic

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BC8 is the same as the 6BC8 except for the following items:

Heater, for Unipotential Cathodes:		
Voltage (AC or DC).	4.2	volts
Current	0.6 ± 6%	amp
Warm-up time (Average).	11	sec

4BN6

Beam Tube

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BN6 is the same as the 6BN6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4BQ7-A

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BQ7-A is the same as the 6BQ7-A except for the following items:

Heater, for Unipotential Cathodes:		
Voltage (AC or DC).	4.2	volts
Current	0.6 ± 6%	amp
Warm-up time (Average).	11	sec

4BQ7A

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BQ7A is the same as the 6BQ7A except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater current = 0.600	4.2	volts
Warm-up time (Average).	11	sec

4BS8

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BS8 is the same as the 6BS8 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater current = 0.600	4.5	volts
Warm-up time (Average).	11	sec

4BU8

Sharp-Cutoff Twin Pentode

With Common Cathode, Grid No.1, & Grid No.2

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4BU8 is the same as the 6BU8 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater current = 0.450	4.2	volts
Warm-up time (Average).	11	sec

4BZ6

Semiremote-Cutoff Pentode

7-PIN MINIATURE TYPE
With Heater Having Controlled Warm-Up Time

The 4BZ6 is the same as the 6BZ6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater current = 0.450	4.2	volts
Warm-up time (Average)	11	sec

4BZ7

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE
With Heater Having Controlled Warm-Up Time

The 4BZ7 is the same as the 6BZ7 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater current = 0.600	4.2	volts
Warm-up time (Average)	11	sec

4CB6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE
With Heater Having Controlled Warm-Up Time

The 4CB6 is the same as the 6CB6 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater current = 0.450	4.2	volts
Warm-up time (Average)	11	sec
Peak heater-cathode voltage:		
Heater negative with respect to cathode	300[a] max.	volts
Heater positive with respect to cathode	200[b] max.	volts

[a] The dc component must not exceed 200 volts.
[b] The dc component must not exceed 100 volts.

4BS8

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BS8 is the same as the 6BS8 except for the following items:

Heater, for Unipotential Cathodes:		
Voltage (AC or DC).	4.5	volts
Current	0.6 ± 6%	amp
Warm-up time (Average).	11	sec

4BU8

Sharp-Cutoff Twin Pentode

With Common Cathode, Grid No.1, & Grid No.2

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BU8 is the same as the 6BU8 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4BZ6

Semiremote-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BZ6 is the same as the 6BZ6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4BZ7

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4BZ7 is the same as the 6BZ7 except for the following items:

Heater, for Unipotential Cathodes:

Voltage (AC or DC)	4.2	volts
Current	0.6 ± 6%	amp
Warm-up time (Average)	11	sec

4CB6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4CB6 is the same as the 6CB6 except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC)	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average)	11	sec

PEAK HEATER-CATHODE VOLTAGE:

Heater negative with respect to cathode	300▲ max.	volts
Heater positive with respect to cathode	200● max.	volts

4CS6

Pentagrid Amplifier

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4CS6 is the same as the 6CS6 except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC)	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average)	11	sec

▲ The dc component must not exceed 200 volts.

● The dc component must not exceed 100 volts.

4CS6

Pentagrid Amplifier

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4CS6 is the same as the 6CS6 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values):*

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.2	volts
Warm-up time (Average).	11	sec

4CY5

Sharp-Cutoff Tetrode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4CY5 is the same as the 6CY5 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values):*

Current	0.300 ± 0.020	amp
Voltage (AC or DC) at heater amperes = 0.300	4.5	volts
Warm-up time (Average).	11	sec

4DE6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4DE6 is the same as the 6DE6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values):*

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.2	volts
Warm-up time (Average).	11	sec

4DT6

Sharp-Cutoff Pentode

With Two Independent Control Grids

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4DT6 is the same as the 6DT6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values):*

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.2	volts
Warm-up time (Average).	11	sec

4DT6A

Sharp-Cutoff Pentode

With Two Independent Control Grids

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4DT6A is the same as the 6DT6A except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values):*

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.2	volts
Warm-up time (Average).	11	sec

4EH7

Semiremote-Cutoff Pentode

9-PIN MINIATURE TYPE

The 4EH7 is the same as the 6EH7 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values):*

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.4	volts

4EJ7

Sharp-Cutoff Pentode

9-PIN MINIATURE TYPE

The 4EJ7 is the same as the 6EJ7 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.450 ± 0.030	amp
Voltage (AC or DC) at heater amperes = 0.450	4.4	volts

4ES8

Variable-Mu Twin Triode

9-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4ES8 is the same as the 6ES8 except for the following items:

Heater Characteristics and Ratings *(Design-Center Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater amperes = 0.600	4	volts
Warm-up time (Average).	11	sec

4EW6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

With Heater Having Controlled Warm-Up Time

The 4EW6 is the same as the 6EW6 except for the following items:

Heater Characteristics and Ratings *(Design-Maximum Values)*:

Current	0.600 ± 0.040	amp
Voltage (AC or DC) at heater amperes = 0.600	4.2	volts
Warm-up time (Average).	11	sec

4DE6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4DT6 is the same as the 6DT6 except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4DT6

Sharp-Cutoff Pentode

With Two Independent Control Grids

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4DT6 is the same as the 6DT6 except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4DT6-A

Sharp-Cutoff Pentode

With Two Independent Control Grids

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4DT6-A is the same as the 6DT6-A except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC).	4.2	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec

4EW6

Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 4EW6 is the same as the 6EW6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	4.2	volts
Current	0.6 ± 6%	amp
Warm-up time (Average)	11	sec

5CG8

Medium-Mu Triode—Sharp-Cutoff Pentode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 5CG8 is the same as the 6CG8-A except for the following items:

Heater, for Unipotential Cathode:

Voltage (AC or DC)	4.7	volts
Current	0.6 ± 6%	amp

5CL8-A

Medium-Mu Triode—Sharp-Cutoff Tetrode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 5CL8-A is the same as the 6CL8-A except for the following items.

Heater, for Unipotential Cathodes:

Voltage (AC or DC)	4.7	volts
Current	0.6 ± 6%	amp

5CM8

High-Mu Triode—Sharp-Cutoff Pentode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 5CM8 is the same as the 6CM8 except for the following items:

Heater, for Unipotential Cathodes:

Voltage (AC or DC)	4.7	volts
Current	0.6 ± 6%	amp

5CQ8

Medium-Mu Triode— Sharp-Cutoff Tetrode

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 5CQ8 is the same as the 6CQ8 except for the following items:

Heater, for Unipotential Cathodes:		
Voltage (AC or DC).	4.7	volts
Current	0.6 ± 6%	amp

5CZ5

Beam Power Tube

9-PIN MINIATURE TYPE

For Equipment Having Series Heater-String Arrangement

The 5CZ5 is the same as the 6CZ5 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC).	4.7	volts
Current	0.6 ± 6%	amp

5EW6

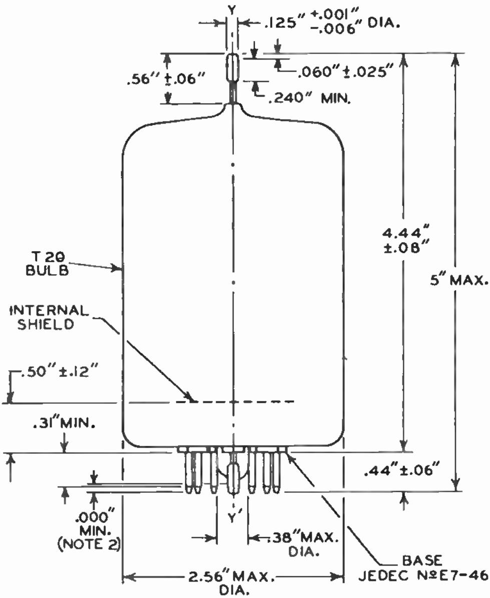
Sharp-Cutoff Pentode

7-PIN MINIATURE TYPE

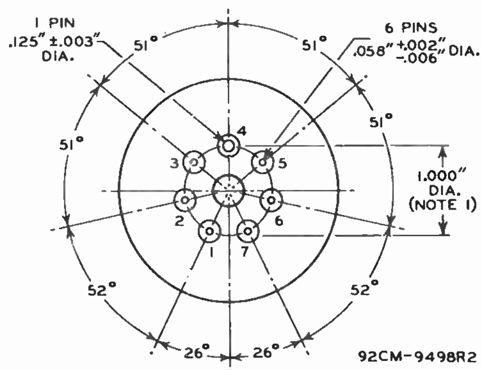
For Equipment Having Series Heater-String Arrangement

The 5EW6 is the same as the 6EW6 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC).	5.6	volts
Current	0.45 ± 6%	amp
Warm-up time (Average).	11	sec



Y
.125" +.001" -.006" DIA.
.56" ±.06"
.060" ±.025"
.240" MIN.
4.44" ±.08"
5" MAX.
T 20 BULB
INTERNAL SHIELD
.50" ±.12"
.31" MIN.
.44" ±.06"
.000" MIN. (NOTE 2)
Y'
.38" MAX. DIA.
BASE JEDEC № E7-46
2.56" MAX. DIA.



1 PIN .125" ±.003" DIA.
6 PINS .058" +.002" -.006" DIA.
51°
51°
51°
51°
52°
52°
26°
26°
1.000" DIA. (NOTE 1)
1
2
3
4
5
6
7

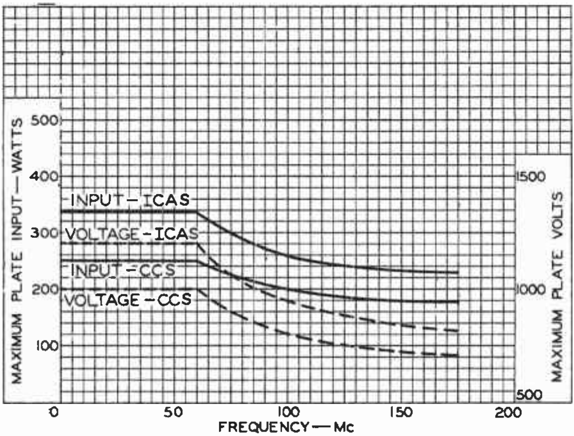
92CM-9498R2

THE REFERENCE AXIS Y-Y' IS DEFINED AS THE AXIS OF THE BASE PIN GAUGE DESCRIBED IN NOTE 1:

NOTE 1: ANGULAR VARIATIONS BETWEEN PINS AND VARIATION IN PIN-CIRCLE DIAMETER ARE HELD TO TOLERANCES SUCH THAT PINS WILL ENTER TO A DISTANCE OF 0.375" A FLAT-PLATE BASE-PIN GAUGE HAVING SIX HOLES 0.0800" ± 0.0005" AND ONE HOLE 0.1450" ± 0.0005" ARRANGED ON A 1.0000" ± 0.0005" DIAMETER CIRCLE AT SPECIFIED ANGLES WITH TOLERANCE OF ± 5' FOR EACH ANGLE. GAUGE IS ALSO PROVIDED WITH A HOLE 0.500" ± 0.010" CONCENTRIC WITH PIN CIRCLE WHOSE CENTER IS ON THE AXIS Y-Y'.

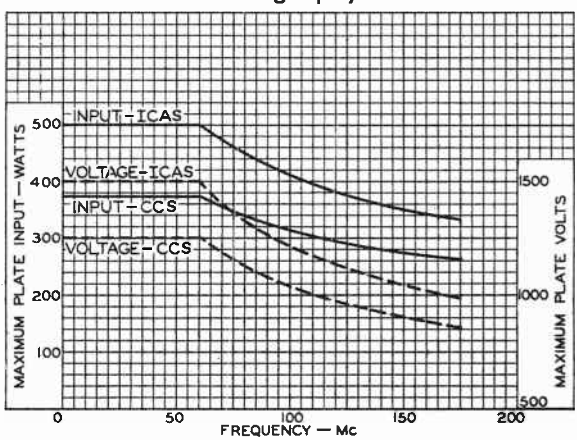
NOTE 2: EXHAUST TIP WILL NOT EXTEND BEYOND THE PLANE WHICH PASSES THROUGH THE ENDS OF THE THREE LONGEST PINS.

RATING CHART I
Class C Telephony Service



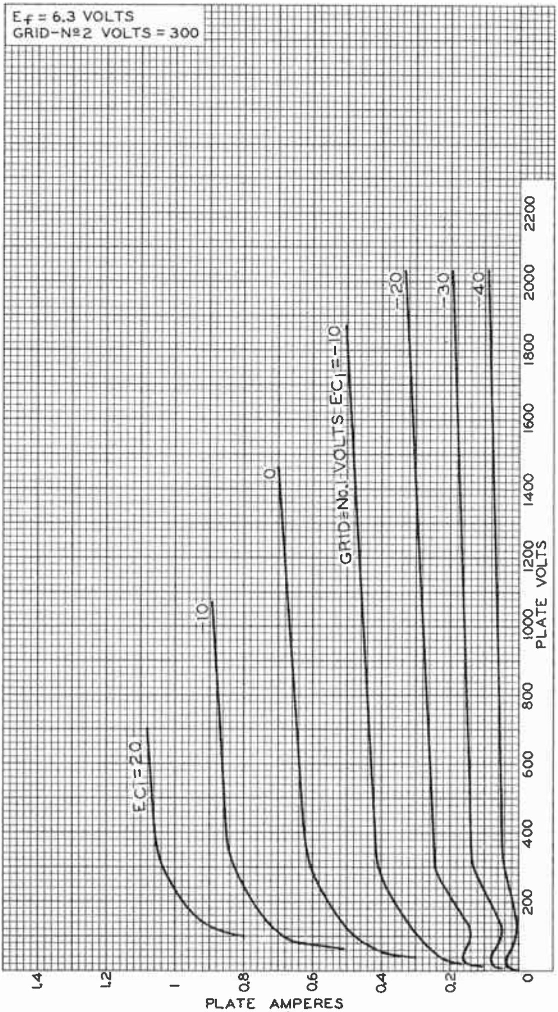
92CS-9492

RATING CHART II
Class C Telegraphy Service



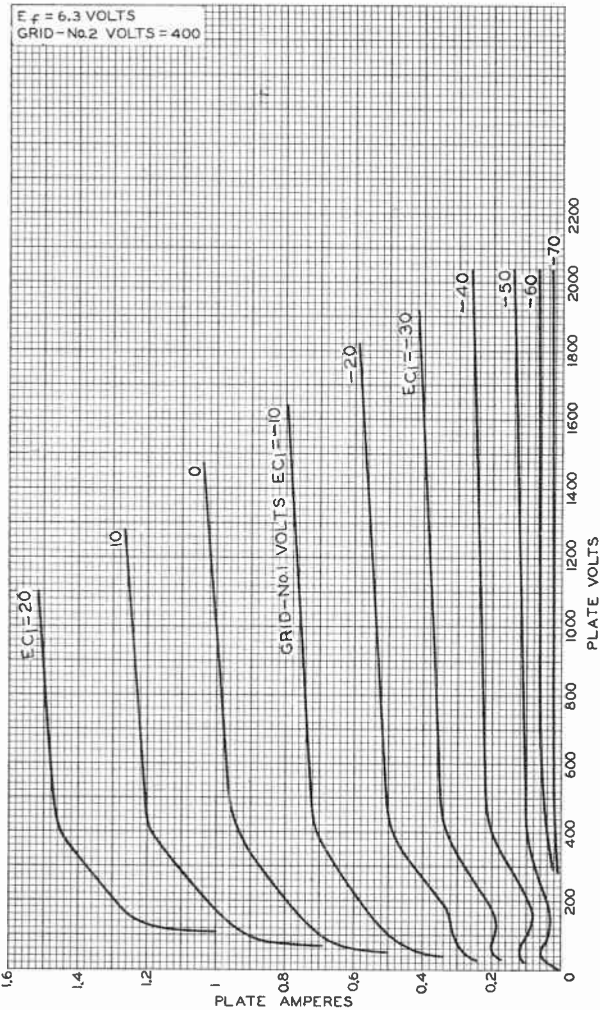
92CS-9491

TYPICAL PLATE CHARACTERISTICS



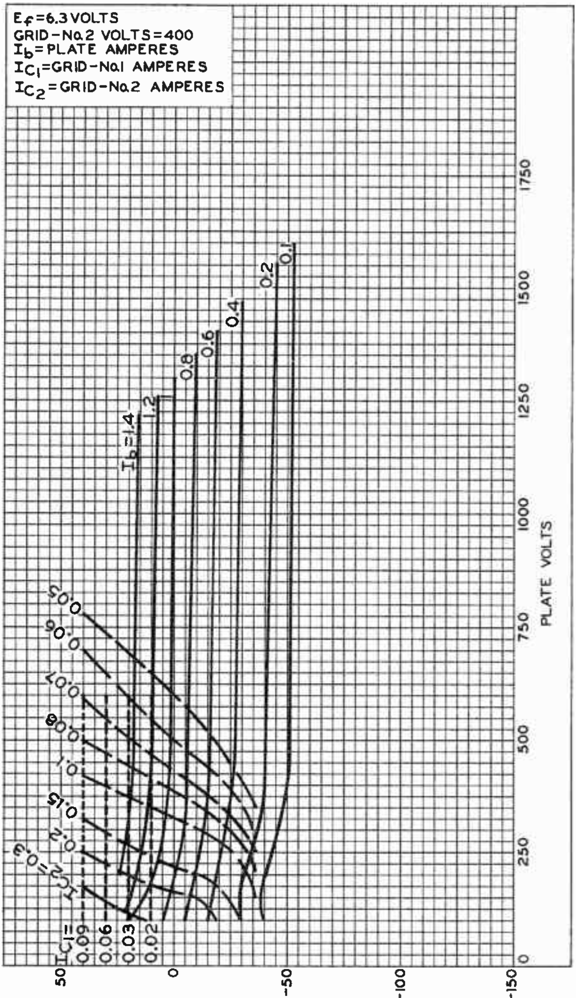
92CM-9511

TYPICAL PLATE CHARACTERISTICS



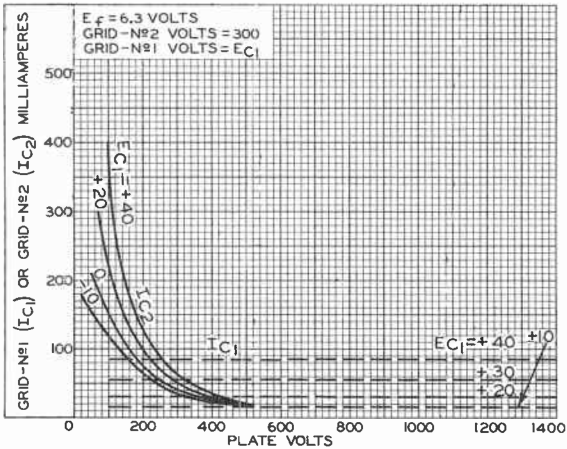
92CM-9502R1

AVERAGE CONSTANT-CURRENT CHARACTERISTICS

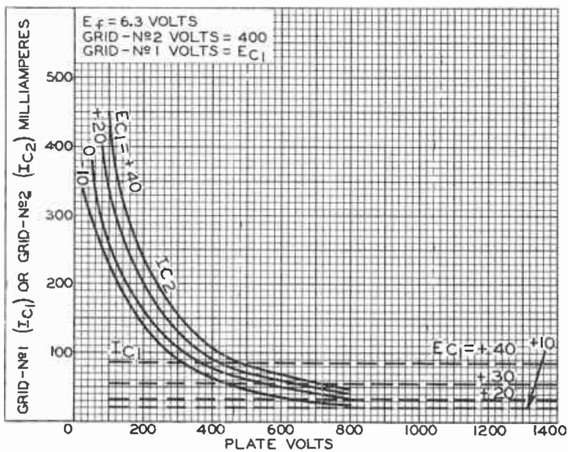


92CM-9512

TYPICAL CHARACTERISTICS

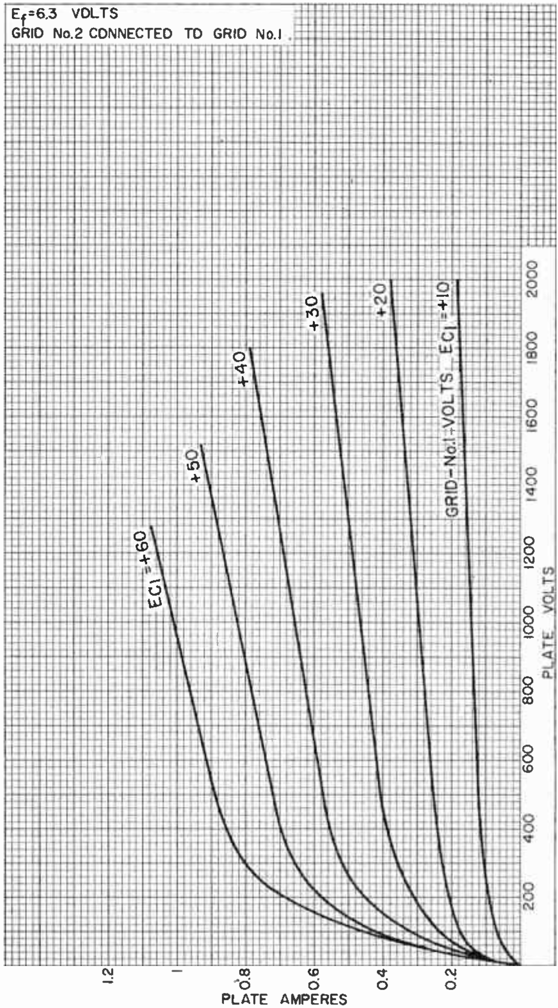


92CS-9501R1



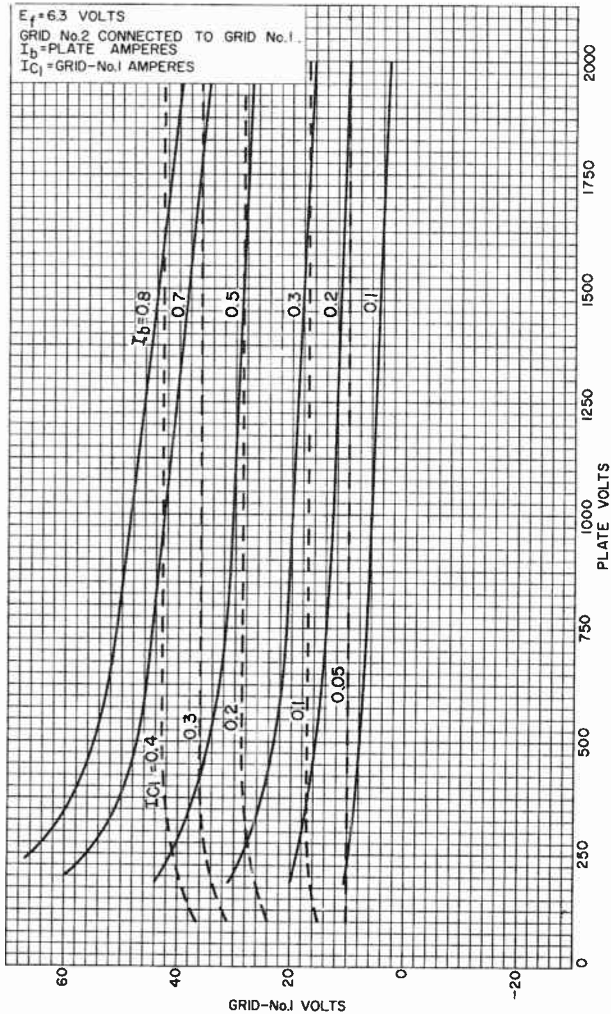
92CS-9500R1

TYPICAL PLATE CHARACTERISTICS
Triode Connection



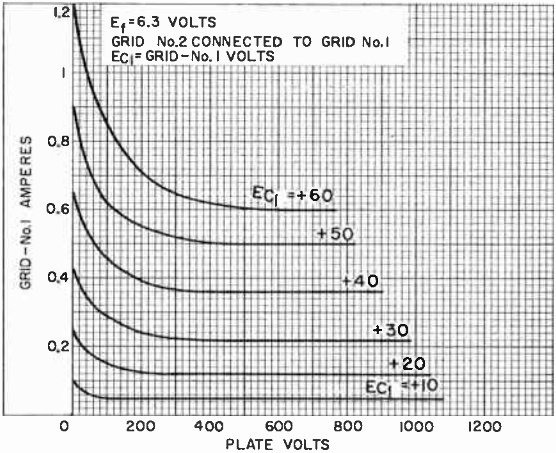
92CM-11045R1

TYPICAL CONSTANT-CURRENT CHARACTERISTICS
Triode Connection



92CM-11047R1

TYPICAL CHARACTERISTICS
Triode Connection



92CS-11046R1

Medium-Mu Twin Triode

9-PIN MINIATURE TYPE

GENERAL DATA

Electrical:

Heater Characteristics and Ratings *(Design-Center Values):*

Voltage (AC or DC)	6.3 ± 0.6	volts
Current at heater volts = 6.3	0.300	amp
Peak heater-cathode voltage (Each unit):		
Heater negative with respect to cathode	60 max.	volts
Heater positive with respect to cathode	120 max.	volts

Direct Interelectrode Capacitances:[a]

	Unit No. 1	*Unit No. 2*	
Grid to plate	1.4	1.4	μμf
Grid to cathode, internal shield, and heater	3.1	3.1	μμf
Plate to cathode, internal shield, and heater	1.75	1.65	μμf
Heater to cathode	2.6	2.7	μμf

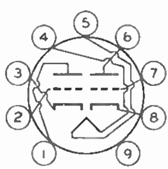
Characteristics, Class A$_1$ Amplifier (Each Unit):[b]

Plate Supply Voltage	100	90	volts
Grid Supply Voltage	9	0	volts
Cathode Resistor	680	120	ohms
Amplification Factor	33	-	
Transconductance	12500	11500	μmhos
Plate Current	15	12	ma

Mechanical:

Operating Position	Any
Type of Cathodes	Coated Unipotential
Maximum Overall Length	2-3/16"
Maximum Seated Length	1-15/16"
Length, Base Seat to Bulb Top (Excluding tip)	1-9/16" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)
Basing Designation for BOTTOM VIEW	9AJ

Pin 1 - Plate of Unit No.2
Pin 2 - Grid of Unit No.2
Pin 3 - Cathode of Unit No.2
Pin 4 - Heater
Pin 5 - Heater



Pin 6 - Plate of Unit No.1
Pin 7 - Grid of Unit No.1
Pin 8 - Cathode of Unit No.1
Pin 9 - Internal Shield

AMPLIFIER — Class A₁

Values are for Each Unit

Maximum Ratings, ***Design-Center Values:***

PLATE VOLTAGE:		
With plate dissipation = 0.8 watt or greater.	220 max.	volts
With plate dissipation less than 0.8 watt.	250 max.	volts
With plate ma. = 0.	400 max.	volts
With cathode ma. = 0.	550 max.	volts
GRID VOLTAGE:		
Negative-bias value	100 max.	volts
Peak-negative value[c].	200 max.	volts
CATHODE CURRENT:		
Peak[c]	100 max.	ma
Average	20 max.	ma
GRID INPUT.	0.03 max.	watt
PLATE DISSIPATION:		
Either plate.	1.5 max.	watts
Both plates (Both units operating). . . .	2 max.	watts
BULB TEMPERATURE (At hottest point on bulb surface).	170 max.	°C

Maximum Circuit Values:

Grid-Circuit Resistance:		
For fixed-bias operation.	Permitted only when plate ma. < 5	
For cathode-bias operation.	1 max.	megohm

[a] Without external shield.

[b] Operation under conditions listed in left-hand column is recommended because of the small spread in characteristics.

[c] Pulse duration (microseconds) = 200 max., duty factor = 0.10 max.

SPECIAL RATINGS & PERFORMANCE DATA

Shock Rating:

Impact Acceleration	500 max.	g

This test is performed on a sample lot of tubes from each production run to determine ability of tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a Navy Type, High-impact (Flyweight) Shock Machine and are subjected to 5 blows at a hammer angle of 30°.

Fatigue Rating:

Vibrational Acceleration.	2.5 max.	g

This test is performed on a sample lot of tubes to determine ability of tube to withstand the specified vibrational acceleration. Tubes are rigidly mounted and are subjected for 32 hours to 2.5-g vibrational acceleration at 50 cycles per second in each of three directions.

Twin Power Pentode

9-PIN MINIATURE TYPE
INTERNALLY NEUTRALIZED FOR PUSH-PULL AMPLIFIER SERVICE
14 WATTS CW INPUT (ICAS) UP TO 500 Mc

For Communications Equipment Operating at Frequencies up to 500 Mc as a Push-Pull RF-Power-Amplifier or as a Frequency-Multiplier Tube

GENERAL DATA

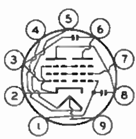
Electrical:

Heater, for Unipotential Cathode:			
Heater arrangement	*Series*	*Parallel*	
Voltage (AC or DC)	12.6 ± 10%	6.3 ± 10%	volts
Current	0.3	0.6	amp
Transconductance (Each Unit) for dc plate volts = 150, dc grid-No.2 volts = 150, and dc plate ma. = 25	10500		μmhos
Mu-Factor, Grid No.2 to Grid No.1 (Each Unit) for dc plate volts = 150, dc grid No.2 volts = 150, and dc plate ma. = 25	31		
Direct Interelectrode Capacitances (Approx., Each Unit):▲			
Grid No.1 to plate	0.15		μμf
Grid No.1 to cathode & grid No.3, grid No.2, and heater	6.4		μμf
Plate to cathode & grid No.3, grid No.2, and heater	1.6		μμf

Mechanical:

Operating Position	Any
Maximum Overall Length	2-5/8"
Maximum Seated Length	2-3/8"
Length, Base Seat to Bulb Top (Excluding tip)	2" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)
Basing Designation for BOTTOM VIEW	9HL

Pin 1 - Grid No.1 of Unit No.2
Pin 2 - Cathode, Grid No.3
Pin 3 - Grid No.1 of Unit No.1
Pin 4 - Heater



Pin 5 - Heater
Pin 6 - Plate of Unit No.2
Pin 7 - Grid No.2
Pin 8 - Plate of Unit No.1
Pin 9 - Heater Tap

PUSH-PULL RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy•
and
PUSH-PULL RF POWER AMPLIFIER — Class C FM Telephony

Values are on a per-tube basis unless otherwise specified

Maximum Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc		
	CCS*	ICAS♦	
DC PLATE VOLTAGE	250 max.	250 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	200 max.	200 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-100 max.	-100 max.	volts
DC PLATE CURRENT	90 max.	100 max.	ma
DC GRID-No.1 CURRENT	6 max.	8 max.	ma
DC CATHODE CURRENT	100 max.	120 max.	ma
PLATE INPUT	12 max.	14 max.	watts
GRID-No.2 INPUT	3 max.	3.5 max.	watts
GRID-No.1 INPUT	0.2 max.	0.24 max.	watt
PLATE DISSIPATION	6 max.	7.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	225 max.	225 max.	°C

Typical Operation:

	At 500 Mc		
DC Plate Voltage	180	200	volts
DC Grid-No.2 Voltage	180	200	volts
DC Grid-No.1 Voltage	-20	-20	volts
From grid resistor for each grid No.1 of	27000	27000	ohms
Peak-to-Peak RF Grid-No.1 Voltage	50	50	volts
DC Plate Current	55	60	ma
DC Grid-No.2 Current	12.5	14	ma
DC Grid-No.1 Current	1.5	1.5	ma
Driver Power Output (Approx.)	1.2	1.2	watts
Useful Power Output (Approx.)•	5	6	watts

PLATE-MODULATED PUSH-PULL RF POWER AMPLIFIER — Class C Telephony

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

Values are on a per-tube basis

Maximum Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc CCS*	ICAS♦	
DC PLATE VOLTAGE	200 max.	200 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	200 max.	200 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-100 max.	-100 max.	volts
DC PLATE CURRENT	64 max.	80 max.	ma
DC GRID-No.1 CURRENT	6 max.	8 max.	ma
DC CATHODE CURRENT	80 max.	96 max.	ma
PLATE INPUT	8 max.	10 max.	watts
GRID-No.2 INPUT	2 max.	2.3 max.	watts
GRID-No.1 INPUT	0.2 max.	0.24 max.	watt
PLATE DISSIPATION	4 max.	5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	225 max.	225 max.	°C

Typical Operation:

	At 500 Mc		
DC Plate Voltage	180	180	volts
DC Grid-No.2 Voltage	180	180	volts
DC Grid-No.1 Voltage	-20	-20	volts
From grid resistor for each grid No.1 of	68000	27000	ohms
Peak-to-Peak RF Grid-No.1 Voltage	45	50	volts
DC Plate Current	40	55	ma
DC Grid-No.2 Current	9.5	12.5	ma
DC Grid-No.1 Current	0.6	1.5	ma
Driver Power Output (Approx.)	1	1.2	watts
Useful Power Output (Approx.)•	3.5	5	watts

FREQUENCY TRIPLER — Class C

Values are on a per-tube basis

Maximum Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc CCS*	ICAS♦	
DC PLATE VOLTAGE	250 max.	250 max.	volts

	CCS*	ICAS♦	
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	200 max.	200 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-100 max.	-100 max.	volts
DC PLATE CURRENT	60 max.	80 max.	ma
DC GRID-No.1 CURRENT	6 max.	8 max.	ma
DC CATHODE CURRENT	70 max.	80 max.	ma
PLATE INPUT	8 max.	10 max.	watts
GRID-No.2 INPUT	3 max.	3.5 max.	watts
GRID-No.1 INPUT	0.2 max.	0.24 max.	watt
PLATE DISSIPATION	6 max.	7.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	225 max.	225 max.	°C

Typical Operation:

	Up to 500 Mc		
DC Plate Voltage	180	200	volts
DC Grid-No.2 Voltage (Approx.)	180	190	volts
Through resistor of	1200	1200	ohms
DC Grid-No.1 Voltage	-74	-74	volts
From grid resistor for each grid No.1 of	82000	82000	ohms
Peak-to-Peak RF Grid-No.1 Voltage	165	165	volts
DC Plate Current	40	46	ma
DC Grid-No.2 Current	9.7	11	ma
DC Grid-No.1 Current	1.8	1.8	ma
Driver Power Output (Approx.)	1.1	1.1	watts
Useful Power Output (Approx.)♦	1.8	2.2	watts

▲ Without external shield.

● Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

* Continuous Commercial Service.

♦ Intermittent Commercial and Amateur Service.

♦ This value of useful power is measured at load of output circuit.

OPERATING CONSIDERATIONS

Shielding of the 6939 in "straight-through" rf-amplifier service may be required for stable operation. To minimize external feedback from the plate to grid No.1, a grounded shield crossing the terminal end of the tube socket through the space between pins 4 and 5 and the space between pins 1 and 9, is generally adequate for this purpose.

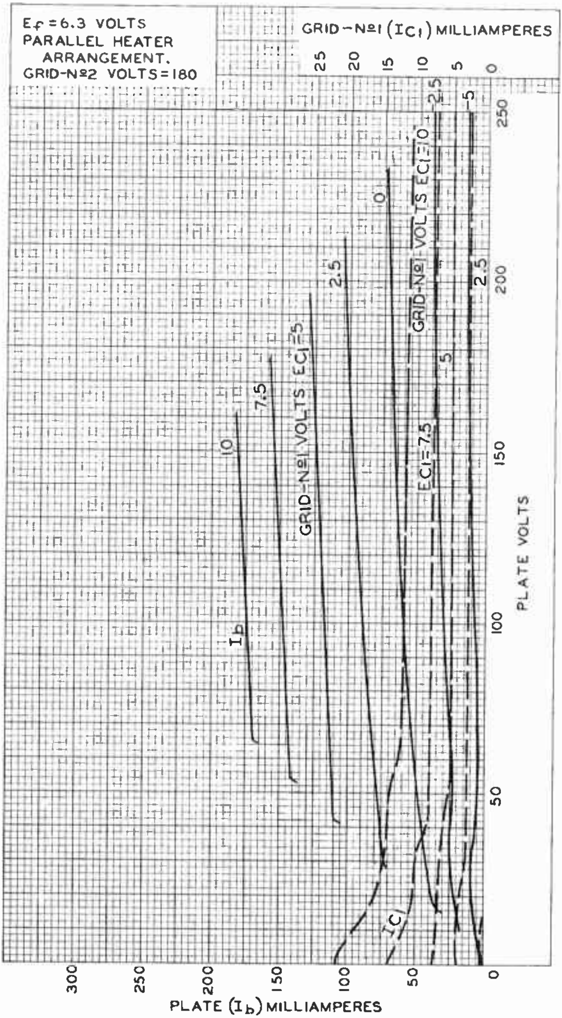
The *heater may be effectively bypassed* by grounding one heater pin at the tube socket and bypassing the other heater pin to ground with a low inductance capacitor. If further isolation of the ungrounded heater pin is required a suitable rf choke followed by another low inductance bypass capacitor, is recommended.

The *cathode* of the 6939 should be grounded by means of the shortest possible connection to reduce the effect of cathode-lead inductance.

The *rf impedance between grid No.2 and the cathode* must be kept low, usually by means of a suitable bypass capacitor. In telephony service when grid No.2 is modulated, a smaller bypass capacitor than is used for telegraphy service may be required in order to avoid excessive af bypassing. However, if the capacitance value is too small, rf feedback may occur between plate and grid No.1, depending on the circuit layout, operating frequency, and power gain of the stage. AF bypassing difficulties can usually be eliminated if the grid-No.2 bypass capacitor is replaced by a series-resonant circuit which is tuned to resonate at the operating frequency. This circuit presents a high impedance to audio frequencies but a very low impedance to its resonant frequency.

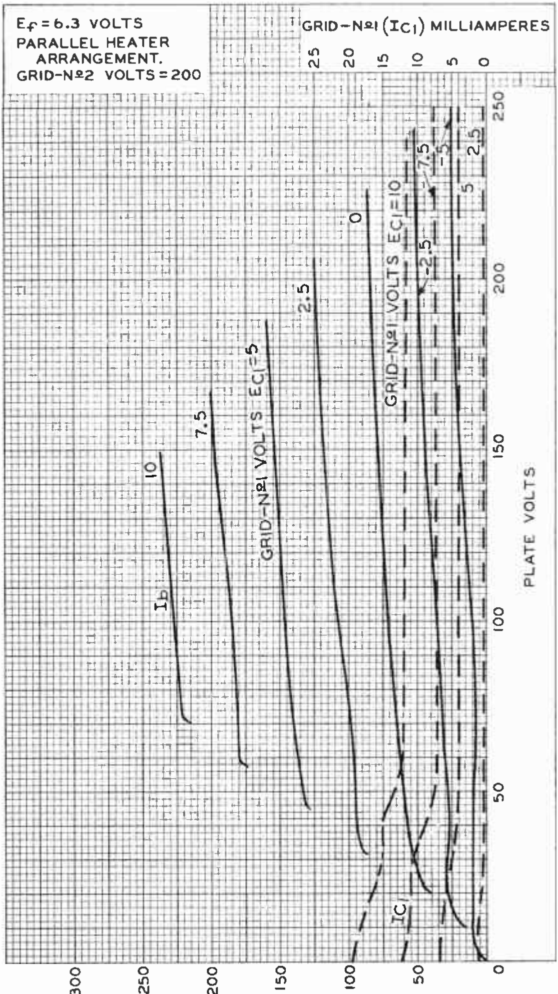
To *prevent generation of parasitic oscillations*, it is recommended that a 100-ohm resistor be connected in series with grid No.2 as close to the socket as possible.

AVERAGE CHARACTERISTICS
Each Unit



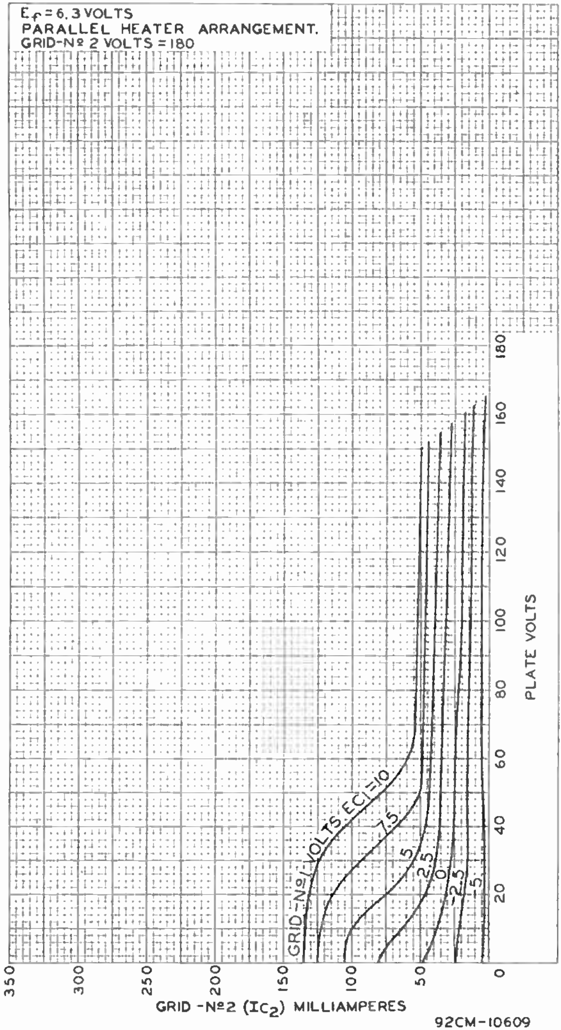
92CM-10614

AVERAGE CHARACTERISTICS
Each Unit

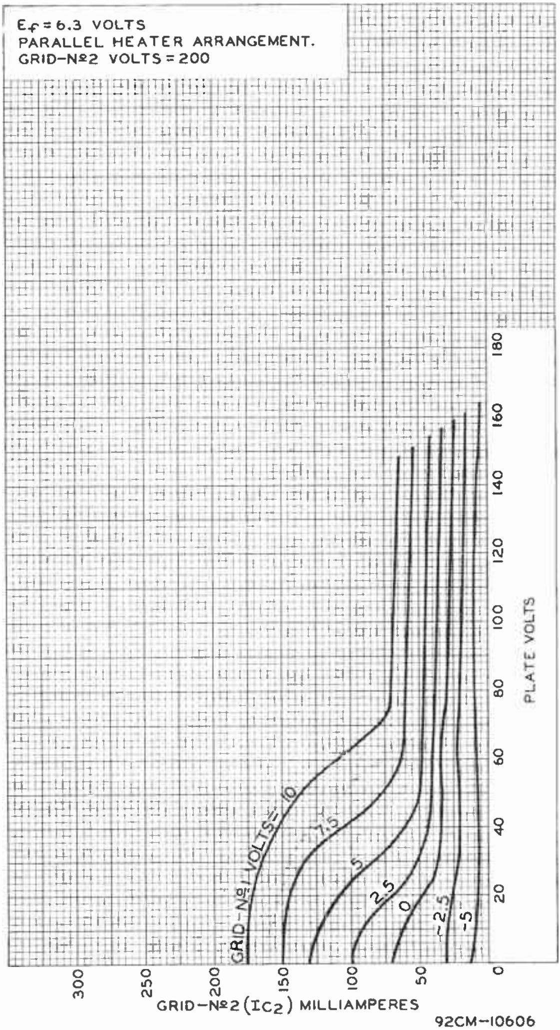


92CM-10613

AVERAGE CHARACTERISTICS
Each Unit



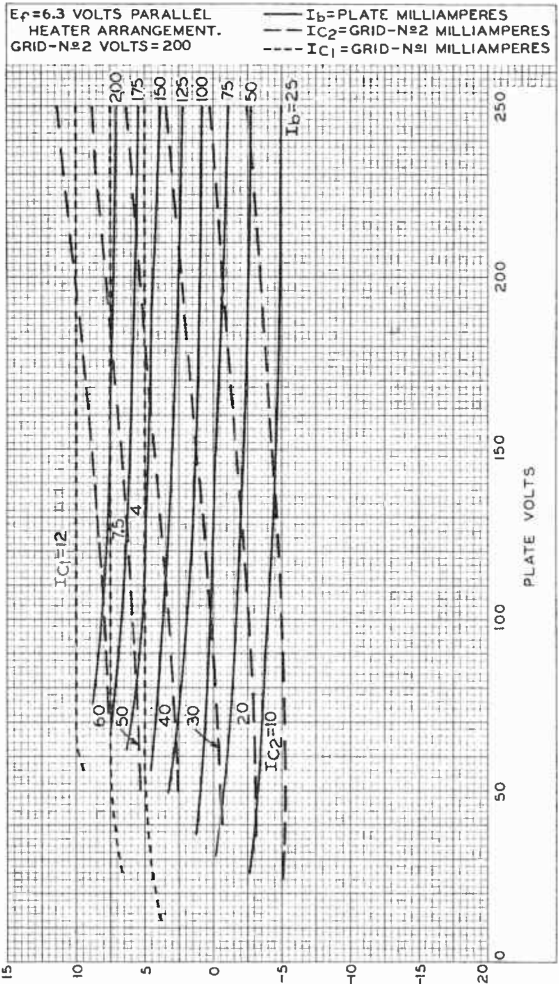
AVERAGE CHARACTERISTICS
Each Unit



AVERAGE CONSTANT-CURRENT CHARACTERISTICS
Each Unit

92CM-10608

AVERAGE CONSTANT-CURRENT CHARACTERISTICS
Each Unit



92CM-10603

RCA

6973

BEAM POWER TUBE

9-PIN MINIATURE TYPE

For high-fidelity audio-amplifier applications

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

Voltage	6.3	ac or dc volts
Current	0.45	amp

Direct Interelectrode Capacitances:°

Grid No.1 to plate	0.7 max.	μμf
Grid No.1 to cathode & grid No.3, grid No.2, and heater	8	μμf
Plate to cathode & grid No.3, grid No.2, and heater	8.5	μμf

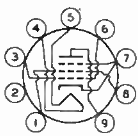
Characteristics, Class A_1 Amplifier:

Plate Voltage	250	volts
Grid-No.2 (Screen-Grid) Voltage	250	volts
Grid-No.1 (Control-Grid) Voltage	-15	volts
Plate Resistance (Approx.)	73000	ohms
Transconductance	4800	μmhos
Plate Current	46	ma
Grid-No.2 Current	3.5	ma
Grid-No.1 Voltage (Approx.) for plate current of 100 μa	-40	volts

Mechanical:

Operating Position	Any
Maximum Overall Length	2-5/8"
Maximum Seated Length	2-3/8"
Length, Base Seat to Bulb Top (Excluding tip)	2" ± 3/32"
Maximum Diameter	7/8"
Dimensional Outline	*See General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JETEC No.E9-1)
Basing Designation for BOTTOM VIEW	9EU

Pin 1 - Grid No.2
Pin 2 - No Connection
Pin 3 - Grid No.1
Pin 4 - Heater
Pin 5 - Heater



Pin 6 - Grid No.1
Pin 7 - Grid No.3, Cathode
Pin 8 - Grid No.2
Pin 9 - Plate

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Maximum Ratings, ***Design-Center Values:***

PLATE VOLTAGE	400 max.	volts
GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
GRID-No.2 INPUT	2 max.	watts
PLATE DISSIPATION	12 max.	watts

°: See next page.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6973

6973

BEAM POWER TUBE

PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	200	max.	volts
Heater positive with respect to cathode	200▲	max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	250	max.	°C

Typical Operation with Fixed Bias:

Values are for 2 tubes

Plate Voltage.	250	350	400	volts
Grid-No.2 Voltage.	250	280	290	volts
Grid-No.1 (Control-Grid) Voltage●. .	-15	-22	-25	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage.	30	44	50	volts
Zero-Signal Plate Current.	92	58	50	ma
Max.-Signal Plate Current.	105	106	107	ma
Zero-Signal Grid-No.2 Current. . . .	7	3.5	2.5	ma
Max.-Signal Grid-No.2 Current. . . .	16	14	13.7	ma
Effective Load Resistance (Plate to plate).	8000	7500	8000	ohms
Total Harmonic Distortion.	2	1.5	2	%
Max.-Signal Power Output	12.5	20	24	watts

Typical Operation with Cathode Bias:

Values are for 2 tubes

Plate-Supply Voltage	300	310	volts
Grid-No.2 Supply Voltage	300	310	volts
Cathode Resistor	230	270	ohms
Peak AF Grid-No.1-to-Grid-No.1 Voltage .	48	55	volts
Zero-Signal Plate Current.	80	77	ma
Max.-Signal Plate Current.	96	92	ma
Zero-Signal Grid-No.2 Current.	6	5	ma
Max.-Signal Grid-No.2 Current.	14	14	ma
Effective Load Resistance (Plate to plate).	5500	6000	ohms
Total Harmonic Distortion.	2	4	%
Max.-Signal Power Output	15	17	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:●			
For fixed-bias operation	0.5	max.	megohm
For cathode-bias operation	1	max.	megohm

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Grid No.2 of each tube connected to tap on plate winding of output transformer

Maximum Ratings, ***Design-Center Values:***

PLATE AND GRID-No.2 (SCREEN-GRID) SUPPLY VOLTAGE	375	max.	volts

○,▲,●: See next page.

RCA

6973

BEAM POWER TUBE

GRID-No.2 INPUT	1.75	max.	watts
PLATE DISSIPATION	12	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	200	max.	volts
Heater positive with respect to cathode	200▲	max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	250	max.	°C

Typical Operation:

Values are for 2 tubes

	Fixed Bias	*Cathode Bias*	
Plate-Supply Voltage	375	370	volts
Grid-No.2 Supply Voltage	*	#	volts
Grid-No.1 (Control-Grid) Voltage●	-33.5	-	volts
Cathode Resistor	-	355	ohms
Peak AF Grid-No.1-to-Grid-No.1 Voltage	67	62	volts
Zero-Signal Cathode Current	62	74	ma
Max.-Signal Cathode Current	95	84	ma
Effective Load Resistance (Plate to plate)	12500	13000	ohms
Total Harmonic Distortion	1.5	1.2	%
Max.-Signal Power Output	18.5	15	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:●			
For fixed-bias operation	0.5	max.	megohm
For cathode-bias operation	1	max.	megohm

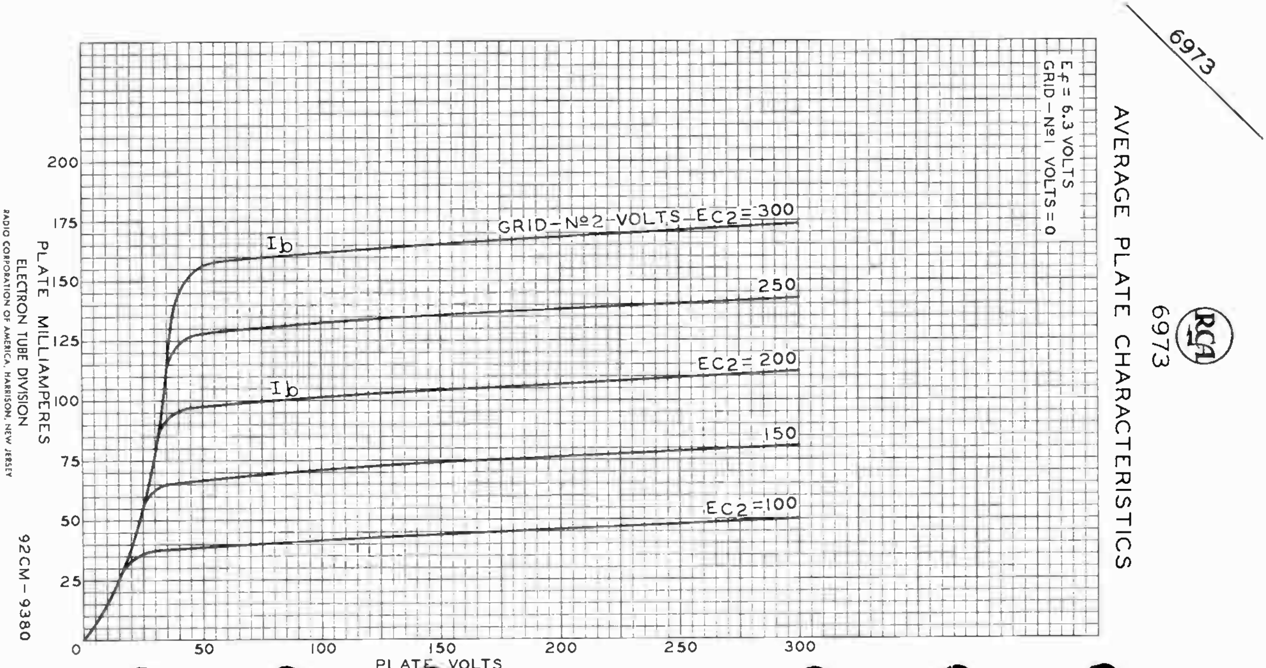
° Without external shield.

▲ The dc component must not exceed 100 volts.

● The type of input coupling network used should not introduce too much resistance in the grid-No.1 circuit. Transformer- or impedance-coupling devices are recommended.

* Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to apply 50 per cent of the plate signal voltage to grid No.2 of each output tube.

\# Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to supply 43 per cent of the plate signal voltage to grid No.2 of each output tube.



6973
AVERAGE PLATE CHARACTERISTICS
RCA
6973
Ef = 6.3 VOLTS
GRID-Nº1 VOLTS = 0
GRID-Nº2-VOLTS-EC2 = 300
250
EC2 = 200
150
EC2 = 100
Ib
Ib
PLATE MILLIAMPERES
PLATE VOLTS
0
50
100
150
200
250
300
25
50
75
100
125
150
175
200
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
92CM-9380

RCA

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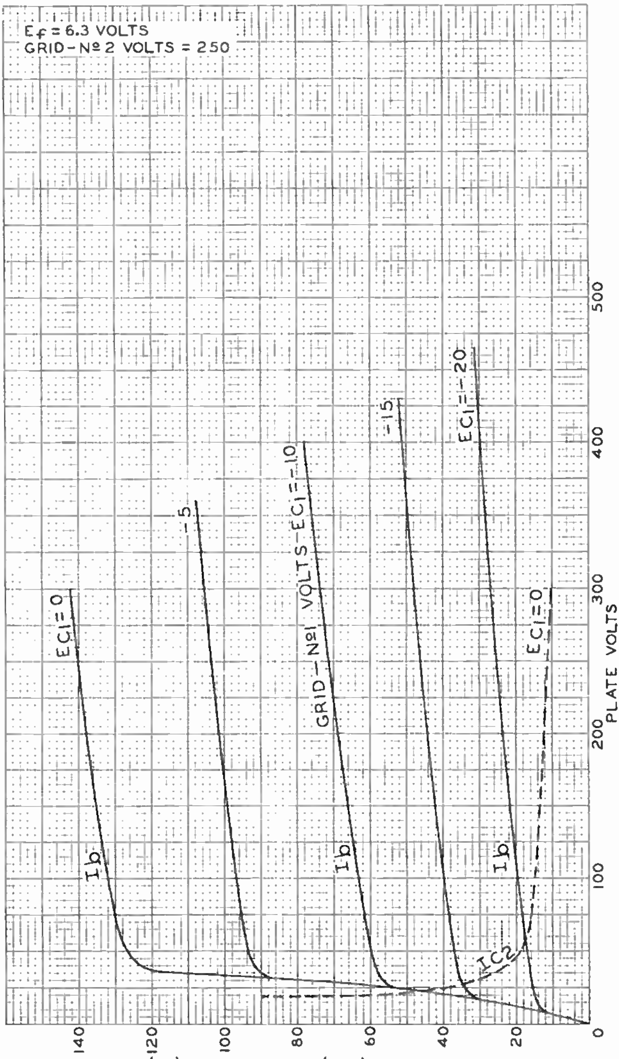
AVERAGE CHARACTERISTICS



ELECTRON TUBE DIVISION 92CM-9389

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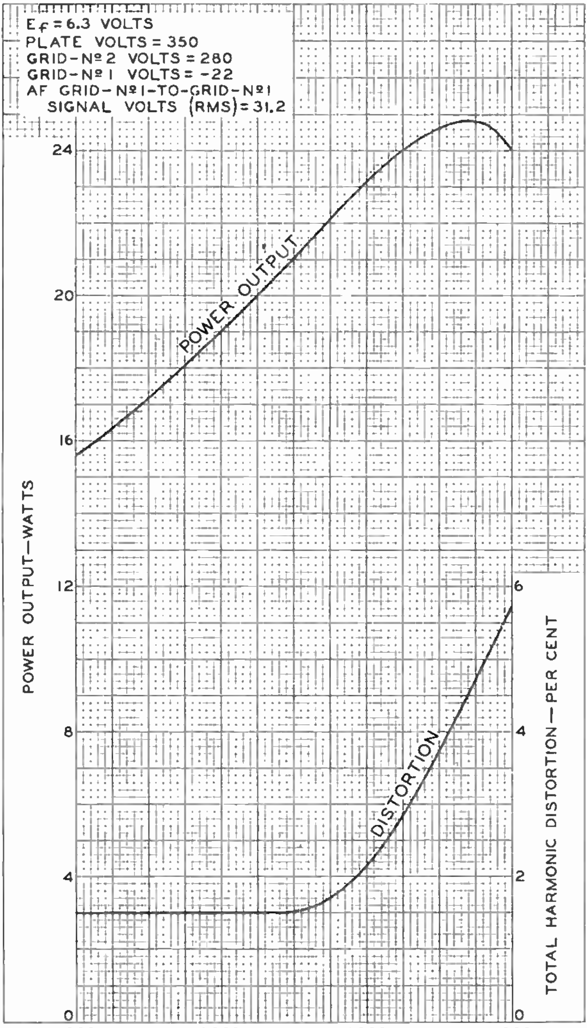
OPERATION CHARACTERISTICS

PUSH-PULL CLASS AB_1 OPERATION



ELECTRON TUBE DIVISION
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92CM-9381

Full-Wave Gas and Mercury-Vapor Rectifier

GENERAL DATA

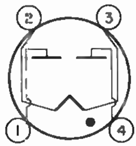
Electrical:[a]

Filament, Coated:		
Voltage (AC)	2.5	volts
Current at 2.5 volts	11.5 ± 1.0	amp
Minimum heating time prior to tube conduction	15	sec
Typical Anode Starting Voltage	10	volts
Peak Tube Voltage Drop at anode amperes = 5	10	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	7-1/2"
Maximum Diameter	2-1/16"
Weight (Approx.)	5 oz
Bulb	T16
Socket	Super-Jumbo 4-Contact
Base	Medium-Metal-Shell Super-Jumbo 4-Pin (JEDEC No.A4-81)
Basing Designation for BOTTOM VIEW	4BS

Pin 1 - Anode No.2
Pin 2 - Filament



Pin 3 - Filament
Pin 4 - Anode No.1

Thermal:

Type of Cooling	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):		
No load	18	°C
Full load	28	°C

FULL-WAVE RECTIFIER[a]

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps

PEAK INVERSE ANODE VOLTAGE	900 max.	volts
ANODE CURRENT (Each Anode):		
Peak	10 max.	amp
Average[b]	2.5 max.	amp
Fault	150 max.	amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)[c]	0 to +90	°C

[a] With circuit returns to filament-transformer center-tap.

[b] Averaged over any interval of 5 seconds maximum.

[c] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +90° C which corresponds approximately to +15° to +65° C ambient.

Half-Wave Mercury-Vapor Rectifier

GENERAL DATA

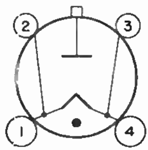
Electrical:[a]

Filament, Coated:		
Voltage (AC)	2.5	volts
Current at 2.5 volts	7 ± 1	amp
Minimum heating time prior to tube conduction	20	sec
Typical Anode Starting Voltage	13	volts
Peak Tube Voltage Drop at anode amperes = 8	12	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	6-3/8"
Maximum Diameter	2-1/16"
Weight (Approx.)	4 oz
Bulb	ST16
Cap	Medium (JEDEC No.C1-5)
Socket	Small 4-Contact
Base	Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)
Basing Designation for BOTTOM VIEW	4AU

Pin 1 – Filament
Pin 2 – Filament
Pin 3 – Filament



Pin 4 – Filament
Cap – Anode

Thermal:

Type of Cooling	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)	30	°C

HALF-WAVE RECTIFIER[a]

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps

PEAK INVERSE ANODE VOLTAGE	2000 max.	volts
ANODE CURRENT:		
Peak	10 max.	amp
Average[b]	2.5 max.	amp
Fault	250 max.	amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)	+35 to +80	°C

[a] With circuit returns to filament-transformer center-tap.
[b] Averaged over any interval of 5 seconds maximum.

Half-Wave Gas and Mercury-Vapor Rectifier

GENERAL DATA

Electrical:[a]

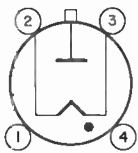
Filament, Coated:		
Voltage (AC)	2.5	volts
Current at 2.5 volts	18 ± 2	amp
Minimum heating time prior to tube conduction	60	sec
Typical Anode Starting Voltage	20	volts
Peak Tube Voltage Drop at anode amperes = 20	9	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	9-1/2"
Maximum Diameter	2-1/16"
Weight (Approx.)	6 oz
Bulb	T16
Cap	Medium (JEDEC No.C1-5)
Socket	Super-Jumbo 4-Contact
Base	Medium-Metal-Shell Super-Jumbo 4-Pin

Terminal Diagram: BOTTOM VIEW

Pin 1 – No Internal Connection
Pin 2 – Filament
Pin 3 – Filament



Pin 4 – No Internal Connection
Cap – Anode

Thermal:

Type of Cooling	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)	30	°C

HALF-WAVE RECTIFIER[a]

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps

PEAK INVERSE ANODE VOLTAGE	1000 max.	volts
ANODE CURRENT:		
Peak	77 max.	amp
Average[b]	6.4 max.	amp
Fault	770 max.	amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)[c]	-40 to +100	°C

[a] With circuit returns to filament-transformer center-tap.

[b] Averaged over any interval of 20 seconds maximum.

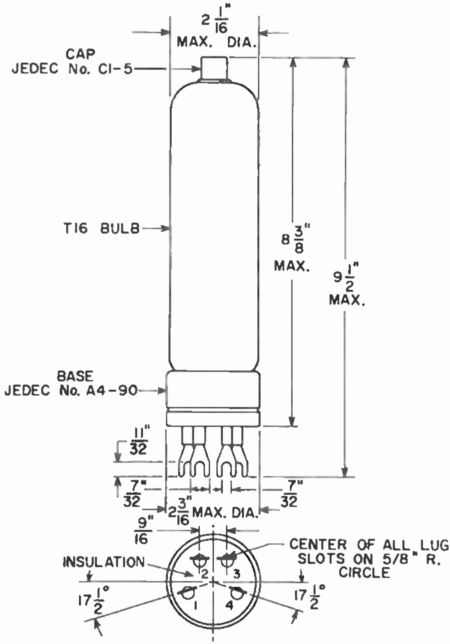
[c] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +100° C which corresponds approximately to +10° to +70° C ambient.

Half-Wave Gas and Mercury-Vapor Rectifier

The 635L/7020 is the same as the 635/7019 except for the following items:

Mechanical:

Maximum Seated Length . . . . 8-3/8"
Base. . . . . .Special Metal Shell (JEDEC No.A4-90)



92CS-11668

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BEAM POWER TUBE

For high-fidelity audio-amplifier applications

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

Voltage	6.3	ac or dc volts
Current	0.9	amp

Direct Interelectrode Capacitances:°

Grid No.1 to plate	1.5	μμf
Grid No.1 to cathode & grid No.3, grid No.2, and heater	10	μμf
Plate to cathode & grid No.3, grid No.2, and heater	7.5	μμf

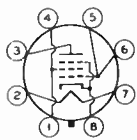
Characteristics, Class A_1 Amplifier:

Plate Voltage	250	volts
Grid-No.2 (Screen-Grid) Voltage	250	volts
Grid-No.1 (Control-Grid) Voltage	−14	volts
Plate Resistance (Approx.)	22500	ohms
Transconductance	6000	μmhos
Plate Current	72	ma
Grid-No.2 Current	5	ma

Mechanical:

Operating Position	Any
Maximum Overall Length	4.62"
Maximum Seated Length	4.06"
Maximum Diameter	1.63"
Bulb	T12
Base	Small-Wafer Octal 8-Pin with Sleeve (JETEC No.B8-191)
Basing Designation for BOTTOM VIEW	8HY

Pin 1 - Grid No.2
Pin 2 - Heater
Pin 3 - Plate
Pin 4 - Grid No.2
Pin 5 - Grid No.1



Pin 6 - Grid No.1
Pin 7 - Heater
Pin 8 - Cathode, Grid No.3

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Maximum Ratings, ***Design-Center Values:***

PLATE VOLTAGE	450	max.	volts
GRID-No.2 (SCREEN-GRID) VOLTAGE	400	max.	volts
CATHODE CURRENT:			
Peak	400	max.	ma
DC	110	max.	ma
GRID-No.2 INPUT	3.5	max.	watts
PLATE DISSIPATION	25	max.	watts

°: See next page.

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BEAM POWER TUBE

PEAK HEATER-CATHODE VOLTAGE:

Heater negative with respect to cathode.	200	max.	volts
Heater positive with respect to cathode.	200▲	max.	volts

Typical Operation with Fixed Bias:

Values are for 2 tubes

Plate Voltage	330	400	450	volts
Grid-No.2 Voltage	330	300	350	volts
Grid-No.1 (Control-Grid) Voltage●.	-24	-25	-30	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	48	50	60	volts
Zero-Signal Plate Current . . .	122	102	95	ma
Max.-Signal Plate Current . . .	184	152	194	ma
Zero-Signal Grid-No.2 Current .	5.6	6	3.4	ma
Max.-Signal Grid-No.2 Current .	18.5	17	19.2	ma
Effective Load Resistance (Plate to plate).	4500	6600	6000	ohms
Total Harmonic Distortion . . .	1	2	1.5	%
Max.-Signal Power Output. . . .	31.5	34	50	watts

Typical Operation with Cathode Bias:

Values are for 2 tubes

Plate-Supply Voltage.	400	380	volts
Grid-No.2 Supply Voltage. . . .	300	380	volts
Cathode Resistor.	200	180	ohms
Peak AF Grid-No.1-to-Grid-No.1 Voltage	57	68.5	volts
Zero-Signal Plate Current . . .	112	138	ma
Max.-Signal Plate Current . . .	128	170	ma
Zero-Signal Grid-No.2 Current .	7	5.6	ma
Max.-Signal Grid-No.2 Current .	16	20	ma
Effective Load Resistance (Plate to plate).	6600	4500	ohms
Total Harmonic Distortion . . .	2	3.5	%
Max.-Signal Power Output. . . .	32	36	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:●

For fixed-bias operation.	0.1	max.	megohm
For cathode-bias operation.	0.5	max.	megohm

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Grid No.2 of each tube connected to tap on plate winding of output transformer

Maximum Ratings, ***Design-Center Values:***

PLATE AND GRID-No.2 (SCREEN-GRID) SUPPLY VOLTAGE.	450	max.	volts

○,▲,●: See next page.

ELECTRON TUBE DIVISION
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BEAM POWER TUBE

CATHODE CURRENT:			
Peak	400	max.	ma
DC	110	max.	ma
GRID-No.2 INPUT	3	max.	watts
PLATE DISSIPATION	25	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode.	200	max.	volts
Heater positive with respect to cathode.	200▲	max.	volts

Typical Operation:

Values are for 2 tubes

Plate-Supply Voltage.	410	volts
Grid-No.2 Supply Voltage.	*	volts
Cathode Resistor.	220	ohms
Peak AF Grid-No.1-to-Grid-No.1 Voltage. .	68	volts
Zero-Signal Cathode Current	134	ma
Max.-Signal Cathode Current	155	ma
Effective Load Resistance (Plate to plate)	8000	ohms
Total Harmonic Distortion	1.6	%
Max.-Signal Power Output.	24	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:●			
For cathode-bias operation.	0.5	max.	megohm

○ Without external shield.

▲ The dc component must not exceed 100 volts.

● The type of input coupling network used should not introduce too much resistance in the grid-No.1 circuit. Transformer- or impedance-coupling devices are recommended.

* Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to apply 43 per cent of the plate signal voltage to grid No.2 of each output tube.

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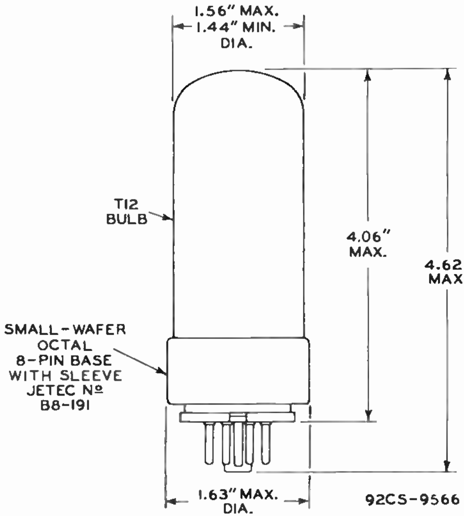
BEAM POWER TUBE



ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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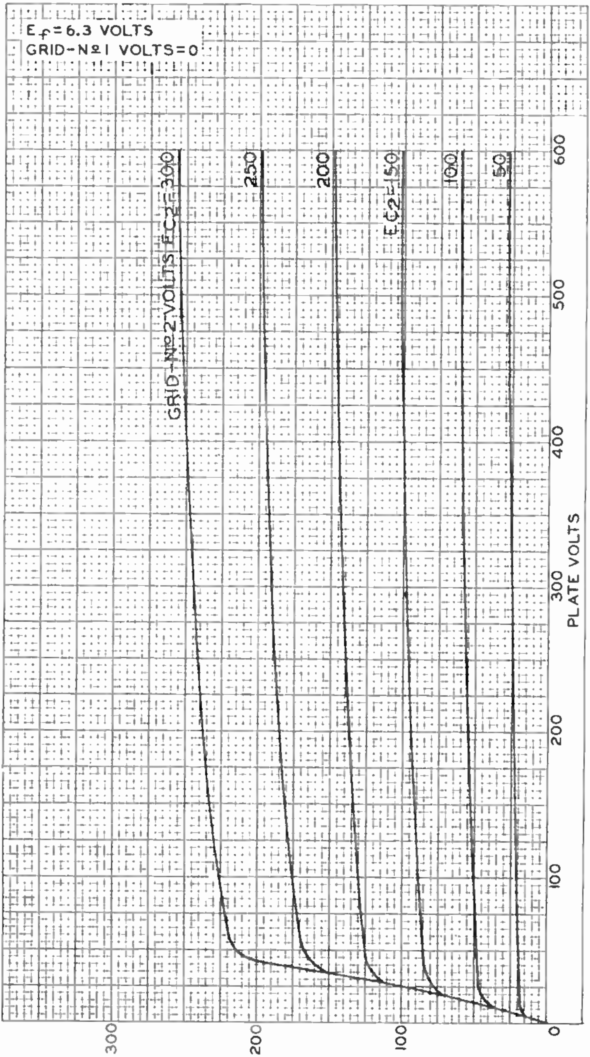
RCA 7027

AVERAGE PLATE CHARACTERISTICS



ELECTRON TUBE DIVISION

92CM-9569

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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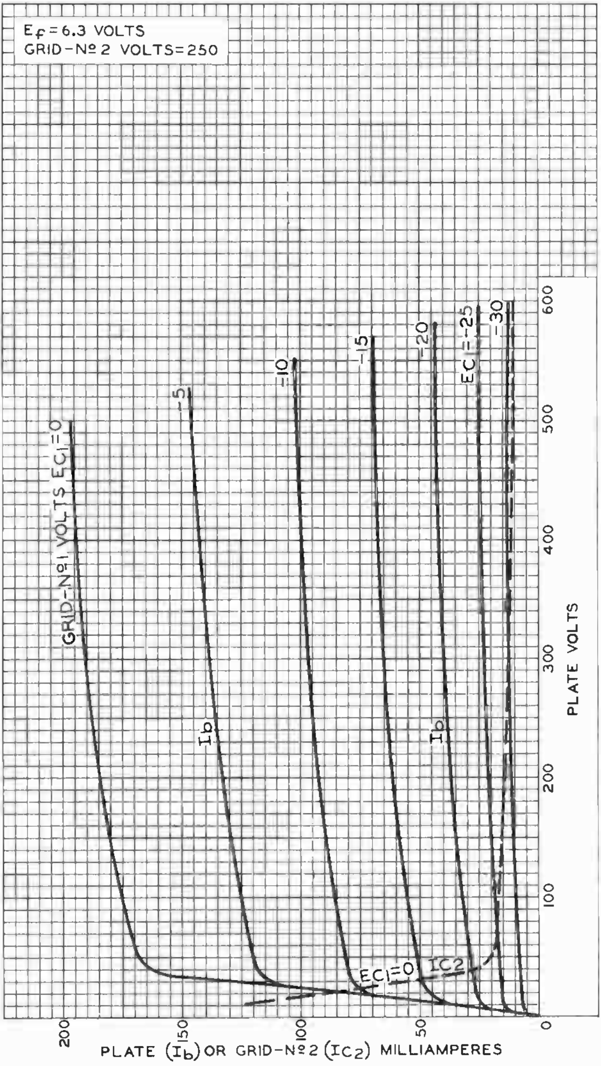
AVERAGE CHARACTERISTICS



ELECTRON TUBE DIVISION

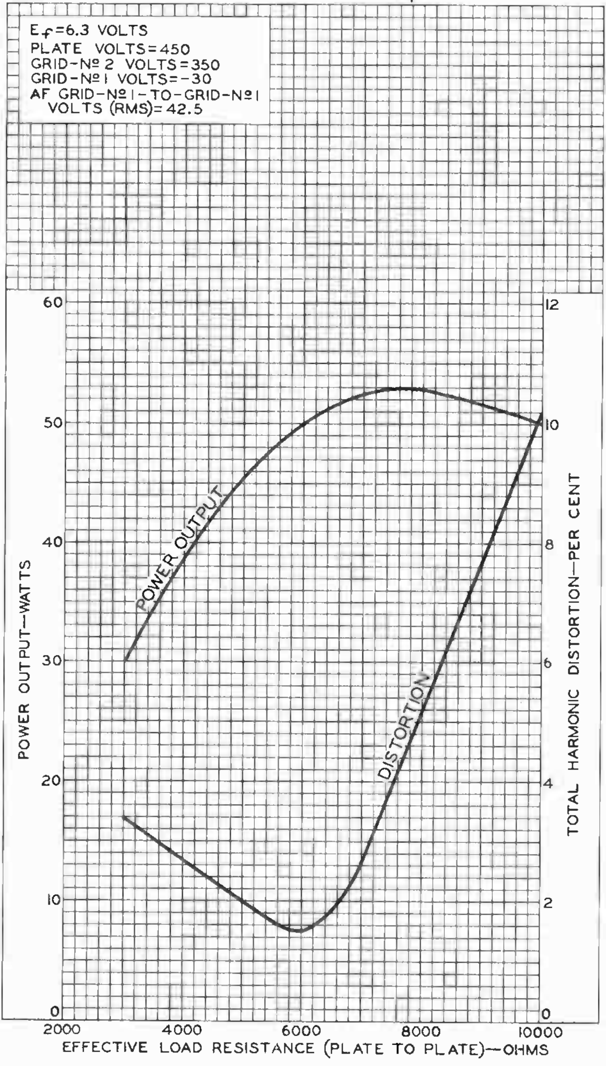
92CM-9570

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7027

OPERATION CHARACTERISTICS

PUSH-PULL CLASS AB1



ELECTRON TUBE DIVISION

92CM-9575

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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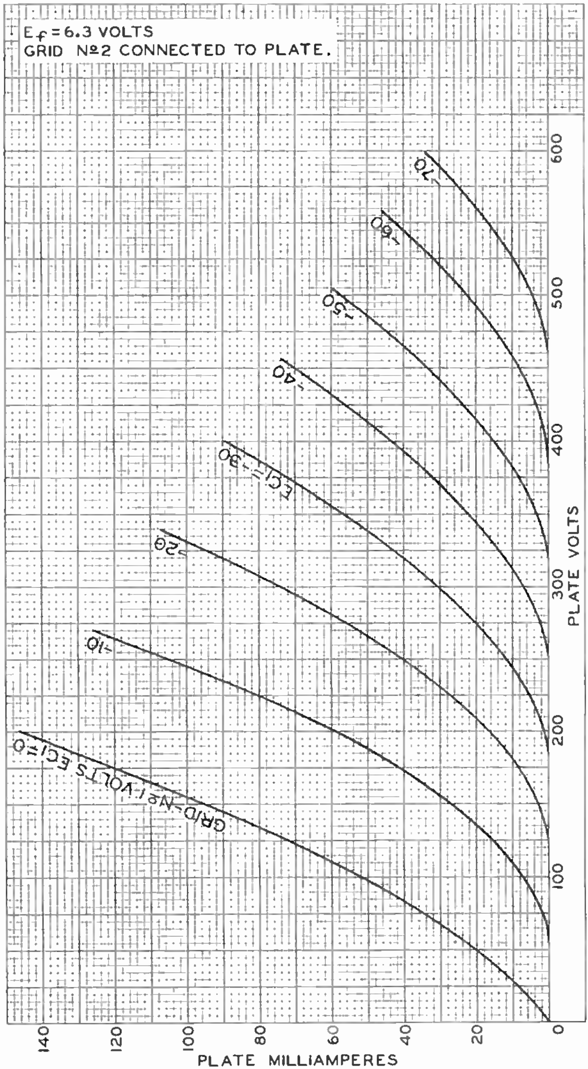
AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION



ELECTRON TUBE DIVISION

92CM-9568

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Beam Power Tube

FORCED-AIR COOLED

COAXIAL-ELECTRODE STRUCTURE	370 WATTS CW OUTPUT UP TO 150 Mc
UNIPOTENTIAL CATHODE	140 WATTS CW OUTPUT AT 500 Mc
COMPACT DESIGN	INTEGRAL RADIATOR

For Use at Frequencies up to 500 Mc

GENERAL DATA

Electrical:

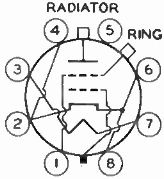
Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	6.0 ± 10%	volts
Current at heater volts = 6.0	2.6	amp
Minimum heating time	30	sec
Mu-Factor, Grid No.2 to Grid No.1, for grid-No.2 volts = 300 and grid-No.2 ma. = 50	5	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate	0.03	μμf
Grid No.1 to cathode, grid No.2, and heater	16	μμf
Plate to cathode, grid No.2, and heater	4.4	μμf

Mechanical:

Operating Position	Any
Maximum Overall Length	2.404"
Maximum Seated Length	1.850"
Maximum Diameter	1.640"
Weight (Approx.)	4 oz
Radiator	Integral part of tube
Socket	Air-System Socket, such as Johnson No.124-110-1[c] (Supplied with Air Chimney)
Base	Special 8-Pin

BOTTOM VIEW

Pin 1 - Grid No.2[d]
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Cathode
Pin 5 - Do Not Use
Pin 6 - Cathode
Pin 7 - Heater



Pin 8 - Cathode
Base Index Plug - Grid No.1
Radiator - Plate
Ring Terminal[e] - Grid No.2

Air Flow:

Through indicated air-system socket—This fitting directs the air over the base seals; past the grid-No.2 seal, glass envelope, and plate seal; and through the radiator to provide effective cooling with minimum air flow. When the tube is operated at maximum plate dissipation for each class of service, a minimum air flow of 5.6 cfm

← Indicates a change.

through the system is required. The corresponding pressure drop is 0.45 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Without air-system socket—If an air-system socket is not used, it is essential that adequate cooling air be directed over the base seals, past the envelope, and through the radiator. Under these conditions and with the tube operating at maximum plate dissipation for each class of service, a minimum air flow of 5.3 cfm must pass through the radiator. The corresponding pressure drop is 0.28 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Plate Temperature (Measured on base end of plate surface at junction with fins)	250 max.	°C
Temperature of Plate Seal	200 max.	°C
Temperature of Base Seals and Grid-No.2 Seal	175 max.	°C

AF POWER AMPLIFIER & MODULATOR — Class AB_1[f]

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

DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[h]	250 max.	ma
GRID-No.2 INPUT[h]	12 max.	watts
PLATE DISSIPATION[h]	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

Values are for 2 tubes

DC Plate Voltage	800	1000	1500	2000	volts
DC Grid-No.2 Voltage	300	300	300	300	volts
DC Grid-No.1 (Control-Grid) Voltage	-40	-43	-50	-50	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	80	86	100	100	volts
Zero-Signal DC Plate Current	210	165	100	100	ma
Max.-Signal DC Plate Current	435	450	456	470	ma
Zero-Signal DC Grid-No.2 Current	0	0	0	0	ma
Max.-Signal DC Grid-No.2 Current	76	52	42	36	ma

Effective Load Resistance (Plate to plate)	4400	4250	6570	8760	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	0	watts
Max.-Signal Power Output (Approx.)	170	230	400	580	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance (Per tube) . . 0.1 max. megohm

AF POWER AMPLIFIER & MODULATOR — Class AB_2[j]

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

DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[h]	250 max.	ma
GRID-No.2 INPUT[h]	12 max.	watts
PLATE DISSIPATION[h]	250 max.	watts
GRID-No.1 (CONTROL-GRID) INPUT	2 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

Values are for 2 tubes

DC Plate Voltage	800	1000	1500	2000	volts
DC Grid-No.2 Voltage	300	300	300	300	volts
DC Grid-No.1 Voltage	-40	-45	-50	-50	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	90	98	106	106	volts
Zero-Signal DC Plate Current	210	166	100	100	ma
Max.-Signal DC Plate Current	500	493	500	500	ma
Zero-Signal DC Grid-No.2 Current	0	0	0	0	ma
Max.-Signal DC Grid-No.2 Current	80	58	46	36	ma
Effective Load Resistance (Plate to plate)	3140	3950	5970	8100	ohms
Max.-Signal Driving Power (Approx.)	0.15	0.15	0.2	0.2	watt
Max.-Signal Power Output (Approx.)	215	270	440	630	watts

RF POWER AMPLIFIER — Class B Television Service

Synchronizing-level conditions per tube unless otherwise specified

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

	54 to 216 Mc	
DC PLATE VOLTAGE	1250 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	volts
DC PLATE CURRENT (AVERAGE)[k]	250 max.	ma

GRID-No.2 INPUT	12 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

	With bandwidth of 5 Mc			
DC Plate Voltage	750	1000	1250	volts
DC Grid-No.2 Voltage	300	300	300	volts
DC Grid-No.1 Voltage	-60	-65	-70	volts
Peak RF Grid-No.1 Voltage:				
Synchronizing level	85	95	100	volts
Pedestal level	65	70	75	volts
DC Plate Current:				
Synchronizing level	335	330	305	ma
Pedestal level	245	240	230	ma
DC Grid-No.2 Current:				
Synchronizing level	50	45	45	ma
Pedestal level	20	15	10	ma
DC Grid-No.1 Current:				
Synchronizing level	15	20	25	ma
Pedestal level	4	4	4	ma
Driver Power Output (Approx.):[1]				
Synchronizing level	7	8	9	watts
Pedestal level	4.25	4.7	5.5	watts
Useful Power Output (Approx.):				
Synchronizing level	135	200	250	watts
Pedestal level	75	110	140	watts

→ **LINEAR RF POWER AMPLIFIER**

Single-Sideband Suppressed-Carrier Service

Maximum Ratings, *Absolute-Maximum Values:*

	Up to 150 Mc		*Up to 500 Mc*	
	CCS[g]	*ICAS*[m]	*CCS*[g]	
DC PLATE VOLTAGE	2000 max.	2250 max.	1250 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	400 max.	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	250 max.	280 max.	250 max.	ma
GRID-No.2 INPUT	12 max.	12 max.	12 max.	watts
PLATE DISSIPATION	250 max.	250 max.	300 max.	watts
PEAK HEATER-CATHODE VOLTAGE:				
Heater negative with respect to cathode	150 max.	150 max.	150 max.	volts
Heater positive with respect to cathode	150 max.	150 max.	150 max.	volts

→ indicates a change.

Typical Class AB_1 "Single-Tone" Operation up to 150 Mc:[n] ←

	CCS[g]			ICAS[m]	
DC Plate Voltage	1000	1500	1800	2000	volts
DC Grid-No.2 Voltage[p]	300	300	300	300	volts
DC Grid-No.1 (Control-Grid) Voltage	-50	-50	-50	-48	volts
Zero-Signal DC Plate Current	50	50	50	60	ma
Zero-Signal DC Grid-No.2 Current	0	0	0	0	ma
Effective RF Load Resistance	1860	3280	4140	4270	ohms
Max.-Signal DC Plate Current	225	225	225	250	ma
Max.-Signal DC Grid-No.2 Current	11	11	11	9	ma
Max.-Signal Peak RF Grid-No.1 Voltage	50	50	50	48	volts
Max.-Signal Driving Power (Approx.)	0	0	0	0	watts
Max.-Signal Power Output (Approx.)	115	200	250	290	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance under Any Condition:

With fixed bias	25000 max.	ohms
With cathode bias	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 150 Mc	150 to 500 Mc	
DC PLATE VOLTAGE	1600 max.	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	-250 max.	volts
DC PLATE CURRENT	200 max.	200 max.	ma
GRID-No.2 INPUT	10 max.	10 max.	watts
GRID-No.1 INPUT	2 max.	2 max.	watts
PLATE DISSIPATION	165 max.	165 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	150 max.	150 max.	volts
Heater positive with respect to cathode	150 max.	150 max.	volts

Typical CCS Operation:

	Up to 150 Mc		
DC Plate Voltage	1200	1600	volts
DC Grid-No.2 Voltage (Modulated approx. 55%)[q]	250	250	volts

← Indicates a change.

DC Grid-No.1 Voltage[r]	-118	-118	volts
Peak AF Grid-No.2 Voltage (For 100% modulation)	180	200	volts
Peak RF Grid-No.1 Voltage	136	136	volts
DC Plate Current	200	200	ma
DC Grid-No.2 Current	23	23	ma
DC Grid-No.1 Current (Approx.)	5	5	ma
Driving Power (Approx.)	2	3	watts
Power Output (Approx.)	150	230	watts

At 165 Mc

DC Plate Voltage	400	600	800	1000	volts
DC Grid-No.2 Voltage (Modulated approx. 55%)[q]	250	250	250	250	volts
DC Grid-No.1 Voltage	-90	-95	-100	-105	volts
Peak AF Grid-No.2 Voltage (For 100% modulation)	140	150	160	170	volts
Peak RF Grid-No.1 Voltage	110	120	120	125	volts
DC Plate Current	200	200	200	200	ma
DC Grid-No.2 Current	40	35	25	20	ma
DC Grid-No.1 Current (Approx.)	7	8	10	15	ma
Driving Power (Approx.)	1	1	1.5	2	ma
Power Output (Approx.)	55	80	100	140	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under Any Condition	25000 max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[s] and RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 150 Mc	*150 to 500 Mc*	
DC PLATE VOLTAGE	2000 max.	1250 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	-250 max.	volts
DC PLATE CURRENT	250 max.	250 max.	ma
GRID-No.2 INPUT	12 max.	12 max.	watts
GRID-No.1 INPUT	2 max.	2 max.	watts
PLATE DISSIPATION	250 max.	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	150 max.	150 max.	volts
Heater positive with respect to cathode	150 max.	150 max.	volts

Typical CCS Operation:

Up to 150 Mc

DC Plate Voltage	1500	2000	volts
DC Grid-No.2 Voltage	250	250	volts

DC Grid-No.1 Voltage	-88	-88	volts
Peak RF Grid-No.1 Voltage	110	110	volts
DC Plate Current	250	250	ma
DC Grid-No.2 Current	24	24	ma
DC Grid-No.1 Current (Approx.)	8	8	ma
Driving Power (Approx.)	1.5	2.5	watts
Power Output (Approx.)	260	370	watts

At 165 Mc

DC Plate Voltage	600	750	1000	1250	volts
DC Grid-No.2 Voltage	250	250	250	250	volts
DC Grid-No.1 Voltage	-75	-80	-80	-90	volts
Peak RF Grid-No.1 Voltage	91	96	95	106	volts
DC Plate Current	200	200	200	200	ma
DC Grid-No.2 Current	37	37	31	20	ma
DC Grid-No.1 Current (Approx.)	11	11	10	11	ma
Driving Power (Approx.)	1	1	1	1.2	watts
Power Output (Approx.)	85	110	150	195	watts

At 500 Mc with coaxial cavity

DC Plate Voltage	600	800	1000	1250	volts
DC Grid-No.2 Voltage	250	250	250	280	volts
DC Grid-No.1 Voltage	-110	-110	-110	-115	volts
DC Plate Current	170	200	200	200	ma
DC Grid-No.2 Current	6	7	7	5	ma
DC Grid-No.1 Current (Approx.)	6	10	10	10	ma
Driver Power Output (Approx.)[l]	15	20	25	30	watts
Useful Power Output (Approx.)	50	95	120	140	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under Any Condition . . . . 25000 max. ohms

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

[c] Available from E.F. Johnson Co., Waseca, Minn.

[d] For use at lower frequencies.

[e] For use at higher frequencies

[f] Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

[g] Continuous Commercial Service.

[h] Averaged over any audio-frequency cycle of sine-wave form.

[j] Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

[k] Averaged over any frame.

[l] The driver stage is required to supply tube losses and rf-circuit losses. The driver stage should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

[m] Intermittent Commercial and Amateur Service.

[n] "Single-Tone" operation refers to that class of amplifier service in which the grid-No.2 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

p Preferably obtained from a fixed supply.

q The dc grid-No.2 voltage must be modulated approximately 55% in phase with the plate modulation in order to obtain 100% modulation of the 7034/4X150A. The use of a series grid-No.2 resistor or reactor may not give satisfactory performance and is therefore not recommended.

r Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

s Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

➞ CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	2.3	2.9	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.05	$\mu\mu$f
Grid No.1 to cathode, grid No.2, and heater	2	14.5	17.0	$\mu\mu$f
Plate to cathode, grid No.2, and heater	2	4.0	4.8	$\mu\mu$f
Grid-No.1 Voltage	1,3,4,5	-32	-46	volts
Grid-No.2 Current	1,3,4,5	-5	3	ma
Power Output	4,5,6	100	-	watts

Note 1: With 6.0 volts on heater.

Note 2: With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and grid-No.1 voltage adjusted to give plate current of 150 milliamperes.

Note 4: With forced-air cooling as specified under GENERAL DATA for *Air-System Socket*.

Note 5: Heater voltage must be applied for at least 30 seconds before application of other voltages.

Note 6: With heater volts = 5.5, dc plate volts = 1000, dc grid-No.2 volts = 250, dc grid-No.1 volts = -90, maximum dc grid-No.1 milliamperes = 20, grid-No.1 signal voltage adjusted to give dc plate current of 200 milliamperes, and a frequency of 475 Mc.

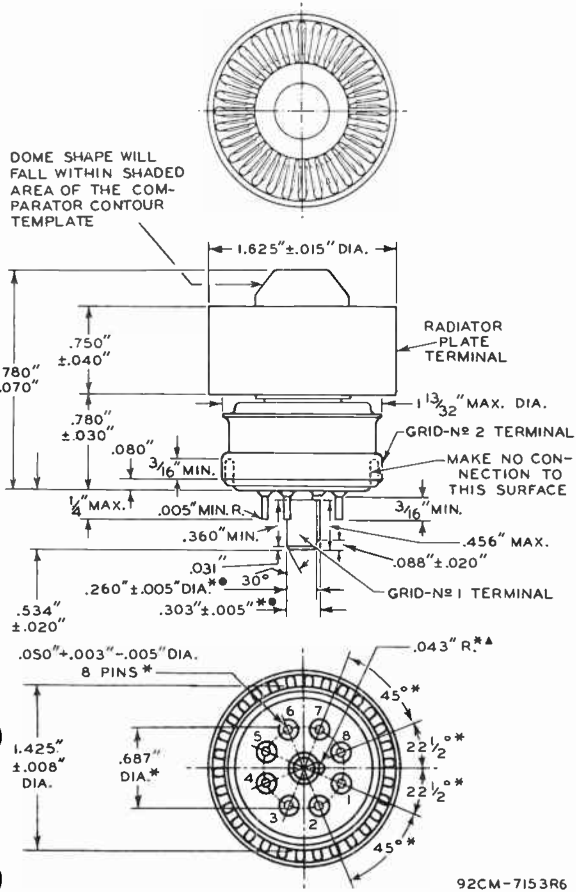
SPECIAL PERFORMANCE DATA

Interelectrode Leakage:

This test is destructive and is performed on a sample lot of tubes from each production run under the following conditions: ac heater volts = 6.6, no voltage on other elements, and specified forced-air cooling for *Air-System Socket*. At the end of 500 hours, with tube at 25° C, and with no voltage applied to heater, the minimum resistance between indicated electrodes as measured with a 500-volt Megger-type ohmmeter having an internal impedance of 2.5 megohms, will be:

Grid No.1 and Grid No.2	10 min.	megohms
Grid No.1 and Cathode	10 min.	megohms
Grid No.2 and Cathode	10 min.	megohms

➞ Indicates a change.



GRID-No. I PLUG DIMENSIONS ARE MEASURED BY THE USE OF THE SERIES OF GAUGES SHOWN IN SKETCHES G_1 AND G_2. IN THE FOLLOWING INSTRUCTIONS FOR THE USE OF THESE GAUGES, "GO" INDICATES THAT THE ENTIRE GRID-No. I PLUG KEY WILL ENTER THE GAUGE; AND "NO-GO" INDICATES THAT THE GRID-No. I PLUG KEY WILL NOT ENTER THE GAUGE MORE THAN 1/16". INSTRUCTIONS FOR THE USE OF THE GAUGES FOLLOW:

▲, ●, *: See next page.

▲ GAUGES G_1-1, G_1-2, G_1-3, AND G_1-4:

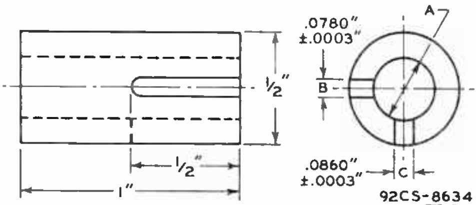
USING ONLY SLOT C, TRY THESE GAUGES IN NUMERICAL ORDER UNTIL ONE IS FOUND THAT WILL ACCEPT THE ENTIRE GRID-No. I PLUG. USING THE FIRST GAUGE THUS FOUND, IT WILL NOT BE POSSIBLE TO INSERT THE GRID-No. I PLUG IN SLOT B.

● GAUGES G_2-1, G_2-2, AND G_3-3:

THE GRID-No. I PLUG WILL BE REJECTED BY GAUGES G_2-1 AND G_2-2, BUT WILL BE ACCEPTED BY GAUGE G_2-3.

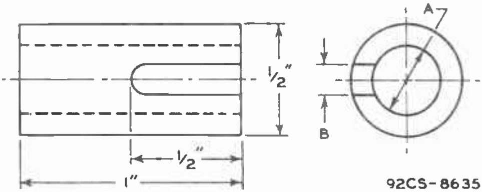
* BASE-PIN POSITIONS ARE HELD TO TOLERANCES SUCH THAT THE ENTIRE LENGTH OF THE PINS WILL, WITHOUT UNDUE FORCE, PASS INTO AND DISENGAGE FROM THE FLAT-PLATE GAUGE SHOWN IN SKETCH G_3.

GAUGE SKETCH G_1



Gauge	Dimension A
G_1-1	.2575" + .0000" − .0005"
G_1-2	.2600" + .0000" − .DD05"
G_1-3	.2625" + .0000" − .0005"
G_1-4	.2650" + .0000" − .0005"

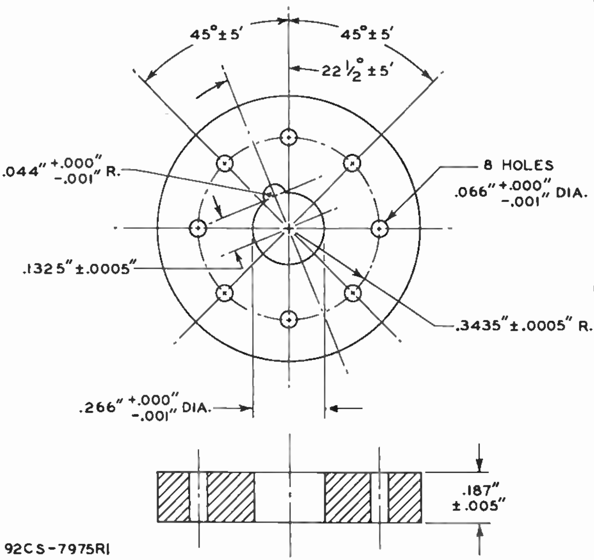
GAUGE SKETCH G_2



92CS-8635

Gauge	Dimension	
	A	B
G_2-1	.2550" + .0000" − .0005"	.125"
G_2-2	.2980" + .0000" − .0005"	none
G_2-3	.3080" + .0000" − .0005"	none

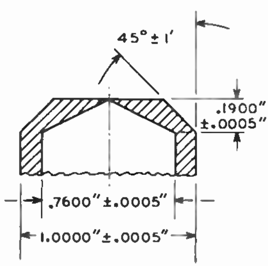
GAUGE SKETCH G_3



92CS-7975R1

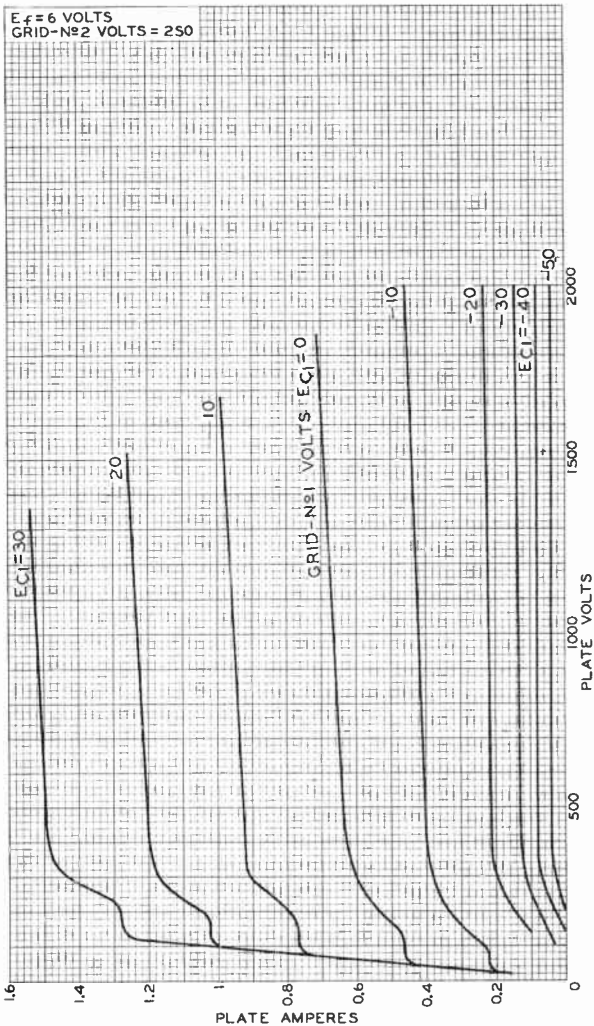
TOLERANCES ARE NOT CUMULATIVE

COMPARATOR CONTOUR TEMPLATE



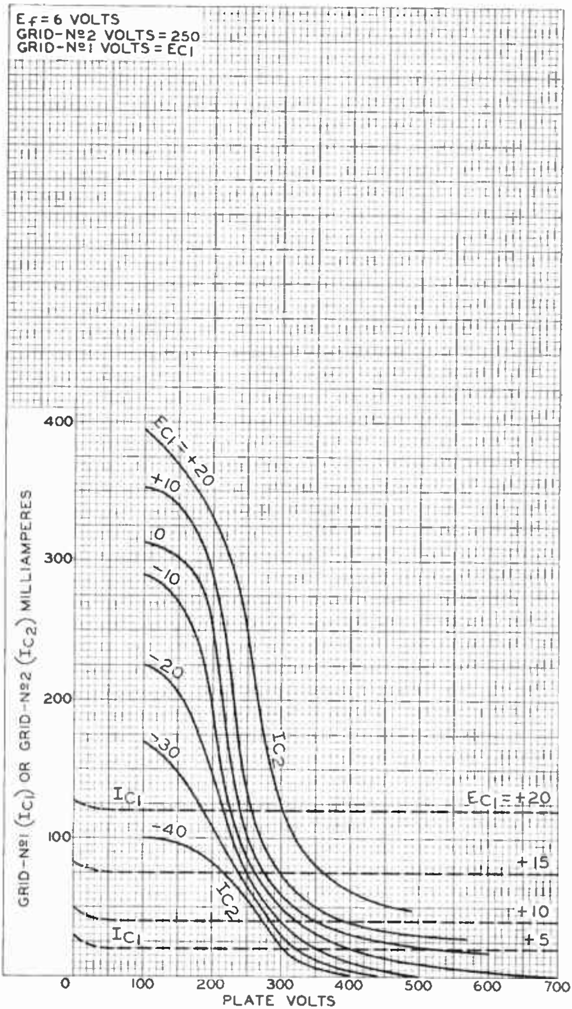
92CS-10554R1

TYPICAL PLATE CHARACTERISTICS



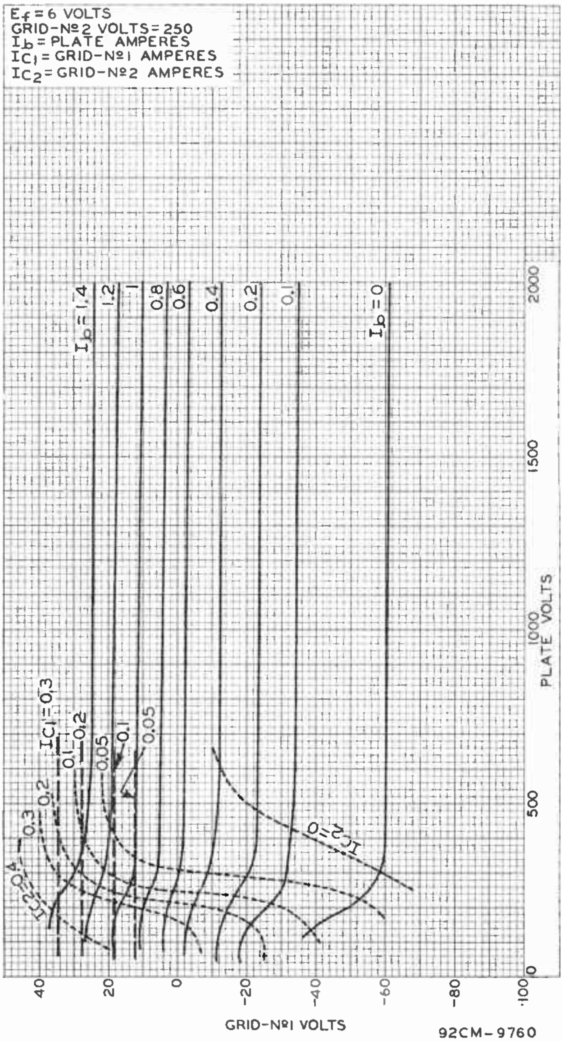
92CM-9755

TYPICAL CHARACTERISTICS

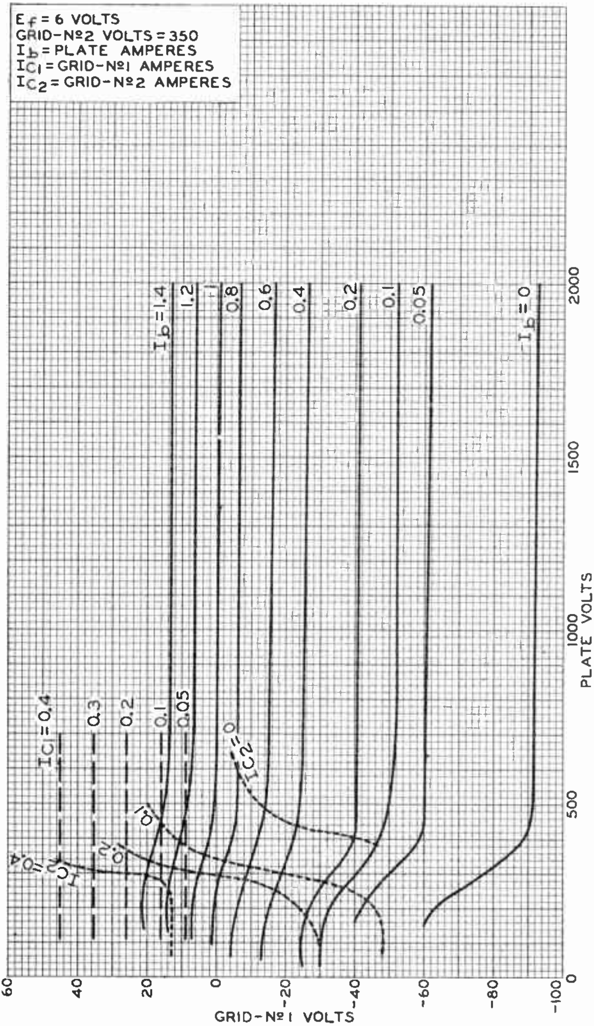


92CM-9756

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9761

Beam Power Tube

FORCED-AIR COOLED

COAXIAL-ELECTRODE STRUCTURE — 370 WATTS CW OUTPUT UP TO 150 Mc
UNIPOTENTIAL CATHODE — 140 WATTS CW OUTPUT AT 500 Mc
COMPACT DESIGN — INTEGRAL RADIATOR

For Use at Frequencies up to 500 Mc

The 7035/4X150D is the same as the 7034/4X150A except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	26.5 ± 10%	volts
Current at heater volts = 26.5.	0.58	amp

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Note	*Min.*	*Max.*	
Heater Current.	1	0.50	0.62	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.05	μμf
Grid No.1 to cathode, grid No.2, and heater.	2	14.5	17.0	μμf
Plate to cathode, grid No.2, and heater.	2	4.0	4.8	μμf
Grid-No.1 Voltage	1,3,4,5	-32	-46	volts
Grid-No.2 Current	1,3,4,5	-5	3	ma
Power Output.	4,5,6	100	-	watts

Note 1: With 26.5 volts on heater.

Note 2: With cylindrical shield having inside diameter of 1-13/16" completely surrounding radiator, and insulated from the top and sides of it by a 1/16" thickness of insulating material; and with a cylindrical shield having inside diameter of 1.460" and length of 5/16" surrounding the grid-No.2 ring terminal and insulated from it. Both shields are connected to ground.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and grid-No.1 voltage adjusted to give plate current of 150 milliamperes.

Note 4: With forced-air cooling as specified under GENERAL DATA for *Air-System Socket*.

Note 5: Heater voltage must be applied for at least 30 seconds before application of other voltages.

Note 6: With heater volts = 24.5, dc plate volts = 1000, dc grid-No.2 volts = 250, dc grid-No.1 volts = -90, maximum dc grid-No.1 milliamperes = 20, grid-No.1 signal voltage adjusted to give dc plate current of 200 milliamperes, and a frequency of 475 Mc.

SPECIAL PERFORMANCE DATA

Interelectrode Leakage:

This test is destructive and is performed on a sample lot of tubes from each production run under the following conditions: ac heater volts = 29.1, no voltage on other elements,

← Indicates a change.

and specified forced-air cooling for *Air-System Socket*. At the end of 500 hours, with tube at 25° C, and with no voltage applied to heater, the minimum resistance between indicated electrodes as measured with a 500-volt Megger-type ohmmeter having an internal impedance of 2.5 megohms, will be:

Grid No.1 and grid No.2	10 min.	megohms
Grid No.1 and cathode	10 min.	megohms
Grid No.2 and cathode	10 min.	megohms

Power Pentode

9-PIN MINIATURE TYPE

For Mobile-Communications Equipment Operating from 6-Cell Storage-Battery Systems. Useful as a Class-C RF-Power-Amplifier, Oscillator, and Frequency-Multiplier Tube up to 40 Mc, and as a Modulator and AF-Power-Amplifier Tube.

The 7054 is the same as the 3077/7054 except for the following items:

Mechanical:

Maximum Overall Length.	2-5/8"
Maximum Seated Length	2-3/8"
Length, Base Seat to Bulb Top (Excluding tip). . . .	2" ± 3/32"

Power Pentode

9-PIN MINIATURE TYPE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3	volts
Current	0.76	amp
Direct Interelectrode Capacitances (Approx.):[a]		
Grid No.1 to plate	0.5	$\mu\mu$f
Grid No.1 to cathode & grid No.3, grid No.2, and heater	10.8	$\mu\mu$f
Plate to cathode & grid No.3, grid No.2, and heater	6.5	$\mu\mu$f
Grid No.1 to heater	0.25	$\mu\mu$f

Characteristics, Class A_1 Amplifier:

Plate Voltage	250	volts
Grid-No.2 Voltage	250	volts
Grid-No.1 Voltage	-7.3	volts
Mu-Factor, Grid No.2 to Grid No.1	19.5	
Plate Resistance (Approx.)	40000	ohms
Transconductance	11300	μmhos
Plate Current	48	ma
Grid-No.2 Current	5.5	ma

Mechanical:

Operating Position	Any
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-13/16"
Length, Base Seat to Bulb Top (Excluding tip)	2-7/16" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)
Basing Designation for BOTTOM VIEW	9CV

Pin 1 – Internal Connection— Do Not Use
Pin 2 – Grid No.1
Pin 3 – Cathode, Grid No.3

Pin 4 – Heater
Pin 5 – Heater
Pin 6 – Same as Pin 1
Pin 7 – Plate
Pin 8 – Same as Pin 1
Pin 9 – Grid No.2

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Maximum Ratings, *Design-Center Values:*

PLATE VOLTAGE	400 max.	volts
GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
CATHODE CURRENT	65 max.	ma
PLATE DISSIPATION	12 max.	watts
ZERO-SIGNAL GRID-No.2 INPUT	2 max.	watts

MAX.-SIGNAL GRID-No.2 INPUT	4 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts

Typical Operation:

Values are for 2 tubes

Plate Voltage	400	volts
Grid-No.2 Voltage	300	volts
Grid-No.1 Voltage	-15	volts
Peak AF Grid-No.1 Voltage	14.8	volts
Zero-Signal Plate Current	15	ma
Max.-Signal Plate Current	105	ma
Zero-Signal Grid-No.2 Current	1.6	ma
Max.-Signal Grid-No.2 Current	25	ma
Effective Load Resistance (Plate to plate)	8000	ohms
Total Harmonic Distortion	4	%
Max.-Signal Power Output	24	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:		
For fixed-bias operation	0.3 max.	megohm

PUSH-PULL AF POWER AMPLIFIER — Class AB_1

Grid No.2 of each tube connected to tap on plate winding of output transformer

Maximum Ratings, *Design-Center Values:*

→ PLATE AND GRID-No.2 (SCREEN-GRID) SUPPLY VOLTAGE	375 max.	volts
CATHODE CURRENT	65 max.	ma
PLATE DISSIPATION	12 max.	watts
ZERO-SIGNAL GRID-No.2 INPUT	2 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	4 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts

Typical Operation:

Values are for 2 tubes

Plate Supply Voltage	375	volts
Grid-No.2 Supply Voltage	b	
Cathode Resistor	220	ohms
Peak AF Grid-No.1 Voltage	17.7	volts
→ Zero-Signal Cathode Current	70	ma
→ Max.-Signal Cathode Current	81	ma
Effective Load Resistance (Plate to plate)	11000	ohms
Total Harmonic Distortion	3	%
Max.-Signal Power Output	16.5	watts

→ indicates a change.

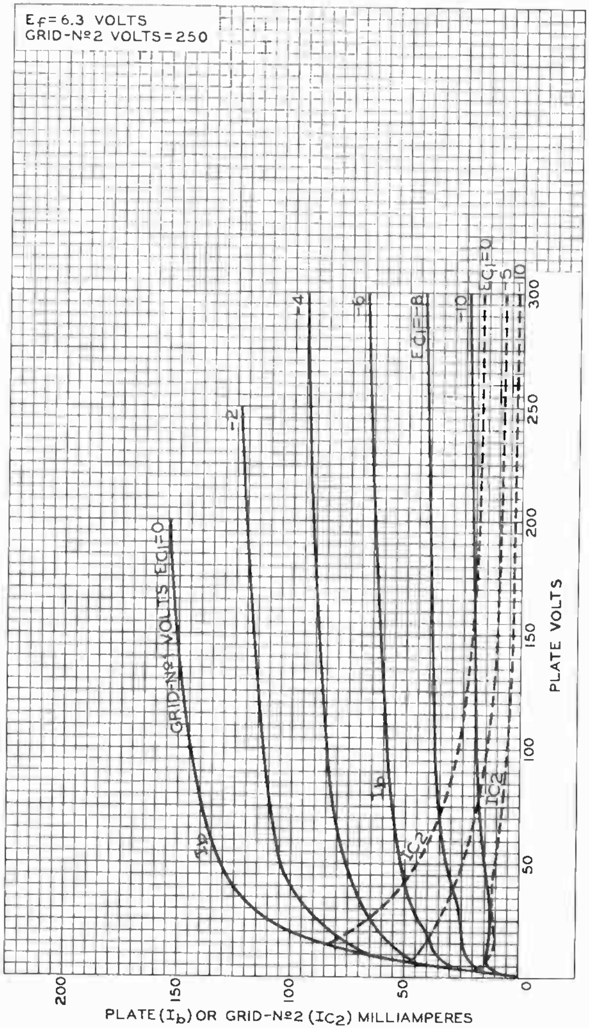
Maximum Circuit Values:

Grid-No.1-Circuit Resistance:		
For cathode-bias operation.	1 max.	megohm

[a] Without external shield.

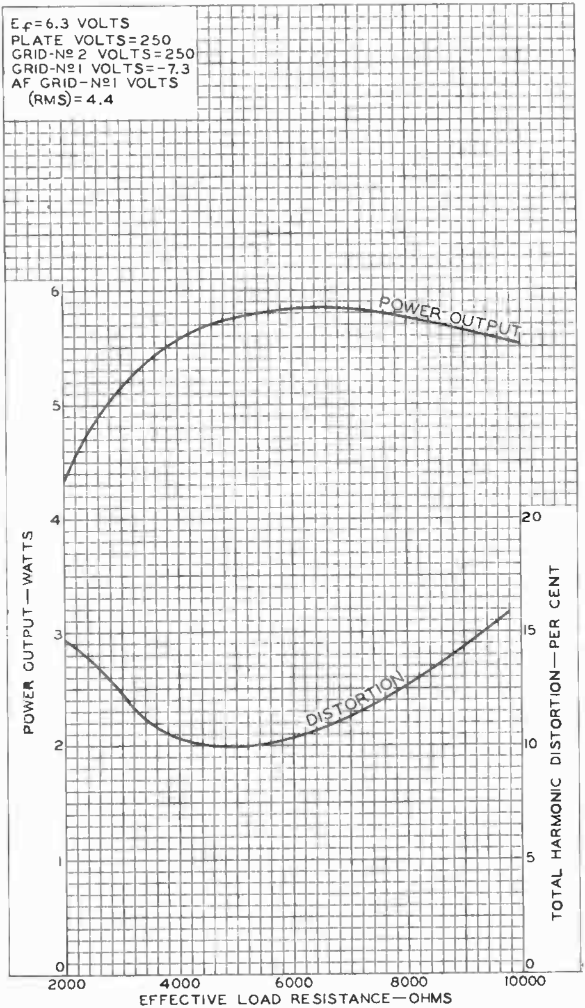
[b] Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center-tap (B+) so as to supply 43 per cent of the plate signal voltage to grid No.2 of each output tube.

AVERAGE CHARACTERISTICS



92CM-9903

OPERATION CHARACTERISTICS



92CM-9902

7203/4CX250B

Beam Power Tube

FORCED-AIR COOLED

CERAMIC-METAL SEALS	400 WATTS CW OUTPUT TO 175 Mc
COAXIAL-ELECTRODE STRUCTURE	250 WATTS CW OUTPUT AT 500 Mc
COMPACT DESIGN	INTEGRAL RADIATOR

For Use at Frequencies up to 500 Mc

The 7203 is unilaterally interchangeable with the 4X250B and bilaterally interchangeable with the 4CX250B.

GENERAL DATA

Electrical:

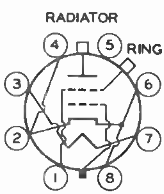
Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	6.0 ± 10%	volts
Current at heater volts = 6.0	2.6	amp
Minimum heating time.	30	sec
Mu-Factor, Grid No.2 to Grid No.1, for grid-No.2 volts = 300 and grid-No.2 ma. = 50.	5.0	←
Direct interelectrode Capacitances:[b]		
Grid No.1 to plate.	0.03	μμf
Grid No.1 to cathode, grid No.2, and heater.	16.0	μμf
Plate to cathode, grid No.2, and heater.	4.4	μμf

Mechanical:

Operating Position.	Any
Maximum Overall Length.	2.464"
Maximum Seated Length	1.91" ←
Maximum Diameter.	1.640"
Weight (Approx.).	4 oz
Radiator.	Integral part of tube
Socket.	Air-System Socket, such as SK-600[c] and SK-606 Air Chimney[c]; or 124-110-1[d] (Supplied with Air Chimney)
Base.	Special 8-Pin

BOTTOM VIEW

Pin 1 - Grid No.2[e]
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Cathode
Pin 5 - Do Not Use
Pin 6 - Cathode
Pin 7 - Heater



Pin 8 - Cathode
Base Index Plug - Grid No.1
Radiator - Plate
Ring Terminal[f] - Grid No.2

Air Flow:

Through indicated air-system socket—This fitting directs the air over the base seals; past the grid-No.2 seal, envelope, and plate seal; and through the radiator to

← indicates a change.

provide effective cooling with minimum air flow. When the tube is operated at maximum plate dissipation for each class of service, a minimum air flow of 3.8 cfm through the system is required. The corresponding pressure drop is approximately 0.3 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Without air-system socket—If an air-system socket is not used, it is essential that adequate cooling air be directed over the base seals, past the envelope, and through the radiator. Under these conditions and with the tube operating at maximum plate dissipation for each class of service, a minimum air flow of 3.6 cfm must pass through the radiator. The corresponding pressure drop is approximately 0.1 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Plate Temperature (Measured on base end of plate surface at junction with fins)	250 max.	°C
Temperature of Plate Seal, Grid-No.2 Seal, and Base Seals	250 max.	°C

AF POWER AMPLIFIER & MODULATOR — Class AB_1[g]

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

DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[j]	250 max.	ma
GRID-No.2 INPUT[j]	12 max.	watts
PLATE DISSIPATION[j]	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

Values are for 2 tubes

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage	350	350	350	volts
DC Grid-No.1 (Control-grid) Voltage	-55	-55	-55	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	94	94	94	volts
Zero-Signal DC Plate Current	166	166	166	ma
Max.-Signal DC Plate Current	500	500	500	ma

Zero-Signal DC Grid-No.2 Current	0	0	0	ma
Max.-Signal DC Grid-No.2 Current (Approx.)	10	8	8	ma
Effective Load Resistance (Plate to plate).	3300	6000	8700	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	220	400	590	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance (Per tube) .	0.1 max.	megohm

RF POWER AMPLIFIER — Class B Television Service

Synchronizing-level conditions per tube unless otherwise specified

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

	54 to 216 Mc	
DC PLATE VOLTAGE.	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . . .	400 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . . .	-250 max.	volts
DC PLATE CURRENT (AVERAGE)[k]	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	150 max.	volts
Heater positive with respect to cathode.	150 max.	volts

Typical CCS Operation:

With bandwidth of 5 Mc

DC Plate Voltage.	1000	1500	2000	volts
DC Grid-No.2 Voltage.	350	350	350	volts
DC Grid-No.1 Voltage.	-60	-65	-70	volts
Peak RF Grid-No.1 Voltage:				
Synchronizing level	65	71	76	volts
Pedestal level.	52	57	62	volts
DC Plate Current:				
Synchronizing level	355	360	360	ma
Pedestal level.	250	250	250	ma
DC Grid-No.2 Current:				
Synchronizing level	27	29	29	ma
Pedestal level.	4	0	0	ma
DC Grid-No.1 Current:				
Synchronizing level	2	5	5	ma
Pedestal level.	0	0	0	ma
Driving Power (Approx.):[l]				
Synchronizing level	0.4	1.2	1.2	watts
Pedestal level.	0	0	0	watts
Power Output (Approx.):				
Synchronizing level	160	300	440	watts
Pedestal level.	90	170	250	watts

LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

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

	Up to 500 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Class AB_1 "Single-Tone" Operation:[m]

At frequencies up to 175 Mc

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage[n]	350	350	350	volts
DC Grid-No.1 (Control-grid) Voltage	-55	-55	-55	volts
Zero-Signal DC Plate Current	83	83	83	ma
Zero-Signal DC Grid-No.2 Current	0	0	0	ma
Effective RF Load Resistance	1650	3000	4350	ohms
Max.-Signal DC Plate Current	250	250	250	ma
Max.-Signal DC Grid-No.2 Current	5	4	4	ma
Max.-Signal Peak RF Grid-No.1 Voltage	47	47	47	volts
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	110	200	295	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation	25000 max.	ohms
For cathode-bias operation	Not recommended	

→ **Typical CCS Operation with "Two-Tone Modulation":[p]**

At 30 Mc

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage[n]	350	350	350	volts
DC Grid-No.1 Voltage[q]	-55	-55	-55	volts
Zero-Signal DC Plate Current	83	83	83	ma
Effective RF Load Resistance	1650	3000	4350	ohms
DC Plate Current at Peak of Envelope	250	250	250	ma
Average DC Plate Current	175	175	175	ma
DC Grid-No.2 Current at Peak of Envelope	30	30	30	ma

→ Indicates a change.

Average DC Grid-No.2 Current	6	9.5	15	ma
Average DC Grid-No.1 Current	0	0	0	ma
Peak-Envelope Driver Power (Approx.)	1	1	1	watt
Output-Circuit Efficiency (Approx.)	95	95	95	%
Distortion Products Level:[r]				
Third Order	29	29	30	db
Fifth Order	40	38	35	db
Useful Power Output (Approx.):[s]				
Average	55	100	147.5	watts
Peak Envelope	110	200	295	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation	25000 max.	ohms
For cathode-bias operation	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 500 Mc	
DC PLATE VOLTAGE	1500 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	volts
DC PLATE CURRENT	200 max.	ma
GRID-No.2 INPUT	8 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	165 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

At frequencies up to 175 Mc

DC Plate Voltage	500	1000	1500	volts
DC Grid-No.2 Voltage (Modulated approx. 55%)[t]	250	250	250	volts
DC Grid-No.1 Voltage[u]	-100	-100	-100	volts
Peak RF Grid-No.1 Voltage	113	113	113	volts
DC Plate Current	200	200	200	ma
DC Grid-No.2 Current	32	31	31	ma
DC Grid-No.1 Current (Approx.)	6	6	6	ma
Driving Power (Approx.)[l]	0.7	0.7	0.7	watt
Power Output (Approx.)	50	140	235	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	25000 max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[v]
and
RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 500 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	volts
DC PLATE CURRENT	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

	At frequencies up to 175 Mc				
DC Plate Voltage	500	1000	1500	2000	volts
DC Grid-No.2 Voltage	250	250	250	250	volts
DC Grid-No.1 Voltage	-90	-90	-90	-90	volts
Peak RF Grid-No.1 Voltage	109	109	109	109	volts
DC Plate Current	250	250	250	250	ma
DC Grid-No.2 Current	48	45	36	30	ma
DC Grid-No.1 Current (Approx.)	12	12	11	11	ma
Driving Power (Approx.)	1	1	1	1	watt
Power Output (Approx.)	65	180	290	400	watts

	At frequency of 500 Mc with coaxial cavity	
DC Plate Voltage	2000	volts
DC Grid-No.2 Voltage	300	volts
DC Grid-No.1 Voltage	-90	volts
DC Plate Current	250	ma
DC Grid-No.2 Current	10	ma
DC Grid-No.1 Current (Approx.)	25	ma
Driver Power Output (Approx.)[i]	18	watts
Useful Power Output (Approx.)	250	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	25000 max.	ohms

a Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

b With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

c Available from Eitel-McCullough, Inc., San Bruno, California.

d Available from E. F. Johnson Co., Waseca, Minnesota.

e For use at lower frequencies.

f For use at higher frequencies.

g Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

h Continuous Commercial Service.

j Averaged over any audio-frequency cycle of sine-wave form.

k Averaged over any frame.

l The driver stage is required to supply tube losses and rf-circuit losses. The driver stage should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

m "Single-Tone" operation refers to that class of amplifier service in which the grid-No.2 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

n Preferably obtained from a fixed supply.

p "Two-Tone Modulation" operation refers to that class of amplifier service in which the input consists of two equal monofrequency rf signals having constant amplitude. These signals are produced in a single-sideband suppressed-carrier system when two equal-and-constant-amplitude audio frequencies are applied to the input of the system.

q Obtained from a fixed supply.

r Without the use of feedback to enhance linerity.

s Measured at load of output circuit having indicated efficiency.

t The dc grid-No.2 voltage must be modulated approximately 55% in phase with the plate modulation in order to obtain 100% modulation of the 7203. The use of a series grid-No.2 resistor or reactor may not give satisfactory performance and is therefore not recommended.

u Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

v Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	2.3	2.9	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.06	μμf ←
Grid No.1 to cathode, grid No.2, and heater	2	14.2	17.2	μμf
Plate to cathode, grid No.2, and heater	2	4.0	4.8	μμf
Grid-No.1 Voltage	1,3,4,5	-32	-46	volts
Grid-No.2 Current	1,3,4,5	-7	3	ma
Useful Power Output	4,5,6	225	-	watts

Note 1: With 6.0 volts on heater.

Note 2: With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and grid-No.1 voltage adjusted to give plate current of 150 ma.

Note 4: With Forced-Air Cooling as specified under GENERAL DATA—*Air-System Socket*.

Note 5: Heater-voltage must be applied for at least 30 seconds before application of other voltages.

Note 6: With heater volts = 5.5, dc plate volts = 2000, dc grid-No.2 volts = 300, dc grid-No.1 volts = -90, dc grid-No.1 ma. = 25 maximum, grid-No.1 signal voltage adjusted to produce dc plate current of 250 ma., and coaxial-cavity amplifier-circuit operating frequency (Mc) = 475.

← Indicates a change.

SPECIAL TESTS & PERFORMANCE DATA

Interelectrode Leakage:

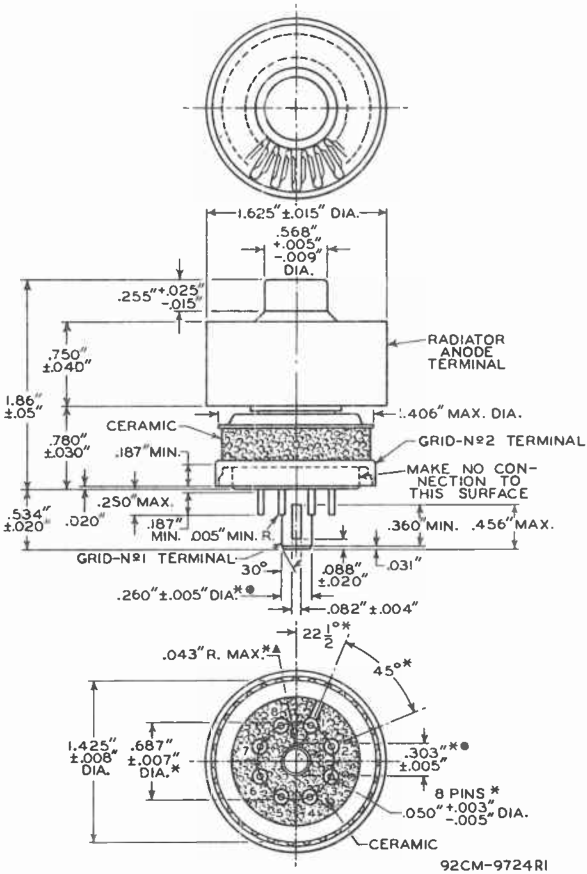
This test is destructive and is performed on a sample lot of tubes from each production run under the following conditions: ac heater volts = 6.6, no voltage on other elements, and specified forced-air cooling for *Air-System Socket*. At the end of 500 hours, with tube at 25° C, and with no voltage applied to heater, the minimum resistance between indicated electrodes as measured with a 500-volt Megger-type ohmmeter having an internal impedance of 2.5 megohms, will be:

Grid No.1 and grid No.2	10 min.	megohms
Grid No.1 and cathode	10 min.	megohms
Grid No.2 and cathode	10 min.	megohms

OPERATING CONSIDERATIONS

The *socket* for the 7203 should be of a type (such as is indicated in the tabulated data) which permits adequate air-cooling of the tube. Although the base will fit a conventional lock-in socket, the latter does not permit adequate cooling and its use is therefore not recommended.

The *plate connection* is made by means of a metal band or spring contacts to the cylindrical surface of the radiator. It is essential that the contact areas be kept clean to minimize rf losses especially at the higher frequencies.



GRID-No. 1-PLUG DIMENSIONS ARE MEASURED BY THE USE OF THE SERIES OF GAUGES SHOWN IN SKETCHES G_1 AND G_2. IN THE FOLLOWING INSTRUCTIONS FOR THE USE OF THESE GAUGES "GO" INDICATES THAT THE ENTIRE GRID-No. 1-PLUG KEY WILL ENTER THE GAUGE; AND "NO-GO" INDICATES THAT THE GRID-No. 1-PLUG KEY WILL NOT ENTER THE GAUGE MORE THAN 1/16". INSTRUCTIONS FOR THE USE OF THE GAUGES FOLLOW:

▲,●,*: See next page.

▲ GAUGES G_1-1, G_1-2, G_1-3, AND G_1-4:

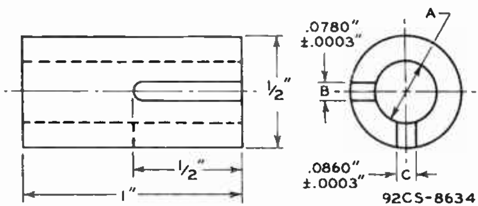
USING ONLY SLOT C, TRY THESE GAUGES IN NUMERICAL ORDER UNTIL ONE IS FOUND THAT WILL ACCEPT THE ENTIRE GRID-No.1 PLUG. USING THE FIRST GAUGE THUS FOUND, IT WILL NOT BE POSSIBLE TO INSERT THE GRID-No.1 PLUG IN SLOT B.

● GAUGES G_2-1, G_2-2, AND G_2-3:

THE GRID-No.1 PLUG WILL BE REJECTED BY GAUGES G_2-1 AND G_2-2, BUT WILL BE ACCEPTED BY GAUGE G_2-3.

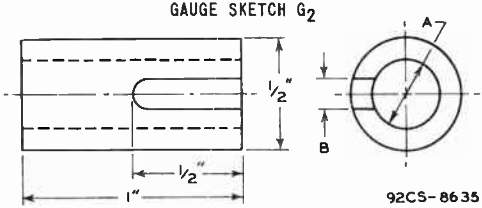
* BASE-PIN POSITIONS ARE HELD TO TOLERANCES SUCH THAT THE ENTIRE LENGTH OF THE PINS WILL, WITHOUT UNDUE FORCE, PASS INTO AND DISENGAGE FROM THE FLAT-PLATE GAUGE SHOWN IN SKETCH G_3.

GAUGE SKETCH G_1



Gauge	Dimension A
G_1-1	.2575" + .0000" − .0005"
G_1-2	.2600" + .0000" − .0005"
G_1-3	.2625" + .0000" − .0005"
G_1-4	.2650" + .0000" − .0005"

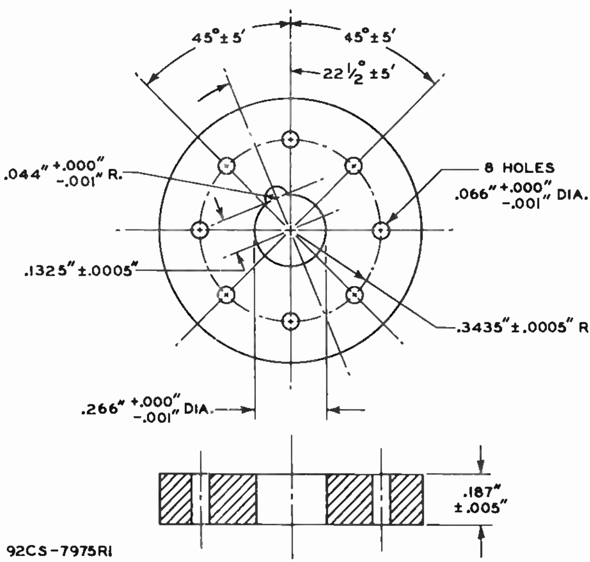
GAUGE SKETCH G_2



92CS-8635

Gauge	Dimension	
	A	B
G_2-1	.2550" + .0000" − .0005"	.125"
G_2-2	.2980" + .0000" − .0005"	none
G_2-3	.3080" + .0000" − .0005"	none

GAUGE SKETCH G_3



92CS-7975R1

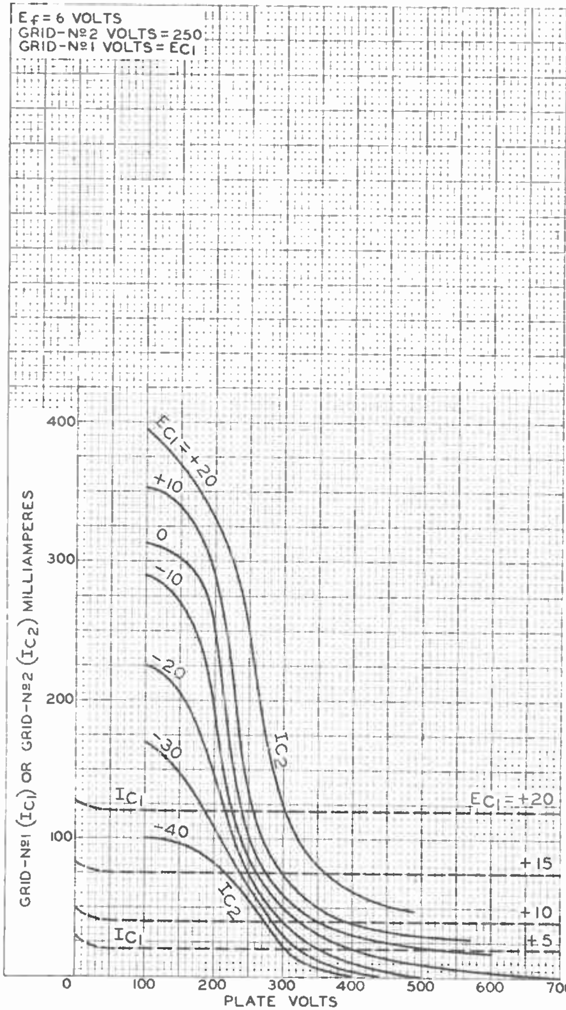
TOLERANCES ARE NOT CUMULATIVE

7203/4CX250B

TYPICAL PLATE CHARACTERISTICS

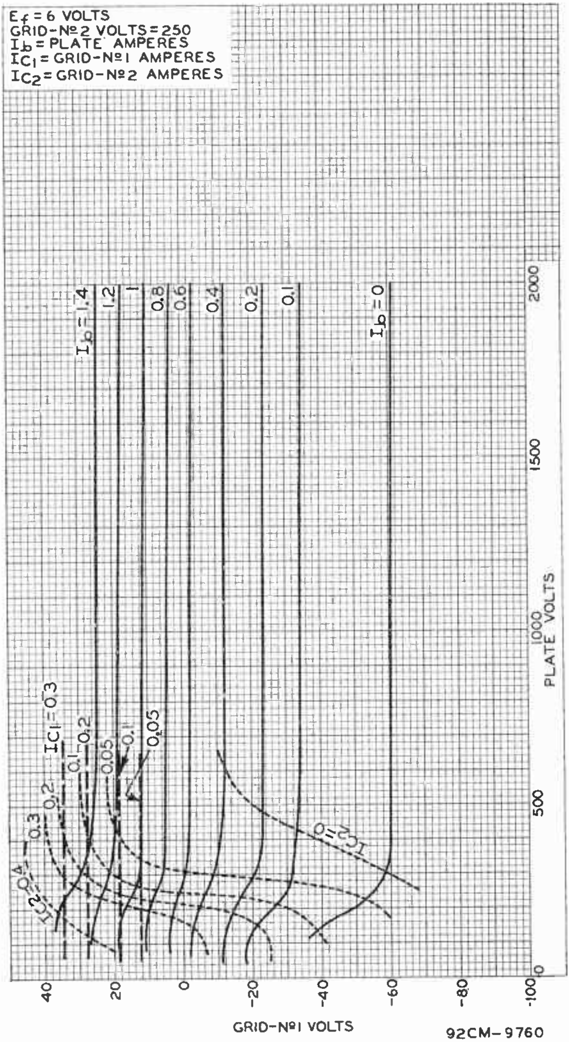
92CM-9755

TYPICAL CHARACTERISTICS

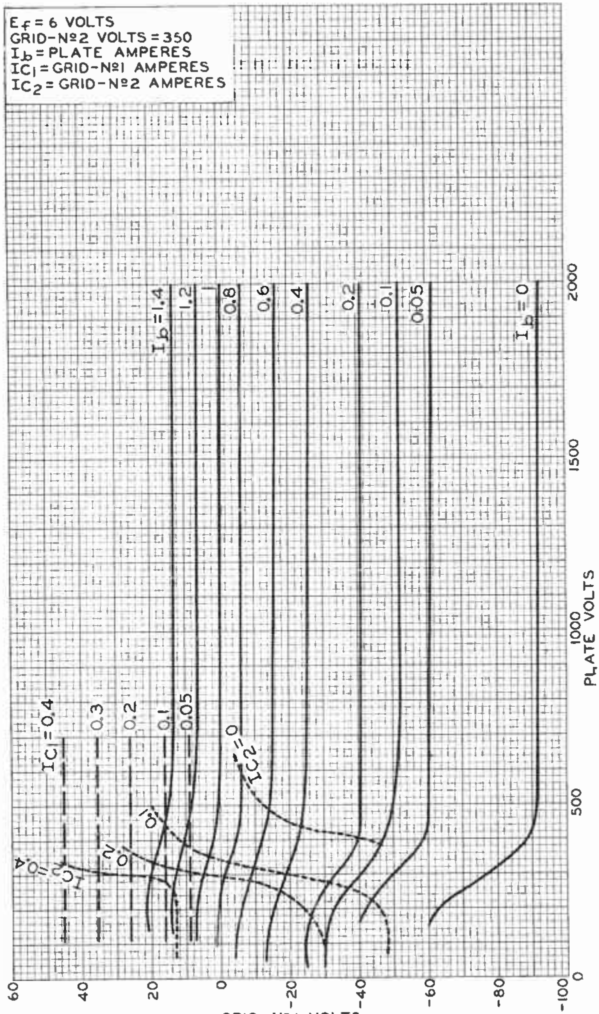


92CM-9756

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9761

Beam Power Tube

FORCED-AIR COOLED

CERAMIC-METAL SEALS — 400 WATTS CW OUTPUT TO 175 Mc
COAXIAL-ELECTRODE STRUCTURE — 250 WATTS CW OUTPUT AT 500 Mc
COMPACT DESIGN — INTEGRAL RADIATOR

For Use at Frequencies up to 500 Mc

The 7204 is unilaterally interchangeable with the 4X250F and bilaterally interchangeable with the 4CX250F. ←

The 7204 is the same as the 7203/4CX250B except for the following items:

Heater, for Unipotential Cathode:
- Voltage (AC or DC)[a] . . . . 26.5 ± 10% volts
- Current at heater volts = 26.5. . . . . . . 0.58 amp

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current	1	0.50	0.62	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.06	μμf ←
Grid No.1 to cathode, grid No.2, and heater	2	14.2	17.2	μμf
Plate to cathode, grid No.2, and heater	2	4.0	4.8	μμf
Grid-No.1 Voltage	1,3,4,5	-32	-46	volts
Grid-No.2 Current	1,3,4,5	-7	3	ma
Useful Power Output	4,5,6	225	-	watts

Note 1: With 26.5 volts on heater.

Note 2: With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and grid-No.1 voltage adjusted to give plate current of 150 ma.

Note 4: With Forced-Air Cooling as specified under GENERAL DATA — *Air-System Socket.*

Note 5: Heater voltage must be applied for at least 30 seconds before application of other voltages.

Note 6: With heater volts = 24.3, dc plate volts = 2000, dc grid-No.2 volts = 300, dc grid-No.1 volts = -90, dc grid-No.1 ma. = 25 maximum, grid-No.1 signal voltage adjusted to produce dc plate current of 250 ma., and coaxial-cavity amplifier-circuit operating frequency (Mc) = 475.

SPECIAL TESTS & PERFORMANCE DATA

Interelectrode Leakage:

This test is destructive and is performed on a sample lot of tubes from each production run under the following condi-

← Indicates a change.

tions; ac heater volts = 29.1, no voltage on other elements, and specified forced-air cooling for *Air-System Socket*. At the end of 500 hours, with tube at 25° C, and with no voltage applied to heater, the minimum resistance between indicated electrodes as measured with a 500-volt Megger-type ohmmeter having an internal impedance of 2.5 megohms, will be:

Grid No.1 and grid No.2	10 min.	megohms
Grid No.1 and cathode	10 min.	megohms
Grid No.2 and cathode	10 min.	megohms

Beam Power Tube

90 Watts CW Input (ICAS) up to 60 Mc
60 Watts CW Input (ICAS) up to 175 Mc
For Use under Severe Shock and Vibration

GENERAL DATA

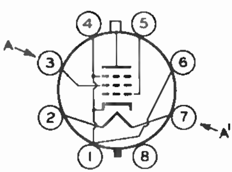
Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	1.25	amp
Transconductance, for plate volts = 200, grid-No.2 volts = 200, and plate ma. = 100	7000	μmhos
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 200, grid-No.2 volts = 200, and plate ma. = 100.	4.5	
Direct Interelectrode Capacitances:*		
Grid No.1 to plate.	0.24 max.	μμf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	13.0	μμf ←
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	8.5	μμf

Mechanical:

Operating Position.	Any
Maximum Overall Length.	3-13/16"
Seated Length	3-1/8" ± 1/8"
Maximum Diameter.	1-21/32"
Weight (Approx.).	2 oz
Bulb.	T12
Cap	Small (JEDEC No.C1-1)
Socket.	Standard Octal 8-Contact
Base. . . .	Small Micanol-Wafer Octal 8-Pin with "770" Sleeve (JEDEC Group 1, No.B8-150)
Basing Designation for BOTTOM VIEW.	7CK ←

Pin 1 – Cathode, Grid No.3, Internal Shield
Pin 2 – Heater
Pin 3 – Grid No.2
Pin 4 – Same as Pin 1



AA' = PLANE OF ELECTRODES

Pin 5 – Grid No.1
Pin 6 – Same as Pin 1
Pin 7 – Heater
Pin 8 – Base Sleeve
Cap – Plate

* See next page.

← indicates a change.

AF POWER AMPLIFIER & MODULATOR — Class AB_1†

Maximum Ratings, ***Absolute-Maximum Values:***

	CCS●	ICAS●●	
DC PLATE VOLTAGE	600 max.	750 max.	volts
DC GRID-No. 2 (SCREEN-GRID) VOLTAGE	250 max.	250 max.	volts
MAX.-SIGNAL DC PLATE CURRENT**	125 max.	135 max.	ma
MAX.-SIGNAL PLATE INPUT**	60 max.	85 max.	watts
MAX.-SIGNAL GRID-No. 2 INPUT**	3 max.	3 max.	watts
PLATE DISSIPATION**	20 max.	25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	135 max.	135 max.	volts
Heater positive with respect to cathode	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	220 max.	°C

Typical CCS Push-Pull Operation:

	Values are for 2 tubes			
DC Plate Voltage	400	500	600	volts
DC Grid-No. 2 Voltage▲	190	185	180	volts
DC Grid-No. 1 (Control-Grid) Voltage:				
With fixed-bias source	-40	-40	-45	volts
Peak AF Grid-No. 1-to-Grid-No. 1 Voltage	80	80	90	volts
Zero-Signal DC Plate Current	63	57	26	ma
Max.-Signal DC Plate Current	228	215	200	ma
Zero-Signal DC Grid-No. 2 Current	2.5	2	1	ma
Max.-Signal DC Grid-No. 2 Current	25	25	23	ma
Effective Load Resistance (Plate to plate)	4000	5500	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	55	70	82	watts

Typical ICAS Push-Pull Operation:

	Values are for 2 tubes		
DC Plate Voltage	600	750	volts
DC Grid-No. 2 Voltage▲	200	195	volts
DC Grid-No. 1 (Control-Grid) Voltage:			
From fixed-bias source	-50	-50	volts

*,†,●,●●,**,▲: See next page.

■ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

⊕⊕ Obtained preferably from a seperate source, or from the plate supply voltage with a voltage divider, or through a series resistor. A series grid-No.2 resistor should be used only when the 7212 is used in a circuit which is not keyed. Grid-No.2 voltage must not exceed 400 volts under key-up conditions.

■ Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current.	1	1.175	1.325	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.24	μμf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater . .	2	12.0	15.0	μμf
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater.	2	7.3	9.5	μμf
Plate Current	3	46	94	ma
Grid-No.2 Current	3	-	5.5	ma
Heater-Cathode Leakage Current:				
Heater 100 volts negative with respect to cathode . .	1	-	100	μa
Heater 100 volts positive with respect to cathode . .	1	-	100	μa
Useful Power Output	4	47	-	watts
Mu-Factor, Grid No.1 to Grid No.2	5	3.6	5.4	←

Note 1: With 6.3 volts ac on heater.

Note 2: Without external shield.

Note 3: With 6.3 volts ac on heater, dc plate volts = 300, dc grid-No.2 volts = 200, and dc grid-No.1 volts = -33.

Note 4: In a single-tube, self-excited oscillator circuit, and with 6.3 volts ac on heater, dc plate volts = 600, dc grid-No.2 volts = 180, grid-No.1 resistor (ohms) = 30,000 ± 10%, dc plate ma. = 100 to 112, dc grid-No.2 ma. = 23 maximum, dc grid-No.1 ma. = 2 to 2.5 and frequency (Mc) = 15.

Note 5: With 6.3 volts ac on heater, dc plate volts = 200, plate ma. = 100, and grid-No.2 volts = 200.

SPECIAL RATINGS & PERFORMANCE DATA ←

500-g Shock Rating:

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are subjected in four different positions to an impact acceleration of 500 g. At the end of this test, tubes are required to meet the following limits:

← Indicates a change.

Useful RF Power Output. . . . . 42 min. watts
For conditions shown under *Characteristics Range Values, Note 4*.
Heater-Cathode
Leakage Current . . . . See *Characteristics Range Values*
The tubes must also meet the established limit for low-frequency vibration (See below).

Fatigue Rating:

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected to 2.5-g vibrational acceleration at 25 cycles per second for 32 hours in each of three positions. At the end of this test, tubes are required to meet the following limits:

Useful RF Power Output. . . . . 42 min. watts
For conditions shown under *Characteristics Range Values, Note 4*.
Heater-Cathode
Leakage Current . . . . See *Characteristics Range Values*
The tubes must also meet the established limit for low-frequency vibration (See below).

Low-Frequency Vibration Performance:

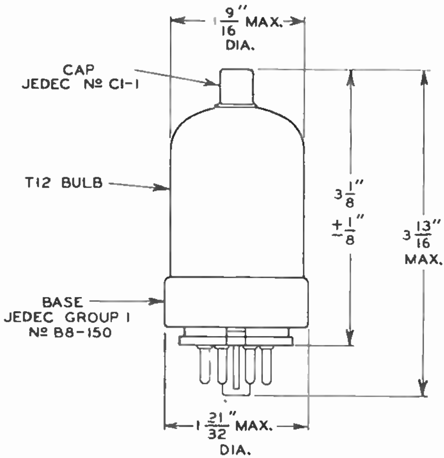
This test is performed on a sample lot of tubes from each production run under the following conditions: Heater volts = 6.3, plate-supply volts = 250, grid-No.2 volts = 200, grid-No.1 voltage varied to give a plate current of 10 milliamperes, plate load resistor (ohms) = 2000, and vibrating frequency of 25 cycles per second with a fixed amplitude of 0.040 inch (total excursion 0.080 inch). The rms output voltage across the plate load resistor as a result of vibration of the tube must not exceed 500 millivolts.

Variable-Frequency Vibration Performance (1):

This test is performed on a sample lot of tubes from each production run. Tubes are vibrated in each of 3 positions through frequency range of from 10 to 50 cycles per second and back to 10 cycles per second. The tubes are vibrated under the same conditions as specified for *Low-Frequency Vibration Performance*. During the test, the tubes will not show an rms output voltage across the plate load resistor in excess of 500 millivolts. At the end of this test, the tubes will not show tap or permanent interelectrode shorts or defects that cause the tubes to be inoperable.

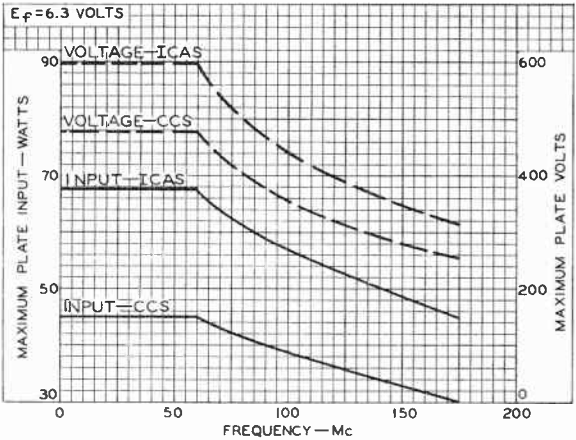
Variable-Frequency Vibration Performance (2):

This test is performed on a sample lot of tubes from each production run. Tubes are vibrated in each of 3 positions, perpendicular and parallel to major axis of the tube, and parallel to longitudinal axis of the tube, through the frequency range from 50 to 120 cycles per second at a fixed acceleration of 10 g under the same voltage, current and load conditions as specified for *Low-Frequency Vibration Performance*. During this test, the tubes will not show an rms output voltage across the plate load resistor in excess of 500 millivolts.


$1\frac{9}{16}$" MAX.
DIA.
CAP
JEDEC № C1-1
T12 BULB
BASE
JEDEC GROUP 1
№ B8-150
$3\frac{1}{8}$" $\pm\frac{1}{8}$"
$3\frac{13}{16}$" MAX.
$1\frac{21}{32}$" MAX.
DIA.

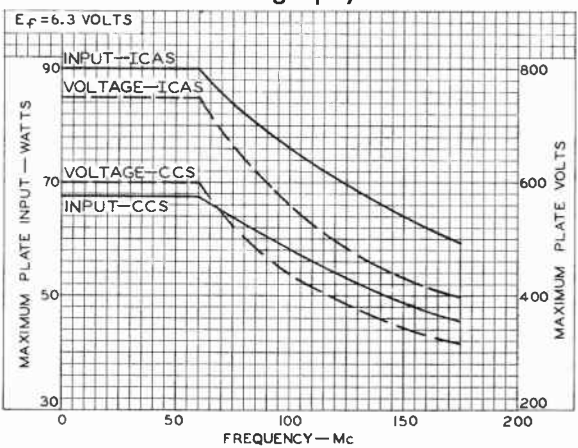
92CS-9625R4

RATING CHART I
Class C Telephony Service



92CS-9614

RATING CHART II
Class C Telegraphy Service



92CS-9615

Beam Power Tube

CERAMIC-METAL SEALS	COAXIAL-ELECTRODE STRUCTURE
UNITIZED-ELECTRODE DESIGN	INTEGRAL RADIATOR
FORCED-AIR COOLED	2500 WATTS CW INPUT

MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

Useful with Full Ratings at Frequencies up to 1215 Mc

GENERAL DATA

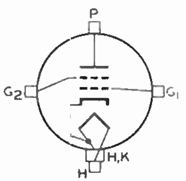
Electrical:

Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)[a]	5.5 typical / 6 max.	volts / volts
Current at heater volts = 5.5. . . .	17.3	amp ←
Minimum heating time at heater volts = 5.5.	5	minutes
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 2500, grid-No.2 volts = 600, and plate ma. = 600 . .	17	
Direct Interelectrode Capacitances:		
Grid No.1 to plate[b]	0.17 max.	μμf
Grid No.1 to cathode & heater. . . .	42	μμf
Plate to cathode & heater[bc]	0.017 max.	μμf ←
Grid No.1 to grid No.2	55	μμf
Grid No.2 to plate	16	μμf
Grid No.2 to cathode & heater[c] . . .	1.4 max.	μμf

Mechanical:

Operating Position . . . . .Any
Overall Length . . . . 3.24" ± 0.10"
Greatest Diameter (See *Dimensional Outline*). . 3.72" ± 0.03" ←
Weight (Approx.) . . . . 2 lbs
Radiator . . . . .Integral part of tube
Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Thermal:

Air Flow:

Through radiator—Adequate air flow to limit the plate-seal temperature to 250° C should be delivered by a blower

← Indicates a change.

through the radiator before and during the application of heater, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator versus percentage of maximum rated plate dissipation for each class of service are shown in accompanying *Typical-Cooling-Requirements* curves. Plate power, grid-No.2 power, heater power, and air flow may be removed simultaneously.

To grid-No.2, grid-No.1, cathode, and heater seals—A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these seals so that its temperature does not exceed the specified maximum value of 250° C. An air flow of 10 cfm is usually adequate.

Seal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	2500 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . . .	1000 max.	volts
MAX.-SIGNAL DC PLATE CURRENT.	1 max.	amp
MAX.-SIGNAL DC GRID-No.1 (CONTROL-GRID) CURRENT	0.2 max.	amp
MAX.-SIGNAL PLATE INPUT	2500 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	50 max.	watts
PLATE DISSIPATION	1500 max.	watts

Typical CCS Class AB_1 "Single-Tone" Operation:[e]

	Up to 60 Mc		
DC Plate Voltage.	2250	2500	volts
DC Grid-No.2 Voltage[f]	700	700	volts
DC Grid-No.1 Voltage.	-50	-50	volts
Zero-Signal DC Plate Current.	0.2	0.2	amp
Zero-Signal DC Grid-No.2 Current.	0	0	amp
Effective RF Load Resistance.	1100	1100	ohms
Max.-Signal DC Plate Current.	0.9	1	amp
→ Max.-Signal DC Grid-No.2 Current.	0.045	0.045	amp
Max.-Signal DC Grid-No.1 Current.	0	0	amp
Max.-Signal Peak RF Grid-No.1 Voltage . .	50	50	volts
Max.-Signal Driving Power (Approx.) . . .	0	0	watts
Max.-Signal Power Output (Approx.). . . .	1000	1250	watts

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . . .	1000 max.	volts

→ Indicates a change.

DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-300	max.	volts
DC PLATE CURRENT	0.85	max.	amp
DC GRID-No.1 CURRENT	0.2	max.	amp
PLATE INPUT	1700	max.	watts
GRID-No.2 INPUT	35	max.	watts
PLATE DISSIPATION	1000	max.	watts

Typical CCS Operation:

In grid-drive circuit at 600 Mc

DC Plate Voltage	1800	2000	volts
DC Grid-No.2 Voltage[g]	500	500	volts
DC Grid-No.1 Voltage[h]	-30	-30	volts
DC Plate Current	0.75	0.83	amp
DC Grid-No.2 Current	0.015	0.015	amp
DC Grid-No.1 Current (Approx.)	0.04	0.04	amp
Driver Power Output (Approx.)[j]	50	55	watts
Useful Power Output (Approx.)	650[k]	800[k]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	5000[l]	max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[m]
and
RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 1215 Mc		
DC PLATE VOLTAGE	2500	max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	1000	max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-300	max.	volts
DC PLATE CURRENT	1	max.	amp
DC GRID-No.1 CURRENT	0.2	max.	amp
PLATE INPUT	2500	max.	watts
GRID-No.2 INPUT	50	max.	watts
PLATE DISSIPATION	1500	max.	watts

Typical CCS Operation:

In grid-drive circuit at 600 Mc

DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage[n]	500	500	volts
DC Grid-No.1 Voltage[p]	-30	-30	volts
DC Plate Current	0.9	1	amp
DC Grid-No.2 Current	0.02	0.02	amp
DC Grid-No.1 Current (Approx.)	0.07	0.07	amp
Driver Power Output (Approx.)[j]	70	75	watts
Useful Power Output (Approx.)	1050[k]	1350[k]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	5000[k]	max.	ohms

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] With external, flat, metal shield having diameter of 8" and center hole approximately 3" in diameter provided with spring fingers that connect the shield to grid-No.2 terminal. Shield is located in plane of grid-No.2 terminal perpendicular to the tube axis.

[c] With external, flat, metal shield having diameter of 8" and center hole approximately 2-3/8" in diameter provided with spring fingers that connect the shield to grid-No.1 terminal. Shield is located in plane of grid-No.1 terminal perpendicular to the tube axis.

[d] Continuous Commercial Service.

[e] "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

[f] Preferably obtained from a fixed supply.

[g] Obtained preferably from a separate source modulated along with the plate supply.

[h] Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

[j] The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated value to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

[k] This value of useful power is measured in load of output circuit.

[l] If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

[m] Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

[n] Obtained preferably from a fixed supply, or from the plate-supply voltage with a voltage divider.

[p] Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

SPECIAL TESTS & PERFORMANCE DATA

Design samples of the 7213 have been subjected to the following tests without adverse effects.

Variable-Frequency Vibration Performance:

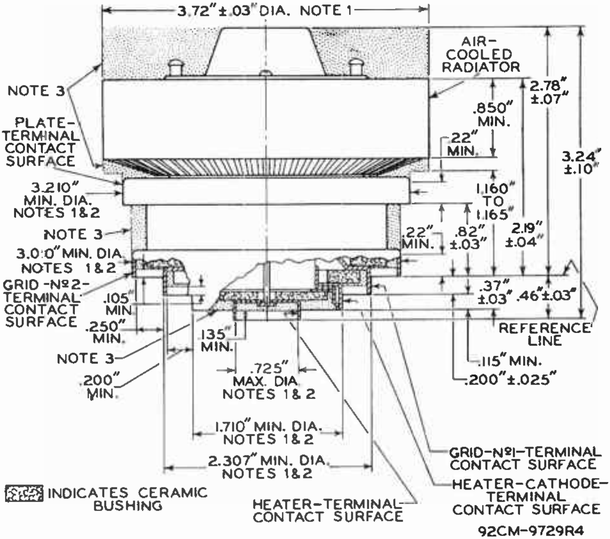
This test was performed (per MIL-E-1C[q], paragraph 4.9.20.3) under the following conditions: heater volts = 5.5, plate-supply volts = 450, grid-No.2 volts = 300, grid-No.1 voltage varied to give a plate current of 10 milliamperes, and plate load resistor (ohms) = 2000. The tubes were vibrated in each of 3 positions through frequency range from 10 to 50 to 10 cycles per second. The vibrating frequency had a fixed amplitude of 0.040 inch (total excursion of 0.080 inch). During the test, the tubes did not show an rms output voltage across the plate load resistor in excess of 500 millivolts. ← At the end of this test, the tubes did not show tap or permanent interelectrode shorts or defects that would cause the tubes to be inoperable. The tubes exhibited no pronounced mechanical resonance during this test.

[q] Military Specification, Electron Tubes and Crystal Rectifiers, 3 October 1955.

← Indicates a change.

Fatigue Performance:

In this test (per MIL-E-1C, paragraph 4.9.20.6), the tubes were rigidly mounted and subjected to 2.5 g vibrational acceleration at 25 cycles per second for 32 hours in each of three positions with heater volts = 5.5. At the end of this test, the tubes did not show permanent or temporary shorts or open circuits, and passed all electrical tests.

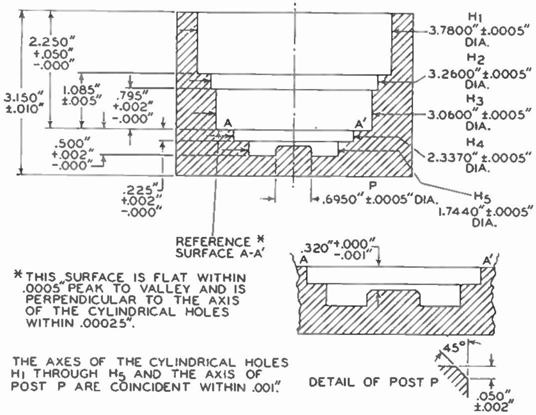


NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE RADIATOR BAND, PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. PROPER ENTRY OF THE TUBE IS OBTAINED WHEN THE GRID-No.2 TERMINAL IS SEATED ON THE SHOULDER A-A'. THE TUBE IS PROPERLY SEATED ON THE SHOULDER WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER MORE THAN 1/16" BETWEEN THE SHOULDER SURFACE AND THE GRID-No.2 TERMINAL. THE GAUGE IS PROVIDED WITH SLOTS TO PERMIT MAKING MEASUREMENT OF SEATING OF GRID-No.2 TERMINAL ON SHOULDER A-A'.

NOTE 2: THE DIAMETER OF EACH TERMINAL IS HELD TO INDICATED VALUES ONLY OVER THE INDICATED MINIMUM LENGTH OF ITS CONTACT SURFACE.

NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

GAUGE SKETCH G_1



* THIS SURFACE IS FLAT WITHIN .0005" PEAK TO VALLEY AND IS PERPENDICULAR TO THE AXIS OF THE CYLINDRICAL HOLES WITHIN .00025".

THE AXES OF THE CYLINDRICAL HOLES H1 THROUGH H5 AND THE AXIS OF POST P ARE COINCIDENT WITHIN .001".

92CM-9735R2

Beam Power Tube

CERAMIC METAL SEALS
UNITIZED-ELECTRODE DESIGN
FORCED-AIR COOLED
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL RADIATOR
180 KW PEAK-PULSE POWER
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Pulsed RF Amplifier Service with Full Ratings at Frequencies up to 1215 Mc

GENERAL DATA

Electrical:

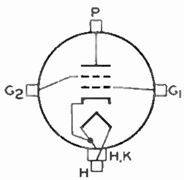
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)[a]	5.5 typical / 6 max.	volts / volts
Current at heater volts = 5.5	17.3	amp
Minimum heating time at heater volts = 5.5	5	minutes
Mu-Factor, Grid-No.2 to Grid No.1 for plate volts = 2500, grid-No.2 volts = 600, and plate ma. = 600	19	
Direct Interelectrode Capacitances:		
Grid No.1 to plate[b]	0.17 max.	μμf
Grid No.1 to cathode & heater	42	μμf
Plate to cathode & heater[b,c]	0.017 max.	μμf
Grid No.1 to grid No.2	55	μμf
Grid No.2 to plate	16	μμf
Grid No.2 to cathode & heater[c]	1.4 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	3.24" ± 0.10"
Greatest Diameter (See *Dimensional Outline*)	3.72" ± 0.03"
Weight (Approx.)	2 lbs
Radiator	Integral part of tube

Terminal Connections (See *Dimensional Outline*):

G1 - Grid-No. 1-Terminal Contact Surface
G2 - Grid-No. 2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H, K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

← Indicates a change.

Thermal:

Air Flow:

Through radiator—Adequate air flow to limit the plate seal temperature to 250° C should be delivered by a blower through the radiator before and during the application of heater, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator versus percentage of maximum rated plate dissipation for each class of service are shown in accompanying *Typical Cooling-Requirements* curves. Plate power, grid-No.2 power, heater power, and air flow may be removed simultaneously.

To grid-No.2, grid-No.1, cathode, and heater seals—A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these seals so that its temperature does not exceed the specified maximum value of 250° C. An air flow of 10 cfm is usually adequate.

Seal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

GRID-PULSED RF AMPLIFIER

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

For maximum "on" time[e] of 10 microseconds

	Up to 1215 Mc	
DC PLATE VOLTAGE	5000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	1200 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-300 max.	volts
DC PLATE CURRENT DURING PULSE	18 max.	amp
DC PLATE CURRENT	0.2 max.	amp
GRID-No.2 INPUT (Average)	50 max.	watts
GRID-No.1 INPUT (Average)	30 max.	watts
PLATE DISSIPATION (Average)	1500 max.	watts

Typical Operation:

In class C cathode-drive circuit with rectangular-wave pulses at 1215 Mc and with duty factor[f] of 0.01

DC Plate Voltage	4500	volts
DC Grid-No.2 Voltage	1000	volts
DC Grid-No.1 Voltage	-80	volts
DC Plate Current during pulse	11	amp
DC Plate Current	0.11	amp
DC Grid-No.2 Current	0.005	amp
DC Grid-No.1 Current	0.01	amp
Driver Power Output at peak of pulse (Approx.)[g]	4.5	kw
Useful Power Output at peak of pulse (Approx.)	20	kw

PLATE- AND SCREEN-PULSED RF AMPLIFIER

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

For maximum "on" time[e] of 10 microseconds

	Up to 1215 Mc	
PEAK POSITIVE-PULSE PLATE VOLTAGE	10000 max.	volts
PEAK POSITIVE-PULSE GRID-No.2 (SCREEN-GRID) VOLTAGE	1200 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-300 max.	volts
DC PLATE CURRENT DURING PULSE	18 max.	amp
DC PLATE CURRENT	0.2 max.	amp
GRID-No.2 INPUT (Average)	50 max.	watts
GRID-No.1 INPUT (Average)	30 max.	watts
PLATE DISSIPATION (Average)	1500 max.	watts

Typical Operation:

In class C cathode-drive circuit with rectangular-wave pulses at 1215 Mc and with duty factor[f] of 0.01

Peak Positive-Pulse Plate Voltage	9000	10000	volts
Peak Positive-Pulse Grid-No.2 Voltage	1000	1000	volts
DC Grid-No.1 Voltage	-80	-80	volts
DC Plate Current during pulse	16	18	amp
DC Plate Current	0.16	0.18	amp
DC Grid-No.2 Current	0.008	0.009	amp
DC Grid-No.1 Current	0.014	0.016	amp
Driver Power Output at peak of pulse (Approx.)[g]	10	11	kw
Useful Power Output at peak of pulse (Approx.)	50	65	kw

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] With external, flat, metal shield having diameter of 8", and center hole approximately 3" in diameter provided with spring fingers that connect the shield to grid-No.2 terminal. Shield is located in plane of grid-No.2 terminal perpendicular to the tube axis.

[c] With external, flat, metal shield having diameter of 8", and center hole approximately 2-3/8" in diameter provided with spring fingers that connect the shield to grid-No.1 terminal. Shield is located in plane of grid-No.1 termmnal perpendicular to the tube axis.

[d] Continuous Commercial Service.

[e] *"On" time* is defined as the sum of the durations of the individual pulses which occur during any 1000-microsecond interval.

Pulse duration is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The *peak value* is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

[f] *Duty factor* for the 7214 is defined as the "on" time in microseconds divided by 1000 microseconds.

[g] The driver stage is required to supply tube losses, rf-circuit losses, and in cathode-drive circuits, the rf power added to the plate input. The driver stage should be designed to provide an excess of power above the indicated value to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

SPECIAL TESTS & PERFORMANCE DATA

Design samples of the 7214 have been subjected to the following tests without adverse effects.

Variable-Frequency Vibration Performance:

This test was performed (per MIL-E-1D[h], paragraph 4.9.20.3) under the following conditions: Heater voltage of 5.5 volts, plate supply voltage of 450 volts, grid-No.2 voltage of 300 volts, grid-No.1 voltage varied to give a plate current of 10 milliamperes, and plate load resistor of 2000 ohms. The tubes were vibrated in each of 3 positions through frequency range from 10 to 50 cycles per second and back to 10 cycles per second. The vibrating frequency had a fixed amplitude of 0.040 inch (total excursion of 0.080 inch). During the test, the tubes did not show an rms output voltage across the plate → load resistor in excess of 500 millivolts.

At the end of this test, the tubes did not show tap or permanent interelectrode shorts or defects that would cause the tubes to be inoperable. The tubes exhibited no pronounced mechanical resonance during this test.

Fatigue Test:

In this test (per MIL-E-1D, paragraph 4.9.20.6), the tubes were rigidly mounted and subjected to 2.5 g vibrational acceleration at 25 cycles per second for 32 hours in each of three positions with 5.5 volts applied to the heater. At the end of this test, the tubes did not show permanent or temporary shorts or open circuits, and passed all electrical tests.

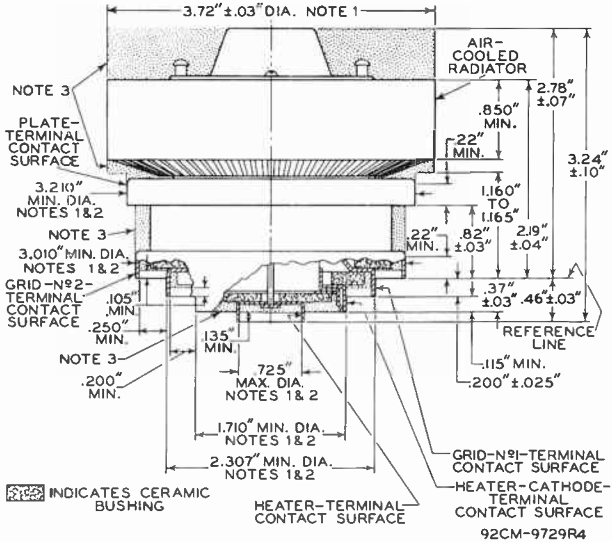
OPERATING CONSIDERATIONS

The *maximum seal temperature* of 250° C is a tube rating and is to be observed in the same manner as other ratings. The temperature may be measured with temperature-sensitive paint, such as Tempilaq. The latter is made by the Tempil Corporation, 132 W. 22nd Street, New York 11, New York in the form of liquid and stick.

The rated plate and grid-No.2 voltages of this tube are extremely dangerous to the user. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

[h] 31 March 1958, Military Specification, Electron Tubes and Crystal Rectifiers.

→ Indicates a change.

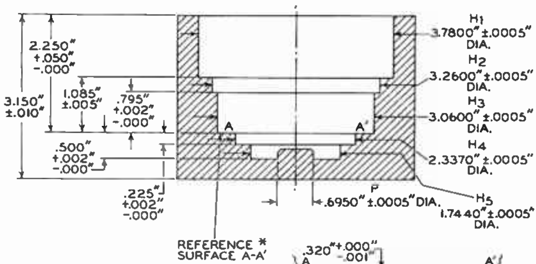


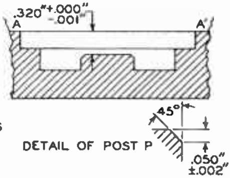
NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE RADIATOR BAND, PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. PROPER ENTRY OF THE TUBE IS OBTAINED WHEN THE GRID-No.2 TERMINAL IS SEATED ON THE SHOULDER A-A'. THE TUBE IS PROPERLY SEATED ON THE SHOULDER WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER MORE THAN 1/16" BETWEEN THE SHOULDER SURFACE AND THE GRID-No.2 TERMINAL. THE GAUGE IS PROVIDED WITH SLOTS TO PERMIT MAKING MEASUREMENT OF SEATING OF GRID-No.2 TERMINAL ON SHOULDER A-A'.

NOTE 2: THE DIAMETER OF EACH TERMINAL IS HELD TO INDICATED VALUES ONLY OVER THE INDICATED MINIMUM LENGTH OF ITS CONTACT SURFACE.

NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

GAUGE SKETCH G_1





* THIS SURFACE IS FLAT WITHIN .0005" PEAK TO VALLEY AND IS PERPENDICULAR TO THE AXIS OF THE CYLINDRICAL HOLES WITHIN .00025".

THE AXES OF THE CYLINDRICAL HOLES H_1 THROUGH H_5 AND THE AXIS OF POST P ARE COINCIDENT WITHIN .001".

92CM-9735R2

Beam Power Tube

For Pulse-Modulator Service
under Severe Shock and Vibration

GENERAL DATA

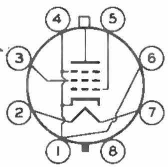
Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3.	1.25	amp
Transconductance, for plate volts = 200, grid-No.2 volts = 200, and plate ma. = 100.	7000	μmhos
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 200, grid-No.2 volts = 200, and plate ma. = 100 . . .	4.5	
Direct Interelectrode Capacitances:[a]		
Grid No.1 to plate	0.24 max.	μμf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater.	13.0	μμf
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater.	8.5	μμf

Mechanical:

Operating Position	Any
Maximum Overall Length	3-13/16"
Seated Length.	3-1/8" ± 1/8"
Maximum Diameter	1-21/32"
Weight (Approx.)	2 oz
Bulb	T12
Cap.	Small (JEDEC No.C1-1)
Socket	Standard Octal 8-Contact
Base	Small-Micanol-Wafer Octal 8-Pin with "770" Sleeve (JEDEC Group 1, No.B8-150)
Basing Designation for BOTTOM VIEW	7CK ←

Pin 1 - Cathode, Grid No.3, Internal Shield
Pin 2 - Heater
Pin 3 - Grid No.2
Pin 4 - Same as Pin 1



AA' = PLANE OF ELECTRODES

Pin 5 - Grid No.1
Pin 6 - Same as Pin 1
Pin 7 - Heater
Pin 8 - Base Sleeve
Cap - Plate

MODULATOR — Rectangular-Wave Modulation

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

For duty factor[c] between 0.001 and 1 and maximum averaging time of 10,000 μsec in any interval

DC PLATE SUPPLY VOLTAGE (E_{bb})[d]	See *Rating Chart I*
INSTANTANEOUS PLATE VOLTAGE.	115% of E_{bb}

← Indicates a change.

DC GRID-No.2 SUPPLY VOLTAGE[d]	500 max.	volts
DC GRID-No.1 SUPPLY VOLTAGE[d]	300 max.	volts
	Minimum—See *Rating Chart I*	
GRID-No.1 VOLTAGE:		
Instantaneous-negative value	400 max.	volts
Peak-positive value	100 max.	volts
PEAK PLATE CURRENT	See *Rating Chart II*	
PEAK GRID-No.2 CURRENT	0.75 max.	amp
PEAK GRID-No.1 CURRENT	0.5 max.	amp
PLATE INPUT	80 max.	watts
GRID-No.2 INPUT	1.75 max.	watts
GRID-No.1 INPUT	0.5 max.	watt
PLATE DISSIPATION[e]	See *Rating Chart I*	
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	135 max.	volts
Heater positive with respect to cathode	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	°C

Typical Operation:

With rectangular-wave shapes in accompanying test circuit and with duty factor[c] of 0.01

DC Plate Supply Voltage	3000	volts
DC Grid-No.2 Supply Voltage	300	volts
DC Grid-No.1 Supply Voltage	-175	volts
Peak-Positive Grid-No.1 Voltage	65	volts
Plate Current:		
Peak	1.5	amp
Average	0.015	amp
DC Grid-No.2 Current	0.004	amp
DC Grid-No.1 Current	0.0025	amp
Load Resistance (R_L), 100 watts, non-inductive	1500 ± 5%	ohms
Coupling Capacitor (C_3)	0.25 (5000 v dc)	μf

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	3000 max.	ohms

[a] Without external shield.

[b] Continuous Commercial Service.

[c] *Duty Factor* for the 7358 is defined as the "on" time in microseconds divided by 10,000 microseconds.
"On" Time is defined as the sum of the durations of all the individual pulses which occur during any 10,000-microsecond interval.
"Pulse Duration" is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The peak value is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

[d] For tube protection, it is essential that sufficient resistance be used in the plate supply circuit, the grid-No.2 supply circuit, and the grid-No.1 supply circuit so that the short-circuit current is limited to 0.5 ampere in each circuit.

[e] Averaged over any interval not exceeding 10,000 microseconds. Care should be used in determining the plate dissipation. A calculated value based on rectangular pulses can be considerably in error when

the actual pulses have a finite rise and fall time. Plate dissipation should preferably be determined by measuring the bulb temperature under actual operating conditions; then, with the tube in the same socket and under the same ambient-temperature conditions, apply to the tube sufficient dc input to obtain the same bulb temperature. This value of dc input is a measure of the plate dissipation.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current	1	1.175	1.325	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.24	μμf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	2	12.0	15.0	μμf
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	2	7.3	9.5	μμf
Mu-Factor, Grid No.2 to Grid No.1	1,3	3.6	5.4	
Plate Current	1,4	46	94	ma
Grid-No.2 Current	1,4	0	5.5	ma
Peak Plate Current	1,5	2.4	-	amp
Heater-Cathode Leakage Current:				
Heater 100 volts negative with respect to cathode	1	-	100	μa
Heater 100 volts positive with respect to cathode	1	-	100	μa

Note 1: With 6.3 volts ac on heater.

Note 2: Without external shield.

Note 3: With dc plate volts = 200, dc grid-No.2 volts = 200, and dc grid-No.1 voltage adjusted to give dc plate current of 100 ma.

Note 4: With dc plate volts = 300, dc grid-No.2 volts = 200, and dc grid-No.1 volts = -33.

Note 5: With the tube in the accompanying test circuit under the following conditions: rectangular-wave modulation (eg_1) applied to grid No.1; pulse duration of 1 microsecond approx.; pulse-repetition rate (approx. 3000 pps) adjusted to give dc plate current of 9 ma. minimum; dc plate supply volts = 3500; dc grid-No.2 supply volts = 500 applied simultaneously with the plate voltage; dc grid-No.1 supply volts = -300; peak-positive grid-No.1 swing of 100 volts; coupling capacitor (C_3) having value of 0.1 μf, 5000 volts dc; and load resistance (R_L) of 1000 ± 5% ohms, 50 watts, non-inductive.

SPECIAL TESTS & PERFORMANCE DATA ←

500-g Shock Test:

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are subjected in four different positions to an impact acceleration of 500 g. At the end of this test, tubes are required to meet the following limits:

Peak Plate Current . . . . 2.4 min. amp

For conditions shown under *Characteristics Range Values*.

← Indicates a change.

Heater-Cathode
Leakage Current. . . . . See *Characteristics Range Values*
The tubes must also meet the established limit for low-frequency vibration (See below).

Fatigue Test:

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected to 2.5 g vibrational acceleration at 25 cycles per second for 32 hours in each of three positions. At the end of this test, tubes are required to meet the following limits:

Peak Plate Current . . . . 2.2 min. amp
For conditions shown under *Characteristics Range Values*.
Heater-Cathode
Leakage Current. . . . See *Characteristics Range Values*
The tubes must also meet the established limit for low-frequency vibration (See below).

Low-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater volts = 6.3, plate supply volts = 250, grid-No.2 volts = 200, grid-No.1 voltage varied to give a plate current of 10 milliamperes, plate load resistor (ohms) = 2000 and vibrating frequency of 25 cycles per second with a fixed amplitude of 0.040 inch (total excursion 0.080 inch). The rms output voltage across the plate load resistor as a result of vibration of the tube must not exceed 500 millivolts.

Variable-Frequency Vibration Performance (1):

This test is performed on a sample lot of tubes from each production run. Tubes are vibrated in each of 3 positions through frequency range of from 10 to 50 cycles per second and back to 10 cycles per second. The tubes are vibrated under the same conditions as specified for *Low Frequency Vibration Performance*. During the test, the tubes will not show an rms output voltage across the plate load resistor in excess of 500 millivolts. At the end of this test, the tubes will not show defects that cause the tubes to be inoperable.

Variable-Frequency Vibration Performance (2):

This test is performed on a sample lot of tubes from each production run. Tubes are vibrated in each of 3 positions, perpendicular and parallel to major axis of the tube, and parallel to longitudinal axis of the tube, through the frequency range from 50 to 120 cycles per second at a fixed acceleration of 10 g under the same voltage, current and load conditions as specified for *Low Frequency Vibration Performance*. During this test, the tubes will not show an rms output voltage across the plate load resistor in excess of 500 millivolts.

OPERATING CONSIDERATIONS

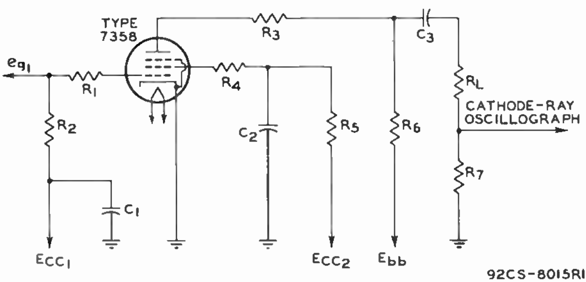
The *bulb* becomes hot during operation. To insure adequate cooling, therefore, it is essential that free circulation of air be provided around the 7358.

The *plate* shows no color when operated with maximum rated dissipation. Connection to the plate cap should be made with a flexible lead to prevent any strain on the seal of the cap.

For *tube protection*, it is essential that sufficient resistance be used in the plate supply circuit, the grid-No.2 supply circuit, and the grid-No.1 supply circuit so that the short-circuit current is limited to 0.5 ampere in each circuit.

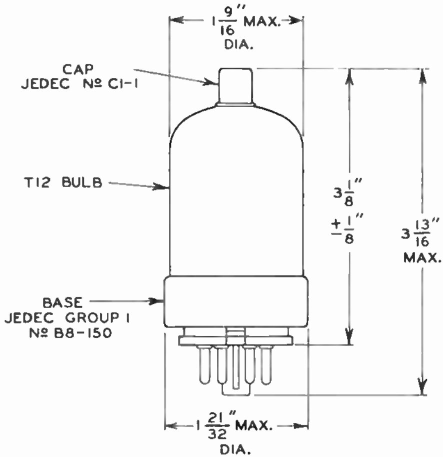
The *accompanying test circuit* requires the use of damping resistors to suppress oscillations which may be caused by the rectangular-wave signal. These resistors should be non-inductive and they should be placed as close as possible to the socket terminals.

TEST CIRCUIT FOR TYPE 7358



C_1: 0.1 µf, 600 v dc.
C_2: 2 µf, 600 v dc.
C_3: For values, See *Typical Operation and Characteristics Range Values (Note 5)*.
R_1: 20 ohms, 1 watt, non-inductive.
R_2: 30,000 ohms, 1 watt.
R_3: 10 ohms, 5 watts, non-inductive.
R_4: 25 ohms, 1 watt, non-inductive.

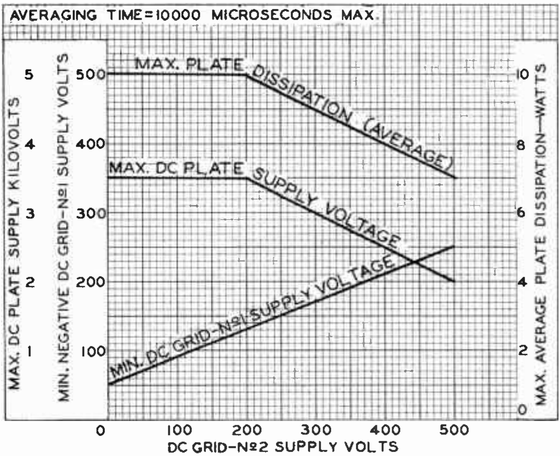
Ecc_1: Grid-No.1 Supply Voltage.
Ecc_2: Grid No.2 Supply Voltage.
E_{bb}: Plate Supply Voltage.
e_{g1}: Rectangular-Wave Signal Voltage.
R_5: 1000 ohms, 1 watt.
R_6: 10,000 ohms, 50 watts.
R_7: 30 ± 1% ohms, 5 watts, non-inductive.
R_L: For values, See *Typical Operation and Characteristics Range Values (Note 5)*.



1 9/16" MAX. DIA.
CAP JEDEC Nº C1-1
T12 BULB
BASE JEDEC GROUP 1 Nº B8-150
3 1/8" ± 1/8"
3 13/16" MAX.
1 21/32" MAX. DIA.

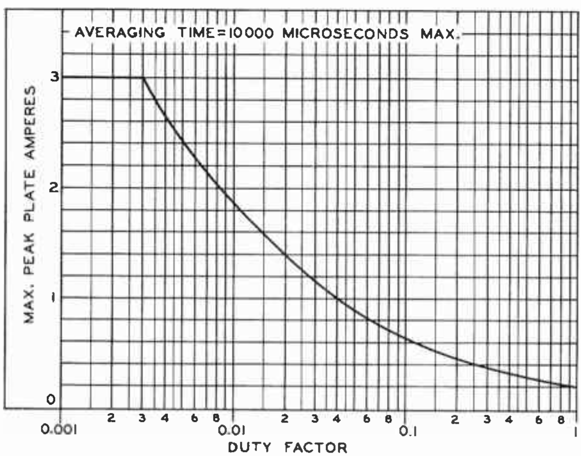
92CS-9625R4

RATING CHART I



92CS-8012R1

RATING CHART II



92CS-8014R1

Beam-Deflection Tube

9-PIN MINIATURE TYPE

For Use in Balanced-Modulator, Balanced Mixer, and Frequency-Converter Applications in Single- and Double-Sideband, Suppressed-Carrier Communication Equipment Operating at Frequencies up to 100 Mc

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current	0.35	amp
Direct Interelectrode Capacitances (Approx.):[a]		
Grid No.1 to all other electrodes except plate	7.5	μμf
Grid No.1 to deflecting electrode No.1	0.015	μμf
Grid No.1 to deflecting electrode No.2	0.015	μμf
Grid-No.1 to plate No.1	0.003	μμf
Grid No.1 to plate No.2	0.003	μμf
Plate No.1 to all other electrodes except deflecting electrode No.1	0.8	μμf
Plate No.2 to all other electrodes except deflecting electrode No.2	0.8	μμf
Plate No.1 to plate No.2	0.3	μμf
Deflecting electrode No.1 to all other electrodes except plate No.1	4.6	μμf
Deflecting electrode No.2 to all other electrodes except plate No.2	4.6	μμf
Deflecting electrode No.1 to plate No.1	4	μμf ←
Deflecting electrode No.2 to plate No.2	4	μμf ←
Deflecting electrode No.1 to deflecting electrode No.2	1.4	μμf

Characteristics, Class A_1 Amplifier:

Plate-No.1 Supply Voltage	150	volts
Plate-No.2 Supply Voltage	150	volts
Deflecting-Electrode-No.1 Supply Voltage	25	volts
Deflecting-Electrode-No.2 Supply Voltage	25	volts
Grid-No.2 Supply Voltage	175	volts
Cathode Resistor	150	ohms
Total Beam Current (Plate-No.1 current plus plate-No.2 current)	8.5	ma ←
Grid-No.2 Current	2.1	ma ←

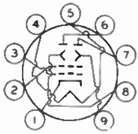
← Indicates a change.

Transconductance:		
Grid No.1 to both plates		
→ connected together	5400	µmhos
Deflecting electrode No.1		
→ to plate No.1[b]	800	µmhos
Deflecting electrode No.2		
→ to plate No.2[b]	800	µmhos
Switching Voltage[c]	11	volts

Mechanical:

Operating Position	Any
Maximum Overall Length	2-5/8"
Maximum Seated Length	2-3/8"
Length, Base Seat to Bulb Top (Excluding tip)	2" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)
Basing Designation for BOTTOM VIEW	9KS

Pin 1 – Cathode, Internal Shield
Pin 2 – Grid No.2
Pin 3 – Grid No.1
Pin 4 – Heater
Pin 5 – Heater



Pin 6 – Plate No.2
Pin 7 – Plate No.1
Pin 8 – Deflecting Electrode No.2
Pin 9 – Deflecting Electrode No.1

BALANCED MODULATOR

Maximum Ratings, ***Absolute-Maximum Values:***

PLATE-No.1 VOLTAGE	300	max.	volts
PLATE-No.2 VOLTAGE	300	max.	volts
DEFLECTING-ELECTRODE-No.1 VOLTAGE	±100	max.	volts
DEFLECTING-ELECTRODE-No.2 VOLTAGE	±100	max.	volts
GRID-No.2 (SCREEN-GRID) VOLTAGE	250	max.	volts
GRID-No.2 INPUT	0.5	max.	watt
PLATE-No.1 DISSIPATION	1.5	max.	watts
PLATE-No.2 DISSIPATION	1.5	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	180	max.	volts
Heater positive with respect to cathode	180[d]	max.	volts

Typical Operation:

In accompanying balanced-modulator circuit utilizing separate excitation[e]

Plate Voltage (Each plate)	150	volts
Deflecting-Electrode Voltage (Approx., each electrode)	25	volts
Grid-No.2 Voltage	175	volts

→ Indicates a change.

Cathode Resistor	1200		ohms
Peak-to-Peak AF Deflecting-Electrode Voltage[f]	2.8		volts
Peak-to-Peak RF Grid-No.1 Voltage	10		volts
Plate Current (Each plate)	1.5		ma
Grid-No.2 Current	0.75		ma
Plate-to-Plate Load Impedance (Approx.)	5000		ohms
Push-Pull, Peak-to-Peak Double-Sideband Output Voltage	4		volts
Carrier Suppression[g]	60		db ←
Third-Order Distortion[g]	-47		db
Fourth-Order Distortion[g]	-45		db

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:			
For fixed-bias operation	0.5	max.	megohm
For cathode-bias operation	2.2	max.	megohms
Deflecting-Electrode-Circuit Resistance (Per deflecting electrode)	0.05	max.	megohm

BALANCED MIXER

Maximum Ratings, ***Absolute-Maximum Values:***

PLATE-No.1 VOLTAGE	300	max.	volts
PLATE-No.2 VOLTAGE	300	max.	volts
DEFLECTING-ELECTRODE-No.1 VOLTAGE	±100	max.	volts
DEFLECTING-ELECTRODE-No.2 VOLTAGE	±100	max.	volts
GRID-No.2 (SCREEN-GRID) VOLTAGE	250	max.	volts
GRID-No.2 INPUT	0.5	max.	watt
PLATE-No.1 DISSIPATION	1.5	max.	watts
PLATE-No.2 DISSIPATION	1.5	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	180	max.	volts
Heater positive with respect to cathode	180[d]	max.	volts

Typical Operation:

In accompanying balanced-mixer circuit utilizing separate excitation[e]

Plate Voltage (Each plate)	150	volts
Deflecting-Electrode Voltage (Approx., each electrode)	25	volts
Grid-No.2 Voltage	175	volts
Cathode Resistor	1200	ohms
Peak-to-Peak Single-Sideband Deflecting-Electrode Voltage[f]	8	volts
Peak-to-Peak RF Grid-No.1 Voltage	10	volts
Plate Current (Each plate)	1.5	ma
Grid-No.2 Current	0.75	ma

← Indicates a change.

Plate-to-Plate Load Impedance (Approx.)	10000		ohms
Push-Pull, Peak-to-Peak Single-Sideband Output Voltage	40		volts
Oscillator Rejection[g]	-40		db
Third-Order Distortion[g]	-40		db
Fourth-Order Distortion[g]	-39		db

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:			
For fixed-bias operation	0.5	max.	megohm
For cathode-bias operation	2.2	max.	megohms
Deflecting-Electrode-Circuit Resistance (Per deflecting electrode)	0.05	max.	megohm

[a] Without external shield.

[b] Defined as the partial derivative of the plate current with respect to the difference between the deflecting-electrode voltages, evaluated about the point of equal plate currents.

[c] Defined as the sum of (a) the absolute value of the difference between the deflecting-electrode voltages when the current to one plate is equal to 90% of the total beam current and (b) the absolute value of the difference between the deflecting-electrode voltages when the current to the same plate is equal to 10% of the total beam current. This sum, expressed in terms of signal voltage, corresponds to the peak-to-peak value of signal voltage that is required between the deflecting electrodes to produce peak-to-peak signal current at either plate equal to 80% of the total beam current.

[d] The dc component must not exceed 100 volts.

[e] Operation with self-excitation and cathode resistor of 300 ohms is similar to operation with separate excitation.

[f] To either deflecting electrode. The other deflecting electrode is bypassed.

[g] Referred to single-sideband output voltage.

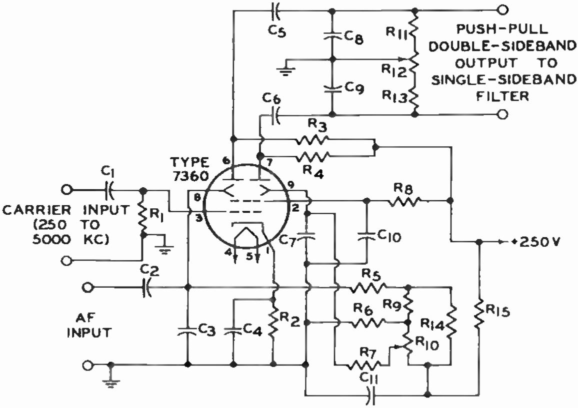
OPERATING CONSIDERATIONS

Deflecting-electrode-circuit resistance should be kept below 0.05 megohm to prevent nonlinear tube operation. The resistances of the two deflecting-electrode circuits should be approximately equal to minimize unbalance. The current drawn by each *deflecting-electrode* is in the order of 40 microamperes.

Magnetic fields adversely affect the intrinsic operating plate-current balance of the 7360. Although this tube is internally shielded to minimize this effect, the tube should be mounted as far as possible from all devices producing extraneous magnetic fields such as transformers, chokes, motors, or similar components. It is recommended that an external shield be used in those applications critical for balance.

Chassis layout should be such that all components and wiring associated with the plates and deflecting electrodes is symmetrical. This consideration is particularly important in rf applications where very small differences in stray capacitance can result in unbalance. Chassis layouts which permit heat or vibration to affect the components associated with one deflecting-electrode circuit or plate circuit more than the other, should be avoided. All components should be rigidly mounted.

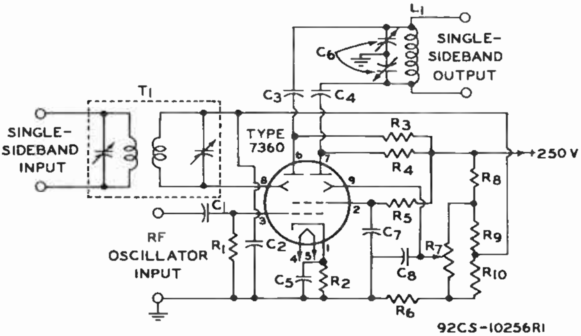
BALANCED-MODULATOR CIRCUIT
With Separate Excitation



92CS-10258

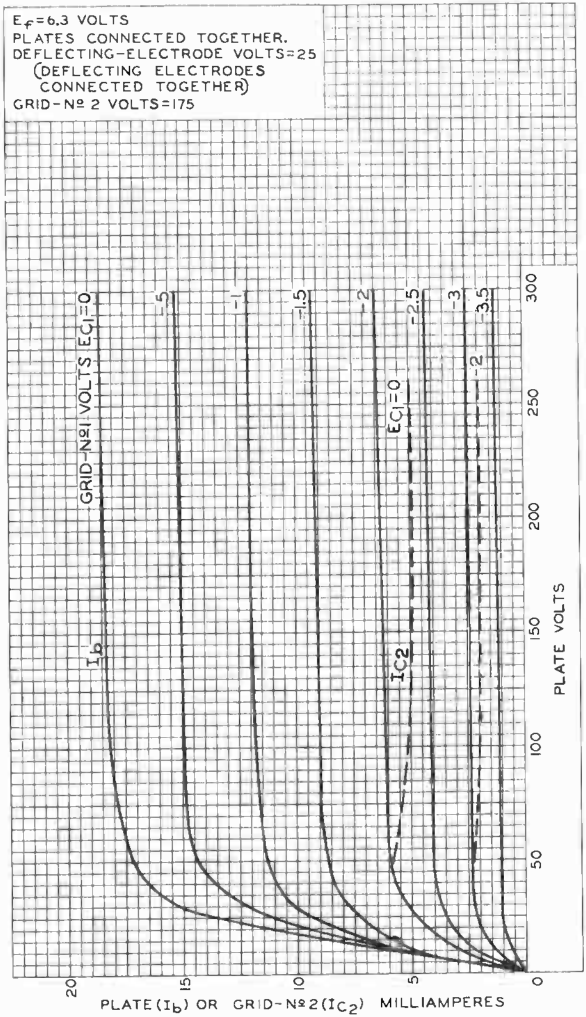
C_1: 0.001 µf
C_2: 0.22 µf
C_3: 0.001 µf
C_4: 0.01 µf
C_5 C_6: 0.0033 µf
C_7: 0.1 µf
C_8 C_9: Sufficient to resonate input of SSB filter
C_{10}: 0.22 µf
C_{11}: 0.47 µf
R_1: 0.47 megohm
R_2: 1200 ohms
R_3 R_4: 68000 ohms
R_5: 47000 ohms
R_6: 12000 ohms
R_7: 47000 ohms
R_8: 0.1 megohm
R_9: 2700 ohms
R_{10}: Carrier-Balance Potentiometer, 5000 ohms
R_{11}: 2700 ohms
R_{12}: Quadrature-Balance Potentiometer, 2500 ohms
R_{13} R_{14}: 2700 ohms
R_{15}: 0.1 megohm
NOTE: All resistors 1/2 watt, ± 10% unless specified. All capacitors 400 volts.

BALANCED-MIXER CIRCUIT
With Separate Excitation



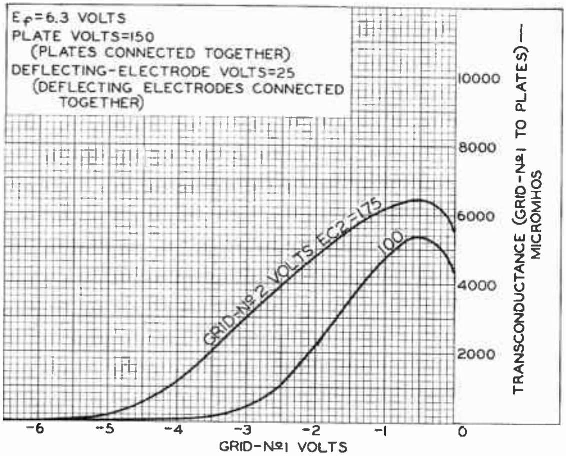
C_1: 0.001 μf
C_2: 0.04 μf
C_3 C_4: 0.001 μf
C_5: 0.04 μf
C_6: Split-Stator Tuning Capacitor to Resonate with L_1
C_7 C_8: 0.04 μf
L_1: Inductor
R_1: 0.47 megohm
R_2: 1200 ohms
R_3 R_4: 68000 ohms
R_5: 0.1 megohm
R_6: 12000 ohms
R_7: Oscillator-Rejection Potentiometer, 5000 ohms
R_8: 0.1 megohm
R_9 R_{10}: 2700 ohms
T_1: Tuned Input Transformer
NOTE: All resistors 1/2 watt, ± 10%, unless specified. All capacitors 400 volts.

AVERAGE CHARACTERISTICS

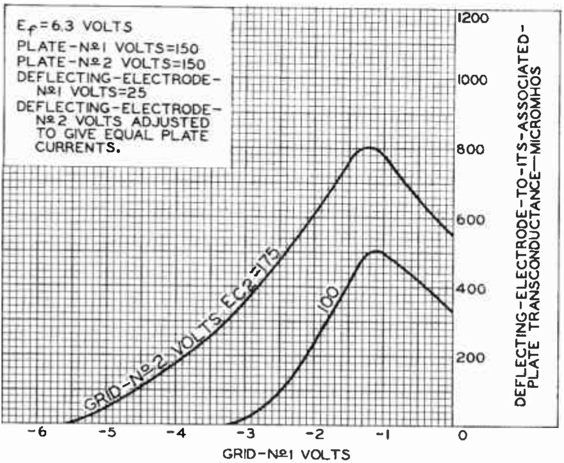


92CM-10253RI

AVERAGE CHARACTERISTICS

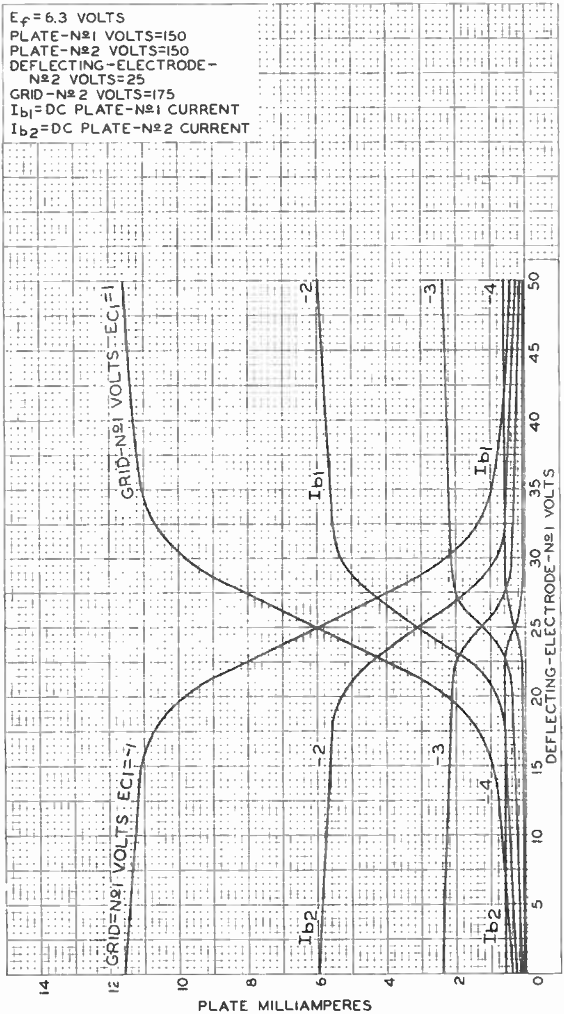


92CS-10250R2



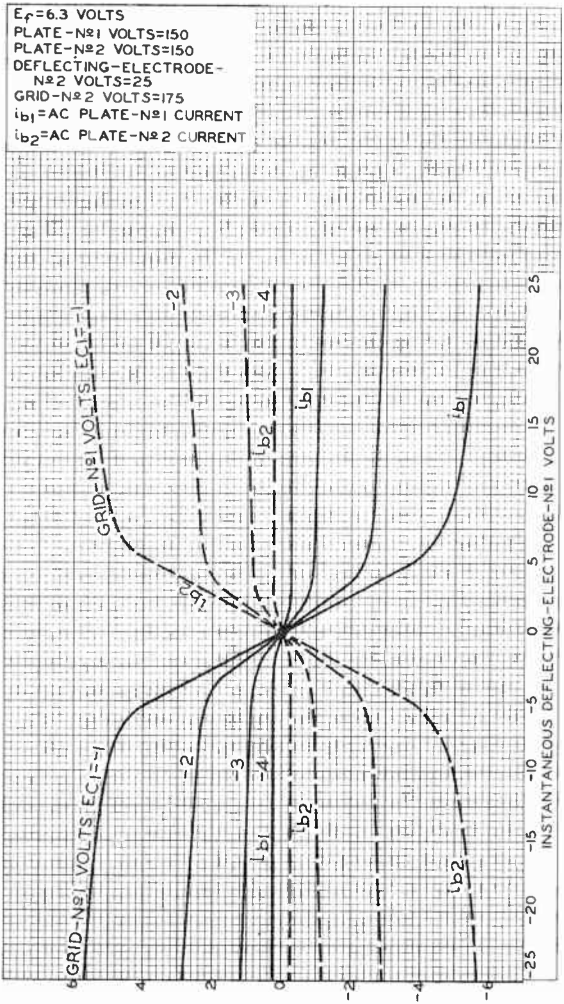
92CS-10249R1

AVERAGE CHARACTERISTICS



92CM-10252R2

OPERATION CHARACTERISTICS



92CM-10264R2

Beam Power Tube

CERAMIC-METAL SEALS | COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN | INTEGRAL RADIATOR
FORCED-AIR COOLED | 180 WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc
under Severe Shock and Vibration

GENERAL DATA

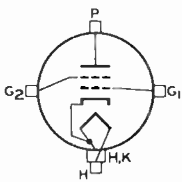
Electrical:

Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)[a]	6.3 ± 10%	volts
Current at heater volts = 6.3	3.2	amp
Minimum heating time.	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100. . .	18	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate.	0.065 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2.	19	μμf
Grid No.2 to plate.	4.5	μμf
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. 1.955"
Maximum Diameter (See *Dimensional Outline*). . . . . . 1.265"
Weight (Approx.). . . . . 2 oz
Radiator. . . . . Integral part of tube
Socket:
For frequencies up to about 400 Mc. . . . . [c]
For use at higher frequencies . . . See *Mounting Arrangement*
Terminal Connections (See *Dimensional Outline*):

G1 - Grid-No.1-Terminal Contact Surface
G2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Air Flow:

Through radiator—Adequate air flow to limit the plate-seal temperature to 250° C should be delivered by a blower through the radiator before and during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator without cowling and with cowling versus plate dissipation are shown in accompanying *Typical-Cooling-Requirements* curves. Plate power, grid-No.2 power, and air flow may be removed simultaneously.

To grid-No.2, grid-No.1, cathode, and heater terminals—A sufficient quantity of air should be delivered to these terminals to prevent their temperature from exceeding the specified maximum value of 250° C.

During standby operation—Cooling air is not normally required when only heater voltage is applied to the tube.

Terminal Temperature (Plate, grid No.2, → grid No.1, cathode, and heater) . . .	250 max.	°C

AF POWER AMPLIFIER & MODULATOR — Class AB_1[d]

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

DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE . . .	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	180 max.	ma
MAX.-SIGNAL PLATE INPUT[f]	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f]	4.5 max.	watts
PLATE DISSIPATION[f]	115 max.	watts

Typical CCS Operation:

Values are for 2 tubes			
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 (Control-grid) Voltage:			
From fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage[h] .	30	30	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	200	200	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Effective Load Resistance (Plate to plate)	4330	7000	ohms
Max.-Signal Driving Power (Approx.) . .	0	0	watts
Max.-Signal Power Output (Approx.) . . .	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:[j]		
For fixed-bias operation	30000 max.	ohms
For cathode-bias operation	Not recommended	

→ Indicates a change.

AF POWER AMPLIFIER & MODULATOR — Class AB_2[k]

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

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 (CONTROL-GRID) CURRENT[f]	30	max.	ma
MAX.-SIGNAL PLATE INPUT[f]	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f]	4.5	max.	watts
PLATE DISSIPATION[f]	115	max.	watts

Typical CCS Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 Voltage: From fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	46	46	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	355	355	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	25	25	ma
Max.-Signal DC Grid-No.1 Current	15	15	ma
Effective Load Resistance (Plate to plate)	2450	3960	ohms
Max.-Signal Driving Power (Approx.)[l]	0.3	0.3	watt
Max.-Signal Power Output (Approx.)	85	140	watts

LINEAR RF POWER AMPLIFIER

Single-Sideband Suppressed-Carrier Service

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

	Up to 1215 Mc		
DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 (CONTROL-GRID) CURRENT	30	max.	ma
MAX.-SIGNAL PLATE INPUT	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	4.5	max.	watts
PLATE DISSIPATION	115	max.	watts

Typical CCS Class AB_1 "Single-Tone" Operation:[m]

	Up to 60 Mc		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 Voltage	-15	-15	volts
Zero-Signal DC Plate Current	40	40	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Effective RF Load Resistance	2165	3500	ohms
Max.-Signal DC Plate Current	100	100	ma
Max.-Signal DC Grid-No.2 Current	10	10	ma

	Up to 60 Mc		
Max.-Signal DC Grid-No.1 Current. . . .	0	0	ma
Max.-Signal Peak RF Grid-No.1 Voltage .	15	15	volts
Max.-Signal Driving Power (Approx.) . .	0	0	watts
Max.-Signal Power Output (Approx.). . .	25	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance
under any condition:
For fixed-bias operation. . . . . 30000 max. ohms
For cathode-bias operation. . . . . Not recommended

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	800 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . .	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . .	-100 max.	volts
DC PLATE CURRENT.	150 max.	ma
DC GRID-No.1 CURRENT.	30 max.	ma
PLATE INPUT	120 max.	watts
GRID-No.2 INPUT	3 max.	watts
PLATE DISSIPATION	75 max.	watts

Typical CCS Operation:

	At 400 Mc		
DC Plate Voltage.	400	700	volts
DC Grid-No.2 Voltage[n]	200	250	volts
DC Grid-No.1 Voltage[p]	-20	-50	volts
DC Plate Current.	100	130	ma
DC Grid-No.2 Current.	5	10	ma
DC Grid-No.1 Current.	5	10	ma
Driver Power Output (Approx.)[q].	2	3	watts
Useful Power Output (Approx.)	16	45	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance
under any condition . . . . 30000[r] max. ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[s] and RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . .	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . .	-100 max.	volts
DC PLATE CURRENT.	180 max.	ma

Beam Power Tube

CERAMIC-METAL SEALS
"ONE-PIECE" ELECTRODE DESIGN
FORCED-AIR COOLED
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL RADIATOR
180 WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc
under Severe Shock and Vibration

GENERAL DATA

Electrical:

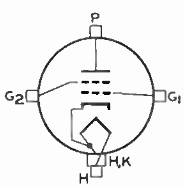
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)[a]	6.3 ± 10%	volts
Current at heater volts = 6.3	3.2	amp ←
Minimum heating time	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100	18	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate	0.065 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2	19	μμf
Grid No.2 to plate	4.5	μμf
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	1.885" + 0.070" − 0.080"
Greatest Diameter (See *Dimensional Outline*)	1.250" ± 0.015"
Weight (Approx.)	2 oz
Radiator	Integral part of tube
Socket:	
For frequencies up to about 400 Mc	c
For use at higher frequencies	See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

G1 – Grid-No.1-Terminal Contact Surface
G2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

← Indicates a change.

	Up to 60 Mc		
Max.-Signal DC Grid-No.1 Current. . . .	0	0	ma
Max.-Signal Peak RF Grid-No.1 Voltage .	15	15	volts
Max.-Signal Driving Power (Approx.) . .	0	0	watts
Max.-Signal Power Output (Approx.). . .	25	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation.	30000 max.	ohms
For cathode-bias operation.	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	800 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . .	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . .	-100 max.	volts
DC PLATE CURRENT.	150 max.	ma
DC GRID-No.1 CURRENT.	30 max.	ma
PLATE INPUT	120 max.	watts
GRID-No.2 INPUT	3 max.	watts
PLATE DISSIPATION	75 max.	watts

Typical CCS Operation:

	At 400 Mc		
DC Plate Voltage.	400	700	volts
DC Grid-No.2 Voltage[n]	200	250	volts
DC Grid-No.1 Voltage[p]	-20	-50	volts
DC Plate Current.	100	130	ma
DC Grid-No.2 Current.	5	10	ma
DC Grid-No.1 Current.	5	10	ma
Driver Power Output (Approx.)[q].	2	3	watts
Useful Power Output (Approx.)	16	45	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000[r] max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[s] and RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 1215 Mc	
DC PLATE VOLTAGE.	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . .	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . .	-100 max.	volts
DC PLATE CURRENT.	180 max.	ma

AF POWER AMPLIFIER & MODULATOR — Class AB_2[k]

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

DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	180 max.	ma
MAX.-SIGNAL DC GRID-No.1 (CONTROL-GRID) CURRENT[f]	30 max.	ma
MAX.-SIGNAL PLATE INPUT[f]	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f]	4.5 max.	watts
PLATE DISSIPATION[f]	115 max.	watts

Typical CCS Operation:

	Values are for 2 tubes		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 Voltage: From fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	46	46	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	355	355	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	25	25	ma
Max.-Signal DC Grid-No.1 Current	15	15	ma
Effective Load Resistance (Plate to plate)	2450	3960	ohms
Max.-Signal Driving Power (Approx.)[l]	0.3	0.3	watt
Max.-Signal Power Output (Approx.)	85	140	watts

LINEAR RF POWER AMPLIFIER

Single-Sideband Suppressed-Carrier Service

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

	Up to 1215 Mc	
DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	180 max.	ma
MAX.-SIGNAL DC GRID-No.1 (CONTROL-GRID) CURRENT	30 max.	ma
MAX.-SIGNAL PLATE INPUT	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	4.5 max.	watts
PLATE DISSIPATION	115 max.	watts

Typical CCS Class AB_1 "Single-Tone" Operation:[m]

	Up to 60 Mc		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 Voltage	-15	-15	volts
Zero-Signal DC Plate Current	40	40	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Effective RF Load Resistance	2165	3500	ohms
Max.-Signal DC Plate Current	100	100	ma
Max.-Signal DC Grid-No.2 Current	10	10	ma

Air Flow:

Through radiator—Adequate air flow to limit the plate-seal temperature to 250° C should be delivered by a blower through the radiator before and during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator without cowling and with cowling versus plate dissipation are shown in accompanying *Typical-Cooling-Requirements* curves. Plate power, grid-No.2 power, and air flow may be removed simultaneously.

To grid-No.2, grid-No.1, cathode, and heater terminals—A sufficient quantity of air should be delivered to these terminals to prevent their temperature from exceeding the specified maximum value of 250° C.

During standby operation—Cooling air is not normally required when only heater voltage is applied to the tube.

Terminal Temperature (Plate, grid No.2, grid No.1, cathode, and heater) . . .	250 max.	volts

AF POWER AMPLIFIER & MODULATOR — Class AB_1[d]

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

DC PLATE VOLTAGE.	1000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE. . .	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	180 max.	ma
MAX.-SIGNAL PLATE INPUT[f].	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f].	4.5 max.	watts
PLATE DISSIPATION[f].	115 max.	watts

Typical CCS Operation:

	Values are for 2 tubes		
DC Plate Voltage.	650	850	volts
DC Grid-No.2 Voltage[g]	300	300	volts
DC Grid-No.1 (Control-grid) Voltage:			
From fixed-bias source.	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage[h].	30	30	volts
Zero-Signal DC Plate Current.	80	80	ma
Max.-Signal DC Plate Current.	200	200	ma
Zero-Signal DC Grid-No.2 Current. . . .	0	0	ma
Max.-Signal DC Grid-No.2 Current. . . .	20	20	ma
Effective Load Resistance (Plate to plate).	4330	7000	ohms
Max.-Signal Driving Power (Approx.) . .	0	0	watts
Max.-Signal Power Output (Approx.). . .	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:[j]		
For fixed-bias operation.	30000 max.	ohms
For cathode-bias operation.	Not recommended	

DC GRID-No.1 CURRENT	30 max.	ma
PLATE INPUT	180 max.	watts
GRID-No.2 INPUT	4.5 max.	watts
PLATE DISSIPATION	115 max.	watts

Typical CCS Operation:

	At 400 Mc		At 1215 Mc	
DC Plate Voltage	400	900	900	volts
DC Grid-No.2 Voltage[t]	200	300	300	volts
DC Grid-No.1 Voltage[u]	-35	-30	-22	volts
DC Plate Current	150	170	170	ma
DC Grid-No.2 Current	5	1	1	ma
DC Grid-No.1 Current	3	10	4	ma
Driver Power Output (Approx.)[q]	3	3	5	watts
Useful Power Output (Approx.)	23	80	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . . 30000[r] max. ohms

a Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

b Measured with special shield adapter.

c For socket to be used with the 7457, consult manufacturers such as J-V-M Microwave Company, 9300 West 47th Street, Brookfield, Illinois; E.F. Johnson Company, Waseca, Minnesota; and Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa.

d Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

e Continuous Commercial Service.

f Averaged over any audio-frequency cycle of sine-wave form.

g Preferably obtained from a fixed supply.

h The driver stage should be capable of supplying the No.1 grids of the Class AB_1 stage with the specified driving voltage at low distortion.

j The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer or impedance coupling devices are recommended.

k Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

l Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.

m "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

n Obtained preferably from a separate source modulated along with the plate supply.

p Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

q The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

r If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

[s] Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

[t] Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

[u] Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
→ Heater Current.	1	2.90	3.55	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.065	μμf
Grid No.1 to cathode & heater.	2	11.8	15.2	μμf
Plate to cathode & heater .	2	-	0.019	μμf
Grid No.1 to grid No.2. . .	2	17.3	21.9	μμf
Grid No.2 to plate.	2	4	5.1	μμf
Grid No.2 to cathode & heater.	2	-	1.30	μμf
→ Grid-No.1 Voltage	1,3	-6	-18	volts
Reverse Grid-No.1 Current . .	1,3	-	-20	μa
Grid-No.2 Current	1,3	-8	+2	ma
Peak Emission	1,4	-	400	peak volts
Interelectrode Leakage Resistance.	5	1	-	megohm
Useful Power Output	6	80	-	watts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with heater volts = 6.3; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration (microseconds) = 2, pulse-repetition frequency (pps) = 60, and duty factor of 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a single-tube, grid-driven coaxial-cavity class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate volts = 1000, dc grid-No.2 volts = 300, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate ma. = 180 maximum, dc grid-No.1 ma. = 20 maximum, and driver power output (watts) = 3.

→ SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube

→ Indicates a change.

Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, New Jersey, on request.

50 g, 11-Millisecond Shock Test:

This test is performed on a sample lot of tubes from each production run to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

500 g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

5-to-2000 cps Variable Frequency and Cycling Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable frequency vibration. With heater volts = 6.3 ac or dc, dc plate supply volts = 300, dc grid-No.2 volts = 250, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute cycle consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.080 inch ± 10%.
b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.
c. 15-to-75 cps with fixed double amplitude of 0.036 inch ± 10%.
d. 75-to-2000 cps at fixed acceleration of 10 g ± 10%.

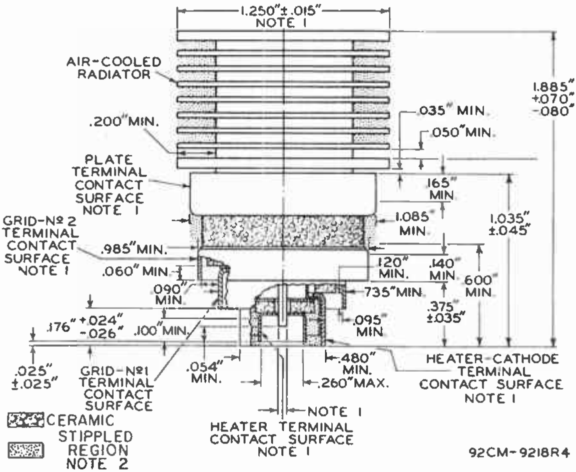
During the above vibration test, tubes will not show an rms output voltage in excess of 15 volts across the plate load resistor in the 5-to-2000 cycle range. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7457 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

During standby periods in intermittent operation, it is recommended that the heater voltage be maintained at normal operating value when the period is less than 15 minutes, and that it be reduced to 80 per cent of normal when the period is between 15 minutes and 2 hours. For longer periods, the heater voltage should be turned off.

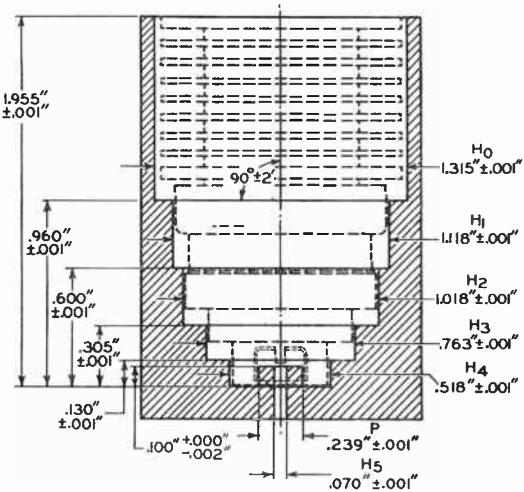
The rated plate and grid-No.2 voltages of this tube are extremely dangerous to the user. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.



NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF H_4. THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE H_4.

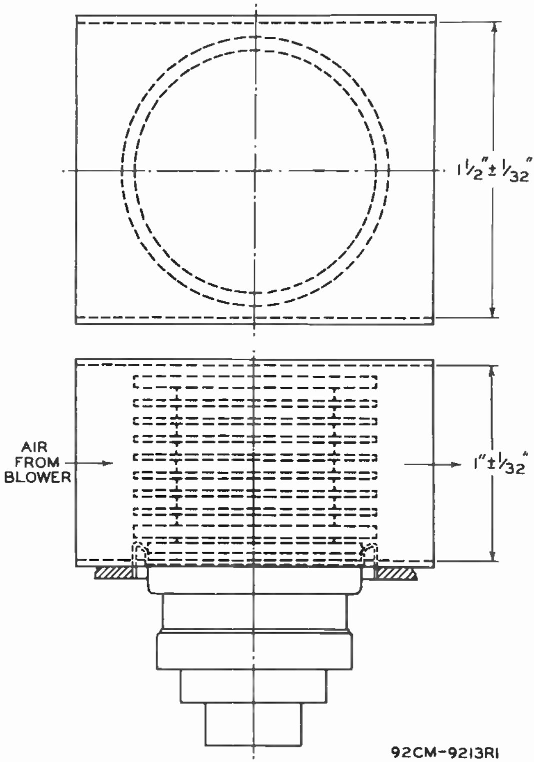
NOTE 2: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

SKETCH G_1

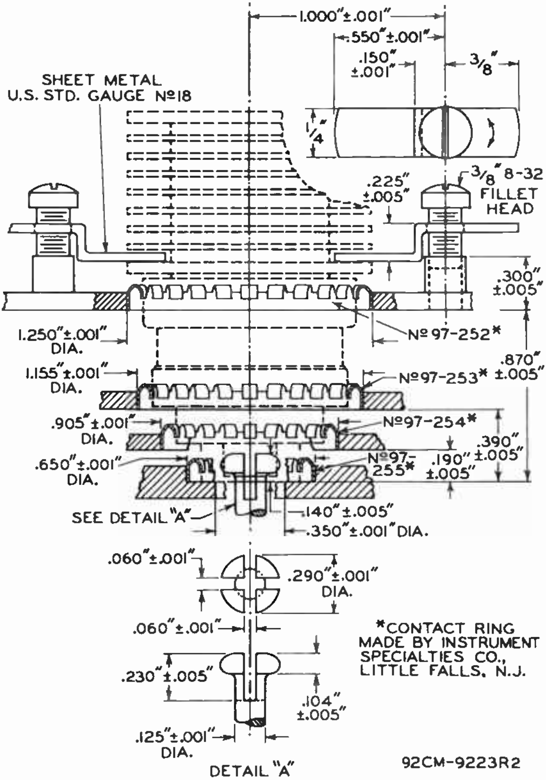


THE AXES OF THE CYLINDRICAL HOLES H_0 THROUGH H_5 AND THE AXES OF POST P ARE COINCIDENT WITHIN 0.001".

RECOMMENDED COWLING
FOR DIRECTING AIR FLOW THROUGH RADIATOR



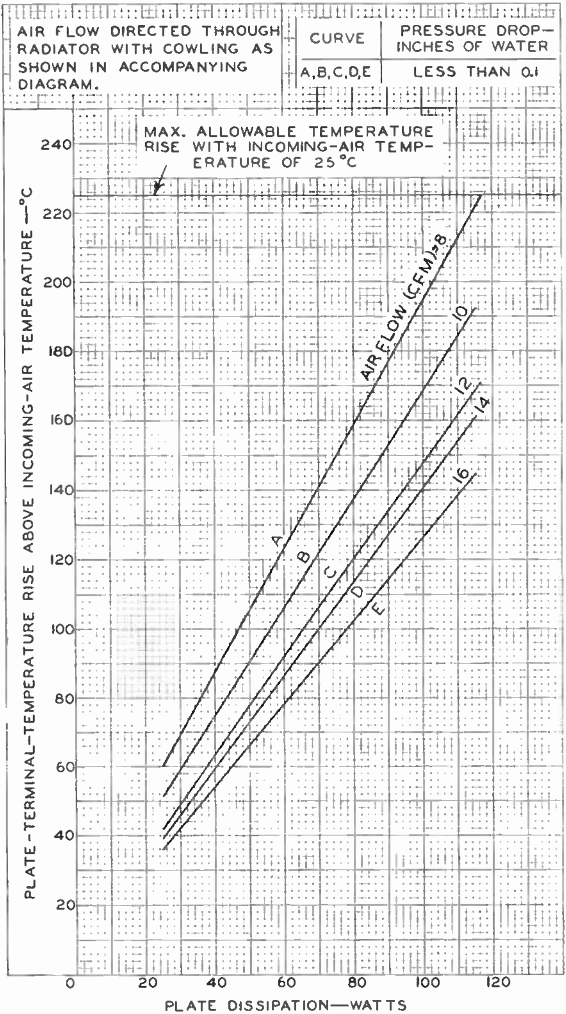
SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS



*CONTACT RING MADE BY INSTRUMENT SPECIALTIES CO., LITTLE FALLS, N.J.

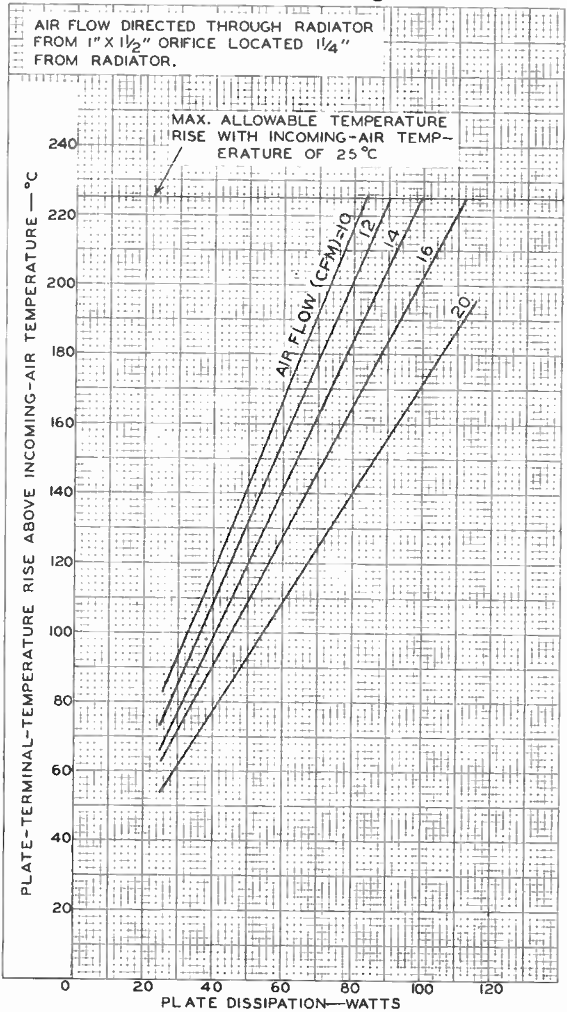
92CM-9223R2

TYPICAL COOLING REQUIREMENTS
With Cowling



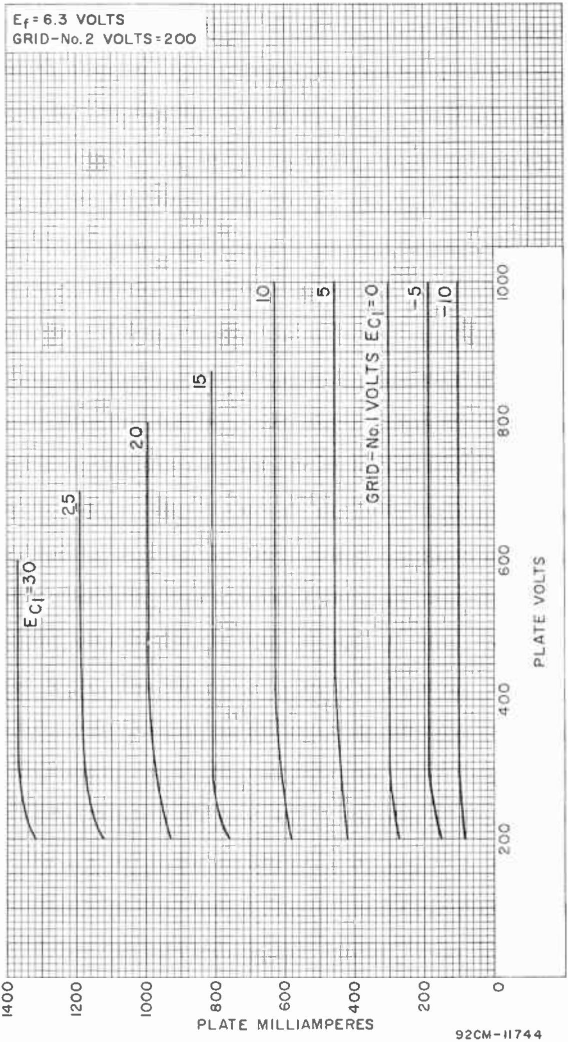
92CM-9219R1

TYPICAL COOLING REQUIREMENTS
Without Cowling



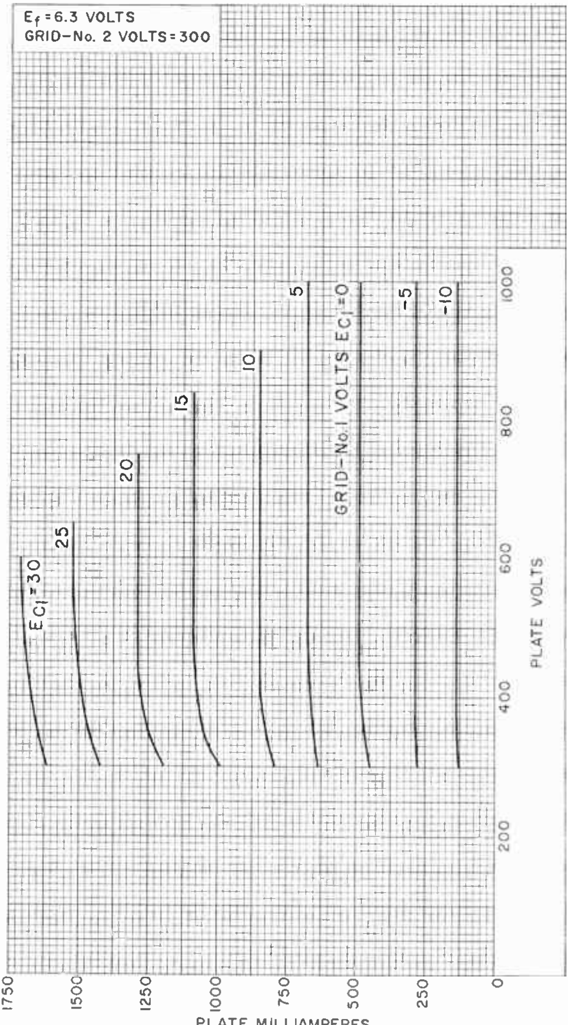
92CM-9220R1

TYPICAL PLATE CHARACTERISTICS



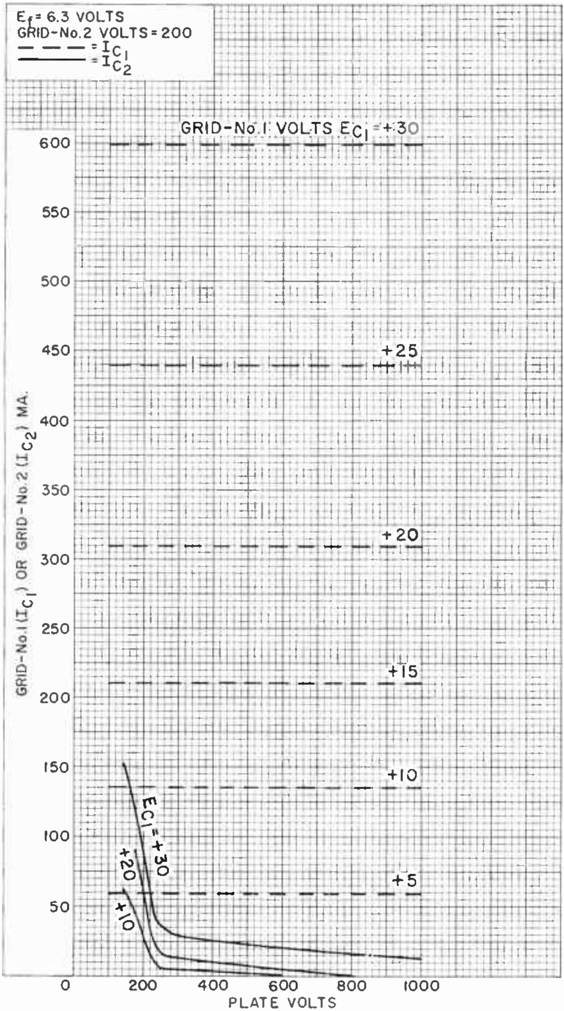
92CM-11744

TYPICAL PLATE CHARACTERISTICS



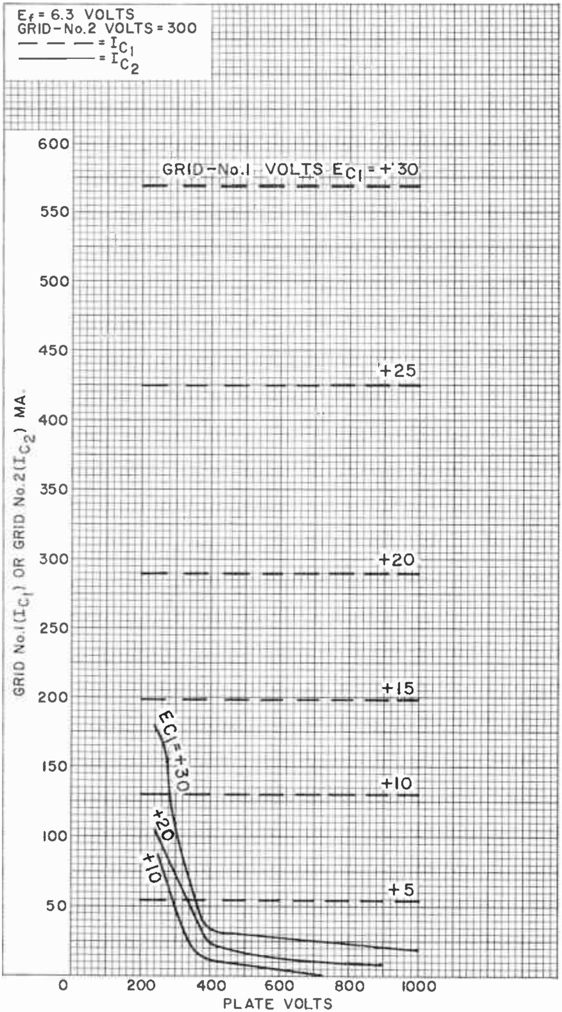
92CM-11746

TYPICAL CHARACTERISTICS



92CM-11747

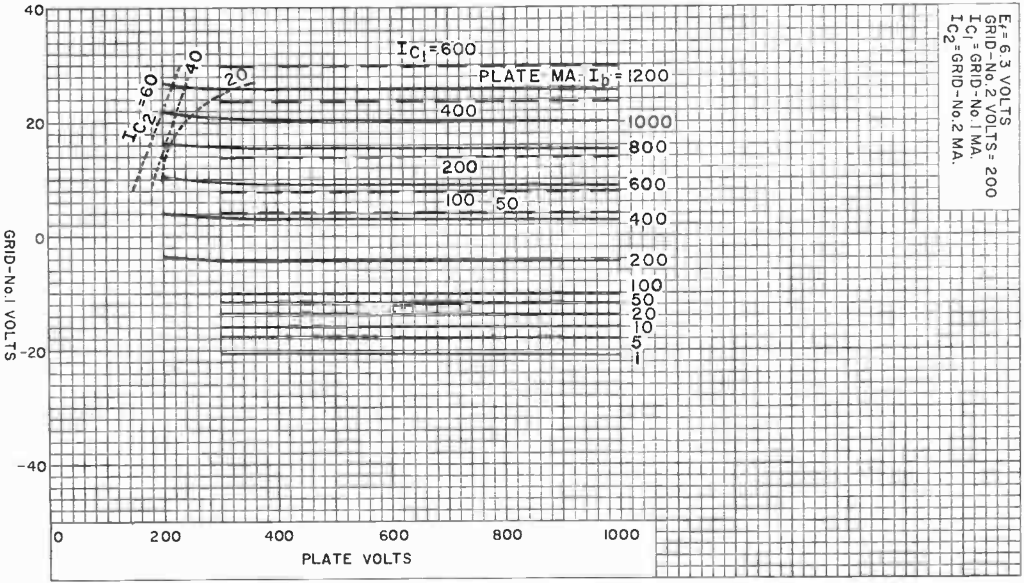
TYPICAL CHARACTERISTICS



92CM-11748

TYPICAL CONSTANT-CURRENT CHARACTERISTICS

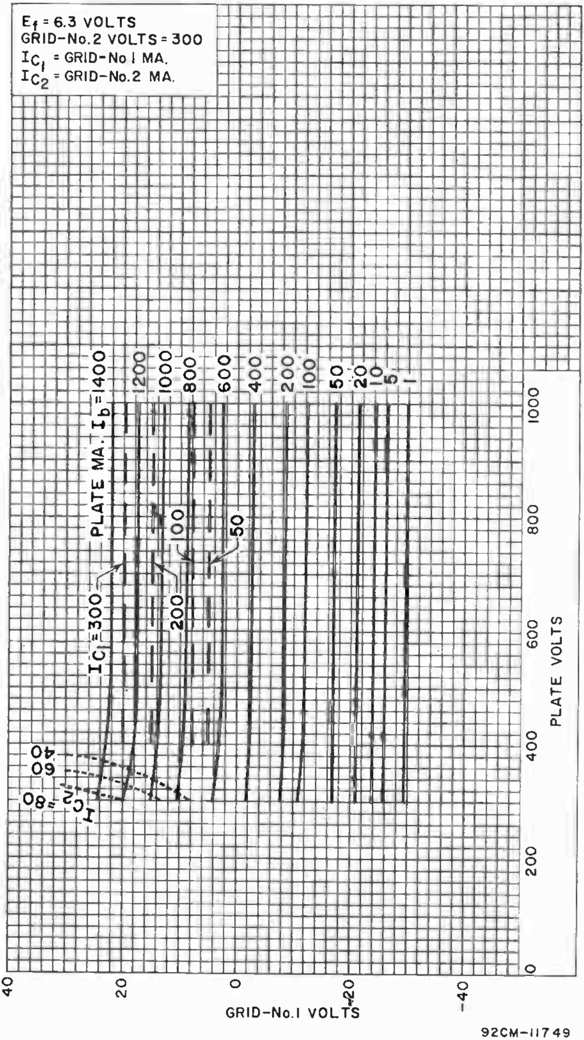
E_f = 6.3 VOLTS
GRID-No. 2 VOLTS = 200
I_{C_1} = GRID-No. 1 MA.
I_{C_2} = GRID-No. 2 MA.



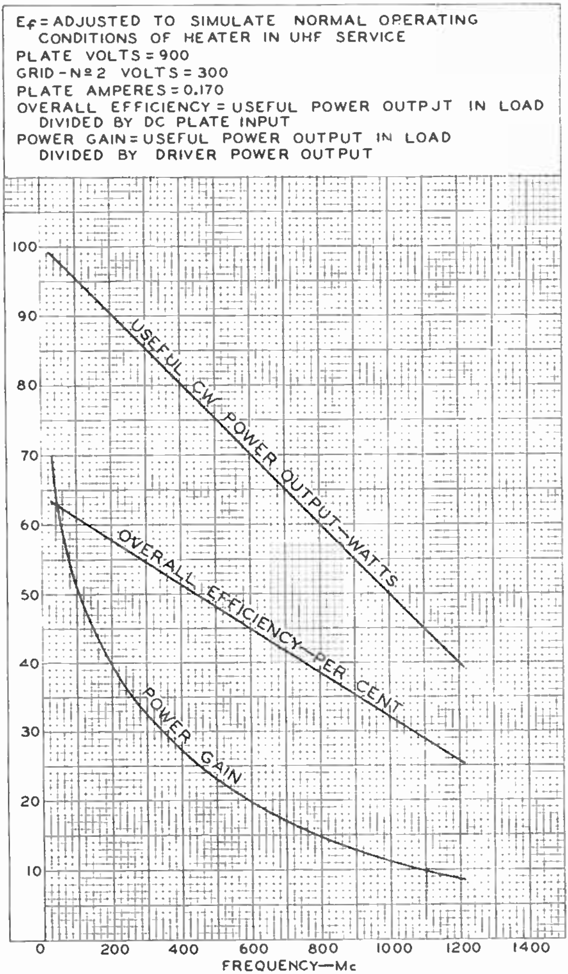
92CM-11745

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS
In Class C Telegraphy or Class C FM Telephony Amplifier Service



92CM-9221

High-Mu Triode

CERAMIC-METAL PENCIL TYPE

FAST WARM-UP TIME — STURDY COAXIAL-ELECTRODE STRUCTURE

For Use as a Low-Noise-Amplifier Tube
in Receiver Applications up to 1500 Mc
under Severe Shock and Vibration

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	0.225	amp
Cathode Warm-Up Time (Average) to reach 80% of operating plate current for dc plate-supply volts = 80, dc grid volts = 0, cathode resistor (ohms) = 0, load resistor (ohms) = 10, and heater volts = 6.3	10	sec
Amplification Factor	80	
Transconductance for dc plate ma. = 13, dc plate volts = 125, and cathode resistor (ohms) = 50	13500	μmhos
Direct Interelectrode Capacitances:[a]		
Grid to plate	2.4	μμf
Grid to cathode and heater	4.4	μμf
Plate to cathode and heater	0.04 max.	μμf
Heater to cathode	2.6	μμf
Cathode to plate	0.04 max.	μμf
Cathode to grid and heater	7.0	μμf
Plate to grid and heater	2.0	μμf

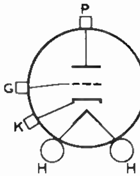
Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Weight (Approx.)	0.3 oz
Sockets:	
Heater-terminals connector	Amerac[b] No.1018-88[c], Grayhill[d] No.22-5, or equivalent
Socket for operation up to about 550 Mc (Including heater-terminals connector)	Jettron[e] No.CD7010, or equivalent
Cavities (Including heater-terminals connector)	J-V-M[f] No.D-7980 Series, Resdel[g] No.10 Series, or equivalent

← Indicates a change.

Terminal Connections (See *Dimensional Outline*):

H - Heater
K - Cathode



G - Grid
P - Plate

→ RADIO-FREQUENCY AMPLIFIER — Class A_1

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

For altitudes up to 100,000 feet and frequencies up to 1500 Mc

DC PLATE VOLTAGE.	250 max.	volts
DC GRID VOLTAGE	-50 max.	volts
DC PLATE CURRENT.	25 max.	ma
PLATE DISSIPATION	2.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	50 max.	volts
Heater positive with respect to cathode.	50 max.	volts
PLATE-SEAL TEMPERATURE.	225 max.	°C

Typical CCS[h] Operation in Cathode-Drive Circuit:

	At 550 Mc	*At 800 Mc*	*At 1100 Mc*	
DC Plate-to-Grid Voltage.	125	125	150	volts
Cathode Resistor.	50	50	50	ohms
Input-Signal-Level Range.	-70 to -20	-70 to -20	-70 to -20	dbm
DC Plate Current.	13	13	13.5	ma
Power Gain.	16.5	18	16	db
Bandwidth	5	5	10	Mc
Noise Figure.	6.5	8.5	12.5	db

Maximum Circuit Values:

Grid-Circuit Resistance:

For fixed-bias operation.	Not recommended	
For cathode-bias operation.	0.25 max.	megohm

[a] Without external shield.
[b] Amerac, Inc., Dunham Road, Beverly, Massachusetts.
[c] For use with cavities.
[d] Grayhill, Inc., 561 Hillgrove Avenue, LaGrange, Illinois.
[e] Jettron Products, Inc., 56 Route 10, Hanover, N.J.
[f] J-V-M Microwave Co., 9300 W. 47th St., Brookfield, Illinois. Indicated No. applies to a series of cavities covering range from 220 up to 1000 Mc and above.
[g] Resdel Engineering Corp., 330 South Fair Oaks Avenue, Pasadena, California. This series of cavities covers the range from 215 to 2325 Mc.
[h] Continuous Commercial Service.

→ Indicates a change.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Note	Min.	Max.	
Heater Current	1	0.205	0.245	amp
Direct Interelectrode Capacitances:				
Grid to plate	-	2.0	2.7	μμf
Grid to cathode	-	3.7	4.9	μμf
Plate to cathode	-	-	0.04	μμf
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,2	-	30	μa
Heater positive with respect to cathode	1,3	-	30	μa
Leakage Resistance:				
From grid to plate and cathode connected together	1,4	100	-	megohms
From plate to grid and cathode connected together	1,5	100	-	megohms
Reverse Grid Current	1,6	-	0.3	μa
Emission Voltage	7	-	4	volts
Amplification Factor	1,8	60	100	
Transconductance	1,8	10000	17000	μmhos
Plate Current (1)	1,8	8.5	17.5	ma
Plate Current (2)	1,9	-	50	μa
Plate Current (3)	1,10	100	-	μa
Power Gain	1,11	13	-	db
Noise Figure	1,11	-	7.5	db
Change in Power Gain	11,12	-	-1	db
Change in Noise Figure	11,12	-	0.5	db
Change in Transconductance	11,12	-	15	%

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

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

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

Note 4: With grid 100 volts negative with respect to plate and cathode which are connected together.

Note 5: With plate 300 volts negative with respect to grid and cathode which are connected together.

Note 6: With dc plate voltage of 200 volts, dc grid voltage of -2 volts, grid resistor of 0.5 megohm.

Note 7: With dc voltage on grid and plate which are connected together adjusted to produce a cathode current of 30 ma., and with 5.5 volts on heater.

Note 8: With dc plate supply voltage of 125 volts, cathode resistor of 50 ohms, and cathode bypass capacitor of 1000 μf.

Note 9: With dc plate voltage of 125 volts and dc grid voltage of -5 volts.

Note 10: With dc plate voltage of 125 volts and dc grid voltage of -2.5 volts.

Note 11: With dc plate supply voltage of 125 volts and cathode resistor of 50 ohms in a single-tube rf amplifier of the cavity type having a bandwidth of 5 ± 0.5 Mc, signal input of -70 dbm, and operating frequency of 550 ± 10 Mc.

Note 12: Reduce heater voltage to 5.7 volts. Change in Power Gain, Noise Figure, and Transconductance values from those obtained with 6.3 volts on heater will not exceed indicated values.

← indicates a change.

→ SPECIAL TESTS & PERFORMANCE DATA

Low-Pressure Voltage-Breakdown Test:

This test (similar to MIL-E-1D, paragraph 4.9.12.1) is performed on a sample lot of tubes every 90 days. Tubes are tested in a chamber at an air pressure equivalent to an altitude of 100,000 feet. Breakdown will not occur when a 60-cycle rms voltage of 300 volts is applied between the plate cylinder and grid flange.

Low-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.19.1) is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, dc plate-supply voltage of 125 volts, cathode resistor of 50 ohms, and plate load resistor of 10,000 ohms. The tubes are vibrated in a plane perpendicular to the tube axis at 40 cycles per second at an acceleration of 10 g. The rms output voltage across the plate load resistor as a result of vibration of the tube will not exceed 100 millivolts.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following test limit:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

Variable-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.20.3) is performed on a sample lot of tubes from each production run. Tube operating conditions are the same as for *Low-Frequency Vibration Performance*. The tubes are vibrated perpendicular to the major axis through a frequency range from 5 to 1000 cps and back. From 5 to 50 cps, the tubes are vibrated at a constant displacement of 0.0400 ± 0.0025 inch. From 50 to 1000 cps, the tubes are vibrated at a constant acceleration of 10 ± 2 g. Total time to complete a sweep cycle is 10 ± 5 minutes. During the test, the tubes will not show an rms output voltage across the plate load resistor in excess of 150 millivolts. Each tube is vibrated for 60 seconds at the frequency which gives maximum vibrational noise output. If, at the end of 60 seconds the vibrational noise output is still increasing, the test shall continue until there is no further increase.

The rms output voltage across the plate load resistor as a result of the vibration of the tube will not exceed the specified limit at any time during the test.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-Cathode Leakage Current. . . .	60 max.	µa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		

→ Indicates a change.

Shock Test:

This test (similar to MIL-E-10, paragraph 4.9.20.5) is performed on a sample lot of tubes from each production run. Tubes are held rigid and are subjected in three different positions to an impact acceleration of 500 g, 5 blows in each position.

At the end of this test, tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-Cathode Leakage Current. . . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Low-Frequency Vibration Output. . . .	200 max.	mv
For conditions shown above under *Low-Frequency Vibration Performance.*		
Change in Transconductance.	-20 max.	%
From initial value for conditions shown under *Characteristics Range Values, Notes 1,8.*		

Fatigue Vibration Test:

This test (similar to MIL-E-10, paragraph 4.9.20.6) is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected to 2.5 g vibrational acceleration in two positions (X1, Y1) for 32 hours each. At the end of this test, tubes will meet the limits specified for the *Shock Test.*

Shorts and Continuity Test:

This test (similar to MIL-E-10, paragraph 4.7.3) is performed on all tubes from each production run. Voltage applied between adjacent elements of the tube under test will be between 20 and 70 volts dc or peak ac. Plate and cathode terminals are tied together and connected to the grid terminal through the shorts test equipment. Tubes are tapped with a rubber tapper three times in each of three mutually perpendicular directions. If a short indication is obtained, the tapping cycle is repeated two times for verification. Acceptance criteria is based on the "Resistance vs. Time Duration" curve shown in paragraph 4.7.7 of MIL-E-10, Amendment 5.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

Ceramic-Seal-Fracture Test:

This test is performed on a sample lot of tubes every 90 days. With the cathode- and plate-cylinder-supports spaced 15/16" ± 1/64", and with the grid flange centered between these supports, the tubes will withstand gradual application of a force of 30 pounds, perpendicular to the axis of the tubes, upon the grid flange without causing fracture of the ceramic insulation.

Seal Strain Test:

This test (similar to MIL-E-1D, paragraph 4.9.6.3) is performed on a sample lot of tubes every 90 days. Tubes are tested by first immersing in water, having a temperature of at least 97° C for at least 15 seconds, and then immersing immediately in water at not more than 5° C for 5 seconds. After drying for 48 hours at room temperature, the tubes will meet the following test limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

Heater-Cycling Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.7) is performed on a sample lot of tubes from each production run. With 6.3 volts on heater and no voltage on plate or grid, the heater is cycled three minutes on and three minutes off for at least 2000 cycles.

At the end of this test, tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-to-Cathode Leakage Current . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Grid-to-Cathode Leakage Resistance. .	50 min.	megohms
For conditions shown under *Characteristics Range Values, Notes 1,4.*		

1-Hour Stability Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.1.a) is performed on a sample lot of tubes from each production run to insure that the tubes have been properly stabilized. Types are operated under the following conditions: Heater voltage of 6.3 volts, plate-supply voltage of 215 volts, and cathode resistor of 150 ohms.

At the end of 1 hour, the change in transconductance value for each tube, referred to its initial transconductance reading, will not exceed 15% of the initial value for conditions shown under *Characteristics Range Values, Notes 1,8.*

In addition, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

100-Hour Survival Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.1.b) is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Life-test conditions are the same as those specified for *1-Hour Stability Life Performance* except that all voltages are cycled at the rate of 110 minutes on and 10 minutes off.

At the end of 100 hours, the tubes will meet the following limits:

Transconductance.	8000 min.	µmhos
For conditions shown under *Characteristics Range Values, Notes 1,8.*		
Plate Current (2)	50 max.	µa
For conditions shown under *Characteristics Range Values, Notes 1,9.*		

In addition, the tubes will not show permanent shorts or open circuits, and will meet the following limit:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

500- and 1000-Hour Average Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.2) is performed on a sample lot of tubes from each production run to insure excellent overall performance and to guard against epidemic failures of tubes to meet any of the characteristics indicated below.

Each tube is life tested under the following conditions: Heater voltage of 6.3 volts; plate-supply voltage of 215 volts; cathode resistor of 150 ohms; heater positive with respect to cathode by 67.5 volts; and plate-seal temperature of 225° C. Heater voltage is cycled at a rate of 110 minutes on and 10 minutes off.

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

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Leakage Resistance:		
From grid to plate and cathode connected together.	60 min.	megohms
From plate to grid and cathode connected together.	60 min.	megohms
For conditions shown under *Characteristics Range Values, Notes 1,4, and 1,5.*		
Power Gain.	12 min.	db
For conditions shown under *Characteristics Range Values, Notes 1,11.*		
Noise Figure.	8.5 max.	db
For conditions shown under *Characteristics Range Values, Notes 1,11.*		
Change in Power Gain.	-1	db
For conditions shown under *Characteristics Range Values, Notes 1,11,12.*		

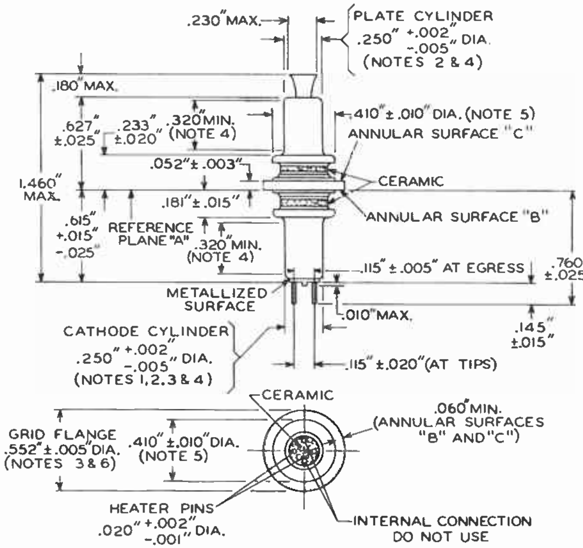
At the end of 1000 hours, the tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Power Gain.	11 min.	db
For conditions shown under *Characteristics Range Values, Notes 1,11.*		
Noise Figure.	9.5 max.	db
For conditions shown under *Characteristics Range Values, Notes 1,11.*		

OPERATING CONSIDERATIONS

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

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



REFERENCE PLANE "A" IS DEFINED AS THAT PLANE AGAINST WHICH ANNULAR SURFACE "B" OF THE GRID FLANGE ABUTS.

ANNULAR SURFACE "B" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE CATHODE CYLINDER.

ANNULAR SURFACE "C" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE PLATE CYLINDER.

NOTE 1: WITH ANNULAR SURFACE "B" RESTING ON REFERENCE PLANE "A". THE AXIS OF THE CATHODE CYLINDER WILL BE WITHIN 2° OF A LINE PERPENDICULAR TO REFERENCE PLANE "A".

NOTE 2: THE AXES OF THE PLATE CYLINDER AND CATHODE CYLINDER WILL COINCIDE WITHIN 0.010".

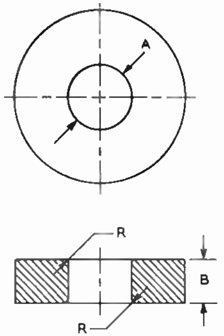
NOTE 3: THE AXES OF THE CATHODE CYLINDER AND GRID FLANGE WILL COINCIDE WITHIN 0.005".

NOTE 4: THE DIAMETER ALONG THE 0.320" MINIMUM LENGTH IS MEASURED WITH "GO" AND "NO-GO" RING GAUGES G_1-1 AND G_1-2, RESPECTIVELY.

NOTE 5: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_2-1 AND G_2-2, RESPECTIVELY.

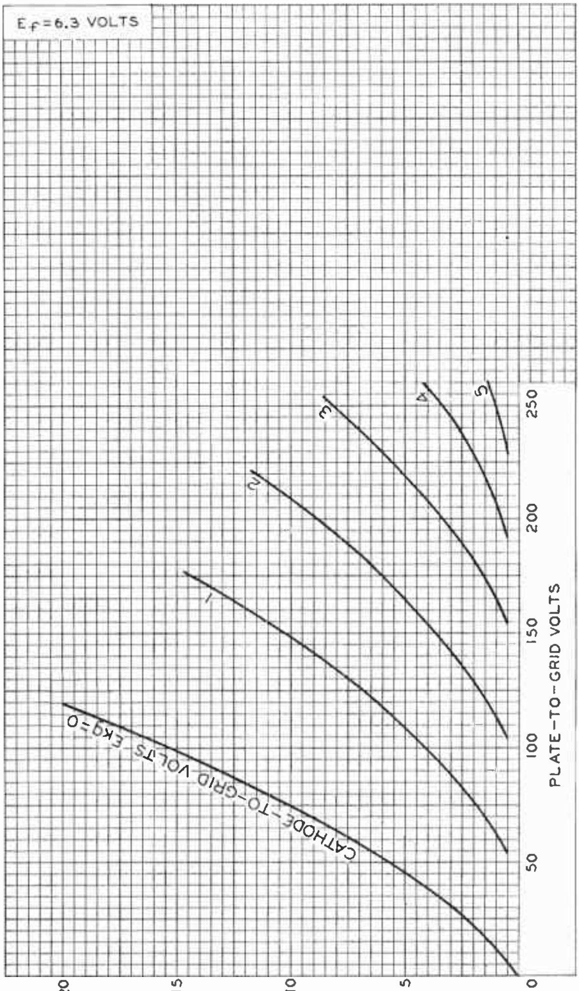
NOTE 6: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_3-1 AND G_3-2, RESPECTIVELY.

GAUGES



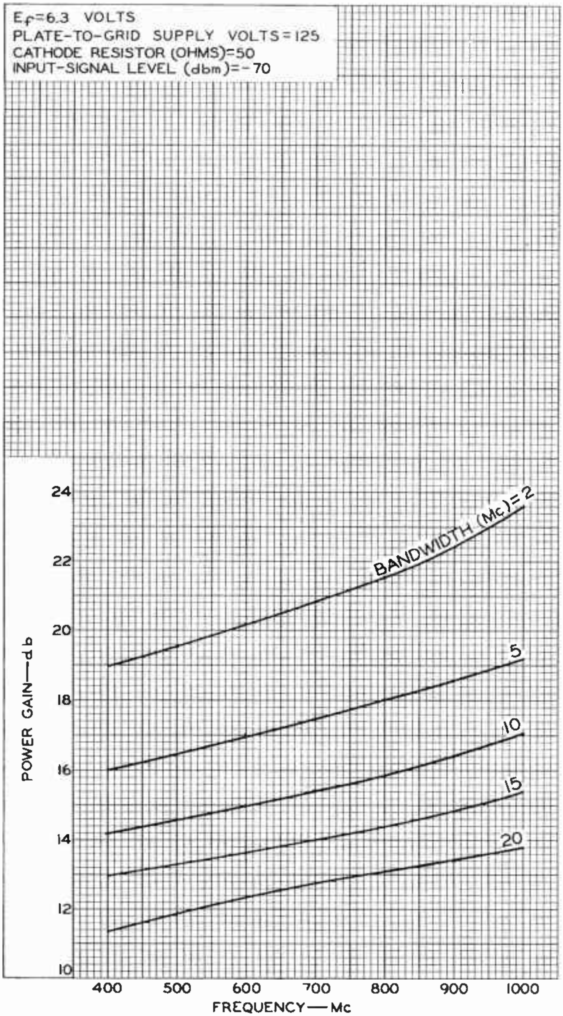
Gauge	Type	Dimension		
		Diameter A	Thickness B	Radius R
G_1-1	GO	0.25200" $^{+0.00000"}_{-0.00007"}$	0.320" $^{+0.001"}_{-0.000"}$	0.003" MAX.
G_1-2	NO-GO	0.24500" $^{+0.00007"}_{-0.00000"}$	-	-
G_2-1	GO	0.42000" $^{+0.00000"}_{-0.00007"}$	-	-
G_2-2	NO-GO	0.40000" $^{+0.00007"}_{-0.00000"}$	-	-
G_3-1	GO	0.55700" $^{+0.00000"}_{-0.00007"}$	-	-
G_3-2	NO-GO	0.54700" $^{+0.00007"}_{-0.00000"}$	-	-

AVERAGE PLATE CHARACTERISTICS
Cathode-Drive Service



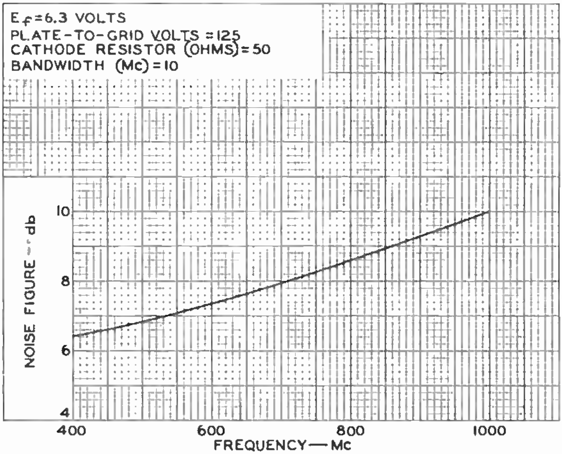
92CM–10458

POWER-GAIN CHARACTERISTICS
Cathode-Drive Service

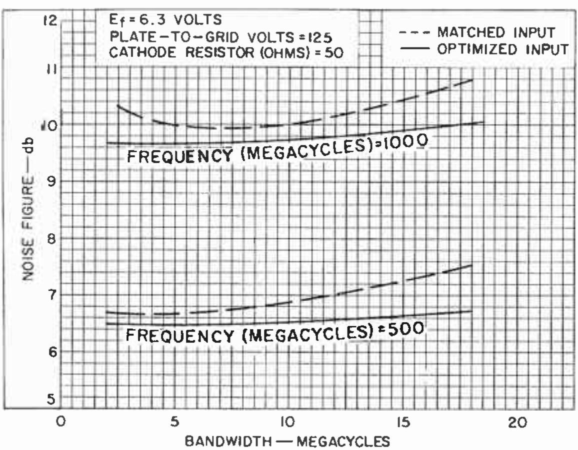


92CM-10271R1

NOISE-FIGURE CHARACTERISTICS
Cathode-Drive Service

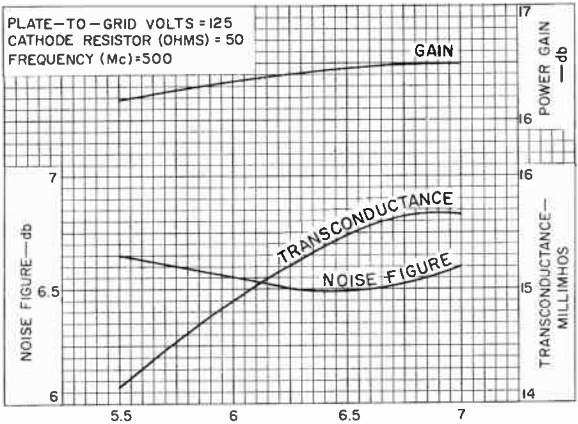


92CS-10270R3



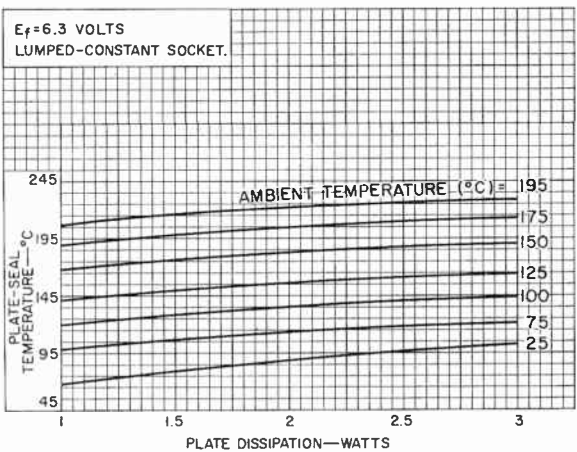
92CS-11497R1

CHARACTERISTICS
Cathode-Drive Service



92CS-11491R1

PLATE-SEAL-TEMPERATURE CHARACTERISTICS



92CS-11488

High-Mu Triode

CERAMIC-METAL PENCIL TYPE

FAST WARM-UP TIME — STURDY COAXIAL-ELECTRODE STRUCTURE

For Use as a Low-Noise-Amplifier Tube
in Receiver Applications up to 1500 Mc
under Severe Shock and Vibration

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	0.225	amp
Cathode Warm-Up Time (Average) to reach 80% of operating plate current for dc plate-supply volts = 80, dc grid volts = 0, cathode resistor (ohms) = 0, load resistor (ohms) = 10, and heater volts = 6.3	10	sec
Amplification Factor	80	
Transconductance for dc plate ma. = 12.5, dc plate volts = 125, and cathode resistor (ohms) = 50	13000	μmhos
Direct Interelectrode Capacitances:[a]		
Grid to plate	2.4	μμf
Grid to cathode and heater	4.4	μμf
Plate to cathode and heater	0.03 max.	μμf
Heater to cathode	2.6	μμf
Cathode to plate	0.03 max.	μμf
Cathode to grid and heater	7	μμf
Plate to grid and heater	2.4	μμf

Mechanical:

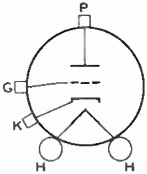
Operating Position	Any
Dimensions	See *Dimensional Outline*
Weight (Approx.)	0.3 oz
Sockets:	
Heater-terminals connector	Amerac[b] No.1018-88,[c] Grayhill[d] No.22-5, or equivalent
Socket for operation up to about 550 Mc (Including heater-terminals connector)	Jettron[e] No.CD7010, or equivalent
Cavities (Including heater-terminals connector)	J-V-M[f] No.D-7980 Series, Resdel[g] No.10 Series, or equivalent

← Indicates a change.

Terminal Connections (See *Dimensional Outline*):

H - Heater

K - Cathode



G - Grid

P - Plate

→ RADIO-FREQUENCY AMPLIFIER — Class A_1

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

For altitudes up to 100,000 feet and frequencies up to 1500 Mc

DC PLATE VOLTAGE.	250 max.	volts
DC GRID VOLTAGE	-50 max.	volts
DC PLATE CURRENT.	25 max.	ma
PLATE DISSIPATION	2.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	50 max.	volts
Heater positive with respect to cathode.	50 max.	volts
PLATE-SEAL TEMPERATURE.	225 max.	°C

Typical CCS[h] Operation in Cathode-Drive Circuit:

	At 550 Mc	*At 700 Mc*	
DC Plate-to-Grid Voltage. . . .	125	125	volts
Cathode Resistor.	50	50	ohms
Input-Signal-Level Range. . . .	-70 to -20	-70 to -20	dbm
DC Plate Current.	12.5	12.5	ma
Power Gain for a bandwidth of 5 Mc	16.5	17	db
Noise Figure.	6.5	7	db

	At 1100 Mc	
DC Plate-to-Grid Voltage.	150	volts
Cathode Resistor.	50	ohms
Input-Signal-Level Range.	-70 to -20	dbm
DC Plate Current.	14	ma
Power Gain for a bandwidth of:		
4 Mc.	20	db
8 Mc.	18	db
Noise Figure.	11.5	db

Maximum Circuit Values:

Grid-Circuit Resistance:		
For fixed-bias operation.	Not recommended	
For cathode-bias operation.	0.25 max.	megohm

→ Indicates a change.

[a] Without external shield.
[b] Amerac, Inc., Dunham Road, Beverly, Massachusetts.
[c] For use with cavities.
[d] Grayhill, Inc., 561 Hillgrove Avenue, LaGrange, Illinois.
[e] Jettron Products, Inc., 56 Route 10, Hanover, N.J.
[f] J-V-M Microwave Co., 9300 W. 47th St., Brockfield, Illinois. Indicated No. applies to a series of cavities covering range from 220 up to 1000 Mc and above.
[g] Resdel Engineering Corp., 330 South Fair Oaks Avenue, Pasadena, California. This series of cavities covers the range from 215 up to 2325 Mc.
[h] Continuous Commercial Service.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.205	0.245	amp
Direct Interelectrode Capacitances:				
Grid to plate	-	2.1	2.8	μμf
Grid to cathode	-	3.8	4.8	μμf
Plate to cathode	-	-	0.03	μμf
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,2	-	30	μa
Heater positive with respect to cathode	1,3	-	30	μa
Leakage Resistance:				
From grid to plate and cathode connected together	1,4	100	-	megohms
From plate to grid and cathode connected together	1,5	100	-	megohms
Reverse Grid Current	1,6	-	0.3	μa
Emission Voltage	7	-	3	volts
Amplification Factor	1,8	60	100	
Transconductance	1,8	10000	16000	μmhos
Plate Current (1)	1,8	8.5	16.5	ma
Plate Current (2)	1,9	-	50	μa
Plate Current (3)	1,10	100	-	μa
Power Gain	1,11	14	-	db
Noise Figure	1,11	-	7	db
Change in Power Gain	11,12	-	-1	db
Change in Noise Figure	11,12	-	+0.5	db
Change in Transconductance	11,12	-	15	%

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

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

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

Note 4: With grid 100 volts negative with respect to plate and cathode which are connected together.

Note 5: With plate 300 volts negative with respect to grid and cathode which are connected together.

Note 6: With dc plate voltage of 200 volts, dc grid voltage of -2 volts, grid resistor of 0.5 megohm.

← Indicates a change.

Note 7: With dc voltage on grid and plate which are connected together adjusted to produce a cathode current of 30 ma., and with 5.5 volts on heater.

Note 8: With dc plate-supply voltage of 125 volts, cathode resistor of 50 ohms, and cathode bypass capacitor of 1000 μf.

Note 9: With dc plate voltage of 125 volts and dc grid voltage of −5 volts.

Note 10: With dc plate voltage of 125 volts and dc grid voltage of −2.5 volts.

Note 11: With dc plate-supply voltage of 125 volts and cathode resistor of 50 ohms in a single-tube rf amplifier of the cavity type having a bandwidth of 5 ± 0.5 Mc, signal input of −70 dbm, and operating frequency of 550 ± 10 Mc.

Note 12: Reduce heater voltage to 5.7 volts. Change in Power Gain, Noise Figure, and Transconductance values from those obtained with 6.3 volts on heater will not exceed indicated values.

→ SPECIAL TESTS & PERFORMANCE DATA

Low-Pressure Voltage-Breakdown Test:

This test (similar to MIL-E-1D, paragraph 4.9.12.1) is performed on a sample lot of tubes every 90 days. Tubes are tested in a chamber at an air pressure equivalent to an altitude of 100,000 feet. Breakdown will not occur when a 60-cycle rms voltage of 300 volts is applied between the plate cylinder and grid flange.

Low-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.19.1) is performed on a sample lot of tubes from each production run under the following conditions: heater voltage of 6.3 volts, dc plate-supply voltage of 125 volts, cathode resistor of 50 ohms, and plate load resistor of 10,000 ohms. The tubes are vibrated in a plane perpendicular to the tube axis at 40 cycles per second at an acceleration of 10 g. The rms output voltage across the plate load resistor as a result of vibration of the tube will not exceed 100 millivolts.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following test limit:

Heater Current. . . . . 300 max. ma
For conditions shown under *Characteristics Range Values, Note 1.*

Variable-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.20.3) is performed on a sample lot of tubes from each production run. Tube operating conditions are the same as for *Low-Frequency Vibration Performance*. The tubes are vibrated perpendicular to the major tube axis through a frequency range from 5 to 2000 cps and back. From 5 to 50 cps, the tubes are vibrated at a constant displacement of 0.0400 ± 0.0025 inch. From 50 to 2000 cps, the tubes are vibrated at a constant acceleration of 10 ± 2 g. Total time to complete a sweep cycle is 10 ± 5 minutes. During the test, the tubes will not show an rms output voltage across the plate load resistor in excess of 50 millivolts. Each tube is vibrated for 60 seconds at the frequency which

→ indicates a change.

gives maximum vibrational noise output. If, at the end of 60 seconds the vibrational noise output is still increasing, the test is continued until there is no further increase.

The rms output voltage across the plate load resistor as a result of the vibration of the tube will not exceed the specified limit at any time during the test.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-Cathode Leakage Current. . . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		

Shock Test:

This test (similar to MIL-E-1D, paragraph 4.9.20.5) is performed on a sample lot of tubes from each production run. Tubes are held rigid and are subjected in three different positions to an impact acceleration of 500 g, 5 blows in each position.

At the end of this test, tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-Cathode Leakage Current. . . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Low-Frequency Vibration Output. . . .	200 max.	mv
For conditions shown above under *Low-Frequency Vibration Performance.*		
Change in Transconductance.	−20 max.	%
From initial value for conditions shown under *Characteristics Range Values, Notes 1,8.*		

Fatigue Vibration Test:

This test (similar to MIL-E-1D, paragraph 4.9.20.6) is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected to 2.5 g vibrational acceleration in two positions (X1, Y1) for 32 hours each. At the end of this test, tubes will meet the limits specified for the *Shock Test.*

Shorts and Continuity Test:

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

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

Ceramic-Seal-Fracture Test:

This test is performed on a sample lot of tubes every 90 days. With the cathode- and plate-cylinder-supports spaced 15/16" ± 1/64", and with the grid flange centered between these supports, the tubes will withstand gradual application of a force of 30 pounds, perpendicular to the axis of the tubes, upon the grid flange, without causing fracture of the ceramic insulation.

Seal Strain Test:

This test (similar to MIL-E-1D, paragraph 4.9.6.3) is performed on a sample lot of tubes every 90 days. Tubes are tested by first immersing in water having a temperature of at least 97° C for at least 15 seconds and then immersing immediately in water at not more than 5° C for 5 seconds. After drying for 48 hours at room temperature, the tubes will meet the following test limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

Grid Blackout:

This test is performed as follows on a sample lot of tubes from each production run:

Signal-output voltage is measured under conditions with heater voltage of 6.3 volts, dc plate-supply voltage of 200 volts, plate load resistor of 10,000 ohms, grid resistor of 15 ohms, and a sine-wave voltage having a frequency of 100 kc and a peak-to-peak value of 0.1 volt applied between the grid and cathode. Then, in addition to the above conditions, a pulse signal with repetition rate of 2000 pps, peak-to-peak voltage of 5 volts, and pulse duration of 0.25 μsec is applied between the grid and cathode. Next, measurement of signal-output voltage is made 0.8 μsec after the leading edge of a pulse. This value of signal-output voltage referred to the initial value will not show a change in excess of −5 db.

Heater-Cycling Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.7) is performed on a sample lot of tubes from each production run. With 6.3 volts on heater and no voltage on plate or grid, the heater is cycled three minutes on and three minutes off for at least 2000 cycles.

At the end of this test, tubes will not show temporary or permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-to-Cathode Leakage Current . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Grid-to-Cathode Leakage Resistance. .	50 min.	megohms
For conditions shown under *Characteristics Range Values, Notes 1,4.*		

1-Hour Stability Life Performance:

This test (similar to MIL-E-10, paragraph 4.11.3.1.a) is performed on a sample lot of tubes from each production run to insure that the tubes have been properly stabilized. Tubes are operated under the following conditions:

Heater voltage of 6.3 volts, plate-supply voltage of 215 volts, and cathode resistor of 150 ohms.

At the end of 1 hour, the change in transconductance value for each tube, referred to its initial transconductance reading, will not exceed 15% of the initial value for conditions shown under *Characteristics Range Values, Notes 1,8.*

In addition, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

44-Hour Grid-Emission Life Performance:

This test is performed on a sample lot of tubes from each production run to insure excellent over-all performance and to guard against epidemic failures of tubes to meet this test requirement. Tubes are operated under the following conditions:

Heater voltage of 7.5 volts, dc plate voltage of 215 volts, grid voltage of -2 volts, and grid resistor of 0.5 megohm.

At the end of 44 hours, the reverse grid current will not exceed 2 microamperes when grid resistor is shorted and grid voltage is increased to -5 volts, other conditions remaining unchanged from the above values.

100-Hour Survival Life Performance:

This test (similar to MIL-E-10, paragraph 4.11.3.1.b) is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Life-test conditions are the same as those specified for *1-Hour Stability Life Performance* except that all voltages are cycled at the rate of 110 minutes on and 10 minutes off.

At the end of 100 hours, the tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current. . . . . 300 max. ma
For conditions shown under *Characteristics Range Values, Note 1.*

Transconductance. . . . . 8000 min. μmhos
For conditions shown under *Characteristics Range Values, Notes 1,8.*

Plate Current (2) . . . . 50 max. μa
For conditions shown under *Characteristics Range Values, Notes 1,9.*

500- and 1000-Hour Average Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.2) is performed on a sample lot of tubes from each production run to insure excellent over-all performance and to guard against epidemic failures of tubes to meet any of the characteristics indicated below. Each tube is life-tested under the following conditions:

Heater voltage of 6.3 volts, plate-supply voltage of 215 volts, cathode resistor of 150 ohms, heater positive with respect to cathode by 67.5 volts, and plate-seal temperature of 225° C. Heater voltage is cycled at a rate of 110 minutes on and 10 minutes off.

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

Heater Current. . . . . 300 max. ma
For conditions shown under *Characteristics Range Values, Note 1.*

Leakage Resistance:
From grid to plate and cathode connected together. . . . 60 min. megohms
From plate to grid and cathode connected together. . . . 60 min. megohms
For conditions shown under *Characteristics Range Values, Notes 1,4 and 1,5.*

Power Gain. . . . . 13 min. db
For conditions shown under *Characteristics Range Values, Notes 1,11.*

Noise Figure. . . . . 8 max. db
For conditions shown under *Characteristics Range Values, Notes 1,11.*

Change in Power Gain. . . . . . . : . . . -1 max. db
For conditions shown under *Characteristics Range Values, Notes 1,11,12.*

At the end of 1000 hours, the tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to meet the following limits:

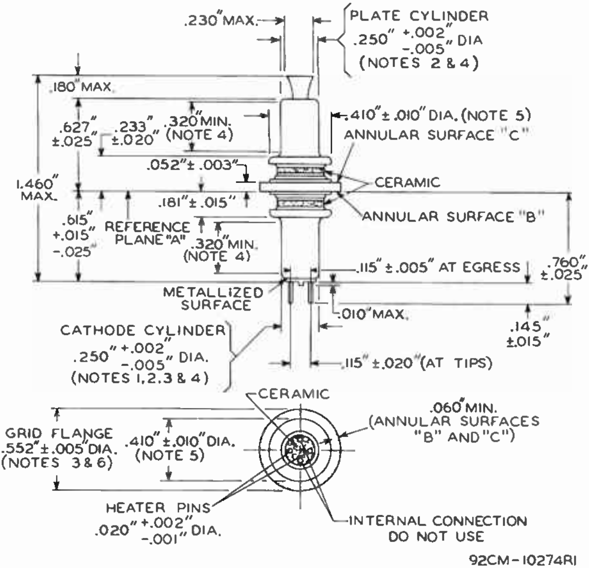
Heater Current. . . . . 300 max. ma
For conditions shown under *Characteristics Range Values, Note 1.*

Power Gain. . . . . 12 min. db
For conditions shown under *Characteristics Range Values, Notes 1,11.*
Noise Figure. . . . . 9.5 max. db
For conditions shown under *Characteristics Range Values, Notes 1,11.*

OPERATING CONSIDERATIONS

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

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



REFERENCE PLANE "A" IS DEFINED AS THAT PLANE AGAINST WHICH ANNULAR SURFACE "B" OF THE GRID FLANGE ABUTS.

ANNULAR SURFACE "B" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE CATHODE CYLINDER.

ANNULAR SURFACE "C" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE PLATE CYLINDER.

NOTE 1: WITH ANNULAR SURFACE "B" RESTING ON REFERENCE PLANE "A", THE AXIS OF THE CATHODE CYLINDER WILL BE WITHIN 2° OF A LINE PERPENDICULAR TO REFERENCE PLANE "A".

NOTE 2: THE AXES OF THE PLATE CYLINDER AND CATHODE CYLINDER WILL COINCIDE WITHIN 0.010".

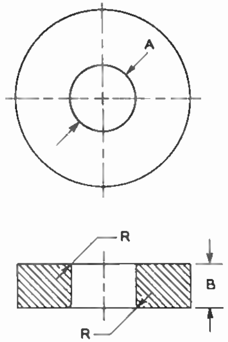
NOTE 3: THE AXES OF THE CATHODE CYLINDER AND GRID FLANGE WILL COINCIDE WITHIN 0.005".

NOTE 4: THE DIAMETER ALONG THE 0.320" MINIMUM LENGTH IS MEASURED WITH "GO" AND "NO-GO" RING GAUGES G_1-1 AND G_1-2, RESPECTIVELY.

NOTE 5: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_2-1 AND G_2-2, RESPECTIVELY.

NOTE 6: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_3-1 AND G_3-2, RESPECTIVELY.

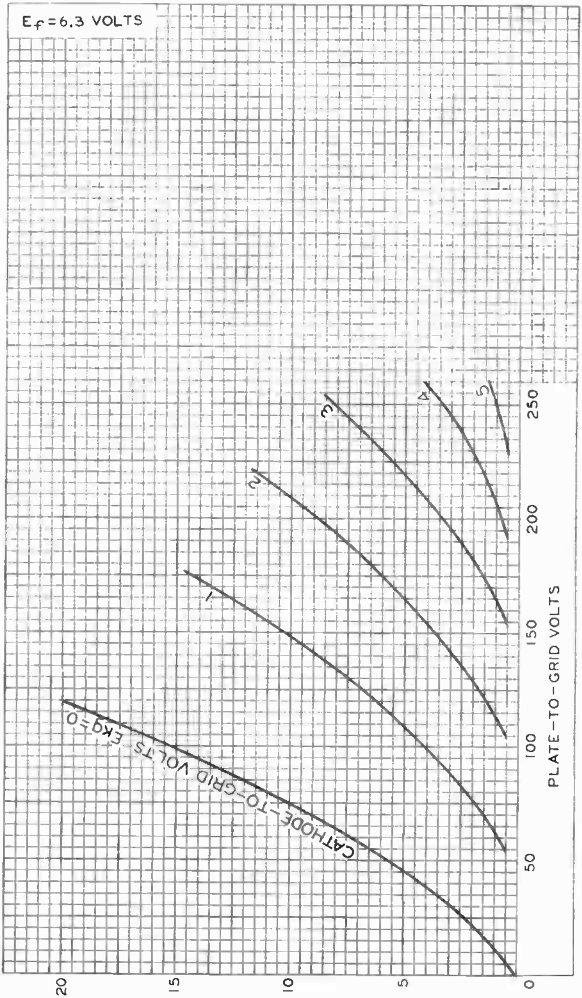
GAUGES



92CS-10370

Gauge	Type	Dimension		
		Diameter A	Thickness B	Radius R
G_1-1	GO	0.25200" +0.00000" −0.00007"	0.320" +0.001" −0.000"	0.003" MAX.
G_1-2	NO-GO	0.24500" +0.00007" −0.00000"	–	–
G_2-1	GO	0.42000" +0.00000" −0.00007"	–	–
G_2-2	NO-GO	0.40000" +0.00007" −0.00000"	–	–
G_3-1	GO	0.55700" +0.00000" −0.00007"	–	–
G_3-2	NO-GO	0.54700" +0.00007" −0.00000"	–	–

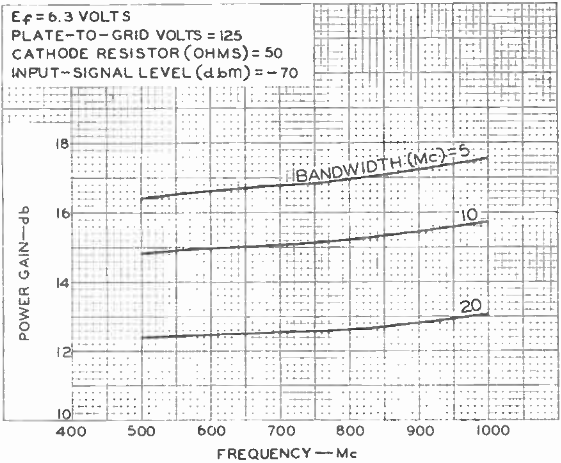
AVERAGE PLATE CHARACTERISTICS
Cathode-Drive Service



92CM-10458

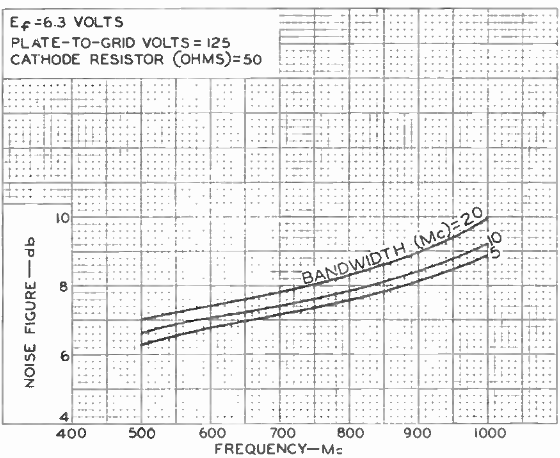
RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

POWER-GAIN CHARACTERISTICS
Cathode-Drive Service



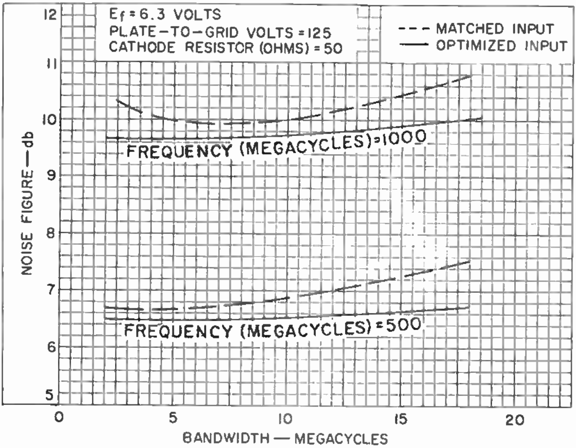
92CS-10456R1

NOISE-FIGURE CHARACTERISTICS
Cathode-Drive Service

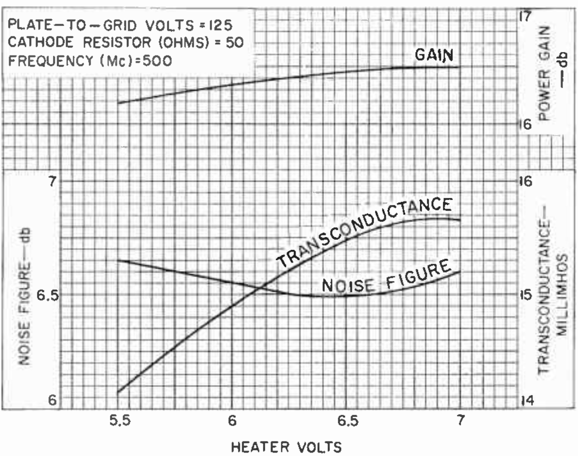


92CS-10455R2

CHARACTERISTICS
Cathode-Drive Service

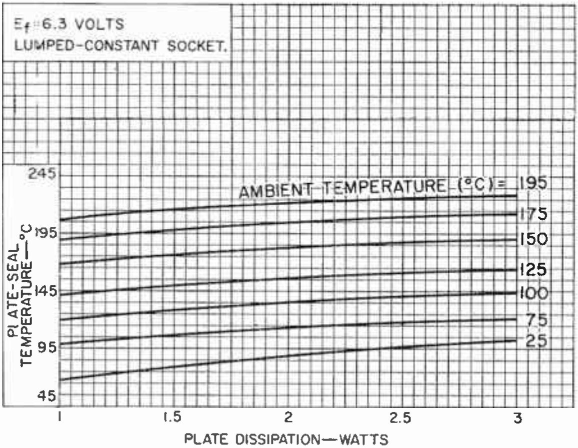


92CS-11497R1



92CS-11491R1

PLATE-SEAL-TEMPERATURE CHARACTERISTICS



92CS-11488

High-Mu Triode

CERAMIC-METAL PENCIL TYPE

FAST WARM-UP TIME — STURDY COAXIAL-ELECTRODE STRUCTURE

For Use at Frequencies up to 5000 Mc in Cathode-Drive Circuits under Severe Shock and Vibration

GENERAL DATA

Electrical:

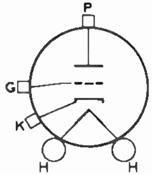
Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	0.225	amp
Cathode Warm-Up Time (Average) to reach 80% of operating plate current for dc plate supply volts = 80, grid volts = 0, cathode resistor (ohms) = 0, load resistor (ohms) = 10, heater volts = 6.3	10	sec
Amplification Factor	70	
Transconductance for dc plate ma. = 14, dc plate volts = 125, and cathode resistor (ohms) = 50	16000	μmhos
Direct Interelectrode Capacitances:[a]		
Grid to plate	2.4	μμf
Grid to cathode and heater	4.4	μμf
Plate to cathode and heater	0.04 max.	μμf
Heater to cathode	2.6	μμf
Cathode to plate	0.04 max.	μμf
Cathode to grid and heater	7.0	μμf
Plate to grid and heater	2.4	μμf

Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Weight (Approx.)	0.3 oz
Sockets:	
Heater-terminals connector	Amerac[b] No.1018-88[c], Grayhill[d] No.22-5, or equivalent
Socket for operation up to about 550 Mc (Including heater-terminals connector)	Jettron[e] No.CD7010, or equivalent
Cavities (Including heater-terminals connector)	Amerac No.1718 (for 4150 Mc), J-V-M[f] No.D-7980 Series, Resdel[g] No.10 Series, or equivalent

← Indicates a change.

Terminal Connections (See *Dimensional Outline*):



H - Heater
K - Cathode
G - Grid
P - Plate

→ RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[h]
and
RF POWER AMPLIFIER — Class C FM Telephony

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

At frequencies up to 5000 Mc and altitudes:

	Up to 80,000 feet	*Between 80,000 and 100,000 feet*	
DC PLATE VOLTAGE	250 max.	200 max.	volts
DC GRID VOLTAGE	-50 max.	-50 max.	volts
DC CATHODE CURRENT	25 max.	25 max.	ma
DC GRID CURRENT	6 max.	6 max.	ma
PLATE DISSIPATION	2.5 max.	2.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	50 max.	50 max.	volts
Heater positive with respect to cathode	50 max.	50 max.	volts
PLATE-SEAL TEMPERATURE	225 max.	225 max.	°C

Typical CCS[j] Operation in Cathode-Drive Circuit:

As oscillator

	At 500 Mc	*At 1000 Mc*	*At 2000 Mc*	*At 3000 Mc*	*At 4150 Mc*	*At 5000 Mc*	
DC Plate-to-Grid Voltage	205	203	151	125	200	200	volts
DC Cathode-to-Grid Voltage	5	3	1	0.1	0.26	-	volts
From a grid resistor of	1000	600	250	500	130	100	ohms
DC Cathode Current	21	24	24	20	23	25	ma
DC Grid Current	5	5	4	0.2	2	-	ma
Useful Power Output (Approx.)	1.6	1.3	0.5	0.15	0.1	0.03	watts

→ Indicates a change.

As amplifier

	At 500 Mc	At 1000 Mc	
DC Plate-to-Grid Voltage.	204	185	volts
DC Cathode-to-Grid Voltage.	4	10	volts
From a grid resistor of	800	2000	ohms
DC Cathode Current.	21	24	ma
DC Grid Current	5	5	ma
Driver Power Output (Approx.)	0.2	0.2	watt
Useful Power Output (Approx.)	2.2	1.4	watts

Maximum Circuit Values:

Grid-Circuit Resistance . . . . 0.25 max. megohm

FREQUENCY DOUBLER — Class C

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

At frequencies up to 2000 Mc and altitudes:

	Up to 80,000 feet	Between 80,000 and 100,000 feet	
DC PLATE VOLTAGE.	250 max.	200 max.	volts
DC GRID VOLTAGE	-50 max.	-50 max.	volts
DC CATHODE CURRENT.	22 max.	22 max.	ma
DC GRID CURRENT	6 max.	6 max.	ma
PLATE DISSIPATION	2.5 max.	2.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode. . . .	50 max.	50 max.	volts
Heater positive with respect to cathode. . . .	50 max.	50 max.	volts
PLATE-SEAL TEMPERATURE. . . .	225 max.	225 max.	°C

Typical CCS[j] Operation in Cathode-Drive Circuit:

	Up to 550 Mc		Up to 1000 Mc		
DC Plate-to-Grid Voltage. . .	193	207	218	181	volts
DC Cathode-to-Grid Voltage. .	18	7	18	6	volts
From a grid resistor of . .	3600	2300	3600	2000	ohms
DC Cathode Current.	20	18	21	19	ma
DC Grid Current	5	3	5	3	ma
Driver Power Output (Approx.)	0.8	0.2	0.8	0.2	watt
Useful Power Output (Approx.)	1.3	0.75	0.9	0.4	watts

Maximum Circuit Values:

Grid-Circuit Resistance . . . . 0.25 max. megohm

← Indicates a change.

FREQUENCY TRIPLER — Class C

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

At frequencies up to 2000 Mc and altitudes:

	Up to 80,000 feet	Between 80,000 and 100,000 feet	
DC PLATE VOLTAGE	250 max.	200 max.	volts
DC GRID VOLTAGE	-50 max.	-50 max.	volts
DC CATHODE CURRENT	20 max.	20 max.	ma
DC GRID CURRENT	6 max.	6 max.	ma
PLATE DISSIPATION	2.5 max.	2.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	50 max.	50 max.	volts
Heater positive with respect to cathode	50 max.	50 max.	volts
PLATE-SEAL TEMPERATURE	225 max.	225 max.	°C

Typical CCS[j] Operation in Cathode-Drive Circuit:

Up to 645 Mc

DC Plate-to-Grid Voltage	202	240	volts
DC Cathode-to-Grid Voltage	27	15	volts
From a grid resistor of	9000	25000	ohms
DC Cathode Current	19	13	ma
DC Grid Current	3	0.6	ma
Driver Power Output (Approx.)	0.6	0.2	watt
Useful Power Output (Approx.)	0.7	0.4	watt

Up to 1000 Mc

DC Plate-to-Grid Voltage	205	185	volts
DC Cathode-to-Grid Voltage	30	10	volts
From a grid resistor of	10000	14000	ohms
DC Cathode Current	19	12	ma
DC Grid Current	3	0.7	ma
Driver Power Output (Approx.)	0.6	0.2	watt
Useful Power Output (Approx.)	0.4	0.15	watt

Maximum Circuit Values:

Grid-Circuit Resistance . . . . 0.25 max. megohm

[a] Without external shield.

[b] Amerac, Inc., Dunham Road, Beverly, Massachusetts.

[c] For use with cavities.

[d] Grayhill, Inc., 561 Hillgrove Avenue, LaGrange, Illinois.

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

[f] J-V-M Microwave Co., 9300 W. 47th St., Brookfield, Illinois. Indicated No. applies to a series of cavities covering range from 220 to 3500 Mc.

[g] Resdel Engineering Corp., 330 South Fair Oaks Avenue, Pasadena, California. This series of cavities covers the range from 215 to 2325 Mc.

[h] Key-down conditions per tube without amplitude modulation. Modulation essentially negative may be used if the positive peak of the audio frequency envelope does not exceed 115 per cent of the carrier conditions.

[j] Continuous Commercial Service.

→ Indicates a change.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Note	*Min.*	*Max.*	
Heater Current	1	0.205	0.245	amp
Direct Interelectrode Capacitances:				
Grid to plate	-	1.5	2.7	μμf
Grid to cathode	-	3.6	5.0	μμf
Plate to cathode	-	-	0.04	μμf
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,2	-	30	μa
Heater positive with respect to cathode	1,3	-	30	μa
Leakage Resistance:				
From grid to plate and cathode connected together	1,4	100	-	megohms
From plate to grid and cathode connected together	1,5	100	-	megohms
Reverse Grid Current	1,6	-	0.3	μa
Emission Voltage	7	-	4	volts
Amplification Factor	1,8	55	85	
Transconductance	1,8	12500	19500	μmhos
Plate Current (1)	1,8	9	19	ma
Plate Current (2)	1,9	-	50	μa
Power Output	1,10	1.7	-	watts
Change in Power Output	1,11	-	0.2	watt

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

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

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

Note 4: With grid 100 volts negative with respect to plate and cathode which are connected together.

Note 5: With plate 300 volts negative with respect to grid and cathode which are connected together.

Note 6: With dc plate voltage of 200 volts, dc grid voltage of -2 volts, grid resistor of 0.5 megohm.

Note 7: With dc voltage on grid and plate which are connected together adjusted to produce a cathode current of 30 ma., and with 5.5 volts on heater.

Note 8: With dc plate supply voltage of 125 volts, cathode resistor of 50 ohms, and cathode bypass capacitor of 1000 μf.

Note 9: With dc plate voltage of 125 volts and dc grid voltage of -5 volts.

Note 10: In a single-tube, cathode-drive amplifier circuit operating at a frequency of approx. 550 ± 10 Mc, and with dc plate to cathode voltage of 250 volts, input-signal power of 0.2 watt, and dc grid voltage adjusted to produce a dc plate current of 20 ma.

Note 11: Reduce heater voltage to 5.7 volts. Change in Power-Output value from that obtained with 6.3 volts on heater will not exceed indicated value.

← Indicates a change.

→ SPECIAL TESTS & PERFORMANCE DATA

Low-Pressure Voltage-Breakdown Test:

This test (similar to MIL-E-1D, paragraph 4.9.12.1) is performed on a sample lot of tubes every 90 days. Tubes are tested in a chamber at an air pressure equivalent to an altitude of 100,000 feet. Breakdown will not occur when a 60-cycle rms voltage of 300 volts is applied between the plate cylinder and grid flange.

Low-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.19.1) is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, dc plate supply voltage of 125 volts, cathode resistor of 50 ohms, and plate load resistor of 10,000 ohms. The tubes are vibrated in a plane perpendicular to the tube axis at 40 cycles per second at an acceleration of 10 g. The rms output voltage across the plate load resistor as a result of vibration of the tube will not exceed 100 millivolts.

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following test limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

Variable-Frequency Vibration Performance:

This test (similar to MIL-E-1D, paragraph 4.9.20.3) is performed on a sample lot of tubes from each production run. Tube operating conditions are the same as for *Low-Frequency Vibration Performance.* The tubes are vibrated perpendicular to the major axis through a frequency range from 5 to 500 cps and back. From 5 to 50 cps, the tubes are vibrated at a constant displacement of 0.0400 ± 0.0025 inch. From 50 to 500 cps, the tubes are vibrated at a constant acceleration of 10 ± 2 g. Total time to complete a sweep cycle is 10 ± 5 minutes. During the test, the tubes will not show an rms output voltage across the plate load resistor in excess of 150 millivolts.

Each tube is vibrated for 60 seconds at the frequency which gives maximum vibrational noise output. If, at the end of 60 seconds, the vibrational noise output is still increasing, the test is continued until there is no further increase.

The rms output voltage across the plate load resistor as a result of the vibration of the tube will not exceed the specified limit at any time during the test.

At the end of the test, the tubes will not show permanent shorts or open circuits and will meet the following test limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

→ Indicates a change.

Shock Test:

This test (similar to MIL-E-1D, paragraph 4.9.20.5) is performed on a sample lot of tubes from each production run. Tubes are held rigid and are subjected in three different positions to an impact acceleration of 500 g, 5 blows in each position.

At the end of this test, tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-Cathode Leakage Current. . . .	60 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Low-Frequency Vibration Output. . . .	200 max.	mv
For conditions shown above under *Low-Frequency Vibration Performance.*		
Change in Transconductance.	−20 max.	%
From initial value for conditions shown under *Characteristics Range Values, Notes 1,8.*		

Fatigue Vibration Test:

This test (similar to MIL-E-1D, paragraph 4.9.20.6) is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected to 2.5 g vibrational acceleration in two positions (X1, Y1) for 32 hours each. At the end of this test, tubes are required to meet the limits specified for the *Shock Test.*

Shorts and Continuity Test:

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

At the end of this test, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

Ceramic-Seal-Fracture Test:

This test is performed on a sample lot of tubes every 90 days. With cathode- and plate-cylinder-supports spaced 15/16" ± 1/64", and with the grid flange centered between these supports, the tubes will withstand the gradual application of a force of 30 pounds, perpendicular to the axis of the tubes, upon the grid flange, without causing fracture of the ceramic insulation.

Seal Strain Test:

This test (similar to MIL-E-1D, paragraph 4.9.6.3) is performed on a sample lot of tubes every 90 days. Tubes are tested by first immersing in water having a temperature of at least 97° C for at least 15 seconds and then immersing immediately in water at not more than 5° C for 5 seconds. After drying for 48 hours at room temperature, the tubes will meet the following test limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

Heater-Cycling Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.7) is performed on a sample lot of tubes from each production run. With 6.3 volts on heater and no voltage on plate or grid, the heater is cycled three minutes on and three minutes off for at least 2000 cycles.

At the end of this test, tubes will not show permanent shorts or open circuits and are required to meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Heater-to-Cathode Leakage Current . .	60 max.	µa
For conditions shown under *Characteristics Range Values, Notes 1,3.*		
Grid-to-Cathode Leakage Resistance. .	50 min.	megohms
For conditions shown under *Characteristics Range Values, Notes 1,4.*		

1-Hour Stability Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.1a) is performed on a sample lot of tubes from each production run to insure that the tubes have been properly stabilized. Tubes are operated under the following conditions:

Heater voltage of 6.3 volts, plate supply voltage of 215 volts, and cathode resistor of 150 ohms.

At the end of 1 hour, the change in transconductance value for each tube, referred to its initial transconductance reading, will not exceed 15% of the initial value, for conditions shown under *Characteristics Range Values, Notes 1,8.*

In addition, the tubes will not show permanent shorts or open circuits and will meet the following limit:

Heater Current.	300 max.	ma

For conditions shown under *Characteristics Range Values, Note 1.*

100-Hour Survival Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.1b) is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Life-test conditions are the same as those specified for *1-Hour Stability Life Performance* except that all voltages are cycled at the rate of 110 minutes on and 10 minutes off.

At the end of 100 hours, the tubes will not show permanent shorts or open circuits and will meet the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		
Transconductance.	9000 min.	μmhos
For conditions shown under *Characteristics Range Values, Notes 1,8.*		
Plate Current (2)	50 max.	μa
For conditions shown under *Characteristics Range Values, Notes 1,9.*		

500- and 1000-Hour Dynamic Life Performance:

This test (similar to MIL-E-1D, paragraph 4.11.3.2) is performed on a sample lot of tubes from each production run to insure high-quality rf performance. Each tube is life-tested as a class C amplifier in special cavity at 550 ± 10 Mc under the following conditions: Heater voltage of 6.3 volts; plate supply voltage of 250 volts; cathode resistor adjusted to give plate current of 25 ma.; and grid-circuit resistance adjusted to give grid current of 6 ma., heater positive with respect to cathode by 67.5 volts, and plate-seal temperature of 225° C. Heater voltage is cycled at a rate of 110 minutes on and 10 minutes off.

At the end of 500 hours, the tubes will not show permanent shorts or open circuits, and will be criticized for total number of tubes failing to pass the following limits:

Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values. Note 1.*		
Leakage Resistance:		
From grid to plate and cathode connected together. . . .	60 min.	megohms
From plate to grid and cathode connected together. . . .	60 min.	megohms
For conditions shown under *Characteristics Range Values. Notes 1,4. and 1,5.*		
Power Output.	1.5 min.	watts
For conditions shown under *Characteristics Range Values, Notes 1,10.*		

At the end of 1000 hours, the tubes will not show permanent shorts or open circuits and will be criticized for total number of tubes failing to pass the following limits:

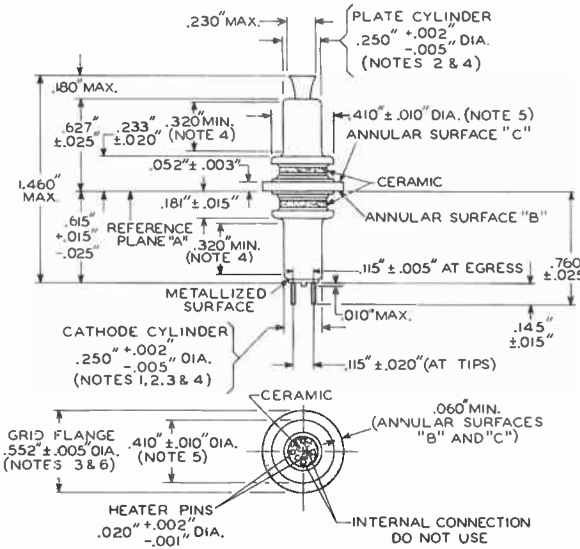
Heater Current.	300 max.	ma
For conditions shown under *Characteristics Range Values, Note 1.*		

Power Output. . . . . 1.3 min. watts
For conditions shown under *Characteristics Range Values*, *Notes 1,10*.

OPERATING CONSIDERATIONS

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

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



92CM-10274R1

REFERENCE PLANE "A" IS DEFINED AS THAT PLANE AGAINST WHICH ANNULAR SURFACE "B" OF THE GRID FLANGE ABUTS.

ANNULAR SURFACE "B" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE CATHODE CYLINDER.

ANNULAR SURFACE "C" IS ON THE SIDE OF THE GRID FLANGE TOWARD THE PLATE CYLINDER.

NOTE 1: WITH ANNULAR SURFACE "B" RESTING ON REFERENCE PLANE "A". THE AXIS OF THE CATHODE CYLINDER WILL BE WITHIN 2° OF A LINE PERPENDICULAR TO REFERENCE PLANE "A".

NOTE 2: THE AXES OF THE PLATE CYLINDER AND CATHODE CYLINDER WILL COINCIDE WITHIN 0.010".

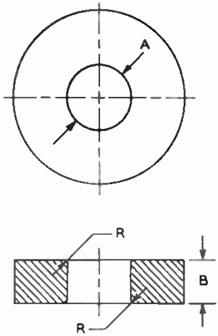
NOTE 3: THE AXES OF THE CATHODE CYLINDER AND GRID FLANGE WILL COINCIDE WITHIN 0.005".

NOTE 4: THE DIAMETER ALONG THE 0.320" MINIMUM LENGTH IS MEASURED WITH "GO" AND "NO-GO" RING GAUGES G_1-1 AND G_1-2, RESPECTIVELY.

NOTE 5: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_2-1 AND G_2-2, RESPECTIVELY.

NOTE 6: THIS DIAMETER IS MEASURED WITH "GO" AND "NO-GO" GAUGES G_3-1 AND G_3-2, RESPECTIVELY.

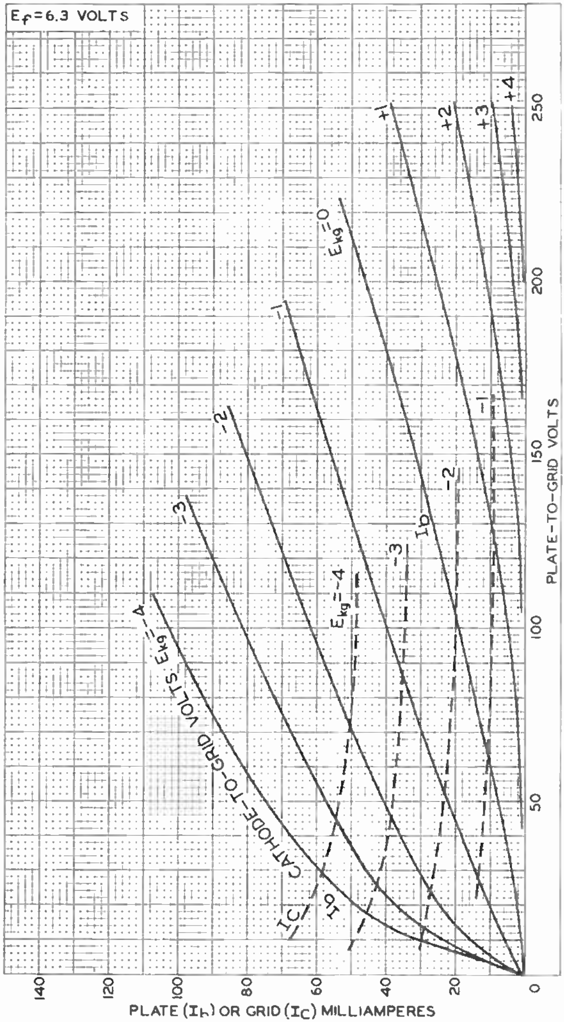
GAUGES



92CS-10370

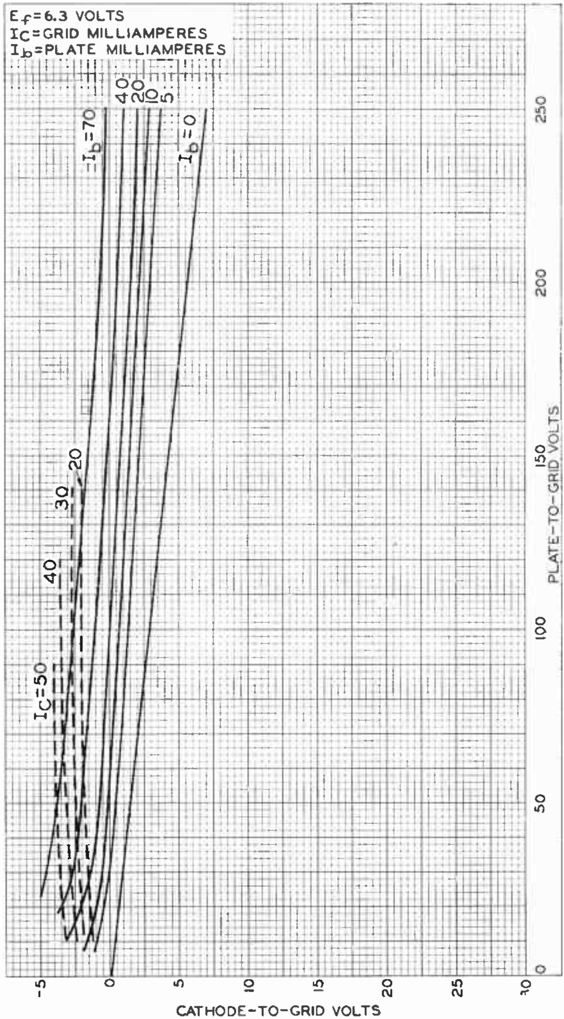
Gauge	Type	Dimension		
		Diameter A	Thickness B	Radius R
G_1-1	GO	0.25200" $^{+0.00000"}_{-0.00007"}$	0.320" $^{+0.001"}_{-0.000"}$	0.003" MAX.
G_1-2	NO-GO	0.24500" $^{+0.00007"}_{-0.00000"}$	-	-
G_2-1	GO	0.42000" $^{+0.00000"}_{-0.00007"}$	-	-
G_2-2	NO-GO	0.40000" $^{+0.00007"}_{-0.00000"}$	-	-
G_3-1	GO	0.55700" $^{+0.00000"}_{-0.00007"}$	-	-
G_3-2	NO-GO	0.54700" $^{+0.00007"}_{-0.00000"}$	-	-

AVERAGE CHARACTERISTICS
Cathode-Drive Service



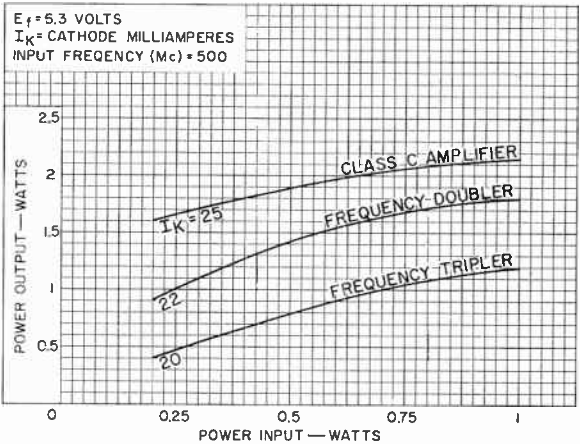
92CM-10262

AVERAGE CONSTANT-CURRENT CHARACTERISTICS
Cathode-Drive Service

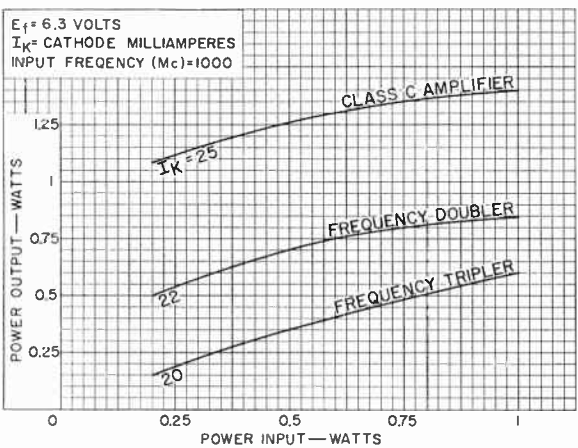


92CM-10263R1

TYPICAL POWER-OUTPUT CHARACTERISTICS
Cathode-Drive Service

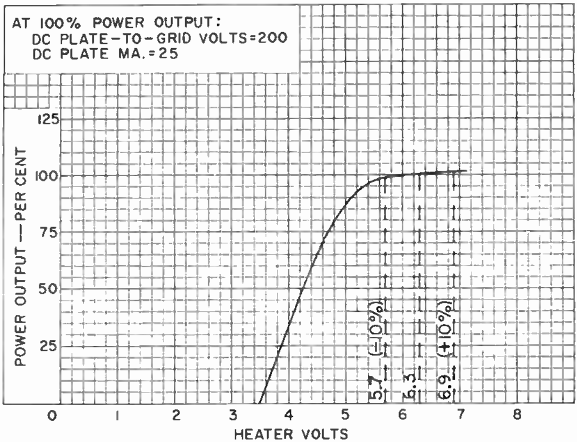


92CS-11625R1



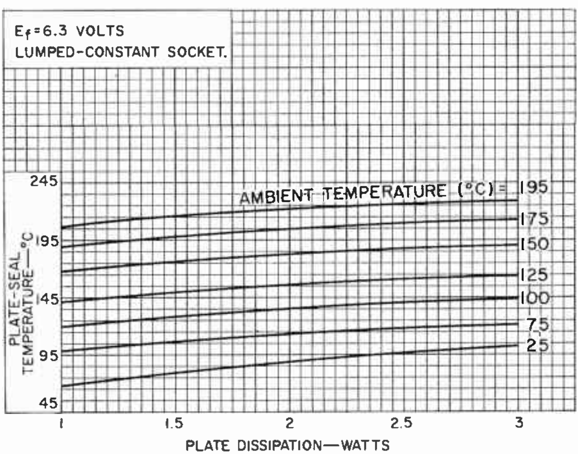
92CS-11626R1

TYPICAL POWER-OUTPUT CHARACTERISTICS With Variation in Heater Voltage Cathode-Drive Service



92CS-11624R1

PLATE-SEAL-TEMPERATURE CHARACTERISTICS



92CS-11488

Medium-Mu Triode

NUVISTOR TYPE

For Industrial Applications

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.14	amp
Direct Interelectrode Capacitances (Approx.):		
Grid to plate	2.2	μμf
Grid to cathode, shell, and heater	4	μμf
Plate to cathode, shell, and heater	1.4	μμf
Plate to cathode	0.2	μμf
Heater to cathode	1.3	μμf

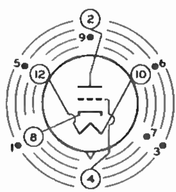
Characteristics, Class A_1 Amplifier:

Plate Supply Voltage	–	–	75	volts
Plate Voltage	26.5	40	–	volts
Grid Supply Voltage	0	0	0	volts
Cathode Resistor	–	–	130	ohms
Amplification Factor	31	35	33	
Grid-Circuit Resistance	0.5	0.5	–	megohm
Plate Resistance (Approx.)	4400	3200	2900	ohms
Transconductance	7000	11000	11500	μmhos
Plate Current	2.8	6.8	10.5	ma
Grid Voltage (Approx.) for plate μa = 10	–	–	-6.5	volts

Mechanical:

Operating Position	Any
Maximum Overall Length	0.8"
Maximum Seated Length	0.625"
Maximum Diameter	0.440"
Envelope	Metal Shell
Socket	Cinch Mfg. Corp. No.133 65 10 001, or equivalent
Base	Medium Ceramic-Wafer Twelvar 5-Pin (JEDEC No.E5-65)
Basing Designation for BOTTOM VIEW	12AQ

Pin 1▲ - Internal Connection— Do Not Use
Pin 2 - Plate
Pin 3 - Same as Pin 1
Pin 4 - Grid
Pin 5 - Same as Pin 1
Pin 6 - Same as Pin 1
Pin 7 - Same as Pin 1
Pin 8 - Cathode
Pin 9 - Same as Pin 1
Pin 10 - Heater
Pin 12 - Heater



INDEX = LARGE LUG
● = PIN CUT OFF

INDUSTRIAL SERVICE

Maximum Ratings, ***Absolute-Maximum Values:***

For operation at any altitude

PLATE SUPPLY VOLTAGE	330 max.	volts
PLATE VOLTAGE	110 max.	volts
GRID VOLTAGE:		
Negative-bias value	55 max.	volts
Peak-positive value	4 max.	volts
GRID CURRENT	2 max.	ma
PLATE CURRENT	20 max.	ma
PLATE DISSIPATION	1 max.	watt
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts

Maximum Circuit Values:

Grid-Circuit Resistance:●		
For fixed-bias operation	0.5 max.	megohm
For cathode-bias operation	1 max.	megohm

▲ Pin is cut off close to ceramic wafer.

● For operation at metal-shell temperatures up to 100° C.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.132	0.148	amp
Direct Interelectrode Capacitances:				
Grid to plate	2	1.9	2.5	μμf
Grid to cathode, shell, and heater	2	3.5	4.5	μμf
Plate to cathode, shell, and heater	2	1.1	1.6	μμf
Heater to cathode	2	1	1.6	μμf
Plate to cathode	2	0.14	0.26	μμf
Plate Current (1)	1,3	9	12	ma
Plate Current (2)	1,4	-	50	μa
Transconductance (1)	1,3	10000	13000	μmhos
Transconductance (2)	3,5	9000	-	μmhos
Transconductance Change:				
Difference between Transconductance (1) and Transconductance (2), expressed in per cent of Transconductance (1)	-	-	15	%
Reverse Grid Current	1,6	-	0.3	μa
Amplification Factor	1,3	26	38	
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,7	-	10	μa
Heater positive with respect to cathode	1,7	-	10	μa

Leakage Resistance:

Between grid and all other electrodes tied together. .	1,8	500	-	megohms
Between plate and all other electrodes tied together. .	1,9	500	-	megohms

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

Note 2: Measured in accordance with EIA Standard RS-191-A.

Note 3: With dc plate supply volts = 75, cathode resistor = 130 ohms, and cathode-bypass capacitor = 1000 μf.

Note 4: With dc plate volts = 75, dc grid volts = -7, and metal shell connected to ground.

Note 5: With 5.7 volts ac or dc on heater.

Note 6: With dc plate volts = 100, grid supply volts = -2.25, grid resistor = 0.5 megohm, and metal shell connected to ground.

Note 7: With 100 volts dc applied between heater and cathode.

Note 8: With grid 100 volts negative with respect to all other electrodes tied together.

Note 9: With plate 300 volts negative with respect to all other electrodes tied together.

SPECIAL RATINGS & PERFORMANCE DATA

Shock Rating:

Impact Acceleration . . . . 1000 max. g

This test is performed on a sample lot of tubes from each production run to determine ability of tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a Navy Type, High-impact (flyweight) Shock Machine and are subjected to 20 blows at a hammer angle of 60° (equivalent to the specified maximum impact acceleration). At the end of this test, tubes are criticized for change in transconductance, reverse grid current, and heater-cathode leakage current, and are then subjected to the Variable-Frequency Vibration Test described below.

Fatigue Rating:

Vibrational Acceleration. . . . . 2.5 max. g

This test is performed on a sample lot of tubes to determine ability of tube to withstand the specified vibrational acceleration. Tubes are rigidly mounted, supplied with nominal heater voltage only, and subjected for 48 hours to 2.5-g vibrational acceleration at 60 cycles per second in the X_1 position. At the end of this test, tubes are criticized for the same characteristics and end-point values as in the Shock Rating Test described above.

Variable-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run. The tube is operated under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1) with the addition of a plate-load resistor of 2000 ohms. During operation, tube is vibrated in the X_1 position through the frequency range from 50 to 10,000 cycles per second with a constant vibrational acceleration of 1 g. During the test, tube will not show an rms output voltage across the plate-load resistor in excess of: (1) 50 millivolts from 50 to 5000 cps, (2) 250 millivolts from 5000 to 7000 cps, and (3) 500 millivolts from 7000 to 10,000 cps.

Low-Pressure Voltage-Breakdown Test:

This test is performed on a sample lot of tubes from each production run. In this test, tubes are operated with 240 rms volts applied between plate and all other electrodes and will not break down or show evidence of corona when subjected to air pressures equivalent to altitudes of up to 100,000 feet.

Heater Cycling:

Cycles of Intermittent Operation. . . . . 2000 min. cycles

This test is performed on a sample lot of tubes from each production run under the following conditions: heater volts = 7.5 cycled one minute on and two minutes off; heater 100 volts negative with respect to cathode; grid, plate, and metal shell connected to ground. At the end of this test, tubes are tested for open heaters, heater-cathode shorts, and heater-cathode leakage current.

Shorts, Continuity, and Reverse Grid Current:

This test is performed on a sample lot of tubes from each production run. Tubes are subjected to the Thyratron-Type Shorts Test described in MIL-E-1D, Amendment 2, Paragraph 4.7.7, except that tapping is done by hand with a soft rubber tapper*. See accompanying Shorts-Test Acceptance-Limits curve. Tubes are criticized for permanent or temporary shorts and open circuits, and also test is made for reverse grid current in excess of one microampere under the conditions specified in CHARACTERISTICS RANGE VALUES for reverse grid current.

Interelectrode Leakage:

Leakage Resistance. . . . . 500 min. megohms

These tests are performed on a sample lot of tubes from each production run under the following conditions: heater volts = 6.3, (1) plate = 300 volts negative with respect to all other electrodes tied together, and (2) grid = 100 volts negative with respect to all other electrodes tied together. Tubes are rejected if the leakage resistance between plate and all other electrodes under condition (1), or between grid and all other electrodes under condition (2), is less than 500 megohms.

Early-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that tubes are properly stabilized. In this test, tubes are operated for 20 hours at maximum-rated plate dissipation. After two hours of operation and again after 20 hours of operation, tubes are checked for transconductance under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1). A tube is rejected if its transconductance after two or 20 hours of operation has changed more than 10 per cent from the 0-hour value.

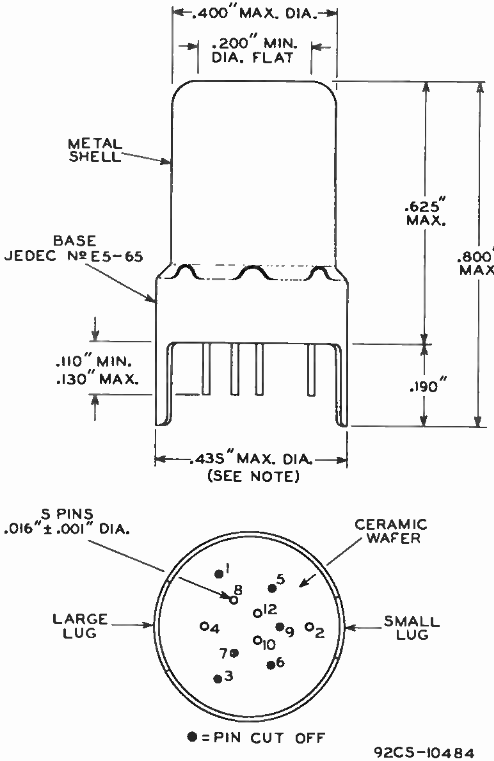
100-Hour Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early-hour inoperatives. Tubes are operated for 100 hours at maximum-rated plate dissipation, and then subjected to the Intermittent Shorts Test previously described. Tubes must then show a transconductance of not less than 7500 micromhos under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1).

1000-Hour Life Performance:

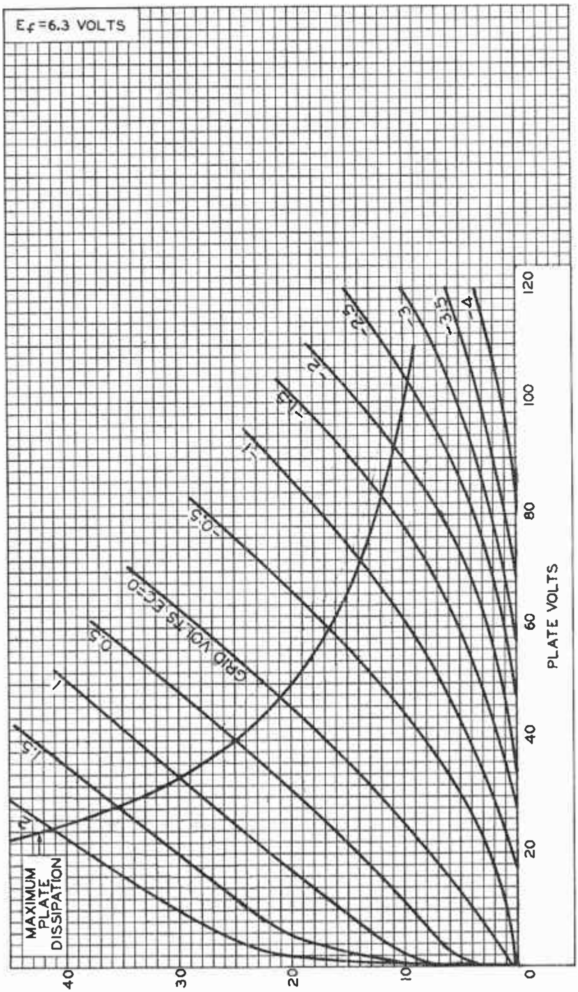
This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and guard against epidemic failures due to excessive changes in any of the characteristics indicated below. In this test, tubes are operated for 1000 hours at maximum-rated plate dissipation, and then criticized for inoperatives, reverse grid current, heater-cathode leakage current, and leakage resistance. In addition, the average change in transconductance of the lot from the 0-hour value for Transconductance (1) specified in CHARACTERISTICS RANGE VALUES, must not exceed 15 per cent at 500 hours, and 20 per cent at 1000 hours.

* Specifications for tapper supplied on request.



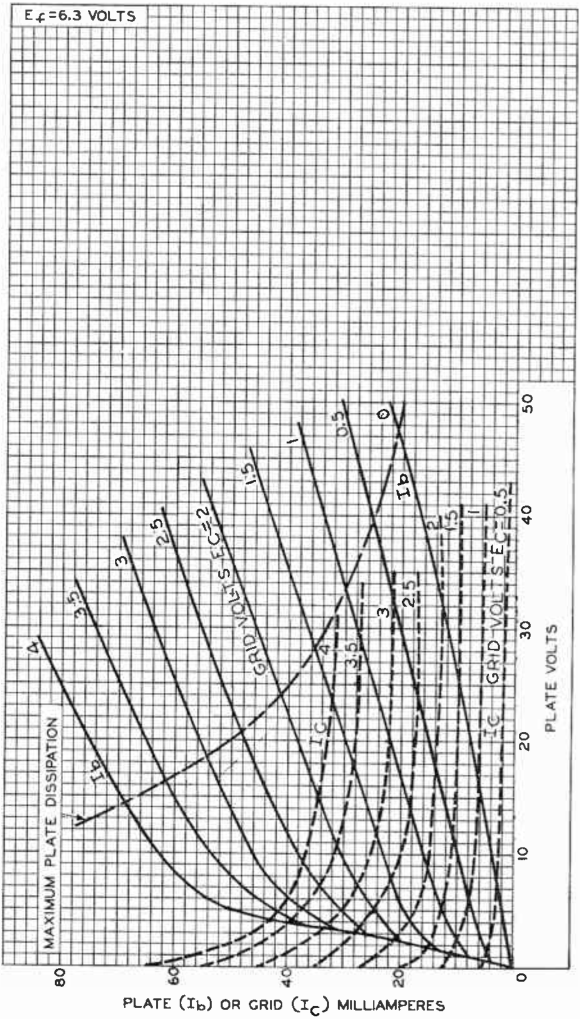
NOTE: MAXIMUM OUTSIDE DIAMETER OF 0.440" IS PERMITTED ALONG 0.190" LUG LENGTH.

AVERAGE PLATE CHARACTERISTICS



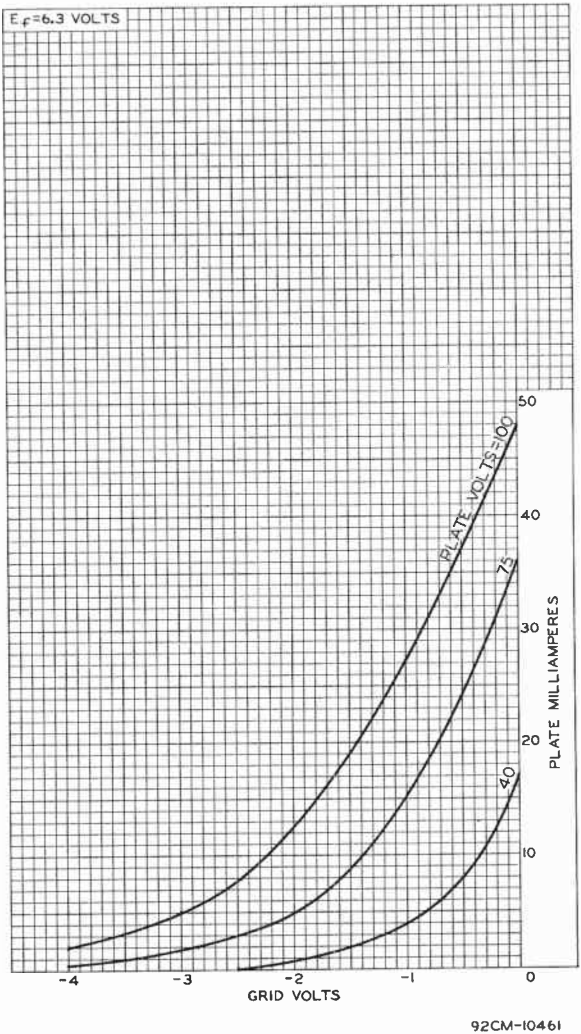
92CM-10460

AVERAGE CHARACTERISTICS

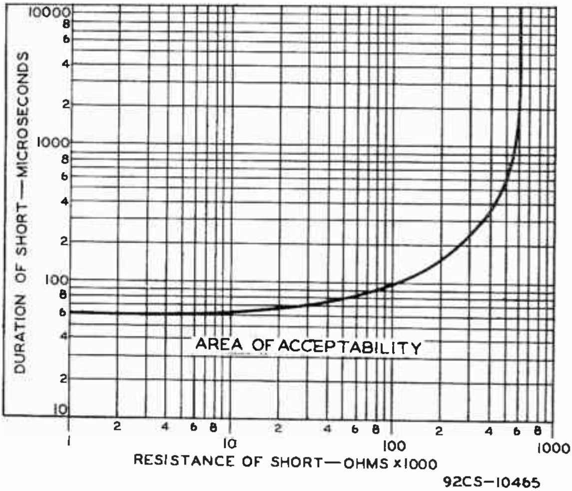


92CM-10464

AVERAGE CHARACTERISTICS



SHORTS-TEST ACCEPTANCE LIMITS



Beam Power Tube

CERAMIC-METAL SEALS — COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN — INTEGRAL RADIATOR
FORCED-AIR COOLED — 9000-WATTS PEAK-PULSE INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc
under Severe Shock and Vibration

GENERAL DATA

Electrical:

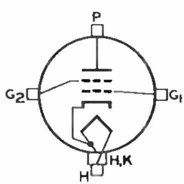
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	3.2	amp
Minimum heating time	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 1000, grid-No.2 volts = 500, and plate ma. = 115	18	
Direct Interelectrode Capacitances:[a]		
Grid No.1 to plate	0.13 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2	20	μμf
Grid No.2 to plate	6.5	μμf ←
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	1.885" + 0.070" − 0.080"
Greatest Diameter (See *Dimensional Outline*)	1.250" ± 0.015"
Weight (Approx.)	2 oz
Radiator	Integral part of tube
Socket:	
For frequencies up to about 400 Mc	[b]
For use at higher frequencies	See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Air Flow:

Through radiator—Adequate air flow to limit the plate terminal temperature to 250° C should be delivered by a blower

← Indicates a change.

through the radiator before and during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator without cowling and with cowling versus plate dissipation are shown in accompanying *Typical-Cooling-Requirements* curves. Plate power, grid-No.2 power, and air flow may be removed simultaneously.

To Grid-No.2, Grid-No.1, Cathode, and Heater Terminals—A sufficient quantity of air should be delivered to these seals to prevent their temperature from exceeding the specified maximum value of 250° C.

During Standby Operation—Cooling air is not normally required when only heater voltage is applied to the tube.

Terminal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

GRID-AND-SCREEN-PULSED RF AMPLIFIER

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

For maximum "on" time[d] of 10 microseconds

	Up to 1215 Mc	
→ DC PLATE VOLTAGE.	2250 max.	volts
PEAK POSITIVE PULSE-GRID-No.2 VOLTAGE	750 max.	volts
DC GRID-No.1 VOLTAGE.	-200 max.	volts
DC PLATE CURRENT DURING PULSE	3000 max.	ma
DC PLATE CURRENT.	80 max.	ma
GRID-No.2 INPUT (Average)	4.5 max.	watts
GRID-No.1 INPUT (Average)	2 max.	watts
PLATE DISSIPATION (Average)	115 max.	watts

Typical Operation:

In class-AB_2 cathode-drive[e] circuit with rectangular-wave pulses at 1215 Mc and with duty factor[f] of 0.01

DC Plate Voltage.	1350	1500	volts
Peak Positive-Pulse Grid-No.2 Voltage	700	700	volts
DC Grid-No.1 Voltage.	0	0	volts
DC Plate Current during pulse	2700	3000	ma
DC Plate Current.	47	53	ma
DC Grid-No.2 Current.	1.6	2	ma
DC Grid-No.1 Current.	5	5	ma
Driver Power Output at peak of pulse (Approx.)[g]	390	460	watts
Useful Power Output at peak of pulse (Approx.).	1600[h]	2300[h]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000 max.	ohms

→ Indicates a change.

PLATE-AND-SCREEN-PULSED RF AMPLIFIER

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

For maximum "on" time[d] of 10 microseconds

	Up to 1215 Mc	
PEAK POSITIVE-PULSE PLATE VOLTAGE	3000 max.	volts
PEAK POSITIVE-PULSE GRID-No.2 VOLTAGE	750 max.	volts
DC GRID-No.1 VOLTAGE	-200 max.	volts
DC PLATE CURRENT DURING PULSE	3000 max.	ma
DC PLATE CURRENT	50 max.	ma
GRID-No.2 INPUT (Average)	4.5 max.	watts
GRID-No.1 INPUT (Average)	2 max.	watts
PLATE DISSIPATION (Average)	115 max.	watts

Typical Operation:

In class AB_2 cathode-drive[e] circuit with rectangular-wave pulses at 1215 Mc and with duty factor[f] of 0.01

Peak Positive-Pulse Plate Voltage	2700	3000	volts
Peak Positive-Pulse Grid-No.2 Voltage	700	700	volts
DC Grid-No.1 Voltage	0	0	volts
DC Plate Current during pulse	2700	3000	ma
DC Plate Current	32	35	ma
DC Grid-No.2 Current	1	2	ma
DC Grid-No.1 Current	9	8	ma
Driver Power Output at peak of pulse (Approx.)[g]	350	450	watts
Useful Power Output at peak of pulse (Approx.)	3700[h]	4500[h]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000 max.	ohms

[a] Measured with special shield adapter.

[b] For socket to be used with the 7649 consult manufacturers such as J-V-M Microwave Company, 4631 Lawndale Avenue, Lyons, Illinois; E. F. Johnson, Waseca, Minnesota; and Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa.

[c] Continous Commercial Service.

[d] *"On" time* is defined as the sum of the durations of all the individual pulses which occur during any 1000-microsecond interval. An increase in dc plate current during the pulse may be permissible at shorter "on" times, and a decrease is usually required at longer "on" times. *Pulse duration* is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The peak value is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

[e] Cathode is at dc ground potential.

[f] *Duty factor* is defined as the ratio of "on" time to total elapsed time in any 1000-microsecond interval.

[g] Driver power output includes circuit losses and feed-through power. It is actual power measured at input to the tube drive circuit. It will vary with frequency of operation and driver circuitry.

[h] This value of useful power is measured in load of output circuit.

→ CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

		Note	Min.	Max.	
1.	Heater Current	1	2.90	4.00	amp
2.	Direct Interelectrode Capacitances:				
	Grid No.1 to plate	2	-	0.13	μμf
	Grid No.1 to cathode & heater	2	11.8	15.2	μμf
	Plate to cathode & heater	2	-	0.019	μμf
	Grid No.1 to grid No.2	2	17.3	21.9	μμf
	Grid No.2 to plate	2	5.8	6.8	μμf
	Grid No.2 to cathode & heater	2	-	1.3	μμf
3.	Grid-No.1 Voltage	1,3	-20	-50	volts
4.	Grid-No.1 Voltage	1,7	-6	-18	volts
5.	Reverse Grid-No.1 Current	1,7	-	-20	μa
6.	Grid-No.2 Current	1,3	-5	11	ma
7.	Peak Emission Voltage	1,4	-	250	volts
8.	Interelectrode Leakage Resistance	5	1	-	megohm
9.	Power Output	1,6	4500	-	watts
10.	Grid-No.1 Cutoff Voltage	1,8	-	-104	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 700 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 13 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 200 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a plate-and-screen-pulsed cathode-drive cavity at 1215 Mc and for conditions with 6.3 volts ac or dc on heater, peak plate voltage of 3000 volts, peak grid-No.2 voltage of 700 volts, driver power of 560 peak watts, and grid-No.1 voltage varied for peak plate current of 3 amperes. Pulse duration is 10 microseconds and duty factor is 0.01.

Note 7: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 8: With dc plate voltage of 2250 volts, dc grid-No.2 voltage of 700 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonance. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, New Jersey, on request.

→ Indicates a change.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.08 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-75 cps with fixed double amplitude of 0.036 inch ± 10%.

d. 75-to-2000 cps at fixed acceleration of 10 g ± 10%.

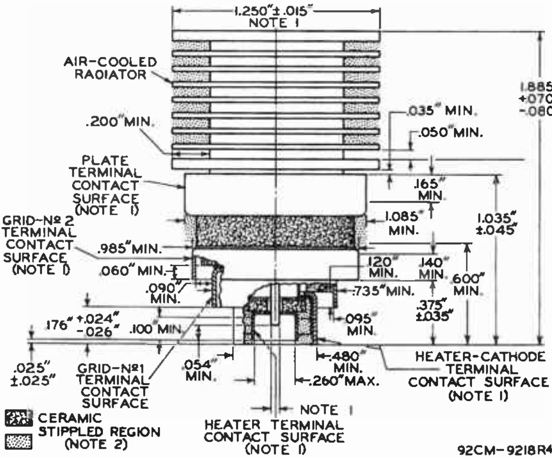
During the above vibration tests, tubes will not show an rms output voltage in excess of 15 volts across the plate load resistor in the 5-to-2000 cps range. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7649 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

During standby periods in intermittent operation, it is recommended that the heater voltage be maintained at normal operating value when the period is less than 15 minutes, and that it be reduced to 80 per cent of normal when the period is between 15 minutes and 2 hours. For longer periods, the heater voltage should be turned off.

The maximum-rated plate and grid-No. 2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.



NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-No. 2 TERMINAL, GRID-No. 1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF H_4. THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE H_4.

NOTE 2: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

Beam Power Tube

CERAMIC-METAL SEALS — COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN — INTEGRAL RADIATOR
FORCED-AIR COOLED — 9000-WATTS PEAK-PULSE INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc
Under Severe Shock and Vibration

GENERAL DATA

Electrical:

Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	3.2	amp
Minimum heating time	60	sec

Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 1000, grid-No.2 volts = 500, and plate ma. = 115.▲	18	

Direct Interelectrode Capacitances:

Grid No.1 to plate	0.13 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2	20	μμf
Grid No.2 to plate	6	μμf
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

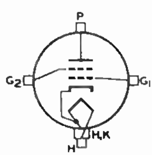
Operating Position	Any
Overall Length	1.885" + 0.070" − 0.080"
Greatest Diameter (See *Dimensional Outline*)	1.250" ± 0.015"
Weight (Approx.)	2 oz
Radiator	Integral part of tube

Socket:

For frequencies up to about 400 Mc. . . . . •
For use at higher frequencies . . . See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Air Flow:

Through radiator—Adequate air flow to limit the plate terminal temperature to 250° C should be delivered by a blower through the radiator before and during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator without cowling and with cowling versus plate dissipation are shown in accompanying Typical-Cooling-Requirements curves. Plate power, grid-No.2 power, and air flow may be removed simultaneously.

To Grid-No.2, Grid-No.1, Cathode, and Heater Terminals—A sufficient quantity of air should be delivered to these seals to prevent their temperature from exceeding the specified maximum value of 250° C.

During Standby Operation—Cooling air is not normally required when only heater voltage is applied to the tube.

Terminal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

GRID-AND-SCREEN-PULSED RF AMPLIFIER

Maximum CCS* Ratings, ***Absolute-Maximum Values:***

For maximum "on" time♦ of 10 microseconds

	Up to 1215 Mc	
DC PLATE VOLTAGE.	1500 max.	volts
PEAK POSITIVE PULSE-GRID-No.2 VOLTAGE	750 max.	volts
DC GRID-No.1 VOLTAGE.	-200 max.	volts
DC PLATE CURRENT DURING PULSE	3000 max.	ma
DC PLATE CURRENT.	80 max.	ma
GRID-No.2 INPUT (Average)	4.5 max.	watts
GRID-No.1 INPUT (Average)	2 max.	watts
PLATE DISSIPATION (Average)	115 max.	watts

Typical Operation:

In class-AB_2 cathode-drive♠ circuit with rectangular-wave pulses at 1215 Mc and with duty factor♦ of 0.01

DC Plate Voltage.	1350	1500	volts
Peak Positive-Pulse Grid-No.2 Voltage	700	700	volts
DC Grid-No.1 Voltage.	0	0	volts
DC Plate Current during pulse	2700	3000	ma
DC Plate Current.	47	53	ma
DC Grid-No.2 Current.	1.6	2	ma
DC Grid-No.1 Current.	5	5	ma
Driver Power Output at peak of pulse (Approx.)♣	390	460	watts
Useful Power Output at peak of pulse (Approx.).	1600●	2300●	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000 max.	ohms

PLATE-AND-SCREEN-PULSED RF AMPLIFIER

Maximum CCS★ Ratings, ***Absolute-Maximum Values:***

For maximum "on" time♦ of 10 microseconds

	Up to 1215 Mc	
PEAK POSITIVE-PULSE PLATE VOLTAGE	3000 max.	volts
PEAK POSITIVE-PULSE GRID-No.2 VOLTAGE . .	750 max.	volts
DC GRID-No.1 VOLTAGE.	-200 max.	volts
DC PLATE CURRENT DURING PULSE	3000 max.	ma
DC PLATE CURRENT.	50 max.	ma
GRID-No.2 INPUT (Average)	4.5 max.	watts
GRID-No.1 INPUT (Average)	2.0 max.	watts
PLATE DISSIPATION (Average)	115 max.	watts

Typical Operation:

In class AB_2 cathode-drive♠ circuit with rectangular-wave pulses at 1215 Mc and with duty factor♣ of 0.01

Peak Positive-Pulse Plate Voltage . . .	2700	3000	volts
Peak Positive-Pulse Grid-No.2 Voltage.	700	700	volts
DC Grid-No.1 Voltage.	0	0	volts
DC Plate Current during pulse	2700	3000	ma
DC Plate Current.	32	35	ma
DC Grid-No.2 Current.	1	2	ma
DC Grid-No.1 Current.	9	8	ma
Driver Power Output at peak of pulse (Approx.)♣	350	450	watts
Useful Power Output at peak of pulse (Approx.).	3700●	4500●	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . . 30000 max. ohms

▲ Measured with special shield adapter.

● For socket to be used with the 7649 consult manufacturers such as J-V-M Microwave Company, 4631 Lawndale Avenue, Lyons, Illinois; E. F. Johnson, Waseca, Minnesota; and Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa.

★ Continous Commercial Service.

♦ *"On" time* is defined as the sum of the durations of all the individual pulses which occur during any 1000-microsecond interval. An increase in dc plate current during the pulse may be permissible at shorter "on" times, and a decrease is usually required at longer "on" times. *Pulse duration* is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The peak value is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

♠ Cathode is at dc ground potential.

♣ *Duty factor* is defined as the ratio of "on" time to total elapsed time in any 1000-microsecond interval.

♣ Driver power output includes circuit losses and feed-through power. It is actual power measured at input to the tube drive circuit. It will vary with frequency of operation and driver circuitry.

● This value of useful power is measured in load of output circuit.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

		Note	Min.	Max.	
1.	Heater Current.	1	2.90	4.00	amp
2.	Direct Interelectrode Capacitances:				
	Grid No.1 to plate.	2	-	0.13	μμf
	Grid No.1 to cathode & heater.	2	11.8	15.2	μμf
	Plate to cathode & heater . .	2	-	0.019	μμf
	Grid No.1 to grid No.2. . . .	2	17.3	21.9	μμf
	Grid No.2 to plate.	2	5.3	6.3	μμf
	Grid No.2 to cathode & heater.	2	-	1.3	μμf
3.	Grid-No.1 Voltage	1,3	-20	-50	volts
4.	Grid-No.1 Voltage	1,7	-6	-15	volts
5.	Reverse Grid-No.1 Current . . .	1,7	-	-20	μa
6.	Grid-No.2 Current	1,3	-10	+5	ma
7.	Peak Emission Voltage	1,4	-	200	volts
8.	Interelectrode Leakage Resistance.	5	1	-	megohm
9.	Power Output.	1,6	4500	-	watts
10.	Grid-No.1 Cutoff Voltage. . . .	1,8	-	-100	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 700 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 13 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 200 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a plate-and-screen-pulsed cathode-drive cavity at 1215 Mc and for conditions with 6.3 volts ac or dc on heater, peak plate voltage of 3000 volts, peak grid-No.2 voltage of 700 volts, driver power of 560 peak watts, and grid-No.1 voltage varied for peak plate current of 3 amperes. Pulse duration is 10 microseconds and duty factor is 0.01.

Note 7: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 8: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 700 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, New Jersey, on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.08 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-75 cps with fixed double amplitude of 0.036 inch ± 10%.

d. 75-to-2000 cps at fixed acceleration of 10 g ± 10%.

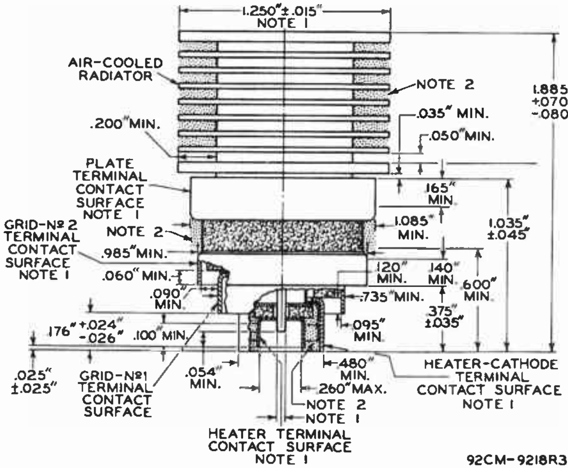
During the above vibration tests, tubes will not show an rms output voltage in excess of 15 volts across the plate load resistor in the 5-to-2000 cps range. At the end of this test, tubes are required to meet the limits for items 1, 3, 5, 8, 9, and 10 under *Characteristics Range Values for Equipment Design.*

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7649 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

During standby periods in intermittent operation, it is recommended that the heater voltage be maintained at normal operating value when the period is less than 15 minutes, and that it be reduced to 80 per cent of normal when the period is between 15 minutes and 2 hours. For longer periods, the heater voltage should be turned off.

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

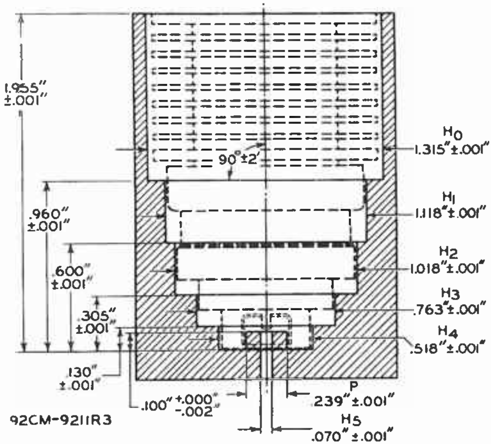


92CM-9218R3

NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF H_4. THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE H_4.

NOTE 2: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

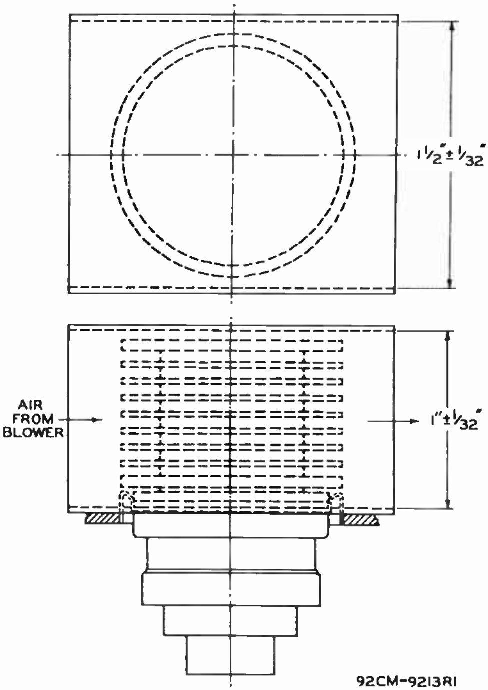
SKETCH G_1



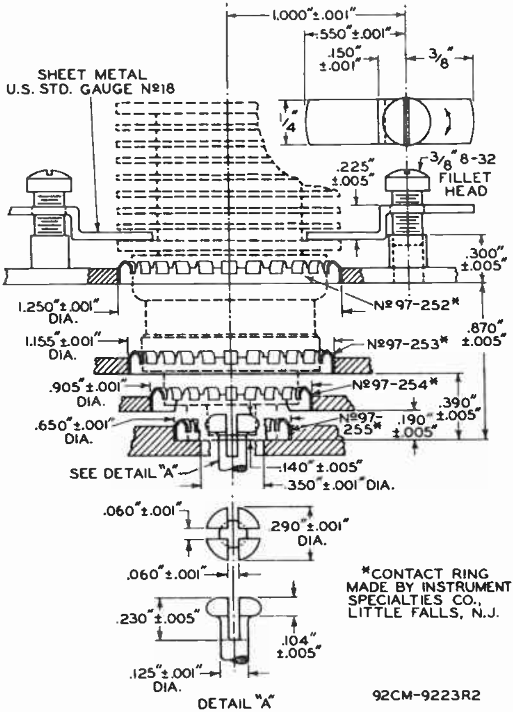
92CM-9211R3

THE AXES OF THE CYLINDRICAL HOLES H_0 THROUGH H_5 AND THE AXES OF POST P ARE COINCIDENT WITHIN 0.001".

RECOMMENDED COWLING FOR DIRECTING AIR FLOW THROUGH RADIATOR



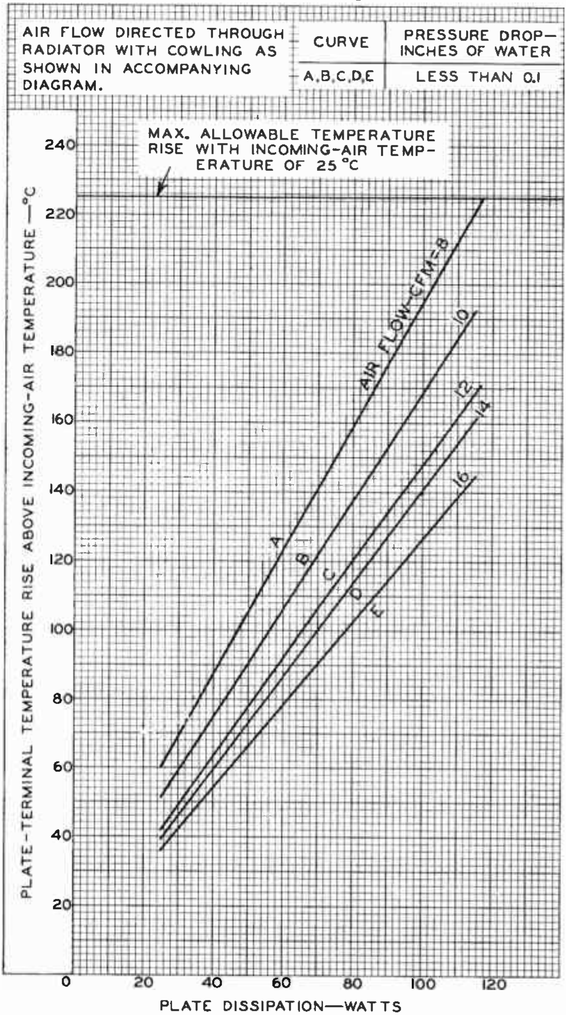
SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS



*CONTACT RING MADE BY INSTRUMENT SPECIALTIES CO., LITTLE FALLS, N.J.

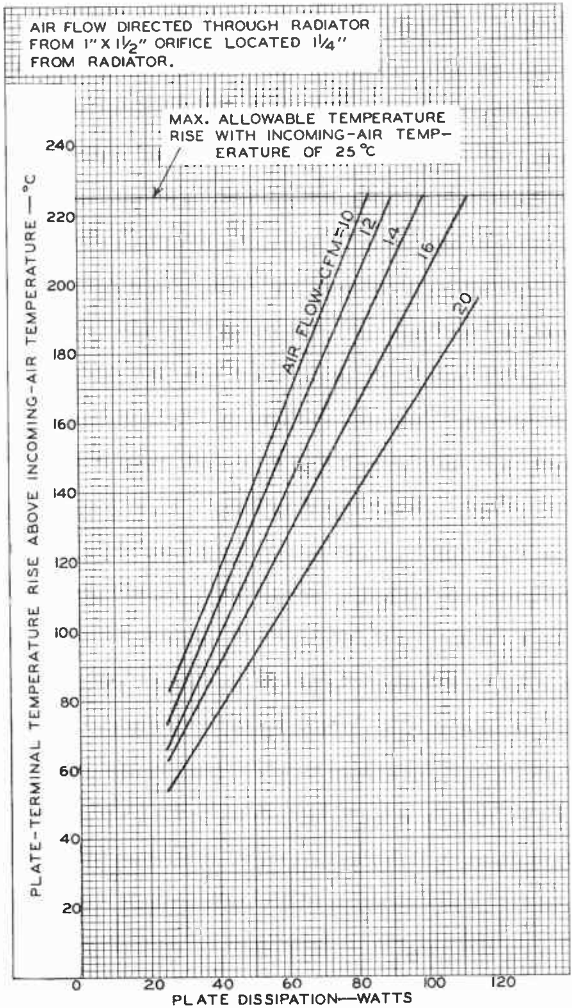
92CM-9223R2

TYPICAL COOLING REQUIREMENTS
With Cowling



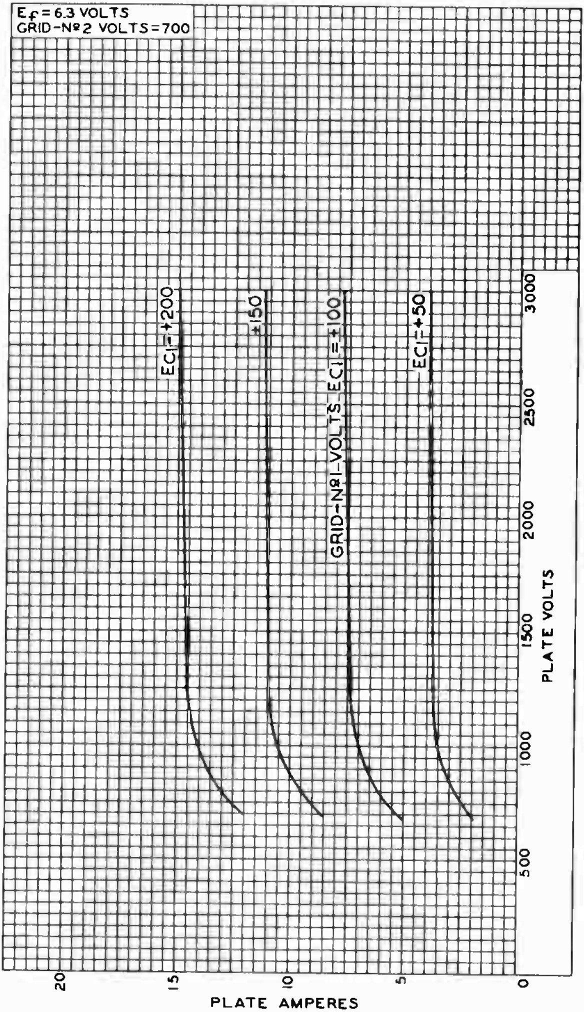
92CM-9219R1

TYPICAL COOLING REQUIREMENTS
Without Cowling



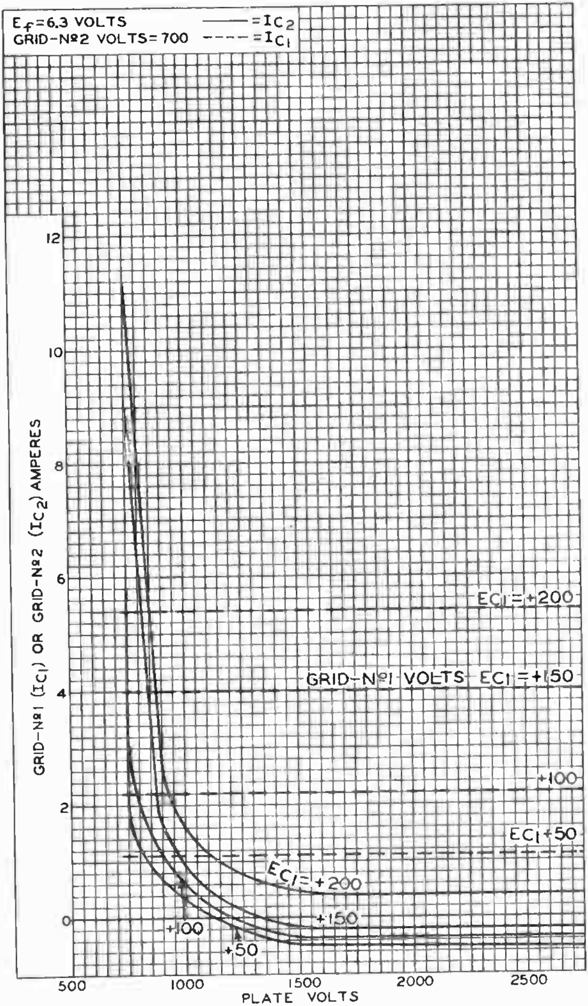
92CM-9220R1

TYPICAL PLATE CHARACTERISTICS



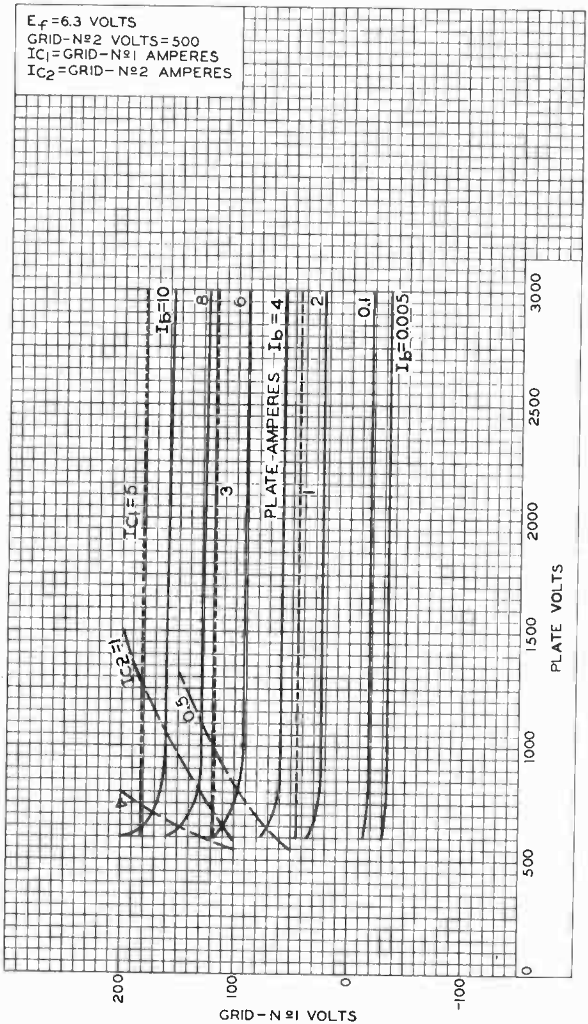
92CM-10649R1

TYPICAL CHARACTERISTICS



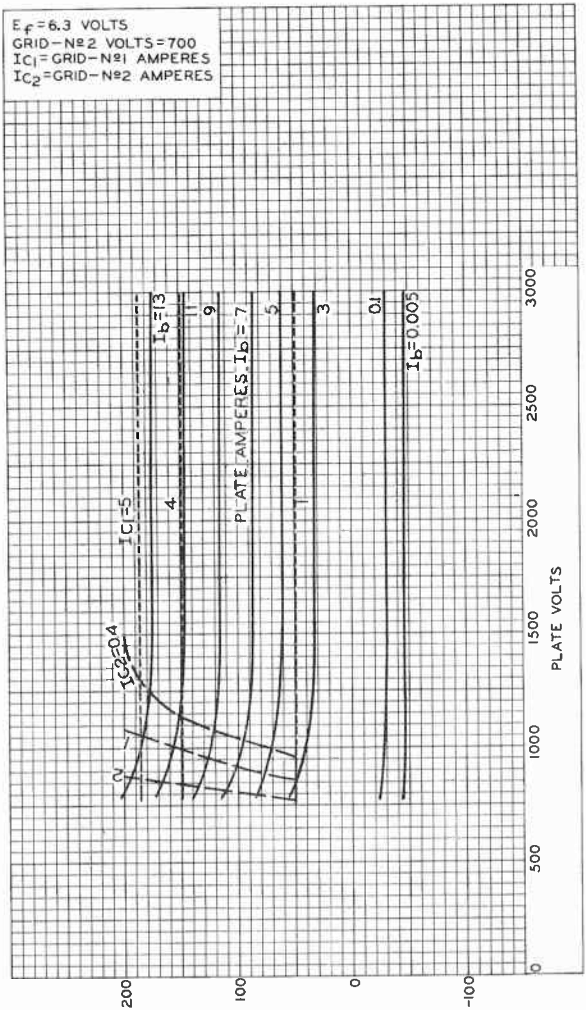
92CM-10653

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10650

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10651

Beam Power Tube

CERAMIC-METAL SEALS
"ONE-PIECE" ELECTRODE DESIGN
FORCED-AIR COOLED
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL RADIATOR
1250-WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use under Severe Shock and Vibration

GENERAL DATA

Electrical:

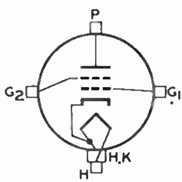
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)[a]	6.3 ± 10%	volts
Current at heater volts = 6.3	7.85	amp
Minimum heating time	120	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 225, grid-No.2 volts = 225, and plate ma. = 100	13	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate	0.11 max.	μμf
Grid No.1 to cathode & heater	29	μμf
Plate to cathode & heater	0.011 max.	μμf
Grid No.1 to grid No.2	37	μμf
Grid No.2 to plate	5.3	μμf
Grid No.2 to cathode & heater	1.1 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	2.34" ± 0.06"
Greatest Diameter (See *Dimensional Outline*)	2.06" ± 0.03"
Weight (Approx.)	3/4 lb
Radiator	Integral part of tube

Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H, K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Air Flow:

Air flow may be removed simultaneously with all voltages.

Through radiator—Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values

← Indicates a change.

of air flow directed through the radiator to maintain the plate core (See *Dimensional Outline*) at 250° C with an incoming air temperature of 25° C and with no restrictions at the plate-contact flange are:

Plate Dissipation (watts)	Air Flow (cubic ft/min)	Static Pressure (inches of water)
100	2	0.04
300	4	0.14
600	11	0.66
700	16	0.96

To grid-No.2, grid-No.1, cathode, and heater terminals—A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these terminals so that no terminal temperature exceeds the specified maximum value of 250° C. An air flow of 2.5 cfm is usually adequate. Forced-air cooling of heater and cathode terminals is usually required during stand-by (heater only) operation.

Plate-Core Temperature	250 max.	°C
Terminal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater)	250 max.	°C

AF POWER AMPLIFIER & MODULATOR

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

DC PLATE VOLTAGE	3000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[d]	500 max.	ma
MAX.-SIGNAL GRID-No.1 CURRENT[d]	100 max.	ma
MAX.-SIGNAL PLATE INPUT[d]	1500 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[d]	25 max.	watts
PLATE DISSIPATION[d]	600 max.	watts

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	2700	3000	volts
DC Grid-No.2 Voltage[e]	450	450	volts
DC Grid-No.1 Voltage from fixed-bias source	-40	-40	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	80	80	volts
Zero-Signal DC Plate Current	200	200	ma
Max.-Signal DC Plate Current	900	1000	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	6	5	ma
Effective Load Resistance (Plate to plate)	6000	6400	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	1400	1600	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

With fixed bias	15000 max.	ohms
With cathode bias	Not recommended	

LINEAR RF POWER AMPLIFIER

Single-Sideband Suppressed-Carrier Service

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

	Up to 1215 Mc	
DC PLATE VOLTAGE	2500 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	500 max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT	100 max.	ma
MAX.-SIGNAL PLATE INPUT	1250 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	25 max.	watts
PLATE DISSIPATION	600 max.	watts

Typical CCS "Single-Tone"[f] Operation:

	In grid-drive circuit at 30 Mc		
DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage[c]	450	450	volts
DC Grid-No.1 Voltage[c]	37	37	volts
Zero-Signal DC Plate Current	160	160	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Effective RF Load Resistance	2500	2700	ohms
Max.-Signal DC Plate Current	450	500	ma
Max.-Signal DC Grid-No.2 Current	4	4	ma
Max.-Signal DC Grid-No.1 Current[g]	0.05	0.05	ma
Output-Circuit Efficiency (Approx.)	90	90	%
Max.-Signal Driver Power Output[h] (Approx.)	1	1	watt
Max.-Signal Useful Power Output (Approx.)	580[j]	680[j]	watts

Typical CCS Operation with "Two-Tone Modulation"[k]

	In grid-drive circuit at 30 Mc		
DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage[c]	450	450	volts
DC Grid-No.1 Voltage[c]	−37	−37	volts
Zero-Signal DC Plate Current	160	160	ma
Effective RF Load Resistance	2500	2700	ohms
DC Plate Current at peak of envelope	450	500	ma
Average DC Plate Current	315	350	ma
DC Grid-No.2 Current at peak of envelope	3	4	ma
Average DC Grid-No.2 Current	1.8	2.5	ma
Average DC Grid-No.1 Current	0.005	0.05	ma
Peak-Envelope Driver Power (Approx.)	1	1	watt
Output-Circuit Efficiency (Approx.)	90	90	%
Distortion Products Level:[l]			
Third Order	−31	−31	db
Fifth Order	−36	−36	db
Useful Power Output (Approx.):			
Average	290	340	watts
Peak Envelope	580[j]	680[j]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:		
For fixed-bias operation	15000 max.	ohms
For cathode-bias operation	Not recommended	

← Indicates a change.

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

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

	Up to 1215 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	−250 max.	volts
DC PLATE CURRENT	500 max.	ma
DC GRID-No.1 CURRENT	100 max.	ma
PLATE INPUT	1000 max.	watts
GRID-No.2 INPUT	17 max.	watts
PLATE DISSIPATION	400 max.	watts

Typical CCS Operation:

In cathode-drive[m] circuit at 400 Mc

DC Plate Voltage	1800	2000	volts
DC Grid-No.2 Voltage[n]	400	400	volts
DC Grid-No.1 Voltage[p]	−45	−35	volts
DC Plate Current	450	500	ma
DC Grid-No.2 Current	6	8	ma
DC Grid-No.1 Current (Approx.)	15	12	ma
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output (Approx.)[q]	35	35	watts
Useful Power Output (Approx.)	500[j]	600[j]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	15000 max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[r]
and
RF POWER AMPLIFIER — Class C FM Telephony

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

	Up to 1215 Mc	
DC PLATE VOLTAGE	2500 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	−250 max.	volts
DC PLATE CURRENT	500 max.	ma
DC GRID-No.1 CURRENT	100 max.	ma
PLATE INPUT	1250 max.	watts
GRID-No.2 INPUT	25 max.	watts
PLATE DISSIPATION	700 max.	watts

Typical CCS Operation:

In cathode-drive[m] circuit at 400 Mc

DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage[s]	400	400	volts
DC Grid-No.1 Voltage	−45	−35	volts
DC Plate Current	450	500	ma
DC Grid-No.2 Current	7	8	ma

DC Grid-No.1 Current (Approx.)	10	12	ma
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output (Approx.)[q]	30	35	watts
Useful Power Output (Approx.)	650[j]	800[j]	watts

In cathode-drive[m] circuit at 1215 Mc

DC Plate Voltage	2500	volts
DC Grid-No.2 Voltage[s]	400	volts
DC Grid-No.1 Voltage	-50	volts
DC Plate Current	500	ma
DC Grid-No.2 Current	6	ma
DC Grid-No.1 Current (Approx.)	10	ma
Output-Circuit Efficiency (Approx.)	70	%
Driver Power Output (Approx.)[q]	80	watts
Useful Power Output (Approx.)	375[j]	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation	15000 max. ohms
For cathode-bias operation	Not recommended

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] Measured with special shield adapter.

[c] Continuous Commercial Service.

[d] Averaged over any audio-frequency cycle of sine-wave form.

[e] Preferably obtained from a fixed supply.

[f] "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

[g] This value represents the approximate grid-No.1 current obtained due to initial electron velocities and contact-potential effects when grid No.1 is driven to zero volts at maximum signal.

[h] Driver power output represents circuit losses and is actual power measured at the input to grid-No.1 circuit used. The tube driving power is zero watts.

[j] This value of useful power is measured in load of output circuit.

[k] "Two-Tone-Modulation" operation refers to that class of amplifier service in which the input consists of two monofrequency rf signals having equal peak amplitude.

[l] With maximum signal output used as a reference, and without the use of feedback to enhance linearity.

[m] Cathode is at dc ground potential.

[n] Obtained preferably from a separate source modulated along with the plate supply.

[p] Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

[q] Driver power output includes circuit losses and feed-through power. It is the actual power measured at input to drive circuit.

[r] Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

[s] Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

→ CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current	1	7.4	8.3	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	–	0.11	μμf
Grid No.1 to cathode & heater	2	26	32	μμf
Plate to cathode & heater	2	–	0.011	μμf
Grid No.1 to grid No.2	2	34	41	μμf
Grid No.2 to plate	2	4.3	6.3	μμf
Grid No.2 to cathode & heater	2	–	1.1	μμf
Reverse Grid-No.1 Current	1,3	–	–50	μa
Peak Emission Current	1,4	80	–	amp
Interelectrode Leakage Resistance	5	8	–	megohms
Grid-No.1 Cutoff Voltage	1,6	–	–87	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 240 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2 and plate tied together; and pulse-voltage source of 850 peak volts connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. Read peak emission current after 1 minute.

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 8 megohms.

Note 6: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N.J., on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different

→ Indicates a change.

positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms, the tube is vibrated along each of three mutually perpendicular axes over an 8-minute cycle consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.080 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-105 cps with fixed double amplitude of 0.036 inch ± 10%.

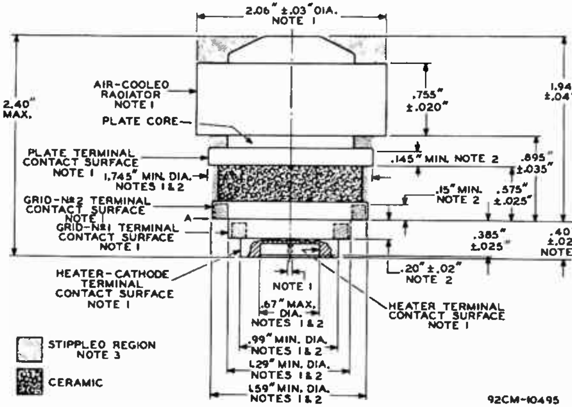
d. 105-to-2000 cps at fixed acceleration of 20 g ± 10%.

At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7650 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

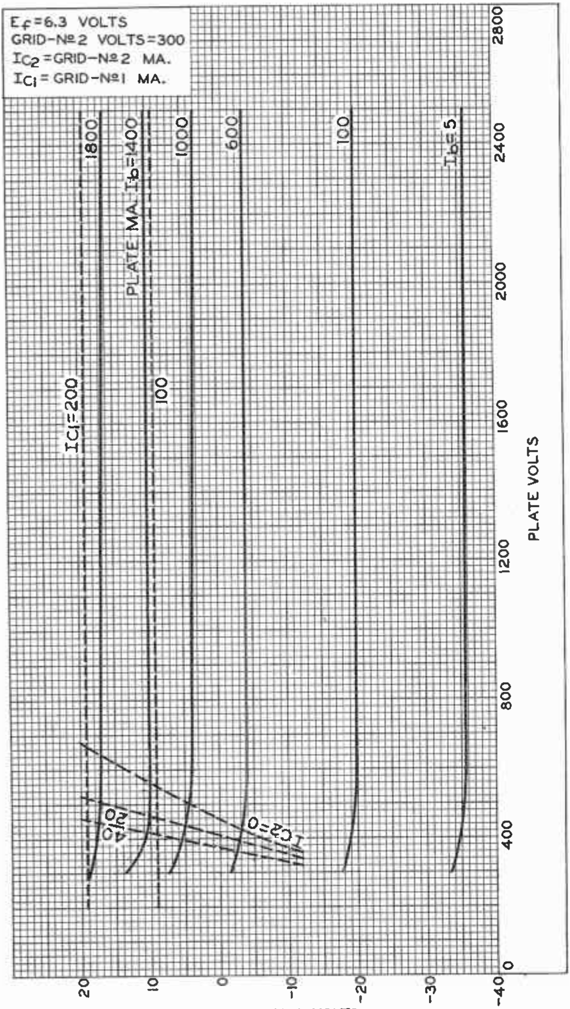


NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE RADIATOR BAND, PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. PROPER ENTRY OF THE TUBE IS OBTAINED WHEN THE GRID-No.2 TERMINAL IS SEATED ON THE SHOULDER A-A′. THE TUBE IS PROPERLY SEATED ON THE SHOULDER WHEN A 0.010" THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER MORE THAN 1/16" BETWEEN THE SHOULDER SURFACE AND THE GRID-No.2 TERMINAL. THE GAUGE IS PROVIDED WITH SLOTS TO PERMIT MAKING MEASUREMENT OF SEATING OF GRID-No.2 TERMINAL ON SHOULDER A-A′.

NOTE 2: THE DIAMETER OF EACH TERMINAL IS HELD TO INDICATED VALUES ONLY OVER THE INDICATED MINIMUM LENGTH OF ITS CONTACT SURFACE.

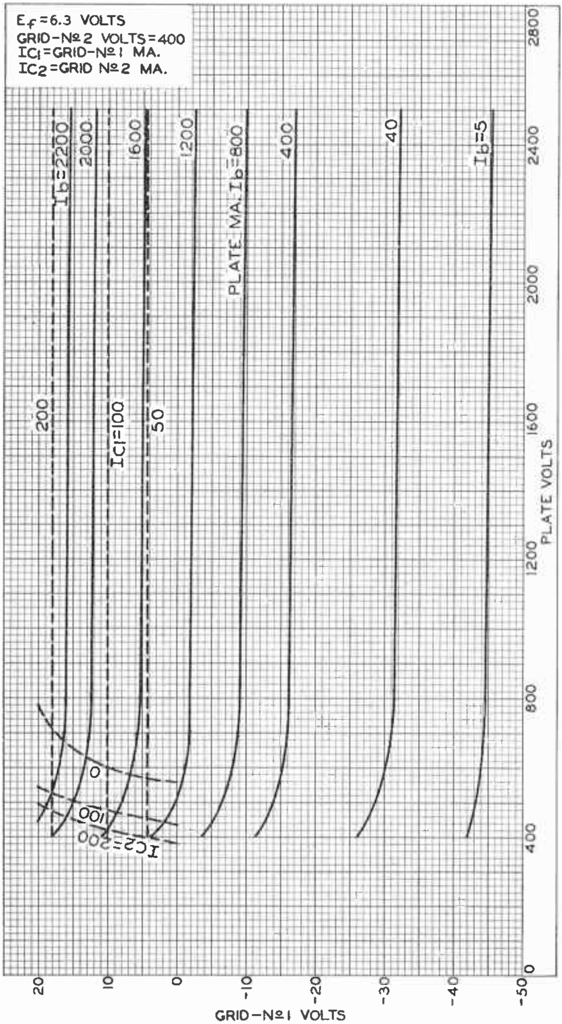
NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES. DIAMETERS OF STIPPLED AREAS ABOVE AIR-COOLED RADIATOR, PLATE-TERMINAL CONTACT SURFACE, AND GRID-No.2-TERMINAL CONTACT SURFACE SHALL NOT BE GREATER THAN ITS ASSOCIATED DIAMETER.

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10493RI

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10494

Beam Power Tube

CERAMIC-METAL SEALS — COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN — INTEGRAL RADIATOR
FORCED-AIR COOLED — 1250-WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use Under Severe Shock and Vibration

GENERAL DATA

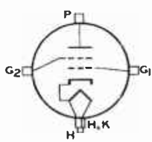
Electrical:

Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)▲	6.3 ± 10%	volts
Current at 6.3 volts	7.5	amp
Minimum heating time	120	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 225, grid-No.2 volts = 225, and plate ma. = 100 . .	13	
Direct Interelectrode Capacitances:●		
Grid No.1 to plate	0.09 max.	$\mu\mu$f
Grid No.1 to cathode & heater. . . .	29	$\mu\mu$f
Plate to cathode & heater.	0.01 max.	$\mu\mu$f
Grid No.1 to grid No.2..	38	$\mu\mu$f
Grid No.2 to plate	5.5	$\mu\mu$f
Grid No.2 to cathode & heater. . . .	0.8 max.	$\mu\mu$f

Mechanical:

Operating Position . . . . Any
Overall Length .2.34" ± 0.06"
Greatest Diameter (See *Dimensional Outline*). . 2.06" ± 0.03"
Weight (Approx.) . . . . 3/4 lb
Radiator . . . . .Integral part of tube
Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Air Flow:

Air flow may be removed simultaneously with all voltages.

Through radiator—Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator to maintain the plate core (See *Dimensional Outline*) at 250° C with an incoming air temperature of 25° C and with no restrictions at the plate-contact flange are:

Plate Dissipation (watts)	Air Flow (cubic ft/min)	Static Pressure (inches of water)
100	2	0.04
300	4	0.14
600	11	0.66
700	16	0.96

To Grid-No.2, Grid-No.1, Cathode, and Heater Terminals—A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these terminals so that no terminal temperature exceeds the specified maximum value of 250° C. An air flow of 2.5 cfm is usually adequate. Forced-air cooling of heater and cathode terminals is usually required during stand-by (heater only) operation.

Plate-Core Temperature	250 max.	°C
Terminal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater)	250 max.	°C

AF POWER AMPLIFIER & MODULATOR

Maximum CCS* Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	3000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
MAX.-SIGNAL DC PLATE CURRENT♦	500 max.	ma
MAX.-SIGNAL GRID-No.1 CURRENT♦	100 max.	ma
MAX.-SIGNAL PLATE INPUT♦	1500 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♦	25 max.	watts
PLATE DISSIPATION♦	600 max.	watts

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	2700	3000	volts
DC Grid-No.2 Voltage♣	450	450	volts
DC Grid-No.1 Voltage from fixed-bias source	-40	-40	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	80	80	volts
Zero-Signal DC Plate Current	200	200	ma
Max.-Signal DC Plate Current	900	1000	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	6	5	ma
Effective Load Resistance (Plate to plate)	6000	6400	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	1400	1600	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

With fixed bias	15000 max.	ohms
With cathode bias	Not recommended	

LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

Maximum CCS* Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc	
DC PLATE VOLTAGE	2500 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	500 max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT	100 max.	ma
MAX.-SIGNAL PLATE INPUT	1250 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	25 max.	watts
PLATE DISSIPATION	600 max.	watts

Typical CCS "Single-Tone"♠ Operation:

	In grid-drive circuit at 30 Mc		
DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage♦	450	450	volts
DC Grid-No.1 Voltage	-40	-40	volts
Zero-Signal DC Plate Current	90	100	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Effective RF Load Resistance	2500	2700	ohms
Max.-Signal DC Plate Current	450	500	ma
Max.-Signal DC Grid-No.2 Current	3	3	ma
Max.-Signal DC Grid-No.1 Current♣	0.1	0.1	ma
Output-Circuit Efficiency (Approx.)	90	90	%
Max.-Signal Driver Power Output® (Approx.)	4	4	watts
Max.-Signal Useful Power Output (Approx.)	580#	680#	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

With fixed bias	15000 max.	ohms
With cathode bias	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

Maximum CCS* Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT	500 max.	ma
DC GRID-No.1 CURRENT	100 max.	ma
PLATE INPUT	1000 max.	watts
GRID-No.2 INPUT	17 max.	watts
PLATE DISSIPATION	400 max.	watts

Typical CCS Operation:

In cathode-drive circuit at 400 Mc*

DC Plate Voltage	1800	2000	volts
DC Grid-No.2 Voltage⊕	400	400	volts
DC Grid-No.1 Voltage†	-45	-35	volts
DC Plate Current	450	500	ma
DC Grid-No.2 Current	6	8	ma
DC Grid-No.1 Current (Approx.)	15	12	ma
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output (Approx.)‡	35	35	watts
Useful Power Output (Approx.)	500#	600#	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	15000 max.	ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy§
and
RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCS* Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc	
DC PLATE VOLTAGE	2500 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT	500 max.	ma
DC GRID-No.1 CURRENT	100 max.	ma
PLATE INPUT	1250 max.	watts
GRID-No.2 INPUT	25 max.	watts
PLATE DISSIPATION	700 max.	watts

Typical CCS Operation:

In cathode-drive circuit at 400 Mc*

DC Plate Voltage	2250	2500	volts
DC Grid-No.2 Voltage□	400	400	volts
DC Grid-No.1 Voltage	-45	-35	volts
DC Plate Current	450	500	ma
DC Grid-No.2 Current	7	8	ma
DC Grid-No.1 Current (Approx.)	10	12	ma
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output (Approx.)‡	30	35	watts
Useful Power Output (Approx.)	650#	800#	watts

In cathode-drive circuit at 1215 Mc*

DC Plate Voltage	2500	volts
DC Grid-No.2 Voltage□	400	volts
DC Grid-No.1 Voltage	-50	volts
DC Plate Current	500	ma
DC Grid-No.2 Current	6	ma
DC Grid-No.1 Current (Approx.)	10	ma
Output-Circuit Efficiency (Approx.)	70	%
Driver Power Output (Approx.)‡	80	watts
Useful Power Output (Approx.)	375#	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

With fixed bias.	15000 max. ohms
With cathode bias.	Not recommended

▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

● Measured with special shield adapter.

★ Continuous Commercial Service.

♦ Averaged over any audio-frequency cycle of sine-wave form.

♠ Preferably obtained from a fixed supply.

♠ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

♣ This value represents the approximate grid-No.1 current obtained due to initial electron velocities and contact-potential effects when grid No.1 is driven to zero volts at maximum signal.

⊕ Driver power output represents circuit losses and is actual power measured at the input to grid-No.1 circuit used. The tube driving power is zero watts.

This value of useful power is measured in load of output circuit.

* Cathode is at dc ground potential.

♣ Obtained preferably from a separate source modulated along with the plate supply.

† Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

‡ Driver power output includes circuit losses and feed-through power. It is the actual power measured at input to drive circuit.

§ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

□ Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current.	1	6.9	8.3	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.09	μμf
Grid No.1 to cathode & heater.	2	26	32	μμf
Plate to cathode & heater.	2	-	0.01	μμf
Grid No.1 to grid No.2.	2	35	42	μμf
Grid No.2 to plate.	2	4.5	6.5	μμf
Grid No.2 to cathode & heater.	2	-	0.8	μμf
Reverse Grid-No.1 Current	1,3	-	-50	μa
Peak Emission Voltage..	1,4	-	850	volts
Interelectrode Leakage Resistance.	5	8	-	megohms
Grid-No.1 Cutoff Voltage.	1,6	-	-80	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 240 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2 and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 80 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 850 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 8 megohms.

Note 6: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N.J., on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

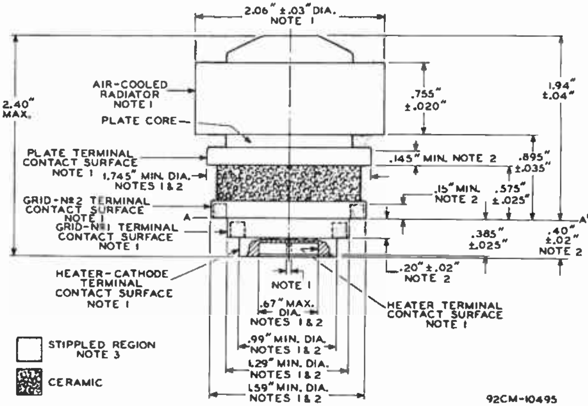
a. 5-to-10 cps with fixed double amplitude of 0.08 inch ± 10%.
b. 10-to-15 cps at fixed acceleration of 0.4 g ± 10%.
c. 15-to-105 cps with fixed double amplitude of 0.036 inch ± 10%.
d. 105-to-2000 cps at fixed acceleration of 20 g ± 10%.

At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7650 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possible come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

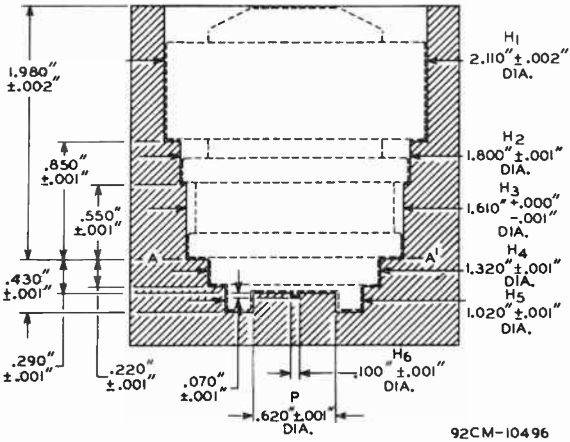


NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE RADIATOR BAND, PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. PROPER ENTRY OF THE TUBE IS OBTAINED WHEN THE GRID-No.2 TERMINAL IS SEATED ON THE SHOULDER A-A'. THE TUBE IS PROPERLY SEATED ON THE SHOULDER WHEN A 0.010" THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER MORE THAN 1/16" BETWEEN THE SHOULDER SURFACE AND THE GRID-No.2 TERMINAL. THE GAUGE IS PROVIDED WITH SLOTS TO PERMIT MAKING MEASUREMENT OF SEATING OF GRID-No.2 TERMINAL ON SHOULDER A-A'.

NOTE 2: THE DIAMETER OF EACH TERMINAL IS HELD TO INDICATED VALUES ONLY OVER THE INDICATED MINIMUM LENGTH OF ITS CONTACT SURFACE.

NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES. DIAMETERS OF STIPPLED AREAS ABOVE AIR-COOLED RADIATOR, PLATE-TERMINAL CONTACT SURFACE, AND GRID-No.2-TERMINAL CONTACT SURFACE SHALL NOT BE GREATER THAN ITS ASSOCIATED DIAMETER.

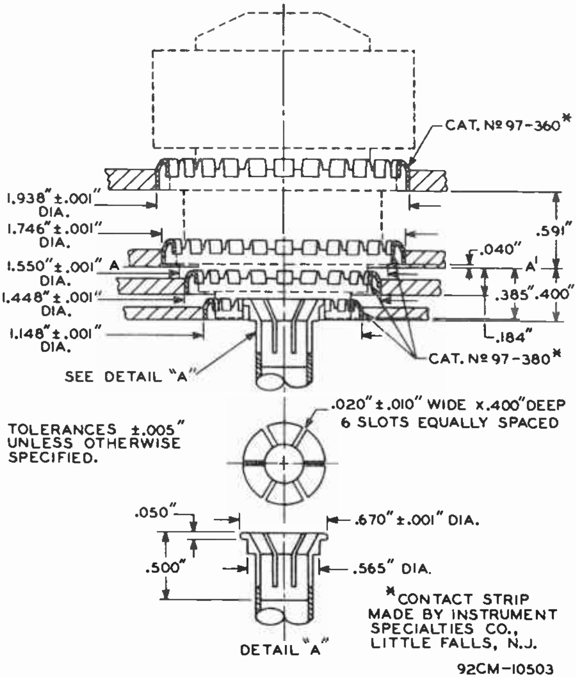
SKETCH G_1



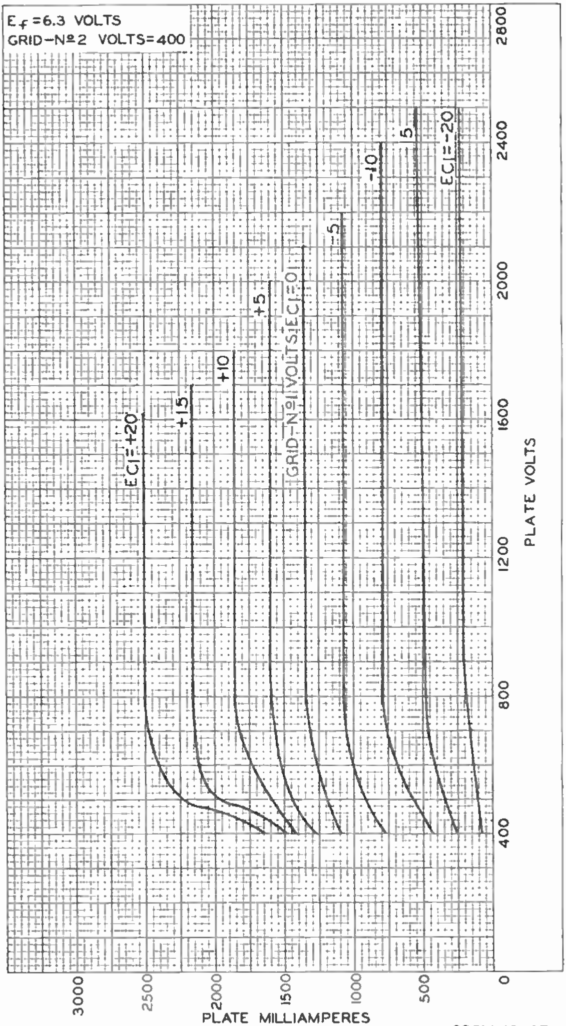
SURFACE A-A' IS FLAT WITHIN 0.0005" PEAK TO VALLEY AND IS PERPENDICULAR TO THE AXIS OF THE CYLINDRICAL HOLES WITHIN 0.00025".

THE AXES OF THE CYLINDRICAL HOLES H_1 THROUGH H_6 AND THE AXIS OF POST P ARE COINCIDENT WITHIN 0.001".

SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS

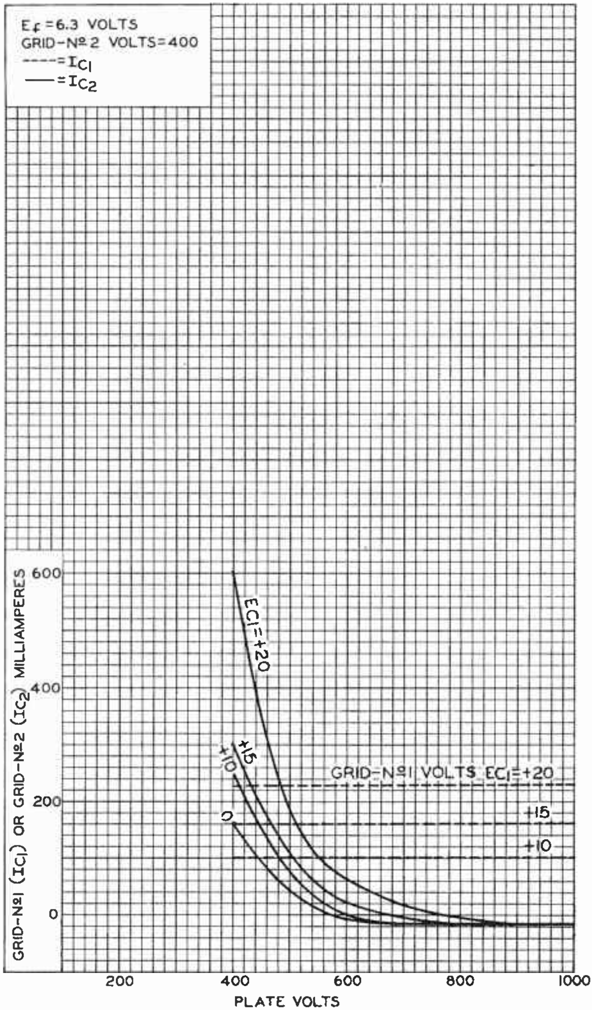


TYPICAL PLATE CHARACTERISTICS



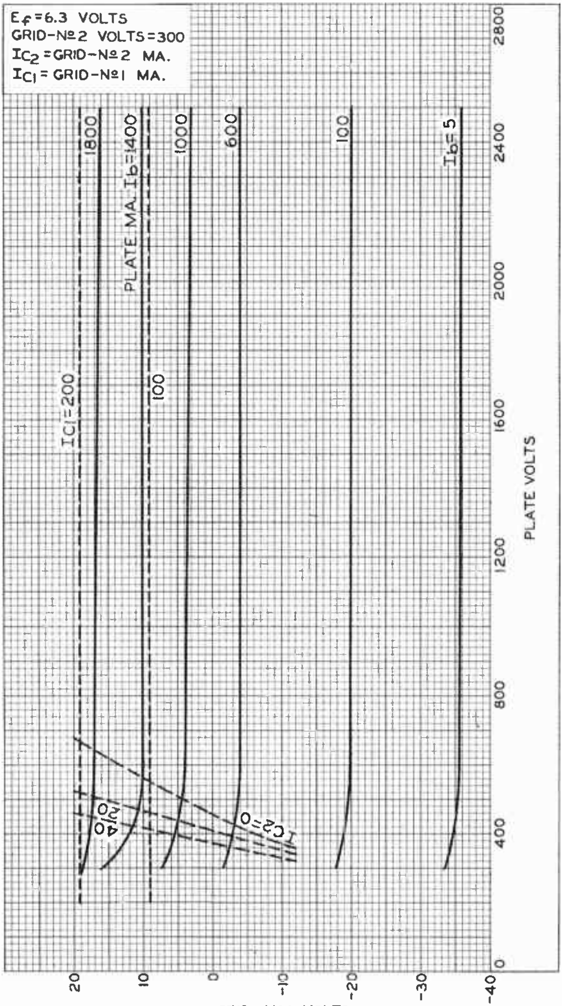
92CM-10487

TYPICAL CHARACTERISTICS



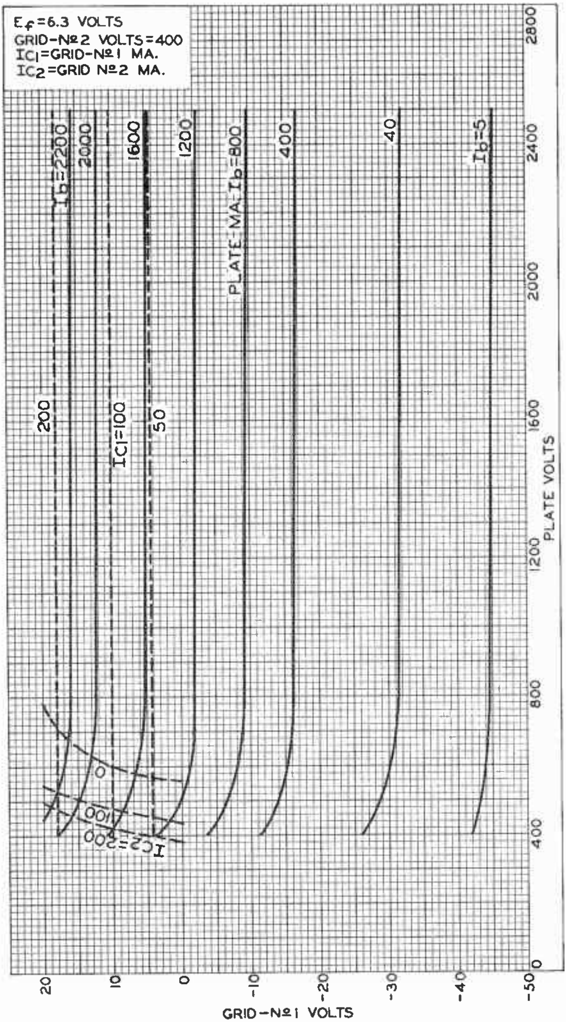
92CM-10488

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10493

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10494

Beam Power Tube

CERAMIC-METAL SEALS — COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN — INTEGRAL RADIATOR
FORCED-AIR COOLED — 27-KW PEAK-PULSE POWER INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use under Severe Shock and Vibration

GENERAL DATA

Electrical:

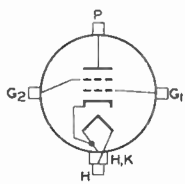
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	7.5	amp
Minimum heating time	120	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 225, grid-No.2 volts = 225, and plate ma. = 100	13	
Direct Interelectrode Capacitances:[a]		
Grid No.1 to plate	0.13 max.	μμf
Grid No.1 to cathode & heater	29	μμf
Plate to cathode & heater	0.01 max.	μμf
Grid No.1 to grid No.2	38	μμf
Grid No.2 to plate	6.5	μμf
Grid No.2 to cathode & heater	0.8 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	2.34" ± 0.06"
Greatest Diameter (See *Dimensional Outline*)	2.06" ± 0.03"
Weight (Approx.)	3/4 lb
Radiator	Integral part of tube

Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Air Flow:

Air flow may be removed simultaneously with all voltages.

Through radiator—Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator during the application of heater, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator to maintain the plate core (See *Dimensional Outline*) at 250° C with an incoming air temperature of 25° C and with no restrictions at the plate-contact flange are:

Plate Dissipation (watts)	Air Flow (cubic ft/min)	Static Pressure (inches of water)
100	2	0.04
300	4	0.14
600	11	0.66

To Grid-No.2, Grid-No.1, Cathode, and Heater Terminals— A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these terminals so that no terminal temperature exceeds the specified maximum value of 250° C. An air flow of 2.5 cfm is usually adequate. Forced-air cooling of heater and cathode terminals is usually required during standby (heater only) operation.

Plate-Core Temperature	250 max.	°C
Terminal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater)	250 max.	°C

GRID-PULSED RF AMPLIFIER and GRID-AND-SCREEN-PULSED RF AMPLIFIER

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

For maximum "on" time[c] of 10 microseconds

	Up to 1215 Mc	
→ DC PLATE VOLTAGE	5000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT DURING PULSE	9 max.	amp
DC PLATE CURRENT	0.5 max.	amp
GRID-No.2 INPUT (Average)	25 max.	watts
GRID-No.1 INPUT (Average)	10 max.	watts
PLATE DISSIPATION (Average)	600 max.	watts

Typical Operation:

In grid-pulsed cathode-drive[d] circuit with rectangular-wave pulse at 1215 Mc and with duty factor[e] of 0.01

DC Plate Voltage	3600	4000	volts
→ Peak-Positive Grid-No.2 Voltage	800	1000	volts
DC Grid-No.1 Voltage	-100	-120	volts
DC Plate Current during pulse	8	9	amp
DC Plate Current	0.19	0.2	amp
DC Grid-No.2 Current	0.005	0.006	amp
DC Grid-No.1 Current	0.02	0.02	amp
Output-Circuit Efficiency (Approx.) . .	80	80	%
Driver Power Output at peak of pulse (Approx.)[f]	5.2	6.3	kw
Useful Power Output at peak of pulse (Approx.)	15[g]	20[g]	kw

→ Indicates a change.

In grid-and-screen-pulsed cathode-drive[d] circuit with rectangular-wave pulses at 1215 Mc with duty factor[e] of 0.01

DC Plate Voltage	3600	4000	volts
Peak Positive-Pulse Grid-No.2 Voltage	800	1000	volts
DC Grid-No.1 Voltage	0	0	volts
DC Plate Current during pulse	8	9	amp
DC Plate Current	0.145	0.165	amp
DC Grid-No.2 Current	0.003	0.006	amp
DC Grid-No.1 Current	0.017	0.017	amp
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output at peak cf pulse (Approx.)[f]	2.4	2.9	kw
Useful Power Output at peak of pulse (Approx.)	11[g]	15[g]	kw

PLATE-AND-SCREEN-PULSED RF AMPLIFIER

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

For maximum "on" time[c] of 10 microseconds

	Up to 1215 Mc	
PEAK POSITIVE-PULSE PLATE VOLTAGE	8000 max.	volts
PEAK POSITIVE-PULSE GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT DURING PULSE	9 max.	amp
DC PLATE CURRENT	0.12 max.	amp
GRID-No.2 INPUT (Average)	25 max.	watts
GRID-No.1 INPUT (Average)	10 max.	watts
PLATE DISSIPATION (Average)	600 max.	watts

Typical Operation:

In cathode-drive[d] circuit with rectangular-wave pulses at 1215 Mc and with duty factor[e] of 0.01

Peak Positive-Pulse Plate Voltage	7200	8000	7200	8000	volts
Peak Positive-Pulse Grid-No.2 Voltage	800	1000	800	1000	volts
DC Grid-No.1 Voltage	0	0	-75	-80	volts
DC Plate Current during pulse	8	9	8	9	amp
DC Plate Current	0.09	0.1	0.09	0.1	amp
DC Grid-No.2 Current	0.003	0.008	0.003	0.004	amp
DC Grid-No.1 Current	0.015	0.016	0.019	0.02	amp
Output-Circuit Efficiency (Approx.)	80	80	80	80	%
Driver Power Output at peak of pulse (Approx.)[f]	1.8	2.2	4.5	5.3	kw
Useful Power Output at peak of pulse (Approx.)	22[g]	28[g]	30[g]	39[g]	kw

[a] Measured with special shield adapter.
[b] Continuous Commercial Service.
[c] *"On" time* is defined as the sum of the durations of all the individual pulses which occur during any 1000-microsecond interval. An increase in

dc plate current during the pulse may be permissible at shorter "on" times, and a decrease is usually required at longer "on" times.

Pulse duration is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The *peak value* is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

d Cathode is at dc ground potential.

e *Duty factor* is defined as the ratio of "on" time to total elapsed time in any 1000-microsecond interval.

f Driver power output includes circuit losses and feed-through power. It is actual power measured at input to tube drive circuit. It will vary with frequency of operation and driver circuitry.

g This value of useful power is measured in load of output circuit.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	6.9	8.3	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.13	μμf
Grid No.1 to cathode & heater	2	26	32	μμf
Plate to cathode & heater	2	-	0.01	μμf
Grid No.1 to grid No.2	2	35	42	μμf
Grid No.2 to plate	2	5.5	7.5	μμf
Grid No.2 to cathode & heater	2	-	0.8	μμf
Reverse Grid-No.1 Current	1,3	-	-50	μa
Peak Emission Voltage	1,4	-	850	volts
Interelectrode Leakage Resistance	5	8	-	megohms
→ Grid-No.1 Cutoff Voltage	1,6	-	-170	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 240 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 80 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 850 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 8 megohms.

Note 6: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and a dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N. J., on request.

→ Indicates a change.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage adjusted ← to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute cycle consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.08 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-105 cps with fixed double amplitude of 0.036 inch ± 10%.

d. 105-to-2000 cps at fixed acceleration of 20 g ± 10%.

At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7651 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

← Indicates a change.

DIMENSIONAL OUTLINE,
GAUGE DRAWING, and
SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS
shown under Type 7650 also apply to the 7651

Beam Power Tube

CERAMIC-METAL SEALS
"ONE-PIECE" ELECTRODE DESIGN
FORCED-AIR COOLED
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL RADIATOR
27-KW PEAK-PULSE POWER INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use Under <u>Severe Shock and Vibration</u>

GENERAL DATA

Electrical:

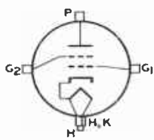
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	7.5	amp
Minimum heating time	120	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 225, grid-No.2 volts = 225, and plate ma. = 100	13	
Direct Interelectrode Capacitances:▲		
Grid No.1 to plate	0.13 max.	μμf
Grid No.1 to cathode & heater	29	μμf
Plate to cathode & heater	0.01 max.	μμf
Grid No.1 to grid No.2	38	μμf
Grid No.2 to plate	6.5	μμf
Grid No.2 to cathode & heater	0.8 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	2.34" ± 0.06"
Greatest Diameter (See *Dimensional Outline*)	2.06" ± 0.03"
Weight (Approx.)	3/4 lb
Radiator	Integral part of tube

Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Air Flow:

Air flow may be removed simultaneously with all voltages.

Through radiator—Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator during the application of heater, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator to maintain the plate core (See *Dimensional Outline*) at 250° C with an incoming air temperature of 25° C and with no restrictions at the plate-contact flange are:

Plate Dissipation (watts)	Air Flow (cubic ft/min)	Static Pressure (inches of water)
100	2	0.04
300	4	0.14
600	11	0.66

To Grid-No.2, Grid-No.1, Cathode, and Heater Terminals—A sufficient quantity of air should be directed at the heater terminal and allowed to flow past each of these terminals so that no terminal temperature exceeds the specified maximum value of 250° C. An air flow of 2.5 cfm is usually adequate. Forced-air cooling of heater and cathode terminals is usually required during standby (heater only) operation.

Plate-Core Temperature	250 max.	°C
Terminal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater)	250 max.	°C

GRID-PULSED RF AMPLIFIER and GRID-AND-SCREEN-PULSED RF AMPLIFIER

Maximum CCS• Ratings, *Absolute-Maximum Values:*

For maximum "on" time of 10 microseconds*

	Up to 1215 Mc	
DC PLATE VOLTAGE	4000 max.	volts
DC GRID-No.2 VOLTAGE	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT DURING PULSE	9 max.	amp
DC PLATE CURRENT	0.5 max.	amp
GRID-No.2 INPUT (Average)	25 max.	watts
GRID-No.1 INPUT (Average)	10 max.	watts
PLATE DISSIPATION (Average)	600 max.	watts

Typical Operation:

In grid-pulsed cathode-drive♦ circuit with rectangular-wave pulse at 1215 Mc and with duty factor♣ of 0.01

DC Plate Voltage	3600	4000	volts
DC Grid-No.2 Voltage	800	1000	volts
DC Grid-No.1 Voltage	-100	-120	volts
DC Plate Current during pulse	8	9	amp
DC Plate Current	0.19	0.2	amp
DC Grid-No.2 Current	0.005	0.006	amp
DC Grid-No.1 Current	0.02	0.02	amp
Output-Circuit Efficiency (Approx.)	80	80	%
Driver Power Output at peak of pulse (Approx.)♠	5.2	6.3	kw
Useful Power Output at peak of pulse (Approx.)	15♣	20♣	kw

In grid-and-screen-pulsed cathode-drive♦ circuit with rectangular-wave pulses at 1215 Mc with duty factor● of 0.01

DC Plate Voltage.	3600	4000	volts
Peak Positive-Pulse Grid-No.2 Voltage .	800	1000	volts
DC Grid-No.1 Voltage.	0	0	volts
DC Plate Current during pulse	8	9	amp
DC Plate Current.	0.145	0.165	amp
DC Grid-No.2 Current.	0.003	0.006	amp
DC Grid-No.1 Current.	0.017	0.017	amp
Output-Circuit Efficiency (Approx.) . .	80	80	%
Driver Power Output at peak of pulse (Approx.)♠	2.4	2.9	kw
Useful Power Output at peak of pulse (Approx.).	11♣	15♣	kw

PLATE-AND-SCREEN-PULSED RF AMPLIFIER

Maximum CCS● Ratings, *Absolute-Maximum Values:*

For maximum "on" time★ of 10 microseconds

	Up to 1215 Mc	
PEAK POSITIVE-PULSE PLATE VOLTAGE. . . .	8000 max.	volts
PEAK POSITIVE-PULSE GRID-No.2 VOLTAGE. .	1200 max.	volts
DC GRID-No.1 VOLTAGE	-250 max.	volts
DC PLATE CURRENT DURING PULSE.	9 max.	amp
DC PLATE CURRENT	0.12 max.	amp
GRID-No.2 INPUT (Average).	25 max.	watts
GRID-No.1 INPUT (Average).	10 max.	watts
PLATE DISSIPATION (Average).	600 max.	watts

Typical Operation:

In cathode-drive♦ circuit with rectangular-wave pulses at 1215 Mc and with duty factor● of 0.01

Peak Positive-Pulse Plate Voltage.	7200	8000	7200	8000	volts
Peak Positive-Pulse Grid-No.2 Voltage. . . .	800	1000	800	1000	volts
DC Grid-No.1 Voltage . . .	0	0	-75	-80	volts
DC Plate Current during pulse	8	9	8	9	amp
DC Plate Current	0.09	0.1	0.09	0.1	amp
DC Grid-No.2 Current . . .	0.003	0.008	0.003	0.004	amp
DC Grid-No.1 Current . . .	0.015	0.016	0.019	0.02	amp
Output-Circuit Efficiency (Approx.) . .	80	80	80	80	%
Driver Power Output at peak of pulse (Approx.)♠.	1.8	2.2	4.5	5.3	kw
Useful Power Output at peak of pulse (Approx.).	22♣	28♣	30♣	39♣	kw

♠ Measured with special shield adapter.

● Continuous Commercial Service.

★ *"On" time* is defined as the sum of the durations of all the individual pulses which occur during any 1000-microsecond interval. An increase in dc plate current during the pulse may be permissible at shorter "on" times, and a decrease is usually required at longer "on" times.

Pulse duration is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. The *peak value* is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

♦ Cathode is at dc ground potential.

● *Duty factor* is defined as the ratio of "on" time to total elapsed time in any 1000-microsecond interval.

♠ Driver power output includes circuit losses and feed-through power. It is actual power measured at input to tube drive circuit. It will vary with frequency of operation and driver circuitry.

♣ This value of useful power is measured in load of output circuit.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current.	1	6.9	8.3	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.13	μμf
Grid No.1 to cathode & heater . .	2	26	32	μμf
Plate to cathode & heater	2	-	0.01	μμf
Grid No.1 to grid No.2.	2	35	42	μμf
Grid No.2 to plate.	2	5.5	7.5	μμf
Grid No.2 to cathode & heater . .	2	-	0.8	μμf
Reverse Grid-No.1 Current	1,3	-	-50	μa
Peak Emission Voltage	1,4	-	850	volts
Interelectrode Leakage Resistance .	5	8	-	megohms
Grid-No.1 Cutoff Voltage.	1,6	-	-150	volts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 240 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 80 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 850 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 8 megohms.

Note 6: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and a dc grid-No.1 voltage adjusted to give a dc plate current of 5 ma.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N. J., on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.08 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-105 cps with fixed double amplitude of 0.036 inch ± 10%.

d. 105-to-2000 cps at fixed acceleration of 20 g ± 10%.

At the end of this test, tubes will not show permanent or temporary shorts or open circuits.

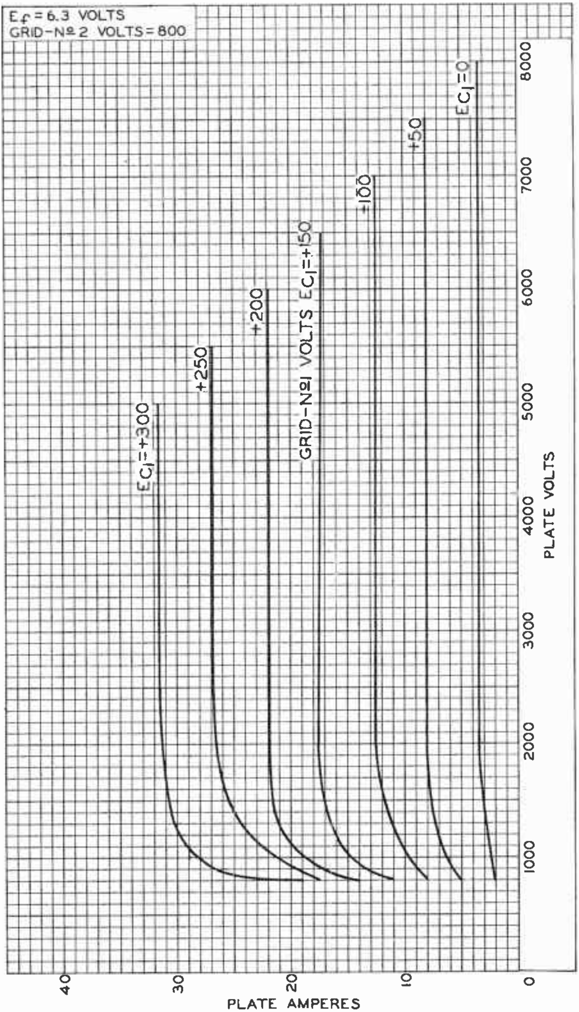
OPERATING CONSIDERATIONS

A suggested *mounting arrangement* for the 7651 is shown in the accompanying drawing along with a layout of the associated contacts. Flexible connectors are required for the plate, grid-No.2, grid-No.1, cathode, and heater contact surfaces.

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.

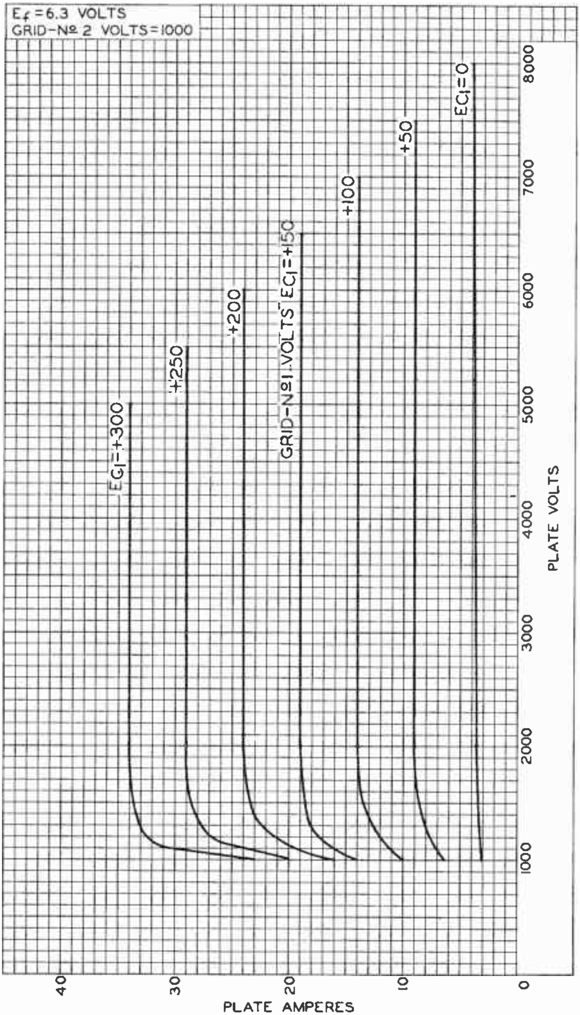
DIMENSIONAL OUTLINE,
GAUGE DRAWING, and
SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS
shown under Type 7650 also apply to the 7651

TYPICAL PLATE CHARACTERISTICS



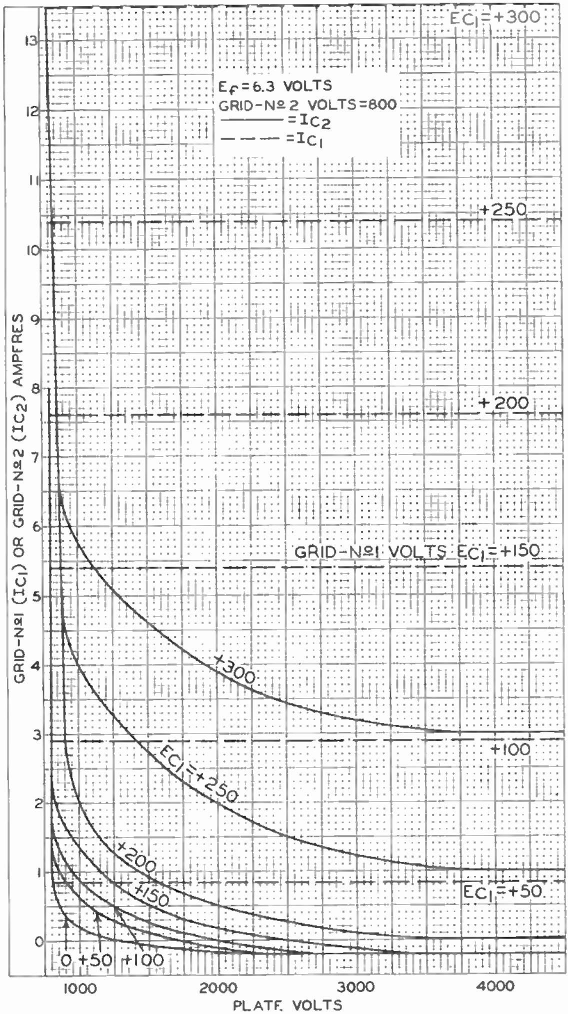
92CM-10492

TYPICAL PLATE CHARACTERISTICS



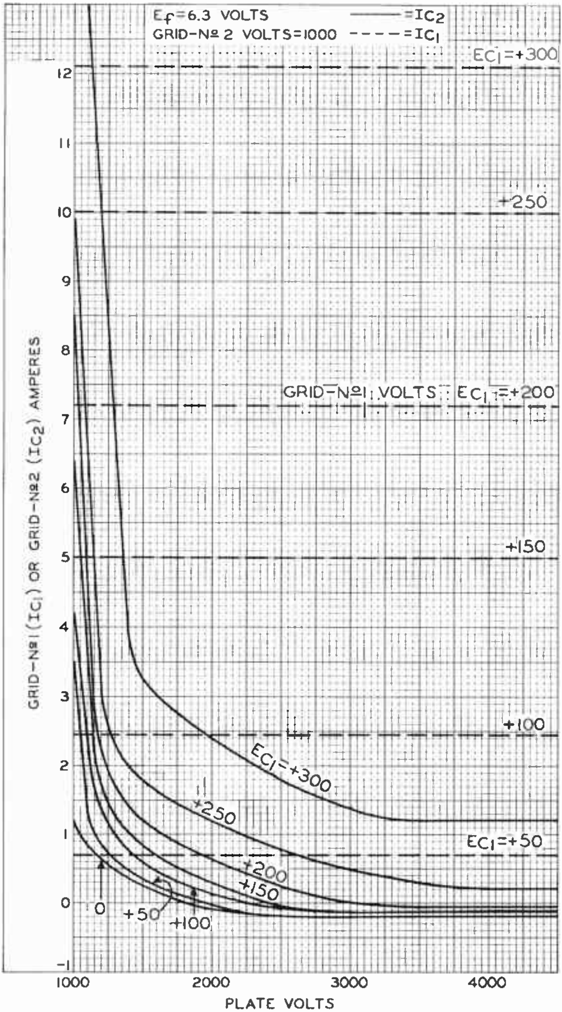
92CM-10491

TYPICAL CHARACTERISTICS



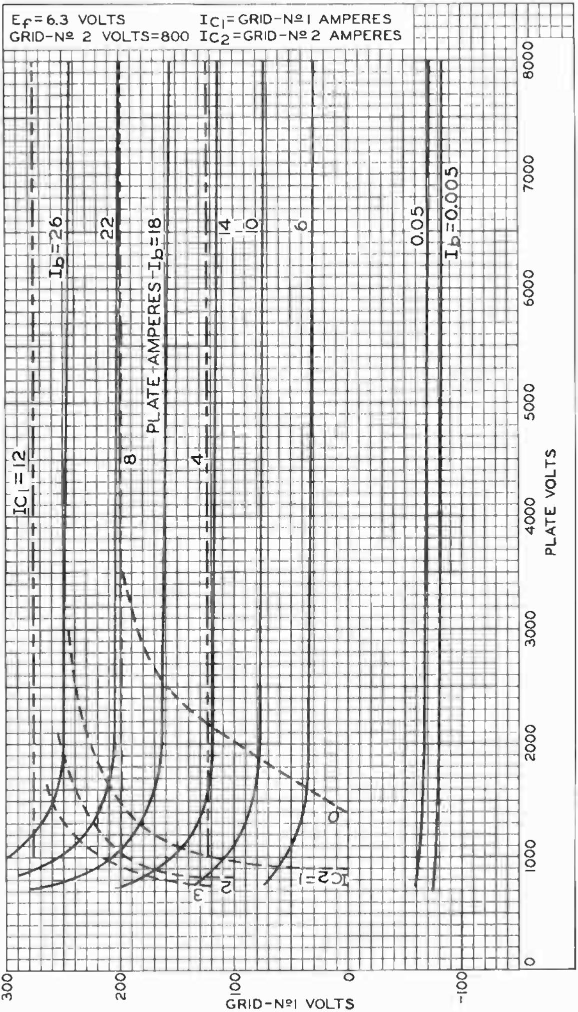
92CM-10502

TYPICAL CHARACTERISTICS



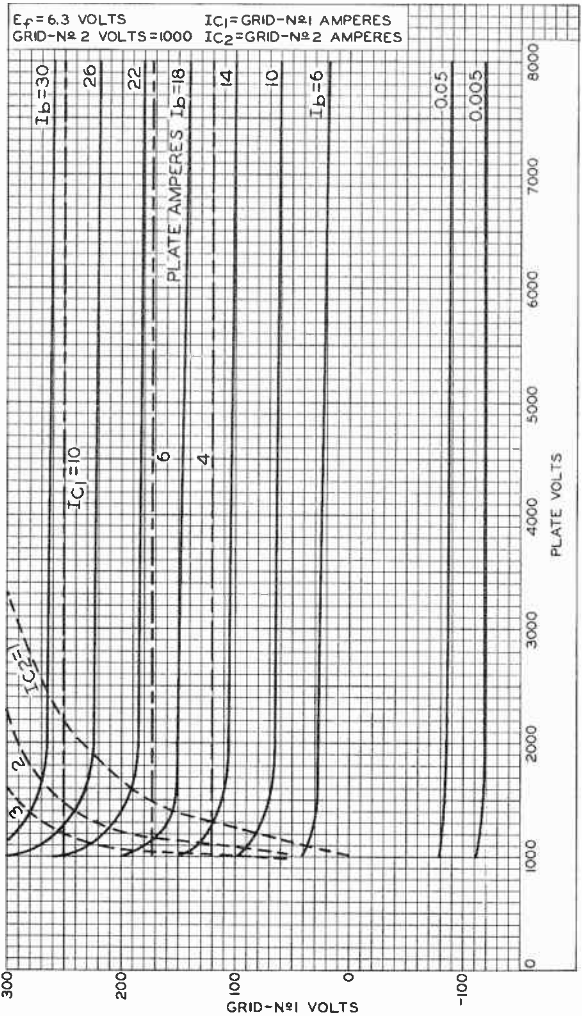
92CM-10501R1

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10490R1

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10489R1

Beam Power Tube

CERAMIC-METAL SEALS
"ONE-PIECE" ELECTRODE DESIGN
CONDUCTION COOLED
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL CONDUCTION CYLINDER
180-WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc under Severe Shock and Vibration

GENERAL DATA

Electrical:

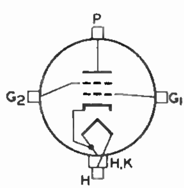
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)▲	6.3 ± 10%	volts
Current at heater volts = 6.3	3.2	amp ←
Minimum heating time	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100	18	
Direct Interelectrode Capacitances:●		
Grid No.1 to plate	0.065 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2	19	μμf
Grid No.2 to plate	4.5	μμf
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	1.885" + 0.70" − 0.80"
Greatest Diameter (See *Dimensional Outline*)	1.119"
Weight (Approx.)	2 oz
Socket:	
For frequencies up to about 400 Mc	★
For use at higher frequencies	See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Thermal:

Conduction-Cylinder Temperature	250 max.	°C
Seal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

← Indicates a change.

Cooling, Conduction:

The conduction cylinder must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the conduction cylinder to the specified maximum value of 250° C. The plate, grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective seal temperature to the specified maximum value of 250° C.

AF POWER AMPLIFIER & MODULATOR — Class AB_1♦

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	4.5	max.	watts
PLATE DISSIPATION♠	♣		

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage●	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage#	30	30	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	200	200	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Effective Load Resistance (Plate to plate)	4330	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:*

For fixed-bias operation	30000 max.	ohms
For cathode-bias operation	Not recommended	

AF POWER AMPLIFIER & MODULATOR — Class AB_2*

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT♠	30	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	4.5	max.	watts
PLATE DISSIPATION♠	♣		

Driver Power Output (Approx.)◊. .	3	3	5	watts
Useful Power Output (Approx.) . .	23	80	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000♡ max.	ohms

▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

● Measured with special shield adapter.

★ For socket to be used with the 7842, consult manufacturers such as J-V-M Microwave Company, 9300 West 47th Street, Brookfield, Illinois; E.F. Johnson Company, Waseca, Minnesota; Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa; and Jettron Products, Route 10, Hanover, New Jersey.

♦ Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

♠ Continuous Commercial Service.

♠ Averaged over any audio-frequency cycle of sine-wave form.

♣ Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data*, and also *Cooling Considerations*.

⊕ Preferably obtained from a fixed supply.

The driver stage should be capable of supplying the No.1 grids of the Class AB_1 stage with the specified driving voltage at low distortion.

* The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer- or impedance-coupling devices are recommended.

✤ Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

† Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.

‡ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

§ Obtained preferably from a separate source modulated along with the plate supply.

□ Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

◊ The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

♡ If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

▲▲ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

●● Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

★★ Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
→ 1. Heater Current	1	2.90	3.55	amp
2. Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	–	0.065	μμf
Grid No.1 to cathode & heater	2	11.8	15.2	μμf
Plate to cathode & heater	2	–	0.019	μμf
Grid No.1 to grid No.2	2	17.3	21.9	μμf
Grid No.2 to plate	2	4	5.1	μμf
Grid No.2 to cathode & heater	2	–	1.3	μμf
→ 3. Grid-No.1 Voltage	1,3	-6	-18	volts
4. Reverse Grid-No.1 Current	1,3	–	-20	μa
5. Grid-No.2 Current	1,3	-8	2	ma
6. Peak Emission Voltage	1,4	–	400	volts
7. Interelectrode Leakage Resistance	5	1	–	megohm
8. Useful Power Output	6	80	–	watts

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

Note 2: Measured with special shield adapter.

Note 3: With dc voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a single-tube, grid-driven, coaxial-cavity, class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N.J., on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-

→ Indicates a change.

Beam Power Tube

CERAMIC-METAL SEALS — COAXIAL-ELECTRODE STRUCTURE
"ONE-PIECE" ELECTRODE DESIGN — INTEGRAL CONDUCTION CYLINDER
CONDUCTION COOLED — 180-WATTS CW INPUT UP TO 1215 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000 Mc Under Severe Shock and Vibration

GENERAL DATA

Electrical:

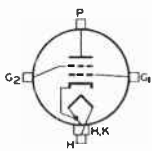
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:		
Voltage (AC or DC)▲	6.3 ± 10%	volts
Current at 6.3 volts	3	amp
Minimum heating time	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100	18	
Direct Interelectrode Capacitances:●		
Grid No.1 to plate	0.065 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.019 max.	μμf
Grid No.1 to grid No.2	19	μμf
Grid No.2 to plate	4.5	μμf
Grid No.2 to cathode & heater	1.3 max.	μμf

Mechanical:

Operating Position	Any
Overall Length	1.885" + 0.70" − 0.80"
Greatest Diameter (See *Dimensional Outline*)	1.119"
Weight (Approx.)	2 oz
Socket:	
For frequencies up to about 400 Mc	★
For use at higher frequencies	See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Thermal:

Conduction-Cylinder Temperature	250 max.	°C
Seal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

Cooling, Conduction:

The conduction cylinder must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the conduction cylinder to the specified maximum value of 250° C. The plate, grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective seal temperature to the specified maximum value of 250° C.

AF POWER AMPLIFIER & MODULATOR — Class AB_1♦

Maximum CCS♣ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	4.5	max.	watts
PLATE DISSIPATION♠	♣		

Typical CCS Push-Pull Operation:

	Values are for 2 tubes		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage#	30	30	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	200	200	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Effective Load Resistance (Plate to plate)	4330	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:*

For fixed-bias operation	30000 max.	ohms
For cathode-bias operation	Not recommended	

AF POWER AMPLIFIER & MODULATOR — Class AB_2*

Maximum CCS♣ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT♠	30	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	4.5	max.	watts
PLATE DISSIPATION♠	♣		

Typical CCS Push-Pull Operation:

	Values are for 2 tubes		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	46	46	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	355	355	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	25	25	ma
Max.-Signal DC Grid-No.1 Current	15	15	ma
Effective Load Resistance (Plate to plate)	2450	3960	ohms
Max.-Signal Driving Power (Approx.)†	0.3	0.3	watt
Max.-Signal Power Output (Approx.)	85	140	watts

LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc		
DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT	30	max.	ma
MAX.-SIGNAL PLATE INPUT	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	4.5	max.	watts
PLATE DISSIPATION	♣		

Typical CCS Class AB$_1$ "Single-Tone" Operation:‡

	Up to 60 Mc		
DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage	-15	-15	volts
Zero-Signal DC Plate Current	40	40	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Effective RF Load Resistance	2165	3500	ohms
Max.-Signal DC Plate Current	100	100	ma
Max.-Signal DC Grid-No.2 Current	10	10	ma
Max.-Signal DC Grid-No.1 Current	0	0	ma
Max.-Signal Peak RF Grid-No.1 Voltage	15	15	volts
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	25	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:
- For fixed-bias operation . . . . 30000 max. ohms
- For cathode-bias operation . . . . Not recommended

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

Maximum CCS♠ Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc		
DC PLATE VOLTAGE	800	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
DC GRID-No.1 VOLTAGE	-100	max.	volts
DC PLATE CURRENT	150	max.	ma
DC GRID-No.1 CURRENT	30	max.	ma
PLATE INPUT	120	max.	watts
GRID-No.2 INPUT	3	max.	watts
PLATE DISSIPATION	♣		

Typical CCS Operation:

	At 400 Mc		
DC Plate Voltage	400	700	volts
DC Grid-No.2 Voltage§	200	250	volts
DC Grid-No.1 Voltage□	-20	-50	volts
DC Plate Current	100	130	ma
DC Grid-No.2 Current	5	10	ma
DC Grid-No.1 Current	5	10	ma
Driver Power Output (Approx.)◊	2	3	watts
Useful Power Output (Approx.)	16	45	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . . 30000♡ max. ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy▲▲
and
RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCS♠ Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc		
DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
DC GRID-No.1 VOLTAGE	-100	max.	volts
DC PLATE CURRENT	180	max.	ma
DC GRID-No.1 CURRENT	30	max.	ma
PLATE INPUT	180	max.	watts
GRID-No.2 INPUT	4.5	max.	watts
PLATE DISSIPATION	♣		

Typical CCS Operation:

	At 400 Mc		*At 1215 Mc*	
DC Plate Voltage	400	900	900	volts
DC Grid-No.2 Voltage●●	200	300	300	volts
DC Grid-No.1 Voltage★★	-35	-30	-22	volts
DC Plate Current	150	170	170	ma
DC Grid-No.2 Current	5	1	1	ma
DC Grid-No.1 Current	3	10	4	ma

Driver Power Output (Approx.)◊. .	3	3	5	watts
Useful Power Output (Approx.) . .	23	80	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . . 30000♡ max. ohms

▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

● Measured with special shield adapter.

★ For socket to be used with the 7842, consult manufacturers such as J-V-M Microwave Company, 9300 West 47th Street, Brookfield, Illinois; E.F. Johnson Company, Waseca, Minnesota; Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa; and Jettron Products, Route 10, Hanover, New Jersey.

♦ Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

♦ Continuous Commercial Service.

♠ Averaged over any audio-frequency cycle of sine-wave form.

♣ Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data*, and also *Cooling Considerations*.

⊕ Preferably obtained from a fixed supply.

The driver stage should be capable of supplying the No.1 grids of the Class AB_1 stage with the specified driving voltage at low distortion.

* The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer- or impedance-coupling devices are recommended.

♣ Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

† Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.

‡ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

§ Obtained preferably from a separate source modulated along with the plate supply.

□ Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

◊ The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

♡ If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

▲▲ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

●● Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

★★ Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
1. Heater Current	1	2.74	3.35	amp
2. Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.065	$\mu\mu$f
Grid No.1 to cathode & heater	2	11.8	15.2	$\mu\mu$f
Plate to cathode & heater	2	-	0.019	$\mu\mu$f
Grid No.1 to grid No.2	2	17.3	21.9	$\mu\mu$f
Grid No.2 to plate	2	4	5.1	$\mu\mu$f
Grid No.2 to cathode & heater	2	-	1.3	$\mu\mu$f
3. Grid-No.1 Voltage	1,3	-6	-15	volts
4. Reverse Grid-No.1 Current	1,3	-	-20	μa
5. Grid-No.2 Current	1,3	-8	2	ma
6. Peak Emission Voltage	1,4	-	400	volts
7. Interelectrode Leakage Resistance	5	1	-	megohm
8. Useful Power Output	6	80	-	watts

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

Note 2: Measured with special shield adapter.

Note 3: With dc voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a single-tube, grid-driven, coaxial-cavity, class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

SPECIAL TESTS & PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N.J., on request.

50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

a. 5-to-10 cps with fixed double amplitude of 0.080 inch ± 10%.

b. 10-to-15 cps at fixed acceleration of 0.41 g ± 10%.

c. 15-to-75 cps with fixed double amplitude of 0.036 inch ± 10%.

d. 75-to-2000 cps at fixed acceleration of 10 g ± 10%.

During the above vibration tests, tubes will not show an rms output voltage in excess of 15 volts across the plate load resistor in the 5-to-2000 cycle range. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design.*

COOLING CONSIDERATIONS

The conduction-cooling system consists, in general, of a constant-temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Careful consideration should be given to the design of a heat-flow path through a coupling device having low electrical conductivity and high thermal conductivity.

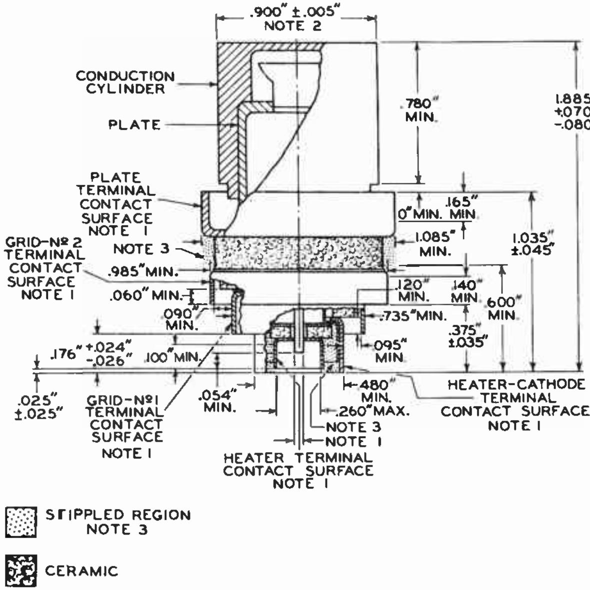
The maximum plate dissipation may be calculated from the equation:

$$W = KA\frac{(T_2 - T_1)}{L}$$

where:

- W = maximum plate dissipation in watts
- K = thermal conductivity♦♦ of the coupling material
- A = area measured at right angles to the direction of the flow of heat in square inches
- T_2, T_1 = temperature in degrees Centigrade of planes or surfaces under consideration
- L = length of heat path in inches through coupling material to produce temperature gradient

♦♦ Thermal conductivity is defined as the time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured in watts per square inch for a thickness of one inch and a difference of temperature of 1° C.



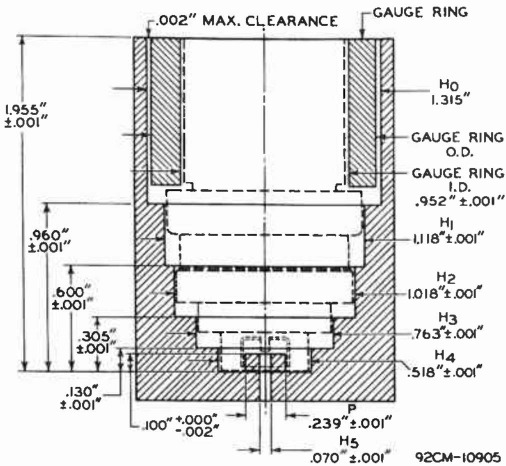
92CM-9218R4

NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF H_4. THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE H_4.

NOTE 2: WITH THE TUBE SEATED IN GAUGE AND WITH THE CONDUCTION CYLINDER CLEAN, SMOOTH, AND FREE OF BURRS, THE GAUGE RING WILL SLIP OVER CONDUCTION CYLINDER AS SHOWN IN SKETCH G_1.

NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

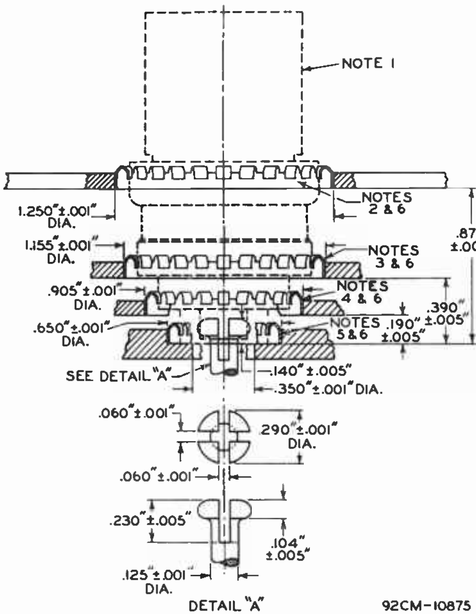
SKETCH G_1



THE AXES OF THE CYLINDRICAL HOLES H_1 THROUGH H_5 AND THE AXIS OF POST P ARE COINCIDENT WITHIN 0.001".

THE AXES OF THE GAUGE-RING INSIDE DIAMETER AND GAUGE-RING OUTSIDE DIAMETER ARE COINCIDENT WITHIN 0.001".

SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS



NOTE 1: IF A CLAMP IS USED, IT MUST BE ADJUSTABLE IN A PLANE NORMAL TO THE MAJOR TUBE AXIS TO COMPENSATE FOR VARIATIONS IN CONCENTRICITY BETWEEN THE CONDUCTION CYLINDER AND THE CONTACT TERMINALS.

NOTE 2: CONTACT RING No. 97-252 OR FINGER STOCK No. 97-380.

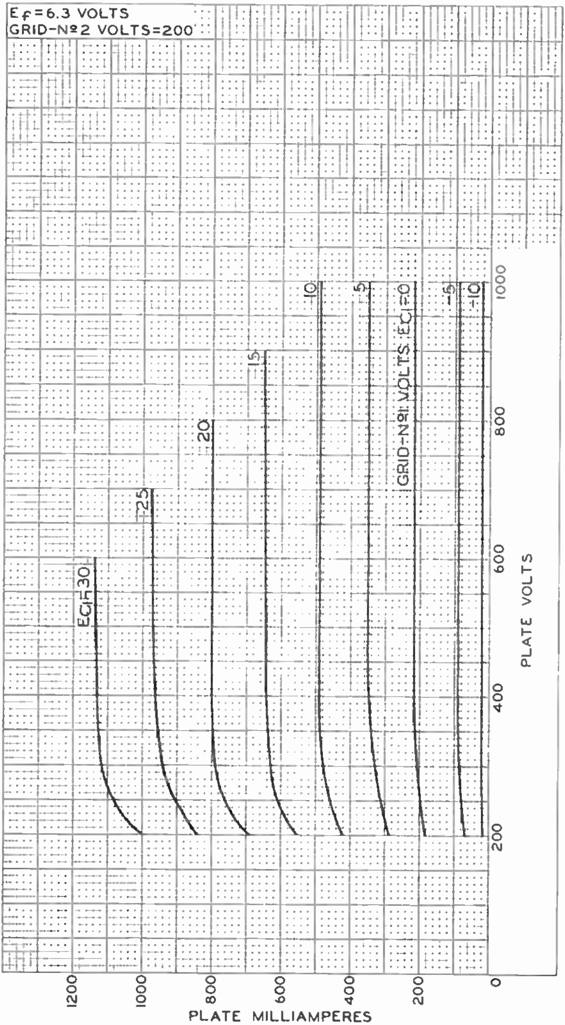
NOTE 3: CONTACT RING No. 97-253 OR FINGER STOCK No. 97-380.

NOTE 4: CONTACT RING No. 97-254 OR FINGER STOCK No. 97-380.

NOTE 5: CONTACT RING No. 97-255 OR FINGER STOCK No. 97-380.

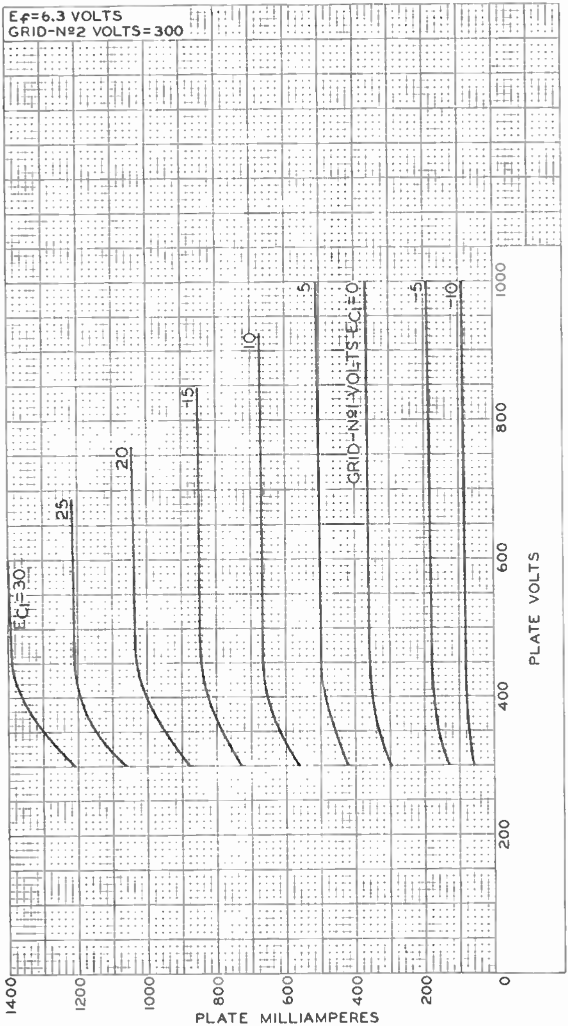
NOTE 6: THE SPECIFIED CONTACT RING OF PREFORMED FINGER STOCK AND FINGER STOCK No. 97-380 PROVIDE ADEQUATE ELECTRICAL CONTACT, BUT THE FINGER STOCK No. 97-380 IS LESS SUSCEPTIBLE TO BREAKAGE THAN THE SPECIFIED CONTACT RING. BOTH TYPES ARE MADE BY INSTRUMENTS SPECIALTIES COMPANY, LITTLE FALLS, NEW JERSEY.

TYPICAL PLATE CHARACTERISTICS



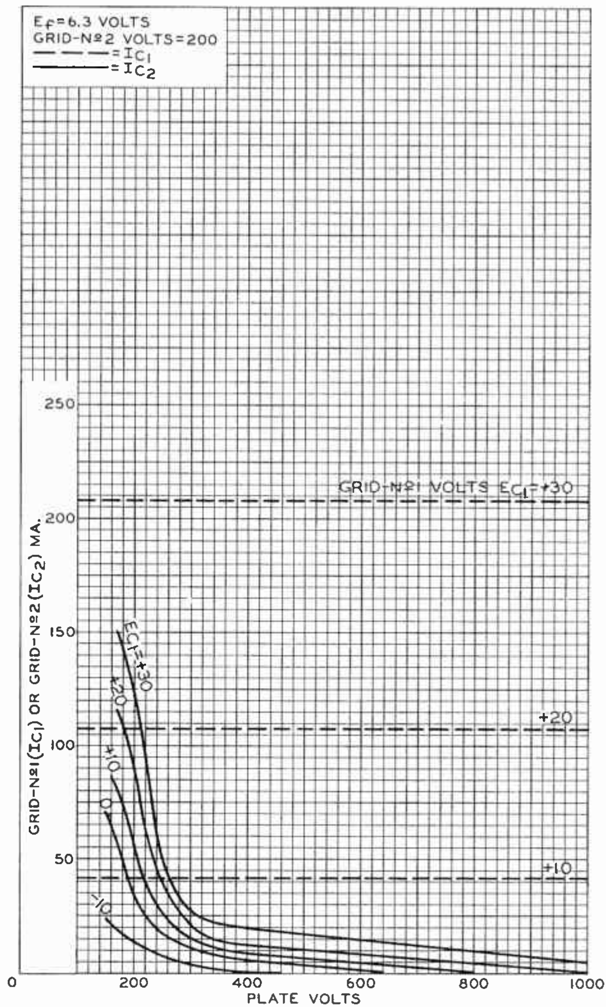
92CM-9228R2

TYPICAL PLATE CHARACTERISTICS



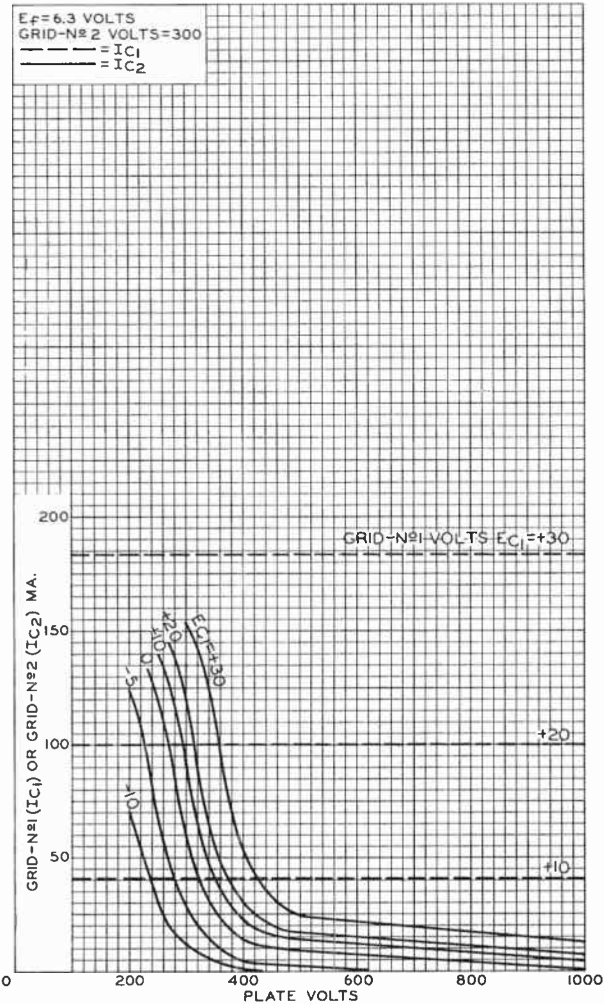
92CM-9222R1

TYPICAL CHARACTERISTICS



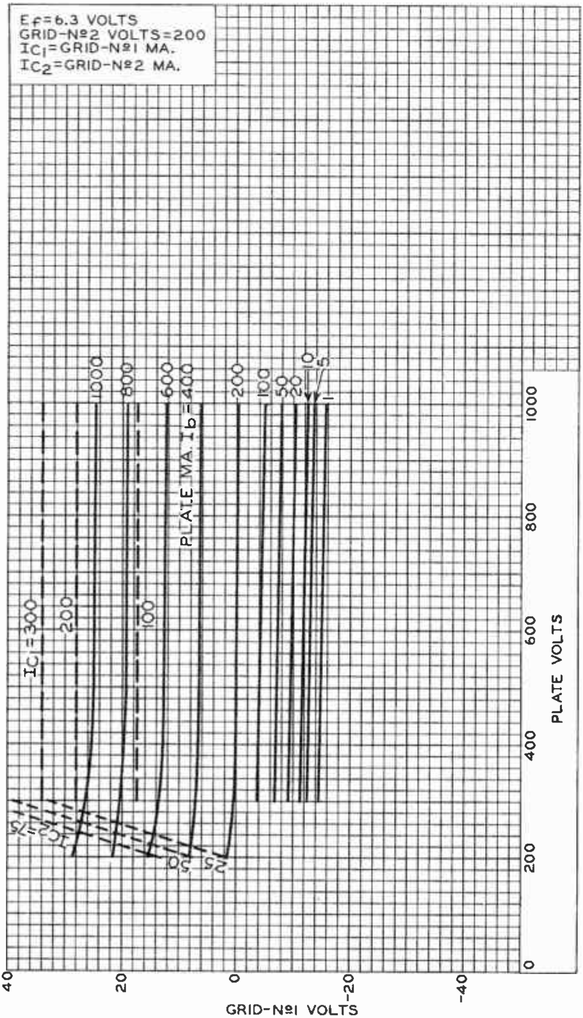
92CM-9224R1

TYPICAL CHARACTERISTICS



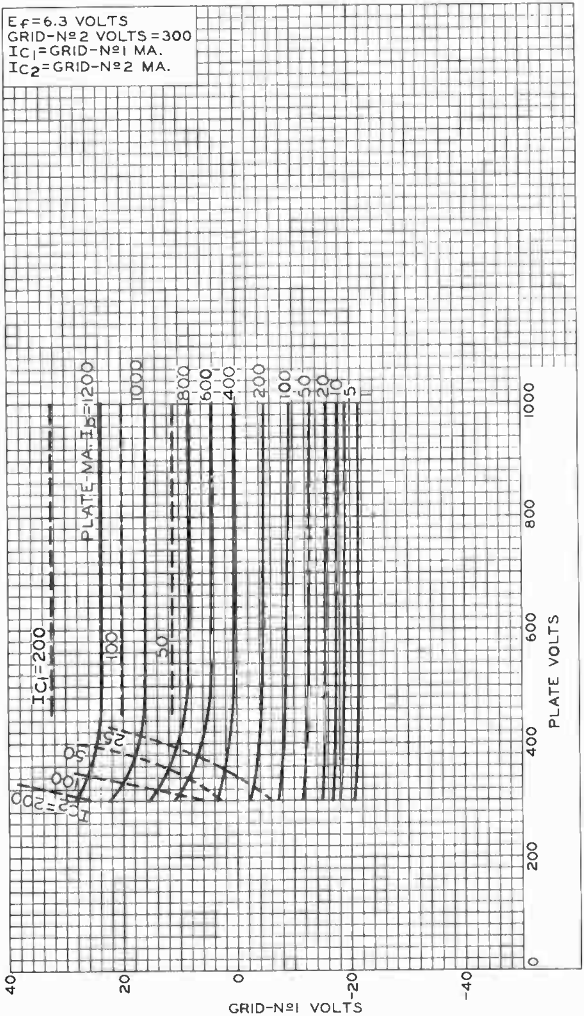
92CM-9225R2

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9233R1

TYPICAL CONSTANT-CURRENT CHARACTERISTICS

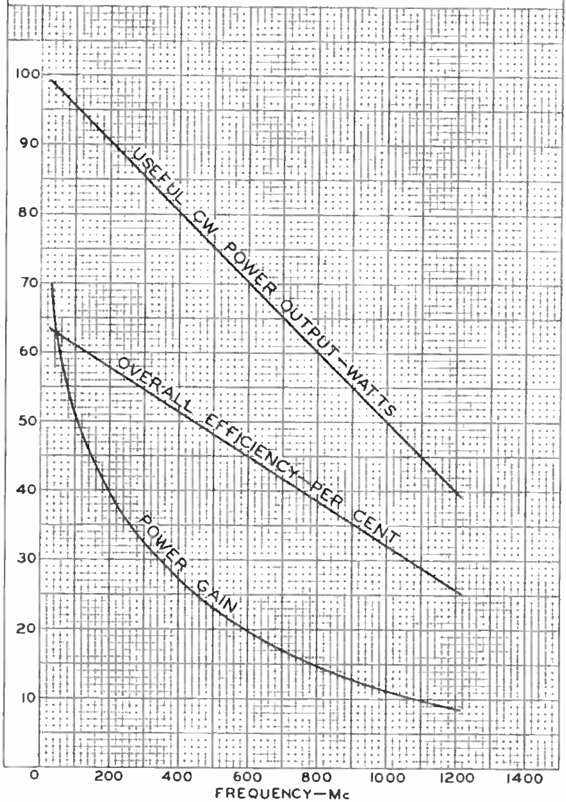


92CM-9232R1

TYPICAL PERFORMANCE CHARACTERISTICS

In Class C Telegraphy or Class C FM Telephony Amplifier Service

E_f = ADJUSTED TO SIMULATE NORMAL OPERATING CONDITIONS OF HEATER IN UHF SERVICE
PLATE VOLTS = 900
GRID-No 2 VOLTS = 300
PLATE AMPERES = 0.170
OVERALL EFFICIENCY = USEFUL POWER OUTPUT IN LOAD DIVIDED BY DC PLATE INPUT
POWER GAIN = USEFUL POWER OUTPUT IN LOAD DIVIDED BY DRIVER POWER OUTPUT



92CM-9221

Beam Power Tube

CERAMIC-METAL SEALS
UNIPOTENTIAL CATHODE
CONDUCTION COOLING

COAXIAL-ELECTRODE STRUCTURE
INTEGRAL CONDUCTION CYLINDER
180 WATTS CW INPUT UP TO 1215 Mc

For Use at Frequencies up to 2000 Mc

The 7843 is the same as the 7844 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	26.5 ± 10%	volts
Current at heater volts = 26.5.	0.52	amp

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current.	1	0.45	0.57	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.065	μμf
Grid No.1 to cathode & heater. . .	2	11.8	15.2	μμf
Plate to cathode & heater	2	-	0.015	μμf
Grid No.1 to grid No.2.	2	15.9	18.9	μμf ←
Grid No.2 to plate.	2	4	5	μμf
Grid No.2 to cathode & heater. . .	2	-	0.4	μμf
Grid-No.1 Voltage	1,3	-6.5	-15	volts
Grid-No.1 Cutoff Voltage.	1,4	-	-30	volts
Grid-No.1 Current	1,5	10	-	ma
Reverse Grid-No.1 Current	1,3	-	-20	μa
Grid-No.2 Current	1,3	-8	+2	ma
Peak Emission Voltage	1,6	-	400	volts
Interelectrode Leakage Resistance .	7	1	-	megohm
Useful Power Output	8	80	-	watts

Note 1: With 26.5 volts ac or dc on heater.

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With plate and grid-No.2 floating and dc grid-No.1 voltage of +2 volts.

Note 6: For conditions with: grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 7: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

← Indicates a change.

Note 8: In a single-tube, grid-driven, coaxial-cavity class-C-amplifier circuit at 400 Mc and for conditions with 24 volts ac or dc on heater, dc plate voltage of 100 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

Beam Power Tube

CERAMIC-METAL SEALS
UNIPOTENTIAL CATHODE
CONDUCTION COOLING

COAXIAL-ELECTRODE STRUCTURE
INTEGRAL CONDUCTION CYLINDER
180 WATTS CW INPUT UP TO 1215 Mc

For Use at Frequencies up to 2000 Mc

The 7843 is the same as the 7844 except for the following items:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)▲	26.5 ± 10%	volts
Current at 26.5 volts	0.52	amp

▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current.	1	0.45	0.57	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate.	2	-	0.065	μμf
Grid No.1 to cathode & heater. . .	2	11.8	15.2	μμf
Plate to cathode & heater	2	-	0.015	μμf
Grid No.1 to grid No.2.	2	16.9	21	μμf
Grid No.2 to plate.	2	4	5	μμf
Grid No.2 to cathode & heater. . .	2	-	0.4	μμf
Grid-No.1 Voltage	1,3	-6.5	-15	volts
Grid-No.1 Cutoff Voltage.	1,4	-	-30	volts
Grid-No.1 Current	1,5	10	-	ma
Reverse Grid-No.1 Current	1,3	-	-20	μa
Grid-No.2 Current	1,3	-8	+2	ma
Peak Emission Voltage	1,6	-	400	volts
Interelectrode Leakage Resistance .	7	1	-	megohm
Useful Power Output	8	80	-	watts

Note 1: With 26.5 volts ac or dc on heater.

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4 With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With plate and grid-No.2 floating and dc grid-No.1 voltage of +2 volts.

Note 6: For conditions with: grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 7: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 8: In a single-tube, grid-driven, coaxial-cavity class-C-amplifier circuit at 400 Mc and for conditions with 24 volts ac or dc on heater, dc plate voltage of 100 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

Beam Power Tube

CERAMIC-METAL SEALS
UNIPOTENTIAL CATHODE
CONDUCTION COOLED

COAXIAL-ELECTRODE STRUCTURE
INTEGRAL CONDUCTION CYLINDER
180 WATTS CW INPUT UP TO 1215 Mc

For Use at Frequencies up to 2000 Mc

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

Voltage (AC or DC)▲	6.3 ± 10%	volts
Current at heater volts = 6.3	2.1	amp
Minimum heating time	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100	18	

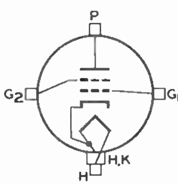
Direct Interelectrode Capacitances:●

Grid No.1 to plate	0.065 max.	μμf
Grid No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.015 max.	μμf
Grid No.1 to grid No.2	17	μμf ←
Grid No.2 to plate	4.4	μμf
Grid No.2 to cathode & heater	0.4 max.	μμf

Mechanical:

Operating Position . . . . Any
Overall Length . . . . 1.885" +0.070" −0.080"
Greatest Diameter (See *Dimensional Outline*) . . . . . 1.119"
Weight (Approx.) . . . . 2 oz
Socket:
For frequencies up to about 400 Mc . . . . ★
For use at higher frequencies . . . See *Mounting Arrangement*
Terminal Connections (See *Dimensional Outline*):

G_1 – Grid-No.1-Terminal Contact Surface
G_2 – Grid-No.2-Terminal Contact Surface
H – Heater-Terminal Contact Surface



H,K – Heater- & Cathode-Terminal Contact Surface
P – Plate-Terminal Contact Surface

Thermal:

Conduction-Cylinder Temperature . . . . 250 max. °C
Seal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater) . . . . 250 max. °C
Cooling, Conduction:
The conduction cylinder must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the conduction cylinder to the specified maximum

← indicates a change.

value of 250° C. The plate, grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective seal temperature to the specified maximum value of 250° C.

AF POWER AMPLIFIER & MODULATOR — Class AB_1♦

Maximum CCS● Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	7	max.	watts
PLATE DISSIPATION♠	♣		

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage⊕	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage#	30	30	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	200	200	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Effective Load Resistance (Plate to plate)	4330	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:*

For fixed-bias operation	30000 max.	ohms
For cathode-bias operation	Not recommended	

AF POWER AMPLIFIER & MODULATOR — Class AB_2⊕

Maximum CCS● Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000	max.	volts
DC GRID-No.2 VOLTAGE	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT♠	30	max.	ma
MAX.-SIGNAL PLATE INPUT♠	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	7	max.	watts
PLATE DISSIPATION♠	♣		

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage⊕	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	46	46	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	355	355	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma

♣ Continuous Commercial Service.

♠ Averaged over any audio-frequency cycle of sine-wave form.

♣ Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data*, and also *Cooling Considerations*.

⊕ Preferably obtained from a fixed supply.

The driver stage should be capable of supplying the No.1 grids of the Class AB_1 stage with the specified driving voltage at low distortion.

* The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer- or impedance-coupling devices are recommended.

♣ Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

† Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.

‡ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

§ Obtained preferably from a separate source modulated along with the plate supply.

□ Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

◇ The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

♡ If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

▲▲ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio frequency envelope does not exceed 115 per cent of the carrier conditions.

●● Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

★★ Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	1.84	2.26	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.065	μμf
Grid No.1 to cathode & heater	2	11.8	15.2	μμf
Plate to cathode & heater	2	-	0.015	μμf
Grid No.1 to grid No.2	2	15.9	18.9	μμf ←
Grid No.2 to plate	2	4	5	μμf
Grid No.2 to cathode & heater	2	-	0.4	μμf
Grid-No.1 Voltage	1,3	-6	-15	volts ←
Grid-No.1 Cutoff Voltage	1,4	-	-30	volts
Grid-No.1 Current	1,5	10	-	ma
Reverse Grid-No.1 Current	1,3	-	-20	μa
Grid-No.2 Current	1,3	-8	+2	ma
Peak Emission Voltage	1,6	-	400	volts
Interelectrode Leakage Resistance	7	1	-	megohm
Useful Power Output	8	80	-	watts

← Indicates a change.

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With plate and grid-No.2 floating and dc grid-No.1 voltage of +2 volts.

Note 6: For conditions with: grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 7: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 8: In a single-tube, grid-driven, coaxial-cavity class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate voltage of 100 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

COOLING CONSIDERATIONS

The conduction-cooling system consists, in general, of a constant-temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Careful consideration should be given to the design of a heat-flow path through a coupling device having low electrical conductivity and high thermal conductivity.

The maximum plate dissipation may be calculated from the equation:

$$W = KA \frac{(T_2 - T_1)}{L}$$

where:

W = maximum plate dissipation in watts

K = thermal conductivity♦♦ of the coupling material

A = area measured at right angles to the direction of the flow of heat in square inches

T_2, T_1 = temperature in degrees Centigrade of planes or surfaces under consideration

L = length of heat path in inches through coupling material to produce temperature gradient

♦♦ Thermal conductivity is defined as the time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured in watts per square inch for a thickness of one inch and a difference of temperature of 1° C.

Beam Power Tube

CERAMIC-METAL SEALS
UNIPOTENTIAL CATHODE
CONDUCTION COOLED

COAXIAL-ELECTRODE STRUCTURE
INTEGRAL CONDUCTION CYLINDER
180 WATTS CW INPUT UP TO 1215 Mc

For Use at Frequencies up to 2000 Mc

GENERAL DATA

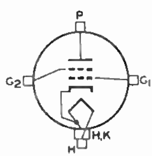
Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)▲	6.3 ± 10%	volts
Current at 6.3 volts.	2.1	amp
Minimum heating time.	60	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100. . . .	18	
Direct Interelectrode Capacitances:●		
Grid No.1 to plate.	0.065 max.	μμf
Gric No.1 to cathode & heater	14	μμf
Plate to cathode & heater	0.015 max.	μμf
Grid No.1 to grid No.2.	19	μμf
Grid No.2 to plate.	4.4	μμf
Grid No.2 to cathode & heater	0.4 max.	μμf

Mechanical:

Operating Position. . . . . Any
Overall Length. . . . . 1.885" +0.070" −0.080"
Greatest Diameter (See *Dimensional Outline*) . . . . . 1.119"
Weight (Approx.). . . . . 2 oz
Socket:
For frequencies up to about 400 Mc. . . . . ★
For use at higher frequencies . . .See *Mounting Arrangement*
Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Thermal:

Conduction-Cylinder Temperature . . . . 250 max. °C
Seal Temperature (Plate, Grid No.2, Grid No.1, Cathode, and Heater) . . . . 250 max. °C
Cooling, Conduction:
The conduction cylinder must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the conduction cylinder to the specified maximum

value of 250° C. The plate, grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective seal temperature to the specified maximum value of 250° C.

AF POWER AMPLIFIER & MODULATOR — Class AB_1♦

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 VOLTAGE	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180 max.	ma
MAX.-SIGNAL PLATE INPUT♠	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	7 max.	watts
PLATE DISSIPATION♠	♣	

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage#	30	30	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	200	200	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Effective Load Resistance (Plate to plate)	4330	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	50	80	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:*

For fixed-bias operation	30000 max.	ohms
For cathode-bias operation	Not recommended	

AF POWER AMPLIFIER & MODULATOR — Class AB_2♦

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 VOLTAGE	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT♠	180 max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT♠	30 max.	ma
MAX.-SIGNAL PLATE INPUT♠	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♠	7 max.	watts
PLATE DISSIPATION♠	♣	

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	46	46	volts
Zero-Signal DC Plate Current	80	80	ma
Max.-Signal DC Plate Current	355	355	ma
Zero-Signal DC Grid-No.2 Current	0	0	ma

Max.-Signal DC Grid-No.2 Current.	25	25	ma
Max.-Signal DC Grid-No.1 Current.	15	15	ma
Effective Load Resistance (Plate to plate) . .	2450	3960	ohms
Max.-Signal Driving Power (Approx.)†. . . .	0.3	0.3	watt
Max.-Signal Power Output (Approx.).	85	140	watts

LINEAR RF POWER AMPLIFIER

Single-Sideband Suppressed-Carrier Service

Maximum CCS♦ Ratings, *Absolute-Maximum Values:*

	Up to 1215 Mc	
DC PLATE VOLTAGE.	1000 max.	volts
DC GRID-No.2 VOLTAGE.	300 max.	volts
MAX.-SIGNAL DC PLATE CURRENT.	180 max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT.	30 max.	ma
MAX.-SIGNAL PLATE INPUT	180 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT	7 max.	watts
PLATE DISSIPATION	♣	

Typical CCS Class AB_1 "Single-Tone" Operation:

	Up to 60 Mc		
DC Plate Voltage.	650	850	volts
DC Grid-No.2 Voltage®	300	300	volts
DC Grid-No.1 Voltage.	-15	-15	volts
Zero-Signal DC Plate Current.	40	40	ma
Zero-Signal DC Grid-No.2 Current.	0	0	ma
Effective RF Load Resistance.	2165	3500	ohms
Max.-Signal DC Plate Current.	100	100	ma
Max.-Signal DC Grid-No.2 Current.	10	10	ma
Max.-Signal DC Grid-No.1 Current.	0	0	ma
Max.-Signal Peak RF Grid-No.1 Voltage . . .	15	15	volts
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.).	25	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation.	30000 max.	ohms
For cathode-bias operation.	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

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

Maximum CCS♦ Ratings, *Absolute-Maximum Values:*

	Up to 1215 Mc	
DC PLATE VOLTAGE.	800 max.	volts
DC GRID-No.2 VOLTAGE.	300 max.	volts
DC GRID-No.1 VOLTAGE.	-100 max.	volts
DC PLATE CURRENT.	150 max.	ma
DC GRID-No.1 CURRENT.	30 max.	ma
PLATE INPUT	120 max.	watts
GRID-No.2 INPUT	4.6 max.	watts
PLATE DISSIPATION	♣	

Typical CCS Operation:

	At 400 Mc		
DC Plate Voltage	400	700	volts
DC Grid-No.2 Voltage§	200	250	volts
DC Grid-No.1 Voltage□	-20	-50	volts
DC Plate Current	100	130	ma
DC Grid-No.2 Current	5	10	ma
DC Grid-No.1 Current	5	10	ma
Driver Power Output (Approx.)◊	2	3	watts
Useful Power Output (Approx.)	16	45	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . 30000♡ max. ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy▲▲
and
RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCS♦ Ratings, ***Absolute-Maximum Values:***

	Up to 1215 Mc	
DC PLATE VOLTAGE	1000 max.	volts
DC GRID-No.2 VOLTAGE	300 max.	volts
DC GRID-No.1 VOLTAGE	-100 max.	volts
DC PLATE CURRENT	180 max.	ma
DC GRID-No.1 CURRENT	30 max.	ma
PLATE INPUT	180 max.	watts
GRID-No.2 INPUT	7 max.	watts
PLATE DISSIPATION	♣	

Typical CCS Operation:

	At 400 Mc		At 1215 Mc	
DC Plate Voltage	400	900	900	volts
DC Grid-No.2 Voltage●●	200	300	300	volts
DC Grid-No.1 Voltage★★	-35	-30	-22	volts
DC Plate Current	150	170	170	ma
DC Grid-No.2 Current	5	1	1	ma
DC Grid-No.1 Current	3	10	4	ma
Driver Power Output (Approx.)◊	3	3	5	watts
Useful Power Output (Approx.)	23	80	40	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . 30000♡ max. ohms

▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

● Measured with special shield adapter.

★ For socket to be used with the 7844, consult manufacturers such as J-V-M Microwave Company, 9300 West 47th Street, Brookfield, Illinois; E.F. Johnson Company, Waseca, Minnesota; and Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa; and Jettron Products, Route 10, Hanover, New Jersey.

♦ Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

♠ Continuous Commercial Service.

♠ Averaged over any audio-frequency cycle of sine-wave form.

♣ Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data*, and also *Cooling Considerations*.

⊕ Preferably obtained from a fixed supply.

The driver stage should be capable of supplying the No.1 grids of the Class AB_1 stage with the specified driving voltage at low distortion.

* The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer- or impedance-coupling devices are recommended.

♣ Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

† Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.

‡ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

§ Obtained preferably from a separate source modulated along with the plate supply.

□ Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

◇ The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

▽ If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

▲▲ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio frequency envelope does not exceed 115 per cent of the carrier conditions.

●● Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.

** Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current	1	1.84	2.26	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.065	μμf
Grid No.1 to cathode & heater	2	11.8	15.2	μμf
Plate to cathode & heater	2	-	0.015	μμf
Grid No.1 to grid No.2	2	16.9	21	μμf
Grid No.2 to plate	2	4	5	μμf
Grid No.2 to cathode & heater	2	-	0.4	μμf
Grid-No.1 Voltage	1,3	-6.5	-15	volts
Grid-No.1 Cutoff Voltage	1,4	-	-30	volts
Grid-No.1 Current	1,5	10	-	ma
Reverse Grid-No.1 Current	1,3	-	-20	μa
Grid-No.2 Current	1,3	-8	+2	ma
Peak Emission Voltage	1,6	-	400	volts
Interelectrode Leakage Resistance	7	1	-	megohm
Useful Power Output	8	80	-	watts

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: With dc plate voltage of 1000 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With plate and grid-No.2 floating and dc grid-No.1 voltage of +2 volts.

Note 6: For conditions with: grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 7: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 8: In a single-tube, grid-driven, coaxial-cavity class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate voltage of 100 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

COOLING CONSIDERATIONS

The conduction-cooling system consists, in general, of a constant-temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Careful consideration should be given to the design of a heat-flow path through a coupling device having low electrical conductivity and high thermal conductivity.

The maximum plate dissipation may be calculated from the equation:

$$W = KA\frac{(T_2 - T_1)}{L}$$

where:

W = maximum plate dissipation in watts

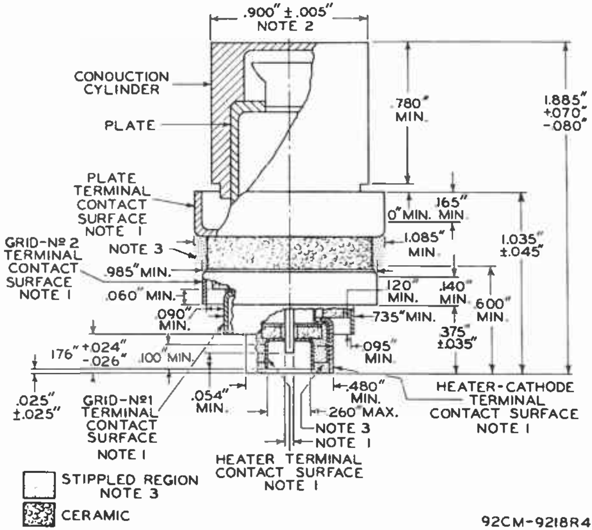
K = thermal conductivity♦♦ of the coupling material

A = area measured at right angles to the direction of the flow of heat in square inches

T_2, T_1 = temperature in degrees Centigrade of planes or surfaces under consideration

L = length of heat path in inches through coupling material to produce temperature gradient

♦♦ Thermal conductivity is defined as the time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured in watts per square inch for a thickness of one inch and a difference of temperature of 1° C.



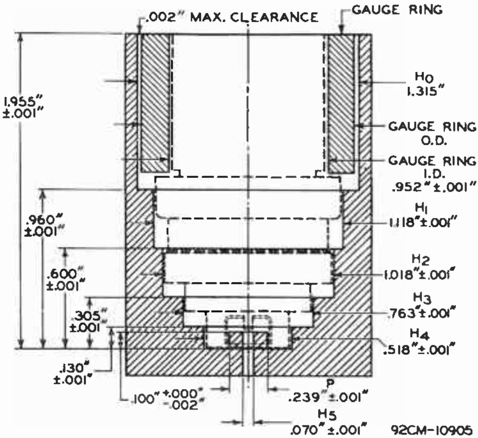
92CM-9218R4

NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1. THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF H_4. THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE H_4.

NOTE 2: WITH THE TUBE SEATED IN GAUGE AND WITH THE CONDUCTION CYLINDER CLEAN, SMOOTH, AND FREE OF BURRS, THE GAUGE RING WILL SLIP OVER CONDUCTION CYLINDER AS SHOWN IN SKETCH G_1.

NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

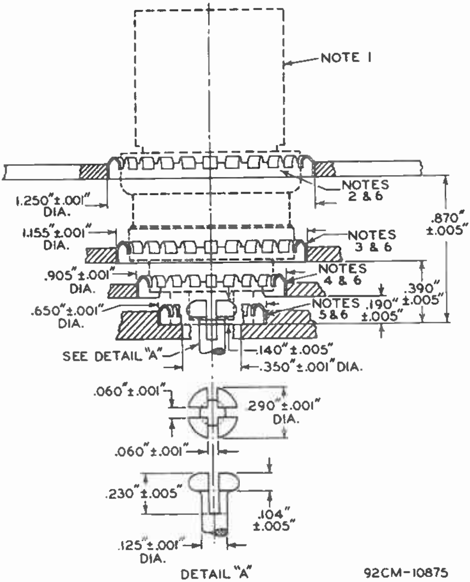
SKETCH G1



THE AXES OF THE CYLINDRICAL HOLES H_1 THROUGH H_5 AND THE AXIS OF POST P ARE COINCIDENT WITHIN 0.001".

THE AXES OF THE GAUGE-RING INSIDE DIAMETER AND GAUGE-RING OUTSIDE DIAMETER ARE COINCIDENT WITHIN 0.001".

SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS



NOTE 1: IF A CLAMP IS USED, IT MUST BE ADJUSTABLE IN A PLANE NORMAL TO THE MAJOR TUBE AXIS TO COMPENSATE FOR VARIATIONS IN CONCENTRICITY BETWEEN THE CONDUCTION CYLINDER AND THE CONTACT TERMINALS.

NOTE 2: CONTACT RING No.97-252 OR FINGER STOCK No.97-380.

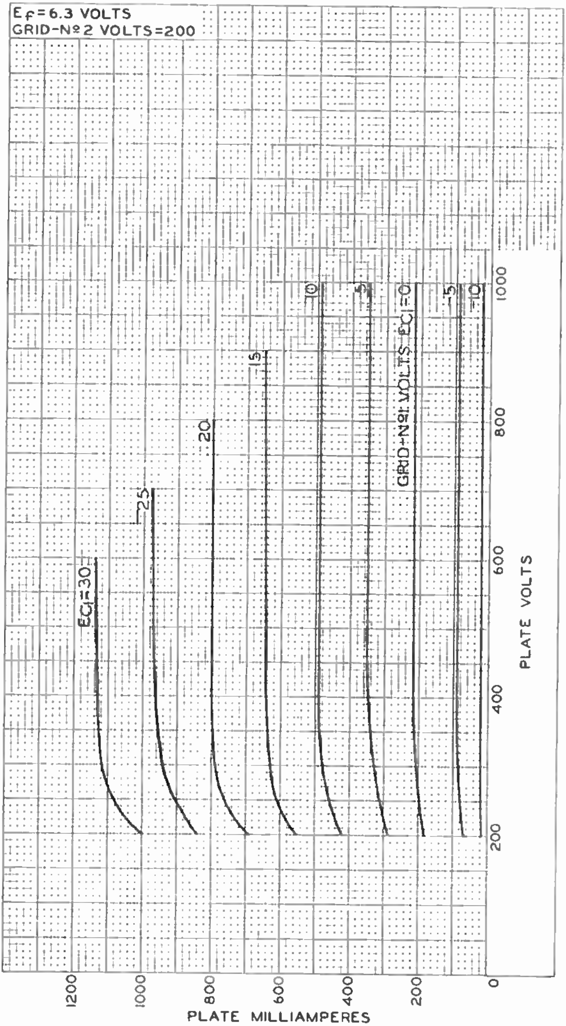
NOTE 3: CONTACT RING No.97-253 OR FINGER STOCK No.97-380.

NOTE 4: CONTACT RING No.97-254 OR FINGER STOCK No.97-380.

NOTE 5: CONTACT RING No.97-255 OR FINGER STOCK No.97-380.

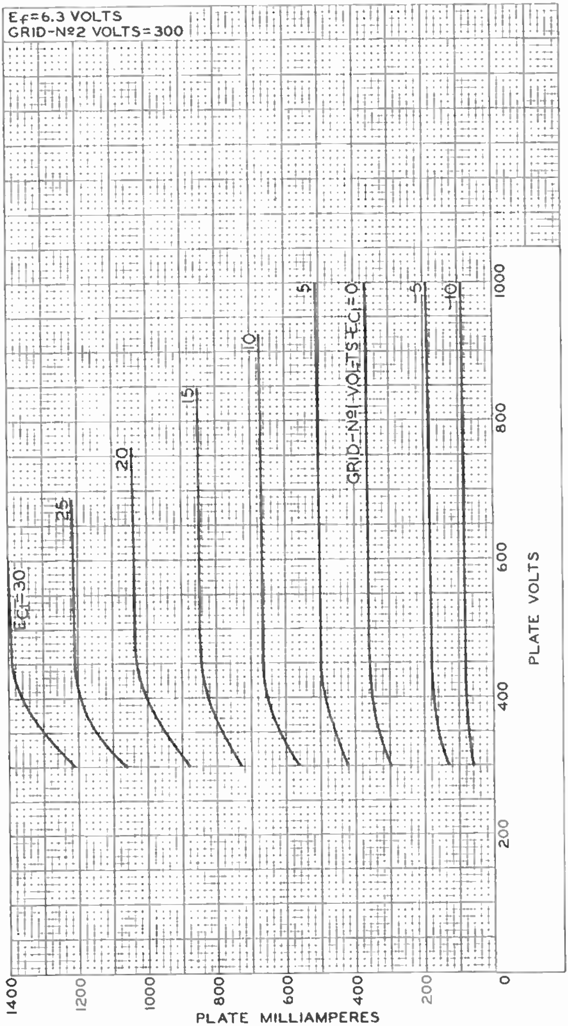
NOTE 6: THE SPECIFIED CONTACT RING OF PREFORMED FINGER STOCK AND FINGER STOCK No.97-380 PROVIDE ADEQUATE ELECTRICAL CONTACT, BUT THE FINGER STOCK No.97-380 IS LESS SUSCEPTIBLE TO BREAKAGE THAN THE SPECIFIED CONTACT RING. BOTH TYPES ARE MADE BY INSTRUMENTS SPECIALTIES COMPANY, LITTLE FALLS, NEW JERSEY.

TYPICAL PLATE CHARACTERISTICS



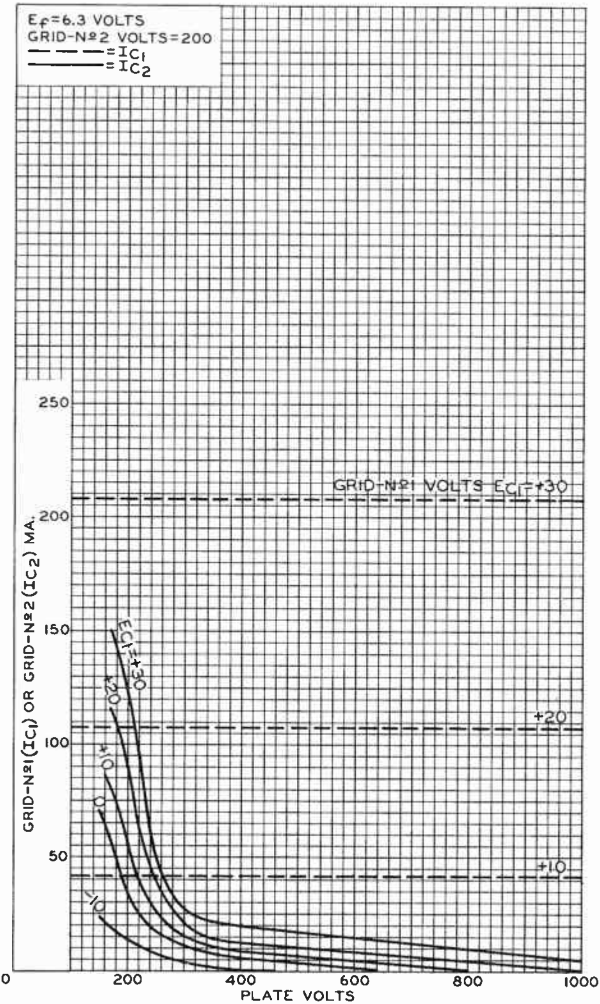
92CM-9228R2

TYPICAL PLATE CHARACTERISTICS



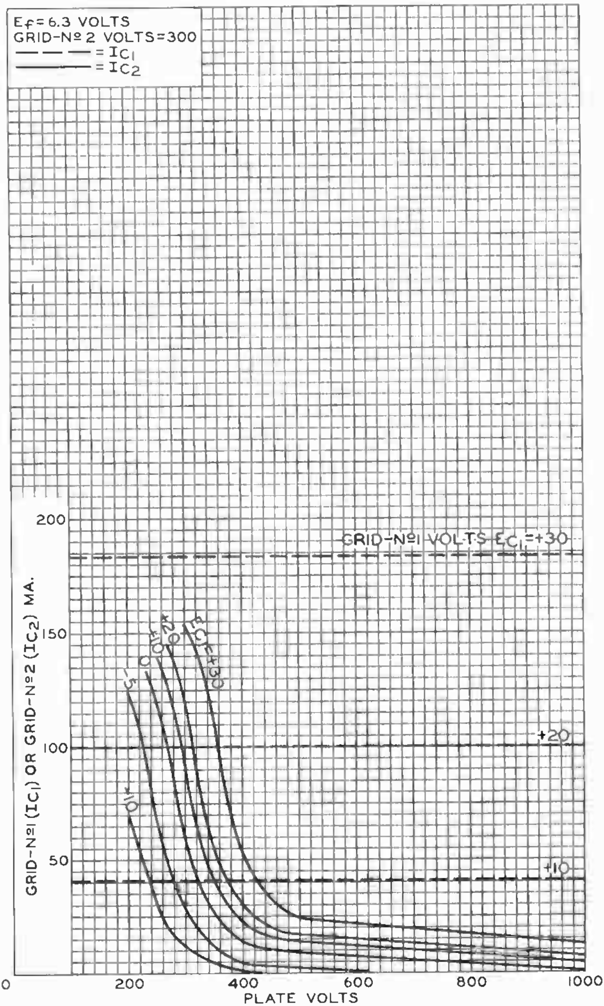
92CM-9222R1

TYPICAL CHARACTERISTICS



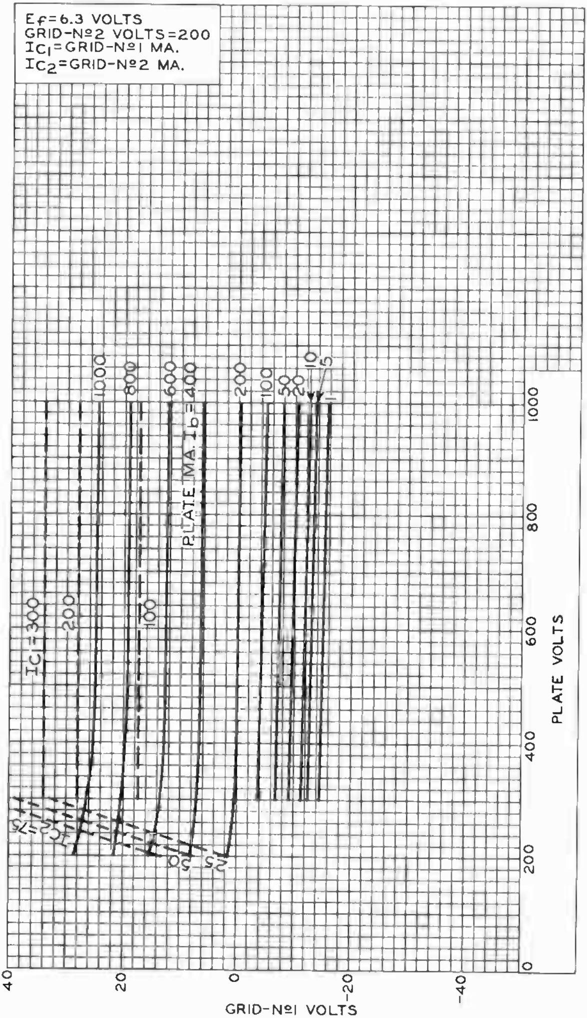
92CM-9224R1

TYPICAL CHARACTERISTICS

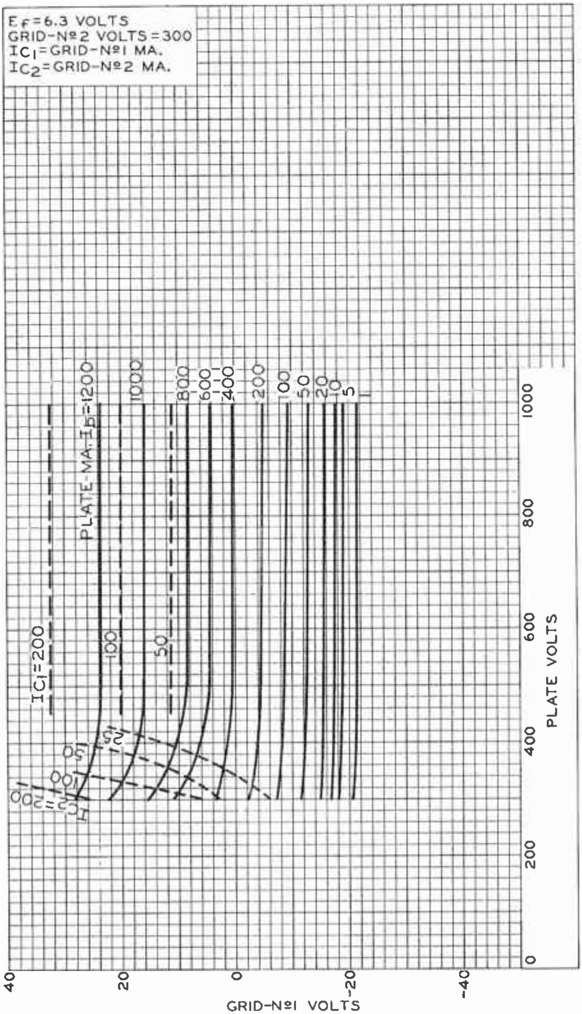


92CM-9225R2

TYPICAL CONSTANT-CURRENT CHARACTERISTICS

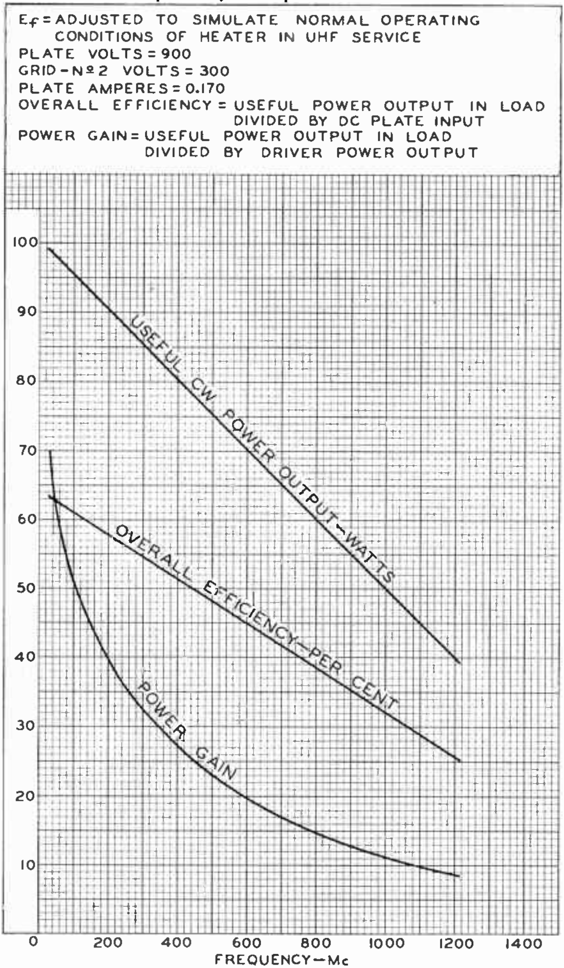


TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9232R1

TYPICAL PERFORMANCE CHARACTERISTICS
In Class C Telegraphy or Class C FM Telephony Amplifier Service



92CM-9221

Beam Power Tube

CERAMIC-METAL SEALS	52.5-WATTS CW INPUT
"ONE-PIECE" ELECTRODE DESIGN	27-WATTS CW OUTPUT AT 400 Mc
CONDUCTION COOLED	15-WATTS CW OUTPUT AT 1200 Mc
COAXIAL-ELECTRODE STRUCTURE	3.2-WATTS CW OUTPUT AT 3000 Mc

UNIPOTENTIAL CATHODE

The 7870 is the same as the 7801 except for the following items:

Heater, for Unipotential Cathode:
Voltage (AC or DC)[a] . . . . 6.3 ± 10% volts
Current at heater volts = 6.3 . . . . 1 amp

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.88	1.1	amp ←
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.025	μμf
Grid No.1 to cathode & heater	2	8.5	10.3	μμf
Plate to cathode & heater	2	-	0.004	μμf
Grid No.1 to grid No.2	2	14	20.6	μμf
Grid No.2 to plate	2	2.1	2.5	μμf
Grid No.2 to cathode & heater	2	-	0.18	μμf
Grid-No.1 Voltage	1,3	-1	-10	volts
Grid-No.1 Cutoff Voltage	1,4	-	-25	volts
Grid-No.2 Current	1,3	-3	2	ma
Positive Grid-No.1 Voltage	1,5	0	14	volts
Transconductance	1,6	7500	-	μmhos

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

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 750 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 35 ma.

Note 4: With dc plate voltage of 750 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With dc plate voltage of 300 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage of -100 volts. Rectangular pulses, pulse duration of 4500 to 5000 microseconds and pulse-repetition frequency of 10 to 12 pps. The positive-pulse grid-No.1 voltage is adjusted to give a plate current of 300 ma. at leading edge of pulse.

Note 6: With dc plate voltage of 300 volts, dc grid-No.2 voltage of 150 volts, dc grid-No.1 voltage adjusted to give a dc plate current of 35 ma.

← Indicates a change.

High-Mu Triode

NUVISTOR TYPE

For Industrial Applications

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.135	amp
Direct Interelectrode Capacitances (Approx.):		
Grid to plate	0.9	μμf
Grid to cathode, shell, and heater	4.2	μμf
Plate to cathode, shell, and heater	1.7	μμf
Plate to cathode	0.22	μμf
Heater to cathode	1.3	μμf

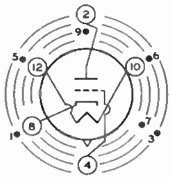
Characteristics, Class A_1 Amplifier:

Plate Supply Voltage	110	volts
Grid Supply Voltage	0	volts
Cathode Resistor	150	ohms
Amplification Factor	64	
Plate Resistance (Approx.)	6800	ohms
Transconductance	9400	μmhos
Plate Current	7	ma
Grid Voltage (Approx.) for plate μa = 10	−4	volts

Mechanical:

Operating Position	Any
Maximum Overall Length	0.800"
Maximum Seated Length	0.625"
Maximum Diameter	0.440"
Weight (Approx.)	1/15 oz
Envelope	Metal Shell
Socket	Cinch Mfg. Corp. No.133 65 10 001, or equivalent
Base	Medium Ceramic-Wafer Twelvar 5-Pin (JEDEC No.E5-65)
Basing Designation for BOTTOM VIEW	12AQ

Pin 1[a] - Internal Connection— Do Not Use
Pin 2 - Plate
Pin 3 - Same as Pin 1
Pin 4 - Grid
Pin 5 - Same as Pin 1
Pin 6 - Same as Pin 1
Pin 7 - Same as Pin 1
Pin 8 - Cathode
Pin 9 - Same as Pin 1
Pin 10 - Heater
Pin 12 - Heater



INDEX = LARGE LUG
● = PIN CUT OFF

INDUSTRIAL SERVICE

Maximum Ratings, ***Absolute-Maximum Values:***

For operation at any altitude

PLATE SUPPLY VOLTAGE	330 max.	volts
PLATE VOLTAGE	110 max.	volts
GRID VOLTAGE:		
Negative-bias value	55 max.	volts
Peak-positive value	2 max.	volts
GRID CURRENT	2 max.	ma
PLATE CURRENT	20 max.	ma
CATHODE CURRENT	15 max.	ma
PLATE DISSIPATION	1 max.	watt
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts

Maximum Circuit Values:

Grid-Circuit Resistance:[b]		
For fixed-bias operation	0.5 max.	megohm
For cathode-bias operation	1 max.	megohm

[a] Pin is cut off close to ceramic wafer.
[b] For operation at metal-shell temperatures up to 150° C.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.125	0.145	amp
Direct Interelectrode Capacitances:				
Grid to plate	2	0.8	1	μμf
Grid to cathode, shell, and heater	2	3.4	5	μμf
Plate to cathode, shell, and heater	2	1.3	2.1	μμf
Heater to cathode	2	1	1.6	μμf
Plate to cathode	2	0.16	0.28	μμf
Plate Current (1)	1,3	5.5	8.8	ma
Plate Current (2)	1,4	-	50	μa
Transconductance (1)	1,3	7900	10900	μmhos
Transconductance (2)	3,5	6900	-	μmhos
Transconductance Change:				
Difference between Transconductance (1) and Transconductance (2), expressed in per cent of Transconductance (1)	-	-	15	%
Reverse Grid Current	1,6	-	0.1	μa
Amplification Factor	1,3	54	74	
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,7	-	5	μa
Heater positive with respect to cathode	1,7	-	5	μa

Leakage Resistance:
Between grid and all other electrodes tied together . . . . 1,8 1000 – megohms
Between plate and all other electrodes tied together . . . . 1,9 1000 – megohms

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

Note 2: Measured in accordance with EIA Standard RS-191-A.

Note 3: With dc plate supply volts = 110, cathode resistor = 150 ohms, and cathode-bypass capacitor = 1000 μf.

Note 4: With dc plate volts = 110, dc grid volts = -5, and metal shell connected to ground.

Note 5: With 5.7 volts ac or dc on heater.

Note 6: With dc plate volts = 150, grid supply volts = -1.7, grid resistor = 0.5 megohm, and metal shell connected to ground.

Note 7: With 100 volts dc applied between heater and cathode.

Note 8: With grid 100 volts negative with respect to all other electrodes tied together.

Note 9: With plate 300 volts negative with respect to all other electrodes tied together.

SPECIAL RATINGS & PERFORMANCE DATA

Shock Rating:

Impact Acceleration. . . . . 1000 max. g

This test is performed on a sample lot of tubes from each production run to determine ability of tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a Navy Type, High-impact (flyweight) Shock Machine and are subjected to 20 blows at the specified maximum impact acceleration. At the end of this test, tubes are criticized for change in transconductance, reverse grid current, and heater-cathode leakage current, and are then subjected to the Variable-Frequency Vibration Test described below.

Fatigue Rating:

Vibrational Acceleration . . . . 2.5 max. g

This test is performed on a sample lot of tubes to determine ability of tube to withstand the specified vibrational acceleration. Tubes are rigidly mounted, supplied with normal heater voltage only, and subjected for 48 hours to 2.5-g vibrational acceleration at 60 cycles per second in a direction perpendicular to the longitudinal axis of the tube. At the end of this test, tubes are criticized for the same characteristics and end-point values as in the Shock Rating Test described above.

Variable-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run. The tube is operated under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1) with the addition of a plate-load resistor of 2000 ohms. During operation, tube is vibrated in a direction perpendicular to the longitudinal axis of the tube through the frequency range from 50 to 15,000 cycles per second under the following conditions: a sweep rate of one octave per 30 seconds from

50 to 3000 cps, a 7-second sweep from 3000 to 15,000 cps, and a constant vibrational acceleration of 1 g. During the test, tube must not show an rms output voltage in excess of: (1) 35 millivolts from 50 to 3000 cps, (2) 60 millivolts from 3000 to 6000 cps, and (3) 500 millivolts from 6000 to 15,000 cps.

Low-Pressure Voltage-Breakdown Test:

This test is performed on a sample lot of tubes from each production run. In this test, tubes are operated with 240 rms volts applied between plate and all other electrodes and will not break down or show evidence of corona when subjected to air pressures equivalent to altitudes of up to 100,000 feet.

Heater Cycling:

Cycles of Intermittent Operation . . . . . 2000 min. cycles

This test is performed on a sample lot of tubes from each production run under the following conditions: heater volts = 7.5 cycled one minute on and two minutes off; heater 100 volts negative with respect to cathode; grid, plate, and metal shell connected to ground. At the end of this test, tubes are tested for open heaters, heater-cathode shorts, and heater-cathode leakage current.

Shorts and Continuity:

This test is performed on a sample lot of tubes from each production run. Tubes are subjected to the Thyratron-Type Shorts Test described in MIL-E-1D, Amendment 2, paragraph 4.7.7, except that tapping is done by hand with a soft rubber tapper[c]. See accompanying *Shorts-Test Acceptance-Limits* curve. Tubes are criticized for permanent or temporary shorts and open circuits.

Early-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that tubes are properly stabilized. In this test, tubes are operated for 20 hours at maximum-rated plate dissipation. After 2 hours of operation and again after 20 hours of operation, tubes are checked for transconductance under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1). A tube is rejected if its transconductance after two or 20 hours of operation has changed more than 10 per cent from the 0-hour value.

100-Hour Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early-hour inoperatives. Tubes are operated for 100 hours at maximum-rated plate dissipation, and then subjected to the Shorts and Continuity test previously described. Tubes must show a value not less than 6200 micromhos for Transconductance (1), and a value not greater than 0.2 microamperes for reverse grid current under conditions specified in CHARACTERISTICS RANGE VALUES.

1000-Hour Conduction Life Performance:

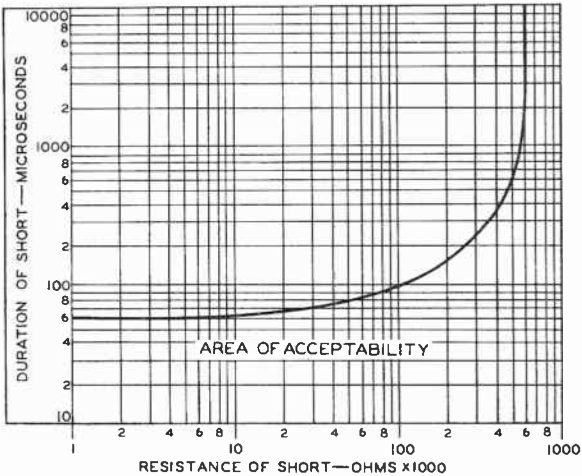
This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and guard against epidemic failures due to excessive changes in any of the characteristics indicated below. In this test, tubes are operated for 1000 hours at maximum-rated plate dissipation, and then criticized for inoperatives, reverse grid current, heater-cathode leakage current, and leakage resistance. In addition, the average change in transconductance of the lot from the 0-hour value for Transconductance (1) specified in CHARACTERISTICS RANGE VALUES, must not exceed 15 per cent at 500 hours, and 20 per cent at 1000 hours.

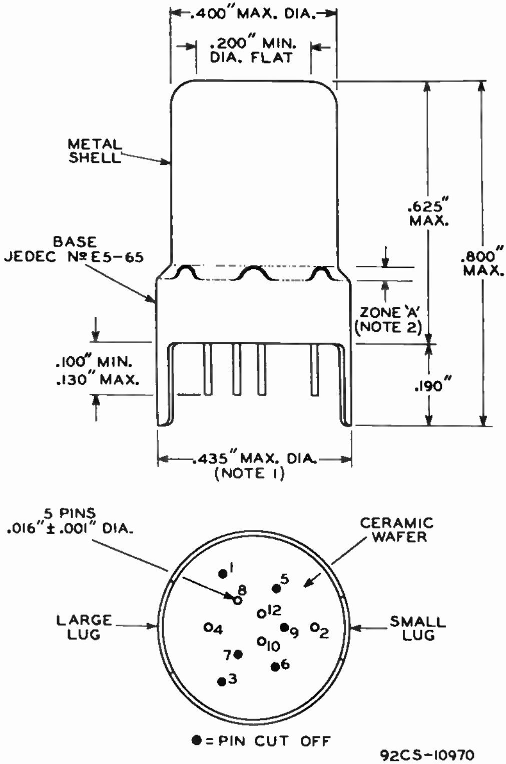
1000-Hour Standby Life Performance:

This test is performed on a sample lot of tubes from each production run. The tubes are operated for 1000 hours with only normal heater voltage applied. Tubes are criticized for inter-electrode leakage, reverse grid current, change in trans-conductance of individual tubes from values at 0-hours and cathode interface resistance greater than 25 ohms. Interface resistance is measured by Method B of ASTM specification F300-57T.

[c] Specifications for tapper supplied on request.

SHORTS-TEST ACCEPTANCE LIMITS

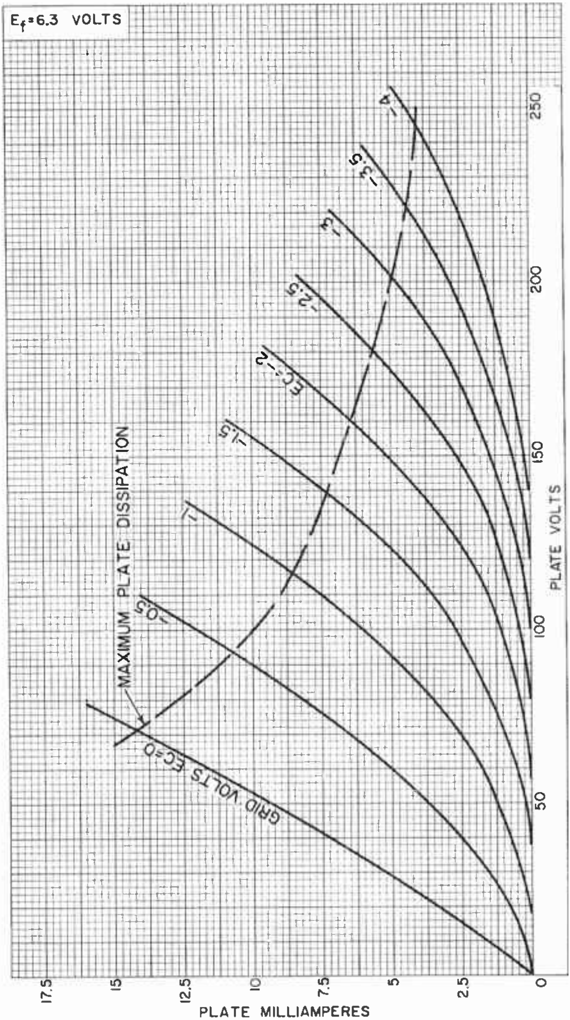




NOTE 1: MAXIMUM OUTSIDE DIAMETER OF 0.440" IS PERMITTED ALONG 0.190" LUG LENGTH.

NOTE 2: SHELL TEMPERATURE SHOULD BE MEASURED IN ZONE "A" BETWEEN BROKEN LINES.

AVERAGE PLATE CHARACTERISTICS



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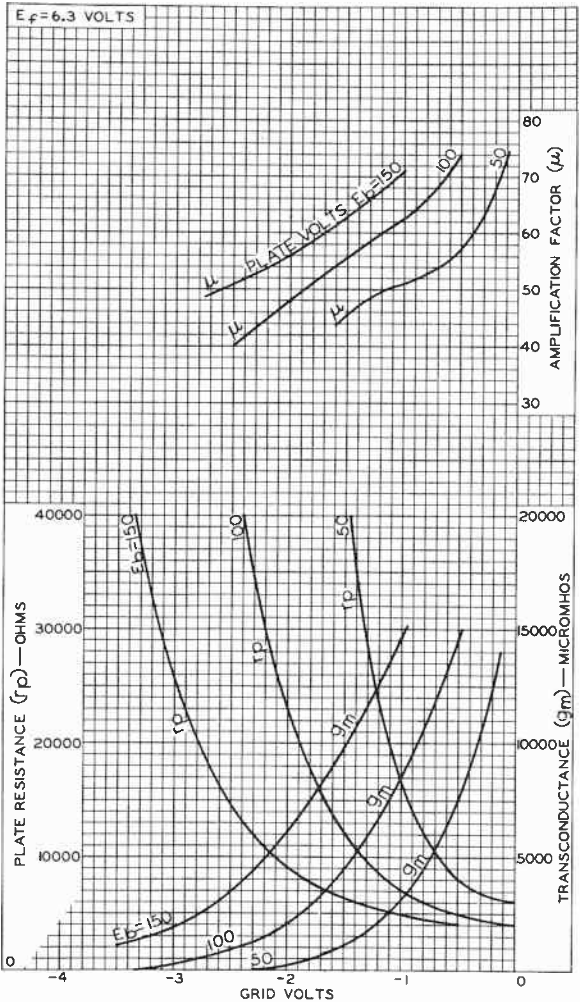
AVERAGE CHARACTERISTICS



92CM-10967

High-Mu Twin Triode

9-PIN MINIATURE TYPE

For Use in Mobile-Communications Equipment
Operating from 6-Cell Storage-Battery Systems

GENERAL DATA

Electrical:

Heater Characteristics and Ratings *(Absolute-Maximum Values)*:		
Voltage (AC or DC)[a]	13.5 ± 1.5	volts
Current at heater volts = 13.5	0.150	amp
Peak heater-cathode voltage (Each unit):		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts

Direct Interelectrode Capacitances (Approx.):

	Without External Shield	*With External Shield*[b]	
Grid-Drive Operation:			
Grid to plate (Each unit). .	1.6	1.6	μμf
Grid to cathode and heater (Each unit).	2.5	2.5	μμf
Plate to cathode and heater (Unit No.1).	0.45	1.2	μμf
Plate to cathode and heater (Unit No.2).	0.38	1.3	μμf
Cathode-Drive Operation:			
Cathode to plate (Unit No.1).	0.2	0.18[d]	μμf
Cathode to plate (Unit No.2).	0.24	0.2[d]	μμf
Cathode to grid and heater (Each unit).	5	5[d]	μμf
Plate to grid and heater (Unit No.1).	1.9	2.7[d]	μμf
Plate to grid and heater (Unit No.2).	1.8	2.7[d]	μμf
Heater to cathode (Each unit).	2.8	2.8[c]	μμf
Plate to plate	0.24	-	μμf

Characteristics, Class A_1 Amplifier (Each Unit):

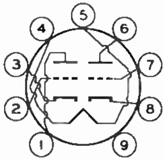
Heater Voltage	13.5	volts
Plate Supply Voltage	250	volts
Cathode Resistor	200	ohms
Amplification Factor	60	
Plate Resistance (Approx.)	10900	ohms
Transconductance	5500	μmhos
Plate Current.	10	ma
Grid Voltage (Approx.) for plate μa = 10 . .	-12	volts

7898

Mechanical:

Operating Position	Any
Type of Cathodes	Coated Unipotential
Maximum Overall Length	2-3/16"
Maximum Seated Length	1-15/16"
Length, Base Seat to Bulb Top (Excluding tip)	1-9/16" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)
Basing Designation for BOTTOM VIEW	9EP

Pin 1 - Plate of Unit No.2
Pin 2 - Grid of Unit No.2
Pin 3 - Cathode of Unit No.2
Pin 4 - Heater
Pin 5 - Heater



Pin 6 - Plate of Unit No.1
Pin 7 - Grid of Unit No.1
Pin 8 - Cathode of Unit No.1
Pin 9 - Do Not Use

AMPLIFIER — Class A_1

Values are for Each Unit

Maximum Ratings, ***Absolute-Maximum Values:***

PLATE VOLTAGE	330 max.	volts
GRID VOLTAGE:		
Negative-bias value	55 max.	volts
Positive-bias value	0 max.	volts
PLATE DISSIPATION	2.75 max.	watts
BULB TEMPERATURE (At hottest point on bulb surface)	180 max.	°C

Maximum Circuit Values:

Grid-Circuit Resistance:		
For fixed-bias operation	0.25 max.	megohm
For cathode-bias operation	1 max.	megohm

[a] Heater will withstand momentary excursions from 11.0 to 16.0 volts.
[b] With external shield JEDEC No.315 connected to cathode of unit under test except as noted.
[c] With external shield JEDEC No.315 connected to ground.
[d] With external shield JEDEC No.315 connected to grid of unit under test.

SPECIAL RATINGS AND PERFORMANCE DATA

Heater-Cycling:

Cycles of Intermittent Operation	1160 min.	cycles

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater volts = 19.5 cycled one minute on and two minutes off; heater 135 volts negative with respect to cathode; all other elements connected to ground. At the end of this test, tubes are tested for heater-cathode shorts and open circuits.

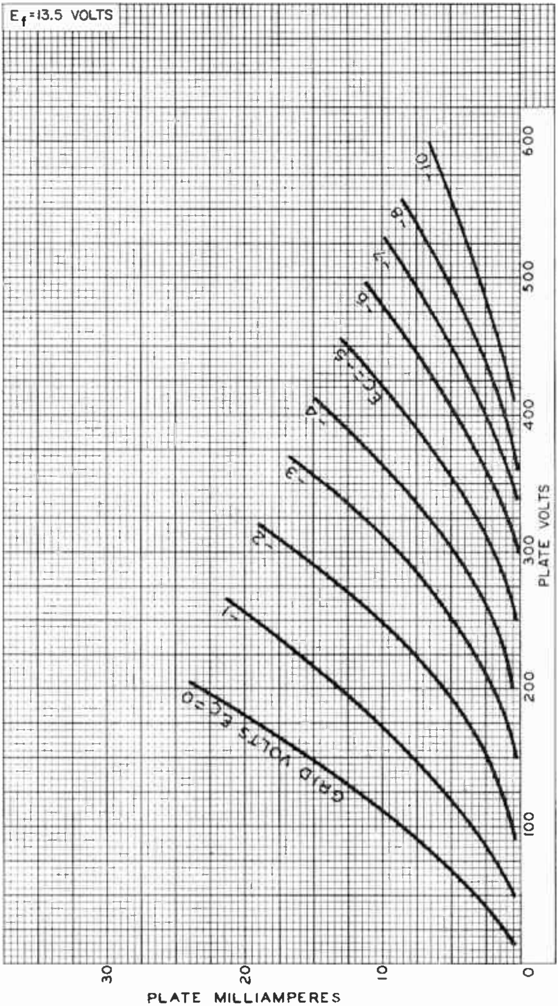
Low-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run under the following conditions: Units connected in parallel, heater volts = 13.5, plate-supply volts = 250, grid volts = -3, plate load resistor (ohms) = 2000, and vibrational acceleration = 2.5 g at 25 cps. In this test, the rms output voltage must not exceed 150 millivolts.

500-Hour Intermittent Life Performance:

This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures. Life testing is conducted under the following conditions: Heater volts = 15.0 and maximum-rated plate dissipation.

AVERAGE PLATE CHARACTERISTICS



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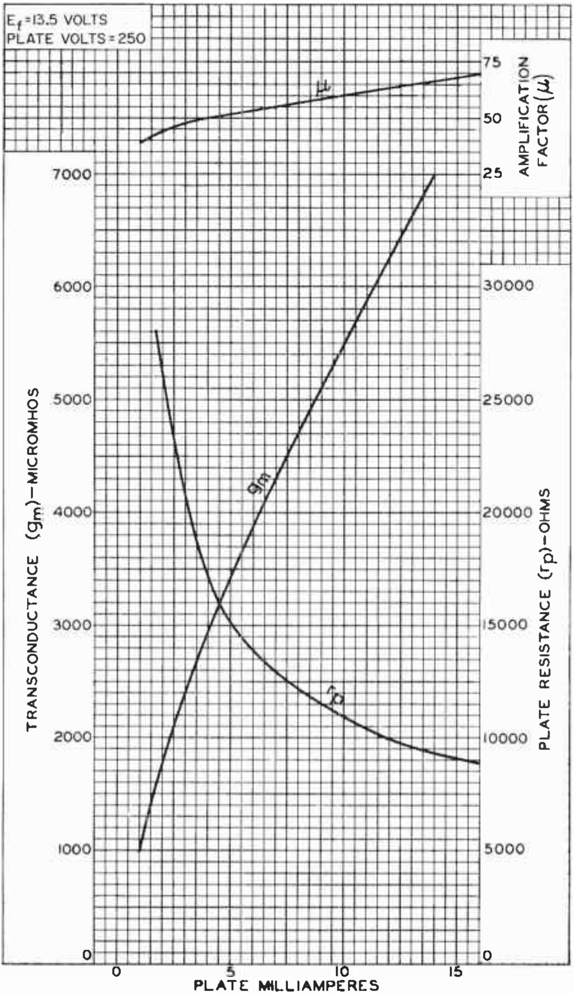
AVERAGE CHARACTERISTICS



92CM-11486

Beam Power Tube

90 WATTS CW INPUT (ICAS) UP TO 60 Mc
60 WATTS CW INPUT (ICAS) UP TO 175 Mc

GENERAL DATA

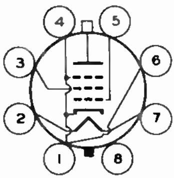
Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	13.5	volts
Current at heater volts = 13.5.	0.585	amp
Minimum heating time.	60	sec
Transconductance, for plate volts = 200, grid-No.2 volts = 200, and plate ma. = 100	7000	μmhos
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 200, grid-No.2 volts = 200 and plate ma. = 100	4.5	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate.	0.24 max.	pf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	13.0	pf
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	8.5	pf

Mechanical:

Operating Position.	Any
Maximum Overall Length.	3-13/16"
Seated Length	3-1/8" ± 1/8"
Maximum Diameter.	1-21/32"
Weight (Approx.).	2.3 oz
Bulb.	T12
Cap	Small (JEDEC No.C1-1)
Base.	Small-Wafer Octal 8-Pin with "770" Sleeve (JEDEC Group 1, No.B8-150)
Basing Designation for BOTTOM VIEW.	7CK

Pin 1 - Cathode, Grid No.3, Internal Shield
Pin 2 - Heater
Pin 3 - Grid No.2
Pin 4 - Same as Pin 1



Pin 5 - Grid No.1
Pin 6 - Same as Pin 1
Pin 7 - Heater
Pin 8 - Base Sleeve
P Cap - Plate

AF POWER AMPLIFIER & MODULATOR — Class AB_1 [c]

Maximum Ratings, *Absolute-Maximum Values:*

	CCS[d]	ICAS[e]	
DC PLATE VOLTAGE	600 max.	750 max.	volts
DC GRID-No.2 VOLTAGE	250 max.	250 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	125 max.	135 max.	ma
MAX.-SIGNAL PLATE INPUT[f]	60 max.	85 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f]	3 max.	3 max.	watts
PLATE DISSIPATION[f]	20 max.	25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	135 max.	135 max.	volts
Heater positive with respect to cathode	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	220 max.	°C

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	400	500	600	volts
DC Grid-No.2 Voltage[g]	190	185	180	volts
DC Grid-No.1 Voltage:				
With fixed-bias source	-40	-40	-45	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage[h]	80	80	90	volts
Zero-Signal DC Plate Current	63	57	26	ma
Max.-Signal DC Plate Current	228	215	200	ma
Zero-Signal DC Grid-No.2 Current	2.5	2	1	ma
Max.-Signal DC Grid-No.2 Current	25	25	23	ma
Effective Load Resistance (Plate to plate)	4000	5500	7000	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	55	70	82	watts

Typical ICAS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	600	750	volts
DC Grid-No.2 Voltage[g]	200	195	volts
DC Grid-No.1 Voltage:			
From fixed-bias source	-50	-50	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage[h]	100	100	volts
Zero-Signal DC Plate Current	28	23	ma
Max.-Signal DC Plate Current	229	220	ma
Zero-Signal DC Grid-No.2 Current	1	1	ma
Max.-Signal DC Grid-No.2 Current	27	26	ma
Effective Load Resistance (Plate to plate)	6000	8000	ohms
Max.-Signal Driving Power (Approx.)	0	0	watts
Max.-Signal Power Output (Approx.)	95	120	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance under any condition:[j]		
With fixed bias	0.1 max.	megohm
With cathode bias	Not recommended	

AF POWER AMPLIFIER & MODULATOR — Class AB_1

Triode Connection—Grid No.2 Connected to Plate

Maximum Ratings, ***Absolute-Maximum Values:***

	CCS	ICAS	
DC PLATE VOLTAGE	400 max.	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[f]	90 max.	90 max.	ma
MAX.-SIGNAL PLATE INPUT[f]	35 max.	35 max.	watts
PLATE DISSIPATION[f]	20 max.	25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	135 max.	135 max.	volts
Heater positive with respect to cathode	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	220 max.	°C

Typical Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	250	400	400	volts
DC Grid-No.1 Voltage	-50	-100	-100	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage[h]	100	200	200	volts
Zero-Signal DC Plate Current	120	40	40	ma
Max.-Signal DC Plate Current	125	100	100	ma
Effective Load Resistance (Plate-to-plate)	5000	8000	8000	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	10	22	22	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance under any condition:[j]		
With fixed bias	0.1 max.	megohm
With cathode bias	0.5 max.	megohm

AF POWER AMPLIFIER & MODULATOR — Class AB_2[k]

Maximum Ratings, ***Absolute-Maximum Values:***

	CCS	ICAS	
DC PLATE VOLTAGE	600 max.	750 max.	volts
DC GRID-No.2 VOLTAGE	250 max.	250 max.	volts

	CCS	ICAS	
MAX.-SIGNAL DC PLATE CURRENT[f]	125 max.	135 max.	ma
MAX.-SIGNAL PLATE INPUT[f]	62.5 max.	90 max.	watts
MAX.-SIGNAL GRID-No.2 INPUT[f]	3 max.	3 max.	watts
PLATE DISSIPATION[f]	20 max.	25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	135 max.	135 max.	volts
Heater positive with respect to cathode	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	220 max.	°C

Typical CCS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	400	500	600	volts
DC Grid-No.2 Voltage[g]	175	175	165	volts
DC Grid-No.1 Voltage:				
From fixed-bias source	-41	-44	-44	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	95	102	97	volts
Zero-Signal DC Plate Current	33	27	22	ma
Max.-Signal DC Plate Current	232	242	207	ma
Zero-Signal DC Grid-No.2 Current	1.1	0.7	0.6	ma
Max.-Signal DC Grid-No.2 Current	18	18	17	ma
Max.-Signal DC Grid-No.1 Current	1.6	1.9	1.1	ma
Effective Load Resistance (Plate to plate)	3700	4600	6800	ohms
Max.-Signal Driving Power (Approx.)[■]	0.2	0.3	0.2	watt
Max.-Signal Power Output (Approx.)	62	83	90	watts

Typical ICAS Push-Pull Operation:

Values are for 2 tubes

DC Plate Voltage	600	750	volts
DC Grid-No.2 Voltage[g]	190	165	volts
DC Grid-No.1 Voltage:			
From fixed-bias source	-48	-46	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	109	108	volts
Zero-Signal DC Plate Current	28	22	ma
Max.-Signal DC Plate Current	270	240	ma
Zero-Signal DC Grid-No.2 Current	1.2	0.3	ma
Max.-Signal DC Grid-No.2 Current	20	20	ma
Max.-Signal DC Grid-No.1 Current	2	2.6	ma
Effective Load Resistance (Plate to plate)	5000	7400	ohms
Max.-Signal Driving Power (Approx.)[■]	0.3	0.4	watt
Max.-Signal Power Output (Approx.)	113	131	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance:[n]		
With fixed bias	30000 max.	volts
With cathode bias	Not recommended	

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1 and at frequencies up to 60 Mc

Maximum Ratings, *Absolute-Maximum Values:*

For maximum plate voltage and maximum plate input above 60 Mc, see Rating Chart I

	CCS	ICAS	
DC PLATE VOLTAGE	480 max.	600 max.	volts
DC GRID-No.2 VOLTAGE	250 max.	250 max.	volts
DC GRID-No.1 VOLTAGE	-150 max.	-150 max.	volts
DC PLATE CURRENT	117 max.	125 max.	ma
DC GRID-No.1 CURRENT	3.5 max.	4 max.	ma
PLATE INPUT	45 max.	67.5 max.	watts
GRID-No.2 INPUT	2 max.	2 max.	watts
PLATE DISSIPATION	13.3 max.	16.7 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	135 max.	135 max.	volts
Heater positive with respect to cathode	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	220 max.	°C

Typical Operation:

	CCS	CCS	ICAS	
DC Plate Voltage	400	475	600	volts
DC Grid-No.2 Voltage[p]	150	135	150	volts
From a series resistor of	33000	51000	56000	ohms
DC Grid-No.1 Voltage[r]	-87	-77	-87	volts
From a grid resistor of	27000	27000	27000	ohms
Peak RF Grid-No.1 Voltage	107	95	107	volts
DC Plate Current	112	94	112	ma
DC Grid-No.2 Current	7.8	6.4	7.8	ma
DC Grid-No.1 Current (Approx.)	3.4	2.8	3.4	ma
Driving Power (Approx.)	0.4	0.3	0.4	watt
Power Output (Approx.)	32	34	52	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance* . . . . 30000 max. ohms

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy and RF POWER AMPLIFIER — Class C FM Telephony

Maximum Ratings, *Absolute-Maximum Values:*

At frequencies up to 60 Mc. For maximum plate voltage and maximum plate input above 60 Mc, see Rating Chart II.

	CCS	ICAS	
DC PLATE VOLTAGE	600 max.	750 max.	volts
DC GRID-No.2 VOLTAGE	250 max.	250 max.	volts
DC GRID-No.1 VOLTAGE	-150 max.	-150 max.	volts
DC PLATE CURRENT	140 max.	150 max.	ma

	CCS	ICAS	
DC GRID-No.1 CURRENT.	3.5 max.	4 max.	ma
PLATE INPUT	67.5 max.	90 max.	watts
GRID-No.2 INPUT	3 max.	3 max.	watts
PLATE DISSIPATION	20 max.	25 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode.	135 max.	135 max.	volts
Heater positive with respect to cathode.	135 max.	135 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface). . . .	220 max.	220 max.	°C

Typical Operation:

As amplifier up to 60 Mc

DC Plate Voltage.	500	600	600	750	volts
DC Grid-No.2 Voltage[t] . . .	170	150	180	160	volts
From a series resistor of .	36000	51000	43000	56000	ohms
DC Grid-No.1 Voltage[u] . . .	-66	-58	-71	-62	volts
From a grid-No.1 resistor of	27000	20000	24000	20000	ohms
From a cathode resistor of	470	470	430	470	ohms
Peak RF Grid-No.1 Voltage .	84	73	91	79	volts
DC Plate Current.	135	112	150	120	ma
DC Grid-No.2 Current. . . .	9	9	10	11	ma
DC Grid-No.1 Current (Approx.)	2.5	2.8	2.8	3.1	ma
Driving Power (Approx.) . .	0.2	0.2	0.3	0.2	watt
Power Output (Approx.). . .	48	52	66	70	watts

As amplifier at 175 Mc

DC Plate Voltage.	320	400	volts
DC Grid-No.2 Voltage[t]	180	190	volts
From a series resistor of . .	13000	20000	ohms
DC Grid-No.1 Voltage[u]	-51	-54	volts
From a grid resistor of . . .	27000	24000	ohms
From a cathode resistor of . .	330	330	ohms
Peak RF Grid-No.1 Voltage . . .	64	68	volts
DC Plate Current.	140	150	ma
DC Grid-No.2 Current.	10	10.4	ma
DC Grid-No.1 Current (Approx.).	2	2.2	ma
Driving Power (Approx.)	3	3	watts
Power Output (Approx.).	25	35	watts

Maximum Circuit Values (CCS or ICAS):

Grid-No.1-Circuit Resistance[s] . . . . 30000 max. ohms

[a] Heater voltage fluctuations will cause variations in power output. The 8032 is designed to meet the EIA Standard RS152A.

[b] With no external shield.

[c] Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

[d] Continuous Commercial Service.

[e] Intermittent Commercial and Amateur Service.

f Averaged over any audio-frequency cycle or sine-wave form.

g Obtained preferably from a separate source or from the plate voltage supply with a voltage divider.

h The driver stage should be capable of supplying the No.1 grids of the class AB_1 stage with the specified driving voltage at low distortion.

j The type of input coupling network used should not introduce too much resistance in the grid-No.1 circuit. Transformer or impedance coupling devices are recommended.

k Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

m Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB_2 stage.

n To minimize distortion, the effective resistance per grid-No.1 circuit of the AB_2 stage should be held at a low value. For this purpose the use of transformer coupling is recommended. In no case, however, should the total dc grid-No.1-circuit resistance exceed 30,000 ohms when the 8032 is operated at maximum ratings. For operation at less than maximum ratings, the dc grid-No.1-circuit resistance may be as high as 100,000 ohms.

p Obtained preferably from a separate source modulated with the plate supply, or from the modulated plate supply through a series resistor.

r Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

s When grid No.1 is driven positive and the 8032 is operated at maximum ratings, the total dc grid-No.1-circuit resistance should not exceed the specified value of 30,000 ohms. If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply. For operation at less than maximum ratings, the dc grid-No.1-circuit resistance may be as high as 100,000 ohms.

t Obtained preferably from separate source, or from the plate-supply voltage with a voltage divider, or through a series resistor. A series grid-No.2 resistor should be used only when the 8032 is used in a circuit which is not keyed. Grid-No.2 voltage must not exceed 400 volts under key-up conditions.

u Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

CHARACTERISTICS RANGE VALUES

	Note	*Min.*	*Max.*	
Heater Current	1	0.550	0.620	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.24	pf
Grid No.1 to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	2	12.0	15.0	pf
Plate to cathode & grid No.3 & internal shield, grid No.2, base sleeve, and heater	2	7.3	9.5	pf
Plate Current	3	46	94	ma
Grid-No.2 Current	3	-	5.5	ma
Dynamic Grid-No.2 Current	4	3	21	ma
Useful Power Output	4	47	-	watts

Note 1: With 13.5 volts ac on heater.

Note 2: With no external shield.

Note 3: With rated ac heater voltage, dc plate voltage of 300 volts, dc grid-No.2 voltage of 200 volts, and dc grid-No.1 voltage of -33 volts.

Note 4: In a single-tube, self-excited oscillator circuit, and with rated ac heater voltage, dc plate voltage of 600 volts, dc grid-No.2 voltage of 180 volts, grid-No.1 resistor of 30,000 ± 10 per cent ohms, dc plate current of 100 to 112 ma., dc grid-No.1 current of 2 to 2.5 ma., and frequency of 15 Mc.

MAXIMUM RATINGS vs OPERATING FREQUENCY

OPERATING FREQUENCY Mc	MAXIMUM PERMISSIBLE PERCENTAGE OF MAXIMUM RATED PLATE VOLTAGE & PLATE INPUT			
	TELEPHONY		TELEGRAPHY	
	Class C Plate-Modulated		Class C Unmodulated	
	Voltage	*Input*	*Voltage*	*Input*
60	100	100	100	100
80	84	92	84	92
125	65	78	65	78
150	58	72	58	72
160	56	70	56	70
175	53	67	53	67

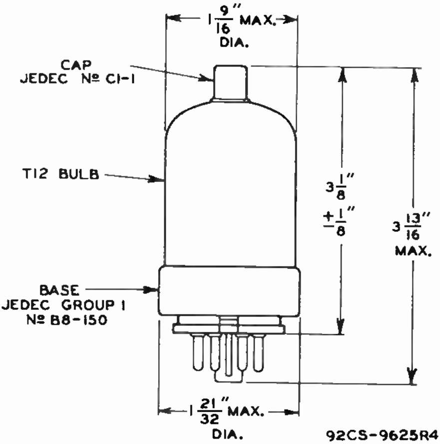
OPERATING CONSIDERATIONS

The maximum bulb temperature is a tube rating and is to be observed in the same manner as other ratings. The temperature may be measured with temperature-sensitive paint, such as Tempilaq. The latter is made by the Tempil Corporation, 132 West 22nd Street, New York 11, New York.

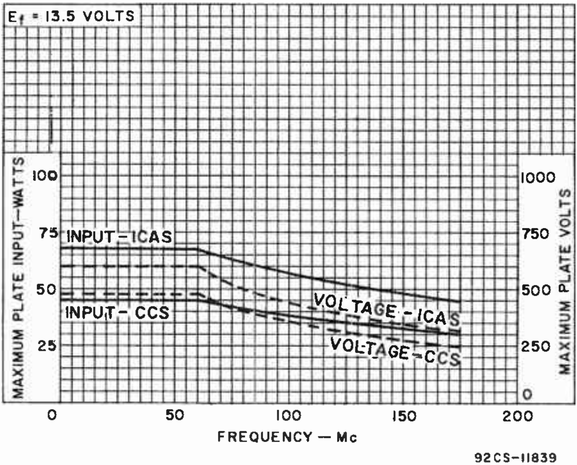
To insure adequate cooling, it is essential that free circulation of air be provided around the tube. In most cases, no additional air is required.

The plate shows no color when the 8032 is operated at full ratings under either CCS or ICAS conditions.

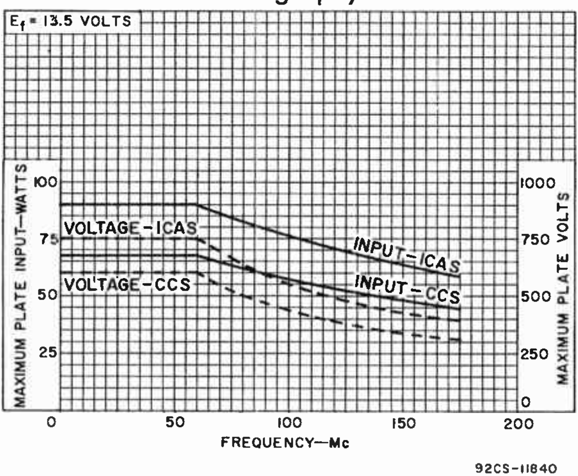
Connections to the plate should be made with a flexible lead to prevent any strain on the seal at the cap.



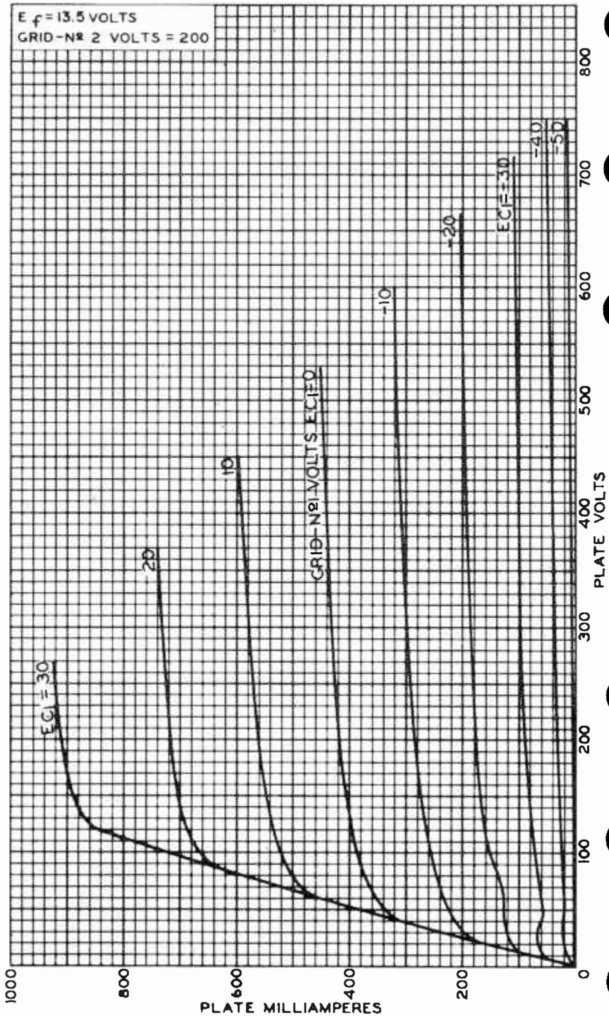
RATING CHART I
Class C Telephony Service



RATING CHART II
Class C Telegraphy Service

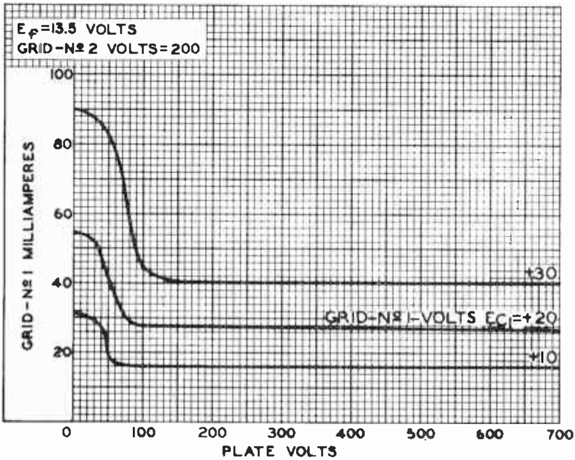


TYPICAL PLATE CHARACTERISTICS

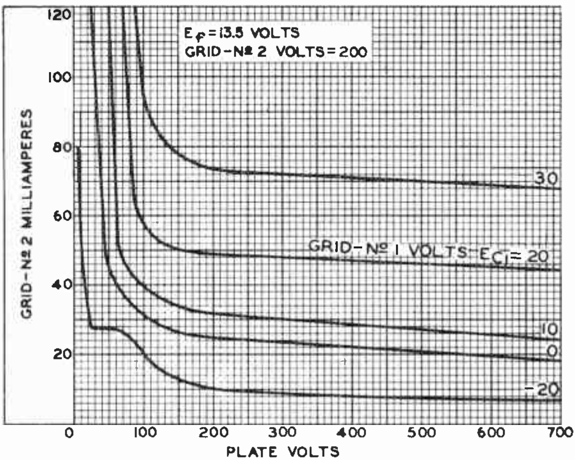


92CS-11845

TYPICAL CHARACTERISTICS

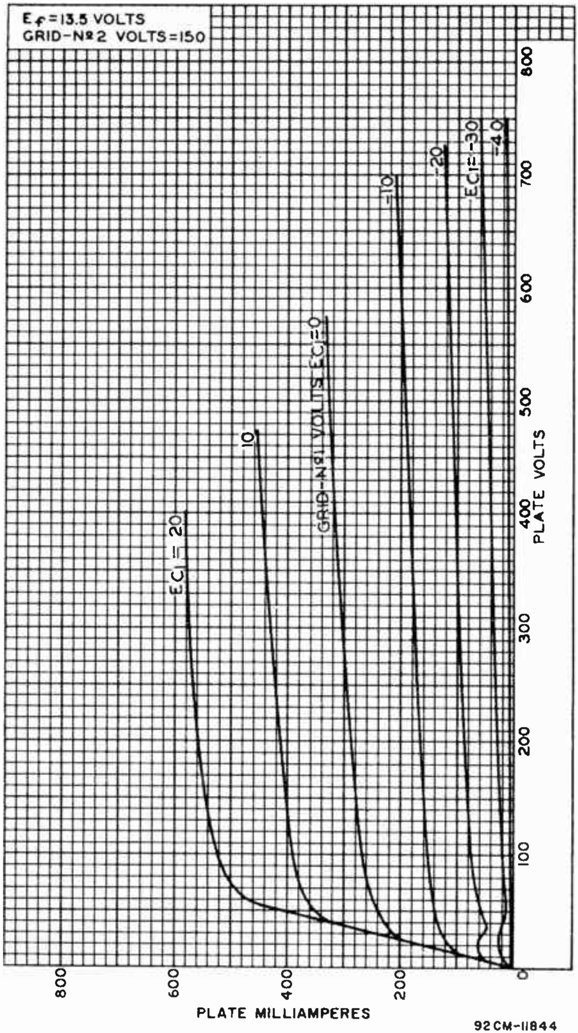


92CS-11847

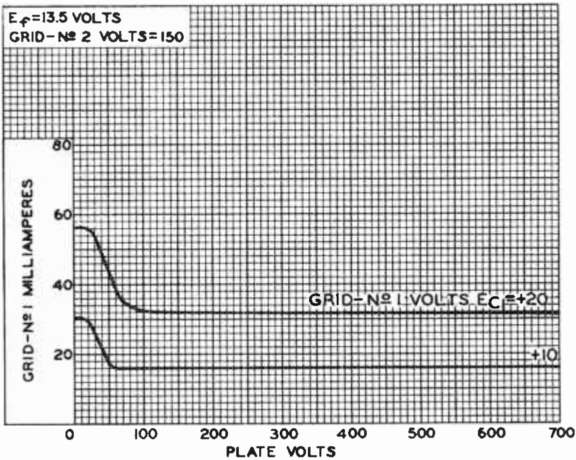


92CS-11848

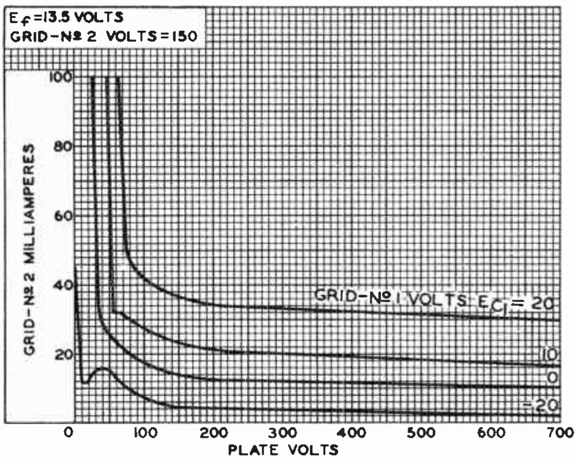
TYPICAL PLATE CHARACTERISTICS



TYPICAL CHARACTERISTICS



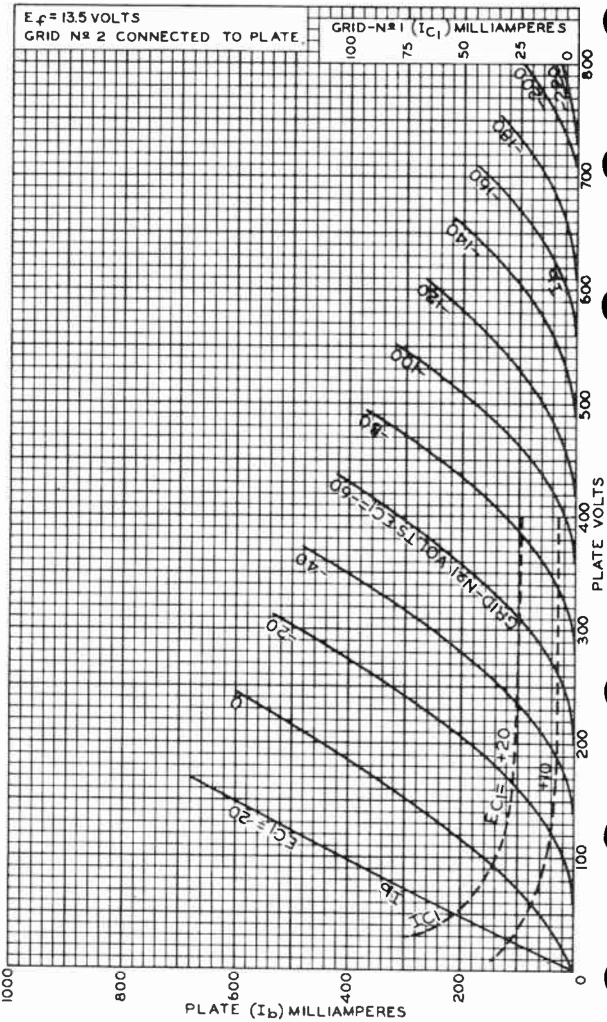
92CS-11849



92CS-11850

8032

TYPICAL CHARACTERISTICS
Triode Connection



92CM-11846

Medium-Mu Triode

NUVISTOR TYPE

For Use with Low-Voltage Power Supplies
in Industrial and Military Applications

GENERAL DATA

Electrical:

Heater Characteristics and Ratings *(Absolute-Maximum Values)*:		
Voltage (AC or DC)	6.3 ± 0.6	volts
Current at heater volts = 6.3	0.135	amp
Peak heater-cathode voltage:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts
Direct Interelectrode Capacitances (Approx.):		
Grid to plate	2.1	μμf
Grid to cathode, shell, and heater	4.0	μμf
Plate to cathode, shell, and heater	1.7	μμf
Plate to cathode	0.34	μμf
Heater to cathode	1.4	μμf

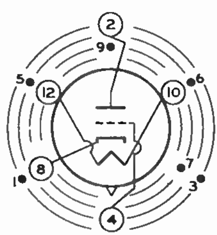
Characteristics, Class A_1 Amplifier:

Plate Supply Voltage	24	volts
Grid Supply Voltage	0	volts
Cathode Resistor	100	ohms
Amplification Factor	11.5	
Plate Resistance (Approx.)	1650	ohms
Transconductance	7000	μmhos
Plate Current	8.5	ma
Grid Voltage (Approx.) for plate μa = 50	-5	volts

Mechanical:

Operating Position	Any
Type of Cathode	Coated Unipotential
Maximum Overall Length	0.800"
Maximum Seated Length	0.625"
Maximum Diameter	0.440"
Weight (Approx.)	1/15 oz
Envelope	Metal Shell MT4
Base	Medium Ceramic-Wafer Twelvar 5-Pin (JEDEC No. E5-65)
Basing Designation for BOTTOM VIEW	12AQ

Pin 1[a] - Do Not Use
Pin 2 - Plate
Pin 3 - Same as Pin 1
Pin 4 - Grid
Pin 5 - Same as Pin 1
Pin 6 - Same as Pin 1
Pin 7 - Same as Pin 1
Pin 8 - Cathode
Pin 9 - Same as Pin 1
Pin 10 - Heater
Pin 12 - Heater



INDEX = LARGE LUG
● = PIN CUT OFF

INDUSTRIAL SERVICE

Maximum Ratings, ***Absolute-Maximum Values:***

For operation at any altitude

PLATE VOLTAGE	50 max.	volts
GRID VOLTAGE:		
Negative-bias value	55 max.	volts
Peak-positive value	2 max.	volts
GRID CURRENT	2 max.	ma
CATHODE CURRENT	15 max.	ma
PLATE DISSIPATION	0.45 max.	watt

Typical Operation:

Plate Supply Voltage	12	24	volts
Grid Supply Voltage	0	0.7	volts
Grid Resistor	33000	-	ohms
Amplification Factor	12.5	12.5	
Plate Resistance (Approx.)	1560	1560	ohms
Transconductance	8000	8000	μmhos
Plate Current	5.8	10	ma

Maximum Circuit Values:

Grid-Circuit Resistance:[b]		
For fixed-bias operation	10 max.	megohms
For cathode-bias operation	10 max.	megohms

[a] Pin is cut off to ceramic wafer.

[b] For operation at metal-shell temperatures up to 150° C. For temperatures above 150° C, see accompanying *Rating Chart*.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.125	0.145	amp
Direct Interelectrode Capacitances:				
Grid to plate	2	1.8	2.4	μμf
Grid to cathode, shell, and heater	2	3.4	4.6	μμf
Plate to cathode, shell, and heater	2	1.4	2.0	μμf
Heater to cathode	2	1.1	1.7	μμf
Plate to cathode	2	0.26	0.42	μμf
Plate Current (1)	1,3	6.5	10.5	ma
Plate Current (2)	1,4	-	50	μa
Transconductance (1)	1,3	6000	8000	μmhos
Transconductance (2)	3,5	5200	-	μmhos
Transconductance Change:				
Difference between transconductance (1) and transconductance (2), expressed in per cent of transconductance (1)	-	-	15	%
Reverse Grid Current	1,6	-	0.05	μa
Amplification Factor	1,3	9	14	

Heater-Cathode Leakage Current:				
Heater negative with respect to cathode.	1,7	–	1	μa
Heater positive with respect to cathode.	1,7	–	1	μa
Leakage Resistance:				
Between grid and all other electrodes tied together. . .	1,8	1000	–	megohms
Between plate and all other electrodes tied together. . .	1,9	1000	–	megohms

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

Note 2: Measured in accordance with EIA Standard RS-191-A.

Note 3: With dc plate supply volts = 24, cathode resistor = 100 ohms, and cathode-bypass capacitor = 1000 μf.

Note 4: With dc plate volts = 24, dc grid volts = -10, and metal shell connected to ground.

Note 5: With 5.7 volts ac or dc on heater.

Note 6: With dc plate volts = 40, grid supply volts = -2, grid resistor = 1 megohm, and metal shell connected to ground.

Note 7: With 100 volts dc applied between heater and cathode.

Note 8: With grid 100 volts negative with respect to all other electrodes tied together.

Note 9: With plate 100 volts negative with respect to all other electrodes tied together.

SPECIAL RATINGS & PERFORMANCE DATA

Shock Rating:

Impact Acceleration . . . . 1000 max. g

This test is performed on a sample lot of tubes from each production run to determine ability of tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a Navy Type, High-impact (flyweight) Shock Machine and are subjected to 20 blows at the specified maximum impact acceleration. At the end of this test, tubes are criticized for change in transconductance, reverse grid current, and heater-cathode leakage current, and are then subjected to the Variable-Frequency Test described below.

Fatigue Rating:

Vibrational Acceleration. . . . . 2.5 max. g

This test is performed on a sample lot of tubes to determine ability of tube to withstand the specified vibrational acceleration. Tubes are rigidly mounted, supplied with nominal heater voltage only, and subjected for 48 hours to 2.5-g vibrational acceleration at 60 cycles per second in the X_1 position. At the end of this test, tubes are criticized for the same characteristics and end-point values as in the Shock Rating Test described above.

Variable-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run. The tube is operated under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1) with the addition of a plate-load resistor of 2000 ohms.

During operation, tube is vibrated in the X_1 position through the frequency range from 50 to 15,000 cycles per second under the following conditions: a sweep rate of one octave per 30 seconds from 50 to 3000 cps, a 7-second sweep from 3000 to 15,000 cps, and a constant vibrational acceleration of 4 g. During the test, tube must not show an output voltage across the plate-load resistor in excess of: (1) 20 rms millivolts from 50 to 3000 cps, (2) 50 peak millivolts from 3000 to 6000 cps, and (3) 500 peak millivolts from 6000 to 15,000 cps.

Low-Pressure Voltage-Breakdown Test:

This test is performed on a sample lot of tubes from each production run. In this test, tubes are operated with 250 rms volts applied between plate and all other electrodes and will not break or show evidence of corona when subjected to air pressures equivalent to altitudes of up to 100,000 feet.

Heater Cycling:

Cycles of Intermittent Operation. . . . . . 2000 min. cycles

This test is performed on a sample lot of tubes from each production run under the following conditions: heater volts = 8.5 cycled one minute on and two minutes off; heater 180 volts negative with respect to cathode; grid, plate, and metal shell connected to ground. At the end of this test, tubes are tested for open heaters and heater-cathode shorts.

Shorts and Continuity:

This test is performed on a sample lot of tubes from each production run. Tubes are subjected to the Thyratron-Type Shorts Test described in MIL-E-1D, Amendment 2, Paragraph 4.7.7, except that tapping is done by hand with a soft rubber tapper[c]. See accompanying *Shorts-Test Acceptance-Limits* curve. Tubes are criticized for permanent or temporary shorts and open circuits.

Early-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that tubes are properly stabilized. In this test, tubes are operated for 20 hours at maximum-rated plate dissipation. After 2 hours of operation and again after 20 hours of operation, tubes are checked for transconductance under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1). A tube is rejected if its transconductance after 2 or 20 hours of operation has changed more than 10 per cent from the 0-hour value.

100-Hour Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early-hour inoperatives. Tubes are operated for 100 hours at maximum-rated plate dissipation, and then subjected to the Shorts and Continuity Test previously described. Tubes must then show a transconductance of not less than 5000 micromhos under the conditions specified in CHARACTERISTICS RANGE VALUES for Transconductance (1).

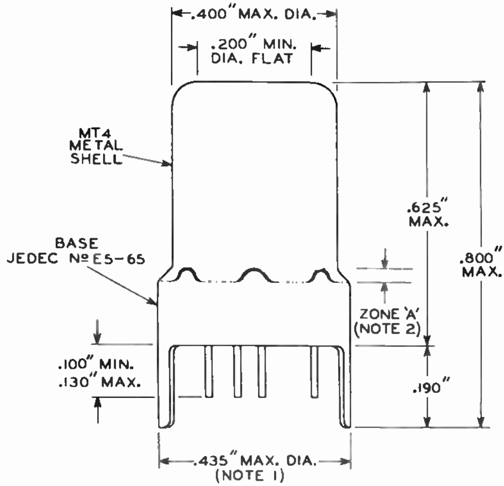
1000-Hour Conduction Life Performance:

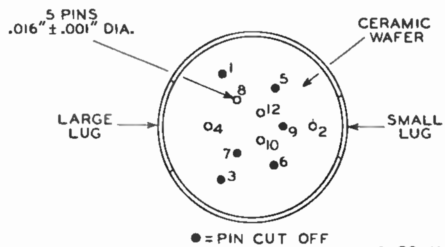
This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and guard against epidemic failures due to excessive changes in any of the characteristics indicated below. In this test, tubes are operated for 1000 hours at maximum-rated plate dissipation[d], and then criticized for inoperatives, reverse grid current, heater-cathode leakage current, and leakage resistance. In addition, the average change in transconductance of the lot from the 0-hour value for Transconductance (1) specified in CHARACTERISTICS RANGE VALUES, must not exceed 15 per cent at 500 hours, and 20 per cent at 1000 hours.

1000-Hour Standby Life Performance:

This test is performed on a sample lot of tubes from each production run. The tubes are operated for 1000 hours with only heater voltage applied. Tubes are criticized for interelectrode leakage, reverse grid current, change in transconductance of individual tubes from values at 0-hours and cathode interface resistance greater than 25 ohms. Interface resistance is measured by Method B of ASTM specification F300-57T.

[c] Specifications for tapper supplied on request.
[d] At metal-shell temperature of 150° C.



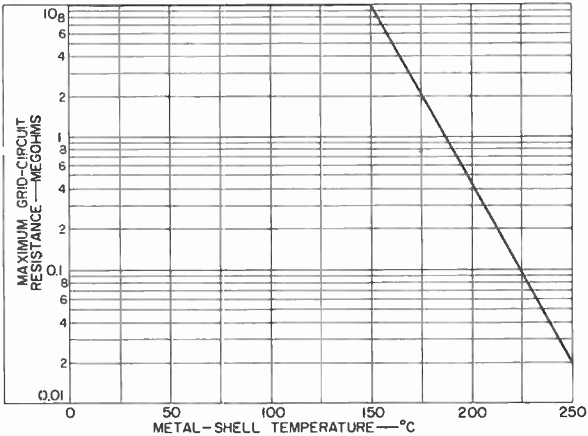


92CS-10970R1

NOTE 1: MAXIMUM OUTSIDE DIAMETER OF 0.440" IS PERMITTED ALONG 0.190" LUG LENGTH.

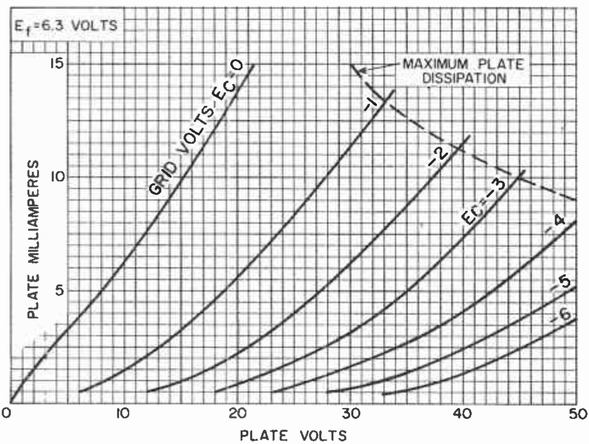
NOTE 2: SHELL TEMPERATURE SHOULD BE MEASURED IN ZONE "A" BETWEEN BROKEN LINES.

RATING CHART



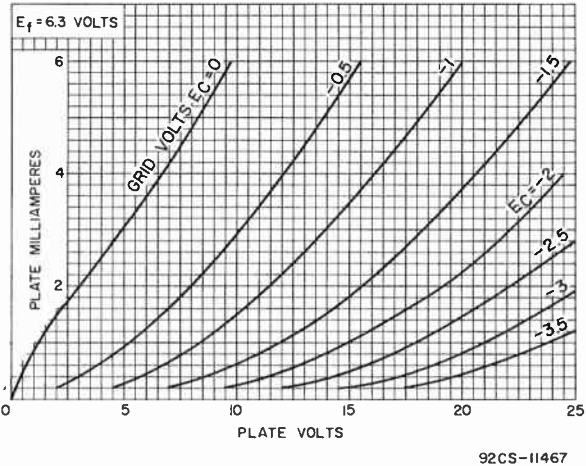
92CS-11479

AVERAGE PLATE CHARACTERISTICS

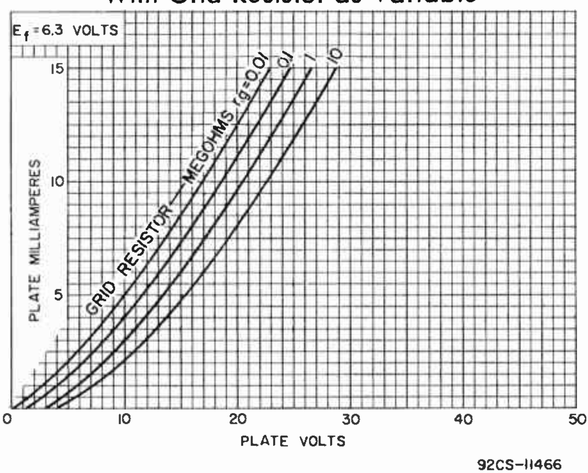


92CS-11469

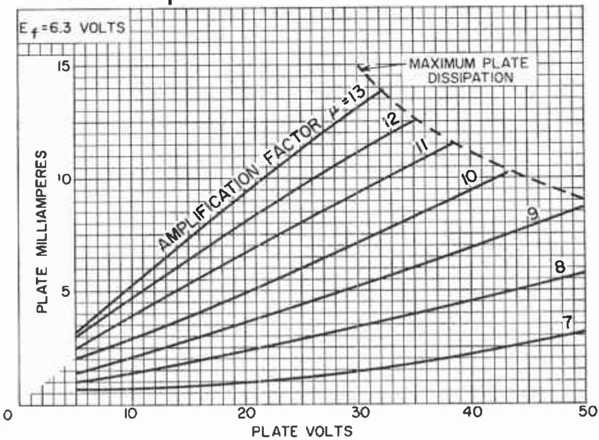
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS
With Grid Resistor as Variable

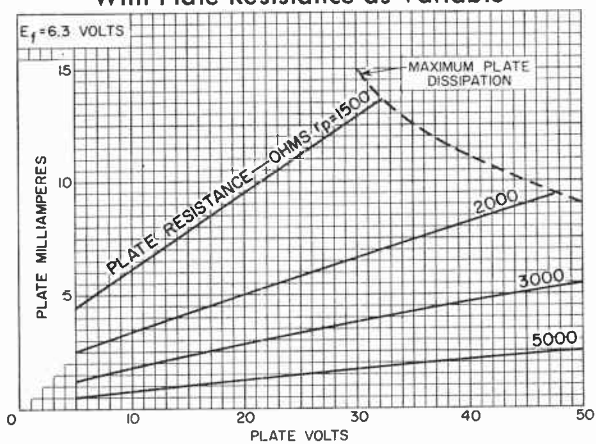


AVERAGE PLATE CHARACTERISTICS
With Amplification Factor as Variable



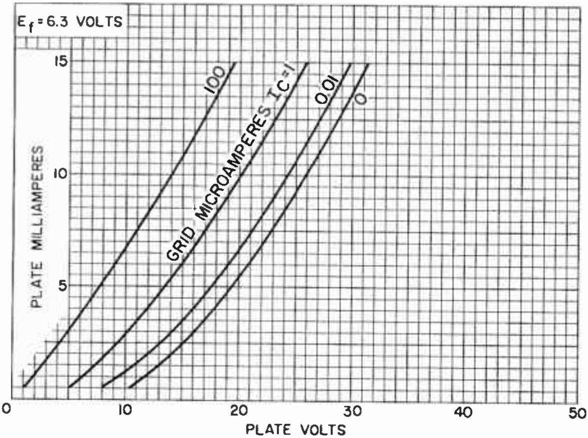
92CS-11471

AVERAGE PLATE CHARACTERISTICS
With Plate Resistance as Variable



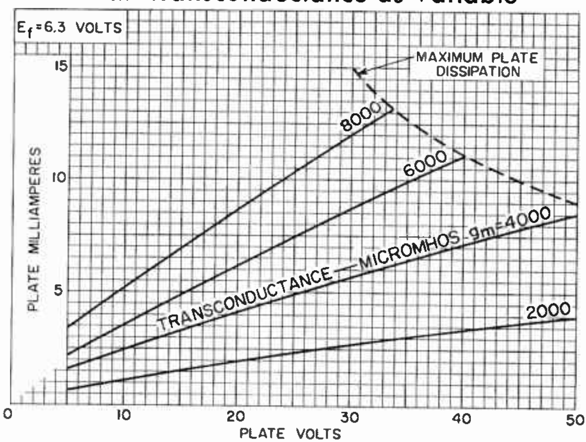
92CS-11465

AVERAGE PLATE CHARACTERISTICS With Grid Current as Variable



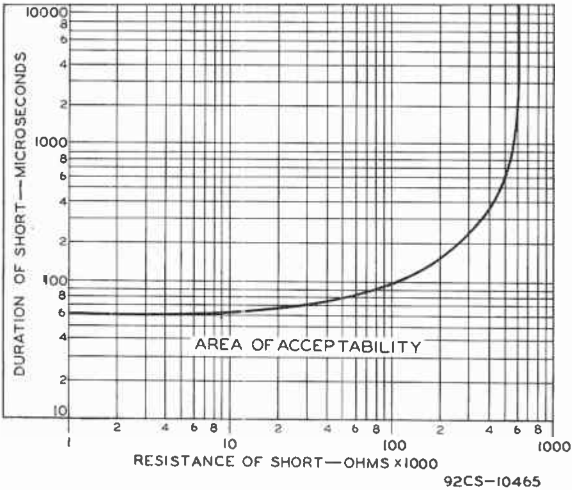
92CS-11468

AVERAGE PLATE CHARACTERISTICS With Transconductance as Variable

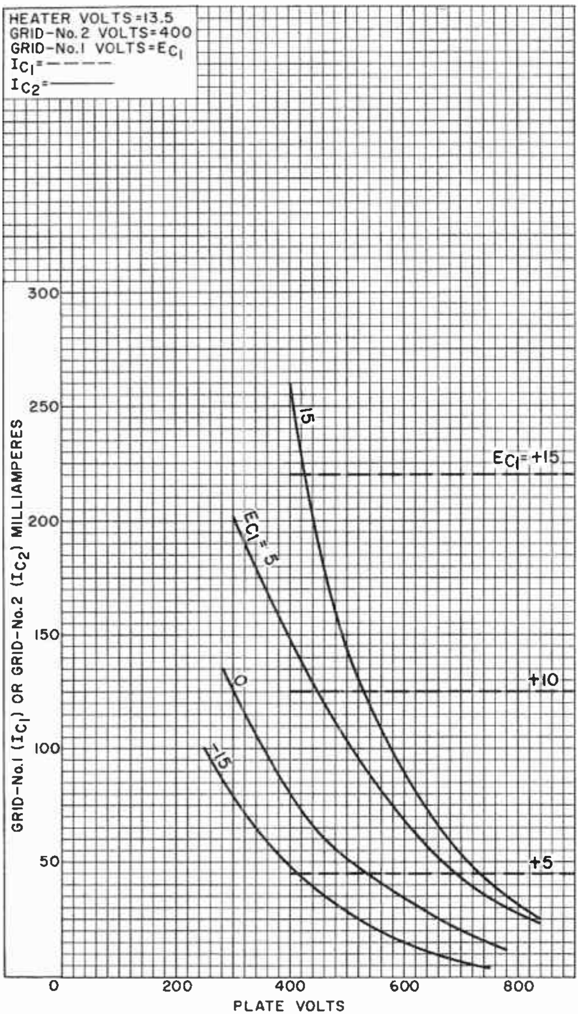


92CS-11470

SHORTS-TEST ACCEPTANCE LIMITS

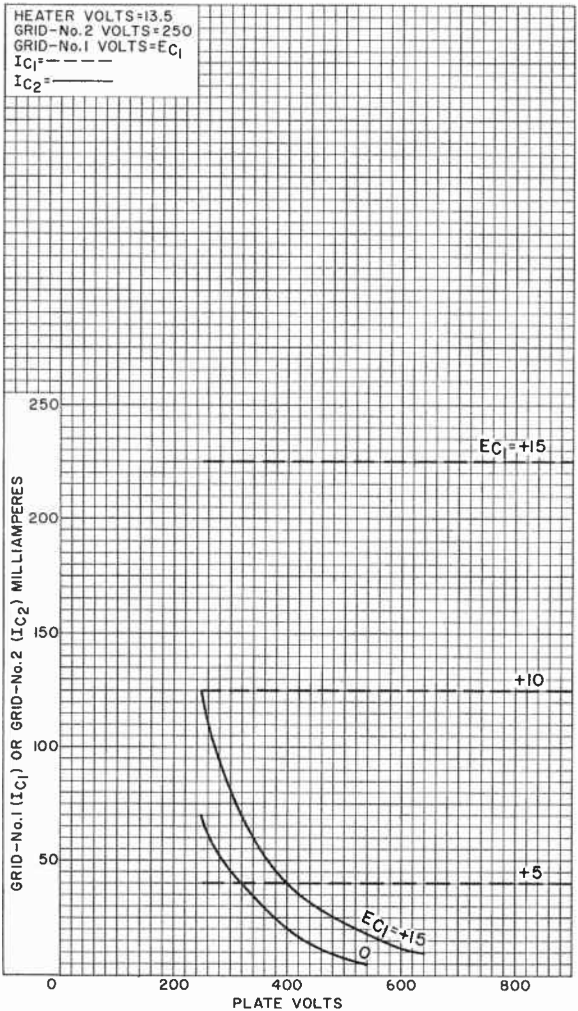


TYPICAL CHARACTERISTICS



92CM-11293R1

TYPICAL CHARACTERISTICS



92CM-11291

Power Pentode

9-PIN MINIATURE TYPE

For Mobile-Communications Equipment Operating from 6-Cell Storage-Battery Systems. Useful as a Class-C RF-Power-Amplifier, Oscillator, and Frequency-Multiplier Tube up to 40 Mc, and as a Modulator and AF-Power-Amplifier Tube.

GENERAL DATA

Electrical:

Heater Characteristics and Ratings *(Absolute-Maximum Values)*:

Voltage (AC or DC)[a]	13.5 ± 1.5	volts
Current at heater volts = 13.5	0.275	amp
Peak heater-cathode voltage:		
Heater negative with respect to cathode	120 max.	volts
Heater positive with respect to cathode	120 max.	volts

Direct Interelectrode Capacitances (Approx.):[b]

Grid No.1 to plate	0.063	μμf
Grid No.1 to all other electrodes except plate	10.2	μμf
Plate to all other electrodes except grid No.1	3.5	μμf

Characteristics, Class A$_1$ Amplifier:

Heater Voltage	13.5	volts
Plate Supply Voltage	250	volts
Grid No.3	*Connected to cathode at socket*	
Grid No.2 Supply Voltage	150	volts
Cathode Resistor	120	ohms
Plate Resistance (Approx.)	0.1	megohm
Transconductance	11500	μmhos
Plate Current	19	ma
Grid-No.2 Current	3.5	ma
Grid-No.1 Voltage (Approx.) for plate μa = 20	-10	volts

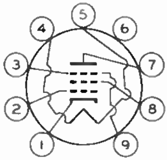
Mechanical:

Operating Position	Any
Type of Cathode	Coated Unipotential
Maximum Overall Length	2-3/16"
Maximum Seated Length	1-15/16"
Length, Base Seat to Bulb Top (Excluding tip)	1-9/16" ± 3/32"
Diameter	0.750" to 0.875"
Dimensional Outline	See *General Section*
Bulb	T6-1/2
Base	Small-Button Noval 9-Pin (JEDEC No.E9-1)

8077/7054

Basing Designation for BOTTOM VIEW 9GK

Pin 1 - Cathode
Pin 2 - Grid No.1
Pin 3 - Grid No.3, Internal Shield
Pin 4 - Heater
Pin 5 - Heater



Pin 6 - No Internal Connection
Pin 7 - Plate
Pin 8 - Grid No.2
Pin 9 - Grid No.3, Internal Shield

AF POWER AMPLIFIER — Class A_1

Maximum Ratings, ***Absolute-Maximum Values:***

PLATE VOLTAGE	330 max.	volts
GRID No.3 (SUPPRESSOR GRID)	*Connect to cathode at socket*	
GRID-No.2 (SCREEN-GRID) VOLTAGE	180 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Negative-bias value	55 max.	volts
Positive-bias value	0 max.	volts
GRID-No.2 INPUT	1 max.	watt
PLATE DISSIPATION	5 max.	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:		
For fixed-bias operation	0.1 max.	megohm
For cathode-bias operation	0.25 max.	megohm

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[c]
and
RF POWER AMPLIFIER — Class C FM Telephony

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

DC PLATE VOLTAGE	300 max.	volts
DC GRID No.3 (SUPPRESSOR GRID)	*Connect to cathode at socket*	
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	175 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Negative-bias value	50 max.	volts
DC PLATE CURRENT	33 max.	ma
DC GRID-No.2 CURRENT	5.5 max.	ma
DC GRID-No.1 CURRENT	3 max.	ma
GRID-No.2 INPUT	1 max.	watt
PLATE DISSIPATION	5 max.	watts

Typical Operation:

At frequencies up to 40 Mc

Heater Voltage	13.5	13.5	13.5	volts
DC Plate Voltage	200	250	300	volts
Grid No.3	*Connected to cathode at socket*			
DC Grid-No.2 Voltage	115	145	175	volts
DC Grid-No.1 Voltage	-7	-9	-12	volts
Peak RF Grid-No.1 Voltage	9	11	16	volts
DC Plate Current	14.5	20	26	ma
DC Grid-No.2 Current	3	4.1	5.5	ma
DC Grid-No.1 Current (Approx.)	0.6	0.85	1	ma

Driving Power (Approx.)	10	12	15	mw
Power Output (Approx.)	1.5	2.7	4	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance . . . . 0.1 max. megohm

FREQUENCY MULTIPLIER

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

Same as for RF POWER AMPLIFIER & OSCILLATOR

Typical Operation:

As doubler up to 40 Mc

DC Plate Voltage	200	250	300	volts
Grid No.3	*Connected to cathode at socket*			
DC Grid-No.2 Voltage	115	145	175	volts
DC Grid-No.1 Voltage	-16	-20	-25	volts
Peak RF Grid-No.1 Voltage	19	24	31	volts
DC Plate Current	11	15	20	ma
DC Grid-No.2 Current	2	3	4	ma
DC Grid-No.1 Current (Approx.)	0.3	0.45	0.6	ma
Driving Power (Approx.)	5	9	13	mw
Useful Power Output (Approx.)	1.4	1.9	2.5	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance . . . . 0.1 max. megohm

[a] The heater will take momentary excursions of 11.0 to 16.0 volts.

[b] Without external shield.

[c] Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

[d] Continuous Commercial Service.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.260	0.290	amp
Transconductance	1,2	8500	14500	µmhos
Plate Current	1,3	13	25	ma
Grid-No.2 Current	1,3	2	5	ma
Reverse Grid-No.1 Current	1,4	-	1.5	µa
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1,5	-	20	µa
Heater positive with respect to cathode	1,5	-	20	µa
Leakage Resistance:				
Between grid-No.1 and all other electrodes tied together	1,6	50	-	megohms
Between plate and all other electrodes tied together	1,7	50	-	megohms

Note 1: With ac or dc heater volts = 13.5.

Note 2: With dc-plate-supply volts = 250, grid-No.2 volts = 150, grid No.3 connected to cathode at socket, cathode resistor (ohms) = 120, and cathode-bypass capacitor (μf) = 1000.

Note 3: With dc plate-supply volts = 250, grid-No.2 supply volts = 150, grid No.3 connected to cathode at socket, and cathode resistor (ohms) = 120.

Note 4: With dc plate-supply volts = 250, grid-No.2 supply volts = 150, grid No.3 connected to cathode at socket, cathode resistor (ohms) = 120, and grid-No.1 resistor (megohms) = 1.

Note 5: With 100 volts dc between heater and cathode.

Note 6: With grid No.1 100 volts negative with respect to all other electrodes tied together.

Note 7: With plate 300 volts negative with respect to all other electrodes tied together.

SPECIAL RATINGS & PERFORMANCE DATA

Heater-Cycling Life Performance:

This test is performed on a sample lot of tubes from each production run. A minimum of 2000 cycles of intermittent operation is applied under the following conditions: heater volts = 19.5 cycled one minute on and two minutes off, heater 135 volts negative with respect to cathode, and all other elements connected to ground. At the end of this test, tubes are checked for heater-cathode shorts and open circuits.

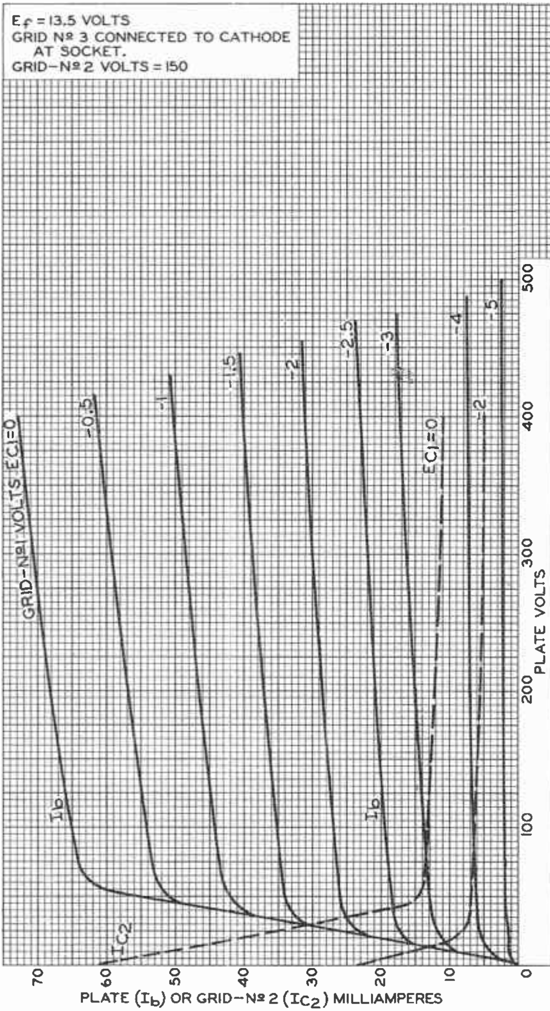
Low-Frequency Vibration Performance:

This test is performed on a sample lot of tubes from each production run under the following conditions: heater volts = 13.5, plate-supply volts = 250, grid No.3 connected to cathode, grid-No.2 supply volts = 150, cathode resistor (ohms) = 120, cathode-bypass capacitor (μf) = 1000, plate load resistor (ohms) = 2000, and vibrational acceleration of 2.5 g at 25 cps. In this test, the rms output voltage must not exceed 150 millivolts.

500-Hour Intermittent Life Performance:

This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures. Life testing is conducted under the following conditions: heater volts = 15 and maximum-rated plate dissipation and grid-No.2 input.

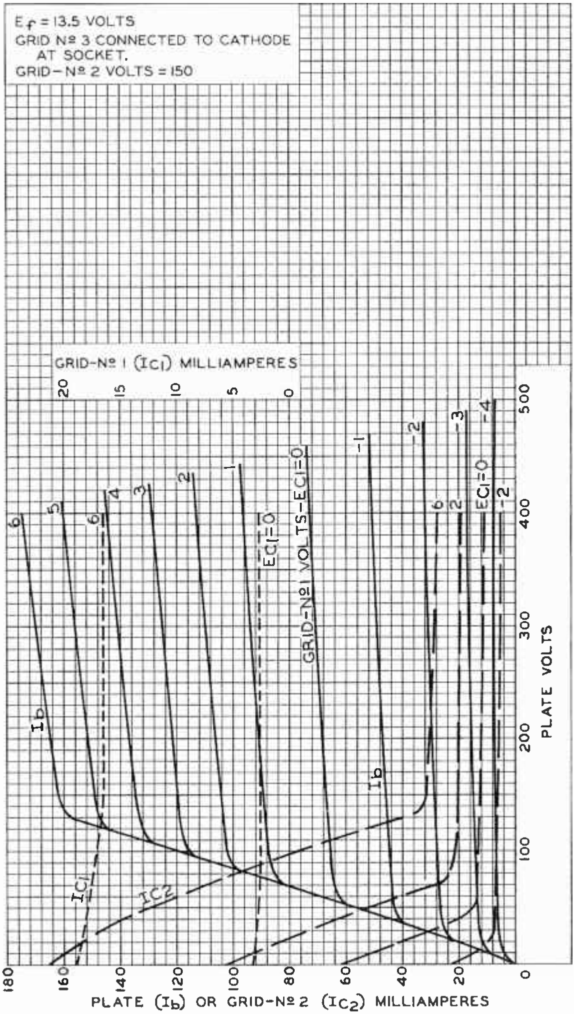
AVERAGE CHARACTERISTICS



92CM-9777R1

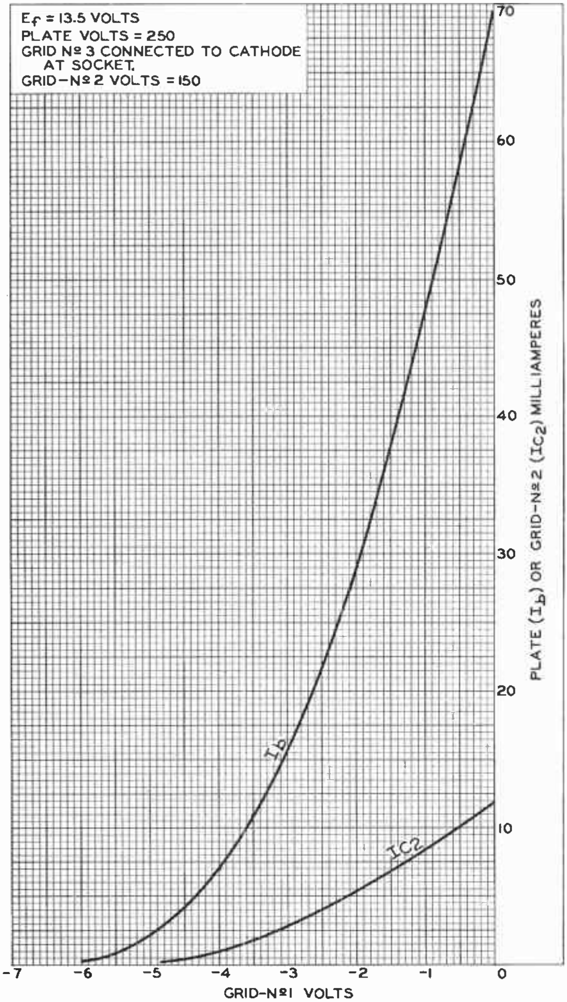
8077/7054

AVERAGE CHARACTERISTICS



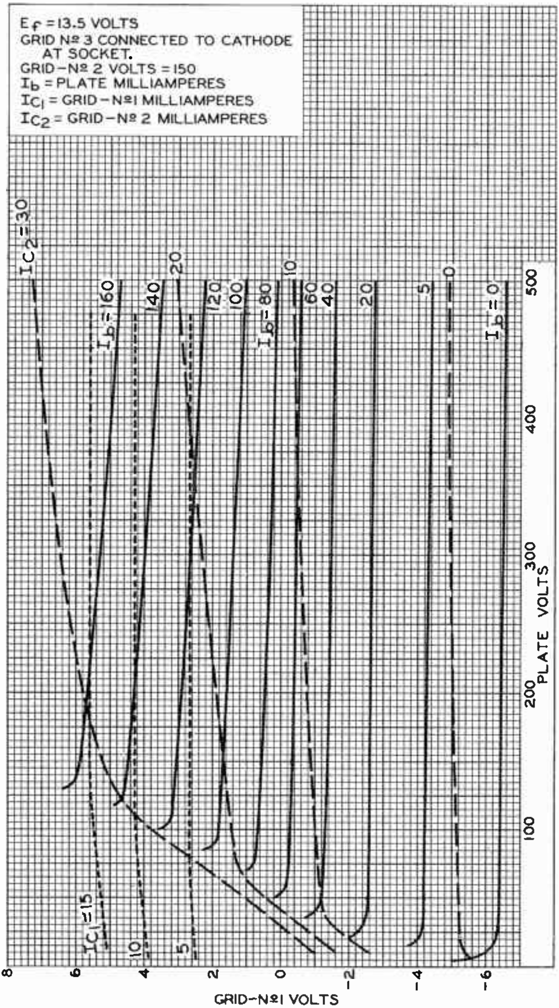
92CM-9778R1

AVERAGE CHARACTERISTICS



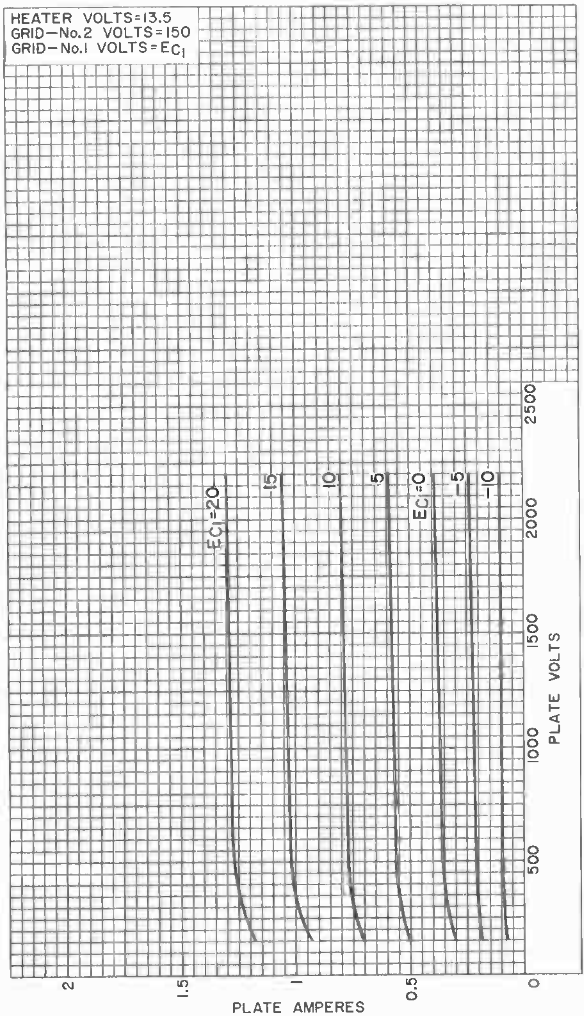
92CM-9775R1

AVERAGE CONSTANT-CURRENT CHARACTERISTICS

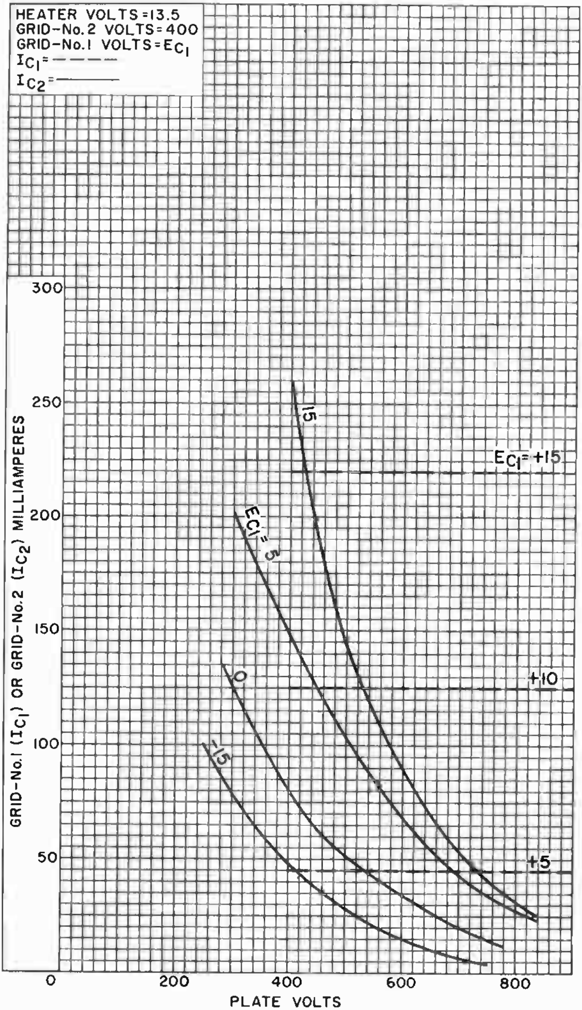


92CM-9776R1

TYPICAL PLATE CHARACTERISTICS

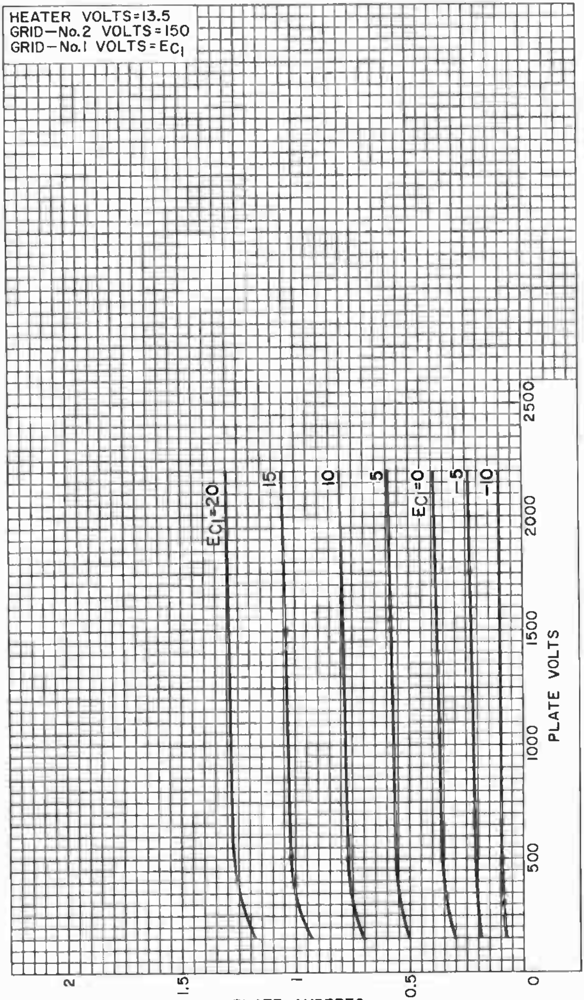


TYPICAL CHARACTERISTICS



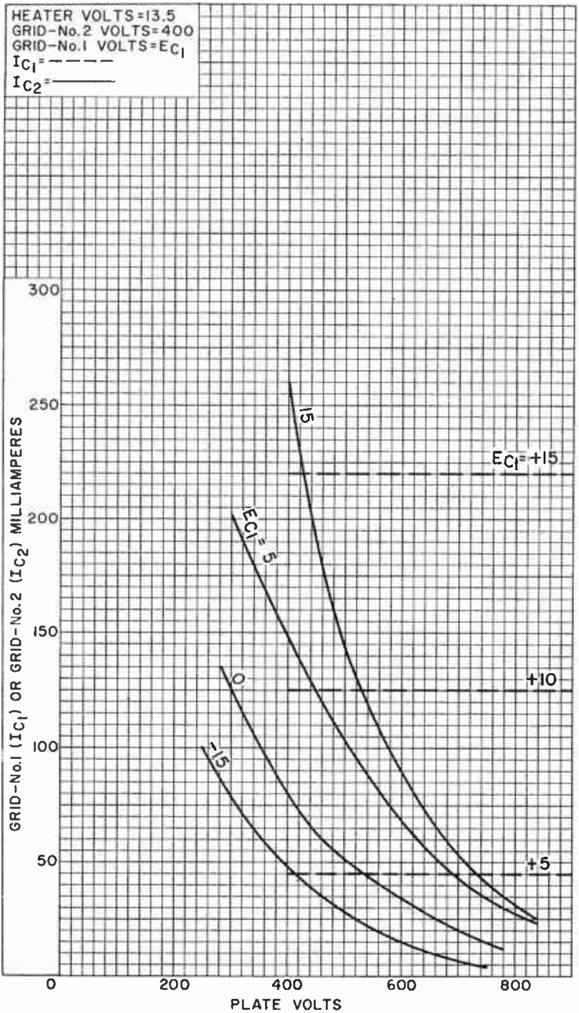
92CM-11293R1

TYPICAL PLATE CHARACTERISTICS



92CM–11289

TYPICAL CHARACTERISTICS



92CM-11293R1

Beam Power Tube

CERAMIC-METAL SEALS
"ONE-PIECE" ELECTRODE DESIGN
COAXIAL-ELECTRODE STRUCTURE
INTEGRAL RADIATOR

2 MEGAWATT MAXIMUM PEAK POWER INPUT UP TO 500 Mc
MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For use at Frequencies up to 500 Mc

GENERAL DATA

Electrical:

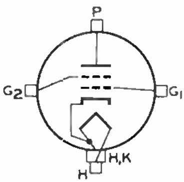
Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode[a]

	Typical	*Maximum*	
Voltage (AC or DC)	22	23	volts
Current at heater volts = 22.	12.6		amp
Minimum heating time.	5		minutes
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 5000, grid-No.2 volts = 1400, and plate ma. = 500 . . .	25		
Direct Interelectrode Capacitances:			
Grid No.1 to plate[b]	0.3 max.		pf
Grid No.1 to cathode & heater	100		pf
Plate to cathode & heater[b,c].	0.03 max.		pf
Grid No.1 to grid No.2.	110		pf
Grid No.2 to plate.	24		pf
Grid No.2 to cathode & heater[c].	1.5 max.		pf

Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. . . . . 7.24"
Maximum Diameter. . . . . 5.56"
Weight (Approx.). . . . . 8.5 lbs
Radiator. . . . . Integral part of tube
Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No-1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H, K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Thermal:

Air Flow:

Through radiator—Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator before and during the application of heater, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator versus plate dissipation are shown in accompanying *Typical-Cooling-Requirements* curve.

To Plate, Grid-No.2, Grid-No.1, Cathode, and Heater Terminals—A sufficient quantity of air should be allowed to flow past each of these terminals to prevent their temperature from exceeding the specified maximum value of 250° C.

Plate power, grid-No.2 power, heater power, and the forced-air flow may be removed simultaneously.

Terminal Temperature[d] (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C
Plate Core Temperature[d]	250 max.	°C

PULSED RF AMPLIFIER

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

For maximum "on" time[f] of 10 microseconds in any 2000-microsecond interval and frequencies up to 500 Mc

PEAK POSITIVE PULSE PLATE VOLTAGE[g]	25000 max.	volts
DC PLATE VOLTAGE[g]	15000 max.	volts
POSITIVE-PULSE GRID-No.2 VOLTAGE:		
Peak	2500 max.	volts
DC	2500 max.	volts
NEGATIVE-PULSE GRID-No.1 VOLTAGE:		
Peak	500 max.	volts
DC	500 max.	volts
DC-PULSE PLATE CURRENT	80 max.	amps
DC PLATE CURRENT	0.5 max.	amp
GRID-No.2 INPUT (Average)	150 max.	watts
GRID-No.1 INPUT (Average)	100 max.	watts
PLATE DISSIPATION (Average)	10000 max.	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	2000 max.	ohms

[a] See *Operating Considerations*.

[b] With external flat metal shield 8" diameter having center hole 4" diameter. Shield is located in plane of the grid-No.2 terminal, perpendicular to the tube axis, and is connected to grid No.2 and ground.

[c] With external flat metal shield 8" diameter having center hole 3-3/8" diameter. Shield is located in plane of the grid-No.1 terminal, perpendicular to the tube axis, and is connected to grid No.1 and ground.

[d] See *Operating Considerations* and also *Dimensional Outline* for temperature-measurement points.

[e] Continuous Commercial Service.

[f] *"On" time* is defined as the sum of the durations of all the individual pulses which occur during the interval. An increase in dc plate current during the pulse may be permissible at shorter "on" times, and a decrease is usually required at longer "on" times. *Pulse duration* is defined as the time interval between the two points on the pulse at which the instantaneous value is 70 per cent of the peak value. *Peak value* is defined as the maximum value of a smooth curve through the average of the fluctuations over the top portion of the pulse.

Duty factor is defined as the ratio of "on" time to total elapsed time in any interval.

[g] Pressurization may be required when the tube is used at high altitudes and plate voltages near the maximum rating to prevent flash-over at the tube seals.

CHARACTERISTICS RANGE VALUES

	Note	Min.	Max.	
Heater Current	1	11.7	13.5	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	-	0.3	pf
Grid No.1 to cathode & heater		91	113	pf
Plate to cathode & heater	2,3	-	0.03	pf
Grid No.1 to grid No.2		99	121	pf
Grid No.2 to plate		21	26	pf
Grid No.2 to cathode & heater	3	-	1.5	pf
Grid-No.1 Voltage	1,4	-27	-61	volts
Grid-No.1 Cutoff Voltage	1,5	-	-95	volts

Note 1: With 22 volts ac or dc on heater.

Note 2: With external flat metal shield 8" diameter having center hole 4" diameter. Shield is located in plane of the grid-No.2 terminal, perpendicular to the tube axis, and is connected to grid No.2 and ground.

Note 3: With external flat metal shield 8" diameter having center hole 3-3/8" diameter. Shield is located in plane of the grid-No.1 terminal, perpendicular to the tube axis, and is connected to grid No.1 and ground.

Note 4: With dc plate voltage of 5000 volts, dc grid-No.2 voltage of 1500 volts, and dc grid-No.1 voltage adjusted to give a plate current of 500 ma.

Note 5: With dc plate voltage of 5000 volts, dc grid-No.2 voltage of 1500 volts, and dc grid-No.1 voltage adjusted to give a plate current of 20 ma.

OPERATING CONSIDERATIONS

Heater

The heater of the 8184 should be operated at constant voltage rather than constant current. The rated heater voltage of 22 volts should be applied for 5 minutes to allow the cathode to reach normal operating temperature before voltages are applied to the other electrodes. Good regulation of the heater voltage is in general economically advantageous from the viewpoint of tube life; in no case should the voltage fluctuations be more than 5%.

Temperature

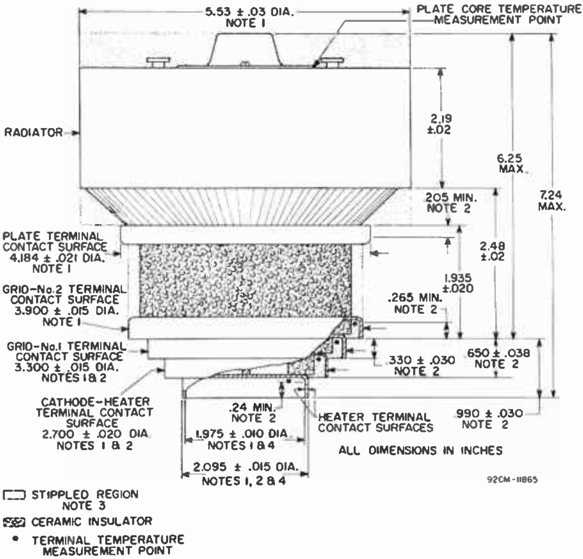
The maximum terminal temperature of 250° C is a tube rating and is to be observed in the same manner as other ratings. The temperature may be measured with temperature-sensitive paint, such as Tempilaq. The latter is made in the form of liquid and stick by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

Standby Operation

During long or frequent standby periods, the 8184 may be operated at decreased heater voltage to conserve life. It is recommended that the heater voltage be reduced to 80% of normal during standby periods up to 2 hours. For longer periods, the heater voltage should be turned off.

Precautions

The maximum-rated plate and grid-No.2 voltages of this tube are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies when any gate or door on the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.



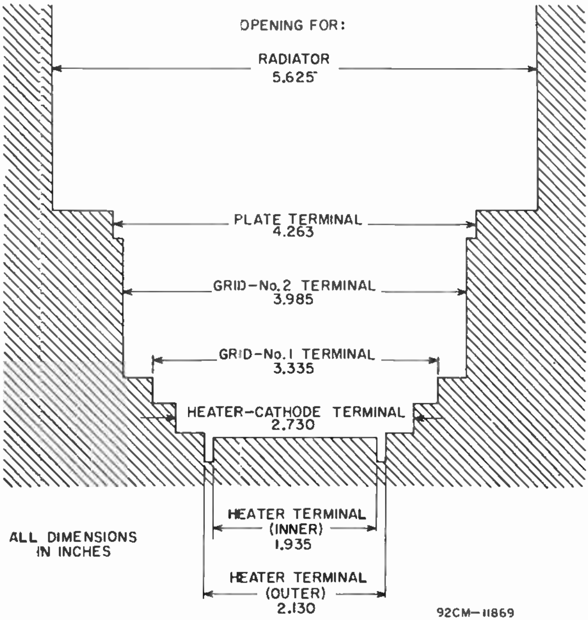
NOTE 1: SEE SKETCH G1 FOR THE MAXIMUM DIAMETRICAL SPACE REQUIRED BY THE 8184 BASED UPON THE DIAMETER AND ECCENTRICITY OF RADIATOR BAND AND OF EACH RING TERMINAL.

NOTE 2: THE DIAMETER OF THE TERMINAL IS HELD TO THE INDICATED VALUE ONLY OVER THE CONTACT SURFACE LENGTH. THE CONTACT SURFACE LENGTH OF THE HEATER, HEATER-CATHODE, AND GRID-No.1 TERMINALS EXTENDS FROM THE EDGE OF ITS TERMINAL TO THE PLANE COINCIDENT WITH THE EDGE OF THE ADJACENT LARGER TERMINAL.

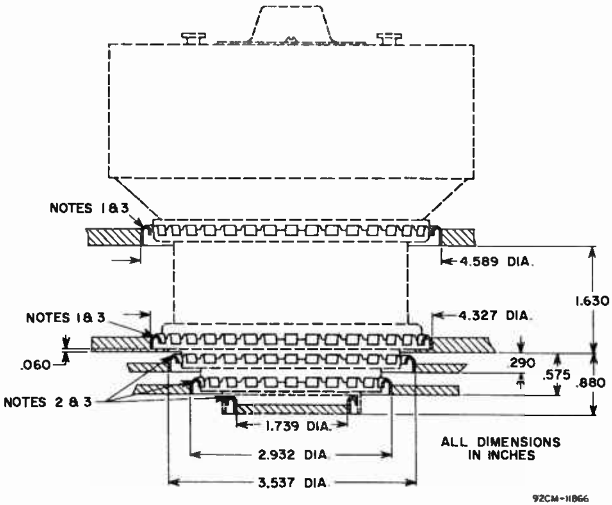
NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR REGIONS.

NOTE 4: THE HEATER TERMINAL IS DIMENSIONED FOR INSIDE DIAMETER AND OUTSIDE DIAMETER TO PROVIDE A CHOICE OF CONTACT MOUNTING; THE DIMENSIONS SHALL NOT BE CONSIDERED CONCURRENTLY.

SKETCH G1



SUGGESTED MOUNTING ARRANGEMENT
& LAYOUT OF ASSOCIATED CONTACTS

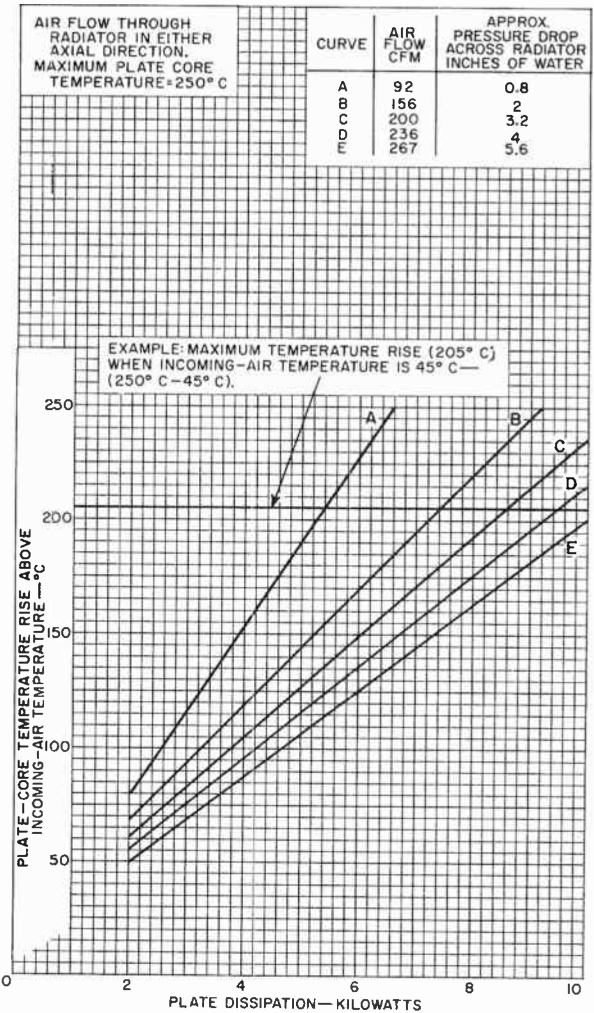


NOTE 1: FINGER STOCK NO. 97-310.

NOTE 2: FINGER STOCK NO. 97-139.

NOTE 3: SPECIFIED FINGER STOCK IS MADE BY INSTRUMENT SPECIALITIES COMPANY, LITTLE FALLS, NEW JERSEY.

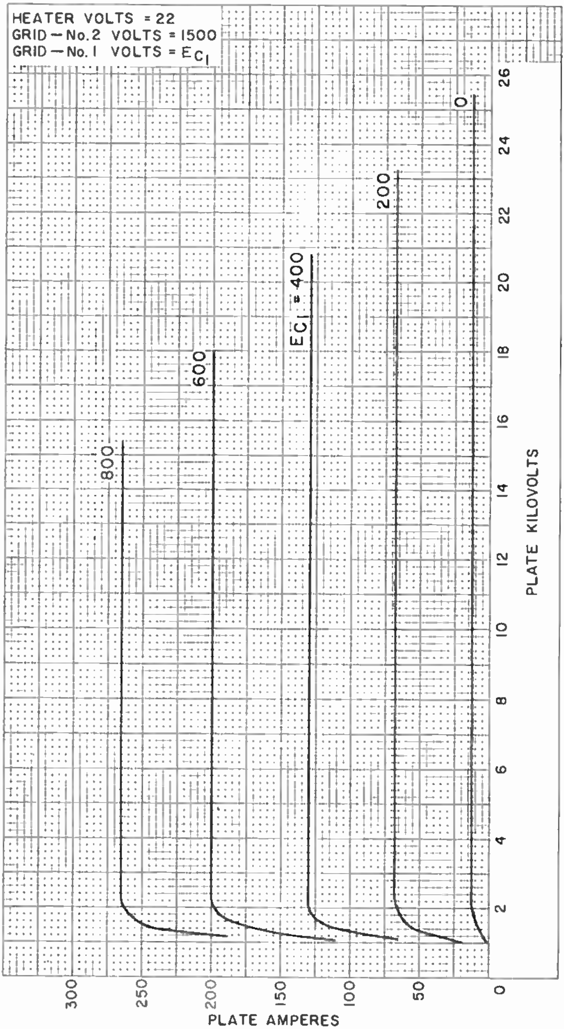
TYPICAL COOLING REQUIREMENTS



CURVE	AIR FLOW CFM	APPROX. PRESSURE DROP ACROSS RADIATOR INCHES OF WATER
A	92	0.8
B	156	2
C	200	3.2
D	236	4
E	267	5.6

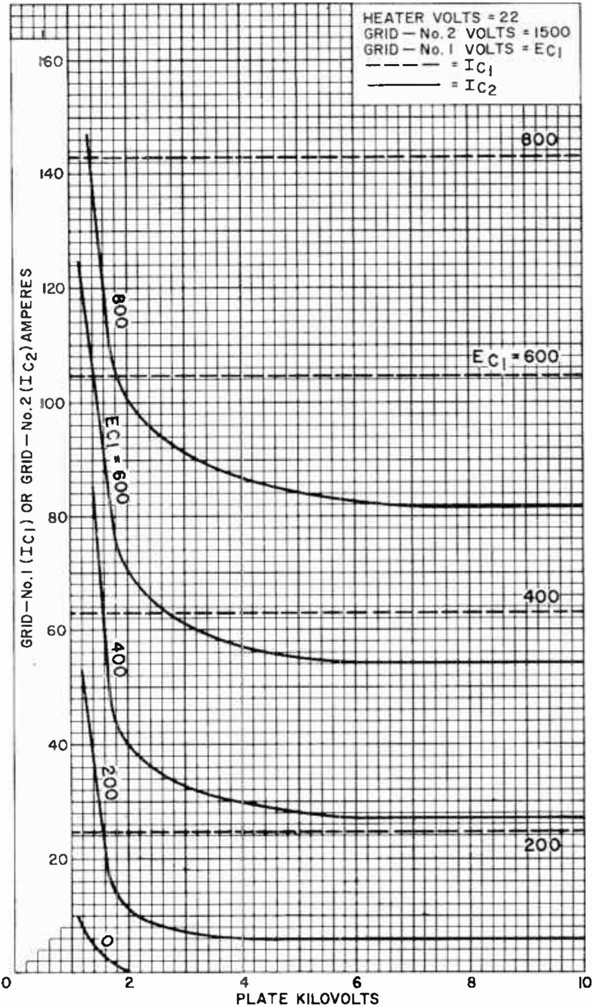
92CM-11861

TYPICAL PLATE CHARACTERISTICS



92CM—11862

TYPICAL CHARACTERISTICS



92CM-11864

9001

DETECTOR AMPLIFIER PENTODE

MIDGET TYPE

Heater ■	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:		
Grid to Plate	0.01 max.	μμf
Input	3.6	μμf
Output	3.0	μμf
Maximum Overall Length		1-13/16"
Maximum Seated Height		1-9/16"
Length from Base Seat to Bulb Top (excluding tip)		1-3/16" ± 3/32"* ←
Maximum Diameter		3/4"
Bulb		T-5-1/2
Base▲		Miniature Button 7-Pin

Pin 1 - Grid
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Heater

Pin 5 - Plate
Pin 6 - Screen
Pin 7 - Cathode, Grid No. 3, Internal Shield

RCA Socket		Stock No. 9914 ←
Mounting Position	BOTTOM VIEW	Any

Maximum and Minimum Ratings Are Design-Center Values

AMPLIFIER

Plate Voltage	250 max.	volts
Screen Voltage	100 max.	volts
Grid Voltage	-3 min.	volts
Plate Dissipation	0.5	watt ←
Screen Dissipation	0.1	watt ←

Typical Operation and Characteristics - Class A_1 Amplifier:

Plate Voltage	90	250	volts
Screen Voltage	90	100	volts
Grid Voltage	-3	-3	volts
Plate Resistance	1.0	●	approx. megohm
Transconductance	1100	1400	μmhos
Plate Current	1.2	2.0	ma.
Screen Current	0.5	0.7	ma.

Typical Operation as Mixer in Superheterodyne Circuit:

Plate Voltage	100	250	volts
Screen Voltage	100	100	volts
Grid Voltage #	-5	-5	approx. volts
Conversion Transconductance	-	550	approx. μmhos

Shielding and *r-f by-passing* of each r-f amplifier stage may be required in order to prevent interstage coupling and to provide the shortest possible circuit returns when the tube is operated at the ultra-high frequencies. R-f by-passing can be accomplished by the use of small condensers having short leads placed close to the tube terminals. It may also be advisable in some applications to supplement the action of the by-pass condensers by r-f chokes close to the condensers in the return or supply leads for the grid, screen,

■, ▲, ●, #: See next page.

*Temporary minimum length = 1-1/16".

← Indicates a change.

OCT. 1, 1943

RCA

9001

DETECTOR AMPLIFIER PENTODE

(continued from preceding page)

plate and heater. The 9001 has two cathode leads in order that the plate and screen r-f circuits may be completed with a minimum of circuit inductance in common with the grid circuit. The grid return may be connected to one cathode terminal and the plate and screen returns may be connected to the other cathode terminal.

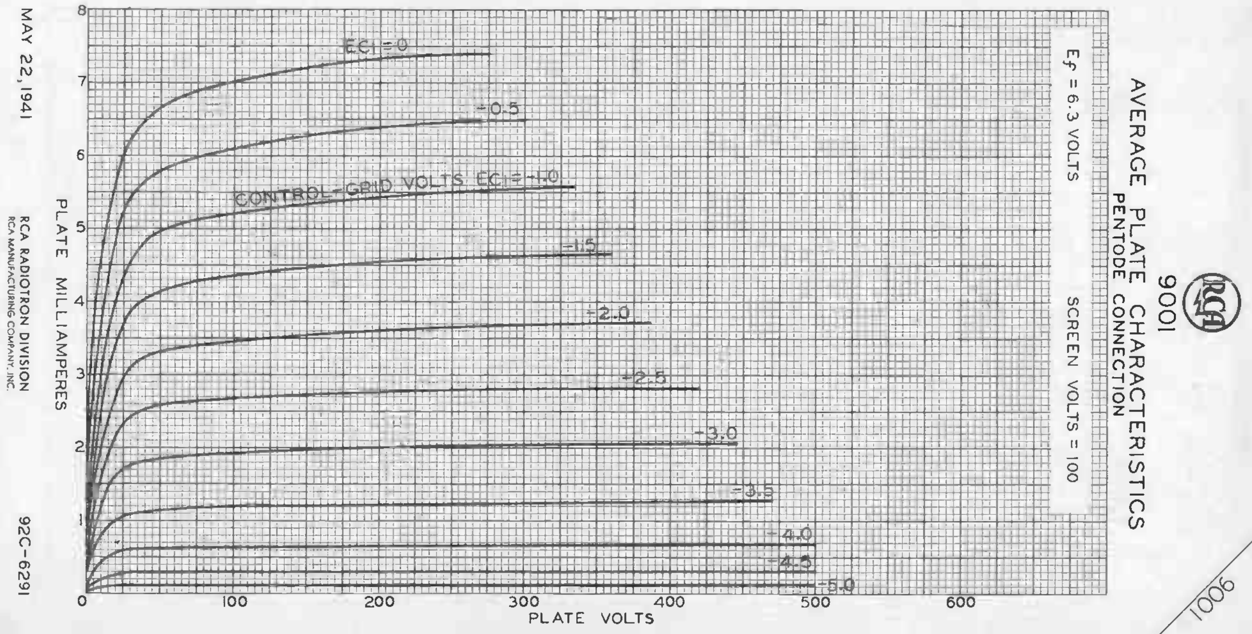
■ The cathode of the 9001, when operated from a transformer, should preferably be connected to the heater circuit. In the case of d-c operation of the heater from a storage battery, the cathode circuit is tied in either directly or through bias resistors to the negative battery terminal. In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.

• Greater than 1.0 megohm.

The grid bias is minimum for an oscillator peak voltage of 4 volts. These values are optimum.

▲ *The center hole in sockets designed for this base provides for the possibility that this tube type may be manufactured with the exhaust-tube tip at the base end. For this reason, it is recommended that in equipment employing this tube type, no material be permitted to obstruct the socket hole.*

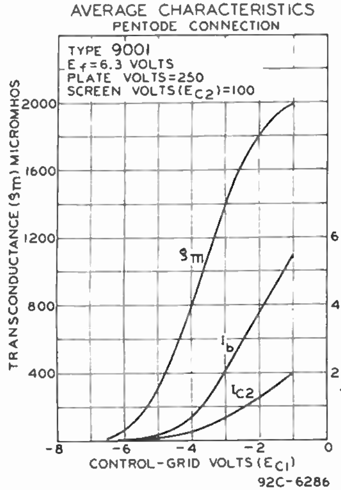
RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

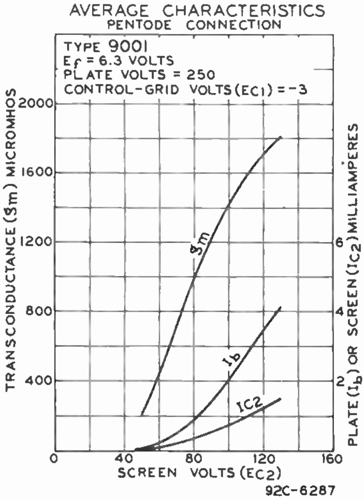

9001
AVERAGE PLATE CHARACTERISTICS
PENTODE CONNECTION
Ef = 6.3 VOLTS
SCREEN VOLTS = 100
CONTROL-GRID VOLTS EC1 = -1.0
EC1 = 0
-0.5
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
PLATE MILLIAMPERES
PLATE VOLTS
0
1
2
3
4
5
6
7
8
100
200
300
400
500
600
MAY 22, 1941
RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.
92C-6291
1006

RCA

9001

DETECTOR AMPLIFIER PENTODE





July 1, 1941

92C-6286
92C-6287

9002

9002

DETECTOR, AMPLIFIER, OSCILLATOR

MIDGET TYPE

Heater ■	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:		
Grid to Plate	1.4	μμf
Grid to Cathode	1.2	μμf
Plate to Cathode	1.1	μμf
Maximum Overall Length		1-13/16"
Maximum Seated Height		1-9/16"
Length from Base Seat to Bulb Top (excluding tip)		1-3/16" ± 3/32"* ←
Maximum Diameter		3/4"
Bulb		T-5-1/2
Base ▲		Miniature Button 7-Pin

Pin 1 - Plate
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Heater

BOTTOM VIEW

Pin 5 - Plate
Pin 6 - Grid
Pin 7 - Cathode

RCA Socket	Stock No. 9914 ←
Mounting Position	Any

Maximum Ratings Are Design-Center Values

AMPLIFIER

Plate Voltage	250 max. volts
Plate Dissipation	1.6 max. watts ←

Typical Operation and Characteristics - Class A_1 Amplifier:

Plate	90	135	180	250	volts
Grid	-2.5	-3.75	-5	-7	volts
Amp. Fact.	25	25	25	25	
Plate Res.	14700	13200	12500	11400	ohms
Transcond.	1700	1900	2000	2200	μmhos
Plate Cur.	2.5	3.5	4.5	6.3	ma.

■ The cathode of the 9002, when operated from a transformer, should preferably be connected to the heater circuit. In the case of d-c operation of the heater from a storage battery, the cathode circuit is tied in either directly or through bias resistors to the negative battery terminal. In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.

▲ *The center hole in sockets designed for this base provides for the possibility that this tube type may be manufactured with the exhaust-tube tip at the base end. For this reason, it is recommended that in equipment employing this tube type, no material be permitted to obstruct the socket hole.*

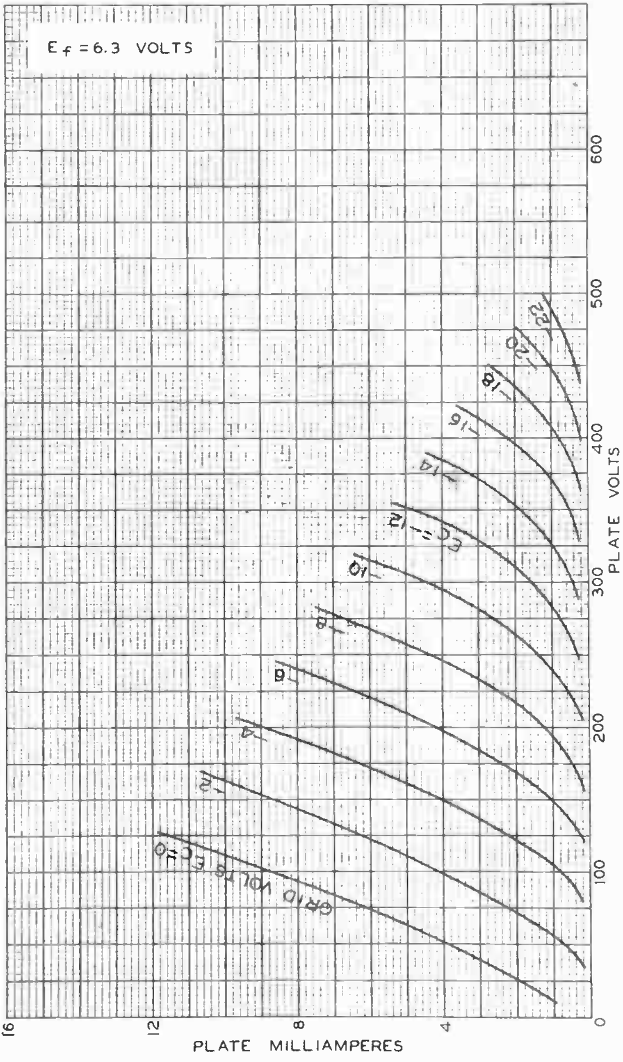
*Temporary minimum length = 1-1/16".

← indicates a change.

9002

9002

AVERAGE PLATE CHARACTERISTICS



SEPT. 17, 1943

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

92C-6284

9003

9003

SUPER-CONTROL R-F AMPLIFIER PENTODE

MIDGET TYPE

Heater	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:		
Grid to Plate	0.01 max.	μμf
Input	3.4	μμf
Output	3.0	μμf
Maximum Overall Length		1-13/16"
Maximum Seated Height		1-9/16"
Length from Base Seat to Bulb Top (excluding tip)		1-3/16" ± 3/32"* ←
Maximum Diameter		3/4"
Bulb		T-5-1/2
Base▲		Miniature Button 7-Pin

Pin 1 - Grid
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Heater

BOTTOM VIEW

Pin 5 - Plate
Pin 6 - Screen
Pin 7 - Cathode, Grid No. 3, Internal Shield

RCA Socket	Stock No. 9914 ←
Mounting Position	Any

Maximum and Minimum Ratings Are Design-Center Values

AMPLIFIER

Plate Voltage	250 max.	volts
Screen Voltage	100 max.	volts
Grid Voltage	-3 min.	volts
Plate Dissipation	1.7 max.	watts ←
Screen Dissipation	0.3 max.	watt ←

Typical Operation and Characteristics - Class A_1 Amplifier:

Plate Voltage	250	volts
Screen Voltage	100	volts
Grid Voltage	-3	volts
Plate Resistance	0.7 approx.	megohm
Transconductance	1800	μmhos
Grid Bias for Transcond. of 15 μmhos	-35	volts
Grid Bias for Transcond. of 2 μmhos	-45	volts
Plate Current	6.7	ma.
Screen Current	2.7	ma.

Typical Operation as Mixer in Superheterodyne Circuit:

Plate Voltage	100	250	volts
Screen Voltage	100	100	volts
Grid Voltage #	-10	-10 approx.	volts
Conversion Transconductance	-	600 approx.	μmhos

The grid bias is minimum for an oscillator peak voltage of 9 volts. These values are optimum.

▲ *The center hole in sockets designed for this base provides for the possibility that this tube type may be manufactured with the exhaust-tube tip at the base end. For this reason, it is recommended that in equipment employing this tube type, no material be permitted to obstruct the socket hole.*

Shielding Considerations & Heater-Cathode Connections for the 9003 are the same as for Type 9001.

← Indicates a change.

*Temporary minimum length = 1-1/16".

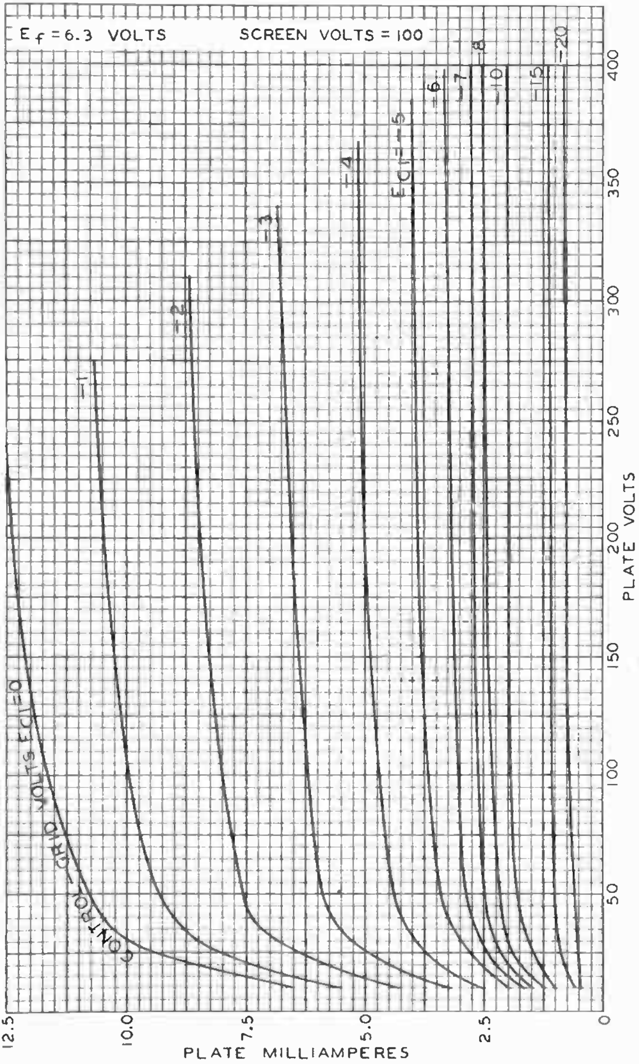
OCT. 1, 1943 DATA

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

9003

9003

AVERAGE PLATE CHARACTERISTICS



SEPT. 17, 1943

RCA VICTOR DIVISION

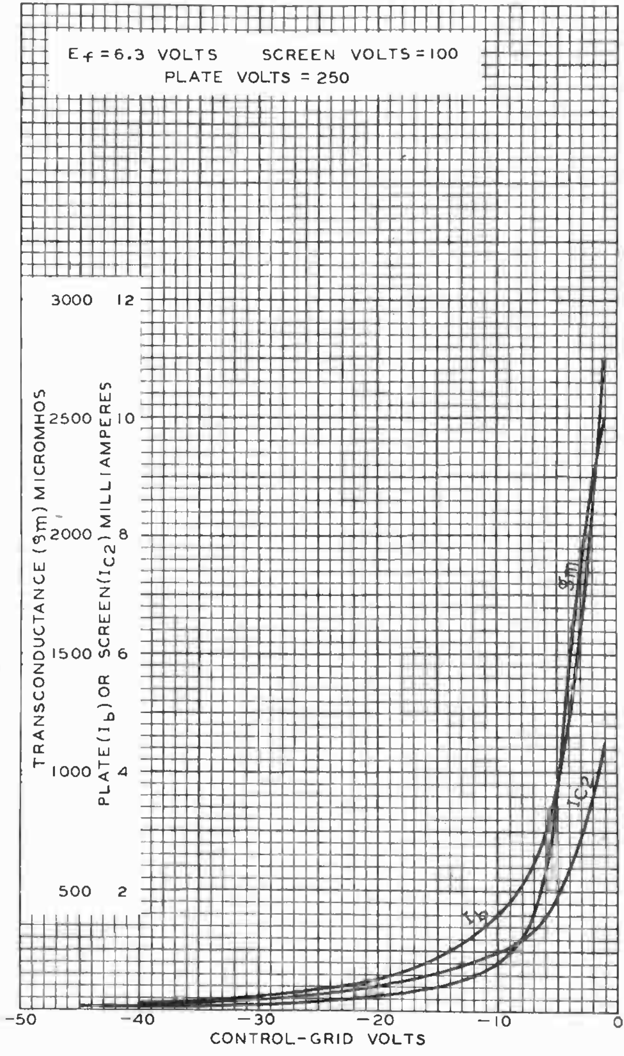
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

92C-6288

9003

9003

AVERAGE CHARACTERISTICS



MAY 29, 1941

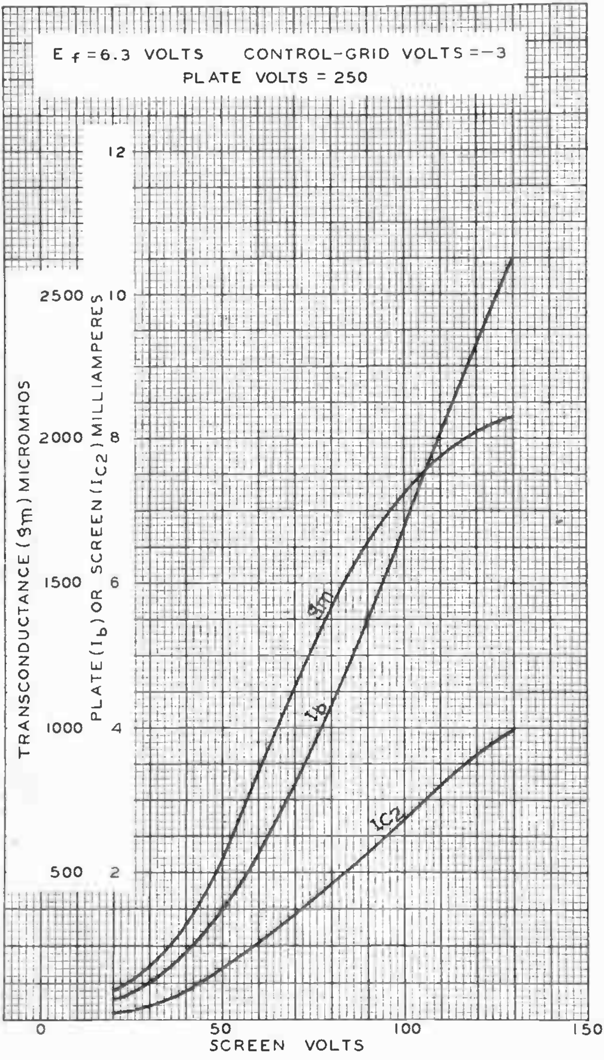
RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

92C-6289

9003

9003

AVERAGE CHARACTERISTICS



MAY 29, 1941

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY INC

92C-6290

9004

U-H-F DIODE

ACORN TYPE

Heater	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:°		
Plate to Cathode	1.3	μμf
Plate to Heater	0.3 approx.	μμf
Heater to Cathode	2.2 approx.	μμf
Overall Length		1-7/32" ± 5/32"
Overall Diameter		1-3/32" ± 1/16"
Bulb		T-4½
RCA Socket		Stock No. 9925
Mounting Position		Any

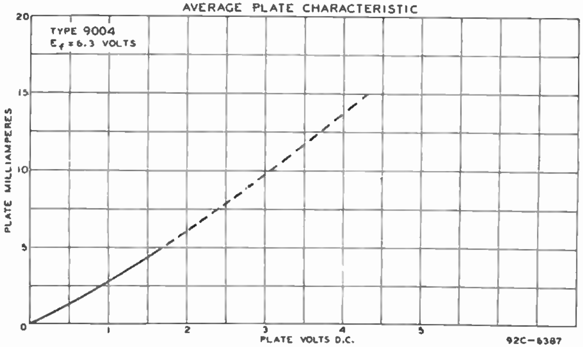
Maximum Ratings Are Design-Center Values

RECTIFIER

A-C Plate Voltage (RMS)	117 max. volts
D-C Output Current	5 max. ma.

The resonant frequency of the 9004 is approximately 850 Mc

°With no external shield.



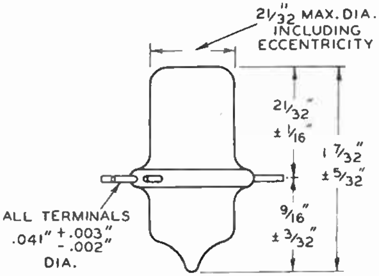
Dec. 1, 1942

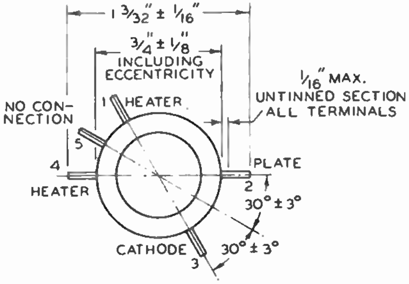
TENTATIVE DATA

9004

9004

U-H-F DIODE





BOTTOM VIEW

92C-6353R1

→ Indicates a change.

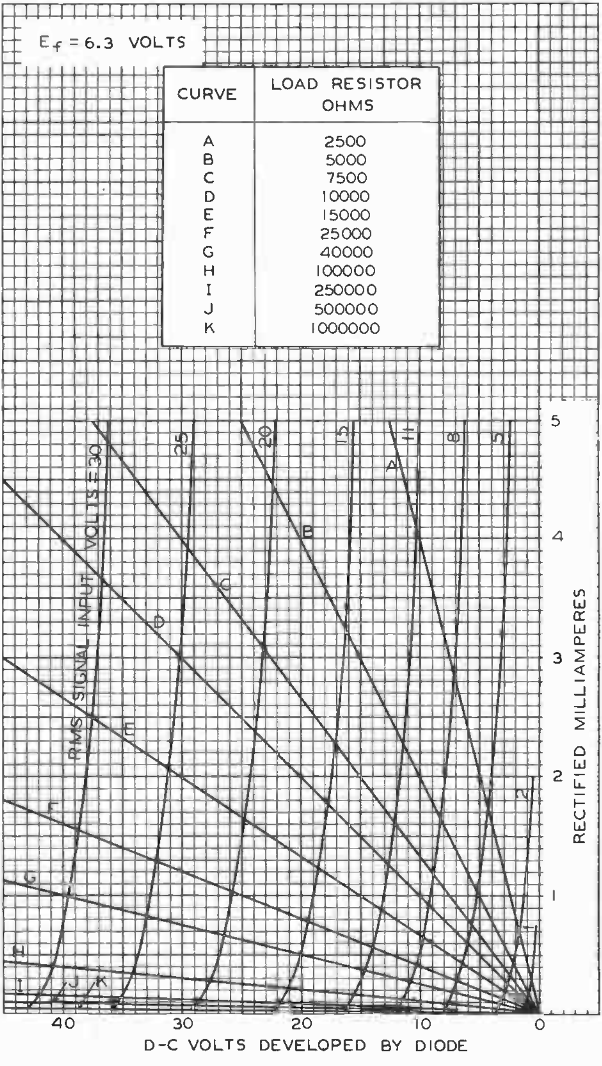
Dec. 1, 1942

92C-6353R1

RCA

9004

AVERAGE CHARACTERISTICS



CURVE	LOAD RESISTOR OHMS
A	2500
B	5000
C	7500
D	10000
E	15000
F	25000
G	40000
H	100000
I	250000
J	500000
K	1000000

MARCH 18, 1942

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

92C-6383

9005

U-H-F DIODE

ACORN TYPE

Heater	Coated Unipotential Cathode	
Voltage	3.6	a-c or d-c volts
Current	0.165	amp.
Direct Interelectrode Capacitances:°		
Plate to Cathode	0.8	μμf
Plate to Heater	0.2 approx.	μμf
Heater to Cathode	1.1 approx.	μμf
Overall Length		1-7/32" ±5/32"
Overall Diameter		1-3/32" ±1/16"
Bulb		T-4½
RCA Socket		Stock No.9925
Mounting Position		Any

Maximum Ratings are Design-Center Values

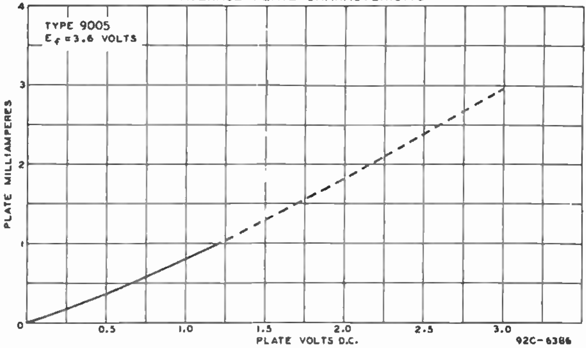
RECTIFIER

A-C Plate Voltage (RMS)	117 max. volts
D-C Output Current	1.0 max. ma.

The resonant frequency of the 9005 is approximately 1500 Mc.

°With no external shield.

AVERAGE PLATE CHARACTERISTIC



Dec. 1, 1942

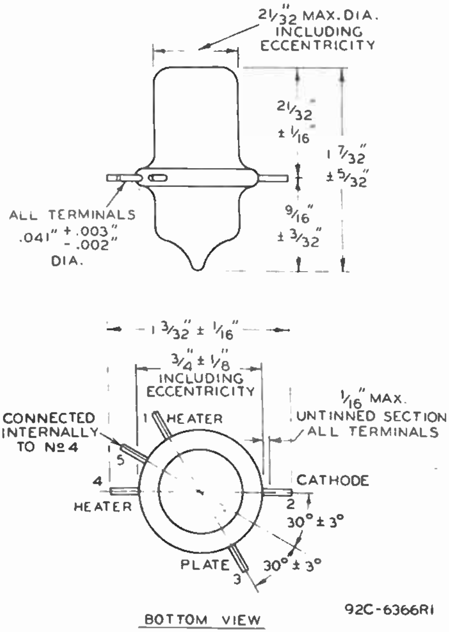
TENTATIVE DATA

RCA RADIOTRON DIVISION

RCA MANUFACTURING COMPANY INC

9005

U-H-F DIODE

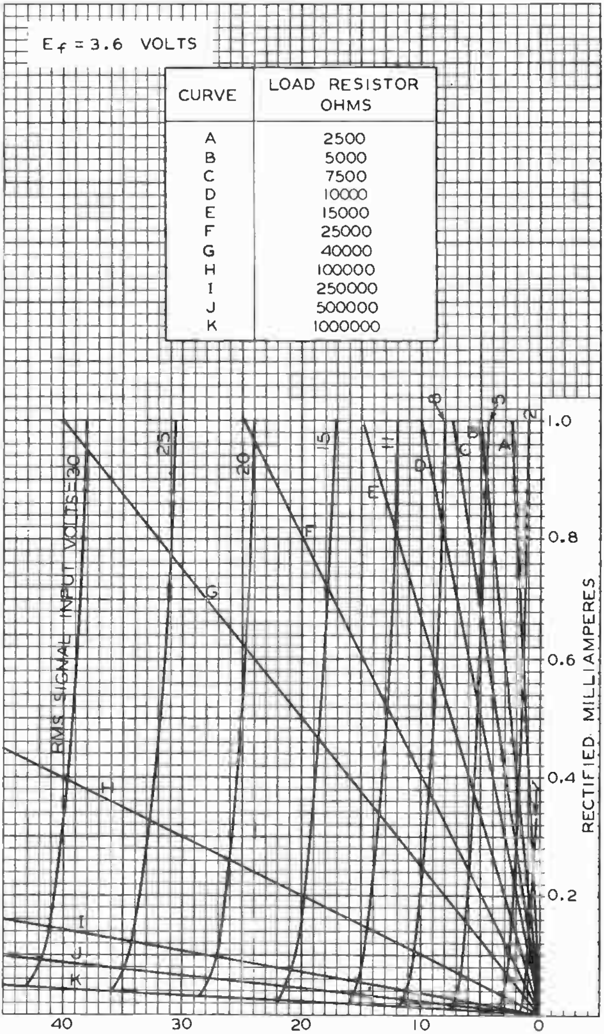


→ Indicates a change.

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

9005

AVERAGE CHARACTERISTICS



CURVE	LOAD RESISTOR OHMS
A	2500
B	5000
C	7500
D	10000
E	15000
F	25000
G	40000
H	100000
I	250000
J	500000
K	1000000

9006

RCA

9006

U-H-F DIODE

MIDGET TYPE

Heater	Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:•		
Plate to Cathode	1.4	μμf
Plate to Heater	0.2	μμf
Cathode to Heater	2.2	μμf
Maximum Overall Length		1-13/16"
Maximum Seated Height		1-9/16"
Length from Base Seat to Bulb Top (excluding tip)		1-3/16 ± 3/32"*
Maximum Diameter		3/4"
Bulb		T-5-1/2
Base▲		Miniature Button 7-Pin

Pin 1 - Plate
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Heater

Pin 5 - Plate
Pin 6 - No Connection
Pin 7 - Cathode

RCA Socket		Stock No. 9914
Mounting Position	BOTTOM VIEW (6BH)	Any

Maximum Ratings Are Design-Center Values

RECTIFIER

Peak Inverse Plate Voltage	750 max.	volts
Peak Plate Current	15 max.	ma.
D-C Output Current	5 max.	ma.
D-C Heater-Cathode Potential	100 max.	volts
Typical Operation as Rectifier:		
A-C Plate Supply Voltage (RMS)	270	volts
Min. Total Effective Plate-Supply Impedance	100	ohms
D-C Output Current	5	ma.

• With no external shield.

The resonant frequency of the 9006 is 700 megacycles (approx).

▲ *The center hole in sockets designed for this base provides for the possibility that this tube type may be manufactured with the exhaust-tube tip at the base end. For this reason, it is recommended that in equipment employing this tube type, no material be permitted to obstruct the socket hole.*

*Temporary minimum length = 1-1/16".

OCT. 1, 1943 DATA

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

9006

9006

U-H-F DIODE