TWIN POWER TRIODE

THE 6394A IS A LONG LIFE, MECHANICALLY RUGGED, TWIN POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 6394A ADEQUATELY MEETS THESE REQUIREMENTS.

THE DESIGN FEATURES ZIRCONIUM COATED GRAPHITE ANODES THAT, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAIN WARP FREE DURING LIFE AND PROVIDE ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODES ARE SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 6394A HAS REPLACED TWO OR THREE TUBE TYPE 608OWA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OF POWER, MANY 6394A TUBE SECTIONS CAN BE PARALLELED AS EXPLAINED IN THE APPLICATION NOTES.
ELECTRICAL DATA

HEATER VOLTAGE 26.5 VOLTS
HEATER CURRENT (E<sub>%</sub> 26.5 VOLTS) 1.30 AMP.
MINIMUM CATHODE HEATING TIME 30 SECONDS
TRANSConDUCTANCE (PER SECTION) 13 500 &mu;MOS
AMPLIFICATION FACTOR 2.7
INTER ELECTRODE CAPACITANCES PER TRIODE SECTION:
GRID TO CATHODE 16.7 &mu;F
GRID TO PLATE 21.8 &mu;F
CATHODE TO PLATE 3.8 &mu;F
HEATER TO CATHODE 15.0 &mu;F
INTER ELECTRODE CAPACITANCES BETWEEN TRIODE SECTIONS:
SECTION #1 PLATE TO SECTION #2 PLATE 0.6 &mu;F

MECHANICAL DATA

MOUNTING POSITION ANY
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)

BULB TT 16 NONEX
BASE LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JETEC #88-98

AVERAGE NET WEIGHT 3.5 OUNCES

MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE) 720 G

MAXIMUM VIBRATION RATING:
(O TO 50 CPS) 10 G
(SO TO 500 CPS) 5 G

RATINGS ABSOLUTE VALUES

POWER DISSIPATION PER PLATE --- 30 WATTS
PLATE CURRENT PER PLATE --- 400 MA DC

IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE

PLATE VOLTAGE 0 400 VOLTS DC
HEATER-CATHODE VOLTAGE -300 +300 VOLTS DC
GRID VOLTAGE -300 0 VOLTS DC
GRID CURRENT PER GRID --- 0 MA
HEATER VOLTAGE 24.0 29.0 VOLTS
ENVELOPE TEMPERATURE --- 250 °C

ALTITUDE FOR FULL RATINGS --- 10 000 FEET

IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FEET

CIRCUIT VALUES
TOTAL GRID CIRCUIT RESISTANCE 500 500 000 OHMS
RESISTANCE PER GRID LEG WHEN TRIODE SECTIONS ARE PARALLELED 500 --- OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.
ADDITIONAL TESTS TO INSURE RELIABILITY
RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 48° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (7206/MSEC)
LIFE TEST: 4000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>PLATE CURRENT (MIN.)</td>
<td>150 MA</td>
</tr>
<tr>
<td>TRANSCONDUCTANCE PER SECTION (MIN.)</td>
<td>9000 μMHO</td>
</tr>
<tr>
<td>HK LEAKAGE (MAX.)</td>
<td>100 μA</td>
</tr>
<tr>
<td>GRID CURRENT (MAX.)</td>
<td>-8 μA</td>
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</tbody>
</table>

RANGE OF VALUES

CONDITIONS:

\[
E_f = 26.5V, E_b = 190V, \\
E_c = 0, R_k/k = 200 Ω, R_{g/g} = 5000Ω \]

BOTH SECTIONS OPERATING, READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING. EACH SECTION READ SEPARATELY.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
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<tbody>
<tr>
<td>PLATE CURRENT PER SECTION</td>
<td>165 MA</td>
<td>200 MA</td>
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<tr>
<td>AMPLIFICATION FACTOR</td>
<td>2.0</td>
<td>3.4</td>
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<tr>
<td>TRANSCONDUCTANCE</td>
<td>11 000</td>
<td>16 000</td>
</tr>
<tr>
<td>HEATER CURRENT PER TUBE</td>
<td>4.75</td>
<td>5.25</td>
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</table>

CONDITIONS:

\[
E_f = 26.5V, E_b = 200V, \\
E_c = 100V, R_k = 0 \]

PLATE CURRENT PER SECTION

<table>
<thead>
<tr>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 MA</td>
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TUNO-SOL

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APPLICATION NOTES

THE 6394A IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CON-
TROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY
LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE
SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOW-
EVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN
EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS.
RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE
CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED,
USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE
MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE
RESISTANCE BECAUSE IT PROVIDES MORE BIASE ON THE SECTIONS TAKING GREATER
PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE FOURTH THE VALUE
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OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE FOURTH
THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS
THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT TWO WATTS) AND THE
ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED
SUPPLY: A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE
PASSING TUBE TO WORK WITH HIGHER BIASE AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE
VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE
AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASS-
ING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS
CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS
LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS
EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE
CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE
LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE
SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF
TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED
FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT
VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS
LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEG-A-
TIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUT-
PUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A
TUBE DROP AS POSSIBLE: A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO
BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES.
SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE
AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE
DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE
ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT
LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF
GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER
VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 26.5 VOLTS AS MEASURED ON
THE TUBE PIN. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A
SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3)
SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.
6394A

EACH TRIODE SECTION
$E_F = 26.5$ Volts

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6394A

$E_F = 26.5$ Volts

$g_m$, $\mu$, $r_p$