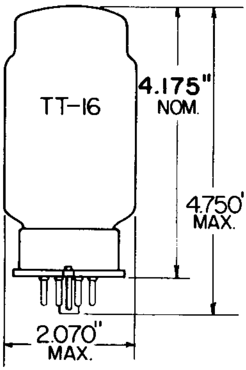
TUNG-SOL

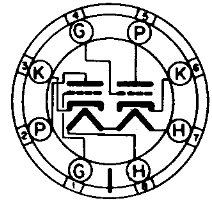
TWIN POWER TRIODE



GLASS BULB

HEATER
6.3±10% VOLTS 5.0 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW
LARGE WAFER WITH
METAL SLEEVE
8 PIN BASE

THE 6336A 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 6336A 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 6336A HAS REPLACED TWO OR THREE TUBE TYPE 6080WA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OF POWER, MANY 6336A TUBE SECTIONS CAN BE PARALLED AS EXPLAINED IN THE APPLICATION NOTES.

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f=6.3 VOLTS)	5.0	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	13 500	μMHOS
AMPLIFICATION FACTOR	2.7	
INTER ELECTRODE CAPACITANCES PER TRIODE SECTION:		
GRID TO CATHODE	16.7	μμf
GRID TO PLATE	21.8	μμf
CATHODE TO PLATE	3.8	μμf
HEATER TO CATHODE	15.0	μμf
INTER ELECTRODE CAPACITANCES BETWEEN TRIODE SECTIONS:		
SECTION #1 PLATE TO SECTION #2 PLATE	0.6	μμf

MECHANICAL DATA

MOUNTING POSITION (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)	ANY	
BULB	TT 16	NONEX
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JETEC #B8-98	
AVERAGE NET WEIGHT	3.5	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	720	G
MAXIMUM VIBRATION RATING:		
(0 TO 50 CPS)	10	G
(50 TO 500 CPS)	5	G

RATINGS

ABSOLUTE VALUES

	MINIMUM	MAXIMUM	
POWER DISSIPATION PER PLATE	---	30	WATTS
PLATE CURRENT PER PLATE (IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE)	---	400	MADC
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	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	250	°C
ALTITUDE FOR FULL RATINGS (IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FEET)	---	10 000	FEET
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE	500	500000	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.

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 48° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (720G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	150	MA
TRANSCONDUCTANCE PER SECTION (MIN.)	9 000	μMHO
HK LEAKAGE (MAX.)	100	μA
GRID CURRENT (MAX.)	-8	μA

RANGE OF VALUES

CONDITIONS: $E_f = 6.3V$, $E_b = 190V$.
$E_c = -0$, $R_{k/k} = 200\ \Omega$, $R_{g/g} = 500\Omega$
BOTH SECTIONS OPERATING. READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING. EACH SECTION READ SEPARATELY.

PLATE CURRENT PER SECTION	165	200	MA,DC
AMPLIFICATION FACTOR	2.0	3.4	
TRANSCONDUCTANCE	11 000	16 000	μMHOS
HEATER CURRENT PER TUBE	4.75	5.25	AMP.

CONDITIONS: $E_f = 6.3V$, $E_b = 200V$.
$E_c = -100V$, $R_k = 0$

PLATE CURRENT PER SECTION	0	10	MA.

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APPLICATION NOTES

THE 6336A IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED 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, HOWEVER, 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 BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE FOURTH THE VALUE $\left(\frac{R}{U+1}\right)$ 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 BIAS 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 PASSING 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 NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT 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 6.3 VOLTS AS MEASURED ON THE TUBE PINS. 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.

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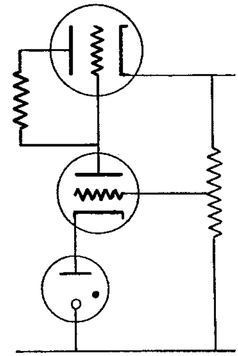


FIGURE 1

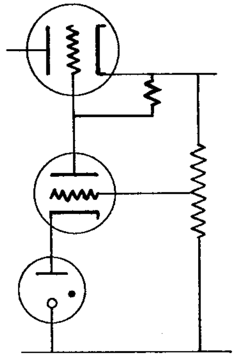


FIGURE 2

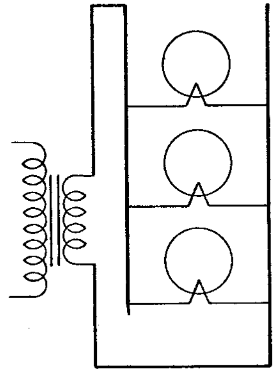
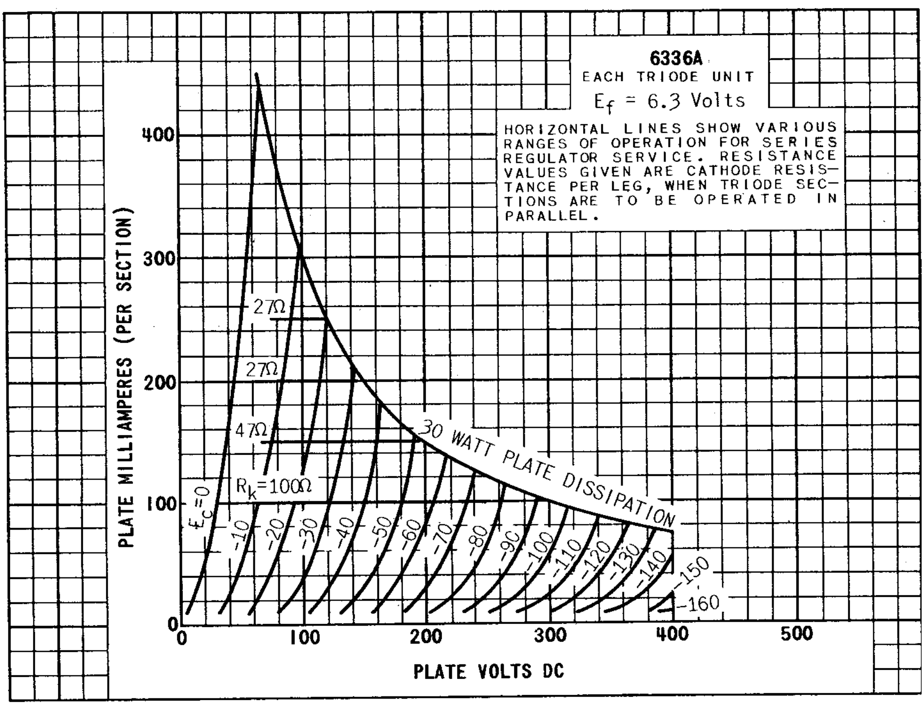
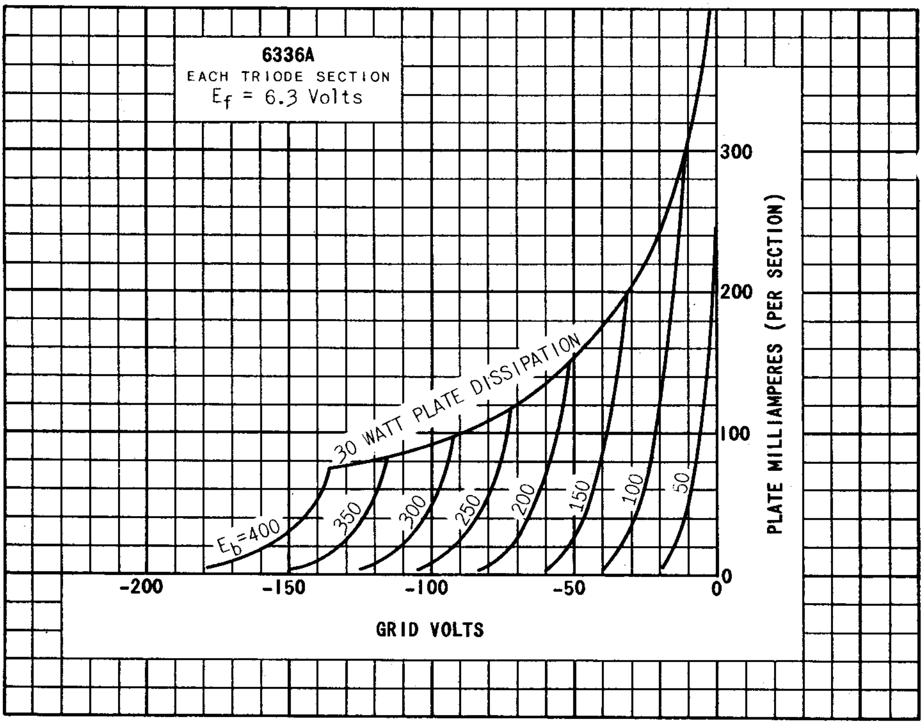
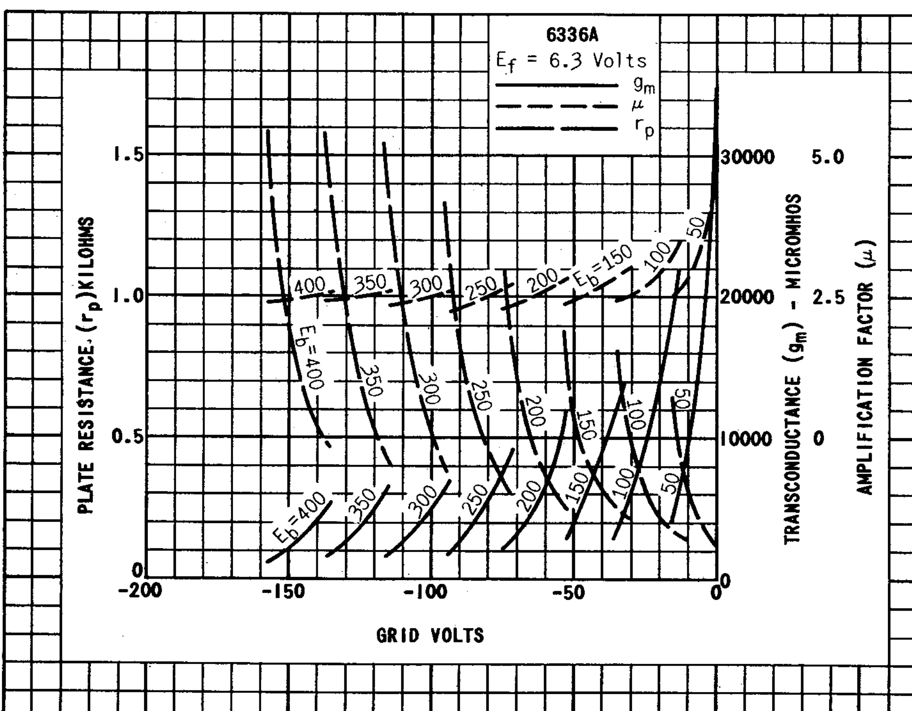


FIGURE 3





6336A
EACH TRIODE SECTION
Ef = 6.3 Volts
30 WATT PLATE DISSIPATION
Eb=400
350
300
250
200
150
100
50
300
200
100
0
PLATE MILLIAMPERES (PER SECTION)
-200
-150
-100
-50
0
GRID VOLTS



6336A
Ef = 6.3 Volts
gm
μ
rp
Eb=400
350
300
250
200
Eb=150
100
50
1.5
1.0
0.5
0
PLATE RESISTANCE (rp) KILOHMS
30000
20000
10000
0
TRANSCONDUCTANCE (gm) - MICROMHOS
5.0
2.5
0
AMPLIFICATION FACTOR (μ)
-200
-150
-100
-50
0
GRID VOLTS