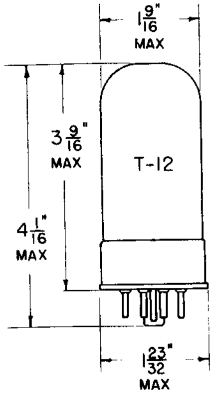
TUNG-SOL

TWIN TRIODE



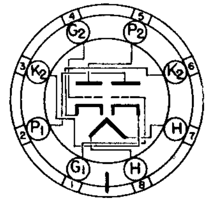
GLASS BULB

HEATER

12.6±5% VOLTS 1.25 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

LARGE WAFER OCTAL
WITH METAL SLEEVE

8BD

THE 7105 IS A 12.6 VOLT VERSION OF THE POPULAR RUGGEDIZED RELIABLE TYPE 6080WA. IN A RELIABLE PROGRAM, TUBES ARE HANDLED IN LOTS WITH MANY DESTRUCTIVE TESTS PERFORMED ON RANDOMLY SELECTED SAMPLES. THUS A TUBE MAY PASS ALL REQUIRED TESTS AND YET BE REJECTED IF IT IS FROM AN UNSATISFACTORY LOT.

WITH THE MOUNT SHOCK ISOLATED FROM THE BULB BY NINE METAL SPRING CLIPS, AND BY THE USE OF HEAVY DUTY PARTS, THE TUBE WILL WITHSTAND A SHOCK IMPULSE OF 450G AND A VIBRATION FORCE OF 10G. OTHER FEATURES ARE HIGH ALTITUDE RATINGS, HIGH BULB TEMPERATURE LIMITS, AND LONG LIFE TESTS WITH MANY LIFE TEST END POINTS. PLATE CURRENT AND TRANSCONDUCTANCE ARE HELD TO CLOSE LIMITS TO PROVIDE GREATER BALANCE BETWEEN TUBE SECTIONS. THIS IS ESPECIALLY ADVANTAGEOUS WHEN MANY TUBES ARE TO BE PARALLELED IN REGULATED POWER SUPPLY SERVICE.

THIS TUBE CAN BE USED FOR ANY APPLICATION REQUIRING HIGH PLATE CURRENT AT LOW PLATE VOLTAGES. THE 12.6 VOLT FILAMENT IS PARTICULARLY ADAPTABLE TO MOBILE EQUIPMENT. ITS PRIMARY USE IS IN ELECTRONICALLY REGULATED POWER SUPPLIES.

ELECTRICAL DATA

HEATER VOLTAGE	12.6±5%	VOLTS
HEATER CURRENT (E_f=6.3VOLTS)	1.25	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	7 000	μMHOS
AMPLIFICATION FACTOR	2.0	
INTER ELECTRODE CAPACITIES PER TRIODE SECTION		
GRID TO CATHODE	6.2	μμf
GRID TO PLATE	8.4	μμf
CATHODE TO PLATE	2.2	μμf
HEATER TO CATHODE	6.3	μμf
INTER ELECTRODE CAPACITIES BETWEEN TRIODE SECTIONS		
SECTION 1 GRID TO SECTION 2 GRID	0.5	μμf
SECTION 1 PLATE TO SECTION 2 PLATE	2.2	μμf

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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	T-12	
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JEDEC #B8-86	
MAXIMUM NET WEIGHT	3	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (D =.08" @ 50 CPS)	10	G

RATINGS
ABSOLUTE VALUES

	MIN.	MAX.	
HEATER VOLTAGE	12.0	13.2	VOLTS
PLATE VOLTAGE (DC)	---	250	VOLTS
GRID VOLTAGE (DC)	---	0	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID CURRENT PER GRID	---	5.	MA.
PLATE CURRENT PER PLATE (DC) (IF SEVERAL TUBE SECTIONS ARE TO BE USED IN PARALLEL WITH EACH OTHER, IT IS RECOMMENDED NOT TO EXCEED 100 MA PER PLATE.)	---	125.	MA.
POWER DISSIPATION PER PLATE	---	13	WATTS
ENVELOPE TEMPERATURE	---	230	°C
ALTITUDE FOR FULL RATINGS	---	60 000	FEET
CIRCUIT VALUES:			
GRID CIRCUIT RESISTANCE FOR CATHODE BIAS OPERATION	---	1.0	MEGOHM
GRID CIRCUIT RESISTANCE FOR FIXED BIAS OR COMBINATION FIXED AND CATHODE BIAS OPERATION	---	0.1	MEGOHM

ADDITIONAL TESTS TO INSURE RELIABILITY
RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450 G/MSEC)

FATIGUE; 25 CPS, 0.08" TOTAL DISPLACEMENT, FOR 32 HOURS IN EACH OF THREE MUTUALLY PERPENDICULAR PLANES (2.5G)

POST SHOCK AND FATIGUE LIMITS:		
VIBRATION (R_p=2000 Ω, E_c=- 7VDC, TIE 1K TO 2K, 1G TO 2G, 1P TO 2P), GENERATED PLATE VOLTAGE (MAX.)	100	MVAC
HEATER-CATHODE LEAKAGE (E_{hk} =±100 VDC) (MAX.)	50	μADC
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)	10	PERCENT
GRID CURRENT (MAX.)	-3	μA
HEATER CYCLING LIFE TEST (E_f= 15V, E_{hk}=300VDC. DURATIOI OF 2000 CYCLES OF 1 MIN. ON AND 1 MIN. OFF) END POINT (E_{hk}=±100V.) (MAX.)	50	μADC
STABILITY LIFE TEST (1 HR.) END POINT:		
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)	10	PERCENT
SURVIVAL RATE LIFE TEST (100 HRS.) END POINT:		
TRANSCONDUCTANCE (MIN.)	5800	μMHOS
INTERMITTENT LIFE TEST (1000 HRS.) END POINTS:		
GRID CURRENT	MIN. 0 MAX. -10	μADC
TRANSCONDUCTANCE (MIN.)	5500	μMHOS
CHANGE IN TRANSCONDUCTANCE BY REDUCING E_f TO 5.7V. (MAX.)	10	PERCENT
HEATER-CATHODE LEAKAGE E_{hk}=±100VDC. (MAX.)	25	μADC
HEATER CURRENT	MIN. 1.15 MAX. 1.35	AMPS
INSULATION OF ELECTRODES: GRID TO ALL OTHERS AND PLATE TO ALL OTHERS (MIN.)	100	MEGOHM

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RANGE OF VALUES

CONDITIONS: $E_f = 12.6V$, $E_b = 135V$, $E_c = 0$, $R_{k/k} = 250\ \Omega$

BOTH SECTIONS OPERATING. EACH SECTION READ SEPARATELY.

INDIVIDUAL PLATE CURRENT (DC)	100	150	MA.
LOT AVERAGE PLATE CURRENT (SAME CONDTIONS)(DC)	115	135	MA.
PLATE CURRENT, DIFFERENCE BETWEEN SECTIONS (DC)	---	25	MA.
INDIVIDUAL SECTION TRANSCONDUCTANCE	6000	8200	μMHOS
LOT AVERAGE TRANSCONDUCTANCE	6600	7400	μMHOS
AMPLIFICATION FACTOR	1.5	2.5	
HEATER CURRENT @ 6.3V.	1.15	1.35	AMP.

SIMILAR TYPE REFERENCE: 6080WA.

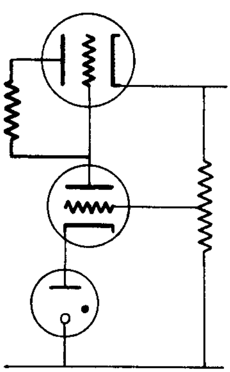

FIGURE 1

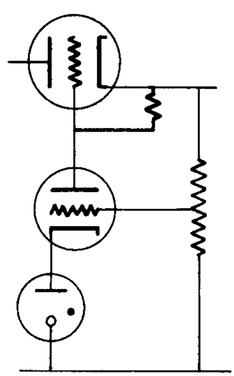

FIGURE 2

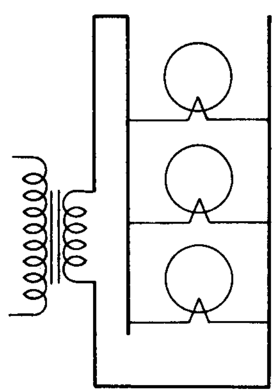

FIGURE 3

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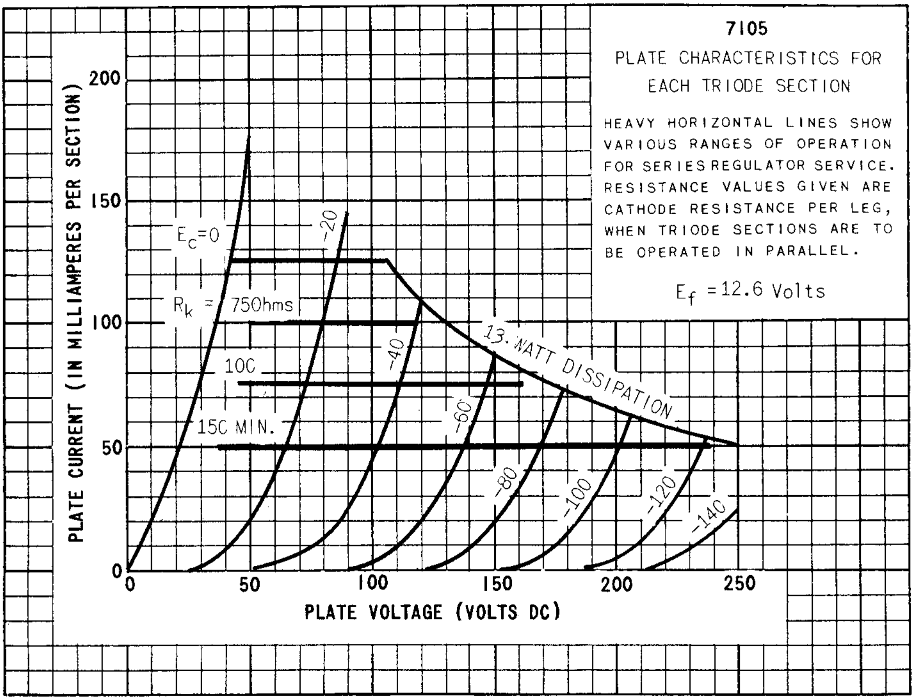
APPLICATION NOTES

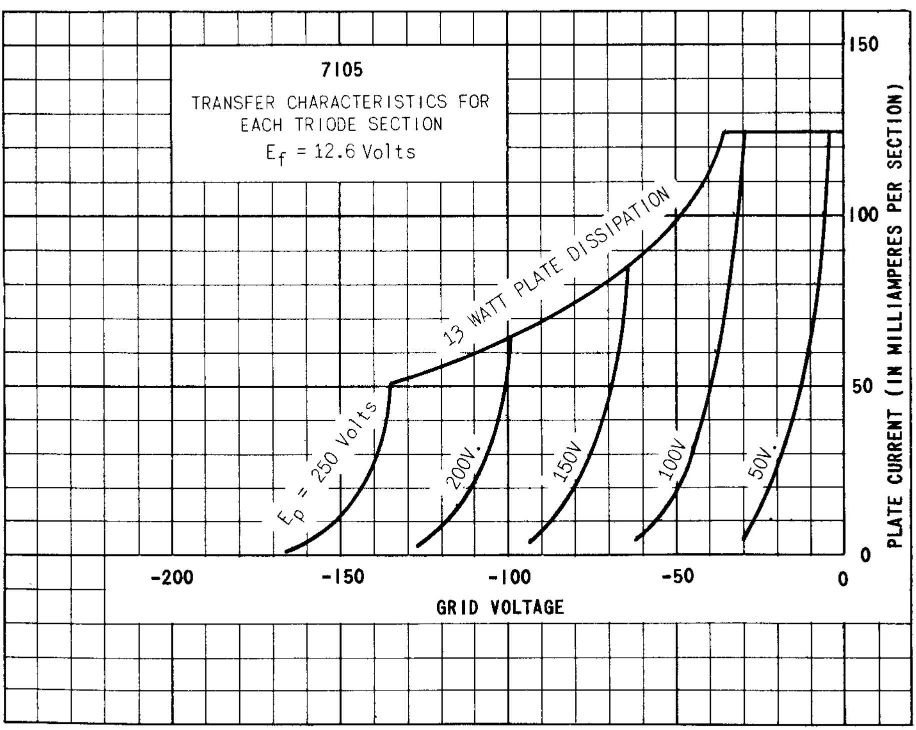
THE 7105 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER 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 THIRD THE VALUE $\left(\frac{R}{U+1}\right)$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE THIRD THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT ONE 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 12.6 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.


7105
PLATE CHARACTERISTICS FOR EACH TRIODE SECTION
HEAVY HORIZONTAL LINES SHOW VARIOUS RANGES OF OPERATION FOR SERIES REGULATOR SERVICE. RESISTANCE VALUES GIVEN ARE CATHODE RESISTANCE PER LEG, WHEN TRIODE SECTIONS ARE TO BE OPERATED IN PARALLEL.
Ef =12.6 Volts
PLATE CURRENT (IN MILLIAMPERES PER SECTION)
200
150
100
50
0
Ec=0
-20
-40
-60
-80
-100
-120
-140
Rk = 75Ohms
10C
15C MIN.
13 WATT DISSIPATION
0
50
100
150
200
250
PLATE VOLTAGE (VOLTS DC)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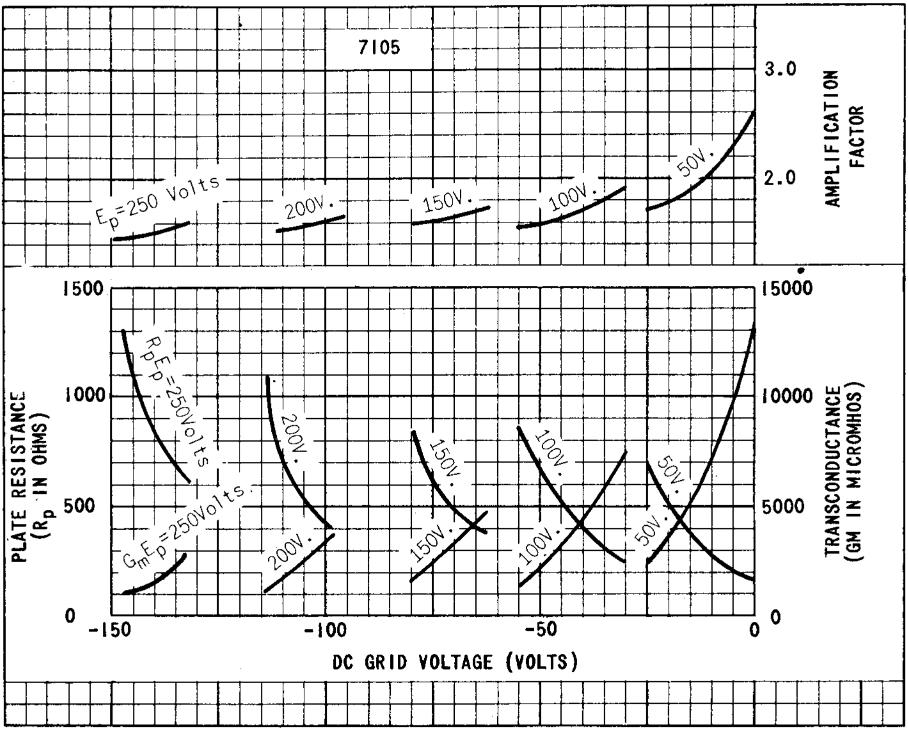
TRANSFER CHARACTERISTICS FOR EACH TRIODE SECTION
Ef = 12.6 Volts
13 WATT PLATE DISSIPATION
Ep = 250 Volts
200V.
150V
100V
50V.
PLATE CURRENT (IN MILLIAMPERES PER SECTION)
150
100
50
0
-200
-150
-100
-50
0
GRID VOLTAGE



7105
3.0
2.0
AMPLIFICATION FACTOR
Ep=250 Volts
200V.
150V.
100V.
50V.
1500
1000
500
0
PLATE RESISTANCE (Rp IN OHMS)
RpEp=250Volts
200V.
150V.
100V.
50V.
GmEp=250Volts.
15000
10000
5000
0
TRANSCONDUCTANCE (GM IN MICROMHOS)
-150
-100
-50
0
DC GRID VOLTAGE (VOLTS)