



**TECHNICAL
DATA**

ECC83/12AX7

DOUBLE TRIODE

High μ double triode, having separate cathodes, primarily intended for use as a resistance-coupled amplifier or phase inverter.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

The heater is centre-tapped and the two sections may be operated in series or in parallel with one another.

Series
Parallel

V_b applied between pins 4 and 5.

V_b applied between pin 9 and pins 4 and 5 connected together.

	Series	Parallel	
V_b	12.6	6.3	V
I_b	0.15	0.3	A

CAPACITANCES

$C_{k-k'}$	0.46	$\mu\mu\text{F}$
$C_{a'-k'}$	0.34	$\mu\mu\text{F}$
* $C_{k-k'}$	1.6	$\mu\mu\text{F}$
* C_{a-k}	1.7	$\mu\mu\text{F}$
$C_{a'-a'}$	< 1.2	$\mu\mu\text{F}$
$C_{a'-g'}$	< 0.1	$\mu\mu\text{F}$
$C_{a'-k'}$	< 0.1	$\mu\mu\text{F}$
$C_{k'-g'}$	< 0.01	$\mu\mu\text{F}$
* C_{k-h}	< 0.15	$\mu\mu\text{F}$

*Each section.

CHARACTERISTICS (each section)

V_a	100	250	V
I_a	0.5	1.2	mA
V_g	-1.0	-2.0	V
gm	1.25	1.6	mA/V
μ	100	100	
r_a	80	62.5	k Ω

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_d max.	1.0	W
I_k max.	8.0	mA
$-V_g$ max.	50	V
* R_{k-k} max.	2.2	M Ω
V_{h-k} max.	180	V
† R_{h-k} max.	20	k Ω

*With grid current biasing R_{k-k} max. = 22 M Ω .

†When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 120k Ω .

INTERNATIONAL ELECTRONICS CORP.

81 Spring Street • New York 12, N. Y.

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High μ double triode, having separate cathodes, primarily intended for use as a resistance-coupled amplifier or phase inverter.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. ◀ AMPLIFIER (with cathode bias)

V_b (V)	R_a (k Ω)	I_k (mA)	R_k (Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}^* (V _{r.m.s.})	D_{tot}^* (%)	R_{g1}^\dagger (k Ω)
400	47	2.45	680	44	37	3.6	150
350	47	1.98	820	42.5	33	4.4	150
300	47	1.55	1000	40	26	5.0	150
250	47	1.18	1200	37.5	23	7.0	150
200	47	0.86	1500	34	18	8.5	150
400	100	1.72	820	63	38	1.7	330
350	100	1.4	1000	61	36	2.2	330
300	100	1.11	1200	57	30	2.7	330
250	100	0.86	1500	54.5	26	3.9	330
200	100	0.65	1800	50	20	4.8	330
400	220	1.02	1200	76.5	38	1.1	680
350	220	0.85	1500	75.5	37	1.6	680
300	220	0.63	2200	72	36	2.6	680
250	220	0.48	2700	66.5	28	3.4	680
200	220	0.36	3300	56	24	4.6	680

* Output voltage and distortion at start of positive grid current. At lower output voltage the distortion is approximately proportional to the output voltage

† R_{g1} = grid resistance of following valve.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. ◀ AMPLIFIER* (with grid current bias)

V_b (V)	R_a (k Ω)	I_k (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} (V _{r.m.s.})	D_{tot} (%)	R_{g1}^\dagger (k Ω)
400	47	3.1	45	37	2.5	150
350	47	2.5	44	33	2.7	150
300	47	2.0	41	26	2.9	150
250	47	1.45	39	23	4.2	150
200	47	1.0	37	18	5.6	150
400	100	1.95	58	38	1.6	330
350	100	1.6	56	36	1.8	330
300	100	1.3	54	30	2.0	330
250	100	1.0	51	26	2.6	330
200	100	0.7	50	20	3.9	330
400	220	1.09	68	38	1.4	680
350	220	0.88	67	37	1.7	680
300	220	0.74	66	36	2.2	680
250	220	0.56	62	28	2.7	680
200	220	0.39	58	24	4.6	680

* Measured with a grid resistance of 10M Ω and signal source impedance $Z_s=100\Omega$.

† R_{g1} = grid resistance of following valve.



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OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER* (with grid current bias)

V_b (V)	R_a (k Ω)	I_k (mA)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%) for $V_{out(r.m.s.)}$			$R_{g1}\dagger$ (k Ω)
				2V	4V	6V	
400	47	3.8	41	2.1	4.2	5.4	150
350	47	3.19	40	2.2	4.2	5.5	150
300	47	2.52	38	2.2	4.5	5.5	150
250	47	1.95	36	2.3	4.6	5.6	150
200	47	1.4	34	2.4	4.7	5.6	150
150	47	0.84	33	2.5	4.6	5.2	150
100	47	0.35	25	1.7	2.1	6.0	150
400	100	2.3	52	1.7	3.5	4.8	330
350	100	1.9	51	1.8	3.6	4.9	330
300	100	1.58	50	1.8	3.6	5.0	330
250	100	1.23	48	1.8	3.8	5.1	330
200	100	0.88	46	1.9	3.8	5.1	330
150	100	0.56	43	1.9	3.0	4.7	330
100	100	0.24	34	1.6	2.3	2.5	330
400	220	1.23	60	1.6	2.7	4.2	680
350	220	1.05	59	1.6	2.8	4.3	680
300	220	0.85	58	1.6	2.9	4.4	680
250	220	0.67	57	1.6	2.9	4.4	680
200	220	0.49	54	1.7	3.0	4.4	680
150	220	0.32	51	1.7	3.0	4.4	680
100	220	0.14	42	1.6	2.5	3.2	680

*Measured with a grid resistance of 10M Ω and signal source impedance Z_s 330k Ω .

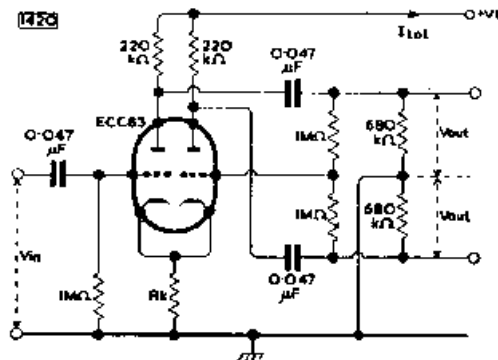
† R_{g1} grid resistance of following valve.

DOUBLE TRIODE

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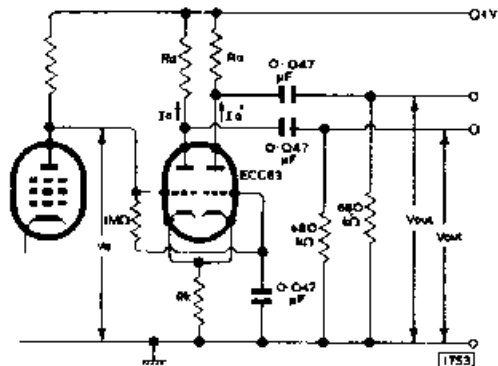
High μ double triode, having separate cathodes, primarily intended for use as a resistance-coupled amplifier or phase inverter.

TYPICAL OPERATING CONDITIONS AS A PHASE INVERTER



V_b (V)	I_{tot} (mA)	R_k (Ω)	V_{out}^* (V _{r.m.s.})	$\frac{V_{out}}{V_{in}}$	D_{tot}^* (%)
250	1.08	1200	35	58	5.5
250	1.08	1200	7	58	1.1
350	1.7	820	45	62	3.5
350	1.7	820	9	62	0.7

*Output voltage and distortion at the start of positive grid current. At lower output voltage the distortion is approximately proportional to the voltage.



V_b (V)	$\dagger V_a$ (approx.) (V)	$I_a + I_a'$ (mA)	R_k (k Ω)	R_a (k Ω)	V_{out}^* (V _{r.m.s.})	$\frac{V_{out}}{V_{in}}$	D_{tot}^* (%)
250	65	1.0	68	100	20	25	1.8
250	65	1.0	68	100	7	25	0.6
350	90	1.2	82	150	35	27	1.8
350	90	1.2	82	150	10	27	0.5

*Output voltage and distortion at the start of positive grid current. At lower output voltage the distortion is approximately proportional to the voltage.

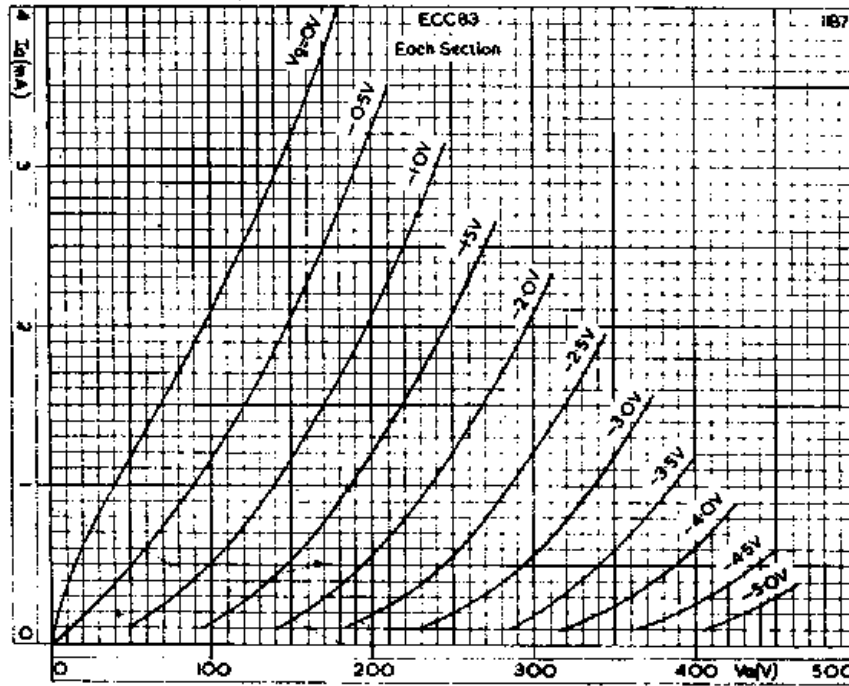
$\dagger V_a$ should be adjusted so that $I_a + I_a' = 1$ mA at $V_b = 250$ V and 1.2 mA at $V_b = 350$ V.



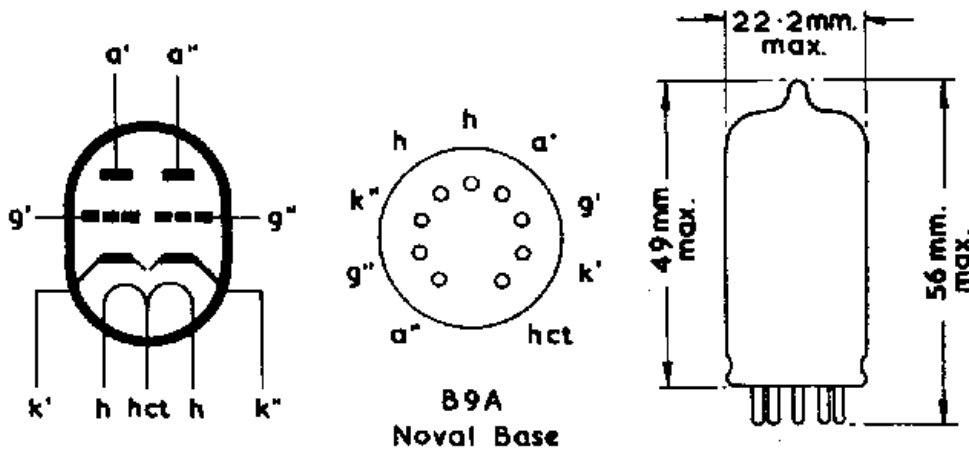
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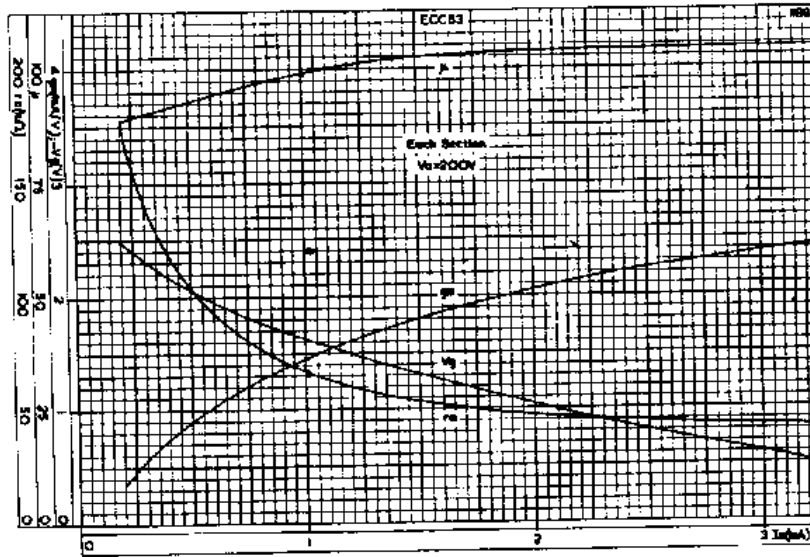
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH GRID VOLTAGE AS PARAMETER (EACH SECTION)



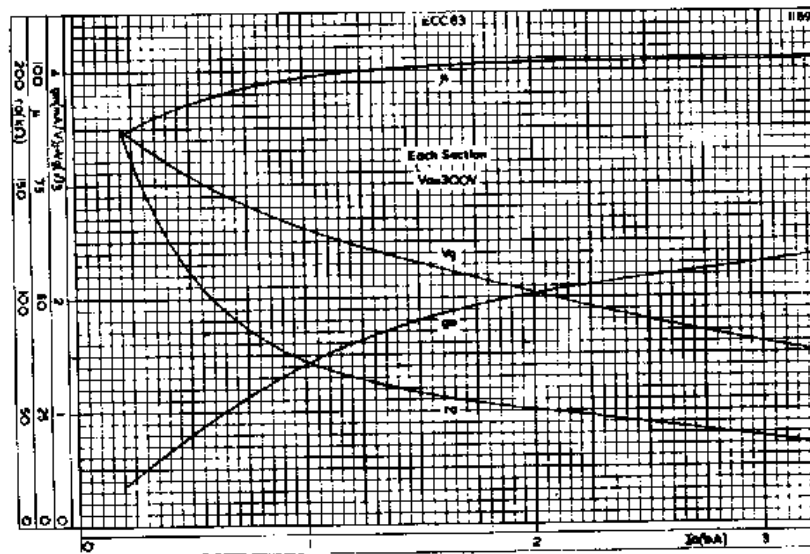
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GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 200 V (EACH SECTION)



GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 300 V (EACH SECTION)



12AX7



DESCRIPTION: The valve comprises two triode units mounted side by side having separate heaters but common heater pin connections. Each triode unit has characteristics somewhat similar to a 6F5G/GT and the units are mounted in a standard T6½ bulb and based with a BVA standard B9A base.

CHARACTERISTICS: Indirectly-heated oxide-coated cathode.

	Series	Parallel
Heater Voltage	12.6	6.3 volts
Heater Current (nominal)	0.15	0.3 ampere
Max. D.C. Heater-Cathode Potential		250 volts

DIMENSIONS:

Max. Overall Length	2 ¹¹ / ₁₆ ins.
Max. Diameter	¹ / ₄ ins.
Max. Seated Height	1 ¹¹ / ₁₆ ins.

BASE: Noval type B9A.

BASE CONNECTIONS:

Pin 1 Plate	} Second Triode Unit.
Pin 2 Grid	
Pin 3 Cathode	
Pin 4 Heater	
Pin 5 Heater	} First Triode Unit.
Pin 6 Plate	
Pin 7 Grid	
Pin 8 Cathode	
Pin 9 Heater Tap	

Note:—The getter is attached to the plate of the first triode unit.

MAXIMUM RATINGS: (Each triode unit).

Max. Plate Voltage	300 volts
Max. Plate Dissipation	1.0 watts
Max. Cathode Current	8 mA
Max. Negative Control Grid Voltage	50 volts
Max. Positive Control Grid Voltage	0

CAPACITIES: (approx.): Measured without shield.

	First Triode Unit	Second Triode Unit
Grid — Plate	1.7	1.7 pF
Grid — Cathode	1.6	1.6 pF
Plate — Cathode	0.46	0.34 pF
Heater — Cathode	4.0	4.0 pF
Plate (1) — Plate (2)		0.75 pF
Grid (1) — Grid (2)		0.008 pF
Grid (1) — Plate (2)		0.03 pF
Grid (2) — Plate (1)		0.06 pF

CHARACTERISTIC CURVES: Attached are curves showing —

- Plate current plotted against plate voltage for various values of grid voltage. (Curve No. 313-27).
- Plate current plotted against grid voltage for various plate voltages. (Curve No. 313-28).
- Mutual conductance, amplification factor and plate resistance plotted against grid voltage. (Curve No. 313-29).





12AX7

TYPICAL OPERATING CONDITIONS:

Class A Amplifier:

Plate Voltage	100	250 volts
Grid Voltage	-1	-2 volts
Amplification Factor	100	100
Plate Impedance	80,000	62,500 ohms
Mutual Conductance	1.25	1.6 mA/V
Plate Current	0.5	1.2 mA

Resistance-Capacity Coupled Amplifier: The valve is very suitable for use as a resistance-capacity coupled amplifier, and below is a table giving a summary of useful values at two different supply voltages for one triode unit:—

a. Plate Supply Voltage 100 volts:

Plate Load (megohms)	0.10		0.22		0.47	
Grid Leak (succeeding valve) (megohms)	0.22	0.47	0.22	0.47	0.47	1.0
Cathode Resistor (ohms)	4700	4800	7000	7400	12000	13000
Output voltage (peak volts)	6	8	6	9	9	11
Voltage Gain	35	41	39	45	48	52

b. Plate Supply Voltage 250 volts:

Plate Load (megohms)	0.10		0.22		0.47	
Grid Leak (succeeding valve) (megohms)	0.22	0.47	0.22	0.47	0.47	1.0
Cathode Resistor (ohms)	1500	1700	2200	2800	4300	5200
Output voltage (peak volts)	47	55	45	57	51	64
Voltage Gain	43	47	49	54	57	61

A graph is attached to this report which shows the relationship between the various valve parameters under conditions of resistance-capacity coupling. This graph (No. 313-30) is taken at a plate supply voltage of 250 volts with three values of plate load resistance (viz.:—100,000, 220,000 and 470,000 ohms) and plots the plate current, amplification factor, mutual conductance and plate impedance against grid voltage. From this graph the correct grid bias (cathode resistor) can be obtained, the stage gain can be calculated and an estimate made of the distortion. The graph is not drawn beyond the limits of the commencement of grid current or around the grid cut-off region.

Below follows a description of the method of using this graph. If, for example, it is desired to use a valve at a supply voltage of 250 volts, a plate load of 470,000 ohms and a succeeding valve grid leak of 470,000 ohms, then to determine the grid bias an inspection of the graph indicates a linear portion of the curve of plate current/grid voltage over the range of -0.8 to -1.8 volts, the mid point being -1.3 volts. At this point the plate current is 0.3 mA, hence the cathode resistor should be 4,300 ohms. The peak input voltage is 0.5 volt and the r.m.s. input 0.35 volt. Following the grid bias voltage upward it is evident that with a plate load of 470,000 ohms, the amplification factor is 97, and the plate impedance is 109,000 ohms. The plate load is effectively in parallel with the succeeding valve grid leak as regards the signal, but not as regards the plate current, hence the effective signal value of the plate load is 470,000 ohms in parallel with 470,000 ohms or is 235,000 ohms. The stage gain is:

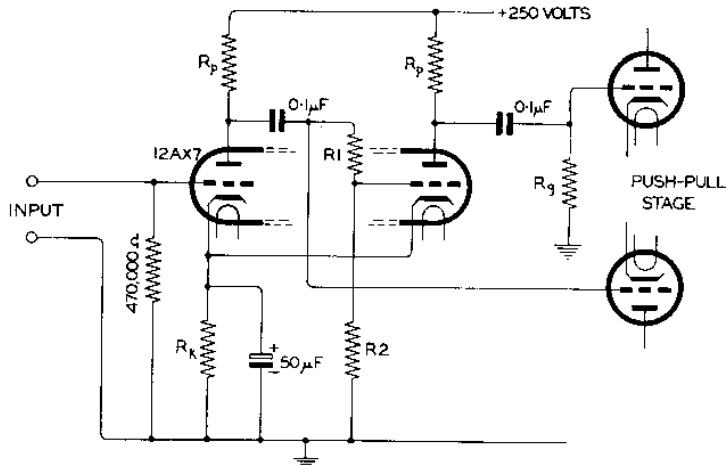
$$\frac{\mu R_p}{R_p + r_p} = \frac{97 \times 235,000}{235,000 + 109,000} = 66$$

or, in the above case:





PARAPHASE AMPLIFIER



	CONDITION 1	CONDITION 2
PLATE LOAD RESISTOR R_p (OHMS)	220,000	100,000
CATHODE BIAS RESISTOR R_k (OHMS)	1,500	6,800
GRID LEAK RESISTOR R_g (OHMS)	470,000	220,000
R1 (OHMS)	470,000	220,000
R2 (OHMS)	7,500	4,300
MAX. R.M.S. OUTPUT VOLTAGE GRID-TO-GRID AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	78	64
VOLTAGE GAIN AT 1Kc/s	90	73.5
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	+0.1	0
GAIN AT 10Kc/s COMPARED WITH 1Kc/s (db)	-2.2	-0.25
GAIN AT 20Kc/s COMPARED WITH 1Kc/s (db)	-5.5	-2.0

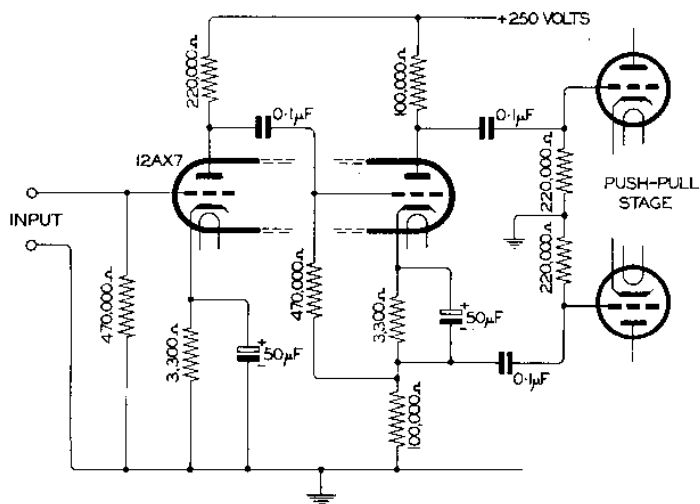




12AX7

REF. No. 313-66

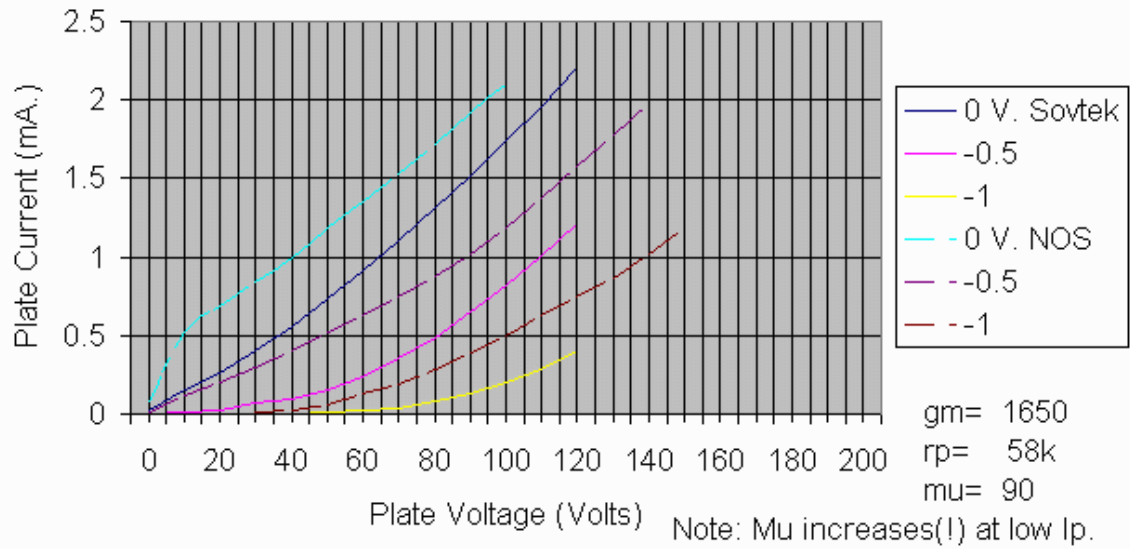
VOLTAGE AMPLIFIER & PHASE INVERTER



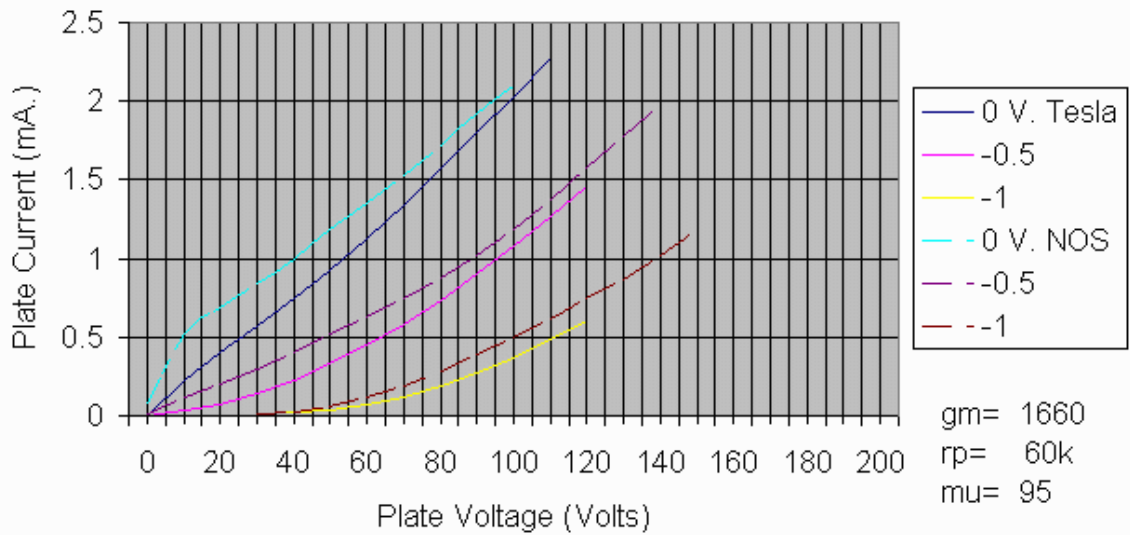
MAX. RMS. OUTPUT VOLTAGE GRID-TO-GRID AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	54
VOLTAGE GAIN AT 1Kc/s	108
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	-0.2
GAIN AT 10Kc/s COMPARED WITH 1Kc/s (db)	-0.4
GAIN AT 20Kc/s COMPARED WITH 1Kc/s (db)	-1.5



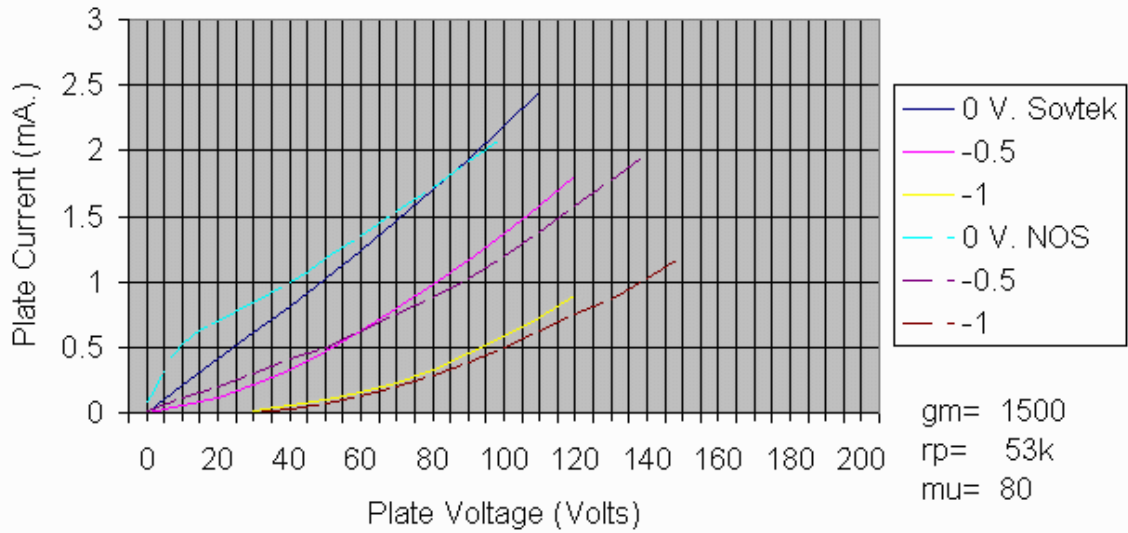
Tube Characteristics Chinese 12AX7A



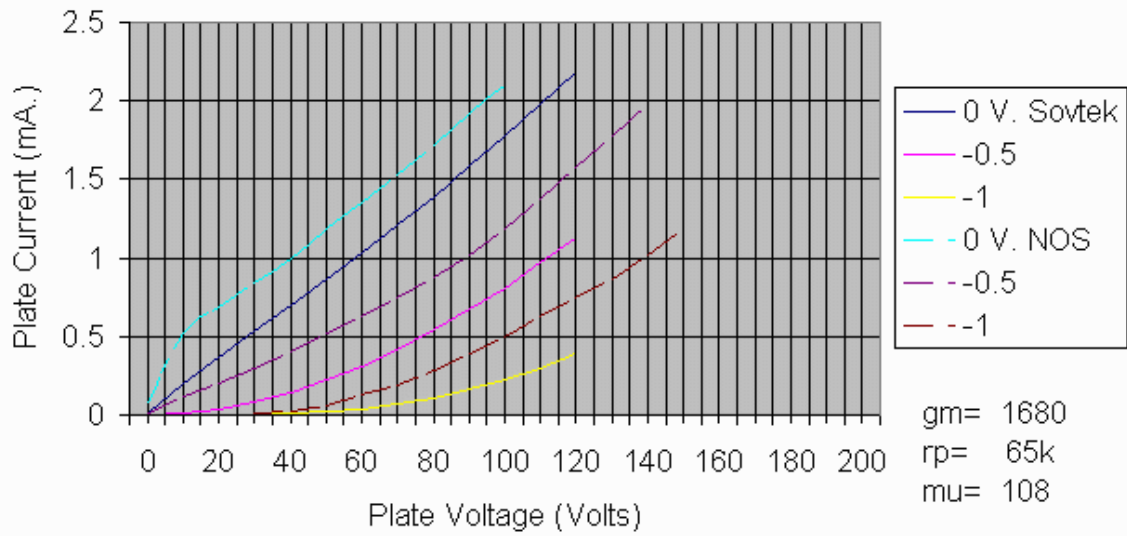
Tube Characteristics Tesla ECC83/12AX7A



Tube Characteristics Sovtek 12AX7WA



Tube Characteristics Sovtek 12AX7WXT





RESISTANCE-COUPLED AMPLIFIER CHARTS (Continued)

<div style="display: flex; justify-content: space-between; align-items: center;"> 10 See Circuit Diagram 1 </div>									
E _{bb}	R _p	R _g	R _{g2}	R _k	C _{g2}	C _k	C	E _o	V.G.
90	0.047	0.047	—	1600	—	3.2	0.061	9	10 [#]
		0.1	—	1800	—	2.5	0.033	11	11★
		0.22	—	2000	—	2.0	0.015	14	11
	0.1	0.1	—	3000	—	1.6	0.032	10	11★
		0.22	—	3800	—	1.1	0.015	15	11
		0.47	—	4500	—	1.0	0.007	18	11
	0.22	0.22	—	6800	—	0.7	0.015	14	11
		0.47	—	9500	—	0.5	0.0065	20	11
		1.0	—	11500	—	0.43	0.0035	24	11
180	0.047	0.047	—	920	—	3.9	0.062	20	11
		0.1	—	1200	—	2.9	0.037	26	12
		0.22	—	1400	—	2.5	0.016	29	12
	0.1	0.1	—	2000	—	1.9	0.032	24	12
		0.22	—	2800	—	1.4	0.016	33	12
		0.47	—	3600	—	1.1	0.007	40	12
	0.22	0.22	—	5300	—	0.8	0.015	31	12
		0.47	—	8300	—	0.56	0.007	44	12
		1.0	—	10000	—	0.48	0.0035	54	12
300	0.047	0.047	—	870	—	4.1	0.065	38	12
		0.1	—	1200	—	3.0	0.034	52	12
		0.22	—	1500	—	2.4	0.016	68	12
	0.1	0.1	—	1900	—	1.9	0.032	44	12
		0.22	—	3000	—	1.3	0.016	68	12
		0.47	—	4000	—	1.1	0.007	80	12
	0.22	0.22	—	5300	—	0.9	0.015	57	12
		0.47	—	8800	—	0.52	0.007	82	12
		1.0	—	11000	—	0.46	0.0035	92	12

■ At 3 volts (RMS) output. ★ At 4 volts (RMS) output.

6C4, 12AU7, 7AU7