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A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE No. 83
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APPLICATION NOTE
ON
RESISTANCE-COUPLED AMPLIFIER DATA FOR THE 6L5-G, 6T7-G, AND 6S7-G

This Note furnishes detailed information on the operation of the 6L5-G, 6T7-G, and 6S7-G as resistance-coupled audio-frequency amplifiers. These tube types are, respectively, a general purpose low-μ triode, a duplex-diode high-μ triode, and a super-control pentode. Because the heater current of these types is only 150 milliamperes at 6.3 volts, they are primarily intended for use in applications requiring low heater power. The resistance-coupled amplifier data are presented in tabular form for easy reference.

The use of series resistors in screen and cathode circuits offers several advantages over fixed-voltage operation: (1) the effects of possible tube differences are minimized; (2) operation over a wide range of plate-supply voltages without appreciable change in gain is feasible; and (3) the low frequency at which the amplifier cuts off can be easily changed. Fixed-bias or fixed-screen-voltage operation increases the tendency of an amplifier to motorboat and decreases the compensating action of the remaining series resistors.

For the triode types 6L5-G and 6T7-G, the values of coupling condenser (C) and cathode-resistor by-pass condenser (C_c) were chosen for an output voltage at 100 cycles of 0.8 the value at 420 cycles. A similar cut-off characteristic at any other low frequency (f_1) can be obtained by multiplying the capacitance values shown by $100/f_1$.

On the chart, the values of C_c are given for an amplifier with d-c heater excitation. When a-c is used, depending on the character of the associated circuits, the gain, and the value of f_1, it may be necessary to increase the value of C_c to minimize hum disturbance.

In the case of the pentode type 6S7-G, the values C, C_c, and C_d were chosen for an output voltage at 100 cycles of 0.7 the value at 420 cycles. A similar cut-off characteristic at any other low frequency (f_1) can be obtained by multiplying the capacitance values shown by $100/f_1$. The comments in the previous paragraph regarding hum disturbances apply for the 6S7-G as well as for the triode types.

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The output voltages listed in the chart obtain for operation at the grid current point; negligible grid current flows at these output voltages. Distortion at maximum output is approximately 5 per cent in all cases.

The data are presented for plate-supply voltages of 90, 180, and 300 volts. When self-bias and series-screen operation are used, the plate voltage may vary approximately 50 per cent with small change in gain. Output voltage, of course, varies with plate-supply voltage. The extent to which the output voltage is affected by variation in plate-supply voltage can be roughly approximated by assuming that the relation between output voltage and plate-supply voltage is linear.

RESISTANCE-COUPLED AMPLIFIER CHART

C = BLOCKING CONDENSER (μf) Cd = SCREEN BY-PASS CONDENSER (μf) Eo = VOLTAGE OUTPUT (Peak Volts) Rd = SCREEN RESISTOR (Megohms) RL = PLATE RESISTOR (Megohms)
Cc = CATHODE BY-PASS CONDENSER (μf) Ebb = PLATE-SUPPLY VOLTAGE (Volts) Rc = CATHODE RESISTOR (Ohms) Rg = GRID RESISTOR (Megohms) V.G. = VOLTAGE GAIN

TRIODE TYPE 6L5-G

Ebb [1]	90									180									300									Ebb [1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg [2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	Rg [2]
Rc	2120	2500	2900	3510	4620	5200	8050	10300	12100	1810	2240	2660	3180	4200	4790	7100	9290	10950	1740	2160	2600	3070	4140	4700	6900	9100	10750	Rc
Cc	2.3	1.86	1.65	1.36	1.08	1	0.61	0.49	0.42	2.9	2.2	1.8	1.46	1.1	1	0.7	0.54	0.46	2.91	2.18	1.82	1.64	1.1	0.81	0.57	0.46	0.4	Cc
C	0.05	0.03	0.014	0.03	0.015	0.0085	0.0125	0.0085	0.0055	0.06	0.03	0.014	0.03	0.0145	0.009	0.014	0.009	0.0055	0.06	0.032	0.015	0.032	0.014	0.0075	0.013	0.0075	0.005	C
Eo [3]	14	17.8	21	16	21.5	23	17.5	21.5	23.6	32	41	46	36	45.5	50	38	46	52	56	68	79	60	79	89	64	80	88	Eo [3]
V.G. [5]	9.3	10.4	10.9	11	11.7	12	11.8	11.9	12	10.4	11.1	11.5	11.6	12.1	12.3	12.1	12.4	12.5	10.9	11.6	11.9	12.1	12.7	12.9	13	12.9	12.8	V.G. [5]

DUPLEX-DIODE HIGH-MU TRIODE TYPE 6T7-G

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rc	4350	4750	5050	7500	8300	9000	12500	14200	15500	2420	2830	3080	4410	5220	5920	7250	9440	10850	1950	2400	2640	3760	4580	5220	6570	8200	9600	Rc
Cc	1.8	1.5	1.43	1.12	1	0.88	0.67	0.6	0.54	2.55	2.25	2	1.5	1.25	1.11	0.91	0.74	0.6	2.85	2.55	2.25	1.57	1.35	1.23	1.02	0.82	0.7	Cc
C	0.023	0.012	0.007	0.012	0.0075	0.005	0.0065	0.0045	0.0035	0.023	0.0135	0.008	0.012	0.008	0.005	0.007	0.0045	0.0035	0.0245	0.0135	0.008	0.012	0.0075	0.005	0.008	0.0055	0.004	C
Eo [3]	5.6	7.8	8.5	7.7	10.2	11.5	9.4	12.3	13.2	21	28.5	31.6	27	33.8	38.5	31	39	42.6	43.7	58	64	57	69	80	62	76.5	85.5	Eo [3]
V.G. [5]	20.3[e]	24[f]	25	28.2[f]	30	31.6	30.5	32.9	34.2	23.7	28.4	30.6	33.7	36.4	38	38.4	40.5	41	26.5	31.9	33.2	36.6	40	41	41.5	43.3	44	V.G. [5]

PENTODE TYPE 6S7-G

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rd	0.59	0.65	0.7	1.5	1.6	1.7	3.2	3.5	3.7	0.58	0.68	0.71	1.6	1.8	1.9	3.3	3.6	3.8	0.59	0.67	0.71	1.7	1.95	2.1	3.6	3.9	4.1	Rd
Rc	870	900	910	1440	1520	1560	2620	2800	3000	530	540	540	850	890	950	1410	1520	1600	430	440	440	620	650	700	1000	1080	1120	Rc
Cd	0.065	0.061	0.057	0.044	0.044	0.043	0.029	0.03	0.031	0.073	0.07	0.065	0.05	0.044	0.046	0.041	0.037	0.031	0.077	0.071	0.071	0.058	0.057	0.055	0.04	0.041	0.043	Cd
Cc	5.1	5	4.58	3.38	3.23	3.22	2.04	1.95	1.92	7.2	6.9	6.6	4.6	4.7	4.4	3.5	3	2.9	8.5	8	8	6	5.8	5.2	4.1	3.9	3.8	Cc
C	0.018	0.01	0.007	0.007	0.0055	0.004	0.004	0.0026	0.0024	0.017	0.01	0.0063	0.0071	0.005	0.0037	0.0041	0.003	0.0024	0.0167	0.01	0.0066	0.0071	0.005	0.0036	0.0037	0.0029	0.0023	C
Eo [3]	16	20.5	22.5	13.7	18	19	12	15.4	16.4	33	43	48	32.5	39.5	44	30	37.5	41.5	57	75	82	54	66	76	52	66	73	Eo [3]
V.G. [5]	33.3	46.5	53.5	55.5	66.5	77	69.5	84	93.5	47.4	66	75	79	104	118	109	134	147	57	78	89	98	122	136	136	162	174	V.G. [5]

[1] Voltage at plate equals Plate-Supply Voltage minus voltage drop in RL and Rc. For other supply voltages differing by as much as 50% from those listed, the values of resistors, condensers, and gain are approximately correct. The value of voltage output, however, for any of these other supply voltages equals the listed voltage output multiplied by the new plate-supply voltage divided by the plate-supply voltage corresponding to the listed voltage output.

[2] For following stage (see Circuit Diagrams).

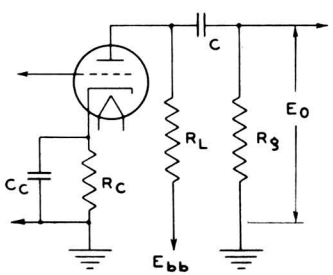
[3] Voltage across Rg at grid-current point.

[5] Voltage Gain at 4 volts (RMS) output unless index letter indicates otherwise.

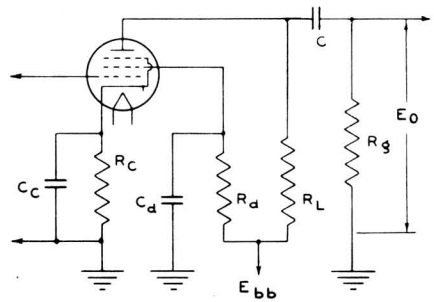
[e] At 2 volts (RMS) output.

[f] At 3 volts (RMS) output.

TRIODE DIAGRAM WITH LEGEND



PENTODE DIAGRAM WITH LEGEND



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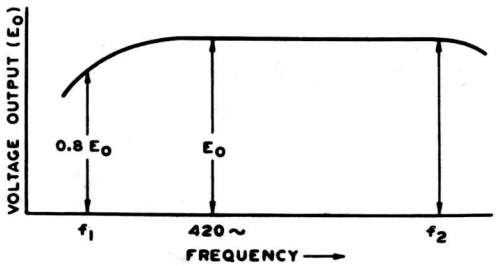
FREQUENCY CHARACTERISTIC OF SINGLE-STAGE RESISTANCE-COUPLED TRIODE AMPLIFIER



NOTES

A. Condensers C and Cc have been chosen to give output voltages equal to 0.8 Eo for f_1 of 100 cycles. For any other value of f_1, multiply values of C and Cc by $100/f_1$.

In the case of condenser Cc, the values shown are for an amplifier with d-c heater excitation. When a-c is used, depending on the character of the associated circuits, the gain, and the value of f_1, it may be necessary to increase the value of Cc to minimize hum disturbances. It may also be desirable to have a d-c potential difference of approximately 10 volts between heater and cathode.

B. f_2 = frequency at which high-frequency response begins to fall off.

C. The voltage output at f_1 for n like stages equals $(0.8\ Eo)^n$.

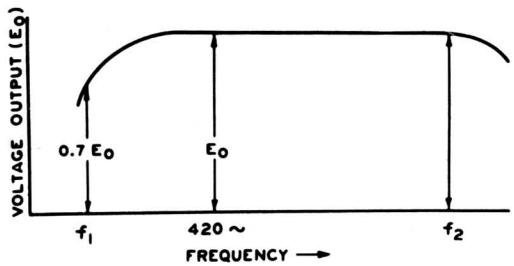
D. Decoupling filters are not necessary for two stages or less.

E. For an amplifier of typical construction, the value of f_2 is well above the audio-frequency range for any value of RL.

F. Always use highest permissible value of Rg.

G. A variation of ± 10% in values of resistors and condensers has only a slight effect on performance.

FREQUENCY CHARACTERISTIC OF SINGLE-STAGE RESISTANCE-COUPLED PENTODE AMPLIFIER



NOTES

A. Condensers C, Cc, and Cd have been chosen to give output voltages equal to 0.7 Eo for f_1 of 100 cycles. For any other value of f_1, multiply values of C, Cc, and Cd by $100/f_1$.

In the case of condenser Cc, the values shown are for an amplifier with d-c heater excitation. When a-c is used, depending on the character of the associated circuits, the gain, and the value of f_1, it may be necessary to increase the value of Cc to minimize hum disturbances. It may also be desirable to have a d-c potential difference of approximately 10 volts between heater and cathode.

B. f_2 = frequency at which high-frequency response begins to fall off.

C. The voltage output at f_1 for n like stages equals $(0.7\ Eo)^n$.

D. Decoupling filters are not necessary for two stages or less.

E. For an amplifier of typical construction, approximate values of f_2 for different values of RL are:

RL	f_2
0.1 Meg.	20000 cps
0.25 "	10000 "
0.5 "	5000 "

F. Always use highest permissible value of Rg.

G. A variation of ± 10% in values of resistors and condensers has only slight effect on performance.

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