RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE NO.67
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APPLICATION NOTE

ON

RESISTANCE-COUPLED AUDIO-FREQUENCY AMPLIFIERS

Difficulties from low-frequency oscillation (motorboating) are often experienced when a high-gain multi-stage audio amplifier of conventional design obtains B-supply voltage from a single power-supply unit. These difficulties are usually due to interstage coupling through a common impedance in the power unit. Customary expedients to prevent motorboating include the use of very large filter condensers and several power-supply units. However, by suitable design, the gain of an audio amplifier of low frequencies can be reduced to such levels that the effects of feed-back through a power unit of conventional design are greatly reduced.

The use of a series screen resistor and a self-bias resistor 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 is 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. The advantages of an amplifier constructed according to the data presented in this Note can be further emphasized by the addition of suitable decoupling resistors and condensers. With a proper decoupling filter in the plate circuit of each stage, three or more amplifier stages can be operated from a single power-supply unit of conventional design without encountering any difficulties due to coupling through the power unit; not more than two stages should be operated from a single power-supply unit when decoupling filters are not used.

Detailed information on the operation of the 2B7, 6B7, 6B8, 6C6, 6J7, and 57 as resistance-coupled audio-frequency amplifiers is presented in the accompanying Pentode Chart. These data obtain for plate-supply voltages from 45 to 600 volts, for plate-resistor values of 0.1, 0.25, and 0.5 megohm, and for a number of grid-resistor values. The combination of resistor and condenser values that is suggested in the Pentode Chart causes a 30 per cent drop in output voltage per stage at 100 cycles. A similar cut-off characteristic at any other low frequency (f_1) can be obtained by multiplying the capacitance values shown in the chart by $100/f_1$.

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The values of resistors and condensers suggested in the Pentode Chart were determined as follows. A cathode-ray oscillograph was connected to show the relation between output voltage and input voltage (dynamic characteristic) of a single stage resistance-coupled amplifier. From previous experience, it is known that in an a-f amplifier employing pentode-type tubes the output voltage is substantially independent of frequency above the cut-off frequency (f_1) and below some higher frequency (f_2). It is also known that the value of the parallel combination of R_L and R_g determines to some extent the value of (f_2). The following approximate values of (f_2) obtain for the recommended values of R_L when normal circuit and tube capacitances are present.

R_L*	f_2
0.1 megohm	20,000 cycles
0.25 "	10,000 cycles
0.5 "	5,000 cycles.

*For the condition where R_L is less than R_g.

For given values of R_L and R_g, the magnitude of R_o, R_d, and the input signal were adjusted until kinks just appeared at the extremities of the dynamic characteristic at the grid-current point. Under these conditions, the tube operates at the center of its dynamic characteristic, which is nearly linear throughout the operating range. Therefore, maximum output at minimum distortion is obtained. The values C_c, C_d, and C were then determined. Very large capacitances were used in the positions indicated by C_c, C_d, and C. The value of each was reduced, in turn, until the output voltage dropped 10 per cent at 100 cycles. Hence, for each stage of amplification, the output voltage at 100 cycles is approximately 0.7 E_o, where E_o is the output voltage at some higher frequency which is less than f_2. For (n) like stages in cascade, the output voltage at 100 cycles is $(0.7\ E_o)^n$. For a given value of decoupling resistor, the size of the decoupling condenser can be determined in the manner similar to that used for obtaining the values of C_c, C_d, and C.

Detailed information on the operation of triodes as resistance-coupled audio-frequency amplifiers is presented in the accompanying Triode Chart. The combination of condenser and resistor values suggested in this Triode Chart causes a 20 per cent drop in output voltage per stage at 100 cycles. A similar cut-off characteristic at any other low frequency (f_1) can be obtained by multiplying the capacitance values shown by $100/f_1$. As with pentodes, the use of self-bias reduces the effects of possible tube differences and permits operation over a wide range of plate-supply voltages without appreciable change in gain. The regulating action of a self-biased triode amplifier is not as good as that of a pentode amplifier having series screen and self-bias resistors, because the regulating action of a screen is not available in a triode.

When a number of high-mu triode amplifier stages are cascaded, the high-frequency response may be severely curtailed, because the high effective input capacitance of a triode shunts the load of the previous tube.

When good high-frequency response from a triode amplifier is desired, therefore, low-mu tubes and low values of plate and grid resistors should be used.

On the Charts, the values of C_o 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_o to minimize hum disturbances. It may also be desirable to have a d-c potential difference of approximately 10 volts between heater and cathode.

RESISTANCE-COUPLED AMPLIFIER CHART FOR PENTODES

PENTODE TYPES: 6C6, 6J7, 57

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	90									180								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [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
SCREEN RESISTOR (Rd) - Megohms	0.37	0.44	0.44	1.1	1.18	1.4	2.18	2.6	2.7	0.44	0.5	0.5	1.1	1.18	1.4	2.45	2.9	2.7
CATHODE RESISTOR (Rc) - Ohms	1200	1100	1300	2400	2600	3600	4700	5500	5500	1000	750	800	1200	1600	2000	2600	3100	3500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.05	0.05	0.05	0.03	0.03	0.025	0.02	0.05	0.02	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.025	0.02
CATHODE BY-PASS CONDENSER (Cc) - µf	5.2	5.3	4.8	3.7	3.2	2.5	2.3	2	2	6.5	6.7	6.7	5.2	4.3	3.8	3.2	2.5	2.8
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.005	0.003	0.005	0.0025	0.0015	0.02	0.01	0.006	0.008	0.005	0.0035	0.005	0.0025	0.0015
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	17	22	33	23	32	33	28	29	27	42	52	59	41	60	60	45	56	60
VOLTAGE GAIN [4]	41	55	66	70	85	92	93	120	140	51	69	83	93	118	140	135	165	165

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	300									600 (max.)								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [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
SCREEN RESISTOR (Rd) - Megohms	0.44	0.5	0.53	1.18	1.18	1.45	2.45	2.9	2.95	0.48	0.53	0.53	1.18	1.18	1.45	2.5	2.94	3
CATHODE RESISTOR (Rc) - Ohms	500	450	600	1100	1200	1300	1700	2200	2300	200	250	300	500	800	800	1050	1400	1500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.07	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.09	0.08	0.08	0.05	0.05	0.05	0.05	0.05	0.05
CATHODE BY-PASS CONDENSER (Cc) - µf	8.5	8.3	8	5.5	5.4	5.8	4.2	4.1	4	11.5	11.1	10.5	8.2	7.2	7	5.7	5.6	4.5
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.005	0.005	0.005	0.003	0.0025	0.02	0.01	0.006	0.008	0.005	0.005	0.005	0.003	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	55	81	96	81	104	110	75	97	100	90	140	150	125	200	180	140	185	165
VOLTAGE GAIN [4]	61	82	94	104	140	185	161	350	240	77	100	112	136	171	210	198	435	350

DUPLEX-DIODE PENTODE TYPES: 2B7, 6B7, 6B8

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	90									180								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [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
SCREEN RESISTOR (Rd) - Megohms	0.37	0.5	0.6	1.18	1.1	1.35	2.6	2.8	2.9	0.44	0.5	0.6	1.18	1.2	1.5	2.6	2.8	3
CATHODE RESISTOR (Rc) - Ohms	2000	2200	2000	3500	3500	3500	5000	6000	6200	1000	1200	1200	1900	2100	2200	3300	3500	3500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.07	0.07	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.08	0.08	0.07	0.05	0.06	0.05	0.04	0.04	0.04
CATHODE BY-PASS CONDENSER (Cc) - µf	3	3	2.8	1.9	2.1	1.9	1.5	1.55	1.5	4.4	4.4	4	2.7	3.2	3	2.1	2	2.2
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.007	0.003	0.004	0.003	0.003	0.02	0.015	0.008	0.01	0.007	0.003	0.005	0.003	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	19	28	29	26	33	32	22	29	27	30	52	53	39	55	53	47	55	53
VOLTAGE GAIN [4]	24	33	37	43	55	65	63	85	100	30	41	46	55	69	83	81	115	116

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	300									600 (max.)								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [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
SCREEN RESISTOR (Rd) - Megohms	0.5	0.55	0.6	1.2	1.2	1.5	2.7	2.9	3.4	0.45	0.6	0.65	1.2	1.35	1.5	2.7	3	3.4
CATHODE RESISTOR (Rc) - Ohms	950	1100	900	1500	1600	1800	2400	2500	2800	350	500	350	1000	1100	1000	1500	1800	2000
SCREEN BY-PASS CONDENSER (Cd) - µf	0.09	0.09	0.08	0.06	0.06	0.08	0.05	0.05	0.05	0.1	0.1	0.1	0.08	0.08	0.09	0.08	0.06	0.08
CATHODE BY-PASS CONDENSER (Cc) - µf	4.6	5	4.8	3.2	3.5	4	2.5	2.3	2.8	6.6	7	7	4	4.4	4.6	3.5	3	3.6
BLOCKING CONDENSER (C) - µf	0.025	0.015	0.009	0.015	0.008	0.004	0.006	0.003	0.0025	0.03	0.02	0.01	0.015	0.01	0.004	0.006	0.0025	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	60	89	86	70	100	95	80	120	90	72	130	120	135	175	150	145	170	190
VOLTAGE GAIN [4]	36	47	54	64	79	100	96	150	145	43	59	67	76	95	110	111	170	180

[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. The 600-volt conditions are maximum.

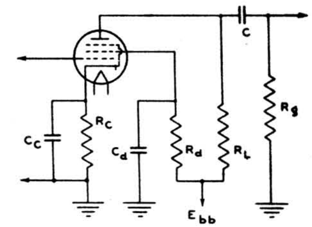
[2] For following stage (see Circuit Diagram).

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

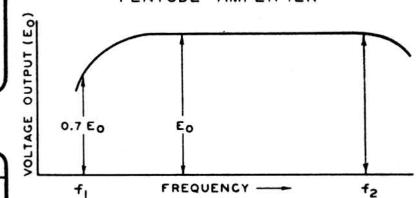
[4] At 5 volts (RMS) output. Gain at full output is somewhat less than the listed values.

EXPLANATION

DIAGRAM WITH LEGEND



FREQUENCY CHARACTERISTIC OF SINGLE-STAGE RESISTANCE-COUPLED PENTODE AMPLIFIER



REMARKS

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. Approximate values of f_2 for different values of RL for an amplifier of typical construction are as follows: RL = 0.1 meg., 20000 cps; RL = 0.25 meg., 10000 cps; RL = 0.5 meg., 5000 cps.

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.

RESISTANCE-COUPLED AMPLIFIER CHART FOR TRIODES

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

TRIODE TYPES: 2A6, 75

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	6300	6600	6700	10000	11000	11500	16200	16600	17400	2600	2900	3000	4300	4800	5300	7000	8000	8800	1900	2200	2300	3300	3900	4200	5300	6100	7000	Rc
Cc	2.2	1.7	1.7	1.24	1.07	0.9	0.75	0.7	0.65	3.3	2.9	2.7	2.1	1.8	1.5	1.3	1.1	0.9	4	3.5	3	2.7	2	1.8	1.6	1.3	1.2	Cc
C	0.02	0.01	0.006	0.01	0.006	0.003	0.005	0.003	0.0015	0.025	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	0.03	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	C
Eo[3]	3	5	6	5	7	10	7	10	13	16	22	23	21	28	33	25	33	38	31	41	45	42	51	60	47	62	67	Eo[3]
V.G.[4]	23[d]	29[b]	31[c]	34[b]	40[c]	40	39	44	48	29	36	37	43	50	53	52	57	58	31	39	42	48	53	56	58	60	63	V.G.[4]

TRIODE TYPE 6F5

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	4400	4800	5000	8000	8800	9000	12200	13500	14700	1800	2000	2200	3500	4100	4500	6100	6900	7700	1300	1600	1700	2600	3200	3500	4500	5400	6100	Rc
Cc	2.5	2.1	1.8	1.33	1.18	0.9	0.76	0.67	0.58	4.4	3.3	2.9	2.3	1.8	1.7	1.3	0.9	0.83	5	3.7	3.2	2.5	2.1	2	1.5	1.2	0.93	Cc
C	0.02	0.01	0.005	0.01	0.005	0.003	0.005	0.003	0.0015	0.025	0.015	0.006	0.01	0.006	0.004	0.006	0.003	0.0015	0.025	0.01	0.006	0.01	0.007	0.004	0.006	0.004	0.002	C
Eo[3]	4	5	6	6	7	10	8	10	12	16	23	25	21	26	32	24	33	37	33	43	48	41	54	63	50	62	70	Eo[3]
V.G.[4]	28[d]	34[b]	35[c]	39[b]	43[c]	44	43	46	48	37	44	46	48	53	57	53	63	66	42	49	52	56	63	67	65	70	70	V.G.[4]

TWIN-TRIODE TYPES: 6A6, 6N7, 53 (ONE TRIODE UNIT)

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	1900	2250	2500	4050	4950	5400	7000	8500	9650	1300	1700	1950	2950	3800	4300	5250	6600	7650	1150	1500	1750	2650	3400	4000	4850	6100	7150	Rc
C	0.025	0.01	0.006	0.01	0.006	0.003	0.006	0.003	0.0015	0.03	0.015	0.007	0.015	0.007	0.0035	0.007	0.0035	0.002	0.03	0.015	0.007	0.015	0.0055	0.003	0.0055	0.003	0.0015	C
Eo[3]	13	19	20	16	20	24	18	23	26	35	46	50	40	50	57	44	54	61	60	83	86	75	87	100	76	94	104	Eo[3]
V.G.[4]	16	19	20	20	22	23	22	23	23	19	21	22	23	24	24	24	25	25	20	22	23	23	24	24	23	24	24	V.G.[4]

TWIN-TRIODE TYPE 79 (ONE TRIODE UNIT)

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	2050	2200	2350	4000	4250	4650	6150	6850	7500	1050	1250	1350	2050	2450	2750	3450	4100	4650	800	1000	1100	1650	2050	2350	2850	3600	4450	Rc
C	0.04	0.015	0.009	0.015	0.006	0.004	0.006	0.004	0.002	0.04	0.02	0.009	0.02	0.01	0.005	0.009	0.0035	0.002	0.025	0.01	0.006	0.01	0.0055	0.003	0.0055	0.003	0.0015	C
Eo[3]	5.8	8.4	9.5	7.1	9.7	12	8.8	12	15	21	27	31	26	34	40	30	39	44	40	57	60	56	66	77	61	75	82	Eo[3]
V.G.[4]	23[b]	29[c]	29	31[c]	33	35	34	38	40	27	31	34	37	41	42	42	44	45	29	34	36	39	42	43	44	46	46	V.G.[4]

TRIODE TYPES: 56, 76

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	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg[2]
Rc	2500	3200	3800	4500	6500	7500	11100	15100	18300	2400	3000	3700	4500	6500	7600	10700	14700	17700	2400	3100	3800	4500	6400	7500	11100	15200	18300	Rc
Cc	2	1.6	1.25	1.05	0.82	0.68	0.48	0.36	0.32	2.5	1.9	1.65	1.45	0.97	0.8	0.6	0.45	0.4	2.8	2.2	1.8	1.6	1.2	0.98	0.69	0.5	0.4	Cc
C	0.06	0.03	0.015	0.03	0.015	0.007	0.015	0.007	0.0035	0.06	0.035	0.015	0.035	0.015	0.008	0.015	0.007	0.0045	0.08	0.045	0.02	0.04	0.02	0.009	0.02	0.009	0.005	C
Eo[3]	16	21	23	19	23	25	21	24	28	36	48	55	45	55	57	49	59	64	65	80	95	74	95	104	82	96	108	Eo[3]
V.G.[4]	7	7.7	8.1	8.1	8.9	9.3	9.4	9.7	9.8	7.7	8.2	9	9.3	9.5	9.8	9.7	10	10	8.3	8.9	9.4	9.5	10	10	10	10	10	V.G.[4]

(continued from preceding page)

TYPES: 6C5 (TRIODE), AND 6C6, 6J7, 57 (AS TRIODES)

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	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg [2]
Rc	2800	3400	3800	4800	6400	7500	11400	14500	17300	2200	2700	3100	3900	5300	6200	9500	12300	14700	2100	2600	3100	3800	5300	6000	9600	12300	14000	Rc
Cc	2	1.62	1.3	1.12	0.84	0.66	0.52	0.4	0.33	2.2	2.1	1.85	1.7	1.25	1.2	0.74	0.55	0.47	3.16	2.3	2.2	1.7	1.3	1.17	0.9	0.59	0.37	Cc
C	0.05	0.025	0.01	0.025	0.01	0.005	0.01	0.006	0.004	0.055	0.03	0.015	0.035	0.015	0.008	0.015	0.008	0.004	0.075	0.04	0.015	0.035	0.015	0.008	0.015	0.008	0.003	C
Eo [3]	14	17	20	16	22	23	18	23	26	34	45	54	41	54	55	44	52	59	57	70	83	65	84	88	73	85	97	Eo [3]
V.G. [4]	9	9	10	10	11	12	12	12	13	10	11	11	12	12	13	13	13	13	11	11	12	12	13	13	13	14	14	V.G. [4]

DUPLEX-DIODE TRIODE TYPE 6Q7

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	4000	4200	4300	7200	7600	8000	11500	12300	13700	1600	1900	2100	3400	4000	4500	6000	7100	7900	1200	1500	1700	2600	3000	3600	4600	5500	6200	Rc
Cc	2.07	1.7	1.5	1.17	1.2	0.9	0.72	0.6	0.45	3	2.5	2.3	1.6	1.3	1.05	0.86	0.76	0.63	4.4	3.6	3.05	2.4	1.66	1.45	1.2	0.9	0.9	Cc
C	0.02	0.01	0.005	0.01	0.006	0.003	0.006	0.003	0.0015	0.02	0.01	0.005	0.01	0.005	0.003	0.006	0.003	0.002	0.03	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	C
Eo [3]	5	8	9	8	11	13	9	13	17	19	26	29	25	31	37	30	36	41	35	52	53	43	52	62	47	60	66	Eo [3]
V.G. [4]	23 [a]	28 [b]	29 [c]	31 [b]	32	33	31	33	37	28	33	35	36	38	40	39	40	41	34	39	40	42	45	45	45	46	47	V.G. [4]

DUPLEX-DIODE TRIODE TYPE 6R7

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	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg [2]
Rc	2300	2600	2900	3500	4400	5000	7600	9800	11300	1700	2100	2500	3000	4100	4600	6700	8800	10000	1600	2000	2400	2900	3800	4400	6300	8400	10600	Rc
Cc	2	1.7	1.27	1.2	0.9	0.77	0.54	0.42	0.38	2.3	1.9	1.5	1.3	0.9	0.8	0.54	0.4	0.33	2.6	2	1.6	1.4	1.1	1	0.7	0.5	0.44	Cc
C	0.05	0.03	0.01	0.03	0.01	0.006	0.015	0.007	0.003	0.05	0.03	0.01	0.03	0.01	0.006	0.01	0.006	0.003	0.055	0.03	0.015	0.03	0.015	0.007	0.015	0.007	0.004	C
Eo [3]	14	18	20	15	19	21	15	18	21	31	40	45	35	43	46	33	40	47	50	62	71	52	68	71	54	62	74	Eo [3]
V.G. [4]	8	9	10	10	10	11	10	11	11	9	9	10	10	10	10	10	10	11	9	9	10	10	10	10	10	11	11	V.G. [4]

DUPLEX-DIODE TRIODE TYPES: 55, 85

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	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg [2]
Rc	3800	4600	5400	6620	9000	10300	15100	20500	24400	3200	4100	5000	6200	8700	10000	14500	20000	24000	3200	4100	5100	5900	8300	9600	14300	19400	23600	Rc
Cc	1.4	1.1	0.86	0.7	0.55	0.5	0.31	0.25	0.2	1.8	1.6	1.2	0.9	0.7	0.57	0.43	0.29	0.24	1.9	1.5	1.2	0.8	0.54	0.43	0.3	0.22	0.2	Cc
C	0.06	0.03	0.015	0.04	0.015	0.007	0.015	0.007	0.004	0.06	0.045	0.02	0.04	0.015	0.008	0.015	0.008	0.004	0.08	0.045	0.015	0.03	0.015	0.006	0.01	0.006	0.003	C
Eo [3]	16	19	23	17	22	25	18	23	26	33	44	49	37	47	50	40	48	53	50	74	85	64	82	88	71	84	94	Eo [3]
V.G. [4]	4.5	4.9	5.1	5.1	5.4	5.5	5.3	5.5	5.6	4.9	5.2	5.3	5.3	5.5	5.5	5.6	5.7	5.7	5.2	5.5	5.6	5.5	5.7	5.8	5.7	5.7	5.8	V.G. [4]

[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.

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

[a] At 2 volts (RMS) output.

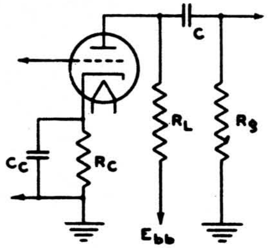
[b] At 3 volts (RMS) output.

[c] At 4 volts (RMS) output.

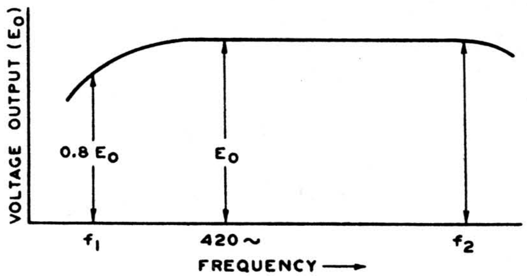
[d] At 2.2 volts (RMS) output.

See next page for Diagrams and Notes.

TRIODE DIAGRAM WITH LEGEND



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 $(0.8\ E_o)^n$.

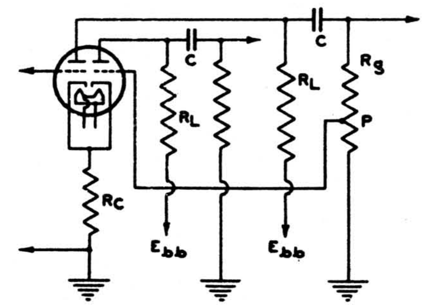
D. Decoupling filters are not necessary for two stages or less.

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.

TWIN-TRIODE DIAGRAM WITH LEGEND



FREQUENCY CHARACTERISTIC OF RESISTANCE-COUPLED TWIN-TRIODE AMPLIFIER

SEE INFORMATION UNDER TRIODE AMPLIFIER WHICH IN GENERAL APPLIES ALSO TO THIS CASE.

NOTES

The diagram given above is for Phase-Inverter Service. The signal input is supplied to the grid of the left-hand triode unit. The grid of the right-hand unit obtains its signal from a tap (P) on the grid resistor (Rg) in the output circuit of the left-hand triode unit. The tap (P) is chosen so as to make the voltage output of the right-hand unit equal to that of the left-hand unit. Its location is determined from the voltage gain values given in the Chart. For example, if the value of voltage gain is 20 (from the Chart), (P) is chosen so as to supply 1/20 of the voltage across (Rg) to the grid of the right-hand triode.

For phase-inverter service, the cathode resistor (Rc) should not be by-passed by a condenser. Omission of the condenser in this service assists in balancing the output voltages. The value of (Rc) is specified on the basis that both units are operating simultaneously at the same values of plate load and plate voltage.

RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey
RCA RADIOTRON
DIVISION

EXPLANATION OF TWIN-TRIODE R_c VALUES

APPLICATION NOTE No. 67
ON
RESISTANCE-COUPLED AUDIO-FREQUENCY AMPLIFIERS

In the Triode Chart of this Note, it should be observed, as stated in Notes under Twin-Triode Diagram, that the R_c values for Twin-Triode types 6A6, 6N7, 53, and 79 are for two triode units on basis that tube type is used in phase-inverter service. Other tabulated data on these types are given for each triode unit.