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RCA MANUFACTURING COMPANY, INC.

A RADIO CORPORATION OF AMERICA SUBSIDIARY

Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE No.90
April 13, 1938

APPLICATION NOTE ON RESISTANCE-COUPLED AMPLIFIER DATA FOR THE 6C8-G, 6F8-G, 6J5, 6J5-G, and 6Z7-G

Resistance-coupled amplifier data for the 6C8-G, 6F8-G, 6J5, 6J5-G, and 6Z7-G are given in this Note. The resistance-coupled data are presented in tabular form for easy reference.

Self-bias operation offers several advantages over fixed-bias 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 operation increases the tendency of an amplifier to motorboat and decreases the compensating action of the plate load resistor.

The values of blocking 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 some applications, it is desirable to know the value of bias voltage across a cathode resistor specified in the chart. This can be determined easily with the aid of a plate family. For a particular operating condition, draw the load line corresponding to the values of R_L and E_{bb} of interest, as shown in Fig.1A. For each point of intersection of the load line and a bias curve (points a, b, c, etc.), calculate a value of bias resistor (R_c). Now, plot a curve (Fig.1B) showing the relation between calculated values of R_c and corresponding bias voltages. An ordinate erected at the specified value of R_c determines the bias.

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RESISTANCE-COUPLED AMPLIFIER CHART

C = BLOCKING CONDENSER (µf)
Cc = CATHODE BY-PASS CONDENSER (µf)

Ebb = PLATE-SUPPLY VOLTAGE (Volts)
Eo = VOLTAGE OUTPUT (Peak Volts)

Rc = CATHODE RESISTOR (Ohms)
Rg = GRID RESISTOR (Megohms)

RL = PLATE RESISTOR (Megohms)
V.G. = VOLTAGE GAIN

TWIN-TRIODE TYPE 6C8-G (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	3040	3700	4520	6770	7870	8830	12400	15000	16500	2420	3080	3560	5170	6560	7550	9840	12500	15600	2120	2840	3250	4750	6100	7100	9000	11500	14500	Rc
Cc	2.34	1.48	1.29	0.95	0.81	0.69	0.51	0.43	0.38	2.34	1.84	1.6	1.25	0.95	0.85	0.66	0.5	0.44	3.93	2.01	1.79	1.29	0.96	0.77	0.67	0.48	0.37	Cc
C	0.028	0.0115	0.006	0.011	0.0065	0.0035	0.006	0.0035	0.0015	0.028	0.012	0.0065	0.012	0.007	0.0035	0.007	0.004	0.0015	0.037	0.013	0.007	0.013	0.0065	0.004	0.007	0.004	0.002	C
Eo [3]	13	17	19	15	19	21	16	20	25	30	40	45	35	45	50	38	44	51	55	73	80	64	80	90	67	83	96	Eo [3]
V.G. [4]	18	20	21	21	23	23	22	24	24	20	22	23	24	25	26	25	26	26	22	23	25	25	26	27	27	27	28	V.G. [4]

TWIN-TRIODE TYPE 6F8-G (ONE TRIODE UNIT),## AND TRIODE TYPES: 6J5, 6J5-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	0.05	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	1650	2070	2380	3470	3940	4420	7860	9760	10690	1190	1490	1740	2330	2830	3230	5560	7000	8110	1020	1270	1500	1900	2440	2700	4590	5770	6950	Rc
Cc	2.80	2.66	1.95	1.85	1.29	1.0	0.73	0.55	0.47	3.27	2.86	2.06	2.19	1.35	1.15	0.81	0.62	0.5	3.56	2.96	2.15	2.31	1.42	1.2	0.87	0.64	0.54	Cc
C	0.06	0.029	0.012	0.035	0.012	0.007	0.0135	0.007	0.004	0.06	0.032	0.0115	0.038	0.012	0.006	0.013	0.007	0.004	0.06	0.034	0.012	0.035	0.0125	0.0065	0.013	0.0075	0.004	C
Eo [3]	11	14	17	12	17	19	14	18	20	24	30	36	26	34	38	28	36	40	41	51	60	43	56	64	46	57	64	Eo [3]
V.G. [4]	11	12	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	13	14	14	14	14	14	14	14	14	V.G. [4]

TWIN-TRIODE TYPE 6Z7-G (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*	1480	1760	1930	3000	3390	3670	5300	6050	6700	930	1100	1210	1820	2110	2400	3240	3890	4360	670	950	1050	1430	1680	1930	2540	3110	3560	Rc*
Cc	2.65	2.02	1.7	1.36	1.1	0.8	0.65	0.61	0.45	3.4	2.6	2.32	1.71	1.38	1.1	0.9	0.703	0.553	3.81	2.63	2.34	1.87	1.46	1.19	0.97	0.72	0.56	Cc
C	0.025	0.0115	0.0065	0.01	0.006	0.0035	0.0055	0.003	0.0015	0.028	0.0115	0.007	0.012	0.007	0.0035	0.006	0.0035	0.002	0.028	0.012	0.007	0.012	0.006	0.0035	0.006	0.0035	0.002	C
Eo [3]	8	11	14	12	15	18	14	18	20	18	28	33	28	34	41	32	38	44	38	52	60	50	59	66	55	70	75	Eo [3]
V.G. [4]	21 [c]	25	26	28	30	33	31	33	35	26	31	32	35	38	39	39	40	41	31	34	36	38	40	43	42	44	45	V.G. [4]

THE CATHODES OF THE TWO UNITS HAVE SEPARATE TERMINALS

\# THE CATHODES OF THE TWO UNITS HAVE A COMMON TERMINAL

[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.

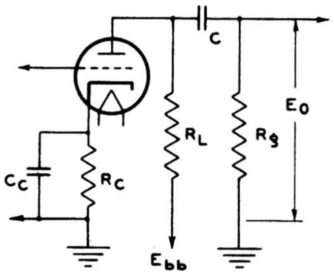
[c] At 4 volts (RMS) output.

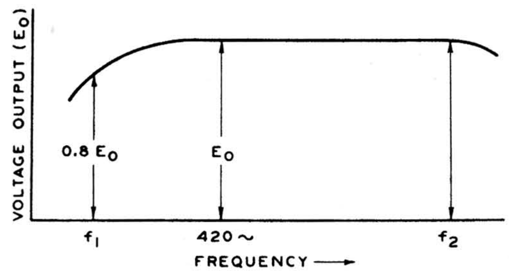
* Values are for phase-inverter service: See NOTES under RESISTANCE-COUPLED PHASE-INVERTER diagram.

(continued on next page)

RESISTANCE-COUPLED TRIODE AMPLIFIER

USING SINGLE TRIODE OR TWIN-TRIODE TYPE WITH SEPARATE CATHODE TERMINALS





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.

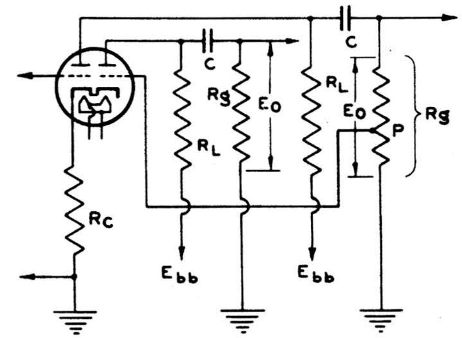
E. For an amplifier of typical construction, the value of f_2 is well above the audio-frequency range for any value of RL.

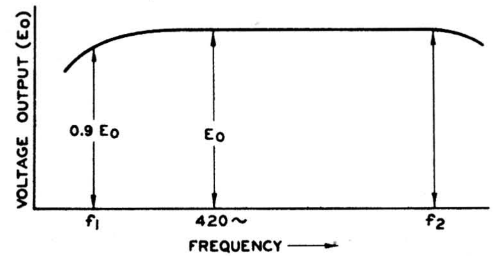
F. Always use highest permissible value of Rg.

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

RESISTANCE-COUPLED PHASE INVERTER

USING TWIN-TRIODE TYPE WITH ONE CATHODE TERMINAL





NOTES

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.

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METHOD OF DETERMINING BIAS VOLTAGE FROM PLATE FAMILY AND LOAD LINE

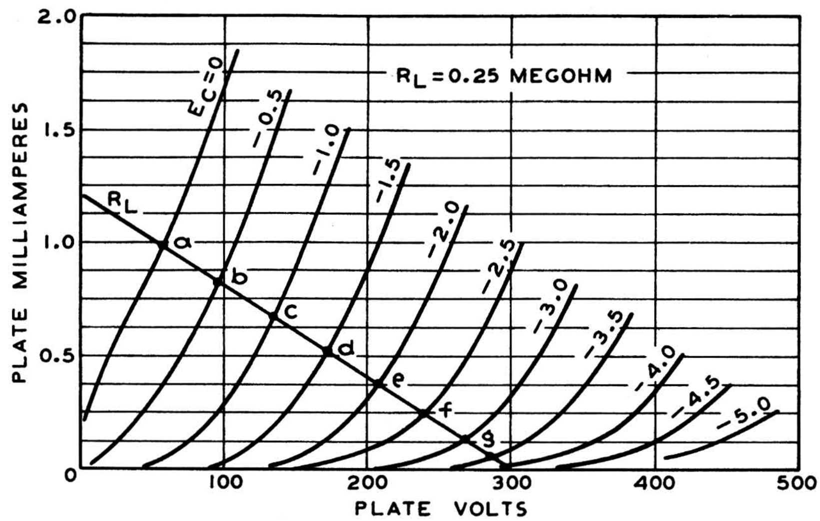

FIG. 1A

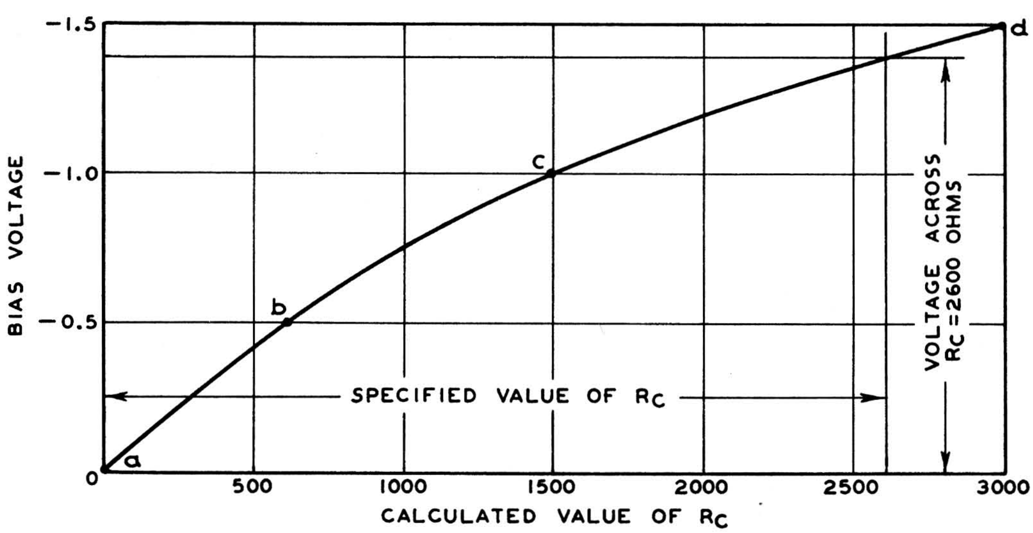

FIG. 1B