

1. List of Symbols

Symbols for electrodes

- a anode
- f heater
- f_m heater center tap
- g grid
- g internal connection
- i.c. cathode
- k internal shield
- s

Voltages

- V_a anode voltage
- V_f heater voltage
- V_{fk} voltage between heater and cathode
- V_g or V_{g1} dc control-grid voltage
- V_{gg} or V_{g1g1} at grid voltage between control grids (push-pull)
- V_g or V_{g1} positive grid voltage (peak value)
- V_{g2} dc screen grid voltage
- V_{g3} dc suppressor grid voltage
- V_{tr} transformer voltage, effective value

Currents

- I_a dc anode current
- I_{ant} antenna current
- I_e emission current
- I_f heater current
- I_{f0} filament starting current
- I_g or I_{g1} dc control grid current
- I_{g2} screen grid current
- I_{g3} suppressor grid current
- I_k dc cathode current

Powers

- P_a anode dissipation
- P_g or P_{g1} grid dissipation
- P_{g2} screen grid dissipation
- P_{g3} suppressor grid dissipation
- P₁ drive power
- P_{1a} anode input power
- P_{1p} drive power, peak value
- P_{mod} modulating power
- P_o output power
- P_{oL} output power in the load

Capacitances

- C_{ag} capacitance grid to anode
- C_{ak} capacitance anode to cathode
- C_{gk} capacitance grid to cathode
- C_i input capacitance, i.e. capacitance between grid No. 1 and all other electrodes except anode
- C_o output capacitance, i.e. capacitance between anode and all other electrodes except grid No. 1

Resistances

- R_a external resistance in an anode lead
- R_{aa} matching resistance of a push-pull amplifier (anode to anode)
- R_{r0} filament cold resistance
- R_g or R_{g1} grid 1 resistance
- R_k cathode resistance

Symbols denoting various quantities

- B bandwidth
- d total distortion
- f frequency
- K distortion
- m modulation factor
- pL static pressure of air
- Pv static pressure of vapour
- Pw static pressure of cooling water
- S transconductance
- T_a outlet temperature of air
- T_b bulb temperature
- T_e inlet temperature of air
- T_{eW} inlet temperature of water
- QL volume of cooling air
- Qv volume of vapourized water
- Qw volume of cooling water
- ΔpL pressure drop of air in the radiator
- Δpw pressure drop of cooling water in the radiator
- sw black level
- sy level
- ws white level
- η efficiency
- μ amplification factor
- μ₂ μ-factor of grid 2
- ↑ air cooling
- ↑ water cooling

2. Introduction

The characteristic data, curves and capacitances in the data sheets apply for average tubes. The maximum and operating data for the recommended classes of operation are supplemented by information on cooling and protective measures.

3. General data

3.1 Design and application

This short description of the design, applications, and output power in conjunction with the general data enables the user to select the best tube for his application.

3.2 Heating

In addition to the heater ratings, the type of heating and cathode material are stated since, as it will be explained below, the type of cathode determines the requirements to be placed on maximum admissible heater voltage fluctuations for optimum tube lifetime. It is generally the heater voltage that must be set up and the heater current should then be within the range stated. Thoriated tungsten cathodes are directly heated, oxide cathodes are indirectly heated.

3.3 Thoriated tungsten cathodes

The heater voltage stated is the maximum value required by a new tube to deliver its nominal output power. The absolute maximum variation caused by temporary mains voltage fluctuations must not exceed ±5% from the nominal value. For industrial RF heating tubes and the radiation cooled power tubes +5/-10% is admissible. As mains voltage fluctuations of up to +10/-20% can occur, the heater voltage will normally require stabilization. The continuous deviation from the nominal value, for example due to a setting up error, must not exceed +1/-3%.

Power Pentodes

used as af power amplifier and modulator and as rf power amplifier and oscillator

Cathode, Heating

Directly heated, thoriated tungsten

V_f	=	12	V \pm 3%
I_f	=	8.5	A

Capacitances

C_i	=	21	pF
C_o	=	30	pF
C_{ag1}	=	0.05	pF

Characteristics

S^1	=	5.5	mA/V
I_{g2g1}^1	=	3.5	A
I_e^2	=	3.5	A

Maximum Ratings³

f	=	10	20	60	MHz
V_a	=	3	2.5	1.8	kV
P_a	=	450	450	450	W
P_o	=	950	725	450	W
T_b	=	180	180	180	$^{\circ}$ C

AF Class B Amplifier, two tubes in push-pull

Operating Characteristics

f	=	10	20	MHz
V_a	=	3000	2500	V
V_{g3}	=	0	0	V
V_{g2}	=	500	500	V
$-V_{g1}$	=	120	115	V
V_{g1p}	=	80	75	V
I_a	=	215	230	mA
I_{g2}	=	30	30	mA
P_{ia}	=	640	575	W
P_a	=	450	445	W
P_{g2}	=	15	15	W
P_o	=	190	130	W
η	=	30	23	%
m	=	100	100	%
I_{g1}	=	4	3	mA
P_{ip}	=	0.7	0.5	W

Maximum Ratings

V_a	=	3000	V
V_{g3}	=	300	V
V_{g2}	=	600	V
$-V_{g1}$	=	300	V
I_a	=	250	mA
P_{ia}	=	675	W
P_a	=	450	W
P_{g3}	=	40	W
P_{g2}	=	100	W
P_{g1}	=	20	W

¹ $V_a = 3$ kV, $V_{g2} = 500$ V, $I_a = 190$ mA

² $V_a = V_{g2} = V_{g1} = 300$ V

³ RF Telegraphy, Class C

RF Class C Suppressor Grid Modulation

Operating Characteristics

f	=	10	20	10	20	MHz
V_a	=	3000	2500	3000	2500	V
V_{g3}	=	190	170	210	200	V
V_{g2}	=	600	600	600	600	V
$-V_{g1}$	=	300	300	300	300	V
V_{g1p}	=	340	340	340	330	V
I_a	=	190	165	175	175	mA
I_{g2}	=	165	165	165	165	mA
I_{g1}	=	5	5	5	5	mA
P_{ip}	=	1.7	1.7	1.7	1.7	W
P_{ia}	=	570	415	525	425	W
P_a	=	370	265	360	325	W
P_{g2}	=	100	100	100	100	W
P_o	=	200	150	165	100	W
η	=	35	36	31	23	%
m	=	80	80	100	100	%
V_{g3p}^1	=	190	170	210	200	V
P_{mod}	=	0	0	0	0	W

Maximum Ratings

V_a	=	3000	V
V_{g3}	=	300	V
V_{g2}	=	600	V
$-V_{g1}$	=	300	V
I_a	=	200	mA

RF Class C Anode and Screen Grid Modulation

Operating Characteristics

f	=	10	20	MHz
V_a	=	2500	2000	V
V_{g3}	=	0	0	V
V_{g2}	=	500	500	V
$-V_{g1}$	=	300	300	V
V_{g1p}	=	385	385	V
I_a	=	325	315	mA
I_{g2}	=	135	135	mA
I_{g1}	=	7	7	mA
P_i	=	2.7	2.7	W
P_{ia}	=	815	630	W
P_a	=	235	205	W
P_{g2}	=	67	67	W
P_o	=	580	425	W
η	=	71	67.5	%
m	=	100	100	%
V_{g2p}	=	500	500	V
P_{mod}	=	440	350	W

Maximum Ratings

V_a	=	2500	V
V_{g3}	=	300	V
V_{g2}	=	500	V
$-V_{g1}$	=	300	V
I_a	=	360	mA
P_{ia}	=	900	W
P_a	=	360	W
P_{g3}	=	40	W
P_{g2}	=	100	W
P_{g1}	=	20	W

RF Class C Oscillator, two tubes in push-pull

Operating Characteristics

f	=	60	MHz
V _a	=	1800	V
V _{g3}	=	0	V
V _{g2}	=	500	V
-V _{g1}	=	200	V
V _{g1p}	=	840	V
I _a	=	945	mA
I _{g2}	=	320	mA
I _{g1}	=	20	mA
P _i	=	40	W
P _{ia}	=	1700	W
P _a	=	800	W
P _{g2}	=	160	W
P _o	=	900	W
η	=	53	%

Maximum Ratings¹

f	=	10	MHz
V _a	=	3000	V
V _{g3}	=	300	V
V _{g2}	=	600	V
-V _{g1}	=	300	V
I _a	=	600	mA
P _{ia}	=	1500	W
P _a	=	450	W
P _{g3}	=	40	W
P _{g2}	=	100	W
P _{g1}	=	20	W

RF Class C Anode Modulation

Operating Characteristics

f	=	10	MHz
V _a	=	2500	V
V _{g3}	=	0	V
V _{g2}	=	500	V
-V _{g1}	=	300	V
V _{g1p}	=	400	V
I _a	=	225	mA
I _{g2}	=	200	mA
I _{g1}	=	15	mA
P _i	=	6	W
P _{ia}	=	565	W
P _a	=	140	W
P _{g2}	=	100	W
P _o	=	350	W
η	=	71	%
m	=	100	%
P _{mod}	=	285	W

Maximum Ratings

V _a	=	2500	V
V _{g3}	=	300	V
V _{g2}	=	500	V
-V _{g1}	=	300	V
I _a	=	360	mA
P _{ia}	=	900	W
P _a	=	360	W
P _{g3}	=	40	W
P _{g2}	=	100	W
P _{g1}	=	20	W

RF Class C Telegraphy

Operating Characteristics

f	=	10	MHz
V _a	=	3000	V
V _{g3}	=	0	V
V _{g2}	=	500	V
-V _{g1}	=	300	V
V _{g1p}	=	450	V
I _a	=	465	mA
I _{g2}	=	200	mA
I _{g1}	=	20	mA
P _i	=	9	W
P _{ia}	=	1400	W
P _a	=	450	W
P _{g2}	=	100	W
P _o	=	950	W
η	=	68	%

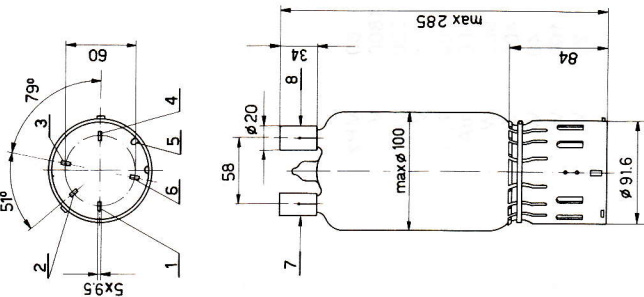
Maximum Ratings

V _a	=	3000	V
V _{g3}	=	300	V
V _{g2}	=	600	V
-V _{g1}	=	300	V
I _a	=	600	mA
P _{ia}	=	1800	W
P _a	=	450	W
P _{g3}	=	40	W
P _{g2}	=	100	W
P _{g1}	=	20	W

¹ one tube

5S045T

Dimensions in mm



Base

- Special
 1 - g1
 2 - g3
 3 - f
 4 - g2
 5 - f_m
 6 - f
 7 - a
 8 - g3

Mounting Position

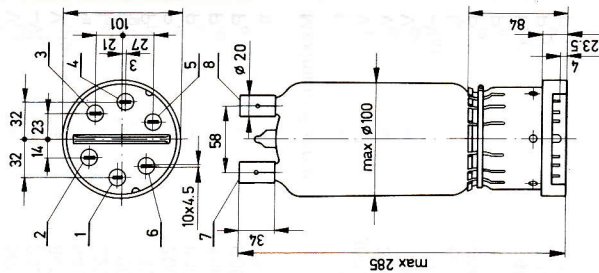
Vertical, base down

Mass

0.9 kg

5S045T-1

Dimensions in mm



Base

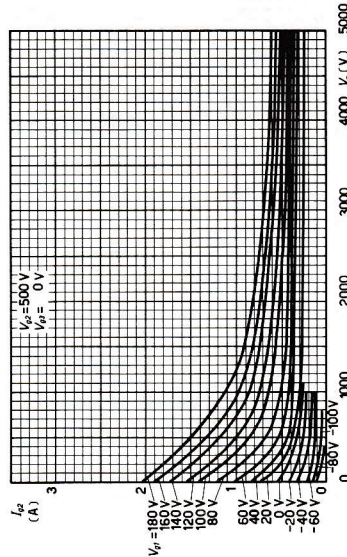
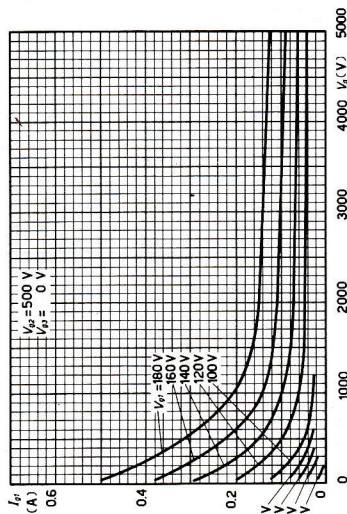
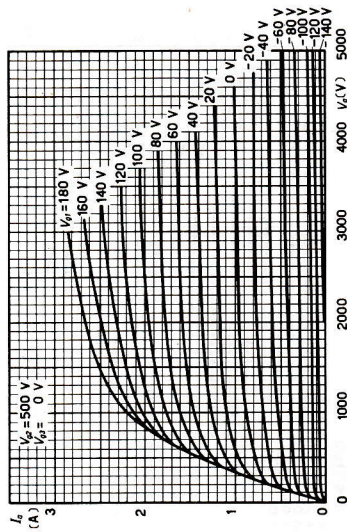
- Special
 1 - f
 2 - g1
 3 - g2
 4 - f_m
 5 - g3
 6 - f
 7 - a
 8 - g3

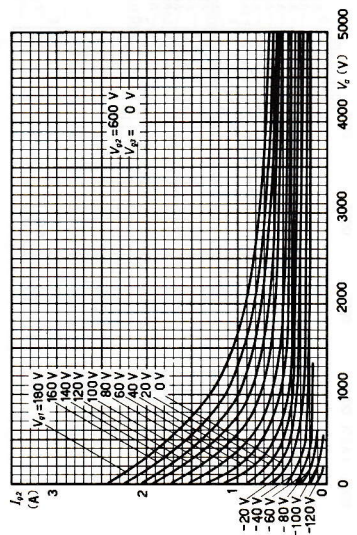
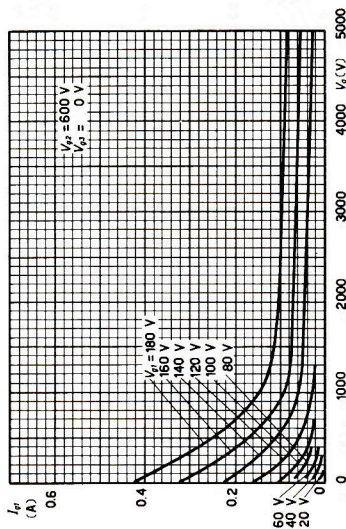
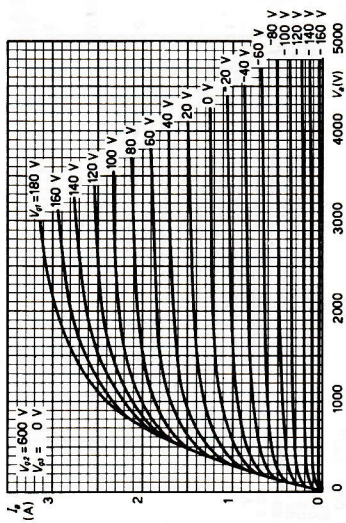
Mounting Position

Vertical, base down

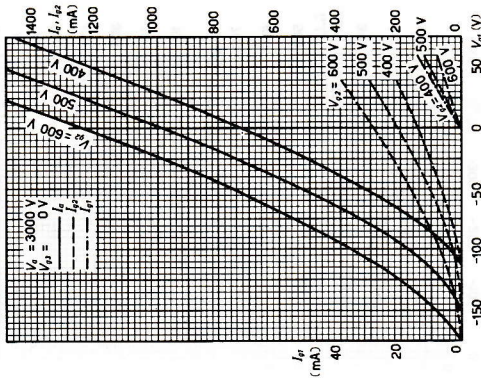
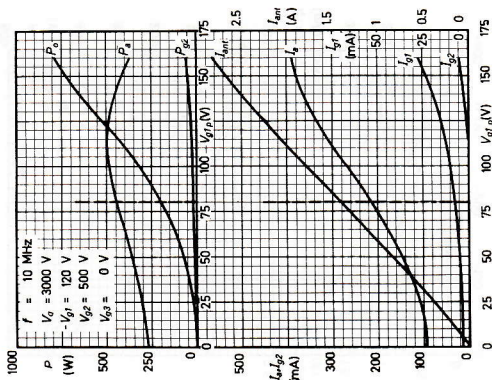
Mass

0.9 kg

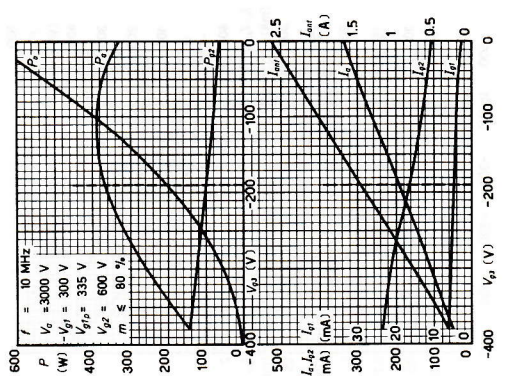
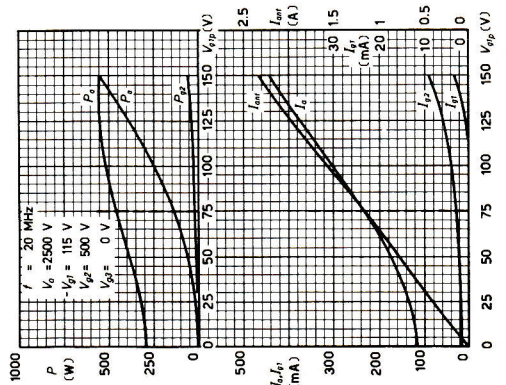




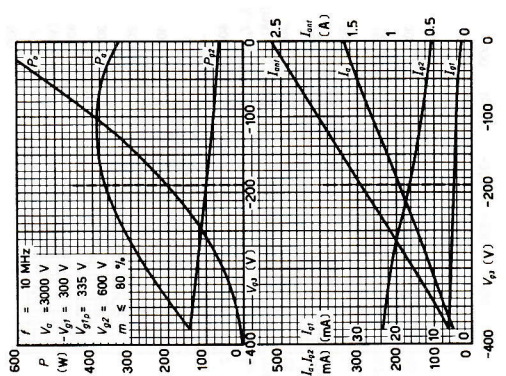
RF Class B Amplifier



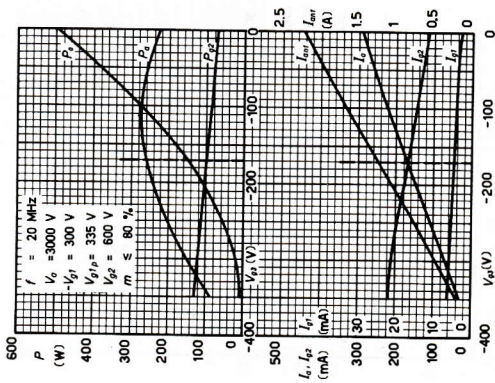
RF Class B Amplifier



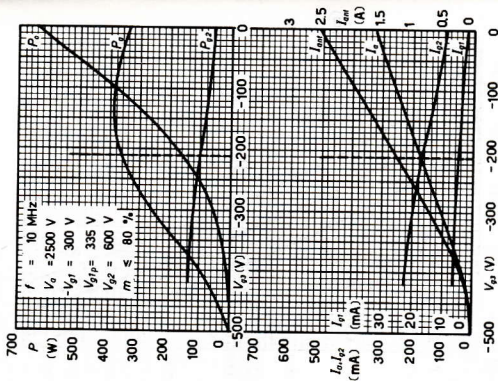
RF Class Suppressor Grid Modulation



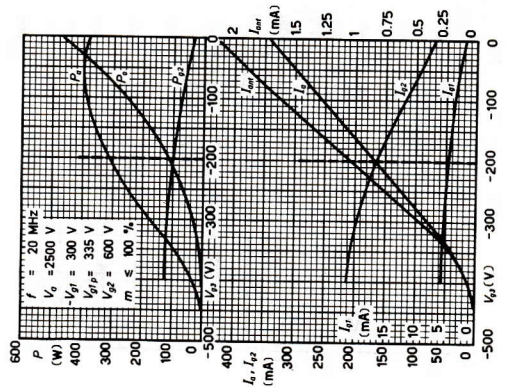
RF Class C Suppressor Grid Modulation



RF Class C Suppressor Grid Modulation



RF Class C Suppressor Grid Modulation



TRANSMITTING TUBES
WITH FORCED-AIR COOLING,
WATER COOLING AND
VAPOUR COOLING