

NPN 5 GHz WIDEBAND TRANSISTOR

NPN transistor in a four-lead dual-emitter plastic envelope (SOT103). This device is designed for application in wideband amplifiers, such as CATV and MATV systems.

PNP complement is BFG32.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (DC)	I_C	max.	75 mA
Total power dissipation up to $T_{amb} = 70^\circ\text{C}$	P_{tot}	max.	700 mW
Junction temperature	T_j	max.	175 $^\circ\text{C}$
DC current gain $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$	h_{FE}	min.	25
Transition frequency at $f = 500\text{ MHz}$ $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$	f_T	typ.	5.0 GHz
Feedback capacitance at $f = 1\text{ MHz}$ $I_C = 0; V_{CE} = 10\text{ V}$	C_{re}	typ.	1.0 pF
Maximum unilateral power gain at $f = 800\text{ MHz}$ $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$	G_{UM}	typ.	15.0 dB
Output power at 1 dB gain compression $V_{CE} = 10\text{ V}; I_C = 70\text{ mA}; f = 800\text{ MHz}$	PL_1	typ.	+21 dBm
Third order intercept point $V_{CE} = 10\text{ V}; I_C = 70\text{ mA}; f = 800\text{ MHz}$	ITO	typ.	+40 dBm

MECHANICAL DATA

SOT103 (see outlines section).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	75 mA
Total power dissipation up to $T_{amb} = 70\text{ }^{\circ}\text{C}$ mounted on a pcb	P_{tot}	max.	700 mW
Storage temperature range	T_{stg}		-65 to $+150\text{ }^{\circ}\text{C}$
Junction temperature	T_j	max.	$175\text{ }^{\circ}\text{C}$

THERMAL RESISTANCEFrom junction to ambient in free air
mounted on glass-fibre pcb

$$R_{th\ j-a} = 150\text{ K/W}$$

From junction to soldering point

$$R_{th\ j-s} = 55\text{ K/W}$$

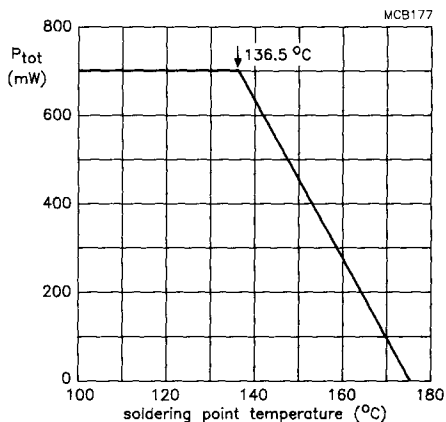


Fig.1 Power derating curve.

CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Collector cut-off current

$$I_E = 0; V_{CB} = 10\text{ V}$$

I_{CBO} max. 100 nA

DC current gain

$$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$$

h_{FE} min. 25
typ. 50

Transition frequency at $f = 500\text{ MHz}$

$$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$$

f_T typ. 5.0 GHz

Collector capacitance at $f = 1\text{ MHz}$

$$I_E = i_e = 0; V_{CB} = 10\text{ V}$$

C_c typ. 1.5 pF

Emitter capacitance at $f = 1\text{ MHz}$

$$I_C = i_c = 0; V_{EB} = 0.5\text{ V}$$

C_e typ. 6.5 pF

Feedback capacitance at $f = 1\text{ MHz}$

$$I_C = 0; V_{CE} = 10\text{ V}$$

C_{re} typ. 1.0 pF

Noise figure at $Z_S = \text{opt.}$ and $T_{amb} = 25\text{ }^{\circ}\text{C}$

$$I_C = 70\text{ mA}; V_{CE} = 10\text{ V}; f = 800\text{ MHz}$$

F typ. 4.0 dB

Maximum unilateral power gain (S_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{[1 - |S_{11}|^2][1 - |S_{22}|^2]}$$

$$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; f = 800\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$$

$$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$$

G_{UM} typ. 15.0 dB
typ. 8.0 dB

Output power at 1 dB gain compression

$$I_C = 70\text{ mA}; V_{CE} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C};$$

$$R_L = 75\text{ }\Omega; \text{measured at } f = 800\text{ MHz}$$

P_{L1} typ. +21 dBm

Third order intercept point (see Fig.2)

$$I_C = 70\text{ mA}; V_{CE} = 10\text{ V};$$

$$R_L = 75\text{ }\Omega; T_{amb} = 25\text{ }^{\circ}\text{C};$$

$$P_p = ITO - 6\text{ dB}; f_p = 800\text{ MHz};$$

$$P_q = ITO - 6\text{ dB}; f_q = 801\text{ MHz};$$

$$\text{measured at } f_{(2q-p)} = 802\text{ MHz and}$$

$$\text{at } f_{(2p-q)} = 799\text{ MHz}$$

ITO typ. +40 dBm

Output voltage at $d_{im} = -60\text{ dB}$

$$I_C = 70\text{ mA}; V_{CE} = 10\text{ V};$$

$$R_L = 75\text{ }\Omega; T_{amb} = 25\text{ }^{\circ}\text{C}$$

$$V_p = V_O \text{ at } d_{im} = -60\text{ dB}; f_p = 795.25\text{ MHz}$$

$$V_q = V_O - 6\text{ dB}; f_q = 803.25\text{ MHz}$$

$$V_r = V_O - 6\text{ dB}; f_r = 805.25\text{ MHz}$$

$$\text{measured at } f_{(p+q-r)} = 793.25\text{ MHz}$$

V_O typ. 700 mV

Second harmonic distortion (see Fig.2)

$$I_C = 70\text{ mA}; V_{CE} = 10\text{ V}; R_L = 75\text{ }\Omega;$$

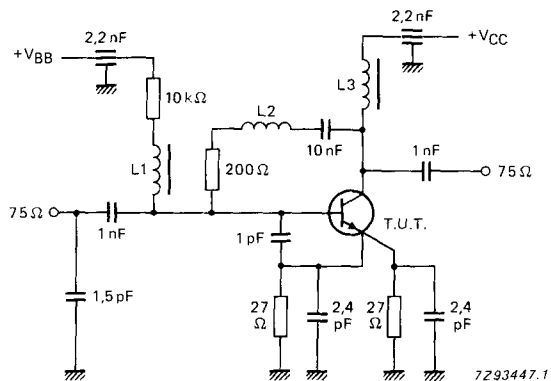
$$VSWR < 2; T_{amb} = 25\text{ }^{\circ}\text{C}$$

$$V_p = V_O = 320\text{ mV at } f_p = 250\text{ MHz}$$

$$V_q = V_O = 320\text{ mV at } f_q = 560\text{ MHz}$$

$$\text{measured at } f_{(p+q)} = 810\text{ MHz}$$

d_2 typ. -52 dB



$L1 = L3 = 5 \mu\text{H}$ micro-choke

$L2 = 1.5$ turns Cu wire (0.4 mm), internal diameter 3 mm, winding pitch 1 mm.

Fig.2 Intermodulation distortion and second harmonic distortion MATV test circuit.

s-parameters (common emitter) at $V_{CE} = 10\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; typical values

I_C mA	f MHz	S_{11}	S_{21}	S_{12}	S_{22}	GUM dB
10	40	0,68/ -50,8°	26,0/155,5°	0,02/ 67,1°	0,90/ -22,7°	38,2
	100	0,68/-106,4°	18,2/126,5°	0,03/ 46,0°	0,65/ -45,7°	30,3
	200	0,68/-142,5°	10,8/107,9°	0,04/ 38,0°	0,41/ -56,9°	24,1
	500	0,71/-173,4°	4,6/ 84,5°	0,05/ 41,2°	0,25/ -69,3°	16,6
	800	0,69/+173,9°	3,0/ 73,3°	0,07/ 49,3°	0,25/ -78,7°	12,7
	1000	0,70/+166,7°	2,4/ 65,8°	0,08/ 52,5°	0,25/ -82,7°	10,8
	1200	0,72/+159,6°	1,9/ 61,5°	0,09/ 56,9°	0,24/ -91,4°	9,3
	1500	0,71/+153,2°	1,7/ 53,2°	0,11/ 60,2°	0,25/-103,8°	7,7
15	2000	0,73/+138,2°	1,2/ 42,7°	0,14/ 63,2°	0,29/-126,1°	5,5
	40	0,60/ -64,1°	33,5/150,8°	0,02/ 64,6°	0,86/ -29,5°	28,4
	100	0,65/-121,2°	21,8/121,5°	0,03/ 45,0°	0,56/ -56,5°	30,8
	200	0,66/-152,0°	12,4/104,8°	0,03/ 40,9°	0,33/ -70,6°	24,9
	500	0,70/-177,4°	5,1/ 83,8°	0,05/ 49,3°	0,19/ -90,4°	17,3
	800	0,68/+171,4°	3,3/ 73,5°	0,07/ 56,4°	0,19/ -98,2°	13,4
	1000	0,69/+164,8°	2,6/ 66,7°	0,08/ 58,4°	0,18/-102,4°	11,5
	1200	0,72/+157,8°	2,2/ 62,8°	0,09/ 61,7°	0,17/-110,5°	10,0
20	1500	0,70/+152,1°	1,8/ 54,6°	0,12/ 63,1°	0,20/-121,3°	8,4
	2000	0,72/+137,2°	1,4/ 44,7°	0,15/ 64,1°	0,23/-139,8°	6,3
	40	0,55/ -75,5°	39,4/147,3°	0,02/ 60,6°	0,83/ -34,8°	38,6
	100	0,63/-130,6°	24,0/118,3°	0,02/ 43,9°	0,51/ -64,8°	31,1
	200	0,66/-156,7°	13,3/102,8°	0,03/ 44,2°	0,29/ -82,0°	25,3
	500	0,70/-179,7°	5,4/ 83,5°	0,05/ 54,3°	0,17/-108,8°	17,7
	800	0,68/+170,0°	3,5/ 73,7°	0,07/ 60,3°	0,17/ -115,6°	13,9
	1000	0,69/+163,7°	2,8/ 67,0°	0,08/ 61,3°	0,16/-119,4°	11,9
30	1200	0,72/+156,9°	2,3/ 63,5°	0,09/ 64,0°	0,15/-129,7°	10,5
	1500	0,69/+151,5°	2,0/ 55,5°	0,12/ 64,3°	0,18/-136,5°	8,8
	2000	0,71/+136,7°	1,5/ 45,9°	0,16/ 63,9°	0,21/-152,0°	6,7
	40	0,51/ -92,9°	47,3/142,3°	0,02/ 58,4°	0,79/ -42,7°	38,8
	100	0,62/-142,5°	26,5/114,3°	0,02/ 44,5°	0,44/ -76,6°	31,5
	200	0,65/-162,4°	14,4/100,6°	0,03/ 49,2°	0,25/ -98,8°	25,9
	500	0,69/+177,9°	5,8/ 83,0°	0,05/ 60,3°	0,17/-132,5°	18,2
	800	0,68/+168,5°	3,8/ 73,8°	0,07/ 64,7°	0,17/-136,9°	14,3
50	1000	0,69/+162,5°	3,0/ 67,5°	0,08/ 64,7°	0,16/-143,7°	12,4
	1200	0,71/+155,8°	2,4/ 64,4°	0,10/ 66,4°	0,15/-155,4°	10,9
	1500	0,68/+150,8°	2,1/ 56,3°	0,12/ 65,7°	0,18/-156,5°	9,3
	2000	0,71/+136,2°	1,6/ 47,2°	0,16/ 64,4°	0,21/-168,4°	7,3
	40	0,49/-113,0°	55,6/136,3°	0,01/ 57,1°	0,71/ -52,4°	39,1
	100	0,63/-153,5°	28,5/110,2°	0,02/ 48,7°	0,39/ -90,8°	32,0
	200	0,65/-168,7°	15,3/ 98,3°	0,02/ 56,7°	0,24/-117,4°	26,3
	500	0,69/+175,9°	6,0/ 82,4°	0,05/ 65,8°	0,20/-149,7°	18,6
	800	0,67/+167,2°	3,9/ 73,6°	0,07/ 68,1°	0,19/-154,7°	15,0
	1000	0,69/+161,5°	3,1/ 67,7°	0,09/ 67,2°	0,18/-162,2°	12,8
	1200	0,71/+155,1°	2,6/ 65,0°	0,10/ 68,7°	0,18/-173,8°	11,3
	1500	0,68/+150,3°	2,2/ 56,9°	0,13/ 66,7°	0,19/-172,1°	9,7
	2000	0,70/+135,7°	1,7/ 48,3°	0,17/ 64,9°	0,21/-177,2°	8,0

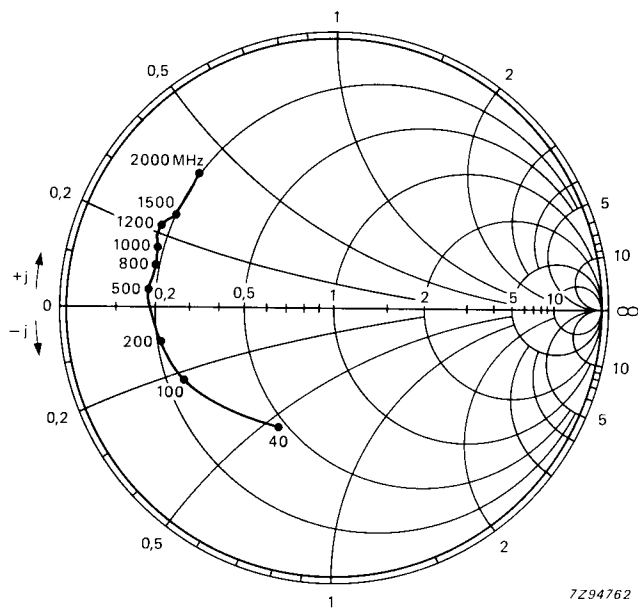


Fig.3 Input impedance, derived from input reflection coefficient S_{11} coordinates, in ohm $\times 50$.

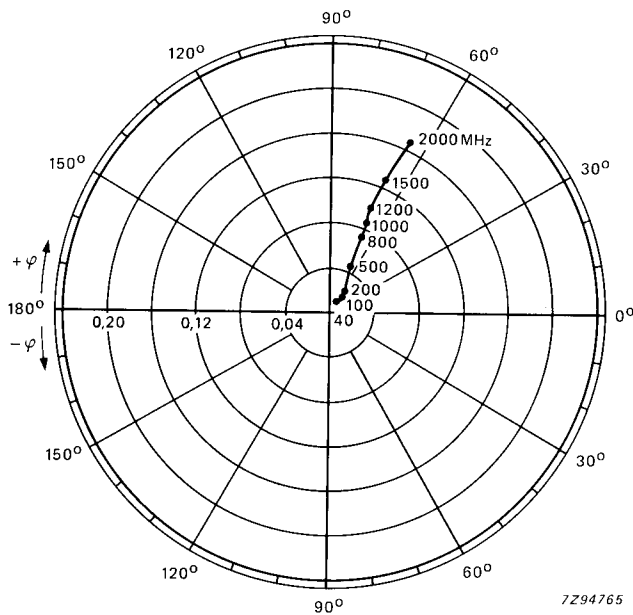


Fig.4 Reverse transmission coefficient S_{12} .

Conditions for Figs 3 to 6: $V_{CE} = 10 \text{ V}$; $I_C = 50 \text{ mA}$; $T_{amb} = 25^\circ \text{C}$.

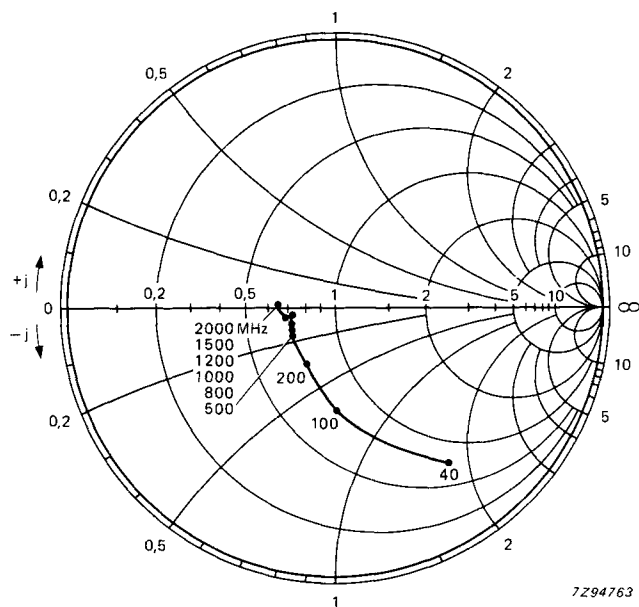


Fig.5 Output impedance, derived from output reflection coefficient S_{22} coordinates, in ohm $\times 50$.

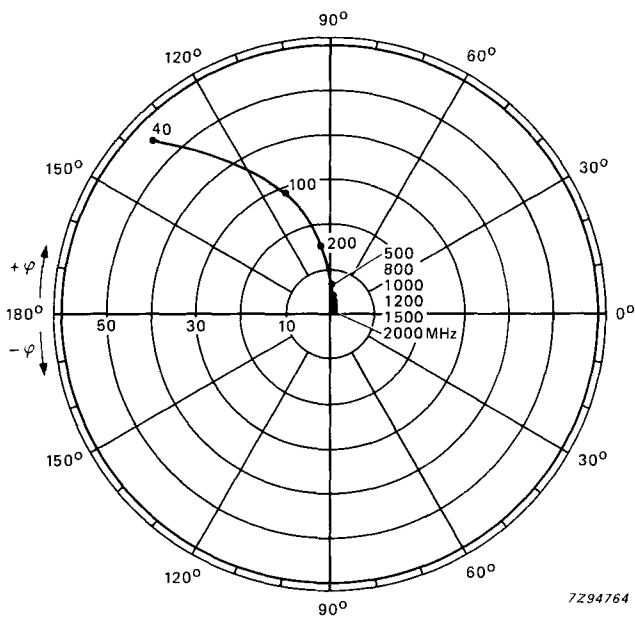


Fig.6 Forward transmission coefficient S_{21} .

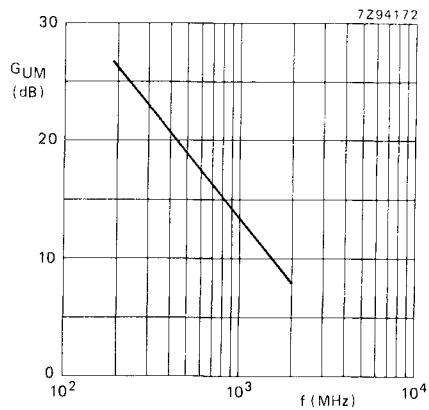


Fig.7 $V_{CE} = 10 \text{ V}$; $I_C = 50 \text{ mA}$; $T_{amb} = 25 \text{ }^{\circ}\text{C}$; typical values.

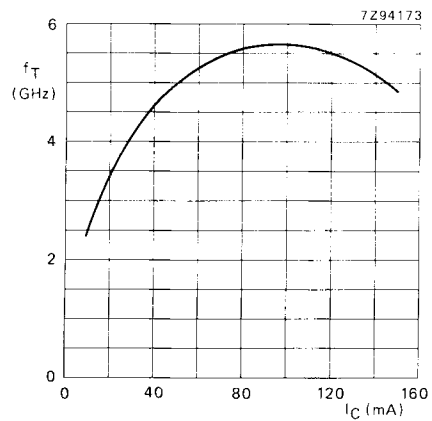


Fig.8 $V_{CE} = 10 \text{ V}$; $f = 500 \text{ MHz}$; $T_j = 25 \text{ }^{\circ}\text{C}$; typical values.

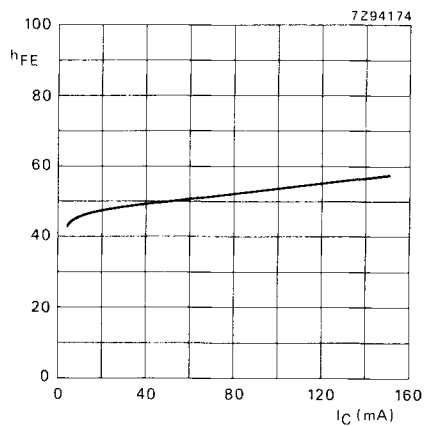


Fig.9 $V_{CE} = 10 \text{ V}$; $T_j = 25 \text{ }^{\circ}\text{C}$; typical values.

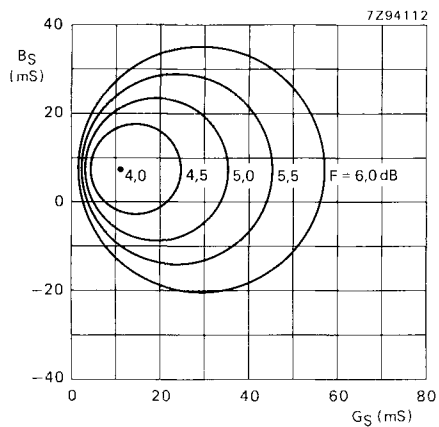


Fig.10 Circles of constant noise figure $I_C = 70 \text{ mA}$; $V_{CE} = 10 \text{ V}$; $f = 800 \text{ MHz}$; typical values.

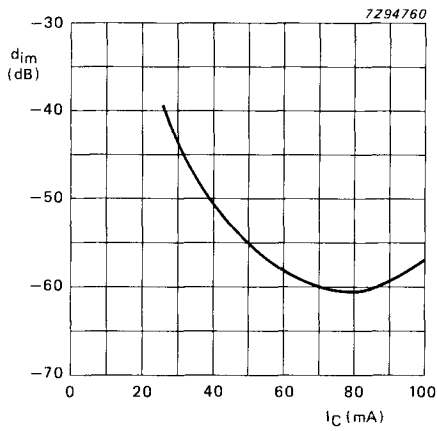


Fig.11 $V_{CE} = 10 \text{ V}$; $V_O = 700 \text{ mV}$;
 $f_{(p+q-r)} = 793.25 \text{ MHz}$; $T_{amb} = 25 \text{ }^\circ\text{C}$;
 typical values.

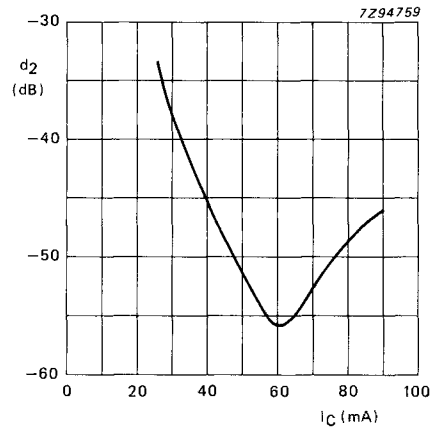


Fig.12 $V_{CE} = 10 \text{ V}$; $V_O = 320 \text{ mV}$;
 $f_{(p+q)} = 810 \text{ MHz}$; $T_{amb} = 25 \text{ }^\circ\text{C}$;
 typical values.

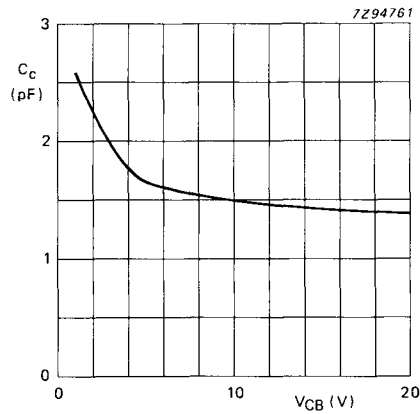


Fig.13 $I_E = i_e = 0$; $f = 1 \text{ MHz}$; $T_j = 25 \text{ }^\circ\text{C}$; typical values.

CLASS-B OPERATION

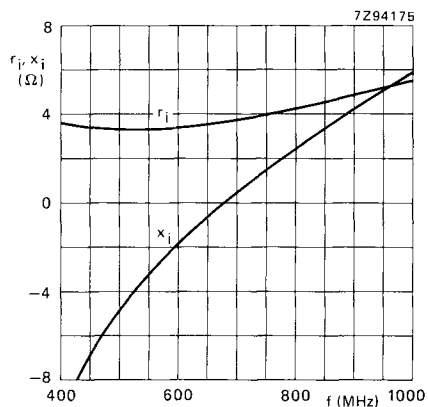


Fig. 14 Input impedance (series components).

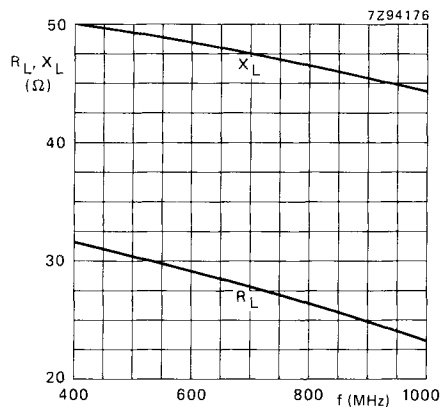


Fig. 15 Load impedance (series components).

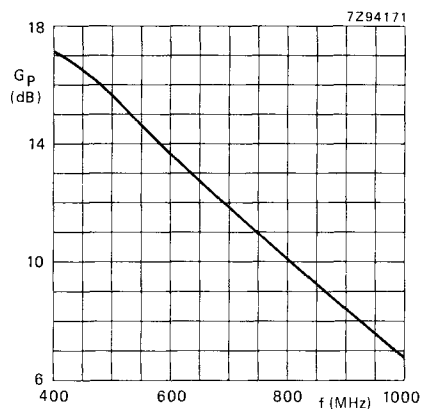


Fig. 16 Power gain as a function of frequency.

Conditions for Figs 14 to 16:

$V_{CE} = 10 \text{ V}$; $P_L = 500 \text{ mW}$; $T_{amb} = 25^\circ\text{C}$;
typical values.

OPERATING NOTE for Figs 14 to 16:

A resistance of 39Ω between base and emitter is recommended to avoid oscillation. This resistance must be effective for RF only.