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 °C	P_{tot}	max.	700 mW
Junction temperature	T_j	max.	175 °C
DC current gain I_C = 50 mA; V_{CE} = 10 V	h_{FE}	min.	25
Transition frequency at f = 500 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	typ.	5.0 GHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 10 V	C_{re}	typ.	1.0 pF
Maximum unilateral power gain at f = 800 MHz I_C = 50 mA; V_{CE} = 10 V	G_{UM}	typ.	15.0 dB
Output power at 1 dB gain compression V_{CE} = 10 V; I_C = 70 mA; f = 800 MHz	P_{L1}	typ.	+21 dBm
Third order intercept point V_{CE} = 10 V; I_C = 70 mA; f = 800 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 °C mounted on a pcb	P_{tot}	max.	700	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on glass-fibre pcb	$R_{th\ j\text{-}a}$	=	150	K/W
From junction to soldering point	$R_{th\ j\text{-}s}$	=	55	K/W

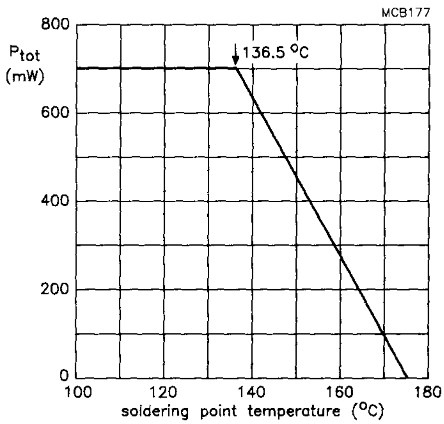
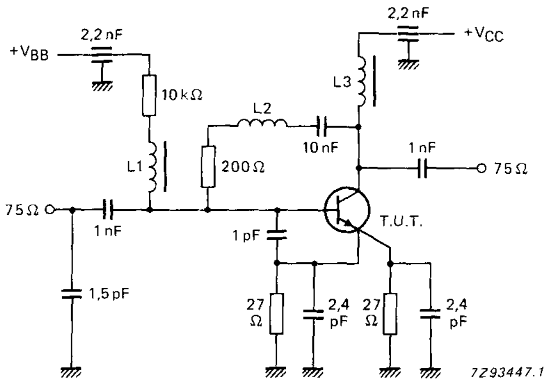


Fig.1 Power derating curve.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	max.	100 nA
DC current gain $I_C = 50$ mA; $V_{CE} = 10$ V	h_{FE}	min. typ.	25 50
Transition frequency at f = 500 MHz $I_C = 50$ mA; $V_{CE} = 10$ V	f_T	typ.	5.0 GHz
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	typ.	1.5 pF
Emitter capacitance at f = 1 MHz $I_C = i_c = 0$; $V_{EB} = 0.5$ V	C_e	typ.	6.5 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; $V_{CE} = 10$ V	C_{re}	typ.	1.0 pF
Noise figure at Z_S = opt. and T_{amb} = 25 °C $I_C = 70$ mA; $V_{CE} = 10$ V; f = 800 MHz	F	typ.	4.0 dB
Maximum unilateral power gain (S_{12} assumed to be zero) $G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{[1-\lvert S_{11}\rvert^2]\ [1-\lvert S_{22}\rvert^2]}$ $I_C = 50$ mA; $V_{CE} = 10$ V; f = 800 MHz; T_{amb} = 25 °C $I_C = 50$ mA; $V_{CE} = 10$ V; f = 2 GHz; T_{amb} = 25 °C	G_{UM}	typ. typ.	15.0 dB 8.0 dB
Output power at 1 dB gain compression $I_C = 70$ mA; $V_{CE} = 10$ V; T_{amb} = 25 °C; $R_L = 75\ \Omega$; measured at f = 800 MHz	P_{L1}	typ.	+21 dBm
Third order intercept point (see Fig.2) $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C; P_p = ITO − 6 dB; f_p = 800 MHz; P_q = ITO − 6 dB; f_q = 801 MHz; measured at $f_{(2q-p)}$ = 802 MHz and at $f_{(2p-q)}$ = 799 MHz	ITO	typ.	+40 dBm
Output voltage at d_{im} = −60 dB $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C $V_p = V_O$ at d_{im} = −60 dB ; f_p = 795.25 MHz $V_q = V_O$ −6 dB ; f_q = 803.25 MHz $V_r = V_O$ −6 dB ; f_r = 805.25 MHz measured at $f_{(p+q-r)}$ = 793.25 MHz	V_O	typ.	700 mV
Second harmonic distortion (see Fig.2) $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2; T_{amb} = 25 °C $V_p = V_O$ = 320 mV at f_p = 250 MHz $V_q = V_O$ = 320 mV at f_q = 560 MHz measured at $f_{(p+q)}$ = 810 MHz	d_2	typ.	−52 dB



L1 = L3 ≈ 5 μH 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 V; T_{amb} = 25 °C; typical values

I_C mA	f MHz	s_{11}	s_{21}	s_{12}	s_{22}	G_{UM} dB
	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
10	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
	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
15	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
	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
20	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
	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
30	800	0,68/+168,5°	3,8/ 73,8°	0,07/ 64,7°	0,17/−136,9°	14,3
	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
50	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

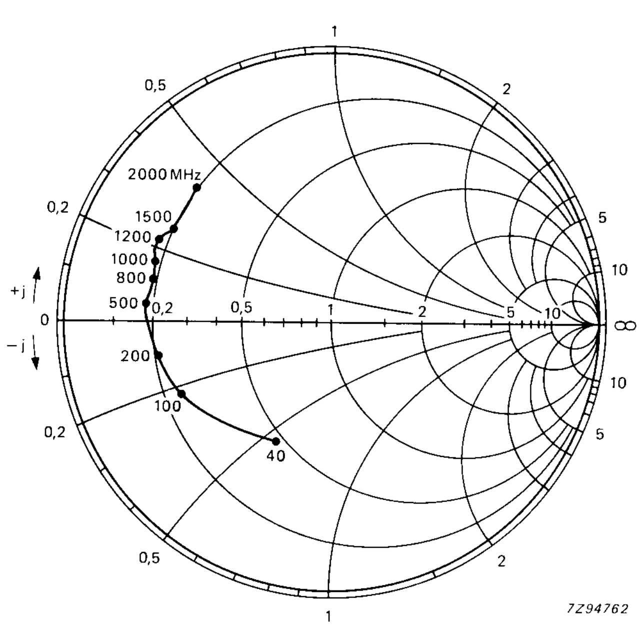


Fig.3 Input impedance, derived from input reflection coefficient S_{11} coordinates, in ohm x 50.

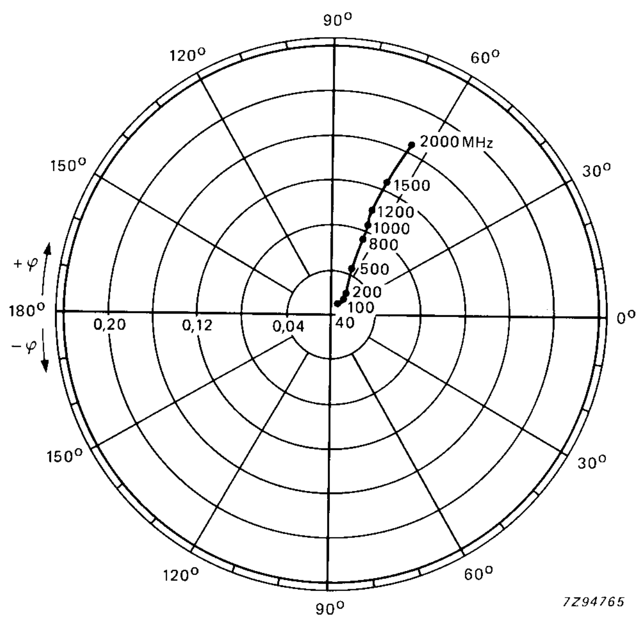


Fig.4 Reverse transmission coefficient S_{12}.

Conditions for Figs 3 to 6: V_{CE} = 10 V; I_C = 50 mA; T_{amb} = 25 °C.

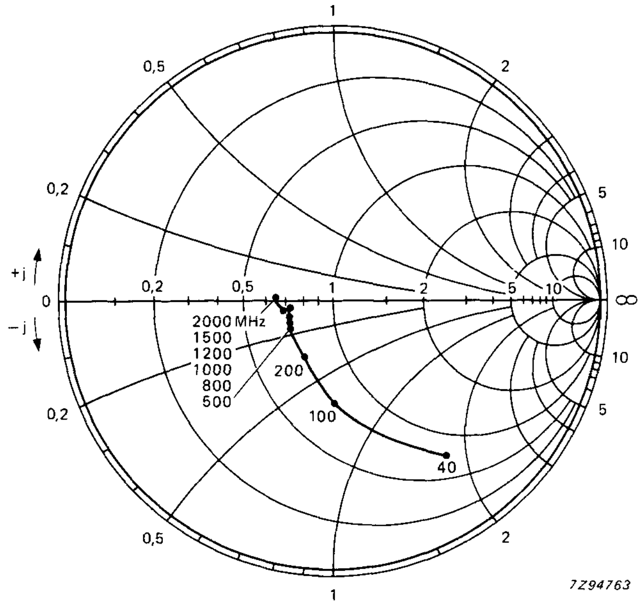


Fig.5 Output impedance, derived from output reflection coefficient S_{22} coordinates, in ohm x 50.

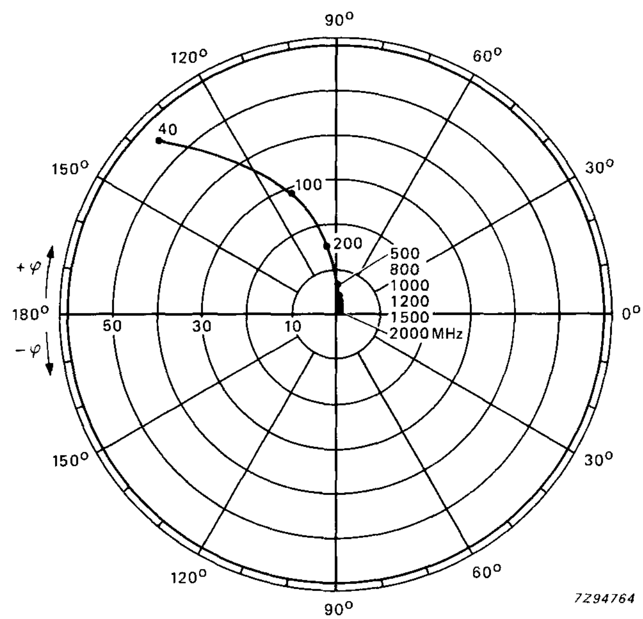


Fig.6 Forward transmission coefficient S_{21}.

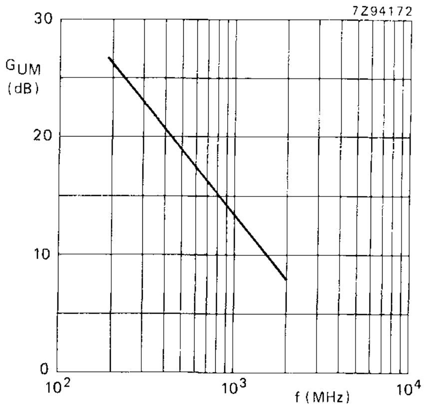


Fig.7 V_{CE} = 10 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

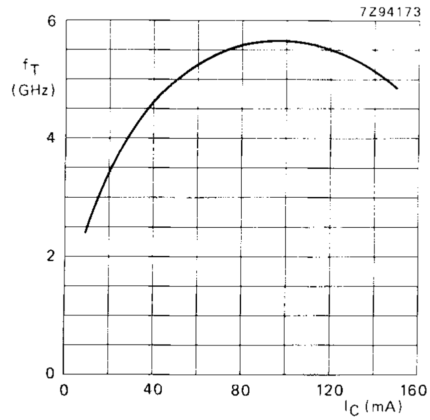


Fig.8 V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C; typical values.

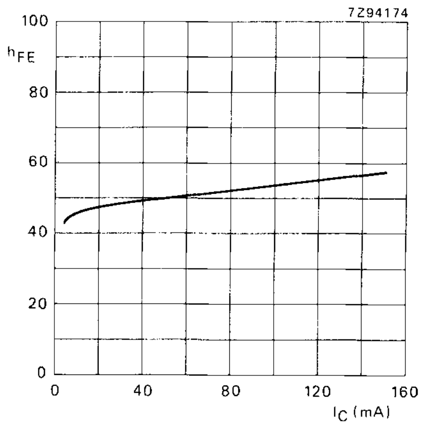


Fig.9 V_{CE} = 10 V; T_j = 25 °C; typical values.

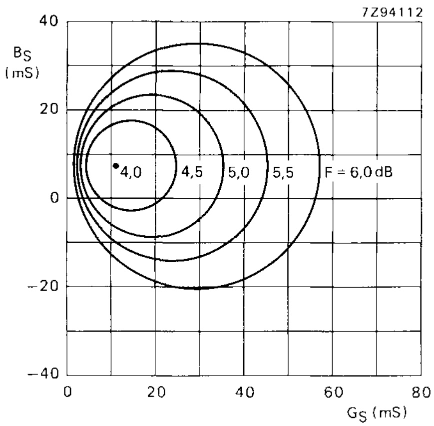


Fig.10 Circles of constant noise figure I_C = 70 mA; V_{CE} = 10 V; f = 800 MHz; typical values.

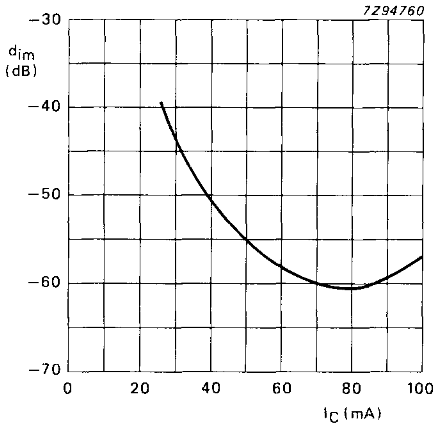


Fig.11 V_{CE} = 10 V; V_O = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C; typical values.

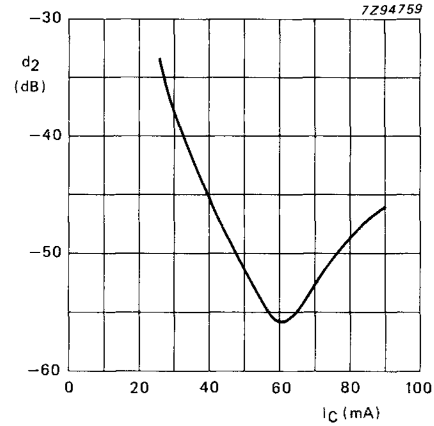


Fig.12 V_{CE} = 10 V; V_O = 320 mV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C; typical values.

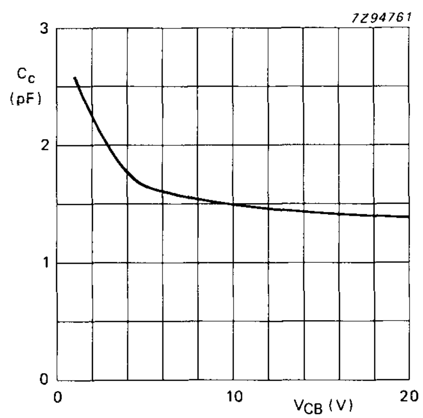


Fig.13 $I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

CLASS-B OPERATION

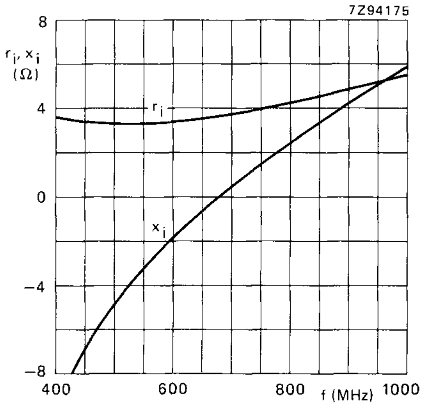


Fig.14 Input impedance (series components).

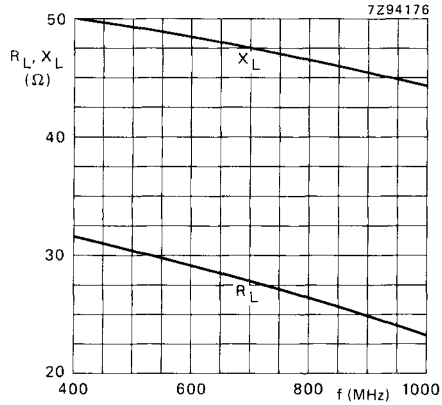


Fig.15 Load impedance (series components).

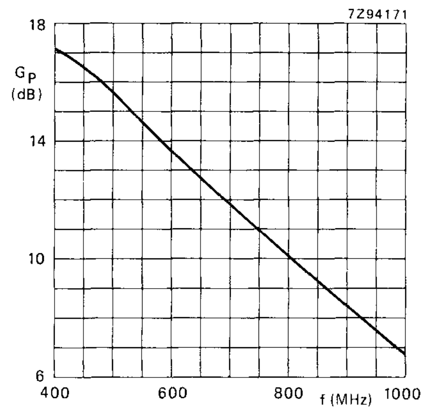


Fig.16 Power gain as a function of frequency.

Conditions for Figs 14 to 16:

V_{CE} = 10 V; P_L = 500 mW; T_{amb} = 25 °C; typical values.

OPERATING NOTE for Figs 14 to 16:

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