NPN 5 GHz wideband transistor BFG96

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DESCRIPTION

NPN transistor in a 4-lead dual-emitter plastic SOT103 envelope.

It is designed for application in wideband amplifiers, such as MATV and CATV systems.

PNP complement is the BFG32.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	emitter
4	base

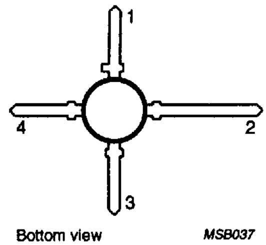

Fig.1 SOT103.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	–	15	V
I_C	DC collector current		–	–	75	mA
P_{tot}	total power dissipation	up to T_s = 136 °C (note 1)	–	–	700	mW
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; T_j = 25 °C	25	80	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	–	5	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	–	1	–	pF
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 70 mA; V_{CE} = 10 V; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	21	–	dBm
ITO	third order intercept point	I_C = 70 mA; V_{CE} = 10 V; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	40	–	dBm

Note

1. T_s is the temperature at the soldering point of the collector lead.

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LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	75	mA
P_{tot}	total power dissipation	up to T_s = 136 °C (note 1)	–	700	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 136 °C (note 1)	55 K/W

Note

1. T_s is the temperature at the soldering point of the collector lead.

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CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 10$ V	25	80	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	6.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1	–	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 50$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 70$ mA; $V_{CE} = 10$ V; Z_S = opt.; f = 800 MHz; $T_{amb} = 25$ °C	–	4	–	dB
P_{L1}	output power at 1 dB gain compression	$V_{CE} = 10$ V; $I_C = 70$ mA; $R_L = 75\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	–	21	–	dBm
ITO	third order intercept point (see Fig.2)	note 2	–	40	–	dBm
V_O	output voltage	note 3	–	700	–	mV
d_2	second order intermodulation distortion (see Fig.2)	note 4	–	–52	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
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.
3. $d_{im} = -60$ 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.
4. $I_C = 70$ 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.

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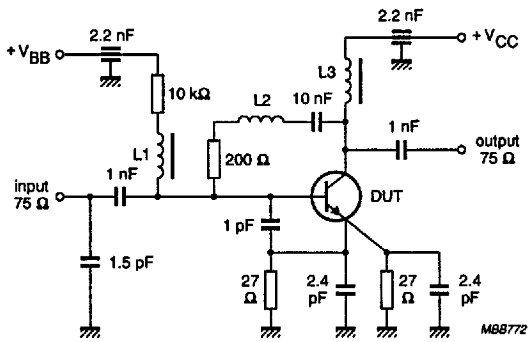


L1 = L3 = 5 μH micro-choke.

L2 = 1.5 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

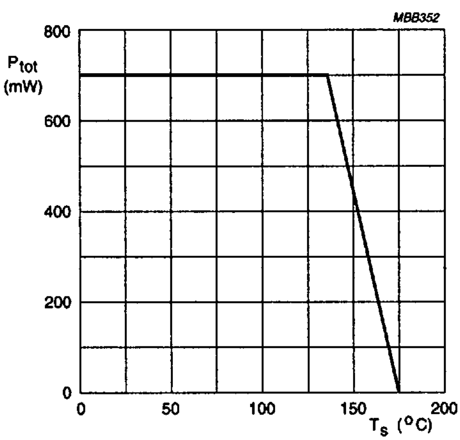
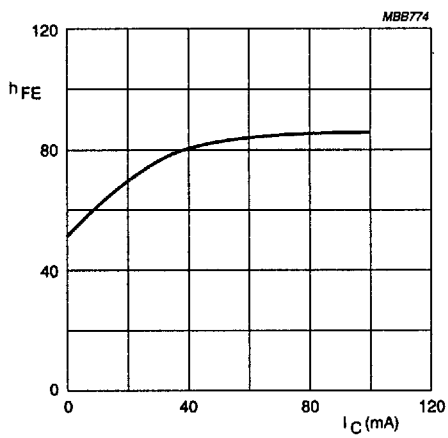


Fig.3 Power derating curve.



$V_{CE} = 10$ V; $T_j = 25$ °C.

Fig.4 DC current gain as a function of collector current.

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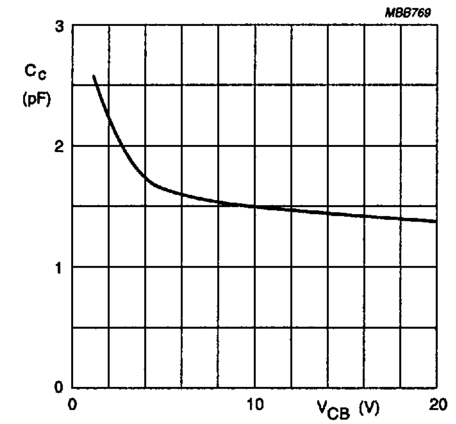
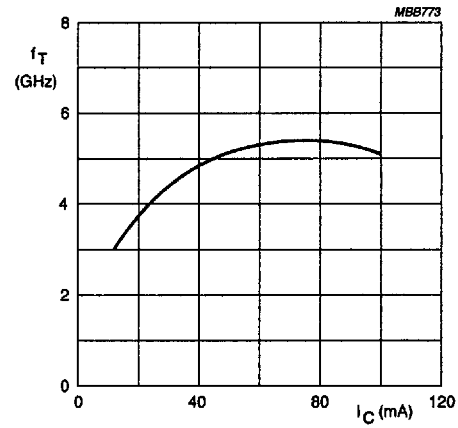


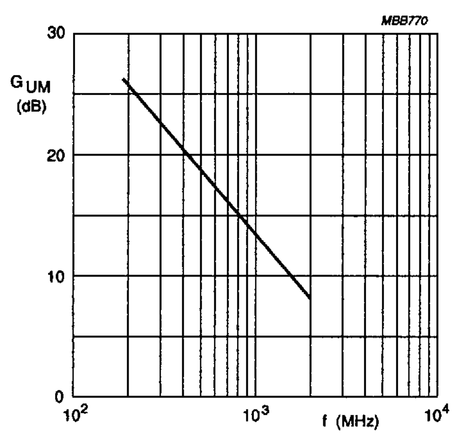
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage.



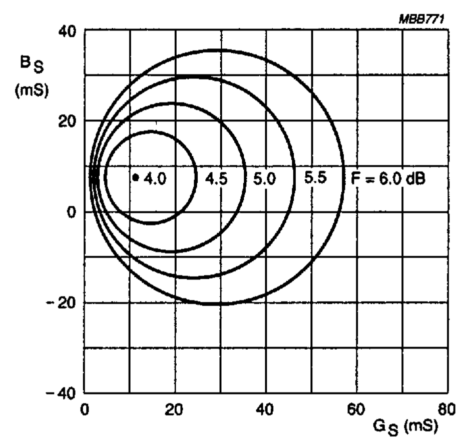
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current.



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

Fig.7 Maximum unilateral power gain as a function of frequency.



I_C = 70 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.8 Noise circle figure.

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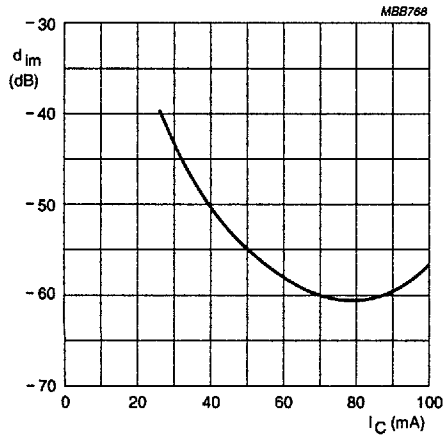
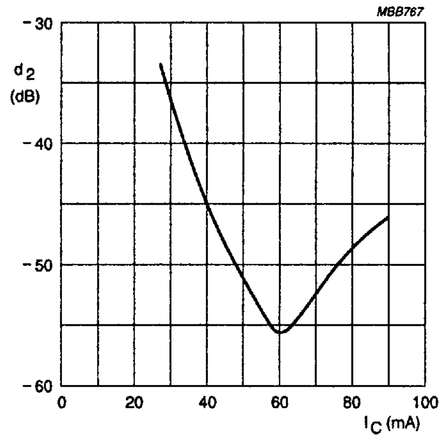


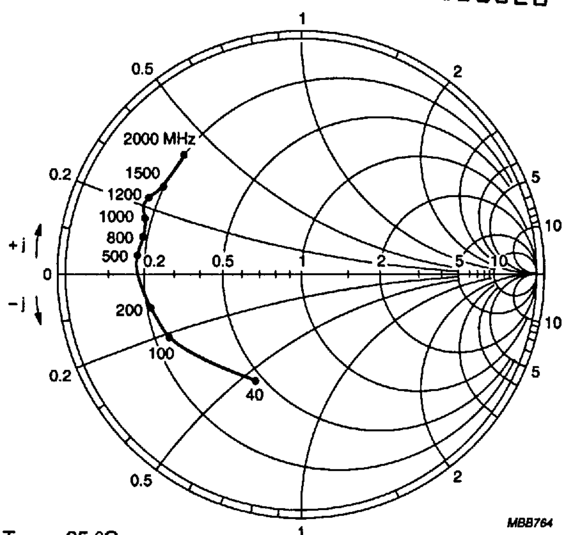
V_{CE} = 10 V; V_O = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.

Fig.9 Intermodulation distortion as a function of collector current.



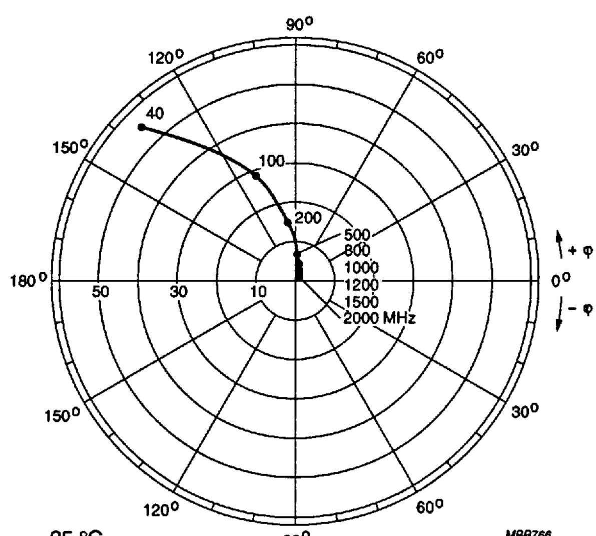
V_{CE} = 10 V; V_O = 320 mV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C.

Fig.10 Second order intermodulation distortion as a function of collector current.



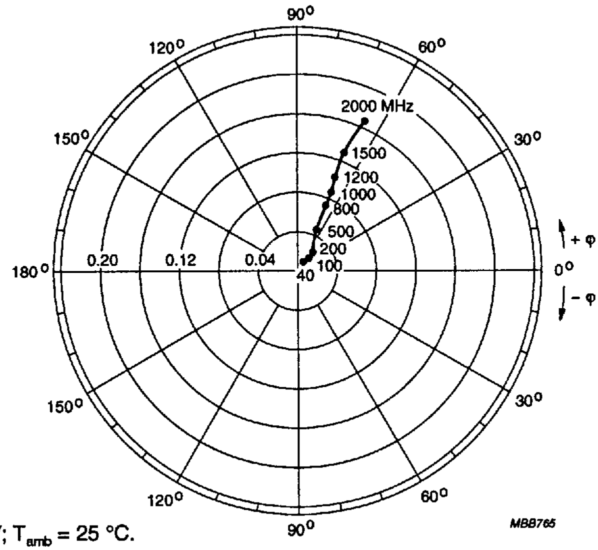
I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.11 Common emitter input reflection coefficient (S_{11}).



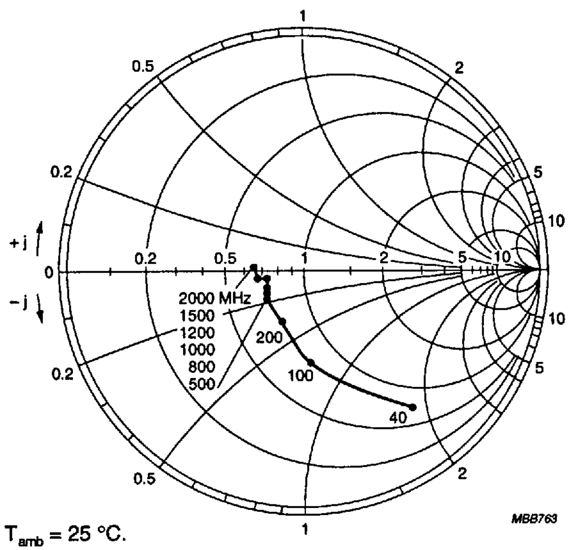
I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.12 Common emitter forward transmission coefficient (S_{21}).



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

Fig.13 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.14 Common emitter output reflection coefficient (S_{22}).

Table 1 Common emitter scattering parameters, I_C = 50 mA; V_{CE} = 10 V

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.435	−95.0	50.872	135.1	0.0120	62.5	0.698	−43.0	37.9
100	0.551	−138.	28.689	113.1	0.0210	51.0	0.417	−72.3	31.6
200	0.615	−161.	15.554	99.2	0.0280	51.4	0.249	−95.9	26.2
300	0.623	−171.	10.577	92.6	0.0360	57.2	0.190	−110.	22.8
400	0.636	−176.	7.991	87.4	0.0420	61.0	0.164	−120.	20.4
500	0.646	178.5	6.427	84.3	0.0490	61.7	0.153	−128.	18.6
600	0.637	174.9	5.428	80.4	0.0580	61.8	0.146	−132.	17.0
700	0.647	171.5	4.636	77.9	0.0660	63.5	0.141	−135.	15.8
800	0.642	167.6	4.118	73.9	0.0730	64.5	0.135	−138.	14.7
900	0.642	164.9	3.683	71.7	0.0820	64.1	0.133	−142.	13.7
1000	0.648	161.5	3.308	69.9	0.0890	65.1	0.132	−146.	12.8
1200	0.664	155.7	2.765	64.8	0.104	64.1	0.135	−152.	11.4
1400	0.670	149.7	2.369	59.0	0.116	62.7	0.147	−157.	10.2
1600	0.681	145.9	2.094	54.7	0.130	63.3	0.158	−159.	9.24
1800	0.690	141.5	1.881	50.0	0.146	60.8	0.170	−161.	8.42
2000	0.716	135.1	1.713	47.2	0.159	59.8	0.173	−164.	7.93
2200	0.735	128.5	1.629	42.7	0.172	58.5	0.184	−171.	7.76
2400	0.735	124.6	1.484	38.5	0.180	58.5	0.206	−178.	6.99
2600	0.744	123.9	1.323	35.8	0.197	57.6	0.236	178.2	6.18
2800	0.762	117.4	1.262	31.3	0.201	54.7	0.261	177.0	6.10
3000	0.744	112.5	1.167	26.7	0.210	55.2	0.274	175.2	5.18

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Table 2 Common emitter scattering parameters, I_C = 70 mA; V_{CE} = 10 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.379	−56.7	27.463	132.2	0.0157	72.0	0.668	−21.9	32.0
100	0.393	−90.1	14.206	112.6	0.0324	66.3	0.515	−25.8	25.1
200	0.512	−120.	7.781	101.9	0.0551	52.6	0.431	−29.8	20.0
300	0.589	−140.	5.603	96.6	0.0628	44.6	0.380	−36.3	17.5
400	0.635	−151.	4.319	90.0	0.0704	40.3	0.355	−39.3	15.5
500	0.651	−159.	3.476	84.0	0.0754	38.6	0.346	−42.5	13.8
600	0.679	−165.	2.904	81.0	0.0813	36.5	0.347	−46.1	12.5
700	0.695	−171.	2.527	79.1	0.0809	36.5	0.347	−53.3	11.5
800	0.705	−177.	2.265	75.7	0.0829	36.9	0.344	−58.0	10.6
900	0.698	179.3	2.013	71.1	0.0863	36.6	0.341	−61.0	9.51
1000	0.705	174.6	1.842	68.1	0.0892	39.8	0.340	−65.9	8.83
1200	0.722	168.0	1.510	63.1	0.0937	40.1	0.351	−74.0	7.35
1400	0.737	161.2	1.319	58.0	0.0961	43.2	0.352	−88.0	6.37
1600	0.738	155.5	1.182	52.5	0.102	49.0	0.358	−99.5	5.46
1800	0.744	150.2	1.058	48.5	0.112	50.4	0.391	−108.	4.71
2000	0.759	143.2	0.978	43.9	0.120	53.7	0.388	−115.	4.24
2200	0.780	137.8	0.899	41.7	0.129	54.5	0.405	−127.	3.92
2400	0.802	134.1	0.822	37.7	0.141	57.8	0.410	−139.	3.57
2600	0.804	130.5	0.754	34.5	0.155	58.5	0.444	−149.	3.01
2800	0.791	125.8	0.725	30.3	0.163	56.6	0.477	−157.	2.61
3000	0.794	119.9	0.680	26.9	0.174	58.4	0.488	−163.	2.15