DISCRETE SEMICONDUCTORS

RF Wideband Transistors and MMICs

Data Handbook SC14
2000

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RF Wideband Transistors and MMICs

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Definitions and disclaimers

Standard library for Data handbooks

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

PREFACE

Dear Customer

We are pleased to introduce the new Philips Semiconductors data handbook SC14: RF Wideband Transistors and MMICs.

We would like to draw your attention to our new MMICs:
BGA2001
BGA2003
BGA2022
BGA2031

To assist you with actual design work, please visit our web site:
http://www.semiconductors.philips.com
to find:

- the latest product specifications
- S-parameters
- spice parameters
- application notes

For further information, contact our franchised distributors or your local Philips Semiconductors sales office.

INDEX

Types added to the range since the last issue of Handbook SC14 (1998 issue) are shown in bold print.

SELECTION GUIDES

FIRST GENERATION NPN WIDEBAND TRANSISTORS (f_T up to 3.5 GHz)

f_T / I_C CURVE (see Fig.1)	PACKAGE			
	SURFACE-MOUNT			
	SOT23	SOT89	SOT223	SOT323
(1)	BFT25			
(2)	BF747 BF547			BF547W
(3)	BFS17			BFS17W
(4)	BFS17A			
(5)	BFR53			
(6)		BFQ17	BFG16A	

SECOND GENERATION WIDEBAND TRANSISTORS (f_T up to 6 GHz)

f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE					
		CERAMIC	SURFACE-MOUNT				
		SOT122	SOT23	SOT89	SOT143	SOT223	SOT323
(7)	NPN		BFR92(A)		BFG92A(/X)		BFR92AW
	PNP		BFT92				BFT92W
(8)	NPN		BFR93(A)		BFG93A(/X)	BFG94	BFR93AW
(9)	PNP		BFT93				BFT93W
(10)	NPN		BFR106	BFQ19		BFG97	
	PNP			BFQ149		BFG31	
(11)	NPN	BFQ34		BFQ18A		BFG35	
(12)	NPN	BFQ68					
(13)	NPN	BFQ136					

THIRD GENERATION NPN WIDEBAND TRANSISTORS (f_T up to 8 GHz)

f_T / I_C CURVE (see Fig.1)	PACKAGE				
	CERAMIC	SURFACE-MOUNT			
	SOT172	SOT23	SOT143	SOT223	SOT323
(14)		BFQ67	BFG67(/X)		BFQ67W
(15)				BFG198	
(16)	BFQ135			BFG135	
(17)	BFQ270				

FOURTH GENERATION NPN WIDEBAND TRANSISTORS (f_T up to 10 GHz)

f_T / I_C CURVE (see Fig.1)	PACKAGE								
	CERAMIC	SURFACE-MOUNT							
	SOT172	SOT23	SOT143	SOT223	SOT323	SOT343	SOT353	SOT363	SOT89
(18)		BFT25A	BFG25A/X		BFS25A	BFG25AW(/X)			
(19)		BFR505	BFG505(/X)		BFS505	BFG505W(/X)	BFC505 BFE505	BFM505	
(20)		BFR520	BFG520(/X)		BFS520	BFG520W(/X)	BFC520 BFE520	BFM520	
(21)		BFR540	BFG540(/X)	BFG541	BFS540	BFG540W(/X)			BFQ540
(22)			BFG590(/X)	BFG591		BFG590W(/X)			
(23)	BFQ621		BFG10(/X)			BFG10W/X			
(24)			BFG11(/X)			BFG11W/X			

FIFTH GENERATION NPN WIDEBAND TRANSISTORS (f$_T$ up to 25 GHz)

f$_T$ / I$_C$ CURVE (see Fig.1)	**PACKAGE**
	SURFACE-MOUNT
	SOT343R
(25)	BFG403W
(26)	BFG410W
(27)	BFG425W
(28)	BFG21W
(29)	BFG480W

MEDIUM POWER TRANSISTORS

PACKAGE	
SURFACE-MOUNT	
SOT96	**SOT223**
BLT71/8	BLT70
	BLT71
	BLT80
	BLT81

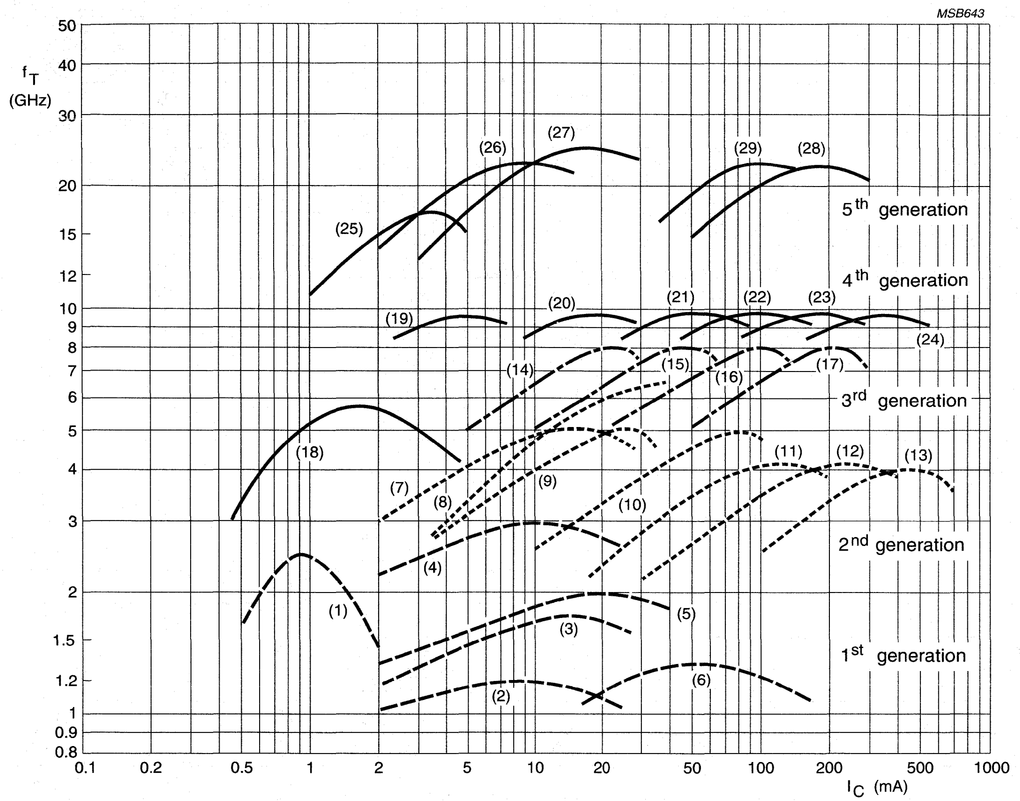

Fig.1 Transition frequency as a function of collector current for the five generations of RF bipolar wideband transistors.

PRODUCT DATA

TYPE NUMBER	f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE	RATINGS		
				V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
BF547	(2)	NPN	SOT23	20	50	300
BF547W	(2)	NPN	SOT323	20	50	300
BF747	(2)	NPN	SOT23	20	50	300
BFC505	(19)	NPN	SOT353	8	18	500
BFC520	(20)	NPN	SOT353	8	70	1000
BFE505	(19)	NPN	SOT353	8	18	500
BFE520	(20)	NPN	SOT353	8	70	1000
BFG10(/X)(8)	(23)	NPN	SOT143	8	250	250
BFG10W/X(8)	(23)	NPN	SOT343	10	250	400
BFG11(/X)(8)	(24)	NPN	SOT143	8	500	400
BFG11W/X(8)	(24)	NPN	SOT343	8	500	760
BFG16A	(6)	NPN	SOT223	25	150	1000
BFG21W(8)	(21)	NPN	SOT343R	4.5	200(1)	600
BFG25A/X	(18)	NPN	SOT143	5	6.5	32
BFG25AW(/X)	(18)	NPN	SOT343	5	6.5	500
BFG31	(10)	PNP	SOT223	15	100	1000
BFG35	(11)	NPN	SOT223	18	150	1000
BFG67(/X)	(14)	NPN	SOT143	10	50	380
BFG92A(/X)	(7)	NPN	SOT143	15	25	400
BFG93A(/X)	(8)	NPN	SOT143	12	35	300
BFG94	(8)	NPN	SOT223	12	60	700
BFG97	(10)	NPN	SOT223	15	100	1000
BFG135	(16)	NPN	SOT223	15	150	1000
BFG198	(15)	NPN	SOT223	10	100	1000
BFG403W	(25)	NPN	SOT343R	4.5	3.6	16
BFG410W	(26)	NPN	SOT343R	4.5	12	54
BFG425W	(27)	NPN	SOT343R	4.5	30	135
BFG480W	(29)	NPN	SOT343R	4.5	250	360
BFG505(/X)	(19)	NPN	SOT143	15(2)	18	150
BFG505W(/X)	(19)	NPN	SOT343	15(2)	18	500
BFG520(/X)	(20)	NPN	SOT143	15(2)	70	300
BFG520W(/X)	(20)	NPN	SOT343	15(2)	70	500
BFG540(/X)	(21)	NPN	SOT143	15(2)	120	500
BFG540W(/X)	(21)	NPN	SOT343	15(2)	120	500
BFG541	(21)	NPN	SOT223	15(2)	120	650
BFG590(/X)	(22)	NPN	SOT143	15	200	400
BFG590W(/X)	(22)	NPN	SOT343	15	200	500
BFG591	(22)	NPN	SOT223	15	200	2000

PRODUCT DATA (continued)

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o(3) (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BF547	1.2		20	100								
BF547W	1.2		20	100								
BF747	1.2		20	100								
BFC505	7.3	1.8		900	3.5		2000			−20(9)	1	3
BFC520	7	1.3		900						−18(9)	5	3
BFE505	9	1.2		900	1.9		2000					
BFE520	9	1.1		900	1.9		2000					
BFG10(/X)			7(4)	1900								
BFG10W/X			10(4)(5)	900		7(4)	1900					
BFG11(/X)			5(4)	1900								
BFG11W/X						6(4)(5)	1900					
BFG16A	1.5		10	500								
BFG21W	18(5)					10(4)(5)	1900					
BFG25A/X	5	1.8	18	1000								
BFG25AW(/X)	5	2	16	1000		8	2000					
BFG31	5		16	500		12	800	550			70	10
BFG35	4		15	500		11	800	750			100	10
BFG67(/X)	8	1.7	17	1000	2.5	10	2000					
BFG92A(/X)	5	2	16	1000	3	11	2000					
BFG93A(/X)	6	1.7	16	1000	2.3	10	2000					
BFG94	6	2.7		500	3	13.5	1000	500	21.5	34	45	10
BFG97	5.5		16	500		12	800	700			70	10
BFG135	7		16	500		12	800	850			100	10
BFG198	8		18	500		15	800	700			70	8
BFG403W	17	1		900	1.6		2000		5	6	1	1
BFG410W	22	0.9		900	1.2		2000		5	15	10	2
BFG425W	25	0.8		900	1.2		2000		12	22	25	2
BFG480W	21	1.2		900	1.8		2000			28	80	2
BFG505(/X)	9	1.6	20	900	1.9	13	2000		4	10	5	6
BFG505W(/X)	9	1.6	19	900	1.9	12	2000		4	10	5	6
BFG520(/X)	9	1.6	19	900	1.9	13	2000	275	17	26	20	6
BFG520W(/X)	9	1.6	17	900	1.85	11	2000	275	17	26	20	6
BFG540(/X)	9	1.9	18	900	2.1	11	2000	500	21	34	40	8
BFG540W(/X)	9	1.9	16	900	2.1	10	2000	500	21	34	40	8
BFG541	9	1.9	15	900	2.1	9	2000	500	21	34	40	8
BFG590(/X)	5		13	900		7.5	2000					
BFG590W(/X)	5		13	900		7.5	2000		21		80	5
BFG591	7		13	900		7.5	2000					

PRODUCT DATA (continued)

TYPE NUMBER	f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE	RATINGS		
				V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
BFM505	(19)	NPN	SOT363	8	18	500
BFM520	(20)	NPN	SOT363	8	70	1000
BFQ17	(6)	NPN	SOT89	25	150	1000
BFQ18A	(11)	NPN	SOT89	18	150	1000
BFQ19	(10)	NPN	SOT89	15	100	1000
BFQ34	(11)	NPN	SOT122	18	150	2700
BFQ67	(14)	NPN	SOT23	10	50	300
BFQ67W	(14)	NPN	SOT323	10	50	300
BFQ68	(12)	NPN	SOT122	18	300	4500
BFQ135	(16)	NPN	SOT172	19	150	2700
BFQ136	(13)	NPN	SOT122A	18	600	9000
BFQ149	(10)	PNP	SOT89	15	100	1000
BFQ270	(17)	NPN	SOT172	19	500	10000
BFQ540	(21)	NPN	SOT89	12	120	1200
BFQ621	(23)	NPN	SOT172	16	150	800
BFR53	(5)	NPN	SOT23	10	50	250
BFR92	(7)	NPN	SOT23	15	25	300
BFR92A	(7)	NPN	SOT23	15	25	300
BFR92AW	(7)	NPN	SOT323	15	25	300
BFR93	(8)	NPN	SOT23	12	35	300
BFR93A	(8)	NPN	SOT23	12	35	300
BFR93AW	(8)	NPN	SOT323	12	35	300
BFR94A	(8)	NPN	SOT122	25	150	3500
BFR106	(10)	NPN	SOT23	15	100	500
BFR505	(19)	NPN	SOT23	15(2)	18	150
BFR520	(20)	NPN	SOT23	15(2)	70	300
BFR540	(21)	NPN	SOT23	15(2)	120	480
BFS17	(3)	NPN	SOT23	15	25	300
BFS17A	(4)	NPN	SOT23	15	25	300
BFS17W	(3)	NPN	SOT323	15	50	300
BFS25A	(18)	NPN	SOT323	5	6.5	32
BFS505	(19)	NPN	SOT323	15(2)	18	150
BFS520	(20)	NPN	SOT323	15(2)	70	300
BFS540	(21)	NPN	SOT323	15(2)	120	500
BFT25	(1)	NPN	SOT23	5	6.5	30
BFT25A	(18)	NPN	SOT23	5	6.5	32
BFT92	(7)	PNP	SOT23	15	25	300
BFT92W	(7)	PNP	SOT323	15	35	300

PRODUCT DATA (continued)

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o(3) (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BFM505	9	1.4	17	900	1.9	10	2000					
BFM520	9	1.7	15	900	1.9	9	2000					
BFQ17	1.5		16	200		6.5	800					
BFQ18A	4											
BFQ19	5.5	3.3	11.5	500		7.5	800					
BFQ34	4	8	16.3	500				1200	26	45	120	15
BFQ67	8	1.7	14	1000	2.7	8	2000					
BFQ67W	8	2	13	1000	2.7	8	2000					
BFQ68	4		13	800				1600	28	47	240	15
BFQ135	6.5		17	500		13.5	800	1200			120	18
BFQ136	4		12.5	800				2500			500	15
BFQ149	5	3.75	12	500								
BFQ270	6		16	500		10	1000	1600			240	18
BFQ540	9	1.9		900				500			40	8
BFQ621	7		18.5	500				1200			120	18
BFR53	2	5(6)		500		10.5	800					
BFR92	5	2.4	18	500				150			14	10
BFR92A	5	2.1	14	1000	3	8	2000	150			14	10
BFR92AW	5	2	14	1000	3	8	2000					
BFR93	5	1.9	16.5	500								
BFR93A	6	1.9	13	1000	3	7	2000	425			30	8
BFR93AW	5	1.5	13	1000	2.1	8	2000					
BFR94A	3.5	8		200	5	13.5	500					
BFR106	5	3.5	11.5	800				350			50	9
BFR505	9	1.6	17	900	1.9	10	2000		4	10	5	6
BFR520	9	1.6	15	900	1.9	9	2000		17	26	20	6
BFR540	9	1.9	14	900	2.1	7	2000	550	21	34	40	8
BFS17	1	4.5		500								
BFS17A	2.8	2.5	13.5	800				150			14	10
BFS17W	1.6	4.5		500								
BFS25A	5	1.8	13	1000								
BFS505	9	1.6	17	900	1.9	10	2000		4	10	5	6
BFS520	9	1.6	15	900	1.9	9	2000		17	26	20	6
BFS540	9	1.9	14	900	2.1	8	2000		21	34	40	8
BFT25	2.3	3.8	18	500		12	800					
BFT25A	5	1.8	15	1000								
BFT92	5	2.5	18	500				150			14	10
BFT92W	5	2.5	17	500	3	11	1000					

PRODUCT DATA (continued)

TYPE NUMBER	f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE	RATINGS		
				V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
BFT93	(9)	PNP	SOT23	12	35	300
BFT93W	(9)	PNP	SOT323	12	50	300
BLT70		NPN	SOT223	8	250	2100
BLT71		NPN	SOT223	8	500	3500
BLT71/8		NPN	SOT96	8	500	2900
BLT80		NPN	SOT223	10	250	2000
BLT81		NPN	SOT223	9.5	500	2000
BSR12		PNP	SOT23	15	100	250
MPSH10		NPN	SOT54	25	40	1000
PBR941		NPN	SOT23	10	50	360
PBR951		NPN	SOT23	10	100	365
PMBT3640		PNP	SOT23	12	80	350
PMBTH10		NPN	SOT23	25	40	400
PMBTH81		PNP	SOT23	20	40	400
PRF947		NPN	SOT323	10	50	250
PRF957		NPN	SOT323	10	100	270

PRODUCT DATA (continued)

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o(3) (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BFT93	5	2.4	16.5	500				300			30	5
BFT93W	5	2.4	15.5	500	3	10	1000					
BLT70	0.6(7)		≥6(4)	900								
BLT71	1.2(7)		≥6(4)	900								
BLT71/8	1.2(7)		≥13(4)	900								
BLT80	0.8(7)		≥6(4)	900								
BLT81	1.2(7)		≥6.5(4)	900								
BSR12	1.5(5)											
MPSH10	0.65(5)											
PBR941	8	1.4	15	1000	2	9.5	2000					
PBR951	8	1.3	14	1000	2	8	2000					
PMBT3640	0.5(5)											
PMBTH10	0.65(5)											
PMBTH81	0.6(5)											
PRF947	8.5	1.5	16	1000	2.1	10	2000					
PRF957	8.5	1.3	15	1000	1.8	9.2	2000					

Notes to Product Data

1. Typical value.
2. V_{CES}.
3. At $d_{im} = -60$ dB, measured according to DIN45004B, par. 6.3: 3-tone test.
4. Power gain G_p.
5. Minimum value.
6. Maximum value.
7. Load power PL(W).
8. Preferred mode of operation: pulsed class-AB.
9. IP3.

SILICON MMICS

TYPE NUMBER	CHARACTERISTICS										
	DESCRIPTION	PACKAGE	V_S (V)	I_S typ. (mA)	NF typ. (dB)	GAIN typ. (dB)	$P_{1\,dB}$ typ. (dBm)	IP3 typ. (dBm)	@ (GHz)	ENABLE	REMARKS
BGA2001	LNA	SOT343R	2.5	4.5	1.3	19.5(1)		–4.5	1.8	no	
BGA2003	linear LNA	SOT343R	2.5	11	1.8	16(1)		–4.8	1.8	yes	
BGA2022(5)	mixer	SOT363	2.8	6	9	6(2)		+6	0.9 to 2.4	no	LO - RF isolation 30 dB
BGA2031(5)	linear variable gain amplifier	SOT551	3.6	51		27(3)	13.5	+48(4)	1.9	yes + control pin	ΔG >60 dB

Notes

1. MSG.
2. G_C.
3. G_p.
4. ACPR in dBc.
5. Under development.

LINE-UPS

Analog cellular (AMPS, (E)TACS, NMT) 900 MHz

INPUT POWER (mW)	1st STAGE	2nd STAGE	3rd STAGE	P_L (W)	SUPPLY VOLTAGE (V)
Bipolar					
1	BFG540/X	BLT80	BLT81	1.2	6
1	BFG540/X	BLT70	BLT71	1.2	4.8
1	BFG10W/X	BLT71/8	–	1.2	4.8

Portable transmitters (860 MHz to 960 MHz)

INPUT POWER (mW)	1st STAGE	2nd STAGE	3rd STAGE	P_L (W)	SUPPLY VOLTAGE (V)
Bipolar					
1	BFG540	BLT80	BLT81	1.2	6
15	BFG93A	BLT80	BLT92/SL	3	7.5

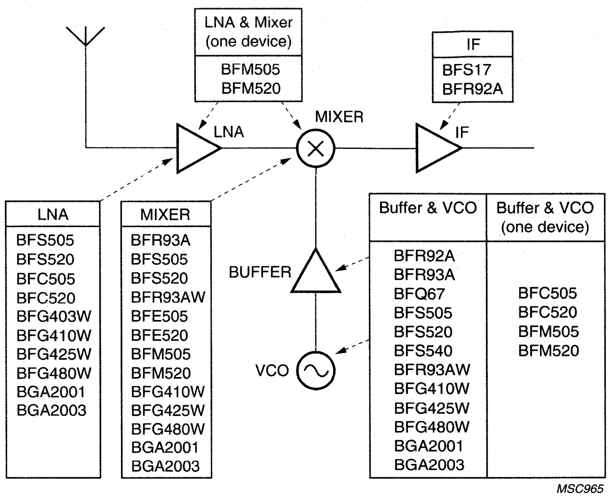

Fig.2 Transistors for receivers.

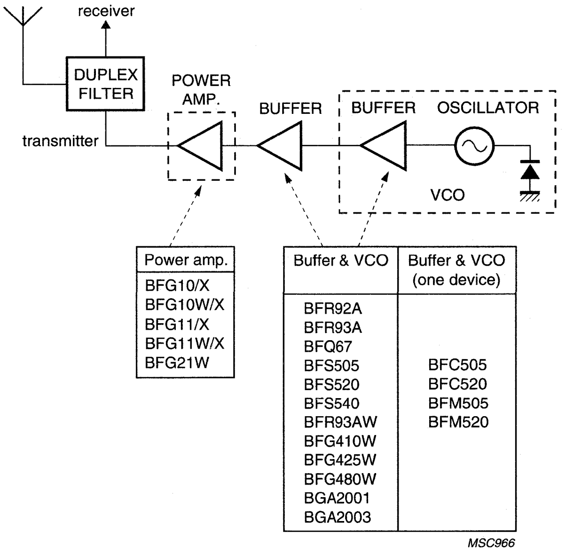

Fig.3 Transistors for transmitters for cordless and cellular phones.

RF wideband transmitters for pager front-end (see Fig.4)

FUNCTION	TYPE NUMBER	REMARKS
RF amplifier	BFC505	higher gain, lower noise, high isolation (0.3 mA)
	BFG403W	high performance, low voltage, low current
	BFR505	higher gain, lower noise (1 mA)
	BFT25A	lowest current (0.2 mA)
Oscillator, mixer or buffer	BFQ67	choice of the transistor is determined by the available current and the required performance
	BFR92A	
	BFR505	
	BFT25A	

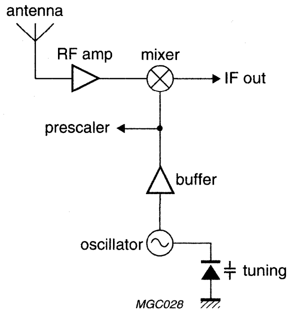

Fig.4 Typical front-end section for pagers.

RF wideband transistors for the receiver section in cordless/cellular phones (see Fig.5)

FUNCTION	TYPE NUMBER	SYSTEM FREQUENCY (MHz)	FEATURES
LNA	BFC505	1900	high isolation gain, low noise current
	BFG410W	900; 1900; 2500	very low noise
	BFG425W	900; 1900; 2500	very low noise
	BFR505	900; 1900	good performance at low current (1 mA)
	BFR520	900; 1900	higher gain, lower noise (10 mA)
Mixer	BFE505	900; 1900	balanced mixer in a single SOT353 package
	BFG505	900; 1900	good performance, low current
	BFG410W	900; 1900; 2500	low noise, high isolation
	BFG520	900; 1900	higher power to IF (10 mA)
	BFR93A	900	low cost, acceptable performance
Buffer and VCO	BFG410W	900; 1900; 2500	excellent isolation
	BFG505	1900	buffer and VCO in a single SOT353 package
	BFQ67	900	third generation, good performance
	BFR92A	900	excellent VCO, good buffer, low-cost
	BFR93A	900	excellent VCO, good buffer, low-cost
	BFR505	900; 1900	good VCO, high-gain buffer, low current
	BFR520	900; 1900	good VCO, higher output power
IF	BFS17A	40 to 100	any first or second generation transistor

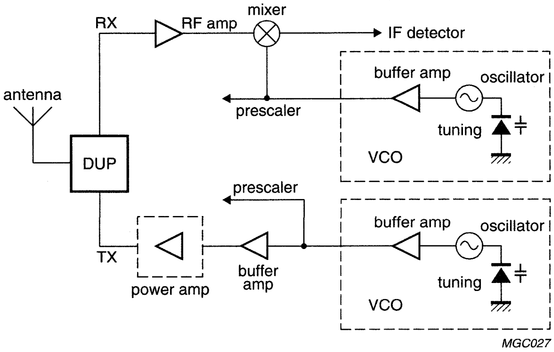

Fig.5 Typical RF section for cordless and cellular phones.

RF wideband transistors for the receiver section in cordless/cellular phones (see Fig.5)

FUNCTION	SYSTEM FREQUENCY (MHz)	SOT23	SOT323	SOT143 (1)	SOT343 (1)	SOT353	SOT363
LNA	900; 1900	BFR505	BFS505	BFG505	BFG505W	BFC505	BFM505
	900; 1900	BFR520	BFS520	BFG520	BFG520W	BFC520	BFM520
Mixer	900	BFR93A	BFR93AW	BFG93A			
	900; 1900	BFR505	BFS505	BFG505	BFG505W	BFE505	BFM505
	900; 1900	BFR520	BFS520	BFG520	BFG520W	BFE520	BFM520
Buffer and VCO	900	BFR92A	BFR92AW	BFG92A			
	900	BFR93A	BFR93AW	BFG93A			
	900	BFQ67	BFQ67W	BFG67			
	900; 1900	BFR505	BFS505	BFG505	BFG505W	BFC505	BFM505
	900; 1900	BFR520	BFS520	BFG520	BFG520W	BFC520	BFM520
IF	40 to 100	BF547	BF547W				
		BFS17	BFS17W	BFG17A			
		BFR92A	BFR92AW	BFG92A			

Note

1. Also available in /X versions.

RF wideband transistors for the power amplifier section in cordless/cellular phones (see Fig.6)

SYSTEM	SUPPLY VOLTAGE (V)	P_{out} (mW)	SOT143	SOT343
CT1, CT1+, CT2, CT2+, CT3	3.3	driver for PA2	BFG67	
			BFG505	BFG505W
			BFG520	BFG520W
		15	BFG67	
		20	BFG520	BFG520W
		40	BFG540	BFG540W
DECT, PHP	3.3	400	BFG540/X	BFG540W/X
			BFG10/X	BFG10W/X
			BFG11/X	BFG11W/X

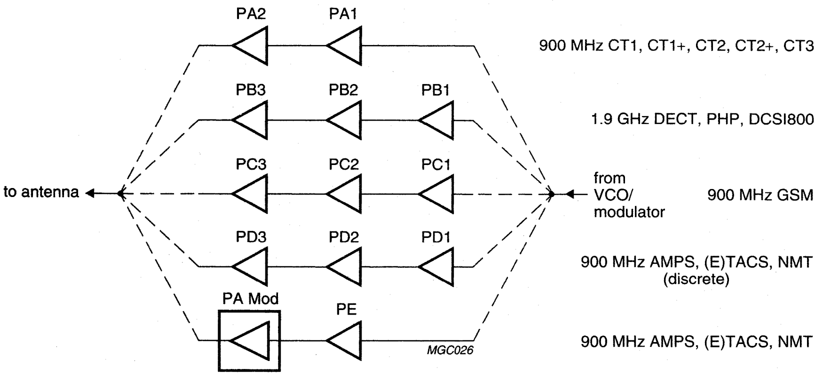

Fig.6 Typical power amplifier section for cordless and cellular phones.

REPLACED/WITHDRAWN TYPES

The following type numbers were included in the previous issue of this data handbook, but are not in the current edition.

TYPE NUMBER	REASON FOR DELETION
BF689K, in SOT54	Discontinued, replaced by BFS17, in SOT23
BF763, in SOT54	Discontinued, replaced by BFS17, in SOT23
BFG17A, in SOT143	Discontinued, replaced by BFS17A, in SOT23
BFG197, in SOT143	Discontinued, replaced by BFG198, in SOT223
BLT82	Discontinued

TYPE NUMBER TO PACKAGE AND MARKING CODE

TYPE NUMBER	PACKAGE	MARKING CODE
BF547	SOT23	E16
BF547W	SOT323	E2
BF747	SOT23	E15
BFC505	SOT353	N0
BFC520	SOT353	N3
BFE505	SOT353	P0
BFE520	SOT353	N5
BFG10	SOT143	N70
BFG10/X	SOT143	N71
BFG10W/X	SOT343	T5
BFG11	SOT143	N72
BFG11/X	SOT143	N73
BFG11W/X	SOT343	S4
BFG16A	SOT223	BFG16A
BFG21W	SOT343	P1
BFG25A/X	SOT143	V11
BFG25AW	SOT343	N6
BFG25AW/X	SOT343	V1
BFG31	SOT223	BFG31
BFG35	SOT223	BFG35
BFG403W	SOT343	P3
BFG410W	SOT343	P4
BFG425W	SOT343	P5
BFG480W	SOT343R	P6
BFG67	SOT143	V3p
BFG67/X	SOT143	V12
BFG67/XR	SOT143	V26
BFG92A/X	SOT143	V14
BFG93A	SOT143	R8p
BFG93A/X	SOT143	V15
BFG94	SOT223	BFG94
BFG97	SOT223	BFG97
BFG135	SOT223	BFG135
BFG198	SOT223	BFG198
BFG505	SOT143	N33
BFG505/X	SOT143	N39
BFG505W	SOT343	N0
BFG505W/X	SOT343	N1
BFG520	SOT143	N36
BFG520/X	SOT143	N42
BFG520/XR	SOT143	N48

TYPE NUMBER	PACKAGE	MARKING CODE
BFG520W	SOT343	N3
BFG520W/X	SOT343	N4
BFG540	SOT143	N37
BFG540/X	SOT143	N43
BFG540/XR	SOT143	N49
BFG540W	SOT343	N9
BFG540W/X	SOT343	N7
BFG541	SOT223	BFG541
BFG590	SOT143	N38
BFG590/X	SOT143	N44
BFG590W	SOT343	T1
BFG590W/X	SOT343	T2
BFG591	SOT223	BFG591
BFM505	SOT363	N0
BFM520	SOT363	N2
BFQ17	SOT89	FA
BFQ18A	SOT89	FF
BFQ19	SOT89	FB
BFQ34	SOT122E	BFQ34/01
BFQ67	SOT23	V2p
BFQ67W	SOT323	V2
BFQ68	SOT122E	BFQ68
BFQ135	SOT172	BFQ135
BFQ136	SOT122E	BFQ136
BFQ149	SOT89	FG
BFQ270	SOT172	BFQ270
BFQ540	SOT89	N4
BFQ621	SOT172	BFQ621
BFR53	SOT23	N1p
BFR92	SOT23	P1p
BFR92A	SOT23	P2p
BFR92AW	SOT323	P2
BFR93	SOT23	R1p
BFR93A	SOT23	R2p
BFR93AW	SOT323	R2
BFR94A	SOT122E	BFR94A
BFR106	SOT23	R7p
BFR505	SOT23	N30
BFR520	SOT23	N28
BFR540	SOT23	N29
BFS17	SOT23	E1p
BFS17A	SOT23	E2p

TYPE NUMBER	PACKAGE	MARKING CODE
BFS17W	SOT323	E1
BFS25A	SOT323	N6
BFS505	SOT323	N0
BFS520	SOT323	N2
BFS540	SOT323	N4
BFT25	SOT23	V1p
BFT25A	SOT23	V10
BFT92	SOT23	W1p
BFT92W	SOT323	W1
BFT93	SOT23	X1p
BFT93W	SOT323	X1
BGA2001	SOT343R	A1
BGA2003	SOT343R	A3
BGA2031	SOT551	G1
MPSH10	SOT54	PSH10
PMBT3640	SOT23	V25
PMBTH10	SOT23	V30
PMBTH81	SOT23	V31
PBR941	SOT23	V0
PBR951	SOT23	W2
PBR947	SOT323	V0
PBR957	SOT323	W2

MARKING CODE AND PACKAGE TO TYPE NUMBER

MARKING CODE	PACKAGE	TYPE NUMBER
A1	SOT343R	BGA2001
A3	SOT343R	BGA2003
BFG16A	SOT223	BFG16A
BFG31	SOT223	BFG31
BFG35	SOT223	BFG35
BFG94	SOT223	BFG94
BFG97	SOT223	BFG97
BFG135	SOT223	BFG135
BFG198	SOT223	BFG198
BFG541	SOT223	BFG541
BFG591	SOT223	BFG591
BFQ34/01	SOT122E	BFQ34
BFQ68	SOT122E	BFQ68
BFQ135	SOT172	BFQ135
BFQ136	SOT122E	BFQ136
BFQ270	SOT172	BFQ270
BFQ621	SOT172	BFQ621
BFR94A	SOT122E	BFR94A
E1	SOT323	BFS17W
E1p	SOT23	BFS17
E2	SOT323	BF547W
E2p	SOT23	BFS17A
E15	SOT23	BF747
E16	SOT23	BF547
FA	SOT89	BFQ17
FB	SOT89	BFQ19
FF	SOT89	BFQ18A
FG	SOT89	BFQ149
G1	SOT551	BGA2031
N0	SOT323	BFS505
N0	SOT343	BFG505W
N0	SOT353	BFC505
N0	SOT363	BFM505
N1	SOT343	BFG505W/X
N1p	SOT23	BFR53
N2	SOT323	BFS520
N2	SOT363	BFM520
N3	SOT343	BFG520W
N3	SOT353	BFC520
N4	SOT323	BFS540
N4	SOT343	BFG520W/X
N4	SOT89	BFQ540
N5	SOT353	BFE520
N6	SOT323	BFS25A
N6	SOT343	BFG25AW
N7	SOT343	BFG540W/X
N9	SOT343	BFG540W
N28	SOT23	BFR520
N29	SOT23	BFR540
N30	SOT23	BFR505
N33	SOT143	BFG505
N36	SOT143	BFG520
N37	SOT143	BFG540
N38	SOT143	BFG590
N39	SOT143	BFG505/X
N42	SOT143	BFG520/X
N43	SOT143	BFG540/X
N44	SOT143	BFG590/X

MARKING CODE	PACKAGE	TYPE NUMBER
N48	SOT143	BFG520/XR
N49	SOT143	BFG540/XR
N70	SOT143	BFG10
N71	SOT143	BFG10/X
N72	SOT143	BFG11
N73	SOT143	BFG11/X
P0	SOT353	BFE505
P1	SOT343	BFG21W
P1p	SOT23	BFR92
P2	SOT323	BFR92AW
P2p	SOT23	BFR92A
P3	SOT343	BFG403W
P4	SOT343	BFG410W
P5	SOT343	BFG425W
P6	SOT343R	BFG480W
PSH10	SOT54	MPSH10
R1p	SOT23	BFR93
R2	SOT323	BFR93AW
R2p	SOT23	BFR93A
R7p	SOT23	BFR106
R8p	SOT143	BFG93A
S4	SOT343	BFG11W/X
T1	SOT343	BFG590W

MARKING CODE	PACKAGE	TYPE NUMBER
T2	SOT343	BFG590W/X
T5	SOT343	BFG10W/X
V0	SOT23	PBR941
V0	SOT323	PRF947
V1	SOT343	BFG25AW/X
V1p	SOT23	BFT25
V2	SOT323	BFQ67W
V2p	SOT23	BFQ67
V3p	SOT143	BFG67
V10	SOT23	BFT25A
V11	SOT143	BFG25A/X
V12	SOT143	BFG67/X
V14	SOT143	BFG92A/X
V25	SOT23	PMBT3640
V26	SOT143	BFG67/XR
V30	SOT23	PMBTH10
V31	SOT23	PMBTH81
W1	SOT323	BFT92W
W1p	SOT23	BFT92
W2	SOT23	PBR951
W2	SOT323	PRF957
X1	SOT323	BFT93W
X1p	SOT23	BFT93

GENERAL

QUALITY

Total Quality Management

Philips Semiconductors is a Quality Company, aiming towards one ultimate standard, that of Business Excellence. The tool we use in striving towards this goal is our Total Quality Management (TQM) system. The TQM is described in our Quality manuals, and is summarized in the following paragraphs. The Philips Business Excellence Programme as part of TQM follows the European Foundation for Quality Management (EFQM) model. The EFQM award is on the level of the Malcolm Baldridge award.

QUALITY ASSURANCE

Quality Assurance (QA) is based on ISO 9000 standards and customer standards such as QS-9000. Our factories are certified to ISO 9000 and QS-9000 by external inspectorates. Sales organizations and headquarters are also certified to ISO 9000. The products of Philips Semiconductors are in conformance with the requirements of international standards.

PARTNERSHIPS WITH CUSTOMERS

Partnerships with customers include Process Quality measurement co-operation (using PPM), design-in agreements, ship-to-stock, just-in-time, sharing technology roadmaps, a change notification programme, self-qualification programmes and application support.

PARTNERSHIPS WITH SUPPLIERS

Our suppliers are certified to ISO 9000 and participate in ship-to-stock programmes. Key-suppliers receive support and feedback through our Supplier Quality System (SQS) audits.

CONTINUOUS IMPROVEMENT PROGRAMME

The continuous improvement programme incorporates continuous process and system improvement, design improvement, complete use of statistical process control, and logistics improvement, driven by key performance indicators. To encourage improvement in teamwork a very popular Quality Improvement Competition is held yearly. With a large number of improvement teams participating, opportunities arise for the sharing of successful improvement ideas.

Advanced quality planning

During the design and development of new products and processes, quality is built-in by advanced quality planning. By means of failure-mode-and-effect analysis the critical parameters of a process are identified. Procedures are then laid down to ensure the highest level of performance for these parameters. The capability of process steps is also planned in this phase in preparation for production under statistical process control.

Quality network

Product quality is the responsibility of the Business Lines, with their Quality and Reliability (Q&R) departments operating in a supportive and controlling manner. The sales organization has Quality Managers who respond to any quality matters raised by customers. Customer complaints are then handled by direct contact between Sales Quality and the relevant Q&R department. General quality requirements are covered by a divisional Quality department.

Product conformance

The assurance of product conformance is an integral part of our Quality Assurance practice. This is achieved by:

- In-line Quality Assurance to monitor process reproducibility during manufacture. Equipment performance and process steps are under statistical process control.
- Acceptance tests on finished products to verify conformance with the device specification. The test results are used for Quality feedback and corrective actions. Periodic sample inspections to monitor and measure the conformance of products are increasingly being replaced by continuous in-line monitoring.
- Qualification tests.

The inspection and test requirements are detailed in the General Quality Specifications in the SNW-FQ-611 series.

Product reliability

Highly accelerated tests are implemented to evaluate and monitor product reliability. Rejects from reliability tests are subjected to failure analysis, so that improvements may be made. This analysis also extends to product related customer complaints.

Customer response

Our quality improvement depends on working together with our customer. We need our customer's input, and we therefore invite constructive comments on all aspects of our performance. For all such matters, please contact your local Philips Semiconductors sales representative.

1. PRO ELECTRON TYPE NUMBERING SYSTEM

1.1 Basic type number

This type designation code applies to discrete semiconductor devices (not integrated circuits), multiples of such devices, semiconductor chips and Darlington transistors.

1.1.1 FIRST LETTER

The first letter gives information about the material for the active part of the device.

A	Germanium or other material with a band gap of 0.6 to 1 eV
B	Silicon or other material with a band gap of 1 to 1.3 eV
C	Gallium arsenide (GaAs) or other material with a band gap of 1.3 eV or more
R	Compound materials, e.g. cadmium sulphide.

1.1.2 SECOND LETTER

The second letter indicates the function for which the device is primarily designed. The same letter can be used for multi-chip devices with similar elements.

In the following list low power types are defined by $R_{th\ j\text{-}c} > 15$ K/W and power types by $R_{th\ j\text{-}c} \leq 15$ K/W.

A	Diode; signal, low power
B	Diode; variable capacitance
C	Transistor; low power, audio frequency
D	Transistor; power, audio frequency
E	Diode; tunnel
F	Transistor; low power, high frequency
G	Multiple of dissimilar devices/miscellaneous devices; e.g. oscillators. Also with special third letter; see Section 1.1.3.
H	Diode; magnetic sensitive
L	Transistor; power, high frequency
N	Photocoupler
P	Radiation detector; e.g. high sensitivity photo-transistor; with special third letter
Q	Radiation generator; e.g. LED, laser; with special third letter; see Section 1.1.3
R	Control or switching device; e.g. thyristor, low power; with special third letter; see Section 1.1.3.
S	Transistor; low power, switching
T	Control or switching device; e.g. thyristor, power; with special third letter; see Section 1.1.3.
U	Transistor; power, switching
W	Surface acoustic wave device
X	Diode; multiplier, e.g. varactor, step recovery
Y	Diode; rectifying, booster
Z	Diode; voltage reference or regulator, transient suppressor diode; with special third letter; see Section 1.1.3.

1.1.3 SERIAL NUMBER/SPECIAL THIRD LETTER

The number comprises three figures running from 100 to 999 for devices primarily intended for consumer equipment, or one letter (Z, Y, X, etc.) and two figures running from 10 to 99 for devices primarily intended for industrial or professional equipment.(1) The letter has no fixed meaning, except in the following cases:

A	For triacs, after second letter 'R' or 'T'
F	For emitters and receivers in fibre-optic communication, after second letter 'G', 'P' or 'Q'. When, the second letter is 'G', the first letter should be defined in accordance with the material of the main optical device.
L	For lasers in non-fibre-optic applications, after second letter 'G' or 'Q'. When the second letter is 'G', the first letter should be defined in accordance with the material of the main optical device.
M	For transistor drivers, after second letter 'R'
O	For opto-triacs after second letter 'R'
R	For Sc resistor network, after second letter 'C'
T	For 3-state bicolour LEDs, after second letter 'Q'
W	For transient voltage suppressor diodes, after second letter 'Z'.

1.2 Version letter(s)

One or two letters may be added to the basic type number to indicate minor electrical or mechanical variants of the basic type. The letters never have a fixed meaning, except that the letter 'R' indicates reverse polarity and the letter 'W' indicates a surface mounted device (SMD).

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(1) When the supply of these serial numbers is exhausted, the serial number may be expanded to three figures for industrial types and four figures for consumer types.

RATING SYSTEMS

The rating systems described are those recommended by the IEC in its publication number 60134.

Remark: It is common practice to use the Absolute Maximum Rating System in published semiconductor data sheets.

Definitions of terms used

ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device.

Remark: This definition excludes inductors, capacitors, resistors and similar components.

CHARACTERISTIC

A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

BOGEY ELECTRONIC DEVICE

An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics that are directly related to the application.

RATING

A value that establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Remark: Limiting conditions may be either maxima or minima.

RATING SYSTEM

The set of principles upon which ratings are established and which determine their interpretation.

Remark: The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type, as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout the life of the device, no absolute maximum value for the intended service is exceeded with any device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

Design maximum rating system

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout the life of the device, no design-maximum value for the intended service is exceeded with a bogey electronic device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

Design centre rating system

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS

The letter symbols for transistors detailed in this section are based on IEC publication number 148.

Basic letters

In the representation of currents, voltages and powers, lower-case letter symbols are used to indicate all instantaneous values that vary with time. All other values are represented by upper-case letters.

Electrical parameters$^{(1)}$ of external circuits and of circuits in which the device forms only a part are represented by upper-case letters. Lower-case letters are used for the representation of electrical parameters inherent in the device. Inductances and capacitances are always represented by upper-case letters.

The following is a list of basic letter symbols used with semiconductor devices:

B, b	Susceptance (imaginary part of an admittance)
C	Capacitance
G, g	Conductance (real part of an admittance)
H, h	Hybrid parameter
I, i	Current
L	Inductance
P, p	Power
R, r	Resistance (real part of an impedance)
V, v	Voltage
X, x	Reactance (imaginary part of an impedance)
Y, y	Admittance
Z, z	Impedance.

Subscripts

Upper-case subscripts are used for the indication of:

- Continuous (DC) values (without signal), e.g. I_D, I_B
- Instantaneous total values, e.g. i_D, i_B
- Average total values, e.g. $I_{D(AV)}$, $I_{B(AV)}$
- Peak total values, e.g. I_{DM}, I_{BM}
- Root-mean-square total values, e.g. $I_{D(RMS)}$; $I_{B(RMS)}$.

Lower-case subscripts are used for the indication of values applying to the varying component alone:

- Instantaneous values, e.g. i_b
- Root-mean-square values, e.g. $I_{d(rms)}$
- Peak values, e.g. I_{bm}
- Average values, e.g. $I_{d(av)}$.

The following is a list of subscripts used with basic letter symbols for semiconductor devices:

A, a	anode
amb	ambient
(AV), (av)	average value
B, b	base
(BO)	breakover
(BR)	breakdown
case	case
C, c	collector
C	controllable
D, d	drain
E, e	emitter
F, f	fall, forward (or forward transfer)
G, g	gate
H	holding
h	heatsink
I, i	input
j-a	junction to ambient
j-mb	junction to mounting base
K, k	cathode
L	load
M, m	peak value
(min)	minimum
(max)	maximum
mb	mounting base
O, o	As first subscript: reverse (or reverse transfer), rise. As second subscript: repetitive, recovery. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal
(OV)	Overload
P, p	Pulse
Q, q	Turn-off
R, r	As first subscript: reverse (or reverse transfer), rise. As second subscript: repetitive, recovery. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal

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(1) For the purpose of this publication, the term 'electrical parameters' applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

(RMS), (rms)	Root-mean-square value
S, s	As first subscript: series, source, storage, stray, switching. As second subscript: surge (non-repetitive). As third subscript: short circuit between the terminal not mentioned and the reference terminal
stg	Storage
th	Thermal
TO	Threshold
tot	Total
W	Working
X, x	Specified circuit
Z, z	Reference or regulator (zener)
1	Input (four-pole matrix)
2	Output (four-pole matrix).

Applications and examples

Transistor currents

The first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive).

Examples: I_D, I_B, i_D, i_B, i_d, i_b, I_{dm}, i_{bm}.

Transistor voltages

A voltage is indicated by the first two subscripts: the first identifies the terminal at which the voltage is measured and the second the reference terminal or the circuit node. The second subscript may be omitted when there is no possibility of confusion.

Examples: V_{GS}, v_{GS}, v_{gs}, V_{gsm}, V_{BE}, v_{BE}, v_{be}, V_{bem}.

Supply voltages or currents

Supply voltages or supply currents are indicated by repeating the appropriate terminal subscript.

Examples: V_{DD}, I_{SS}, V_{CC}; I_{EE}.

A reference terminal is indicated by a third subscript.

Example: V_{DDS}, V_{CCE}.

Devices with more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal, followed by a number. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

I_{D2}	Continuous (DC) current flowing into the second gate terminal
$V_{B2\text{-}E}$	Continuous (DC) voltage between the terminals of second base and emitter.

Multiple devices

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

I_{2B}	Continuous (DC) current flowing into the base terminal of the second unit
$V_{1D\text{-}2D}$	Continuous (DC) voltage between the drain terminals of the first and second units.

Electrical parameters

The upper-case variant of a subscript is used for the designation of static (DC) values.

Examples:

g_{FS}	Static value of forward transconductance in common-source configuration (DC current gain)
h_{FE}	Static value of forward current transfer in common-emitter configuration (DC current gain)
R_{DS}	DC value of the drain-source resistance.
R_E	DC value of the external emitter resistance.

The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript is used for the designation of small-signal values.

Examples:

g_{fs}	Small-signal value of the short-circuit forward transconductance in common-source configuration
h_{fe}	Small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration
$Z_i = R_i + jX_i$	Small-signal value of the input impedance.

If more than one subscript is used, subscripts for which a choice of style is allowed, the subscripts chosen are all upper-case or all lower-case.

Examples: h_{FE}, y_{RE}, h_{fe}, g_{FS}.

FOUR-POLE MATRIX PARAMETERS

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer.

Examples: h_i (or h_{11}), h_o (or h_{22}), h_f (or h_{21}), h_r (or h_{12}).

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E}).

DISTINCTION BETWEEN REAL AND IMAGINARY PARTS

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts are used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: $Z_i = R_i + jX_i$, $y_{fe} = g_{fe} + jb_{fe}$.

If such symbols do not exist or are not suitable, the notation shown in the following examples is used.

Examples:

Re (h_{ib}) etc. for the real part of h_{ib}

Im (h_{ib}) etc. for the imaginary part of h_{ib}.

S-PARAMETER DEFINITIONS

The S-parameter symbols in this section are based on IEC publication 747-7.

S-parameters (return losses or reflection coefficients) of a module can be defined as the S_{11} and the S_{22} of a two-port network (see Fig.1).

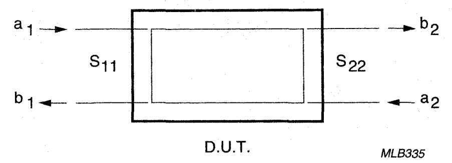


Fig.1 Two-port network with reflection coefficients S11 and S22.

$$b_1 = S_{11} \cdot a_1 + S_{12} \cdot a_2 \quad (1)$$

$$b_2 = S_{21} \cdot a_1 + S_{22} \cdot a_2 \quad (2)$$

where:

$$a_1 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_1) = \text{signal into port 1} \quad (3)$$

$$a_2 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_2 + Z_o \cdot i_2) = \text{signal into port 2}$$

$$b_1 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_1) = \text{signal out port 1} \quad (4)$$

$$b_2 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_2) = \text{signal out port 2}$$

From (1) and (2) formulae for the return losses can be derived:

$$S_{11} = \left.\frac{b_1}{a_1}\right| a_2 = 0 \quad (5)$$

$$S_{22} = \left.\frac{b_2}{a_2}\right| a_1 = 0 \quad (6)$$

In (5), $a_2 = 0$ means output port terminated with Z_o (derived from formula (4)).

In (6), $a_1 = 0$ means input port terminated with Z_o (derived from formula (3)).

Measurement

The return losses are measured with a network analyzer after calibration, where the influence of the test jig is eliminated. The necessary termination of the other port with Z_o is done automatically by the network analyzer.

The network analyser must have a directivity of at least 40 dB to obtain an accuracy of 0.5 dB when measuring return loss figures of 20 dB. A full two-port correction method can be used to improve the accuracy.

TAPE AND REEL PACKING

Tape and reel packing meets the feed requirements of automatic pick and place equipment (packing conforms to IEC publication 286-2 and 286-3). Additionally, the tape is an ideal shipping container.

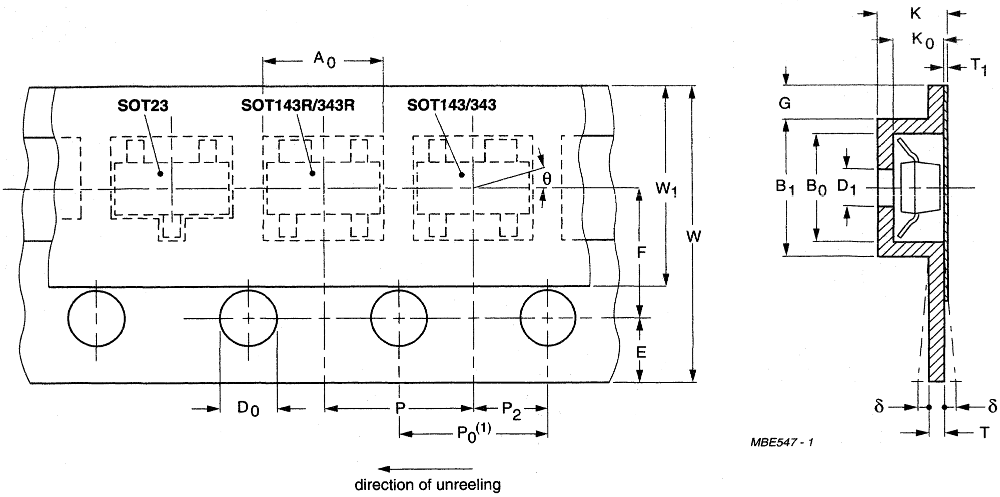
Packing types

Table 1 Packing quantities per reel

PACKAGE	TAPE WIDTH (mm)	REEL SIZE (mm)	QUANTITY PER REEL	12NC (note 1) ends with:
SOT23	8	180	3000	...215
		330	10000	...235
SOT143(R)	8	180	3000	...215
		330	10000	...235
SOT323	8	180	3000	...115
		330	10000	...135
SOT343(R)	8	180	3000	...115
		330	10000	...135
SOT353	8	180	3000	...115
SOT363	8	180	3000	...115
SOT89	12	180	1000	...115
SOT223	12	180	1000	...115
SOT551	8	180	3000	...115

Notes

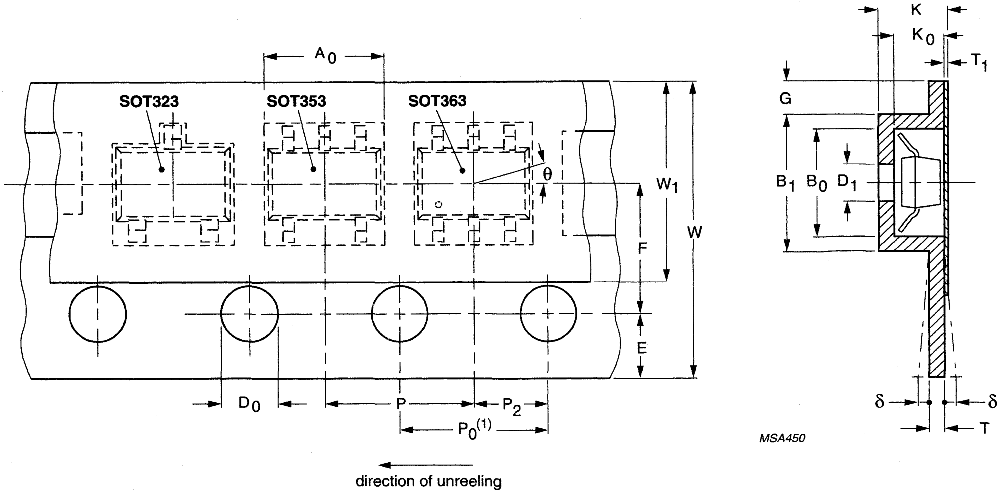
1. 12NC is the Philips twelve-digit ordering code.



For dimensions see Table 2.

(1) Tolerance over any 10 pitches: ±0.2 mm.

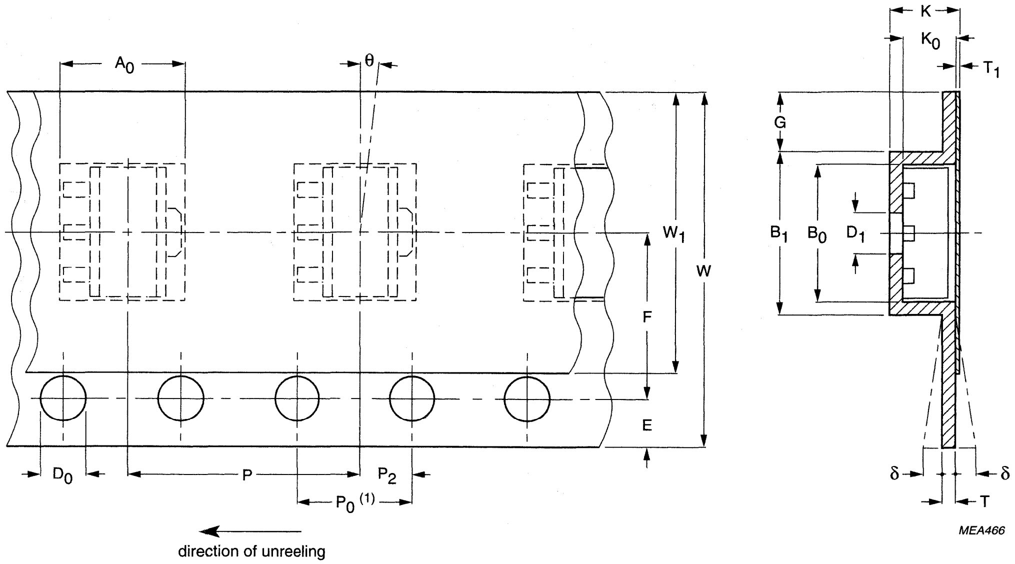
Fig.1 Specification for 8 mm tape (SOT23, SOT143, SOT143R, SOT343 and SOT343R).



For dimensions see Table 2.

(1) Tolerance over any 10 pitches: ±0.2 mm.

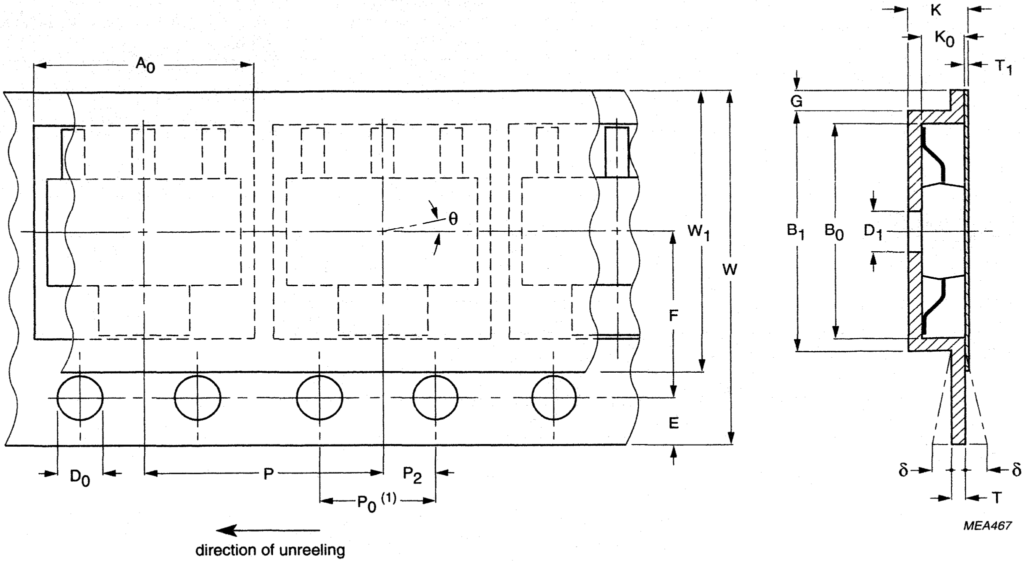
Fig.2 Specification for 8 mm tape (SOT323, SOT353 and SOT363).



For dimensions see Table 2.

(1) Tolerance over any 10 pitches: ±0.2 mm.

Fig.3 Specification for 12 mm tape (SOT89).



For dimensions see Table 2.

(1) Tolerance over any 10 pitches: ±0.2 mm.

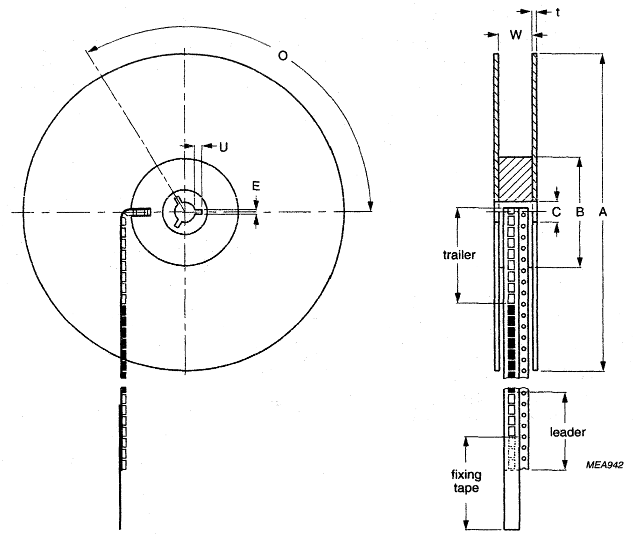
Fig.4 Specification for 12 mm tape (SOT223).

Table 2 SMD packages: tape dimensions (in mm)

DIMENSION (Figs 1 to 6)	**CARRIER TAPE**			**TOLERANCE**
	8 mm	**12 mm**	**16 mm**	
Overall dimensions				
W	8.0	12.0	16.0	±0.2
K	<1.5	<2.4	<2.2	–
G	>0.75	>0.75	>1.65	–
Sprocket holes; note 1				
D_0	1.5	1.5	1.5	+0.1/–0
E	1.75	1.75	1.75	±0.1
P_0	4.0	4.0	4.0	±0.1
Relative placement compartment				
P_2	2.0	2.0	2.0	±0.1
F	3.5	5.5	7.5	±0.05
Compartment				
A_0	Compartment dimensions depend on package size. Maximum clearance between device and compartment is 0.3 mm; the minimum clearance ensures that the device is not totally restrained within the compartment.			
B_0				
B_1				
K_0				
D_1	>1.0	>1.5	>1.5	–
P	4.0	8.0	12.0	±0.1
θ	<15°	<15°	–	–
Cover tape; note 2				
W_1	<5.4	<9.5	–	–
T_1	<0.1	<0.1	–	–
Carrier tape				
W	8.0	12.0	16.0	±0.2
T	<0.2	<0.2	<0.4	–
δ	<0.3	<0.3	<0.3	–

Notes

1. Tolerance over any 10 pitches ±0.2 mm.
2. The cover tape shall not overlap the tape or sprocket holes.



For dimensions see Table 1.

Fig.5 Reel specification.

Table 3 Reel dimensions (in mm)

DIMENSION (see Fig.5)	CARRIER TAPE			TOLERANCE
	8 mm	**12 mm**	**16 mm**	
Flange				
A	180(1) – 286 or 330	180 or 330	180 or 330	±0.5
t	1.5	1.5	1.5	+0.5/–0.1
W	8.4	12.4	18	18.0+0.2
Hub				
B	62	62	62	±1.5
C	12.75	12.75	12.75	+0.15/–0.2
Key slot				
E	2	2	2	±0.2
U	4	4	4	±0.5
O	120°	120°	120°	–

Note

1. Large reel diameter depends on individual package (286 or 350).

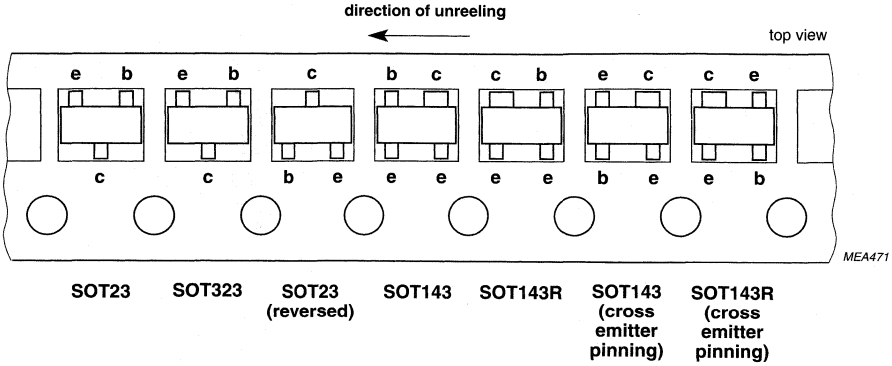


Fig.6 Orientation of components: SOT23, SOT143, SOT143R and SOT323 (8 mm tape).

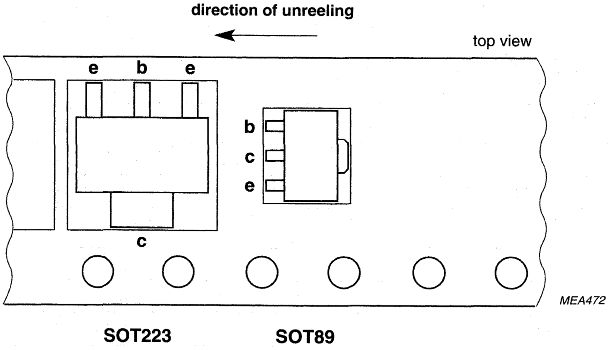


Fig.7 Orientation of components: SOT223 and SOT89 (12 mm tape).

MOUNTING AND SOLDERING

Mounting methods

There are two basic forms of electronic component construction, those with leads for through-hole mounting and microminiature types for surface mounting (SMD). Through-hole mounting gives a very rugged construction and uses well established soldering methods. Surface mounting has the advantages of high packing density plus high-speed automated assembly. Surface mounting techniques are complex and this chapter gives only a simplified overview of the subject.

Although many electronic components are available as surface mounting types, some are not and this often leads to the use of through-hole as well as surface mounting components on one substrate (a mixed print). The mix of components affects the soldering methods that can be applied. A substrate having SMDs mounted on one or both sides but no through-hole components is likely to be suitable for reflow or wave soldering. A double sided mixed print that has through-hole components and some SMDs on one side and densely packed SMDs on the other normally undergoes a sequential combination of reflow and wave soldering. When the mixed print has only through-hole components on one side and all SMDs on the other, wave soldering is usually applied.

Reflow soldering

SOLDER PASTE

Most reflow soldering techniques utilize a paste that is a mixture of flux and solder. The solder paste is applied to the substrate before the components are placed. It is of sufficient viscosity to hold the components in place and, therefore, an application of adhesive is not required. Drying of the solder paste by preheating increases the viscosity and prevents any tendency for the components to become displaced during the soldering process. Preheating also minimizes thermal shock and drives off flux solvents.

Screen printing

This is the best high-volume production method of solder paste application. An emulsion-coated, fine mesh screen with apertures etched in the emulsion to coincide with the surfaces to be soldered is placed over the substrate. A squeegee is passed across the screen to force solder paste through the apertures and on to the substrate. The layer thickness of screened solder paste is usually between 150 and 200 μm.

Stencilling

In this method a stencil with etched holes to pass the paste is used. The thickness of the stencil determines the amount of amount of solder paste that is deposited on the substrate. This method is also suited to high-volume work.

Dispensing

A computer-controlled pressure syringe dispenses small doses of paste to where it is required. This method is mainly suitable for small production runs and laboratory use.

Pin transfer

A pin picks up a droplet of solder paste from a reservoir and transfers it to the surface of the substrate or component. A multi-pin arrangement with pins positioned to match the substrate is possible and this speeds up the process time.

REFLOW TECHNIQUES

Thermal conduction

The prepared substrates are carried on a conveyor belt, first through a preheating stage and then through a soldering stage. Heat is transferred to the substrate by conduction through the belt. Figure 1 shows a theoretical time/temperature relationship for thermal conduction reflow soldering. This method is particularly suited to thick film substrates and is often combined with infrared heating.

Infrared

An infrared oven has several heating elements giving a broad spectrum of infrared radiation, normally above and below a closed loop belt system. There are separate zones for preheating, soldering and cooling. Dwell time in the soldering zone is kept as short as possible to prevent damage to components and substrate. A typical heating. profile is shown in Fig.2. This reflow method is often applied in double-sided prints.

Vapour phase

A substrate is immersed in the vapours of a suitable boiling liquid. The vapours transfer latent heat of condensation to the substrate and solder reflow takes place. Temperature is controlled precisely by the boiling point of the liquid at a given pressure. Some systems employ two vapour zones, one above the other. An elevator tray, suspended from a hoist mechanism passes the substrate vertically through the first vapour zone into the secondary soldering zone and then hoists it out of the vapour to be cooled.
A theoretical time/temperature relationship for this method is shown in Fig.3.

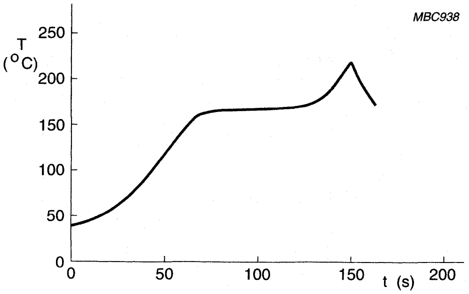


Fig.1 Theoretical time/temperature curve for a typical thermal conductive reflow cycle.

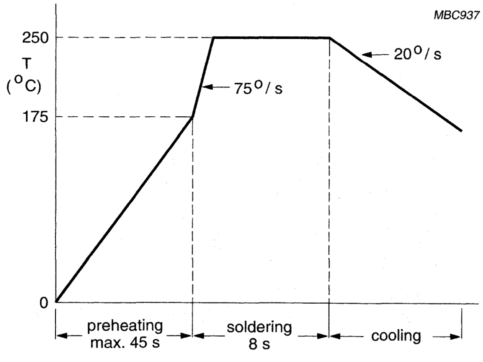


Fig.2 Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm/min.

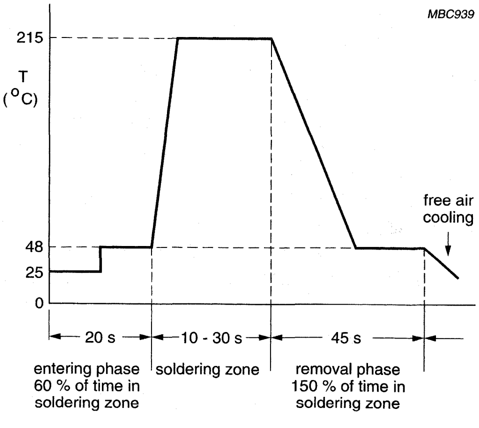


Fig.3 Theoretical time/temperature curve relationship for dual vapour reflow soldering.

Wave soldering

This soldering technique is not recommended for SOT89.

ADHESIVE APPLICATION

Since there are no connecting wires to retain them, leadless and short-leaded components are held in place with adhesive for wave soldering. A spot of adhesive is carefully placed between each SMD and the substrate. The adhesive is then heat-cured to withstand the forces of the soldering process, during which the components are fully immersed in solder. There are several methods of adhesive application.

Pin transfer method

A pin is used to transfer a droplet of adhesive from a reservoir to a precise position on the surface where it is required. The size of the droplet depends on pin diameter, depth to which the pin is dipped in the reservoir, rheology of the adhesive, and the temperature of adhesive and surrounds. The pin can be part of a pin array (bed of nails) that corresponds exactly with the required adhesive positions on the substrate. With this method, adhesive can be applied to the whole of one side of a substrate in one operation and is therefore suitable for high-volume production and can be used with pre-loaded mixed prints.

Alternatively, pins can be used to transfer adhesive to the components before they are placed on the substrate. This adds flexibility to production runs where variations in layout must be accommodated.

Screen printing method

A fine mesh screen is coated with emulsion except in the positions where the adhesive is required to pass. The screen is placed on the substrate and a squeegee passing across it forces adhesive through the uncoated parts of the screen. The amount of adhesive printed-through depends on the size of the uncoated screen areas, the thickness of the screen coating, the rheology of the adhesive and various machine parameters. With this method, the substrate must be flat and pre-loaded mixed prints cannot be accommodated.

Pressure syringe method

A computer-controlled syringe dispenses adhesive from an enclosed reservoir by means of pulses of compressed air. The adhesive dot size depends on the size of the syringe nozzle, the duration and pressure of the pulsed air and the viscosity of the adhesive. This method is most suited to low volume production. An advantage is the flexibility provided by computer programmability.

FLUXING

The quality of the soldered connections between components and substrate is critical for circuit performance and reliability. Flux promotes solderability of the connecting surfaces and is chosen for the following attributes:

- Removal of surface oxides
- Prevention of reoxidation
- Transference of heat from source to joint area
- Residue that is non-corrosive or, if residue is corrosive, should be easy to clean away after soldering
- Ability to improve wettability (readiness of a metal surface to form an alloy at its interface with the solder) to ensure strong joints with low electrical resistance
- Suitability for the desired method of flux application.

In wave soldering, liquified flux is usually applied as a foam, a spray or in a wave.

Foam

Flux foam is made by forcing low-pressure, water-free clean air through an aerator immersed in liquid flux. Fine bubbles of flux are directed onto the substrate/component surfaces where they burst and form a thin, even layer. The flux also penetrates any plated-through holes. The flux has to be chosen for its foaming capabilities.

Spray

Several methods of spray fluxing exist, the most common involves a mesh drum rotating in liquid flux. Air is blown into the drum which, when passing through the fine mesh, directs a spray of flux onto the underside of the substrate. The amount of flux deposited is controllable by the speed of the substrate passing through the spray, the speed of rotation of the drum and the density of the flux.

Wave

A wave fluxer creates a double flowing wave of liquid flux which adheres to the surface as the substrate passes through. Wave height control is essential and a soft wipe-off brush is usually incorporated to remove excess flux from the substrate.

PRE-HEATING

Pre-heating of the substrate and components is performed immediately before soldering. This reduces thermal shock as the substrate enters the soldering process, causes the flux to become more viscous and accelerates the chemical action of the flux and so speeds up the soldering action.

SOLDERING

Wave soldering is usually the best method to use when high throughput rates are required. The single wave soldering principle (see Fig.4) is the most straight forward method and can be used on simple substrates with two-terminal SMD components. More complex substrates with increased circuit density and closer spacing of conductors can pose the problems of nonwetting (dry joints) and solder bridging. Bridging can occur across the closely spaced leads of multi-leaded devices as well as across adjacent leads on neighbouring components. Nonwetting is usually caused by components with plastic bodies. The plastic is not wetted by solder and creates a depression in the solder wave, which is augmented by surface tension. This can cause a shadow behind the component and prevent solder from reaching the joint surfaces. A smooth laminar solder wave is required to avoid bridging and a high pressure wave is needed to completely cover the areas that are difficult to wet. These conflicting demands are difficult to attain in a single wave but dual wave techniques go a long way in overcoming the problem.

In a dual wave machine (see Fig.5), the substrate first comes into contact with a turbulent wave which has a high vertical velocity. This ensures good solder contact with both edges of the components and prevents joints from being missed. The second smooth laminar wave completes the formation of the solder fillet, removes excess solder and prevents bridging. Figure 6 indicates the time/temperature relationship measured at the soldering site in dual wave soldering.

New methods of wave soldering are developing continually. For example, the Omega System is a single wave agitated by pulses, which combines the functions of smoothness and turbulence. In another, a lambda wave injects air bubbles in the final part of the wave. A further innovation is the hollow jet wave in which the solder wave flows in the opposite direction to the substrate.

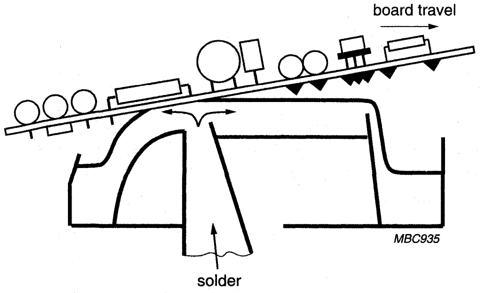


Fig.4 Single wave soldering principle.

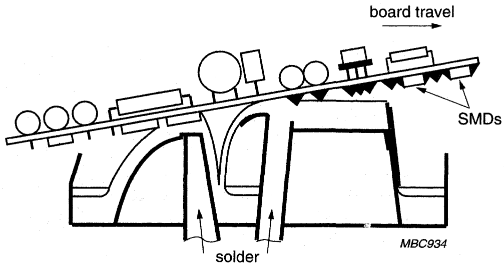


Fig.5 Dual wave soldering principle.

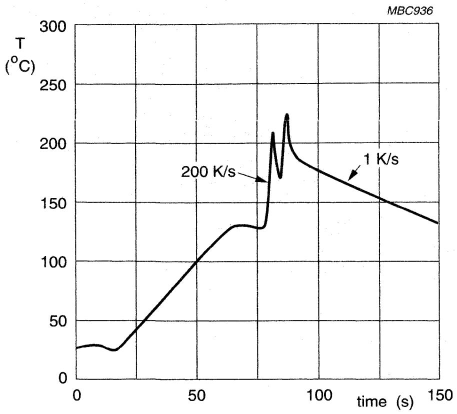


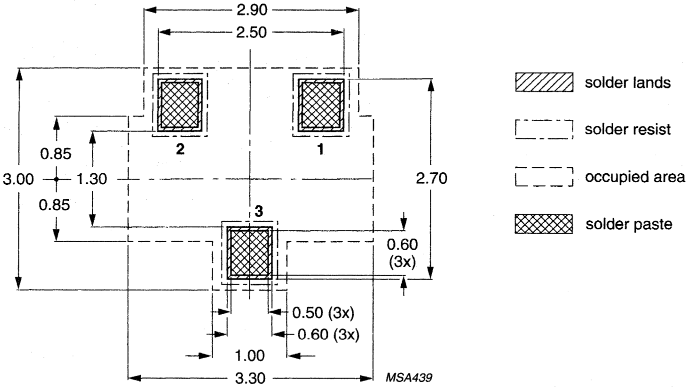
Fig.6 Typical time-temperature curve measured at the soldering site.

Footprint design

The footprint design of a component for surface mounting is influenced by many factors:

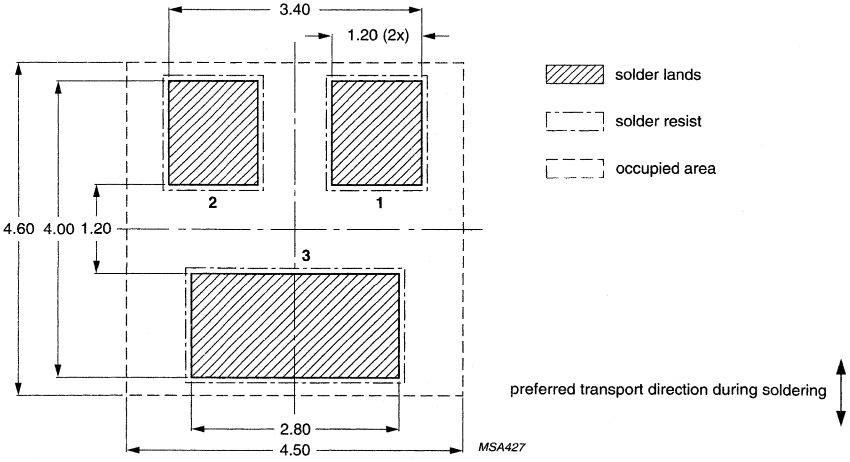
- Features of the component, its dimensions and tolerances
- Circuit board manufacturing processes
- Desired component density
- Minimum spacing between components
- Circuit tracks under the component
- Component orientation (if wave soldering)
- Positional accuracy of solder resist to solder lands
- Positional accuracy of solder paste to solder lands (if reflow soldering)
- Component placement accuracy
- Soldering process parameters
- Solder joint reliability parameters.

SOT23 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

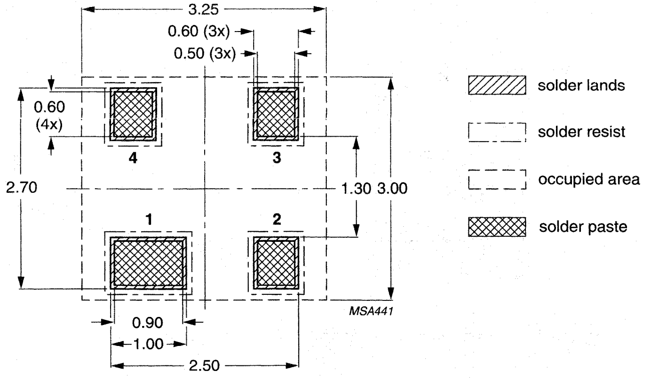
Fig.7 Reflow soldering footprint for SOT23; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

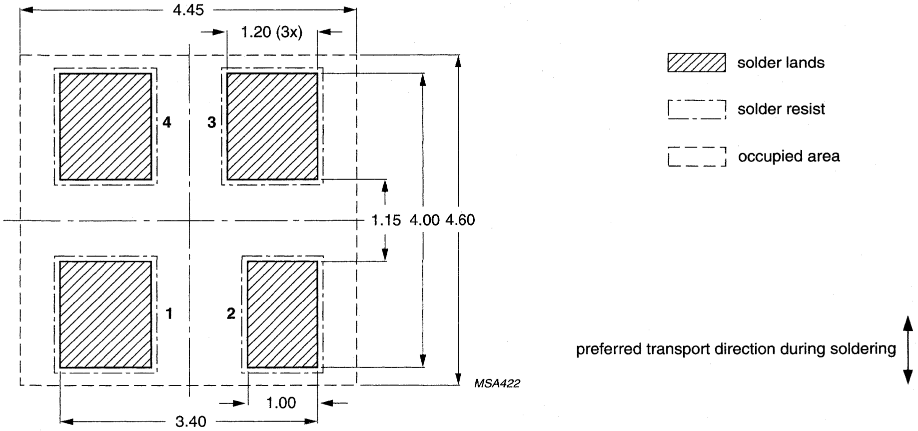
Fig.8 Wave soldering footprint for SOT23; typical dimensions.

SOT143 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

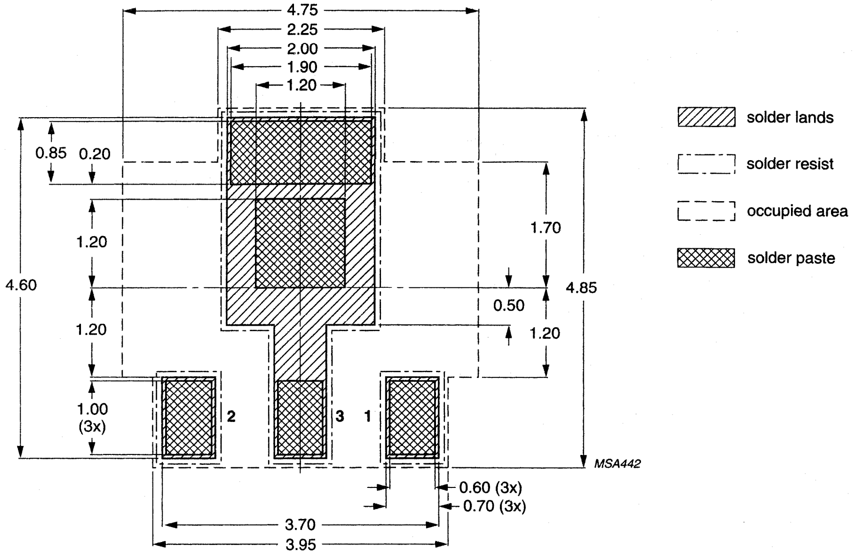
Fig.9 Reflow soldering footprint for SOT143B; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

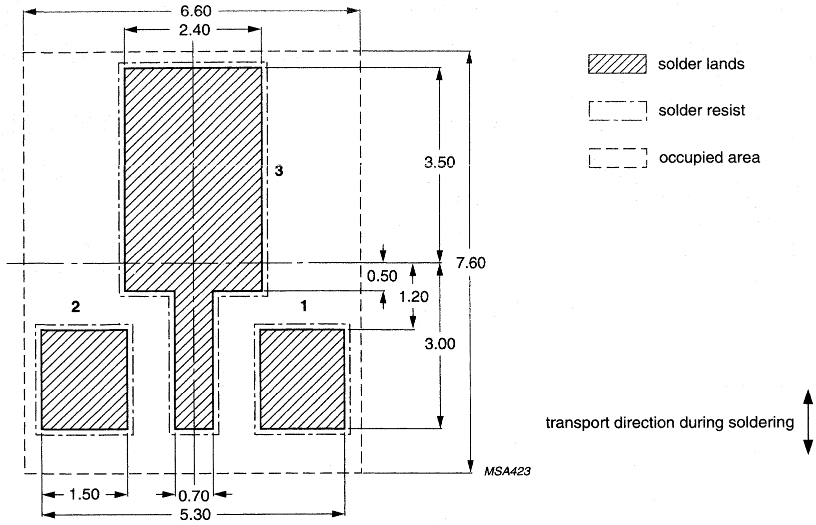
Fig.10 Wave soldering footprint for SOT143B; typical dimensions.

SOT89 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.11 Reflow soldering footprint for SOT89; typical dimensions.



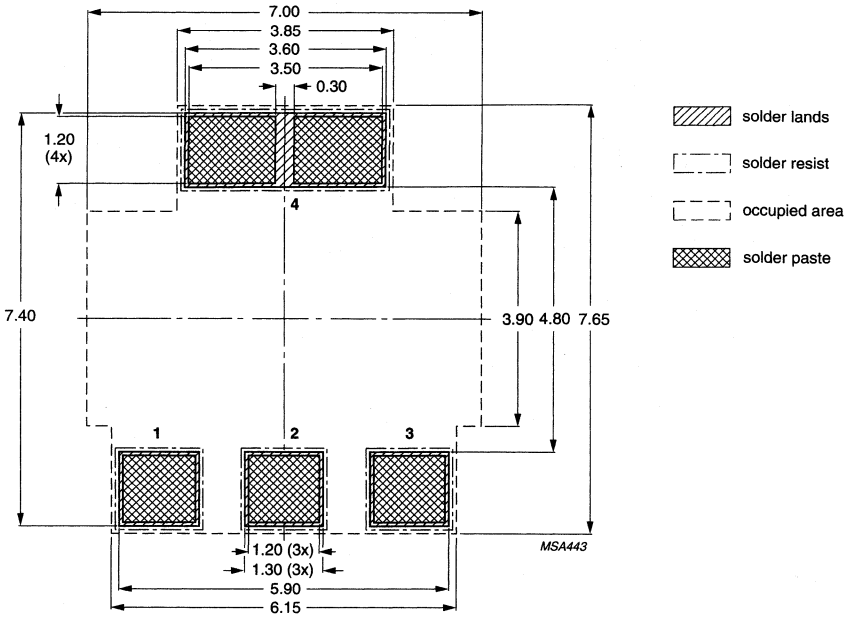
We do not recommend SOT89 for wave soldering, SOT223 is preferred.

Dimensions in mm.

Placement accuracy: ±0.25 mm.

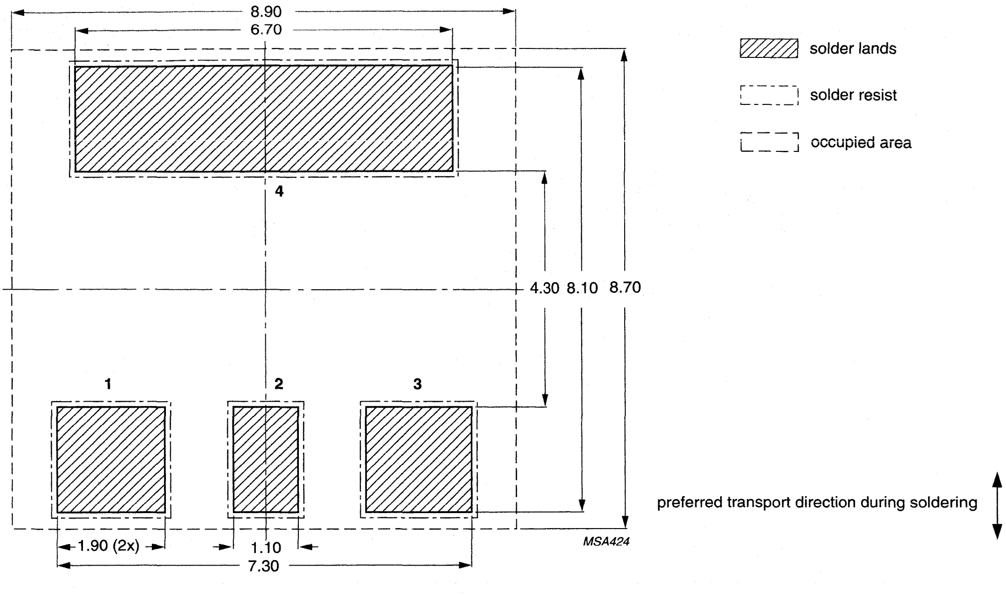
Fig.12 Wave soldering footprint for SOT89: typical dimensions.

SOT223 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

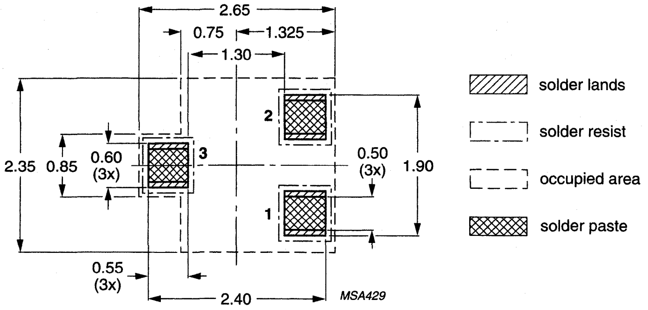
Fig.13 Reflow soldering footprint for SOT223; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

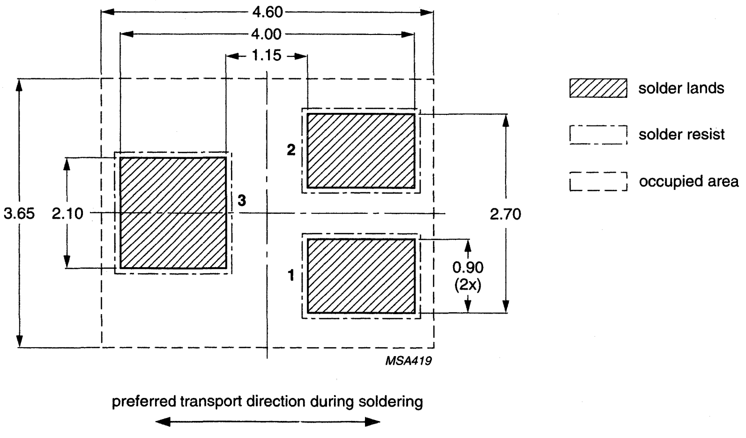
Fig.14 Wave soldering footprint for SOT223; typical dimensions.

SOT323 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

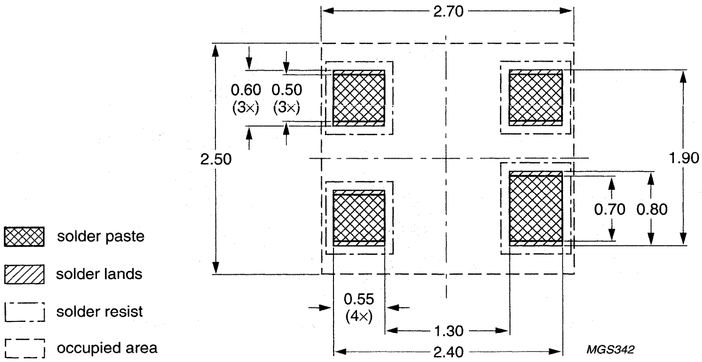
Fig.15 Reflow soldering footprint for SOT323 (SC-70); typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

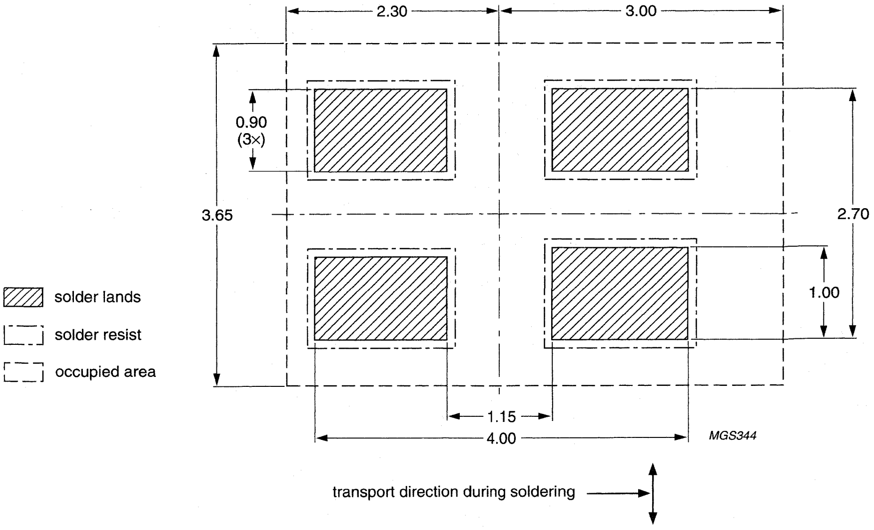
Fig.16 Wave soldering footprint for SOT323 (SC-70); typical dimensions.

SOT343 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

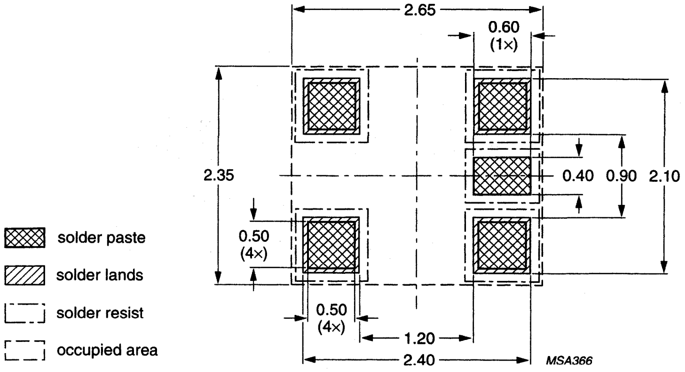
Fig.17 Reflow soldering footprint for SOT343; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

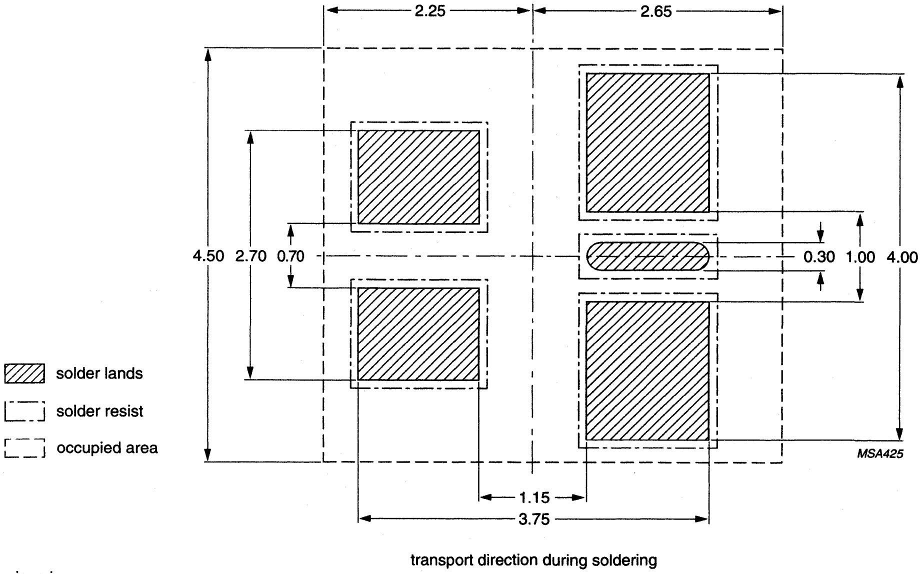
Fig.18 Wave soldering footprint for SOT343; typical dimensions.

SOT353 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

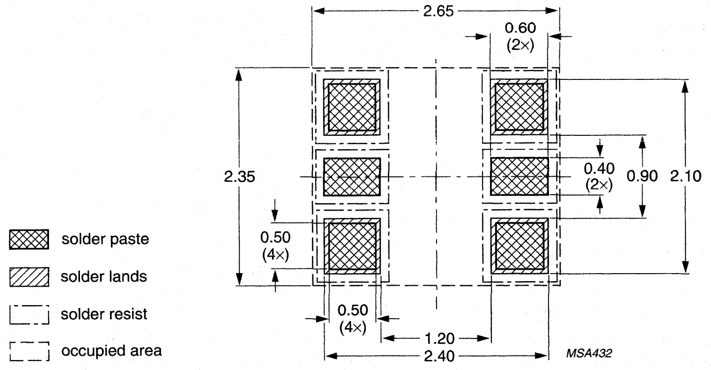
Fig.19 Reflow soldering footprint for SOT353 (SC-88A); typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

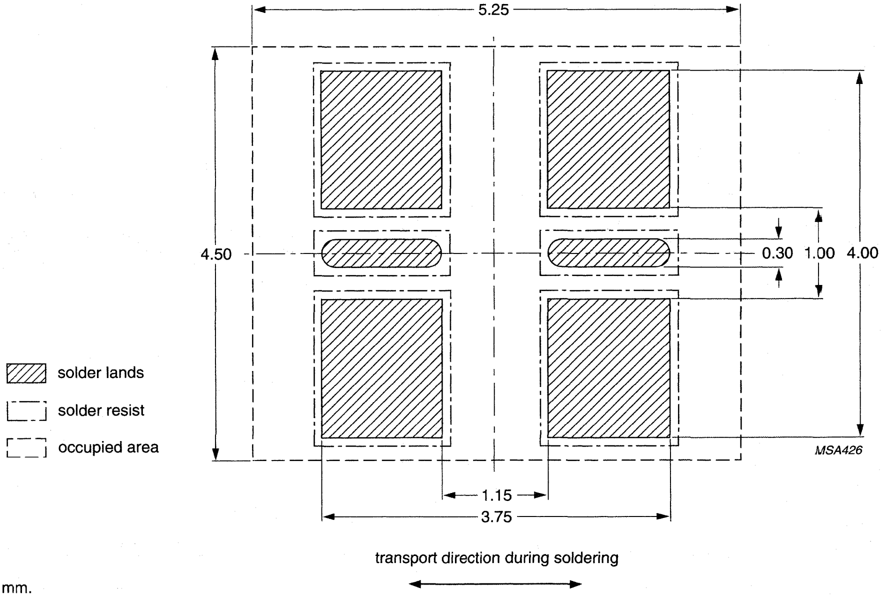
Fig.20 Wave soldering footprint for SOT353 (SC-88A); typical dimensions.

SOT363 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.21 Reflow soldering footprint for SOT363 (SC-88); typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.22 Wave soldering footprint for SOT363 (SC-88); typical dimensions.

THERMAL CONSIDERATIONS

Thermal resistance

Circuit performance and long-term reliability are affected by the temperature of the transistor die. Normally, both are improved by keeping the die temperature (junction temperature) low.

Electrical power dissipated in any semiconductor device is a source of heat. This increases the temperature of the die above a certain reference point. The most relevant reference point of the semiconductor device is the soldering point (i.e. the point on the printed-circuit board where the collector lead is soldered to a heat-draining point see Figs 1 and 2).

The temperature rise as a function of dissipation power, 'thermal resistance', is given in the data sheets as the $R_{th(j-s)}$ value. The heat is drained by conduction via the leadframe, soldering point and substrate (printed-circuit board) to ambient. The amount of radiated and convected heat is negligible in comparison to the conducted heat.

The elements of thermal resistance are defined as follows:

P_d	Power dissipation (W)
$R_{th(j-s)}$	Thermal resistance from junction to soldering point (K/W)
$R_{th(s-a)}$	Thermal resistance from soldering point to ambient (K/W)
$R_{th(j-a)}$	Thermal resistance from junction to ambient (K/W)
T_j	Junction temperature of the die (°C)
T_s	Soldering point temperature (°C)
T_{amb}	Ambient temperature (°C)
T_{ref}	Temperature of the reference point (°C)

The peak temperature of the die depends on the ability of the package and its mounting to transfer heat from this die to ambient environment (see Fig.3). The basic relationship between die temperature (junction temperature) and power dissipation is:

$$T_{j(max)} = T_{amb} + P_{d\,max} \times [R_{th(j-s)} + R_{th(s-a)}]$$

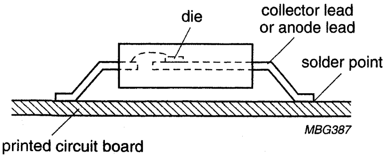


Fig.1 Assembly of SMD package and PCB.

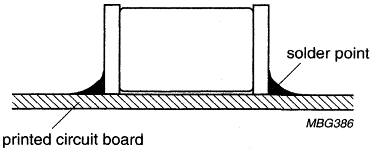


Fig.2 Assembly of SOD80-like package and PCB.

Thermal Considerations

Thermal resistance from junction to soldering point [$R_{th(j\text{-}s)}$]

In the example for $T_{j(max)}$, only T_{amb} and $R_{th(s\text{-}a)}$ can be varied by the user. The construction of the printed-circuit board (PCB) and the ambient condition (as there is air flow) affect $R_{th(s\text{-}a)}$. The device power dissipation can be controlled to a limited extent, under recommended usage. The supply voltage and circuit loading dictate a fixed power maximum. The $R_{th(j\text{-}s)}$ value is essentially independent of external mounting method and cooling air, but is sensitive to the materials used in the package construction, the die mount and the die area, all of which are fixed.

Values of $T_{j(max)}$ and $R_{th(j\text{-}s)}$, or $R_{th(j\text{-}c)}$ are given in the device data sheets. For applications where T_s is known, T_j can be calculated from:

$T_j = T_s + P_d \times R_{th(j\text{-}s)}$

Thermal resistance from soldering point to ambient [$R_{th(s\text{-}a)}$]

There is a limiting value for the soldering point temperature. For the normal tin alloy (Sn-Pb 60% - 40%): $T_{s\ max} = 110\ ^{\circ}C$. The value of T_s can be calculated from:

$T_s = T_a + P_d \times R_{th(s\text{-}a)}$.

The thermal resistance from soldering point to ambient depends on the shape and material of the tracks on a printed-circuit board as illustrated in Fig.4.

Summary of the SMD envelopes

These thermal considerations are valid for the following packages:

SC70, SOT23, SOT89, SOT143, SOT223, SOT323, SOT343, and SO8 (SOT96-1).

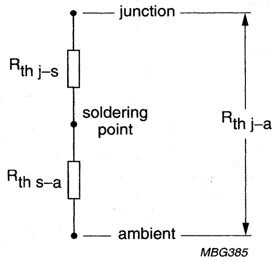
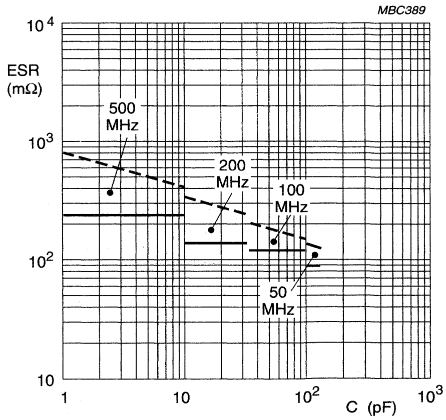


Fig.3 Representation of thermal resistance paths of a device mounted on a substrate or printed board.



(1) Single-sided, unplated.
(2) Single-sided, plated.
(3) Double-sided, unplated.
(4) Double-sided, plated.

Fig.4 Thermal resistance [$R_{th(s\text{-}a)}$] as a function of pad area on different configurations of FR4 epoxy fibre-glass circuit board.

Temperature calculation under pulsed conditions

In pulsed power conditions, the peak temperature of the die depends on the pulse time and duty factor as well as the ability of the package and its mounting to disperse heat.

When power is applied in repetitive square-wave pulses with a certain duty factor (δ), the variation in junction temperature has a sawtooth characteristic.

The average steady-state junction temperature is:

$T_{j(av)} = T_{ref} + \delta \times P_d \times R_{th(j\text{-}ref)}$

The peak junction temperature, however, is the most relevant to performance reliability. This can be calculated by heating and cooling step functions that result in heating and cooling curves shifted in time as shown in Fig.5.

The peak value of T_j is reached at the end of a power pulse and the minimum value immediately before the next power pulse. The thermal ripple is the difference between $T_{j(peak)}$ and $T_{j(min)}$.

Calculation of $T_{j(peak)}$ after n pulses:

$$T_{j(peak)} = T_{ref} + P_d \times \sum_{a=0}^{a=n-1} [Z_{th(at-w)} - Z_{th(at)}]$$

where a is an integer number.

Approximation method of finding $T_{j(peak)}$

With this method it is assumed that the average load is immediately followed by two square power pulses as shown in Fig.6. This two-pulse approximation method is accurate enough for finding $T_{j(peak)}$.

The junction temperature at the end of the second pulse is:

$$T_{j(peak)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t+w)} + Z_{th(w)} - Z_{th(t)}]$$

The junction temperature immediately before the second power pulse is:

$$T_{j(min)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t)} + Z_{th(w)} - Z_{th(t-w)}]$$

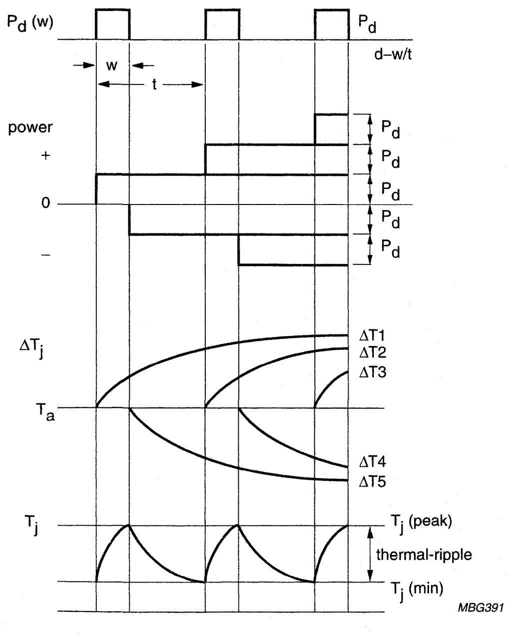
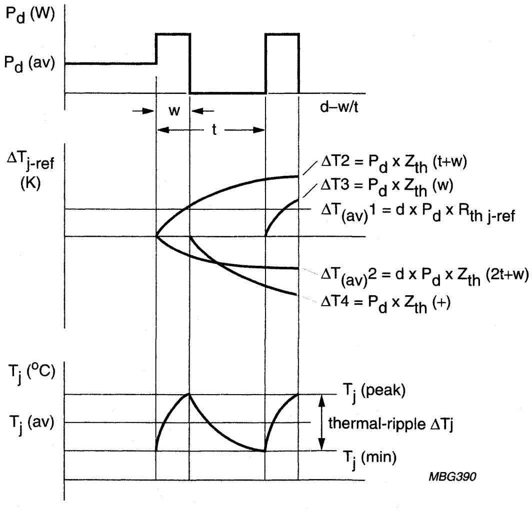


Fig.5 Heating effect of three identical power pulses after thermal stabilization.



$T_j\ (peak) = T_a + \Delta T1 + \Delta T2 + \Delta T3 + \Delta T4 - \Delta T5 - \Delta T6 - \Delta T7$

Fig.6 Two-pulse approximation method of finding peak steady-state junction temperature [$T_{j(peak)}$].

The thermal ripple is:

$\Delta T_j = T_{j(peak)} - T_{j(min)}$

$\Delta T_j = P_d \times [\delta \times (Z_{th(t)} - Z_{th(t+w)}) - 2 \times Z_{th(t)} + Z_{th(w)} + Z_{th(t-w)}]$

Reducing calculation time

To be able to point out the junction peak temperature at a certain pulse time and duty cycle, a graph similar to that shown in Fig.7 is included in relevant data sheets. In this example, the curves have been derived using the formula $T_{j(peak)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t+w)} + Z_{th(w)} - Z_{th(t)}]$, with typical values inserted.

The pulse width along the X-axis meets a particular duty cycle curve, indicating the Z_{th} value in K/W along the Y-axis.

$T_{j(peak)} = P_{d(peak)} \times Z_{th(j\text{-}s)} + P_{d(av)} \times R_{th(s\text{-}a)} + T_a$ (°C)

Soldering point temperature provides a better reference point than ambient temperature as this is subject to many uncontrolled variables. Therefore, the thermal resistance from junction to soldering point [$R_{th(j\text{-}s)}$] is becoming a more relevant measurement path.

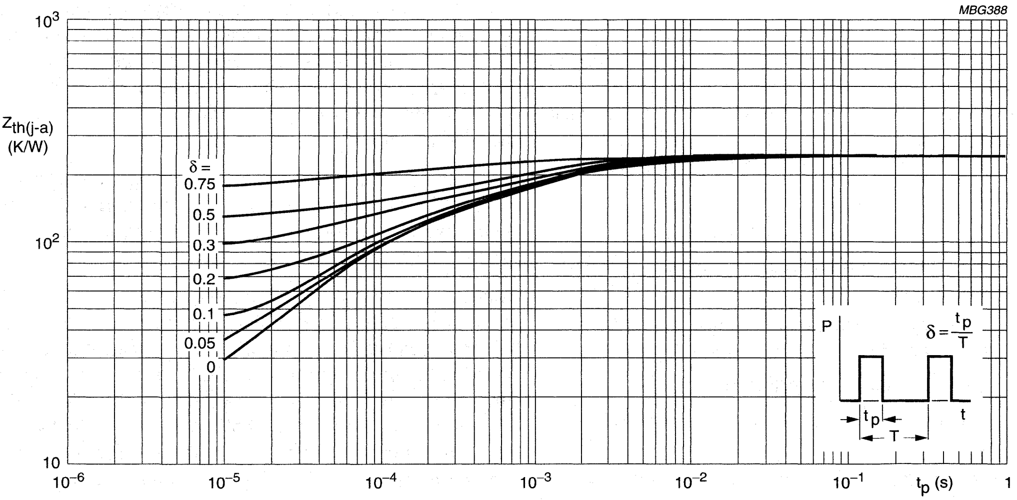


Fig.7 Direct reading of thermal impedance from junction to soldering point for calculation of junction temperature at pulsed power condition.

ELECTROSTATIC CHARGES

Electrostatic charges can exist in many things; for example, man-made-fibre clothing, moving machinery, objects with air blowing across them, plastic storage bins, sheets of paper stored in plastic envelopes, paper from electrostatic copying machines, and people. The charges are caused by friction between two surfaces, at least one of which is non-conductive. The magnitude and polarity of the charges depend on the different affinities for electrons of the two materials rubbing together, the friction force and the humidity of the surrounding air.

Electrostatic discharge is the transfer of an electrostatic charge between bodies at different potentials and occurs with direct contact or when induced by an electrostatic field. Our devices **can** be damaged if the following precautions are not taken.

WORK STATION

Figure 1 shows a working area suitable for safely handling electrostatic sensitive devices. It has a work bench, the surface of which is conductive or covered by an antistatic sheet. Typical resistivity for the bench surface is between 1 and 500 kΩ per cm^2. The floor should also be covered with antistatic material.

The following precautions should be observed:

- Persons at a work bench should be earthed via a wrist strap and a resistor
- All mains-powered electrical equipment should be connected via an earth leakage switch
- Equipment cases should be earthed
- Relative humidity should be maintained between 50 and 65%
- An ionizer should be used to neutralize objects with immobile static charges.

RECEIPT AND STORAGE

Our devices are packed for dispatch in antistatic/conductive containers, usually boxes, tubes or blister tape. The fact that the contents are sensitive to electrostatic discharge is shown by warning labels on both primary and secondary packing.

The devices should be kept in their original packing whilst in storage. If a bulk container is partially unpacked, the unpacking should be performed at a protected work station. Any devices that are stored temporarily should be packed in conductive or antistatic packing or carriers.

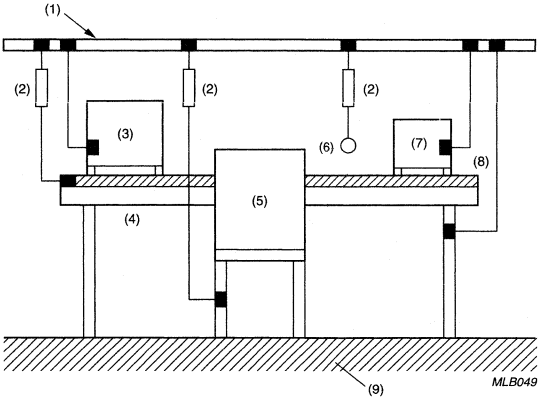
ASSEMBLY

The devices must be removed from their protective packing with earthed component pincers or short-circuit clips. Short-circuit clips must remain in place during mounting, soldering and cleansing/drying processes. Do not remove more devices from the storage packing than are needed at any one time. Production/assembly documents should state that the product contains electrostatic sensitive devices and that special precautions need to be taken.

All tools used during assembly, including soldering tools and solder baths, must be earthed. All hand tools should be of conductive or antistatic material and, where possible, should not be insulated.

Measuring and testing of completed circuit boards must be done at a protected work station. Place the soldered side of the circuit board on conductive or antistatic foam and remove the short-circuit clips. Remove the circuit board from the foam, holding the board only at the edges. Make sure the circuit board does not touch the conductive surface of the work bench. After testing, replace the circuit board on the conductive foam to await packing.

Assembled circuit boards should be handled in the same way as unmounted devices. They should also carry warning labels and be packed in conductive or antistatic packing.



(1) Earthing rail.
(2) Resistor (500 kΩ ± 10%, 0.5 W).
(3) Ionizer.
(4) Work bench.
(5) Chair.
(6) Wrist strap.
(7) Electrical equipment.
(8) Conductive surface/antistatic sheet.
(9) Antistatic floor.

Fig.1 Protected work station.

APPLICATION INFORMATION

APPLICATION REPORTS

The following application reports are available on our Internet site:
http://www.semiconductors.philips.com

1. 1890MHZ
   1890MHz low power down converter with 110MHz IF (BFG505 and BFG505/X)
2. 1P9GHZ3
   Low Noise, Low Current preamplifier for 1.9 GHz at 3 V (BFG505)
3. 1P9GHZLC
   Low Noise 900 MHz preamplifier at 3 V (BFG505)
4. 1U5GHZLN
   1,5 GHz Low Noise Amplifier with the BFG425W
5. 2GHZUDR
   2 GHz Driver-Amplifier with the BFG425W
6. 400MHZUL
   400MHz Low Noise Amplifier with the BFG540W/X
7. 900MHAP2
   900MHz Driver-Amplifier with Enable-Switch using the BFG425W
8. 900MHZ
   Low Noise 900 MHz preamplifier at 3 V (BFR/BFG/505/520)
9. 900MHZDR
   900MHz Driver-Amplifier with the BFG425W
10. 933MHZ
    933 MHz Low Power Down converter with 60 MHz IF (BFG505/X,BFG520, BFG540/X)
11. DECT
    Power Amplifier for 1.9 GHz Dect and PHS (BFG425W and BFG21W)
12. IMUIP3
    Improved IP3 behaviour of the 900MHz Low Noise Amplifier with the BFG425W
13. KV96157A
    Ultra Low Noise Amplifiers for 900 and 2000 MHz with High IP3 (BFG410W and BFG425W)
14. PAGER
    Preamplifier for pager applications (BFC505)
15. 9001800MHZ
    Demoboard for the BGA2001 (900 and 1800MHz)
16. LNA
    Demoboard for the BGA2001
17. LNA900MHZ
    Demoboard 900MHz LNA with the BGA2003
18. WBCDMA
    Demoboard W-CDMA for the BGA2003

DEVICE DATA

in alphanumeric sequence

NPN 1 GHz wideband transistor BF547

FEATURES

- Feedback capacitance typ. 1 pF
- Stable oscillator operation
- High current gain
- Good thermal stability.

APPLICATIONS

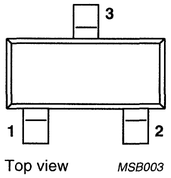
- It is intended for VHF and UHF TV-tuner applications and can be used as a mixer and/or oscillator.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

DESCRIPTION

Low cost NPN transistor in a plastic SOT23 package.



Marking code: E16.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
f_T	transition frequency	I_C = 15 mA; V_{CE} 10 V; f = 500 MHz	1.2	1.6	GHz
C_{re}	feedback capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	1	–	pF

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	from junction to soldering point	note 1	260	K/W

Note

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

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	$I_C = 2$ mA; $V_{CE} = 10$ V	40	95	250	
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	0.8	1.2	1.6	GHz
C_{re}	feedback capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	20	–	dB

Note

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 .

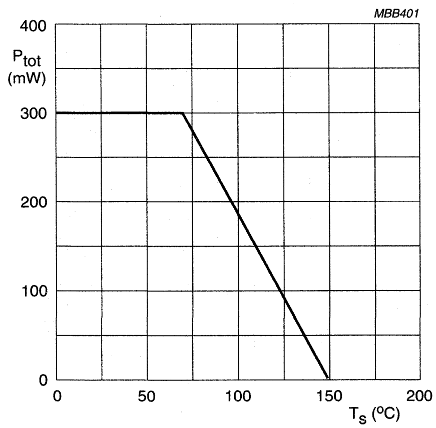
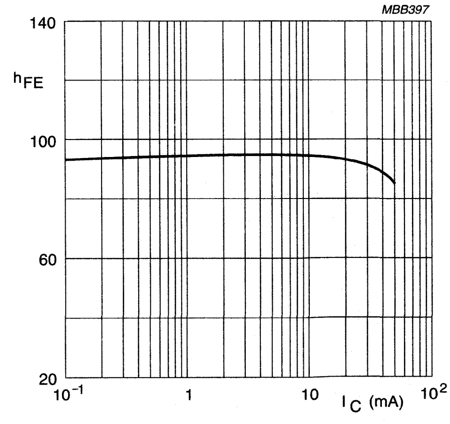
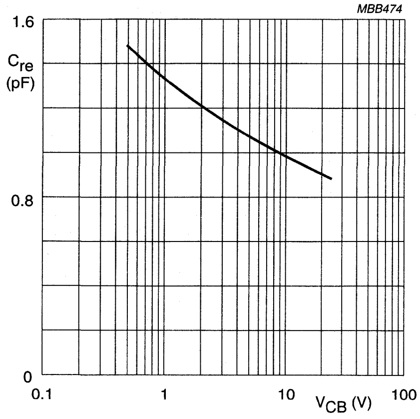


Fig.2 Power derating curve.



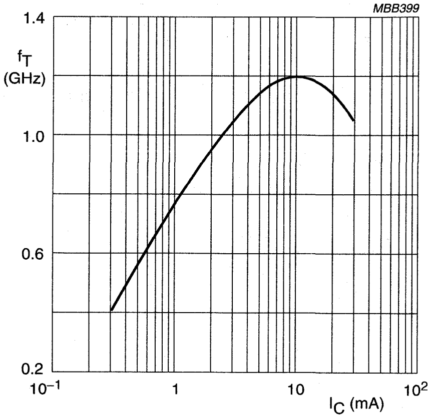
V_{CE} = 10 V.

Fig.3 DC current gain as a function of collector current.



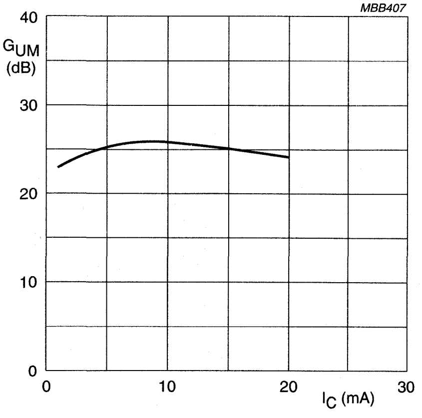
$I_E = i_e = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage



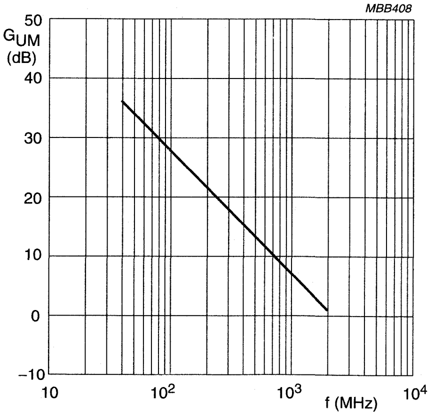
V_{CE} = 10 V; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current.



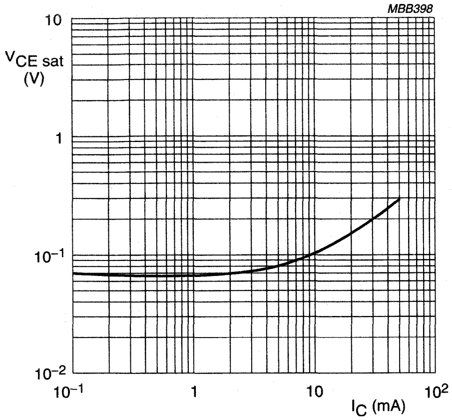
V_{CE} = 10 V; f = 100 MHz.

Fig.6 Maximum unilateral power gain as a function of collector current.



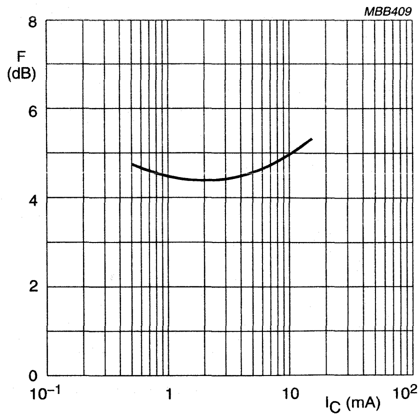
V_{CE} = 10 V; I_C = 15 mA.

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



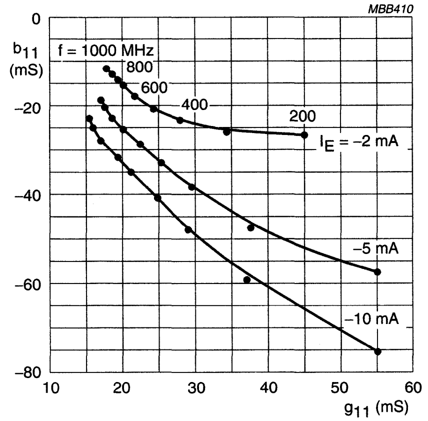
$I_C/I_B = 10$.

Fig.8 Collector-emitter saturation voltage as a function of collector current.



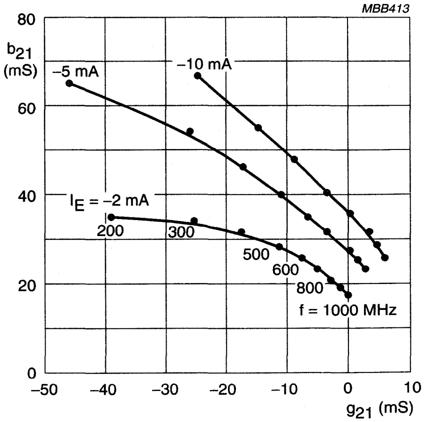
$V_{CE} = 10$ V; $Z_S = Z_L = 50\ \Omega$; f = 100 MHz.

Fig.9 Common emitter noise figure as a function of collector current.



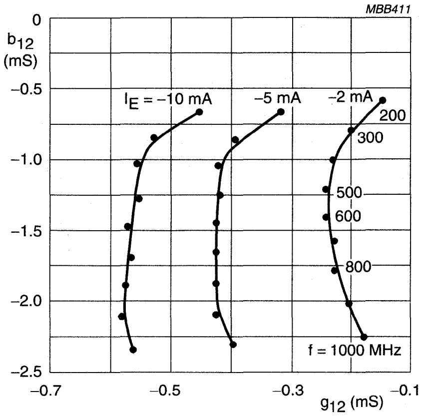
$V_{CB} = 10$ V.

Fig.10 Common base input admittance (Y_{11}).



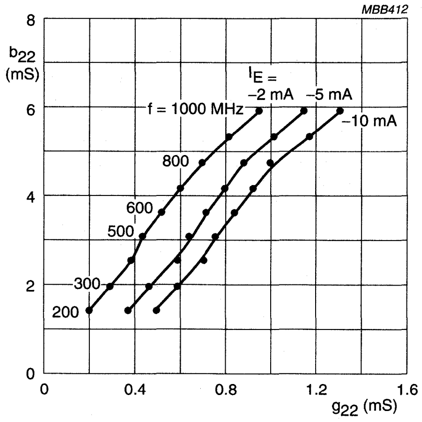
$V_{CB} = 10$ V.

Fig.11 Common base forward admittance (Y_{21}).



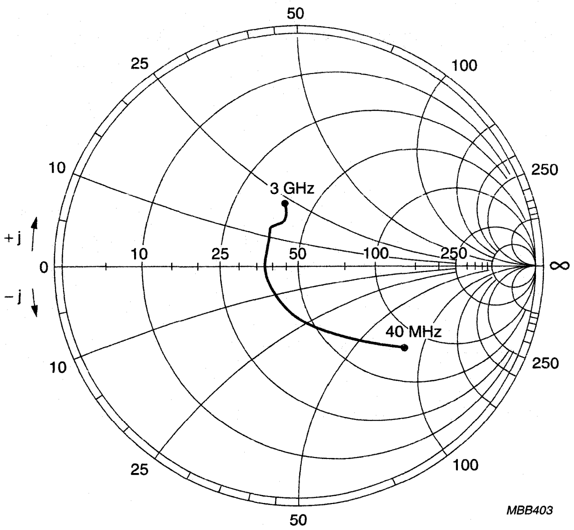
V_{CB} = 10 V.

Fig.12 Common base reverse admittance (Y_{12}).



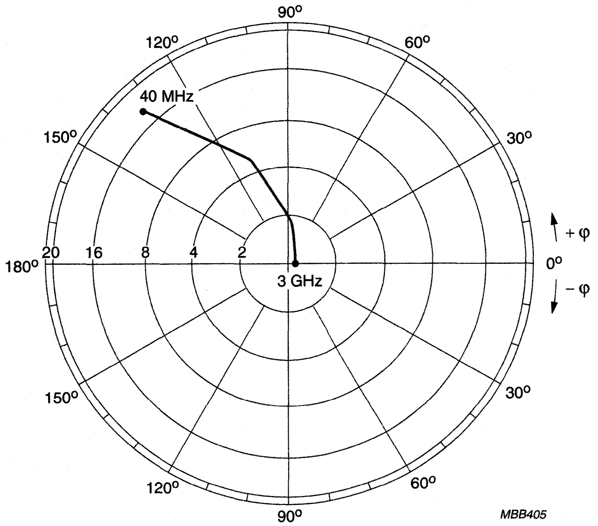
V_{CB} = 10 V.

Fig.13 Common base output admittance (Y_{22}).



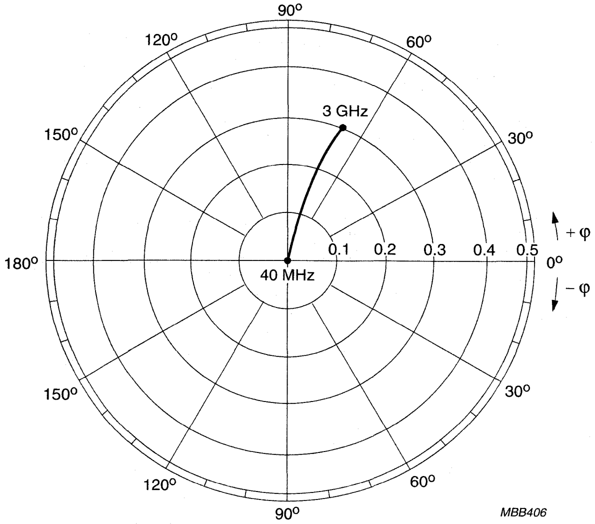
V_{CE} = 10 V; I_C = 15 mA; Z_O = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



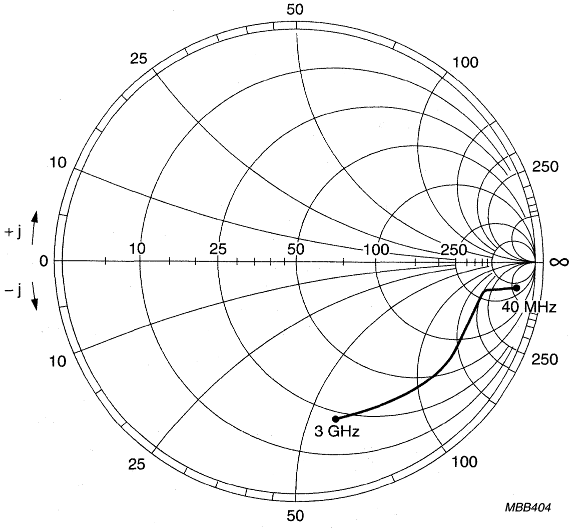
V_{CE} = 10 V; I_C = 15 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 10 V; I_C = 15 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 10 V; I_C = 15 mA; Z_O = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

Table 1 Common base Y-parameters; V_{CB} = 10 V; I_E = –2 mA

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	69.0	–10.2	–68.0	12.3	–0.02	–0.1	–0.01	0.3
100	60.4	–20.6	–58.0	25.6	–0.06	–0.3	–0.08	0.7
200	45.0	–27.4	–39.1	34.5	–0.10	–0.6	0.19	1.4
300	34.3	–26.4	–25.4	34.0	–0.20	–0.8	0.29	1.9
400	27.7	–23.3	–17.2	31.1	–0.20	–1.0	0.37	2.5
500	24.0	–20.4	–11.7	27.6	–0.20	–1.2	0.45	3.0
600	21.5	–18.0	–7.8	25.0	–0.20	–1.4	0.53	3.6
700	20.0	–15.6	–5.3	22.6	–0.20	–1.6	0.60	4.2
800	18.6	–14.0	–3.0	20.2	–0.20	–1.8	0.69	4.7
900	18.3	–12.8	–1.3	18.7	–0.20	–2.0	0.82	5.3
1000	17.8	–11.7	–0.1	17.1	–0.20	–2.2	0.95	5.9

Table 2 Common base Y-parameters; V_{CB} = 10 V; I_E = –5 mA

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	132.6	–35.7	–130.5	38.8	–0.06	–0.2	–0.06	0.4
100	96.3	–62.0	–91.1	67.9	–0.20	–0.5	0.21	0.8
200	54.7	–57.8	–46.0	64.7	–0.30	–0.7	0.38	1.4
300	37.5	–46.9	–26.4	53.8	–0.40	–0.8	0.47	2.0
400	29.2	–38.6	–16.6	45.8	–0.40	–1.0	0.58	2.5
500	25.3	–32.8	–11.0	39.8	–0.40	–1.3	0.63	3.1
600	22.0	–28.4	–6.3	35.0	–0.40	–1.4	0.71	3.6
700	20.3	–25.2	–3.3	31.4	–0.40	–1.6	0.80	4.2
800	18.7	–22.6	–0.6	27.6	–0.40	–1.9	0.88	4.7
900	17.8	–20.7	1.4	25.2	–0.40	–2.1	1.01	5.3
1000	17.3	–19.1	3.0	23.0	–0.40	–2.3	1.15	6.0

Table 3 Common base Y-parameters; V_{CB} = 10 V; I_E = −10 mA

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	189.0	−79.6	−185.5	83.0	−0.10	−0.3	−0.09	0.4
100	108.5	−99.0	−101.4	105.4	−0.30	−0.5	0.30	0.9
200	55.2	−76.2	−44.6	82.8	−0.50	−0.7	0.44	1.4
300	37.1	−59.0	−24.3	65.7	−0.50	−0.9	0.60	2.0
400	28.8	−47.6	−14.6	54.4	−0.60	−1.0	0.69	2.5
500	24.7	−40.2	−8.6	46.7	−0.60	−1.3	0.75	3.1
600	21.2	−35.0	−3.4	40.8	−0.60	−1.5	0.84	3.6
700	19.3	−31.0	−0.2	36.2	−0.60	−1.7	0.93	4.2
800	17.2	−27.5	2.6	31.1	−0.60	−1.9	1.00	4.7
900	16.4	−25.2	4.6	28.3	−0.60	−2.1	1.15	5.3
1000	15.8	−23.0	6.0	25.5	−0.60	−2.3	1.31	6.0

Table 4 Common base Y-parameters; V_{CB} = 10 V; I_E = −15 mA

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	206.5	−113.8	−202.6	118.1	−0.20	−0.3	0.2	0.5
100	104.3	−114.0	−96.4	120.1	−0.40	−0.5	0.4	0.9
200	53.1	−81.1	−41.7	87.7	−0.50	−0.7	0.6	1.4
300	35.9	−62.1	−22.0	68.6	−0.60	−0.8	0.7	2.0
400	28.1	−50.0	−12.5	56.9	−0.60	−1.1	0.8	2.5
500	23.4	−42.3	−6.1	48.2	−0.60	−1.3	0.8	3.1
600	20.1	−36.4	−1.2	41.6	−0.60	−1.5	0.9	3.6
700	18.2	−32.0	2.0	36.7	−0.60	−1.7	1.0	4.2
800	16.2	−28.2	4.5	31.3	−0.60	−1.9	1.1	4.7
900	15.5	−25.7	6.5	28.1	−0.60	−2.1	1.3	5.3
1000	14.7	−23.5	7.9	24.9	−0.60	−2.3	1.4	5.9

NPN 1 GHz wideband transistor BF547W

FEATURES

Stable oscillator operation

- High current gain
- Good thermal stability.

APPLICATIONS

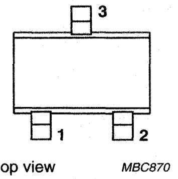
It is primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners.

DESCRIPTION

Silicon NPN transistor in a plastic SOT323 (S-mini) package. The BF547W uses the same crystal as the SOT23 version, BF547.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: E2.

Fig.1 SOT323

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	–	20	V
I_C	collector current (DC)		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 63 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 10 V	40	95	250	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 10 V; f = 1 MHz	–	1	–	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz	0.8	1.2	1.6	GHz
G_{UM}	maximum unilateral power gain	I_C = 1 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C	–	20	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	up to T_s = 63 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	+150	°C

Note to the “Quick reference data” and “Limiting values”

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 63$ °C; note 1	290	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 0.01$ mA; $I_E = 0$	–	–	30	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10$ mA; $I_B = 0$	–	–	20	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 0.01$ mA; $I_C = 0$	–	–	3	V
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 10$ V	40	95	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	0.8	1.2	1.6	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz; $T_{amb} = 25$ °C;	–	20	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)}$ dB.

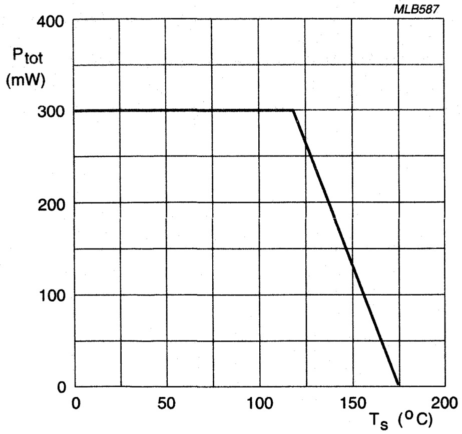
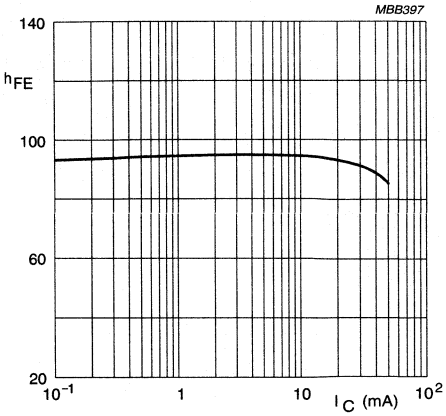
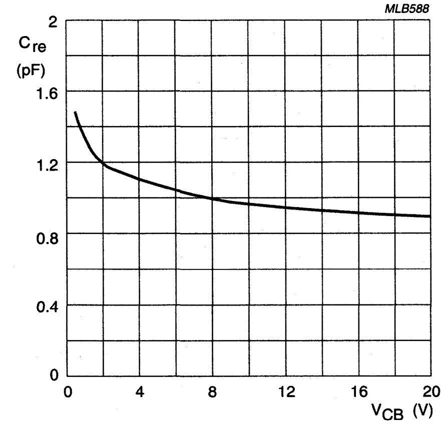


Fig.2 Power derating curve.



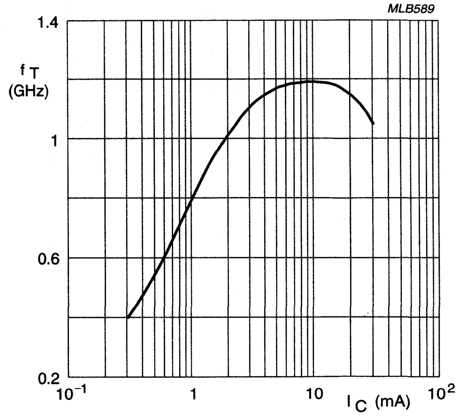
V_{CE} = 10 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current; typical values.



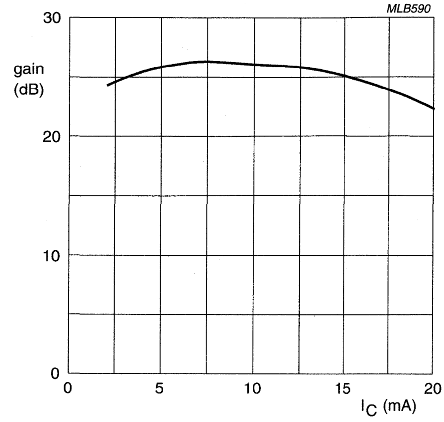
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



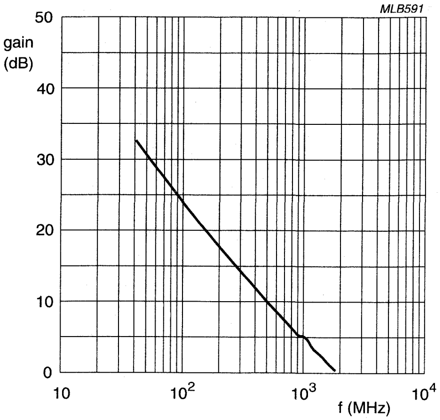
V_{CE} = 10 V; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



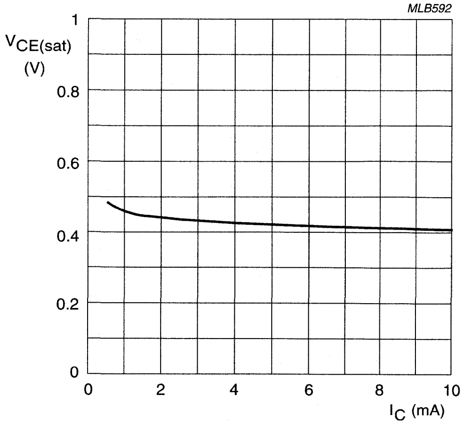
V_{CE} = 10 V; f = 100 MHz.

Fig.6 Gain as a function of collector current; typical values.



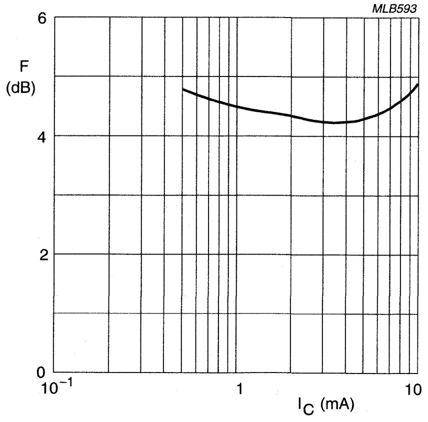
V_{CE} = 10 V; I_C = 15 mA.

Fig.7 Gain as a function of frequency; typical values.



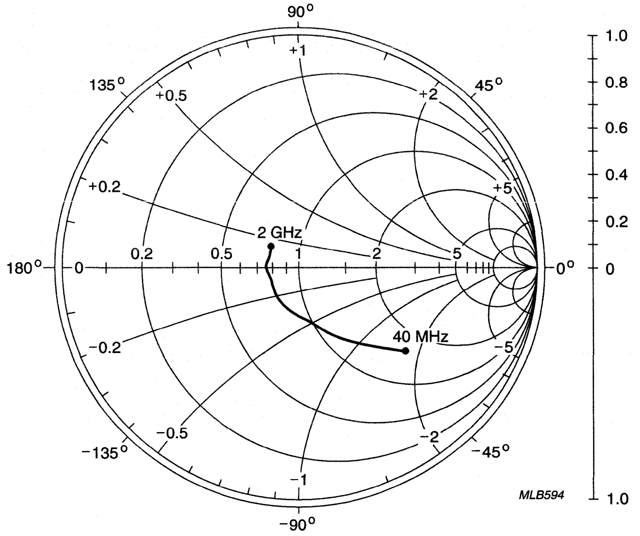
I_C/I_B = 10.

Fig.8 Collector-emitter saturation voltage as a function of collector current; typical values.



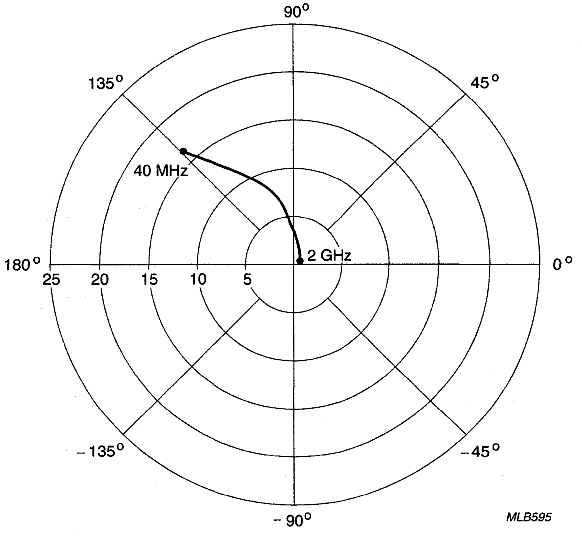
V_{CE} = 10 V; Z_S = Z_L = 50 Ω; f = 100 MHz.

Fig.9 Minimum noise figure as a function of collector current; typical values.



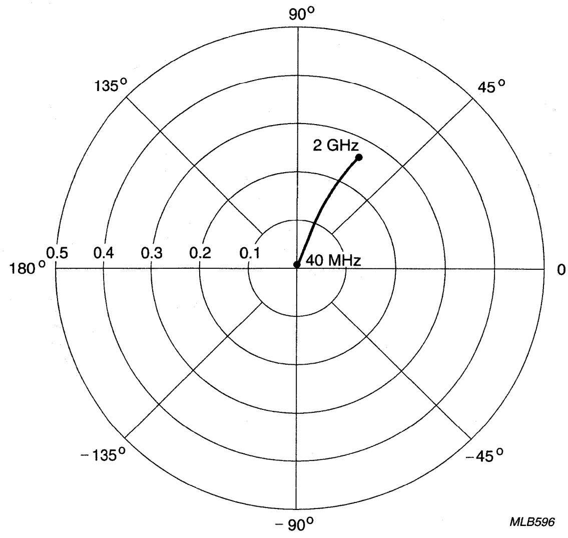
V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.10 Common emitter input reflection coefficient (s_{11}); typical values.



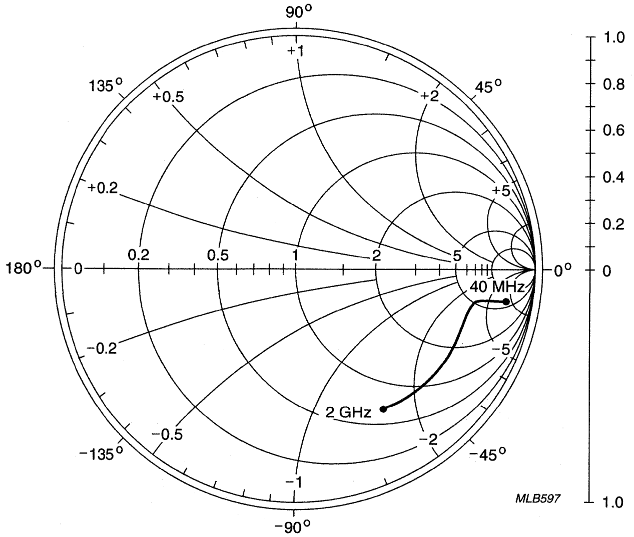
V_{CE} = 10 V; I_C = 15 mA.

Fig.11 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 10 V; I_C = 15 mA.

Fig.12 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

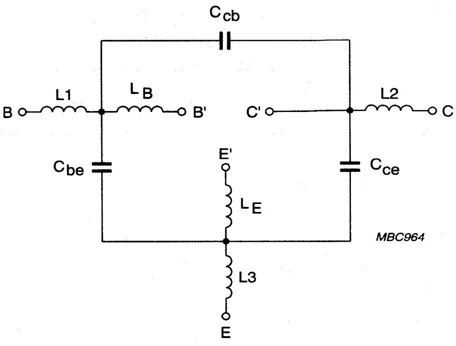
Fig.13 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BF547W crystal

SEQUENCE NO.	PARAMETER	VALUE	UNIT
1	IS	289.1	aA
2	BF	94.29	–
3	NF	0.989	–
4	VAF	90.00	V
5	IKF	158.6	mA
6	ISE	426.6	aA
7	NE	1.491	–
8	BR	12.32	–
9	NR	0.989	–
10	VAR	19.39	V
11	IKR	24.75	mA
12	ISC	249.7	pA
13	NC	1.200	–
14	RB	50.00	Ω
15	IRB	1.000	µA
16	RBM	50.00	Ω
17	RE	0.500	Ω
18	RC	1.309	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.071	pF
23	VJE	727.3	mV
24	MJE	0.332	–
25	TF	92.98	ps
26	XTF	43.89	–
27	VTF	1.813	V
28	ITF	143.9	mA
29	PTF	0.000	deg
30	CJC	1.167	pF
31	VJC	489.0	mV
32	MJC	0.253	–
33	XCJC	0.150	–
34	TR	50.00	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.950	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 100 MHz.

Fig.14 Package equivalent circuit SOT323.

List of components (see Fig.14).

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH

NPN 1 GHz wideband transistor BF747

FEATURES

- Stable oscillator operation
- High current gain
- Good thermal stability.

APPLICATIONS

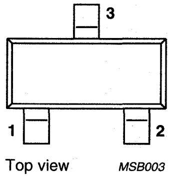
- It is intended for VHF and UHF TV-tuner applications and can be used as a mixer and/or oscillator.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

DESCRIPTION

Low cost NPN transistor in a plastic SOT23 package.



Marking code: E15.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to $T_s = 70$ °C; note 1	–	300	mW
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	1.2	1.6	GHz

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to $T_s = 70$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 70$ °C; note 1	260	K/W

Note

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

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	$I_C = 2$ mA; $V_{CE} = 10$ V	40	95	250	
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	0.8	1.2	1.6	GHz
C_{re}	feedback capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	20	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \dfrac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB .

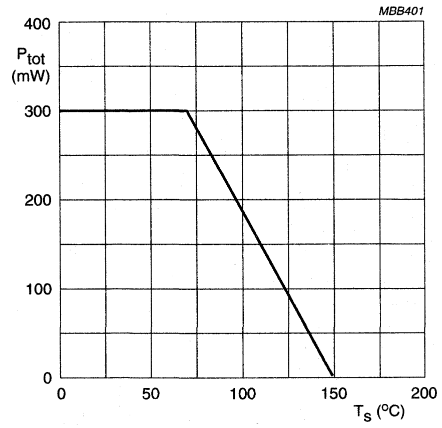
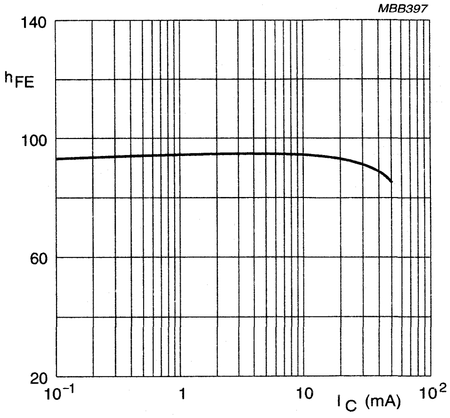
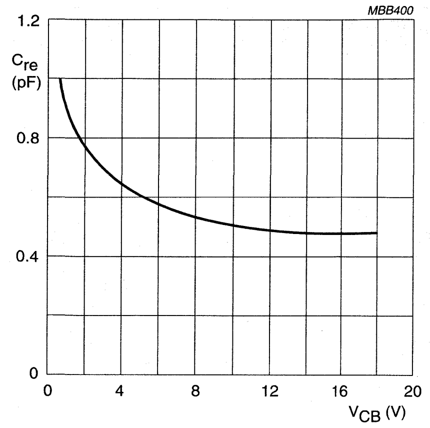


Fig.2 Power derating curve.



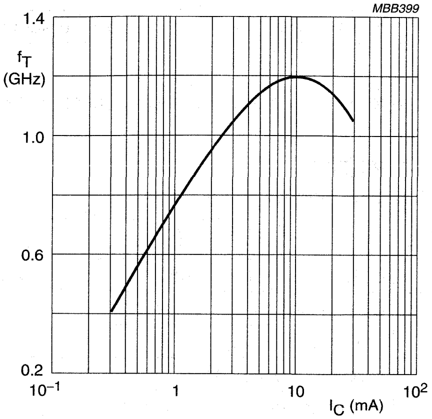
$V_{CE} = 10$ V.

Fig.3 DC current gain as a function of collector current.



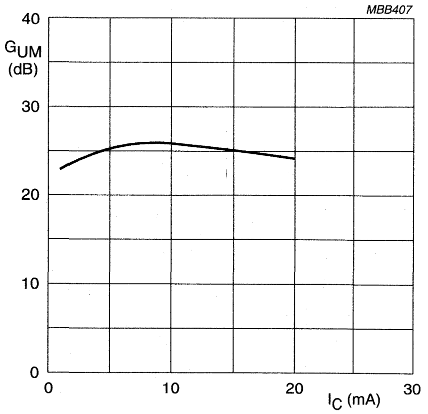
$I_E = i_e = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



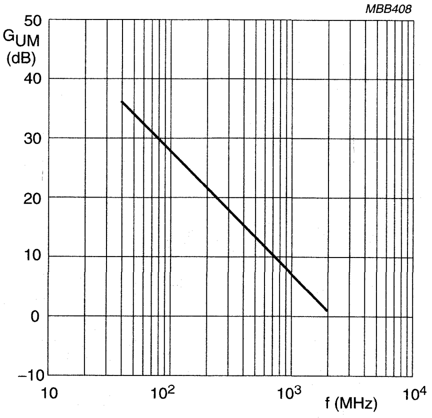
V_{CE} = 10 V; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current.



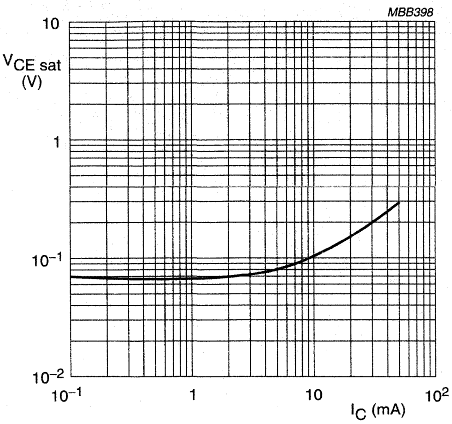
V_{CE} = 10 V; f = 100 MHz.

Fig.6 Maximum unilateral power gain as a function of collector current.



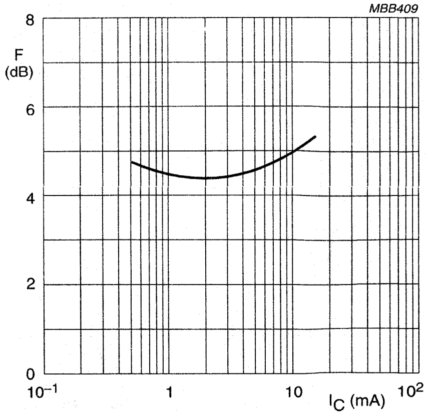
I_C = 15 mA; V_{CE} = 10 V.

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



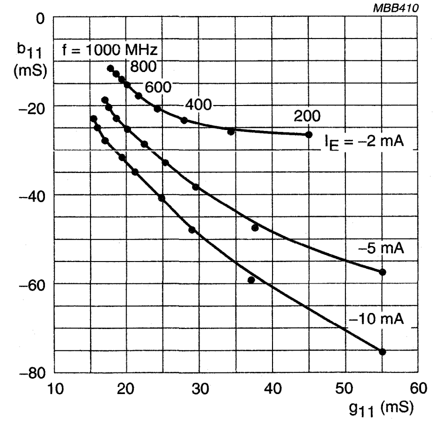
$I_C/I_B = 10$.

Fig.8 Collector-emitter saturation voltage as a function of collector current.



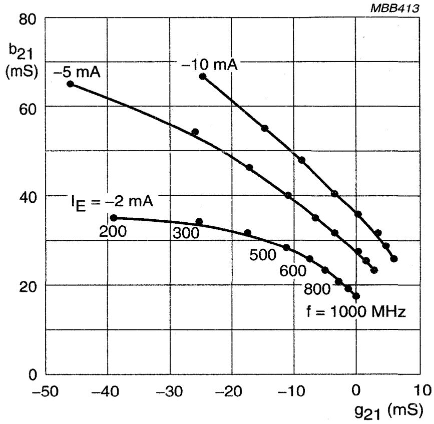
$V_{CE} = 10$ V; $Z_S = Z_L = 50$ Ω.; f = 100 MHz.

Fig.9 Common emitter noise figure as a function of collector current.



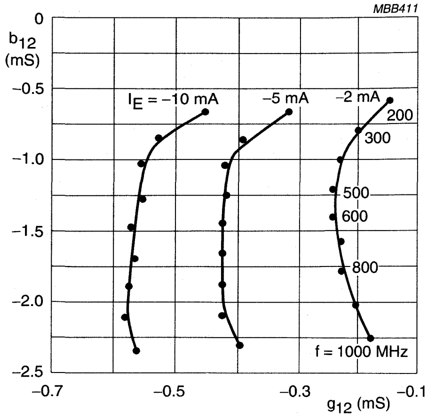
$V_{CB} = 10$ V.

Fig.10 Common base input admittance (Y_{11}).



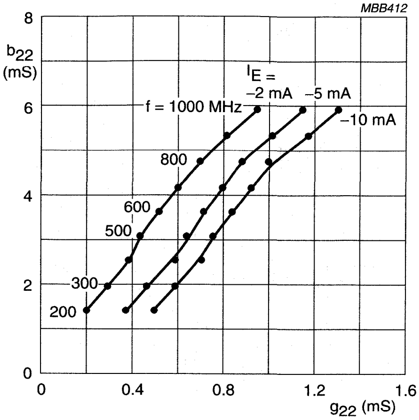
$V_{CB} = 10$ V.

Fig.11 Common base forward admittance (Y_{21}).



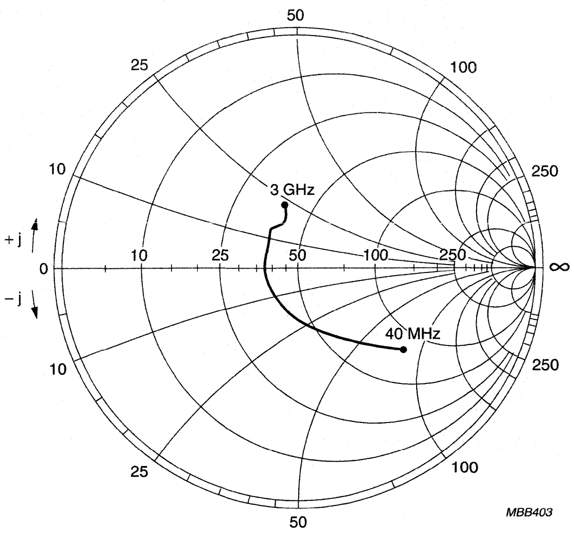
V_{CB} = 10 V.

Fig.12 Common base reverse admittance (Y_{12}).



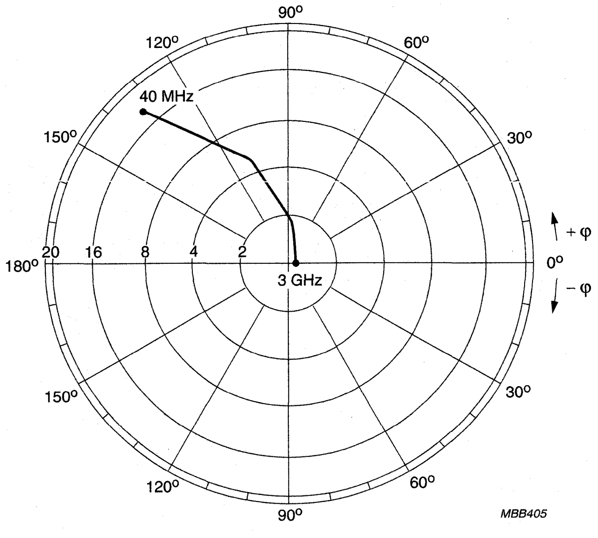
V_{CB} = 10 V.

Fig.13 Common base output admittance (Y_{22}).



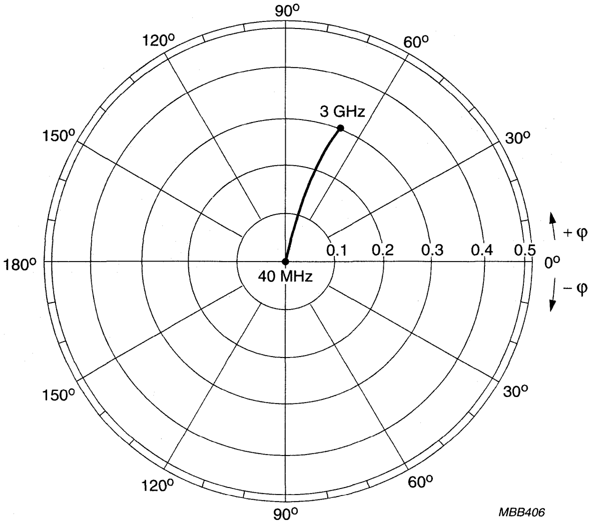
I_C = 15 mA; V_{CE} = 10 V; Z_O = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



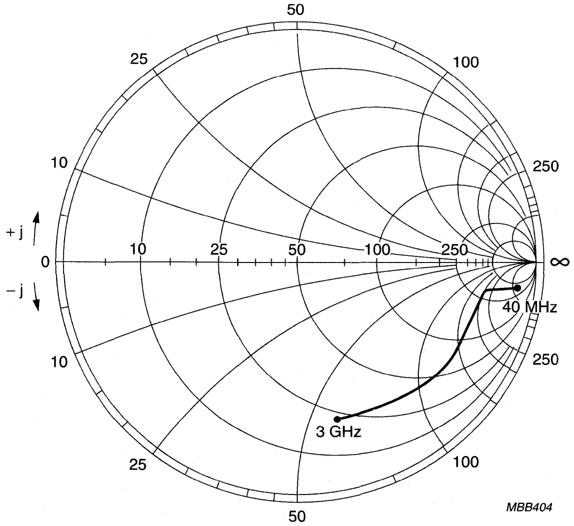
I_C = 15 mA; V_{CE} = 10 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 15 mA; V_{CE} = 10 V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



I_C = 15 mA; V_{CE} = 10 V; Z_O = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

Table 1 Common base Y-parameters, I_E = –2 mA; V_{CB} = 10 V, typical values.

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	69.0	–10.2	–68.0	12.3	–0.02	–0.1	–0.01	0.3
100	60.4	–20.6	–58.0	25.6	–0.06	–0.3	–0.08	0.7
200	45.0	–27.4	–39.1	34.5	–0.10	–0.6	0.19	1.4
300	34.3	–26.4	–25.4	34.0	–0.20	–0.8	0.29	1.9
400	27.7	–23.3	–17.2	31.1	–0.20	–1.0	0.37	2.5
500	24.0	–20.4	–11.7	27.6	–0.20	–1.2	0.45	3.0
600	21.5	–18.0	–7.8	25.0	–0.20	–1.4	0.53	3.6
700	20.0	–15.6	–5.3	22.6	–0.20	–1.6	0.60	4.2
800	18.6	–14.0	–3.0	20.2	–0.20	–1.8	0.69	4.7
900	18.3	–12.8	–1.3	18.7	–0.20	–2.0	0.82	5.3
1000	17.8	–11.7	–0.1	17.1	–0.20	–2.2	0.95	5.9

Table 2 Common base Y-parameters, I_E = –5 mA; V_{CB} = 10 V, typical values.

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**	**REAL (mS)**	**IMAG. (mS)**
40	132.6	–35.7	–130.5	38.8	–0.06	–0.2	–0.06	0.4
100	96.3	–62.0	–91.1	67.9	–0.20	–0.5	0.21	0.8
200	54.7	–57.8	–46.0	64.7	–0.30	–0.7	0.38	1.4
300	37.5	–46.9	–26.4	53.8	–0.40	–0.8	0.47	2.0
400	29.2	–38.6	–16.6	45.8	–0.40	–1.0	0.58	2.5
500	25.3	–32.8	–11.0	39.8	–0.40	–1.3	0.63	3.1
600	22.0	–28.4	–6.3	35.0	–0.40	–1.4	0.71	3.6
700	20.3	–25.2	–3.3	31.4	–0.40	–1.6	0.80	4.2
800	18.7	–22.6	–0.6	27.6	–0.40	–1.9	0.88	4.7
900	17.8	–20.7	1.4	25.2	–0.40	–2.1	1.01	5.3
1000	17.3	–19.1	3.0	23.0	–0.40	–2.3	1.15	6.0

Table 3 Common base Y-parameters, I_E = –10 mA; V_{CB} = 10 V, typical values.

f (MHZ)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)
40	189.0	–79.6	–185.5	83.0	–0.10	–0.3	–0.09	0.4
100	108.5	–99.0	–101.4	105.4	–0.30	–0.5	0.30	0.9
200	55.2	–76.2	–44.6	82.8	–0.50	–0.7	0.44	1.4
300	37.1	–59.0	–24.3	65.7	–0.50	–0.9	0.60	2.0
400	28.8	–47.6	–14.6	54.4	–0.60	–1.0	0.69	2.5
500	24.7	–40.2	–8.6	46.7	–0.60	–1.3	0.75	3.1
600	21.2	–35.0	–3.4	40.8	–0.60	–1.5	0.84	3.6
700	19.3	–31.0	–0.2	36.2	–0.60	–1.7	0.93	4.2
800	17.2	–27.5	2.6	31.1	–0.60	–1.9	1.00	4.7
900	16.4	–25.2	4.6	28.3	–0.60	–2.1	1.15	5.3
1000	15.8	–23.0	6.0	25.5	–0.60	–2.3	1.31	6.0

Table 4 Common base Y-parameters, I_E = –15 mA; V_{CB} = 10 V, typical values.

f (MHz)	Y_{11}		Y_{21}		Y_{12}		Y_{22}	
	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)	REAL (mS)	IMAG. (mS)
40	206.5	–113.8	–202.6	118.1	–0.20	–0.3	0.2	0.5
100	104.3	–114.0	–96.4	120.1	–0.40	–0.5	0.4	0.9
200	53.1	–81.1	–41.7	87.7	–0.50	–0.7	0.6	1.4
300	35.9	–62.1	–22.0	68.6	–0.60	–0.8	0.7	2.0
400	28.1	–50.0	–12.5	56.9	–0.60	–1.1	0.8	2.5
500	23.4	–42.3	–6.1	48.2	–0.60	–1.3	0.8	3.1
600	20.1	–36.4	–1.2	41.6	–0.60	–1.5	0.9	3.6
700	18.2	–32.0	2.0	36.7	–0.60	–1.7	1.0	4.2
800	16.2	–28.2	4.5	31.3	–0.60	–1.9	1.1	4.7
900	15.5	–25.7	6.5	28.1	–0.60	–2.1	1.3	5.3
1000	14.7	–23.5	7.9	24.9	–0.60	–2.3	1.4	5.9

NPN wideband cascode transistor BFC505

FEATURES

- Small size
- High power gain at low bias current and high frequencies
- High reverse isolation
- Low noise figure
- Gold metallization ensures excellent reliability
- Minimum operating voltage V_{C2-E1} = 1 V.

APPLICATIONS

- Low voltage, low current, low noise and high gain amplifiers
- Oscillator buffer amplifiers
- Wideband voltage-to-current converters.

DESCRIPTION

Cascode amplifier with two discrete dies in a surface mount, 5-pin SOT353 (S-mini) package. The amplifier is primarily intended for low power RF communications equipment, such as pagers and has a very low feedback capacitance resulting in high isolation.

PINNING - SOT353

PIN	SYMBOL	DESCRIPTION
1	b_2	base 2
2	e_1	emitter 1
3	b_1	base 1
4	c_1/e_2	collector 1/emitter 2
5	c_2	collector 2

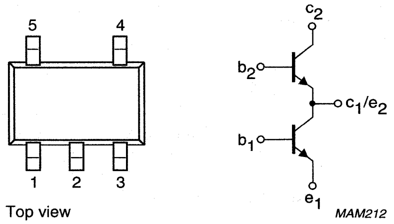


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

b_2 connected to ground via 1 nF (0603) capacitor, e_1 connected directly to ground.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance C_{B1-C2}	I_e = 0; V_{C2-E1} = 0; f = 1 MHz	–	–	10	fF
$\lvert s_{21}/s_{12}\rvert^2$	maximum isolation	I_C = 5 mA; V_{C2} = V_{B2} = 3 V; f = 900 MHz	60	–	–	dB
MSG	maximum stable power gain	I_C = 0.5 mA; V_{C2} = V_{B2} = 1 V; f = 900 MHz; T_{amb} = 25 °C	–	22	–	dB
F	noise figure	I_C = 0.5 mA; V_{C2-E1} = 1 V; f = 500 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.4	dB
		I_C = 1 mA; V_{C2-E1} = 3 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.8	2.1	dB
$R_{th\ j-s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

NPN wideband cascode transistor BFC505

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

$T_j = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $I_B = 0$	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 6\ V$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5\ mA$; $V_{CE} = 6\ V$	60	120	250	
AC characteristics of the cascode configuration measured in test circuit (note 1)						
f_T	transition frequency	$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 1\ GHz$	–	7.3	–	GHz
C_c	collector capacitance T2	$I_E = i_e = 0$; $V_{C2\text{-}B2} = 0$; $f = 1\ MHz$	–	0.4	–	pF
C_{re2}	feedback capacitance T2	$I_C = 0$; $V_{C2\text{-}E1} = 3\ V$; $f = 1\ MHz$	–	250		fF
C_{re}	feedback capacitance	$I_C = 0$; $V_{C2\text{-}E1} = 3\ V$; $f = 1\ MHz$	–	–	10	fF
MSG	maximum stable power gain; note 2	$I_C = 0.25\ mA$; $V_{C2\text{-}E1} = 1\ V$; $f = 300\ MHz$; $T_{amb} = 25\ °C$	–	25	–	dB
		$I_C = 0.5\ mA$; $V_{C2\text{-}E1} = 1\ V$; $f = 900\ MHz$; $T_{amb} = 25\ °C$	–	22	–	dB
		$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 2\ GHz$; $T_{amb} = 25\ °C$	–	23	–	dB
$\|s_{21}\|^2$	insertion power gain	$I_C = 0.5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 300\ MHz$; $T_{amb} = 25\ °C$	–	21	–	dB
		$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 900\ MHz$; $T_{amb} = 25\ °C$	–	16	–	dB
		$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 2\ GHz$; $T_{amb} = 25\ °C$	–	11	–	dB
$\|s_{21}/s_{12}\|^2$	maximum isolation; note 3	$I_C = 0.5\ mA$; $V_{C2\text{-}E1} = 1\ V$; $f = 900\ MHz$	40	45	–	dB
		$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 900\ MHz$	60	68	–	dB
		$I_C = 5\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 2\ GHz$	40	48	–	dB
F	noise figure	$I_C = 0.5\ mA$; $V_{C2\text{-}E1} = 1\ V$; $f = 500\ MHz$; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.4	dB
		$I_C = 1\ mA$; $V_{C2\text{-}E1} = 3\ V$; $f = 900\ MHz$; $\Gamma_S = \Gamma_{opt}$	–	1.8	2.1	dB
		$I_C = 1\ mA$; $V_{C2\text{-}E1} = 1\ V$; $f = 2\ GHz$; $\Gamma_S = \Gamma_{opt}$	–	3.5	–	dB
IP_3	third order intercept point (input)	note 4	–	–20	–	dBm

Notes

1. $V_{B2} = V_{C2-E1}/2 + 0.6\ V$
2. $MSG = |s_{12}/s_{21}| \times (k - \sqrt{k^2 - 1})$; $k = \dfrac{1 + |s_{11} \times s_{22} - s_{12} \times s_{21}|^2 - (|s_{11}|^2 - |s_{22}|^2)}{2 \times |s_{12} \times s\sqrt{\ }_{21}|}$
3. Maximum isolation is defined as the isolation when S_{21} of the amplifier is reduced to unity (buffer application).
4. $I_C = 1$ mA; $V_{CE} = 3$ V; $R_S = 50\ \Omega$; Z_L = opt; $T_{amb} = 25$ °C; $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 904$ MHz.

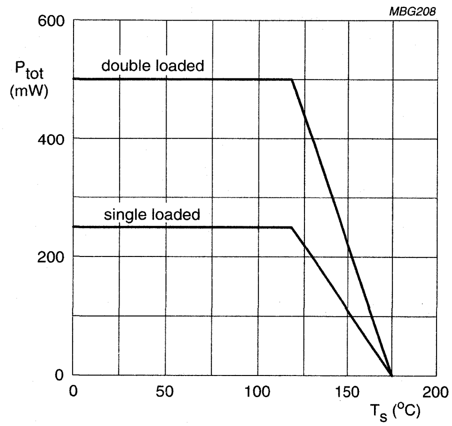
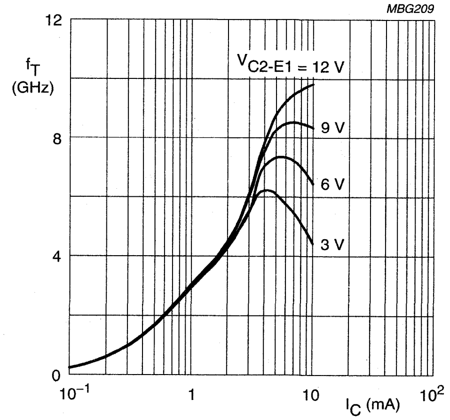
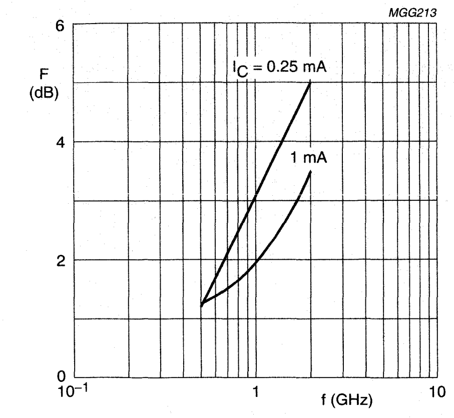


Fig.2 Power derating as a function of soldering point temperature; typical values.



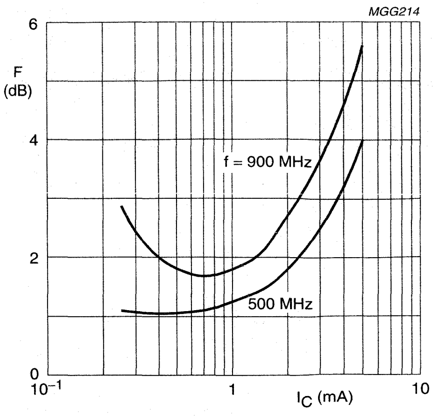
f = 1 GHz; T_{amb} = 25 °C.

Fig.3 Transition frequency as a function of collector current; typical values.



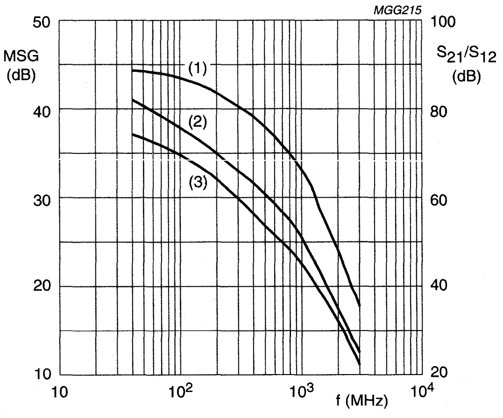
$V_{C2\text{-}E1}$ = 1 V.

Fig.4 Minimum noise figure as a function of frequency; typical values.



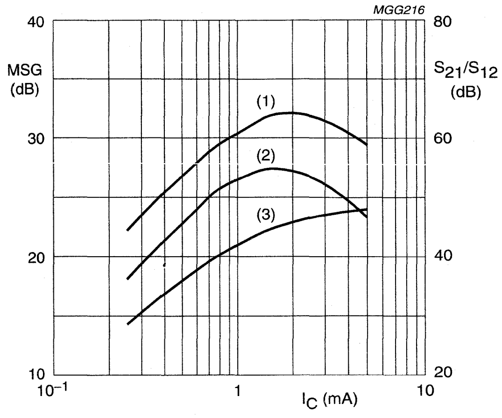
$V_{C2\text{-}E1}$ = 1 V.

Fig.5 Minimum noise figure as a function of collector current; typical values.



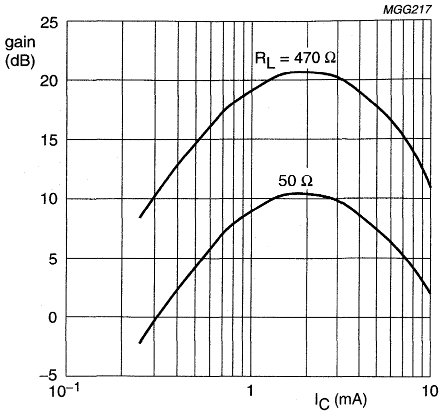
(1) I_C = 5 mA; $V_{C2\text{-}E1}$ = 3 V.
(2) I_C = 1 mA; $V_{C2\text{-}E1}$ = 1 V.
(3) I_C = 0.5 mA; $V_{C2\text{-}E1}$ = 1 V.

Fig.6 Maximum stable gain and isolation as functions of frequency; typical values.



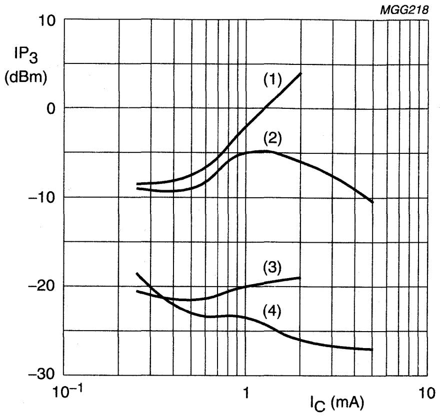
(1) $V_{C2\text{-}E1}$ = 1 V; f = 500 MHz.
(2) $V_{C2\text{-}E1}$ = 1 V; f = 900 MHz.
(3) $V_{C2\text{-}E1}$ = 3 V; f = 2 GHz.

Fig.7 Maximum stable gain and isolation as functions of collector current; typical values.



V_{CE} = 1 V; R_S = 50 Ω; X_S = X_L = opt; f = 900 MHz.

Fig.8 Transducer gain as a function of collector current; typical values.



Point tuned for maximum gain with double slug tuners; f = 900 MHz.

(1) IP_3 (output); $V_{C2\text{-}E1}$ = 3 V. (2) IP_3 (output); $V_{C2\text{-}E1}$ = 1 V.

(3) IP_3 (input); $V_{C2\text{-}E1}$ = 3 V. (4) IP_3 (input); $V_{C2\text{-}E1}$ = 1 V.

Fig.9 Third order intercept point as a function of collector current; typical values.

NPN wideband cascode transistor BFC505

APPLICATION INFORMATION

SPICE parameters for any single BFC505 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	134.1	aA
2	BF	180.0	–
3	NF	0.988	–
4	VAF	38.34	V
5	IKF	150.0	mA
6	ISE	27.81	fA
7	NE	2.051	–
8	BR	55.19	–
9	NR	0.982	–
10	VAR	2.459	V
11	IKR	2.920	mA
12	ISC	17.45	aA
13	NC	1.062	–
14	RB	20.00	Ω
15	IRB	1.000	μA
16	RBM	20.00	Ω
17	RE	1.171	Ω
18	RC	4.350	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	284.7	fF
23	VJE	600.0	mV
24	MJE	0.303	–
25	TF	7.037	ps
26	XTF	12.34	–
27	VTF	1.701	V
28	ITF	30.64	mA
29	PTF	0.000	deg
30	CJC	242.4	fF
31	VJC	188.6	mV
32	MJC	0.041	–
33	XCJC	0.130	–
34	TR	1.332	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.897	–

Note

1. These parameters have not been extracted, the default values are shown.

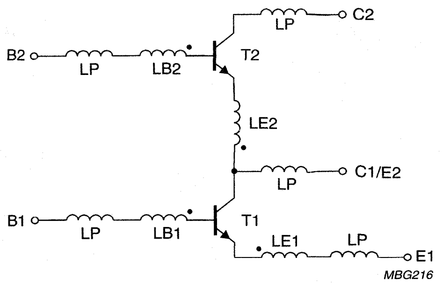


Fig.10 Package equivalent circuit SOT353A (inductance only).

Lead and mutual inductances (nH)

LP	0.4
LB1,2	0.5
LE1,2	0.8

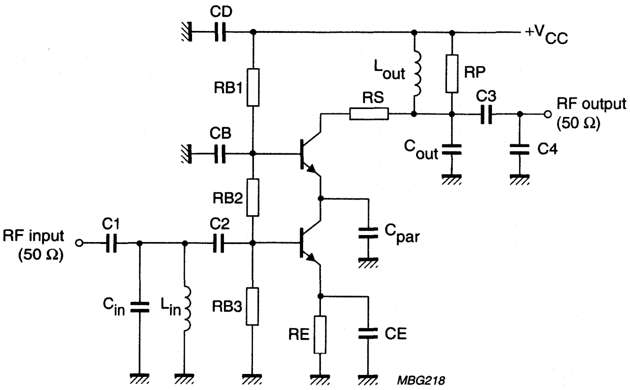
M(LB1,LE1)	+0.4
M(LB1,LE2)	+0.25

	B1	E1	B2	C2
E1	35			
B2	3.5	35		
C2	2	35	36	
C1/E2	36	35	2	15

MBG217

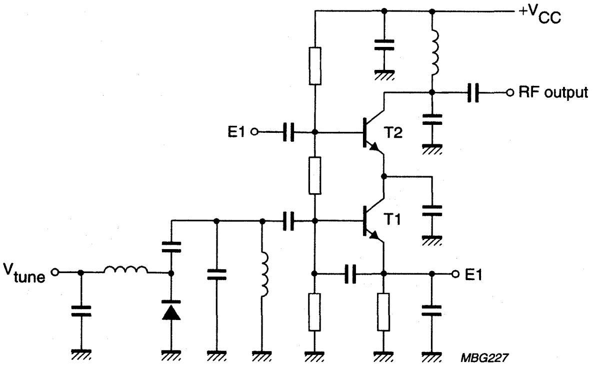
Fig.11 Package capacitance (fF) between indicated nodes.

Typical application circuits



RS increases stability.

Fig.12 Narrowband amplifier.



T1 forms a colpitts oscillator.
T2 acts as a buffer amplifier.

Fig.13 VCO/buffer combination.

NPN wideband cascode transistor BFC520

FEATURES

- Small size
- High power gain at low bias current and high frequencies
- High reverse isolation
- Low noise figure
- Gold metallization ensures excellent reliability
- Minimum operating voltage $V_{C2-E1} = 1$ V.

APPLICATIONS

- Low noise, high gain amplifiers
- Oscillator buffer amplifiers
- Wideband voltage-to-current converters.

DESCRIPTION

Cascode amplifier with two discrete dies in a surface mount, 5-pin SOT353 (S-mini) package. The amplifier is primarily intended for low power RF communications equipment, such as pagers and cordless phones and has a very low feedback capacitance resulting in high isolation.

PINNING - SOT353

SYMBOL	PIN	DESCRIPTION
b_2	1	base 2
e_1	2	emitter 1
b_1	3	base 1
c_1/e_2	4	collector 1/emitter 2
c_2	5	collector 2

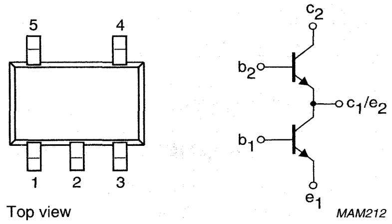


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

$V_{C2-E1} = 3$ V; $I_C = 20$ mA; $V_{B2} = 2.1$ V; b_2 connected to ground via 1 nF (0603) capacitor, e_1 connected directly to ground.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance C_{B1-C2}		–	–	10	fF
$\lvert s_{21}/s_{12}\rvert^2$	maximum isolation	f = 900 MHz; $T_{amb} = 25$ °C	–	−63	–	dB
		f = 2 GHz; $T_{amb} = 25$ °C	–	−38	–	dB
MSG	maximum stable power gain (narrowband)	f = 900 MHz; $T_{amb} = 25$ °C	–	31	–	dB
		f = 2 GHz; $T_{amb} = 25$ °C	–	19	–	dB
F	noise figure	$I_C = 5$ mA; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.6	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $I_B = 0$	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
AC characteristics of the cascode configuration						
f_T	transition frequency	$I_C = 20$ mA; $V_{C2\text{-}E1} = 3$ V; f = 1 GHz	–	7	–	GHz
C_c	collector capacitance T2	$I_E = i_e = 0$; $V_{C2\text{-}B2} = 1$ V; f = 1 MHz	–	0.55	–	pF
C_{re2}	feedback capacitance T2	$I_C = 0$; $V_{C2\text{-}E1} = 3$ V; f = 1 MHz	–	500	–	fF
C_{re}	feedback capacitance	$I_C = 0$; $V_{C2\text{-}E1} = 3$ V; f = 1 MHz	–	–	10	fF
MSG	maximum stable power gain; note 1	$I_C = 20$ mA; $V_{C2\text{-}E1} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	31	–	dB
		$I_C = 20$ mA; $V_{C2\text{-}E1} = 3$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	19	–	dB
$\vert s_{21}\vert^2$	insertion power gain	$I_C = 20$ mA; $V_{C2\text{-}E1} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
		$I_C = 20$ mA; $V_{C2\text{-}E1} = 3$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	13	–	dB
$\vert s_{21}/s_{12}\vert^2$	maximum isolation; note 2	f = 900 MHz	–	63	–	dB
		f = 2 GHz	–	38	–	dB
F	noise figure	$I_C = 5$ mA; $V_{C2\text{-}E1} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.6	dB
IP_3	third order intercept point (input)	note 3	–	−18	–	dBm

Notes

1. MSG = $|s_{12}/s_{21}| \times (k - \sqrt{k^2 - 1})$ $\quad k = \dfrac{1 + |s_{11} \times s_{22} - s_{12} \times s_{21}|^2 - (|s_{11}|^2 - |s_{22}|^2)}{2 \times |s_{12} \times s_{21}|}$
2. Maximum isolation is defined as the isolation when S_{21} of the amplifier is reduced to unity (buffer application).
3. I_C =5 mA; $V_{CE} = 3$ V; $R_S = 50\ \Omega$; Z_L = opt; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 904$ MHz.

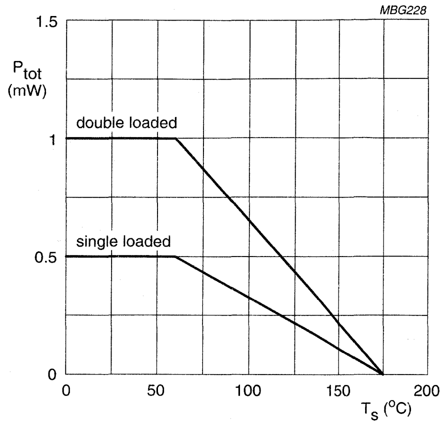
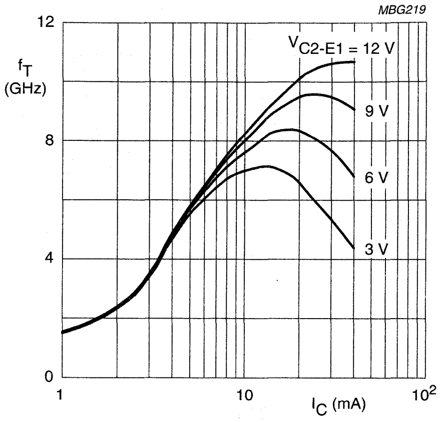
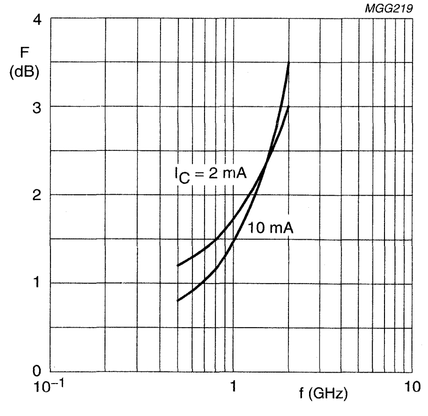


Fig.2 Power derating as a function of soldering point temperature; typical values.



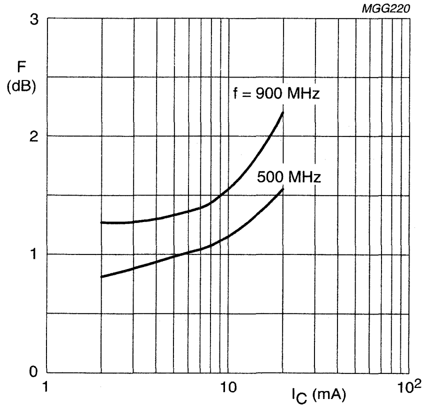
f = 1 GHz; T_{amb} = 25 °C.

Fig.3 Transition frequency as a function of collector current; typical values.



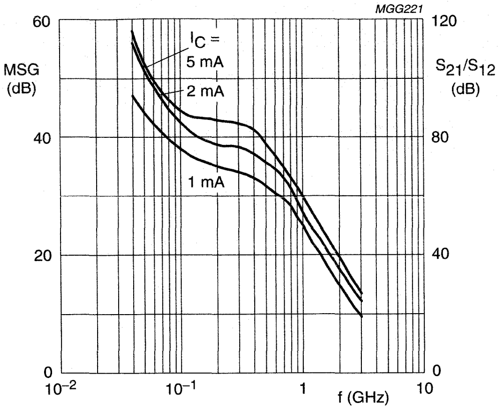
V_{C2-E1} = 3 V.

Fig.4 Minimum noise figure as a function of frequency; typical values.



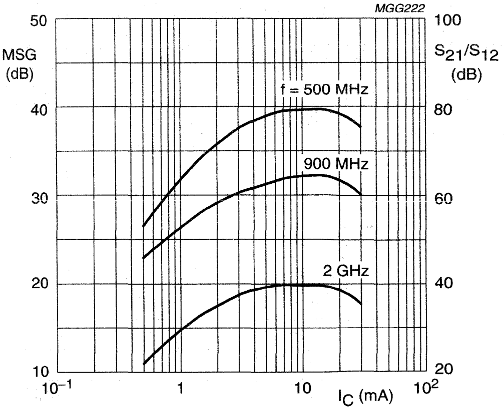
V_{C2-E1} = 3 V.

Fig.5 Minimum noise figure as a function of collector current; typical values.



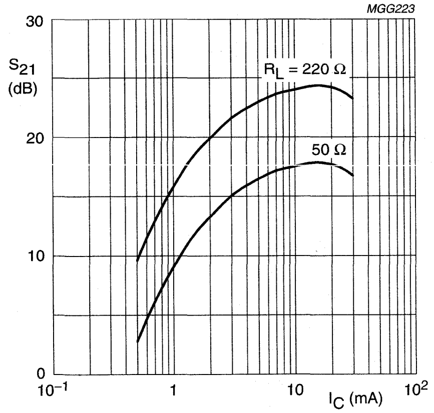
V_{C2-E1} = 3 V.

Fig.6 Maximum stable gain as a function of frequency; typical values.



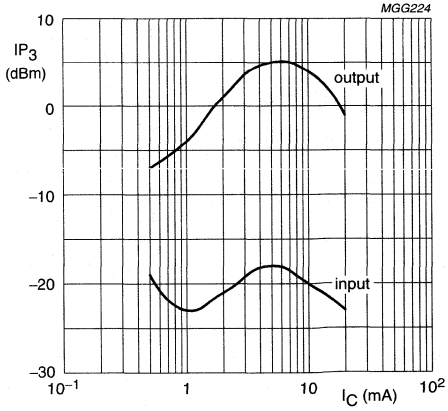
V_{C2-E1} = 3 V.

Fig.7 Maximum stable gain and isolation as functions of collector current; typical values.



V_{C2-E1} = 3 V; R_S = 50 Ω; X_S = X_L = opt; f = 900 MHz.

Fig.8 Insertion gain as a function of collector current; typical values.



Point tuned for maximum gain with double slug tuners.

V_{C2-E1} = 3 V; f = 900 MHz.

Fig.9 Third order intercept point as a function of collector current; typical values.

APPLICATION INFORMATION

SPICE parameters for any single BFC520 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510.0	mA
6	ISE	283.0	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	775.3	mΩ
18	RC	2.210	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.071	–
33	XCJC	0.130	–
34	TR	543.7	ps
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.

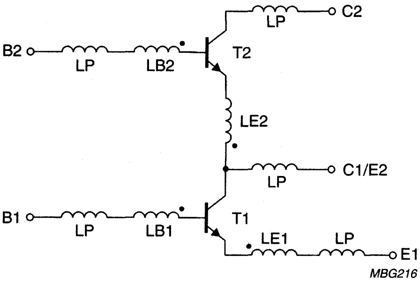


Fig.10 Package equivalent circuit SOT353A (inductance only).

Lead and mutual inductances (nH)

LP	0.4
LB1,2	0.5
LE1,2	0.8

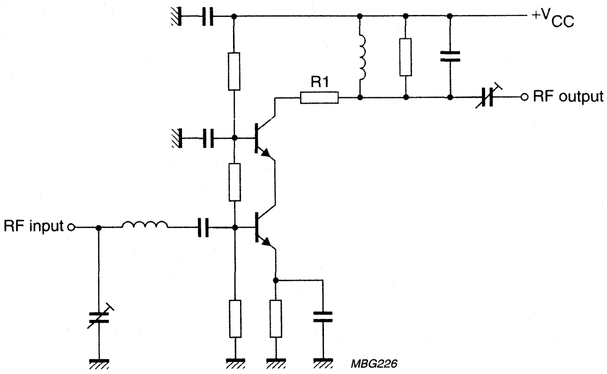
M(LB1,LE1)	+0.4
M(LB1,LE2)	+0.25

	B1	E1	B2	C2
E1	35			
B2	3.5	35		
C2	2	35	36	
C1/E2	36	35	2	15

MBG217

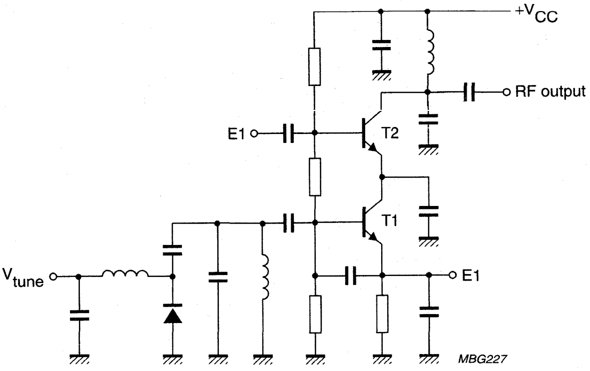
Fig.11 Package capacitance (fF) between indicated nodes.

Typical application circuits



R1 increases stability (10 to 47 Ω).

Fig.12 Narrowband amplifier.



T1 forms a colpitts oscillator.

T2 acts as a buffer amplifier.

Fig.13 VCO/buffer combination.

NPN wideband differential transistor — BFE505

FEATURES

- Small size
- High power gain at low bias current and voltage
- Temperature matched
- Balanced configuration
- h_{FE} matched
- Continues to operate at $V_{CE} < 1$ V.

APPLICATIONS

- Single balanced mixers
- Balanced amplifiers
- Balanced oscillators.

DESCRIPTION

Emitter coupled dual NPN silicon RF transistor in a surface mount, 5-pin SOT353 (S-mini) package. The transistor is primarily intended for applications in the RF front end as a balanced mixer, a differential amplifier in analog and digital cellular phones, and in cordless phones, pagers and satellite TV-tuners.

PINNING - SOT353B

SYMBOL	PIN	DESCRIPTION
b_1	1	base 1
e	2	emitter
b_2	3	base 2
c_2	4	collector 2
c_1	5	collector 1

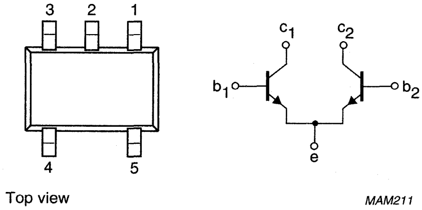


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance C_{BC}	$I_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.25	0.3	pF
MSG/G_{max}	maximum power gain	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; f = 2 GHz	–	10	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.7	dB
		$I_C = 3$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.1	dB
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 3$ V	60	120	250	
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+175	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 μA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 2.5 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector-base leakage current	I_E = 0; V_{CB} = 6 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V	60	120	250	
DC characteristics of the dual transistor						
Δh_{FE}	ratio of highest and lowest DC current gain	I_{C1} = I_{C2} = 5 mA; V_{CE1} = V_{CE2} = 6 V	1	1.2	–	
ΔV_{BEO}	difference between highest and lowest base-emitter voltage (offset voltage)	I_{E1} = I_{E2} = 10 mA; T_{amb} = 25 °C	0	1	–	mV
AC characteristics of any single transistor						
f_T	transition frequency	I_C = 5 mA; V_{CE} = 3 V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 3 V; f = 1 MHz	–	0.3	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 3 V; f = 1 MHz	–	0.25	–	pF
MSG/G_{max}	maximum power gain; note 1	I_C = 5 mA; V_{CE} = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	17	–	dB
		I_C = 5 mA; V_{CE} = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	I_C = 5 mA; V_{CE} = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 3 V; f = 900 MHz; Γ_S = Γ_{opt}	–	1.2	1.7	dB
		I_C = 3 mA; V_{CE} = 3 V; f = 2 GHz; Γ_S = Γ_{opt}	–	1.9	2.1	dB

Note

1. Maximum gain of the differential amplifier is higher because of internal emitter connection (see Fig.2).

APPLICATION INFORMATION

SPICE parameters for any single BFE505 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	134.1	aA
2	BF	180.0	–
3	NF	0.988	–
4	VAF	38.34	V
5	IKF	150.0	mA
6	ISE	27.81	fA
7	NE	2.051	–
8	BR	55.19	–
9	NR	0.982	–
10	VAR	2.459	V
11	IKR	2.920	mA
12	ISC	17.45	aA
13	NC	1.062	–
14	RB	20.00	Ω
15	IRB	1.000	μA
16	RBM	20.00	Ω
17	RE	1.171	Ω
18	RC	4.350	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	284.7	fF
23	VJE	600.0	mV
24	MJE	0.303	–
25	TF	7.037	ps
26	XTF	12.34	–
27	VTF	1.701	V
28	ITF	30.64	mA
29	PTF	0.000	deg
30	CJC	242.4	fF
31	VJC	188.6	mV
32	MJC	0.041	–
33	XCJC	0.130	–
34	TR	1.332	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.897	–

Note

1. These parameters have not been extracted, the default values are shown.

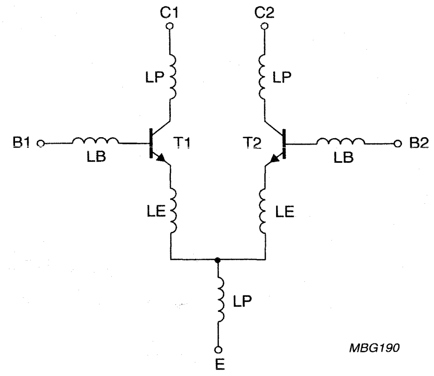


Fig.2 Package equivalent circuit SOT353B (inductance only).

Lead inductances (nH)

LP	0.4
LB	0.8
LE	0.6

E	35			
B2	3.5	35		
C2	2	35	36	
C1	36	35	2	15
	B1	E	B2	C2

MBG191

Fig.3 Package capacitance (fF) between indicated nodes.

Typical application circuit

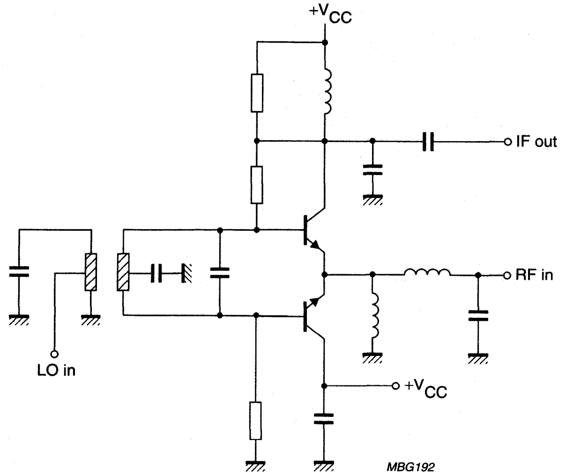


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

NPN wideband differential transistor | BFE520

FEATURES

- Small size
- High power gain at low bias current and voltage
- Temperature matched
- Balanced configuration
- h_{FE} matched
- Continues to operate at $V_{CE} < 1$ V.

APPLICATIONS

- Single balanced mixers
- Balanced amplifiers
- Balanced oscillators.

DESCRIPTION

Emitter coupled dual NPN silicon RF transistor in a surface mount 5-pin SOT353 (S-mini) package. The transistor is primarily intended for applications in the RF front end as a balanced mixer, a differential amplifier in analog and digital cellular phones, and in cordless phones, pagers and satellite TV-tuners.

PINNING - SOT353B

PIN	SYMBOL	DESCRIPTION
b_1	1	base 1
e	2	emitter
b_2	3	base 2
c_2	4	collector 2
c_1	5	collector 1

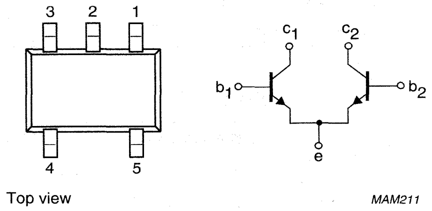


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance C_{BC}	$I_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.35	0.4	pF
MSG/G_{max}	maximum power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz	–	16	–	dB
		$I_C = 20$ mA; $V_{CE} = 3$ V; f = 2 GHz	–	9	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	–	dB
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 3$ V	60	120	250	
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $I_B = 0$	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
DC characteristics of the dual transistor						
Δh_{FE}	ratio of highest and lowest DC current gain	$I_{C1} = I_{C2} = 20$ mA; $V_{CE1} = V_{CE2} = 6$ V	1	1.2	–	
ΔV_{BEO}	difference between highest and lowest base-emitter voltage (offset voltage)	$I_{E1} = I_{E2} = 30$ mA; $T_{amb} = 25$ °C	0	1	–	mV
AC characteristics of any single transistor						
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.4	0.45	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.35	0.4	pF
MSG/G_{max}	maximum power gain; note 1	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 20$ mA; $V_{CE} = 3$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	–	dB

Note

1. Maximum gain of the differential amplifier is higher because of internal emitter connection (see Fig.2).

APPLICATION INFORMATION

SPICE parameters for any single BFE520 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510.0	mA
6	ISE	283.0	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	µA
16	RBM	10.00	Ω
17	RE	775.3	mΩ
18	RC	2.210	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.071	–
33	XCJC	0.130	–
34	TR	543.7	ps
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.

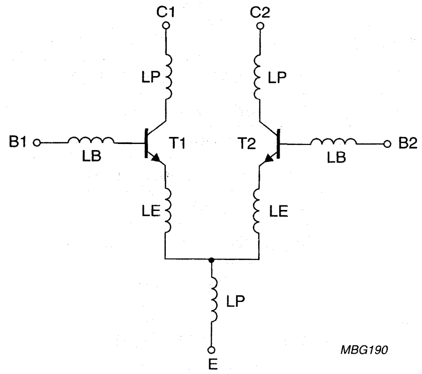
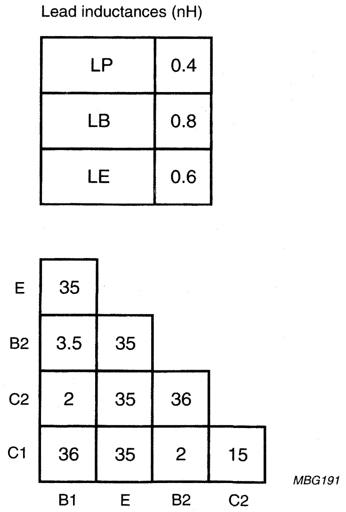


Fig.2 Package equivalent circuit SOT353B (inductance only).



Lead inductances (nH)

LP	0.4
LB	0.8
LE	0.6

	B1	E	B2	C2
E	35			
B2	3.5	35		
C2	2	35	36	
C1	36	35	2	15

Fig.3 Package capacitance (fF) between indicated nodes.

NPN wideband differential transistor BFE520

Typical application circuit

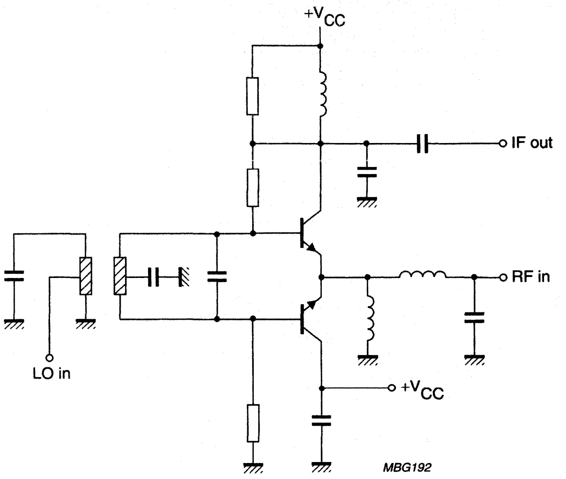


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

NPN 2 GHz RF power transistor

BFG10; BFG10/X

FEATURES

- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Common emitter class-AB operation in hand-held radio equipment at 1.9 GHz.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in plastic, 4-pin dual-emitter SOT143 package.

PINNING

PIN	DESCRIPTION
BFG10 (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG10/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter

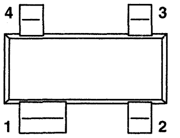


Fig.1 SOT143.

MARKING

TYPE NUMBER	CODE
BFG10	N70
BFG10/X	N71

QUICK REFERENCE DATA

RF performance at T_{amb} = 25 °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle: < 1 : 8	1.9	3.6	200	≥5	≥50

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	250	mA
$I_{C(AV)}$	average collector current		–	250	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; see Fig.2; note 1	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 60 °C; note 1; P_{tot} = 400 mW	290	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.1 mA	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 5 mA	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	V
I_{CES}	collector leakage current	V_{CE} = 5 V; V_{BE} = 0	–	100	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	25	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 3.6 V; f = 1 MHz	–	3	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 3.6 V; f = 1 MHz	–	2	pF

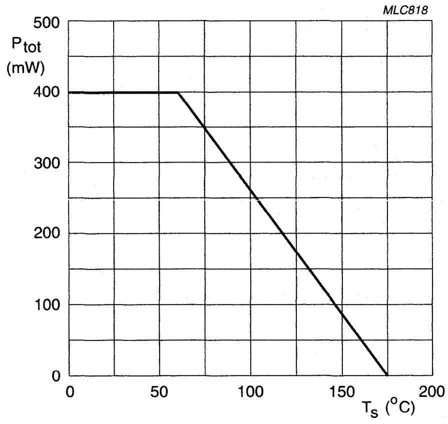
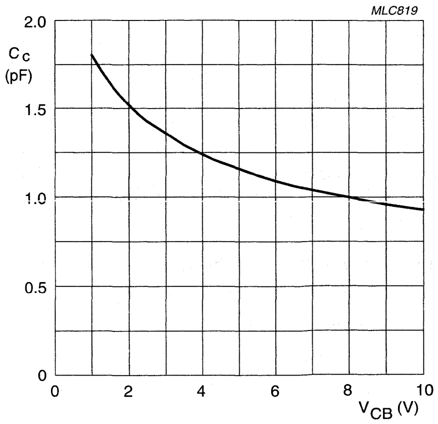


Fig.2 Power derating curve



I_C = 0; f = 1 MHz.

Fig.3 Collector capacitance as a function of collector-base voltage; typical values.

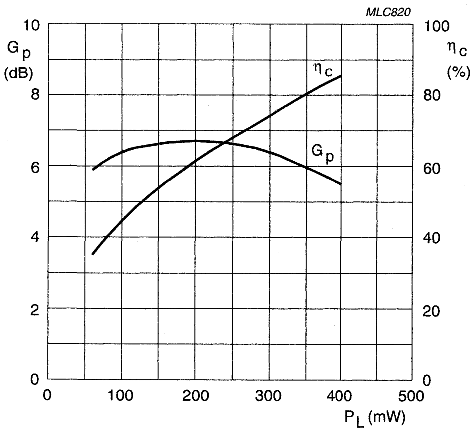
APPLICATION INFORMATION

RF performance at $T_{amb} = 25$ °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle: < 1 : 8	1.9	3.6	1	200	>5 typ. 7	>50 typ. 60

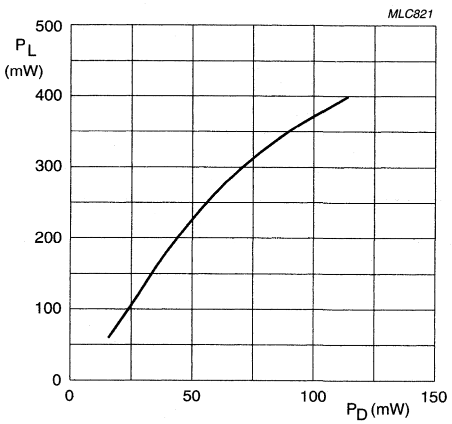
Ruggedness in class-AB operation

The BFG10 is capable of withstanding a load mismatch corresponding to VSWR = 8 : 1 through all phases, at rated output power under pulsed conditions up to a supply voltage of 7 V, f = 1.9 GHz and a duty cycle of 1 : 8.



Pulsed, class-AB operation.
$V_{CE} = 3.6$ V; $V_{BE} = 0.65$ V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for $P_L = 200$ mW.

Fig.4 Power gain and efficiency as functions of load power; typical values.



Pulsed, class-AB operation.
$V_{CE} = 3.6$ V; $V_{BE} = 0.65$ V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for $P_L = 200$ mW.

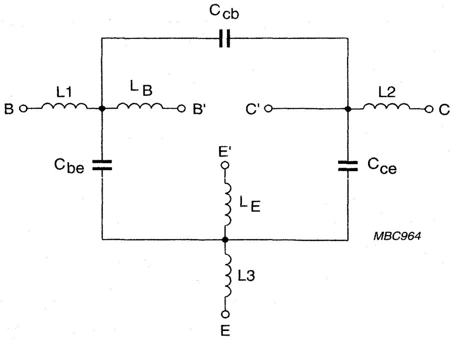
Fig.5 Load power as a function of drive power; typical values.

SPICE parameters for the BFG10 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	2.714	fA
2	BF	102.8	–
3	NF	0.998	–
4	VAF	28.12	V
5	IKF	6.009	A
6	ISE	403.2	pA
7	NE	2.937	–
8	BR	31.01	–
9	NR	0.999	–
10	VAR	2.889	V
11	IKR	0.284	A
12	ISC	1.487	fA
13	NC	1.100	–
14	RB	3.500	Ω
15	IRB	1.000	μA
16	RBM	3.500	Ω
17	RE	0.217	Ω
18	RC	0.196	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	5.125	pF
23	VJE	0.600	V
24	MJE	0.367	–
25	TF	12.07	ps
26	XTF	99.40	–
27	VTF	7.220	V
28	ITF	3.950	A
29	PTF	0.000	deg
30	CJC	2.327	pF
31	VJC	0.668	V
32	MJC	0.398	–
33	XCJC	0.160	–
34(1)	TR	0.000	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.652	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 100 MHz.

Fig.6 Package equivalent circuit SOT143.

List of components (see Fig.6)

DESIGNATION	VALUE	UNIT
C_{be}	84	fF
C_{cb}	17	fF
C_{ce}	191	fF
L1	0.12	nH
L2	0.21	nH
L3	0.06	nH
L_B	0.95	nH
L_E	0.40	nH

Test circuit information

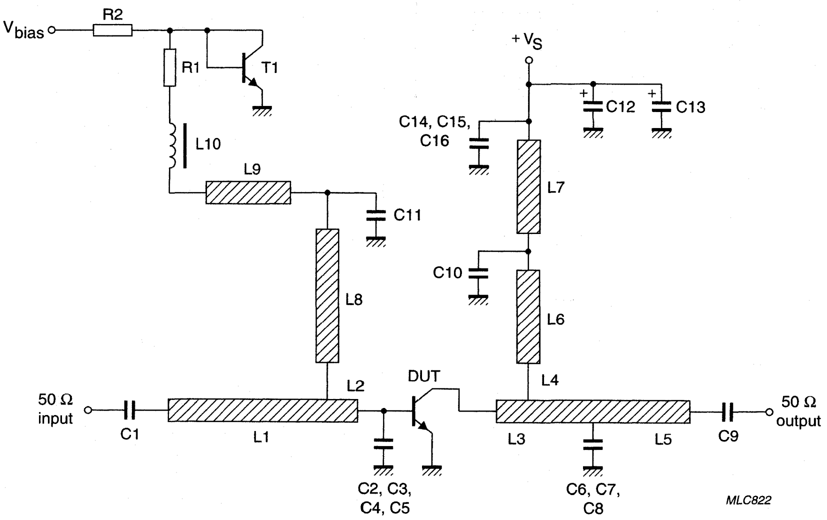


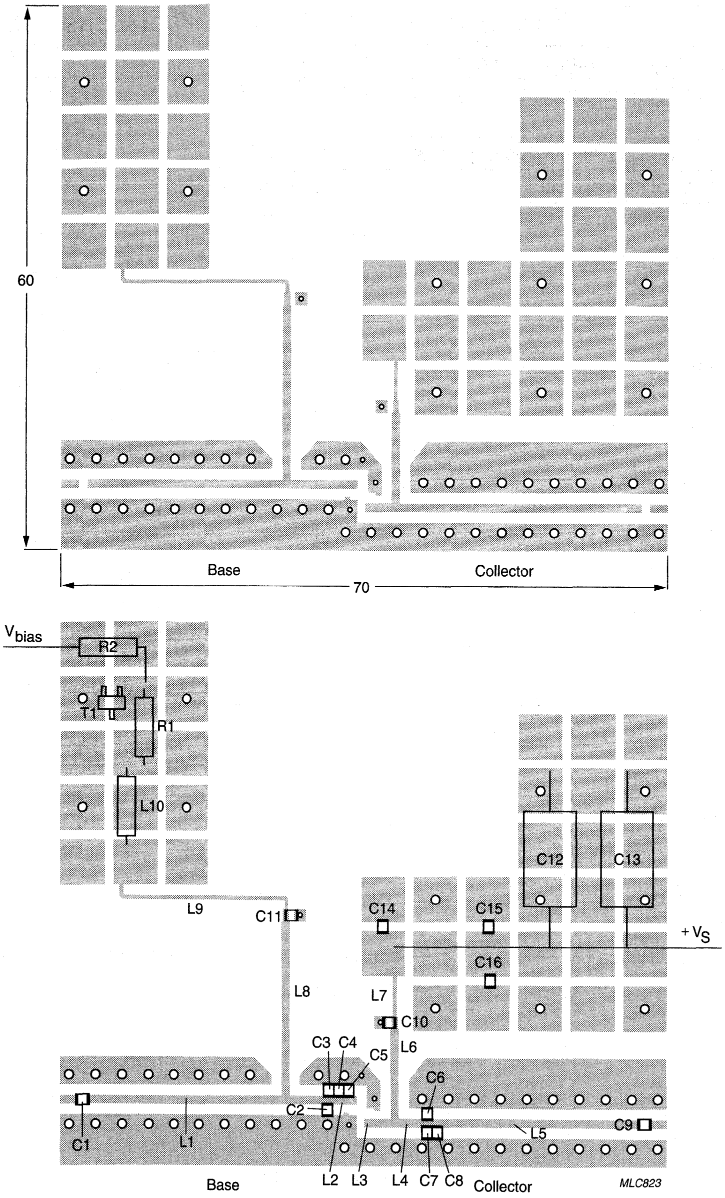
Fig.7 Common-emitter test circuit for class-AB operation at 1.9 GHz.

List of components used in test circuit (see Fig.7)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C9, C10, C11	multilayer ceramic chip capacitor; note 1	24 pF		
C2, C3, C4, C5, C6, C7	multilayer ceramic chip capacitor; note 1	0.86 pF		
C8	multilayer ceramic chip capacitor; note 1	1.1 pF		
C12, C13	electrolytic capacitor	470 μF; 10 V		2222 031 34471
C14, C15, C16	multilayer ceramic chip capacitor; note 1	10 nF		
L1	stripline; note 2		length 28.5 mm width 0.93 mm	
L2	stripline; note 2		length 2.3 mm width 0.93 mm	
L3	stripline; note 2		length 3.1 mm width 0.93 mm	
L4	stripline; note 2		length 3.3 mm width 0.93 mm	
L5	stripline; note 2		length 16.3 mm width 0.93 mm	
L6	stripline; note 2		length 10 mm width 0.93 mm	
L7	stripline; note 2		length 4.4 mm width 0.4 mm	
L8	stripline; note 2		length 19.3 mm width 0.93 mm	
L9	stripline; note 2		length 19.7 mm width 0.4 mm	
L10	micro choke			
T1	BD228			
R1	metal film resistor	20 Ω; 0.4 W		2322 157 10209
R2	metal film resistor	530 Ω; 0.4 W		2322 157 15301

Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a $\frac{1}{32}$ inch double copper-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 6$).



Dimensions in mm.

The components are situated on one side of the copper-clad PTFE microfibre-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.8 Printed-circuit board and component lay-out for common-emitter test circuit in Fig.7.

UHF power transistor BFG10W/X

FEATURES

- High efficiency
- Small size discrete power amplifier
- 900 MHz and 1.9 GHz operating areas
- Gold metallization ensures excellent reliability.

APPLICATIONS

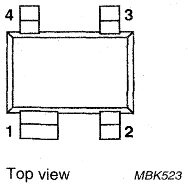
- Common emitter class-AB operation in hand-held radio equipment up to 1.9 GHz.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic, 4-pin dual-emitter SOT343 package.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter



Marking code: T5.

Fig.1 SOT343.

QUICK REFERENCE DATA

RF performance at T_{amb} = 25 °C in a common-emitter test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle: < 1 : 2; t_p = 10 ms	1.9	3.6	200	≥5	≥50
Pulsed, class-AB, duty cycle: < 1 : 8; t_p = 4.6 ms	0.9	6	650	≥10	≥50
	0.9	6	360	≥12.5	≥50

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	250	mA
$I_{C(AV)}$	average collector current		–	250	mA
P_{tot}	total power dissipation	up to T_s = 102 °C; note 1	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	up to T_s = 102 °C; note 1; P_{tot} = 400 mW	180	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.1 mA	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 5 mA	10	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	V
I_{CES}	collector cut-off current	V_{CE} = 6 V; V_{BE} = 0	–	100	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	25	–	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 6 V; f = 1 MHz	–	3	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 6 V; f = 1 MHz	–	2	pF

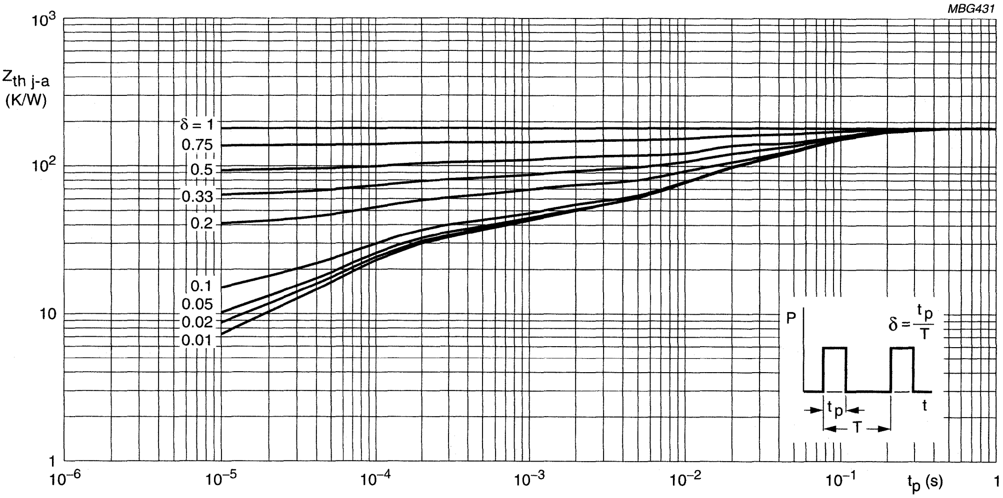


Fig.2 Transient thermal impedance from junction to soldering point as a function of pulse time; typical values.

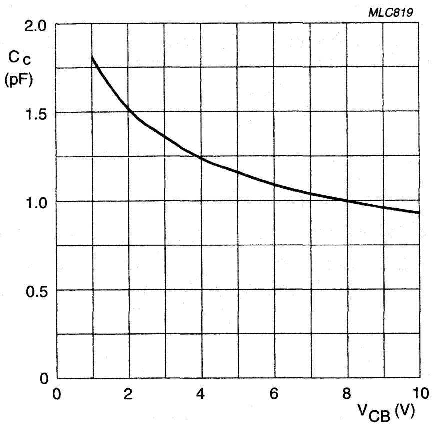


Fig.3 Collector capacitance as a function of collector-base voltage.

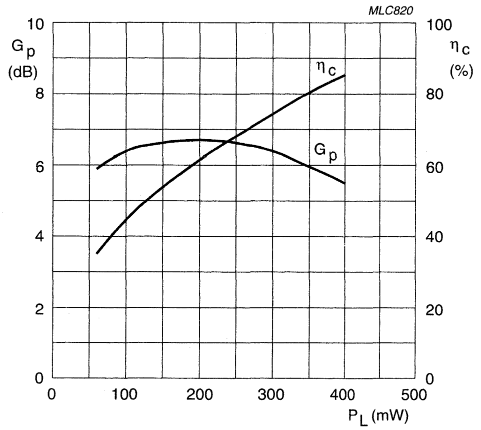
APPLICATION INFORMATION

RF performance at T_{amb} = 25 °C in a common-emitter test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle: < 1 : 2; t_p = 10 ms	1.9	3.6	200	≥5; typ. 7	≥50; typ. 60
Pulsed, class-AB, duty cycle: < 1 : 8; t_p = 5 ms	0.9	6	650	≥10	≥50
	0.9	6	360	≥12.5	≥50

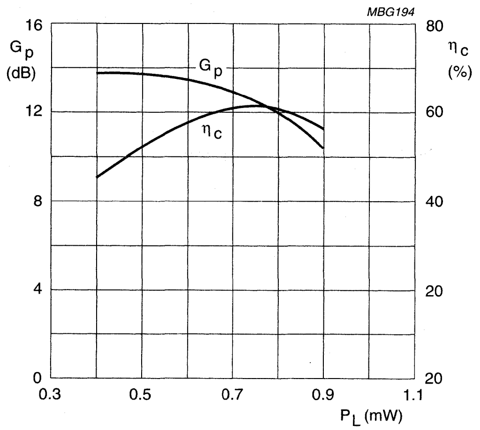
Ruggedness in class-AB operation

The BFG10W/X is capable of withstanding a load mismatch corresponding to VSWR = 6 : 1 through all phases under pulsed conditions up to a supply voltage of 8.6 V under the conditions: 900 MHz; 650 mW; t_p = 4.6 ms; duty cycle of 1 : 8 and up to a supply voltage of 5.5 V under the conditions: 1.9 GHz; 200 mW; t_p = 10 ms; duty cycle of 1 : 2.



Pulsed, class-AB operation.
V_{CE} = 3.6 V; f = 1.9 GHz; duty cycle < 1 : 2.
Circuit optimized for P_L = 200 mW.

Fig.4 Power gain and efficiency as functions of load power; typical values.



Pulsed, class-AB operation.
V_{CE} = 6 V; f = 900 MHz; duty cycle < 1 : 8.
Circuit optimized for P_L = 600 mW.

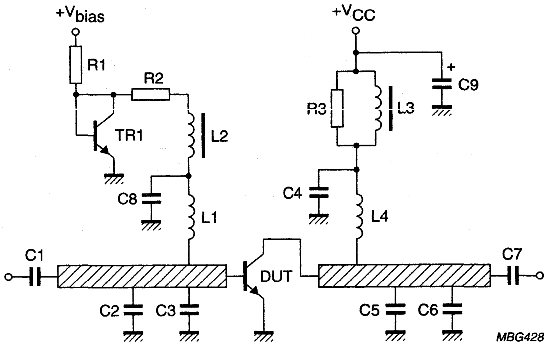
Fig.5 . Power gain and efficiency as functions of load power; typical values.

List of components (see Fig.6)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
TR1	bias transistor, BC548 or equivalent	note 1		
C1, C4, C7	capacitor; notes 2 and 3	120 pF		
C2	capacitor; note 2	6.8 pF		
C3	capacitor; note 2	0.5 pF		
C5	capacitor; note 2	1.2 pF		
C6	capacitor; note 2	1.9 pF		
C8	Philips multilayer capacitor	1 nF, 10 V		
C9	Philips capacitor	1500 µF, 10 V		2222 032 14152
L1	6 turns enamelled 0.7 mm copper wire		length 3.5 mm	
L4	2 turns enamelled 0.7 mm copper wire		length 3 mm	
L2, L3	RF choke, Philips			4312 020 36690
R1	metal film resistor	275 Ω		
R2	metal film resistor	100 Ω		
R3	metal film resistor	10 Ω		

Notes

1. V_{BE} at 1 mA must be 0.65 V.
2. American Technical Ceramics type 100A or capacitor of same quality.
3. Resonant at 1900 MHz.



PCB RT5880, thickness 0.79 mm.

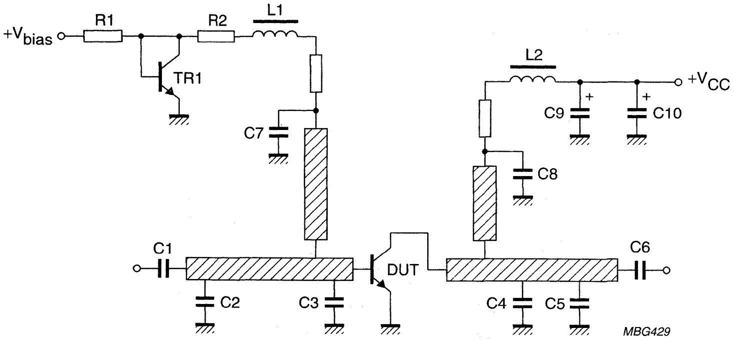
Fig.6 Class-AB test circuit at f = 900 MHz.

List of components (see Fig.6)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
TR1	bias transistor, BC548 or equivalent	note 1		
C1, C6, C7, C8	capacitor; notes 2 and 3	24 pF		
C2	capacitor; note 2	0.4 pF		
C3	capacitor; note 2	2.4 pF		
C4	capacitor; note 2	0.5 pF		
C5	capacitor; note 2	1.2 pF		
C9, C10	Philips capacitor	1500 µF, 10 V		2222 032 14152
L1, L2	RF choke, Philips			4330 030 36301
R1, R2	metal film resistor	75 Ω		
R3, R4	metal film resistor	10 Ω		

Notes

1. V_{BE} at 1 mA must be 0.65 V.
2. American Technical Ceramics type 100A or capacitor of same quality.
3. Resonant at 1900 MHz.



PCB RT5880, thickness 0.79 mm.

Fig.7 Class-AB test circuit at f = 1.9 GHz.

NPN 2 GHz RF power transistor

BFG11; BFG11/X

FEATURES

- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Common emitter class-AB operation in hand-held radio equipment at 1.9 GHz.

PINNING

PIN	DESCRIPTION
BFG11 (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG11/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter

DESCRIPTION

NPN silicon planar epitaxial transistors encapsulated in a plastic, 4-pin dual-emitter SOT143 package.

MARKING

TYPE NUMBER	CODE
BFG11	N72
BFG11/X	N73

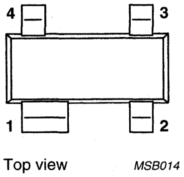


Fig.1 SOT143.

QUICK REFERENCE DATA

RF performance at T_{amb} = 25 °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle < 1 : 8	1.9	3.6	400	≥4	≥50

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
$I_{C(AV)}$	average collector current		–	500	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; note 1; see Fig.2	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 60 °C; note 1; P_{tot} = 400 mW	290	K/W

Note to the “Limiting values” **and** “Thermal characteristics”

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

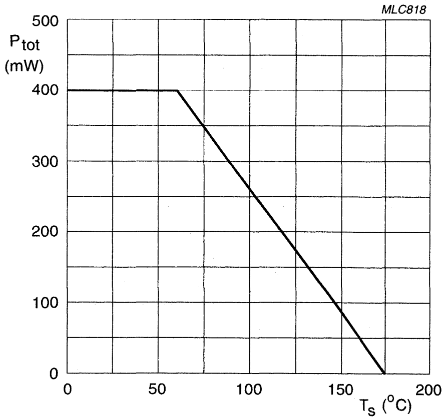
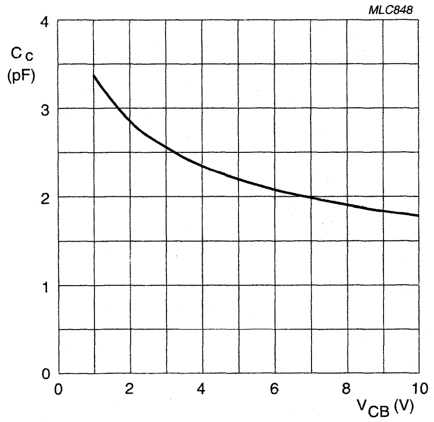


Fig.2 Power derating curve.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.1 mA; I_E = 0	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA; I_C = 0	2.5	–	V
I_{CES}	collector cut-off current	V_{CE} = 8 V; V_{BE} = 0	–	100	μA
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	25	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 3.6 V; f = 1 MHz	–	4	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 3.6 V; f = 1 MHz	–	3	pF



I_C = 0; f = 1 MHz.

Fig.3 Collector capacitance as a function of collector-base voltage; typical values.

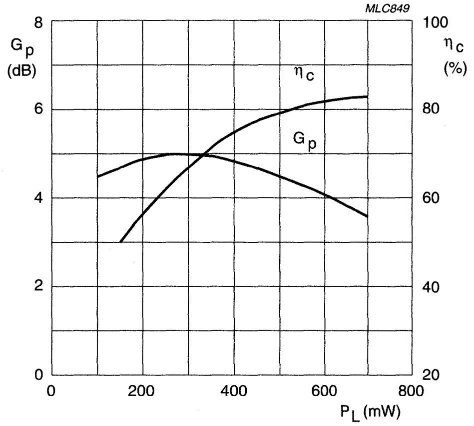
APPLICATION INFORMATION

RF performance at T_{amb} = 25 °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle < 1 : 8	1.9	3.6	1	400	≥4 typ. 5	≥50 typ. 70

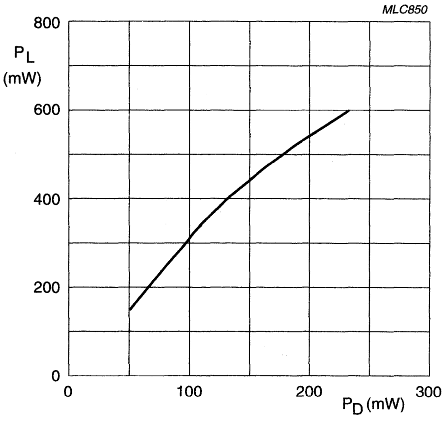
Ruggedness in class-AB operation

The BFG11 is capable of withstanding a load mismatch corresponding to VSWR = 8 : 1 through all phases, at rated output power under pulsed conditions up to a supply voltage of 8 V, f = 1.9 GHz and a duty cycle of 1 : 8.



Pulsed, class-AB operation.
V_{CE} = 3.6 V; V_{BE} = 0.65 V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for P_L = 400 mW.

Fig.4 Power gain and collector efficiency as functions of load power; typical values.



Pulsed, class-AB operation.
V_{CE} = 3.6 V; V_{BE} = 0.65 V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for P_L = 400 mW.

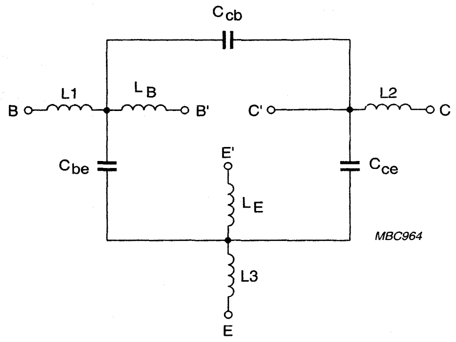
Fig.5 Load power as a function of drive power; typical values.

SPICE parameters for the BFG11 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	3.338	fA
2	BF	97.14	–
3	NF	0.988	–
4	VAF	31.40	V
5	IKF	51.45	A
6	ISE	23.53	pA
7	NE	2.386	–
8	BR	13.73	–
9	NR	0.989	–
10	VAR	2.448	V
11	IKR	100.0	A
12	ISC	54.10	fA
13	NC	1.224	–
14	RB	1.740	Ω
15	IRB	1.000	μA
16	RBM	1.740	Ω
17	RE	59.65	mΩ
18	RC	0.124	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	9.555	pF
23	VJE	0.600	V
24	MJE	0.315	–
25	TF	12.96	ps
26	XTF	400.0	–
27	VTF	0.866	V
28	ITF	5.940	A
29	PTF	0.000	deg
30	CJC	4.274	pF
31	VJC	0.650	V
32	MJC	0.392	–
33	XCJC	0.150	–
34(1)	TR	0.000	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.742	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 100 MHz.

Fig.6 Package equivalent circuit SOT143.

List of components (see Fig.6)

DESIGNATION	VALUE	UNIT
C_{be}	84	fF
C_{cb}	17	fF
C_{ce}	191	fF
L1	0.12	nH
L2	0.21	nH
L3	0.06	nH
L_B	0.95	nH
L_E	0.40	nH

Test circuit information

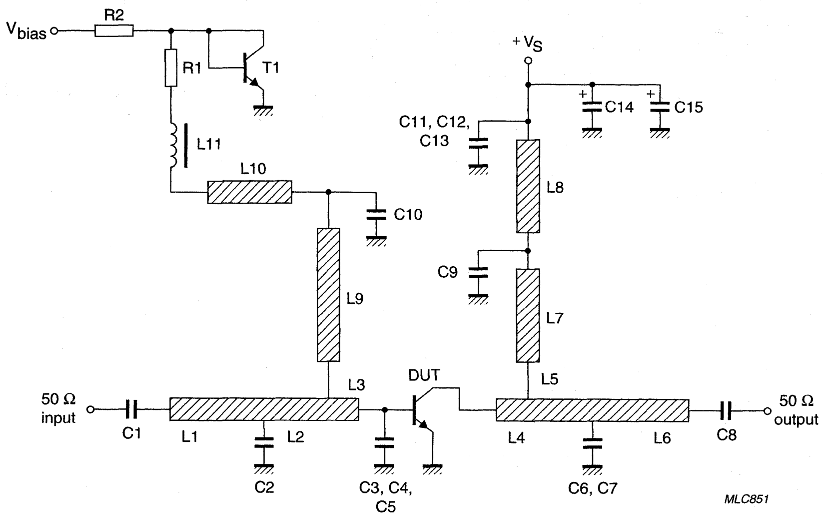


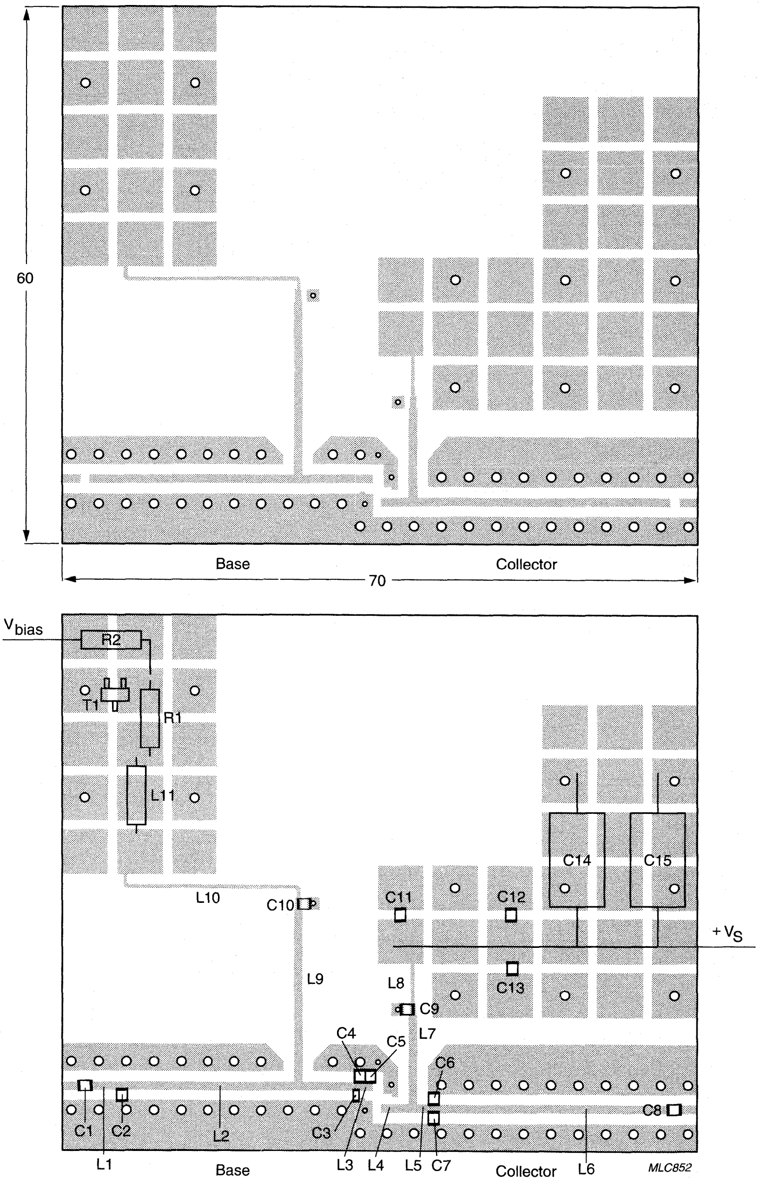
Fig.7 Common-emitter test circuit for class-AB operation at 1 900 MHz.

List of components used in test circuit (see Fig.8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE N0.
C1, C8, C9, C10	multilayer ceramic chip capacitor; note 1	24 pF		
C2	multilayer ceramic chip capacitor; note 1	0.4 pF		
C3	multilayer ceramic chip capacitor; note 1	0.6 pF		
C4, C7	multilayer ceramic chip capacitor; note 1	1 pF		
C5, C6,	multilayer ceramic chip capacitor; note 1	1.5 pF		
C11, C12,C13	multilayer ceramic chip capacitor; note 1	10 nF		
C14, C15	electrolytic capacitor	10 V; 470 μF		2222 031 34471
L1	stripline; note 2		length 4 mm width 0.93 mm	
L2	stripline; note 2		length 26 mm width 0.93 mm	
L3	stripline; note 2		length 1.9 mm width 0.93 mm	
L4	stripline; note 2		length 3.1 mm width 0.93 mm	
L5	stripline; note 2		length 1.8 mm width 0.93 mm	
L6	stripline; note 2		length 26.4 mm width 0.93 mm	
L7	stripline; note 2		length 10 mm width 0.93 mm	
L8	stripline; note 2		length 4.4 mm width 0.4 mm	
L9	stripline; note 2		length 19.3 mm width 0.93 mm	
L10	stripline; note 2		length 19.7 mm width 0.4 mm	
L11	micro choke			
T1	BD228			
R1	metal film resistor	20 Ω; 0.4 W		2322 157 10209
R2	metal film resistor	265 Ω; 0.4 W		2322 157 12651

Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a $\frac{1}{32}$ inch double copper-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 6$).



Dimensions in mm.

The components are situated on one side of the copper-clad PTFE microfibre-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.8 Printed-circuit board and component lay-out for common-emitter test circuit in Fig.7.

FEATURES

- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability
- Linear and non-linear operation.

APPLICATIONS

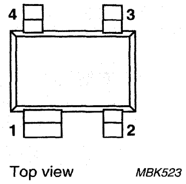
- Common emitter class-AB operation in handheld radio equipment at 1.9 GHz such as DECT, PHS.
- Driver for DCS 1800.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic 4-pin dual-emitter SOT343 package.

PINNING - SOT343

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter



Marking code: S4

Fig.1 Simplified outline.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common-emitter test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, $\delta < 1:2$; $t_p = 5$ ms	1.9	3.6	400	≥6	≥60

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; note 1	–	760	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 60 °C; P_{tot} = 760 mW; note 1	150	K/W

Note to the Limiting values and Thermal characteristics

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

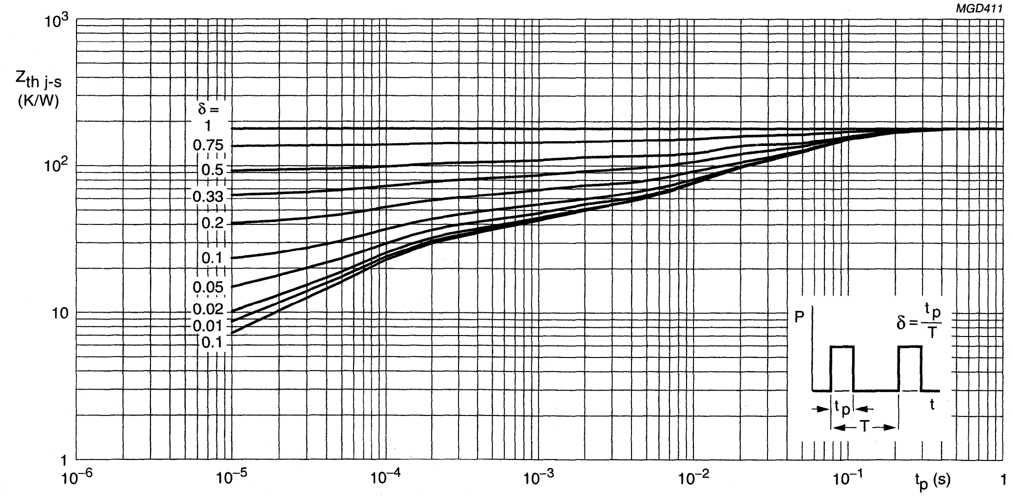


Fig.2 Transient thermal impedance from junction to soldering point as a function of pulse time; typical values.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; open emitter	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; open base	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; open collector	2.5	–	V
I_{CES}	collector cut-off current	V_{CE} = 8 V; V_{BE} = 0	–	100	μA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 100 mA	25	–	
C_c	collector capacitance	V_{CB} = 3.6 V; $I_E = i_e$ = 0; f = 1 MHz	–	5	pF
C_{re}	feedback capacitance	V_{CE} = 3.6 V; I_C = 0; f = 1 MHz	–	4	pF

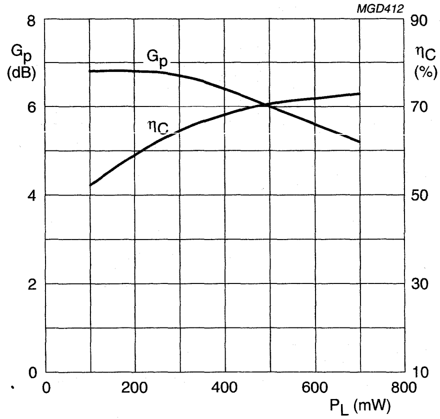
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common-emitter test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, $\delta < 1:2$; t_p = 5 ms	1.9	3.6	1	400	≥6	≥60

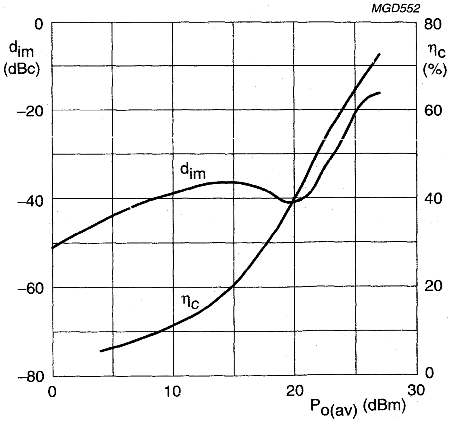
Ruggedness in class-AB operation

The transistors are capable of withstanding a load mismatch corresponding to VSWR = 8 : 1 through all phases, at rated output power under pulsed conditions at f = 1.9 GHz: t_p = 1.25 ms, $\delta = 1:8$ at V_{CE} = 7 V and t_p = 5 ms, $\delta = 1:2$ at V_{CE} = 4.5 V.



V_{CE} = 3.6 V; V_{BE} = 0.65 V; f = 1.9 GHz; $\delta < 1:8$; t_p = 1.25 ms.

Fig.3 Power gain and efficiency as functions of load power; typical values.



V_{CE} = 3.6 V; $I_{C\varphi}$ = 1 mA; f_1 = 1990.0 MHz; f_2 = 1990.1 MHz; $\delta = 1:8$; t_p = 625 μs.

Fig.4 Two tone intermodulation distortion and efficiency as functions of average output power; typical values.

List of components used in test circuit (see Figs 5 and 6)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C8, C9, C10	multilayer ceramic chip capacitor; note 1	24 pF		
C2, C3	multilayer ceramic chip capacitor; note 1	2 pF		
C4	multilayer ceramic chip capacitor; note 1	1.2 pF		
C5	multilayer ceramic chip capacitor; note 1	0.2 pF		
C6, C7,	multilayer ceramic chip capacitor; note 1	1.3 pF		
C11, C12, C13	multilayer ceramic chip capacitor; note 1	10 nF		
C14, C15	electrolytic capacitor	470 μF; 10 V		2222 032 14152
L1	stripline; note 2		length 22.5 mm width 0.9 mm	
L2	stripline; note 2		length 6 mm width 0.9 mm	
L3	stripline; note 2		length 1 mm width 0.9 mm	
L4	stripline; note 2		length 2.5 mm width 0.9 mm	
L5	stripline; note 2		length 4.5 mm width 0.9 mm	
L6	stripline; note 2		length 24.5 mm width 0.9 mm	
L7	stripline; note 2		length 20 mm width 0.9 mm	
L8	stripline; note 2		length 10.5 mm width 0.9 mm	
L9	stripline; note 2		length 4.4 mm width 0.4 mm	
L10	stripline; note 2		length 19.7 mm width 0.4 mm	
L11, L12	RF choke	1 μH		4330 030 36301
R1	metal film resistor	78.7 Ω; 0.4 W		
R2	metal film resistor	38.3 Ω; 0.4 W		
R3	metal film resistor	10 Ω; 0.4 W		
T1	bias transistor	BC548; note 3		

Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a double copper-clad printed-circuit board with PTFE fibre-glass dielectric $\varepsilon_r = 6.15$; $\tan\delta = 0.0019$; thickness = 0.64 mm; copper cladding = 35 μm.
3. Or equivalent ($V_{BE} = 0.65$ V at $T_{amb} = 25$ °C).

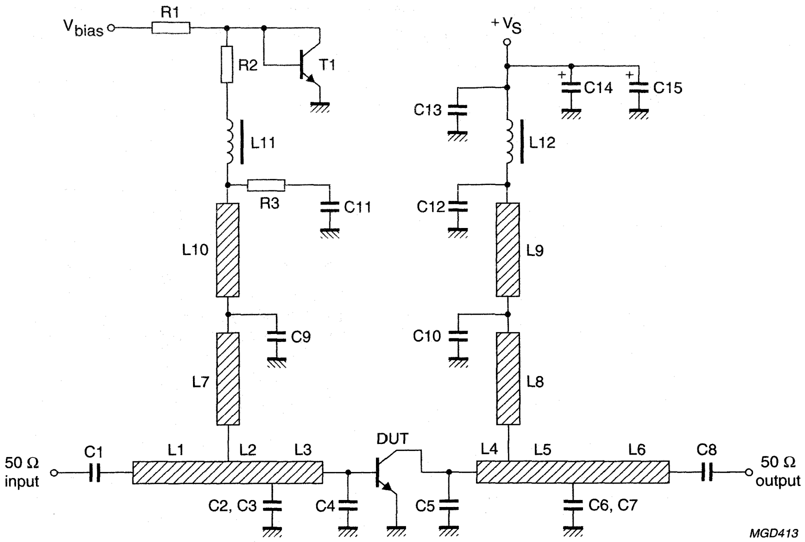
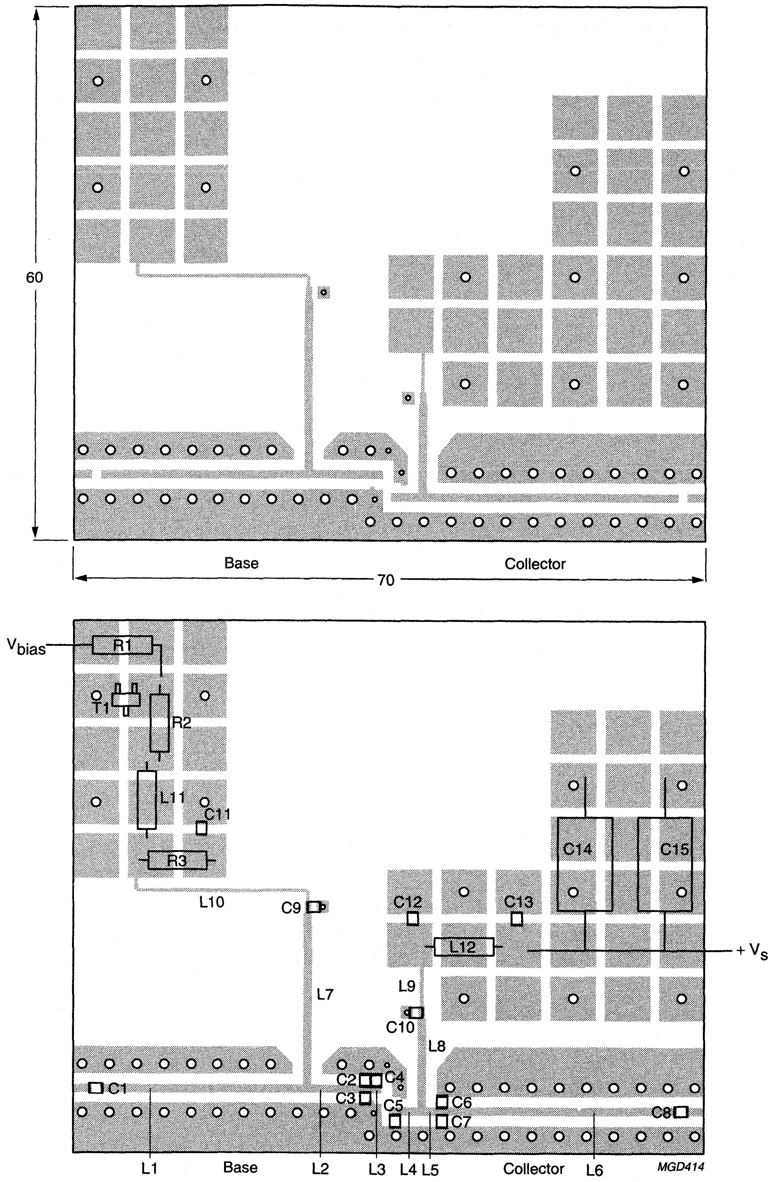


Fig.5 Common-emitter test circuit for class-AB operation at 1.9 GHz.

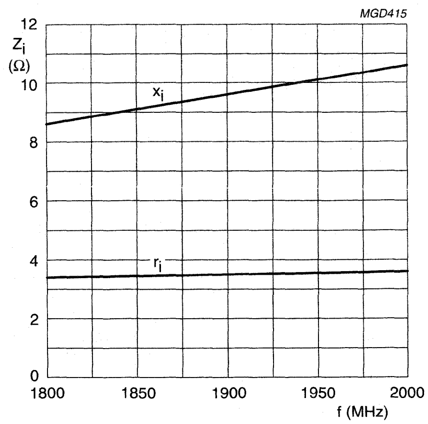


Dimensions in mm.

Fig.6 Component layout for common-emitter test circuit.

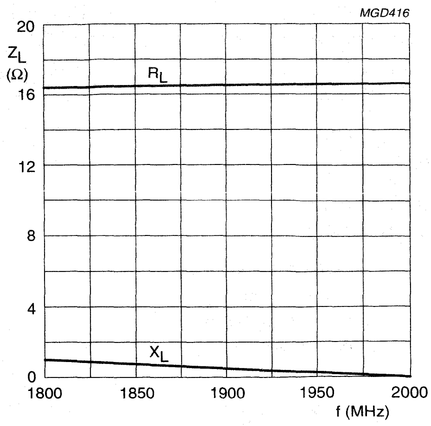
NPN 2 GHz power transistor

BFG11W/X



$V_{CE} = 3.6$ V; $V_{BE} = 0.65$ V; $P_L = 400$ mW.

Fig.7 Input impedance as a function of frequency (series components), typical values.



$V_{CE} = 3.6$ V; $V_{BE} = 0.65$ V; $P_L = 400$ mW.

Fig.8 Load impedance as a function of frequency (series components), typical values.

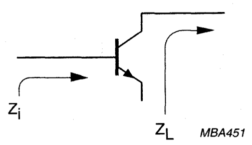


Fig.9 Definition of transistor impedance.

NPN 2 GHz wideband transistor BFG16A

FEATURES

- High power gain
- Good thermal stability
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN transistor mounted in a plastic SOT223 envelope.

It is primarily intended for use in wideband amplifiers, aerial amplifiers and vertical amplifiers in high speed oscilloscopes.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

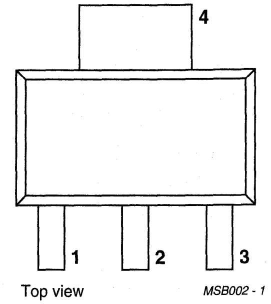


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	–	25	V
I_C	DC collector current		–	–	150	mA
P_{tot}	total power dissipation	up to T_s = 110 °C; note 1	–	–	1	W
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 5 V; T_j = 25 °C	25	80	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	1.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	10	–	dB

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 110 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 110$ °C; note 1	40	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 0.1$ mA	25	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 10$ mA	18	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 0.1$ mA	3	–	–	V
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 28$ V	–	–	20	μA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 5$ V	25	80	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	10.0	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.5	–	pF
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	1.5	–	GHz
G_{UM}	maximum unilateral power gain note 1	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	10	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.

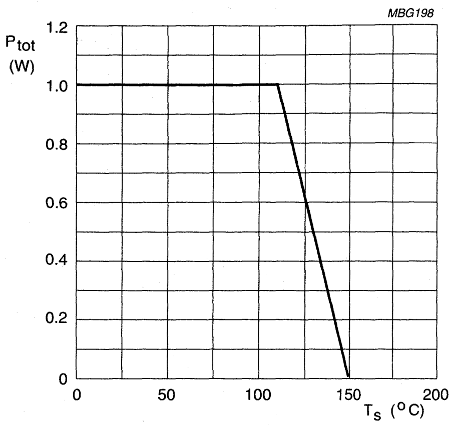
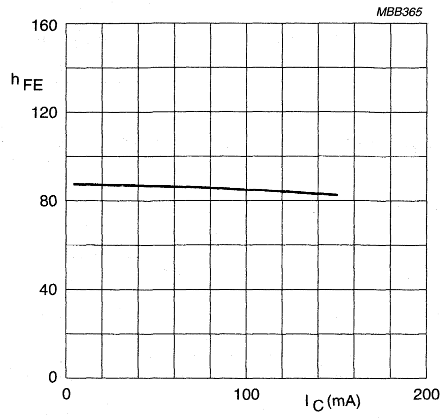
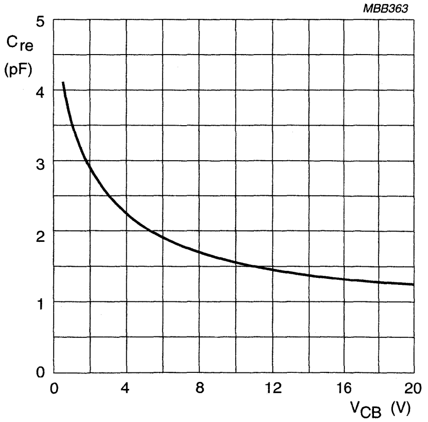


Fig.2 Power derating curve.



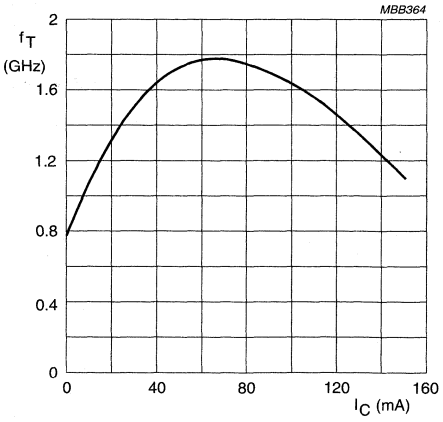
V_{CE} = 10 V; T_j = 25 °C.

Fig.3 DC current gain as function of collector current.



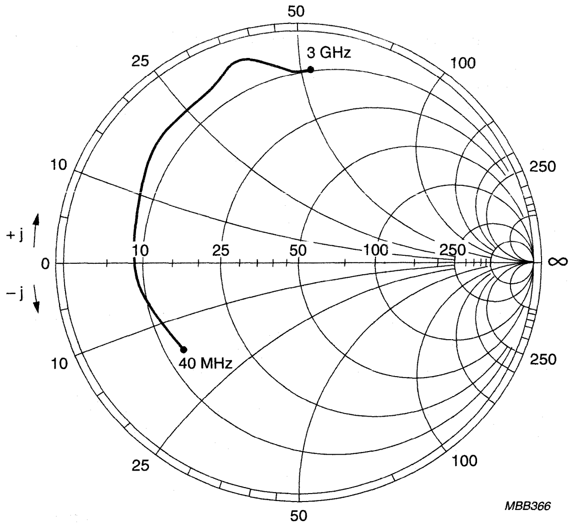
$I_C = i_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as function of collector-base voltage.



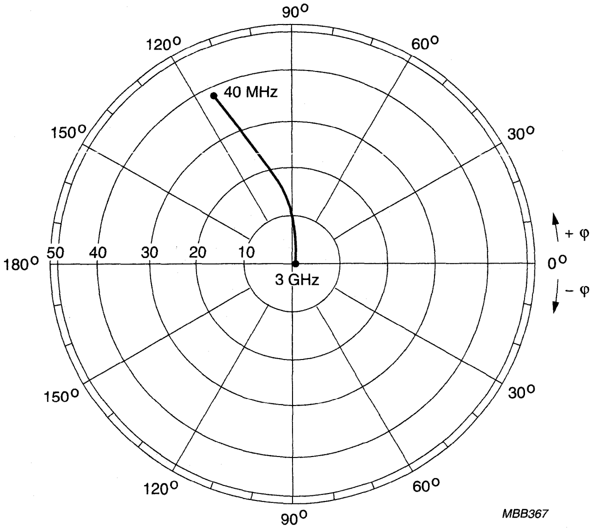
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current.



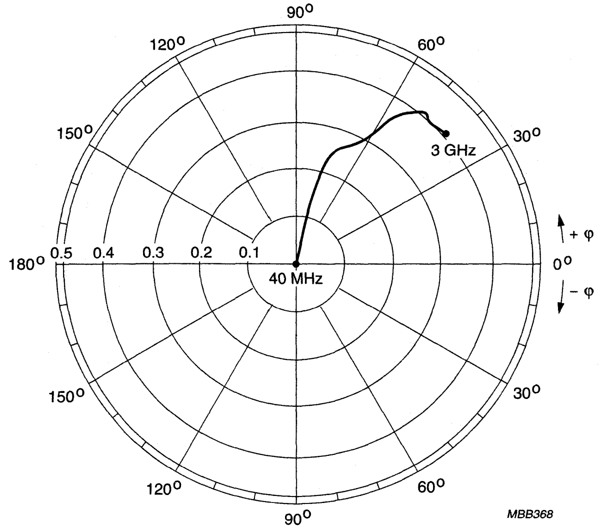
I_C = 70 mA; V_{CE} = 15 V; Z_o = 50 Ω.

Fig.6 Common emitter input reflection coefficient (S_{11}).



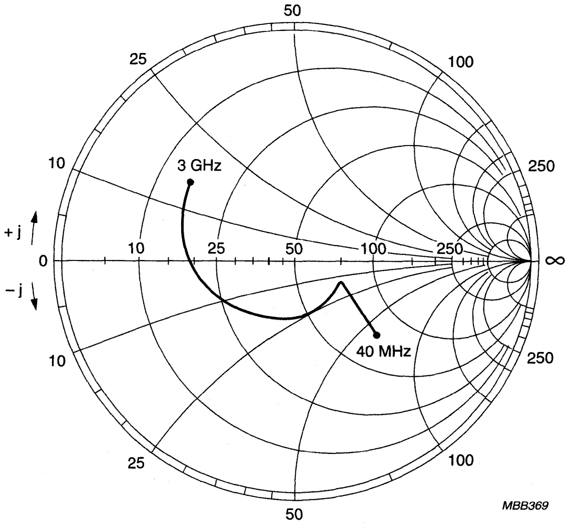
I_C = 70 mA; V_{CE} = 15 V.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 70 mA; V_{CE} = 15 V.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



I_C = 70 mA; V_{CE} = 15 V; Z_o = 50 Ω.

Fig.9 Common emitter output transmission coefficient (S_{22}).

UHF power transistor BFG21W

FEATURES

- High power gain
- High efficiency
- 1.9 GHz operating area
- Linear and non-linear operation.

APPLICATIONS

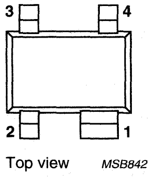
- Common emitter class-AB output stage in hand held radio equipment at 1.9 GHz such as DECT, PHS, etc.
- Driver for DCS1800, 1900.

DESCRIPTION

NPN double polysilicon bipolar power transistor with buried layer for low voltage medium power applications encapsulated in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1, 3	emitter
2	base
4	collector



Marking code: P1.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (dBm)	G_p (dB)	η_C (%)
Pulsed class-AB; $\delta < 1:2$; $t_p = 5$ ms	1.9	3.6	26	≥10	typ.55

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
V_{EBO}	emitter-base voltage	open collector	–	1	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C; note 1	–	600	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

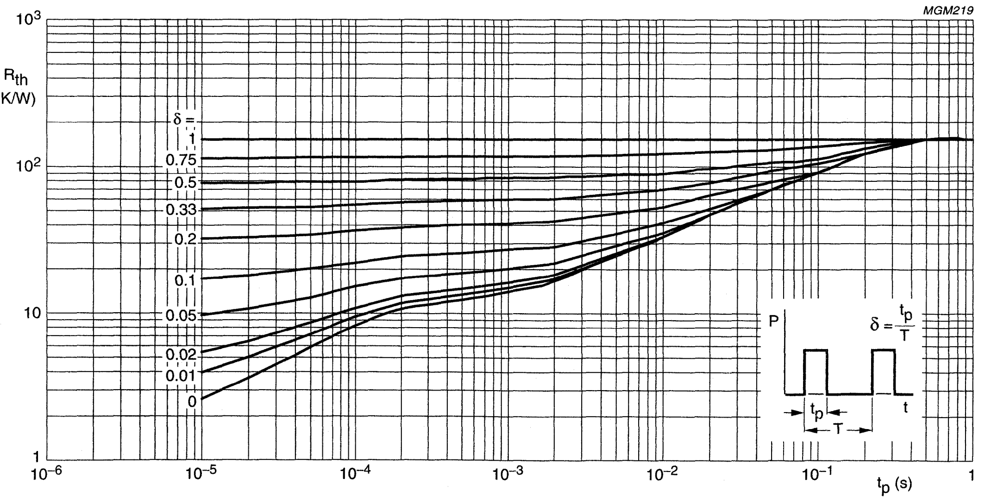
1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 60$ °C; P_{tot} = 600 mW; note 1	150	K/W

Note

1. T_s is the temperature at the soldering point of the emitter pins.



At temperature stabilization solder point has been reached.

Fig.2 Transient thermal resistance as a function of pulse time; typical values.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.1 mA	15	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	4.5	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	R_{BE} < 1 kΩ, I_C = 10 mA	10	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	1	–	V
I_{CES}	collector leakage current	V_{CE} = 5 V; V_{BE} = 0	–	10	μA
h_{FE}	DC current gain	I_C = 200 mA; V_{CE} = 2 V	40	100	
C_c	collector capacitance	$I_E = i_e$= 0; V_{CB} = 3 V; f = 1 MHz	–	3	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 3.6 V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	I_C = 200 mA; V_{CE} = 3.6 V; f = 700 MHz	18	–	GHz

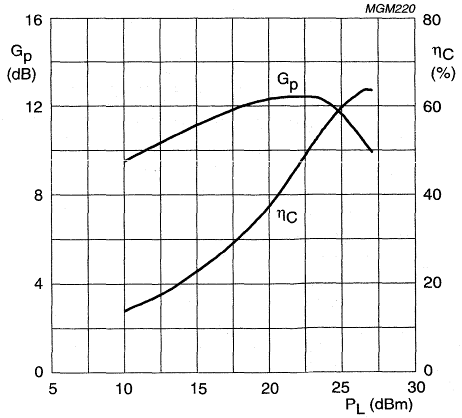
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see Figs 4 and 5).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (dBm)	G_p (dB)	η_C (%)
Pulsed; class-AB; δ < 1 : 2; t_p = 5 ms	1.9	3.6	1	26	≥10	typ. 55

Ruggedness in class-AB operation

The transistor is capable of withstanding a load mismatch corresponding to VSWR = 6 : 1 through all phases at 26 dBm output power under pulsed conditions: δ = 1 : 2; t_p = 5 ms; f = 1.9 GHz at V_{CE} = 4.5 V.



Pulsed, class-AB operation; δ < 1 : 2; t_p = 5 ms.
f = 1.9 GHz; V_{CE} = 3.6 V; I_{CQ} = 1 mA; tuned at P_L = 26 dBm.

Fig.3 Power gain and collector efficiency as a function of the load power; typical values.

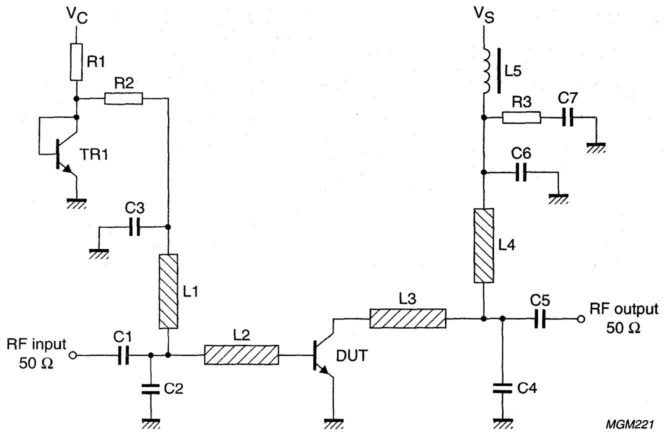


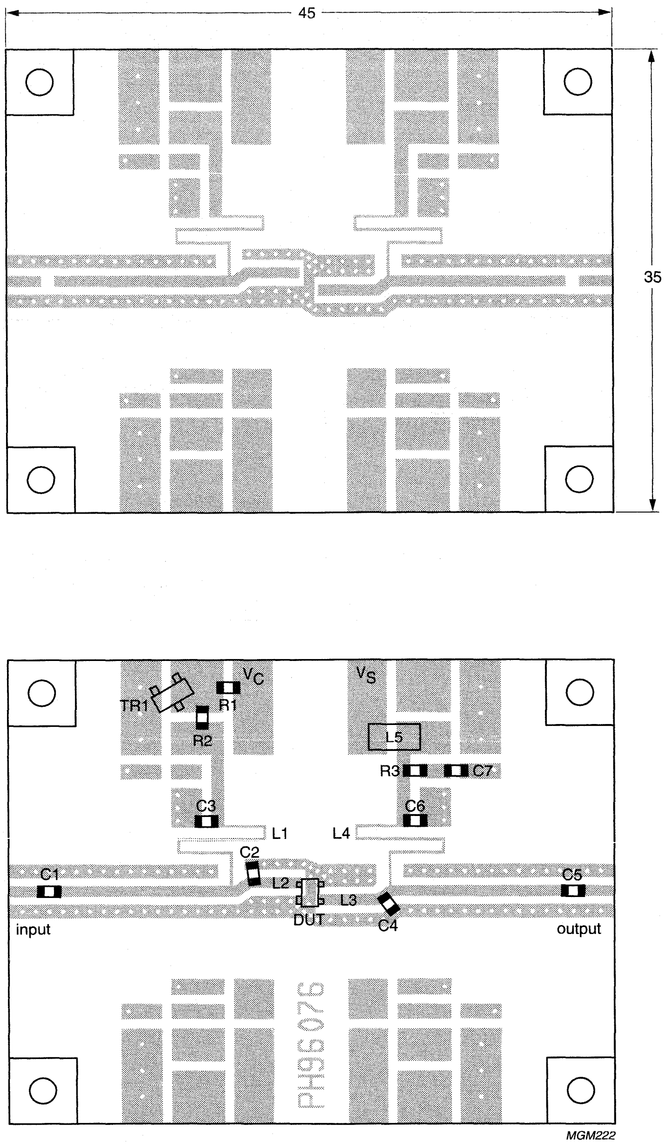
Fig.4 Common emitter test circuit for class-AB operation at 1.9 GHz.

List of components used in test circuit (see Figs 4 and 5)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C5	multilayer ceramic chip capacitor; note 1	24 pF		
C2	multilayer ceramic chip capacitor; note 1	3.3 pF		
C3, C6	multilayer ceramic chip capacitor, note 1	15 pF		
C4	multilayer ceramic chip capacitor; note 1	2.4 pF		
C7	multilayer ceramic chip capacitor; note 1	1 nF		
L1, L4	stripline; note 2	100 Ω	18 × 0.2 mm	
L2	stripline; note 2	50 Ω	3.2 × 0.8 mm	
L3	stripline; note 2	50 Ω	4.6 × 0.8 mm	
L5	Grade 4S2 Ferroxcube chip bead			4330 030 36300
R1	metal film resistor	220 Ω; 0.4 W		
R2, R3	metal film resistor	10 Ω; 0.4 W		
TR1	NPN transistor	BC817		9335 895 20215

Notes

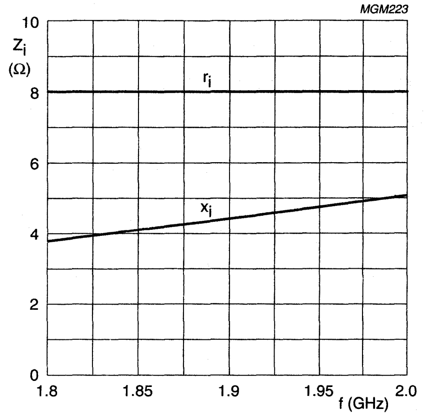
1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 6.15$, $\tan \delta = 0.0019$); thickness 0.64 mm, copper cladding = 35 μm.



Dimensions in mm.

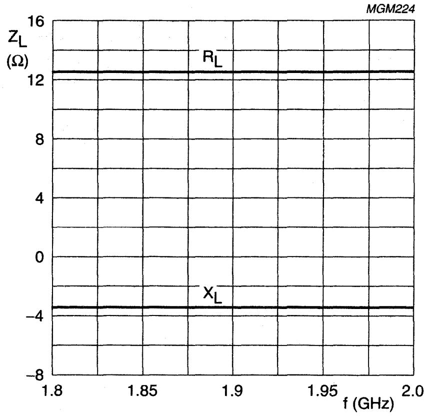
The components are situated on one side of the copper-clad PTFE fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.5 Printed-circuit board and component lay-out for 1.9 GHz class-AB test-circuit in Fig.4.



$V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; $P_L = 26$ dBm; $T_s \leq 60$ °C.

Fig.6 Input impedance as function of frequency (series components); typical values.



$V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; $P_L = 26$ dBm; $T_s \leq 60$ °C.

Fig.7 Load impedance as a function of frequency (series components); typical values.

NPN 5 GHz wideband transistor

BFG25A/X

FEATURES

- Low current consumption (100 µA to 1 mA)
- Low noise figure
- Gold metallization ensures excellent reliability.

APPLICATIONS

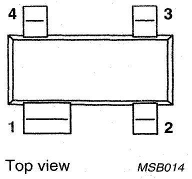
- RF low power amplifiers, such as pocket telephones, paging systems, with signal frequencies up to 2 GHz.

DESCRIPTION

NPN silicon wideband transistor in a four-lead dual emitter SOT143B plastic package (cross emitter).

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter



Marking code: V11.

Fig.1 SOT143B.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	8	V
V_{CEO}	collector-emitter voltage		–	–	5	V
I_C	collector current (DC)		–	–	6.5	mA
P_{tot}	total power dissipation	$T_s \leq 165$ °C	–	–	32	mW
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	18	–	dB
F	noise figure	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $\Gamma = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	1.8	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; $\Gamma = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	2	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	6.5	mA
P_{tot}	total power dissipation	$T_s \leq 165$ °C; note 1	–	32	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	320	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 1$ V; f = 1 MHz	–	0.21	0.3	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	18	–	dB
F	noise figure	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $\Gamma = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	1.8	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; $\Gamma = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	2	–	dB

Note

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

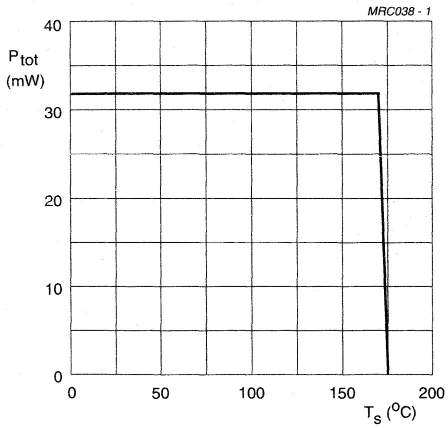
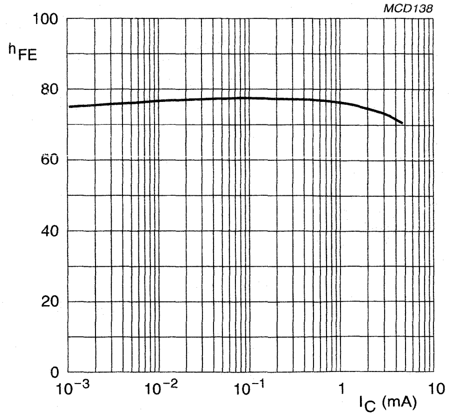
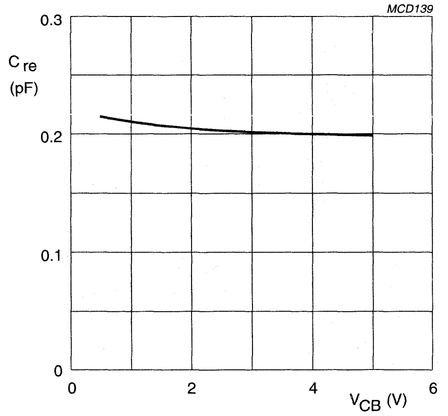


Fig.2 Power derating curve.



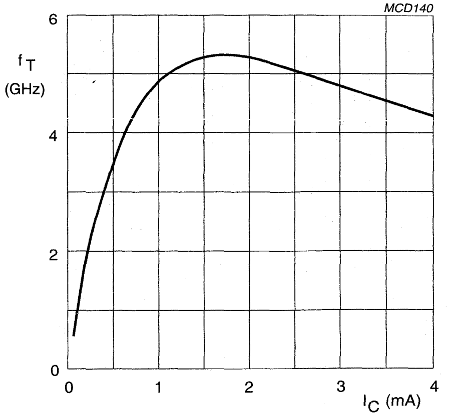
V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current; typical values.



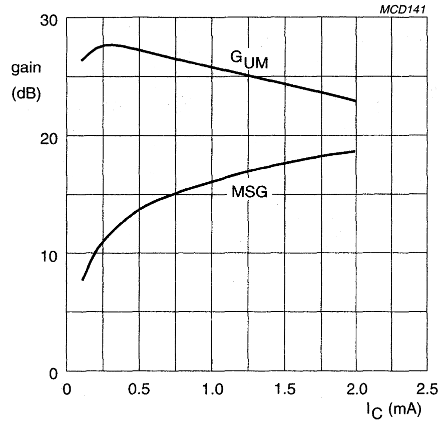
$I_C = i_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



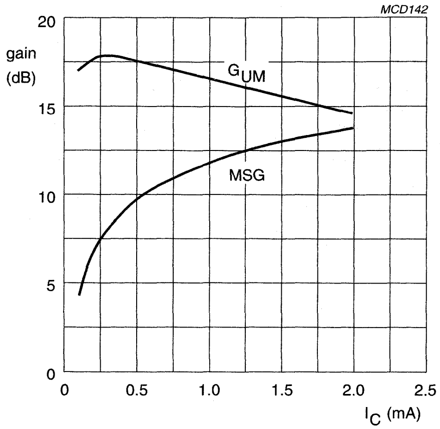
V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



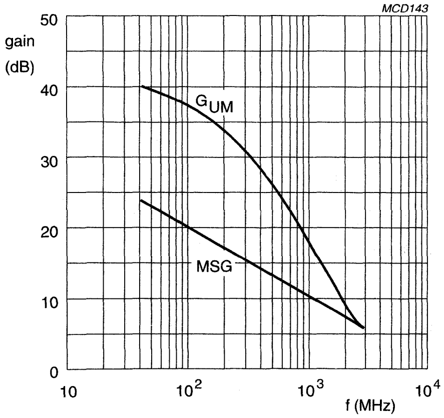
V_{CE} = 1 V; f = 500 MHz.
GUM = maximum unilateral power gain;
MSG = maximum stable gain.

Fig.6 Gain as a function of collector current; typical values.



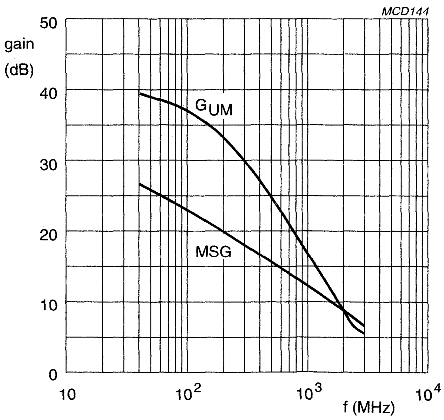
V_{CE} = 1 V; f = 1 GHz.
GUM = maximum unilateral power gain;
MSG = maximum stable gain.

Fig.7 Gain as a function of collector current; typical values.



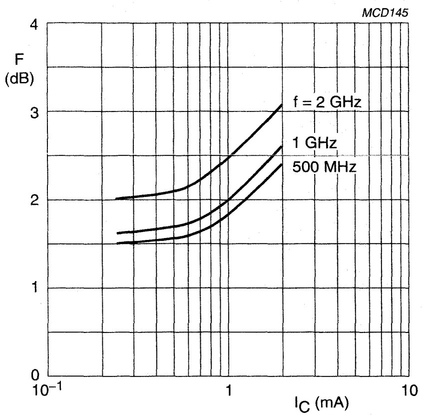
I_C = 0.5 mA; V_{CE} = 1 V.
GUM = maximum unilateral power gain;
MSG = maximum stable gain.

Fig.8 Gain as a function of frequency; typical values.



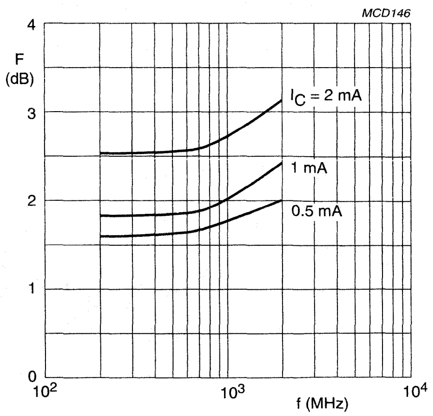
I_C = 1 mA; V_{CE} = 1 V.
GUM = maximum unilateral power gain;
MSG = maximum stable gain.

Fig.9 Gain as a function of frequency; typical values.



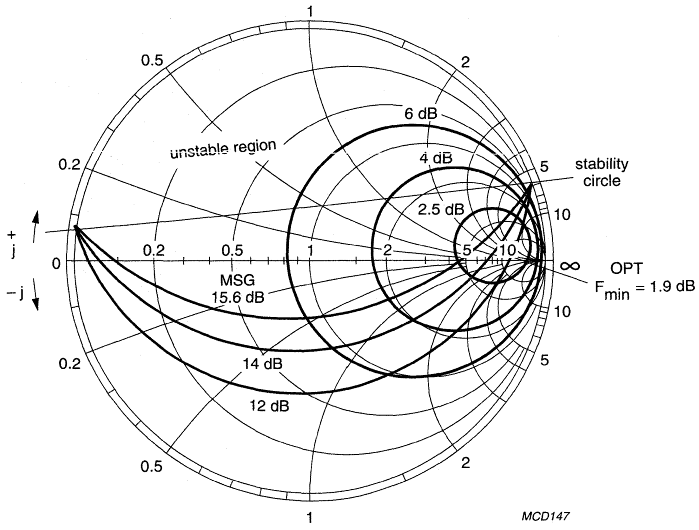
V_{CE} = 1 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



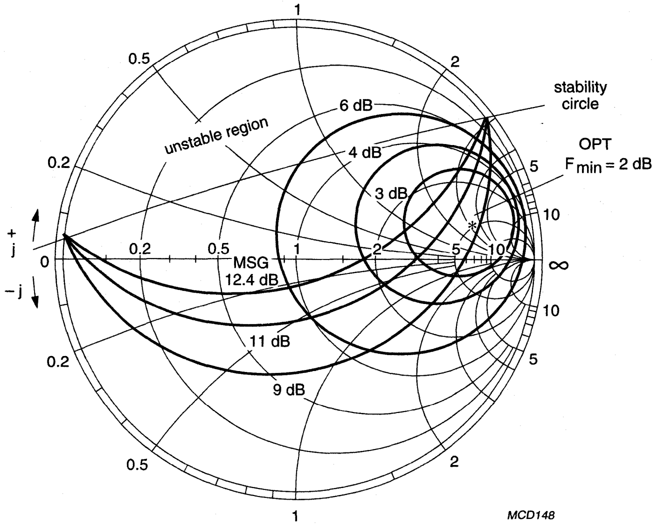
V_{CE} = 1 V.

Fig.11 Minimum noise figure as a function of frequency; typical values.



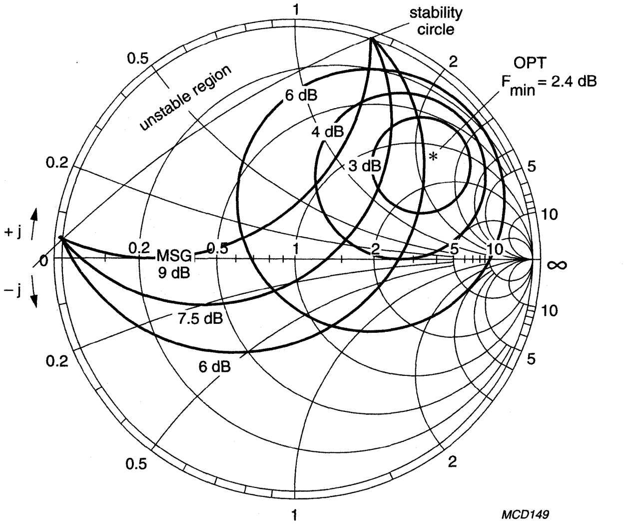
I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; Z_O = 50 Ω; Maximum stable gain = 15.6 dB; F_{min} = 1.9 dB; Γ_{opt} = 0.85, 5°; $R_n/50$ = 2.4.

Fig.12 Common emitter noise figure circles; typical values.



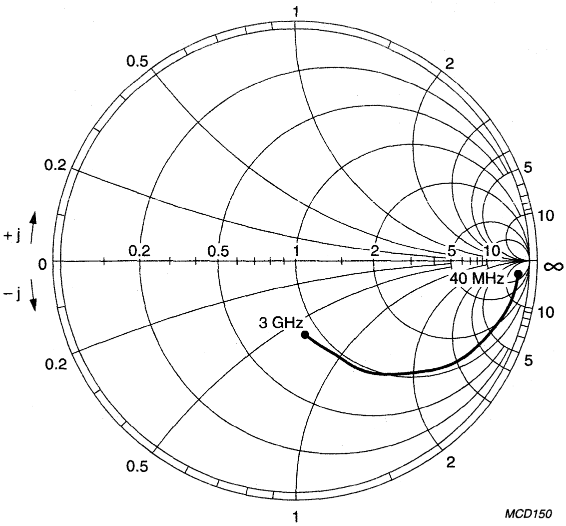
I_C = 1 mA; V_{CE} = 1 V; f = 1000 MHz; Z_O = 50 Ω; Maximum stable gain = 12.4 dB; F_{min} = 2 dB; Γ_{opt} = 0.78, 14°; R_n/50 = 2.6.

Fig.13 Common emitter noise figure circles; typical values.



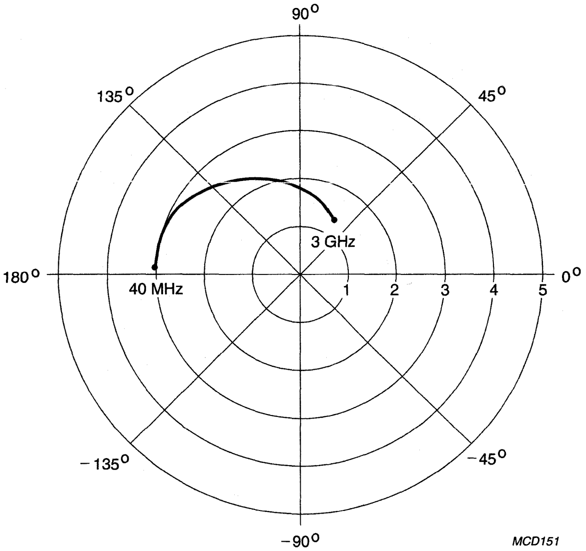
I_C = 1 mA; V_{CE} = 1 V; f = 2000 MHz; Z_O = 50 Ω; Maximum stable gain = 8.9 dB; F_{min} = 2.4 dB; Γ_{opt} = 0.72, 38°; R_n/50 = 1.9.

Fig.14 Common emitter noise figure circles; typical values.



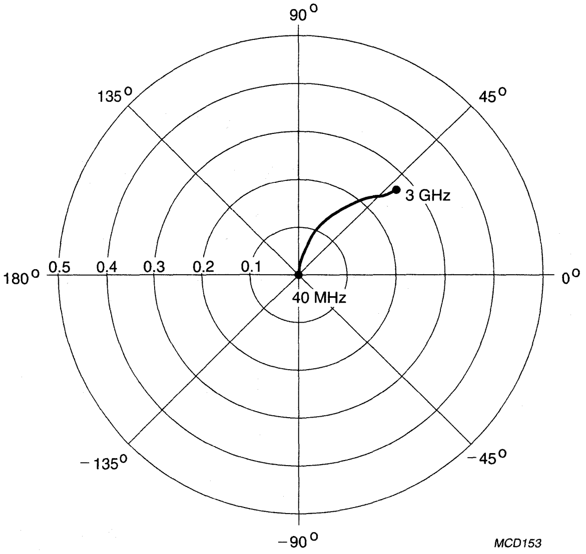
I_C = 1 mA; V_{CE} = 1 V; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (S_{11}); typical values.



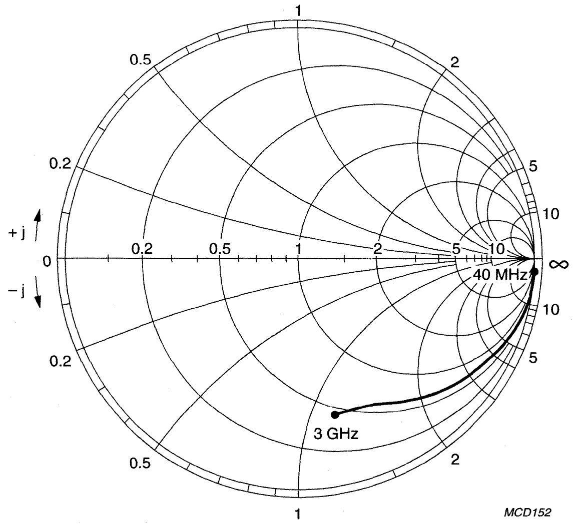
I_C = 1 mA; V_{CE} = 1 V.

Fig.16 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 1 mA; V_{CE} = 1 V.

Fig.17 Common emitter reverse transmission coefficient (S_{12}); typical values.



I_C = 1 mA; V_{CE} = 1 V; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (S_{22}); typical values.

NPN 5 GHz wideband transistors BFG25AW; BFG25AW/X

FEATURES

- Low current consumption (100 µA to 1 mA)
- Low noise figure
- Gold metallization ensures excellent reliability.

APPLICATIONS

Wideband applications in UHF low power amplifiers, such as pocket telephones and paging systems.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

PINNING

PIN	DESCRIPTION
BFG25AW	
1	collector
2	base
3	emitter
4	emitter
BFG25AW/X	
1	collector
2	emitter
3	base
4	emitter

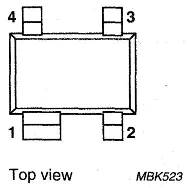


Fig.1 SOT343N.

MARKING

TYPE NUMBER	CODE
BFG25AW	N6
BFG25AW/X	V1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	–	5	V
I_C	collector current (DC)		–	–	6.5	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 1$ V; f = 1 MHz	–	0.2	0.3	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz	–	2	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	6.5	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; see Fig.2; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 85$ °C; note 1	180	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100$ μA; $I_E = 0$	–	–	8	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1$ mA; $I_B = 0$	–	–	5	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 100$ μA; $I_C = 0$	–	–	2	V
I_{CBO}	collector leakage current	open emitter; $V_{CB} = 5$ V; $I_E = 0$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 1$ V; f = 1 MHz	–	0.2	0.3	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz	–	1.9	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz	–	2		dB

Note

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

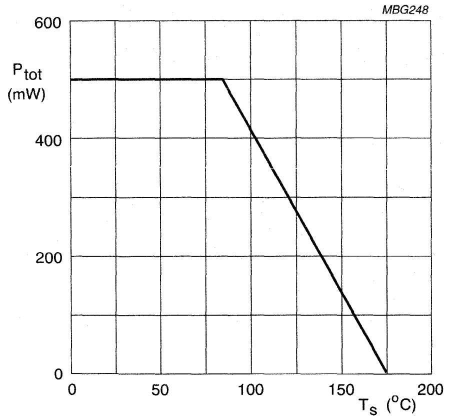
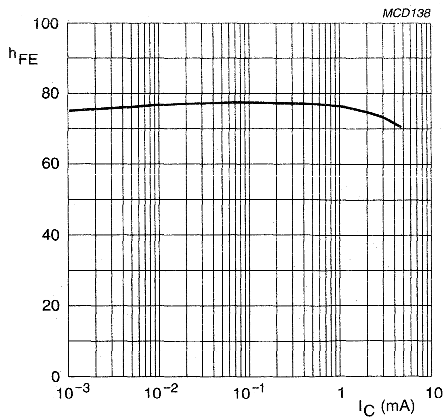
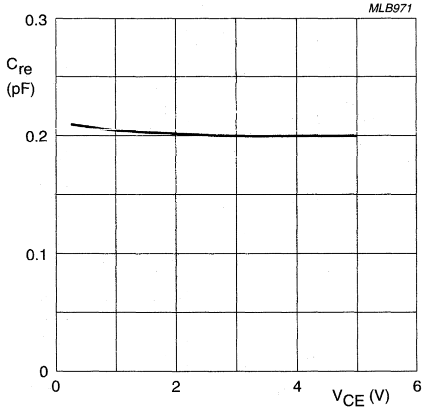


Fig.2 Power derating curve.



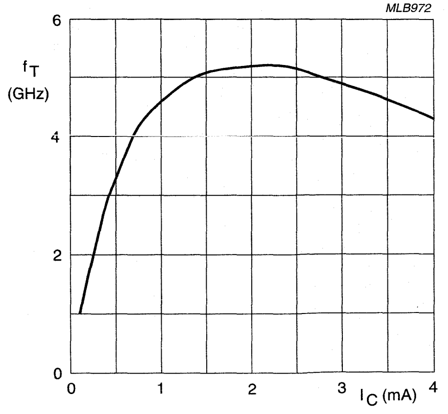
V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current; typical values.



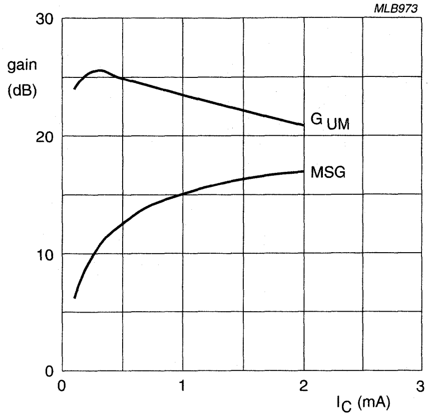
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



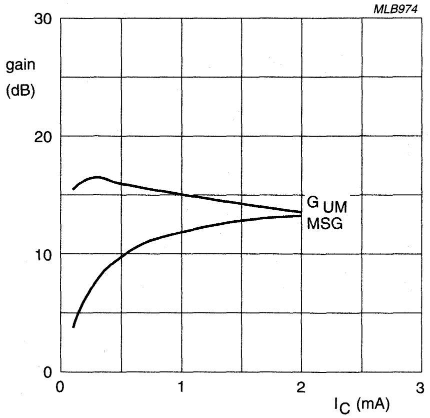
f = 500 MHz; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



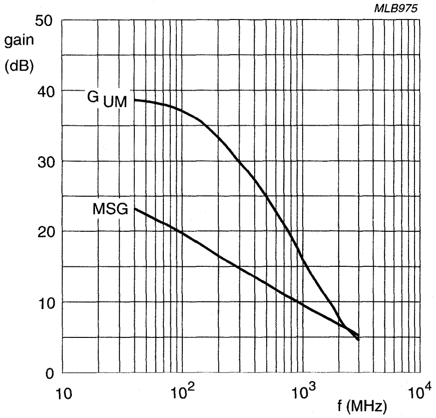
f = 500 MHz; V_{CE} = 1 V.

Fig.6 Gain as a function of collector current; typical values.



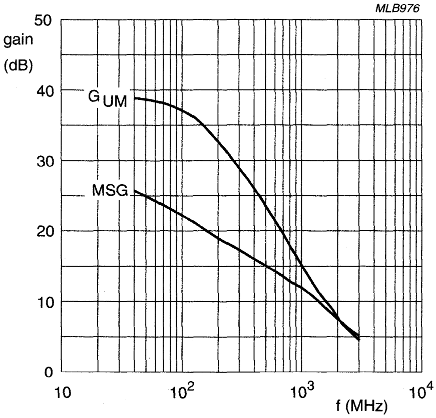
f = 1 GHz; V_{CE} = 1 V.

Fig.7 Gain as a function of collector current; typical values.



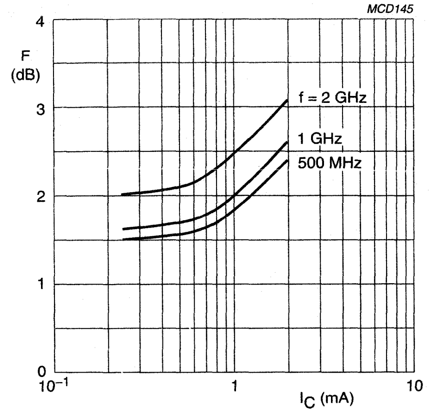
I_C = 0.5 mA; V_{CE} = 1 V.

Fig.8 Gain as a function of frequency; typical values.



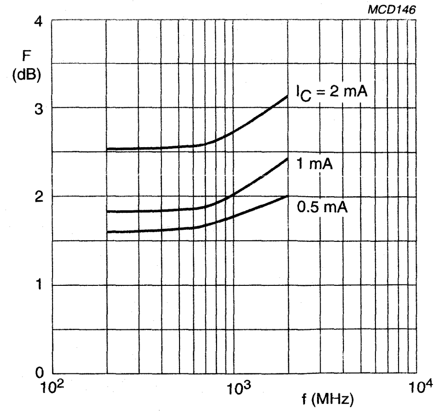
I_C = 1 mA; V_{CE} = 1 V.

Fig.9 Gain as a function of frequency; typical values.



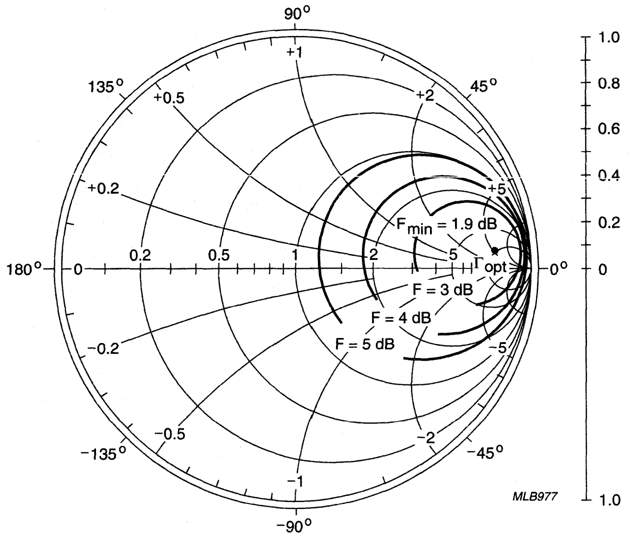
V_{CE} = 1 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



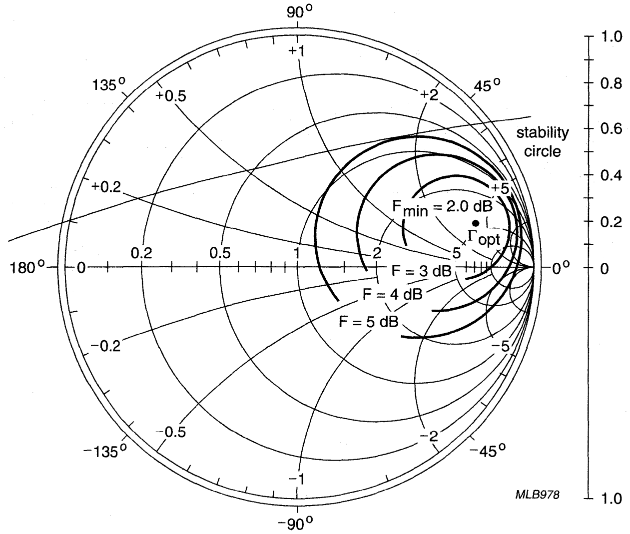
V_{CE} = 1 V.

Fig.11 Minimum noise figure as a function of frequency; typical values.



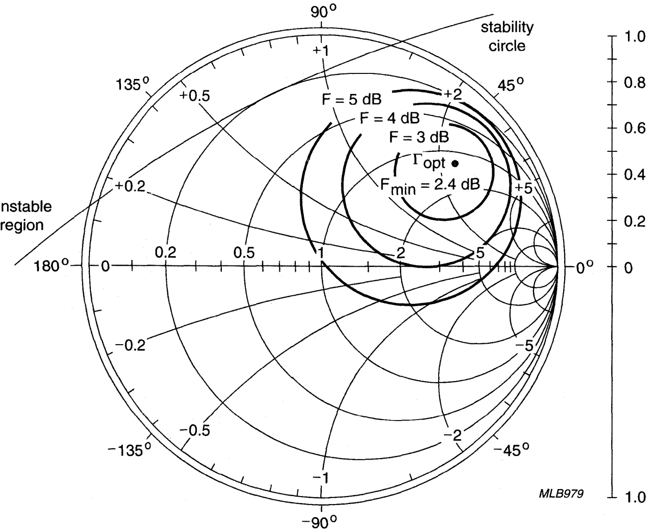
f = 500 MHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

Fig.12 Common emitter noise figure circles; typical values.



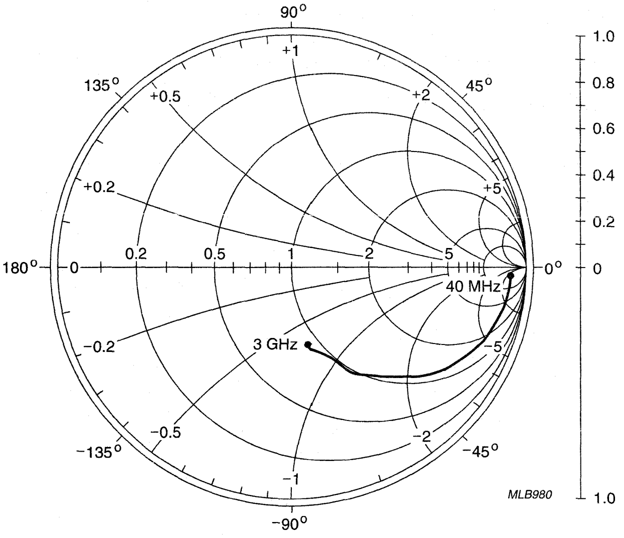
f = 1 GHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

Fig.13 Common emitter noise figure circles; typical values.



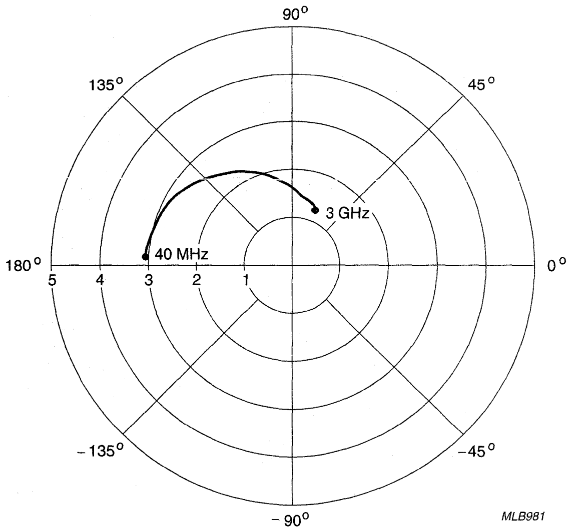
f = 2 GHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



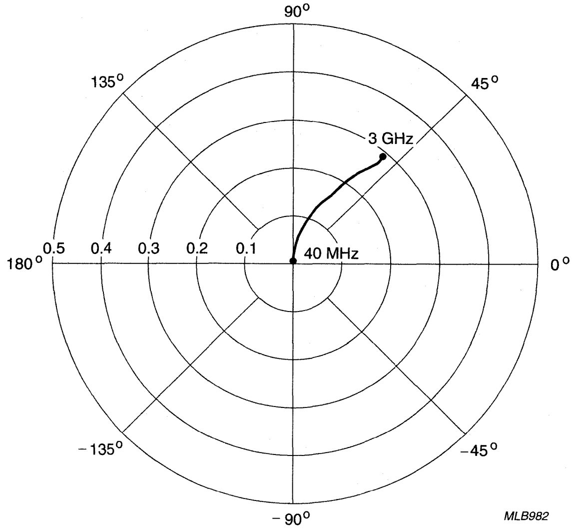
V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω..

Fig.15 Common emitter input reflection coefficient (S_{11}); typical values.



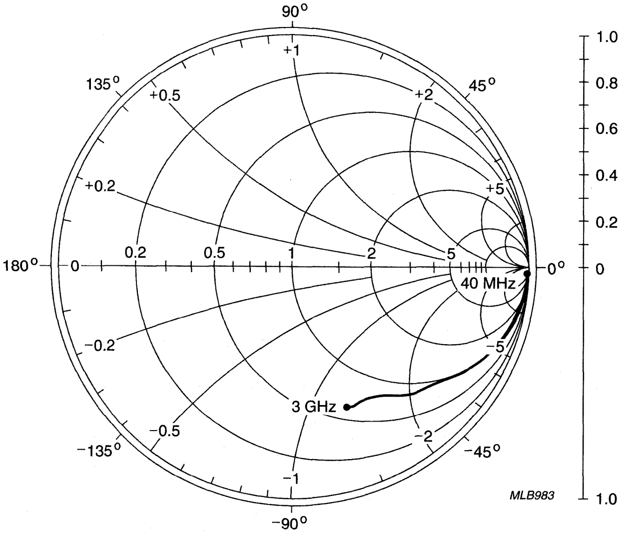
V_{CE} = 1 V; I_C = 1 mA.

Fig.16 Common emitter forward transmission coefficient (S_{21}); typical values.



V_{CE} = 1 V; I_C = 1 mA.

Fig.17 Common emitter reverse transmission coefficient (S_{12}); typical values.



V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

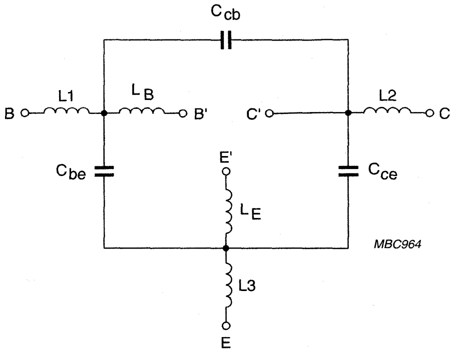
Fig.18 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for the BFG25W crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	13.77	aA
2	BF	85.65	–
3	NF	0.980	–
4	VAF	50.80	V
5	IKF	10.00	A
6	ISE	2.199	fA
7	NE	1.857	–
8	BR	16.97	–
9	NR	0.986	–
10	VAR	2.491	V
11	IKR	188.0	mA
12	ISC	205.1	aA
13	NC	1.107	–
14	RB	80.00	Ω
15	IRB	1.000	μA
16	RBM	80.00	Ω
17	RE	7.911	Ω
18	RC	5.300	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	223.0	fF
23	VJE	669.7	mV
24	MJE	0.060	–
25	TF	5.112	ps
26	XTF	7.909	–
27	VTF	1.338	V
28	ITF	5.662	mA
29	PTF	15.37	deg
30	CJC	229.0	fF
31	VJC	394.7	mV
32	MJC	0.043	–
33	XCJC	0.050	–
34	TR	13.26	ns
35 (1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.988	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.19 Package equivalent circuit SOT343N.

List of components (see Fig.19)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

PNP 5 GHz wideband transistor BFG31

FEATURES

- High output voltage capability
- High gain bandwidth product
- Good thermal stability
- Gold metallization ensures excellent reliability.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

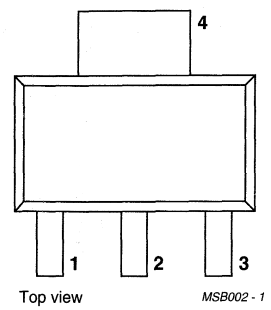


Fig.1 SOT223.

DESCRIPTION

PNP planar epitaxial transistor mounted in a plastic SOT223 envelope.

It is intended for wideband amplifier applications.

NPN complement is the BFG97.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–15	V
I_C	DC collector current		–	–	–100	mA
P_{tot}	total power dissipation	up to T_s = 135 °C ; note 1	–	–	1	W
h_{FE}	DC current gain	I_C = –70 mA; V_{CE} = –10 V; T_{amb} = 25 °C	25	–	–	
f_T	transition frequency	I_C = –70 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	–	5.0	–	GHz
G_{UM}	maximum unilateral power gain	I_C = –70 mA; V_{CE} = –10 V; f = 800 MHz; T_{amb} = 25 °C	–	12	–	dB
V_o	output voltage	I_C = –100 mA; V_{CE} = –10 V; R_L = 75 Ω; T_{amb} = 25 °C	–	600	–	mV

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		–	–100	mA
P_{tot}	total power dissipation	up to T_s = 135 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 135 °C; note 1	40 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 mA	–20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –10 mA	–18	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = –0.1 mA	–3	–	–	V
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = –10 V	–	–	–1	μA
h_{FE}	DC current gain	I_C = –70 mA; V_{CE} = –10 V; T_{amb} = 25 °C	25	–	–	
C_{cb}	collector-base capacitance	I_C = 0; V_{CB} = –10 V; f = 1 MHz;	–	1.8	–	pF
C_{eb}	emitter-base capacitance	I_C = 0; V_{EB} = –10 V; f = 1 MHz	–	5	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = –10 V; f = 1 MHz; T_{amb} = 25 °C	–	1.6	–	pF
f_T	transition frequency	I_C = –70 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	–	5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = –70 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = –70 mA; V_{CE} = –10 V; f = 800 MHz; T_{amb} = 25 °C	–	12	–	dB
V_o	output voltage	note 2	–	600	–	mV
V_o	output voltage	note 3	–	550	–	mV

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. d_{im} = –60 dB; I_C = –70 mA; V_{CE} = –10 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_o$ at d_{im} = –60 dB; f_p = 850.25 MHz;
   $V_q = V_o$ –6 dB; f_q = 858.25 MHz;
   $V_r = V_o$ –6 dB; f_r = 860.25 MHz;
   measured at $f_{(p+q-r)}$ = 848.25 MHz.
3. d_{im} = –60 dB (DIN 45004B); I_C = –70 mA; V_{CE} = –10 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_o$ = at d_{im} = –60 dB; f_p = 445.25 MHz;
   $V_q = V_o$ –6 dB; f_q = 453.25 MHz;
   $V_r = V_o$ –6 dB; f_r = 455.25 MHz;
   measured at $f_{(p+q-r)}$ = 443.25 MHz.

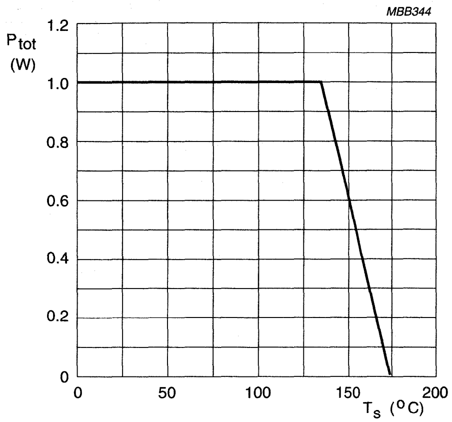
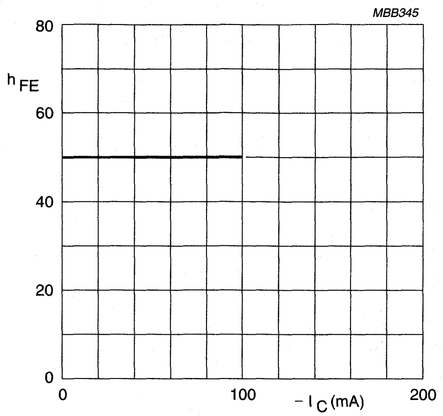
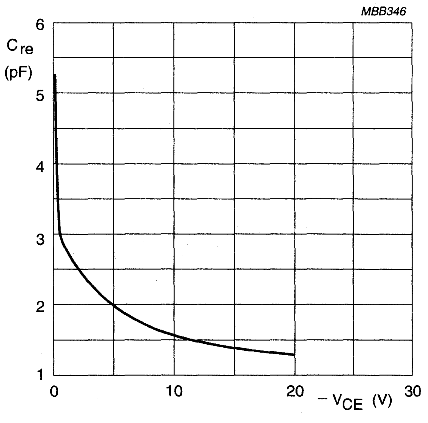


Fig.2 Power derating curve.



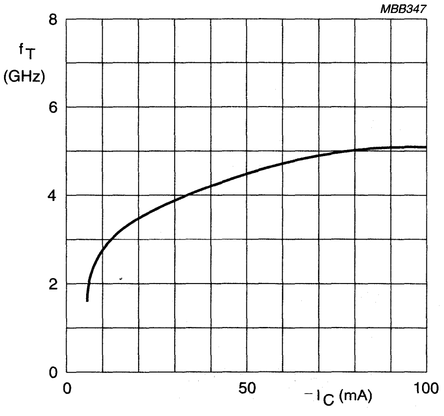
$V_{CE} = -10$ V; $T_{amb} = 25$ °C.

Fig.3 DC current gain as a function of collector current.



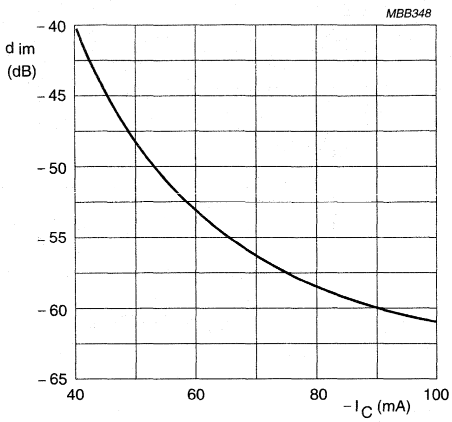
f = 1 MHz; $T_{amb} = 25$ °C

Fig.4 Feedback capacitance as a function of collector-emitter voltage.



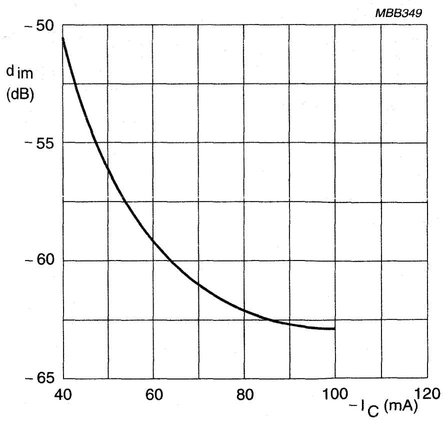
$V_{CE} = -10$ V; $T_{amb} = 25$ °C.

Fig.5 Transition frequency as a function of collector current.



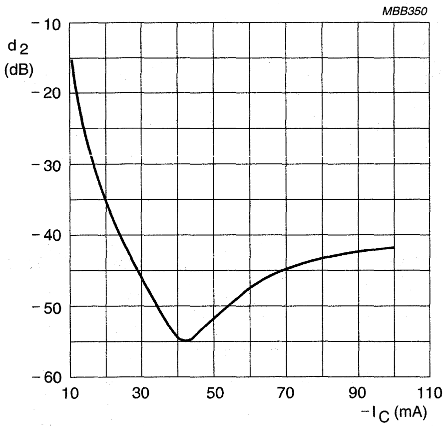
$V_{CE} = -10$ V; $V_o = 650$ mV; $T_{amb} = 25$ °C;
$f_{(p+q-r)} = 443.25$ MHz.

Fig.6 Intermodulation distortion as a function of collector current.



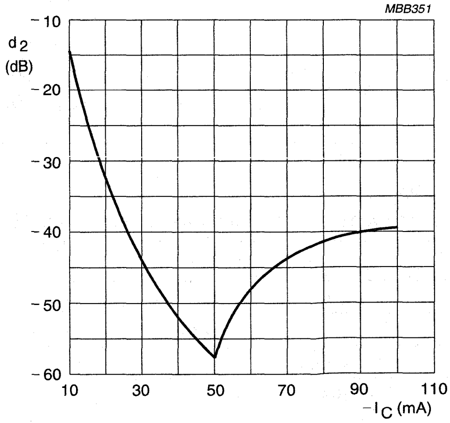
$V_{CE} = -10$ V; $V_o = 550$ mV; $T_{amb} = 25$ °C;
$f_{(p+q-r)} = 848.25$ MHz.

Fig.7 Intermodulation distortion as a function of collector current.



$V_{CE} = -10$ V; $V_o = 50$ dBmV; $T_{amb} = 25$ °C;
$f_{(p+q)} = 450$ MHz.

Fig.8 Second order intermodulation distortion as a function of collector current.



$V_{CE} = -10$ V; $V_o = 50$ dBmV; $T_{amb} = 25$ °C;
$f_{(p+q)} = 810$ MHz.

Fig.9 Second order intermodulation distortion as a function of collector current.

NPN 4 GHz wideband transistor BFG35

DESCRIPTION

NPN planar epitaxial transistor mounted in a plastic SOT223 envelope, intended for wideband amplifier applications. It features high output voltage capabilities.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

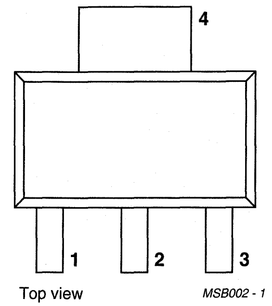


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	18	V
I_C	DC collector current		–	–	150	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V; T_j = 25 °C	25	70	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	4	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	15	–	dB
		I_C = 100 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	11	–	dB
V_o	output voltage	I_C = 100 mA; V_{CE} = 10 V; d_{im} = −60 dB; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C	–	750	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	1	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 135 °C (note 1)	40	K/W

Note

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

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	–	–	1	μA
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V	25	70	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	10	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1.2	–	pF
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	4	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 100$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	11	–	dB
V_o	output voltage	note 2	–	750	–	mV
		note 3	–	800	–	mV
d_2	second order intermodulation distortion	note 4	–	–55	–	dB
		note 5	–	–57	–	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. $d_{im} = -60$ dB (DIN 45004B); $I_C = 100$ 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.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 100$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C
   $V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 445.25$ MHz;
   $V_q = V_o$ –6 dB; $f_q = 453.25$ MHz;
   $V_r = V_o$ –6 dB; $f_r = 455.25$ MHz;
   measured at $f_{(p+q-r)} = 443.25$ MHz.
4. $I_C = 60$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$;
   $V_p = V_q = V_o = 50$ dBmV;
   $f_{(p+q)} = 450$ MHz; $f_p = 50$ MHz; $f_q = 400$ MHz.
5. $I_C = 60$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$;
   $V_p = V_q = V_O = 50$ dBmV;
   $f_{(p+q)} = 810$ MHz; $f_p = 250$ MHz; $f_q = 560$ MHz.

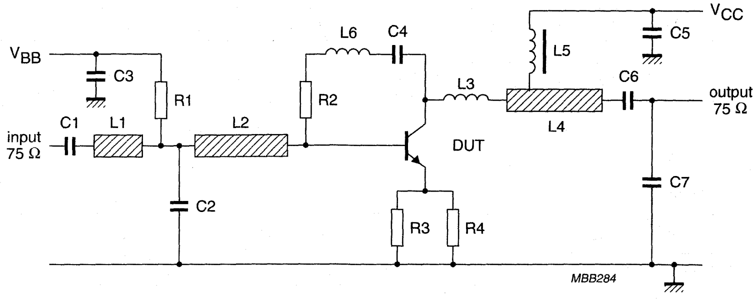


Fig.2 Intermodulation and second harmonic test circuit.

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C3, C5, C6	multilayer ceramic capacitor	10 nF		2222 590 08627
C2, C7	multilayer ceramic capacitor	1 pF		2222 851 12108
C4 (note 1)	miniature ceramic plate capacitor	10 nF		2222 629 08103
L1	microstrip line	75 Ω	length 7mm; width 2.5 mm	
L2	microstrip line	75 Ω	length 22mm; width 2.5 mm	
L3 (note 1)	1.5 turns 0.4 mm copper wire		int. dia. 3 mm; winding pitch 1 mm	
L4	microstripline	75 Ω	length 19 mm; width 2.5 mm	
L5	Ferroxcube choke	5 μH		3122 108 20153
L6 (note 1)	0.4 mm copper wire	≈25 nH	length 30 mm	
R1	metal film resistor	10 kΩ		2322 180 73103
R2 (note 1)	metal film resistor	200 Ω		2322 180 73201
R3, R4	metal film resistor	27 Ω		2322 180 73279

Note

1. Components C4, L3, L6 and R2 are mounted on the underside of the PCB.
   The circuit is constructed on a double copper-clad printed circuit board with PTFE dielectric ($\varepsilon_r = 2.2$); thickness $1/16$ inch; thickness of copper sheet $1/32$ inch.

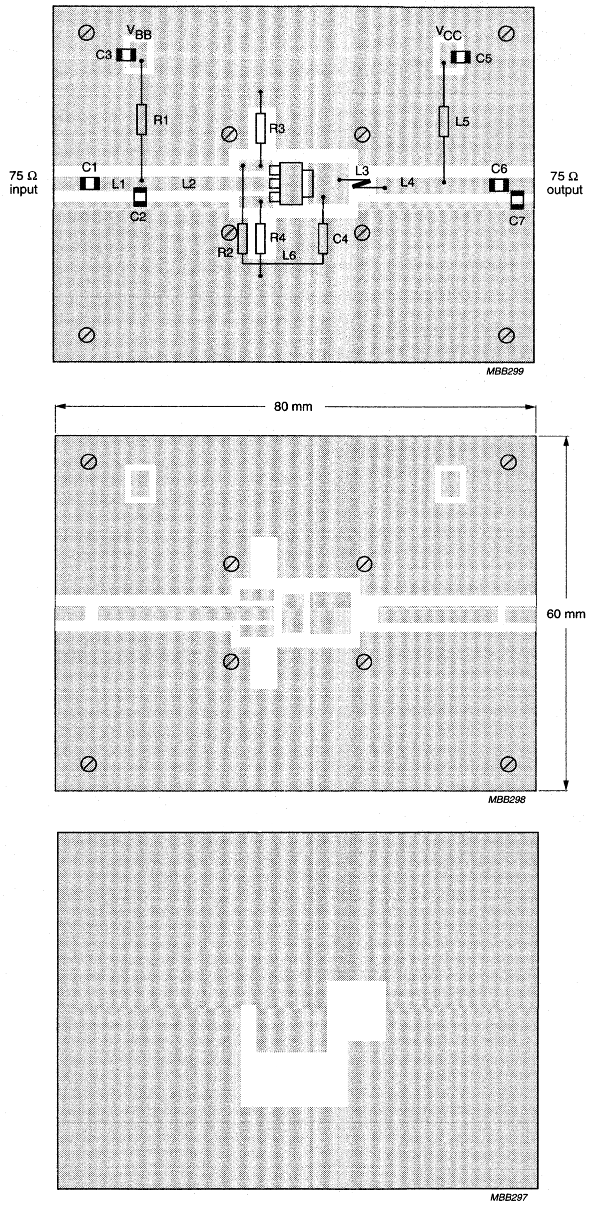


Fig.3 Intermodulation test circuit printed circuit board.

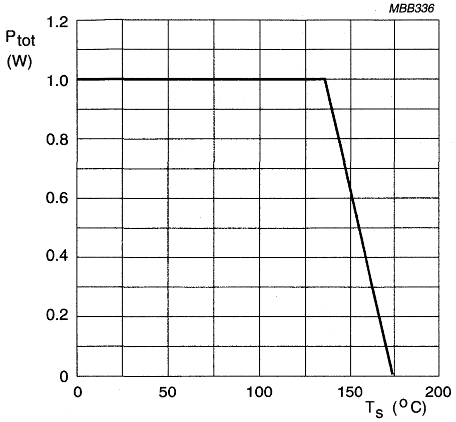
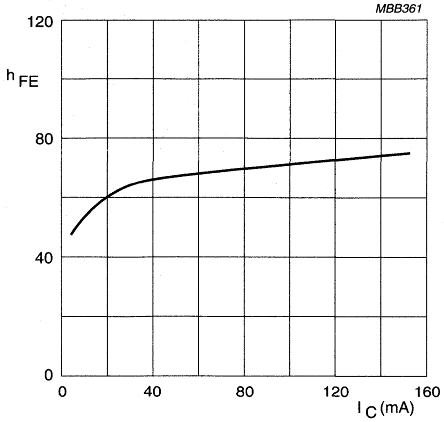
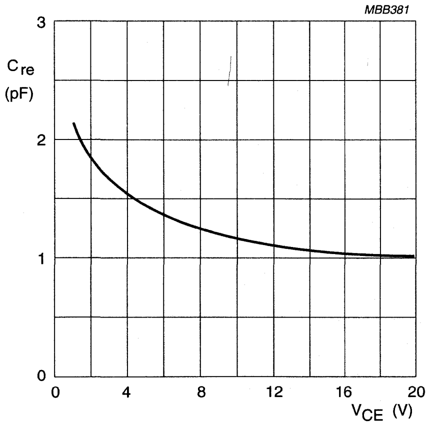


Fig.4 Power derating curve.



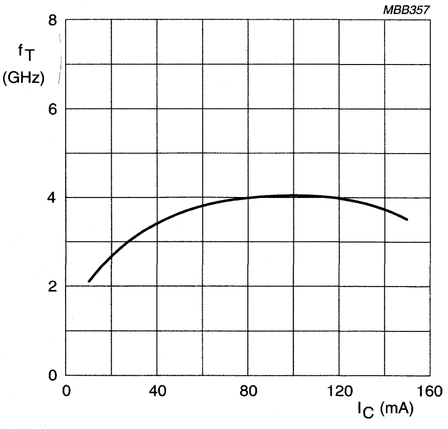
V_{CE} = 10 V; T_j = 25 °C.

Fig.5 DC current gain as a function of collector current.



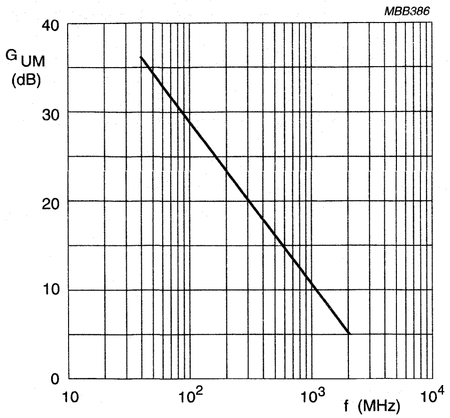
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.6 Feedback capacitance as a function of collector-emitter voltage.



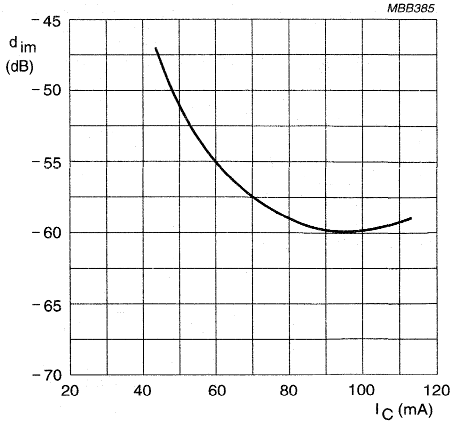
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C

Fig.7 Transition frequency as a function of collector current.



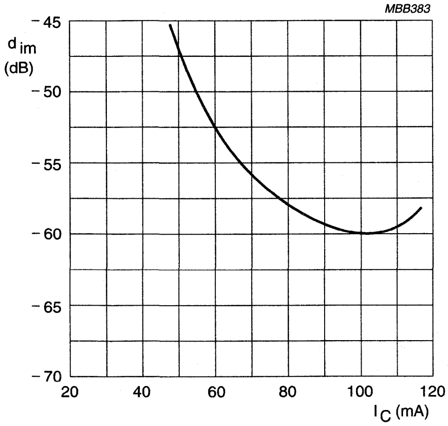
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.8 Maximum unilateral power gain as a function of frequency.



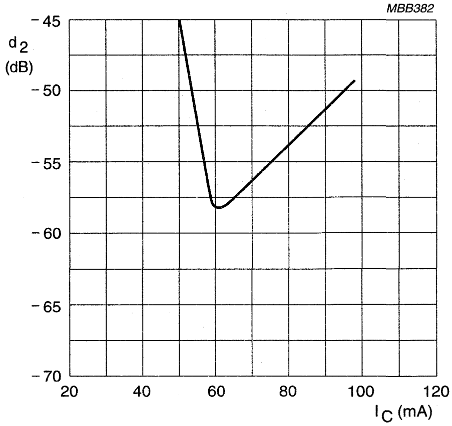
V_{CE} = 10 V; V_o = 800 mV; $f_{(p+q-r)}$ = 443.25 MHz; T_{amb} = 25 °C.

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



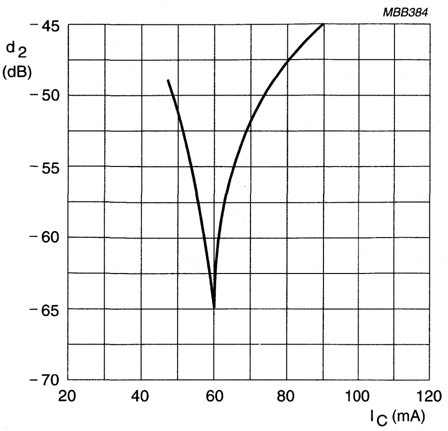
V_{CE} = 10 V; V_o = 750 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.

Fig.10 Intermodulation distortion as a function of collector current.



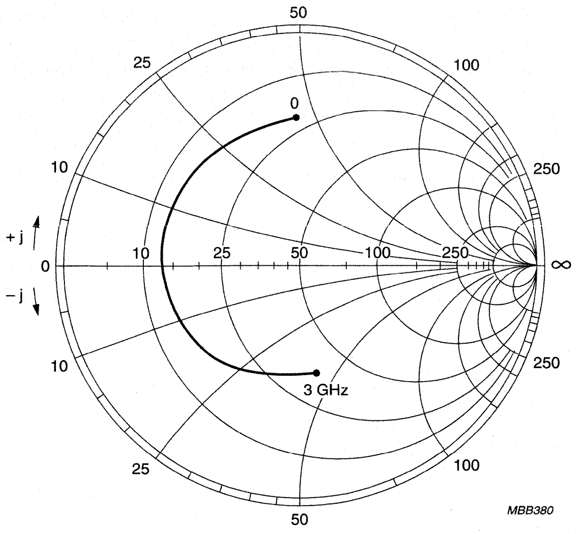
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 450 MHz; T_{amb} = 25 °C.

Fig.11 Second order intermodulation distortion as a function of collector current.



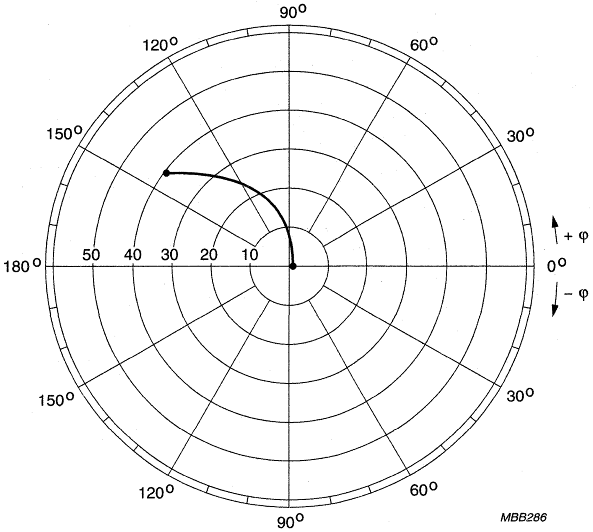
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C.

Fig.12 Second order intermodulation distortion as a function of collector current.



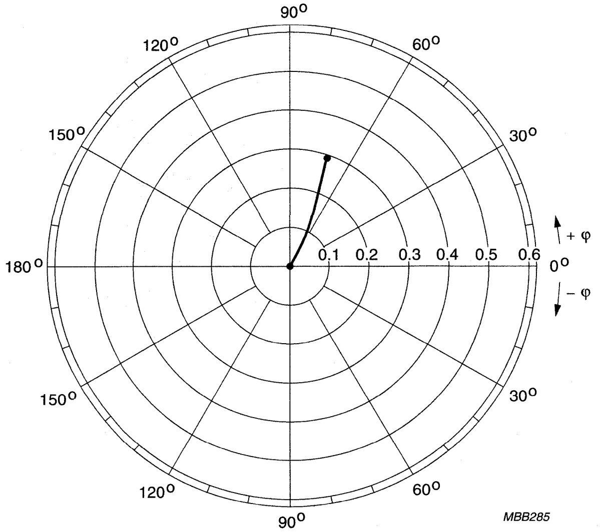
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.13 Common emitter input reflection coefficient (S_{11}).



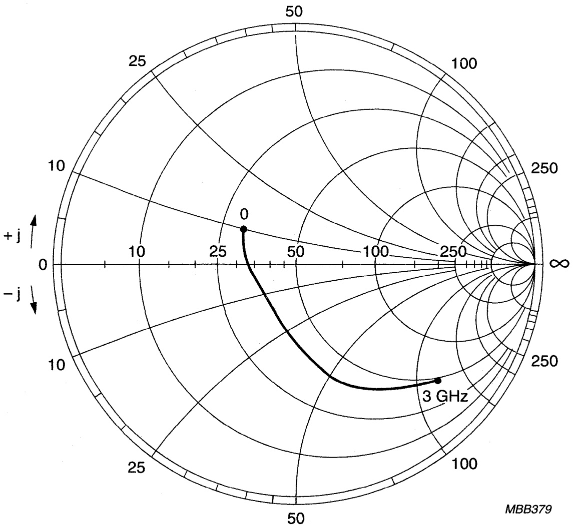
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.14 Common emitter forward transmission coefficient (S_{21}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.15 Common emitter reverse transmission coefficient (S_{12}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.16 Common emitter output reflection coefficient (S_{22}).

NPN 8 GHz wideband transistors BFG67; BFG67/X; BFG67/XR

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

Wideband applications in the GHz range, such as satellite TV tuners and portable RF communications equipment.

DESCRIPTION

NPN silicon transistor in a 4-pin, dual-emitter SOT143B plastic package. Available with in-line emitter pinning (BFG67) and cross emitter pinning (BFG67/X). Version with reverse pinning (BFG67/XR) also available on request.

MARKING

TYPE NUMBER	CODE
BFG67 (Fig.1)	V3
BFG67/X (Fig.1)	V12
BFG67/XR (Fig.2)	V26

PINNING

PIN	DESCRIPTION		
	BFG67	BFG67/X	BFG67/XR
1	collector	collector	collector
2	base	emitter	emitter
3	emitter	base	base
4	emitter	emitter	emitter

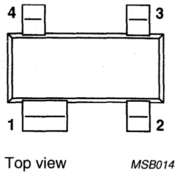


Fig.1 Simplified outline SOT143B.

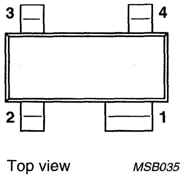


Fig.2 Simplified outline SOT143R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	10	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_s \leq 65$ °C	–	300	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 8$ V; f = 1 MHz	0.5	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 500 MHz	8	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	1.3	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	2.2	–	dB

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_s \leq 65$ °C; see Fig.3; note 1	–	380	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	290	K/W

Note

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

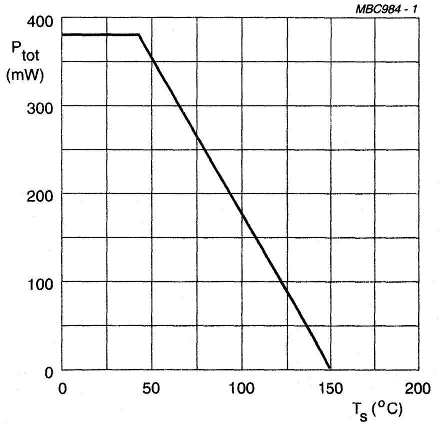


Fig.3 Power derating curve.

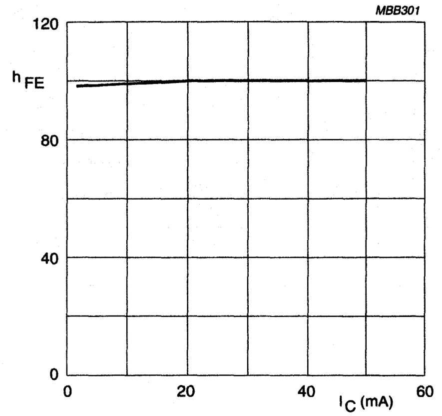
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	V_{CB} = 5 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 5 V	60	100	–	
f_T	transition frequency	I_C = 15 mA; V_{CE} = 8 V; f = 500 MHz	–	8	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	1.3	–	pF
C_{re}	feedback capacitance	$I_C = i_c$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	–	17	–	dB
		I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V T_{amb} = 25 °C; f = 1 GHz	–	1.3	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	–	1.7	–	dB
		I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz; Z_S = 60 Ω	–	2.5	–	dB
		I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz; Z_S = 60 Ω	–	3	–	dB

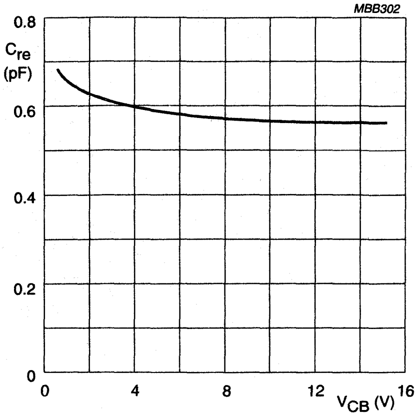
Note

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.



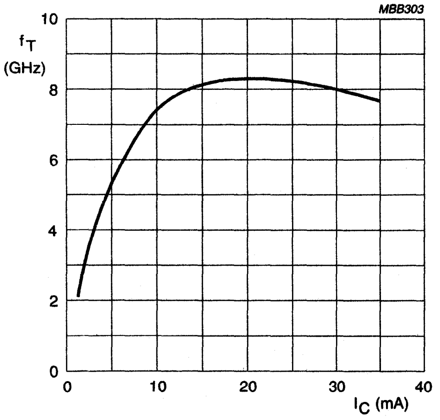
V_{CE} = 5 V.

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



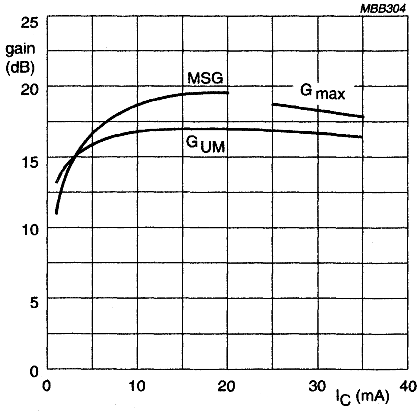
$I_C = i_c = 0$; f = 1 MHz.

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



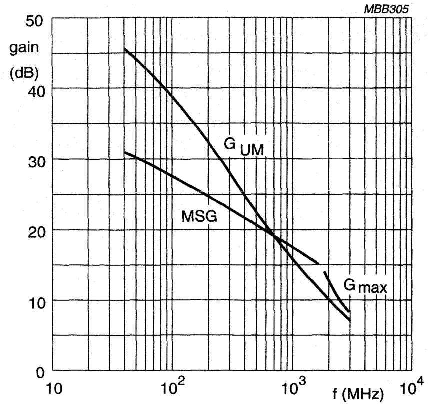
V_{CE} = 8 V; T_{amb} = 25 °; f = 2 GHz.

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



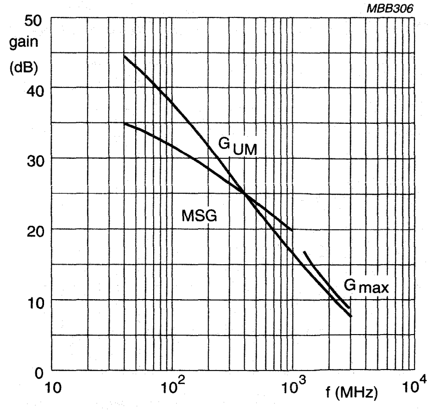
V_{CE} = 8 V; f = 1 GHz.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.7 Gain as a function of collector current.



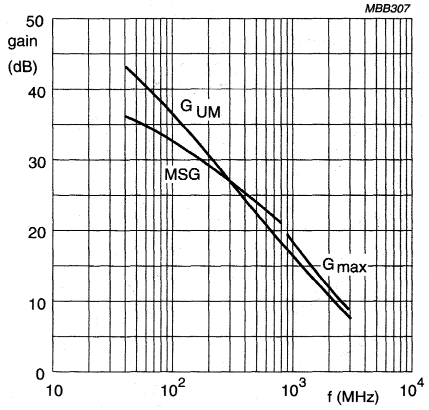
V_{CE} = 8 V; I_C = 5 mA.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.8 Gain as a function of frequency.



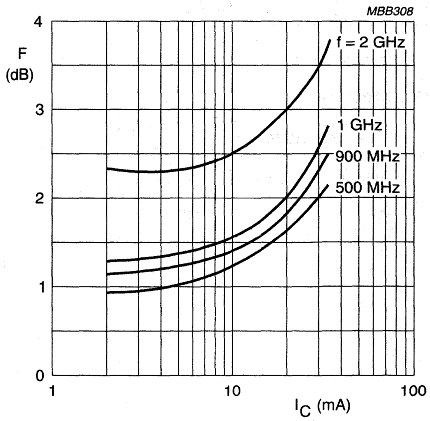
V_{CE} = 8 V; I_C = 15 mA.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.9 Gain as a function of frequency.



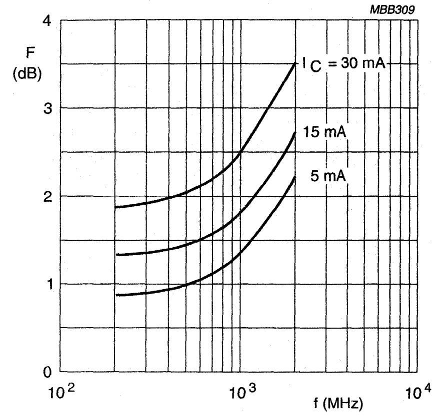
V_{CE} = 8 V; I_C = 30 mA.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.10 Gain as a function of frequency.



V_{CE} = 8 V.

Fig.11 Minimum noise figure as a function of collector current.



V_{CE} = 8 V.

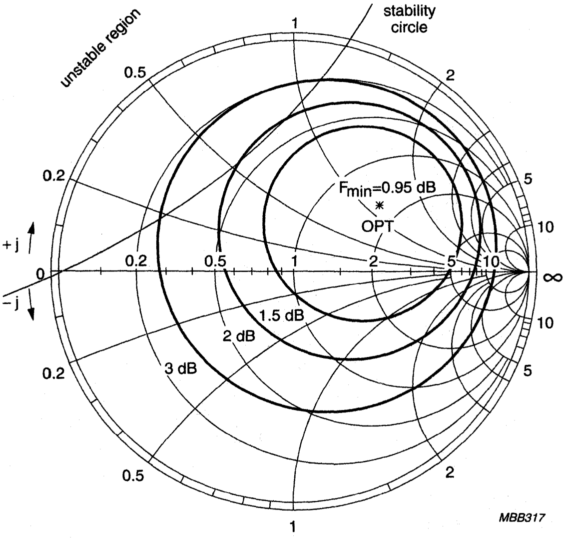
Fig.12 Minimum noise figure as a function of frequency.

BFG67/X

f (MHz)	V_{CE} (V)	I_C (mA)
500	8	5

Noise Parameters

F_{min} (dB)	Gamma (opt)		R_n/50
	(mag)	(ang)	
0.95	0.455	33.8	0.288



Z_O = 50 Ω.

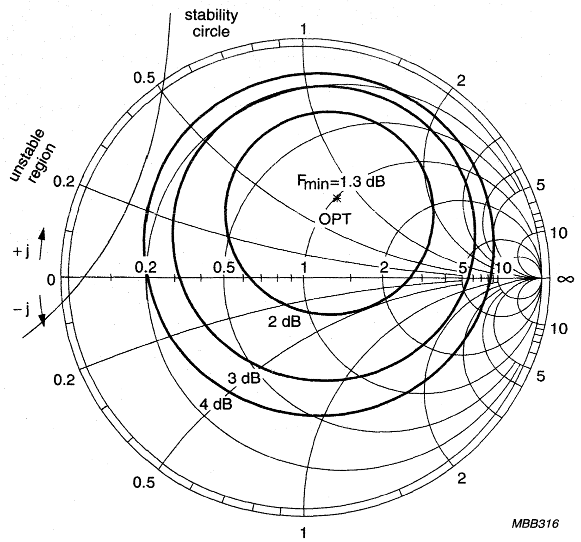
Fig.13 Noise circle figure.

BFG67/X

f (MHz)	V_{CE} (V)	I_C (mA)
1000	8	5

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
1.3	0.375	65.9	0.304



$Z_O = 50\ \Omega$.

Fig.14 Noise circle figure.

BFG67/X

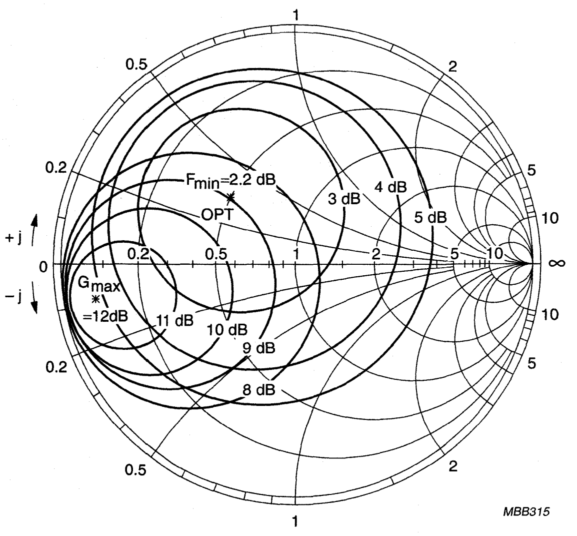
f (MHz)	V_{CE} (V)	I_C (mA)
2000	8	5

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2.2	0.391	136.5	0.184

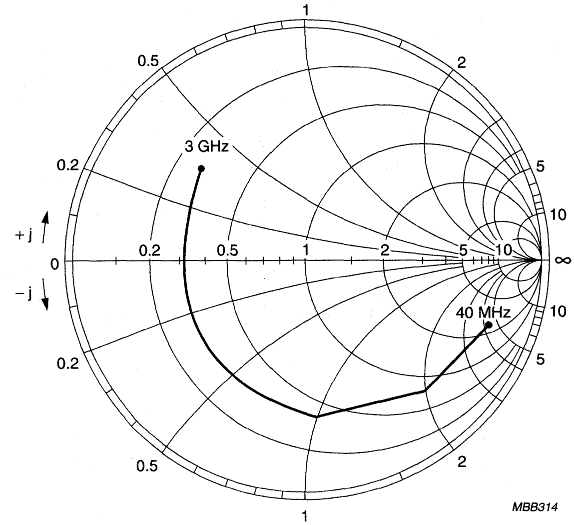
Average Gain Parameters

G_{MAX} (dB)	Gamma (max)	
	(mag)	(ang)
12	0.839	−170



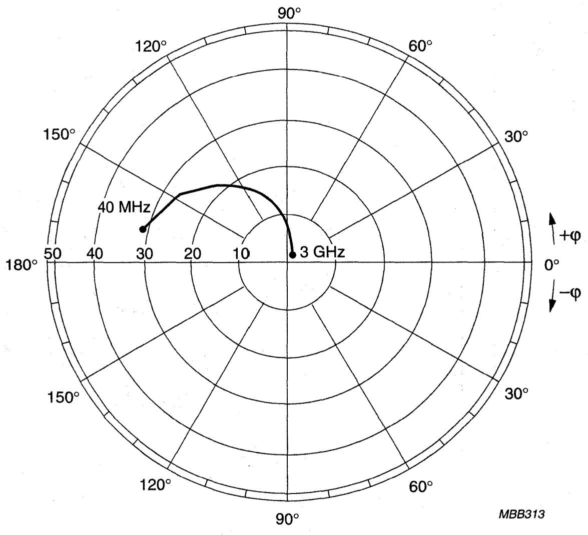
$Z_O = 50\ \Omega$.

Fig.15 Noise circle figure.



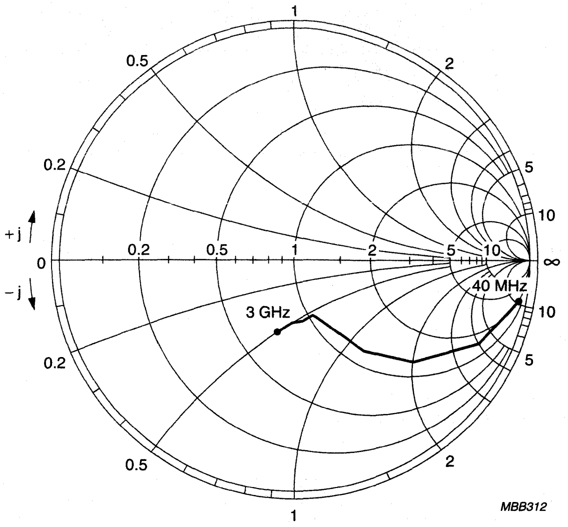
V_{CE} = 8 V; I_C = 15 mA; Z_O = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



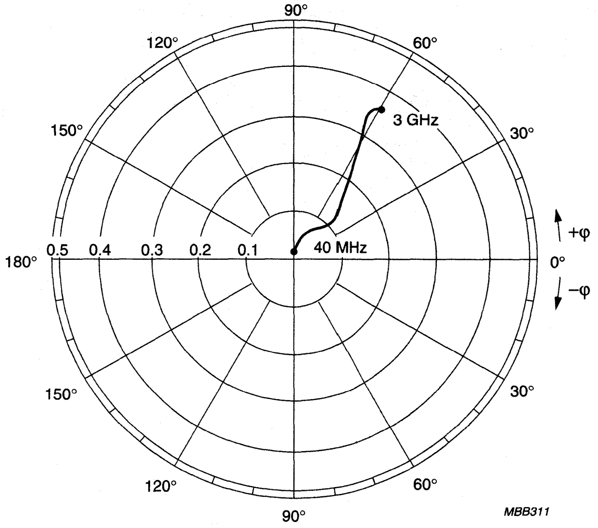
V_{CE} = 8 V; I_C = mA; Z_O = 50 Ω.

Fig.17 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 15 mA.

Fig.18 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 8 V; I_C = 15 mA.

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor

BFG92A/X

FEATURES

- High power gain
- Low noise figure
- Gold metallization ensures excellent reliability.

APPLICATIONS

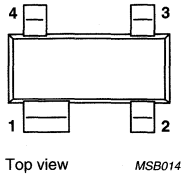
Wideband applications in the UHF and microwave range.

DESCRIPTION

Silicon NPN transistor in a 4-pin, dual-emitter SOT143B plastic package.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter



Marking code: V14.

Fig.1 SOT143B.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	20	V
V_{CEO}	collector-emitter voltage		–	–	15	V
I_C	collector current (DC)		–	–	25	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C	–	–	400	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	11	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2	–	dB

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	2	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C; note 1	–	400	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	290	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 10$ V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	11	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	3	–	dB

Note

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.

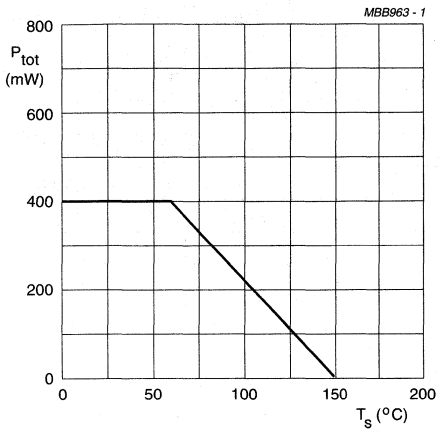
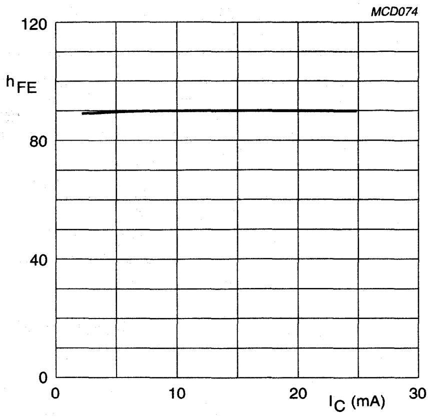
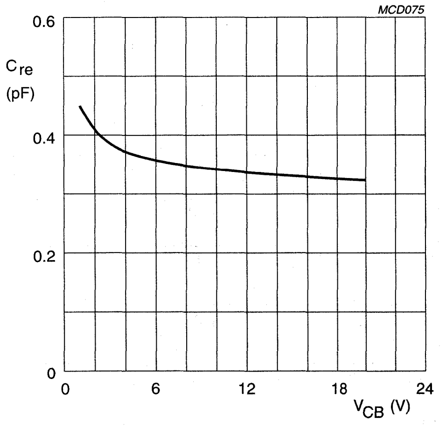


Fig.2 Power derating curve.



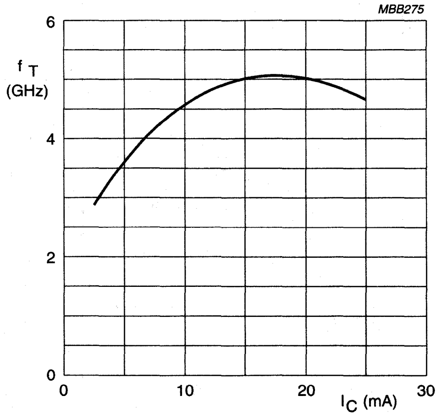
V_{CE} = 10 V.

Fig.3 DC current gain as a function of collector current; typical values.



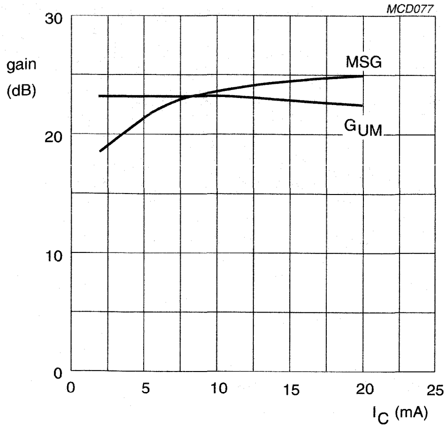
$I_C = i_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



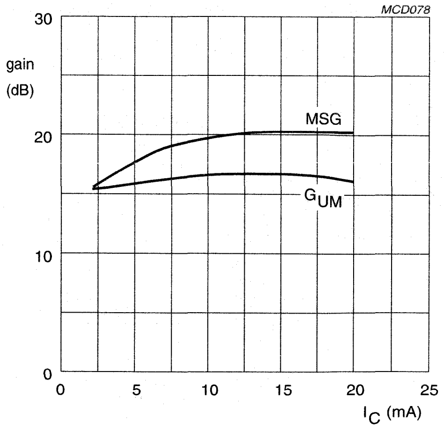
V_{CE} = 10 V; T_{amb} = 25 °C; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



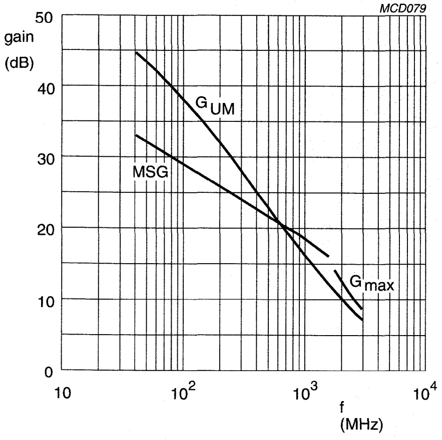
V_{CE} = 10 V; f = 500 MHz.

Fig.6 Gain as a function of collector current; typical values.



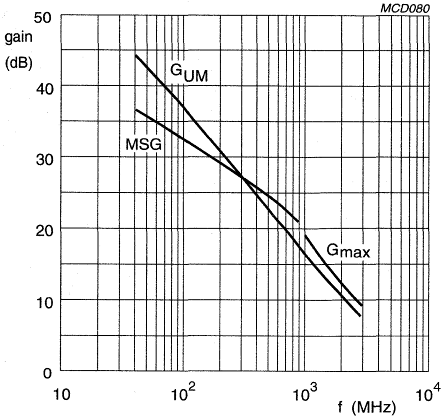
V_{CE} = 10 V; f = 1 GHz.

Fig.7 Gain as a function of collector current; typical values.



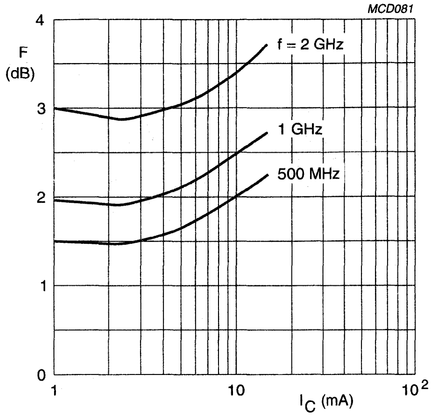
V_{CE} = 10 V; I_C = 5 mA.

Fig.8 Gain as a function of frequency; typical values.



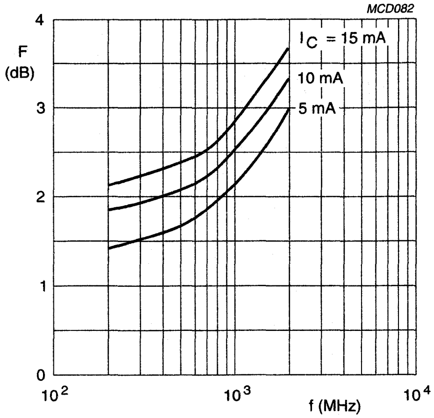
V_{CE} = 10 V; I_C = 15 mA.

Fig.9 Gain as a function of frequency; typical values.



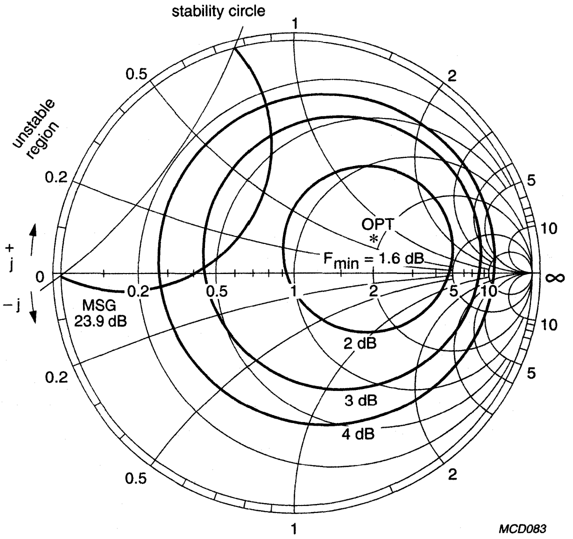
V_{CE} = 10 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



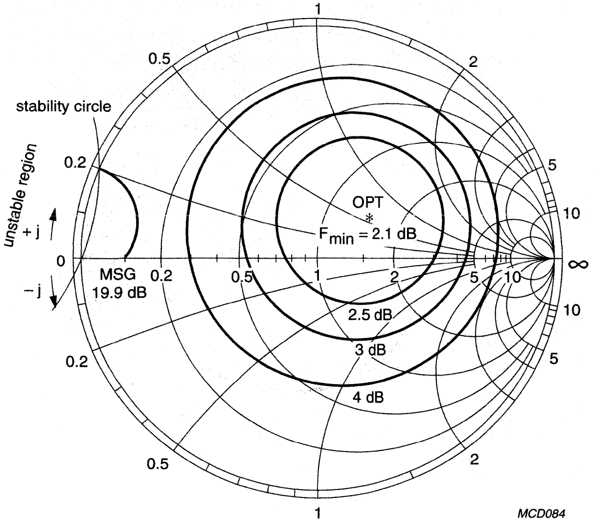
V_{CE} = 10 V.

Fig.11 Minimum noise figure as a function of frequency; typical values.



Z_o = 50 Ω.
Maximum stable gain = 23.9 dB.

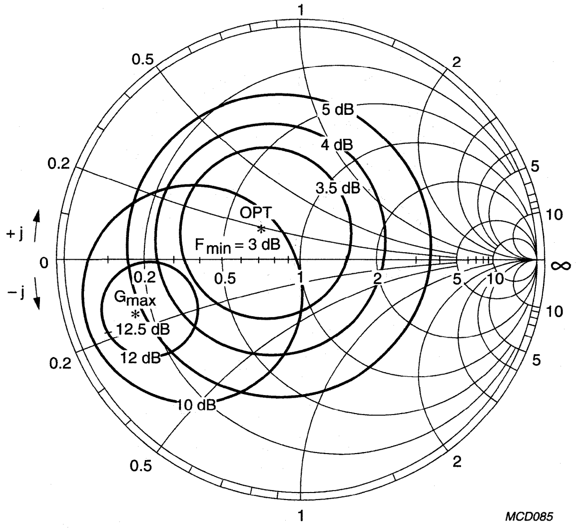
Fig.12 Common emitter noise figure circles; typical values.



Z_o = 50 Ω.

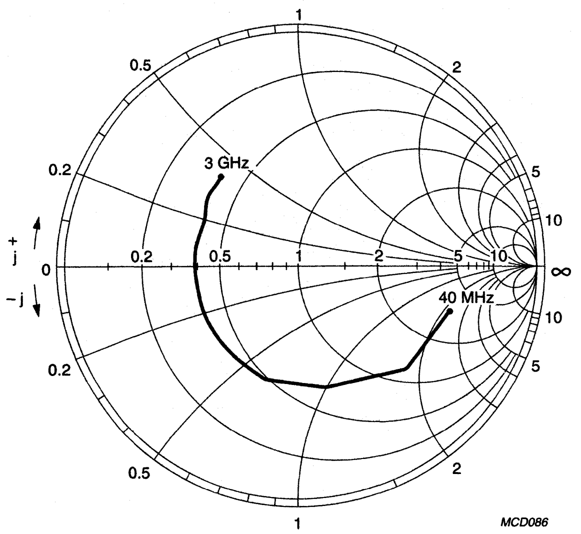
Maximum stable gain = 19.9 dB.

Fig.13 Common emitter noise figure circles; typical values.



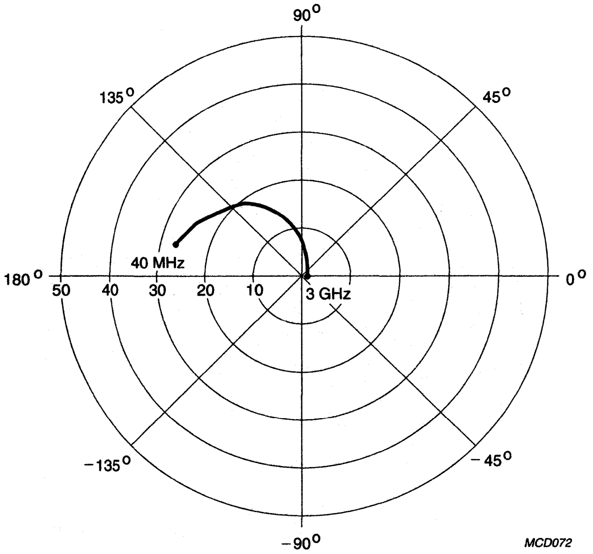
Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



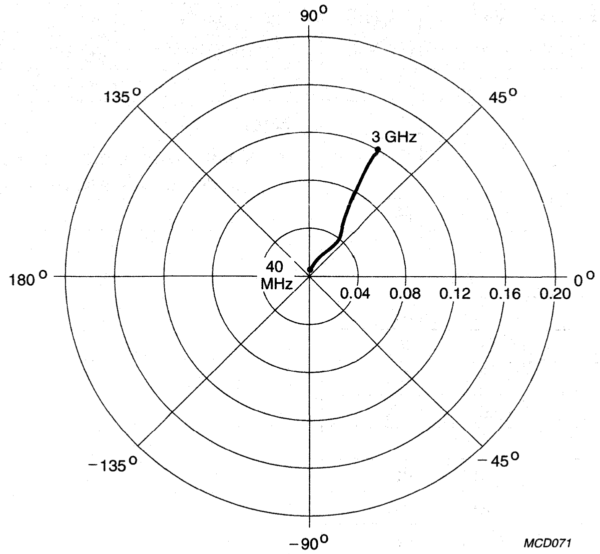
V_{CE} = 10 V; I_C = 15 mA.

Fig.15 Common emitter input reflection coefficient (S_{11}); typical values.



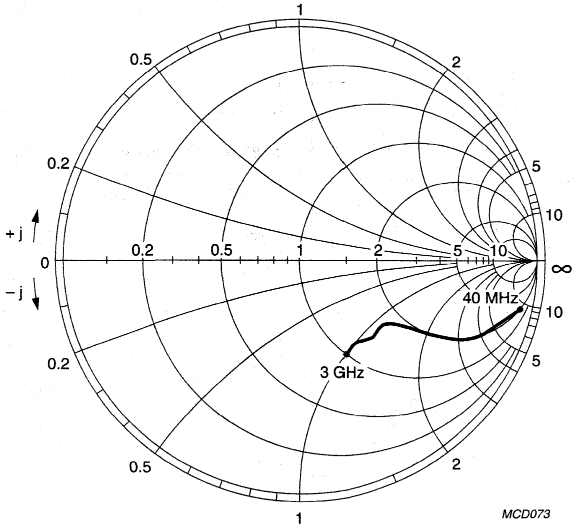
V_{CE} = 10 V; I_C = 15 mA.

Fig.16 Common emitter forward transmission coefficient (S_{21}); typical values.



V_{CE} = 10 V; I_C = 15 mA.

Fig.17 Common emitter reverse transmission coefficient (S_{12}); typical values.



V_{CE} = 10 V; I_C = 15 mA.

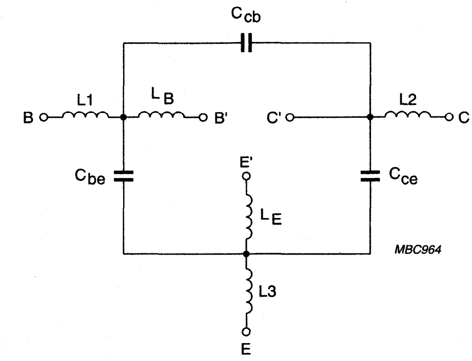
Fig.18 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for BFR90A/X die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	411.8	aA
2	BF	102.6	–
3	NF	997.2	m
4	VAF	62.67	V
5	IKF	3.200	A
6	ISE	4.010	fA
7	NE	1.577	–
8	BR	18.10	–
9	NR	996.2	m
10	VAR	3.369	V
11	IKR	1.281	A
12	ISC	279.9	aA
13	NC	1.075	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	1.164	Ω
18	RC	2.320	Ω
19 (note 1)	XTB	0.000	–
20 (note 1)	EG	1.110	eV
21 (note 1)	XTI	3.000	–
22	CJE	890.5	fF
23	VJE	600.0	mV
24	MJE	258.5	m
25	TF	15.49	ps
26	XTF	39.14	–
27	VTF	2.152	V
28	ITF	213.7	mA
29	PTF	0.000	deg
30	CJC	546.5	fF
31	VJC	380.8	mV
32	MJC	202.9	m
33	XCJC	150.0	m
34	TR	5.618	ns
35 (note 1)	CJS	0.000	F
36 (note 1)	VJS	750.0	mV
37 (note 1)	MJS	0.000	–
38	FC	850.0	m

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$.
$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$.
f_c = scaling frequency = 100 MHz.

Fig.19 Package equivalent circuit SOT143B.

List of components (see Fig.19)

DESIGNATION	VALUE	UNIT
C_{be}	84	fF
C_{cb}	17	fF
C_{ce}	191	fF
L1	0.12	nH
L2	0.21	nH
L3	0.06	nH
L_B	0.95	nH
L_E	0.40	nH

NPN 6 GHz wideband transistors BFG93A; BFG93A/X

FEATURES

- High power gain
- Low noise figure
- Gold metallization ensures excellent reliability.

APPLICATIONS

Wideband applications in the UHF and microwave range.

DESCRIPTION

NPN transistor in a 4-pin, dual-emitter SOT143B plastic package.

PINNING

PIN	DESCRIPTION
BFG93A	
1	collector
2	base
3	emitter
4	emitter
BFG93A/X	
1	collector
2	emitter
3	base
4	emitter

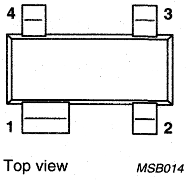


Fig.1 SOT143B.

MARKING

TYPE NUMBER	CODE
BFG93A	R8
BFG93A/X	V15

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	collector current (DC)		–	–	35	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	300	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.7	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; note 1	–	300	mW
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction operating temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	290	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 5$ V; f = 1 MHz	–	1.9	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.3	–	dB

Note

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.

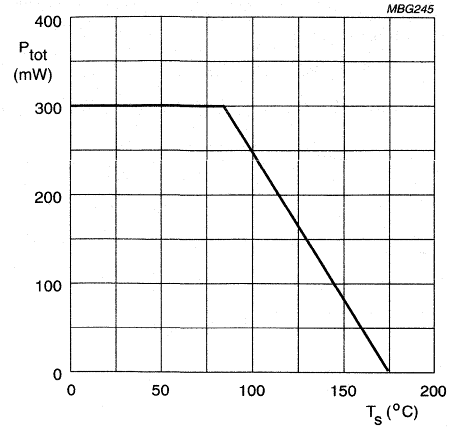
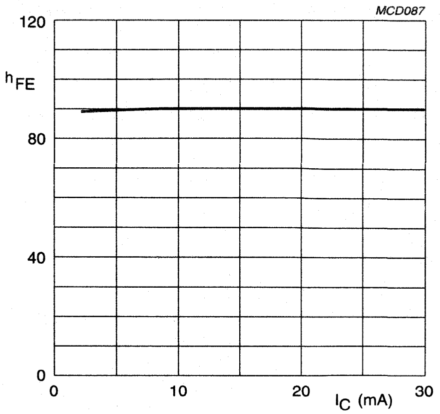
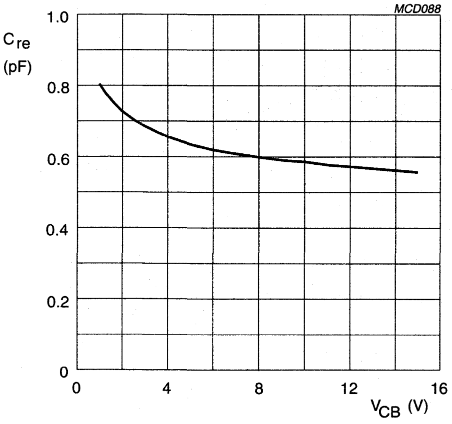


Fig.2 Power derating curve.



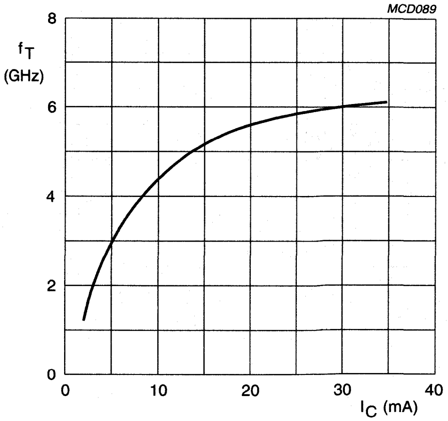
V_{CE} = 5 V.

Fig.3 DC current gain as a function of collector current; typical values.



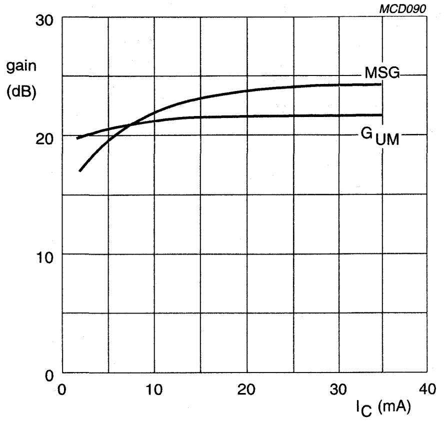
$I_C = i_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



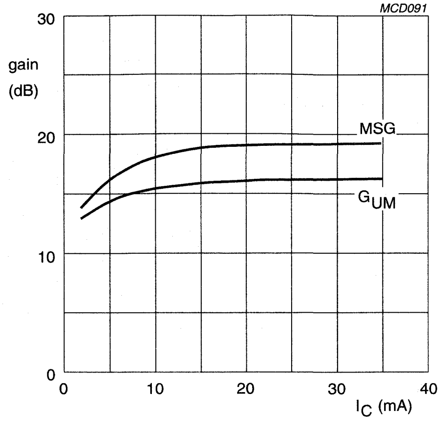
V_{CE} = 5 V; T_{amb} = 25 °C; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



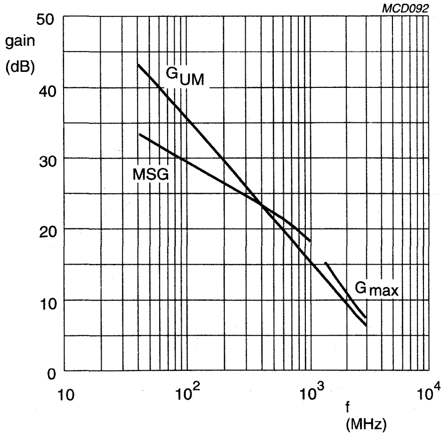
V_{CE} = 8 V; f = 500 MHz.

Fig.6 Gain as a function of collector current; typical values.



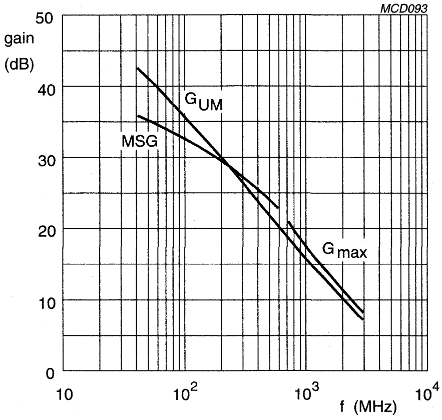
V_{CE} = 8 V; f = 1 GHz.

Fig.7 Gain as a function of collector current; typical values.



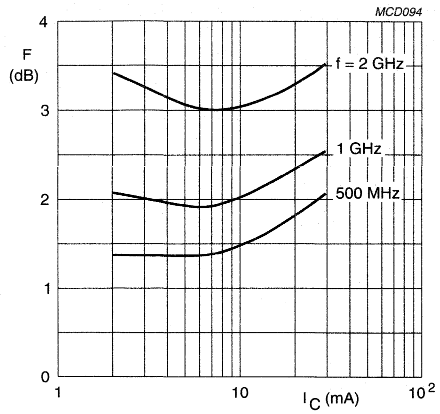
V_{CE} = 8 V; I_C = 10 mA.

Fig.8 Gain as a function of frequency; typical values.



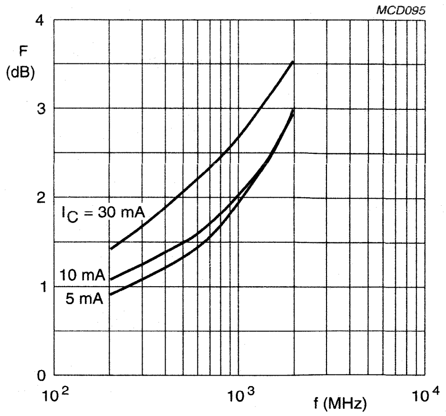
V_{CE} = 8 V; I_C = 30 mA.

Fig.9 Gain as a function of frequency; typical values.



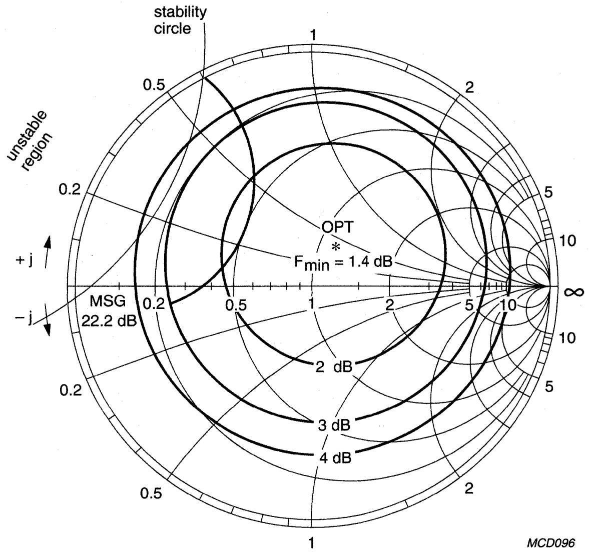
V_{CE} = 8 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



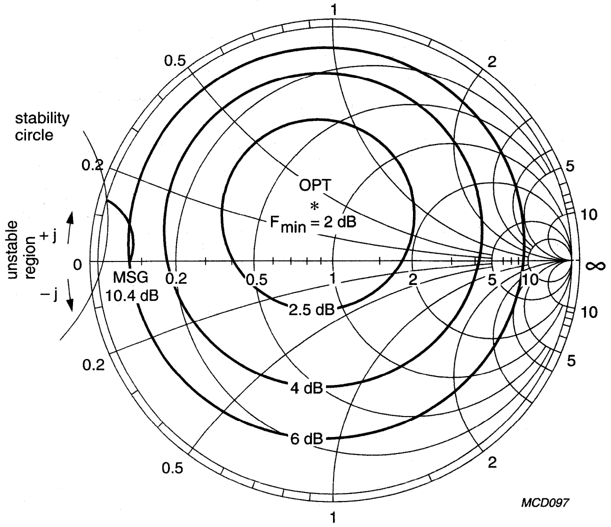
V_{CE} = 8 V.

Fig.11 Minimum noise figure as a function of frequency; typical values.



Z_o = 50 Ω.
Maximum stable gain = 22.2 dB.

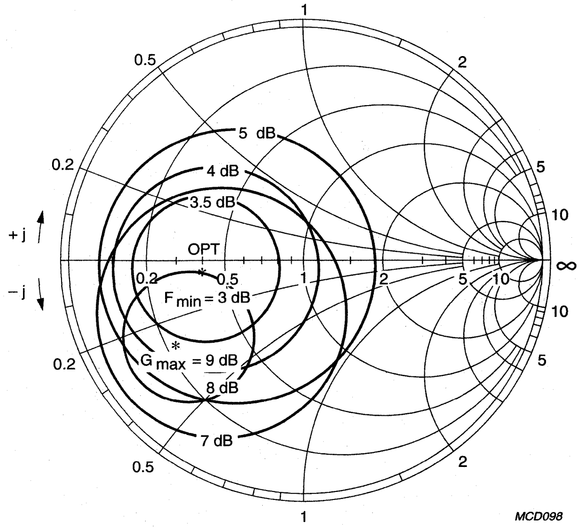
Fig.12 Common emitter noise figure circles; typical values.



Z_o = 50 Ω.

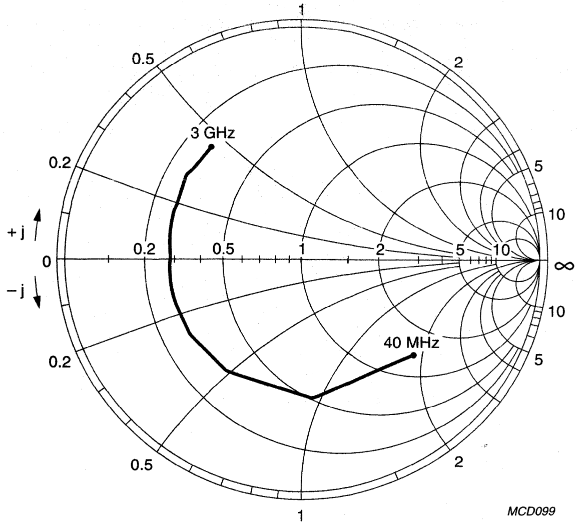
Maximum stable gain = 10.4 dB.

Fig.13 Common emitter noise figure circles; typical values.



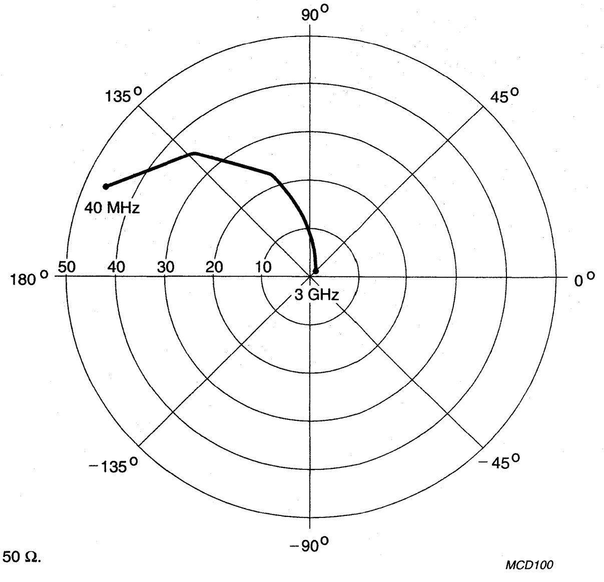
Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



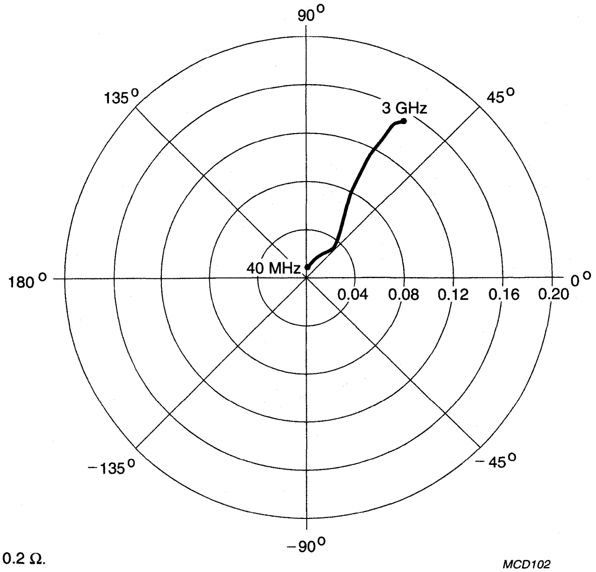
V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (S_{11}).



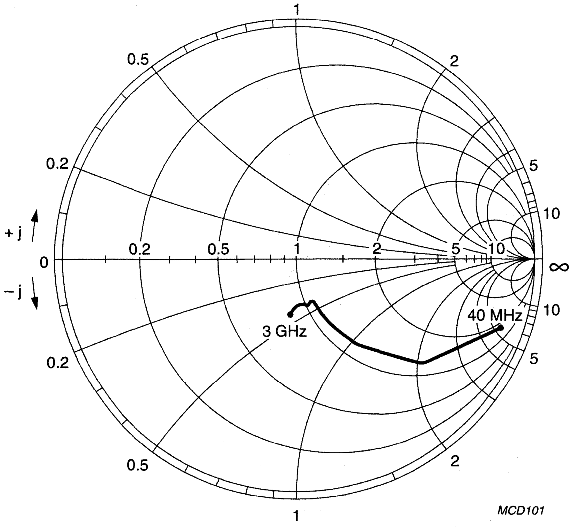
V_{CE} = 8 V; I_C = 30 mA; R_{max} = 50 Ω.

Fig.16 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 30 mA; R_{max} = 0.2 Ω.

Fig.17 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

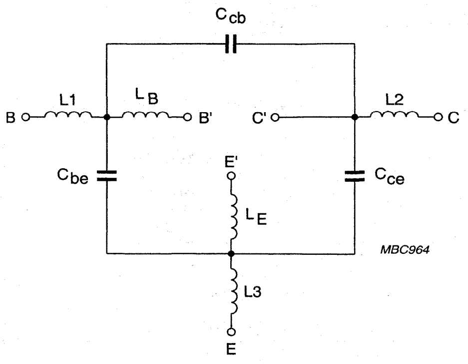
Fig.18 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR91A(/X) die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.328	fA
2	BF	102.0	–
3	NF	1.000	–
4	VAF	51.90	V
5	IKF	8.155	A
6	ISE	13.90	fA
7	NE	15.12	–
8	BR	17.69	–
9	NR	994.0	m
10	VAR	3.280	V
11	IKR	10.00	A
12	ISC	1.043	aA
13	NC	1.189	–
14	RB	10.00	Ω
15	IRB	1.000	µA
16	RBM	10.00	Ω
17	RE	763.6	mΩ
18	RC	9.000	Ω
19 (note 1)	XTB	0.000	–
20 (note 1)	EG	1.110	EV
21 (note 1)	XTI	3.000	–
22	CJE	2.032	pF
23	VJE	600.0	mV
24	MJE	290.0	m
25	TF	6.557	ps
26	XTF	38.97	–
27	VTF	10.93	V
28	ITF	521.0	mA
29	PTF	0.000	deg
30	CJC	1.003	pF
31	VJC	340.8	mV
32	MJC	194.2	m
33	XCJC	120.0	m
34	TR	3.073	ns
35 (note 1)	CJS	0.000	F
36 (note 1)	VJS	750.0	mV
37 (note 1)	MJS	0.000	–
38	FC	800.0	m

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$.
$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$.
f_c = scaling frequency = 1000 MHz.

Fig.19 Package equivalent circuit SOT143B.

List of components (see Fig.19)

DESIGNATION	VALUE	UNIT
C_{be}	84	fF
C_{cb}	17	fF
C_{ce}	191	fF
L1	0.12	nH
L2	0.21	nH
L3	0.06	nH
L_B	0.95	nH
L_E	0.40	nH

NPN 6 GHz wideband transistor BFG94

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN transistor mounted in a plastic SOT223 envelope. It is primarily intended for use in communication and instrumentation systems.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

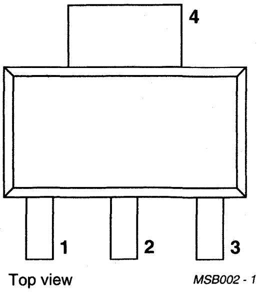


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	DC collector current		–	–	60	mA
P_{tot}	total power dissipation	up to T_s = 140 °C (note 1)	–	–	700	mW
C_{re}	feedback capacitance	$I_C = 0$; V_{CE} = 10 V; f = 1 MHz	–	–	0.8	pF
f_T	transition frequency	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	4	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	11.5	13.5	–	dB
V_O	output voltage	I_C = 45 mA; V_{CE} = 10 V; d_{im} = –60 dB; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	500	–	mV
P_{L1}	output power at 1 dB gain compression	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	21.5	–	dBm

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	60	mA
P_{tot}	total power dissipation	up to $T_s = 140$ °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 $T_s = 140$ °C (note 1)	50 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

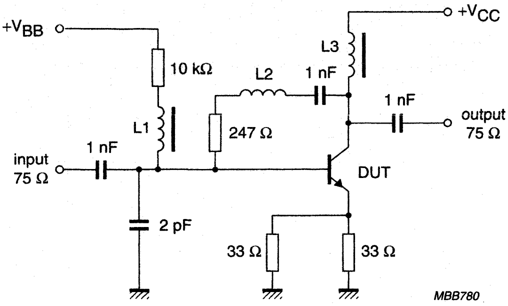
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	45	90	–	
		$I_C = 45$ mA; $V_{CE} = 10$ V	–	100	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.9	2	pF
C_e	emitter capacitance	$I_C = i_e = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2.9	4.5	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.5	0.8	pF
f_T	transition frequency	$I_C = 45$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	4	–	–	GHz
		$I_C = 30$ mA; $V_{CE} = 5$ V; f = 1 GHz; $T_{amb} = 25$ °C	4	6	–	GHz
G_{UM}	maximum unilateral power gain (note1)	$I_C = 45$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	11.5	13.5	–	dB
F	minimum noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 45$ mA; $V_{CE} = 10$ V; f = 500 MHz	–	2.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 45$ mA; $V_{CE} = 10$ V; f = 1 GHz	–	3	–	dB
V_O	output voltage	note 2	–	500	–	mV
d_2	second order intermodulation distortion	note 3	–	–51	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 45$ mA; $V_{CE} = 10$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C; measured at f = 1 GHz	–	21.5	–	dBm
ITO	third order intercept point	note 4	–	34	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\ \log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}.$$

2. $d_{im} = -60$ dB (DIN 45004B, par 6.3: 3-tone); $I_C = 45$ 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; $V_r = V_O - 6$ dB;
   $f_q = 803.25$ MHz; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz.
3. $I_C = 45$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_q = V_O = 280$ mV;
   $f_p = 250$ MHz; $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ MHz.
4. $I_C = 45$ mA; $V_{CE} = 10$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
   $f_p = 1000$ MHz; $f_q = 1001$ MHz;
   measured at $f_{(2p-q)}$ and $f_{(2q-p)}$.



L1 = L3 = 5 μH micro-choke.
L2 = 1 turn copper wire (0.4 mm), internal diameter 4 mm.

Fig.2 Test circuit for second and third order intermodulation distortion.

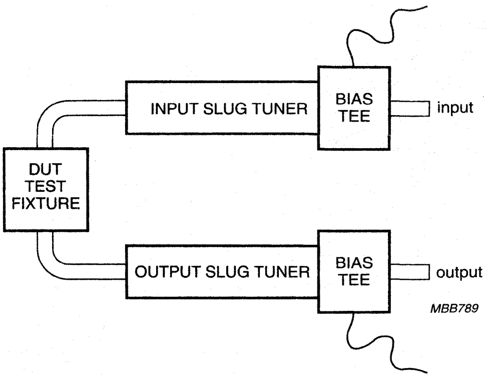


Fig.3 Measurement set-up for third order intercept point and 1 dB gain compression.

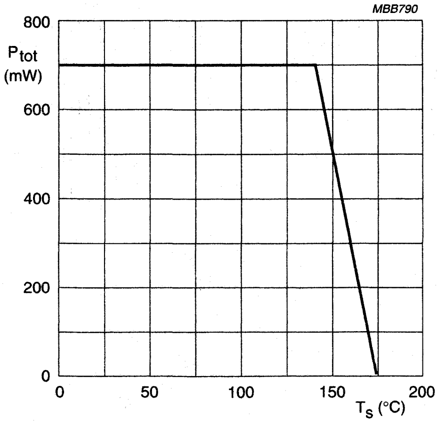
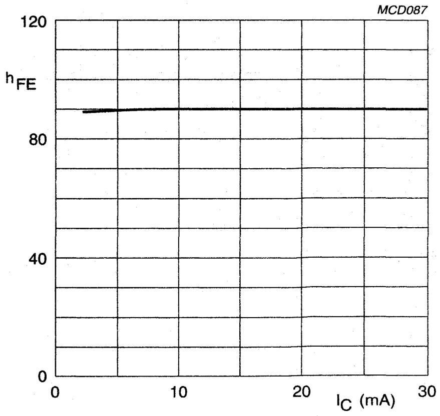
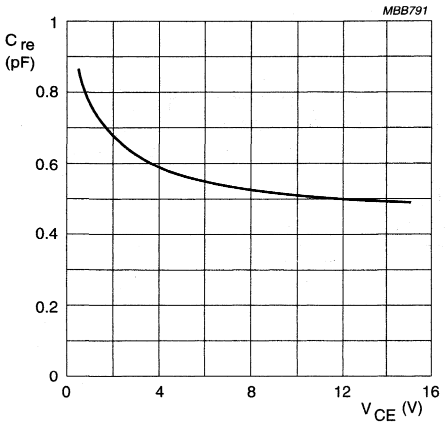


Fig.4 Power derating curve.



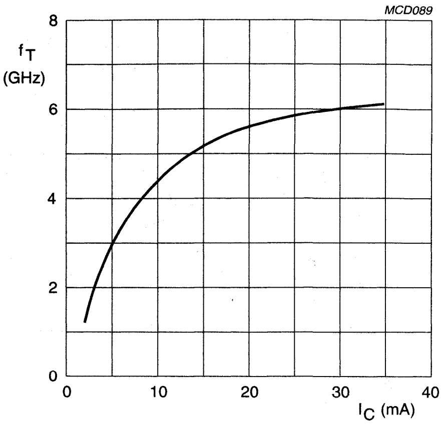
$V_{CE} = 10$ V; $T_j = 25$ °C

Fig.5 DC current gain as a function of collector current.



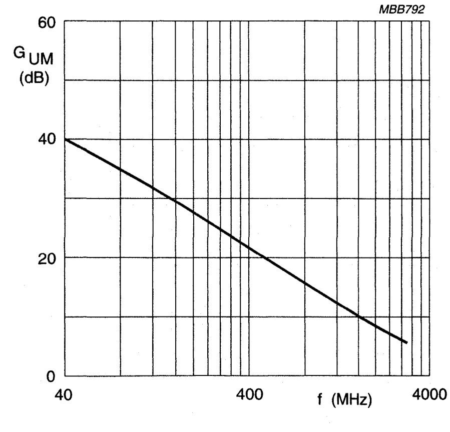
$I_C = i_c = 0$; f = 1 MHz.

Fig.6 Feedback capacitance as a function of collector-emitter voltage.



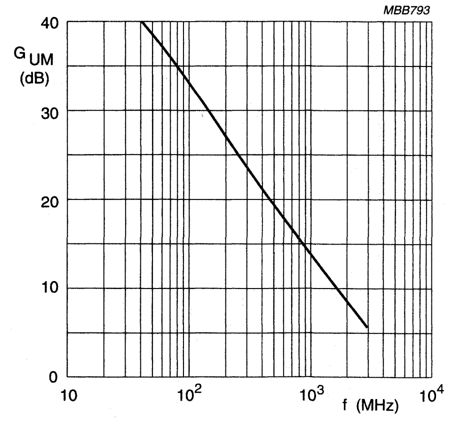
V_{CE} = 10 V; f = 1 GHz.

Fig.7 Transition frequency as a function of collector current.



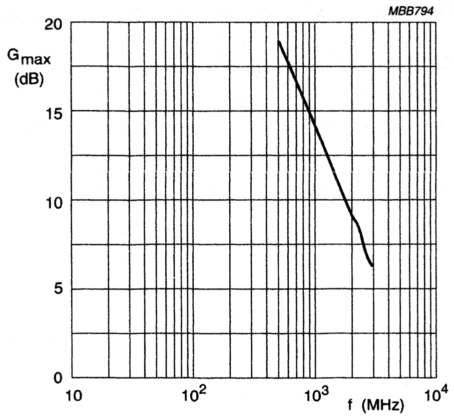
I_c = 45 mA; V_{CE} = 10 V.

Fig.8 Maximum unilateral power gain as a function of frequency.



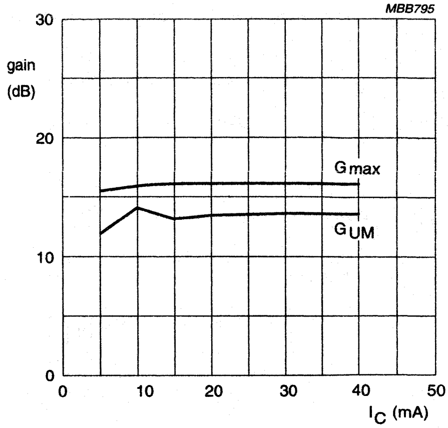
I_c = 20 mA; V_{CE} = 8 V.

Fig.9 Maximum unilateral power gain as a function of frequency.



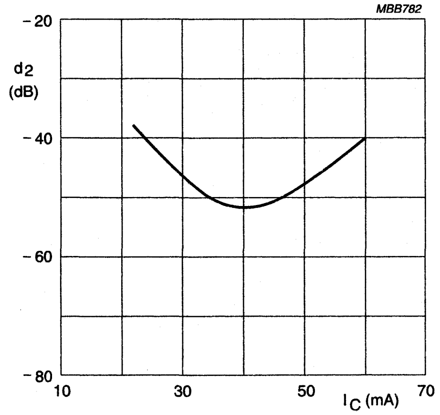
I_c = 20 mA; V_{CE} = 8 V.

Fig.10 Maximum available stable gain as a function of frequency.



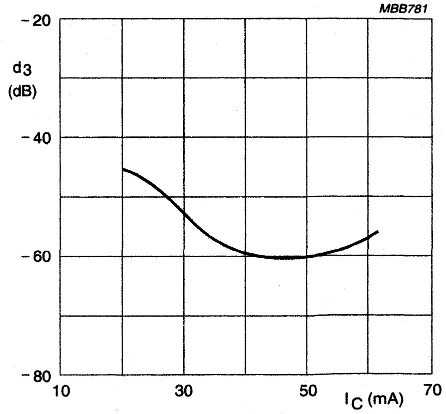
V_{CE} = 8 V; f = 1 GHz.
G_{max} = maximum available stable gain.
G_{UM} = maximum unilateral power gain.

Fig.11 Gain as a function of collector current.



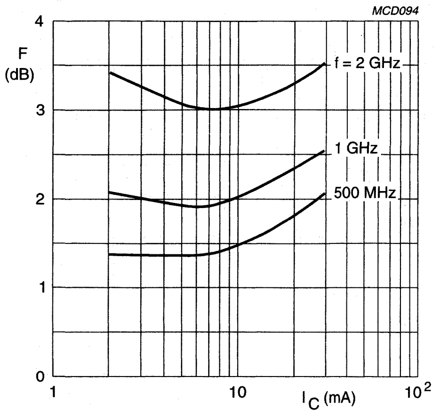
I_c = 45 mA; V_{CE} = 10 V; $f_{(p+q)}$ = 810 MHz.
See test circuit, Fig.2

Fig.12 Second order intermodulation distortion as a function of collector current.



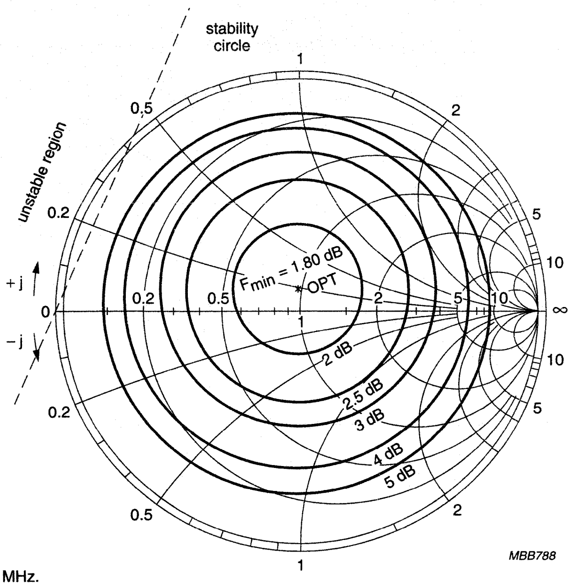
I_c = 45 mA; V_{CE} = 10 V; $f_{(p+q-r)}$ = 793.25 MHz.
See test circuit, Fig.2

Fig.13 Third order intermodulation distortion as a function of collector current.



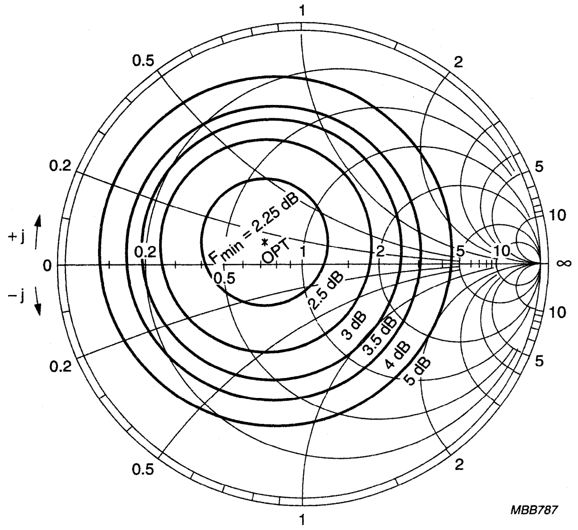
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of collector current.



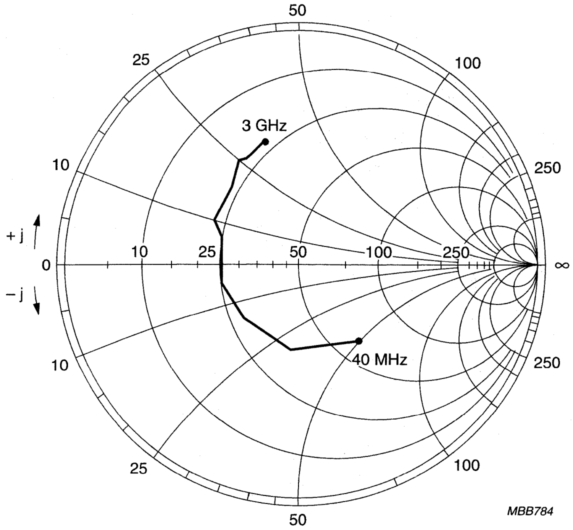
Ic = 15 mA; VCE = 10 V; f = 500 MHz.

Fig.15 Noise circle.



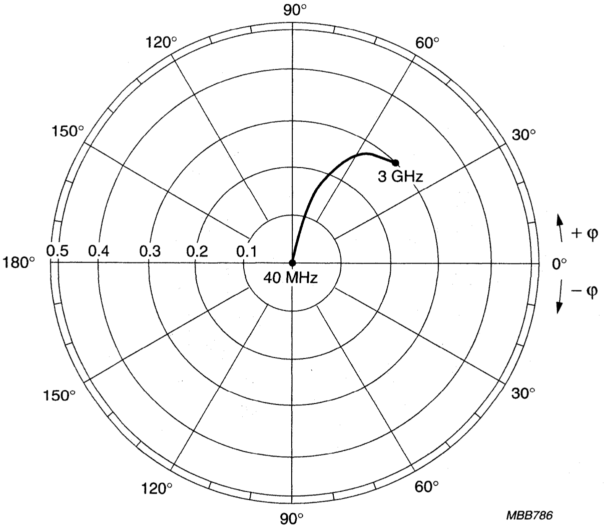
Ic = 15 mA; VCE = 10 V; f =1 GHz.

Fig.16 Noise circle.



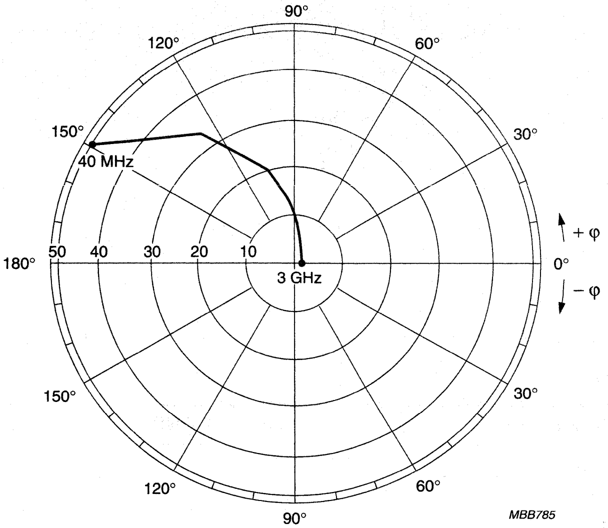
I_C = 45 mA; V_{CE} = 10 V.
Z_O = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



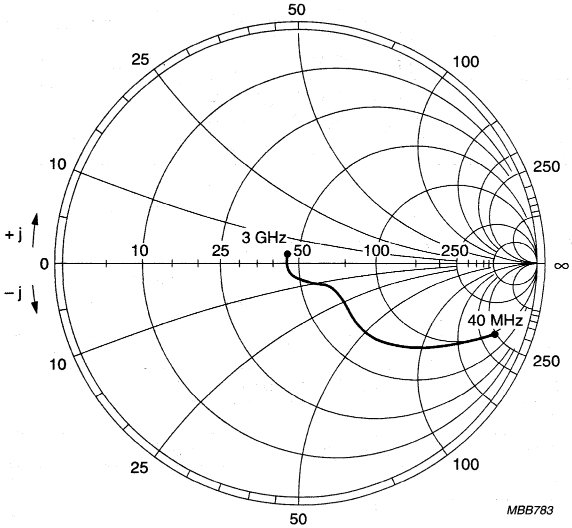
I_C = 45 mA; V_{CE} = 10 V.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 45 mA; V_{CE} = 10 V.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



I_C = 45 mA; V_{CE} = 10 V.
Z_O = 50 Ω.

Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFG97

DESCRIPTION

NPN planar epitaxial transistor mounted in a plastic SOT223 envelope.
It features excellent output voltage capabilities, and is primarily intended for use in MATV applications.

PNP complement is the BFG31.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

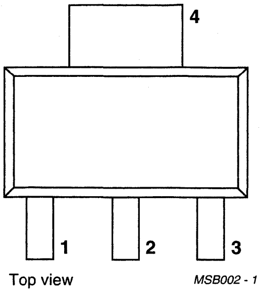


Fig.1 SOT223.

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		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 125 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 70 mA; V_{CE} = 10 V; T_j = 25 °C	25	80	–	
f_T	transition frequency	I_C = 70 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	5.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 70 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 70 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	12	–	dB
V_o	output voltage	I_C = 70 mA; V_{CE} = 10 V; d_{im} = −60 dB; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C	–	700	–	mV

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		–	100	mA
P_{tot}	total power dissipation	up to T_s = 125 °C (note 1)	–	1	W
T_{stg}	storage temperature		−65	150	°C
T_j	junction temperature		–	175	°C

Note

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

NPN 5 GHz wideband transistor BFG97

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 125 °C (note 1)	50 K/W

Note

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

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	$I_C = 70$ mA; $V_{CE} = 10$ V	25	80	–	
f_T	transition frequency	$I_C = 70$ mA; $V_{CE} = 10$ V; f = 500 MHz; T_{amb} = 25 °C	–	5.5	–	GHz
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
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 70$ mA; $V_{CE} = 10$ V; f = 500 MHz; T_{amb} = 25 °C	–	16	–	dB
		$I_C = 70$ mA; $V_{CE} = 10$ V; f = 800 MHz; T_{amb} = 25 °C	–	12	–	dB
V_o	output voltage	note 2	–	750	–	mV
		note 3	–	700	–	mV
d_2	second order intermodulation distortion	note 4	–	–56	–	dB
		note 5	–	–53	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

2. $d_{im} = -60$ dB (DIN 45004B); $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C
   $V_p = V_o$ at $d_{im} = -60$ dB;
   $V_q = V_o$ –6 dB; f_p = 445.25 MHz;
   $V_r = V_o$ –6 dB; f_q = 453.25 MHz; f_r = 455.25 MHz;
   measured at $f_{(p+q-r)}$ = 443.25 MHz.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C
   $V_p = V_o$ at $d_{im} = -60$ dB;
   $V_q = V_o$ –6 dB; f_p = 795.25 MHz;
   $V_r = V_o$ –6 dB; f_q = 803.25 MHz; f_r = 805.25 MHz;
   measured at $f_{(p+q-r)}$ = 793.25 MHz.
4. $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C;
   $V_p = V_q = V_o$ = 50 dBmV; $f_{(p+q)}$ = 450 MHz; f_p = 50 MHz; f_q = 400 MHz.
5. $I_C = 70$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; T_{amb} = 25 °C;
   $V_p = V_q = V_o$ = 50 dBmV; $f_{(p+q)}$ = 810 MHz; f_p = 250 MHz; f_q = 560 MHz.

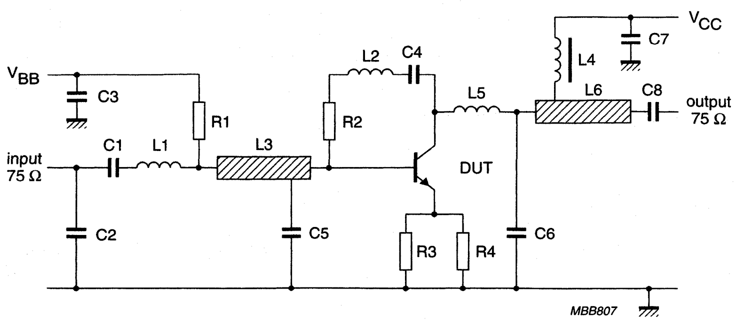


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C2, C3, C7, C8	multilayer ceramic capacitor	10 nF		2222 590 08627
C1, C4, C6	multilayer ceramic capacitor	1.2 pF		2222 851 12128
C5 (note 1)	miniature ceramic plate capacitor	10 nF		2222 629 08103
L1 (note 1)	0.5 turns 0.4 mm copper wire		int. dia. 3 mm	
L2	microstripline	75 Ω	length 14 mm; width 2.5 mm	
L3	microstripline	75 Ω	length 8 mm; width 2.5 mm	
L4, L5 (note 1)	1.5 turns 0.4 mm copper wire		int. dia. 3 mm; winding pitch 1 mm	
L6	microstripline	75 Ω	length 19 mm; width 2.5 mm	
L7	Ferroxcube choke	5 μH		3122 108 20153
R1	metal film resistor	10 kΩ		2322 180 73103
R2 (note 1)	metal film resistor	220 Ω		2322 180 73221
R3, R4	metal film resistor	30 Ω		2322 180 73309

Notes

The circuit has been built on a double copper-clad printed circuit board with PTFE dielectric ($\varepsilon_r = 2.2$); thickness $1/16$ inch; thickness of copper sheet 2 × 35 μm.

1. Components C5, L1, L4, L5, and R2 are mounted on the underside of the PCB.

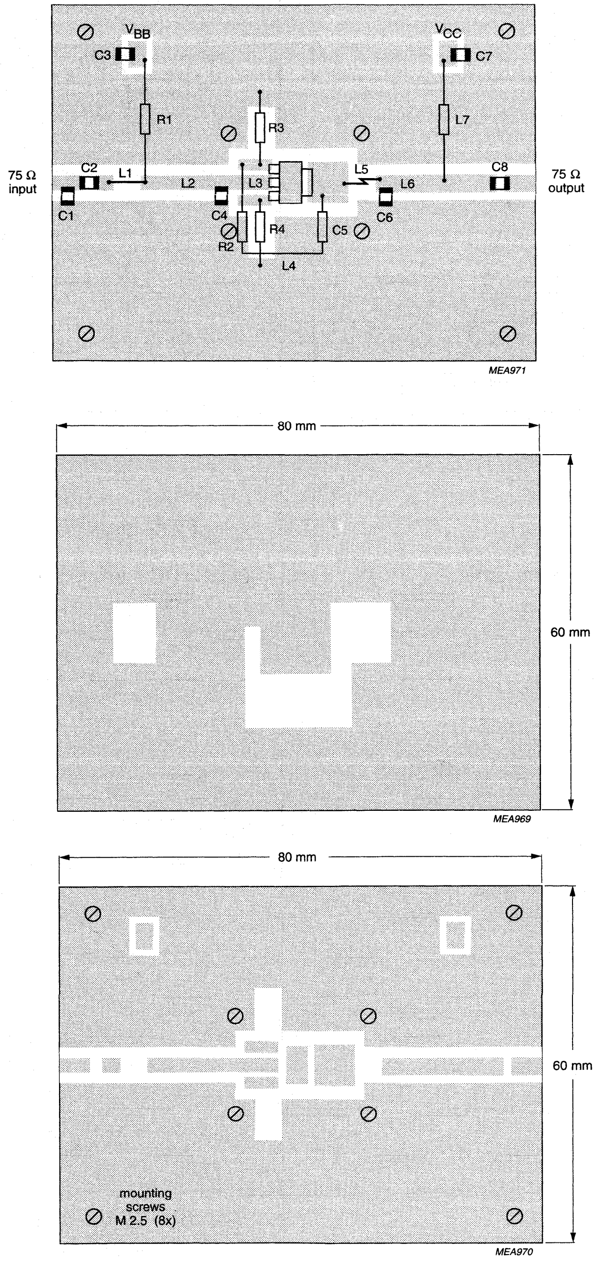


Fig.3 Intermodulation distortion and second order intermodulation distortion printed circuit board.

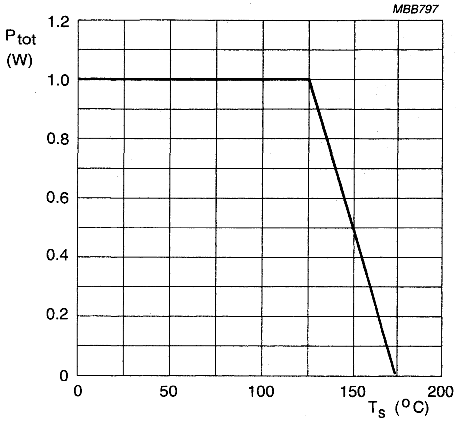
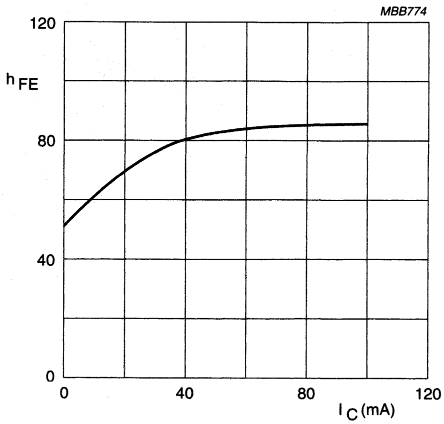
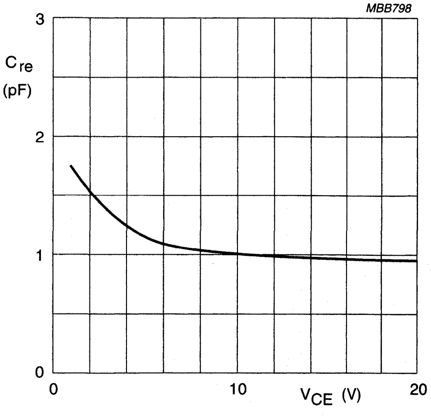


Fig.4 Power derating curve.



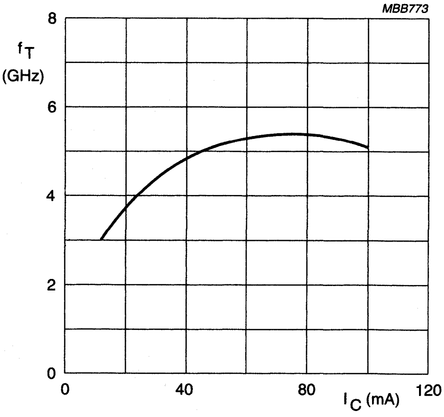
V_{CE} = 10 V; T_j = 25 °C.

Fig.5 DC current gain as a function of collector current.



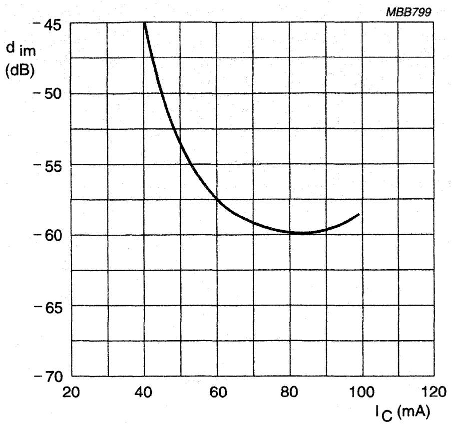
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.6 Feedback capacitance as a function of collector-emitter voltage.



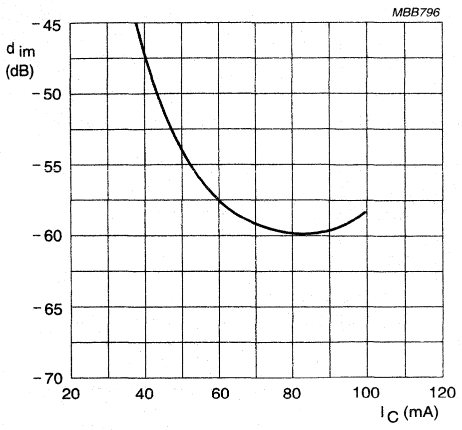
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

Fig.7 Transition frequency as a function of collector current.



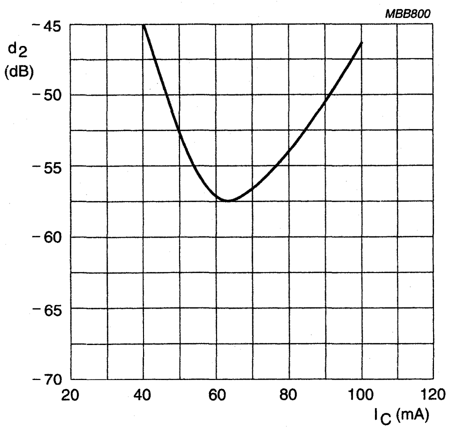
V_{CE} = 10 V; V_o = 750 mV; $f_{(p+q-r)}$ = 443.25 MHz;
T_{amb} = 25 °C.

Fig.8 Intermodulation distortion as a function of collector current.



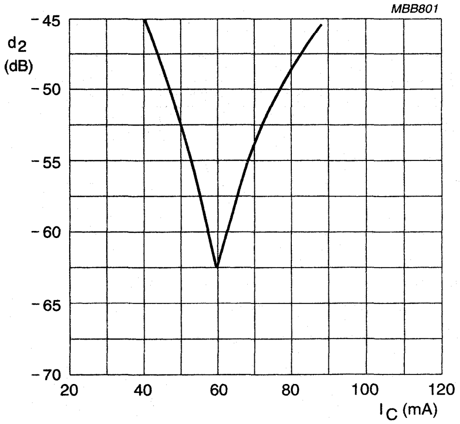
V_{CE} = 10 V; V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz;
T_{amb} = 25 °C.

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



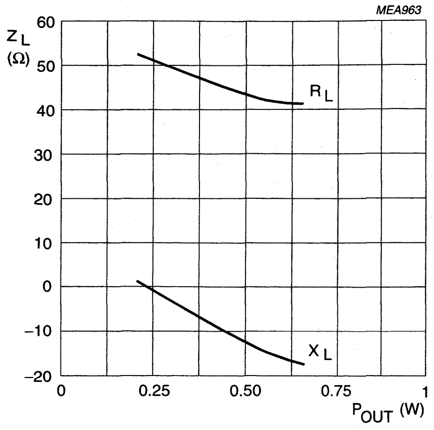
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 450 MHz;
T_{amb} = 25 °C.

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



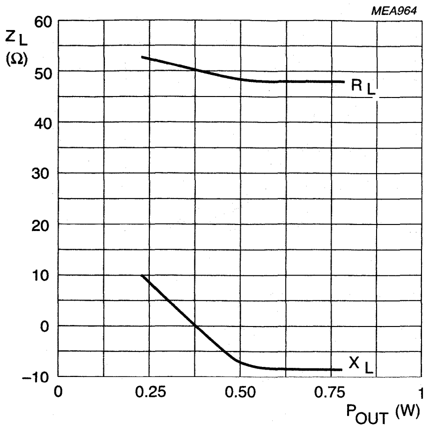
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz;
T_{amb} = 25 °C.

Fig.11 Second order intermodulation distortion as a function of collector current.



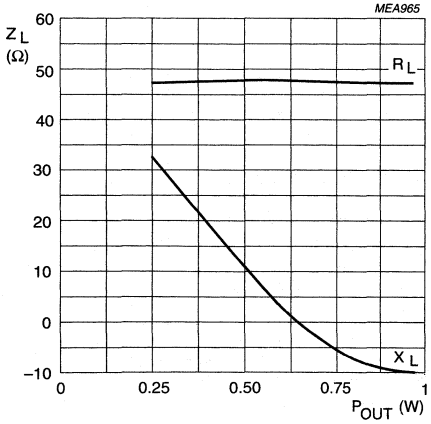
V_{CE} = 6 V; f = 900 MHz.

Fig.12 Load impedance as a function of output power.



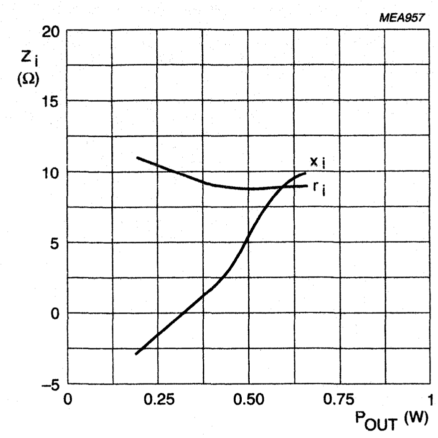
V_{CE} = 7.5 V; f = 900 MHz.

Fig.13 Load impedance as a function of output power.



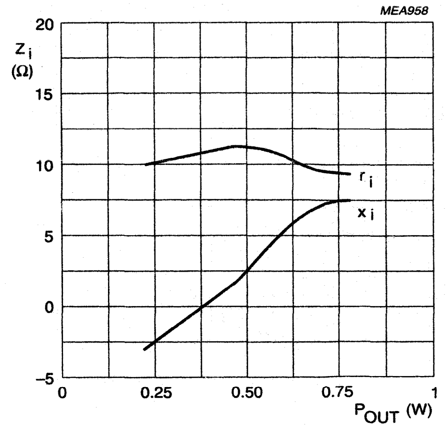
V_{CE} = 10 V; f = 900 MHz.

Fig.14 Load impedance as a function of output power.



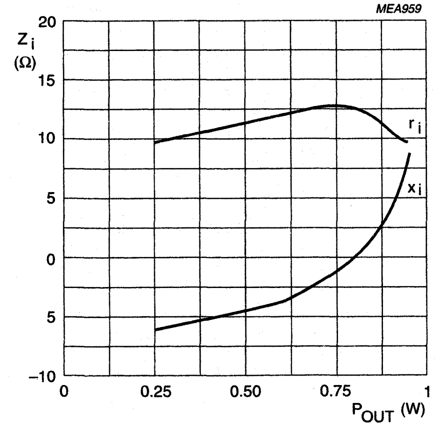
V_{CE} = 6 V; f = 900 MHz.

Fig.15 Input impedance as a function of output power.



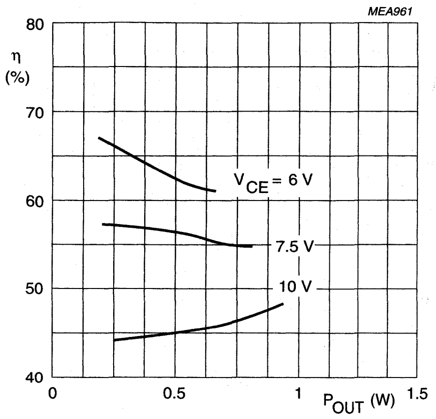
V_{CE} = 7.5 V; f = 900 MHz.

Fig.16 Input impedance as a function of output power.



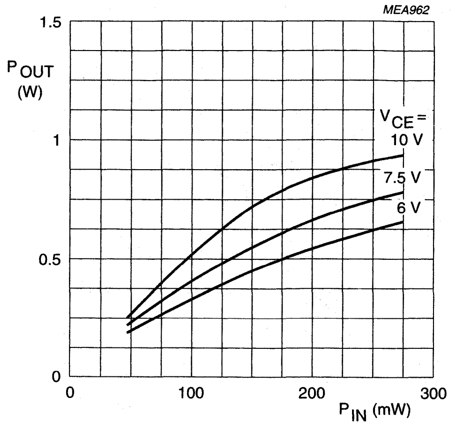
V_{CE} = 10 V; f = 900 MHz.

Fig.17 Input impedance as a function of output power.



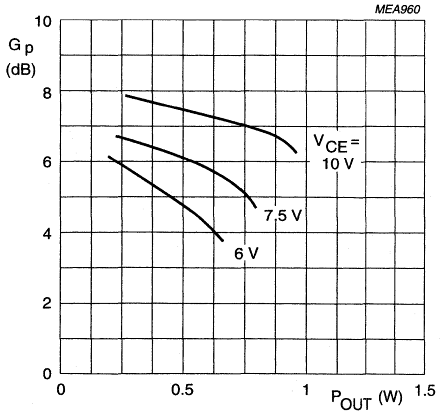
f = 900 MHz.

Fig.18 Efficiency as a function of output power.



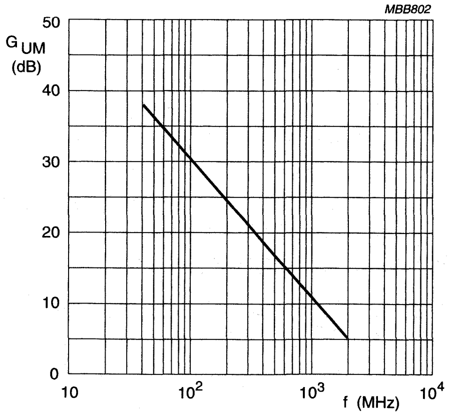
f = 900 MHz.

Fig.19 Output power as a function of input power.



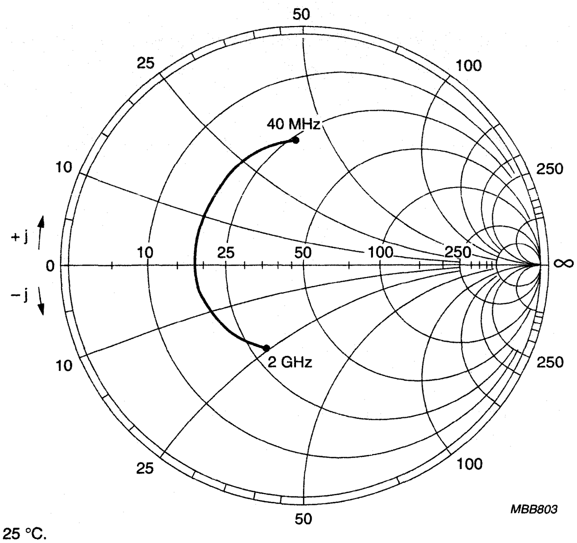
f = 900 MHz.

Fig.20 Power gain as a function of output power.



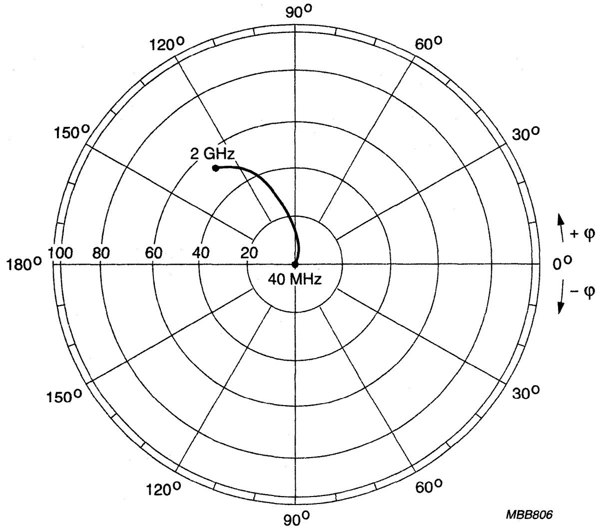
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.21 Maximum unilateral power gain as a function of frequency.



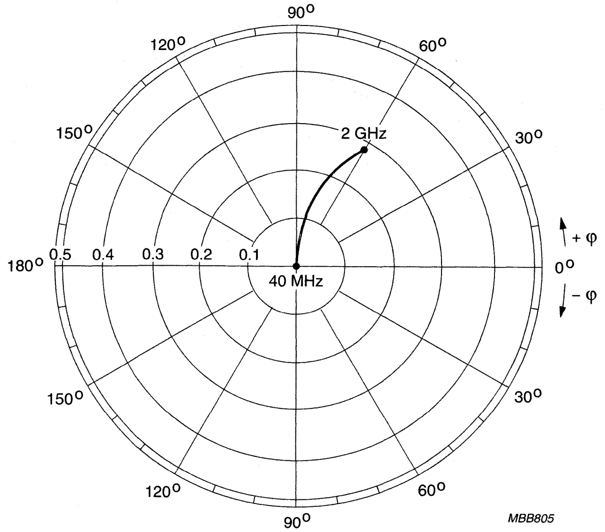
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.22 Common emitter input reflection coefficient (S_{11}).



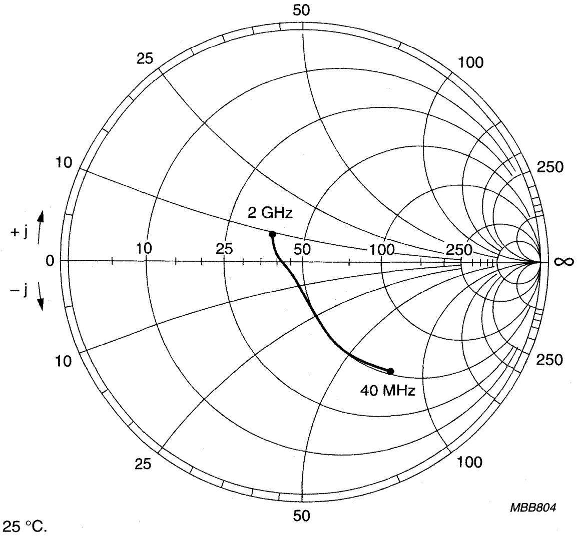
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.23 Common emitter forward transmission coefficient (S_{21}).



I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.24 Common emitter reverse transmission coefficient (S_{12}).



I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.25 Common emitter output reflection coefficient (S_{22}).

NPN 7GHz wideband transistor BFG135

DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT223 envelope, intended for wideband amplifier applications. The small emitter structures, with integrated emitter-ballasting resistors, ensure high output voltage capabilities at a low distortion level.

The distribution of the active areas across the surface of the device gives an excellent temperature profile.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

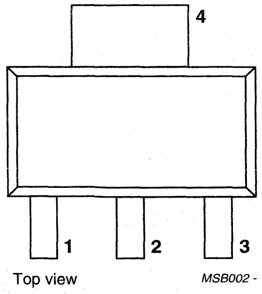


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	–	15	V
I_C	DC collector current		–	–	150	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V; T_j = 25 °C	80	130	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 100 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	12	–	dB
V_o	output voltage	d_{im} = –60 dB; I_C = 100 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	–	850	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 145 °C (note 1)	30 K/W

Note

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

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	–	–	1	μA
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V	80	130	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	7	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1.2	–	pF
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 100$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	12	–	dB
V_o	output voltage	note 1	–	900	–	mV
		note 2	–	850	–	mV
d_2	second order intermodulation distortion	$I_C = 90$ mA; $V_{CE} = 10$ V; $V_O = 50$ dBmV; $T_{amb} = 25$ °C; $f_{(p+q)} = 450$ MHz; $f_p = 50$ MHz; $f_q = 400$ MHz	–	−58	–	dB
		$I_C = 90$ mA; $V_{CE} = 10$ V; $V_O = 50$ dBmV; $T_{amb} = 25$ °C; $f_{(p+q)} = 810$ MHz; $f_p = 250$ MHz; $f_q = 560$ MHz	–	−53	–	dB

Notes

1. $d_{im} = -60$ dB (DIN 45004B); $I_C = 100$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 445.25$ MHz;
   $V_q = V_o$ −6 dB; $f_q = 453.25$ MHz;
   $V_r = V_o$ −6 dB; $f_r = 455.25$ MHz;
   measured at $f_{(p+q-r)} = 443.25$ MHz.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = 100$ 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.

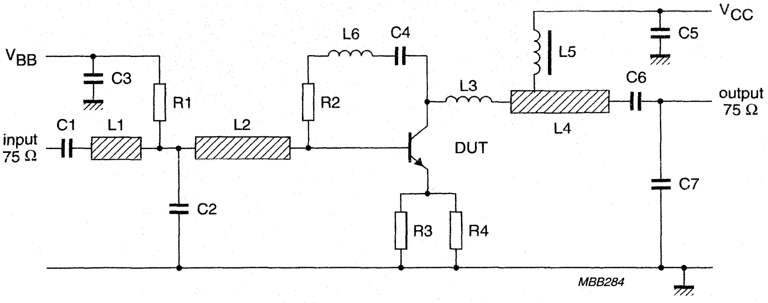


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	UNIT	DIMENSIONS	CATALOGUE NO.
C1, C3, C5, C6	multilayer ceramic capacitor	10	nF		2222 590 08627
C2, C7	multilayer ceramic capacitor	1	pF		2222 851 12108
C4 (note 1)	miniature ceramic plate capacitor	10	nF		2222 629 08103
L1	microstripline	75	Ω	length 7 mm; width 2.5 mm	
L2	microstripline	75	Ω	length 22mm; width 2.5 mm	
L3 (note 1)	1.5 turns 0.4 mm copper wire			int. dia. 3 mm; winding pitch 1 mm	
L4	microstripline	75	Ω	length 19 mm; width 2.5 mm	
L5	Ferroxcube choke	5	μH		3122 108 20153
L6 (note 1)	0.4 mm copper wire	≈25	nH	length 30 mm	
R1	metal film resistor	10	kΩ		2322 180 73103
R2 (note 1)	metal film resistor	200	Ω		2322 180 73201
R3, R4	metal film resistor	27	Ω		2322 180 73279

Note

1. Components C4, L3, L6 and R2 are mounted on the underside of the PCB.
The circuit is constructed on a double copper-clad printed circuit board with PTFE dielectric ($\varepsilon_r = 2.2$); thickness $\frac{1}{16}$ inch; thickness of copper sheet $\frac{1}{32}$ inch.

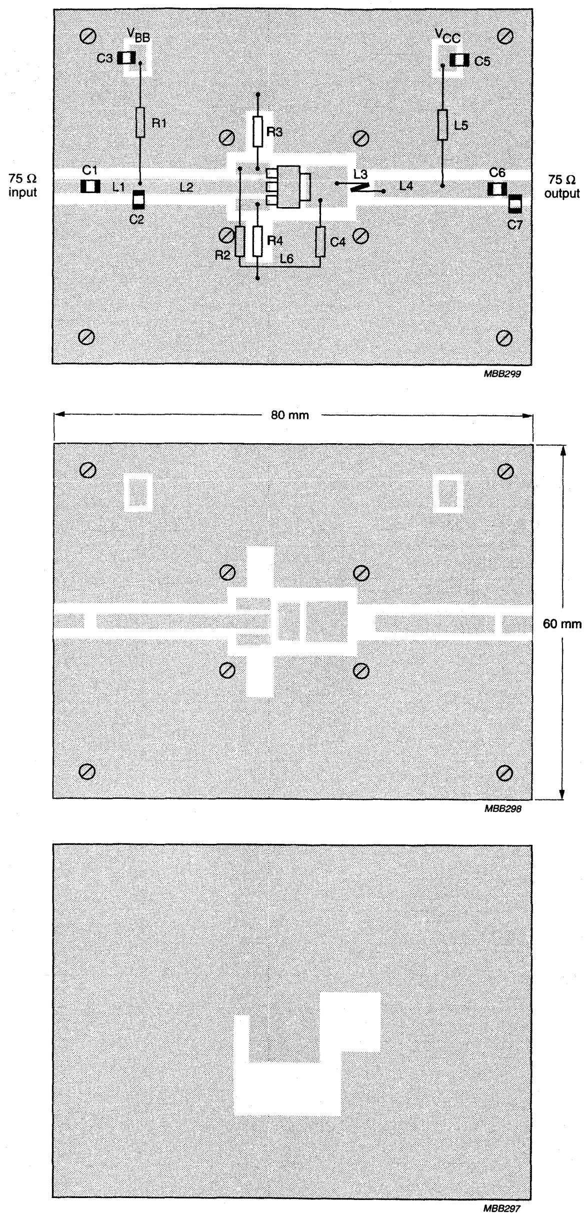


Fig.3 Intermodulation distortion test printed-circuit board.

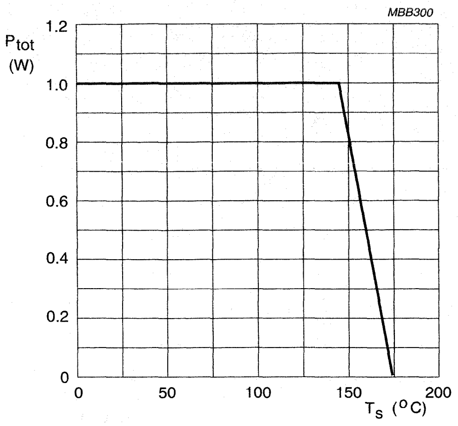
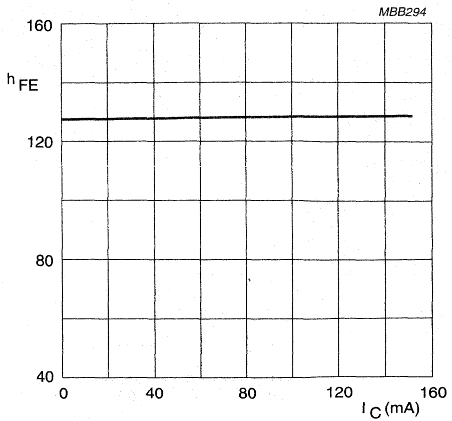
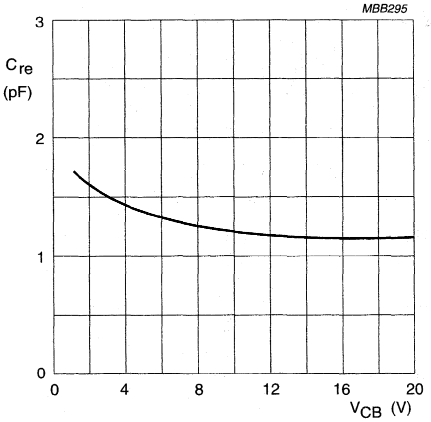


Fig.4 Power derating curve.



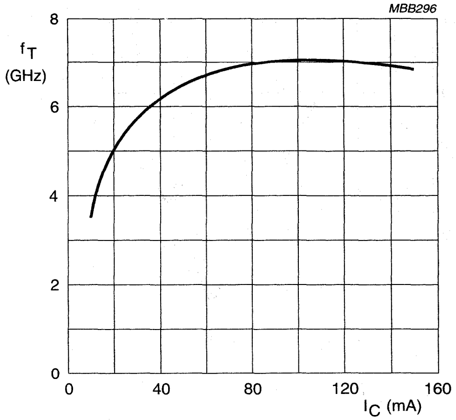
V_{CE} = 10 V; T_j = 25 °C.

Fig.5 DC current gain as a function of collector current.



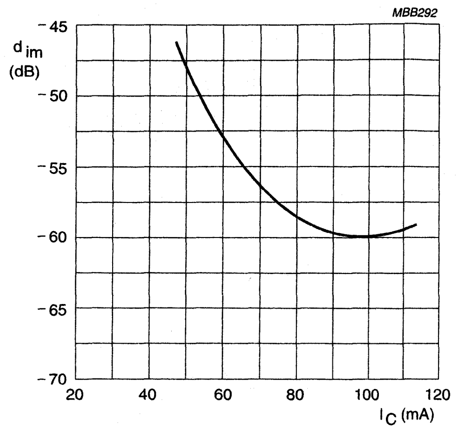
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.6 Feedback capacitance as a function of collector-base voltage.



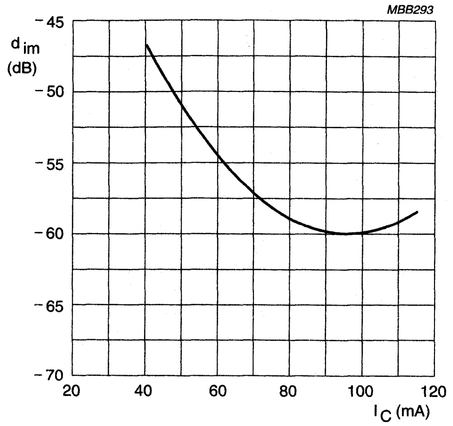
V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.7 Transition frequency as a function of collector current.



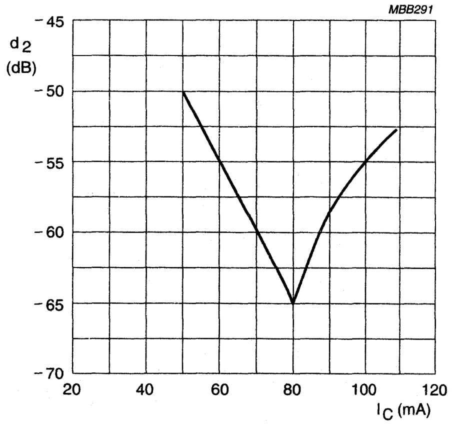
V_{CE} = 10 V; V_o = 900 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 443.25 MHz.

Fig.8 Intermodulation distortion as a function of collector current.



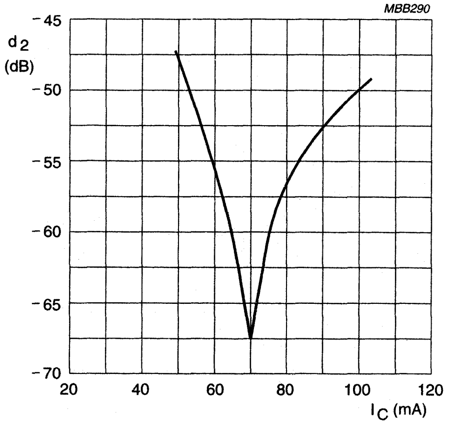
V_{CE} = 10 V; V_o = 850 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 793.25 MHz.

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



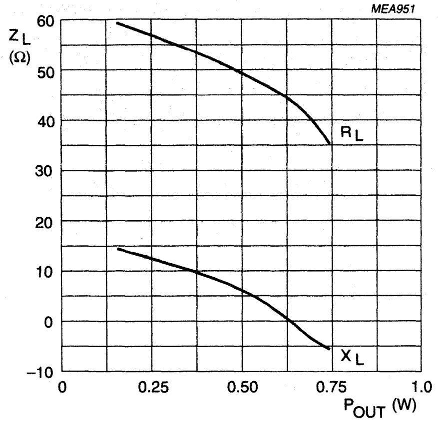
V_{CE} = 10 V; V_o = 50 dBmV; T_{amb} = 25 °C;
$f_{(p+q)}$ = 450 MHz.

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



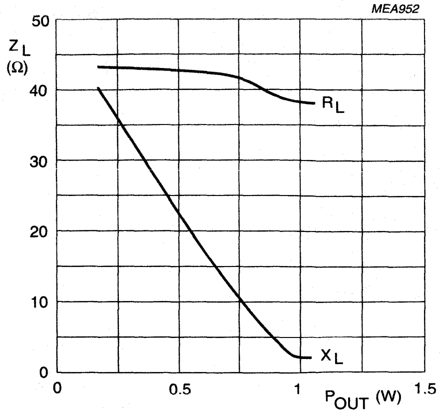
V_{CE} = 10 V; V_o = 50 dBmV; T_{amb} = 25 °C
$f_{(p+q)}$ = 810 MHz.

Fig.11 Second order intermodulation distortion as a function of collector current.



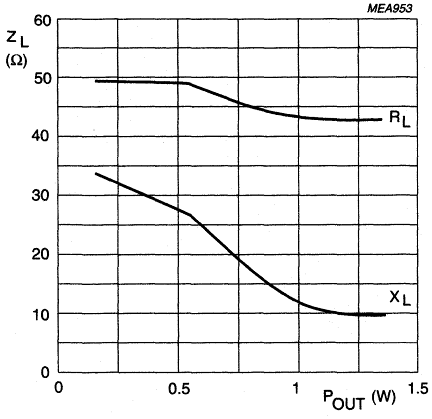
V_{CE} = 7.5 V; f = 900 MHz.

Fig.12 Load impedance as a function of output power.



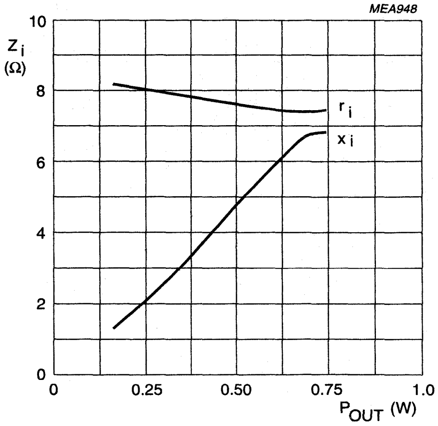
V_{CE} = 10 V; f = 900 MHz.

Fig.13 Load impedance as a function of output power.



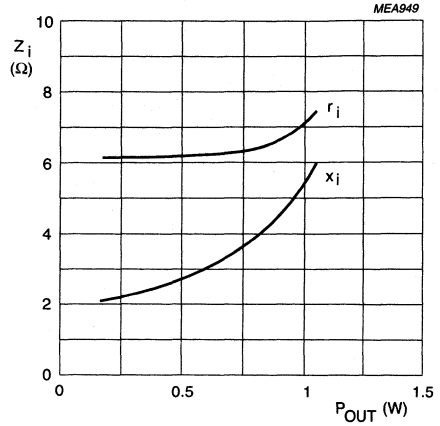
V_{CE} = 12.5 V; f = 900 MHz.

Fig.14 Load impedance as a function of output power.



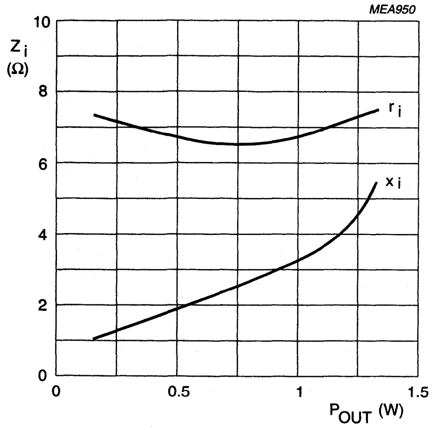
V_{CE} = 7.5 V; f = 900 MHz.

Fig.15 Input impedance as a function of output power.



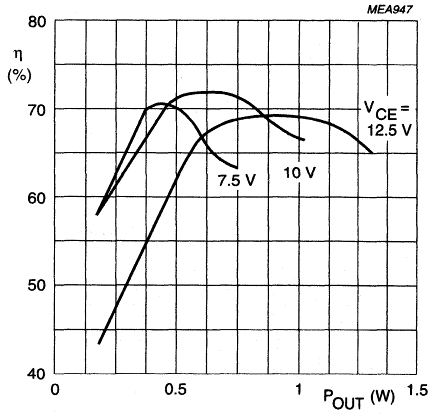
V_{CE} = 10 V; f = 900 MHz.

Fig.16 Input impedance as a function of output power.



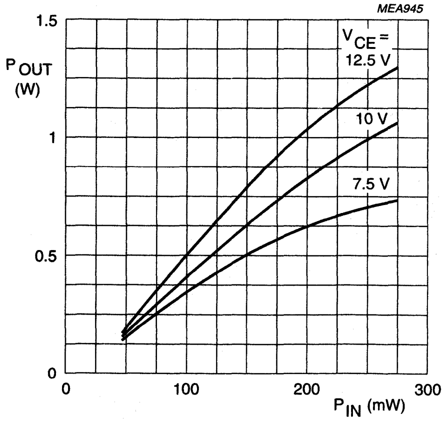
V_{CE} = 12.5 V; f = 900 MHz.

Fig.17 Input impedance as a function of output power.



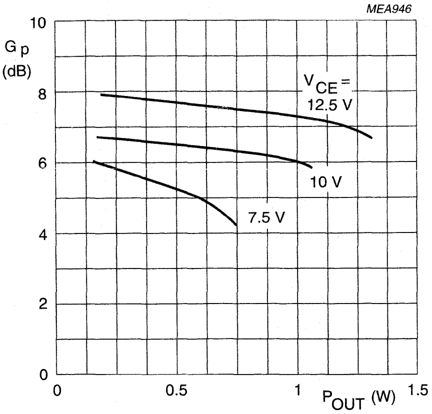
f = 900 MHz.

Fig.18 Efficiency as a function of output power.



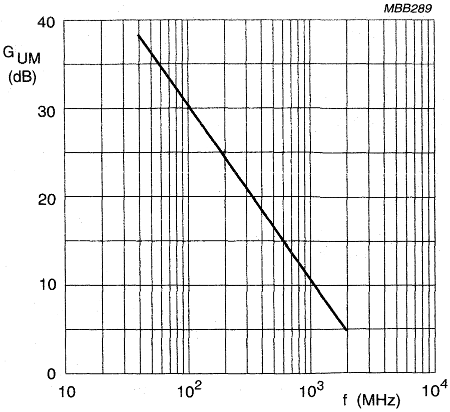
f = 900 MHz.

Fig.19 Output power as a function of input power.



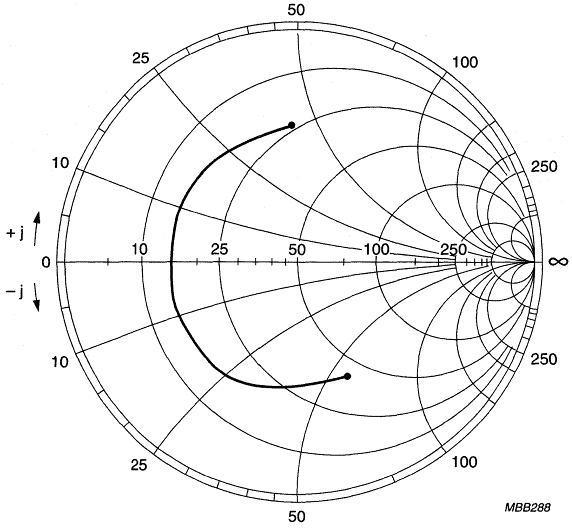
f = 900 MHz.

Fig.20 Power gain as a function of output power.



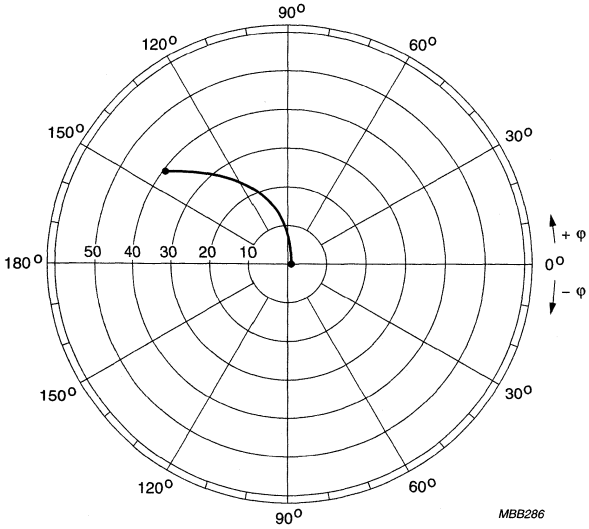
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.21 Maximum unilateral power gain as a function of frequency.



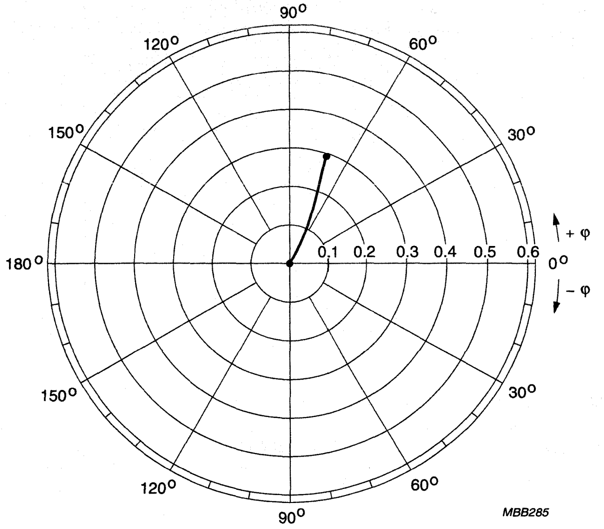
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω..

Fig.22 Common emitter input reflection coefficient (S_{11}).



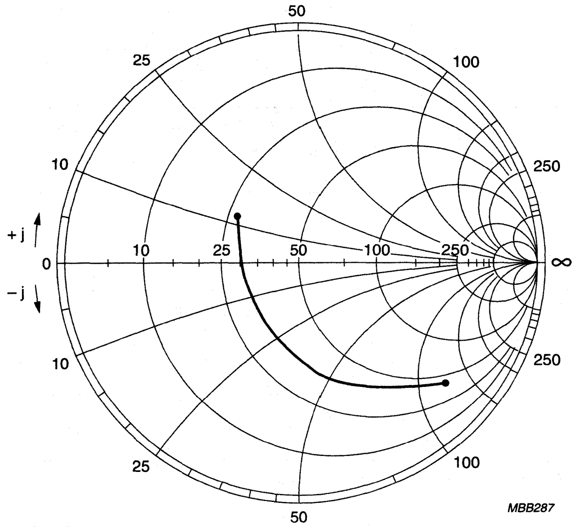
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.23 Common emitter forward transmission coefficient (S_{21}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.24 Common emitter reverse transmission coefficient (S_{12}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω..

Fig.25 Common emitter output reflection coefficient (S_{22}).

NPN 8 GHz wideband transistor BFG198

DESCRIPTION

NPN planar epitaxial transistor in a plastic SOT223 envelope, intended for wideband amplifier applications. The device features a high gain and excellent output voltage capabilities.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

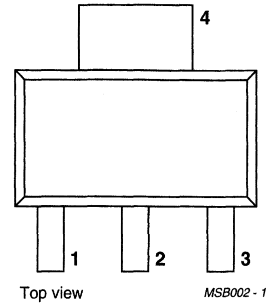


Fig.1 SOT223.

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	–	–	10	V
I_C	DC collector current		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V; T_j = 25 °C	40	90	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	8	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 8 V; f = 500 MHz; T_{amb} = 25 °C	–	18	–	dB
		I_C = 50 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB
V_o	output voltage	d_{im} = –60 dB; I_C = 70 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	–	700	–	mV

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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	100	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 135 °C (note 1)	40	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 8$ V; f = 1 MHz	–	0.8	–	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	8	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 50$ mA; $V_{CE} = 8$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	18	–	dB
		$I_C = 50$ mA; $V_{CE} = 8$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	15	–	dB
V_o	output voltage	note 2	–	750	–	mV
		note 3	–	700	–	mV
d_2	second order intermodulation distortion	note 4	–	–55	–	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. $d_{im} = -60$ dB (DIN 45004B); $I_C = 70$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_o$ at $d_{im} = -60$ dB;
   $V_q = V_o$ –6 dB; $f_p = 445.25$ MHz;
   $V_r = V_o$ –6 dB; $f_q = 453.25$ MHz; $f_r = 455.25$ MHz
   measured at $f_{(p+q-r)} = 443.25$ MHz.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 70$ mA; $V_{CE} = 8$ 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. $I_C = 50$ mA; $V_{CE} = 8$ V; $V_o = 50$ dBmV;
   $f_{(p+q)} = 810$ MHz; $f_p = 250$ MHz; $f_q = 560$ MHz.

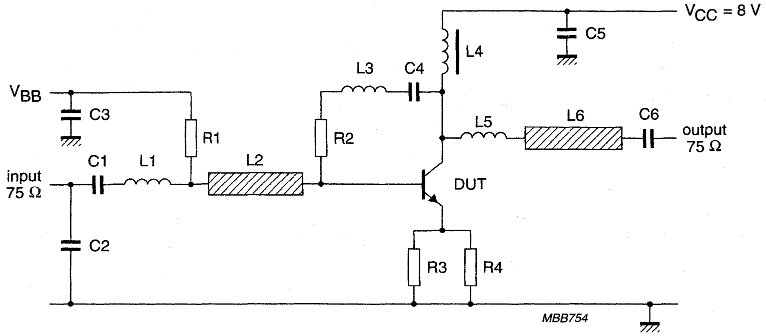


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	UNIT	DIMENSIONS	CATALOGUE NO.
C2	multilayer ceramic capacitor	1.2	pF		2222 851 12128
C1, C4, C6, C7	multilayer ceramic capacitor	10	nF		2222 590 08627
C3	multilayer ceramic capacitor	10	nF		2222 851 12128
C5 (note 1)	multilayer ceramic capacitor	10	nF		2222 629 08103
C8	multilayer ceramic capacitor	1.5	pF		2222 851 12158
L1 (note 1)	1.5 turns 0.4 mm copper wire			int. dia. 3 mm; winding pitch 1 mm	
L2	microstripline	75	Ω	length 22 mm; width 2.5 mm	
L3 (note 1)	0.4 mm copper wire	≈24	nH	length 30 mm	
L4 (note 1)	0.4 mm copper wire	≈3.6	nH	length 4 mm	
L5	microstripline	75	Ω	length 19 mm; width 2.5 mm	
L6	Ferroxcube choke	5	µH		3122 108 20153
R1	metal film resistor	10	Ω		2322 180 73103
R2 (note 1)	metal film resistor	220	Ω		2322 180 73221
R3, R4	metal film resistor	30	Ω		2322 180 73309

Note

1. Components C5, L1, L3, L4, and R2 are mounted on the underside of the PCB.
   The circuit is constructed on a double copper-clad printed circuit board with PTFE dielectric ($\varepsilon_r = 2.2$); thickness $\frac{1}{16}$ inch; thickness of copper sheet 2 x 35 µm; see Fig.2.

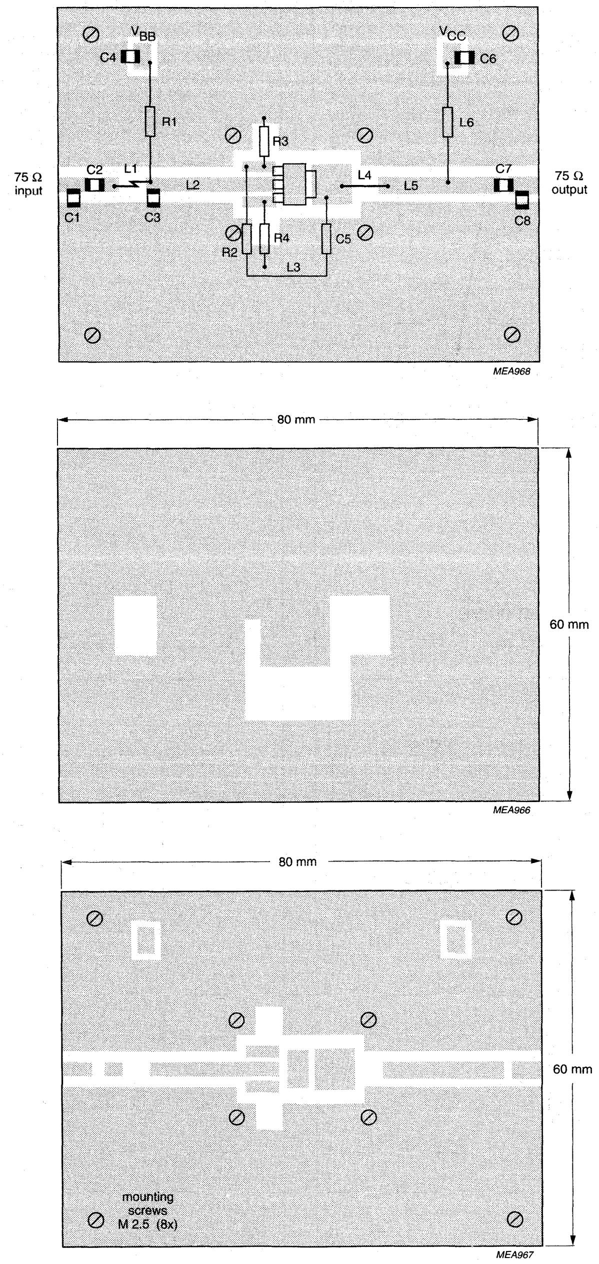


Fig.3 Intermodulation distortion and second order intermodulation distortion printed-circuit board.

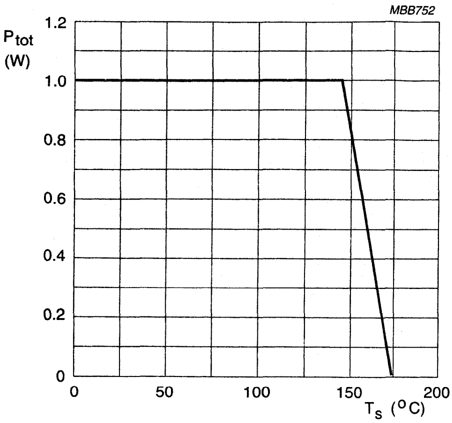
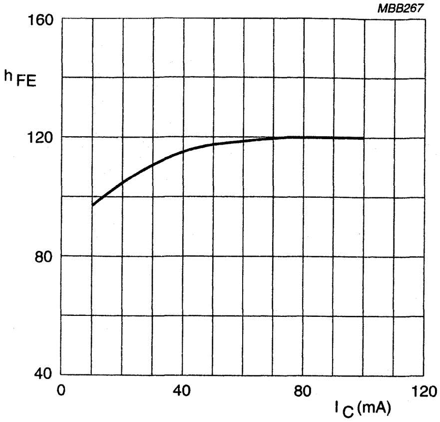
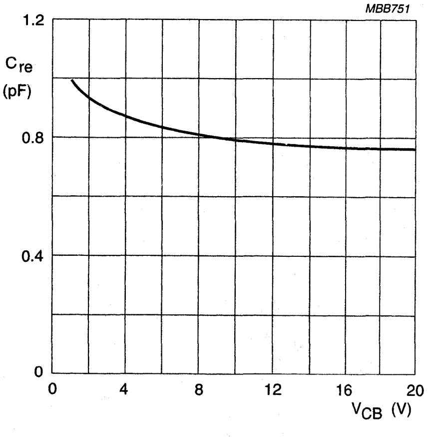


Fig.4 Power derating curve.



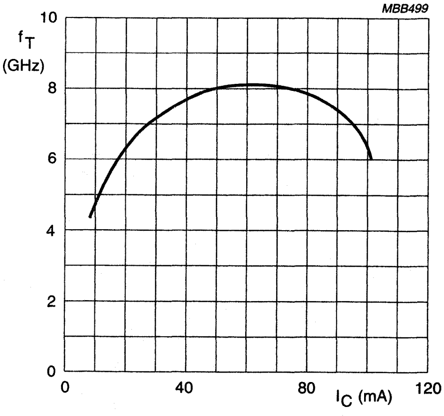
V_{CE} = 5 V; T_j = 25 °C.

Fig.5 DC current gain as a function of collector current.



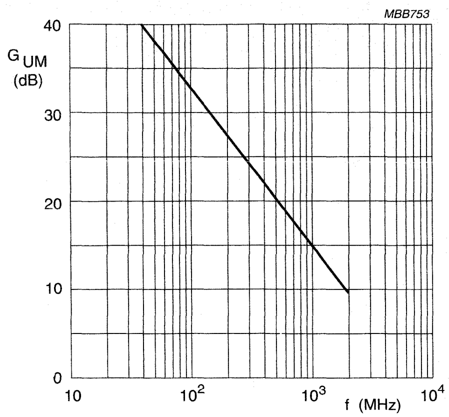
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.6 Feedback capacitance as a function of collector-base voltage.



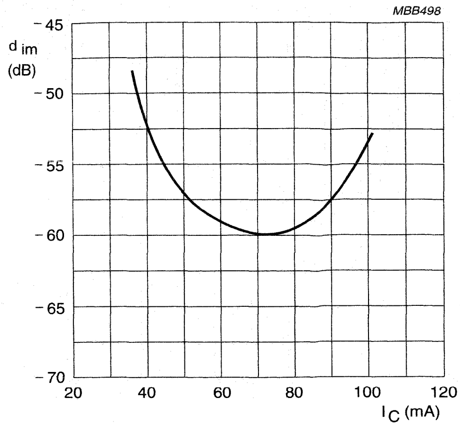
V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.7 Transition frequency as a function of collector current.



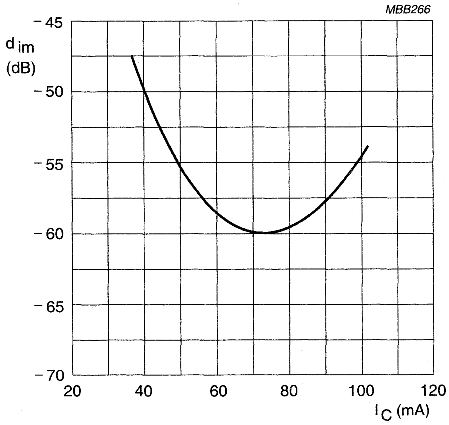
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C;

Fig.8 Maximum gain as a function of frequency.



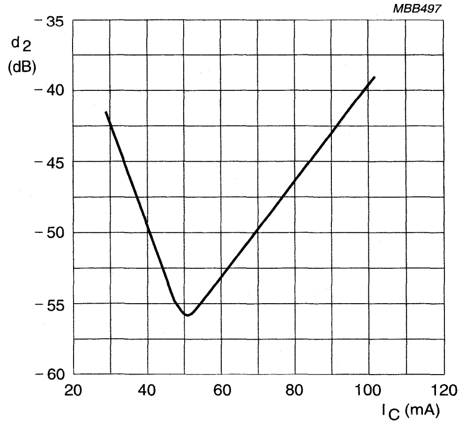
V_{CE} = 8 V; V_o = 750 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 443.25 MHz.

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



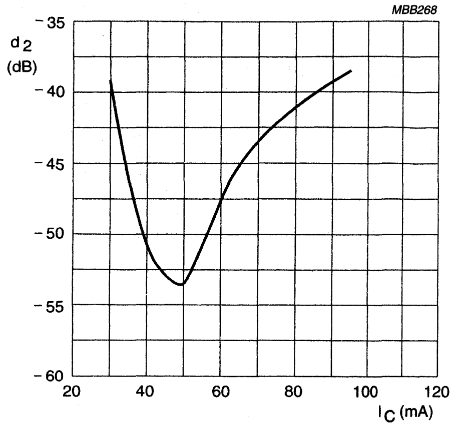
V_{CE} = 8 V; V_o = 700 mV; T_{amb} = 25 °C;
$f_{(p+q)}$ = 793.25 MHz.

Fig.10 Intermodulation distortion as a function of collector current.



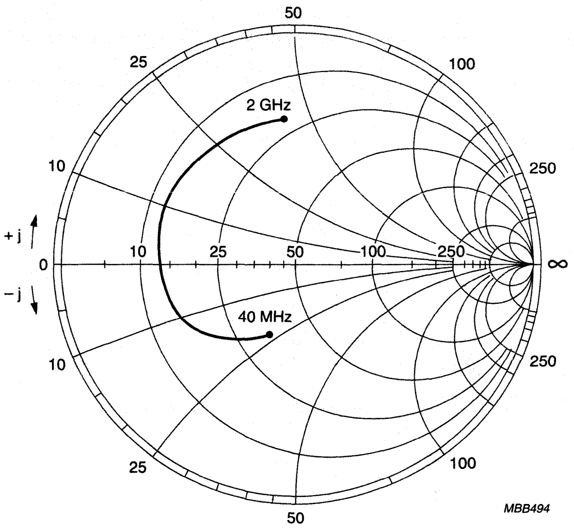
V_{CE} = 8 V; V_o = 50 dBmV; T_{amb} = 25 °C
$f_{(p+q)}$ = 450 MHz.

Fig.11 Second order intermodulation distortion as a function of collector current.



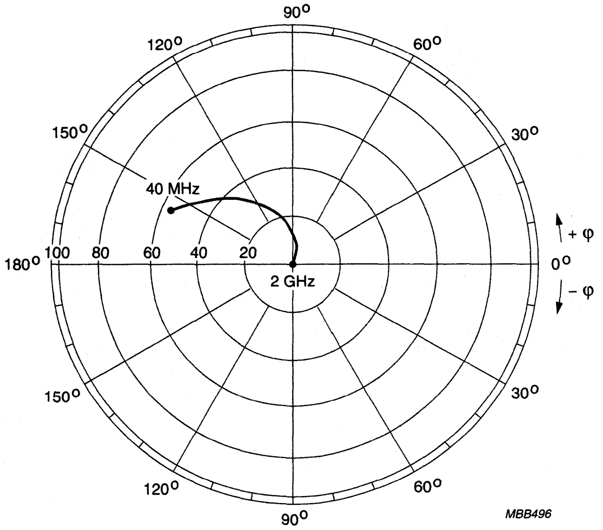
V_{CE} = 8 V; V_o = 50 dBmV; T_{amb} = 25 °C
$f_{(p+q)}$ = 810 MHz.

Fig.12 Second order intermodulation distortion as a function of collector current.



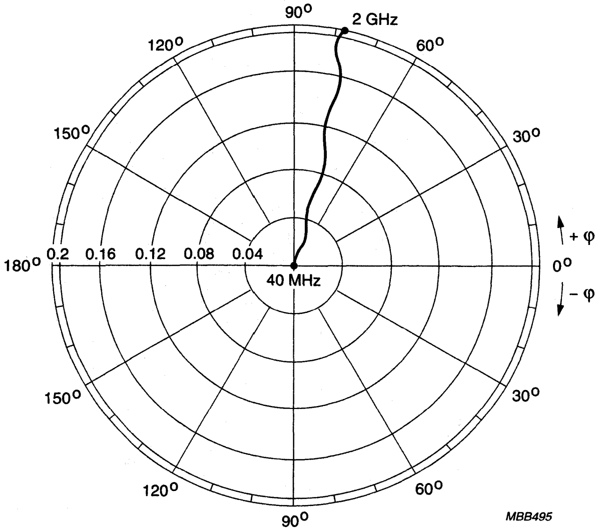
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.13 Common emitter input reflection coefficient (S_{11}).



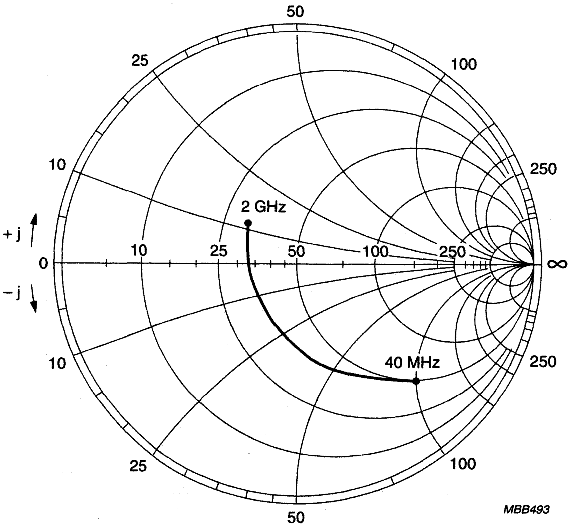
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.14 Common emitter forward transmission coefficient (S_{21}).



I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.15 Common emitter reverse transmission coefficient (S_{12}).



I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.16 Common emitter output reflection coefficient (S_{22}).

NPN 17 GHz wideband transistor BFG403W

FEATURES

- Low current
- Very high power gain
- Low noise figure
- High transition frequency
- Very low feedback capacitance.

APPLICATIONS

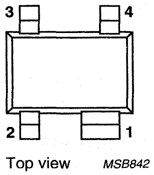
- Pager front ends
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors.

DESCRIPTION

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



Marking code: P3.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	–	4.5	V
I_C	collector current (DC)		–	3	3.6	mA
P_{tot}	total power dissipation	$T_s \leq 140$ °C	–	–	16	mW
h_{FE}	DC current gain	$I_C = 3$ mA; $V_{CE} = 2$ V; $T_j = 25$ °C	50	80	120	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	20	–	fF
f_T	transition frequency	$I_C = 3$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	17	–	GHz
G_{max}	maximum power gain	$I_C = 3$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	22	–	dB
F	noise figure	$I_C = 1$ mA; $V_{CE} = 2$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1	–	dB

CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
V_{EBO}	emitter-base voltage	open collector	–	1	V
I_C	collector current (DC)		–	3.6	mA
P_{tot}	total power dissipation	$T_s \leq 140$ °C; note 1; see Fig.2	–	16	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	820	K/W

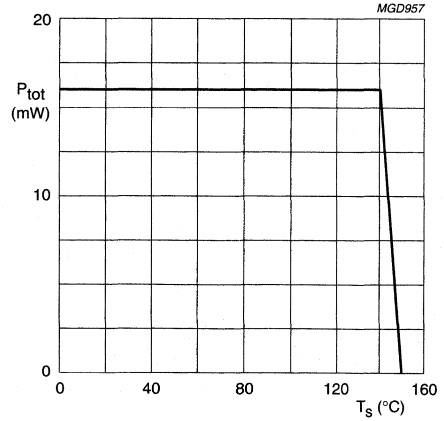


Fig.2 Power derating curve.

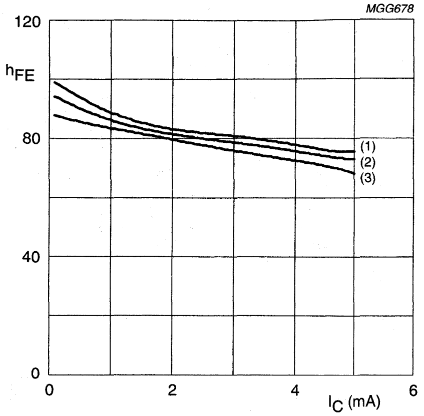
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 µA; I_E = 0	10	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0	4.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 2.5 µA; I_C = 0	1	–	–	V
I_{CBO}	collector-base leakage current	I_E = 0; V_{CB} = 4.5 V	–	–	15	nA
h_{FE}	DC current gain	I_C = 3 mA; V_{CE} = 2 V; see Fig.3	50	80	120	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 2 V; f = 1 MHz	–	170	–	fF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	315	–	fF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 2 V; f = 1 MHz; see Fig.4	–	20	–	fF
f_T	transition frequency	I_C = 3 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C; see Fig.5	–	17	–	GHz
G_{max}	maximum power gain; note 1	I_C = 0.5 mA; V_{CE} = 1 V; f = 900 MHz; T_{amb} = 25 °C; see Figs 6 and 8	–	20	–	dB
		I_C = 3 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C; see Figs 7 and 8	–	22	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 0.5 mA; V_{CE} = 1 V; f = 900 MHz; T_{amb} = 25 °C; see Fig.8	–	5	–	dB
		I_C = 3 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C; see Fig.8	–	14	–	dB
F	noise figure	I_C = 1 mA; V_{CE} = 2 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1	–	dB
		I_C = 1 mA; V_{CE} = 2 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1.6	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 1 mA; V_{CE} = 1 V; f = 900 MHz; $Z_S = Z_{S\,opt}$; $Z_L = Z_{L\,opt}$; note 2	–	–5	–	dBm
ITO	third order intercept point	I_C = 1 mA; V_{CE} = 1 V; f = 900 MHz; $Z_S = Z_{S\,opt}$; $Z_L = Z_{L\,opt}$; note 2	–	6	–	dBm

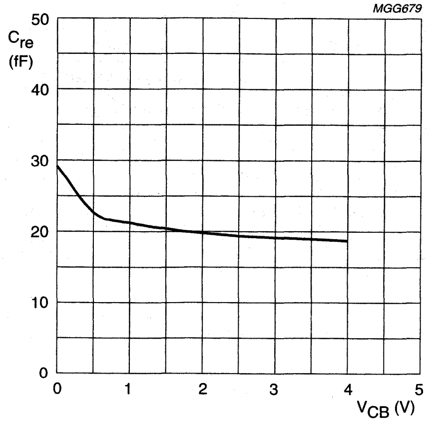
Notes

1. G_{max} is the maximum power gain, if K > 1. If K < 1 then G_{max} = MSG; see Figs 6, 7 and 8.
2. Z_S is optimized for noise; Z_L is optimized for gain.



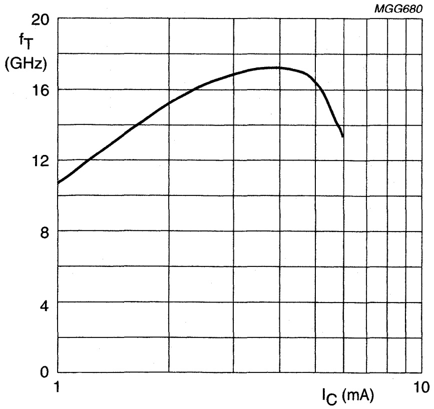
(1) V_{CE} = 3 V.
(2) V_{CE} = 2 V.
(3) V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current; typical values.



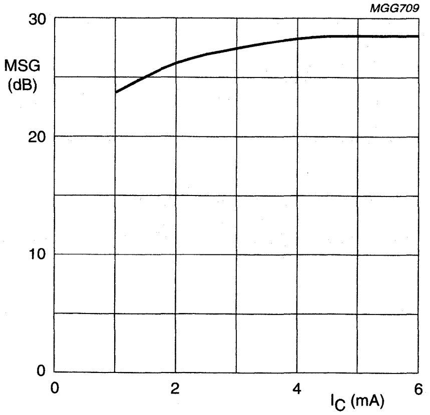
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



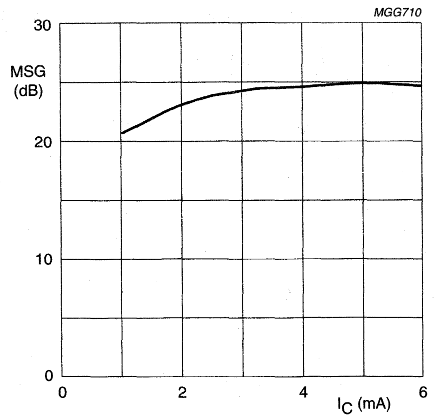
V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



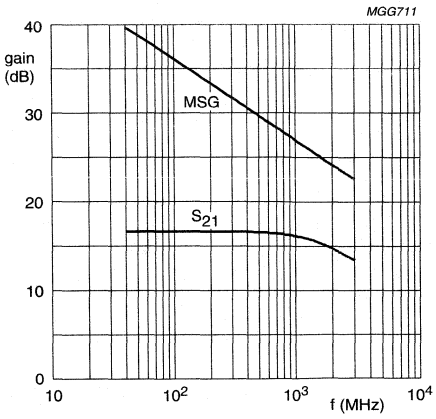
V_{CE} = 2 V; f = 900 MHz.

Fig.6 Maximum stable gain as a function of collector current; typical values.



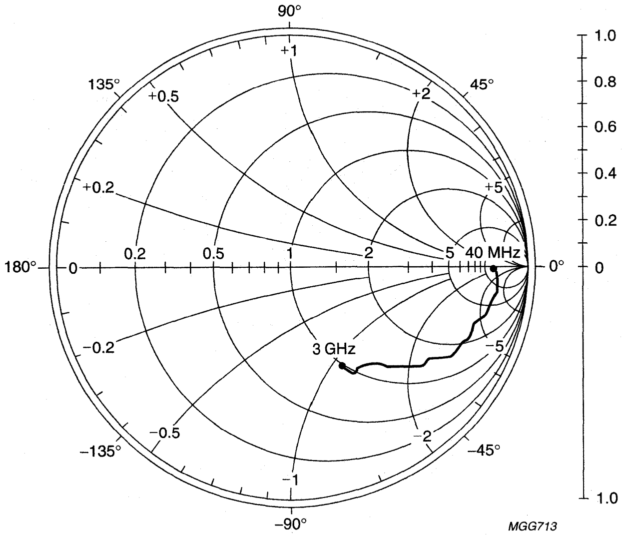
V_{CE} = 2 V; f = 2 GHz.

Fig.7 Maximum stable gain as a function of collector current; typical values.



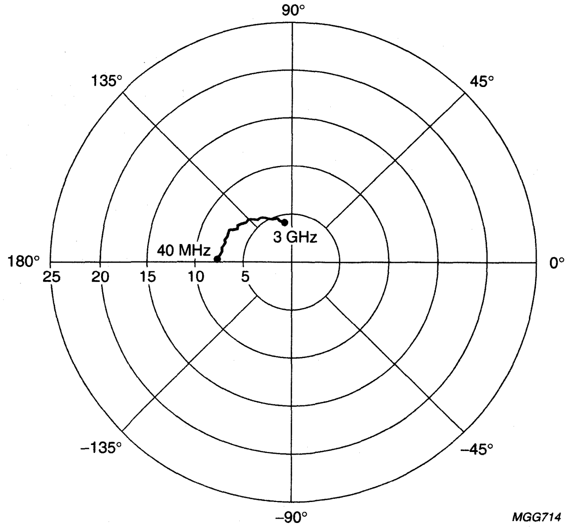
I_C = 3 mA; V_{CE} = 2 V.

Fig.8 Gain as a function of frequency; typical values.



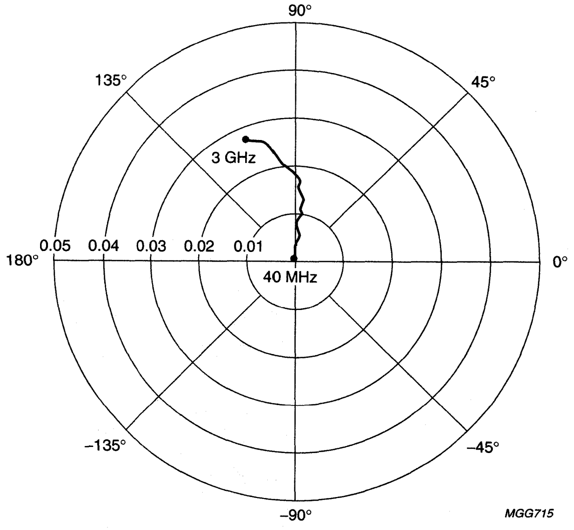
I_C = 3 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}); typical values.



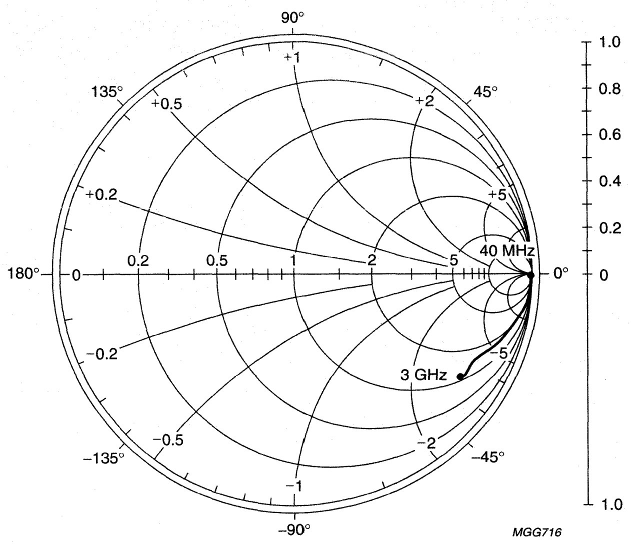
I_C = 3 mA; V_{CE} = 2 V.

Fig.10 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 3 mA; V_{CE} = 2 V.

Fig.11 Common emitter reverse transmission coefficient (S_{12}); typical values.



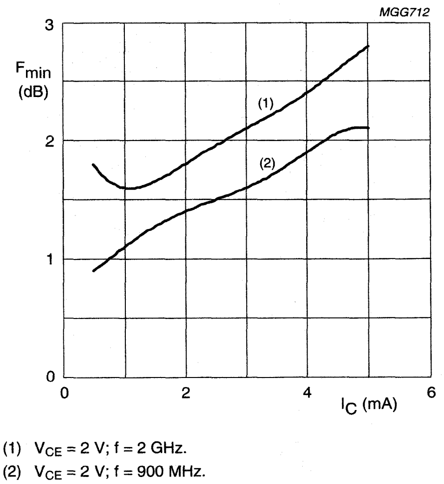
I_C = 3 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.12 Common emitter output reflection coefficient (S_{22}); typical values.

Noise data

V_{CE} = 2 V; typical values.

f (MHz)	I_C (mA)	F_{min} (dB)	Γ_{mag}	Γ_{angle}	r_n (Ω)
900	0.5	0.9	0.91	4.7	1.41
	1	1.1	0.83	5.1	1.12
	2	1.4	0.71	5.1	0.97
	3	1.6	0.62	5.0	0.88
	4	1.9	0.56	4.9	0.84
	5	2.1	0.50	4.2	0.82
2000	0.5	1.8	0.71	27.5	1.47
	1	1.6	0.74	26.1	1.11
	2	1.8	0.64	26.3	0.93
	3	2.1	0.56	26.1	0.91
	4	2.4	0.48	26.7	0.9
	5	2.8	0.45	25.8	0.85



(1) V_{CE} = 2 V; f = 2 GHz.

(2) V_{CE} = 2 V; f = 900 MHz.

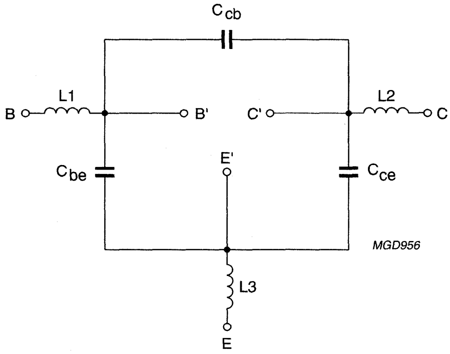
Fig.13 Minimum noise figure as a function of the collector current; typical values.

SPICE parameters for the BFG403W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	5.554	aA
2	BF	145.0	–
3	NF	0.993	–
4	VAF	31.12	V
5	IKF	35.75	mA
6	ISE	35.35	fA
7	NE	3.000	–
8	BR	11.37	–
9	NR	0.985	–
10	VAR	1.874	V
11	IKR	0.014	A
12	ISC	57.08	aA
13	NC	1.546	–
14	RB	122.4	Ω
15	IRB	0.000	A
16	RBM	52.45	Ω
17	RE	1.511	Ω
18	RC	15.12	Ω
19 (1)	XTB	1.500	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	36.61	fF
23	VJE	900.0	mV
24	MJE	0.346	–
25	TF	4.122	ps
26	XTF	68.20	–
27	VTF	2.004	V
28	ITF	0.179	A
29	PTF	0.000	deg
30	CJC	16.21	fF
31	VJC	556.9	mV
32	MJC	0.207	–
33	XCJC	0.500	–
34 (1)	TR	00.00	ns
35 (1)	CJS	78.59	fF
36 (1)	VJS	418.3	mV
37 (1)	MJS	0.239	–
38	FC	0.550	–
39 (2)(3)	C_{bp}	145	fF
40 (2)	R_{sb1}	25	Ω
41 (3)	R_{sb2}	19	Ω

Notes

1. These parameters have not been extracted, the default values are shown.
2. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb1} between B′ and E′.
3. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb2} between C′ and E′.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT343R2.

List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	80	fF
C_{cb}	2	fF
C_{ce}	80	fF
L1	1.1	nH
L2	1.1	nH
L3 (note 1)	0.25	nH

Note

1. External emitter inductance to be added separately due to the influence of the printed-circuit board.

NPN 22 GHz wideband transistor BFG410W

FEATURES

- Very high power gain
- Low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance.

APPLICATIONS

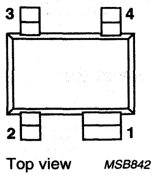
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors
- Pagers
- Satellite television tuners (SATV)
- High frequency oscillators.

DESCRIPTION

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



Marking code: P4.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	–	4.5	V
I_C	collector current (DC)		–	10	12	mA
P_{tot}	total power dissipation	$T_s \leq 110$ °C	–	–	54	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 2$ V; $T_j = 25$ °C	50	80	120	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	45	–	fF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	22	–	GHz
G_{max}	maximum power gain	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	21	–	dB
F	noise figure	$I_C = 1$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	–	dB

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
V_{EBO}	emitter-base voltage	open collector	–	1	V
I_C	collector current (DC)		–	12	mA
P_{tot}	total power dissipation	$T_s \leq 110$ °C; note 1; see Fig.2	–	54	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	750	K/W

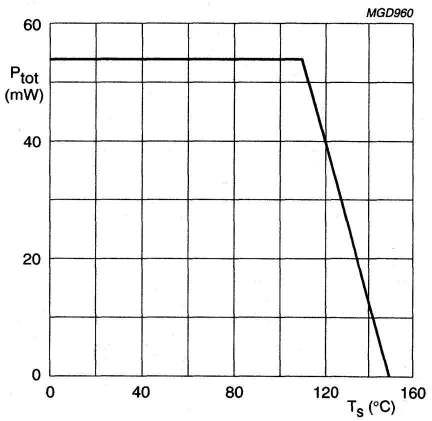


Fig.2 Power derating curve.

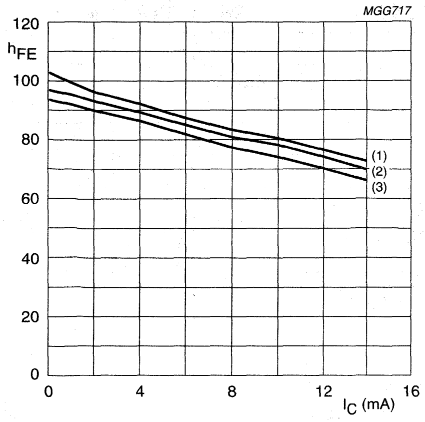
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	10	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1$ mA; $I_B = 0$	4.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	1	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 4.5$ V	–	–	15	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 2$ V; see Fig.3	50	80	120	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	220	–	fF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	400	–	fF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz; see Fig.4	–	45	–	fF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.5	–	22	–	GHz
G_{max}	maximum power gain; note 1	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Figs 7 and 8	–	21	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.8	–	18	–	dB
F	noise figure	$I_C = 1$ mA; $V_{CE} = 2$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	0.9	–	dB
		$I_C = 1$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1.2	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $Z_S = Z_{S\ opt}$; $Z_L = Z_{L\ opt}$; note 2	–	5	–	dBm
ITO	third order intercept point	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 2 GHz; $Z_S = Z_{S\ opt}$; $Z_L = Z_{L\ opt}$; note 2	–	15	–	dBm

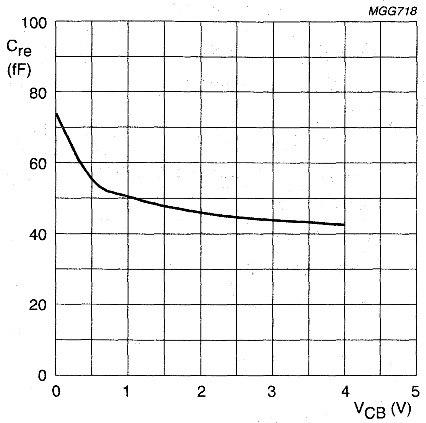
Notes

1. G_{max} is the maximum power gain, if K > 1. If K < 1 then G_{max} = MSG; see Figs 6, 7 and 8.
2. Z_S is optimized for noise; Z_L is optimized for gain.



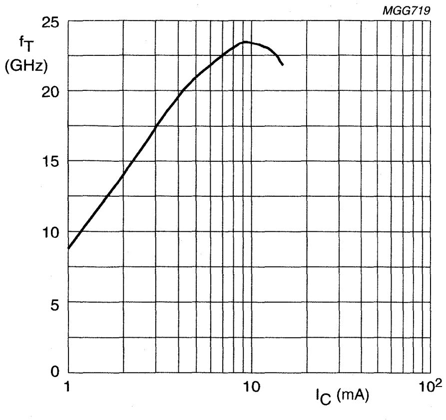
(1) V_{CE} = 3 V.
(2) V_{CE} = 2 V.
(3) V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current; typical values.



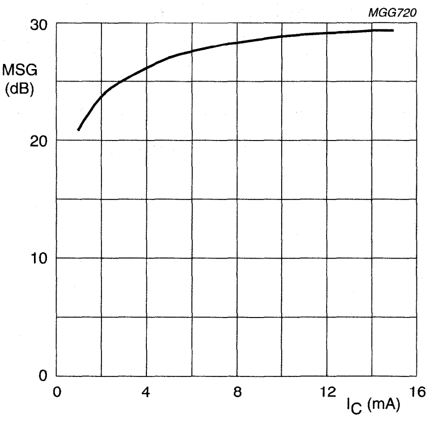
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



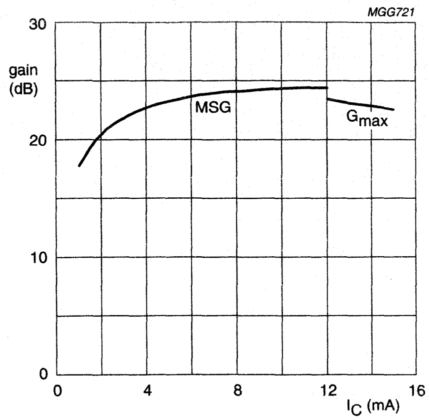
V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



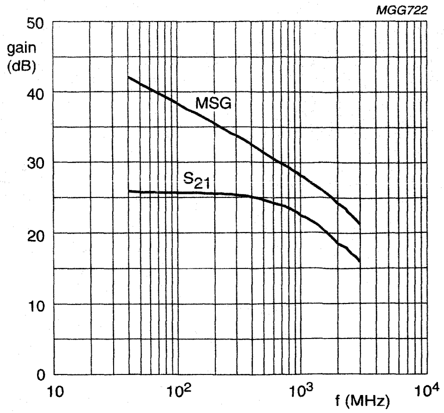
V_{CE} = 2 V; f = 900 MHz.

Fig.6 Maximum stable gain as a function of collector current; typical values.



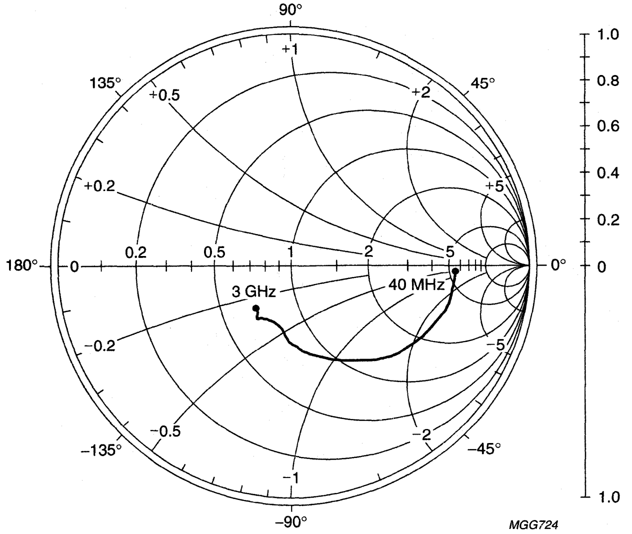
V_{CE} = 2 V; f = 2 GHz.

Fig.7 Gain as a function of collector current; typical values.



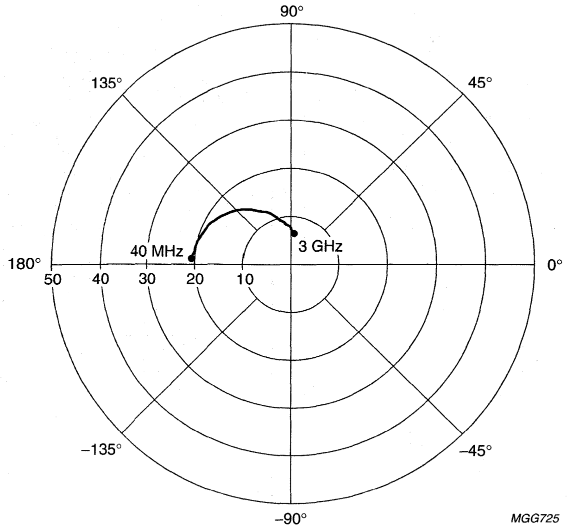
I_C = 10 mA; V_{CE} = 2 V.

Fig.8 Gain as a function of frequency; typical values.



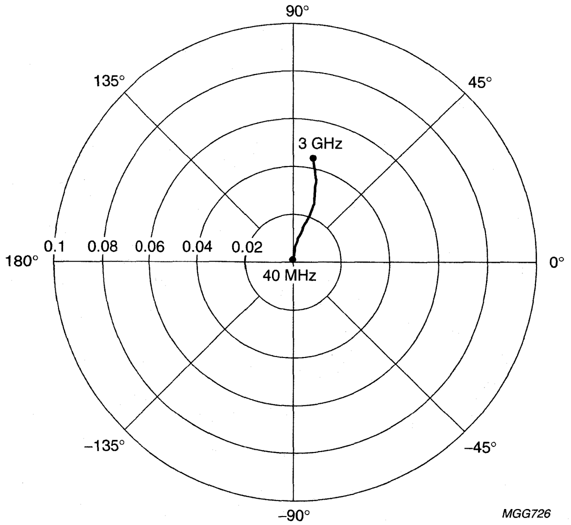
I_C = 10 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}); typical values.



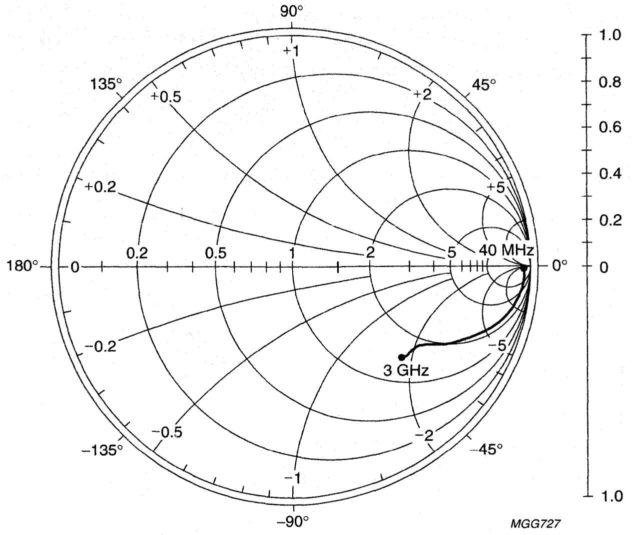
$I_C = 10$ mA; $V_{CE} = 2$ V.

Fig.10 Common emitter forward transmission coefficient (S_{21}); typical values.



$I_C = 10$ mA; $V_{CE} = 2$ V.

Fig.11 Common emitter reverse transmission coefficient (S_{12}); typical values.



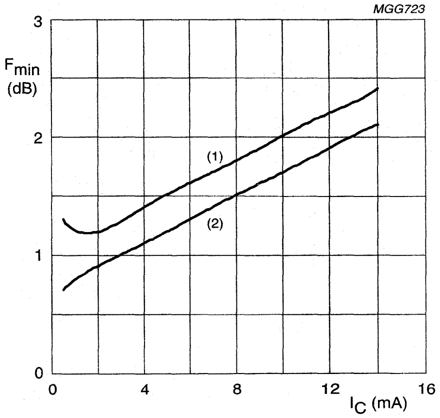
I_C = 10 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.12 Common emitter output reflection coefficient (S_{22}); typical values.

Noise data

V_{CE} = 2 V; typical values.

f (MHz)	I_C (mA)	F_{min} (dB)	Γ_{mag}	Γ_{angle}	r_n (Ω)
900	1	0.8	0.73	11.2	0.56
	2	0.9	0.58	10.1	0.43
	4	1.1	0.40	10.1	0.33
	6	1.3	0.28	11.0	0.30
	8	1.5	0.20	8.0	0.30
	10	1.7	0.14	10.5	0.27
	12	1.9	0.06	10.1	0.25
	14	2.1	0.05	14.2	0.26
2000	1	1.2	0.64	35.7	0.57
	2	1.2	0.50	35.8	0.44
	4	1.4	0.34	34.4	0.37
	6	1.6	0.25	33.7	0.34
	8	1.8	0.17	34.5	0.35
	10	2.0	0.12	35.8	0.34
	12	2.2	0.05	38.0	0.35
	14	2.4	0.03	44.8	0.34



(1) f = 2 GHz; V_{CE} = 2 V.
(2) f = 900 MHz; V_{CE} = 2 V.

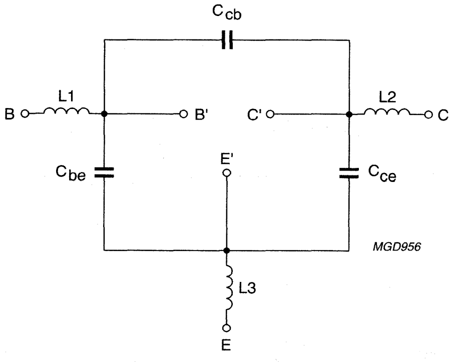
Fig.13 Minimum noise figure as a function of the collector current; typical values.

SPICE parameters for the BFG410W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	19.42	aA
2	BF	145.0	–
3	NF	0.993	–
4	VAF	31.12	V
5	IKF	125.0	mA
6	ISE	123.6	fA
7	NE	3.000	–
8	BR	11.37	–
9	NR	0.985	–
10	VAR	1.874	V
11	IKR	50.00	mA
12	ISC	199.6	aA
13	NC	1.546	–
14	RB	35.00	Ω
15	IRB	0.000	A
16	RBM	15.00	Ω
17	RE	432.0	mΩ
18	RC	4.324	Ω
19 (1)	XTB	1.500	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	128.0	fF
23	VJE	900.0	mV
24	MJE	0.346	–
25	TF	4.122	ps
26	XTF	68.20	–
27	VTF	2.004	V
28	ITF	0.627	A
29	PTF	0.000	deg
30	CJC	56.68	fF
31	VJC	556.9	mV
32	MJC	0.207	–
33	XCJC	0.500	–
34 (1)	TR	0.000	ns
35 (1)	CJS	274.8	fF
36 (1)	VJS	418.3	mV
37 (1)	MJS	0.239	–
38	FC	0.550	–
39 (2)(3)	C_{bp}	145	fF
40 (2)	R_{sb1}	25	Ω
41 (3)	R_{sb2}	19	Ω

Notes

1. These parameters have not been extracted, the default values are shown.
2. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb1} between B′ and E′.
3. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb2} between C′ and E′.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT343R2.

List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	80	fF
C_{cb}	2	fF
C_{ce}	80	fF
L1	1.1	nH
L2	1.1	nH
L3 (note 1)	0.25	nH

Note

1. External emitter inductance to be added separately due to the influence of the printed-circuit board.

NPN 25 GHz wideband transistor BFG425W

FEATURES

- Very high power gain
- Low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance.

APPLICATIONS

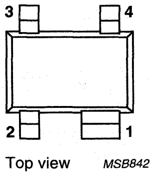
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors
- Pagers
- Satellite television tuners (SATV)
- High frequency oscillators.

DESCRIPTION

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



Marking code: P5.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	–	4.5	V
I_C	collector current (DC)		–	25	30	mA
P_{tot}	total power dissipation	$T_s \leq 103$ °C	–	–	135	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 2$ V; $T_j = 25$ °C	50	80	120	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	95	–	fF
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	25	–	GHz
G_{max}	maximum power gain	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	20	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	–	dB

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	10	V
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
V_{EBO}	emitter-base voltage	open collector	–	1	V
I_C	collector current (DC)		–	30	mA
P_{tot}	total power dissipation	$T_s \leq 103$ °C; note 1; see Fig.2	–	135	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	350	K/W

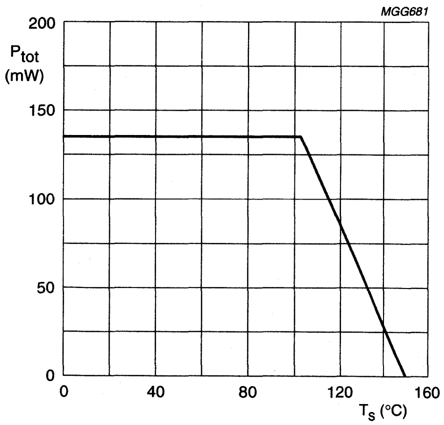


Fig.2 Power derating curve.

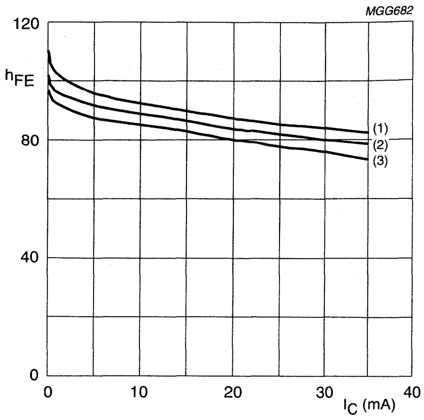
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	10	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1$ mA; $I_B = 0$	4.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	1	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 4.5$ V	–	–	15	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 2$ V; see Fig.3	50	80	120	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	300	–	fF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	575	–	fF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz; see Fig.4	–	95	–	fF
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.5	–	25	–	GHz
G_{max}	maximum power gain; note 1	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Figs 7 and 8	–	20	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.8	–	17	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 2$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	0.8	–	dB
		$I_C = 2$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1.2	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $Z_S = Z_{S\ opt}$; $Z_L = Z_{L\ opt}$; note 2	–	12	–	dBm
ITO	third order intercept point	$I_C = 25$ mA; $V_{CE} = 2$ V; f = 2 GHz; $Z_S = Z_{S\ opt}$; $Z_L = Z_{L\ opt}$; note 2	–	22	–	dBm

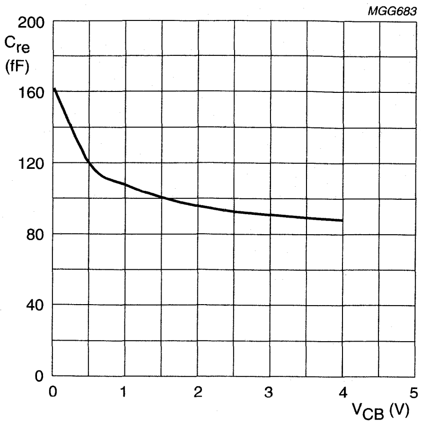
Notes

1. G_{max} is the maximum power gain, if K > 1. If K < 1 then G_{max} = MSG; see Figs 6, 7 and 8.
2. Z_S is optimized for noise; Z_L is optimized for gain.



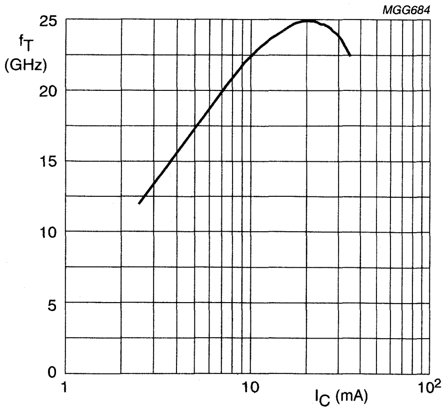
(1) V_{CE} = 3 V.
(2) V_{CE} = 2 V.
(3) V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current; typical values.



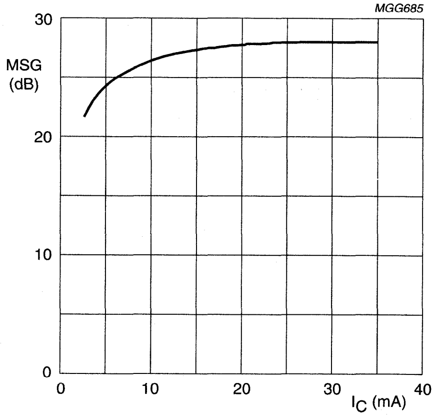
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



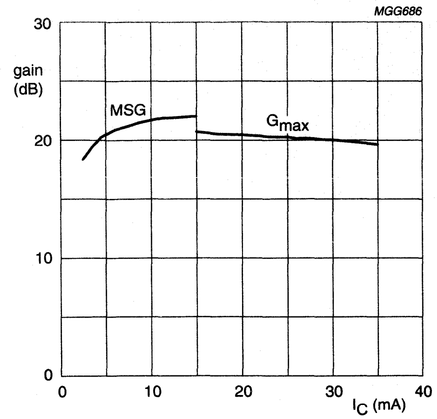
V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



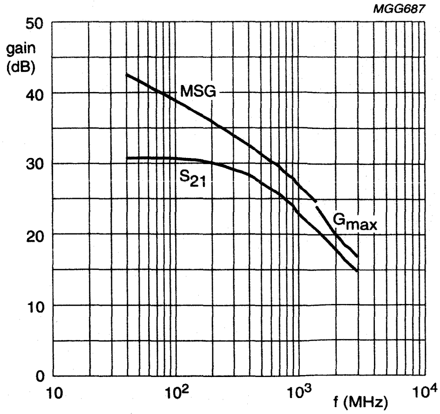
V_{CE} = 2 V; f = 900 MHz.

Fig.6 Maximum stable gain as a function of collector current; typical values.



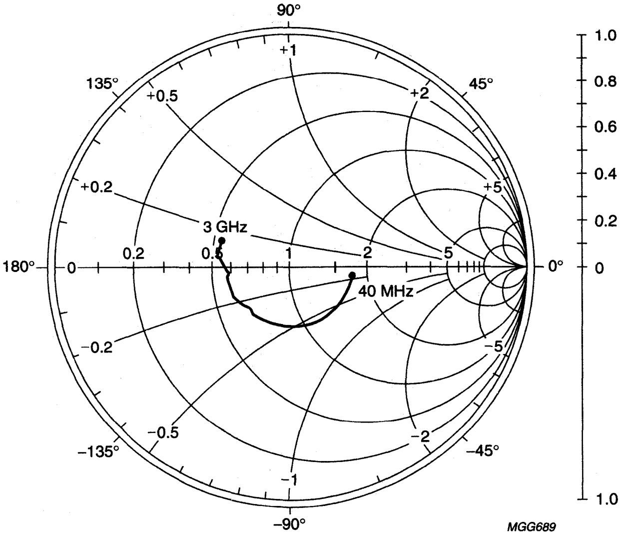
V_{CE} = 2 V; f = 2 GHz.

Fig.7 Gain as a function of collector current; typical values.



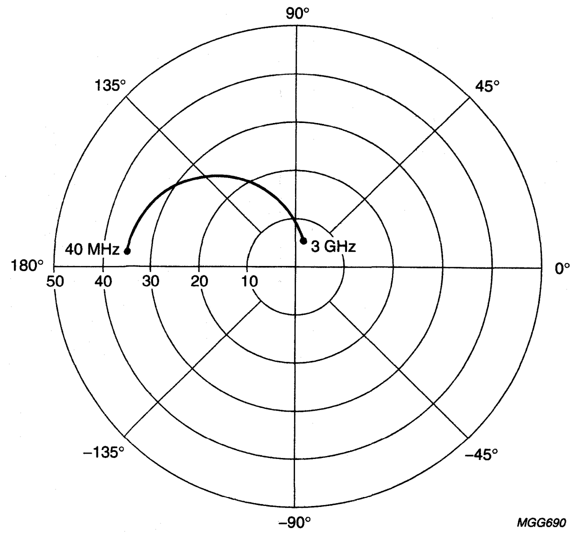
I_C = 25 mA; V_{CE} = 2 V.

Fig.8 Gain as a function of frequency; typical values.



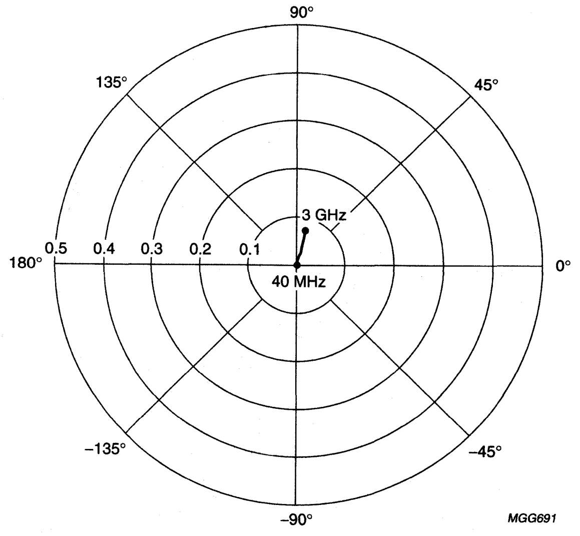
I_C = 25 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}); typical values.



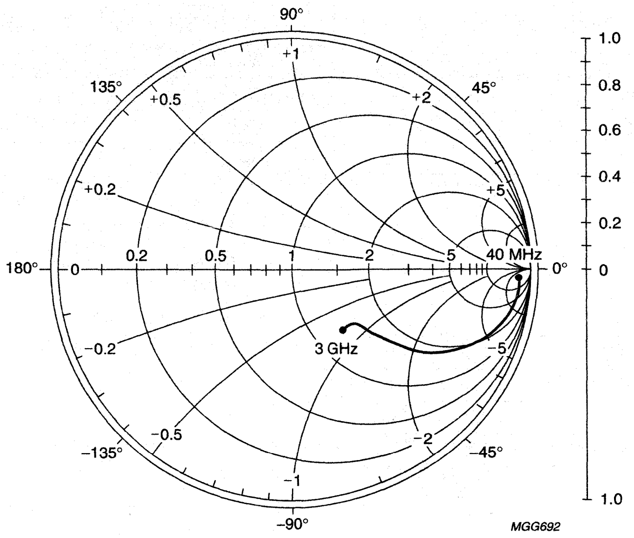
I_C = 25 mA; V_{CE} = 2 V.

Fig.10 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 25 mA; V_{CE} = 2 V.

Fig.11 Common emitter reverse transmission coefficient (S_{12}); typical values.



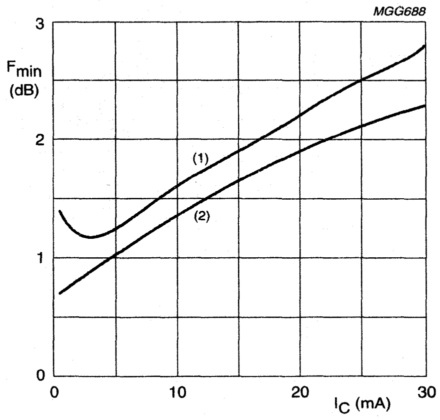
$I_C = 25$ mA; $V_{CE} = 2$ V; $Z_o = 50\ \Omega$.

Fig.12 Common emitter output reflection coefficient (S_{22}); typical values.

Noise data

$V_{CE} = 2$ V; typical values.

f (MHz)	I_C (mA)	F_{min} (dB)	Γ_{mag}	Γ_{angle}	r_n (Ω)
900	1	0.7	0.67	19.1	0.40
	2	0.8	0.48	17.8	0.27
	4	1	0.28	11.7	0.24
	10	1.4	0.02	−63.9	0.19
	15	1.6	0.11	−162.4	0.18
	20	1.9	0.19	−165.5	0.18
	25	2.1	0.25	−166.3	0.19
	30	2.3	0.29	−166.5	0.19
2000	1	1.3	0.56	57.5	0.36
	2	1.2	0.43	57.2	0.25
	4	1.2	0.22	60.8	0.18
	10	1.6	0.06	137.4	0.19
	15	1.9	0.13	−162.1	0.20
	20	2.2	0.17	−155.5	0.20
	25	2.5	0.22	−152.2	0.21
	30	2.8	0.27	−150.8	0.25



(1) $V_{CE} = 2$ V; f = 2 GHz.

(2) $V_{CE} = 2$ V; f = 900 MHz.

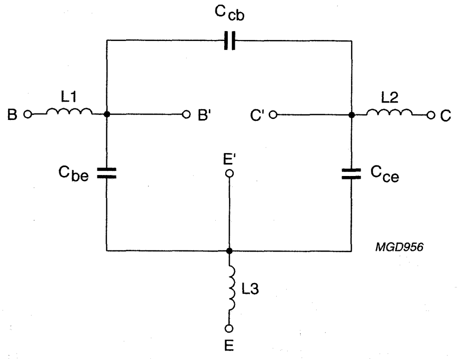
Fig.13 Minimum noise figure as a function of the collector current; typical values.

SPICE parameters for the BFG425W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	47.17	aA
2	BF	145.0	–
3	NF	0.993	–
4	VAF	31.12	V
5	IKF	304.0	mA
6	ISE	300.2	fA
7	NE	3.000	–
8	BR	11.37	–
9	NR	0.985	–
10	VAR	1.874	V
11	IKR	0.121	A
12	ISC	484.8	aA
13	NC	1.546	–
14	RB	14.41	Ω
15	IRB	0.000	A
16	RBM	6.175	Ω
17	RE	177.9	mΩ
18	RC	1.780	Ω
19 (1)	XTB	1.500	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	310.9	fF
23	VJE	900.0	mV
24	MJE	0.346	–
25	TF	4.122	ps
26	XTF	68.20	–
27	VTF	2.004	V
28	ITF	1.525	A
29	PTF	0.000	deg
30	CJC	137.7	fF
31	VJC	556.9	mV
32	MJC	0.207	–
33	XCJC	0.500	–
34 (1)	TR	0.000	ns
35 (1)	CJS	667.5	fF
36 (1)	VJS	418.3	mV
37 (1)	MJS	0.239	–
38	FC	0.550	–
39 (2)(3)	C_{bp}	145	fF
40 (2)	R_{sb1}	25	Ω
41 (3)	R_{sb2}	19	Ω

Notes

1. These parameters have not been extracted, the default values are shown.
2. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb1} between B′ and E′.
3. Bonding pad capacity C_{bp} in series with substrate resistance R_{sb2} between C′ and E′.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT343R2.

List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	80	fF
C_{cb}	2	fF
C_{ce}	80	fF
L1	1.1	nH
L2	1.1	nH
L3 (note 1)	0.25	nH

Note

1. External emitter inductance to be added separately due to the influence of the printed-circuit board.

NPN wideband transistor BFG480W

FEATURES

- High power gain
- High efficiency
- Low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance
- Linear and non-linear operation.

APPLICATIONS

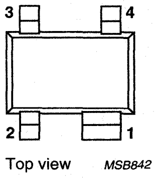
- RF front end with high linearity system demands (CDMA)
- Common emitter class AB driver.

DESCRIPTION

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a 4-pin dual-emitter SOT343R plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



Marking code: P6.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
I_C	collector current (DC)		80	250	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C	–	360	mW
f_T	transition frequency	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	21	–	GHz
G_{max}	maximum gain	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C	16	–	dB
F	noise figure	$I_C = 8$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	1.8	–	dB
G_p	power gain	Pulsed; class-AB; $\delta < 1:2$; $t_p = 5$ ms; $V_{CE} = 3.6$ V; f = 2 GHz; $P_L = 100$ mW	13.5	–	dB
η_C	collector efficiency	Pulsed; class-AB; $\delta < 1:2$; $t_p = 5$ ms; $V_{CE} = 3.6$ V; f = 2 GHz; $P_L = 100$ mW	45	–	%

CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A, and SNW-FQ-302B.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	14.5	V
V_{CEO}	collector-emitter voltage	open base	–	4.5	V
V_{EBO}	emitter-base voltage	open collector	–	1	V
I_C	collector current (DC)		–	250	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C; note 1; see Fig.2	–	360	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	250	K/W

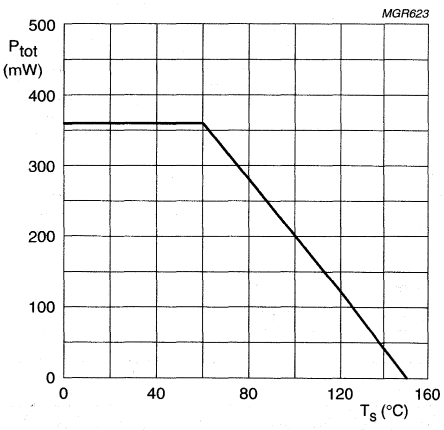


Fig.2 Power derating curve.

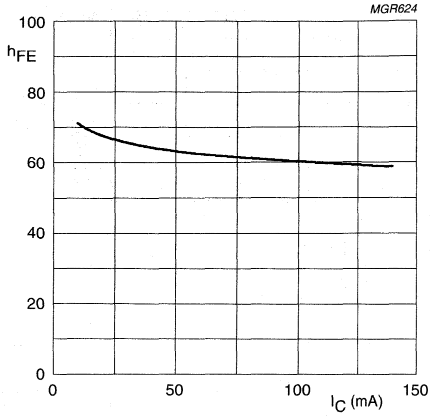
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 50\ \mu A$; $I_E = 0$	14.5	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 5$ mA; $I_B = 0$	4.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 100\ \mu A$; $I_C = 0$	1	–	–	V
I_{CBO}	collector-base leakage current	$V_{CE} = 5$ V; $V_{BE} = 0$	–	–	70	nA
h_{FE}	DC current gain	$I_C = 80$ mA; $V_{CE} = 2$ V; see Fig.3	40	60	100	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 2$ V; f = 1 MHz	–	1.4	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2.2	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 2$ V; f = 1 MHz; see Fig.4	–	340	–	fF
f_T	transition frequency	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.5	–	21	–	GHz
G_{max}	maximum power gain; note 1	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Figs 7 and 8	–	16	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $T_{amb} = 25$ °C; see Fig.8	–	12	–	dB
F	noise figure	$I_C = 8$ mA; $V_{CE} = 2$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1.2	–	dB
		$I_C = 8$ mA; $V_{CE} = 2$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$; see Fig.13	–	1.8	–	dB
P_{L1}	output power at 1 dB gain compression	Class-AB; $\delta < 1 : 2$; $t_p = 5$ ms; $V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; f = 2 GHz	–	20	–	dBm
ITO	third order intercept point	$I_C = 80$ mA; $V_{CE} = 2$ V; f = 2 GHz; $Z_S = Z_{S\ opt}$; $Z_L = Z_{L\ opt}$; note 2	–	28	–	dBm

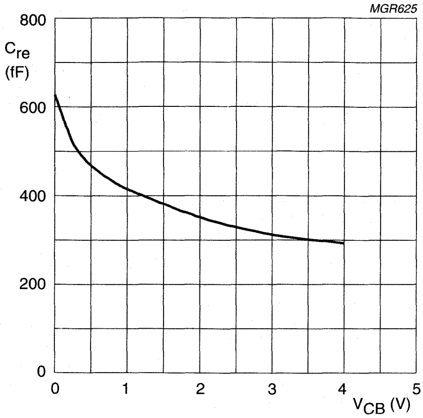
Notes

1. G_{max} is the maximum power gain, if $K > 1$. If $K < 1$ then G_{max} = MSG; see Figs 6, 7 and 8.
2. Z_S is optimized for noise; Z_L is optimized for gain.



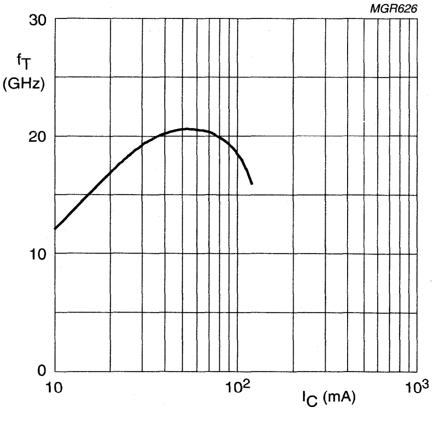
$V_{CE} = 2$ V.

Fig.3 DC current gain as a function of collector current; typical values.



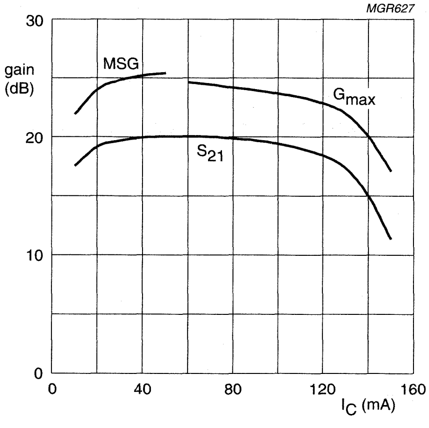
$I_C = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



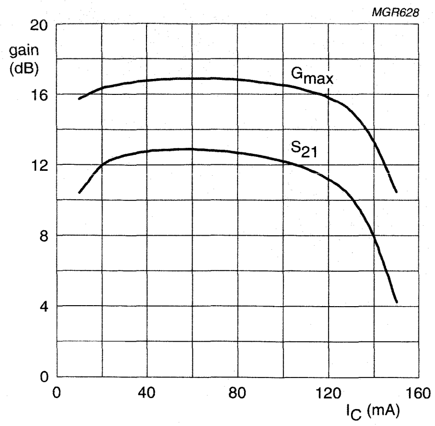
f = 2 GHz; $V_{CE} = 2$ V; $T_{amb} = 25$ °C.

Fig.5 Transition frequency as a function of collector current; typical values.



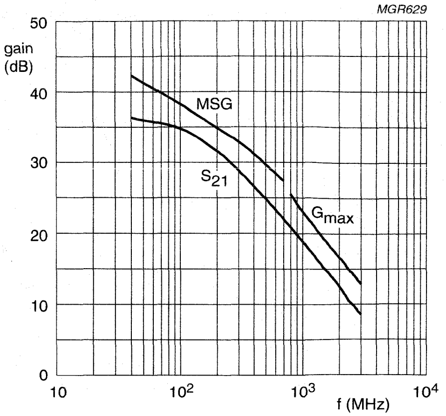
f = 900 MHz; $V_{CE} = 2$ V.

Fig.6 Gain as a function of collector current; typical values.



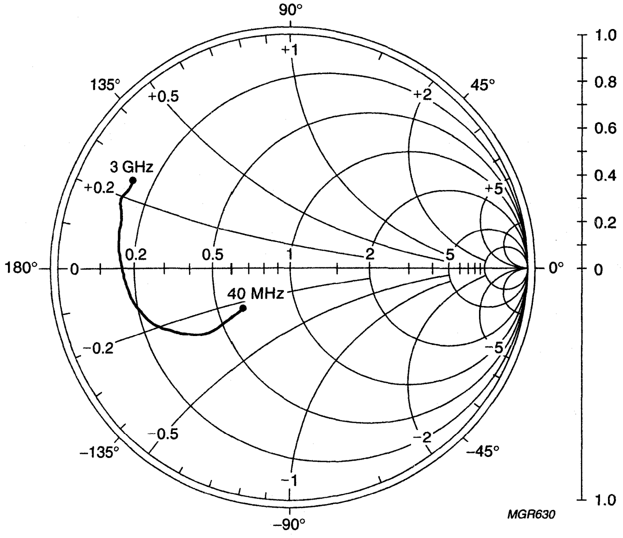
V_{CE} = 2 V; f = 2 GHz.

Fig.7 Gain as a function of collector current; typical values.



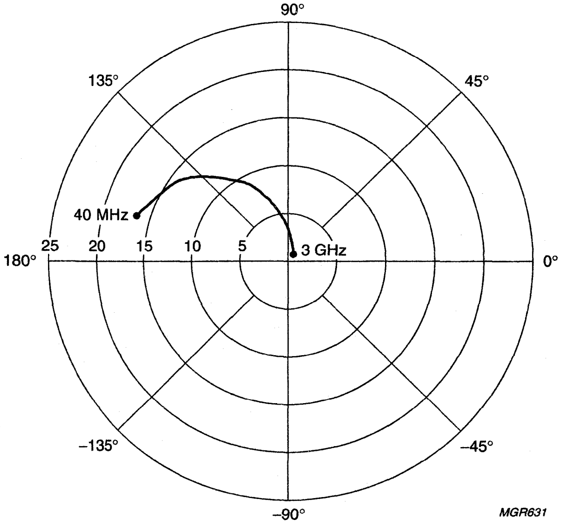
I_C = 80 mA; V_{CE} = 2 V.

Fig.8 Gain as a function of frequency; typical values.



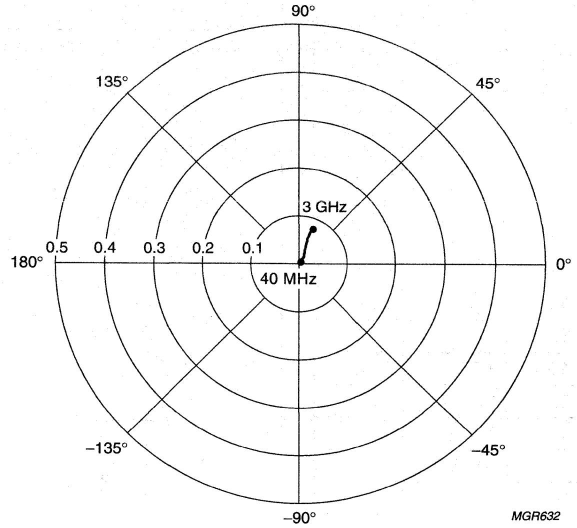
I_C = 80 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}); typical values.



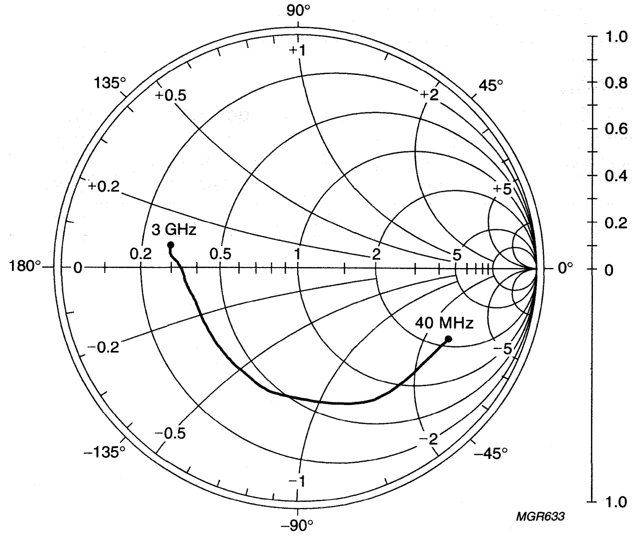
I_C = 80 mA; V_{CE} = 2 V.

Fig.10 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 80 mA; V_{CE} = 2 V.

Fig.11 Common emitter reverse transmission coefficient (S_{12}); typical values.



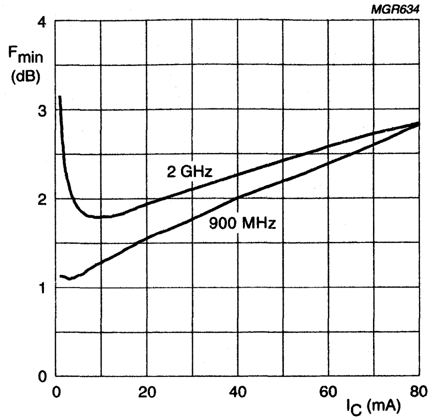
I_C = 80 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.12 Common emitter output reflection coefficient (S_{22}); typical values.

Noise data

V_{CE} = 2 V; typical values.

f (MHz)	I_C (mA)	F_{min} (dB)	Γ_{mag}	Γ_{angle}	r_n (Ω)
900	2	1.1	0.41	96.1	0.21
	4	1.1	0.31	106.6	0.14
	6	1.2	0.27	118.4	0.12
	8	1.2	0.26	131.7	0.10
	10	1.3	0.28	143.2	0.10
	20	1.6	0.39	166.2	0.07
	40	2.0	0.49	176.0	0.07
	60	2.3	0.57	179.5	0.07
	80	2.9	0.45	177.3	0.18
2000	2	2.4	0.57	171.9	0.09
	4	2.0	0.49	178.9	0.08
	6	1.8	0.46	−175.7	0.09
	8	1.8	0.44	−171.7	0.09
	10	1.8	0.43	−168.4	0.09
	12	1.8	0.44	−165.3	0.10
	14	1.8	0.44	−163.7	0.10
	20	1.9	0.46	−158.3	0.11
	40	2.3	0.52	−150.2	0.14
	60	2.6	0.56	−147.7	0.18
	80	2.8	0.60	−146.1	0.22



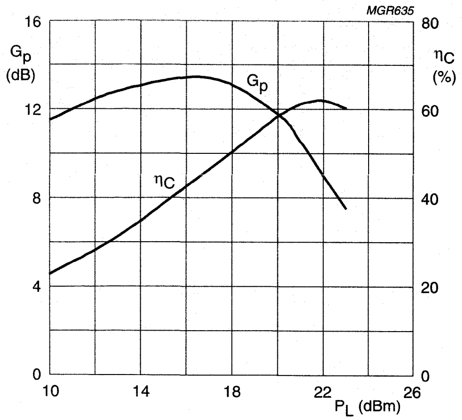
V_{CE} = 2 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.

APPLICATION INFORMATION

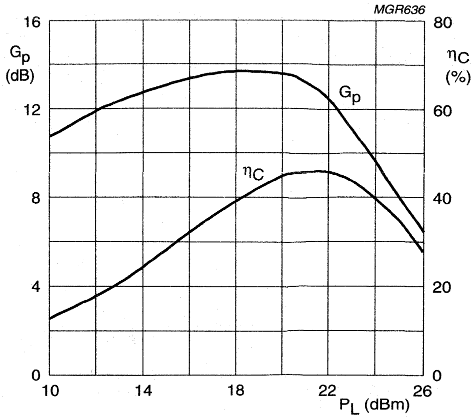
RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see Figs 18 and 19).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (mW)	G_p (dB)	η_C (%)
Pulsed; class-AB; $\delta < 1 : 2$; $t_p = 5$ ms	2	3.6	1	100	typ. 13.5	typ. 45



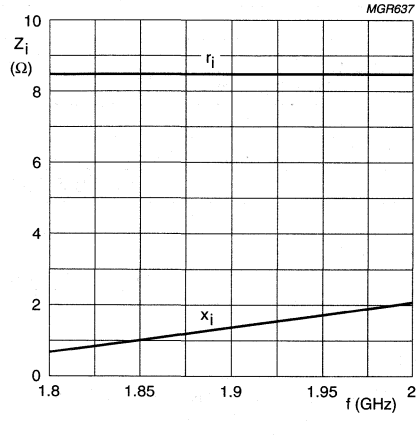
Pulsed, class-AB operation; $\delta < 1$; 2; $t_p = 5$ ms.
f = 2 GHz; $V_{CE} = 2.4$ V; $I_{CQ} = 1$ mA; tuned at $P_L = 100$ mW.

Fig.14 Power gain and collector efficiency as a function of load power; typical values.



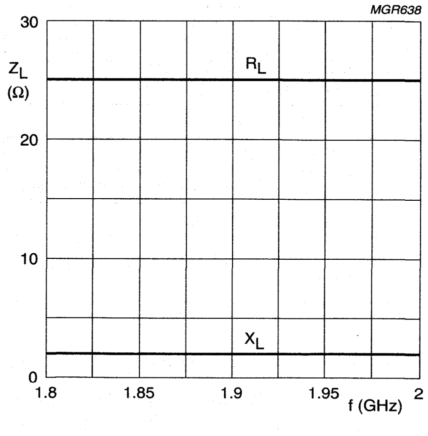
Pulsed, class-AB operation; $\delta < 1$; 2; $t_p = 5$ ms.
f = 2 GHz; $V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; tuned at $P_L = 100$ mW.

Fig.15 Power gain and collector efficiency as a function of load power; typical values.



$V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; $P_L = 100$ mW; $T_s \leq 60$ °C.

Fig.16 Input impedance as function of frequency (series components); typical values.



$V_{CE} = 3.6$ V; $I_{CQ} = 1$ mA; $P_L = 100$ mW; $T_s \leq 60$ °C.

Fig.17 Load impedance as a function of frequency (series components); typical values.

NPN wideband transistor BFG480W

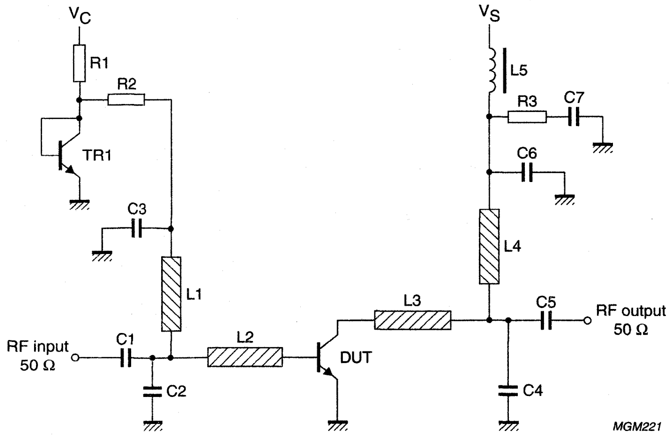


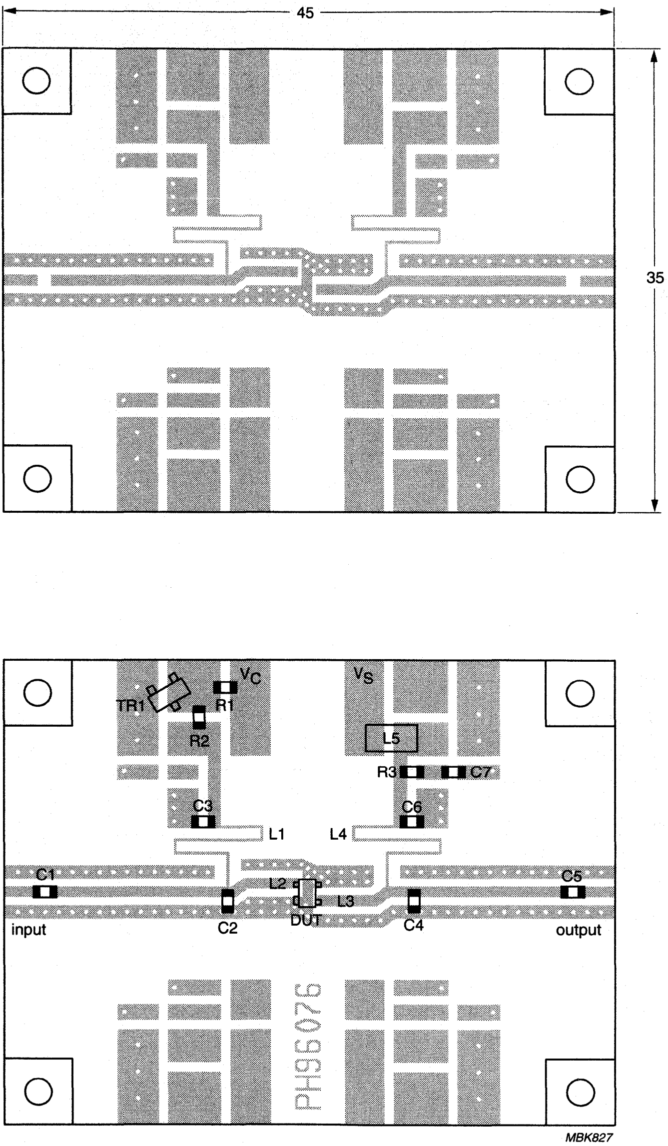
Fig.18 Common emitter test circuit for class-AB operation at 2 GHz.

List of components used in test circuit (see Figs 18 and 19)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C5	multilayer ceramic chip capacitor; note 1	24 pF		
C2, C4	multilayer ceramic chip capacitor; note 1	2 pF		
C3, C6	multilayer ceramic chip capacitor, note 1	15 pF		
C7	multilayer ceramic chip capacitor; note 1	1 nF		
L1, L4	stripline; note 2	100 Ω	18 x 0.2 mm	
L2	stripline; note 2	50 Ω	5 x 0.8 mm	
L3	stripline; note 2	50 Ω	6 x 0.8 mm	
L5	Grade 4S2 Ferroxcube chip bead			4330 030 36300
R1	metal film resistor	220 Ω; 0.4 W		
R2, R3	metal film resistor	10 Ω; 0.4 W		
TR1	NPN transistor	BC817		9335 895 20215

Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 6.15$, $\tan \delta = 0.0019$); thickness 0.64 mm, copper cladding = 35 μm.



Dimensions in mm.

The components are situated on one side of the copper-clad PTFE fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.19 Printed-circuit board and component layout for 2 GHz class-AB test circuit in Fig.18.

NPN 9 GHz wideband transistors

BFG505; BFG505/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

RF front end applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV).

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT143B plastic package.

MARKING

TYPE NUMBER	CODE
BFG505	N33
BFG505/X	N39

PINNING

PIN	DESCRIPTION	
	BFG505	BFG505/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

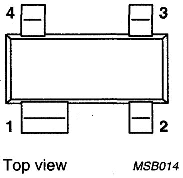


Fig.1 Simplified outline SOT143B.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	collector current (DC)		–	–	18	mA
P_{tot}	total power dissipation	$T_s \leq 130$ °C	–	–	150	mW
h_{FE}	DC current gain	$V_{CE} = 6$ V; $I_C = 5$ mA	60	120	250	
C_{re}	feedback capacitance	$V_{CB} = 6$ V; $I_C = i_c = 0$; f = 1 MHz	–	0.2	–	pF
f_T	transition frequency	$V_{CE} = 6$ V; $I_C = 5$ mA; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$V_{CE} = 6$ V; $I_C = 5$ mA; $T_{amb} = 25$ °C; f = 900 MHz	–	20	–	dB
		$V_{CE} = 6$ V; $I_C = 5$ mA; $T_{amb} = 25$ °C; f = 2 GHz	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	$V_{CE} = 6$ V; $I_c = 5$ mA; $T_{amb} = 25$ °C; f = 900 MHz	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $V_{CE} = 6$ V; $I_c = 1.25$ mA; $T_{amb} = 25$ °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $V_{CE} = 6$ V; $I_c = 5$ mA; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $V_{CE} = 6$ V; $I_c = 1.25$ mA; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	18	mA
P_{tot}	total power dissipation	$T_s \leq 130$ °C; see Fig.2; note 1	–	150	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	290	K/W

Note

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

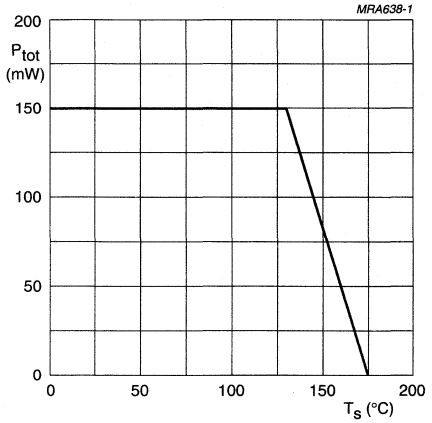


Fig.2 Power derating curve.

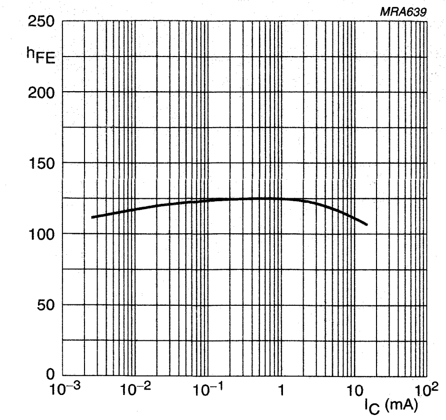
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 6 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V; see Fig.3	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$ V_{EB} = 0.5 V; f = 1 MHz	–	0.4	–	pF
C_c	collector capacitance	V_{CB} = 6 V; $I_E = i_e = 0$; f = 1 MHz	–	0.3	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz; see Fig.4	–	0.2	–	pF
f_T	transition frequency	I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz; see Fig.5	–	9	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	20	–	dB
		I_c = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	I_c = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 5 mA; V_{CE} = 6 V; R_L = 50 Ω; T_{amb} = 25 °C; f = 900 MHz	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

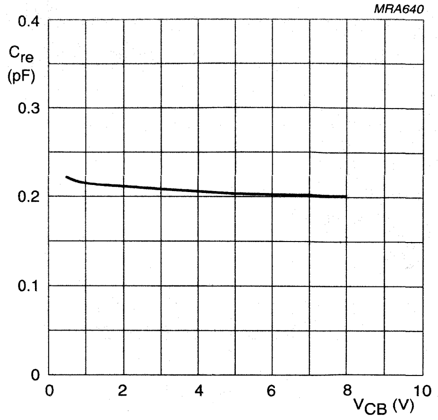
Notes

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. V_{CE} = 6 V; I_C = 5 mA; R_L = 50 Ω; T_{amb} = 25 °C;
   f_p = 900 MHz; f_q = 902 MHz;
   measured at $2f_p - f_q$ = 898 MHz and $2f_q - f_p$ = 904 MHz.



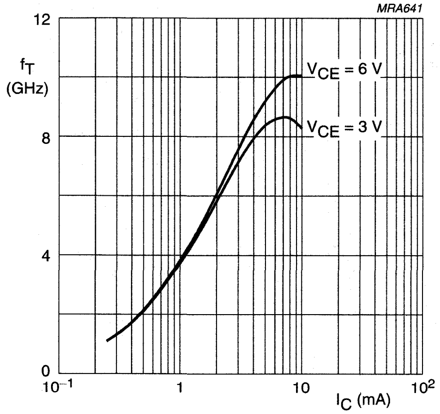
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current.



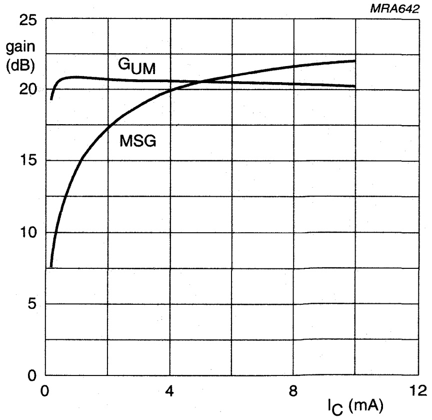
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



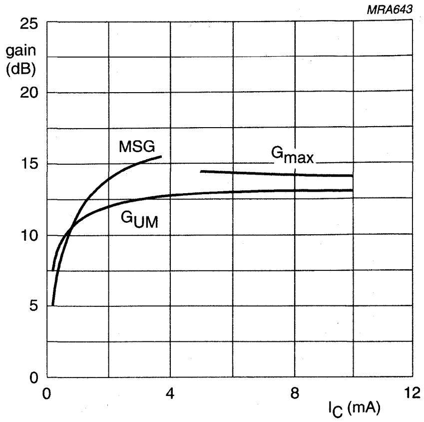
T_{amb} = 25 °C; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current.



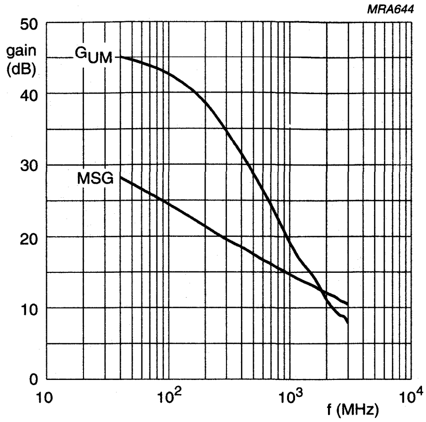
V_{CE} = 6 V; f = 900 MHz.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.6 Gain as a function of collector current.



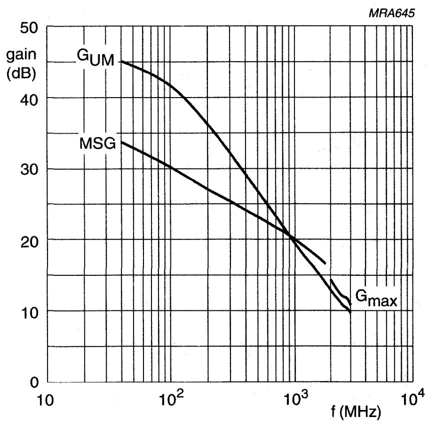
V_{CE} = 6 V; f = 2 GHz.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.7 Gain as a function of collector current.



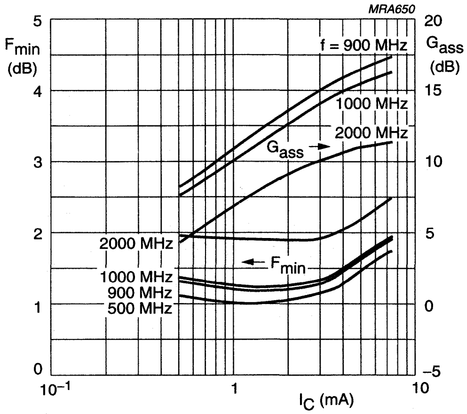
V_{CE} = 6 V; I_C = 1.25 mA.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.8 Gain as a function of frequency.



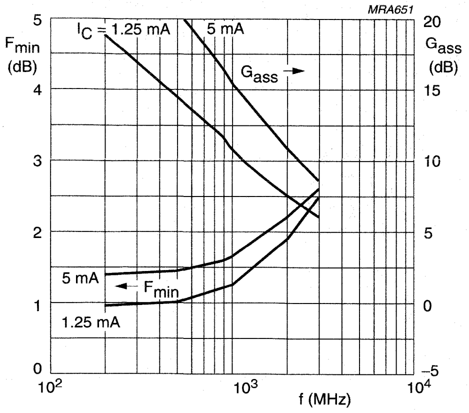
V_{CE} = 6 V; I_C = 5 mA.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain;
G_{max} = maximum available gain.

Fig.9 Gain as a function of frequency.



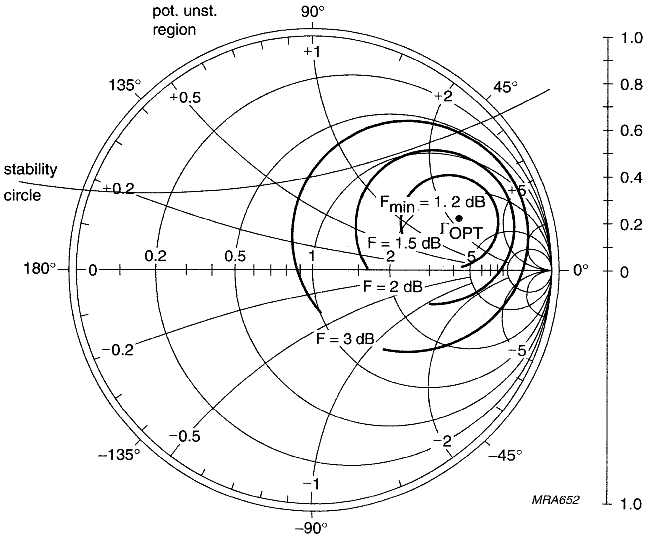
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



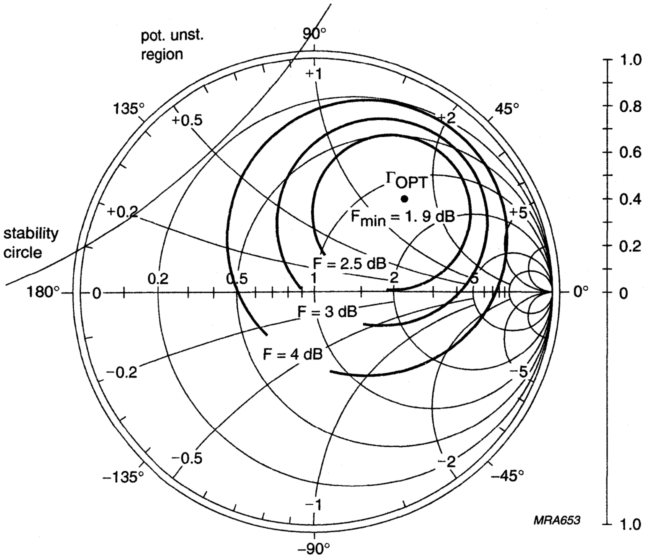
V_{CE} = 6 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.
V_{CE} = 6 V; I_c = 1.25 mA; f = 900 MHz.

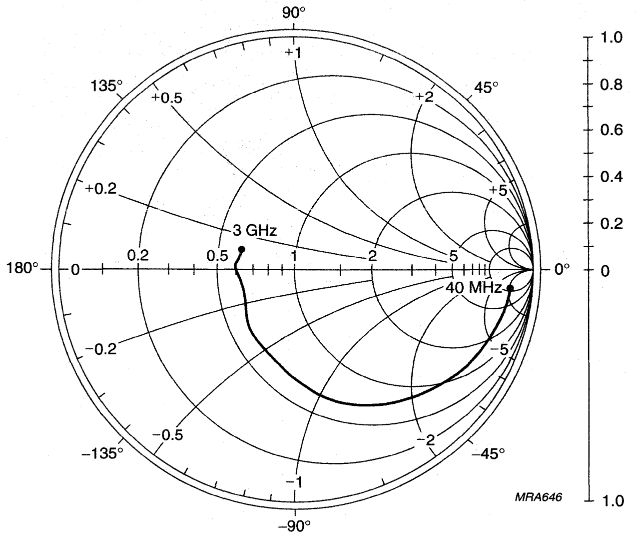
Fig.12 Noise circle figure.



Z_o = 50 Ω.

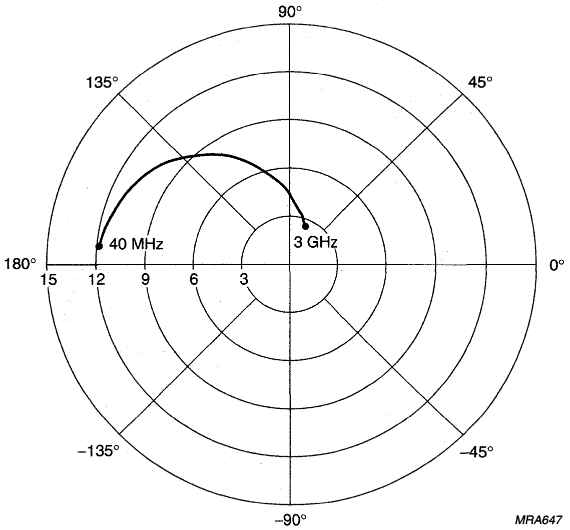
V_{CE} = 6 V; I_c = 1.25 mA; f = 2000 MHz.

Fig.13 Noise circle figure.



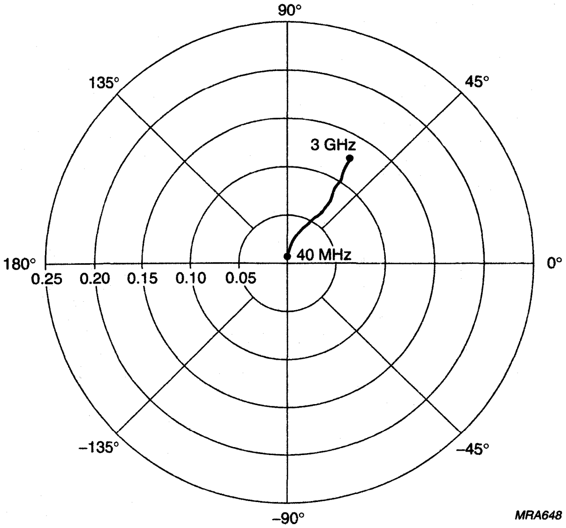
V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



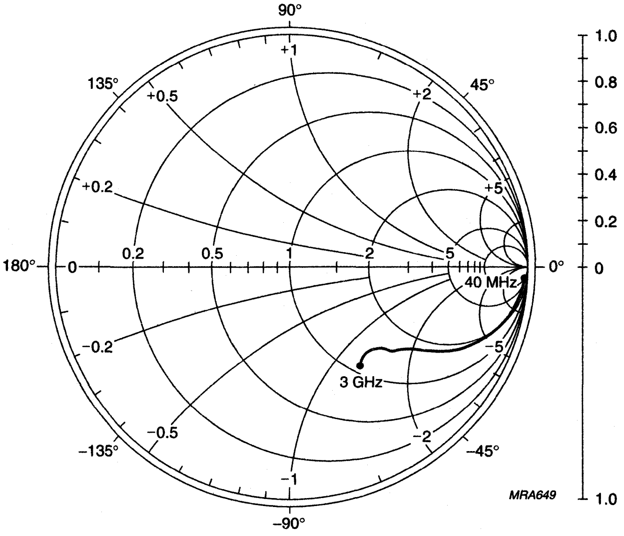
V_{CE} = 6 V; I_C = 5 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



$V_{CE} = 6$ V; $I_C = 5$ mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



$V_{CE} = 6$ V; $I_C = 5$ mA.
$Z_o = 50\ \Omega$.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistors

BFG505W; BFG505W/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

RF front end applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV).

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

MARKING

TYPE NUMBER	CODE
BFG505W	N0
BFG505W/X	N1

PINNING

PIN	DESCRIPTION	
	BFG505W	BFG505W/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

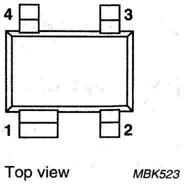


Fig.1 Simplified outline SOT343N.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	collector current (DC)		–	–	18	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.2	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	19	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C		12	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 2 GHz	–	1.9	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	18	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; see Fig.2; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 85$ °C; note 1	180	K/W

Note

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

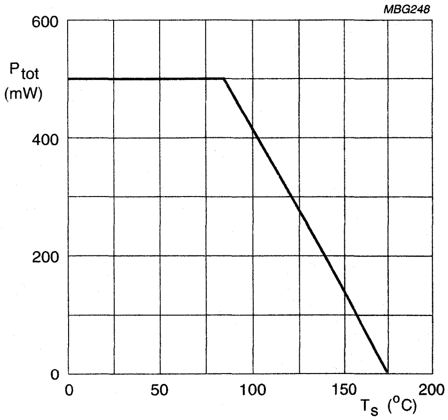


Fig.2 Power derating curve.

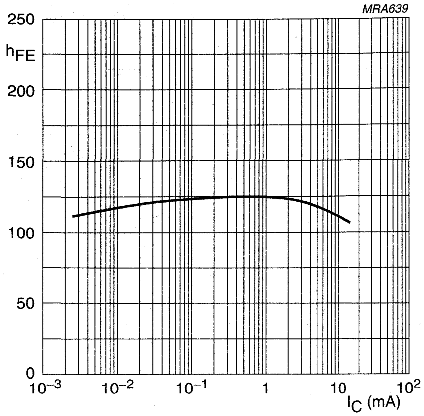
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $R_{BE} = 0$	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector leakage current	$V_{CB} = 6$ V; $I_E = 0$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V see Fig.3	60	120	250	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C; see Fig.5	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz; see Fig.4	–	0.2	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	19	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	12	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

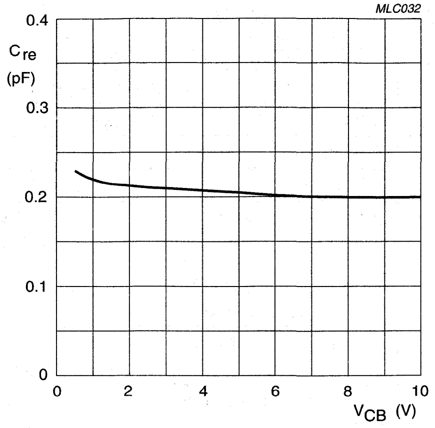
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero. $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $2f_p - f_q = 898$ MHz and $2f_q - f_p = 904$ MHz.



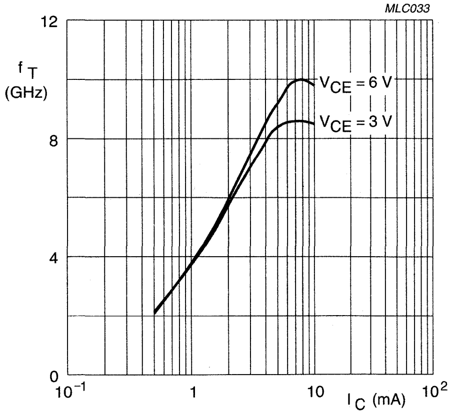
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



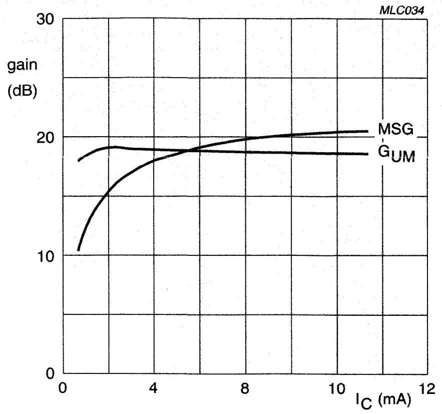
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



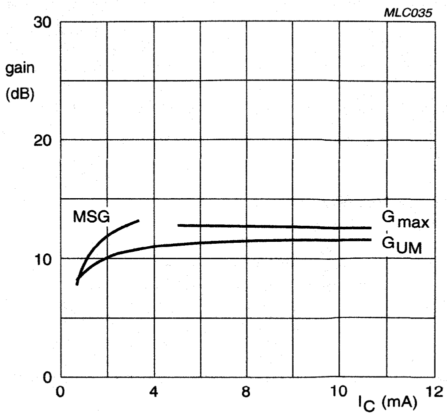
f = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



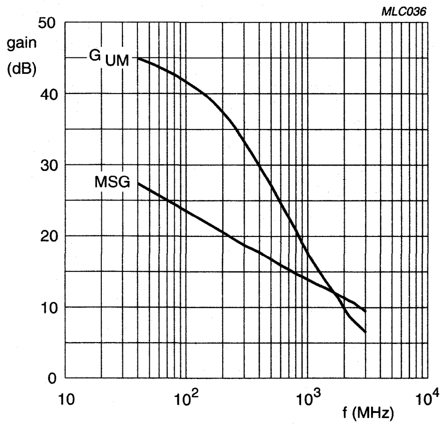
f = 900 MHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



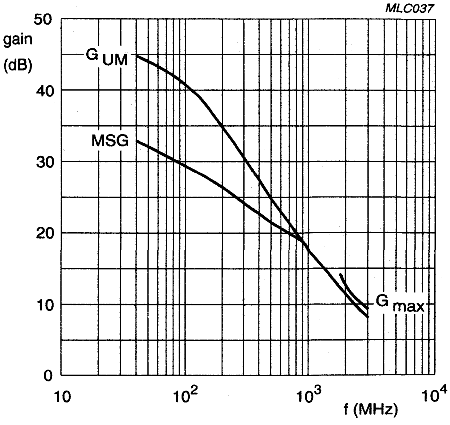
f = 2 GHz; V_{CE} = 6 V.

Fig.7 Gain as a function of collector current; typical values.



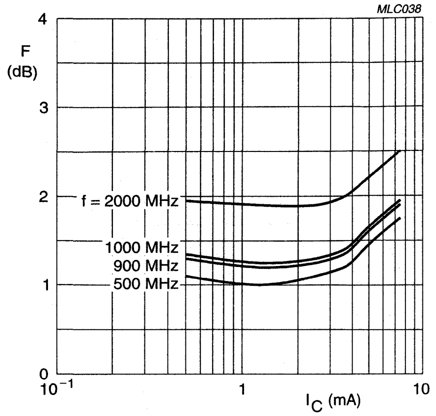
I_C = 1.25 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



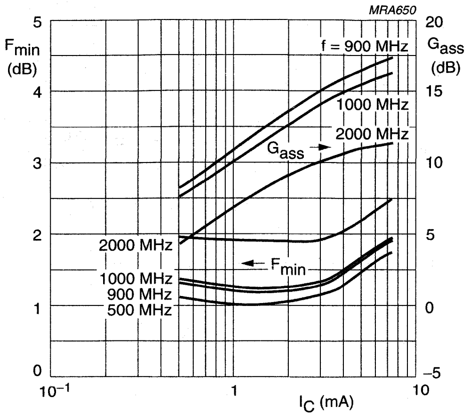
I_C = 5 mA; V_{CE} = 6 V.

Fig.9 Gain as a function of frequency; typical values.



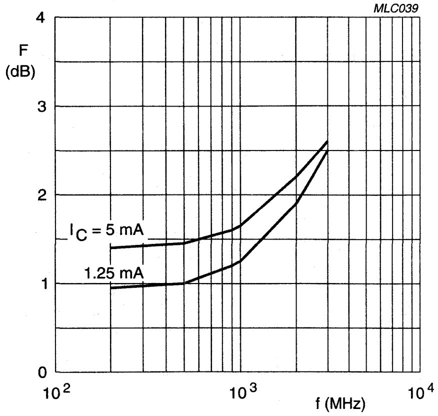
V_{CE} = 6 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



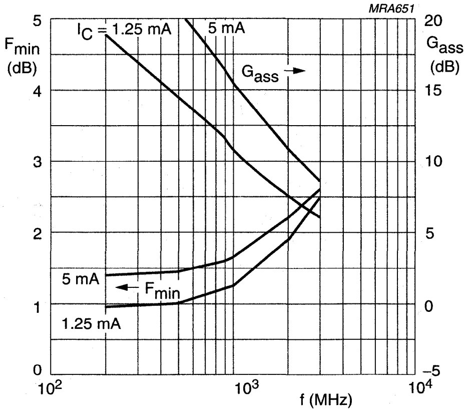
V_{CE} = 6 V.

Fig.11 Associated available gain as a function of collector current; typical values.



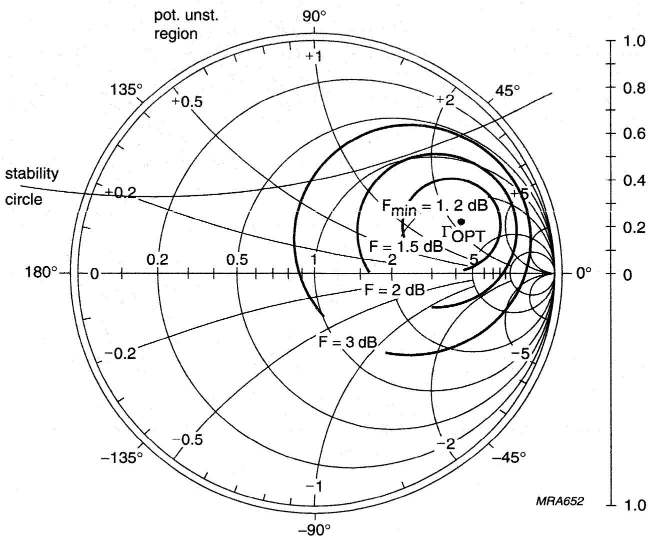
V_{CE} = 6 V.

Fig.12 Minimum noise figure as a function of frequency; typical values.



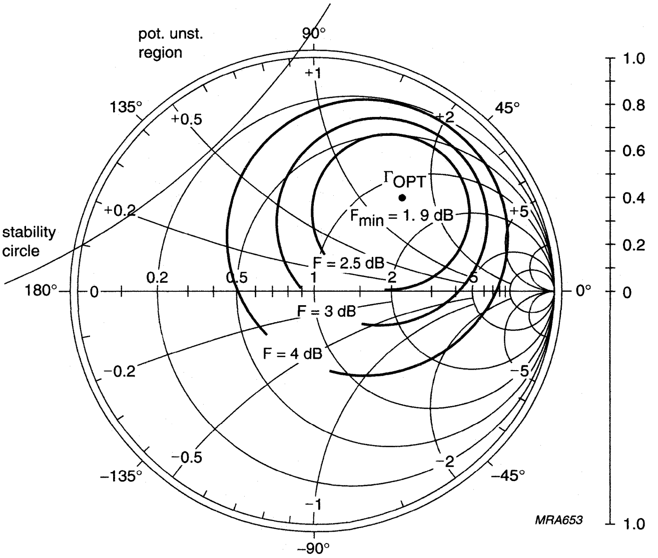
V_{CE} = 6 V.

Fig.13 Associated available gain as a function of frequency; typical values.



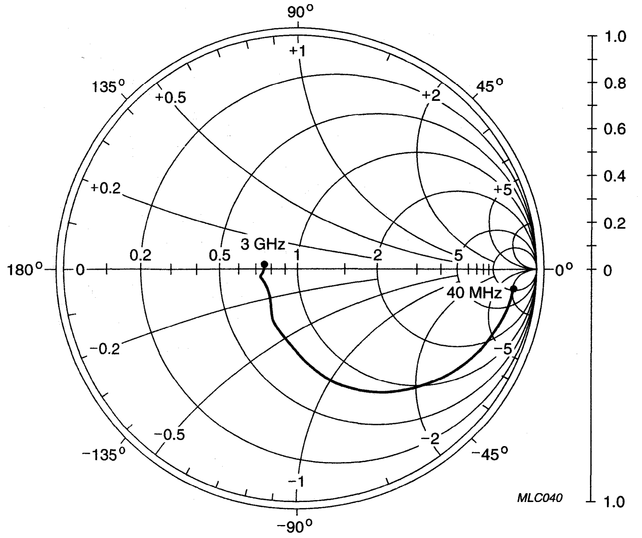
f = 900 MHz; V_{CE} = 6 V; I_C = 1.25 mA; Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



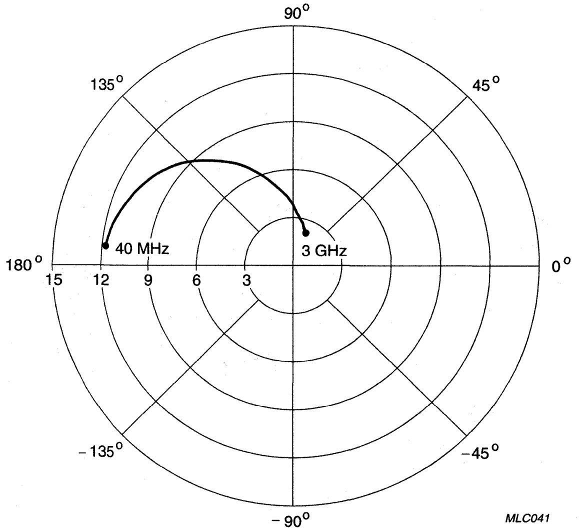
f = 2 GHz; V_{CE} = 6 V; I_C = 1.25 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



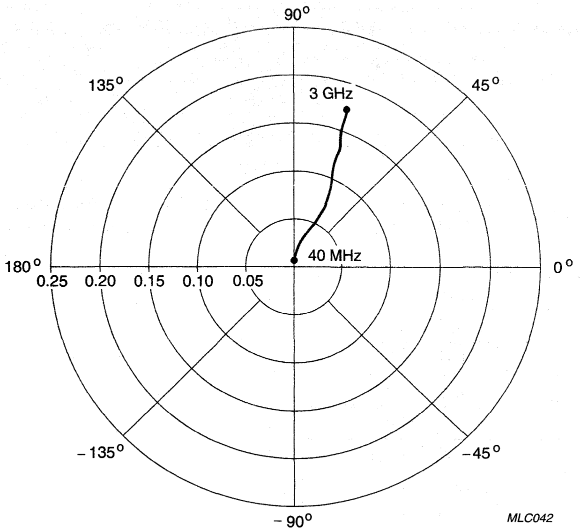
V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}); typical values.



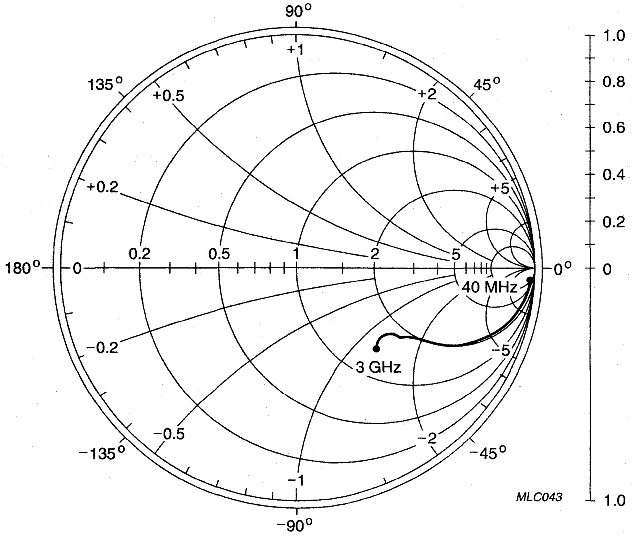
V_{CE} = 6 V; I_C = 5 mA.

Fig.17 Common emitter forward transmission coefficient (S_{21}); typical values.



V_{CE} = 6 ; I_C = 5 mA.

Fig.18 Common emitter reverse transmission coefficient (S_{12}); typical values.



V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

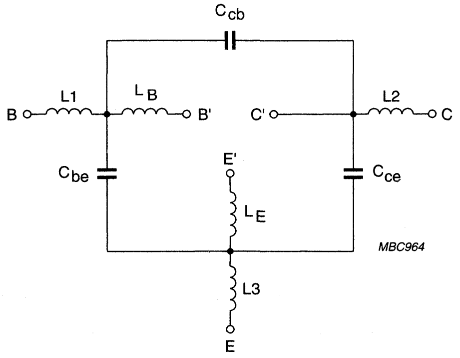
Fig.19 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for the BFG505W(/X) die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	134.1	aA
2	BF	180.0	–
3	NF	0.988	–
4	VAF	38.34	V
5	IKF	150.0	mA
6	ISE	27.81	fA
7	NE	2.051	–
8	BR	55.19	–
9	NR	0.982	–
10	VAR	2.459	V
11	IKR	2.920	mA
12	ISC	17.45	aA
13	NC	1.062	–
14	RB	20.00	Ω
15	IRB	1.000	µA
16	RBM	20.00	Ω
17	RE	1.171	Ω
18	RC	4.350	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	284.7	fF
23	VJE	600.0	mV
24	MJE	0.303	–
25	TF	7.037	ps
26	XTF	12.34	–
27	VTF	1.701	V
28	ITF	30.64	mA
29	PTF	0.000	deg
30	CJC	242.4	fF
31	VJC	188.6	mV
32	MJC	0.041	–
33	XCJC	0.130	–
34	TR	1.332	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.897	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.20 Package equivalent circuit SOT343N.

List of components (see Fig.20)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

NPN 9 GHz wideband transistor BFG520; BFG520/X; BFG520/XR

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistors, intended for applications in the RF frontend in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV) and repeater amplifiers in fibre-optic systems.

The transistors are encapsulated in 4-pin, dual-emitter plastic SOT143 and SOT143R envelopes.

PINNING

PIN	DESCRIPTION
BFG520 (Fig.1) Code: N36	
1	collector
2	base
3	emitter
4	emitter
BFG520/X (Fig.1) Code: N42	
1	collector
2	emitter
3	base
4	emitter
BFG520/XR (Fig.2) Code: N48	
1	collector
2	emitter
3	base
4	emitter

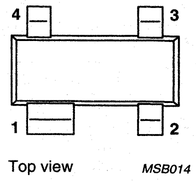


Fig.1 SOT143B.

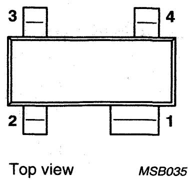


Fig.2 SOT143R.

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		–	–	70	mA
P_{tot}	total power dissipation	up to T_s = 88 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 6 V; T_j = 25 °C	60	120	250	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	19	–	dB
		I_C = 20 mA; V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	17	18	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_c = 5 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	1.9	–	dB

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	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 88 °C; note 1	–	300	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 = 88 °C; note 1	290 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.6	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	19	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	17	18	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm
V_o	output voltage	note 3	–	275	–	mV
d_2	second order intermodulation distortion	$I_C = 20$ mA; $V_{CE} = 6$ V; $V_o = 75$ mV; $T_{amb} = 25$ °C; $f_{(p+q)} = 810$ MHz	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

2. $I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C;
$f_p = 900$ MHz; $f_q = 902$ MHz;
measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.

3. $d_{im} = -60$ dB (DIN 45004B);
$V_p = V_o$; $V_q = V_o -6$ dB; $V_r = V_o -6$ dB;
$f_p = 795.25$ MHz; $f_q = 803.25$ MHz; $f_r = 805.25$ MHz;
measured at $f_{(p+q-r)} = 793.25$ MHz

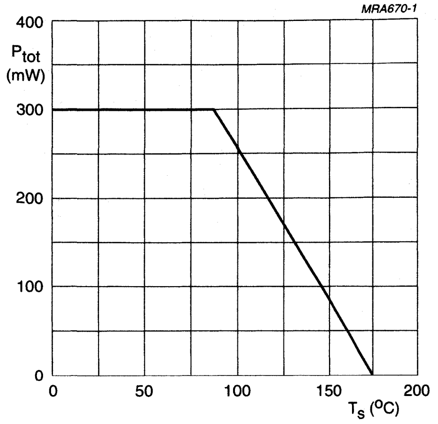
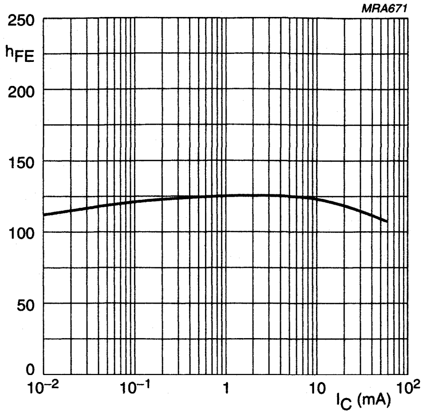
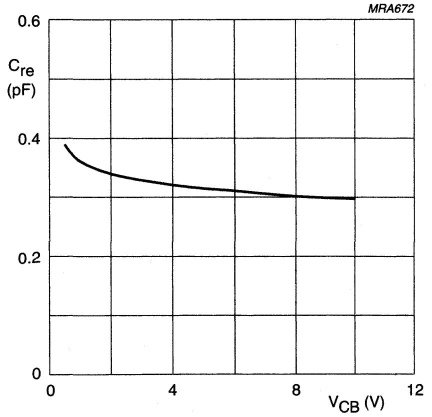


Fig.3 Power derating curve.



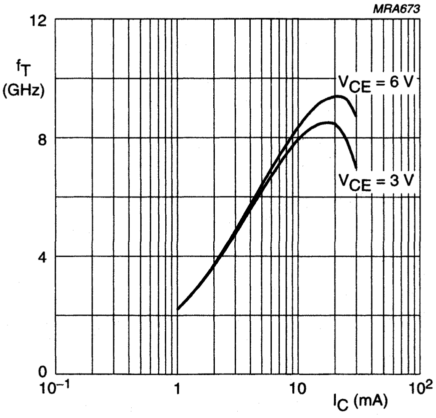
V_{CE} = 6 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

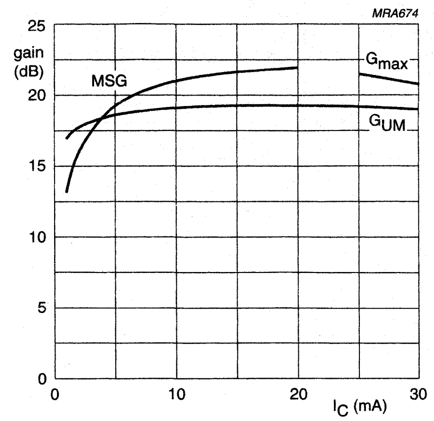
Fig.5 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

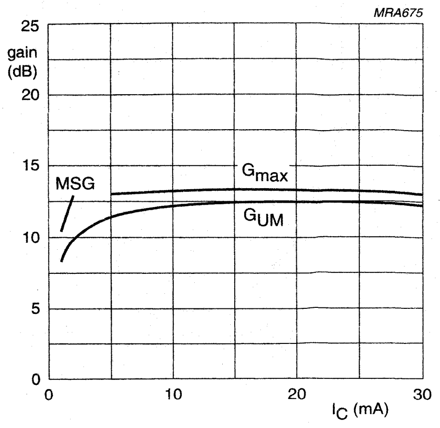
Fig.6 Transition frequency as a function of collector current.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



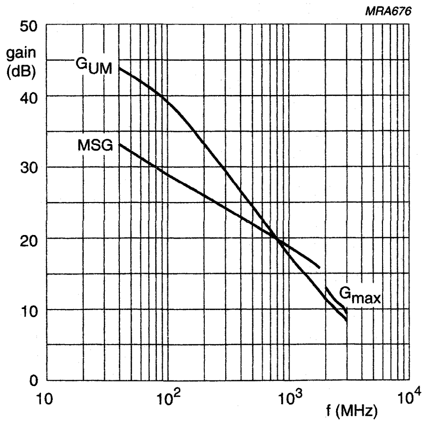
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



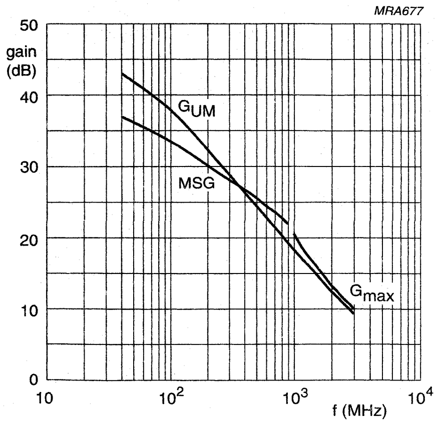
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.8 Gain as a function of collector current.



I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.10 Gain as a function of frequency.

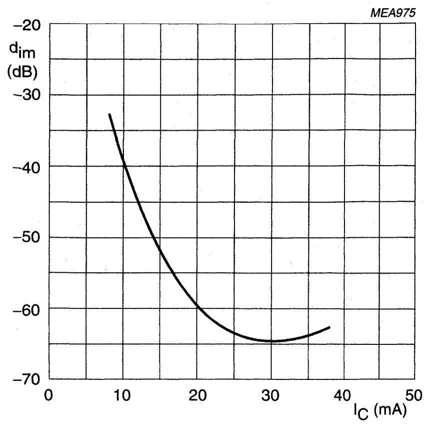


Fig.11 Intermodulation distortion as a function of collector current.

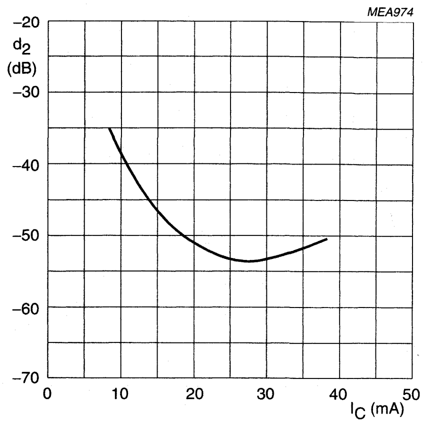
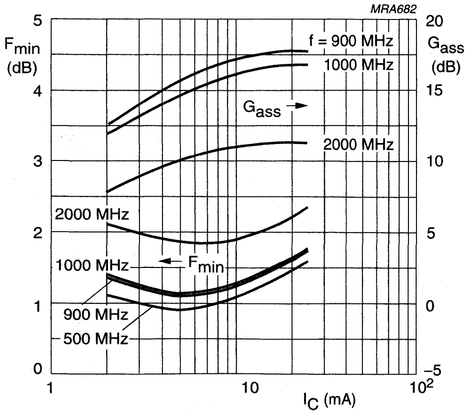
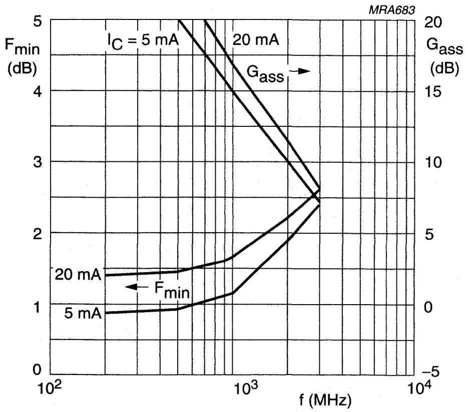


Fig.12 Second order intermodulation distortion as a function of collector current.



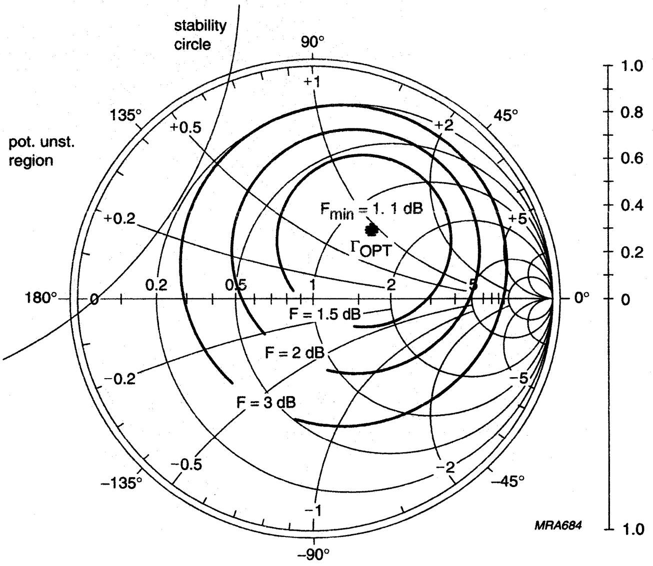
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.



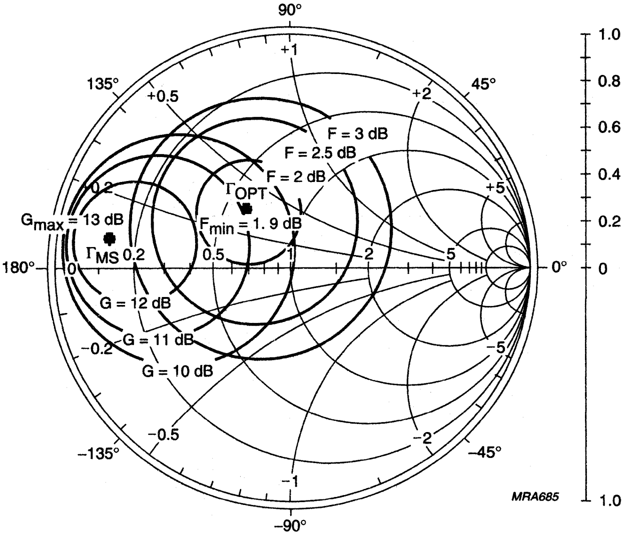
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.14 Minimum noise figure and associated available gain as functions of frequency.



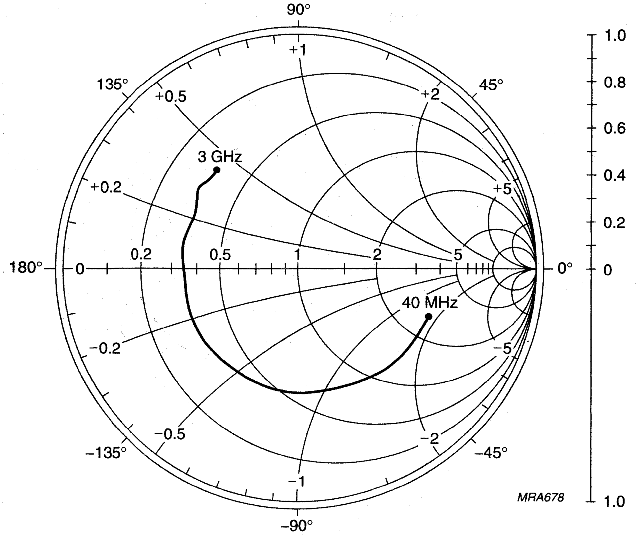
I_C = 5 mA; V_{CE} = 6 V;
f = 900 MHz; Z_o = 50 Ω.

Fig.15 Noise circle figure.



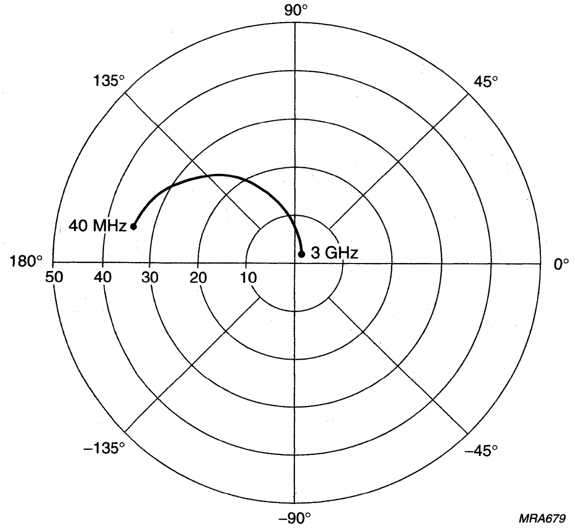
I_C = 5 mA; V_{CE} = 6 V;
f = 2 GHz; Z_o = 50 Ω.

Fig.16 Noise circle figure.



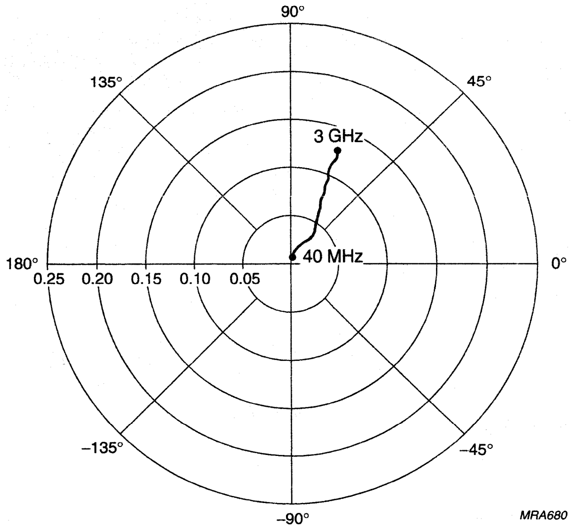
I_C = 20 mA; V_{CE} = 6 V.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



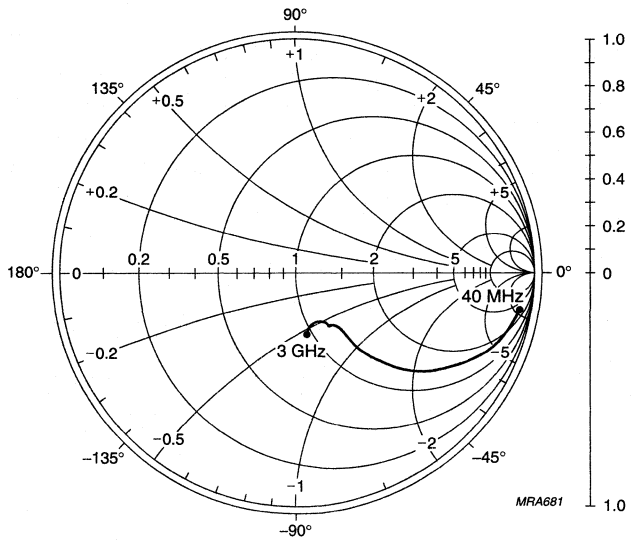
I_C = 20 mA; V_{CE} = 6 V.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 20 mA; V_{CE} = 6 V.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



I_C = 20 mA; V_{CE} = 6 V.
Z_o = 50 Ω.

Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistors BFG520W; BFG520W/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

RF front end wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV) and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

MARKING

TYPE NUMBER	CODE
BFG520W	N3
BFG520W/X	N4

PINNING

PIN	DESCRIPTION	
	BFG250W	BFG250W/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

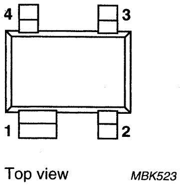


Fig.1 Simplified outline SOT343N.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	collector current (DC)		–	–	70	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz	–	1.1	1.6	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	70	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; see Fig.2; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 85$ °C; note 1	180	K/W

Note

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

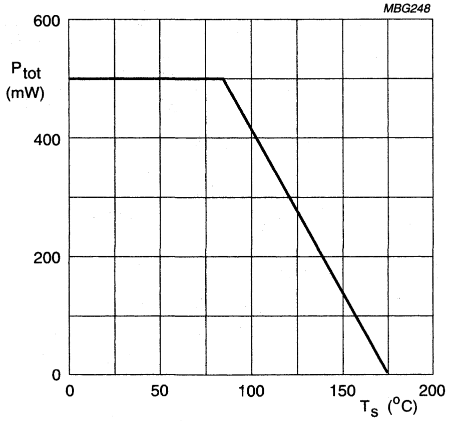


Fig.2 Power derating curve.

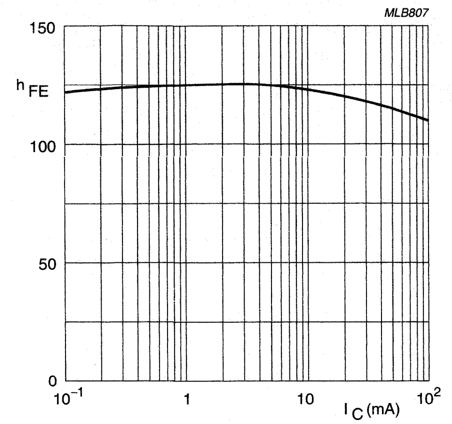
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C =10 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; R_{BE} = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector leakage current	V_{CB} = 6 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 6 V; see Fig.3	60	120	250	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz; see Fig.4	–	0.35	–	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C; see Fig.5	–	9	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	17	–	dB
		I_C = 20 mA; V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C	–	11	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 2 GHz	–	1.85	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; R_L = 50 Ω; T_{amb} = 25 °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm
V_o	output voltage	note 3	–	275	–	mV
d_2	second order intermodulation distortion	note 4	–	−50	–	dB

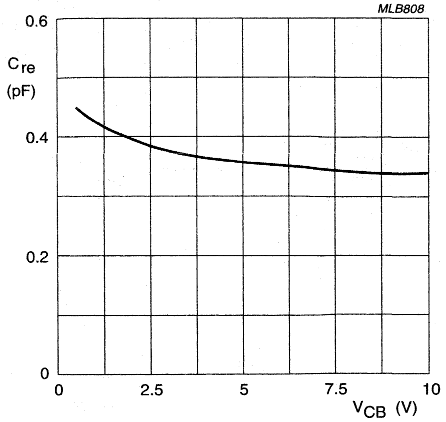
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero. $G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{(1-\lvert S_{11}\rvert^2)(1-\lvert S_{22}\rvert^2)}$ dB.
2. I_C = 20 mA; V_{CE} = 6 V; R_L = 50 Ω; T_{amb} = 25 °C;
   f_p = 900 MHz; f_q = 902 MHz; measured at $2f_p - f_q$ = 898 MHz and $2f_q - f_p$ = 904 MHz.
3. d_{im} = −60 dB (DIN45004B); I_C = 20 mA; V_{CE} = 6 V; $V_p = V_o$; $V_q = V_o$ −6 dB; $V_r = V_o$ −6 dB; R_L = 75 Ω;
   f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_p + f_q - f_r$ = 793.25 MHz.
4. I_C = 20 mA; V_{CE} = 6 V; V_o = 75 mV; R_L = 75 Ω; T_{amb} = 25 °C;
   f_p = 250 MHz; f_q = 560 MHz; measured at $f_p + f_q$ = 810 MHz.



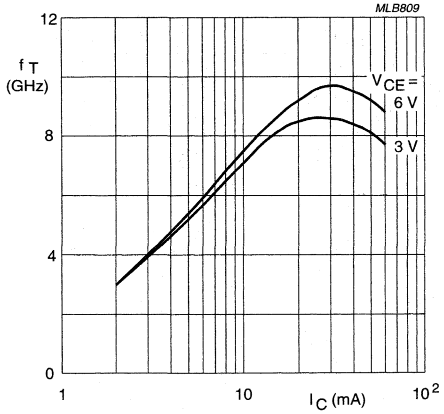
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



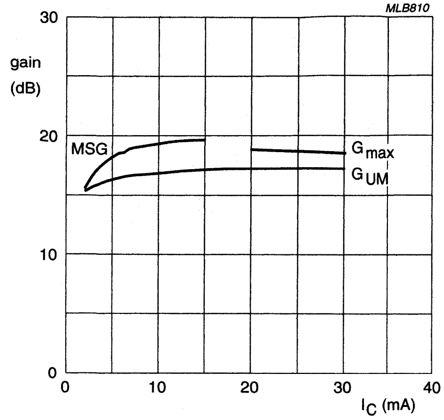
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



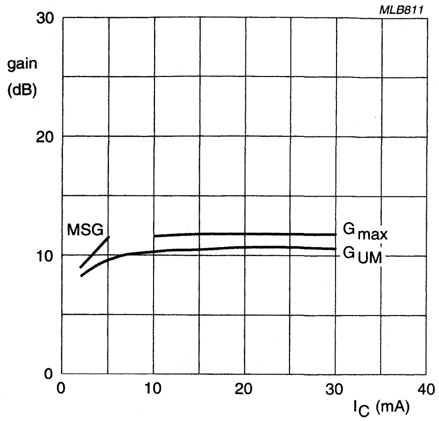
f = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



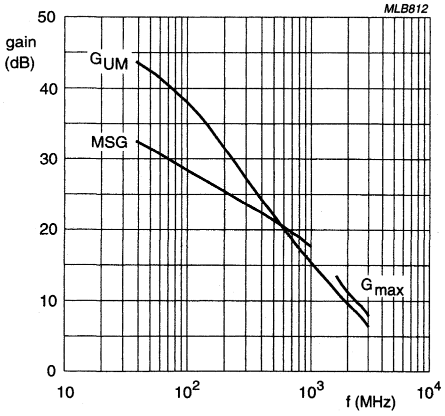
f = 900 MHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



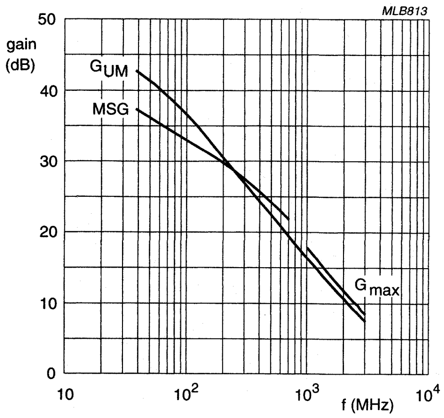
f = 2 GHz; V_{CE} = 6 V.

Fig.7 Gain as a function of collector current; typical values.



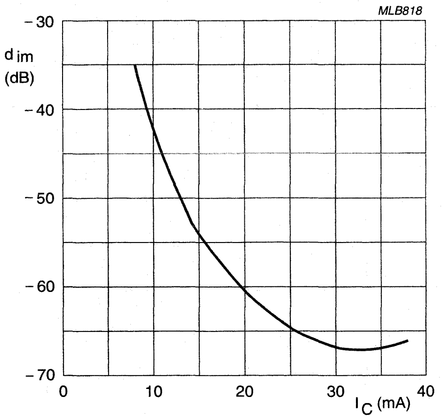
I_C = 5 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



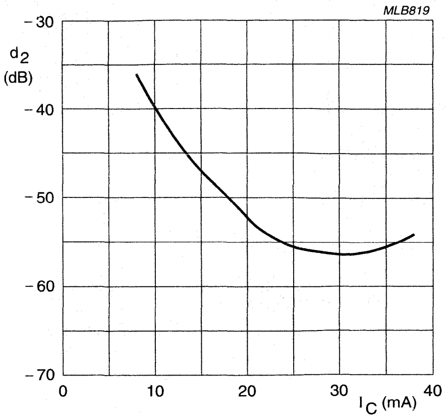
I_C = 20 mA; V_{CE} = 6 V.

Fig.9 Gain as a function of frequency; typical values.



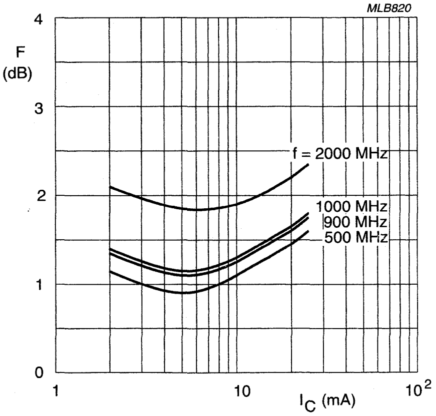
V_o = 275 mV; $f_p + f_q - f_r$ = 793.25 MHz; V_{CE} = 6 V;
R_L = 75 Ω; T_{amb} = 25 °C.

Fig.10 Intermodulation distortion as a function of collector current; typical values.



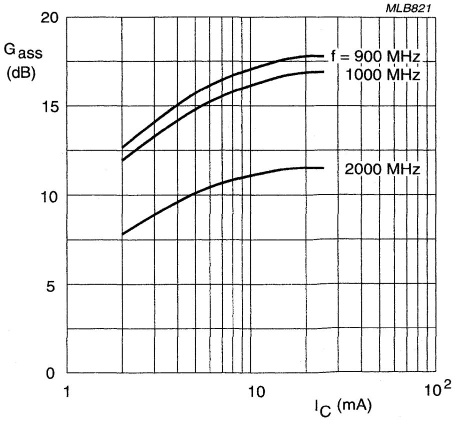
V_o = 75 mV; $f_p + f_q$ = 810 MHz; V_{CE} = 6 V;
R_L = 75 Ω T_{amb} = 25 °C.

Fig.11 Second order intermodulation distortion as a function of collector current; typical values.



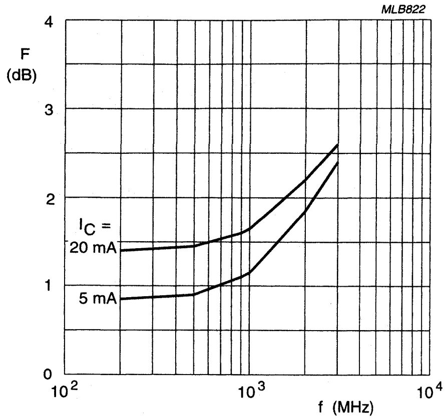
V_{CE} = 6 V.

Fig.12 Minimum noise figure as a function of collector current; typical values.



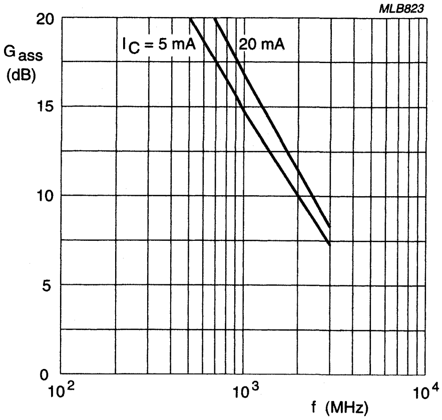
V_{CE} = 6 V.

Fig.13 Associated available gain as a function of collector current; typical values.



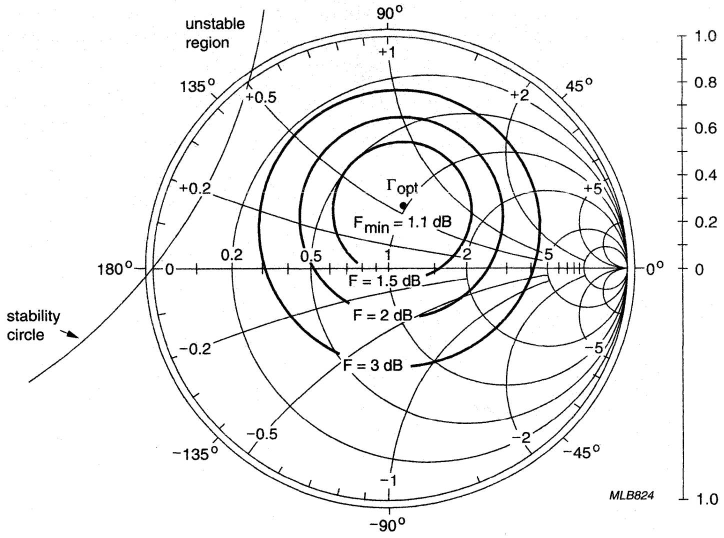
V_{CE} = 6 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



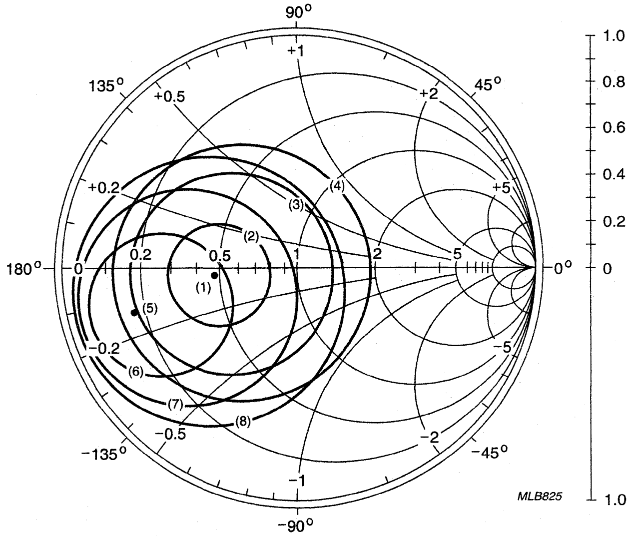
V_{CE} = 6 V.

Fig.15 Associated available gain as a function of frequency; typical values.



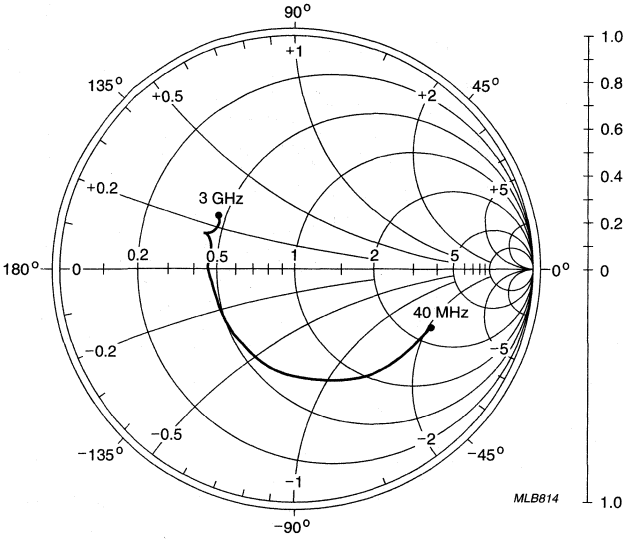
$f = 900$ MHz; $V_{CE} = 6$ V; $I_C = 5$ mA; $Z_o = 50\ \Omega$.

Fig.16 Common emitter noise figure circles; typical values.



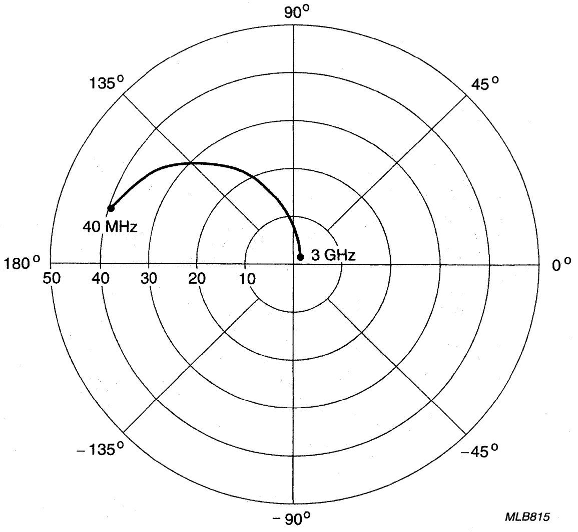
(1) Γ_{opt}; $F_{min} = 1.85$ dB.
(2) F = 2 dB.
(3) F = 2.5 dB.
(4) F = 3 dB.
(5) Γ_{ms}; $G_{max} = 11.8$ dB.
(6) G = 11 dB.
(7) G = 10 dB.
(8) G = 9 dB.
$f = 2$ GHz; $V_{CE} = 6$ V; $I_C = 5$ mA; $Z_o = 50\ \Omega$.

Fig.17 Common emitter noise figure circles; typical values.



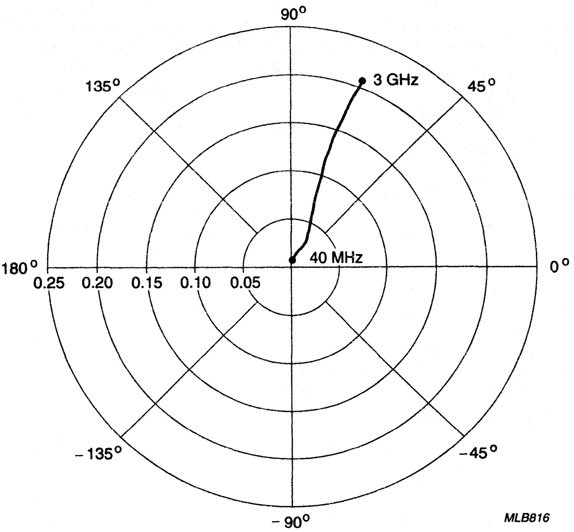
V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

Fig.18 Common emitter input reflection coefficient (S_{11}); typical values.



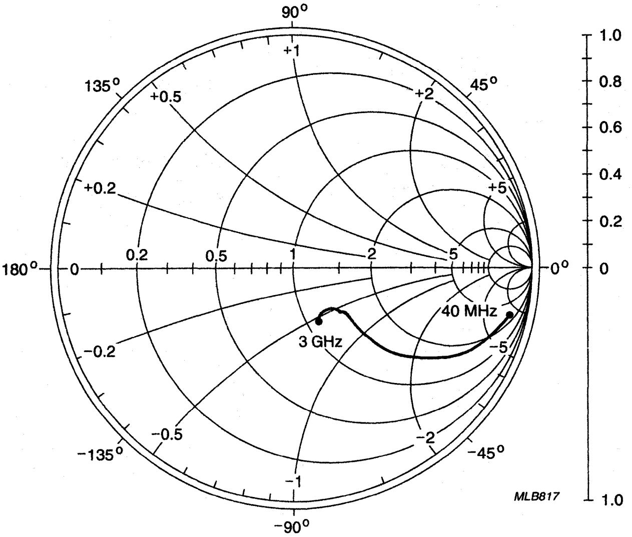
V_{CE} = 6 V; I_C = 20 mA.

Fig.19 Common emitter forward transmission coefficient (S_{21}); typical values.



V_{CE} = 6 V; I_C = 20 mA.

Fig.20 Common emitter reverse transmission coefficient (S_{12}); typical values.



V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

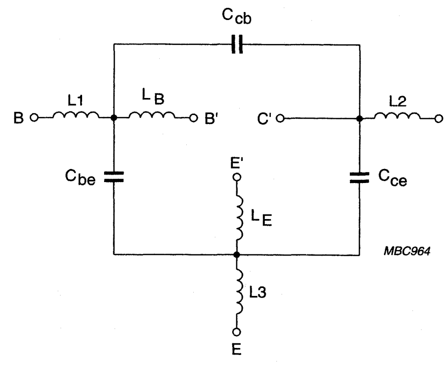
Fig.21 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for the BFG520W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510	mA
6	ISE	283	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	775.3	mΩ
18	RC	2.210	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.070	–
33	XCJC	0.130	–
34	TR	543.7	ps
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.22 Package equivalent circuit SOT343N.

List of components (see Fig.22)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

NPN 9 GHz wideband transistor

BFG540; BFG540/X; BFG540/XR

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistors, intended for wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optical systems.

The transistors are mounted in plastic SOT143B and SOT143R packages.

PINNING

PIN	DESCRIPTION
BFG540 (Fig.1) Code: N37	
1	collector
2	base
3	emitter
4	emitter
BFG540/X (Fig.1) Code: N43	
1	collector
2	emitter
3	base
4	emitter
BFG540/XR (Fig.2) Code: N49	
1	collector
2	emitter
3	base
4	emitter

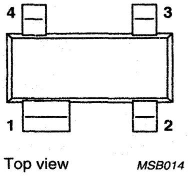


Fig.1 SOT143B.

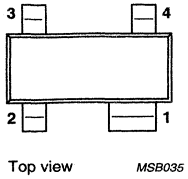


Fig.2 SOT143R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to $T_s = 60$ °C; note 1	–	–	400	mW
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_j = 25$ °C	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 8$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	18	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	11	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	2.1	–	dB

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to $T_s = 60$ °C (note 1)	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 60$ °C note 1	290	K/W

Note

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

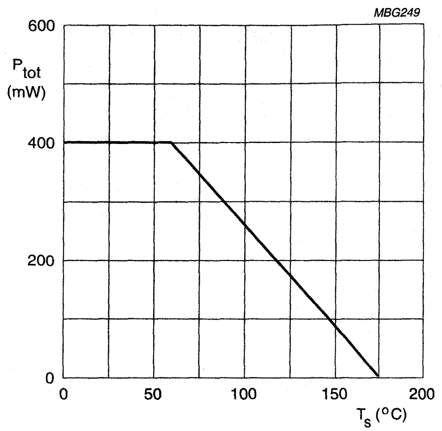
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 8$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	18	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	11	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_O	output voltage	note 3	–	500	–	mV
d_2	second order intermodulation distortion	note 4	–	–50	–	dB

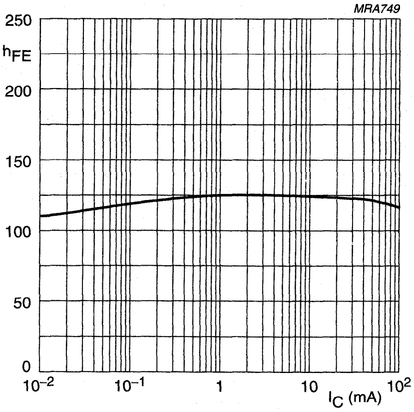
Notes

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. $V_{CE} = 8$ V; $I_C = 40$ mA; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 40$ mA; $V_{CE} = 8$ V; $Z_L = Z_S = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$; $V_q = V_O - 6$ dB; $V_r = V_O - 6$ dB;
   $f_p = 795.25$ MHz; $f_q = 803.25$ MHz; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz.
4. $I_C = 40$ mA; $V_{CE} = 8$ V; $V_O = 275$ mV; $T_{amb} = 25$ °C;
   $f_p = 250$ MHz; $f_q = 560$ MHz; measured at $f_{(p+q)} = 810$ MHz.



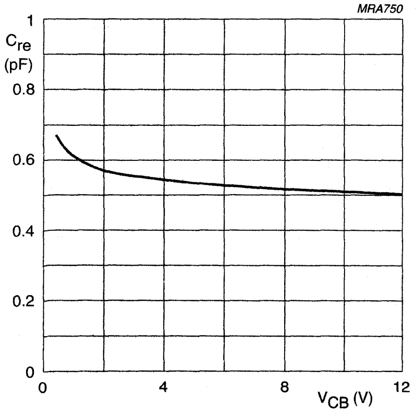
$V_{CE} \leq 10$ V.

Fig.3 Power derating curve.



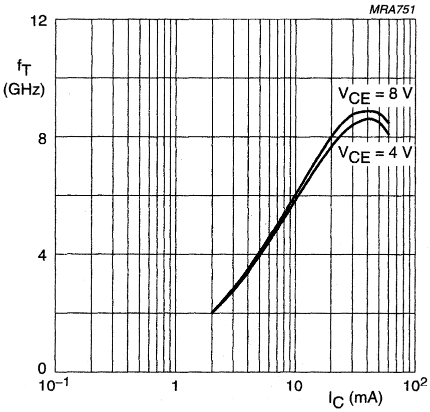
$V_{CE} = 8$ V; $T_j = 25$ °C.

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



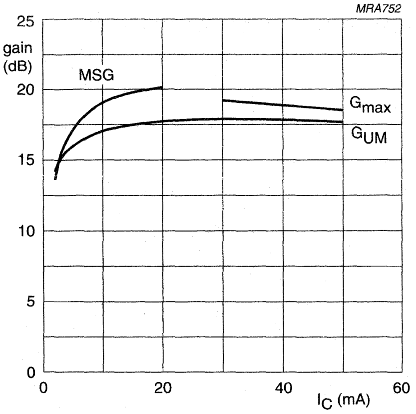
$I_C = 0$; f = 1 MHz.

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



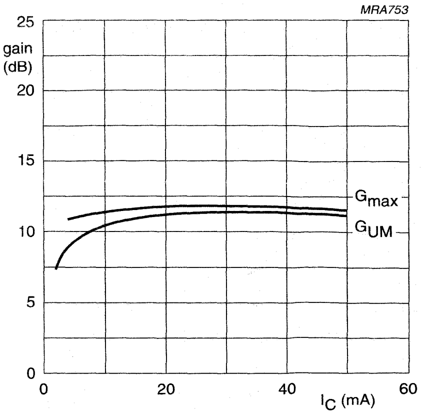
f = 1 GHz; $T_{amb} = 25$ °C.

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



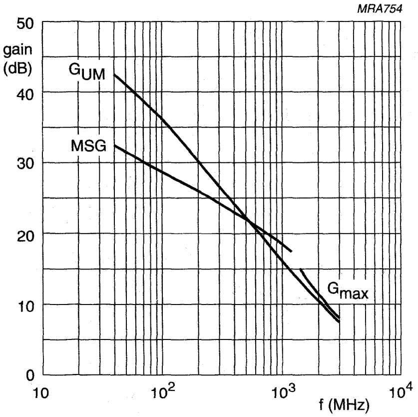
V_{CE} = 8 V; f = 900 MHz.
MSG = maximum stable gain; G_{max} = maximum available gain;
G_{UM} = maximum unilateral power gain.

Fig.7 Gain as a function of collector current.



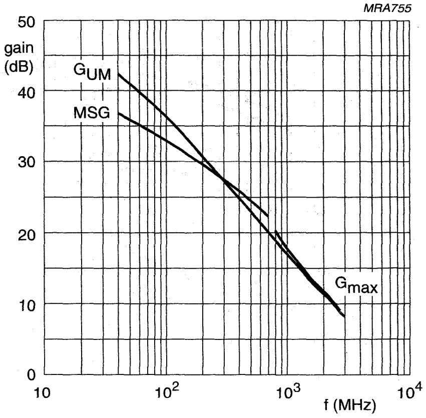
V_{CE} = 8 V; f = 2 GHz.
G_{max} = maximum available gain;
G_{UM} = maximum unilateral power gain.

Fig.8 Gain as a function of collector current.



I_C = 10 mA; V_{CE} = 8 V.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain; G_{max} = maximum available gain.

Fig.9 Gain as a function of frequency.



I_C = 40 mA; V_{CE} = 8 V.
G_{UM} = maximum unilateral power gain;
MSG = maximum stable gain; G_{max} = maximum available gain.

Fig.10 Gain as a function of frequency.

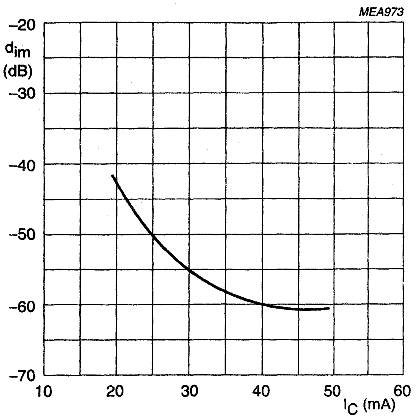


Fig.11 Intermodulation distortion as a function of collector current.

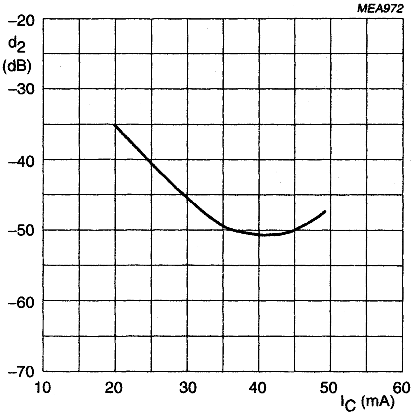
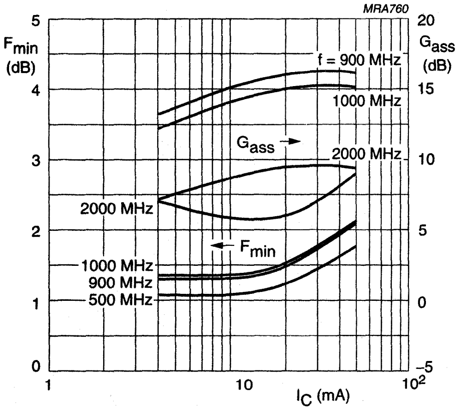
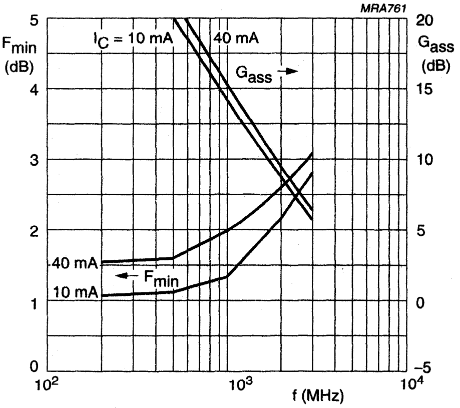


Fig.12 Second order intermodulation distortion as a function of collector current.



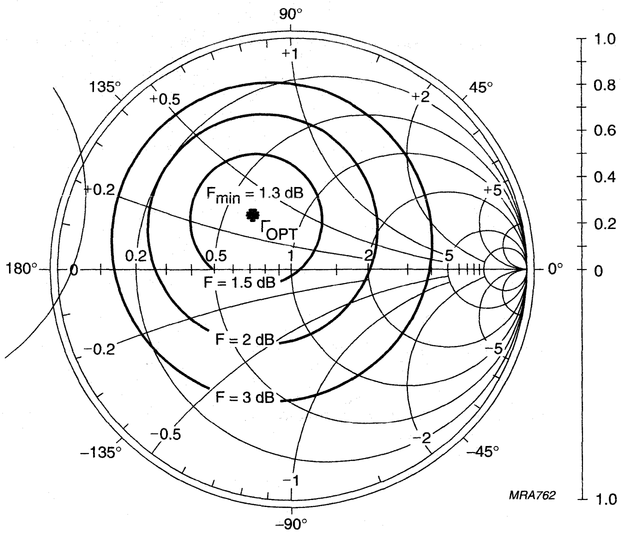
V_{CE} = 8 V.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.



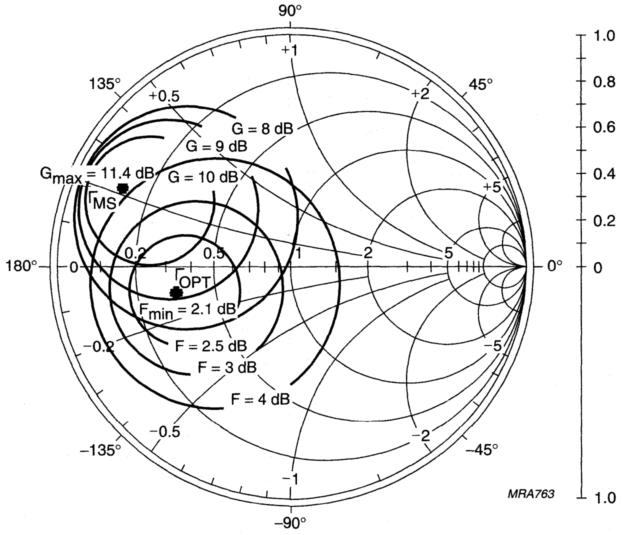
V_{CE} = 8 V.

Fig.14 Minimum noise figure and associated available gain as functions of frequency.



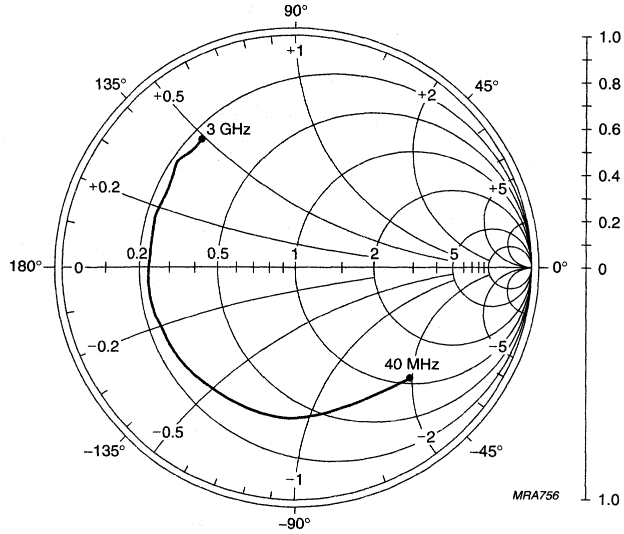
I_C = 10 mA; V_{CE} = 8 V; Z_o = 50 Ω; f = 900 MHz.

Fig.15 Noise circle figure.



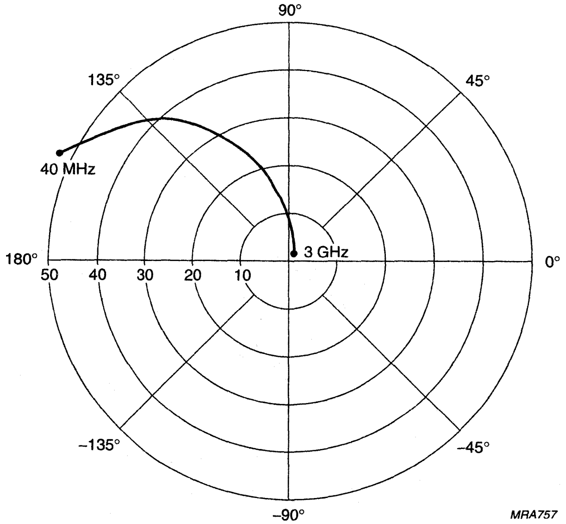
I_C = 10 mA; V_{CE} = 8 V; Z_o = 50 Ω; f = 2 GHz.

Fig.16 Noise circle figure.



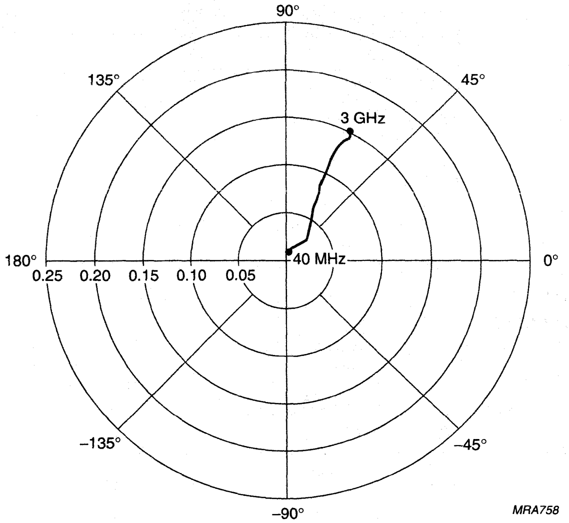
I_C = 40 mA; V_{CE} = 8 V; Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



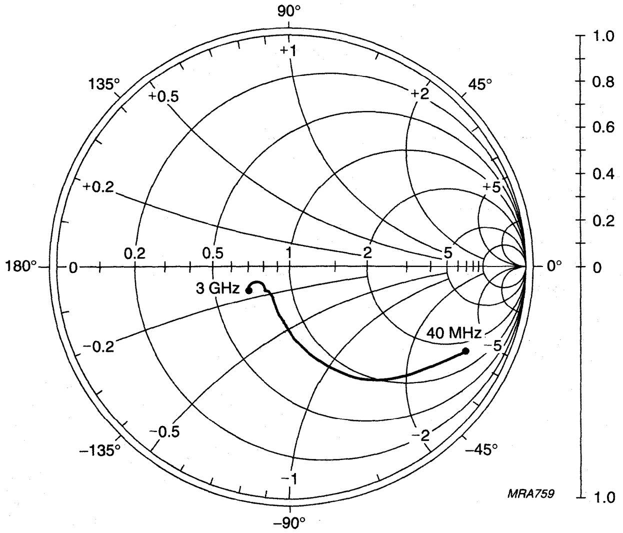
I_C = 40 mA; V_{CE} = 8 V.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 40 mA; V_{CE} = 8 V.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



I_C = 40 mA; V_{CE} = 8 V; Z_o = 50 Ω.

Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor

BFG540W
BFG540W/X; BFG540W/XR

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

They are intended for applications in the RF front end, in wideband applications in the GHz range such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343N and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG540W	N9
BFG540W/X	N7
BFG540W/XR	N8

PINNING

PIN	DESCRIPTION
BFG540W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG540W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG540W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

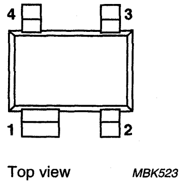


Fig.1 SOT343N.

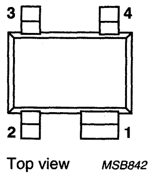


Fig.2 SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	collector current (DC)		–	–	120	mA
P_{tot}	total power dissipation	up to $T_s = 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C		10	–	dB
$\|s_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	14	15	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 2 GHz	–	2.1	–	dB

LIMITING VALUES

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

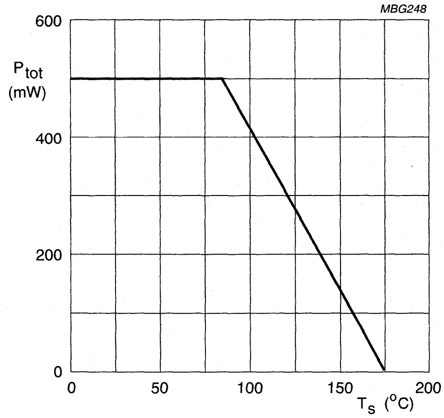
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	120	mA
P_{tot}	total power dissipation	up to T_s = 85 °C; see Fig.3; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 85 °C; note 1	180	K/W

Note to the "Limiting values" **and** "Thermal characteristics"

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



$V_{CE} \leq 10$ V.

Fig.3 Power derating curve.

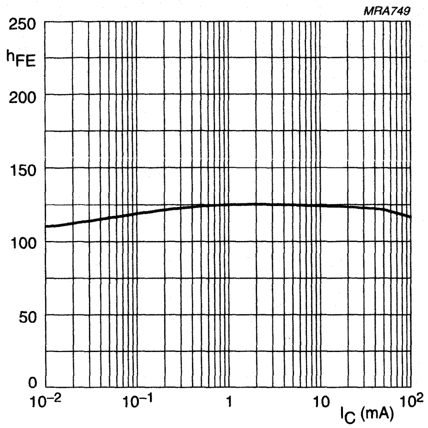
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA ; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 40 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 100 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector cut-off current	open emitter; V_{CB} = 8 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	60	120	250	
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 40 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	14	15	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 2 GHz	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; R_L = 50 Ω; T_{amb} = 25 °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_o	output voltage	note 3	–	500	–	mV
d_2	second order intermodulation distortion	note 4	–	–50	–	dB

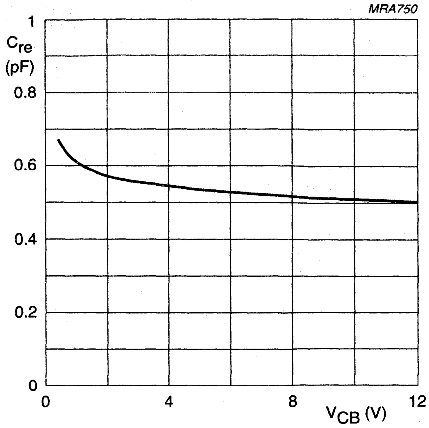
Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.
2. I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; T_{amb} = 25 °C;
   a) f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 898 MHz and $f_{(2q-p)}$ = 904 MHz.
3. d_{im} = –60 dB (DIN45004B); $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB; R_L = 75 Ω; V_{CE} = 8 V; I_C = 40 mA;
   a) f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_{(p+q-r)}$ = 793.25 MHz.
4. I_C = 40 mA; V_{CE} = 8 V; V_o = 275 mV; R_L = 75 Ω; T_{amb} = 25 °C;
   a) f_p = 250 MHz; f_q = 560 MHz; measured at $f_{(p+q)}$ = 810 MHz.



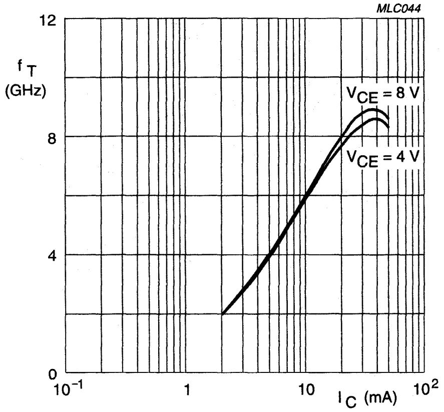
V_{CE} = 8 V.

Fig.4 DC current gain as a function of collector current; typical values.



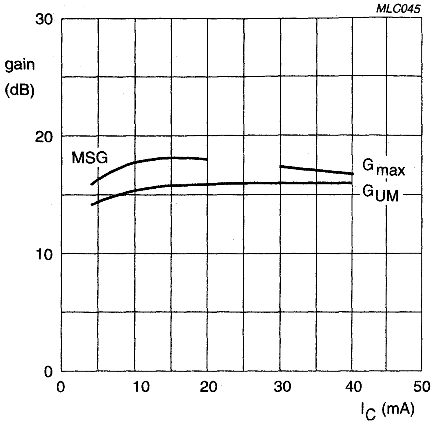
I_C = 0; f = 1 MHz.

Fig.5 Feedback capacitance as a function of collector-base voltage; typical values.



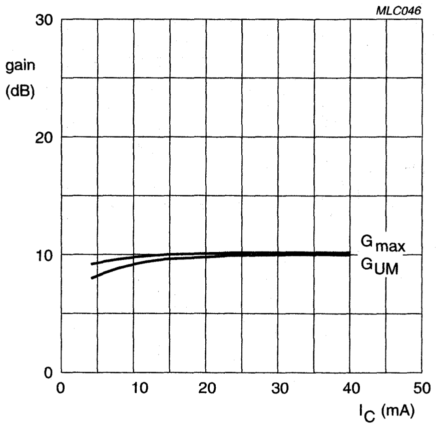
f = 1 GHz; T_{amb} = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



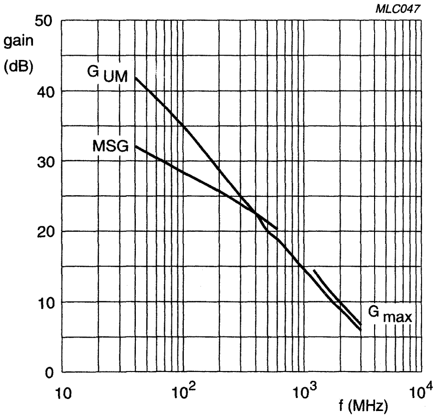
f = 900 MHz; V_{CE} = 8 V.

Fig.7 Gain as a function of collector current; typical values.



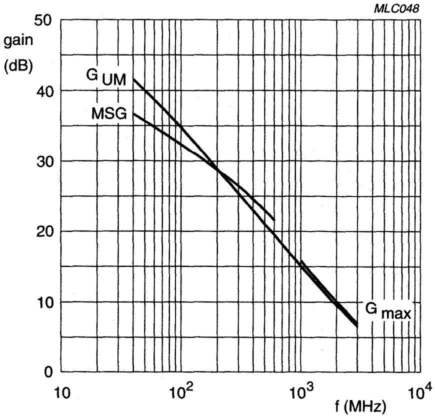
f = 2 GHz; V_{CE} = 8 V.

Fig.8 Gain as a function of collector current; typical values.



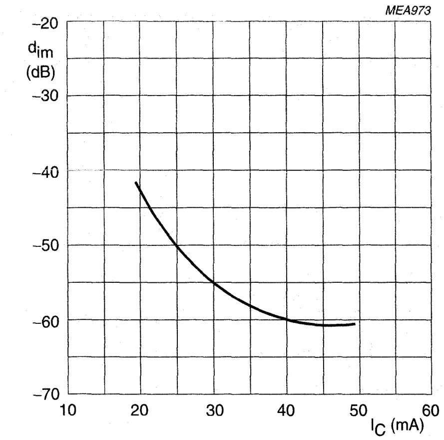
I_C = 10 mA; V_{CE} = 8 V.

Fig.9 Gain as a function of frequency; typical values.



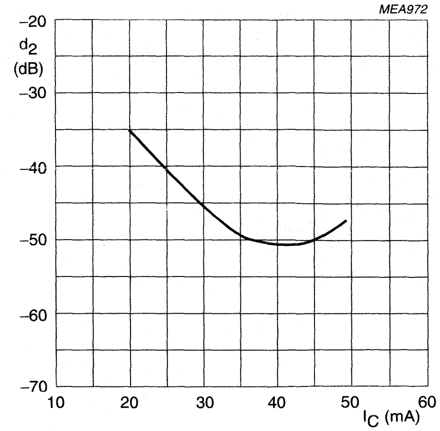
I_C = 40 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.



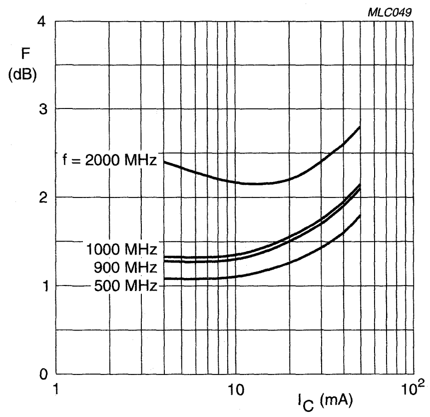
V_o = 500 mV; $f_{(p+q-r)}$ = 793.25 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



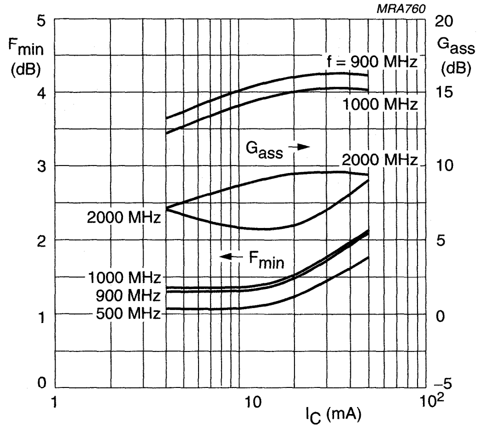
V_o = 275 mV; $f_{(p+q)}$ = 810 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

Fig.12 Second order intermodulation distortion as a function of collector current; typical values.



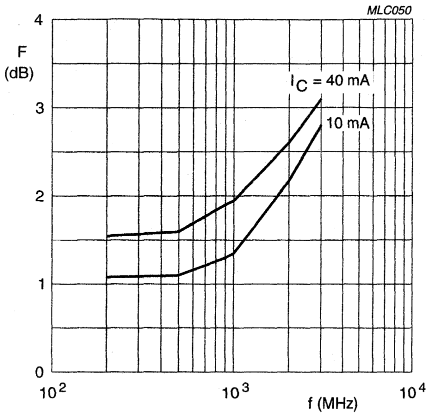
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



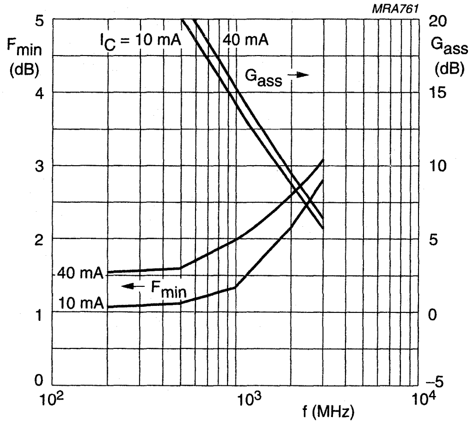
V_{CE} = 8 V.

Fig.14 Associated available gain as a function of collector current; typical values.



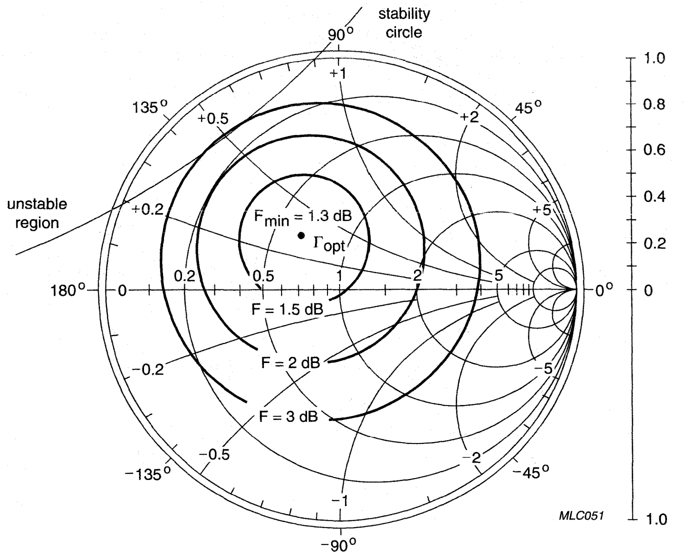
V_{CE} = 8 V.

Fig.15 Minimum noise figure as a function of frequency; typical values.



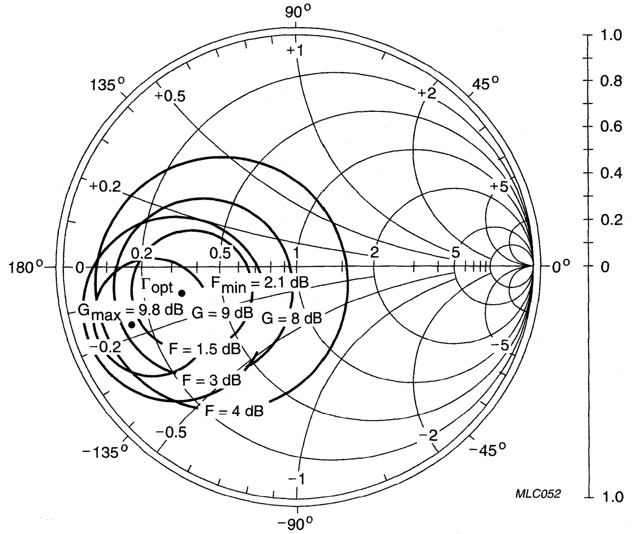
V_{CE} = 8 V.

Fig.16 Associated available gain as a function of frequency; typical values.



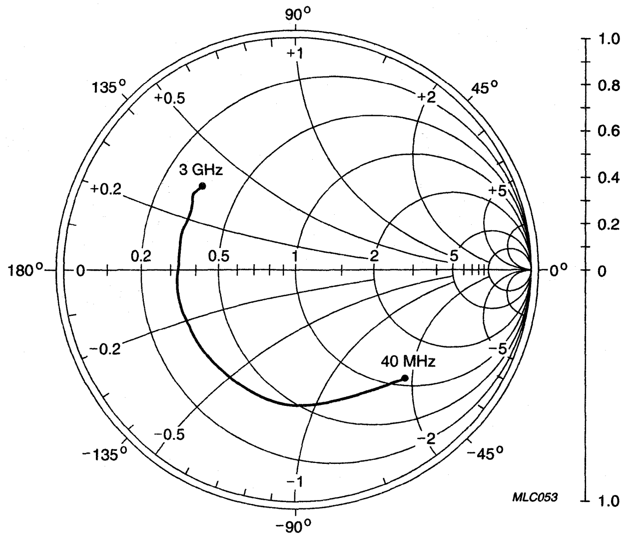
f = 900 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles; typical values.



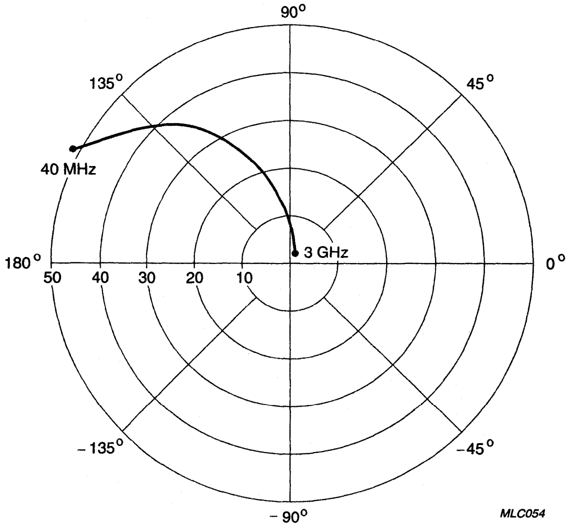
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.18 Common emitter noise figure circles; typical values.



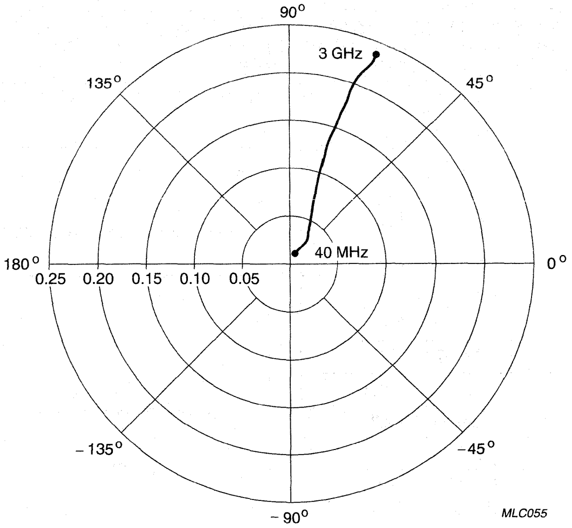
V_{CE} = 8 V; I_C = 40 mA; Z_o = 50 Ω.

Fig.19 Common emitter input reflection coefficient (s_{11}); typical values.



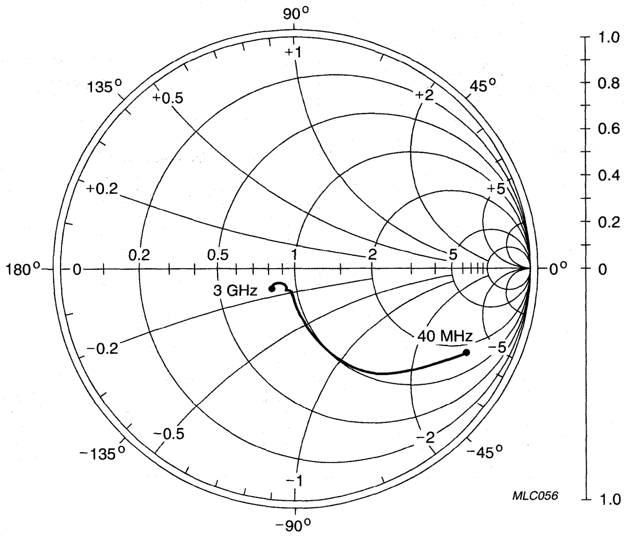
V_{CE} = 8 V; I_C = 40 mA.

Fig.20 Common emitter forward transmission coefficient (s_{21}); typical values.



$V_{CE} = 8$ V; $I_C = 40$ mA.

Fig.21 Common emitter reverse transmission coefficient (s_{12}); typical values.



$V_{CE} = 8$ V; $I_C = 40$ mA; $Z_o = 50\ \Omega$.

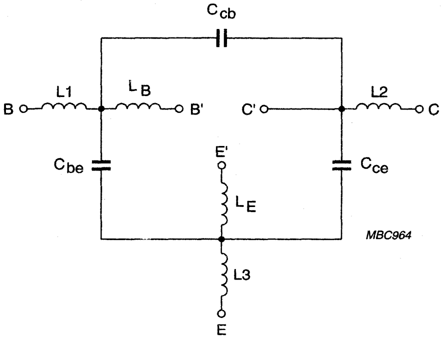
Fig.22 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFG540W crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.045	fA
2	BF	184.3	–
3	NF	0.981	–
4	VAF	41.69	V
5	IKF	10.00	A
6	ISE	232.4	fA
7	NE	2.028	–
8	BR	43.99	–
9	NR	0.992	–
10	VAR	2.097	V
11	IKR	166.2	mA
12	ISC	129.8	aA
13	NC	1.064	–
14	RB	5.000	Ω
15	IRB	1.000	μA
16	RBM	5.000	Ω
17	RE	353.5	mΩ
18	RC	1.340	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	1.978	pF
23	VJE	600.0	mV
24	MJE	0.332	–
25	TF	7.457	ps
26	XTF	11.40	–
27	VTF	3.158	V
28	ITF	156.9	mA
29	PTF	0.000	deg
30	CJC	793.7	fF
31	VJC	185.5	mV
32	MJC	0.084	–
33	XCJC	0.150	–
34	TR	1.598	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.814	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.23 Package equivalent circuit SOT343N; SOT343R.

List of components (see Fig.23).

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

NPN 9 GHz wideband transistor BFG541

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor, intended for wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

The transistors are mounted in a plastic SOT223 envelope.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

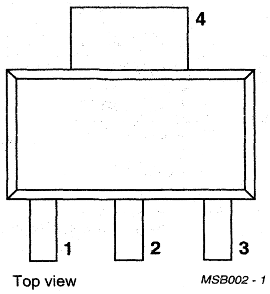


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to $T_s = 140$ °C; note 1	–	–	650	mW
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_j = 25$ °C	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.3	1.8	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	21	–	dBm
ITO	third order intercept point	$I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	34	–	dBm

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to $T_s = 140$ °C; note 1	–	650	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 $T_s = 140$ °C; note 1	55 K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 8$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	1	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_c = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	$I_c = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_o	output voltage	note 3	–	500	–	mV
d_2	second order intermodulation distortion	note 4	–	–50	–	dB

Notes

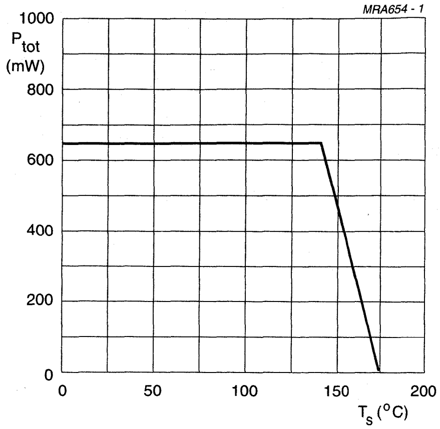
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

2. $I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2p-q)} = 904$ MHz.

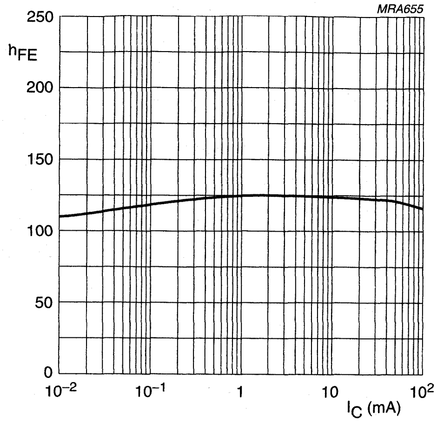
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 40$ mA; $V_{CE} = 8$ V; $Z_L = Z_s = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_o$; $V_q = V_o - 6$ dB; $V_r = V_o - 6$ dB;
   $f_p = 795.25$ MHz; $f_q = 803.25$ MHz; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz

4. $I_C = 40$ mA; $V_{CE} = 8$ V; $V_o = 325$ mV; $T_{amb} = 25$ °C;
   $f_p = 250$ MHz; $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ MHz



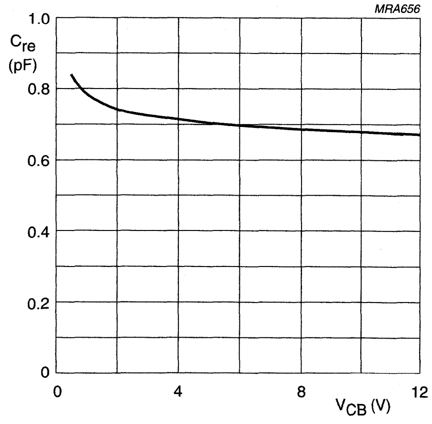
$V_{CE} \leq 10$ V.

Fig.2 Power derating curve.



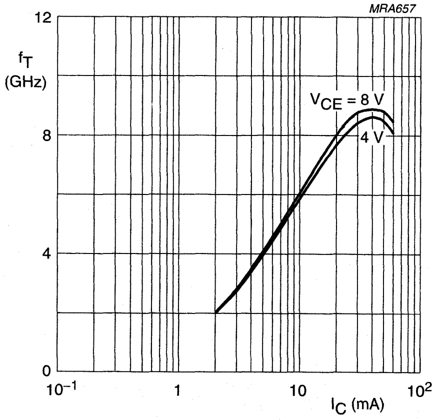
$V_{CE} = 8$ V; $T_j = 25$ °C.

Fig.3 DC current gain as a function of collector current.



$I_C = 0$; $f = 1$ MHz.

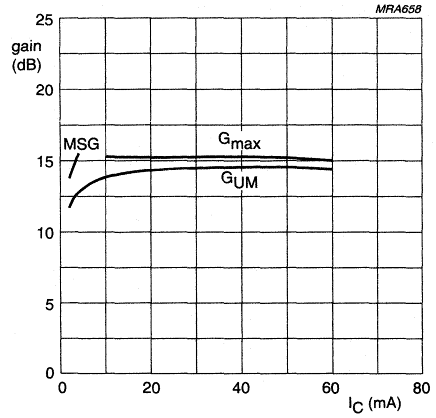
Fig.4 Feedback capacitance as a function of collector-base voltage.



$f = 1$ GHz; $T_{amb} = 25$ °C.

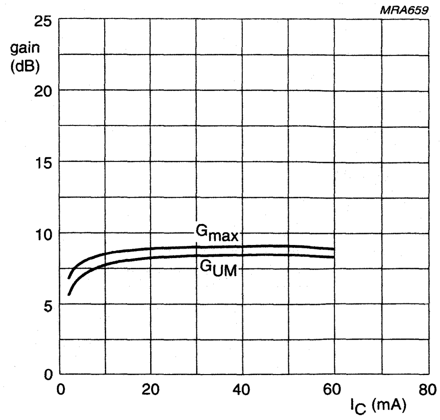
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



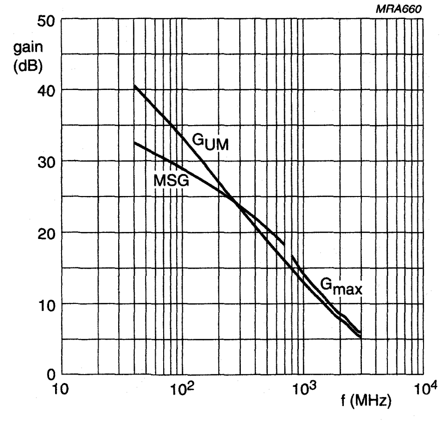
V_{CE} = 8 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



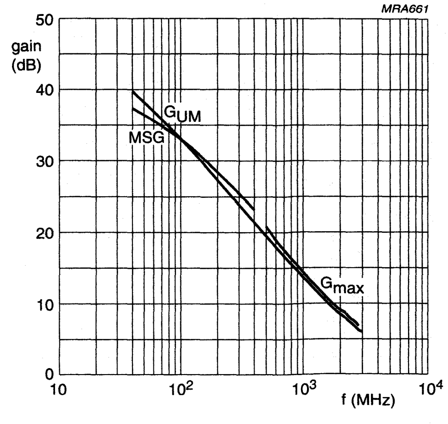
V_{CE} = 8 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



I_C = 10 mA; V_{CE} = 8 V.

Fig.8 Gain as a function of frequency.



I_C = 40 mA; V_{CE} = 8 V.

Fig.9 Gain as a function of frequency.

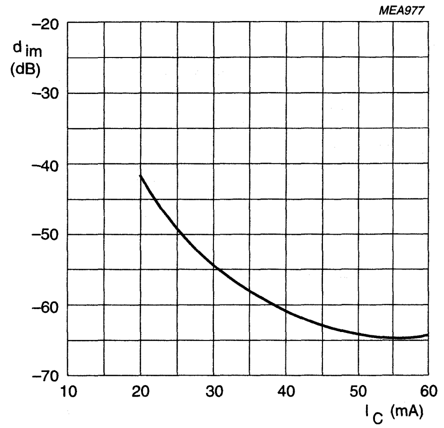


Fig.10 Intermodulation distortion as a function of collector current.

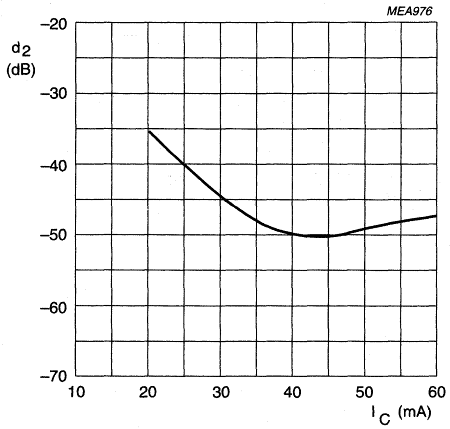
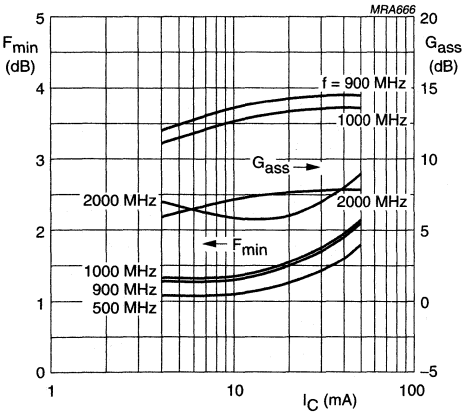
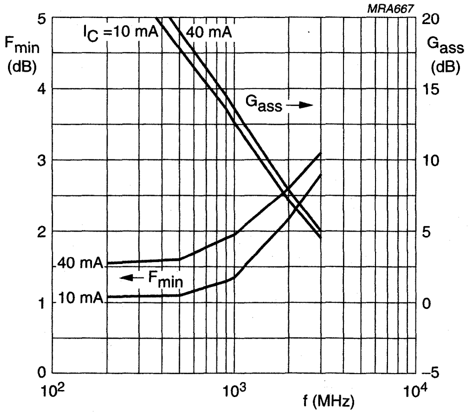


Fig.11 Second order intermodulation distortion as a function of collector current.



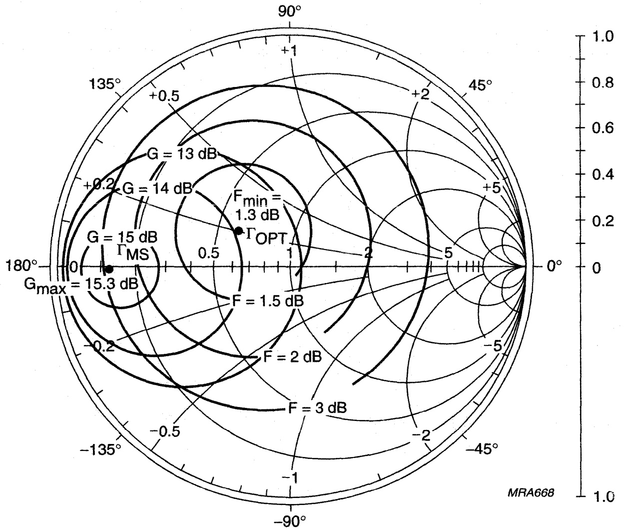
VCE = 8 V.

Fig.12 Minimum noise figure and associated available gain as functions of collector current.



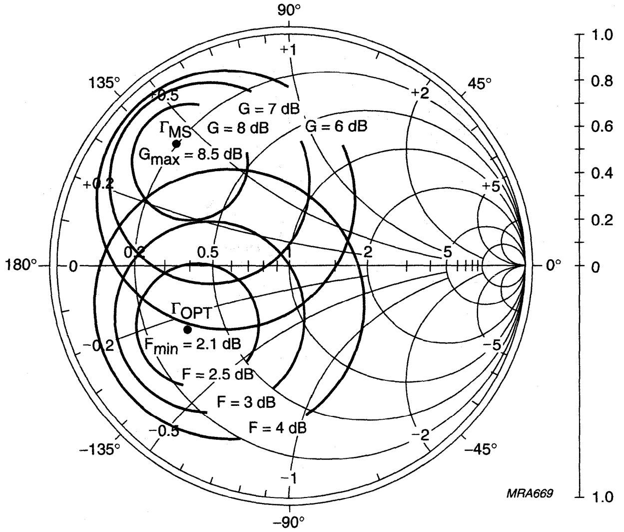
VCE = 8 V.

Fig.13 Minimum noise figure and associated available gain as functions of frequency.



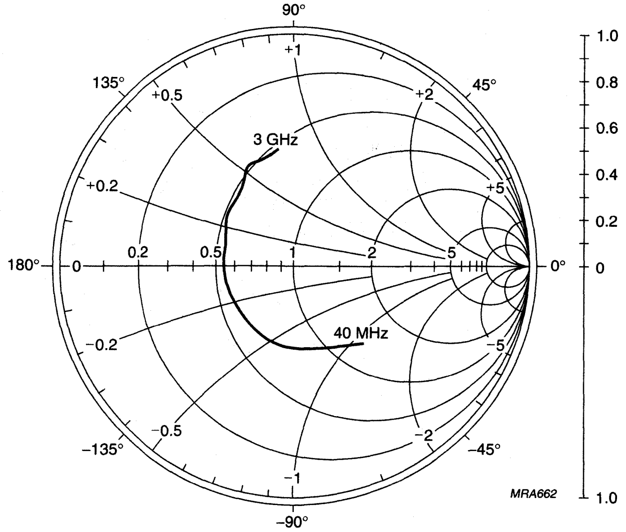
I_C = 10 mA; V_{CE} = 8 V;
Z_o = 50 Ω; f = 900 MHz.

Fig.14 Noise circle figure.



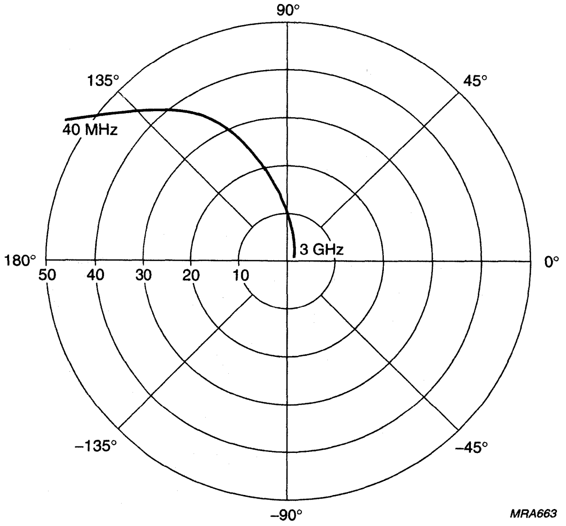
I_C = 10 mA; V_{CE} = 8 V;
Z_o = 50 Ω; f = 2 GHz.

Fig.15 Noise circle figure.



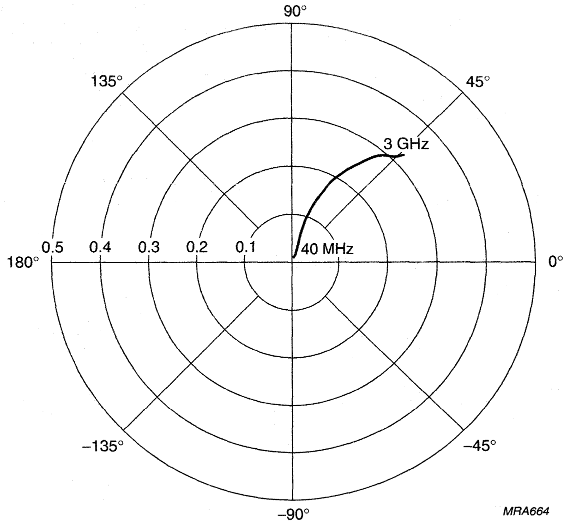
I_C = 40 mA; V_{CE} = 8 V.
Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



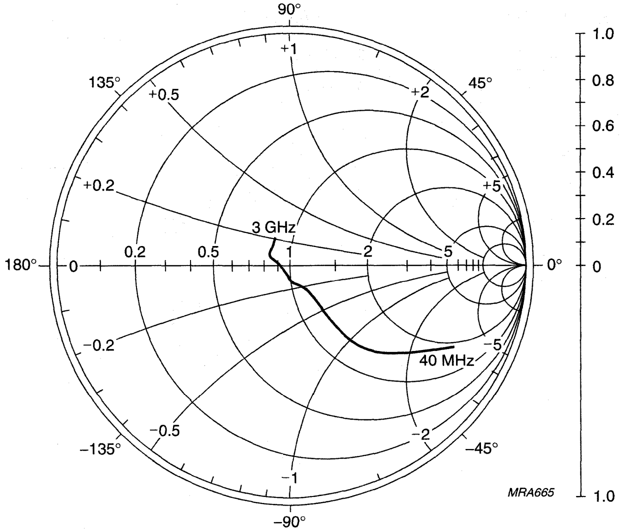
I_C = 40 mA; V_{CE} = 8 V.

Fig.17 Common emitter forward transmission coefficient (S_{21}).



I_C = 40 mA; V_{CE} = 8 V.

Fig.18 Common emitter reverse transmission coefficient (S_{12}).



I_C = 40 mA; V_{CE} = 8 V.
Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistors

BFG590; BFG590/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

- MATV/CATV amplifiers and RF communications subscriber equipment in the GHz range
- Ideally suitable for use in class-A, (A)B and C amplifiers with either pulsed or continuous drive.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT143B plastic package.

MARKING

TYPE NUMBER	CODE
BFG590	N38
BFG590/X	N44

PINNING

PIN	DESCRIPTION	
	BFG590	BFG590/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

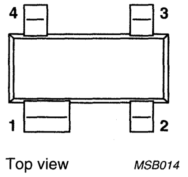


Fig.1 Simplified outline SOT143B.

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	collector current (DC)		–	–	200	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C	–	–	400	mW
h_{FE}	DC current gain	I_C = 35 mA; V_{CE} = 8 V	50	90	280	
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 8 V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	I_C = 80 mA; V_{CE} = 4 V; f = 1 GHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 80 mA; V_{CE} = 4 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 80 mA; V_{CE} = 4 V; f = 900 MHz; T_{amb} = 25 °C	–	11	–	dB

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C; see Fig.2; note 1	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 60$ °C; note 1	290	K/W

Note

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

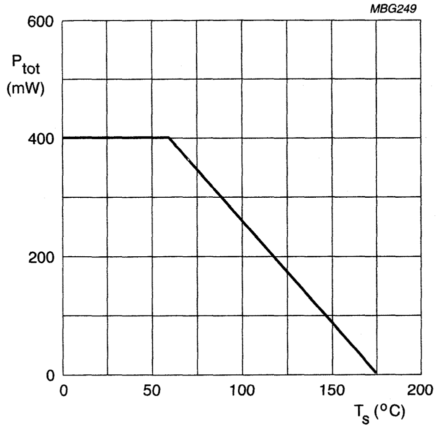


Fig.2 Power derating curve.

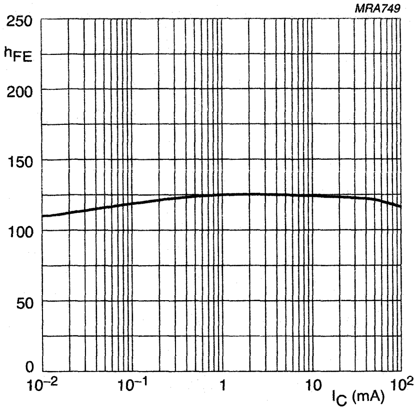
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; I_C = 0	3	–	–	V
I_{CBO}	collector-base leakage current	V_{CB} = 10 V; I_E = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 70 mA; V_{CE} = 8 V; see Fig.3	60	120	250	
f_T	transition frequency	I_C = 80 mA; V_{CE} = 4 V; f = 1 GHz; see Fig.5	–	5	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz; see Fig.4	–	0.7	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 80 mA; V_{CE} = 4 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
		I_C = 80 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 80 mA; V_{CE} = 4 V; f = 900 MHz; T_{amb} = 25 °C	–	11	–	dB

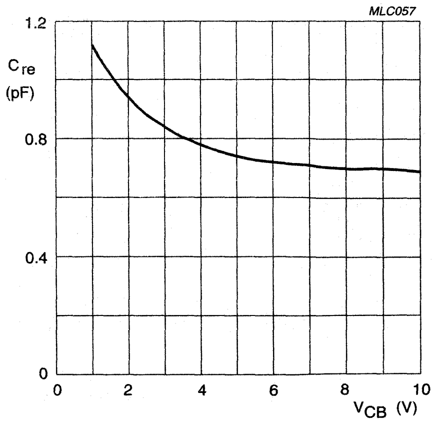
Note

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.



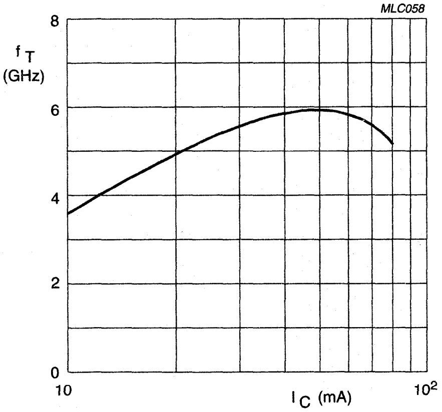
V_{CE} = 8 V.

Fig.3 DC current gain as a function of collector current; typical values.



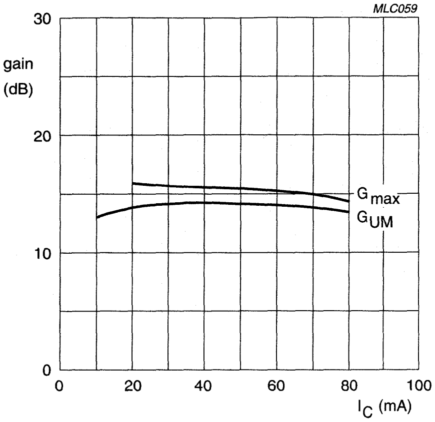
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



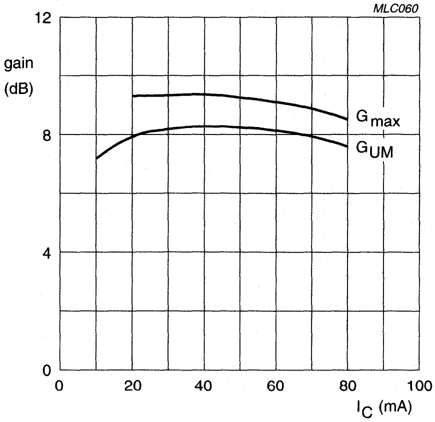
V_{CE} = 4 V; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current; typical values.



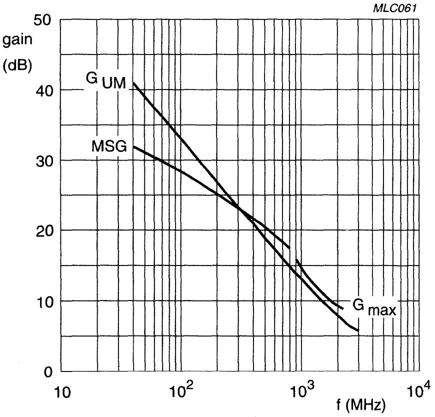
f = 900 MHz; V_{CE} = 4 V.

Fig.6 Gain as a function of collector current; typical values.



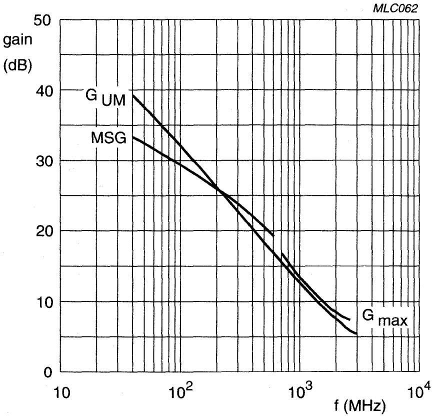
f = 2 GHz; V_{CE} = 4 V.

Fig.7 Gain as a function of collector current; typical values.



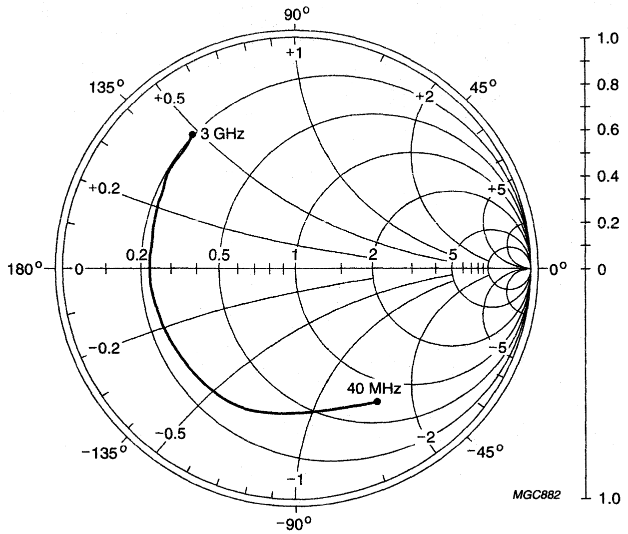
I_C = 20 mA; V_{CE} = 4 V.

Fig.8 Gain as a function of frequency; typical values.



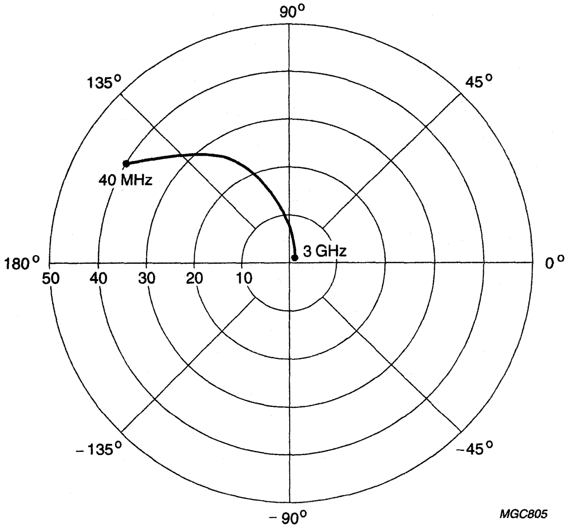
I_C = 80 mA; V_{CE} = 4 V.

Fig.9 Gain as a function of frequency; typical values.



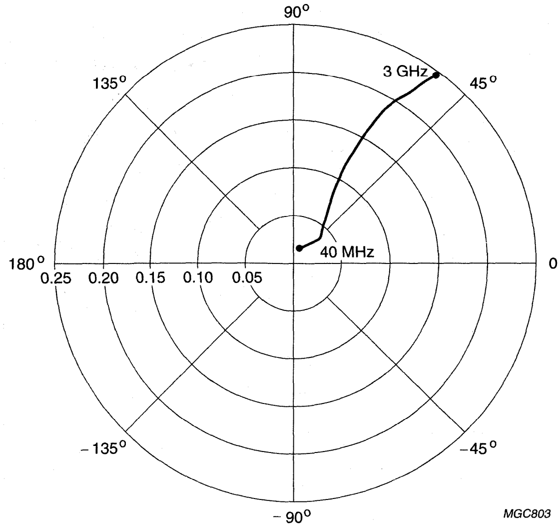
I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

Fig.10 Common emitter input reflection coefficient (S_{11}); typical values.



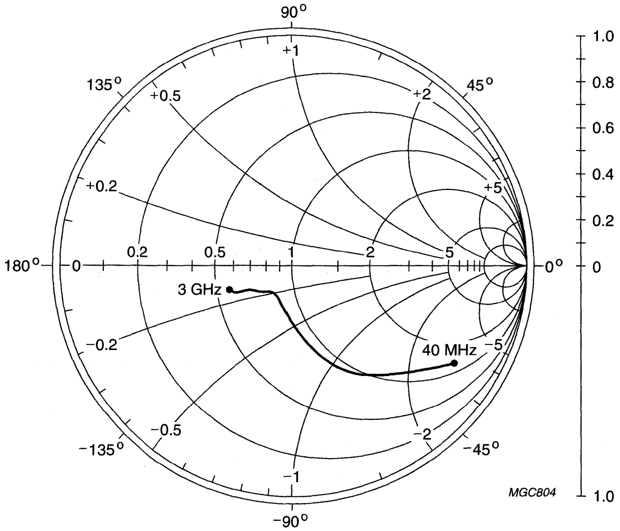
I_C = 80 mA; V_{CE} = 4 V.

Fig.11 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 80 mA; V_{CE} = 4 V.

Fig.12 Common emitter reverse transmission coefficient (S_{12}); typical values.



I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

Fig.13 Common emitter output reflection coefficient (S_{22}); typical values.

NPN 5 GHz wideband transistors BFG590W; BFG590W/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

- MATV/CATV amplifiers and RF communications subscriber equipment in the GHz range
- Ideally suitable for use in class-A, (A)B and C amplifiers with either pulsed or continuous drive.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

PINNING

PIN	DESCRIPTION
BFG590W	
1	collector
2	base
3	emitter
4	emitter
BFG590W/X	
1	collector
2	emitter
3	base
4	emitter

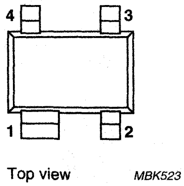


Fig.1 SOT343N.

MARKING

TYPE NUMBER	CODE
BFG590W	T1
BFG590W/X	T2

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	collector current (DC)		–	–	200	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 70$ mA; $V_{CE} = 8$ V	60	90	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	$I_C = 80$ mA; $V_{CE} = 4$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 80$ mA; $V_{CE} = 4$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	13	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 80$ mA; $V_{CE} = 4$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	11	–	dB

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; see Fig.2; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 85$ °C; note 1	180	K/W

Note

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

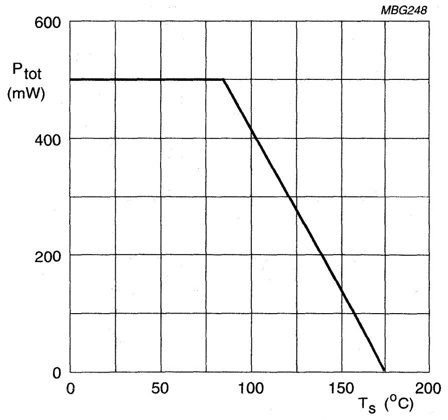


Fig.2 Power derating curve.

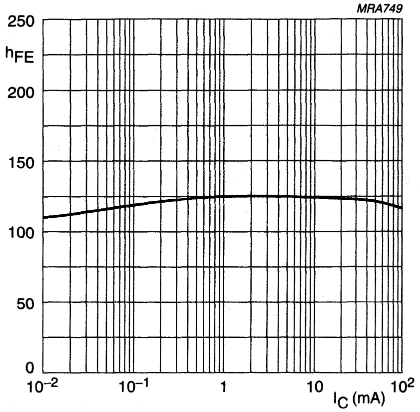
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; I_C = 0	3	–	–	V
I_{CBO}	collector leakage current	V_{CB} = 10 V; I_E = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 70 mA; V_{CE} = 8 V	60	90	250	
f_T	transition frequency	I_C = 80 mA; V_{CE} = 4 V; f = 1 GHz; T_{amb} = 25 °C	–	5	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.7	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 80 mA; V_{CE} = 4 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
		I_C = 80 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 80 mA; V_{CE} = 4 V; f = 1 GHz; T_{amb} = 25 °C	–	11	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 80 mA; V_{CE} = 5 V; f = 900 MHz; R_L = 50 Ω; T_{amb} = 25 °C	–	21	–	dBm

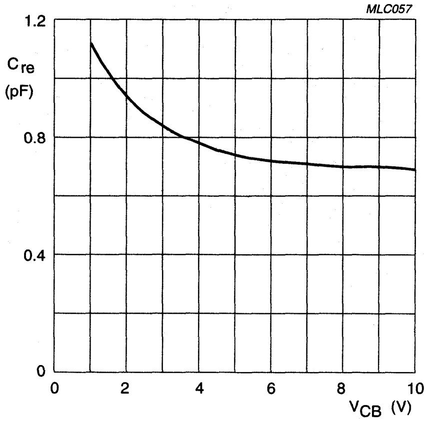
Note

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



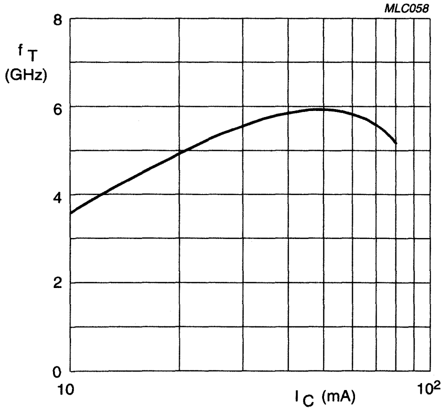
V_{CE} = 8 V.

Fig.3 DC current gain as a function of collector current; typical values.



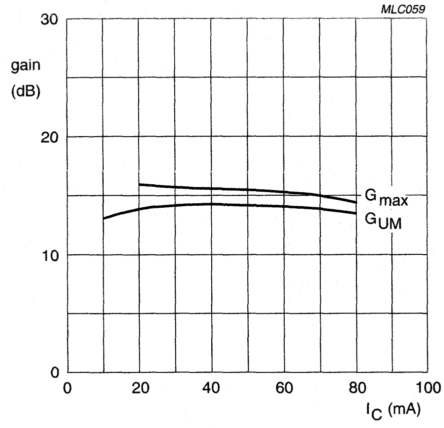
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



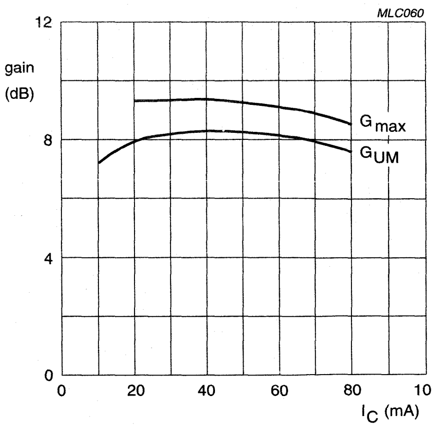
V_{CE} = 4 V; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current; typical values.



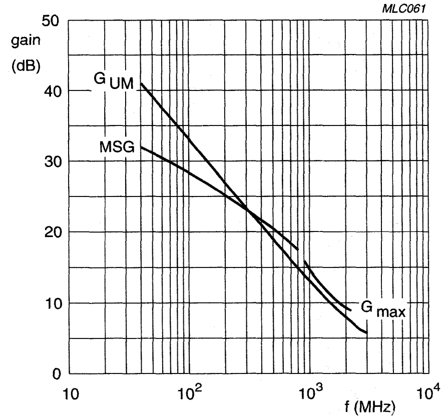
f = 900 MHz; V_{CE} = 4 V.

Fig.6 Gain as a function of collector current; typical values.



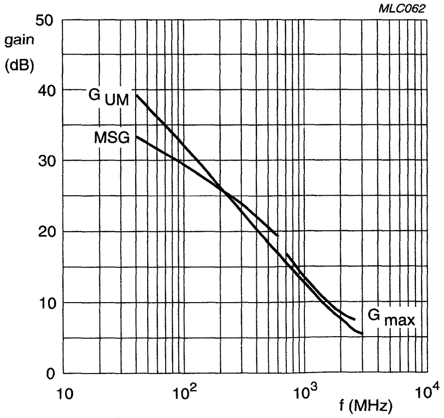
f = 2 GHz; V_{CE} = 4 V.

Fig.7 Gain as a function of collector current; typical values.



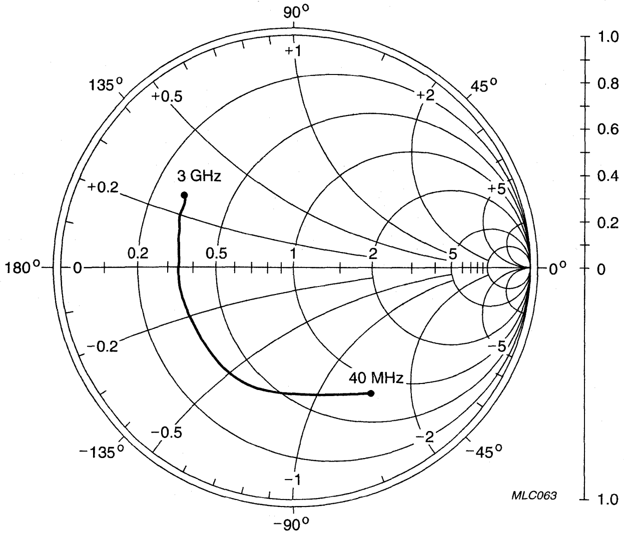
I_C = 20 mA; V_{CE} = 4 V.

Fig.8 Gain as a function of frequency; typical values.



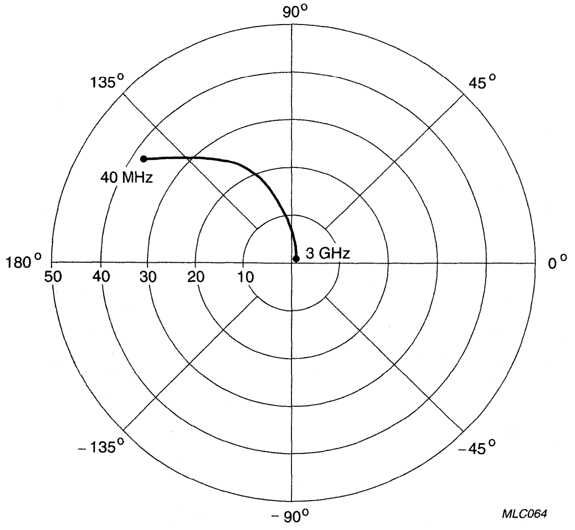
I_C = 80 mA; V_{CE} = 4 V.

Fig.9 Gain as a function of frequency; typical values.



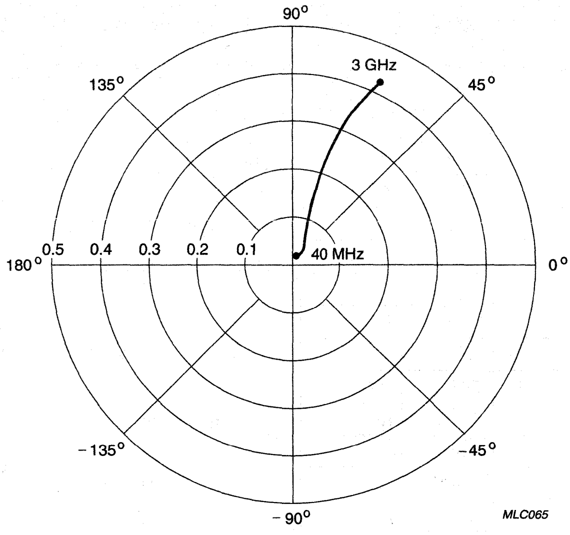
I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

Fig.10 Common emitter input reflection coefficient (S_{11}); typical values.



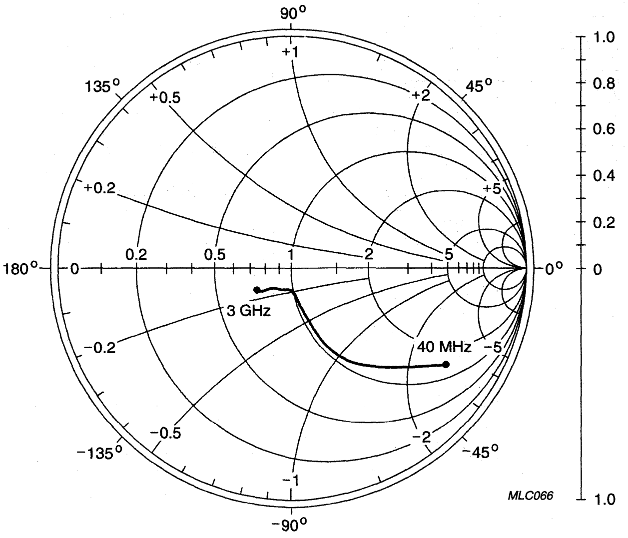
I_C = 80 mA; V_{CE} = 4 V.

Fig.11 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 80 mA; V_{CE} = 4 V.

Fig.12 Common emitter reverse transmission coefficient (S_{12}); typical values.



I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

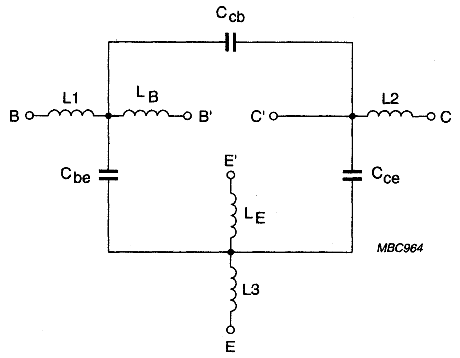
Fig.13 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for the BFG590W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.341	fA
2	BF	123.5	–
3	NF	0.988	–
4	VAF	75.85	V
5	IKF	9.656	A
6	ISE	232.2	fA
7	NE	2.134	–
8	BR	10.22	–
9	NR	1.016	–
10	VAR	1.992	V
11	IKR	294.1	mA
12	ISC	211.0	aA
13	NC	0.997	–
14	RB	5.000	Ω
15	IRB	1.000	µA
16	RBM	5.000	Ω
17	RE	1.275	Ω
18	RC	920.6	mΩ
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	3.821	pF
23	VJE	600.0	mV
24	MJE	0.348	–
25	TF	13.60	ps
26	XTF	71.73	–
27	VTF	10.28	V
28	ITF	1.929	A
29	PTF	0.000	deg
30	CJC	1.409	pF
31	VJC	219.4	mV
32	MJC	0.166	–
33	XCJC	0.150	–
34	TR	2.340	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.733	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT343N.

List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

NPN 7 GHz wideband transistor BFG591

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

Intended for applications in the GHz range such as MATV or CATV amplifiers and RF communications subscriber equipment.

DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic, 4-pin SOT223 package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

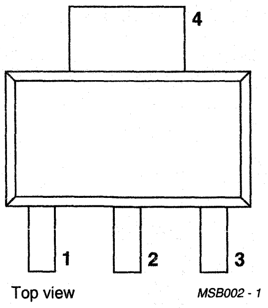


Fig.1 SOT223.

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	collector current (DC)		–	–	200	mA
P_{tot}	total power dissipation	up to T_s = 80 °C; note 1	–	–	2	W
h_{FE}	DC current gain	I_C = 70 mA; V_{CE} = 8 V	60	90	250	
C_{re}	feedback capacitance	$I_C = I_c = 0$; V_{CE} = 12 V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	I_C = 70 mA; V_{CE} = 12 V; f = 1 GHz	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 70 mA; V_{CE} = 12 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 70 mA; V_{CE} = 12 V; f = 900 MHz; T_{amb} = 25 °C	–	12	–	dB

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	up to T_s = 80 °C; note 1	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	35	K/W

Note to the Limiting values and Thermal characteristics

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

NPN 7 GHz wideband transistor BFG591

CHARACTERISTICS

$T_j = 25$ °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 0.1$ mA; $I_E = 0$	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10$ mA; $I_B = 0$	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 0.1$ mA; $I_C = 0$	3	–	–	V
I_{CBO}	collector-base leakage current	$I_E = 0$; $V_{CB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 70$ mA; $V_{CE} = 8$ V	60	90	250	
C_{re}	feedback capacitance	$I_B = I_b = 0$; $V_{CE} = 12$ V; f = 1 MHz	–	0.7	–	pF
f_T	transition frequency	$I_C = 70$ mA; $V_{CE} = 12$ V; f = 1 GHz	–	7	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 70$ mA; $V_{CE} = 12$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	13	–	dB
		$I_C = 70$ mA; $V_{CE} = 12$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	7.5	–	dB
$\|s_{21}\|^2$	insertion power gain	$I_C = 70$ mA; $V_{CE} = 12$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	12	–	dB
V_o	output voltage	note 2	–	700	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.
2. $d_{im} = 60$ dB (DIN45004B);
   $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB;
   $f_p = 795.25$ MHz; $f_q = 803.25$ MHz; $f_r = 803.25$ MHz; measured at $f_{(p+q-r)} = 793.25$ MHz.

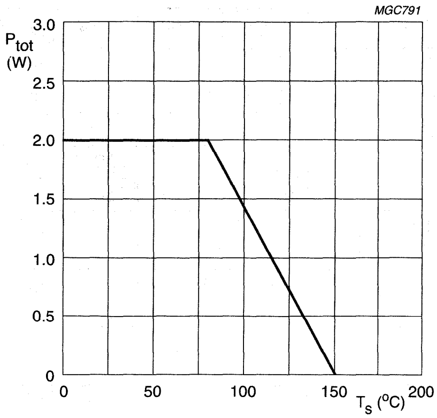
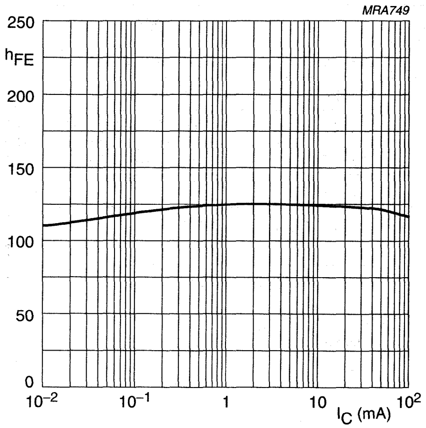
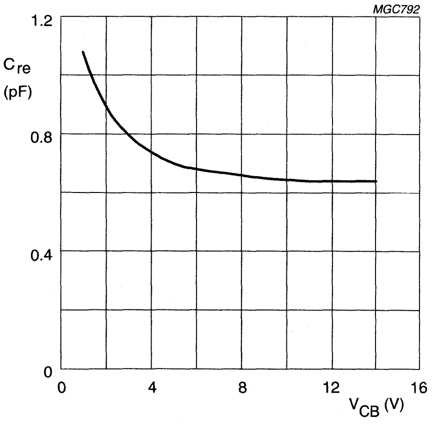


Fig.2 Power derating curve.



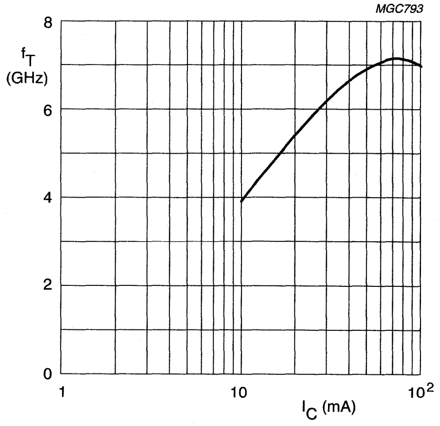
V_{CE} = 12 V.

Fig.3 DC current gain as a function of collector current, typical values.



I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.

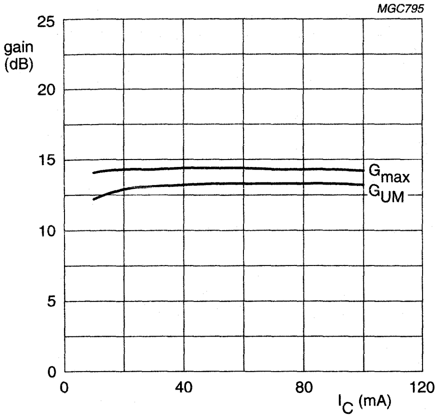


f = 1 GHz; V_{CE} = 12 V.

Fig.5 Transition frequency as a function of collector current, typical values.

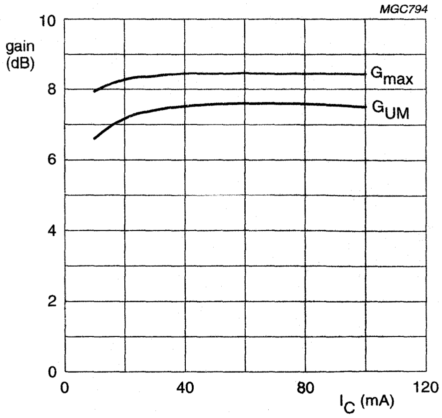
NPN 7 GHz wideband transistor

BFG591



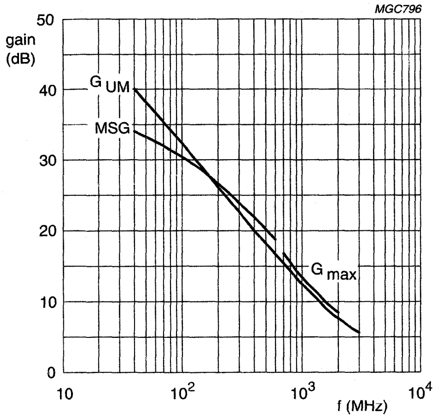
f = 900 MHz; V_{CE} = 12 V.

Fig.6 Gain as a function of collector current; typical values.



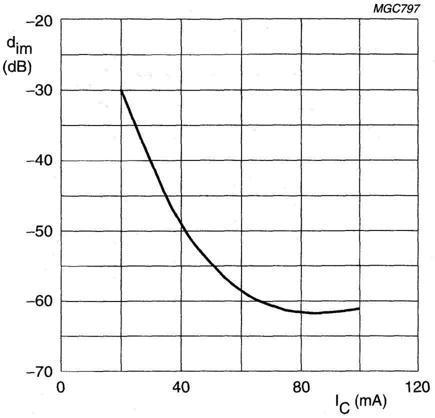
f = 2 GHz; V_{CE} = 12 V.

Fig.7 Gain as a function of collector current; typical values.



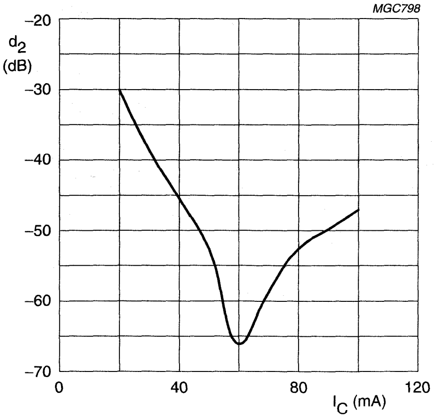
I_C = 70 mA; V_{CE} = 12 V.

Fig.8 Gain as a function of frequency; typical values.



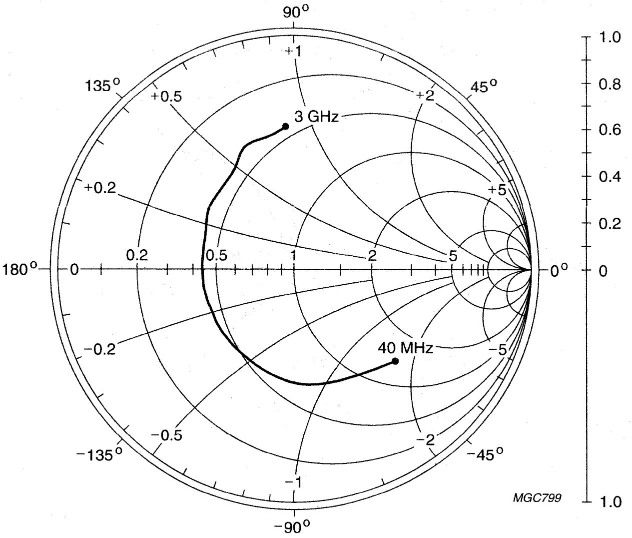
V_{CE} = 12 V; V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz.

Fig.9 Intermodulation distortion as a function of collector current; typical values.



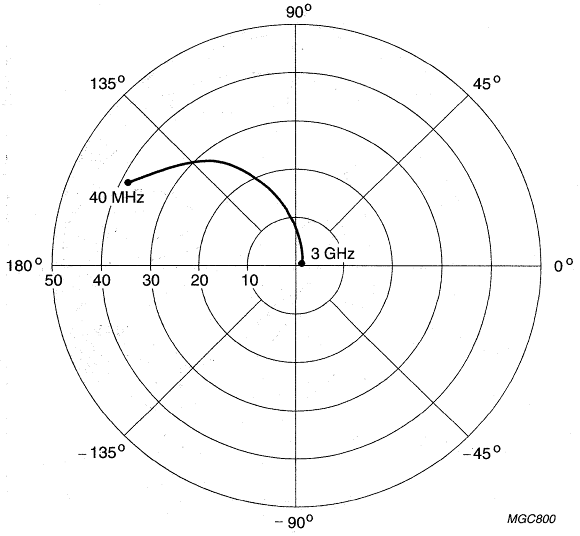
V_{CE} = 12 V; V_o = 316 mV; $f_{(p+q)}$ = 810 MHz.

Fig.10 Second order Intermodulation distortion as a function of collector current; typical values.



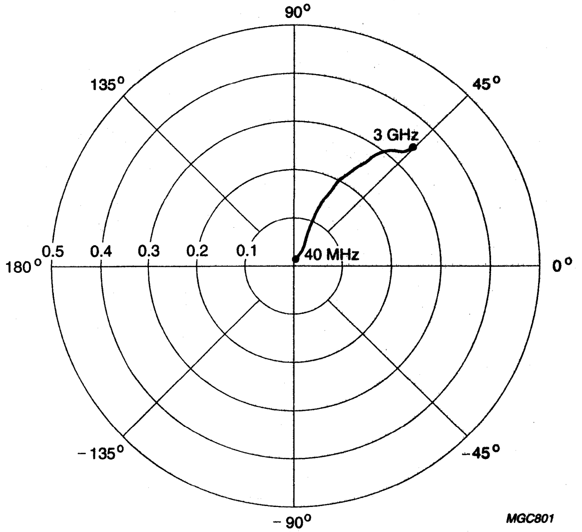
V_{CE} = 12 V; I_C = 70 mA; Z_o = 50 Ω.

Fig.11 Common emitter input reflection coefficient (s_{11}); typical values.



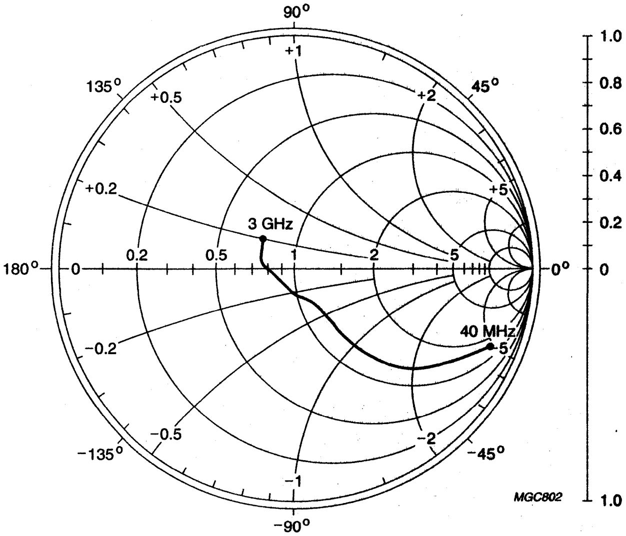
V_{CE} = 12 V; I_C = 70 mA.

Fig.12 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 12 V; I_C = 70 mA.

Fig.13 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 12 V; I_C = 70 mA; Z_o = 50 Ω.

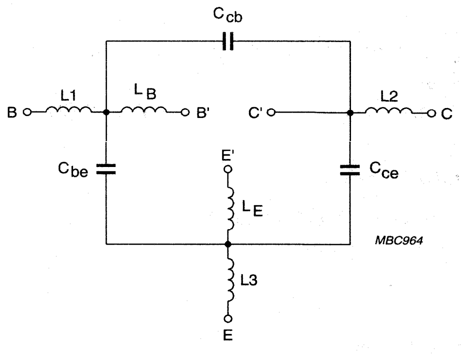
Fig.14 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFG591 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.341	fA
2	BF	123.5	–
3	NF	.988	m
4	VAF	75.85	V
5	IKF	9.656	A
6	ISE	232.2	fA
7	NE	2.134	–
8	BR	10.22	–
9	NR	1.016	–
10	VAR	1.992	V
11	IKR	294.1	mA
12	ISC	211.0	aA
13	NC	997.2	–
14	RB	5.00	Ω
15	IRB	1.000	µA
16	RBM	5.00	Ω
17	RE	1.275	Ω
18	RC	920.6	mΩ
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	EV
21 (1)	XTI	3.000	–
22	CJE	3.821	pF
23	VJE	600.0	mV
24	MJE	348.5	m
25	TF	13.60	ps
26	XTF	71.73	–
27	VTF	10.28	V
28	ITF	1.929	A
29	PTF	0.000	deg
30	CJC	1.409	pF
31	VJC	219.4	mV
32	MJC	166.5	m
33	XCJ	2.340	m
34	TR	543.7	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	733.2	m

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.15 Package equivalent circuit SOT223.

List of components (see Fig.15)

DESIGNATION	VALUE	UNIT
C_{be}	182	fF
C_{cb}	16	fF
C_{ce}	249	fF
L1	0.025	nH
L2	1.19	nH
L3	0.60	nH
L_B	1.50	nH
L_E	0.50	nH

Dual NPN wideband transistor

BFM505

FEATURES

- Small size
- Temperature and h_{FE} matched
- Low noise and high gain
- High gain at low current and low capacitance at low voltage
- Gold metallization ensures excellent reliability.

APPLICATIONS

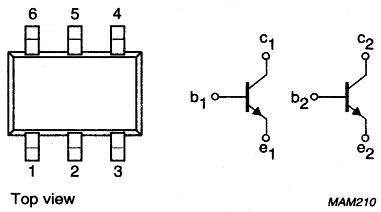
- Oscillator and buffer amplifiers
- Balanced amplifiers
- LNA/mixer.

DESCRIPTION

Dual transistor with two silicon NPN RF dies in a surface mount, 6-pin SOT363 (S-mini) package. The transistors are primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular phones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING - SOT363A

PIN	SYMBOL	DESCRIPTION
1	b_1	base 1
2	e_1	emitter 1
3	c_2	collector 2
4	b_2	base 2
5	e_2	emitter 2
6	c_1	collector 1



Marking code: N0.

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance	$I_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.22	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 3$V; f = 1 GHz	–	9	–	GHz
$\|s_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	14	15	–	dB
G_{UM}	maximum unilateral power gain	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
F	noise figure	$I_C = 1$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

LIMITING VALUES

In accordance with the Absolute Maximum System IEC 134.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $I_B = 0$	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector-base leakage current	$V_{CB} = 6$ V; $I_E = 0$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
DC characteristics of the dual transistor						
Δh_{FE}	ratio of highest and lowest DC current gain	$I_{C1} = I_{C2} = 5$ mA; $V_{CE1} = V_{CE2} = 6$ V	1	1.2	–	
ΔV_{BEO}	difference between highest and lowest base-emitter voltage (offset voltage)	$I_{E1} = I_{E2} = 10$ mA; $T_{amb} = 25$ °C	0	1	–	mV
AC characteristics of any single transistor						
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.31	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.22	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = 5$ mA; $V_{CE} = 3$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
$\|s_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	14	15	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.4	1.8	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	–	dB
		$I_C = 1$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB

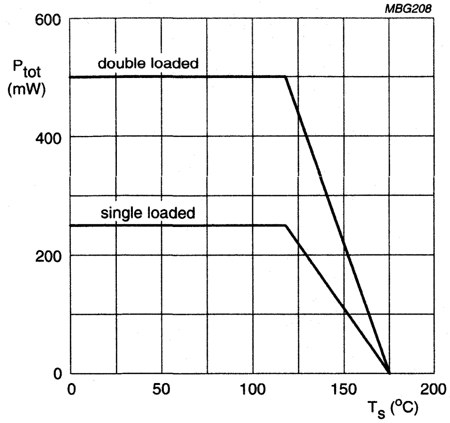
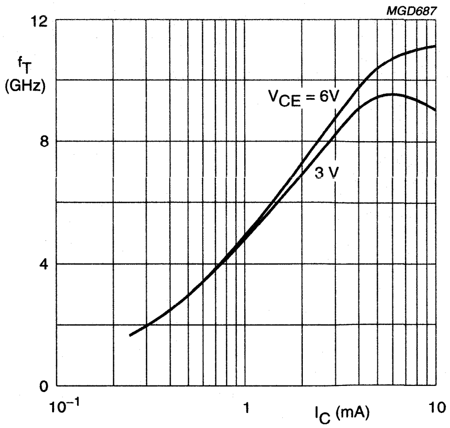
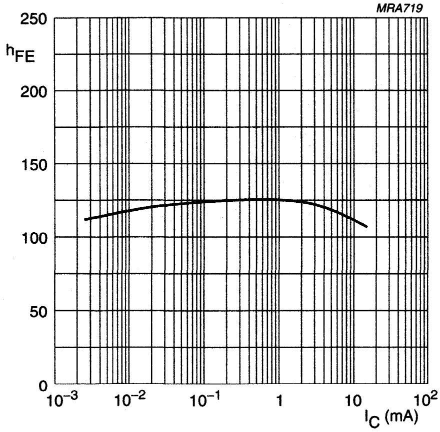


Fig.2 Power derating as a function of soldering point temperature; typical values.



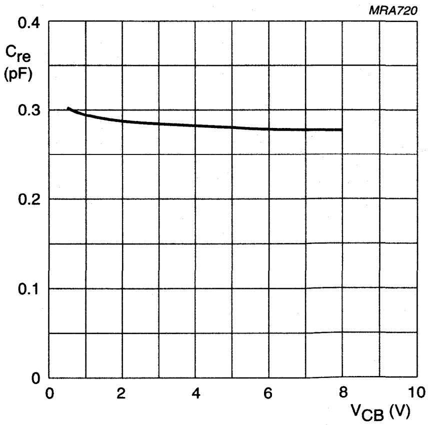
f = 1 GHz; T_{amb} = 25 °C.

Fig.3 Transition frequency as a function of collector current; typical values.



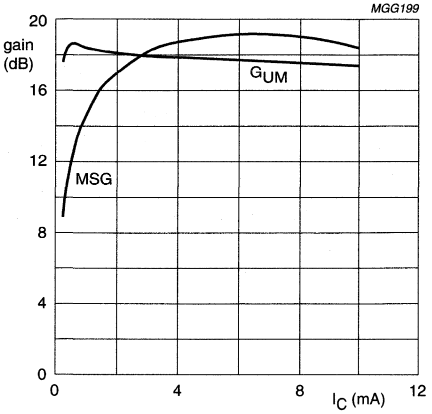
V_{CE} = 6 V.

Fig.4 DC current gain as a function of collector current; typical values.



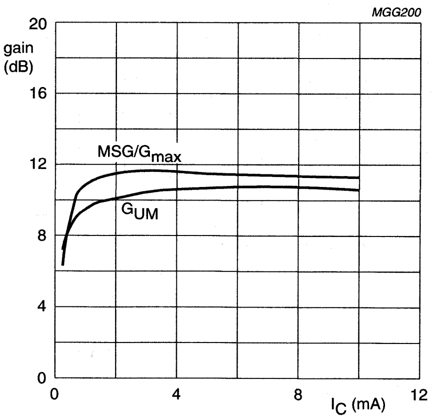
I_C = 0; f = 1 MHz.

Fig.5 Feedback capacitance as a function of collector-base voltage; typical values.



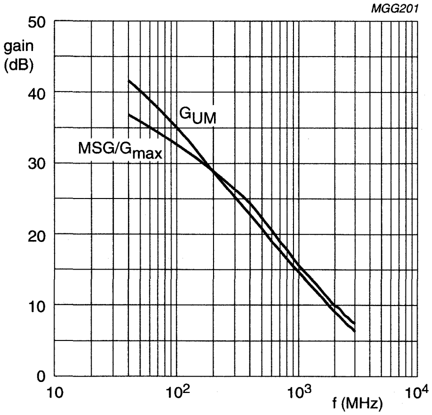
f = 900 MHz; V_{CE} = 3 V.

Fig.6 Gain as a function of collector current; typical values.



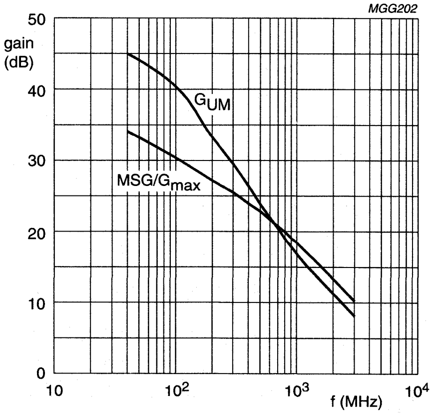
f = 2 GHz; V_{CE} = 3 V.

Fig.7 Gain as a function of collector current; typical values.



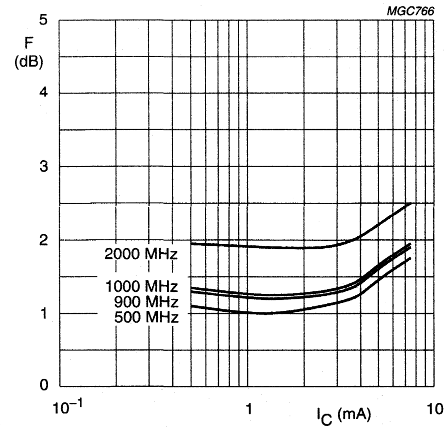
I_C = 1 mA; V_{CE} = 3 V.

Fig.8 Gain as a function of frequency; typical values.



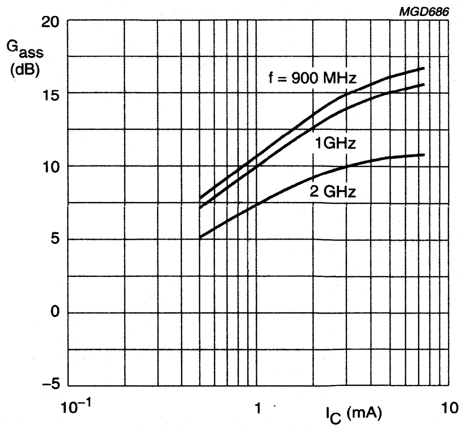
I_C = 5 mA; V_{CE} = 3 V.

Fig.9 Gain as a function of frequency; typical values.



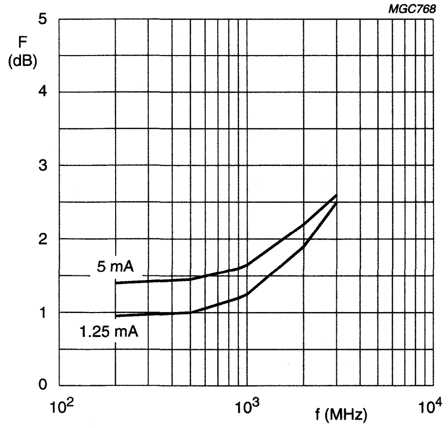
V_{CE} = 3 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



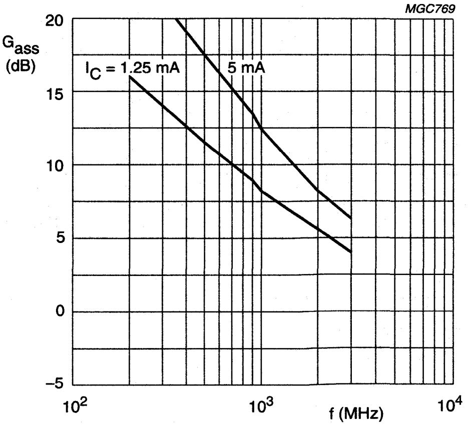
V_{CE} = 3 V.

Fig.11 Associated available gain as a function of collector current; typical values.



V_{CE} = 3 V.

Fig.12 Minimum noise figure as a function of frequency; typical values.



V_{CE} = 3 V.

Fig.13 Associated available gain as a function of frequency; typical values.

APPLICATION INFORMATION

SPICE parameters for any single BFM505 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	134.1	aA
2	BF	180.0	–
3	NF	0.988	–
4	VAF	38.34	V
5	IKF	150.0	mA
6	ISE	27.81	fA
7	NE	2.051	–
8	BR	55.19	–
9	NR	0.982	–
10	VAR	2.459	V
11	IKR	2.920	mA
12	ISC	17.45	aA
13	NC	1.062	–
14	RB	20.00	Ω
15	IRB	1.000	μA
16	RBM	20.00	Ω
17	RE	1.171	Ω
18	RC	4.350	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	284.7	fF
23	VJE	600.0	mV
24	MJE	0.303	–
25	TF	7.037	ps
26	XTF	12.34	–
27	VTF	1.701	V
28	ITF	30.64	mA
29	PTF	0.000	deg
30	CJC	242.4	fF
31	VJC	188.6	mV
32	MJC	0.041	–
33	XCJC	0.130	–
34	TR	1.332	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.897	–

Note

1. These parameters have not been extracted, the default values are shown.

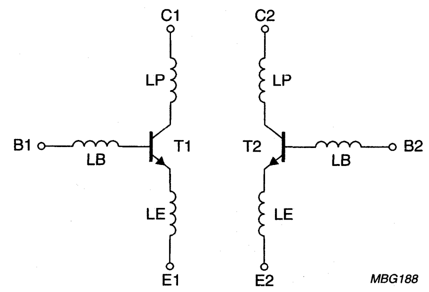


Fig.14 Package equivalent circuit SOT363A (inductance only).

Lead inductances (nH)

LP	0.4
LB	0.6
LE	1.0

E2	3				
E1	27	6			
B2	1	27	3		
C2	3	17	36	48	
C1	48	36	17	3	6
	B1	E2	E1	B2	C2

MBG189

Fig.15 Package capacitance (fF) between indicated nodes.

Dual NPN wideband transistor BFM520

FEATURES

- Small size
- Temperature and h_{FE} matched
- Low noise and high gain
- High gain at low current and low capacitance at low voltage
- Gold metallization ensures excellent reliability.

APPLICATIONS

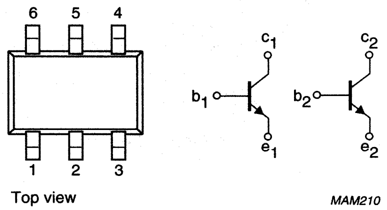
- Oscillator and buffer amplifiers
- Balanced amplifiers
- LNA/mixers.

DESCRIPTION

Dual transistor with two silicon NPN RF dies in a surface mount 6-pin SOT363 (S-mini) package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular phones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING - SOT363A

PIN	SYMBOL	DESCRIPTION
1	b_1	base 1
2	e_1	emitter 1
3	c_2	collector 2
4	b_2	base 2
5	e_2	emitter 2
6	c_1	collector 1



Marking code: N2.

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance	$I_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz	–	9	–	GHz
$\|s_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14.5	–	dB
G_{UM}	maximum unilateral power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.6	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \mu A$; $I_B = 0$	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu A$; $I_C = 0$	2.5	–	–	V
I_{CBO}	collector-base leakage current	$V_{CB} = 6$ V; $I_E = 0$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
DC characteristics of the dual transistor						
Δh_{FE}	ratio of highest and lowest DC current gain	$I_{C1} = I_{C2} = 20$ mA; $V_{CE1} = V_{CE2} = 6$ V	1	1.2	–	
ΔV_{BEO}	difference between highest and lowest base-emitter voltage (offset voltage)	$I_{E1} = I_{E2} = 30$ mA; $T_{amb} = 25$ °C	0	1	–	mV
AC characteristics of any single transistor						
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 3$ V; f = 1 MHz	–	0.4	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = 20$ mA; $V_{CE} = 3$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 3$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	9	–	dB
$\left\|s_{21}\right\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14.5	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.6	dB
		$I_C = 20$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.7	2.1	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB

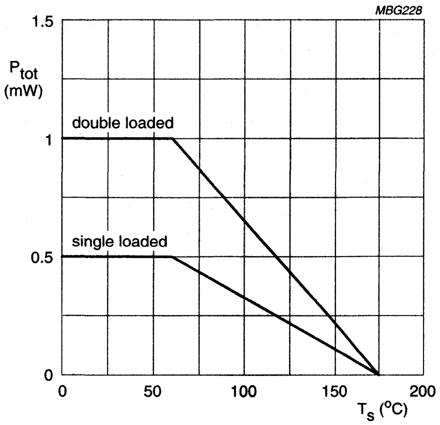
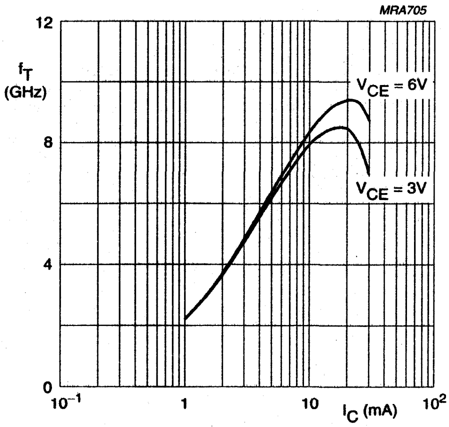
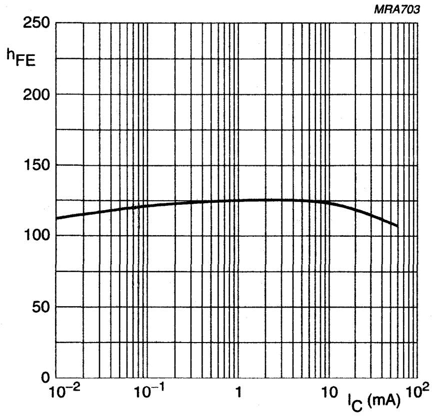


Fig.2 Power derating as a function of soldering point temperature; typical values.



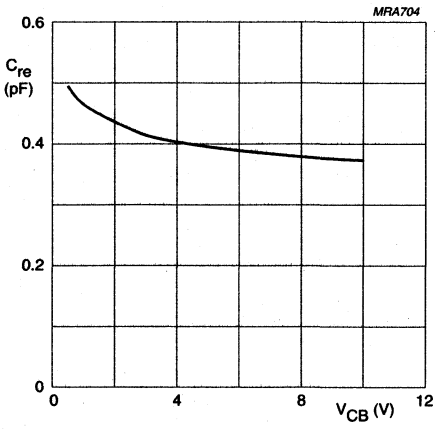
f = 1 GHz; T_{amb} = 25 °C.

Fig.3 Transition frequency as a function of collector current; typical values.



V_{CE} = 6 V.

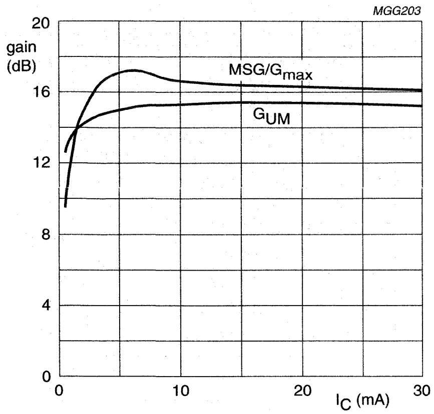
Fig.4 DC current gain as a function of collector current; typical values.



I_C = 0; f = 1 MHz.

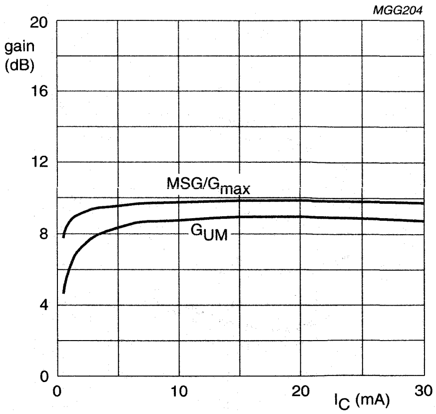
Fig.5 Feedback capacitance as a function of collector-base voltage; typical values.

Dual NPN wideband transistor | BFM520



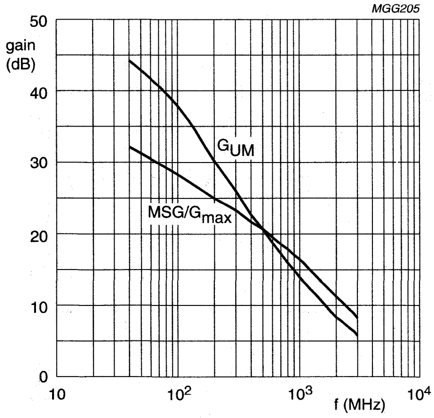
f = 900 MHz; V_{CE} = 3 V.

Fig.6 Gain as a function of collector current; typical values.



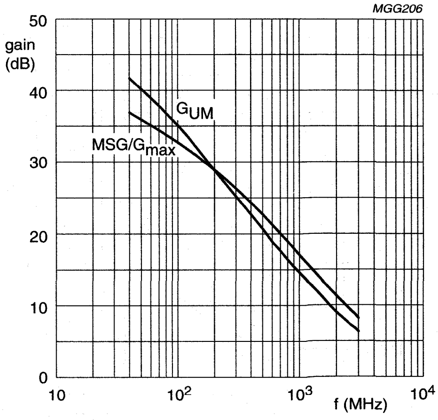
f = 2 GHz; V_{CE} = 3 V.

Fig.7 Gain as a function of collector current; typical values.



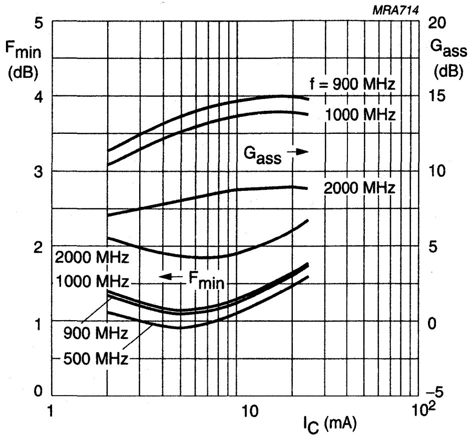
I_C = 5 mA; V_{CE} = 3 V.

Fig.8 Gain as a function of frequency; typical values.



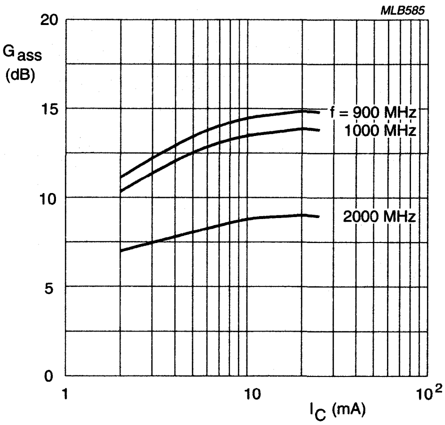
I_C = 20 mA; V_{CE} = 3 V.

Fig.9 Gain as a function of frequency; typical values.



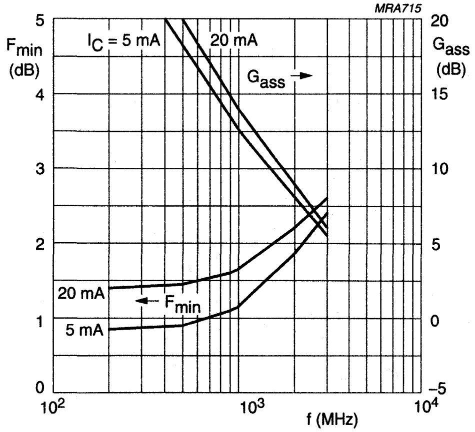
V_{CE} = 3 V.

Fig.10 Minimum noise figure as a function of collector current, typical values.



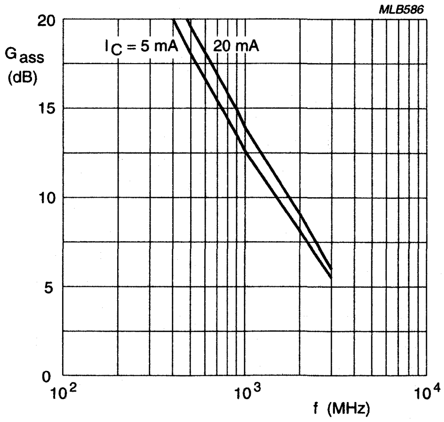
V_{CE} = 3 V.

Fig.11 Associated available gain as a function of collector current, typical values.



V_{CE} = 3 V.

Fig.12 Minimum noise figure as a function of frequency, typical values.



V_{CE} = 3 V.

Fig.13 Associated available gain as a function of frequency, typical values.

APPLICATION INFORMATION

SPICE parameters for any single BFM520 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510.0	mA
6	ISE	283.0	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	0.775	Ω
18	RC	2.210	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.071	–
33	XCJC	0.130	–
34	TR	543.7	ps
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.

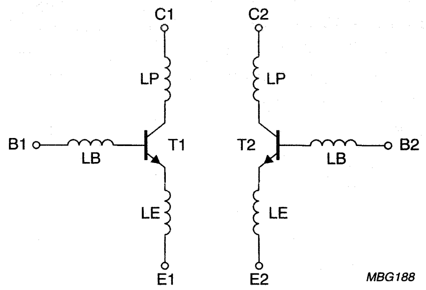


Fig.14 Package equivalent circuit SOT363A (inductance only).

Lead inductances (nH)

LP	0.4
LB	0.6
LE	1.0

E2	3				
E1	27	6			
B2	1	27	3		
C2	3	17	36	48	
C1	48	36	17	3	6
	B1	E2	E1	B2	C2

MBG189

Fig.15 Package capacitance (fF) between indicated nodes.

NPN 1 GHz wideband transistor BFQ17

DESCRIPTION

NPN transistor in a SOT89 plastic envelope intended for application in thick and thin-film circuits. The transistor has extremely good intermodulation properties and a high power gain.

PINNING

PIN	DESCRIPTION
Code: FA	
1	emitter
2	collector
3	base

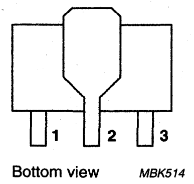


Fig.1 SOT89.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
f_T	transition frequency	I_C = 150 mA; V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C	1.5	–	GHz
C_{re}	feedback capacitance	I_C = 10 mA; V_{CE} = 15 V; f = 1 MHz; T_{amb} = 25 °C	1.9	–	pF

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CER}	collector-emitter voltage	$R_{BE} \leq 50\ \Omega$	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
I_{CM}	peak collector current	f > 1 MHz	–	300	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 145 °C (note 1)	30 K/W

Note

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

CHARACTERISTICS

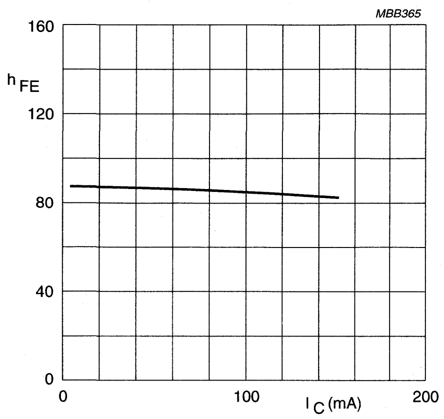
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V; T_j = 50 °C	–	–	20	μA
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA	–	–	0.5	V
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 5 V	25	80	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 15 V; f = 1 MHz	–	–	4	pF
C_{re}	feedback capacitance	I_C = 10 mA; V_{CE} = 15 V; f = 1 MHz; T_{amb} = 25 °C	–	1.9	–	pF
f_T	transition frequency	I_C = 150 mA; V_{CE} = 15 V; f = 500 MHz	–	1.5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 60 mA; V_{CE} = 15 V; f = 200 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 60 mA; V_{CE} = 15 V; f = 800 MHz; T_{amb} = 25 °C	–	6.5	–	dB

Note

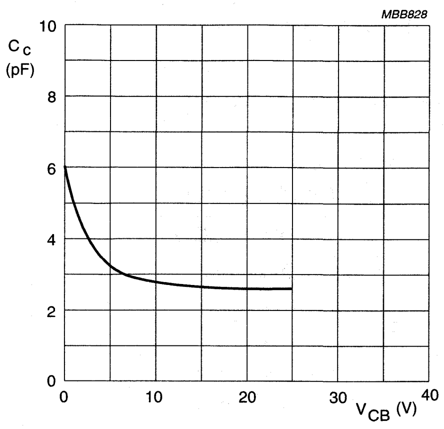
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}.$$



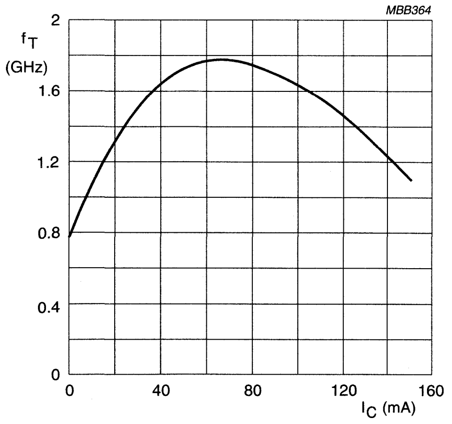
V_{CE} = 5 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



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

Fig.3 Collector capacitance as a function of collector-base voltage.



V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.

NPN 4 GHz wideband transistor BFQ18A

DESCRIPTION

NPN transistor in a plastic SOT89 envelope intended for application in thick and thin-film circuits. It is primarily intended for MATV purposes.

PINNING

PIN	DESCRIPTION
Code: FF	
1	emitter
2	collector
3	base

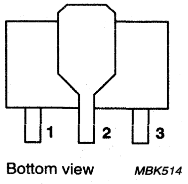


Fig.1 SOT89.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 155 °C (note 1)	–	1	W
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	4	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 10.7 MHz	1.2	–	pF
d_{im}	intermodulation distortion	I_C = 80 mA; V_{CE} = 10 V; R_L = 75 Ω; V_o = 700 mV; measured at $f_{(p+q-r)}$ = 793.25 MHz	–	–60	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 155 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 155 °C (note 1)	20 K/W

Note

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

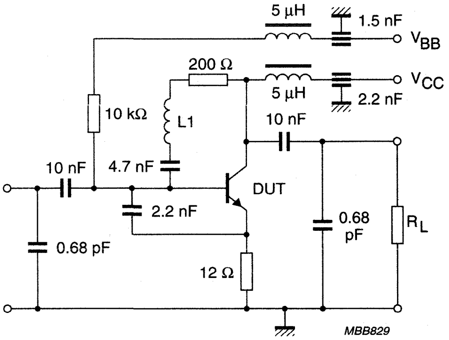
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	UNIT
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V	25	–	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	2	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 0.5 V; f = 1 MHz	–	11	pF
C_{re}	feedback capacitance	$I_C = 0$; V_{CE} = 10 V; f = 10.7 MHz	–	1.2	pF
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz	–	4	GHz
d_{im}	intermodulation distortion (see Fig.2)	note 1	–	–60	dB

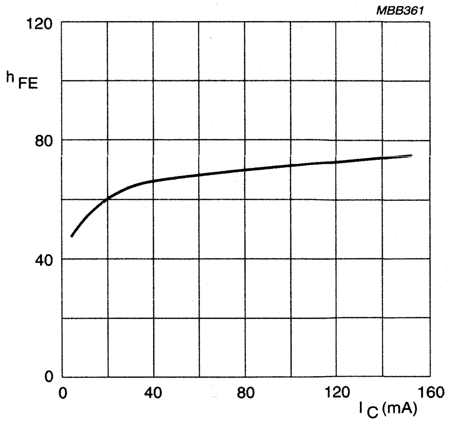
Note

1. I_c = 80 mA; V_{CE} = 10 V; R_L = 75 Ω;
   $V_p = V_o$ = 700 mV; 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.



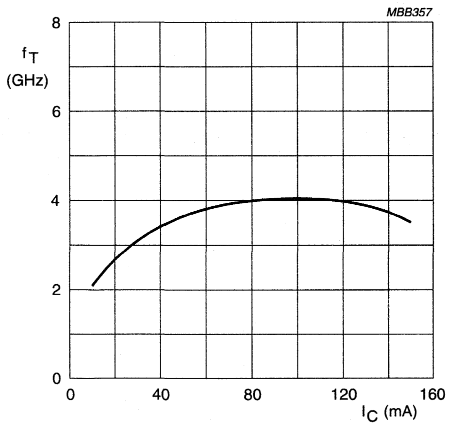
f = 40 – 860 MHz.

Fig.2 Intermodulation distortion MATV test circuit.



V_{CE} = 10 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



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

Fig.4 Transition frequency as a function of collector current.

NPN 5 GHz wideband transistor BFQ19

DESCRIPTION

NPN transistor in a SOT89 plastic envelope intended for application in thick and thin-film circuits. It is primarily intended for use in UHF and microwave amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc.

The transistor features very low intermodulation distortion and high power gain. Due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

PINNING

PIN	DESCRIPTION
Code: FB	
1	emitter
2	collector
3	base

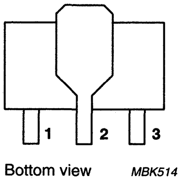


Fig.1 SOT89.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	100	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
f_T	transition frequency	I_c = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	5.5	–	GHz
C_{re}	feedback capacitance	I_c = 10 mA; V_{CE} = 10 V; f = 1 MHz; T_{amb} = 25 °C	1.3	–	pF
F	noise figure	I_c = 50 mA; V_{CE} = 10 V; Z_s = opt.; f = 500 MHz; T_{amb} = 25 °C	3.3	–	dB

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	–	3.3	V
I_C	DC collector current		–	100	mA
I_{CM}	peak collector current	f > 1 MHz	–	150	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 145$ °C (note 1)	30 K/W

Note

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

CHARACTERISTICS

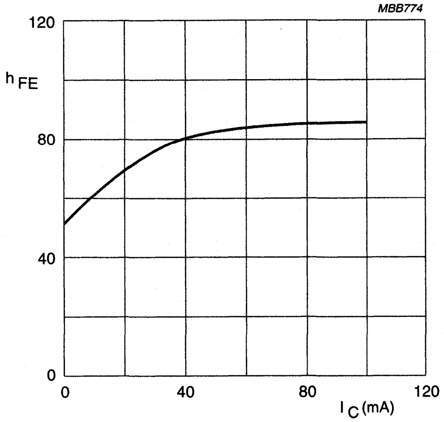
$T_j = 25$ °C unless otherwise specified.

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	$I_C = 70$ mA; $V_{CE} = 10$ V	25	80	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	5	–	pF
C_{re}	feedback capacitance	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	1.3	–	pF
f_T	transition frequency	$I_C = 70$ mA; $V_{CE} = 10$ V; f = 500 MHz	4.4	5.5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	11.5	–	dB
		$I_C = 50$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	7.5	–	dB
F	noise figure	$I_C = 50$ mA; $V_{CE} = 10$ V; Z_s = opt.; f = 500 MHz; $T_{amb} = 25$ °C	–	3.3	–	dB

Note

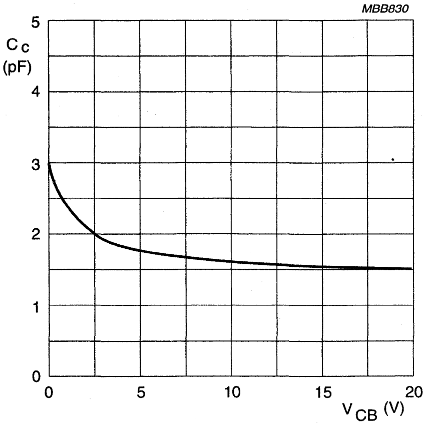
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$



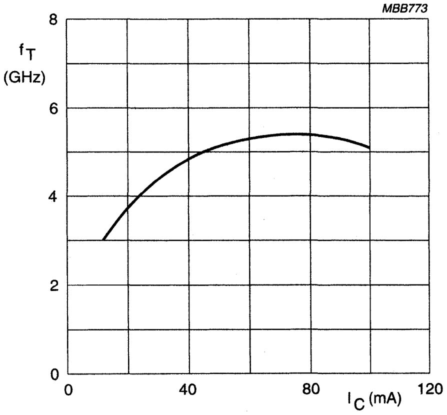
V_{CE} = 10 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



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

Fig.3 Collector capacitance as a function of collector-base voltage.



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

Fig.4 Transition frequency as a function of collector current.

NPN 4 GHz wideband transistor BFQ34

DESCRIPTION

NPN transistor encapsulated in a 4 lead SOT122A envelope with a ceramic cap. All leads are isolated from the stud.

It is primarily intended for driver and final stages in MATV system amplifiers. It is also suitable for use in low power band IV and V equipment. Diffused emitter-ballasting resistors and the application of gold sandwich metallization ensure an optimum temperature profile and excellent reliability properties. The device also features high output voltage capabilities.

PINNING

PIN	DESCRIPTION
Code: BFQ34/01	
1	collector
2	emitter
3	base
4	emitter

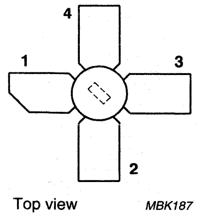


Fig.1 SOT122A.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
I_C	collector current		–	150	mA
P_{tot}	total power dissipation	up to $T_c = 160$ °C	–	2.7	W
f_T	transition frequency	$I_C = 150$ mA; $V_{CE} = 15$ V; f = 500 MHz	4	–	GHz
V_o	output voltage	$I_C = 120$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C; $d_{im} = -60$ dB $f_{(p+q-r)} = 793.25$ MHz	1.2	–	V
P_{L1}	output power at 1 dB gain compression	$I_C = 120$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	26	–	dBm
ITO	third order intercept point	$I_C = 120$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C	45	–	dBm

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_c = 160 °C	–	2.7	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	15 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

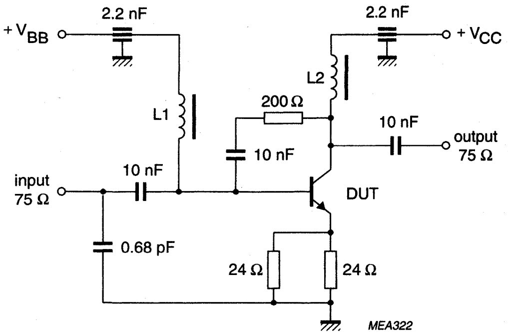
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 15$ V	–	–	100	μA
h_{FE}	DC current gain	$I_C = 75$ mA; $V_{CE} = 15$ V	25	70	–	
		$I_C = 150$ mA; $V_{CE} = 15$ V	25	70	–	
f_T	transition frequency	$I_C = 75$ mA; $V_{CE} = 15$ V; f = 500 MHz	3	3.5	–	GHz
		$I_C = 150$ mA; $V_{CE} = 15$ V; f = 500 MHz	3.5	4	–	GHz
C_c	collector capacitance	$I_E = 0$; $V_{CB} = 15$ V; f = 1 MHz	–	2	2.75	pF
C_e	emitter capacitance	$I_C = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
C_{re}	feedback capacitance	$I_C = 10$ mA; $V_{CE} = 15$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	1	1.35	pF
$C_{c\text{-}s}$	collector-stud capacitance	note 1	–	0.8	–	pF
F	noise figure (see Fig.2)	$I_C = 120$ mA; $V_{CE} = 15$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	8	–	dB
G_{UM}	maximum unilateral power gain (note 2)	$I_C = 120$ mA; $V_{CE} = 15$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16.3	–	dB
V_o	output voltage	Figs 2 and 7 and note 3	–	1.2	–	V
P_{L1}	output power at 1 dB gain compression (see Fig.2)	note 4	–	26	–	dBm
ITO	third order intercept point (see Fig.2)	note 5	–	45	–	dBm

Notes

1. Measured with grounded emitter and base.
2. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

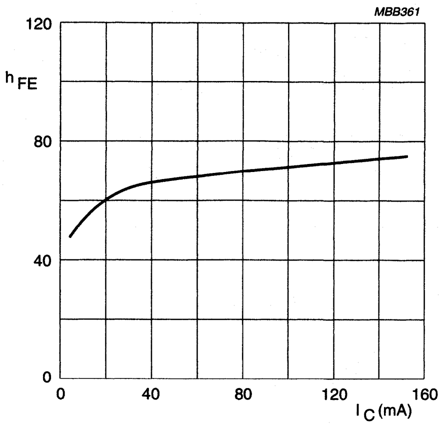
$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\text{dB.}$$

3. $d_{im} = -60$ dB (DIN 45004B, par. 6.3.: 3-tone); $I_C = 120$ mA; $V_{CE} = 15$ 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. $I_C = 120$ mA; $V_{CE} = 15$ V; $T_{amb} = 25$ °C; $R_L = 75\ \Omega$;
   measured at f = 800 MHz.
5. $I_C = 120$ mA; $V_{CE} = 15$ 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.



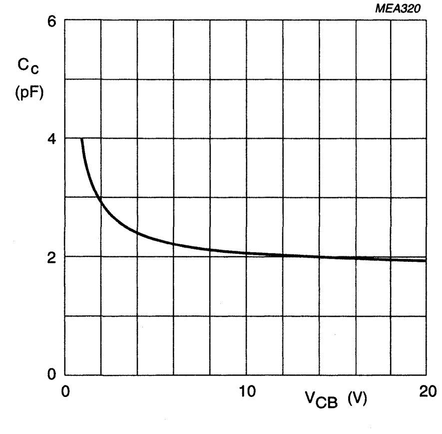
f = 40 to 860 MHz; L1 = L2 = 5 μH Ferroxcube coil.

Fig.2 Intermodulation distortion MATV test circuit.



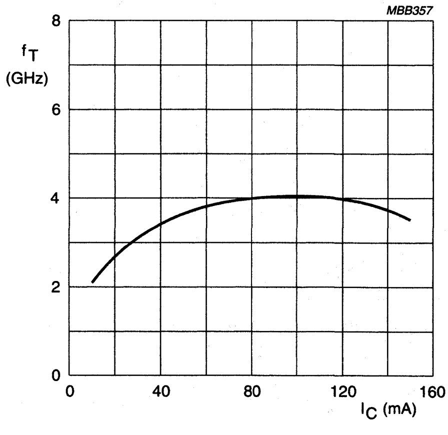
V_{CE} = 15 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



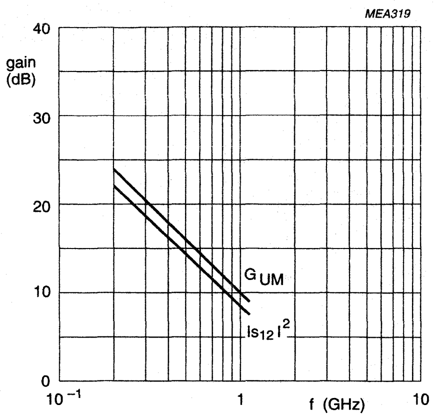
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



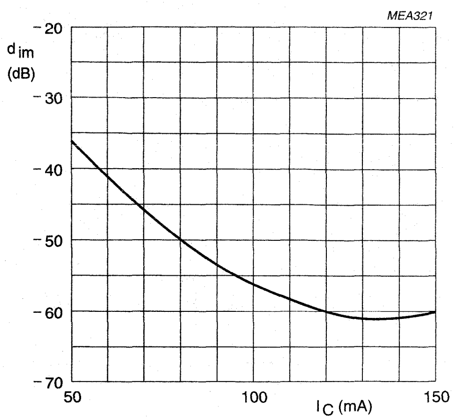
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C.

Fig.5 Transition frequency as a function of collector current.



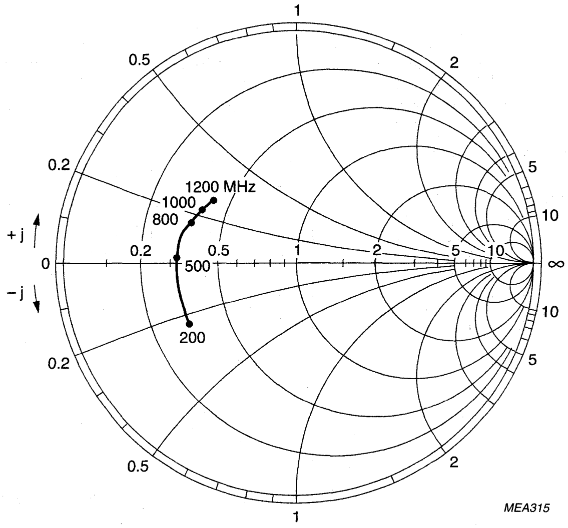
I_c = 120 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.6 Gain as a function of frequency.



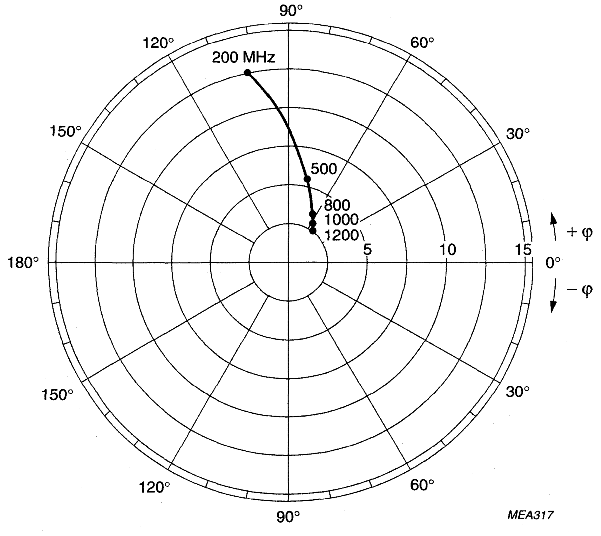
V_o = 1.2 V; V_{CE} = 15 V; $f_{(p+q-r)}$ = 793.25 MHz

Fig.7 Intermodulation distortion as a function of collector current.



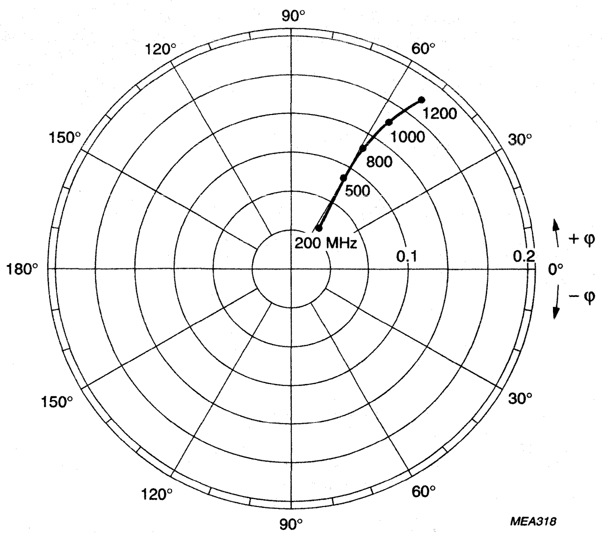
I_c = 120 mA; V_{CE} = 15 V; T_{amb}= 25 °C.
Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



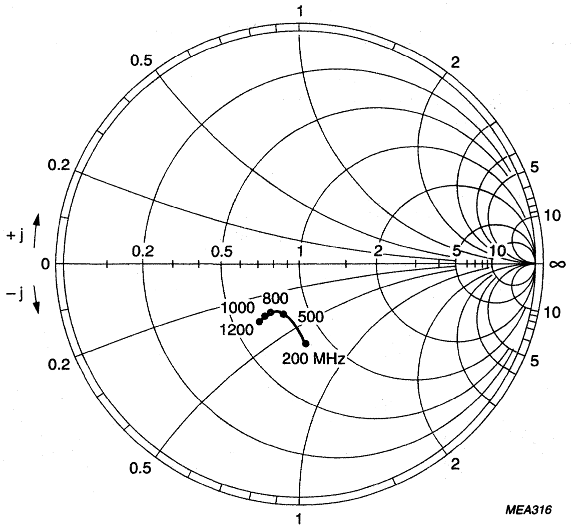
I_c = 120 mA; V_{CE} = 15 V; T_{amb}= 25 °C.

Fig.9 Common emitter forward transmission coefficient (S_{21}).



I_c = 120 mA; V_{CE} = 15 V; T_{amb}= 25 °C.

Fig.10 Common emitter reverse transmission coefficient (S_{12}).



I_c = 120 mA; V_{CE} = 15 V; T_{amb}= 25 °C.
Z_o = 50 Ω.

Fig.11 Common emitter output reflection coefficient (S_{22}).

NPN 8 GHz wideband transistor BFQ67

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

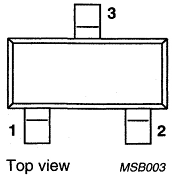
Satellite TV tuners and RF portable communications equipment up to 2 GHz.

DESCRIPTION

Silicon NPN wideband transistor in a plastic SOT23 package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: V2p.

Fig.1 SOT23.

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	–	–	10	V
I_C	collector current (DC)		–	–	50	mA
P_{tot}	total power dissipation	$T_s \leq 97$ °C; note 1	–	–	300	mW
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 5$ V	60	100	–	
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 8$ V	–	8	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	14	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	1.3	–	dB

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_s \leq 97$ °C; note 1	–	300	mW
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	260	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 5$ V	60	100	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.3	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 8$ V	–	8	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 8$ V; f = 2 GHz	–	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.3	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 15$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.2	–	dB
		$I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz; $Z_s = 60\ \Omega$	–	2.5	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 15$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.7	–	dB
		$I_C = 15$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz; $Z_s = 60\ \Omega$	–	3	–	dB

Note

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 .

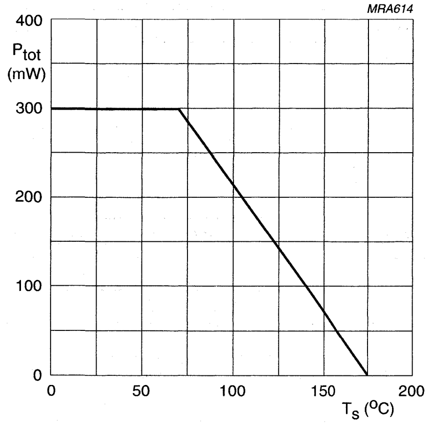
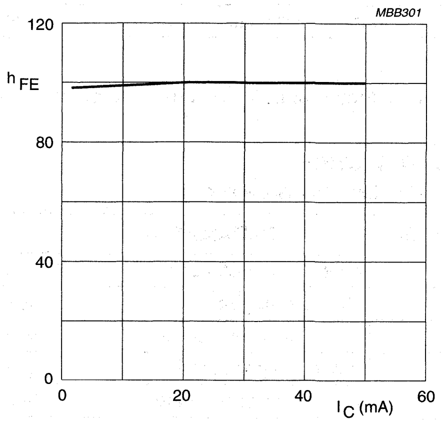
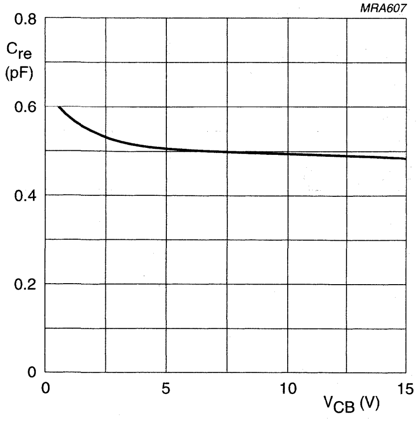


Fig.2 Power derating curve.



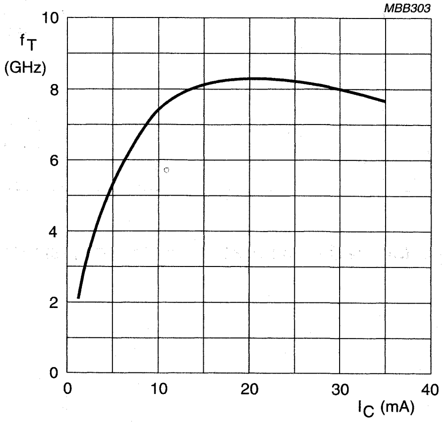
V_{CE} = 5 V.

Fig.3 DC current gain as a function of collector current, typical values.



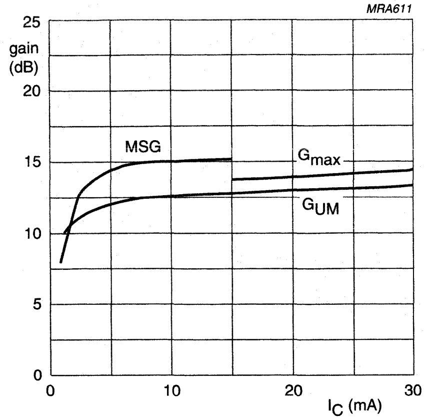
$I_C = i_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.



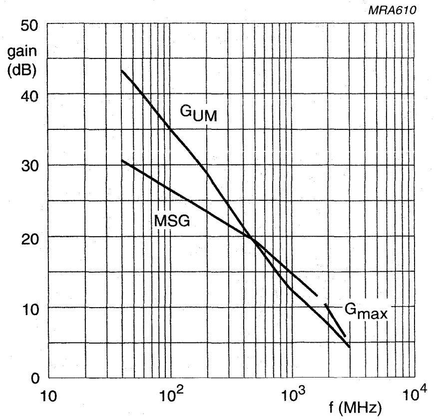
V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz.

Fig.5 Transition frequency as a function of collector current, typical values.



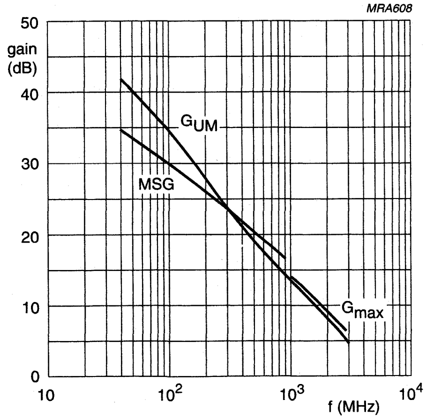
V_{CE} = 8 V; f = 1 GHz.

Fig.6 Gain as a function of collector current, typical values.



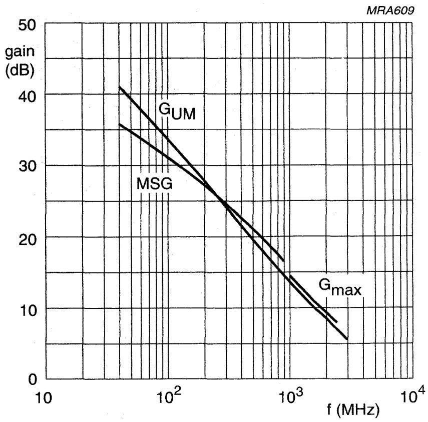
V_{CE} = 8 V; I_C = 5 mA.

Fig.7 Gain as a function of frequency, typical values.



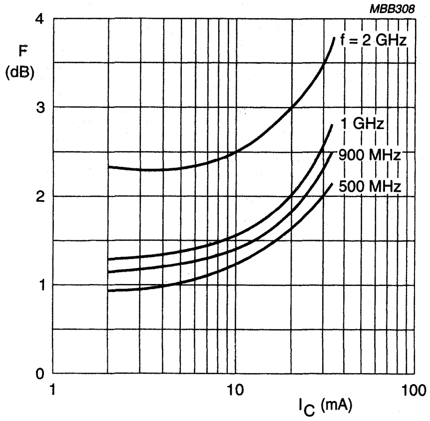
V_{CE} = 8 V; I_C = 15 mA.

Fig.8 Gain as a function of frequency, typical values.



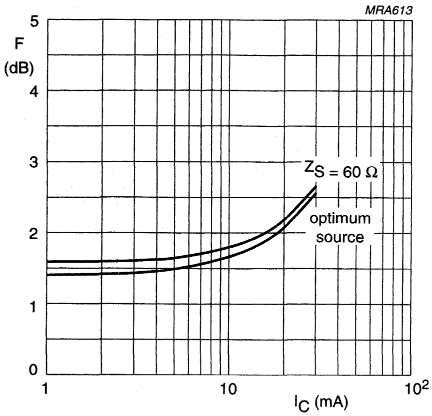
V_{CE} = 8 V; I_C = 30 mA.

Fig.9 Gain as a function of frequency, typical values.



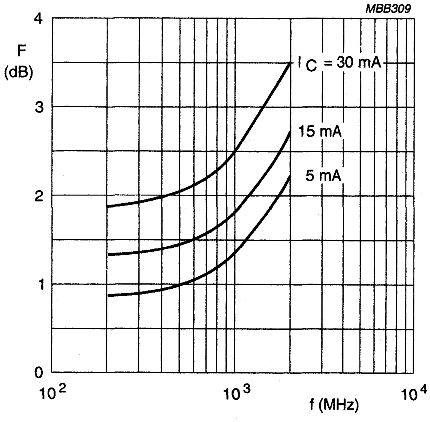
V_{CE} = 8 V.

Fig.10 Minimum noise figure as a function of collector current, typical values.



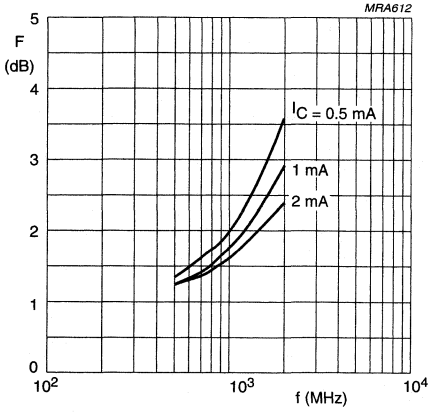
V_{CE} = 6 V; f = 900 MHz.

Fig.11 Noise figure as a function of collector current, typical values.



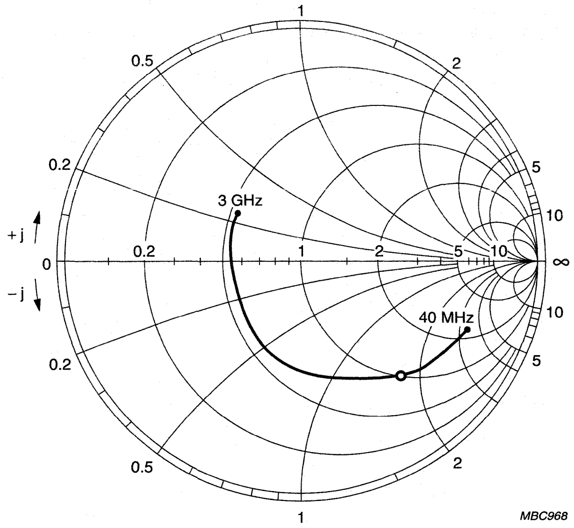
V_{CE} = 8 V.

Fig.12 Minimum noise figure as a function of frequency, typical values.



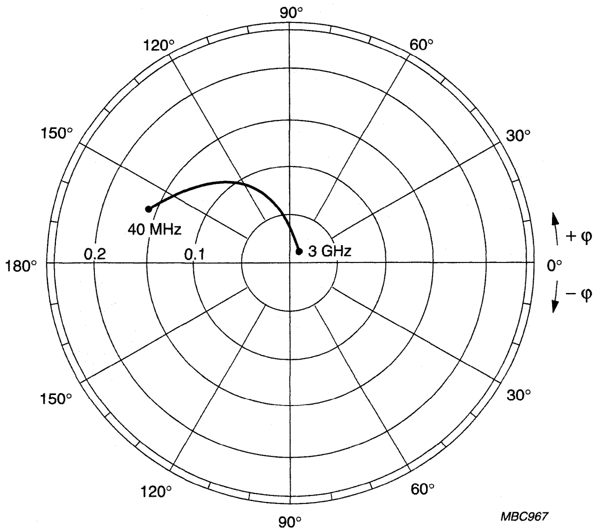
V_{CE} = 1 V.

Fig.13 Minimum noise figure as a function of frequency, typical values.



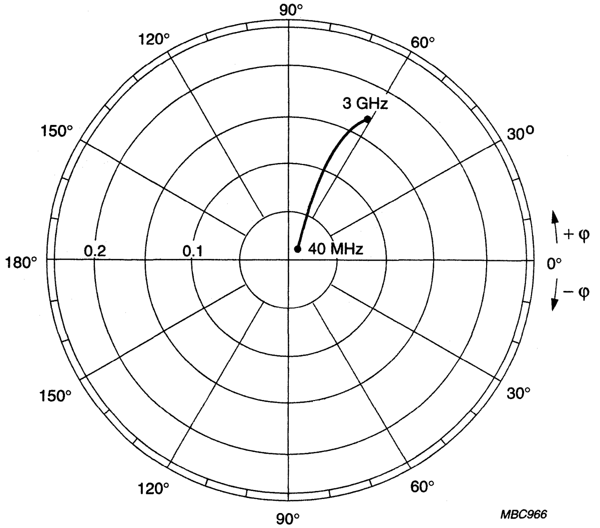
V_{CE} = 8 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}), typical values.



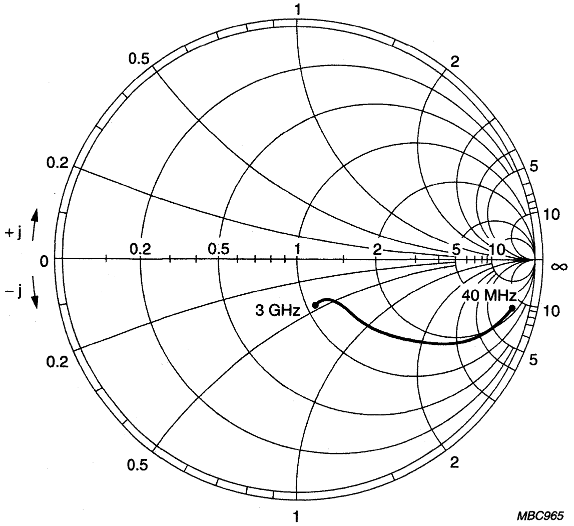
V_{CE} = 8 V; I_C = 15 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}), typical values.



V_{CE} = 8 V; I_C = 15 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}), typical values.



V_{CE} = 8 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}), typical values.

NPN 8 GHz wideband transistor BFQ67W

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

PINNING

PIN	DESCRIPTION
Code: V2	
1	base
2	emitter
3	collector

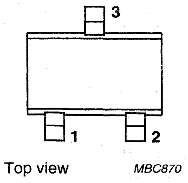


Fig.1 SOT323.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is designed for wideband applications such as satellite TV tuners and RF portable communications equipment up to 2 GHz.

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	–	–	10	V
I_C	DC collector current		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 5 V; T_j = 25 °C	60	100	–	
f_T	transition frequency	I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	8	–	GHz
G_{UM}	maximum unilateral power gain	I_c = 15 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	13	–	dB
F	noise figure	I_c = 5 mA; V_{CE} = 8 V; f = 1 GHz	–	1.3	–	dB

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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 118 °C; note 1	190 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 5$ V	60	100	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.3	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 1 GHz $T_{amb} = 25$ °C	–	13	–	dB
		$I_C = 15$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	1.3	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 15$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	2	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; f = 2 GHz	–	2.2	–	dB
		$I_C = 5$ mA; $V_{CE} = 8$ V; f = 2 GHz; $Z_s = 60\ \Omega$	–	2.5	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 15$ mA; $V_{CE} = 8$ V; f = 2 GHz	–	2.7	–	dB
		$I_C = 5$ mA; $V_{CE} = 8$ V; f = 2 GHz; $Z_s = 60\ \Omega$	–	3	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB.}$$

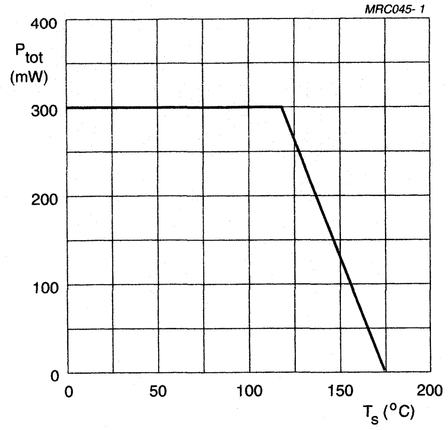
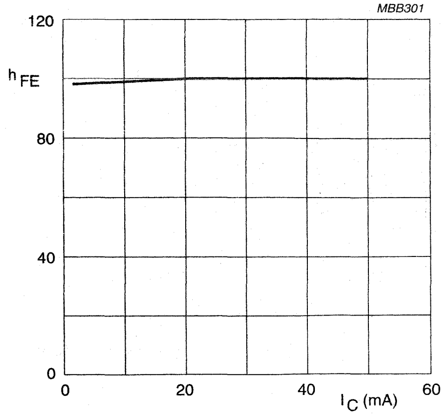
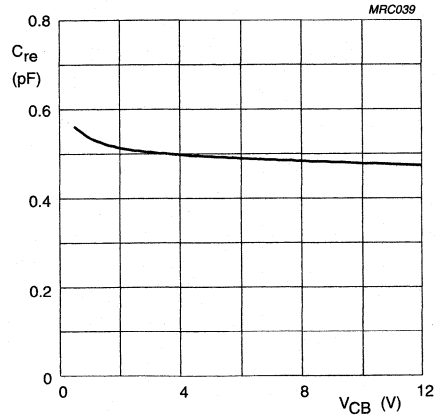


Fig.2 Power derating curve.



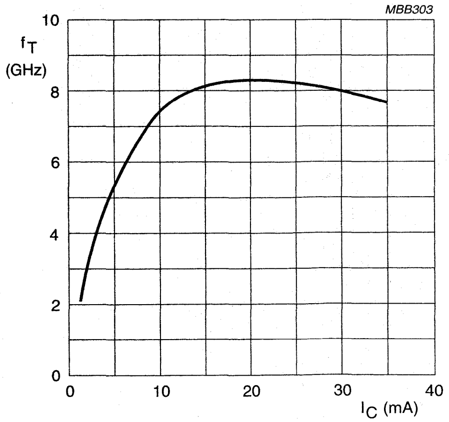
V_{CE} = 5 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

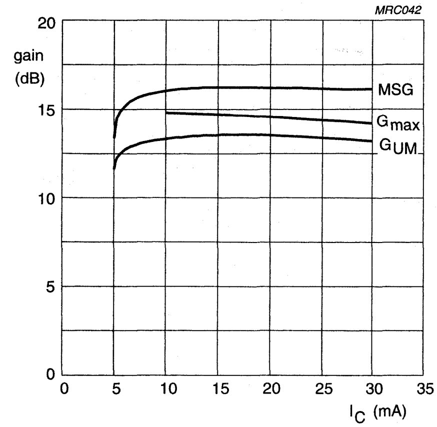
Fig.4 Feedback capacitance as a function of collector-base voltage.



V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C.

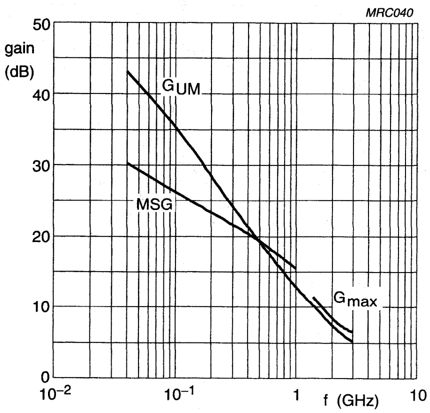
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



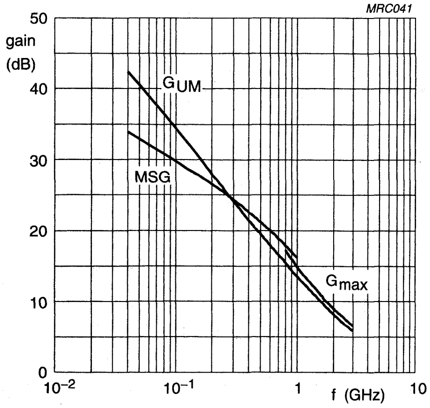
V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



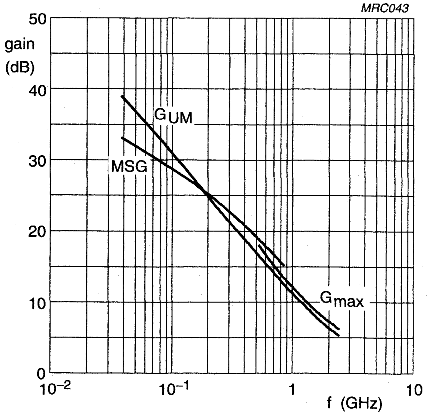
I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

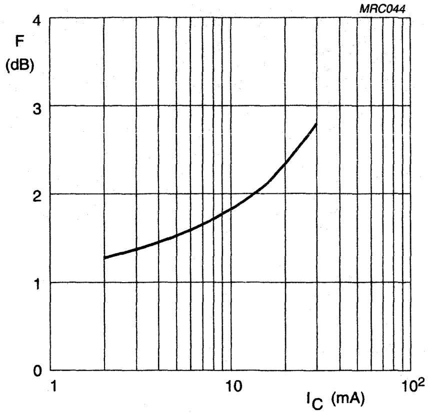
Fig.8 Gain as a function of frequency.



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

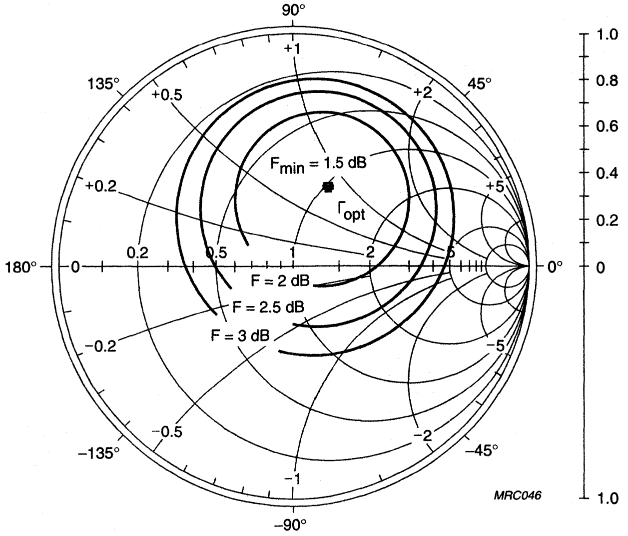
Fig.9 Gain as a function of frequency.

NPN 8 GHz wideband transistor BFQ67W



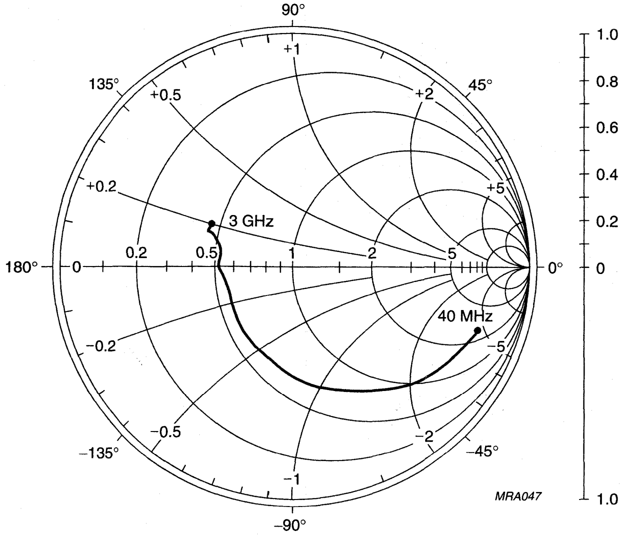
V_{CE} = 8 V; f = 1 GHz.

Fig.10 Minimum noise figure as a function of collector current.



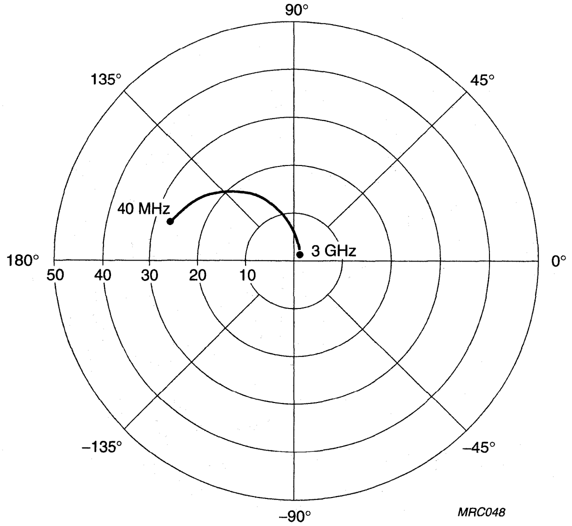
I_C = 5 mA; V_{CE} = 8 V;
f = 1 GHz; Z_o = 50 Ω.

Fig.11 Noise circle.



I_C = 15 mA; V_{CE} = 8 V; Z_o = 50 Ω.

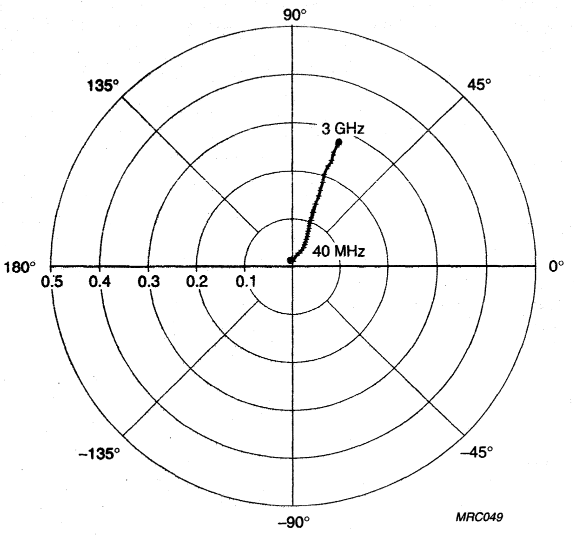
Fig.12 Common emitter input reflection coefficient (S_{11}).



I_C = 15 mA; V_{CE} = 8 V.

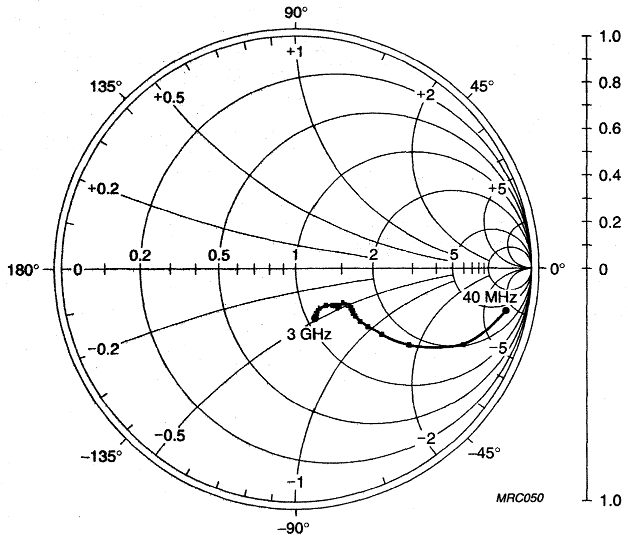
Fig.13 Common emitter forward transmission coefficient (S_{21}).

NPN 8 GHz wideband transistor BFQ67W



I_C = 15 mA; V_{CE} = 8 V.

Fig.14 Common emitter reverse transmission coefficient (S_{12}).



I_C = 15 mA; V_{CE} = 8 V; Z_o = 50 Ω.

Fig.15 Common emitter output reflection coefficient (S_{22}).

NPN 4 GHz wideband transistor BFQ68

DESCRIPTION

NPN transistor mounted in a four-lead dual-emitter SOT122A envelope with a ceramic cap. All leads are isolated from the stud. Diffused emitter-ballasting resistors and the application of gold sandwich metallization ensure an optimum temperature profile and excellent reliability properties. It features very high output voltage capabilities.

It is primarily intended for final stages in MATV system amplifiers, and is also suitable for use in low power band IV and V equipment.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

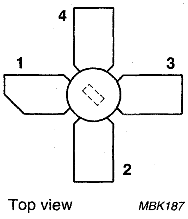


Fig.1 SOT122A.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	18	V
I_C	collector current		–	300	mA
P_{tot}	total power dissipation	up to $T_c = 110$ °C	–	4.5	W
f_T	transition frequency	$I_C = 240$ mA; $V_{CE} = 15$ V; f = 500 MHz; $T_j = 25$ °C	4	–	GHz
V_o	output voltage	$I_c = 240$ mA; $V_{CE} = 15$ V; $d_{im} = -60$ dB; $R_L = 75\ \Omega$; $f_{(p+q-r)} = 793.25$ MHz; $T_{amb} = 25$ °C	1.6	–	V
P_{L1}	output power at 1 dB gain compression	$I_c = 240$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	28	–	dBm
ITO	third order intercept point	$I_c = 240$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	47	–	dBm

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	300	mA
P_{tot}	total power dissipation	up to T_c = 110 °C	–	4.5	W
T_{stg}	storage temperature		−65	150	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	20 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

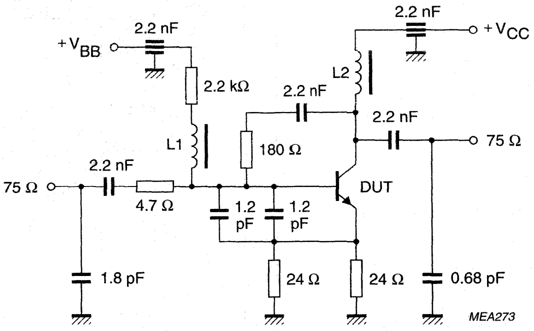
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 15$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 240$ mA; $V_{CE} = 15$ V	25	75	–	
f_T	transition frequency	$I_C = 240$ mA; $V_{CE} = 15$ V; f = 500 MHz	–	4	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 15$ V; f = 1 MHz	–	3.8	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	20	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 15$ V; f = 1 MHz	–	2.3	–	pF
C_{cs}	collector-stud capacitance	note 1	–	0.8	–	pF
G_{UM}	maximum unilateral power gain (note 2)	$I_C = 240$ mA; $V_{CE} = 15$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	13	–	dB
V_o	output voltage	note 3	–	1.6	–	V
P_{L1}	output power at 1 dB gain compression (see Fig.2)	$I_C = 240$ mA; $V_{CE} = 15$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C; measured at f = 800 MHz	–	28	–	dBm
ITO	third order intercept point (see Fig.2)	note 4	–	47	–	dBm

Notes

1. Measured with emitter and base grounded.
2. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

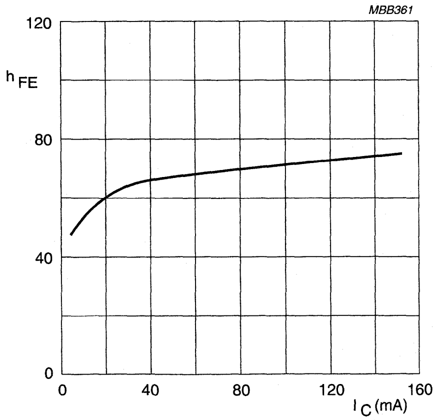
$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

3. $d_{im} = -60$ dB (see Figs 2 and 7) (DIN 45004B); $I_C = 240$ mA; $V_{CE} = 15$ 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. $I_C = 240$ mA; $V_{CE} = 15$ 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.



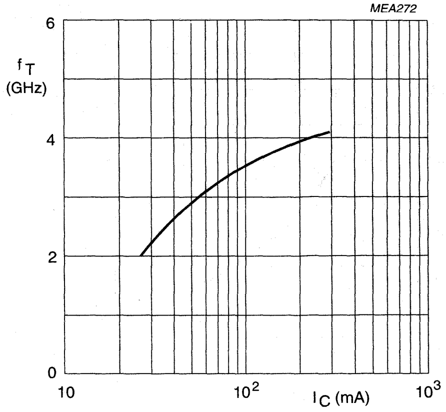
f = 40 to 860 MHz.
L1 = L2 = 5 μH Ferroxcube choke.

Fig.2 Intermodulation distortion MATV test circuit.



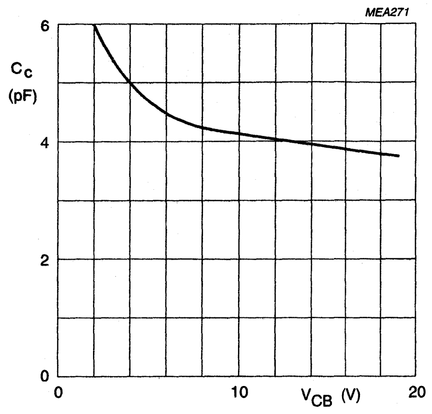
V_{CE} = 10 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



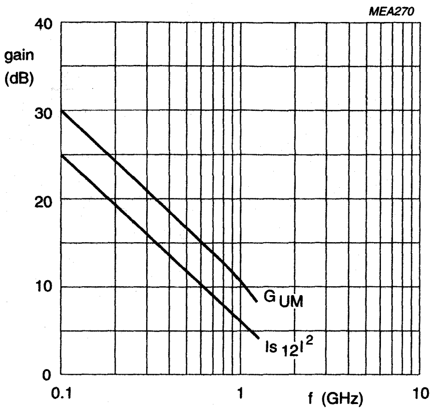
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C

Fig.4 Transition frequency as a function of collector current.



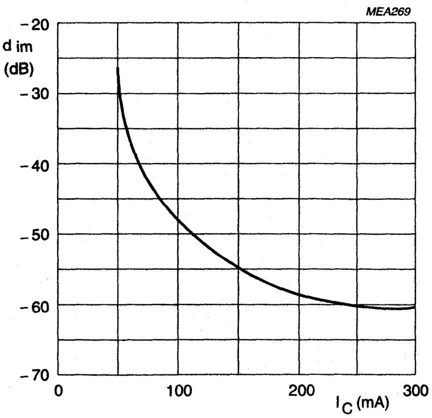
$I_E = i_e = 0$; f = 1 MHz

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



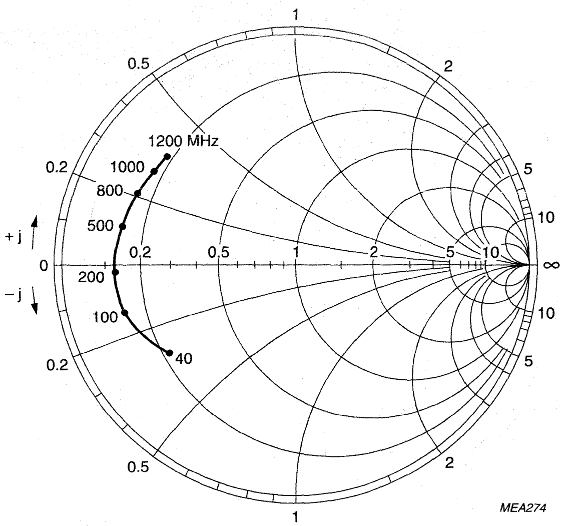
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C

Fig.6 Gain as a function of frequency.



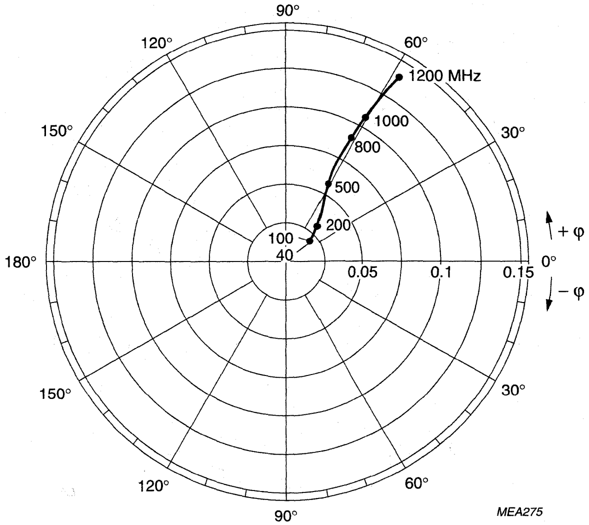
V_{CE} = 15 V; V_o = 1.6 V; $f_{(p+q-r)}$ = 793.25 MHz.

Fig.7 Intermodulation distortion as a function of collector current.



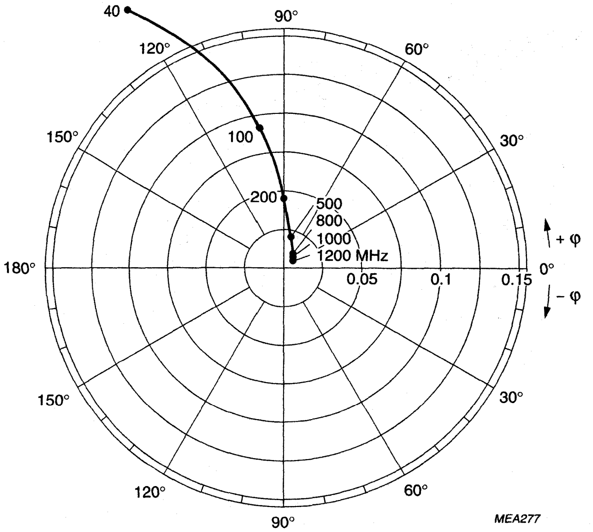
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



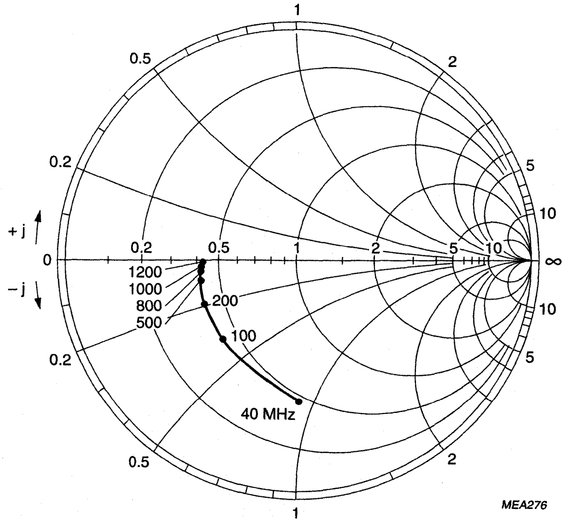
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.9 Common emitter forward transmission coefficient (S_{21}).



I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.10 Common emitter reverse transmission coefficient (S_{12}).



I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.11 Common emitter output reflection coefficient (S_{22}).

NPN 6.5 GHz wideband transistor BFQ135

FEATURES

- Optimum temperature profile and excellent reliability properties ensured by emitter-ballasting resistors and application of gold sandwich metallization.

APPLICATIONS

- MATV and microwave amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

DESCRIPTION

NPN wideband transistor in a 4-lead dual-emitter SOT172A2 package with a ceramic cap. All leads are isolated from the mounting base.

PINNING

PIN	DESCRIPTION
1	collector
2, 4	emitter
3	base

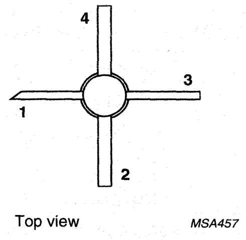


Fig.1 SOT172A2.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	19	V
I_C	collector current (DC)		–	–	150	mA
P_{tot}	total power dissipation	$T_c \leq 145$ °C	–	–	2.7	W
h_{FE}	DC current gain	$I_C = 120$ mA; $V_{CE} = 18$ V; $T_{amb} = 25$ °C	55	–	–	
f_T	transition frequency	$I_C = 120$ mA; $V_{CE} = 18$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	6.5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 120$ mA; $V_{CE} = 18$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	17	–	dB
		$I_C = 120$ mA; $V_{CE} = 18$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	13.5	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 120$ mA; $V_{CE} = 18$ V; $R_L = 75\ \Omega$; $f_p + f_q - f_r = 793.25$ MHz; $T_{amb} = 25$ °C	–	1.2	–	V

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged.
All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	19	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	150	mA
P_{tot}	total power dissipation	$T_c \leq 145$ °C	–	2.7	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	20	K/W

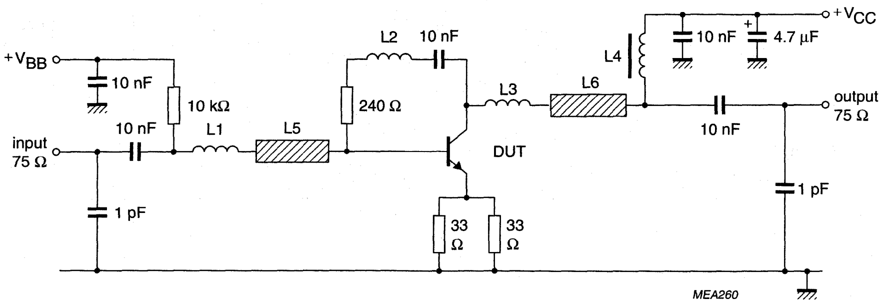
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 18$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 120$ mA; $V_{CE} = 18$ V; $T_{amb} = 25$ °C	55	–	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 18$ V; f = 1 MHz	–	1.8	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	5.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 18$ V; f = 1 MHz	–	1	1.2	pF
f_T	transition frequency	$I_C = 120$ mA; $V_{CE} = 18$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	6.5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 120$ mA; $V_{CE} = 18$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	17	–	dB
		$I_C = 120$ mA; $V_{CE} = 18$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	13.5	–	dB
V_O	output voltage	note 2	–	1.35	–	V
		note 3	–	1.2	–	V
d_2	second order intermodulation distortion	note 4	–	−70	–	dB
		note 5	–	−70	–	dB

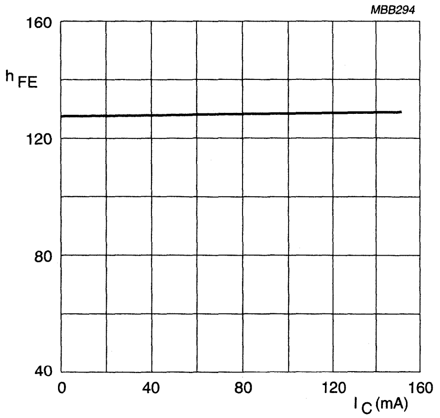
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}$.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = 120$ mA; $V_{CE} = 18$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 445.25$ MHz;
   $V_q = V_O$ −6 dB; $f_q = 453.25$ MHz;
   $V_r = V_O$ −6 dB; $f_r = 455.25$ MHz;
   measured at $f_p + f_q - f_r = 443.25$ MHz.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 120$ mA; $V_{CE} = 18$ 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 $f_p + f_q - f_r = 793.25$ MHz.
4. $I_C = 90$ mA; $V_{CE} = 18$ V; $V_O = 50$ dBmV; $T_{amb} = 25$ °C;
   $f_p = 50$ MHz; $f_q = 400$ MHz;
   measured at $f_p + f_q = 450$ MHz.
5. $I_C = 90$ mA; $V_{CE} = 18$ V; $V_O = 50$ dBmV; $T_{amb} = 25$ °C;
   $f_p = 250$ MHz; $f_q = 560$ MHz;
   measured at $f_p + f_q = 810$ MHz.



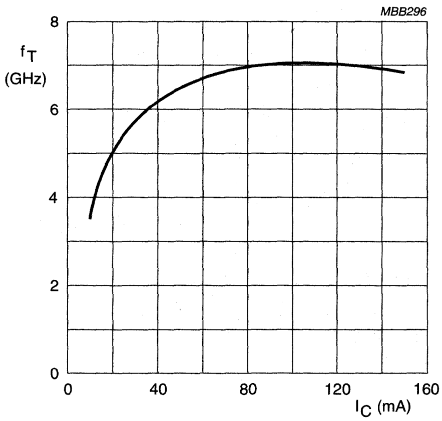
L1 = 8 nH.
L2 = 15 nH (2 turns copper wire, internal diameter 2 mm).
L3 = 10 nH (2 turns copper wire, internal diameter 1.5 mm).
L5: Lp = 21 mm; Rc = 75 Ω.
L6: Lp = 16 mm; Rc = 75 Ω.

Fig.2 Intermodulation distortion test circuit.



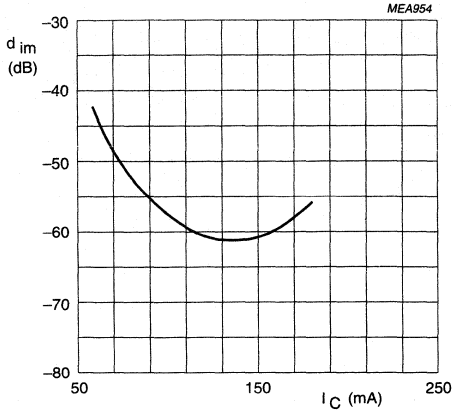
V_{CE} = 18 V; T_{amb} = 25 °C.

Fig.3 DC current gain as a function of collector current; typical values.



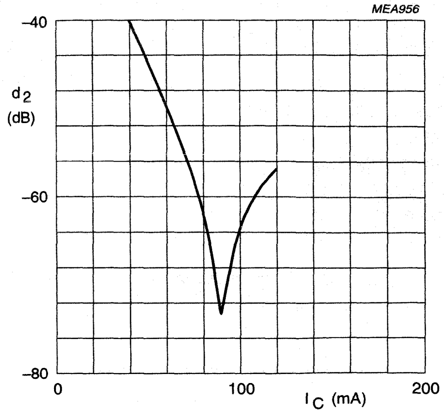
V_{CE} = 18 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.4 Transition frequency as a function of collector current; typical values.



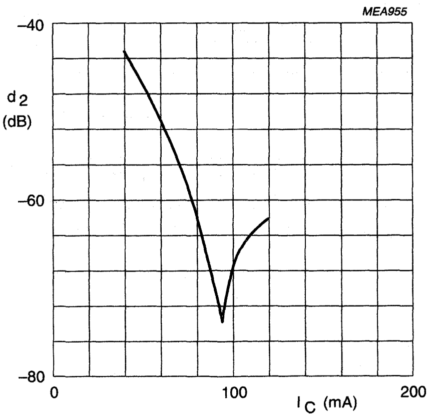
V_{CE} = 18 V.

Fig.5 Intermodulation distortion as a function of collector current; typical values.



V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C; measured at $f_p + f_q$ = 450 MHz.

Fig.6 Second order intermodulation distortion as a function of collector current; typical values.



V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C; measured at $f_p + f_q$ = 810 MHz.

Fig.7 Second order intermodulation distortion as a function of collector current; typical values.

NPN 4 GHz wideband transistor BFQ136

DESCRIPTION

NPN transistor in a four-lead dual-emitter SOT122A envelope with a ceramic cap. All leads are isolated from the stud. Diffused emitter-ballasting resistors and the application of gold sandwich metallization ensure an optimum temperature profile and excellent reliability properties. It features extremely high output voltage capabilities.

It is primarily intended for final stages in UHF amplifiers.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

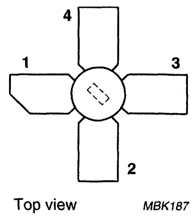


Fig.1 SOT122A.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	18	V
I_C	DC collector current		–	600	mA
P_{tot}	total power dissipation	up to T_c = 100 °C	–	9	W
f_T	transition frequency	I_C = 500 mA; V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C	4.0	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 500 mA; V_{CE} = 15 V; f = 800 MHz; T_{amb} = 25 °C	12.5	–	dB
V_o	output voltage	I_c = 500 mA; V_{CE} = 15 V; d_{im} = −60 dB; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C	2.5	–	V

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	18	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	600	mA
P_{tot}	total power dissipation	up to T_c = 100 °C	–	9	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	11 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 15$ V	–	–	75	μA
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 15$ V	25	75	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 15$ V; f = 1 MHz	–	7.0	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	40	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 15$ V; f = 1 MHz	–	4.0	–	pF
C_{cs}	collector-stud capacitance	note 1	–	0.8	–	pF
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 15$ V; f = 500 MHz	–	4.0	–	GHz
G_{UM}	maximum unilateral power gain (note 2)	$I_C = 500$ mA; $V_{CE} = 15$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	12.5	–	dB
V_o	output voltage (see Fig.2)	note 3	–	2.5	–	V

Notes

1. Measured with emitter and base grounded.
2. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB.}$$

3. $d_{im} = -60$ dB; $I_C = 500$ mA; $V_{CE} = 15$ 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.

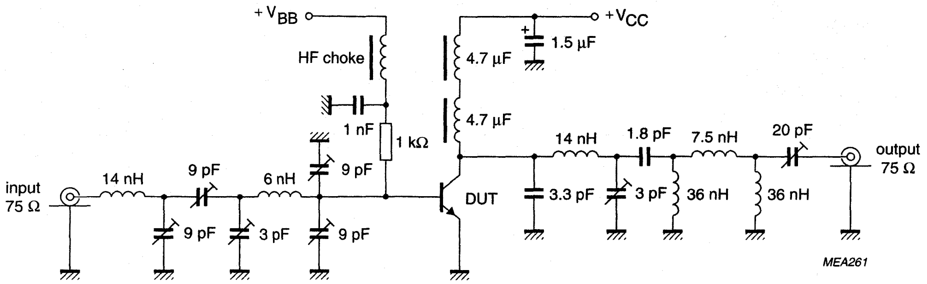
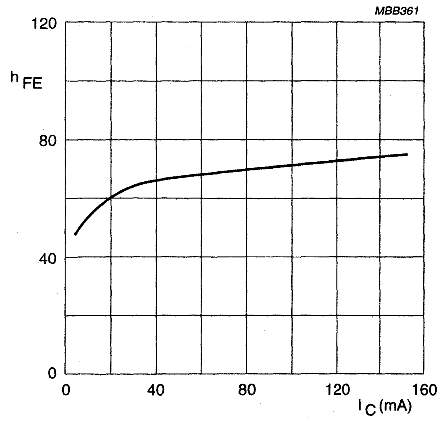
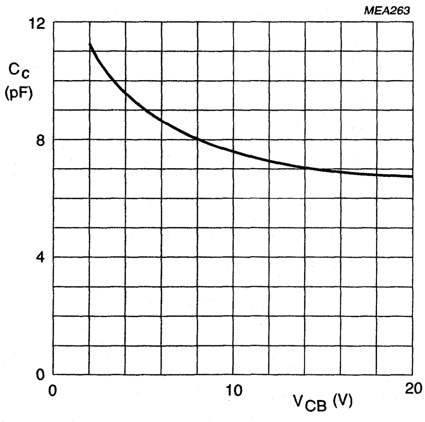


Fig.2 Intermodulation distortion MATV test circuit.



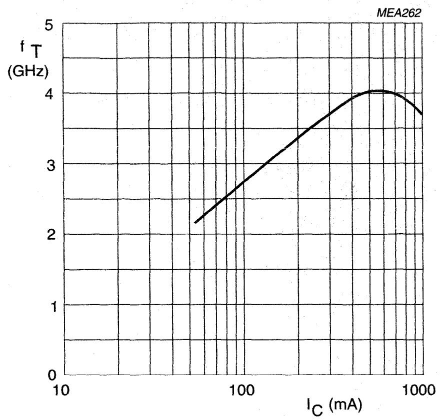
V_{CE} = 15 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



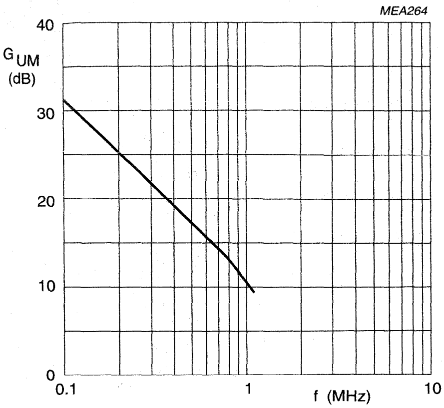
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C

Fig.4 Collector capacitance as a function of collector-base voltage.



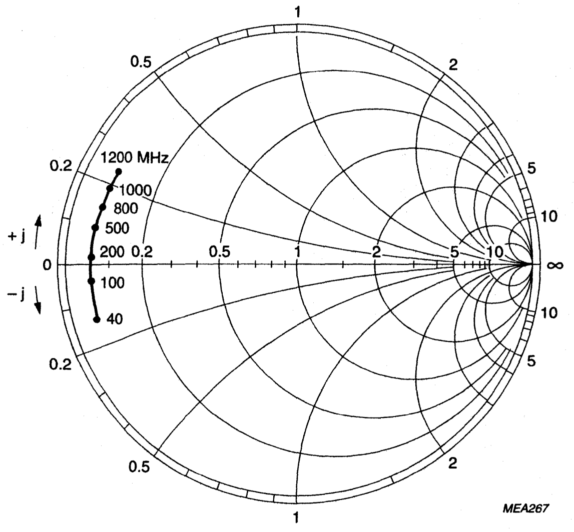
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C

Fig.5 Transition frequency as a function of collector current.



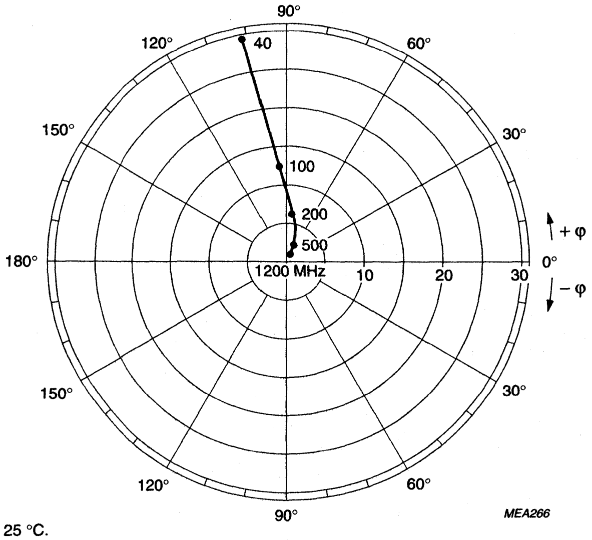
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of frequency.



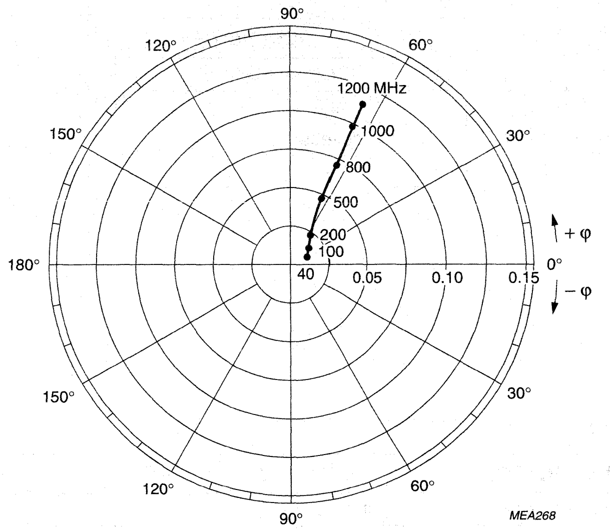
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.7 Common emitter input reflection coefficient (S_{11}).



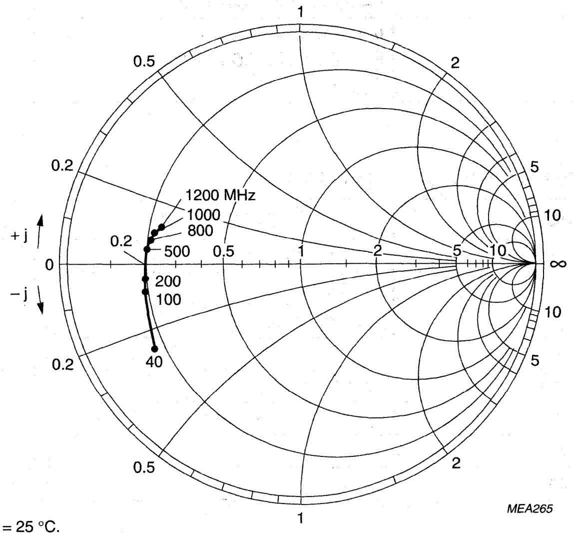
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.8 Common emitter forward transmission coefficient (S_{21}).



I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.9 Common emitter reverse transmission coefficient (S_{12}).



I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.10 Common emitter output reflection coefficient (S_{22}).

PNP 5 GHz wideband transistor BFQ149

DESCRIPTION

PNP transistor in a SOT89 envelope. It is intended for use in UHF applications such as broadband aerial amplifiers (30 to 860 MHz) and in microwave amplifiers such as radar systems, spectrum analysers, etc., using SMD technology.

PINNING

PIN	DESCRIPTION
Code: FG	
1	emitter
2	collector
3	base

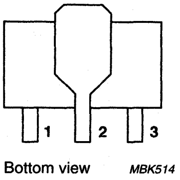


Fig.1 SOT89.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–15	V
I_C	DC collector current		–	–	–100	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = –70 mA; V_{CE} = –10 V; T_j = 25 °C	20	50	–	
f_T	transition frequency	I_C = –75 mA; V_{CE} = –10 V; f = 500 MHz; T_j = 25 °C	4	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = –50 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	–	12	–	dB
F	noise figure	I_C = –50 mA; V_{CE} = –10 V; R_s = 60 Ω; f = 500 MHz; T_{amb} = 25 °C	–	3.75	–	dB

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		–	–100	mA
I_{CM}	peak collector current	f > 1 MHz	–	–150	mA
P_{tot}	total power dissipation	up to T_s = 135 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 135 °C (note 1)	40 K/W

Note

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

CHARACTERISTICS

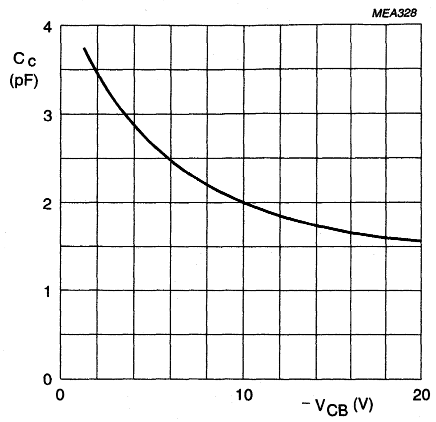
T_j = 25 °C unless otherwise specified.

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	$I_C = -70$ mA; $V_{CE} = -10$ V	20	50	–	
f_T	transition frequency	$I_C = -70$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	4	5	–	GHz
C_c	collector capacitance	$I_E = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	2	–	pF
C_e	emitter capacitance	$I_C = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = -10$ V; f = 1 MHz	–	1.7	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	–	12	–	dB
F	noise figure	$I_C = -50$ mA; $V_{CE} = -10$ V; $R_s = 60\ \Omega$; f = 500 MHz; T_{amb} = 25 °C	–	3.75	–	dB

Note

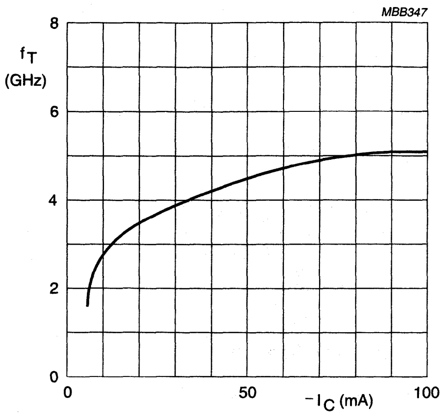
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)} \text{dB}.$$



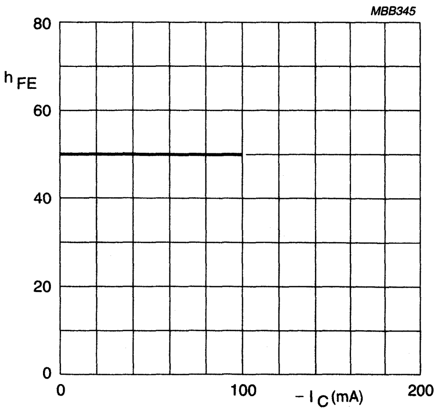
$I_E = 0$; f = 1 MHz; $T_j = 25$ °C.

Fig.2 Collector capacitance as a function of collector-base voltage.



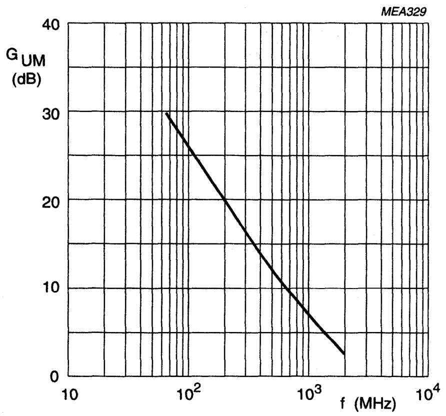
$V_{CE} = -10$ V; f = 500 MHz; $T_{amb} = 25$ °C.

Fig.3 Transition frequency as a function of collector current.



$V_{CE} = -10$ V; $T_j = 25$ °C.

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



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

Fig.5 Maximum unilateral power gain as a function of frequency.

NPN 6 GHz wideband transistor BFQ270

FEATURES

- High power gain
- Emitter-ballasting resistors for good thermal stability
- Gold metallization ensures excellent reliability.

DESCRIPTION

Silicon NPN transistor mounted in a 4-lead dual-emitter SOT172A1. envelope with a ceramic cap. All leads are isolated from the mounting base.

It is primarily intended for use in MATV and CATV amplifiers.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

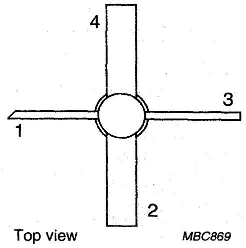


Fig.1 SOT172A1.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	–	19	V
I_C	DC collector current		–	–	500	mA
P_{tot}	total power dissipation	up to $T_c = 100$ °C	–	–	10	W
h_{FE}	DC current gain	$I_C = 240$ mA; $V_{CE} = 18$ V; $T_j = 25$ °C	60	–	–	
f_T	transition frequency	$I_C = 240$ mA; $V_{CE} = 18$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	6	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 240$ mA; $V_{CE} = 18$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	10	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 240$ mA; $V_{CE} = 18$ V; $R_L = 75\ \Omega$; $f_{(p+q-r)} = 793.25$ MHz	–	1.6	–	V

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO discs are not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	19	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	500	mA
P_{tot}	total power dissipation	up to $T_c = 100$ °C	–	10	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	10 K/W

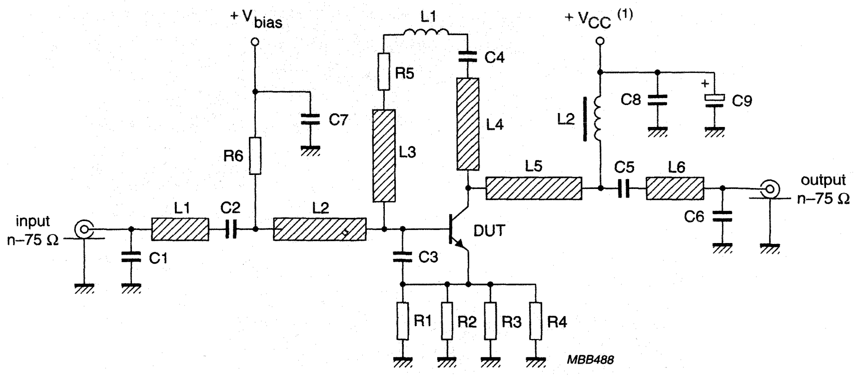
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 18$ V	–	–	100	μA
h_{FE}	DC current gain	$I_C = 240$ mA; $V_{CE} = 18$ V	60	110	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 18$ V; f = 1 MHz	–	3.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 18$ V; f = 1 MHz	2	2.6	–	pF
C_{cs}	collector-stud capacitance		–	1.2	–	pF
f_T	transition frequency	$I_C = 240$ mA; $V_{CE} = 18$ V; f = 1 GHz; $T_{amb} = 25$ °C	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 240$ mA; $V_{CE} = 18$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 240$ mA; $V_{CE} = 18$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	10	–	dB
V_O	output voltage	note 2	–	1.6	–	V
d_2	second order intermodulation distortion	note 3	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\dfrac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}$
2. $d_{im} = -60$ dB (DIN 45004); $I_C = 240$ mA; $V_{CE} = 18$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$; $f_p = 795.25$ 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.
3. $I_C = 240$ mA; $V_{CE} = 18$ V; $R_L = 75\ \Omega$;
   $V_p = V_q = V_O = 50.5$ dBmV = 335 mV;
   $f_{(p+q)} = 810$ MHz; $f_p = 250$ MHz; $f_q = 560$ MHz.



(1) $+V_c$ is equivalent to $V_{CE} = V_c - I_c\,(A) \times 17$.

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

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	miniature ceramic plate capacitor	0.82 pF		2222 680 03827
C2, C5, C7, C8	multilayer ceramic capacitor	10 nF		2222 852 47103
C3	multilayer ceramic chip capacitor	2.2 pF		2222 855 12228
C4 (note 1)	miniature ceramic plate capacitor	1 nF		2222 630 08102
C6	miniature ceramic plate capacitor	1.2 pF		2222 680 03128
C9	electrolytic capacitor	4.7 µF		2222 014 28478
L1 (note 1)	4.5 turns loosely wound 0.4 mm enamelled copper wire	≈35 nH	internal coil diameter 2 mm	
L2	Ferroxcube choke	5 µH		3122 108 20153
ML1, ML6	microstripline	75 Ω	width 2.46 mm; length 9 mm	
ML2, ML5	microstripline	75 Ω	width 2.46 mm; length 22 mm	
ML3, ML4	microstripline	145 Ω	width 0.5 mm; length 12 mm	
R1, R2, R3, R4	metal film resistor	68 Ω	type MR25	2322 151 76819
R5 (note 1)	metal film resistor	240 Ω	type SFR16T	2322 180 73241
R6	metal film resistor	10 kΩ	type SFR16T	2322 180 73103

Note

1. Components C4, L1, and R5 are mounted in a cavity in the brass ground plate.

The circuit is constructed on a printed circuit board and 10 mm thick brass ground plate, with a relative dielectric constant of ($\varepsilon_r = 2.2$), thickness 1.57 mm; thickness of copper 0.017 mm (E.G. Rogers' RT/Duroid 5880).

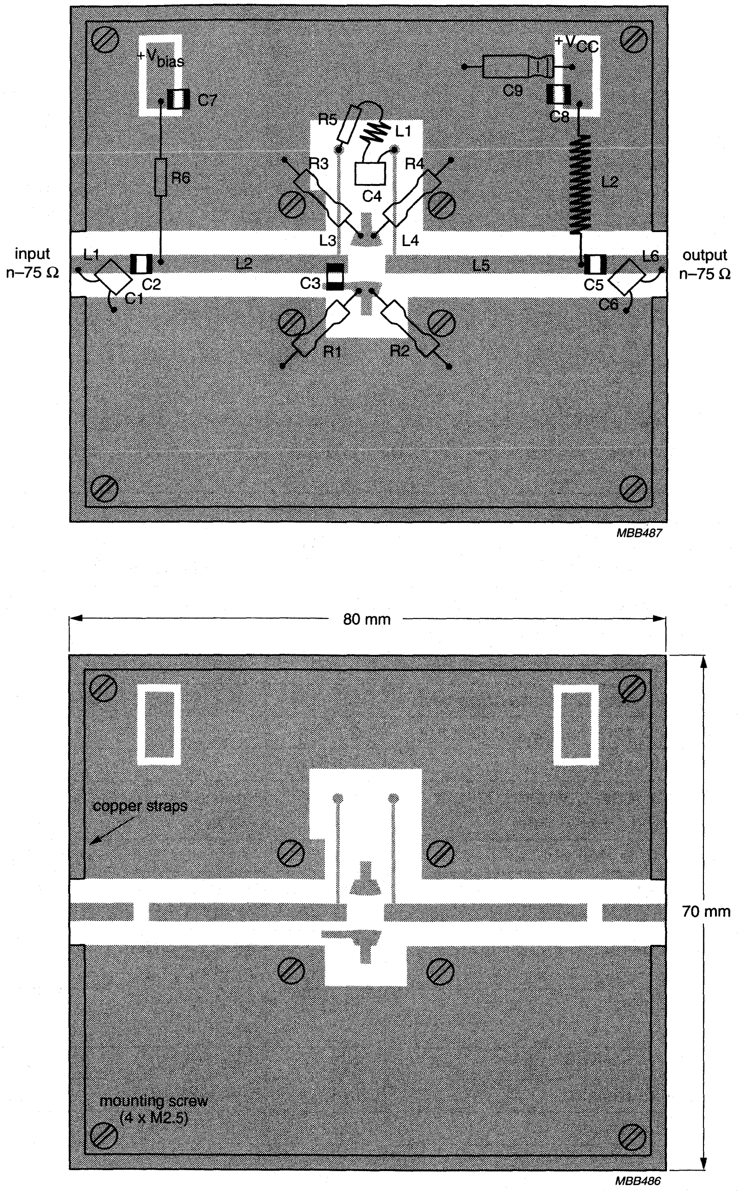


Fig.3 Intermodulation test circuit printed circuit board.

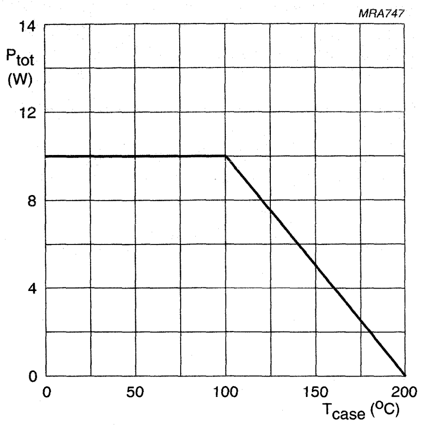
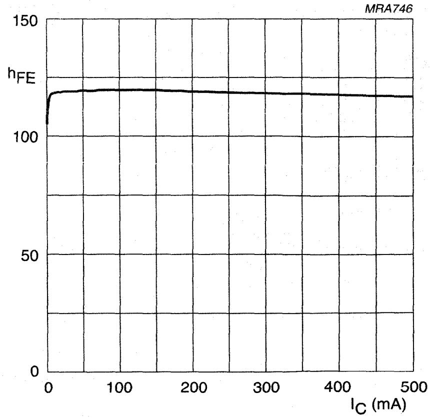
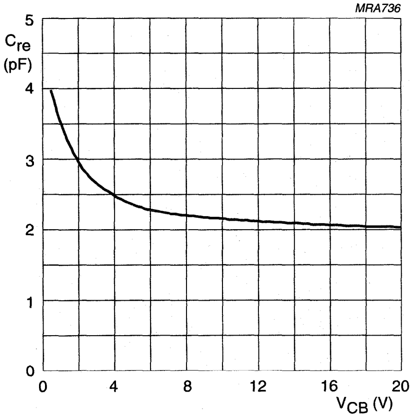


Fig.4 Power derating curve.



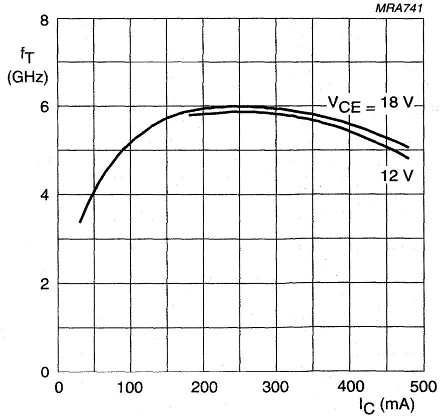
V_{CE} = 18 V; T_j = 25 °C.

Fig.5 DC current gain as a function of collector current.



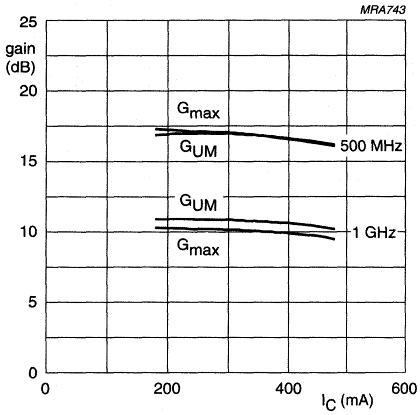
i_c = 0; f = 1 MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage.



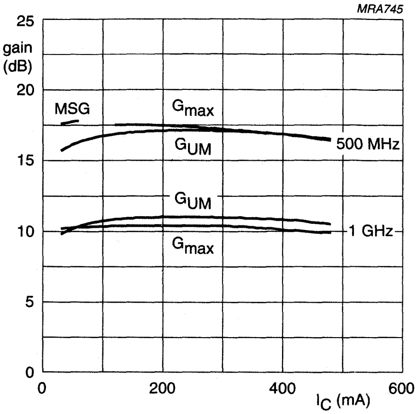
f = 1 GHz; T_{amb} = 25 °C.

Fig.7 Transition frequency as a function of collector current.



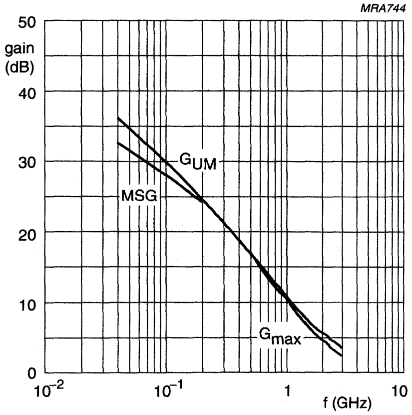
V_{CE} = 12 V.

Fig.8 Gain as a function of collector current.



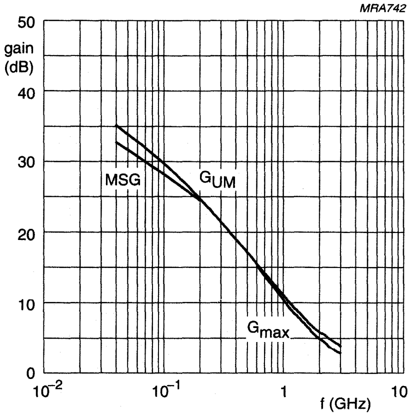
V_{CE} = 18 V.

Fig.9 Gain as a function of collector current.



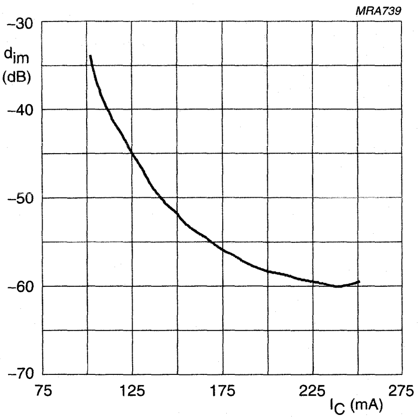
I_c = 240 mA; V_{CE} = 12 V.

Fig.10 Gain as a function of frequency.



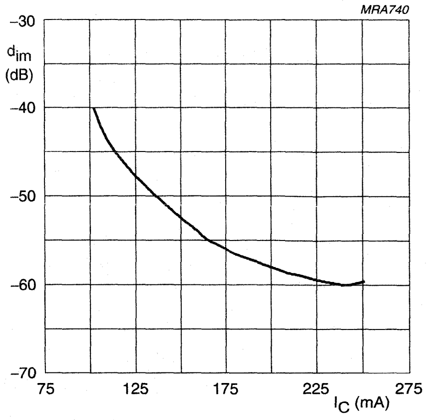
I_c = 240 mA; V_{CE} = 18 V.

Fig.11 Gain as a function of frequency.



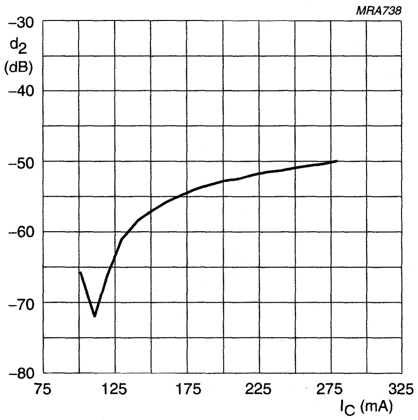
3-tone d_{im}; (V_{CE} = 18 V);
f_p = 445.25 MHz; V_o = 65.11 dBmV (1.8 V);
f_q = 453.25 MHz; V_o = 59.11 dBmV;
f_r = 455.25 MHz; V_o = 59.11 dBmV;
$f_{(p+q-r)}$ = 443.25 MHz.

Fig.12 Intermodulation distortion as a function of collector current.



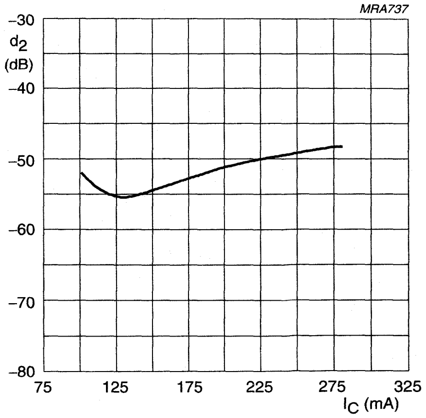
3-tone d_{im}; (V_{CE} = 18 V);
f_p = 795.25 MHz; V_o = 64.08 dBmV (1.6 V);
f_q = 803.25 MHz; V_o = 58.08 dBmV;
f_r = 805.25 MHz; V_o = 58.08 dBmV;
$f_{(p+q-r)}$ = 793.25 MHz.

Fig.13 Intermodulation distortion as a function of collector current.



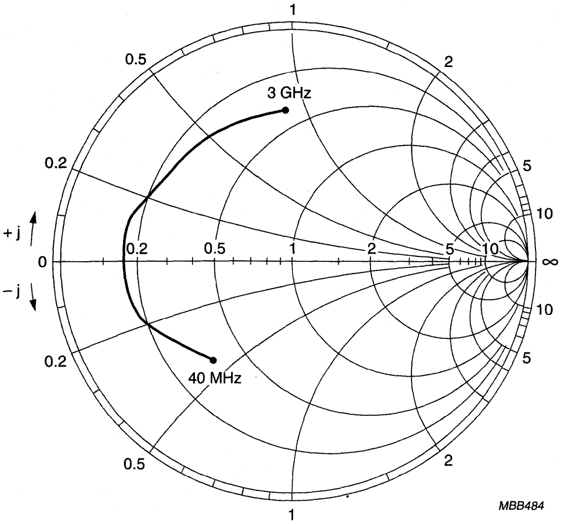
V_{CE} = 18 V;
f_p = 50 MHz; V_o = 50.5 dBmV (0.335 V);
f_q = 400 MHz; V_o = 50.5 dBmV;
$f_{(p+q)}$ = 450 MHz.

Fig.14 Second order intermodulation distortion as a function of collector current.



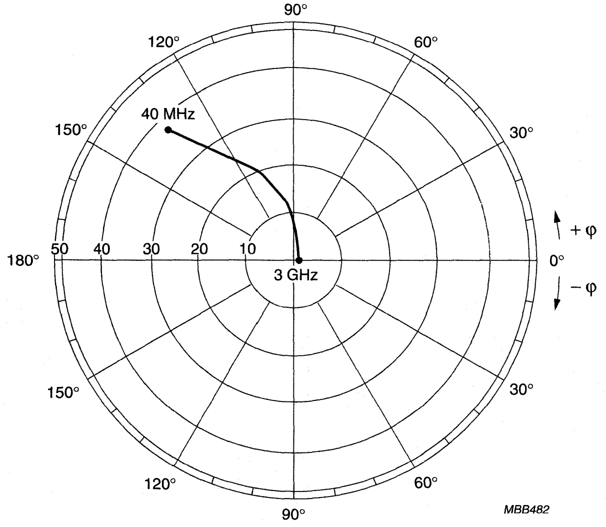
V_{CE} = 18 V;
f_p = 250 MHz; V_o = 50.5 dBmV (0.335 V);
f_q = 560 MHz; V_o = 50.5 dBmV;
$f_{(p+q)}$ = 810 MHz.

Fig.15 Second order intermodulation distortion as a function of collector current.



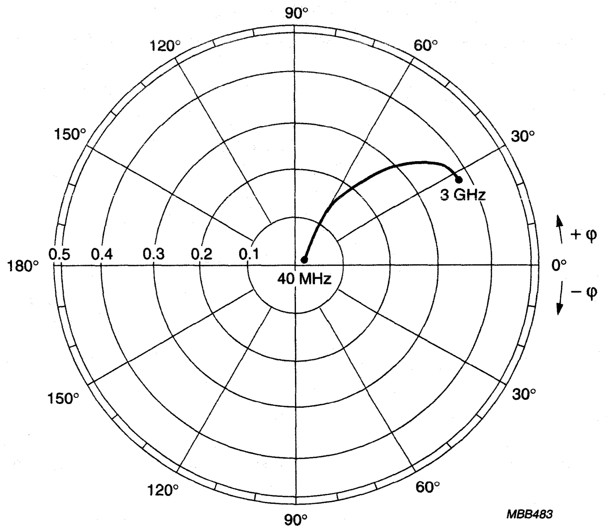
I_c = 240 mA; V_{CE} = 18 V.
Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



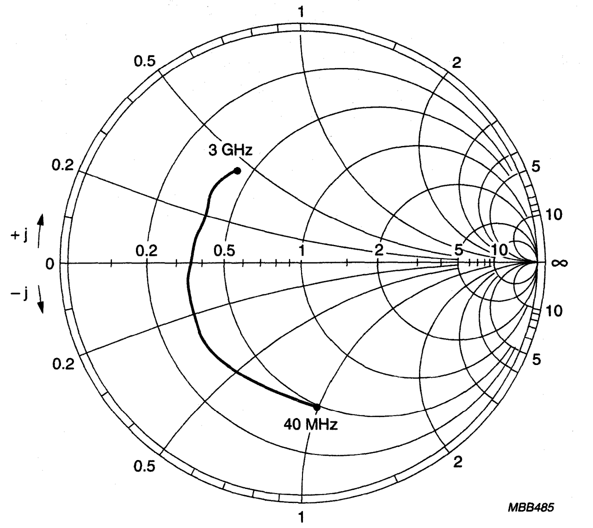
I_c = 240 mA; V_{CE} = 18 V.

Fig.17 Common emitter forward transmission coefficient (S_{21}).



I_c = 240 mA; V_{CE} = 18 V.

Fig.18 Common emitter reverse transmission coefficient (S_{12}).



I_c = 240 mA; V_{CE} = 18 V.
Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN wideband dual transistor BFQ540

FEATURES

- High gain
- High output voltage
- Low noise
- Gold metallization ensures excellent reliability
- Low thermal resistance.

APPLICATIONS

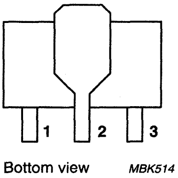
- VHF, UHF and CATV amplifiers.

DESCRIPTION

NPN wideband dual transistor in a plastic SOT89 package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base



Marking code: N4.

Fig.1 SOT89.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
V_{EBO}	collector-base voltage	open collector	–	–	2	V
I_C	collector current (DC)		–	–	120	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C; note 1	–	–	1.2	W
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_j = 25$ °C	60	120	250	
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	12	13	–	dB
F	noise figure	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.4	dB

Note

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

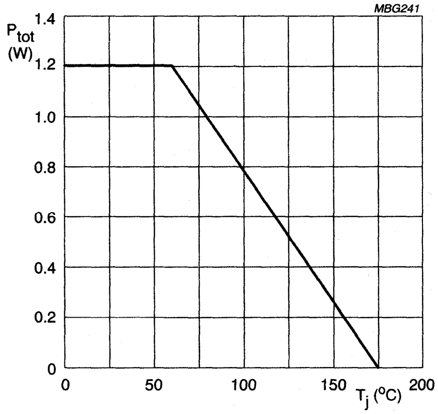
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	120	mA
P_{tot}	total power dissipation	$T_s \leq 60$ °C	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 60$ °C; $P_{tot} = 1.2$ W	95	K/W



$V_{CE} \leq 9$ V.

Fig.2 Power derating curve.

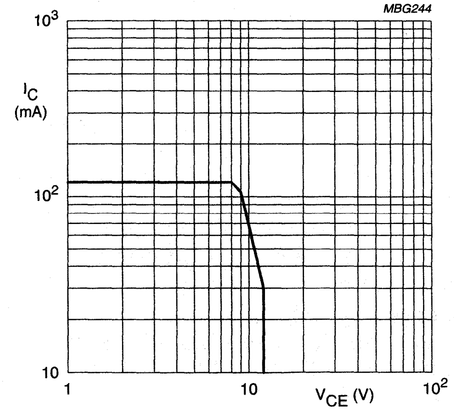


Fig.3 SOAR.

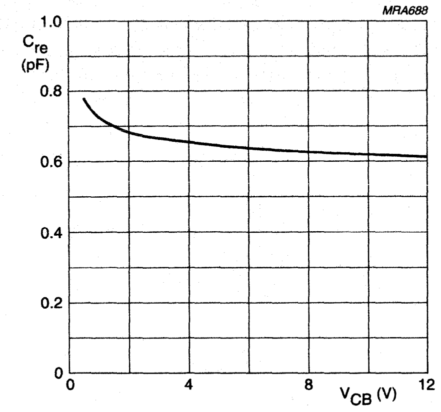
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 40 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 100 μA; I_C = 0	2	–	–	V
I_{CBO}	collector-base leakage current	V_{CB} = 8 V; I_E = 0	–	–	50	nA
I_{EBO}	emitter-base leakage current	V_{CB} = 1 V; I_C = 0	–	–	200	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	60	120	250	
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f_m = 1 GHz	–	9	–	GHz
C_e	emitter capacitance	$I_C = i_e$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 8 V; f = 1 MHz	–	0.9	–	pF
$\|S_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
V_o	output voltage	note 1	–	500	–	mV
		note 2	–	350	–	mV
d_2	second order intermodulation distortion	note 3	–	–	–53	dB
F	noise figure	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.4	dB

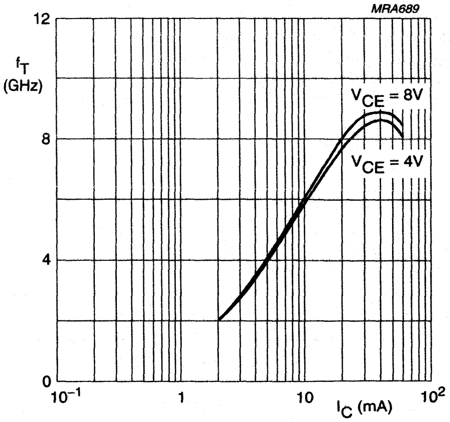
Notes

1. d_{im} = –60 dB (DIN45004B); V_{CE} = 8 V; I_C = 40 mA; R_L = 50 Ω;
   $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB;
   f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.5 MHz;
   measured at $f_p + f_q - f_r$ = 793.25 MHz.
2. d_{im} = –60 dB (DIN 45004B); I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω;
   $V_p = V_q = V_o$; f_p = 806 MHz; f_q = 810 MHz;
   measured at $2f_p - f_q$ = 802 MHz.
3. I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω;
   $V_p = V_q$ = 225 mV; f_p = 250 MHz; f_q = 560 MHz;
   measured at $f_p + f_q$ = 810 MHz.



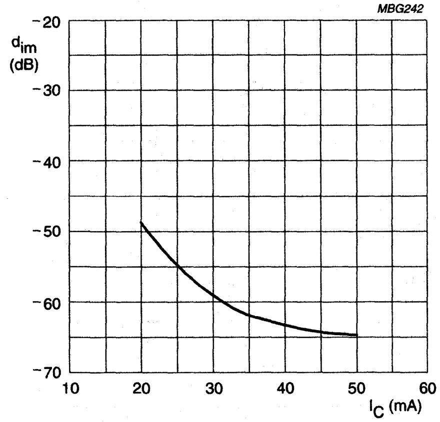
$I_C = 0$; $f = 1$ MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



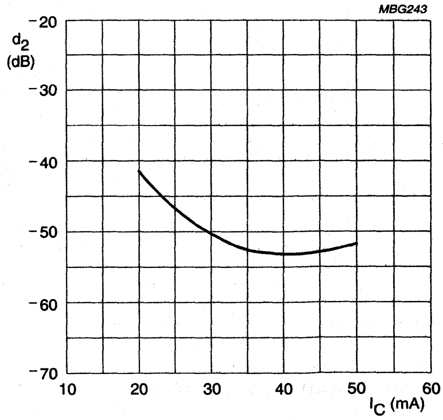
$f = 1$ GHz; $T_{amb} = 25$ °C.

Fig.5 Transition frequency as a function of collector current; typical values.



$V_{CE} = 8$ V; $V_o = 475$ mV; $R_L = 50\ \Omega$.
$f_p + f_q - f_r = 793.25$ MHz; $T_{amb} = 25$ °C.

Fig.6 Intermodulation distortion as a function of collector current; typical values.



$V_{CE} = 8$ V; $V_o = 225$ mV; $R_L = 50\ \Omega$; $f_p + f_q = 810$ MHz; $T_{amb} = 25$ °C.

Fig.7 Second order intermodulation distortion as a function of collector current; typical values.

NPN 7 GHz wideband transistor BFQ621

FEATURES

- High power gain
- High output voltage
- High maximum junction temperature
- Gold metallization ensures excellent reliability.

APPLICATIONS

It is primarily intended for use in MATV and microwave amplifiers, such as aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

DESCRIPTION

Silicon NPN transistor in a 4-lead dual-emitter SOT172A2 package with a ceramic cap. All leads are isolated from the mounting base. Emitter ballasting resistors and application of gold sandwich metallization ensures an optimum temperature profile and excellent reliability properties.

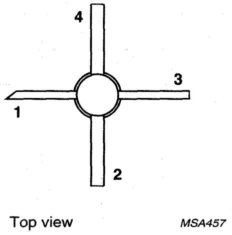


Fig.1 SOT172A2.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	16	V
I_C	collector current (DC)		–	–	150	mA
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	–	8	W
h_{FE}	DC current gain	I_C = 120 mA; V_{CE} = 18 V; T_{amb} = 25 °C	40	–	–	
f_T	transition frequency	I_C = 120 mA; V_{CE} = 18 V; f = 1 GHz; T_{amb} = 25 °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 120 mA; V_{CE} = 18 V; f = 500 MHz; T_{amb} = 25 °C	–	18.5	–	dB
V_O	output voltage	I_C = 120 mA; V_{CE} = 18 V; $f_{(p+q-r)}$ = 793.25 MHz; d_{im} = −60 dB; R_L = 75 Ω	–	1.2	–	V

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

NPN 7 GHz wideband transistor BFQ621

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	16	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	150	mA
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	8	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	+200	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	P_{tot} = 8 W; up to T_{mb} = 25 °C	21.9	K/W

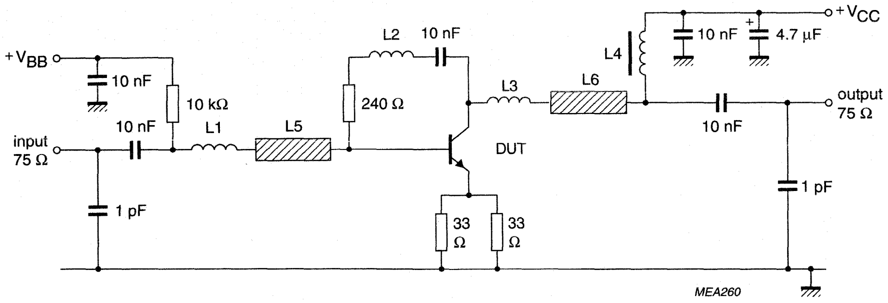
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; I_E = 0	–	–	25	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0	–	–	16	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; I_C = 0	–	–	2	V
I_{CBO}	collector-base leakage current	I_E = 0; V_{CB} = 18 V	–	–	100	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V	50	–	160	
f_T	transition frequency	I_C = 120 mA; V_{CE} = 18 V; f = 1 GHz; see Fig.3	–	7	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 18 V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	5	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 18 V; f = 1 MHz; see Fig.4	–	0.85	1.2	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 120 mA; V_{CE} = 18 V; f = 500 MHz; T_{amb} = 25 °C;	–	18.5	–	dB
		I_C = 120 mA; V_{CE} = 18 V; f = 800 MHz; T_{amb} = 25 °C;	–	14.5	–	dB
V_O	output voltage	note 2	–	1.35	–	V
		note 3	–	1.2	–	V
d_2	second order intermodulation distortion	note 4	–	–60	–	dB
		note 5	–	–60	–	dB

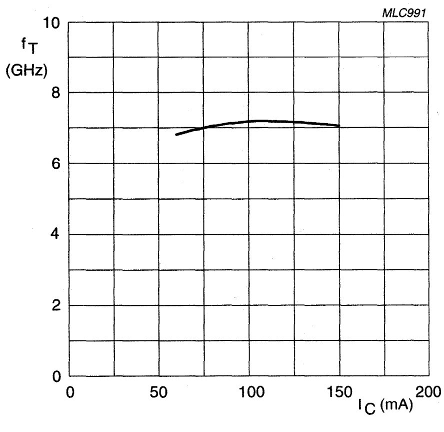
Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.
2. d_{im} = –60dB (DIN45004B); see Fig.2; I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; f_p = 445.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 453.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 455.25 MHz;
   measured at $f_{(p+q-r)}$ = 443.25 MHz; see Fig.5.
3. d_{im} = –60dB (DIN45004B); see Fig.2; I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; 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; see Fig.6.
4. V_O = 50 dBmV = 316 mV; I_C = 90 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 450 MHz; see Fig.7.
5. V_O = 50 dBmV = 316 mV; I_C = 90 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 810 MHz; see Fig.8.



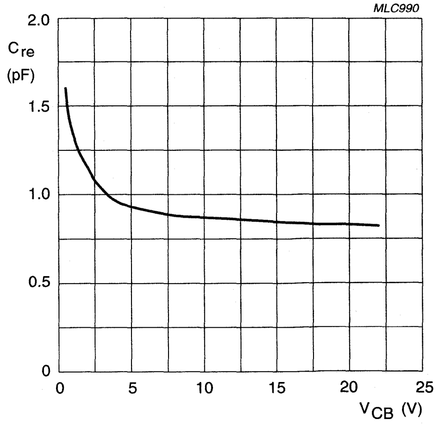
L1 = 8 nH.
L2 = 15 nH, 2 turns copper wire, internal diameter 2 mm.
L3 = 10 nH, 2 turns copper wire, internal diameter 1.5 mm.
L5: Lp = 21 mm; Rc = 75 Ω.
L6: Lp = 16 mm; Rc = 75 Ω.

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



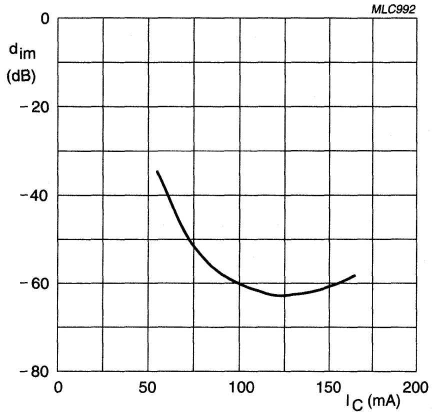
V_{CE} = 18 V; f = 1 GHz.

Fig.3 Transition frequency as a function of collector current; typical values.



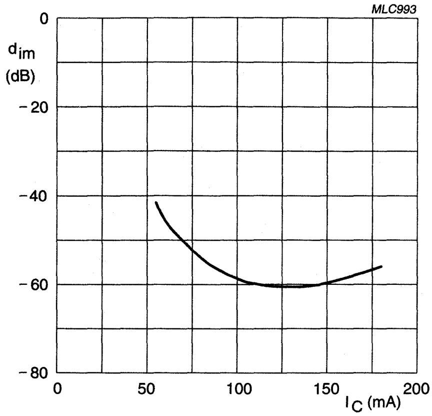
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



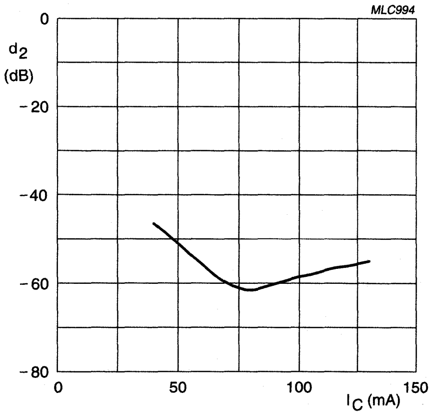
V_O = 1.35 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 443.25 MHz; see Fig.2.

Fig.5 Intermodulation distortion as a function of collector current; typical values.



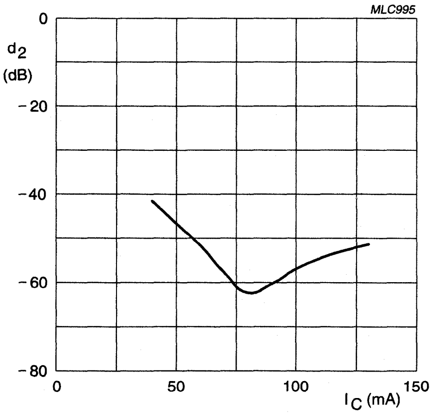
V_O = 1.2 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 793.25 MHz; see Fig.2.

Fig.6 Intermodulation distortion as a function of collector current; typical values.



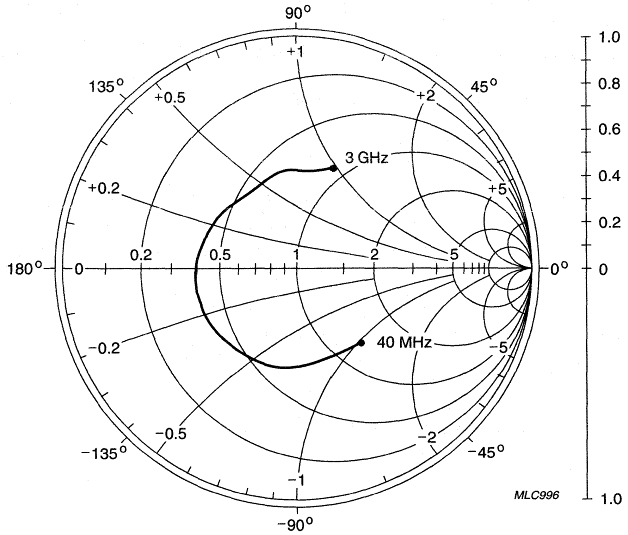
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 450 MHz; see Fig.2.

Fig.7 Second order distortion as a function of collector current; typical values.



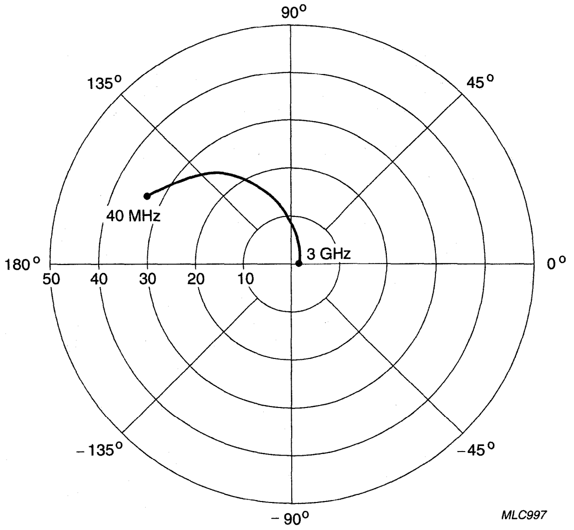
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 810 MHz; see Fig.2.

Fig.8 Second order distortion as a function of collector current; typical values.



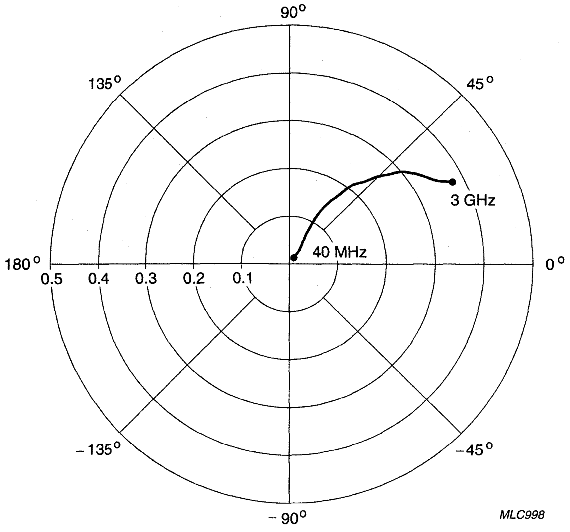
V_{CE} = 18 V; I_C = 120 mA; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (s_{11}); typical values.



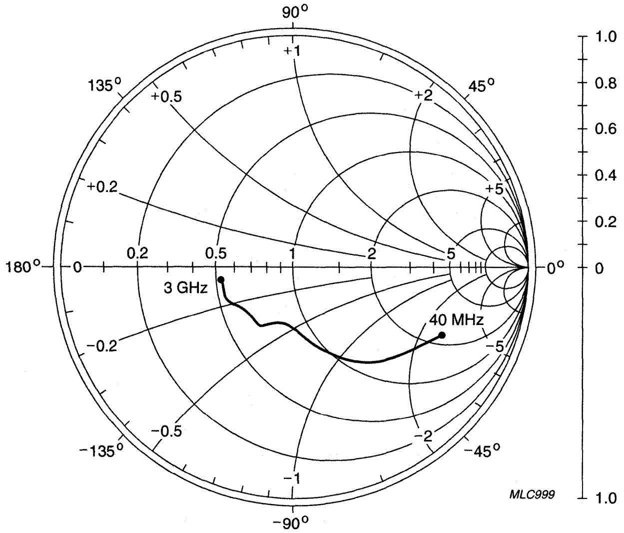
V_{CE} = 18 V; I_C = 120 mA.

Fig.10 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 18 V; I_C = 120 mA.

Fig.11 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 18 V; I_C = 120 mA; Z_o = 50 Ω.

Fig.12 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFQ621 crystal

SEQUENCE NO.	PARAMETER	VALUE	UNIT
1	IS	1.358	fA
2	BF	112.2	–
3	NF	0.991	–
4	VAF	78.06	V
5	IKF	4.291	A
6	ISE	643.3	fA
7	NE	1.851	–
8	BR	5.776	–
9	NR	0.999	–
10	VAR	2.350	V
11	IKR	50.26	mA
12	ISC	2.454	fA
13	NC	1.175	–
14	RB	8.000	Ω
15	IRB	1.000	μA
16	RBM	8.000	Ω
17	RE	1.585	Ω
18	RC	1.880	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	3.985	pF
23	VJE	0.600	V
24	MJE	0.327	–
25	TF	14.02	ps
26	XTF	398.1	–
27	VTF	2.940	mV
28	ITF	3.084	A
29	PTF	45.00	deg
30	CJC	1.529	pF
31	VJC	0.216	V
32	MJC	0.158	–
33	XCJC	0.120	–
34	TR	9.070	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.735	–

Note

1. These parameters have not been extracted, the default values are shown.

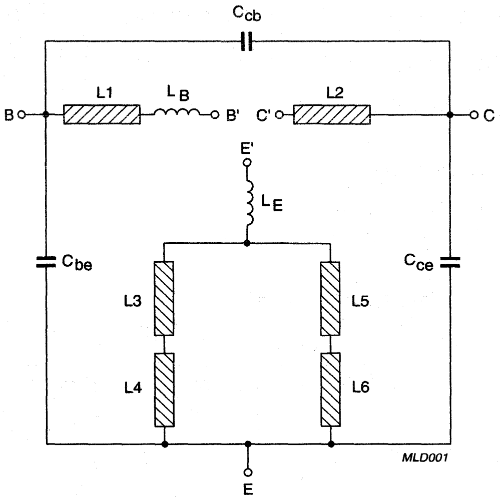


Fig.13 Package equivalent circuit SOT172A2.

List of components (see Fig.13)

DESIGNATION	VALUE	UNIT
C_{be}	225	fF
C_{cb}	36	fF
C_{ce}	362	fF
L1(1)	L = 1.37; W = 2.64	mm
L2(1)	L = 1.60; W = 2.64	mm
L3(1)	L = 0.51; W = 0.33	mm
L4(1)	L = 0.81; W = 2.06	mm
L5(1)	L = 2.77; W = 0.33	mm
L6(1)	L = 0.94; W = 2.06	mm
L_B	1.85	nH
L_E	1.22	nH

Note

1. The micro striplines are on a double copper-clad substrate; $\varepsilon_r = 6.5$; h = 1.18 mm.

NPN 2 GHz wideband transistor BFR53

FEATURES

- Very low intermodulation distortion
- Very high power gain.

APPLICATIONS

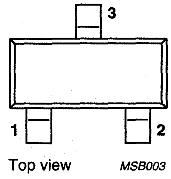
- Thick and thin-film circuits.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: N1.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	18	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	250	mW
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	0.9	–	pF
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_j = 25$ °C	2	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 800 MHz; $T_{amb} = 25$ °C	10.5	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	18	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 85$ °C; note 1	260	K/W

Note

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

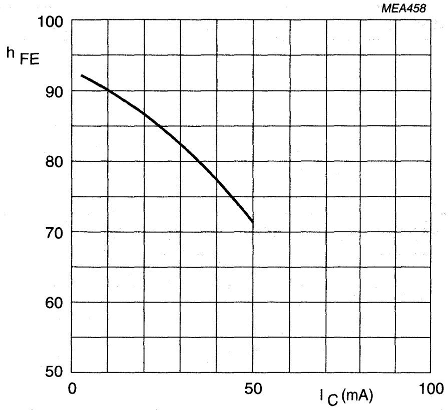
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 5$ V; see Fig.2	25	–	–	
		$I_C = 50$ mA; $V_{CE} = 5$ V; see Fig.2	25	–	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz; see Fig.3	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.5	–	pF
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.9	–	pF
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 5$ V; f = 500 MHz; see Fig.4	–	2	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 800 MHz; $T_{amb} = 25$ °C; see Fig.5	–	10.5	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C; see Fig.6	–	–	5	dB

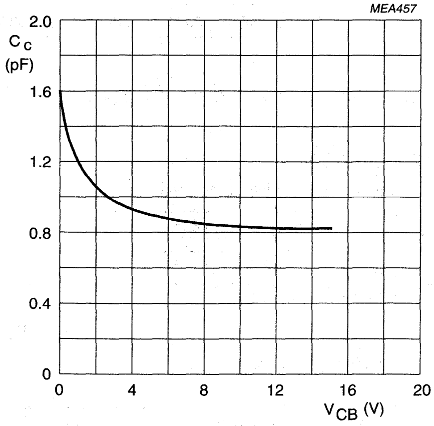
Note

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



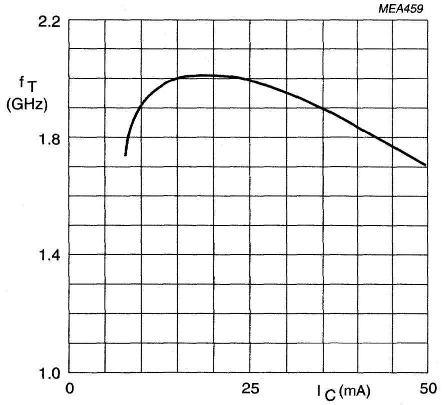
V_{CE} = 5 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current; typical values.



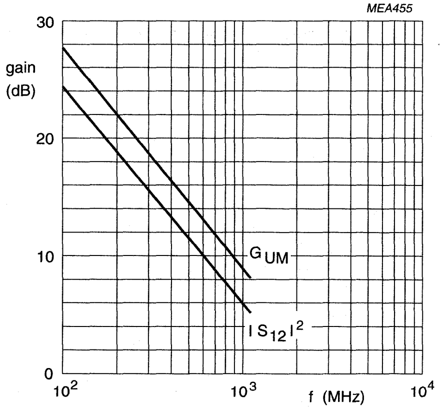
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.3 Collector capacitance as a function of collector-base voltage; typical values.



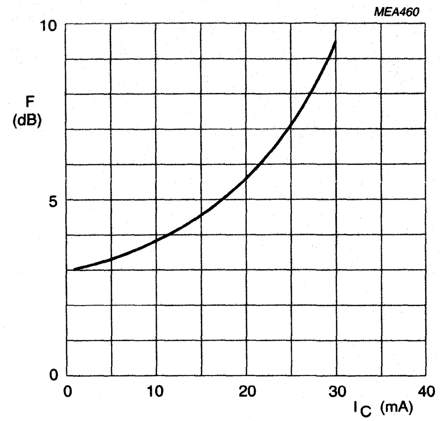
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current; typical values.



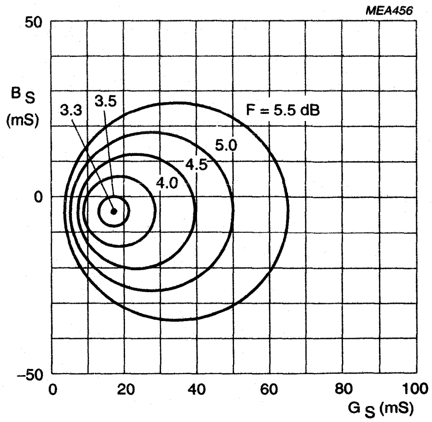
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.5 Gain as a function of frequency; typical values.



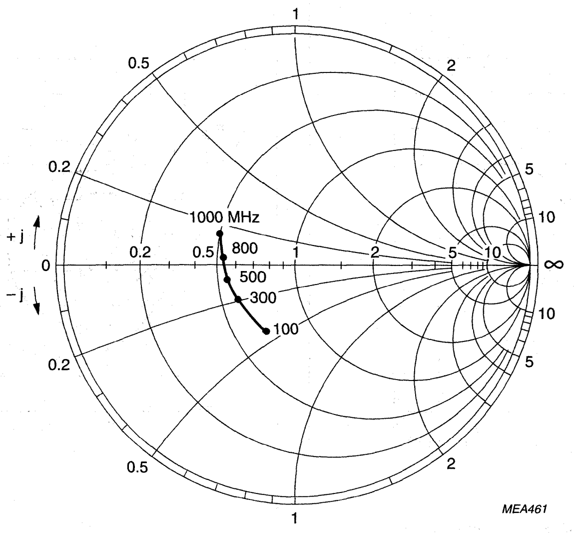
V_{CE} = 5 V; f = 500 MHz; G_S = 20 mS; B_S is tuned; T_{amb} = 25 °C.

Fig.6 Minimum noise figure as a function of collector current; typical values.



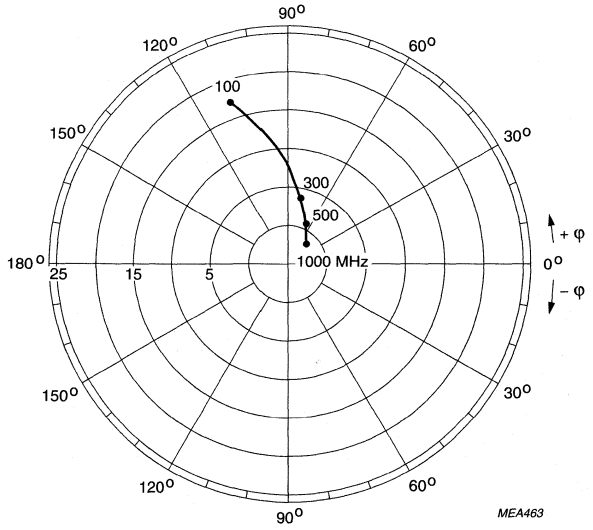
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.7 Circles of constant noise figure; typical values.



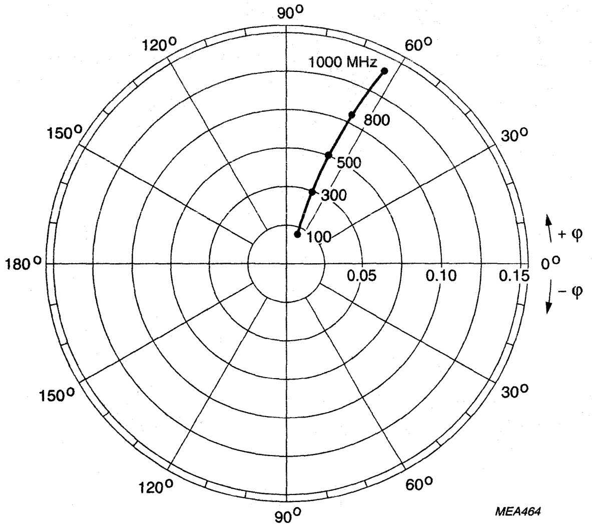
I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.8 Common emitter input reflection coefficient (S_{11}).



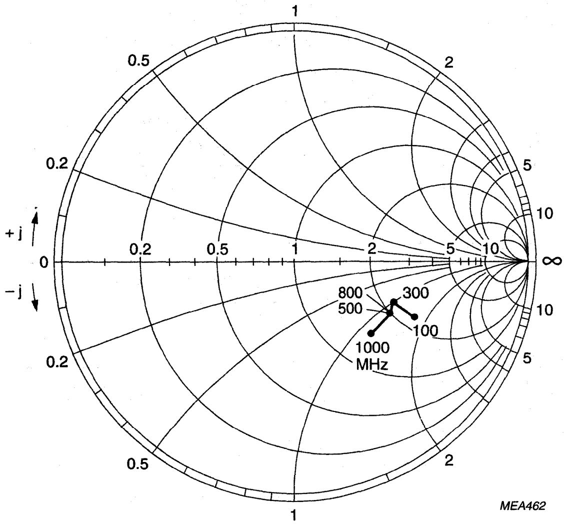
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.9 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.10 Common emitter reverse transmission coefficient (S_{12}).



I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.11 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFR92

DESCRIPTION

NPN transistor in a plastic SOT23 envelope primarily intended for use in RF wideband amplifiers and oscillators. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

PNP complement is BFT92.

PINNING

PIN	DESCRIPTION
Code: P1p	
1	base
2	emitter
3	collector

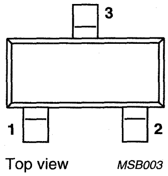


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	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		–	25	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	mW
f_T	transition frequency	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 10 V; f = 1 MHz	0.4	–	pF
G_{UM}	maximum unilateral power gain	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_s = opt.	2.4	–	dB
V_o	output voltage	d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 MHz	150	–	mV

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	–	2	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 95 °C; note 1	260 K/W

Note

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

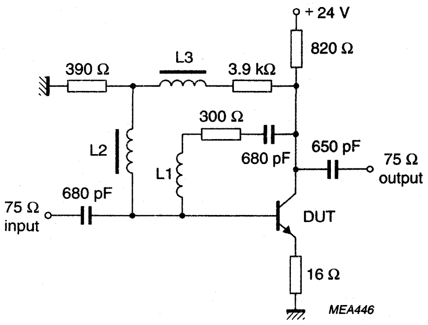
CHARACTERISTICS

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	–	–	50	nA
h_{FE}	DC current gain	I_C = 14 mA; V_{CE} = 10 V	40	90	–	
f_T	transition frequency	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	0.75	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	0.8	–	pF
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 10 V; f = 1 MHz; T_{amb} = 25 °C	–	0.4	–	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	18	–	dB
F	noise figure (see Fig.2 and note 2)	I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_s = opt.	–	2.4	–	dB
V_o	output voltage	note 3	–	150	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\text{dB}$
2. Crystal mounted in a SOT37 envelope (BFR90).
3. d_{im} = −60 dB (DIN 45004B); I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_o$ at d_{im} = −60 dB; f_p = 495.25 MHz;
   $V_q = V_o$ −6 dB; f_q = 503.25 MHz;
   $V_r = V_o$ −6 dB; f_r = 505.25 MHz;
   measured at $f_{(p+q-r)}$ = 493.25 MHz.



L2 = L3 = 5 µH Ferroxcube choke, catalogue number 3122 108 20150.

L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

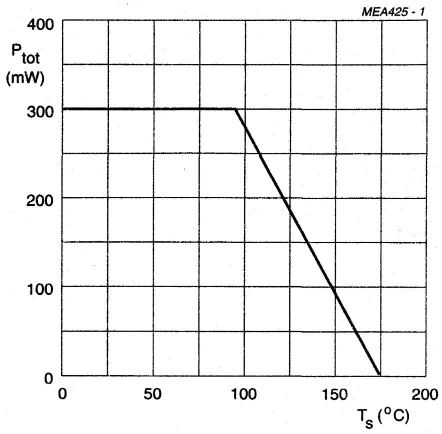
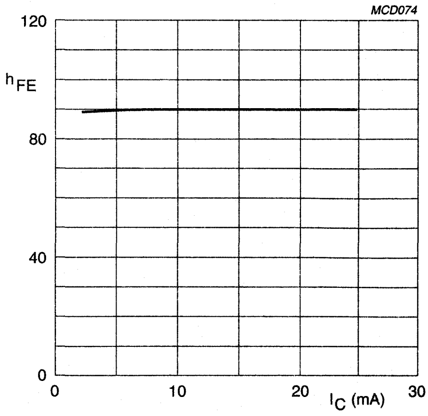
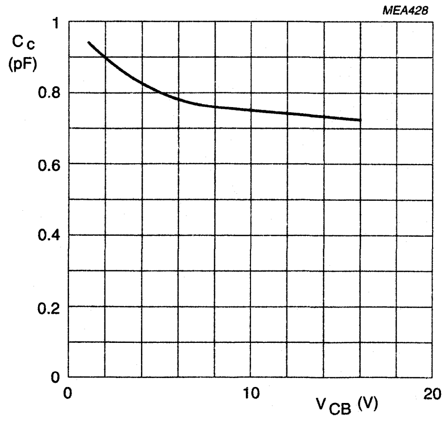


Fig.3 Power derating curve.



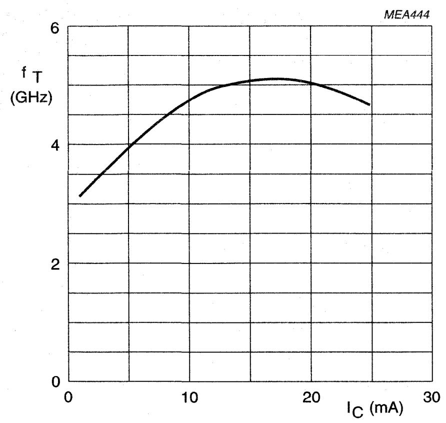
V_{CE} = 10 V; T_j = 25 °C.

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



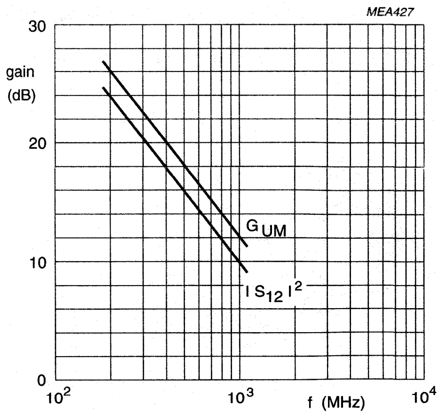
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



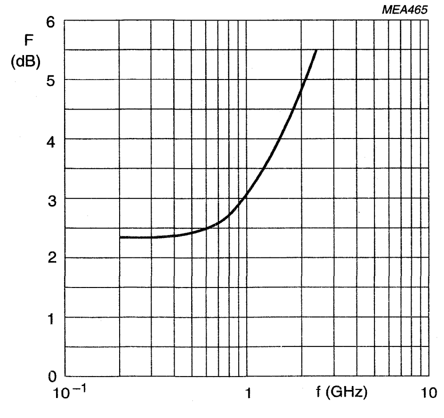
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

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



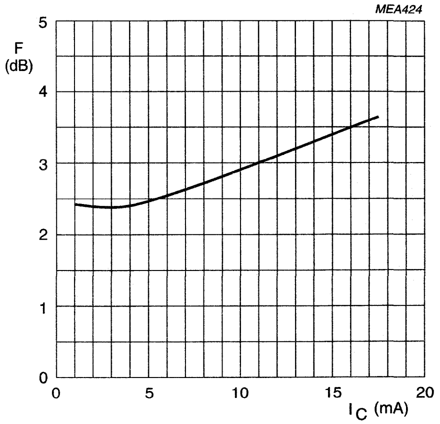
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



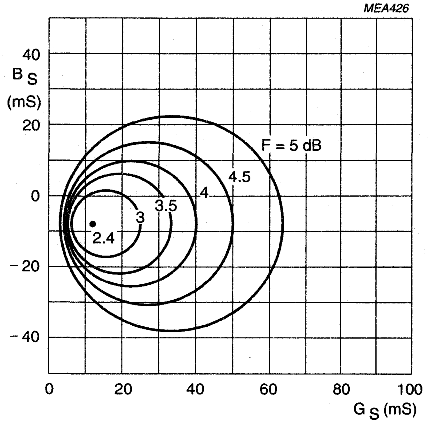
I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_s = opt.

Fig.8 Minimum noise figure as a function of frequency.



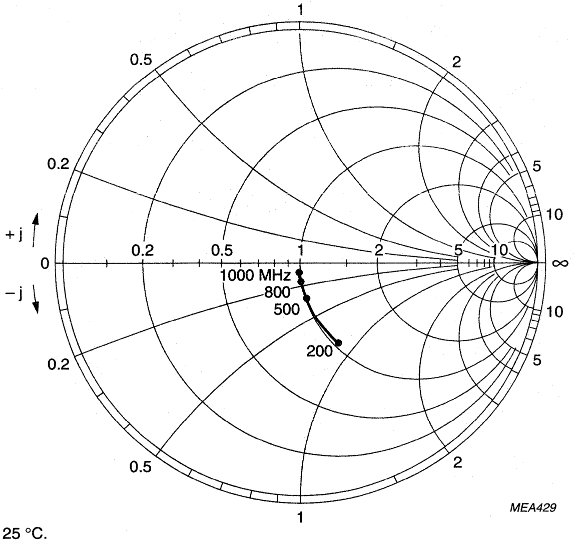
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_s = opt.

Fig.9 Minimum noise figure as a function of collector current.



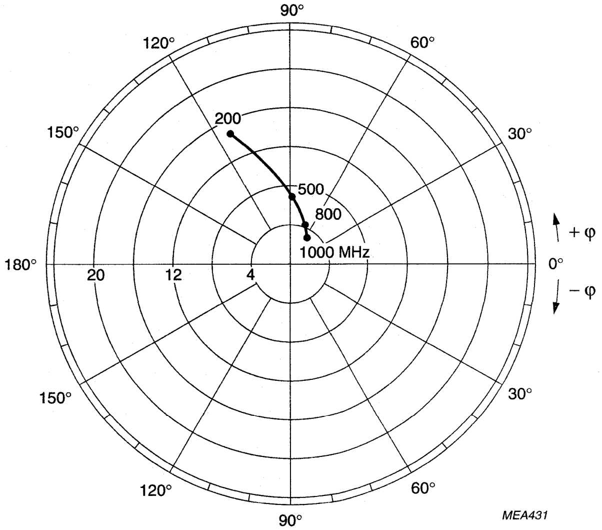
I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Noise circle figure.



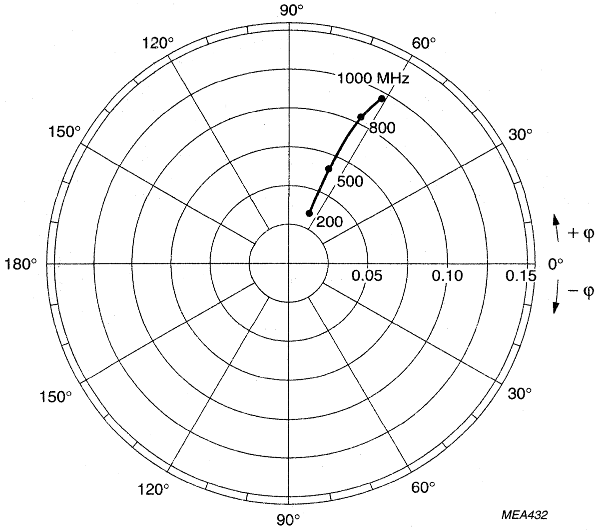
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

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



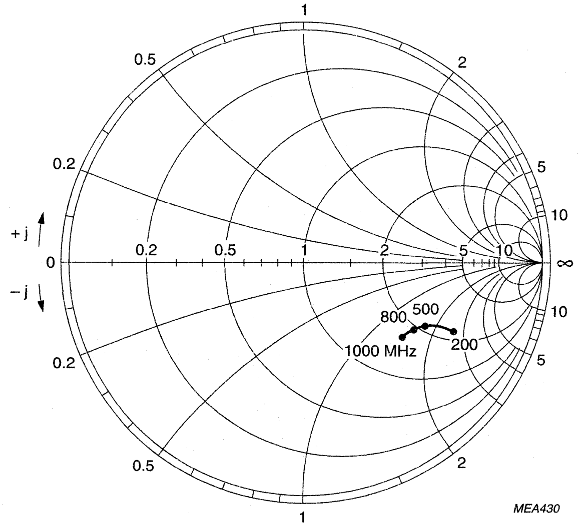
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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



$I_C = 14$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C.

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



$I_C = 14$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C.
$Z_o = 50$ Ω.

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

NPN 5 GHz wideband transistor BFR92A

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion.

APPLICATIONS

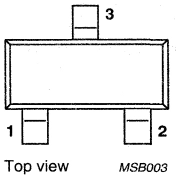
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT92.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: P2p.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	20	V
V_{CEO}	collector-emitter voltage		–	15	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C	–	300	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C	2.1	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $f_p + f_q - f_r = 793.25$ MHz	150	–	mV

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	2	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C; note 1; see Fig.3	–	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 95$ °C; note 1	260	K/W

Note

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

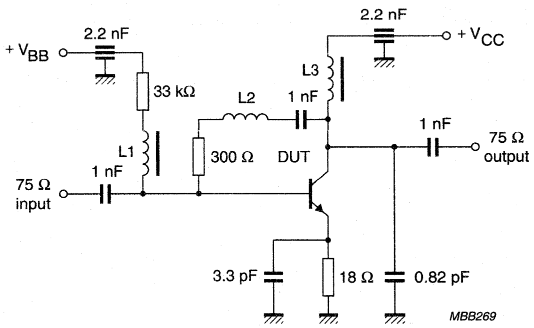
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V; see Fig.4	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz; see Fig.5	–	0.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 10$ V; f = 1 MHz	–	1.2	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz; see Fig.6	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C; see Figs 13 and 14	–	2.1	–	dB
		$I_C = 5$ mA; $V_{CE} = 10$ V; f = 2 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C; see Figs 13 and 14	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	150	–	mV
d_2	second order intermodulation distortion	notes 2 and 4; see Fig.16	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\mathrm{dB}$.
2. Measured on the same die in a SOT37 package (BFR90A).
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °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 $f_p + f_q - f_r = 793.25$ MHz.
4. $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °C
   $V_p = 60$ mV at $f_p = 250$ MHz;
   $V_q = 60$ mV at $f_q = 560$ MHz;
   measured at $f_p + f_q = 810$ MHz.



L1 = L3 = 5 µH choke.

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

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

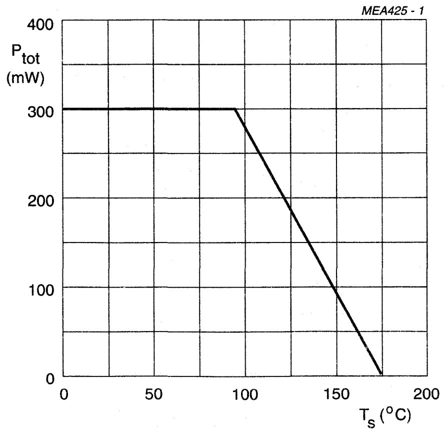
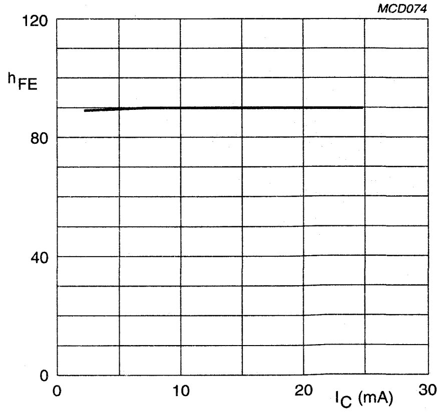
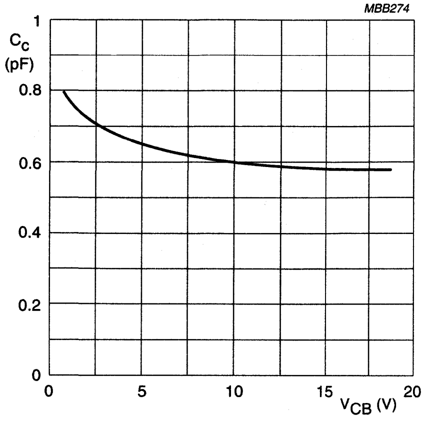


Fig.3 Power derating curve.



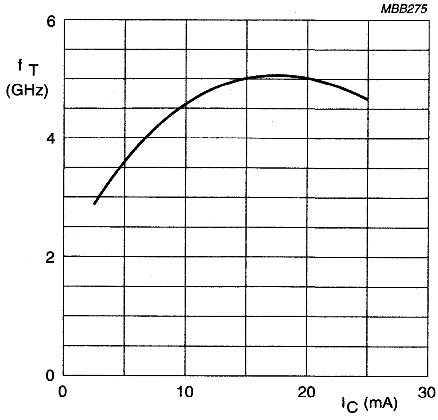
V_{CE} = 10 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current; typical values.



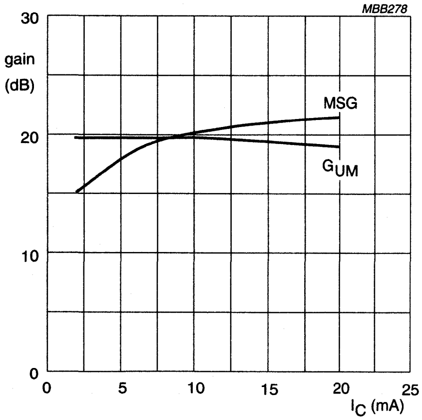
$I_C = i_c = 0$; f = 1 MHz; T_j = 25 °C.

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



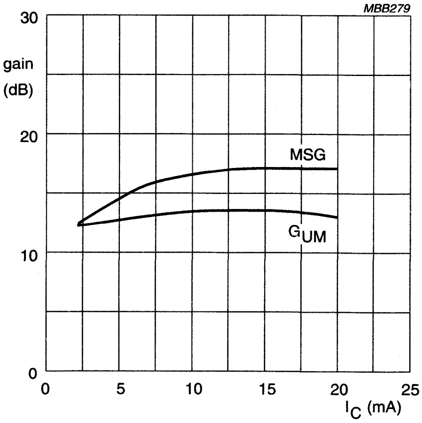
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



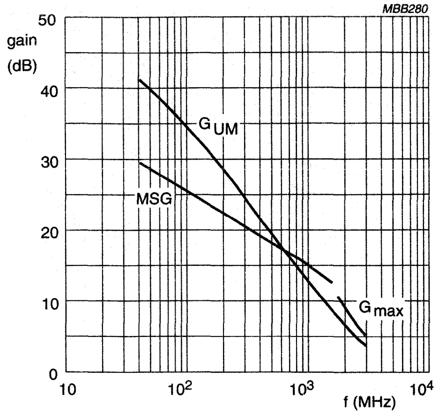
V_{CE} = 10 V; f = 500 MHz.
MSG = maximum stable gain;
G_{UM} = maximum unilateral power gain.

Fig.7 Gain as a function of collector current; typical values.



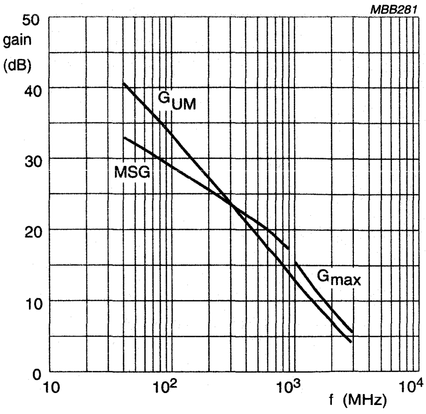
V_{CE} = 10 V; f = 1 GHz.
MSG = maximum stable gain;
G_{UM} = maximum unilateral power gain.

Fig.8 Gain as a function of collector current; typical values.



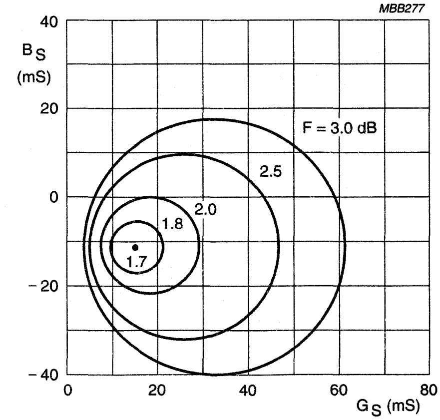
I_C = 5 mA; V_{CE} = 10 V.
G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.

Fig.9 Gain as a function of frequency; typical values.



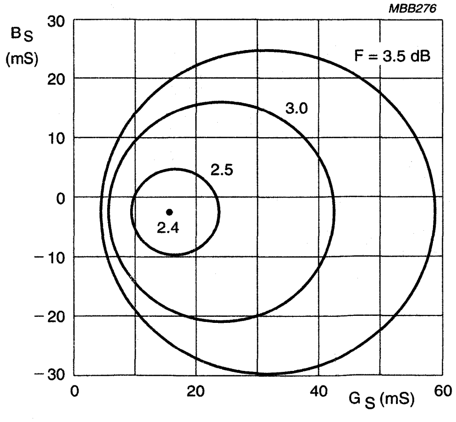
I_C = 15 mA; V_{CE} = 10 V.
G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.

Fig.10 Gain as a function of frequency; typical values.



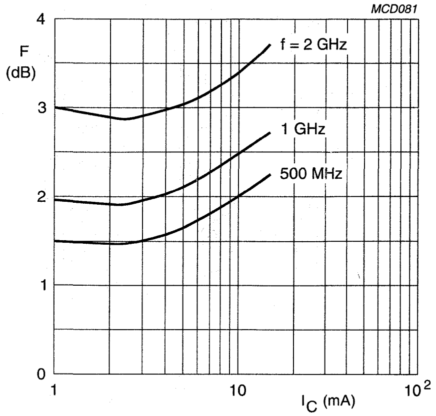
I_C = 4 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.11 Circles of constant noise figure; typical values.



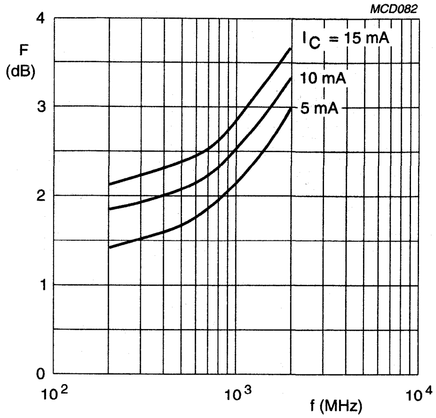
I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.12 Circles of constant noise figure; typical values.



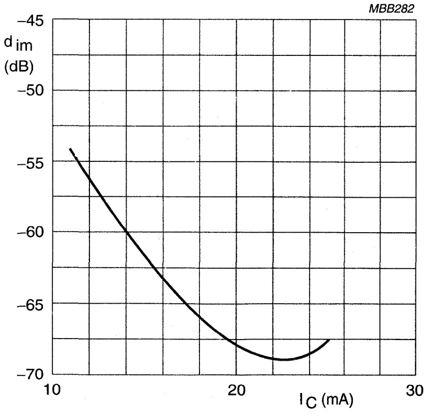
V_{CE} = 10 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



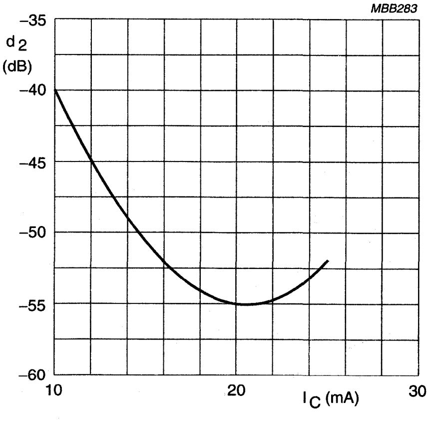
V_{CE} = 10 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



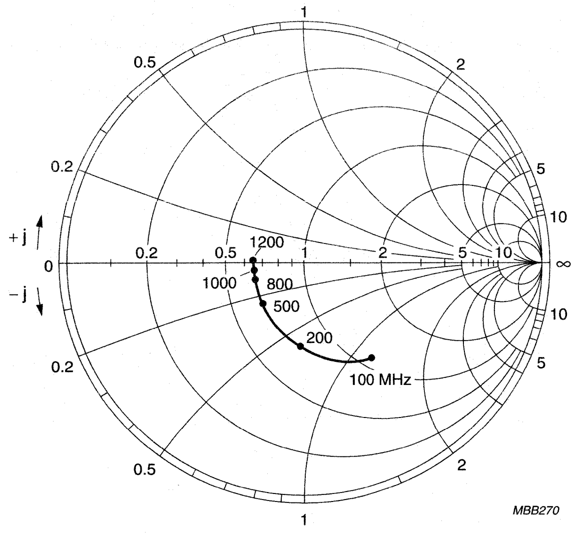
V_{CE} = 10 V; V_O = 150 mV (43.5 dBmV);
$f_p + f_q – f_r$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.15 Intermodulation distortion; typical values.



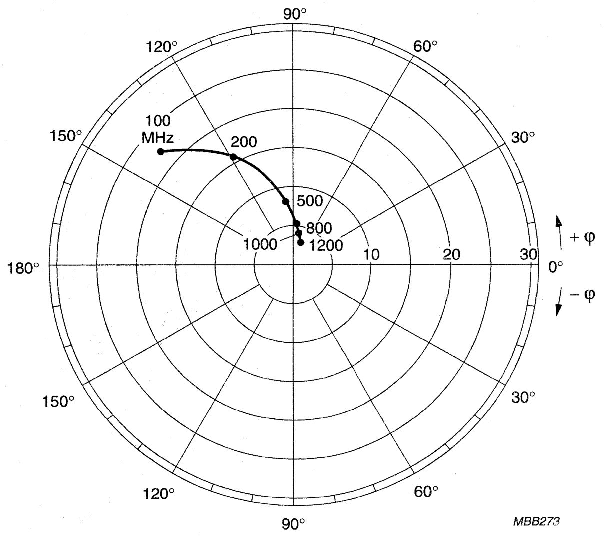
V_{CE} = 10 V; V_O = 60 mV; $f_p + f_q – f_r$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion; typical values.



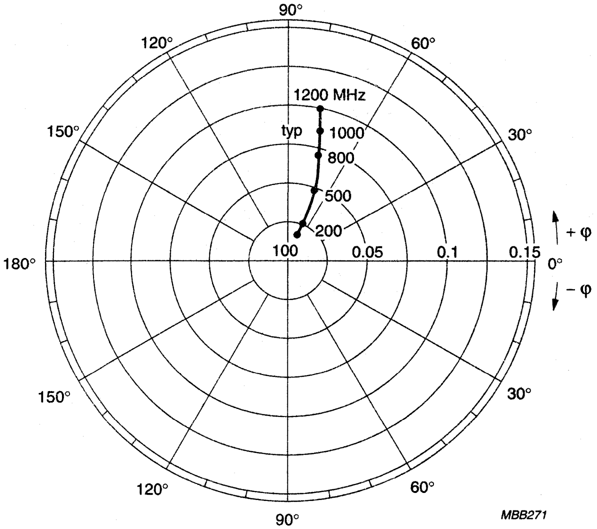
I_C = 14 mA; V_{CE} = 10 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.17 Common emitter input reflection coefficient (S_{11}); typical values.



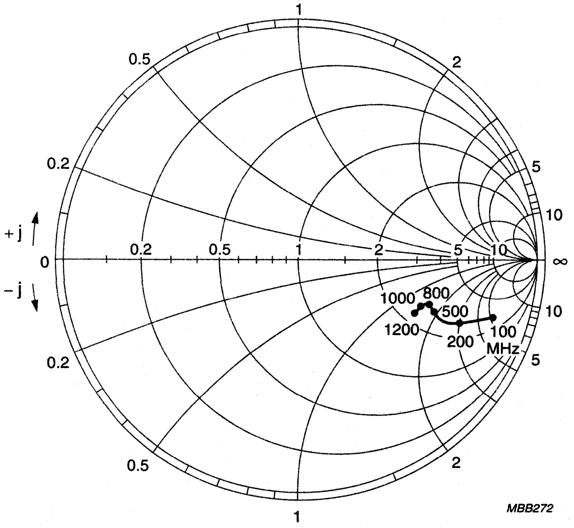
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}); typical values.



I_C = 14 mA; V_{CE} = 10 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.20 Common emitter output reflection coefficient (S_{22}); typical values.

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) package.

APPLICATIONS

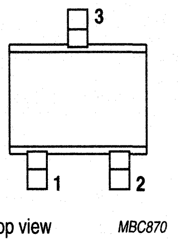
It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz.

DESCRIPTION

Silicon NPN transistor encapsulated in a plastic SOT323 (S-mini) package. The BFR92AW uses the same crystal as the SOT23 version, BFR92A.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: P2.

Fig.1 SOT323

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	collector current (DC)		–	–	25	mA
P_{tot}	total power dissipation	up to $T_s = 93$ °C; note 1	–	–	300	mW
h_{FE}	current gain	$I_C = 15$ mA; $V_{CE} = 10$ V	40	90	–	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$	–	2	–	dB
T_j	junction temperature		–	–	150	°C

Note

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

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	–	2	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; see Fig.2; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 93 °C; note 1	190	K/W

Note to the Limiting values and Thermal characteristics

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

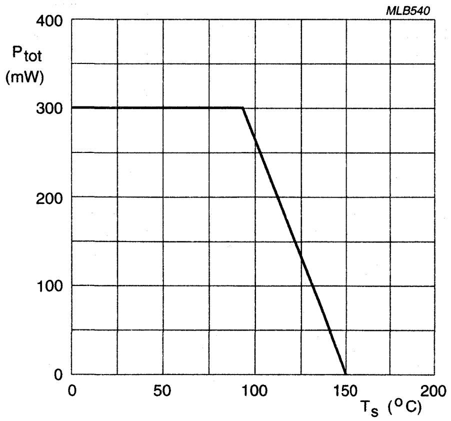


Fig.2 Power derating curve

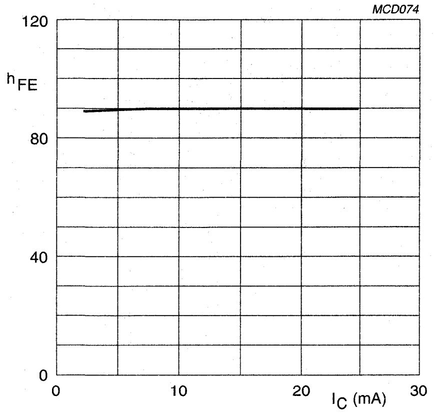
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$	–	2	–	dB
		$I_C = 5$ mA; $V_{CE} = 10$ V; f = 2 GHz; $\Gamma_s = \Gamma_{opt}$	–	3	–	dB

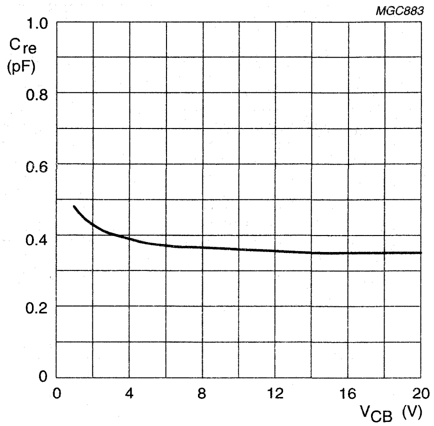
Note

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.



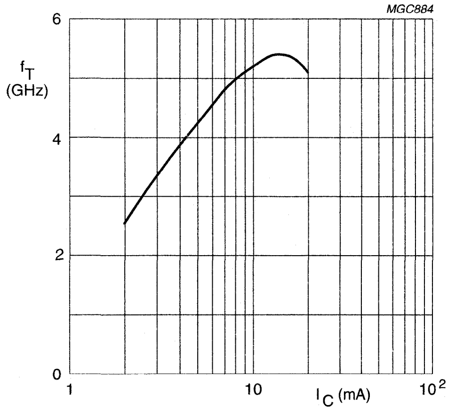
V_{CE} = 10 V.

Fig.3 DC current gain as a function of collector current; typical values.



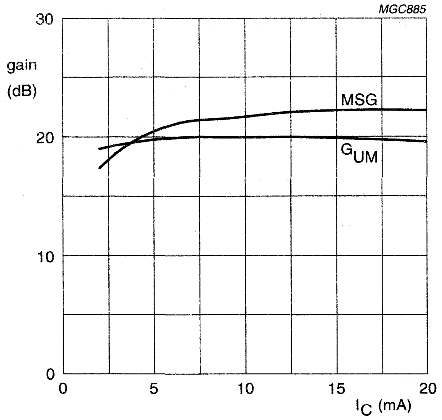
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



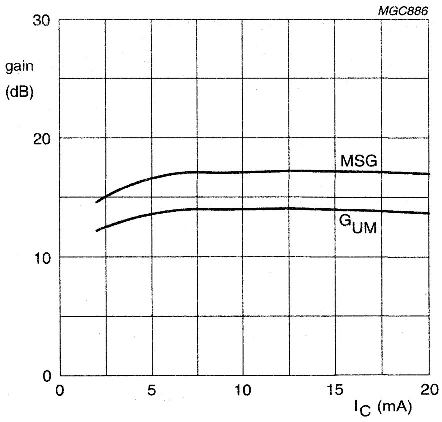
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



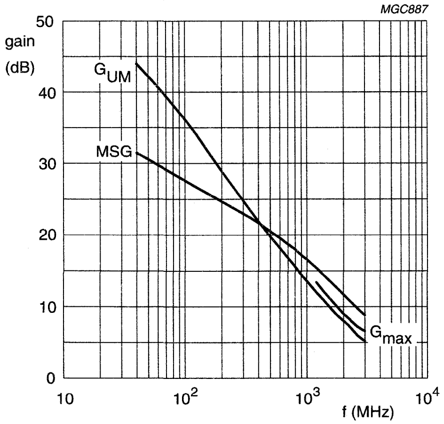
V_{CE} = 10 V; f = 500 MHz.

Fig.6 Gain as a function of collector current; typical values.



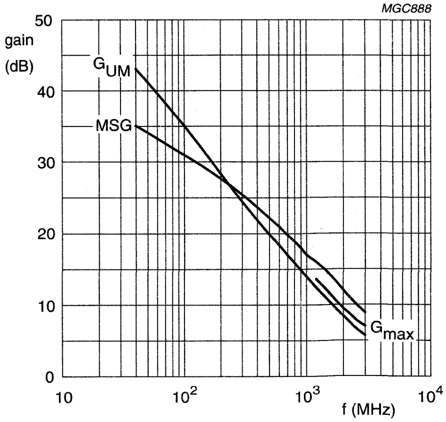
V_{CE} = 10 V; f = 1 GHz.

Fig.7 Gain as a function of collector current; typical values.



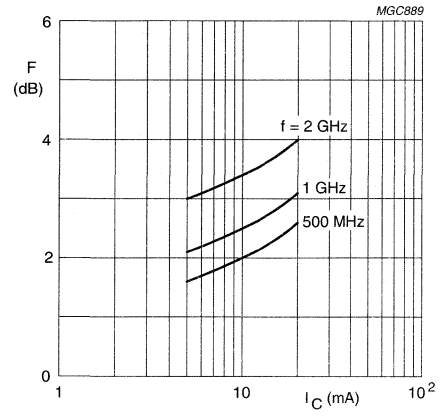
V_{CE} = 10 V; I_C = 5 mA.

Fig.8 Gain as a function of frequency; typical values.



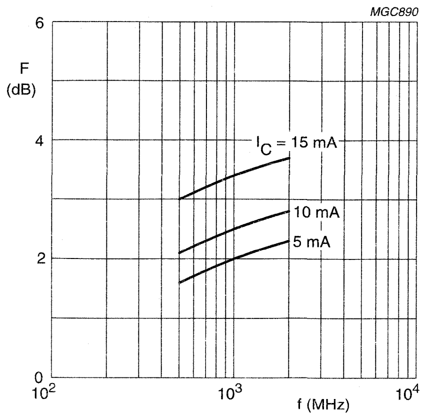
V_{CE} = 10 V; I_C = 15 mA.

Fig.9 Gain as a function of frequency; typical values.



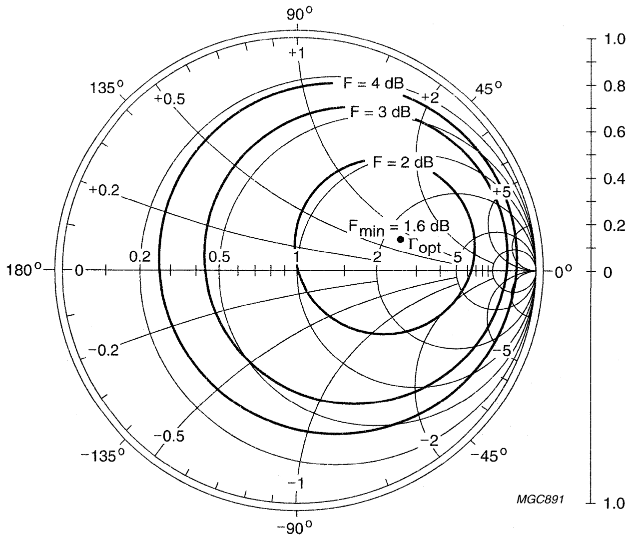
V_{CE} = 10 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



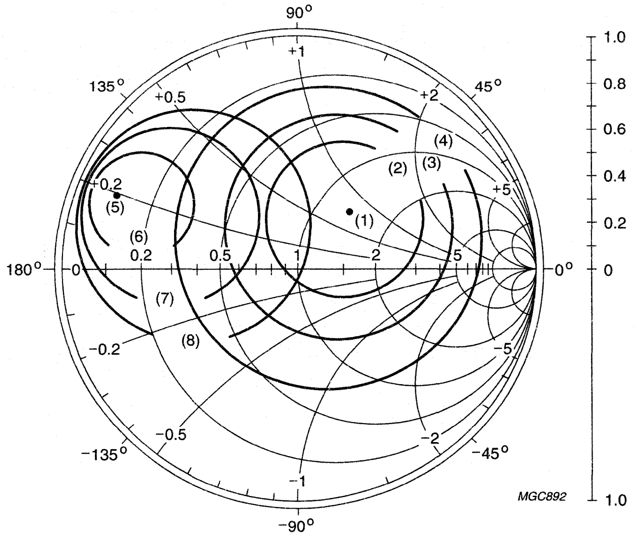
V_{CE} = 10 V.

Fig.11 Minimum noise figure as a function of frequency; typical values.



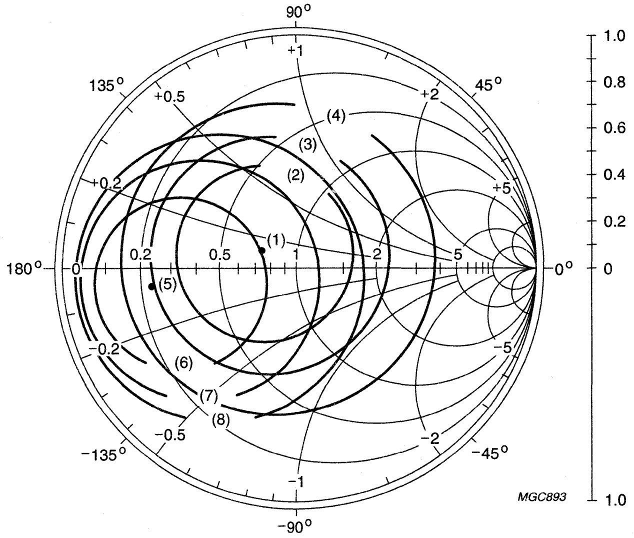
f = 500 MHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.12 Common emitter noise figure circles; typical values.



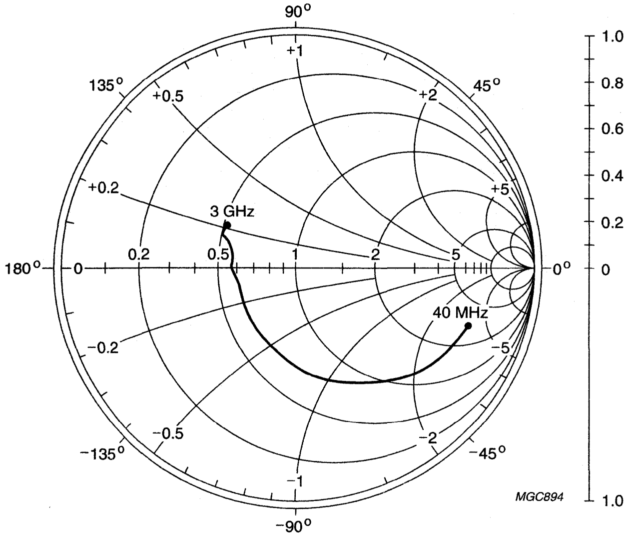
(1) Γ_{opt}; F_{min} = 2.1 dB.
(2) F = 2.5 dB.
(3) F = 3 dB.
(4) F = 4 dB.
(5) Γ_{ms}; G_{max} = 15.7 dB.
(6) G = 15 dB.
(7) G = 14 dB.
(8) G = 13 dB.
f = 1 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.13 Common emitter noise figure circles; typical values.



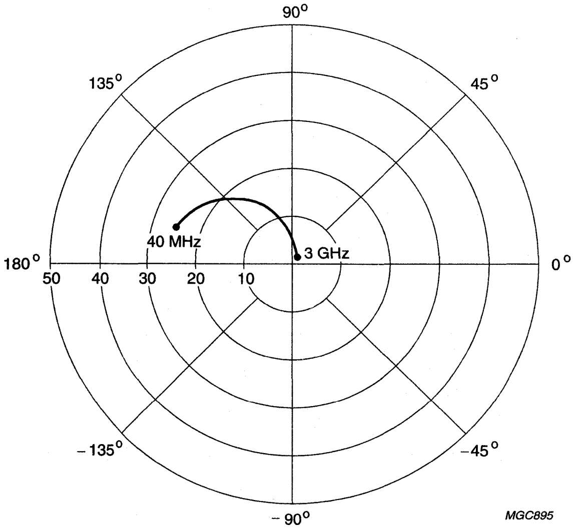
(1) Γ_{opt}; F_{min} = 3 dB.
(2) F = 3.5 dB.
(3) F = 4 dB.
(4) F = 5 dB.
(5) Γ_{ms}; G_{max} = 9.1 dB.
(6) G = 8 dB.
(7) G = 7 dB.
(8) G = 6 dB.
f = 2 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



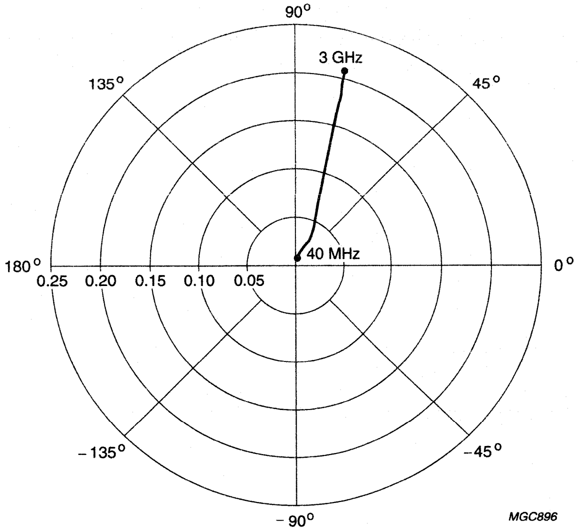
V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



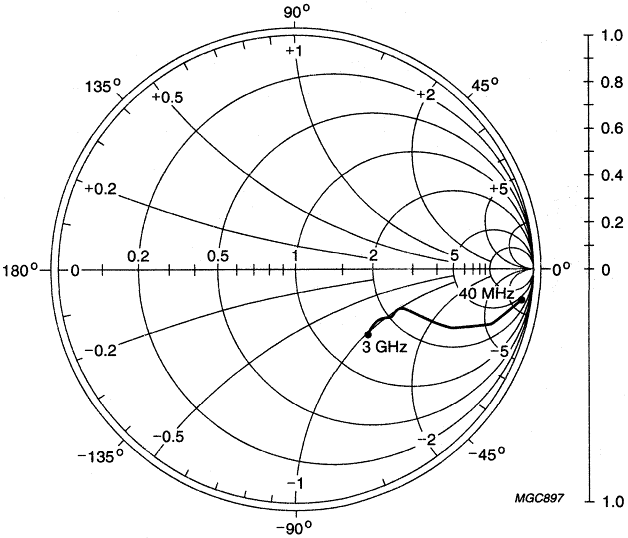
V_{CE} = 10 V; I_C = 15 mA.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



$V_{CE} = 10$ V; $I_C = 15$ mA.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.



$V_{CE} = 10$ V; $I_C = 15$ mA; $Z_o = 50$ Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

NPN 5 GHz wideband transistor BFR93

FEATURES

- Very low intermodulation distortion
- High power gain
- Excellent wideband properties and low noise up to high frequencies due to its very high transition frequency.

APPLICATIONS

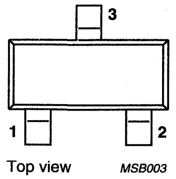
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: R1p.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C	–	300	mW
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 1 MHz	0.8	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_j = 25$ °C	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	16.5	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	1.9	–	dB
d_{im}	intermodulation distortion	$I_C = 30$ mA; $V_{CE} = 5$ V; $R_L = 75\ \Omega$; $V_O = 300$ mV; $f_p + f_q - f_r = 493.25$ MHz; $T_{amb} = 25$ °C	–60	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

NPN 5 GHz wideband transistor BFR93

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 95$ °C; note 1	260	K/W

Note

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

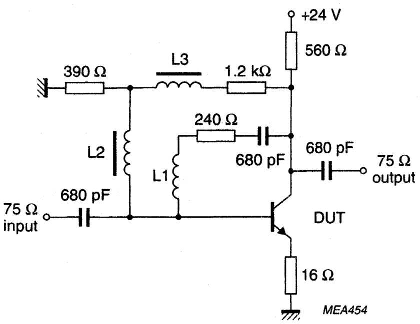
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.8	–	pF
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.8	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16.5	–	dB
F	noise figure (note 2)	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; Z_S = opt.; $T_{amb} = 25$ °C	–	1.9	–	dB
d_{im}	intermodulation distortion	note 3	–	–60	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}$
2. Die mounted in a SOT37 package (BFR91).
3. $I_C = 30$ mA; $V_{CE} = 5$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °C;
   $V_p = V_O = 300$ mV at $f_p = 495.25$ MHz;
   $V_q = V_O$ –6 dB at $f_q = 503.25$ MHz;
   $V_r = V_O$ –6 dB at $f_r = 505.25$ MHz;
   measured at $f_p + f_q - f_r = 493.25$ MHz.



L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.

L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

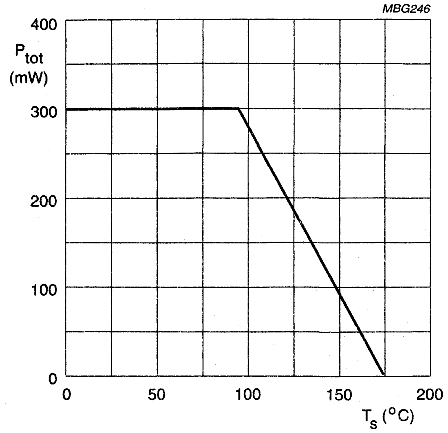
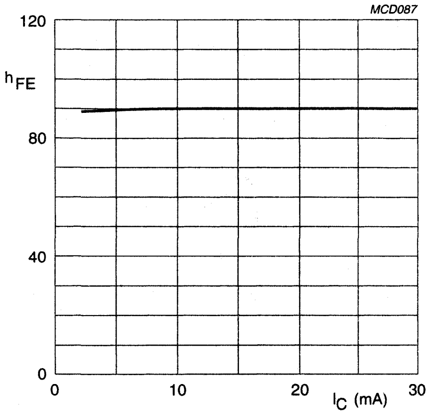
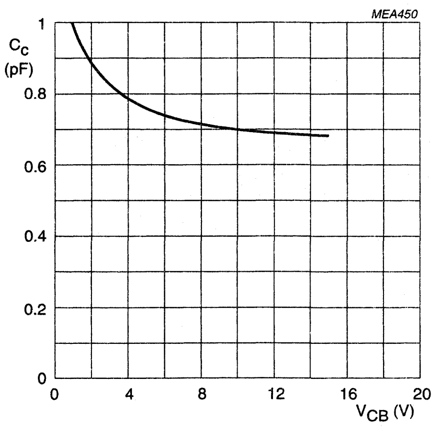


Fig.3 Power derating curve.



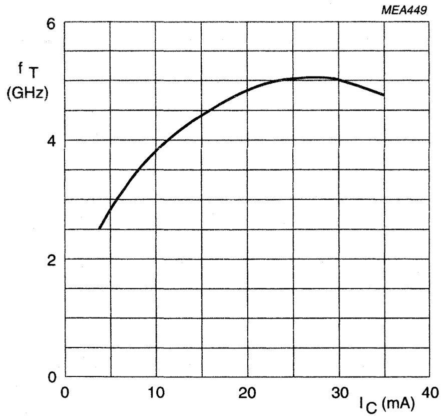
V_{CE} = 5 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current; typical values.



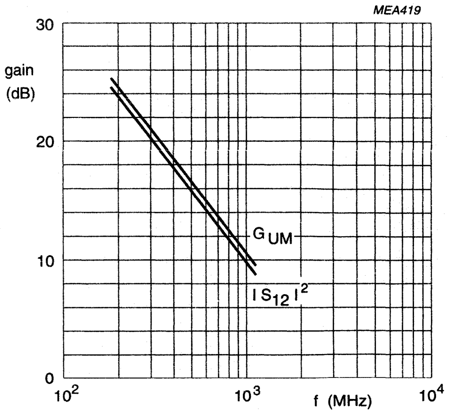
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



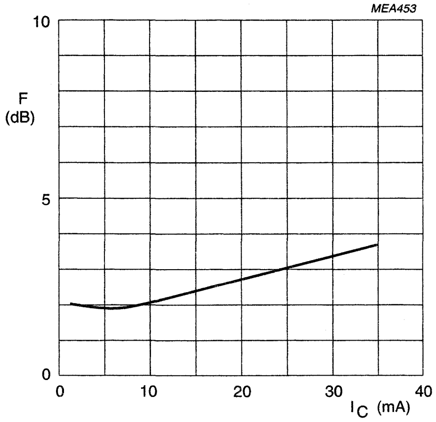
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



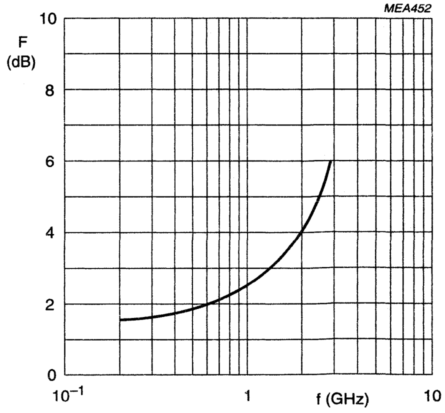
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency; typical values.



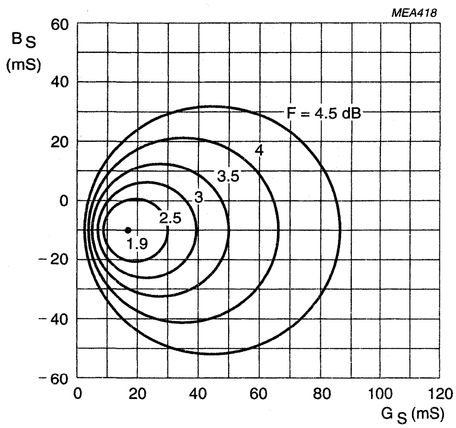
V_{CE} = 5 V; f = 500 MHz; Z_S = opt.; T_{amb} = 25 °C.

Fig.8 Minimum noise figure as a function of collector current; typical values.



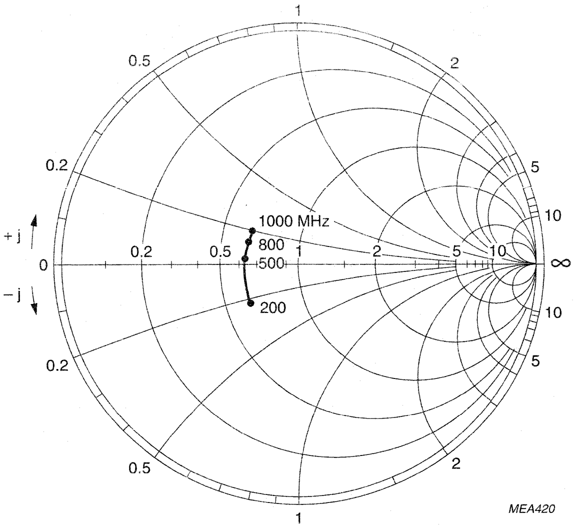
I_C = 2 mA; V_{CE} = 5 V; Z_S = opt.; T_{amb} = 25 °C.

Fig.9 Minimum noise figure as a function of frequency; typical values.



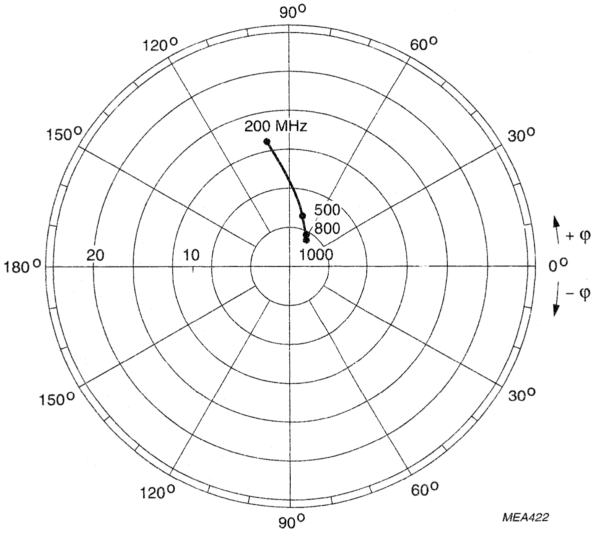
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Circles of constant noise figure; typical values.



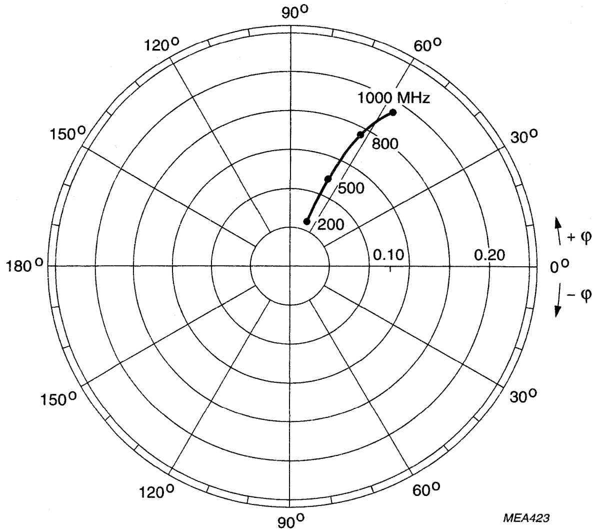
I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

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



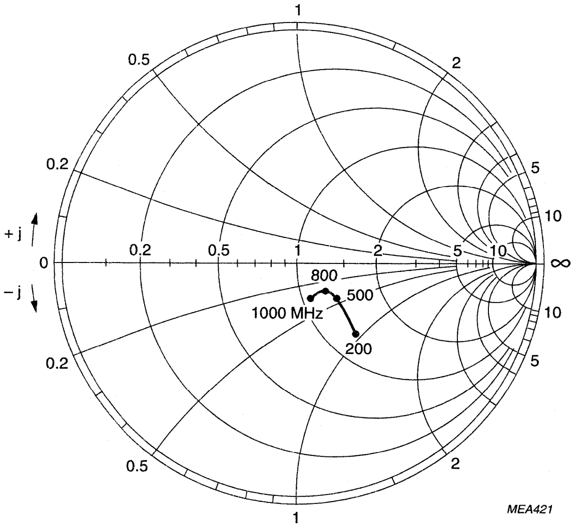
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

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



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

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



I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

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

NPN 6 GHz wideband transistor BFR93A

FEATURES

- High power gain
- Low noise figure
- Very low intermodulation distortion.

APPLICATIONS

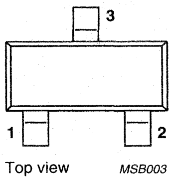
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: R2p.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C	–	300	mW
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 5$ V; f = 1 MHz	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	6	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	13	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	7	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 8$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C	1.9	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C; $f_p + f_q - f_r = 793.25$ MHz	425	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	+175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 95$ °C; note 1	260	K/W

Note

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

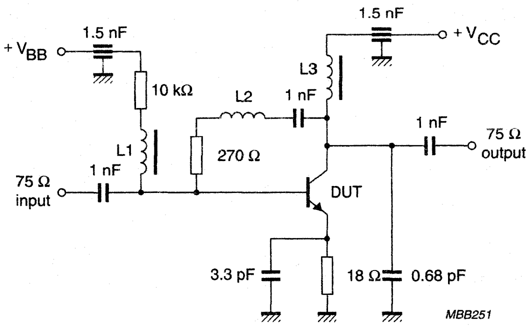
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.9	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	13	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	7	–	dB
F	noise figure (note 2)	$I_C = 5$ mA; $V_{CE} = 8$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	1.9	–	dB
		$I_C = 5$ mA; $V_{CE} = 8$ V; f = 2 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	425	–	mV
d_2	second order intermodulation distortion	notes 2 and 4	–	–50	–	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. Measured on the same die in a SOT37 package (BFR91A).
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 30$ mA; $V_{CE} = 8$ 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 at $f_q = 803.25$ MHz;
   $V_r = V_O$ −6 dB at $f_r = 805.25$ MHz;
   measured at $f_p + f_q - f_r = 793.25$ MHz.
4. $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = 200$ mV at $f_p = 250$ MHz;
   $V_q = 200$ mV at $f_q = 560$ MHz;
   measured at $f_p + f_q = 810$ MHz.



L1 = L3 = 5 μH choke.

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

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

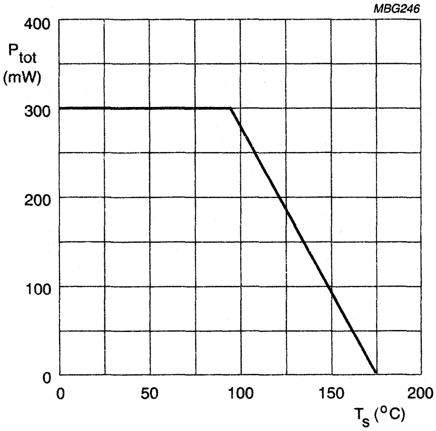
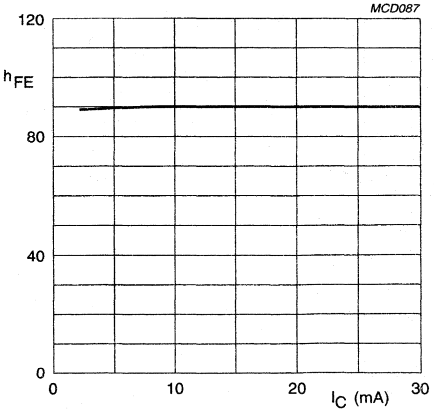
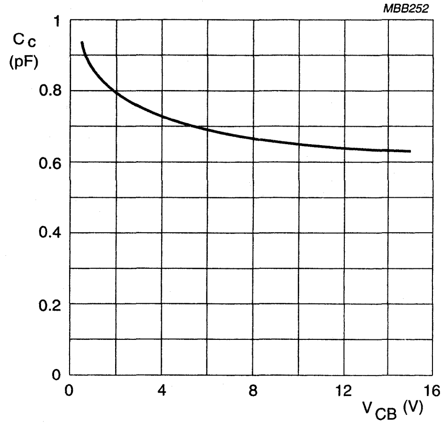


Fig.3 Power derating curve.



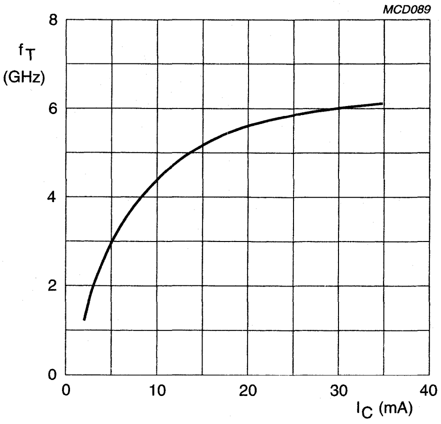
$V_{CE} = 5$ V; $T_j = 25$ °C.

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



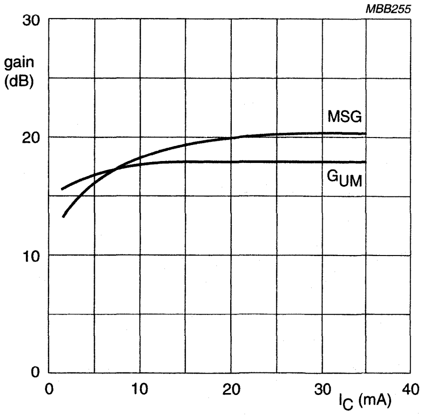
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



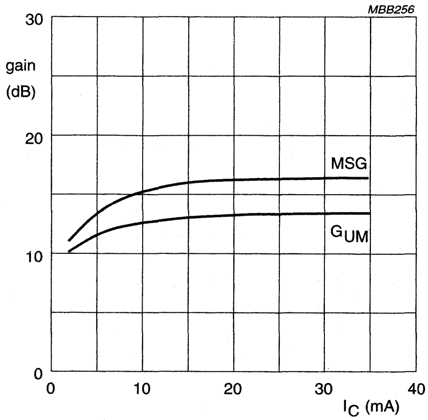
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



V_{CE} = 8 V; f = 500 MHz.

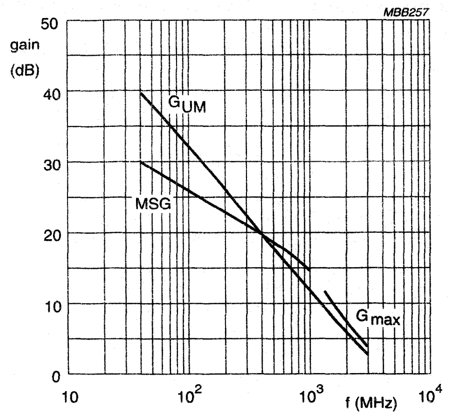
Fig.7 Gain as a function of collector current; typical values.



V_{CE} = 8 V; f = 1 GHz.

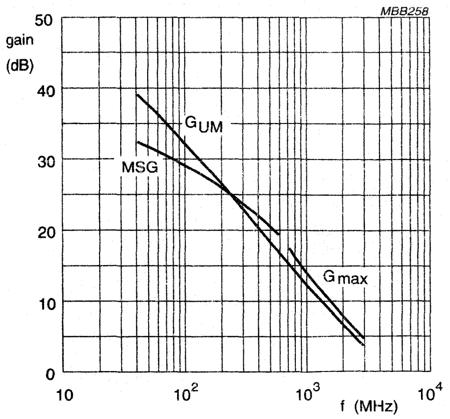
Fig.8 Gain as a function of collector current; typical values.

NPN 6 GHz wideband transistor | BFR93A



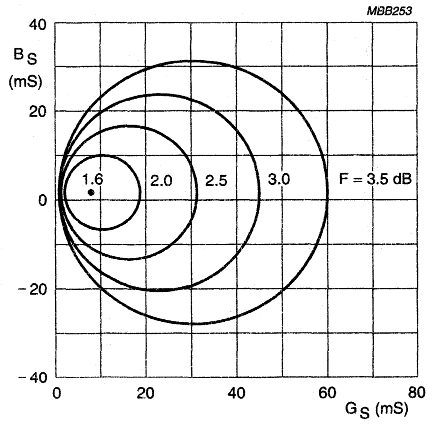
I_C = 10 mA; V_{CE} = 8 V.

Fig.9 Gain as a function of frequency; typical values.



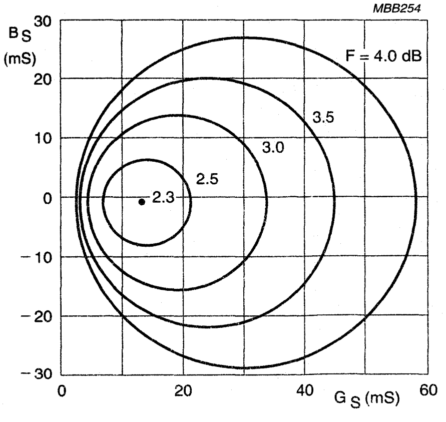
I_C = 30 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.



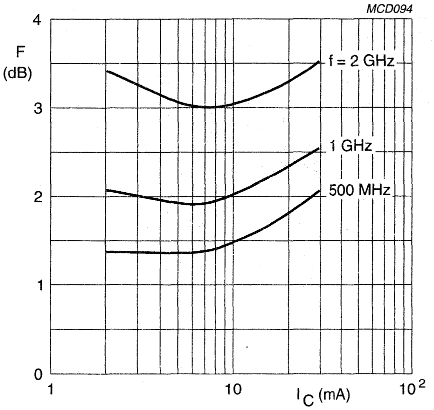
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.11 Circles of constant noise figure; typical values.



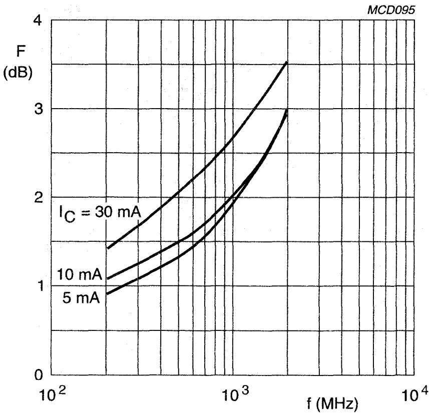
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.12 Circles of constant noise figure; typical values.



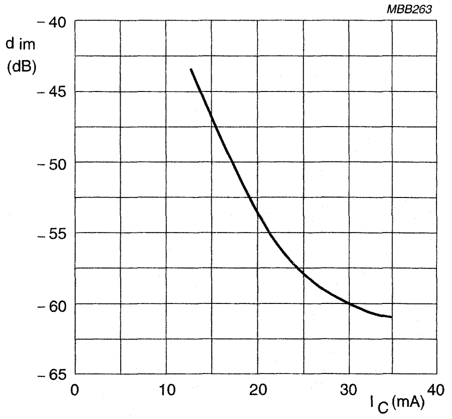
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



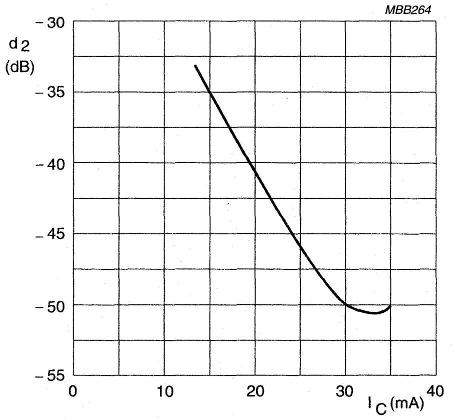
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



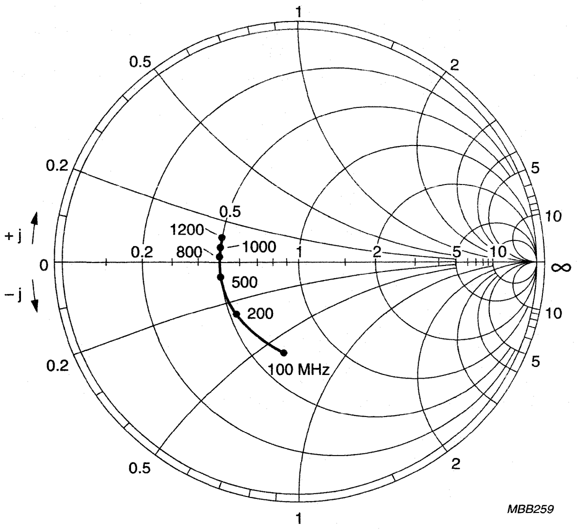
V_{CE} = 8 V; V_O = 425 mV (52.6 dBmV);
$f_p + f_q - f_r$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2)

Fig.15 Intermodulation distortion; typical values.



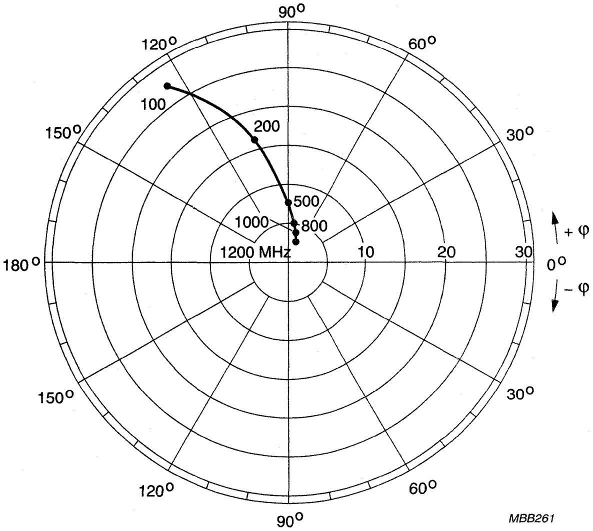
V_{CE} = 8 V; V_O = 200 mV (46 dBmV);
$f_p + f_q - f_r$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2)

Fig.16 Second order intermodulation distortion; typical values.



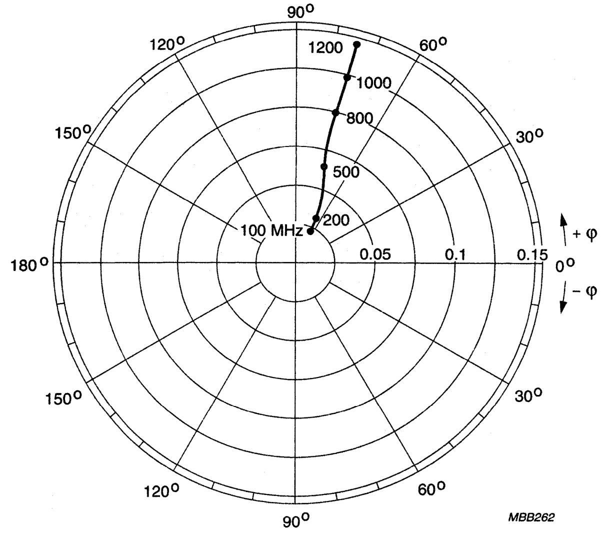
I_C = 30 mA; V_{CE} = 8 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.17 Common emitter input reflection coefficient (S_{11}).



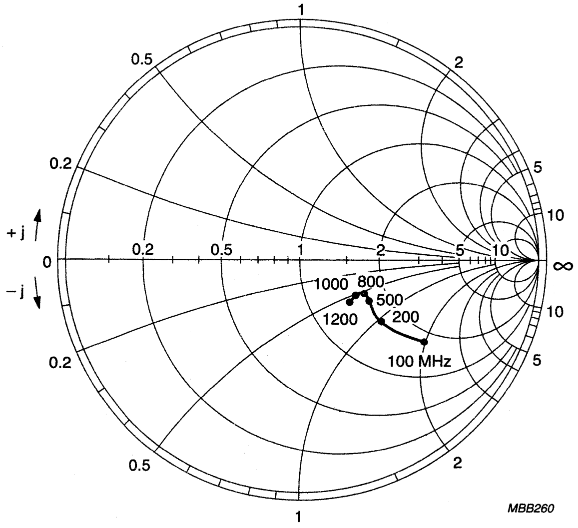
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



I_C = 30 mA; V_{CE} = 8 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFR93AW

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) package.

APPLICATIONS

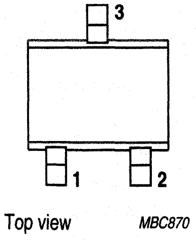
It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz.

DESCRIPTION

Silicon NPN transistor encapsulated in a plastic SOT323 (S-mini) package. The BFR93AW uses the same crystal as the SOT23 version, BFR93A.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: R2.

Fig.1 SOT323

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	collector current (DC)		–	–	35	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	40	90	–	
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	–	0.6	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz	4	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	13	–	dB
		I_C = 30 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	8	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 8 V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$	–	1.5	–	dB
T_j	junction temperature		–	–	150	°C

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITION	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; see Fig.2; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITION	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 93 °C; note 1	190	K/W

Note to the Limiting values and Thermal characteristics

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

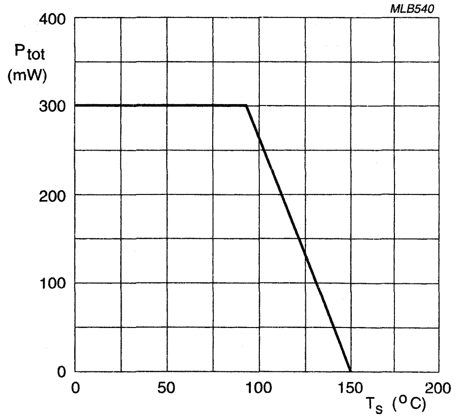


Fig.2 Power derating curve.

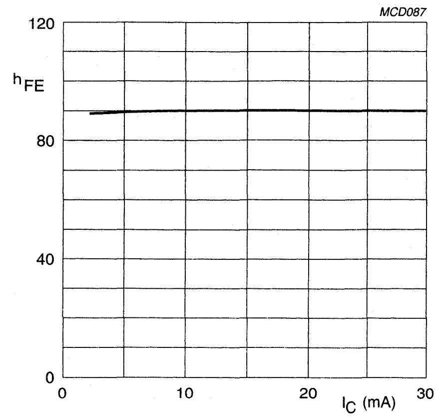
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2.3	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 5$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	4	5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 30$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	13	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 8$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$	–	1.5	–	dB
		$I_C = 5$ mA; $V_{CE} = 8$ V; f = 2 GHz; $\Gamma_s = \Gamma_{opt}$	–	2.1	–	dB

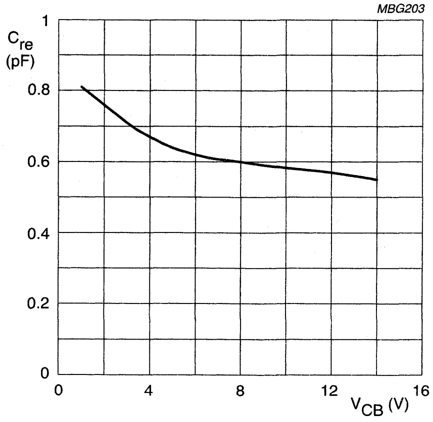
Note

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.



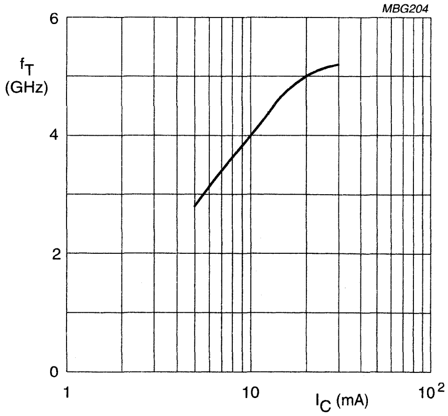
V_{CE} = 5 V.

Fig.3 DC current gain as a function of collector current; typical values.



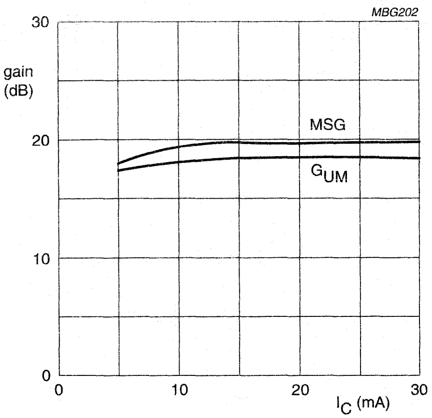
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



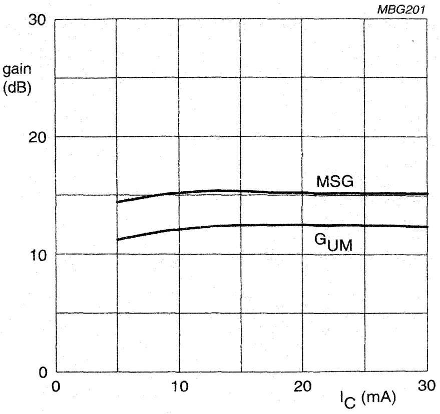
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



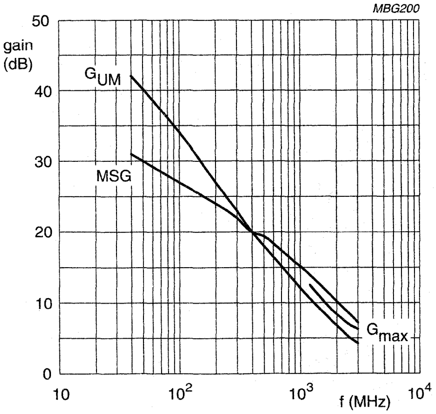
V_{CE} = 8 V; f = 500 MHz.

Fig.6 Gain as a function of collector current; typical values.



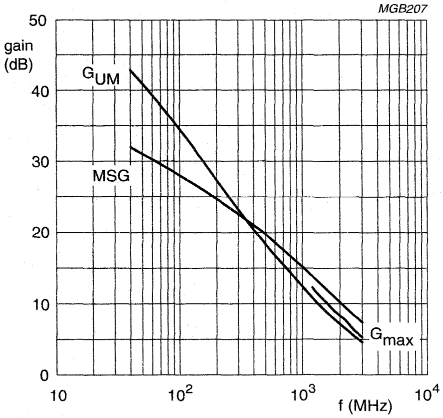
V_{CE} = 8 V; f = 1 GHz.

Fig.7 Gain as a function of collector current; typical values.



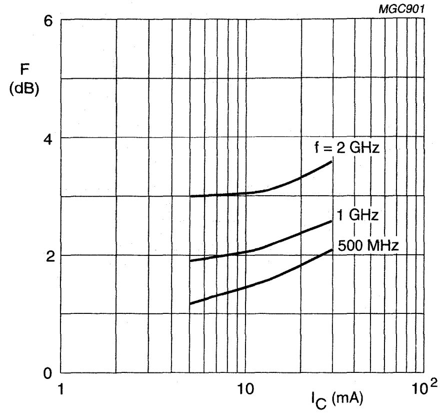
V_{CE} = 8 V; I_C = 10 mA.

Fig.8 Gain as a function of frequency; typical values.



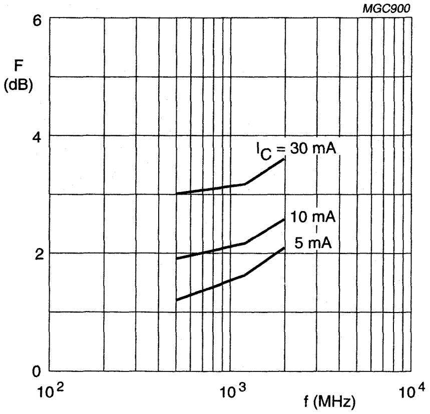
V_{CE} = 8 V; I_C = 30 mA.

Fig.9 Gain as a function of frequency; typical values.



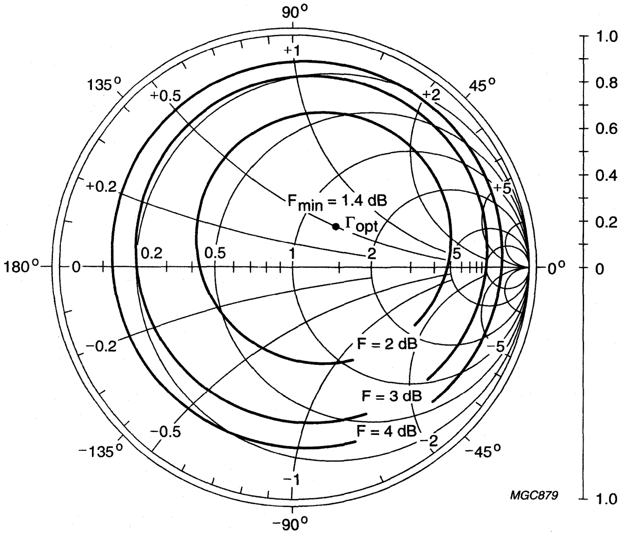
V_{CE} = 8 V.

Fig.10 Minimum noise figure as a function of collector current; typical values.



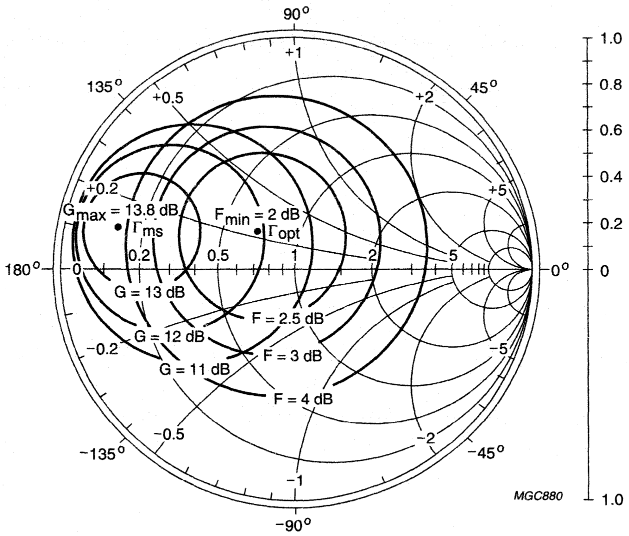
V_{CE} = 8 V.

Fig.11 Minimum noise figure as a function of collector current; typical values.



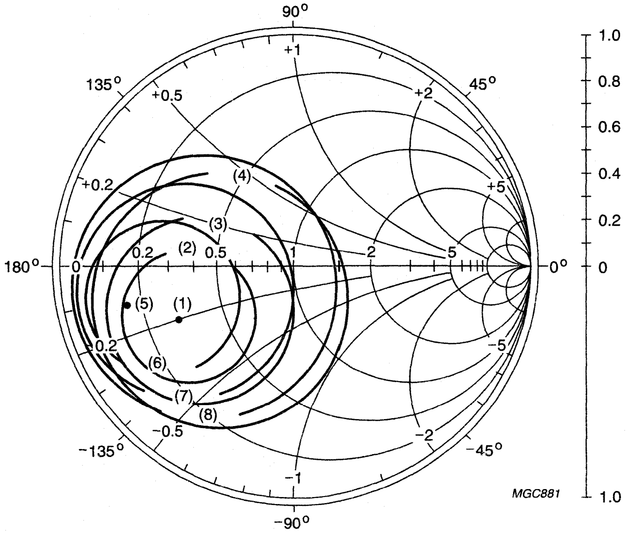
f = 500 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.12 Common emitter noise figure circles; typical values.



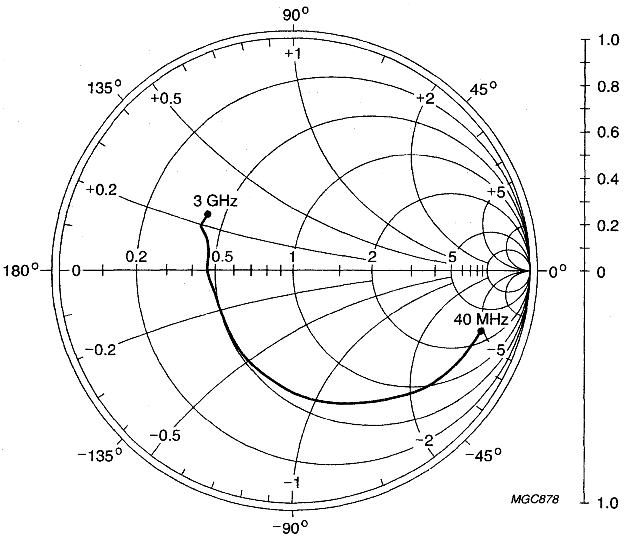
f = 1 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.13 Common emitter noise figure circles; typical values.



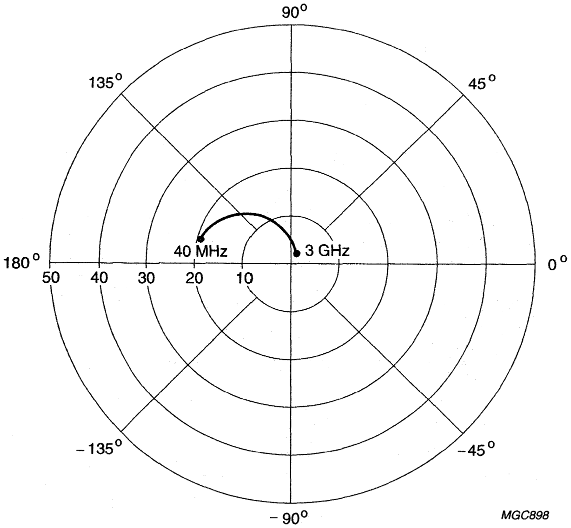
(1) Γ_{opt}; F_{min} = 3 dB.
(2) F = 3.5 dB.
(3) F = 4 dB.
(4) F = 5 dB.
(5) Γ_{ms}; G_{max} = 8.1 dB.
(6) G = 7 dB.
(7) G = 6 dB.
(8) G = 5 dB.
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.14 Common emitter noise figure circles; typical values.



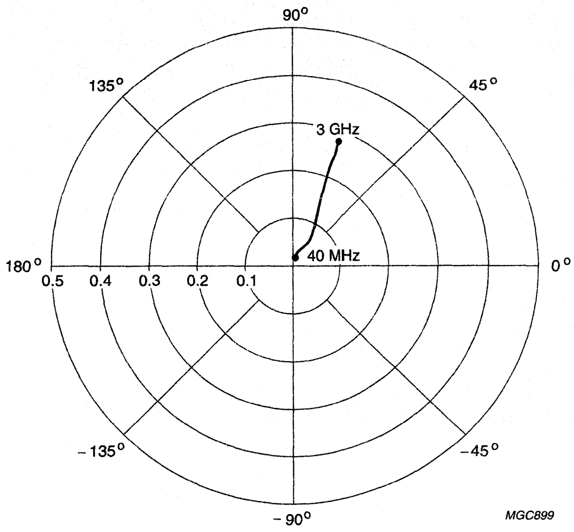
V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



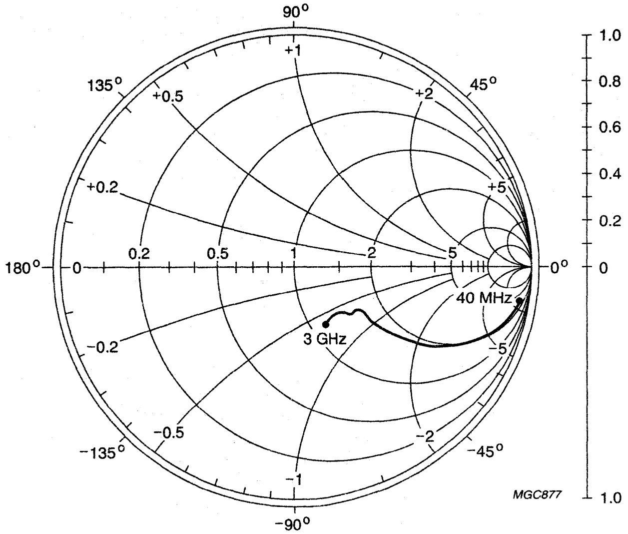
V_{CE} = 8 V; I_C = 30 mA.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 8 V; I_C = 30 mA.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

NPN 3.5 GHz wideband transistor BFR94A

DESCRIPTION

NPN resistance-stabilized transistor in a SOT122E capstan envelope.

It features extremely low cross modulation, intermodulation and second order intermodulation distortion. Due to its high transition frequency, it has a high power gain, in conjunction with good wideband properties, and low noise up to high frequencies.

It is primarily intended for CATV and MATV applications.

The BFR94A is a replacement for the BFR94. The SOT122E footprint is similar to that of the SOT48, used for the BFR94.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

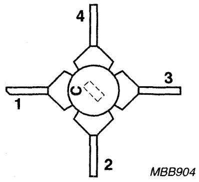


Fig.1 SOT122E.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to $T_c = 145$ °C; $f > 1$ MHz	–	3.5	W
f_T	transition frequency	$I_c = 90$ mA; $V_{CE} = 20$ V; $f = 500$ MHz; $T_j = 25$ °C	3.5	–	GHz
F	noise figure	$I_c = 90$ mA; $V_{CE} = 20$ V; $f = 200$ MHz; $T_{amb} = 25$ °C	8	10	dB
d_{im}	intermodulation distortion	$I_c = 90$ mA; $V_{CE} = 20$ V; $V_o = 60$ dBmV; $f_{(p+q-r)} = 194.25$ MHz	−63	–	dB
d_2	second order intermodulation distortion	$I_c = 90$ mA; $V_{CE} = 20$ V; $V_o = 48$ dBmV; $f_p + f_q = 210$ MHz	–	−56	dB

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	35	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	150	mA
I_{CM}	peak collector current	f > 1 MHz	–	300	mA
P_{tot}	total power dissipation	up to T_c = 145 °C; f > 1 MHz	–	3.5	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	15 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

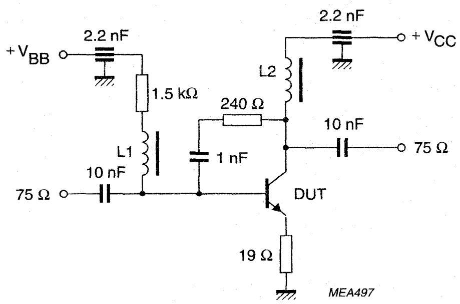
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 20$ V	30	–	–	
		$I_C = 150$ mA; $V_{CE} = 20$ V	30	–	–	
f_T	transition frequency	$I_C = 90$ mA; $V_{CE} = 20$ V; f = 500 MHz	–	3.5	–	GHz
		$I_C = 150$ mA; $V_{CE} = 20$ V; f = 500 MHz	–	3.5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 20$ V; f = 1 MHz	–	3.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	–	pF
C_{re}	feedback capacitance	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 1 MHz	–	1.3	–	pF
C_{cs}	collector-stud capacitance	f = 1 MHz	–	2	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 90$ mA; $V_{CE} = 20$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	13.5	–	dB
F	noise figure	$I_C = 90$ mA; $V_{CE} = 20$ V; f = 200 MHz; $T_{amb} = 25$ °C	–	8	10	dB
		$I_C = 90$ mA; $V_{CE} = 20$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	5	–	dB
d_{im}	intermodulation distortion	note 2	–	−63	–	dB
d_2	second order intermodulation distortion	note 3	–	–	−56	dB
V_o	output voltage	see Fig.2 and note 4	–	700	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

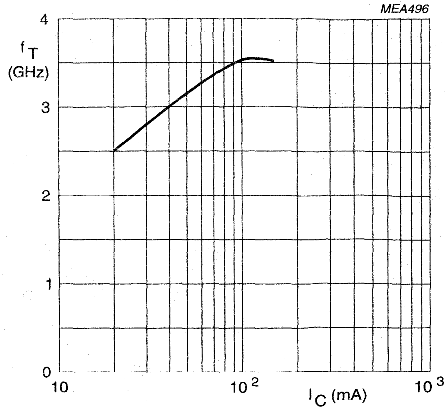
$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB.}$$

2. $I_C = 90$ mA; $V_{CE} = 20$ V; $R_L = 75\ \Omega$;
   $V_p = V_o = 60$ dBmV at $f_p = 196.25$ MHz;
   $V_q = V_o - 6$ dB at $f_q = 203.25$ MHz;
   $V_r = V_o - 6$ dB at $f_r = 205.25$ MHz;
   measured at $f_{(p+q-r)} = 194.25$ MHz.
3. $I_C = 90$ mA; $V_{CE} = 20$ V;
   $f_p = 66$ MHz; $f_q = 144$ MHz; $f_p + f_q = 210$ MHz; $V_o = 48$ dBmV.
4. $d_{im} = -60$ dB (DIN 45004B); $I_c = 90$ mA; $V_{CE} = 20$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 495.25$ MHz;
   $V_q = V_o - 6$ dB; $f_q = 503.25$ MHz;
   $V_r = V_o - 6$ dB; $f_r = 505.25$ MHz;
   measured at $f_{(p+q-r)} = 493.25$ MHz.



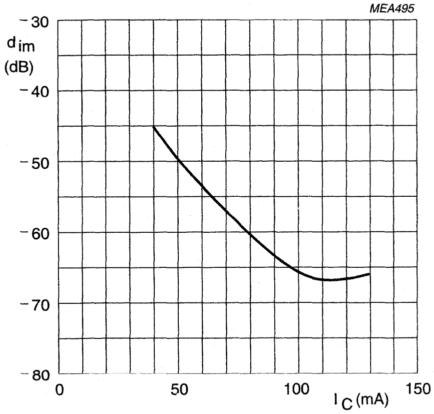
L1 = L2 = 5 μH Ferroxcube choke, catalogue number 3122 108 20153.

Fig.2 Intermodulation distortion MATV test circuit.



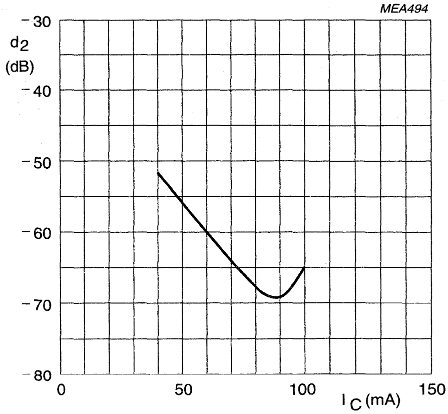
V_{CE} = 20 V; f = 500 MHz; T_j = 25 °C.

Fig.3 Transition frequency as a function of collector current.



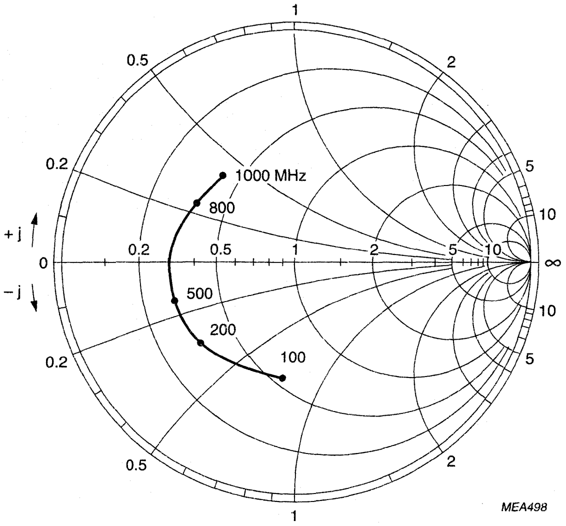
Measured in CATV test circuit.
V_{CE} = 20 V; V_o = 60 dBmV;
$f_{(p+q-r)}$ = 194. 25 MHz.

Fig.4 Intermodulation distortion as a function of collector current.



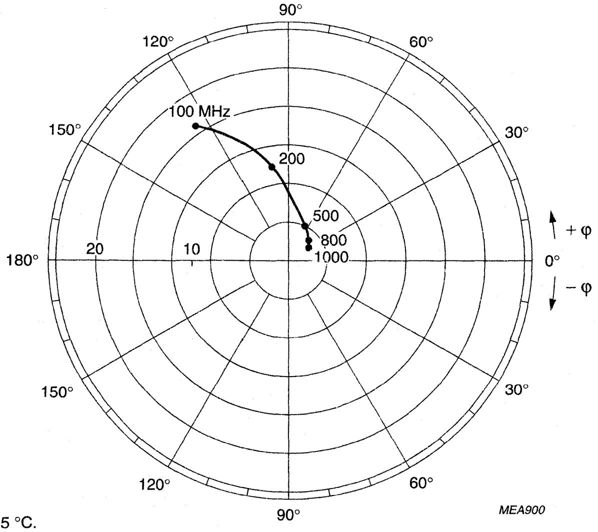
Measured in CATV test circuit.
V_{CE} = 20 V; V_o = 48 dBmV; f = 210 MHz.

Fig.5 Second order intermodulation distortion as a function of collector current.



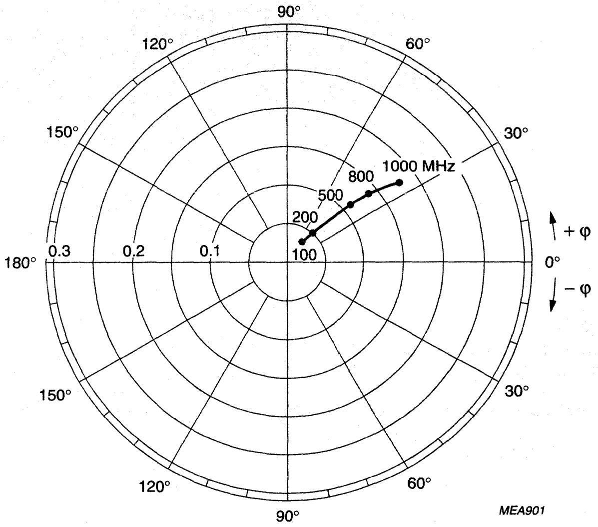
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.6 Common emitter input reflection coefficient (S_{11}).



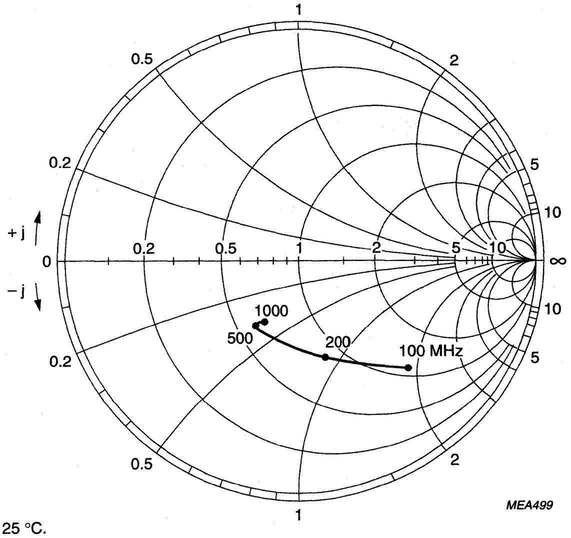
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.9 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFR106

DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT23 envelope. It is primarily intended for low noise, general RF applications.

PINNING

PIN	DESCRIPTION
Code: R7p	
1	base
2	emitter
3	collector

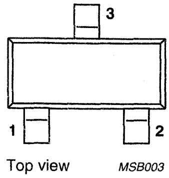


Fig.1 SOT23.

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		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	–	500	mW
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 9 V; T_{amb} = 25 °C	25	80	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 9 V; f = 500 MHz; T_{amb} = 25 °C	–	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 6 V; f = 800 MHz; T_{amb} = 25 °C	–	11.5	–	dB
V_o	output voltage	I_C = 50 mA; V_{CE} = 9 V; R_L = 75 Ω; T_{amb} = 25 °C; d_{im} = –60 dB; $f_{(p+q-r)}$ = 793.25 MHz	–	350	–	mV

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		–	100	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C; note 1	210 K/W

Note

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

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; $V_{CE} = 9$ V	25	80	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 9$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	5	–	GHz
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	–	4.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1.2	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 6$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	11.5	–	dB
F	noise figure	$I_C = 30$ mA; $V_{CE} = 6$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	3.5	–	dB
d_2	second order intermodulation distortion	note 2	–	–50	–	dB
V_o	output voltage	note 3	–	350	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB}.$$

2. $I_C = 30$ mA; $V_{CE} = 6$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $f_{(p+q)} = 810$ MHz; $V_o = 100$ mV.
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 50$ mA; $V_{CE} = 9$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C; $f_{(p+q-r)} = 793.25$ MHz.

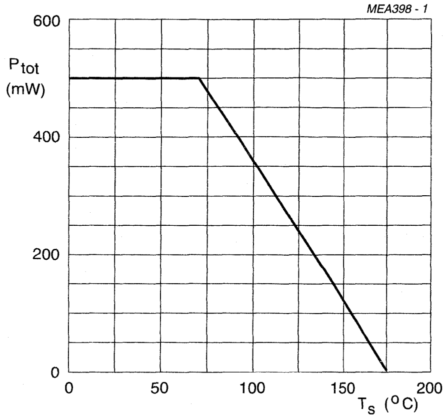
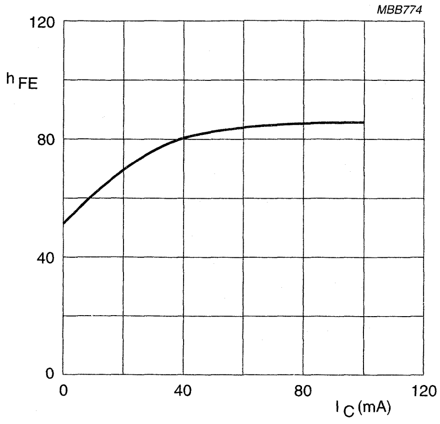
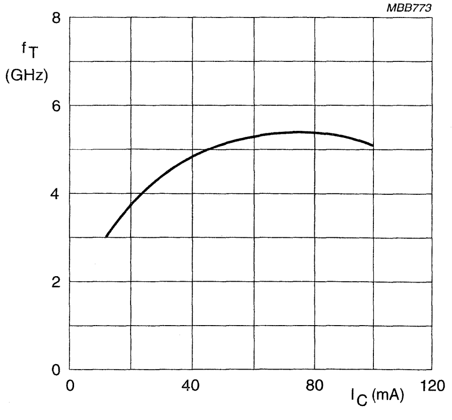


Fig.2 Power derating curve.



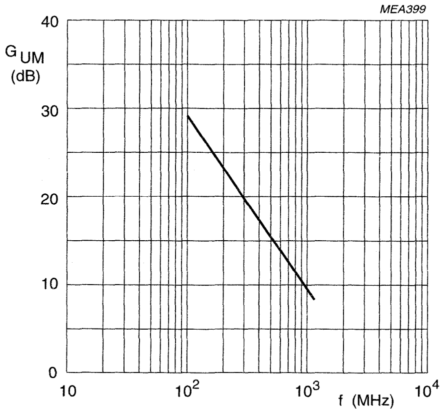
V_{CE} = 9 V; T_{amb} = 25 °C.

Fig.3 DC current gain as a function of collector current.



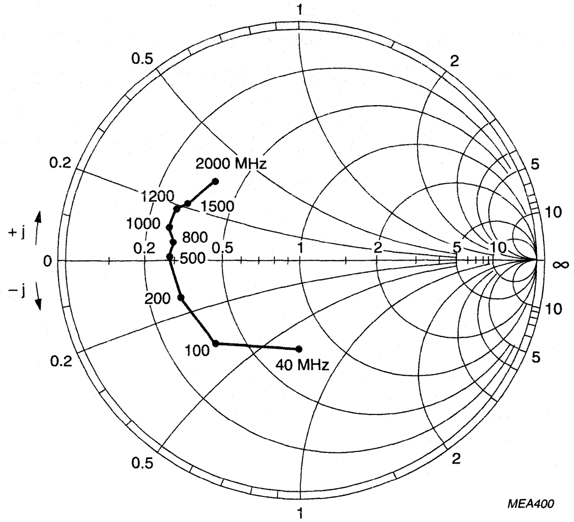
V_{CE} = 9 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



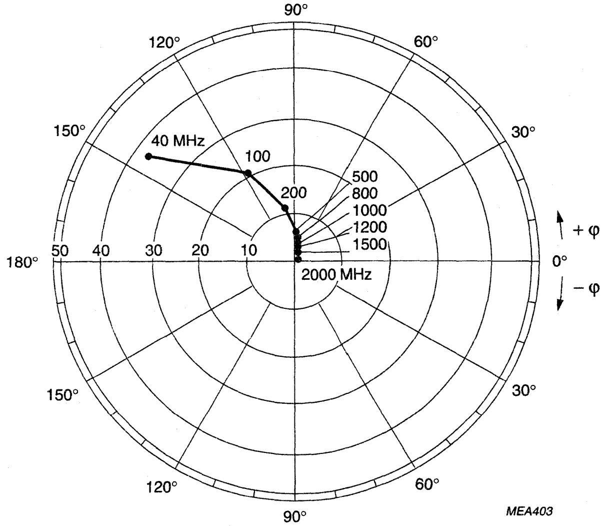
I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.5 Maximum unilateral power gain as a function of frequency.



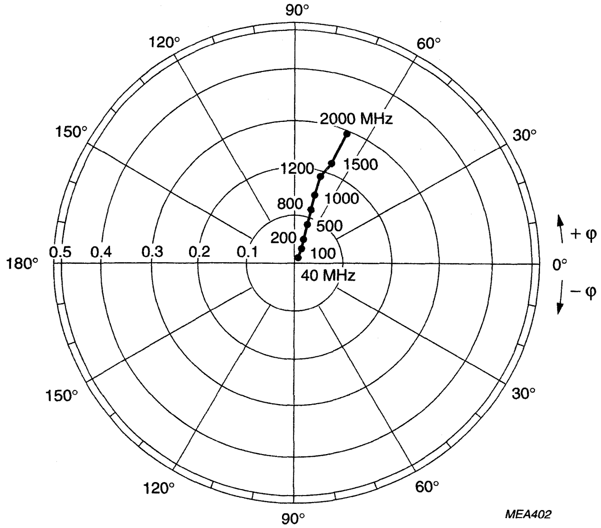
I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.6 Common emitter input reflection coefficient (S_{11}).



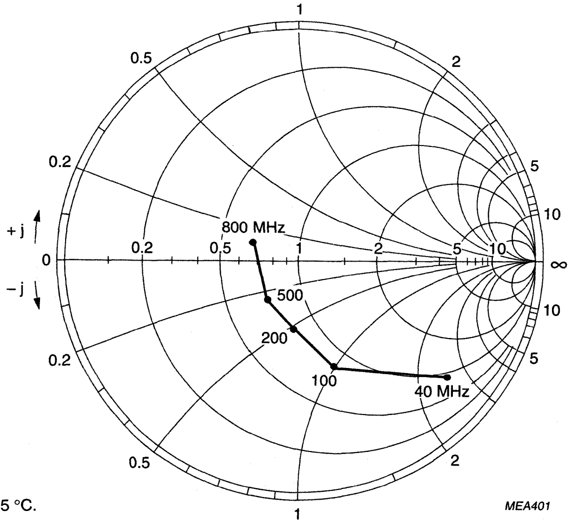
I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.9 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor BFR505

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR505 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV).

The transistor is encapsulated in a plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: N30	
1	base
2	emitter
3	collector

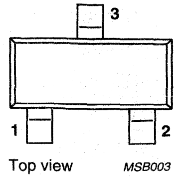


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	18	mA
P_{tot}	total power dissipation	up to $T_s = 135$ °C; note 1	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB

Note

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

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage		–	2.5	V
I_C	DC collector current	continuous	–	18	mA
P_{tot}	total power dissipation	up to T_s = 135 °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.4	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C; f = 900 MHz	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{dB}.$$

2. $I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
$f_p = 900$ MHz; $f_q = 902$ MHz;
measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.

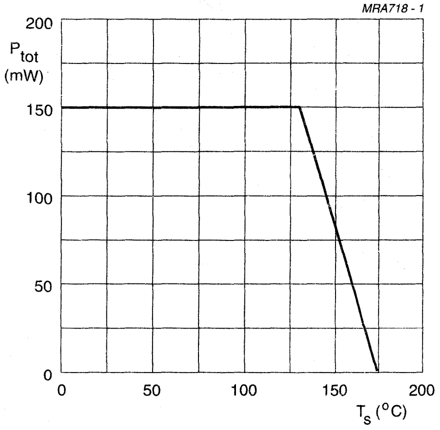
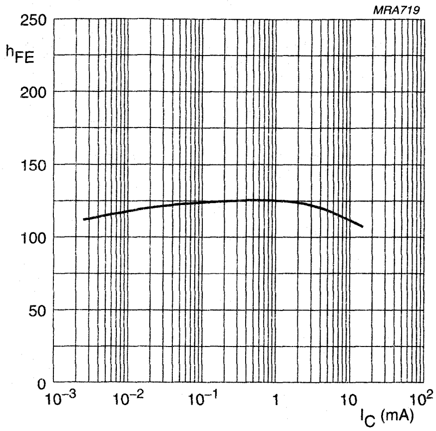
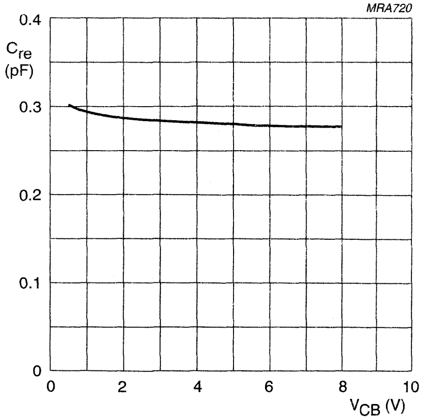


Fig.2 Power derating curve.



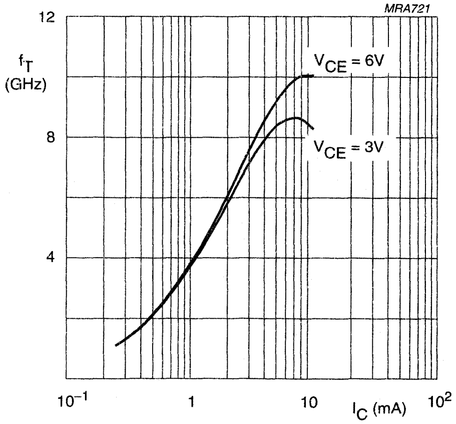
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current.



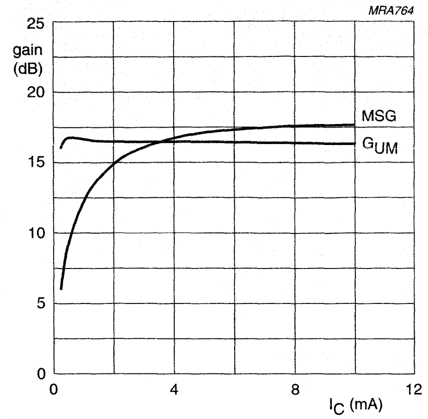
I_c = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



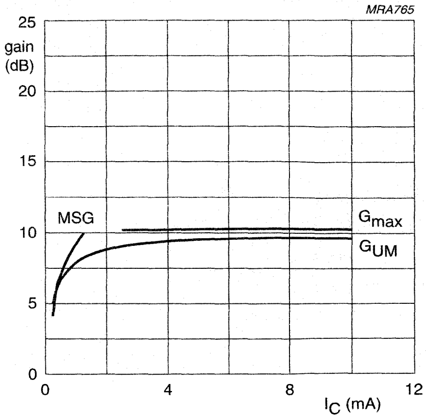
T_{amb} = 25 °C; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current.



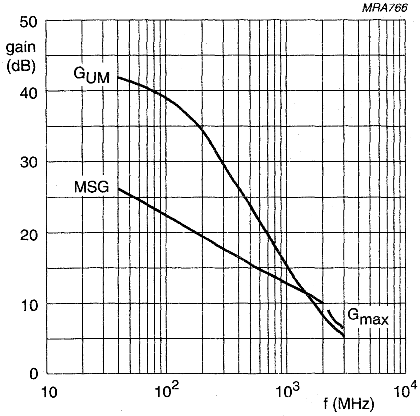
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



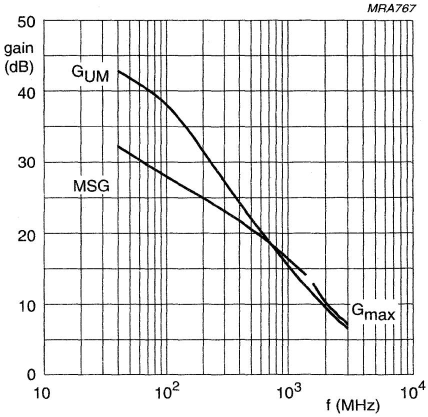
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



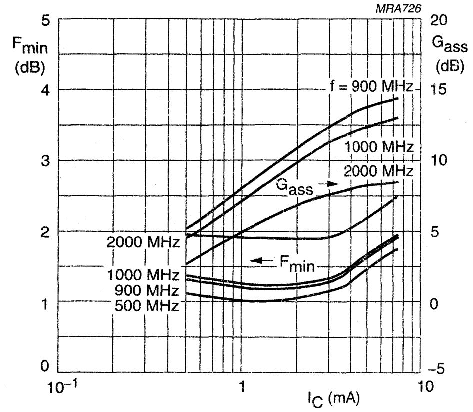
V_{CE} = 6 V; I_c = 1.25 mA.

Fig.8 Gain as a function of frequency.



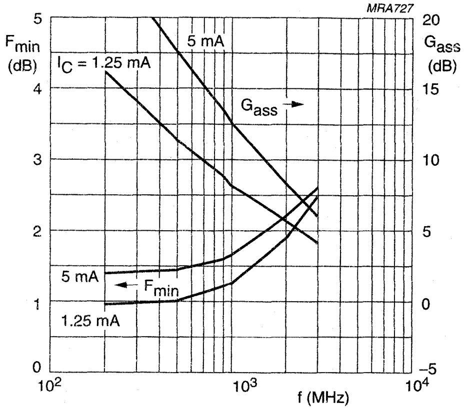
V_{CE} = 6 V; I_c = 5 mA.

Fig.9 Gain as a function of frequency.



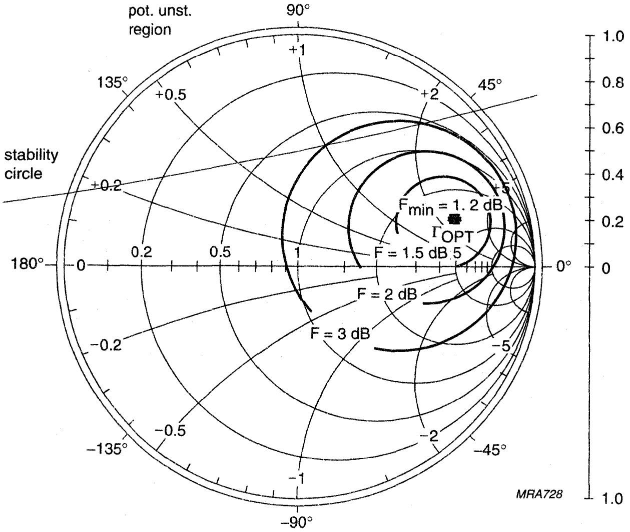
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



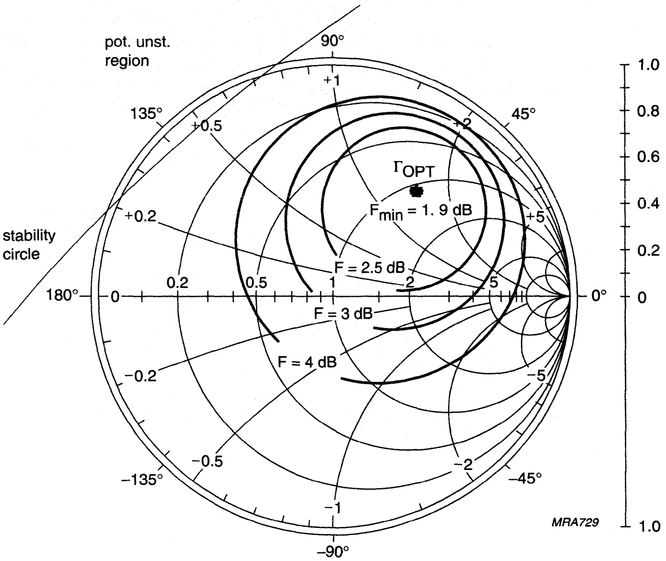
V_{CE} = 6 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.
V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

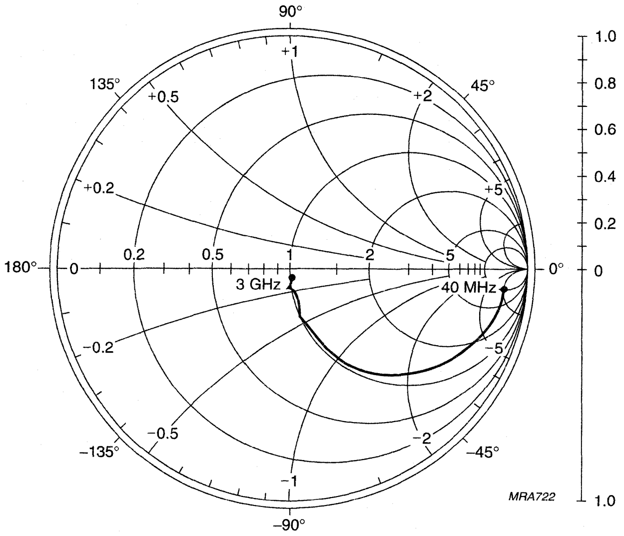
Fig.12 Noise circle figure.



$Z_o = 50\ \Omega$.

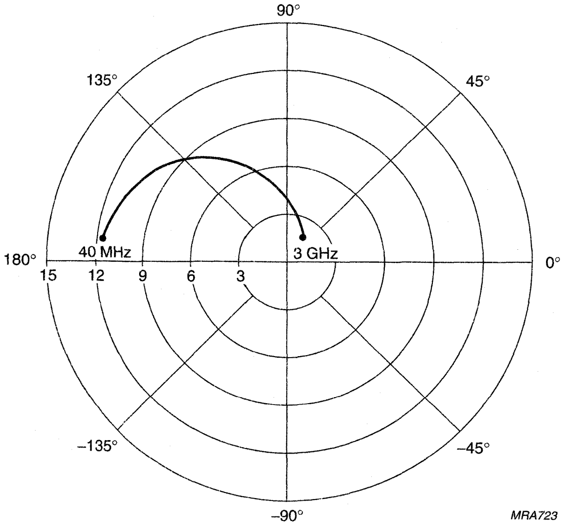
$V_{CE} = 6$ V; $I_C = 5$ mA; f = 2000 MHz.

Fig.13 Noise circle figure.



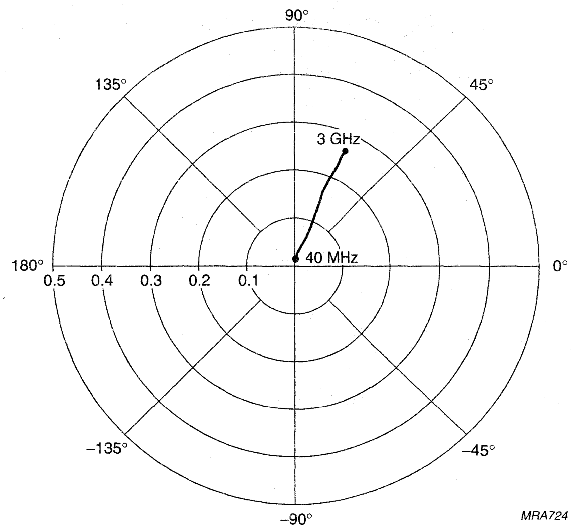
V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



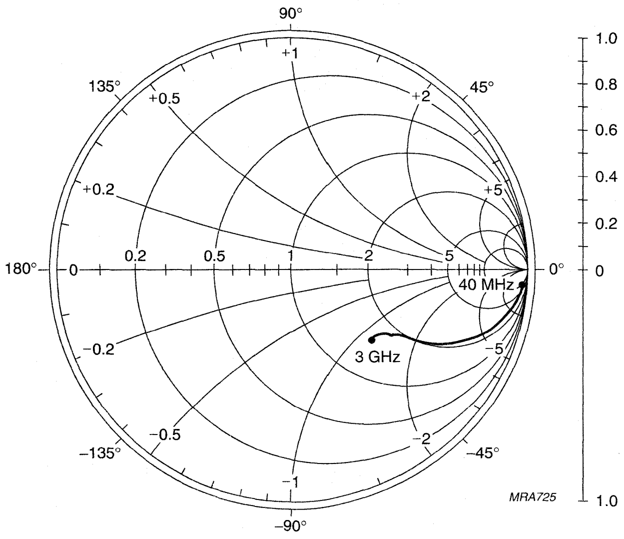
V_{CE} = 6 V; I_C = 5 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 6 V; I_C = 5 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor BFR520

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR520 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV) and repeater amplifiers in fibre-optic systems.

The transistor is encapsulated in a plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: N28	
1	base
2	emitter
3	collector

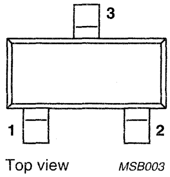


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	70	mA
P_{tot}	total power dissipation	up to $T_s = 97$ °C; note 1	–	–	300	mW
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB

Note

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

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to $T_s = 97$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50$ Ω; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

2. $I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50$ Ω; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.

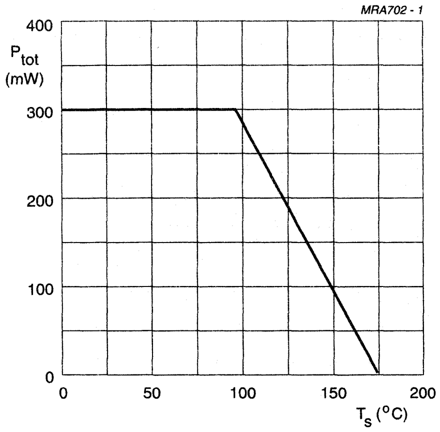
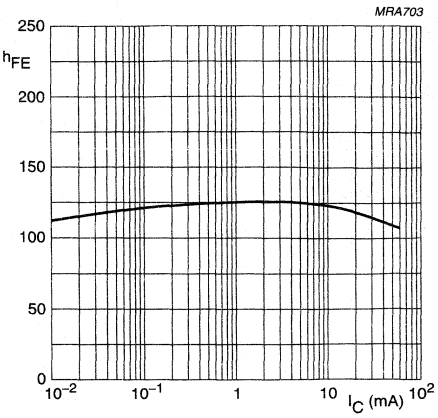
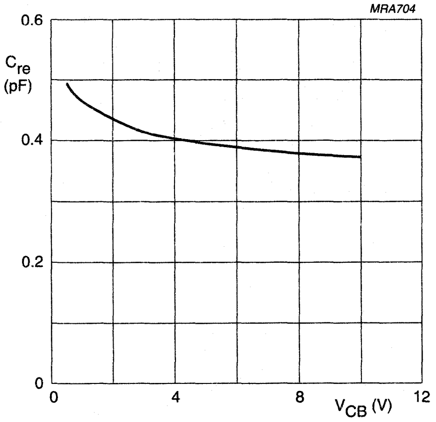


Fig.2 Power derating curve.



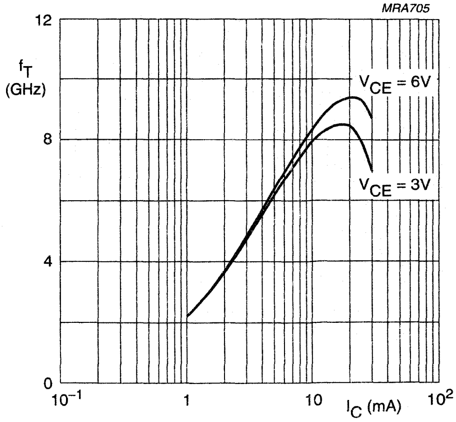
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current.



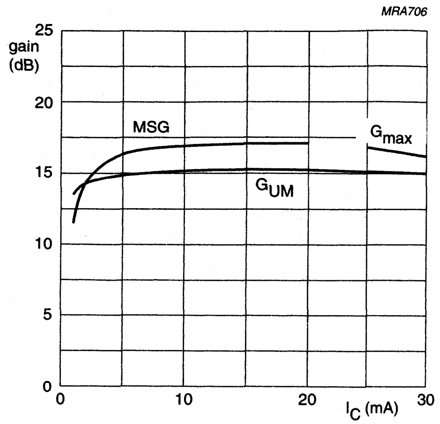
$i_C = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



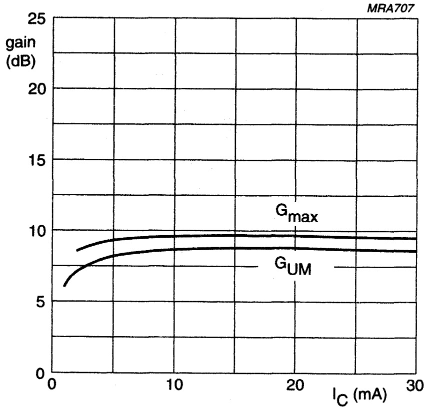
T_{amb} = 25 °C; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current.



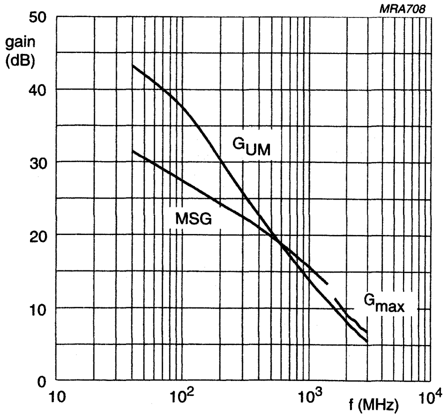
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



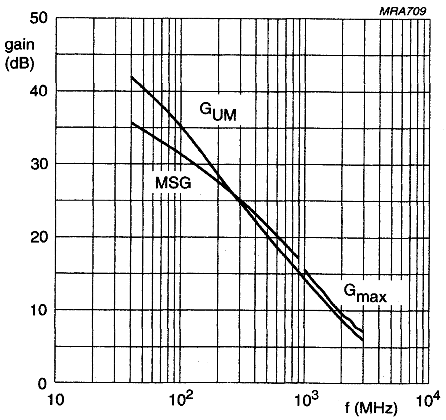
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



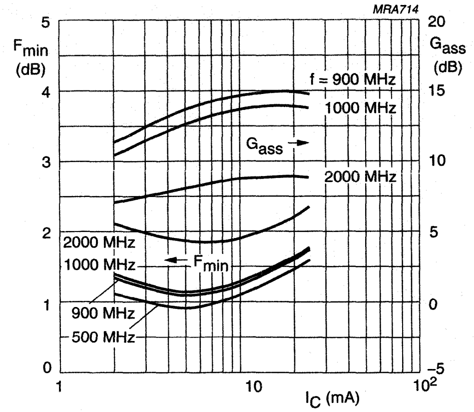
V_{CE} = 6 V; I_c = 5 mA.

Fig.8 Gain as a function of frequency.



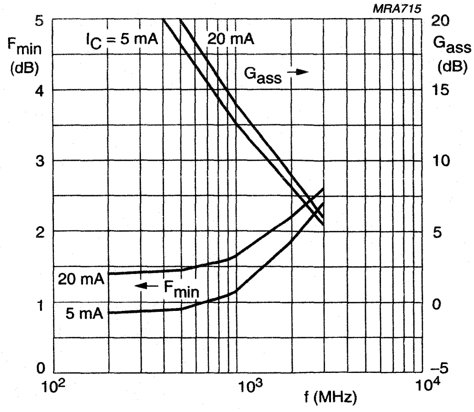
V_{CE} = 6 V; I_c = 20 mA.

Fig.9 Gain as a function of frequency.



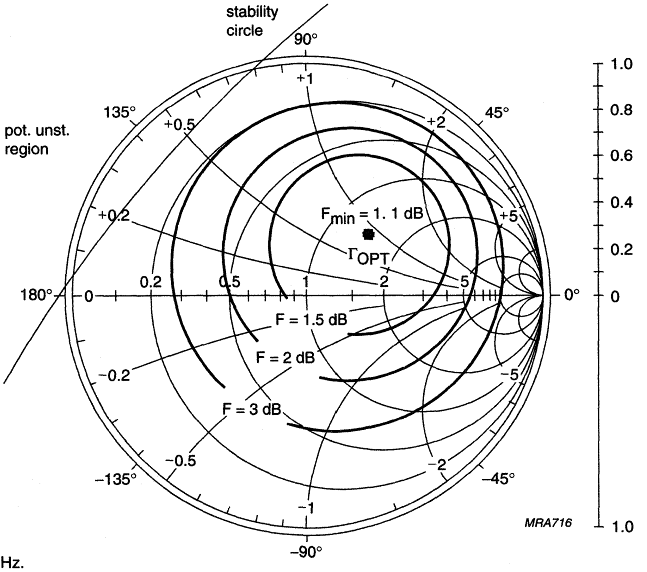
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



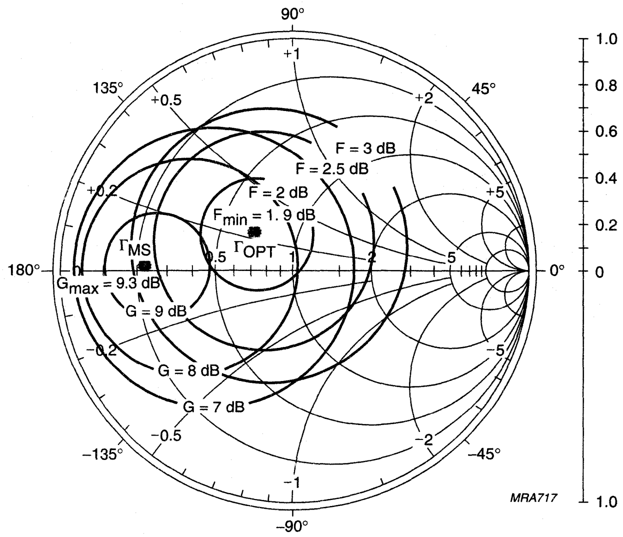
V_{CE} = 6 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



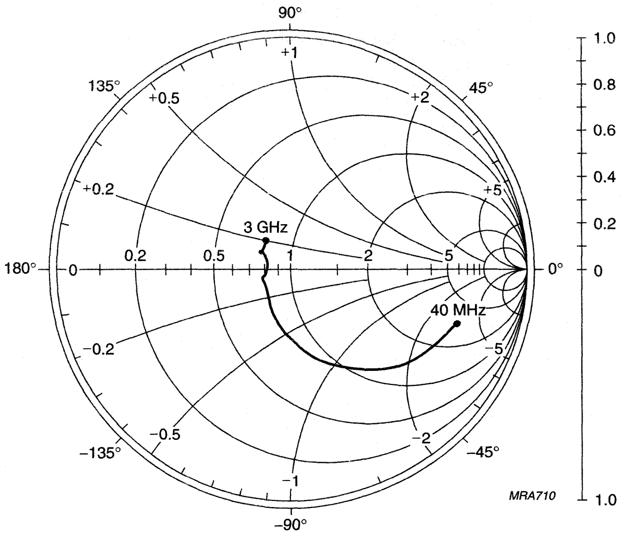
$Z_o = 50\ \Omega$.
V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

Fig.12 Noise circle figure.



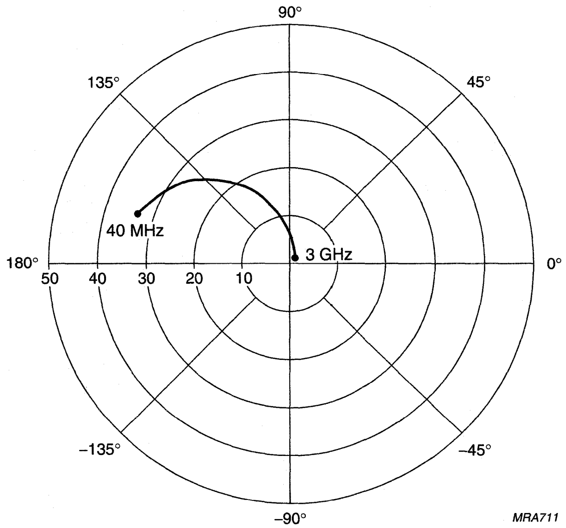
$Z_o = 50\ \Omega$.
$V_{CE} = 6$ V; $I_C = 5$ mA; f = 2000 MHz.

Fig.13 Noise circle figure.



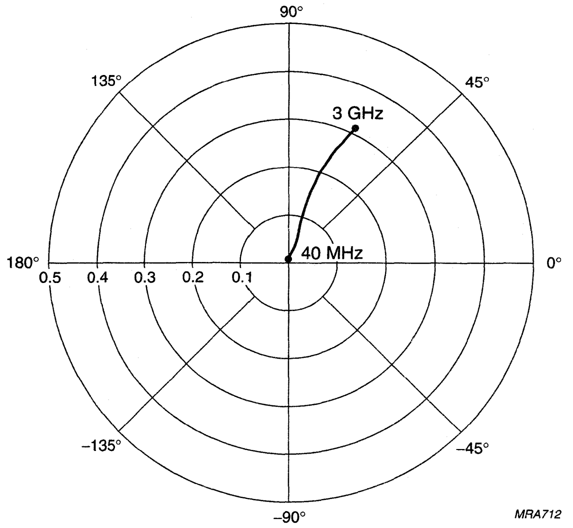
V_{CE} = 6 V; I_C = 20 mA.
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



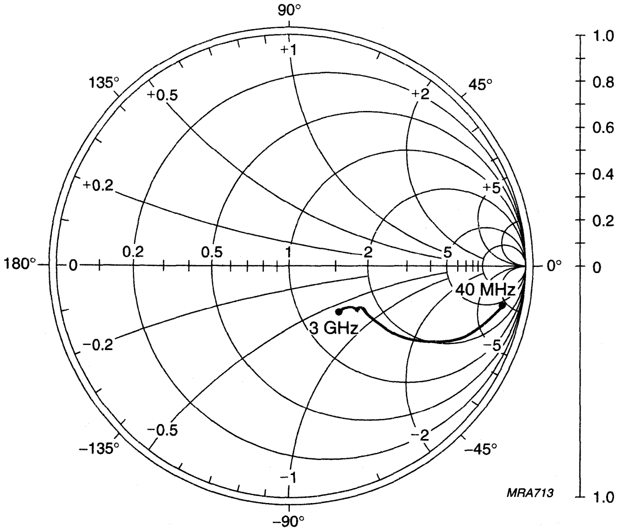
V_{CE} = 6 V; I_C = 20 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 6 V; I_C = 20 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 6 V; I_C = 20 mA.
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor

BFR540

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR540 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

The transistor is encapsulated in a plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: N29	
1	base
2	emitter
3	collector

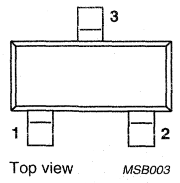


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to $T_s = 70$ °C; note 1	–	–	500	mW
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	14	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	7	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.1	–	dB

Note

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

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to $T_s = 70$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point	see note 1	260 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 8$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	14	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	7	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C; f = 900 MHz	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_o	output voltage (note 3)	$I_C = 40$ mA; $V_{CE} = 8$ V; $Z_L = Z_S = 75\ \Omega$; $T_{amb} = 25$ °C	–	550	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\ \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB.}$$

2. $I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$;
   $T_{amb} = 25$ °C; f = 900 MHz;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.
3. $d_{im} = -60$ dB (DIN 45004B);
   $V_p = V_O$; $V_q = V_O$ –6 dB; $f_p = 795.25$ MHz;
   $V_R = V_O$ –6 dB; $f_q = 803.25$ MHz; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz; preliminary data.

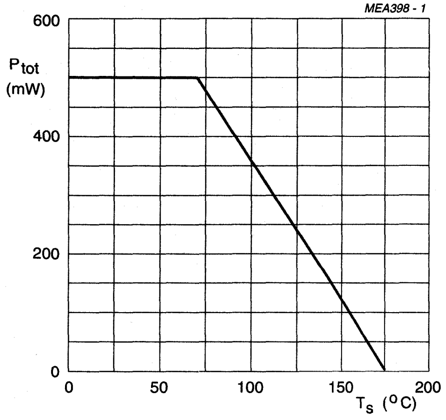
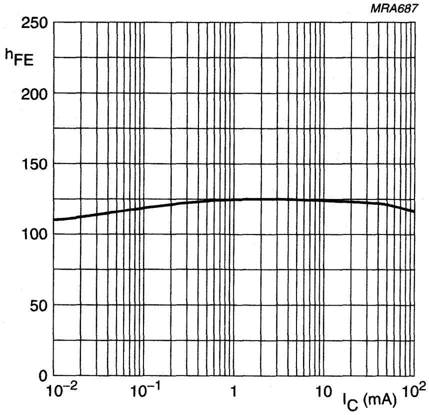
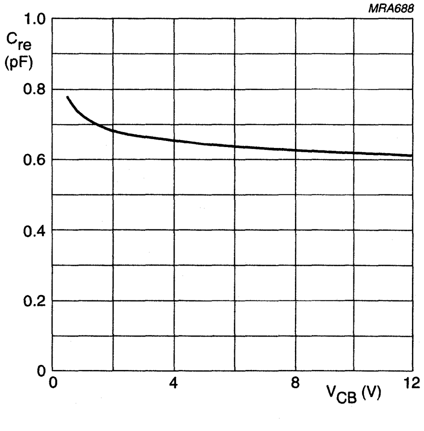


Fig.2 Power derating curve.



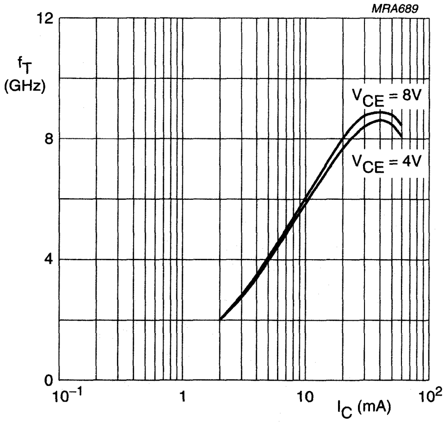
V_{CE} = 8 V.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

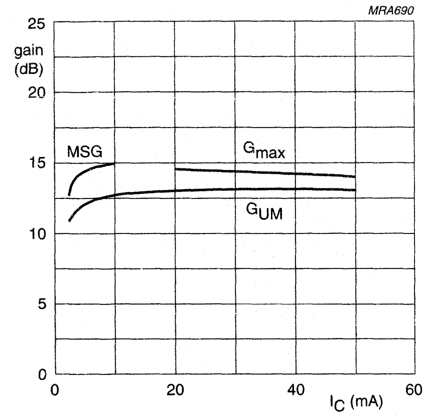
Fig.4 Feedback capacitance as a function of collector-base voltage.



T_{amb} = 25 °C; f = 1 GHz.

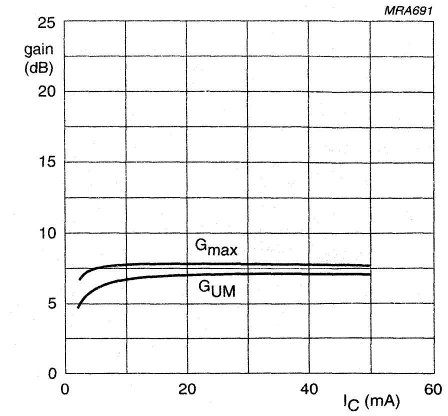
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



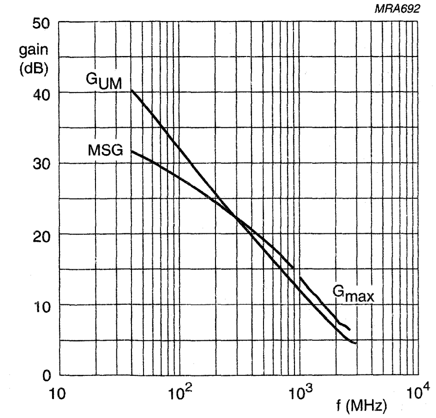
V_{CE} = 8 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



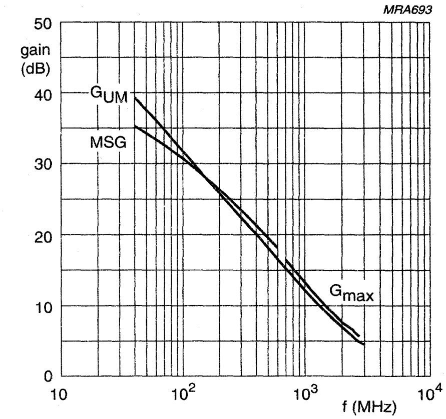
V_{CE} = 8 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



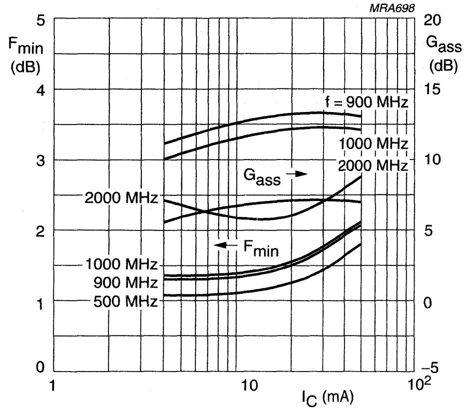
V_{CE} = 8 V; I_c = 10 mA.

Fig.8 Gain as a function of frequency.



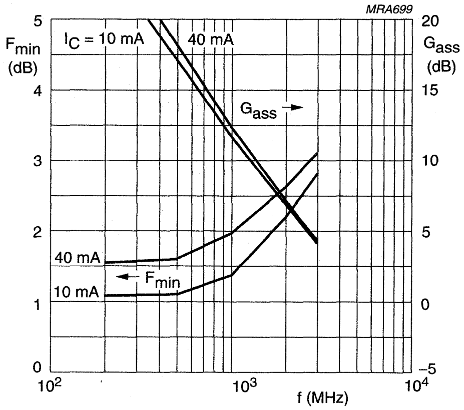
V_{CE} = 8 V; I_c = 40 mA.

Fig.9 Gain as a function of frequency.



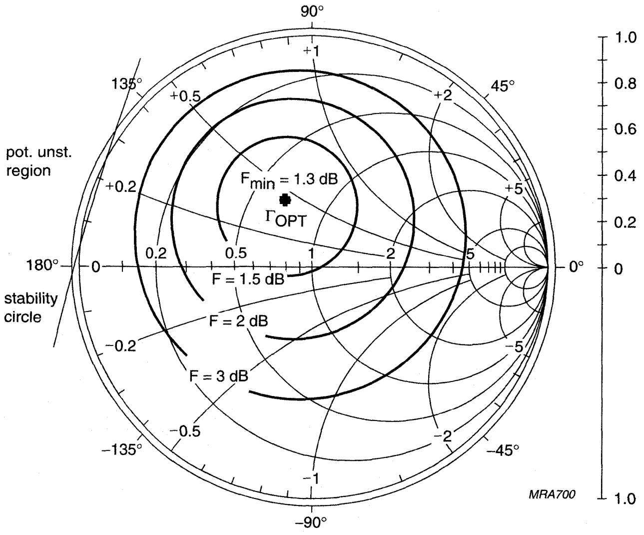
V_{CE} = 8 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



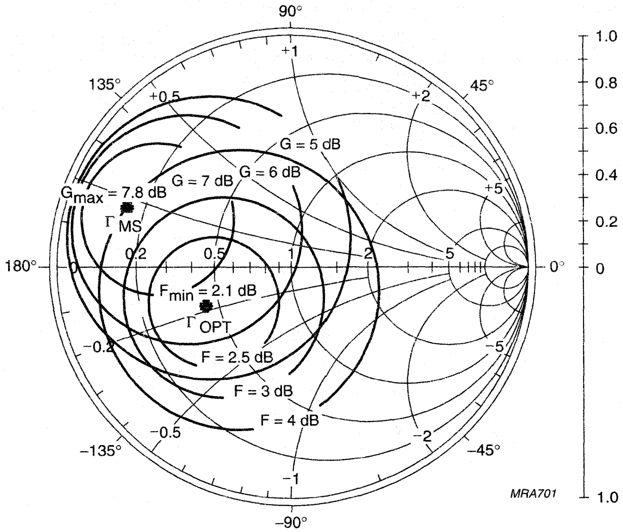
V_{CE} = 8 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.
V_{CE} = 8 V; I_C = 10 mA; f = 900 MHz.

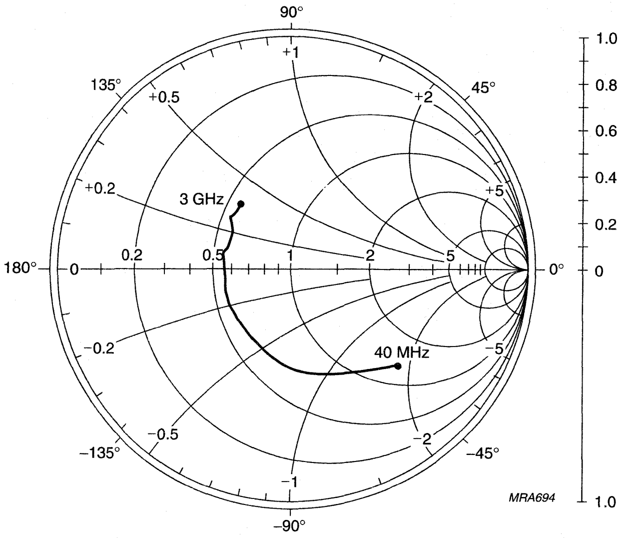
Fig.12 Noise circle figure.



$Z_o = 50\ \Omega$.

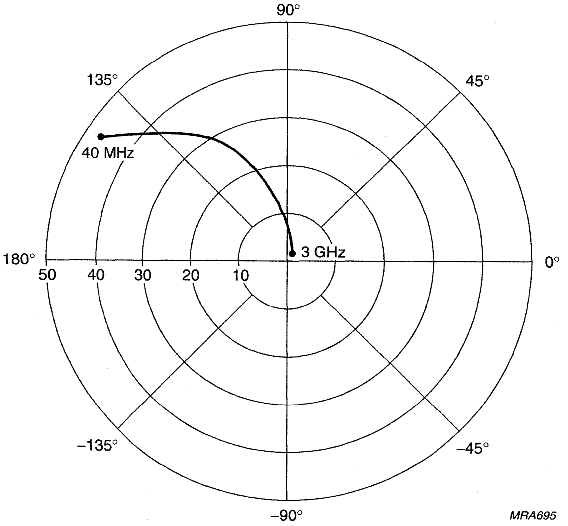
$V_{CE} = 8$ V; $I_C = 10$ mA; f = 2000 MHz.

Fig.13 Noise circle figure.



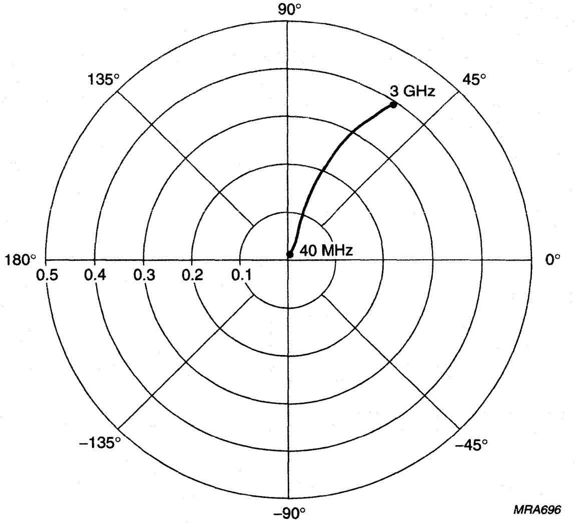
V_{CE} = 8 V; I_C = 40 mA.
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



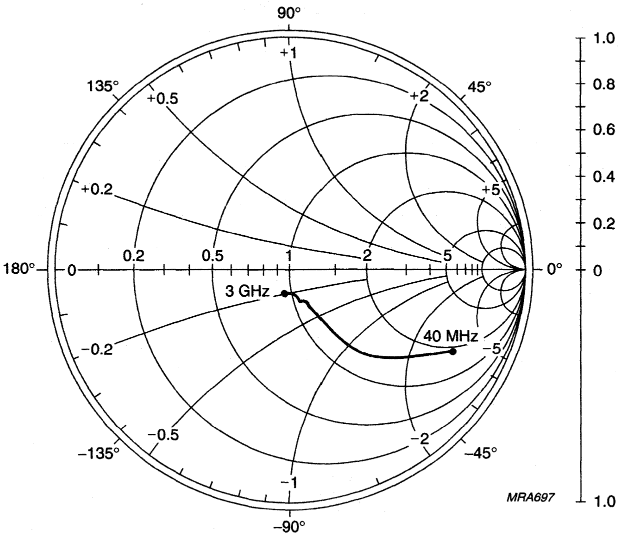
V_{CE} = 8 V; I_C = 40 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 40 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 8 V; I_C = 40 mA.
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 1 GHz wideband transistor BFS17

DESCRIPTION

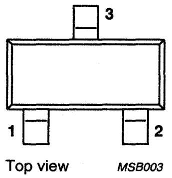
NPN transistor in a plastic SOT23 package.

APPLICATIONS

- A wide range of RF applications such as:
  - Mixers and oscillators in TV tuners
  - RF communications equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: E1p.

Fig.1 SOT23.

QUICK REFERENCED DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	1	–	GHz
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz; T_j = 25 °C	4.5	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note to the Quick reference data and the Limiting values

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C; note 1	260	K/W

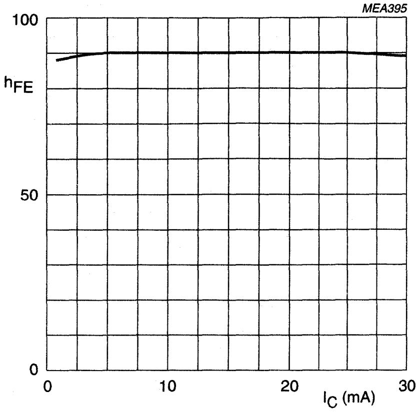
Note

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

CHARACTERISTICS

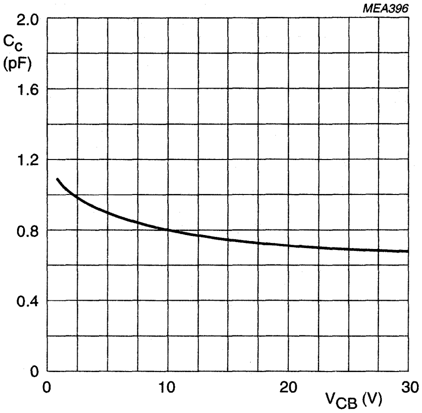
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	–	–	10	nA
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V	25	90	–	
		I_C = 25 mA; V_{CE} = 1 V	25	90	–	
f_T	transition frequency	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz	–	1	–	GHz
		I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	–	1.6	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	0.8	1.5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	–	2	pF
C_{re}	feedback capacitance	I_C = 1 mA; V_{CE} = 5 V; f = 1 MHz	–	0.65	–	pF
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz	–	4.5	–	dB



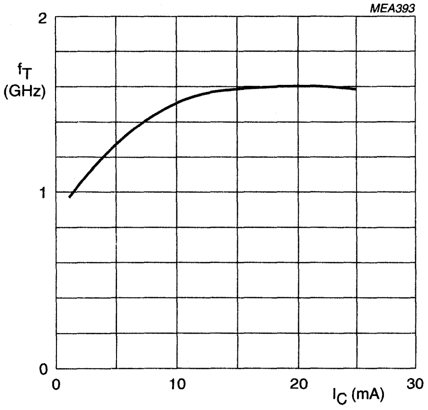
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



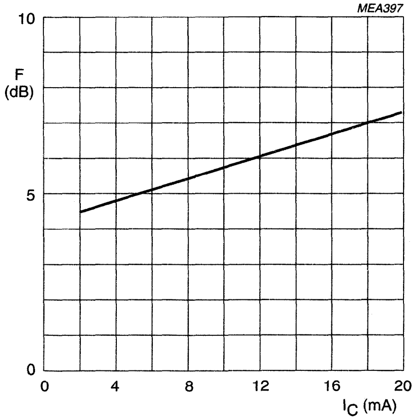
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.3 Collector capacitance as a function of collector-base voltage.



V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz; T_j = 25 °C.

Fig.5 Minimum noise figure as a function of collector current.

NPN 3 GHz wideband transistor BFS17A

DESCRIPTION

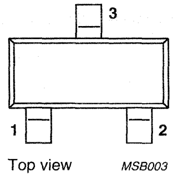
NPN transistor in a plastic SOT23 package.

APPLICATIONS

- It is intended for RF applications such as oscillators in TV tuners.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: E2p.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	2.8	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz	13.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	2.5	–	dB
V_O	output voltage	d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	150	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note to the Quick reference data and the Limiting values

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C; note 1	260	K/W

Note

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

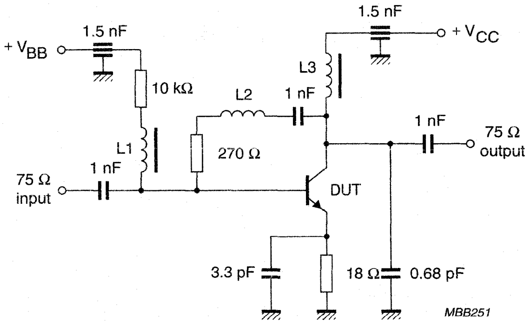
CHARACTERISTICS

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	–	–	50	nA
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V; T_{amb} = 25 °C	25	90	–	
		I_C = 25 mA; V_{CE} = 1 V; T_{amb} = 25 °C	25	90	–	
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	2.8	–	GHz
C_c	collector capacitance	I_E = 0; V_{CB} = 10 V; f = 1 MHz; T_{amb} = 25 °C	–	0.7	–	pF
C_e	emitter capacitance	I_C = 0; V_{EB} = 0.5 V; f = 1 MHz	–	1.25	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz	–	0.6	–	pF
G_{UM}	maximum unilateral power gain note 1	I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz	–	13.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; Z_S = 60 Ω; f = 800 MHz; T_{amb} = 25 °C	–	2.5	–	dB
V_O	output voltage	note 2	–	150	–	mV

Notes

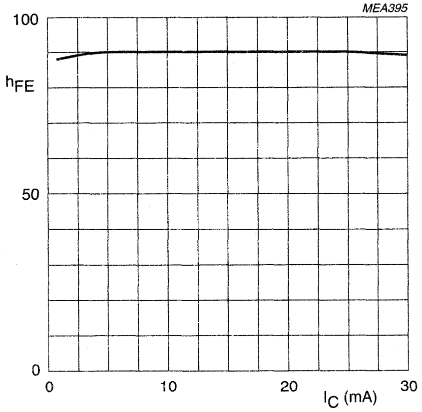
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. d_{im} = –60 dB (DIN 45004B); I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; f_p = 795.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 803.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 805.25 MHz;
   measured at $f_{(p+q-r)}$ = 793.25 MHz.



L1 = L3 = 5 µH Ferroxcube choke.

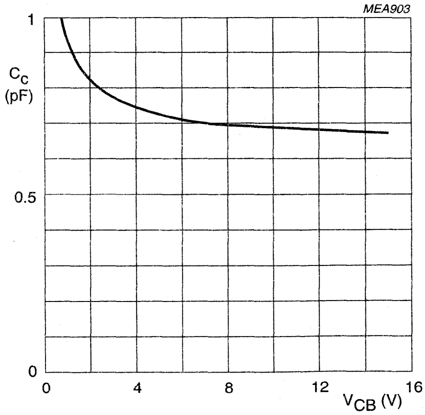
L2 = 3 turns 0.4 mm copper wire; winding pitch 1 mm; internal diameter 3 mm.

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



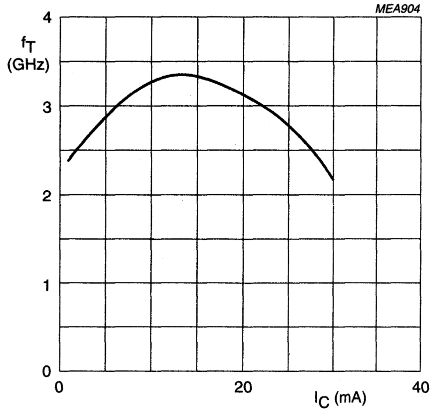
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.3 DC current gain as a function of collector current.



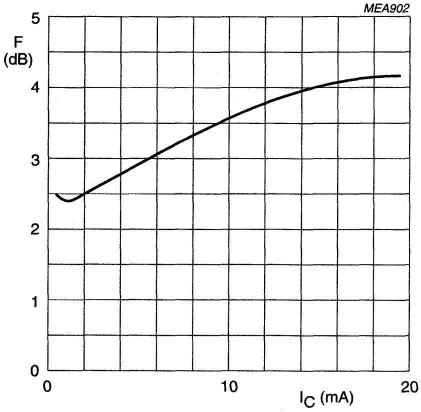
I_E = 0; f = 1 MHz; T_{amb} = 25 °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current.



V_{CE} = 5 V; Z_s = 60 Ω; f = 800 MHz; T_{amb} = 25 °C.

Fig.6 Minimum noise figure as a function of collector current.

NPN 1 GHz wideband transistor BFS17W

APPLICATIONS

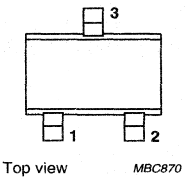
Primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners.

DESCRIPTION

Silicon NPN transistor in a plastic SOT323 (S-mini) package. The BFS17W uses the same crystal as the SOT23 version, BFS17.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: E1

Fig.1 SOT323

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	25	V
V_{CEO}	collector-emitter voltage		–	–	15	V
I_C	DC collector current		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 118 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V	25	90	–	
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V	–	1.6	–	GHz
C_c	collector capacitance	I_E = 0; V_{CB} = 10 V; f = 1 MHz	–	0.8	1.5	pF
C_{re}	feedback capacitance	I_C = 1 mA; V_{CE} = 5 V; f = 1 MHz	–	0.75	–	pF
T_j	junction temperature		–	–	175	°C

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	T_s = 118 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 118$ °C; note 1	190	K/W

Note

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

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	–	–	10	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 1$ V	25	90	–	
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	1.6	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.8	1.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2	–	pF
C_{re}	feedback capacitance	$I_B = i_b = 0$; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.75	–	pF
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; $\Gamma_S = \Gamma_{opt}$	–	4.5	–	dB

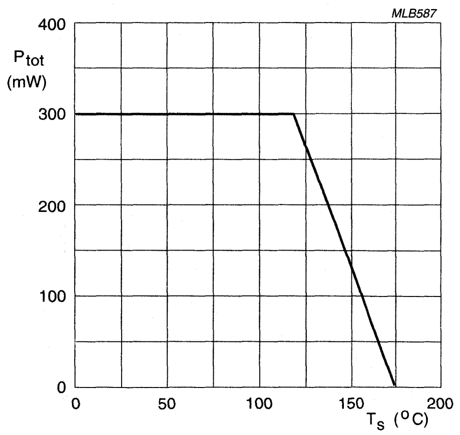
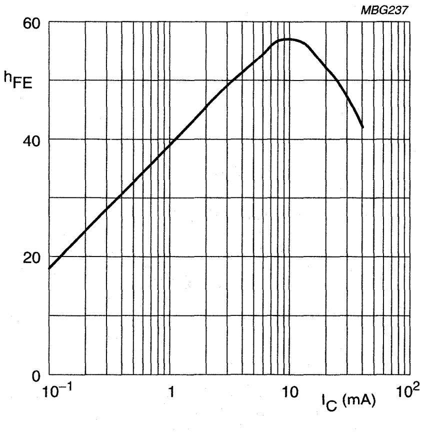
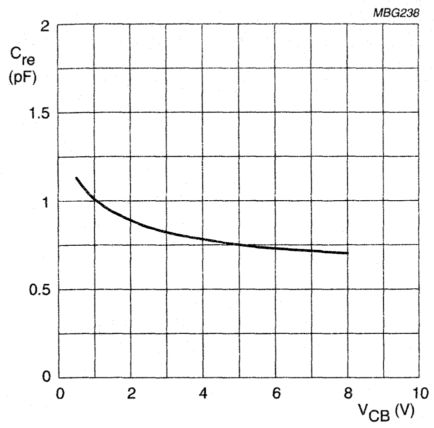


Fig.2 Power derating curve.



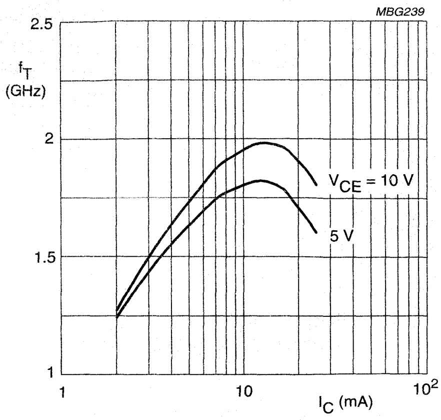
$V_{CE} = 1$ V.

Fig.3 DC current gain as a function of collector current; typical values.



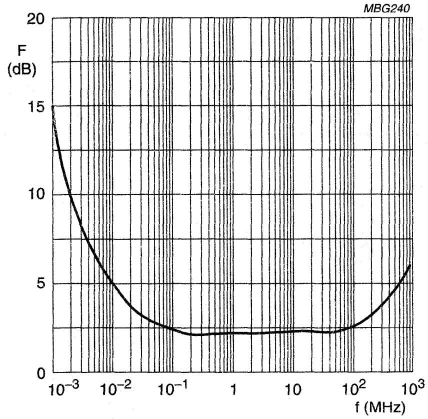
$I_B = i_b = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



T_{amb} = 25 °C; f = 500 MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



V_{CE} = 10 V.

Fig.6 Minimum noise figure as function of frequency; typical values.

NPN 5 GHz wideband transistor

BFS25A

FEATURES

- Low current consumption
- Low noise figure
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is designed for use in RF amplifiers and oscillators in pagers and pocket phones with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N6	
1	base
2	emitter
3	collector

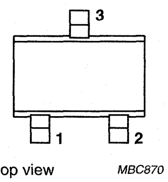


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	–	5	V
I_C	DC collector current		–	–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 170 °C; note 1	–	–	32	mW
h_{FE}	DC current gain	I_C = 0.5 mA; V_{CE} = 1 V; T_j = 25 °C	50	80	200	
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	I_c = 0.5 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	–	13	–	dB
F	noise figure	I_c = 0.5 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	–	1.8	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 170 °C; note 1	–	32	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 170$ °C; note 1	190 K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 1$ V; f = 1 MHz	–	0.3	0.45	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	1.8	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

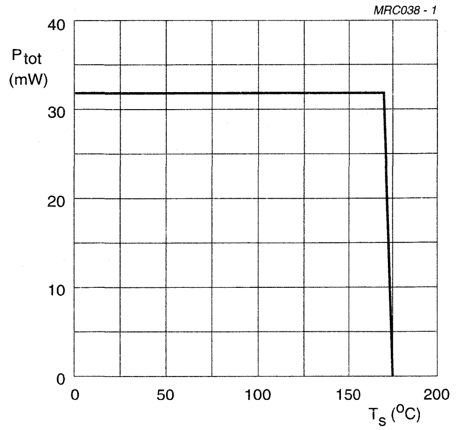
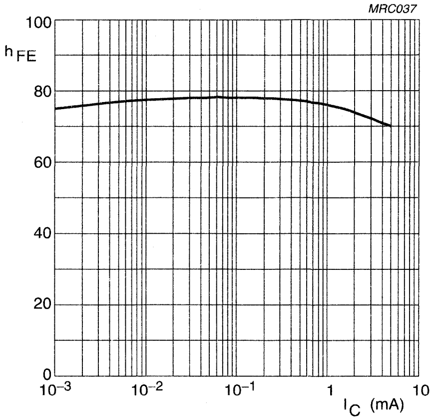
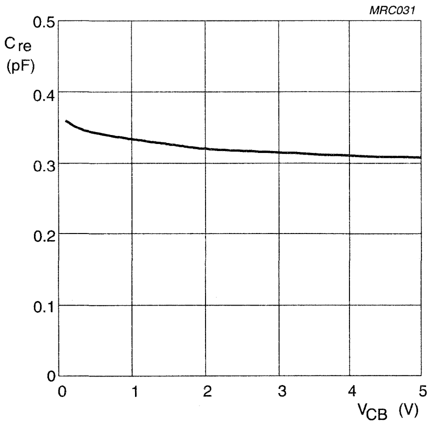


Fig.2 Power derating curve.



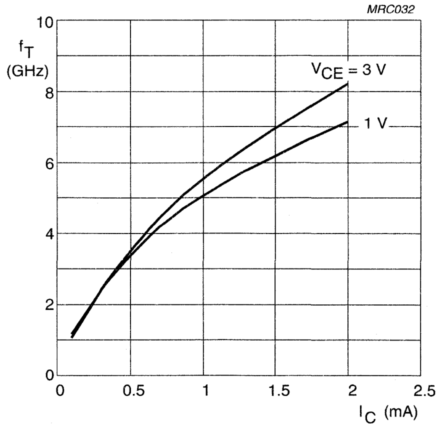
V_{CE} = 1 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

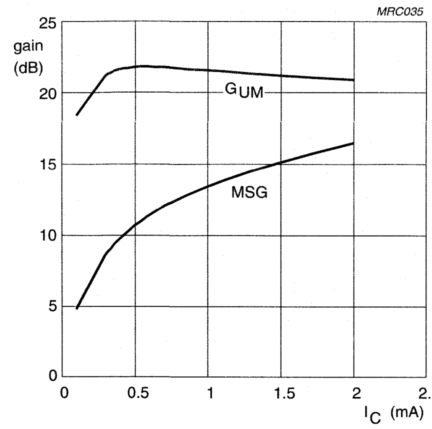
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

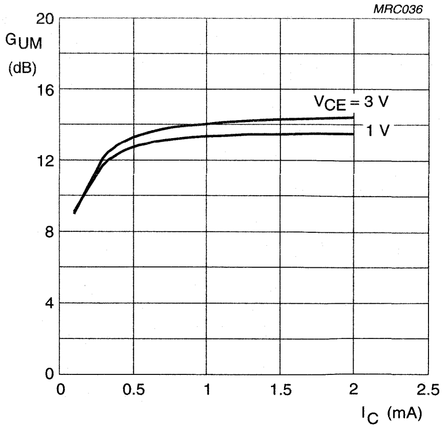
Fig.5 Transition frequency as a function of collector current.

In Figs 7 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



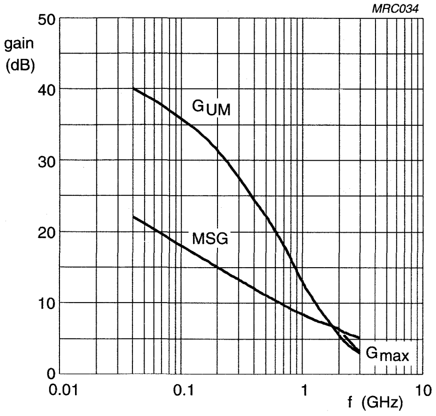
V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



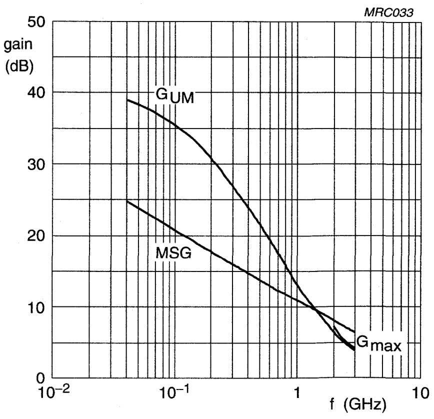
f = 1 GHz; T_{amb} = 25 °C.

Fig.7 Maximum unilateral power gain as a function of collector current.



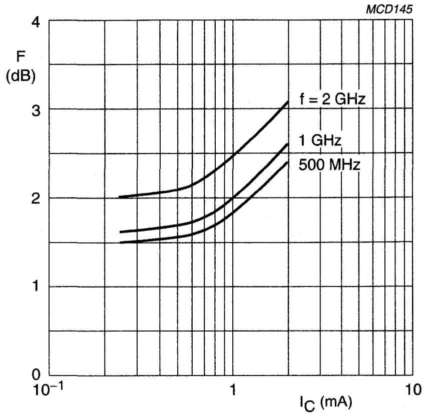
I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



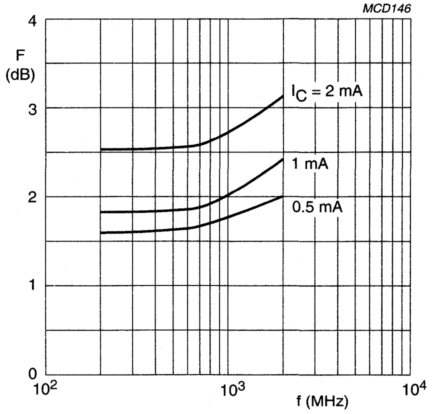
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



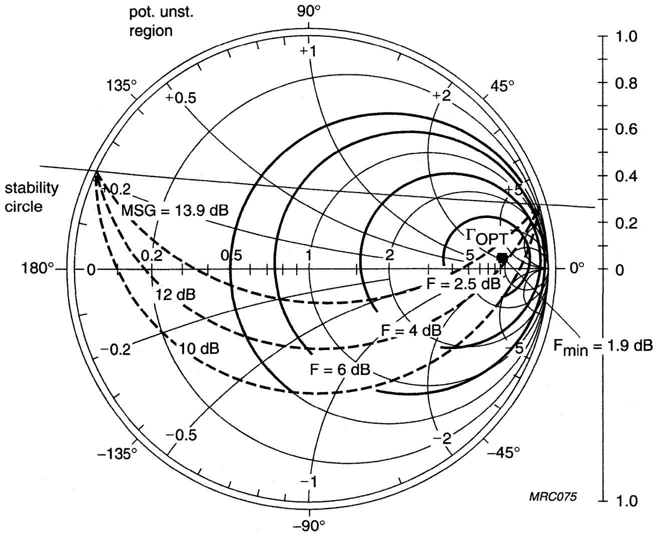
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



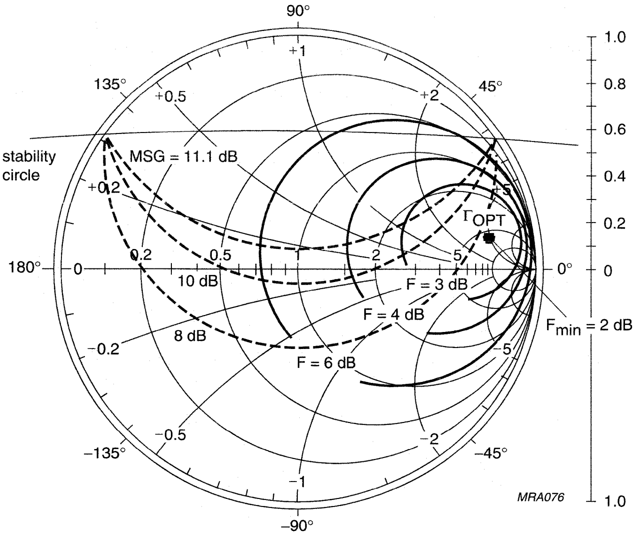
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



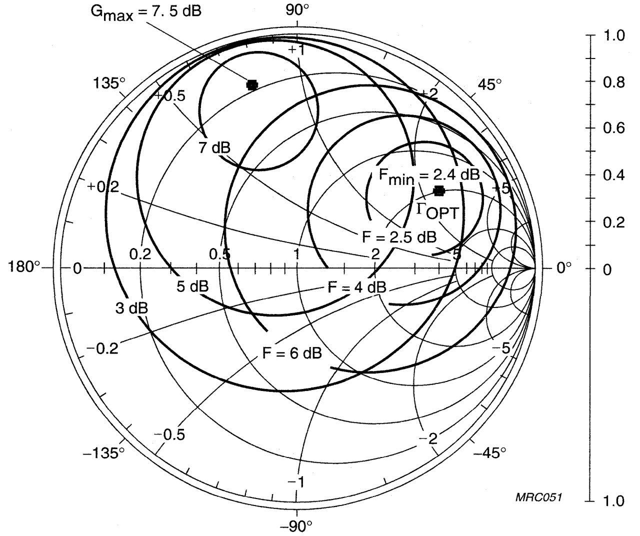
I_C = 1 mA; V_{CE} = 1 V;
f = 500 MHz; Z_o = 50 Ω.

Fig.12 Noise circle.



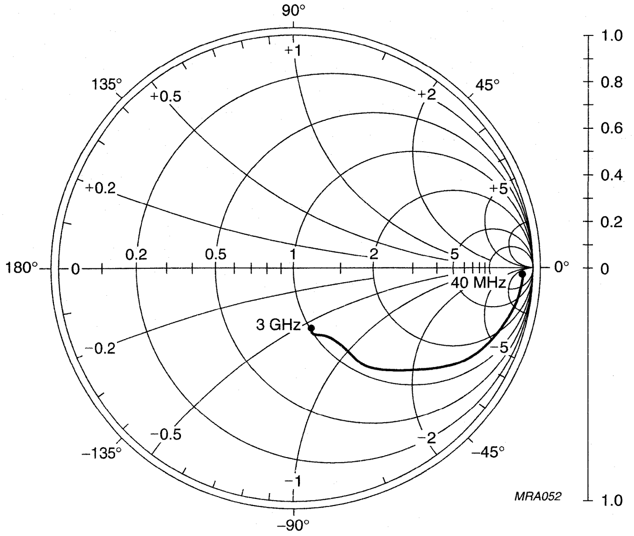
I_C = 1 mA; V_{CE} = 1 V;
f = 1 GHz; Z_o = 50 Ω.

Fig.13 Noise circle.



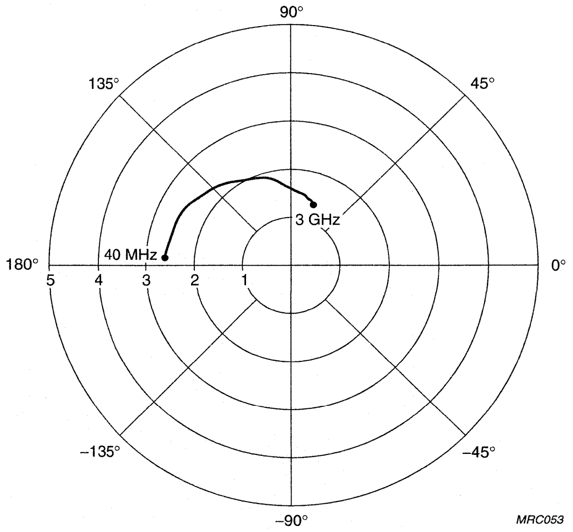
I_C = 1 mA; V_{CE} = 1 V;
f = 2 GHz; Z_o = 50 Ω.

Fig.14 Noise circle.



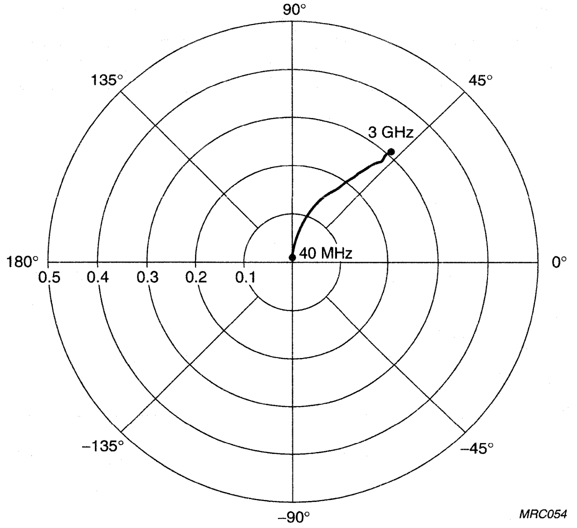
I_C = 1 mA; V_{CE} = 1 V;
Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (S_{11}).



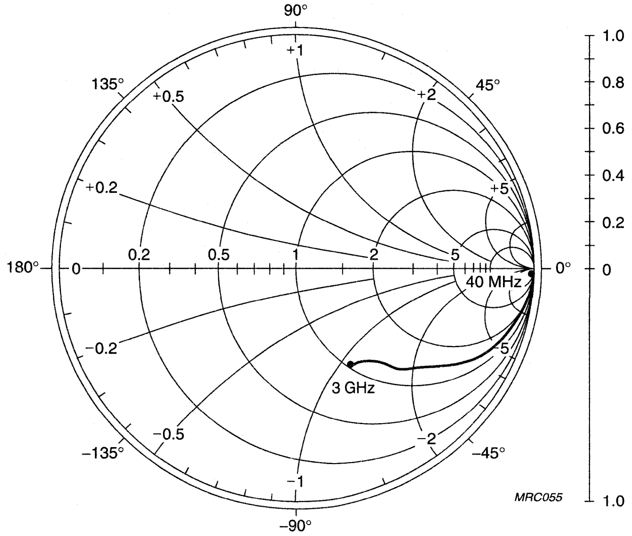
I_C = 1 mA; V_{CE} = 1 V.

Fig.16 Common emitter forward transmission coefficient (S_{21}).



$I_C = 1$ mA; $V_{CE} = 1$ V.

Fig.17 Common emitter reverse transmission coefficient (S_{12}).



$I_C = 1$ mA; $V_{CE} = 1$ V;
$Z_o = 50\ \Omega$.

Fig.18 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor BFS505

FEATURES

- Low current consumption
- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

PINNING

PIN	DESCRIPTION
	Code: N0
1	base
2	emitter
3	collector

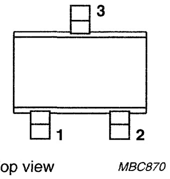


Fig.1 SOT323.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for low power amplifiers, oscillators and mixers particularly in RF portable communication equipment (cellular phones, cordless phones, pagers) up to 2 GHz.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	18	mA
P_{tot}	total power dissipation	up to $T_s = 147$ °C; note 1	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_j = 25$ °C	60	120	250	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_c = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
F	noise figure	$I_c = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.2	1.7	dB

Note

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

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 147 °C; note 1	–	150	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 = 147 °C; note 1	190 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.4	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 0.5$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	10	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_c = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB.}$$

2. $I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C;
$f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2q-p)} = 904$ MHz.

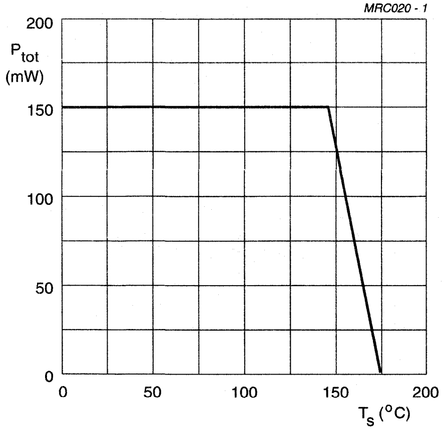
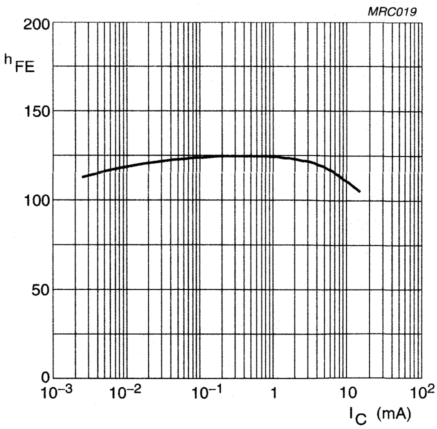
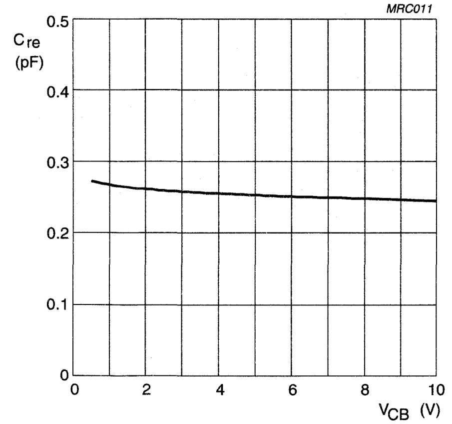


Fig.2 Power derating curve.



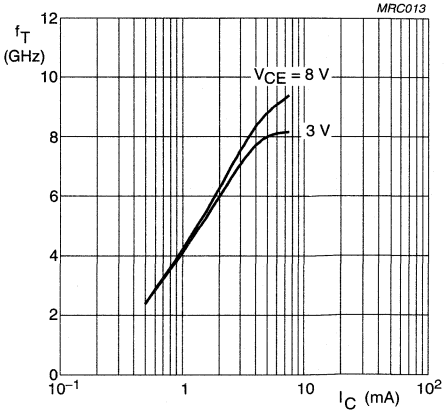
V_{CE} = 6 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

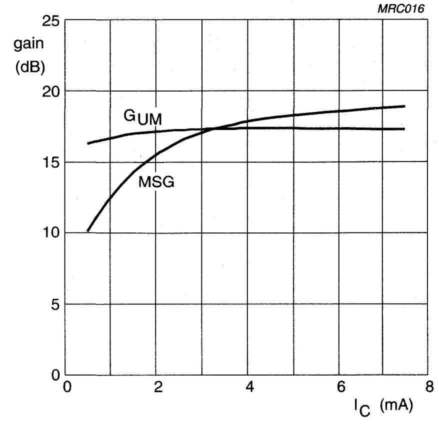
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

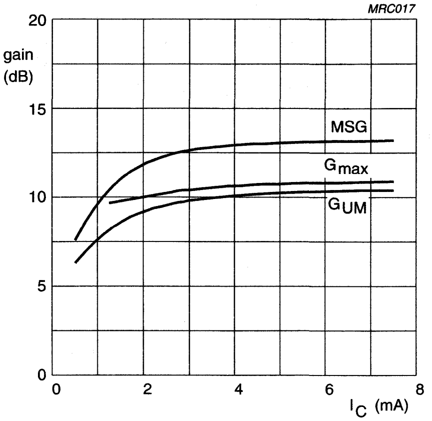
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



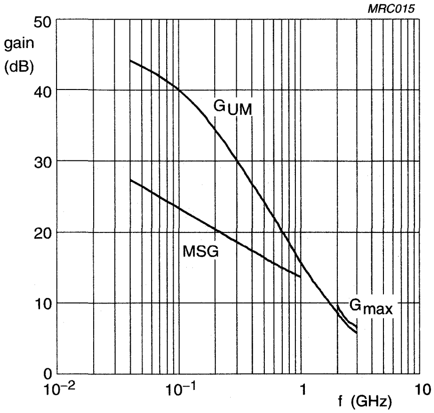
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



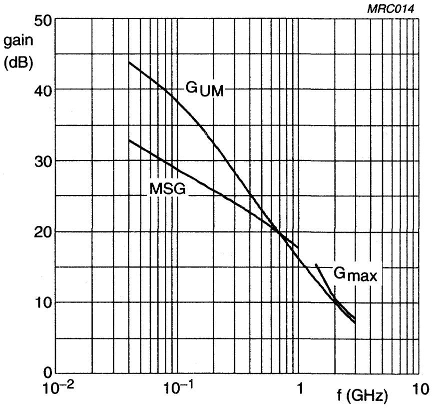
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



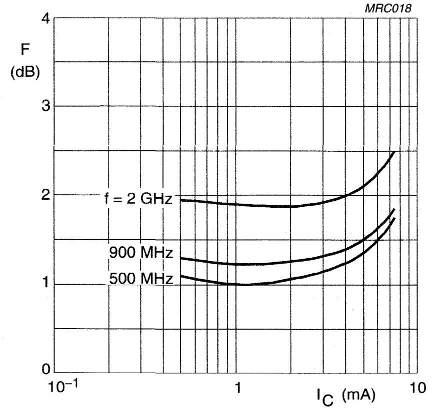
I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



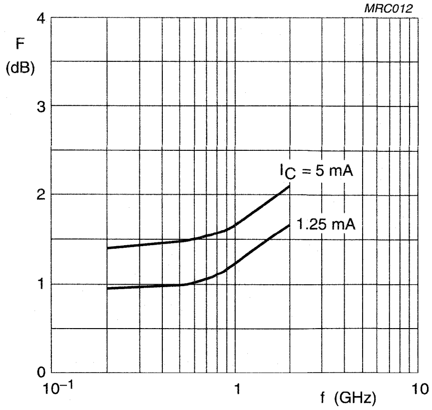
I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



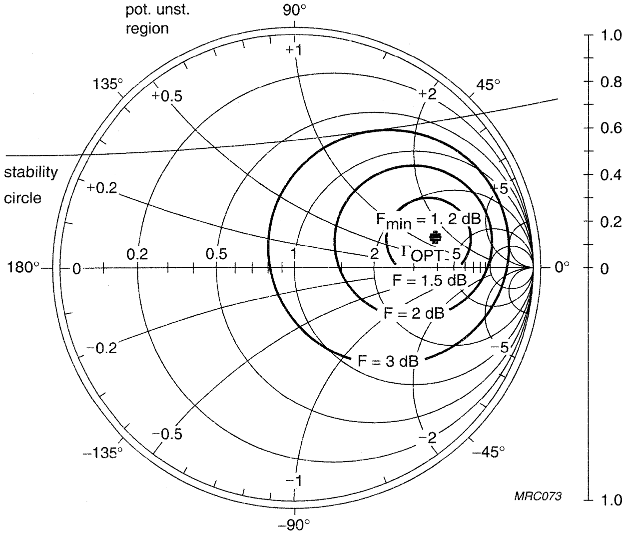
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



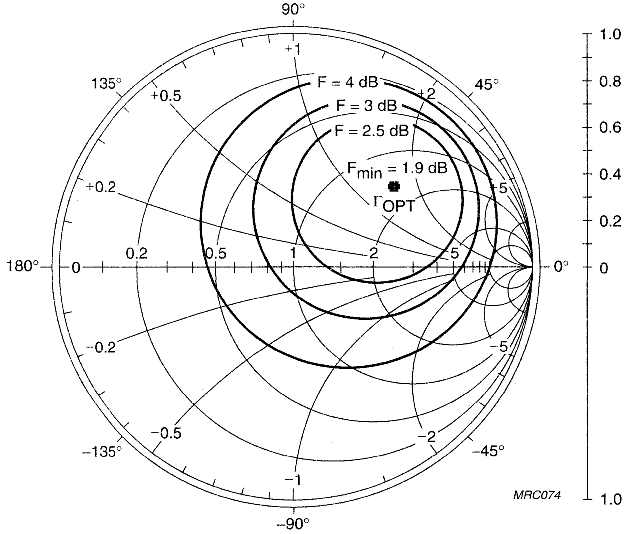
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



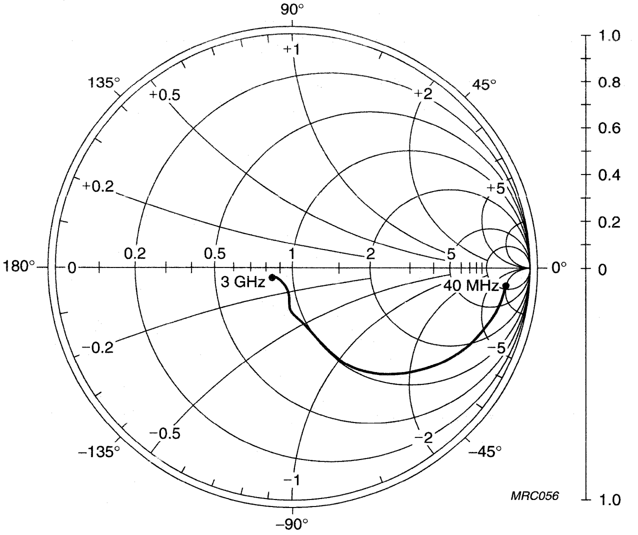
I_C = 1.25 mA; V_{CE} = 6 V;
f = 900 MHz; Z_o = 50 Ω.

Fig.12 Noise circle.



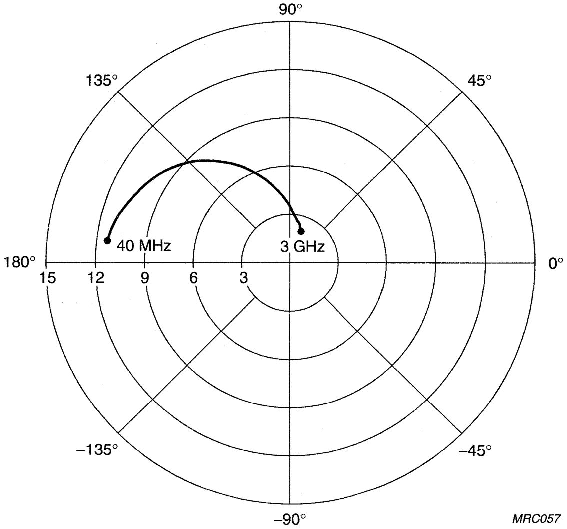
I_C = 1.25 mA; V_{CE} = 6 V;
f = 2 GHz; Z_o = 50 Ω.

Fig.13 Noise circle.



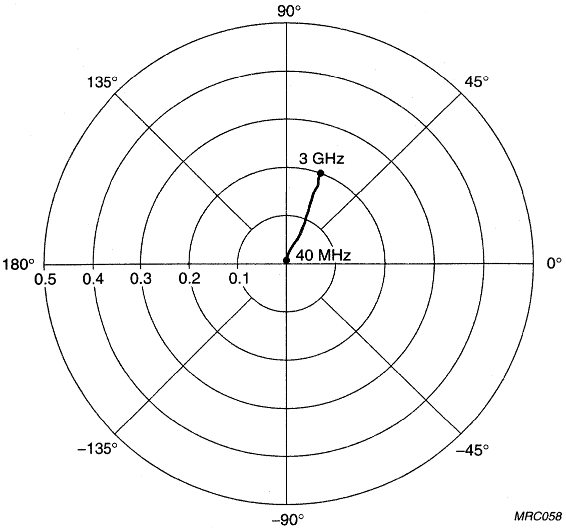
I_C = 5 mA; V_{CE} = 6 V;
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



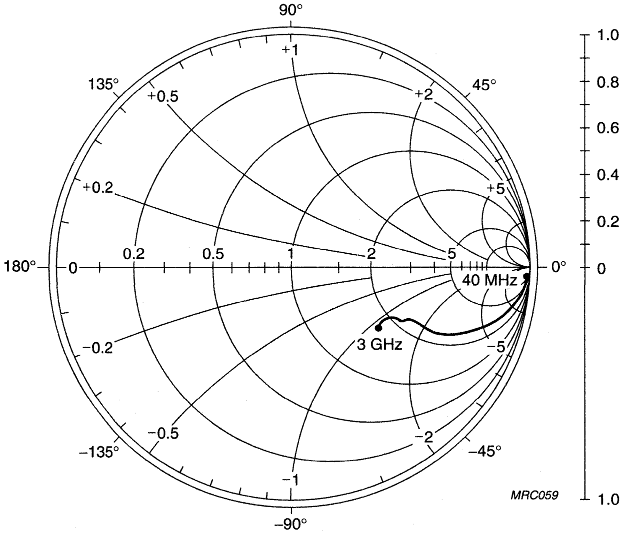
I_C = 5 mA; V_{CE} = 6 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 5 mA; V_{CE} = 6 V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



I_C = 5 mA; V_{CE} = 6 V;
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor BFS520

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope. It is intended for wideband applications such as satellite TV tuners, cellular phones, cordless phones, pagers etc., with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N2	
1	base
2	emitter
3	collector

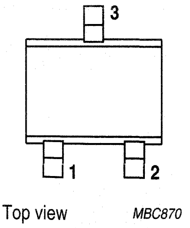


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	70	mA
P_{tot}	total power dissipation	up to $T_s = 118$ °C; note 1	–	–	300	mW
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_j = 25$ °C	60	120	250	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_c = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
F	noise figure	$I_c = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.1	1.6	dB

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to $T_s = 118$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 118$ °C; note 1	190 K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CE} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_c = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB}.$$

2. $I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C; $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2q-p)} = 904$ MHz.

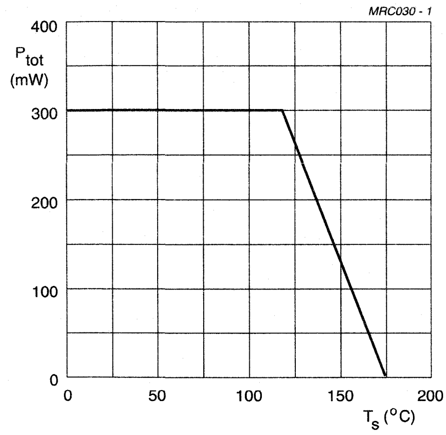
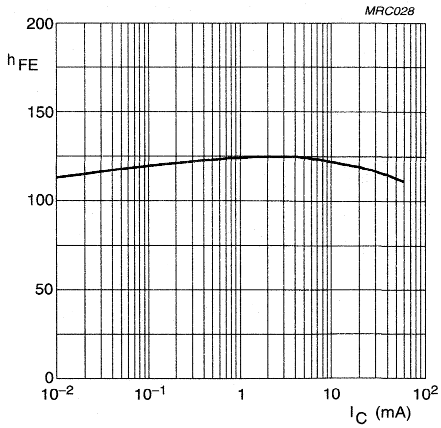
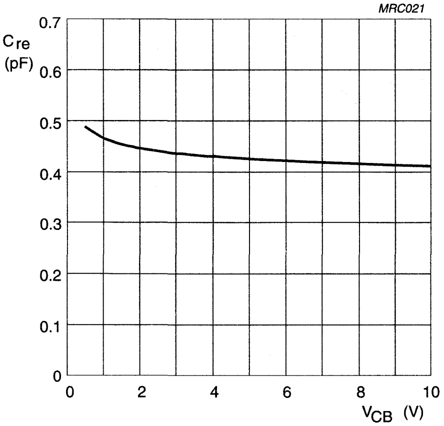


Fig.2 Power derating curve.



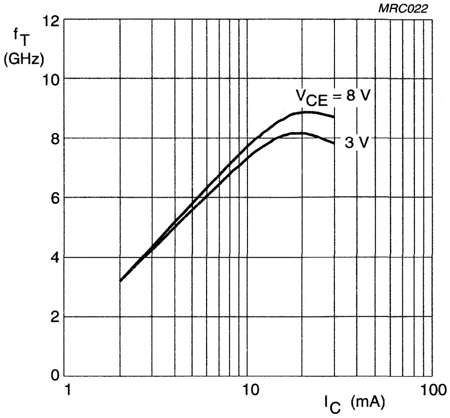
V_{CE} = 6 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

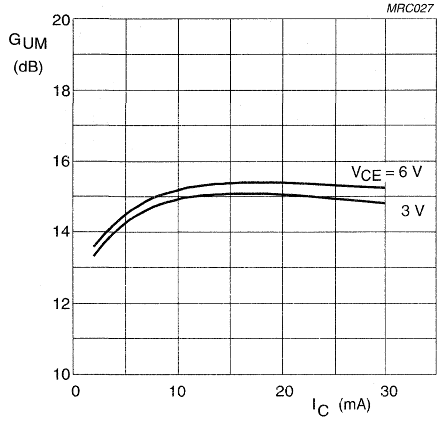
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

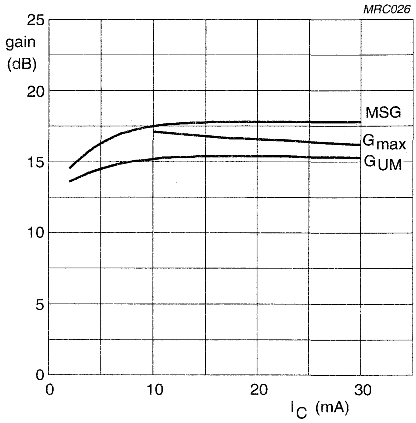
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



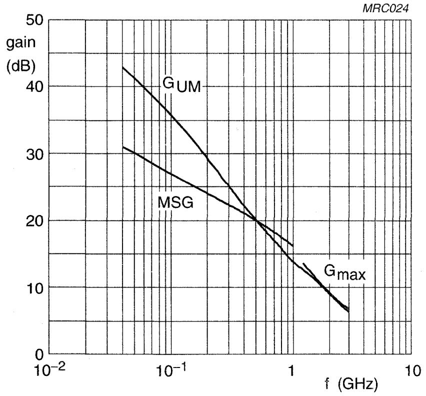
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of collector current.



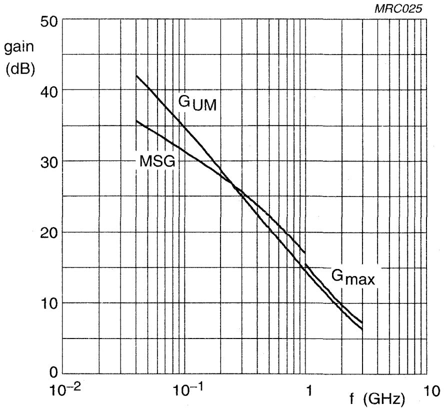
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



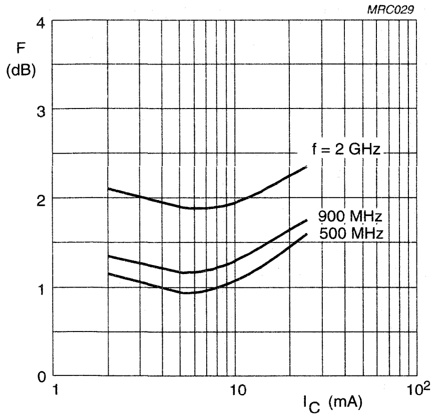
I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



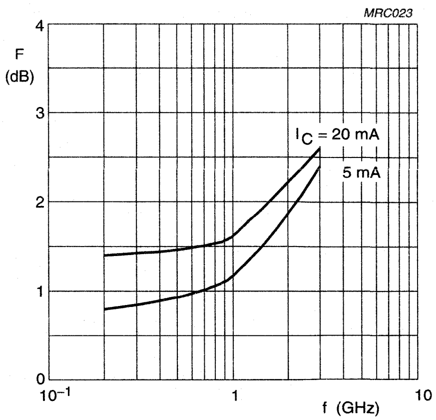
I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



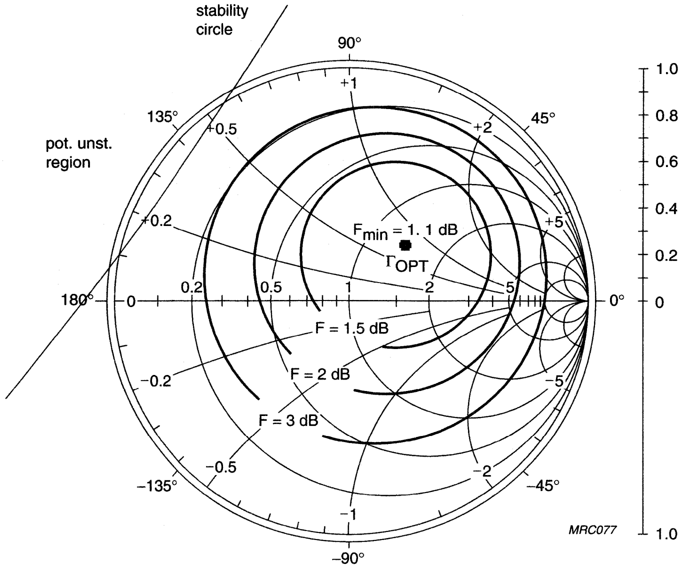
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



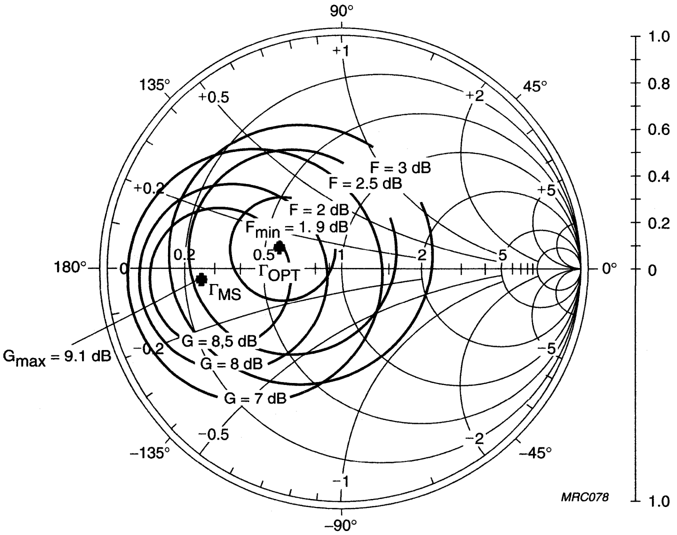
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



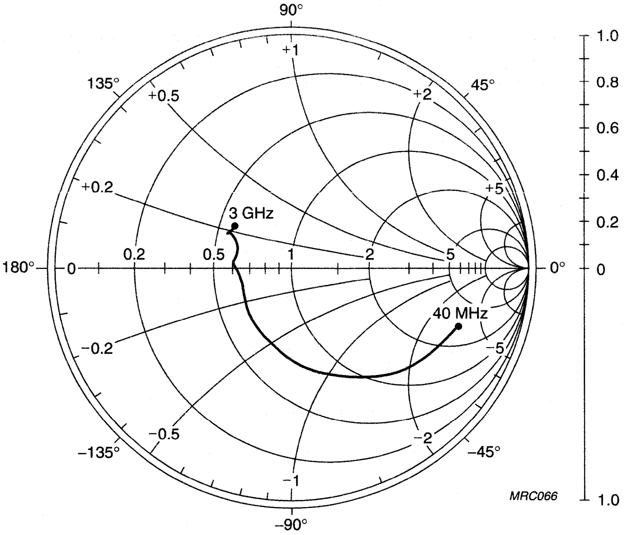
I_C = 5 mA; V_{CE} = 6 V;
f = 900 MHz; Z_o = 50 Ω.

Fig.12 Noise circle.



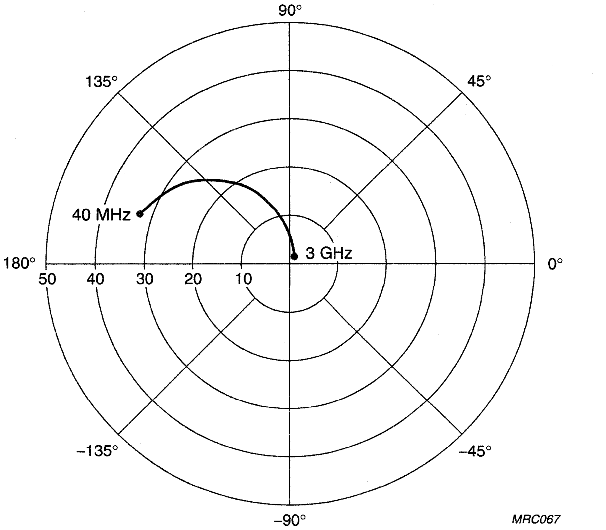
I_C = 5 mA; V_{CE} = 6 V;
f = 2 GHz; Z_o = 50 Ω.

Fig.13 Noise circle.



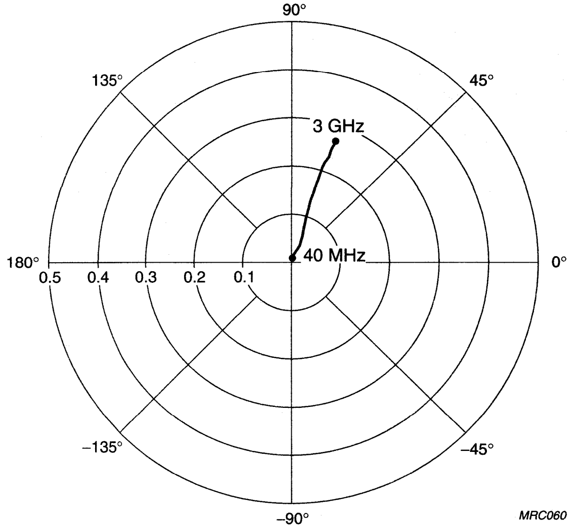
I_C = 20 mA; V_{CE} = 6 V;
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



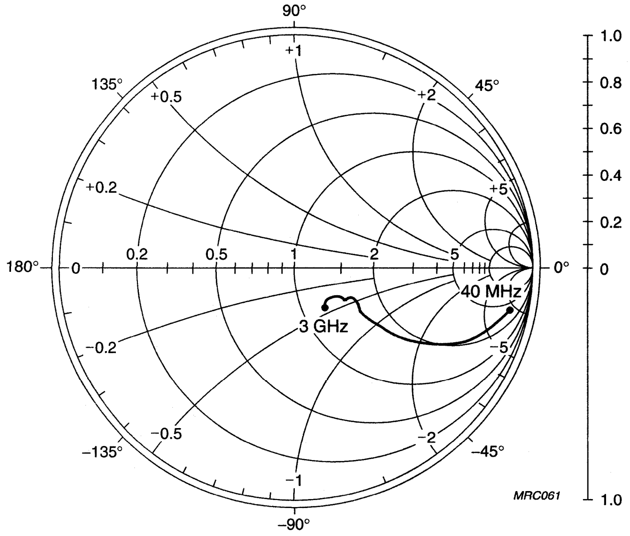
I_C = 20 mA; V_{CE} = 6 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 20 mA; V_{CE} = 6 V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



I_C = 20 mA; V_{CE} = 6 V;
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor BFS540

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for RF wideband amplifier applications such as satellite TV systems and RF portable communication equipment with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
	Code: N4
1	base
2	emitter
3	collector

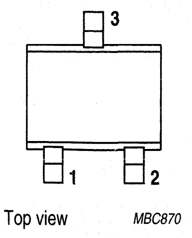


Fig.1 SOT323.

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		–	–	120	mA
P_{tot}	total power dissipation	up to T_s = 80 °C; note 1	–	–	500	mW
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V; T_j = 25 °C	60	120	250	
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	14	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	1.3	1.7	dB

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_{CES}	collector-emitter voltage	R_{BE} = 0	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to T_s = 80 °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 80 °C; note 1	190 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

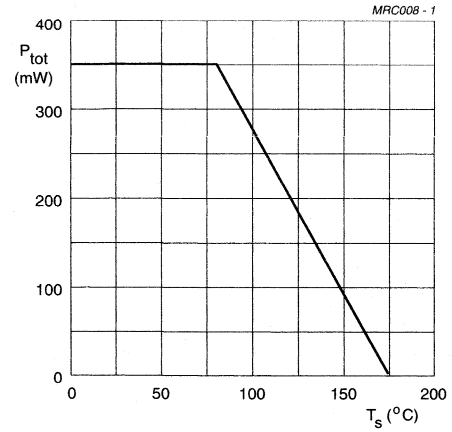
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CE} = 8 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	60	120	250	
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	14	–	dB
		I_C = 40 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	8	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	I_c = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; f = 900 MHz; T_{amb} = 25 °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

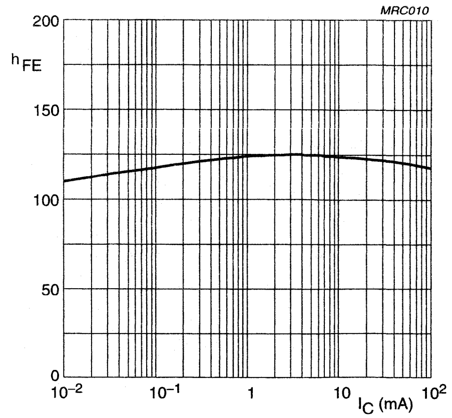
$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB.}$$

2. I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; f = 900 MHz; T_{amb} = 25 °C;
f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 898 MHz and at $f_{(2q-p)}$ = 904 MHz.



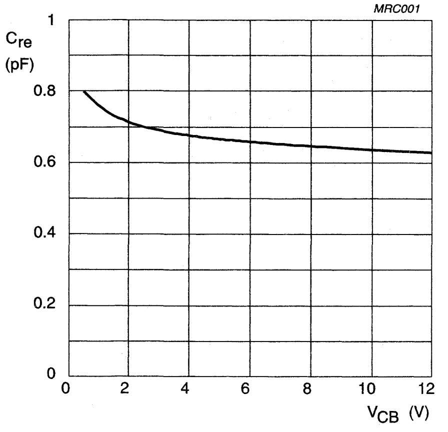
$V_{CE} \leq 10$ V.

Fig.2 Power derating curve.



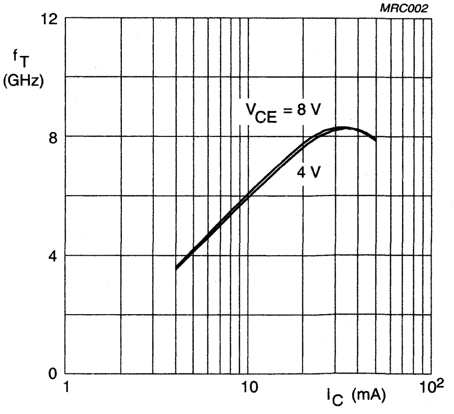
$V_{CE} = 8$ V; $T_j = 25$ °C.

Fig.3 DC current gain as a function of collector current.



$I_C = 0$; f = 1 MHz.

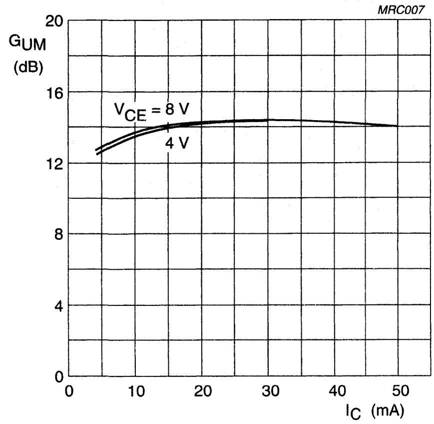
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; $T_{amb} = 25$ °C.

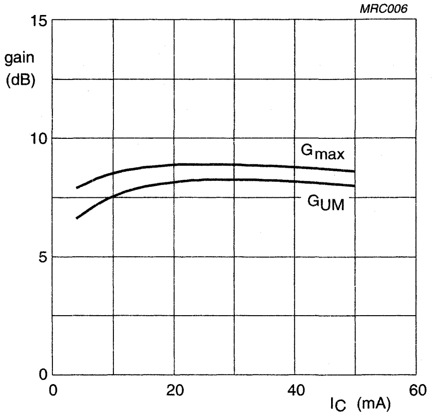
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



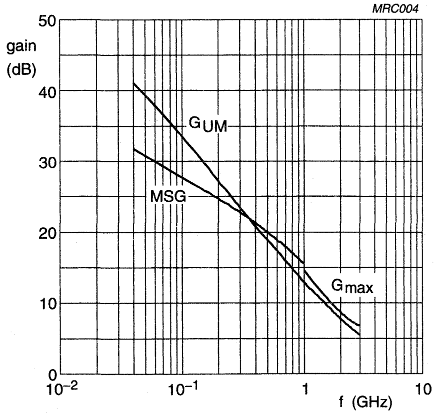
f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of collector current.



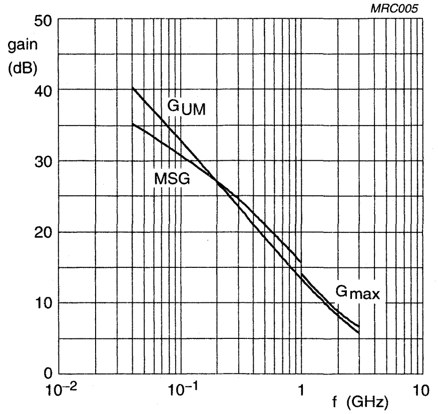
V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



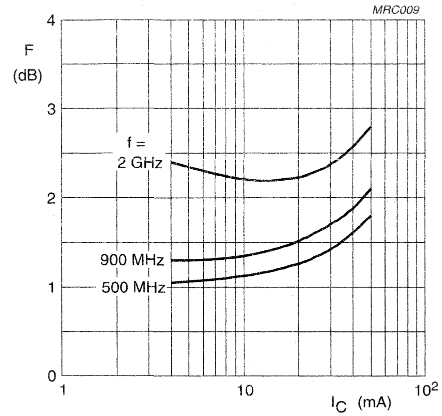
I_C = 10 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



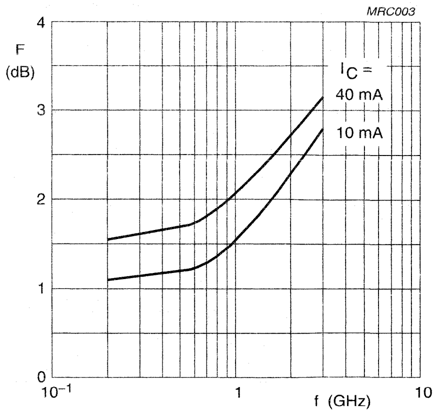
I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



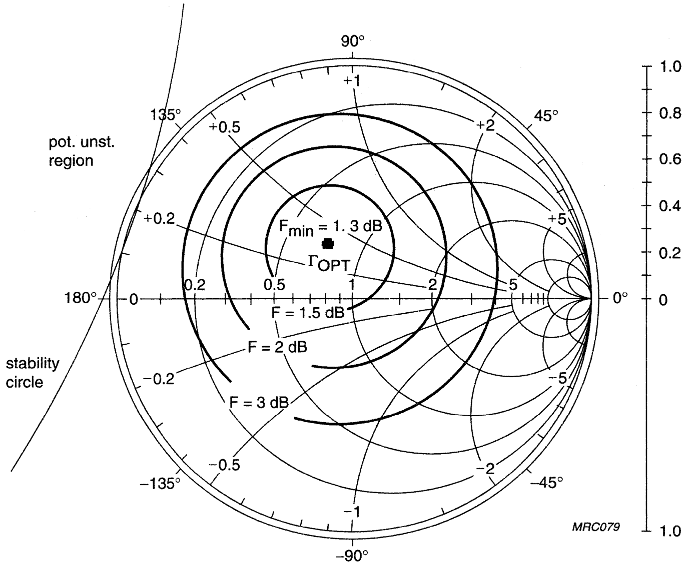
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



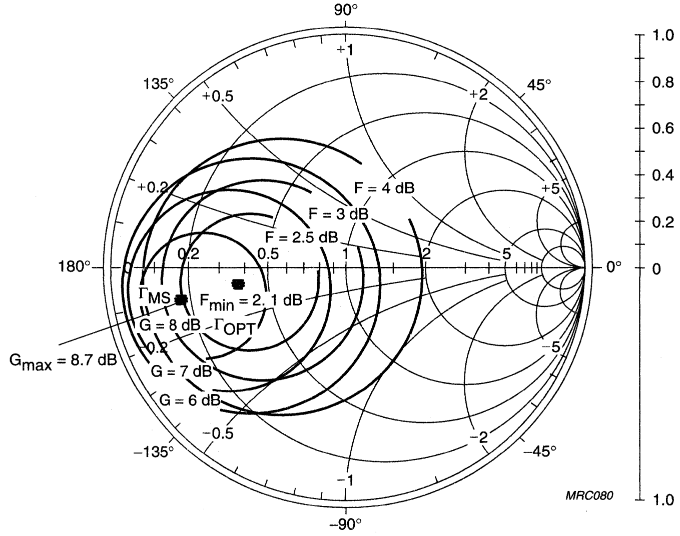
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



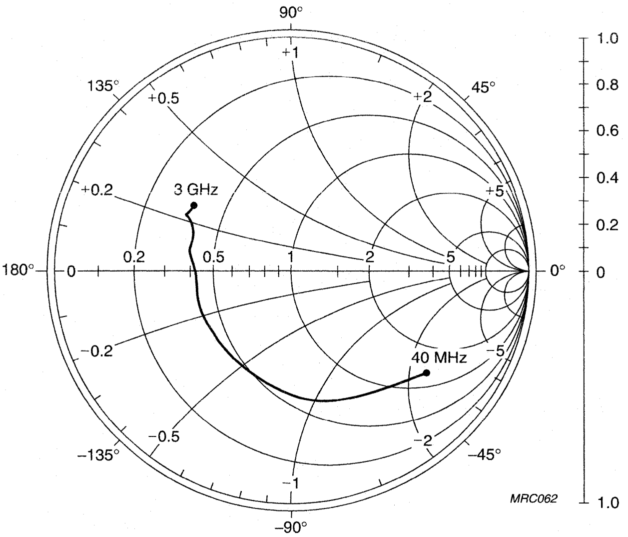
I_C = 10 mA; V_{CE} = 8 V;
f = 900 MHz; Z_o = 50 Ω.

Fig.12 Noise circle.



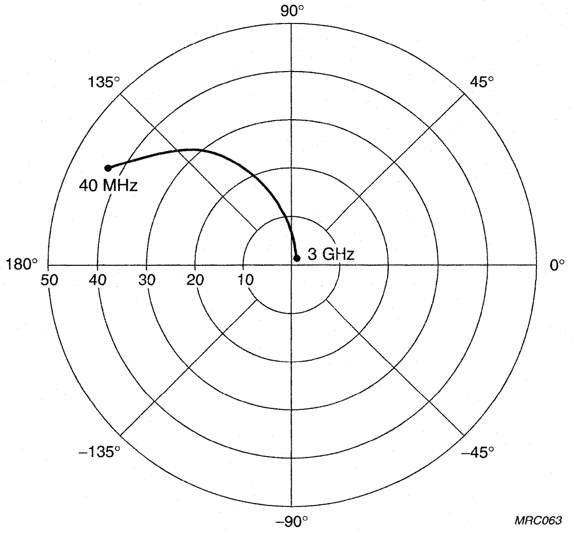
I_C = 10 mA; V_{CE} = 8 V;
f = 2 GHz; Z_o = 50 Ω.

Fig.13 Noise circle.



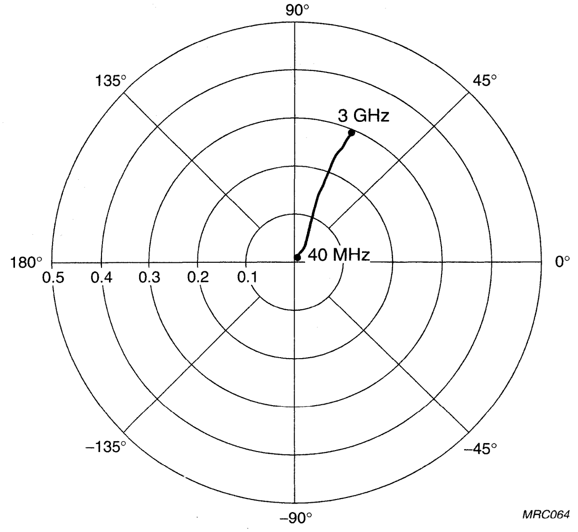
I_C = 40 mA; V_{CE} = 8 V;
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



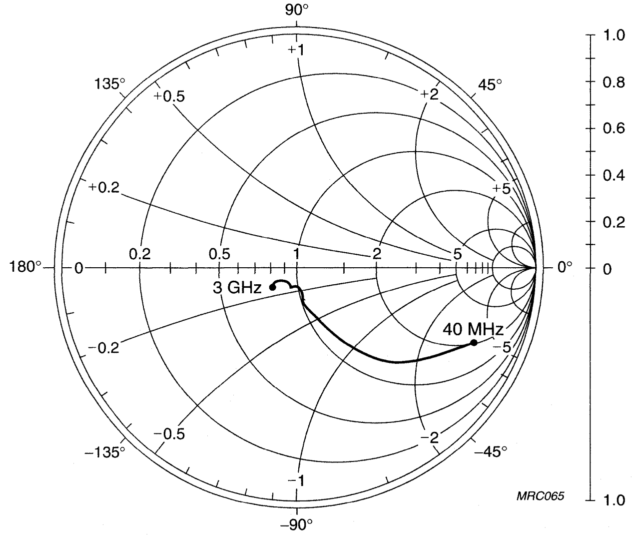
I_C = 40 mA; V_{CE} = 8 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 40 mA; V_{CE} = 8 V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



I_C = 40 mA; V_{CE} = 8 V;
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

NPN 2 GHz wideband transistor BFT25

DESCRIPTION

NPN transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF low power amplifiers, such as in pocket phones, paging systems, etc. The transistor features low current consumption (100 µA to 1 mA); due to its high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

PINNING

PIN	DESCRIPTION
Code: V1p	
1	base
2	emitter
3	collector

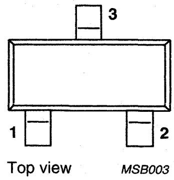


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
I_c	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 167 °C; note 1	–	30	mW
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	2.3	–	GHz
C_{re}	feedback capacitance	I_C = 1 mA; V_{CE} = 1 V; f = 1 MHz; T_{amb} = 25 °C	–	0.45	pF
G_{UM}	maximum unilateral power gain	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	3.8	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
I_{CM}	peak collector current	f > 1 MHz	–	10	mA
P_{tot}	total power dissipation	up to T_s = 167 °C; note 1	–	30	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 167°C; note 1	260 K/W

Note

1. T_s = is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

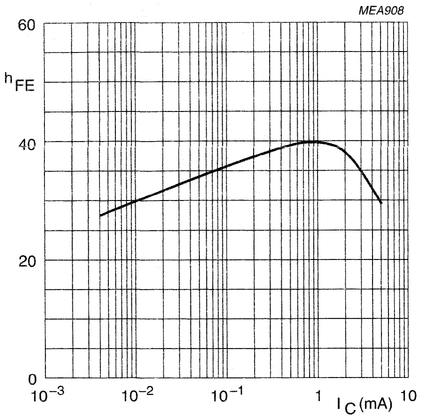
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 1$ V	20	30	–	
		$I_C = 1$ mA; $V_{CE} = 1$ V	20	40	–	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz	1.2	2.3	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 0.5$ V; f = 1 MHz	–	–	0.6	pF
C_e	emitter capacitance	$I_c = i_c = 0$; $V_{EB} = 0$; f = 1 MHz	–	–	0.5	pF
C_{re}	feedback capacitance	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	–	0.45	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	18	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	12	–	dB
F	noise figure	$I_C = 0.1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	5.5	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	3.8	–	dB

Note

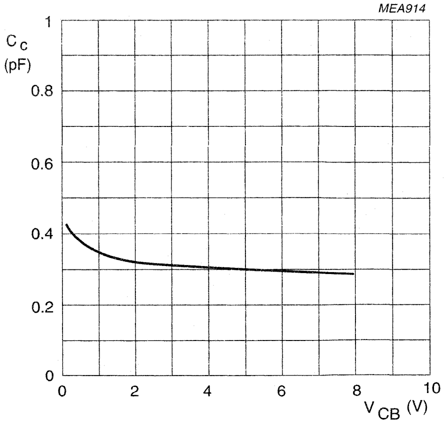
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{dB.}$$



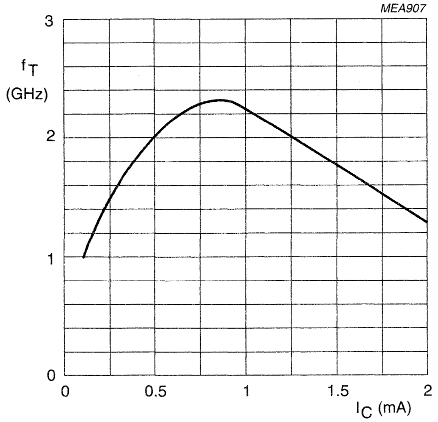
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



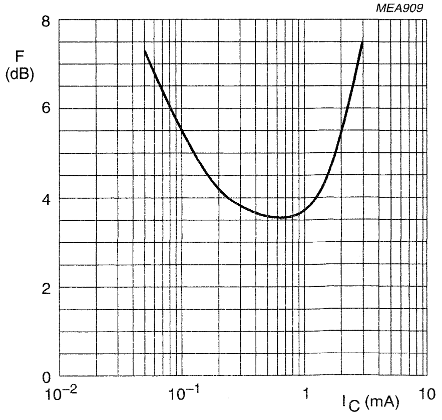
I_E = i_e = 0; f = 1 MHz; T_j = 25 °C.

Fig.3 Collector capacitance as a function of collector-base voltage.



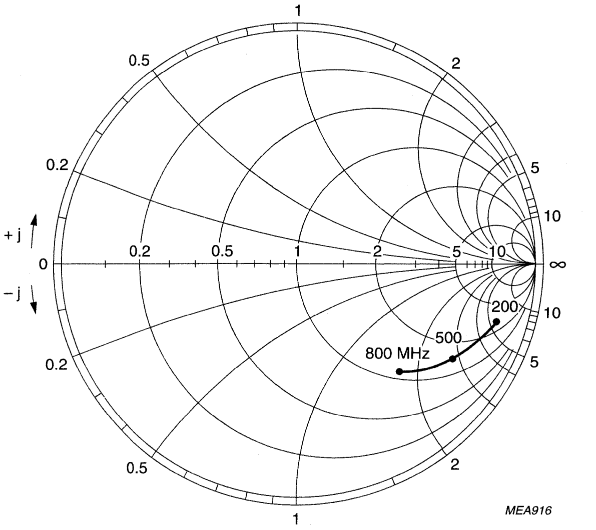
V_{CE} = 1 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



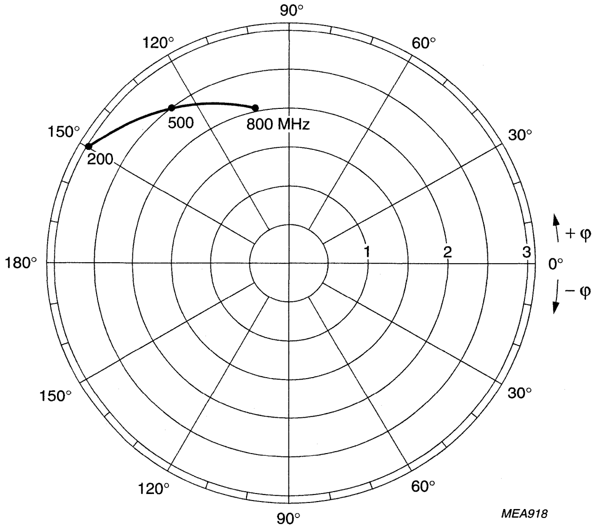
V_{CE} = 1 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Minimum noise figure as a function of collector current.



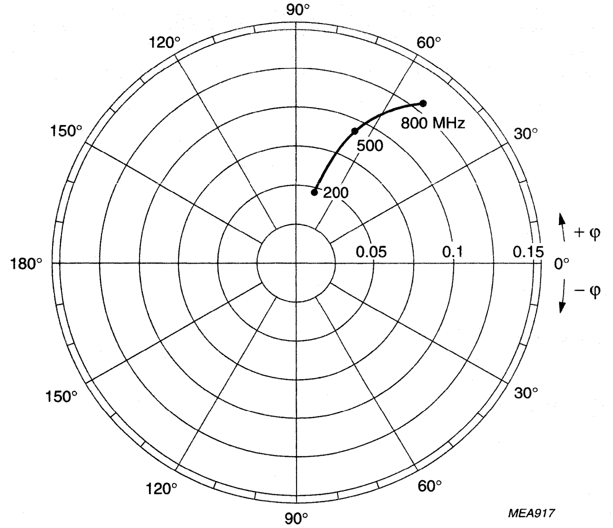
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.6 Common emitter input reflection coefficient (S_{11}).



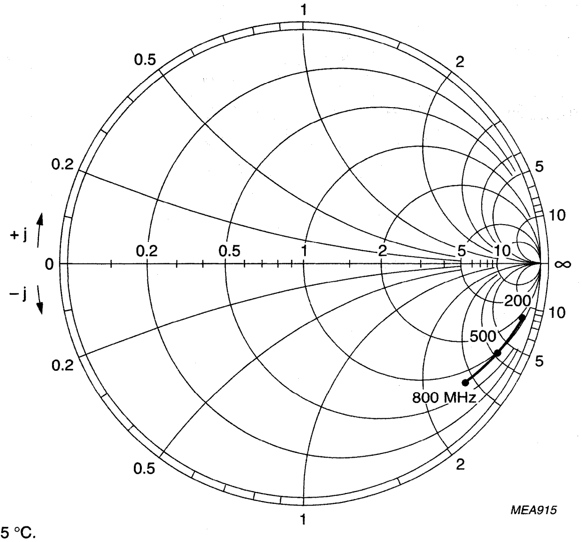
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.9 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFT25A

FEATURES

- Low current consumption (100 µA – 1 mA)
- Low noise figure
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFT25A is a silicon npn transistor, primarily intended for use in RF low power amplifiers, such as pocket telephones and paging systems with signal frequencies up to 2 GHz.

The transistor is encapsulated in a 3-pin plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: V10	
1	base
2	emitter
3	collector

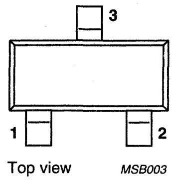


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	–	5	V
I_C	DC collector current		–	–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 165 °C; note 1	–	–	32	mW
h_{FE}	DC current gain	I_C = 0.5 mA; V_{CE} = 1 V	50	80	200	
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
F	noise figure	$\Gamma = \Gamma_{opt}$; I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	1.8	–	dB
		$\Gamma = \Gamma_{opt}$; I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	2	–	dB

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 165 °C; note 1	–	32	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 500 MHz	3.5	5	–	GHz
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 1$ V; f = 1 MHz	–	0.3	0.45	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 0.5$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	15	–	dB
F	noise figure	$\Gamma = \Gamma_{opt}$; $I_C = 0.5$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.8	–	dB
		$\Gamma = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\text{dB.}$$

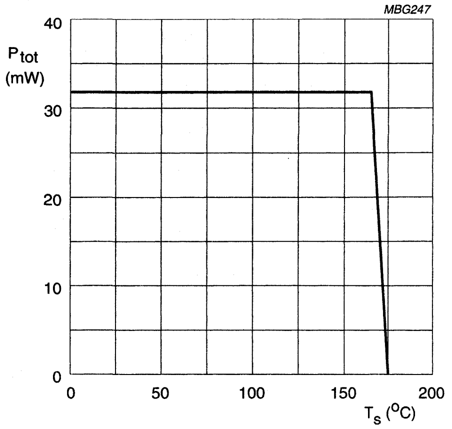
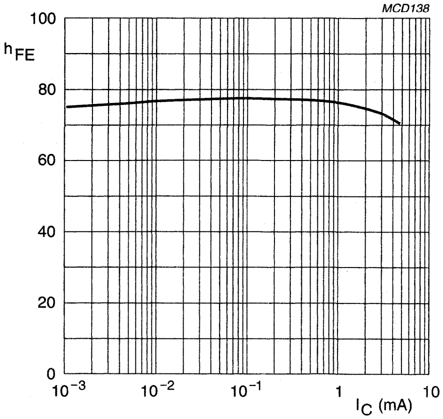
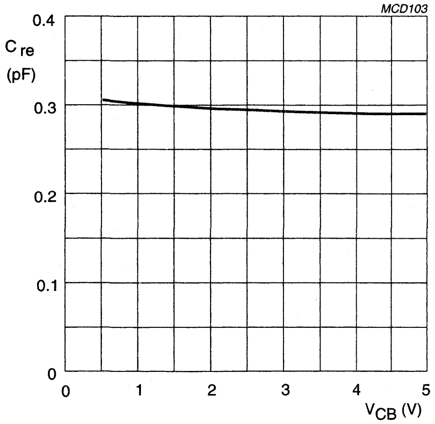


Fig.2 Power derating curve.



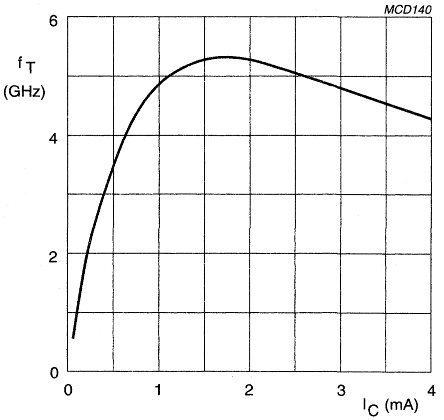
V_{CE} = 1 V.

Fig.3 DC current gain as a function of collector current.



$I_c = i_c = 0$; f = 1 MHz.

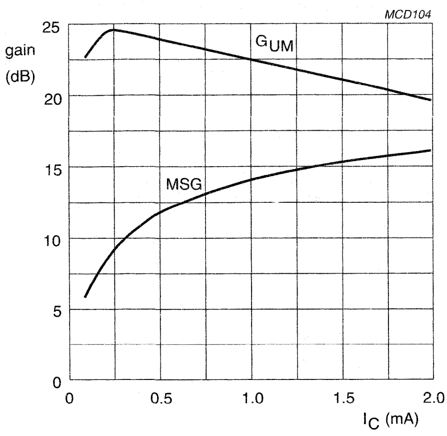
Fig.4 Feedback capacitance as a function of collector-base voltage.



V_{CE} = 1 V; T_{amb} = 25 °C; f = 500 MHz.

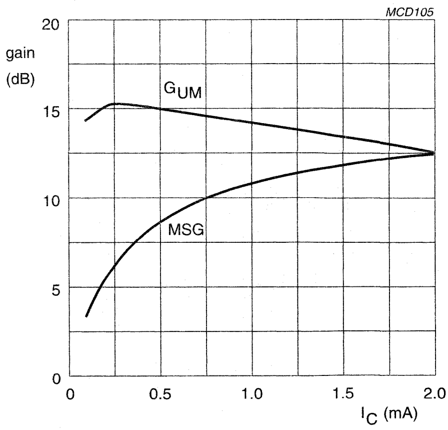
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



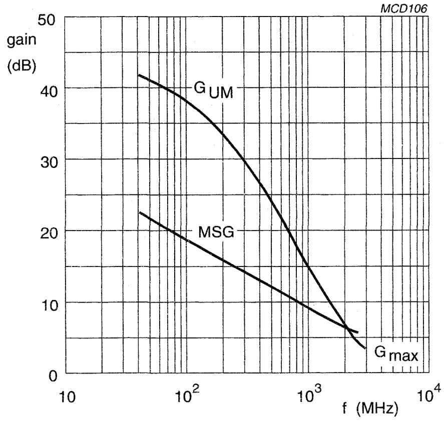
V_{CE} = 1 V; f = 500 MHz.

Fig.6 Gain as a function of collector current.



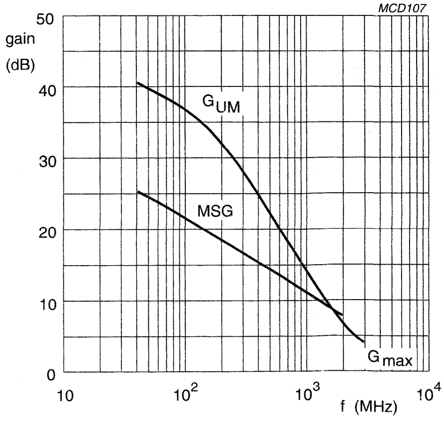
V_{CE} = 1 V; f = 1 GHz.

Fig.7 Gain as a function of collector current.



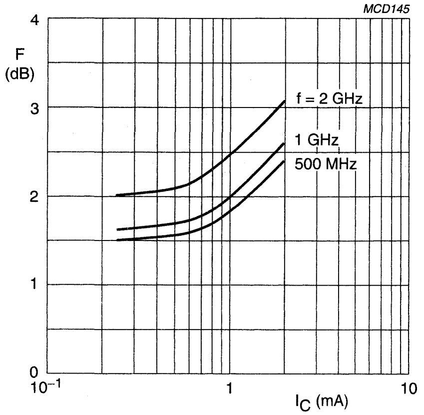
V_{CE} = 1 V; I_c = 0.5 mA.

Fig.8 Gain as a function of frequency.



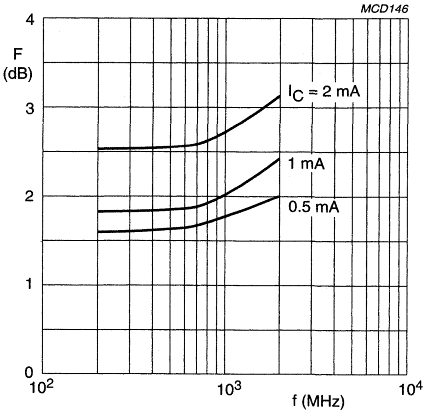
V_{CE} = 1 V; I_c = 1 mA.

Fig.9 Gain as a function of frequency.



V_{CE} = 1 V.

Fig.10 Minimum noise figure as a function of collector current.



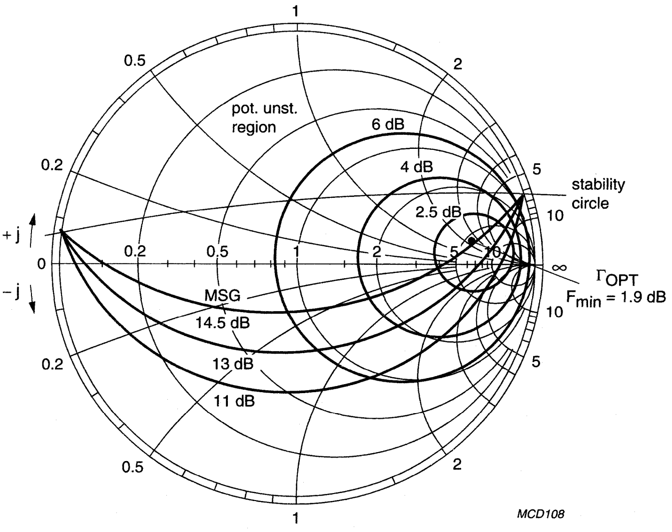
V_{CE} = 1 V.

Fig.11 Minimum noise figure as a function of frequency.

f (MHz)	V_{CE} (V)	I_C (mA)
500	1	1

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
1.9	0.79	4	2.5



Z_o = 50 Ω.

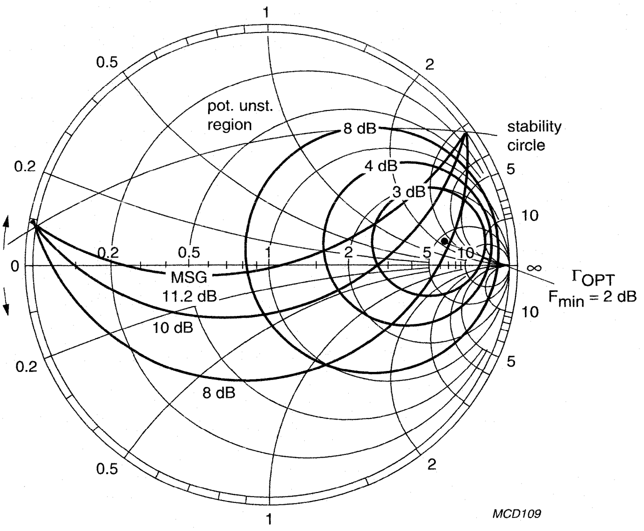
Average gain parameter: MSG = 14.5 dB.

Fig.12 Noise circle figure.

f (MHz)	V_{CE} (V)	I_C (mA)
1000	1	1

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2	0.74	8	2.6



$Z_o = 50\ \Omega$.

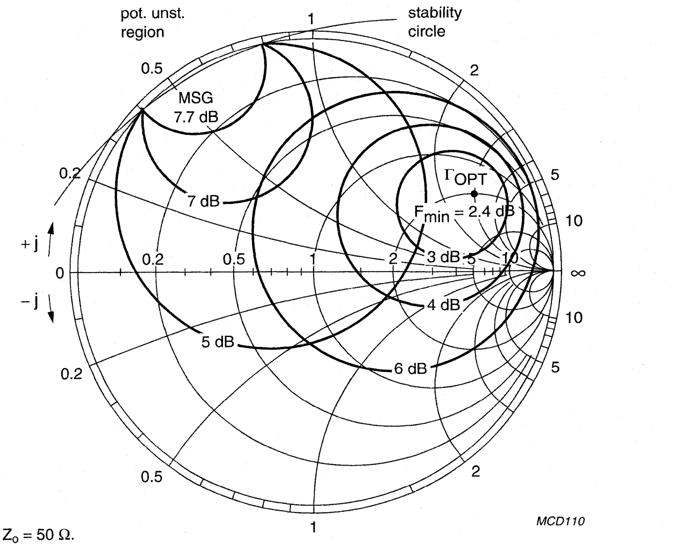
Average gain parameter: MSG = 11.2 dB.

Fig.13 Noise circle figure.

f (MHz)	V_{CE} (V)	I_C (mA)
2000	1	1

Noise Parameters

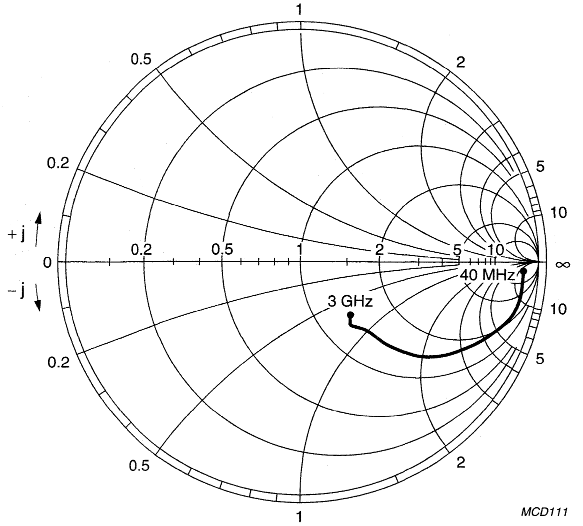
F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2.4	0.72	26	1.7



$Z_o = 50\ \Omega$.

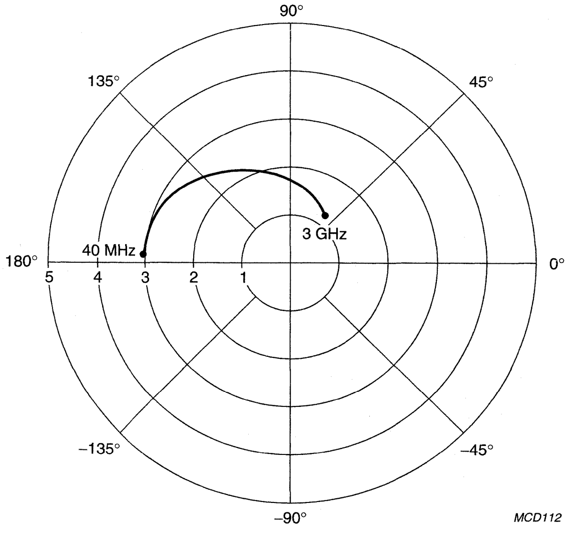
Average gain parameter: MSG = 7.7 dB.

Fig.14 Noise circle figure.



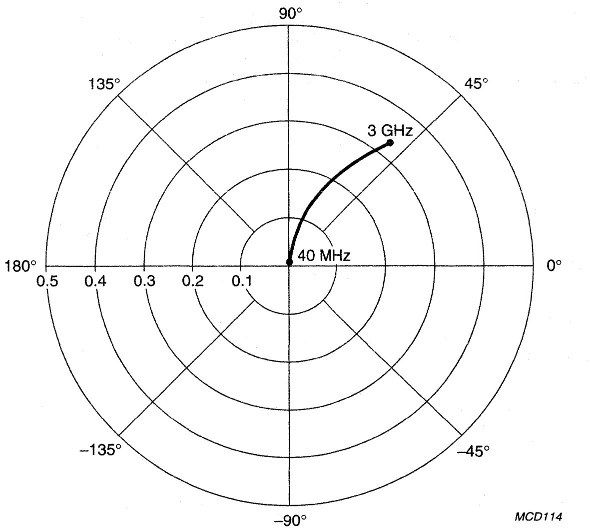
V_{CE} = 1 V; I_C = 1 mA.
Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (S_{11}).



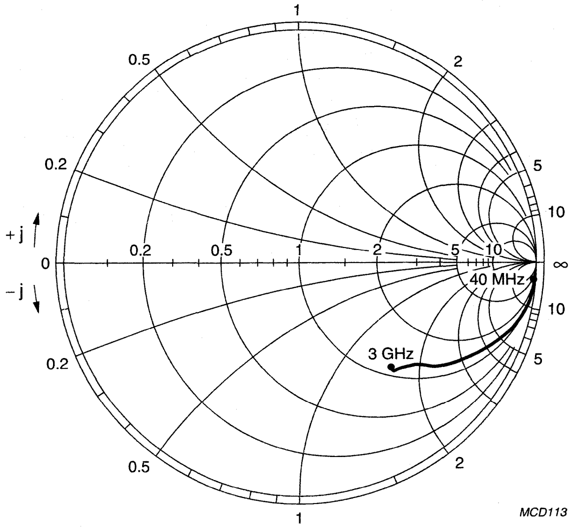
V_{CE} = 1 V; I_C = 1 mA.

Fig.16 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 1 V; I_C = 1 mA.

Fig.17 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 1 V; I_C = 1 mA.
Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (S_{22}).

PNP 5 GHz wideband transistor BFT92

DESCRIPTION

PNP transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF wideband amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

NPN complements are BFR92 and BFR92A.

PINNING

PIN	DESCRIPTION
Code: W1p	
1	base
2	emitter
3	collector

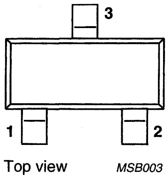


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	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		–	−25	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	mW
f_T	transition frequency	I_C = −14 mA; V_{CE} = −10 V; f = 500 MHz	5	–	GHz
C_{re}	feedback capacitance	I_C = −2 mA; V_{CE} = −10 V; f = 1 MHz	0.7	–	pF
G_{UM}	maximum unilateral power gain	I_C = −14 mA; V_{CE} = −10 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = −5 mA; V_{CE} = −10 V; f = 500 MHz; T_{amb} = 25 °C	2.5	–	dB
d_{im}	intermodulation distortion	I_C = −14 mA; V_{CE} = −10 V; R_L = 75 Ω; V_o = 150 mV; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 MHz	−60	–	dB

Note

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

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	–	–2	V
I_C	DC collector current		–	–25	mA
I_{CM}	peak collector current	f > 1 MHz	–	–35	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	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 = 95 °C; note 1	260 K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

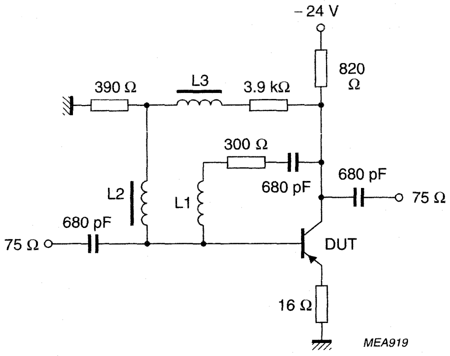
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -10$ V;	–	–	−50	nA
h_{FE}	DC current gain	$I_C = -14$ mA; $V_{CE} = -10$ V	20	50	–	
f_T	transition frequency	$I_C = -14$ mA; $V_{CE} = -10$ V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.75	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	0.8	–	pF
C_{re}	feedback capacitance	$I_C = -2$ mA; $V_{CE} = -10$ V; f = 1 MHz	–	0.7	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = -14$ mA; $V_{CE} = -10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	18	–	dB
F	noise figure	$I_C = -5$ mA; $V_{CE} = -10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	2.5	–	dB
V_o	output voltage	note 2	–	150	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\,\text{dB}.$$

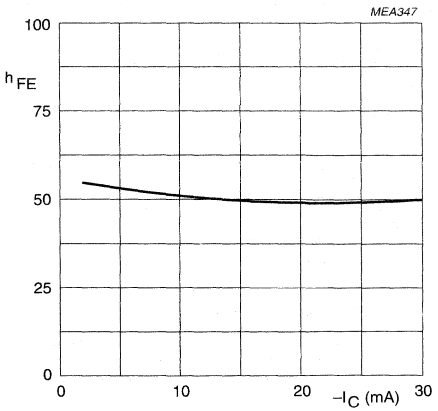
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -14$ mA; $V_{CE} = -10$ V; $R_L = 75\ \Omega$;
$V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 495.25$ MHz;
$V_q = V_o$ −6 dB; $f_q = 503.25$ MHz;
$V_r = V_o$ −6 dB; $f_r = 505.25$ MHz;
measured at $f_{(p+q-r)} = 493.25$ MHz.



L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.

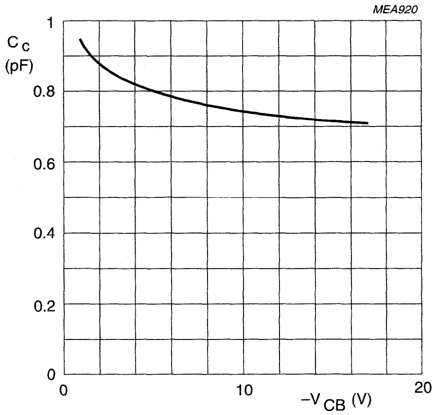
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



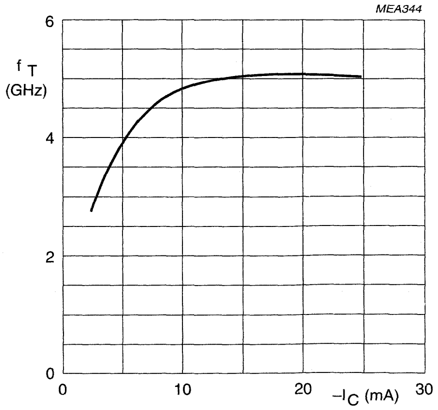
$V_{CE} = -10$ V; $T_j = 25$ °C.

Fig.3 DC current gain as a function of collector current.



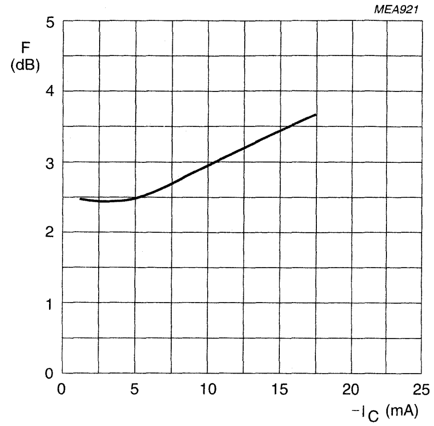
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



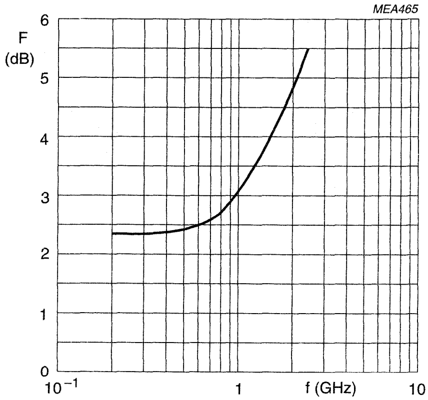
$V_{CE} = -10$ V; f = 500 MHz; $T_j = 25$ °C.

Fig.5 Transition frequency as a function of collector current.



$V_{CE} = -10$ V; Z_s = opt.; f = 500 MHz; $T_{amb} = 25$ °C.

Fig.6 Minimum noise figure as a function of collector current.



$I_c = -2$ mA; $V_{CE} = -10$ V; Z_s = opt.; $T_{amb} = 25$ °C.

Fig.7 Minimum noise figure as a function of frequency.

PNP 4 GHz wideband transistor BFT92W

FEATURES

High power gain

- Gold metallization ensures excellent reliability
- SOT323 (S-mini) package.

APPLICATION

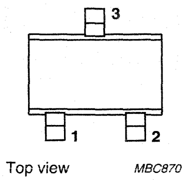
It is intended as a general purpose transistor for wideband applications up to 2 GHz.

DESCRIPTION

Silicon PNP transistor in a plastic, SOT323 (S-mini) package. The BFT92W uses the same crystal as the SOT23 version, BFT92.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: W1.

Fig.1 SOT323.

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	collector current (DC)		–	–	–35	mA
P_{tot}	total power dissipation	up to $T_s = 93$ °C; note 1	–	–	300	mW
h_{FE}	DC current gain	$I_C = -15$ mA; $V_{CE} = -10$ V	20	50	–	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 500 MHz	–	4	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	17	–	dB
F	noise figure	$I_C = -5$ mA; $V_{CE} = -10$ V; f = 500 MHz	–	2.5	–	dB
T_j	junction temperature		–	–	150	°C

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	–2	V
I_C	collector current (DC)		–	–25	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 93 °C; note 1	190	K/W

Note to the "Limiting values" and "Thermal characteristics"

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

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	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -15$ mA; $V_{CE} = -10$ V	20	50	–	
f_T	transition frequency	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	–	4	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.65	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	0.75	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	–	17	–	dB
		$I_C = -15$ mA; $V_{CE} = -10$ V; f = 1 GHz; T_{amb} = 25 °C	–	11	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = -5$ mA; $V_{CE} = -10$ V; f = 500 MHz	–	2.5	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = -5$ mA; $V_{CE} = -10$ V; f = 1 GHz	–	3	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.

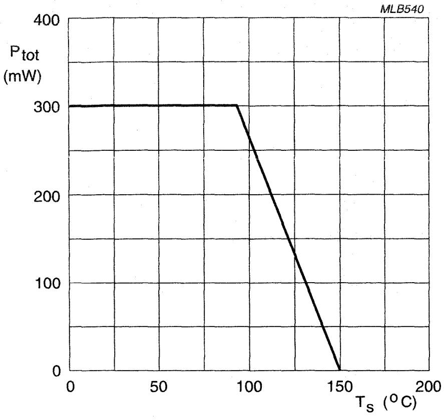
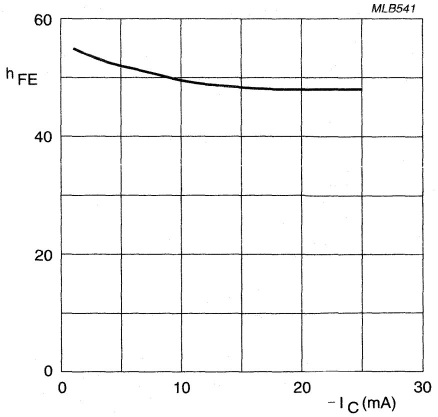
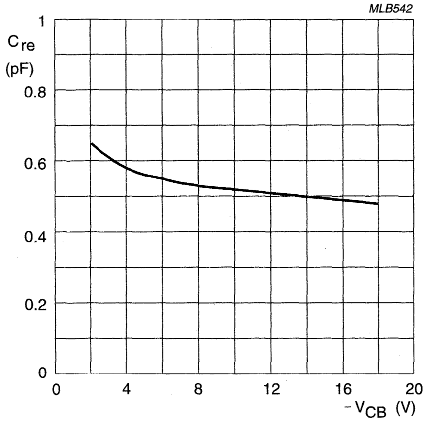


Fig.2 Power derating curve.



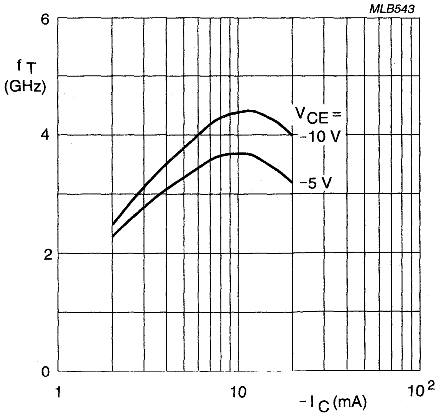
$V_{CE} = -10$ V; $T_j = 25$ °C.

Fig.3 DC current gain as a function of collector current, typical values.



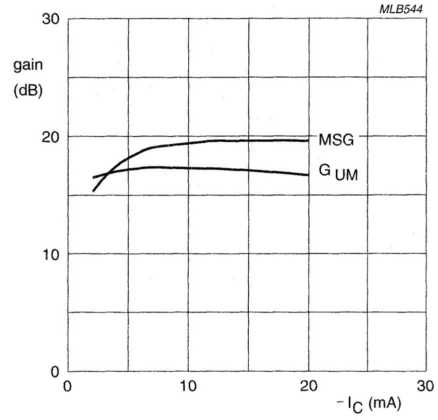
$I_C = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.



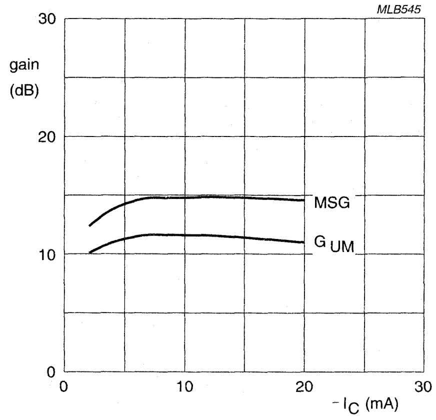
f = 500 MHz; $T_{amb} = 25$ °C.

Fig.5 Transition frequency as a function of collector current, typical values.



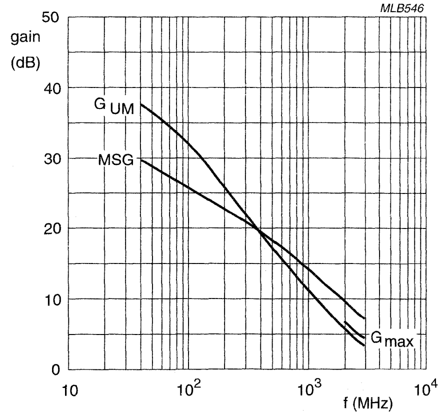
f = 500 MHz; V_{CE} = −10 V.
MSG = maximum stable gain.

Fig.6 Gain as a function of collector current, typical values.



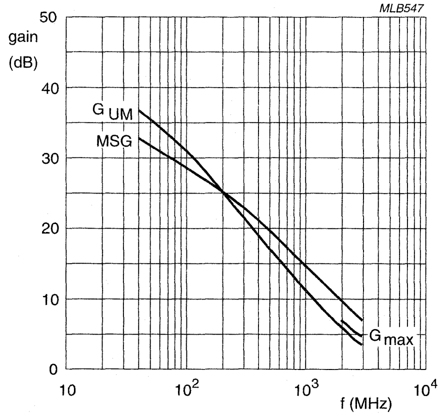
f = 1 GHz; V_{CE} = −10 V.
MSG = maximum stable gain.

Fig.7 Gain as a function of collector current, typical values.



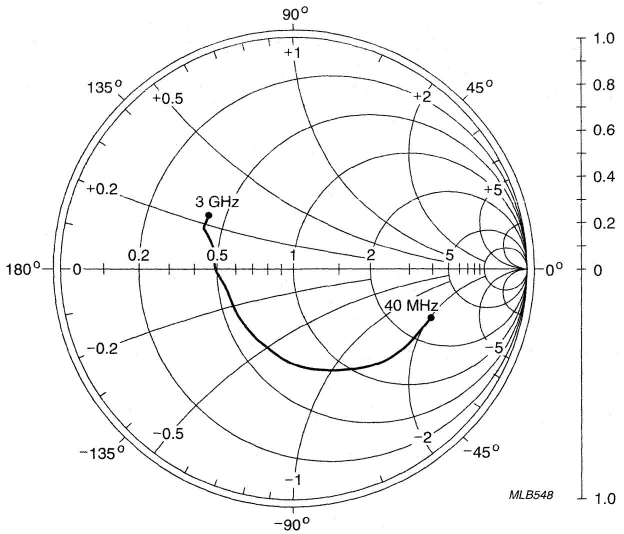
I_C = −5 mA; V_{CE} = −10 V.
MSG = maximum stable gain.

Fig.8 Gain as a function of frequency, typical values.



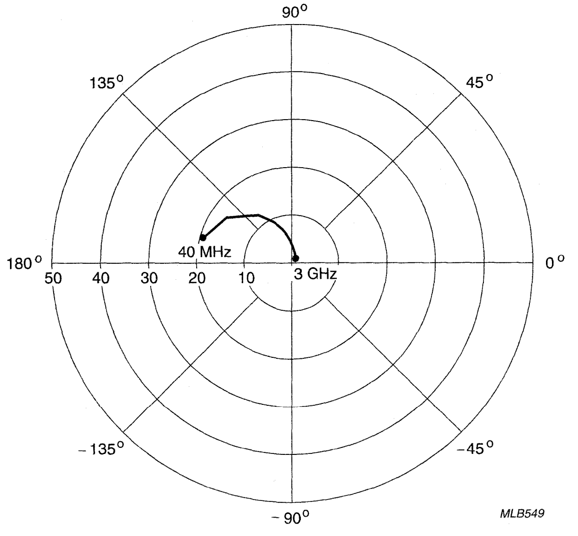
I_C = −15 mA; V_{CE} = −10 V.
MSG = maximum stable gain.

Fig.9 Gain as a function of frequency, typical values.



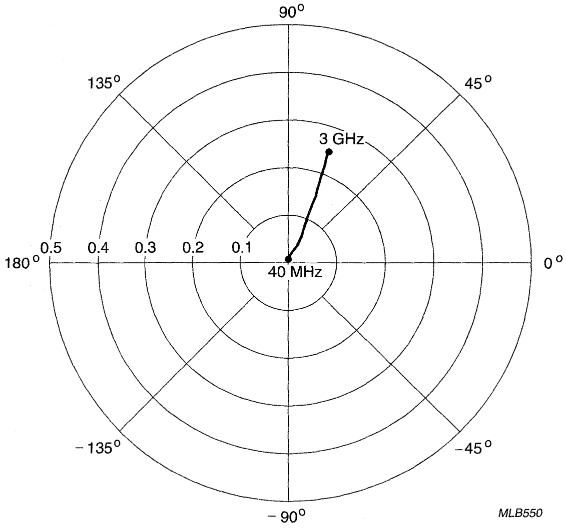
$V_{CE} = -10$ V; $I_C = -15$ mA.

Fig.10 Common emitter input reflection coefficient (s_{11}), typical values.



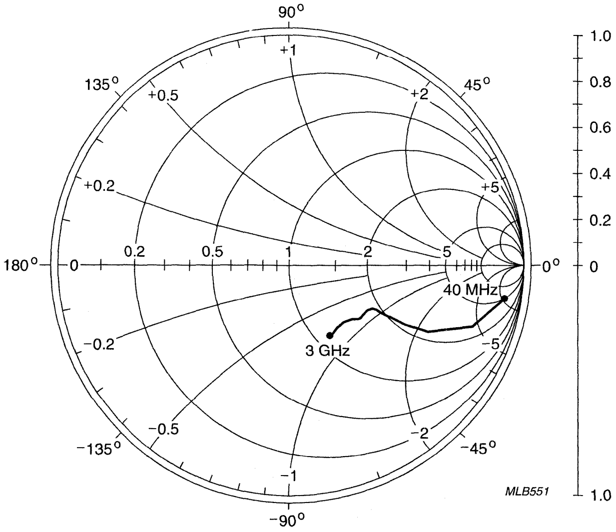
$V_{CE} = -10$ V; $I_C = -15$ mA.

Fig.11 Common emitter forward transmission coefficient (s_{21}), typical values.



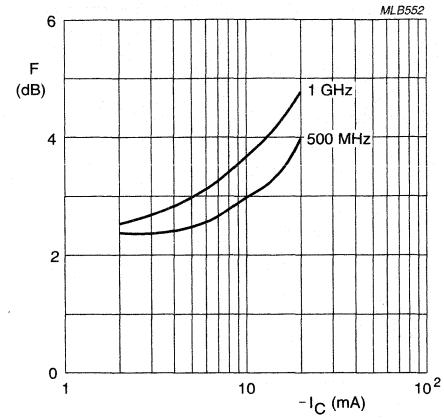
$V_{CE} = -10$ V; $I_C = -15$ mA.

Fig.12 Common emitter reverse transmission coefficient (s_{12}), typical values.



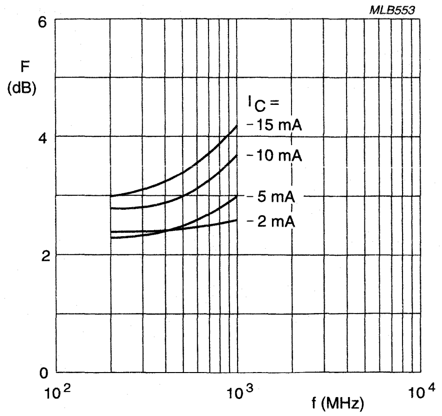
$V_{CE} = -10$ V; $I_C = -15$ mA.

Fig.13 Common emitter output reflection coefficient (s_{22}), typical values.



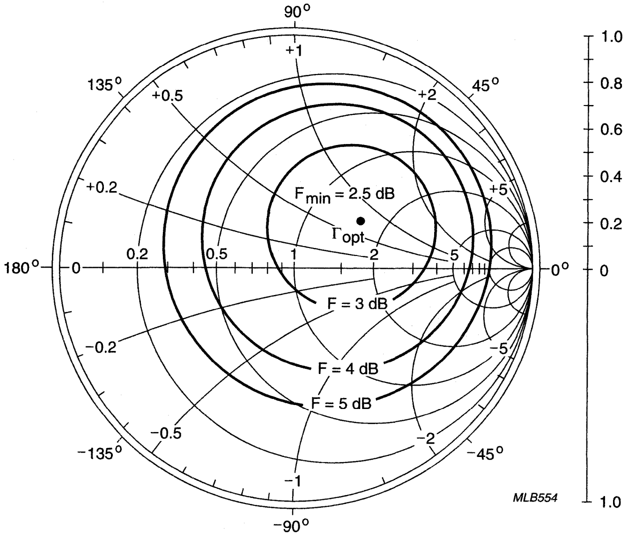
$V_{CE} = -10$ V.

Fig.14 Minimum noise figure as a function of collector current, typical values.



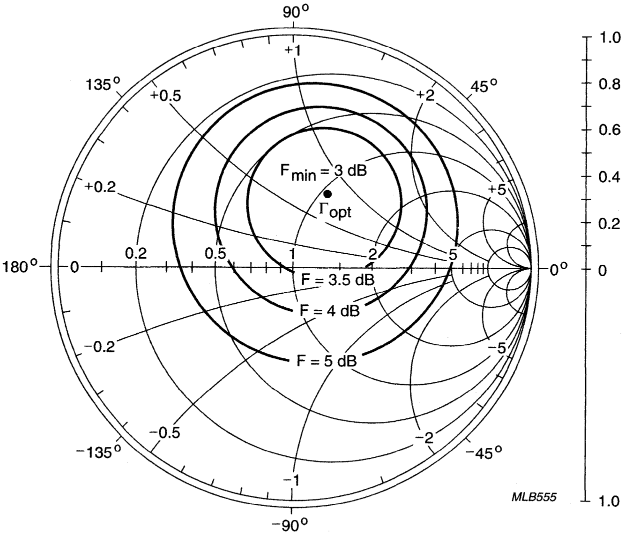
$V_{CE} = -10$ V.

Fig.15 Minimum noise figure as a function of frequency, typical values.



f = 500 MHz; V_{CE} = −10 V; I_C = −5 mA; Z_o = 50 Ω.

Fig.16 Common emitter noise figure circles, typical values.



f = 1 GHz; V_{CE} = −10 V; I_C = −5 mA; Z_o = 50 Ω.

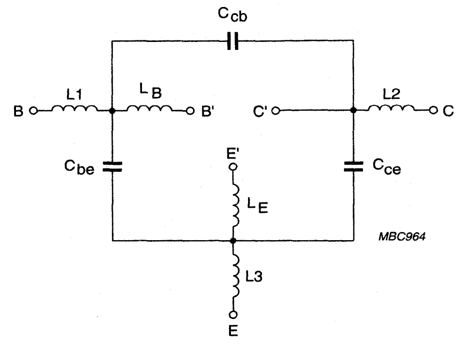
Fig.17 Common emitter noise figure circles, typical values.

SPICE parameters for the BFT92W crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	437.5	aA
2	BF	33.58	–
3	NF	1.009	–
4	VAF	23.39	V
5	IKF	99.53	mA
6	ISE	87.05	fA
7	NE	1.943	–
8	BR	4.947	–
9	NR	1.002	–
10	VAR	3.903	V
11	IKR	5.281	mA
12	ISC	35.88	fA
13	NC	1.393	–
14	RB	5.000	Ω
15	IRB	1.000	μA
16	RBM	5.000	Ω
17	RE	1.000	Ω
18	RC	10.00	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	746.6	fF
23	VJE	600.0	mV
24	MJE	0.357	–
25	TF	17.49	ps
26	XTF	1.354	–
27	VTF	155.6	mV
28	ITF	1.000	mA
29	PTF	45.00	deg
30	CJC	937.1	fF
31	VJC	396.4	mV
32	MJC	0.200	–
33	XCJC	0.106	–
34	TR	8.422	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.768	–

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.18 Package equivalent circuit SOT323.

List of components (see Fig.18)

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH

PNP 5 GHz wideband transistor BFT93

DESCRIPTION

PNP transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF wideband amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

NPN complements are BFR93 and BFR93A.

PINNING

PIN	DESCRIPTION
Code: X1p	
1	base
2	emitter
3	collector

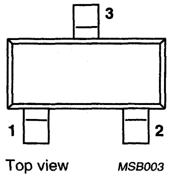


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–12	V
I_c	DC collector current		–	–35	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	mW
f_T	transition frequency	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = –2 mA; V_{CE} = –5 V; f = 1 MHz	1	–	pF
G_{UM}	maximum unilateral power gain	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	16.5	–	dB
F	noise figure	I_C = –10 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	2.4	–	dB
V_o	output voltage	d_{im} = –60 dB; I_C = –30 mA; V_{CE} = –5 V; R_L = 75 Ω; $f_{(p+q-r)}$ = 493.25 MHz	300	–	mV

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–12	V
V_{EBO}	emitter-base voltage	open collector	–	–2	V
I_C	DC collector current		–	–35	mA
I_{CM}	peak collector current	f > 1 MHz	–	–50	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	300	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 = 70 °C; (note 1)	260 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

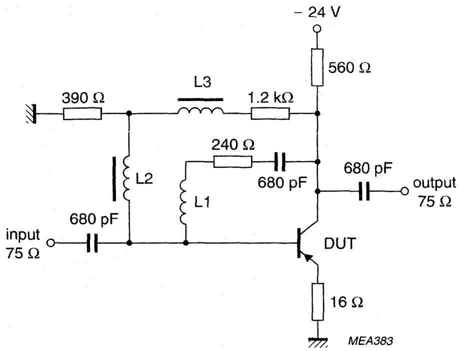
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -5$ V	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -30$ mA; $V_{CE} = -5$ V	20	50	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.95	–	pF
C_e	emitter capacitance	$I_c = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	1.8	–	pF
C_{re}	feedback capacitance	$I_C = -2$ mA; $V_{CE} = -5$ V; f = 1 MHz	–	1	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16.5	–	dB
F	noise figure	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	2.4	–	dB
V_o	output voltage	see Fig.2 and note 2	–	300	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{dB.}$$

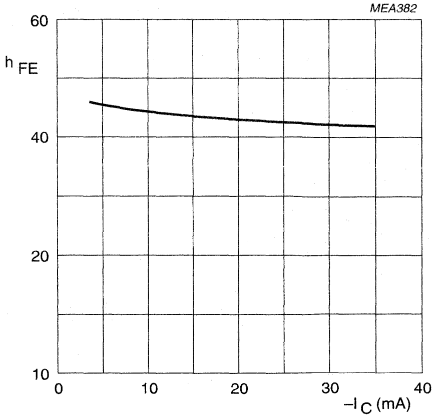
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -30$ mA; $V_{CE} = -5$ V; $R_L = 75\ \Omega$;
   $V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 495.25$ MHz;
   $V_q = V_o$ –6 dB; $f_q = 503.25$ MHz;
   $V_r = V_o$ –6 dB; $f_r = 505.25$ MHz;
   measured at $f_{(p+q-r)} = 493.25$ MHz.



L2 = L3 = 5 µH Ferroxcube choke, catalogue number 3122 108 20150.

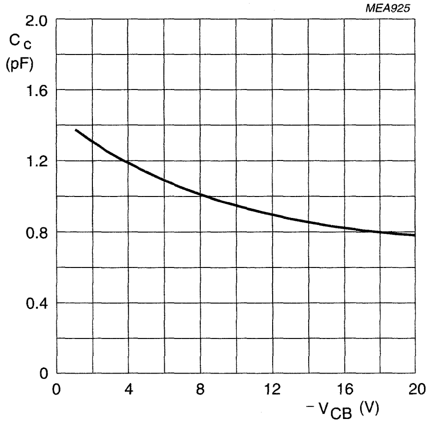
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



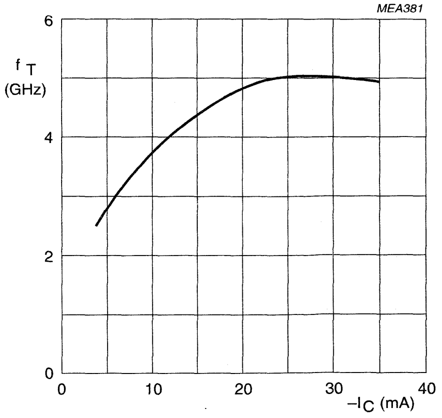
V_{CE} = −5 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current.



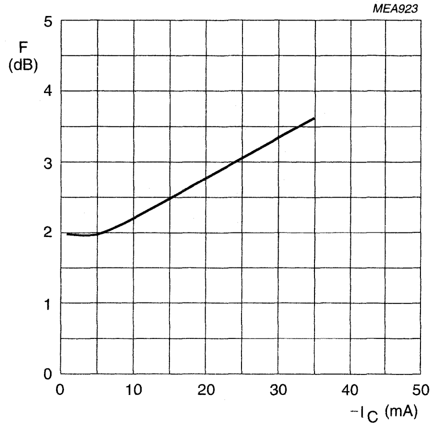
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



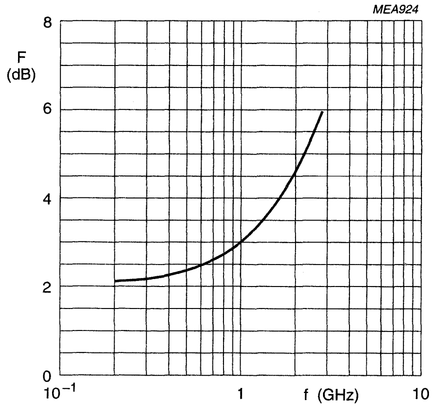
V_{CE} = −5 V; f = 500 MHz; T_j = 25 °C.

Fig.5 Transition frequency as a function of collector current.



V_{CE} = –5 V; Z_s = opt.; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Minimum noise figure as a function of collector current.



I_C = –2 mA; V_{CE} = –5 V; Z_s = opt.; T_{amb} = 25 °C.

Fig.7 Minimum noise figure as a function of frequency.

PNP 4 GHz wideband transistor BFT93W

FEATURES

High power gain

- Gold metallization ensures excellent reliability
- SOT323 (S-mini) package.

APPLICATIONS

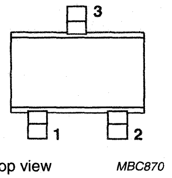
It is intended as a general purpose transistor for wideband applications up to 2 GHz.

DESCRIPTION

Silicon PNP transistor in a plastic, SOT323 (S-mini) package. The BFT93W uses the same crystal as the SOT23 version, BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



BFT93W Marking code: X1.

Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–	–12	V
I_C	collector current (DC)		–	–	–50	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = –30 mA; V_{CE} = –5 V	20	50	–	
C_{re}	feedback capacitance	I_C = 0; V_{CE} = –5 V; f = 1 MHz	–	1	–	pF
f_T	transition frequency	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz	–	4	–	GHz
G_{UM}	maximum unilateral power gain	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	–	15.5	–	dB
F	noise figure	I_C = –10 mA; V_{CE} = –5 V; f = 500 MHz	–	2.4	–	dB
T_j	junction temperature		–	–	150	°C

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–12	V
V_{EBO}	emitter-base voltage	open collector	–	–2	V
I_C	collector current (DC)		–	–50	mA
P_{tot}	total power dissipation	up to T_s = 93 °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 93 °C; note 1	190	K/W

Note to the "Limiting values" and "Thermal characteristics"

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

CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -5$ V	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -30$ mA; $V_{CE} = -5$ V	20	50	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz; T_{amb} = 25 °C	–	4	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	1.2	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	1.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = -5$ V; f = 1 MHz	–	1	–	pF
G_{UM}	maximum unilateral power gain; note 1	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz; T_{amb} = 25 °C	–	15.5	–	dB
		$I_C = -30$ mA; $V_{CE} = -5$ V; f = 1 GHz; T_{amb} = 25 °C	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = -10$ mA; $V_{CE} = -5$ V; f = 500 MHz	–	2.4	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = -10$ mA; $V_{CE} = -5$ V; f = 1 GHz	–	3	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.

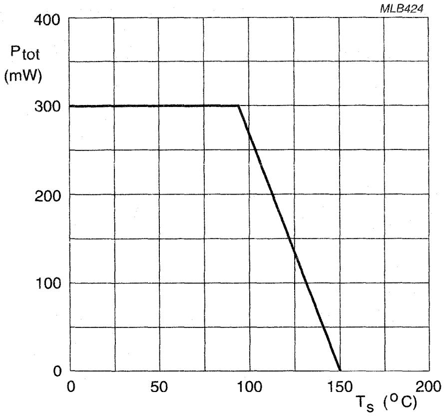
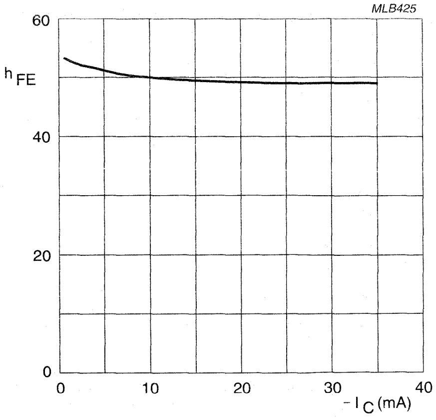
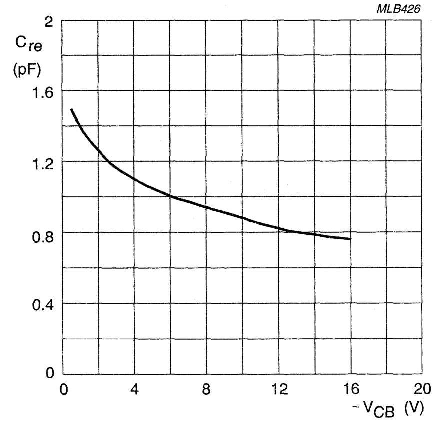


Fig.2 Power derating as a function of the soldering point temperature.



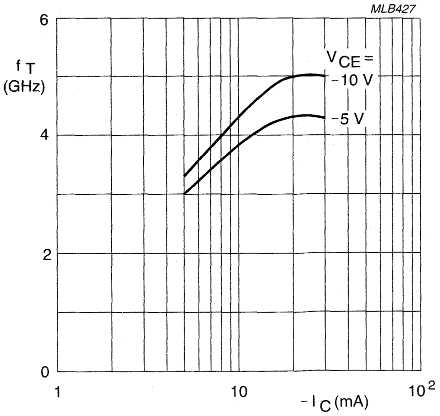
V_{CE} = –5 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current, typical values.



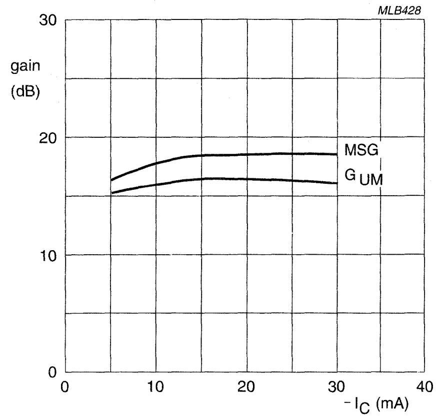
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.



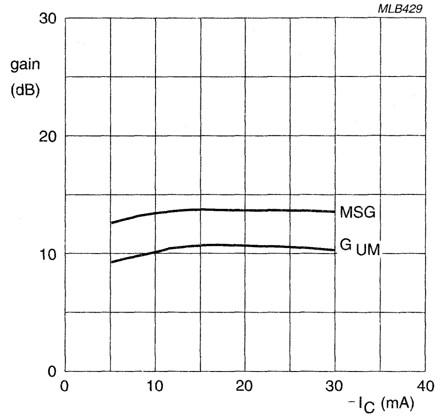
f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current, typical values.



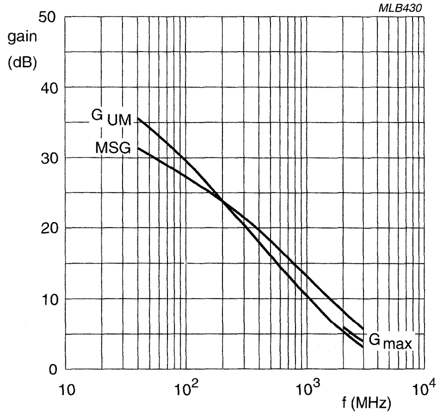
V_{CE} = −5 V; f = 500 MHz.

Fig.6 Gain as a function of collector current, typical values.



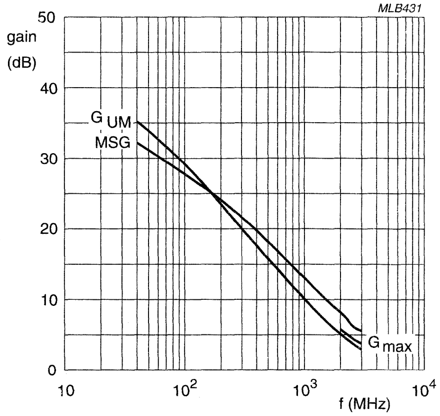
V_{CE} = −5 V; f = 1 GHz.

Fig.7 Gain as a function of collector current, typical values.



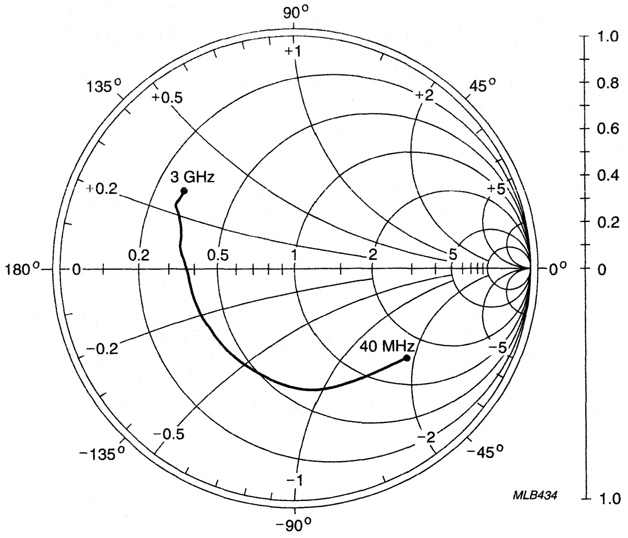
V_{CE} = −5 V; I_C = −10 mA.

Fig.8 Gain as a function of frequency, typical values.



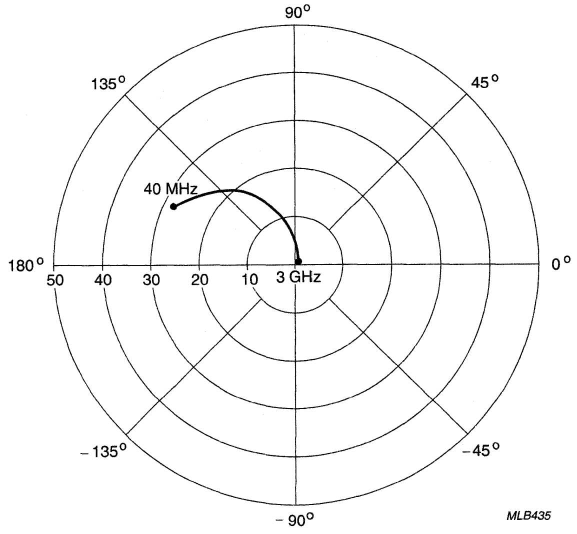
V_{CE} = −5 V; I_C = −30 mA.

Fig.9 Gain as a function of frequency, typical values.



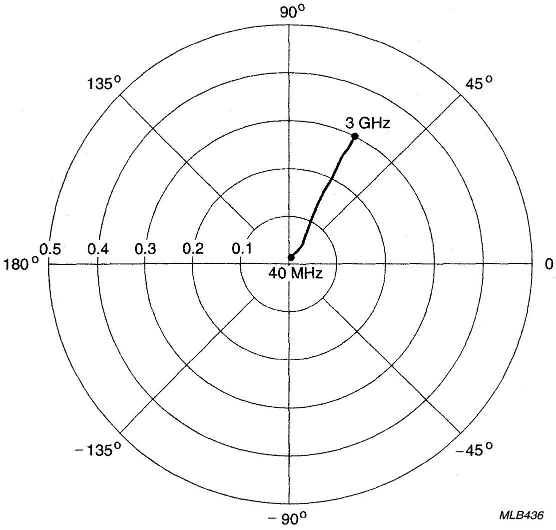
V_{CE} = −10 V; I_C = −30 mA.

Fig.10 Common emitter input reflection coefficient (s_{11}), typical values.



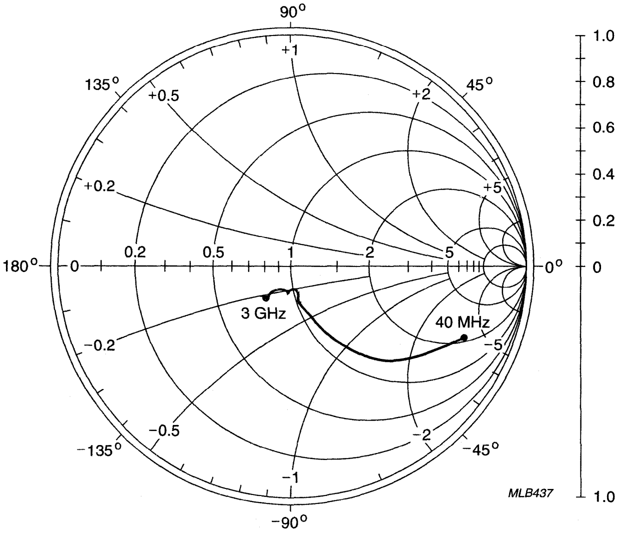
V_{CE} = −10 V; I_C = −30 mA.

Fig.11 Common emitter forward transmission coefficient (s_{21}), typical values.



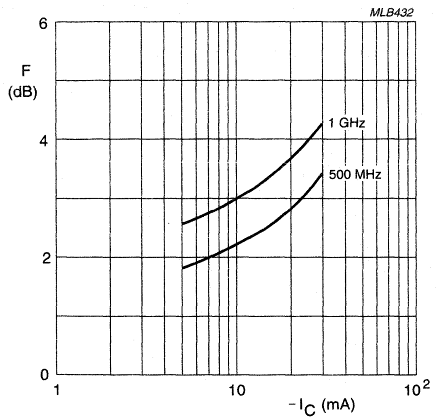
$V_{CE} = -10$ V; $I_C = -30$ mA.

Fig.12 Common emitter reverse transmission coefficient (s_{12}), typical values.



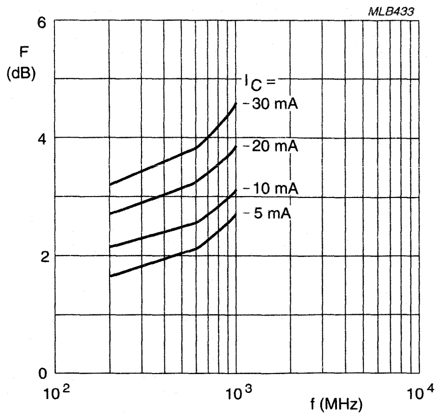
$V_{CE} = -10$ V; $I_C = -30$ mA.

Fig.13 Common emitter output reflection coefficient (s_{22}), typical values.



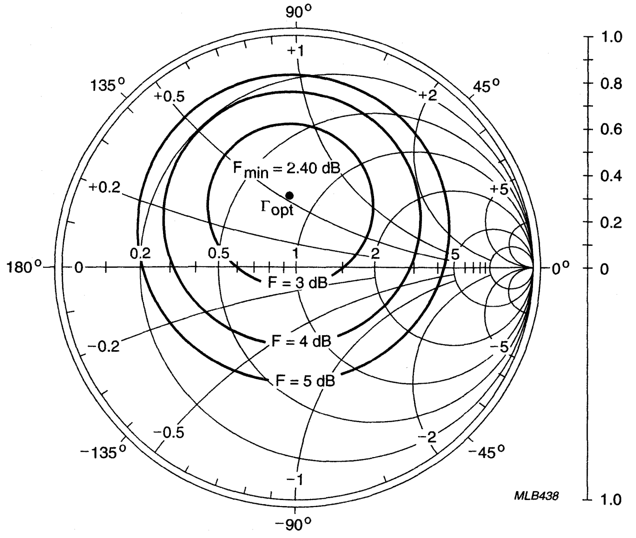
$V_{CE} = -5$ V.

Fig.14 Minimum noise figure as a function of collector current, typical values.



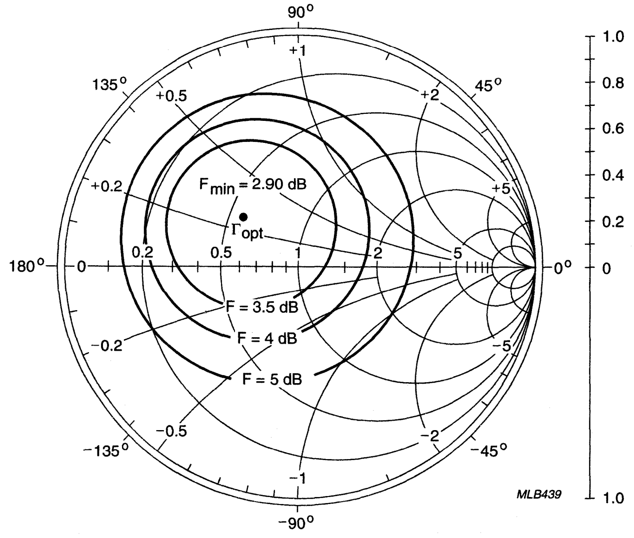
$V_{CE} = -5$ V.

Fig.15 Minimum noise figure as a function of frequency, typical values.



V_{CE} = −5 V; I_C = −10 mA; f = 500 MHz; Z_o = 50 Ω.

Fig.16 Common emitter noise figure circles, typical values.



V_{CE} = −5 V; I_C = −10 mA; f = 1 GHz; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles, typical values.

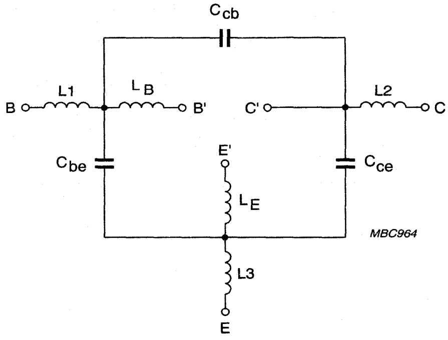
SPICE parameters for the BFT93W crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	835.1	aA
2	BF	48.56	–
3	NF	1.000	–
4	VAF	19.01	V
5	IKF	146.8	mA
6	ISE	90.94	fA
7	NE	1.749	–
8	BR	12.18	–
9	NR	997.6	m
10	VAR	3.374	V
11	IKR	6.742	mA
12	ISC	23.42	fA
13	NC	1.449	–
14	RB	10.00	Ω
15	IRB	1.000	µA
16	RBM	10.00	Ω
17	RE	200.0	mΩ
18	RC	3.800	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	EV
21(1)	XTI	3.000	–
22	CJE	1.570	pF
23	VJE	600.0	mV
24	MJE	382.2	m
25	TF	14.85	ps
26	XTF	2.209	–
27	VTF	2.989	V
28	ITF	14.37	mA
29	PTF	0.000	deg
30	CJC	1.995	pF
31	VJC	584.4	mV
32	MJC	281.3	m
33	XCJC	120.0	m
34	TR	3.000	ns

SEQUENCE No.	PARAMETER	VALUE	UNIT
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	811.6	m

Note

1. These parameters have not been extracted, the default values are shown.



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$;
Fc = scaling frequency = 1 GHz.

Fig.18 Package equivalent circuit SOT323.

List of components (see Fig.18).

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH

Table 1 Common emitter scattering parameters: V_{CE} = –5 V; I_C = –5 mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
40	0.759	–20.5	11.294	165.0	0.023	78.5	0.945	–12.3	34.5
100	0.711	–49.0	10.079	147.7	0.050	64.5	0.834	–27.8	28.3
200	0.630	–88.0	8.082	126.7	0.076	51.2	0.631	–44.0	22.5
300	0.586	–113.6	6.355	113.1	0.090	45.1	0.491	–52.8	19.1
400	0.566	–130.5	5.116	104.1	0.099	42.9	0.403	–58.5	16.6
500	0.557	–141.8	4.266	97.5	0.107	42.8	0.349	–62.5	14.8
600	0.551	–150.5	3.653	92.2	0.113	43.7	0.316	–65.2	13.3
700	0.546	–157.1	3.193	87.7	0.120	44.9	0.293	–66.8	12.0
800	0.543	–162.7	2.838	83.9	0.127	46.2	0.277	–67.7	10.9
900	0.541	–167.6	2.551	80.4	0.133	47.6	0.263	–68.1	9.9
1000	0.541	–172.0	2.323	77.4	0.140	49.1	0.249	–68.7	9.1
1200	0.549	–179.4	1.975	71.7	0.153	51.6	0.223	–71.8	7.7
1400	0.559	174.8	1.737	66.4	0.168	53.8	0.212	–78.3	6.6
1600	0.565	170.3	1.555	61.7	0.183	55.2	0.215	–84.5	5.7
1800	0.566	165.6	1.420	57.7	0.197	56.8	0.220	–87.5	4.9
2000	0.575	160.5	1.310	54.2	0.213	58.3	0.215	–91.0	4.3
2200	0.594	156.3	1.217	51.1	0.228	59.7	0.208	–98.1	3.8
2400	0.613	153.7	1.135	47.7	0.242	60.6	0.217	–107.7	3.4
2600	0.623	151.4	1.064	44.8	0.255	60.9	0.242	–114.1	2.9
2800	0.618	148.2	1.019	41.7	0.271	61.5	0.264	–116.9	2.6
3000	0.621	144.5	0.975	39.3	0.289	61.9	0.275	–119.3	2.2

Table 2 Noise data: V_{CE} = –5 V; I_C = –5 mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	(deg)	
500	1.80	0.307	86.5	0.320
1000	2.55	0.358	121.0	0.280

Table 3 Common emitter scattering parameters: V_{CE} = –5 V; I_C = –10 mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	
40	0.608	–31.5	18.195	160.2	0.020	75.6	0.900	–18.0	34.4
100	0.571	–72.1	15.044	138.8	0.041	60.6	0.725	–38.4	28.5
200	0.538	–114.5	10.475	117.4	0.059	51.1	0.490	–56.6	23.1
300	0.531	–136.1	7.676	106.0	0.070	49.3	0.360	–66.3	19.7
400	0.531	–149.0	5.989	98.6	0.079	50.2	0.287	–73.0	17.4
500	0.532	–157.3	4.907	93.2	0.088	51.8	0.245	–77.9	15.5
600	0.534	–163.6	4.161	88.9	0.097	53.8	0.221	–81.4	14.1
700	0.533	–168.6	3.613	85.1	0.106	55.4	0.204	–83.2	12.8
800	0.532	–172.9	3.195	81.8	0.116	56.9	0.192	–84.2	11.7
900	0.534	–176.8	2.866	78.8	0.125	58.1	0.179	–84.5	10.7
1000	0.535	179.7	2.603	76.2	0.135	59.3	0.167	–85.3	9.9
1200	0.545	173.7	2.206	71.2	0.153	61.0	0.145	–90.1	8.5
1400	0.557	169.2	1.931	66.6	0.172	62.0	0.140	–98.7	7.4
1600	0.561	165.5	1.724	62.2	0.191	62.3	0.149	–104.6	6.5
1800	0.563	161.2	1.570	58.5	0.208	62.7	0.154	–106.3	5.7
2000	0.574	156.6	1.447	55.2	0.227	63.2	0.150	–109.4	5.0
2200	0.593	153.0	1.343	52.4	0.244	63.7	0.148	–117.9	4.5
2400	0.612	150.6	1.251	49.2	0.260	64.0	0.165	–127.5	4.1
2600	0.620	148.8	1.171	46.3	0.274	63.5	0.192	–131.8	3.6
2800	0.616	146.0	1.122	43.2	0.290	63.3	0.213	–132.1	3.3
3000	0.618	142.3	1.074	40.7	0.309	63.2	0.223	–133.3	2.9

Table 4 Noise data: V_{CE} = –5 V; I_C = –10 mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	**(deg)**	
500	2.40	0.304	94.7	0.430
1000	2.90	0.321	136.9	0.270

Table 5 Common emitter scattering parameters: $V_{CE} = -5$ V; $I_C = -20$ mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	
40	0.450	−49.1	25.274	154.6	0.018	72.5	0.830	−24.1	34.1
100	0.475	−99.1	18.682	130.2	0.034	59.2	0.608	−47.9	28.5
200	0.502	−135.9	11.661	110.7	0.047	54.5	0.379	−67.2	23.3
300	0.516	−151.8	8.244	101.0	0.058	55.6	0.270	−77.9	20.0
400	0.526	−161.1	6.342	94.7	0.068	58.1	0.215	−86.1	17.7
500	0.530	−167.1	5.156	90.2	0.079	60.1	0.185	−92.5	15.8
600	0.534	−171.9	4.350	86.3	0.089	61.9	0.169	−96.7	14.4
700	0.535	−175.7	3.768	83.0	0.101	63.2	0.157	−98.7	13.1
800	0.536	−179.1	3.326	80.1	0.112	64.0	0.147	−99.8	12.0
900	0.538	177.7	2.980	77.3	0.123	64.8	0.137	−100.5	11.1
1000	0.541	174.9	2.703	74.9	0.134	65.4	0.127	−101.9	10.2
1200	0.554	169.8	2.285	70.3	0.154	66.2	0.111	−109.1	8.8
1400	0.566	166.1	1.995	65.9	0.175	66.6	0.112	−118.8	7.7
1600	0.571	162.6	1.777	61.7	0.195	66.0	0.125	−122.9	6.8
1800	0.573	158.8	1.616	58.2	0.214	66.0	0.130	−123.1	6.0
2000	0.585	154.4	1.488	55.0	0.234	66.1	0.127	−126.2	5.3
2200	0.604	151.0	1.380	52.4	0.252	66.2	0.130	−135.1	4.8
2400	0.624	148.8	1.285	49.4	0.268	66.2	0.152	−143.0	4.4
2600	0.633	147.1	1.200	46.6	0.282	65.5	0.180	−144.7	3.9
2800	0.626	144.3	1.148	43.5	0.299	65.0	0.199	−143.3	3.5
3000	0.629	140.8	1.100	41.0	0.319	64.7	0.208	−143.7	3.2

Table 6 Noise data: $V_{CE} = -5$ V; $I_C = -20$ mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	**(deg)**	
500	2.80	0.301	100.8	0.610
1000	3.60	0.356	152.2	0.280

Table 7 Common emitter scattering parameters: V_{CE} = –5 V; I_C = –30 mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
40	0.382	–62.3	28.063	151.4	0.016	71.2	0.781	–27.1	33.7
100	0.453	–113.1	19.479	126.1	0.030	58.8	0.543	–51.8	28.3
200	0.502	–144.8	11.682	107.7	0.043	56.8	0.327	–70.7	23.1
300	0.521	–158.0	8.162	98.8	0.054	58.9	0.232	–81.5	19.8
400	0.532	–165.8	6.248	92.9	0.065	61.4	0.185	–89.9	17.5
500	0.537	–170.8	5.069	88.6	0.076	63.4	0.161	–96.5	15.7
600	0.542	–174.9	4.269	84.9	0.088	65.0	0.148	–100.5	14.2
700	0.543	–178.2	3.692	81.7	0.099	65.8	0.139	–102.3	13.0
800	0.545	178.7	3.258	78.8	0.111	66.4	0.131	–103.2	11.9
900	0.548	176.0	2.917	76.1	0.122	67.0	0.123	–103.6	10.9
1000	0.552	173.2	2.644	73.8	0.133	67.4	0.114	–104.8	10.1
1200	0.565	168.6	2.233	69.2	0.154	68.0	0.101	–112.5	8.7
1400	0.577	165.0	1.948	64.9	0.175	68.2	0.105	–121.9	7.6
1600	0.584	161.7	1.734	60.8	0.195	67.5	0.119	–125.4	6.7
1800	0.586	157.9	1.577	57.3	0.214	67.3	0.125	–125.0	5.8
2000	0.598	153.6	1.451	54.2	0.234	67.3	0.124	–128.3	5.2
2200	0.620	150.3	1.345	51.5	0.252	67.5	0.129	–137.0	4.8
2400	0.639	148.1	1.251	48.7	0.269	67.5	0.152	–144.6	4.3
2600	0.646	146.3	1.169	46.0	0.284	66.6	0.181	–146.1	3.8
2800	0.642	143.4	1.118	43.0	0.300	66.2	0.200	–144.7	3.4
3000	0.644	139.8	1.071	40.5	0.321	65.7	0.210	–145.0	3.1

Table 8 Noise data: V_{CE} = –5 V; I_C = –30 mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	(deg)	
500	3.40	0.308	104.2	0.830
1000	4.20	0.380	164.0	0.310

Table 9 Common emitter scattering parameters: $V_{CE} = -10$ V; $I_C = -5$ mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	
40	0.837	−16.8	11.098	166.4	0.020	80.4	0.947	−10.2	36.0
100	0.781	−40.2	10.061	150.4	0.046	67.6	0.856	−23.6	29.9
200	0.670	−73.9	8.331	130.4	0.073	54.7	0.674	−38.2	23.6
300	0.592	−98.6	6.727	116.7	0.088	48.3	0.537	−46.3	19.9
400	0.547	−116.1	5.490	107.3	0.098	45.8	0.447	−51.2	17.3
500	0.523	−128.7	4.616	100.5	0.106	45.2	0.389	−54.5	15.4
600	0.507	−138.6	3.971	94.9	0.114	45.6	0.352	−56.5	13.8
700	0.495	−146.1	3.476	90.3	0.121	46.4	0.327	−57.6	12.5
800	0.487	−152.5	3.094	86.3	0.129	47.3	0.309	−58.0	11.4
900	0.481	−158.1	2.782	82.6	0.136	48.2	0.294	−57.8	10.4
1000	0.478	−163.1	2.532	79.5	0.143	49.3	0.279	−57.8	9.5
1200	0.483	−171.8	2.155	73.7	0.156	51.0	0.250	−59.2	8.1
1400	0.493	−178.2	1.895	68.4	0.171	52.4	0.234	−63.8	7.0
1600	0.499	176.9	1.694	63.6	0.185	53.2	0.232	−69.2	6.1
1800	0.501	172.0	1.541	59.6	0.198	54.4	0.233	−71.8	5.3
2000	0.509	166.5	1.418	55.9	0.212	55.5	0.227	−74.1	4.6
2200	0.529	161.8	1.317	52.6	0.224	56.5	0.215	−79.5	4.0
2400	0.550	158.8	1.228	49.0	0.236	57.2	0.215	−88.7	3.6
2600	0.564	156.7	1.148	45.9	0.246	57.5	0.232	−96.4	3.1
2800	0.564	153.7	1.100	42.8	0.259	58.2	0.253	−100.1	2.8
3000	0.569	150.0	1.051	40.2	0.274	58.9	0.262	−102.7	2.4

Table 10 Noise data: $V_{CE} = -10$ V; $I_C = -5$ mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	**(deg)**	
500	2.00	0.340	73.0	0.440
1000	2.50	0.380	105.0	0.360

Table 11 Common emitter scattering parameters: $V_{CE} = -10$ V; $I_C = -10$ mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	
40	0.744	−24.2	18.034	162.0	0.019	77.2	0.902	−15.2	35.9
100	0.666	−56.4	15.339	142.3	0.040	63.6	0.757	−33.0	30.0
200	0.556	−95.4	11.171	121.0	0.059	53.5	0.533	−49.6	24.0
300	0.507	−119.1	8.353	109.0	0.071	50.8	0.398	−57.9	20.5
400	0.485	−134.4	6.576	101.2	0.081	51.0	0.319	−63.2	18.0
500	0.474	−144.5	5.412	95.6	0.090	52.2	0.272	−66.9	16.1
600	0.469	−152.4	4.597	91.1	0.099	53.7	0.243	−69.2	14.6
700	0.465	−158.4	3.997	87.2	0.108	54.9	0.224	−70.3	13.3
800	0.461	−163.5	3.537	83.9	0.118	56.1	0.209	−70.3	12.2
900	0.459	−168.1	3.170	80.8	0.128	57.0	0.196	−69.7	11.2
1000	0.460	−172.3	2.875	78.2	0.137	57.8	0.183	−69.3	10.4
1200	0.469	−179.3	2.435	73.1	0.155	59.1	0.157	−71.0	8.9
1400	0.482	175.4	2.130	68.4	0.173	59.8	0.144	−77.4	7.8
1600	0.488	171.5	1.898	64.1	0.191	59.7	0.147	−83.7	6.8
1800	0.489	167.2	1.723	60.4	0.207	59.9	0.150	−85.2	6.0
2000	0.501	162.2	1.584	57.0	0.224	60.3	0.144	−87.1	5.3
2200	0.522	158.0	1.469	54.0	0.239	60.6	0.134	−94.3	4.8
2400	0.543	155.4	1.367	50.7	0.253	60.7	0.140	−106.3	4.3
2600	0.557	153.8	1.278	47.8	0.264	60.3	0.162	−113.7	3.9
2800	0.556	151.0	1.222	44.7	0.278	60.4	0.183	−115.3	3.5
3000	0.560	147.6	1.168	42.1	0.295	60.4	0.192	−116.6	3.1

Table 12 Noise data: $V_{CE} = -10$ V; $I_C = -10$ mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	**(deg)**	
500	2.40	0.270	83.0	0.400
1000	2.90	0.350	115.0	0.350

Table 13 Common emitter scattering parameters: V_{CE} = −10 V; I_C = −20 mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	**MAGNITUDE (ratio)**	**ANGLE (deg)**	
40	0.655	−33.6	25.207	156.9	0.018	74.2	0.840	−20.3	35.8
100	0.568	−73.8	19.459	133.9	0.035	61.0	0.644	−41.3	29.8
200	0.487	−113.4	12.634	113.7	0.050	54.9	0.416	−58.0	24.0
300	0.463	−134.1	9.050	103.5	0.061	55.1	0.299	−66.3	20.6
400	0.456	−146.7	6.997	96.9	0.072	56.9	0.236	−72.0	18.2
500	0.453	−154.7	5.702	92.1	0.082	58.5	0.200	−76.3	16.3
600	0.453	−161.0	4.818	88.2	0.093	60.0	0.179	−79.0	14.8
700	0.451	−165.7	4.171	84.8	0.104	61.0	0.165	−79.9	13.5
800	0.451	−169.9	3.683	81.8	0.115	61.8	0.155	−79.9	12.4
900	0.452	−173.7	3.297	79.0	0.126	62.4	0.143	−79.0	11.4
1000	0.454	−177.3	2.986	76.6	0.137	62.9	0.132	−78.5	10.6
1200	0.467	176.6	2.521	71.9	0.157	63.4	0.110	−81.6	9.2
1400	0.482	172.4	2.200	67.6	0.176	63.4	0.103	−90.5	8.0
1600	0.490	168.8	1.956	63.6	0.195	62.8	0.110	−97.4	7.1
1800	0.493	164.8	1.774	60.1	0.212	62.7	0.114	−98.0	6.2
2000	0.505	159.8	1.630	56.8	0.230	62.7	0.109	−100.1	5.6
2200	0.528	155.9	1.509	54.1	0.245	62.8	0.103	−109.7	5.0
2400	0.550	153.6	1.405	51.0	0.260	62.7	0.115	−122.8	4.6
2600	0.563	151.9	1.312	48.1	0.273	62.2	0.141	−128.2	4.1
2800	0.562	149.2	1.253	45.2	0.287	62.0	0.160	−127.8	3.7
3000	0.565	145.8	1.199	42.6	0.305	61.7	0.169	−128.3	3.4

Table 14 Noise data: V_{CE} = −10 V; I_C = −20 mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	**(deg)**	
500	3.00	0.240	98.0	0.440
1000	3.60	0.320	131.0	0.400

Table 15 Common emitter scattering parameters: V_{CE} = –10 V; I_C = –30 mA.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		G_{UM} (dB)
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
40	0.617	–39.1	28.045	153.9	0.017	73.1	0.797	–22.6	35.4
100	0.529	–82.4	20.389	129.6	0.032	60.3	0.583	–44.1	29.4
200	0.464	–120.8	12.630	110.4	0.047	56.4	0.364	–59.3	23.7
300	0.449	–139.7	8.920	101.0	0.058	57.3	0.259	–66.3	20.3
400	0.446	–151.0	6.853	94.8	0.069	59.4	0.204	–71.2	17.9
500	0.446	–158.1	5.569	90.3	0.081	60.9	0.174	–75.0	16.0
600	0.448	–163.5	4.694	86.5	0.092	62.2	0.158	–77.2	14.5
700	0.449	–167.8	4.060	83.3	0.103	63.0	0.147	–77.7	13.2
800	0.450	–171.7	3.579	80.4	0.115	63.6	0.139	–77.1	12.1
900	0.452	–175.1	3.204	77.7	0.126	63.8	0.131	–75.9	11.2
1000	0.456	–178.5	2.902	75.4	0.136	64.1	0.122	–75.0	10.3
1200	0.472	175.9	2.448	70.8	0.157	64.3	0.103	–77.7	8.9
1400	0.488	171.7	2.134	66.6	0.176	64.2	0.097	–87.1	7.8
1600	0.498	168.1	1.898	62.5	0.194	63.6	0.106	–94.6	6.9
1800	0.502	164.0	1.721	59.1	0.211	63.4	0.112	–95.7	6.0
2000	0.516	159.3	1.580	56.0	0.229	63.5	0.108	–98.0	5.4
2200	0.539	155.4	1.464	53.2	0.245	63.7	0.103	–108.1	4.8
2400	0.562	152.9	1.362	50.2	0.260	63.6	0.116	–121.5	4.4
2600	0.575	151.2	1.273	47.4	0.272	63.0	0.141	–127.4	3.9
2800	0.573	148.4	1.217	44.5	0.287	62.9	0.162	–127.3	3.5
3000	0.576	144.7	1.164	42.0	0.305	62.6	0.172	–128.1	3.2

Table 16 Noise data: V_{CE} = –10 V; I_C = –30 mA.

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(ratio)	(deg)	
500	3.60	0.250	101.0	0.550
1000	4.20	0.310	143.0	0.480

Silicon MMIC amplifier

BGA2001

FEATURES

- Low current, low voltage
- Very high power gain
- Low noise figure
- Integrated temperature compensated biasing
- Supply and RF output pin combined.

APPLICATIONS

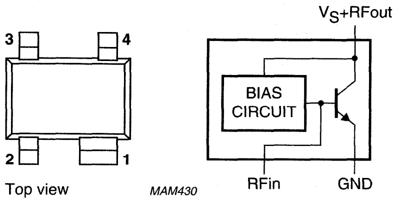
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors
- Low noise amplifiers
- Satellite television tuners (SATV)
- High frequency oscillators.

DESCRIPTION

Silicon MMIC amplifier consisting of an NPN double polysilicon transistor with integrated biasing for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1	GND
2	RF in
3	GND
4	V_S + RFout



Marking code: A1.

Fig.1 Simplified outline (SOT343R) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_S	DC supply voltage	RF input AC coupled	–	4.5	V
I_S	DC supply current	$V_{VS\text{-}OUT}$ = 2.5 V; RF input AC coupled	4.5	–	mA
MSG	maximum stable gain	$V_{VS\text{-}OUT}$ = 2.5 V; f = 1.8 GHz; T_{amb} = 25 °C	19.5	–	dB
NF	noise figure	$V_{VS\text{-}OUT}$ = 2.5 V; f = 1.8 GHz; $\Gamma_S = \Gamma_{opt}$	1.3	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	supply voltage	RF input AC coupled	–	4.5	V
I_S	supply current (DC)	forced by DC voltage on RF input	–	30	mA
P_{tot}	total power dissipation	$T_s \leq 100$ °C	–	135	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	350	K/W

CHARACTERISTICS

RF input AC coupled; T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current	$V_{VS\text{-}OUT} = 1$ V	–	0.7	–	mA
		$V_{VS\text{-}OUT} = 2.5$ V	3	4.5	6	mA
		$V_{VS\text{-}OUT} = 4.5$ V	–	11	–	mA
MSG	maximum stable gain	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 900 MHz	–	22	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 1.8 GHz	–	19.5	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 900 MHz	–	18	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 1.8 GHz	–	14	–	dB
P_L	load power	at 1 dB gain compression point; $V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4.4$ mA; f = 900 MHz;	–	–2	–	dBm
NF	noise figure	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4$ mA; f = 1.8 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	–	dB
$IP3_{(in)}$	input intercept point	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4.4$ mA; f = 900 MHz	–	–7.4	–	dBm
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 4.5$ mA; f = 1800 MHz	–	–4.5	–	dBm

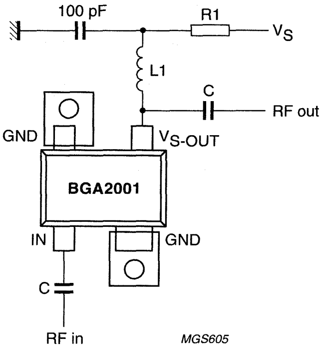


Fig.2 Typical application circuit.

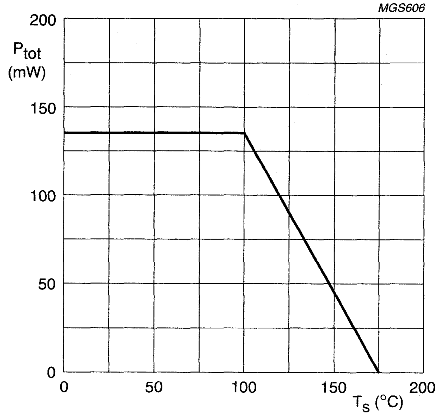
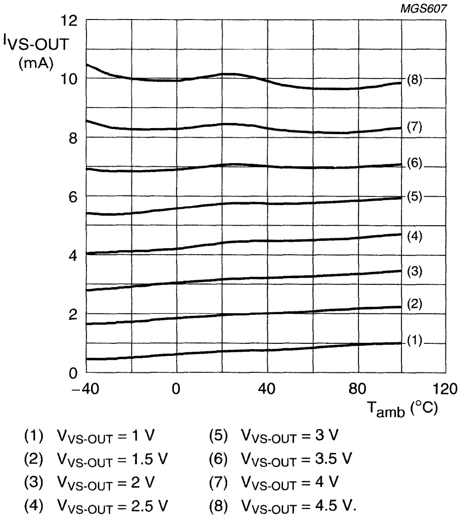


Fig.3 Power derating curve.



(1) $V_{VS\text{-}OUT} = 1$ V
(2) $V_{VS\text{-}OUT} = 1.5$ V
(3) $V_{VS\text{-}OUT} = 2$ V
(4) $V_{VS\text{-}OUT} = 2.5$ V
(5) $V_{VS\text{-}OUT} = 3$ V
(6) $V_{VS\text{-}OUT} = 3.5$ V
(7) $V_{VS\text{-}OUT} = 4$ V
(8) $V_{VS\text{-}OUT} = 4.5$ V.

Fig.4 Bias current ($I_{VS\text{-}OUT}$) as a function of ambient temperature with $V_{VS\text{-}OUT}$ as parameter; typical values.

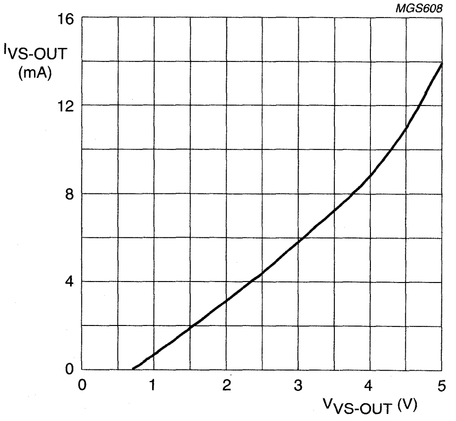
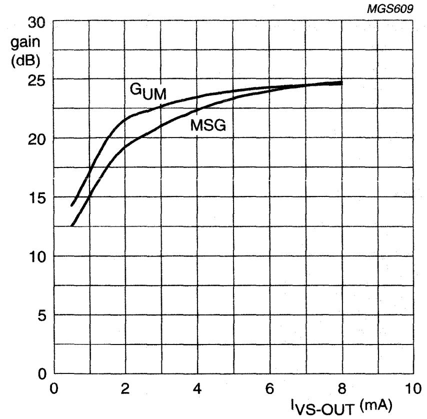
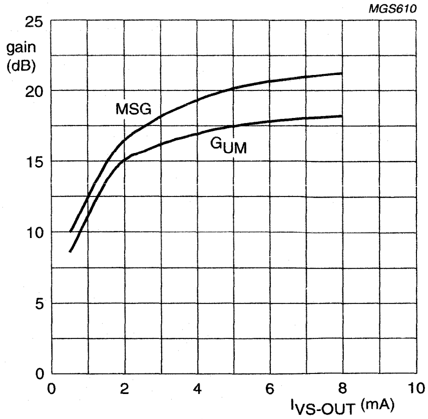


Fig.5 Bias current ($I_{VS\text{-}OUT}$) as a function of voltage at the output pin ($V_{VS\text{-}OUT}$); typical values.



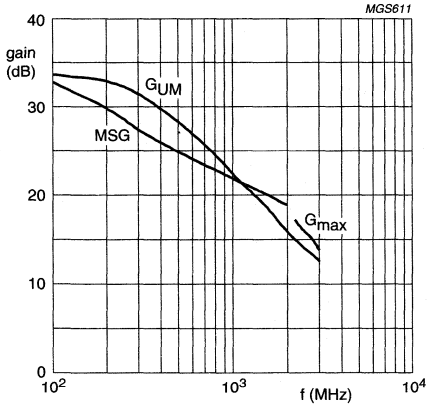
f = 900 MHz.

Fig.6 Gain as a function of bias current ($I_{VS\text{-}OUT}$); typical values.



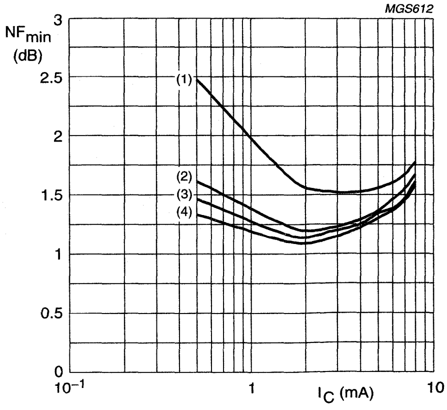
f = 1800 MHz.

Fig.7 Gain as a function of bias current ($I_{VS\text{-}OUT}$); typical values.



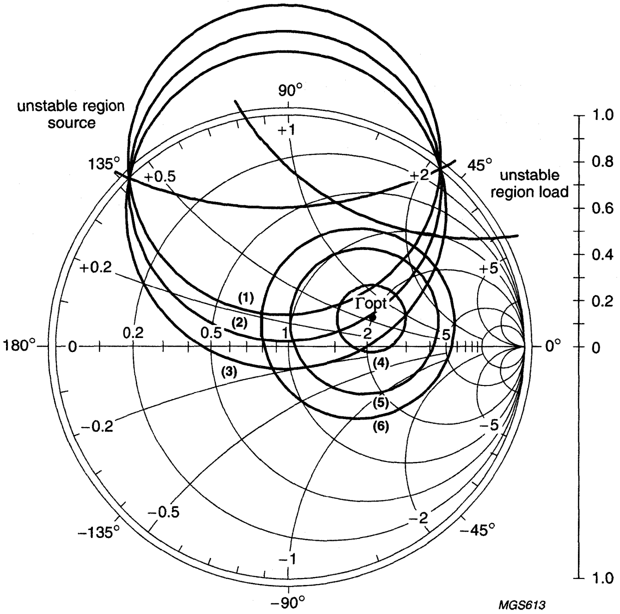
$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA.

Fig.8 Gain as a function of frequency; typical values.



(1) f = 2400 MHz
(2) f = 1000 MHz
(3) f = 900 MHz
(4) f = 1800 MHz.

Fig.9 Minimum noise figure as a function of bias current ($I_{VS\text{-}OUT}$); typical values.



f = 900 MHz; $V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

(1) G = 22 dB

(2) G = 21 dB

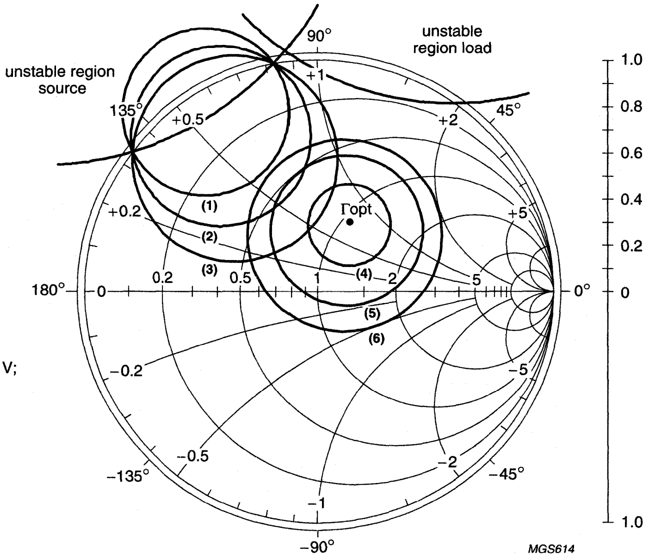
(3) G = 20 dB

(4) NF = 1.3 dB

(5) NF = 1.5 dB

(6) NF = 1.7 dB.

Fig.10 Noise, stability and gain circles; typical values.



f = 1800 MHz; $V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

(1) G = 19 dB

(2) G = 18 dB

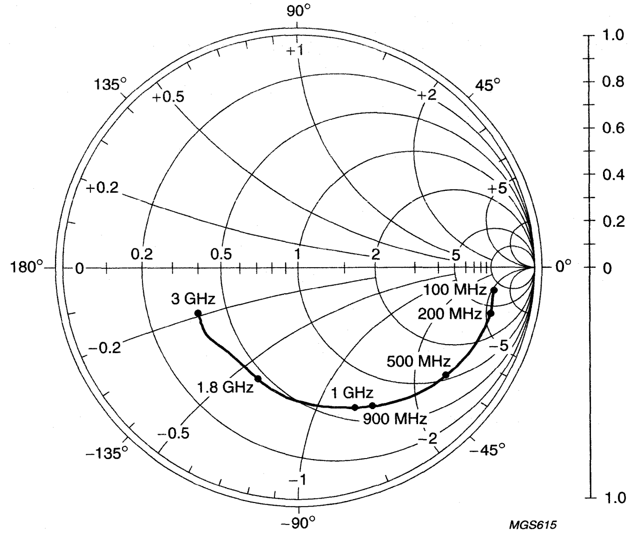
(3) G = 17 dB

(4) NF = 1.3 dB

(5) NF = 1.5 dB

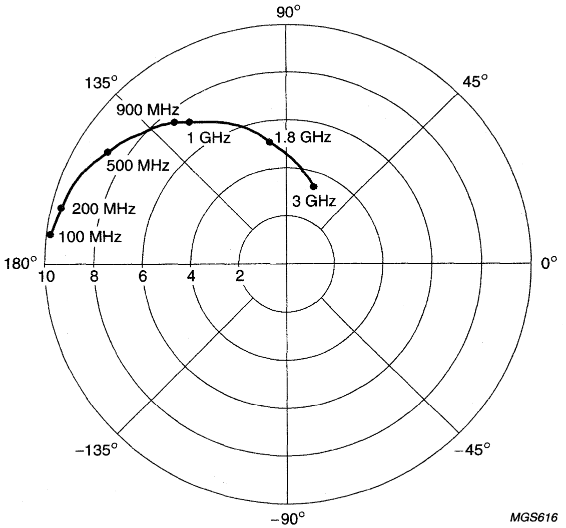
(6) NF = 1.7 dB.

Fig.11 Noise, stability and gain circles; typical values.



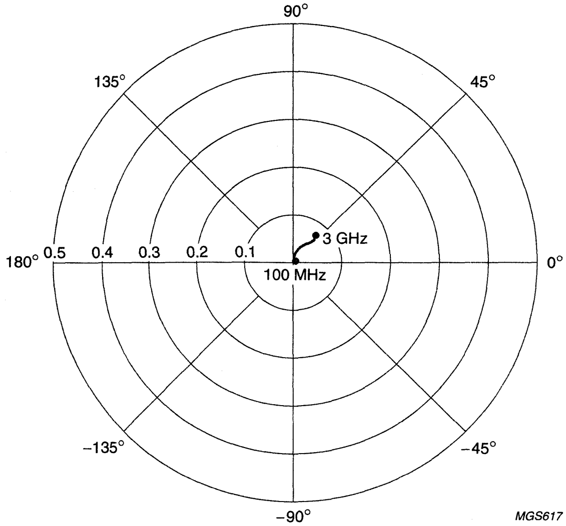
$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

Fig.12 Common emitter input reflection coefficient (s_{11}); typical values.



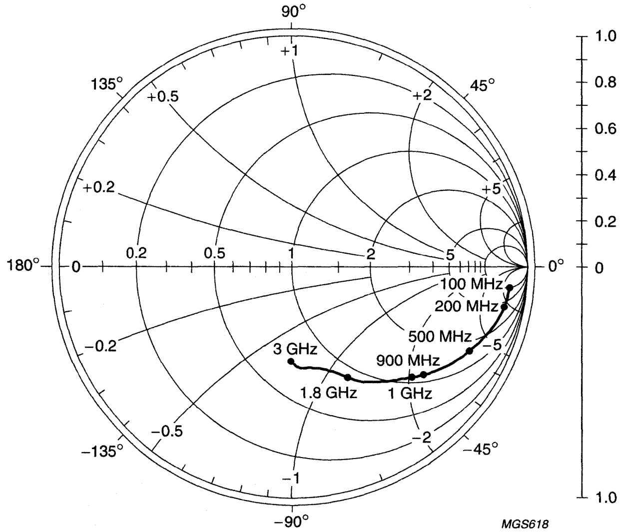
$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

Fig.13 Common emitter forward transmission coefficient (s_{21}); typical values.



$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

Fig.14 Common emitter reverse transmission coefficient (s_{12}); typical values.



$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 4 mA; Z_o = 50 Ω.

Fig.15 Common emitter output reflection coefficient (s_{22}); typical values.

FEATURES

- Low current
- Very high power gain
- Low noise figure
- Integrated temperature compensated biasing
- Control pin for adjustment bias current
- Supply and RF output pin combined.

APPLICATIONS

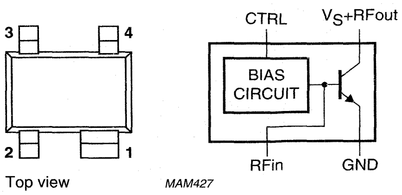
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Low noise amplifiers
- Satellite television tuners (SATV)
- High frequency oscillators.

DESCRIPTION

Silicon MMIC amplifier consisting of an NPN double polysilicon transistor with integrated biasing for low voltage applications in a plastic, 4-pin SOT343R package.

PINNING

PIN	DESCRIPTION
1	GND
2	RF in
3	CTRL (bias current control)
4	V_S + RF out



Marking code: A3.

Fig.1 Simplified outline (SOT343R) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_S	DC supply voltage	RF input AC coupled	–	4.5	V
I_S	DC supply current	$V_{VS\text{-}OUT}$ = 2.5 V; I_{CTRL} = 1 mA; RF input AC coupled	11	–	mA
MSG	maximum stable gain	$V_{VS\text{-}OUT}$ = 2.5 V; f = 1 800 MHz; T_{amb} = 25 °C	16	–	dB
NF	noise figure	$V_{VS\text{-}OUT}$ = 2.5 V; f = 1 800 MHz; $\Gamma_S = \Gamma_{opt}$	1.8	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	supply voltage	RF input AC coupled	–	4.5	V
V_{CTRL}	voltage on control pin		–	2	V
I_S	supply current (DC)	forced by DC voltage on RF input or I_{CTRL}	–	30	mA
I_{CTRL}	control current		–	3	mA
P_{tot}	total power dissipation	$T_s \leq 100$ °C	–	135	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	350	K/W

CHARACTERISTICS

RF input AC coupled; $T_j = 25$ °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current	$V_{VS\text{-}OUT} = 2.5$ V; $I_{CTRL} = 0.4$ mA	3	4.5	6	mA
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{CTRL} = 1.0$ mA	8	11	15	mA
MSG	maximum stable gain	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 900 MHz	–	24	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 1800 MHz	–	16	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 900 MHz	18	19	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 1800 MHz	13	14	–	dB
s_{12}	isolation	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 0$; f = 900 MHz	–	26	–	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 0$; f = 1800 MHz	–	20	–	dB
NF	noise figure	$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.8	2	dB
		$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; f = 1800 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.8	2	dB
$IP3_{(in)}$	input intercept point; note 1	$V_{VS\text{-}OUT} = 2.3$ V; $I_{VS\text{-}OUT} = 3.6$ mA; f = 900 MHz	–	–6.5	–	dBm
		$V_{VS\text{-}OUT} = 2.3$ V; $I_{VS\text{-}OUT} = 3.5$ mA; f = 1800 MHz	–	–4.8	–	dBm

Note

1. See application note RNR-T45-99-B-0514.

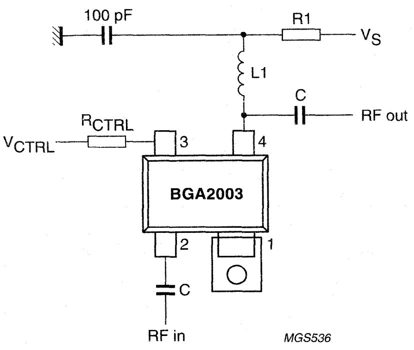


Fig.2 Typical application circuit.

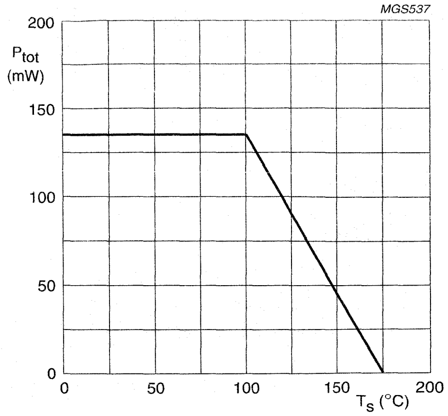
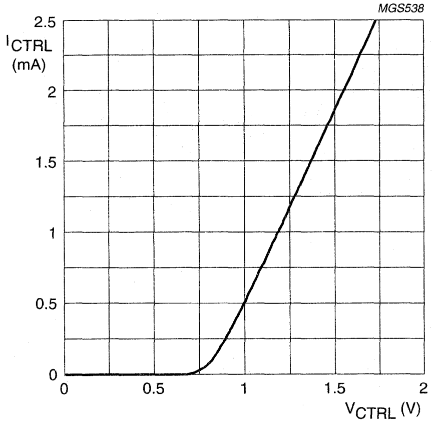
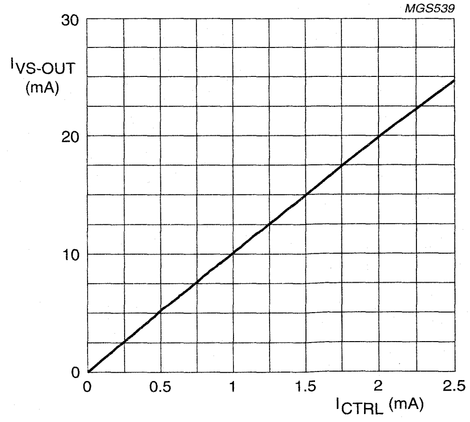


Fig.3 Power derating.



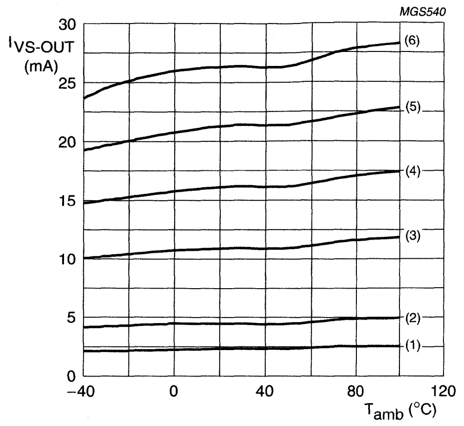
$I_{CTRL} = (V_{CTRL} - 0.83)/296$.

Fig.4 Control current as a function of the control voltage on pin 3; typical values.



$V_{S\text{-}OUT} = 2.5$ V.

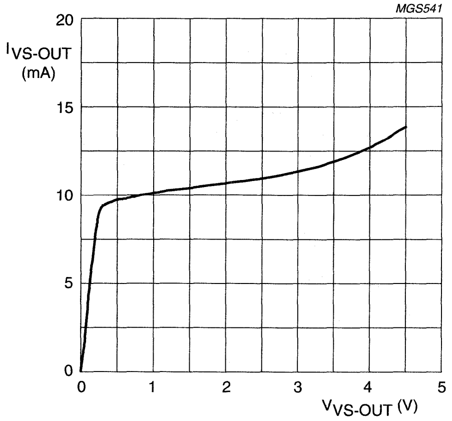
Fig.5 Bias current as a function of the control current; typical values.



V_{S-OUT} = 2.5 V.

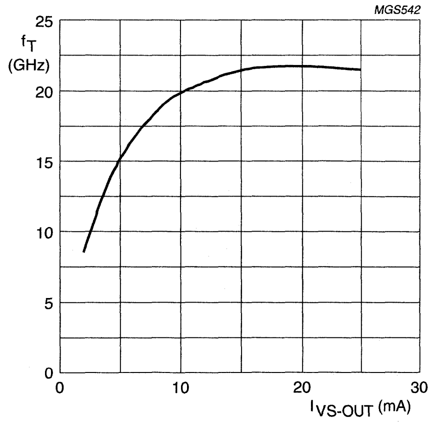
(1) I_{CTRL} = 0.2 mA.
(2) I_{CTRL} = 0.4 mA.
(3) I_{CTRL} = 1.0 mA.
(4) I_{CTRL} = 1.5 mA.
(5) I_{CTRL} = 2.0 mA.
(6) I_{CTRL} = 2.5 mA.

Fig.6 Bias current (I_{VS-OUT}) as a function of the ambient temperature with I_{CTRL} as parameter; typical values.



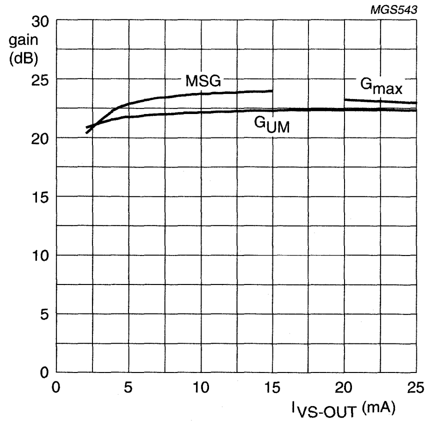
I_{CTRL} = 1 mA.

Fig.7 Bias current (I_{VS-OUT}) as a function of the voltage at the output pin (V_{VS-OUT}); typical values.



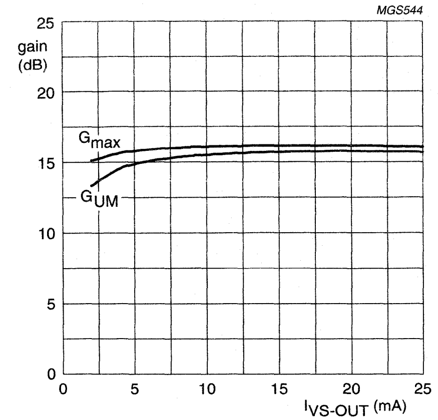
V_{VS-OUT} = 2.5 V; f = 1000 MHz.

Fig.8 Transition frequency as a function of the bias current (I_{VS-OUT}); typical values.



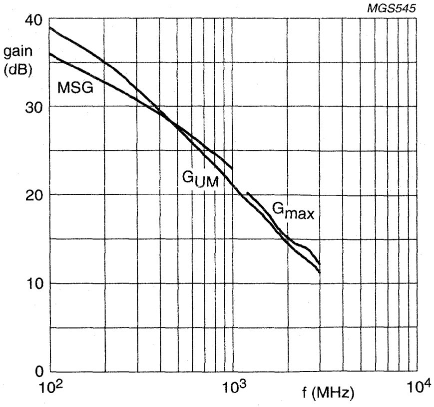
V_{VS-OUT} = 2.5 V; f = 900 MHz.

Fig.9 Gain as a function of the bias current (I_{VS-OUT}); typical values.



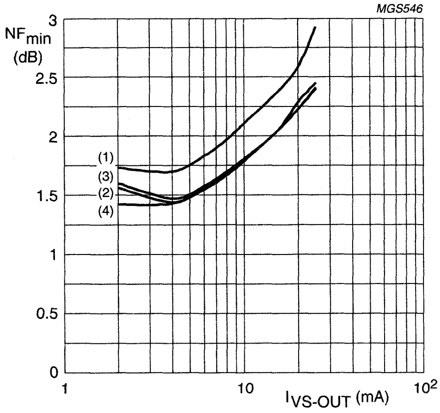
$V_{VS\text{-}OUT}$ = 2.5 V; f = 1800 MHz.

Fig.10 Gain as a function of the bias current ($I_{VS\text{-}OUT}$); typical values.



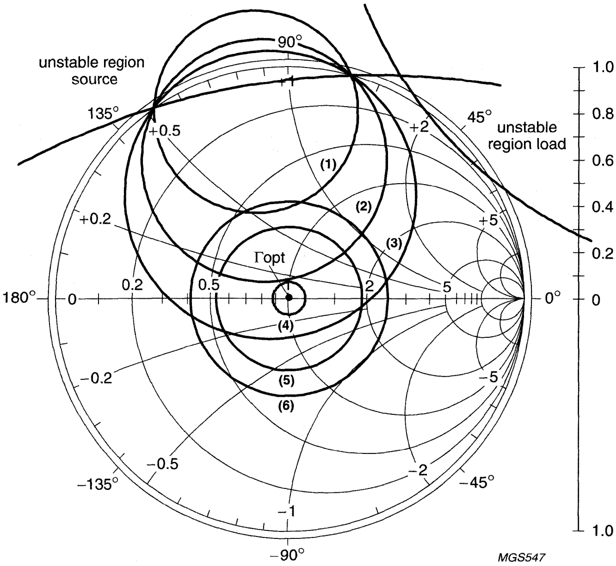
$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 10 mA.

Fig.11 Gain as a function of frequency; typical values.



(1) f = 2400 MHz.
(2) f = 1800 MHz.
(3) f = 1000 MHz.
(4) f = 900 MHz.

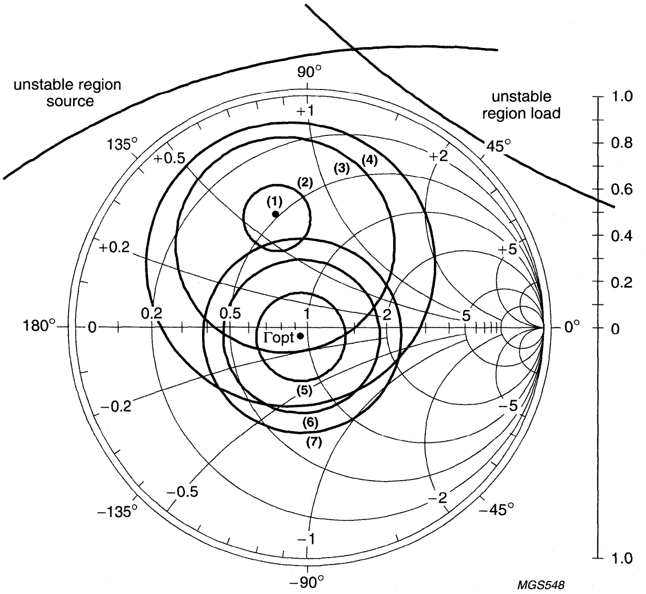
Fig.12 Minimum noise figure as a function of the bias current ($I_{VS\text{-}OUT}$); typical values.



f = 900 MHz; $V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 10 mA; Z_o = 50 Ω.

(1) G = 23 dB.
(2) G = 22 dB.
(3) G =21 dB.
(4) NF = 1.8 dB.
(5) NF = 2 dB.
(6) NF = 2.2 dB.

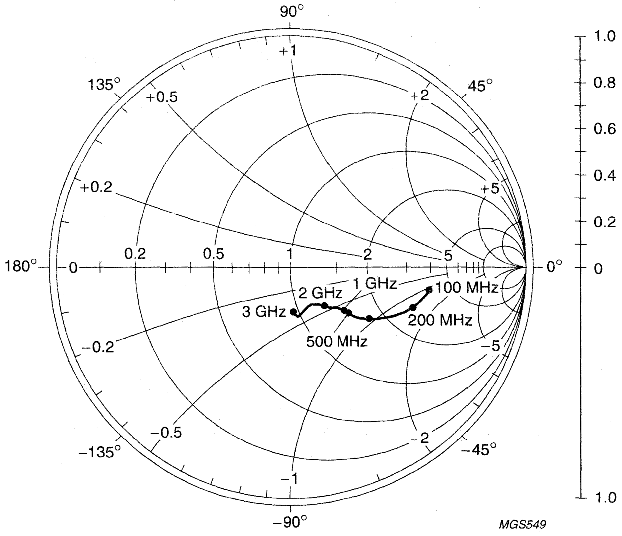
Fig.13 Noise, stability and gain circles; typical values.



f = 1800 MHz; $V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 10 mA; Z_o = 50 Ω.

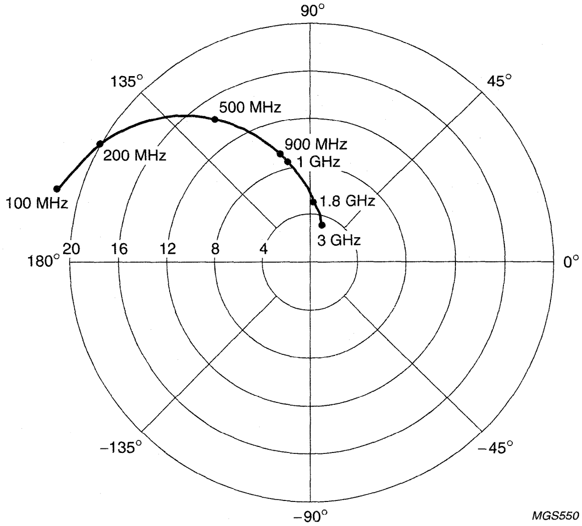
(1) G_{max} = 16.1 dB.
(2) G = 16 dB.
(3) G = 15 dB.
(4) G = 14 dB.
(5) NF = 1.9 dB.
(6) NF = 2.1 dB.
(7) NF = 2.3 dB.

Fig.14 Noise, stability and gain circles; typical values.



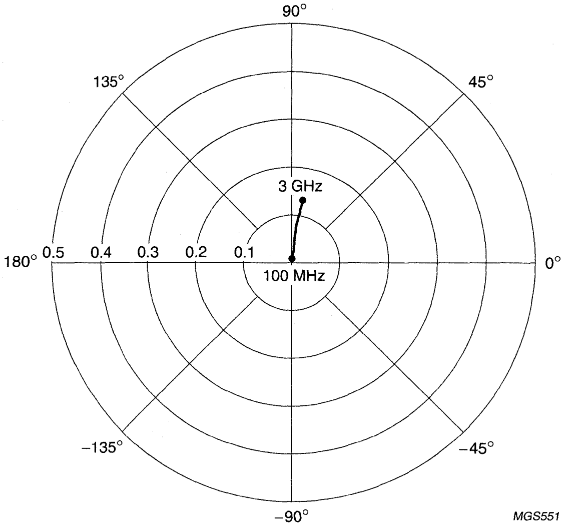
$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; $Z_o = 50\ \Omega$.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



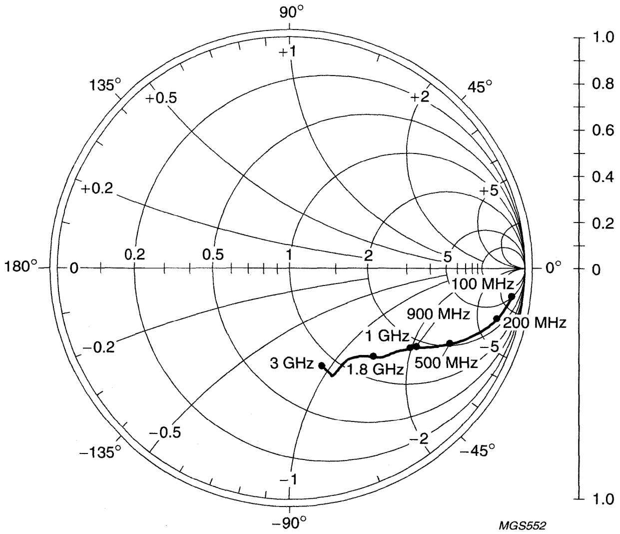
$V_{VS\text{-}OUT} = 2.5$ V; $I_{VS\text{-}OUT} = 10$ mA; $Z_o = 50\ \Omega$.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 10 mA; Z_o = 50 Ω.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.



$V_{VS\text{-}OUT}$ = 2.5 V; $I_{VS\text{-}OUT}$ = 10 mA; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

MMIC mixer BGA2022

FEATURES

- Large frequency range:
  - Cellular band (900 MHz)
  - PCS band (1900 MHz)
  - WLAN band (2.4 GHz).
- High isolation
- High linearity
- High conversion gain.

APPLICATIONS

Receiver side of wireless systems that require high conversion gain and high linearity at low supply current, such as CDMA. Trade-off between gain and intermodulation is determined by one external inductor.

DESCRIPTION

Silicon double poly MMIC mixer in a 6-lead plastic SOT363 package.

PINNING

PIN	DESCRIPTION
1	LO - GND
2	LO - signal
3	V_S
4	IF - out
5	RF - feedback
6	RF - signal

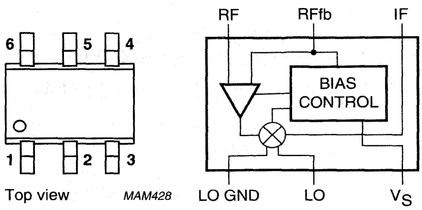


Fig.1 Simplified outline (SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_S	supply voltage		2.7	2.8	2.85	V
I_S	supply current		–	6	–	mA
G_{conv}	conversion gain	f_{RF} = 900 MHz	–	6	–	dB
NF	noise figure	f_{RF} = 900 MHz	–	9	–	dB
IP_3	input third order intercept point	f_{RF} = 900 MHz	–	6	–	dBm
	LO – RF isolation	f_{RF} = 900 MHz	–	30	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	supply voltage		–	4	V
I_S	supply current		–	20	mA
P_{LO}	oscillator power	note 1	–	tbf	dBm
P_{RF}	RF power	note 1	–	tbf	dBm
P_{tot}	total power dissipation	$T_s \leq$ tbf °C; note 2	–	60	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Notes

1. LO and RF signals always AC coupled; no external DC voltage supplied to pin 1, 2 and 6.
2. T_s is the temperature at the soldering point of the ground tab.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point	$T_s \leq$ tbf °C; P_{tot} = 17 mW; note 1	tbf	K/W

Note

1. T_s is the temperature at the soldering point of the ground tab.

CHARACTERISTICS

f_{RF} = 900 MHz; f_{LO} = 983 MHz; f_{IF} = 83 MHz; V_S = 2.8 V; P_{LO} = 0 dBm; T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
f_{LO}	local oscillator frequency		0.5	–	2.5	GHz
f_{RF}	signal frequency	external matching	0.5	–	2.5	GHz
f_{IF}	intermediate frequency		10	–	400	MHz
V_S	supply voltage		2.7	2.8	2.85	V
I_S	supply current		–	6	–	mA
$G_{conv(p)}$	power conversion gain	900 MHz	–	6	–	dB
		1900 MHz	–	6	–	dB
		2.4 GHz	–	6	–	dB
NF	noise figure	DSB; 900 MHz	–	9	–	dB
		DSB; 1900 MHz	–	9	–	dB
		DSB; 2.4 GHz	–	9	–	dB
IP_3	intercept point third order intermodulation	900 MHz; Δf_{RF} = 100 kHz	–	6	–	dBm
		1900 MHz; Δf_{RF} = 100 kHz	–	6	–	dBm
		2.4 GHz; Δf_{RF} = 100 kHz	–	6	–	dBm
	RF – LO isolation		–	–26	–	dB
	LO – RF isolation		–	–30	–	dB
	LO – IF isolation		–	–20	–	dB
	RF – IF isolation		–	–29	–	dB
$VSWR_{LO}$	voltage standing wave ratio on LO input		–	1.5	2	
Z_{IF}	IF output impedance	open collector	–	tbf	–	kΩ

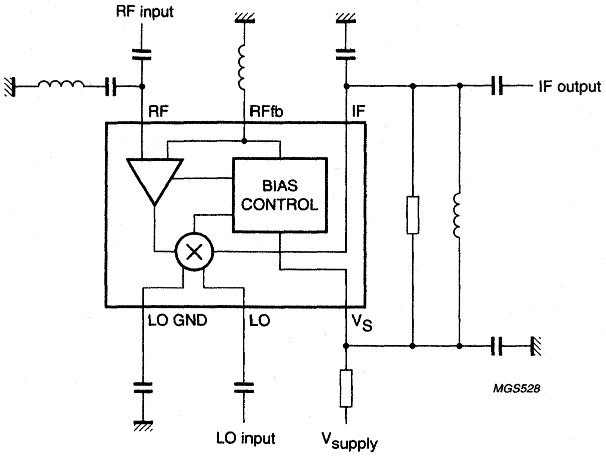


Fig.2 Application diagram (values tbf).

MMIC variable gain amplifier | BGA2031

FEATURES

- High gain
- Excellent adjacent channel power rejection
- Small SMD package
- Low dissipation.

APPLICATIONS

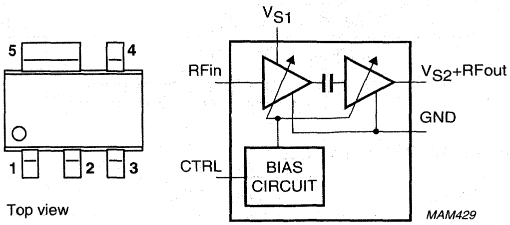
- General purpose variable gain amplifier for low voltage and medium power
- Driver for power amplifiers in systems that require good linearity, such as CDMA, both cellular band (850 MHz) and PCS (1.9 GHz). This is because of the high output power and good linearity.

DESCRIPTION

Silicon Monolitic Microwave Integrated Circuit (MMIC) 2 stage variable gain amplifier in double polysilicon technology in a 5-pin SOT551A plastic SMD package for low voltage medium power applications.

PINNING

PIN	DESCRIPTION
1	RF in
2	CTRL
3	V_{S1}
4	V_{S2} + RF out
5	GND



Marking code: G1.

Fig.1 Simplified outline (SOT551A) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{S1}, V_{S2}	supply voltages		3.6	4.1	V
I_S	supply current into pin 3 + pin 4	$V_{CTRL} = 0$	0	–	μA
		$V_{CTRL} = 2.7$ V; $V_S = 3.6$ V	51	63	mA
		$V_{CTRL} = 2.4$ V; $V_S = 3$ V	30	37	mA
P_L	load power	at 1 dB gain compression point; f = 1.9 GHz	13.5	–	dBm
ACPR	adjacent channel power rejection	f = 1.9 GHz; $P_L = 12$ dBm	48	–	dBc
		f = 836 MHz; $P_L = 8$ dBm	55	–	dBc
G_p	power gain	f = 1.9 GHz; $P_L = 12$ dBm	26	–	dB
		f = 836 MHz; $P_L = 8$ dBm	27	–	dB
ΔG	gain control range	f = 836 MHz; $P_L = 8$ dBm	70	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	DC supply voltage		–	4.2	V
I_{CTRL}	control current	$V_{CTRL} = 2.7$ V; $V_{S1} = 4.2$ V; $V_{S2} = 4.2$ V	–	1.2	mA
I_{S1}	current into pin 3	$V_{S1} = 4.2$ V	–	27	mA
I_{S2}	current into pin 4	$V_{S2} = 4.2$ V	–	50	mA
P_D	drive power		–	tbf	dBm
P_{tot}	total power dissipation	$T_s \leq 90$ °C	–	280	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	operating junction temperature		–	150	°C

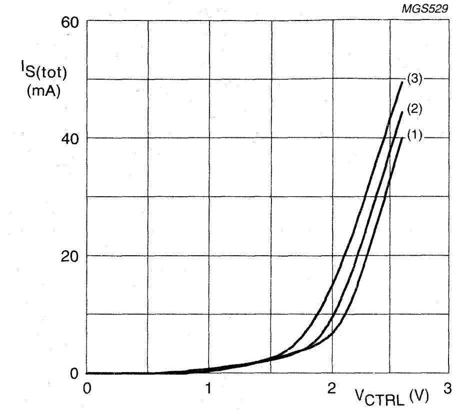
THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point	$P_{tot} = 280$ mW; $T_s \leq 90$ °C	215	K/W

CHARACTERISTICS

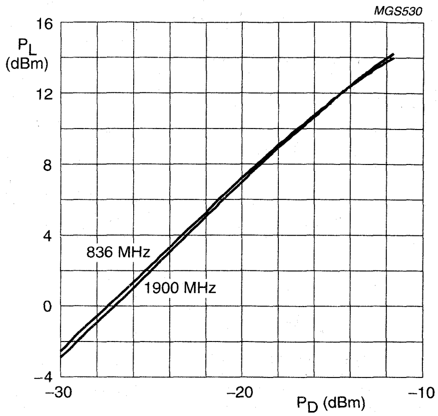
T_j = 25 °C; $Z_S = Z_L = 50\ \Omega$; V_S = 3.6 V; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
f	frequency range		800	–	2500	MHz
V_{S1}, V_{S2}	supply voltages		2.7	3.6	4.1	V
I_S	supply current (in pin 3 + pin 4)	$V_{CTRL} = 0$	–	0	10	μA
		V_{CTRL} = 2.7 V; V_S = 3.6 V	39	51	63	mA
		V_{CTRL} = 2.4 V; V_S = 3 V	23	30	37	mA
I_{CTRL}	control current	V_{CTRL} = 2.7 V	0.7	0.92	1.1	mA
f = 1900 MHz						
f	frequency range		1850	–	1950	MHz
G_P	power gain	V_{CTRL} = 2.7 V; P_L = 12 dBm	–	26	–	dB
ΔG	gain control range	$0 < V_{CTRL} < 2.7$ V	–	61	–	dB
G_{CS}	gain control slope	middle of ΔG	–	38	–	dB/V
ACPR	adjacent channel power rejection	±1.23 MHz offset; BW_{ACP} = 30 kHz; $BW_{carrier}$ = 1.23 MHz; P_L = 10 dBm	–	48	–	dBc
		±1.98 MHz offset; BW_{ACP} = 30 kHz; $BW_{carrier}$ = 1.23 MHz; P_L = 10 dBm	–	67	–	dBc
P_L	load power	at 1 dB gain compression point	–	13.5	–	dBm
P_N	noise power	in CDMA receive band (1895 – 1955 MHz)	–	tbf	–	dBm/Hz
$VSWR_{IN}$	input VSWR	V_{CTRL} = 2.7 V	–	1:3.5	–	
$VSWR_{OUT}$	output VSWR	V_{CTRL} = 2.7 V	–	1:1.6	–	
f = 836 MHz						
f	frequency range		824	–	849	MHz
G_P	power gain	V_{CTRL} = 2.7 V; P_L = 8 dBm	–	27	–	dB
ΔG	gain control range	$0 < V_{CTRL} < 2.7$ V	–	70	–	dB
G_{CS}	gain control slope	middle of ΔG	–	40	–	dB/V
ACPR	adjacent channel power rejection	±885 kHz offset; BW_{ACP} = 30 kHz; $BW_{carrier}$ = 1.23 MHz; P_L = 8 dBm	–	55	–	dBc
		±1.98 MHz offset; BW_{ACP} = 30 kHz; $BW_{carrier}$ = 1.23 MHz; P_L = 8 dBm	–	69	–	dBc
P_L	load power	at 1 dB gain compression point	–	12	–	dBm
P_N	noise power	in CDMA receive band (869 to 894 MHz)	–	tbf	–	dBm/Hz
$VSWR_{IN}$	input VSWR	V_{CTRL} = 2.7 V	–	1:2	–	
$VSWR_{OUT}$	output VSWR	V_{CTRL} = 2.7 V	–	1:1.7	–	



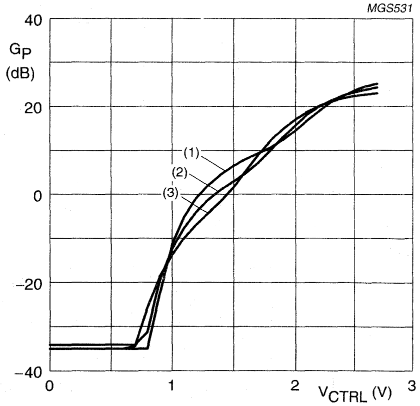
V_S = 3.6 V.
(1) T_{amb} = −30 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 85 °C.

Fig.2 Total supply current as a function of control voltage; typical values.



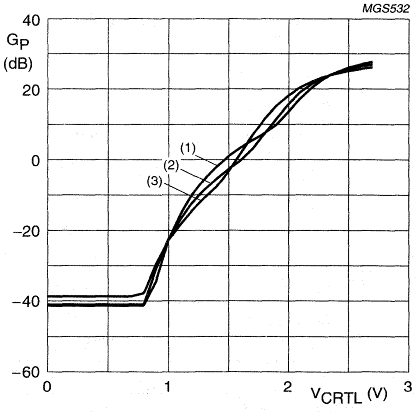
V_S = 3.6 V; V_C = 2.7 V.

Fig.3 Load power as a function of the drive power; typical values.



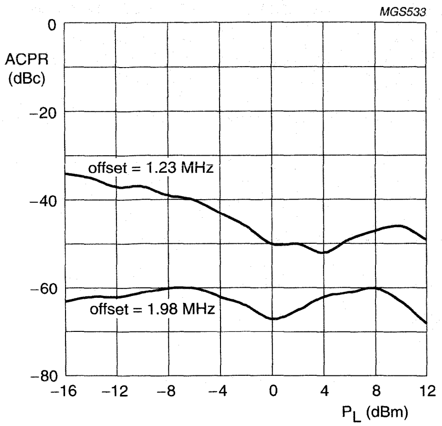
V_S = 3.6 V; f = 1.9 GHz.
(1) T_{amb} = −30 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 85 °C.

Fig.4 Power gain as a function of control voltage; typical values.



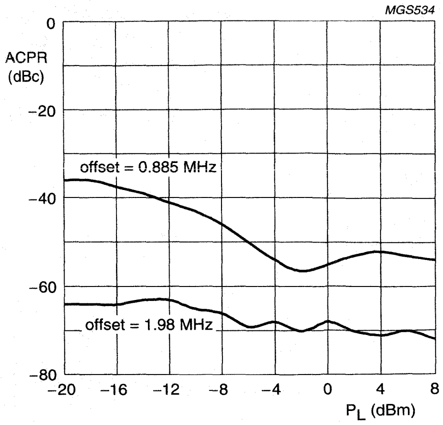
V_S = 3.6 V; f = 836 MHz.
(1) T_{amb} = −30 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 85 °C.

Fig.5 Power gain as a function of control voltage; typical values.



$V_S = 3.6$ V; f = 1.9 GHz; $P_D = -13.5$ dBm.

Fig.6 Adjacent channel power rejection as a function of the load power; typical values.



$V_S = 3.6$ V; f = 836 MHz; $P_D = -19$ dBm.

Fig.7 Adjacent channel power rejection as a function of the load power; typical values.

ELECTRICAL BLOCK DIAGRAM

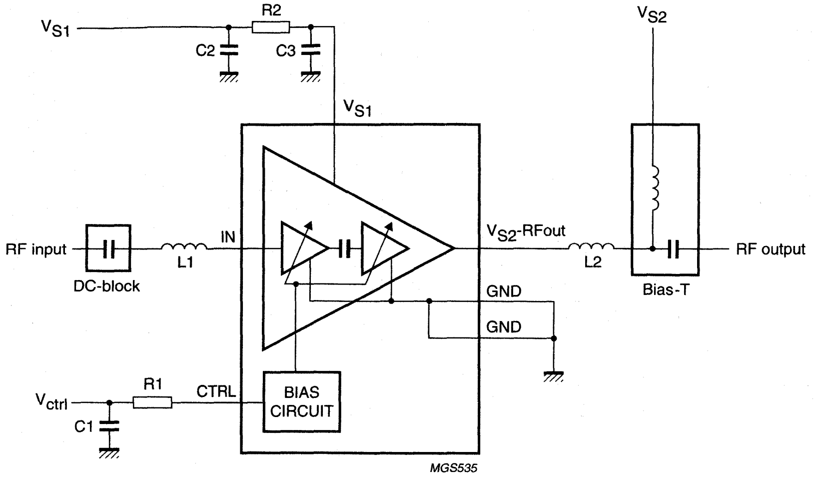


Fig.8 Test diagram.

List of components (see Fig.8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	multilayer ceramic chip capacitor	10 nF	0603	tbf
C2	multilayer ceramic chip capacitor	22 nF	0603	tbf
C3	multilayer ceramic chip capacitor	1.5 nF	0603	tbf
L1, L2	stripline; note 1	50 Ω		tbf
R1	SMD resistor	22 Ω; 0.16 W	0603	tbf
R2	SMD resistor	2.4 Ω; 0.16 W	0603	tbf

Note

1. The striplines are on a gold plated double copper-clad printed-circuit board (ε_r = 6.15), board thickness = 0.64 mm, copper thickness = 35 μm, gold thickness = 5 μm.

UHF power transistor

BLT70

FEATURES

- Very high efficiency
- Low supply voltage.

APPLICATIONS

- Hand-held radio equipment in common emitter class-AB operation in the 900 MHz communication band.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic SOT223H SMD package.

PINNING - SOT223H

PIN	SYMBOL	DESCRIPTION
1	e	emitter
2	b	base
3	e	emitter
4	c	collector

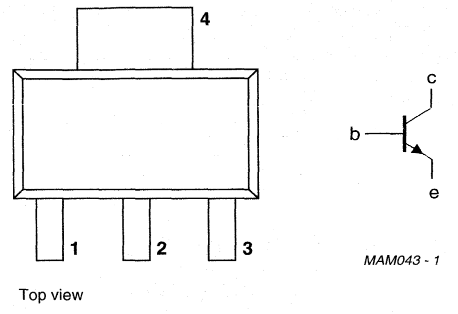


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see Fig.7).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	600	≥6	≥60

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	16	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	250	mA
P_{tot}	total power dissipation	T_s = 60 °C; note 1	–	2.1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 2.1 W; T_s = 60 °C; note 1	55	K/W

Note to the "Limiting values" and "Thermal characteristics"

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

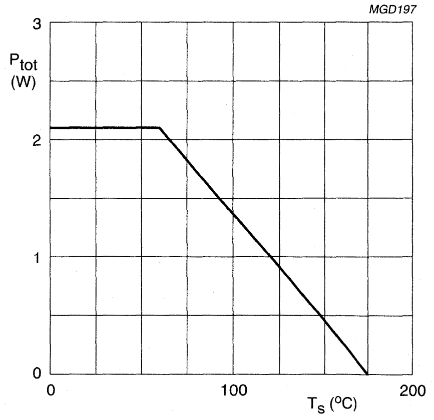
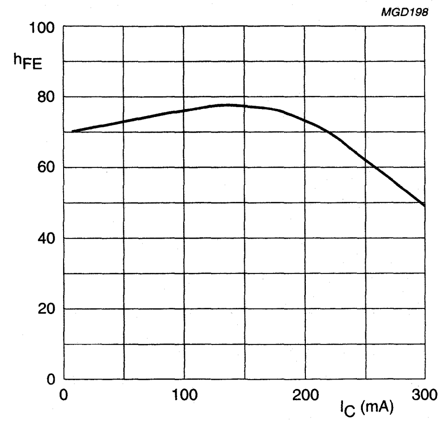


Fig.2 DC SOAR.

CHARACTERISTICS

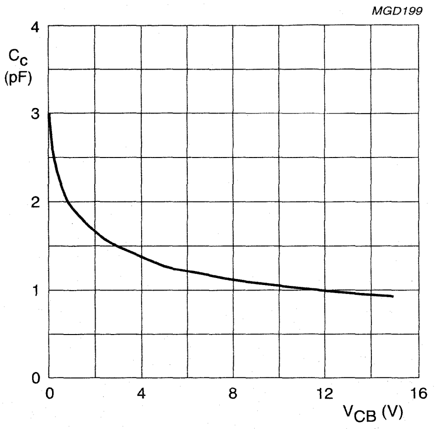
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.5 mA	16	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 5 mA	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.2 mA	2.5	–	V
I_{CES}	collector leakage current	V_{CE} = 7 V; V_{BE} = 0	–	0.1	mA
h_{FE}	DC current gain	V_{CE} = 4.8 V; I_C = 100 mA	25	–	
C_c	collector capacitance	V_{CB} = 4.8 V; $I_E = i_e$ = 0; f = 1 MHz	–	3.5	pF
C_{re}	feedback capacitance	V_{CE} = 4.8 V; I_C = 0; f = 1 MHz	–	2.5	pF



V_{CE} = 4.8 V; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current; typical values.



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

Fig.4 Collector capacitance as a function of collector-base voltage; typical values.

APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see note 1 and Fig.7).

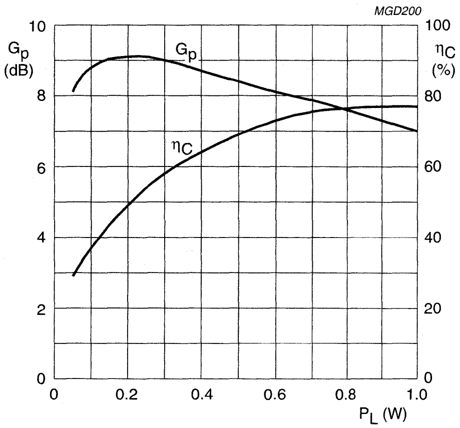
MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (W)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	0.01	0.6	≥6 typ. 8.1	≥60 typ. 73

Note

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

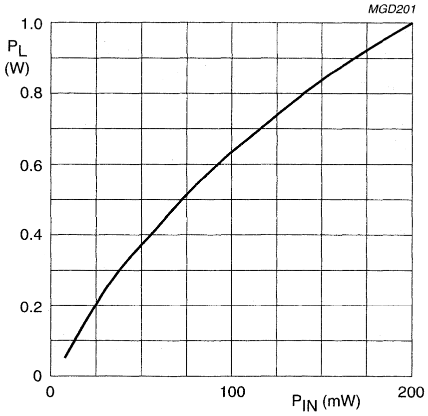
Ruggedness in class-AB operation

The BLT70 is capable of withstanding a load mismatch corresponding to VSWR = 6 : 1 through all phases under the following conditions: f = 900 MHz; V_{CE} = 6.5 V; P_L = 0.5 W; $T_s \leq 60$ °C.



f = 900 MHz; V_{CE} = 4.8 V; I_{CQ} = 0.01 mA; $T_s \leq 60$ °C.

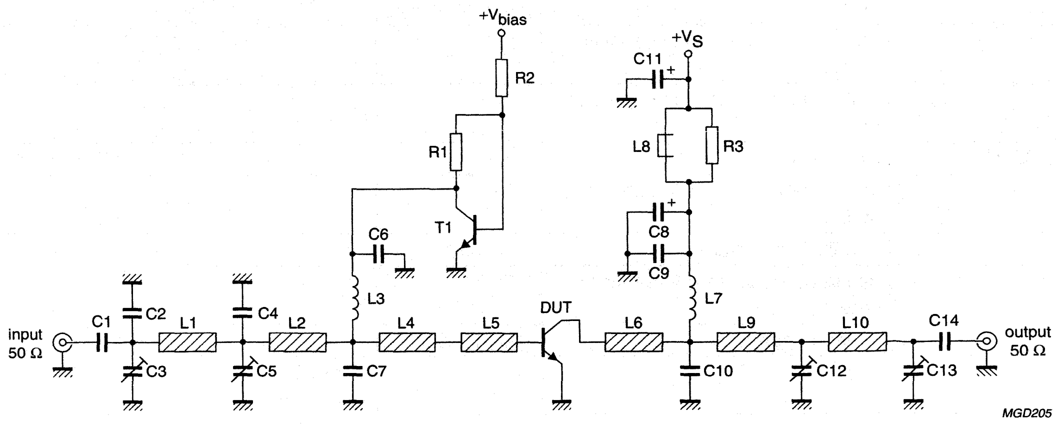
Fig.5 Power gain and collector efficiency as functions of load power; typical values.



f = 900 MHz; V_{CE} = 4.8 V; I_{CQ} = 0.01 mA; $T_s \leq 60$ °C.

Fig.6 Load power as a function of input power; typical values.

Test circuit information



$V_S = V_{bias}$ = typ. 4.8 V.

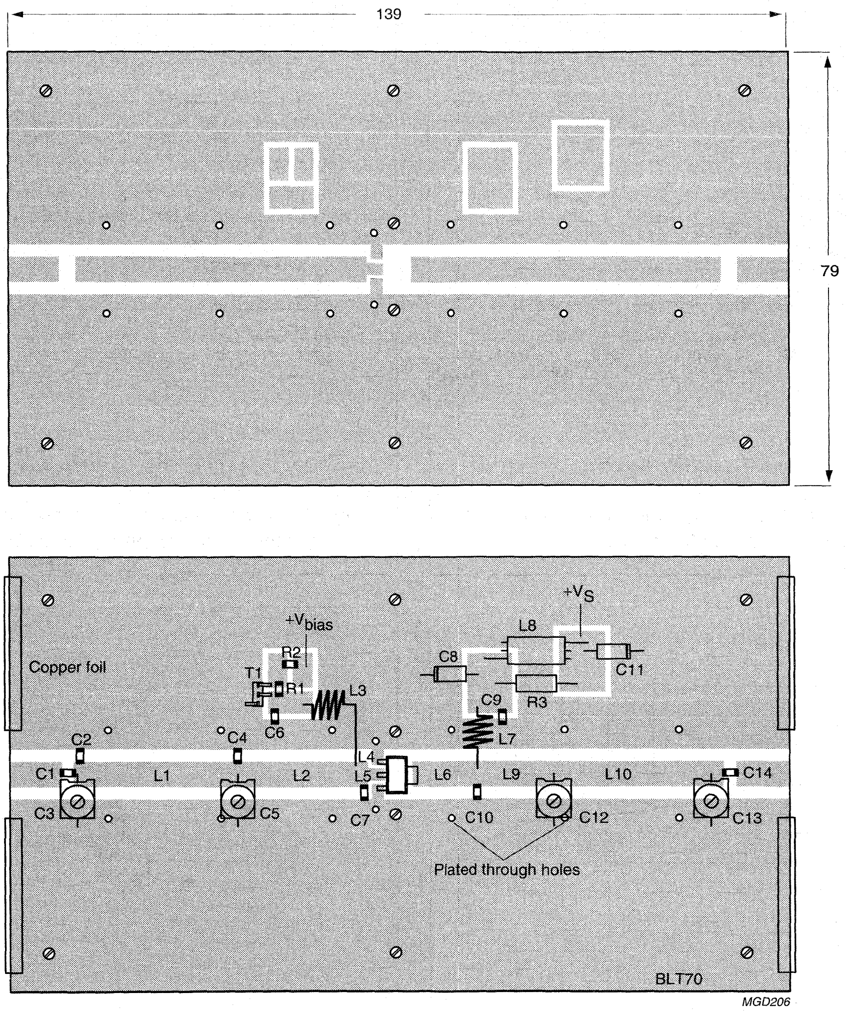
Fig.7 Common emitter test circuit for class-AB operation at 900 MHz.

List of components used in test circuit (see Figs 7 and 8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C6, C9, C14	multilayer ceramic chip capacitor; note 1	100 pF		
C2	multilayer ceramic chip capacitor; note 1	1 pF		
C4	multilayer ceramic chip capacitor; note 1	2.4 pF		
C3, C5, C12, C13	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09004
C7	multilayer ceramic chip capacitor; note 1	5.1 pF		
C8	tantalum capacitor	1 μF, 35 V		
C10	multilayer ceramic chip capacitor; note 1	2.7 pF		
C11	tantalum capacitor	100 μF, 20 V		
L1	stripline; note 2	50 Ω	length 29.1 mm width 5 mm	
L2	stripline; note 2	50 Ω	length 21 mm width 5 mm	
L3	8 turns enamelled 0.8 mm copper wire	216 nH	length 7 mm internal dia. 4.5 mm	
L4	stripline; note 2	50 Ω	length 1 mm width 5 mm	
L5	stripline; note 2	50 Ω	length 3 mm width 2.5 mm	
L6	stripline; note 2	50 Ω	length 12 mm width 5 mm	
L7	8 turns enamelled 0.8 mm copper wire	105 nH	length 7 mm internal dia. 3.4 mm	
L8	grade 3B Ferroxcube wideband HF choke			4132 020 36640
L9	stripline; note 2	50 Ω	length 12 mm width 5 mm	
L10	stripline; note 2	50 Ω	length 28 mm width 5 mm	
R1	metal film resistor	0.1 W, 15 Ω		
R2	metal film resistor	0.1 W, 390 Ω		
R3	metal film resistor	0.6 W, 10 Ω		
T1	NPN transistor	BD139		

Notes

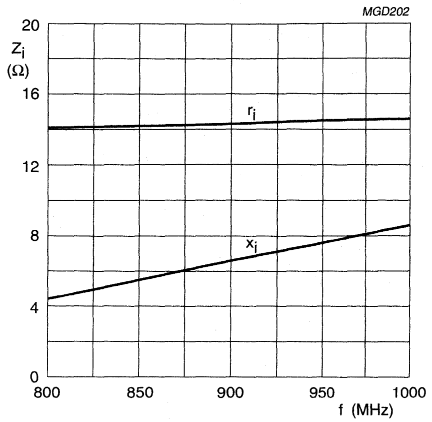
1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board, with DUROID dielectric ($\varepsilon_r = 2.2$); thickness $^1/_{16}$ inch; thickness of the copper sheet 2 × 35 μm.



Dimensions in mm.

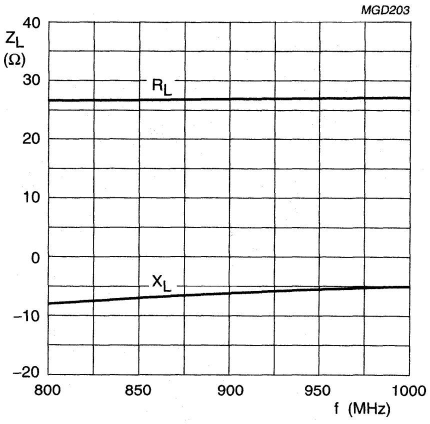
The components are situated on one side of the copper-clad PCB, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.8 Printed-circuit board and component lay-out for 900 MHz class-AB test circuit in Fig.7.



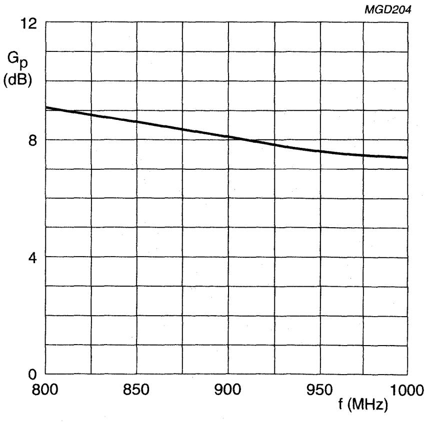
V_{CE} = 4.8 V; I_{CQ} = 0.01 mA; P_L = 0.6 W; $T_s \leq 60$ °C.

Fig.9 Input impedance as a function of frequency (series components); typical values.



V_{CE} = 4.8 V; I_{CQ} = 0.01 mA; P_L = 0.6 W; $T_s \leq 60$ °C.

Fig.10 Load impedance as a function of frequency (series components); typical values.



V_{CE} = 4.8 V; I_{CQ} = 0.01 mA; P_L = 0.6 W; $T_s \leq 60$ °C.

Fig.11 Power gain as a function of frequency; typical values.

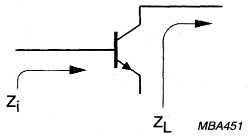


Fig.12 Definition of transistor impedance.

UHF power transistor BLT71

FEATURES

- Very high efficiency
- Low supply voltage.

APPLICATIONS

- Hand-held radio equipment in common emitter class-AB operation in the 900 MHz communications band.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a SOT223 envelope.

PINNING - SOT223

PIN	SYMBOL	DESCRIPTION
1	e	emitter
2	b	base
3	e	emitter
4	c	collector

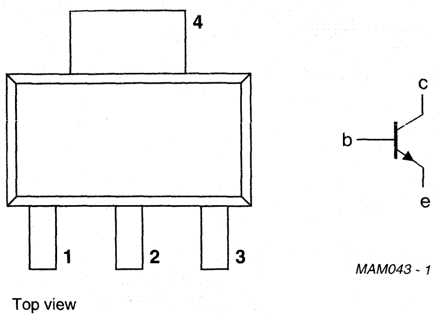


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	1.2	≥6	≥60

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	16	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	up to T_s = 90 °C	–	3.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 3.5 W; up to T_s = 90 °C; note 1	24	K/W

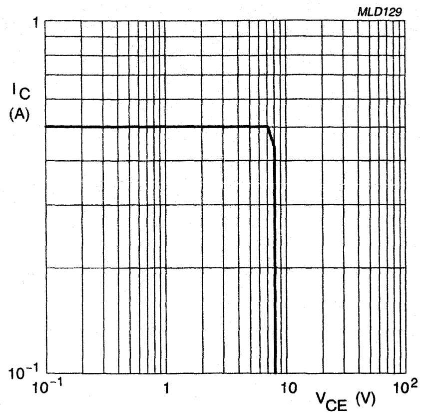
Note

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

CHARACTERISTICS

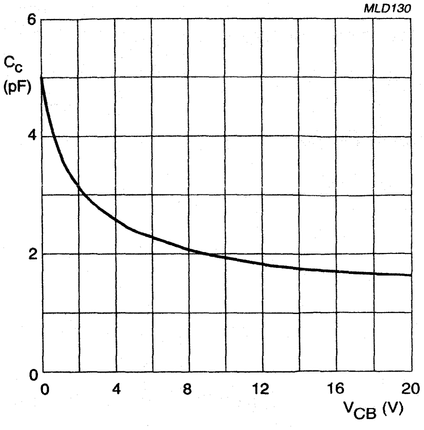
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.5 mA	16	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	8	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	–	V
I_{CES}	collector leakage current	V_{CE} = 8 V; V_{BE} = 0	–	–	100	µA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 100 mA	25	–	–	
C_c	collector capacitance	V_{CB} = 4.8 V; I_E = i_e = 0; f = 1 MHz	–	–	7	pF
C_{re}	feedback capacitance	V_{CE} = 4.8 V; I_C = 0; f = 1 MHz	–	–	5	pF



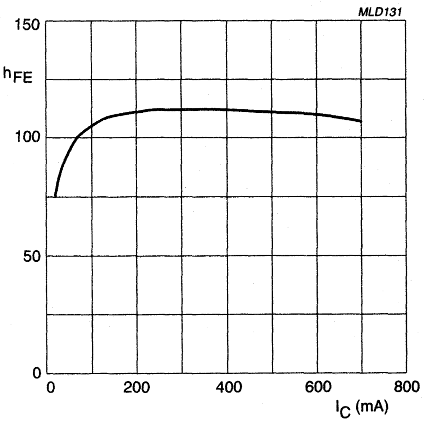
T_s = 90 °C.

Fig.2 DC SOAR.



$I_E = i_e = 0$; f = 1 MHz.

Fig.3 Collector capacitance as a function of collector-base voltage; typical values.



Measured under pulsed conditions: $t_p \leq 300\ \mu s$; $\delta \leq 0.01$.
V_{CE} = 4.8 V.

Fig.4 DC current gain as a function of collector current; typical values.

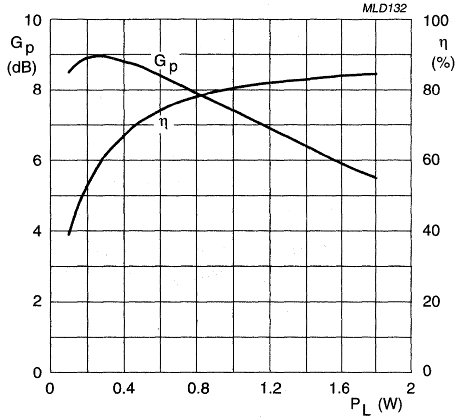
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (W)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	1	1.2	≥6	≥60

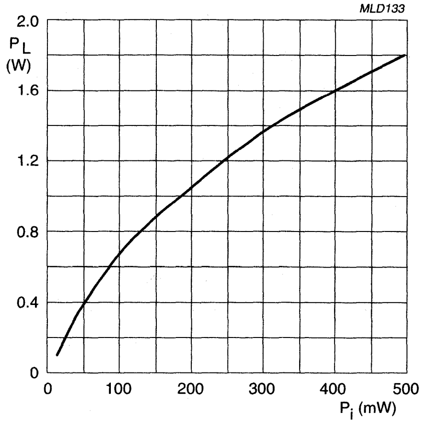
Ruggedness in class-AB operation

The BLT71 is capable of withstanding a load mismatch corresponding to VSWR = 6 : 1 through all phases under the following conditions: P_L = 1.2 W; V_{CE} = 6.5 V; f = 900 MHz.



V_{CE} = 4.8 V.
I_{CQ} = 1 mA.
f = 900 MHz.

Fig.5 Power gain and efficiency as functions of load power; typical values.



V_{CE} = 4.8 V.
I_{CQ} = 1 mA.
f = 900 MHz.

Fig.6 Load power as a function of input power; typical values.

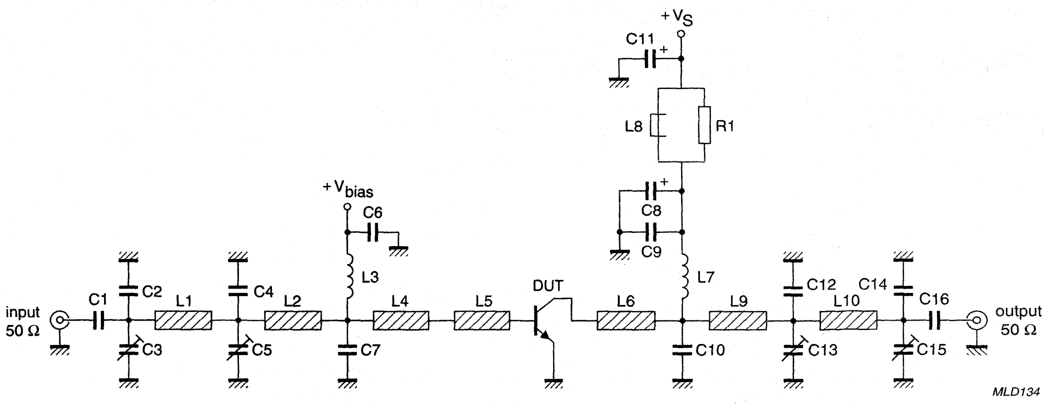


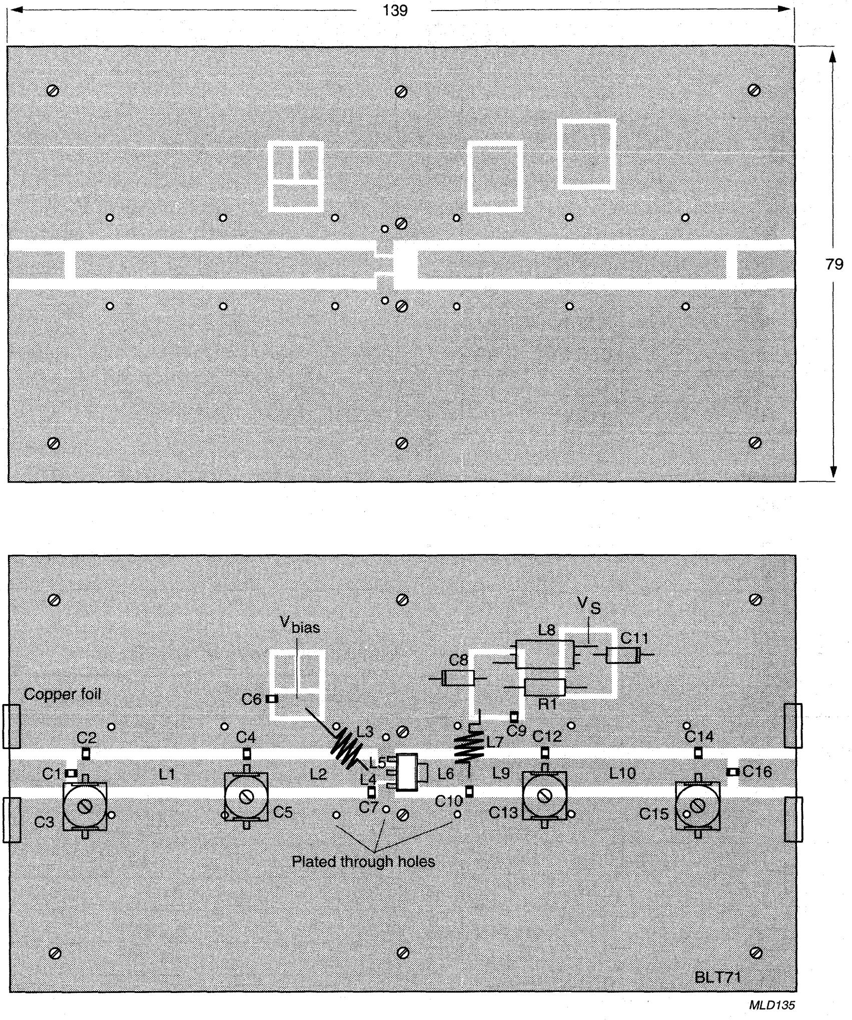
Fig.7 Class-AB test circuit at 900 MHz.

List of components (see Figs 7 and 8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C6, C9, C16	multilayer ceramic chip capacitor; note 1	100 pF		
C2, C4, C12, C14	multilayer ceramic chip capacitor; note 1	1 pF		
C3, C5, C13, C15	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09004
C7	multilayer ceramic chip capacitor; note 1	6.8 pF		
C8	tantalum capacitor	1 µF, 35 V		
C10	multilayer ceramic chip capacitor; note 1	5.1 pF		
C11	tantalum capacitor	100 µF, 20 V		
L1	stripline; note 2	50 Ω	length 28.5 mm width 5 mm	
L2	stripline; note 2	50 Ω	length 23 mm width 5 mm	
L3	11 turns enamelled 0.6 mm copper wire	100 nH	length 7.5 mm internal dia. 3.3 mm	
L4	stripline; note 2	50 Ω	length 1 mm width 5 mm	
L5	stripline; note 2	50 Ω	length 3 mm width 2.5 mm	
L6	stripline; note 2	50 Ω	length 9 mm width 5 mm	
L7	7 turns enamelled 0.6 mm copper wire	37 nH	length 7.3 mm internal dia. 3.3 mm	
L8	grade 3B Ferroxcube wideband HF choke			4132 020 36640
L9	stripline; note 2	50 Ω	length 13.5 mm width 5 mm	
L10	stripline; note 2	50 Ω	length 26.5 mm width 5 mm	
R1	metal film resistor	0.1 W, 10 Ω		

Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board, with DUROID dielectric ($\varepsilon_r = 2.2$); thickness $^1/_{16}$ inch; thickness of the copper sheet 2 × 35 µm.



Dimensions in mm.

The components are situated on one side of the copper-clad PCB, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

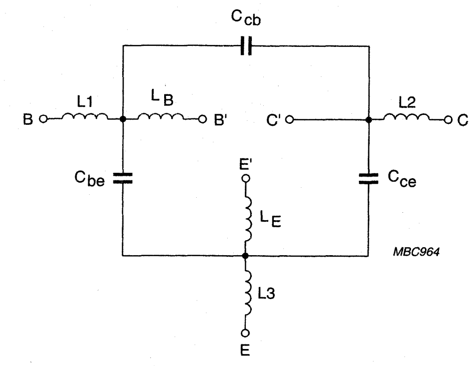
Fig.8 Component lay-out and printed-circuit board for 900 MHz class-AB test circuit.

SPICE parameters for the BLT71 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	3.503	fA
2	BF	190.5	–
3	NF	0.981	–
4	VAF	35.45	V
5	IKF	24.52	A
6	ISE	184.9	fA
7	NE	1.475	–
8	BR	12.61	–
9	NR	1.042	–
10	VAR	1.476	V
11	IKR	2.206	A
12	ISC	866.5	aA
13	NC	1.025	–
14	RB	2.000	Ω
15	IRB	1.000	μA
16	RBM	2.000	Ω
17	RE	373.8	mΩ
18	RC	330.6	mΩ
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	9.746	pF
23	VJE	0.600	V
24	MJE	0.288	–
25	TF	11.99	ps
26	XTF	0.979	–
27	VTF	19.52	mV
28	ITF	0.137	A
29	PTF	0.000	deg
30	CJC	5.028	pF
31	VJC	0.609	V
32	MJC	0.368	–
33	XCJC	0.150	–
34	TR	3.841	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.813	–

Note

1. These parameters have not been extracted, the default values are shown.

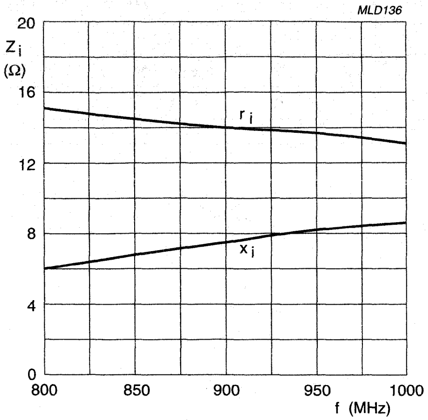


$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$;
Fc = scaling frequency = 1 GHz.

Fig.9 Package equivalent circuit SOT223H.

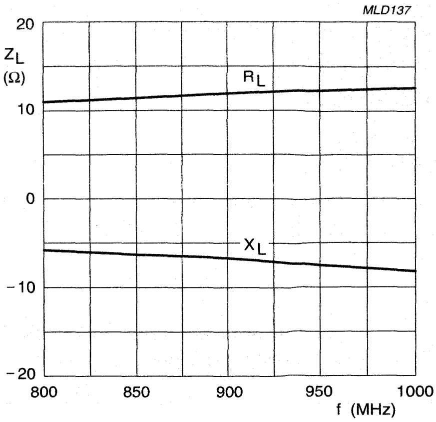
List of components (see Fig.9)

DESIGNATION	VALUE	UNIT
C_{be}	182	fF
C_{cb}	16	fF
C_{ce}	249	fF
L1	0.025	nH
L2	1.19	nH
L3	0.6	nH
L_B	1.85	nH
L_E	1.22	nH



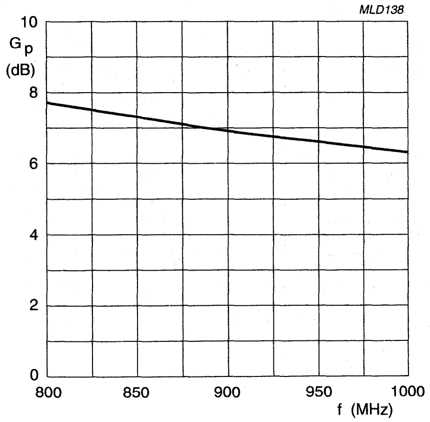
V_{CE} = 4.8 V; I_{CQ} = 1 mA.
P_L = 1.2 W; T_{amb} = 25 °C.

Fig.10 Input impedance as a function of frequency (series components); typical values.



V_{CE} = 4.8 V; I_{CQ} = 1 mA.
P_L = 1.2 W; T_{amb} = 25 °C.

Fig.11 Load impedance as a function of frequency (series components); typical values.



V_{CE} = 4.8 V; I_{CQ} = 1 mA.
P_L = 1.2 W; T_{amb} = 25 °C.

Fig.12 Gain as a function of frequency; typical values.

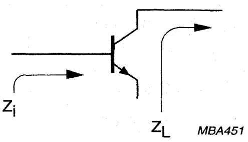


Fig.13 Definition of transistor impedance.

UHF power transistor BLT71/8

FEATURES

- High efficiency
- Very high gain
- Internal pre-matched input
- Low supply voltage.

APPLICATIONS

- Hand-held radio equipment in common emitter class-AB operation for the 900 MHz communication band.

DESCRIPTION

NPN silicon planar epitaxial power transistor encapsulated in a SOT96-1 (SO8) plastic SMD package.

PINNING - SOT96-1

PIN	SYMBOL	DESCRIPTION
1, 8	b	base
2, 4, 5, 7	e	emitter
3, 6	c	collector

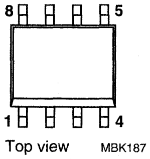


Fig.1 Simplified outline.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	1.2	≥11 typ. 13	≥55 typ. 63

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	16	V
V_{CEO}	collector-emitter voltage	open base	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s = 60$ °C; $V_{CE} \leq 6.5$ V; note 1	–	2.9	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{dis} = 2.9 W; T_s = 60 °C; note 1	40	K/W

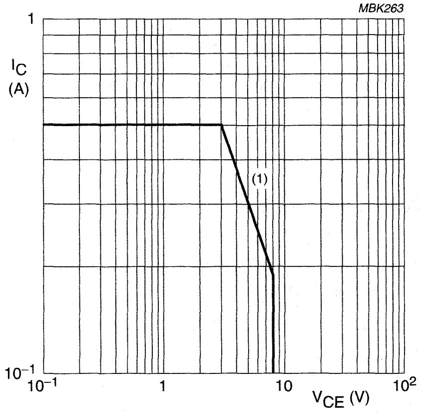
Note

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

CHARACTERISTICS

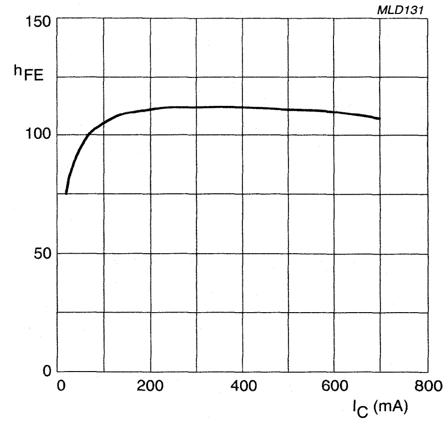
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.5 mA	16	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	V
I_{CES}	collector leakage current	V_{CE} = 8 V; V_{BE} = 0	–	0.1	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 100 mA	25	–	
C_c	collector capacitance	V_{CB} = 4.8 V; $I_E = i_e$ = 0; f = 1 MHz	–	7	pF
C_{re}	feedback capacitance	V_{CE} = 4.8 V; I_C = 0; f = 1 MHz	–	5	pF



T_s = 115 °C.

Fig.2 DC SOAR.



V_{CE} = 4.8 V.

Measured under pulse conditions: $t_p \leq 300$ µs; $\delta \leq 0.001$.

Fig.3 DC current gain as a function of collector current; typical values.

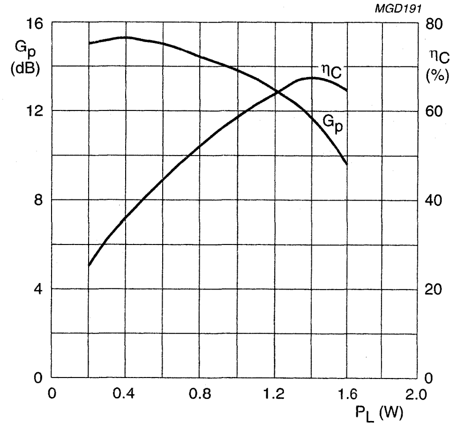
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (W)	G_p (dB)	η_C (%)
CW, class-AB	900	4.8	3	1.2	≥11 typ. 13	≥55 typ. 63

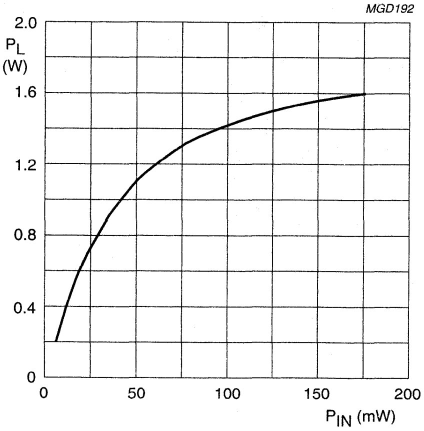
Ruggedness in class-AB operation

The BLT71/8 is capable of withstanding a load mismatch corresponding to VSWR = 6 : 1 through all phases under the following conditions: f = 900 MHz; $V_{CE} = 6.5$ V; $I_{CQ} = 3$ mA; $P_L = 1.2$ W; $T_s = 60$ °C.



$V_{CE} = 4.8$ V; $I_{CQ} = 3$ mA; f = 900 MHz.

Fig.4 Power gain and collector efficiency as functions of load power; typical values.



$V_{CE} = 4.8$ V; $I_{CQ} = 3$ mA; f = 900 MHz.

Fig.5 Load power as a function of input power; typical values.

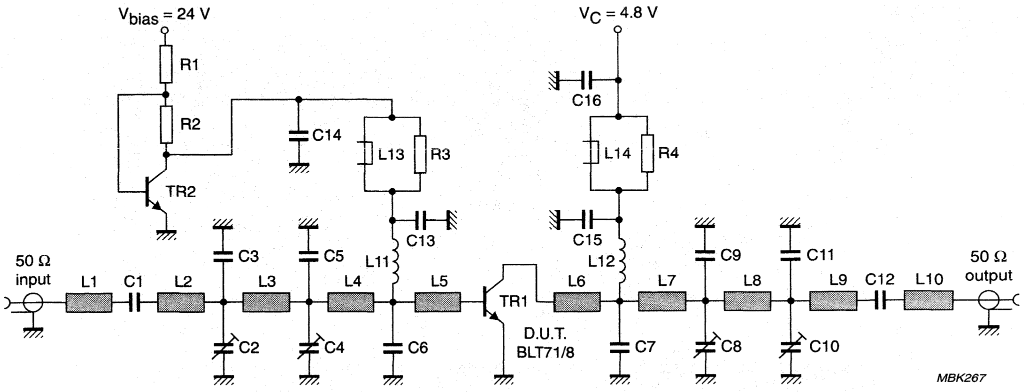
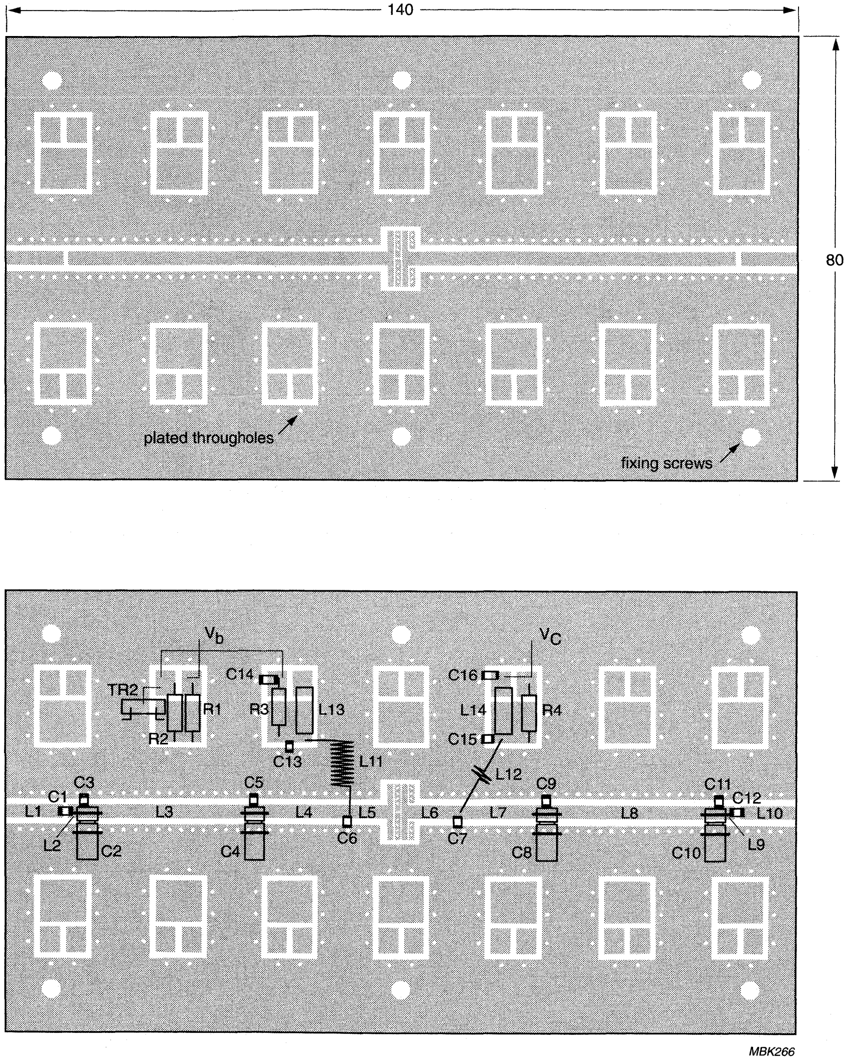


Fig.6 Class-AB test circuit at f = 900 MHz.



Dimensions in mm

The components are situated on one side of the copper-clad printed circuit board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.7 Printed-circuit board and component lay-out for the 900 MHz class-AB test circuit.

List of components (see Figs 6 and)7.

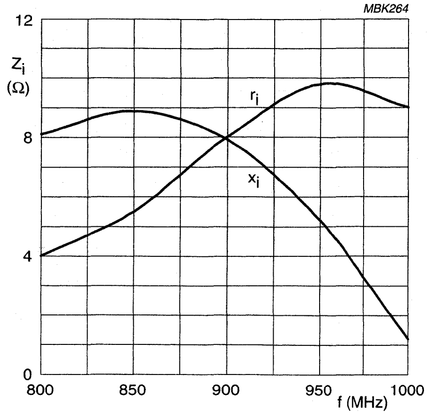
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C12, C13, C15	multilayer ceramic chip capacitor; note 1	120 pF		
C2, C4, C8, C10	Giga-Trim capacitor; note 2	0.6 to 4.5 pF		
C3	multilayer ceramic chip capacitor; note 1	4.7 pF		
C5	multilayer ceramic chip capacitor; note 1	5.6 pF		
C6	multilayer ceramic chip capacitor; note 1	3.9 pF		
C7	multilayer ceramic chip capacitor; note 1	6.8 pF		
C9	multilayer ceramic chip capacitor; note 1	7.5 pF		
C11	multilayer ceramic chip capacitor; note 1	5.1 pF		
C14, C16	multilayer ceramic chip capacitor; note 1	10 nF		
L1, L10	stripline; note 3	50 Ω	10 x 2.4 mm	
L2	stripline; note 3	50 Ω	2 x 2.4 mm	
L3	stripline; note 3	50 Ω	30.4 x 2.4 mm	
L4	stripline; note 3	50 Ω	17.4 x 2.4 mm	
L5	stripline; note 3	50 Ω	6.8 x 2.4 mm	
L6	stripline; note 3	50 Ω	8 x 2.4 mm	
L7	stripline; note 3	50 Ω	19 x 2.4 mm	
L8	stripline; note 3	50 Ω	28 x 2.4 mm	
L9	stripline; note 3	50 Ω	1.6 x 2.4 mm	

L11	10 turns 1 mm enamelled copper wire	140 nH	int. dia. = 4 mm;
			lead 1 = 2.5 mm;
			lead 2 = 11 mm	

L12	2 turns 1 mm enamelled copper wire	60 nH	int. dia. = 2 mm; leads = 2 x 7.5 mm	
L13, L14	4S2 wideband RF choke			4330 030 36301
R1	metal film resistor	1.4 kΩ; 0.6 W		2322 156 11402
R2, R3, R4	metal film resistor	10 Ω; 0.6 W		2322 156 11009
TR1	device under test	BLT71/8		
TR2	NPN transistor	BD139		9330 912 20112

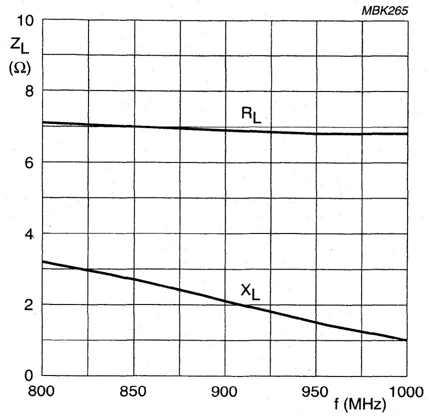
Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. Tekelec Giga-trim, type 37271.
3. The striplines are on a double copper-clad printed-circuit board, with DUROID dielectric ($\varepsilon_r = 2.2$); thickness 0.79 mm, thickness of the copper sheet 2 x 35 μm.



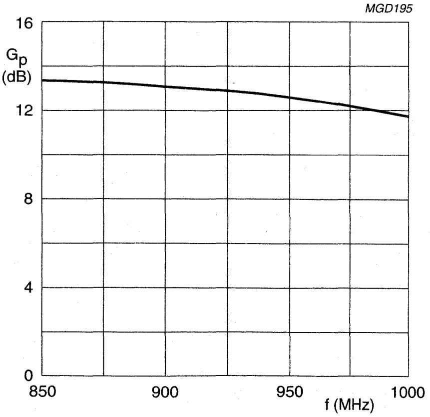
V_{CE} = 4.8 V; I_{CQ} = 3 mA; P_L = 1.2 W; T_{amb} = 25 °C.

Fig.8 Input impedance as a function of frequency (series components); typical values.



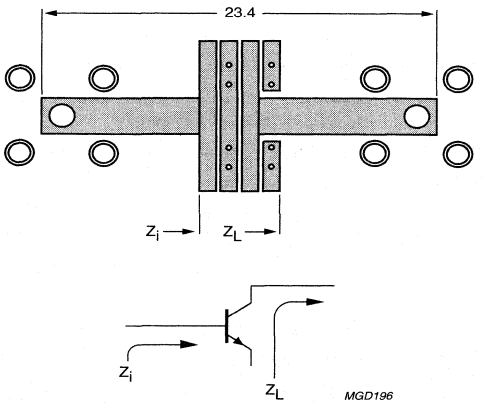
V_{CE} = 4.8 V; I_{CQ} = 3 mA; P_L = 1.2 W; T_{amb} = 25 °C.

Fig.9 Load impedance as a function of frequency (series components); typical values.



V_{CE} = 4.8 V; I_{CQ} = 3 mA; P_L = 1.2 W; T_{amb} = 25 °C.

Fig.10 Power gain as a function of frequency (series components); typical values.



Dimensions in mm.

Fig.11 RF test print and definition of transistor impedance.

UHF power transistor BLT80

FEATURES

- SMD encapsulation
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Hand-held radio equipment in the 900 MHz communication band.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic SOT223 SMD package.

PINNING - SOT223

PIN	SYMBOL	DESCRIPTION
1	e	emitter
2	b	base
3	e	emitter
4	c	collector

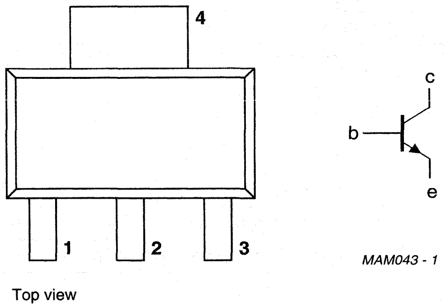


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see Fig.7).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-B narrow band	900	7.5	0.8	≥6	≥60

LIMITING VALUES

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

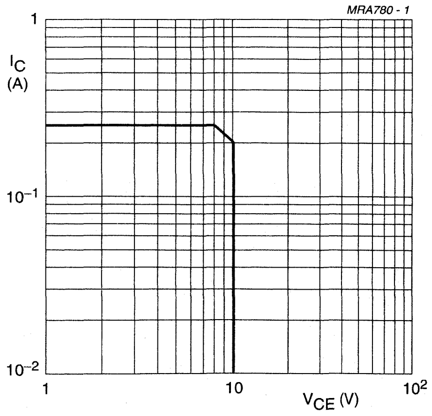
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	250	mA
$I_{C(AV)}$	average collector current		–	250	mA
I_{CM}	peak collector current	f > 1 MHz	–	750	mA
P_{tot}	total power dissipation	T_s = 131 °C; note 1	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 2 W; T_s = 131 °C; note 1	22	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	P_{tot} = 2 W; T_{amb} = 25 °C; note 2	85	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. T_s is the temperature at the soldering point of the collector pin.
2. Transistor mounted on a printed-circuit board measuring 40 × 40 × 1 mm, collector pad 35 × 17 mm.



T_s = 131 °C.

Fig.2 DC SOAR.

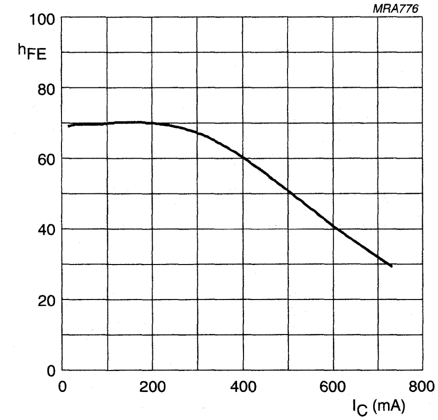
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 2.5 mA	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 5 mA	10	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.5 mA	3	–	V
I_{CES}	collector leakage current	V_{CE} = 10 V; V_{BE} = 0	–	0.1	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 150 mA; note 1; see Fig.3	25	–	
C_c	collector capacitance	V_{CB} = 7.5 V; $I_E = i_e$ = 0; f = 1 MHz; see Fig.4	–	3.5	pF
C_{re}	feedback capacitance	V_{CE} = 7.5 V; I_C = 0; f = 1 MHz	–	2.5	pF

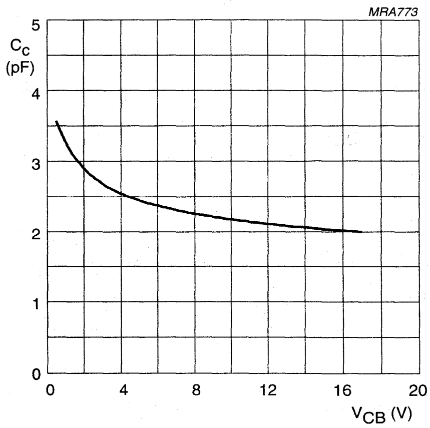
Note

1. Measured under pulsed conditions: $t_p \leq 200$ µs; $\delta \leq 0.02$.



V_{CE} = 7.5 V; $t_p \leq 200$ µs; $\delta \leq 0.02$; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current; typical values.



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

Fig.4 Collector capacitance as a function of collector-base voltage; typical values.

APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see note 1 and Fig.7).

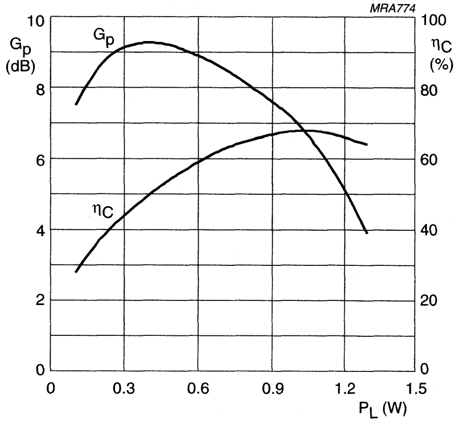
MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-B narrow band	900	7.5	0.8	≥6 typ. 8	≥60 typ. 67

Note

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

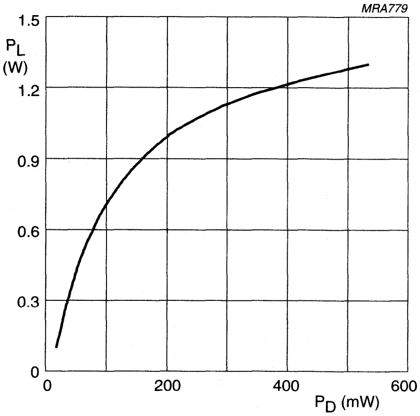
Ruggedness in class-AB operation

The BLT80 is capable of withstanding a load mismatch corresponding to VSWR = 50 : 1 through all phases under the following conditions: f = 900 MHz; V_{CE} = 9 V; P_L = 0.8 W; $T_s \leq 60$ °C.



Class-B; f = 900 MHz; V_{CE} = 7.5 V; $T_s \leq 60$ °C.

Fig.5 Power gain and collector efficiency as functions of load power; typical values.



Class-B; f = 900 MHz; V_{CE} = 7.5 V; $T_s \leq 60$ °C.

Fig.6 Load power as a function of drive power; typical values.

Test circuit information

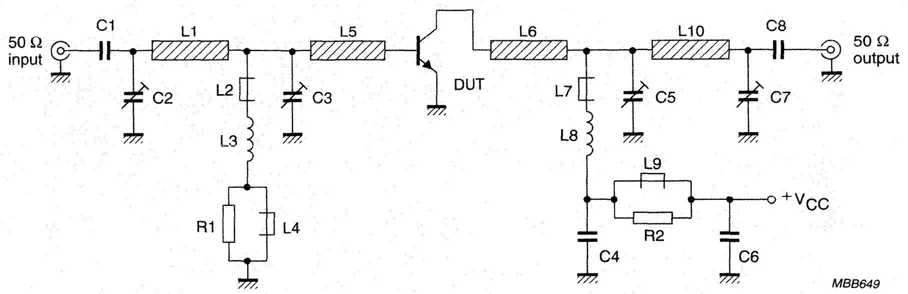


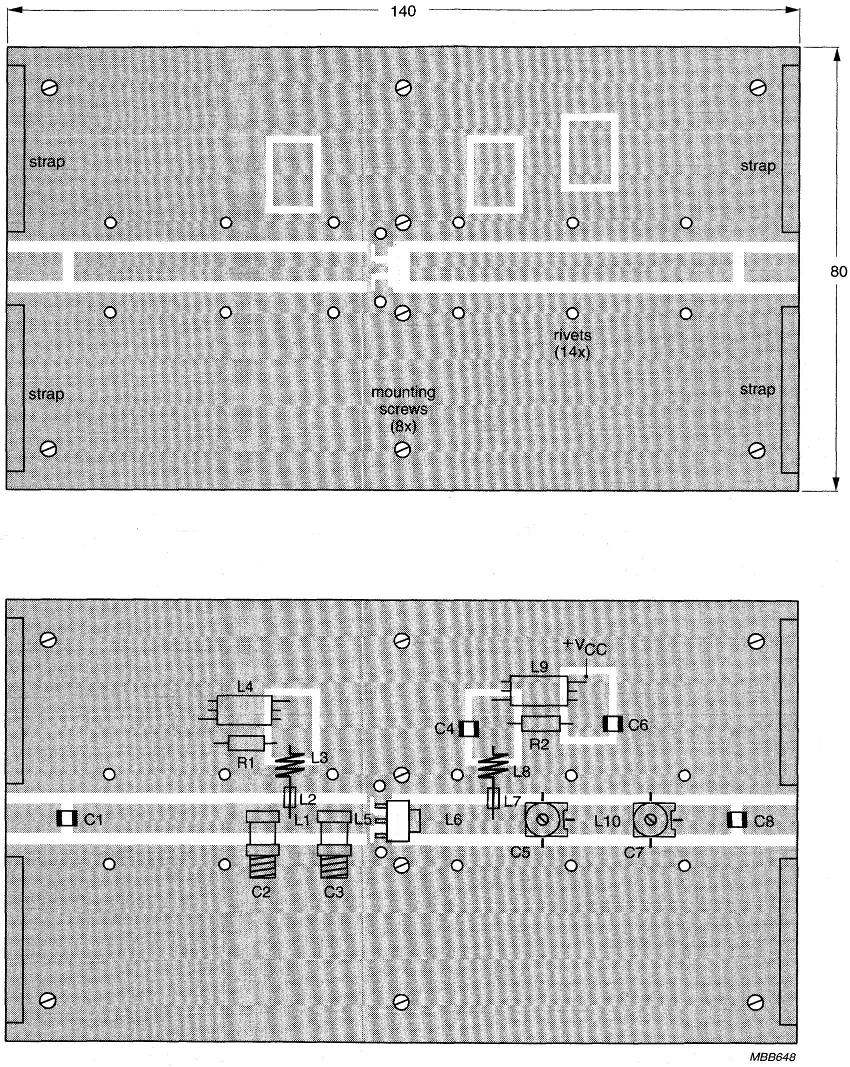
Fig.7 Common emitter test circuit for class-B operation at 900 MHz.

List of components used in test circuit (see Figs 7 and 8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C8	multilayer ceramic chip capacitor; note 1	100 pF		
C2, C3	type 9105 Voltronix KM10 trimmer	0.6 to 10 pF		
C4	multilayer ceramic chip capacitor; note 1	220 pF		
C5, C7	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09001
C6	multilayer ceramic chip capacitor; note 1	1 nF		
L1	stripline; note 2	50 Ω	length 13 mm width 4.85 mm	
L2, L7	1 turn 0.4 mm copper wire on grade 3B core			4330 030 32221
L3, L8	6 turns enamelled 0.8 mm copper wire		internal dia. 3 mm	
L4, L9	grade 3B Ferroxcube wideband HF choke			4312 020 36640
L5	stripline; note 2	50 Ω	length 8.4 mm width 4.85 mm	
L6	stripline; note 2	50 Ω	length 20 mm width 4.85 mm	
L10	stripline; note 2	50 Ω	length 21 mm width 4.85 mm	
R1, R2	metal film resistor	10 Ω, 0.25 W		

Notes

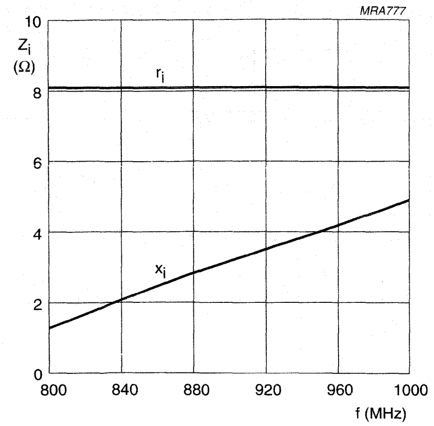
1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board, with PTFE fibre-glass dielectric ($\varepsilon_r = 2.2$); thickness $\frac{1}{16}$ inch; thickness of the copper sheet 35 μm.



Dimensions in mm.

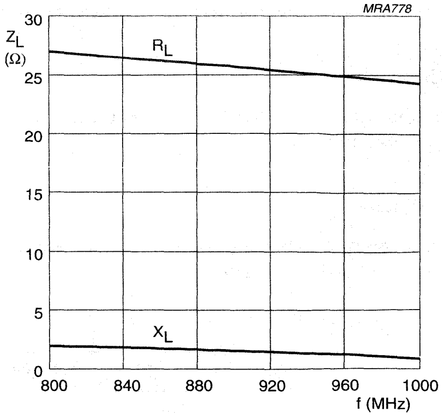
The components are situated on one side of the copper-clad PTFE fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws and copper foil straps under the emitter leads.

Fig.8 Printed-circuit board and component lay-out for 900 MHz class-B test circuit in Fig.7.



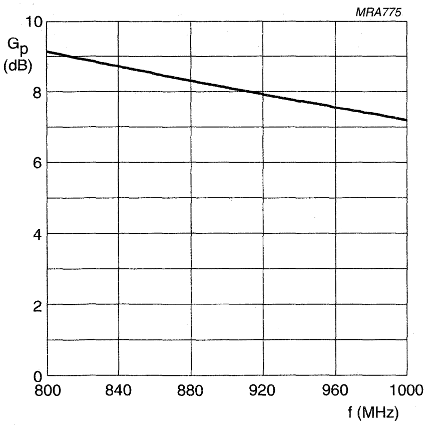
Class-B; V_{CE} = 7.5 V; P_L = 0.8 W; $T_s \leq 60$ °C.

Fig.9 Input impedance as a function of frequency (series components); typical values.



Class-B; V_{CE} = 7.5 V; P_L = 0.8 W; $T_s \leq 60$ °C.

Fig.10 Load impedance as a function of frequency (series components); typical values.



Class-B; V_{CE} = 7.5 V; P_L = 0.8 W; $T_s \leq 60$ °C.

Fig.11 Power gain as a function of frequency; typical values.

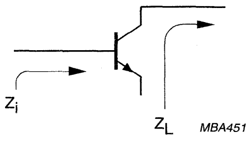


Fig.12 Definition of transistor impedance.

UHF power transistor BLT81

FEATURES

- SMD encapsulation
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Hand-held radio equipment in the 900 MHz communication band.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic SOT223 SMD package.

PINNING - SOT223

PIN	SYMBOL	DESCRIPTION
1	e	emitter
2	b	base
3	e	emitter
4	c	collector

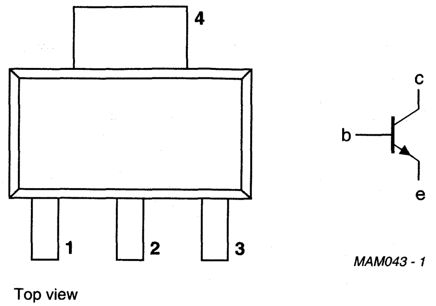


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see Fig.7).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-B narrow band	900	7.5	1.2	≥6	≥60
		6	1.2	typ. 6.5	typ. 77

LIMITING VALUES

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

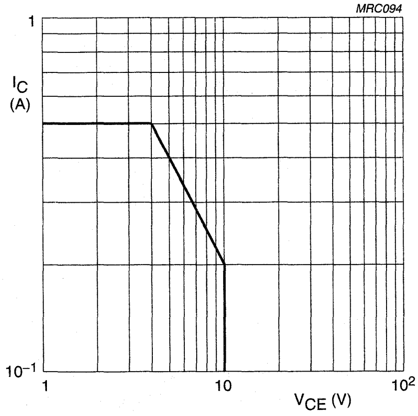
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	9.5	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
$I_{C(AV)}$	average collector current		–	500	mA
P_{tot}	total power dissipation	T_s = 110 °C; note 1	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 2 W; T_s = 110 °C; note 1	32	K/W

Note to the "Limiting values" and "Thermal characteristics"

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



T_s = 110 °C.

Fig.2 DC SOAR.

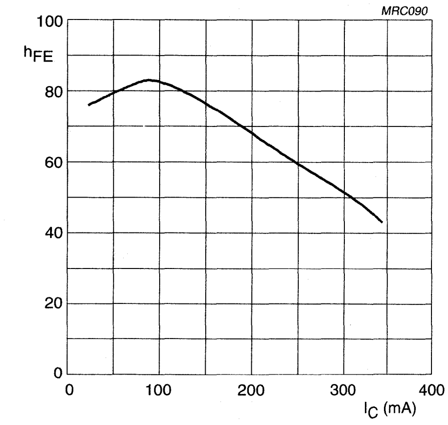
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 1 mA	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	9.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	–	V
I_{CES}	collector leakage current	V_{CE} = 10 V; V_{BE} = 0	–	–	0.1	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 300 mA; note 1;	25	–	–	
C_c	collector capacitance	V_{CB} = 7.5 V; $I_E = i_e$ = 0; f = 1 MHz;	–	2.7	4	pF
C_{re}	feedback capacitance	V_{CE} = 7.5 V; I_C = 0; f = 1 MHz	–	1.7	3	pF

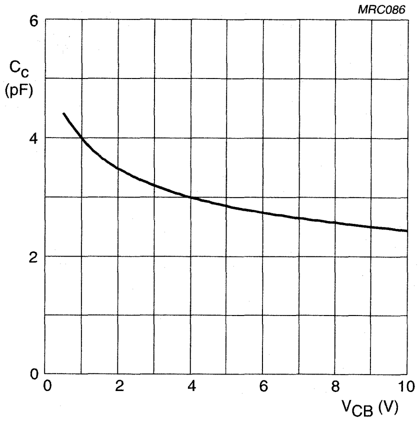
Note

1. Measured under pulsed conditions: $t_p \leq 200$ µs; $\delta \leq 0.02$.



V_{CE} = 7.5 V; $t_p \leq 200$ µs; $\delta \leq 0.02$; T_j = 25 °C.

Fig.3 DC current gain as a function of collector current; typical values.



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

Fig.4 Collector capacitance as a function of collector-base voltage; typical values.

APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see note 1 and Fig.7).

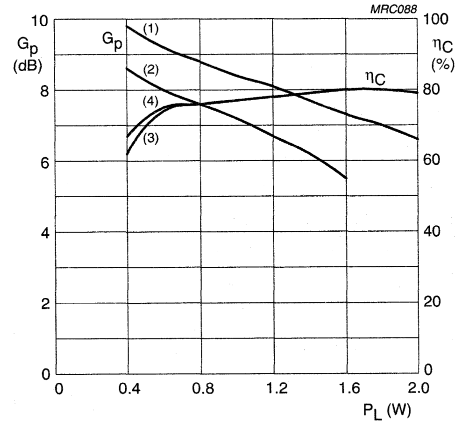
MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW, class-B narrow band	900	7.5	1.2	≥6 typ. 8	≥60 typ. 77
		6	1.2	typ. 6.5	typ. 77

Note

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

Ruggedness in class-AB operation

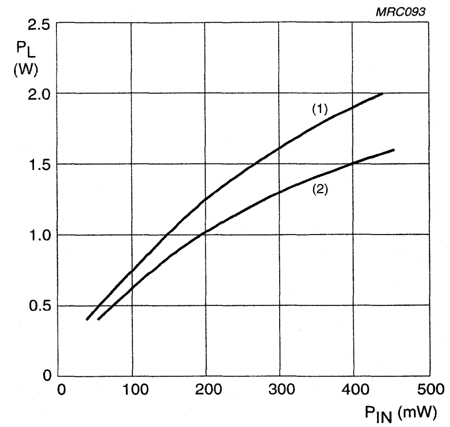
The BLT81 is capable of withstanding a load mismatch corresponding to VSWR = 50 : 1 through all phases under the following conditions: f = 900 MHz; V_{CE} = 9 V; P_L = 1.2 W; $T_s \leq 60$ °C.



Class-B; f = 900 MHz; $T_s \leq 60$ °C.

(1) V_{CE} = 7.5 V.
(2) V_{CE} = 6 V.
(3) V_{CE} = 7.5 V.
(4) V_{CE} = 6 V.

Fig.5 Power gain and collector efficiency as functions of load power; typical values.



Class-B; f = 900 MHz; $T_s \leq 60$ °C.

(1) V_{CE} = 7.5 V.
(2) V_{CE} = 6 V.

Fig.6 Load power as a function of input power; typical values.

Test circuit information

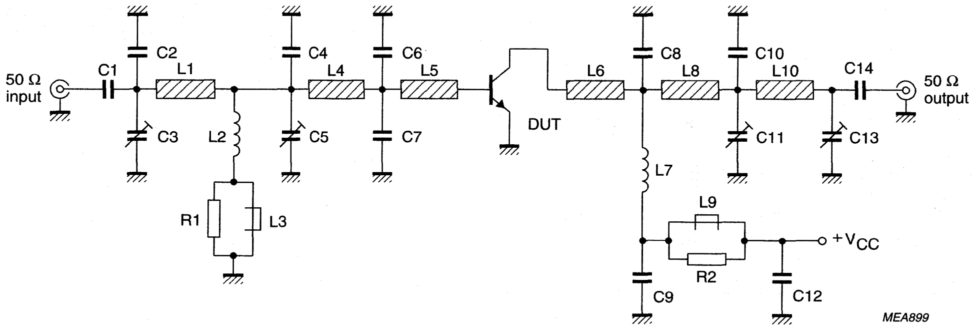


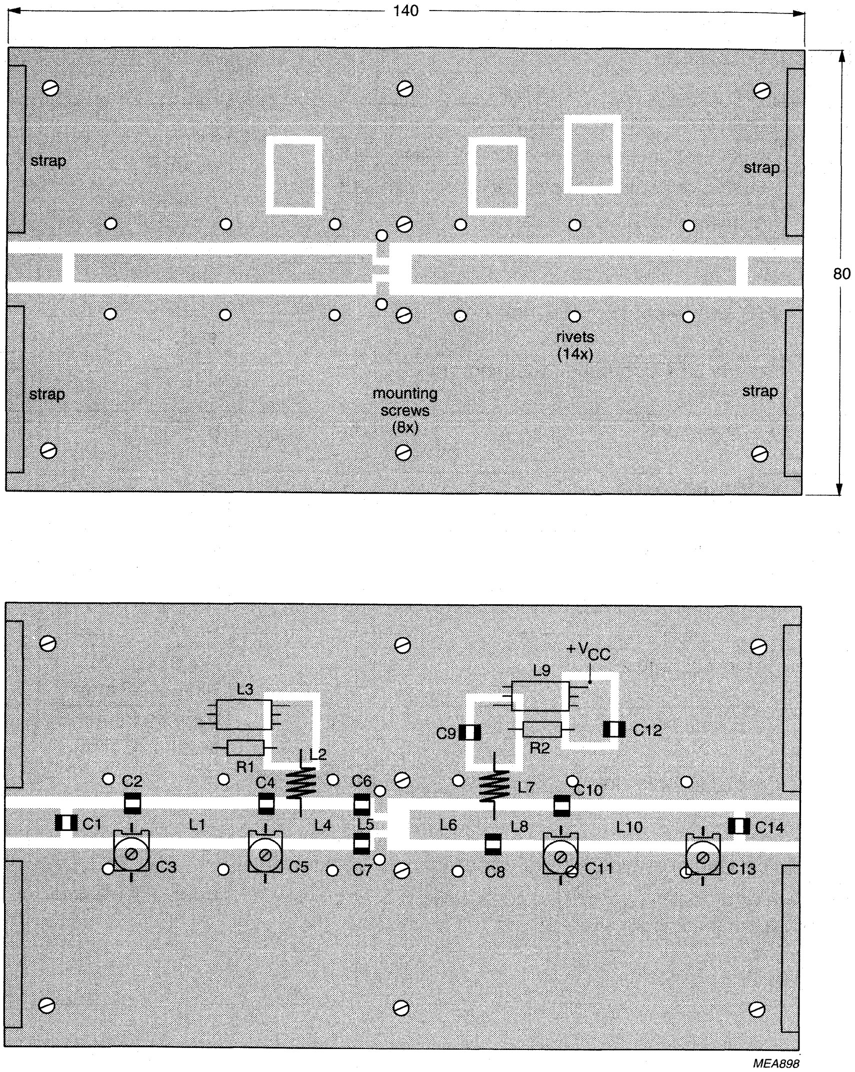
Fig.7 Common emitter test circuit for class-B operation at 900 MHz.

List of components used in test circuit (see Figs 7 and 8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C14	multilayer ceramic chip capacitor; note 1	100 pF		
C2	multilayer ceramic chip capacitor; note 1	3 pF		
C3, C5, C11, C13	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09004
C4	multilayer ceramic chip capacitor; note 1	5.6 pF		
C6, C7, C10	multilayer ceramic chip capacitor; note 1	5.1 pF		
C8	multilayer ceramic chip capacitor; note 1	3.6 pF		
C9	multilayer ceramic chip capacitor; note 1	220 pF		
C12	multilayer ceramic chip capacitor;	1 nF		
L1	stripline; note 2	50 Ω	length 26.6 mm width 4.85 mm	
L2	10 turns enamelled 0.6 mm copper wire	250 nH	int. dia. 4.5 mm leads 2 × 5 mm	
L3, L9	grade 3B Ferroxcube wideband HF choke			4312 020 36640
L4	stripline; note 2	50 Ω	length 18 mm width 4.85 mm	
L5	stripline; note 2	75 Ω	length 3.5 mm width 2.5 mm	
L6	stripline; note 2	50 Ω	length 10 mm width 4.85 mm	
L7	4 turns enamelled 0.6 mm copper wire	65 nH	int. dia. 4.5 mm leads 2 × 5 mm	
L8	stripline; note 2	50 Ω	length 15 mm width 4.85 mm	
L10	stripline; note 2	50 Ω	length 24.6 mm width 4.85 mm	
R1, R2	metal film resistor	10 Ω, 0.25 W		

Notes

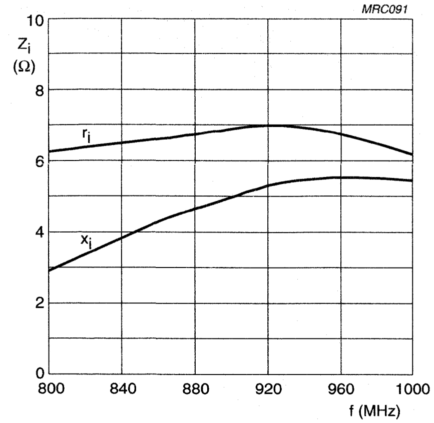
1. American Technical Ceramics type 100B or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board, with PTFE fibre-glass dielectric ($\varepsilon_r = 2.2$); thickness $\frac{1}{16}$ inch; thickness of the copper sheet 35 μm.



Dimensions in mm.

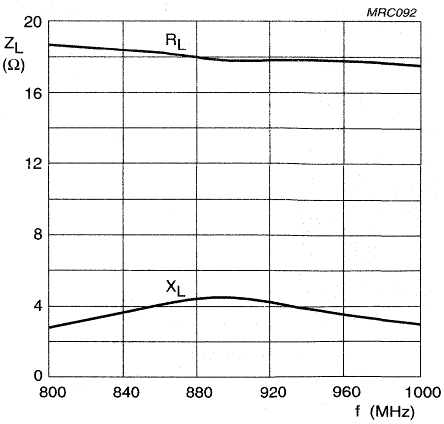
The components are situated on one side of the copper-clad PTFE fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws and copper foil straps under the emitter leads.

Fig.8 Printed-circuit board and component lay-out for 900 MHz class-B test circuit in Fig.7.



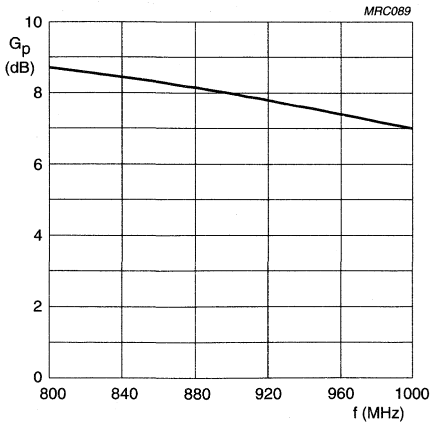
Class-B; V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq$ 60 °C.

Fig.9 Input impedance as a function of frequency (series components); typical values.



Class-B; V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq$ 60 °C.

Fig.10 Load impedance as a function of frequency (series components); typical values.



Class-B; V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq$ 60 °C.

Fig.11 Power gain as a function of frequency; typical values.

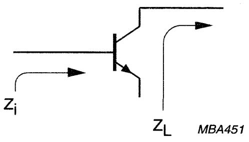


Fig.12 Definition of transistor impedance.

UHF power transistor BLT92/SL

DESCRIPTION

NPN silicon planar epitaxial transistor primarily intended for use in handheld radio stations in the 900 MHz communications band.

This device has been designed specifically for class-B operation.

FEATURES

- internal input matching capacitor for a high power gain
- gold metallization ensures excellent reliability

The transistor has a 4-lead studless envelope with a ceramic cap (SOT122D). All leads are isolated from the mounting base.

PINNING

1 = collector
2 = emitter
3 = base
4 = emitter

QUICK REFERENCE DATA

RF performance at T_{mb} = 25 °C in a common-emitter class-B circuit

MODE OF OPERATION	V_{CE} (V)	f (MHz)	P_L (W)	G_p (dB)	η_C (%)
CW (class-B)	7.5	900	3.0	> 7.0	> 50

PIN CONFIGURATION

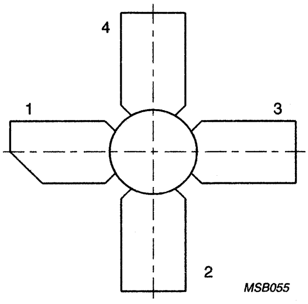


Fig.1 Simplified outline, SOT122D.

PRODUCT SAFETY This device incorporates beryllium oxide (BeO), the dust of which is toxic. The device is entirely safe provided that the internal BeO disc is not damaged.

RATINGS

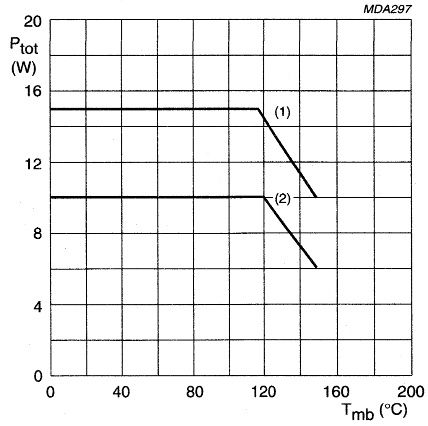
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	10	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.0	V
Collector current				
DC or average	I_C; $I_{C(AV)}$	max.	1.2	A
(peak value); f > 800 MHz	I_{CM}	max.	3.6	A
Total power dissipation				
at T_{amb} < 120 °C; f > 800 MHz	P_{tot}	max.	10	W
Storage temperature range	T_{stg}		−65 to +150	°C
Operating junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

Dissipation = 10 W; T_{mb} = 25 °C

From junction to mounting base (f > 800 MHz)	$R_{th\ j\text{-}mb(RF)}$	max.	6.0	K/W



(1) Short-time RF operation during mismatch (f > 800 MHz).

(2) Continuous RF operation (f > 800 MHz).

Fig.2 Total power dissipation as a function of temperature.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-base breakdown voltage open emitter; I_C = 10 mA	$V_{(BR)CBO}$	>	20	V
Collector-emitter breakdown voltage open base; I_C = 20 mA	$V_{(BR)CEO}$	>	10	V
Emitter-base breakdown voltage open collector; I_E = 2 mA	$V_{(BR)EBO}$	>	3.0	V
Collector cut-off current V_{BE} = 0; V_{CE} = 10 V	I_{CES}	<	5.0	mA
Second breakdown energy L = 25 mH; f = 50 Hz; R_{BE} = 10 Ω	E_{SBR}	>	1.0	mJ
DC current gain I_C = 600 mA; V_{CE} = 5 V	h_{FE}	>	25	
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; V_{CB} = 7.5 V	C_c	typ.	11	pF
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 7.5 V	C_{re}	typ.	6.0	pF
Collector-mounting base capacitance	$C_{c\text{-}mb}$	typ.	1.2	pF

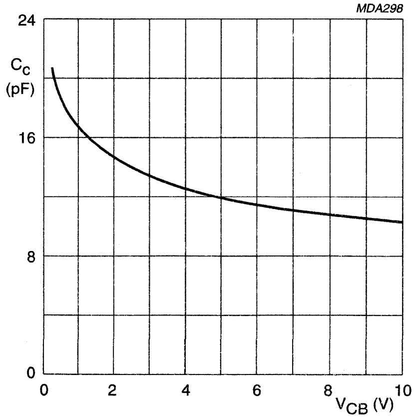


Fig.3 Collector capacitance as a function of collector-base voltage; f = 1 MHz; $I_E = i_e = 0$; typical values.

APPLICATION INFORMATION

RF performance in CW operation (common-emitter circuit; class-B); f = 900 MHz; T_{mb} = 25 °C

MODE OF OPERATION	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
Class-B; CW	7.5	3.0	> 7.0 typ. 8.5	> 50 typ. 57

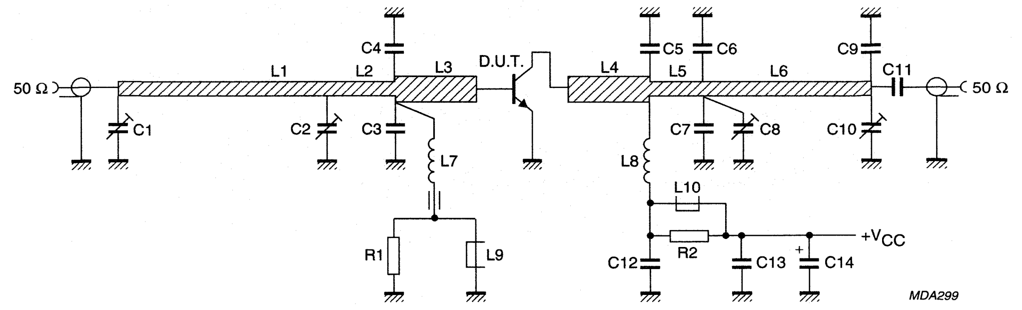


Fig.4 Class-B test circuit at f = 900 MHz.

List of components:

C1 = C2 = C8 = C10 = 1.4 to 5.5 pF film dielectric trimmer (cat. no. 2222 809 09001)
C3 = C6 = C7 = 3.3 pF multilayer ceramic chip capacitor(1)
C4 = C5 = C9 = 5.6 pF multilayer ceramic chip capacitor(1)
C11 = C12 = C13 = 180 pF multilayer ceramic chip capacitor
C14 = 1 µF (35 V) tantalum capacitor
L1 = 50 Ω stripline (25 mm × 2.4 mm)
L2 = 50 Ω stripline (11 mm × 2.4 mm)
L3 = L4 = 25 Ω stripline (11.5 mm × 6.0 mm)
L5 = 50 Ω stripline (7.0 mm × 2.4 mm)
L6 = 50 Ω stripline (27.0 mm × 2.4 mm)
L7 = 4 turns closely wound enamelled Cu wire (0.4 mm), int. dia;. 3 mm, with ferrite beat (cat. no. 4330 830 32221) over the coldside lead
L8 = 1 turn Cu wire (1.0 mm); int. dia. 5.5 mm; length 2 mm; leads 2 × 5 mm
L9 = L10 = Ferroxcube wideband HF choke, grade 3B (cat. no. 4312 020 36642)
R1 = R2 = 10 Ω ± 5%; 0.25 W metal film resistor

The striplines on a double Cu-clad printed circuit board with PTFE fibreglass dielectric (ε_r = 2.2); thickness 1/32 inch; thickness of copper-sheet 2 × 35 µm.

Note

1. American Technical Ceramics capacitor type 100 A or capacitor of same quality.

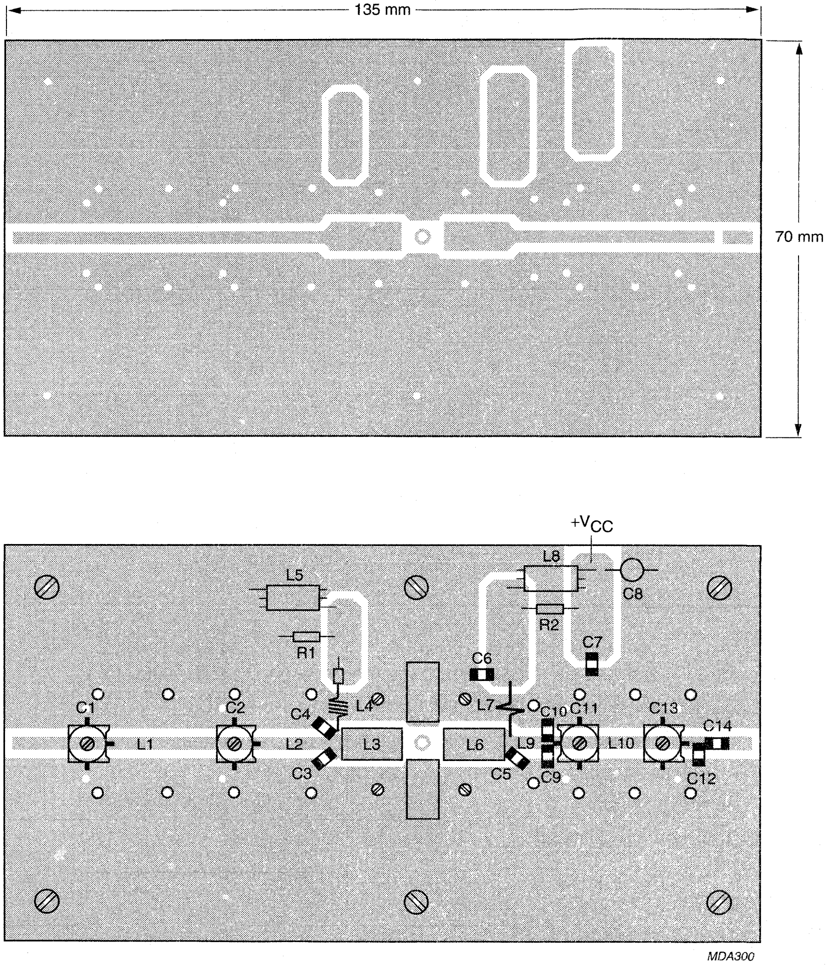
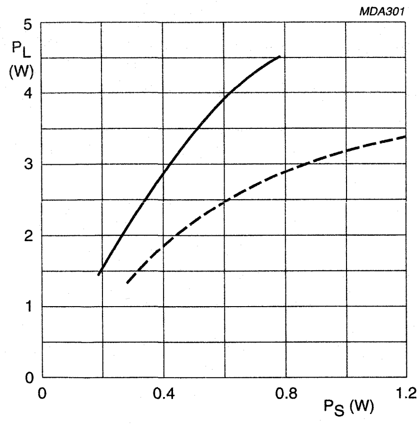


Fig.5 Printed circuit board and component layout for 900 MHz class-B test circuit.

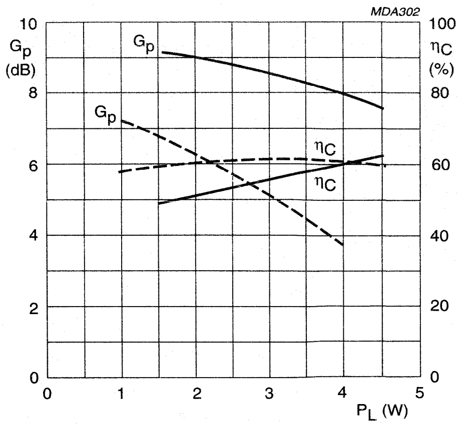
Note:

The circuit and the components are on one side of the PTFE fibreglass board; the other side is un-etched copper serving as groundplane. Earth connections are made by hollow rivets and also by fixing-screws and copper straps around the board and under the emitters to provide a direct contact between the copper on the component side and the groundplane.



f = 900 MHz; T_{mb} = 25 °C; class-B operation; typical values.
—— V_{CE} = 7.5 V
– – – V_{CE} = 5.0 V

Fig.6 Load power as a function of source power.

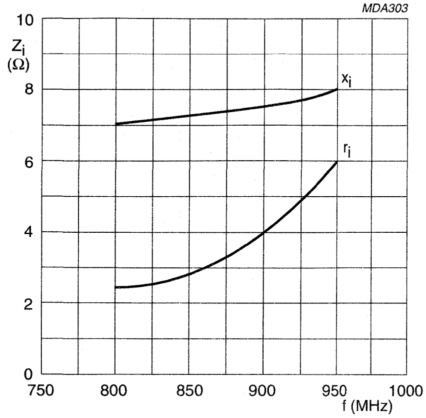


f = 900 MHz; T_{mb} = 25 °C; class-B operation; typical values.
—— V_{CE} = 7.5 V
– – – V_{CE} = 5.0 V

Fig.7 Power gain and efficiency as a function of load power.

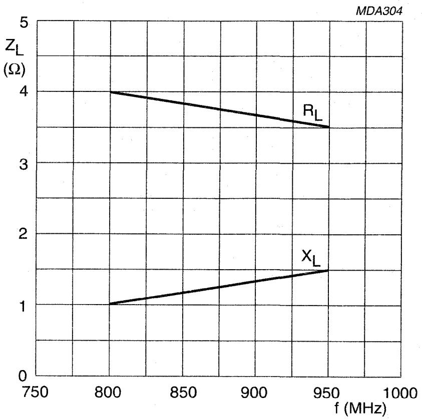
RUGGEDNESS

The device is capable of withstanding a full load mismatch (VSWR = 50; all phases) at rated load power up to a supply voltage of 9.0 V at T_{mb} = 25 °C.



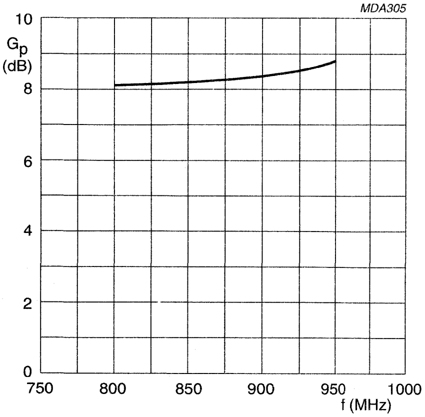
V_{CE} = 7,5 V; P_L = 3 W; f = 800 - 960 MHz; T_{mb} = 25 °C; class-B operation; typical values.

Fig.8 Input impedance as a function of frequency (series components).



V_{CE} = 7,5 V; P_L = 3 W; f = 800 - 960 MHz; T_{mb} = 25 °C; class-B operation; typical values.

Fig.9 Load impedance as a function of frequency (series components).



V_{CE} = 7,5 V; P_L = 3 W; f = 800 - 960 MHz; T_{mb} = 25 °C; class-B operation; typical values.

Fig.10 Power gain as a function of frequency.

PNP switching transistor BSR12

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed, saturated switching applications for industrial service in thick and thin-film circuits.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.

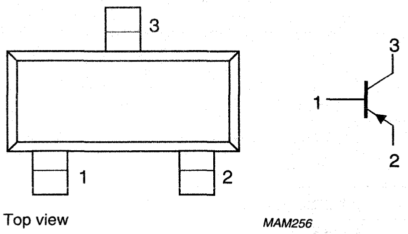


Fig.1 Simplified outline (SOT23) and symbol.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING

TYPE NUMBER	MARKING CODE
BSR12	B5p

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–15	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
T_j	junction temperature		–	150	°C
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	30	–	
		$I_C = -50$ mA; $V_{CE} = -1$ V	30	120	
f_T	transition frequency	f = 500 MHz; $I_C = -50$ mA; $V_{CE} = -10$ V	1.5	–	GHz
t_{off}	turn-off time	$I_{Con} = -30$ mA; $I_{Bon} = -3$ mA; $I_{Boff} = 3$mA	–	30	ns

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–15	V
V_{EBO}	emitter-base voltage	open collector	–	–3	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500	K/W

Note

1. Transistor mounted on a ceramic substrate 8 × 10 × 0.7 mm.

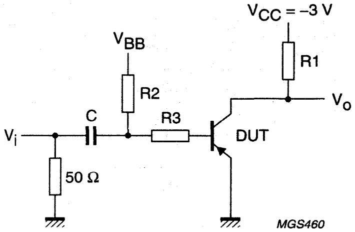
CHARACTERISTICS

T_{amb} = 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	–	–	–50	nA
		$I_E = 0$; $V_{CB} = -10$ V; $T_{amb} = 125$ °C	–	–	–5	μA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = -10$ V	–	–	–50	nA
$V_{(BR)CBO}$	breakdown voltage	$I_E = 0$; $I_C = -10$ μA	–15	–	–	V
$V_{(BR)CES}$	breakdown voltage	$V_{BE} = 0$; $I_C = -10$ μA	–15	–	–	V
$V_{(BR)EBO}$	breakdown voltage	$I_C = 0$; $I_E = -100$ μA	–3	–	–	V
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_B = 0$; $I_C = -10$ mA	–15	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	–	–	–130	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–180	–270	mV
		$I_C = -100$ mA; $I_B = -10$ mA; note 1	–	–	–450	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	–725	–	–920	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	–800	–	–1 150	mV
		$I_C = -100$ mA; $I_B = -10$ mA; note 1	–900	–	–1 500	mV
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -1$ V; note 1	30	–	–	
		$I_C = -10$ mA; $V_{CE} = -1$ V; note 1	30	–	–	
		$I_C = -50$ mA; $V_{CE} = -1$ V; note 1	30	–	120	
		$I_C = -50$ mA; $V_{CE} = -1$ V; $T_{amb} = 55$ °C; note 1	30	–	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V; note 1	20	–	–	
f_T	transition frequency	IC = –50 mA; $V_{CE} = -10$ V; f = 500 MHz	1.5	–	–	GHz
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = -5$ V	–	–	4.5	pF
C_e	emitter capacitance	$I_C = I_c = 0$; $V_{EB} = -0.5$ V	–	–	6	pF
Switching time (see Fig.2)						
t_{on}	turn-on time	$V_i = -6.85$ V; $V_{BB} = 0$ V; $I_{Con} = -30$ mA; $I_{Bon} = -3.0$ mA	–	–	20	ns
t_{off}	turn-off time	$V_i = 11.7$ V; $V_{BB} = -9.85$ V; $I_{Con} = -30$ mA; $I_{Bon} = -3$ mA; $I_{Boff} = 3$ mA	–	–	30	ns

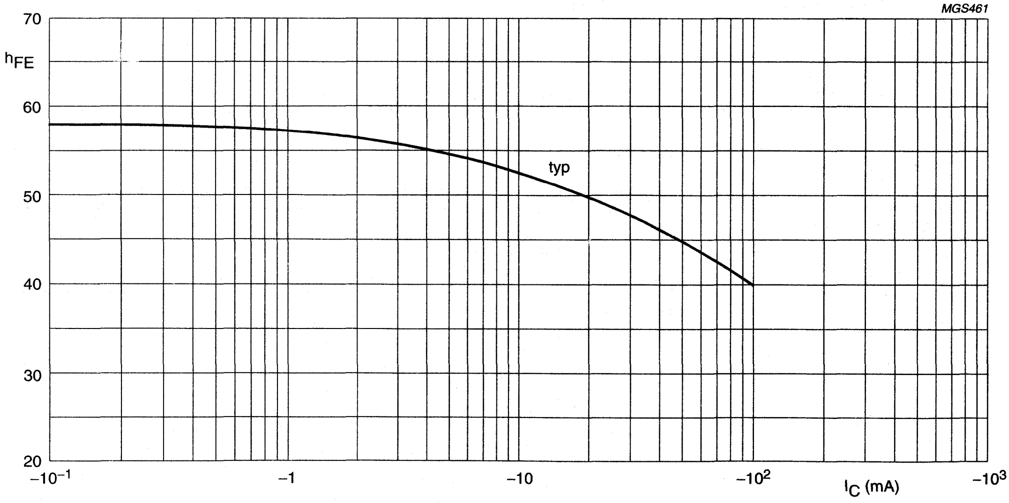
Note

1. Pulse test: $t_p = 300$ μs; $\delta = 0.01$.



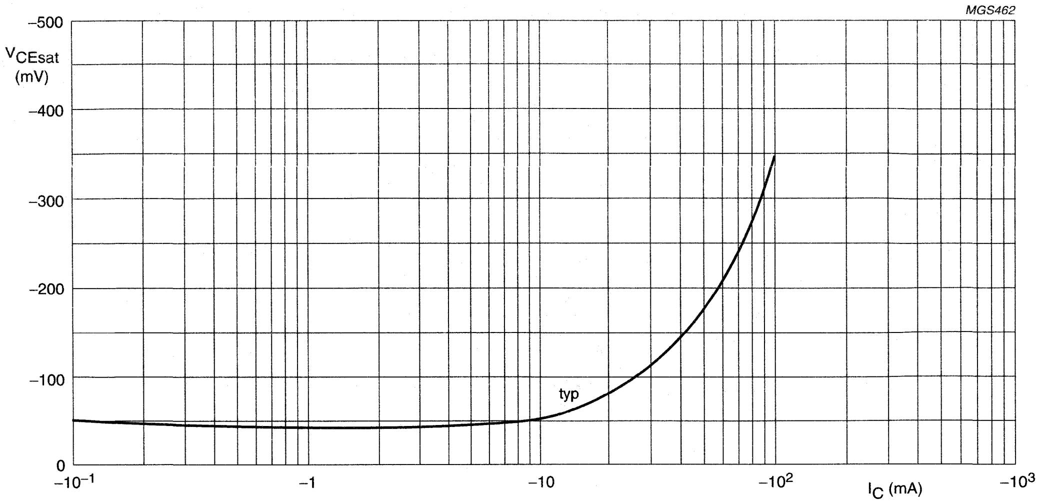
R1 = 94 Ω; R2 = 1 kΩ; R3 = 2 kΩ; C = 0.1 μF.
Pulse generator: Pulse duration t_p = 400 ns. Rise time t_r < 1 ns. Output impedance Z_O = 50 Ω.
Sampling scope: Rise time t_r < 1 ns. Input impedance Z_i = 100 kΩ.

Fig.2 Test circuit for switching times.



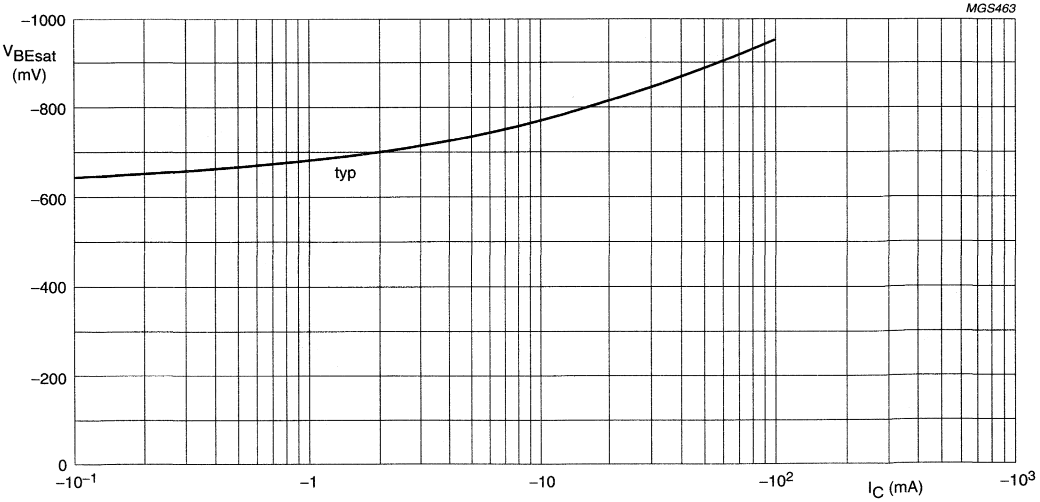
V_{CE} = − 1 V; T_{amb} = 25°C.

Fig.3 DC current gain; typical values.



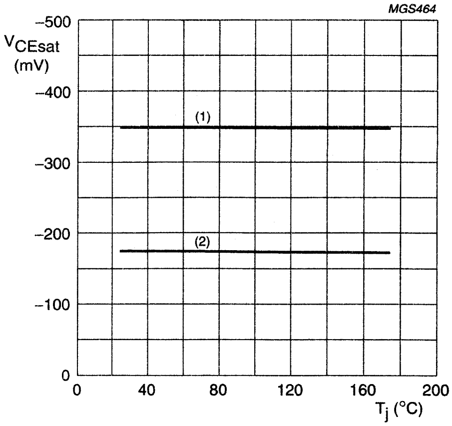
$I_C/I_B = 10$.

Fig.4 Collector-emitter saturation voltage as a function of collector current; typical values.



$I_C/I_B = 10$.

Fig.5 Base-emitter saturation voltage as a function of collector current; typical values.



(1) $I_C = 100$ mA; $I_B = 10$ mA

(2) $I_C = 50$ mA and $I_B = 5$ mA.

Fig.6 Collector-emitter saturation voltage as a function of junction temperature; typical values.

NPN 1 GHz general purpose switching transistor MPSH10

FEATURES

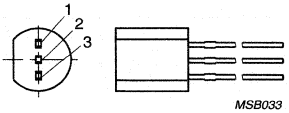
- Low cost
- High power gain.

DESCRIPTION

Silicon NPN general purpose transistor in a SOT54 (TO-92) package. PNP complement is the MPSH81.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base



Marking code: PSH10.

Fig.1 SOT54.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
P_{tot}	total power dissipation	T_s = 25 °C; note 1	–	1	W
T_j	junction temperature		–	150	°C
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 4 mA	60	–	
C_{re}	collector-emitter feedback capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	650	–	MHz
r_bC_c	collector-base time constant	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	–	9	ps

Note

1. T_s is the temperature at the soldering point of the collector lead, 4 mm from the body.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	40	mA
P_{tot}	total power dissipation	T_s = 25 °C; note 1	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector lead, 4 mm from the body.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	125	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		250	K/W

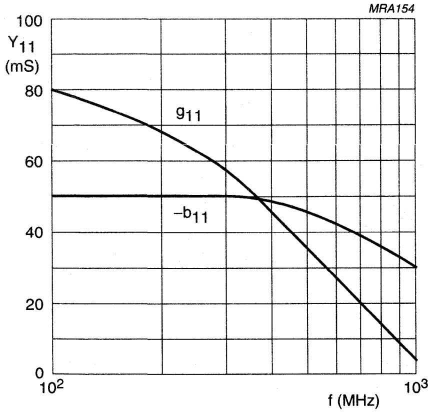
Note

1. T_s is the temperature at the soldering point of the collector lead, 4 mm from the body.

CHARACTERISTICS

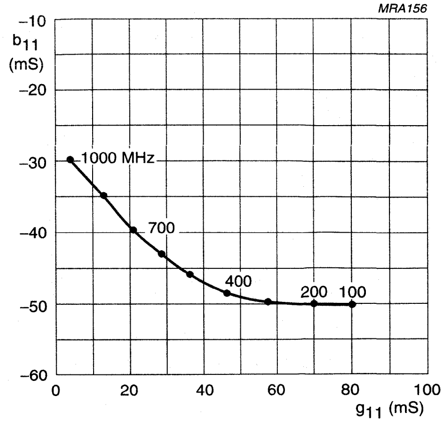
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 100 μA; I_E = 0	30	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0	25	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	3	–	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 4 mA; I_B = 0.4 mA	–	0.5	V
V_{BEon}	base-emitter ON voltage	V_{CE} = 10 V; I_C = 4 mA	–	0.95	V
I_{CBO}	collector-base cut-off current	V_{CB} = 25 V; I_E = 0	–	100	nA
I_{EBO}	emitter-base cut-off current	V_{CB} = 25 V; I_C = 0	–	100	nA
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 4 mA	60	–	
C_{re}	collector-emitter feedback capacitance	V_{CB} = 10 V; I_E = i_e = 0; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	V_{CB} = 10 V; I_C = i_c = 0; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	650	–	MHz
r_bC_c	collector-base time constant	V_{CB} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	–	9	ps



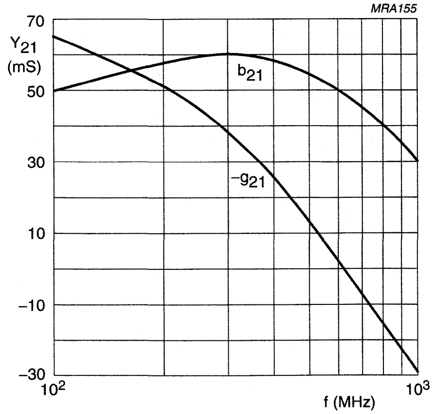
V_{CB} = 10 V; I_C = 4 mA.

Fig.2 Common base input admittance (Y_{11}) as a function of frequency.



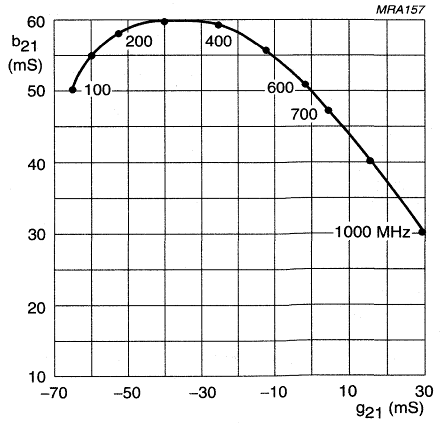
V_{CB} = 10 V; I_C = 4 mA.

Fig.3 Common base input admittance (Y_{11}).



V_{CB} = 10 V; I_C = 4 mA.

Fig.4 Common base forward transfer admittance (Y_{21}) as a function of frequency.

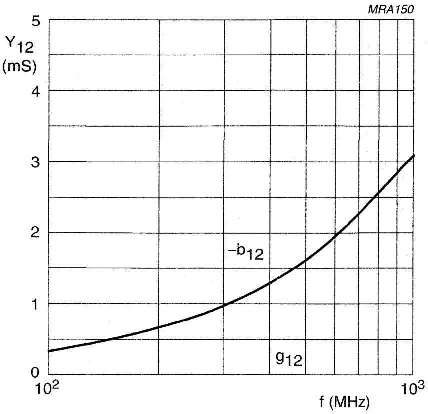


V_{CB} = 10 V; I_C = 4 mA.

Fig.5 Common base forward transfer admittance (Y_{21}).

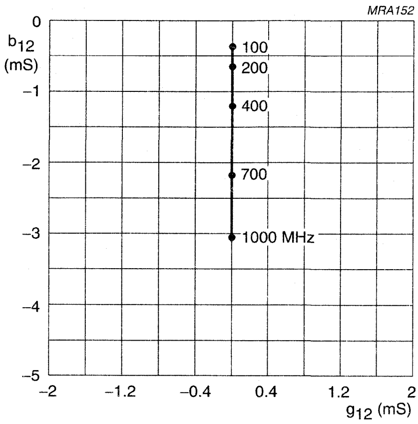
NPN 1 GHz general purpose switching transistor

MPSH10



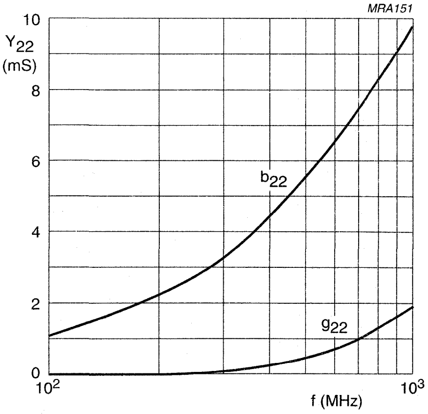
V_{CB} = 10 V; I_C = 4 mA.

Fig.6 Common base reverse transfer admittance (Y_{12}) as a function of frequency.



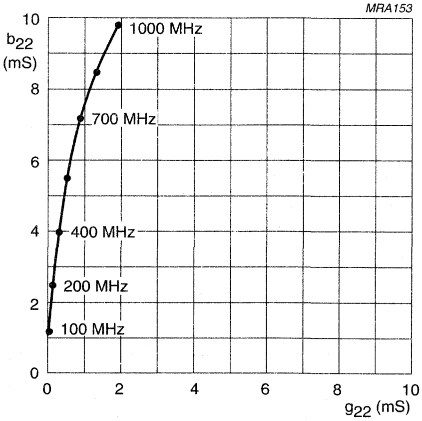
V_{CB} = 10 V; I_C = 4 mA.

Fig.7 Common base reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; I_C = 4 mA.

Fig.8 Common base reverse admittance (Y_{22}) as a function of frequency.



V_{CB} = 10 V; I_C = 4 mA.

Fig.9 Common base reverse admittance (Y_{22}).

UHF wideband transistor PBR941

FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

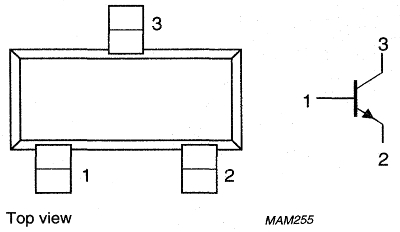
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT23 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING - SOT23

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: V0.

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	0.3	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	8	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	15	–	dB
F	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	1.4	–	dB
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	360	mW
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$P_{tot} = 360$ mW	–	320	K/W

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	1.5	V
I_C	collector current (DC)		–	50	mA
$I_{C(AV)}$	average collector current		–	50	mA
P_{tot}	total power dissipation	T_s = 60 °C; note 1	–	360	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	P_{tot} = 360 mW; T_s = 60 °C; note 1	320	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics						
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 μA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 100 μA; I_B = 0	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	1.5	–	–	V
I_{CBO}	collector-base leakage current	V_{CB} = 10 V; I_E = 0	–	–	100	nA
I_{EBO}	emitter-base leakage current	V_{EB} = 1 V; I_C = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V	50	100	200	
		I_C = 15 mA; V_{CE} = 6 V	–	100	–	
AC characteristics						
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 6 V; f = 1 GHz	–	8	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 15 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
		I_C = 15 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	9.5	–	dB
F	noise figure	$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	1.4	–	dB
		$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 2 GHz	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\ \log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB

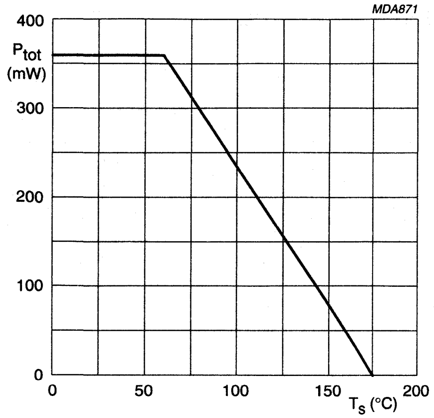
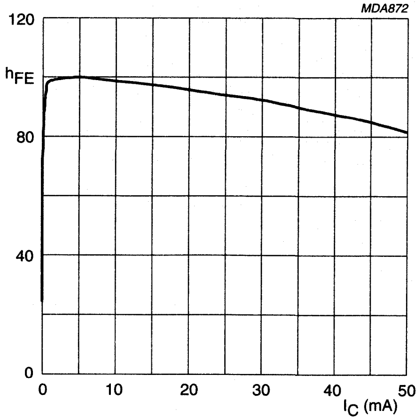
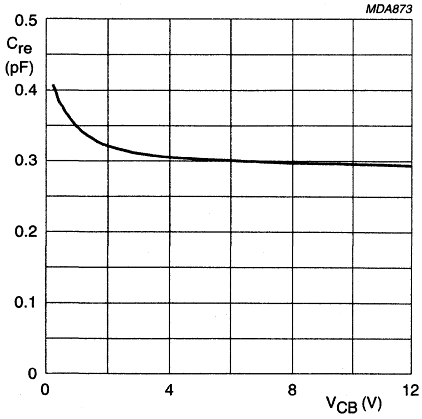


Fig.2 Power derating as a function of soldering point temperature.



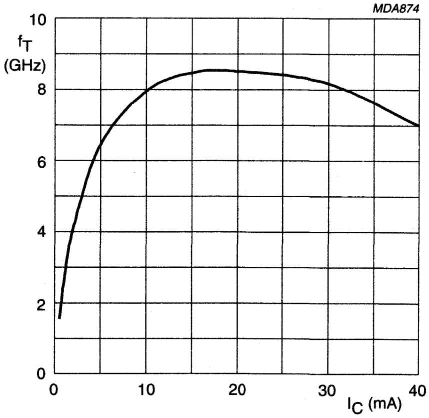
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



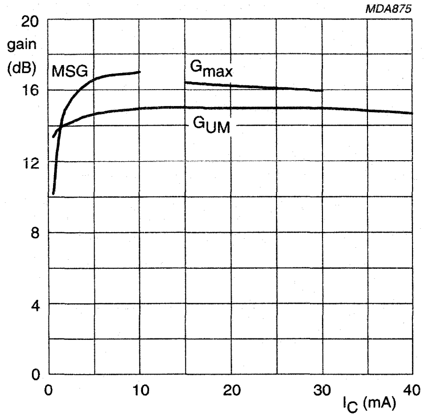
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



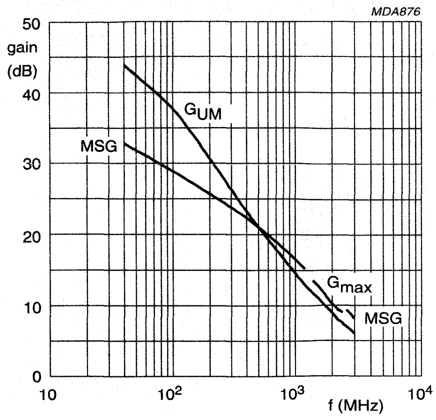
V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



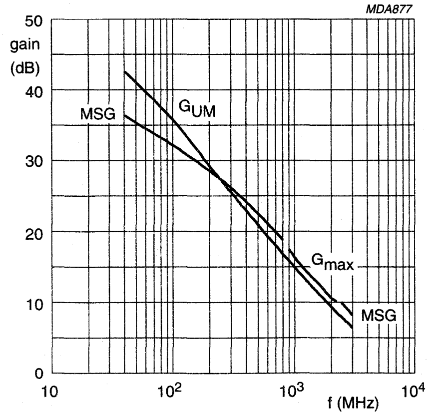
f = 1 GHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



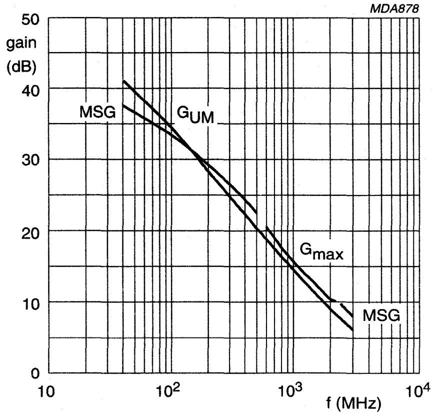
I_C = 5 mA; V_{CE} = 6 V.

Fig.7 Gain as a function of frequency; typical values.



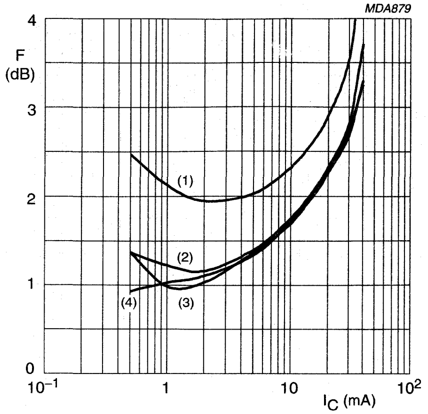
I_C = 15 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



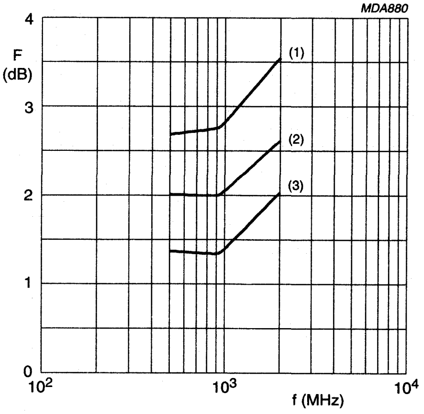
I_C = 30 mA; V_{CE} = 6 V.

Fig.9 Gain as a function of frequency; typical values.



V_{CE} = 6 V.
(1) f = 2000 MHz.
(2) f = 1000 MHz.
(3) f = 500 MHz.
(4) f = 900 MHz.

Fig.10 Minimum noise figure as a function of collector current, typical values.



V_{CE} = 6 V.
(1) I_C = 30 mA.
(2) I_C = 15 mA.
(3) I_C = 5 mA.

Fig.11 Minimum noise figure as a function of frequency, typical values.

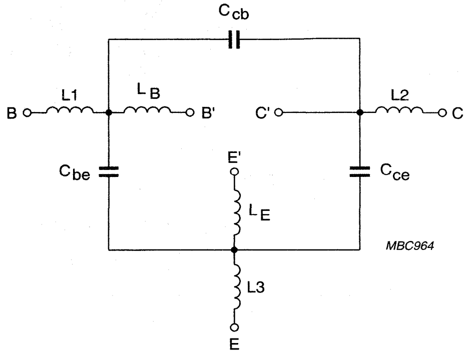
APPLICATION INFORMATION

SPICE parameters for the PBR941 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.466	fA
2	BF	150.4	–
3	NF	1.000	–
4	VAF	53.06	V
5	IKF	180.0	mA
6	ISE	57.30	fA
7	NE	2.000	–
8	BR	27.68	–
9	NR	1.000	–
10	VAR	1.976	V
11	IKR	9.943	mA
12	ISC	1.420	aA
13	NC	1.000	–
14	RB	12.14	Ω
15	IRB	0.000	µA
16	RBM	4.957	Ω
17	RE	0.597	Ω
18	RC	1.988	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	0.568	pF
23	VJE	600.0	mV
24	MJE	0.412	–
25	TF	2.037	ps
26	XTF	30.90	–
27	VTF	3.148	V
28	ITF	131.8	mA
29	PTF	0.000	deg
30	CJC	205.8	fF
31	VJC	296.2	mV
32	MJC	0.118	–
33	XCJC	0.104	–
34	TR	0.000	ps
35(1)	CJS	0.000	F
36(1)	VJS	700.0	mV
37(1)	MJS	0.000	–
38	FC	0.943	–
39(2)	C_{bpb}	83.00	fF
40(2)	C_{bpe}	84.00	fF
41	AF	1.000	–
42	KF	4×10^{-16}	–

Notes

1. These parameters have not been extracted, the default values are shown.
2. C_{bpb}, C_{bpe}; base-bondpad and emitter-bondpad capacitance to collector.

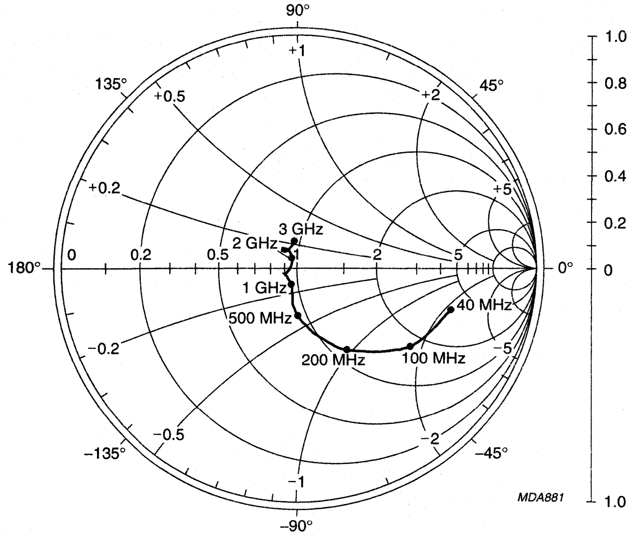


$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.12 Package equivalent circuit SOT23.

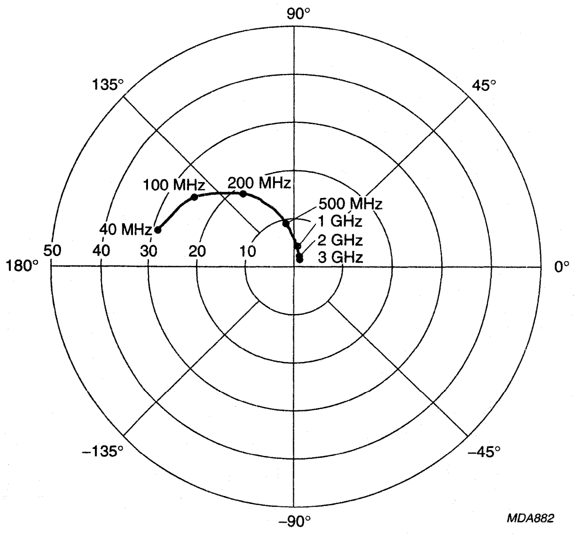
List of components (see Fig.12)

DESIGNATION	VALUE	UNIT
C_{be}	7	fF
C_{cb}	80	fF
C_{ce}	80	fF
L1	0.35	nH
L2	0.17	nH
L3	0.35	nH
L_B	0.40	nH
L_E	0.83	nH



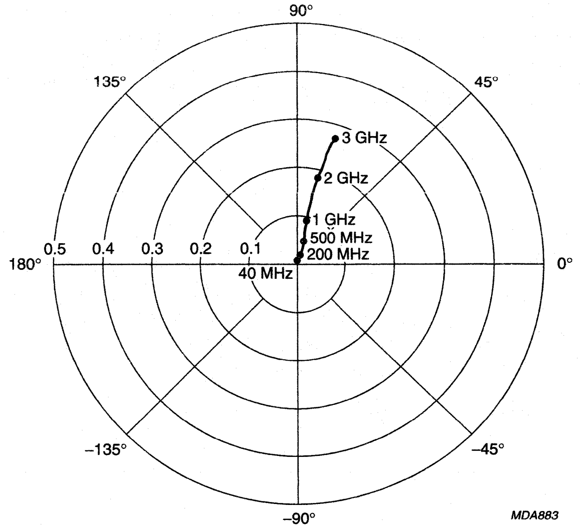
V_{CE} = 6 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.13 Common emitter input reflection coefficient (S_{11}); typical values.



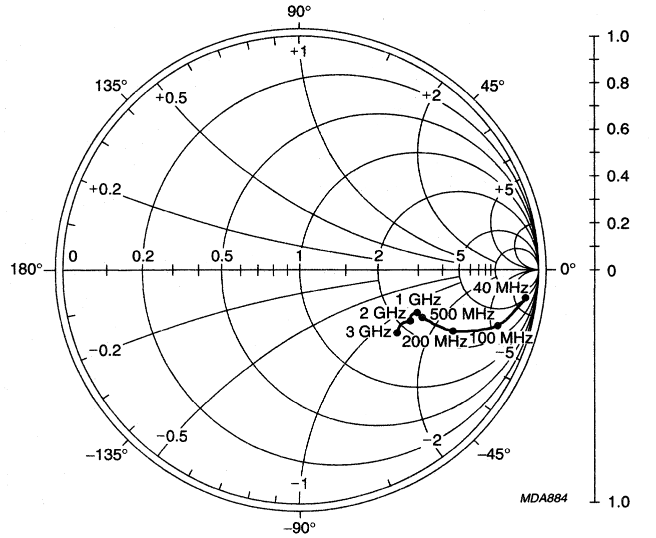
V_{CE} = 6 V; I_C = 15 mA.

Fig.14 Common emitter forward transmission coefficient (S_{21}); typical values.



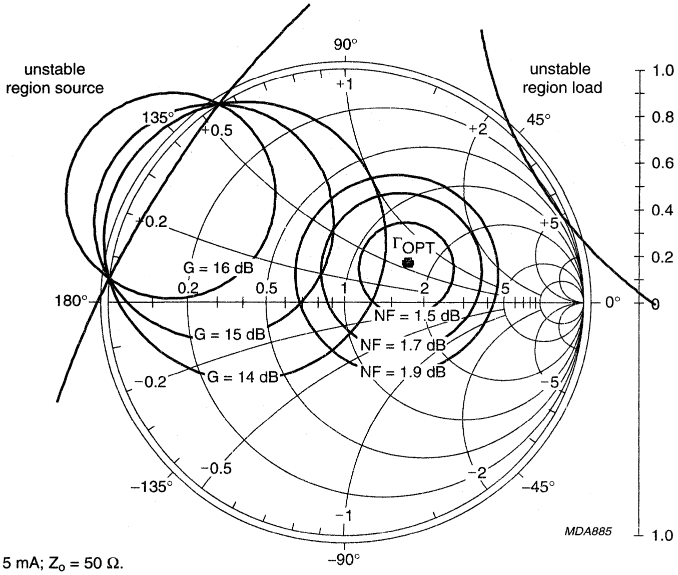
V_{CE} = 6 V; I_C = 15 mA.

Fig.15 Common emitter reverse transmission coefficient (S_{12}); typical values.



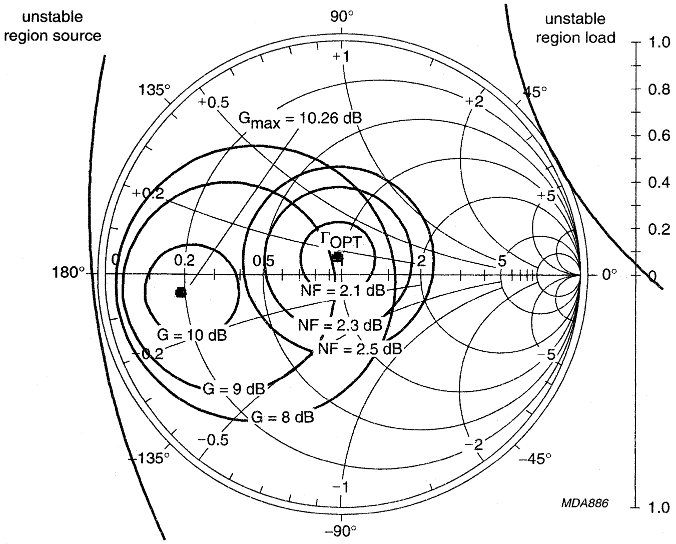
V_{CE} = 6 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.16 Common emitter output reflection coefficient (S_{22}); typical values.



f = 1 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.17 Common emitter available gain circles; typical values.



f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.18 Common emitter available gain circles; typical values.

UHF wideband transistor PBR951

FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

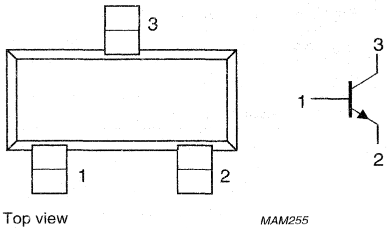
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT23 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING - SOT23

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: W2.

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	0.4	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	8	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 1 GHz	14	–	dB
F	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	1.3	–	dB
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	365	mW
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$P_{tot} = 365$ mW	–	315	K/W

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	1.5	V
I_C	collector current (DC)		–	100	mA
$I_{C(AV)}$	average collector current		–	100	mA
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	365	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point; note 1	$P_{tot} = 365$ mW; $T_s = 60$ °C; note 1	315	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 100\ \mu A$; $I_B = 0$	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 10\ \mu A$; $I_C = 0$	1.5	–	–	V
I_{CBO}	collector-base leakage current	$V_{CB} = 10$ V; $I_E = 0$	–	–	100	nA
I_{EBO}	emitter-base leakage current	$V_{EB} = 1$ V; $I_C = 0$	–	–	100	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	50	100	200	
		$I_C = 15$ mA; $V_{CE} = 6$ V	–	100	–	
AC characteristics						
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	–	8	–	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	14	–	dB
		$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	8	–	dB
F	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	1.3	–	dB
		$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz	–	2	–	dB

Note

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

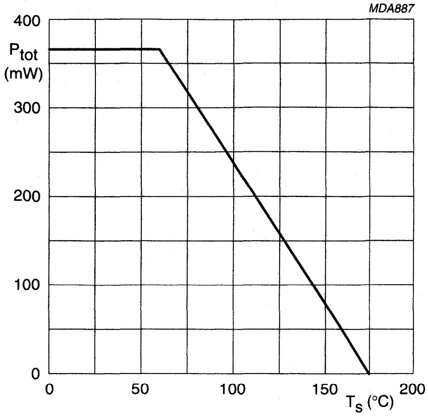
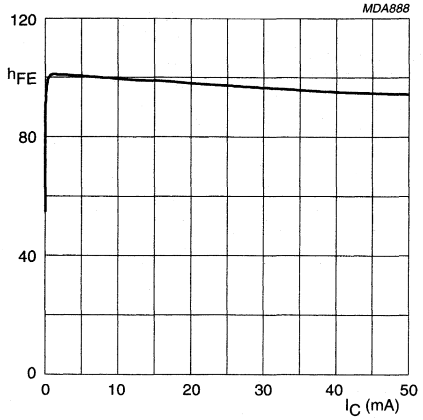
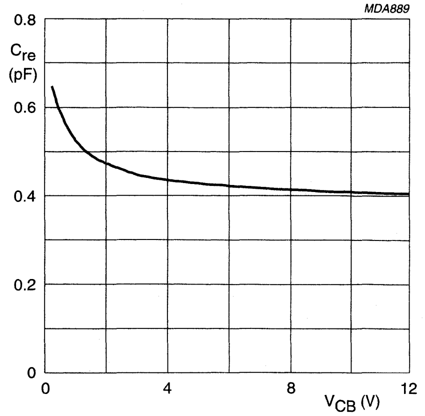


Fig.2 Power derating as a function of soldering point temperature.



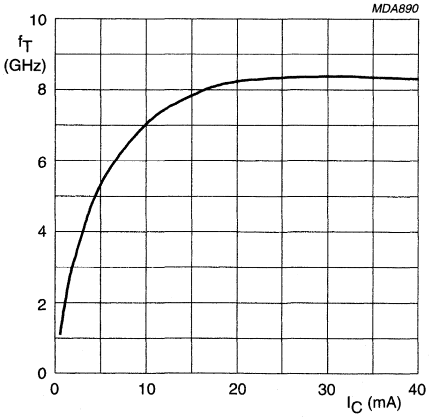
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



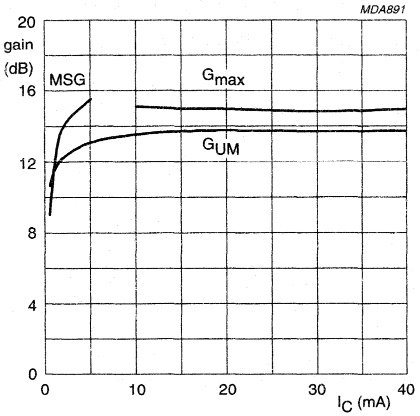
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



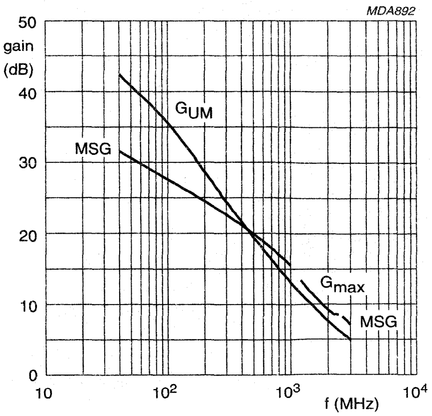
V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



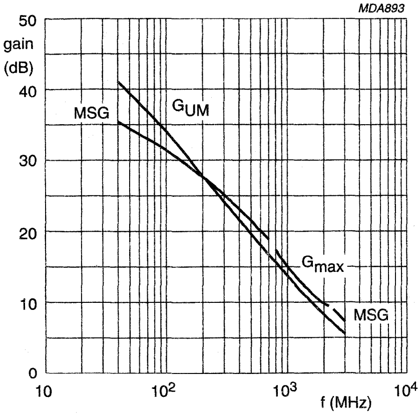
f = 1 GHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



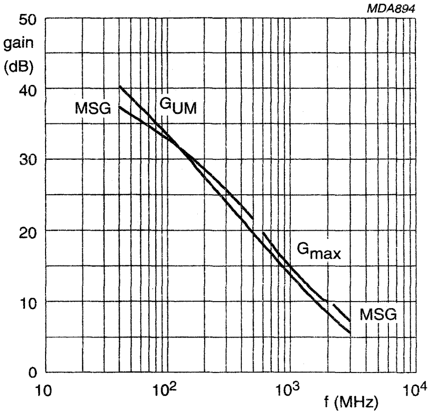
I_C = 5 mA; V_{CE} = 6 V.

Fig.7 Gain as a function of frequency; typical values.



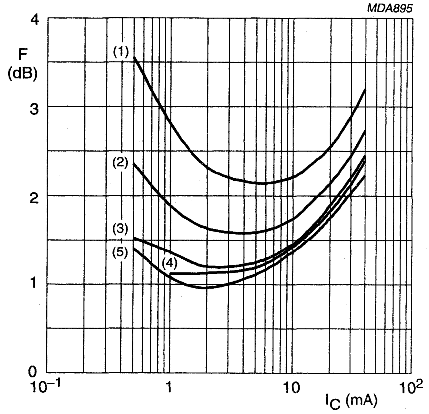
I_C = 15 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



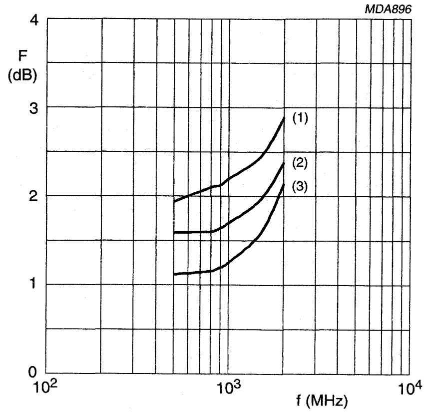
I_C = 30 mA; V_{CE} = 6 V.

Fig.9 Gain as a function of frequency; typical values.



V_{CE} = 6 V.
(1) f = 2000 MHz.
(2) f = 1500 MHz.
(3) f = 1000 MHz.
(4) f = 900 MHz.
(5) f = 500 MHz.

Fig.10 Minimum noise figure as a function of collector current, typical values.



V_{CE} = 6 V.
(1) I_C = 30 mA.
(2) I_C = 15 mA.
(3) I_C = 5 mA.

Fig.11 Minimum noise figure as a function of frequency, typical values.

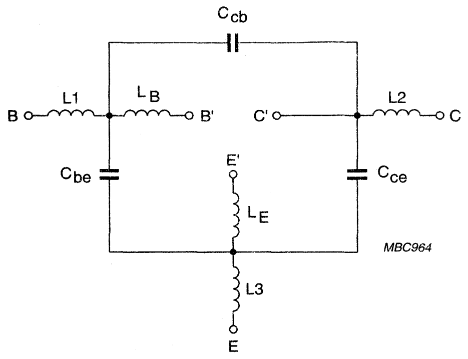
APPLICATION INFORMATION

SPICE parameters for the PBR951 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.963	fA
2	BF	102.3	–
3	NF	1.002	–
4	VAF	64.75	V
5	IKF	841.1	mA
6	ISE	35.77	fA
7	NE	2.138	–
8	BR	90.16	–
9	NR	1.000	–
10	VAR	3.198	V
11	IKR	25.77	mA
12	ISC	156.6	aA
13	NC	1.047	–
14	RB	6.071	Ω
15	IRB	0.000	μA
16	RBM	2.478	Ω
17	RE	0.164	Ω
18	RC	1.315	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.161	pF
23	VJE	600.0	mV
24	MJE	0.394	–
25	TF	3.073	ps
26	XTF	10.25	–
27	VTF	4.599	V
28	ITF	53.49	mA
29	PTF	0.000	deg
30	CJC	409.9	fF
31	VJC	287.1	mV
32	MJC	0.111	–
33	XCJC	0.104	–
34	TR	0.000	ps
35(1)	CJS	0.000	F
36(1)	VJS	700.0	mV
37(1)	MJS	0.000	–
38	FC	0.888	–
39(2)	C_{bpb}	73.00	fF
40(2)	C_{bpe}	131.00	fF
41	AF	1.000	–
42	KF	4×10^{-16}	–

Notes

1. These parameters have not been extracted, the default values are shown.
2. C_{bpb}, C_{bpe}; base-bondpad and emitter-bondpad capacitance to collector.

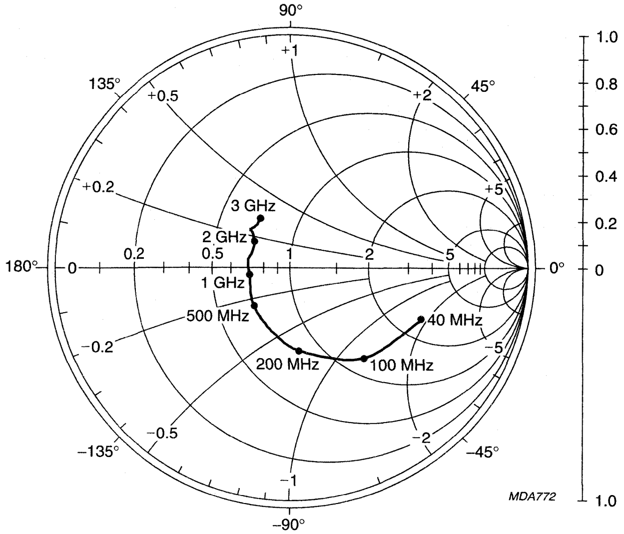


$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.12 Package equivalent circuit SOT23.

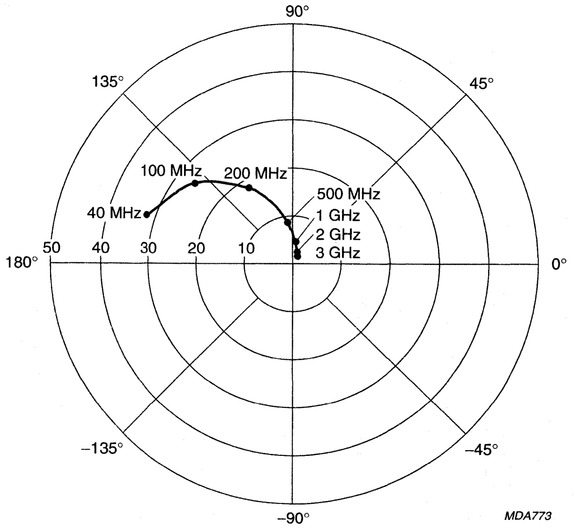
List of components (see Fig.12)

DESIGNATION	VALUE	UNIT
C_{be}	7	fF
C_{cb}	80	fF
C_{ce}	80	fF
L1	0.35	nH
L2	0.17	nH
L3	0.35	nH
L_B	0.40	nH
L_E	0.83	nH



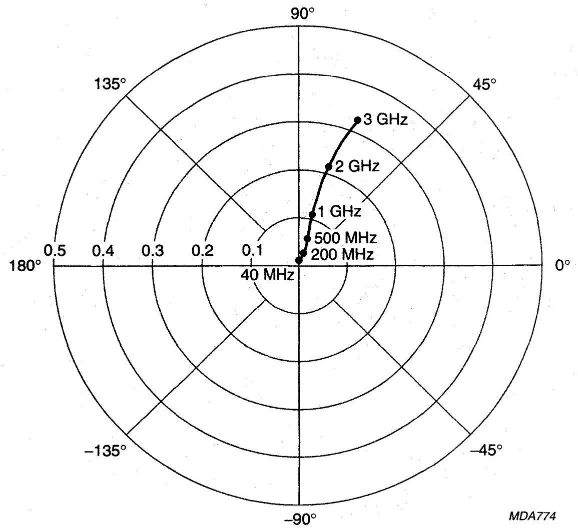
V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.13 Common emitter input reflection coefficient (S_{11}); typical values.



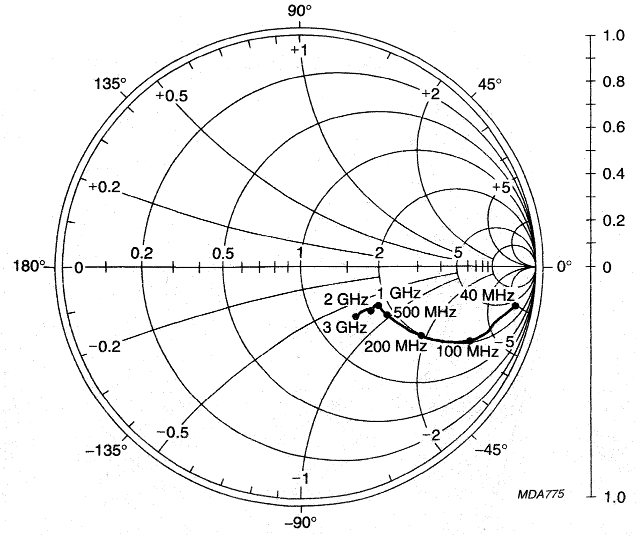
V_{CE} = 6 V; I_C = 30 mA.

Fig.14 Common emitter forward transmission coefficient (S_{21}); typical values.



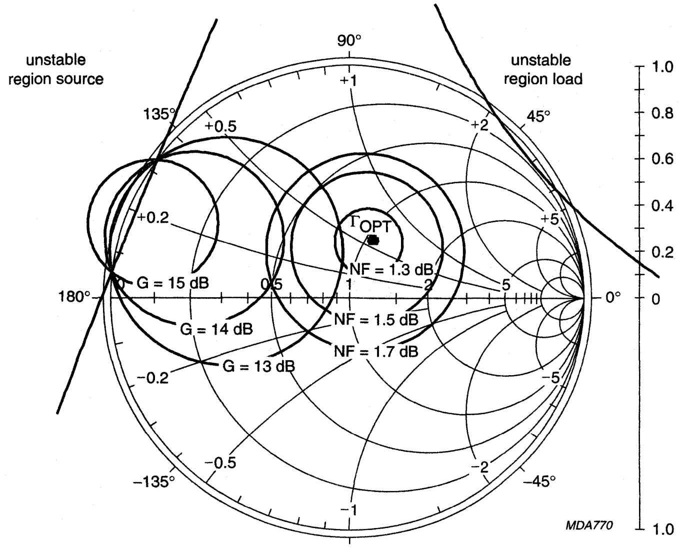
V_{CE} = 6 V; I_C = 30 mA.

Fig.15 Common emitter reverse transmission coefficient (S_{12}); typical values.



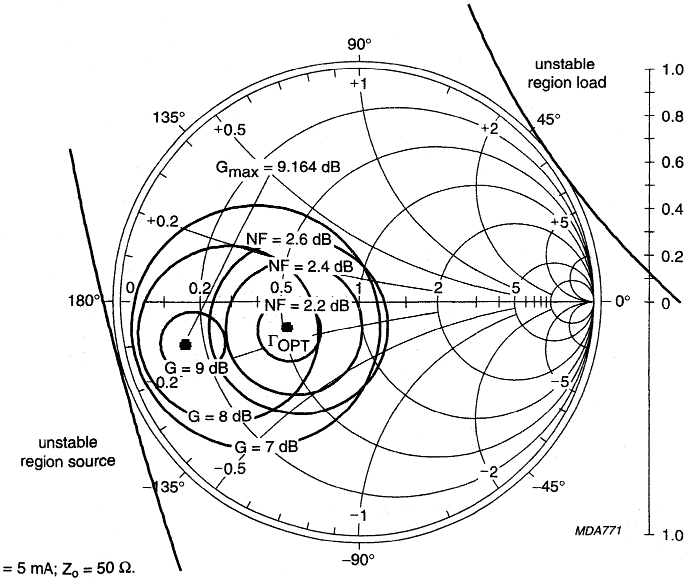
V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.16 Common emitter output reflection coefficient (S_{22}); typical values.



f = 1 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.17 Common emitter available gain circles; typical values.



f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.18 Common emitter available gain circles; typical values.

PNP 1 GHz switching transistor PMBT3640

DESCRIPTION

PNP general purpose switching transistor in a SOT23 package.

PINNING

PIN	DESCRIPTION
Code: V25	
1	base
2	emitter
3	collector

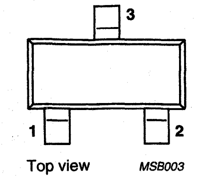


Fig.1 SOT23.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{CBO}$	collector-base voltage	open emitter	–	12	V
$-V_{CEO}$	collector-emitter voltage	open base	–	12	V
$-V_{EBO}$	emitter-base voltage	open collector	–	4	V
$-I_C$	DC collector current		–	80	mA
P_{tot}	total power dissipation	up to T_s = 85 °C (note 1)	–	350	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

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

PNP 1 GHz switching transistor PMBT3640

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Off characteristics					
$-V_{(BR)CBO}$	collector-base breakdown voltage	$-I_C = 100\ \mu A$; $I_E = 0$	12	–	V
$-V_{(BR)CES}$	collector-emitter breakdown voltage	$-I_C = 100\ \mu A$; $V_{BE} = 0$	12	–	V
$-V_{(BR)EBO}$	emitter-base breakdown voltage	$-I_E = 100\ \mu A$; $I_C = 0$	4	–	V
$-I_{CES}$	collector cut-off current	$-V_{CE} = 6$ V; $V_{BE} = 0$	–	0.01	μA
		$-V_{CE} = 6$ V; $V_{BE} = 0$; $T_{amb} = 65$ °C	–	1	μA
$-I_B$	base current	$-V_{CE} = 6$ V; $V_{BE} = 0$	–	10	nA
On characteristics; pulse test: pulse width ≤ 300 μs, duty cycle ≤ 2%.					
h_{FE}	DC current gain	$-I_C = 10$ mA; $-V_{CE} = 0.3$ V	30	120	
		$-I_C = 50$ mA; $-V_{CE} = 1$ V	20	–	
$-V_{CEsat}$	collector-emitter saturation voltage	$-I_C = 10$ mA; $-I_B = 1$ mA	–	0.2	V
		$-I_C = 50$ mA; $-I_B = 5$ mA	–	0.6	V
		$-I_C = 10$ mA; $-I_B = 1$ mA; $T_{amb} = 65$ °C	–	0.25	V
$-V_{BEsat}$	base-emitter saturation voltage	$-I_C = 10$ mA; $-I_B = 0.5$ mA	0.75	0.95	V
		$-I_C = 10$ mA; $-I_B = 1$ mA	0.8	1	V
		$-I_C = 50$ mA; $-I_B = 5$ mA	–	1.5	V
Small-signal characteristics					
f_T	transition frequency	$-I_C = 10$ mA; $-V_{CE} = 5$ V; f = 100 MHz	500	–	MHz
C_c	output capacitance	$I_E = 0$; $-V_{CB} = 5$ V; f = 1 MHz	–	3.5	pF
C_e	input capacitance	$I_C = 0$; $-V_{EB} = 0.5$ V; f = 1 MHz	–	3.5	pF
Switching times					
t_d	delay time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-V_{BE(off)} = 1.9$ V; $-I_{B1} = 5$ mA	–	10	ns
t_s	storage time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-I_{B1} = -I_{B2} = 5$ mA	–	20	ns
t_r	rise time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-V_{BE(off)} = 1.9$ V; $-I_{B1} = 5$ mA	–	30	ns
t_f	fall time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-I_{B1} = -I_{B2} = 5$ mA	–	12	ns
t_{on}	turn-on time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-V_{BE(off)} = 1.9$ V; $-I_{B1} = 5$ mA	–	25	ns
		$-V_{CC} = 1.5$ V; $-I_C = 10$ mA; $-I_{B1} = 0.5$ mA	–	60	ns
t_{off}	turn-off time	$-V_{CC} = 6$ V; $-I_C = 50$ mA; $-V_{BE(off)} = 1.9$ V; $-I_{B1} = I_{B2} = 5$ mA	–	35	ns
		$-V_{CC} = 1.5$ V; $-I_C = 10$ mA; $-I_{B1} = I_{B2} = 0.5$ mA	–	75	ns

NPN 1 GHz general purpose switching transistor PMBTH10

FEATURES

- Low cost
- High power gain.

DESCRIPTION

The PMBTH10 is a general purpose silicon npn transistor, encapsulated in a SOT23 plastic envelope. Its pnp complement is the PMBTH81.

PINNING

PIN	DESCRIPTION
Code: V30	
1	base
2	emitter
3	collector

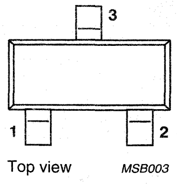


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
P_{tot}	total power dissipation	T_s = 45 °C (note 1)	–	400	mW
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 4 mA	60	–	
C_{re}	collector-emitter feedback capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	650	–	MHz
r_bC_c	collector-base time constant	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	–	9	ps

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	40	mA
P_{tot}	total power dissipation	T_s = 45 °C (note 1)	–	400	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

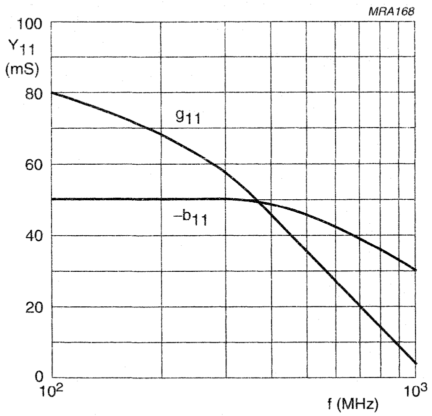
Note

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

CHARACTERISTICS

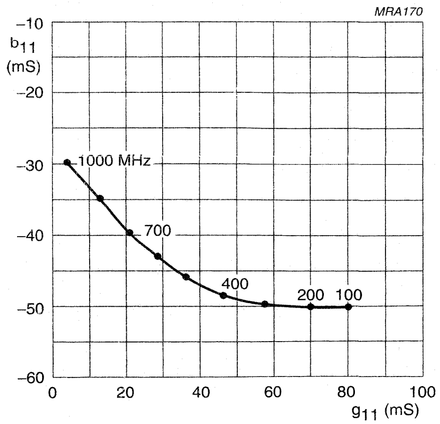
$T_j = 25$ °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 100$ μA; $I_E = 0$	30	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 1$ mA; $I_B = 0$	25	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 10$ μA; $I_C = 0$	3	–	V
$V_{CE\ sat}$	collector-emitter saturation voltage	$I_C = 4$ mA; $I_B = 0.4$ mA	–	0.5	V
$V_{BE\ on}$	base-emitter ON voltage	$V_{CE} = 10$ V; $I_C = 4$ mA	–	0.95	V
I_{CBO}	collector-base cut-off current	$V_{CB} = 25$ V; $I_E = 0$	–	100	nA
I_{EBO}	emitter-base cut-off current	$V_{CB} = 25$ V; $I_C = 0$	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; $I_C = 4$ mA	60	–	
C_{re}	collector-emitter feedback capacitance	$V_{CB} = 10$ V; $I_E = i_e = 0$; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	$V_{CB} = 10$ V; $I_C = i_c = 0$; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 4$ mA; f = 100 MHz; $T_{amb} = 25$ °C	650	–	MHz
r_bC_c	collector-base time constant	$V_{CB} = 10$ V; $I_C = 4$ mA; f = 100 MHz; $T_{amb} = 25$ °C	–	9	ps



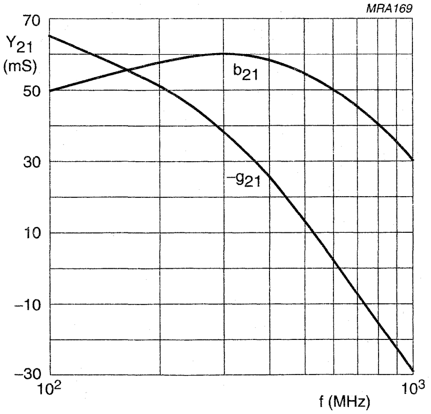
V_{CB} = 10 V; I_C = 4 mA.

Fig.2 Common base input admittance (Y_{11}) as a function of frequency.



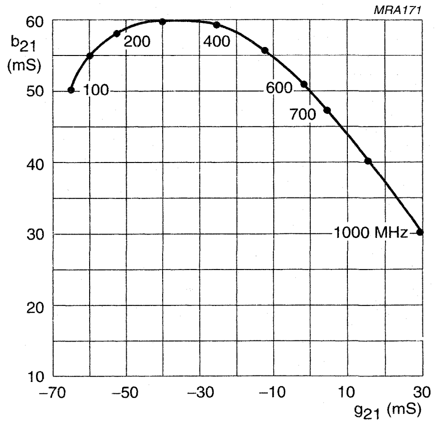
V_{CB} = 10 V; I_C = 4 mA.

Fig.3 Common base input admittance (Y_{11}).



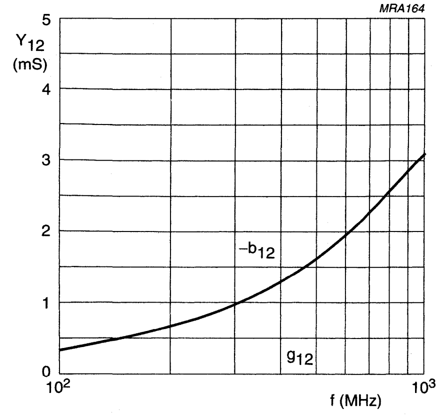
V_{CB} = 10 V; I_C = 4 mA.

Fig.4 Common base forward transfer admittance (Y_{21}) as a function of frequency.



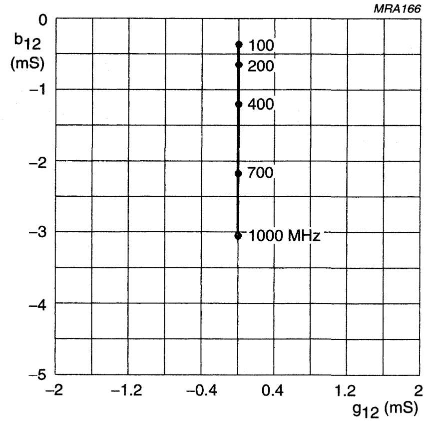
V_{CB} = 10 V; I_C = 4 mA.

Fig.5 Common base forward transfer admittance (Y_{21}).



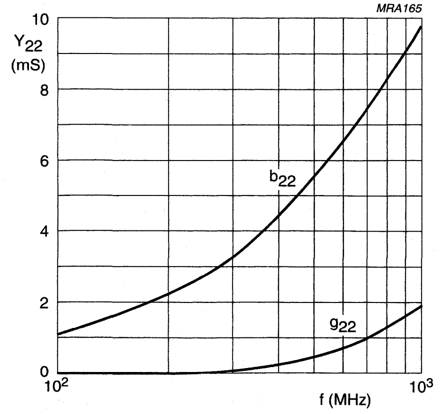
V_{CB} = 10 V; I_C = 4 mA.

Fig.6 Common base reverse transfer admittance (Y_{12}) as a function of frequency.



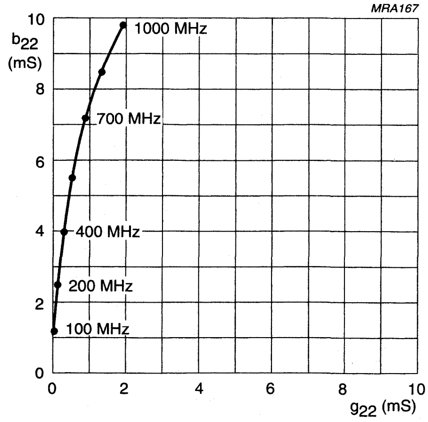
V_{CB} = 10 V; I_C = 4 mA.

Fig.7 Common base reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; I_C = 4 mA.

Fig.8 Common base reverse admittance (Y_{22}) as a function of frequency.



V_{CB} = 10 V; I_C = 4 mA.

Fig.9 Common base reverse admittance (Y_{22}).

PNP 1 GHz switching transistor PMBTH81

FEATURES

- Low cost
- High transition frequency.

DESCRIPTION

The PMBTH81 is a general purpose silicon pnp transistor, encapsulated in a SOT23 plastic envelope. Its complement is the PMBTH10.

PINNING

PIN	DESCRIPTION
Code: V31	
1	base
2	emitter
3	collector

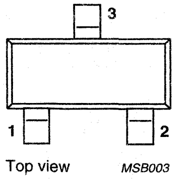


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
P_{tot}	total power dissipation	T_s = 45 °C (note 1)	–	400	mW
C_{ce}	collector-emitter capacitance	V_{CB} = 10 V; I_B = 0; f = 1 MHz	–	0.65	pF
C_{cb}	collector-base capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	–	0.85	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 5 mA; f = 100 MHz; T_{amb} = 25 °C	600	–	MHz

Note

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

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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	40	mA
P_{tot}	total power dissipation	$T_s = 45$ °C (note 1)	–	400	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

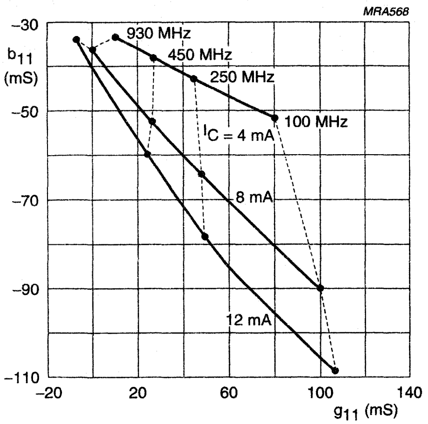
Note

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

CHARACTERISTICS

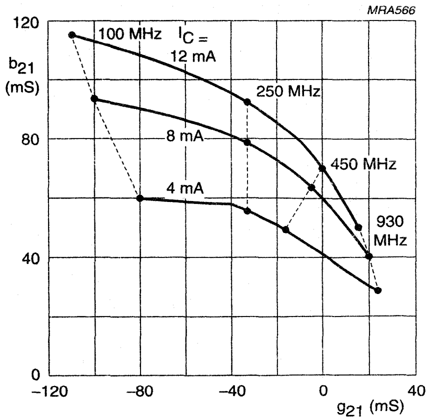
$T_j = 25$ °C

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 10\ \mu A$; $I_E = 0$	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 1$ mA; $I_B = 0$	20	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 10\ \mu A$; $I_C = 0$	3	–	V
$V_{CE\ sat}$	collector-emitter saturation voltage	$I_C = 5$ mA; $I_B = 0.5$ mA	–	0.5	V
$V_{BE\ on}$	base-emitter ON voltage	$V_{CE} = 10$ V; $I_C = 5$ mA	–	0.9	V
I_{CBO}	collector-base cut-off current	$V_{CB} = 10$ V; $I_E = 0$	–	100	nA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 2$ V; $I_C = 0$	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; $I_C = 5$ mA	60	–	
C_{ce}	collector-emitter capacitance	$V_{CB} = 10$ V; $I_B = 0$; f = 1 MHz	–	0.65	pF
C_{cb}	collector-base capacitance	$V_{CB} = 10$ V; $I_E = 0$; f = 1 MHz	–	0.85	pF
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 5$ mA; f = 100 MHz; $T_{amb} = 25$ °C	600	–	MHz



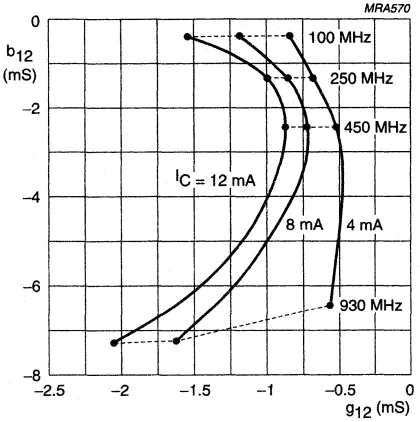
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.2 Common base input admittance (Y_{11}).



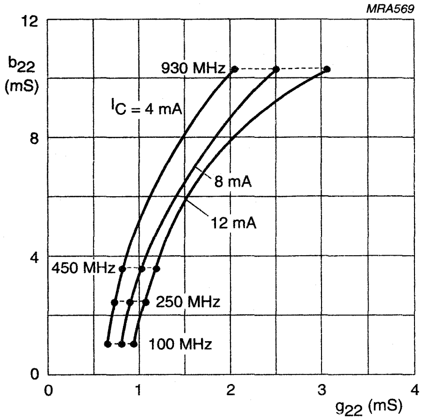
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.3 Forward transfer admittance (Y_{21}).



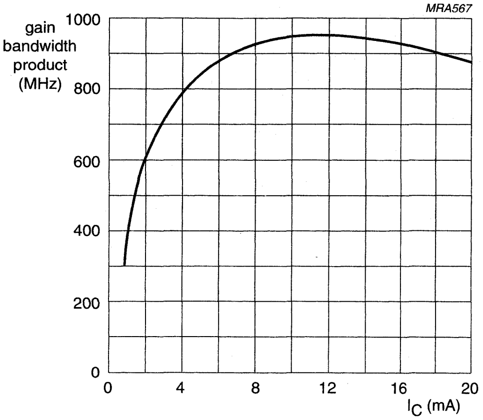
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.4 Reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.5 Common base output admittance (Y_{22}).



V_{CE} =10 V; f = 100 MHz.

Fig.6 Current gain-bandwidth product as a function of collector current.

UHF wideband transistor PRF947

FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

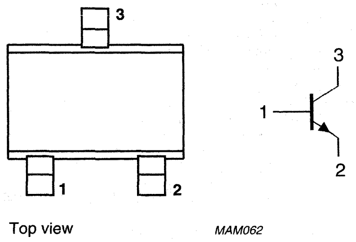
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT323 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: V0.

Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	–	8.5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	1.5	–	dB
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	–	250	mW
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$P_{tot} = 250$ mW	–	–	460	K/W

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	1.5	V
I_C	DC collector current		–	50	mA
$I_{C(AV)}$	average collector current		–	50	mA
P_{tot}	total power dissipation	T_s = 60 °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 250 mW; T_s = 60 °C; note 1	460	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\ \mu A$; $I_E = 0$	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 100\ \mu A$; $I_B = 0$	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 10\ \mu A$; $I_C = 0$	1.5	–	–	V
I_{CBO}	collector-base leakage current	$V_{CB} = 10$ V; $I_E = 0$	–	–	100	nA
I_{EBO}	emitter-base leakage current	$V_{EB} = 1$ V; $I_C = 0$	–	–	100	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	50	100	200	
		$I_C = 15$ mA; $V_{CE} = 6$ V	–	100	–	
AC characteristics						
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	–	8.5	–	GHz
$\lvert s_{21}\rvert^2$	insertion gain	$I_C = 15$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	14.5	–	dB
G_{UM}	maximum unilateral power gain; note 1	$I_C = 15$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	16	–	dB
		$I_C = 15$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	1.5	–	dB
		$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz	–	2.1	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{\lvert s_{21}\rvert^2}{(1-\lvert s_{11}\rvert^2)(1-\lvert s_{22}\rvert^2)}$ dB

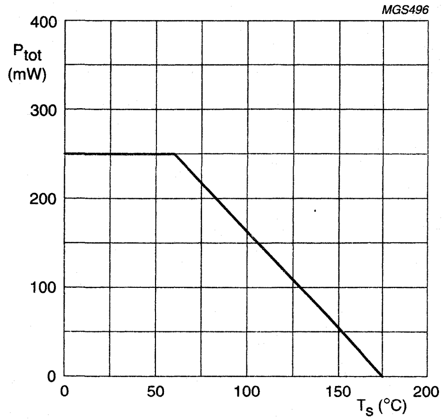
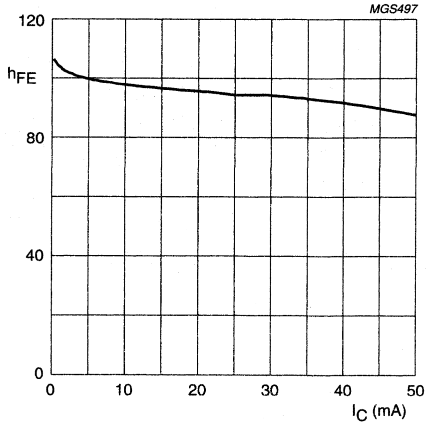
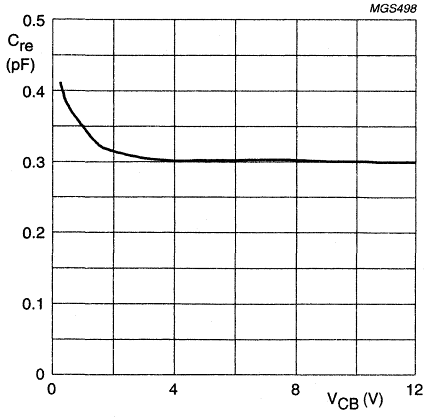


Fig.2 Power derating as a function of soldering point temperature.



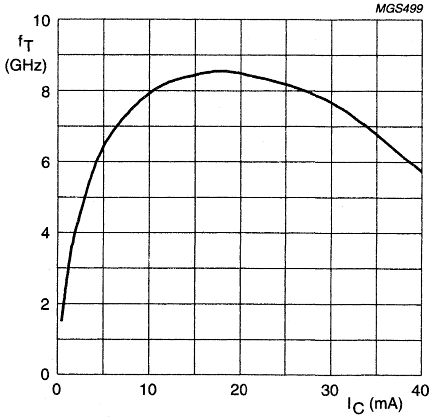
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



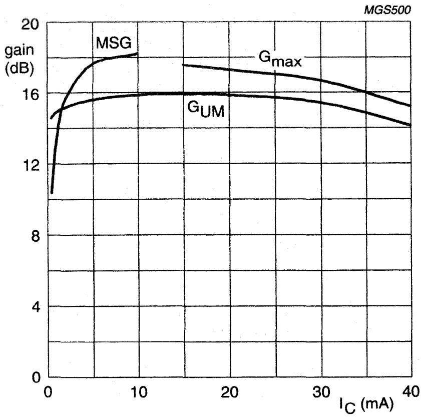
$I_C = I_c = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



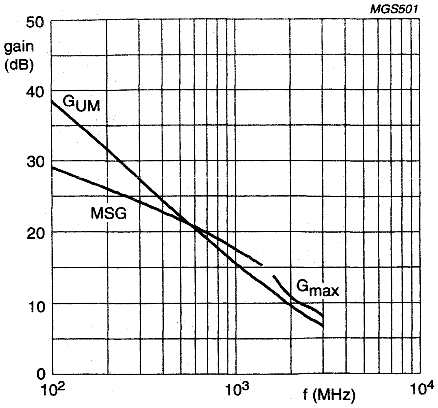
V_{CE} = 6 V; f_m = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



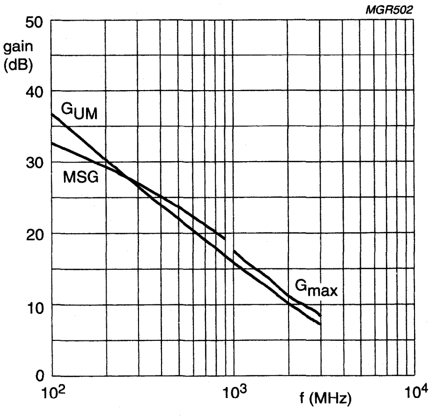
f = 1 GHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



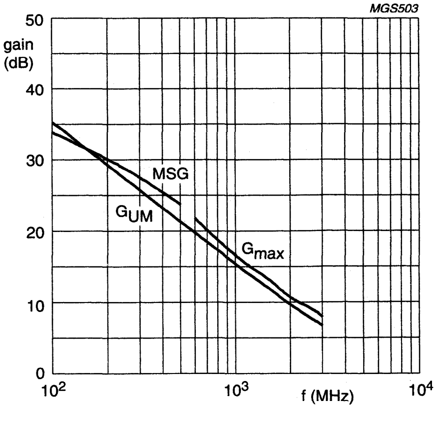
I_C = 5 mA; V_{CE} = 6 V.

Fig.7 Gain as a function of frequency; typical values.



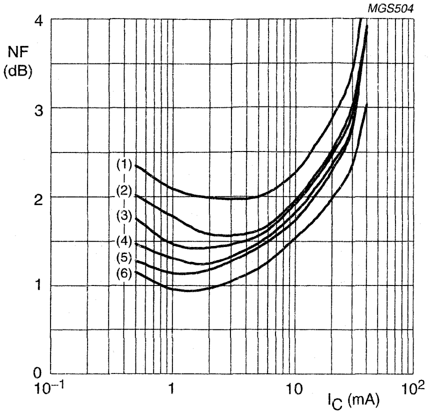
I_C = 15 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



I_C = 30 mA; V_{CE} = 6 V.

Fig.9 Gain as a function of frequency; typical values.



V_{CE} = 6 V.

(1) f = 2 GHz

(2) f = 1.5 GHz

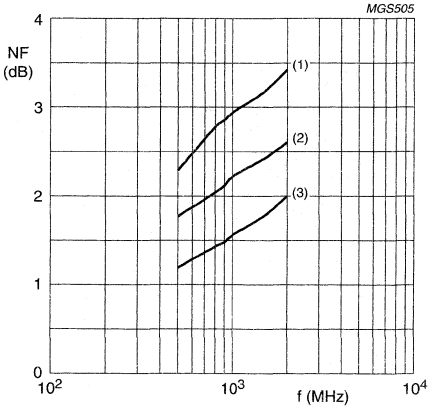
(3) f = 1 GHz

(4) f = 900 MHz

(5) f = 800 MHz

(6) f = 500 MHz.

Fig.10 Minimum noise figure as a function of collector current; typical values.



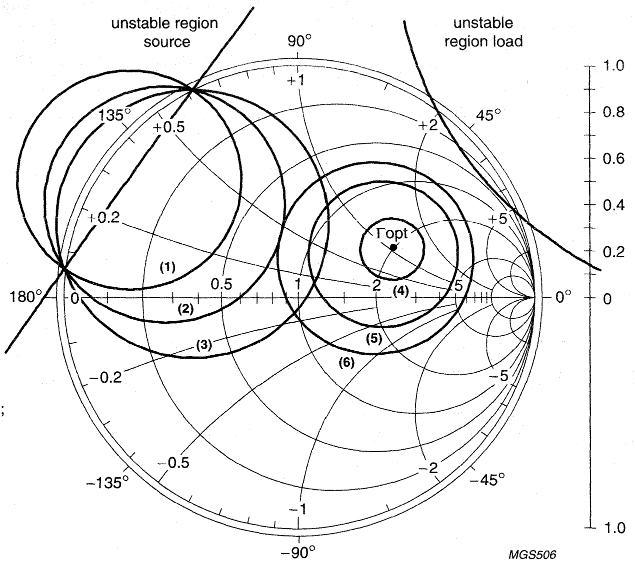
V_{CE} = 6 V.

(1) I_C = 30 mA

(2) I_C = 15 mA

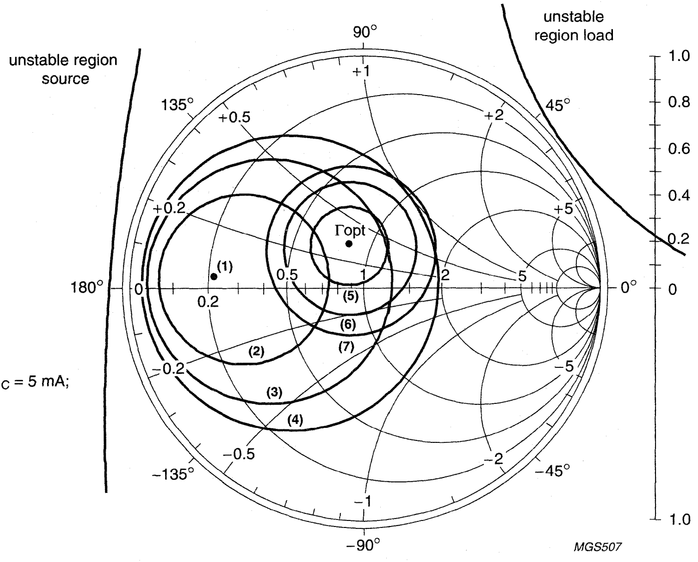
(3) I_C = 5 mA.

Fig.11 Minimum noise figure as a function of frequency; typical values.



f = 1 GHz; V_{CE} = 6 V; I_C = 5 mA;
Z_o = 50 Ω.
(1) G = 17 dB
(2) G = 16 dB
(3) G = 15 dB
(4) NF = 1.6 dB
(5) NF = 1.8 dB
(6) NF = 2 dB.

Fig.12 Common emitter available gain, noise and stability circles; typical values.



f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA;
Z_o = 50 Ω.
(1) G_{max} = 10.9 dB
(2) G = 10 dB
(3) G = 9 dB
(4) G = 8 dB
(5) NF = 2.1 dB
(6) NF = 2.3 dB
(7) NF = 2.5 dB.

Fig.13 Common emitter available gain, noise and stability circles; typical values.

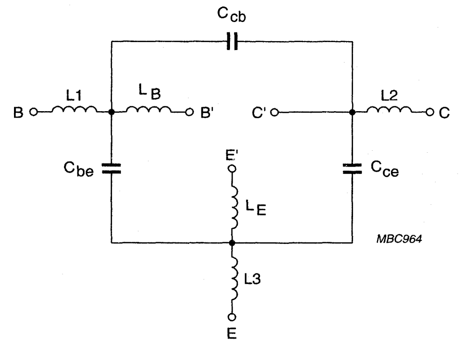
APPLICATION INFORMATION

SPICE parameters for the PRF947 die.

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.466	fA
2	BF	150.4	–
3	NF	1.000	–
4	VAF	53.06	V
5	IKF	180.0	mA
6	ISE	57.30	fA
7	NE	2.000	–
8	BR	27.68	–
9	NR	1.000	–
10	VAR	1.976	V
11	IKR	9.943	mA
12	ISC	1.420	aA
13	NC	1.000	–
14	RB	12.14	Ω
15	IRB	0.000	μA
16	RBM	4.957	Ω
17	RE	0.597	Ω
18	RC	1.988	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	0.568	pF
23	VJE	600.0	mV
24	MJE	0.412	–
25	TF	2.037	ps
26	XTF	30.90	–
27	VTF	3.148	V
28	ITF	131.8	mA
29	PTF	0.000	deg
30	CJC	205.8	fF
31	VJC	296.2	mV
32	MJC	0.118	–
33	XCJC	0.104	–
34	TR	0.000	ps
35(1)	CJS	0.000	F
36(1)	VJS	700.0	mV
37(1)	MJS	0.000	–
38	FC	0.943	–
39(2)	C_{bpb}	83.00	fF
40(2)	C_{bpe}	84.00	fF
41	AF	1.000	–
42	KF	4×10^{-16}	–

Notes

1. These parameters have not been extracted, the default values are shown.
2. C_{bpb}, C_{bpe}: base-bondpad and emitter-bondpad capacitance to collector.

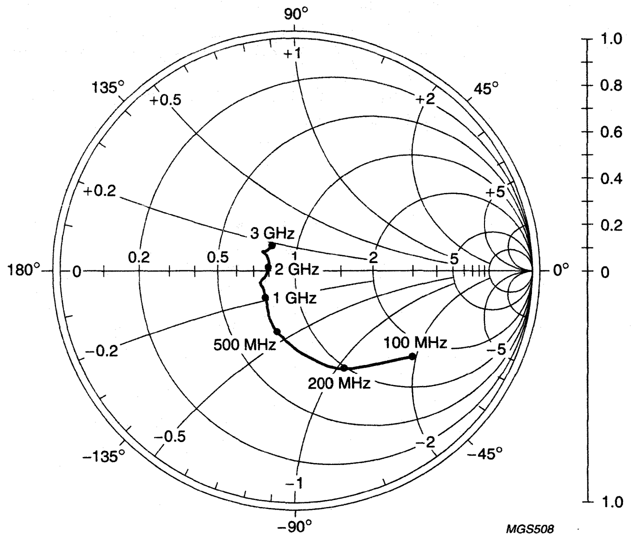


$QL_B = 50$; $QL_E = 50$;
$QL_B(f) = QL_B\sqrt{(f/f_c)}$;
$QL_E(f) = QL_E\sqrt{(f/f_c)}$;
f_c = corner frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT323.

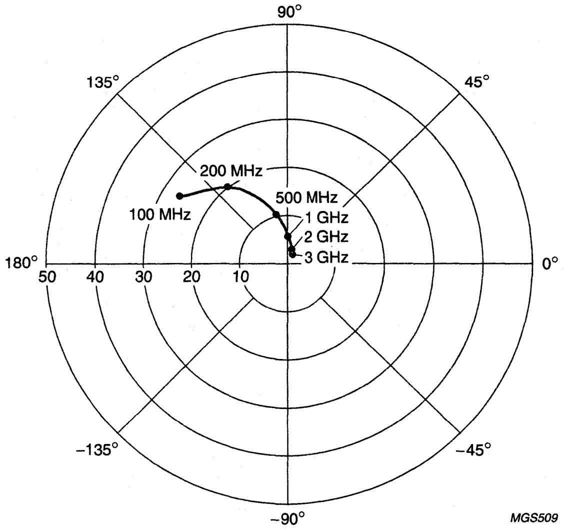
List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH



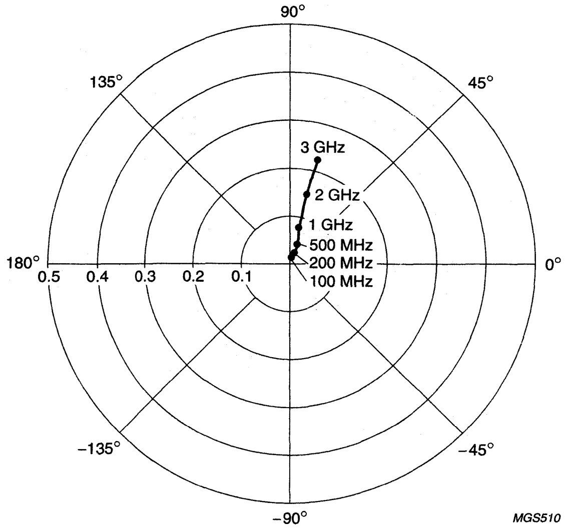
V_{CE} = 6 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



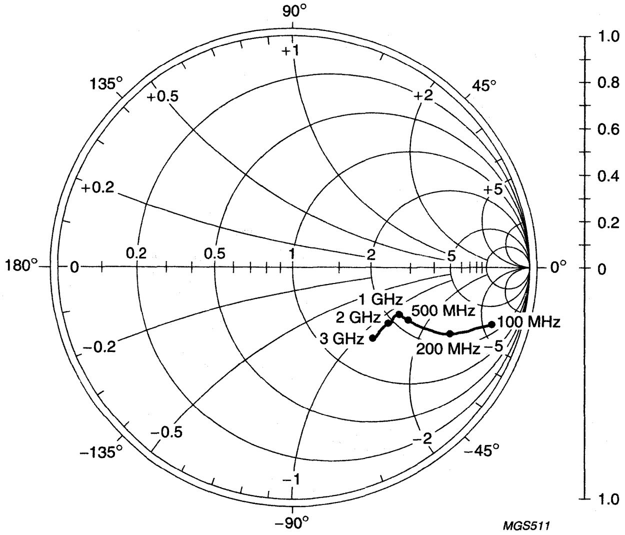
V_{CE} = 6 V; I_C = 15 mA.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 15 mA.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 6 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

UHF wideband transistor PRF957

FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

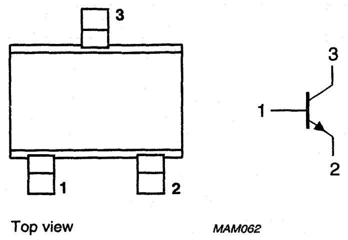
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT323 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: W2.

Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	–	8.5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	15	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	1.3	–	dB
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	–	270	mW
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$P_{tot} = 270$ mW	–	–	425	K/W

Note

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

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	1.5	V
I_C	DC collector current		–	100	mA
$I_{C(AV)}$	average collector current		–	100	mA
P_{tot}	total power dissipation	$T_s = 60$ °C; note 1	–	270	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$P_{tot} = 270$ mW; $T_s = 60$ °C; note 1	425	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics						
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 μA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 100 μA; I_B = 0	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	1.5	–	–	V
I_{CBO}	collector-base leakage current	V_{CB} = 10 V; I_E = 0	–	–	100	nA
I_{EBO}	emitter-base leakage current	V_{EB} = 1 V; I_C = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V	50	100	200	
		I_C = 15 mA; V_{CE} = 6 V	–	100	–	
AC characteristics						
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 6 V; f_m = 1 GHz	–	8.5	–	GHz
$\|s_{21}\|^2$	insertion gain	I_C = 30 mA; V_{CE} = 6 V; f = 1 GHz	–	14	–	dB
G_{UM}	maximum unilateral power gain; note 1	I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
		I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	9.2	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	1.3	–	dB
		$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 2 GHz	–	1.8	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB

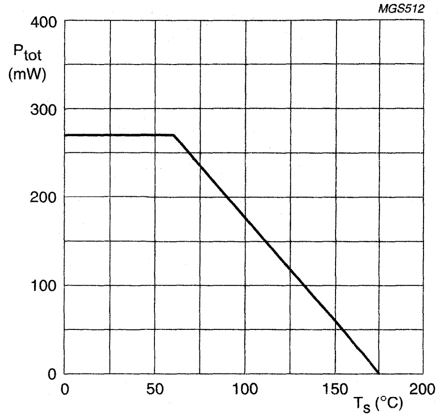
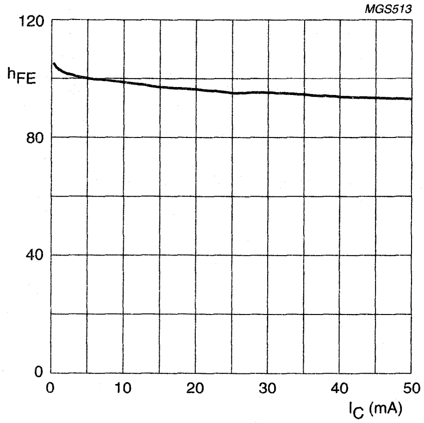
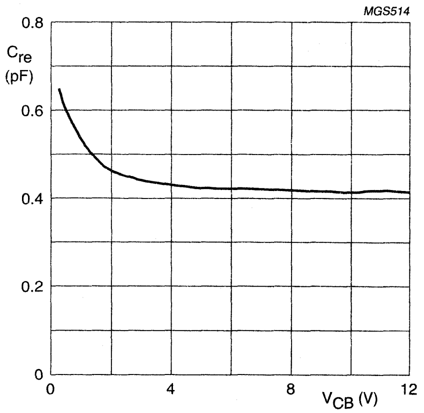


Fig.2 Power derating as a function of soldering point temperature.



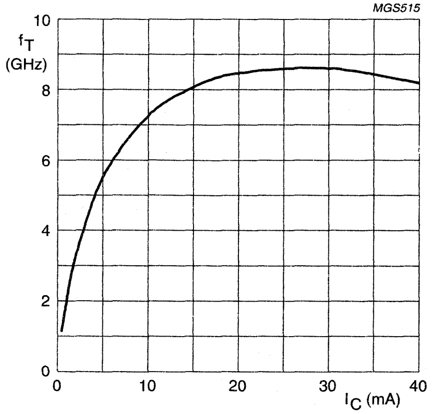
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



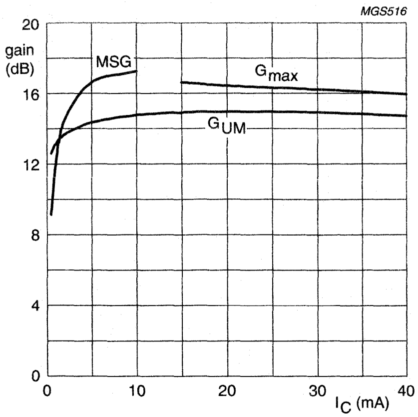
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



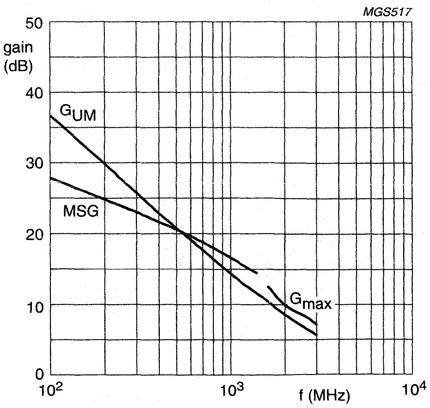
V_{CE} = 6 V; f_m = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



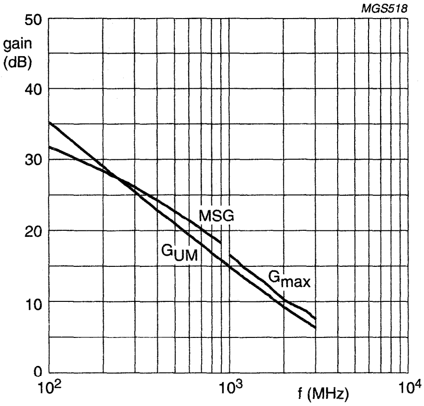
f = 1 GHz; V_{CE} = 6 V.

Fig.6 Gain as a function of collector current; typical values.



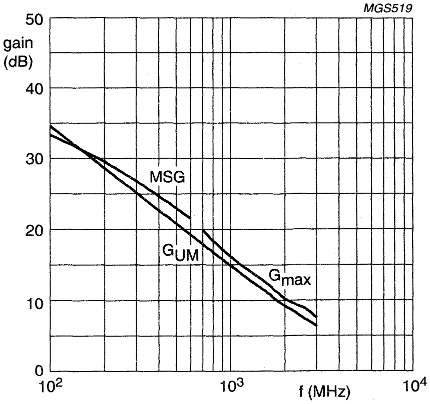
I_C = 5 mA; V_{CE} = 6 V.

Fig.7 Gain as a function of frequency; typical values.



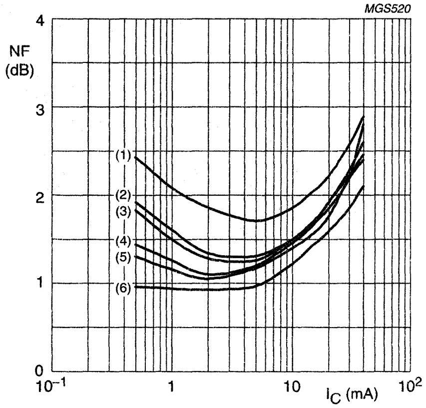
I_C = 15 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



I_C = 30 mA; V_{CE} = 6 V.

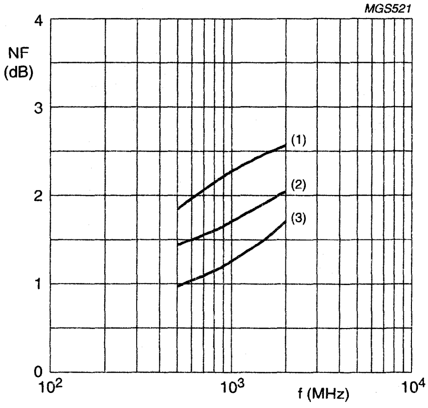
Fig.9 Gain as a function of frequency; typical values.



V_{CE} = 6 V.

(1) f = 2 GHz
(2) f = 1.5 GHz
(3) f = 1 GHz
(4) f = 900 MHz
(5) f = 800 MHz
(6) f = 500 MHz.

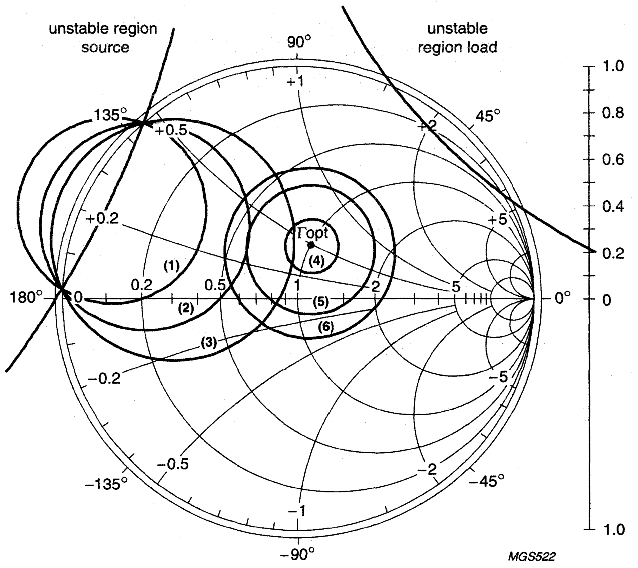
Fig.10 Minimum noise figure as a function of collector current; typical values.



V_{CE} = 6 V.

(1) I_C = 30 mA
(2) I_C = 15 mA
(3) I_C = 5 mA.

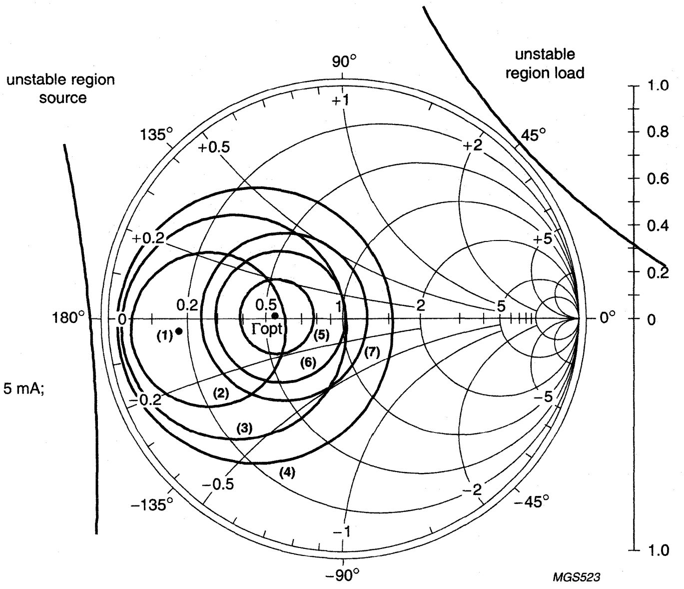
Fig.11 Minimum noise figure as a function of frequency; typical values.



f = 1 GHz; V_{CE} = 6 V; I_C = 5 mA;
Z_o = 50 Ω.

(1) G = 16 dB
(2) G = 15 dB
(3) G = 14 dB
(4) NF = 1.3 dB
(5) NF = 1.5 dB
(6) NF = 1.7 dB.

Fig.12 Common emitter available gain, noise and stability circles; typical values.



f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA;
Z_o = 50 Ω.

(1) G_{max} = 9.95 dB
(2) G = 9 dB
(3) G = 8 dB
(4) G = 7 dB
(5) NF = 1.8 dB
(6) NF = 2 dB
(7) NF = 2.2 dB.

Fig.13 Common emitter available gain, noise and stability circles; typical values.

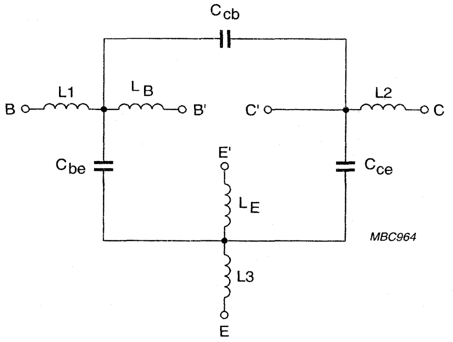
APPLICATION INFORMATION

SPICE parameters for the PRF957 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.963	fA
2	BF	102.3	–
3	NF	1.002	–
4	VAF	64.75	V
5	IKF	841.1	mA
6	ISE	35.77	fA
7	NE	2.138	–
8	BR	90.16	–
9	NR	1.000	–
10	VAR	3.198	V
11	IKR	25.77	mA
12	ISC	156.6	aA
13	NC	1.047	–
14	RB	6.071	Ω
15	IRB	0.000	μA
16	RBM	2.478	Ω
17	RE	0.164	Ω
18	RC	1.315	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.161	pF
23	VJE	600.0	mV
24	MJE	0.394	–
25	TF	3.073	ps
26	XTF	10.25	–
27	VTF	4.599	V
28	ITF	53.49	mA
29	PTF	0.000	deg
30	CJC	409.9	fF
31	VJC	287.1	mV
32	MJC	0.111	–
33	XCJC	0.104	–
34	TR	0.000	ps
35(1)	CJS	0.000	F
36(1)	VJS	700.0	mV
37(1)	MJS	0.000	–
38	FC	0.888	–
39(2)	C_{bpb}	73.00	fF
40(2)	C_{bpe}	131.00	fF

Notes

1. These parameters have not been extracted, the default values are shown.
2. C_{bpb}, C_{bpe}: base-bondpad and emitter-bondpad capacitance to collector.

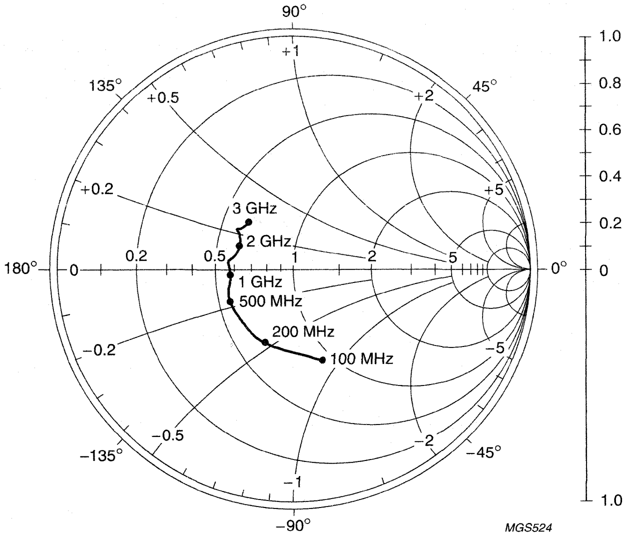


$QL_B = 50$; $QL_E = 50$;
$QL_B(f) = QL_B\sqrt{(f/f_c)}$;
$QL_E(f) = QL_E\sqrt{(f/f_c)}$;
f_c = corner frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT323.

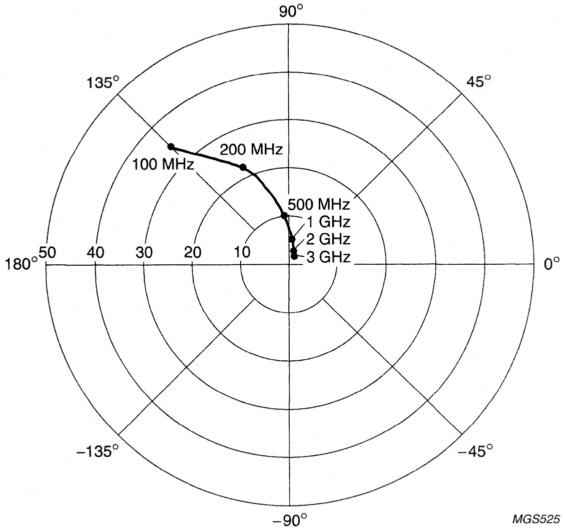
List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH



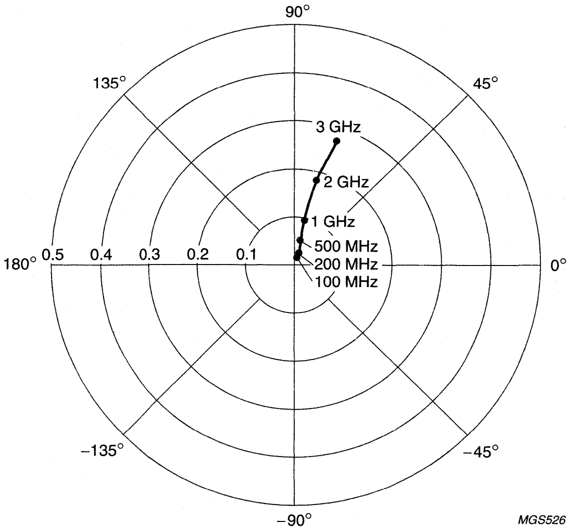
V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



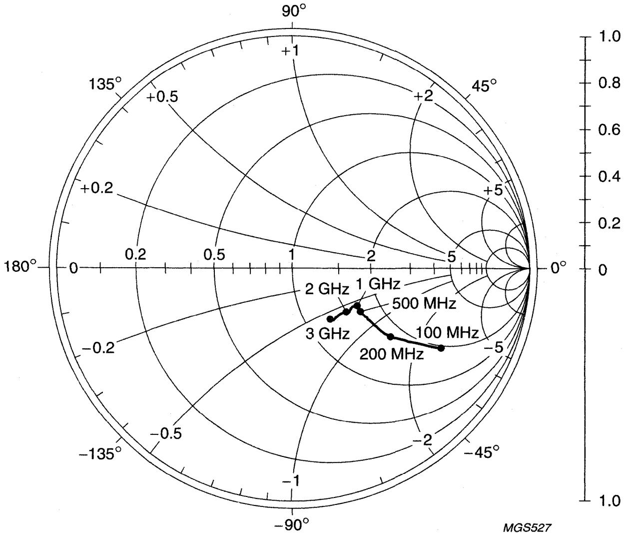
V_{CE} = 6 V; I_C = 30 mA.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 30 mA.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.



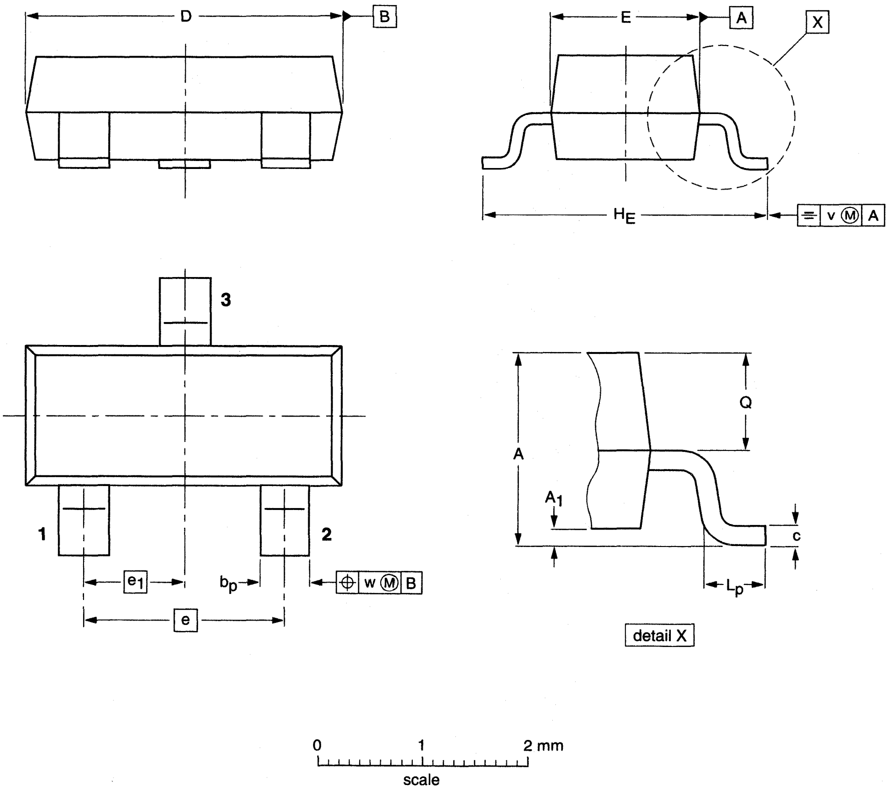
V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

PACKAGE OUTLINES

Package	Surface-mount	Page
SOT23	yes	790
SOT54	no	791
SOT89	yes	792
SOT96-1	yes	793
SOT122A	no	794
SOT122D	no	795
SOT122E	no	796
SOT143B	yes	797
SOT143R	yes	798
SOT172A1	no	799
SOT172A2	no	800
SOT223	yes	801
SOT323	yes	802
SOT343N	yes	803
SOT343R	yes	804
SOT353	yes	805
SOT363	yes	806
SOT551A	yes	807

Plastic surface mounted package; 3 leads **SOT23**

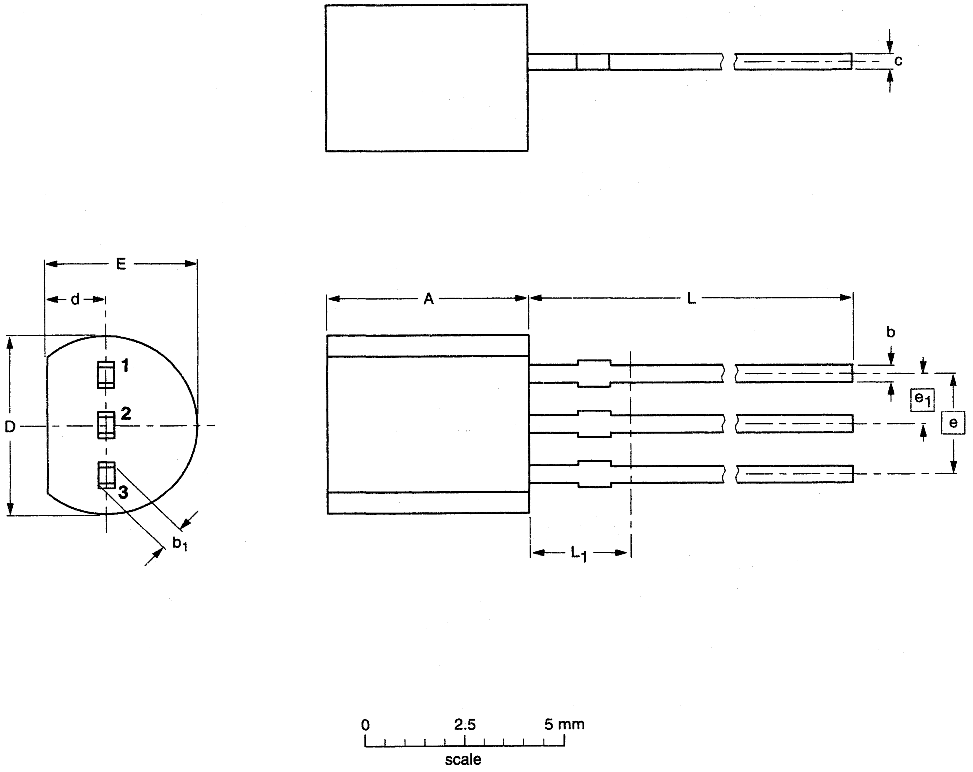


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT23						97-02-28

Plastic single-ended leaded (through hole) package; 3 leads SOT54



DIMENSIONS (mm are the original dimensions)

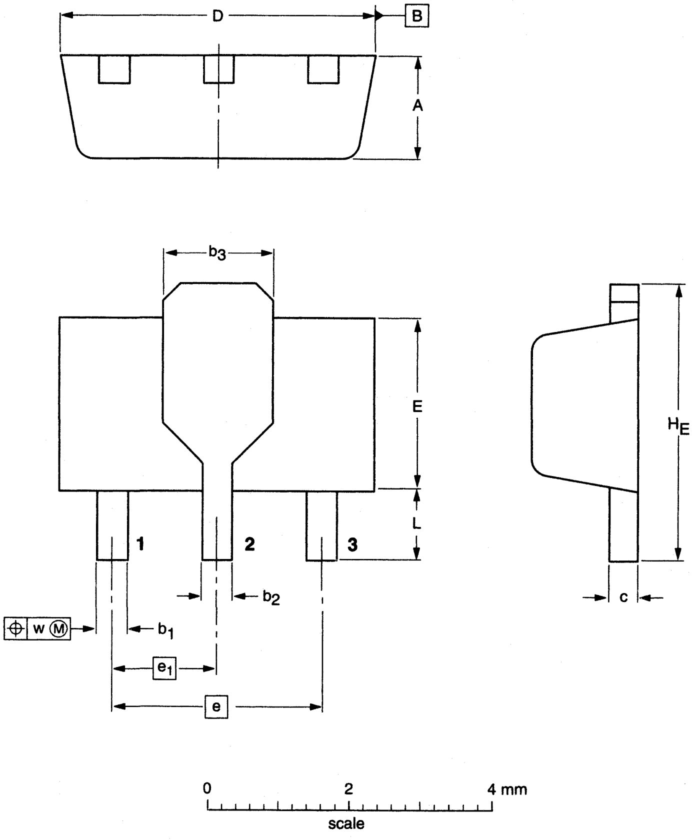
UNIT	A	b	b_1	c	D	d	E	e	e_1	L	$L_1^{(1)}$
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT54		TO-92	SC-43			97-02-28

Plastic surface mounted package; collector pad for good heat transfer; 3 leads SOT89

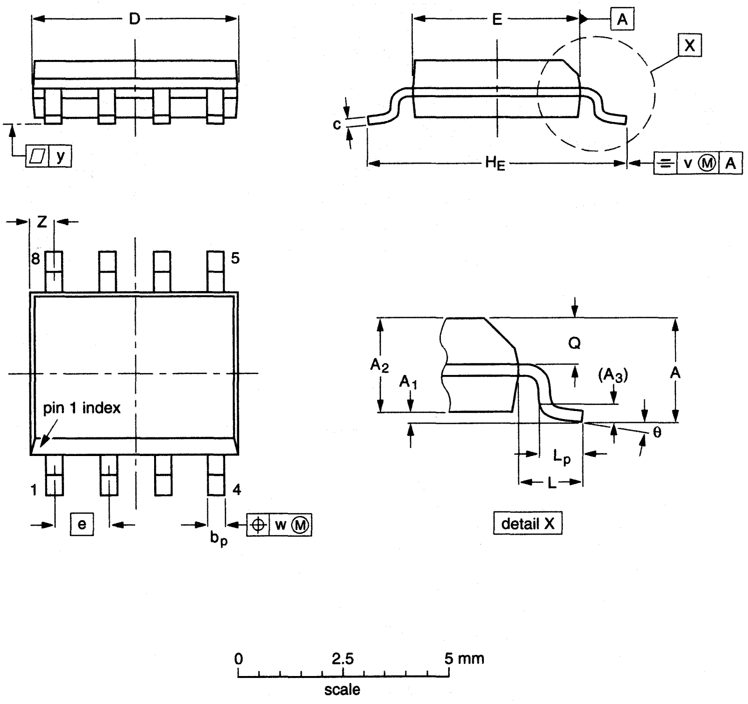


DIMENSIONS (mm are the original dimensions)

UNIT	A	b_1	b_2	b_3	c	D	E	e	e_1	H_E	L min.	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.37	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT89						97-02-28

SO8: plastic small outline package; 8 leads; body width 3.9 mm SOT96-1

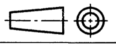


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

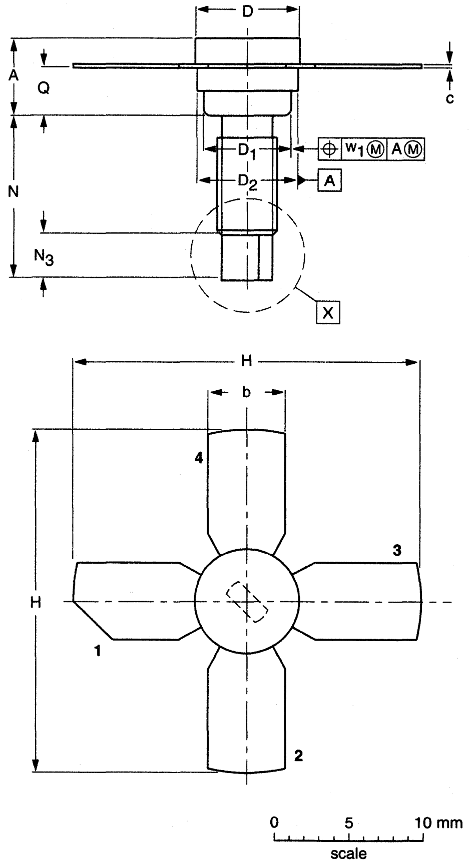
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

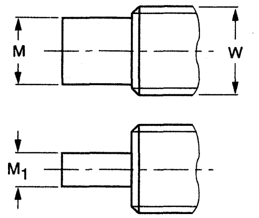
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				~~95-02-04~~ 97-05-22

Studded ceramic package; 4 leads SOT122A





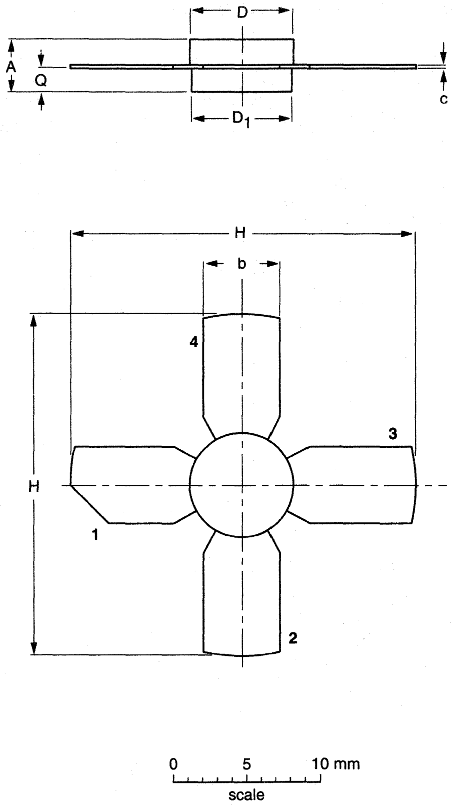
detail X

DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_1	D_2	H	M	M_1	N	N_3	Q	W	w_1
mm	5.92 4.80	5.85 5.58	0.15 0.10	7.50 7.23	6.48 6.22	7.24 6.93	27.43 25.78	3.18 2.67	1.66 1.39	12.95 12.70	3.68 2.92	3.35 2.79	8-32 UNC	0.38
inches	0.233 0.189	0.230 0.220	0.006 0.004	0.295 0.285	0.255 0.245	0.285 0.273	1.080 1.015	0.125 0.105	0.065 0.055	0.510 0.500	0.145 0.115	0.132 0.110		0.015

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122A						99-03-29

Studless ceramic package; 4 leads **SOT122D**

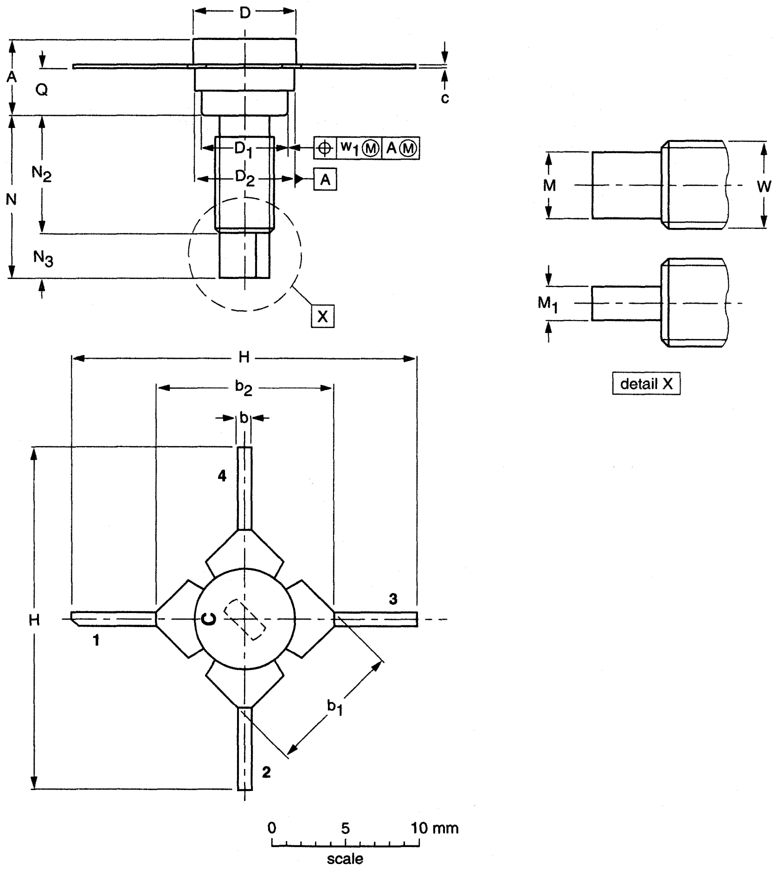


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_1	H	Q
mm	4.14 3.27	5.85 5.58	0.15 0.10	7.50 7.23	7.24 6.99	27.43 25.78	1.57 1.32
inches	0.163 0.129	0.230 0.220	0.006 0.004	0.295 0.285	0.285 0.275	1.080 1.015	0.062 0.052

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122D						99-03-29

Studded ceramic package; 4 leads **SOT122E**

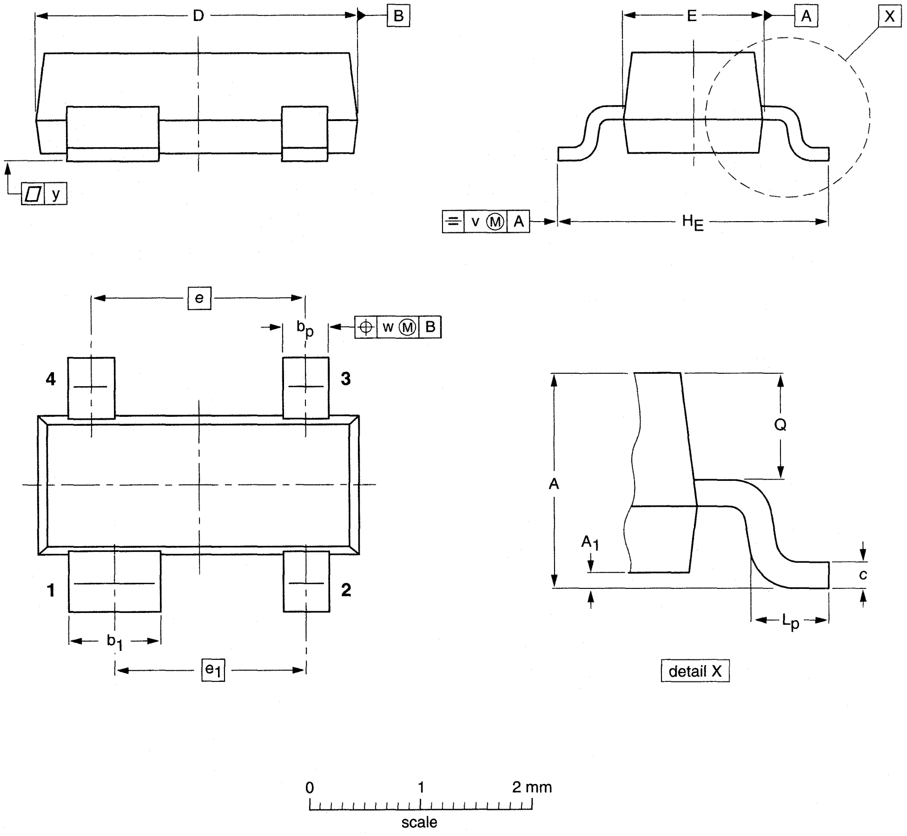


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	b_1	b_2	c	D	D_1	D_2	H	M	M_1	N	N_2	N_3	Q	W	w_1
mm	5.97 4.80	1.05 0.73	10.75 10.43	14.25 13.94	0.18 0.14	7.50 7.23	6.48 6.22	7.16 6.99	27.56 26.29	3.18 2.92	1.63 1.42	11.82 11.04	8.89 7.36	3.68 2.92	3.38 2.79	8-32 UNC	0.38
inches	0.235 0.189	0.041 0.029	0.423 0.411	0.561 0.549	0.007 0.004	0.295 0.285	0.255 0.245	0.282 0.275	1.085 1.035	0.125 0.115	0.064 0.056	0.465 0.435	0.350 0.290	0.145 0.115	0.133 0.110		0.015

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122E						99-03-29

Plastic surface mounted package; 4 leads SOT143B

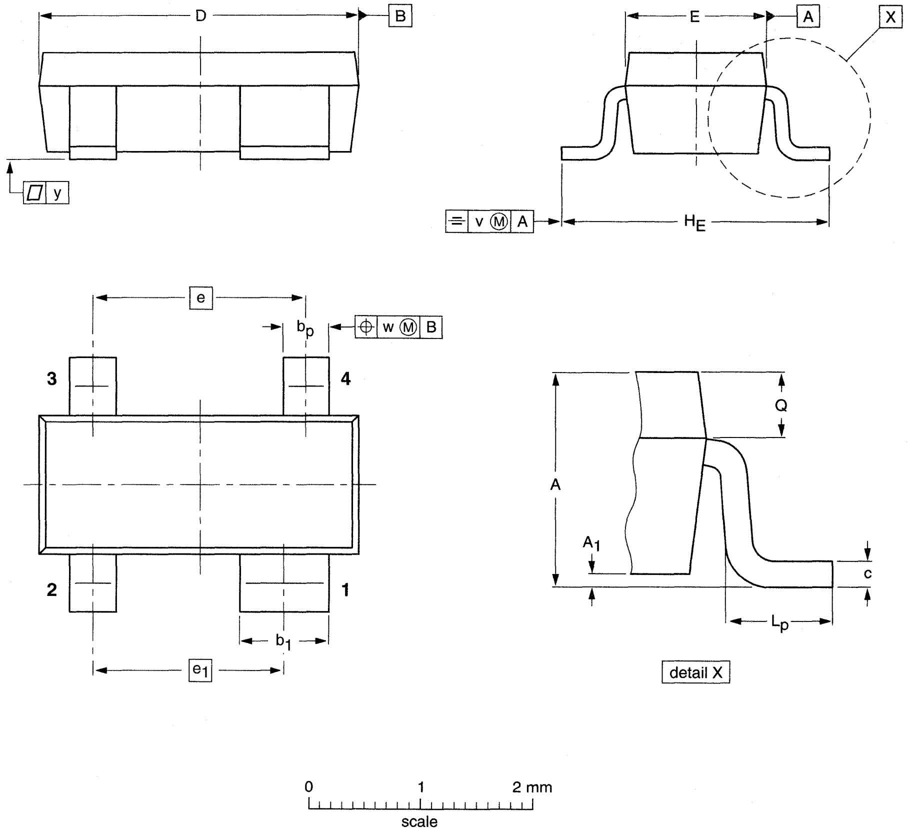


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

Plastic surface mounted package; reverse pinning; 4 leads **SOT143R**

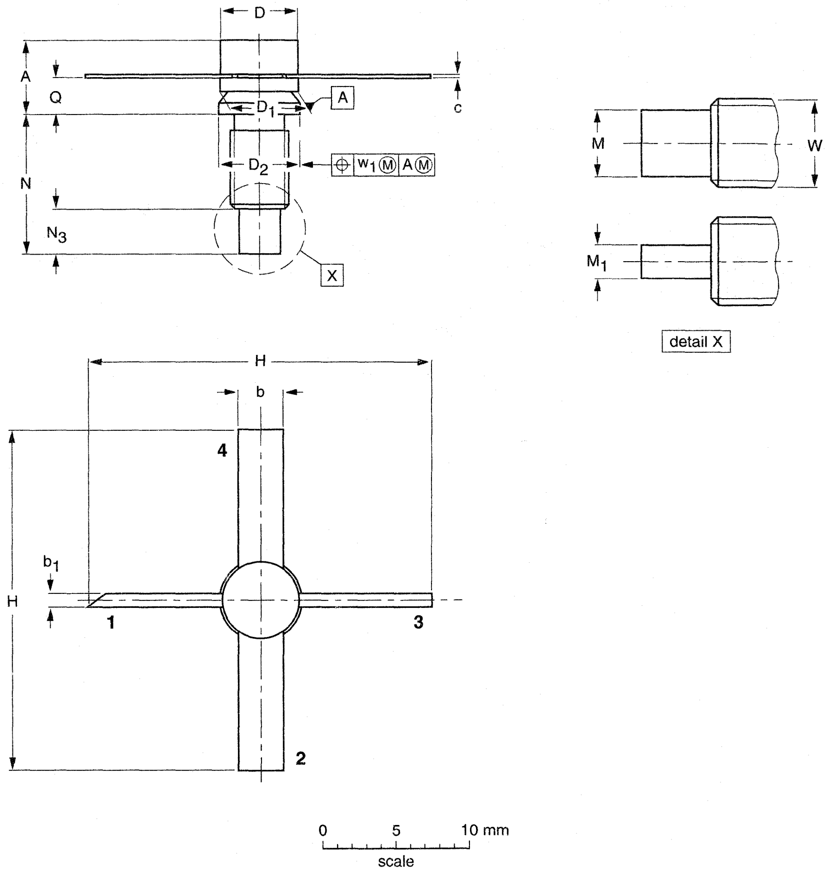


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.55 0.25	0.45 0.25	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143R						97-03-10

Studded ceramic package; 4 leads **SOT172A1**

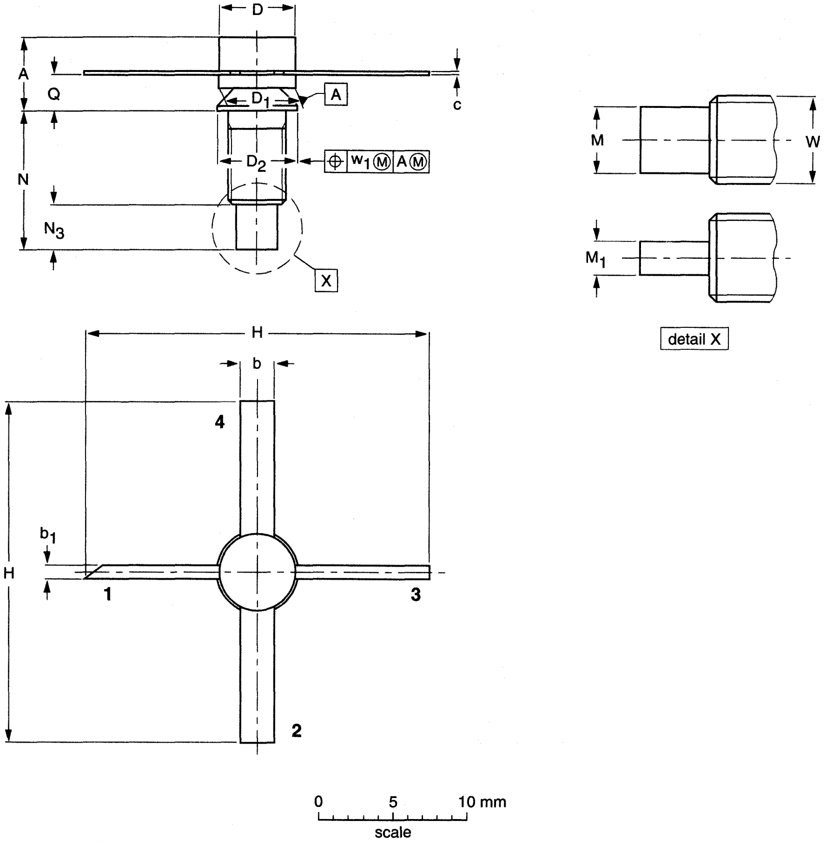


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	b_1	c	D	D_1	D_2	H	M	M_1	N	N_3	Q	W	w_1
mm	5.31 4.34	3.31 3.04	0.89 0.63	0.16 0.10	5.20 4.95	5.33 5.08	5.33 5.08	26.17 24.63	3.05 2.79	1.66 1.39	11.82 10.89	3.69 2.92	2.74 2.34	8-32 UNC	0.38
inches	0.209 0.171	0.130 0.120	0.035 0.025	0.006 0.004	0.205 0.195	0.210 0.200	0.210 0.200	1.030 0.970	0.120 0.110	0.065 0.055	0.465 0.429	0.145 0.115	0.108 0.092		0.015

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT172A1						99-03-29

Studded ceramic package; 4 leads SOT172A2

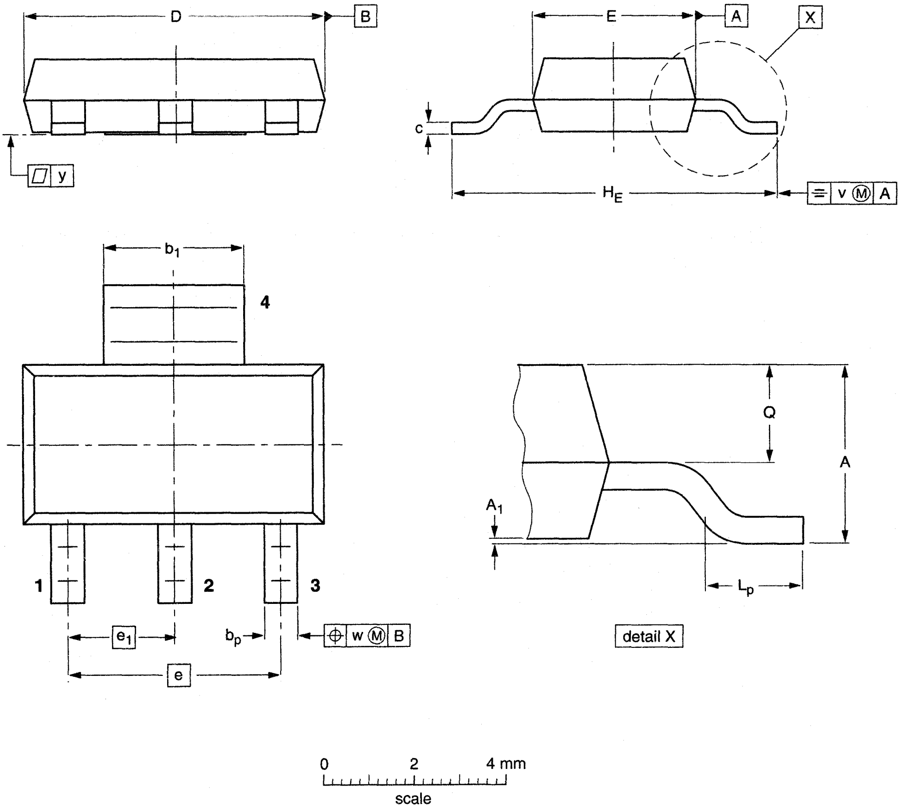


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	b_1	c	D	D_1	D_2	H	M	M_1	N	N_3	Q	W	w_1
mm	5.51 4.45	1.66 1.39	0.89 0.63	0.16 0.10	5.20 4.95	5.31 5.05	5.33 5.08	23.37 22.35	3.05 2.79	1.66 1.39	11.56 11.05	3.43 3.18	2.95 2.43	8-32 UNC	0.38
inches	0.217 0.175	0.065 0.055	0.035 0.025	0.006 0.004	0.205 0.195	0.209 0.199	0.210 0.200	0.920 0.880	0.120 0.110	0.065 0.055	0.455 0.435	0.135 0.125	0.116 0.096		0.015

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT172A2						99-03-29

Plastic surface mounted package; collector pad for good heat transfer; 4 leads **SOT223**

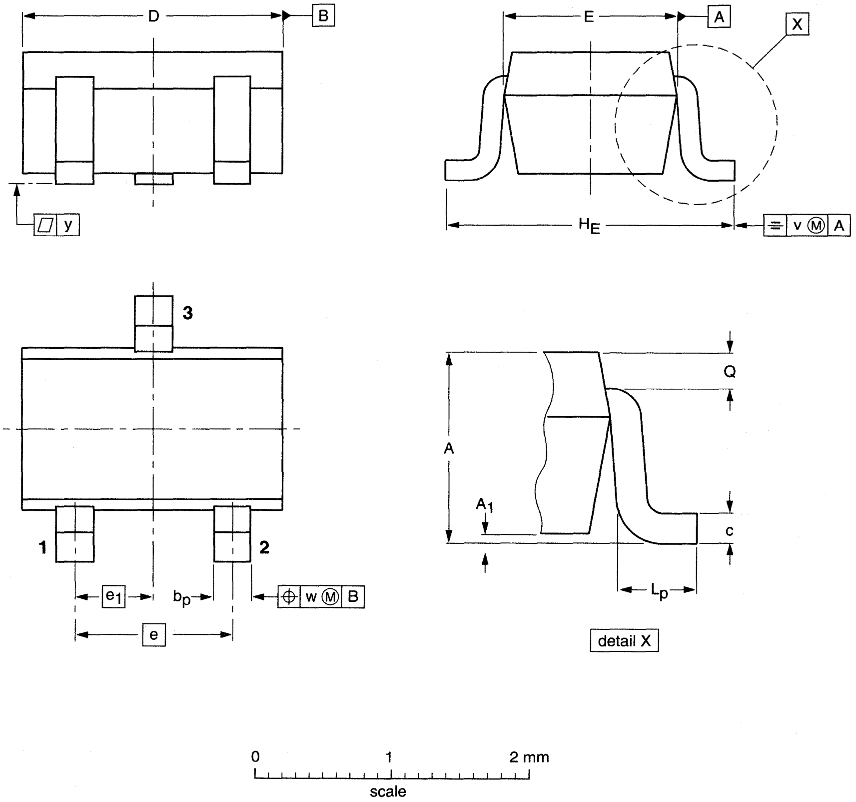


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

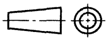
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT223						~~96-11-11~~ 97-02-28

Plastic surface mounted package; 3 leads SOT323

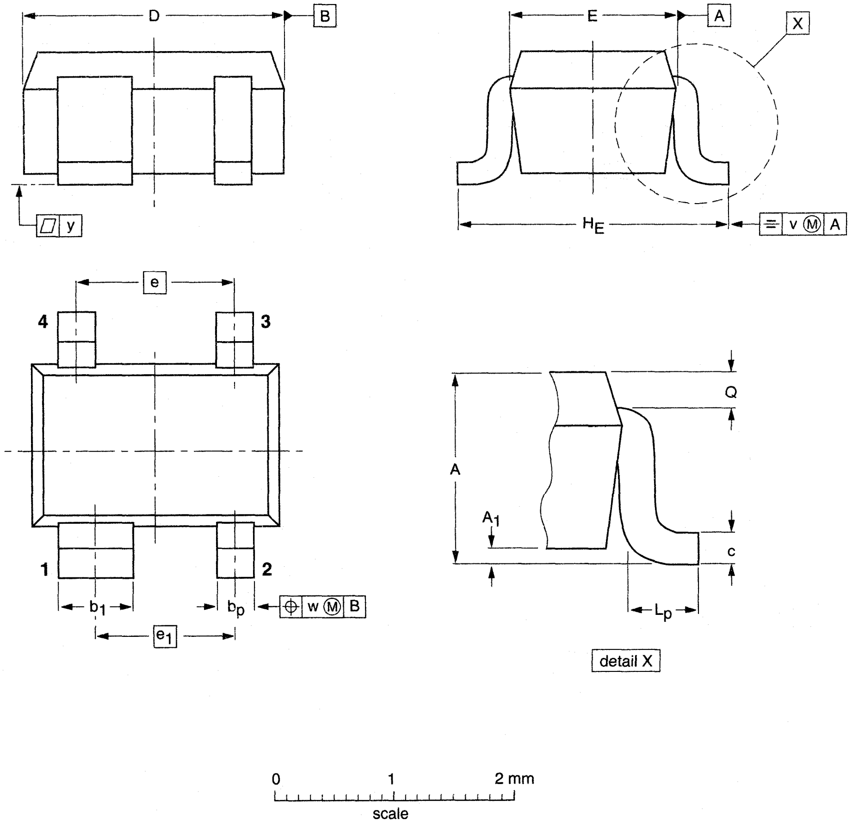


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.8	0.1	0.4 0.3	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT323			SC-70			97-02-28

Plastic surface mounted package; 4 leads **SOT343N**

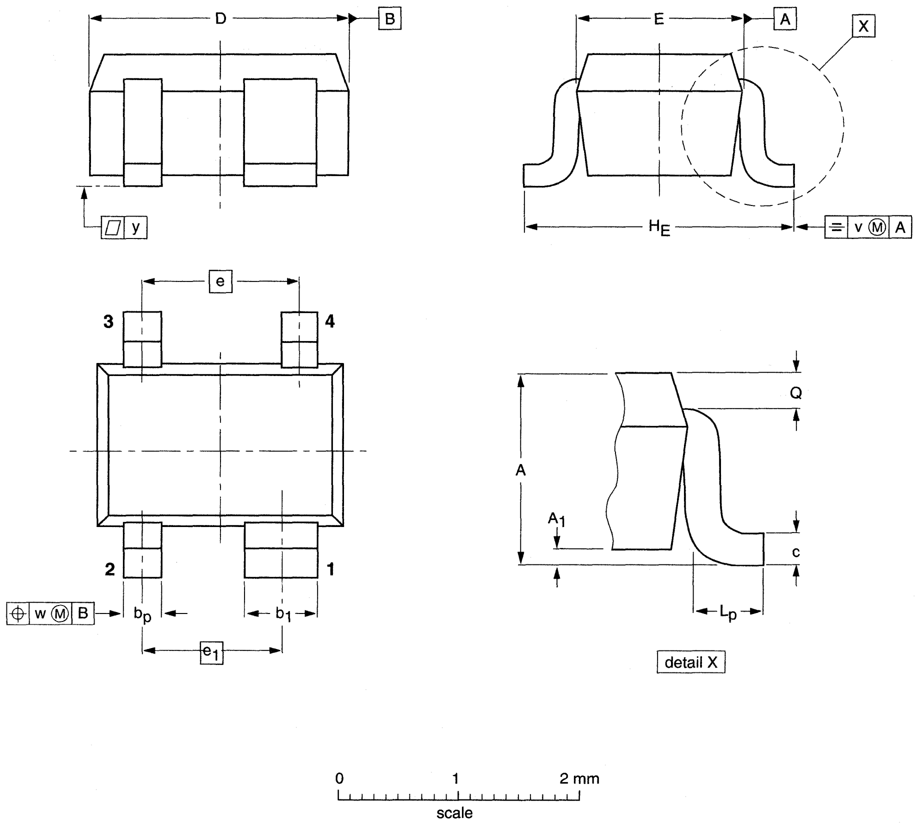


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343N						97-05-21

Plastic surface mounted package; reverse pinning; 4 leads **SOT343R**

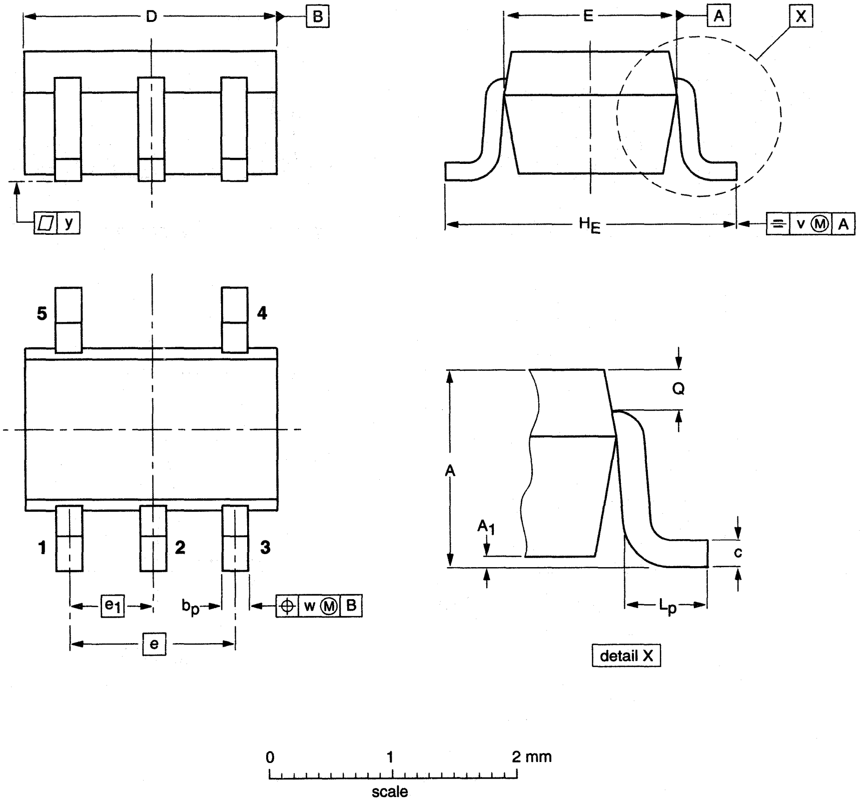


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343R						97-05-21

Plastic surface mounted package; 5 leads **SOT353**

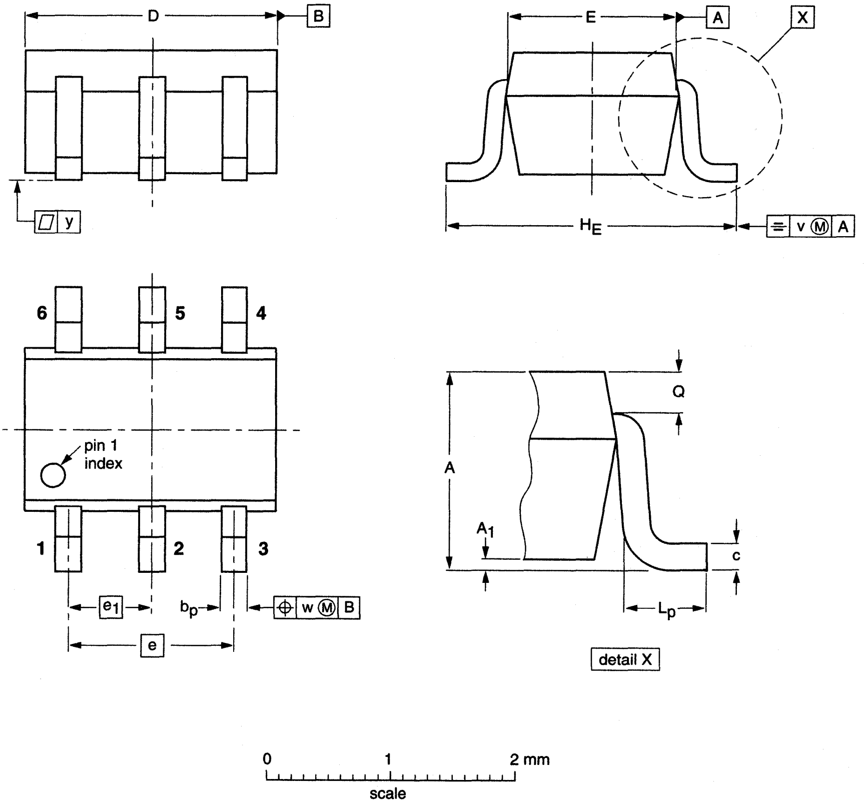


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E (2)	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

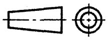
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT353			SC-88A			97-02-28

Plastic surface mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT363			SC-88			97-02-28

Plastic surface mounted package; 5 leads **SOT551A**

Package under development

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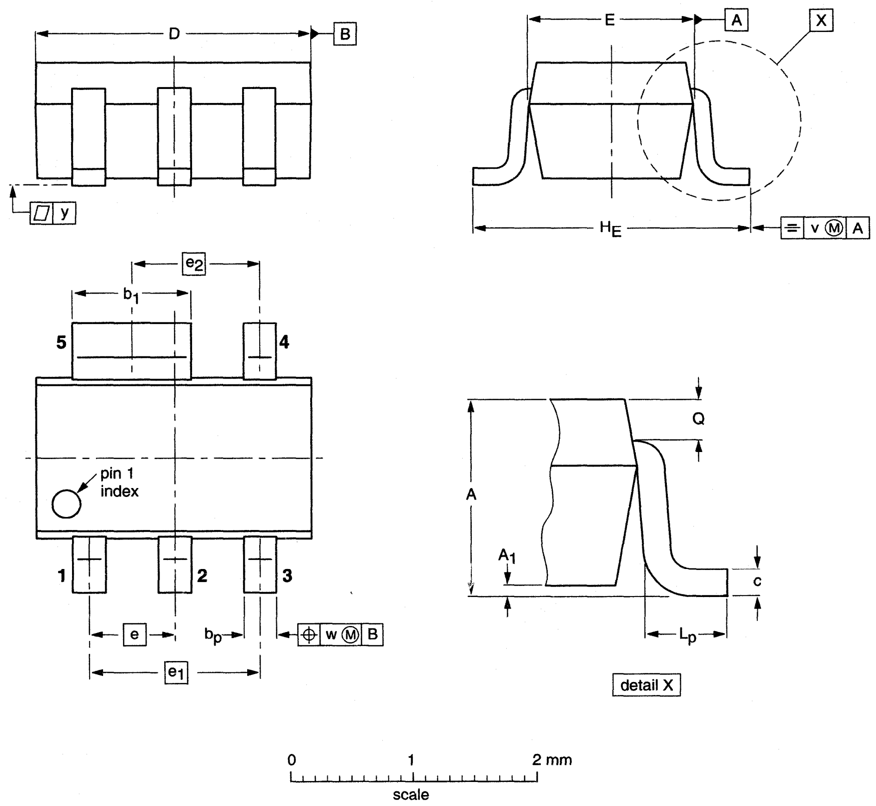

DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	e_2	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1	0.3 0.2	0.8 1.0	0.25 0.10	2.2 1.8	1.35 1.15	0.65	1.3	0.975	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT551A						1999-05-07

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Data handbook system

DATA HANDBOOK SYSTEM

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SC16	Wideband Hybrid Amplifier Modules for CATV
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DC03	Television Tuners, Coaxial Aerial Input Assemblies
DC04	Colour Monitor and Multimedia Tubes
DC05	Wire Wound Components

Advanced Ceramics & Modules

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ACM2	Discrete Ceramics
ACM3 (MA03)	Piezoelectric Ceramics and Specialty Ferrites

BC Components

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