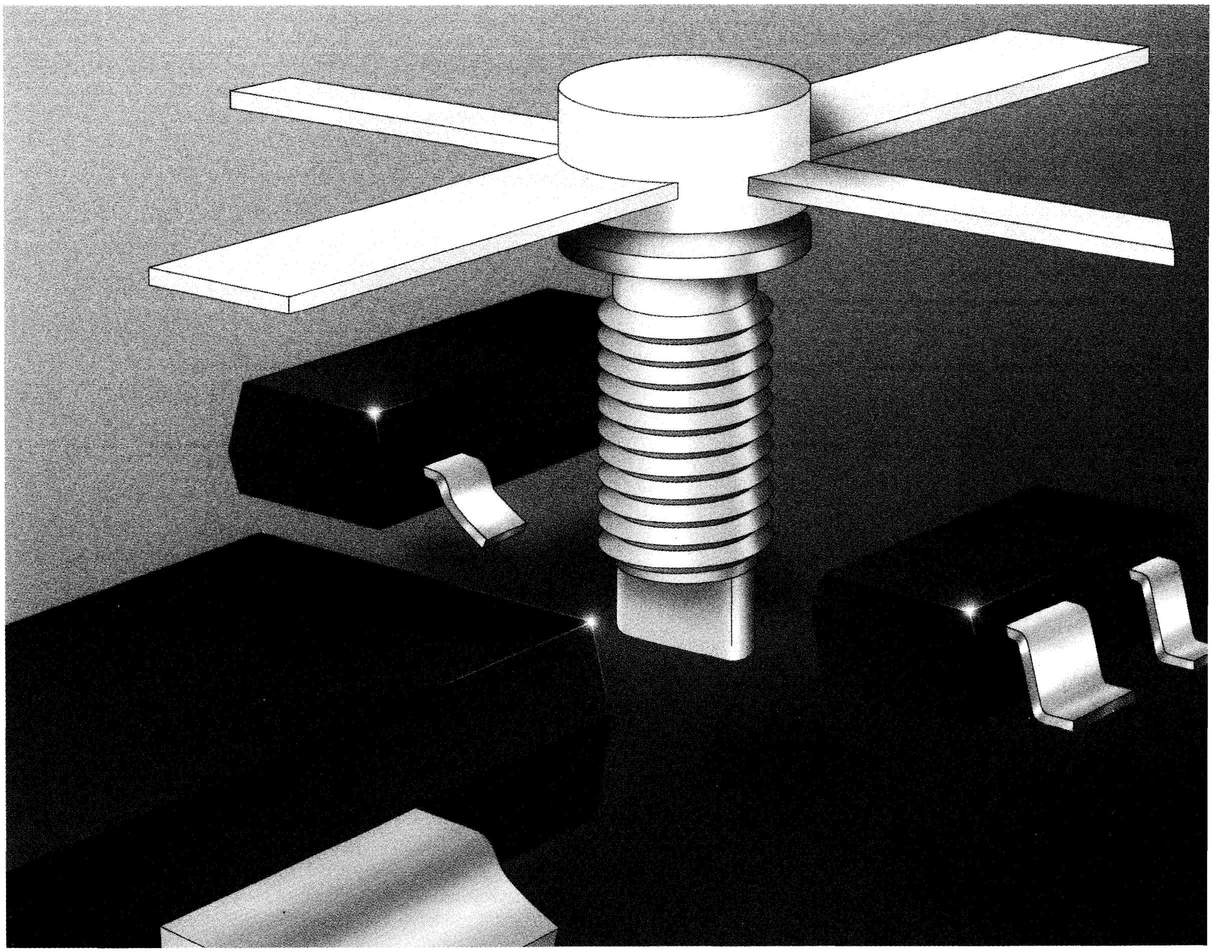
RF Wideband Transistors



1996

DATA HANDBOOK SC14

Philips Semiconductors

PHILIPS

QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

RF Wideband Transistors, Video Transistors and Modules

CONTENTS

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.

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ALPHANUMERIC INDEX

Types added to the range since the last issue of Handbook SC14 (1993 issue) are shown in bold print.

SELECTION GUIDE

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

f_T / I_C CURVE (see Fig.1)	PACKAGE					
	PLASTIC, LEADED	SURFACE-MOUNT				
	TO-92	SOT23	SOT89	SOT143	SOT223	SOT323
(1)		BFT25				
(2)		BF747 BF547				BF547W
(3)	BF689K BF763	BFS17				BFS17W
(4)		BFS17A		BFG17A		
(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	SOT173 (note 1)	SOT23	SOT89	SOT143 (note 2)	SOT223	SOT323	SOT343 (note 2)
(7)	NPN			BFR92(A)		BFG92A (/X)(/XR)		BFR92AW	BFG92AW (/X)(/XR)
	PNP			BFT92				BFT92W	
(8)	NPN		BFP91A	BFR93(A)		BFG93A (/X)(/XR)	BFG94	BFR93AW	BFG93AW (/X)(/XR)
(9)	PNP			BFT93				BFT93W	
(10)	NPN		BFP96	BFR106	BFQ19		BFG97		
	PNP				BFQ149		BFG31		
(11)	NPN				BFQ18A		BFG35		
(11)	NPN	BFQ34							
(12)	NPN	BFQ68							
(13)	NPN	BFQ136							

Notes

1. Short-lead version (SOT173X) also available.
2. SOT143 and SOT343 packages are available with alternative pinning.
   European pinning - no type number suffix; USA pinning - suffix /X; Japanese pinning - suffix /XR.
   Brackets around the suffixes (/X) and (/XR) denote pinning options. No brackets means no options, (e.g. BFG10W/X: available only with USA pinning).

THIRD GENERATION NPN WIDEBAND TRANSISTORS (f_T up to 12 GHz)

f_T / I_C CURVE (see Fig.1)	PACKAGE						
	CERAMIC		SURFACE-MOUNT				
	SOT172	SOT173 (note 1)	SOT23	SOT143 (note 2)	SOT223	SOT323	SOT343 (note 2)
(14)		BFQ66	BFQ67	BFG67 (/X)(/XR)		BFQ67W	BFG67W (/X)(/XR)
(15)				BFG197 (/X)(/XR)	BFG198		BFG197W (/X)(/XR)
(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 (note 2)	SOT223	SOT323	SOT343 (note 2)	SOT353 (note 3)	SOT363 (note 3)
(18)		BFT25A	BFG25A/X		BFS25A	BFG25AW (/X)(/XR)		
(19)		BFR505	BFG505 (/X)(/XR)		BFS505	BFG505W (/X)(/XR)	BFC505 BFE505	BFM505
(20)		BFR520	BFG520 (/X)(/XR)		BFS520	BFG520W (/X)(/XR)	BFC520 BFE520	BFM520
(21)		BFR540	BFG540 (/X)(/XR)	BFG541	BFS540	BFG540W (/X)(/XR)	BFC540 BFE540	BFM540
(22)			BFG590 (/X)(/XR)	BFG591		BFG590W (/X)(/XR)		
(23)	BFQ621		BFG10(/X)			BFG10W/X		
(24)			BFG11(/X)			BFG11W/X (note 3)		

Notes

1. Short-lead version (SOT173X) also available.
2. SOT143 and SOT343 packages are available with alternative pinning.
   European pinning - no type number suffix; USA pinning - suffix /X; Japanese pinning - suffix /XR.
   Brackets around the suffixes (/X) and (/XR) denote pinning options. No brackets means no options, (e.g. BFG10W/X: available only with USA pinning).
3. Development types.

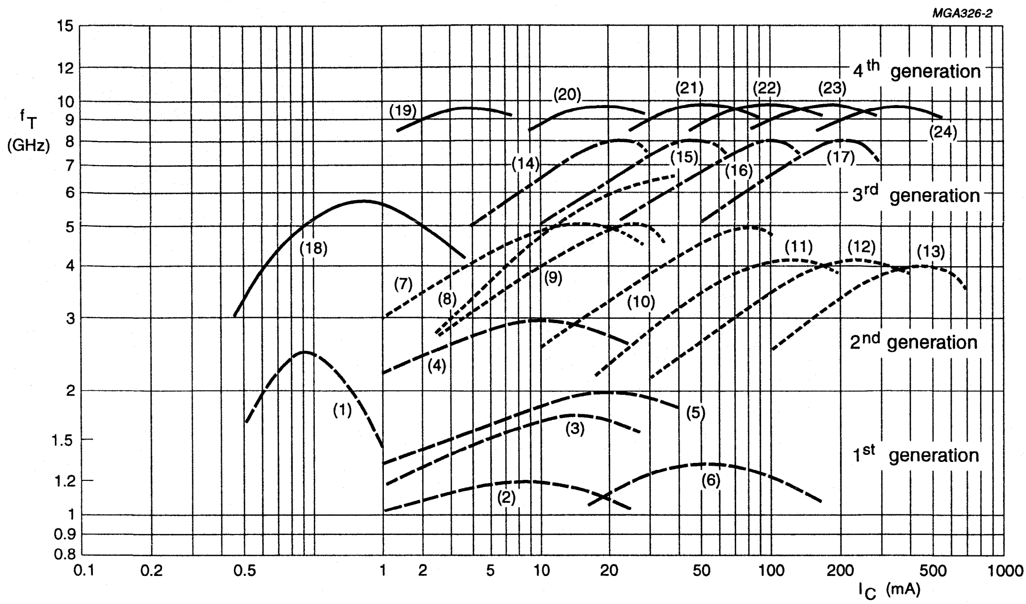


Fig.1 Transition frequency (f_T) characteristics as a function of collector current (I_C) for the four generations of RF bipolar wideband transistors.

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
BF689K	(3)	NPN	TO-92	15	25	360
BF747	(2)	NPN	SOT23	20	50	300
BF763	(3)	NPN	TO-92	25	25	360
BFG10(/X)	(23)	NPN	SOT143	8	250	250
BFG10W/X	(23)	NPN	SOT343	10	250	400
BFG11(/X)	(24)	NPN	SOT143	8	500	400
BFG16A	(6)	NPN	SOT223	25	150	1000
BFG17A	(4)	NPN	SOT143	15	50	300
BFG25A/X	(18)	NPN	SOT143	5	6.5	32
BFG25AW(/X)(/XR)	(18)	NPN	SOT343	5	6.5	500
BFG31	(10)	PNP	SOT223	15	100	1000
BFG35	(11)	NPN	SOT223	18	150	1000
BFG67(/X)(/XR)	(14)	NPN	SOT143	10	50	380
BFG67W(/X)(/XR)	(14)	NPN	SOT343	10	50	500
BFG92A(/X)(/XR)	(7)	NPN	SOT143	15	25	400
BFG92AW(/X)(/XR)	(7)	NPN	SOT343	15	25	500
BFG93A(/X)(/XR)	(8)	NPN	SOT143	12	35	300
BFG93AW(/X)(/XR)	(8)	NPN	SOT343	12	35	500
BFG94	(8)	NPN	SOT223	12	60	700
BFG97	(10)	NPN	SOT223	15	100	1000
BFG135	(16)	NPN	SOT223	15	150	1000
BFG197(/X)(/XR)	(15)	NPN	SOT143	10	100	350
BFG197W(/X)(/XR)	(15)	NPN	SOT343	10	100	500
BFG198	(15)	NPN	SOT223	10	100	1000
BFG505(/X)(/XR)	(19)	NPN	SOT143	15(2)	18	150
BFG505W(/X)(/XR)	(19)	NPN	SOT343	15(2)	18	500
BFG520(/X)(/XR)	(20)	NPN	SOT143	15(2)	70	300
BFG520W(/X)(/XR)	(20)	NPN	SOT343	15(2)	70	500
BFG540(/X)(/XR)	(21)	NPN	SOT143	15(2)	120	500
BFG540W(/X)(/XR)	(21)	NPN	SOT343	15(2)	120	500
BFG541	(21)	NPN	SOT223	15(2)	120	650
BFG590(/X)(/XR)	(22)	NPN	SOT143	15	200	400
BFG590W(/X)(/XR)	(22)	NPN	SOT343	15	200	500
BFG591	(22)	NPN	SOT223	15	200	2000
BFP91A	(8)	NPN	SOT173	12	50	600
BFP96	(10)	NPN	SOT173	15	100	1000

PRODUCT DATA

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o[1] (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BF547	1.2		20	100								
BF547W	1.2		20	100								
BF689K	1.8	4		100	3	16[4]	200					
BF747	1.2		20	100								
BF763	1.8	5		800								
BFG10(/X)			7[4]	1900								
BFG10W/X			10[4]	900		7[4]	1900					
BFG11(/X)			5[4]	1900								
BFG16A	1.5		10	500								
BFG17A	2.8	2.5	15	800								
BFG25A/X	5	1.8	18	1000								
BFG25AW(/X)(/XR)	5	2	16	1000								
BFG31	5		16	500		12	800	550			70	10
BFG35	4		15	500		11	800	750			100	10
BFG67(/X)(/XR)	8	1.7	17	1000	2.5	10	2000					
BFG67W(/X)(/XR)	7.5	1.7	15.5	1000	2.2	10	2000					
BFG92A(/X)(/XR)	5	2	16	1000	3	11	2000					
BFG92AW(/X)(/XR)	6	2.1	15.5	1000	3	10	2000					
BFG93A(/X)(/XR)	6	1.7	16	1000	2.3	10	2000					
BFG93AW(/X)(/XR)	7	2	14.5	1000	3	9	2000					
BFG94	6	2.7		500	3	13.5	1000	500	21.5	34	45	10
BFG97	5.5	2	16	500		12	800	700			70	10
BFG135	7		16	500		12	800	850			100	10
BFG197(/X)(/XR)	7.5	2.3	16	1000		10	2000					
BFG197W(/X)(/XR)	7.5	2.4	14	1000	3.5	9	2000	700			30	8
BFG198	8		18	500		15	800	700			70	8
BFG505(/X)(/XR)	9	1.6	20	900	1.9	13	2000		4	10	5	6
BFG505W(/X)(/XR)	9	1.6	19	900	1.9	12	2000		4	10	5	6
BFG520(/X)(/XR)	9	1.6	19	900	1.9	13	2000	275	17	26	20	6
BFG520W(/X)(/XR)	9	1.6	17	900	1.85	11	2000	275	17	26	20	6
BFG540(/X)(/XR)	9	1.9	18	900	2.1	11	2000	500	21	34	40	8
BFG540W(/X)(/XR)	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)(/XR)	5		13	900		7.5	2000					
BFG590W(/X)(/XR)	5		13	900		7.5	2000		21		80	5
BFG591	7		13	900		7.5	2000					
BFP91A	6		22.5	500	2.3	18.5	800					
BFP96	5		19	500	3.7	15	800					

PRODUCT DATA

TYPE NUMBER	f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE	RATINGS		
				V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
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
BFQ66	(14)	NPN	SOT173	10	50	350
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	SOT122	18	600	9000
BFQ149	(10)	PNP	SOT89	15	100	1000
BFQ270	(17)	NPN	SOT172	19	500	10000
BFQ540	(21)	NPN	SOT89	15(3)	120	950
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
BFT93	(9)	PNP	SOT23	12	35	300

PRODUCT DATA

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o[(1)] (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
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
BFQ66	8	2.7	11.5	2000								
BFQ67	8	1.7	14	1000	8	2.7	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	1.3		900				450			40	8
BFQ621	7		18.5	500				1200			120	18
BFR53	2	5		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	6	1.9	16.5	500								
BFR93A	6	1.9	13	1000	3	7	2000	425			30	8
BFR93AW	6	1.5	13	1000	2.1	8	2000					
BFR94A	3.5	8		200								
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					
BFT93	5	2.4	16.5	500				300			30	5

PRODUCT DATA

TYPE NUMBER	f_T / I_C CURVE (see Fig.1)	POLARITY	PACKAGE	RATINGS		
				V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
BFT93W	(9)	PNP	SOT323	12	50	300
MPSH10		NPN	TO-92	25	40	1000
PMBT3640		PNP	SOT23	12	80	350
PMBTH10		NPN	SOT23	25	40	400
PMBTH81		PNP	SOT23	20	40	400

DEVELOPMENT TYPES

TYPE NUMBER	POLARITY	PACKAGE	RATINGS		
			V_{CEO} (V)	I_C (mA)	P_{tot} (mW)
BFC505	NPN	SOT353	15(2)	18	500
BFC520	NPN	SOT353	15(2)	70	1000
BFC540	NPN	SOT353	15(2)	120	1000
BFE505	NPN	SOT353	15(2)	18	500
BFE520	NPN	SOT353	15(2)	70	1000
BFE540	NPN	SOT353	15(2)	120	1000
BFG11W/X	NPN	SOT343	8	500	630
BFM505	NPN	SOT363	15(2)	18	500
BFM520	NPN	SOT363	15(2)	70	1000
BFM540	NPN	SOT363	15(2)	120	1000

Notes

1. Typical values at $d_{im} = -60$ dB, measured according to DIN45004B, para. 6.3: 3-tone test.
2. V_{CES}.
3. Minimum value.
4. Power gain G_p.

PRODUCT DATA

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BFT93W	5	2.4	15.5	500	3	10	1000					
MPSH10	0.65(3)											
PMBT3640	0.5(3)											
PMBTH10	0.65(3)											
PMBTH81	0.6(3)											

DEVELOPMENT TYPES

TYPE NUMBER	CHARACTERISTICS, typical values											
	f_T (GHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	F (dB)	G_{UM} (dB)	@ f (MHz)	V_o(1) (mV)	P_L (dBm)	ITO (dBm)	@ I_C (mA)	& V_{CE} (V)
BFC505	6	1.6		900	2.4		2000					
BFC520	7	1.3		900	2.4		2000					
BFC540	9	1.6		900	2.9		2000					
BFE505	9	1.2		900	1.9		2000					
BFE520	9	1.1		900	1.9		2000					
BFE540	9	1.3		900	1.9		2000					
BFG11W/X			6(4)	1900								
BFM505	9	1.2	17	900	1.9	10	2000					
BFM520	9	1.6	15	900	1.9	9	2000					
BFM540	9	1.9	14	900	2.1	7	2000					

Notes

1. Typical values at d_{im} = –60 dB, measured according to DIN45004B, para. 6.3: 3-tone test.
2. V_{CES}.
3. Minimum value.
4. Power gain G_p.

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	6.0
1	BFG540/X	BLT70	BLT71	1.2	4.8
1	BFG520W/X	BFG10W/X	BLT61	1.2	3.6

Digital cellular (GSM) 900 MHz

INPUT POWER (mW)	1st STAGE	2nd STAGE	3rd STAGE	P_L (W)	SUPPLY VOLTAGE (V)
Bipolar					
1	BFG540W/X	BFG10W/X	BLT72	3.0 pulsed	4.8
1	BFG540W/X	BFG10W/X	BLT82	3.5 pulsed	6.0

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	6.0
15	BFG91A	BLT80	BLT92/SL	3.0	7.5

Digital cellular (GSM) 1800 MHz

INPUT POWER (mW)	1st STAGE	2nd STAGE	3rd STAGE	P_L (W)	SUPPLY VOLTAGE (V)
Bipolar					
4	BFG540W/X	BFG10W/X	BLT13	2.0	6.0

RF wideband transmitters for pager front-end (see Fig.2)

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

Note

1. Equivalent types are available in SOT23, SOT143, SOT323, or SOT343 packages.

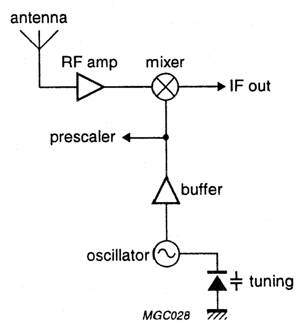


Fig.2 Typical front-end section for pagers.

RF wideband transistors for the receiver section in cordless/cellular phones (see Fig.3)

FUNCTION	TYPE NUMBER	SYSTEM FREQUENCY (MHz)	FEATURES
LNA	BFC505	1900	high isolation gain, low noise current
	BFR505	900; 1900	good performance at low current (1 mA)
	BFR520	900; 1900	higher gain, lower noise (10 mA)
Mixer	BFR93A	900	low cost, acceptable performance
	BFG505	900; 1900	good performance, low current
	BFG520	900; 1900	higher power to IF (10 mA)
	BFE505	900; 1900	balanced mixer in a single SOT353 package
Buffer and VCO	BFR92A	900	excellent VCO, good buffer, low-cost
	BFR93A	900	excellent VCO, good buffer, low-cost
	BFQ67	900	third generation, good performance
	BFR 505	900; 1900	good VCO, high-gain buffer, low current
	BFR520	900; 1900	good VCO, higher output power
	BFG505	1900	buffer and VCO in a single SOT353 package
IF	BFS17A	40 to 100	any first or second generation transistor

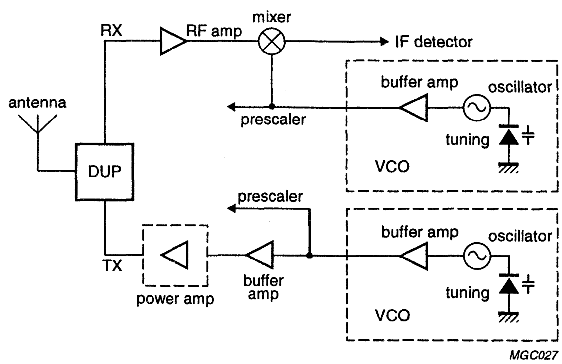


Fig.3 Typical RF section for cordless and cellular phones.

RF wideband transistors for the receiver section in cordless/cellular phones (see Fig.3)

FUNCTION	SYSTEM FREQUENCY (MHz)	SOT23	SOT323	SOT143 (1)	SOT343 (1)	SOT353 (2)	SOT363 (2)
LNA	900; 1900	BFR505	BFS505	BFG505	BFG505W	BFC505	BFM505
	900; 1900	BFR 520	BFS520	BFG520	BFG520W	BFC520	BFM520
Mixer	900	BFR93A	BFR93AW	BFG93A	BFG93AW		
	900; 1900	BFR505	BFS505	BFG505	BFG505W	BFE505	BFM505
	900; 1900	BFR520	BFS520	BFG520	BFG520W	BFE520	BFM520
Buffer and VCO	900	BFR92A	BFR92AW	BFG92A	BFG92AW		
	900	BFR93A	BFR93AW	BFG93A	BFG93AW		
	900	BFQ67	BFQ67W	BFG67	BFG67W		
	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	BFG92AW		

Note

1. Also available in /X and /XR versions.
2. Under development.

RF wideband transistors for the power amplifier section in cordless/cellular phones (see Fig.4)

SYSTEM	SUPPLY VOLTAGE (V)	P_{out} (mW)	SOT143	SOT343
CT1, CT1+, CT2, CT2+ CT3	3.3	driver for PA2	BFG67	BFG67W
			BFG505	BFG505W
			BFG520	BFG520W
		15	BFG67	BFG67W
		20	BFG520	BFG520W
		40	BFG540	BFG540W
DECT, PHP	3.3	400	BFG540/X	BFG540W/X
			BFG10/X	BFG10W/X
			BFG11/X	BFG11W/X (1)

Note

1. Under development.

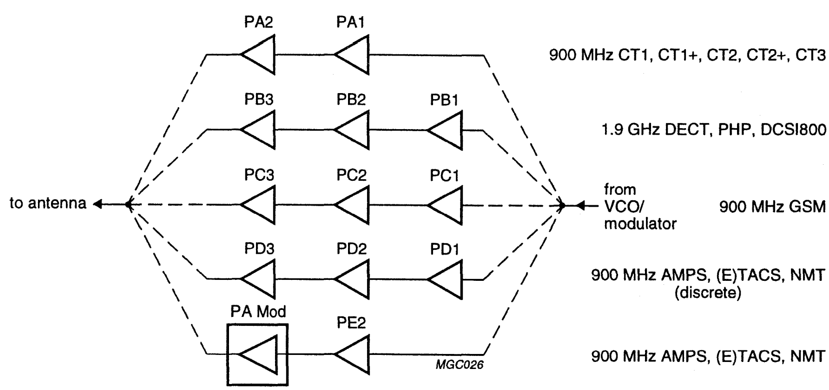


Fig.4 Typical power amplifier section for cordless and cellular phones.

MARKING CODES

RF Wideband Transistors

Marking codes

TYPE NUMBER TO PACKAGE AND MARKING CODE

TYPE NUMBER	PACKAGE	MARKING CODE
BF547	SOT23	E16
BF547W	SOT323	E2
BF689K	SOT54	F689K
BF747	SOT23	E15
BF763	SOT18	BF763
BFC505	SOT353	N0
BFC520	SOT353	N3
BFC540	SOT353	N7
BFE505	SOT353	P0
BFE520	SOT353	N5
BFE540	SOT353	N9
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
BFG17A	SOT143	E6p
BFG25A/X	SOT143	V11
BFG25AW	SOT343	N6
BFG25AW/X	SOT343	V1
BFG25AW/XR	SOT343	V3
BFG31	SOT223	BFG31
BFG35	SOT223	BFG35
BFG67	SOT143	V3p
BFG67/X	SOT143	V12
BFG67/XR	SOT143	V26
BFG92A/X	SOT143	V14
BFG92A/XR	SOT143	V29
BFG93A	SOT143	R8p
BFG93A/XR	SOT143	V33
BFG94	SOT223	BFG94
BFG97	SOT223	BFG97
BFG135	SOT223	BFG135
BFG197	SOT143	V5p
BFG197/X	SOT143	V13
BFG198	SOT223	BFG198
BFG505	SOT143	N33
BFG505/X	SOT143	N39

TYPE NUMBER	PACKAGE	MARKING CODE
BFG505/XR	SOT143	N45
BFG505W	SOT343	N0
BFG505W/X	SOT343	N1
BFG505W/XR	SOT343	P0
BFG520	SOT143	N36
BFG520/X	SOT143	N42
BFG520/XR	SOT143	N48
BFG520W	SOT343	N3
BFG520W/X	SOT343	N4
BFG520W/XR	SOT343	N5
BFG540	SOT143	N37
BFG540/X	SOT143	N43
BFG540/XR	SOT143	N49
BFG540W	SOT343	N9
BFG540W/X	SOT343	N7
BFG540W/XR	SOT343	N8
BFG541	SOT223	BFG541
BFG590	SOT143	N38
BFG590/X	SOT143	N44
BFG590/XR	SOT143	N50
BFG590W	SOT343	T1
BFG590W/X	SOT343	T2
BFG590W/XR	SOT343	T3
BFG591	SOT223	BFG591
BFM505	SOT363	N0
BFM520	SOT363	N2
BFM540	SOT363	N7
BFP91A	SOT173	BFP91A
BFP96	SOT173	BFP96
BFQ17	SOT89	FA
BFQ18A	SOT89	FF
BFQ19	SOT89	FB
BFQ22S	SOT18	BFQ22S
BFQ24	SOT18	BFQ24
BFQ34	SOT122E	BFQ34/01
BFQ52	SOT18	BFQ52
BFQ53	SOT18	BFQ53
BFQ63	SOT18	BFQ63
BFQ66	SOT173	BFQ66
BFQ67	SOT23	V2p
BFQ67W	SOT323	V2

TYPE NUMBER	PACKAGE	MARKING CODE
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
BFR95	SOT5	BFR95
BFR106	SOT23	R7p
BFR505	SOT23	N30
BFR520	SOT23	N28
BFR540	SOT23	N29
BFS17	SOT23	E1p
BFS17A	SOT23	E2p
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
BFW16A	SOT5	BFW16A
BFW30	SOT18	BFW30
BFY90	SOT18	BFY90
MPSH10	SOT54	PSH10
PMBT3640	SOT23	V25
PMBTH10	SOT23	V30
PMBTH81	SOT23	V31

MARKING CODE AND PACKAGE TO TYPE NUMBER

MARKING CODE	PACKAGE	TYPE NUMBER
BF763	SOT18	BF763
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
BFP91A	SOT173	BFP91A
BFP96	SOT173	BFP96
BFQ22S	SOT18	BFQ22S
BFQ24	SOT18	BFQ24
BFQ34/01	SOT122E	BFQ34
BFQ52	SOT18	BFQ52
BFQ53	SOT18	BFQ53
BFQ63	SOT18	BFQ63
BFQ66	SOT173	BFQ66
BFQ68	SOT122E	BFQ68
BFQ135	SOT172	BFQ135
BFQ136	SOT122E	BFQ136
BFQ270	SOT172	BFQ270
BFQ621	SOT172	BFQ621
BFR94A	SOT122E	BFR94A
BFR95	SOT5	BFR95
BFW16A	SOT5	BFW16A
BFW30	SOT18	BFW30
BFY90	SOT18	BFY90
E1	SOT323	BFS17W
E1p	SOT23	BFS17
E2	SOT323	BF547W
E2p	SOT23	BFS17A
E6p	SOT143	BFG17A
E15	SOT23	BF747
E16	SOT23	BF547
F689K	SOT54	BF689K
FA	SOT89	BFQ17
FB	SOT89	BFQ19

MARKING CODE	PACKAGE	TYPE NUMBER
FF	SOT89	BFQ18A
FG	SOT89	BFQ149
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	SOT343	BFG520W/XR
N5	SOT353	BFE520
N6	SOT323	BFS25A
N6	SOT343	BFG25AW
N7	SOT343	BFG540W/X
N7	SOT353	BFC540
N7	SOT363	BFM540
N8	SOT343	BFG540W/XR
N9	SOT343	BFG540W
N9	SOT353	BFE540
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
N45	SOT143	BFG505/XR
N48	SOT143	BFG520/XR
N49	SOT143	BFG540/XR
N50	SOT143	BFG590/XR
N70	SOT143	BFG10

MARKING CODE	PACKAGE	TYPE NUMBER
N71	SOT143	BFG10/X
N72	SOT143	BFG11
N73	SOT143	BFG11/X
P0	SOT343	BFG505W/XR
P0	SOT353	BFE505
P1p	SOT23	BFR92
P2	SOT323	BFR92AW
P2p	SOT23	BFR92A
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
T2	SOT343	BFG590W/X
T3	SOT343	BFG590W/XR
T5	SOT343	BFG10W/X
V1	SOT343	BFG25AW/X
V1p	SOT23	BFT25
V2	SOT323	BFQ67W
V2p	SOT23	BFQ67
V3	SOT343	BFG25AW/XR
V3p	SOT143	BFG67
V5p	SOT143	BFG197
V10	SOT23	BFT25A
V11	SOT143	BFG25A/X
V12	SOT143	BFG67/X
V13	SOT143	BFG197/X
V14	SOT143	BFG92A/X
V25	SOT23	PMBT3640
V26	SOT143	BFG67/XR
V29	SOT143	BFG92A/XR
V30	SOT23	PMBTH10
V31	SOT23	PMBTH81
V33	SOT143	BFG93A/XR
W1	SOT323	BFT92W
W1p	SOT23	BFT92
X1	SOT323	BFT93W
X1p	SOT23	BFT93

GENERAL

QUALITY

Total Quality Management

Philips Semiconductors is a Quality Company, renowned for the high quality of our products and service. We keep alive this tradition by constantly aiming towards one ultimate standard, that of zero defects. This aim is guided by our Total Quality Management (TQM) system, the basis of which is described in the following paragraphs.

QUALITY ASSURANCE

Based on ISO 9000 standards, customer standards such as Ford TQE and IBM MDQ. Our factories are certified to ISO 9000 by external inspectorates.

PARTNERSHIPS WITH CUSTOMERS

PPM co-operations, design-in agreements, ship-to-stock, just-in-time and self-qualification programmes, and application support.

PARTNERSHIPS WITH SUPPLIERS

Ship-to-stock, statistical process control and ISO 9000 audits.

QUALITY IMPROVEMENT PROGRAMME

Continuous process and system improvement, design improvement, complete use of statistical process control, realization of our final objective of zero defects, and logistics improvement by ship-to-stock and just-in-time agreements.

Advanced quality planning

During the design and development of new products and processes, quality is built-in by advanced quality planning. Through failure-mode-and-effect analysis the critical parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase.

Product conformance

The assurance of product conformance is an integral part of our quality assurance (QA) practice. This is achieved by:

- Incoming material management through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Critical process steps are 100% 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. The inspection and test requirements are detailed in the general quality specifications.
- Periodic inspections to monitor and measure the conformance of products.

Product reliability

With the increasing complexity of Original Equipment Manufacturer (OEM) equipment, component reliability must be extremely high. Our research laboratories and development departments study the failure mechanisms of semiconductors. Their studies result in design rules and process optimization for the highest built-in product reliability. Highly accelerated tests are applied to the products reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

Customer responses

Our quality improvement depends on joint action with our customer. We need our customer's inputs and we invite constructive comments on all aspects of our performance. Please contact our local sales representative.

Recognition

The high quality of our products and services is demonstrated by many Quality Awards granted by major customers and international organizations.

PRO ELECTRON TYPE NUMBERING SYSTEM

Basic type number

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

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.

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 $R_{th\ j\text{-}mb}$ > 15 K/W and power types by $R_{th\ j\text{-}mb} \leq$ 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 under Section "Serial number"
- 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
- R Control or switching device; e.g. thyristor, low power; with special third letter
- S Transistor; low power, switching
- T Control or switching device; e.g. thyristor, low power; with special third letter
- 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.

SERIAL NUMBER

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)

(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.

Version letter

A letter may be added to the basic type number to indicate minor electrical or mechanical variants of the basic type.

RATING SYSTEMS

The rating systems described are those recommended by the IEC in its publication number 134.

Definitions of terms used

ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device. 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. Limiting conditions may be either maxima or minima.

RATING SYSTEM

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

(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.

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, iB
- 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
(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).

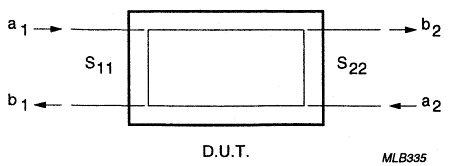


Fig.1 Two-port network with reflection coefficients S_{11} and S_{22}.

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

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

where:

$$a_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 + Z_0 \cdot i_1) = \text{signal into port 1} \quad (3)$$

$$a_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 + Z_0 \cdot i_2) = \text{signal into port 2}$$

$$b_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 + Z_0 \cdot i_1) = \text{signal out port 1} \quad (4)$$

$$b_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 + Z_0 \cdot i_2) = \text{signal out port 2}$$

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_0 (derived from formula (4)).

In (6), $a_1 = 0$ means input port terminated with Z_0 (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_0 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 TO-92 (SOT54) leaded types

The transistors are supplied on tape in boxes (ammopack) or on reels. The number per reel and per ammopack is 2000. The ammopack has 80 layers of 25 transistors each. Each layer contains 25 transistors, plus one empty position in order to fold the layer correctly.The ammopack is accessible from both sides, enabling the user to choose between 'normal' (see Fig.3) and 'reverse' tape. 'Normal' is indicated by a plus sign (+) on the ammopack and 'reverse' by a minus sign (–). In the European version, the leading pin is the emitter.

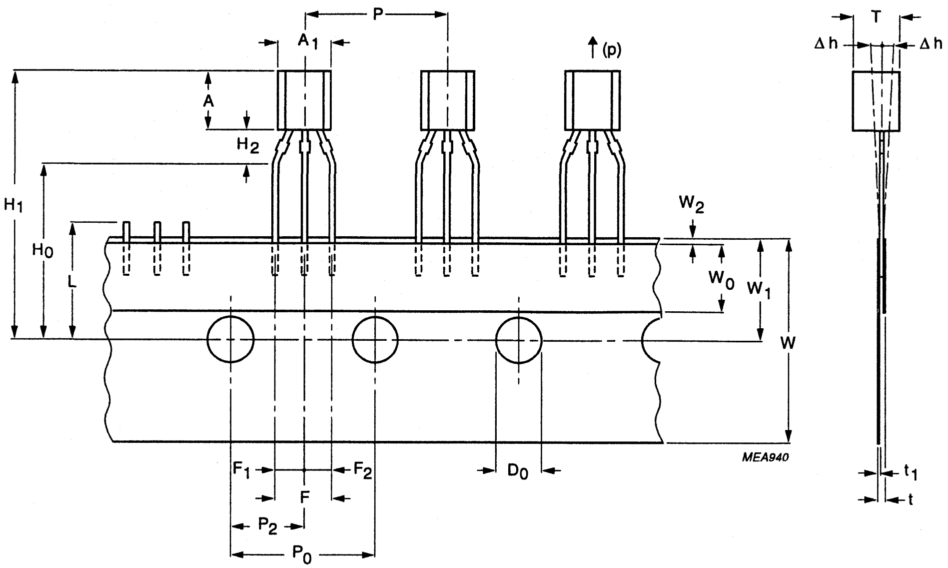


Fig.2 TO-92 (SOT54) transistors on tape.

Table 1 Tape specification TO-92 (SOT54) leaded types

SYMBOL	DIMENSION	SPECIFICATIONS					REMARKS
		MIN.	NOM.	MAX.	TOL.	UNIT	
A_1	body width	4	–	4.8	–	mm	
A	body height	4.8	–	5.2	–	mm	
T	body thickness	3.5	–	3.9	–	mm	
P	pitch of component	–	12.7	–	±1	mm	
P_0	feed hole pitch	–	12.7	–	±0.3	mm	
	cumulative pitch error	–	–	–	±0.1		note 1
P_2	feed hole centre to component centre	–	6.35	–	±0.4	mm	to be measured at bottom of clinch
F	distance between outer leads	–	5.08	–	+0.6/–0.2	mm	
Δh	component alignment	–	0	1	–	mm	at top of body
W	tape width	–	18	–	±0.5	mm	
W_0	hold-down tape width	–	6	–	±0.2	mm	
W_1	hole position	–	9	–	+0.7/–0.5	mm	
W_2	hold-down tape position	–	0.5	–	±0.2	mm	
H_0	lead wire clinch height	–	16.5	–	±0.5	mm	
H_1	component height	–	–	23.25	–	mm	
L	length of snipped leads	–	–	11	–	mm	
D_0	feed hole diameter	–	4	–	±0.2	mm	
t	total tape thickness	–	–	1.2	–	mm	t_1 = 0.3 to 0.6
F_1, F_2	lead-to-lead distance	–	–	–	+0.4/–0.2	mm	
H_2	clinch height	–	–	–	–	mm	
(p)	pull-out force	6	–	–	–	N	

Note

1. Measured over 20 devices.

Dropouts

A maximum of 0.5% of the specified number of transistors in each packing may be missing. Up to 3 consecutive components may be missing provided the gap is followed by 6 consecutive components.

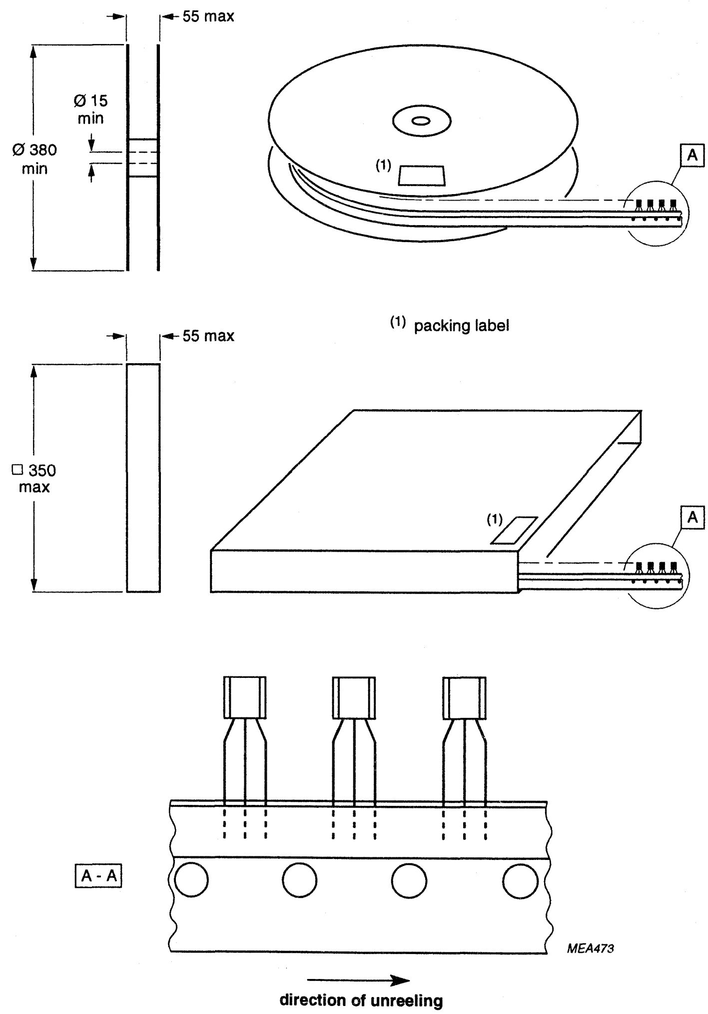
Tape splicing

Splice the carrier tape on the back and/or front so that the feed hole pitch (P_0) is maintained (see Figs 2 and 4).

Bulk packing

In addition to TO-92 (SOT54) on tape, TO-92 can also be delivered in bulk. Products are packed in boxes in foil and plastic bags with 1 000 pieces to a bag and 5 bags to a box.

As well as the standard TO-92 with straight leads, (see Fig.5) leads with delta pinning are available in bulk, on request (see Fig.6).



Dimensions in mm.

Fig.3 Dimensions of reel and box.

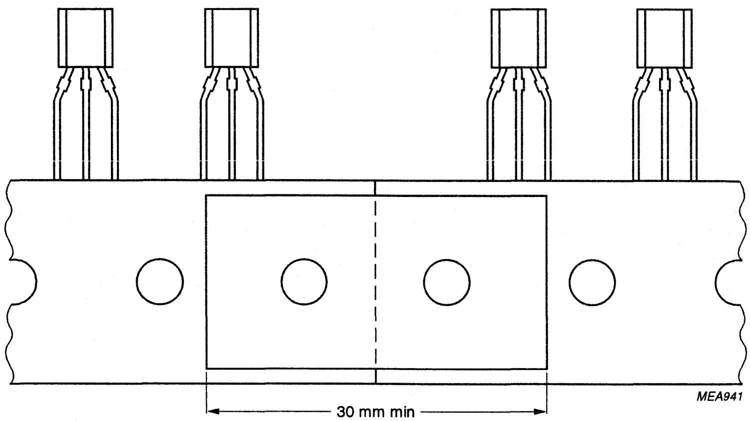
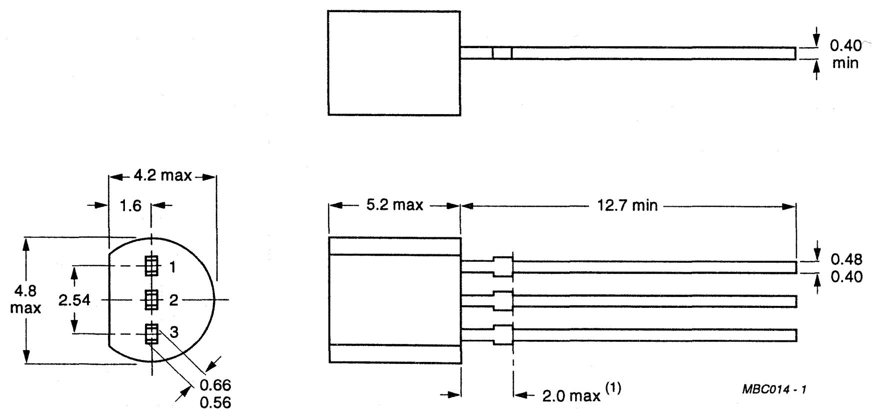


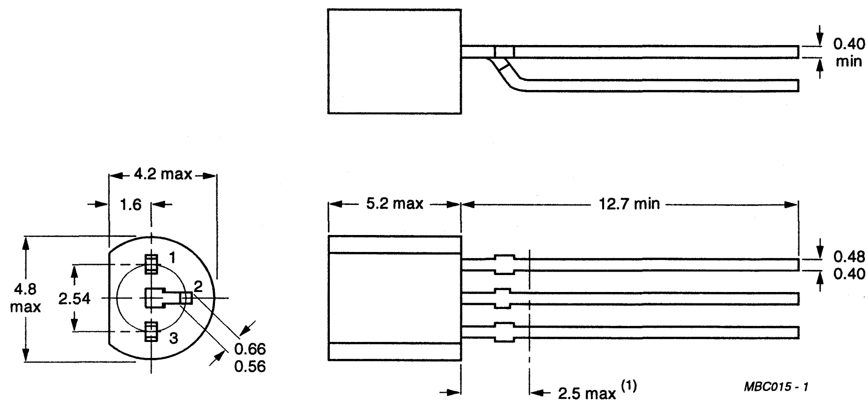
Fig.4 Joining tape with splicing patch.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.5 TO-92 (SOT54) with straight leads.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.6 TO-92 (SOT54) with delta pinning.

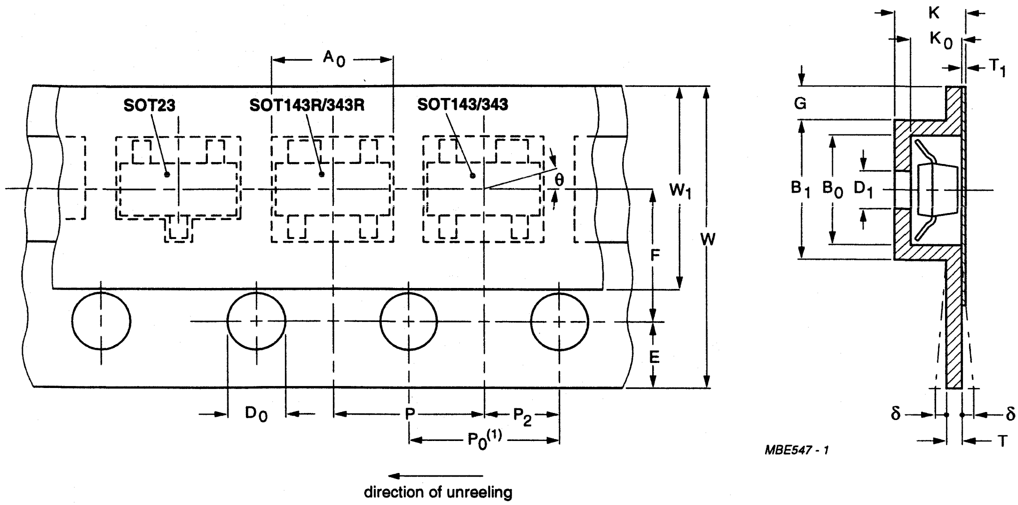
Packing types

Table 2 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	8	180	3000	...215(2)
SOT143R		330	10000	...235(2)
SOT143 (cross emitter pinning)		180	3000	...215(2)
SOT143R (cross emitter pinning)		330	10000	...235(2)
SOT323	8	180	3000	...115
		330	10000	...135
SOT343	8	180	3000	...115
SOT353	8	180	3000	...115
SOT363	8	180	3000	...115
SOT89	12	180	3000	...115
SOT173X	12	180	3000	...115
SOT223	12	180	3000	...115

Notes

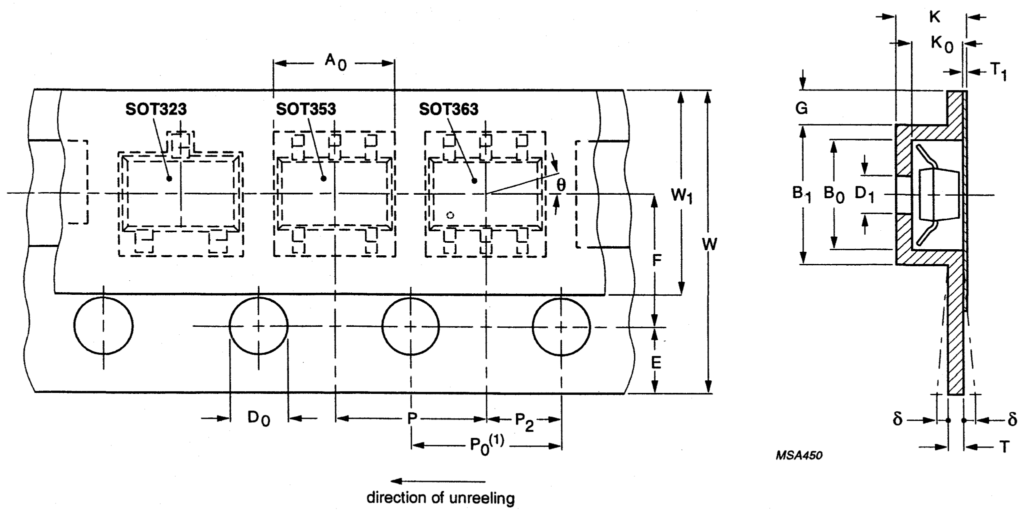
1. 12NC is the Philips twelve-digit ordering code.
2. Distinction between the pinning variants is made by the first nine digits of the 12NC.



For dimensions see Table 3.

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

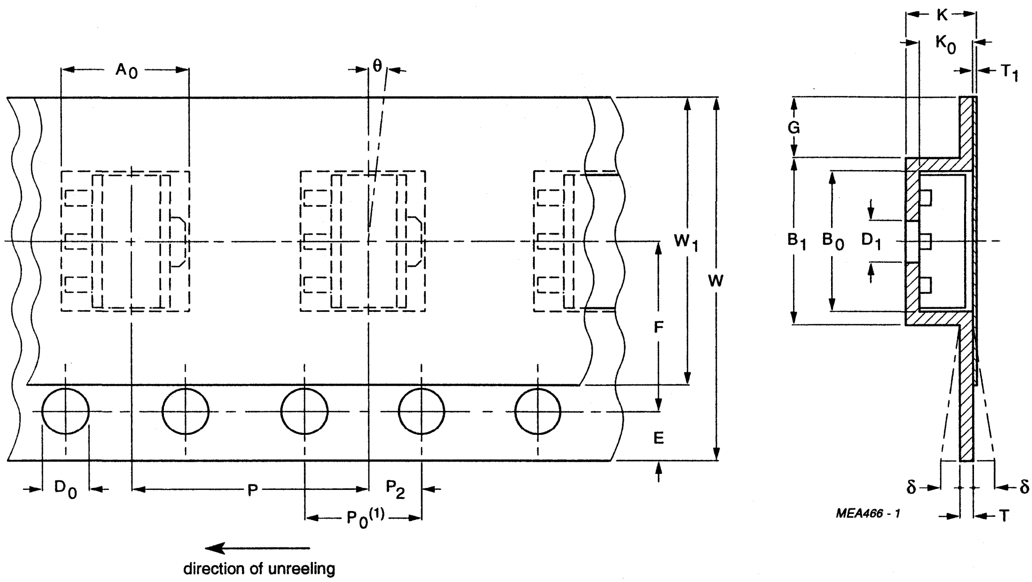
Fig.7 Specification for 8 mm tape (SOT23, SOT143, SOT143R, SOT343 and SOT343R).



For dimensions see Table 3.

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

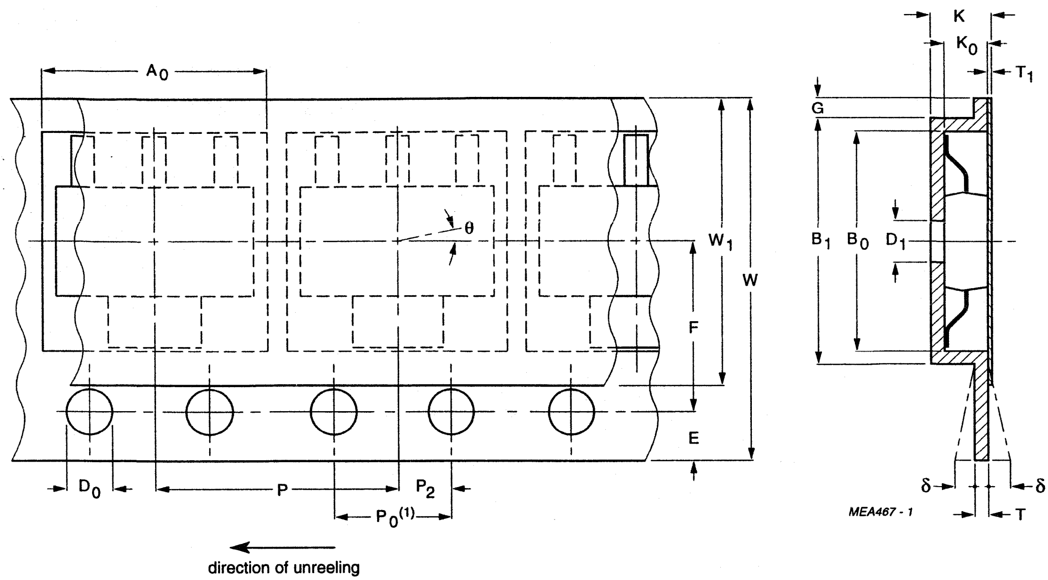
Fig.8 Specification for 8 mm tape (SOT323, SOT353 and SOT363).



For dimensions see Table 3.

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

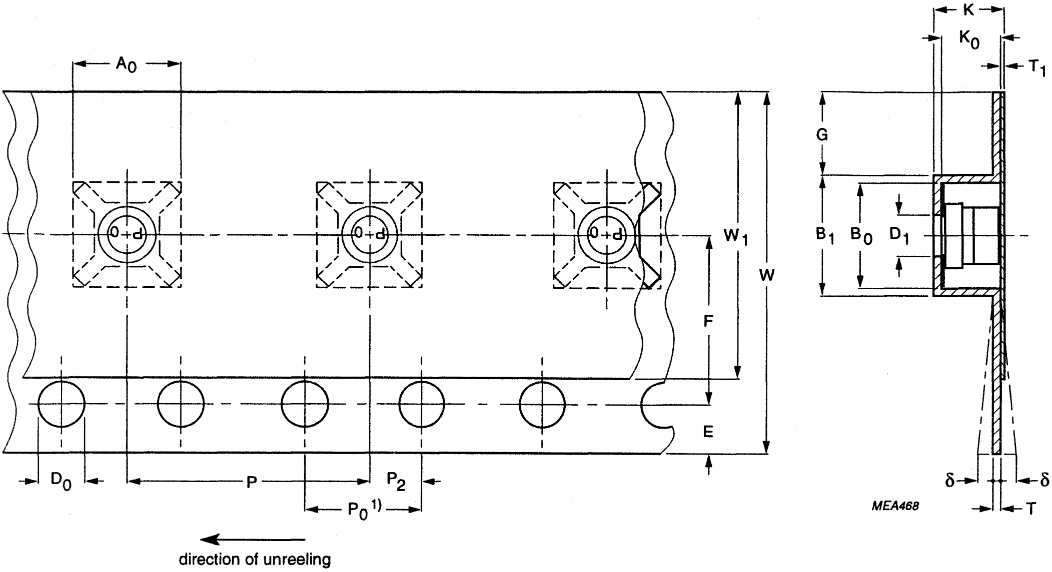
Fig.9 Specification for 12 mm tape (SOT89).



For dimensions see Table 3.

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

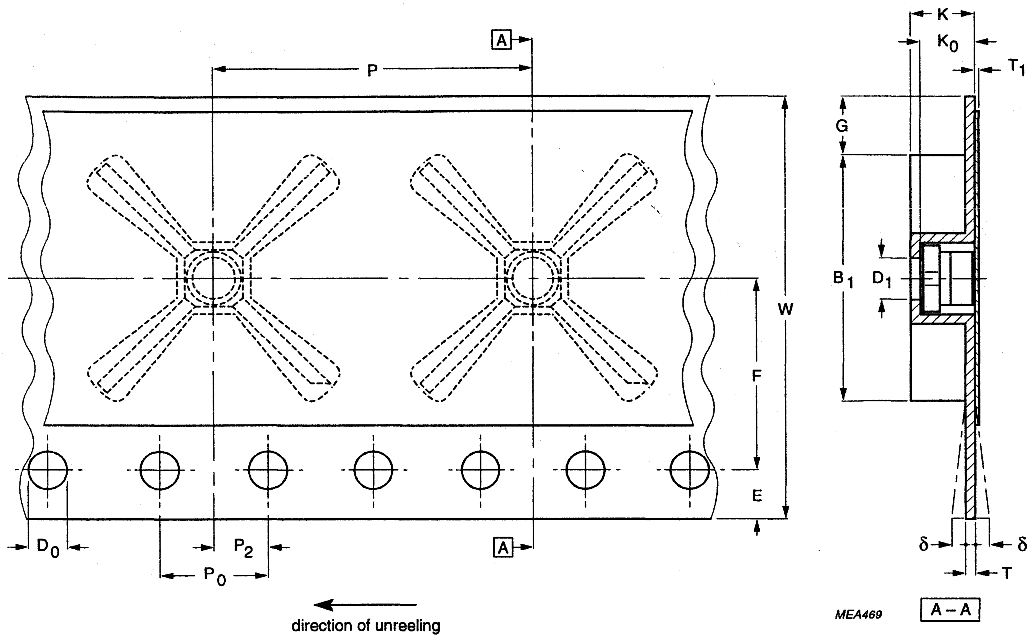
Fig.10 Specification for 12 mm tape (SOT223).



For dimensions see Table 3.

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

Fig.11 Specification for 12 mm tape (SOT173X).



For dimensions see Table 3.

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

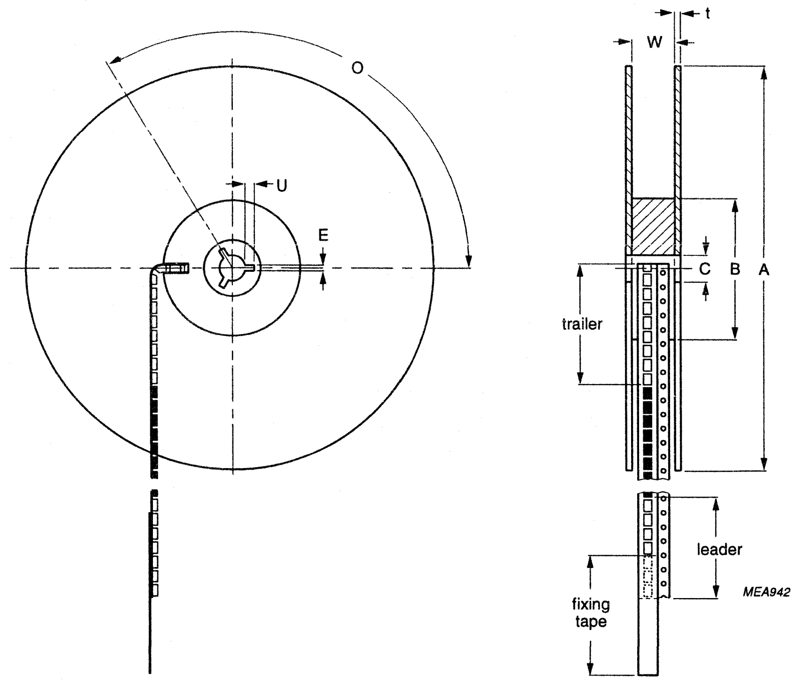
Fig.12 Specification for 16 mm tape (SOT173).

Table 3 SMD packages: tape dimensions (in mm)

DIMENSION (Figs 7 to 12)	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 4.

Fig.13 Reel specification.

Table 4 Reel dimensions (in mm)

DIMENSION (see Fig.13)	**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).

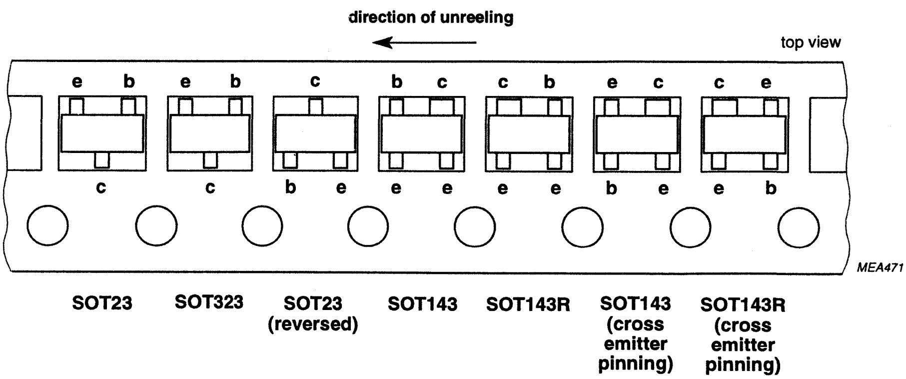


Fig.14 Orientation of components: SOT23, SOT143, SOT143R, SOT323 (8 mm tape).

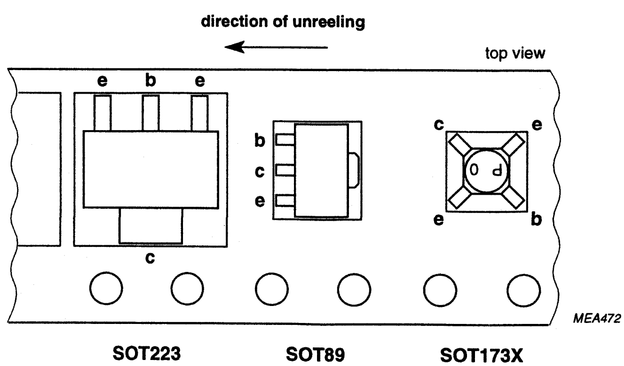


Fig.15 Orientation of components: SOT223, SOT89, SOT173X (12 mm tape).

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 16 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.17. 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.18.

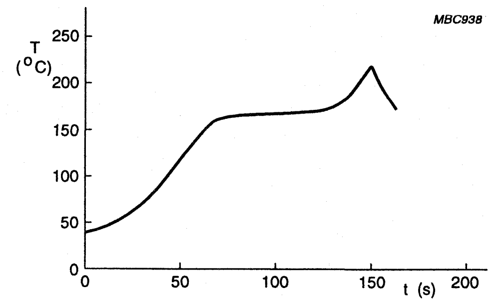


Fig.16 Theoretical time/temperature curve for a typical thermal conductive reflow cycle.

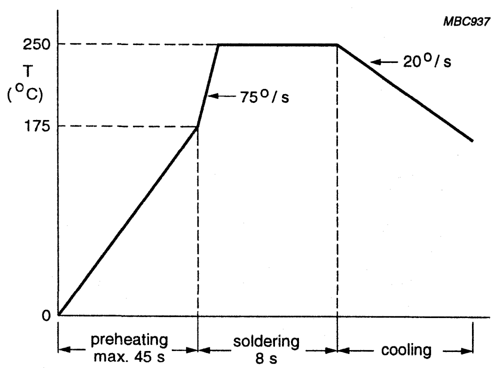


Fig.17 Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm/min.

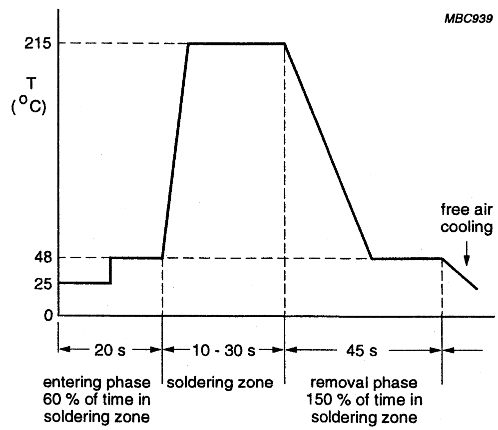


Fig.18 Theoretical time/temperature curve relationship for dual vapour reflow soldering.

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.19) 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.20), 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 21 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.

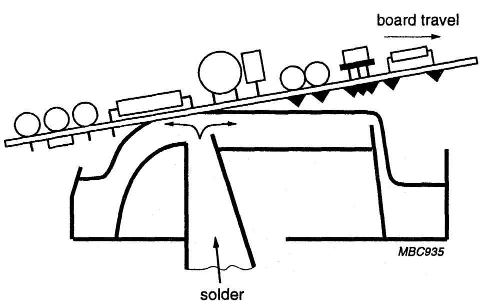


Fig.19 Single wave soldering principle.

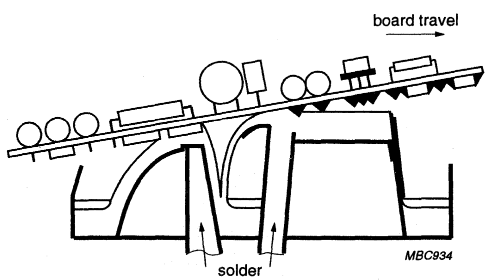


Fig.20 Dual wave soldering principle.

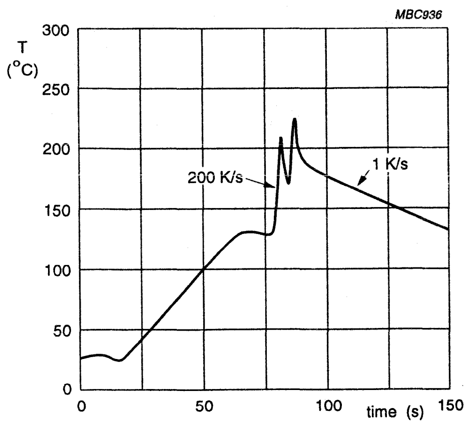


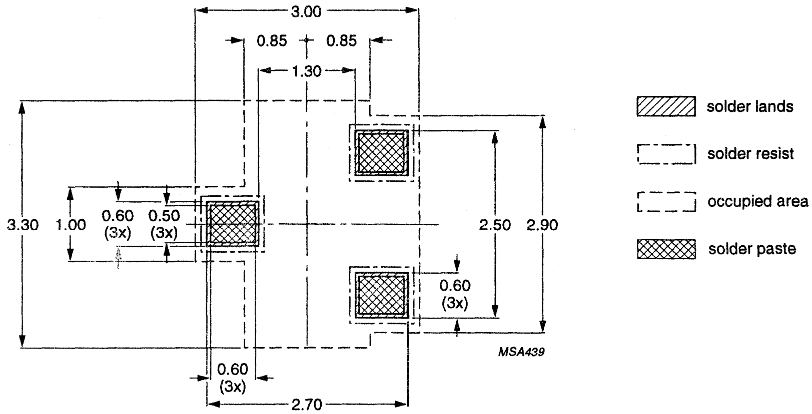
Fig.21 Typical time-temperature curve measured at the soldering site.

Footprint design

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

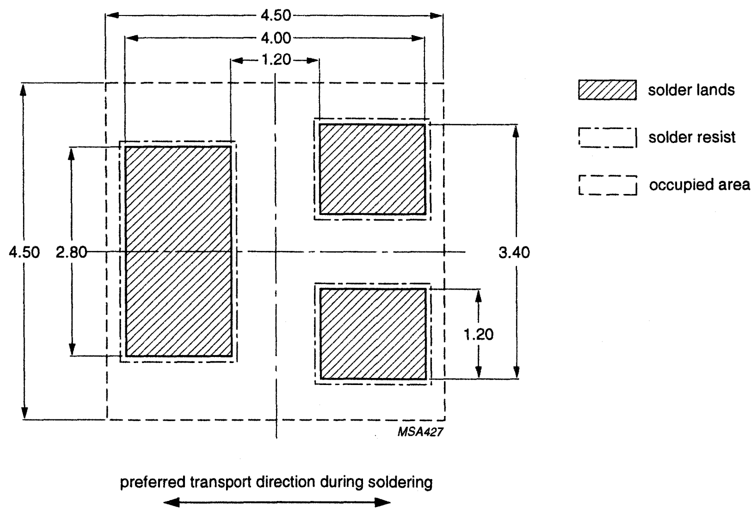
- Features of the component, its dimensions and tolerances
- Circuit board manufacturing processes
- Desired component density
- Minimum spacing between components
- Circuit tracks under the component
- Component orientation (if wave soldering)
- Positional accuracy of solder resist to solder lands
-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

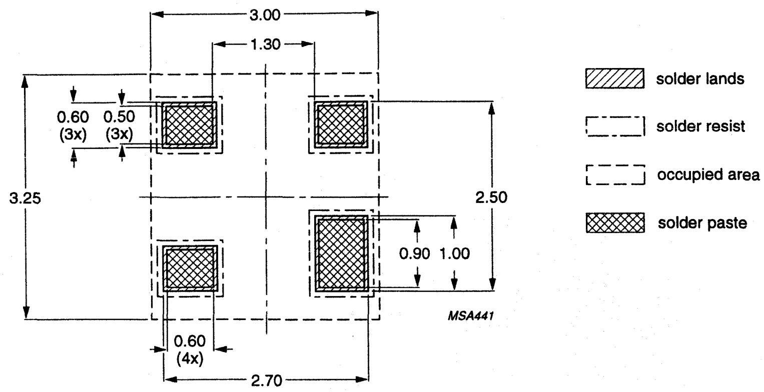
Fig.22 Reflow soldering footprint for SOT23; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

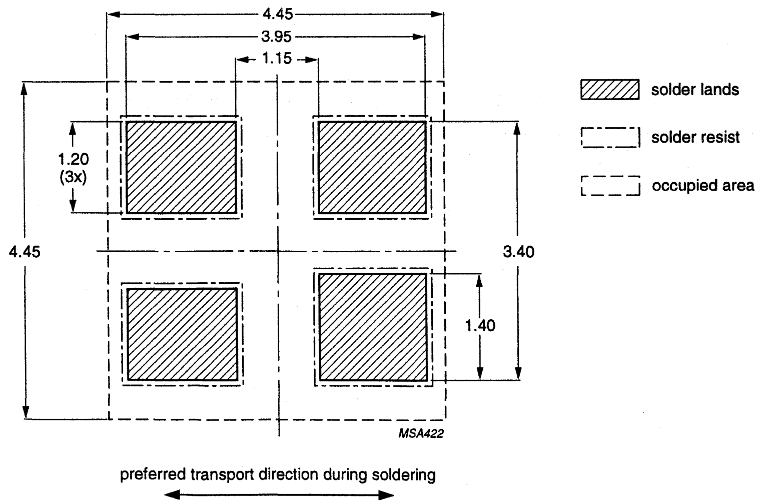
Fig.23 Wave soldering footprint for SOT23; typical dimensions.

SOT143 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

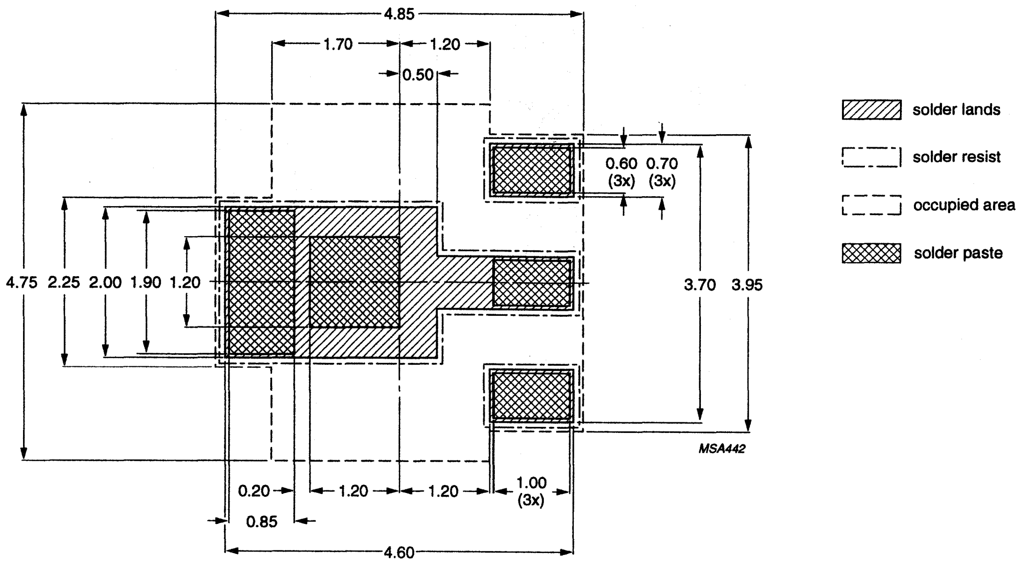
Fig.24 Reflow soldering footprint for SOT143; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.25 Wave soldering footprint for SOT143; typical dimensions.

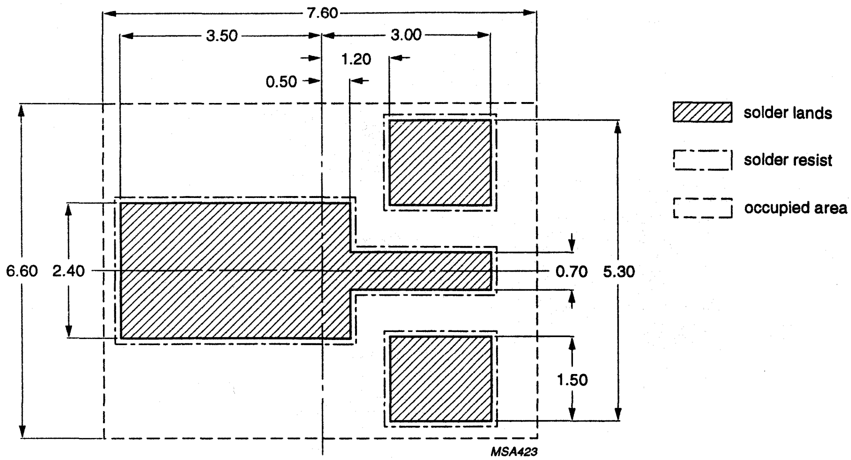
SOT89 FOOTPRINTS



Dimensions in mm.

Placement accuracy: ±0.25 mm.

Fig.26 Reflow soldering footprint for SOT89; typical dimensions.



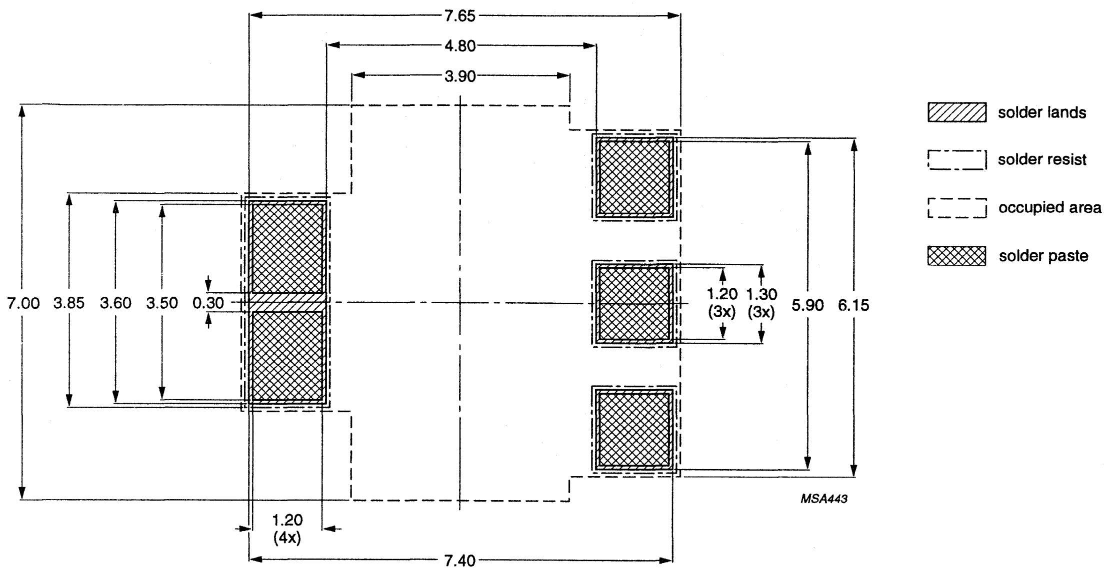
We do not recommend SOT89 for wave soldering, SOT223 is preferred.

Dimensions in mm.

Placement accuracy: ±0.25 mm.

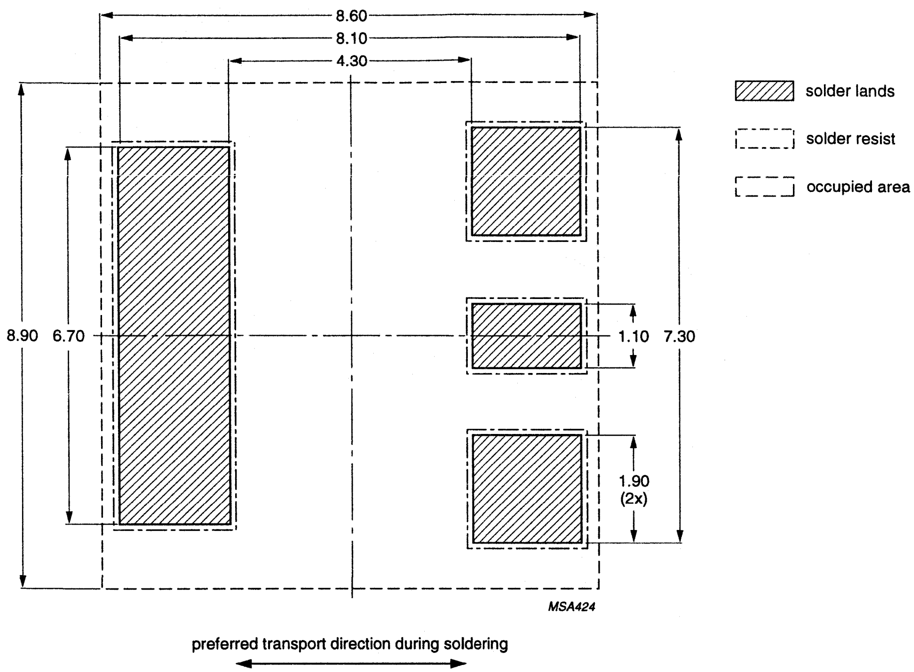
Fig.27 Wave soldering footprint for SOT89: typical dimensions.

SOT223 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

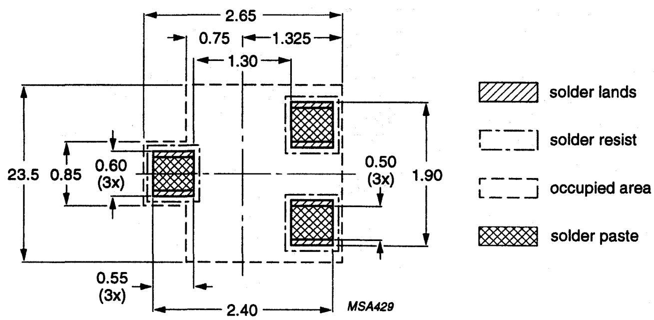
Fig.28 Reflow soldering footprint for SOT223; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

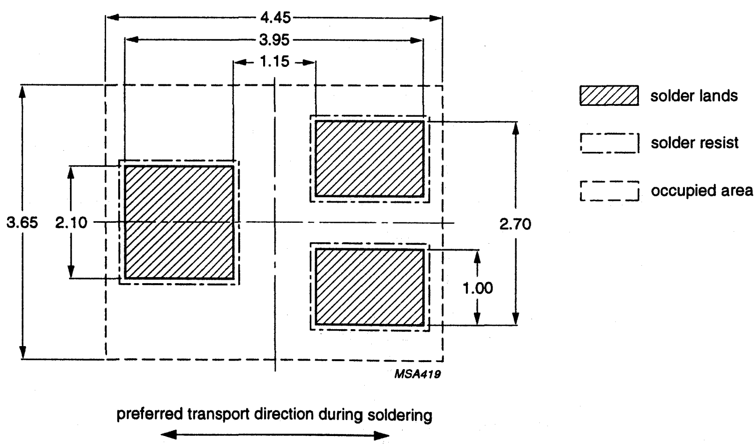
Fig.29 Wave soldering footprint for SOT223; typical dimensions.

SOT323 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

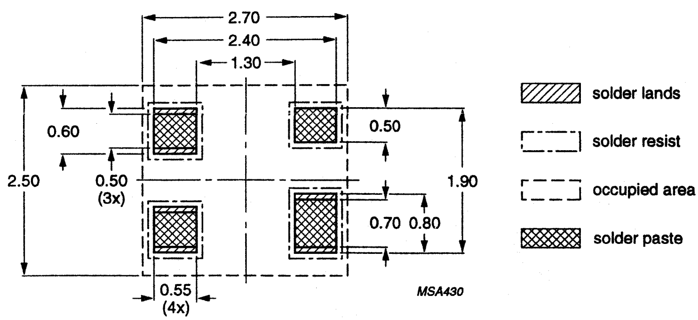
Fig.30 Reflow soldering footprint for SOT323; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

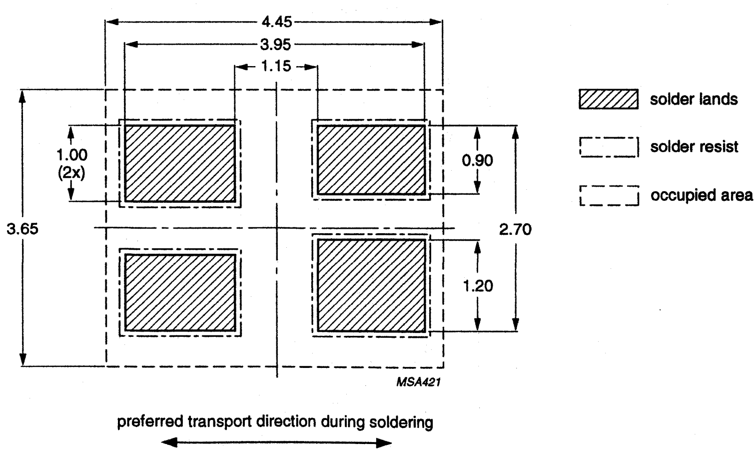
Fig.31 Wave soldering footprint for SOT323; typical dimensions.

SOT343 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

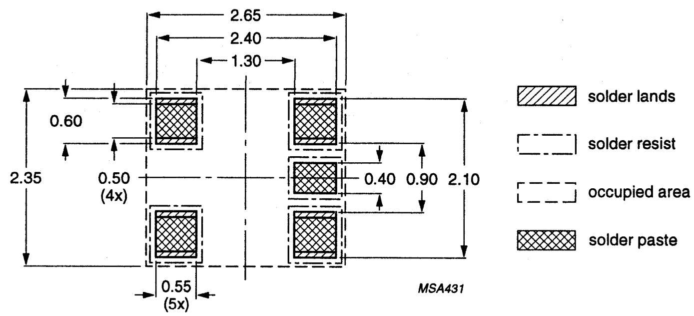
Fig.32 Reflow soldering footprint for SOT343; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

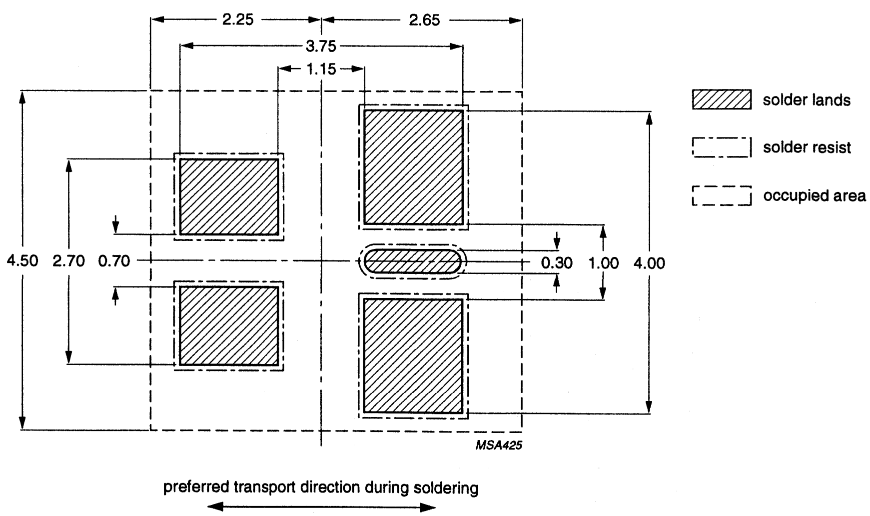
Fig.33 Wave soldering footprint for SOT343; typical dimensions.

SOT353 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

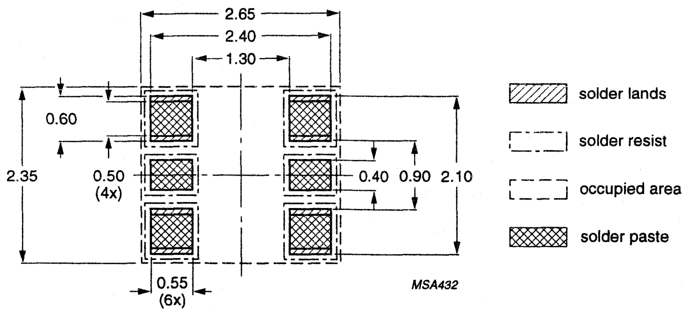
Fig.34 Reflow soldering footprint for SOT353; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

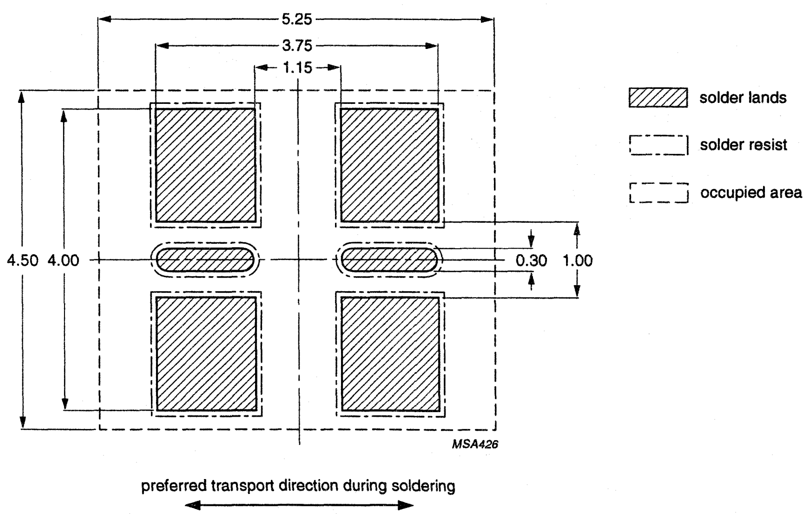
Fig.35 Wave soldering footprint for SOT353; typical dimensions.

SOT363 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.36 Reflow soldering footprint for SOT363; typical dimensions.



Dimensions in mm.
Placement accuracy: ±0.25 mm.

Fig.37 Wave soldering footprint for SOT363; typical dimensions.

Hand soldering microminiature components

It is possible to solder microminiature components with a light-weight hand-held soldering iron, but this method has obvious drawbacks and should be restricted to laboratory use and/or incidental repairs on production circuits:

- Hand-soldering is time-consuming and therefore expensive.
- The component cannot be positioned accurately and the connecting tags may come into contact with the substrate and damage it.
- There is a risk of breaking the substrate and internal connections in the component could be damaged.
- The component package could be damaged by the iron.

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 38 and 39).

The temperature rise as a function of dissipation power, 'thermal resistance', is given in the data sheets as the $R_{th\ j\text{-}s}$ 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)
$R_{th\ j\text{-}s}$	Thermal resistance from junction to soldering point (K/W)
$R_{th\ s\text{-}a}$	Thermal resistance from soldering point to ambient (K/W)
$R_{th\ j\text{-}a}$	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.40). The basic relationship between die temperature (junction temperature) and power dissipation is:

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

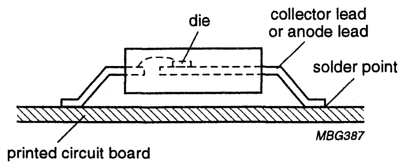


Fig.38 Assembly of SMD package and PCB.

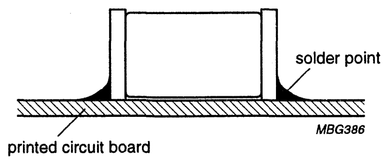


Fig.39 Assembly of SOD80-like package and PCB.

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 °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.41.

Summary of the SMD envelopes

These thermal considerations are valid for the following envelopes:

SOD80, SOD87, SOD106, SOD110, SOD123, SOD323, SC59, SC70, SOT23, SOT89, SOT123,SOT143, SOT223, SOT323, SOT343, SOT346 and SO8 (SOT96-1).

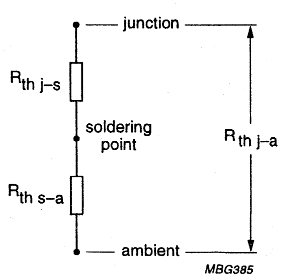
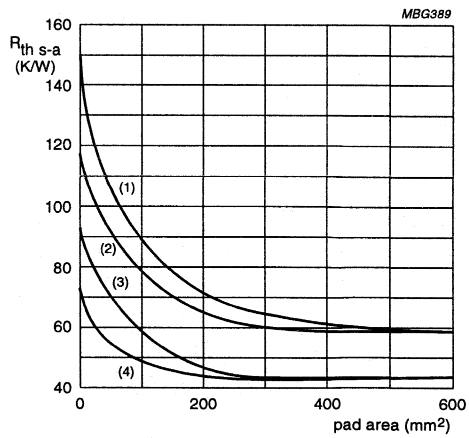


Fig.40 Representation of thermal resistance paths of a device mounted on a substrate or printed board.



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

Fig.41 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.42.

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.

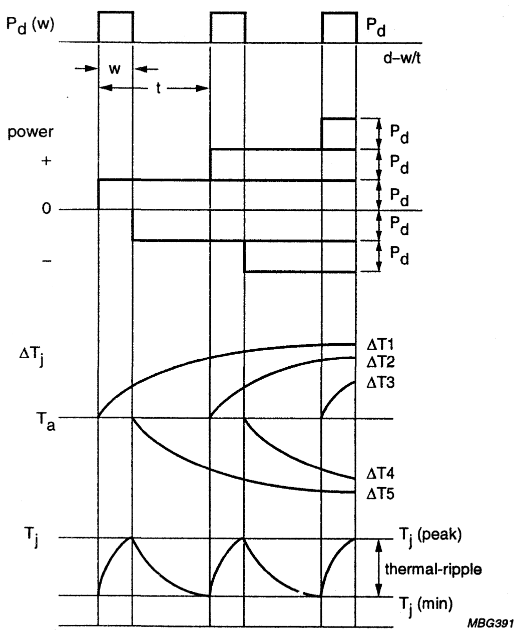
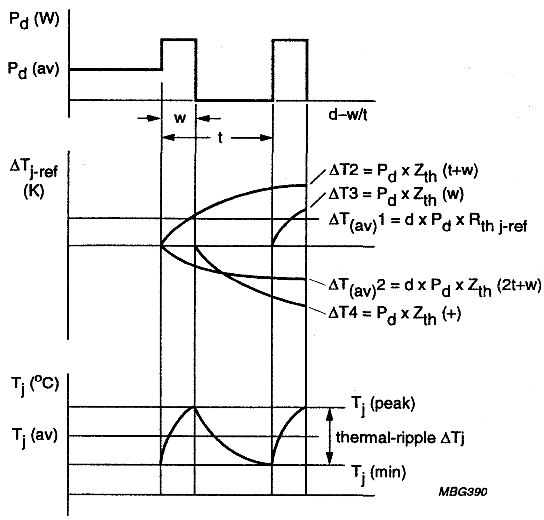


Fig.42 Heating effect of three identical power pulses after thermal stabilization.

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.43. This two-pulse approximation method is accurate enough for finding $T_{j(peak)}$.



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

Fig.43 Two-pulse approximation method of finding peak steady-state junction temperature [$T_{j(peak)}$].

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

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

The junction temperature immediately before the second power pulse is:

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

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.44 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.

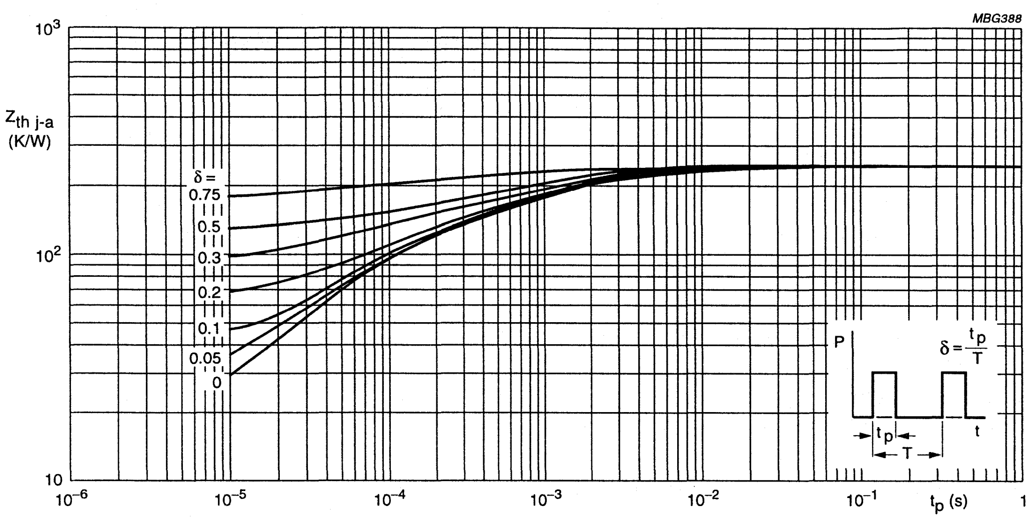


Fig.44 Direct reading of thermal impedance from junction to soldering point for calculation of junction temperature at pulsed power condition.

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 45 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.

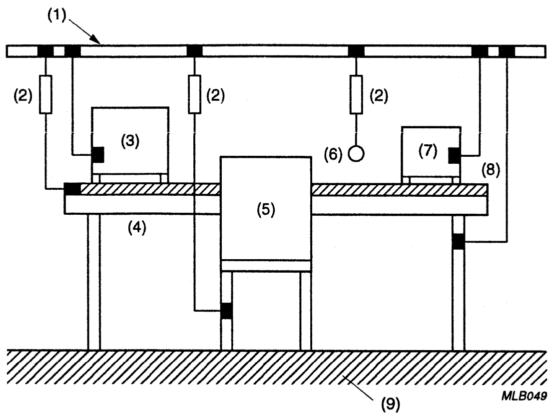
ASSEMBLY

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.45 Protected work station.

APPLICATION REPORTS

APPLICATION REPORTS

Copies of the following application reports can be requested via your local sales office.

1. A wideband amplifier with the BFQ34 and BFQ68, *"NCO8003, 24 April 1980".*
2. House connection amplifier with BFG135 (and BFG31) in push-pull technique, *"PCALH/AT-TVT 20/89, 11 September 1989"* (German language).
3. Satellite IF amplifier with BFG198 and BFG67, *"PCALH/AT-TVT 45/90, 11 October 1990"* (German language).
4. Power Amplifier for 900 MHz at 6 V (BFG540/X). Application information of a 1.2 W surface mount RF power amplifier in the 872 to 905 MHz communications band, *"RNR45/023/1993, 12 January 1993".*
5. Power Amplifier for 1.9 GHz at 3 V (BFG10/X, BFG11/X and BFG540/X),*"RNR45/458/1992, 29 September 1993"* (3rd version). Application information of a surface mount RF power amplifier for 1.9 GHz Digital Personal Handy Phone and DECT at 3 V.
6. Low Noise 900 MHz preamplifier at 3 V with BFR/BFG505/520, *"RNR45/589/1992, 17 December 1992".*
7. Low Noise, Low Current preamplifier for 1.9 GHz at 3 V (BFG505), *"RNR45/343/1992, 16 July 1992".*
8. 933 MHz Low Power Down converter with 60 MHz IF (BFG505/X, BFG520 and BFG540/X), *"RNR45/465/1993, 30 September 1993".*
9. 1890 MHz Low Power Down converter with 110 MHz IF (BFG505, BFG505/X and BFG520), *"RNR45/465/1993, 26 January 1994"* (2nd version).
10. Preamplifier for pager applications (BFC505), *"RNR-T45-95-B-341, 22 May 1995".*
11. GSM Power Amplifier for 900 MHz at 6 V (BFG540W/X, BFG10W/X, BLT82).
    Application information of a 3.5 W surface mount RF power amplifier in the 880 to 915 MHz communication band, 31 January 1995.

POWER AMPLIFIER for 900 MHz at 6V

In this note some results of measurements are described performed on a RF amplifier for 900 MHz applications. The amplifier is able to deliver 1.2 W RF output power with an efficiency better than 45%. The amplifier is build up with three bipolar transistors, the broadband transistor BFG540/x and the RF power transistors BLT80 and BLT81.

The amplifier, a demonstration board showing the BFG540, BLT80 and BLT81 line-up, is developed for maximum gain and efficiency under the conditions : output power 1.2W, supply voltage 6V, and frequency 900MHz. If more or less output power is needed some changes have to be made to the matching circuitry, to obtain a good gain and efficiency at the desired output power.

The amplifier has about 30dB gain at 1.2W output power. Since the amplifier is build up with bipolar transistors no supply voltage is lost, caused by switches, as in GaAs FET designs. The total 6V supply voltage is available for operation. No negative voltage is needed.

General characteristics:

Supply voltage U[Vs]	6V	
Frequency range	872 - 905 MHz	
Output power	1.2 W	P_{drive} = 1 mW
Efficiency	46 %	P_{out} = 1.2 W
Gain	30.8 dB	
Load & Source impedance	50 Ohm	
Printed circuit board	FR4, (ϵ_r=4.7, h=0.51 mm)	Epoxy, Size=23 x 42 mm, could be reduced to half this size by a relayout.
Rugged	Output VSWR = 4.4:1	Vs=8V, Pout=1.5W max.
Harmonic content	-39 dBc	P_{out}=1.2W
Dynamic range	P_{out} = 0 - 30.8 dBm	Vc=0 - 4.6 V
Off-state Current dissipation	< 200 μA	Vc > 5.4V
Control current i[Vc]	-1.1mA	Vc=0V
Components	BFG540/x BLT80 BLT81 BC807/BC817 resistors capacitors	in SOT143/X in SOT223 in SOT223 small PNP and NPN transistors for biasing Philips 0603 Philips 0603

Circuit diagram

For the development of a 900 MHz amplifier, impedance information is needed about the RF transistors for designing the matching circuits. The amplifier is build up with 3 stages, a BFG540 operating in class A, and the BLT80 and BLT81 operating in class AB. The design of the class A, BFG540 stage can be done with S-parameter information available on floppy disc. The design of the class AB stages, the BLT80 and BLT81 can be done with the spice parameters and package parameters. These data is also available on floppy disk.

In appendix A1 the circuit diagram of the amplifier is shown. The bottom half of the circuit is the RF amplification part. It consists of the three RF transistors (BFG540/x, BLT80 and BLT81), matching circuitry (striplines, capacitors) and bias stubs. (striplines & decoupling capacitors) Because of expected instability the BFG540/x transistor is not loaded with the optimum load for maximum gain, but with 50Ω. The transformation from the input impedance of the BLT80 to a load impedance of 50Ω is done by shunt capacitors C15, C16 and C33.

The top half of the circuit shows the circuit, to assure a class A bias for the BFG540/x, and a 0.6V bias voltage to supply the BLT80 and BLT81.

The BFG540/x transistor is operating in class A with a maximum collector current of 35mA. At this current the BFG540/x gives optimum performance.
The stabilization of the collector current is done by a low frequency PNP transistor(BC807) which compares the voltage drop on a resistance in the collector (R3) of the BFG540/x with a voltage determined by the voltage on external pin Vc. This bias circuit gives a biasing which is independent of temperature and Hfe. The voltage drop on R1 is about 0.35V.
A voltage of 0V on pin Vc gives a collector current of 35mA. A voltage of 5V on pin Vc switches the BFG540/x off. Any value above 0V on pin Vc reduces the DC collector current of the BFG540/x. As a result of this the RF output power from the BFG540/x, and from the total amplifier is limited.

The low frequency transistor BC817 is also used as a diode. Connecting the collector to the emitter gives a forward voltage of about 0.7V at a low current (1mA).

The BLT80 and BLT81 transistors are operating in class AB. The bias voltage on the base of these transistors is supplied by transistor T4, which is functioning as an emitter-follower. The voltage on the base of T4 is about 1.3V. This voltage is dependent on the base-emitter voltage of the BFG540/x and the forward voltage of transistor T3. This bias circuit has a temperature coefficient of -2mV/°C, equal to the temperature coefficient of the knee voltage of the BLT80 and BLT81.

The maximum power at the output is available when a 0V is applied to pin Vc. A voltage higher than 0V on pin Vc will reduce the output power.

This function can be reversed by using an extra BC817 transistor in the bias circuitry. If this is needed the control circuit has to be changed as shown in appendix A2. With the changed Vc-circuit maximum output power is available with Vc' at 4V. With 0V on pin Vc' no output power is generated.

A layout of the circuit can be found in appendix B1 & B2. Appendix B2 shows a part of layout, including the component numbers.

Measurement results

In appendix C, D and E the results of measurements are shown.
Unless otherwise given the measurement conditions are :

- Gnd: 0V,
- Vc: set to a voltage to between 0 and 4.6V to get 1.2W output power.
- Vs: 6V
- Pin: 1mW, available from a source with a 50 Ohm impedance
- Pout: measured in a 50 Ohm load.
- $T_{amb.}$ 25°C

Appendix C1 Gain and efficiency vs. control voltage

This figure shows the output power and efficiency as a function of the control voltage Vc. The best efficiency is obtained at an output power of about 1.2W. A control voltage of 0V gives the highest output power.

Appendix C2 Efficiency vs. frequency

This figure shows the efficiency of the amplifier vs. the frequency. The output power is set to 1.2W. The optimum efficiency is obtained in the band from 870 to 905 MHz.

Appendix D1 Output power vs. supply voltage

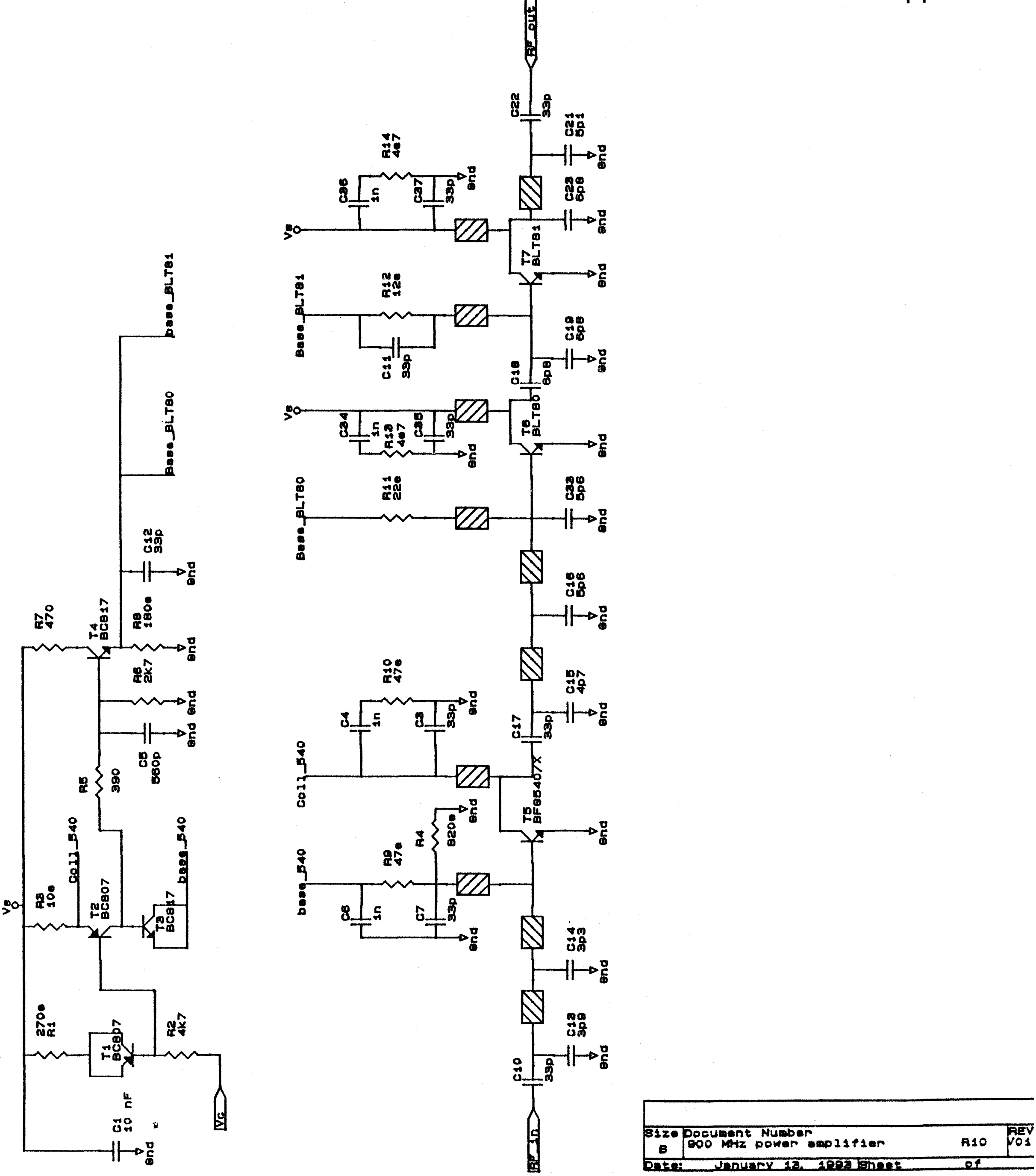
This plot shows the maximum output power (Vc=0V) at a supply voltage range from 5V to 6.6V. The amplifier is able to deliver already 1.2W at 5.5V.

Appendix D2 Harmonics vs. frequency

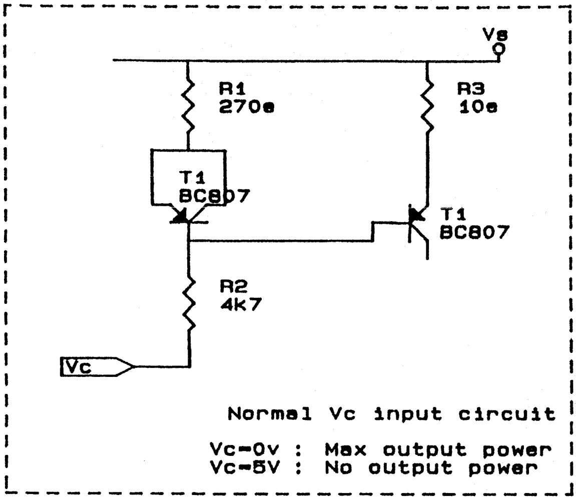
The harmonics are about 39dB below the carrier for all frequencies in the band.

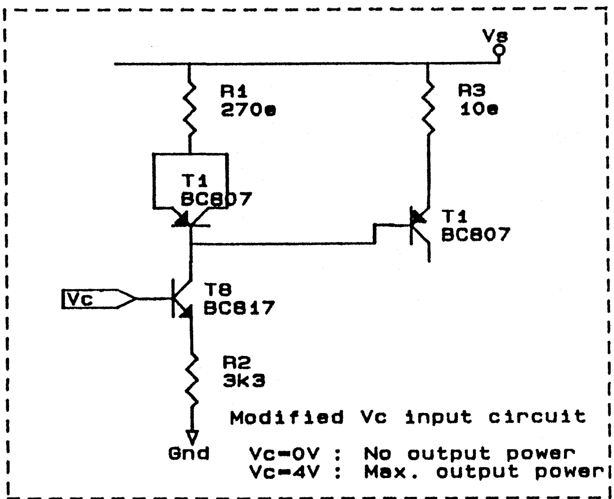
Appendix E Pout vs. Pin

App. A1


RF_out
RF_in
Vs
Vc
Gnd
Size
B
Document Number
900 MHz power amplifier
R10
REV

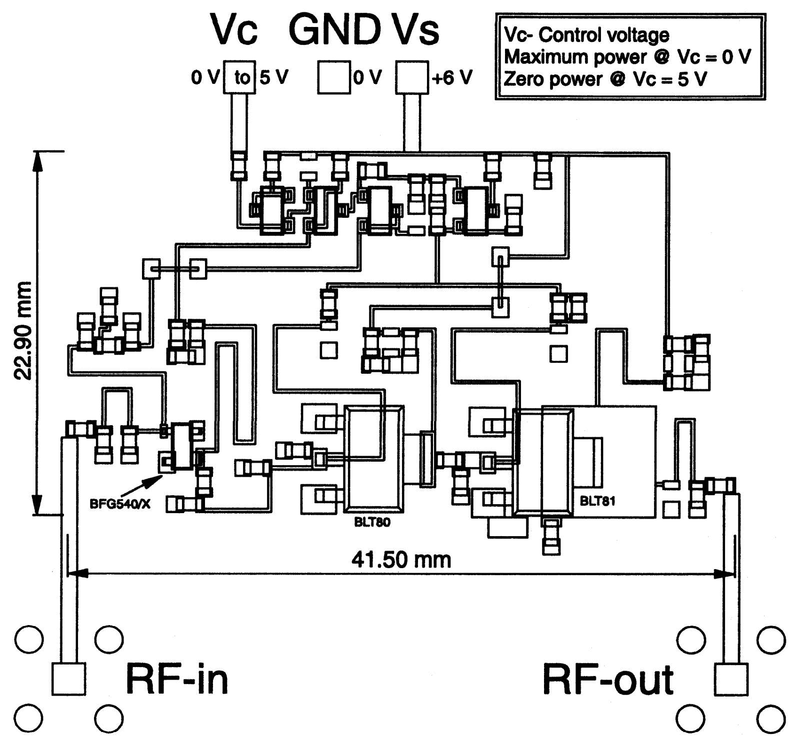
App. A2



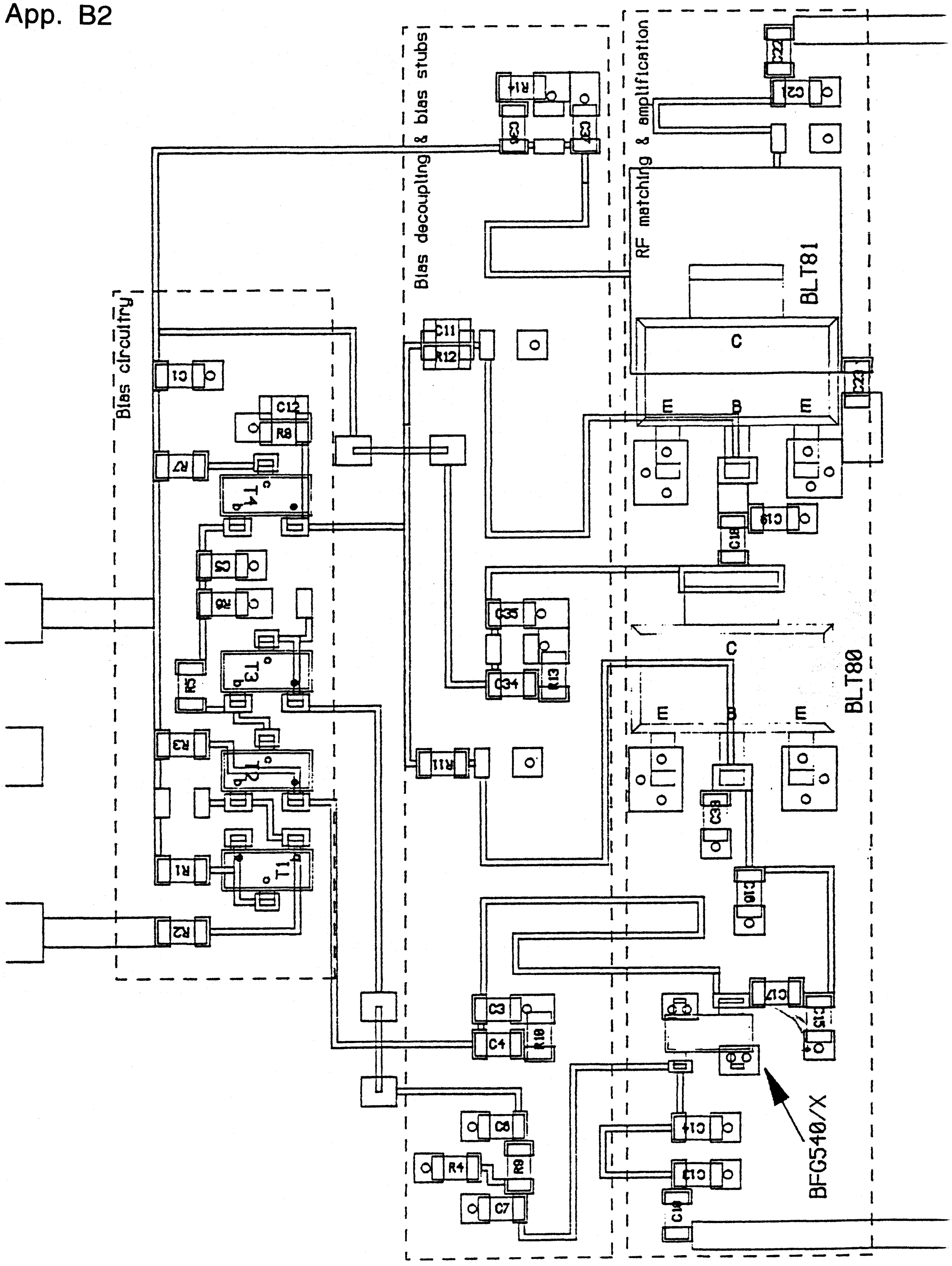


Size	Document Number	REV.
A		
Date: January 14, 1993	Sheet of	

APP B1


Vc GND Vs
0 V to 5 V
0 V
+6 V
Vc- Control voltage
Maximum power @ Vc = 0 V
Zero power @ Vc = 5 V
22.90 mm
BFG540/X
BLT80
BLT81
41.50 mm
RF-in
RF-out

App. B2

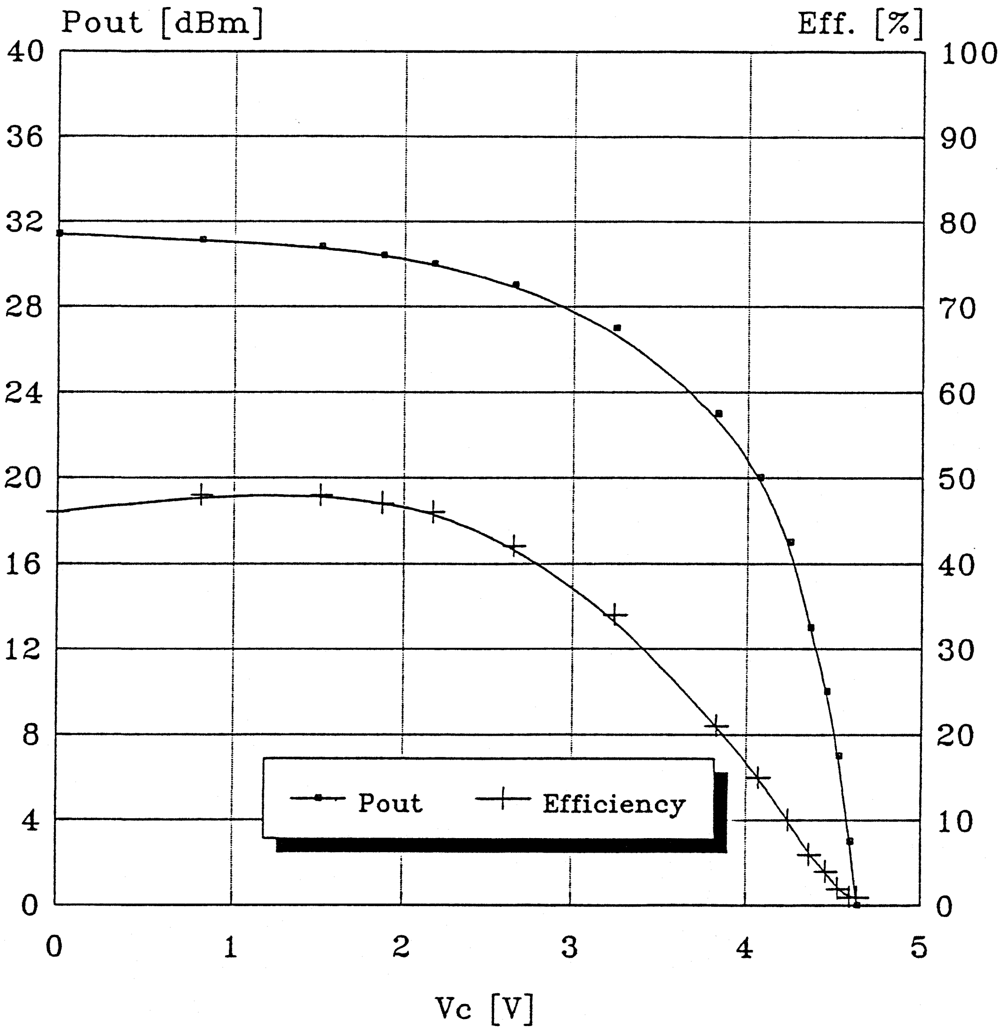

Bias circuitry
Bias decoupling & bias stubs
RF matching & amplification
BLT81
BLT80
BFG540/X
C
E
B
E
T1
T2
T3
T4
R1
R2
R3
R4
R5
R7
R8
R9
R11
R12
R13
R14
R18
C1
C3
C4
C7
C8
C11
C12
C17
C18
C19
C21
C22
C23
C34
C35
C36
C37
C38

App. C1

Pout & Eff. vs. Control voltage

900 MHz amplifier

BFG540/x - BLT80 - BLT81



F=900Mhz, Pin=0 dBm, Vs=6V

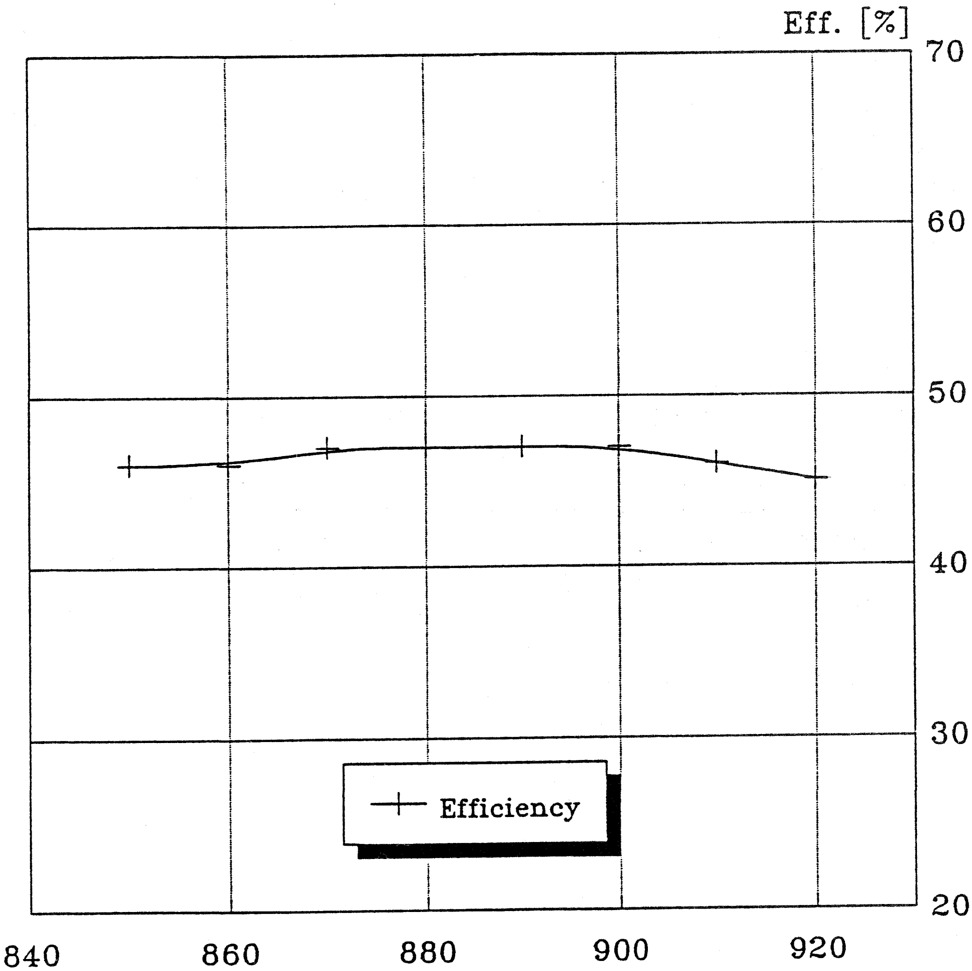
"r10_v01\v001"

App. C2

Efficiency vs. Frequency

900 MHz amplifier

BFG540/x - BLT80 - BLT81



Pin=0dBm, Pout=1.2W, Vs=6V

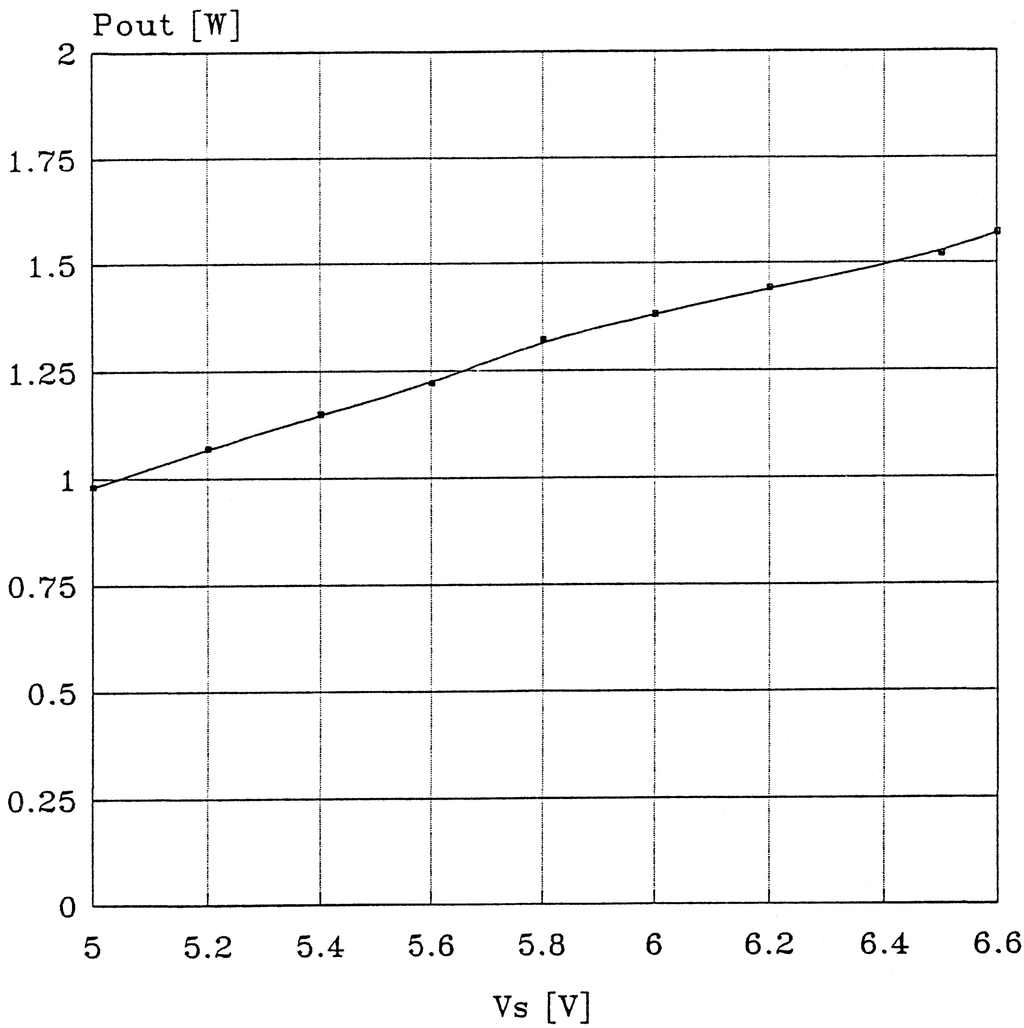
"r10_v01\v002"

App. D1

Max. Pout vs. Supply voltage

900 MHz amplifier

BFG540/x - BLT80 - BLT81



F=900Mhz, Pin=0dBm, Vc=0V

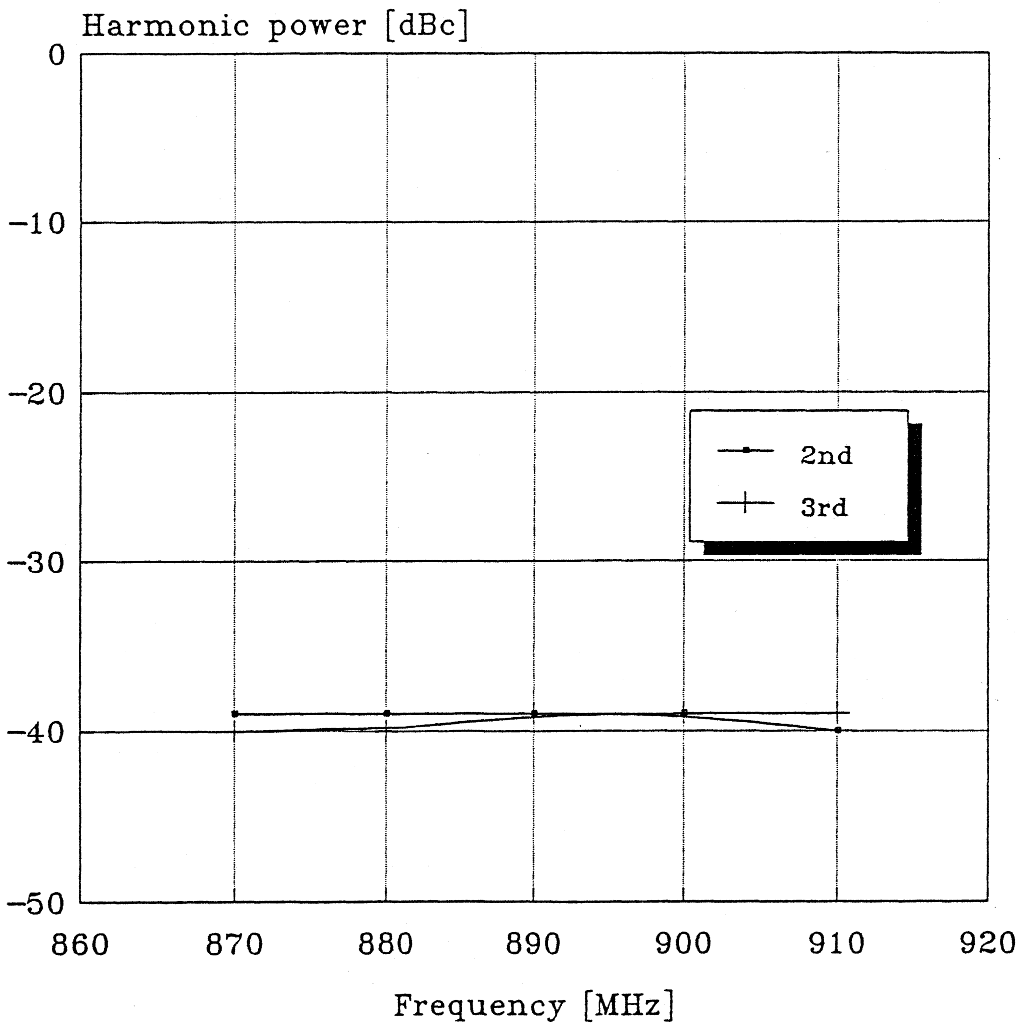
"r10_v01\v003"

App. D2

Harmonics. vs. Frequency

900 MHz amplifier

BFG540/x - BLT80 - BLT81



Pin=0dBm, Pout=1.2W, Vc=6V

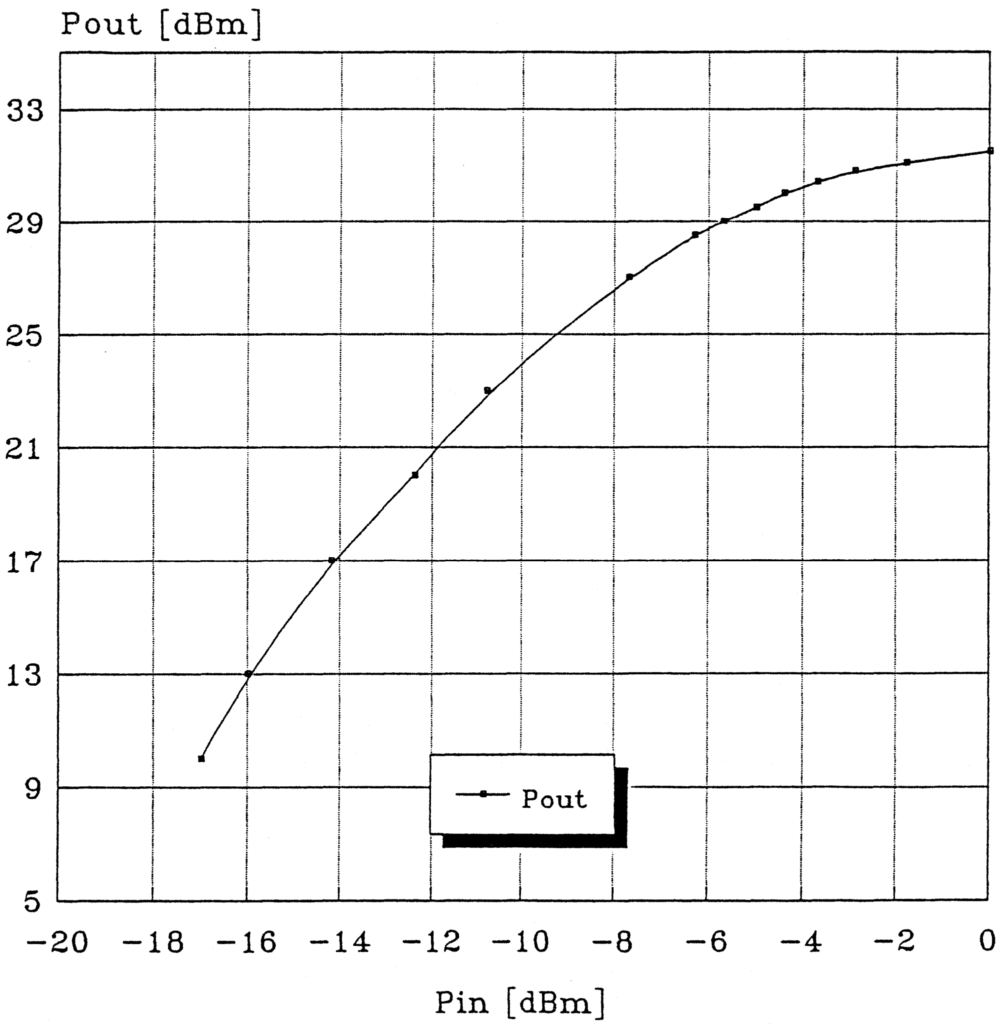
"r10_v01\v004"

App. E

Pout vs. Pin

900 MHz amplifier

BFG540/x - BLT80 - BLT81



F = 900 Mhz, Vc=0V, Vs=6V

"r10_v01\v001"

In this note some results of measurements are described performed on a RF amplifier for 1.9GHz applications. The amplifier is build up from three bipolar transistors, the broadband transistor BFG540/X and the new RF power transistors BFG10/X and BFG11/X.

The amplifier, a demonstration board showing the BFG540, BFG10 and BFG11 line-up, is developed for maximum gain and efficiency under the conditions : output power 26dBm, supply voltage 3.6V, frequency 1900MHz. The amplifier gives about 25dB gain at 26 dBm output power. If more gain is needed a pre-stage could be added with the BFG505 transistor. This could increase the gain with about 10dB, without a significant decrease of efficiency. Since the amplifier is build up with bipolar transistors no supply voltage is lost caused by switches, as in GaAs FET designs. The total 3 x 1.2V supply voltage is available for operation.

General characteristics:

Supply voltage	3.3 - 3.6 V	
Frequency	1880 - 1920 MHz	
Gain	> 20 dB	Measured : 25 dB
Output power	26 dBm	
Efficiency	40 %	@ 26 dBm output power
Intermodulation IM2 *)	30dBc	@ 23 dBm PEP
Type of operation	pulsed	Duty cycle 1 - 12.5%
Printed circuit board size	21 x 13 mm	
Printed circuit board	FR4 (Er=4.7, h=0.5mm)	Epoxy
Components		Package:
	BFG540/X	SOT143/X **)
	BFG10/X	SOT143/X **)
	BFG11/X	SOT143/X **)
	BC807/BC817	small npn and pnp transistors in SOT23 used for biasing the BFG540/X, BFG10/X and BFG11/X
	resistors	philips 0603
	capacitors	Philips 0603

*) Important for the Japanese PHP system only.
**) Also available in SOT143

Circuit diagram

For the development of a 1.9GHz amplifier, impedance information is needed about the RF transistors for designing the matching circuits. The amplifier is build up with 3 stages, a BFG540 operating in class A, and the BFG10 and BFG11 operating in class AB. The design of the class A, BFG540 stage can be done with S-parameter information available on floppy disc. The conjugate match input and load impedances are given in the table below. The design of the BFG10 and BFG11 stages can be done by using measured impedances given in the next table:

Transistor	Operation in class	Input impedance		Opt. load impedance	
		Re [Ω]	Im [Ω]	Re [Ω]	Im [Ω]
BFG540	A, [30mA/3.6V]	7.1	13.9	44.6	40.1
BFG10	AB, [Ube=0.72V]	5.6	16.0	12.4	-1.2
BFG11	AB, [Ube=0.72V]	8.4	16.3	12.4	-1.2

In appendix A the circuit diagram is shown of the amplifier. The RF amplification part is build up with the transistors BFG540/X, BFG10/X and BFG11/X and matching circuits. The matching is done by shunt and series capacitors, series transmission lines and shorted stubs. A capacitor with a value of 8.2 pF is about series resonance at 1.9 GHz.

The BFG540/X transistor is operating in Class A at a collector current of 30mA. At this current the BFG540/X gives optimum performance.
The stabilization of the collector current is done by a low frequency PNP transistor which compares the voltage drop on a collector resistance of the BFG540/X with a voltage determined by the voltage on Vc. This bias circuit gives a biasing which is independent of temperature and Hfe. The voltage drop on R3 is about 0.3V.
A voltage of 0V on pin Vc gives a collector current of 30mA. A voltage of 3.0V on pin Vc switches the BFG540/X off.

The low frequency transistor BC817 is also used as a diode. Connecting the collector to the emitter gives a forward voltage of about 0.7V at a low current (1mA).

Under pulsed conditions the pin Vc should be applied with **negative** pulses of 0V.

The BFG10/X and BFG11/X are operating in class AB. The bias voltage of the BFG10/X and BFG11/X is set to about 0.72V during RF. This voltage is pulsed and derived from the biascircuit of the Class A bias circuit.

A layout of the circuit at a scale of 10 : 1 can be found in appendix B.

Measurement results

In appendix C to F the results of measurements are given. The measurements are all performed under pulsed conditions with a duty cycle of 10%.

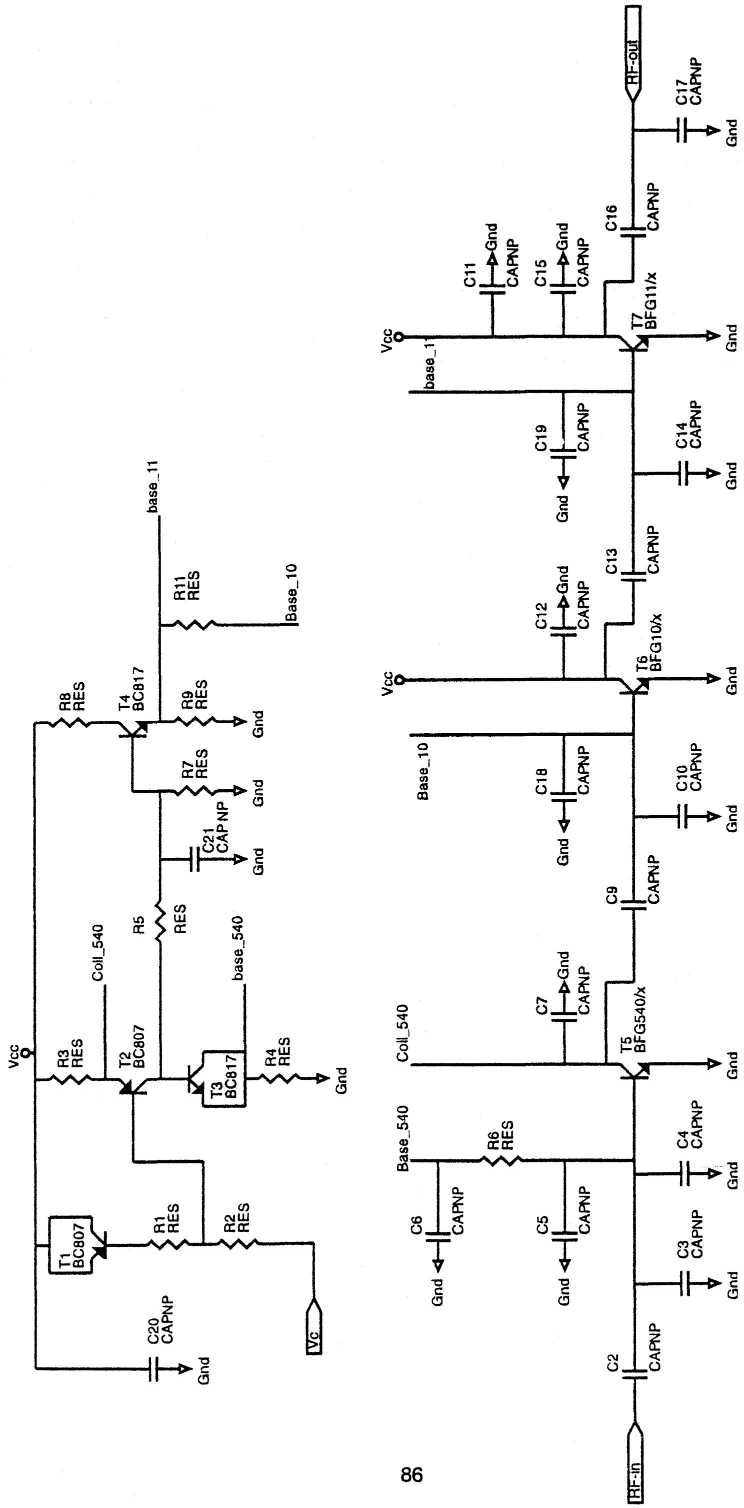
Appendix C Gain and efficiency vs. Pout.
These pictures show the performance of the amplifier for 3.6V supply voltage.

Appendix D Pout and efficiency vs. the supply voltage
This plot shows the output for a constant input power when the supply voltage is varied over the range 3.0 to 4.2V.

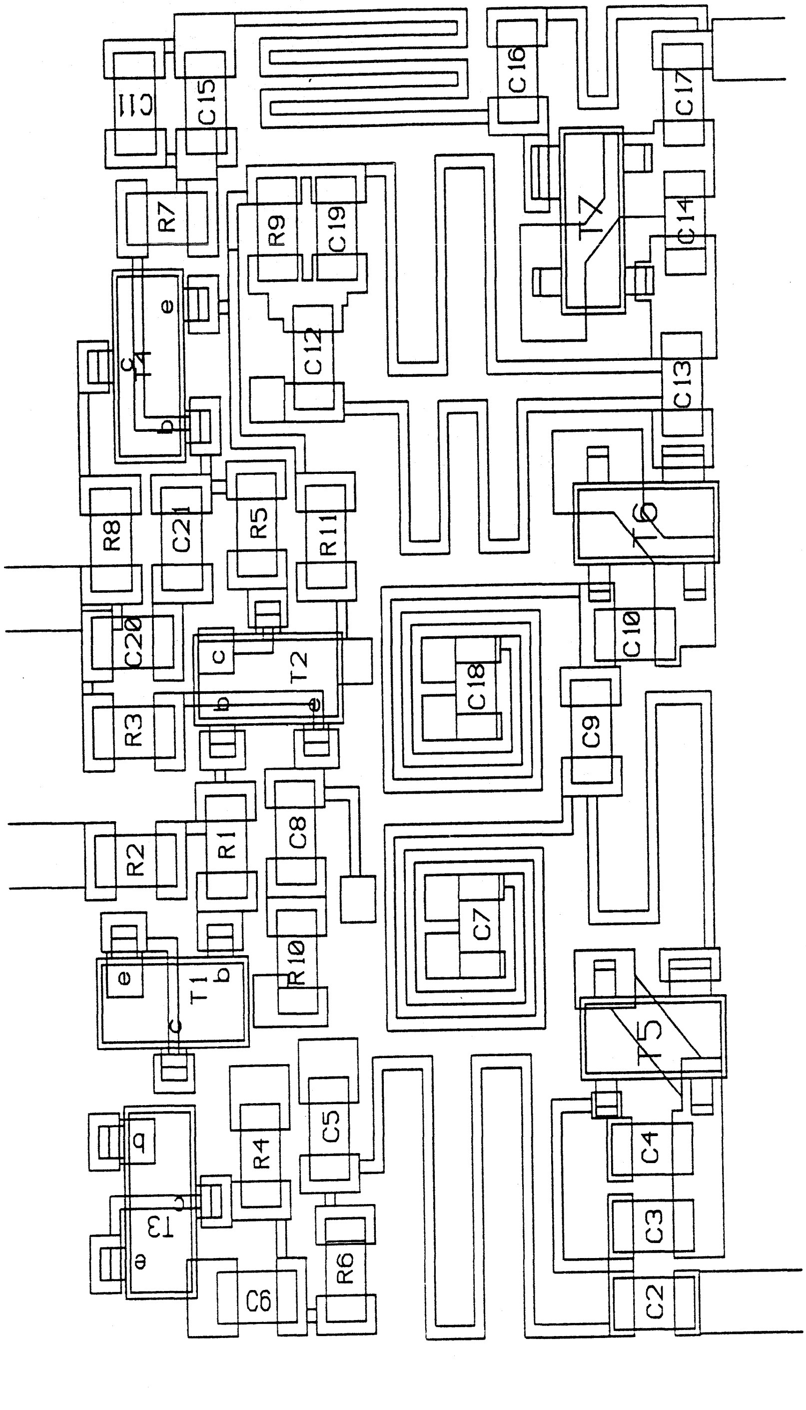
Appendix E Gain and efficiency vs. frequency
The gain drops about 0.5dB over the frequency range from 1880 MHz to 1900 MHz.

Appendix F Pout and efficiency vs. Control voltage
When the control voltage is changed from 0V to 3V the output power is decreasing. The output power vs. the control voltage is shown in this plot.

App. A


RF-out
C17 CAPNP
Gnd
C16 CAPNP
C11 CAPNP
C15 CAPNP
T7 BFG11/x
Vcc
base_11
C19 CAPNP
C14 CAPNP
C13 CAPNP
C12 CAPNP
T6 BFG10/x
Base_10
C18 CAPNP
C10 CAPNP
C9 CAPNP
C7 CAPNP
T5 BFG540/x
Coll_540
Base_540
R6 RES
C4 CAPNP
C6 CAPNP
C5 CAPNP
C3 CAPNP
C2 CAPNP
RF-in
R11 RES
R8 RES
T4 BC817
R9 RES
R7 RES
C21 CAP NP
R5 RES
base_540
R3 RES
T2 BC807
T3 BC817
R4 RES
T1 BC807
R1 RES
R2 RES
Vc
C20 CAPNP

App. B1


C11
C15
C16
C17
R7
R9
C19
T7
C14
T4
c
e
b
C12
C13
R8
C21
R5
R11
T6
C20
T2
C10
R3
C18
C9
R2
R1
C8
C7
R10
T1
T5
R4
C5
C4
T3
C3
R6
C6
C2

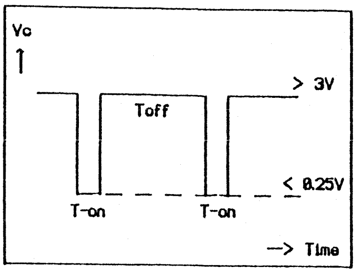
App. B2

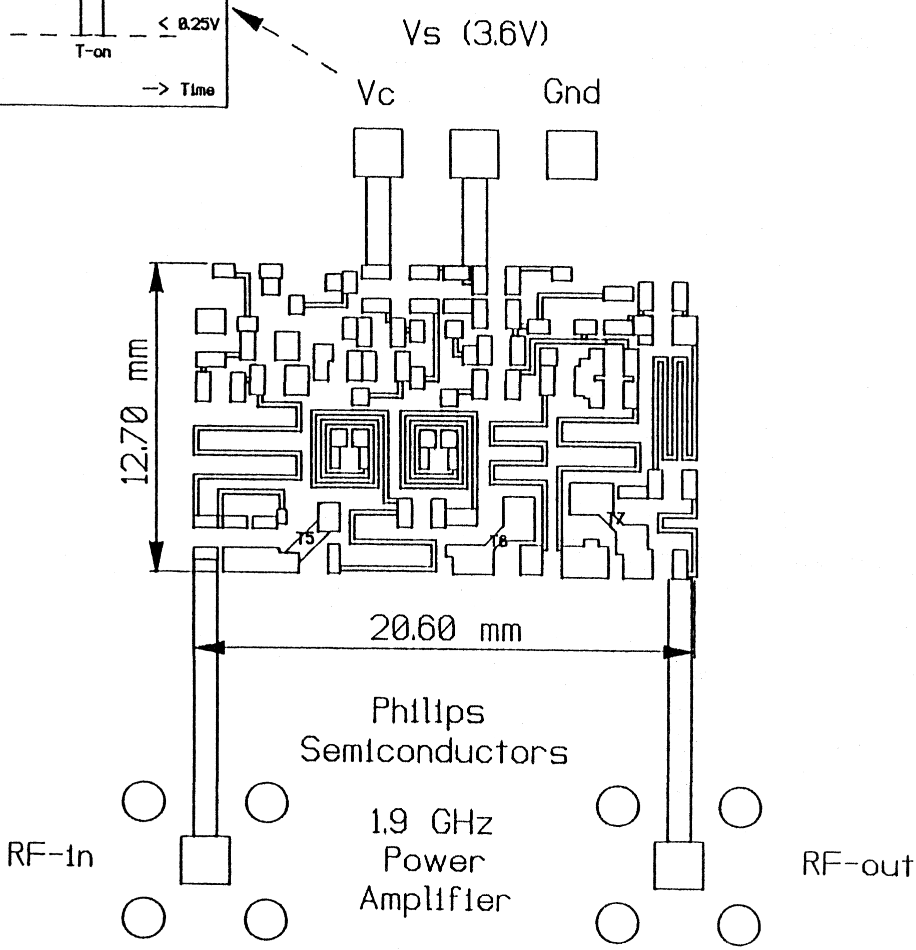
"RL027"

Componentlist 1.9 GHz Power Amplifier

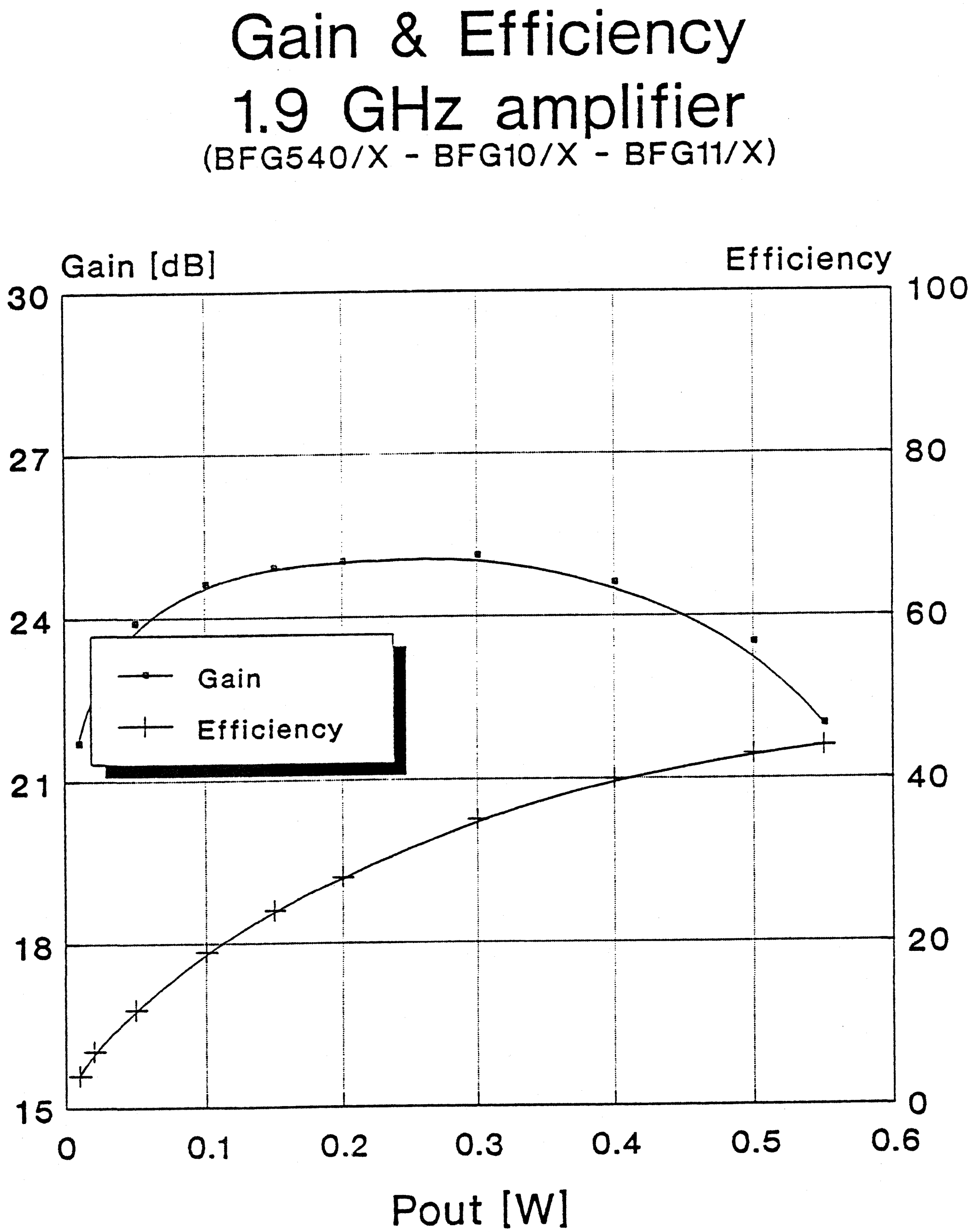
T1	BC807	R1	330E	C1	-
T2	BC807	R2	3K3	C2	8p2
T3	BC817	R3	10E	C3	0p68
T4	BC817	R4	820E	C4	3p3
T5	BFG540/X	R5	220E	C5	8p2
T6	BFG10/X	R6	47E	C6	1n
T7	BFG11/X	R7	2K7	C7	8p2
		R8	220E	C8	-
		R9	180E	C9	2p2
		R10	-	C10	2p7
		R11	15E	C11	1n
				C12	8p2
				C13	3p9
				C14	3p0
				C15	10p
				C16	3p9
				C17	2p2
				C18	8p2
				C19	8p2
				C20	10n
				C21	560p

App. B3


Vc
> 3V
Toff
≤ 0.25V
T-on
T-on
--> Time

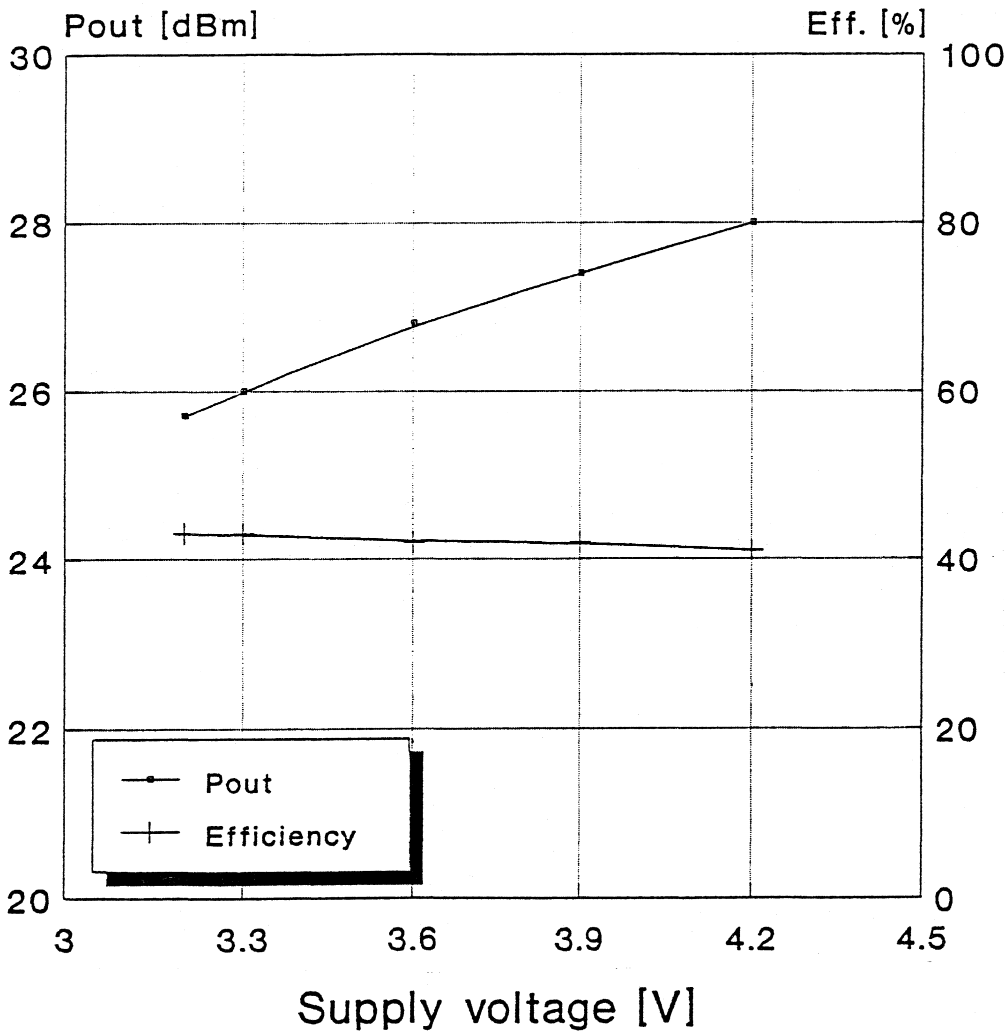

Vs (3.6V)
Vc
Gnd
12.70 mm
T5
T6
T7
20.60 mm
Philips
Semiconductors
1.9 GHz
Power
Amplifier
RF-in
RF-out

App. C



F=1.88GHz, Control=0.00V
"R06_V05\V001"

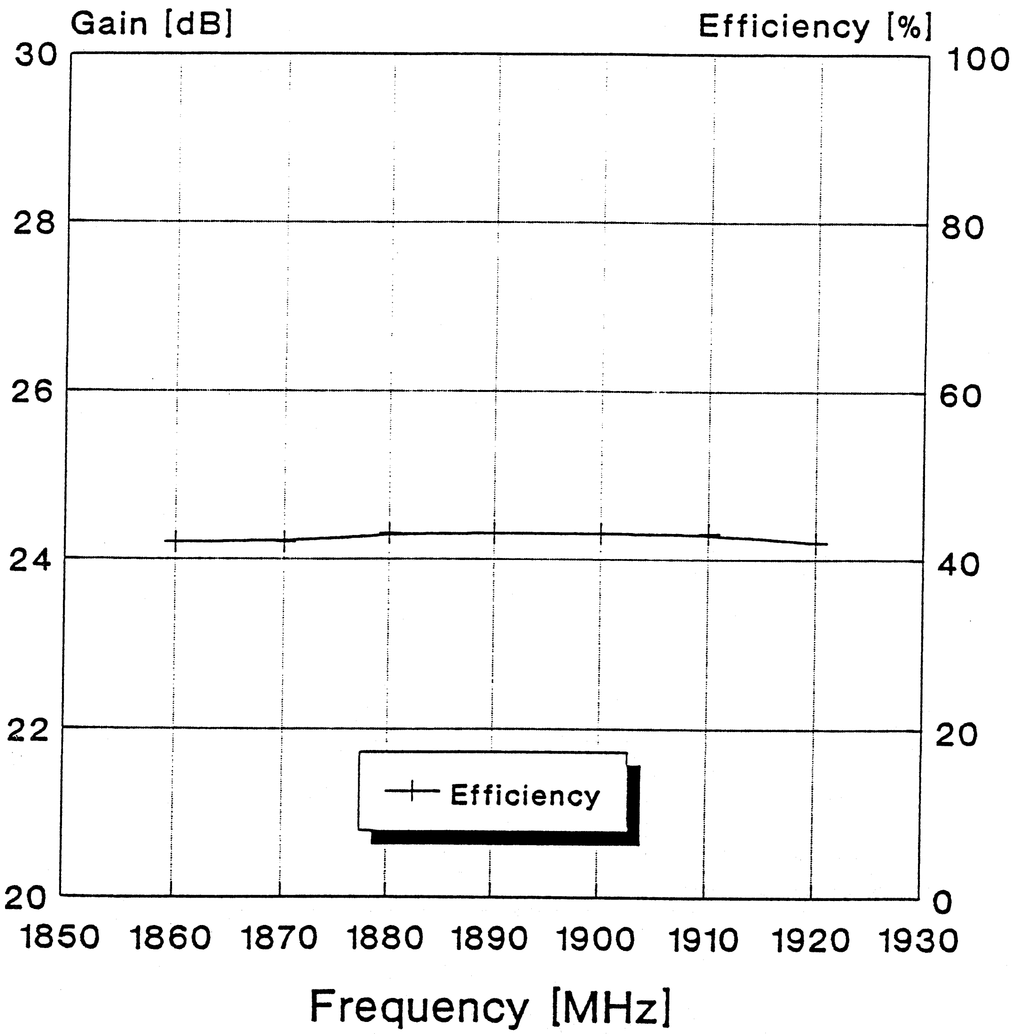
Pout & Eff. vs. supply voltage
1.9 GHz amplifier
(BFG540/X - BFG10/X - BFG11/X)



F=1.88GHz, Contr=0.00V, Pin=3dB
"R06_V05\V003"

App. E

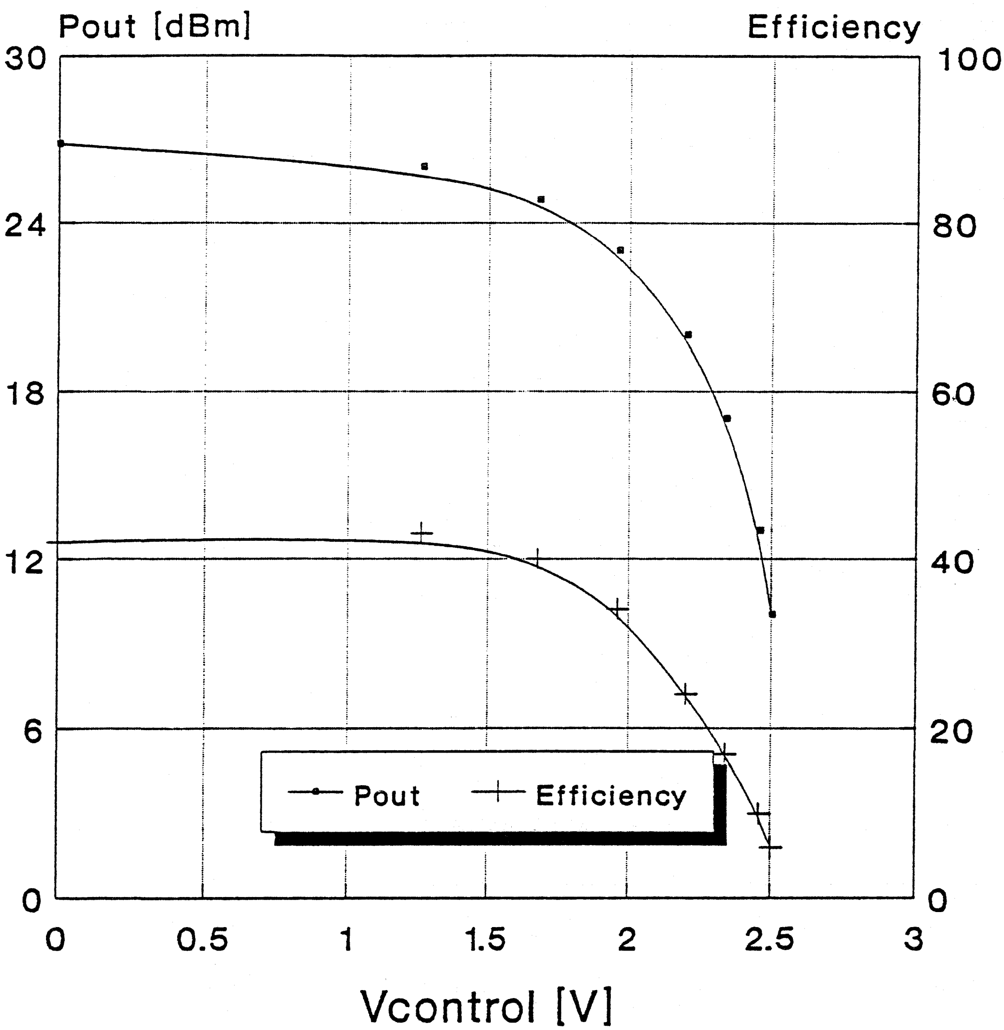
Gain & Efficiency vs. Frequency
1.9 GHz amplifier
(BFG540/X - BFG10/X - BFG11/X)



Vs=3.6V, Pin=3dBm, Pout=26dBm
"R06_V04\V005"

App. F

Pout vs. control voltage
1.9 GHz amplifier
(BFG540/X - BFG10/X - BFG11/X)



Vs=3.6V, F=1.88GHz, Pin=3dBm
"R06_V05\V007"

900 MHz LOW NOISE AMPLIFIER DEMOBOARD

Summary: The performance of wideband transistors, BFG505 (BFG520, BFR505, BFR520) is demonstrated in a 900 MHz Low Noise Amplifier in the frontend of a subscriber handset. (i.e. Cordless phone, cellular phone) The transistors, as evaluated in this application note, are available in the SOT23, SOT323 (SC70) and SOT143 (3 versions) packages.

General characteristics of demoboard with BFG505:

Supply	2.5-3.6 V, 2 mA	
Gain	typ. 11 dB	
Noise Figure	F<1.5 dB	includes losses
In/Out return loss	S11,S22<-10 dB	
PCB size	10 x 10 mm	active area
Components	BFG505 resistors capacitors coils	SOT143 Philips 0603/0805 Philips 0603 air wounded int. diam 1.5 mm wire 0.4 mm Cu
Stability	stable when terminated with 50 Ohm at all frequencies	

Introduction

Several AC-parameters are of importance when designing an RF low noise amplifier. The main goal is to improve system sensitivity. An optimally designed Low Noise Amp will be a trade off between noise and gain. Furthermore, when using 50 Ohm designed bandpass filters, a mismatch can result in extra losses. Obtaining 50 Ohm matching is also an important design aspect. Other AC-parameters include isolation to reduce Local Oscillator radiation and linearity. This contributes less to system performance, as it is determined mostly by the mixer. Other design requirements are a small size and very low power consumption.

Meeting all these requirements will always result in a design that is a trade off. Philips' fourth generation bipolar wideband transistors can meet the required specifications as they offer outstanding performance at 900 MHz.

Theory

A simplified formula valid for lower frequencies can learn us what match we should present to the input port of the bipolar transistor used in common emitter configuration to obtain minimum Noise Figure.
The optimal source impedance for minimum noise $R_s\{opt\}$ is given by:

$R_s\{opt\} = \sqrt{[ß/s*(1/s+2*r_b)]}$ Ohm

while

$s= qI_c/kT$ and $ß= H_{FE}(DC)$

This formula takes into account both shot noise and thermal noise.
One can see that a low bias current results in farely high impedances. (for the BFR505 X-tal at 2 mA follows: $R_s\{opt\}$= 270 Ohm) For higher frequencies the optimum source impedances must be more inductive to be able to tune out internal device parasitics.The power match which gives optimum gain occurs for: $R_s\{opt\}= ß/s+ R_b$ (1.4 kOhm)
It is easily seen that for low currents both noise and gain match cannot be realised simultaneously.

The only way of obtaining noise and gain match simultaneously is applying a feedback. This can be done by a series emitter induction.
At 900 MHz, a few nH emitter induction can change the input impedance considerably and it will bring noise and gain match closer together at the cost of some gain (a few dB).
This makes a properly matched low noise design possible.
To show what trade-off can be reached figure 1 shows the results of Touchstone (R)* simulations based on the noise and gain parameters from the Touchstone Data diskette**.
Return losses at both input and output were below -10 dB.

As far as stability is concerned, it is impossible to design the amplifier to be unconditionally stable for both input and output for all source and load impedances at all frequencies.
Some damping at frequencies outside the 900 MHz band could be necessary in some practical cases.
Negative feedback increases stability, postive feedback decreases stability.
Positive feedback can occur when the emitter is capacitively loaded. As far as possible, we should avoid this in an RF design.

* Touchstone is a registered trademark of Eesof
** Noise & s-parameter library surface mounted devices, available at your local Philips Sales office.

Practical circuit

The input and output match were realized with lumped elements since they give the smallest size at 900 MHz. (see fig. 2)
Decoupling capacitors forming short circuit at 900 MHz are 27 pF. Power supply decoupling is done with a 1 nF capacitor.
The coils could be replaced by PCB-track inductors or SMD inductors. Attention should be given to the value of the emitter induction which can be realized through a few mm track. A proper ground should be available. One should be carefull in choosing capacitance and inductance especially at the input since low Q elements give noise degradation.
The high impedance match at the input is not easy to realize and is most sensitive to parameter spread of the passive components. The PCB design was optimized for minimum noise.
Simulated component values for the different transistors can be found in figures 3-6. Results of measurements are shown in figures 7-9. Circuit layout can be seen in fig. 10. It was build on a 1 mm FR4 epoxy substrate.
Theoretical component values may slightly differ from practical values due to layout parasitics.

Biasing considerations.
At 3V supply, stable biasing can be difficult.
To reduce the effects of H_{FE} spread a decoupled emitter resistor is often necessary. This decouple capacitor increases the risk for instability. Another solution, requiring a low cost low frequency PNP transistor can be seen in fig.11.
This solution gives H_{FE} independent biasing in grounded emitter configuration.

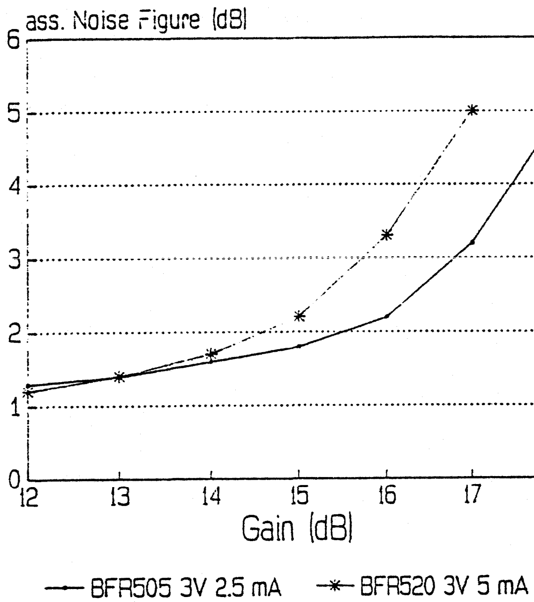


Fig. 1 Gain and associated Noise Figure

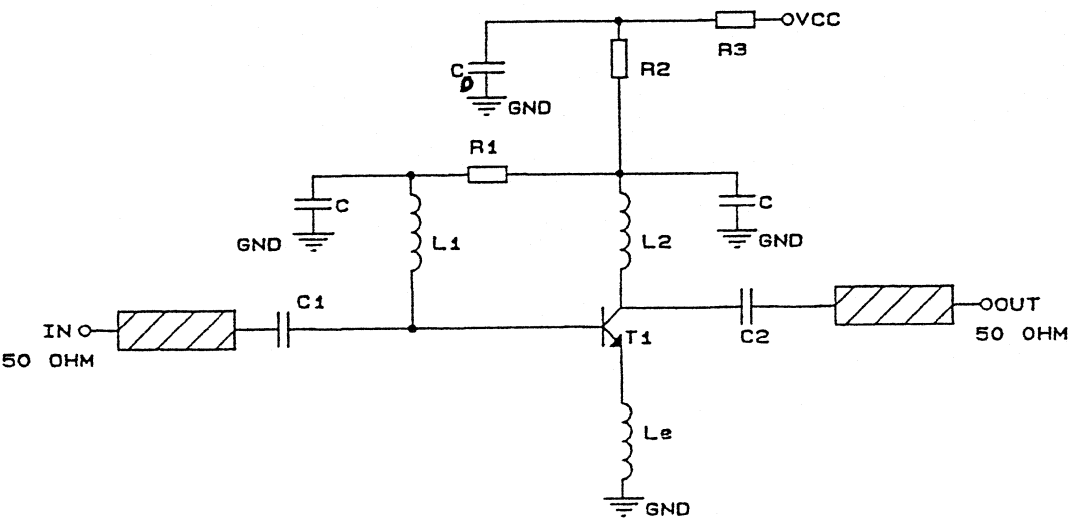


Fig 2. Schematic circuit diagram

Fig 3. BFG505 3V 2.5 mA values of components

C1 pF	2.3	2.5	2.8	2.9	2.9	2.4	1.7
L1 nH	14	12.5	11	9.5	8.4	7.1	7.0
Le nH	3.9	3.0	2.3	1.9	1.6	1.6	2.0
C2 pF	2.2	2.2	2.1	1.9	1.7	1.2	0.8
L2 nH	14	13.4	13.3	13.0	13.0	14.7	17.7
G dB	12	13	14	15	16	17	18
NF dB	1.4	1.5	1.7	1.9	2.3	3.3	5.1

Fig 4. BFR505 3V 2.5 mA values of components

C1 pF	2.4	3.1	3.1	3.0	1.5		
L1 nH	12.5	11.5	9.5	7.5	8.2		
Le nH	2.8	2.0	1.6	1.5	1.6		
C2 pF	2.9	2.5	2.2	1.7	1.1		
L2 pF	13	12.7	11.5	11.9	12.1		
G dB	11	12	13	14	15		
NF dB	1.4	1.6	1.9	2.6	4.4		

Fig 5. BFR520 3V 5 mA value of components

C1 pF	5.7	7.2	8.5	9.5	10		
L1 nH	10.4	8.5	7	5.3	4		
Le nH	0.7	0.3	0.1	0.05	0.0		
C2 pF	3.6	3.2	2.7	2.0	1.4		
L2 nH	10.5	9.5	9.0	9.5	11.5		
G dB	12	13	14	15	16		
NF dB	1.3	1.5	1.8	2.3	3.5		

Fig 6. BFG520 3V 5 mA values of components

C1 pF	5.2	10	27	33	33		
L1 nH	13.7	20	12	8	5.9		
Le nH	2.2	1.0	0.7	0.5	0.4		
C2 pF	3.2	3.7	3.3	2.9	2.1		
L2 nH	13.3	11.3	9.3	8.7	9.1		
G dB	12	14	15	16	17		
NF dB	1.2	1.3	1.6	2.1	2.8		

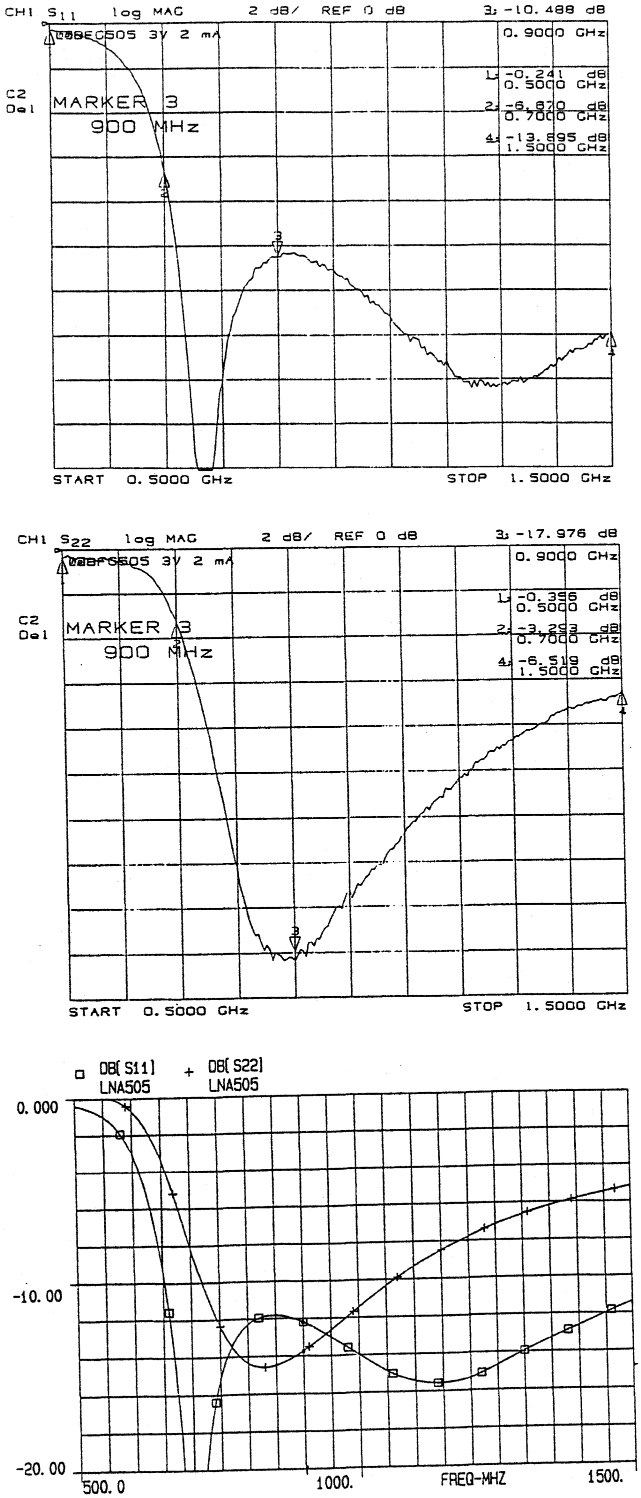


Fig 7. Measured and simulated in/out match.

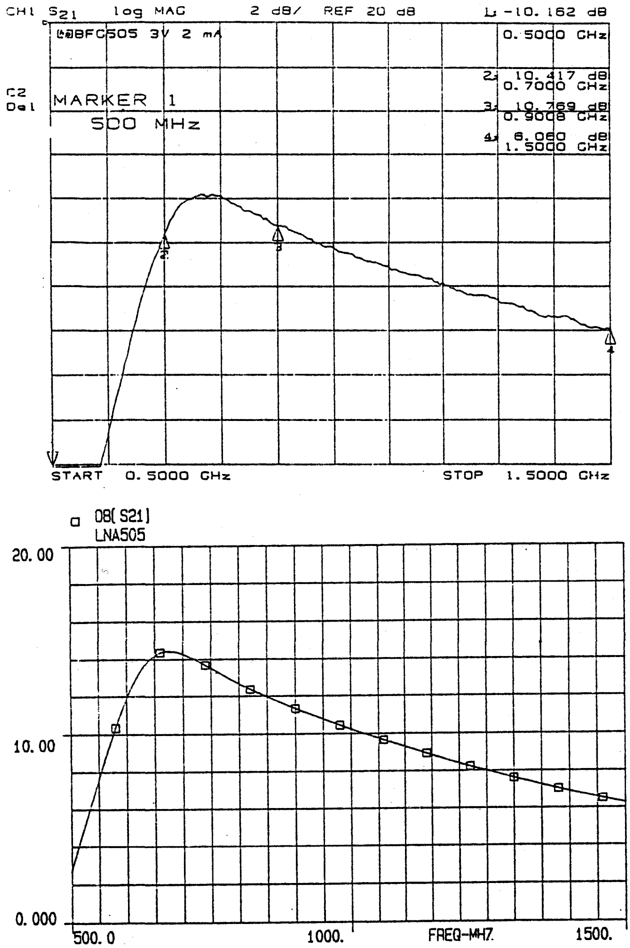


Fig.8 Measured and simulated gain.

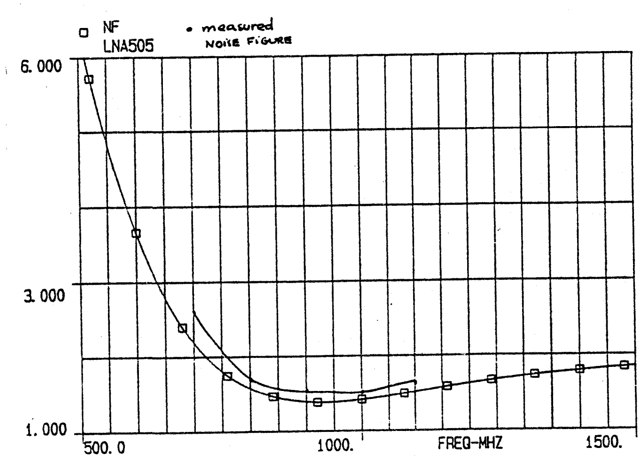


Fig.9 Measured and simulated Noise Figure

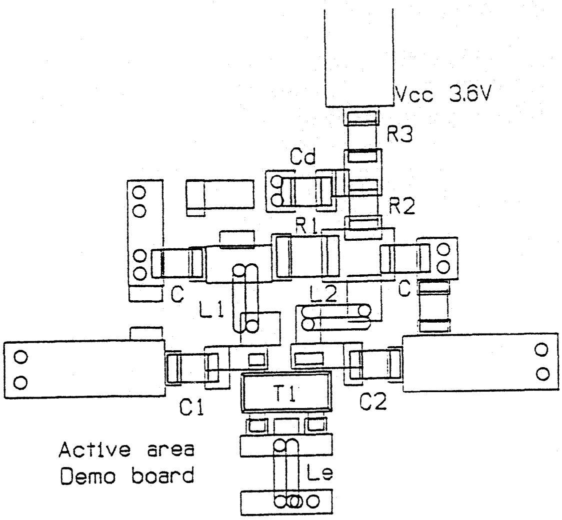


Fig. 10 Active Area Demoboard

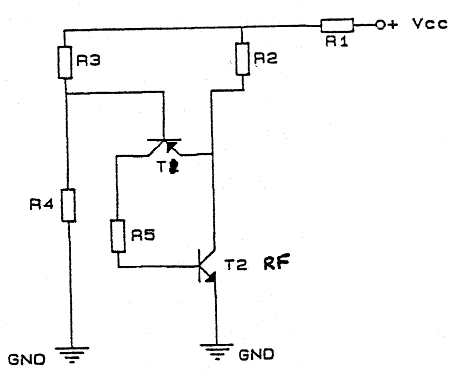


Fig. 11 schematic diagram biasing circuit

1890 MHz LOW POWER DOWNCONVERTER WITH 110 MHz I.F.

Introduction

This application note describes the performance of a 1890 MHz low voltage (3 volt) downconverter intended for wireless applications like DECT, PHP and other 1.8-2 GHz applications. The main intention is to demonstrate the superior performance of the new Philips fourth generation RF wideband bipolar transistors used as an RF preamplifier and mixer. In addition, a buffer and oscillator circuit are also included in this design to make it convenient in assessing overall performance. The designs of the RF preamplifier and mixer were treated as more important while that of the oscillator and buffer were not the primary focus.

In determining the performance of a downconverter, several specs are important and the best trade-off between these will depend on the importance of these in the system. The system designer will decide which are the more important: signal handling (linearity), sensitivity (noise figure), supply power (efficiency). This application note includes the design for only one configuration for a cordless telephone (DECT); however other downconverter designs can be derived from this basic design to satisfy the other system requirements.

Circuit Design Requirements

The converter block diagram (see fig. 1, next page) is the typical block diagram for a converter suitable in general for any of these systems. A particular system other than DECT may require something different, but the concepts are basically the same.

Preselect Filter Requirements

In the block diagram (fig. 1) between A and B and between C and D are the preselect filters, which are included in this design to improve image rejection; to reject out of band signals (such as coming from the transmitter); and to increase isolation from VCO to antenna (necessary for the LO radiation spec to be met). The most frequently used RF filters are made with high dielectric constant ceramic material with low loss tangent. They can be very small in size while maintaining low insertion loss,very important since the loss at the input adds directly to degrade the overall noise figure. The insertion loss of the SMD filters appeared to be around 2 dB. When 1 dB insertion loss filters are used in this application, the overall noise Figue will improve by about 1.5 dB. (Another application board, with low-loss but larger dimension filters is available upon request.)

The number of poles used in the filtering in this design is 4; two 2-pole filters with 1 in front of the RF preamplifier and 1 in the interstage between the RF preamplifier and the mixer. This give a better trade-off between noise and intermodulation. The input filter might in practice be part of a diplexer between transmitter and receiver or a RF-switch might be included in case of a TDMA system.
The number of poles necessary to get sufficient image rejection depends, ofcourse, very much on the chosen intermediate frequency. The lower the IF, the more selective the filters need to be.

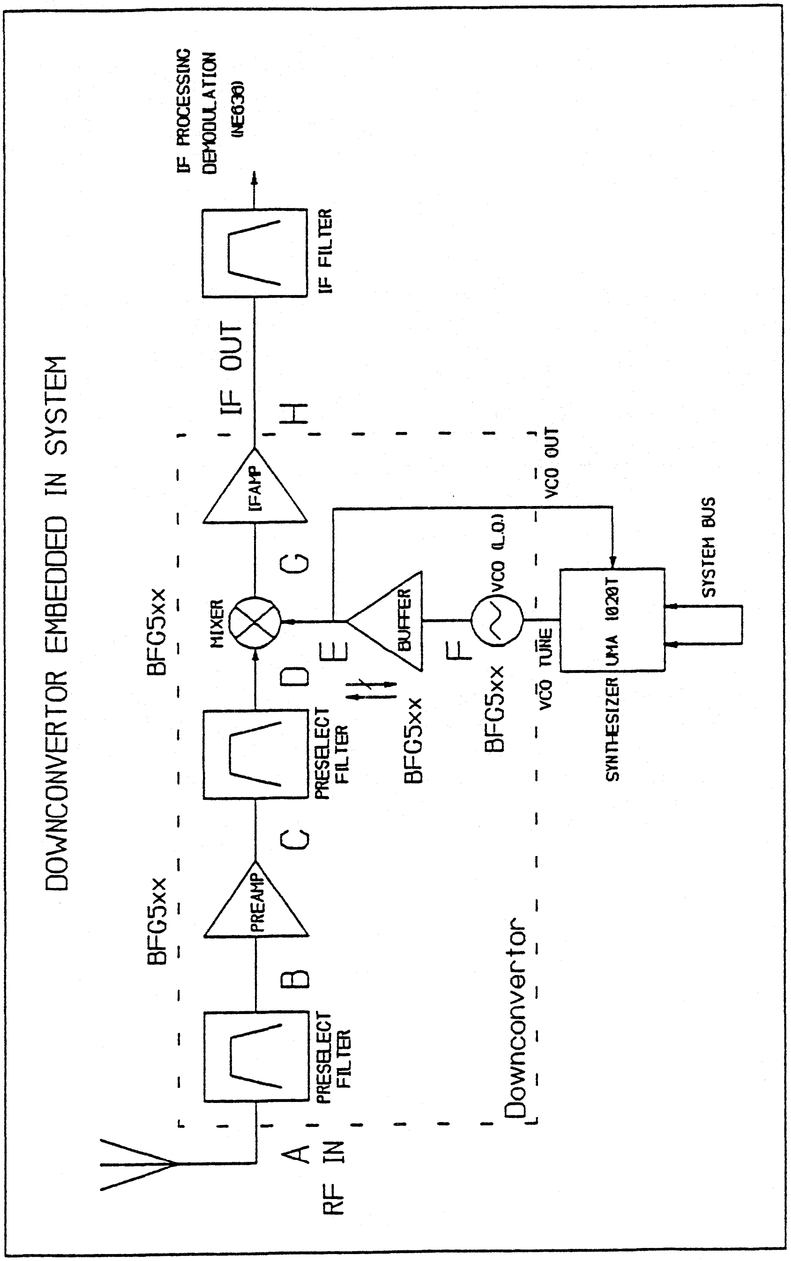


Fig 1. System diagram receiver downconverter.

RF preamplifier Requirements

The preamplifier (between B and C) is required to improve the downconverter noise figure as the mixer Noise Figure on its own is too high. The preamplifier also helps to improve isolation from VCO to antenna and adds some gain. The amplifier needs to be matched to 50 Ohms, since trhe bandpass filters require a 50 ohm load for correct functionality.

Mixer Requirements

Any of various mixer configurations could be considered. The mixer should provide a linear mixing conversion, i.e. provide an output level at the IF which is in proportion to the RF input signal level. In addition the choice is based on the most important requirements: the isolation required between the LO and the RF input (or points D and E); and the Noise Figure and linearity requirements. Linearity may be expressed by specifying IP_3 (third order intercept point) and/or F.R.S. (first repeated spot) specification; the latter being a measure of inband 2nd order distortion.(This specification is important when the receive band is wide) The mixer should also give sufficient gain so that an additional IF-amplifier would not be required (between G and H).

VCO and Buffer Requirements

The VCO should provide a signal with high spectral purity (low phase noise) in order not to degrade receiver sensitivity when strong signals are present in adjacent channels. Requirements for the VCO include a predefined tuning slope and tuning range, and a reproducibility of the center frequency without the requirement for tuning or trimming in production. Also the output level should be sufficient to drive the mixer or buffer while operating at a low current. When the mixer isolation or VCO buffering is not sufficient (causing, either or both, too much leak through of the LO to the antenna and oscillator pulling), a buffer amplifier is necessary. VCO frequency-pulling can be improved considerably by using a well designed buffer amplifier.

MAIN SYSTEM CHARACTERISTICS

Fin=1890 MHz Fout=110 MHz (FLO=1780 MHz tuned by means of Vtune)

CHARACTERISTIC	VALUE	REMARKS
CONVERSION POWER GAIN	typ. 20 dB	includes filter losses
NOISE FIGURE	<9 dB typ. 7 dB	includes losses depends on filters
IP3	typ. -15 dBm	at input
1 dB COMPRESSION	typ. -3 dBm	at output
LO RADIATION	< 1 nW	on RF input
FREQUENCY PULLING	< 50 kHz shift LO	RF input > 12 dBm
IMAGE REJECTION	typ. >60 dB	imagefreq=1670 MHz
SUPPLY VOLTAGE	typ. 3.3 V	Vcc1=Vcc2
SUPPLY CURRENT	typ. 11 mA	mixer/pre= 4 mA LO/ buff = 7 mA
VCO CNR@100 kHz (phase noise)	typ -105 dBcHz	not optimised
REPRODUCABILITY	GAIN +/- 0.5 dB (*)	no alignments
BOARD SIZE	28x16x6 mm 15x23x2 mm	preamp+mix+filt. LO+buffer
PCB material	epoxy FR4 h=0.5 mm	Er=4.6
input impedance load impedance	50 Ohm 50 Ohm	@ 1890 MHz @ 110 MHz

(*) with parts of +/- 5% tolerance (filter tolerances not included)
See also the graphs in the appendix.

Circuit Design

The circuit was built with the following sub-blocks:

1. **RF Preamplifier and filters**
2. **Mixer, IF-Matching**
3. **VCO and Buffer amp**

The circuit diagram is shown in fig. 2

RF preamplifier Design

The RF preamplifier is designed with the BFG505/x, which is gain optimized for low current in the range 1 to 5 mA. this transistor, in the SOT143 package style, has an F_T of 9 GHz, a maximum Gain of more than 13 dB at 1900 MHz, and a minimum noise Figure of 1.9 dB at 1900 MHz and 2 mA.
In order to fix the operating point, the choice must be made for the bias current setting to get a certain amount of minimum gain combined with an adequate low noise figure. Once the mixer Noise Figure has been determined (normally between 6 and 10 dB), the best trade-off between gain and noise figure for the preamplifier can also be determined. While, on the one hand, higher preamplifier gain will lower the overall intercept point due to higher mixer drive, more attention is given to a low noise figure for the RF preamplifier, with more attention to high intercept point given to the mixer design.

The DC bias point stabilization is provided with a low cost PNP transistor, which eliminates the influence of h_{FE} on the bias current setting without using a capacitance bypassed resistor in the emitter lead. At this frequency capacitor bypassing tends towards instability so it is to be avoided. With the PNP transistor biasing method the circuit is unconditionally stable. The preselect filters are mounted on the bottom side of the PCB. When parts count is a critical factor the biasing method can be simplified, yield analysis to predict gain variation is necessary, however.

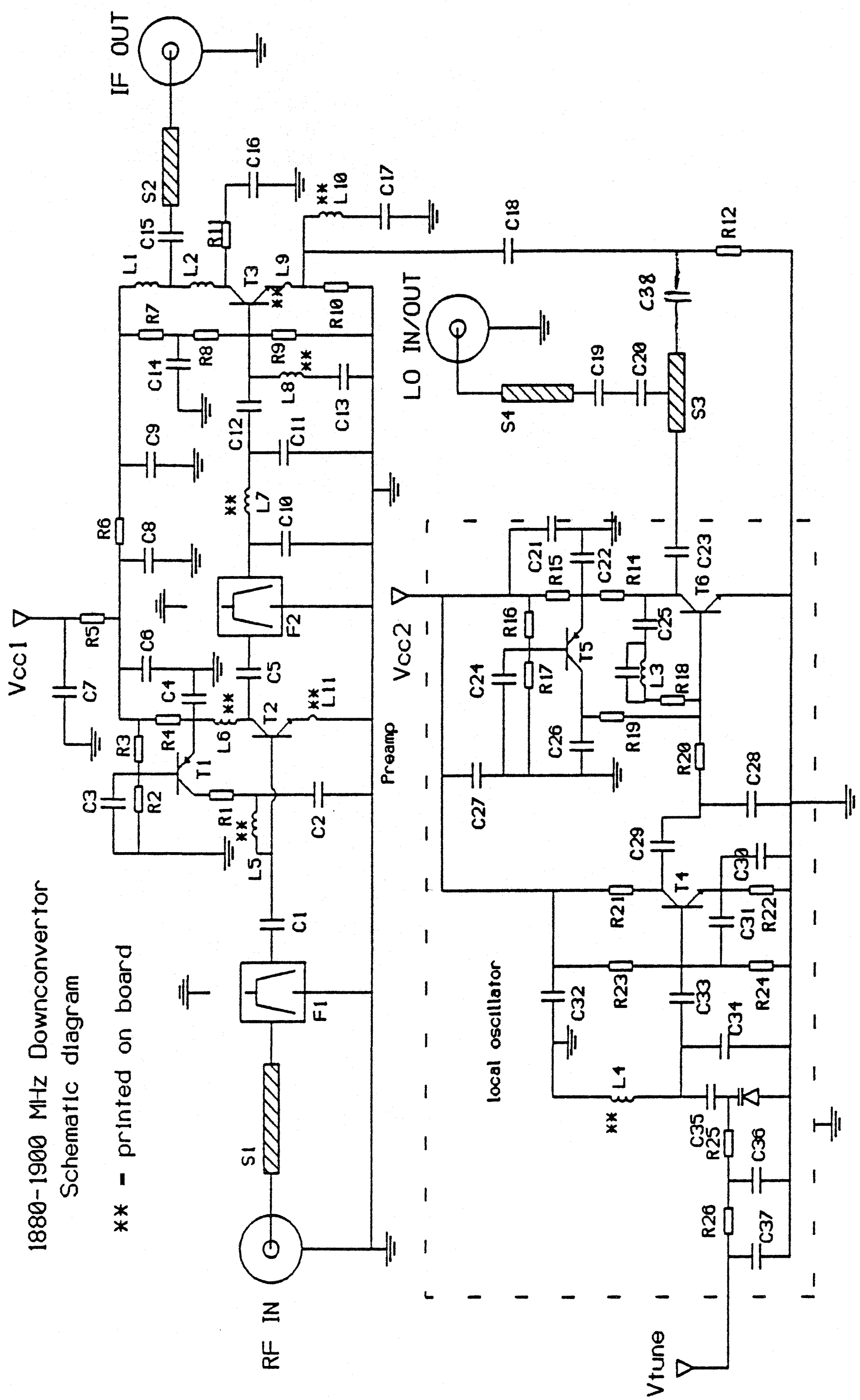


Fig 2. Schematic diagram complete downconverter

Mixer Circuit

A single transistor solution, in this case the BFG505, was chosen for the mixer design with RF input connected to the base and LO to the emitter. This was done to simplify matching, but other configurations would also give comparable performance. (For example, RF and LO both connected to the base terminal). Circuit optimization was done using large-signal CAD analysis based on SPICE modelling. Critical aspects are:

- matching RF port/LO port
- isolation
- instability
- linearity

Matching to the RF is done with a pi-section C6-L7-C8. The LO-port is not matched but by means of a resistors (R12) a properly defined LO drive impedance is made. When another VCO is used, matching to the mixer can easily be achieved with a 3-resistor attenuator. When driven from a 50 ohm source, output impedance of this attenuator should be around 20 Ohms for highest Conversion Gain. For intermediate frequency both base and emitter are capacitive loaded to give highest conversion gain. The value of the emitter decoupling capacitor (C15) should be chosen carefully (could make the circuit unstable, if the wrong value is chosen); resistive feedback is used for DC stabilization. The IF match (L1, L2, C16, C17) transforms the 50 Ohm load impedance into a high impedance. This high impedance at the collector results in a significant gain contribution since the output impedance of the transistor is almost a perfect current source at IF.

If the impedance has to be transformed down to a low load impedance (50 ohms) to the IF output or filter from the high collector impedance, more than one LC sections might be needed, otherwise the bandwith becomes too narrow and the sensitivity towards component spread high. Gain limitation can be caused by the component tolerance spread, if alignment has to be avoided. A transformation factor of about 30 can be reached with 5% tolerance value components and a double LC section. In this way the 50 Ohm load was transformed into 1.5 kOhm at the collector of the mixer transistor. A 50 Ohm match might be a somewhat unrealistic value for intermediate frequency filters but this theory holds also for other transformation factors. Typically, X-tal filters have a high impedance (1-2 kOhm) and this considerably reduces component count since the double LC-match is not necessary in this case. DECT IF filters are typically SAW filters, and those filters have a 50 Ohm impedance.

Favourably the collector impedance should be ohmic at very high frequencies. This is done by means of R11/C16. A too inductive load here can lead towards instability. This method also eliminates gain variations caused by the parasitic impedances of the SMD coils at 1900 MHz. Observe the specifications of the mixer on the next page. The mixer design was optimized using CAD tools for a DC-current of 1.8 mA.

Measured characteristics of this mixer amp

CONVERSION POWER GAIN	12 dB	
IP3	-5 dBm	input, LO=-4 dBm
SSB NOISE FIGURE	9 dB	LO=-4 dBm
DC-current	2.0 mA	
load imp. collector	1.5 kOhm	transf. factor =30
LO source impedance	50 Ohm	

Local Oscillator and buffer

The bufferamp is designed to have 0 dB of gain, to act also as limiter and to have high isolation. The isolation is important to improve the frequency pulling and also to improve the intercept point of the downconverter. If the isolation of the buffer amp is too low this can cause modulation of the oscillator by the RF input spectrum, and the resulting FM-sidebands will be seen as linearity reduction. To increase the isolation of the buffer a neutralizing coil (L4) was added which tunes out the feedback capacitance of the RF transistor. This improves the buffer isolation by as much as 15 dB without making it unstable. Another solution that may work better is the use of a cascoded transistor stage as the buffer. A small coil (L3) is used for better match between buffer and mixer transistor. This coil can also be printed on board due to its low value (12 nH) but in the application a SMD coil was used.

The VCO design used is a straightforward common collector (colpitts) design. The BFG505/X transistor was used as the VCO as its low capacitances assure high frequency operation. Even with the small size printed coil on FR4 used as resonator a phase noise of -105 dBcHz at 100 kHz offset was obtained, which is satisfactory for most digital systems. When a better phase noise is required, using the BFG520 transistor together with a high Q resonator is advised.

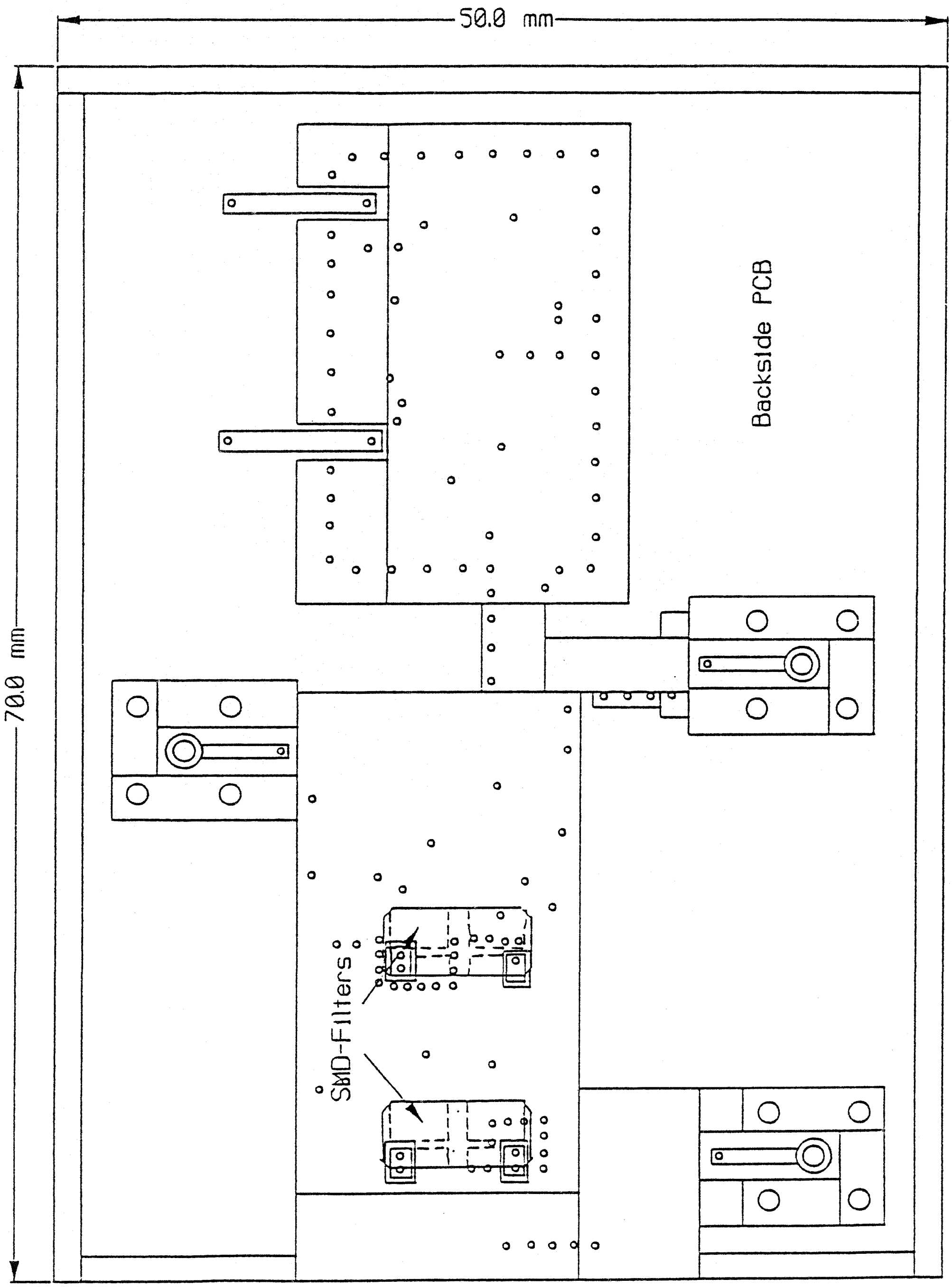
<u>Testing Mixer/Preamplifier</u>

In order to measure the performance of the mixer/preamp seperately, it is necessary to remove the jumper on the PCB and to change C20 into 8p2 (was 1p0). The LO output (normally intended for prescaler/synthesizer) can be used as the input. Some matching has to be applied since the LO-input is not matched to 50 Ohm, disturbing the LO-signal because of reflections when feeded from an external source. A three resistor attenuator can be applied. The oscillator should be turned off by means of removing the 10 Ohm resistor between Vcc1 and Vcc2.
A supply of 3.3 Volt should be connected to Vcc1. When the converter is used in a TDMA system, the capacitors of 10 nF can be replaced by 1 nF to enhance supply switching time.
Results of measurements and board layout are in the appendices

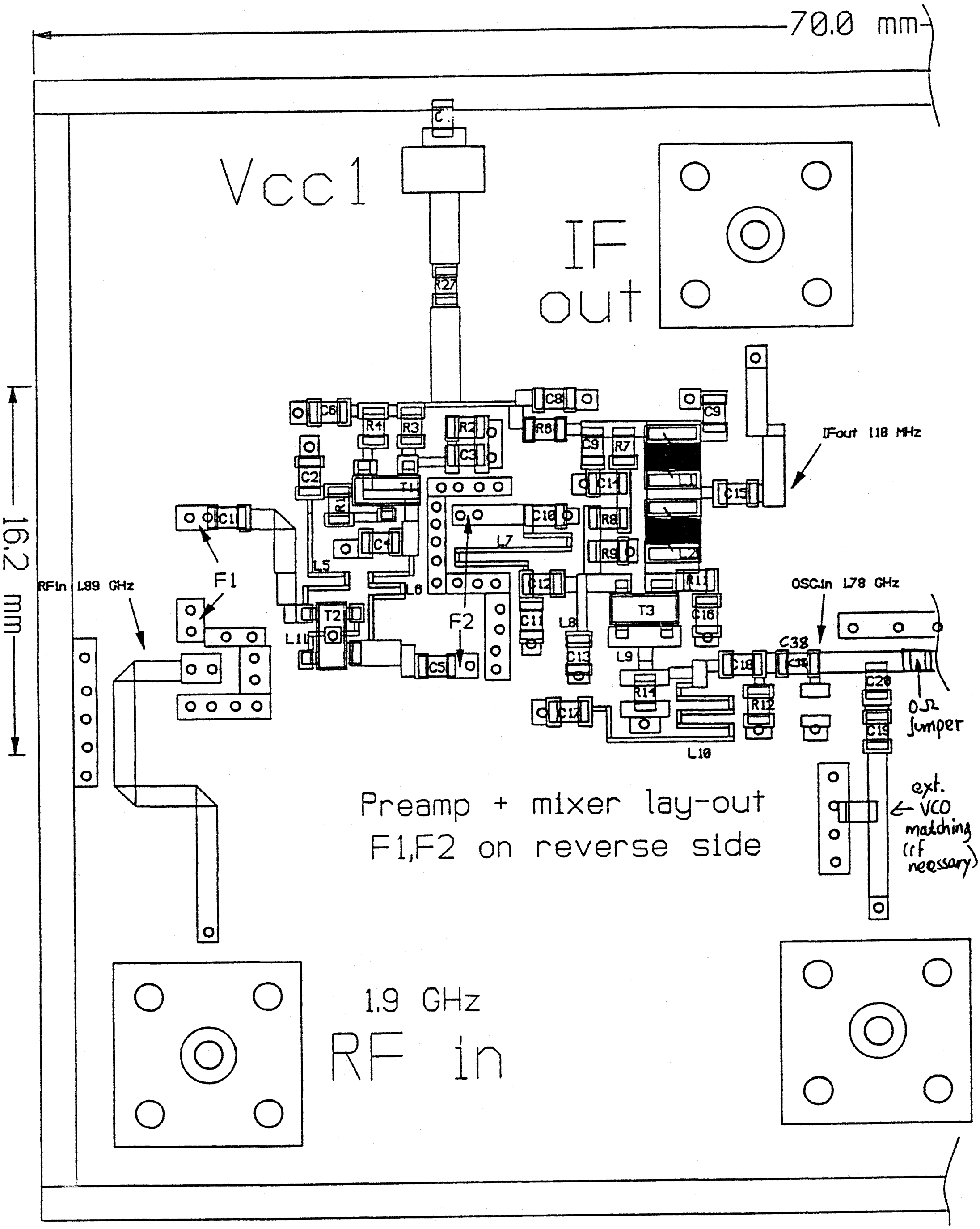
Appendices:

Appendix A1: Board layout total, backside
Appendix A2: " " preamp + mixer (detail)
Appendix A3: " " VCO + buffer (detail)
Appendix B : components list
Appendix C : typical measurements results

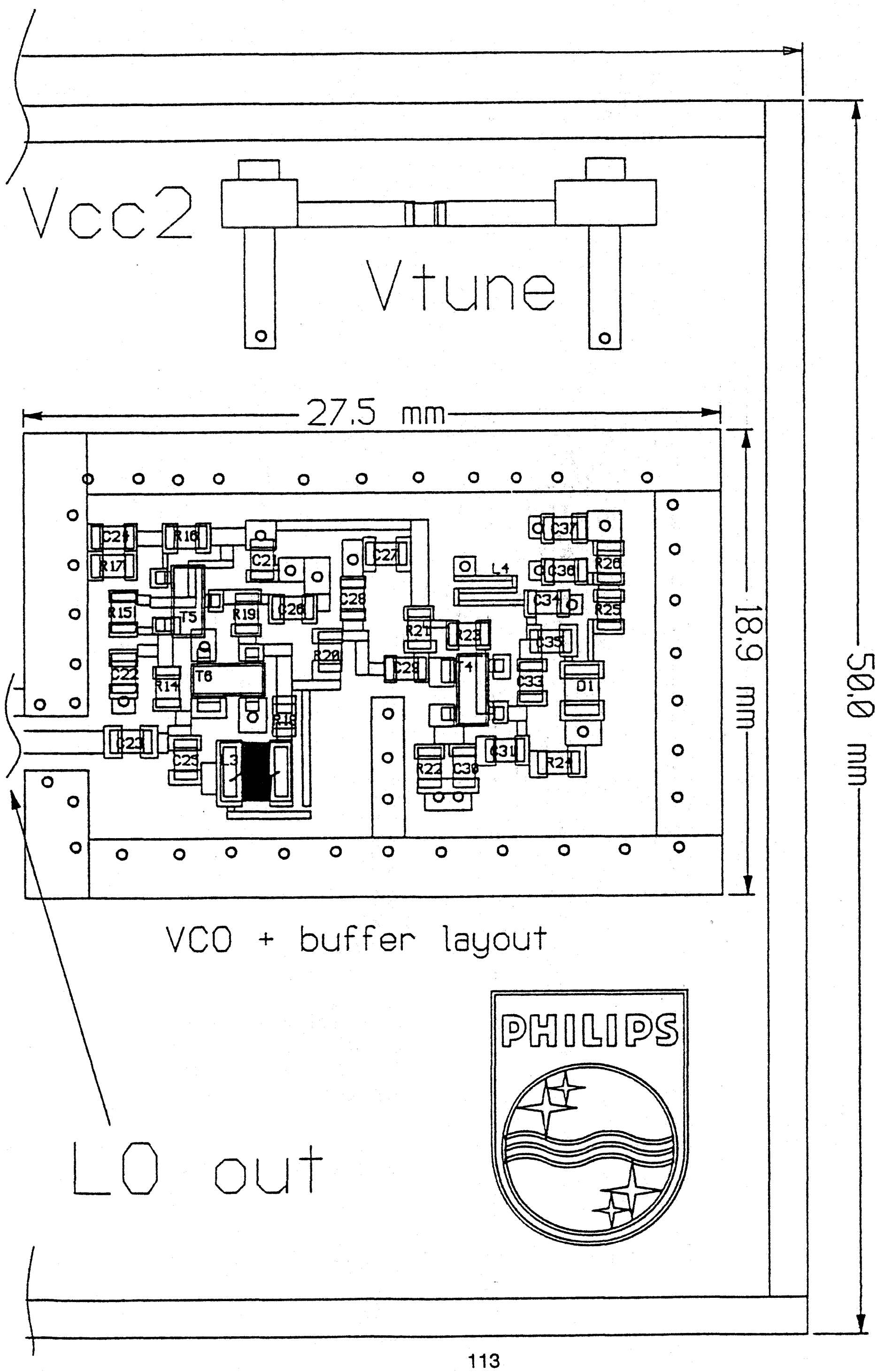
Appendix A1 Board layout total (Backside)



Appendix A2 Board layout preamp + mixer (detail)



Appendix A3 Board layout VCO + buffer (detail)



Appendix B Components list

Capacitors

C3,C6,C7,C8,C9,C14,C21,C22,
C24,C26,C27,C32,C36,C37..................10nF
C1,C5,C38..........................2p2
C2,C4,C12,C19......................8p2
C10................................0p56
C29,C11............................1p5
C17................................82pF
C15,C16............................4p7
C20,C33............................1p0
C23,C38............................10pF
C30................................1P0
C31................................0P56
C33................................1p2
C34................................omitted
C35................................0p82
C37................................3p9
C18................................2p7
C25,C28,C13........................1 nF

Resistors

R1,R2,R9...........................5k6
R3,R11,R19.........................2k7
R4.................................390
R5.................................27
R6.................................22
R7.................................1k8
R8,R24,R23.........................8k2
R10,R15,R22........................220
R12................................47
R14................................330
R16................................1k8
R17................................3k3
R18................................15
R20................................12
R21................................180
R25................................2k7
R26................................100k

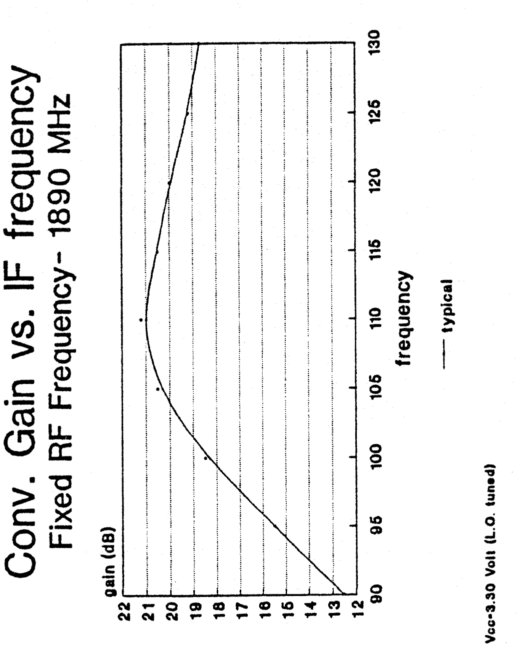
Coils,filters

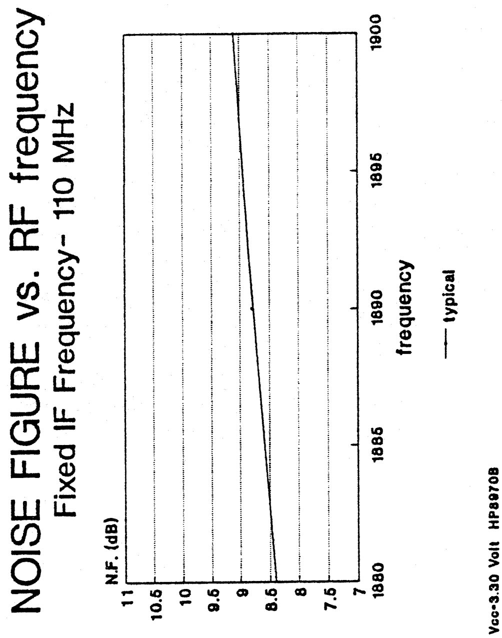
L1.................................270 nH SMD 1008
L2.................................1000 nH SMD 1008
L3.................................18 nH SMD 0805
L4-L11.............................on PCB
(L4=5 nH;L5=5.5 nH;L6=5 nH;L7=8 nH
L8=2 nH;L9=0.7nH;L10=12nH;L11=0.5 nH)
F1,F2..............................Siemens 2-pole SMD
(Siemens type B69812-N1897-A320)

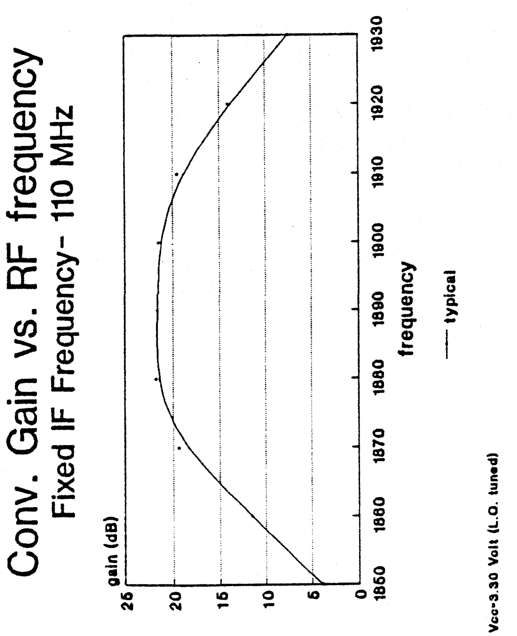
Semiconductors

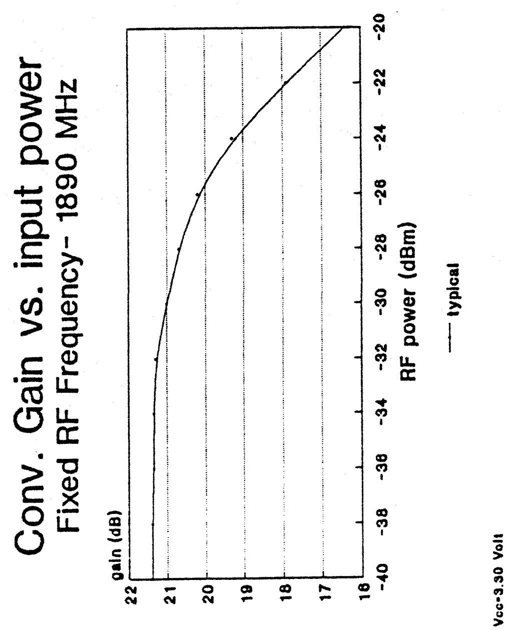
T1,T5..............................BC807 (5DP)
T2,T4,T6...........................BFG505X (N39)
T3.................................BFG505 (N33)
D1.................................BB131

Appendix C


Conv. Gain vs. IF frequency
Fixed RF Frequency- 1890 MHz
gain (dB)
22
21
20
19
18
17
16
15
14
13
12
90
95
100
105
110
115
120
125
130
frequency
— typical
Vcc=3.30 Volt (L.O. tuned)


NOISE FIGURE vs. RF frequency
Fixed IF Frequency- 110 MHz
N.F. (dB)
11
10.5
10
9.5
9
8.5
8
7.5
7
1880
1885
1890
1895
1900
frequency
— typical
Vcc=3.30 Volt HP8970B


Conv. Gain vs. RF frequency
Fixed IF Frequency- 110 MHz
gain (dB)
25
20
15
10
5
0
1850
1860
1870
1880
1890
1900
1910
1920
1930
frequency
— typical
Vcc=3.30 Volt (L.O. tuned)


Conv. Gain vs. input power
Fixed RF Frequency- 1890 MHz
gain (dB)
22
21
20
19
18
17
16
-40
-38
-36
-34
-32
-30
-28
-26
-24
-22
-20
RF power (dBm)
— typical
Vcc=3.30 Volt

933 MHz LOW POWER DOWNCONVERTER WITH 60 MHz I.F.

Introduction

This application note describes the performance of a 900 MHz low voltage (3 volt) downconverter intended for wireless applications like GSM, AMPS, TACS, CT1, CT1+ and NMT.
The main intention is to demonstrate the superior performance of the new Philips fourth generation RF wideband bipolar transistors used as an RF preamplifier and mixer. In addition, a buffer and oscillator circuit are also included in this design to make it convenient in assessing overall performance. The designs of the RF preamplifier and mixer were treated as more important while that of the oscillator and buffer were not the primary focus.

In determining the performance of a downconverter, several specs are important and the best trade-off between these will depend on the importance of these in the system. The system designer will decide which are the more important: signal handling (linearity), sensitivity (noise figure), supply power (efficiency). This application note includes the design for only one configuration for a cordless telephone (CT1+); however other downconverter designs can be derived from this basic design to satisfy the other system requirements.

Circuit Design Requirements

The converter block diagram (see fig. 1, next page) is the typical block diagram for a converter suitable in general for any of these systems. A particular system other than CT1+ may require something different, but the concepts are basically the same.

Preselect Filter Requirements

In the block diagram (fig. 1) between A and B and between C and D are the preselect filters, which are included in this design to improve image rejection; to reject out of band signals (such as coming from the transmitter); and to increase isolation from VCO to antenna (necessary for the LO radiation spec to be met). The most frequently used RF filters are made with high dielectric constant ceramic material with low loss tangent. They can be very small in size while maintaining low insertion loss,very important since the loss at the input adds directly to degrade the overall noise figure. The insertion loss of the SMD filters appeared to be around 2 dB.

The number of poles used in the filtering in this design is 4; two 2-pole filters with 1 in front of the RF preamplifier and 1 in the interstage between the RF preamplifier and the mixer. This give a better trade-off between noise and intermodulation. The input filter might in practice be part of a diplexer between transmitter and receiver.
The number of poles necessary to get sufficient image rejection depends, ofcourse, very much on the chosen intermediate frequency. The lower the IF, the more selective the filters need to be. SAW filters are also available for this purpose, which are in general more selective, but give a higher insertion loss.

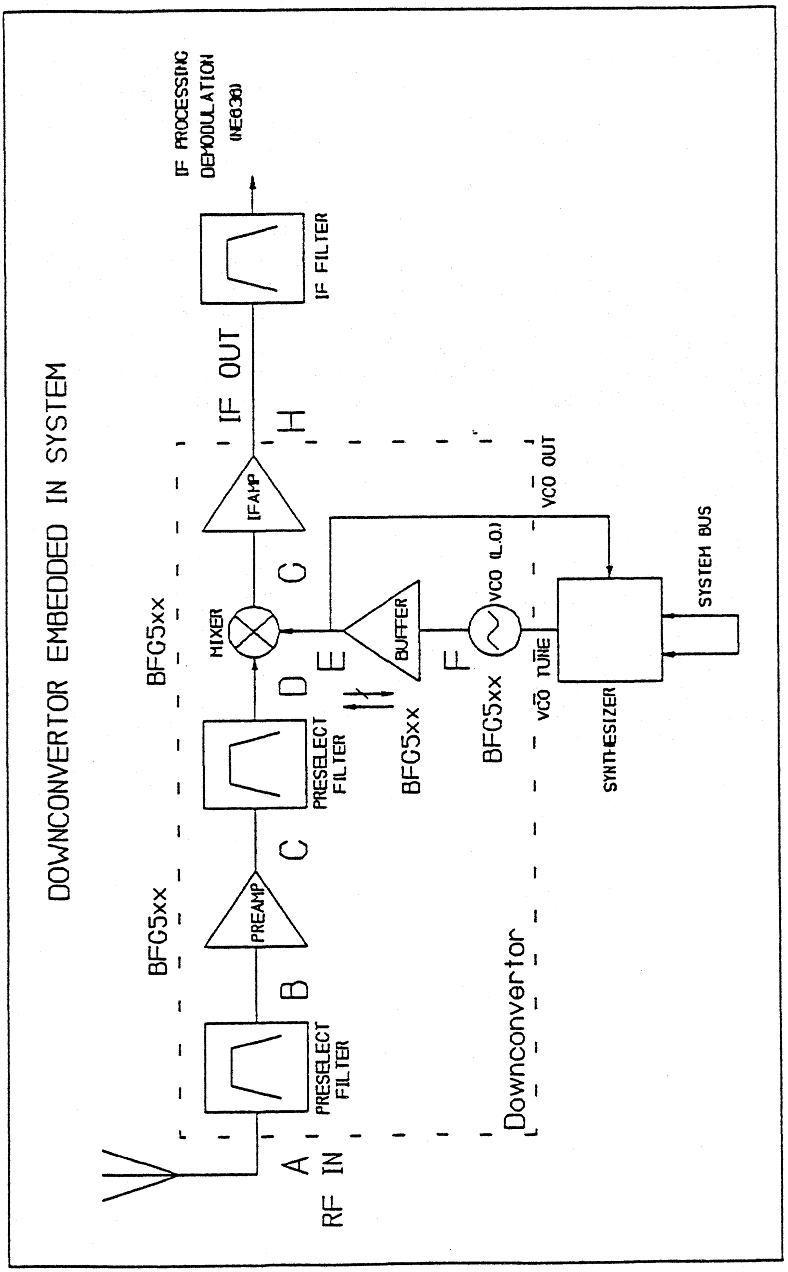


Fig 1. Block diagram receiver downconverter

RF Preamplifier requirements

The preamplifier (between B and C) is required to improve the downconverter noise figure as the mixer Noise Figure on its own is too high. The preamplifier also helps to improve isolation from VCO to antenna and adds some gain.

Mixer Requirements

Any of various mixer configurations could be considered. The mixer should provide a linear mixing conversion, i.e. provide an output level at the IF which is in proportion to the RF input signal level. In addition the choice is based on the most important requirements: the isolation required between the LO and the RF input (or points D and E); and the Noise Figure and linearity requirements. Linearity may be expressed by specifying IP_3 (third order intercept point) and/or F.R.S. (first repeated spot) specification; the latter being a measure of inband 2nd order distortion. The mixer should also give sufficient gain so that an additional IF-amplifier would not be required (between G and H).

VCO and Buffer Requirements

The VCO should provide a signal with high spectral purity (low phase noise) in order not to degrade receiver sensitivity when strong signals are present in adjacent channels. Requirements for the VCO include a predefined tuning slope and tuning range, and a reproducibility of the center frequency without the requirement for tuning or trimming in production. Also the output level should be sufficient to drive the mixer or buffer while operating at a low current. When the mixer isolation or VCO buffering is not sufficient (causing, either or both, too much leak through of the LO to the antenna and oscillator pulling), a buffer amplifier is necessary. VCO frequency-pulling can be improved considerably by using a well designed buffer amplifier.

MAIN SYSTEM CHARACTERISTICS

Fin= 931 MHz Fout=60 MHz (FLO=871 MHz tuned by means of Vtune)

CHARACTERISTIC	VALUE	REMARKS
CONVERSION POWER GAIN	typ. 20 dB	includes filter losses
NOISE FIGURE	typ. 6 dB	includes losses
IP3	typ. -10 dBm	at input
1 dB COMPRESSION	typ. -3 dBm	at output
LO RADIATION	< 100 pW	on RF input
FREQUENCY PULLING	< 50 kHz shift LO	RF input > 12 dBm
IMAGE REJECTION	typ. 78 dB	imagefreq=811 MHz
SUPPLY VOLTAGE	typ. 3.3 V	Vcc1=Vcc2
SUPPLY CURRENT	typ. 11 mA	mixer/pre= 4 mA LO/ buff = 7 mA
VCO CNR@100 kHz (phase noise)	typ -115 dBcHz	not optimised
REPRODUCABILITY	GAIN +/- 0.5 dB (*)	no alignments
BOARD SIZE	28x16x6 mm 15x23x2 mm	preamp+mix+filt. LO+buffer
PCB material	epoxy FR4 h=0.5 mm	Er=4.6
in/load impedance	50 Ohm	at meas. frequency

(*) with parts of +/- 5% tolerance (filter tolerances not included)
See also the graphs in the appendix.

Appendices:

Appendix A1: Board layout preamp + mixer
Appendix A2: " " VCO + buffer
Appendix A3: " " backside PCB (filters)
Appendix B : components list
Appendix C : measurements

Circuit Design

The circuit was built with the following sub-blocks:

1. RF Preamplifier and filters
2. Mixer, IF-Matching
3. VCO and Buffer amp

The circuit diagram is shown in fig. 2

RF preamplifier Design

The RF preamplifier is designed with the BFG505/x, which is gain optimized for low current in the range 1 to 5 mA. this transistor, in the SOT143 package style, has an F_T of 9 GHz, a maximum Gain of more than 16 dB at 900 MHz, and a minimum noise Figure of 1.2 dB at 900 MHz and 2 mA.
In order to fix the operating point, the choice must be made for the bias current setting to get a certain amount of minimum gain combined with an adequate low noise figure. Once the mixer Noise Figure has been determined (normally between 6 and 10 dB), the best trade-off between gain and noise figure for the preamplifier can also be determined. While, on the one hand, higher preamplifier gain will lower the overall intercept point due to higher mixer drive, more attention is given to a low noise figure for the RF preamplifier, with more attention to high intercept point given to the mixer design.

To simplify the design, due to extra gain available, the output matching of the preamplifier was done with a shunt resistor (R8), rather than using an LC-match. This lowers the gain somewhat but eliminates the use of a coil which takes more space on the board and/or is more costly than the resistor. The lower saturation point that results was not a problem, as the linearity is still sufficient. (In fact, the preamplifier bias current could still be reduced.)

The DC bias point stabilization is provided with a low cost PNP transistor, which eliminates the influence of h_{FE} on the bias current setting without using a capacitance bypassed resistor in the emitter lead. At this frequency capacitor bypassing tends towards instability so it is to be avoided. With the PNP transistor biasing method the circuit is unconditionally stable. The preselect filters are mounted on the bottom side of the PCB. When parts count is a critical factor the biasing method can be simplified, yield analysis to predict gain variation is necessary, however.

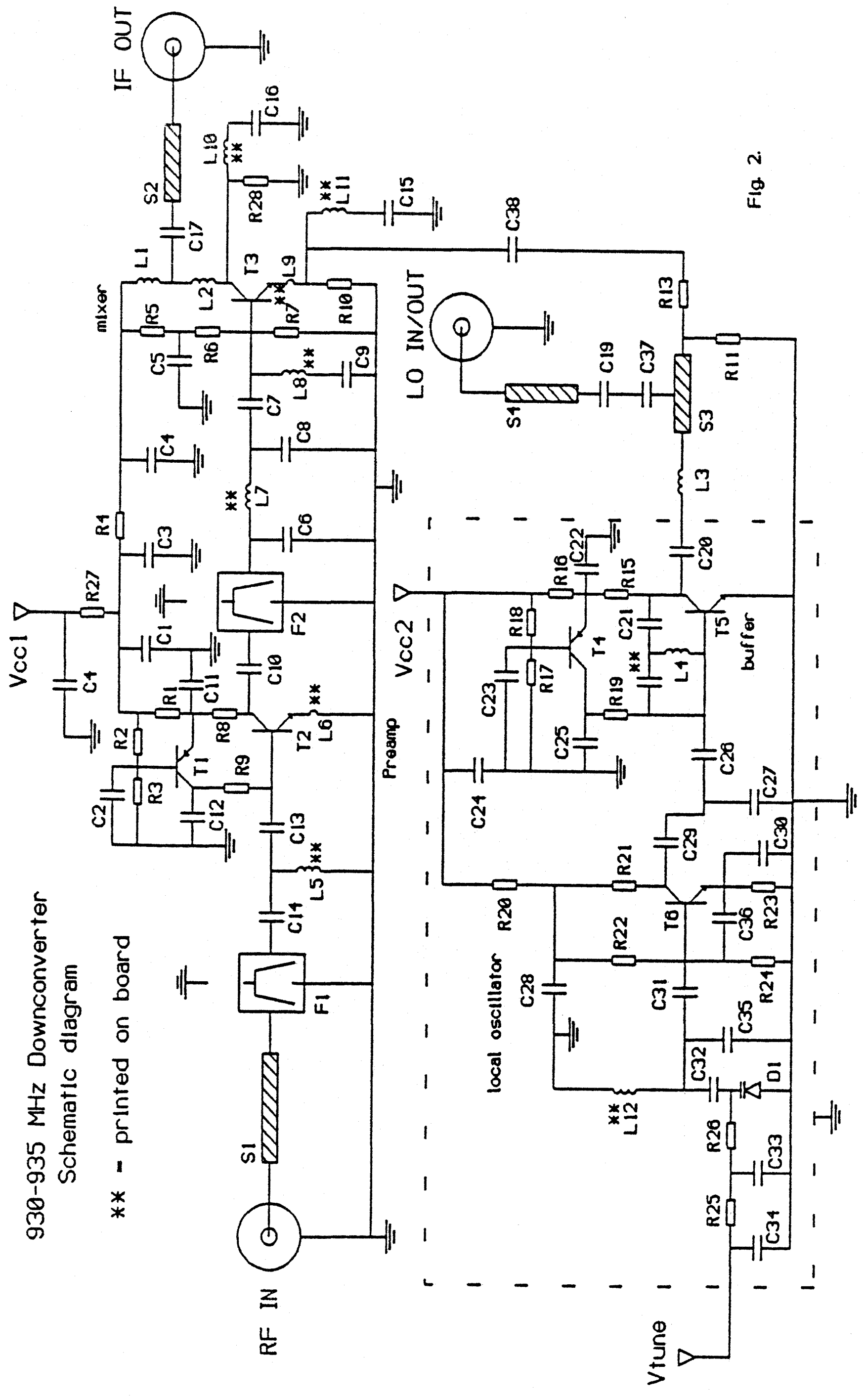


Fig 2. schematic diagram receiver downconverter

Mixer Circuit

A single transistor solution, in this case the BFG520, was chosen for the mixer design with RF input connected to the base and LO to the emitter. This was done to simplify matching, but other configurations would also give comparable performance. Circuit optimization was done using large-signal CAD analysis based on SPICE modelling. Critical aspects are:

- matching RF port/LO port
- isolation
- instability
- linearity

Matching to the RF is done with a pi-section C6-L7-C8. The LO-port is not matched but by means of two resistors (R12, R11) a properly defined LO drive impedance is made. For intermediate frequency both base and emitter are capacitive loaded to give highest conversion gain. The value of the emitter decoupling capacitor (C15) should be chosen carefully (could make the circuit unstable, if the wrong value is chosen); resistive feedback is used for DC stabilization. The IF match (L1, L2, C16, C17) transforms the 50 Ohm load impedance into a high impedance. This high impedance at the collector results in a significant gain contribution since the output impedance of the transistor is almost a perfect current source at IF.

If the impedance has to be transformed down to a low load impedance (50 ohms) to the IF output or filter from the high collector impedance, more than one LC sections might be needed, otherwise the bandwith becomes too narrow and the sensitivity towards component spread high. Gain limitation can be caused by the component tolerance spread, if alignment has to be avoided. A transformation factor of about 30 can be reached with 5% tolerance value components and a double LC section. In this way the 50 Ohm load was transformed into 1.5 kOhm at the collector of the mixer transistor. A 50 Ohm match might be a somewhat unrealistic value for intermediate frequency filters but this theory holds also for other transformation factors. Typically, X-tal filters have a high impedance (1-2 kOhm) and this considerably reduces component count since the double LC-match is not necessary in this case.

Favourably the collector impedance should be low ohmic at RF frequencies. This is done by means of L10. A too inductive load here can lead towards instability. Therefore, the load formed by L10-C16 is not yet at series resonance at 900 MHz. This method also eliminates gain variations caused by the parasitic impedances of the SMD coils at 900 MHz. Observe the specifications of the mixer on the next page. The mixer design was optimized using CAD tools for a DC-current of 1.8 mA.

Measured characteristics of this mixer amp

CONVERSION POWER GAIN	12 dB	
IP3	-2 dBm	input, LO=-2 dBm
NOISE FIGURE	8 dB	LO=-2 dBm supressed image
DC-current	1.8 mA	
load imp. collector	1.5 kOhm	transf. factor =30
LO source impedance	50 Ohm	

Local Oscillator and buffer

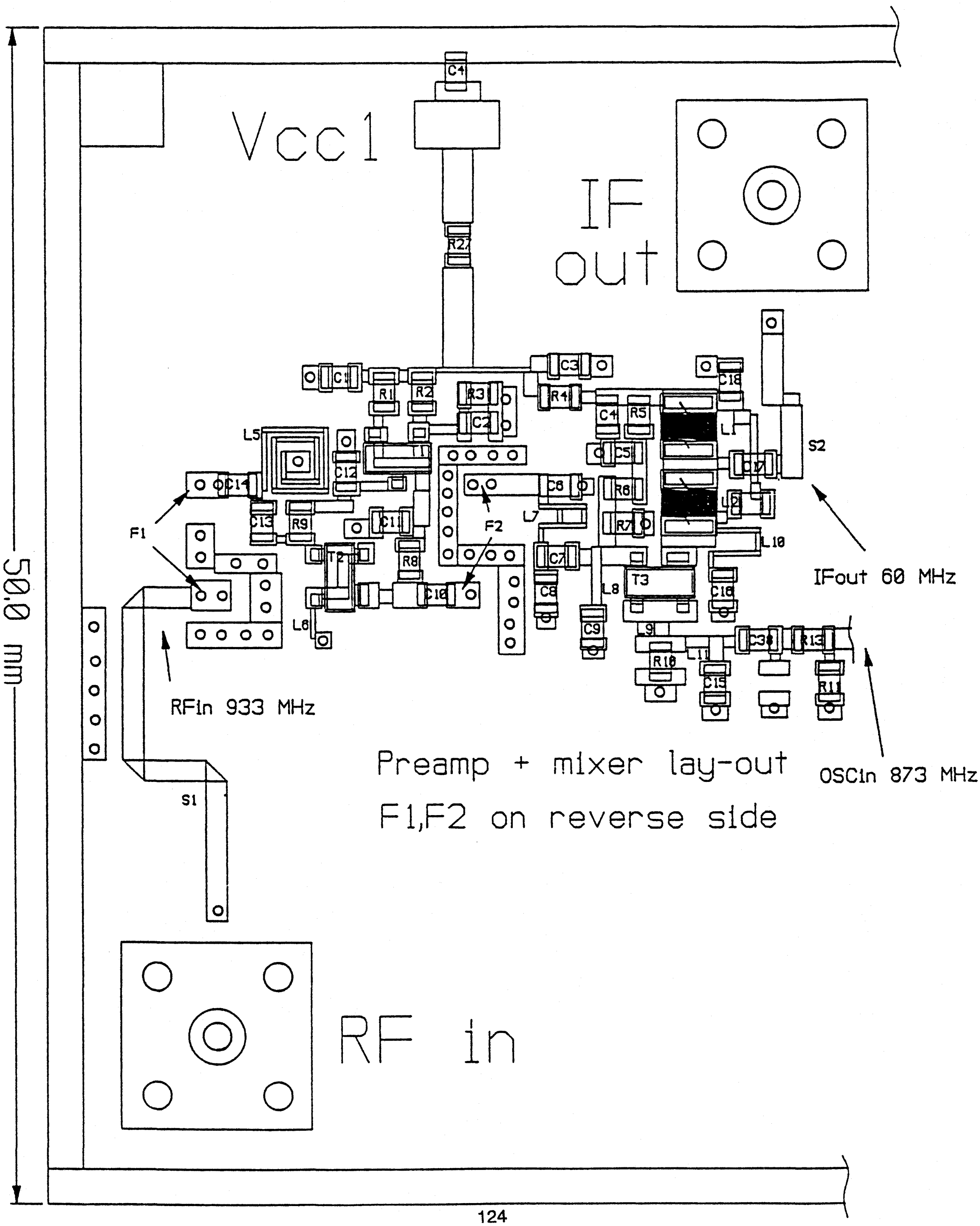
The bufferamp is designed to have 0 dB of gain, to act also as limiter and to have high isolation. The isolation is important to improve the frequency pulling and also to improve the intercept point of the downconverter. If the isolation of the buffer amp is too low this can cause modulation of the oscillator by the RF input spectrum, and the resulting FM-sidebands will be seen as linearity reduction. To increase the isolation of the buffer a neutralizing coil (L4) was added which tunes out the feedback capacitance of the RF transistor. This improves the buffer isolation by as much as 15 dB without making it unstable. Another solution that may work better is the use of a cascoded transistor stage as the buffer. A small coil (L3) is used for better match between buffer and mixer transistor. This coil can also be printed on board due to its low value (12 nH) but in the application a SMD coil was used.

The VCO design used is a straightforward common collector (colpitts) design. The BFG540/X transistor was used as the VCO as its low base resistance assures low phase noise (a result of low losses in the resonant circuit). Even with the small size printed coil on FR4 used as resonator a phase noise of -115 dBcHz at 100 kHz offset was obtained, which is satisfactory for most systems.

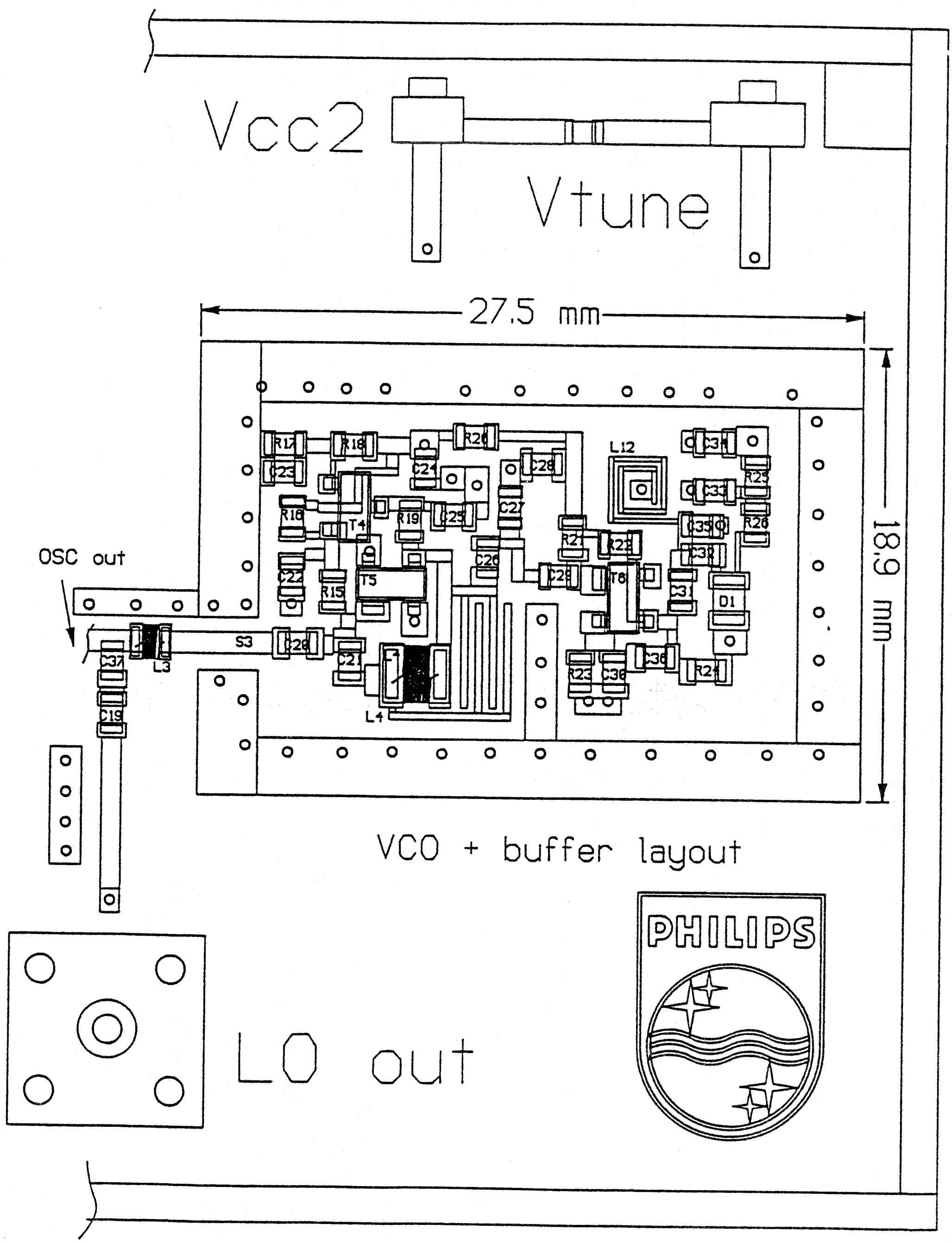
<u>Testing Mixer/Preamplifier</u>

In order to measure the performance of the mixer/preamp seperately, it is necessary to remove L3 and to change C36 into 33 pF (was 3p9). The LO output (normally intended for prescaler/synthesizer) can be used as the input. The oscillator should be turned off by means of removing the 10 Ohm resistor between Vcc1 and Vcc2. A supply of 3.3 Volt shoulinto 33pF (was 3p9). The LO-output (normally intended for prescaler/synthesizer)
can be used as input. The oscillator should be turned off by means of removing the 10 Ohm resistor between Vcc1 and Vcc2.
A supply of 3.3 Volt should be connected to Vcc1.
Results of measurements and board layout are in the appendices

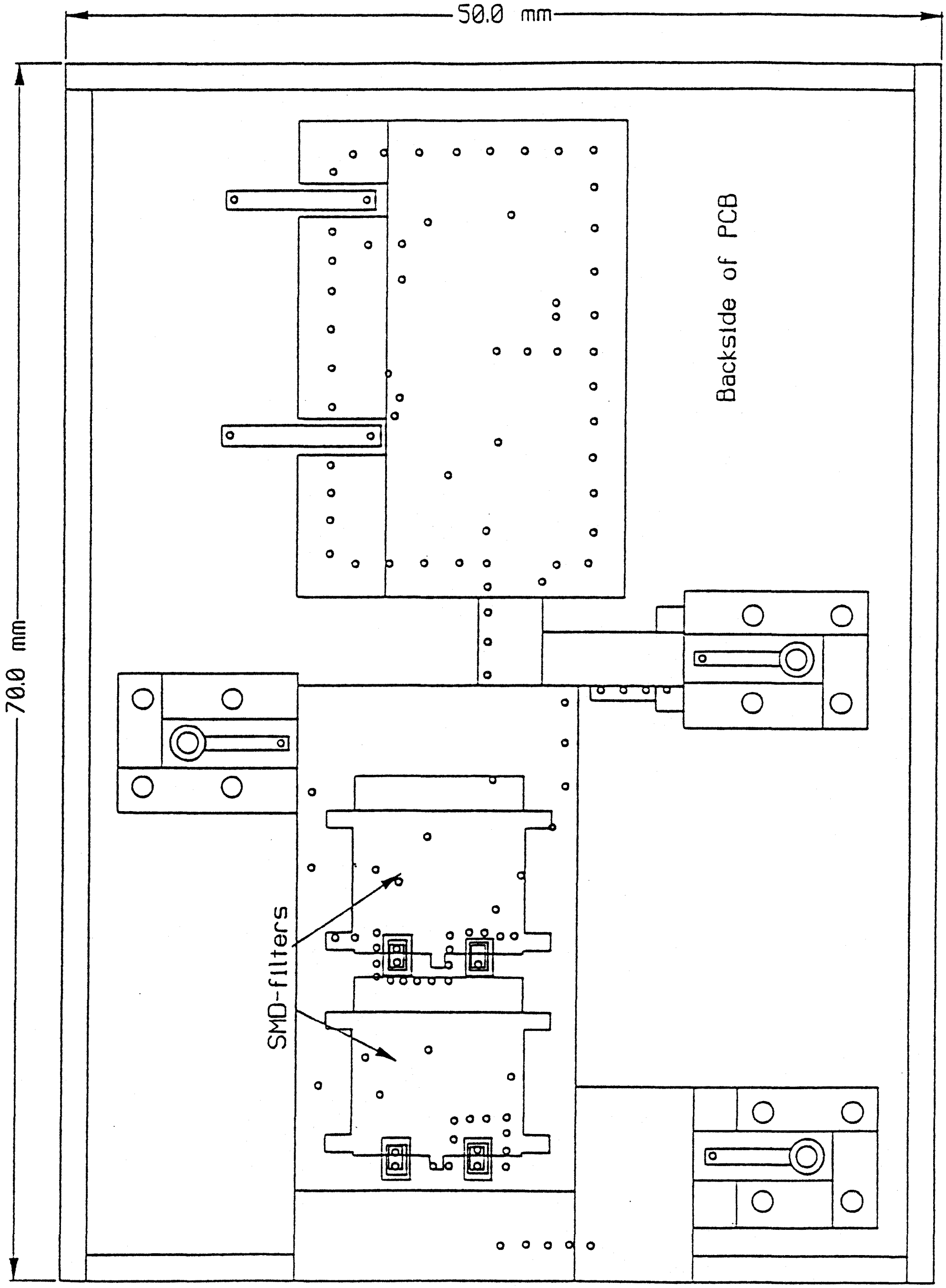
Appendix A1


Vcc1
IF out
RF in
RFin 933 MHz
IFout 60 MHz
OSCin 873 MHz
Preamp + mixer lay-out
F1,F2 on reverse side
50.0 mm
F1
F2
S1
S2
L5
T1
T2
T3

Appendix A2


Vcc2
Vtune
27.5 mm
18.9 mm
OSC out
S3
L3
L4
L12
T4
T5
T8
D1
VCO + buffer layout
PHILIPS
LO out

Appendix A3



Appendix B

Capacitors

```
C1,C3,C4,C9,C11,C12,C15,
C18,C23,C24,C25,C33,C34.................10nF
C2,C5,C21,C26,C27,C28,C29...............1nF
C6......................................1P6
C7......................................150pF
C8......................................5p6
C10,C19,C20.............................33p
C13.....................................820pF
C14.....................................3pF
C16.....................................0p56
C17.....................................10pF
C22.....................................270pF
C30.....................................1p0
C31.....................................3p3
C32.....................................1p2
C35,C36.................................to tune VCO freq.
C37.....................................3p9
C38.....................................27pF
```

Resistors

```
R1,R10..................................220
R2,R26..................................2k7
R3,R7,R17...............................5k6
R4......................................22
R5,R18,R19..............................1k8
R6,R9,R24,R25...........................8k2
R8......................................330
R11.....................................68
R13.....................................12
R15.....................................390
R16.....................................120
R20.....................................22
R21.....................................180
R22.....................................8k2
R23.....................................470
R27.....................................18
R28.....................................8k2
```

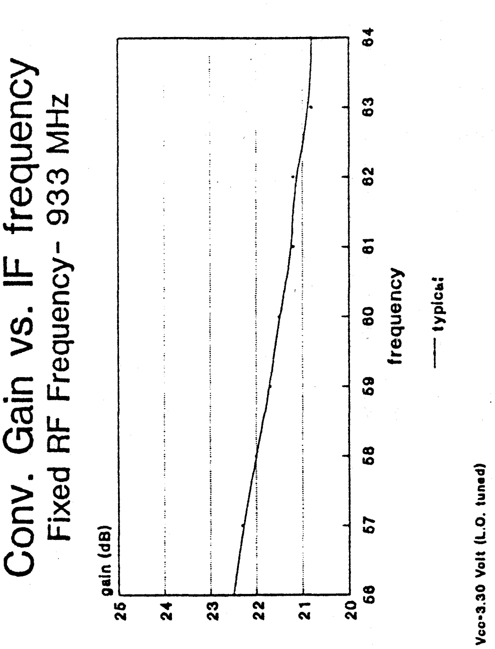
Coils,filters

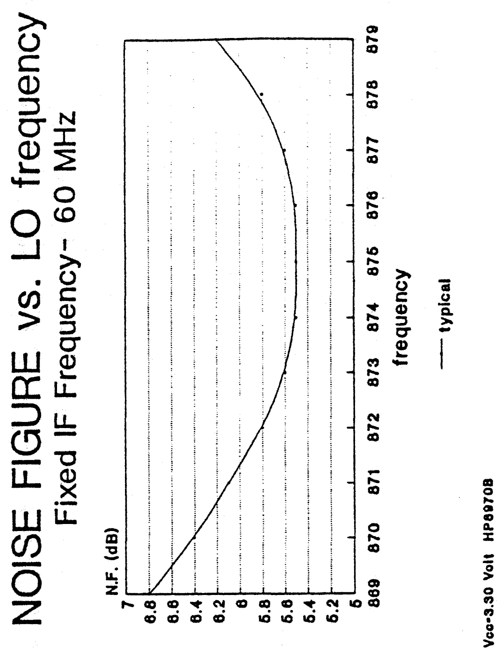
```
L1......................................560 nH SMD 1008
L2......................................2200 nH SMD 1008
L3......................................12 nH SMD 0805
L4......................................56 nH SMD 1008
F1,F2...................................Siemens   2-pole   SMD
(see app.)
```

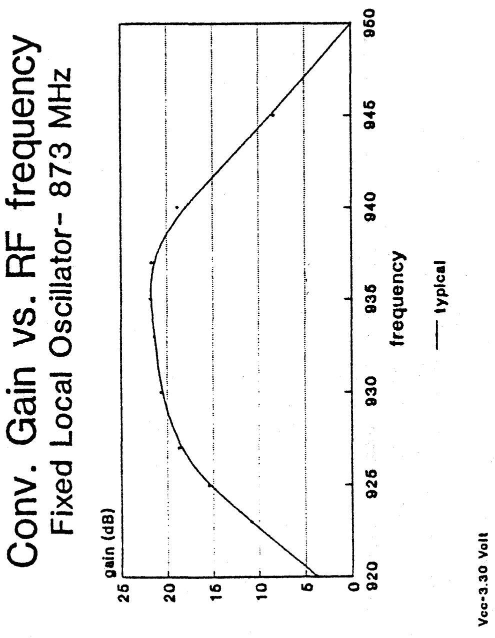
Semiconductors

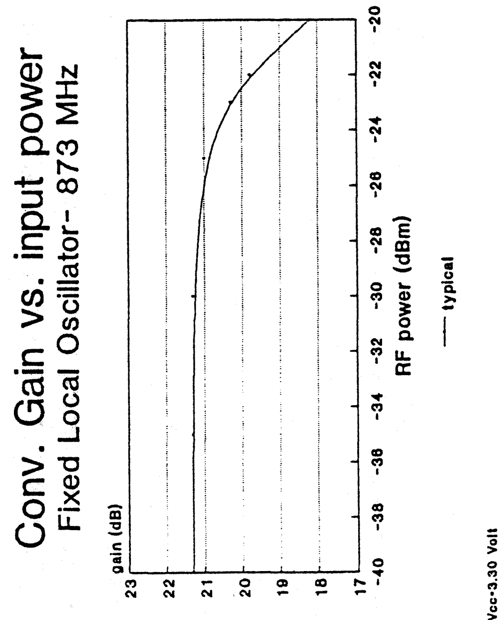
```
T1,T4...................................BC807   (5DP)
T2,T5...................................BFG505X (N39)
T3......................................BFG520  (N36)
D1......................................BB131
T6......................................BFG540/X(N43)
```

Appendix C


Conv. Gain vs. IF frequency
Fixed RF Frequency- 933 MHz
gain (dB)
frequency
typical
Vcc=3.30 Volt (L.O. tuned)


NOISE FIGURE vs. LO frequency
Fixed IF Frequency- 60 MHz
N.F. (dB)
frequency
typical
Vcc=3.30 Volt HP8970B


Conv. Gain vs. RF frequency
Fixed Local Oscillator- 873 MHz
gain (dB)
frequency
typical
Vcc=3.30 Volt


Conv. Gain vs. input power
Fixed Local Oscillator- 873 MHz
gain (dB)
RF power (dBm)
typical
Vcc=3.30 Volt

Low noise, low current preamplifier for 1.9 GHz at 3 V

Application report

In this short note some results of measurements are derscribed performed on a LNA for the 1.8 - 2.0 GHz frequency range.
The amplifier is build with a low cost bipolar transistor on a low cost epoxy PCB.
The design was done at a DC voltage of 3 Volts, 2.5 mA.
Even under this low dissipation conditions an amplifier with low noise figure and associated high gain can be build while keeping the input impedance within reasonable limits from 50 Ohm.
Most low noise concepts give high mismatch at the input port. This design matches better than a 1:2 VSWR making it easier to connect to 50 Ohm designed bandpass filters or aerials.

General characteristics:

Supply voltage	2.5 - 3.6 V	
Gain	> 10 dB typ. 11 dB	
Noise Figure	< 2.5dB typ. 2.4 dB	with PCB and cap. losses
Linearity	IP3 > 7 dBm typ. 9 dBm (output)	
VSWR	input < 1:2 typ. 1.5 output < 1:2.5	
PCB material	FR4 (ϵ_r=4.7, h=0.5 mm	Epoxy
Components	BFG505 resistors capacitors	SOT143 Philips 0603/0805 Philips 0603

Circuit diagram

The circuit diagram is straightforward.
Biasing is simply done by resistive feedback. The stabilisation factor might be too small to compensate for the HFE spread (or temperature) of the device, but since the supply dependency of gain is proven not to be very large (appendix C) this way of biasing is preferable because of reduced component count. The current setting can be lowered to about 1 mA while maintaining high gain and low noise figure.

The decoupling network (R1 - C3) might be omitted but serves to improve linearity.
The source and load match (S2, S3 resp. S4, S5) are designed to give a good compromise between noise, gain and matching performance. The matching striplines represent 70 Ohm transmisssion lines with S2 and S5 acting as short-circuited stubs with electrical lenght of ca. 1/6λ and S3 and S4 even shorter.

They can be replaced by any inductive element giving the same induction at the operation frequency.
Proper grounding is essential in GHz design. If no proper ground is available, an estimate of parasitic series induction must be made to take into account while designing.
The 10pF capacitors serve only as DC blocking capacitors and are not critical in value. They are at series resonance at about 2 GHz. No attempt has been made to make the circuit as small as possible, since it only represents a sub-circuit.
Reducing the size can be done by chosing narrower lines for S2, S5 so that they can become shorter and folded more.
Also a higher epsilon material can reduce the size.

900 MHz version

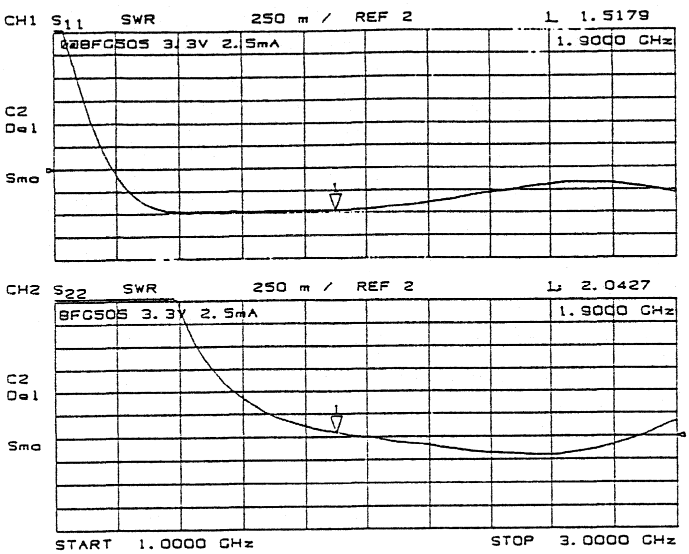
With the same transistor an amplifier at 900 MHz can be build.
Providing 50 Ohm input/output impedance, 1.3 dB Noise Figure, a Gain of over 10 dB and a current of only 1 mA it is very suitable for low power applications.
Observe the schematic diagram in appendix G, where the input impedance is realized through feedback in the emitter (L3).
The coils are made of closely wound enamelled Cu- wire, d=0.4 mm; int. diam=1.6 mm. (at 900 MHz, coils are preferably used because of their small size)

Measurement results

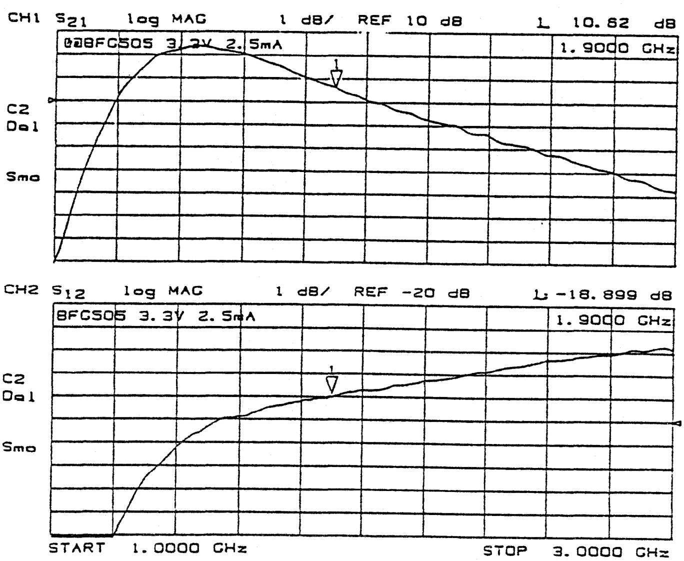
A: VSWR versus frequency
B: Gain/isolation versus frequency
C: Gain and current versus supply voltage
D: Intermodulation behaviour (IP3)
E+F: schematic diagram and layout
G: schematic diagram 900 MHz version

Measurements

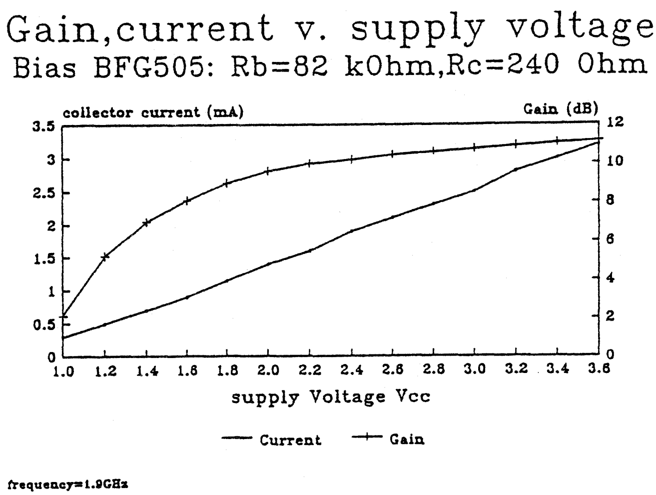
A



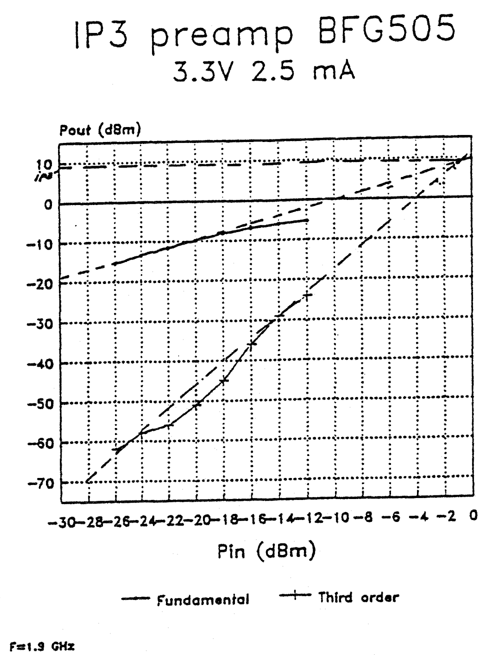
B



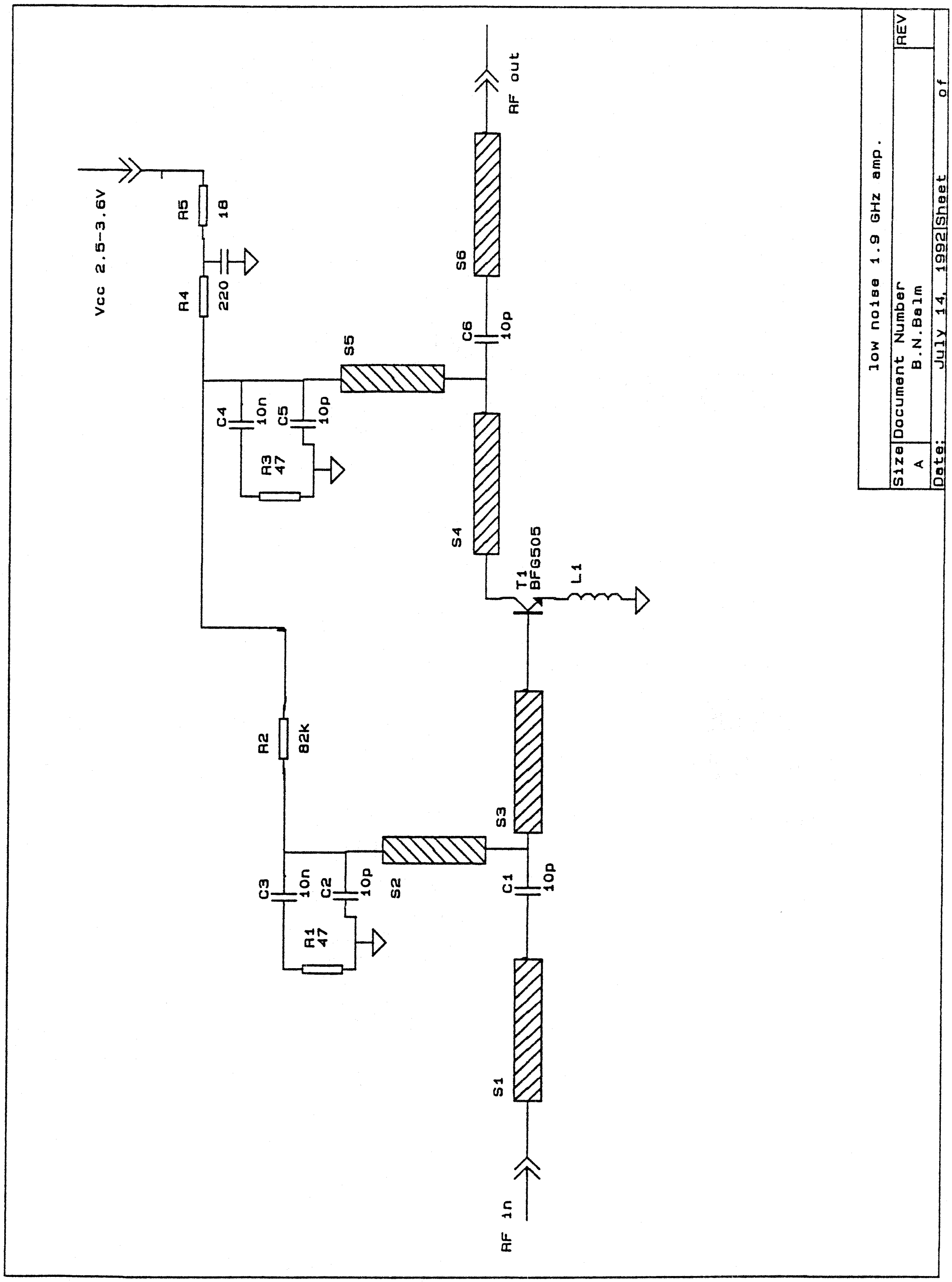
C


Gain,current v. supply voltage
Bias BFG505: Rb=82 kOhm,Rc=240 Ohm
collector current (mA)
Gain (dB)
3.5
3
2.5
2
1.5
1
0.5
0
12
10
8
6
4
2
0
1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6
supply Voltage Vcc
Current
Gain
frequency=1.9GHz

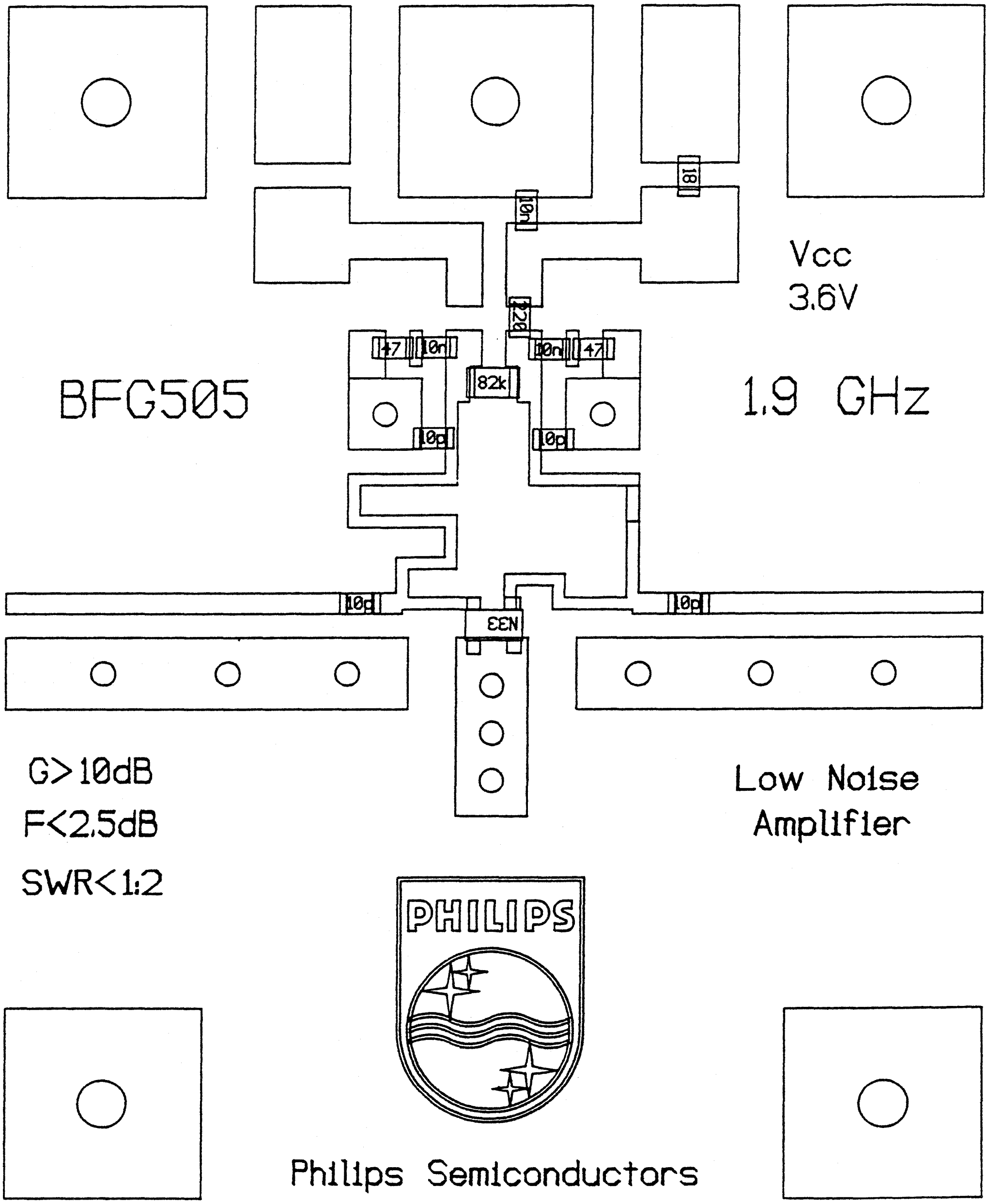
D


IP3 preamp BFG505
3.3V 2.5 mA
Pout (dBm)
10
0
-10
-20
-30
-40
-50
-60
-70
-30-28-26-24-22-20-18-16-14-12-10-8 -6 -4 -2 0
Pin (dBm)
Fundamental
Third order
F=1.9 GHz

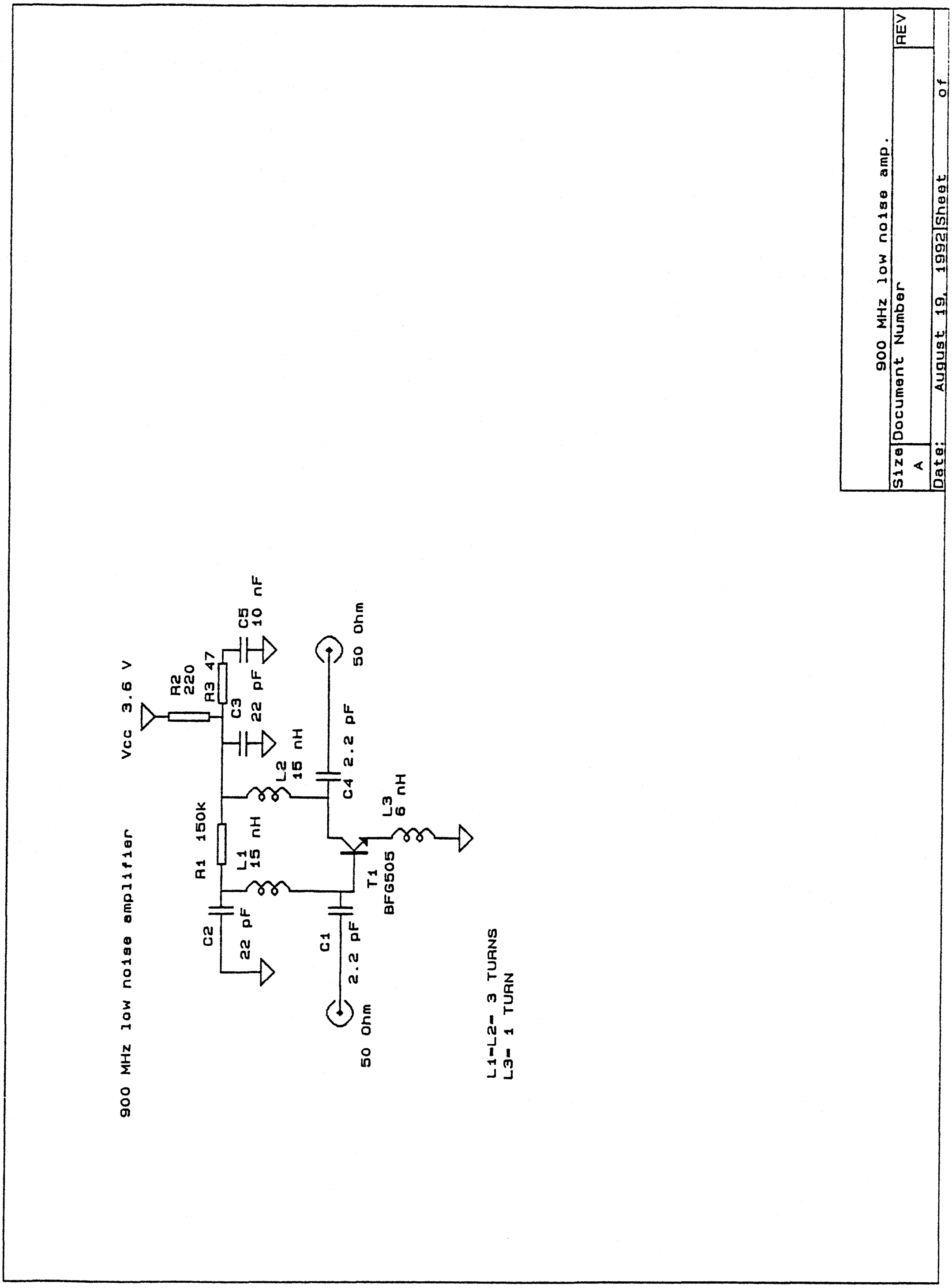
E


RF out
Vcc 2.5-3.6V
R5
18
R4
220
S6
C6
10p
S5
C4
10n
C5
10p
R3
47
S4
T1
BFG505
L1
R2
82k
S3
C3
10n
C2
10p
S2
C1
10p
R1
47
S1
RF in
low noise 1.9 GHz amp.
Size
A
Document Number
B.N.Balm
REV
Date:
July 14, 1992
Sheet
of

F


18
10n
47
10n
10n
47
82k
10p
10p
10p
10p
Vcc
3.6V
BFG505
1.9 GHz
G>10dB
F<2.5dB
SWR<1:2
Low Noise
Amplifier
PHILIPS
Philips Semiconductors

G


900 MHz low noise amplifier
Vcc 3.6 V
R2 220
R3 47
C5 10 nF
C3 22 pF
L2 15 nH
C4 2.2 pF
50 Ohm
R1 150k
L1 15 nH
L3 6 nH
T1 BFG505
C2 22 pF
C1 2.2 pF
50 Ohm
L1-L2- 3 TURNS
L3- 1 TURN
900 MHz low noise amp.
Size
A
Document Number
REV
Date: August 19, 1992
Sheet
of

SCATTERING PARAMETERS

INTRODUCTION

S-parameters in this book are published as polar scattering diagrams. They are also available on a diskette in tabular form for use with TOUCHSTONE®, LIBRA® and MDS®. The diskette is included with this book and can be found inside the rear cover. On the diskette you will find the selection program that will run under the Windows Operating System. The selection program provides a quick and easy-to-use path to find the correct data files.

A list of the contents of the S-parameter library is given in the following pages.

If you have any questions regarding the S-parameter data please contact your local Philips Semiconductors sales representative.

TOUCHSTONE, LIBRA and MDS are registered trademarks by EEsof Inc., Hewlett Packard Inc. and Compact Software Inc.

COMMON BASE DATA

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BF547	SOT23	10	2	0.04 to 1.0	–
BF547	SOT23	10	5	0.04 to 1.0	–
BF547	SOT23	10	10	0.04 to 1.0	–
BF547	SOT23	10	20	0.04 to 1.0	–
BF747	SOT23	10	2	0.04 to 2.0	–
BF747	SOT23	10	5	0.04 to 2.0	–
BF747	SOT23	10	10	0.04 to 2.0	–
BF747	SOT23	10	15	0.04 to 2.0	–
BFR106	SOT23	5	15	0.04 to 2.0	–
BFR106	SOT23	5	30	0.04 to 2.0	–
BFR106	SOT23	5	50	0.04 to 2.0	–
BFR106	SOT23	5	70	0.04 to 2.0	–
BFR106	SOT23	10	15	0.04 to 2.0	–
BFR106	SOT23	10	30	0.04 to 2.0	–
BFR92A	SOT23	5	2	0.04 to 3.0	–
BFR92A	SOT23	5	5	0.04 to 3.0	–
BFR92A	SOT23	5	10	0.04 to 3.0	–
BFR92A	SOT23	5	15	0.04 to 3.0	–
BFR92A	SOT23	5	20	0.04 to 3.0	–
BFR92A	SOT23	10	2	0.04 to 3.0	–
BFR92A	SOT23	10	5	0.04 to 3.0	–
BFR92A	SOT23	10	10	0.04 to 3.0	–
BFR92A	SOT23	10	15	0.04 to 3.0	–
BFR92A	SOT23	10	20	0.04 to 3.0	–
BFR93A	SOT23	5	5	0.04 to 3.0	–
BFR93A	SOT23	5	10	0.04 to 3.0	–
BFR93A	SOT23	5	20	0.04 to 3.0	–
BFR93A	SOT23	5	30	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFR93A	SOT23	8	5	0.04 to 3.0	–
BFR93A	SOT23	8	10	0.04 to 3.0	–
BFR93A	SOT23	8	20	0.04 to 3.0	–
BFR93A	SOT23	8	30	0.04 to 3.0	–
BFS17	SOT23	5	2	0.04 to 2.0	–
BFS17	SOT23	5	5	0.04 to 2.0	–
BFS17	SOT23	5	10	0.04 to 2.0	–
BFS17	SOT23	5	15	0.04 to 2.0	–
BFS17	SOT23	5	20	0.04 to 2.0	–
BFS17	SOT23	10	2	0.04 to 2.0	–
BFS17	SOT23	10	5	0.04 to 2.0	–
BFS17	SOT23	10	10	0.04 to 2.0	–
BFS17	SOT23	10	15	0.04 to 2.0	–
BFS17	SOT23	10	20	0.04 to 2.0	–
BFS17A	SOT23	5	2	0.04 to 2.0	–
BFS17A	SOT23	5	5	0.04 to 2.0	–
BFS17A	SOT23	5	10	0.04 to 2.0	–
BFS17A	SOT23	5	15	0.04 to 2.0	–
BFS17A	SOT23	5	20	0.04 to 2.0	–
BFS17A	SOT23	10	2	0.04 to 2.0	–
BFS17A	SOT23	10	5	0.04 to 2.0	–
BFS17A	SOT23	10	10	0.04 to 2.0	–
BFS17A	SOT23	10	15	0.04 to 2.0	–
BFS17A	SOT23	10	20	0.04 to 2.0	–
MPSH10	SOT54	10	5	0.04 to 1.0	–
MPSH10	SOT54	10	10	0.04 to 1.0	–
MPSH10	SOT54	10	20	0.04 to 1.0	–
PMBTH10	SOT23	10	5	0.04 to 1.0	–
PMBTH10	SOT23	10	10	0.04 to 1.0	–
PMBTH10	SOT23	10	20	0.04 to 1.0	–
PMBTH81	SOT23	–10	–5	0.04 to 1.0	–
PMBTH81	SOT23	–10	–10	0.04 to 1.0	–
PMBTH81	SOT23	–10	–20	0.04 to 1.0	–

COMMON EMITTER DATA

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BF547	SOT23	10	2	0.04 to 1.0	–
BF547	SOT23	10	5	0.04 to 1.0	–
BF547	SOT23	10	10	0.04 to 1.0	–
BF547	SOT23	10	15	0.04 to 1.0	–
BF547W	SOT323	10	2	0.04 to 2.0	–
BF547W	SOT323	10	5	0.04 to 2.0	–
BF547W	SOT323	10	10	0.04 to 2.0	–
BF547W	SOT323	10	15	0.04 to 2.0	–
BF747	SOT23	10	2	0.04 to 2.0	–
BF747	SOT23	10	5	0.04 to 2.0	–
BF747	SOT23	10	10	0.04 to 2.0	–
BF747	SOT23	10	15	0.04 to 2.0	–
BFG135	SOT223	10	10	0.04 to 3.0	–
BFG135	SOT223	10	25	0.04 to 3.0	–
BFG135	SOT223	10	50	0.04 to 3.0	–
BFG135	SOT223	10	75	0.04 to 3.0	–
BFG135	SOT223	10	100	0.04 to 3.0	–
BFG16A	SOT223	5	50	0.04 to 2.0	–
BFG16A	SOT223	5	100	0.04 to 2.0	–
BFG16A	SOT223	5	150	0.04 to 2.0	–
BFG16A	SOT223	10	50	0.04 to 2.0	–
BFG16A	SOT223	10	75	0.04 to 2.0	–
BFG16A	SOT223	10	100	0.04 to 2.0	–
BFG16A	SOT223	15	50	0.04 to 2.0	–
BFG16A	SOT223	15	70	0.04 to 2.0	–
BFG197	SOT143	4	10	0.04 to 3.0	0.5 to 2.0
BFG197	SOT143	4	20	0.04 to 3.0	0.5 to 2.0
BFG197	SOT143	4	30	0.04 to 3.0	–
BFG197	SOT143	4	50	0.04 to 3.0	–
BFG197	SOT143	4	70	0.04 to 3.0	–
BFG197	SOT143	6	50	0.04 to 3.0	0.5 to 2.0
BFG197	SOT143	8	10	0.04 to 3.0	–
BFG197	SOT143	8	20	0.04 to 3.0	–
BFG197	SOT143	8	30	0.04 to 3.0	–
BFG197/X	SOT143	4	10	0.04 to 3.0	0.5 to 2.0
BFG197/X	SOT143	4	20	0.04 to 3.0	0.5 to 2.0
BFG197/X	SOT143	4	30	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG197/X	SOT143	4	50	0.04 to 3.0	–
BFG197/X	SOT143	4	70	0.04 to 3.0	–
BFG197/X	SOT143	6	50	0.04 to 3.0	0.5 to 2.0
BFG197/X	SOT143	8	10	0.04 to 3.0	–
BFG197/X	SOT143	8	20	0.04 to 3.0	–
BFG197/X	SOT143	8	30	0.04 to 3.0	–
BFG197W	SOT343	4	10	0.04 to 3.0	0.5 to 2.0
BFG197W	SOT343	4	20	0.04 to 3.0	0.5 to 2.0
BFG197W	SOT343	4	30	0.04 to 3.0	–
BFG197W	SOT343	4	50	0.04 to 3.0	–
BFG197W	SOT343	4	70	0.04 to 3.0	–
BFG197W	SOT343	6	50	0.04 to 3.0	0.5 to 2.0
BFG197W	SOT343	8	10	0.04 to 3.0	–
BFG197W	SOT343	8	20	0.04 to 3.0	–
BFG197W	SOT343	8	30	0.04 to 3.0	–
BFG197W/X	SOT343	4	10	0.04 to 3.0	0.5 to 2.0
BFG197W/X	SOT343	4	20	0.04 to 3.0	0.5 to 2.0
BFG197W/X	SOT343	4	30	0.04 to 3.0	–
BFG197W/X	SOT343	4	50	0.04 to 3.0	–
BFG197W/X	SOT343	4	70	0.04 to 3.0	–
BFG197W/X	SOT343	6	50	0.04 to 3.0	0.5 to 2.0
BFG197W/X	SOT343	8	10	0.04 to 3.0	–
BFG197W/X	SOT343	8	20	0.04 to 3.0	–
BFG197W/X	SOT343	8	30	0.04 to 3.0	–
BFG197W/XR	SOT343	4	10	0.04 to 3.0	0.5 to 2.0
BFG197W/XR	SOT343	4	20	0.04 to 3.0	0.5 to 2.0
BFG197W/XR	SOT343	4	30	0.04 to 3.0	–
BFG197W/XR	SOT343	4	50	0.04 to 3.0	–
BFG197W/XR	SOT343	4	70	0.04 to 3.0	–
BFG197W/XR	SOT343	6	50	0.04 to 3.0	0.5 to 2.0
BFG197W/XR	SOT343	8	10	0.04 to 3.0	–
BFG197W/XR	SOT343	8	20	0.04 to 3.0	–
BFG197W/XR	SOT343	8	30	0.04 to 3.0	–
BFG198	SOT223	4	10	0.04 to 3.0	–
BFG198	SOT223	4	20	0.04 to 3.0	–
BFG198	SOT223	4	30	0.04 to 3.0	–
BFG198	SOT223	4	50	0.04 to 3.0	–
BFG198	SOT223	4	70	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG198	SOT223	8	10	0.04 to 3.0	–
BFG198	SOT223	8	20	0.04 to 3.0	–
BFG198	SOT223	8	30	0.04 to 3.0	–
BFG198	SOT223	8	50	0.04 to 3.0	–
BFG198	SOT223	8	70	0.04 to 3.0	–
BFG25A/X	SOT143	1	0.1	0.04 to 3.0	–
BFG25A/X	SOT143	1	0.25	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	1	0.5	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	1	1	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	1	2	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	3	0.1	0.04 to 3.0	–
BFG25A/X	SOT143	3	0.25	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	3	0.5	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	3	1	0.04 to 3.0	0.5 to 2.0
BFG25A/X	SOT143	3	2	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	1	0.1	0.04 to 3.0	–
BFG25AW	SOT343	1	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	1	0.5	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	1	1	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	1	2	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	3	0.1	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	3	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW	SOT343	3	0.5	0.04 to 3.0	–
BFG25AW	SOT343	3	1	0.04 to 3.0	–
BFG25AW	SOT343	3	2	0.04 to 3.0	–
BFG25AW/X	SOT343	1	0.1	0.04 to 3.0	–
BFG25AW/X	SOT343	1	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	1	0.5	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	1	1	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	1	2	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	3	0.1	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	3	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW/X	SOT343	3	0.5	0.04 to 3.0	–
BFG25AW/X	SOT343	3	1	0.04 to 3.0	–
BFG25AW/X	SOT343	3	2	0.04 to 3.0	–
BFG25AW/XR	SOT343	1	0.1	0.04 to 3.0	–
BFG25AW/XR	SOT343	1	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW/XR	SOT343	1	0.5	0.04 to 3.0	0.5 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG25AW/XR	SOT343	1	1	0.04 to 3.0	0.5 to 2.0
BFG25AW/XR	SOT343	1	2	0.04 to 3.0	0.5 to 2.0
BFG25AW/XR	SOT343	3	0.1	0.04 to 3.0	0.5 to 2.0
BFG25AW/XR	SOT343	3	0.25	0.04 to 3.0	0.5 to 2.0
BFG25AW/XR	SOT343	3	0.5	0.04 to 3.0	–
BFG25AW/XR	SOT343	3	1	0.04 to 3.0	–
BFG25AW/XR	SOT343	3	2	0.04 to 3.0	–
BFG31	SOT223	–5	–15	0.04 to 2.0	–
BFG31	SOT223	–5	–30	0.04 to 2.0	–
BFG31	SOT223	–5	–50	0.04 to 2.0	–
BFG31	SOT223	–5	–70	0.04 to 2.0	–
BFG31	SOT223	–10	–15	0.04 to 2.0	–
BFG31	SOT223	–10	–30	0.04 to 2.0	–
BFG31	SOT223	–10	–50	0.04 to 2.0	–
BFG31	SOT223	–10	–70	0.04 to 2.0	–
BFG35	SOT223	10	20	0.04 to 3.0	–
BFG35	SOT223	10	30	0.04 to 3.0	–
BFG35	SOT223	10	50	0.04 to 3.0	–
BFG35	SOT223	10	70	0.04 to 3.0	–
BFG35	SOT223	10	100	0.04 to 3.0	–
BFG505	SOT143	3	0.5	0.04 to 3.0	–
BFG505	SOT143	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	3	5	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	3	7.5	0.04 to 3.0	–
BFG505	SOT143	6	0.5	0.04 to 3.0	–
BFG505	SOT143	6	1.25	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	6	5	0.04 to 3.0	0.9 to 2.0
BFG505	SOT143	6	7.5	0.04 to 3.0	–
BFG505/X	SOT143	3	0.5	0.04 to 3.0	–
BFG505/X	SOT143	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	3	5	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	3	7.5	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG505/X	SOT143	6	0.5	0.04 to 3.0	–
BFG505/X	SOT143	6	1.25	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	6	5	0.04 to 3.0	0.9 to 2.0
BFG505/X	SOT143	6	7.5	0.04 to 3.0	–
BFG505/XR	SOT143	3	0.5	0.04 to 3.0	–
BFG505/XR	SOT143	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	3	5	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	3	7.5	0.04 to 3.0	–
BFG505/XR	SOT143	6	0.5	0.04 to 3.0	–
BFG505/XR	SOT143	6	1.25	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	6	5	0.04 to 3.0	0.9 to 2.0
BFG505/XR	SOT143	6	7.5	0.04 to 3.0	–
BFG505W	SOT343	3	0.5	0.04 to 3.0	–
BFG505W	SOT343	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	3	5	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	3	7.5	0.04 to 3.0	–
BFG505W	SOT343	6	0.5	0.04 to 3.0	–
BFG505W	SOT343	6	1.25	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	6	5	0.04 to 3.0	0.9 to 2.0
BFG505W	SOT343	6	7.5	0.04 to 3.0	–
BFG505W/X	SOT343	3	0.5	0.04 to 3.0	–
BFG505W/X	SOT343	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	3	5	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	3	7.5	0.04 to 3.0	–
BFG505W/X	SOT343	6	0.5	0.04 to 3.0	–
BFG505W/X	SOT343	6	1.25	0.04 to 3.0	0.9 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG505W/X	SOT343	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	6	5	0.04 to 3.0	0.9 to 2.0
BFG505W/X	SOT343	6	7.5	0.04 to 3.0	–
BFG505W/XR	SOT343	3	0.5	0.04 to 3.0	–
BFG505W/XR	SOT343	3	1.25	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	3	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	3	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	3	5	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	3	7.5	0.04 to 3.0	–
BFG505W/XR	SOT343	6	0.5	0.04 to 3.0	–
BFG505W/XR	SOT343	6	1.25	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	6	2.5	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	6	3.75	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	6	5	0.04 to 3.0	0.9 to 2.0
BFG505W/XR	SOT343	6	7.5	0.04 to 3.0	–
BFG520	SOT143	3	2	0.04 to 3.0	–
BFG520	SOT143	3	5	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	3	10	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	3	15	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	3	20	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	3	30	0.04 to 3.0	–
BFG520	SOT143	6	2	0.04 to 3.0	–
BFG520	SOT143	6	5	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	6	10	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	6	15	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	6	20	0.04 to 3.0	0.9 to 2.0
BFG520	SOT143	6	30	0.04 to 3.0	–
BFG520/X	SOT143	3	2	0.04 to 3.0	–
BFG520/X	SOT143	3	5	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	3	10	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	3	15	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	3	20	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	3	30	0.04 to 3.0	–
BFG520/X	SOT143	6	2	0.04 to 3.0	–
BFG520/X	SOT143	6	5	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	6	10	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	6	15	0.04 to 3.0	0.5 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG520/X	SOT143	6	20	0.04 to 3.0	0.5 to 2.0
BFG520/X	SOT143	6	30	0.04 to 3.0	–
BFG520/XR	SOT143	3	2	0.04 to 3.0	–
BFG520/XR	SOT143	3	5	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	3	10	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	3	15	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	3	20	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	3	30	0.04 to 3.0	–
BFG520/XR	SOT143	6	2	0.04 to 3.0	–
BFG520/XR	SOT143	6	5	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	6	10	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	6	15	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	6	20	0.04 to 3.0	0.5 to 2.0
BFG520/XR	SOT143	6	30	0.04 to 3.0	–
BFG520W	SOT343	3	2	0.04 to 3.0	–
BFG520W	SOT343	3	5	0.04 to 3.0	–
BFG520W	SOT343	3	10	0.04 to 3.0	–
BFG520W	SOT343	3	15	0.04 to 3.0	–
BFG520W	SOT343	3	20	0.04 to 3.0	–
BFG520W	SOT343	3	30	0.04 to 3.0	–
BFG520W	SOT343	6	2	0.04 to 3.0	–
BFG520W	SOT343	6	5	0.04 to 3.0	–
BFG520W	SOT343	6	10	0.04 to 3.0	–
BFG520W	SOT343	6	15	0.04 to 3.0	–
BFG520W	SOT343	6	20	0.04 to 3.0	–
BFG520W	SOT343	6	30	0.04 to 3.0	–
BFG520W/X	SOT343	3	2	0.04 to 3.0	–
BFG520W/X	SOT343	3	5	0.04 to 3.0	–
BFG520W/X	SOT343	3	10	0.04 to 3.0	–
BFG520W/X	SOT343	3	15	0.04 to 3.0	–
BFG520W/X	SOT343	3	20	0.04 to 3.0	–
BFG520W/X	SOT343	3	30	0.04 to 3.0	–
BFG520W/X	SOT343	6	2	0.04 to 3.0	–
BFG520W/X	SOT343	6	5	0.04 to 3.0	–
BFG520W/X	SOT343	6	10	0.04 to 3.0	–
BFG520W/X	SOT343	6	15	0.04 to 3.0	–
BFG520W/X	SOT343	6	20	0.04 to 3.0	–
BFG520W/X	SOT343	6	30	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG520W/XR	SOT343	3	2	0.04 to 3.0	–
BFG520W/XR	SOT343	3	5	0.04 to 3.0	–
BFG520W/XR	SOT343	3	10	0.04 to 3.0	–
BFG520W/XR	SOT343	3	15	0.04 to 3.0	–
BFG520W/XR	SOT343	3	20	0.04 to 3.0	–
BFG520W/XR	SOT343	3	30	0.04 to 3.0	–
BFG520W/XR	SOT343	6	2	0.04 to 3.0	–
BFG520W/XR	SOT343	6	5	0.04 to 3.0	–
BFG520W/XR	SOT343	6	10	0.04 to 3.0	–
BFG520W/XR	SOT343	6	15	0.04 to 3.0	–
BFG520W/XR	SOT343	6	20	0.04 to 3.0	–
BFG520W/XR	SOT343	6	30	0.04 to 3.0	–
BFG540	SOT143	4	4	0.04 to 3.0	–
BFG540	SOT143	4	10	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	4	20	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	4	30	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	4	40	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	4	50	0.04 to 3.0	–
BFG540	SOT143	8	4	0.04 to 3.0	–
BFG540	SOT143	8	10	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	8	20	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	8	30	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	8	40	0.04 to 3.0	0.9 to 2.0
BFG540	SOT143	8	50	0.04 to 3.0	–
BFG540/X	SOT143	4	4	0.04 to 3.0	–
BFG540/X	SOT143	4	10	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	4	20	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	4	30	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	4	40	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	4	50	0.04 to 3.0	–
BFG540/X	SOT143	8	4	0.04 to 3.0	–
BFG540/X	SOT143	8	10	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	8	20	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	8	30	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	8	40	0.04 to 3.0	0.9 to 2.0
BFG540/X	SOT143	8	50	0.04 to 3.0	–
BFG540/XR	SOT143	4	4	0.04 to 3.0	–
BFG540/XR	SOT143	4	10	0.04 to 3.0	0.9 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG540/XR	SOT143	4	20	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	4	30	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	4	40	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	4	50	0.04 to 3.0	–
BFG540/XR	SOT143	8	4	0.04 to 3.0	–
BFG540/XR	SOT143	8	10	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	8	20	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	8	30	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	8	40	0.04 to 3.0	0.9 to 2.0
BFG540/XR	SOT143	8	50	0.04 to 3.0	–
BFG540W	SOT343	4	4	0.04 to 3.0	–
BFG540W	SOT343	4	10	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	4	20	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	4	30	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	4	40	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	4	50	0.04 to 3.0	–
BFG540W	SOT343	8	4	0.04 to 3.0	–
BFG540W	SOT343	8	10	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	8	20	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	8	30	0.04 to 3.0	0.9 to 2.0
BFG540W	SOT343	8	40	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	4	4	0.04 to 3.0	–
BFG540W/X	SOT343	4	10	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	4	20	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	4	30	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	4	40	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	4	50	0.04 to 3.0	–
BFG540W/X	SOT343	8	4	0.04 to 3.0	–
BFG540W/X	SOT343	8	10	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	8	20	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	8	30	0.04 to 3.0	0.9 to 2.0
BFG540W/X	SOT343	8	40	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	4	4	0.04 to 3.0	–
BFG540W/XR	SOT343	4	10	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	4	20	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	4	30	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	4	40	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	4	50	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG540W/XR	SOT343	8	4	0.04 to 3.0	–
BFG540W/XR	SOT343	8	10	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	8	20	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	8	30	0.04 to 3.0	0.9 to 2.0
BFG540W/XR	SOT343	8	40	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	4	4	0.04 to 3.0	–
BFG541	SOT223	4	10	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	4	20	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	4	30	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	4	40	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	4	50	0.04 to 3.0	–
BFG541	SOT223	8	4	0.04 to 3.0	–
BFG541	SOT223	8	10	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	8	20	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	8	30	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	8	40	0.04 to 3.0	0.9 to 2.0
BFG541	SOT223	8	50	0.04 to 3.0	–
BFG590	SOT143	4	10	0.04 to 3.0	–
BFG590	SOT143	4	20	0.04 to 3.0	–
BFG590	SOT143	4	30	0.04 to 3.0	–
BFG590	SOT143	4	40	0.04 to 3.0	–
BFG590	SOT143	4	50	0.04 to 3.0	–
BFG590	SOT143	4	60	0.04 to 3.0	–
BFG590	SOT143	4	70	0.04 to 3.0	–
BFG590	SOT143	4	80	0.04 to 3.0	–
BFG590	SOT143	8	10	0.04 to 3.0	–
BFG590	SOT143	8	20	0.04 to 3.0	–
BFG590	SOT143	8	30	0.04 to 3.0	–
BFG590	SOT143	8	40	0.04 to 3.0	–
BFG590/X	SOT143	4	10	0.04 to 3.0	–
BFG590/X	SOT143	4	20	0.04 to 3.0	–
BFG590/X	SOT143	4	30	0.04 to 3.0	–
BFG590/X	SOT143	4	40	0.04 to 3.0	–
BFG590/X	SOT143	4	50	0.04 to 3.0	–
BFG590/X	SOT143	4	60	0.04 to 3.0	–
BFG590/X	SOT143	4	70	0.04 to 3.0	–
BFG590/X	SOT143	4	80	0.04 to 3.0	–
BFG590/X	SOT143	8	10	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG590/X	SOT143	8	20	0.04 to 3.0	–
BFG590/X	SOT143	8	30	0.04 to 3.0	–
BFG590/X	SOT143	8	40	0.04 to 3.0	–
BFG590/XR	SOT143	4	10	0.04 to 3.0	–
BFG590/XR	SOT143	4	20	0.04 to 3.0	–
BFG590/XR	SOT143	4	30	0.04 to 3.0	–
BFG590/XR	SOT143	4	40	0.04 to 3.0	–
BFG590/XR	SOT143	4	50	0.04 to 3.0	–
BFG590/XR	SOT143	4	60	0.04 to 3.0	–
BFG590/XR	SOT143	4	70	0.04 to 3.0	–
BFG590/XR	SOT143	4	80	0.04 to 3.0	–
BFG590/XR	SOT143	8	10	0.04 to 3.0	–
BFG590/XR	SOT143	8	20	0.04 to 3.0	–
BFG590/XR	SOT143	8	30	0.04 to 3.0	–
BFG590/XR	SOT143	8	40	0.04 to 3.0	–
BFG590W	SOT343	4	10	0.04 to 3.0	–
BFG590W	SOT343	4	20	0.04 to 3.0	–
BFG590W	SOT343	4	30	0.04 to 3.0	–
BFG590W	SOT343	4	40	0.04 to 3.0	–
BFG590W	SOT343	4	50	0.04 to 3.0	–
BFG590W	SOT343	4	60	0.04 to 3.0	–
BFG590W	SOT343	4	70	0.04 to 3.0	–
BFG590W	SOT343	4	80	0.04 to 3.0	–
BFG590W	SOT343	8	10	0.04 to 3.0	–
BFG590W	SOT343	8	20	0.04 to 3.0	–
BFG590W	SOT343	8	30	0.04 to 3.0	–
BFG590W	SOT343	8	40	0.04 to 3.0	–
BFG590W/X	SOT343	4	10	0.04 to 3.0	–
BFG590W/X	SOT343	4	20	0.04 to 3.0	–
BFG590W/X	SOT343	4	30	0.04 to 3.0	–
BFG590W/X	SOT343	4	40	0.04 to 3.0	–
BFG590W/X	SOT343	4	50	0.04 to 3.0	–
BFG590W/X	SOT343	4	60	0.04 to 3.0	–
BFG590W/X	SOT343	4	70	0.04 to 3.0	–
BFG590W/X	SOT343	4	80	0.04 to 3.0	–
BFG590W/X	SOT343	8	10	0.04 to 3.0	–
BFG590W/X	SOT343	8	20	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG590W/X	SOT343	8	30	0.04 to 3.0	–
BFG590W/X	SOT343	8	40	0.04 to 3.0	–
BFG590W/XR	SOT343	4	10	0.04 to 3.0	–
BFG590W/XR	SOT343	4	20	0.04 to 3.0	–
BFG590W/XR	SOT343	4	30	0.04 to 3.0	–
BFG590W/XR	SOT343	4	40	0.04 to 3.0	–
BFG590W/XR	SOT343	4	50	0.04 to 3.0	–
BFG590W/XR	SOT343	4	60	0.04 to 3.0	–
BFG590W/XR	SOT343	4	70	0.04 to 3.0	–
BFG590W/XR	SOT343	4	80	0.04 to 3.0	–
BFG590W/XR	SOT343	8	10	0.04 to 3.0	–
BFG590W/XR	SOT343	8	20	0.04 to 3.0	–
BFG590W/XR	SOT343	8	30	0.04 to 3.0	–
BFG590W/XR	SOT343	8	40	0.04 to 3.0	–
BFG591	SOT223	12	10	0.04 to 3.0	–
BFG591	SOT223	12	20	0.04 to 3.0	–
BFG591	SOT223	12	30	0.04 to 3.0	–
BFG591	SOT223	12	40	0.04 to 3.0	–
BFG591	SOT223	12	50	0.04 to 3.0	–
BFG591	SOT223	12	60	0.04 to 3.0	–
BFG591	SOT223	12	70	0.04 to 3.0	–
BFG591	SOT223	12	80	0.04 to 3.0	–
BFG591	SOT223	12	90	0.04 to 3.0	–
BFG591	SOT223	12	100	0.04 to 3.0	–
BFG67	SOT143	4	2	0.04 to 3.0	–
BFG67	SOT143	4	5	0.04 to 3.0	–
BFG67	SOT143	4	10	0.04 to 3.0	–
BFG67	SOT143	4	15	0.04 to 3.0	–
BFG67	SOT143	4	20	0.04 to 3.0	–
BFG67	SOT143	4	30	0.04 to 3.0	–
BFG67	SOT143	8	2	0.04 to 3.0	–
BFG67	SOT143	8	5	0.04 to 3.0	0.5 to 2.0
BFG67	SOT143	8	10	0.04 to 3.0	–
BFG67	SOT143	8	15	0.04 to 3.0	0.5 to 2.0
BFG67	SOT143	8	20	0.04 to 3.0	–
BFG67	SOT143	8	30	0.04 to 3.0	0.5 to 2.0
BFG67/X	SOT143	4	2	0.04 to 3.0	–
BFG67/X	SOT143	4	5	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG67/X	SOT143	4	10	0.04 to 3.0	–
BFG67/X	SOT143	4	15	0.04 to 3.0	–
BFG67/X	SOT143	4	20	0.04 to 3.0	–
BFG67/X	SOT143	4	30	0.04 to 3.0	–
BFG67/X	SOT143	8	2	0.04 to 3.0	–
BFG67/X	SOT143	8	5	0.04 to 3.0	0.5 to 2.0
BFG67/X	SOT143	8	10	0.04 to 3.0	–
BFG67/X	SOT143	8	15	0.04 to 3.0	0.5 to 2.0
BFG67/X	SOT143	8	20	0.04 to 3.0	–
BFG67/X	SOT143	8	30	0.04 to 3.0	0.5 to 2.0
BFG67W	SOT343	4	2	0.04 to 3.0	–
BFG67W	SOT343	4	5	0.04 to 3.0	–
BFG67W	SOT343	4	10	0.04 to 3.0	–
BFG67W	SOT343	4	15	0.04 to 3.0	–
BFG67W	SOT343	4	20	0.04 to 3.0	–
BFG67W	SOT343	4	30	0.04 to 3.0	–
BFG67W	SOT343	8	2	0.04 to 3.0	–
BFG67W	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG67W	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG67W	SOT343	8	15	0.04 to 3.0	0.5 to 2.0
BFG67W	SOT343	8	20	0.04 to 3.0	–
BFG67W	SOT343	8	30	0.04 to 3.0	0.5 to 2.0
BFG67W/X	SOT343	4	2	0.04 to 3.0	–
BFG67W/X	SOT343	4	5	0.04 to 3.0	–
BFG67W/X	SOT343	4	10	0.04 to 3.0	–
BFG67W/X	SOT343	4	15	0.04 to 3.0	–
BFG67W/X	SOT343	4	20	0.04 to 3.0	–
BFG67W/X	SOT343	4	30	0.04 to 3.0	–
BFG67W/X	SOT343	8	2	0.04 to 3.0	–
BFG67W/X	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG67W/X	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG67W/X	SOT343	8	15	0.04 to 3.0	0.5 to 2.0
BFG67W/X	SOT343	8	20	0.04 to 3.0	–
BFG67W/X	SOT343	8	30	0.04 to 3.0	0.5 to 2.0
BFG67W/XR	SOT343	4	2	0.04 to 3.0	–
BFG67W/XR	SOT343	4	5	0.04 to 3.0	–
BFG67W/XR	SOT343	4	10	0.04 to 3.0	–
BFG67W/XR	SOT343	4	15	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG67W/XR	SOT343	4	20	0.04 to 3.0	–
BFG67W/XR	SOT343	4	30	0.04 to 3.0	–
BFG67W/XR	SOT343	8	2	0.04 to 3.0	–
BFG67W/XR	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG67W/XR	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG67W/XR	SOT343	8	15	0.04 to 3.0	0.5 to 2.0
BFG67W/XR	SOT343	8	20	0.04 to 3.0	–
BFG67W/XR	SOT343	8	30	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	5	2	0.04 to 3.0	–
BFG92A	SOT143	5	5	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	5	10	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	5	15	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	5	20	0.04 to 3.0	–
BFG92A	SOT143	10	2	0.04 to 3.0	–
BFG92A	SOT143	10	5	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	10	10	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	10	15	0.04 to 3.0	0.5 to 2.0
BFG92A	SOT143	10	20	0.04 to 3.0	–
BFG92A/X	SOT143	5	2	0.04 to 3.0	–
BFG92A/X	SOT143	5	5	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	5	10	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	5	15	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	5	20	0.04 to 3.0	–
BFG92A/X	SOT143	10	2	0.04 to 3.0	–
BFG92A/X	SOT143	10	5	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	10	10	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	10	15	0.04 to 3.0	0.5 to 2.0
BFG92A/X	SOT143	10	20	0.04 to 3.0	–
BFG92AW	SOT343	5	2	0.04 to 3.0	–
BFG92AW	SOT343	5	5	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	5	10	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	5	15	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	5	20	0.04 to 3.0	–
BFG92AW	SOT343	10	2	0.04 to 3.0	–
BFG92AW	SOT343	10	5	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	10	10	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	10	15	0.04 to 3.0	0.5 to 2.0
BFG92AW	SOT343	10	20	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG92AW/X	SOT343	5	2	0.04 to 3.0	–
BFG92AW/X	SOT343	5	5	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	5	10	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	5	15	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	5	20	0.04 to 3.0	–
BFG92AW/X	SOT343	10	2	0.04 to 3.0	–
BFG92AW/X	SOT343	10	5	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	10	10	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	10	15	0.04 to 3.0	0.5 to 2.0
BFG92AW/X	SOT343	10	20	0.04 to 3.0	–
BFG92AW/XR	SOT343	5	2	0.04 to 3.0	–
BFG92AW/XR	SOT343	5	5	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	5	10	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	5	15	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	5	20	0.04 to 3.0	–
BFG92AW/XR	SOT343	10	2	0.04 to 3.0	–
BFG92AW/XR	SOT343	10	5	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	10	10	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	10	15	0.04 to 3.0	0.5 to 2.0
BFG92AW/XR	SOT343	10	20	0.04 to 3.0	–
BFG93A	SOT143	5	5	0.04 to 3.0	0.5 to 2.0
BFG93A	SOT143	5	10	0.04 to 3.0	0.5 to 2.0
BFG93A	SOT143	5	20	0.04 to 3.0	–
BFG93A	SOT143	5	30	0.04 to 3.0	0.5 to 2.0
BFG93A	SOT143	8	5	0.04 to 3.0	0.5 to 2.0
BFG93A	SOT143	8	10	0.04 to 3.0	0.5 to 2.0
BFG93A	SOT143	8	20	0.04 to 3.0	–
BFG93A	SOT143	8	30	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	5	5	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	5	10	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	5	20	0.04 to 3.0	–
BFG93A/X	SOT143	5	30	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	8	5	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	8	10	0.04 to 3.0	0.5 to 2.0
BFG93A/X	SOT143	8	20	0.04 to 3.0	–
BFG93A/X	SOT143	8	30	0.04 to 3.0	0.5 to 2.0
BFG93AW	SOT343	5	5	0.04 to 3.0	–
BFG93AW	SOT343	5	10	0.04 to 3.0	0.5 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFG93AW	SOT343	5	20	0.04 to 3.0	–
BFG93AW	SOT343	5	30	0.04 to 3.0	0.5 to 2.0
BFG93AW	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG93AW	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG93AW	SOT343	8	20	0.04 to 3.0	–
BFG93AW	SOT343	8	30	0.04 to 3.0	–
BFG93AW/X	SOT343	5	5	0.04 to 3.0	–
BFG93AW/X	SOT343	5	10	0.04 to 3.0	0.5 to 2.0
BFG93AW/X	SOT343	5	20	0.04 to 3.0	–
BFG93AW/X	SOT343	5	30	0.04 to 3.0	0.5 to 2.0
BFG93AW/X	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG93AW/X	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG93AW/X	SOT343	8	20	0.04 to 3.0	–
BFG93AW/X	SOT343	8	30	0.04 to 3.0	–
BFG93AW/XR	SOT343	5	5	0.04 to 3.0	–
BFG93AW/XR	SOT343	5	10	0.04 to 3.0	0.5 to 2.0
BFG93AW/XR	SOT343	5	20	0.04 to 3.0	–
BFG93AW/XR	SOT343	5	30	0.04 to 3.0	0.5 to 2.0
BFG93AW/XR	SOT343	8	5	0.04 to 3.0	0.5 to 2.0
BFG93AW/XR	SOT343	8	10	0.04 to 3.0	0.5 to 2.0
BFG93AW/XR	SOT343	8	20	0.04 to 3.0	–
BFG93AW/XR	SOT343	8	30	0.04 to 3.0	–
BFG94	SOT223	10	15	0.04 to 3.0	0.5 to 1.0
BFG94	SOT223	10	30	0.04 to 3.0	0.5 to 1.0
BFG94	SOT223	10	45	0.04 to 3.0	0.5 to 1.0
BFG97	SOT223	5	15	0.04 to 3.0	–
BFG97	SOT223	5	30	0.04 to 3.0	–
BFG97	SOT223	5	50	0.04 to 3.0	–
BFG97	SOT223	5	70	0.04 to 3.0	–
BFG97	SOT223	10	15	0.04 to 3.0	–
BFG97	SOT223	10	30	0.04 to 3.0	–
BFG97	SOT223	10	50	0.04 to 3.0	–
BFG97	SOT223	10	70	0.04 to 3.0	–
BFP91A	SOT173	5	5	0.04 to 2.0	–
BFP91A	SOT173	5	10	0.04 to 2.0	–
BFP91A	SOT173	5	20	0.04 to 2.0	–
BFP91A	SOT173	5	30	0.04 to 2.0	–
BFP91A	SOT173	8	5	0.04 to 2.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFP91A	SOT173	8	10	0.04 to 2.0	–
BFP91A	SOT173	8	20	0.04 to 2.0	–
BFP91A	SOT173	8	30	0.04 to 2.0	–
BFP96	SOT173	5	15	0.04 to 3.0	–
BFP96	SOT173	5	30	0.04 to 3.0	–
BFP96	SOT173	5	50	0.04 to 3.0	–
BFP96	SOT173	5	70	0.04 to 3.0	–
BFP96	SOT173	10	15	0.04 to 3.0	–
BFP96	SOT173	10	30	0.04 to 3.0	–
BFP96	SOT173	10	50	0.04 to 3.0	–
BFQ135	SOT172	12	60	0.04 to 2.0	–
BFQ135	SOT172	12	90	0.04 to 2.0	–
BFQ135	SOT172	12	120	0.04 to 2.0	–
BFQ135	SOT172	12	150	0.04 to 2.0	–
BFQ135	SOT172	18	60	0.04 to 2.0	–
BFQ135	SOT172	18	90	0.04 to 2.0	–
BFQ135	SOT172	18	120	0.04 to 2.0	–
BFQ135	SOT172	18	150	0.04 to 2.0	–
BFQ149	SOT89	–5	–15	0.04 to 3.0	–
BFQ149	SOT89	–5	–30	0.04 to 3.0	–
BFQ149	SOT89	–5	–50	0.04 to 3.0	–
BFQ149	SOT89	–5	–70	0.04 to 3.0	–
BFQ149	SOT89	–10	–15	0.04 to 3.0	–
BFQ149	SOT89	–10	–30	0.04 to 3.0	–
BFQ149	SOT89	–10	–50	0.04 to 3.0	–
BFQ149	SOT89	–10	–70	0.04 to 3.0	–
BFQ18A	SOT89	10	20	0.04 to 3.0	–
BFQ18A	SOT89	10	30	0.04 to 3.0	–
BFQ18A	SOT89	10	50	0.04 to 3.0	–
BFQ18A	SOT89	10	70	0.04 to 3.0	–
BFQ18A	SOT89	10	100	0.04 to 3.0	–
BFQ19	SOT89	5	15	0.04 to 3.0	–
BFQ19	SOT89	5	30	0.04 to 3.0	–
BFQ19	SOT89	5	50	0.04 to 3.0	–
BFQ19	SOT89	5	70	0.04 to 3.0	–
BFQ19	SOT89	10	15	0.04 to 3.0	–
BFQ19	SOT89	10	30	0.04 to 3.0	–
BFQ19	SOT89	10	50	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFQ270	SOT172	12	180	0.04 to 3.0	–
BFQ270	SOT172	12	240	0.04 to 3.0	–
BFQ270	SOT172	12	300	0.04 to 3.0	–
BFQ270	SOT172	12	360	0.04 to 3.0	–
BFQ270	SOT172	12	420	0.04 to 3.0	–
BFQ270	SOT172	18	180	0.04 to 3.0	–
BFQ270	SOT172	18	240	0.04 to 3.0	–
BFQ270	SOT172	18	300	0.04 to 3.0	–
BFQ270	SOT172	18	360	0.04 to 3.0	–
BFQ270	SOT172	18	420	0.04 to 3.0	–
BFQ621	SOT172	12	60	0.04 to 2.0	–
BFQ621	SOT172	12	90	0.04 to 2.0	–
BFQ621	SOT172	12	120	0.04 to 2.0	–
BFQ621	SOT172	12	150	0.04 to 2.0	–
BFQ621	SOT172	18	60	0.04 to 2.0	–
BFQ621	SOT172	18	90	0.04 to 2.0	–
BFQ621	SOT172	18	120	0.04 to 2.0	–
BFQ621	SOT172	18	150	0.04 to 2.0	–
BFQ66	SOT173	4	2	0.04 to 4.0	–
BFQ66	SOT173	4	5	0.04 to 4.0	–
BFQ66	SOT173	4	10	0.04 to 4.0	–
BFQ66	SOT173	4	15	0.04 to 4.0	–
BFQ66	SOT173	8	2	0.04 to 4.0	–
BFQ66	SOT173	8	5	0.04 to 4.0	–
BFQ66	SOT173	8	10	0.04 to 4.0	–
BFQ66	SOT173	8	15	0.04 to 4.0	–
BFQ67	SOT23	4	2	0.04 to 3.0	–
BFQ67	SOT23	4	5	0.04 to 3.0	–
BFQ67	SOT23	4	10	0.04 to 3.0	–
BFQ67	SOT23	4	15	0.04 to 3.0	–
BFQ67	SOT23	4	20	0.04 to 3.0	–
BFQ67	SOT23	4	30	0.04 to 3.0	–
BFQ67	SOT23	8	2	0.04 to 3.0	–
BFQ67	SOT23	8	5	0.04 to 3.0	–
BFQ67	SOT23	8	10	0.04 to 3.0	–
BFQ67	SOT23	8	15	0.04 to 3.0	–
BFQ67	SOT23	8	20	0.04 to 3.0	–
BFQ67	SOT23	8	30	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFQ67W	SOT323	4	2	0.04 to 3.0	1
BFQ67W	SOT323	4	5	0.04 to 3.0	1
BFQ67W	SOT323	4	10	0.04 to 3.0	1
BFQ67W	SOT323	4	15	0.04 to 3.0	1
BFQ67W	SOT323	4	20	0.04 to 3.0	1
BFQ67W	SOT323	4	30	0.04 to 3.0	1
BFQ67W	SOT323	8	2	0.04 to 3.0	1
BFQ67W	SOT323	8	5	0.04 to 3.0	1
BFQ67W	SOT323	8	10	0.04 to 3.0	1
BFQ67W	SOT323	8	15	0.04 to 3.0	1
BFQ67W	SOT323	8	20	0.04 to 3.0	1
BFQ67W	SOT323	8	30	0.04 to 3.0	1
BFR106	SOT23	5	15	0.04 to 2.0	–
BFR106	SOT23	5	30	0.04 to 2.0	–
BFR106	SOT23	5	50	0.04 to 2.0	–
BFR106	SOT23	5	70	0.04 to 2.0	–
BFR106	SOT23	10	15	0.04 to 2.0	–
BFR106	SOT23	10	30	0.04 to 2.0	–
BFR505	SOT23	3	0.5	0.04 to 3.0	–
BFR505	SOT23	3	1.25	0.04 to 3.0	0.9-2.0
BFR505	SOT23	3	2.5	0.04 to 3.0	0.9-2.0
BFR505	SOT23	3	3.75	0.04 to 3.0	0.9-2.0
BFR505	SOT23	3	5	0.04 to 3.0	0.9-2.0
BFR505	SOT23	3	7.5	0.04 to 3.0	–
BFR505	SOT23	6	0.5	0.04 to 3.0	–
BFR505	SOT23	6	1.25	0.04 to 3.0	0.9-2.0
BFR505	SOT23	6	2.5	0.04 to 3.0	0.9-2.0
BFR505	SOT23	6	3.75	0.04 to 3.0	0.9-2.0
BFR505	SOT23	6	5	0.04 to 3.0	0.9-2.0
BFR505	SOT23	6	7.5	0.04 to 3.0	–
BFR520	SOT23	3	2	0.04 to 3.0	–
BFR520	SOT23	3	5	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	3	10	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	3	15	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	3	20	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	3	30	0.04 to 3.0	–
BFR520	SOT23	6	2	0.04 to 3.0	–
BFR520	SOT23	6	5	0.04 to 3.0	0.5 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFR520	SOT23	6	10	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	6	15	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	6	20	0.04 to 3.0	0.5 to 2.0
BFR520	SOT23	6	30	0.04 to 3.0	–
BFR540	SOT23	4	4	0.04 to 3.0	–
BFR540	SOT23	4	10	0.04 to 3.0	0.9-2.0
BFR540	SOT23	4	20	0.04 to 3.0	0.9-2.0
BFR540	SOT23	4	30	0.04 to 3.0	0.9-2.0
BFR540	SOT23	4	40	0.04 to 3.0	0.9-2.0
BFR540	SOT23	4	50	0.04 to 3.0	–
BFR540	SOT23	8	4	0.04 to 3.0	–
BFR540	SOT23	8	10	0.04 to 3.0	0.9-2.0
BFR540	SOT23	8	20	0.04 to 3.0	0.9-2.0
BFR540	SOT23	8	30	0.04 to 3.0	0.9-2.0
BFR540	SOT23	8	40	0.04 to 3.0	0.9-2.0
BFR540	SOT23	8	50	0.04 to 3.0	–
BFR92A	SOT23	5	2	0.04 to 3.0	–
BFR92A	SOT23	5	5	0.04 to 3.0	–
BFR92A	SOT23	5	10	0.04 to 3.0	–
BFR92A	SOT23	5	15	0.04 to 3.0	–
BFR92A	SOT23	5	20	0.04 to 3.0	–
BFR92A	SOT23	10	2	0.04 to 3.0	–
BFR92A	SOT23	10	5	0.04 to 3.0	–
BFR92A	SOT23	10	10	0.04 to 3.0	–
BFR92A	SOT23	10	15	0.04 to 3.0	–
BFR92A	SOT23	10	20	0.04 to 3.0	–
BFR92AW	SOT323	5	2	0.04 to 3.0	–
BFR92AW	SOT323	5	5	0.04 to 3.0	–
BFR92AW	SOT323	5	10	0.04 to 3.0	–
BFR92AW	SOT323	5	15	0.04 to 3.0	–
BFR92AW	SOT323	5	20	0.04 to 3.0	–
BFR92AW	SOT323	10	2	0.04 to 3.0	–
BFR92AW	SOT323	10	5	0.04 to 3.0	–
BFR92AW	SOT323	10	10	0.04 to 3.0	–
BFR92AW	SOT323	10	15	0.04 to 3.0	–
BFR92AW	SOT323	10	20	0.04 to 3.0	–
BFR93A	SOT23	5	5	0.04 to 3.0	–
BFR93A	SOT23	5	10	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFR93A	SOT23	5	20	0.04 to 3.0	–
BFR93A	SOT23	5	30	0.04 to 3.0	–
BFR93A	SOT23	8	5	0.04 to 3.0	–
BFR93A	SOT23	8	10	0.04 to 3.0	–
BFR93A	SOT23	8	20	0.04 to 3.0	–
BFR93A	SOT23	8	30	0.04 to 3.0	–
BFR93AW	SOT323	5	5	0.04 to 3.0	0.5 to 2.0
BFR93AW	SOT323	5	10	0.04 to 3.0	0.5 to 2.0
BFR93AW	SOT323	5	20	0.04 to 3.0	–
BFR93AW	SOT323	5	30	0.04 to 3.0	0.5 to 2.0
BFR93AW	SOT323	8	5	0.04 to 3.0	0.5 to 2.0
BFR93AW	SOT323	8	10	0.04 to 3.0	0.5 to 2.0
BFR93AW	SOT323	8	20	0.04 to 3.0	–
BFR93AW	SOT323	8	30	0.04 to 3.0	0.5 to 2.0
BFS17	SOT23	5	2	0.04 to 2.0	–
BFS17	SOT23	5	5	0.04 to 2.0	–
BFS17	SOT23	5	10	0.04 to 2.0	–
BFS17	SOT23	5	15	0.04 to 2.0	–
BFS17	SOT23	5	20	0.04 to 2.0	–
BFS17	SOT23	10	2	0.04 to 2.0	–
BFS17	SOT23	10	5	0.04 to 2.0	–
BFS17	SOT23	10	10	0.04 to 2.0	–
BFS17	SOT23	10	15	0.04 to 2.0	–
BFS17	SOT23	10	20	0.04 to 2.0	–
BFS17A	SOT23	5	2	0.04 to 2.0	–
BFS17A	SOT23	5	5	0.04 to 2.0	–
BFS17A	SOT23	5	10	0.04 to 2.0	–
BFS17A	SOT23	5	15	0.04 to 2.0	–
BFS17A	SOT23	5	20	0.04 to 2.0	–
BFS17A	SOT23	10	2	0.04 to 2.0	–
BFS17A	SOT23	10	5	0.04 to 2.0	–
BFS17A	SOT23	10	10	0.04 to 2.0	–
BFS17A	SOT23	10	15	0.04 to 2.0	–
BFS17A	SOT23	10	20	0.04 to 2.0	–
BFS17W	SOT323	5	2	0.04 to 3.0	–
BFS17W	SOT323	5	5	0.04 to 3.0	–
BFS17W	SOT323	5	10	0.04 to 3.0	–
BFS17W	SOT323	5	15	0.04 to 3.0	–

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFS17W	SOT323	5	20	0.04 to 3.0	–
BFS17W	SOT323	10	2	0.04 to 3.0	–
BFS17W	SOT323	10	5	0.04 to 3.0	–
BFS17W	SOT323	10	10	0.04 to 3.0	–
BFS17W	SOT323	10	15	0.04 to 3.0	–
BFS17W	SOT323	10	20	0.04 to 3.0	–
BFS25A	SOT323	1	0.1	0.04 to 3.0	–
BFS25A	SOT323	1	0.25	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	1	0.5	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	1	1	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	1	2	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	3	0.1	0.04 to 3.0	–
BFS25A	SOT323	3	0.25	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	3	0.5	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	3	1	0.04 to 3.0	0.5 to 2.0
BFS25A	SOT323	3	2	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	3	0.5	0.04 to 3.0	–
BFS505	SOT323	3	1.25	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	3	2.5	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	3	3.75	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	3	5	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	3	7.5	0.04 to 3.0	–
BFS505	SOT323	6	0.5	0.04 to 3.0	–
BFS505	SOT323	6	1.25	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	6	2.5	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	6	3.75	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	6	5	0.04 to 3.0	0.5 to 2.0
BFS505	SOT323	6	7.5	0.04 to 3.0	–
BFS520	SOT323	3	2	0.04 to 3.0	–
BFS520	SOT323	3	5	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	3	10	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	3	15	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	3	20	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	3	30	0.04 to 3.0	–
BFS520	SOT323	6	2	0.04 to 3.0	–
BFS520	SOT323	6	5	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	6	10	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	6	15	0.04 to 3.0	0.5 to 2.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFS520	SOT323	6	20	0.04 to 3.0	0.5 to 2.0
BFS520	SOT323	6	30	0.04 to 3.0	–
BFS540	SOT323	4	4	0.04 to 3.0	–
BFS540	SOT323	4	10	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	4	20	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	4	30	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	4	40	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	4	50	0.04 to 3.0	–
BFS540	SOT323	8	4	0.04 to 3.0	–
BFS540	SOT323	8	10	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	8	20	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	8	30	0.04 to 3.0	0.5 to 2.0
BFS540	SOT323	8	40	0.04 to 3.0	0.5 to 2.0
BFT25	SOT23	1	0.1	0.04 to 3.0	–
BFT25	SOT23	1	0.2	0.04 to 3.0	–
BFT25	SOT23	1	0.5	0.04 to 3.0	–
BFT25	SOT23	1	1	0.04 to 3.0	–
BFT25A	SOT23	1	0.1	0.04 to 3.0	–
BFT25A	SOT23	1	0.25	0.04 to 3.0	–
BFT25A	SOT23	1	0.5	0.04 to 3.0	–
BFT25A	SOT23	1	1	0.04 to 3.0	–
BFT25A	SOT23	1	2	0.04 to 3.0	–
BFT25A	SOT23	3	0.1	0.04 to 3.0	–
BFT25A	SOT23	3	0.25	0.04 to 3.0	–
BFT25A	SOT23	3	0.5	0.04 to 3.0	–
BFT25A	SOT23	3	1	0.04 to 3.0	–
BFT25A	SOT23	3	2	0.04 to 3.0	–
BFT92	SOT23	–5	–2	0.04 to 3.0	–
BFT92	SOT23	–5	–5	0.04 to 3.0	–
BFT92	SOT23	–5	–10	0.04 to 3.0	–
BFT92	SOT23	–5	–15	0.04 to 3.0	–
BFT92	SOT23	–5	–20	0.04 to 3.0	–
BFT92	SOT23	–10	–2	0.04 to 3.0	–
BFT92	SOT23	–10	–5	0.04 to 3.0	–
BFT92	SOT23	–10	–10	0.04 to 3.0	–
BFT92	SOT23	–10	–15	0.04 to 3.0	–
BFT92	SOT23	–10	–20	0.04 to 3.0	–
BFT92W	SOT323	–5	–2	0.04 to 3.0	0.5 to 1.0

PART #	PACKAGE	BIAS CONDITION		SCATTERING PARAMETERS	NOISE PARAMETERS
		V_{CE} (V)	I_C (mA)	f (GHz)	f (GHz)
BFT92W	SOT323	–5	–5	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–5	–10	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–5	–15	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–5	–20	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–10	–2	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–10	–5	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–10	–10	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–10	–15	0.04 to 3.0	0.5 to 1.0
BFT92W	SOT323	–10	–20	0.04 to 3.0	0.5 to 1.0
BFT93	SOT23	–5	–5	0.04 to 3.0	–
BFT93	SOT23	–5	–10	0.04 to 3.0	–
BFT93	SOT23	–5	–20	0.04 to 3.0	–
BFT93	SOT23	–5	–30	0.04 to 3.0	–
BFT93	SOT23	–10	–5	0.04 to 3.0	–
BFT93	SOT23	–10	–10	0.04 to 3.0	–
BFT93	SOT23	–10	–20	0.04 to 3.0	–
BFT93	SOT23	–10	–30	0.04 to 3.0	–
BFT93W	SOT323	–5	–5	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–5	–10	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–5	–20	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–5	–30	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–10	–5	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–10	–10	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–10	–20	0.04 to 3.0	0.5 to 1.0
BFT93W	SOT323	–10	–30	0.04 to 3.0	0.5 to 1.0
MPSH10	SOT54	10	5	0.04 to 1.0	–
MPSH10	SOT54	10	10	0.04 to 1.0	–
MPSH10	SOT54	10	20	0.04 to 1.0	–
PMBTH10	SOT23	10	5	0.04 to 1.0	–
PMBTH10	SOT23	10	10	0.04 to 1.0	–
PMBTH10	SOT23	10	30	0.04 to 1.0	–
PMBTH81	SOT23	–10	–5	0.04 to 1.0	–
PMBTH81	SOT23	–10	–10	0.04 to 1.0	–
PMBTH81	SOT23	–10	–20	0.04 to 1.0	–

SPICE AND PACKAGE PARAMETERS

INTRODUCTION

Spice and package parameters for time domain simulators such as MICROWAVE SPICE®, HSPICE®, PSPICE® and for harmonic balance simulators such as LIBRA®, jOMEGA® and MDS® are available for most of Philips Semiconductors products. This data is available on a diskette which is included with this book and can be found inside the rear cover. To make the data easily accessible it is available as a separate spice model for the die, as a model to simulate the package parasitics and as a subcircuit that combines both the package and die model per transistor type into one easy-to-use spice model.

On the diskette you will find the selection program that will run under the Windows Operating System. The selection program provides a quick and easy to use path to find the correct data files.
If you have any questions regarding the S-parameter data please contact your local Philips Semiconductors sales representative.

TOUCHSTONE®, LIBRA®, MDS®, MICROWAVE SPICE®, HSPICE®, PSPICE® and jOMEGA® are registered trademarks by EEsof Inc., Hewlett Packard Inc., Compact Software Inc., MicroSim Inc. and META Software Inc..

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

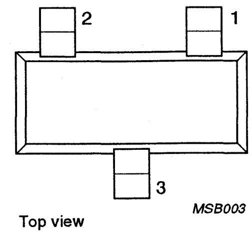
- It is intended for VHF and UHF TV-tuner applications
- Can be used as a mixer and/or oscillator.

DESCRIPTION

Low cost NPN transistor in a plastic SOT23 package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: E16.

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
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 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		–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 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	$I_E = 0$; $V_{CB} = 10$ 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.

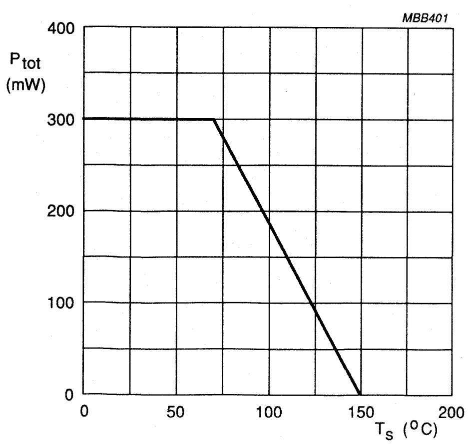
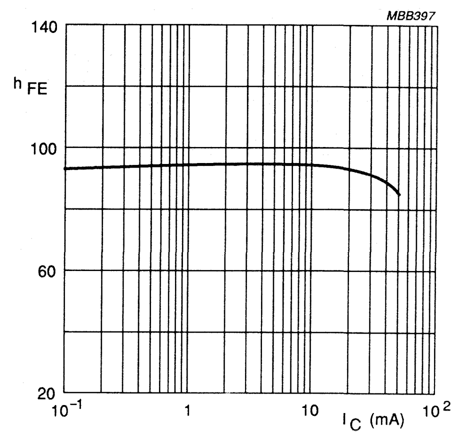
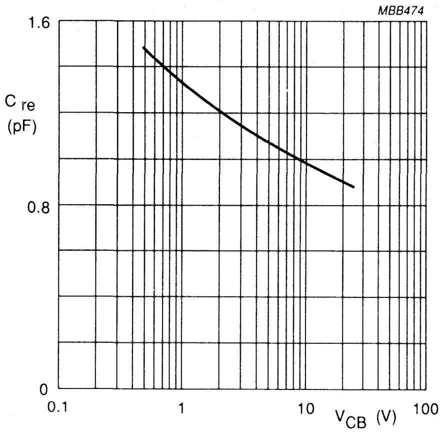


Fig.2 Power derating curve.



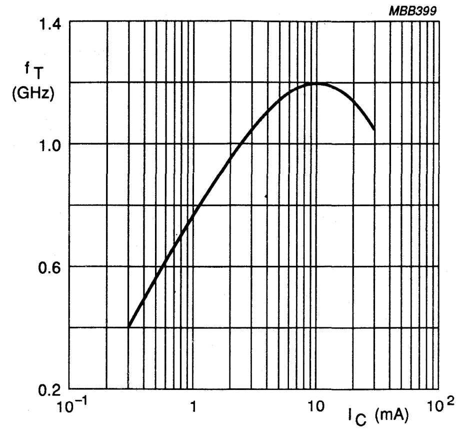
$V_{CE} = 10$ V.

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



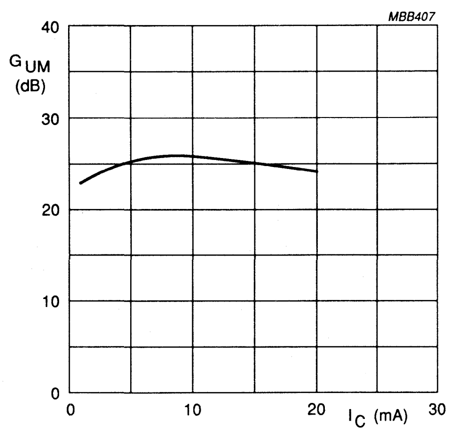
$I_E = i_e = 0$; f = 1 MHz.

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



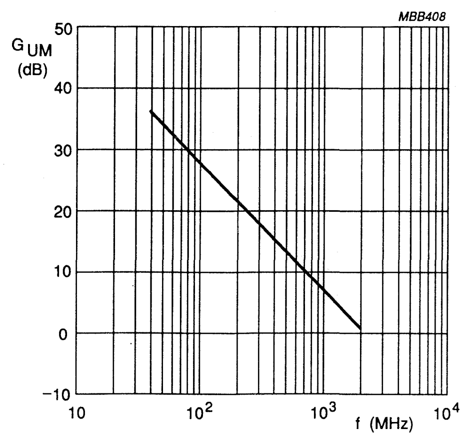
V_{CE} = 10 V; f = 500 MHz.

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



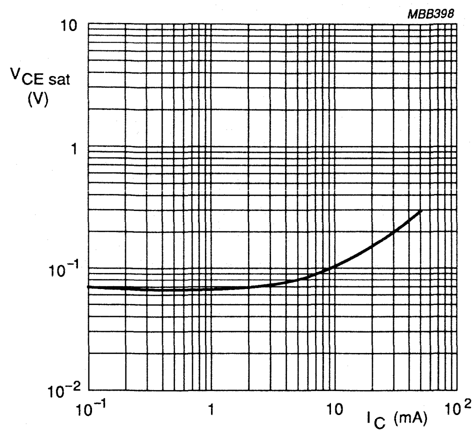
V_{CE} = 10 V; f = 100 MHz.

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



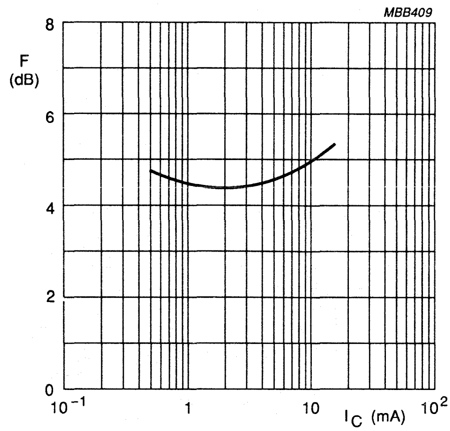
V_{CE} = 10 V; I_C = 15 mA.

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



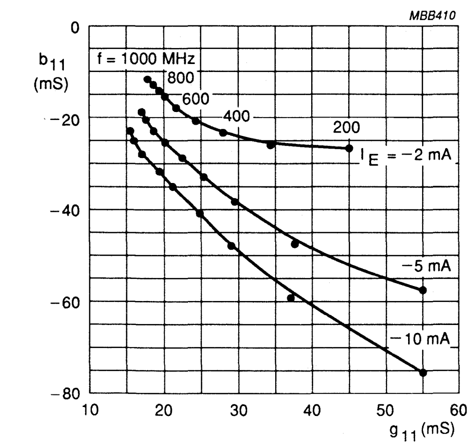
$I_C/I_B = 10$.

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



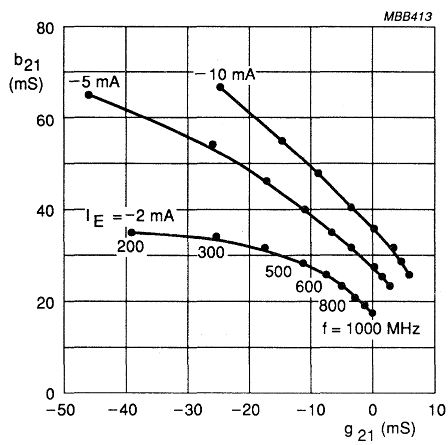
$V_{CE} = 10$ V; $Z_S = Z_L = 50\ \Omega$; f = 100 MHz.

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



$V_{CB} = 10$ V.

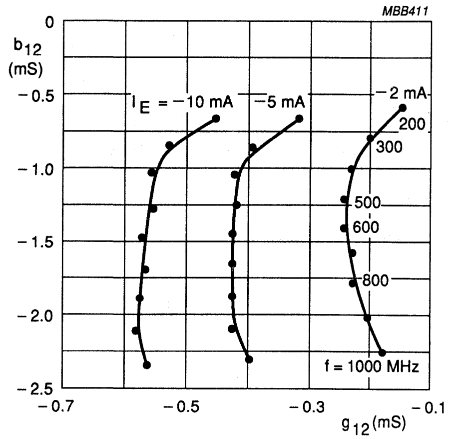
Fig.10 Common base input admittance (Y_{11}).



$V_{CB} = 10$ V.

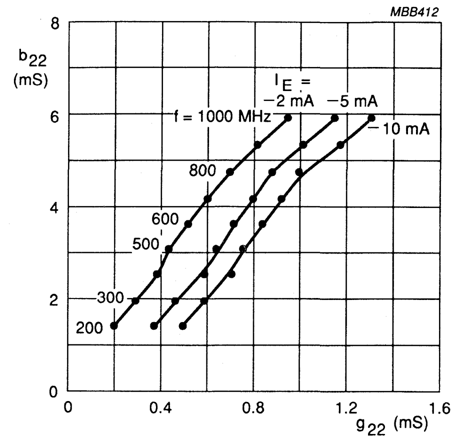
Fig.11 Common base forward admittance (Y_{21}).

NPN 1 GHz wideband transistor BF547



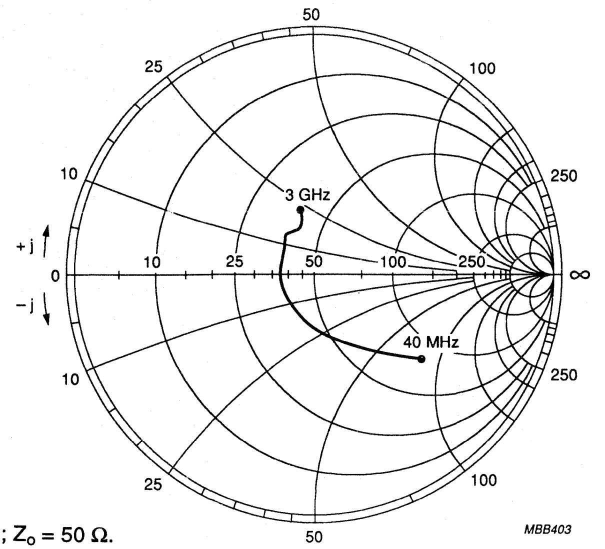
V_{CB} = 10 V.

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



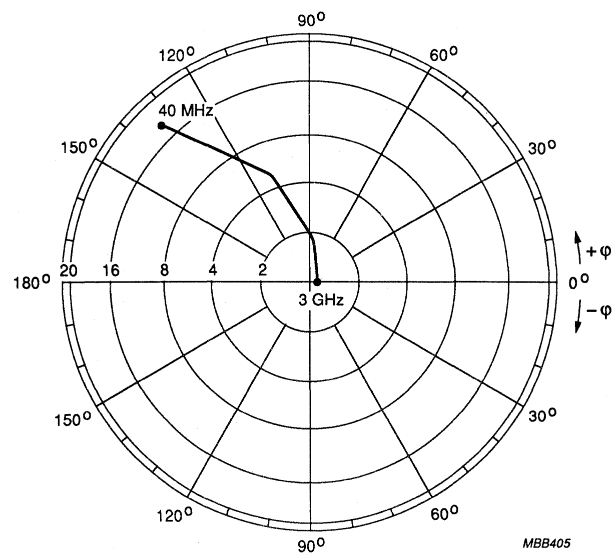
V_{CB} = 10 V.

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



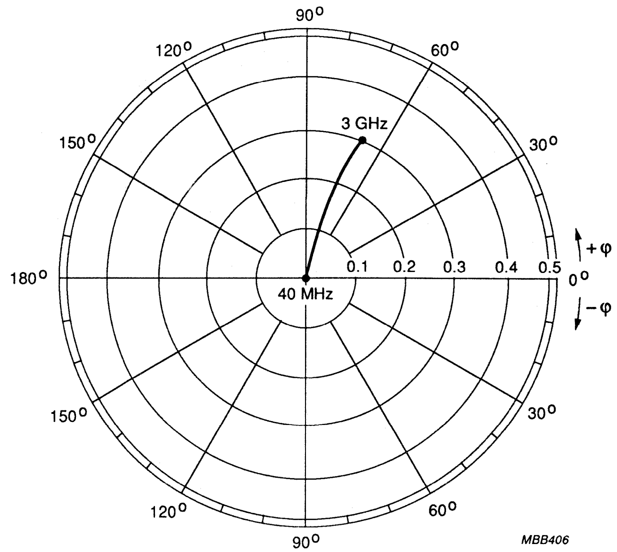
V_{CE} = 10 V; I_C = 15 mA.; Z_o = 50 Ω.

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



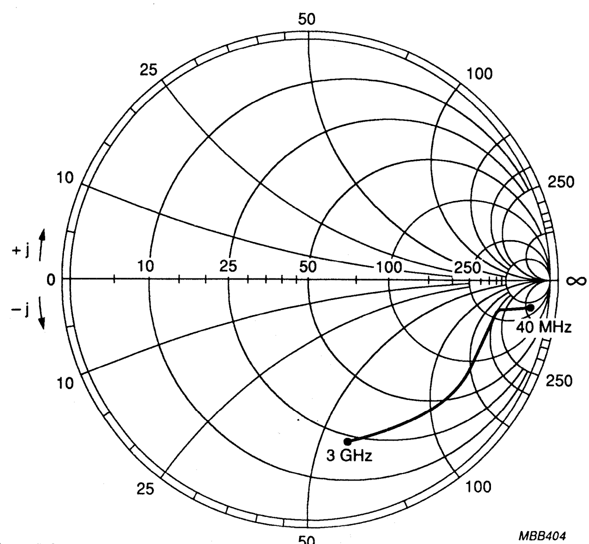
V_{CE} = 10 V; I_C = 15 mA.

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

NPN 1 GHz wideband transistor BF547

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

f (MHz)	Y_{11} REAL (mS)	Y_{11} IMAG. (mS)	Y_{21} REAL (mS)	Y_{21} IMAG. (mS)	Y_{12} REAL (mS)	Y_{12} IMAG. (mS)	Y_{22} REAL (mS)	Y_{22} 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} REAL (mS)	Y_{11} IMAG. (mS)	Y_{21} REAL (mS)	Y_{21} IMAG. (mS)	Y_{12} REAL (mS)	Y_{12} IMAG. (mS)	Y_{22} REAL (mS)	Y_{22} 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

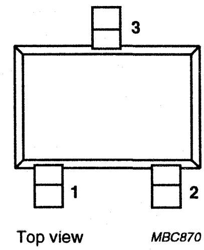
It is primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners.

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.

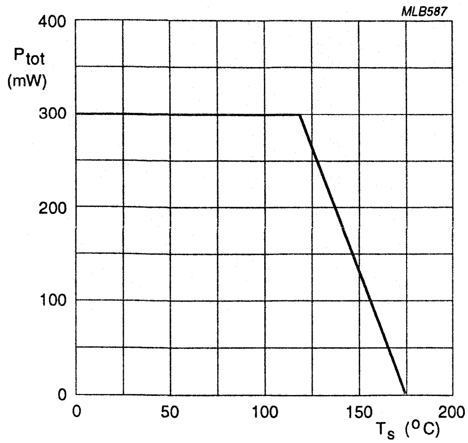
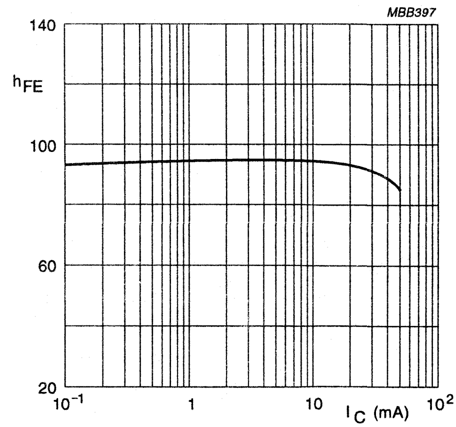
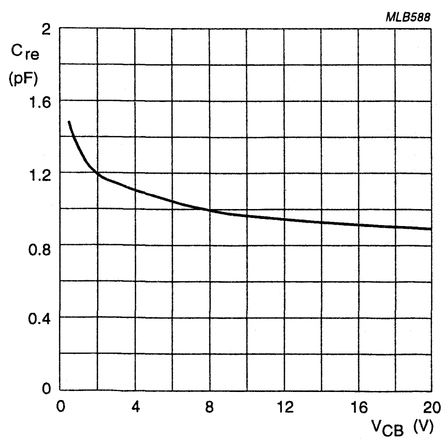


Fig.2 Power derating curve.



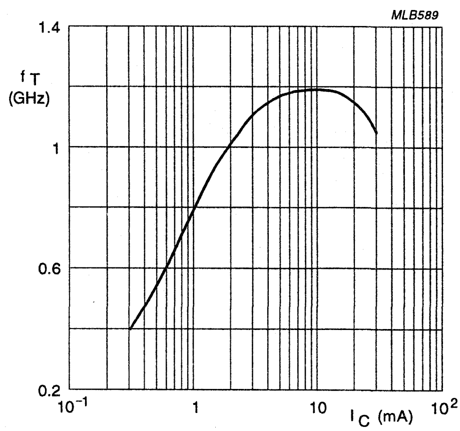
V_{CE} = 10 V; T_j = 25 °C.

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



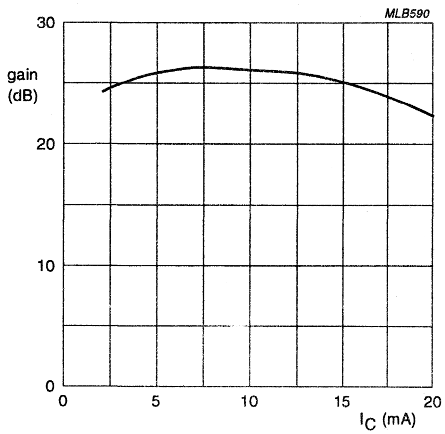
I_C = 0; f = 1 MHz.

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



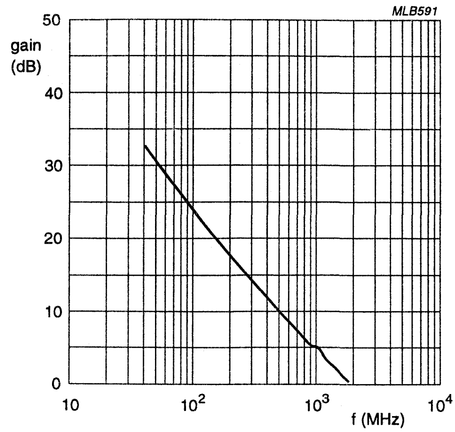
V_{CE} = 10 V; f = 500 MHz.

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



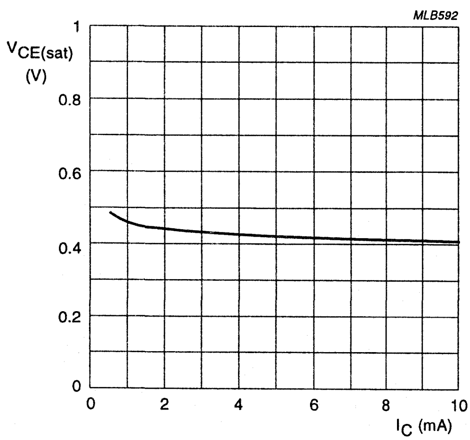
V_{CE} = 10 V; f = 100 MHz.

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



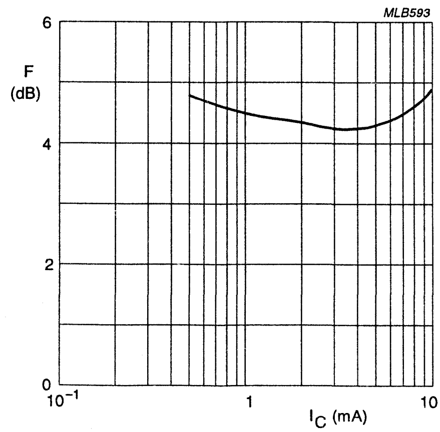
V_{CE} = 10 V; I_C = 15 mA.

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



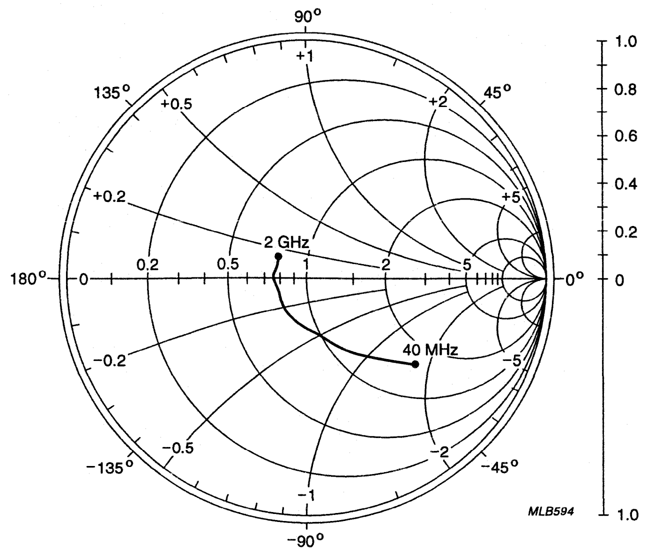
I_C/I_B = 10.

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



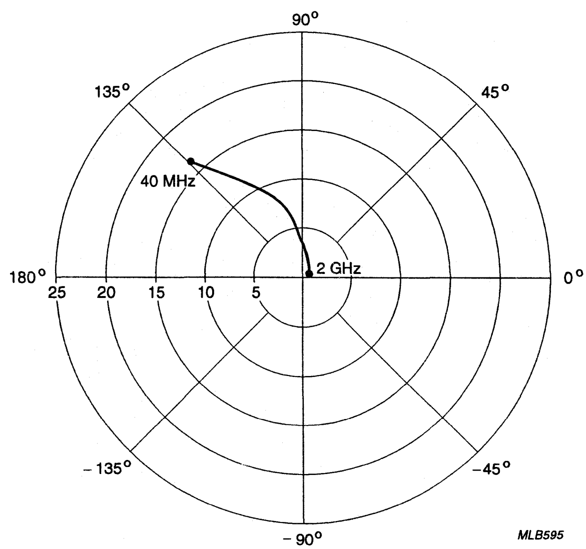
V_{CE} = 10 V; Z_S = Z_L = 50 Ω; f = 100 MHz.

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.

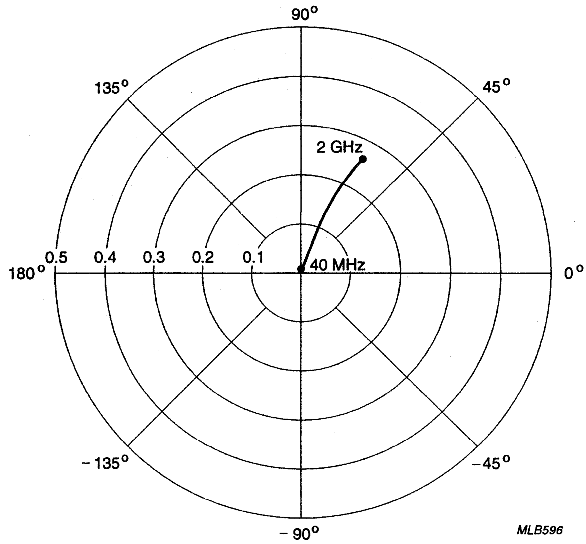
Fig.10 Common emitter input reflection coefficient (s_{11}); typical values.



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

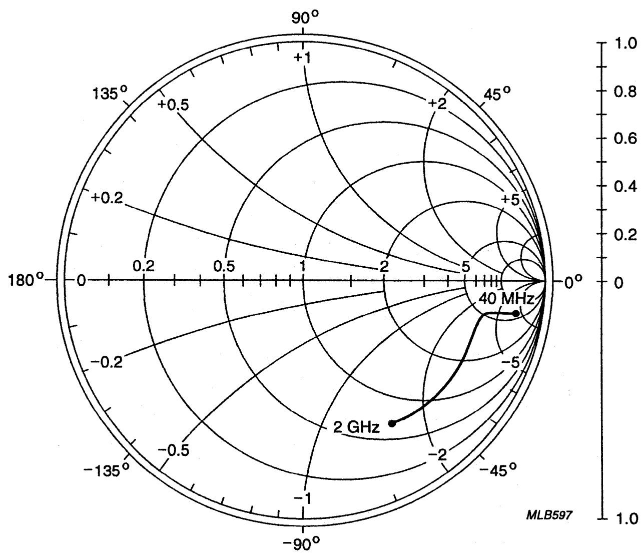
Fig.11 Common emitter forward transmission coefficient (s_{21}); typical values.

# NPN 1 GHz wideband transistor	BF547W



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.

NPN 2 GHz wideband transistor | BF689K

DESCRIPTION

NPN transistor in a plastic SOT54 (TO-92 variant) envelope. It is intended for application as an amplifier or oscillator in the VHF and UHF range.

PINNING

PIN	DESCRIPTION
	Code: F689
1	emitter
2	base
3	collector

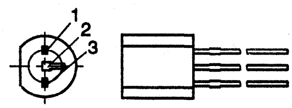


Fig.1 SOT54.

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		–	–	25	mA
P_{tot}	total power dissipation	up to T_{amb} = 60 °C	–	–	360	mW
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V; T_j = 25 °C	20	–	–	
		I_C = 20 mA; V_{CE} = 5 V; T_j = 25 °C	35	–	–	
f_T	transition frequency	I_C = 15 mA; V_{CE} = 5 V; f = 500 MHz	–	1.8	–	GHz

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_{CER}	collector-emitter voltage	$R_{BE} \leq 50\ \Omega$	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current	$t_p < 1\ \mu s$	–	50	mA
P_{tot}	total power dissipation	up to T_{amb}= 60 °C	–	360	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	250 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	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 2$ V	–	–	1	μA
$V_{CE\ sat}$	collector-emitter saturation voltage	$I_C = 25$ mA; $I_B = 1.25$ mA	–	–	1.0	V
$V_{BE\ sat}$	base-emitter saturation voltage	$I_C = 25$ mA; $I_B = 1.25$ mA	–	–	1.0	V
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	20	–	–	
		$I_C = 20$ mA; $V_{CE} = 5$ V	35	–	–	
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	1.8	–	GHz
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	1.1	–	pF
G_p	power gain	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 100 MHz; $T_{amb} = 25$ °C; $Z_S = 60\ \Omega$; $R_L = 2\ k\Omega$	–	16	–	dB
		$I_C = 2$ mA; $V_{CE} = 5$ V; f = 200 MHz; $T_{amb} = 25$ °C; $Z_S = 60\ \Omega$; $R_L = 920\ \Omega$	–	16	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 100 MHz; $T_{amb} = 25$ °C; $Z_S = 60\ \Omega$	–	4	–	dB
		$I_C = 2$ mA; $V_{CE} = 5$ V; f = 200 MHz; $T_{amb} = 25$ °C; $Z_S = 60\ \Omega$	–	3	–	dB

NPN 1 GHz wideband transistor | BF747

FEATURES

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

DESCRIPTION

Low cost NPN transistor in a plastic SOT23 envelope.

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

PINNING

PIN	DESCRIPTION
Code: E15	
1	base
2	emitter
3	collector

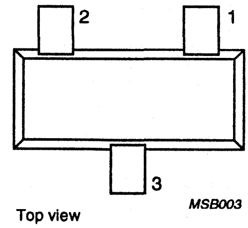


Fig.1 SOT23.

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

LIMITING VALUES

In accordance with the Absolute Maximum 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 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)	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	–	–	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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.

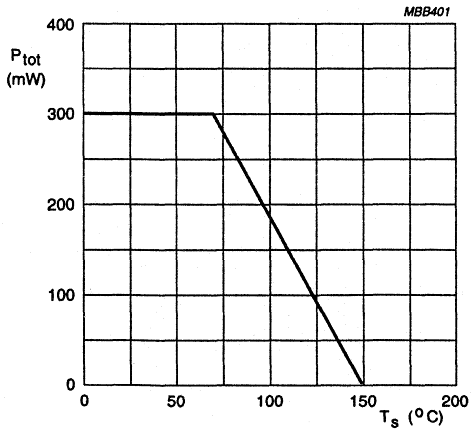
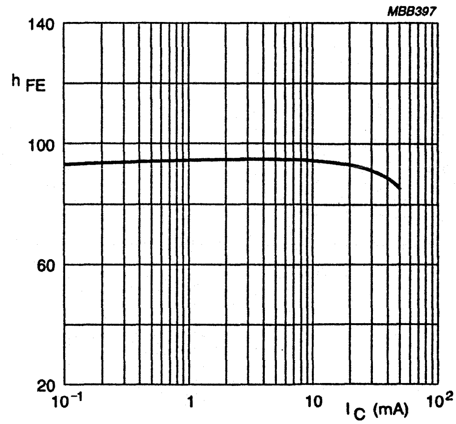
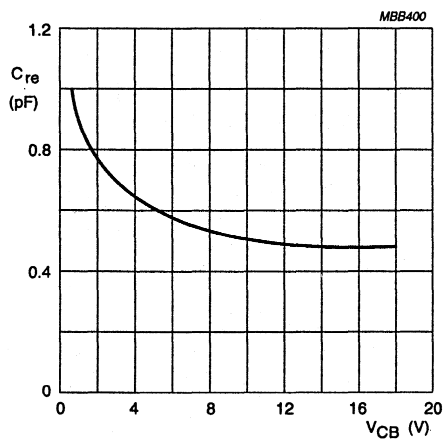


Fig.2 Power derating curve.



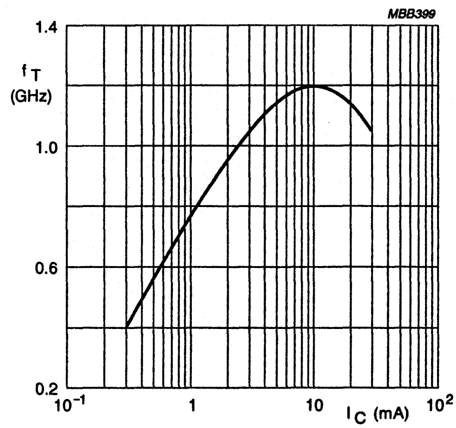
V_{CE} = 10 V.

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



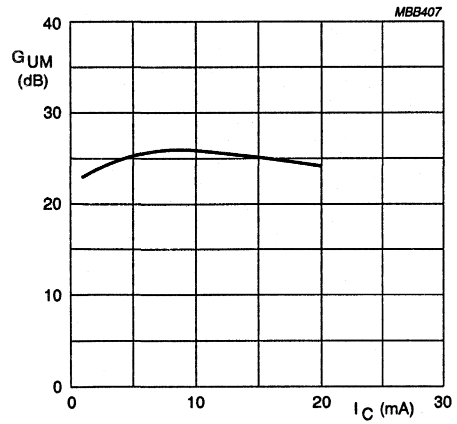
$I_E = i_e = 0$; f = 1 MHz.

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



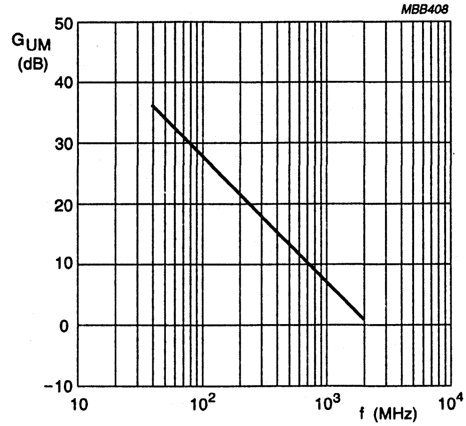
V_{CE} = 10 V; f = 500 MHz.

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



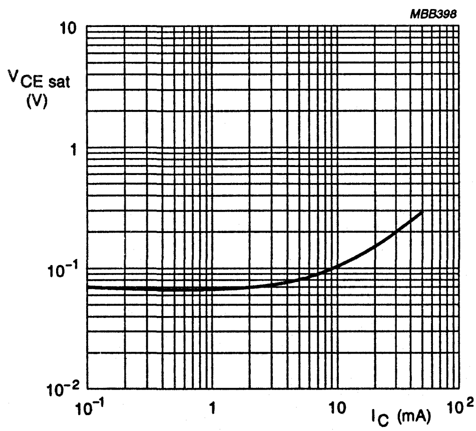
V_{CE} = 10 V; f = 100 MHz.

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



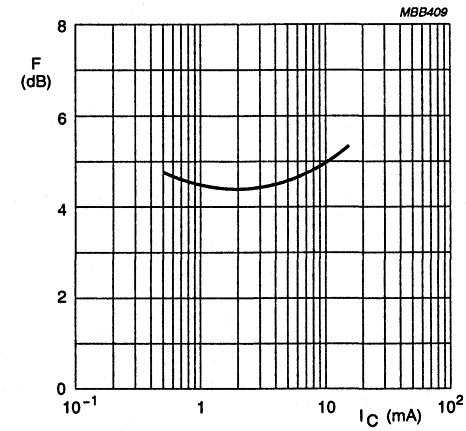
I_C = 15 mA; V_{CE} = 10 V.

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



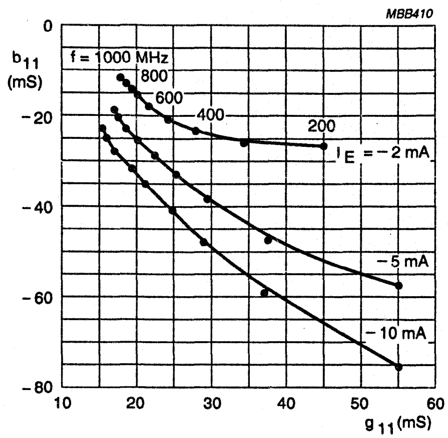
I_C/I_B = 10.

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



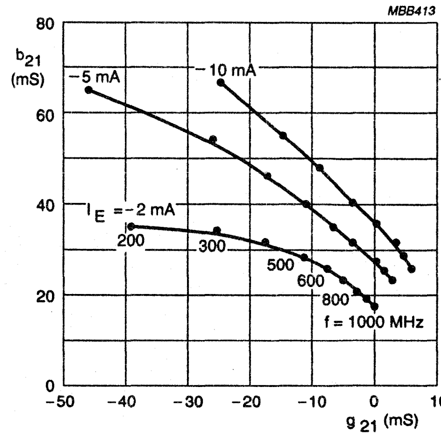
V_{CE} = 10 V; f = 100 MHz; $Z_S = Z_L$ = 50 Ω

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



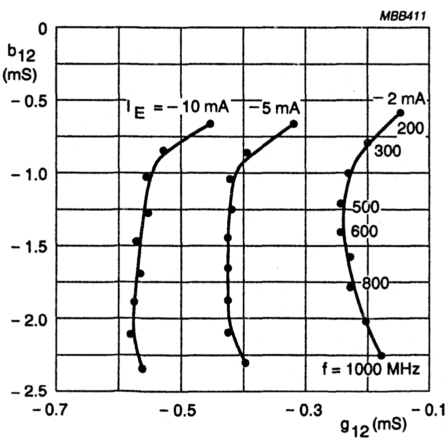
V_{CB} = 10 V.

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



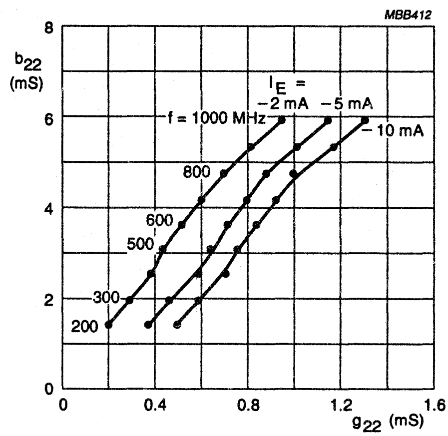
V_{CB} = 10 V.

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



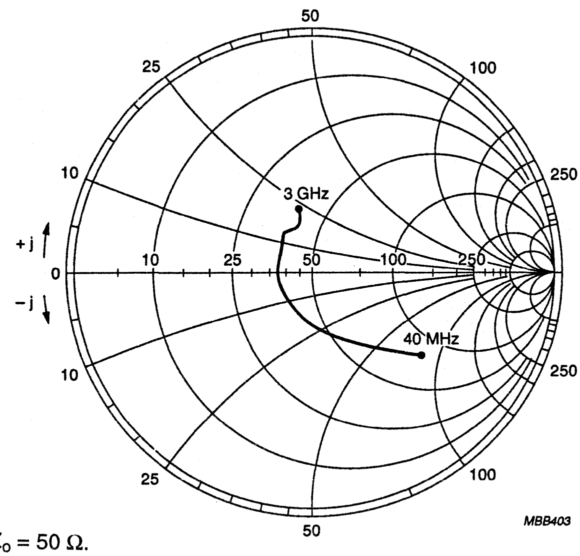
V_{CB} = 10 V.

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



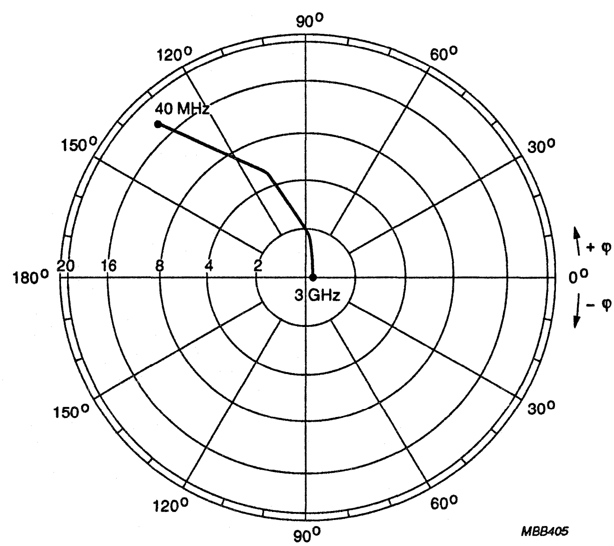
V_{CB} = 10 V.

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



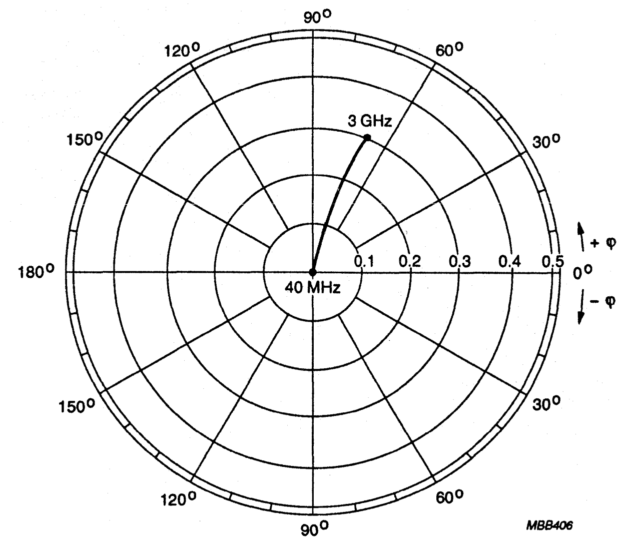
I_C = 15 mA; V_{CE} = 10 V ; Z_o = 50 Ω.

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



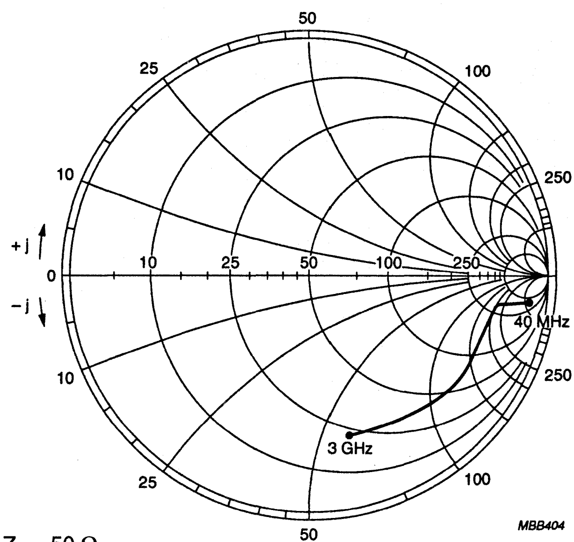
I_C = 15 mA; V_{CE} = 10 V.

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 2 GHz wideband transistor | BF763

DESCRIPTION

NPN transistor in a plastic SOT54 (TO-92 variant) envelope.

It is primarily intended for use in RF amplifiers and oscillators.

PINNING

PIN	DESCRIPTION
Code: F763	
1	emitter
2	base
3	collector

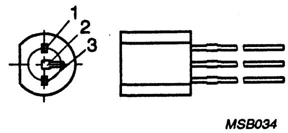


Fig.1 SOT54.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base	15	–	–	V
I_C	DC collector current		–	–	25	mA
P_{tot}	total power dissipation	up to T_{amb} = 60 °C	–	–	360	mW
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V; T_j = 25 °C	25	–	250	
f_T	transition frequency	I_C = 5 mA; V_{CE} = 10 V; f = 100 MHz	–	1.8	–	GHz

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	–	25	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_{amb} = 60 °C	–	360	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	250 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0	15	–	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 10 μA; I_E = 0	25	–	–	V
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	–	0.5	V
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V	25	–	250	
f_T	transition frequency	I_C = 5 mA; V_{CE} = 10 V; f = 100 MHz	–	1.8	–	GHz
F	noise figure	I_C = 5 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C; Z_S = 60 Ω	–	5.0	–	dB

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 crystals 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

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

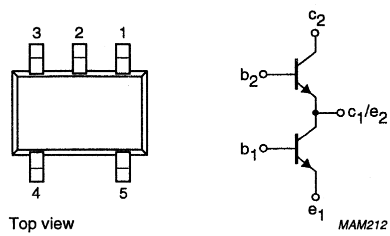


Fig.1 SOT353.

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
$\left\|s_{21}/s_{12}\right\|^2$	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	–	20	–	dB
F	noise figure	I_C = 0.25 mA; f = 300 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.5	dB
		I_C = 1 mA; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.6	1.8	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 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 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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	
AC characteristics of the cascode configuration						
f_T	transition frequency	I_C = 5 mA; V_{C2-E1} = 3 V; f = 1 GHz	–	6	–	GHz
C_{cb}	collector capacitance	$I_E = i_e$ = 0; V_{C2-B2} = 0; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{C2-E1} = 3 V; f = 1 MHz	–	–	10	fF
MSG	maximum stable power gain; note 1	I_C = 0.25 mA; V_{C2-E1} = 1 V; f = 300 MHz; T_{amb} = 25 °C	–	20	–	dB
		I_C = 0.5 mA; V_{C2-E1} = 1 V; f = 900 MHz; T_{amb} = 25 °C	–	21	–	dB
		I_C = 5 mA; V_{C2-E1} = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	22	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 0.5 mA; V_{C2-E1} = 3 V; f = 300 MHz; T_{amb} = 25 °C	–	21	–	dB
		I_C =5 mA; V_{C2-E1} = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C =5 mA; V_{C2-E1} = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	10.5	–	dB
$\|s_{21}/s_{12}\|^2$	maximum isolation; note 2	I_C = 0.5 mA; V_{C2-E1} = 1 V; f = 900 MHz	40	–	–	dB
		I_C = 5 mA; V_{C2-E1} = 3 V; f = 900 MHz	60	–	–	dB
		I_C = 5 mA; V_{C2-E1} = 3 V; f = 2 GHz	40	–	–	dB
F	noise figure	I_C = 0.25 mA; V_{C2-E1} = 3 V; f = 300 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.5	dB
		I_C = 1 mA; V_{C2-E1} = 3 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.6	1.8	dB
		I_C = 3 mA; V_{C2-E1} = 3 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	2.4	2.6	dB
IP_3	third order intercept point (input)	note 3	–	–9	–	dBm

Notes

1. MSG = $\left|s_{12}/s_{21}\right| \times \left(k - \sqrt{k^2 - 1}\right)$; $k = \dfrac{1 + \left|s_{11} \times s_{22} - s_{12} \times s_{21}\right|^2 - \left(\left|s_{11}\right|^2 - \left|s_{22}\right|^2\right)}{2 \times \left|s_{12} \times s\sqrt{\ }_{21}\right|}$.
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; $R_S = R_L$ = 50 Ω; T_{amb} = 25 °C; f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 904 MHz.

NPN wideband cascode transistor BFC505

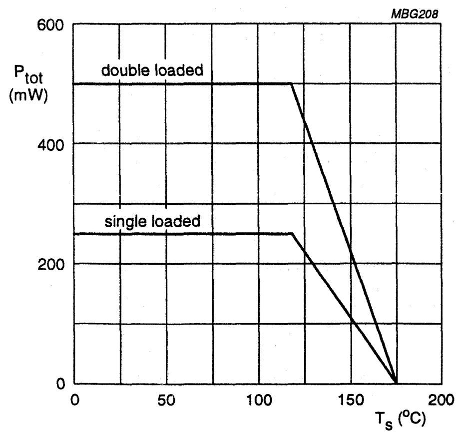
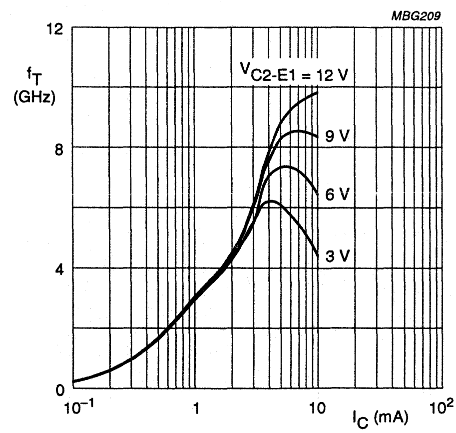
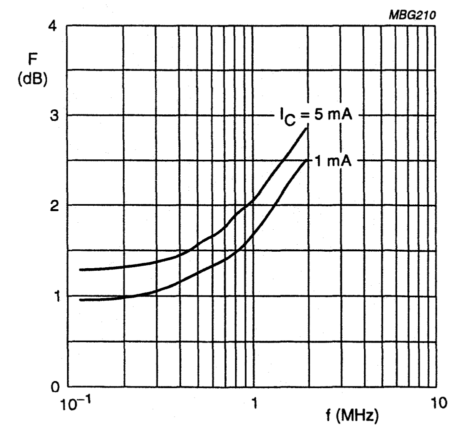


Fig.2 Power derating curves; typical values.



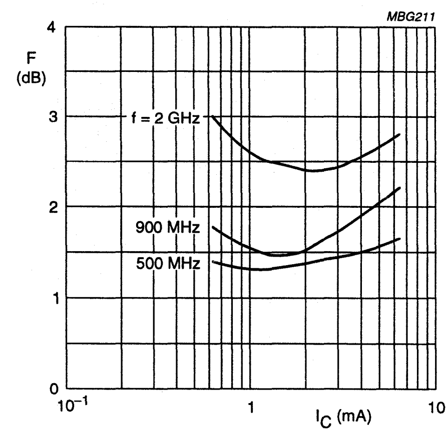
f = 1 GHz; T_{amb} = 25 °C.

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



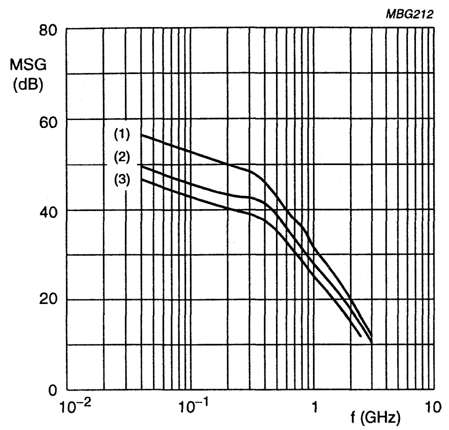
$V_{C2\text{-}E1}$ = 1 V.

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



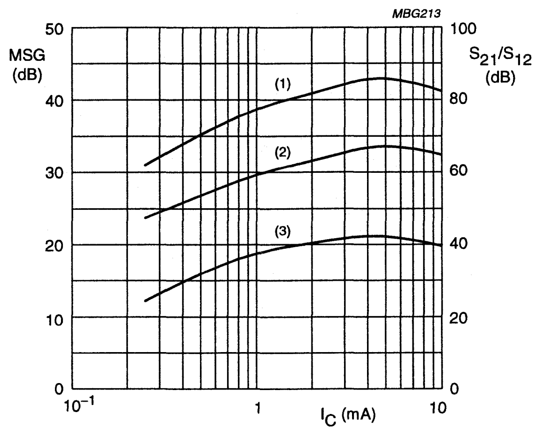
$V_{C2\text{-}E1}$ = 1 V.

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



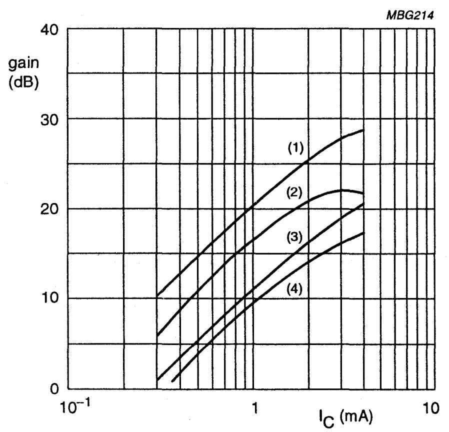
(1) I_C = 5 mA; V_{CE1} = 3 V.
(2) I_C = 1 mA; V_{CE1} = 1 V.
(3) I_C = 0.5 mA; V_{CE1} = 1 V.

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



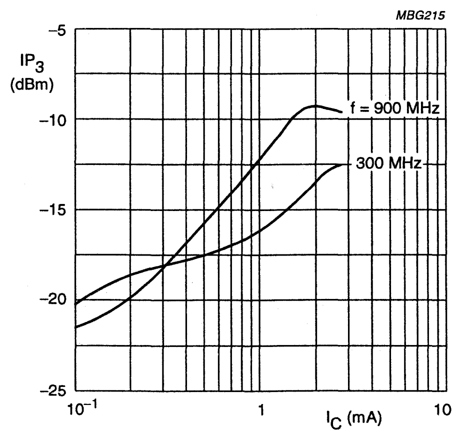
(1) V_{CE1} = 1 V; f = 500 MHz.
(2) V_{CE1} = 1 V; f = 900 MHz.
(3) V_{CE1} = 3 V; f = 2 GHz.

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



(1) V_C = 1 V; R_L = 470 Ω; f = 300 MHz.
(2) V_C = 1 V; R_L = 470 Ω; f = 900 MHz.
(3) V_C = 3 V; R_L = 50 Ω; f = 300 MHz.
(4) V_C = 3 V; R_L = 50 Ω; f = 900 MHz.

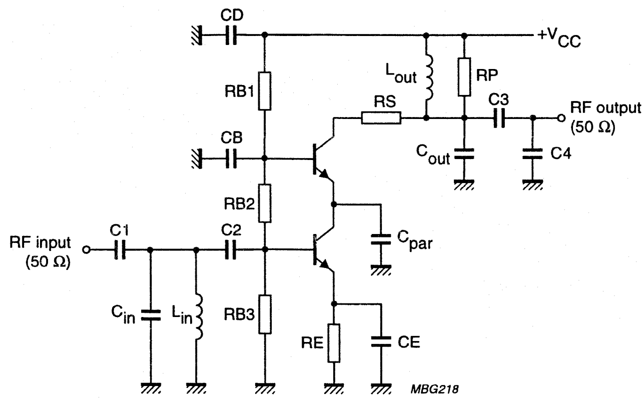
Fig.8 Insertion gain as a function of collector current; typical values.



V_C = 1 V; R_S = R_L = 50 Ω.

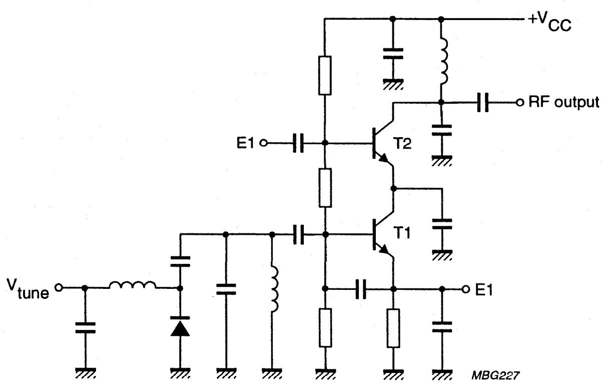
Fig.9 Third order intercept point (input) as a function of collector current; typical values.

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

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

DESCRIPTION

Cascode amplifier with two discrete crystals 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

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

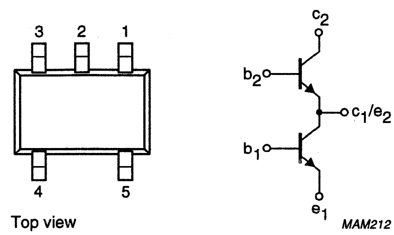


Fig.1 SOT353.

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	–	–67	–	dB
		f = 2 GHz	–	–38	–	dB
MSG	maximum stable power gain (narrowband)	f = 900 MHz	–	33	–	dB
		f = 2 GHz	–	19	–	dB
F	noise figure	f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.6	dB
		f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	2.4	2.7	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 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 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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 = 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	$I_E = i_e$ = 0; $V_{C2\text{-}B2}$ = 1 V; f = 1 MHz	–	0.55	–	pF
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	–	33	–	dB
		I_C = 20 mA; $V_{C2\text{-}E1}$ = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	19	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 20 mA; $V_{C2\text{-}E1}$ = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	19	–	dB
		I_C = 20 mA; $V_{C2\text{-}E1}$ = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	14	–	dB
$\|s_{21}/s_{12}\|^2$	maximum isolation; note 2	f = 900 MHz	–	67	–	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
		I_C = 5 mA; $V_{C2\text{-}E1}$ = 3 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	2.4	2.7	dB
IP_3	third order intercept point (input)	note 3	–	+3	–	dBm

Notes

1. $MSG = \left|s_{12}/s_{21}\right| \times \left(k - \sqrt{k^2 - 1}\right)$ $\quad k = \dfrac{1 + \left|s_{11} \times s_{22} - s_{12} \times s_{21}\right|^2 - \left(\left|s_{11}\right|^2 - \left|s_{22}\right|^2\right)}{2 \times \left|s_{12} \times s_{21}\right|}$
2. Maximum isolation is defined as the isolation when S_{21} of the amplifier is reduced to unity (buffer application).
3. I_C = 20 mA; V_{CE} = 3 V; $R_S = R_L$ = 50 Ω; T_{amb} = 25 °C; f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 904 MHz.

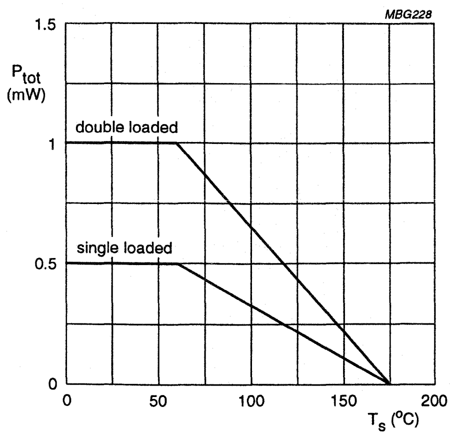
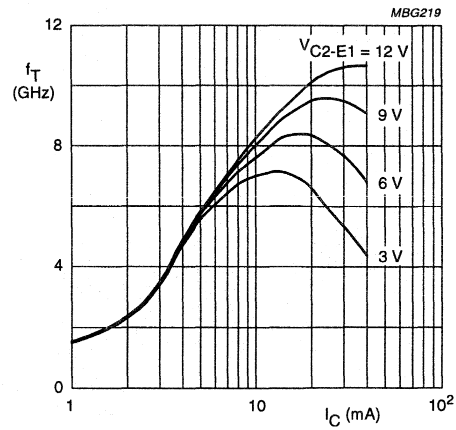
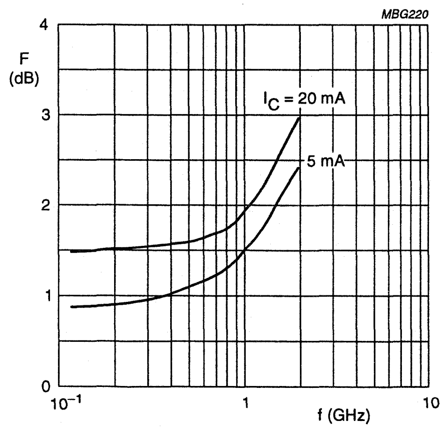


Fig.2 Power derating curves; typical values.



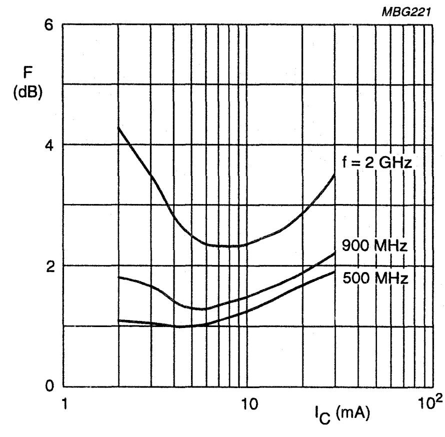
f = 1 GHz; T_{amb} = 25 °C.

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



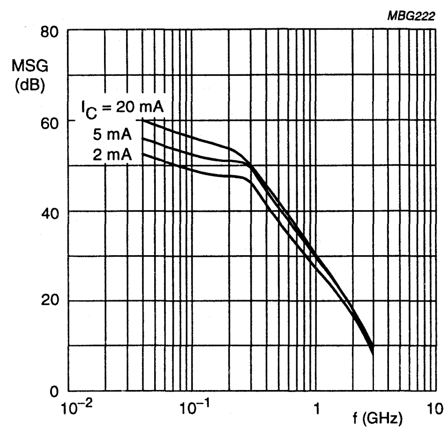
V_{C2-E1} = 3V.

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



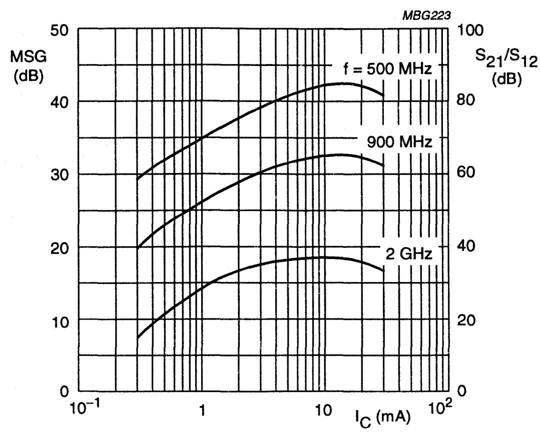
V_{C2-E1} = 3 V.

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



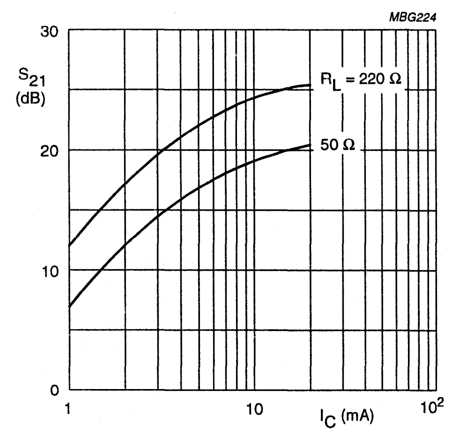
$V_{C2\text{-}E1}$ = 3 V.

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



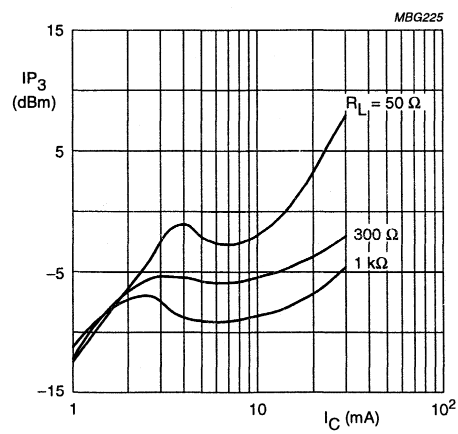
$V_{C2\text{-}E1}$ = 3 V.

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



$V_{C2\text{-}E1}$ = 3 V; R_S = 50 Ω; f = 900 MHz.

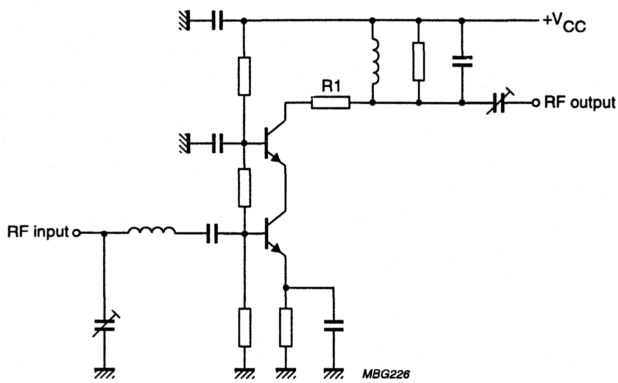
Fig.8 Insertion gain as a function of collector current; typical values.



$V_{C2\text{-}E1}$ = 3 V; Z_s = 50 Ω; f = 900 MHz.

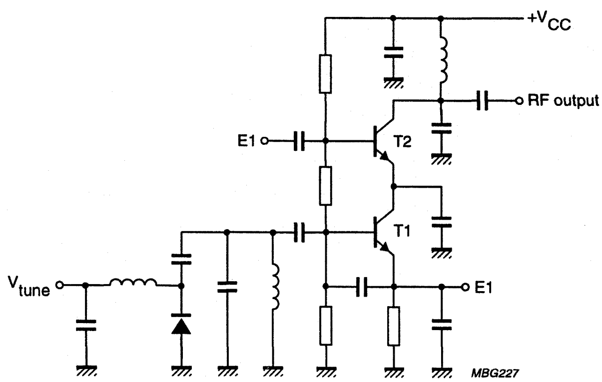
Fig.9 Third order intercept point (input) as a function of collector current; typical values.

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 cascode transistor | BFC540

FEATURES

- Small size
- High reverse isolation
- High linearity
- Low noise figure
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Wideband voltage-to-current converters
- High isolation power amplifier drivers
- Low noise, high gain amplifiers.

DESCRIPTION

Cascode amplifier with two discrete crystals in a surface mount, 5-pin SOT353 (S-mini) package. The amplifier is primarily intended for wideband applications, such as analog and digital cellular phones (CT1, CT2, DECT, etc.), radar detectors, satellite TV-tuners, MATV/CATV amplifiers and repeater amplifiers in fibre-optical systems.

PINNING

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

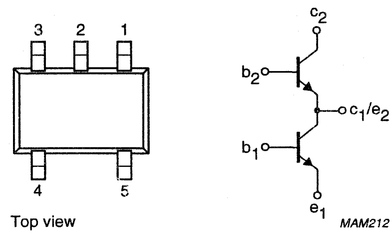


Fig.1 SOT353.

QUICK REFERENCE DATA

V_{C2-E1} = 12 V; I_C = 40 mA; V_{B2} = 6.6 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	–	–63	–	dB
		f = 2 GHz	–	–33	–	dB
MSG	maximum stable power gain (narrowband)	f = 900 MHz	–	31.5	–	dB
		f = 2 GHz	–	16.5	–	dB
F	noise figure	f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.6	2	dB
		f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	2.9	3.2	dB
$R_{th\ j-s}$	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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	–	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 = 10 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 100 μA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector-base leakage 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	
AC characteristics of the cascode configuration						
f_T	transition frequency	I_C = 40 mA; V_{C2-E1} = 12 V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{C2-B2} = 6 V; f = 1 MHz	–	0.85	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 12 V; f = 1 MHz	–	–	10	fF
MSG	maximum stable power gain; note 1	I_C = 40 mA; V_{C2-E1} = 12 V; f = 900 MHz; T_{amb} = 25 °C	–	31.5	–	dB
		I_C = 40 mA; V_{C2-E1} = 12 V; f = 2 GHz; T_{amb} = 25 °C	–	16.5	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{C2-E1} = 12 V; f = 900 MHz; T_{amb} = 25 °C	–	21.5	–	dB
		I_C = 40 mA; V_{C2-E1} = 12 V; f = 2 GHz; T_{amb} = 25 °C	–	16	–	dB
$\|s_{21}/s_{12}\|^2$	maximum isolation; note 2	f = 900 MHz	–	−63	–	dB
		f = 2 GHz	–	−33	–	dB
F	noise figure	I_C = 10 mA; V_{C2-E1} = 12 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.6	2	dB
		I_C = 10 mA; V_{C2-E1} = 12 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	2.9	3.2	dB
IP_3	third order intercept point (output)	note 3	–	28	–	dBm

Notes

1. $$MSG = \left|s_{12}/s_{21}\right| \times \left(k - \sqrt{k^2 - 1}\right) \; ; \quad k = \frac{1 + \left|s_{11} \times s_{22} - s_{12} \times s_{21}\right|^2 - \left(\left|s_{11}\right|^2 - \left|s_{22}\right|^2\right)}{2 \times \left|s_{12} \times s_{21}\right|}$$
2. Maximum isolation is defined as the isolation when S_{21} of the amplifier is reduced to unity (buffer application).
3. I_C = 40 mA; V_{CE} = 12 V; $R_S = R_L$ = 50 Ω; T_{amb} = 25 °C; f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 904 MHz.

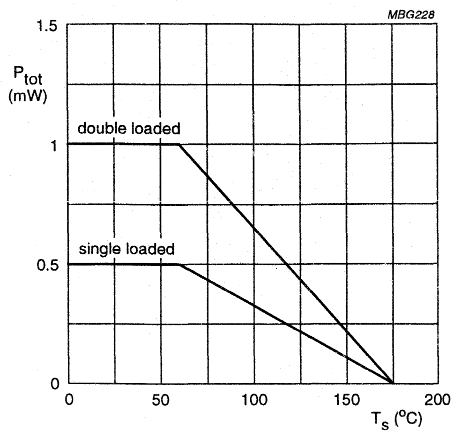
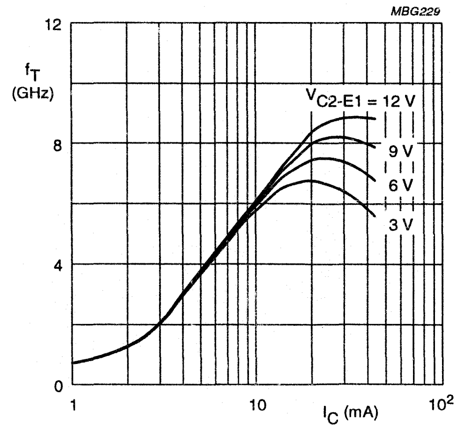
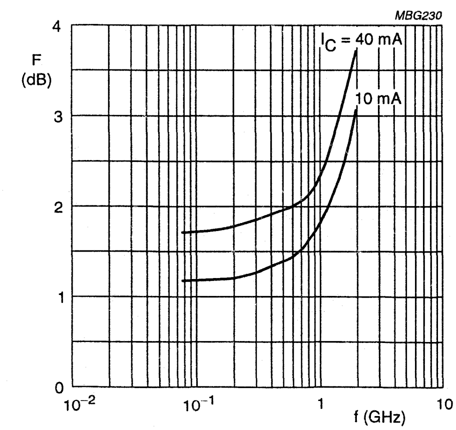


Fig.2 Power derating curves; typical values.



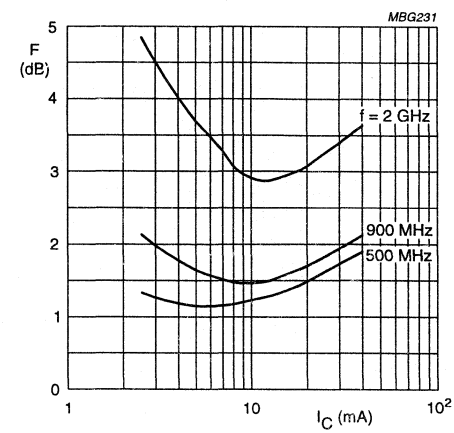
f = 1 GHz; T_{amb} = 25 °C.

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



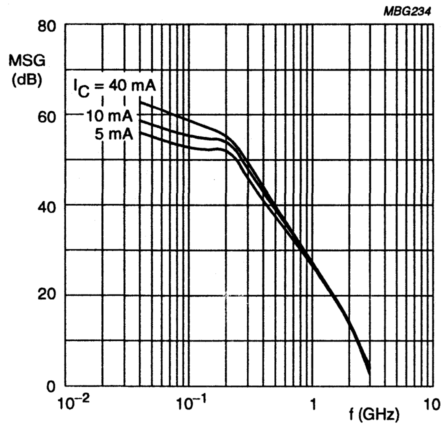
V_{C2-E1} = 12 V.

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



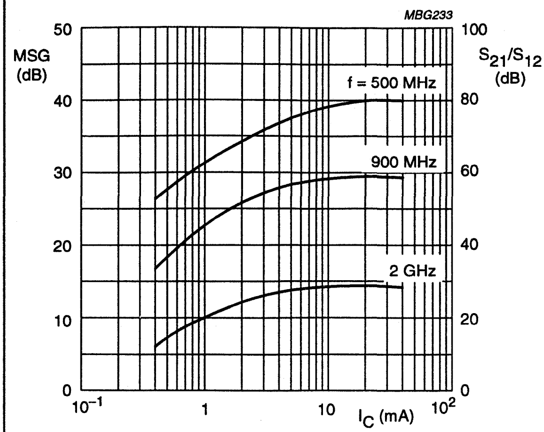
V_{C2-E1} = 12 V.

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



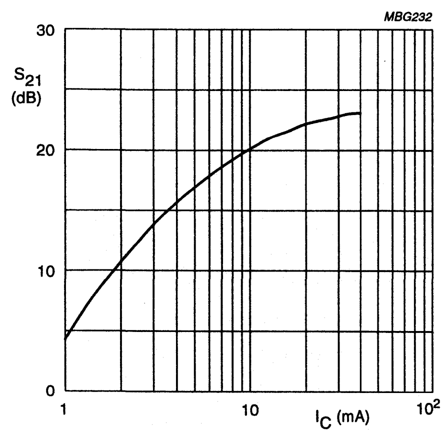
V_{C2-E1} = 12 V.

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



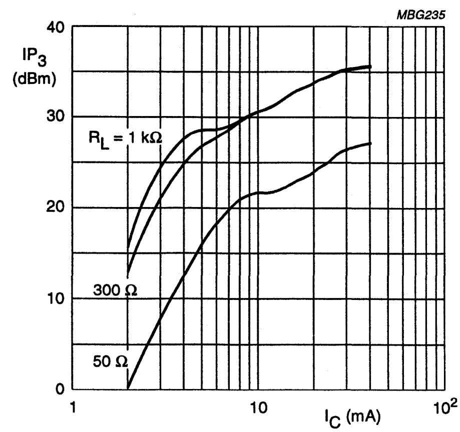
V_{C2-E1} = 12 V.

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



V_{C2-E1} = 12 V; $R_S = R_L$ = 50 Ω; f = 900 MHz.

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



V_{C2-E1} = 12 V; R_s = 50 Ω; f = 900 MHz.

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

Typical application circuit

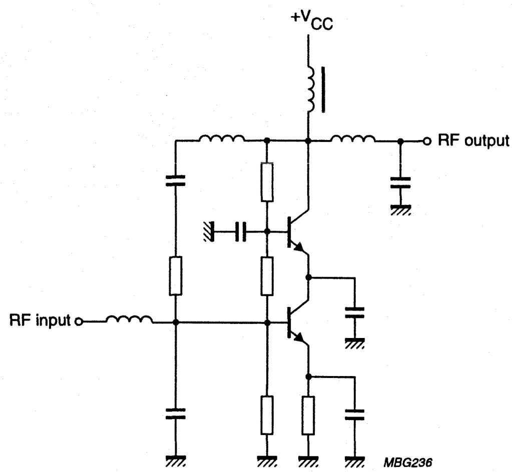


Fig.12 MATV/SATV wideband feedback amplifier.

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

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

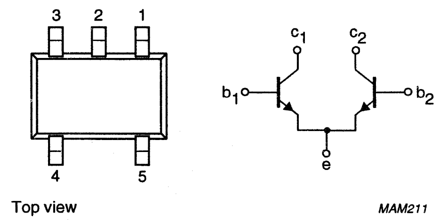


Fig.1 SOT353.

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	
$R_{th\ j-s}$	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 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
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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	
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
$\|s_{21}\|^2$	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; $\Gamma_S = \Gamma_{opt}$	–	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

Note

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

Typical application circuit

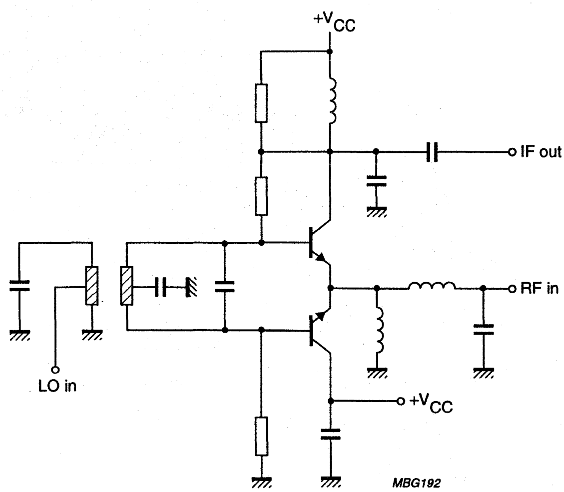


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

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 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

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

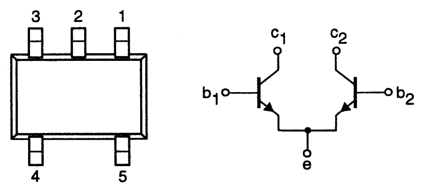


Fig.1 SOT353.

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_{CES}	collector-emitter voltage	base-emitter shorted	–	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	–	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 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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 = 20 mA; V_{CE} = 6 V	60	120	250	
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
$\|s_{21}\|^2$	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).

Typical application circuit

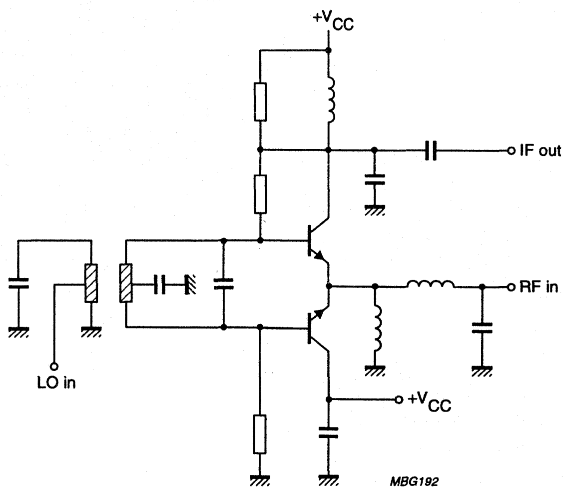


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

NPN wideband differential transistor — BFE540

FEATURES

- Small size
- Low voltage operation
- Temperature matched
- Balanced configuration
- h_{FE} matched.

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 wideband applications such as analog and digital cellular phones, radar detectors, satellite TV-tuners, MATV/CATV amplifiers and repeater amplifiers in fibre-optical systems.

PINNING

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

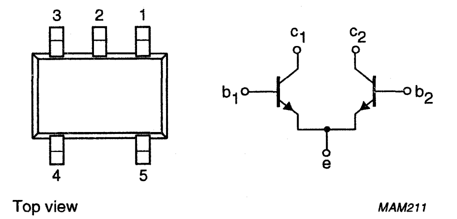


Fig.1 SOT353.

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	–	0.55	–	pF
MSG/G_{max}	maximum power gain	$I_C = 40$ mA; $V_{CE} = 3$ V; f = 900 MHz	–	13	–	dB
		$I_C = 40$ mA; $V_{CE} = 3$ V; f = 2 GHz	–	7.5	–	dB
F	noise figure	$I_C = 10$ mA; $V_{CE} = 3$ V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.8	dB
		$I_C = 10$ mA; $V_{CE} = 3$ V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.4	dB
h_{FE}	DC current gain	$I_C = 40$ 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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 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 = 10 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 100 μA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector-base leakage 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	
AC characteristics of any single transistor						
f_T	transition frequency	I_C = 40 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	–	0.85	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 3 V; f = 1 MHz	–	0.55	–	pF
MSG/G_{max}	maximum gain; note 1	I_C = 40 mA; V_{CE} = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	13	–	dB
		I_C = 40 mA; V_{CE} = 3 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 3 V; f = 900 MHz; T_{amb} = 25 °C	–	12	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 3 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.8	dB
		I_C = 10 mA; V_{CE} = 3 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.4	dB

Note

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

Typical application circuit

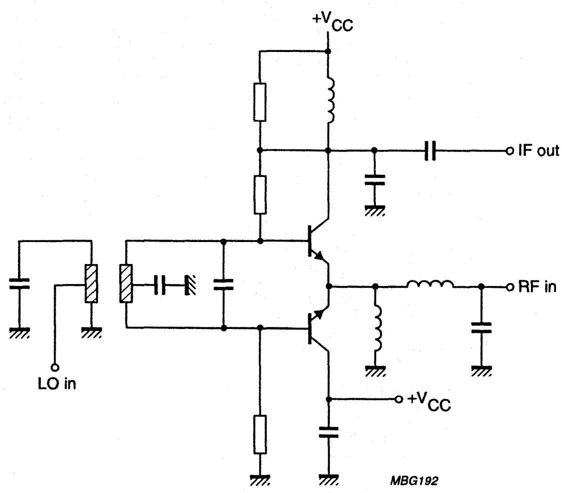


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

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

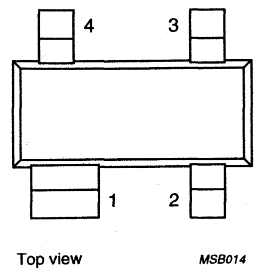


Fig.1 SOT143.

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

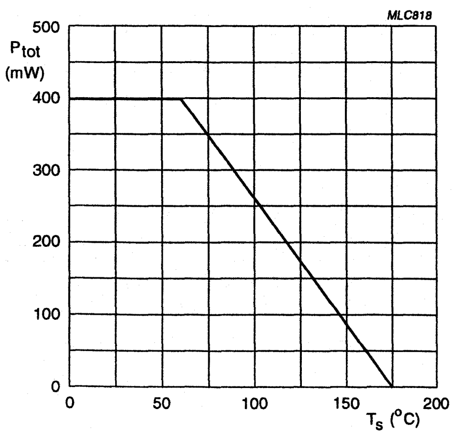
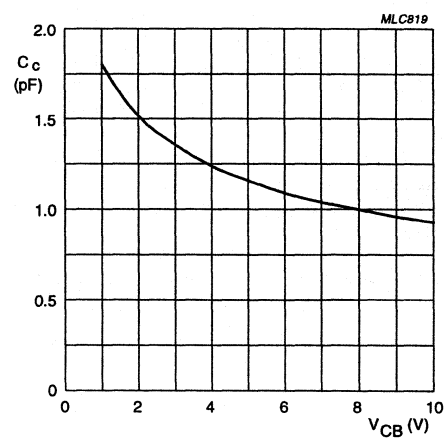


Fig.2 Power derating curve



I_C = 0; f = 1 MHz.

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

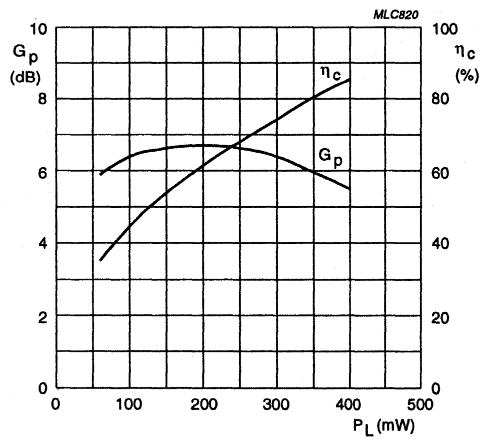
APPLICATION INFORMATION

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

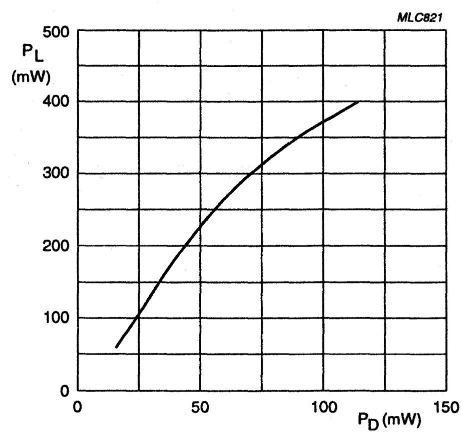
Ruggedness in class-AB operation

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.

Test circuit information

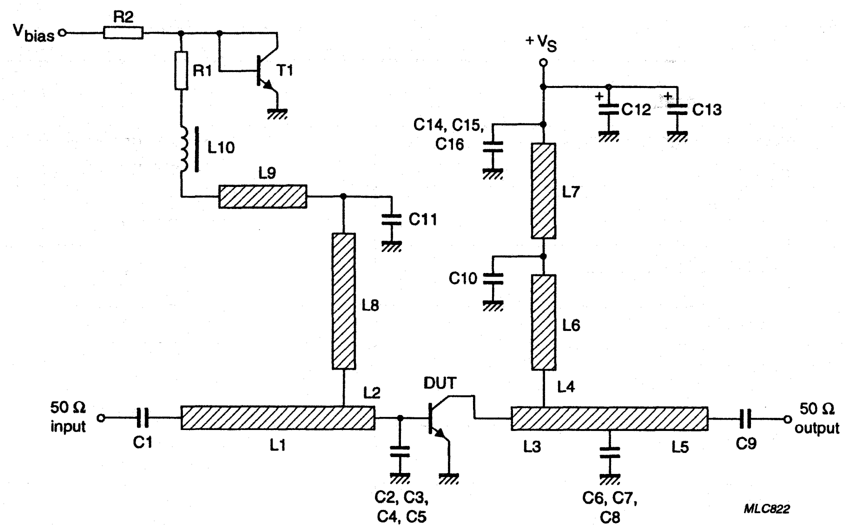


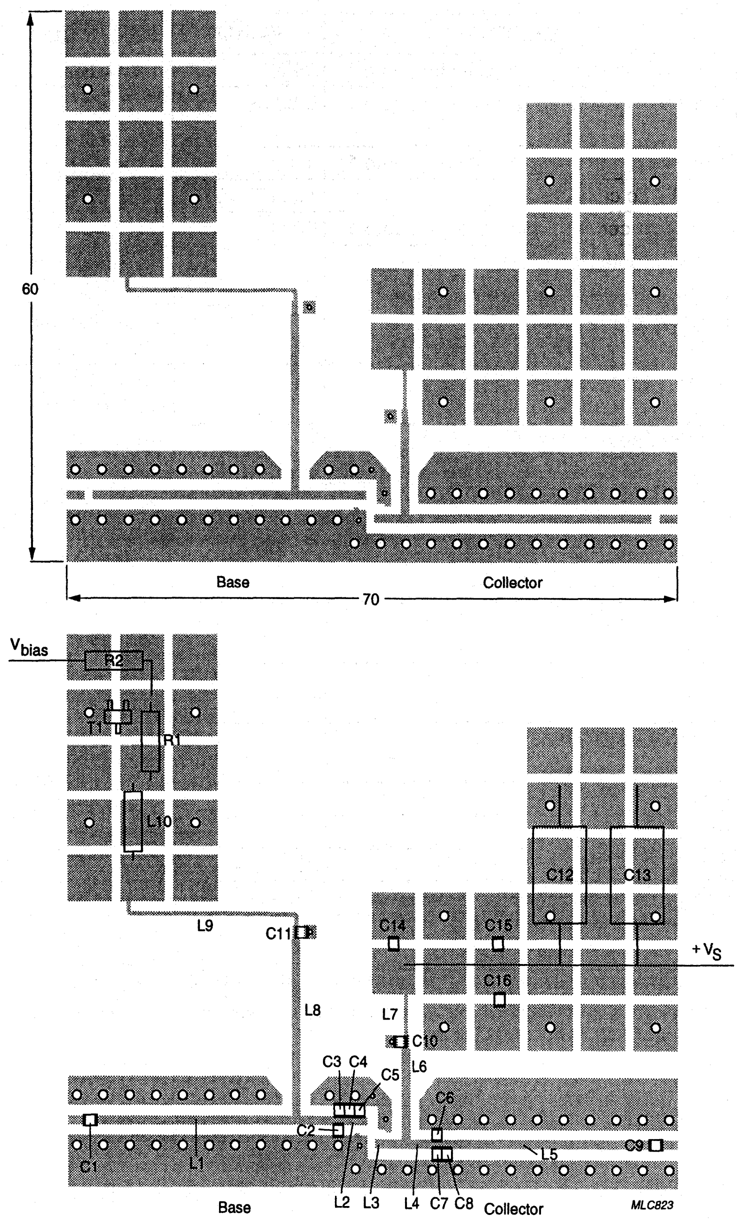
Fig.7 Common-emitter test circuit for class-AB operation at 1.9 GHz.

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 (ε_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

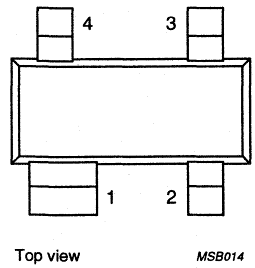
- Common emitter class-AB operation in hand-held radio equipment up to 1.9 GHz.

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
$R_{th\ j\text{-}s}$	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

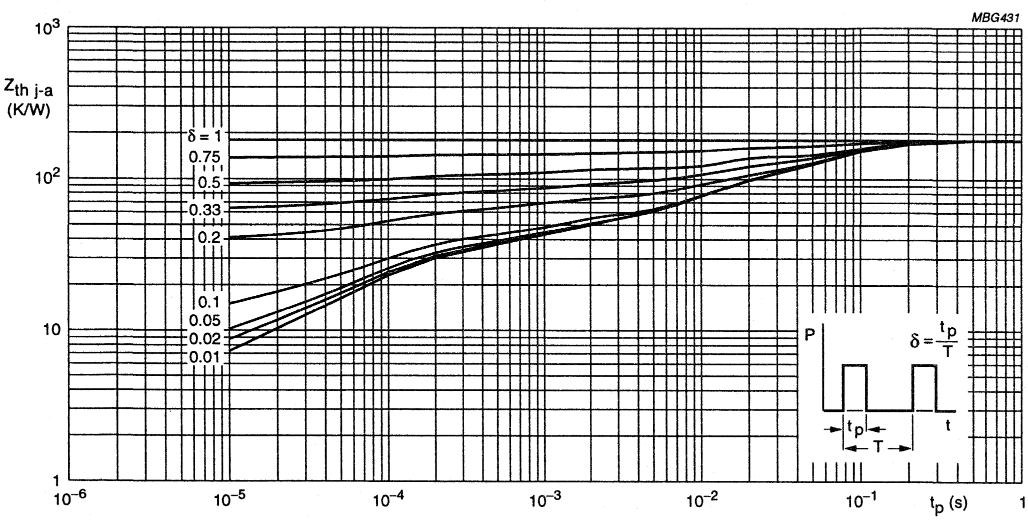


Fig.2 Transient thermal impedance from junction to soldering point as a function of pulse time; typical values.

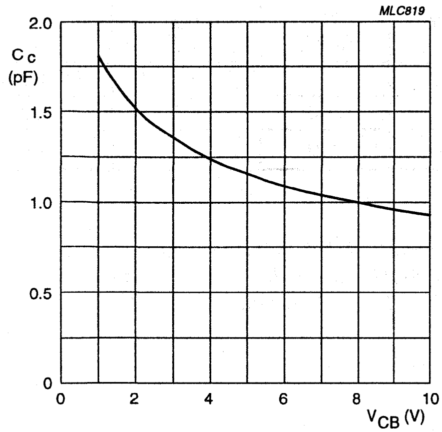


Fig.3 Collector capacitance as a function of collector-base voltage.

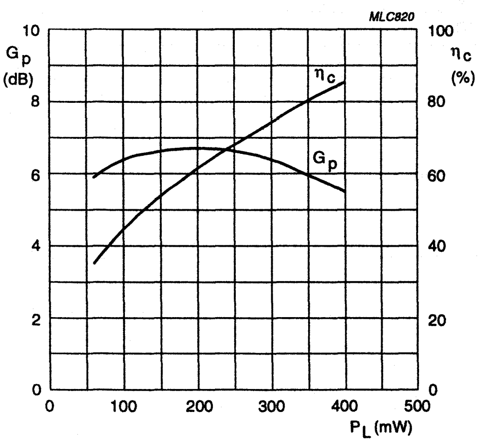
APPLICATION INFORMATION

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

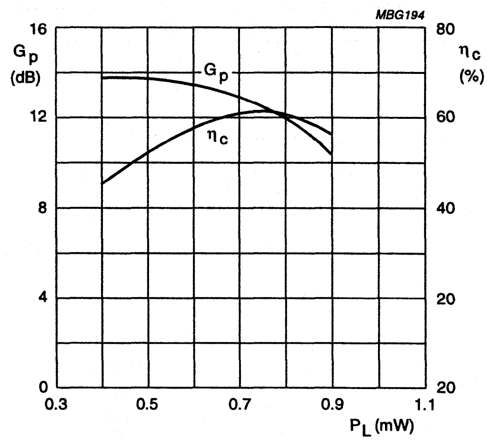
Ruggedness in class-AB operation

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.

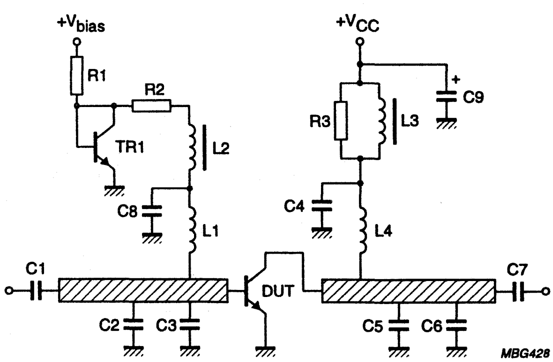
Fig.5 Power gain and efficiency as functions of load power; typical values.

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.

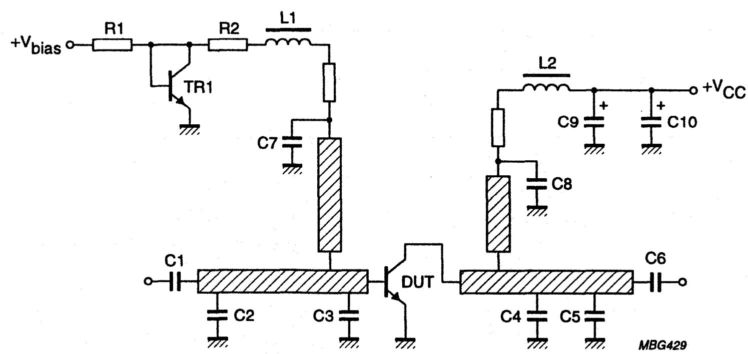
Fig.6 Class-AB test circuit at f = 900 MHz.

List of components (see Fig.7)

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

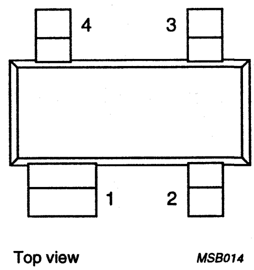


Fig.1 SOT143.

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.

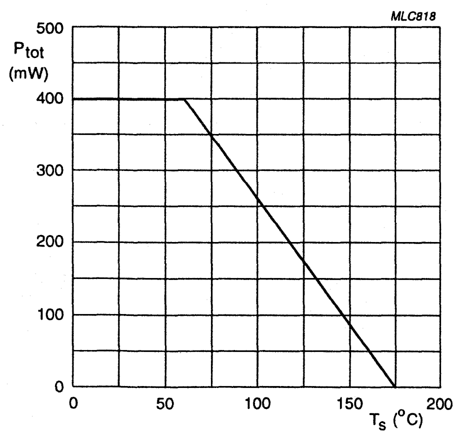
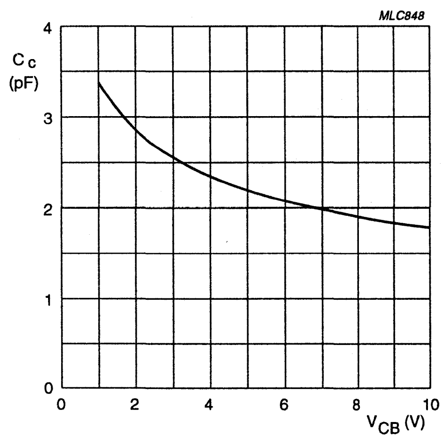


Fig.2 Power derating curve.

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.

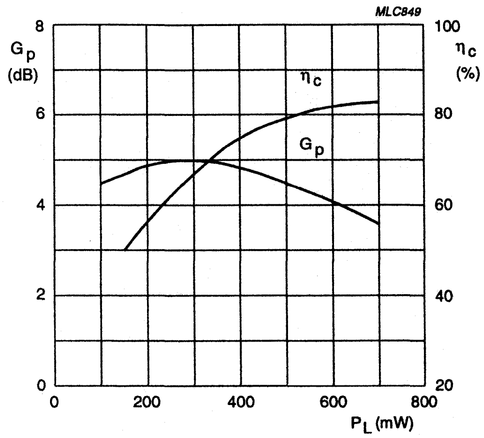
APPLICATION INFORMATION

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

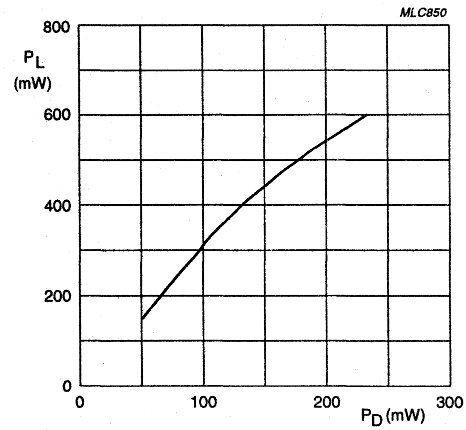
Ruggedness in class-AB operation

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.

Test circuit information

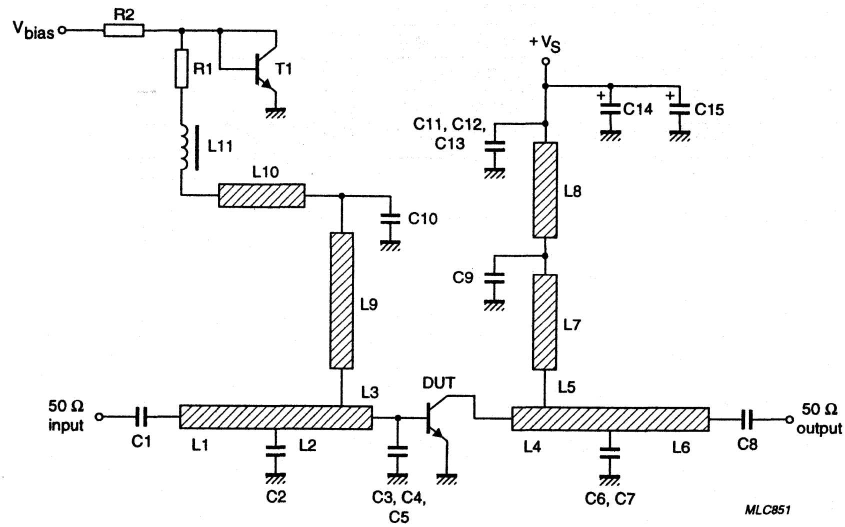


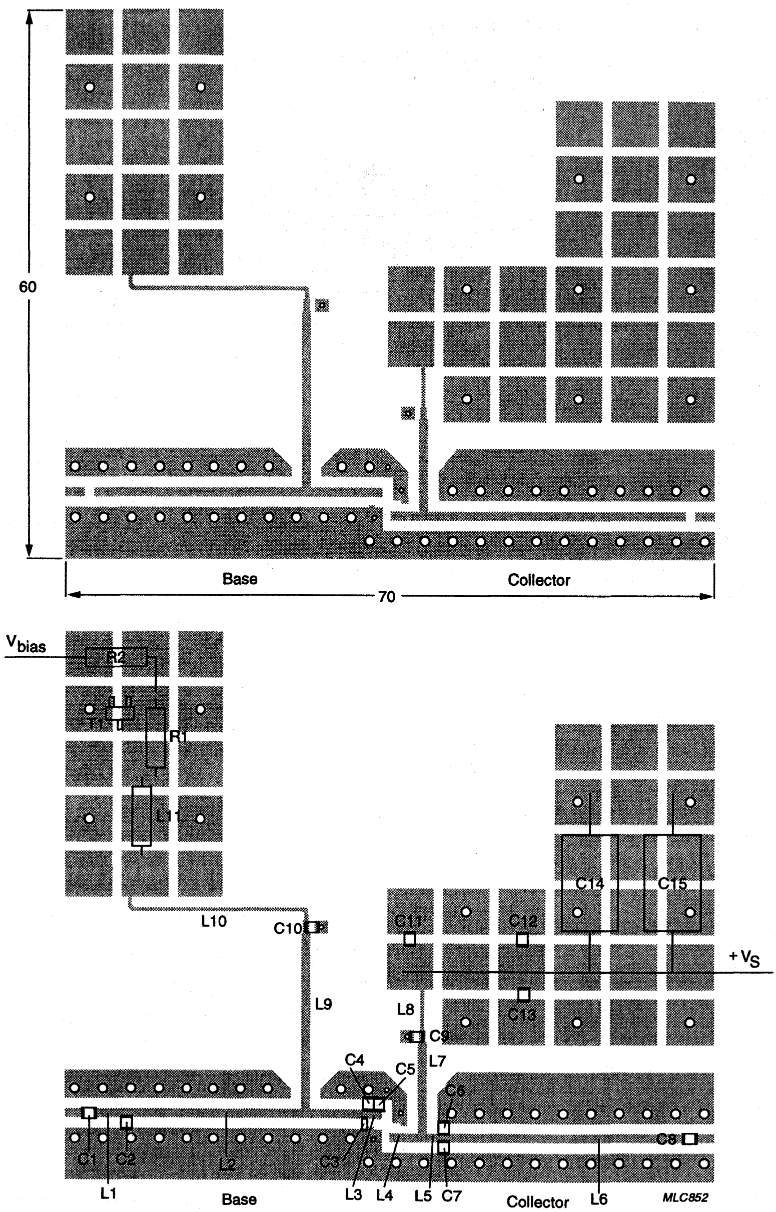
Fig.7 Common-emitter test circuit for class-AB operation at 1900 MHz.

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

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
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 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.

NPN 2 GHz DECT power transistor — BFG11W/X

FEATURES

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

APPLICATIONS

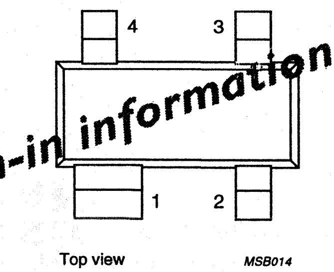
- Common emitter class-AB operation in handheld radio equipment at 1.9 GHz.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a plastic SOT343 package.

PINNING

PIN	DESCRIPTION
BFG11W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter



Marking code: S4

Fig.1 SOT343.

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, duty cycle: < 1 : 2; t_p = 10 ms	1.9	3.6	400	≥6	≥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
$I_{C(AV)}$	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; note 1	–	630	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} = 630 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 = 10 mA	8	–	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} = 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	–	5	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 3.6 V; 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, duty cycle: < 1 : 2; t_p = 10 ms	1.9	3.6	1	400	>6	>50

Ruggedness in class-AB operation

The transistors are capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases, at rated output power under pulsed conditions up to a supply voltage of 5.5 V, f = 1.9 GHz and a duty cycle of 1 : 2, t_p = 10 ms.

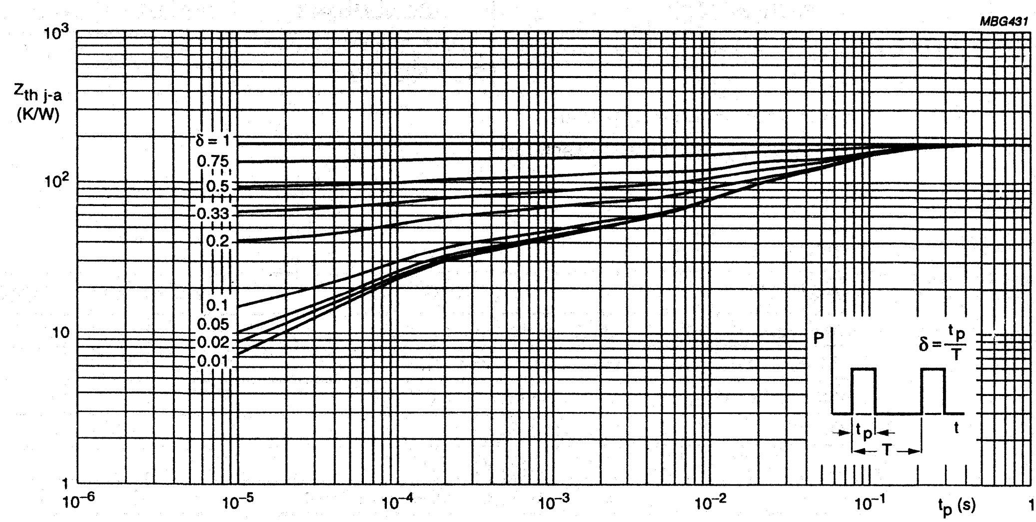
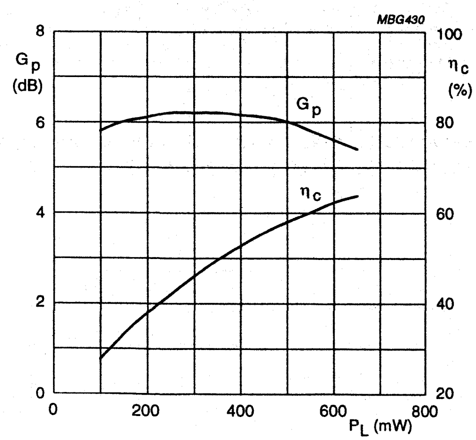


Fig.2 Transient thermal impedance from junction to soldering point as a function of pulse time; typical values.



Pulsed, class-AB operation.

V_{CE} = 3.6 V; f = 1.9 GHz; duty cycle < 1 : 2.

Circuit optimized for P_L = 400 mW.

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

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

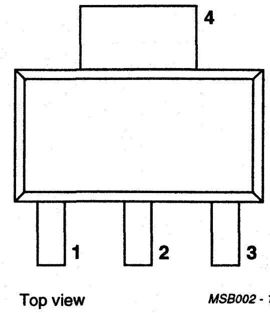


Fig.1 SOT223.

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.

NPN 2 GHz wideband transistor | BFG16A

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.

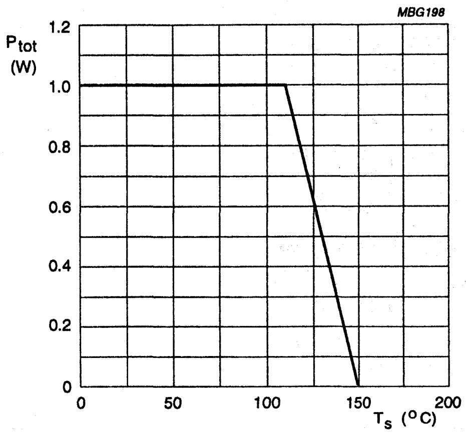
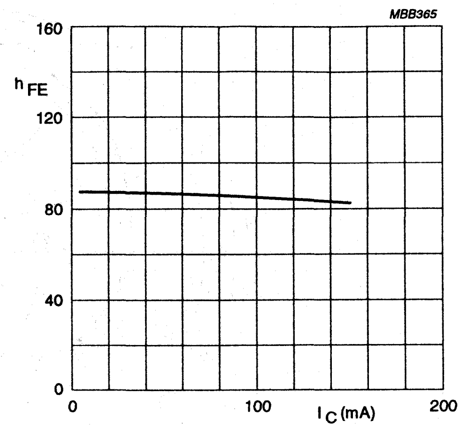
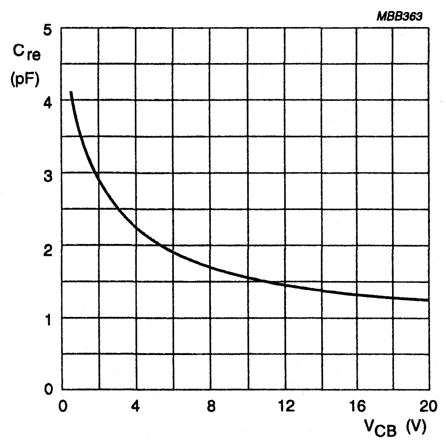


Fig.2 Power derating curve.



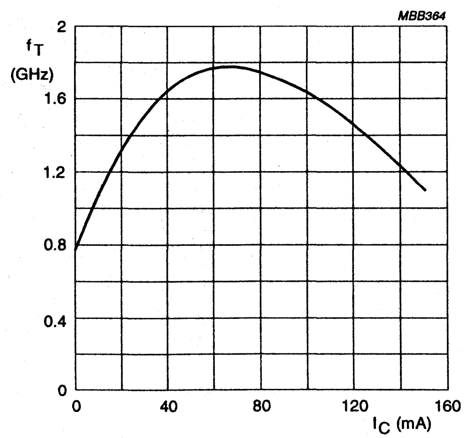
V_{CE} = 10 V; T_j = 25 °C.

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



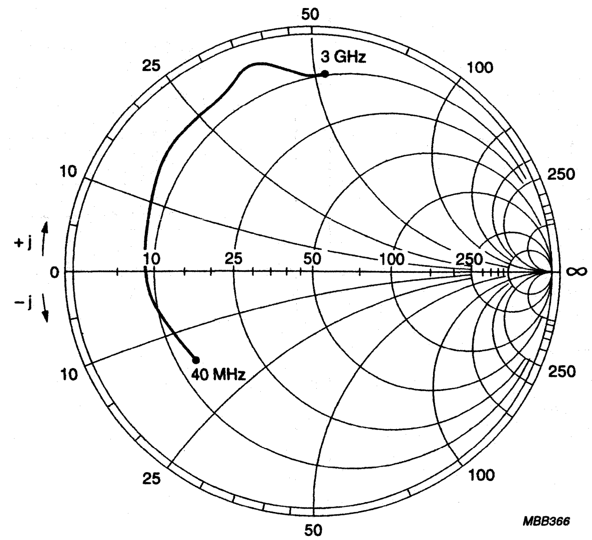
I_C = i_c = 0; f = 1 MHz.

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



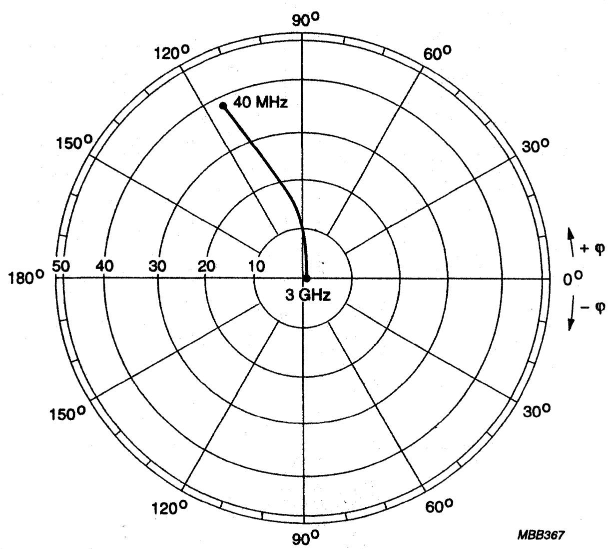
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

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



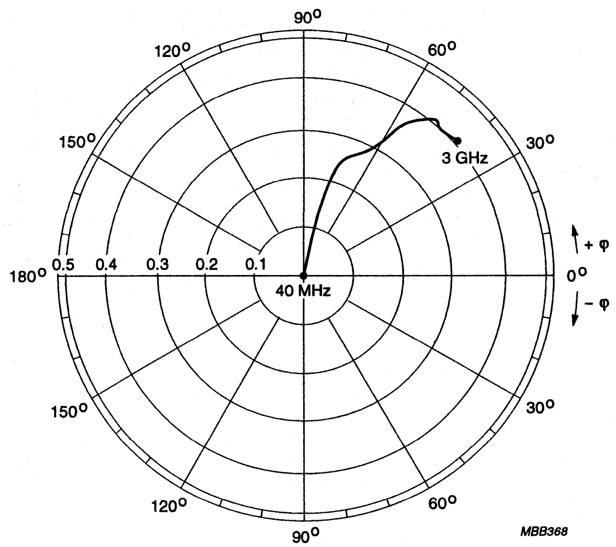
I_C = 70 mA; V_{CE} = 15 V; Z_o = 50 Ω.

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



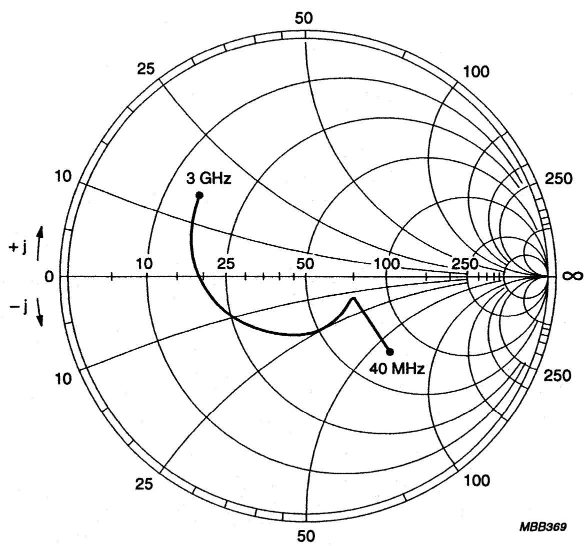
I_C = 70 mA; V_{CE} = 15 V.

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}).

NPN 3 GHz wideband transistor | BFG17A

DESCRIPTION

NPN wideband transistor in a microminiature plastic SOT143 surface mounting envelope with double emitter bonding.

It is intended for use in wideband aerial amplifiers using SMD technology.

PINNING

PIN	DESCRIPTION
Code: E6	
1	collector
2	base
3	emitter
4	emitter

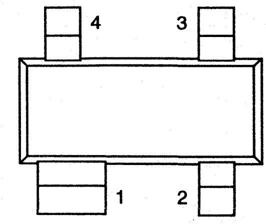


Fig.1 SOT143.

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		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 85 °C; note 1	–	–	300	mW
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 1 V; T_{amb} = 25 °C	20	–	150	
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	2.8	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz	–	0.4	–	pF
G_{UM}	maximum unilateral power gain	I_C = 15 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C; Z_S = 60 Ω; b_s = opt.	–	2.5	–	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	–	15	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 = 85 °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 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	290	K/W

Note

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

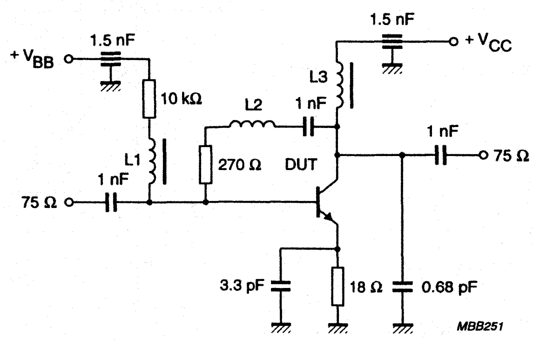
CHARACTERISTICS

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} = 10 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 1 V; T_{amb} = 25 °C	20	75	150	
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	–	0.4	–	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 15 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C; Z_S = 60 Ω; b_s = opt.	–	2.5	–	dB
V_o	output voltage	note 2	–	150	–	mV

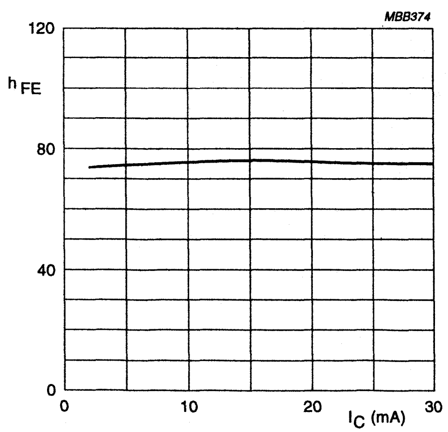
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\dfrac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB..
2. d_{im} = –60 dB (DIN 45004B, para. 6,3: 3-tone); I_C = 14 mA; V_{CE} = 10 V; Z_L = 75 Ω.
   $V_p = V_o$; 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.



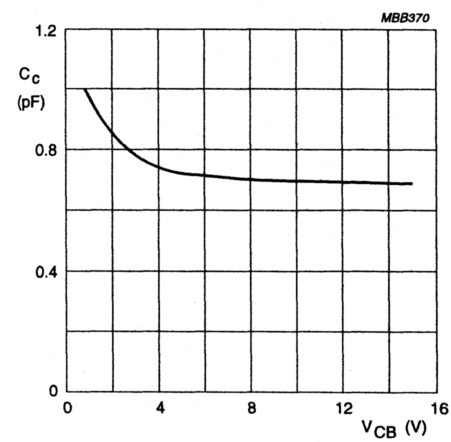
(1) L1 = L3 = 5 μH Ferroxcube choke.
(2) L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

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



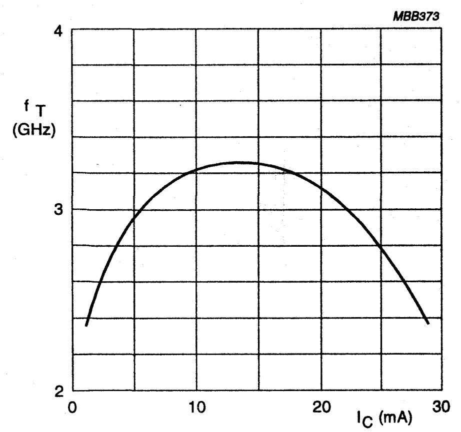
V_{CE} = 1 V; T_{amb} = 25 °C.

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



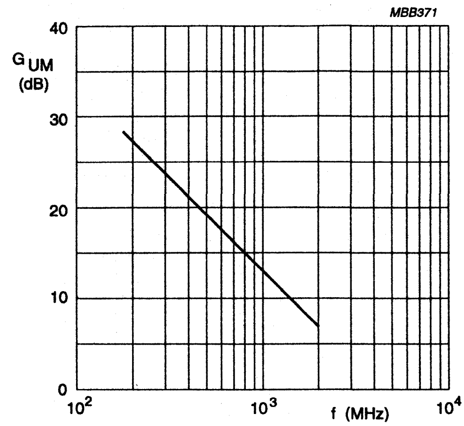
I_E = 0; f = 1 MHz; T_{amb} = 25 °C

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



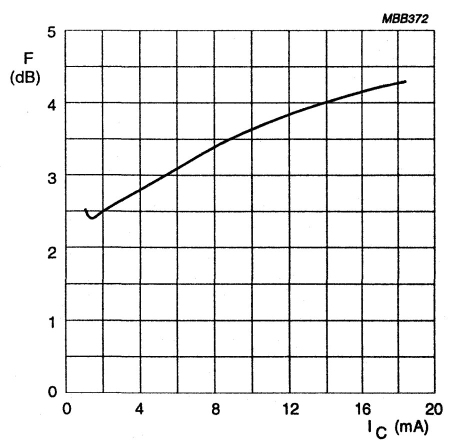
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

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



I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

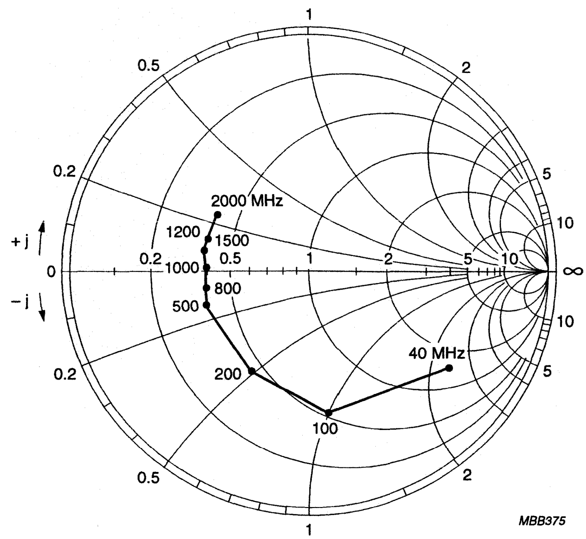
Fig.6 Maximum unilateral power gain as a function of frequency.



V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C; Z_S = 60 Ω; b_s = opt.

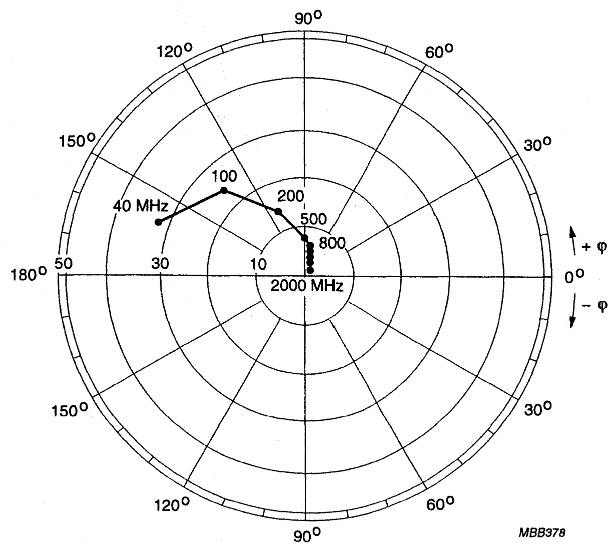
Fig.7 Minimum noise figure as a function of collector current.

NPN 3 GHz wideband transistor BFG17A



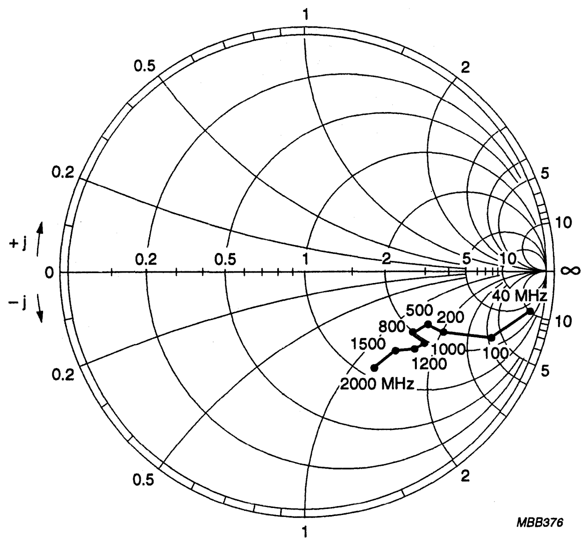
I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



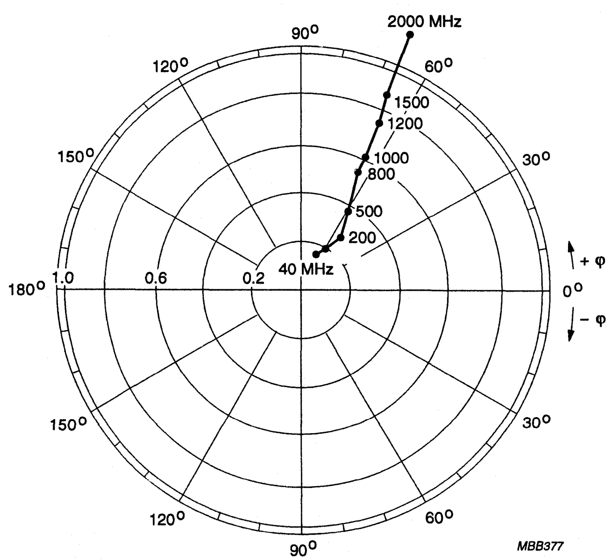
I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.9 Common emitter forward transmission coefficient (S_{21}).



I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.10 Common emitter reverse transmission coefficient (S_{12}).



I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

Fig.11 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor

BFG25A/X

FEATURES

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

DESCRIPTION

The BFG25A/X is a silicon npn transistor, primarily intended for use in RF low power amplifiers, such as pocket telephones, paging systems, with signal frequencies up to 2 GHz.

The transistor is encapsulated in a four-lead dual emitter plastic SOT143 envelope (cross emitter).

PINNING

PIN	DESCRIPTION
	Code: V11
1	collector
2	emitter
3	base
4	emitter

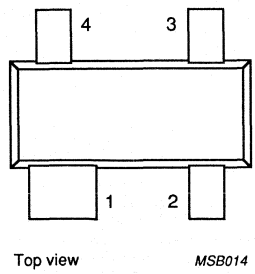


Fig.1 SOT143.

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	–	18	–	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 range		–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)	320 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	μA
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	–	0.21	0.3	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	–	18	–	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 $G_{UM} = 10 \log \frac{|S_{21}|}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

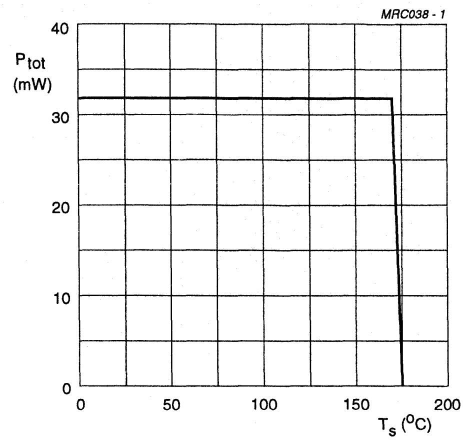
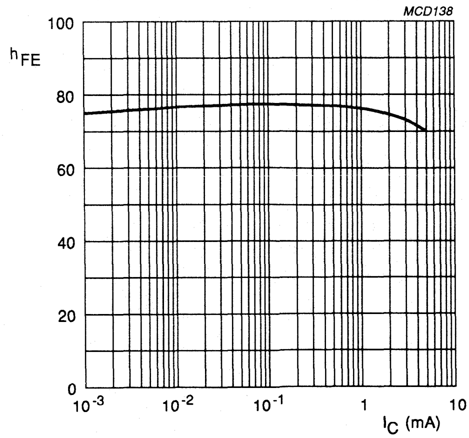
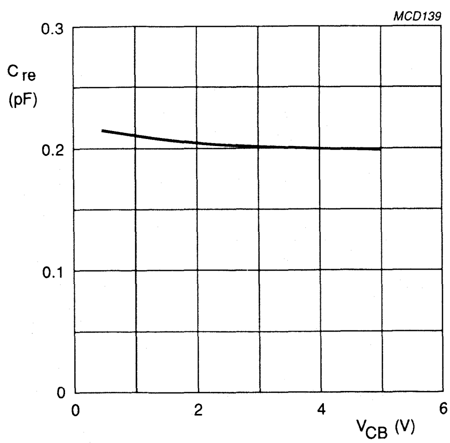


Fig.2 Power derating curve.



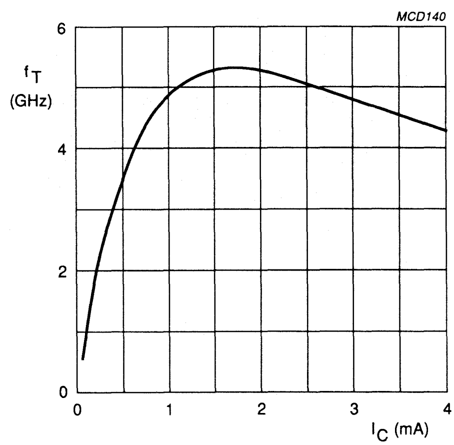
V_{CE} = 1 V.

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



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

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

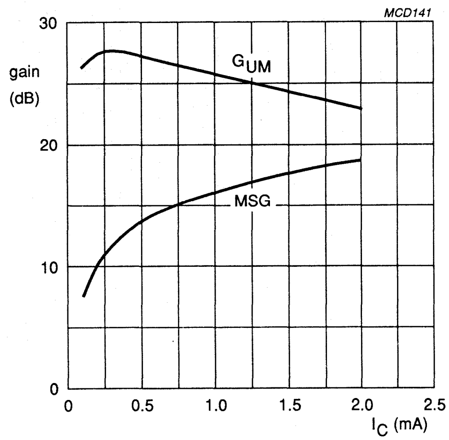


V_{CE} = 1 V; T_{amb} = 25 °C; f = 500 MHz.

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

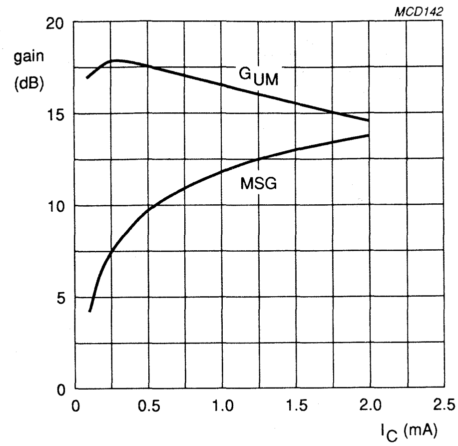
NPN 5 GHz wideband transistor | BFG25A/X

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain.



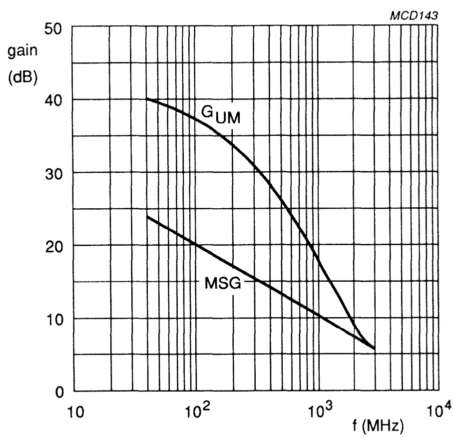
V_{CE} = 1 V; f = 500 MHz.

Fig.6 Gain as a function of collector current.



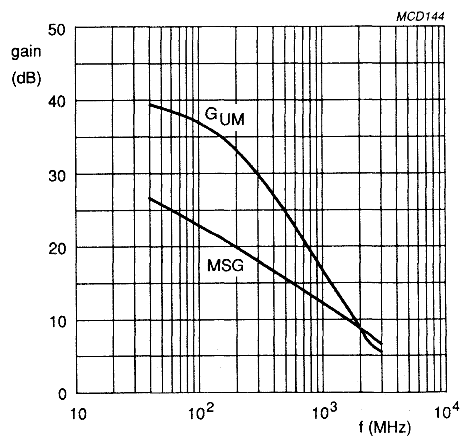
V_{CE} = 1 V; f = 1 GHz.

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.

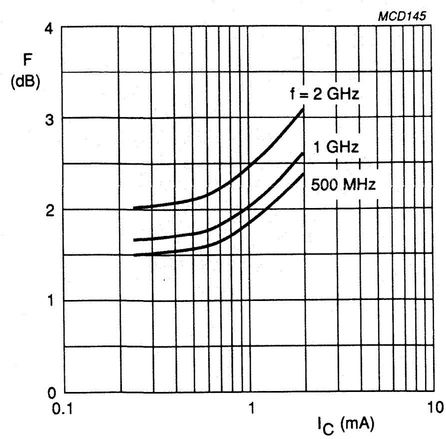


V_{CE} = 1 V; I_C = 1 mA.

Fig.9 Gain as a function of frequency.

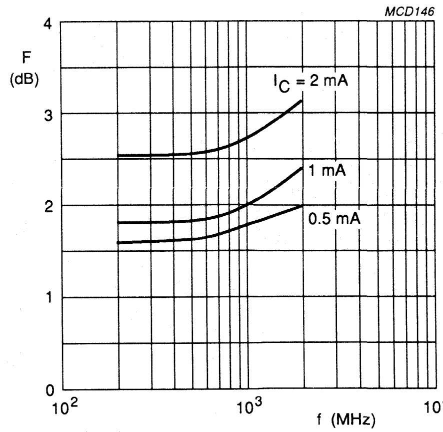
NPN 5 GHz wideband transistor

BFG25A/X



V_{CE} = 1 V.

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



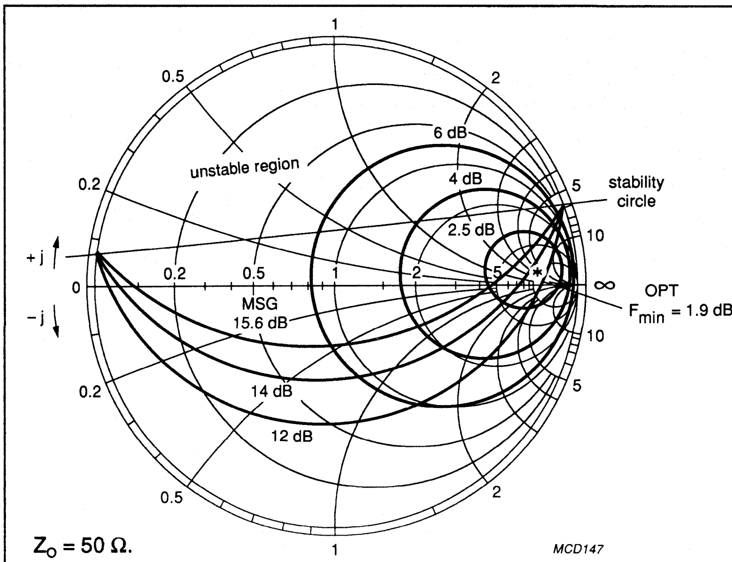
V_{CE} = 1 V.

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	0.85	5	2.4



Z_O = 50 Ω.
Maximum stable gain = 15.6 dB.

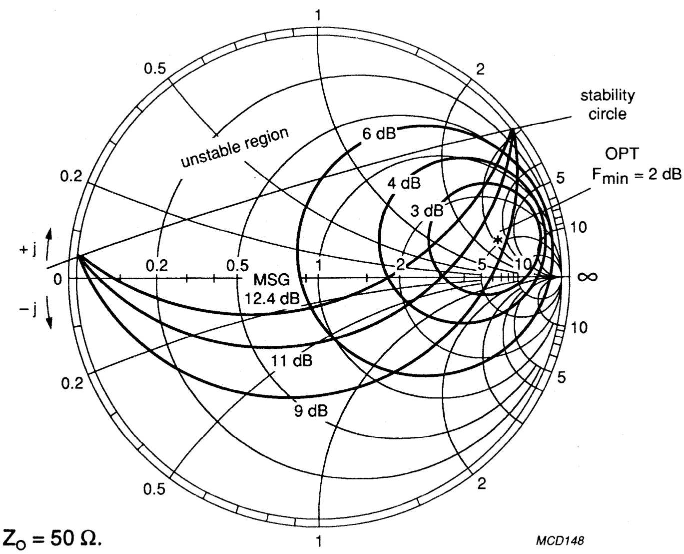
Fig.12 Noise circle figure.

NPN 5 GHz wideband transistor | BFG25A/X

f (MHz)	V_{CE} (V)	I_C (mA)
1000	1	1

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2	0.78	14	2.6



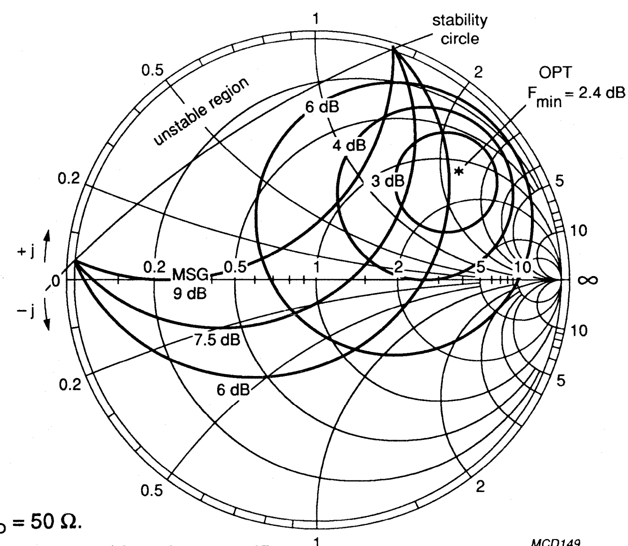
Z_O = 50 Ω.
Maximum stable gain = 12.4 dB.

Fig.13 Noise circle figure.

f (MHz)	V_{CE} (V)	I_C (mA)
2000	1	1

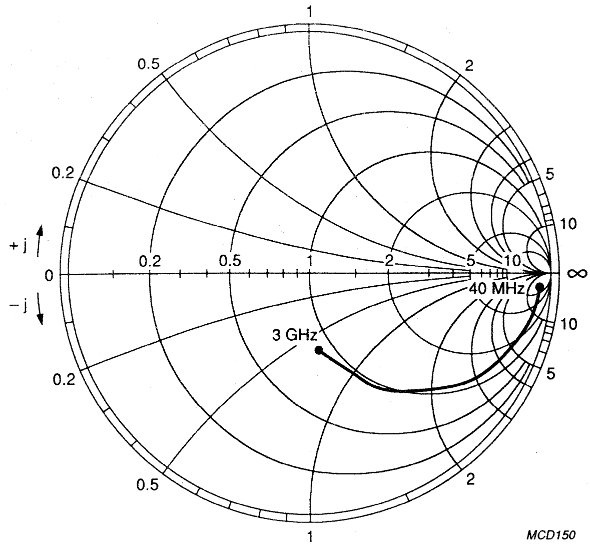
Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2.4	0.72	38	1.9



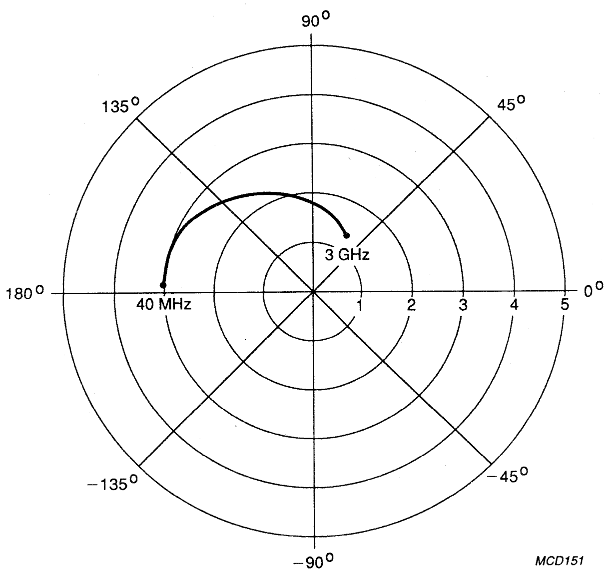
Z_O = 50 Ω.
Maximum stable gain = 8.9 dB.

Fig.14 Noise circle figure.



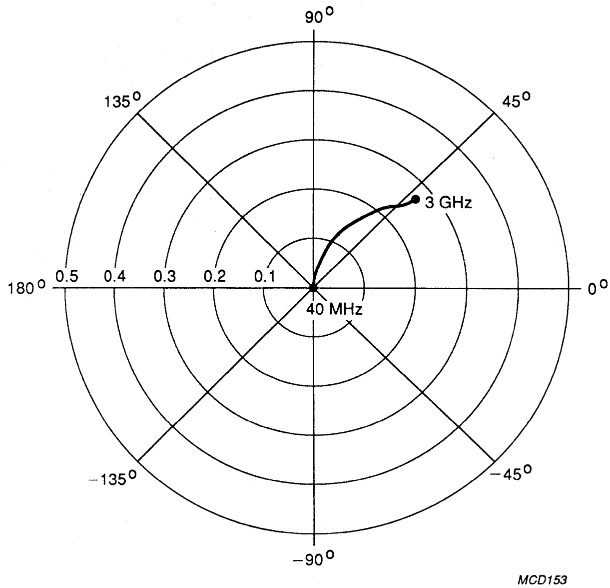
V_{CE} = 1 V; I_C = 1 mA.
Z_o = 50 Ω.

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



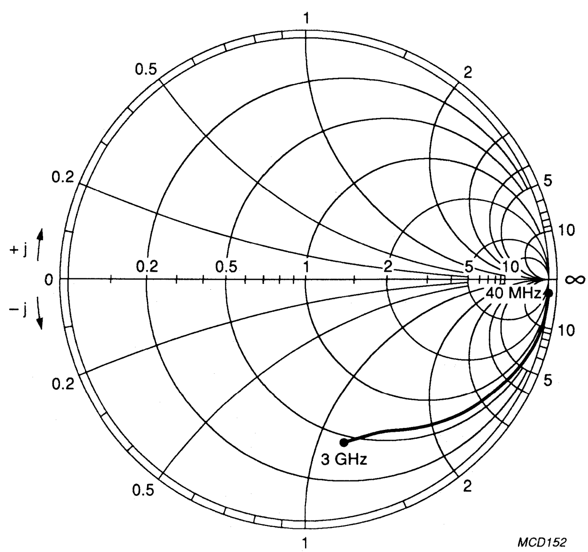
V_{CE} = 1 V; I_C = 1 mA.

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}).

FEATURES

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

APPLICATIONS

They are intended for wideband applications in UHF low power amplifiers, such as pocket telephones, paging systems.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG25AW	N6
BFG25AW/X	V1
BFG25AW/XR	V3

PINNING

PIN	DESCRIPTION
BFG25AW (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG25AW/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG25AW/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

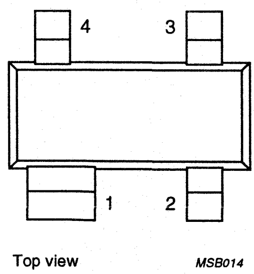


Fig.1 SOT343.

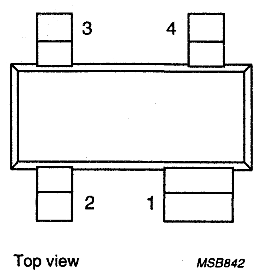


Fig.2 SOT343R.

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	up to T_s = 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	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.

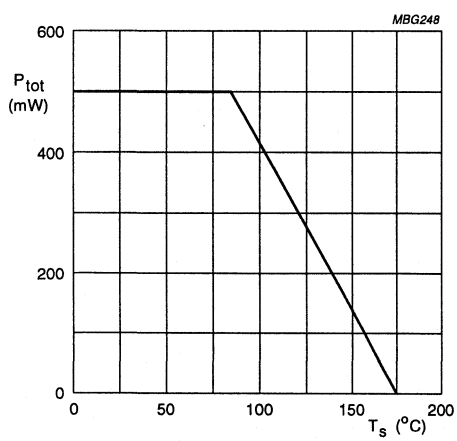


Fig.3 Power derating curve.

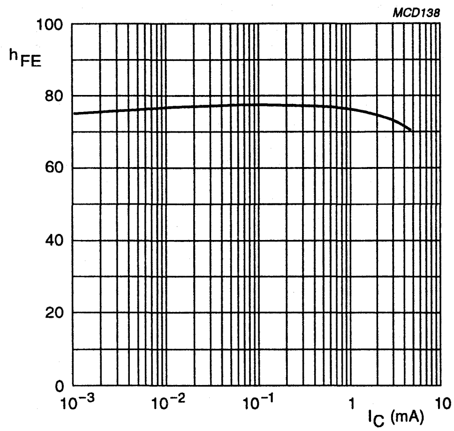
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 100$ µA; $I_E = 0$	–	–	8	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 1$ mA; $I_B = 0$	–	–	5	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 100$ µA; $I_C = 0$	–	–	2	V
I_{CBO}	collector cut-off 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

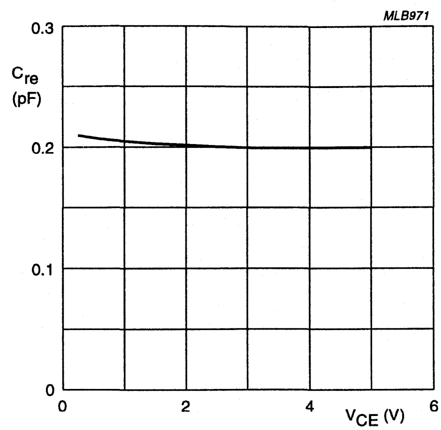
Note

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.



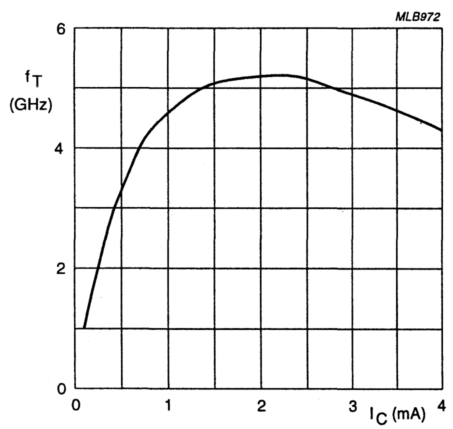
V_{CE} = 1 V.

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.

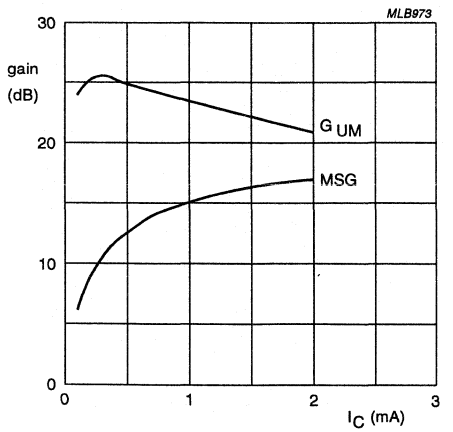


f = 500 MHz; V_{CE} = 1 V; T_{amb} = 25 °C.

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

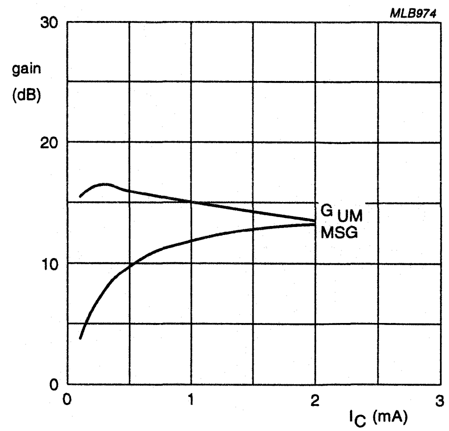
NPN 5 GHz wideband transistor

BFG25AW
BFG25AW/X; BFG25AW/XR



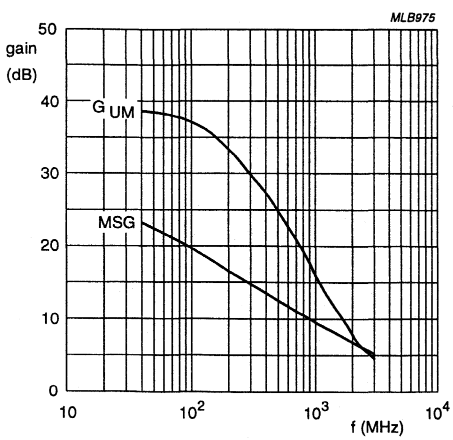
f = 500 MHz; V_{CE} = 1 V.

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



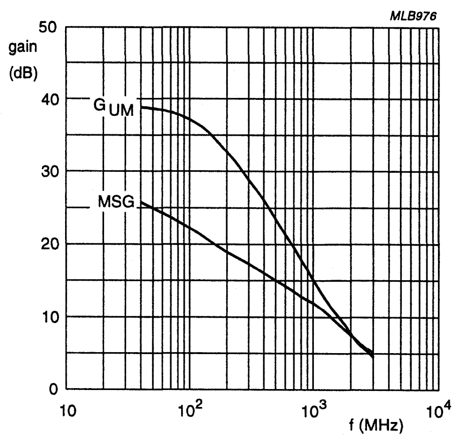
f = 1 GHz; V_{CE} = 1 V.

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



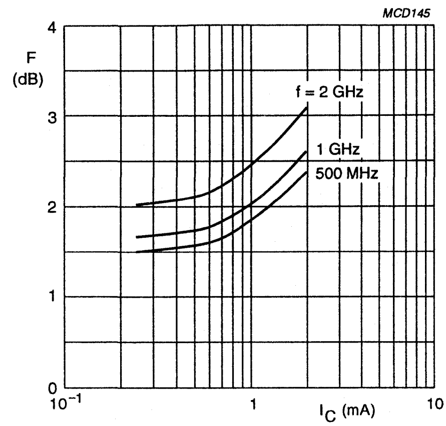
I_C = 0.5 mA; V_{CE} = 1 V.

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



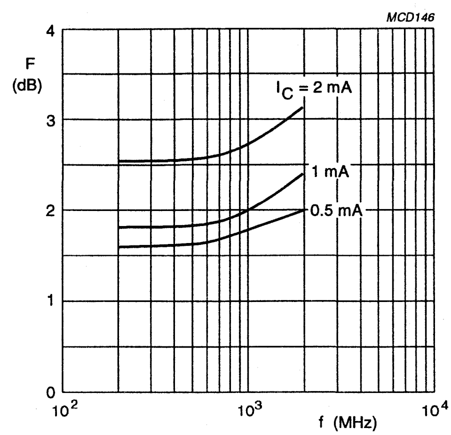
I_C = 1 mA; V_{CE} = 1 V.

Fig.10 Gain as a function of frequency; typical values.



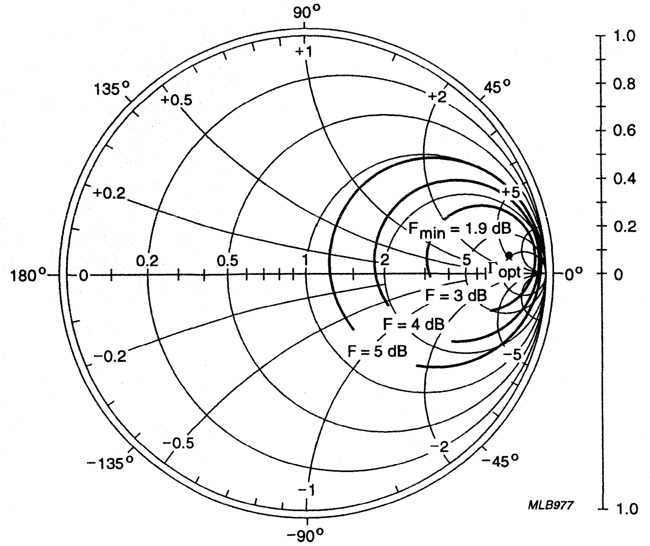
V_{CE} = 1 V.

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



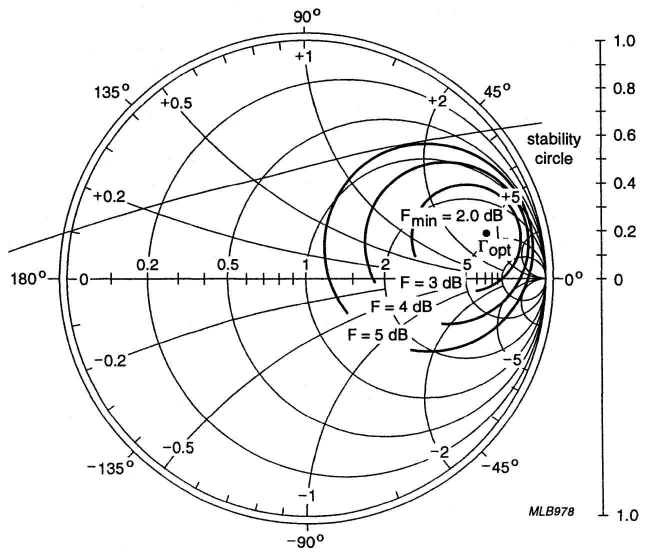
V_{CE} = 1 V.

Fig.12 Minimum noise figure as a function of frequency; typical values.



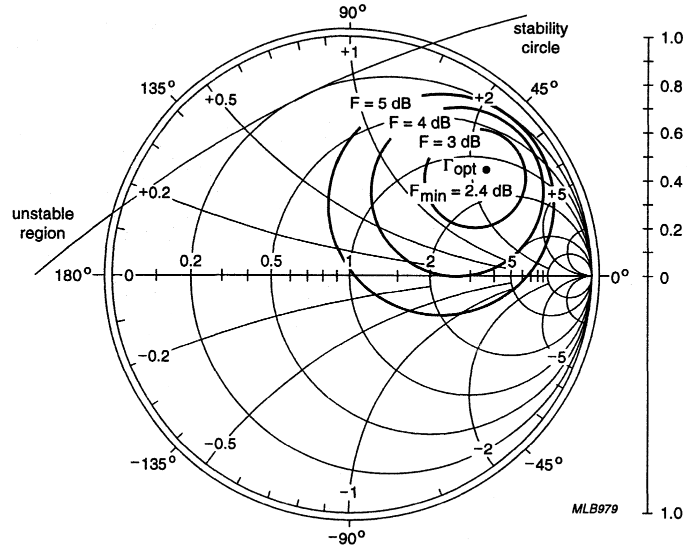
f = 500 MHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

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



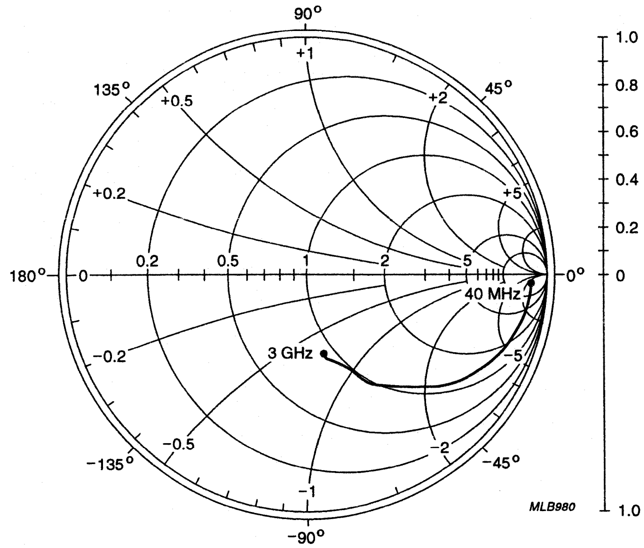
f = 1 GHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

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



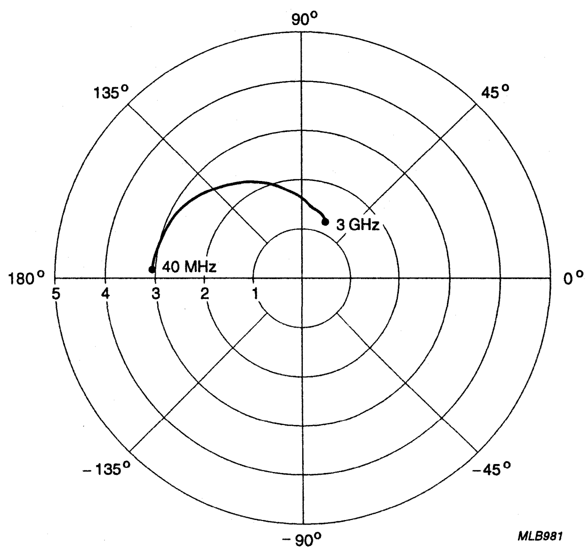
f = 2 GHz; V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



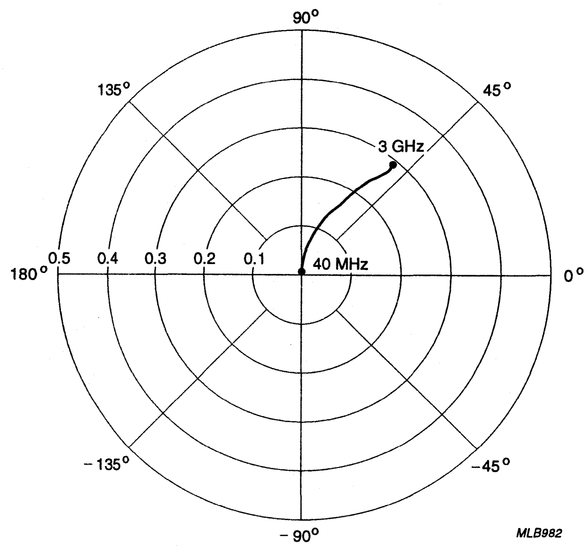
V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω..

Fig.16 Common emitter input reflection coefficient (s_{11}); typical values.



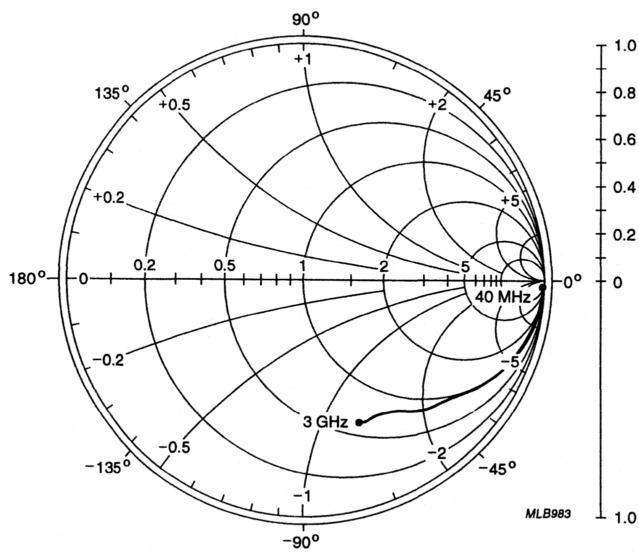
V_{CE} = 1 V; I_C = 1 mA.

Fig.17 Common emitter forward transmission coefficient (s_{21}); typical values.



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

Fig.18 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 1 V; I_C = 1 mA; Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (s_{22}); typical values.

PNP 5 GHz wideband transistor BFG31

FEATURES

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

DESCRIPTION

PNP planar epitaxial transistor mounted in a plastic SOT223 envelope.

It is intended for wideband amplifier applications.

NPN complement is the BFG97.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

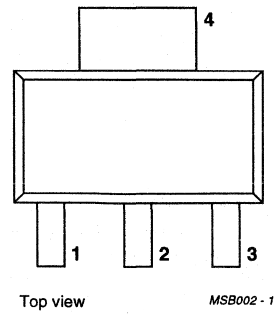


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–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.

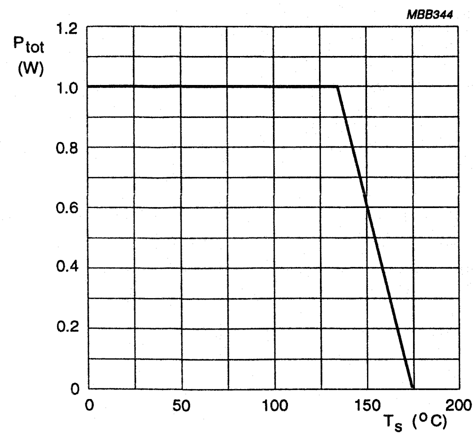
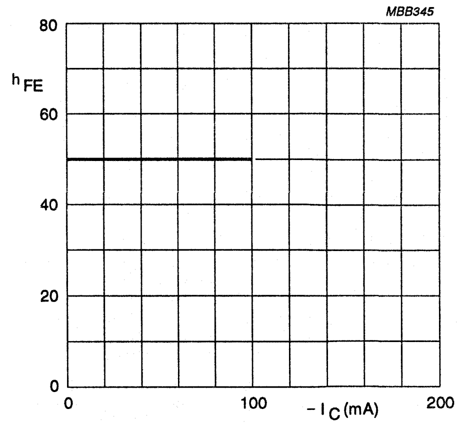
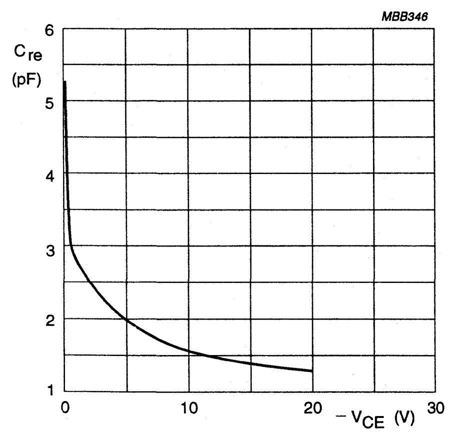


Fig.2 Power derating curve.



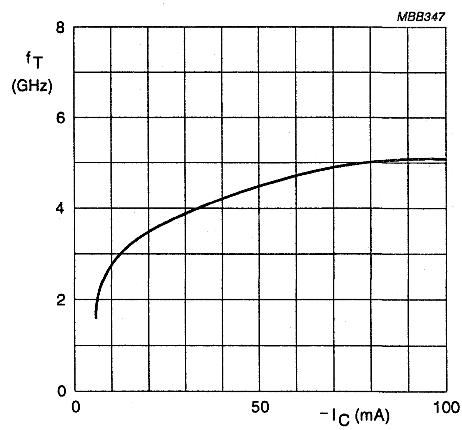
V_{CE} = −10 V; T_{amb} = 25 °C.

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



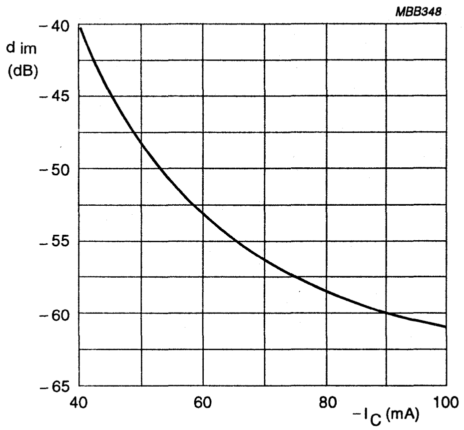
f = 1 MHz; T_{amb} = 25 °C

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



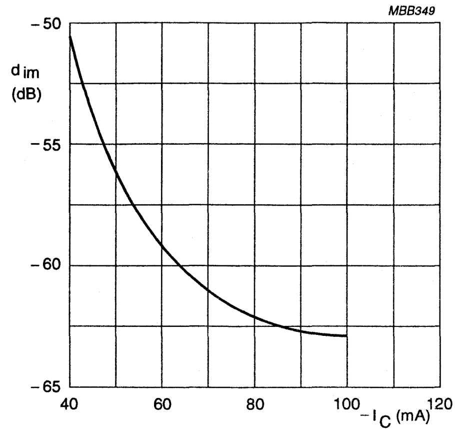
V_{CE} = −10 V; T_{amb} = 25 °C.

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



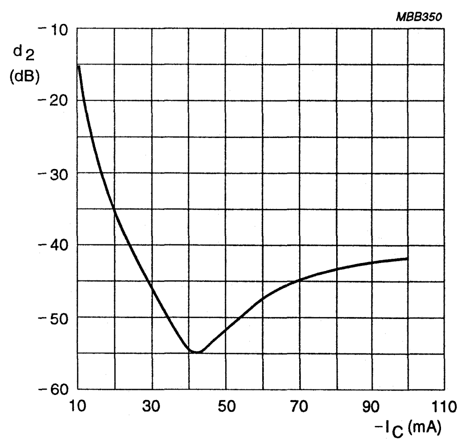
V_{CE} = −10 V; V_o = 650 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 443.25 MHz.

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



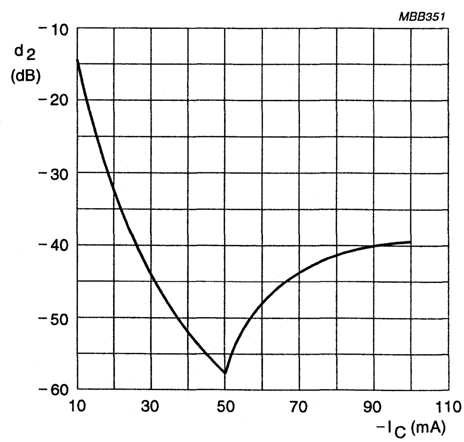
V_{CE} = −10 V; V_o = 550 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 848.25 MHz.

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.

PNP complement is the BFG55.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

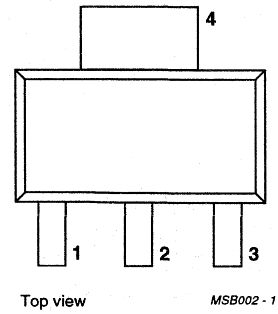


Fig.1 SOT223.

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 Ω; 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 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.
4. I_C = 60 mA; V_{CE} = 10 V; R_L = 75 Ω;
   $V_p = V_q = V_o$ = 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 Ω;
   $V_p = V_q = V_O$ = 50 dBmV;
   $f_{(p+q)}$ = 810 MHz; f_p = 250 MHz; f_q = 560 MHz.

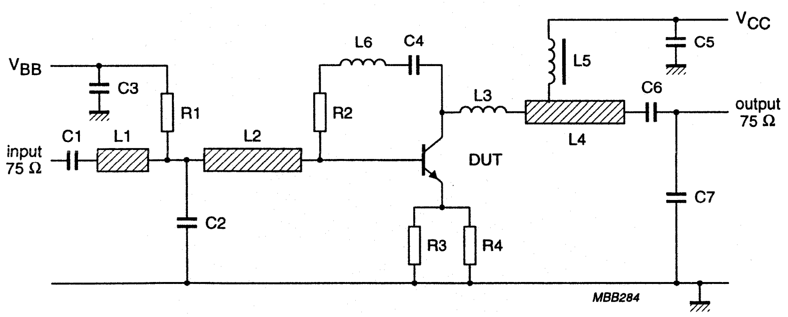


Fig.2 Intermodulation and second harmonic test circuit.

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	microstripline	75 Ω	length 7mm; 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

Notes

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.

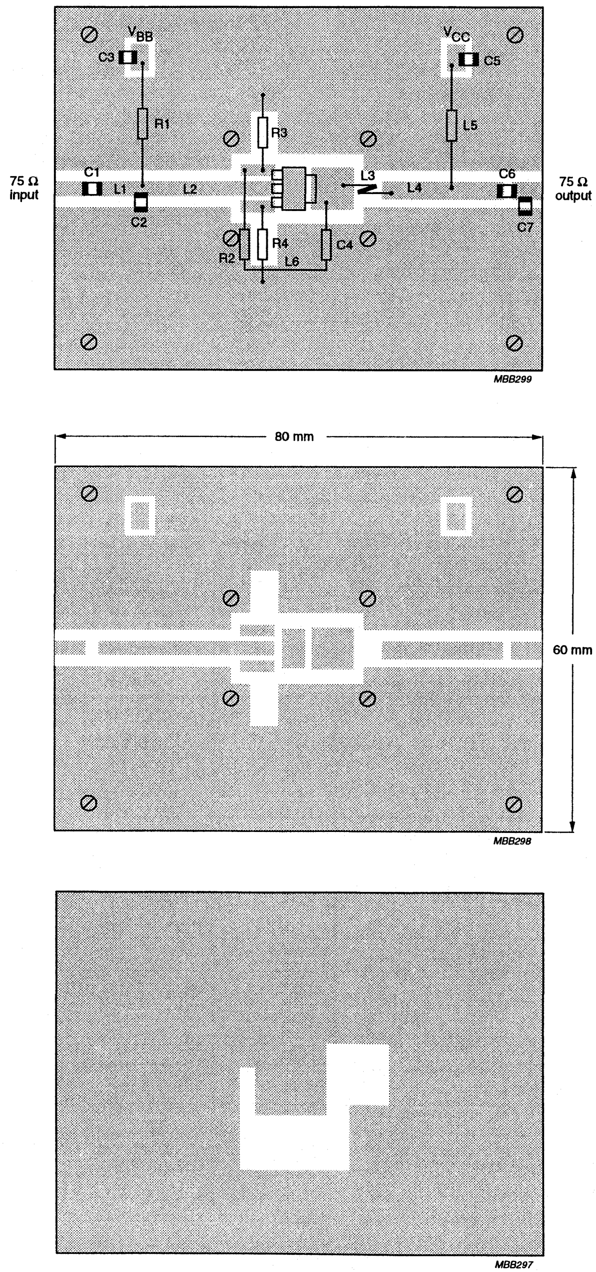


Fig.3 Intermodulation test circuit printed circuit board.

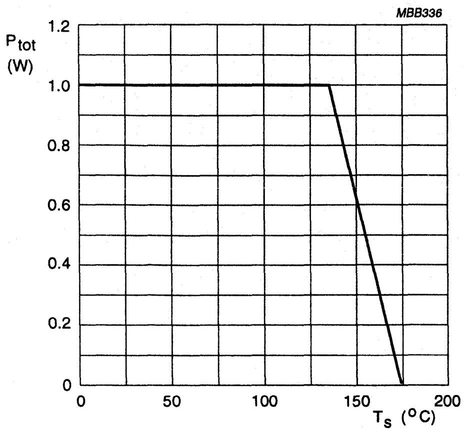
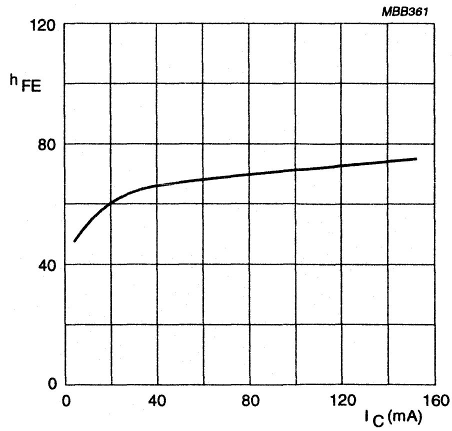
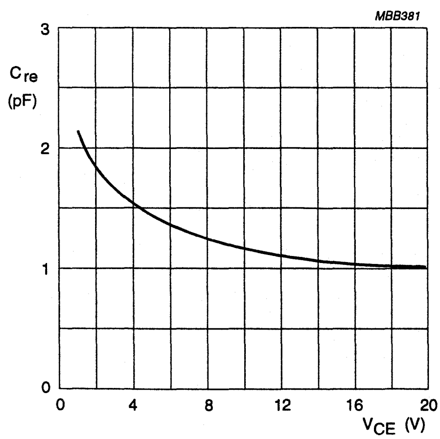


Fig.4 Power derating curve.



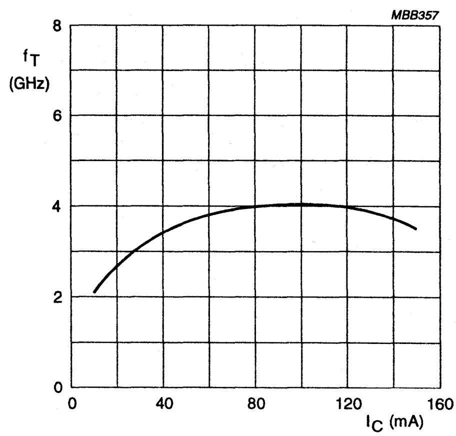
V_{CE} = 10 V; T_j = 25 °C.

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



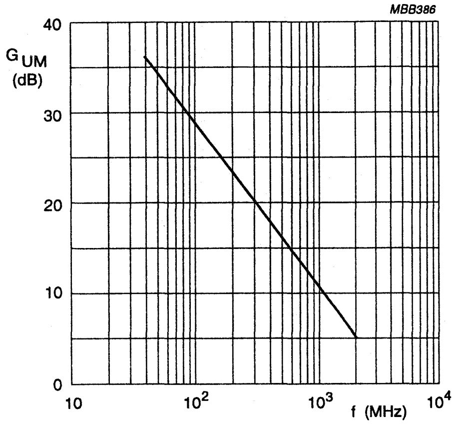
I_E = 0; f = 1 MHz; T_j = 25 °C.

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



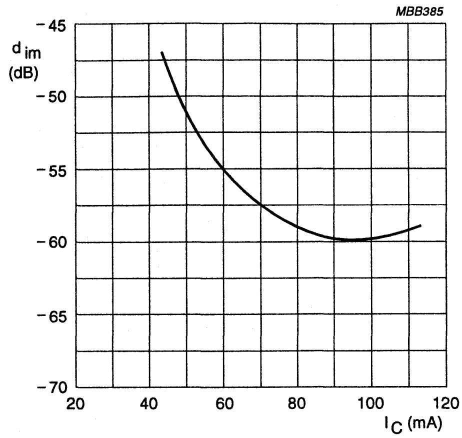
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C

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



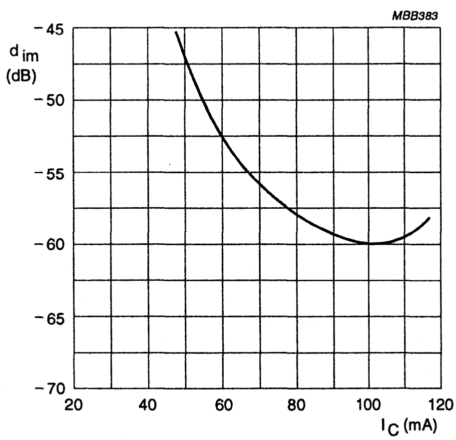
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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



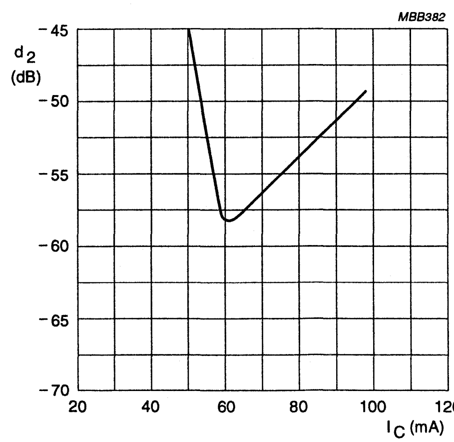
V_{CE} = 10 V; V_o = 800 mV; $f_{(p+q-r)}$ = 443.25 MHz; T_{amb} = 25 °C.

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



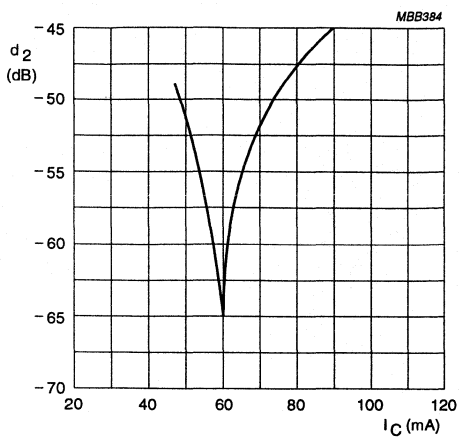
V_{CE} = 10 V; V_o = 750 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.

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



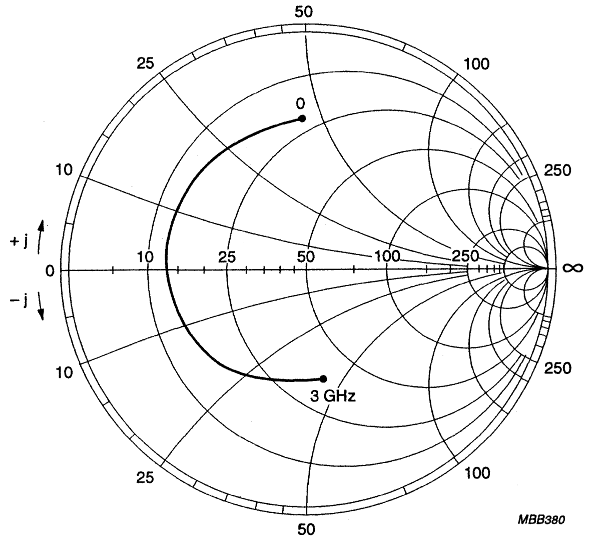
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 450 MHz; T_{amb} = 25 °C.

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



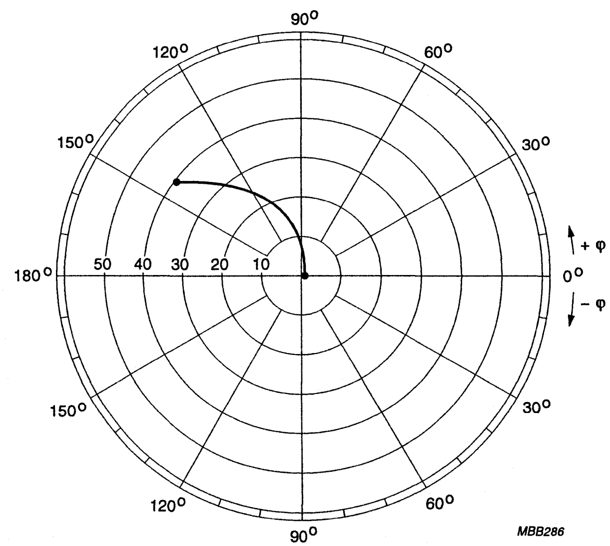
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C.

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



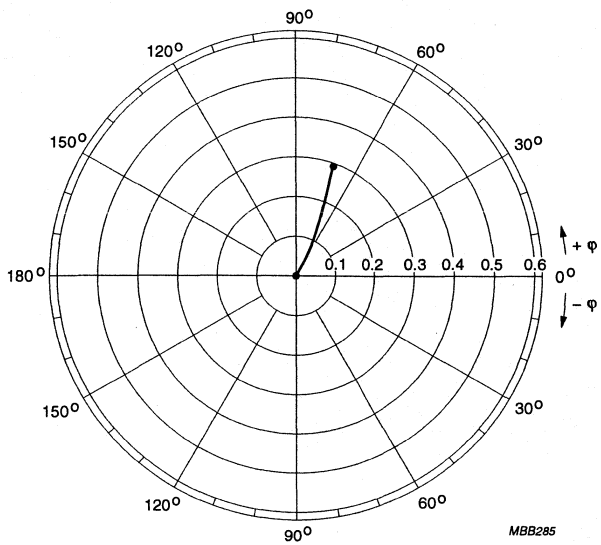
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

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



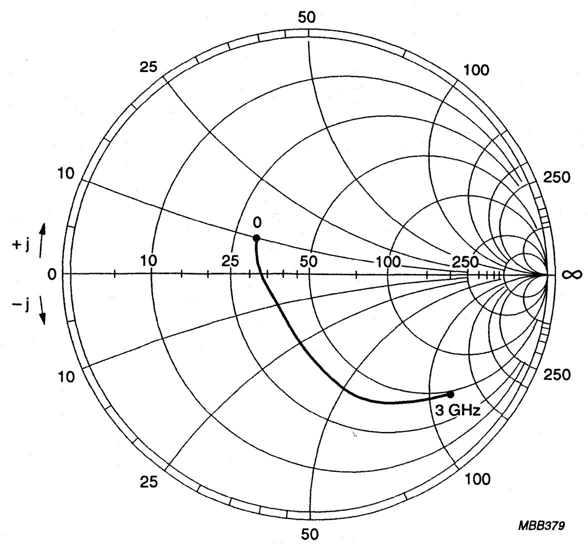
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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 transistor

BFG67; BFG67/X; BFG67R; BFG67/XR

FEATURES

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

DESCRIPTION

The BFG67 is a silicon npn transistor in a 4-pin, dual-emitter plastic SOT143 envelope. It is available as in-line emitter pinning (BFG67) and cross emitter pinning (BFG67/X). Versions with reverse pinning (BFG67R and BFG67/XR) are available upon request.

This transistor is designed for wideband applications in the GHz range, such as satellite TV tuners and portable RF communications equipment.

PINNING

PIN	DESCRIPTION
BFG67 (Fig.1) Code: V3	
1	collector
2	base
3	emitter
4	emitter
BFG67/X (Fig.1) Code: V12	
1	collector
2	emitter
3	base
4	emitter
BFG67R (Fig.2) Code: V27	
1	collector
2	base
3	emitter
4	emitter
BFG67/XR (Fig.2) Code: V26	
1	collector
2	emitter
3	base
4	emitter

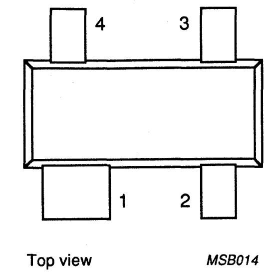


Fig.1 SOT143.

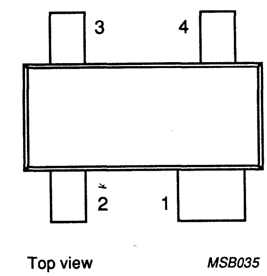


Fig.2 SOT143R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
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 = 65 °C (note 1)	–	–	380	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

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	–	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 = 65 °C (note 1)	–	380	mW
T_{stg}	storage temperature range		–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)	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	open emitter; 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; f = 1 GHz; T_{amb} = 25 °C	–	17	–	dB
		I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	1.3	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 15 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	1.7	–	dB
		I_C = 5 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C; Z_s = 60 Ω	–	2.5	–	dB
		I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C; Z_s = 60 Ω	–	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.

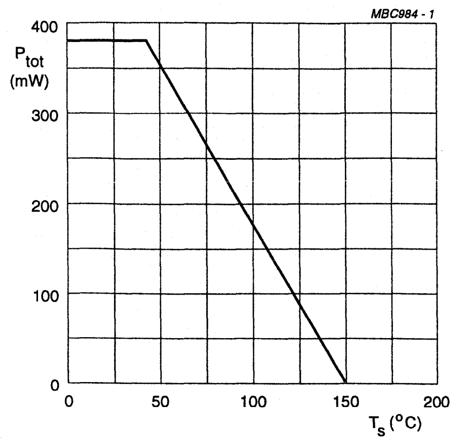
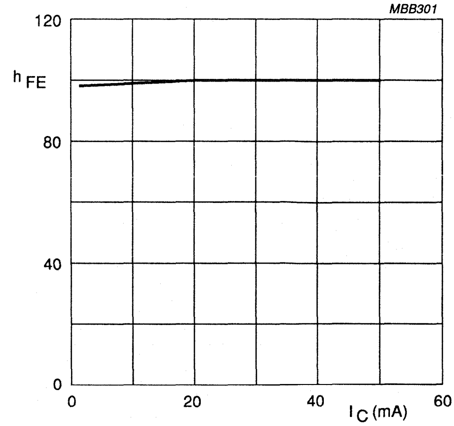
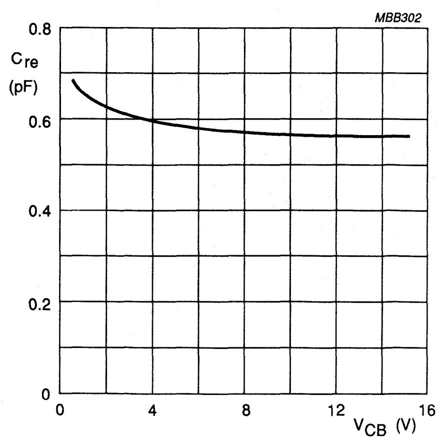


Fig.3 Power derating curve.



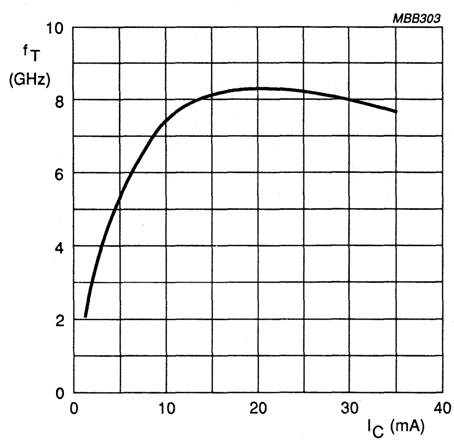
V_{CE} = 5 V.

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



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

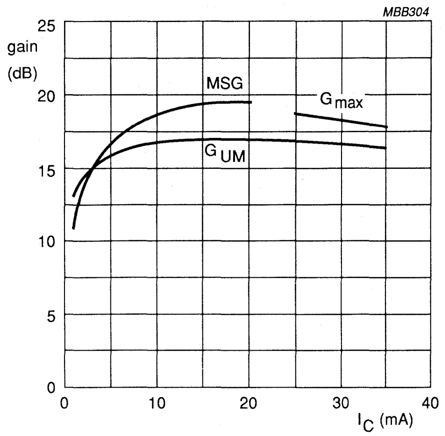
Fig.5 Feedback capacitance as a function of collector-base voltage.



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

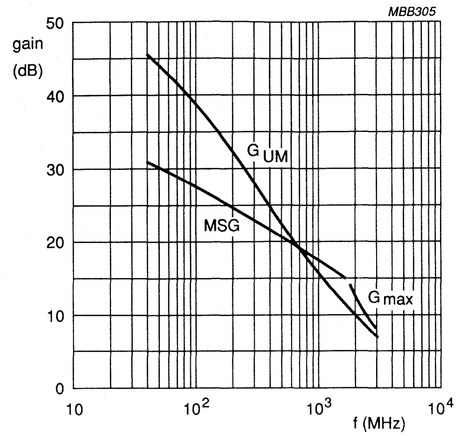
Fig.6 Transition frequency as a function of collector current.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



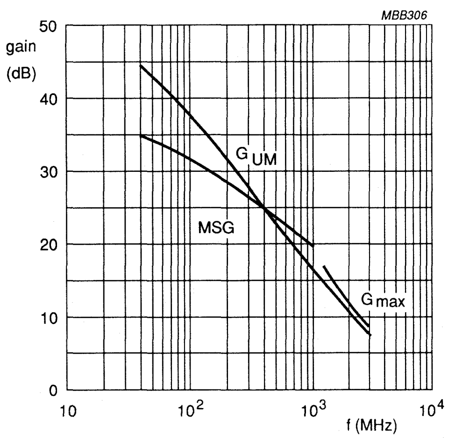
V_{CE} = 8 V; f = 1 GHz.

Fig.7 Gain as a function of collector current.



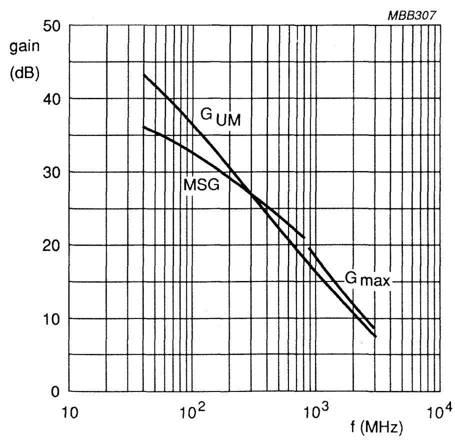
V_{CE} = 8 V; I_C = 5 mA.

Fig.8 Gain as a function of frequency.



V_{CE} = 8 V; I_C = 15 mA.

Fig.9 Gain as a function of frequency.

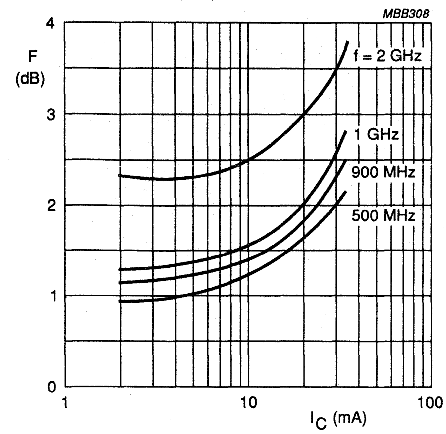


V_{CE} = 8 V; I_C = 30 mA.

Fig.10 Gain as a function of frequency.

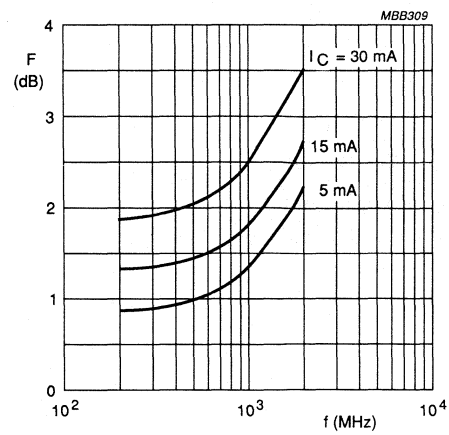
NPN 8 GHz wideband transistor

BFG67; BFG67/X; BFG67R; BFG67/XR



V_{CE} = 8 V.

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



V_{CE} = 8 V.

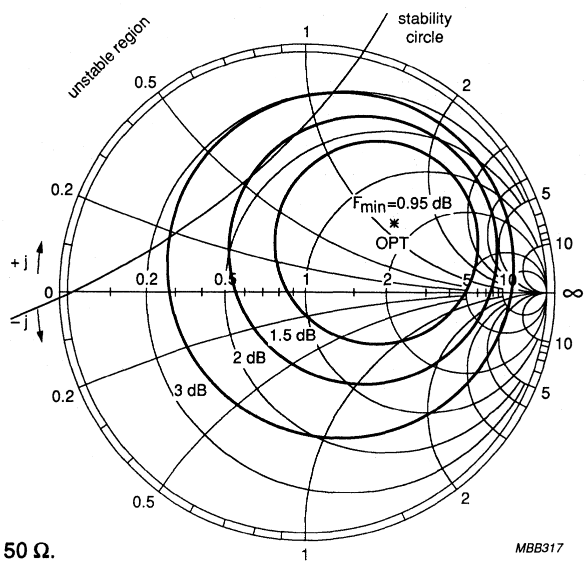
Fig.12 Minimum noise figure as a function of frequency.

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

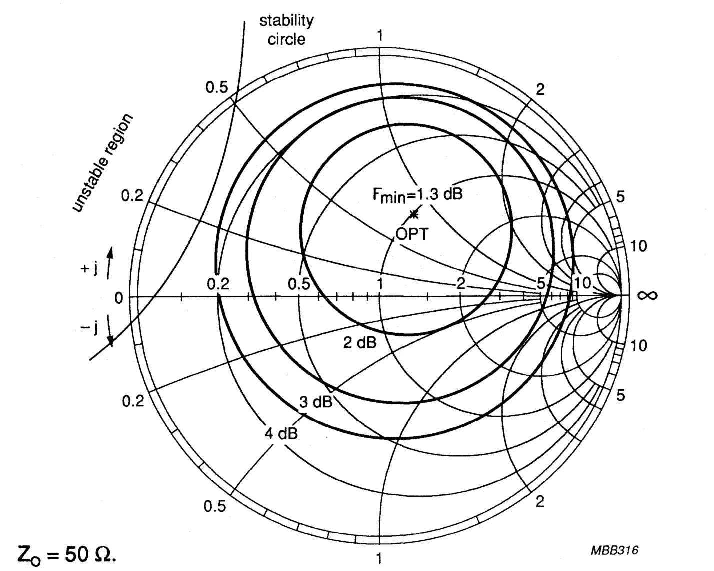


Fig.14 Noise circle figure.

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

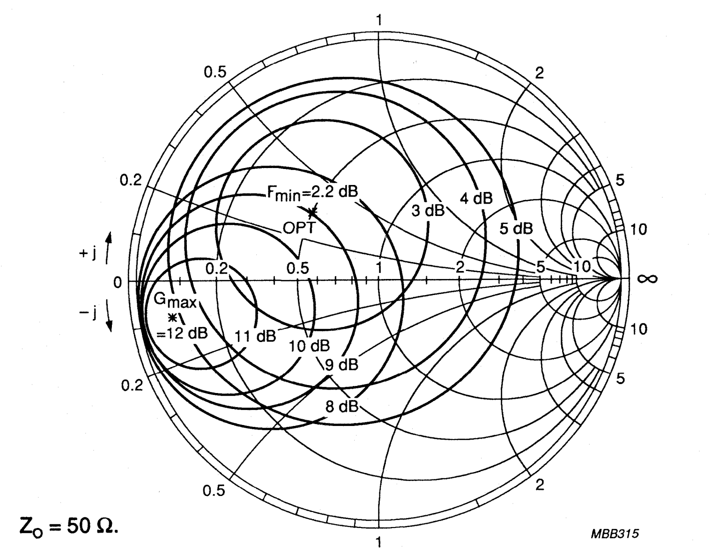
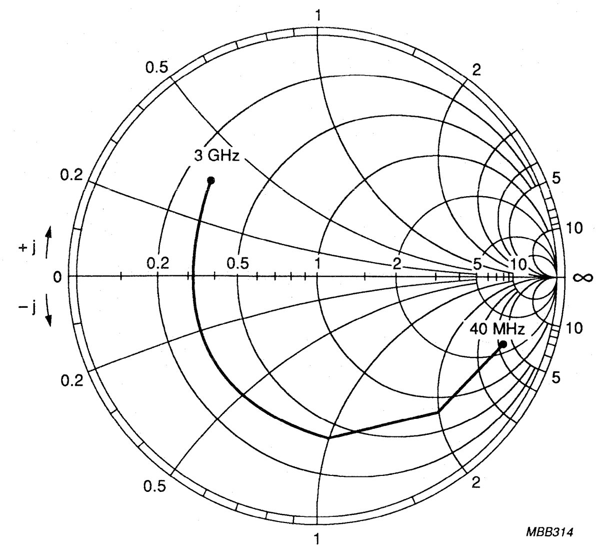
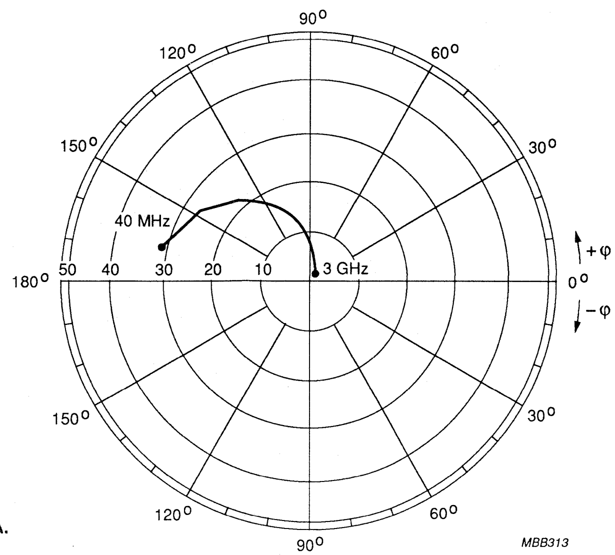


Fig.15 Noise circle figure.



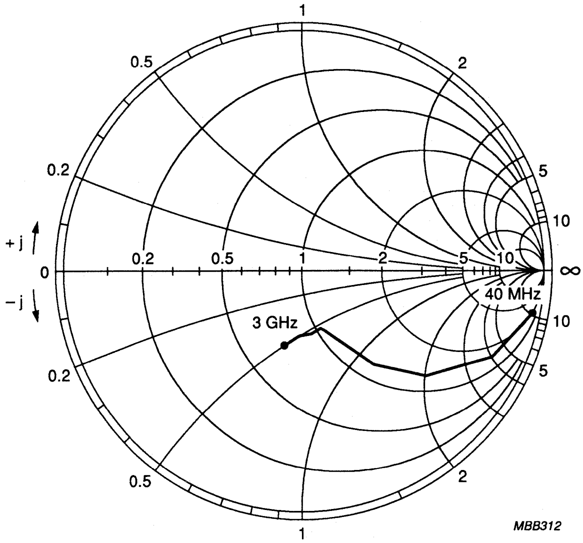
V_{CE} = 8 V; I_C = 15 mA.
Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



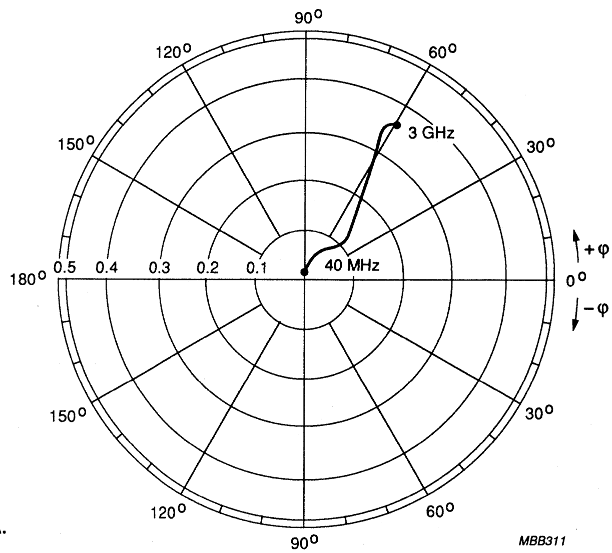
V_{CE} = 8 V; I_C = 15 mA.

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.

Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 8 GHz wideband transistor

BFG67W
BFG67W/X; BFG67W/XR

FEATURES

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

APPLICATIONS

They are intended for wideband applications in the GHz range such as analog satellite television systems and portable RF communication equipment.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG67W	V2
BFG67W/X	V6
BFG67W/XR	V7

PINNING

PIN	DESCRIPTION
BFG67W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG67W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG67W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

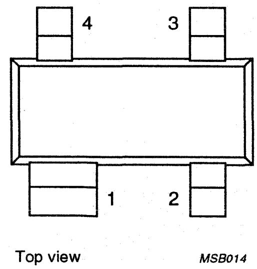


Fig.1 SOT343.

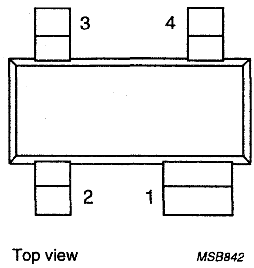


Fig.2 SOT343R.

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	up to T_s = 85 °C	–	–	500	mW
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 5 V	60	100	–	
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 8 V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 8 V; f = 500 MHz; T_{amb} = 25 °C	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 15 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	15.5	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; 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	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.

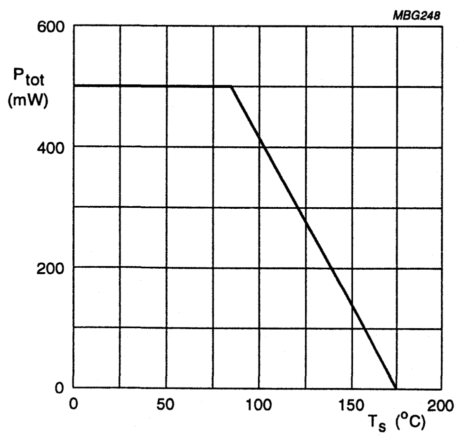


Fig.3 Power derating curve.

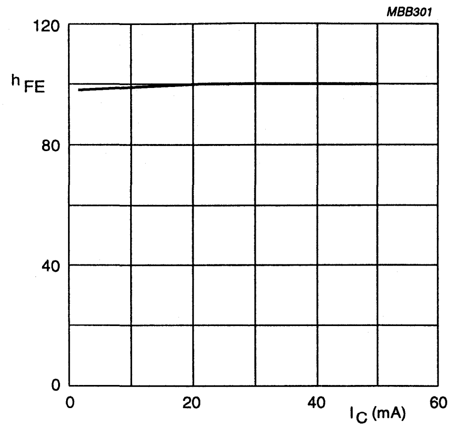
CHARACTERISTICS

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
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	–	–	10	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	–	–	2.5	V
I_{CBO}	collector cut-off current	open emitter; 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; T_{amb} = 25 °C	–	7.5	–	GHz
C_c	collector capacitance	I_E = i_e = 0; V_{CE} = 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_{CE} = 8 V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 15 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	15.5	–	dB
		I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	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	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; f = 2 GHz	–	2.2	–	dB

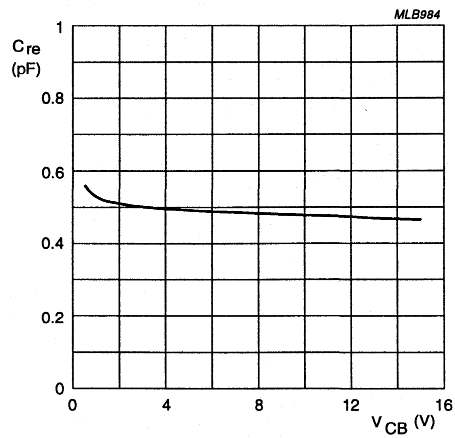
Note

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.



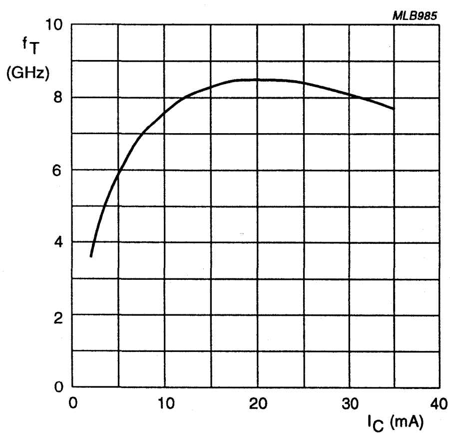
V_{CE} = 5 V.

Fig.4 DC current gain as a function of collector current; typical values.



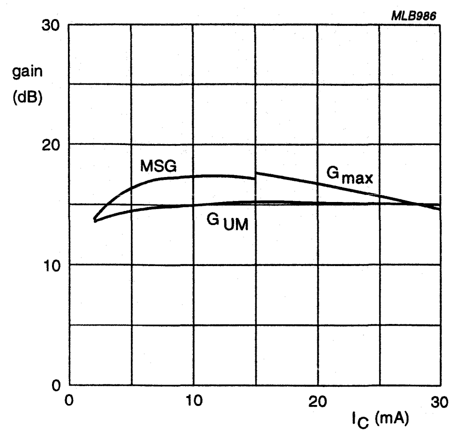
I_C = 0; f = 1 MHz.

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



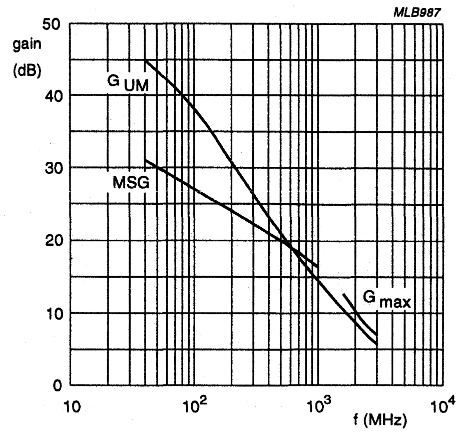
f = 2 GHz; V_{CE} = 8 V; T_{amb} = 25 °C.

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



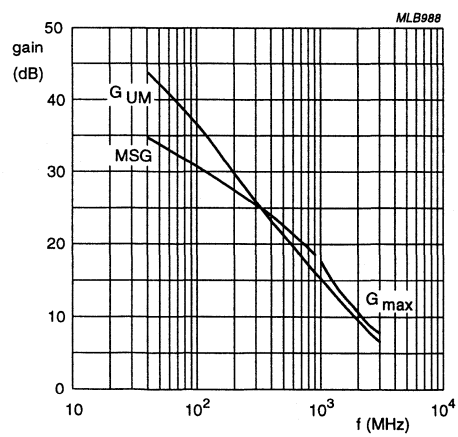
f = 1 GHz; V_{CE} = 8 V.

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



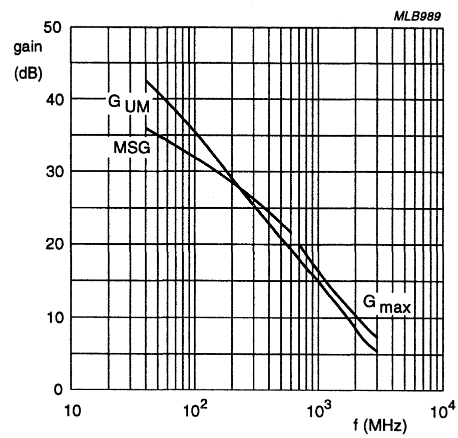
I_C = 5 mA; V_{CE} = 8 V.

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



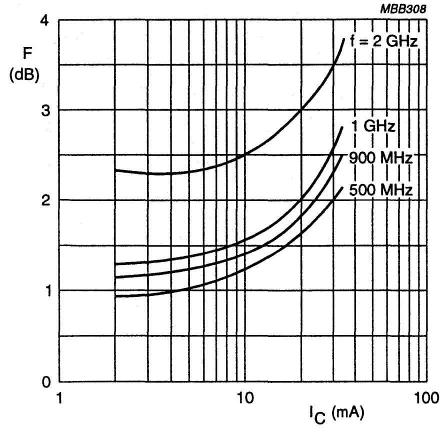
I_C = 15 mA; V_{CE} = 8 V.

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



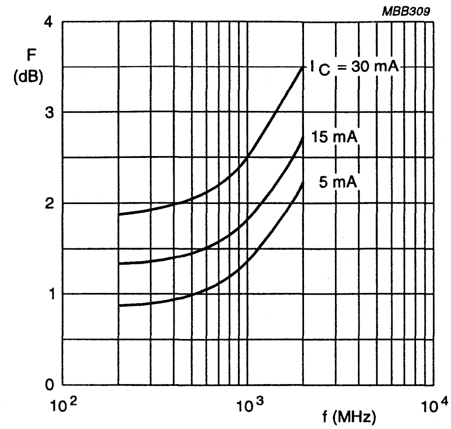
I_C = 30 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.



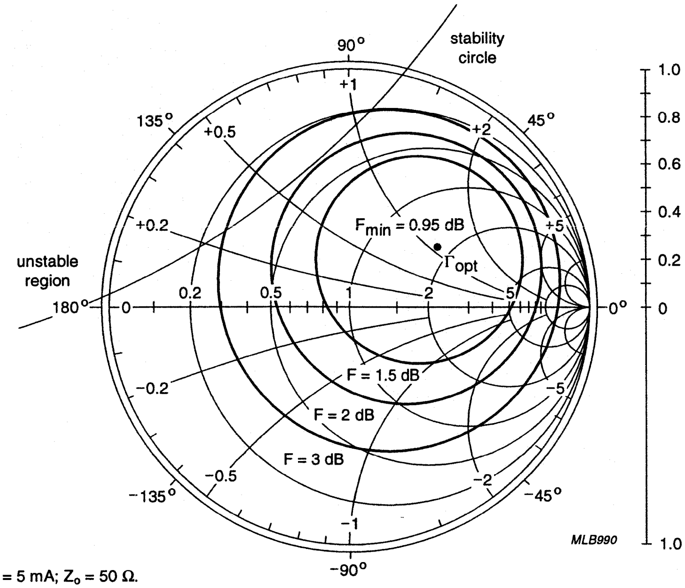
V_{CE} = 8 V.

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



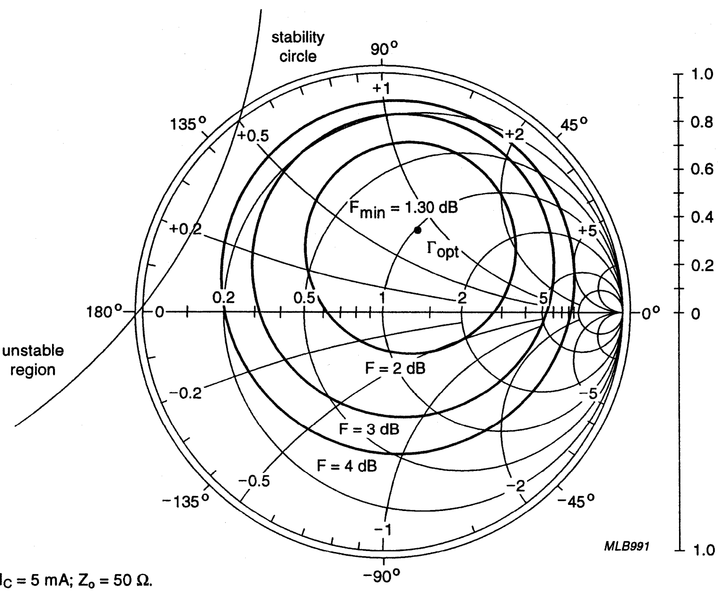
V_{CE} = 8 V.

Fig.12 Minimum noise figure as a function of frequency; typical values.



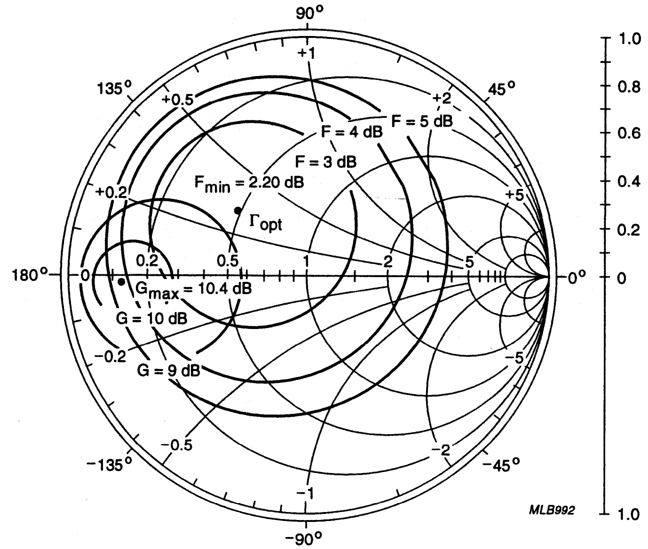
f = 500 MHz; V_{CE} = 8 V; I_C = 5 mA; Z_o = 50 Ω.

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



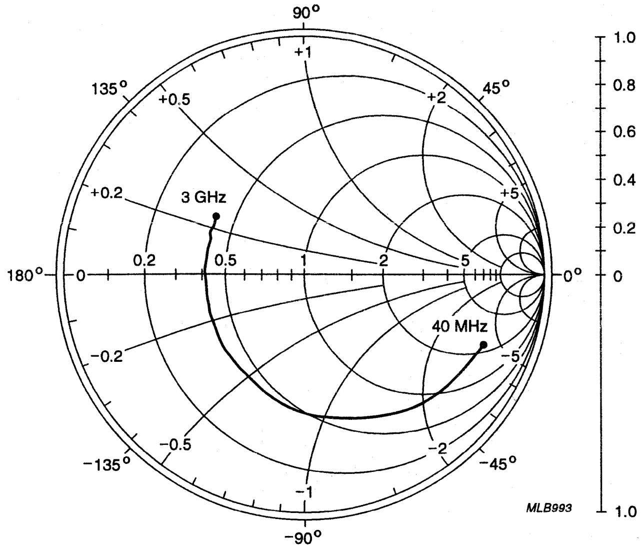
f = 1 GHz; V_{CE} = 8 V; I_C = 5 mA; Z_o = 50 Ω.

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



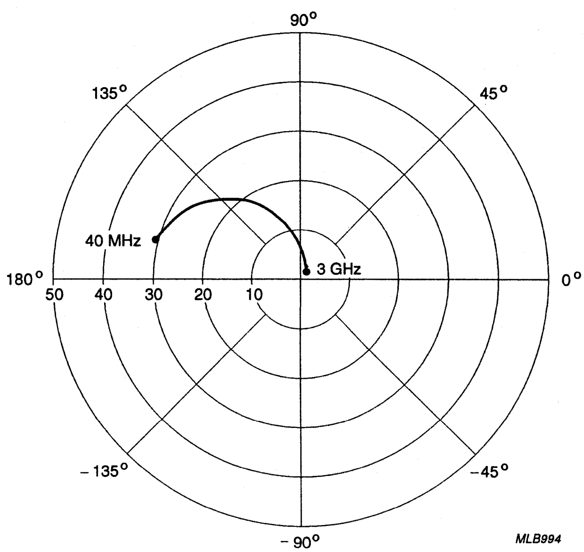
f = 2 GHz; V_{CE} = 8 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



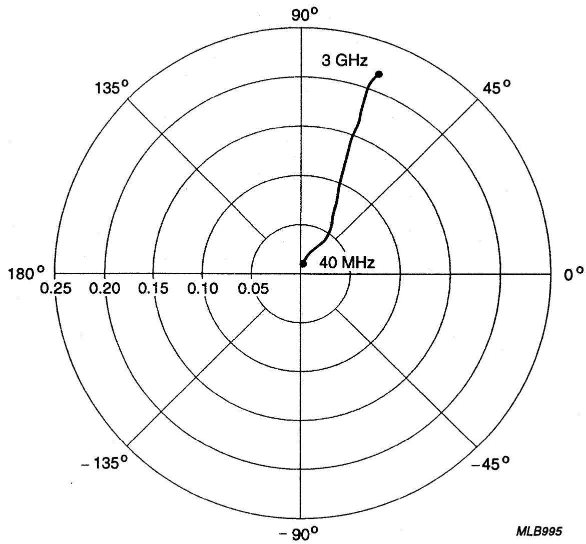
V_{CE} = 8 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (s_{11}); typical values.



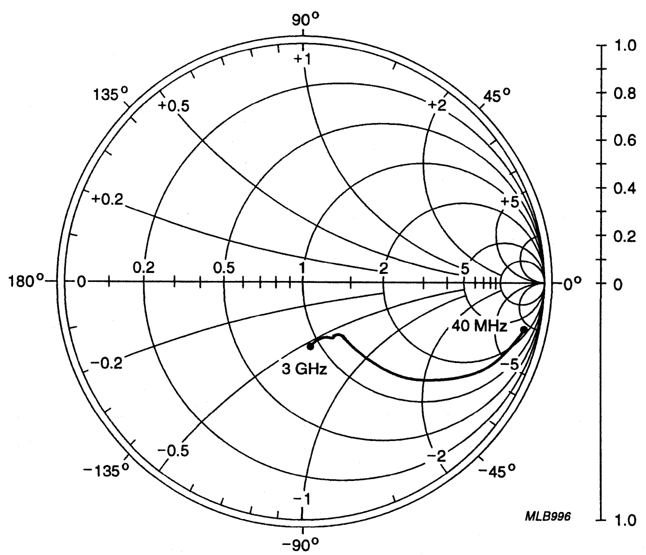
V_{CE} = 8 V; I_C = 15 mA.

Fig.17 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 8 V; I_C = 15 mA.

Fig.18 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 8 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (s_{22}); typical values.

NPN 5 GHz wideband transistors

BFG92A; BFG92A/X; BFG92A/XR

FEATURES

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

DESCRIPTION

The BFG92 is a silicon NPN transistor in a 4-pin, dual-emitter plastic SOT143 envelope. It is primarily intended for wideband applications in the UHF and microwave range.

PINNING

PIN	DESCRIPTION
BFG92A (Fig.1) Code: P8	
1	collector
2	base
3	emitter
4	emitter
BFG92A/X (Fig.1) Code: V14	
1	collector
2	emitter
3	base
4	emitter
BFG92A/XR (Fig.2) Code: V29	
1	collector
2	emitter
3	base
4	emitter

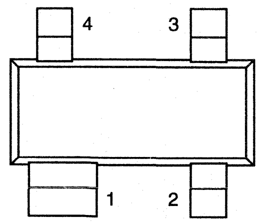


Fig.1 SOT143.

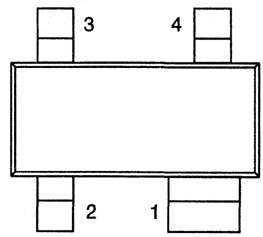


Fig.2 SOT143R.

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 value	–	–	25	mA
P_{tot}	total power dissipation	up to T_S = 60 °C; note 1	–	–	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	–	2.0	–	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	collector current	DC value, continuous	–	25	mA
P_{tot}	total power dissipation	up to T_S = 60 °C; note 1	–	400	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	from junction to soldering point; 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 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	–	2.0	–	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.

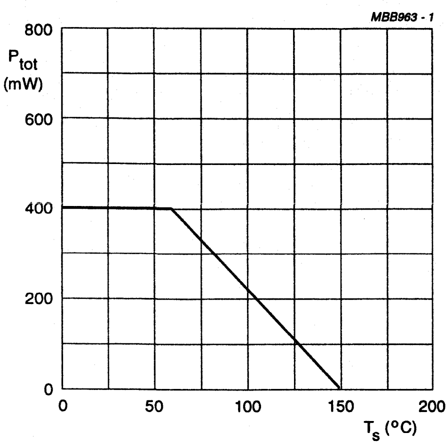
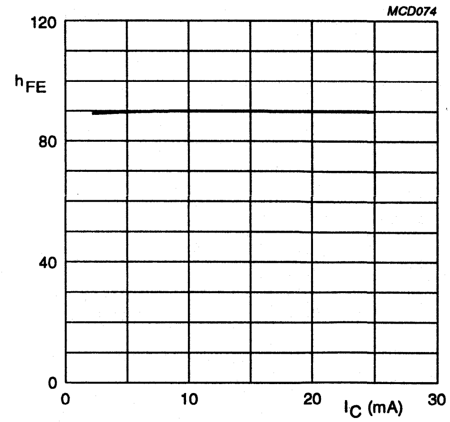
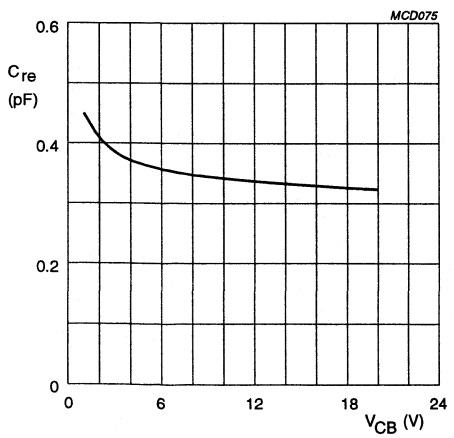


Fig.3 Power derating curve.



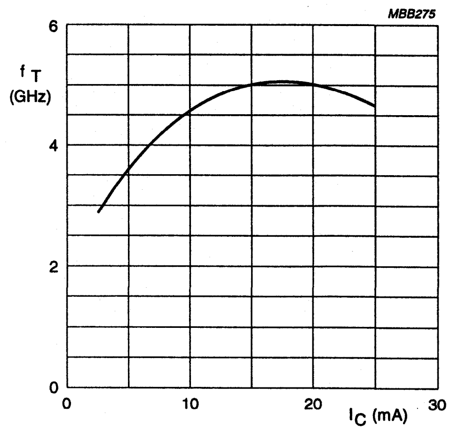
V_{CE} = 10 V.

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



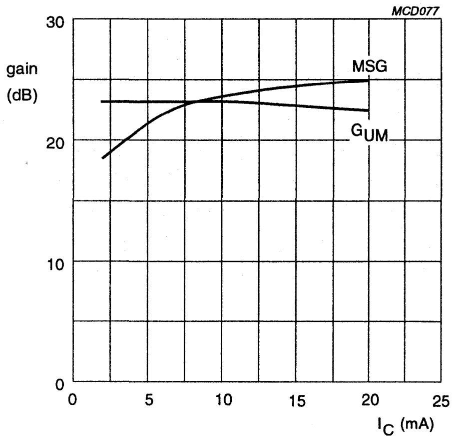
$I_C = i_c = 0$; f = 1 MHz.

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



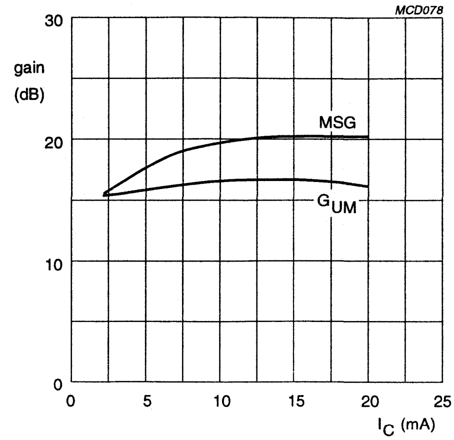
V_{CE} = 10 V; T_{amb} = 25 °C; f = 500 MHz.

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



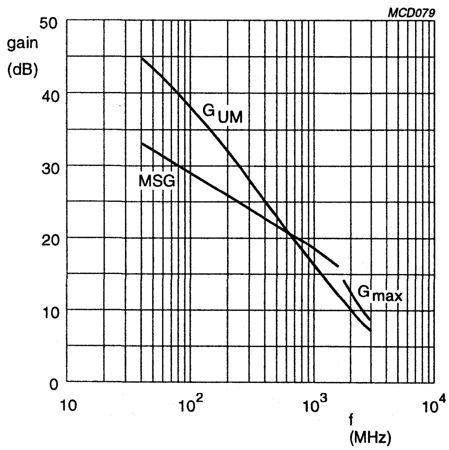
V_{CE} = 10 V; f = 500 MHz.

Fig.7 Gain as a function of collector current.



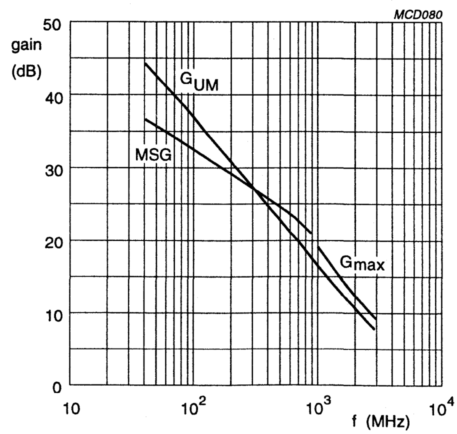
V_{CE} = 10 V; f = 1 GHz.

Fig.8 Gain as a function of collector current.



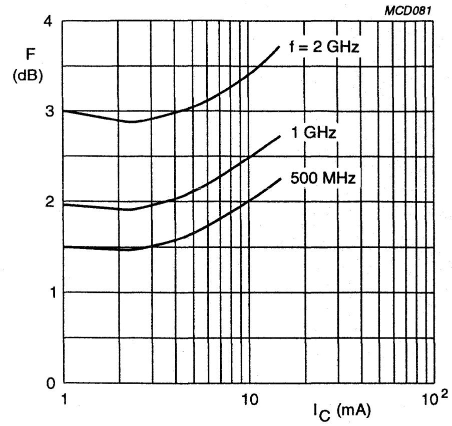
V_{CE} = 10 V; I_C = 5 mA.

Fig.9 Gain as a function of frequency.



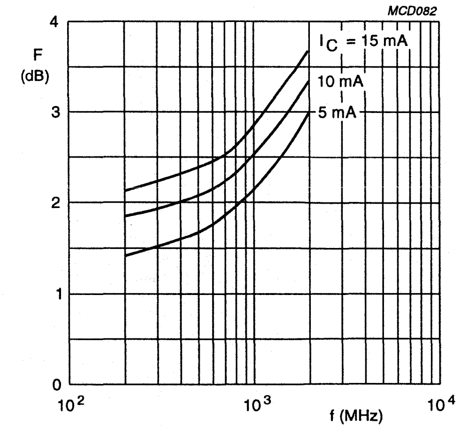
V_{CE} = 10 V; I_C = 15 mA.

Fig.10 Gain as a function of frequency.



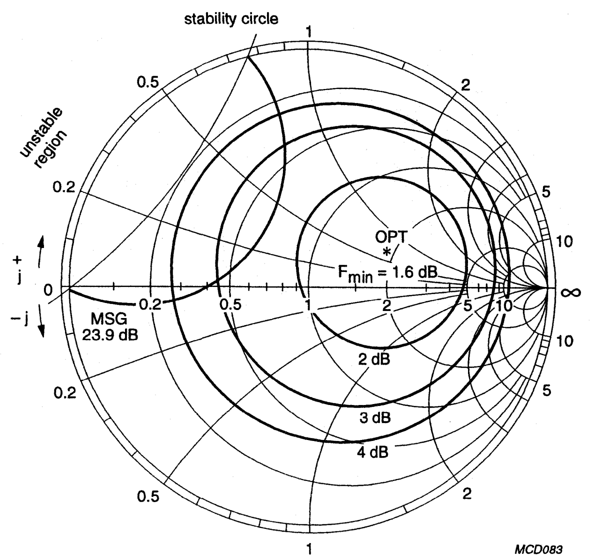
V_{CE} = 10 V.

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



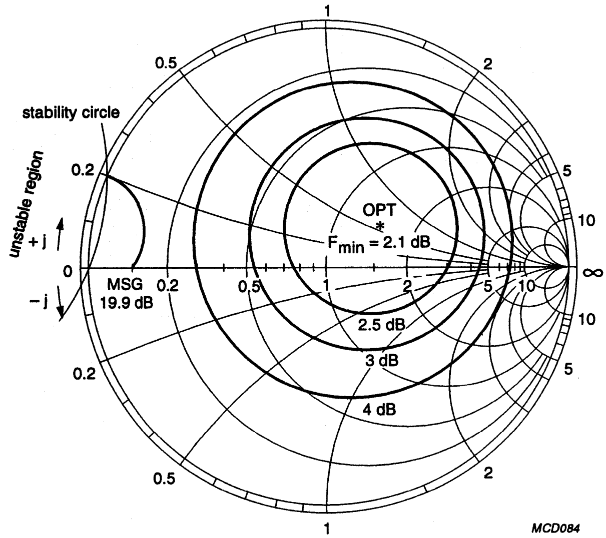
V_{CE} = 10 V.

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



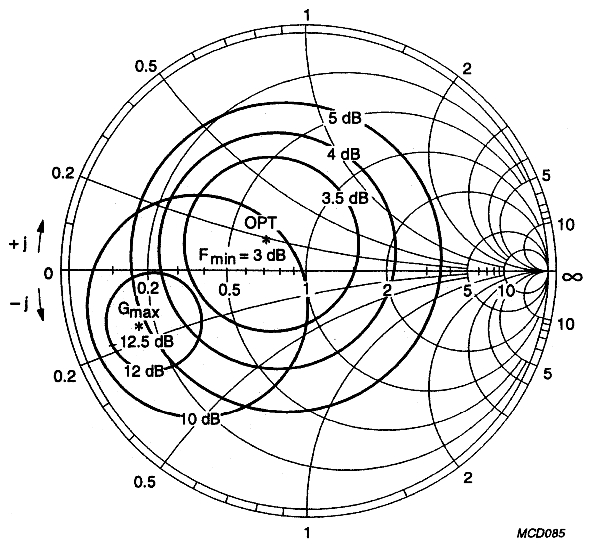
Z_o = 50 Ω.
Maximum stable gain = 23.9 dB.

Fig.13 Noise circle figure.



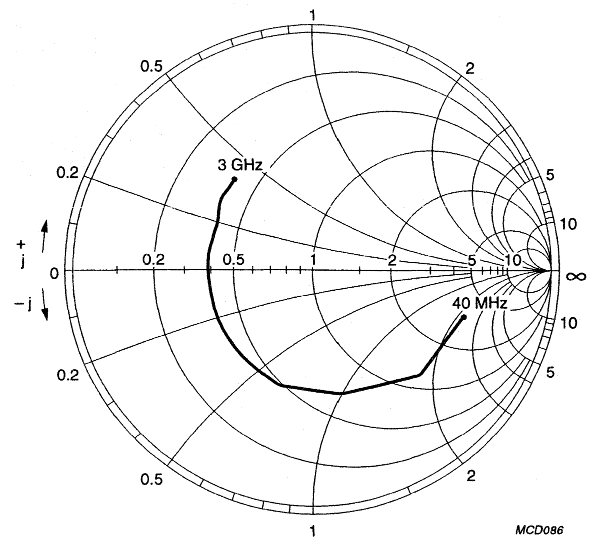
Z_o = 50 Ω.
Maximum stable gain = 19.9 dB.

Fig.14 Noise circle figure.



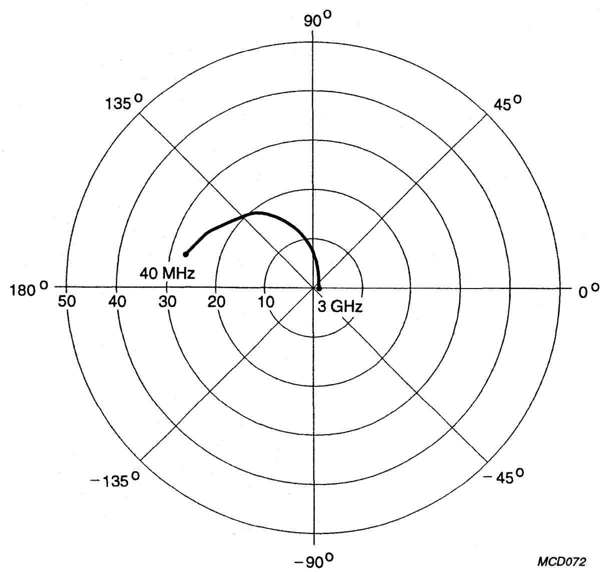
Z_o = 50 Ω.

Fig.15 Noise circle figure.



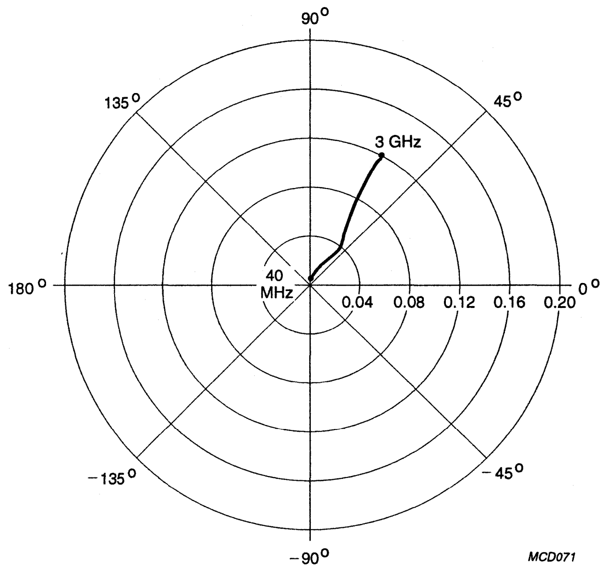
V_{CE} = 10 V; I_C = 15 mA.

Fig.16 Common emitter input reflection coefficient (S_{11}).



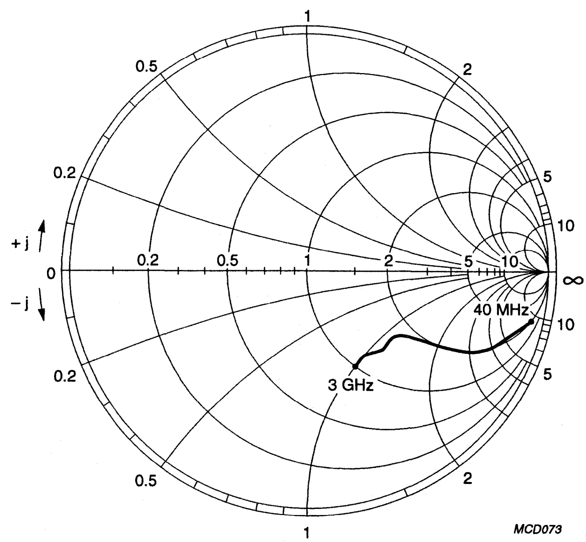
V_{CE} = 10 V; I_C = 15 mA.

Fig.17 Common emitter forward transmission coefficient (S_{21}).



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

Fig.18 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 6 GHz wideband transistor

BFG92AW
BFG92AW/X; BFG92AW/XR

FEATURES

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

APPLICATIONS

They are intended for wideband applications in the UHF and microwave ranges.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG92AW	P8
BFG92AW/X	P9
BFG92AW/XR	P2

PINNING

PIN	DESCRIPTION
BFG92AW (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG92AW/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG92AW/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

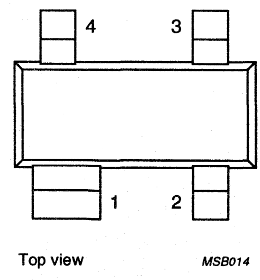


Fig.1 SOT343.

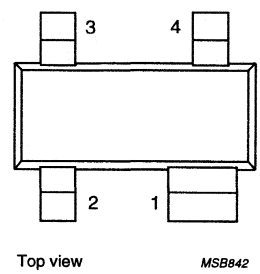


Fig.2 SOT343R.

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 = 85 °C	–	–	500	mW
h_{FE}	DC 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	–	0.35	–	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 15 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	15.5	–	dB
		I_C = 15 mA; V_{CE} = 10 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 10 V; f = 1 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_{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 = 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.

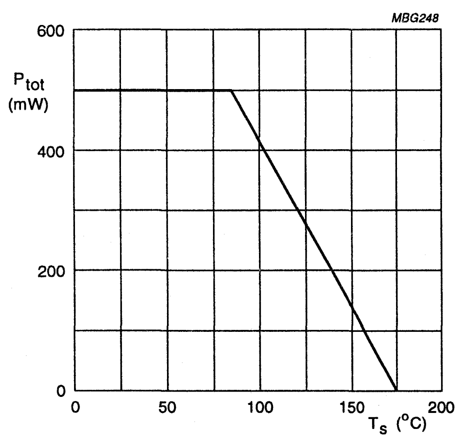


Fig.3 Power derating curve.

CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

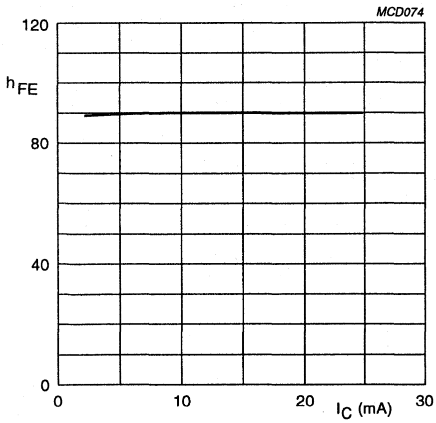
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA; I_E = 0	–	–	20	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	–	–	15	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	–	–	2	V
I_{CBO}	collector cut-off current	open emitter; V_{CB} = 10 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 10 V	40	90	–	
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	6	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CE} = 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
G_{UM}	maximum unilateral power gain; note 1	I_C = 15 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	15.5	–	dB
		I_C = 15 mA; V_{CE} = 10 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 10 V; f = 1 GHz	–	2.1	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 10 V; f = 2 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.

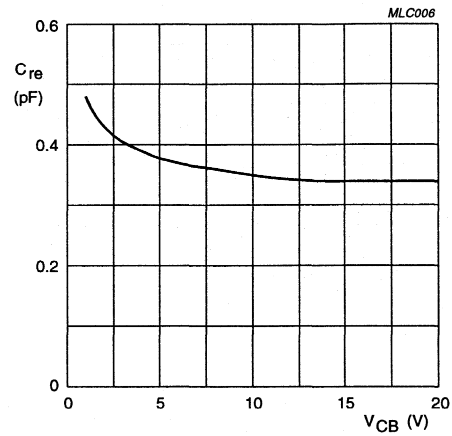
NPN 6 GHz wideband transistor

BFG92AW
BFG92AW/X; BFG92AW/XR



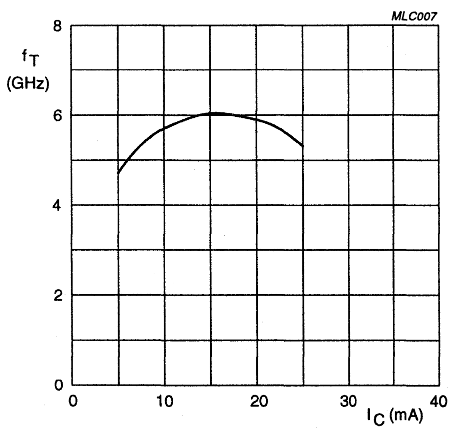
V_{CE} = 10 V.

Fig.4 Current gain (DC) 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.

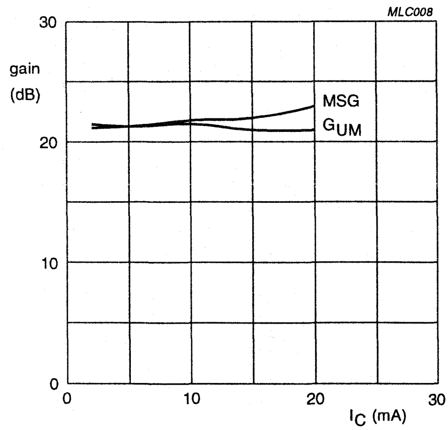


f = 500 MHz; V_{CE} = 10 V; T_{amb} = 25 °C.

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

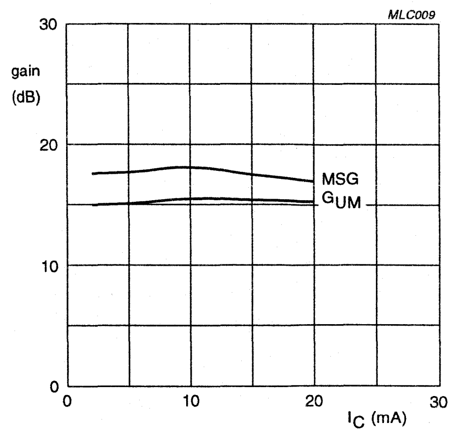
NPN 6 GHz wideband transistor

BFG92AW
BFG92AW/X; BFG92AW/XR



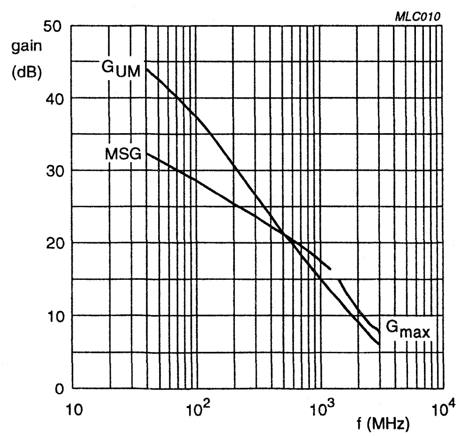
f = 500 MHz; V_{CE} = 10 V.

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



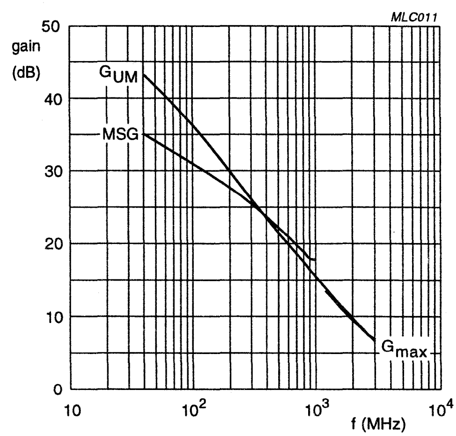
f = 1 GHz; V_{CE} = 10 V.

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



I_C = 5 mA; V_{CE} = 10 V.

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

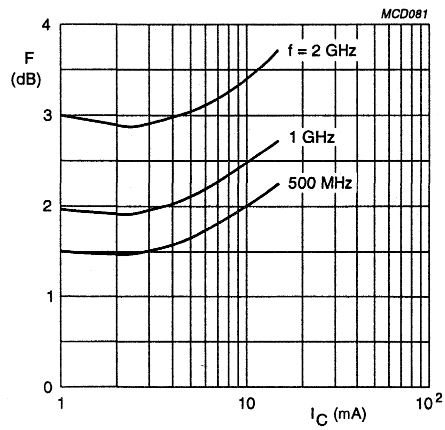


I_C = 15 mA; V_{CE} = 10 V.

Fig.10 Gain as a function of frequency; typical values.

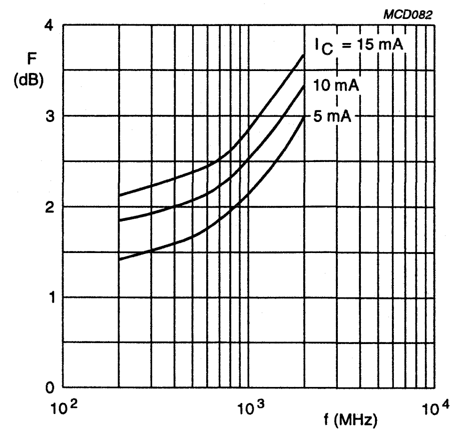
NPN 6 GHz wideband transistor

BFG92AW BFG92AW/X; BFG92AW/XR



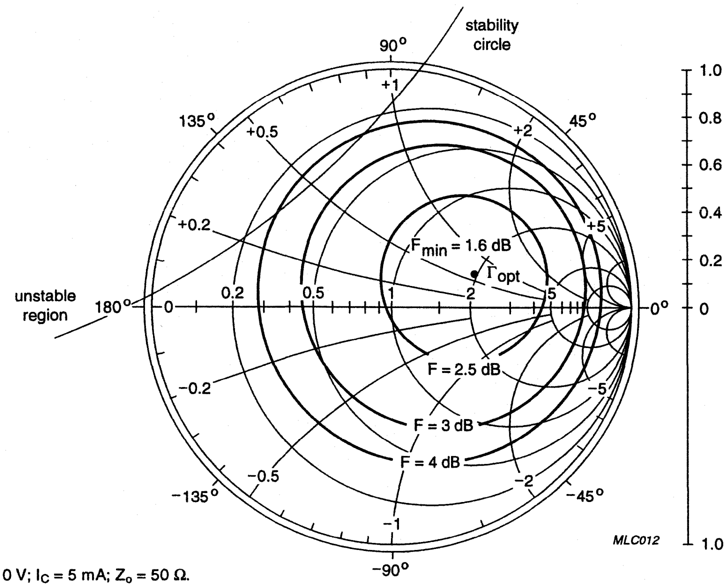
V_{CE} = 10 V.

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



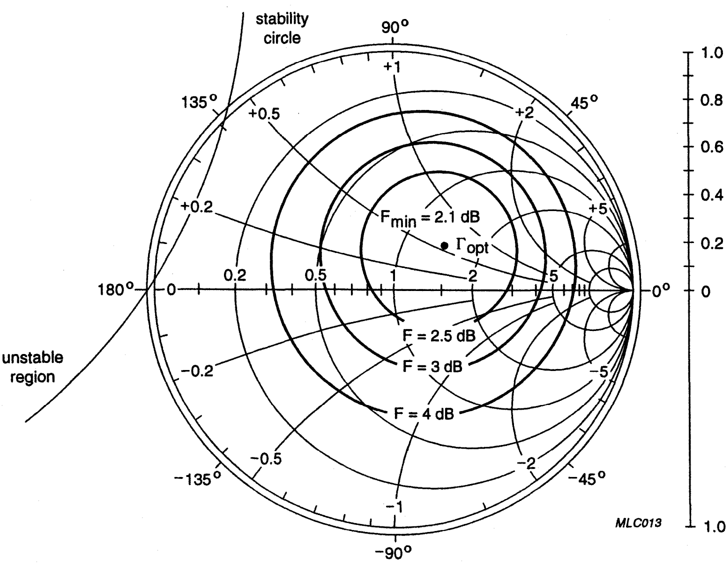
V_{CE} = 10 V.

Fig.12 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.13 Common emitter noise figure circles; typical values.

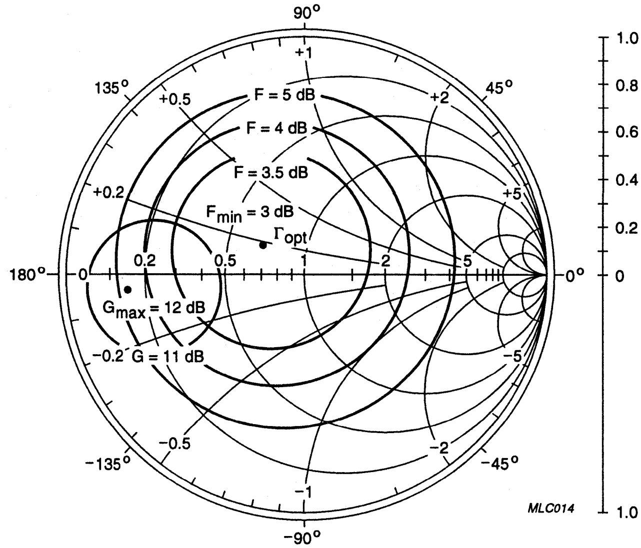


f = 1 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

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

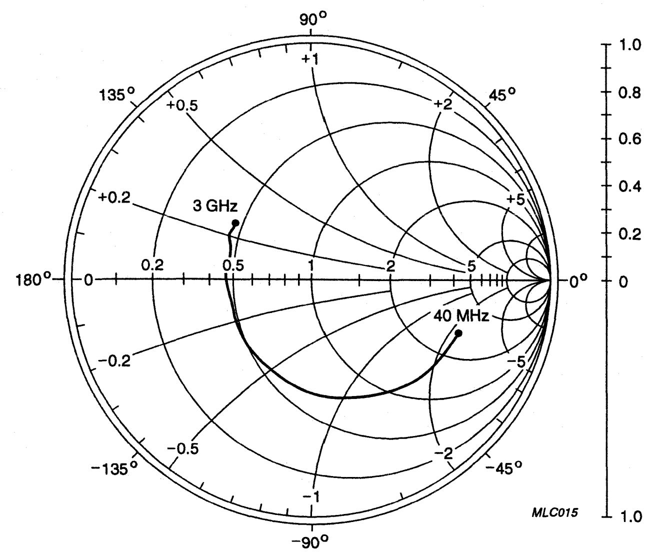
NPN 6 GHz wideband transistor

BFG92AW
BFG92AW/X; BFG92AW/XR



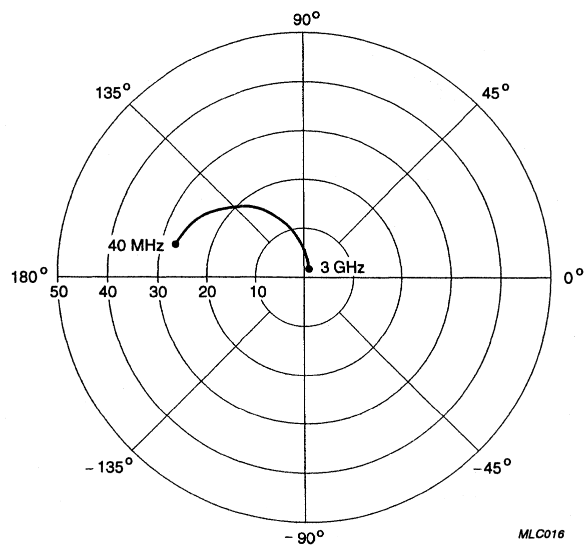
f = 2 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



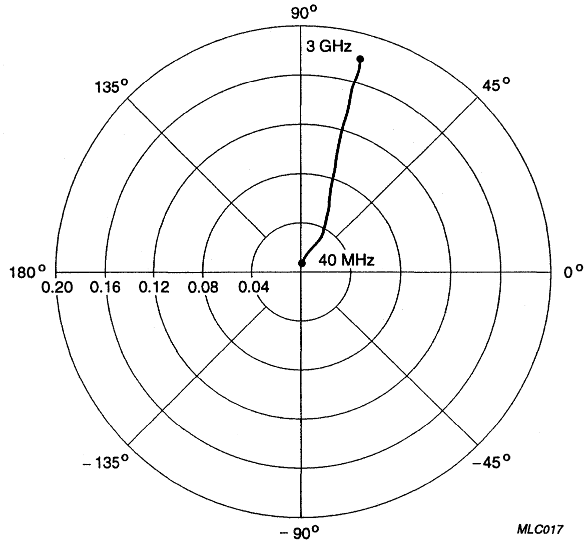
V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (s_{11}); typical values.



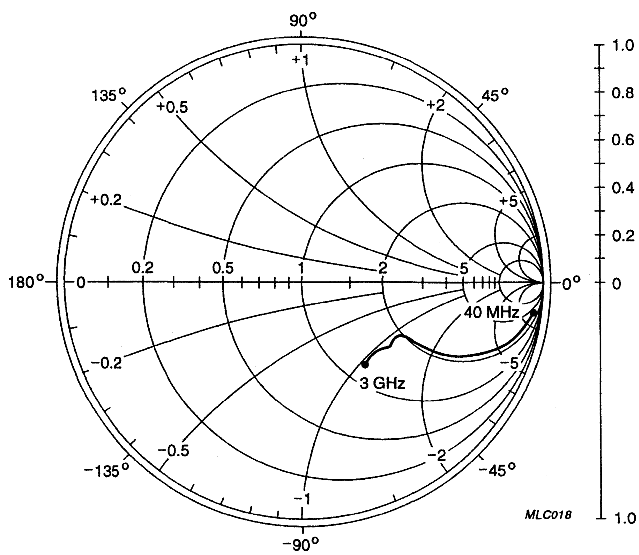
V_{CE} = 10 V; I_C = 15 mA.

Fig.17 Common emitter forward transmission coefficient (s_{21}); typical values.



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

Fig.18 Common emitter reverse transmission coefficient (s_{12}); typical values.



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

Fig.19 Common emitter output reflection coefficient (s_{22}); typical values.

NPN 6 GHz wideband transistors

BFG93A; BFG93A/X; BFG93A/XR

FEATURES

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

DESCRIPTION

The BFG93 is a silicon NPN transistor in a 4-pin, dual-emitter plastic SOT143 envelope. It is primarily intended for wideband applications in the UHF and microwave range.

PINNING

PIN	DESCRIPTION
BFG93A (Fig.1) Code: R8	
1	collector
2	base
3	emitter
4	emitter
BFG93A/X (Fig.1) Code: V15	
1	collector
2	emitter
3	base
4	emitter
BFG93A/XR (Fig.2) Code: V33	
1	collector
2	emitter
3	base
4	emitter

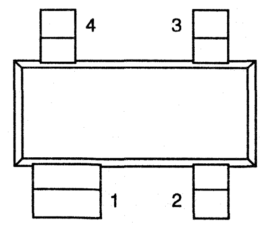


Fig.1 SOT143.

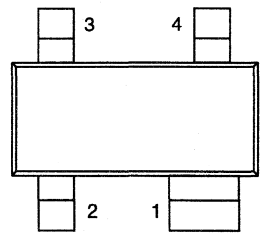


Fig.2 SOT143XR.

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 value	–	–	35	mA
P_{tot}	total power dissipation	up to T_S = 85 °C; note 1	–	–	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

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	collector current	DC value, continuous	–	35	mA
P_{tot}	total power dissipation	up to T_S = 85 °C; note 1	–	300	mW
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction operating temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	from junction to soldering point; 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 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.

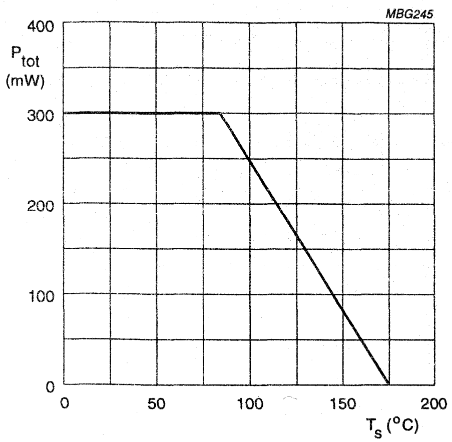
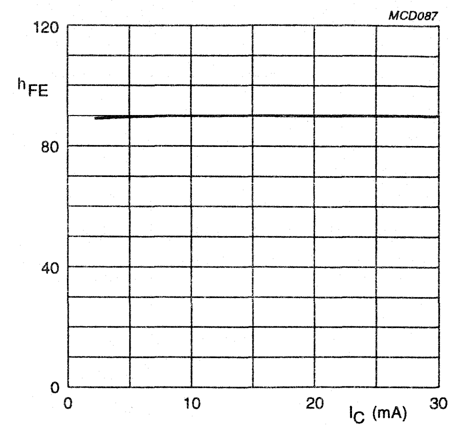
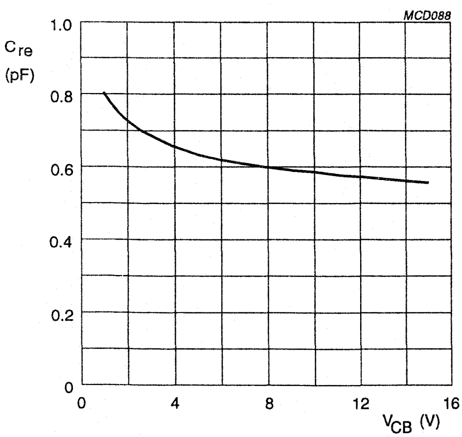


Fig.3 Power derating curve.



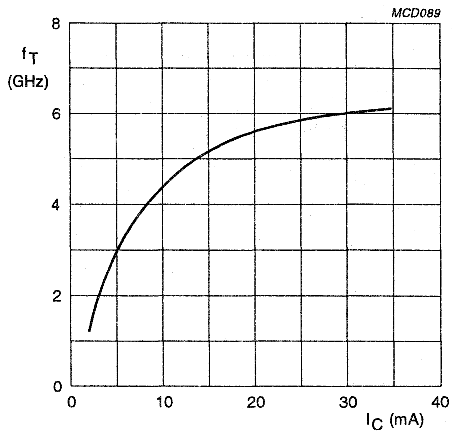
V_{CE} = 5 V.

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



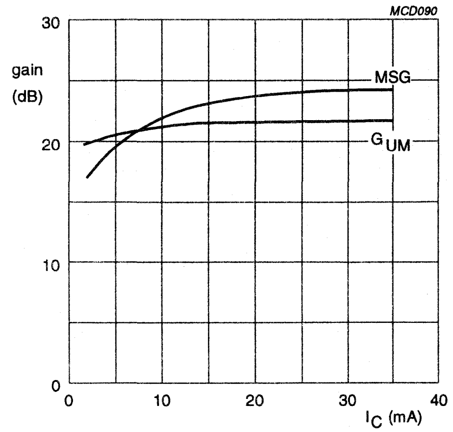
$I_C = i_c = 0$; f = 1 MHz.

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



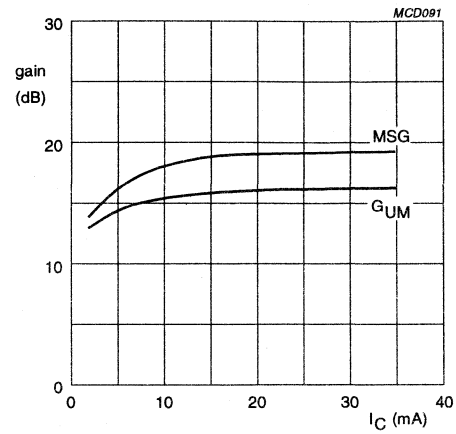
V_{CE} = 5 V; T_{amb} = 25 °C; f = 500 MHz.

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



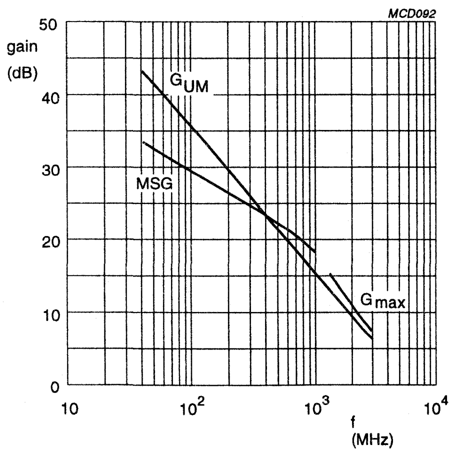
V_{CE} = 8 V; f = 500 MHz.

Fig.7 Gain as a function of collector current.



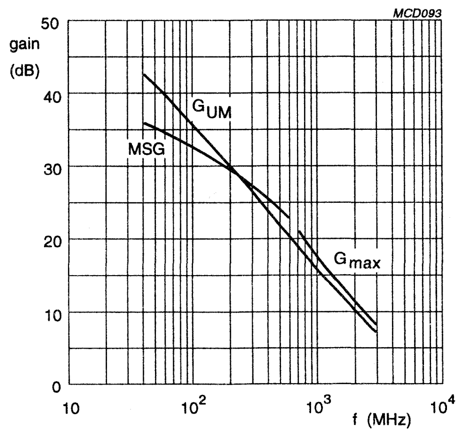
V_{CE} = 8 V; f = 1 GHz.

Fig.8 Gain as a function of collector current.



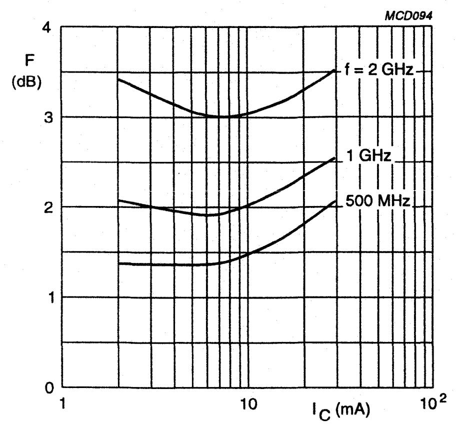
V_{CE} = 8 V; I_C = 10 mA.

Fig.9 Gain as a function of frequency.



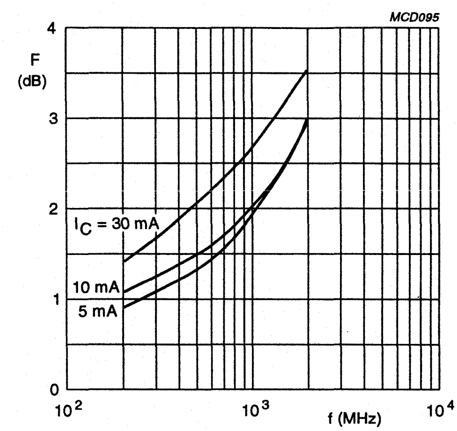
V_{CE} = 8 V; I_C = 30 mA.

Fig.10 Gain as a function of frequency.



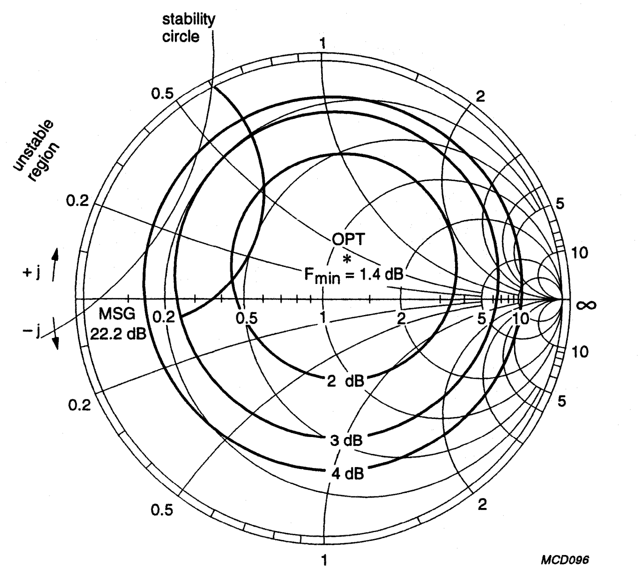
V_{CE} = 8 V.

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



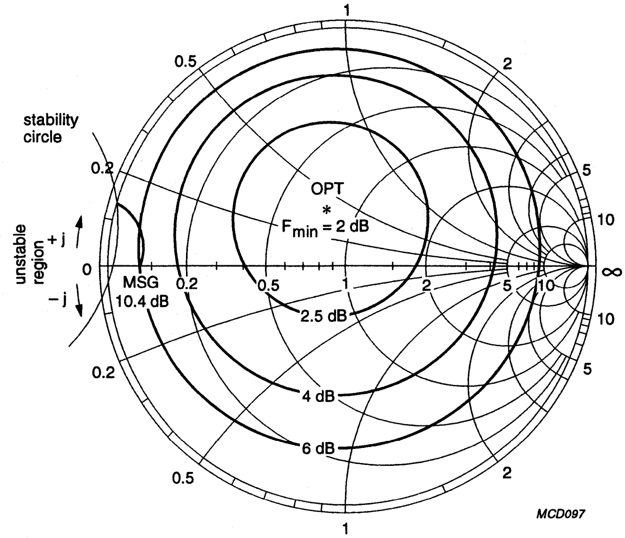
V_{CE} = 8 V.

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



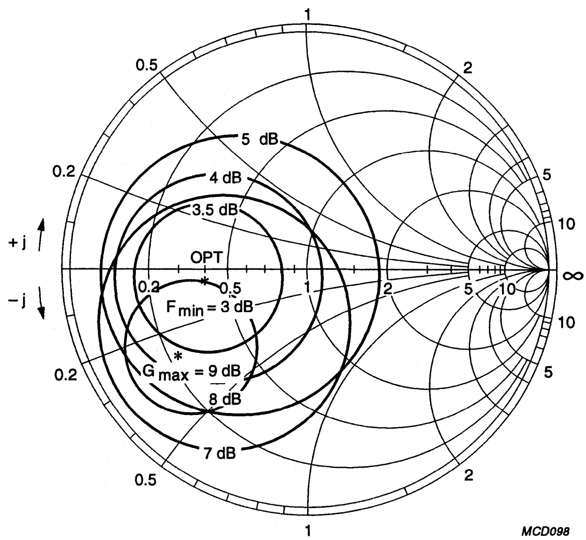
Z_o = 50 Ω.
Maximum stable gain = 22.2 dB.

Fig.13 Noise circle figure.



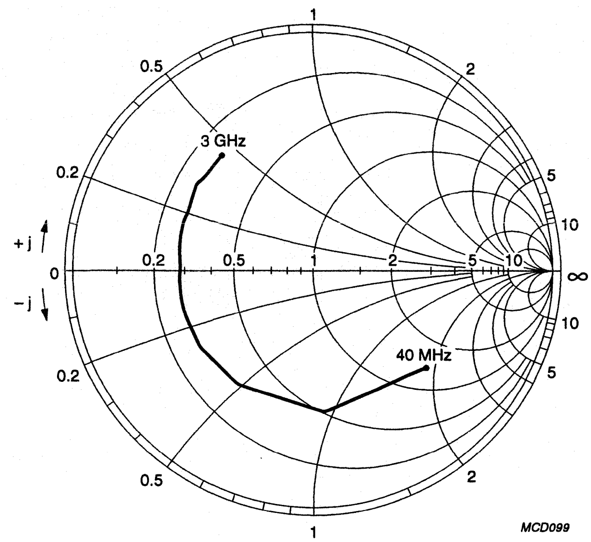
Z_o = 50 Ω.
Maximum stable gain = 10.4 dB.

Fig.14 Noise circle figure.



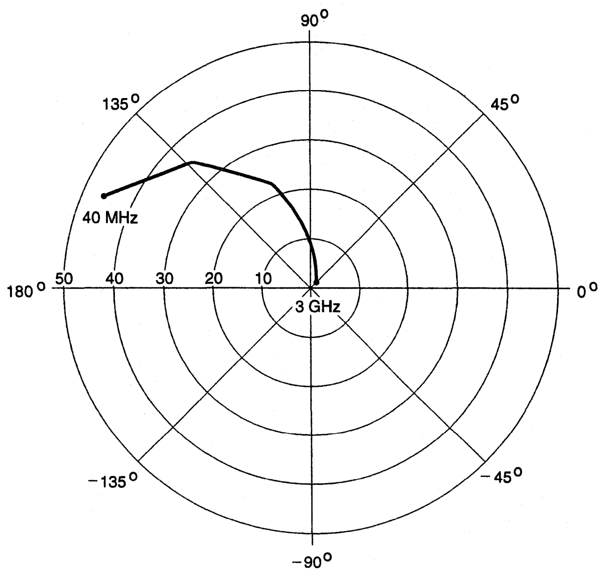
Z_o = 50 Ω.

Fig.15 Noise circle figure.



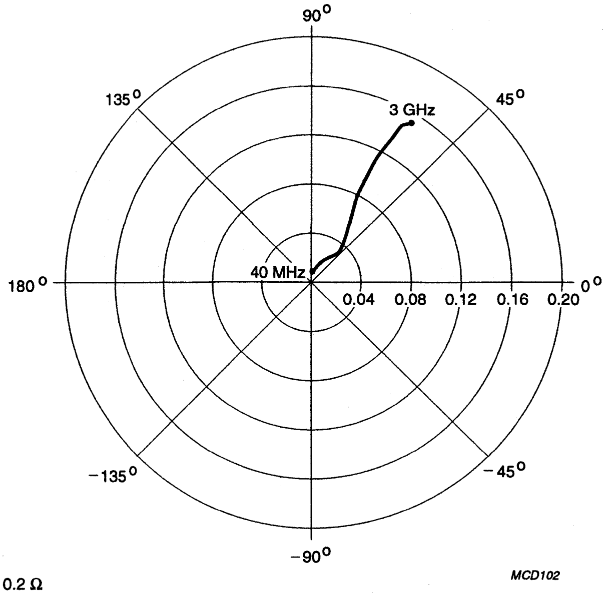
V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



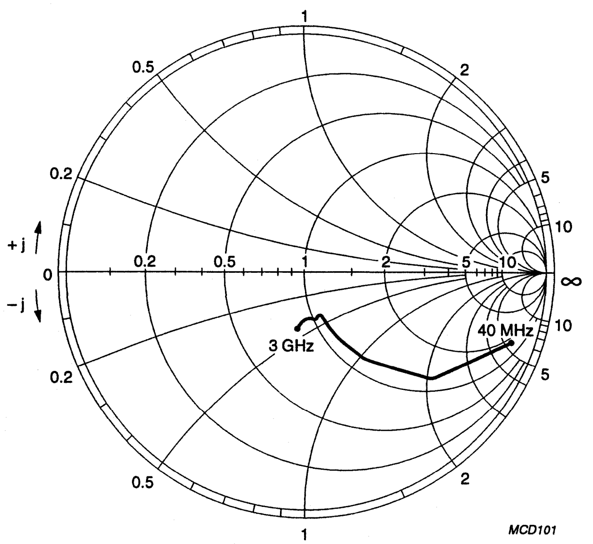
V_{CE} = 8 V; I_C = 30 mA; R_{max} = 50 Ω

Fig.17 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 30 mA; R_{max} = 0.2 Ω

Fig.18 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 7 GHz wideband transistor

BFG93AW
BFG93AW/X; BFG93AW/XR

FEATURES

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

APPLICATIONS

They are intended for wideband applications in the UHF and microwave ranges.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG93AW	R8
BFG93AW/X	R9
BFG93AW/XR	R0

PINNING

PIN	DESCRIPTION
BFG93AW (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG93AW/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG93AW/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

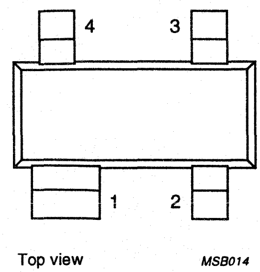


Fig.1 SOT343.

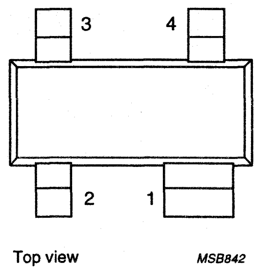


Fig.2 SOT343R.

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 = 85 °C	–	–	500	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	–	0.6	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	14.5	–	dB
		I_C = 30 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	9	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 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	–	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 = 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.

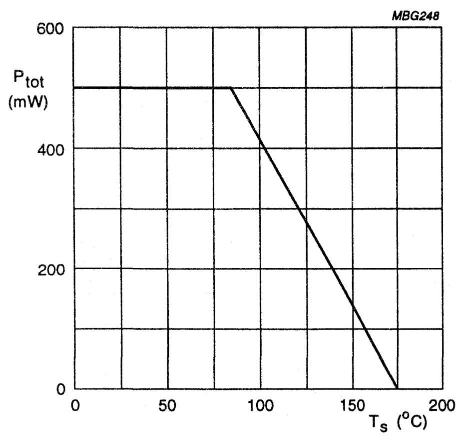


Fig.3 Power derating curve.

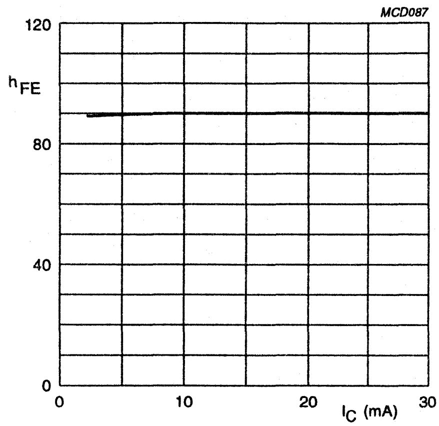
CHARACTERISTICS

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	–	–	15	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	–	–	12	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 µA; I_C = 0	–	–	2	V
I_{CBO}	collector cut-off current	open emitter; V_{CB} = 5 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	40	90	–	
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	7	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CE} = 5 V; f = 1 MHz	–	0.9	–	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 = 0; V_{CE} = 5 V; f = 1 MHz	–	0.6	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 30 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	14.5	–	dB
		I_C = 30 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	9	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 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	–	3	–	dB

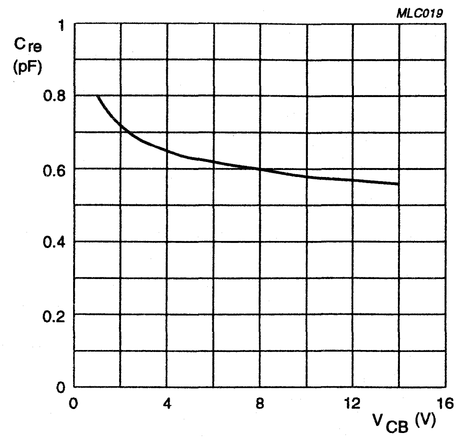
Note

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.



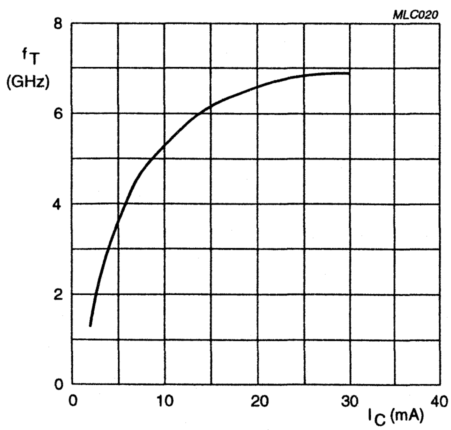
V_{CE} = 5 V.

Fig.4 Current gain (DC) 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.

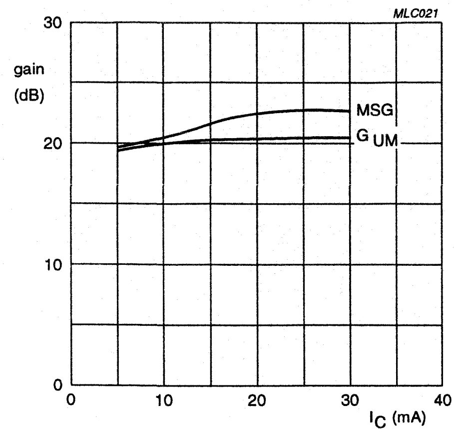


f = 500 MHz; V_{CE} = 5 V; T_{amb} = 25 °C.

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

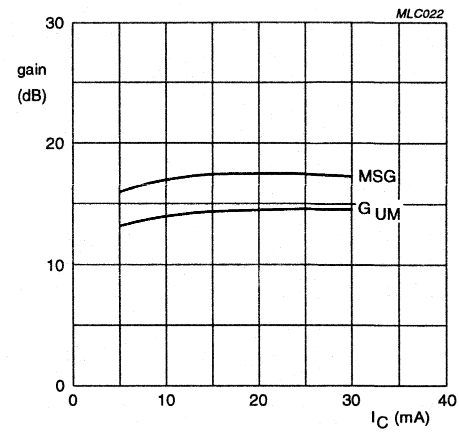
NPN 7 GHz wideband transistor

BFG93AW
BFG93AW/X; BFG93AW/XR



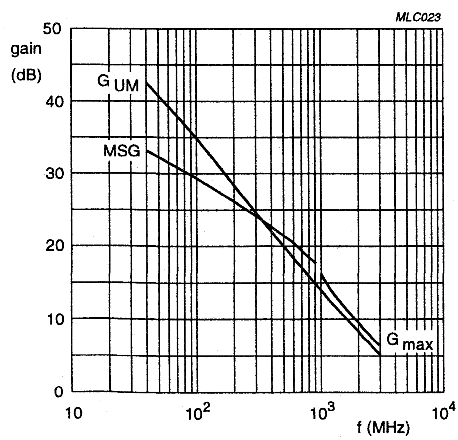
f = 500 MHz; V_{CE} = 8 V.

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



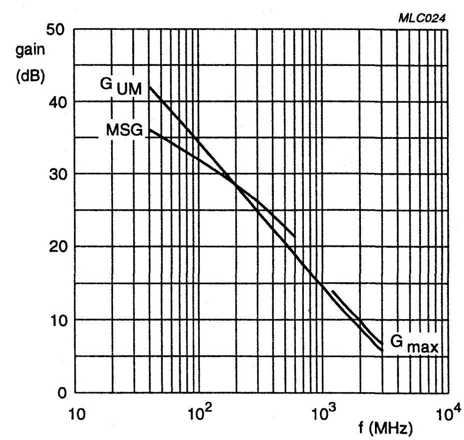
f = 1 GHz; V_{CE} = 8 V.

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.

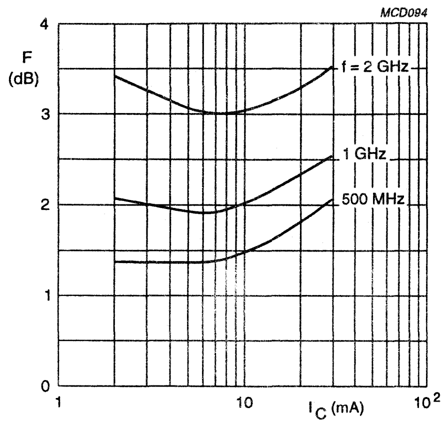


I_C = 30 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.

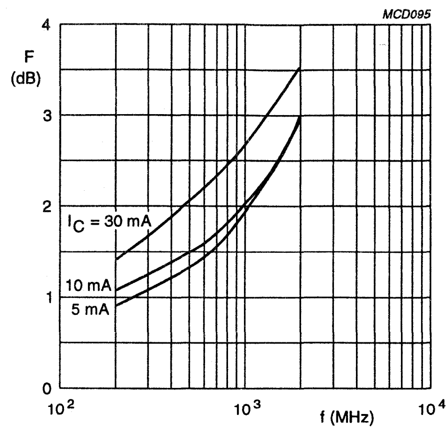
NPN 7 GHz wideband transistor

BFG93AW
BFG93AW/X; BFG93AW/XR



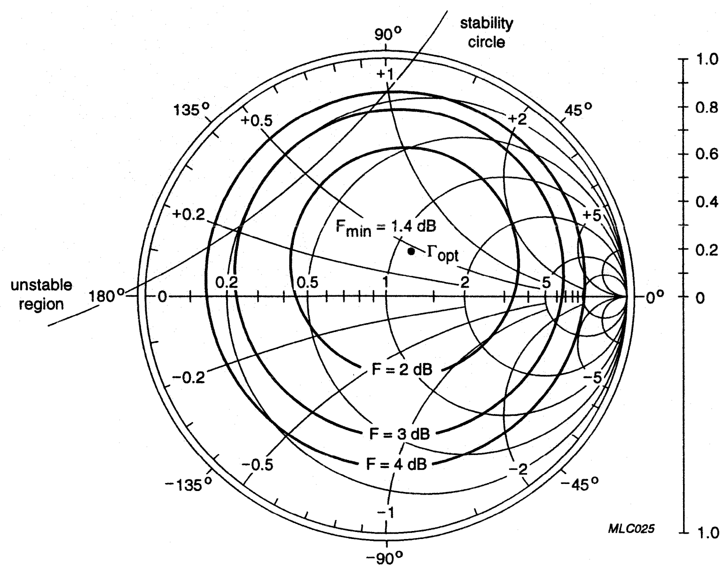
V_{CE} = 8 V.

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



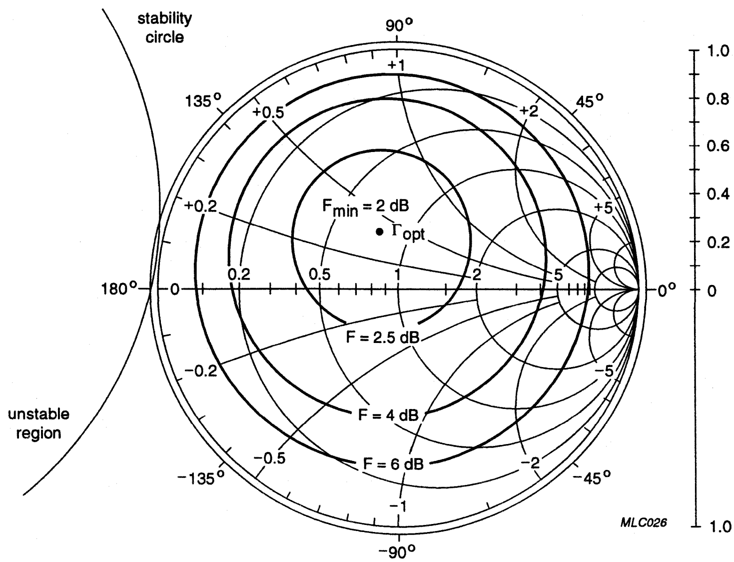
V_{CE} = 8 V.

Fig.12 Minimum noise figure as a function of frequency; typical values.



f = 500 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

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

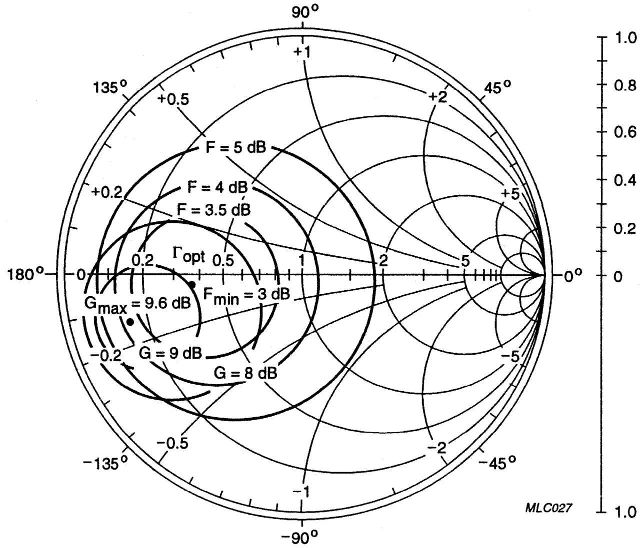


f = 1 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

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

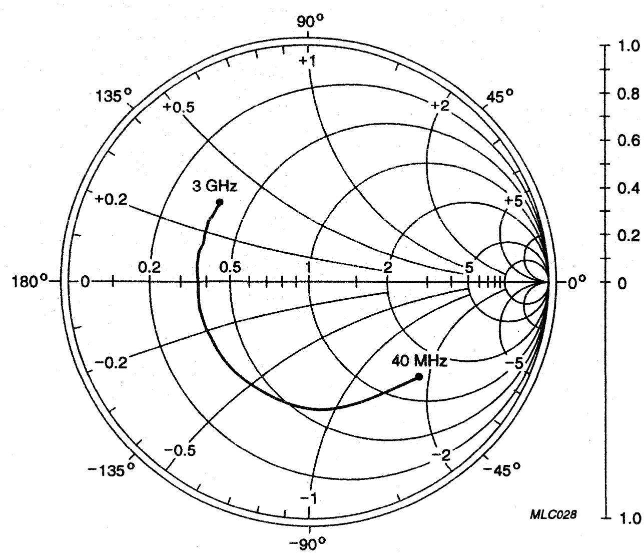
NPN 7 GHz wideband transistor

BFG93AW
BFG93AW/X; BFG93AW/XR



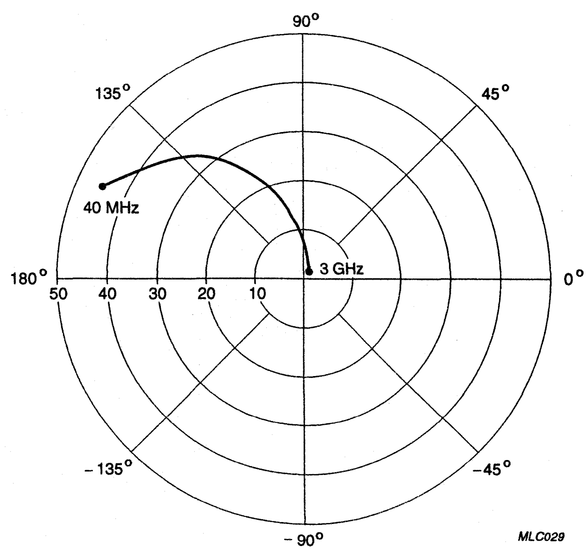
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



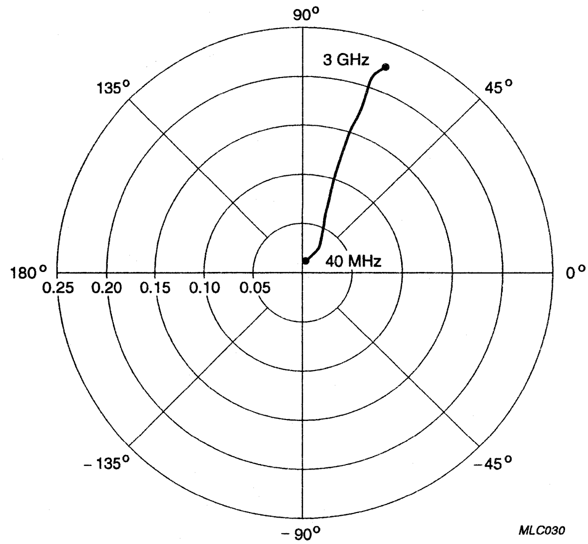
V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (s_{11}); typical values.



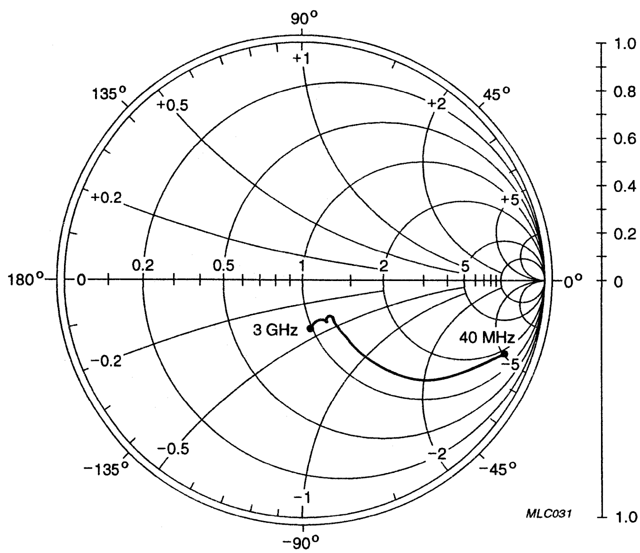
V_{CE} = 8 V; I_C = 30 mA.

Fig.17 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 8 V; I_C = 30 mA.

Fig.18 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (s_{22}); typical values.

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

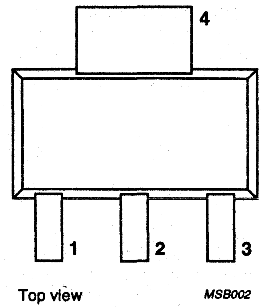


Fig.1 SOT223.

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

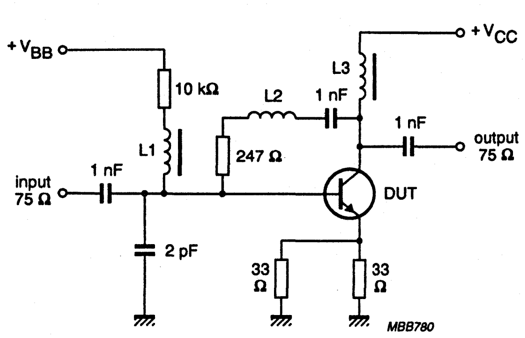
T_j = 25 °C unless otherwise specified.

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 (note 1)	$I_C = 45$ 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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ 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 $f_{(2q-p)}$.

NPN 6 GHz wideband transistor BFG94



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.

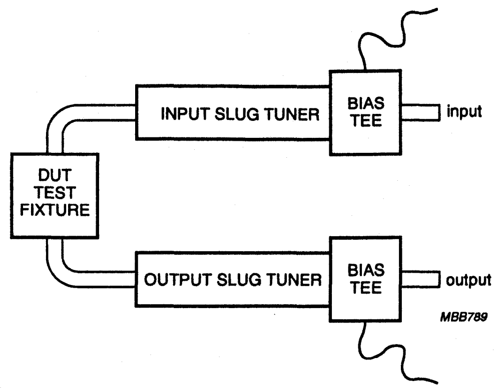


Fig.3 Measurement set-up for third order intercept point and 1 dB gain compression.

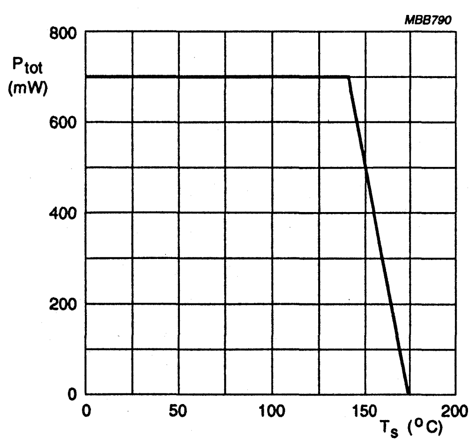
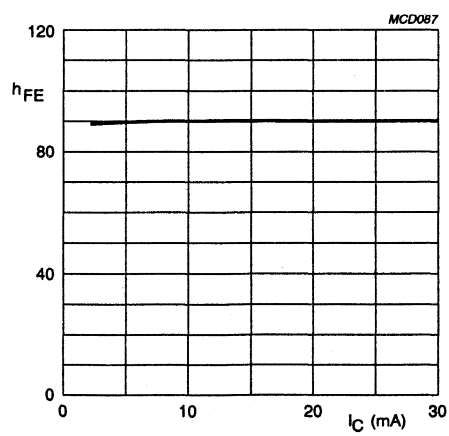
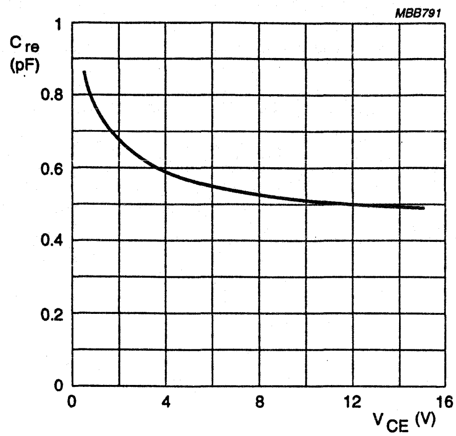


Fig.4 Power derating curve.



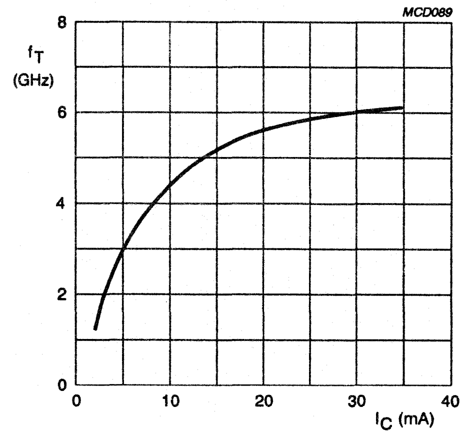
V_{CE} = 10 V; T_j = 25 °C

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



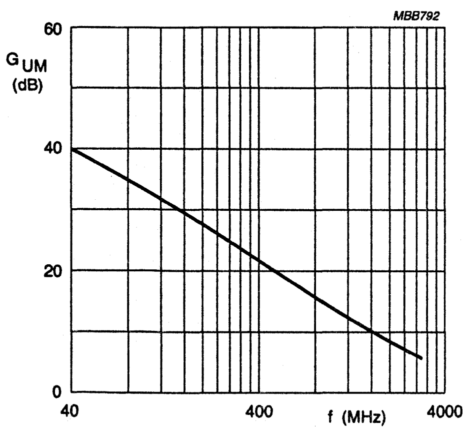
$I_C = i_c = 0$; f = 1 MHz.

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



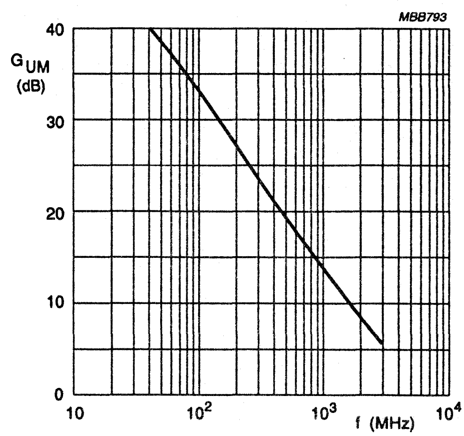
V_{CE} = 10 V; f = 1 GHz.

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



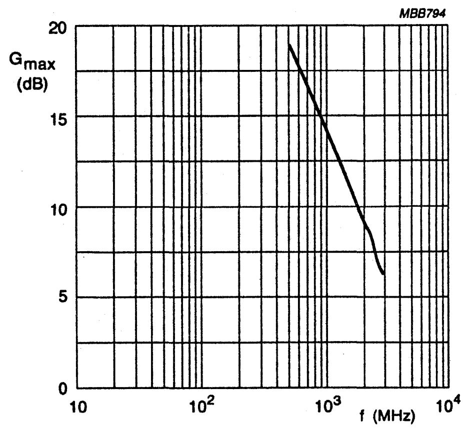
I_C = 45 mA; V_{CE} = 10 V.

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



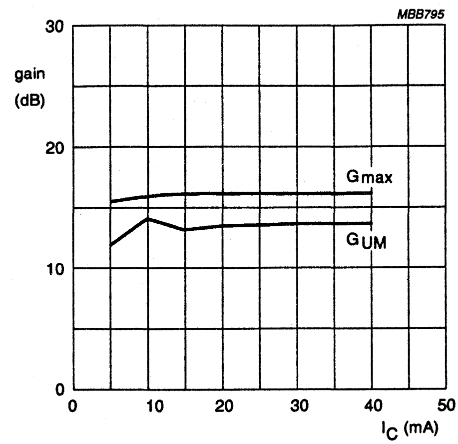
I_C = 20 mA; V_{CE} = 8 V.

Fig.9 Maximum unilateral power gain as a function of frequency.



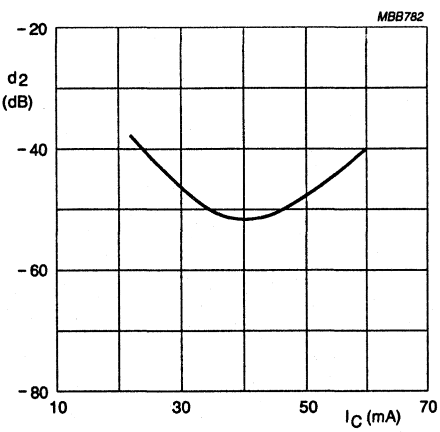
I_C = 20 mA; V_{CE} = 8 V.

Fig.10 Maximum available stable gain as a function of frequency.



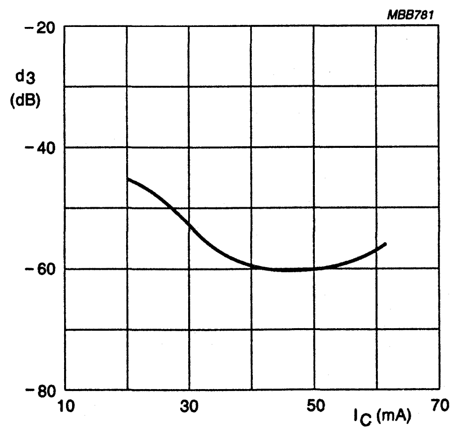
V_{CE} = 8 V; f = 1 GHz.
G_{max} = maximum available stable gain.
G_{UM} = maximum unilateral power gain.

Fig.11 Gain as a function of collector current.



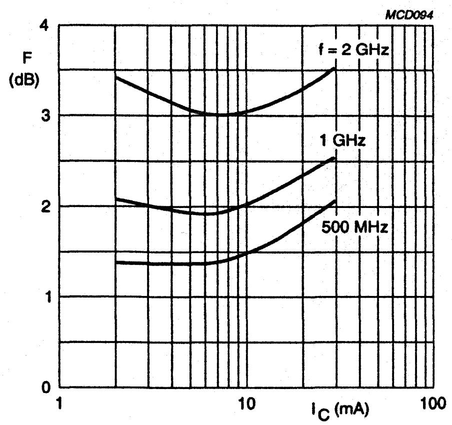
I_C = 45 mA; V_{CE} = 10 V; $f_{(p+q)}$ = 810 MHz.
See test circuit, Fig.2

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



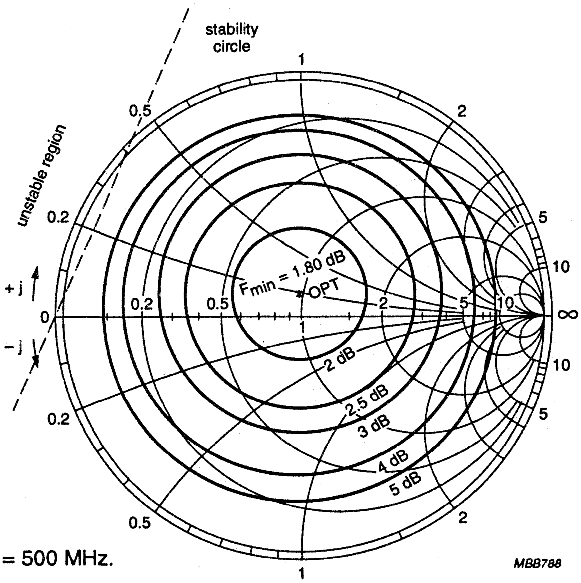
I_C = 45 mA; V_{CE} = 10 V; $f_{(p+q-r)}$ = 793.25 MHz.
See test circuit, Fig.2

Fig.13 Third order intermodulation distortion as a function of collector current.



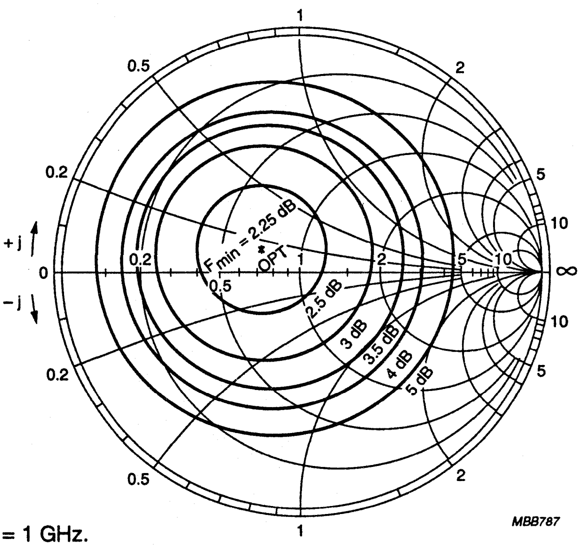
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of collector current.



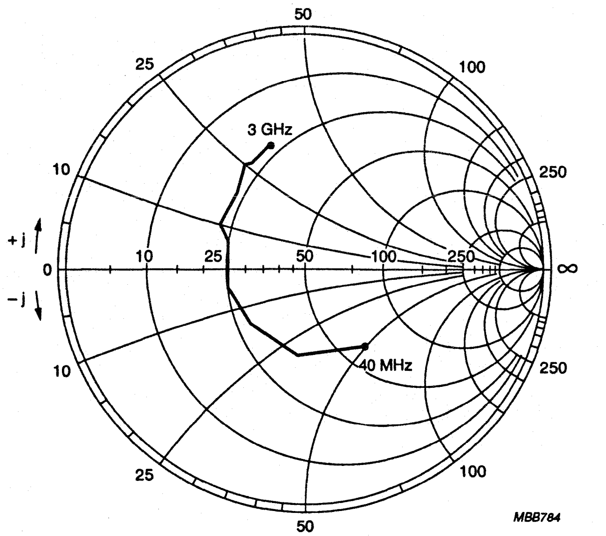
I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz.

Fig.15 Noise circle.



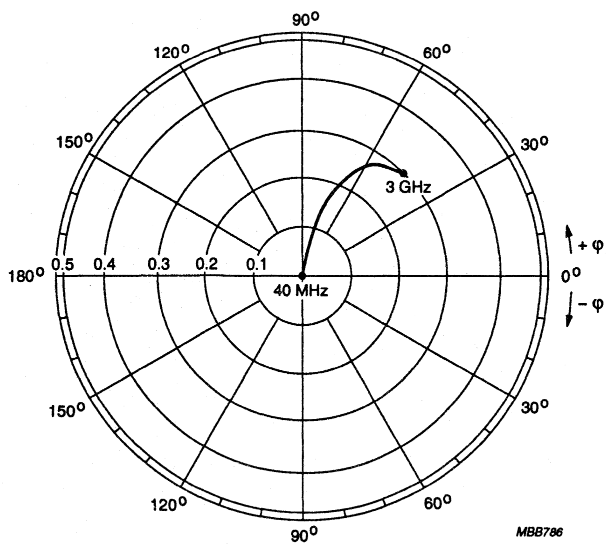
I_C = 15 mA; V_{CE} = 10 V; f = 1 GHz.

Fig.16 Noise circle.



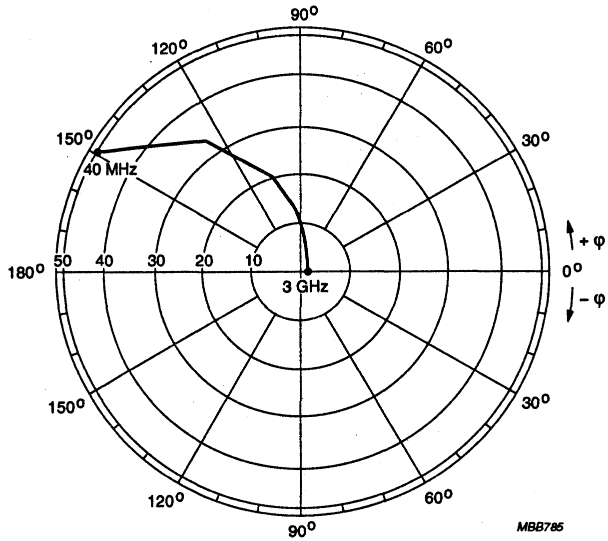
I_C = 45 mA; V_{CE} = 10 V.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



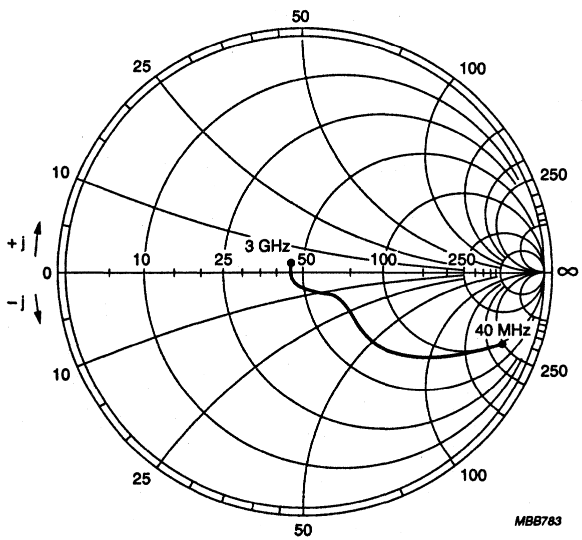
I_C = 45 mA; V_{CE} = 10 V.

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 transitor 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

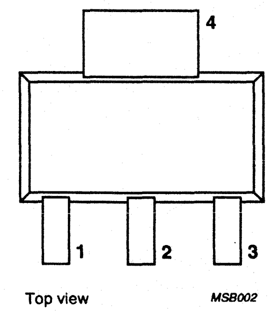


Fig.1 SOT223.

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.

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. 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;
   $V_q = V_O$ –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 Ω; 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 Ω; 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 Ω; 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.

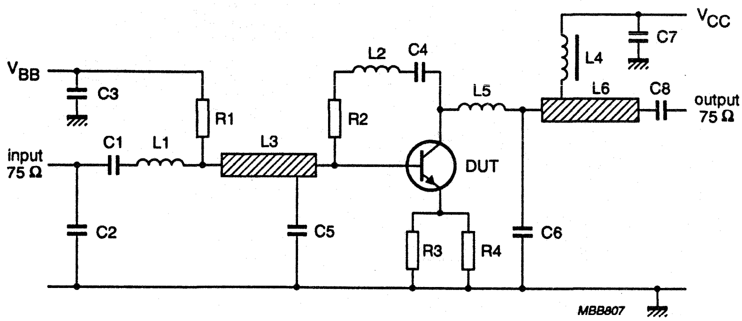


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

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 x 35 µm.

1. Components C5, L1, L4, L5, and R2 are mounted on the underside of the PCB.

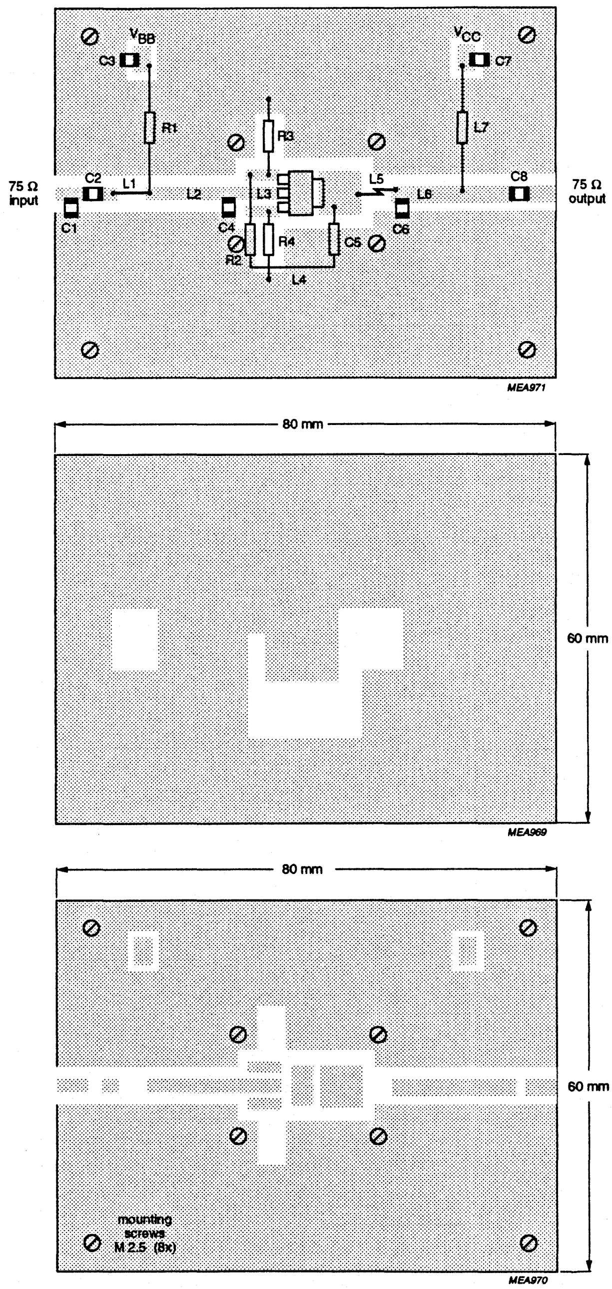


Fig.3 Intermodulation distortion and second order intermodulation distortion printed circuit board.

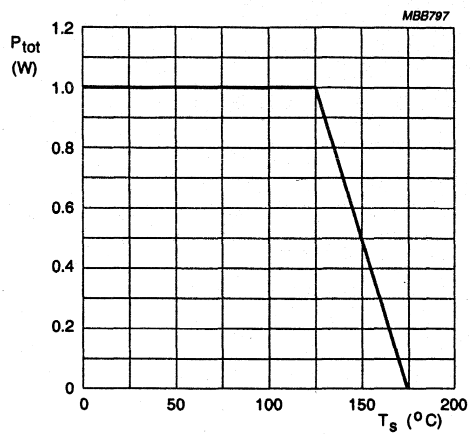
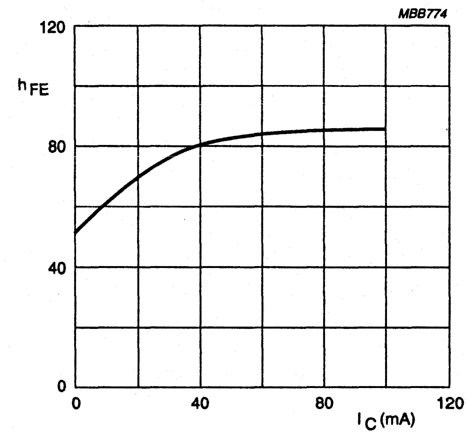
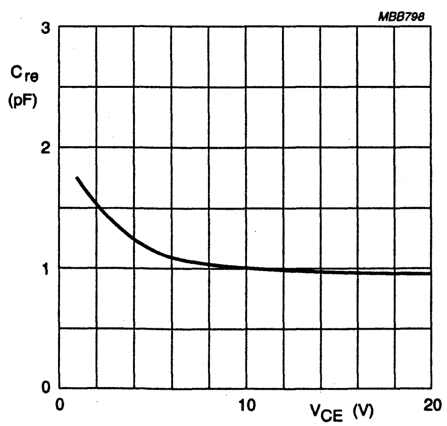


Fig.4 Power derating curve.



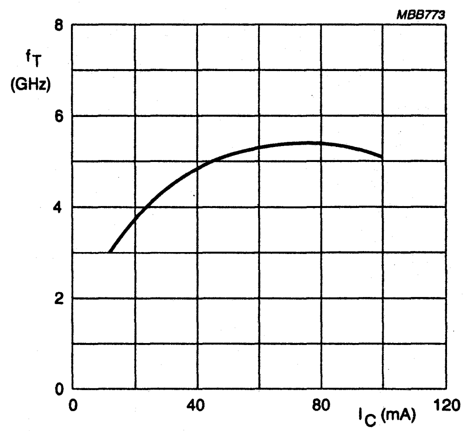
V_{CE} = 10 V; T_j = 25 °C.

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



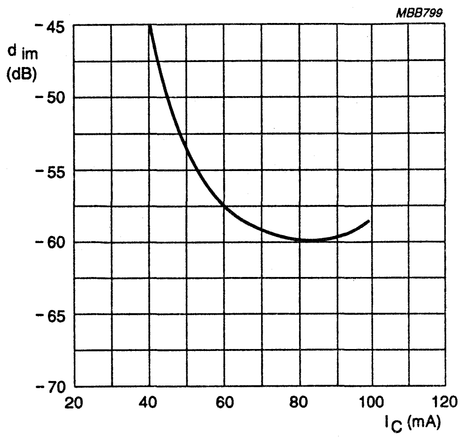
I_E = 0; f = 1 MHz; T_j = 25 °C.

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



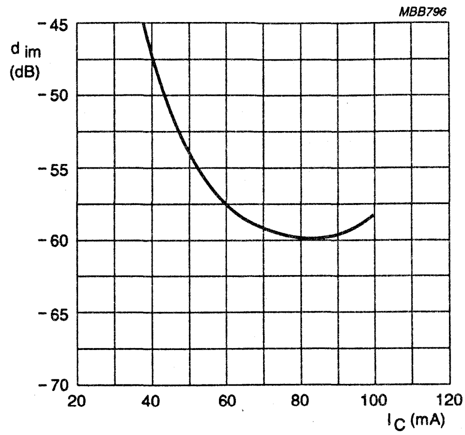
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

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



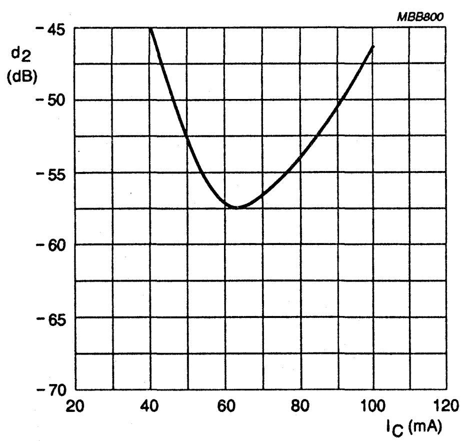
V_{CE} = 10 V; V_O = 750 mV; $f_{(p+q-r)}$ = 443.25 MHz;
T_{amb} = 25 °C.

Fig.8 Intermodulation disortion as a function of collector current.



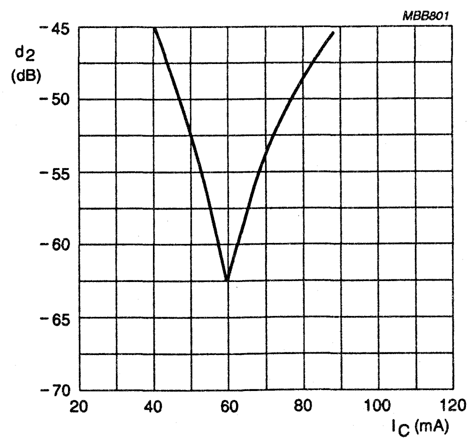
V_{CE} = 10 V; V_O = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz;
T_{amb} = 25 °C.

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



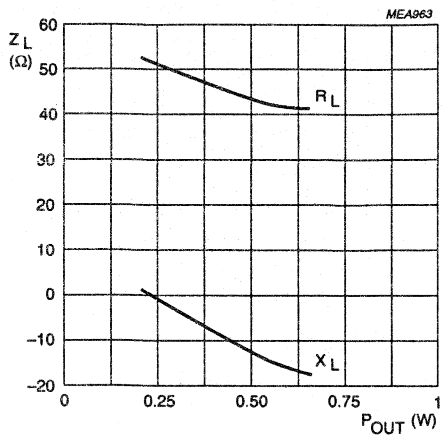
V_{CE} = 10 V; V_O = 50 dBmV; $f_{(p+q)}$ = 450 MHz;
T_{amb} = 25 °C.

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



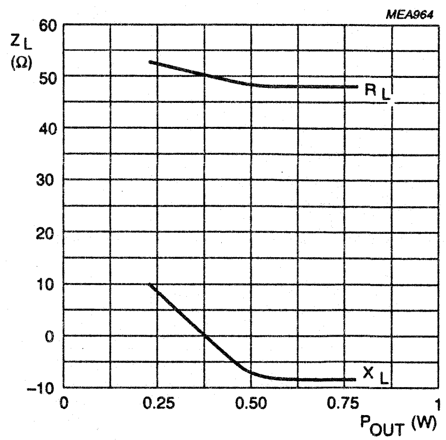
V_{CE} = 10 V; V_O = 50 dBmV; $f_{(p+q)}$ = 810 MHz;
T_{amb} = 25 °C.

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



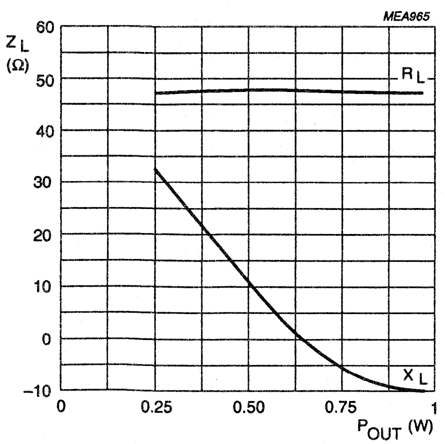
V_{CE} = 6 V; f = 900 MHz.

Fig.12 Load impedance as a function of output power.



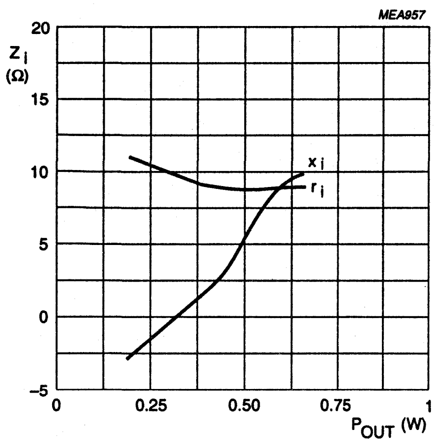
V_{CE} = 7.5 V; f = 900 MHz.

Fig.13 Load impedance as a function of output power.



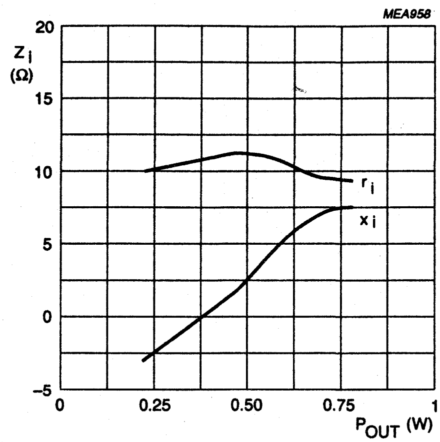
V_{CE} = 10 V; f = 900 MHz.

Fig.14 Load impedance as a function of output power.



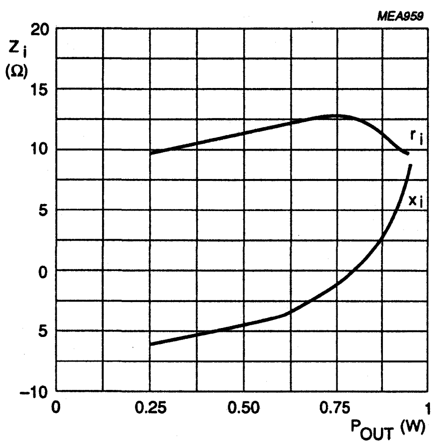
V_{CE} = 6 V; f = 900 MHz.

Fig.15 Input impedance as a function of output power.



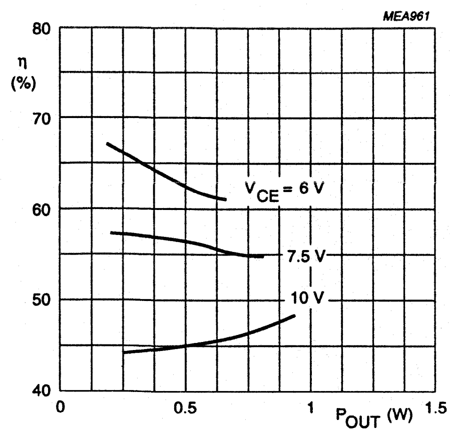
V_{CE} = 7.5 V; f = 900 MHz.

Fig.16 Input impedance as a function of output power.



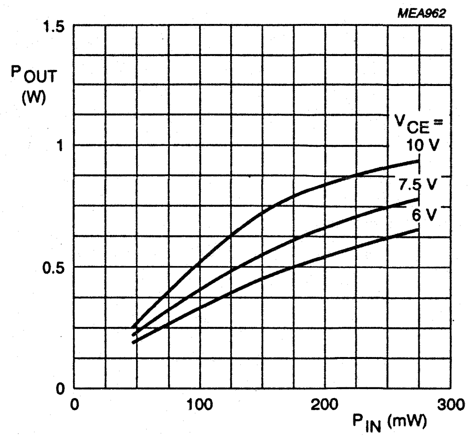
V_{CE} = 10 V; f = 900 MHz.

Fig.17 Input impedance as a function of output power.



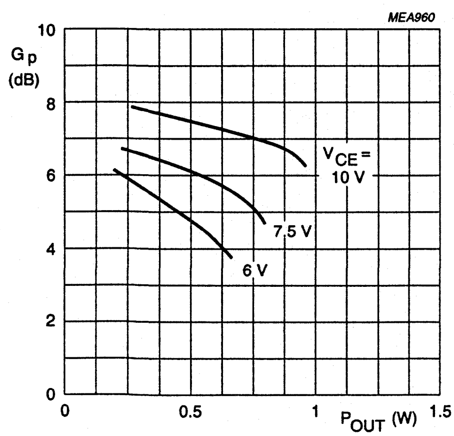
f = 900 MHz.

Fig.18 Efficiency as a function of output power.



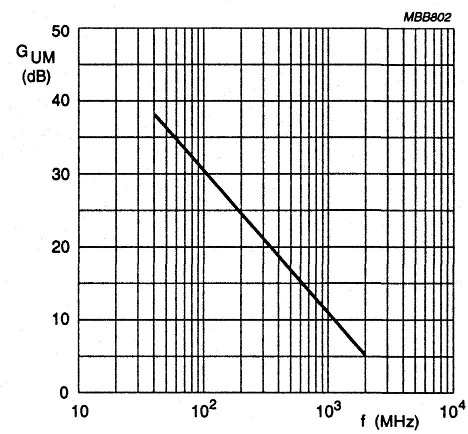
f = 900 MHz.

Fig.19 Output power as a function of input power.



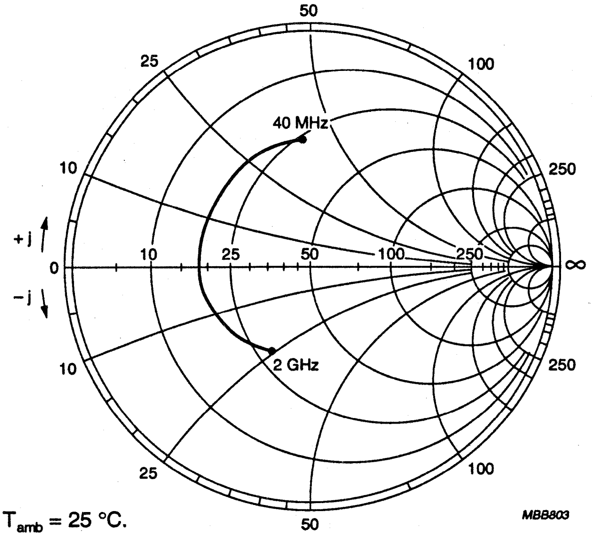
f = 900 MHz.

Fig.20 Power gain as a function of output power.



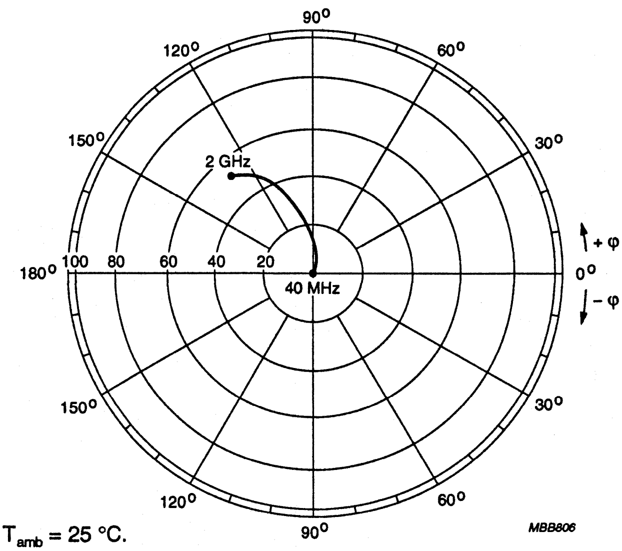
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.21 Maximum unilateral power gain as a function of frequency.



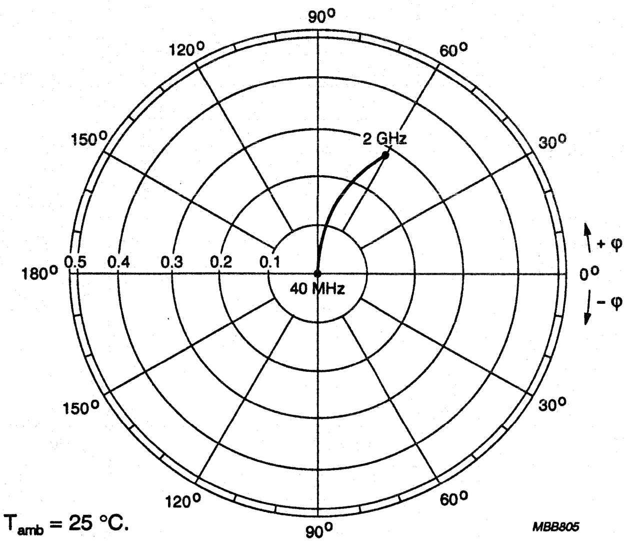
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.22 Common emitter input reflection coefficient (S_{11}).



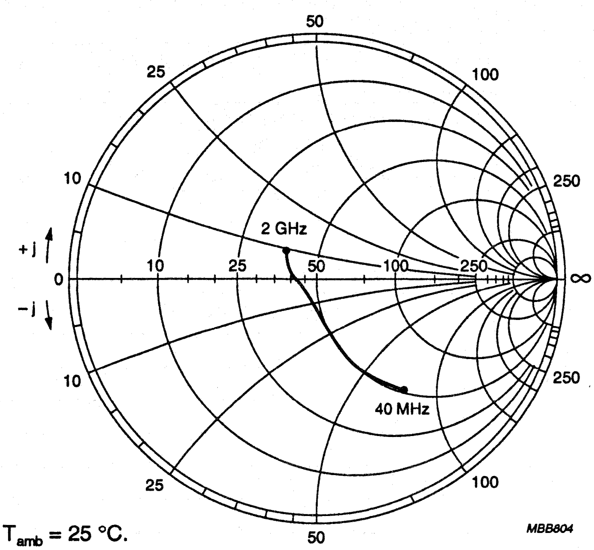
I_C = 70 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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}).

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

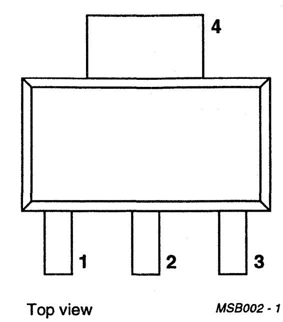


Fig.1 SOT223.

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 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.
2. d_{im} = –60 dB (DIN 45004B); I_C = 100 mA; V_{CE} = 10 V; R_L = 75 Ω; 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.

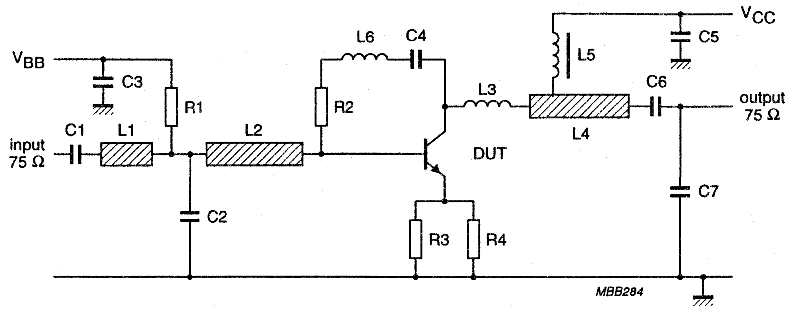


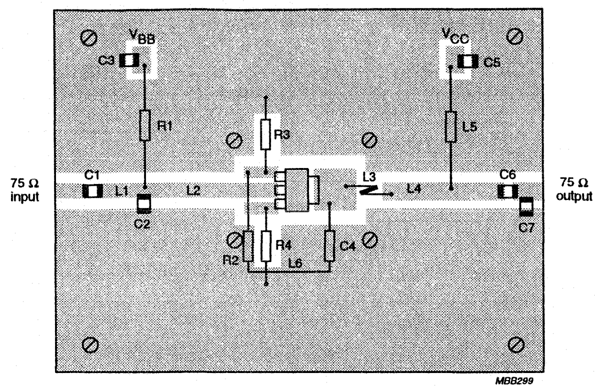
Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

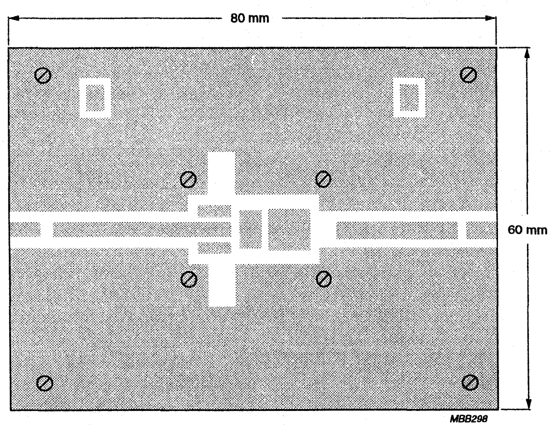
List of components (see test circuit)

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 (ε_r = 2.2); thickness 1⁄16 inch; thickness of copper sheet 1⁄32 inch.





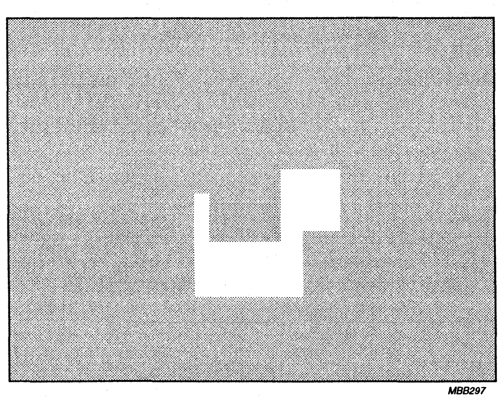


Fig.3 Intermodulation distortion test printed-circuit board.

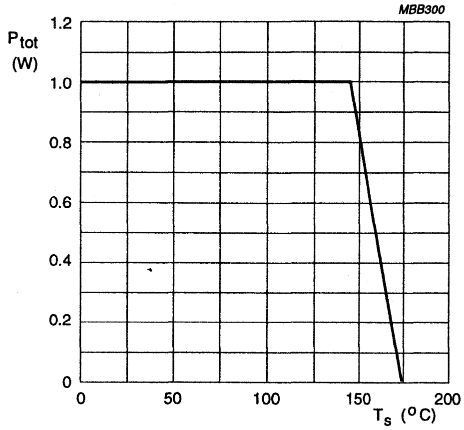
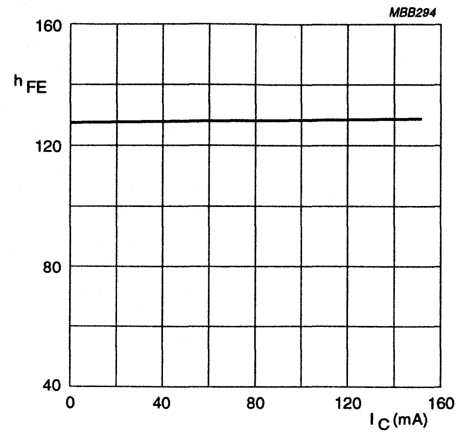
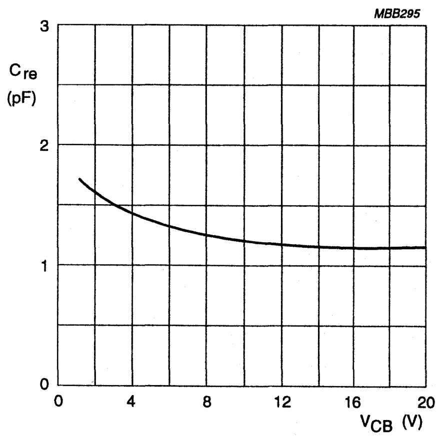


Fig.4 Power derating curve.



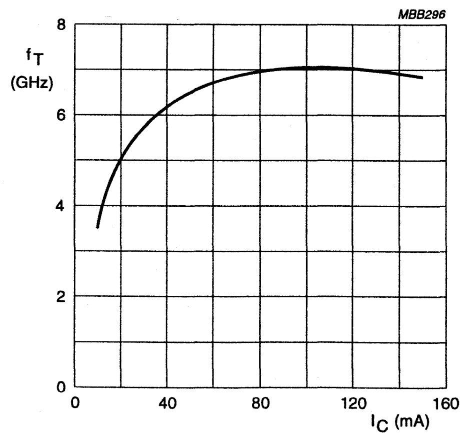
V_{CE} = 10 V; T_j = 25 °C.

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



I_E = 0; f = 1 MHz; T_j = 25 °C.

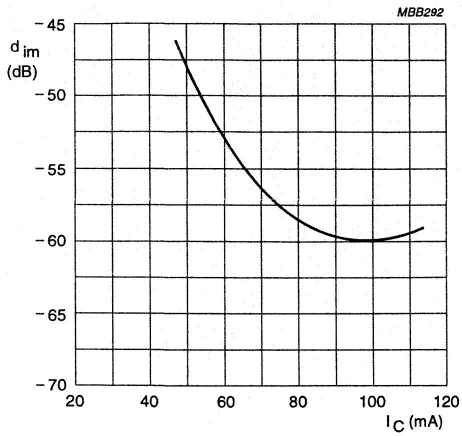
Fig.6 Feedback capacitance as a function of collector-base voltage.



V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C.

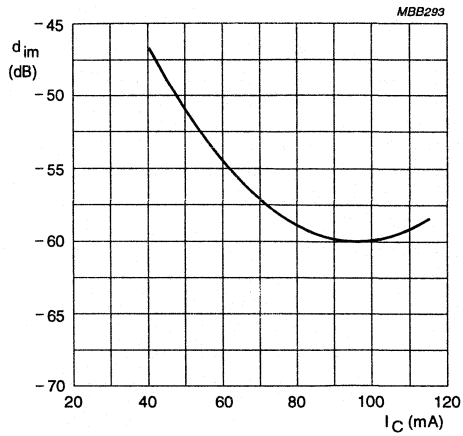
Fig.7 Transition frequency as a function of collector current.

NPN 7GHz wideband transistor BFG135



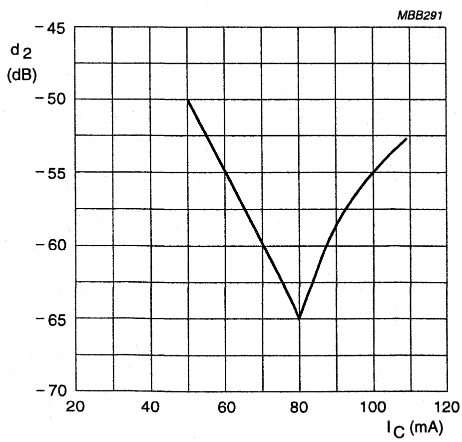
V_{CE} = 10 V; V_o = 900 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 443.25 MHz.

Fig.8 Intermodulation distortion as a function of collector current.



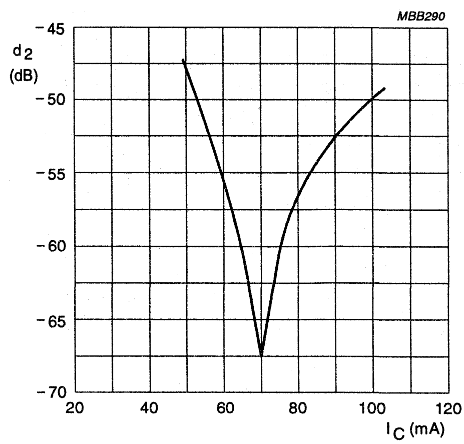
V_{CE} = 10 V; V_o = 850 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 793.25 MHz.

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.

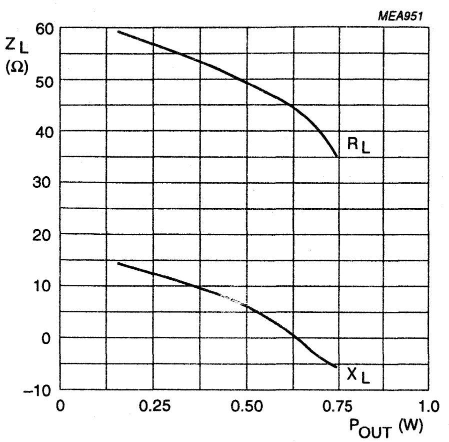
Fig.10 Second order intermodulation distortion as a function of collector current.



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

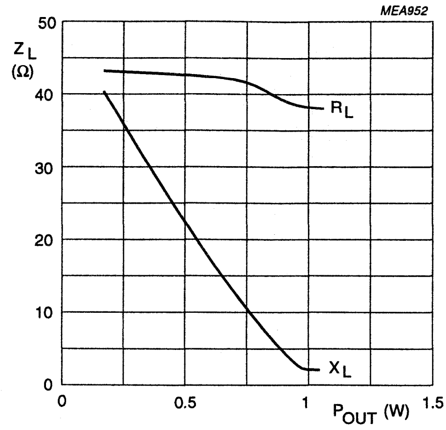
Fig.11 Second order intermodulation distortion as a function of collector current.

NPN 7GHz wideband transistor BFG135



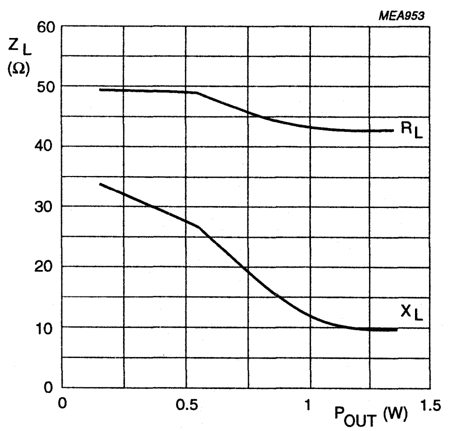
V_{CE} = 7.5 V; f = 900 MHz.

Fig.12 Load impedance as a function of output power.



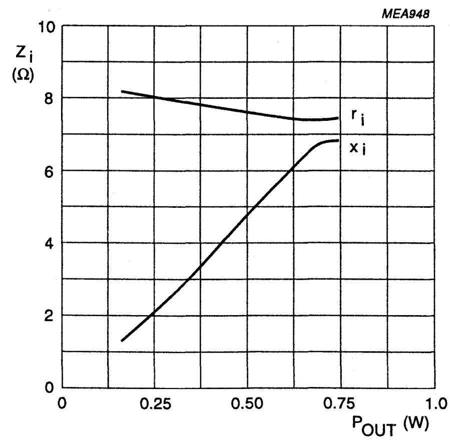
V_{CE} = 10 V; f = 900 MHz.

Fig.13 Load impedance as a function of output power.



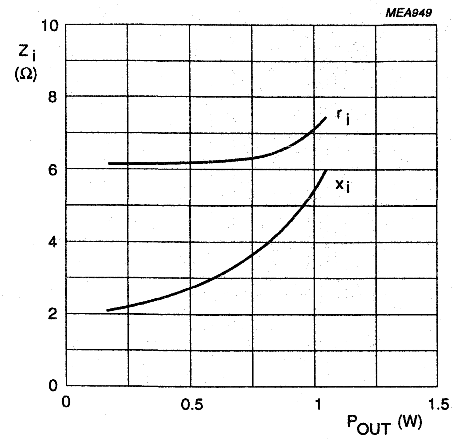
V_{CE} = 12.5 V; f = 900 MHz.

Fig.14 Load impedance as a function of output power.



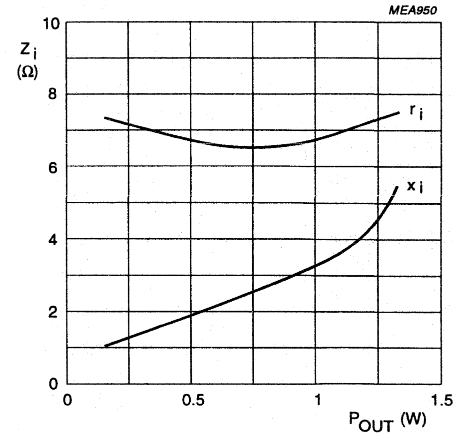
V_{CE} = 7.5 V; f = 900 MHz.

Fig.15 Input impedance as a function of output power.



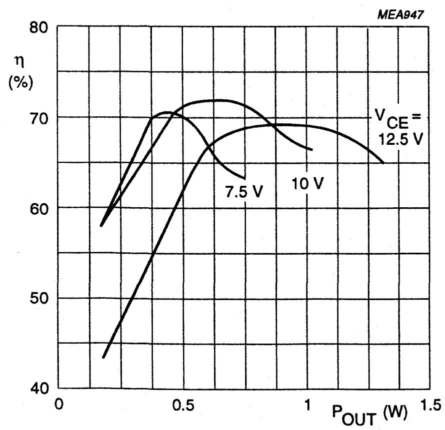
V_{CE} = 10 V; f = 900 MHz.

Fig.16 Input impedance as a function of output power.



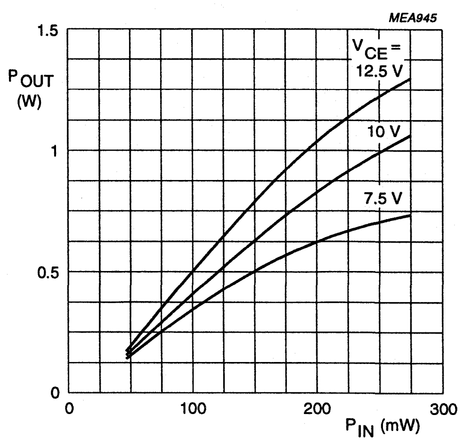
V_{CE} = 12.5 V; f = 900 MHz.

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.

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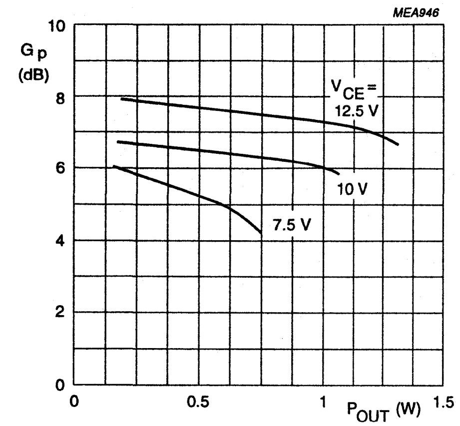
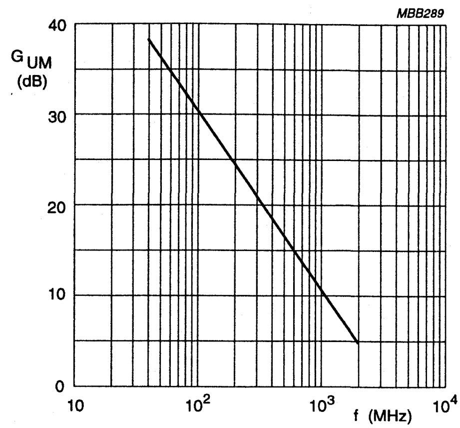


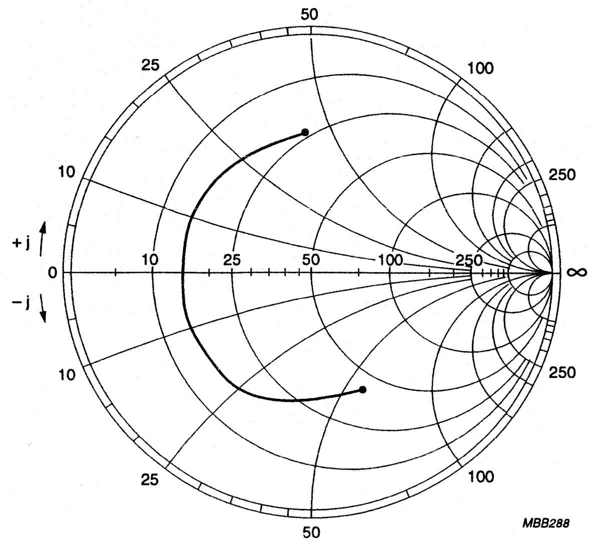
f = 900 MHz.

Fig.20 Power gain as a function of output power.



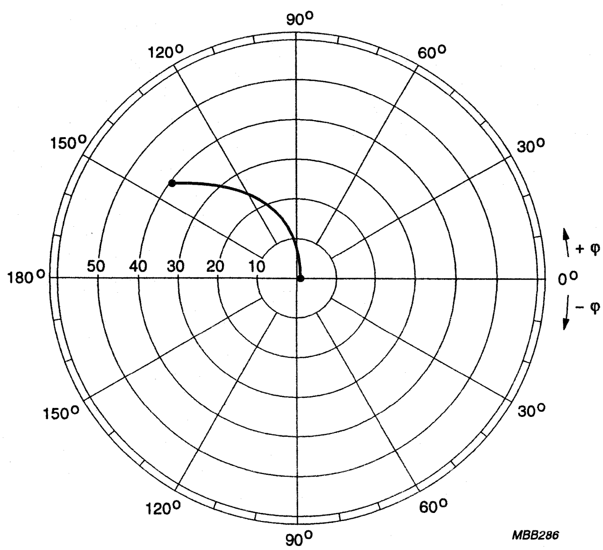
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.21 Maximum unilateral power gain as a function of frequency.



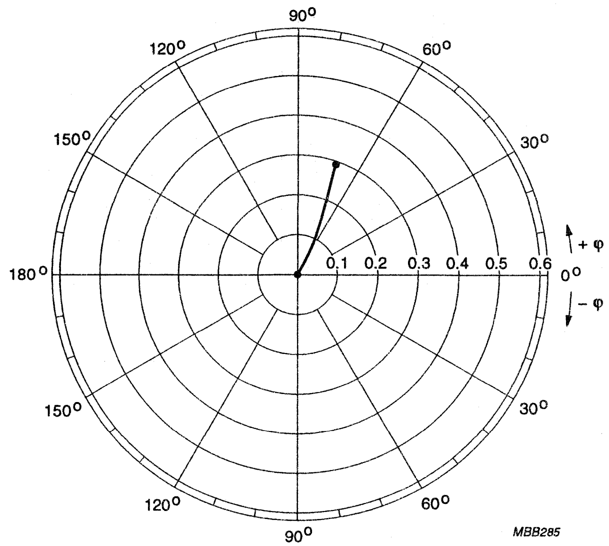
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω..

Fig.22 Common emitter input reflection coefficient (S_{11}).



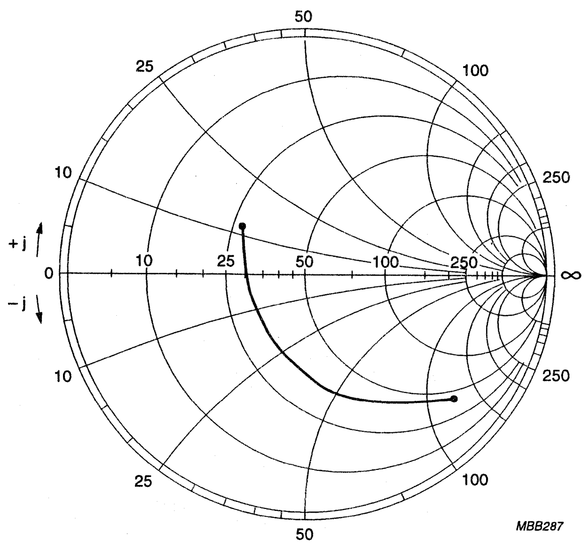
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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 7 GHz wideband transistor

BFG197; BFG197/X; BFG197/XR

FEATURES

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

DESCRIPTION

The BFG197 is a silicon NPN transistor in a 4-pin, dual-emitter plastic SOT143 envelope. It is primarily intended for wideband applications in the GHz range, such as satellite TV systems and repeater amplifiers in fibre-optic systems.

PINNING

PIN	DESCRIPTION
BFG197 (Fig.1) Code: V5	
1	collector
2	base
3	emitter
4	emitter
BFG197/X (Fig.1) Code: V13	
1	collector
2	emitter
3	base
4	emitter
BFG197A/XR (Fig.2) Code: V35	
1	collector
2	emitter
3	base
4	emitter

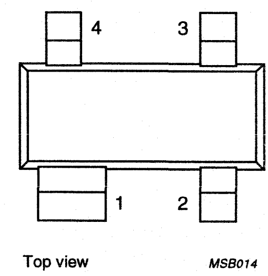


Fig.1 SOT143.

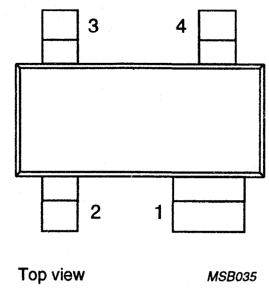


Fig.2 SOT143XR.

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 value	–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 75 °C; note 1	–	–	350	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CB} = 8 V; f = 1 MHz	–	0.85	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	16	–	dB
		I_C = 50 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	–	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_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current	DC value, continuous	–	100	mA
P_{tot}	total power dissipation	up to T_s = 75 °C; note 1	–	350	mW
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction operating temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	from junction to soldering point; 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 leakage current	I_E = 0; V_{CB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	110	–	
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	–	3.3	–	pF
C_{re}	feedback capacitance	$I_C = i_c$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.85	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 50 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	16	–	dB
		I_C = 50 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	2.3	–	dB
d_2	second order intermodulation distortion	V_{CE} = 6 V;V_o = 50 dBmV;	–	–51	–	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.

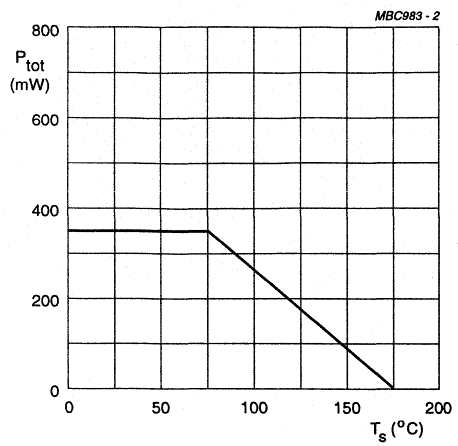
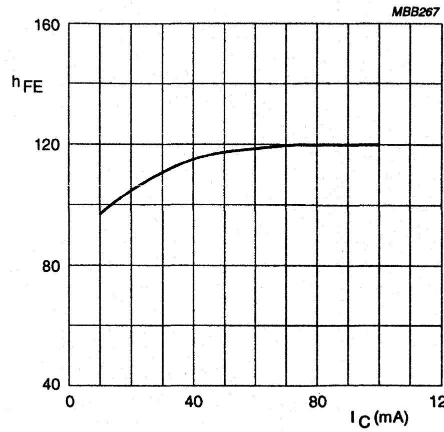
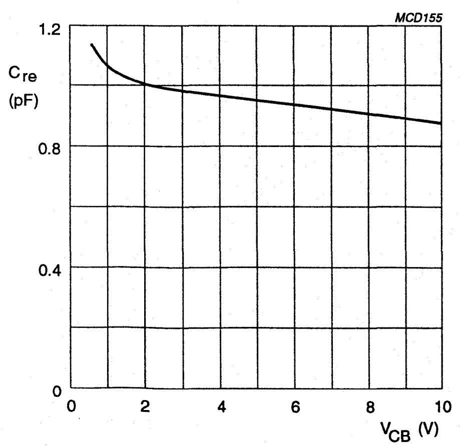


Fig.3 Power derating curve.



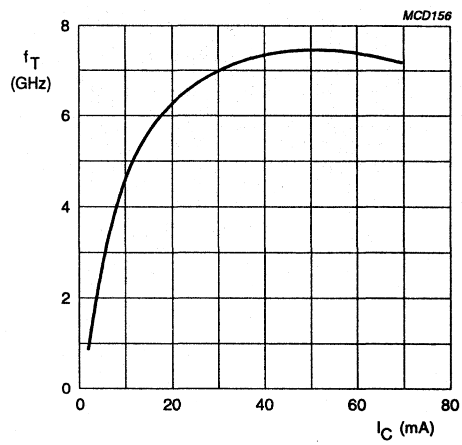
V_{CE} = 5 V.

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



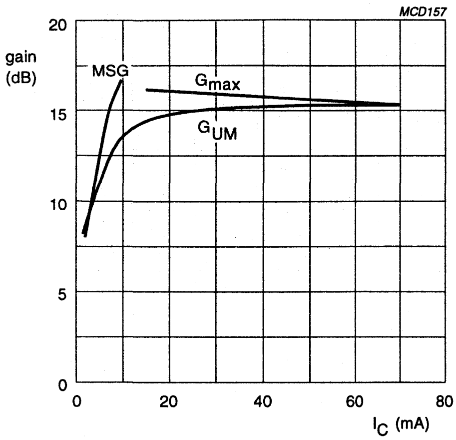
$I_C = i_c = 0$; f = 1 MHz.

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



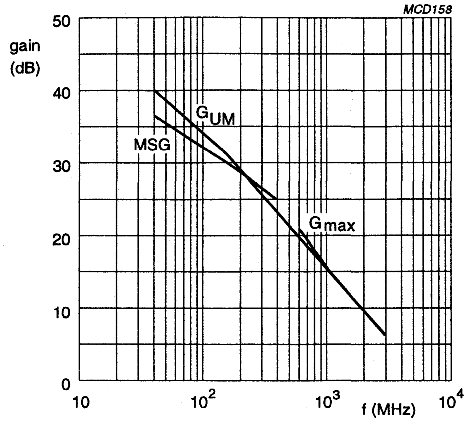
V_{CE} = 4 V; T_{amb} = 25 °C; f = 2 GHz.

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



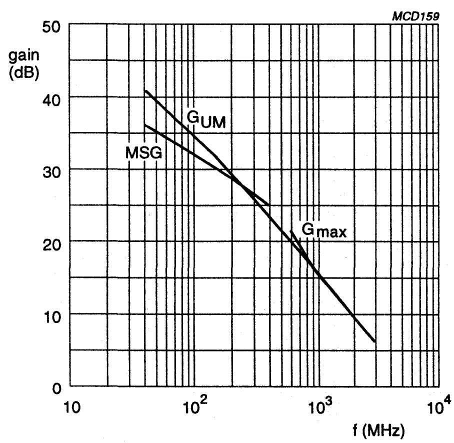
V_{CE} = 4 V; f = 1 GHz.

Fig.7 Gain as a function of collector current.



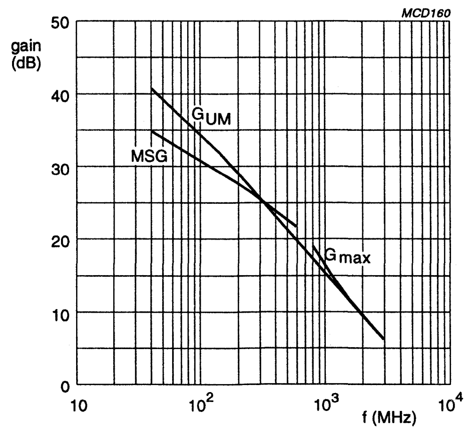
V_{CE} = 4 V; I_C = 50 mA.

Fig.8 Gain as a function of frequency.



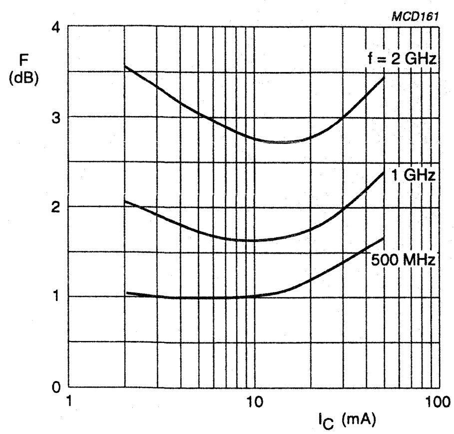
V_{CE} = 6 V; I_C = 50 mA.

Fig.9 Gain as a function of frequency.



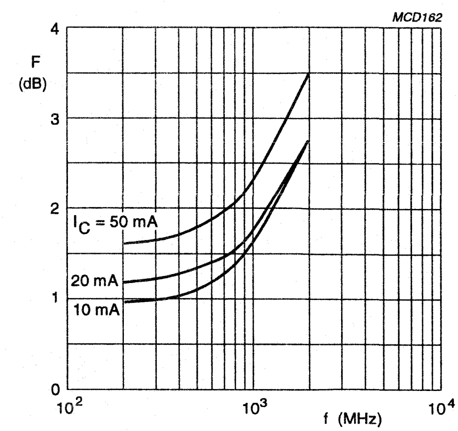
V_{CE} = 8 V; I_C = 30 mA.

Fig.10 Gain as a function of frequency.



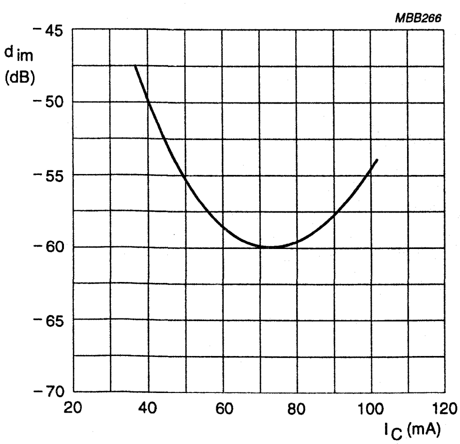
V_{CE} = 6 V.

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



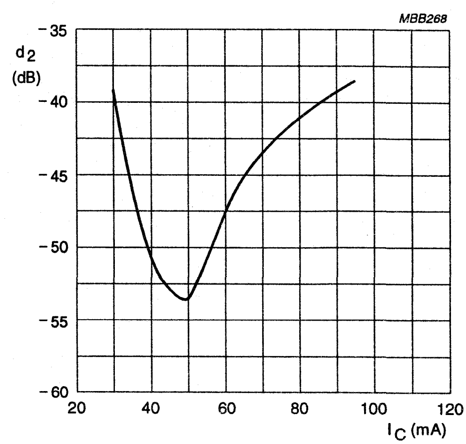
V_{CE} = 6 V.

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



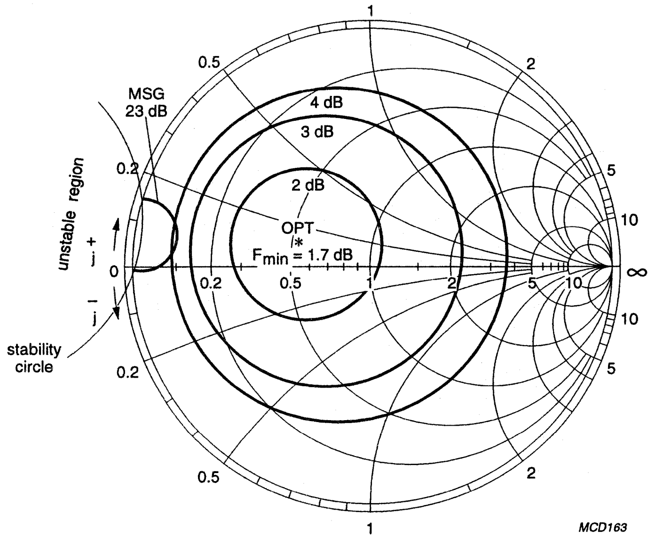
V_{CE} = 8 V ; V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.

Fig.13 Intermodulation distortion, typical values.



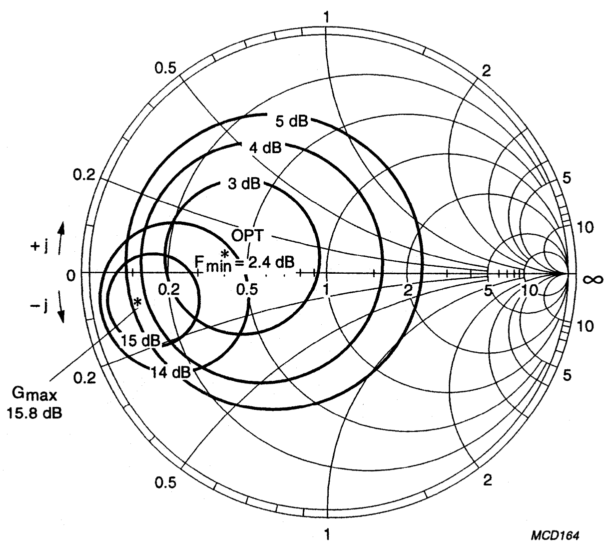
V_{CE} = 8 V; V_o = 50 mV; $f_{(p+q-r)}$ = 810 MHz; T_{amb} = 25 °C.

Fig.14 Second order intermodulation distortion, typical values.



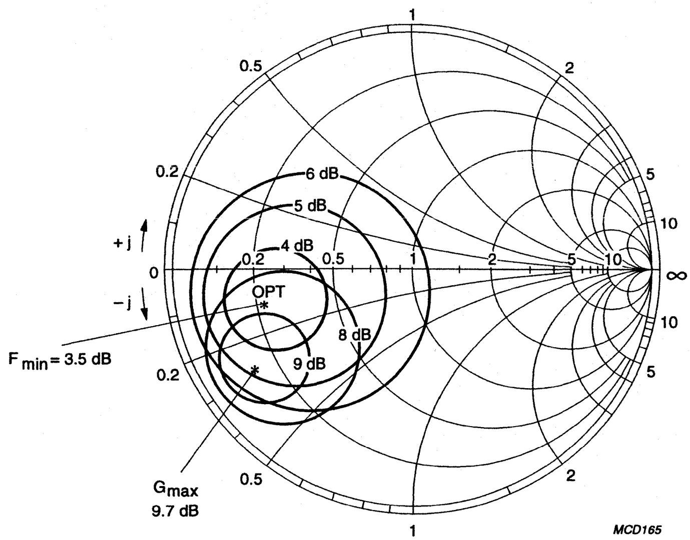
$Z_o = 50\ \Omega$.
Maximum stable gain = 23 dB.

Fig.15 Noise circle figure.



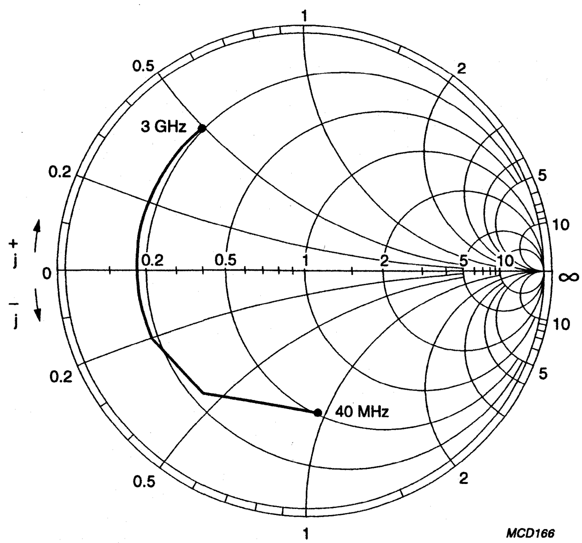
$Z_o = 50\ \Omega$.

Fig.16 Noise circle figure.



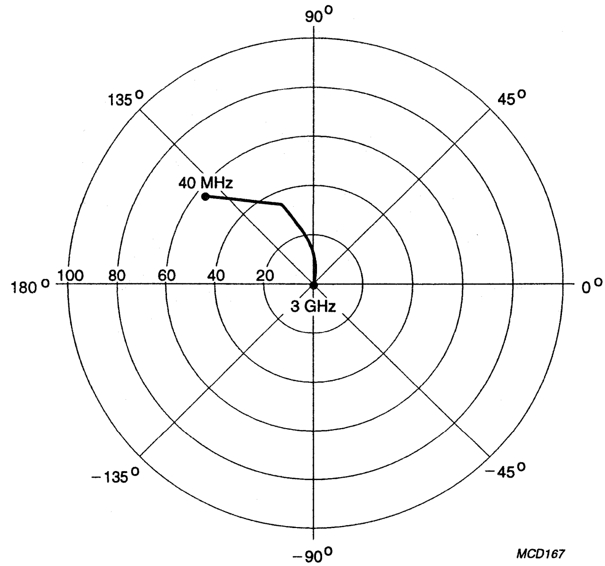
Z_o = 50 Ω.

Fig.17 Noise circle figure.



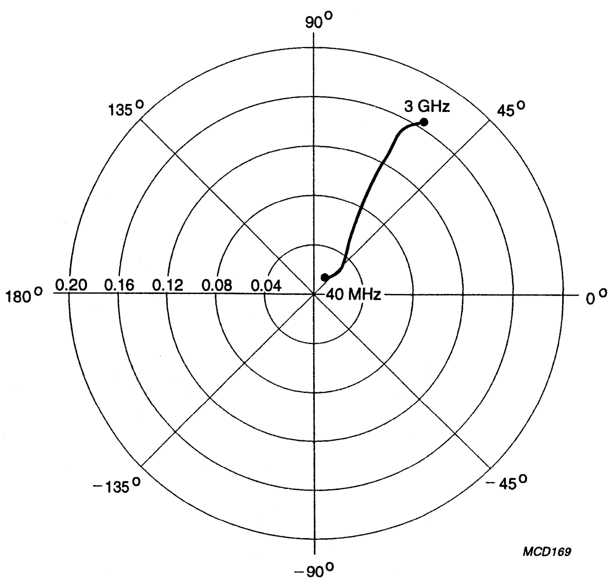
V_{CE} = 6 V; I_C = 50 mA.

Fig.18 Common emitter input reflection coefficient (S_{11}).



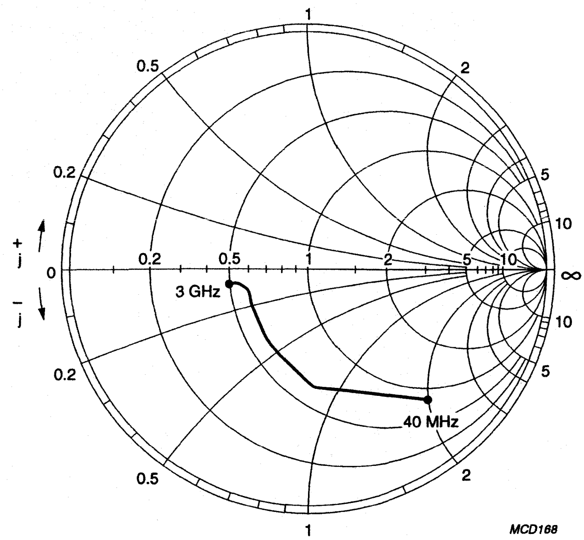
V_{CE} = 6 V; I_C = 50 mA.

Fig.19 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 6 V; I_C = 50 mA.

Fig.20 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 6 V; I_C = 50 mA.

Fig.21 Common emitter output reflection coefficient (S_{22}).

NPN 7 GHz wideband transistor

BFG197W
BFG197W/X; BFG197W/XR

FEATURES

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

APPLICATIONS

They are intended primarily for wideband applications in the GHz range such as satellite television systems and repeater amplifiers in fibre-optic systems.

DESCRIPTION

Silicon NPN transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG197W	V5
BFG197W/X	V8
BFG197W/XR	V9

PINNING

PIN	DESCRIPTION
BFG197W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG197W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG197W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

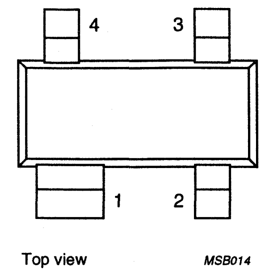


Fig.1 SOT343.

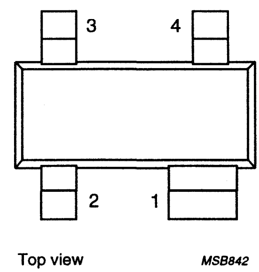


Fig.2 SOT343R.

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)		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 85 °C	–	–	500	mW
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	110	–	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.75	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	14	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 30 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 500 MHz	–	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	–	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)		–	100	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.

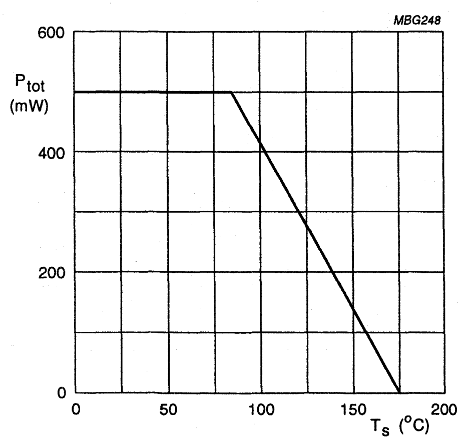


Fig.3 Power derating curve.

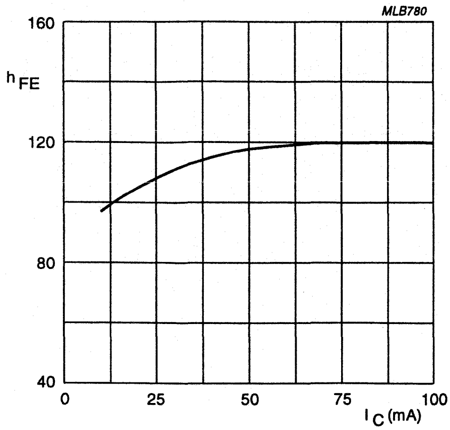
CHARACTERISTICS

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 = 0.05 mA; I_E = 0	–	–	20	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	–	–	10	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.05 mA; I_C = 0	–	–	2.5	V
I_{CBO}	collector cut-off current	open emitter; I_E = 0; V_{CB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	110	–	
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	–	3.3	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.75	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	14	–	dB
		I_C = 50 mA; V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C	–	9	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 30 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 500 MHz	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz	–	2.4	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 2 GHz	–	3.5	–	dB
V_o	output voltage	note 2	–	700	–	mV
d_2	second order intermodulation distortion	note 3	–	–55	–	dB

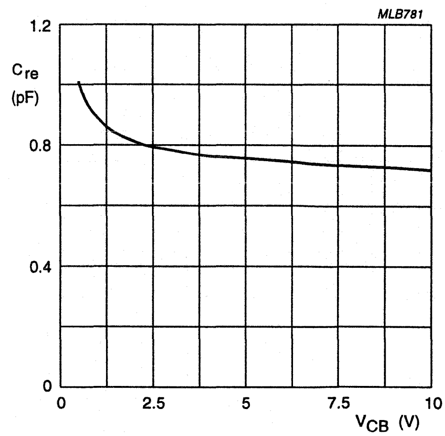
Notes

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} = –60 dB (DIN45004B); T_{amb} = 25 °C; I_C = 30 mA; V_{CE} = 8 V; R_L = 75 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 = 805.25 MHz; measured at $f_{(p+q-r)}$ = 793.25 MHz.
3. I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz.



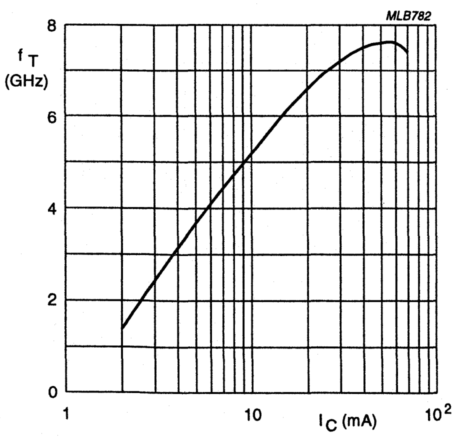
V_{CE} = 4 V.

Fig.4 DC current gain as a function of collector current; typical values.



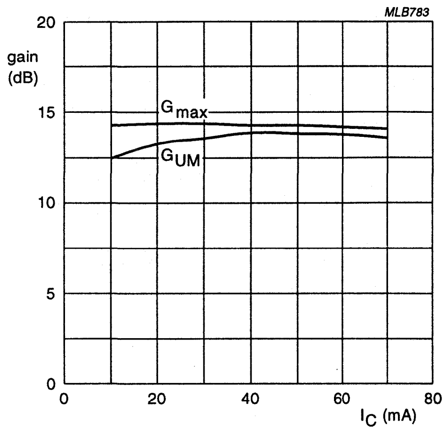
I_C = 0; f = 1 MHz.

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



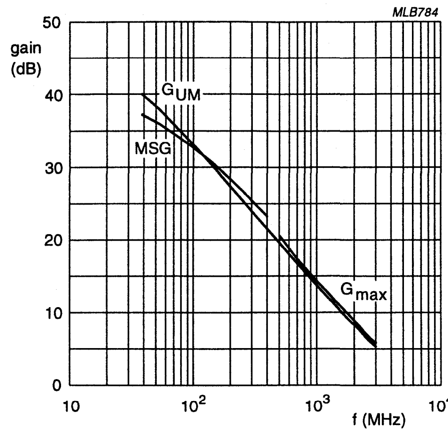
f = 2 GHz; V_{CE} = 4 V; T_{amb} = 25 °C.

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



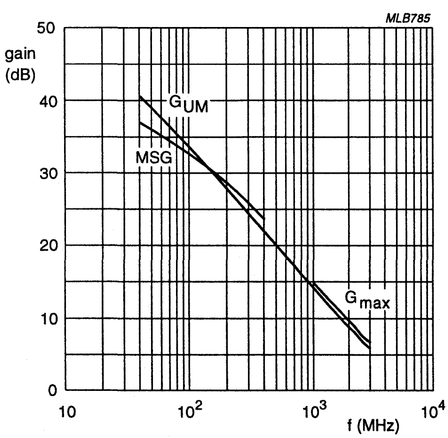
f = 1 GHz; V_{CE} = 4 V.

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



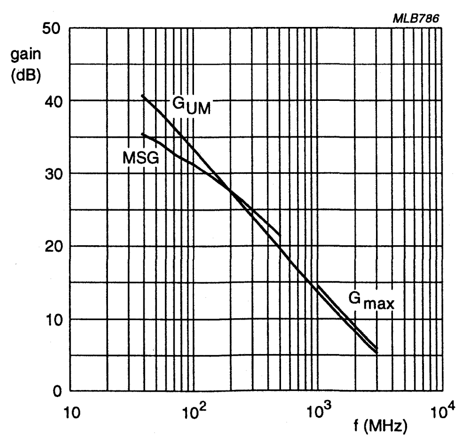
I_C = 50 mA; V_{CE} = 4 V.

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



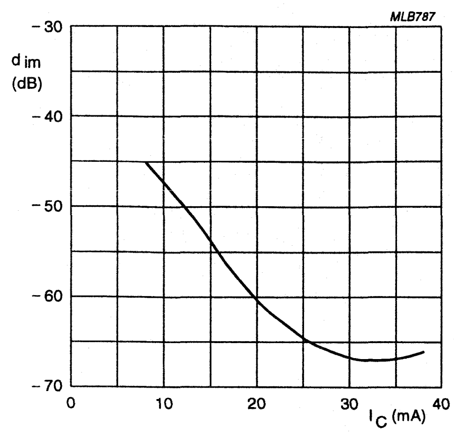
I_C = 50 mA; V_{CE} = 6 V.

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



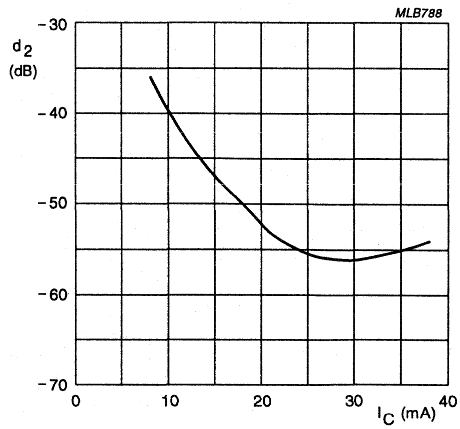
I_C = 30 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.



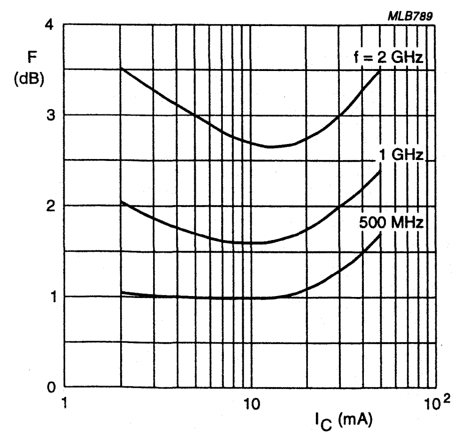
V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



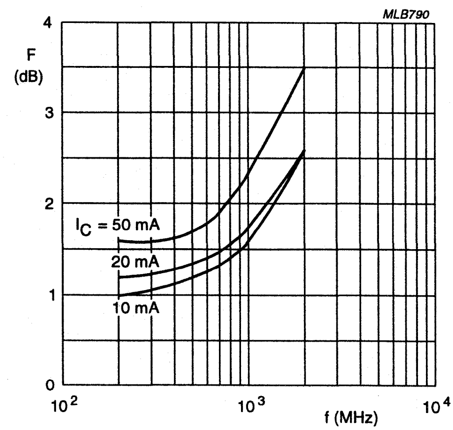
V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; V_{CE} = 8 V; T_{amb} = 25 °C.

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



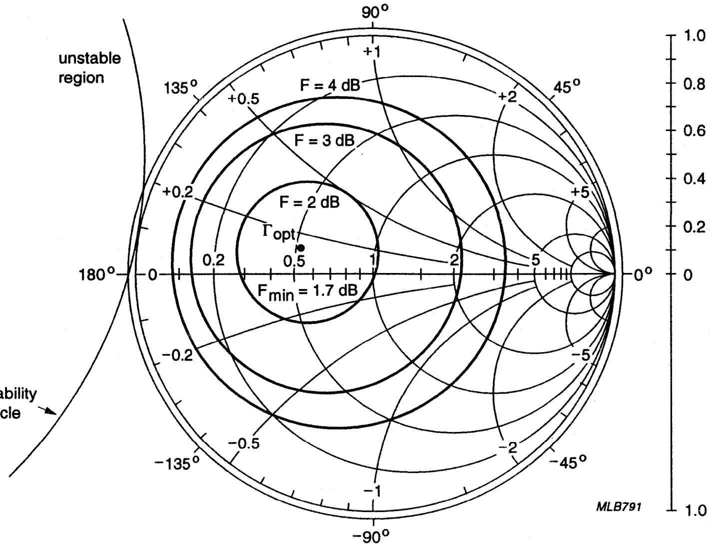
V_{CE} = 6 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



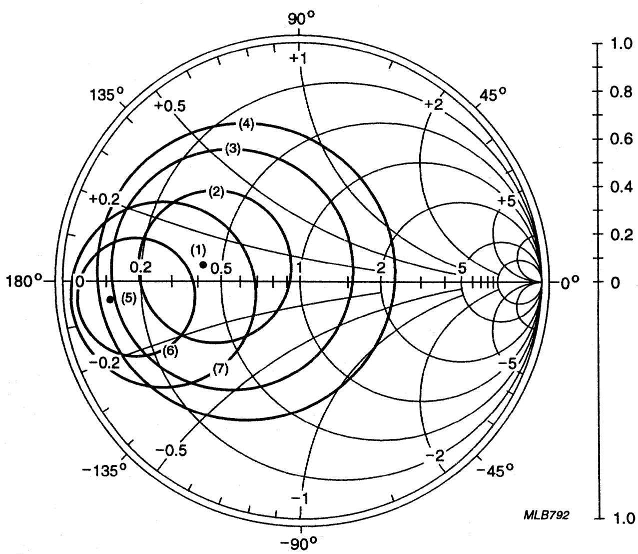
V_{CE} = 6 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



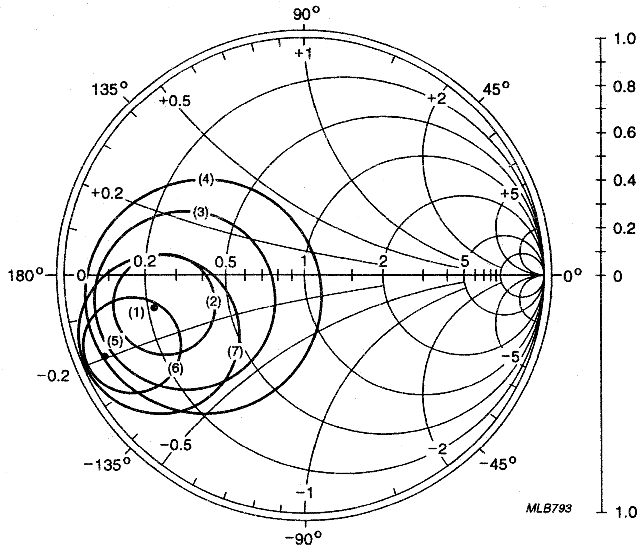
f = 500 MHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



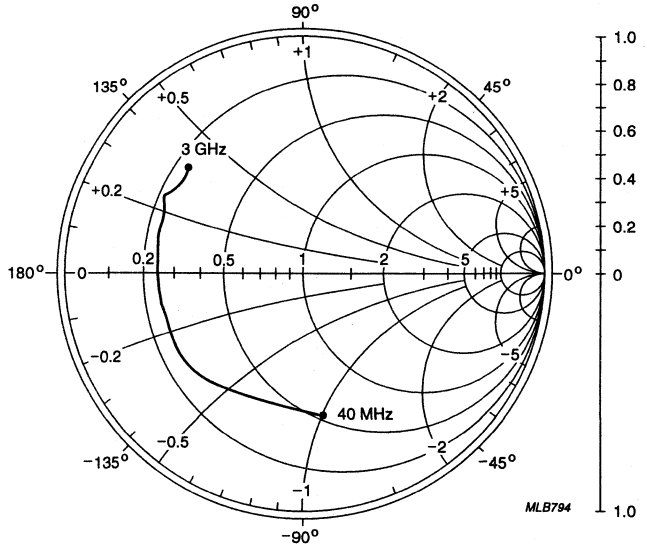
(1) Γ_{opt}; F_{min} = 2.4 dB.
(2) F = 3 dB.
(3) F = 4 dB.
(4) F = 5 dB.
(5) Γ_{ms}; G_{max} = 14.9 dB.
(6) G = 14 dB.
(7) G = 13 dB.
f = 1 GHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.16 Common emitter noise figure circles; typical values.



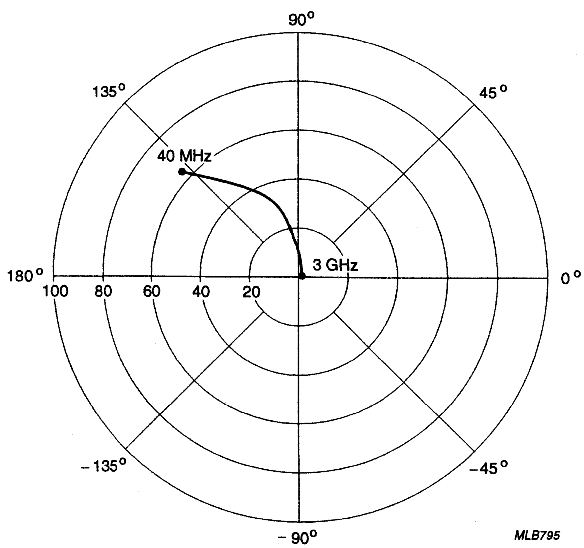
(1) Γ_{opt}; F_{min} = 3.5 dB.
(2) F = 4 dB.
(3) F = 5 dB.
(4) F = 6 dB.
(5) Γ_{ms}; G_{max} = 9.8 dB.
(6) G = 9 dB.
(7) G = 8 dB.
f = 2 GHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles; typical values.



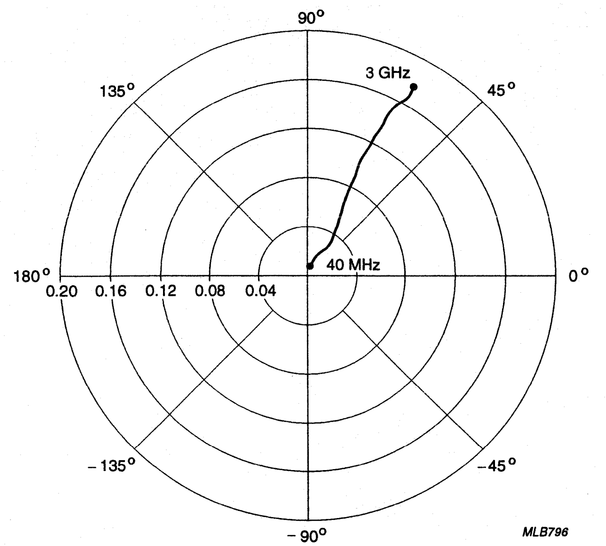
V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.18 Common emitter input reflection coefficient (s_{11}); typical values.



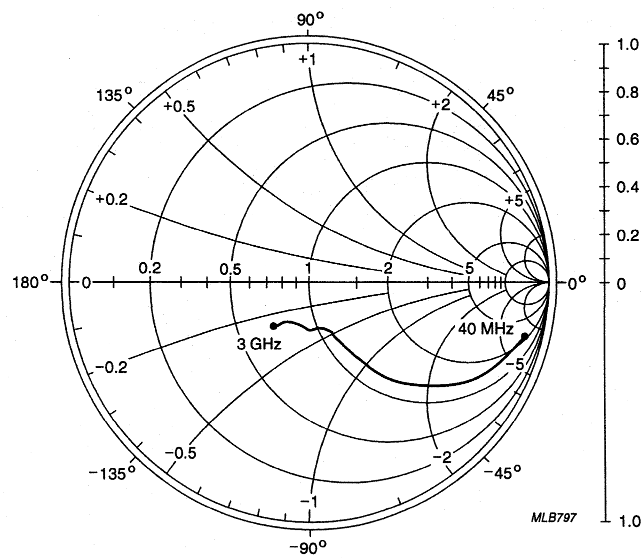
V_{CE} = 6 V; I_C = 50 mA.

Fig.19 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 50 mA.

Fig.20 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.21 Common emitter output reflection coefficient (s_{22}); typical values.

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

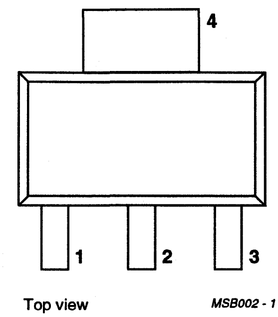


Fig.1 SOT223.

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

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.
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.

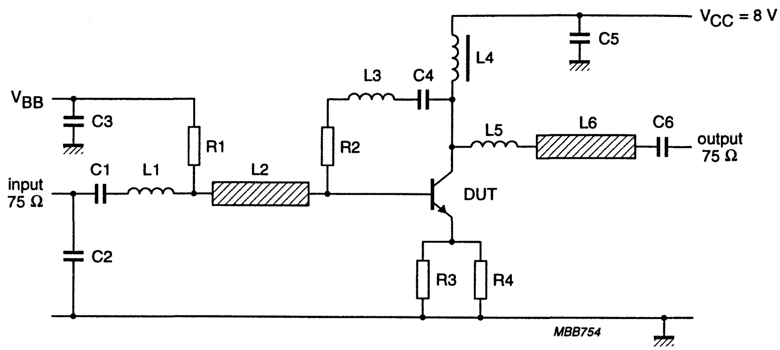


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

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 (ε_r = 2.2); thickness $1/16$ inch; thickness of copper sheet 2 x 35 μm; see Fig.2.

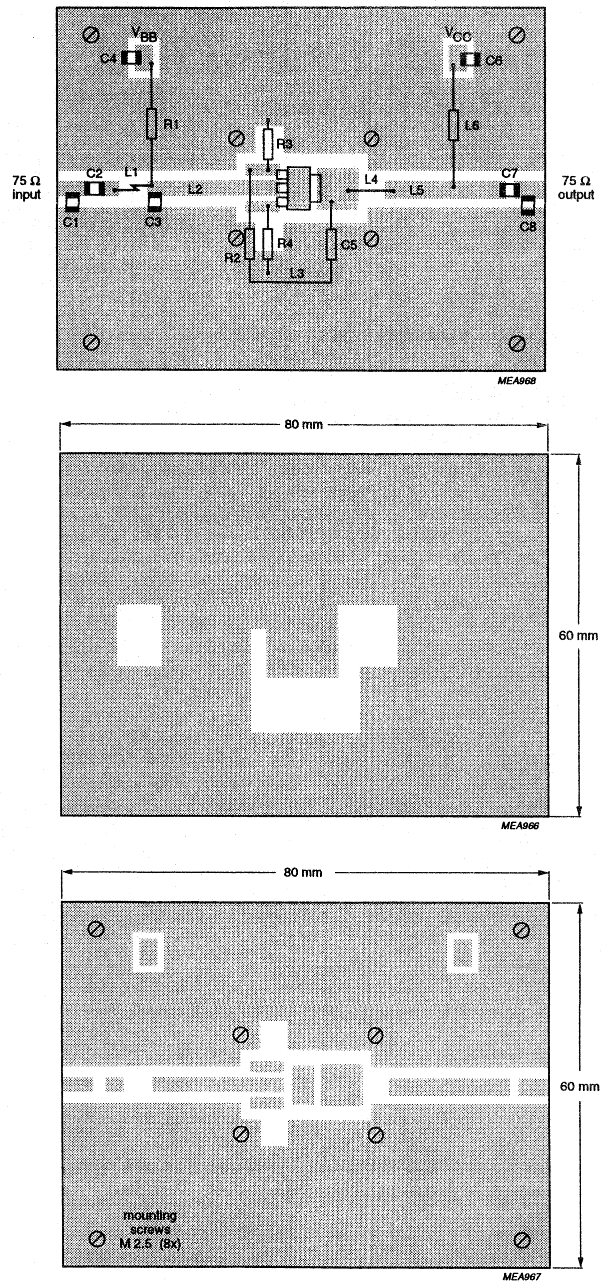


Fig.3 Intermodulation distortion and second order intermodulation distortion printed-circuit board.

NPN 8 GHz wideband transistor BFG198

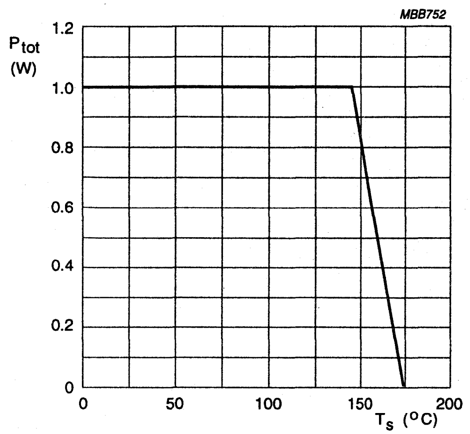
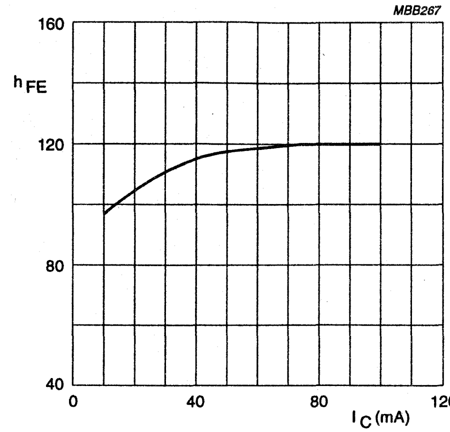
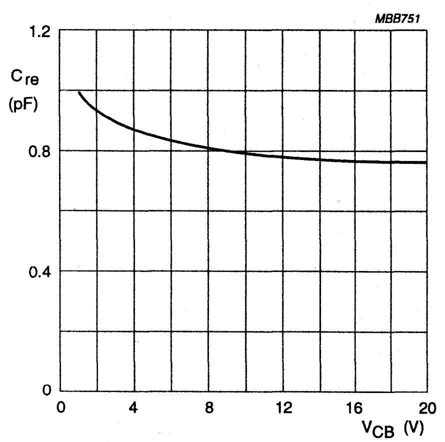


Fig.4 Power derating curve.



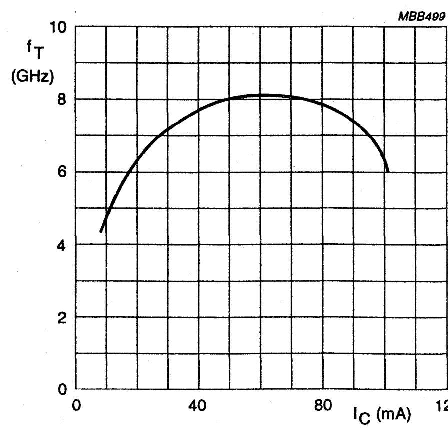
V_{CE} = 5 V; T_j = 25 °C.

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



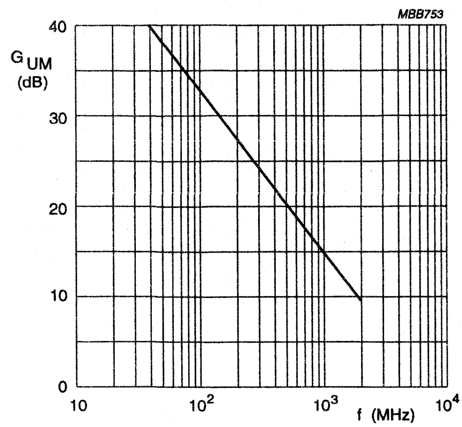
I_E = 0; f = 1 MHz; T_j = 25 °C.

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



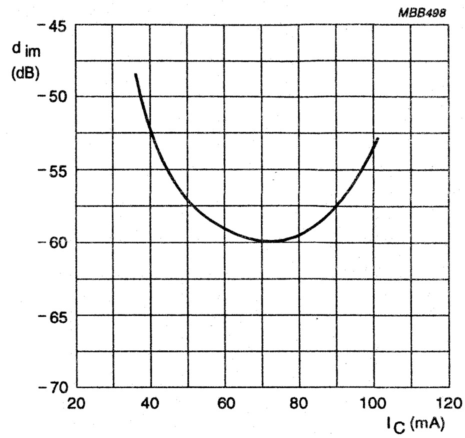
V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C.

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



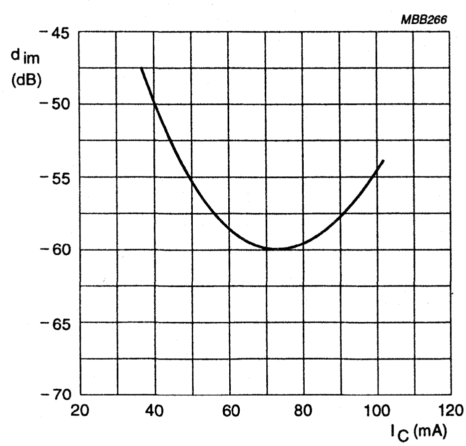
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C;

Fig.8 Maximum gain as a function of frequency.



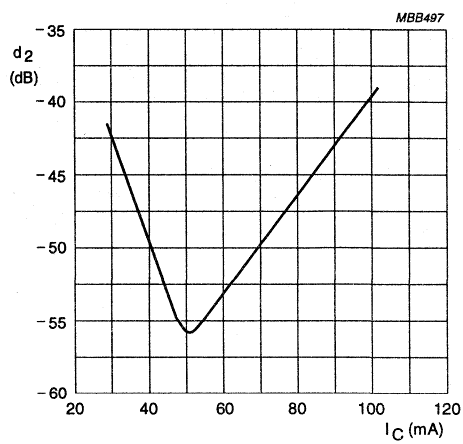
V_{CE} = 8 V; V_o = 750 mV; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 443.25 MHz.

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



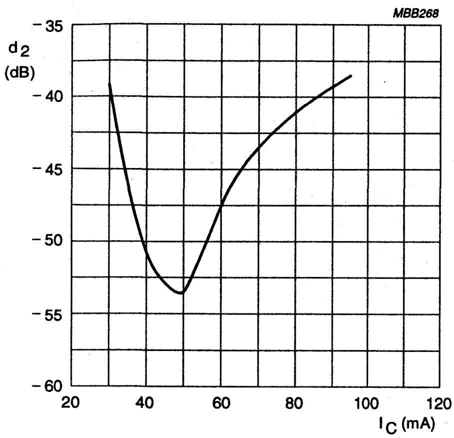
V_{CE} = 8 V; V_o = 700 mV; T_{amb} = 25 °C; $f_{(p+q)}$ = 793.25 MHz.

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



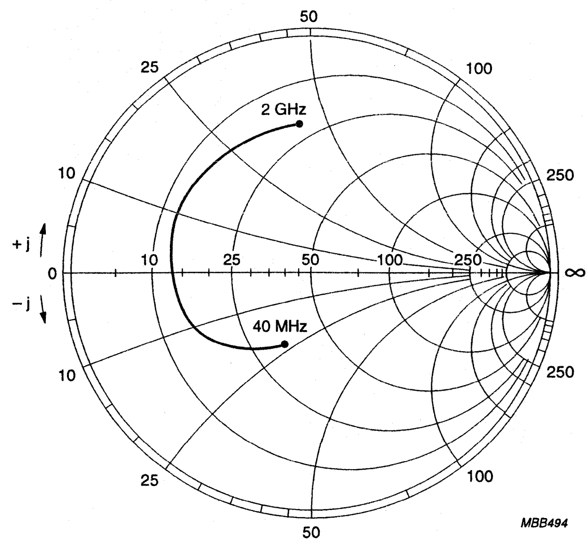
V_{CE} = 8 V; V_o = 50 dBmV; T_{amb} = 25 °C $f_{(p+q)}$ = 450 MHz.

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



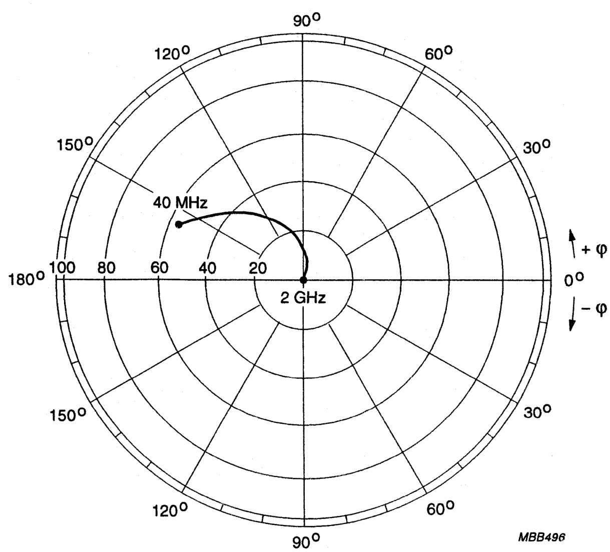
V_{CE} = 8 V; V_o = 50 dBmV; T_{amb} = 25 °C
$f_{(p+q)}$ = 810 MHz.

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



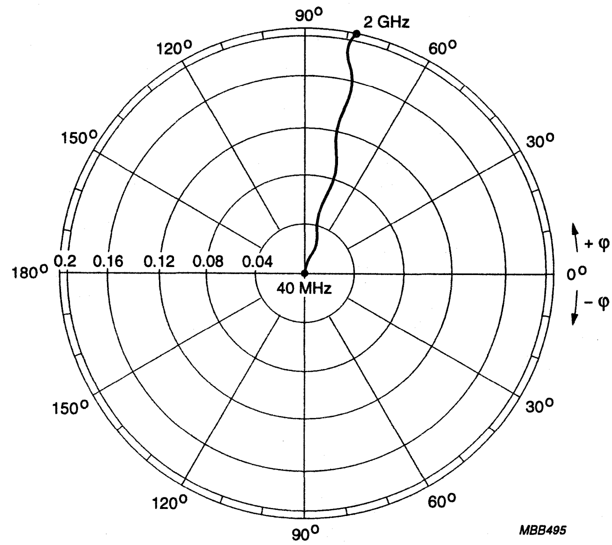
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C; Z_o = 50 Ω.

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



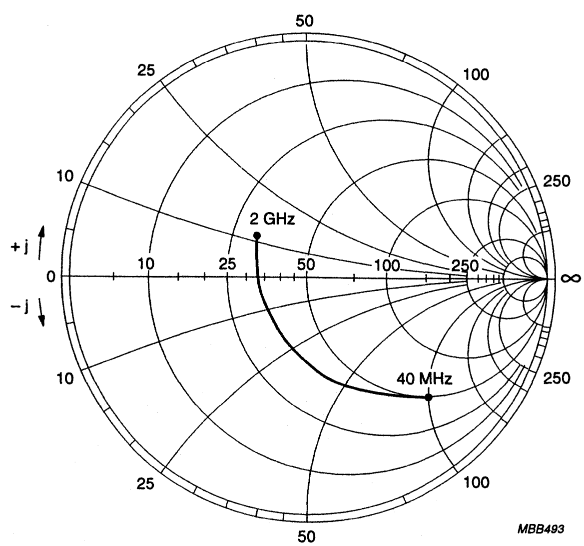
I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

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 9 GHz wideband transistor — BFG505; BFG505/X; BFG505/XR

FEATURES

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

DESCRIPTION

The BFG505 is an NPN silicon planar epitaxial transistor, 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).

The transistors are mounted in a plastic SOT143 envelope.

PINNING

PIN	DESCRIPTION
BFG505 (Fig.1) Code: N33	
1	collector
2	base
3	emitter
4	emitter
BFG505/X (Fig.1) Code: N39	
1	collector
2	emitter
3	base
4	emitter
BFG505/XR (Fig.2) Code: N45	
1	collector
2	emitter
3	base
4	emitter

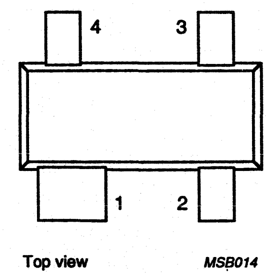


Fig.1 SOT143.

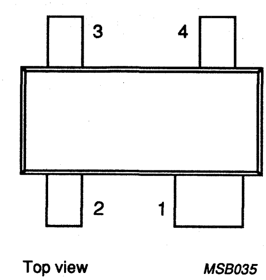


Fig.2 SOT143R.

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		–	–	18	mA
P_{tot}	total power dissipation	up to T_s = 130 °C; note 1	–	–	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	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 130 °C; note 1	–	150	mW
T_{stg}	storage temperature range		–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)	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	V_{CB} = 6 V; I_E = 0;	–	–	50	nA
h_{FE}	DC current gain	V_{CE} = 6 V; I_C = 5 mA;	60	120	250	
C_e	emitter capacitance	V_{EB} = 0.5 V; $I_C = i_c$ = 0; 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	V_{CB} = 6 V; 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 (note 1)	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
P_{L1}	output power at 1 dB gain compression	V_{CE} = 6 V; I_C = 5 mA; 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 $f_{(2p-q)}$ = 898 MHz and $f_{(2q-p)}$ = 904 MHz.

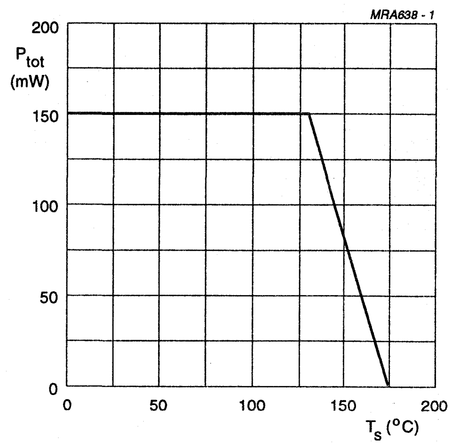
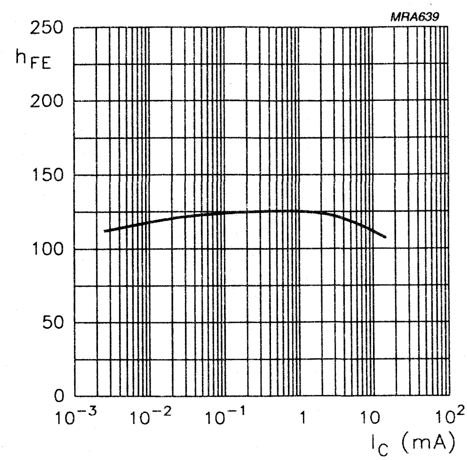
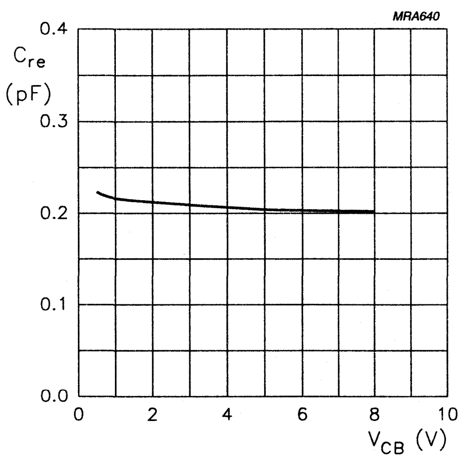


Fig.3 Power derating curve.



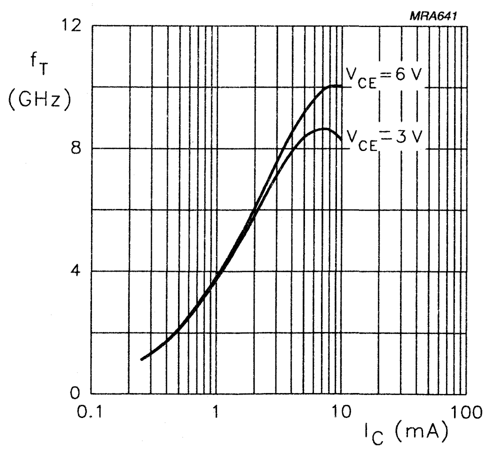
V_{CE} = 6 V.

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



I_C = 0; f = 1 MHz.

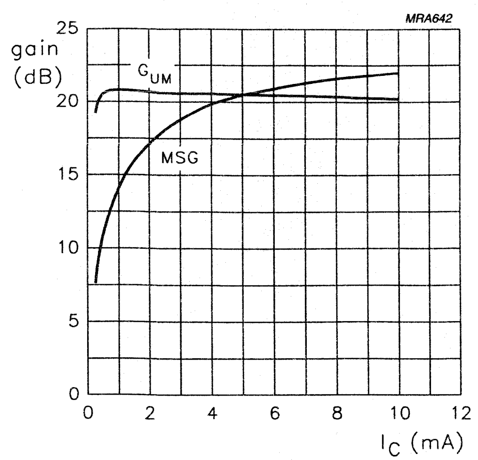
Fig.5 Feedback capacitance as a function of collector-base voltage.



T_{amb} = 25 °C; f = 1 GHz.

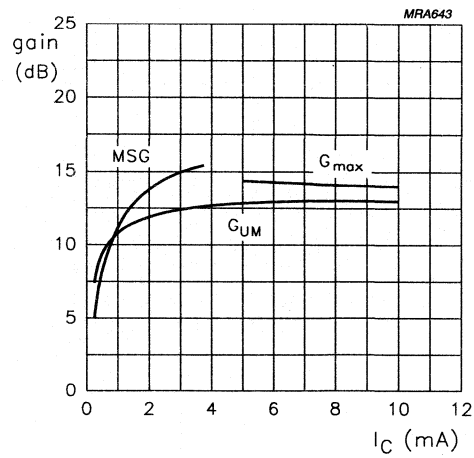
Fig.6 Transition frequency as a function of collector current.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



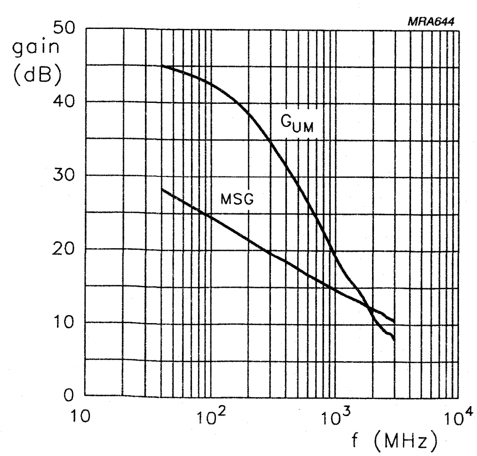
V_{CE} = 6 V; f = 900 MHz.

Fig.7 Gain as a function of collector current.



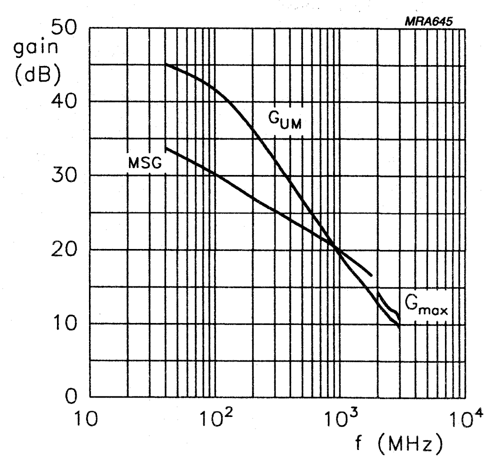
V_{CE} = 6 V; f = 2 GHz.

Fig.8 Gain as a function of collector current.



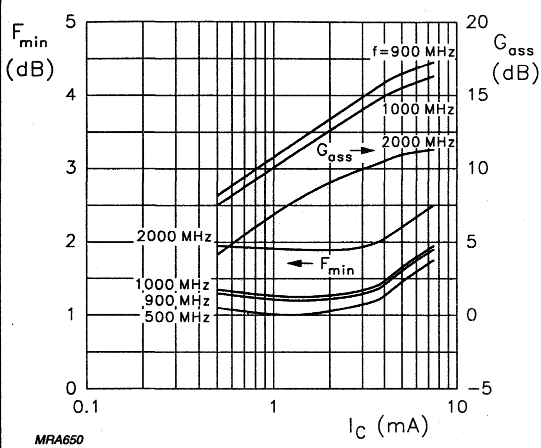
V_{CE} = 6 V; I_C = 1.25 mA.

Fig.9 Gain as a function of frequency.



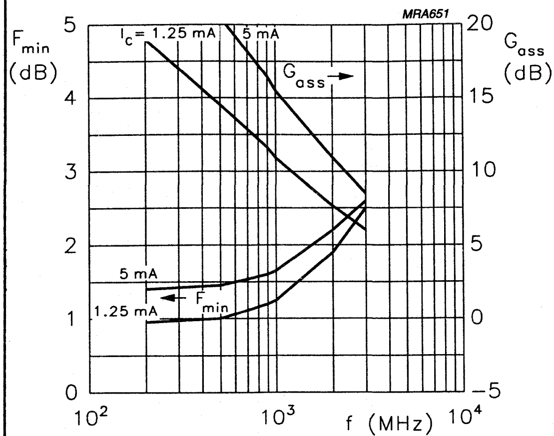
V_{CE} = 6 V; I_C = 5 mA.

Fig.10 Gain as a function of frequency.



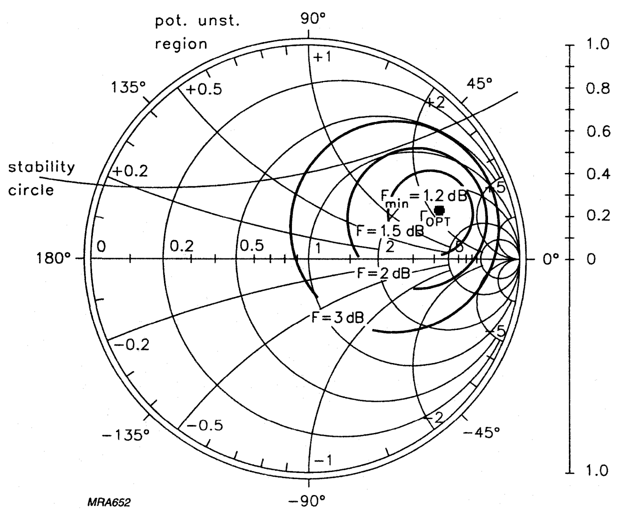
V_{CE} = 6 V.

Fig.11 Minimum noise figure and associated available gain as functions of collector current.



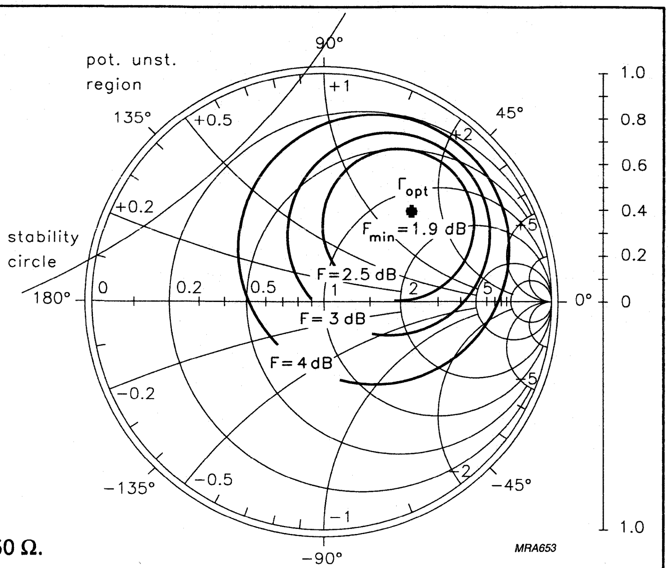
V_{CE} = 6 V.

Fig.12 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.

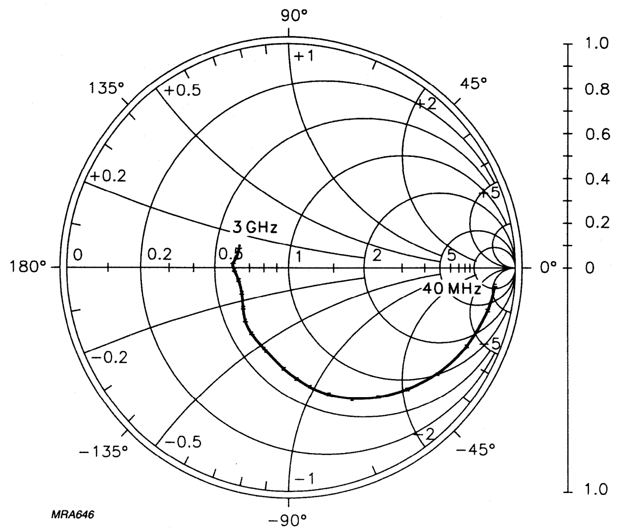
Fig.13 Noise circle figure.



$Z_O = 50\ \Omega$.

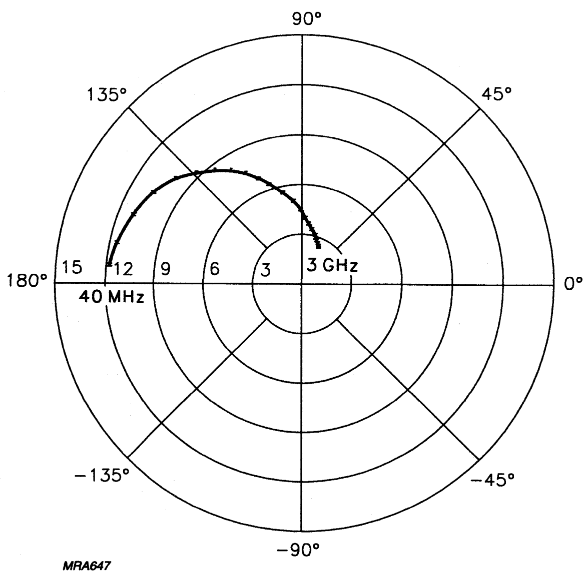
$V_{CE} = 6$ V; $I_C = 1.25$ mA; f = 2000 MHz.

Fig.14 Noise circle figure.



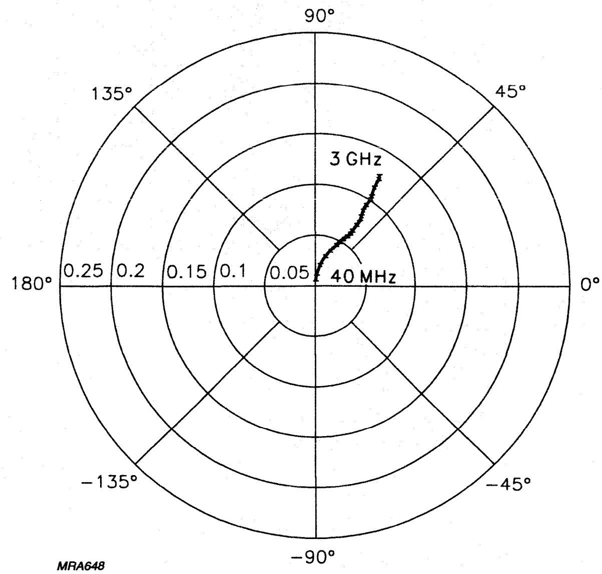
V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

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



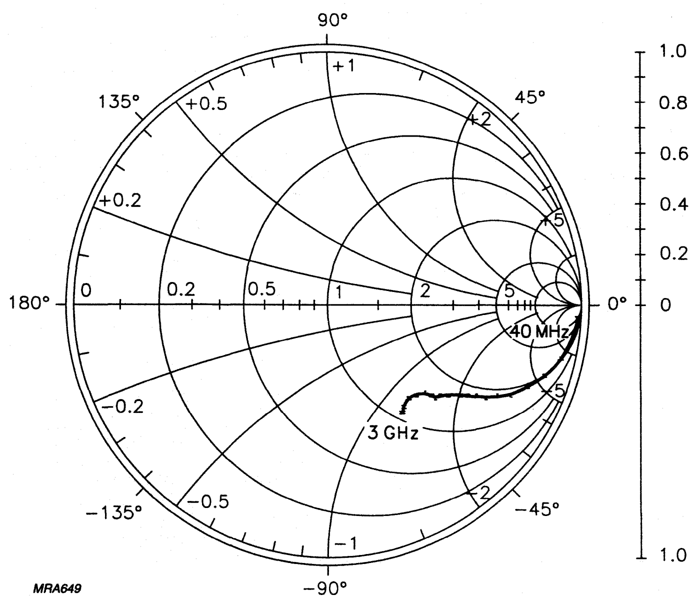
V_{CE} = 6 V; I_C = 5 mA.

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



V_{CE} = 6 V; I_C = 5 mA.

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



V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

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

NPN 9 GHz wideband transistor

BFG505W
BFG505W/X; BFG505W/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).

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG505W	N0
BFG505W/X	N1
BFG505W/XR	P0

PINNING

PIN	DESCRIPTION
BFG505W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG505W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG505W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

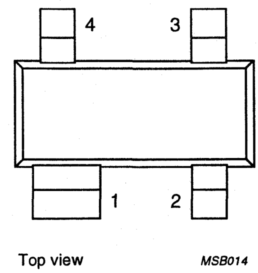


Fig.1 SOT343.

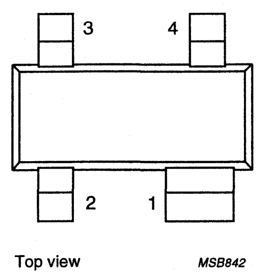


Fig.2 SOT343R.

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)		–	–	18	mA
P_{tot}	total power dissipation	up to $T_s = 85$ °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	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.

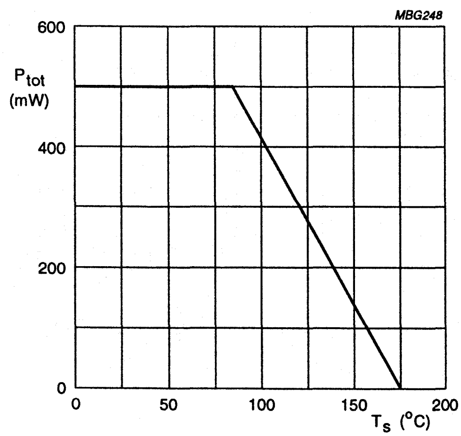


Fig.3 Power derating curve.

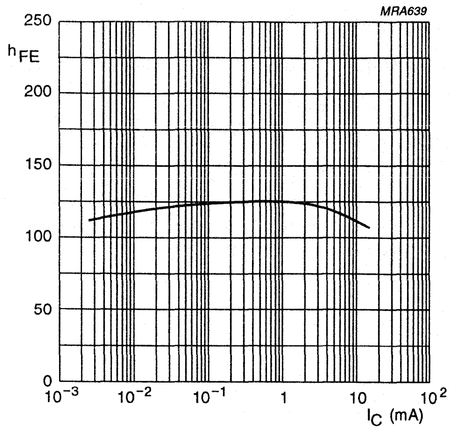
CHARACTERISTICS

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 = 2.5 μA ; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 10 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 2.5 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector cut-off current	open emitter; 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	
f_T	transition frequency	I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	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	–	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 Ω; T_{amb} = 25 °C	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

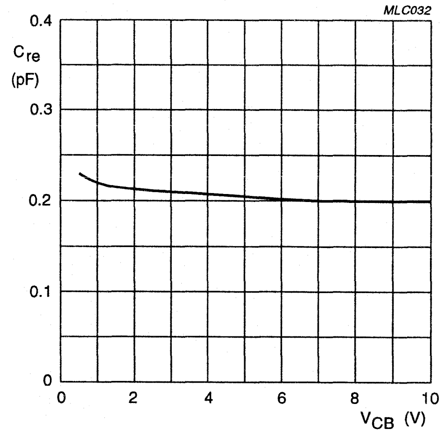
Notes

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 Ω; T_{amb} = 25 °C;
   f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 904 MHz.



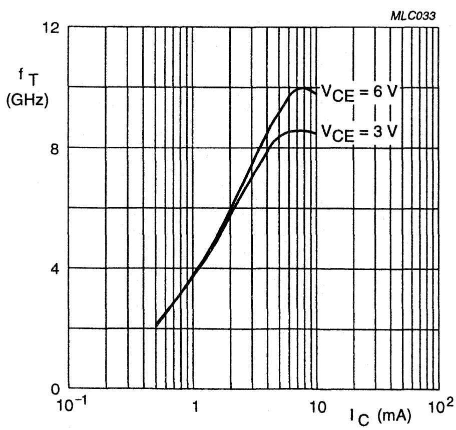
V_{CE} = 6 V.

Fig.4 DC current gain as a function of collector current; typical values.



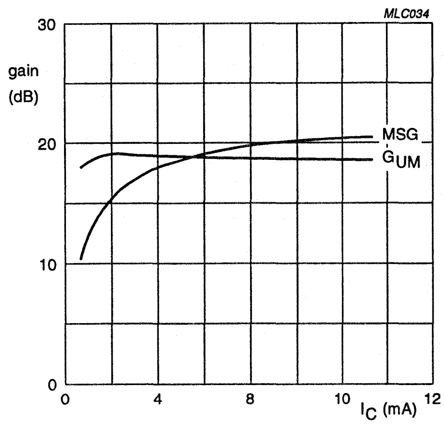
I_C = 0; f = 1 MHz.

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



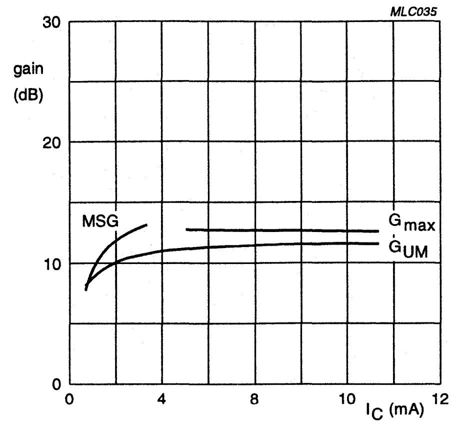
f = 1 GHz; T_{amb} = 25 °C.

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



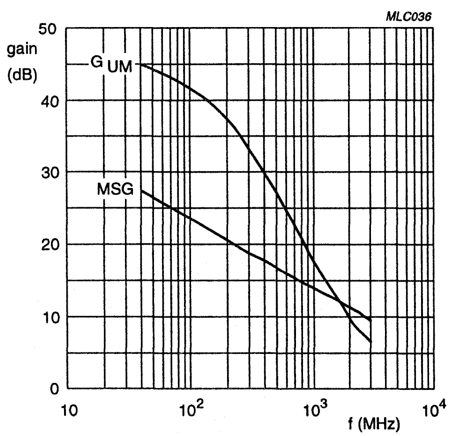
f = 900 MHz; V_{CE} = 6 V.

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



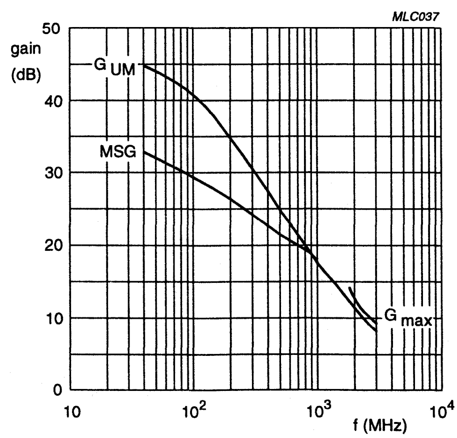
f = 2 GHz; V_{CE} = 6 V.

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



I_C = 1.25 mA; V_{CE} = 6 V.

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

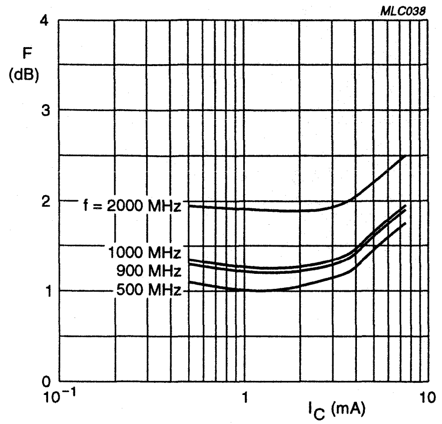


I_C = 5 mA; V_{CE} = 6 V.

Fig.10 Gain as a function of frequency; typical values.

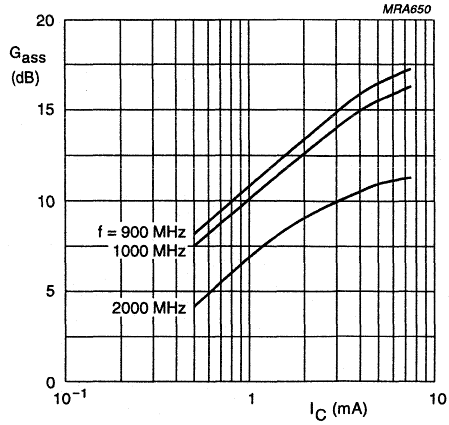
NPN 9 GHz wideband transistor

BFG505W BFG505W/X; BFG505W/XR



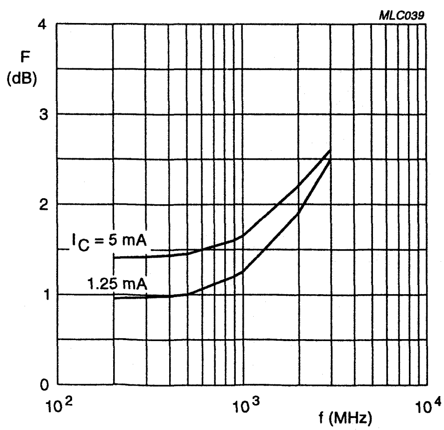
V_{CE} = 6 V.

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



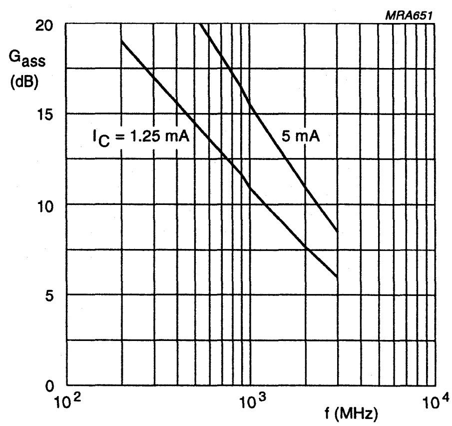
V_{CE} = 6 V.

Fig.12 Associated available gain as a function of collector current; typical values.



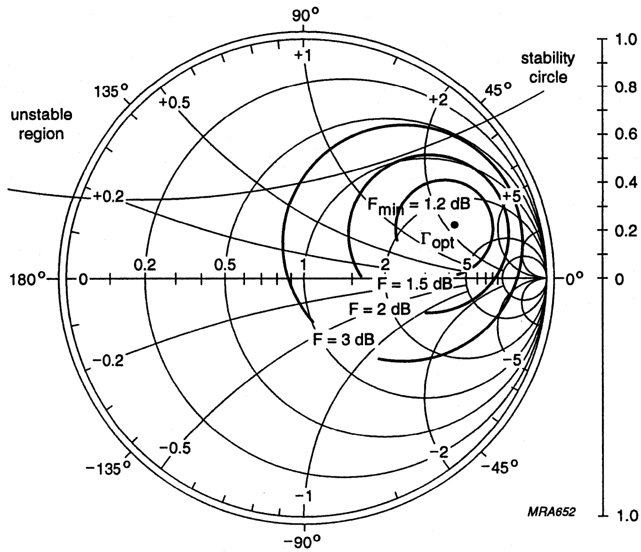
V_{CE} = 6 V.

Fig.13 Minimum noise figure as a function of frequency; typical values.



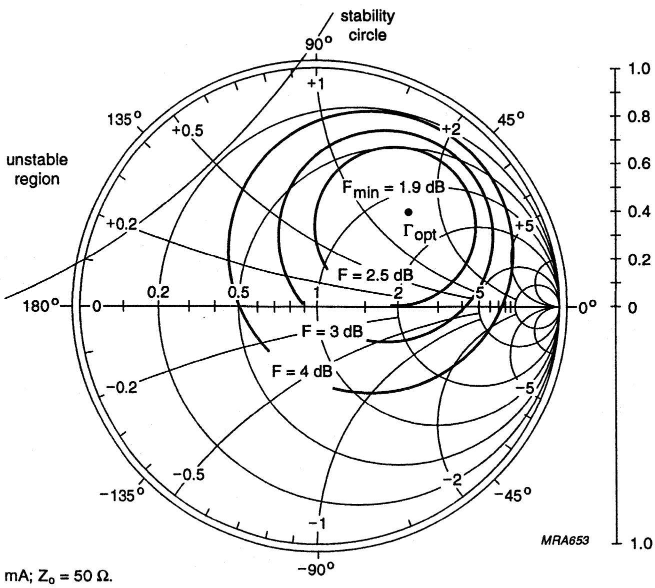
V_{CE} = 6 V.

Fig.14 Associated available gain as a function of frequency; typical values.



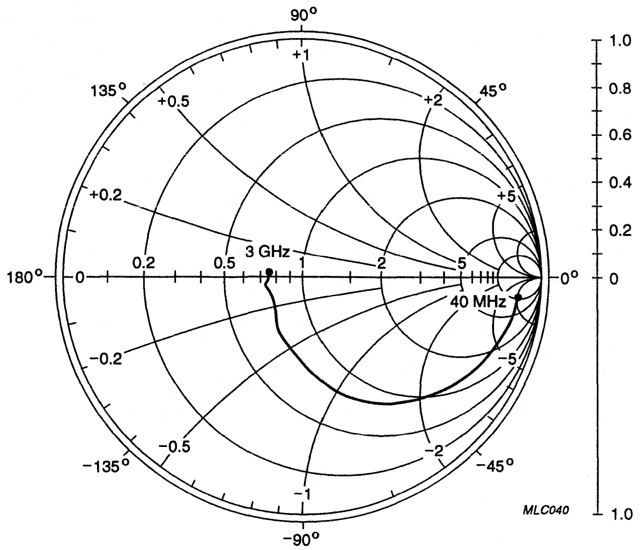
f = 900 MHz; V_{CE} = 6 V; I_C = 1.25 mA; Z_o = 50 Ω.

Fig.15 Common emitter noise figure circles; typical values.



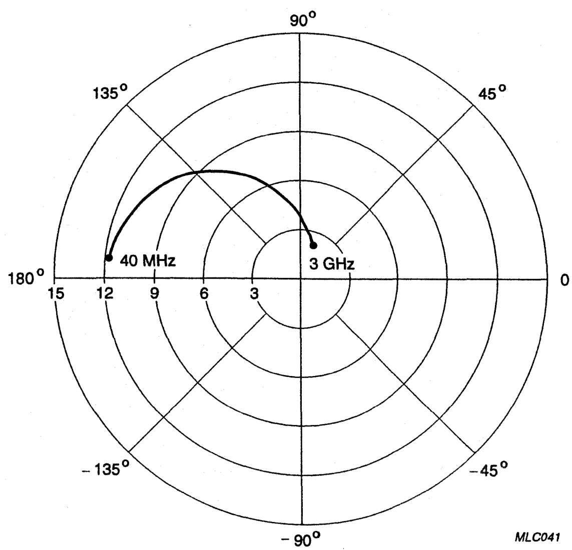
f = 2 GHz; V_{CE} = 6 V; I_C = 1.25 mA; Z_o = 50 Ω.

Fig.16 Common emitter noise figure circles; typical values.



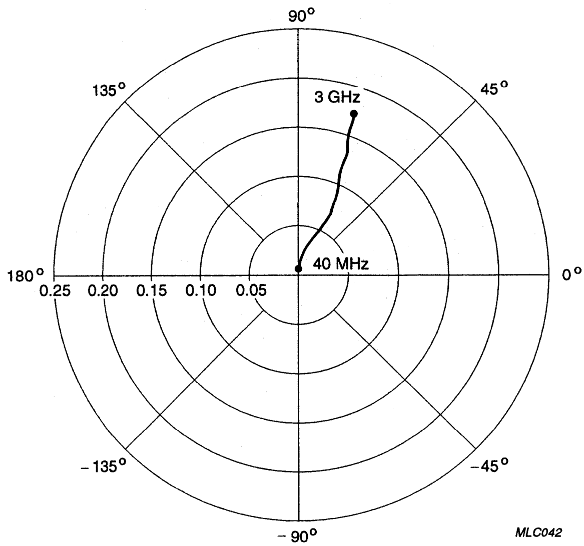
V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (s_{11}); typical values.



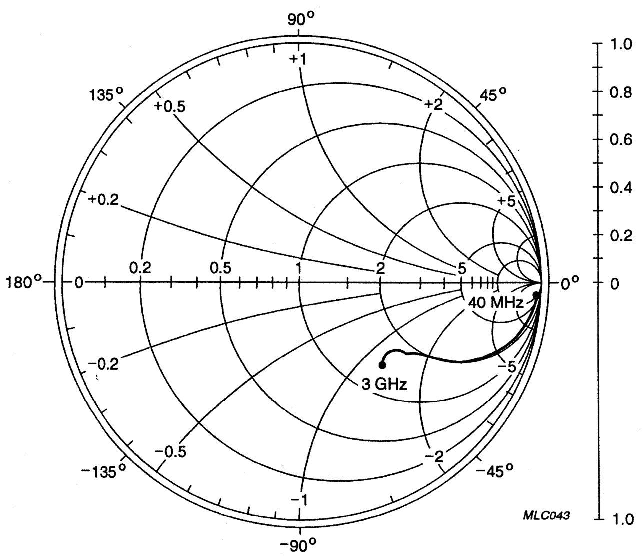
V_{CE} = 6 V; I_C = 5 mA.

Fig.18 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 5 mA.

Fig.19 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.20 Common emitter output reflection coefficient (s_{22}); typical values.

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

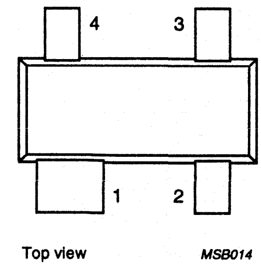


Fig.1 SOT143.

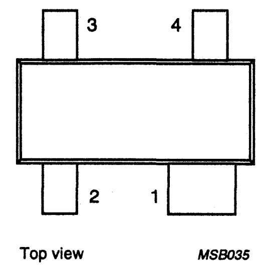


Fig.2 SOT143R.

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; $R_L = 50$ Ω; 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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 20$ mA; $V_{CE} = 6$ 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 $f_{(2q-p)} = 904$ 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

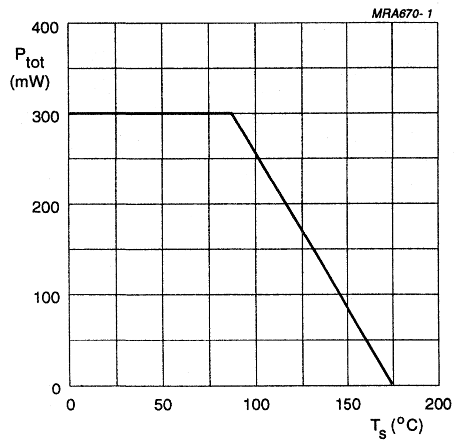
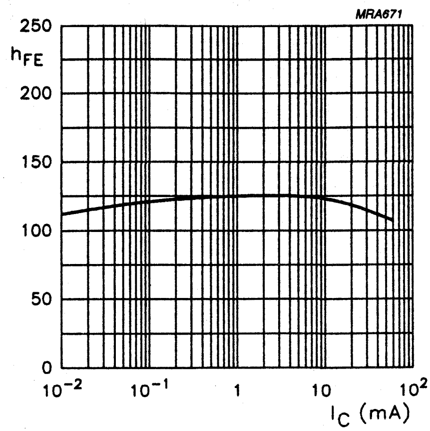
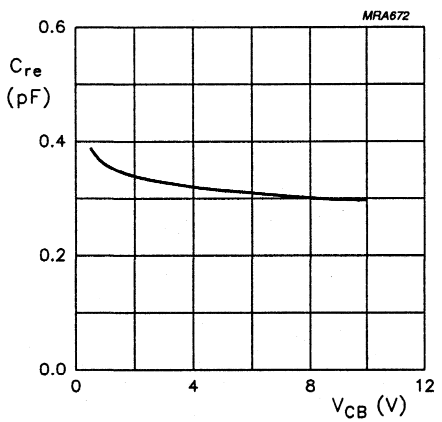


Fig.3 Power derating curve.



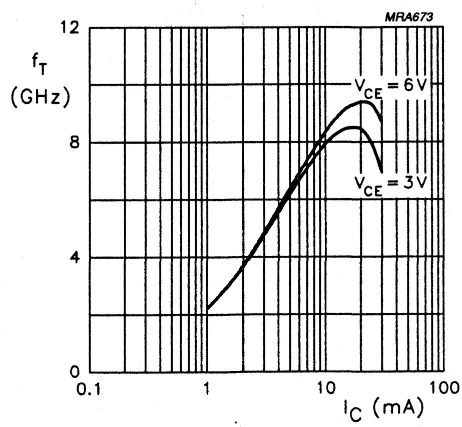
V_{CE} = 6 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

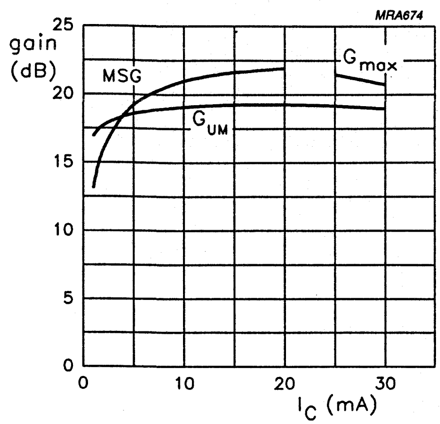
Fig.5 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

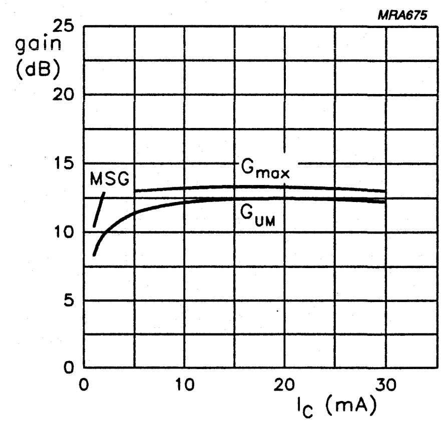
Fig.6 Transition frequency as a function of collector current.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



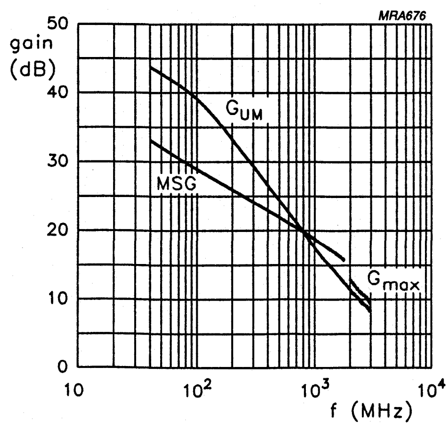
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



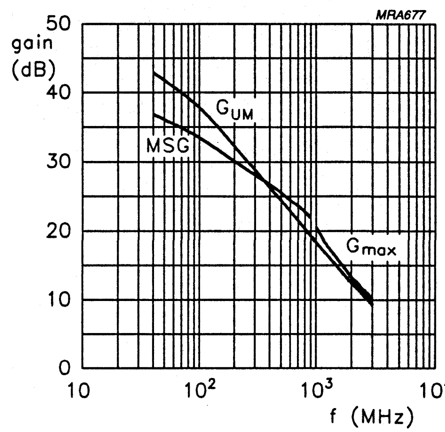
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

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.

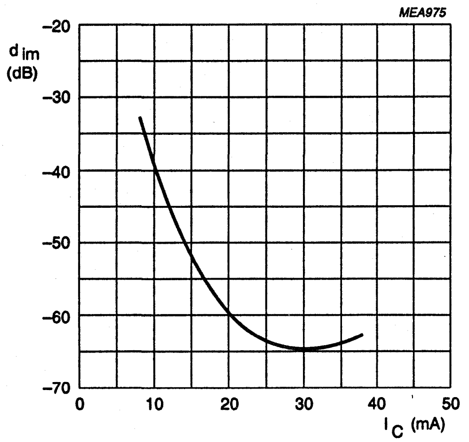


Fig.11 Intermodulation distortion as a function of collector current.

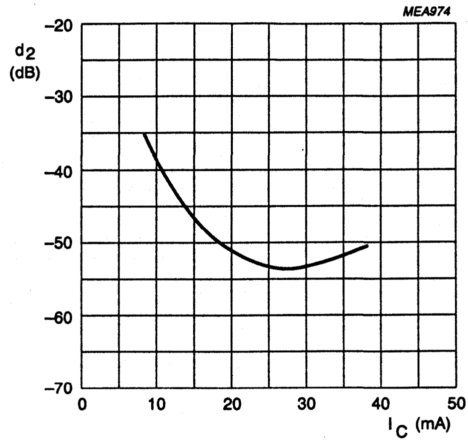
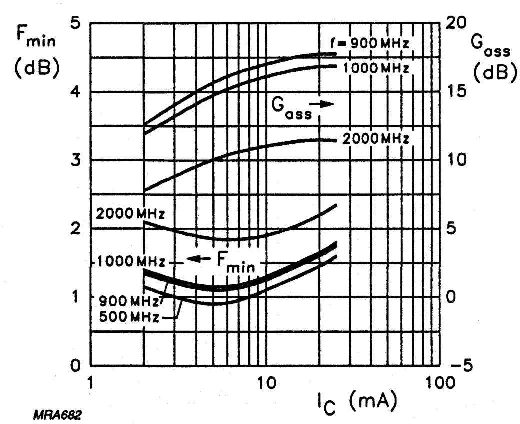
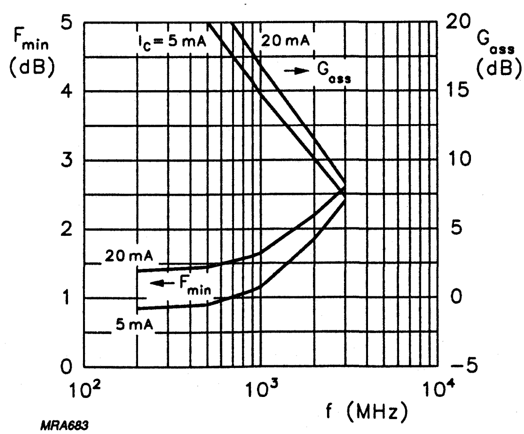


Fig.12 Second order intermodulation distortion as a function of collector current.



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.

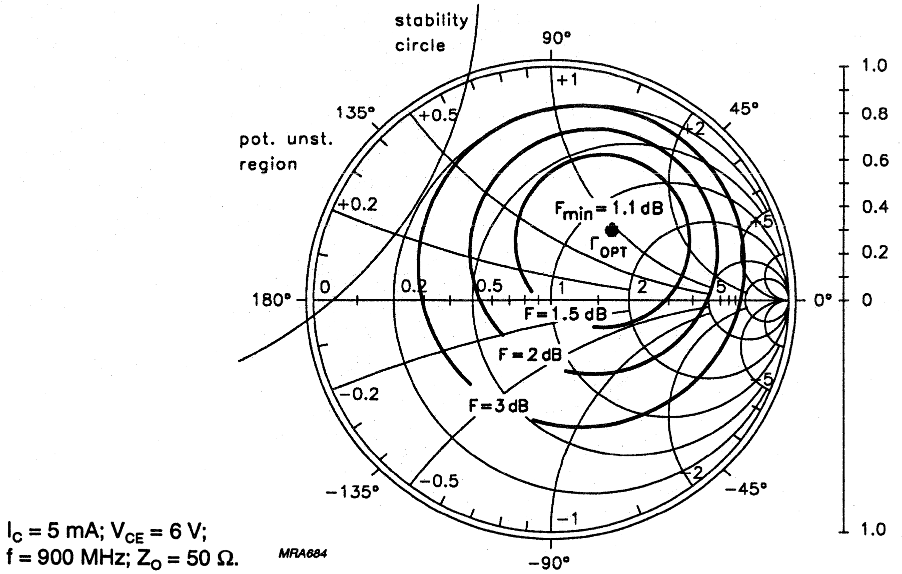


Fig.15 Noise circle figure.

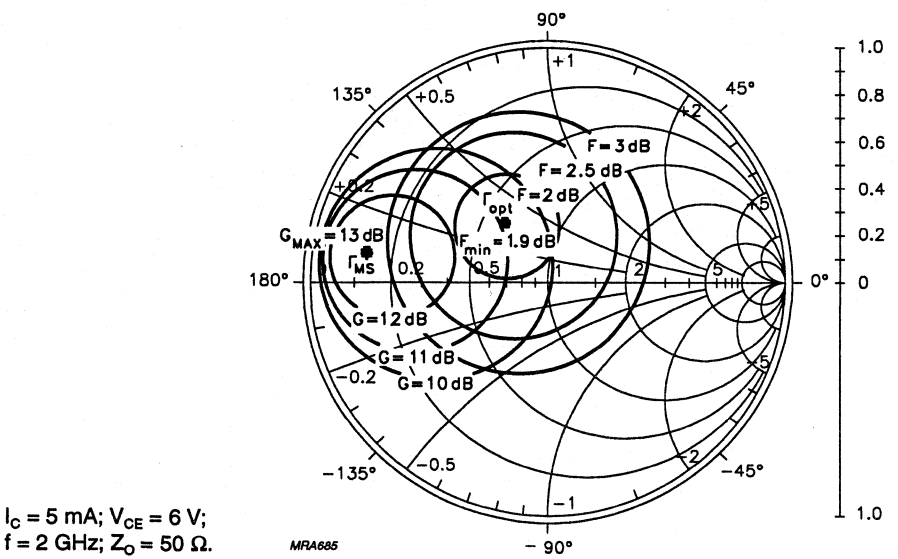
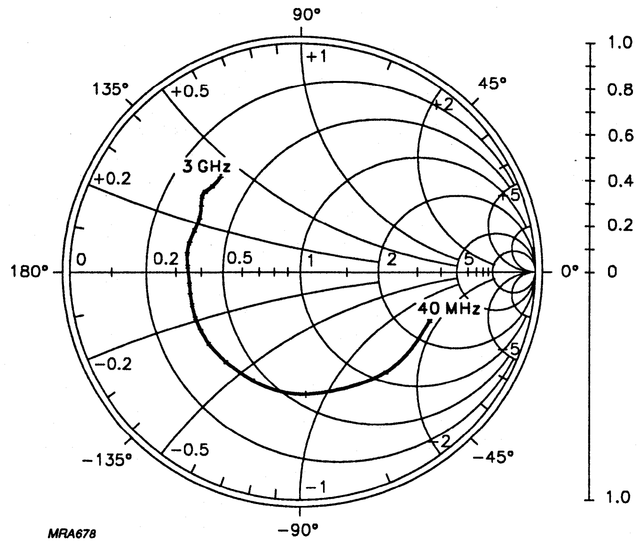
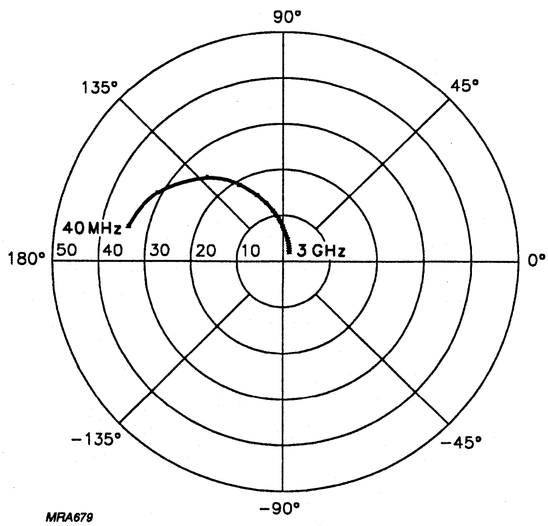


Fig.16 Noise circle figure.



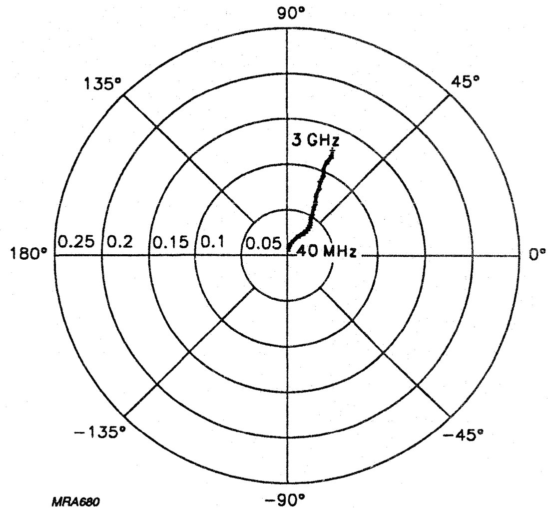
I_C = 20 mA; V_{CE} = 6 V.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



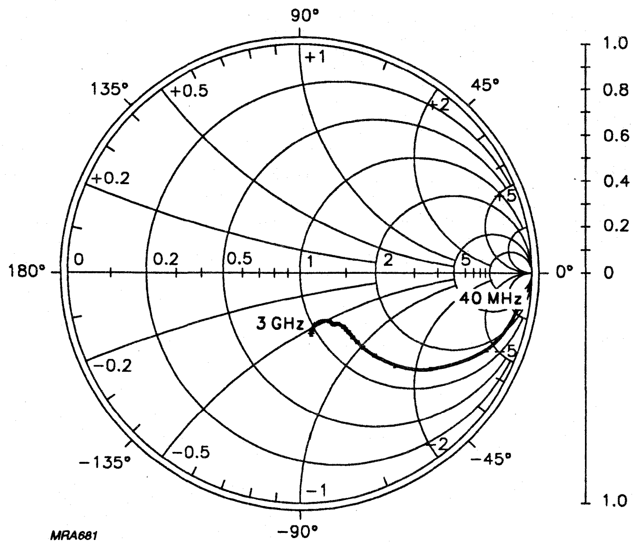
I_C = 20 mA; V_{CE} = 6 V.

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 transistor

BFG520W
BFG520W/X; BFG520W/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) and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG520W	N3
BFG520W/X	N4
BFG520W/XR	N5

PINNING

PIN	DESCRIPTION
BFG520W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG520W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG520W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

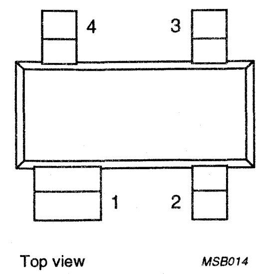


Fig.1 SOT343.

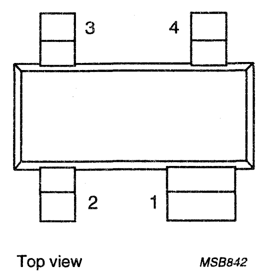


Fig.2 SOT343R.

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)		–	–	70	mA
P_{tot}	total power dissipation	up to $T_s = 85$ °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
$\lvert s_{21}\rvert^2$	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

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	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.

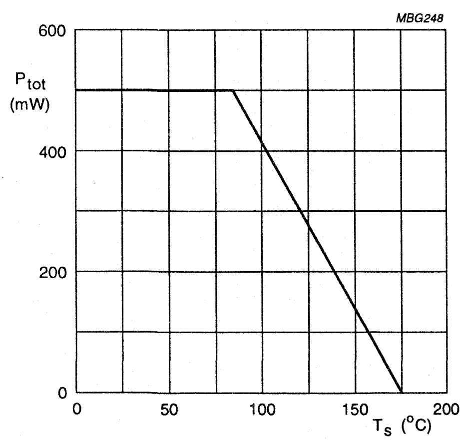


Fig.3 Power derating curve.

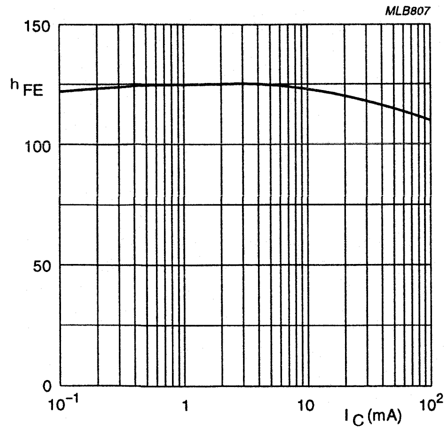
CHARACTERISTICS

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 = 10 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector cut-off current	open emitter; 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	
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; 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
$\|s_{21}\|^2$	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
		$\Gamma_s = \Gamma_{opt}$; 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

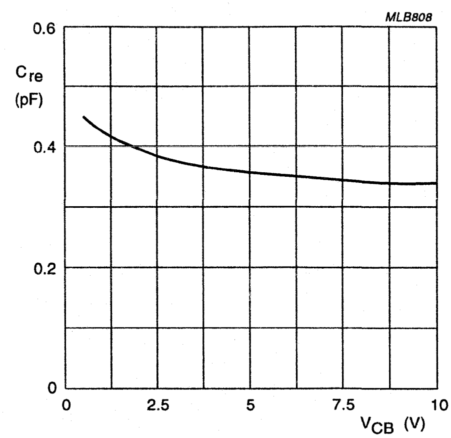
Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ 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 $f_{(2p-q)}$ = 898 MHz and $f_{(2q-p)}$ = 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 $f_{(p+q-r)}$ = 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 $f_{(p+q)}$ = 810 MHz.



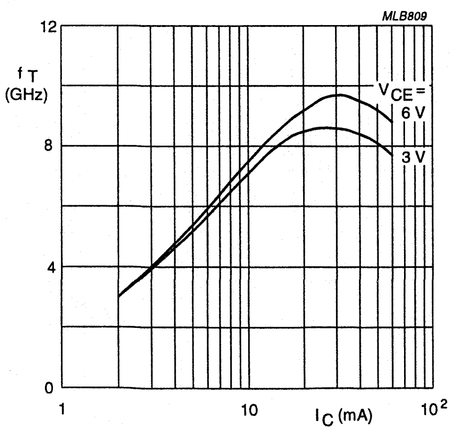
V_{CE} = 6 V.

Fig.4 DC current gain as a function of collector current; typical values.



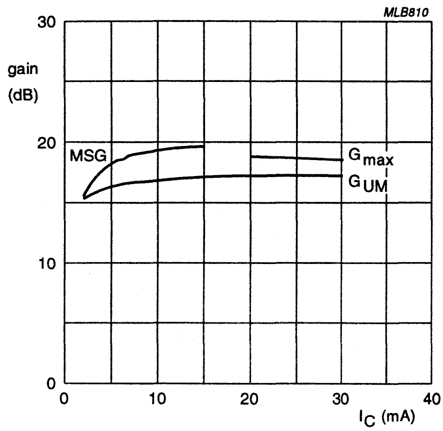
I_C = 0; f = 1 MHz.

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



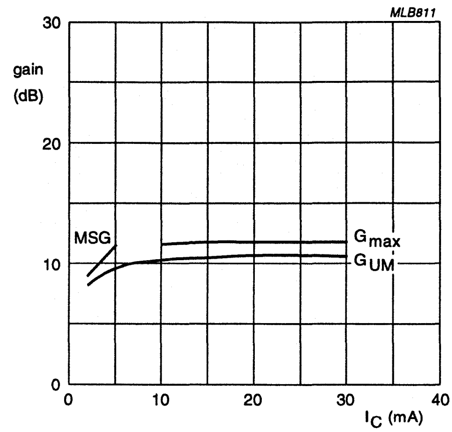
f = 1 GHz; T_{amb} = 25 °C.

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



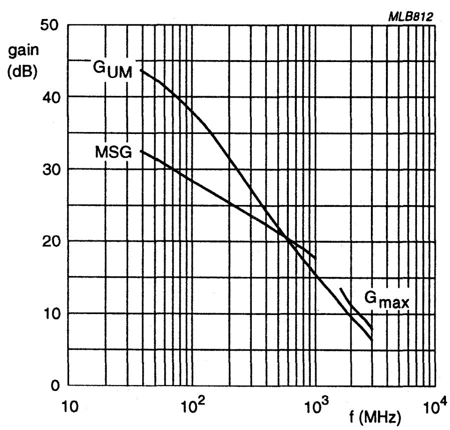
f = 900 MHz; V_{CE} = 6 V.

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



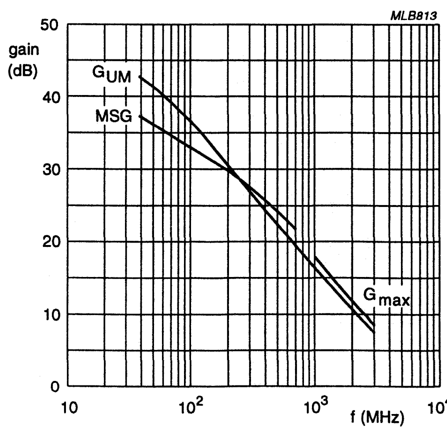
f = 2 GHz; V_{CE} = 6 V.

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



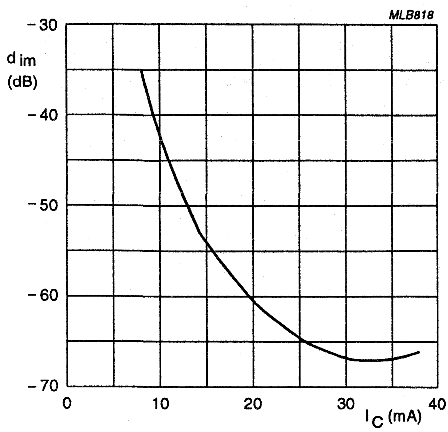
I_C = 5 mA; V_{CE} = 6 V.

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



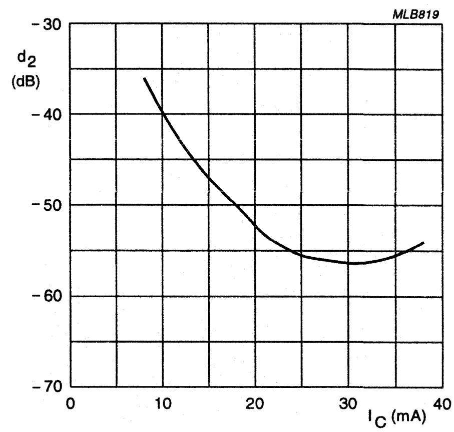
I_C = 20 mA; V_{CE} = 6 V.

Fig.10 Gain as a function of frequency; typical values.



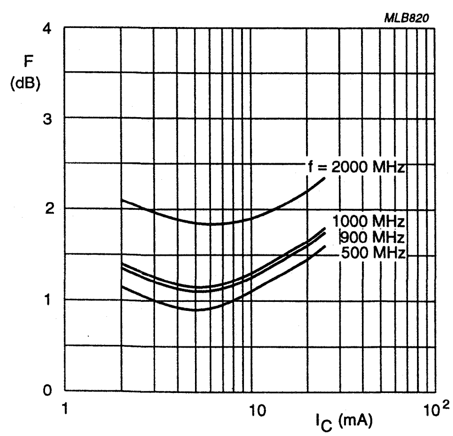
V_o = 275 mV; $f_{(p+q-r)}$ = 793.25 MHz; V_{CE} = 6 V; R_L = 75 Ω; T_{amb} = 25 °C.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



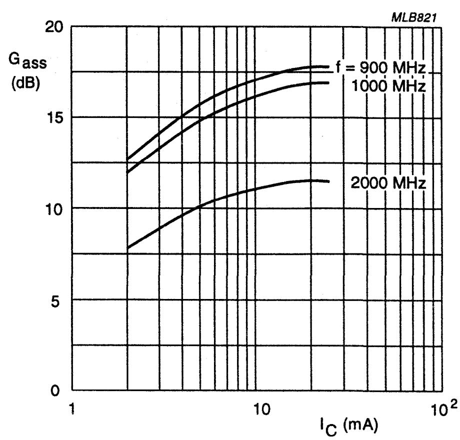
V_o = 75 mV; $f_{(p+q)}$ = 810 MHz; V_{CE} = 6 V; R_L = 75 Ω; T_{amb} = 25 °C.

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



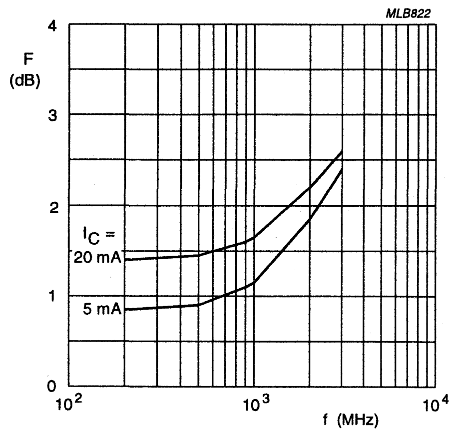
V_{CE} = 6 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



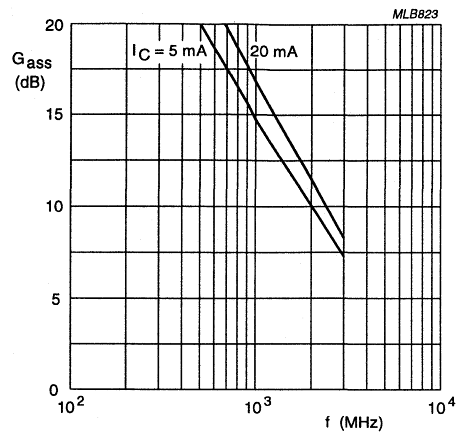
V_{CE} = 6 V.

Fig.14 Associated available gain as a function of collector current; typical values.



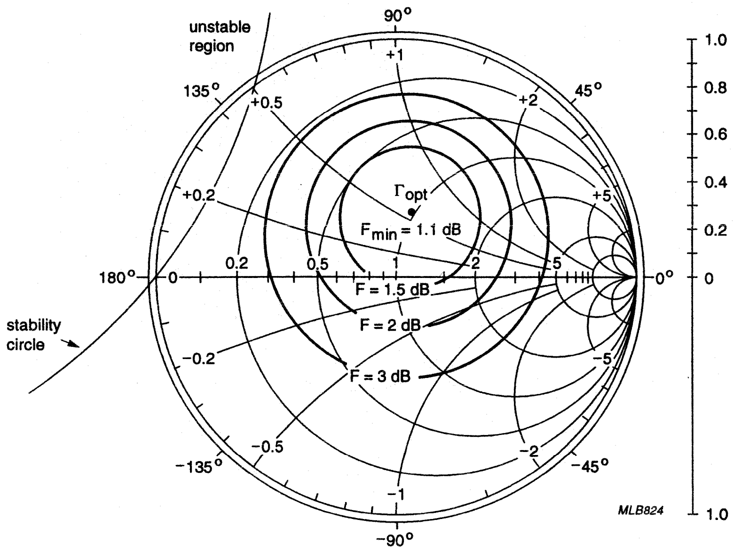
V_{CE} = 6 V.

Fig.15 Minimum noise figure as a function of frequency; typical values.



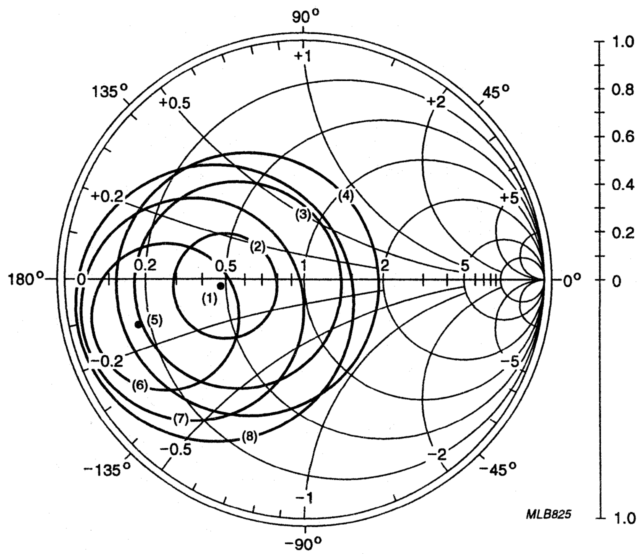
V_{CE} = 6 V.

Fig.16 Associated available gain as a function of frequency; typical values.



f = 900 MHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

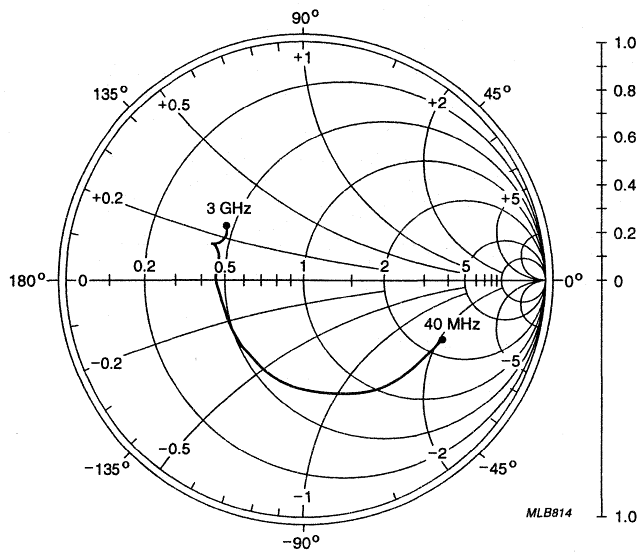
Fig.17 Common emitter noise figure circles; typical values.



(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.

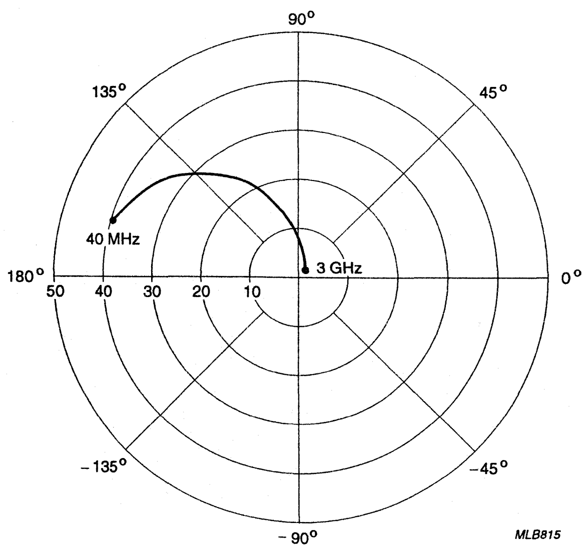
f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.18 Common emitter noise figure circles; typical values.



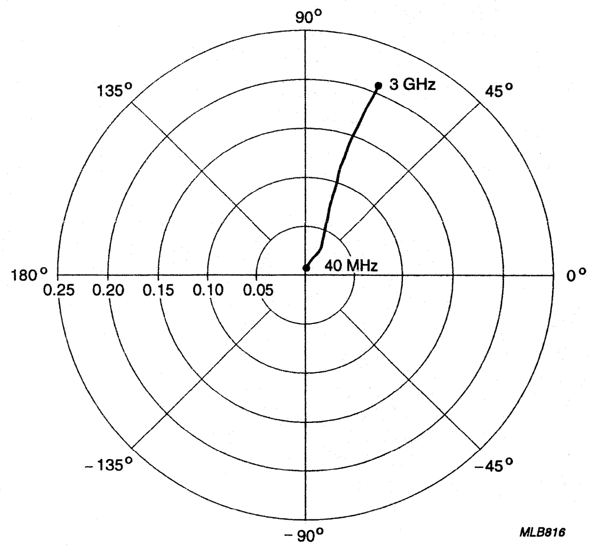
V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

Fig.19 Common emitter input reflection coefficient (s_{11}); typical values.



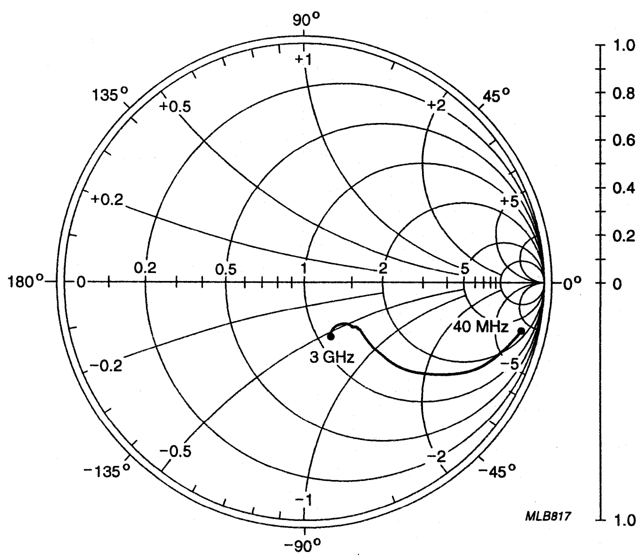
V_{CE} = 6 V; I_C = 20 mA.

Fig.20 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 20 mA.

Fig.21 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

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

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 SOT143 and SOT143R envelopes.

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

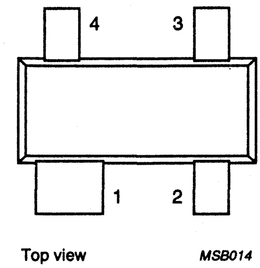


Fig.1 SOT143.

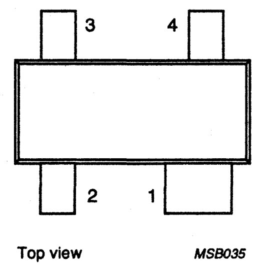


Fig.2 SOT143R.

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
$\lvert S_{21}\rvert^2$	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		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 60$ °C (note 1)	290 K/W

Note

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

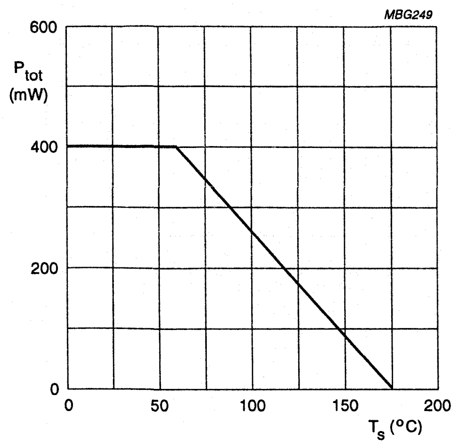
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 8$ 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

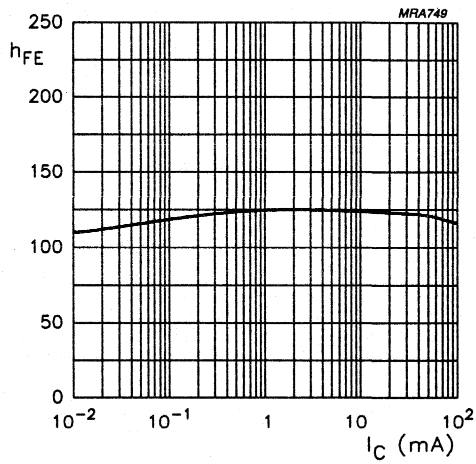
Notes

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



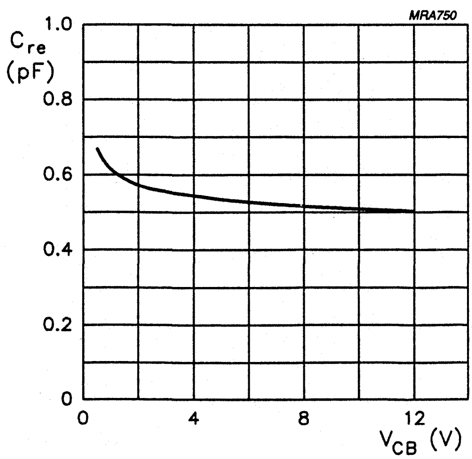
$V_{CE} \leq 10$ V.

Fig.3 Power derating curve.



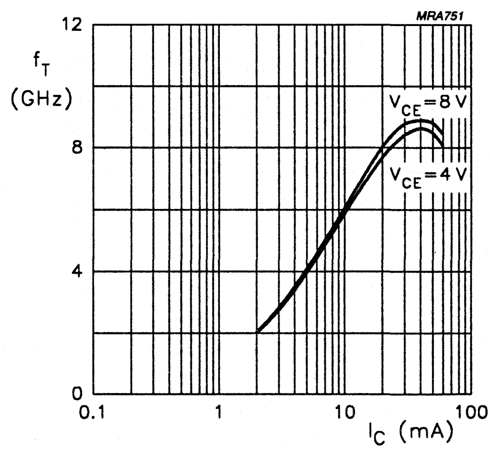
$V_{CE} = 8$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

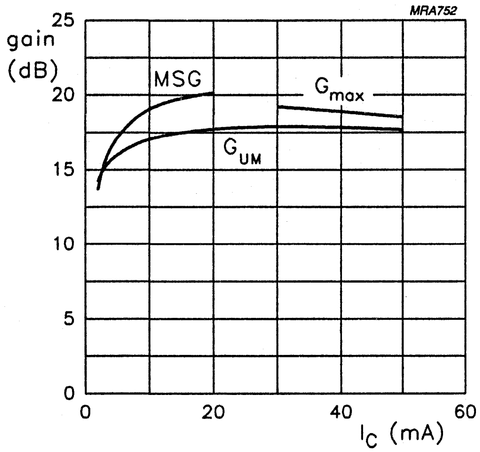
Fig.5 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; $T_{amb} = 25$ °C.

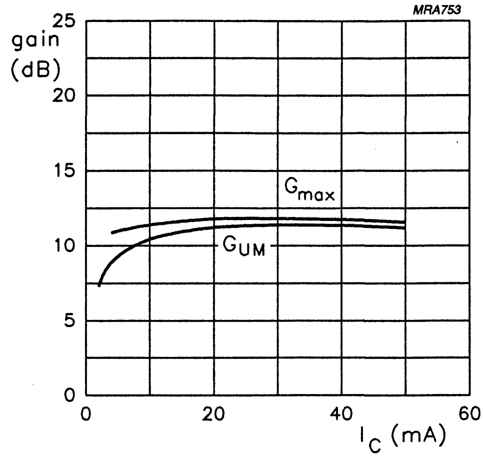
Fig.6 Transition frequency as a function of collector current.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



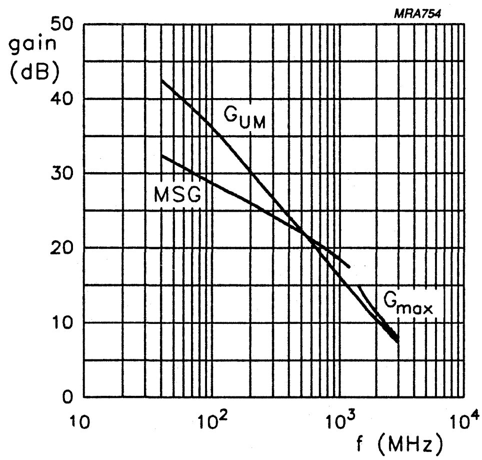
V_{CE} = 8 V; f = 900 MHz.

Fig.7 Gain as a function of collector current.



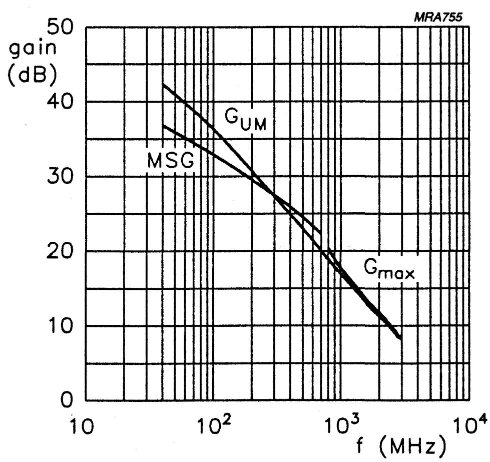
V_{CE} = 8 V; f = 2 GHz.

Fig.8 Gain as a function of collector current.



I_C = 10 mA; V_{CE} = 8 V.

Fig.9 Gain as a function of frequency.



I_C = 40 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency.

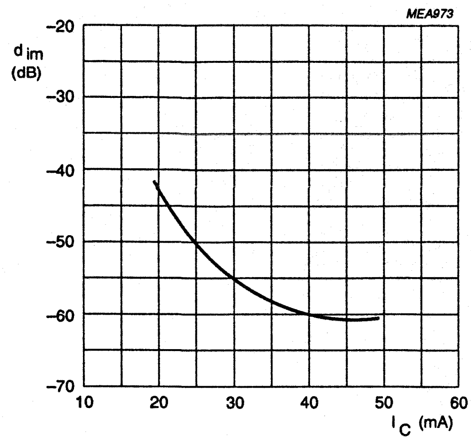


Fig.11 Intermodulation distortion as a function of collector current.

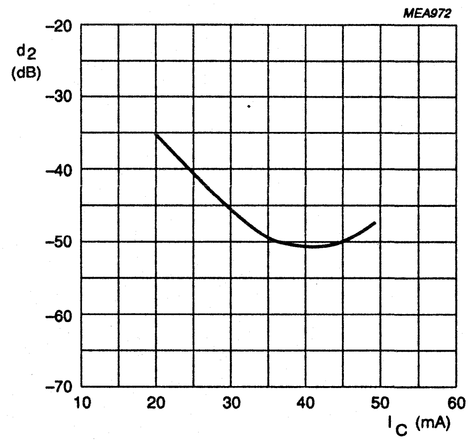
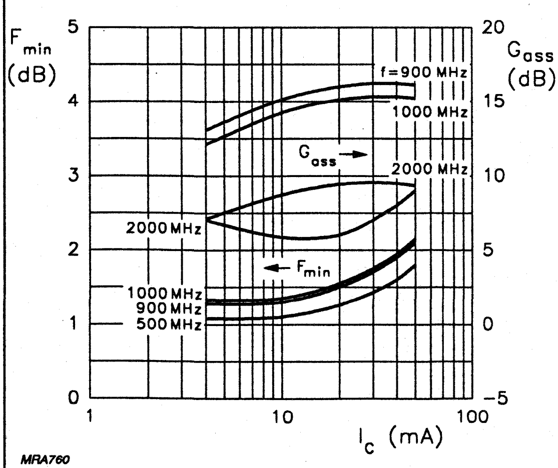
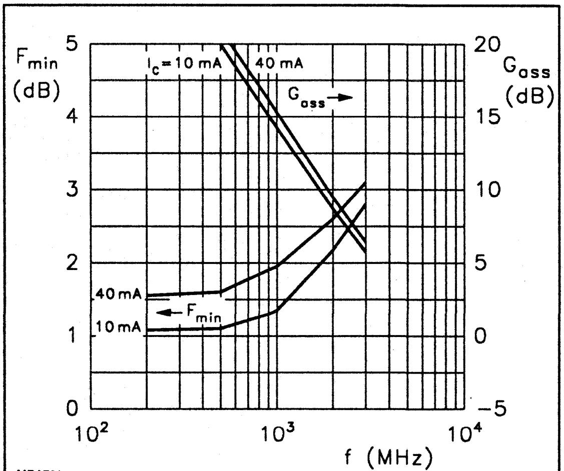


Fig.12 Second order intermodulation distortion as a function of collector current.



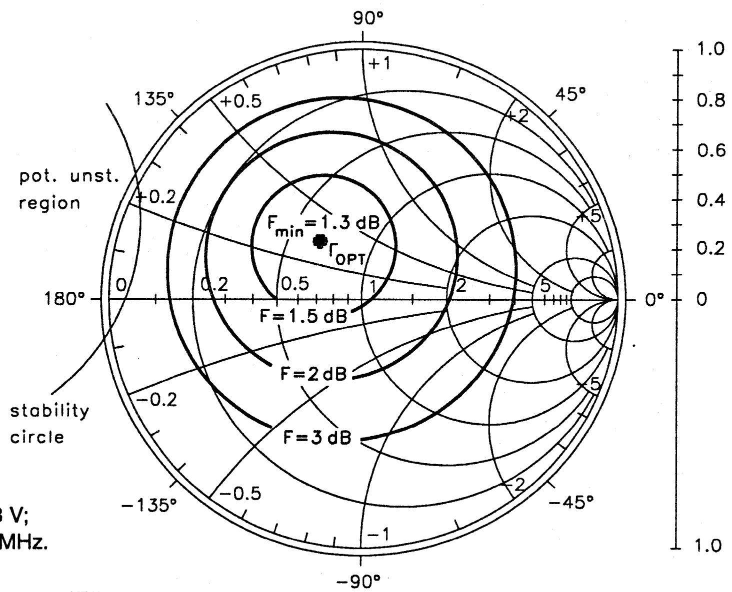
V_{CE} = 8 V.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.



V_{CE} = 8 V.

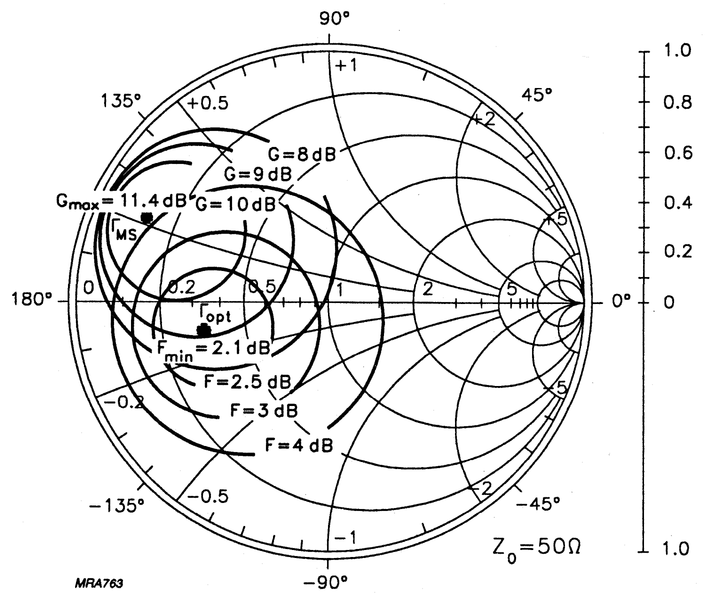
Fig.14 Minimum noise figure and associated available gain as functions of frequency.



I_C = 10 mA; V_{CE} = 8 V;
Z_O = 50 Ω; f = 900 MHz.

MRA762

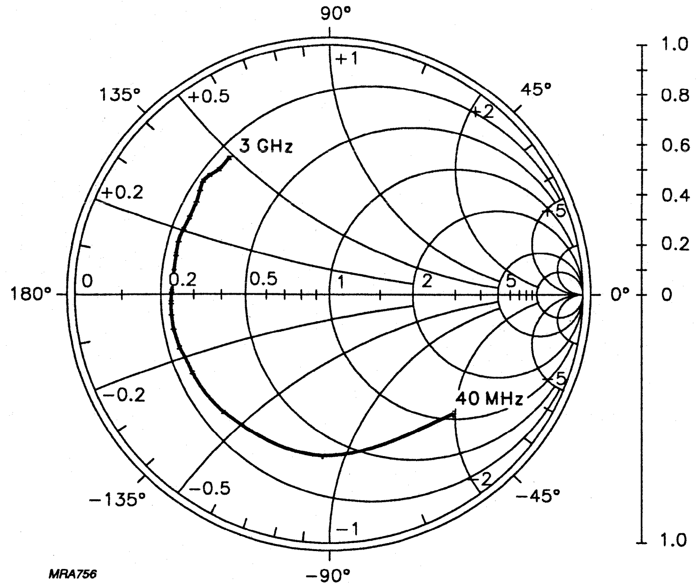
Fig.15 Noise circle figure.



I_C = 10 mA; V_{CE} = 8 V;
Z_O = 50 Ω; f = 2 GHz.

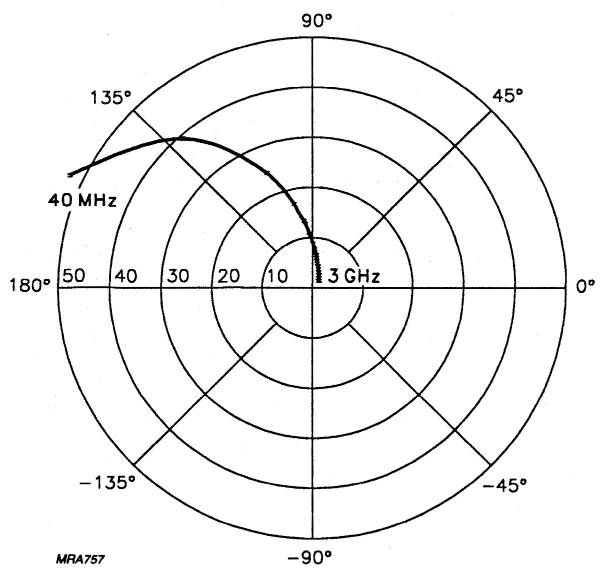
MRA763

Fig.16 Noise circle figure.



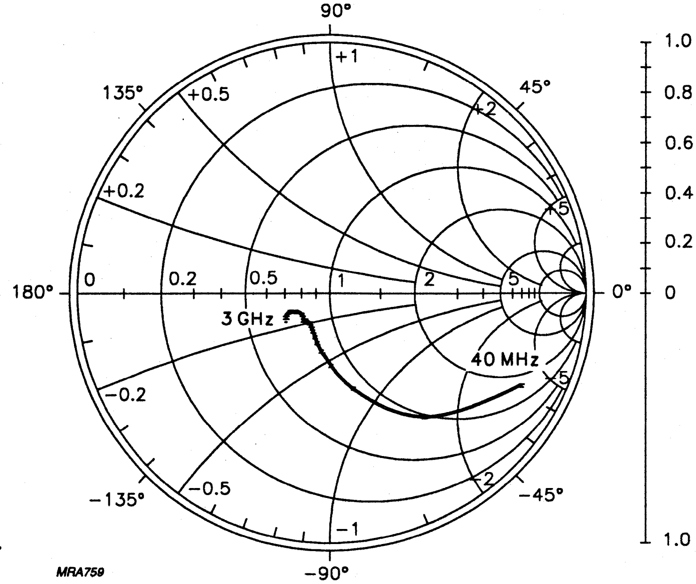
I_C = 40 mA; V_{CE} = 8 V.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



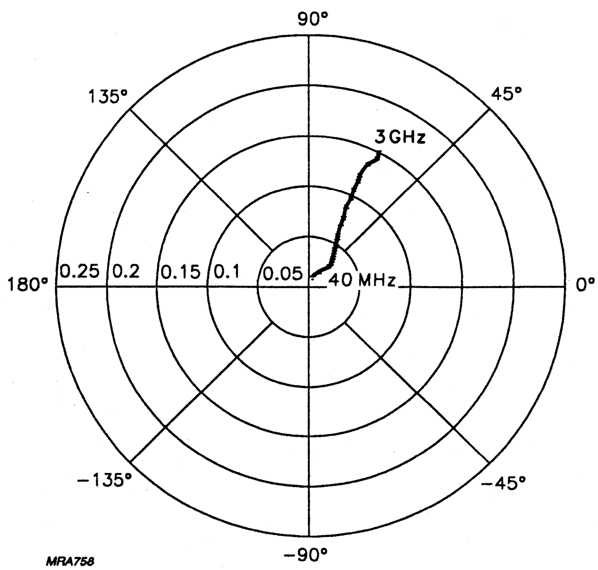
I_C = 40 mA; V_{CE} = 8 V.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 40 mA; V_{CE} = 8 V.
Z_o = 50 Ω.

Fig.19 Common emitter output reflection coefficient (s_{22}).



I_C = 40 mA; V_{CE} = 8 V.

Fig.20 Common emitter reverse transmission coefficient (s_{12}).

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 SOT343 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

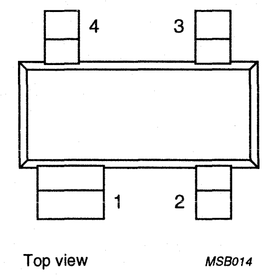


Fig.1 SOT343.

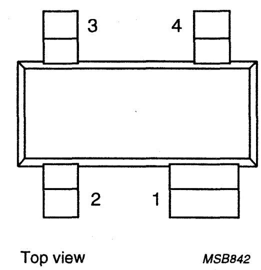


Fig.2 SOT343R.

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).

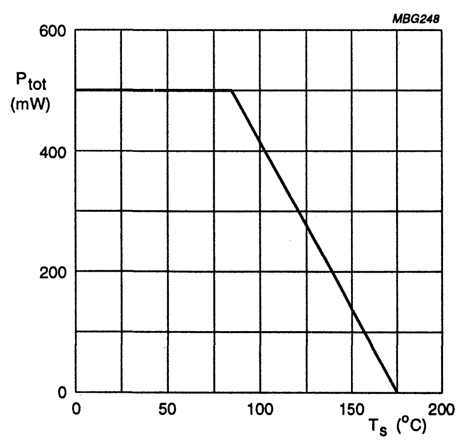
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	120	mA
P_{tot}	total power dissipation	up to T_s = 85 °C; see Fig.3; note 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).

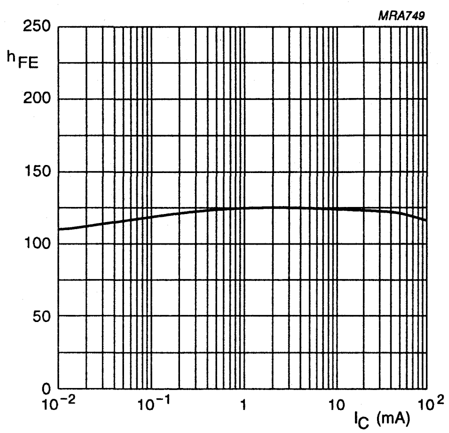
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA ; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 40 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 100 μA; I_C = 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;
   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;
   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;
   f_p = 250 MHz; f_q = 560 MHz; measured at $f_{(p+q)}$ = 810 MHz.

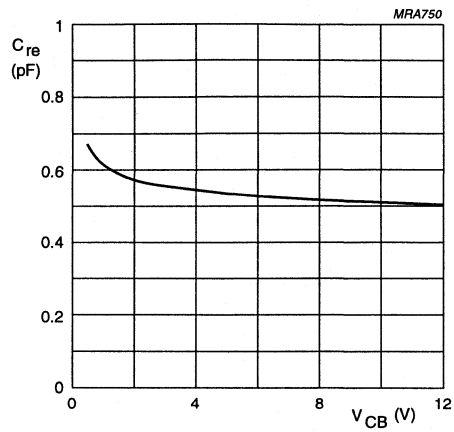
NPN 9 GHz wideband transistor

BFG540W
BFG540W/X; BFG540W/XR



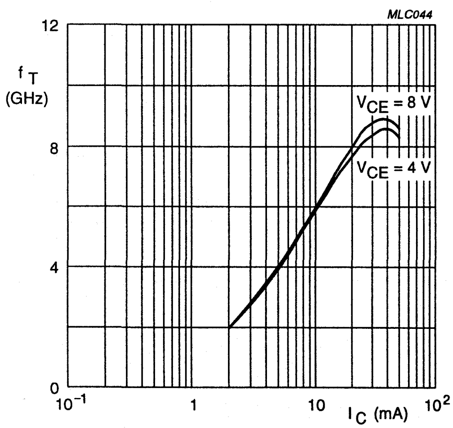
V_{CE} = 8 V.

Fig.4 DC current gain as a function of collector current; typical values.



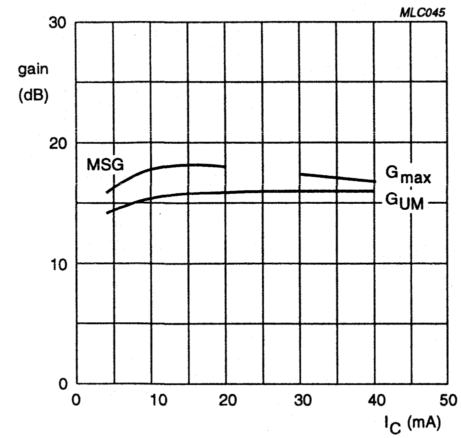
I_C = 0; f = 1 MHz.

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



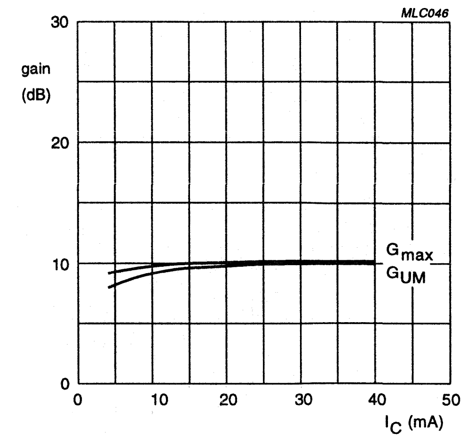
f = 1 GHz; T_{amb} = 25 °C.

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



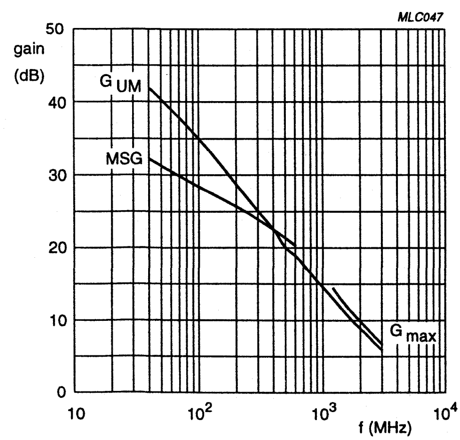
f = 900 MHz; V_{CE} = 8 V.

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



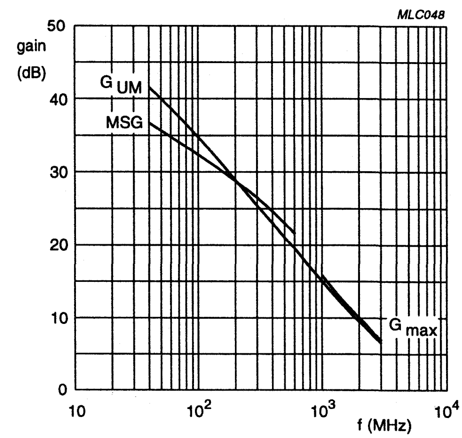
f = 2 GHz; V_{CE} = 8 V.

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



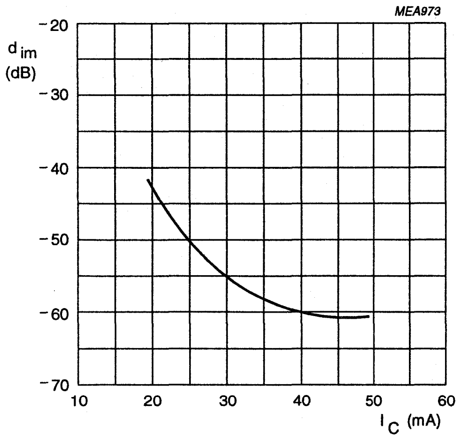
I_C = 10 mA; V_{CE} = 8 V.

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



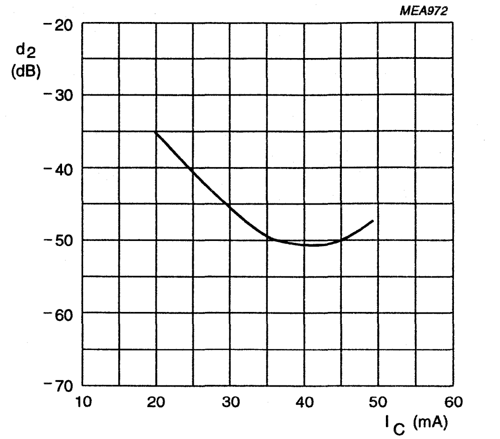
I_C = 40 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.



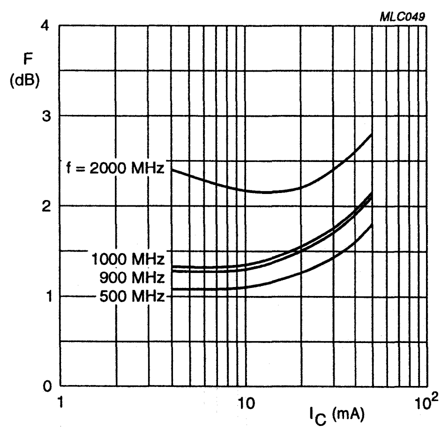
V_o = 500 mV; $f_{(p+q-r)}$ = 793.25 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



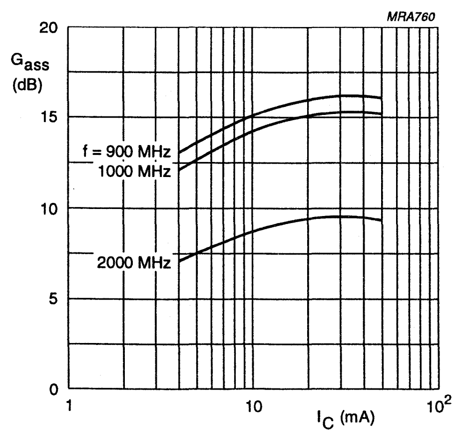
V_o = 275 mV; $f_{(p+q)}$ = 810 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

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



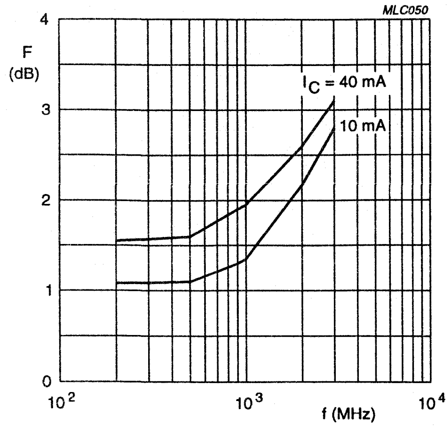
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



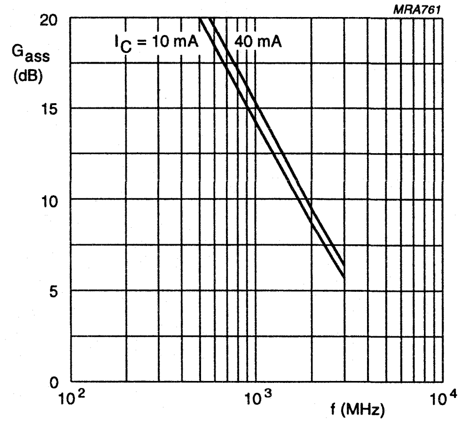
V_{CE} = 8 V.

Fig.14 Associated available gain as a function of collector current; typical values.



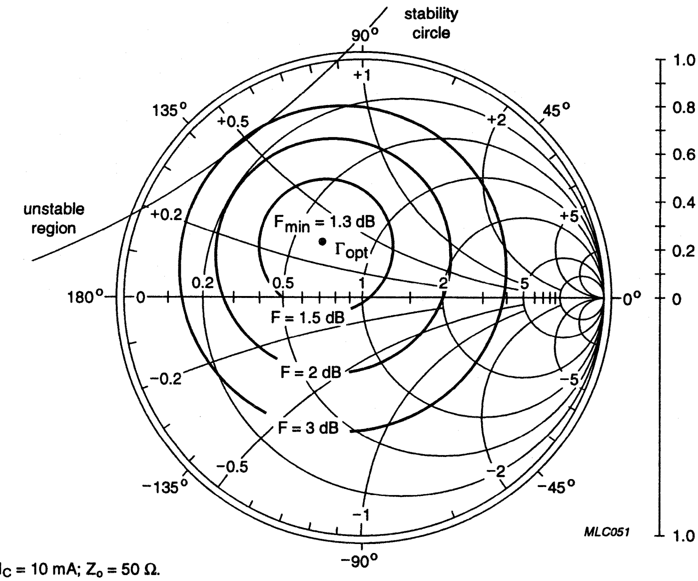
V_{CE} = 8 V.

Fig.15 Minimum noise figure as a function of frequency; typical values.



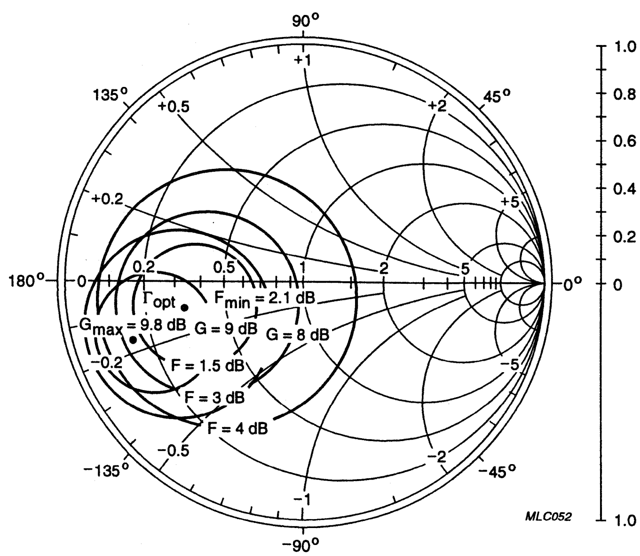
V_{CE} = 8 V.

Fig.16 Associated available gain as a function of frequency; typical values.



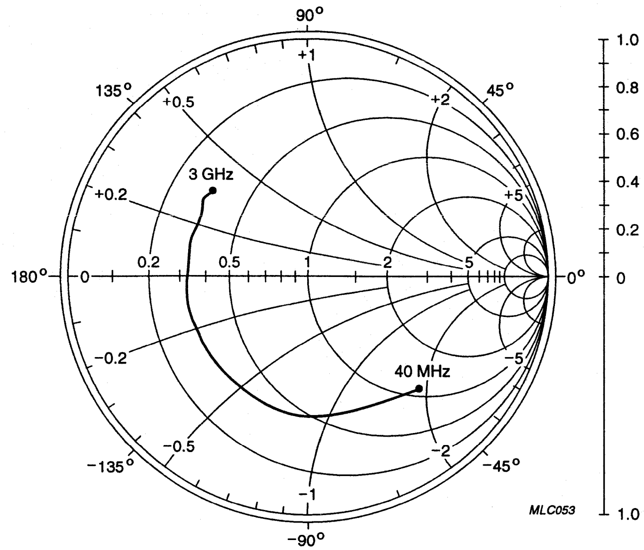
f = 900 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles; typical values.



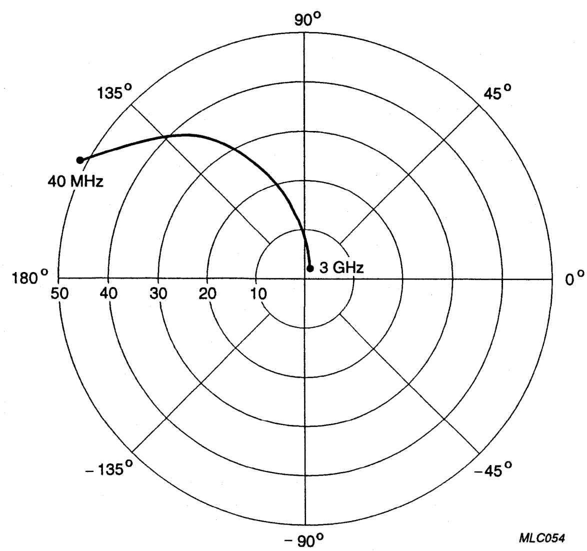
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.18 Common emitter noise figure circles; typical values.



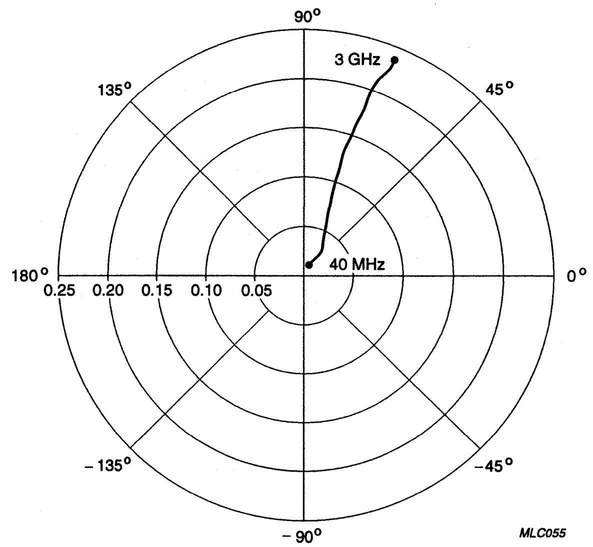
V_{CE} = 8 V; I_C = 40 mA; Z_o = 50 Ω.

Fig.19 Common emitter input reflection coefficient (s_{11}); typical values.



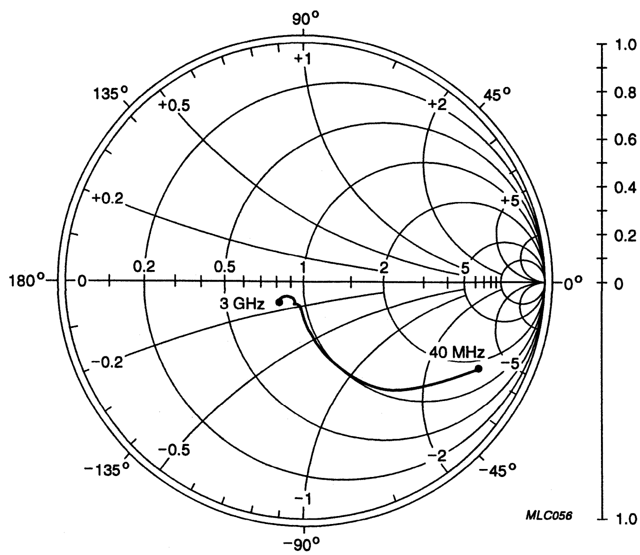
V_{CE} = 8 V; I_C = 40 mA.

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 Ω.

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

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

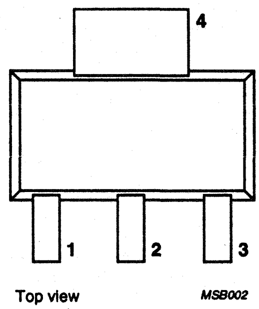


Fig.1 SOT223.

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.

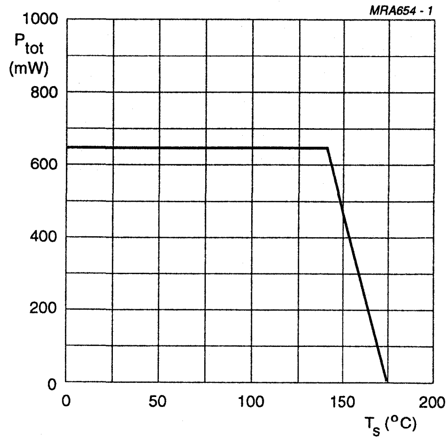
CHARACTERISTICS

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 Ω; 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

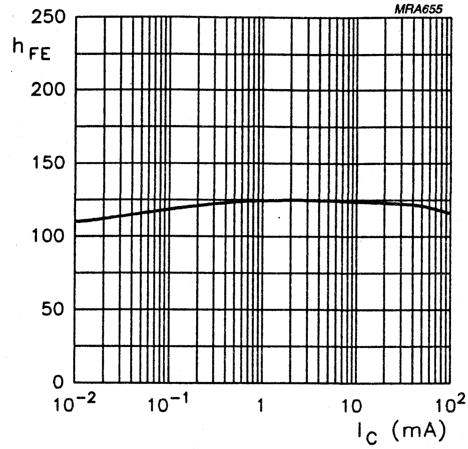
Notes

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. 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 $f_{(2p-q)}$ = 904 MHz.
3. d_{im} = –60 dB (DIN 45004B); I_C = 40 mA; V_{CE} = 8 V; $Z_L = Z_S$ = 75 Ω; 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



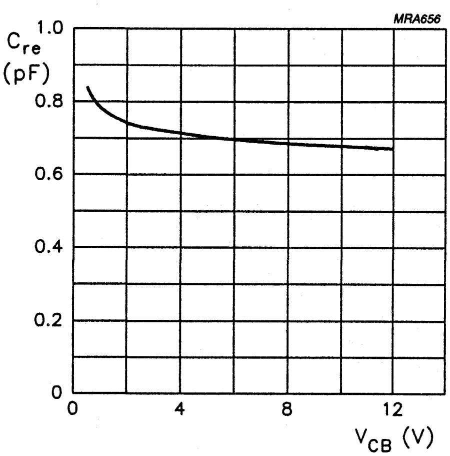
$V_{CE} \leq 10$ V.

Fig.2 Power derating curve.



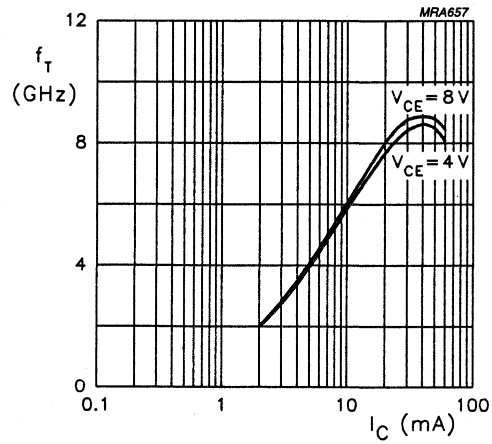
$V_{CE} = 8$ V; $T_j = 25$ °C.

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.

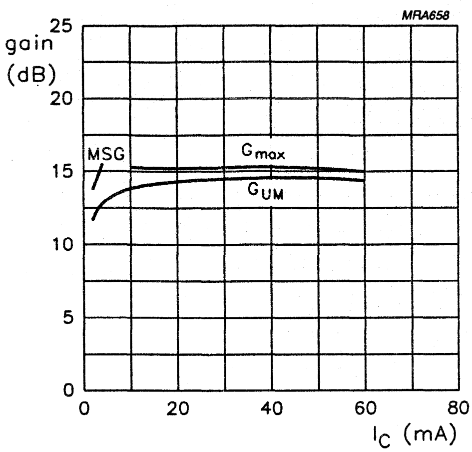


f = 1 GHz; $T_{amb} = 25$ °C.

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

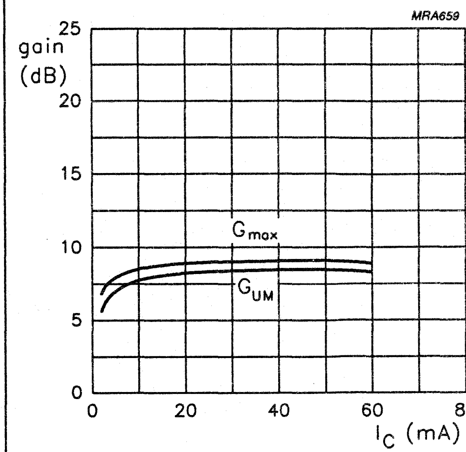
NPN 9 GHz wideband transistor BFG541

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



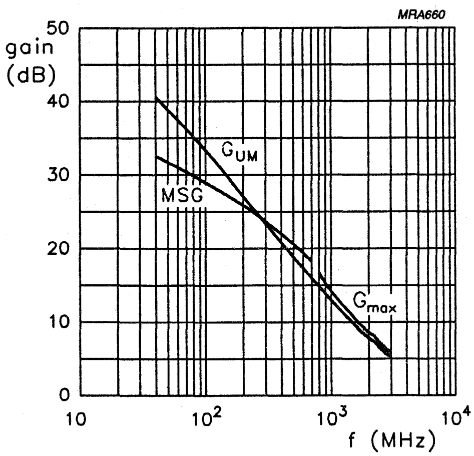
V_{CE} = 8 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



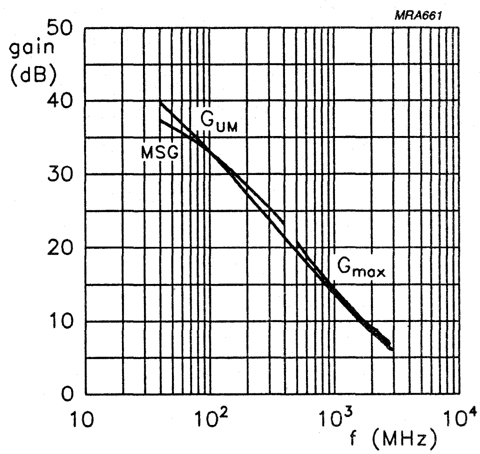
V_{CE} = 8 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



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.

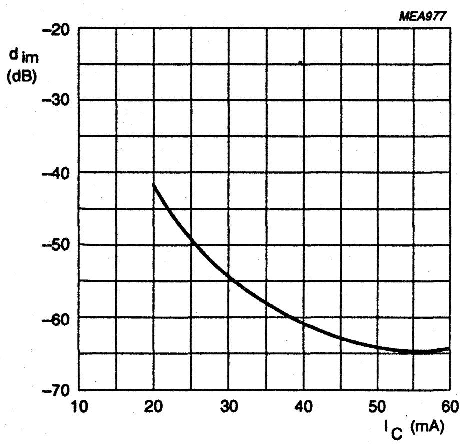


Fig.10 Intermodulation distortion as a function of collector current.

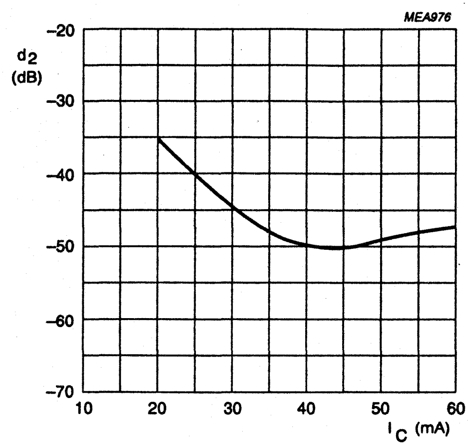
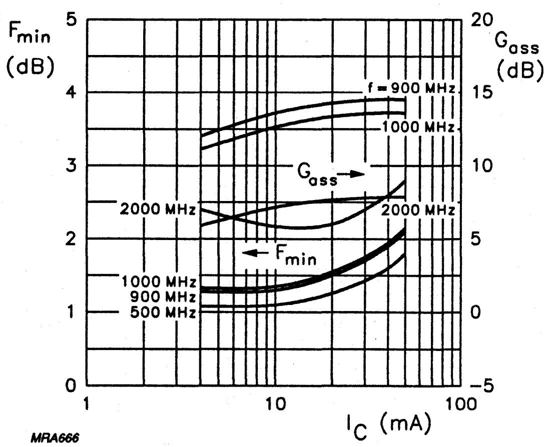
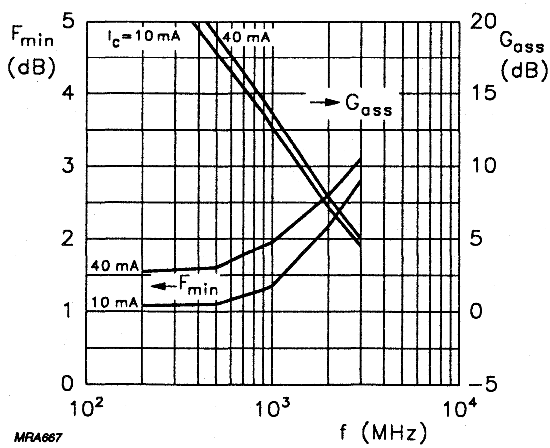


Fig.11 Second order intermodulation distortion as a function of collector current.



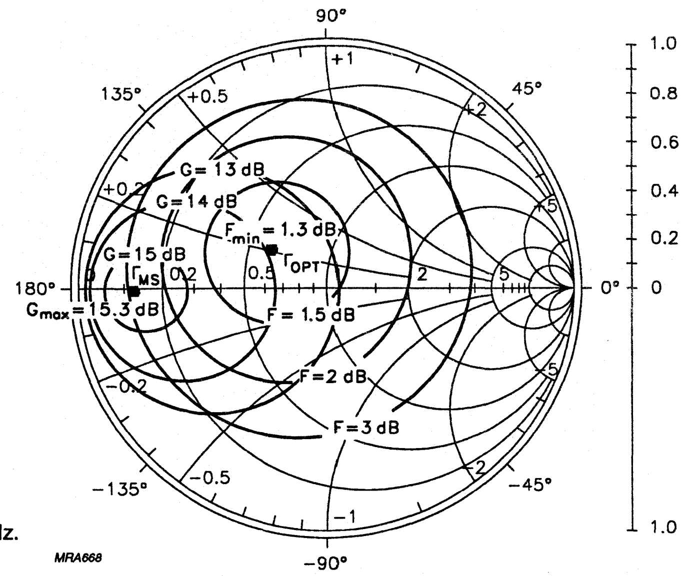
V_{CE} = 8 V.

Fig.12 Minimum noise figure and associated available gain as functions of collector current.



V_{CE} = 8 V.

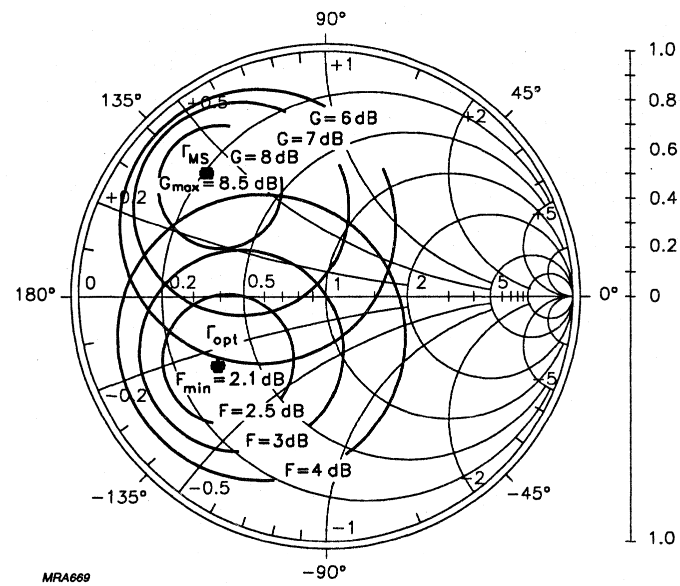
Fig.13 Minimum noise figure and associated available gain as functions of frequency.



I_C = 10 mA; V_{CE} = 8 V;
Z_O = 50 Ω; f = 900 MHz.

MRA668

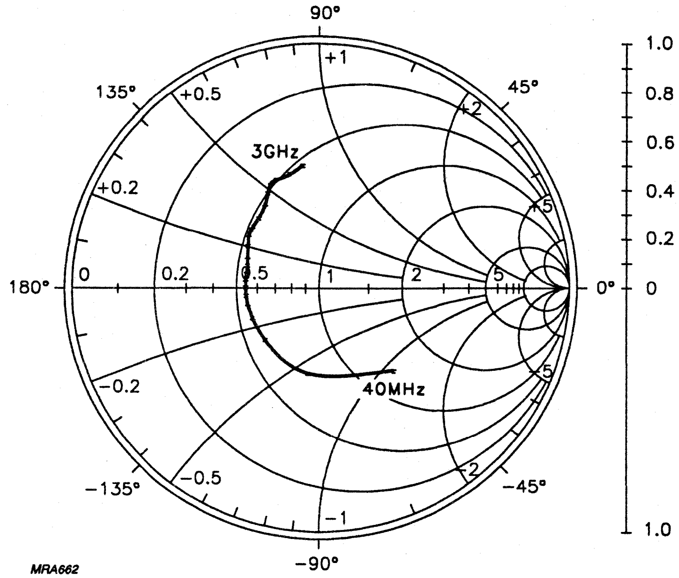
Fig.14 Noise circle figure.



I_C = 10 mA; V_{CE} = 8 V;
Z_O = 50 Ω; f = 2 GHz.

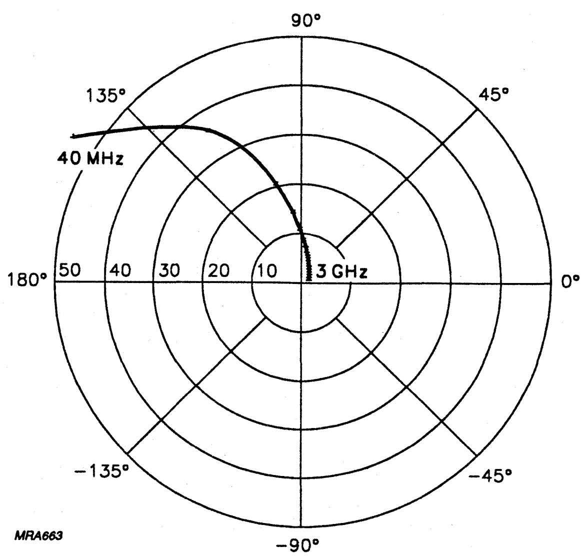
MRA669

Fig.15 Noise circle figure.



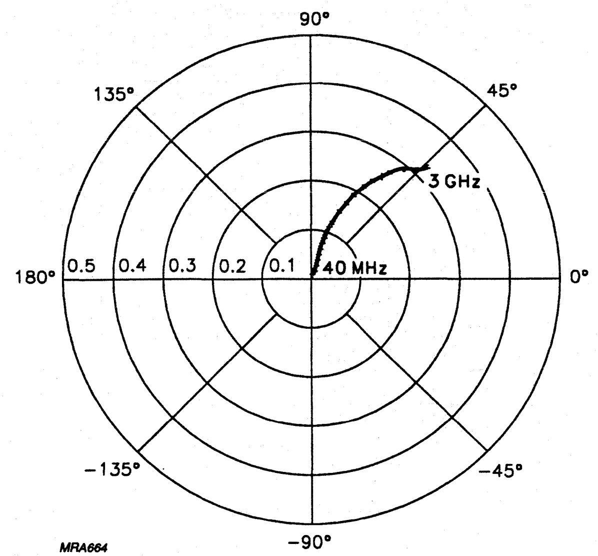
I_C = 40 mA; V_{CE} = 8 V.
Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



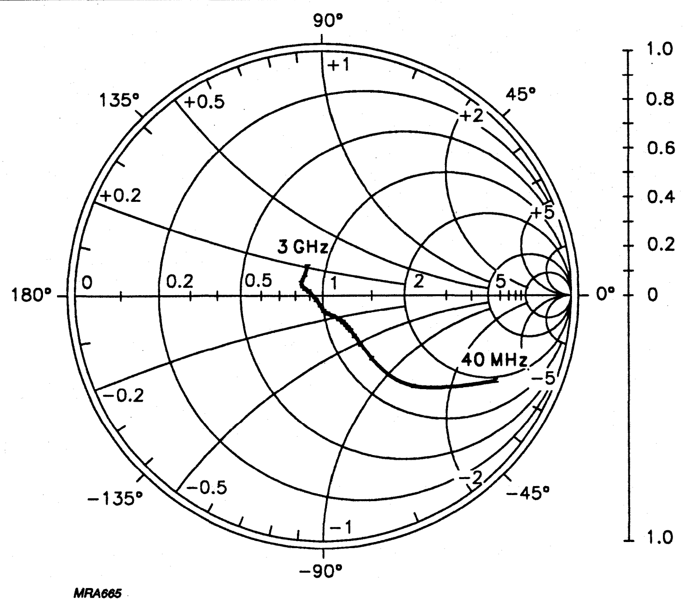
I_C = 40 mA; V_{CE} = 8 V.

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_0 = 50 Ω.

Fig.19 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor

BFG590; BFG590/X; BFG590/XR

FEATURES

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

APPLICATIONS

They are intended for applications in the GHz range such as MATV/CATV amplifiers and RF communications subscriber equipment. They are ideally suitable for use in class-A, (A)B and C amplifiers with either pulsed or continuous drive.

DESCRIPTION

NPN silicon planar epitaxial transistors encapsulated in plastic, 4-pin dual-emitter SOT143 and SOT143R packages.

MARKING

TYPE NUMBER	CODE
BFG590	N38
BFG590/X	N44
BFG590/XR	N50

PINNING

PIN	DESCRIPTION
BFG590 (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG590/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG590/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

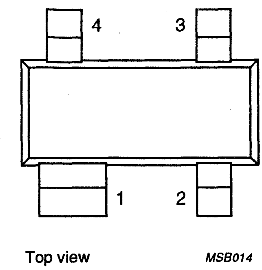


Fig.1 SOT143.

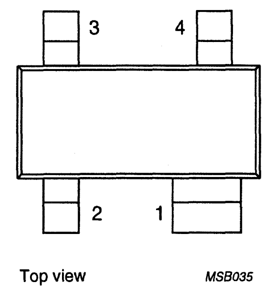


Fig.2 SOT143R.

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	collector current (DC)		–	–	200	mA
P_{tot}	total power dissipation	up to T_s = 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	up to T_s = 60 °C; see Fig.3; note 1	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 60 °C; note 1	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.

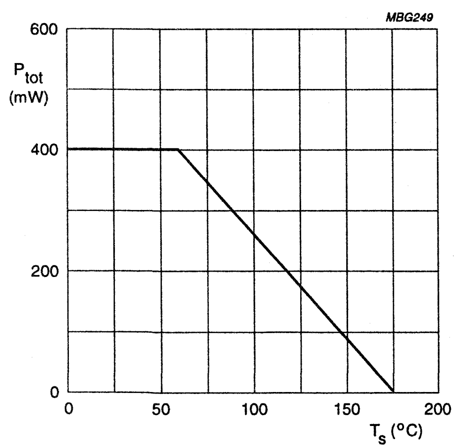


Fig.3 Power derating curve.

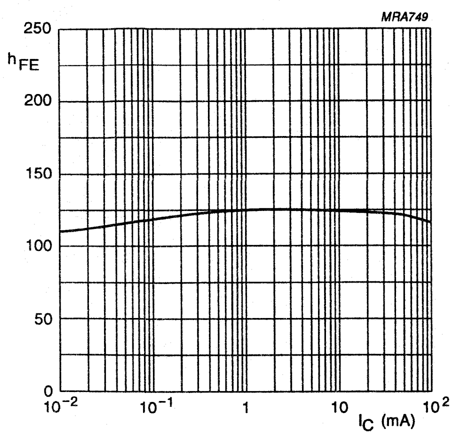
CHARACTERISTICS

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 = 0.1 mA ; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; 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	60	120	250	
f_T	transition frequency	I_C = 80 mA; V_{CE} = 4 V; f = 1 GHz;	–	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 = 900 MHz; T_{amb} = 25 °C	–	11	–	dB

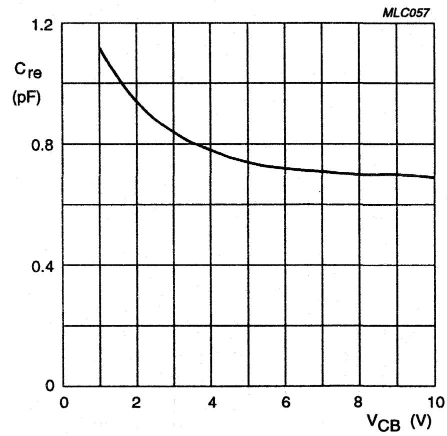
Note

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.



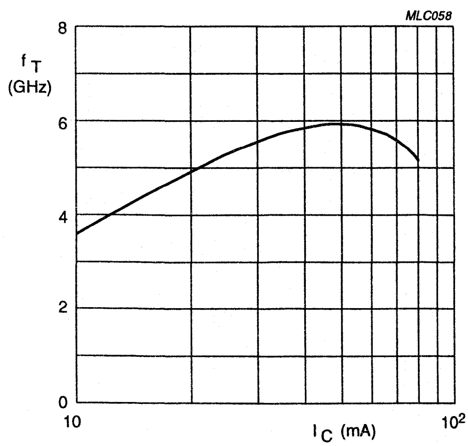
V_{CE} = 8 V.

Fig.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.

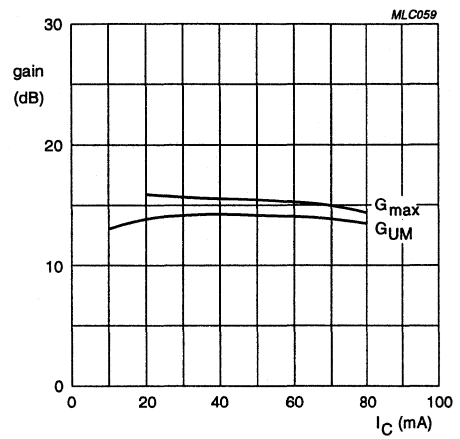


V_{CE} = 4 V; f = 1 GHz.

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

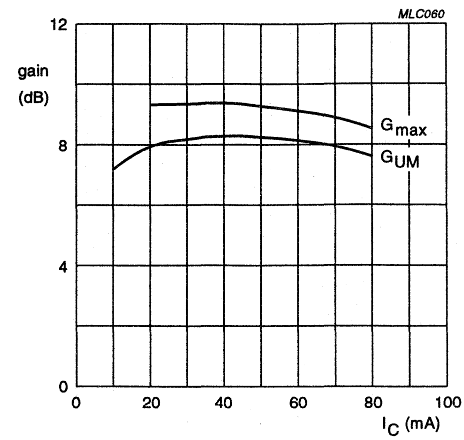
NPN 5 GHz wideband transistor

BFG590; BFG590/X; BFG590/XR



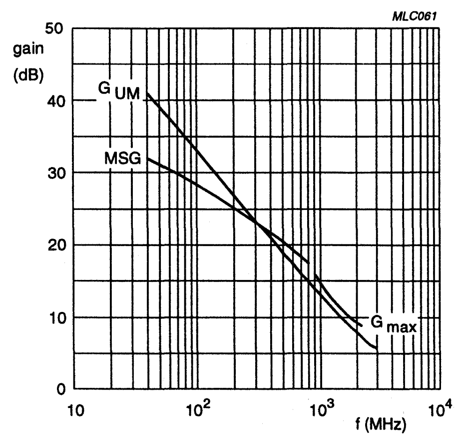
f = 900 MHz; V_{CE} = 4 V.

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



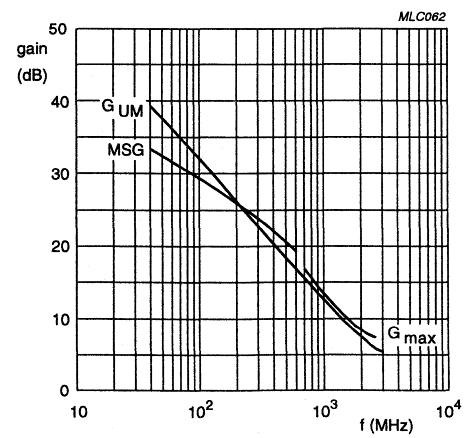
f = 2 GHz; V_{CE} = 4 V.

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



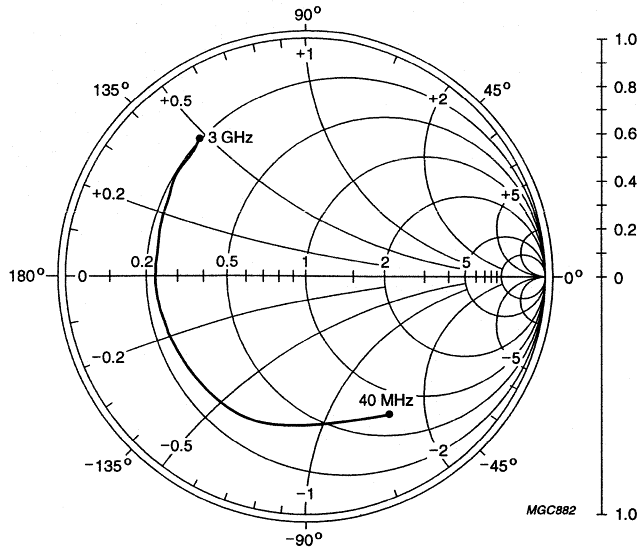
I_C = 20 mA; V_{CE} = 4 V.

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



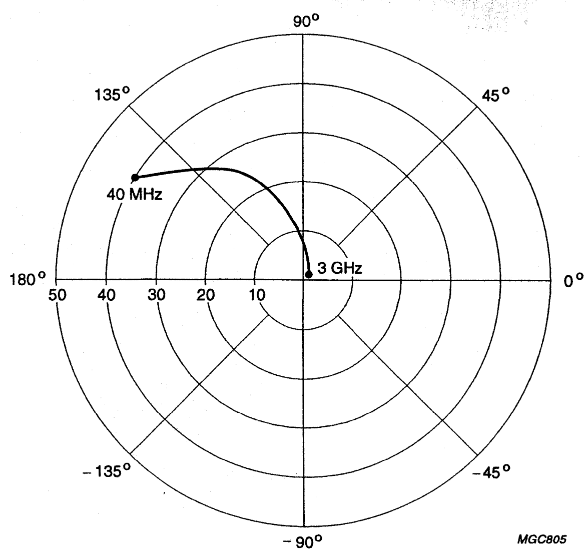
I_C = 80 mA; V_{CE} = 4 V.

Fig.10 Gain as a function of frequency; typical values.



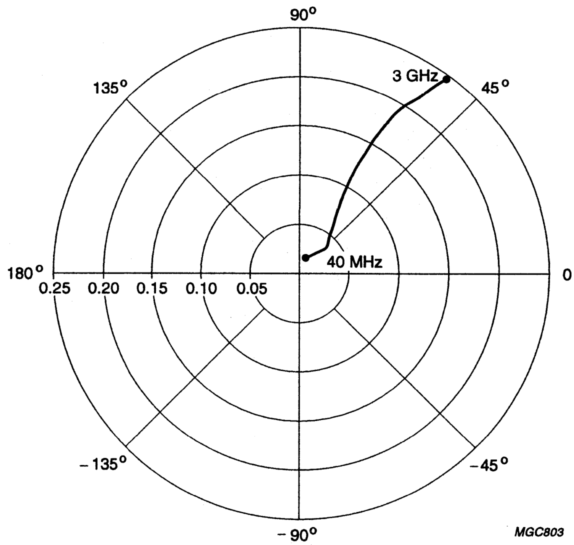
I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

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



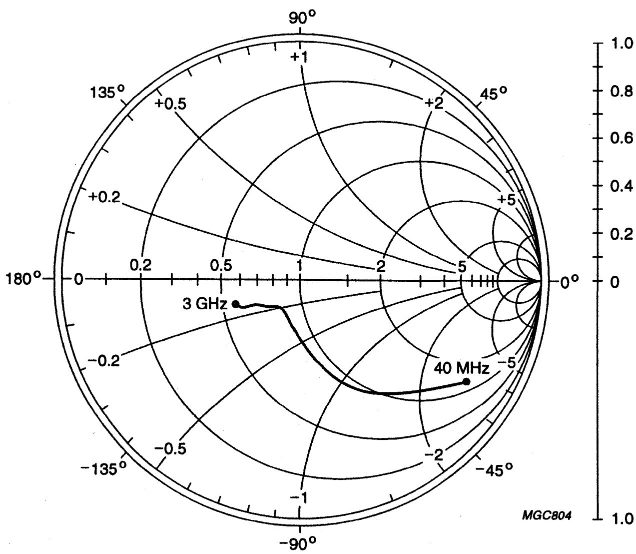
I_C = 80 mA; V_{CE} = 4 V.

Fig.12 Common emitter forward transmission coefficient (s_{21}); typical values.



I_C = 80 mA; V_{CE} = 4 V.

Fig.13 Common emitter reverse transmission coefficient (s_{12}); typical values.



I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

Fig.14 Common emitter output reflection coefficient (s_{22}); typical values.

NPN 5 GHz wideband transistor

BFG590W
BFG590W/X; BFG590W/XR

FEATURES

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

APPLICATIONS

They are intended for wideband applications in the GHz range such as MATV/CATV amplifiers and RF communications subscriber equipment. They are ideally suitable for use in class-A, (A)B and C amplifiers with either pulsed or continuous drive.

DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG590W	T1
BFG590W/X	T2
BFG590W/XR	T3

PINNING

PIN	DESCRIPTION
BFG590W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG590W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG590W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

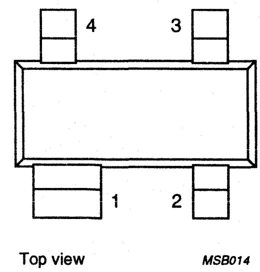


Fig.1 SOT343.

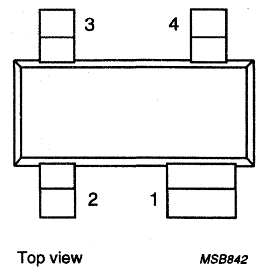


Fig.2 SOT343R.

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 = 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
$\lvert s_{21}\rvert^2$	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	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.

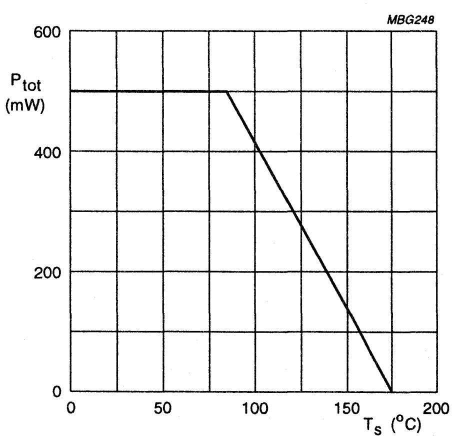


Fig.3 Power derating curve.

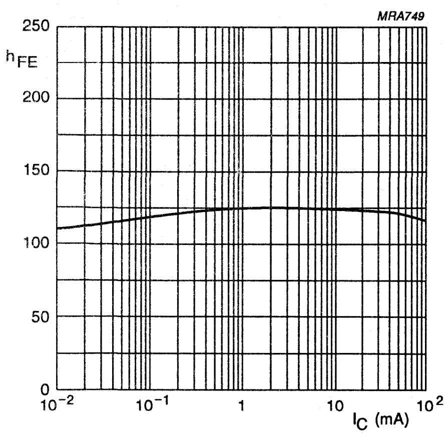
CHARACTERISTICS

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 = 0.1 mA ; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA; I_C = 0	3	–	–	V
I_{CBO}	collector cut-off 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

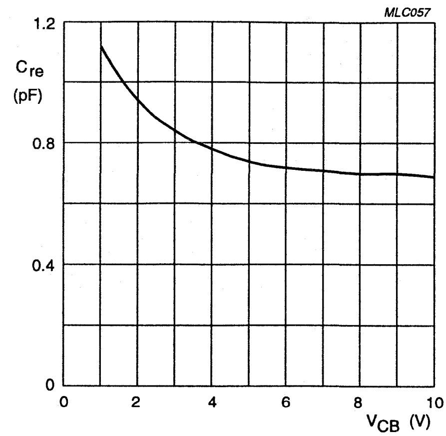
Notes

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.



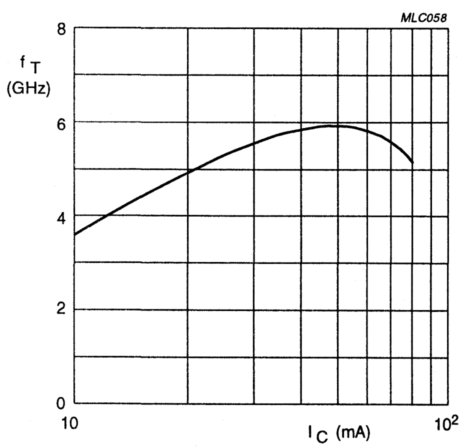
V_{CE} = 8 V.

Fig.4 DC current gain as a function of collector current; typical values.



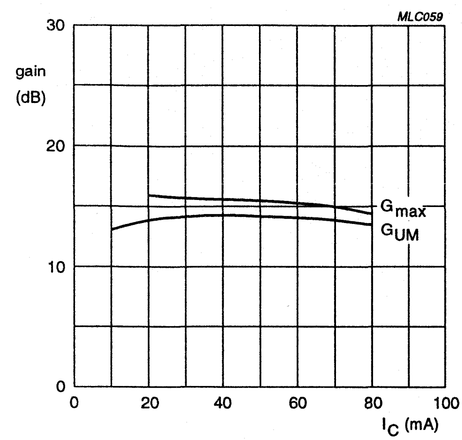
I_C = 0; f = 1 MHz.

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



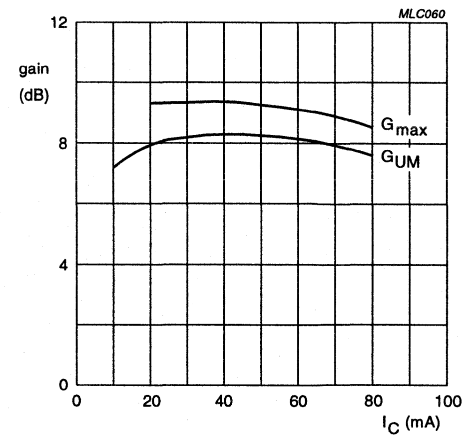
V_{CE} = 4 V; f = 1 GHz.

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



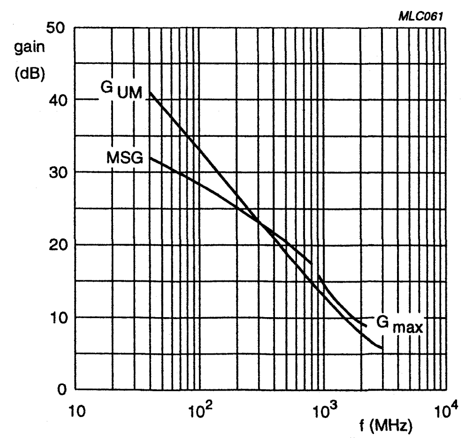
f = 900 MHz; V_{CE} = 4 V.

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



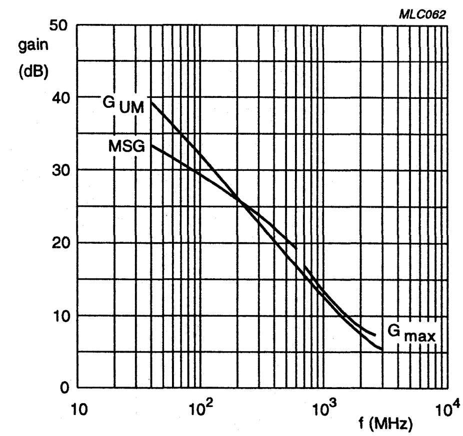
f = 2 GHz; V_{CE} = 4 V.

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



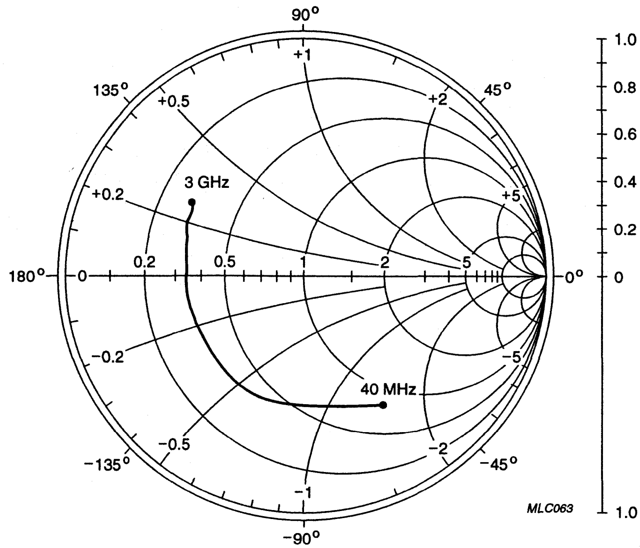
I_C = 20 mA; V_{CE} = 4 V.

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



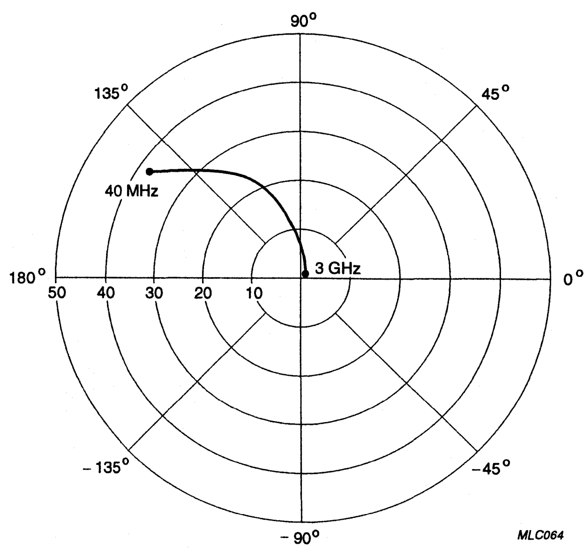
I_C = 80 mA; V_{CE} = 4 V.

Fig.10 Gain as a function of frequency; typical values.



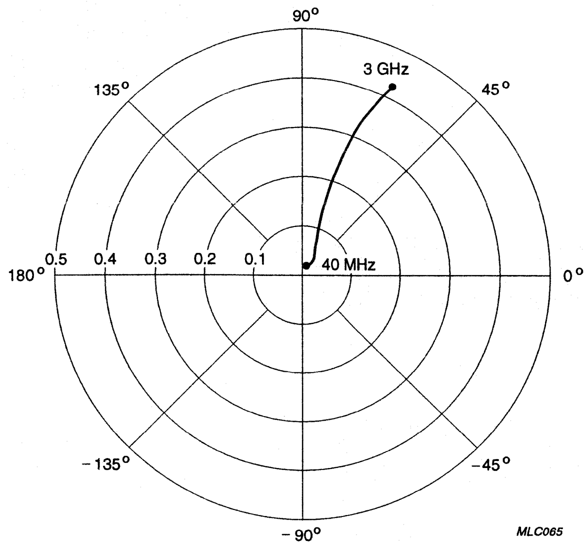
I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

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



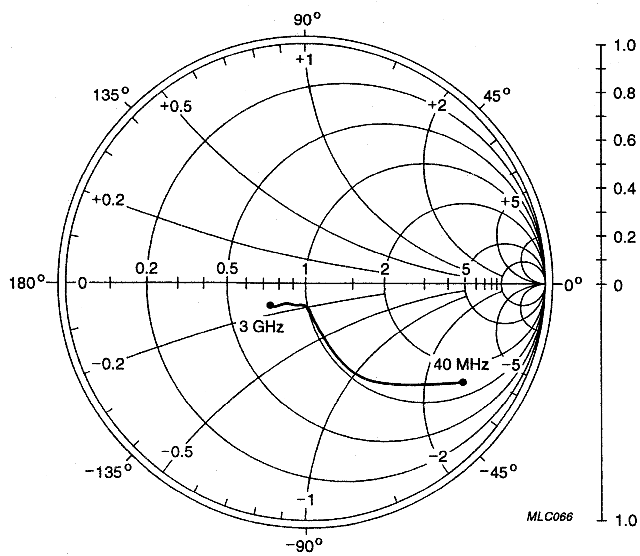
I_C = 80 mA; V_{CE} = 4 V.

Fig.12 Common emitter forward transmission coefficient (s_{21}); typical values.



I_C = 80 mA; V_{CE} = 4 V.

Fig.13 Common emitter reverse transmission coefficient (s_{12}); typical values.



I_C = 80 mA; V_{CE} = 4 V; Z_o = 50 Ω.

Fig.14 Common emitter output reflection coefficient (s_{22}); typical values.

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

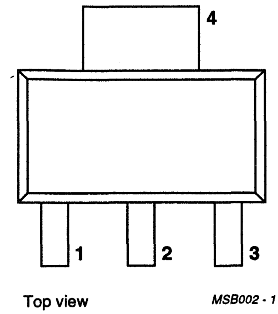


Fig.1 SOT223.

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.

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.

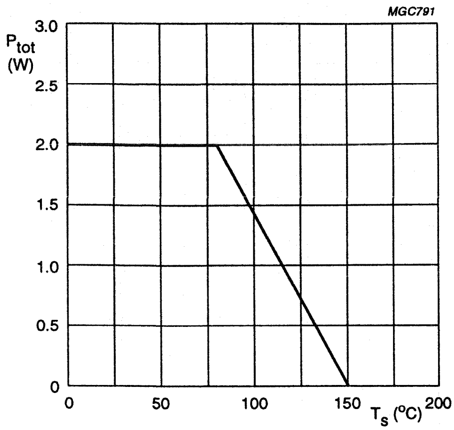
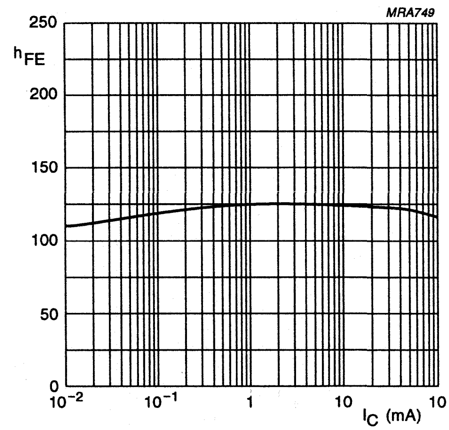
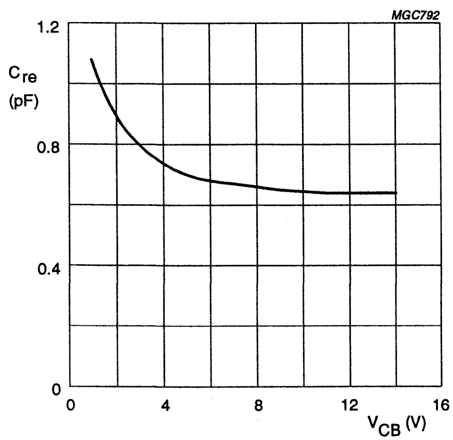


Fig.2 Power derating curve.



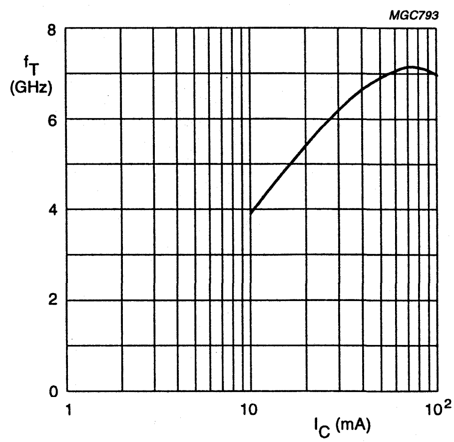
V_{CE} = 12 V.

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



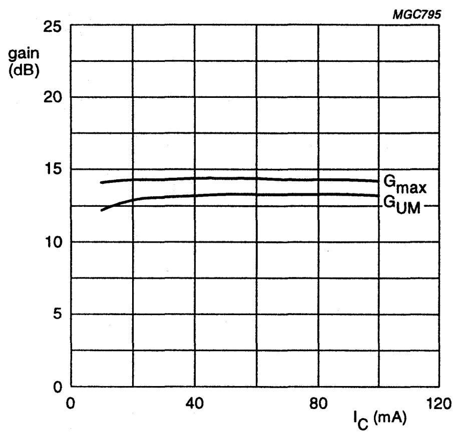
I_C = 0; f = 1 MHz.

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



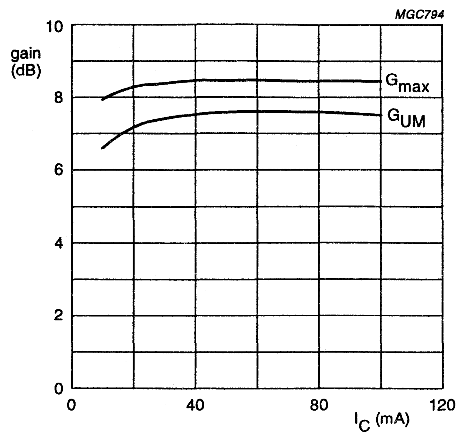
f = 1 GHz; V_{CE} = 12 V.

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



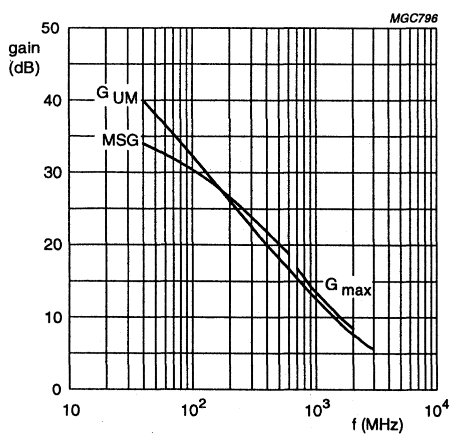
f = 900 MHz; V_{CE} = 12 V.

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



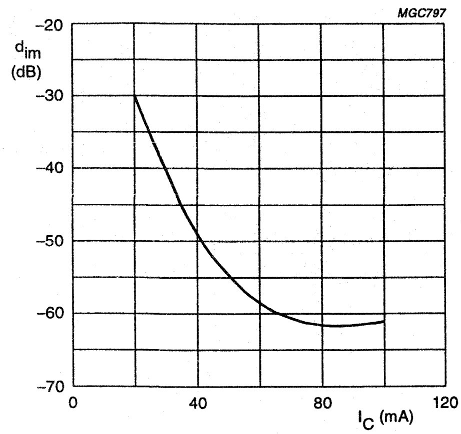
f = 2 GHz; V_{CE} = 12 V.

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



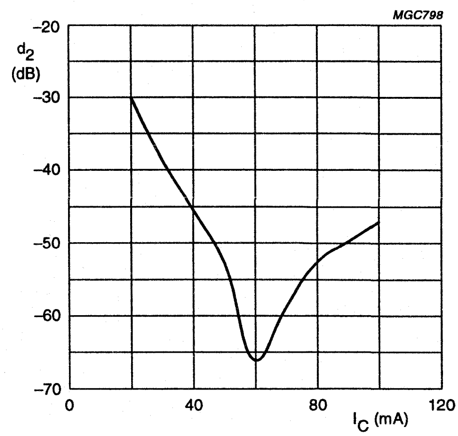
I_C = 70 mA; V_{CE} = 12 V.

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



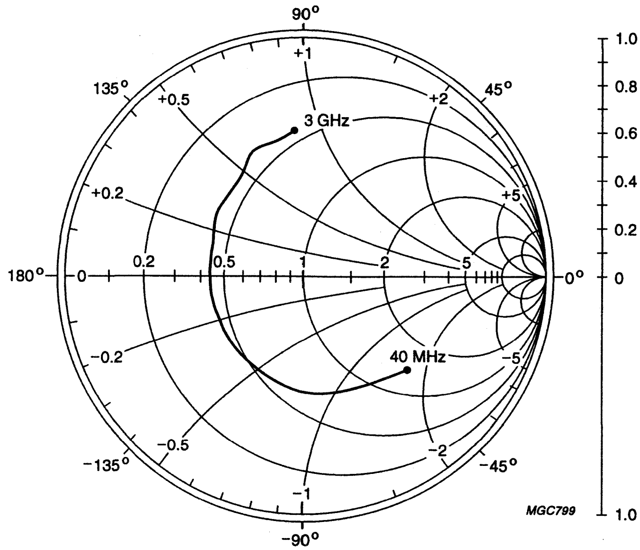
V_{CE} = 12 V; V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz.

Fig.9 Intermodulation distortion as a function of collector current; typical values.



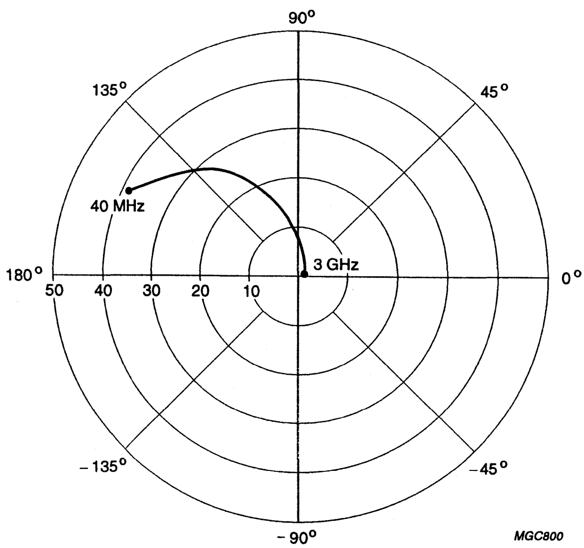
V_{CE} = 12 V; V_o = 316 mV; $f_{(p+q)}$ = 810 MHz.

Fig.10 Second order Intermodulation distortion as a function of collector current; typical values.



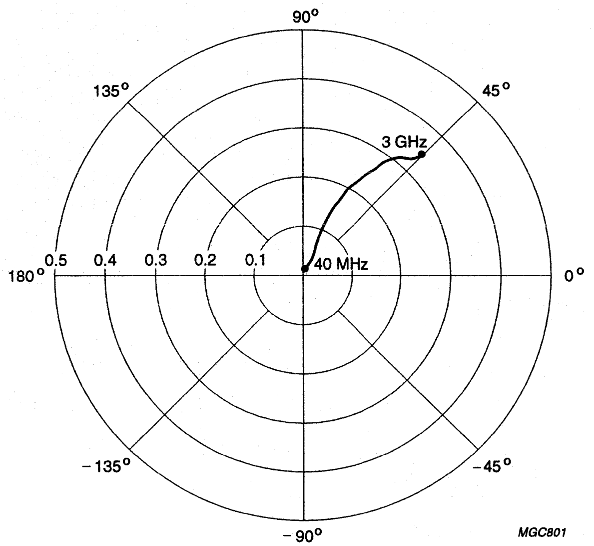
V_{CE} = 12 V; I_C = 70 mA; Z_o = 50 Ω.

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



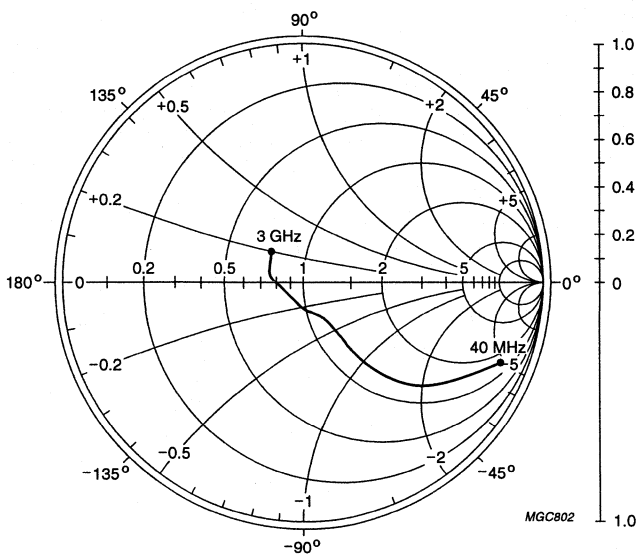
V_{CE} = 12 V; I_C = 70 mA.

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.

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

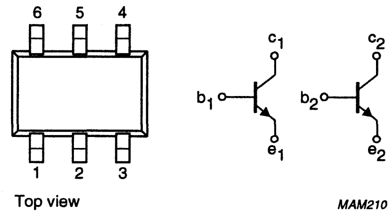
- Oscillator and buffer in one package
- Balanced amplifiers
- LNA/mixer.

DESCRIPTION

Dual transistor with two silicon NPN RF crystals 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

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 SOT363.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance	$I_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.2	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
$\lvert s_{21}\rvert^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
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; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.7	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 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 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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	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	
AC characteristics of any single transistor						
f_T	transition frequency	I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 6 V; f = 1 MHz	–	0.35	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.2	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	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; f = 900 MHz; T_{amb} = 25 °C	13	14	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 6 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.2	1.7	dB
		I_C = 5 mA; V_{CE} = 6 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.

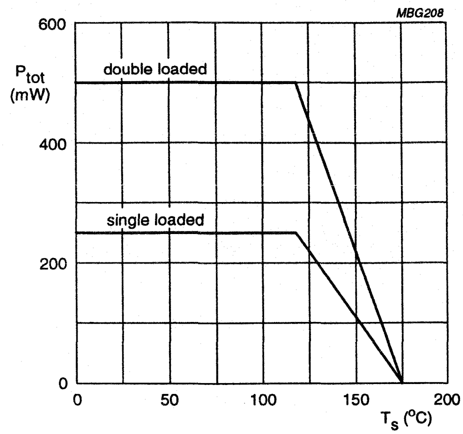
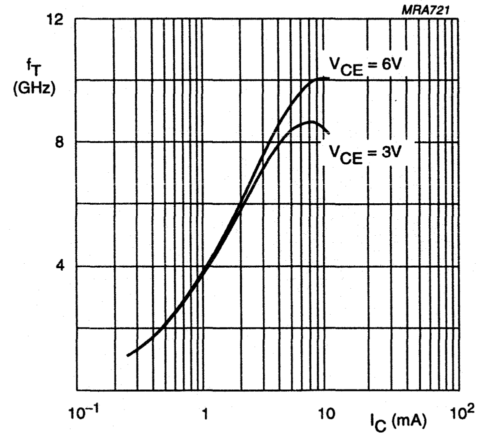
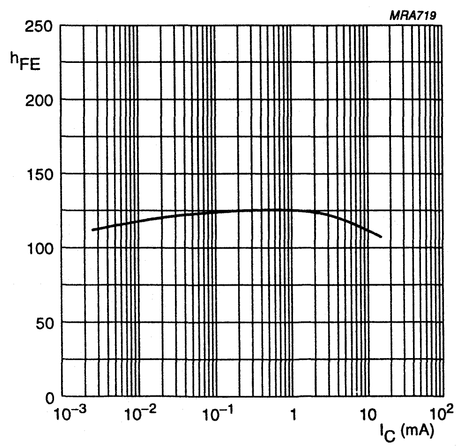


Fig.2 Power derating curves; typical values.



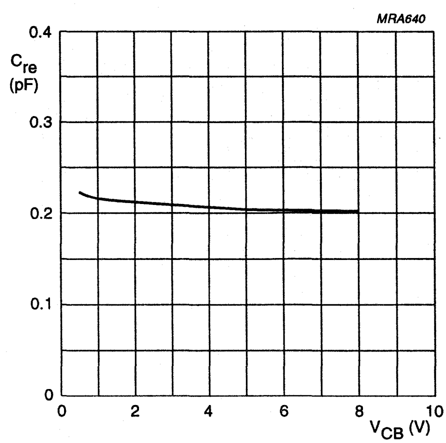
f = 1 GHz; T_{amb} = 25 °C.

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



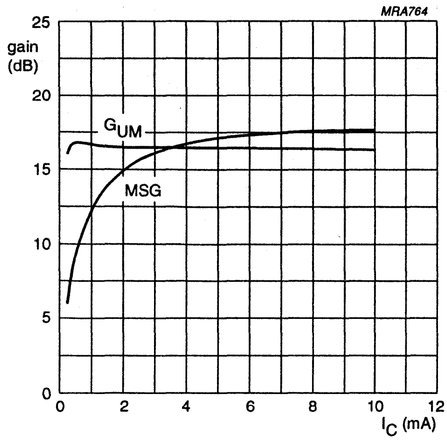
V_{CE} = 6 V.

Fig.4 DC current gain as a function of collector current; typical values.



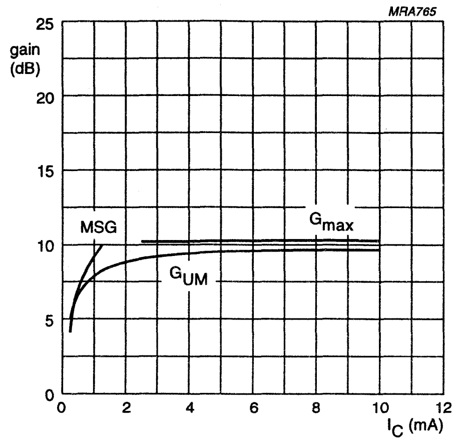
I_C = 0; f = 1 MHz.

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



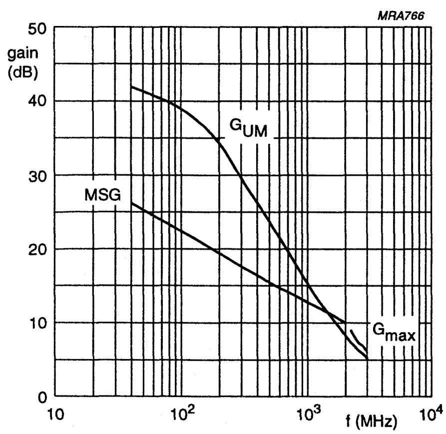
f = 900 MHz; V_{CE} = 6 V.

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



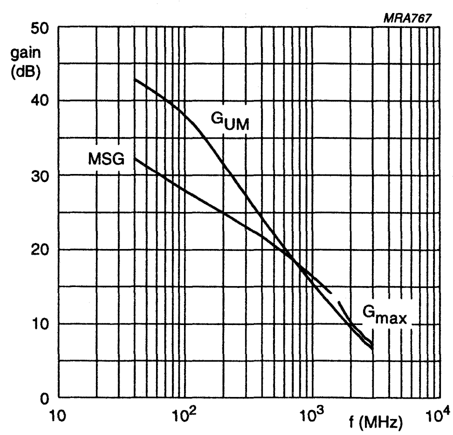
f = 2 GHz; V_{CE} = 6 V.

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



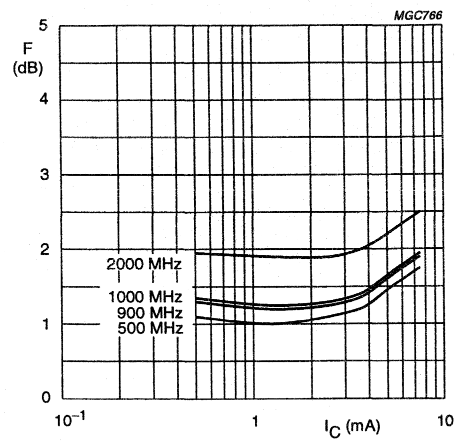
I_C = 1.25 mA; V_{CE} = 6 V.

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



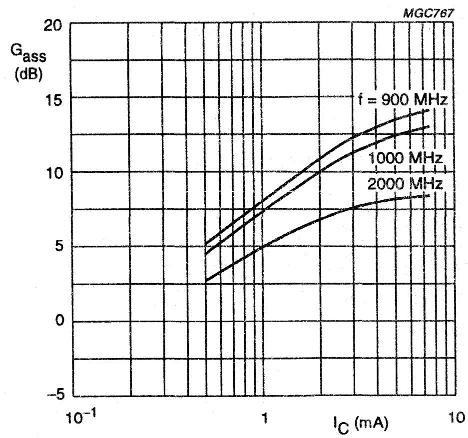
I_C = 5 mA; V_{CE} = 6 V.

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



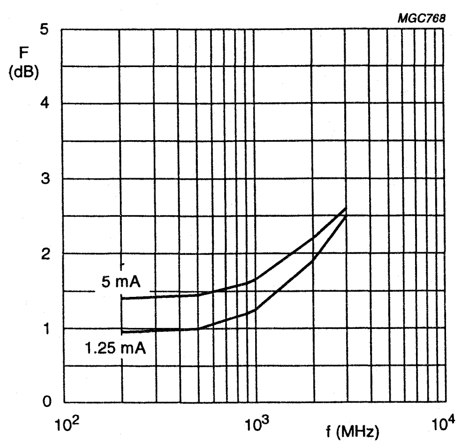
V_{CE} = 6 V.

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



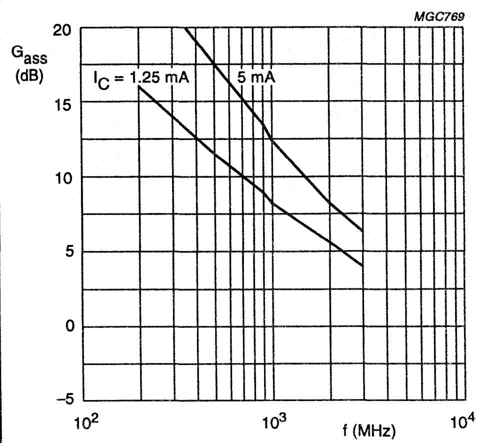
V_{CE} = 6 V.

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.

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

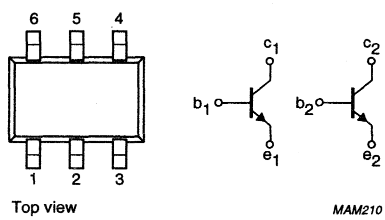
- Oscillator and buffer in one package
- Balanced amplifiers
- LNA/mixers.

DESCRIPTION

Dual transistor with two silicon NPN RF crystals 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

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 SOT363A.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance	$I_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
$\|s_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
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; $\Gamma_S = \Gamma_{opt}$	–	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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	–	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 μA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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	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	
AC characteristics of any single transistor						
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz	–	9	–	GHz
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
G_{UM}	maximum unilateral power gain; note 1	I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	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; f = 900 MHz; T_{amb} = 25 °C	13	14	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 6 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
		I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.6	2.1	dB
		I_C = 5 mA; V_{CE} = 6 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.

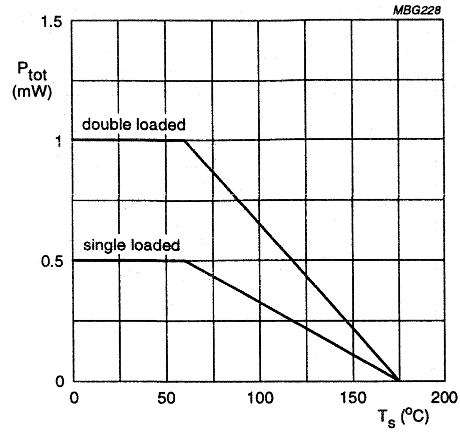
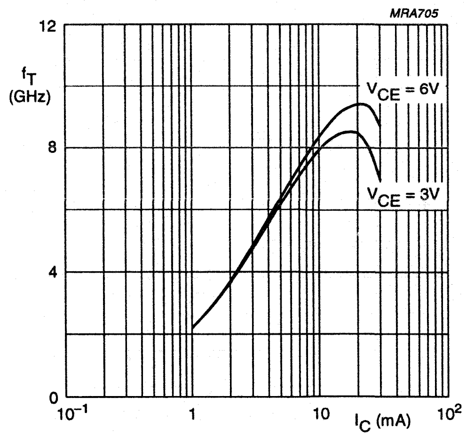
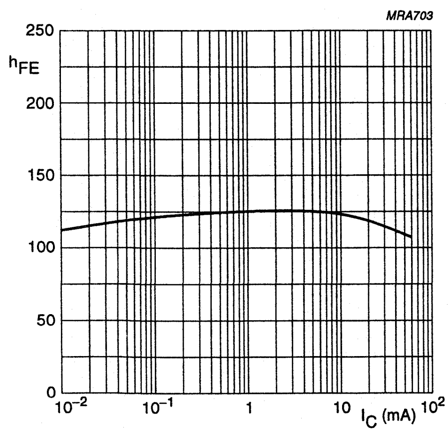


Fig.2 Power derating curves; typical values.



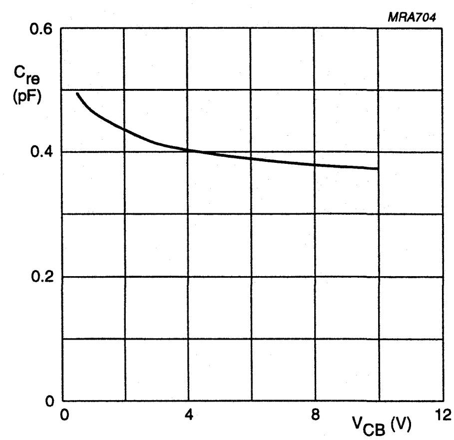
f = 1 GHz; T_{amb} = 25 °C.

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



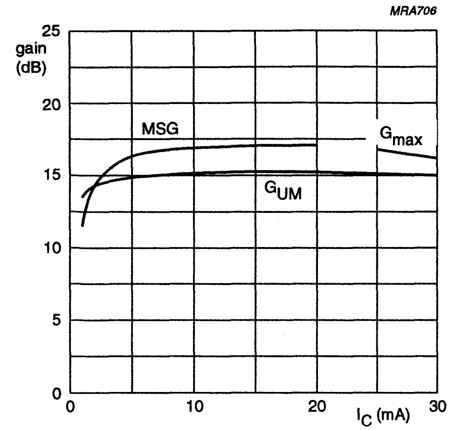
V_{CE} = 6 V.

Fig.4 DC current gain as a function of collector current; typical values.



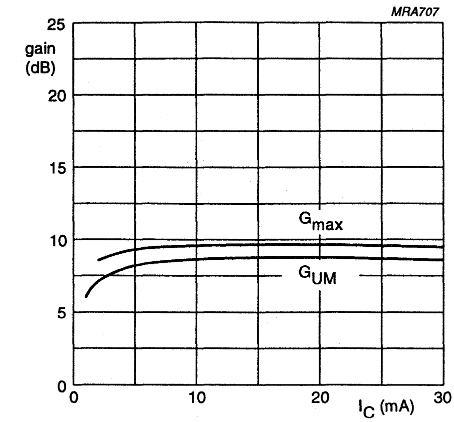
I_C = 0; f = 1 MHz.

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



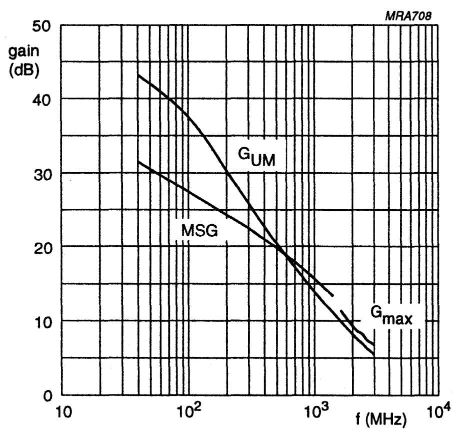
f = 900 MHz; V_{CE} = 6 V.

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



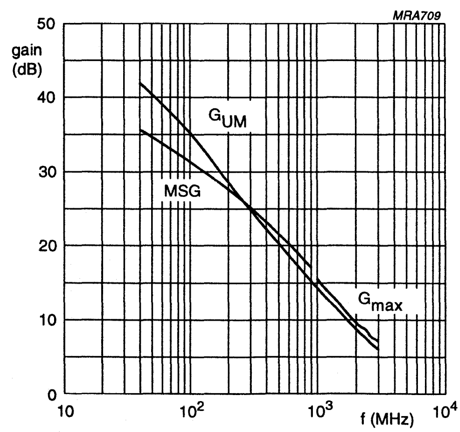
f = 2 GHz; V_{CE} = 6 V.

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



I_C = 5 mA; V_{CE} = 6 V.

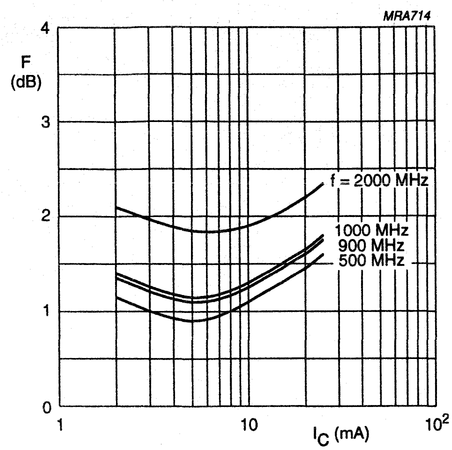
Fig.8 Gain as a function of frequency; typical values.



I_C = 20 mA; V_{CE} = 6 V.

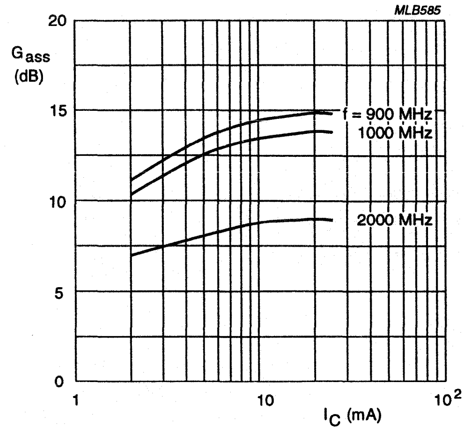
Fig.9 Gain as a function of frequency; typical values.

Dual NPN wideband transistor | BFM520



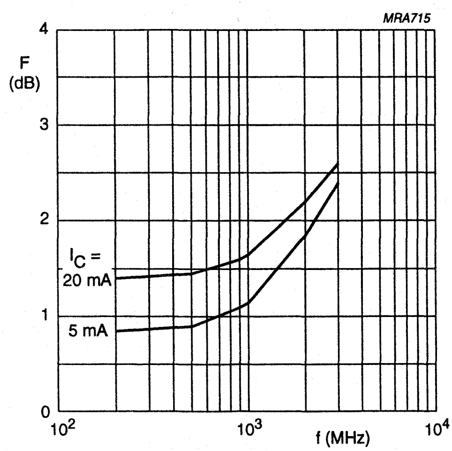
V_{CE} = 6 V.

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



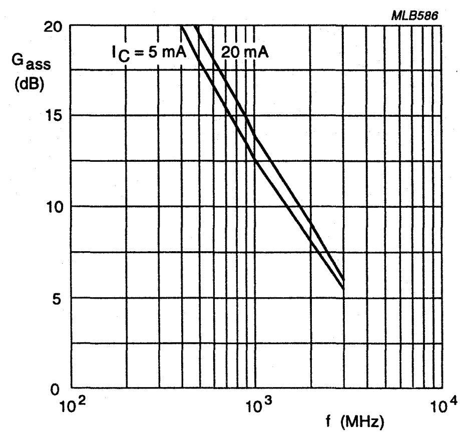
V_{CE} = 6 V.

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.

NPN wideband dual transistor — BFM540

FEATURES

- Small size
- Temperature and h_{FE} matched
- Low noise and high gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

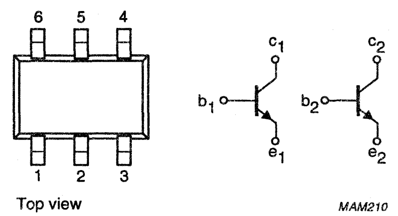
- Oscillator and buffer in one envelope
- Balanced amplifiers
- Wideband amplifiers.

DESCRIPTION

Dual transistor with two silicon NPN RF crystals 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 telephones, cordless phones, radar detectors, pagers, satellite TV-tuners and MATV/CATV amplifiers.

PINNING

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: N7.

Fig.1 SOT363.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance	$I_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	9	–	GHz
$\|s_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	12	13	–	dB
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; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.8	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_{CES}	collector-emitter voltage	base-emitter shorted	–	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 = 118 °C; note 1	–	1	W
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
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 μA; I_B = 0	15	–	–	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	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	
AC characteristics of any single transistor						
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz	–	9	–	GHz
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} = 6 V; f = 1 MHz	–	0.6	–	pF
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; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.3	1.8	dB
		I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	2.4	dB
		I_C = 10 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

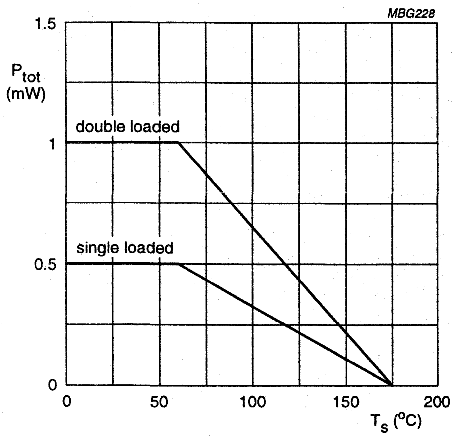
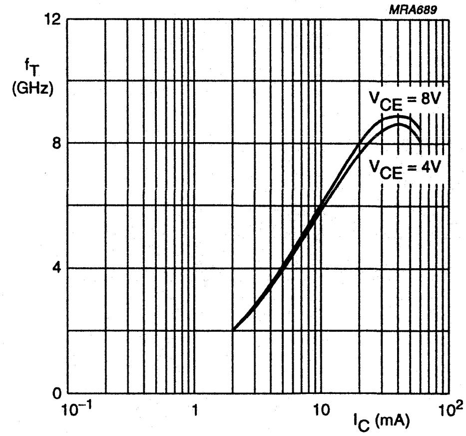
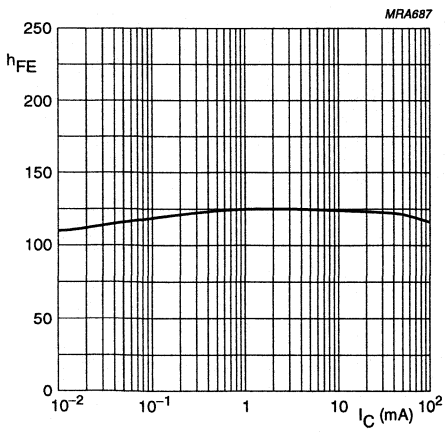


Fig.2 Power derating curves; typical values.



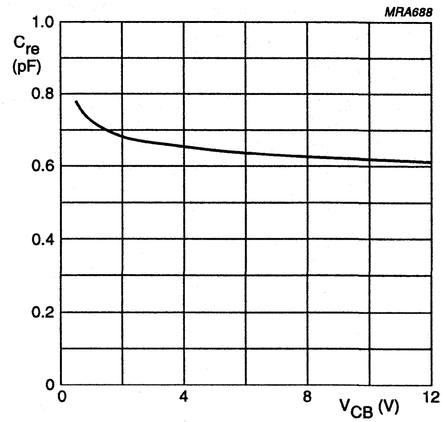
f = 1 GHz; T_{amb} = 25 °C.

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



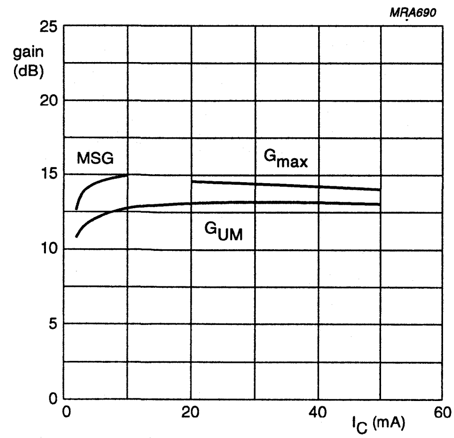
V_{CE} = 8 V.

Fig.4 DC current gain as a function of collector current; typical values.



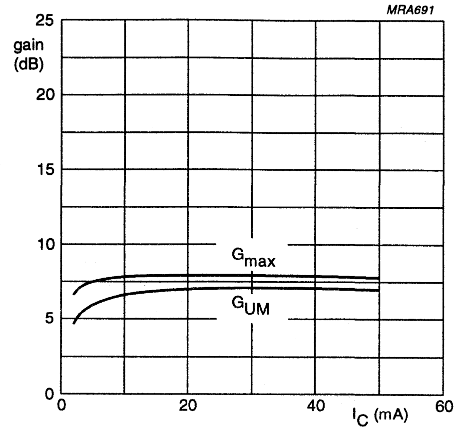
I_C = 0; f = 1 MHz.

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



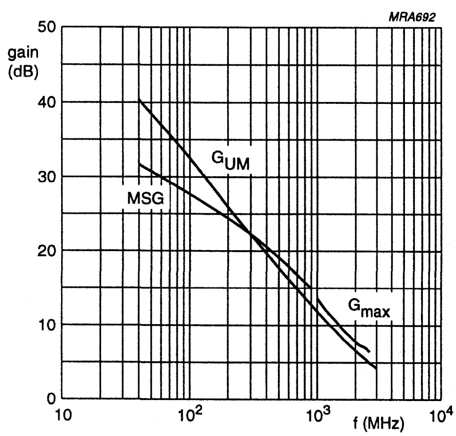
f = 900 MHz; V_{CE} = 8 V.

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



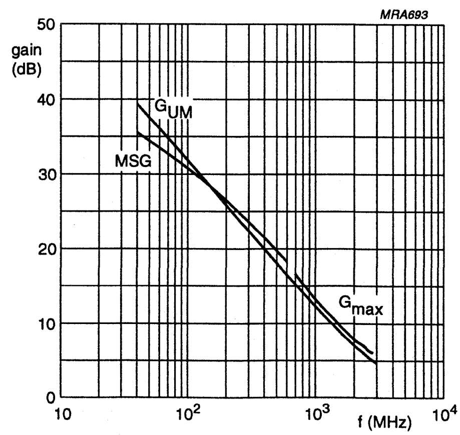
f = 2 GHz; V_{CE} = 8 V.

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



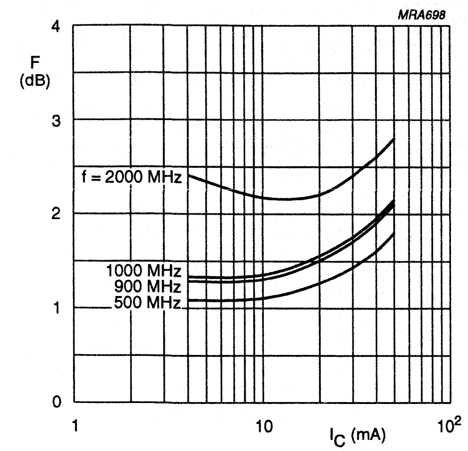
I_C = 10 mA; V_{CE} = 8 V.

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



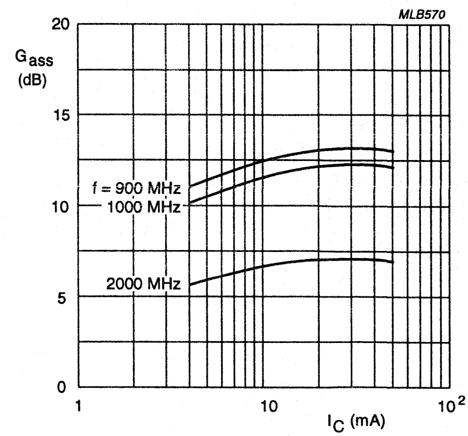
I_C = 40 mA; V_{CE} = 8 V.

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



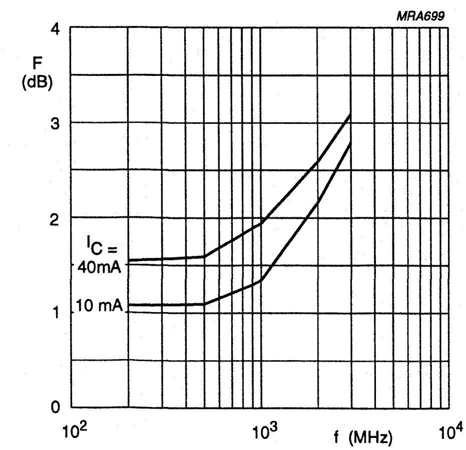
V_{CE} = 8 V.

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



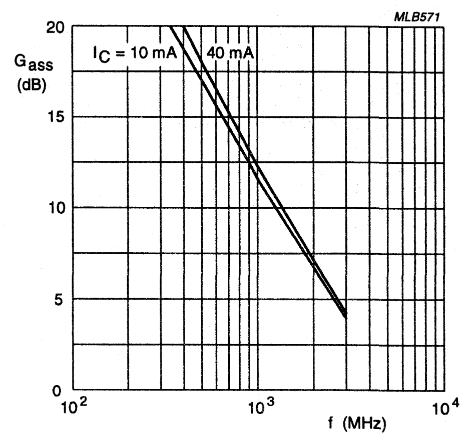
V_{CE} = 8 V.

Fig.11 Associated available gain 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} = 8 V.

Fig.13 Associated available gain as a function of frequency; typical values.

NPN 6 GHz wideband transistor BFP91A

DESCRIPTION

NPN transistor in hermetically-sealed sub-miniature SOT173 and SOT173X micro-stripline envelopes. It features low noise, high gain and low distortion figures and is primarily designed for RF wideband amplifiers and applications up to 1 GHz.

PNP complement is BFQ23C.

PINNING

PIN	DESCRIPTION
Code: P1	
1	collector
2	emitter
3	base (indicated by a red dot on body)
4	emitter

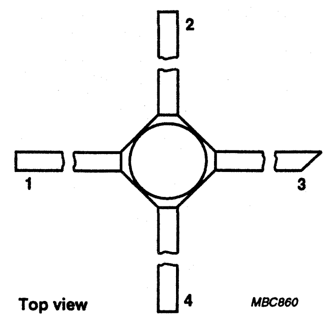


Fig.1 SOT173.

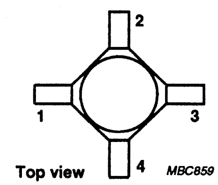


Fig.2 SOT173X.

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		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 125 °C (note 1)	–	–	600	mW
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V; T_j = 25 °C	40	90	–	
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	–	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; f = 500 MHz; T_{amb} = 25 °C	–	22.5	–	dB
		I_C = 30 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C	–	18.5	–	dB

Note

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

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		–	50	mA
P_{tot}	total power dissipation	up to T_s = 125 °C (note 1)	–	600	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 = 125 °C (note 1)	85 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	$I_E = 0$; $V_{CB} = 10$ 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	–	2.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 8$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	22.5	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	18.5	–	dB
F	noise figure	$I_C = 4$ mA; $V_{CE} = 8$ V; Z_S = opt.; f = 800 MHz; $T_{amb} = 25$ °C	–	1.6	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; Z_S = opt.; f = 800 MHz; $T_{amb} = 25$ °C	–	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.

NPN 6 GHz wideband transistor BFP91A

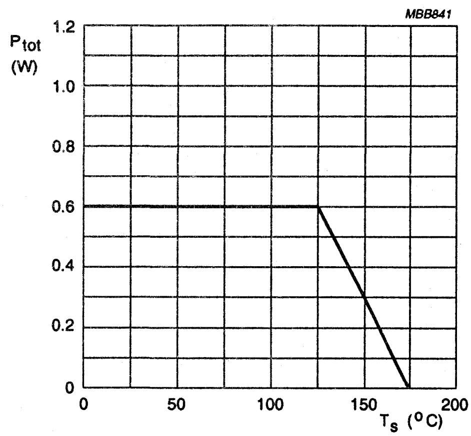
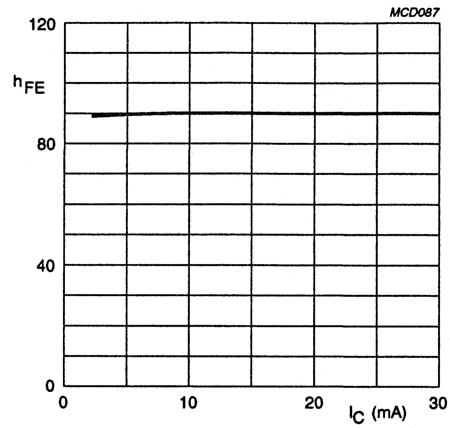
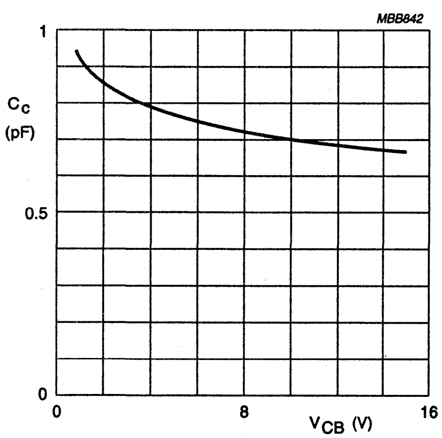


Fig.3 Power derating curve.



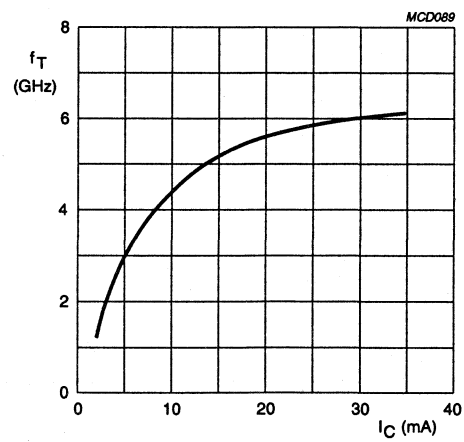
V_{CE} = 5 V; T_j = 25 °C.

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.

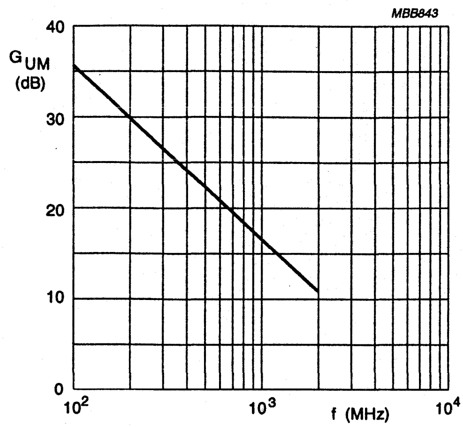


V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

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

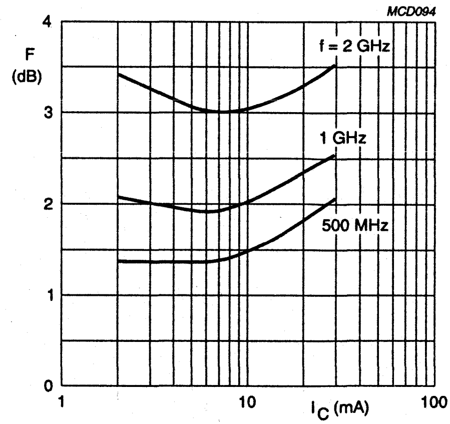
NPN 6 GHz wideband transistor

BFP91A



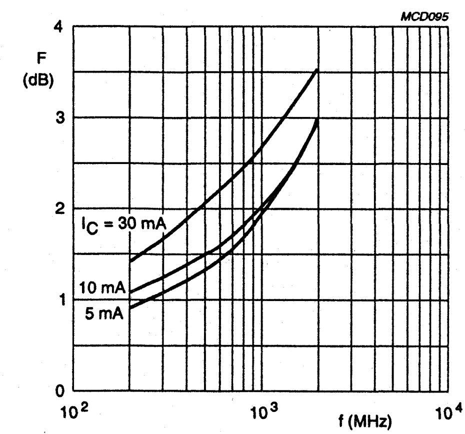
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

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



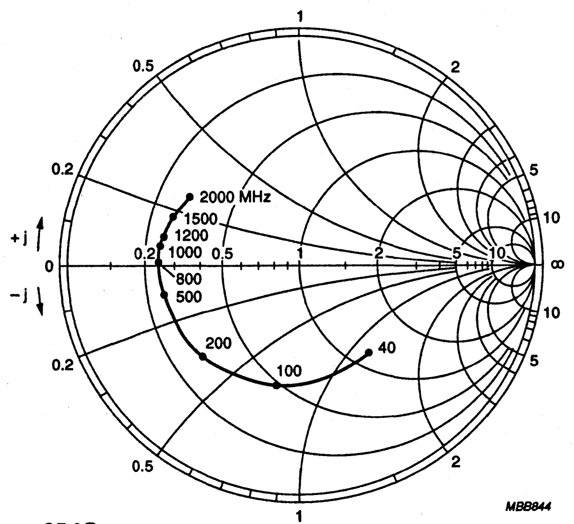
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.8 Minimum noise figure as a function of collector current.



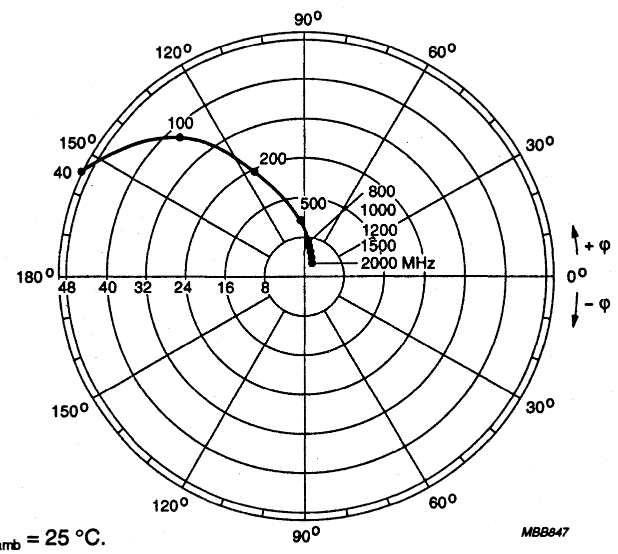
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.9 Minimum noise figure as a function of frequency.



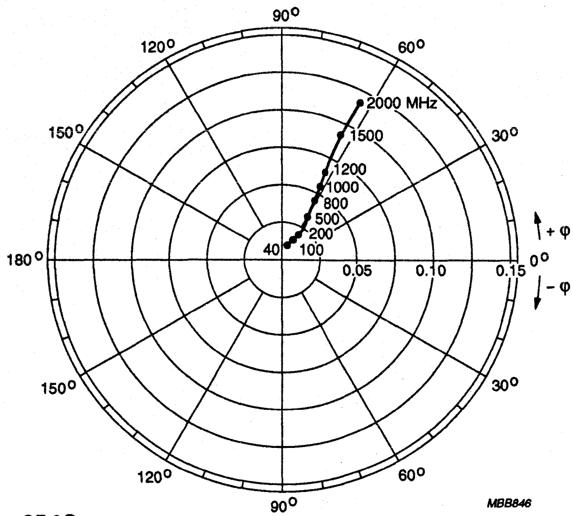
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.10 Common emitter input reflection coefficient (S_{11}).



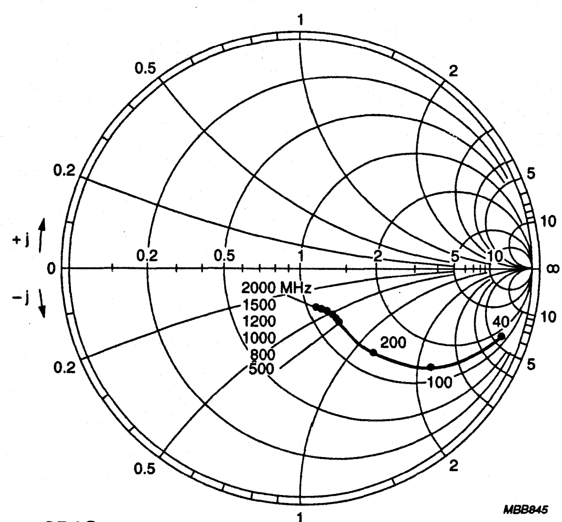
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

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



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.13 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor | BFP96

DESCRIPTION

NPN transistor in hermetically sealed sub-miniature SOT173 and SOT173X micro-stripline envelopes. It features low noise, high gain and low distortion figures and is primarily intended for RF wideband amplifiers and applications up to 1 GHz.

PNP complement is BFQ32C.

PINNING

PIN	DESCRIPTION
Code: P6	
1	collector
2	emitter
3	base (indicated by a red dot on body)
4	emitter

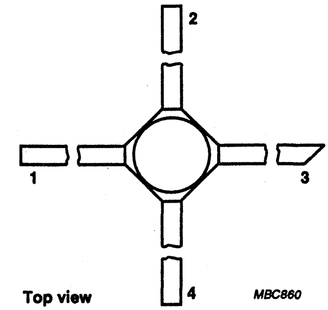


Fig.1 SOT173.

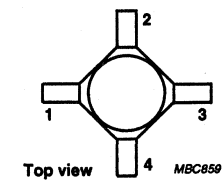


Fig.2 SOT173X.

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 = 90 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; T_j = 25 °C	25	80	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	–	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	19	–	dB
		I_C = 50 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB

Note

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

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 = 90 °C (note 1)	–	1	W
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 = 90 °C (note 1)	85 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} = 10 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V	25	80	–	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	1.3	–	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} = 10 V; f = 1 MHz	–	1	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	19	–	dB
		I_C = 50 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	15	–	dB
F	noise figure	I_C = 50 mA; V_{CE} = 10 V; Z_S = opt.; f = 800 MHz; T_{amb} = 25 °C	–	3.7	–	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.

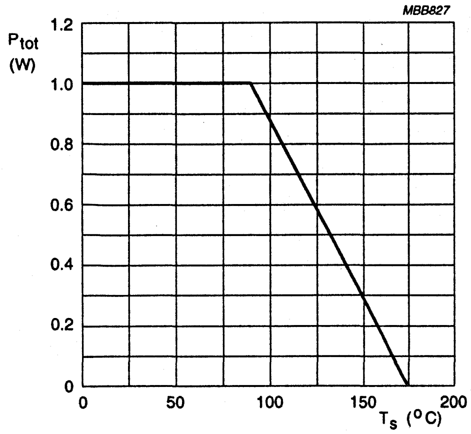
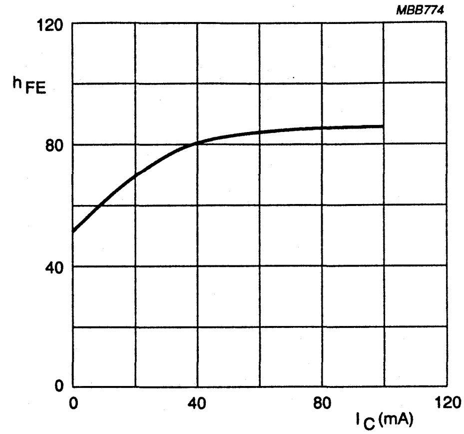
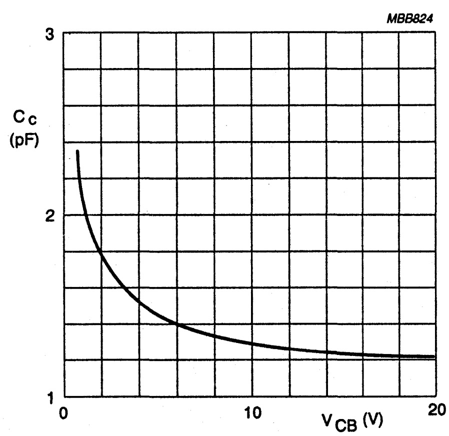


Fig.3 Power derating curve.



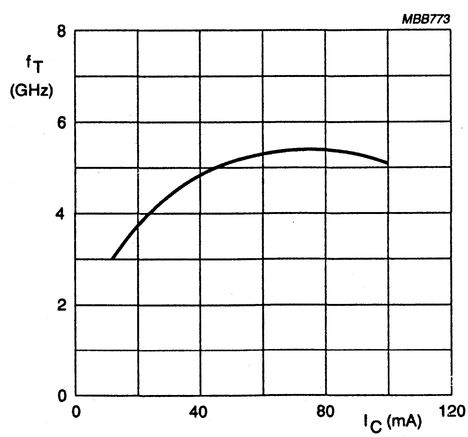
V_{CE} = 10 V; T_j = 25 °C.

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



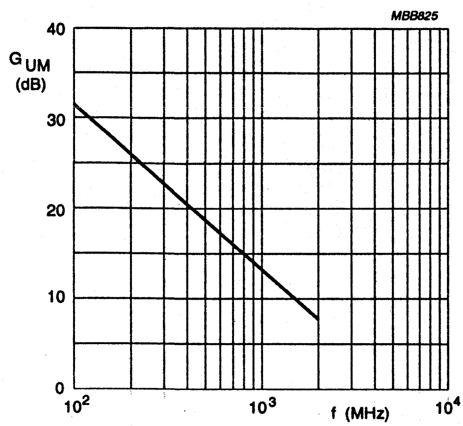
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



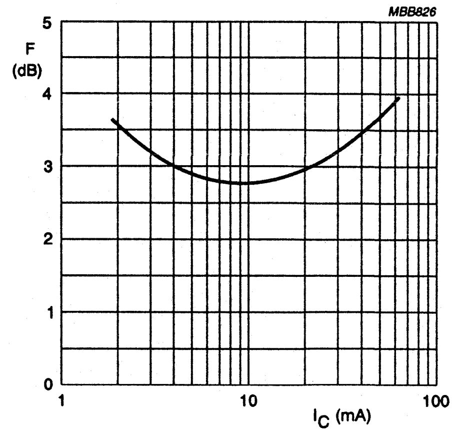
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

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



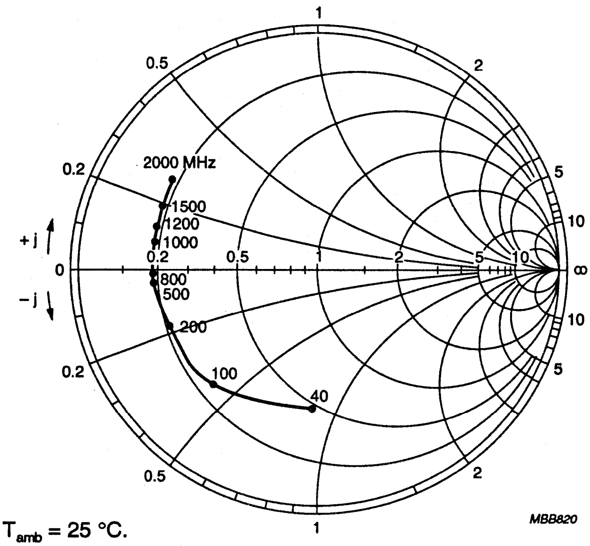
I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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



V_{CE} = 10 V; f = 1 MHz; T_{amb} = 25 °C.

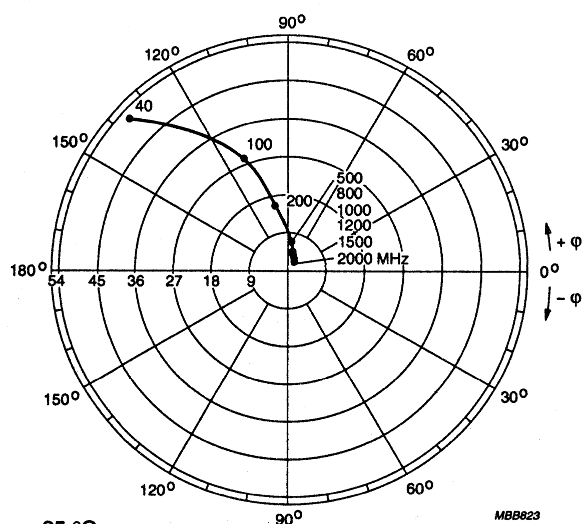
Fig.8 Minimum noise figure as a function of collector current.



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

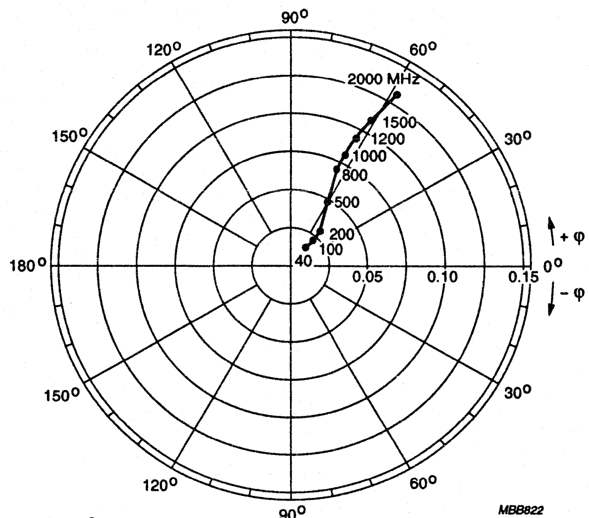
Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}).



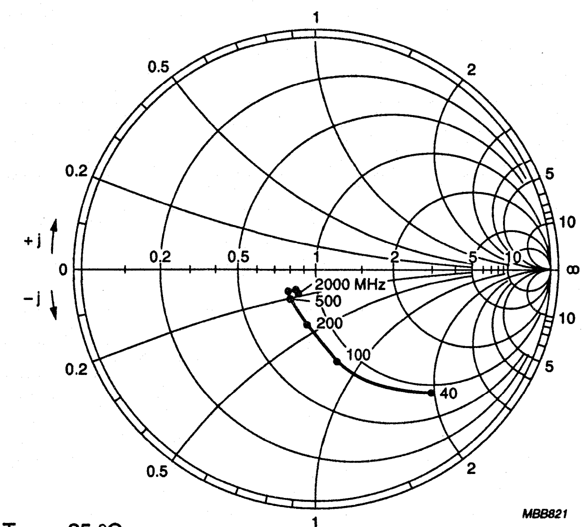
I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.10 Common emitter forward transmission coefficient (S_{21}).



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

Fig.11 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.12 Common emitter output reflection coefficient (S_{22}).

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	base
3	collector

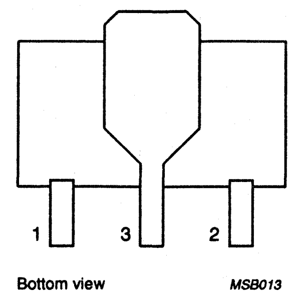


Fig.1 SOT89.

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.

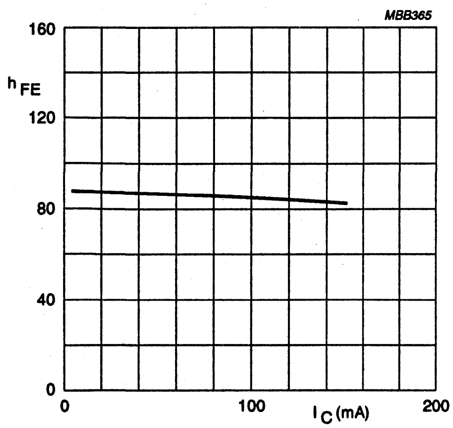
CHARACTERISTICS

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

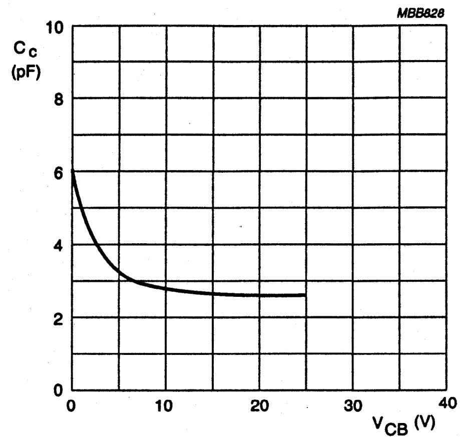
Note

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



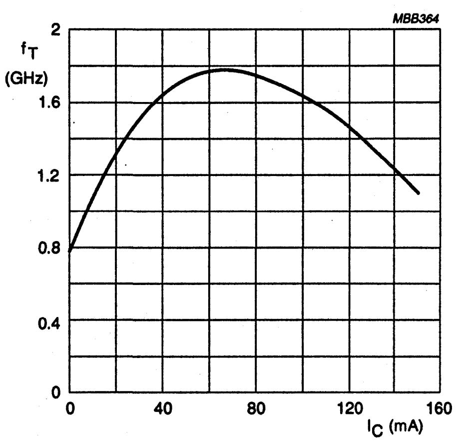
V_{CE} = 5 V; T_j = 25 °C.

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	base
3	collector

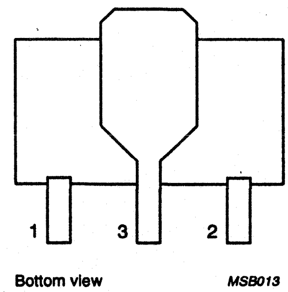


Fig.1 SOT89.

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.

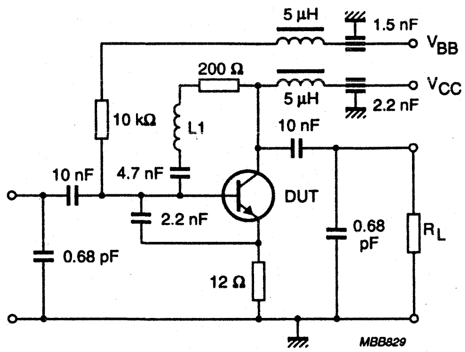
CHARACTERISTICS

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

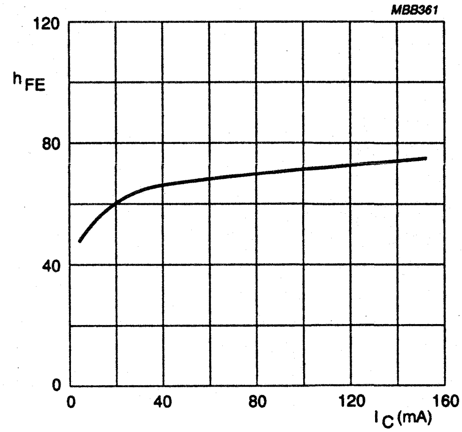
Note

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.



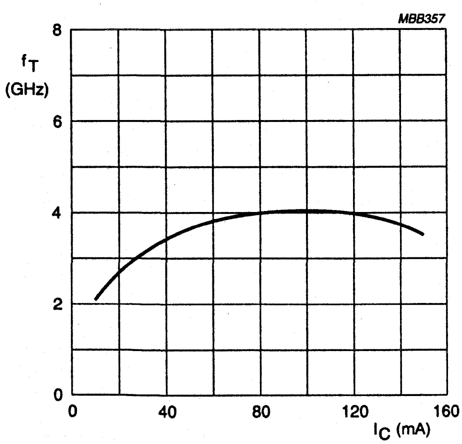
f = 40 - 860 MHz.

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 analyzers 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	base
3	collector

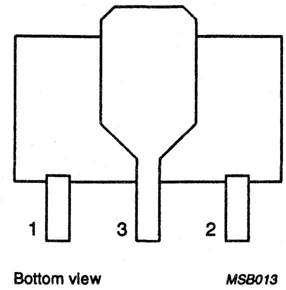


Fig.1 SOT89.

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

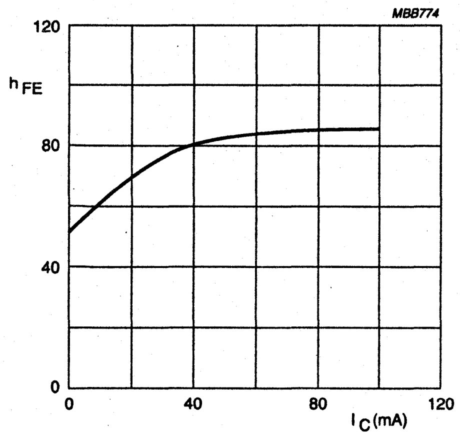
T_j = 25 °C unless otherwise specified.

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

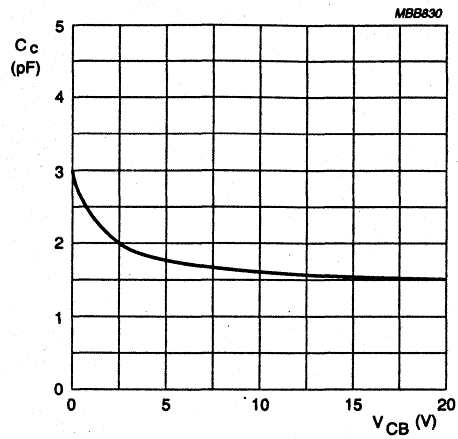
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.

NPN 5 GHz wideband transistor BFQ19



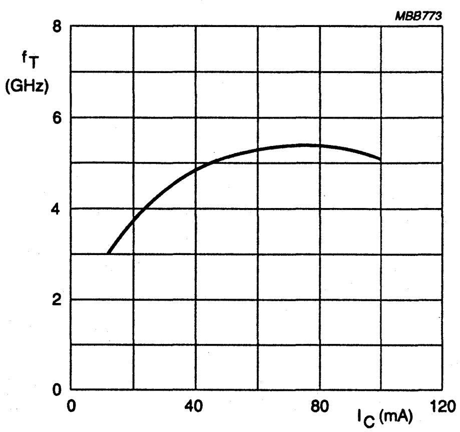
V_{CE} = 10 V; T_j = 25 °C.

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 6 GHz wideband transistor BFQ22S

DESCRIPTION

NPN transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. It is primarily intended for use in UHF and microwave aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

The transistor has extremely high power gain and good low noise performance.

PNP complement is BFQ24.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

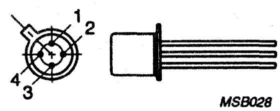


Fig.1 TO-72.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
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 = 50 °C (note 1)	–	250	mW
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	6	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	0.65	–	pF
F	noise figure	I_C = 10 mA; V_{CE} = 8 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	1.5	–	dB
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	16	–	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	–	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 = 50 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 50 °C (note 1)	600 K/W

Note

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

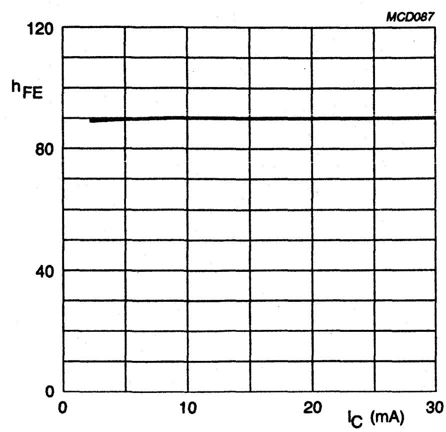
CHARACTERISTICS

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 = 10 mA; V_{CE} = 5 V	45	90	–	
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	–	0.65	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz	–	6	–	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	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 8 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	–	1.5	–	dB

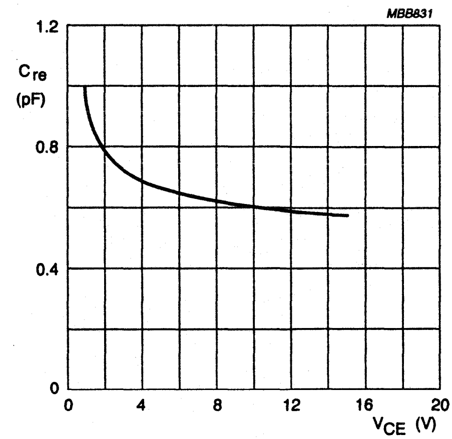
Note

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



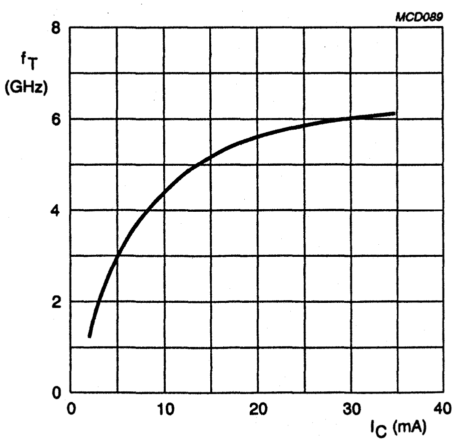
V_{CE} = 8 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



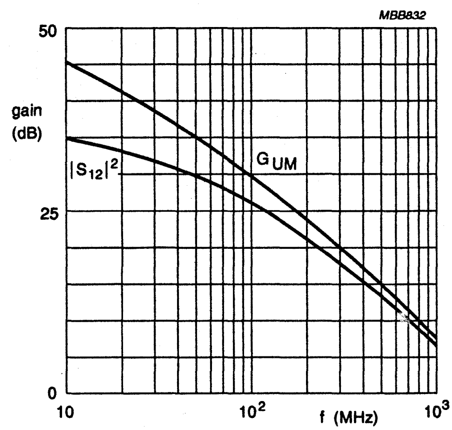
f = 1 MHz; T_{amb} = 25 °C.

Fig.3 Feedback capacitance as a function of collector-emitter voltage.



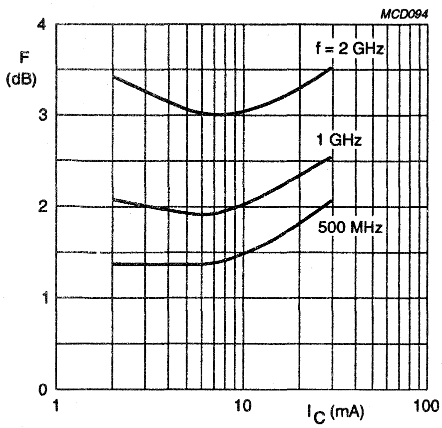
V_{CE} = 5 V; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.5 Maximum unilateral power gain as a function of frequency.



V_{CE} = 8 V; Z_S = opt.; T_{amb} = 25 °C.

Fig.6 Minimum noise figure as a function of collector current.

PNP 5 GHz wideband transistor — BFQ24

DESCRIPTION

PNP transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. It is primarily intended for use in UHF and microwave amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers etc.

The transistor features extremely high power gain coupled with good low noise performance.

NPN complement is BFQ22S.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

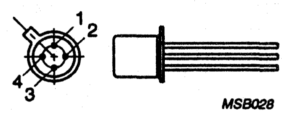


Fig.1 TO-72.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
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 = 50 °C (note 1)	–	250	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 = 0; V_{CE} = –5 V; f = 1 MHz; T_{amb} = 25 °C	0.8	–	pF
G_{UM}	maximum unilateral power gain	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	15	–	dB
F	noise figure	I_C = –2 mA; V_{CE} = –5 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	2.4	–	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	–	–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 = 50 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 50 °C (note 1)	600 K/W

Note

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

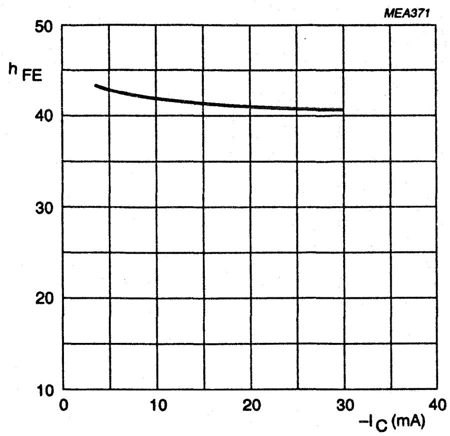
CHARACTERISTICS

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 = –30 mA; V_{CE} = –5 V	20	40	–	
C_c	collector capacitance (note 2)	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	–	2.5	–	pF
C_{re}	feedback capacitance (note 1)	I_C = 0; V_{CE} = –5 V; f = 1 MHz	–	0.8	–	pF
f_T	transition frequency (note 1)	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (notes 1 and 3)	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz T_{amb} = 25 °C	–	15	–	dB
F	noise figure (note 1)	I_C = –2 mA; V_{CE} = –5 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	–	2.4	–	dB

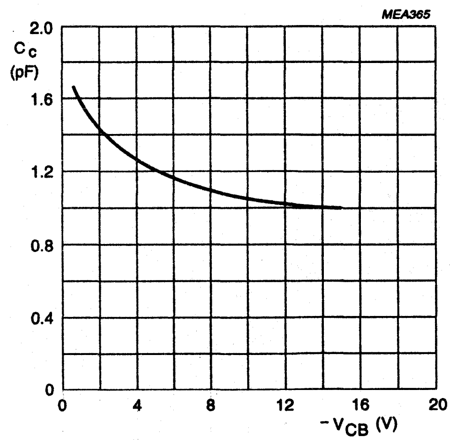
Notes

1. Shield lead grounded.
2. Shield lead not connected.
3. 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.



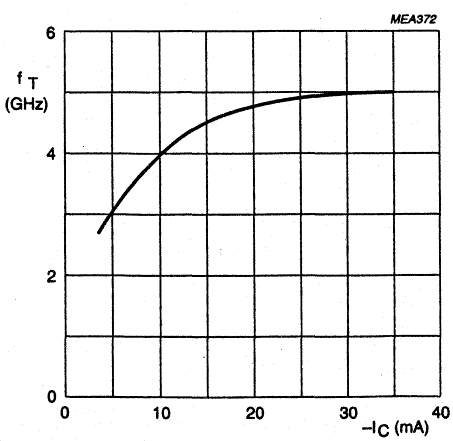
$V_{CE} = -5$ V; $T_j = 25$ °C.

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.

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.

A SOT5 (TO-39) version (ref: ON4497) is available on request.

PINNING

PIN	DESCRIPTION
Code: BFQ34/01	
1	collector
2	emitter
3	base
4	emitter

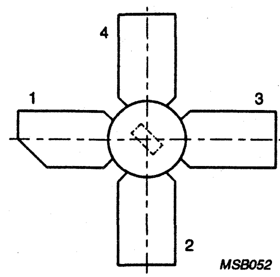


Fig.1 SOT122A.

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 Ω; 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 Ω; 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 Ω; 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

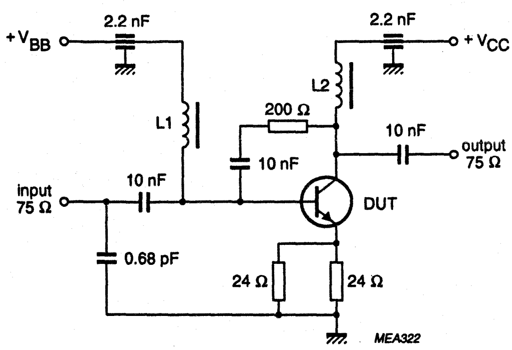
CHARACTERISTICS

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

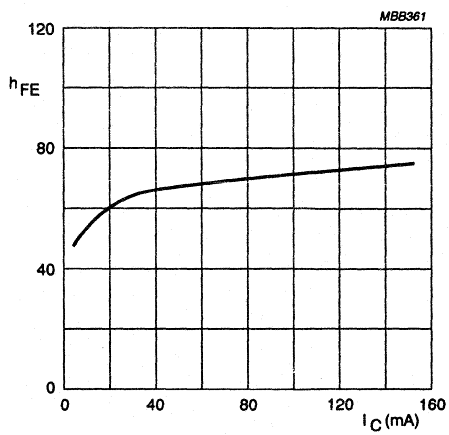
Notes

1. Measured with grounded emitter and base.
2. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
3. d_{im} = –60 dB (DIN 45004B, par. 6.3.: 3-tone); I_C = 120 mA; V_{CE} = 15 V; R_L = 75 Ω; 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 Ω;
   measured at f = 800 MHz.
5. I_C = 120 mA; V_{CE} = 15 V; R_L = 75 Ω; 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.



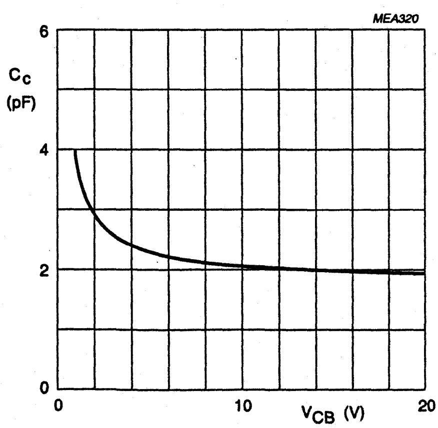
f = 40 to 860 MHz; L1 = L2 = 5 μH Ferroxcube coil.

Fig.2 Intermodulation distortion MATV test circuit.



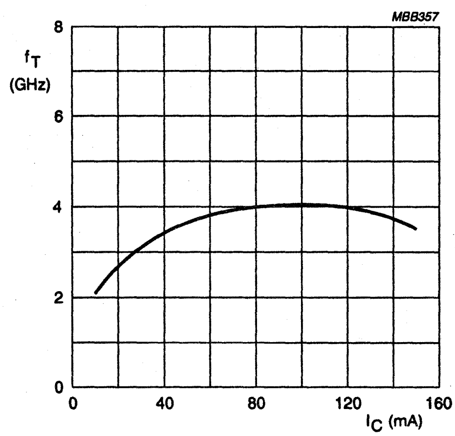
V_{CE} = 15 V; T_j = 25 °C.

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



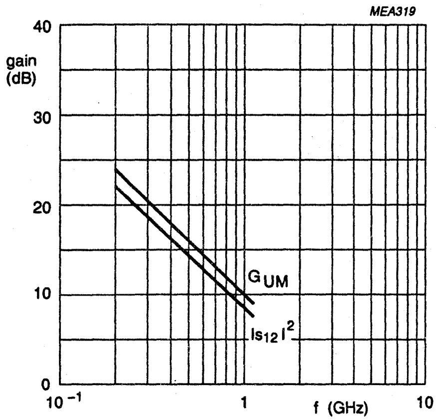
I_E = 0; f = 1 MHz; T_j = 25 °C.

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



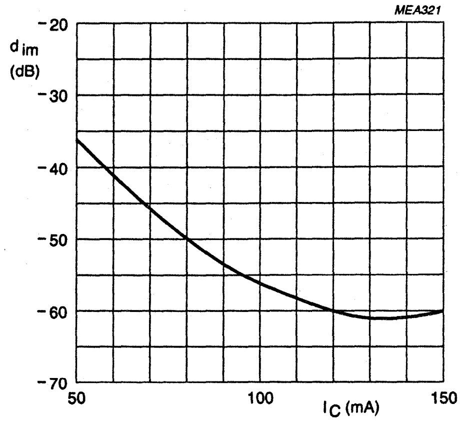
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C.

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



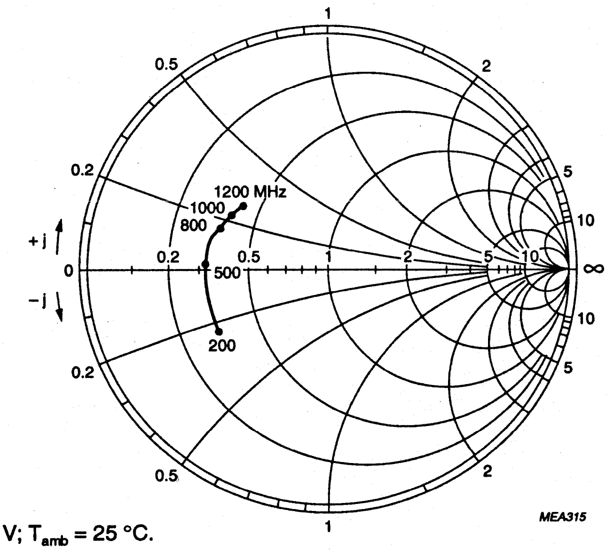
I_C = 120 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.6 Gain as a function of frequency.



V_O = 1.2 V; V_{CE} = 15 V; $f_{(p+q-r)}$ = 793.25 MHz

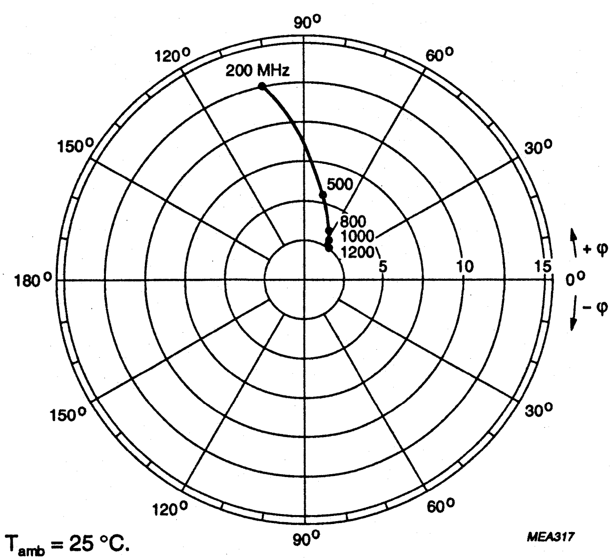
Fig.7 Intermodulation distortion as a function of collector current.



I_C = 120 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

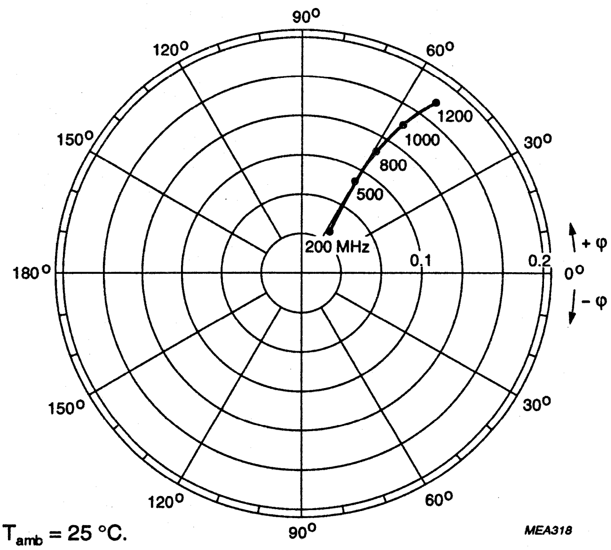
Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



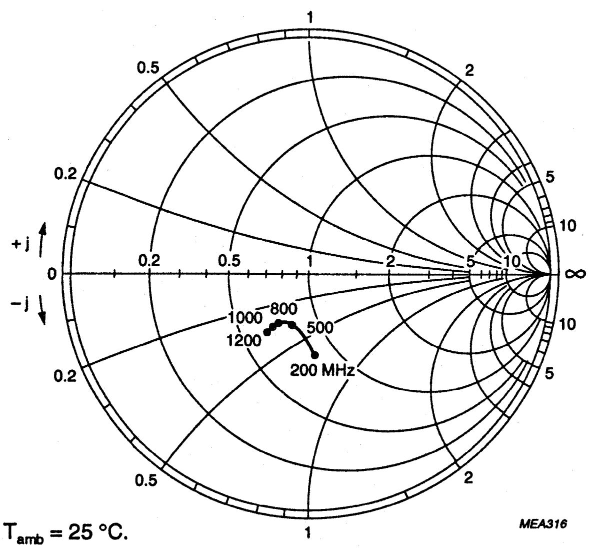
I_C = 120 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

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}).

PNP 5 GHz wideband transistor BFQ52

DESCRIPTION

PNP transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. It is primarily intended for use in RF amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

The transistor features extremely high power gain coupled with good low noise performance.

NPN complement is BFQ53.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

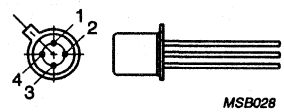


Fig.1 TO-72.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
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 = 50 °C (note 1)	–	250	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 = 0; V_{CE} = –10 V; f = 1 MHz	0.5	–	pF
G_{UM}	maximum unilateral power gain	I_C = –14 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	17	–	dB
F	noise figure	I_C = –2 mA; V_{CE} = –10 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	2.7	–	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_{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 = 50 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 50 °C (note 1)	600 K/W

Note

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

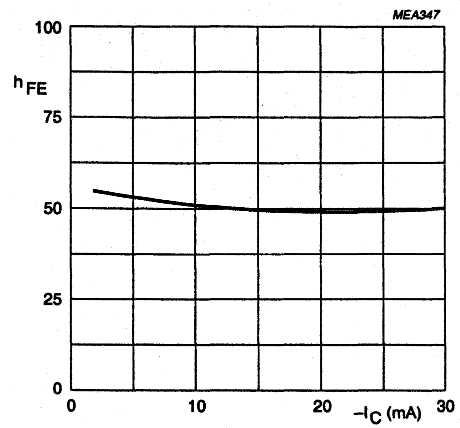
CHARACTERISTICS

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} = −10 V	–	–	−50	nA
h_{FE}	DC current gain	I_C = −14 mA; V_{CE} = −10 V	20	50	–	
C_c	collector capacitance (note 2)	$I_E = i_e$ = 0; V_{CB} = −10 V; f = 1 MHz	–	0.85	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = −0.5 V; f = 1 MHz	–	1.2	–	pF
C_{re}	feedback capacitance (note 1)	I_C = 0; V_{CE} = −10 V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency (note 1)	I_C = −14 mA; V_{CE} = −10 V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (notes 1 and 3)	I_C = −14 mA; V_{CE} = −10 V; f = 500 MHz; T_{amb} = 25 °C	–	17	–	dB
F	noise figure (note 1)	I_C = −2 mA; V_{CE} = −10 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	–	2.7	–	dB

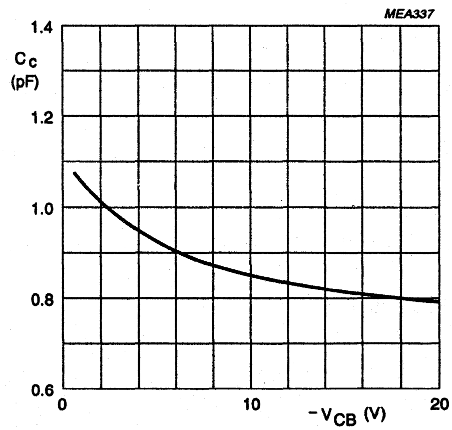
Notes

1. Shield lead grounded.
2. Shield lead not connected
3. 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.



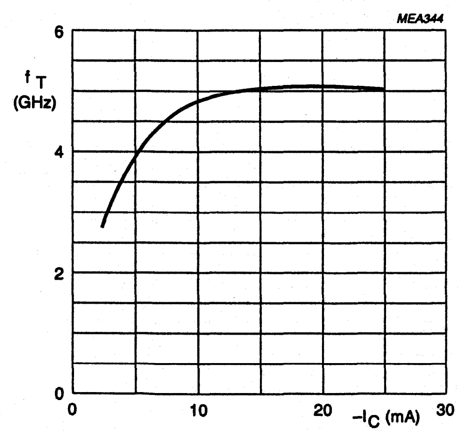
$V_{CE} = -10$ V; $T_j = 25$ °C.

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 5 GHz wideband transistor BFQ53

DESCRIPTION

NPN transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. It is primarily intended for use in RF amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

The transistor has extremely high power gain coupled with good low noise performance.

PNP complement is BFQ52.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

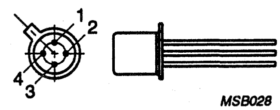


Fig.1 TO-72.

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 = 50 °C (note 1)	–	250	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 = 0; V_{CE} = 10 V; f = 1 MHz	0.45	–	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; Z_S = opt.; f = 1 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_{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 = 50 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 50 °C (note 1)	600 K/W

Note

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

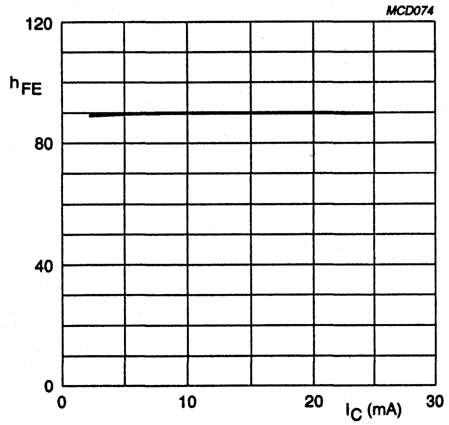
CHARACTERISTICS

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} = 10 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 14 mA; V_{CE} = 10 V	40	90	–	
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	–	1.2	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	–	0.45	–	pF
f_T	transition frequency	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz	–	5	–	GHz
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; Z_S = opt.; f = 1 GHz; T_{amb} = 25 °C	–	2.1	–	dB

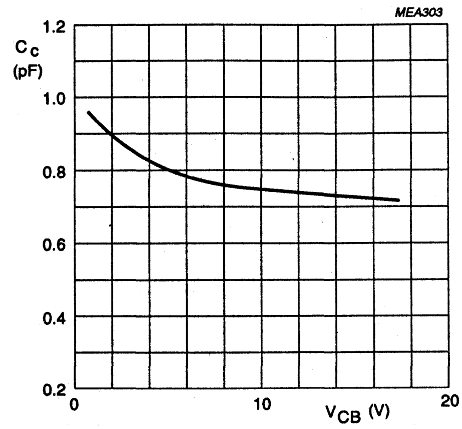
Note

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.



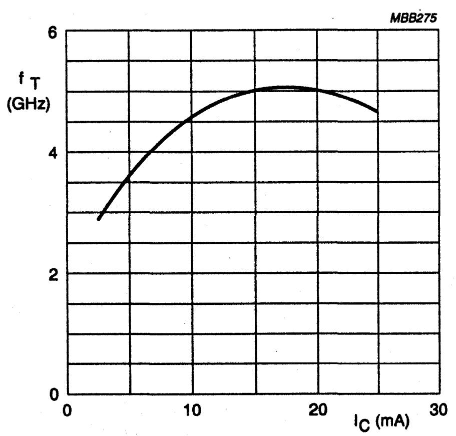
V_{CE} = 10 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



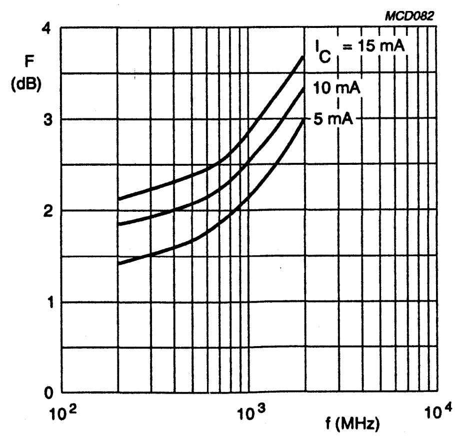
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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.



V_{CE} = 10 V; Z_S = opt.; T_{amb} = 25 °C

Fig.5 Minimum noise figure as a function of frequency.

NPN 5 GHz wideband transistor BFQ63

DESCRIPTION

NPN transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. It is primarily intended for use in UHF and microwave amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

The transistor features the combination of high power gain, high transition frequency and low noise up to high frequencies.

PNP complement is BFQ32M.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

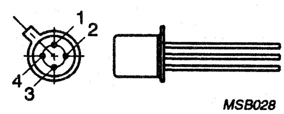


Fig.1 TO-72.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	75	mA
P_{tot}	total power dissipation	up to T_s = 50 °C (note 1)	–	250	mW
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	1	–	pF
G_{UM}	maximum unilateral power gain	I_C = 20 mA; V_{CE} = 5 V; f = 200 MHz; T_{amb} = 25 °C	17.5	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 5 V; Z_S = opt.; f = 200 MHz; T_{amb} = 25 °C	–	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	V
I_C	DC collector current		–	75	mA
I_{CM}	peak collector current	f > 1 MHz	–	150	mA
P_{tot}	total power dissipation	up to T_s = 50 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 50 °C (note 1)	600 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} = 10 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 5 V	25	80	–	
C_c	collector capacitance	$I_C = i_c$ = 0; V_{CB} = 5 V; f = 1 MHz	–	1.3	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	–	1	1.4	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 50 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	11.5	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 5 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C	–	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.

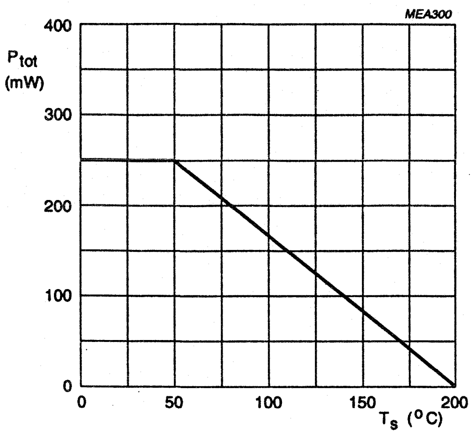
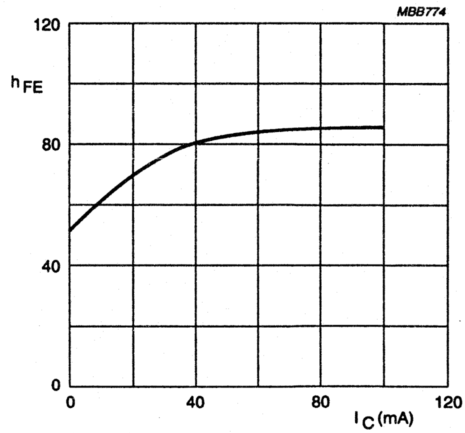
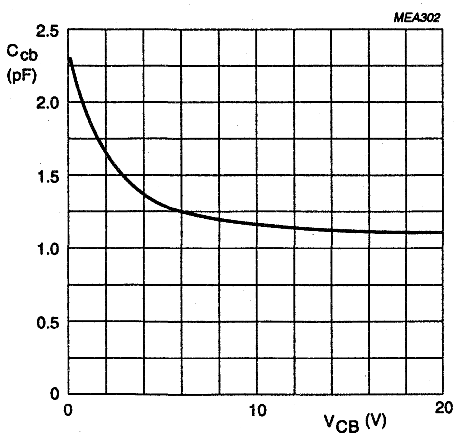


Fig.2 Power derating curve.



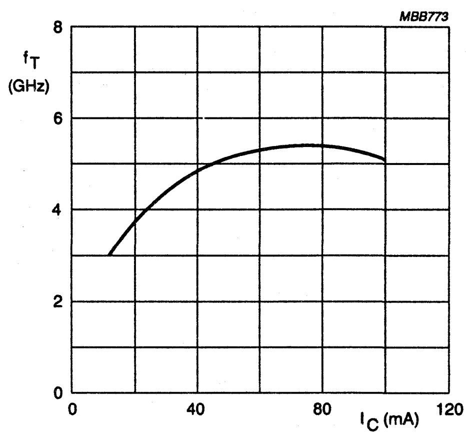
V_{CE} = 5 V; T_j = 25 °C.

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



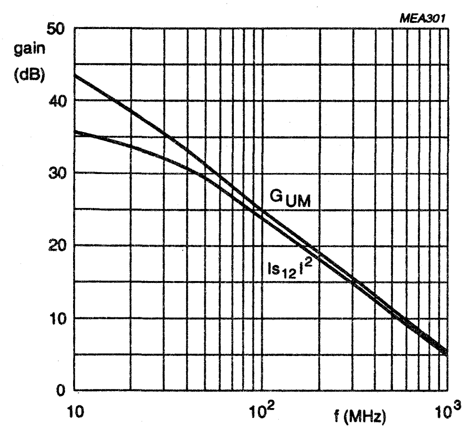
$I_C = i_c = 0$; f = 1 MHz; T_j = 25 °C.

Fig.4 Collector-base 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.



I_C = 50 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.6 Gain as a function of frequency.

NPN 8 GHz wideband transistor

BFQ66

DESCRIPTION

Small-signal planar epitaxial NPN transistor in hermetically-sealed sub-miniature SOT173 and SOT173X micro-stripline envelopes.

It is designed for wideband applications in the GHz range, such as satellite TV systems (SATV) and repeater amplifiers in fibre-optic systems. The transistor features a very high transition frequency and a very low noise figure up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: Q6	
1	collector
2	emitter
3	base (indicated by a red dot on body)
4	emitter

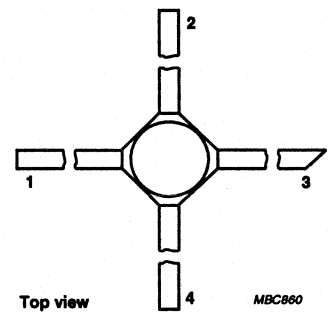


Fig.1 SOT173.

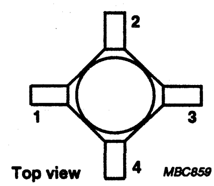


Fig.2 SOT173X.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
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 = 145 °C (note 1)	–	–	350	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 = 500 MHz; T_j = 25 °C	–	8	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	11.5	–	dB

Note

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

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 = 145 °C (note 1)	–	350	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 = 145 °C (note 1)	80 K/W

Note

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

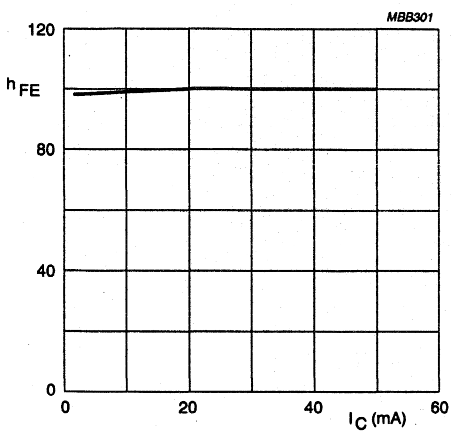
CHARACTERISTICS

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	$I_C = 0$; $V_{CE} = 8$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 500 MHz	–	8	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	11.5	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 8$ V; $Z_S = 50\ \Omega$; f = 2 GHz; $T_{amb} = 25$ °C	–	2.1	–	dB
		$I_C = 15$ mA; $V_{CE} = 8$ V; $Z_S = 50\ \Omega$; f = 2 GHz; $T_{amb} = 25$ °C	–	2.7	4	dB

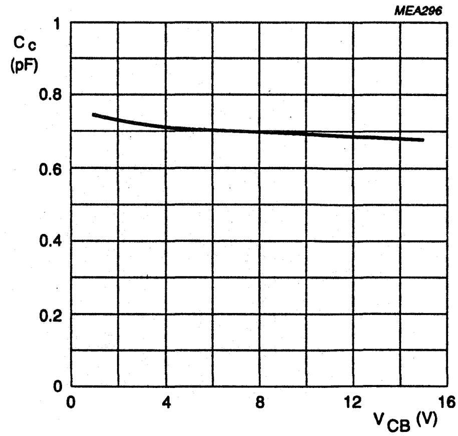
Note

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.



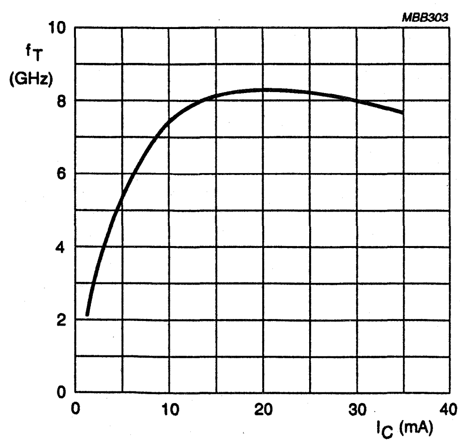
V_{CE} = 5 V; T_j = 25 °C.

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



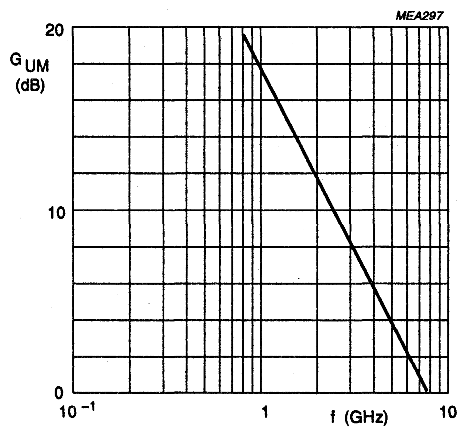
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C

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



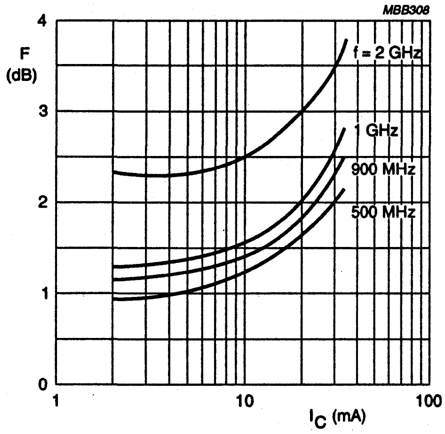
V_{CE} = 8 V; f = 500 MHz; T_j = 25 °C

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



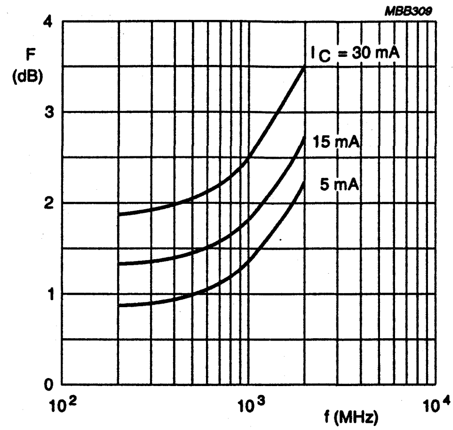
I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C

Fig.6 Maximum unilateral power gain as a function of frequency.



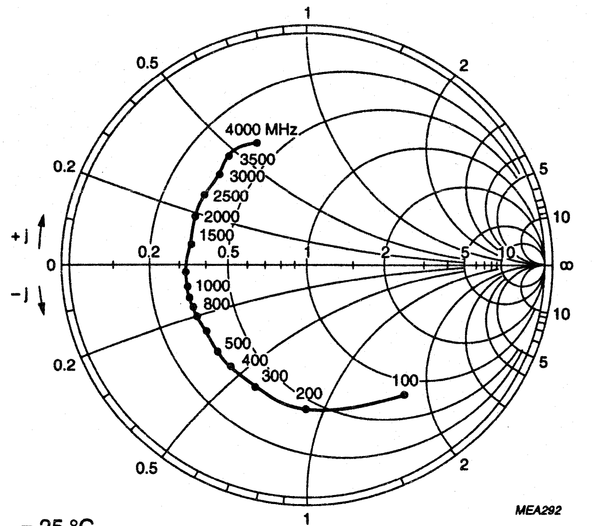
V_{CE} = 8 V; T_{amb} = 25 °C

Fig.7 Minimum noise figure as a function of collector current.



V_{CE} = 8 V; T_{amb} = 25 °C

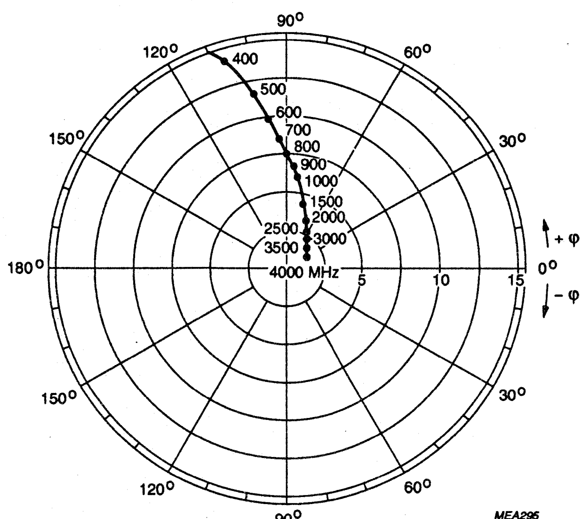
Fig.8 Minimum noise figure as a function of frequency.



I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

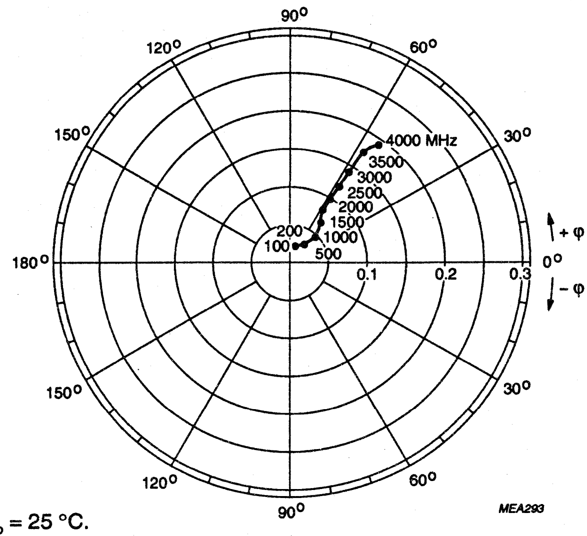
Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (S_{11}).



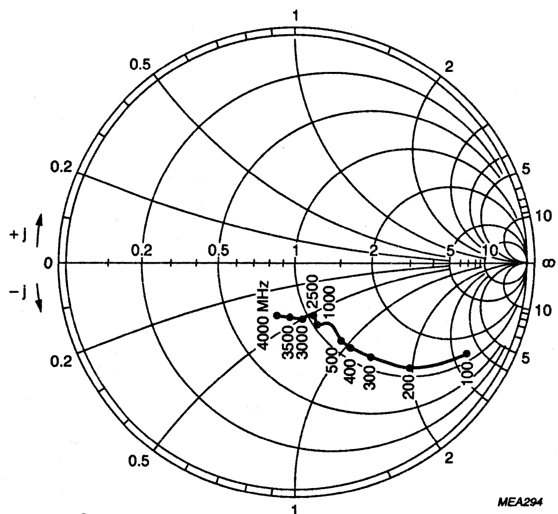
I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.10 Common emitter forward transmission coefficient (S_{21}).



I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Common emitter reverse transmission coefficient (S_{12}).



I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.12 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.

DESCRIPTION

Silicon NPN transistor in a plastic SOT23 envelope. It is designed for wideband applications such as satellite TV tuners and RF portable communications equipment up to 2 GHz.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

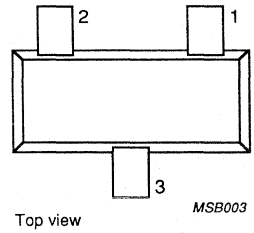


Fig.1 SOT23.

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	–	–	10	V
I_C	DC collector current		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 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

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 = 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 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	$I_C = 15$ 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.

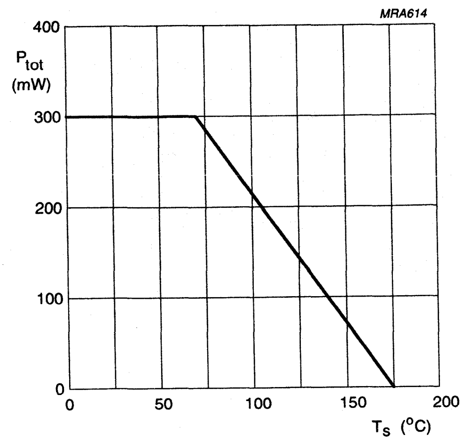
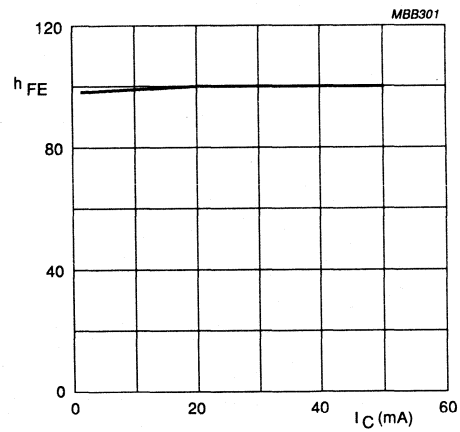
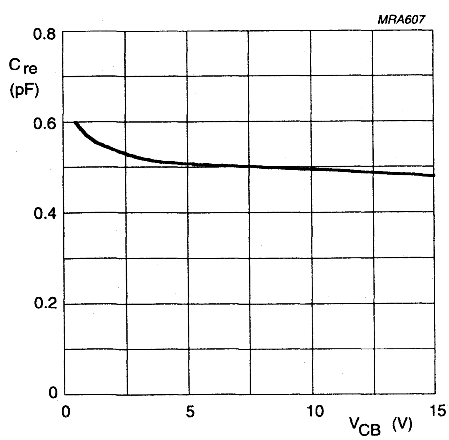


Fig.2 Power derating curve.



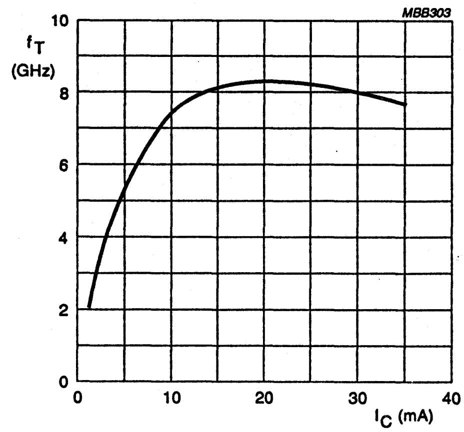
V_{CE} = 5 V.

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.

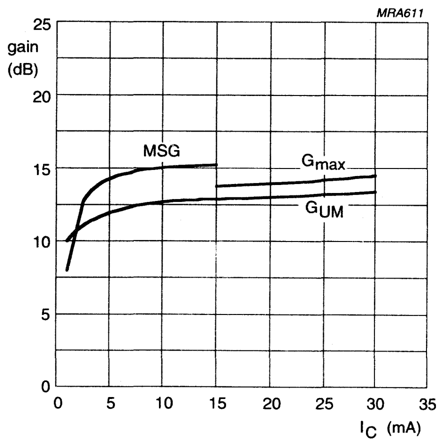


V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz.

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

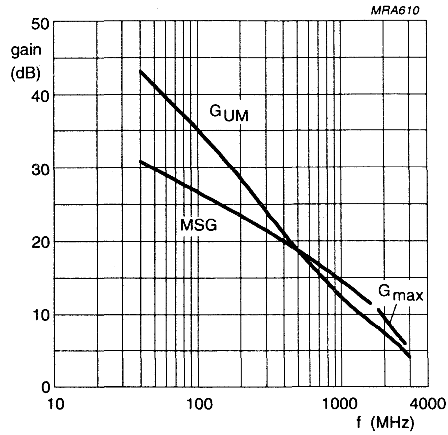
NPN 8 GHz wideband transistor BFQ67

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



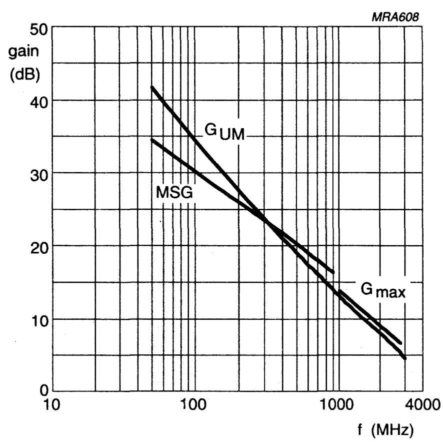
V_{CE} = 8 V; f = 1 GHz.

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



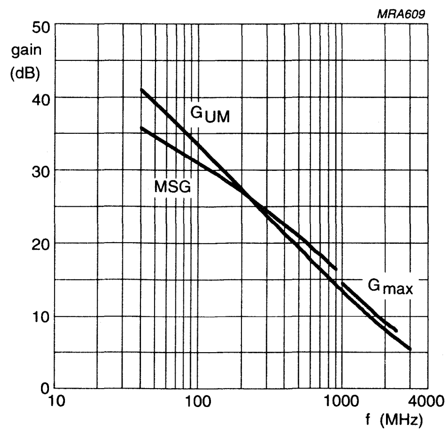
V_{CE} = 8 V; I_C = 5 mA.

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



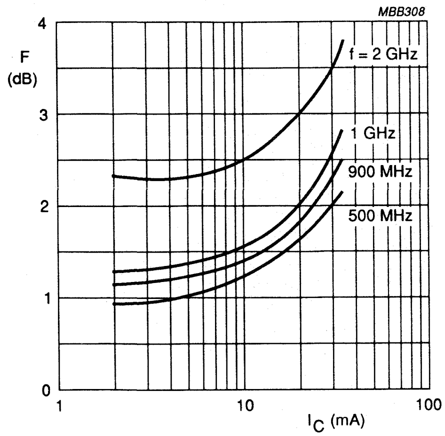
V_{CE} = 8 V; I_C = 15 mA.

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



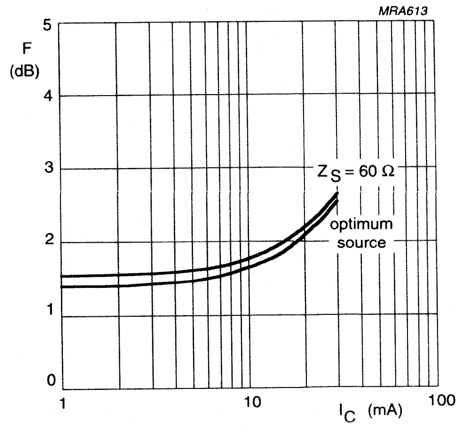
V_{CE} = 8 V; I_C = 30 mA.

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



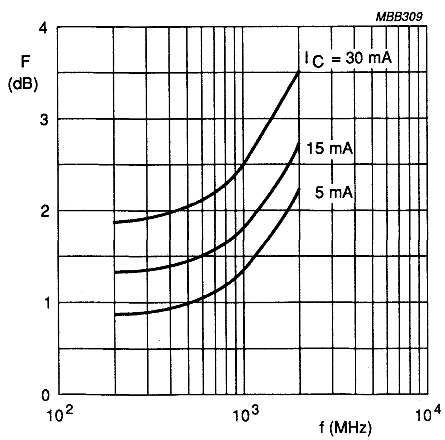
V_{CE} = 8 V.

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



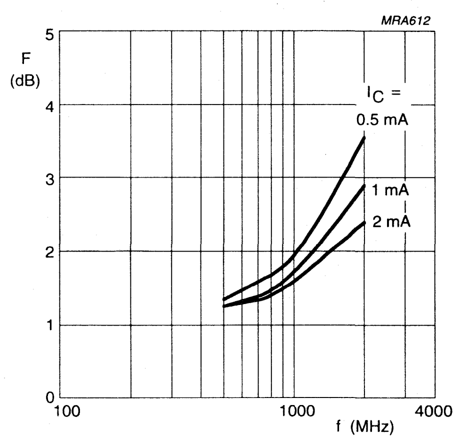
V_{CE} = 6 V; f = 900 MHz.

Fig.11 Noise figure as a function of collector current, typical values.



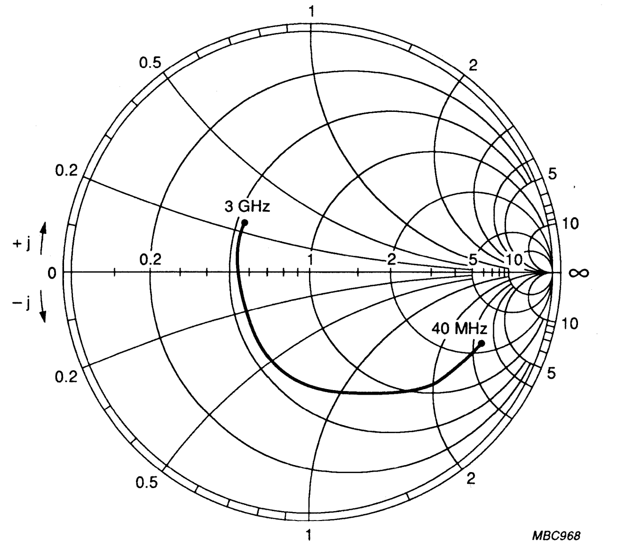
V_{CE} = 8 V.

Fig.12 Minimum noise figure as a function of frequency, typical values.



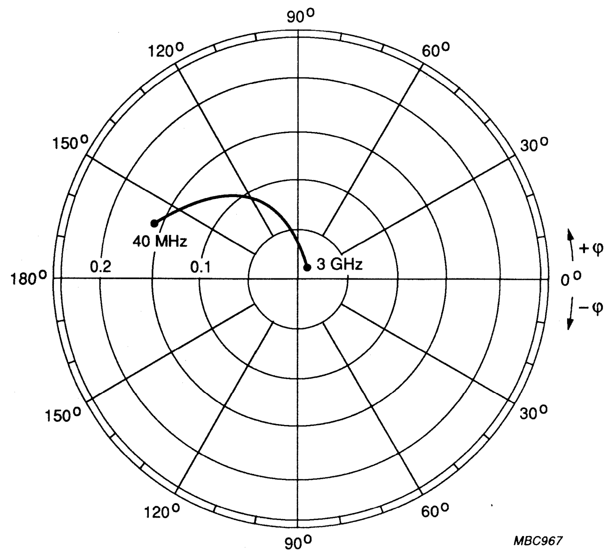
V_{CE} = 1 V.

Fig.13 Minimum noise figure as a function of frequency, typical values.



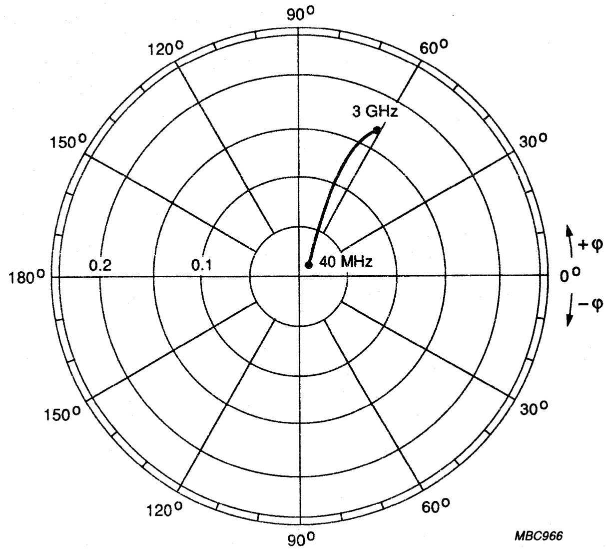
V_{CE} = 8 V; I_C = 15 mA.
Z_o = 50 Ω.

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



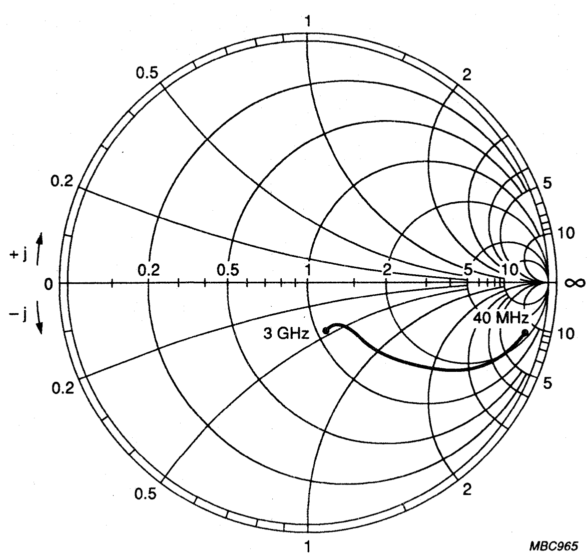
V_{CE} = 8 V; I_C = 15 mA.

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.

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.

PINNING

PIN	DESCRIPTION
	Code: V2
1	base
2	emitter
3	collector

PIN CONFIGURATION

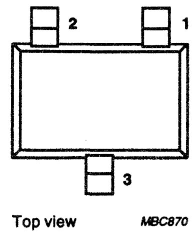


Fig.1 SOT323.

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	–	–	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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

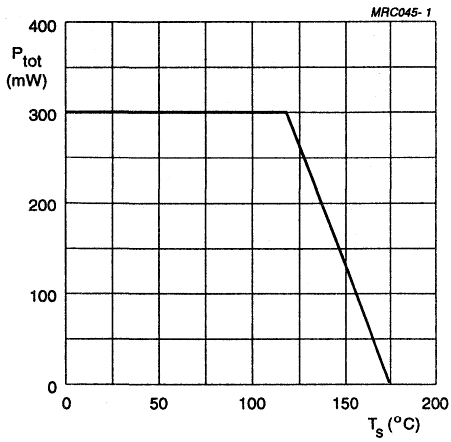
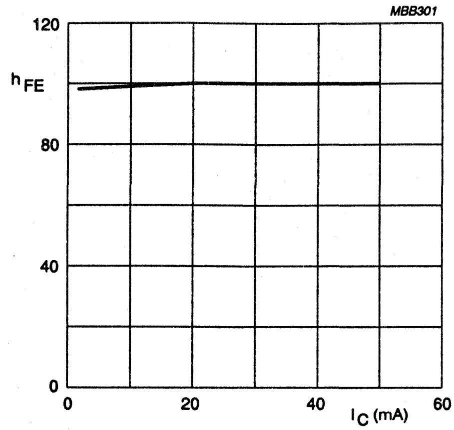
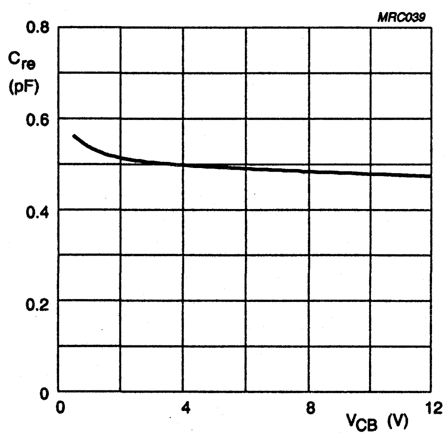


Fig.2 Power derating curve.



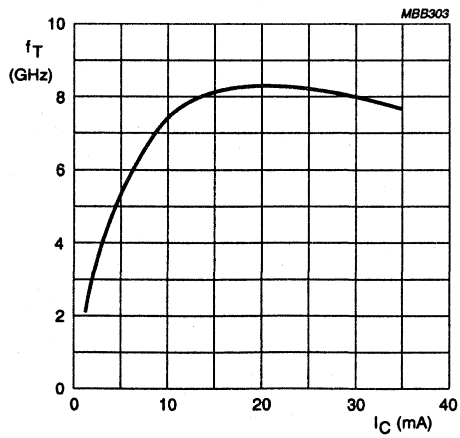
V_{CE} = 5 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

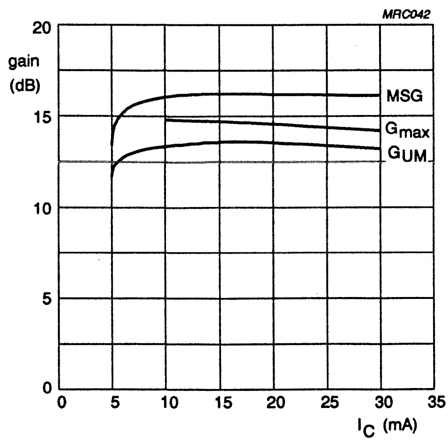
Fig.4 Feedback capacitance as a function of collector-base voltage.



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

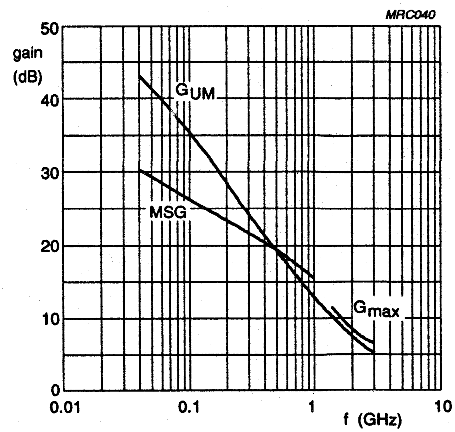
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



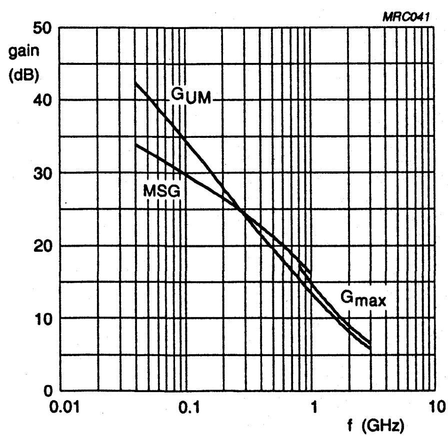
V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



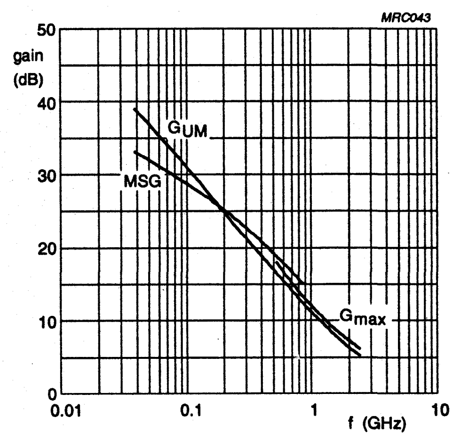
I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



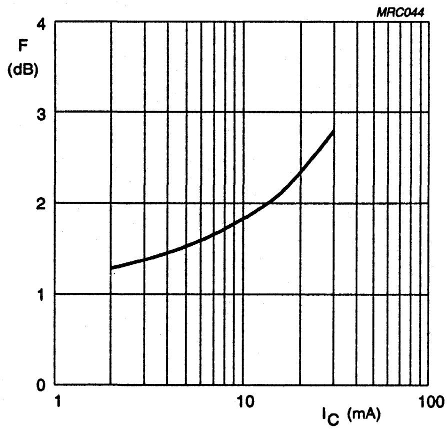
I_C = 15 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



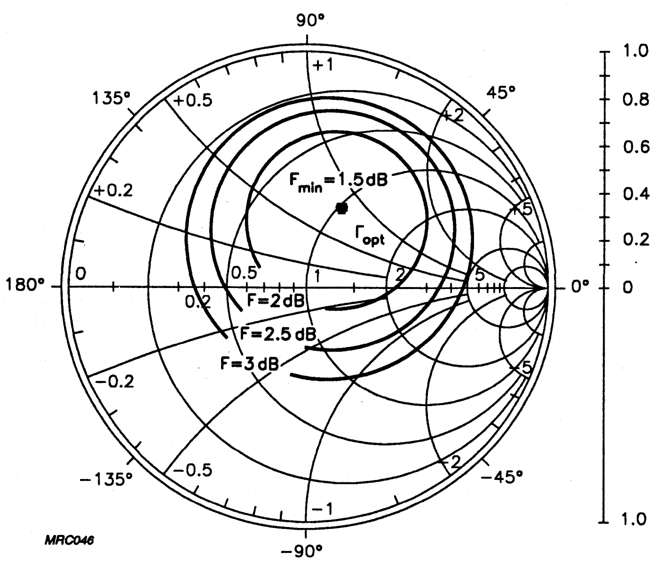
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



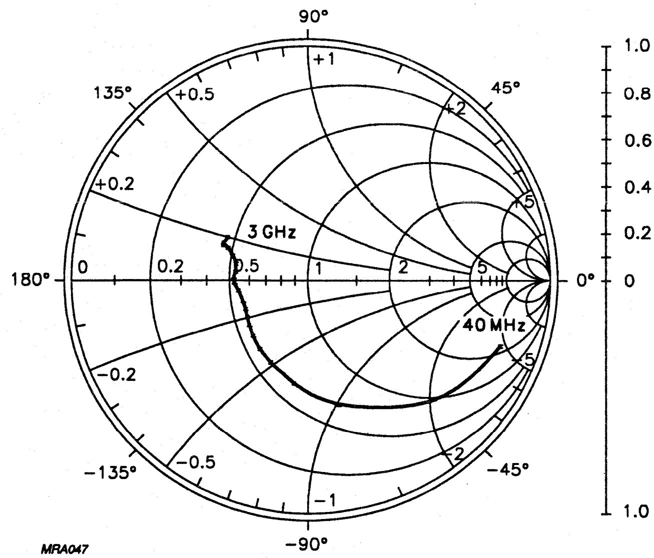
V_{CE} = 8 V; f = 1 GHz.

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



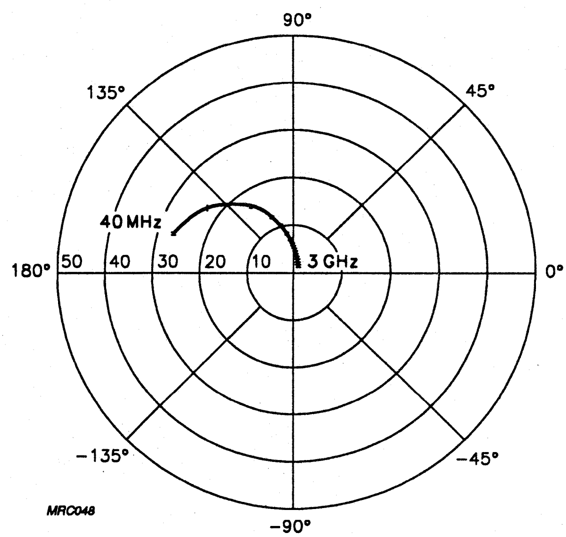
I_C = 5 mA; V_{CE} = 8 V;
f = 1 GHz; Z_o = 50 Ω.

Fig.11 Noise circle.



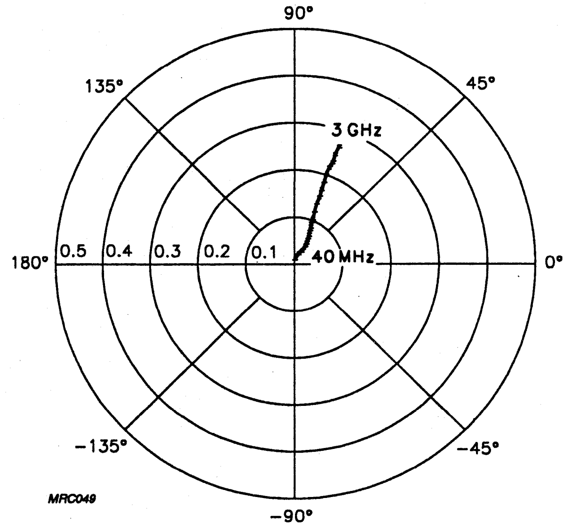
I_C = 15 mA; V_{CE} = 8 V; Z_O = 50 Ω.

Fig.12 Common emitter input reflection coefficient (S_{11}).



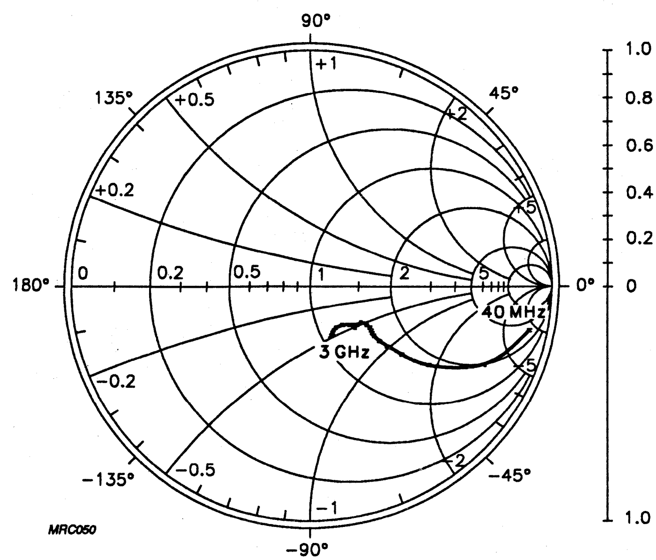
I_C = 15 mA; V_{CE} = 8 V.

Fig.13 Common emitter forward transmission coefficient (S_{21}).



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

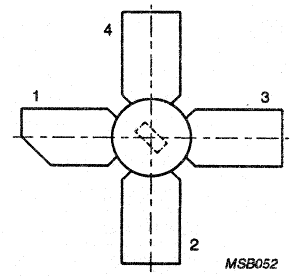


Fig.1 SOT122A.

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 Ω; $f_{(p+q-r)}$ = 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 Ω; 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 Ω; 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

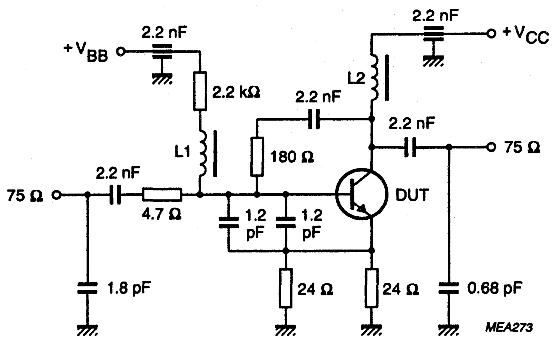
CHARACTERISTICS

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; $R_L = 75$ Ω; $T_{amb} = 25$ °C; measured at f = 800 MHz	–	28	–	dBm
ITO	third order intercept point (see Fig.2)	note 4	–	47	–	dBm

Notes

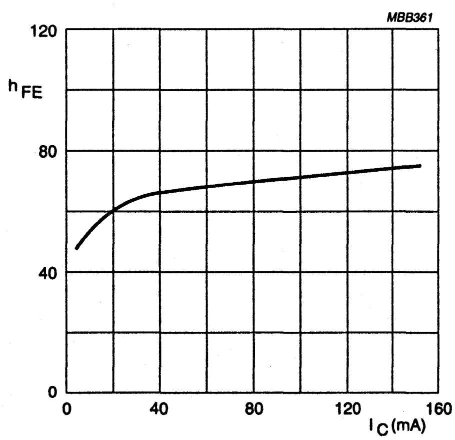
1. Measured with emitter and base grounded.
2. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
3. $d_{im} = -60$ dB (see Figs 2 and 7) (DIN 45004B); $I_C = 240$ mA; $V_{CE} = 15$ V; $R_L = 75$ Ω; $T_{amb} = 25$ °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; $R_L = 75$ Ω; $T_{amb} = 25$ °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.

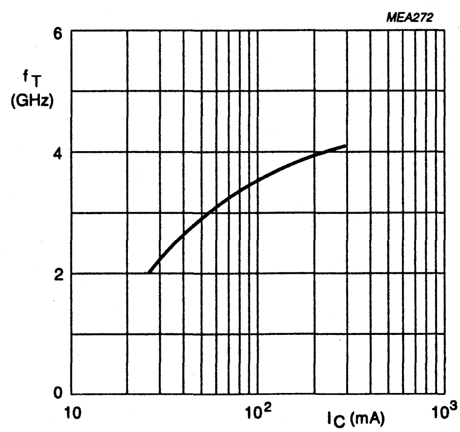
L1 = L2 = 5 μH Ferroxcube choke.

Fig.2 Intermodulation distortion MATV test circuit.



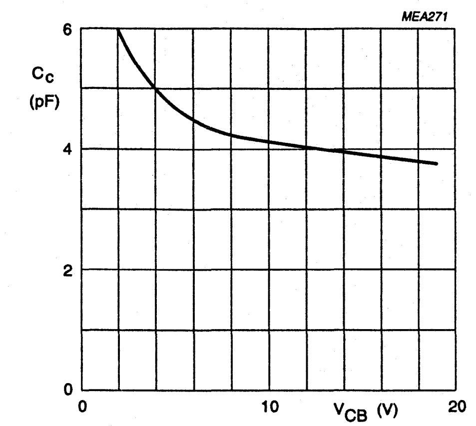
V_{CE} = 10 V; T_j = 25 °C.

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



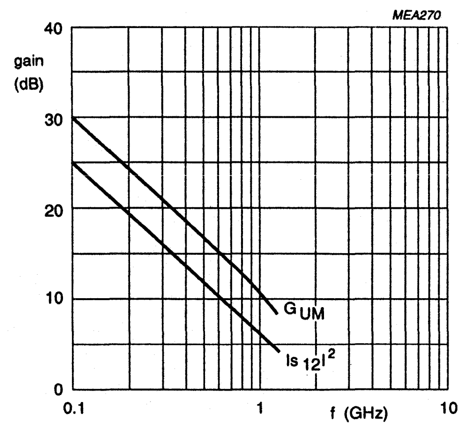
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C

Fig.4 Transition frequency as a function of collector current.



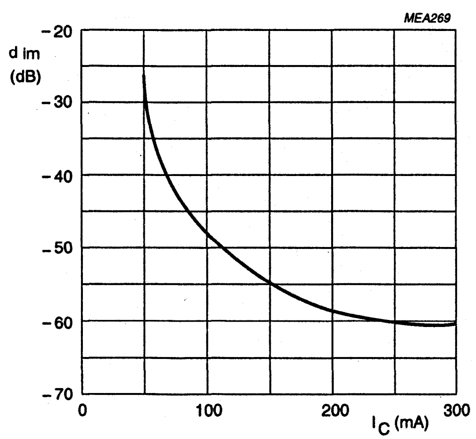
$I_E = i_e = 0$; f = 1 MHz

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



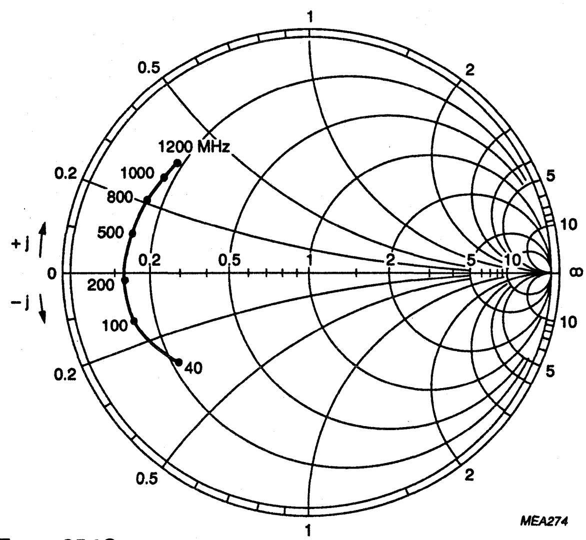
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C

Fig.6 Gain as a function of frequency.



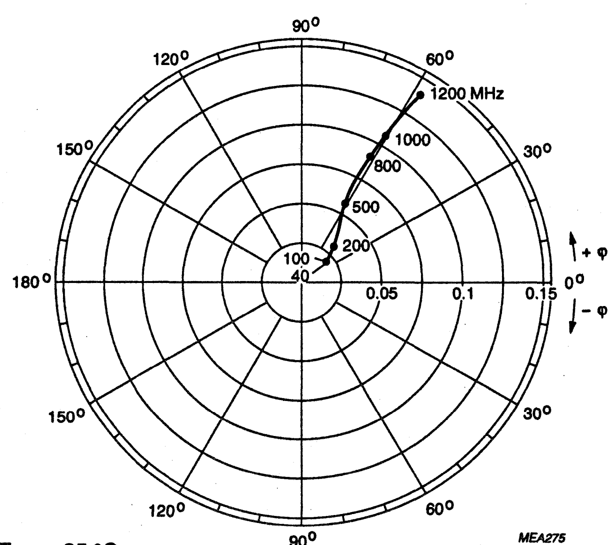
V_{CE} = 15 V; V_O = 1.6 V; $f_{(p+q-r)}$ = 793.25 MHz.

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



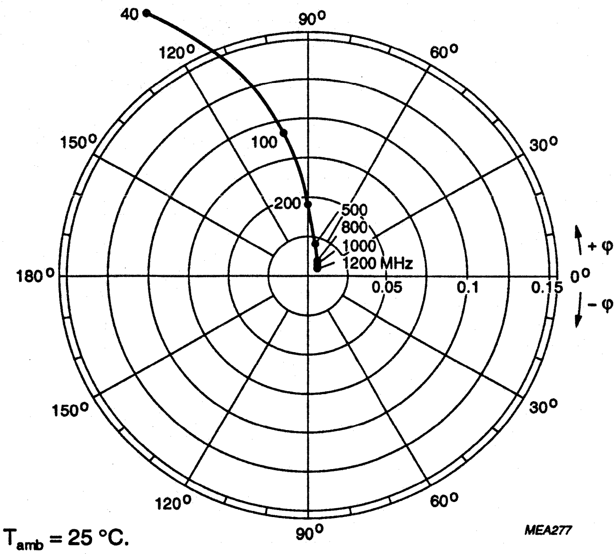
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



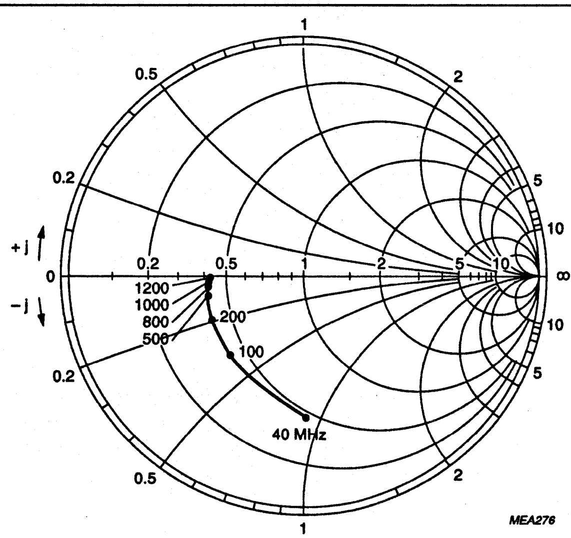
I_C = 240 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

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

DESCRIPTION

NPN transistor in a 4-lead dual-emitter SOT172A2 envelope with a ceramic cap. All leads are isolated from the mounting base.

It is primarily intended for use in MATV and microwave amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

Emitter-ballasting resistors and application of gold sandwich metallization ensure an optimum temperature profile and excellent reliability properties.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

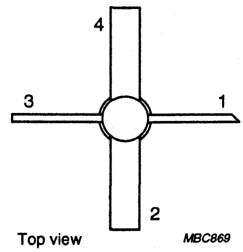


Fig.1 SOT172A2.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	19	V
I_C	DC collector current		–	–	150	mA
P_{tot}	total power dissipation	up to T_c = 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} = -60dB; I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	–	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 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		–	150	mA
P_{tot}	total power dissipation	up to T_c = 145 °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	20 K/W

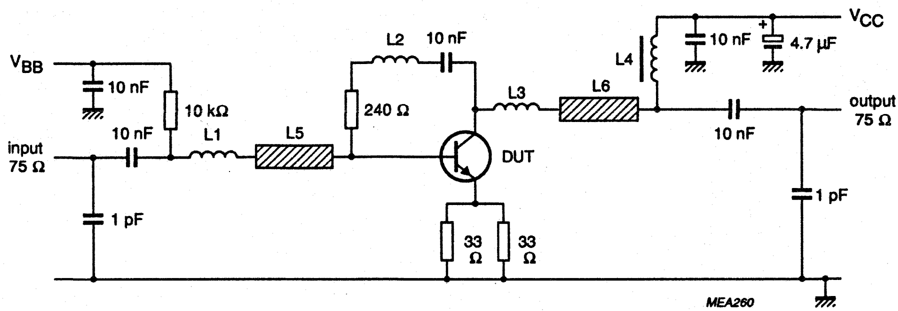
CHARACTERISTICS

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	–	–	
f_T	transition frequency	I_C = 120 mA; V_{CE} = 18 V; f = 1 GHz; T_{amb} = 25 °C	–	6.5	–	GHz
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
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

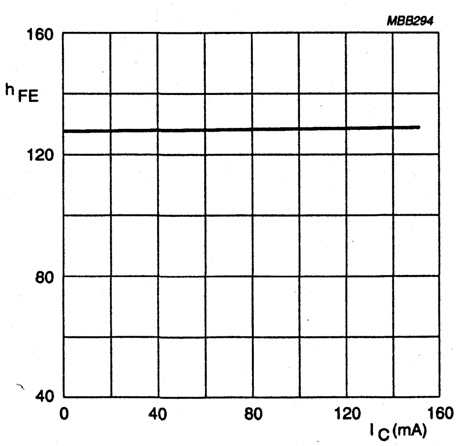
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. d_{im} = –60 dB (DIN45004B); I_C = 120 mA; V_{CE} = 18 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.
3. d_{im} = –60 dB (DIN 45004B); I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; 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 = 90 mA; V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 450 MHz; f_p = 50 MHz; f_q = 400 MHz.
5. I_C = 90 mA; V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 810 MHz; f_p = 250 MHz; f_q = 560 MHz.



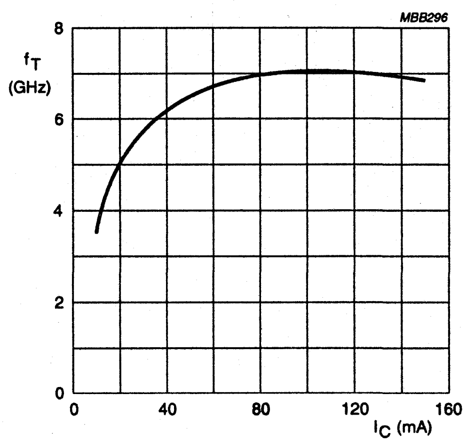
L1 = 8 nH
L2 = 15 nH (2 turns copper wire, internal diameter 2 mm)
L3 = 10 nH (2 turns copper wire, internal diameter 1.5 mm)
L5: Lp = 21 mm; Rc = 75 Ω
L6: Lp = 16 mm; Rc = 75 Ω

Fig.2 Intermodulation distortion test circuit.



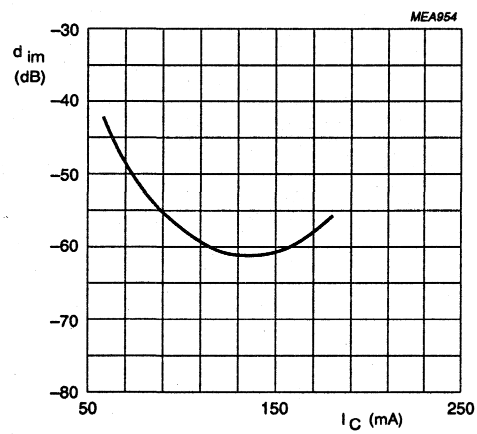
V_{CE} = 18 V; T_{amb} = 25 °C.

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



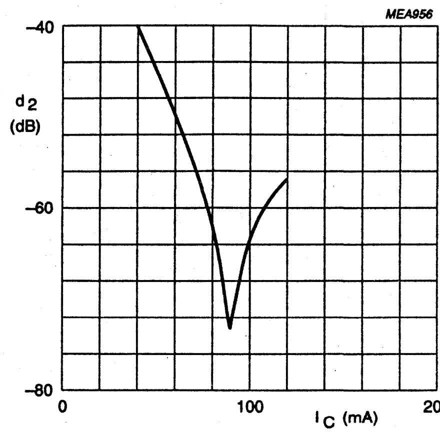
V_{CE} = 18 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.4 Transition frequency as a function of collector current.



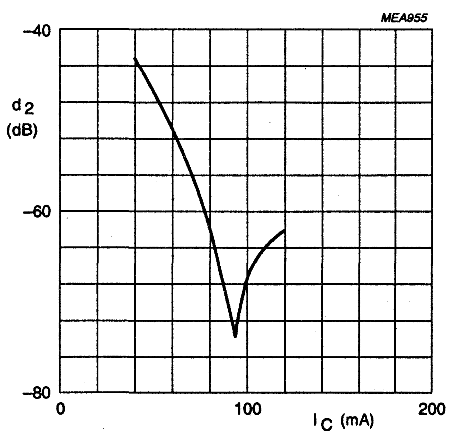
V_{CE} = 18 V.

Fig.5 Intermodulation distortion as a function of collector current.



V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C; measured at $f_{(p+q)}$ = 450 MHz.

Fig.6 Second order intermodulation distortion as a function of collector current.



V_{CE} = 18 V; V_O = 50 dBmV; T_{amb} = 25 °C; measured at $f_{(p+q)}$ = 810 MHz.

Fig.7 Second order intermodulation distortion as a function of collector current.

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

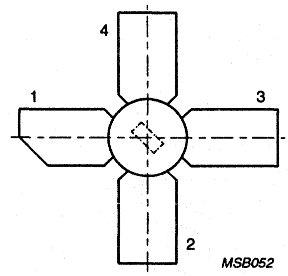


Fig.1 SOT122A.

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
3. d_{im} = –60 dB; I_C = 500 mA; V_{CE} = 15 V; R_L = 75 Ω; 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.

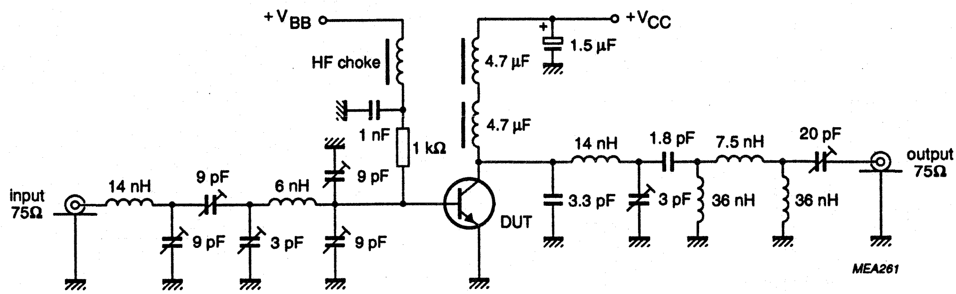
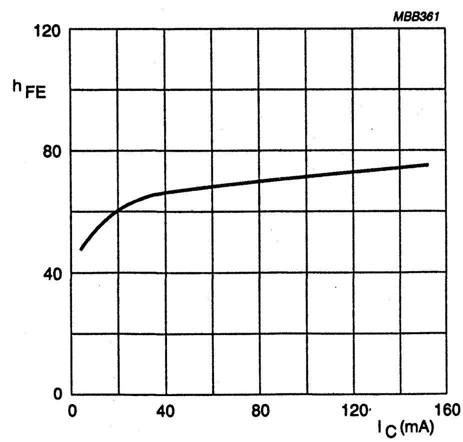
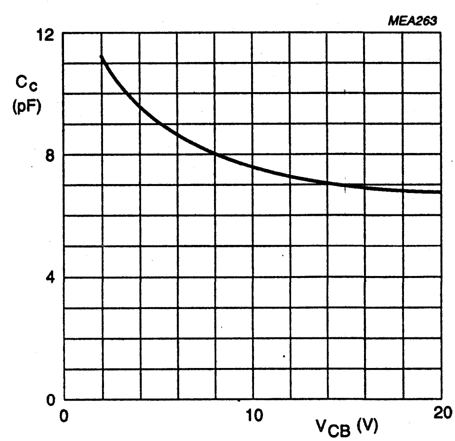


Fig.2 Intermodulation distortion MATV test circuit.



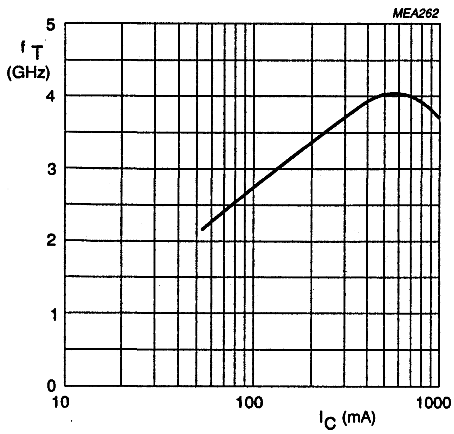
V_{CE} = 15 V; T_j = 25 °C.

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



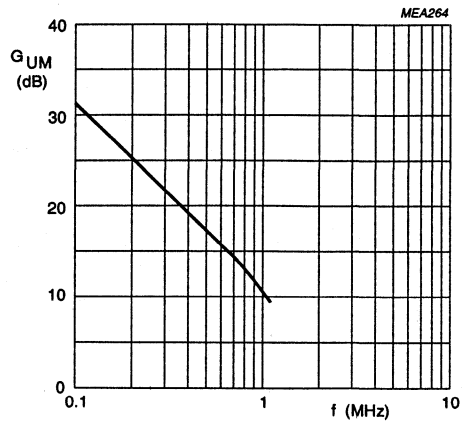
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C

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



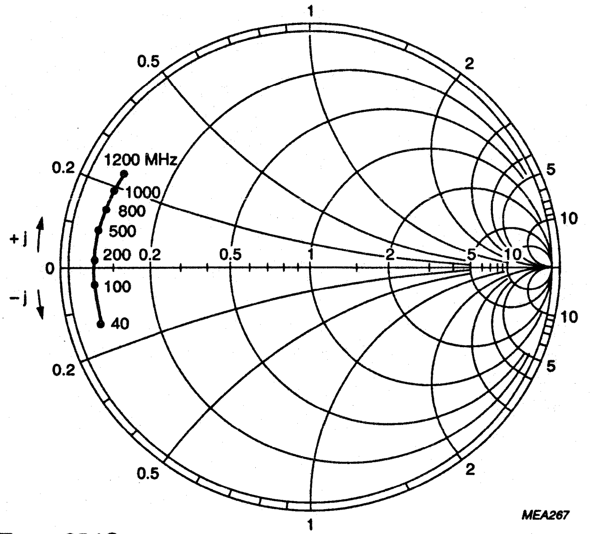
V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C

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



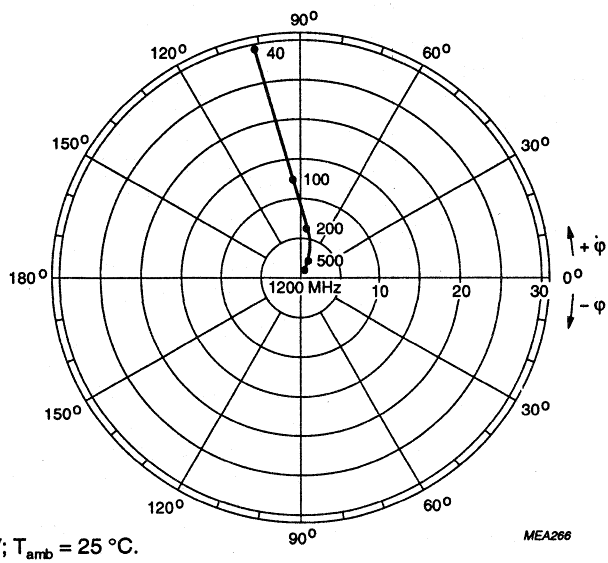
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of frequency.



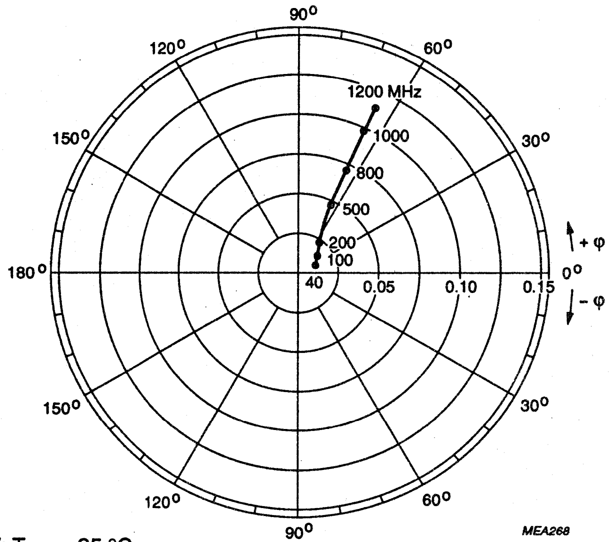
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.7 Common emitter input reflection coefficient (S_{11}).



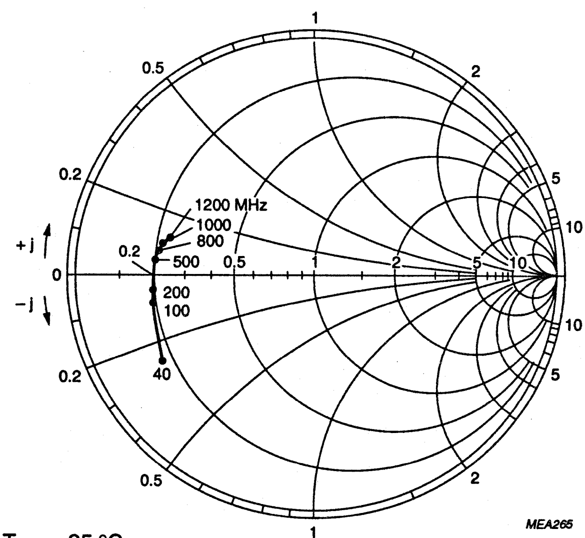
I_C = 500 mA; V_{CE} = 15 V; T_{amb} = 25 °C.

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 analyzers, etc., using SMD technology.

PINNING

PIN	DESCRIPTION
Code: FG	
1	emitter
2	base
3	collector

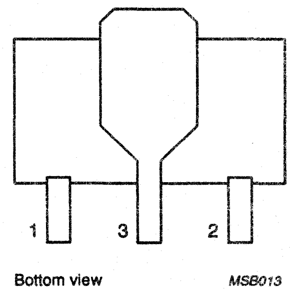


Fig.1 SOT89.

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_{amb} = 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.

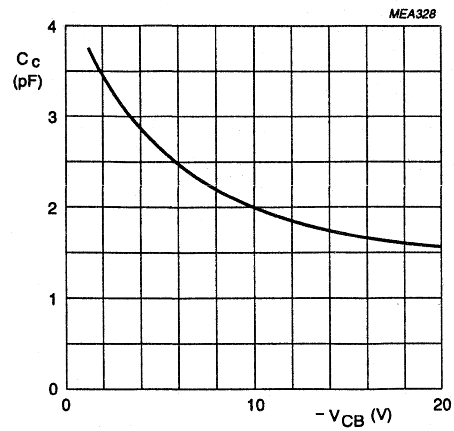
CHARACTERISTICS

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

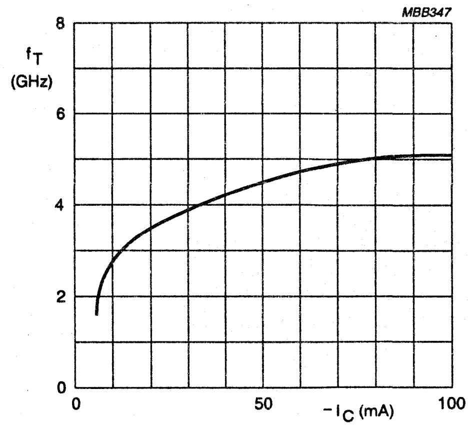
Note

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



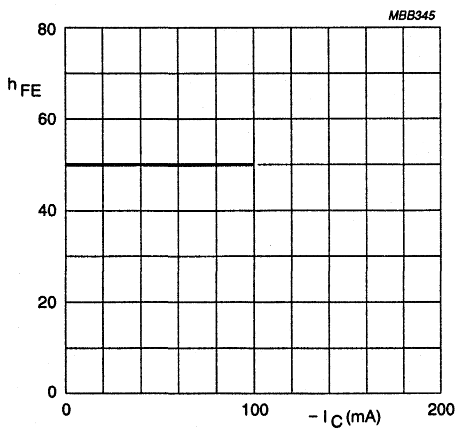
$I_E = 0$; f = 1 MHz; T_j = 25 °C.

Fig.2 Collector capacitance as a function of collector-base voltage.



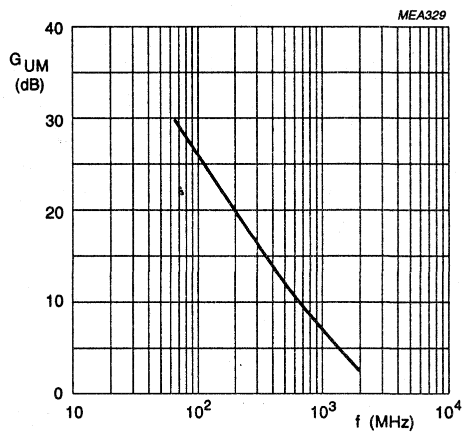
V_{CE} = −10 V; f = 500 MHz; T_{amb} = 25 °C.

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 SOT172A2 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

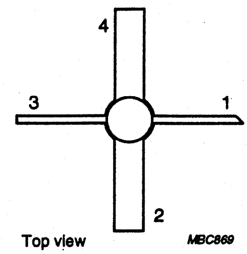


Fig.1 SOT172A1.

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 Ω; $f_{(p+q-r)}$ = 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

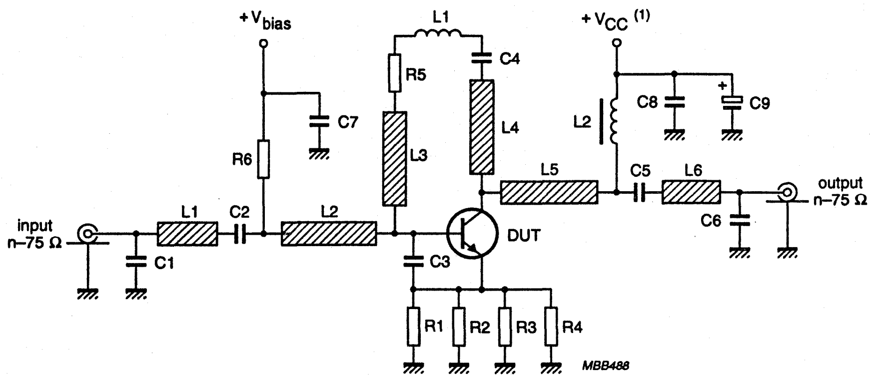
CHARACTERISTICS

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. d_{im} = –60 dB (DIN 45004); I_C = 240 mA; V_{CE} = 18 V; R_L = 75 Ω;
   $V_p = V_O$; 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 Ω;
   $V_p = V_q = V_O$ = 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) x 17.

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

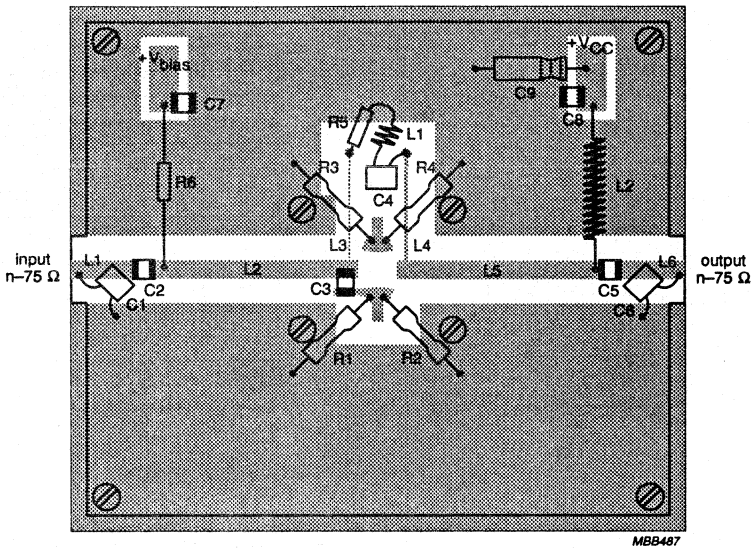
List of components (see test circuit)

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

Notes

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).

1. Components C4, L1, and R5 are mounted in a cavity in the brass ground plate.



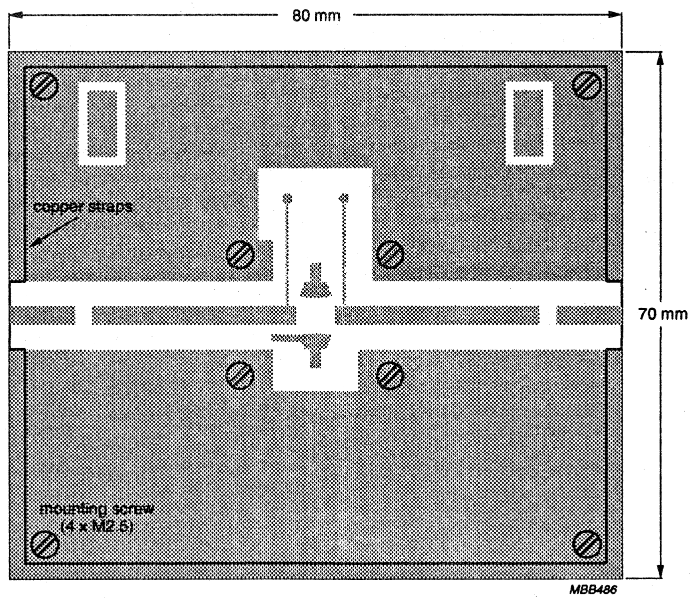


Fig.3 Intermodulation test circuit printed circuit board.

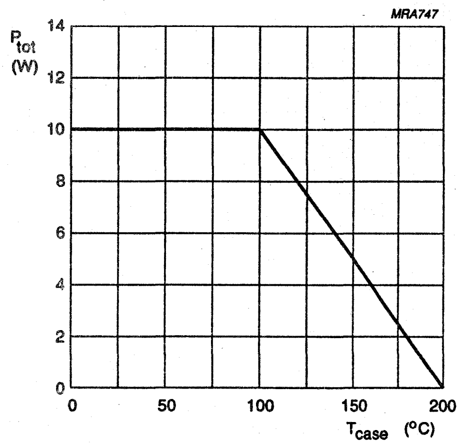
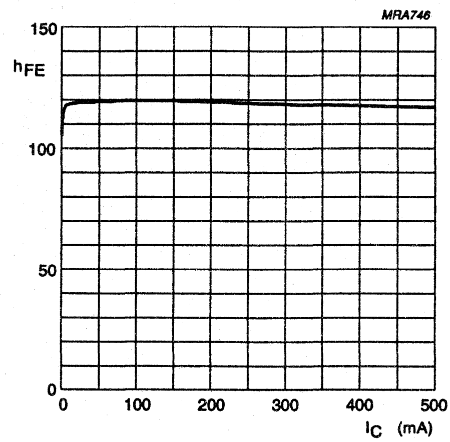
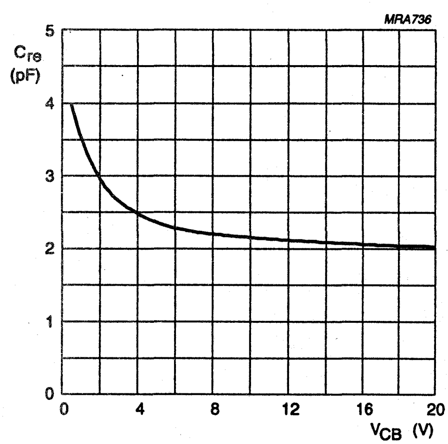


Fig.4 Power derating curve.



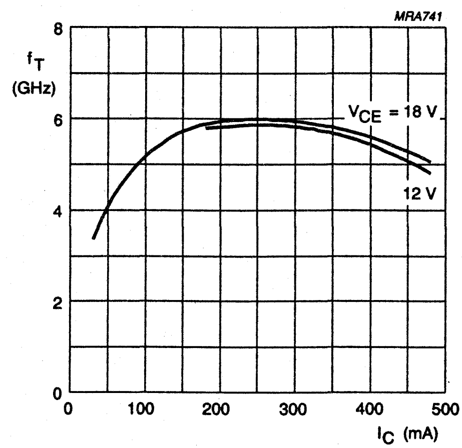
V_{CE} = 18 V; T_j = 25 °C.

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



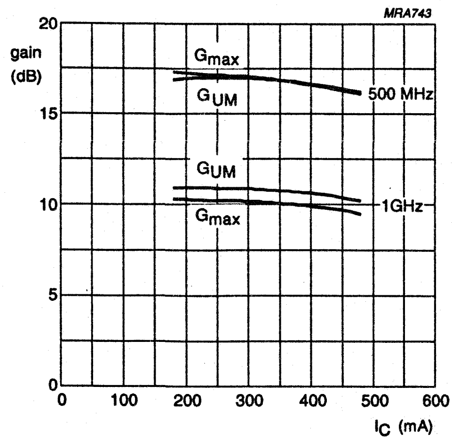
I_C = 0; f = 1 MHz.

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



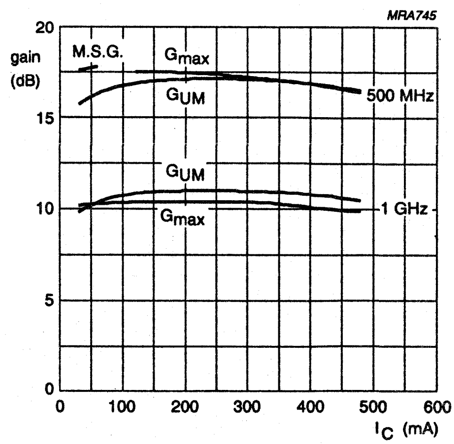
f = 1 GHz; T_{amb} = 25 °C.

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



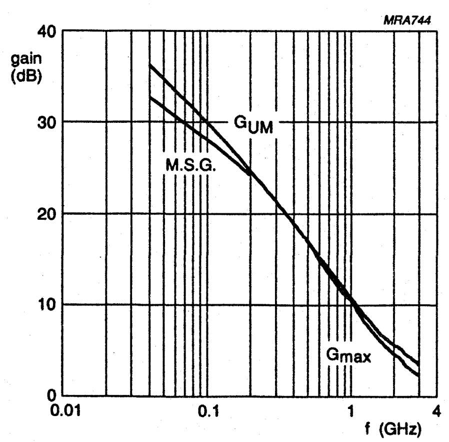
V_{CE} = 12 V.

Fig.8 Gain as a function of collector current.



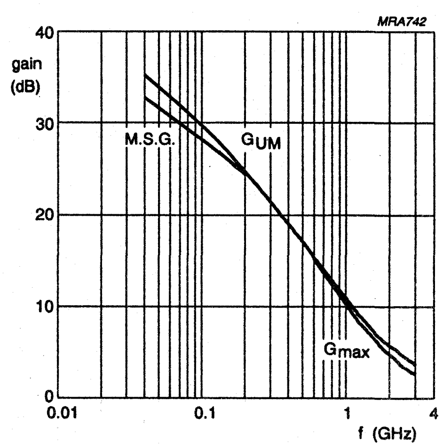
V_{CE} = 18 V.

Fig.9 Gain as a function of collector current.



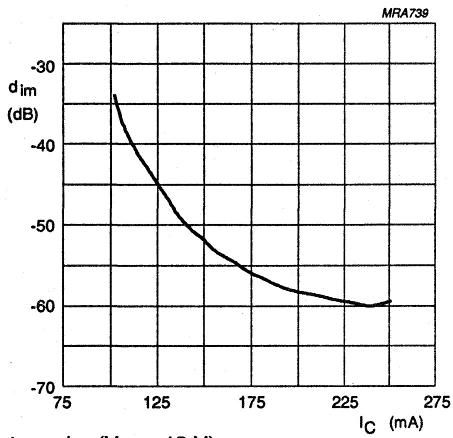
I_C = 240 mA; V_{CE} = 12 V.

Fig.10 Gain as a function of frequency.



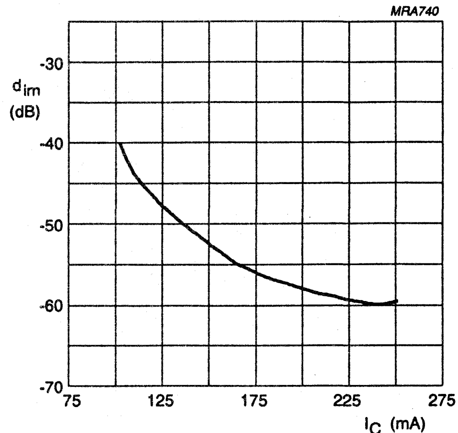
I_C = 240 mA; V_{CE} = 18 V.

Fig.11 Gain as a function of frequency.



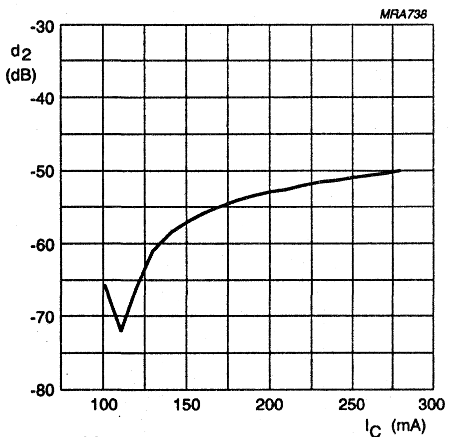
3-tone d_{im}; (V_{CE} = 18 V);
f_p = 445.25 MHz; V_O = 65.11 dBmV (1.8 V);
f_q = 453.25 MHz; V_O = 59.11 dBmV;
f_r = 455.25 MHz; V_O = 59.11 dBmV;
$f_{(p+q-r)}$ = 443.25 MHz.

Fig.12 Intermodulation distortion as a function of collector current.



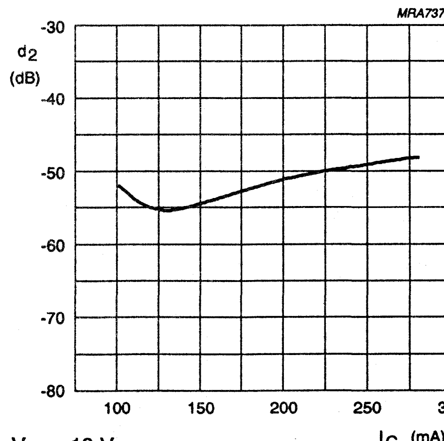
3-tone d_{im}; (V_{CE} = 18 V);
f_p = 795.25 MHz; V_O = 64.08 dBmV (1.6 V);
f_q = 803.25 MHz; V_O = 58.08 dBmV;
f_r = 805.25 MHz; V_O = 58.08 dBmV;
$f_{(p+q-r)}$ = 793.25 MHz.

Fig.13 Intermodulation distortion as a function of collector current.



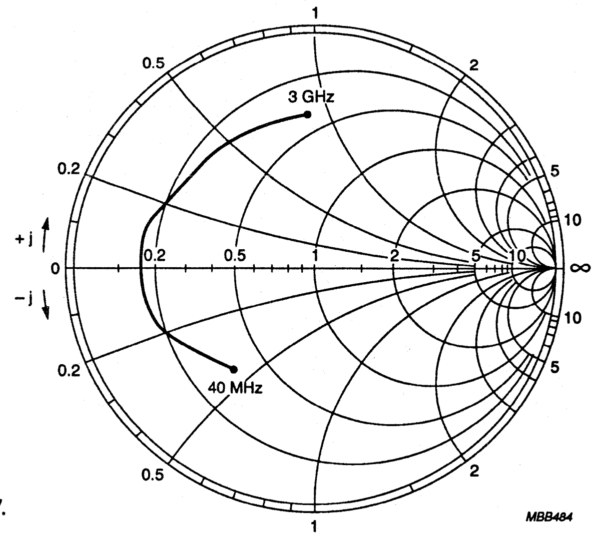
V_{CE} = 18 V;
f_p = 50 MHz; V_O = 50.5 dBmV (0.335 V);
f_q = 400 MHz; V_O = 50.5 dBmV;
$f_{(p+q)}$ = 450 MHz.

Fig.14 Second order intermodulation distortion as a function of collector current.



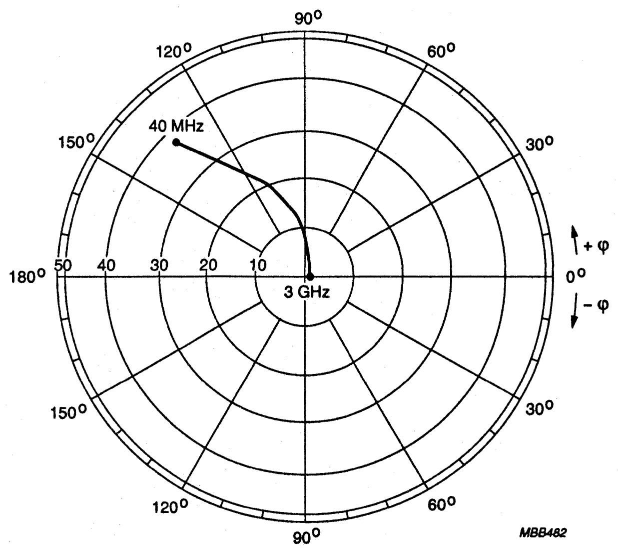
V_{CE} = 18 V;
f_p = 250 MHz; V_O = 50.5 dBmV (0.335 V);
f_q = 560 MHz; V_O = 50.5 dBmV;
$f_{(p+q)}$ = 810 MHz.

Fig.15 Second order intermodulation distortion as a function of collector current.



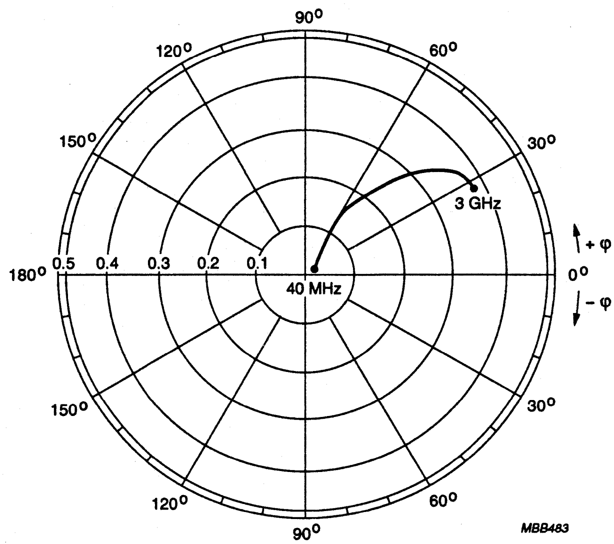
I_C = 240 mA; V_{CE} = 18 V.
Z_o = 50 Ω.

Fig.16 Common emitter input reflection coefficient (S_{11}).



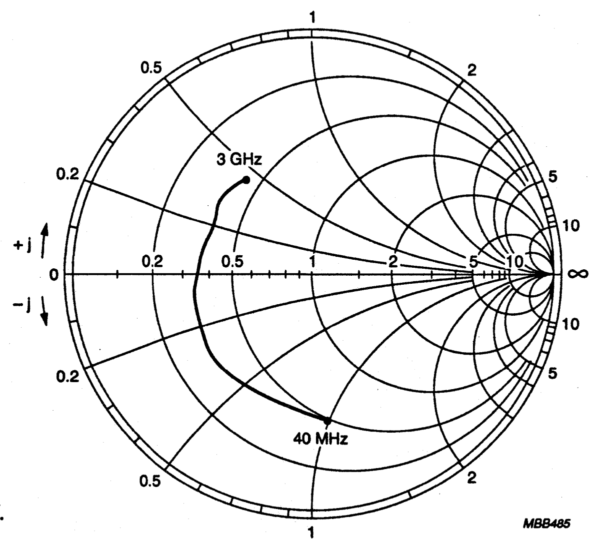
I_C = 240 mA; V_{CE} = 18 V.

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 9 GHz wideband 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

Silicon NPN transistor in a plastic SOT89 package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

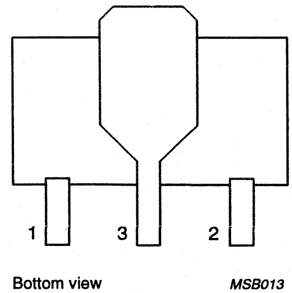


Fig.1 SOT89.

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	–	–	12	V
V_{EBO}	collector-base voltage	open collector	–	–	2	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to T_s = 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.

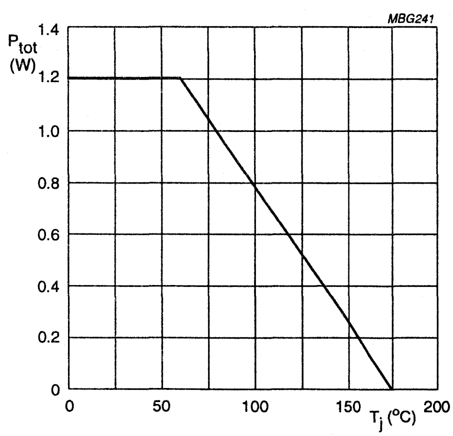
LIMITING VALUES

In accordance with the Absolute Maximum 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	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to $T_s = 60$ °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	up to $T_s = 60$ °C; $P_{tot} = 1.2$ W	95	K/W



$V_{CE} \leq 9$ V.

Fig.2 Power derating curve.

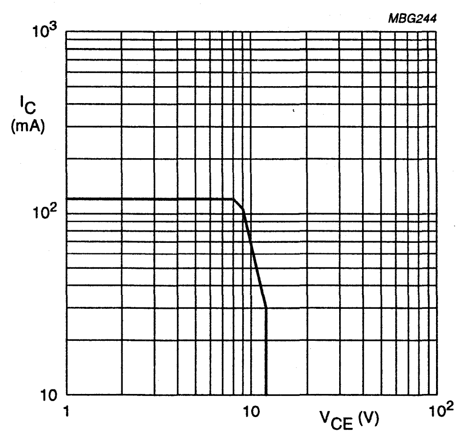


Fig.3 SOAR.

CHARACTERISTICS

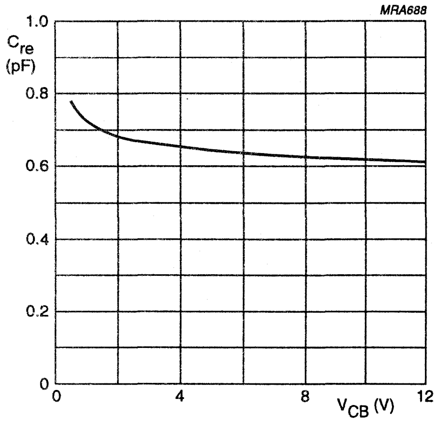
T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 10 μA; I_E = 0	–	–	20	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0	–	–	12	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 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

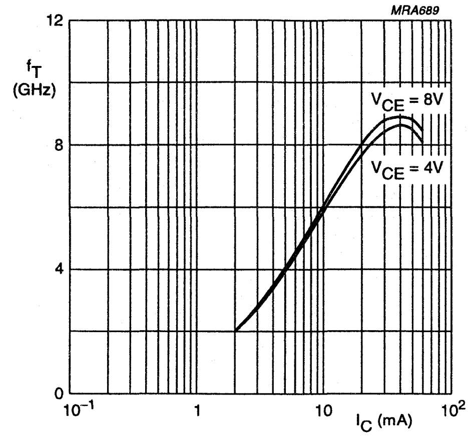
1. d_{im} = –60 dB (DIN45004B); V_{CE} = 8 V; I_C = 40 mA; R_L = 50 Ω;
   $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB;
   f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.5 MHz;
   measured at $f_{(p+q-r)}$ = 793.25 MHz.
2. d_{im} = –60 dB (DIN 45004B); I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω;
   $V_p = V_q = V_o$; f_p = 806 MHz; f_q = 810 MHz;
   measured at $f_{(2p-q)}$ = 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 $f_{(p+q)}$ = 810 MHz.

NPN 9 GHz wideband transistor — BFQ540



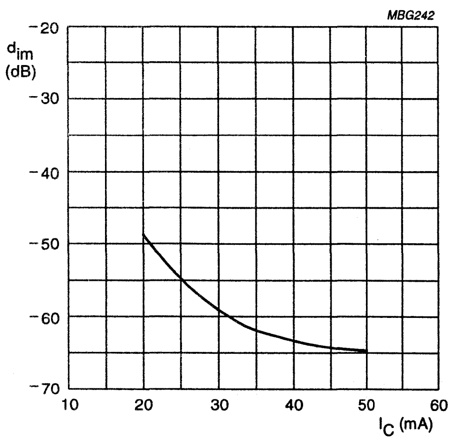
I_C = 0; f = 1 MHz.

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



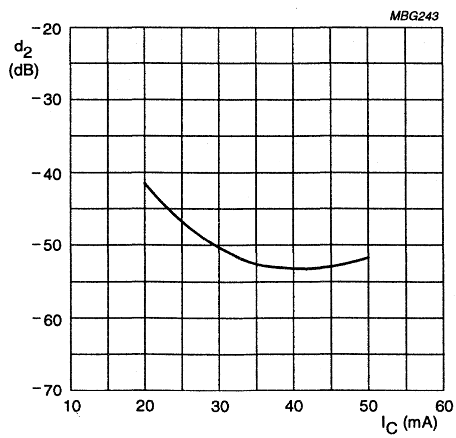
f = 1 GHz; T_{amb} = 25 °C.

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



V_{CE} = 8 V; V_o = 475 mV; R_L = 50 Ω.
$f_{(p+q-r)}$ = 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 Ω; $f_{(p+q)}$ = 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.

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.

APPLICATIONS

It is primarily intended for use in MATV and microwave amplifiers, such as aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

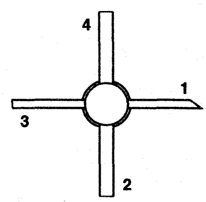


Fig.1 SOT172A2.

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

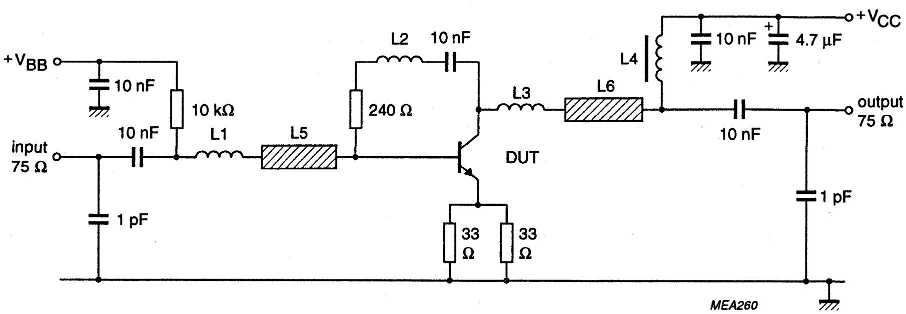
CHARACTERISTICS

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

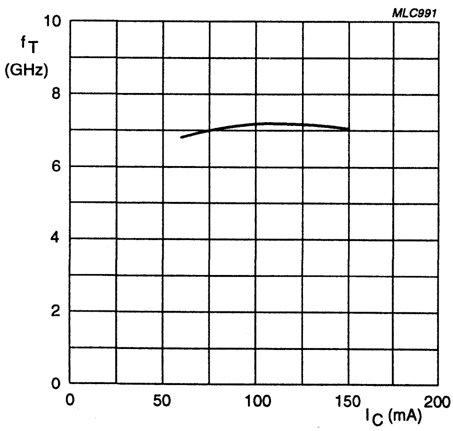
Notes

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.



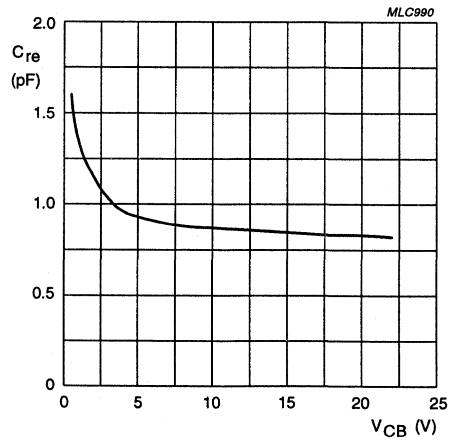
L1 = 8 nH.
L2 = 15 nH, 2 turns copper wire, internal diameter 2 mm.
L3 = 10 nH, 2 turns copper wire, internal diameter 1.5 mm.
L5: Lp = 21 mm; Rc = 75 Ω.
L6: Lp = 16 mm; Rc = 75 Ω.

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



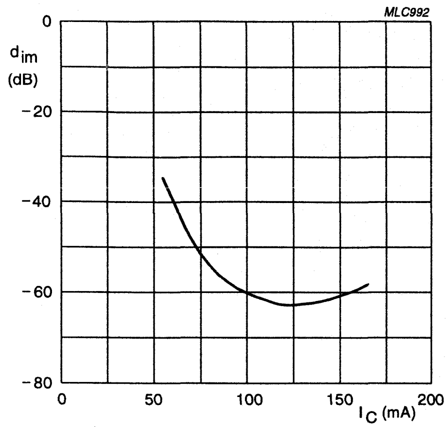
V_{CE} = 18 V; f = 1 GHz.

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



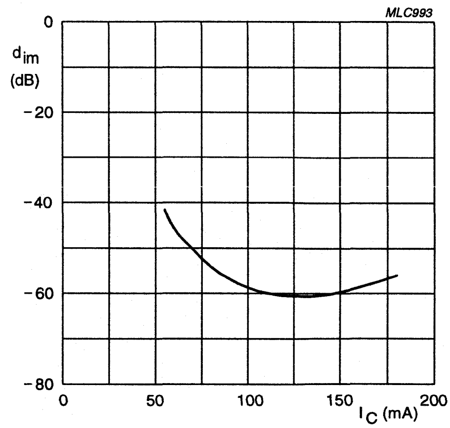
I_C = 0; f = 1 MHz.

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



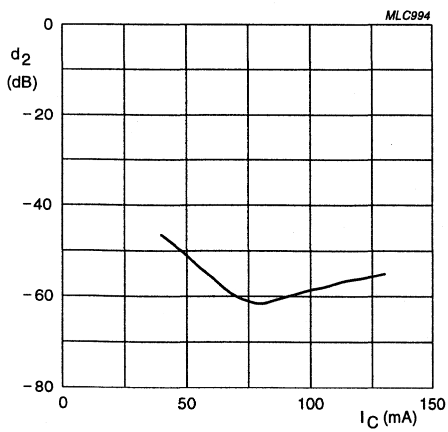
V_O = 1.35 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 443.25 MHz; see Fig.2.

Fig.5 Intermodulation distortion as a function of collector current; typical values.



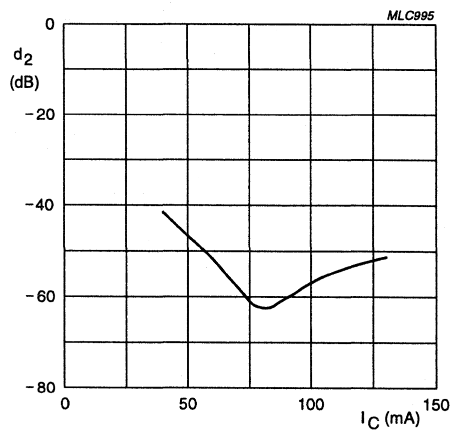
V_O = 1.2 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 793.25 MHz; see Fig.2.

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



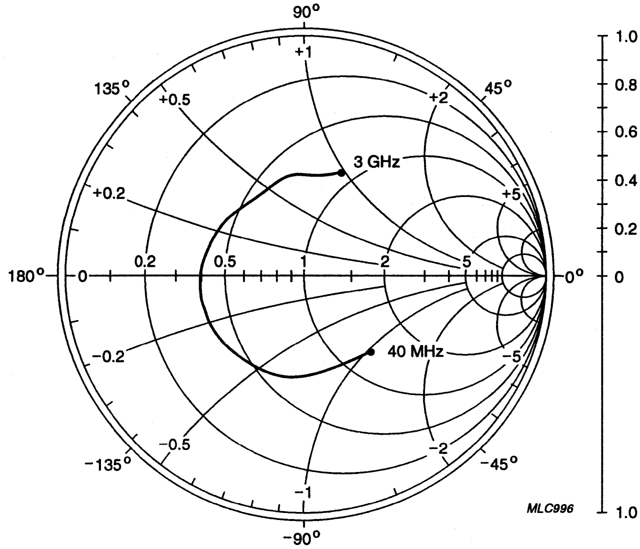
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 450 MHz; see Fig.2.

Fig.7 Second order distortion as a function of collector current; typical values.



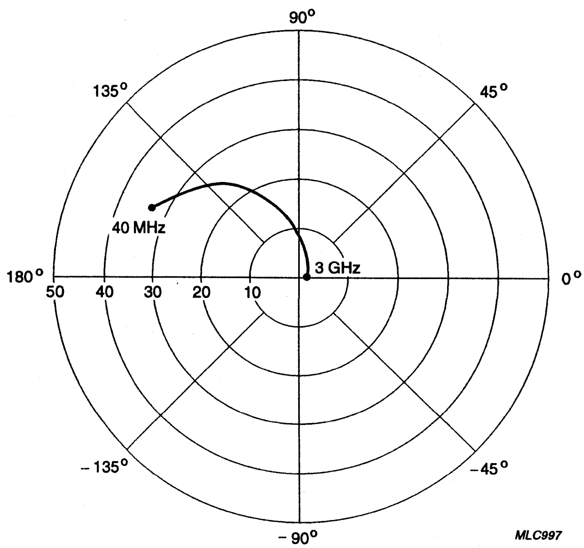
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 810 MHz; see Fig.2.

Fig.8 Second order distortion as a function of collector current; typical values.



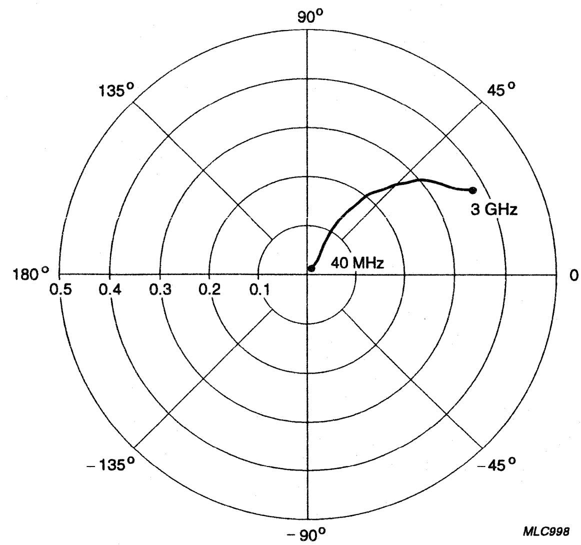
V_{CE} = 18 V; I_C = 120 mA; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (s_{11}); typical values.



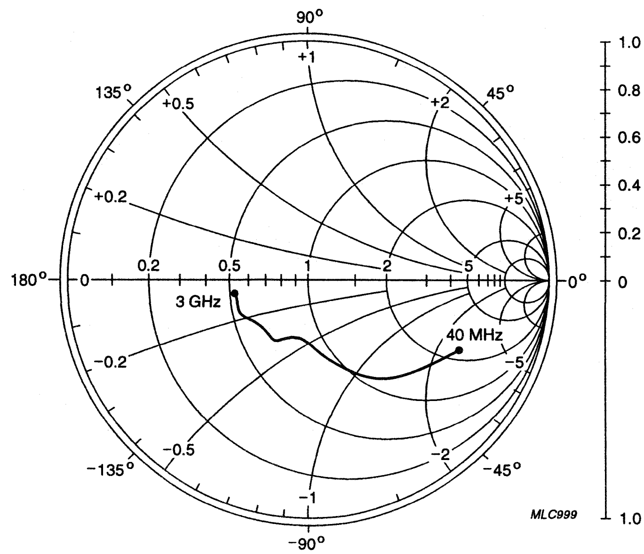
V_{CE} = 18 V; I_C = 120 mA.

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.

NPN 2 GHz wideband transistor | BFR53

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is intended for application in thick and thin-film circuits. The transistor has very low intermodulation distortion and very high power gain.

PINNING

PIN	DESCRIPTION
Code: N1	
1	base
2	emitter
3	collector

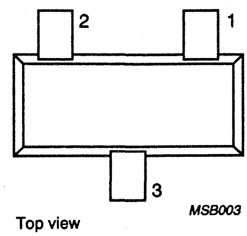


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	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	up to T_s = 110 °C; note 1	–	250	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	2	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	0.9	–	pF
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 System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	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	DC collector current		–	50	mA
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	up to T_s = 110 °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	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 110 °C; note 1	260 K/W

Note

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

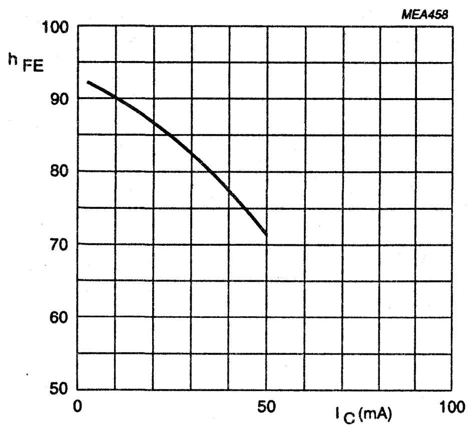
CHARACTERISTICS

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 = 25 mA; V_{CE} = 5 V	25	–	–	
		I_C = 50 mA; V_{CE} = 5 V	25	–	–	
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} = 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	–	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	–	10.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	–	5	dB

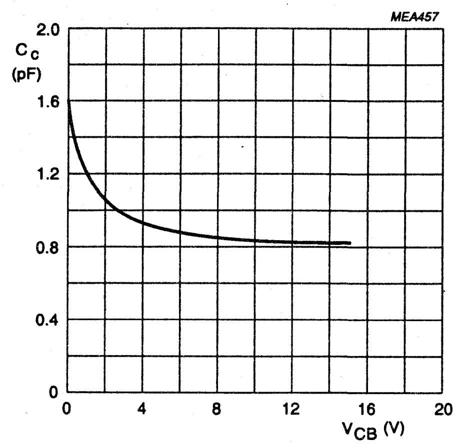
Note

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



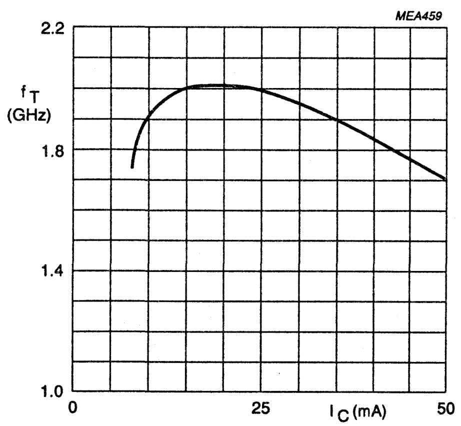
V_{CE} = 5 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



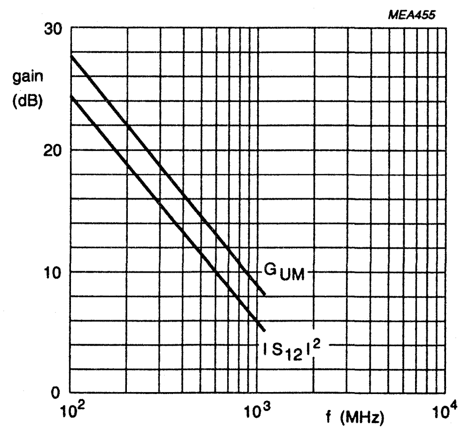
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C

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



V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

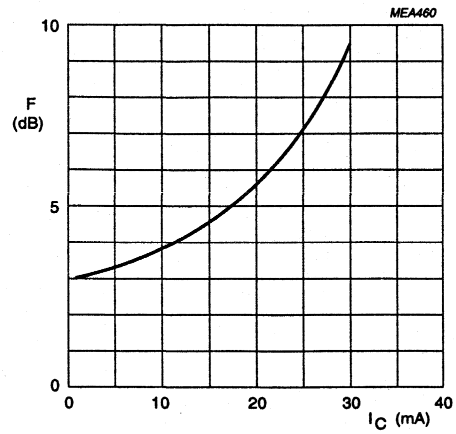
Fig.4 Transition frequency as a function of collector current.



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

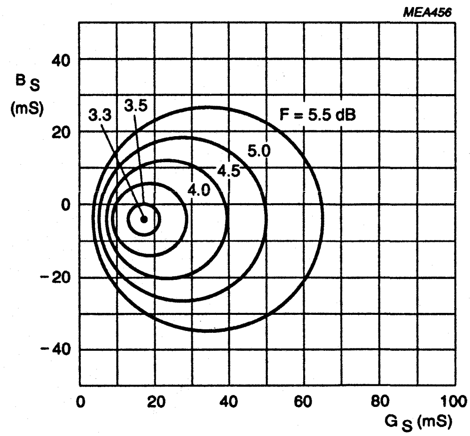
Fig.5 Gain as a function of frequency.

NPN 2 GHz wideband transistor BFR53



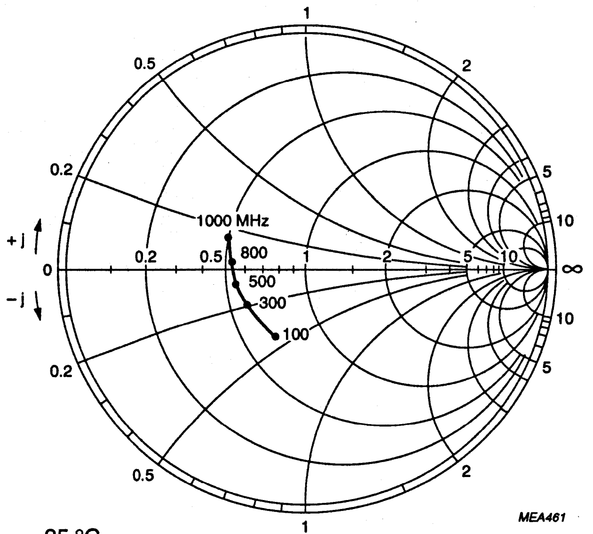
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; G_S = 20 mS; B_S is tuned.

Fig.6 Minimum noise figure as a function of collector current.



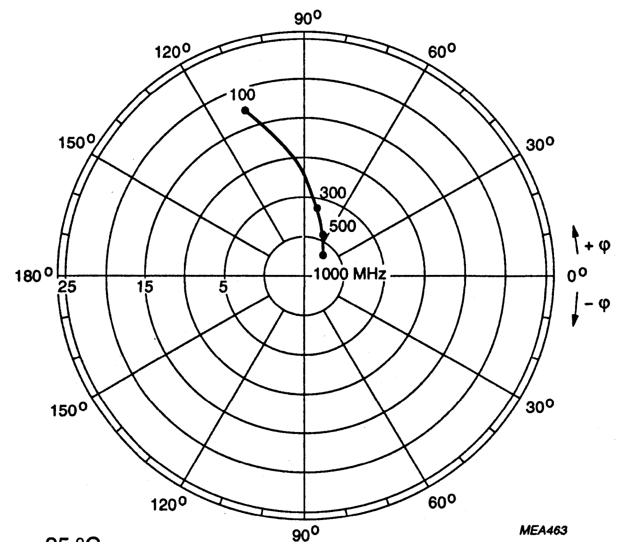
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.7 Noise circle figure.



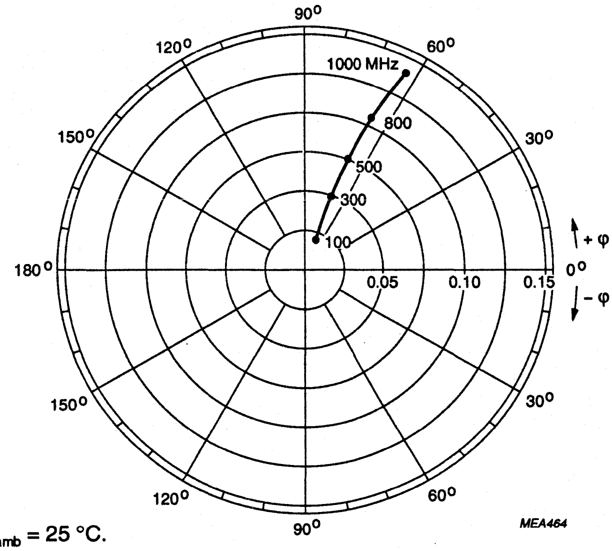
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.8 Common emitter input reflection coefficient (S_{11}).



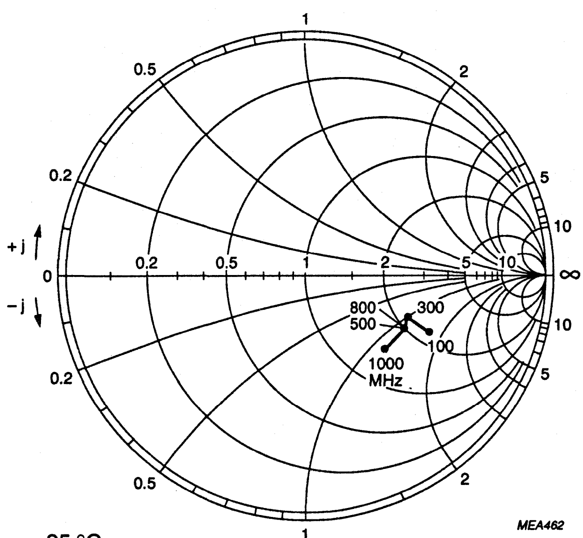
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

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; T_{amb} = 25 °C.
Z_o = 50 Ω.

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

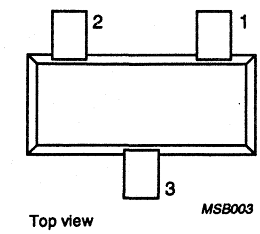


Fig.1 SOT23.

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.

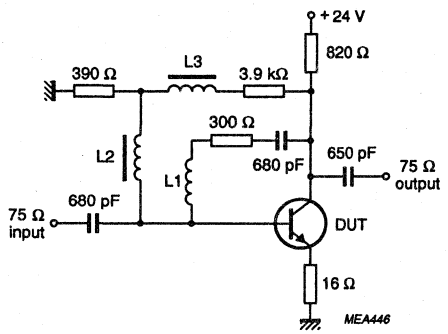
CHARACTERISTICS

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ 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.

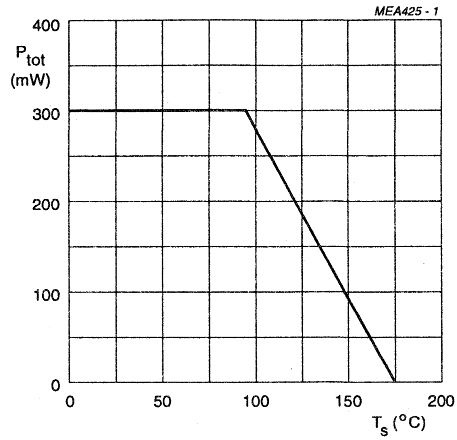
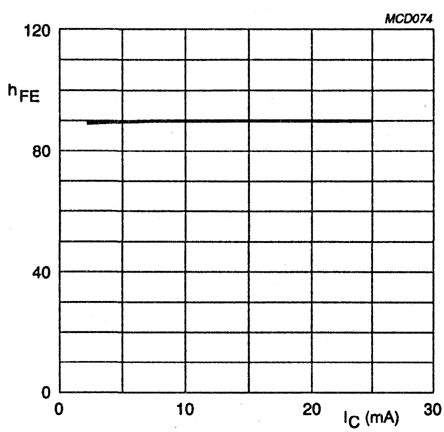
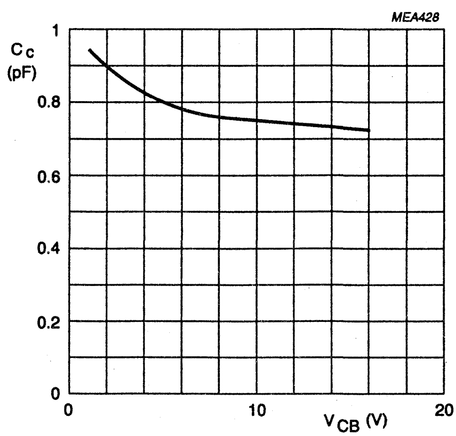


Fig.3 Power derating curve.



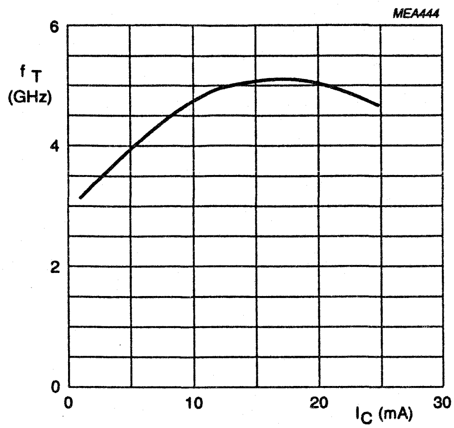
V_{CE} = 10 V; T_j = 25 °C.

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



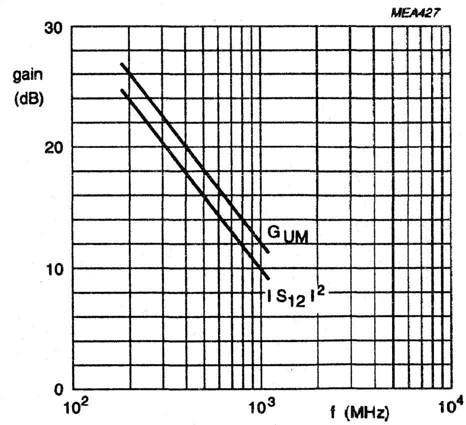
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



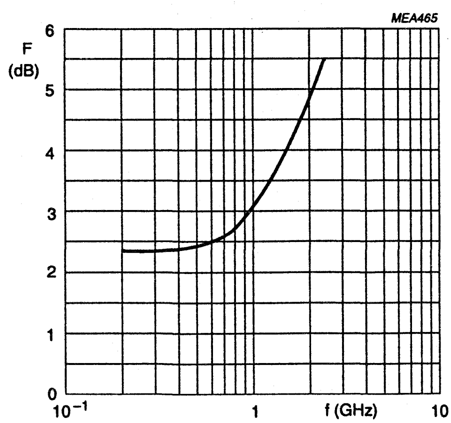
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

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



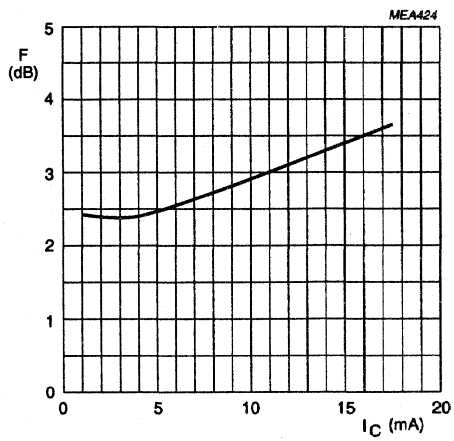
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



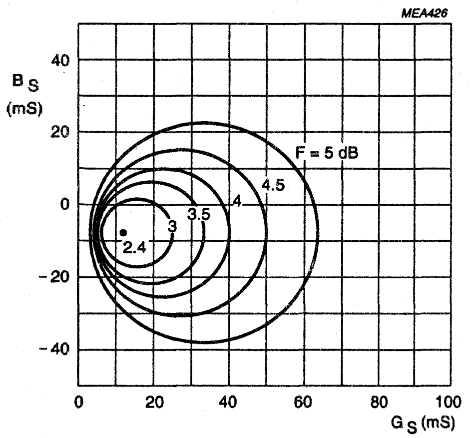
I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_S = opt.

Fig.8 Minimum noise figure as a function of frequency.



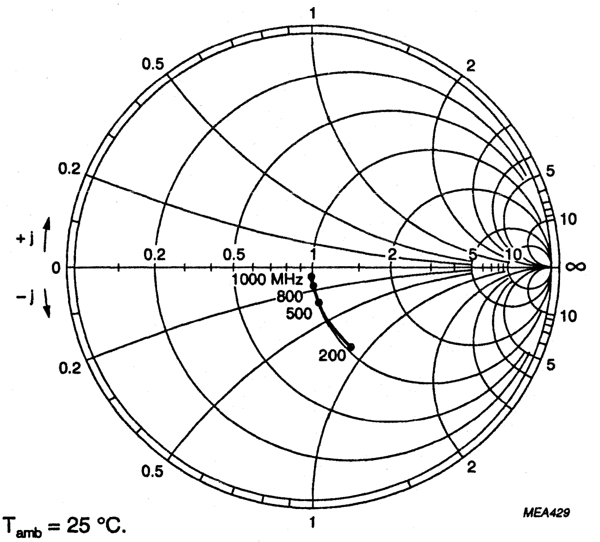
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.

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



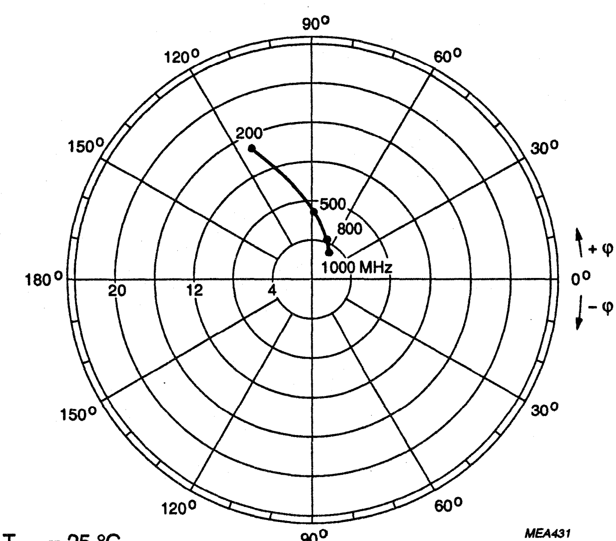
I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Noise circle figure.



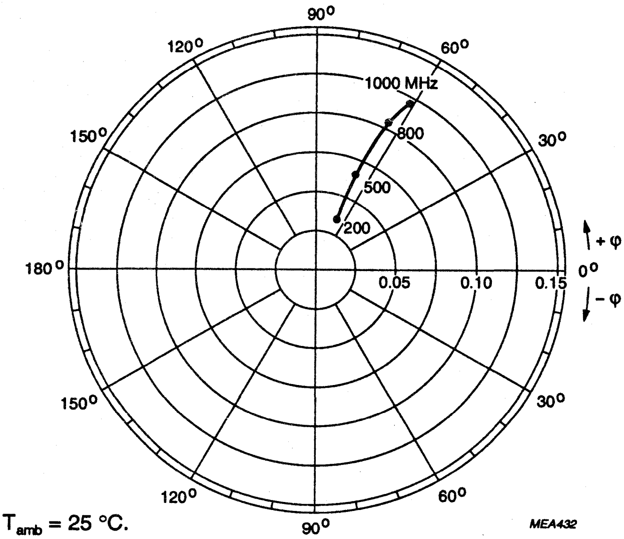
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

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



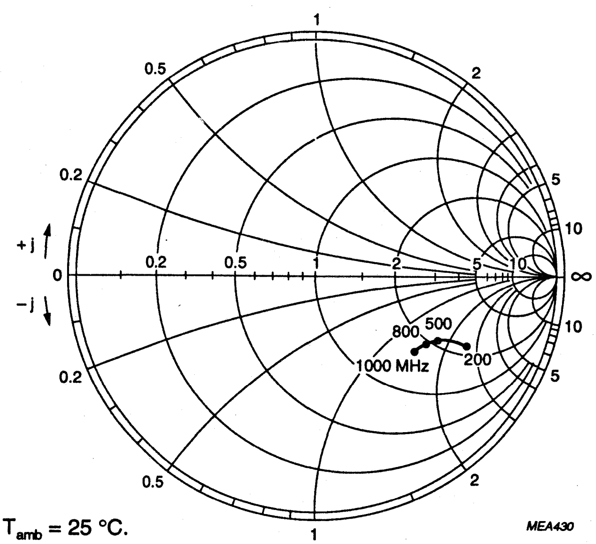
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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
- PNP complement is BFT92.

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is primarily intended for use in RF wideband amplifiers and oscillators.

PINNING

PIN	DESCRIPTION
Code: P2p	
1	base
2	emitter
3	collector

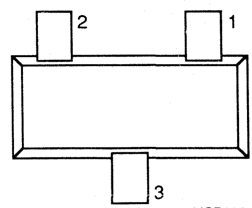


Fig.1 SOT23.

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	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 95 °C; note 1	–	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; T_{amb} = 25 °C; f = 1 GHz	14	–	dB
		I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C; f = 2 GHz	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 10 V; T_{amb} = 25 °C; f = 1 GHz	2.1	–	dB
V_O	output voltage	d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz	150	–	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	–	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	T_s = 95 °C (note 1)	–	300	mW
T_{stg}	storage temperature range		–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.

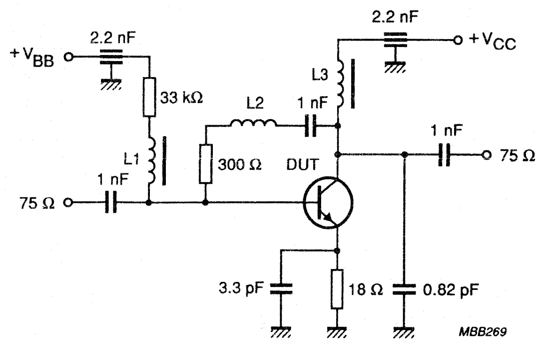
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ 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	–	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	–	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	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2.1	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	150	–	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 crystal in a SOT37 envelope (BFR90A).
3. d_{im} = –60 dB (DIN 45004B); T_{amb} = 25 °C; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; VSWR < 2;
   $V_p = V_O$ 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. T_{amb} = 25 °C; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; VSWR < 2;
   V_p = 60 mV at f_p = 250 MHz;
   V_q = 60 mV at f_q = 560 MHz;
   measured at $f_{(p+q)}$ = 810 MHz.

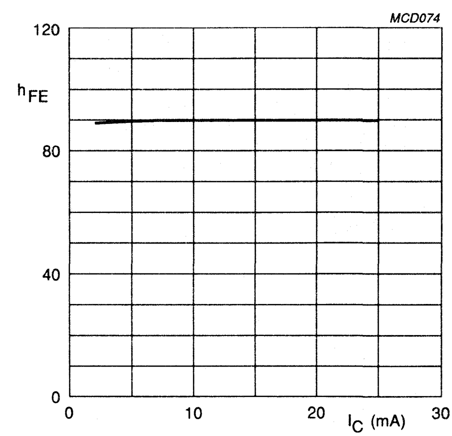


L1 = L3 = 5 μH choke.

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

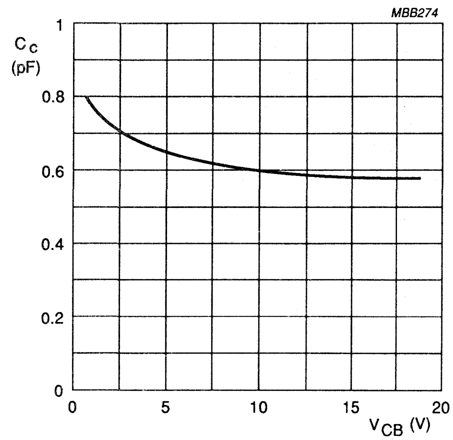
Fig.2 Intermodulation distortion and second harmonic distortion MATV test circuit.

Fig.3 Power derating curve.



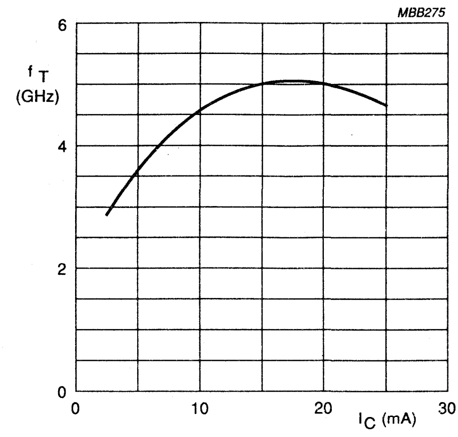
V_{CE} = 10 V; T_j = 25 °C.

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.

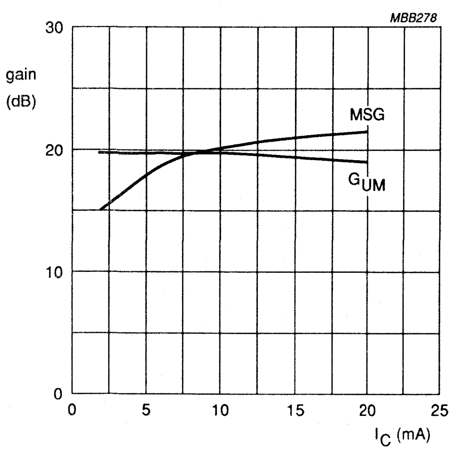
Fig.5 Collector capacitance as a function of collector-base voltage, typical values.



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

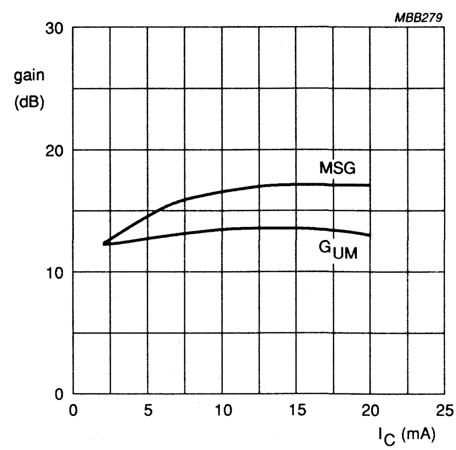
Fig.6 Transition frequency as a function of collector current, typical values.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



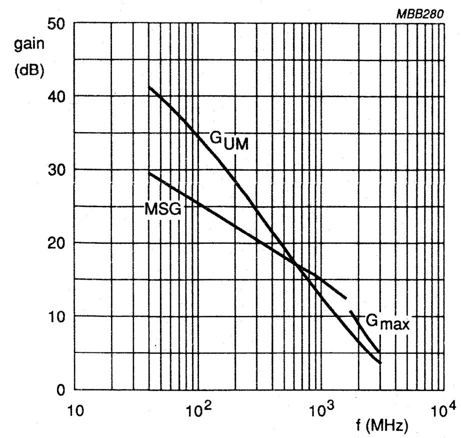
$V_{CE} = 10$ V; f = 500 MHz.

Fig.7 Gain as a function of collector current.



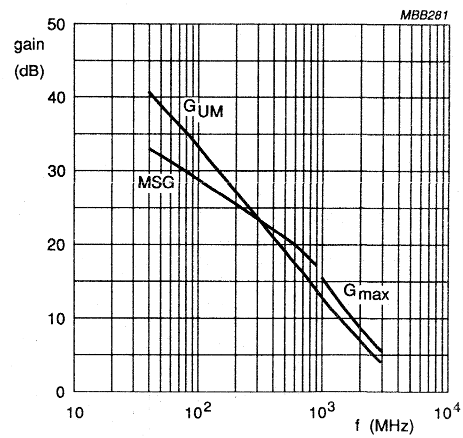
$V_{CE} = 10$ V; f = 1 GHz.

Fig.8 Gain as a function of collector current.



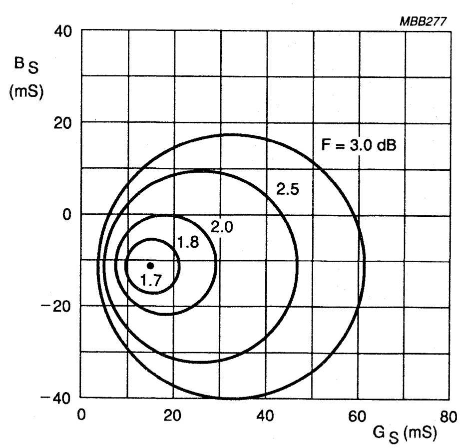
V_{CE} = 10 V; I_C = 5 mA.

Fig.9 Gain as a function of frequency.



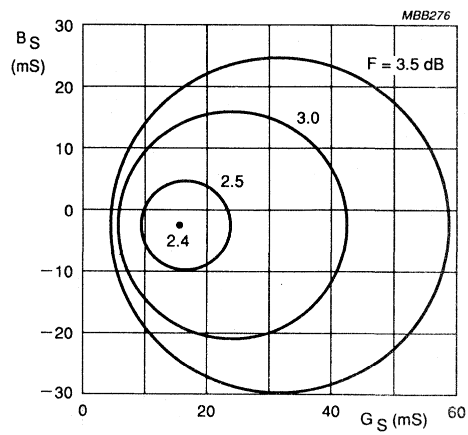
V_{CE} = 10 V; I_C = 15 mA.

Fig.10 Gain as a function of frequency.



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.

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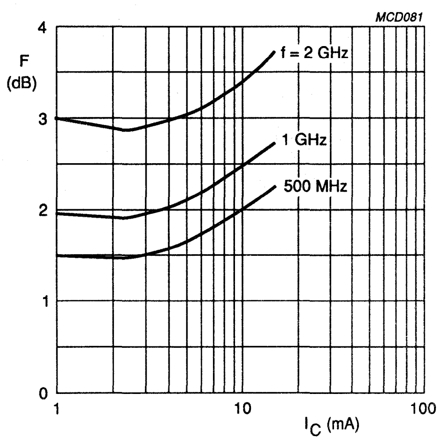
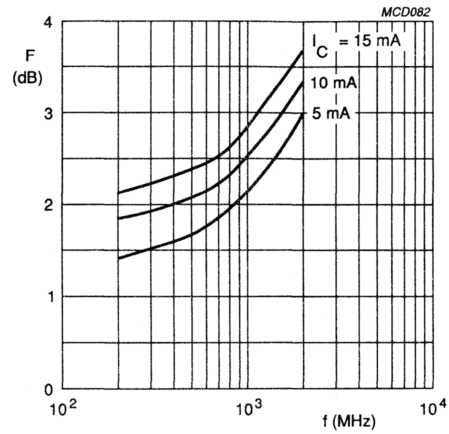


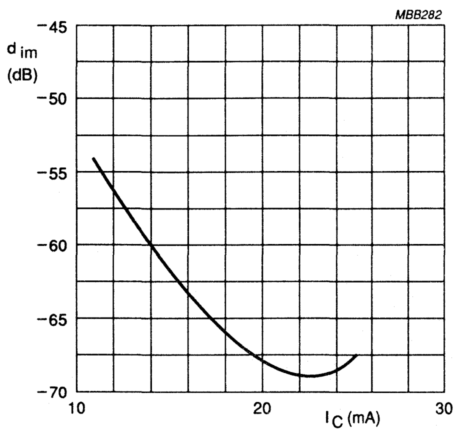
V_{CE} = 10 V.

Fig.13 Minimum noise figure as a function of collector current.



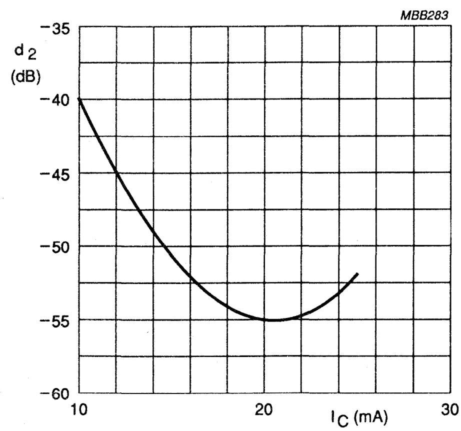
V_{CE} = 10 V.

Fig.14 Minimum noise figure as a function of frequency.



V_{CE} = 10 V; V_o = 150 mV (43.5 dBmV); $f_{(p+q-r)}$ = 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; $f_{(p+q-r)}$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion, typical values.

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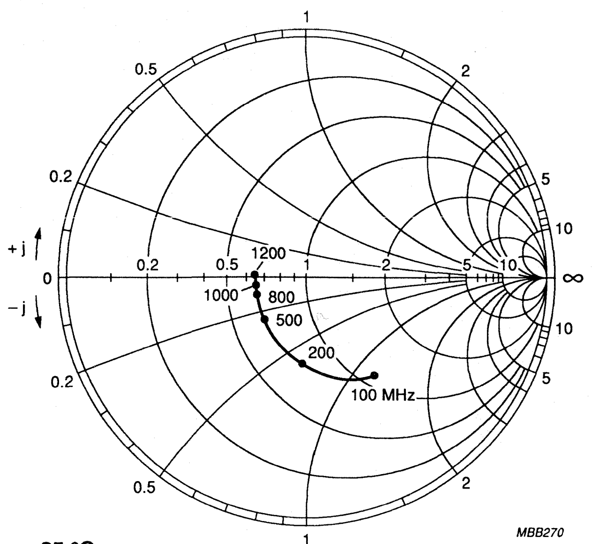
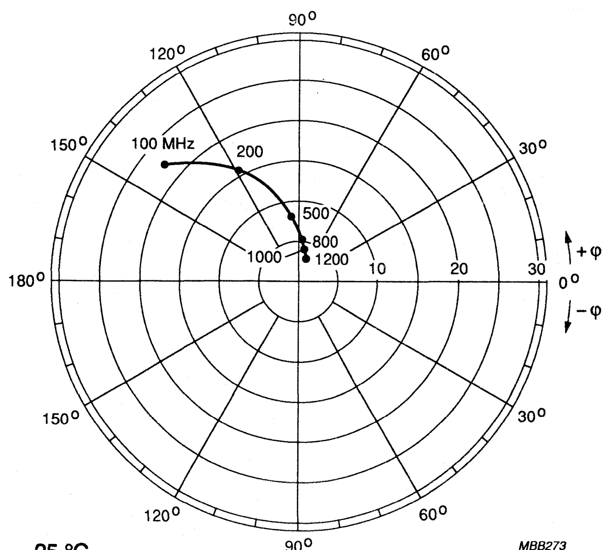


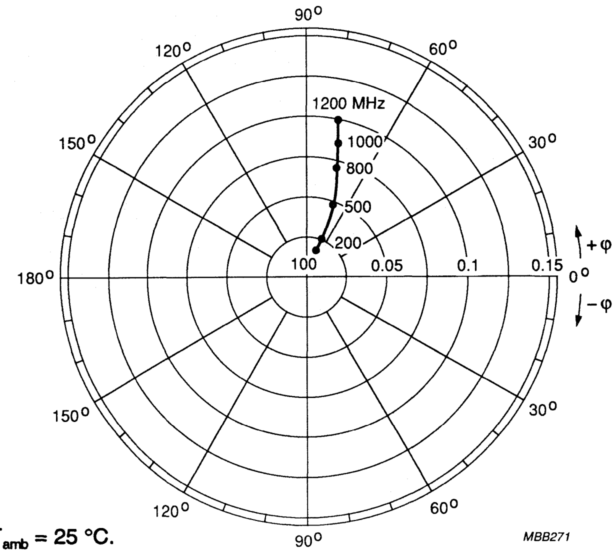
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



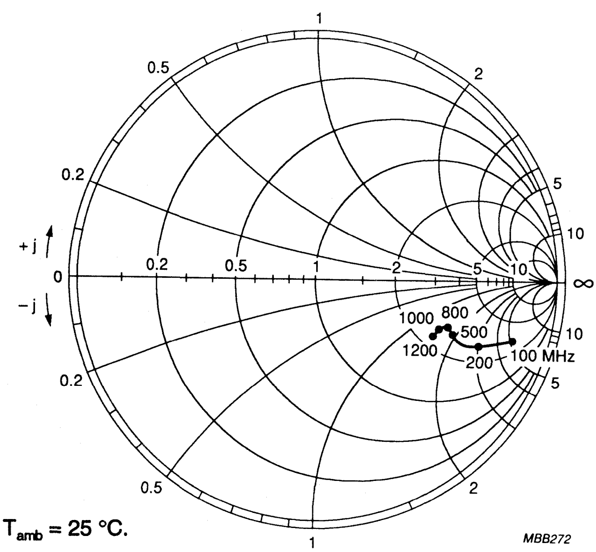
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor — BFR92AW

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) package.

APPLICATIONS

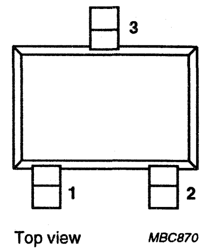
It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz.

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.

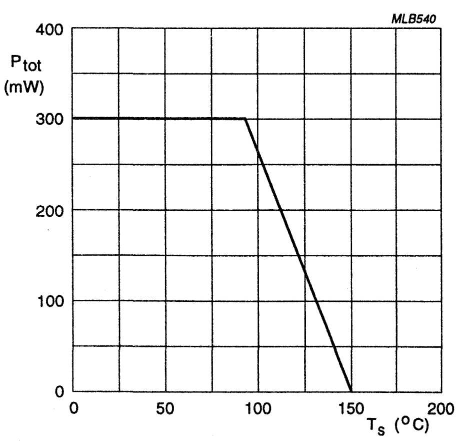


Fig.2 Power derating curve

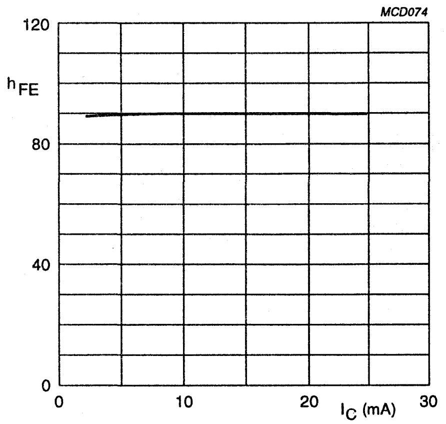
CHARACTERISTICS

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

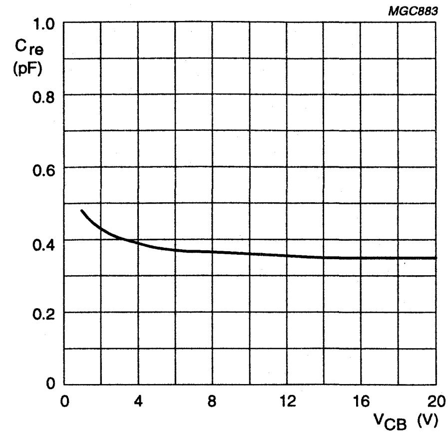
Note

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.



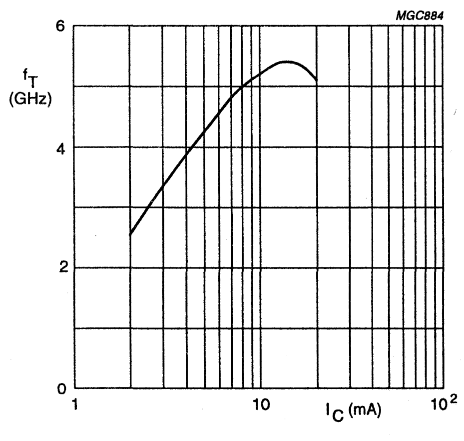
V_{CE} = 10 V.

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



I_C = 0; f = 1 MHz.

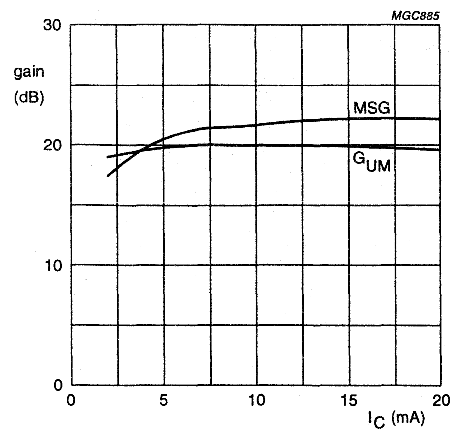
Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

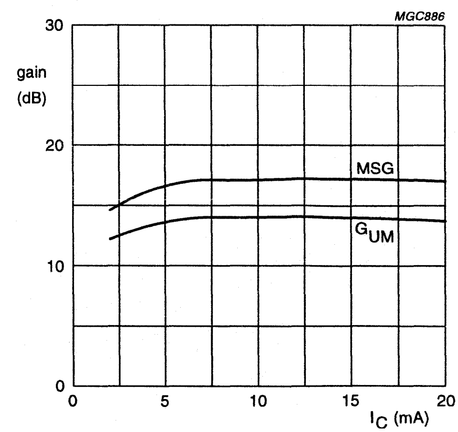
Fig.5 Transition frequency as a function of collector current; typical values.

NPN 5 GHz wideband transistor BFR92AW



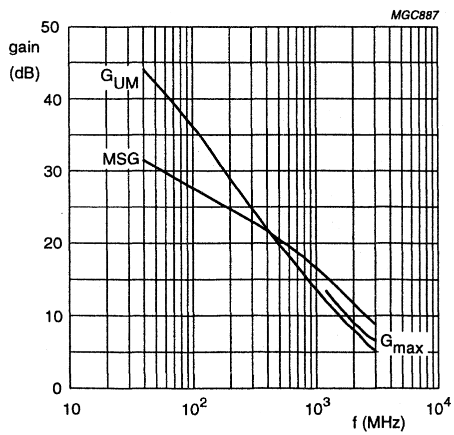
V_{CE} = 10 V; f = 500 MHz.

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



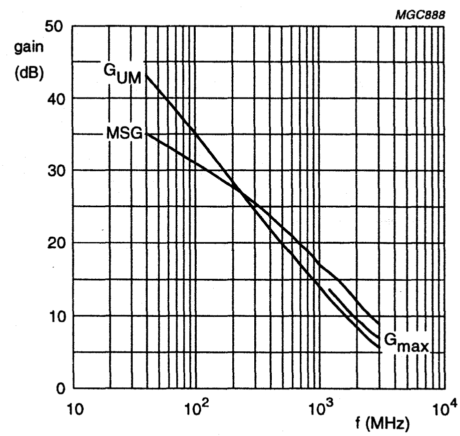
V_{CE} = 10 V; f = 1 GHz.

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



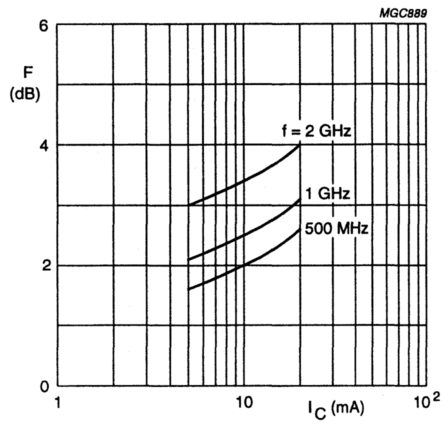
V_{CE} = 10 V; I_C = 5 mA.

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



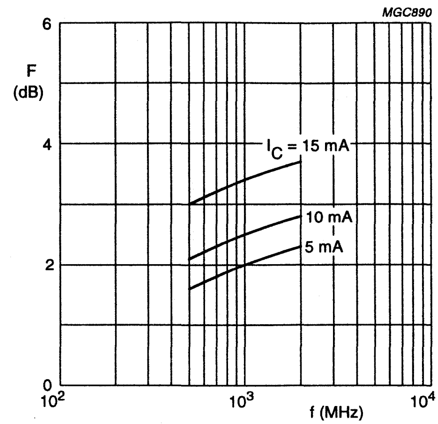
V_{CE} = 10 V; I_C = 15 mA.

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



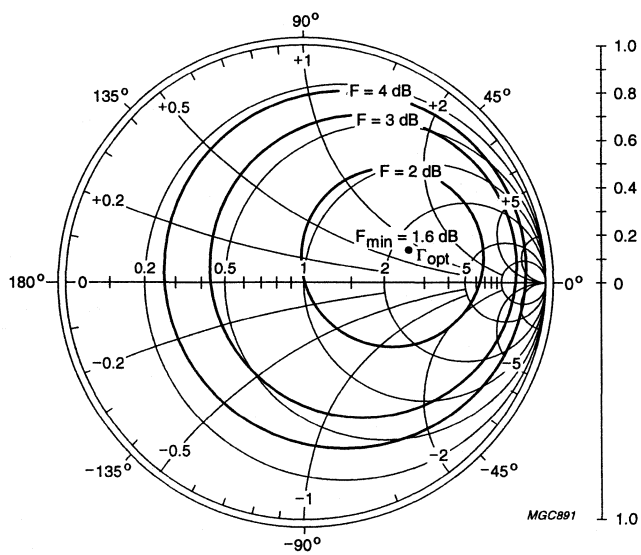
V_{CE} = 10 V.

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



V_{CE} = 10 V.

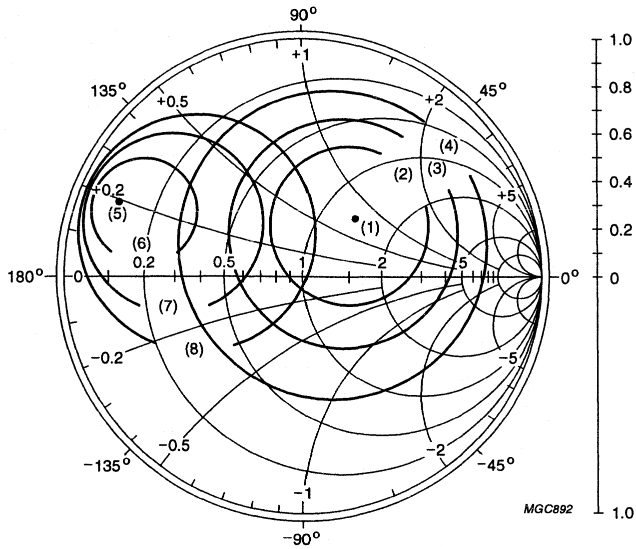
Fig.11 Minimum noise figure as a function of frequency; typical values.



f = 500 MHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

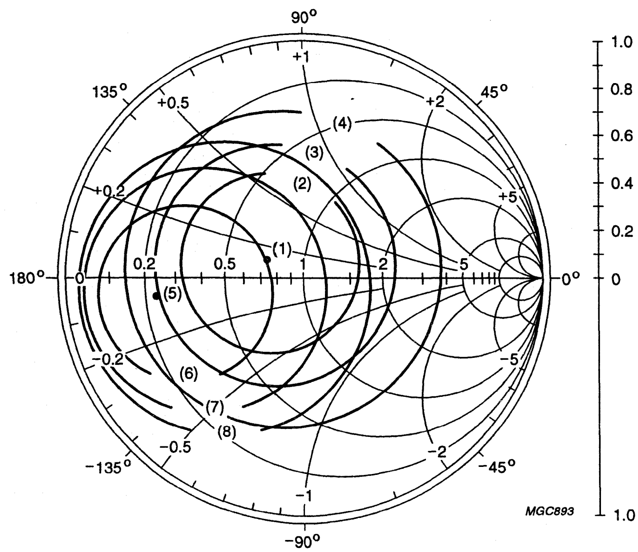
Fig.12 Common emitter noise figure circles; typical values.

NPN 5 GHz wideband transistor BFR92AW



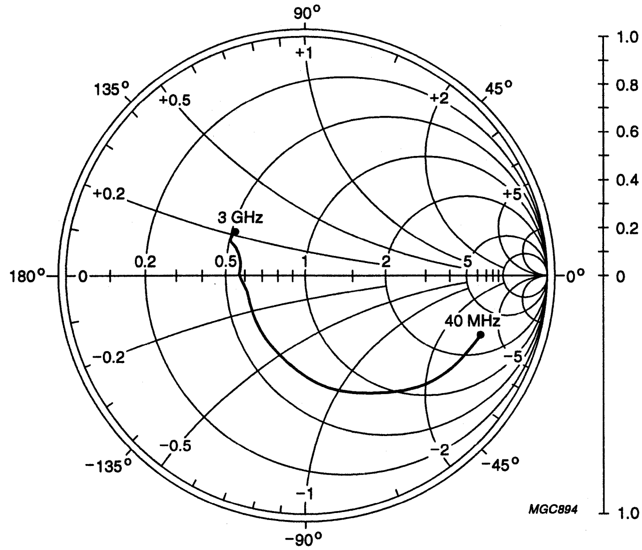
(1) Γ_{opt}; F_{min} = 2.1 dB.
(2) F = 2.5 dB.
(3) F = 3 dB.
(4) F = 4 dB.
(5) Γ_{ms}; G_{max} = 15.7 dB.
(6) G = 15 dB.
(7) G = 14 dB.
(8) G = 13 dB.
f = 1 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

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



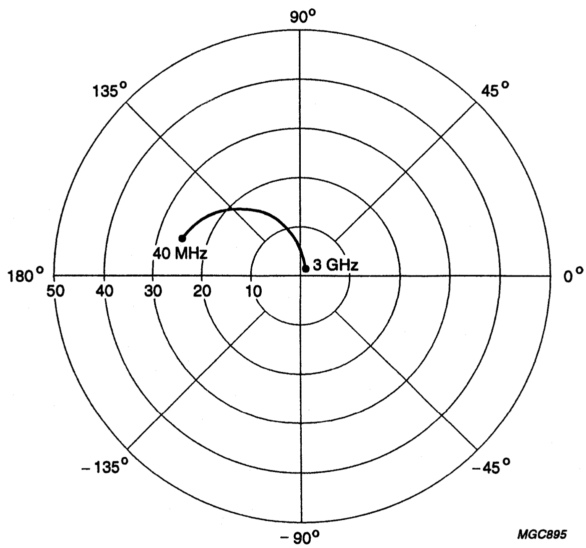
(1) Γ_{opt}; F_{min} = 3 dB.
(2) F = 3.5 dB.
(3) F = 4 dB.
(4) F = 5 dB.
(5) Γ_{ms}; G_{max} = 9.1 dB.
(6) G = 8 dB.
(7) G = 7 dB.
(8) G = 6 dB.
f = 2 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_o = 50 Ω.

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



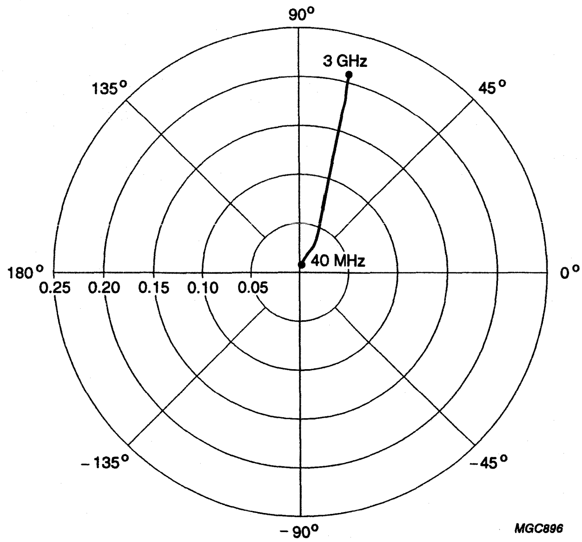
V_{CE} = 10 V; I_C = 15 mA; Z_o = 50 Ω.

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



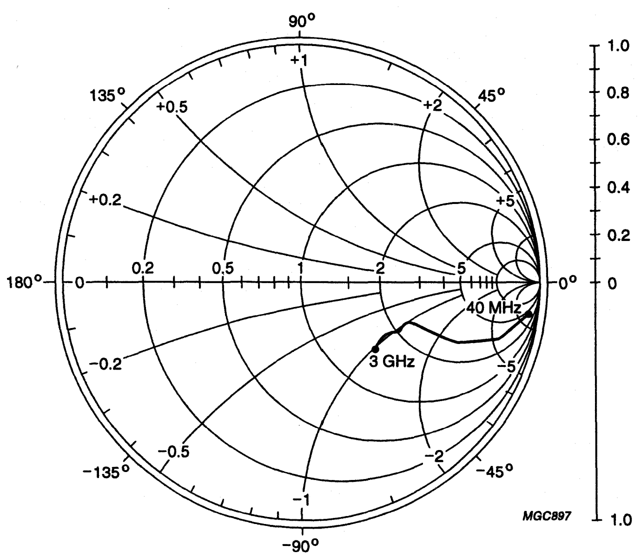
V_{CE} = 10 V; I_C = 15 mA.

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

DESCRIPTION

NPN transistor in a plastic SOT23 envelope primarily intended for use in RF amplifiers and oscillators. 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.

A SOT54 (TO-92) version (ref: ON4186) is available on request.

PNP complement is BFT93.

PINNING

PIN	DESCRIPTION
	Code: R1p
1	base
2	emitter
3	collector

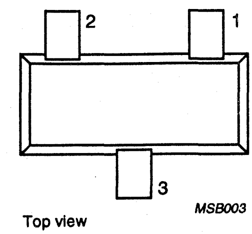


Fig.1 SOT23.

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	0.8	–	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 = 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 Ω; V_O = 300 mV; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 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	–	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
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.

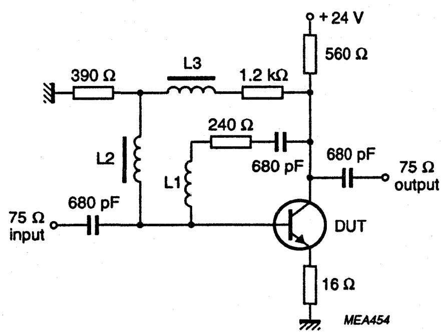
CHARACTERISTICS

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 = 30 mA; V_{CE} = 5 V	40	90	–	
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	–	0.7	–	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
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; T_{amb} = 25 °C; Z_S = opt.	–	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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. Crystal mounted in a SOT37 envelope (BFR91).
3. I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; 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 $f_{(p+q-r)}$ = 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.

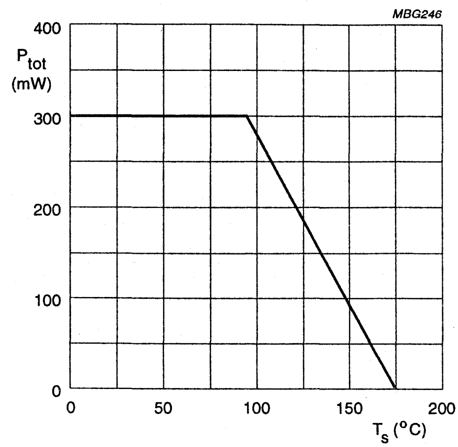
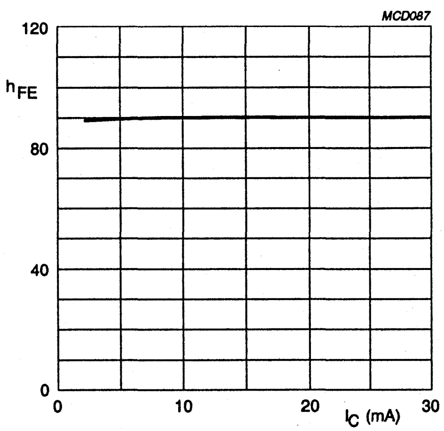
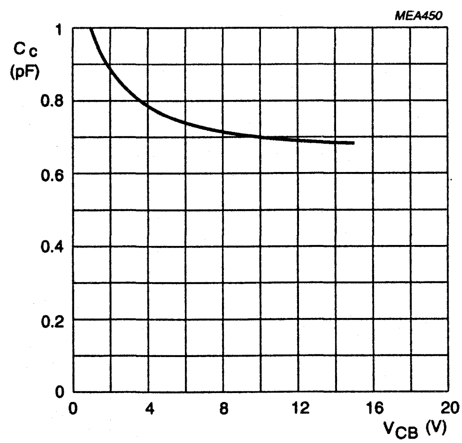


Fig.3 Power derating curve.



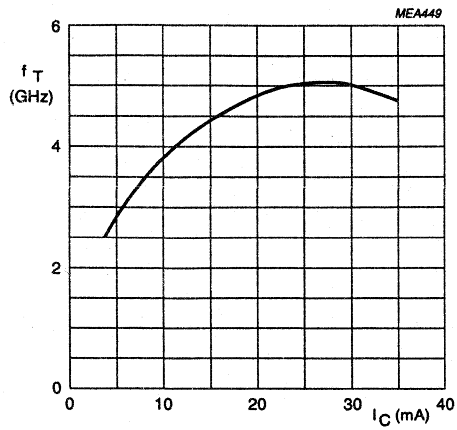
V_{CE} = 5 V; T_j = 25 °C.

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



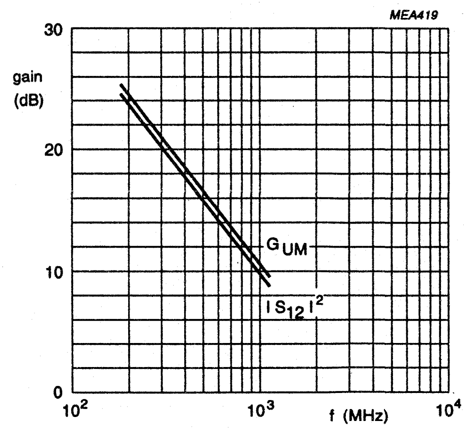
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



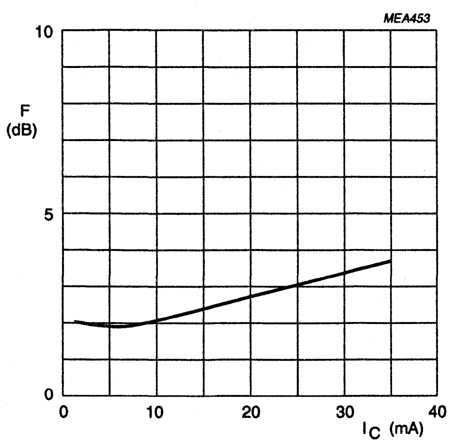
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

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



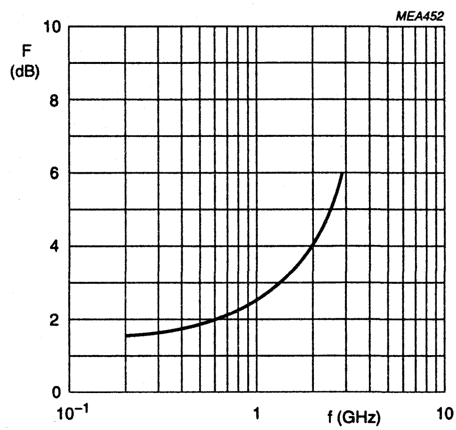
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



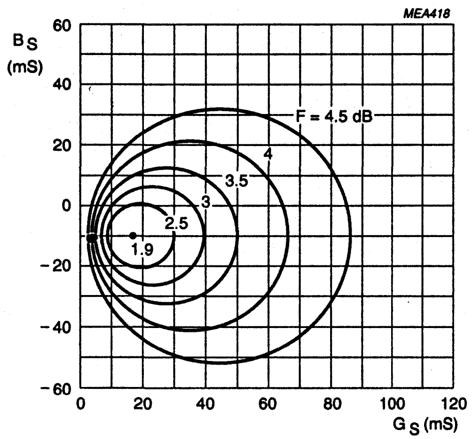
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.

Fig.8 Minimum noise figure as a function of collector current.



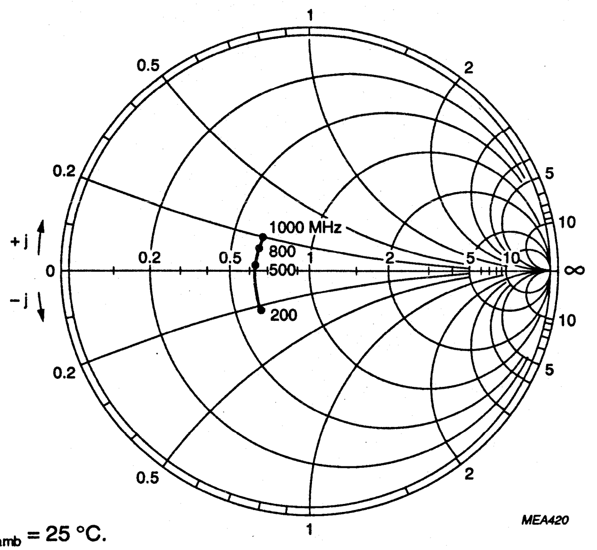
I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C; Z_S = opt.

Fig.9 Minimum noise figure as a function of frequency.



I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

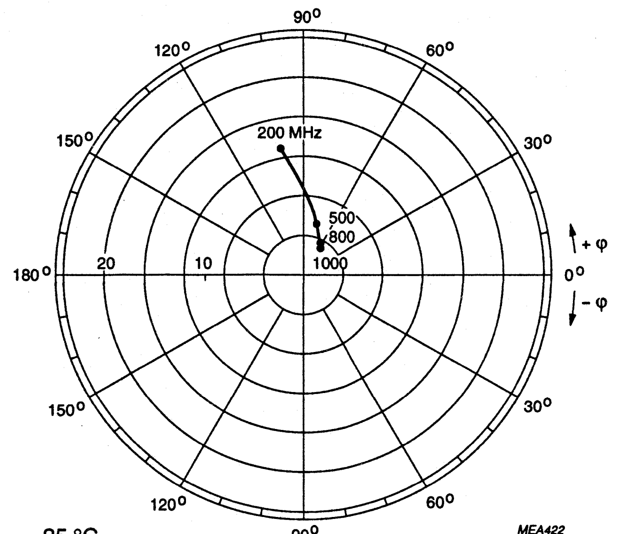
Fig.10 Noise circle figure.



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

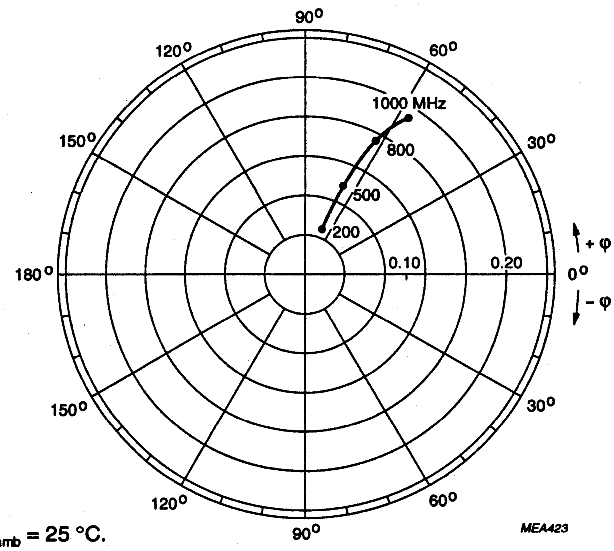
Z_o = 50 Ω.

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



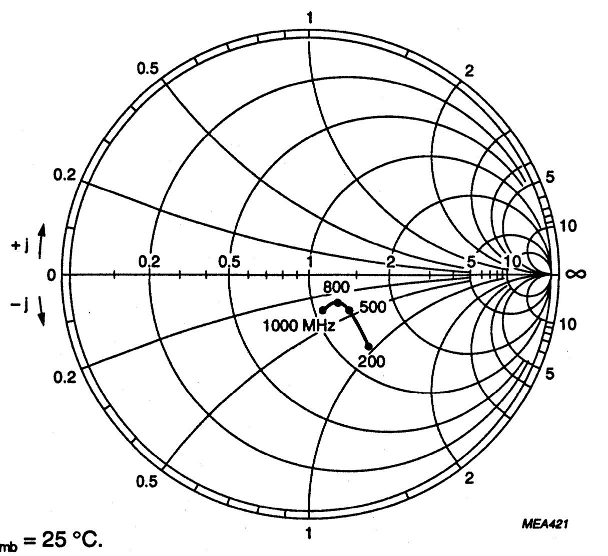
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

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



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

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



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

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

NPN 6 GHz wideband transistor — BFR93A

FEATURES

- High power gain
- Low noise figure
- Very low intermodulation distortion
- PNP complement is the BFT93.

PINNING

PIN	DESCRIPTION
	Code: R2p
1	base
2	emitter
3	collector

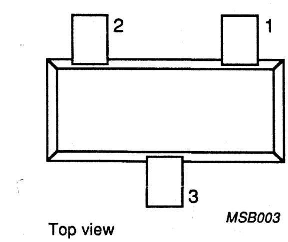


Fig.1 SOT23.

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is primarily intended for use in RF wideband amplifiers and oscillators.

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
C_{re}	feedback capacitance	V_{CE} = 5 V; I_C = 0; 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; T_{amb} = 25 °C; f = 1 GHz	13	–	dB
		I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	7	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	1.9	–	dB
V_O	output voltage	d_{im} = −60 dB; I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	425	–	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	–	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
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	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.

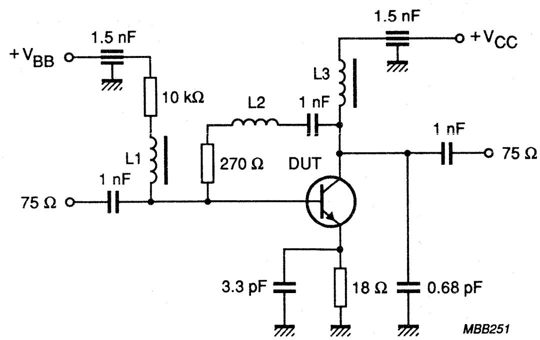
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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	–	1.9	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; 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	–	13	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	7	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.9	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	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 crystal in a SOT37 envelope (BFR91A).
3. $d_{im} = -60$ dB (DIN 45004B); $T_{amb} = 25$ °C; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ 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. $T_{amb} = 25$ °C; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$;
   $V_p = 200$ mV at $f_p = 250$ MHz;
   $V_q = 200$ mV at $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ 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.

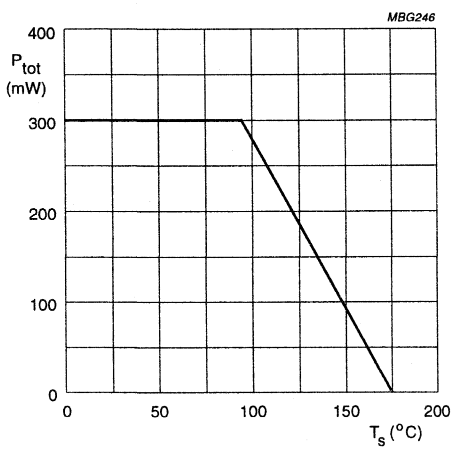
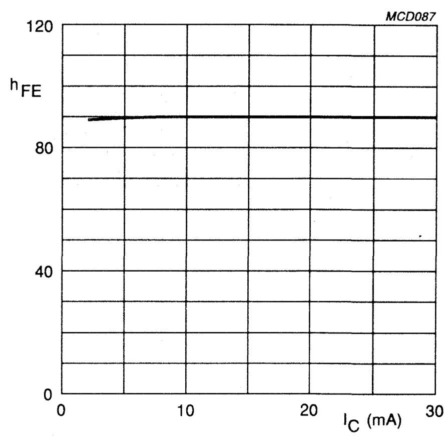


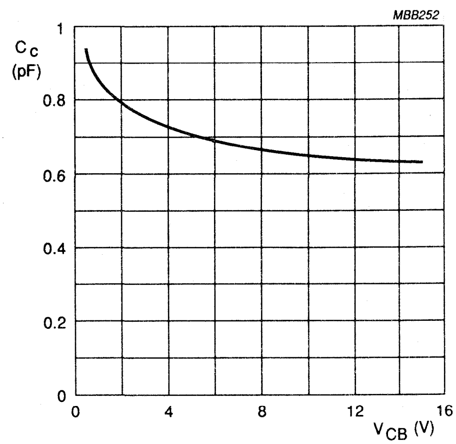
Fig.3 Power derating curve.



V_{CE} = 5 V; T_j = 25 °C.

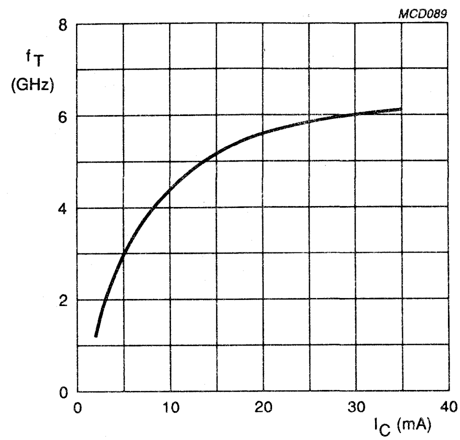
Fig.4 DC current gain as a function of collector current.

NPN 6 GHz wideband transistor BFR93A



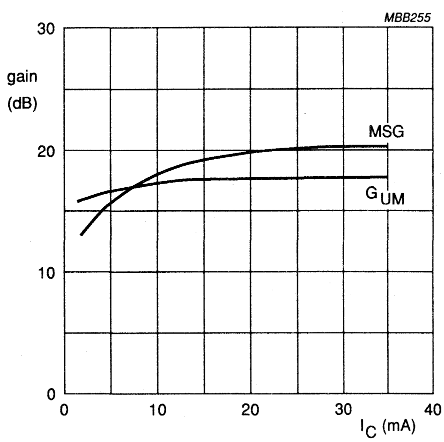
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

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



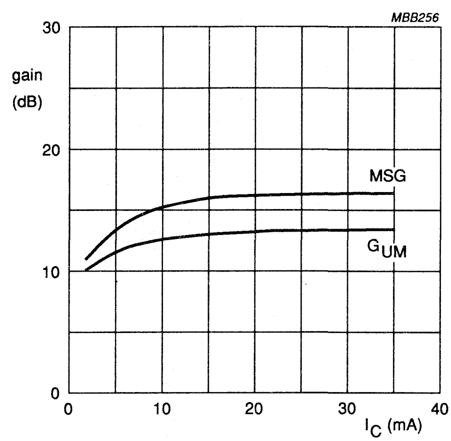
$V_{CE} = 5$ V; $T_j = 25$ °C; f = 500 MHz.

Fig.6 Transition frequency as a function of collector current, typical values.



$V_{CE} = 8$ V; f = 500 MHz.

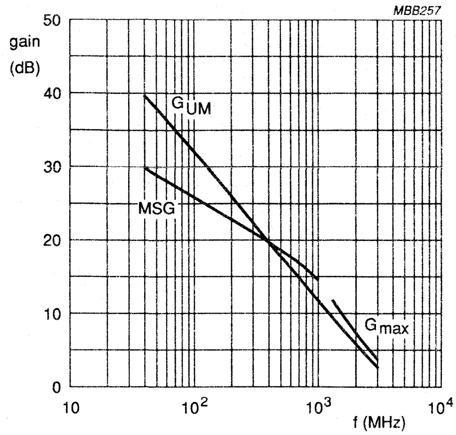
Fig.7 Gain as a function of collector current.



$V_{CE} = 8$ V; f = 1 GHz.

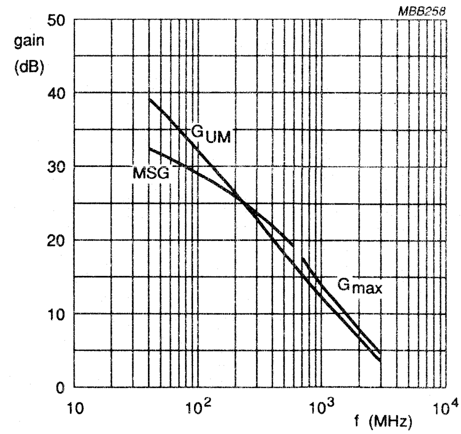
Fig.8 Gain as a function of collector current.

NPN 6 GHz wideband transistor BFR93A



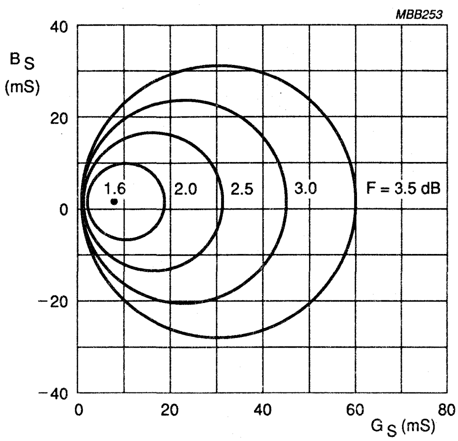
V_{CE} = 8 V; I_C = 10 mA.

Fig.9 Gain as a function of frequency.



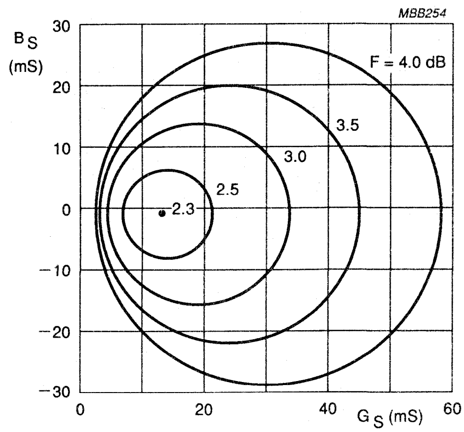
V_{CE} = 8 V; I_C = 30 mA.

Fig.10 Gain as a function of frequency.



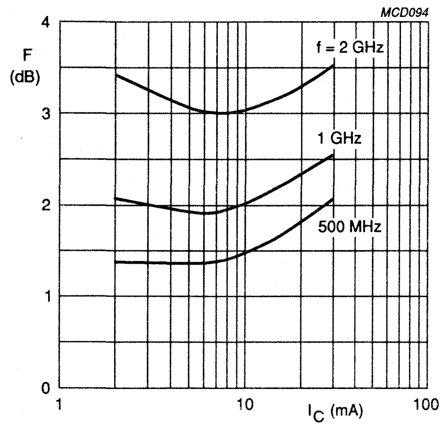
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.11 Circles of constant noise figure, typical values.



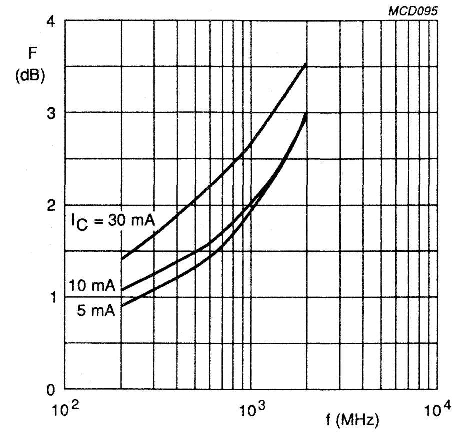
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.12 Circles of constant noise figure, typical values.



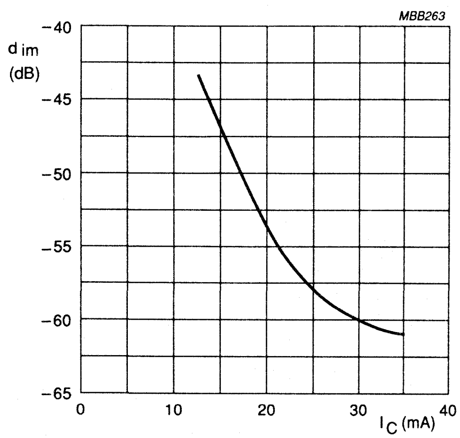
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current.



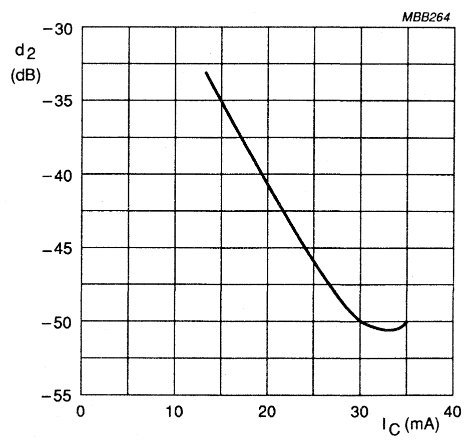
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of frequency.



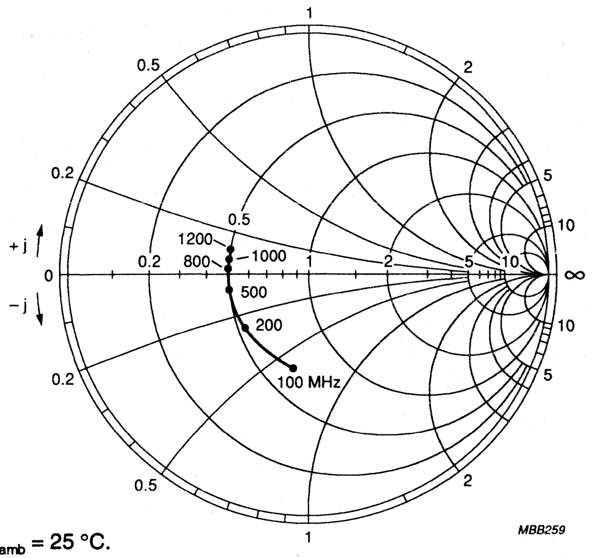
V_{CE} = 8 V; V_o = 425 mV (52.6 dBmV);
$f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.15 Intermodulation distortion, typical values.



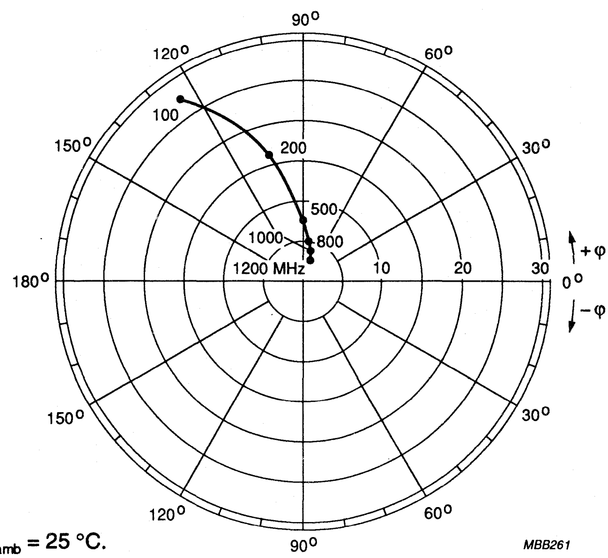
V_{CE} = 8 V; V_o = 200 mV (46 dBmV);
$f_{(p+q-r)}$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion, typical values.



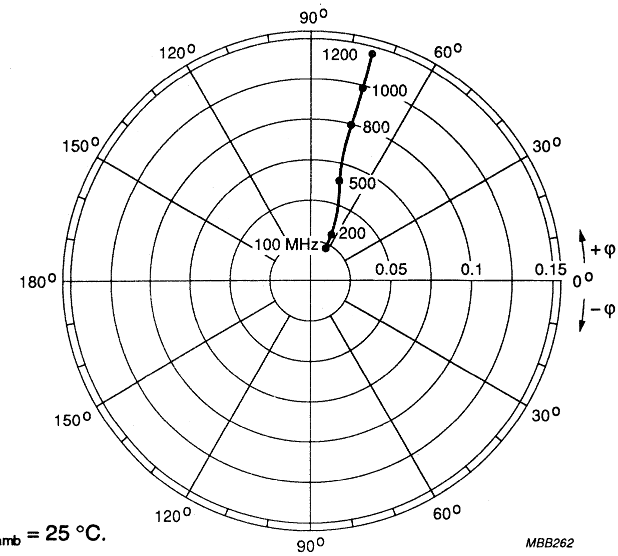
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



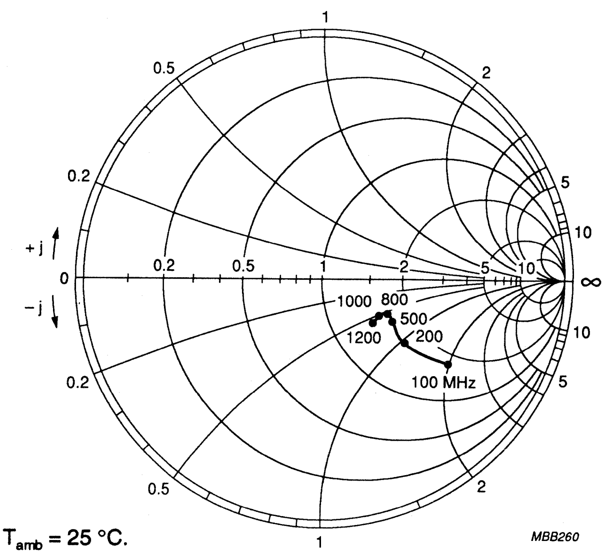
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).



V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.
Z_o = 50 Ω.

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

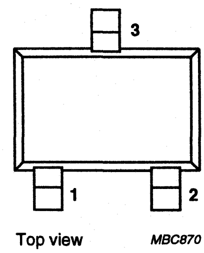
It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz.

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.

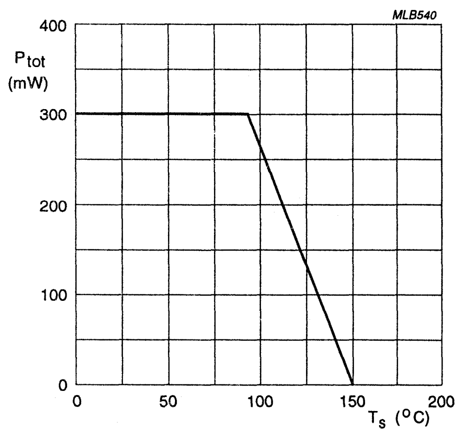


Fig.2 Power derating curve.

CHARACTERISTICS

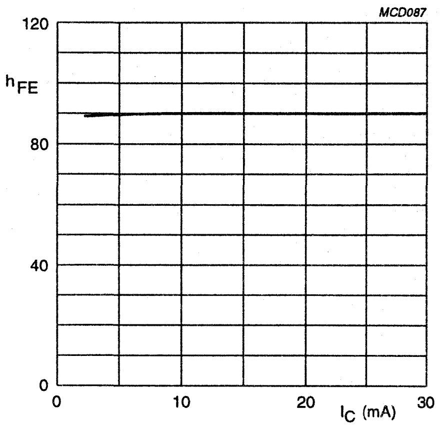
T_j = 25 °C (unless otherwise specified).

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

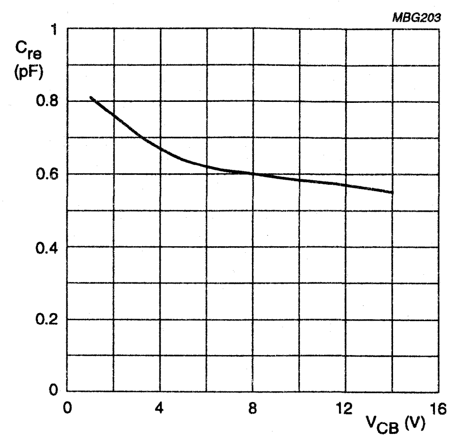
1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero and $G_{UM} = 10\log\frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.

NPN 5 GHz wideband transistor BFR93AW



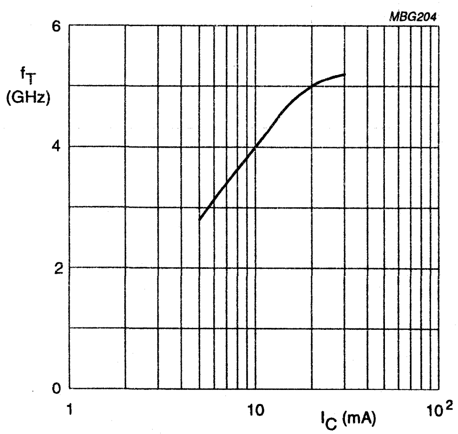
V_{CE} = 5 V.

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



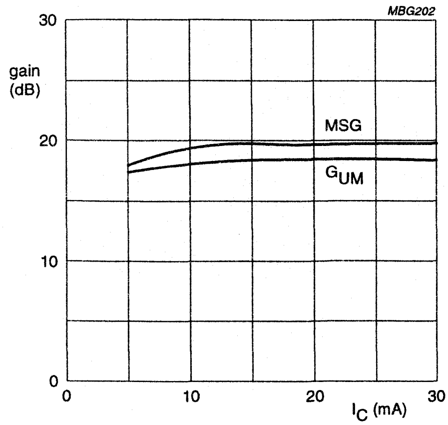
I_C = 0; f = 1 MHz.

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



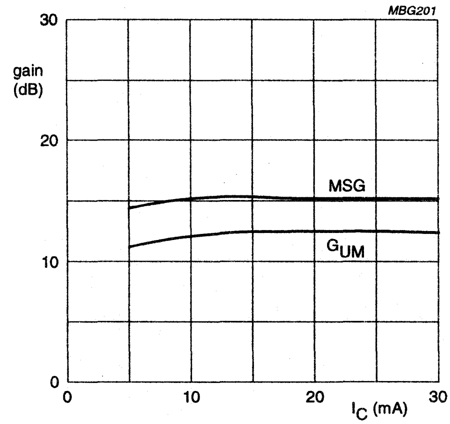
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

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



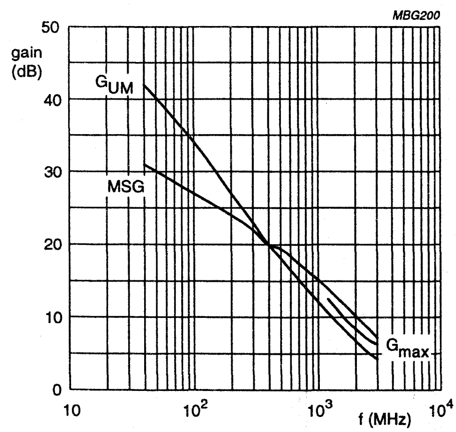
V_{CE} = 8 V; f = 500 MHz.

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



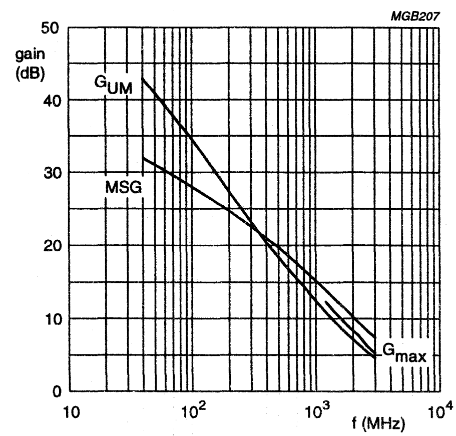
V_{CE} = 8 V; f = 1 GHz.

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



V_{CE} = 8 V; I_C = 10 mA.

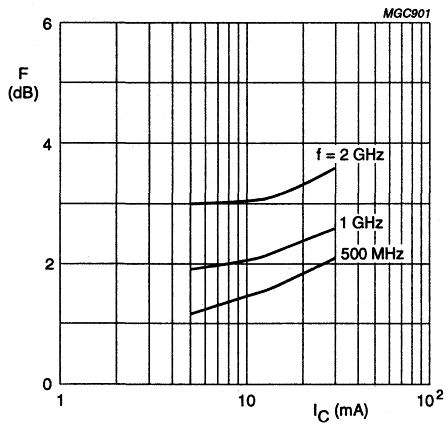
Fig.8 Gain as a function of frequency; typical values.



V_{CE} = 8 V; I_C = 30 mA.

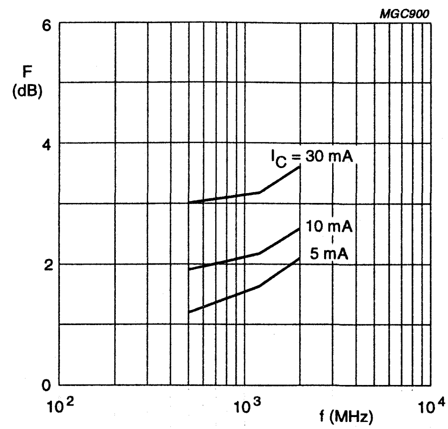
Fig.9 Gain as a function of frequency; typical values.

NPN 5 GHz wideband transistor | BFR93AW



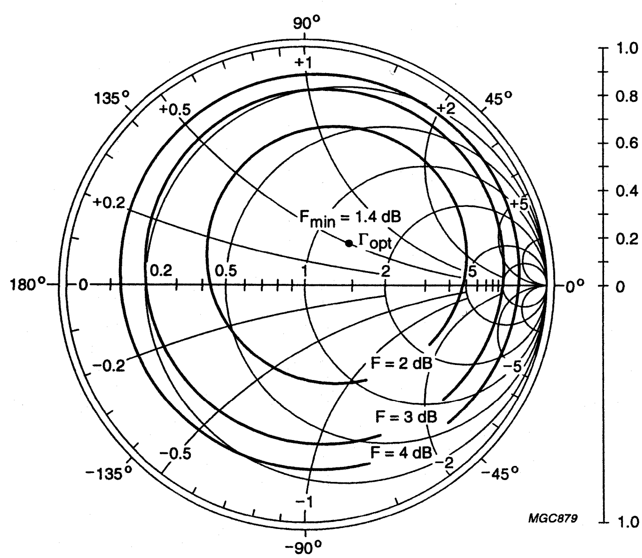
V_{CE} = 8 V.

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



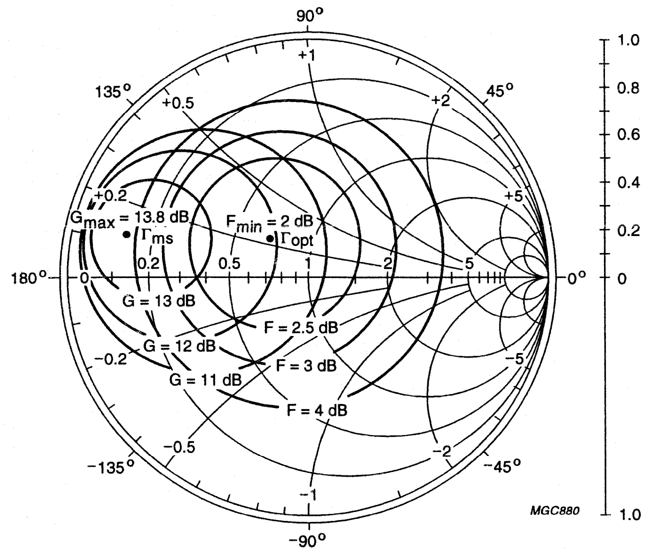
V_{CE} = 8 V.

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



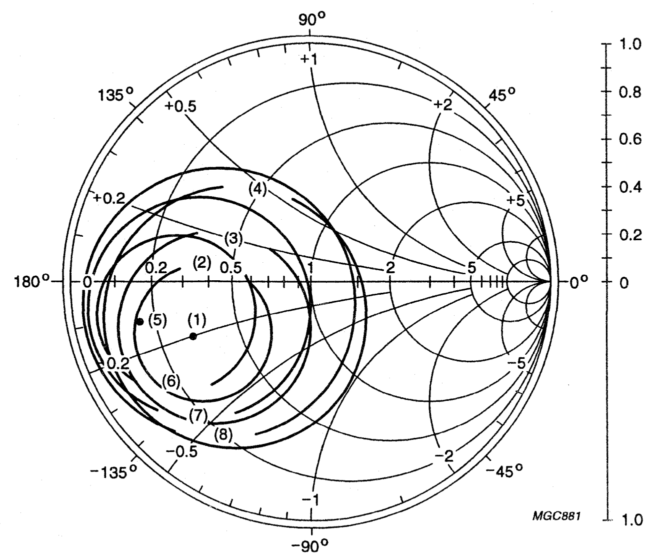
f = 500 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

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



f = 1 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

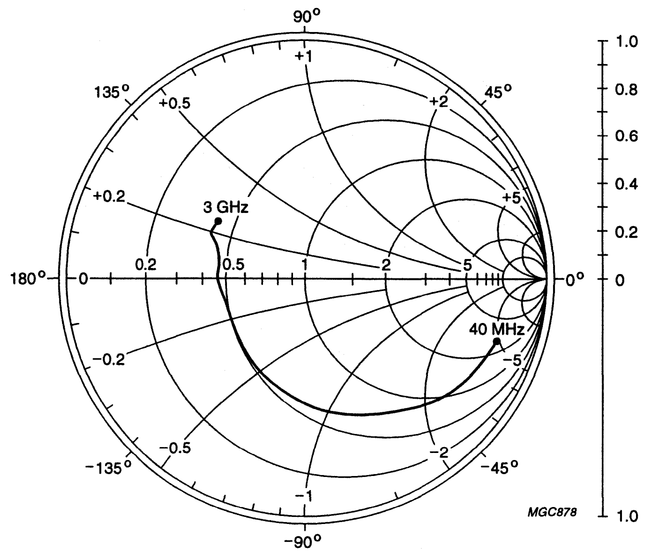
Fig.13 Common emitter noise figure circles; typical values.



(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.

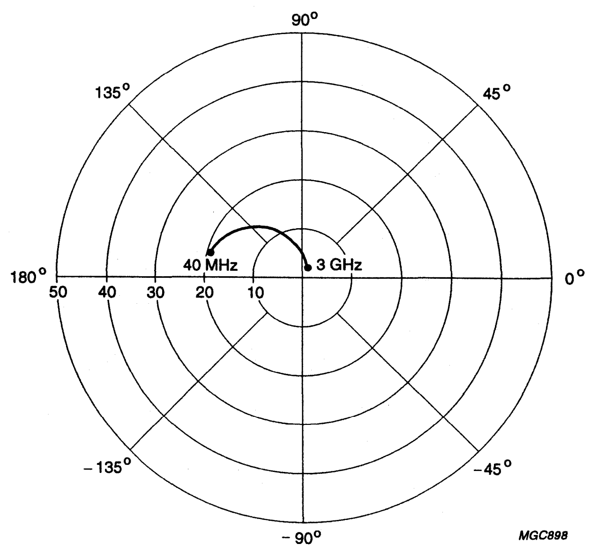
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

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



V_{CE} = 8 V; I_C = 30 mA; Z_o = 50 Ω.

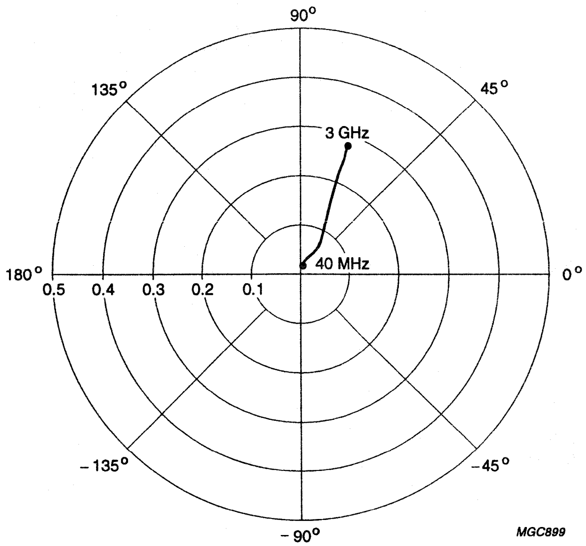
Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



V_{CE} = 8 V; I_C = 30 mA.

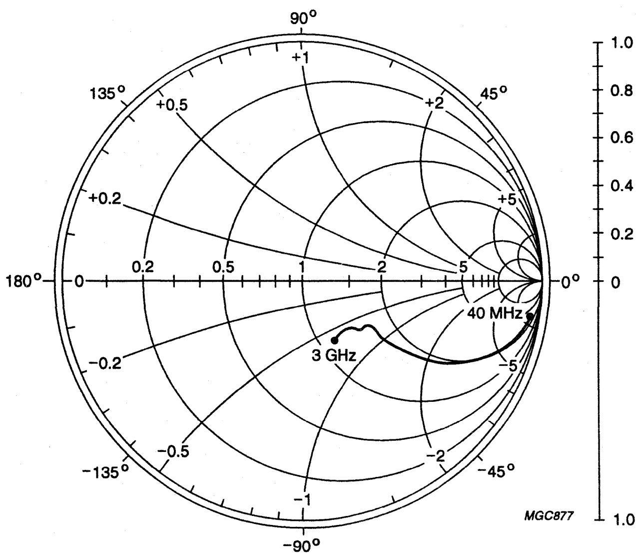
Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.

NPN 5 GHz wideband transistor BFR93AW



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

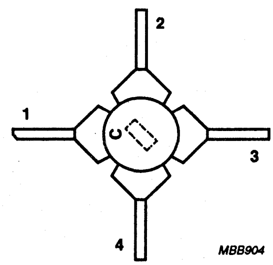


Fig.1 SOT122E.

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

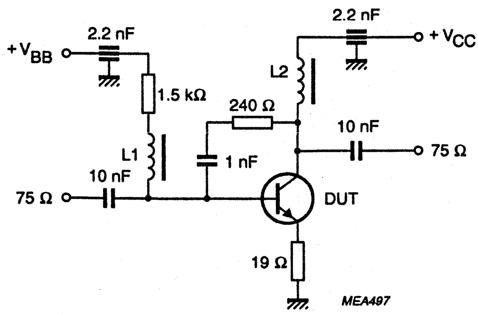
CHARACTERISTICS

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

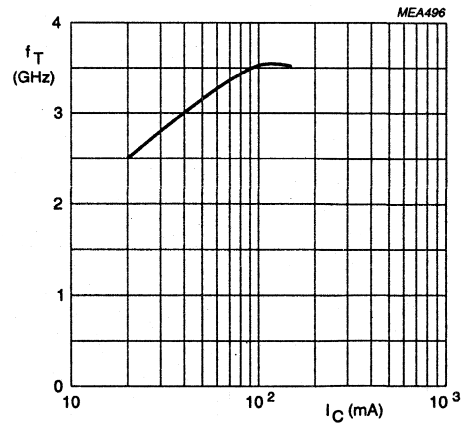
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 90$ mA; $V_{CE} = 20$ V; $R_L = 75$ Ω;
   $V_p = V_O = 60$ 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; $R_L = 75$ 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.



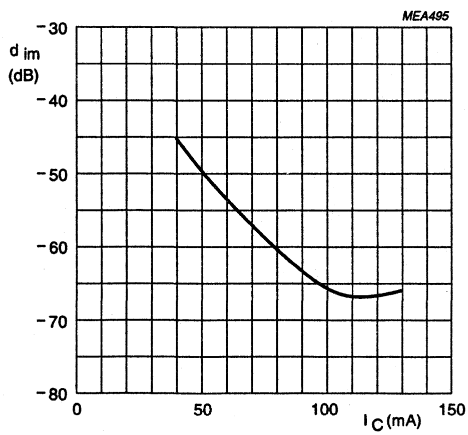
L1 = L2 = 5 μH Ferroxcube choke, catalogue number 3122 108 20153.

Fig.2 Intermodulation distortion MATV test circuit.



V_{CE} = 20 V; f = 500 MHz; T_j = 25 °C.

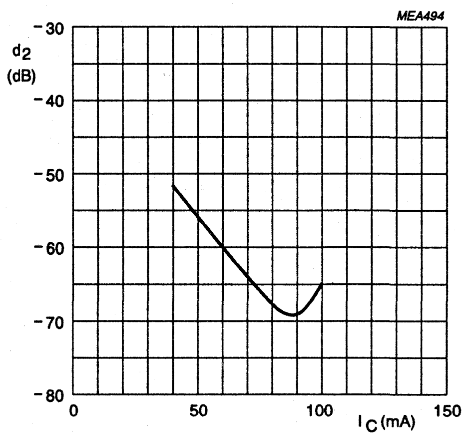
Fig.3 Transition frequency as a function of collector current.



Measured in CATV test circuit.

V_{CE} = 20 V; V_O = 60 dBmV;
$f_{(p+q-r)}$ = 194.25 MHz.

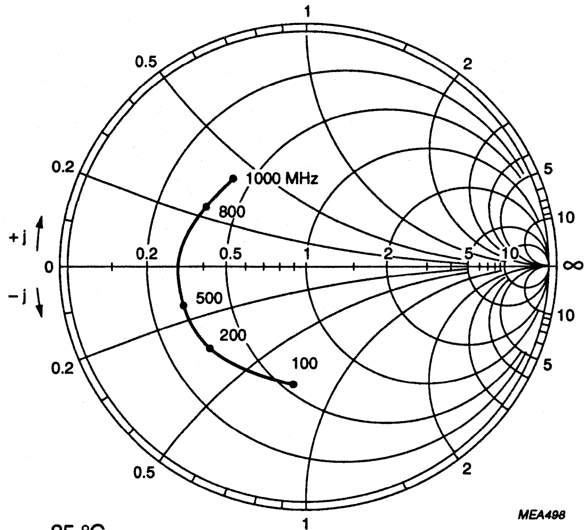
Fig.4 Intermodulation distortion as a function of collector current.



Measured in CATV test circuit.

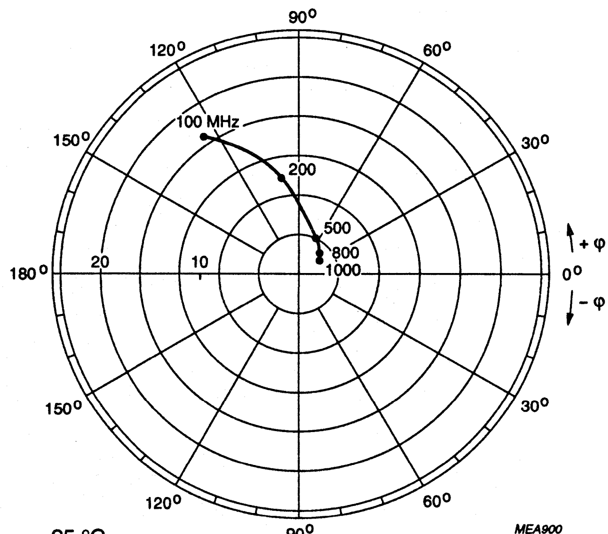
V_{CE} = 20 V; V_O = 48 dBmV; f = 210 MHz.

Fig.5 Second order intermodulation distortion as a function of collector current.



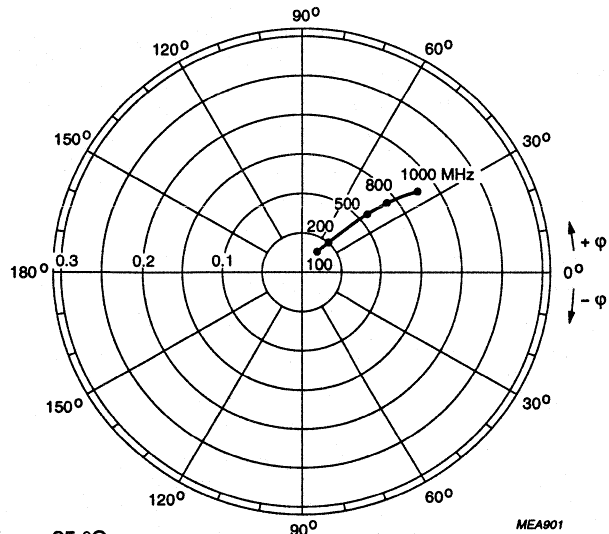
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

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



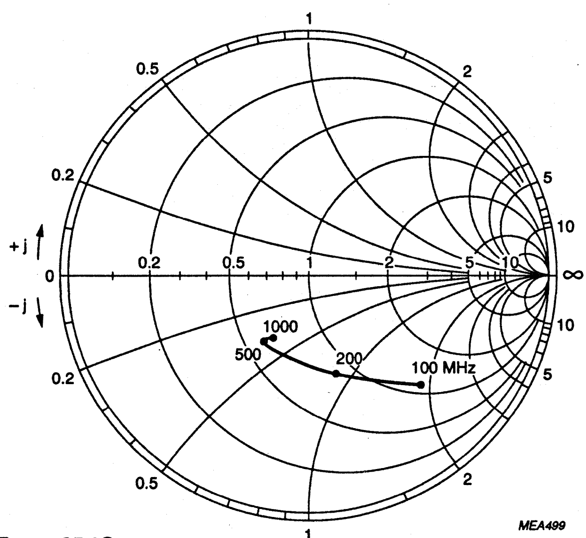
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.

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_0 = 50 Ω.

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

NPN 3.5 GHz wideband transistor BFR95

DESCRIPTION

NPN resistance-stabilized transistor in a SOT5 (TO-39) metal envelope, with collector connected to the case.

The transistor features low cross modulation, intermodulation and second order intermodulation distortion. Due to its high transition frequency, it has a high power gain combined with excellent wideband properties and low noise up to high frequencies.

It is primarily intended for CATV and MATV applications.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

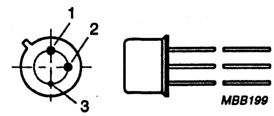


Fig.1 SOT5.

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_s = 125 °C (note 1)	–	1.5	W
f_T	transition frequency	I_C = 80 mA; V_{CE} = 20 V; f = 500 MHz; T_j = 25 °C	3.5	–	GHz
F	noise figure	I_C = 80 mA; V_{CE} = 18 V; f = 200 MHz; T_{amb} = 25 °C	9	10	dB
d_{im}	intermodulation distortion	I_C = 80 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C; V_O = 60 dBmV; $f_{(p+q-r)}$ = 194.25 MHz	–64	–	dB
d_2	second order intermodulation distortion	I_C = 80 mA; V_{CE} = 18 V; T_{amb} = 25 °C V_O = 48 dBmV; $f_{(p+q)}$ = 210 MHz	–62	–	dB

Note

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

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_s = 125 °C (note 1)	–	1.5	W
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

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 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} = 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 = 80 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_{re}	feedback capacitance	I_C = 10 mA; V_{CE} = 20 V; f = 1 MHz	–	1.6	–	pF
F	noise figure	I_C = 80 mA; V_{CE} = 18 V; f = 200 MHz; T_{amb} = 25 °C	–	9	10	dB
d_{im}	intermodulation distortion	note 1	–	–64	–	dB
d_2	second order intermodulation distortion	note 2	–	–62	–56	dB

Notes

1. I_C = 80 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$ = 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.
2. I_C = 80 mA; V_{CE} = 18 V; T_{amb} = 25 °C;
   f_p = 66 MHz; f_q = 144 MHz; $f_{(p+q)}$ = 210 MHz; V_O = 48 dBmV.

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

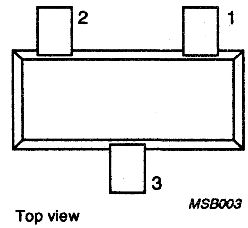


Fig.1 SOT23.

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. I_C = 30 mA; V_{CE} = 6 V; R_L = 75 Ω; 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 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz.

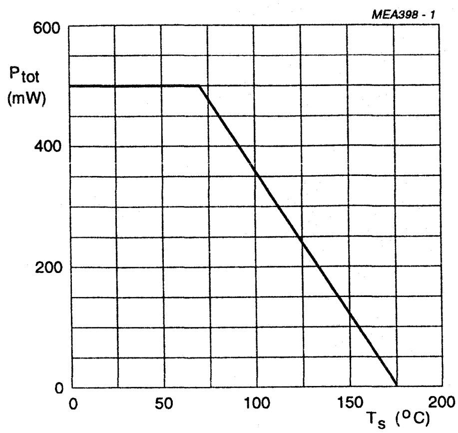
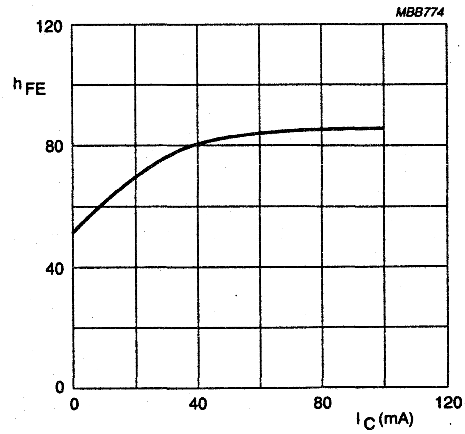
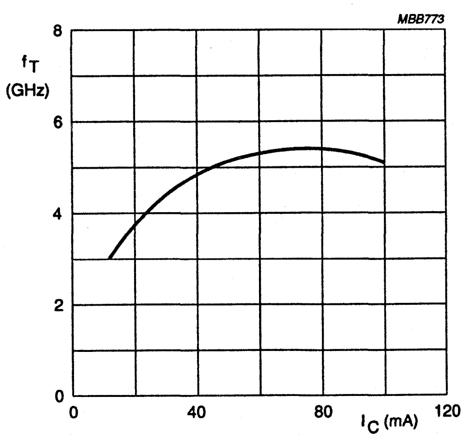


Fig.2 Power derating curve.



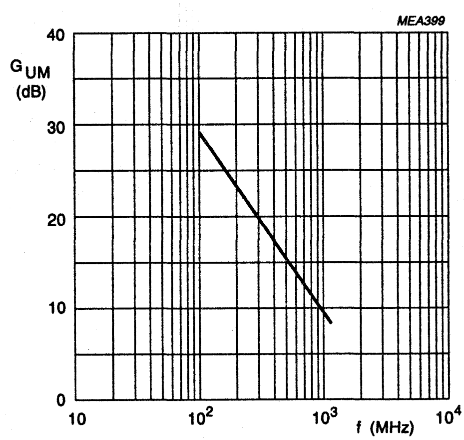
V_{CE} = 9 V; T_{amb} = 25 °C.

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



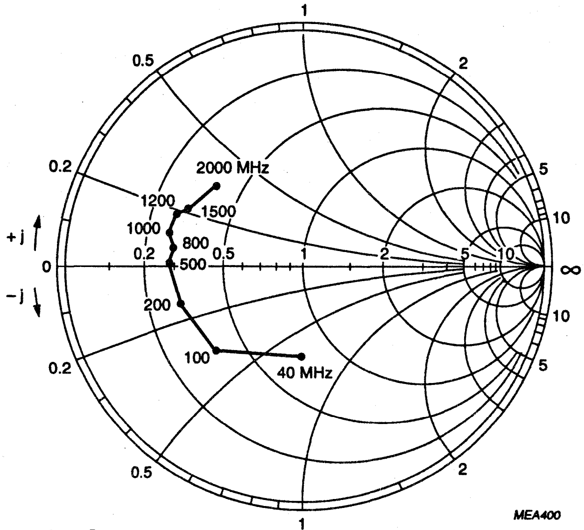
V_{CE} = 9 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



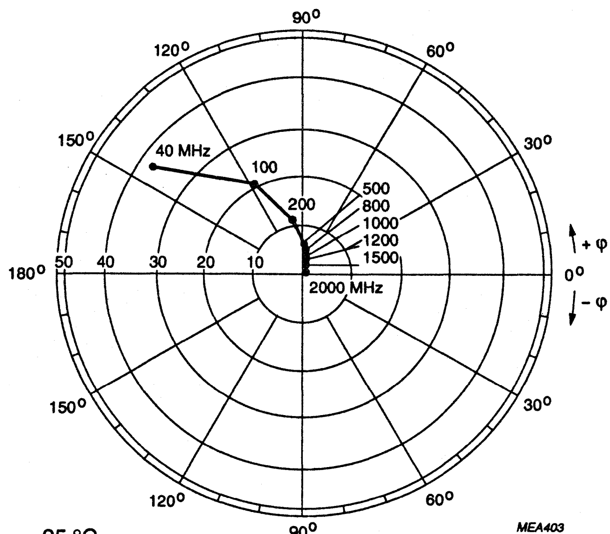
I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.5 Maximum unilateral power gain as a function of frequency.



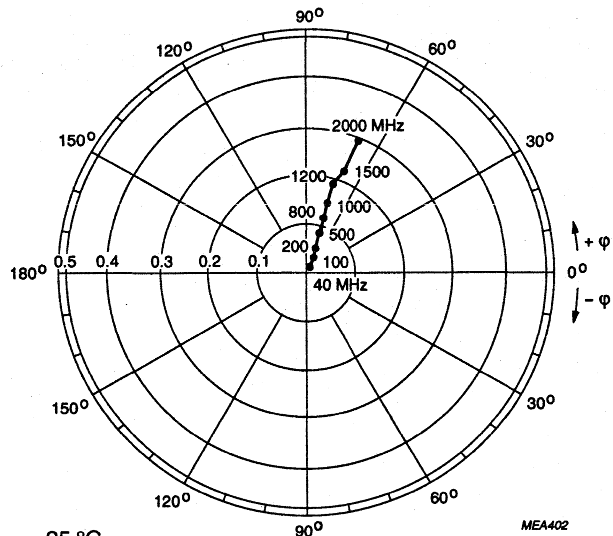
$I_C = 30\ mA$; $V_{CE} = 6\ V$; $T_{amb} = 25\ °C$.
$Z_0 = 50\ \Omega$.

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



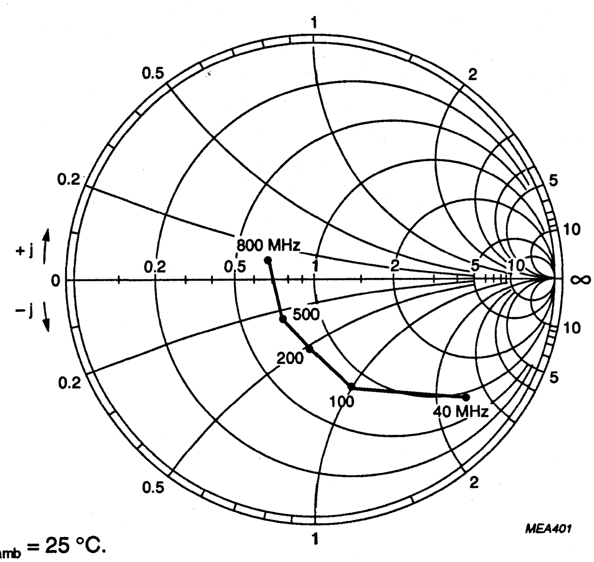
$I_C = 30\ mA$; $V_{CE} = 6\ V$; $T_{amb} = 25\ °C$.

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.

PINNING

PIN	DESCRIPTION
	Code: N30
1	base
2	emitter
3	collector

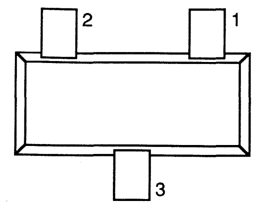


Fig.1 SOT23.

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.

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
$\lvert S_{21}\rvert^2$	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 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 $G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{(1 - \lvert S_{11}\rvert^2)(1 - \lvert S_{22}\rvert^2)}$ dB.
2. I_C = 5 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.

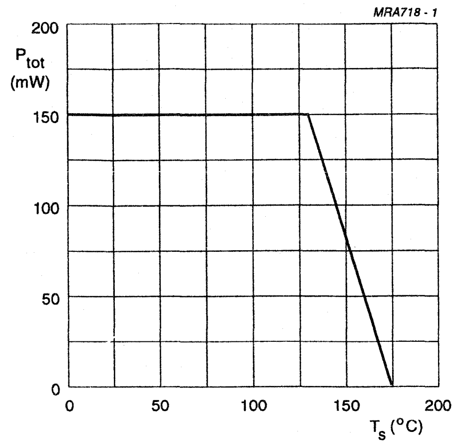
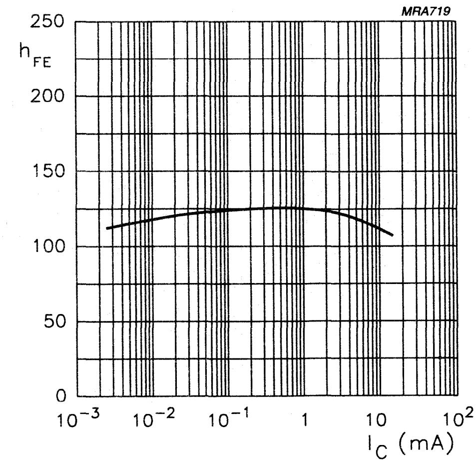
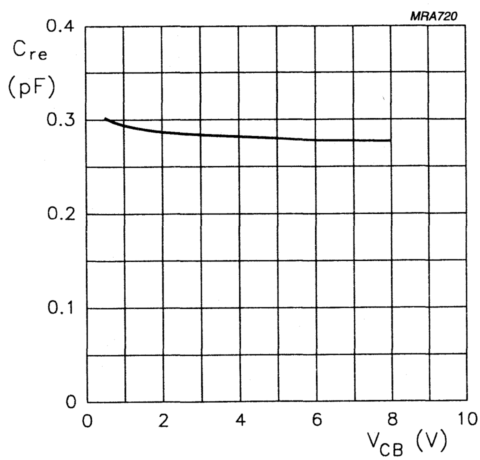


Fig.2 Power derating curve.



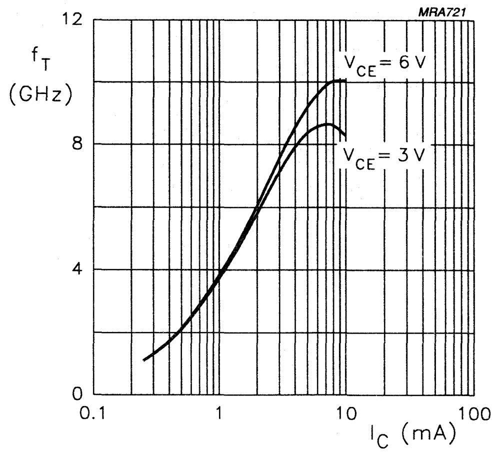
V_{CE} = 6 V.

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



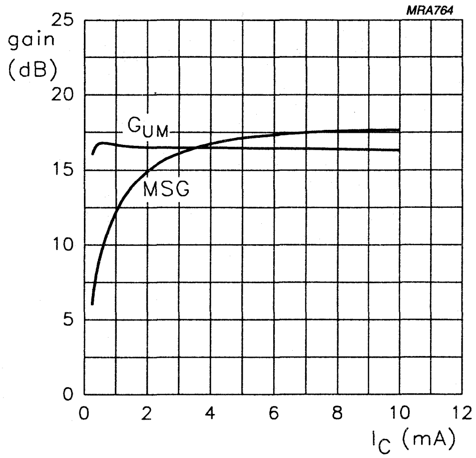
I_C = 0; f = 1 MHz.

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



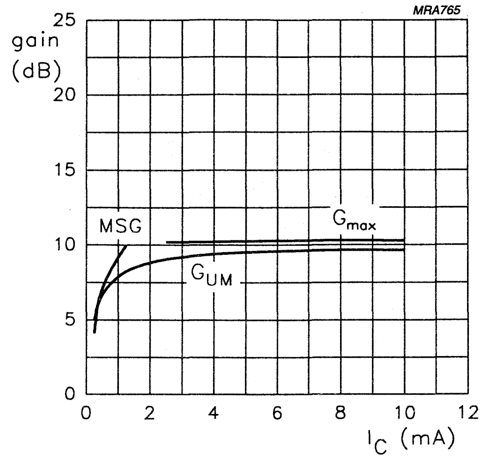
T_{amb} = 25 °C; f = 1 GHz.

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



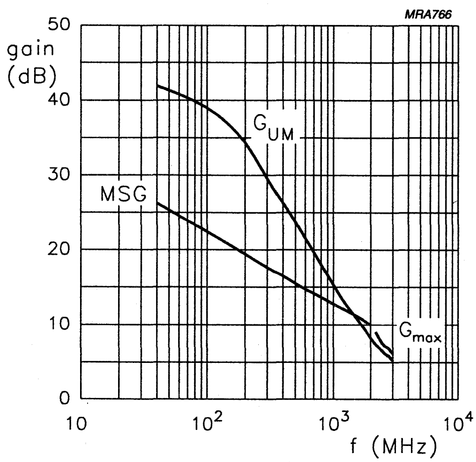
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



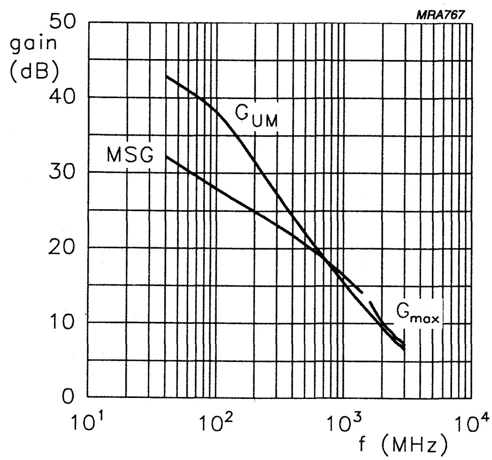
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



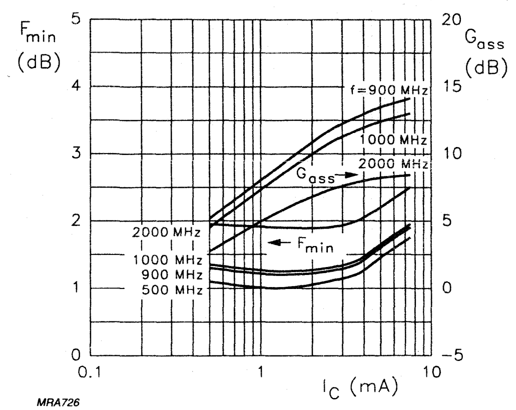
V_{CE} = 6 V; I_C = 1.25 mA.

Fig.8 Gain as a function of frequency.



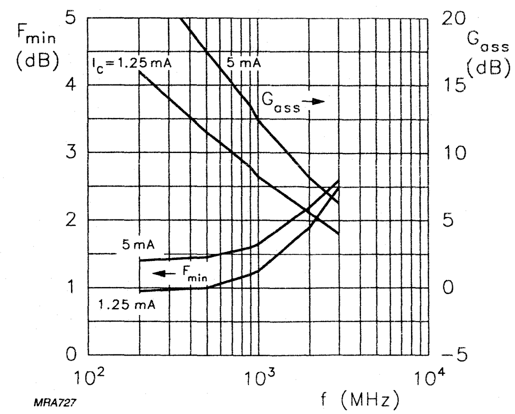
V_{CE} = 6 V; I_C = 5 mA.

Fig.9 Gain as a function of frequency.



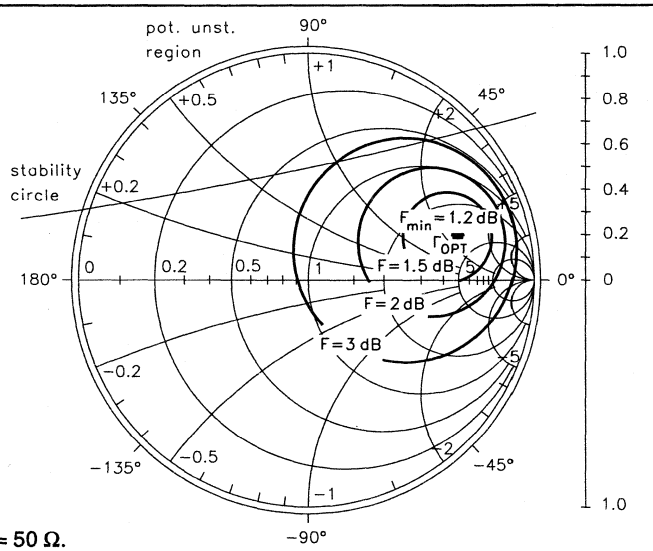
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



V_{CE} = 6 V.

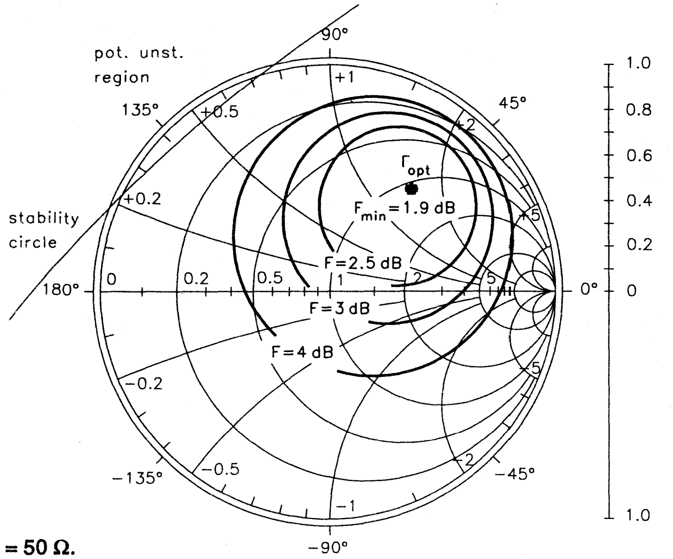
Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_O = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

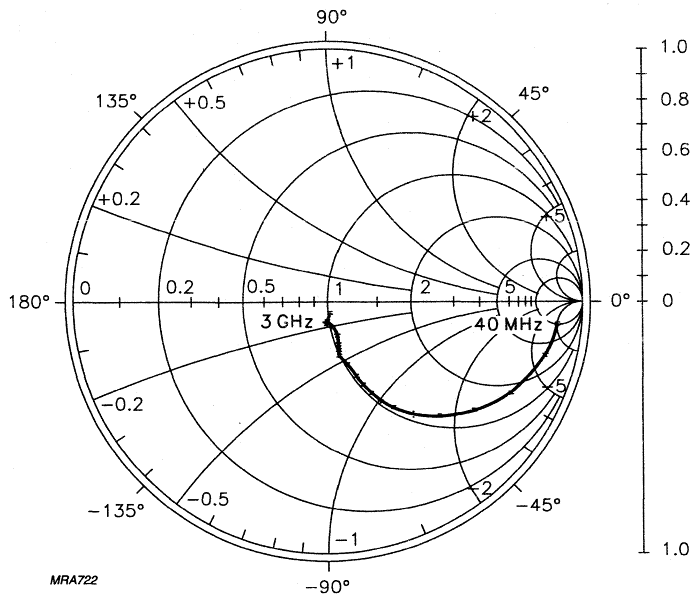
Fig.12 Noise circle figure.



Z_o = 50 Ω.

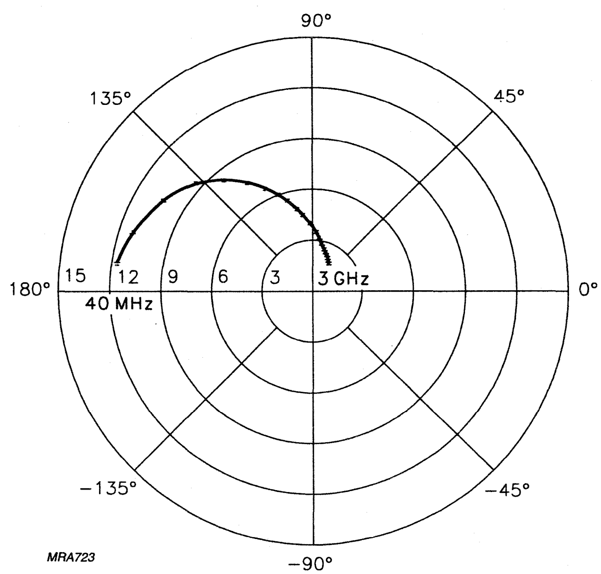
V_{CE} = 6 V; I_C = 5 mA; f = 2000 MHz.

Fig.13 Noise circle figure.



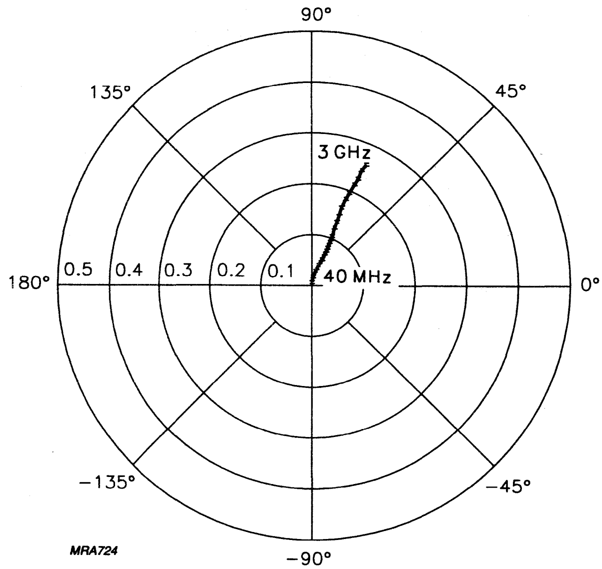
V_{CE} = 6 V; I_C = 5 mA.
Z_o = 50 Ω.

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



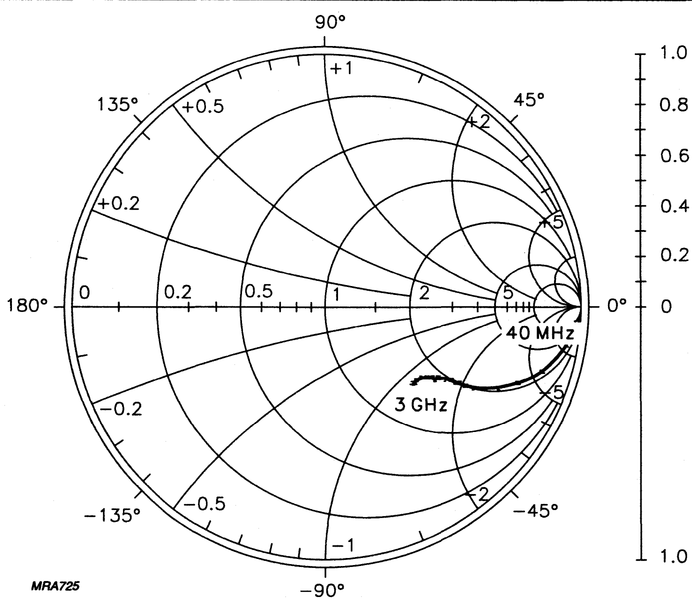
V_{CE} = 6 V; I_C = 5 mA.

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.

PINNING

PIN	DESCRIPTION
Code: N28	
1	base
2	emitter
3	collector

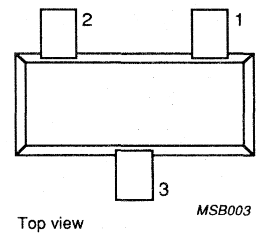


Fig.1 SOT23.

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.

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.

NPN 9 GHz wideband transistor BFR520

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; $R_L = 50\ \Omega$; $T_{amb} = 25$ °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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. $I_C = 20$ 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.

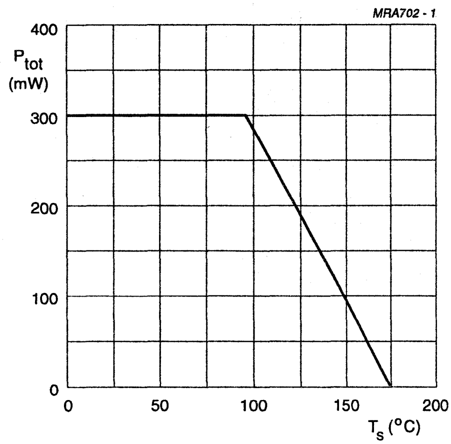
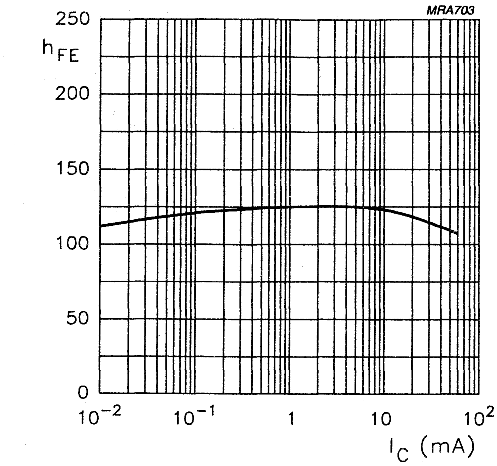
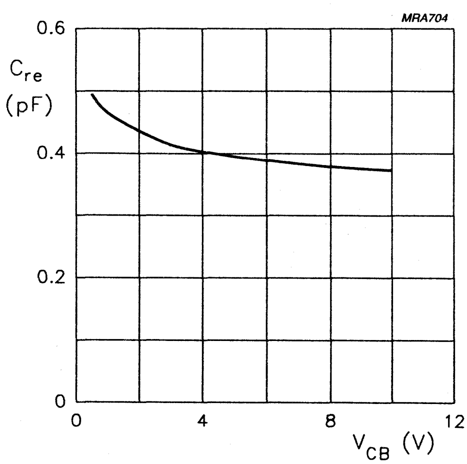


Fig.2 Power derating curve.



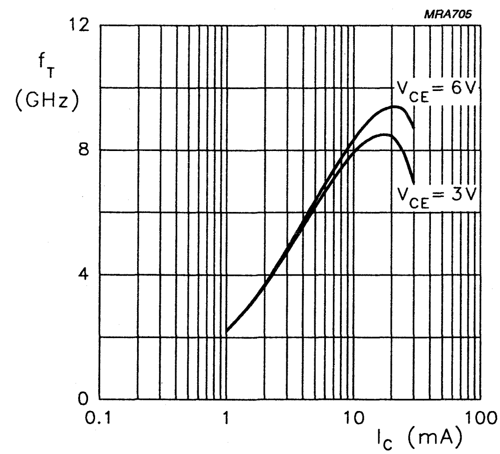
V_{CE} = 6 V.

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



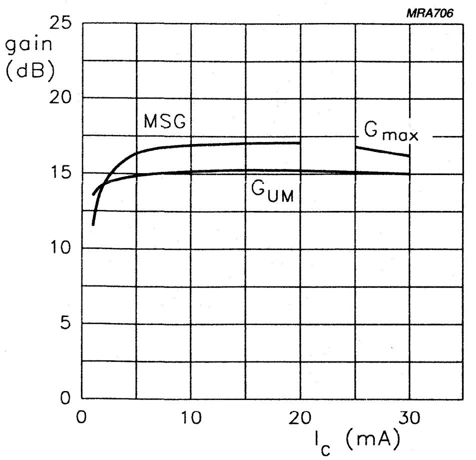
I_C = 0; f = 1 MHz.

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



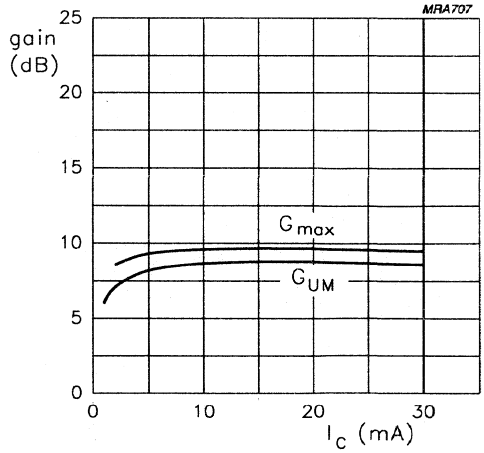
T_{amb} = 25 °C; f = 1 GHz.

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



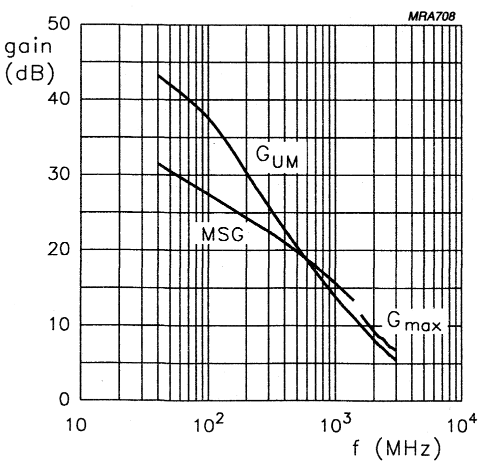
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



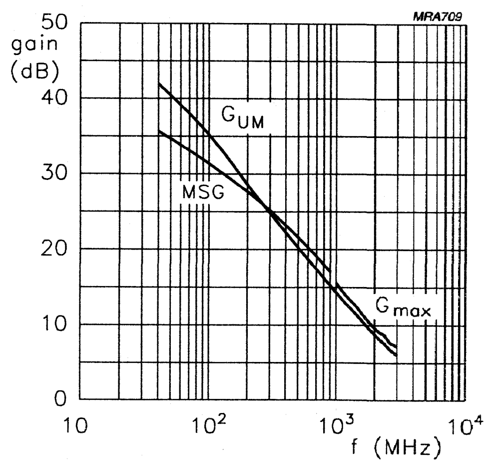
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



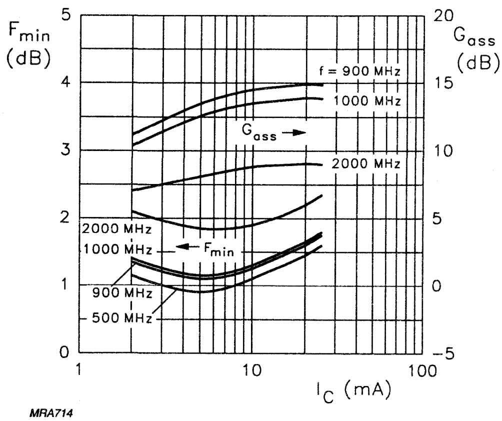
V_{CE} = 6 V; I_C = 5 mA.

Fig.8 Gain as a function of frequency.



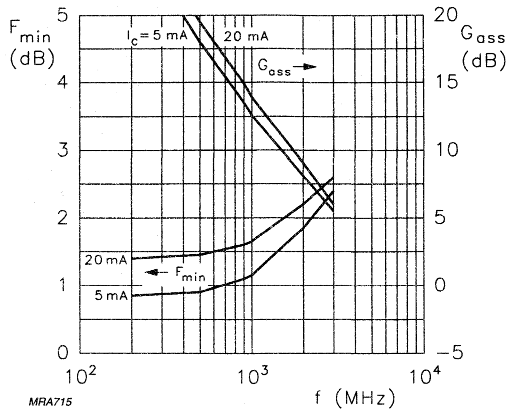
V_{CE} = 6 V; I_C = 20 mA.

Fig.9 Gain as a function of frequency.



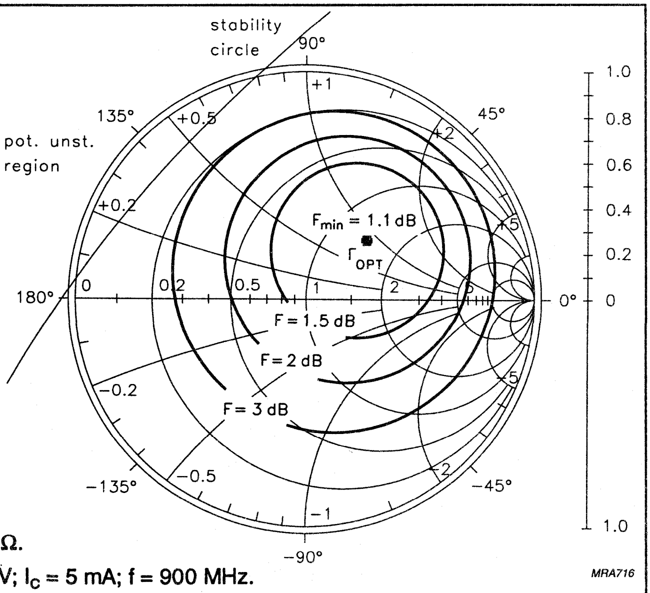
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



V_{CE} = 6 V.

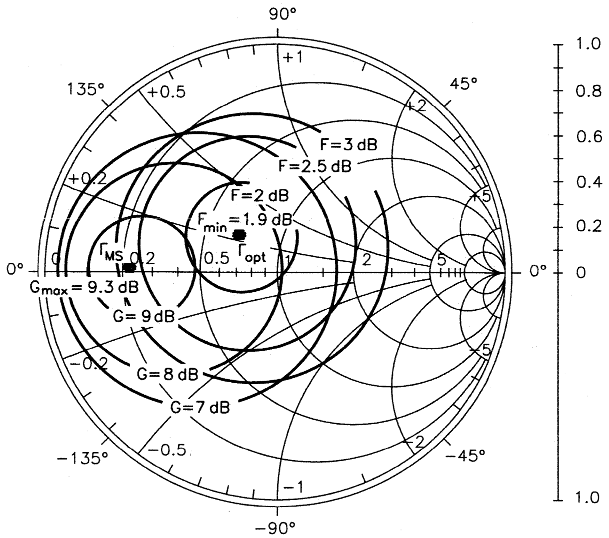
Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

Fig.12 Noise circle figure.

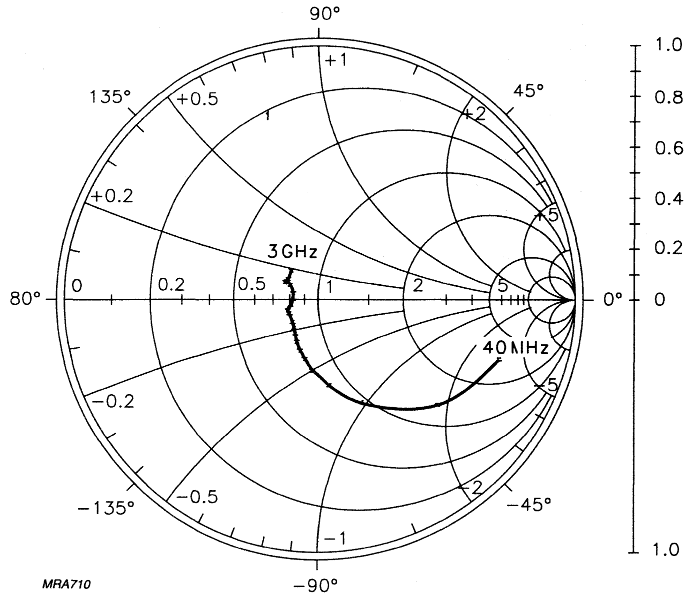


Z_O = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 2000 MHz.

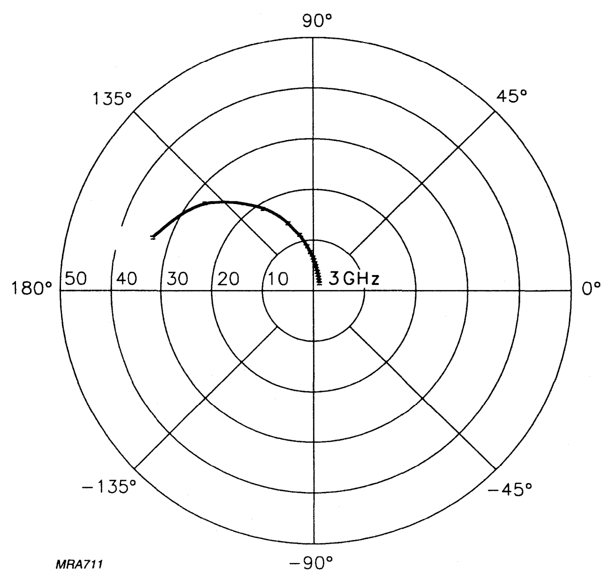
Fig.13 Noise circle figure.

NPN 9 GHz wideband transistor BFR520



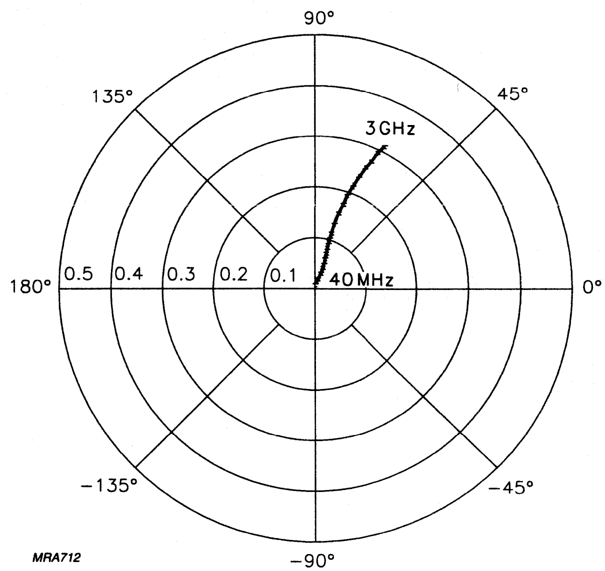
V_{CE} = 6 V; I_C = 20 mA.
Z_o = 50 Ω.

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



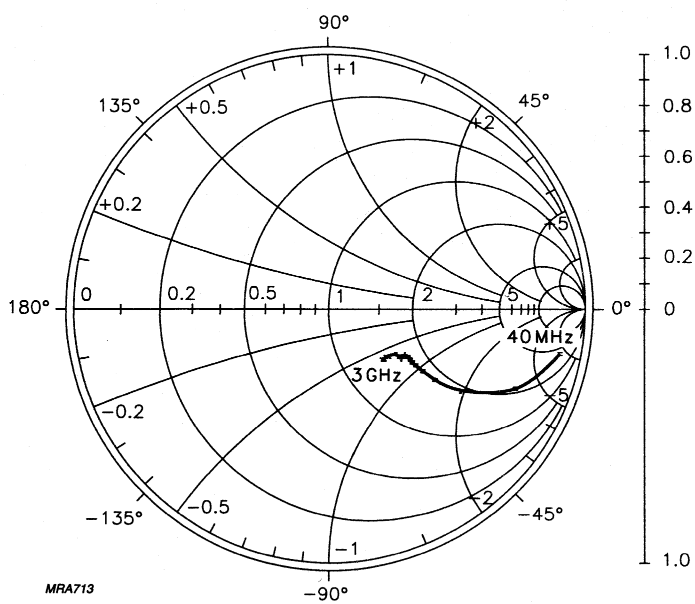
V_{CE} = 6 V; I_C = 20 mA.

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

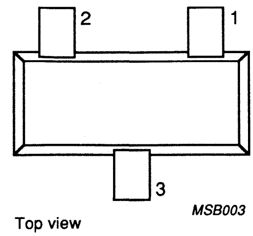


Fig.1 SOT23.

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	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (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	$I_E = 0$; $V_{CB} = 8$ 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
$\lvert S_{21}\rvert^2$	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 $G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{(1 - \lvert S_{11}\rvert^2)(1 - \lvert S_{22}\rvert^2)}$ 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.

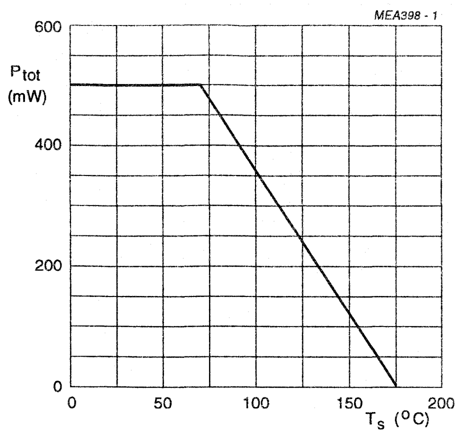
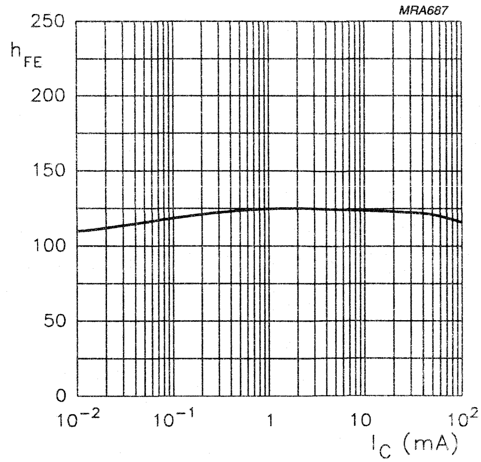
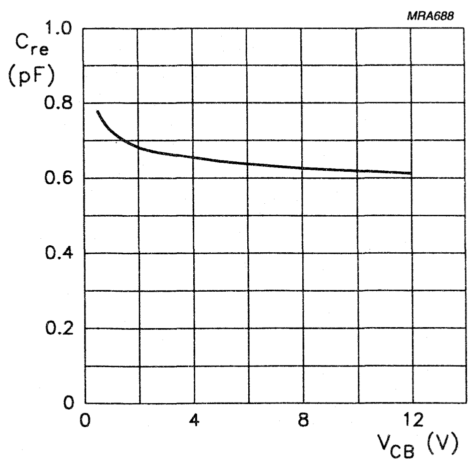


Fig.2 Power derating curve.



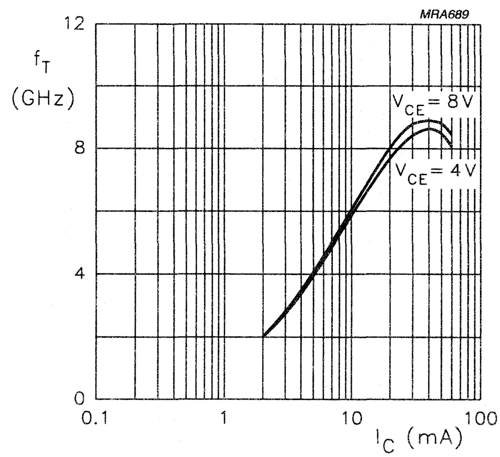
V_{CE} = 8 V.

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



I_C = 0; f = 1 MHz.

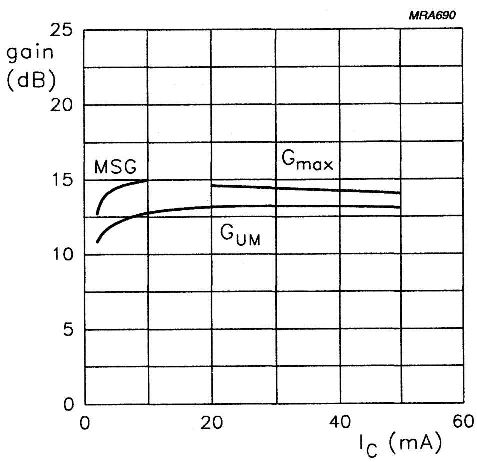
Fig.4 Feedback capacitance as a function of collector-base voltage.



T_{amb} = 25 °C; f = 1 GHz.

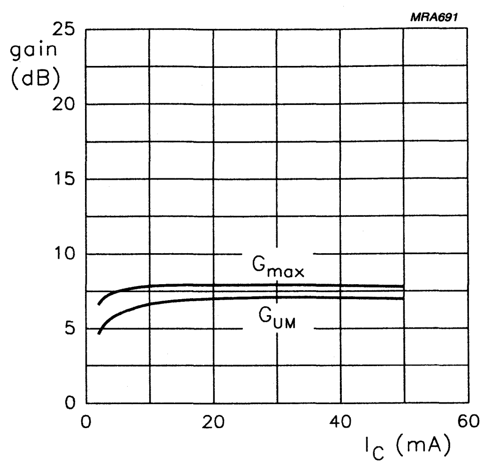
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



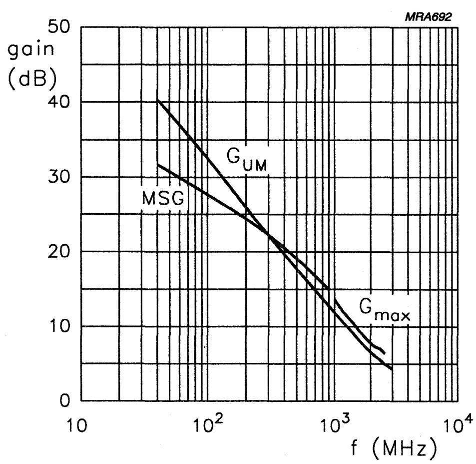
V_{CE} = 8 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



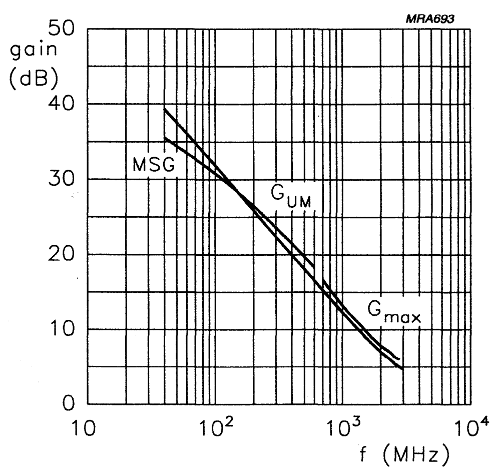
V_{CE} = 8 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



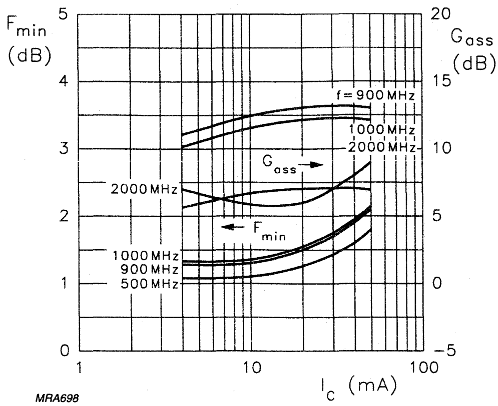
V_{CE} = 8 V; I_C = 10 mA.

Fig.8 Gain as a function of frequency.



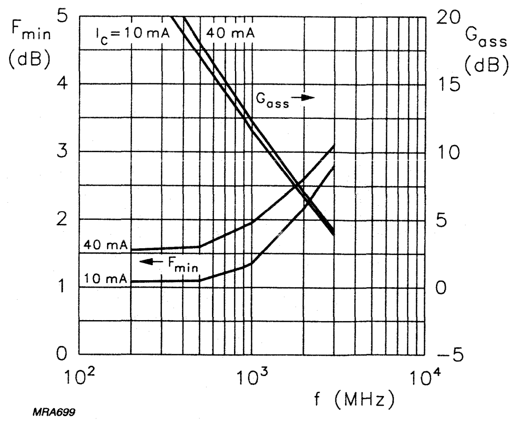
V_{CE} = 8 V; I_C = 40 mA.

Fig.9 Gain as a function of frequency.



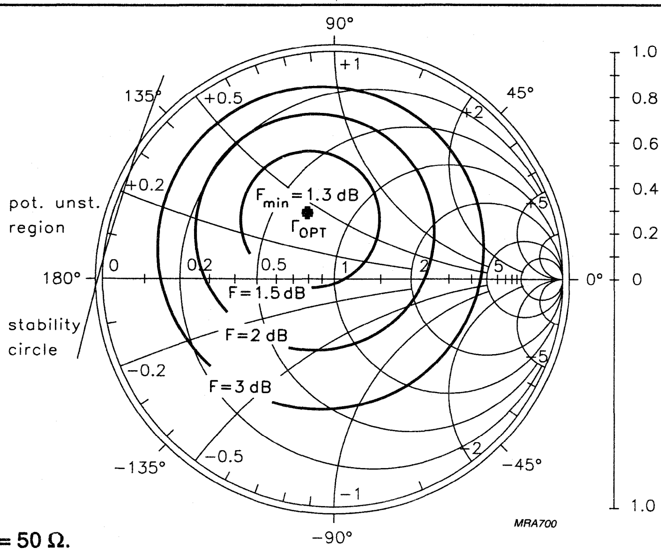
V_{CE} = 8 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



V_{CE} = 8 V.

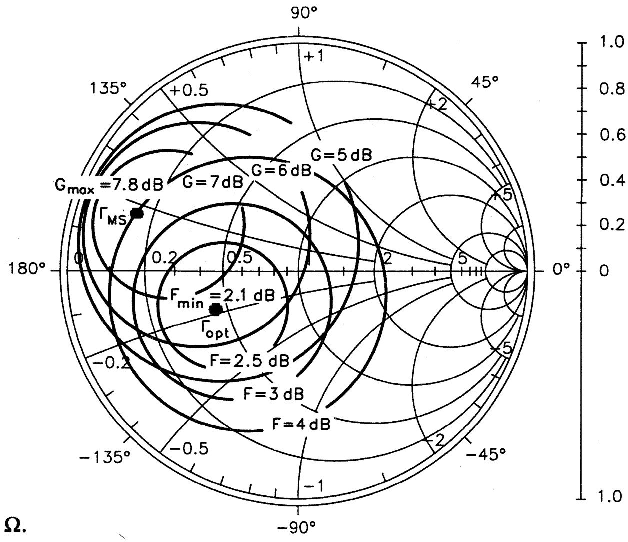
Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_O = 50 Ω.

V_{CE} = 8 V; I_C = 10 mA; f = 900 MHz.

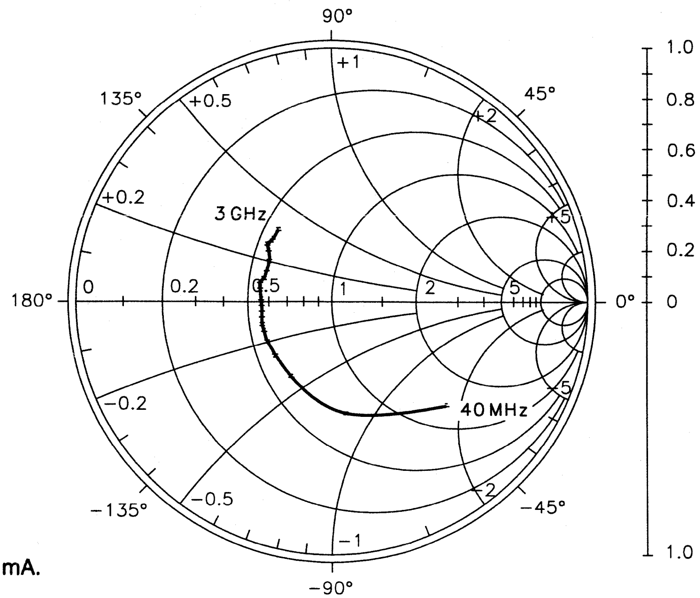
Fig.12 Noise circle figure.



Z_O = 50 Ω.

V_{CE} = 8 V; I_C = 10 mA; f = 2000 MHz.

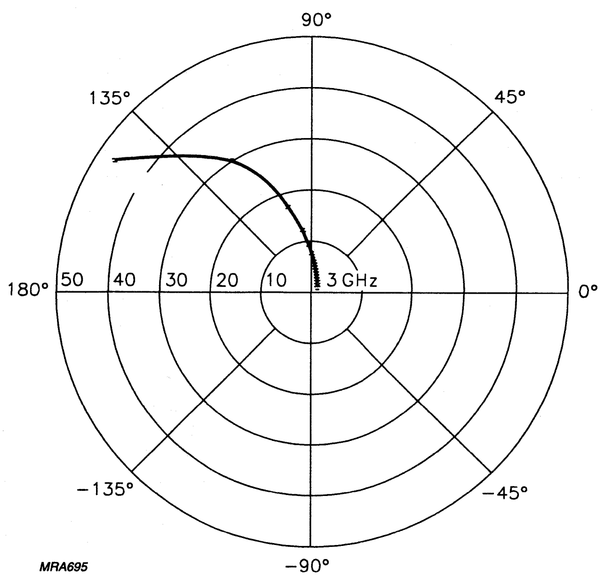
Fig.13 Noise circle figure.



V_{CE} = 8 V; I_C = 40 mA.
Z_o = 50 Ω.

MRA694

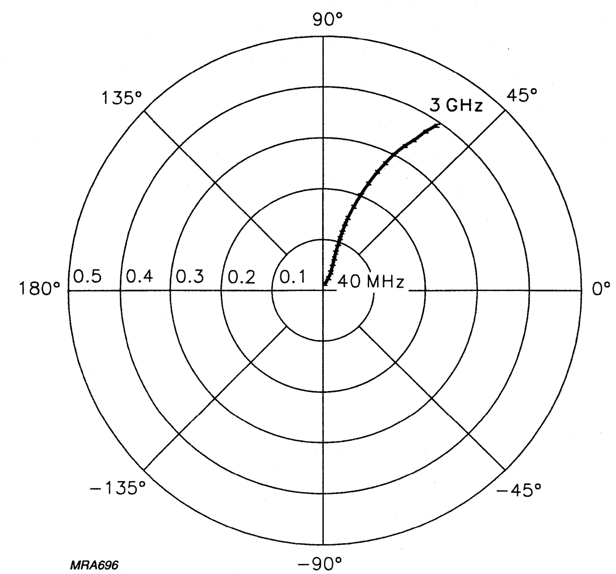
Fig.14 Common emitter input reflection coefficient (S_{11}).



V_{CE} = 8 V; I_C = 40 mA.

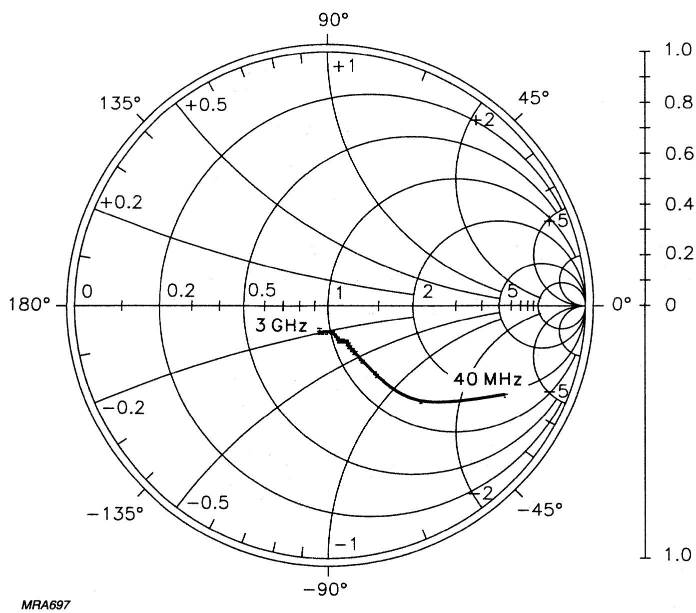
MRA695

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 envelope.

It is intended for a wide range of RF applications, such as mixers and oscillators in TV tuners and RF communications equipment.

PINNING

PIN	DESCRIPTION
	Code: E1p
1	base
2	emitter
3	collector

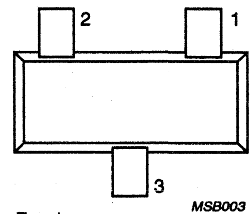


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	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 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

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)	260 K/W

Note

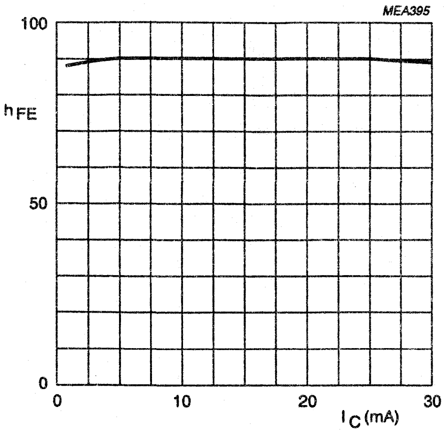
1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

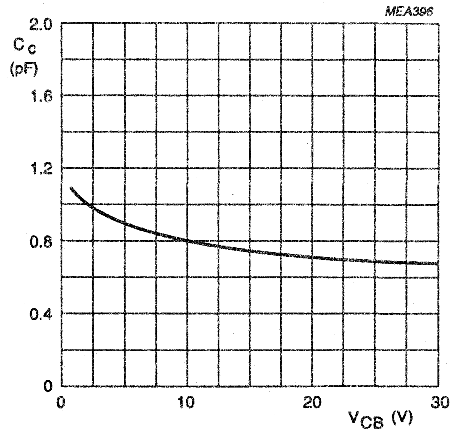
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	–	–	10	nA
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V	25	90	–	
		I_C = 25 mA; V_{CE} = 1 V	25	90	–	
f_T	transition frequency	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz	–	1	–	GHz
		I_C = 25 mA; V_{CE} = 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

NPN 1 GHz wideband transistor BFS17



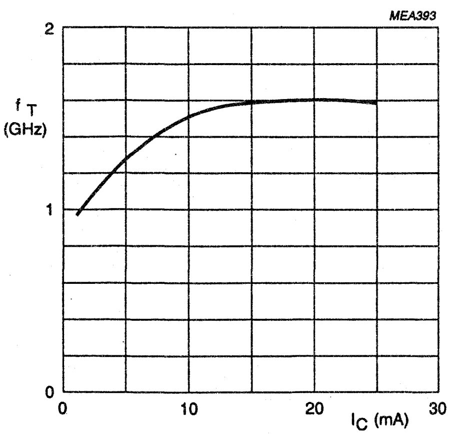
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



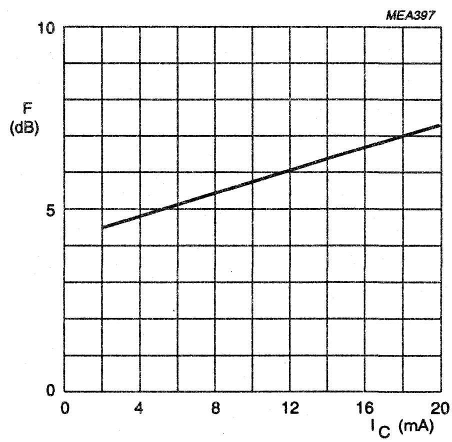
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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 envelope.

It is intended for a wide range of RF applications such as TV tuners.

PINNING

PIN	DESCRIPTION
	Code: E2p
1	base
2	emitter
3	collector

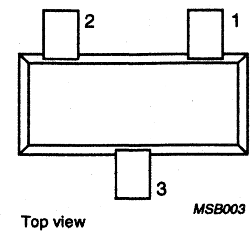


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	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 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

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)	260 K/W

Note

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

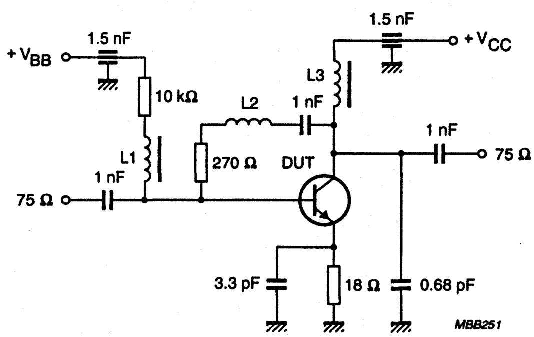
CHARACTERISTICS

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 = 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

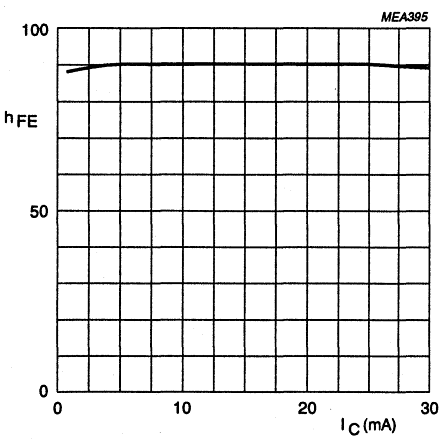
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. d_{im} = –60 dB (DIN 45004B); I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; f_p = 795.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 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.

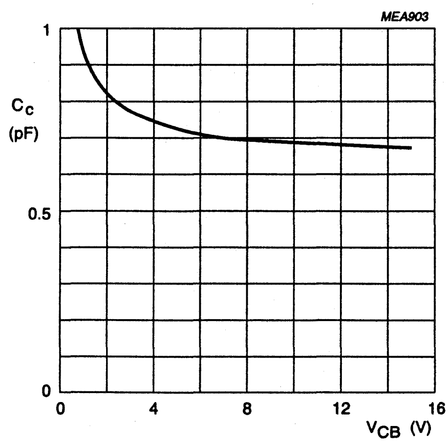
L2 = 3 turns 0.4 mm copper wire; winding pitch 1 mm; internal diameter 3 mm.

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



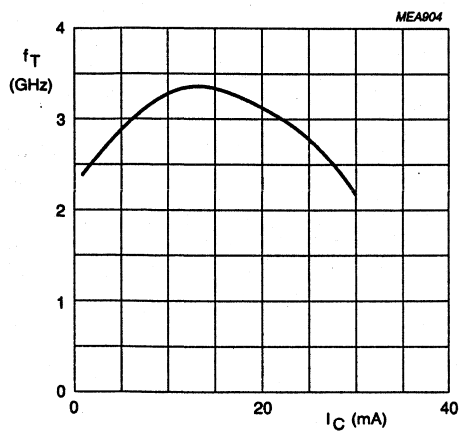
V_{CE} = 1 V; T_{amb} = 25 °C.

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



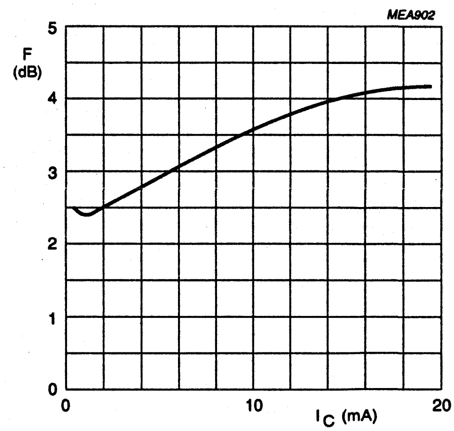
I_E = 0; f = 1 MHz; T_{amb} = 25 °C.

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

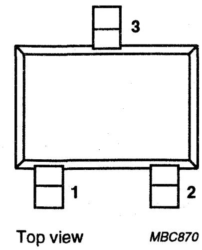
Primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners.

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

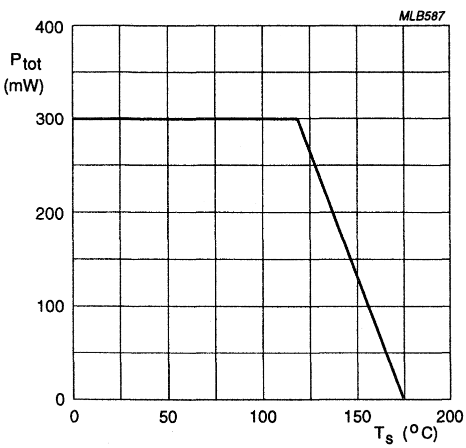
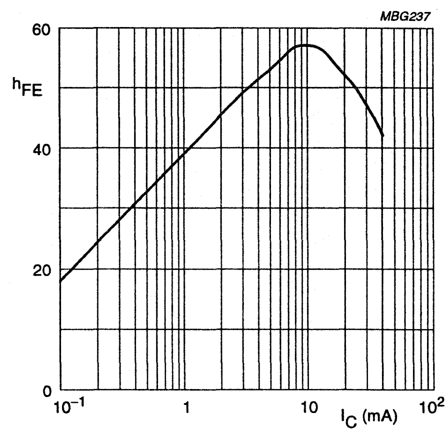
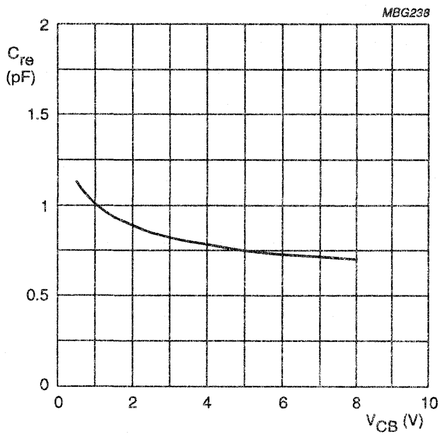


Fig.2 Power derating curve.



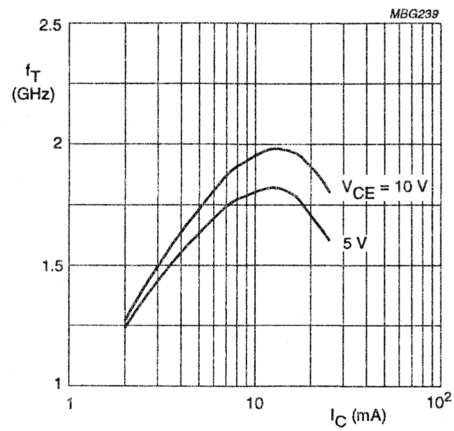
V_{CE} = 1 V.

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



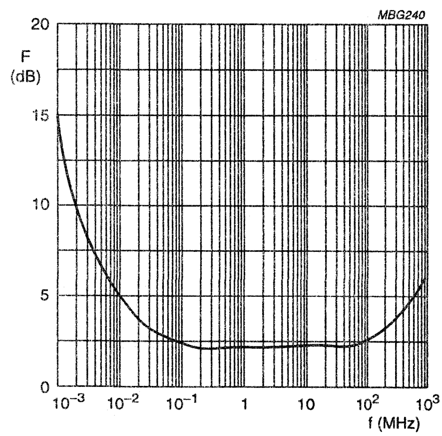
$I_B = i_b = 0$; f = 1 MHz.

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

PIN CONFIGURATION

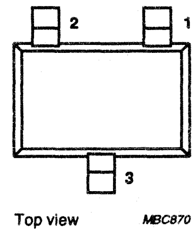


Fig.1 SOT323.

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	μA
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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

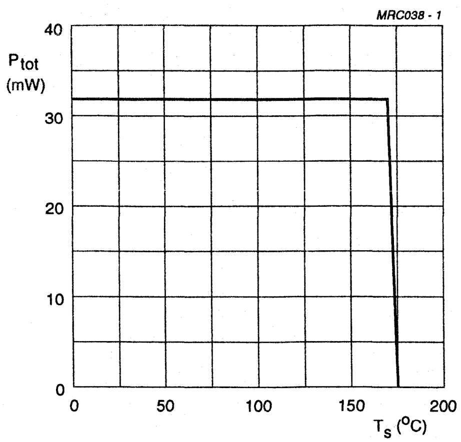
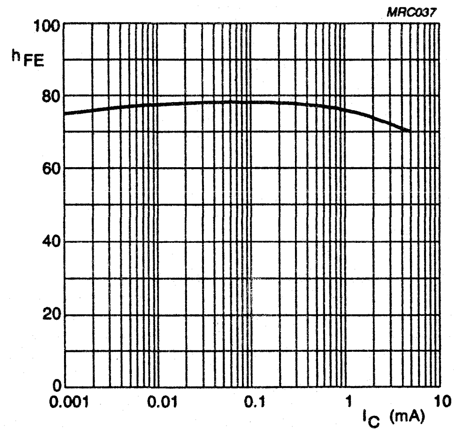
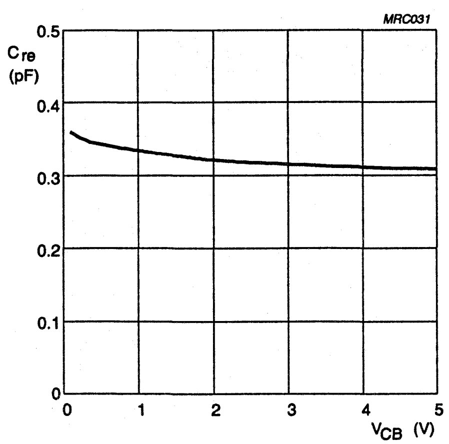


Fig.2 Power derating curve.



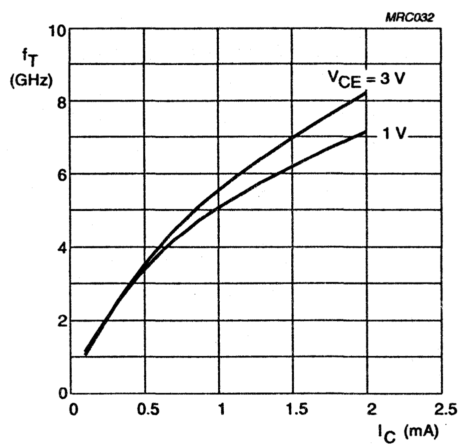
V_{CE} = 1 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

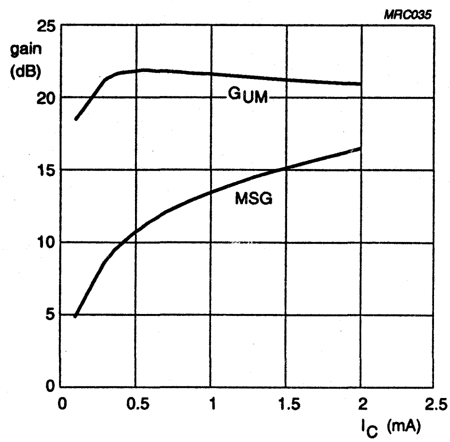
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

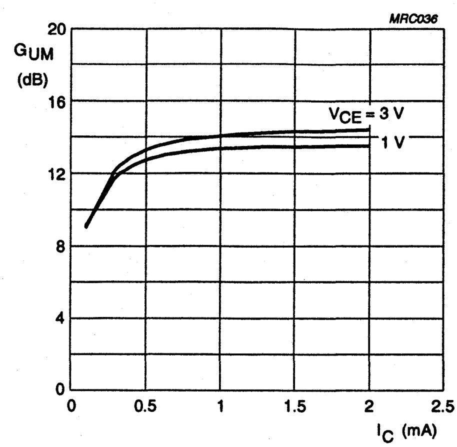
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



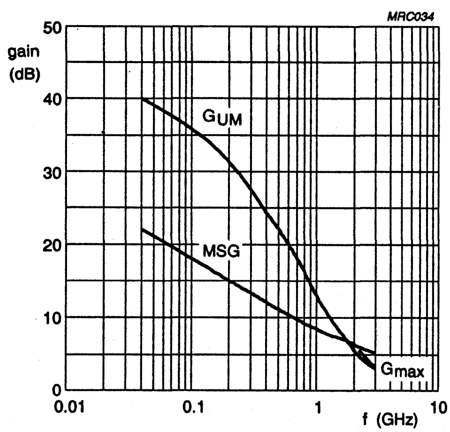
V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



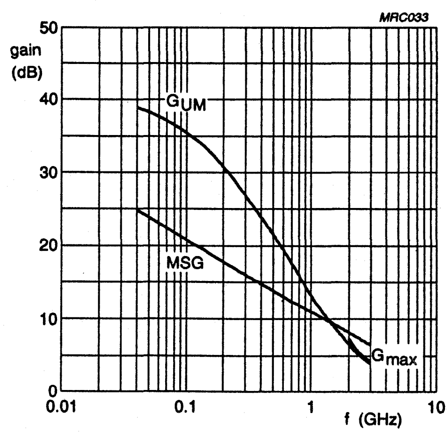
f = 1 GHz; T_{amb} = 25 °C.

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.

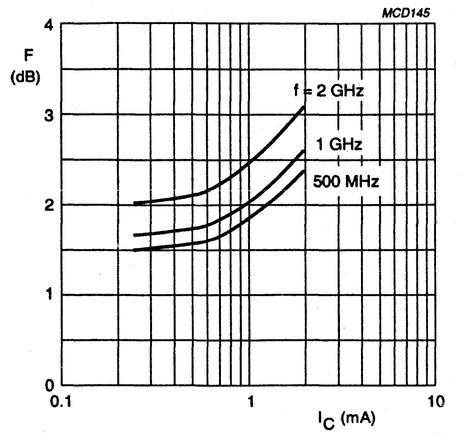
Fig.8 Gain as a function of frequency.



I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

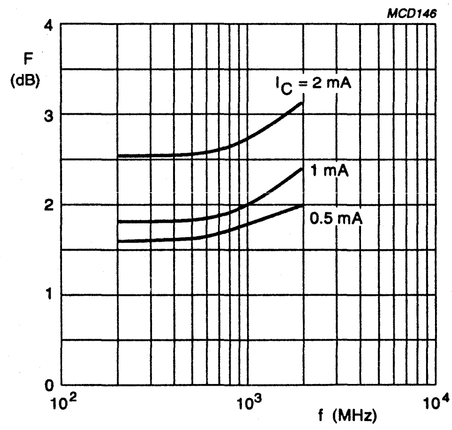
Fig.9 Gain as a function of frequency.

NPN 5 GHz wideband transistor | BFS25A



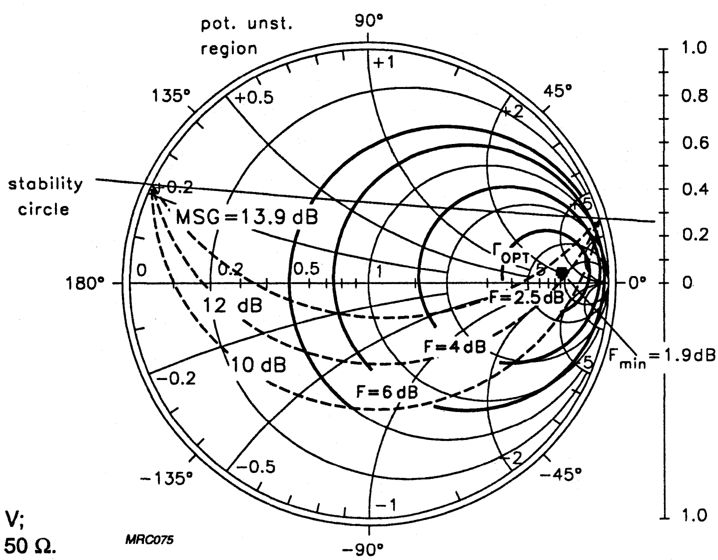
V_{CE} = 1 V; T_{amb} = 25 °C.

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



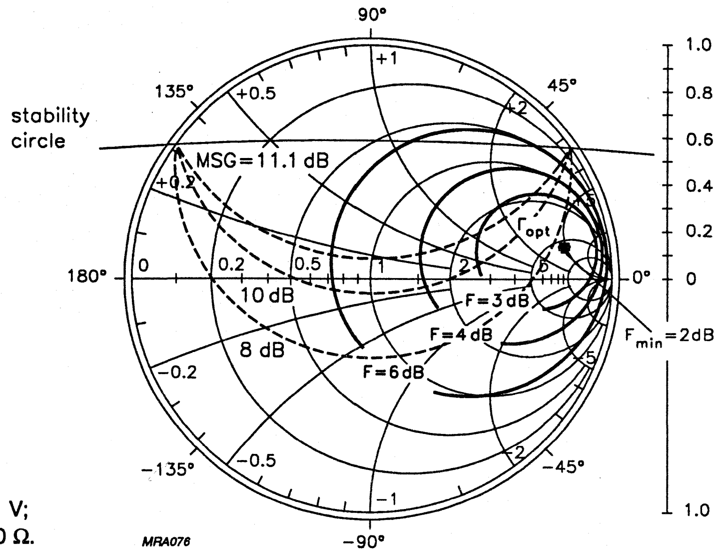
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



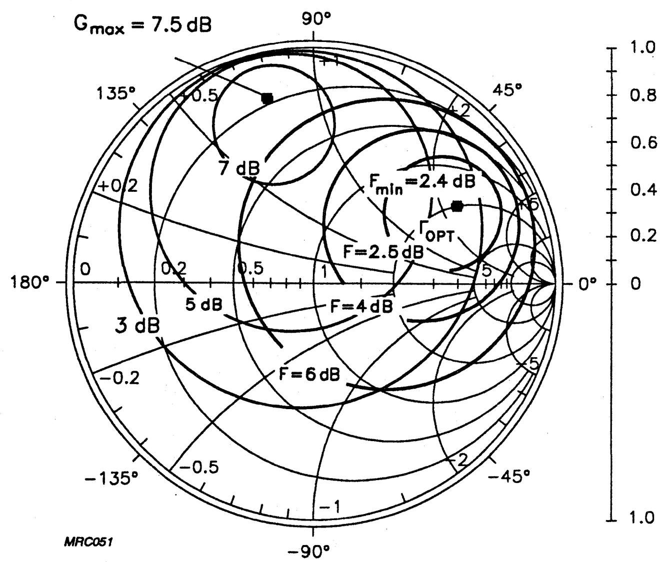
I_C = 1 mA; V_{CE} = 1 V;
f = 500 MHz; Z_O = 50 Ω.

Fig.12 Noise circle.



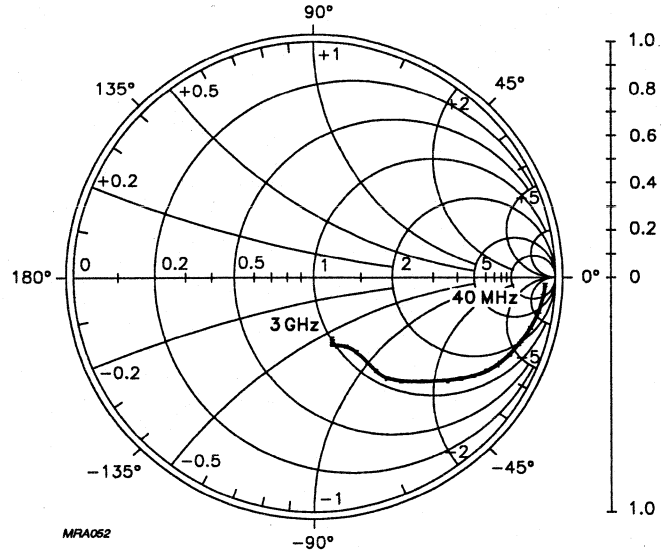
I_C = 1 mA; V_{CE} = 1 V;
f = 1 GHz; Z_O = 50 Ω.

Fig.13 Noise circle.



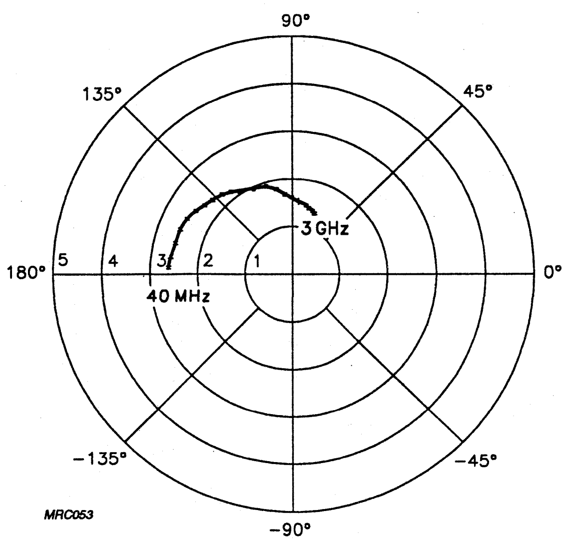
I_C = 1 mA; V_{CE} = 1 V;
f = 2 GHz; Z_O = 50 Ω.

Fig.14 Noise circle.



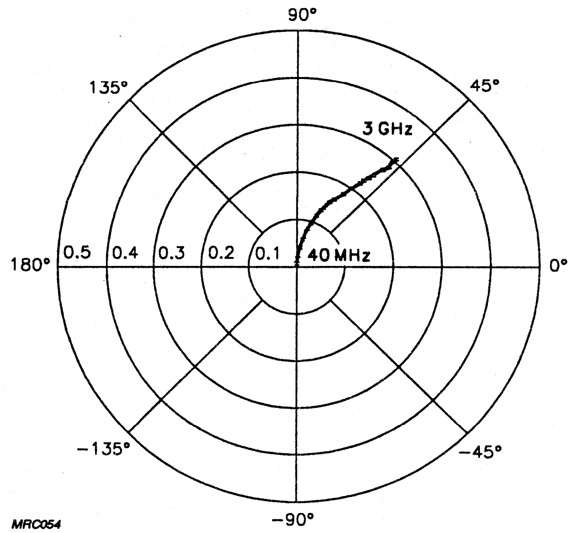
I_C = 1 mA; V_{CE} = 1 V;
Z_O = 50 Ω.

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



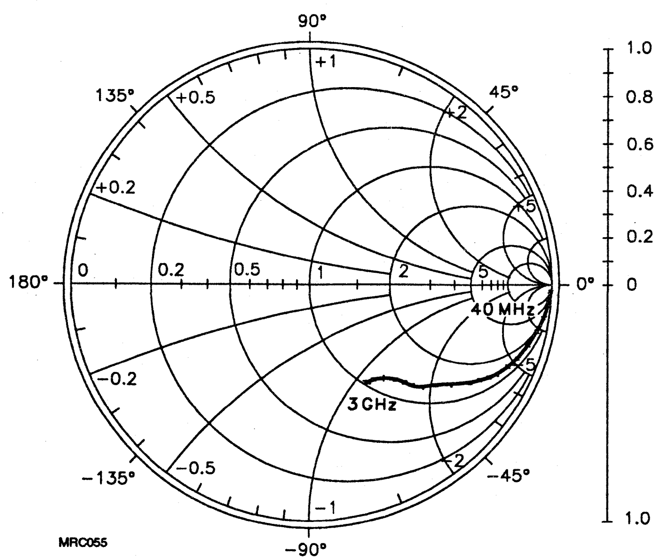
I_C = 1 mA; V_{CE} = 1 V.

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 Ω.

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.

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.

PINNING

PIN	DESCRIPTION
Code: N0	
1	base
2	emitter
3	collector

PIN CONFIGURATION

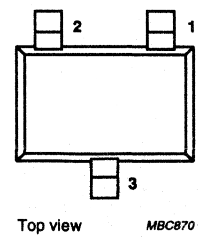


Fig.1 SOT323.

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		–	–	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.

NPN 9 GHz wideband transistor BFS505

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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ 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 $f_{(2p-q)} = 904$ MHz.

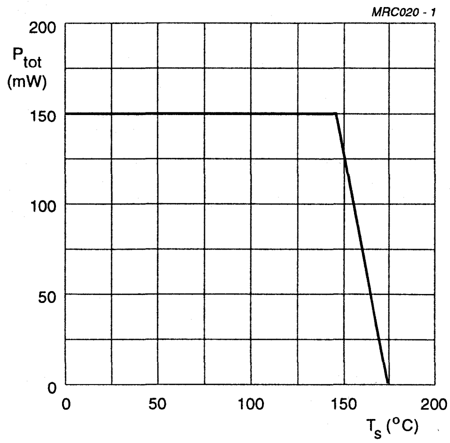
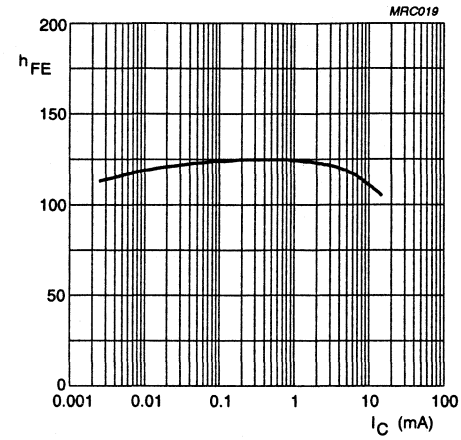
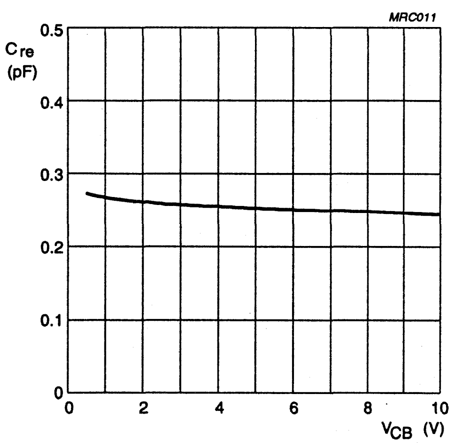


Fig.2 Power derating curve.



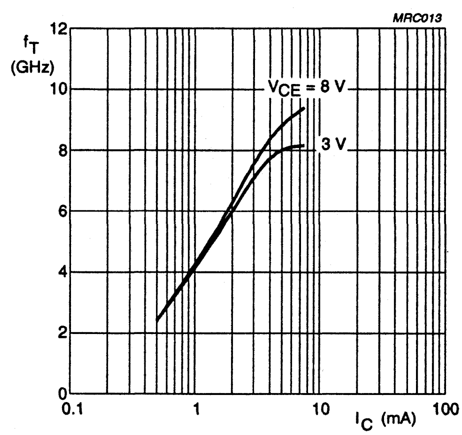
V_{CE} = 6 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

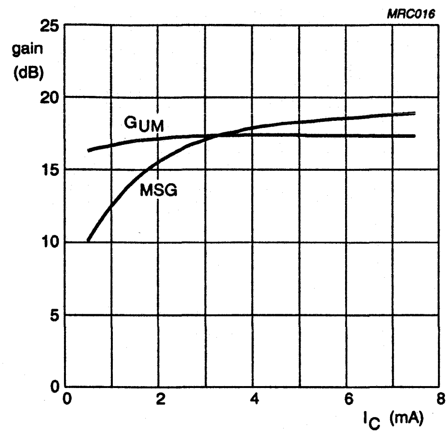
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

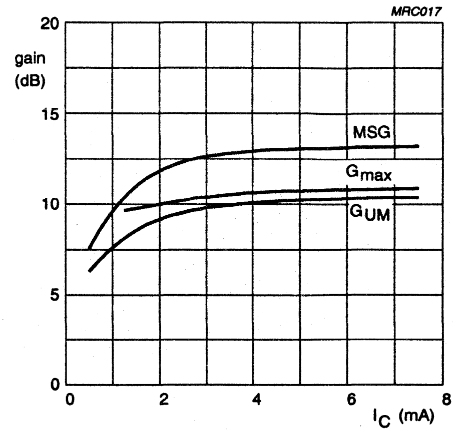
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



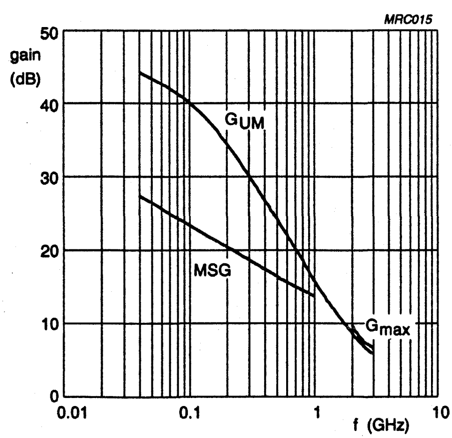
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



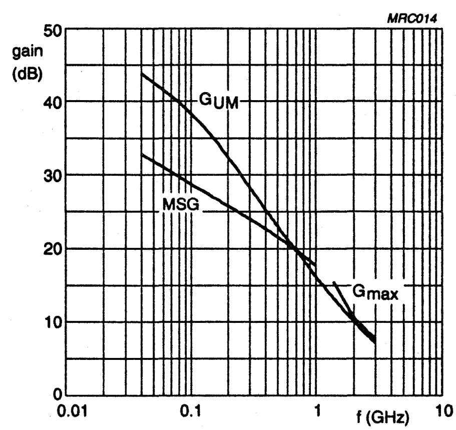
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

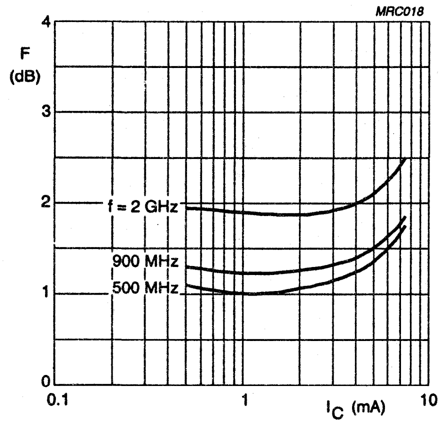
Fig.8 Gain as a function of frequency.



I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

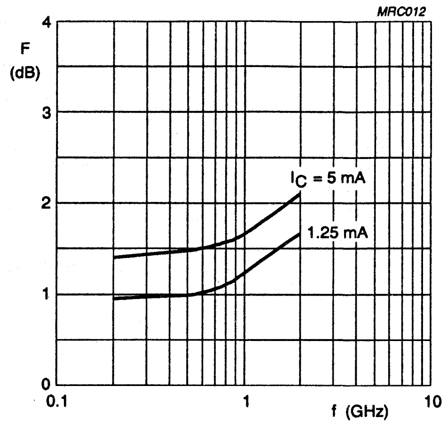
Fig.9 Gain as a function of frequency.

NPN 9 GHz wideband transistor BFS505



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.

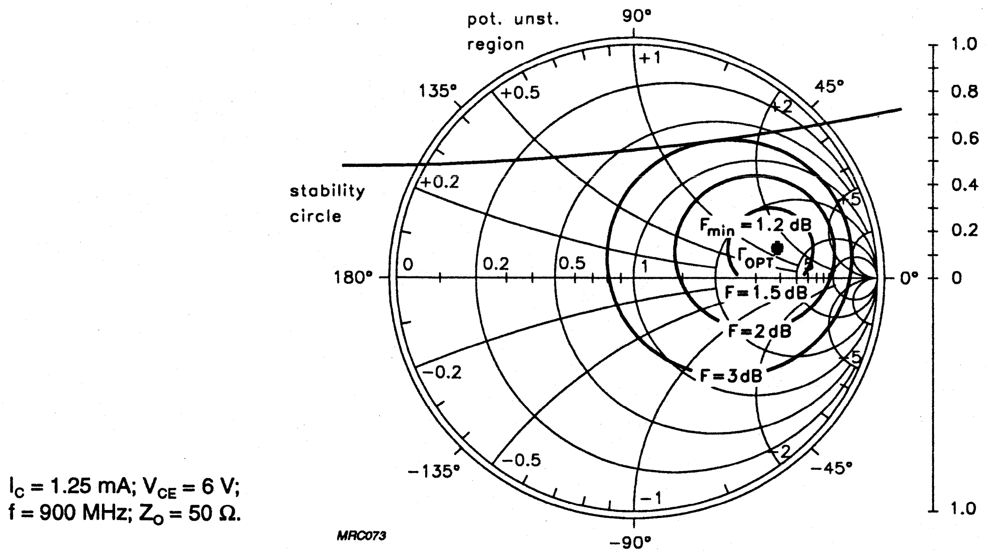


Fig.12 Noise circle.

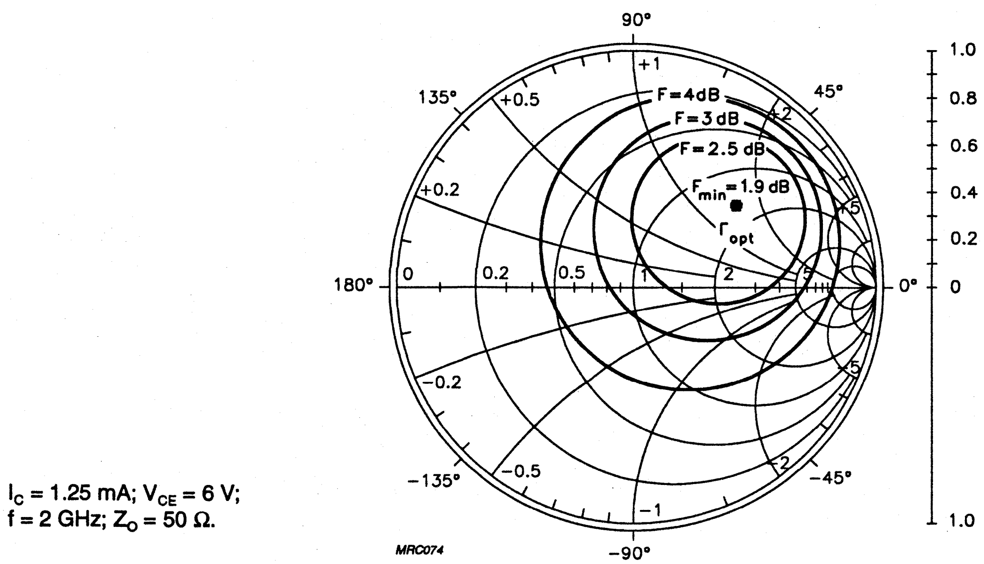
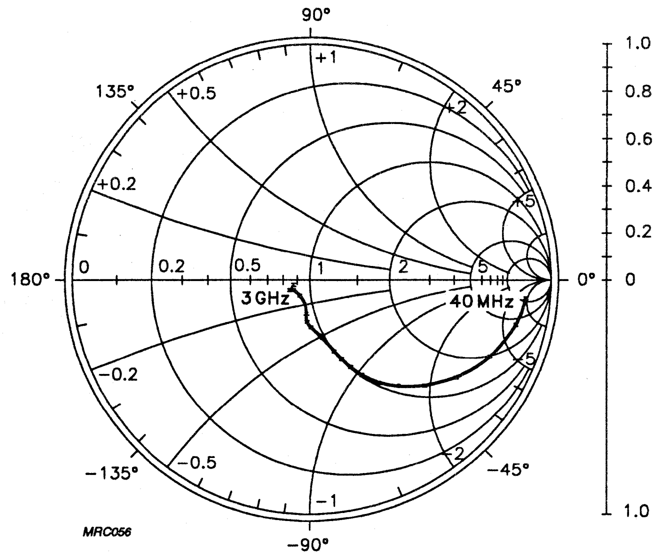
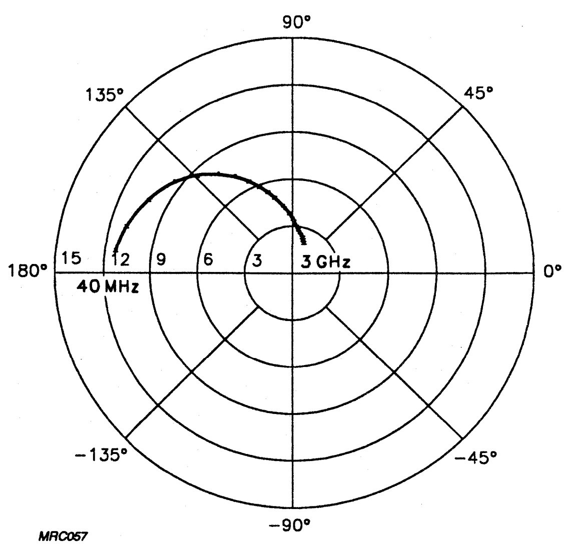


Fig.13 Noise circle.



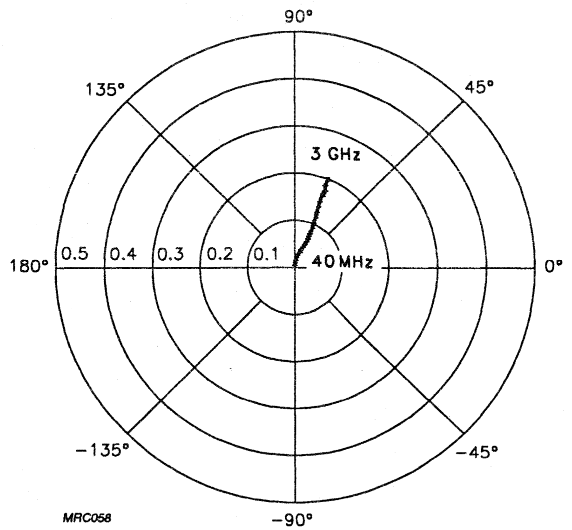
I_C = 5 mA; V_{CE} = 6 V;
Z_O = 50 Ω.

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



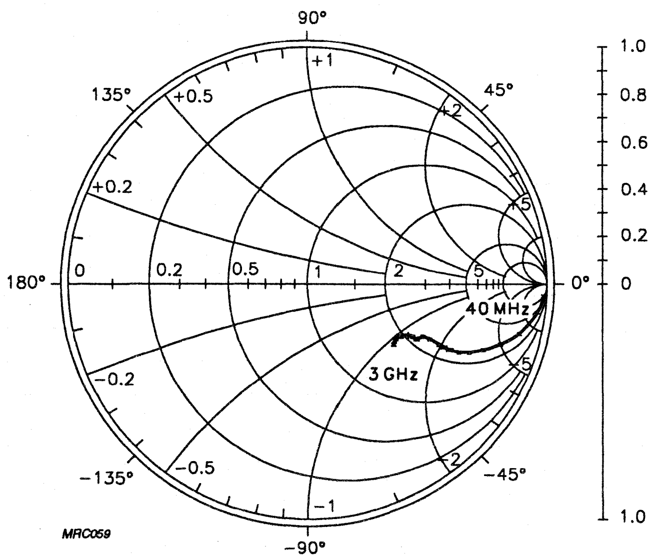
I_C = 5 mA; V_{CE} = 6 V.

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}).

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

PIN CONFIGURATION

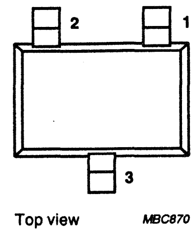


Fig.1 SOT323.

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 Ω; 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 $G_{UM} = 10 \log \dfrac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. I_C = 20 mA; V_{CE} = 6 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 $f_{(2p-q)}$ = 904 MHz.

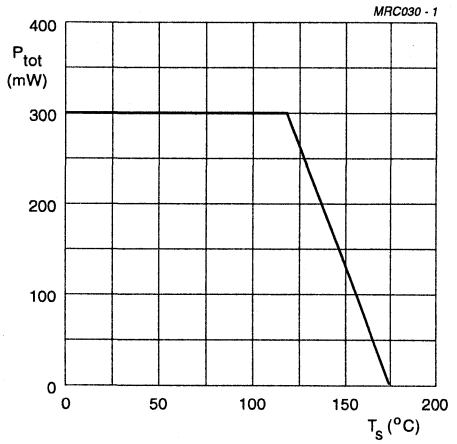
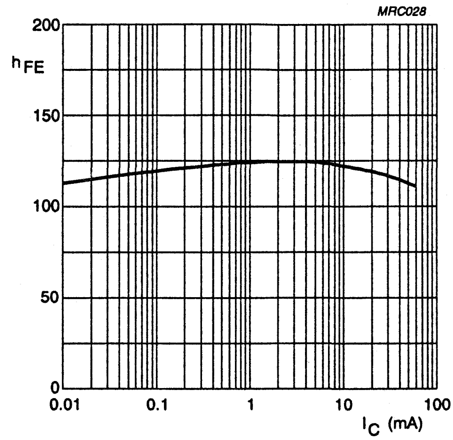
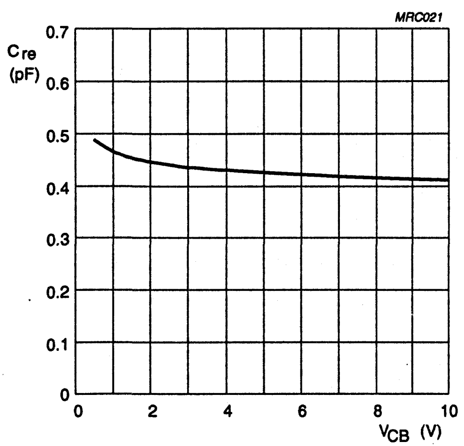


Fig.2 Power derating curve.



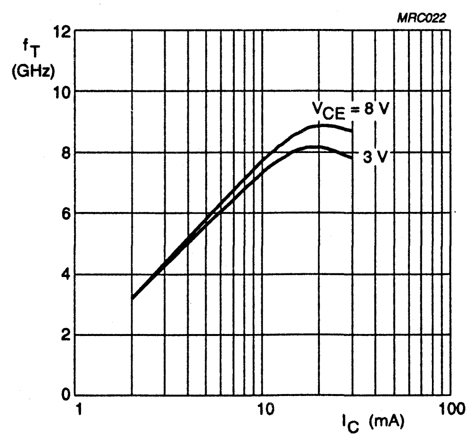
V_{CE} = 6 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

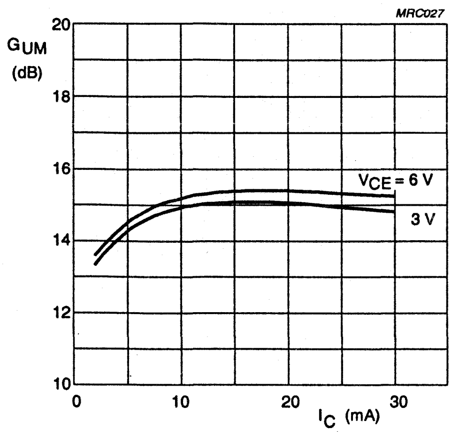
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

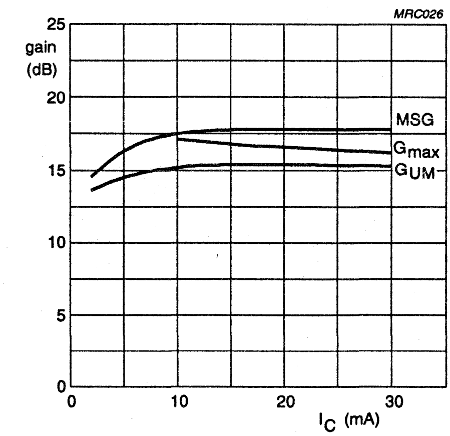
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



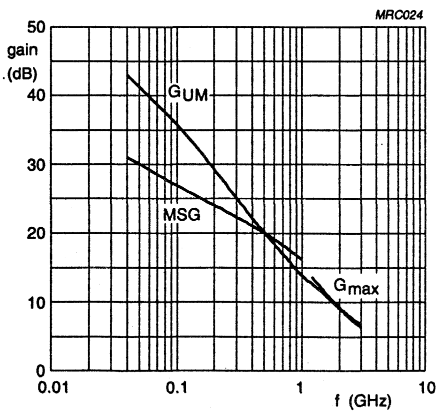
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

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



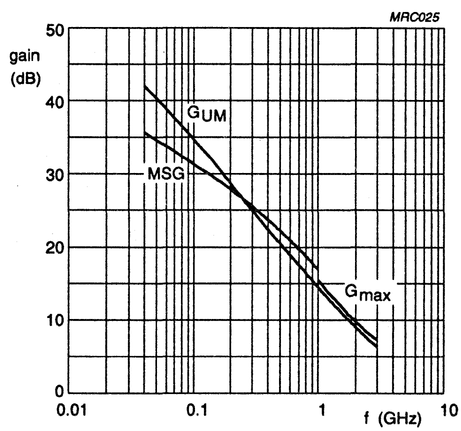
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



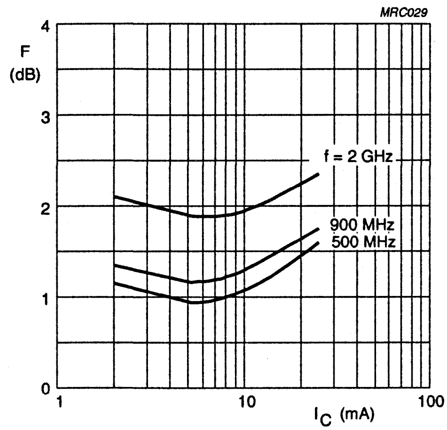
I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



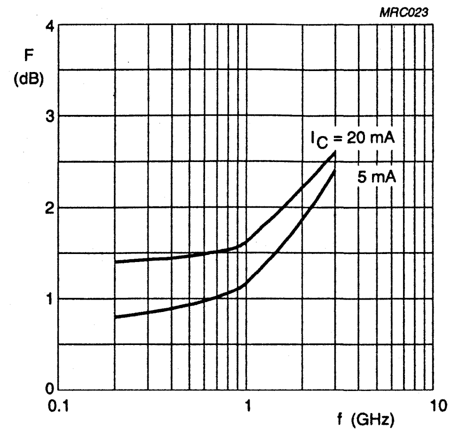
I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

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.

NPN 9 GHz wideband transistor

BFS520

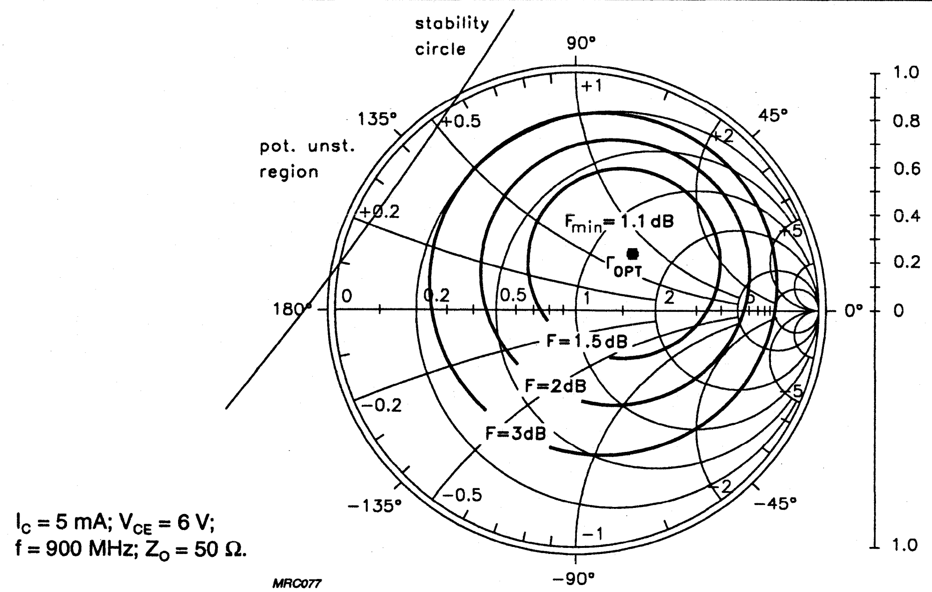


Fig.12 Noise circle.

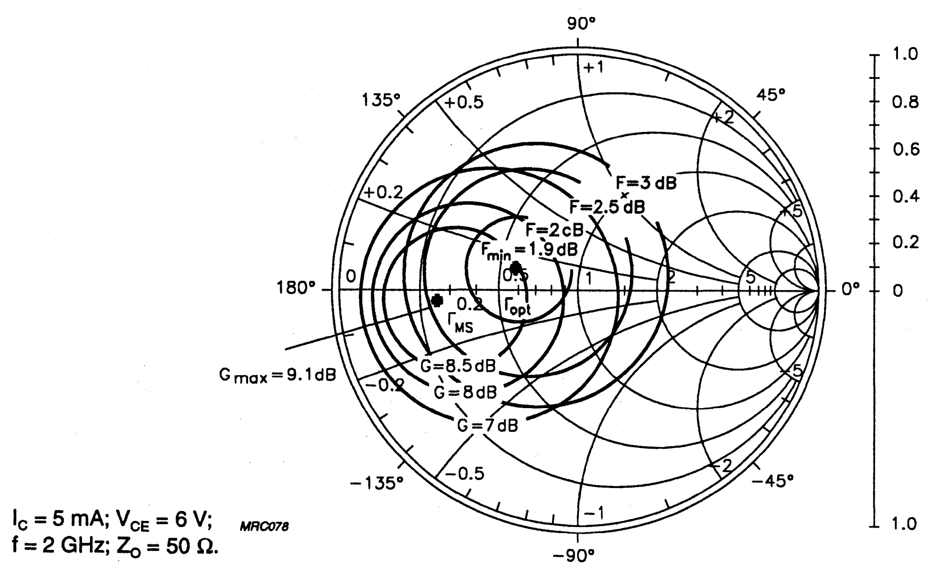
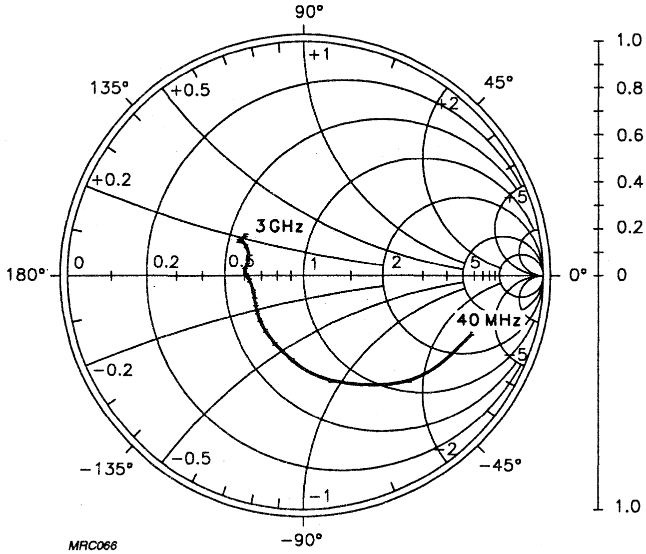


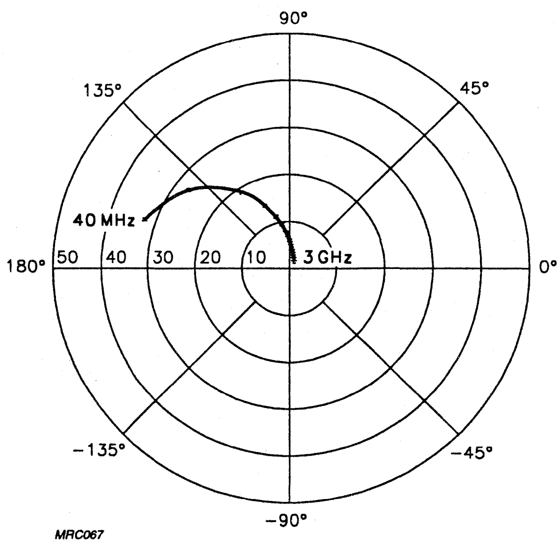
Fig.13 Noise circle.

NPN 9 GHz wideband transistor BFS520



I_C = 20 mA; V_{CE} = 6 V;
Z_O = 50 Ω.

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

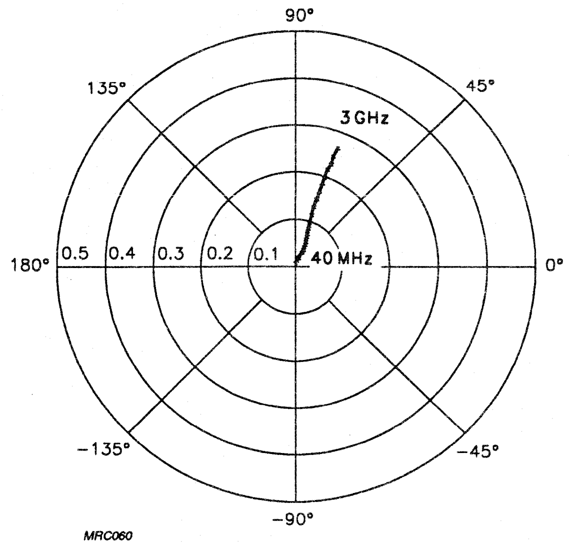


I_C = 20 mA; V_{CE} = 6 V.

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

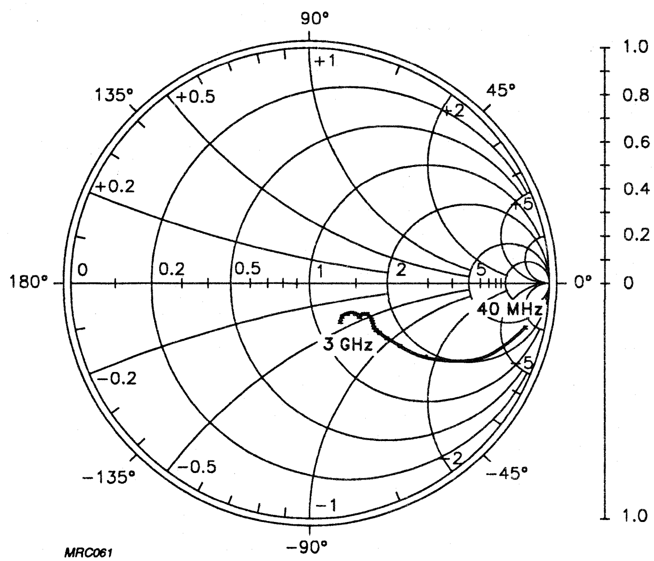
NPN 9 GHz wideband transistor

BFS520



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

PIN CONFIGURATION

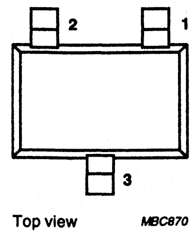


Fig.1 SOT323.

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.

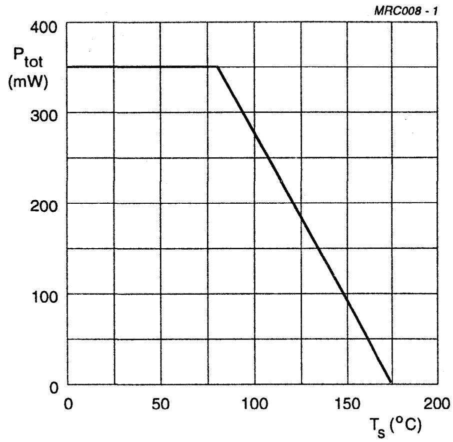
CHARACTERISTICS

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
$\lvert S_{21}\rvert^2$	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

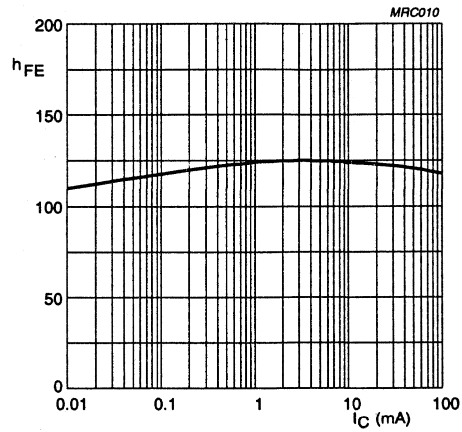
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ 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 $f_{(2p-q)}$ = 904 MHz.



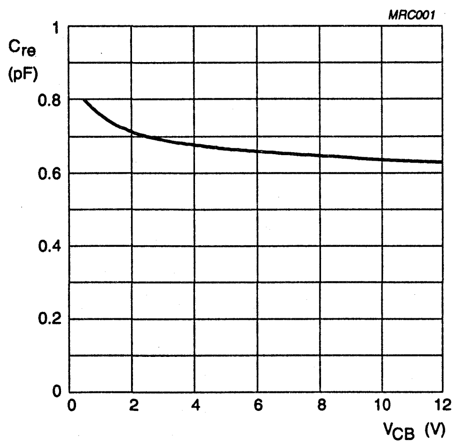
$V_{CE} \leq 10$ V.

Fig.2 Power derating curve.



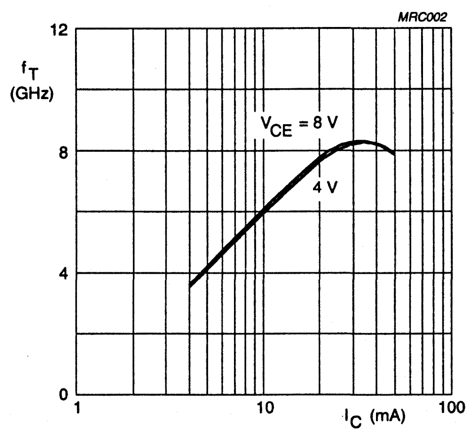
$V_{CE} = 8$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

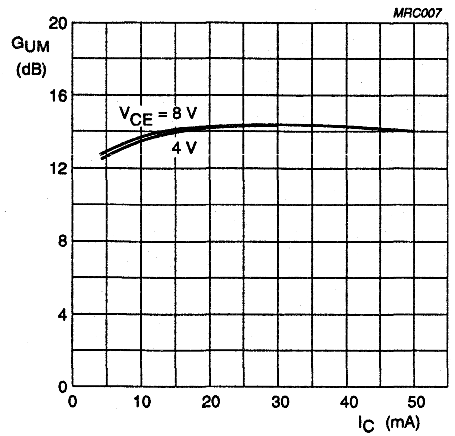
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; $T_{amb} = 25$ °C.

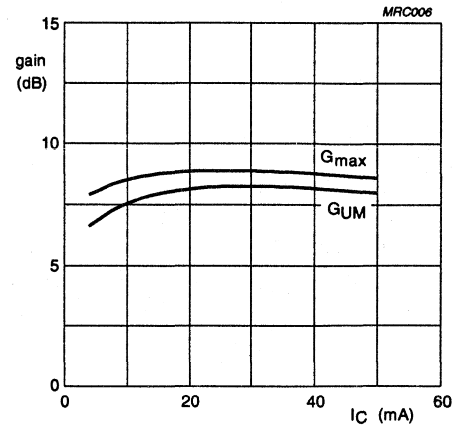
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



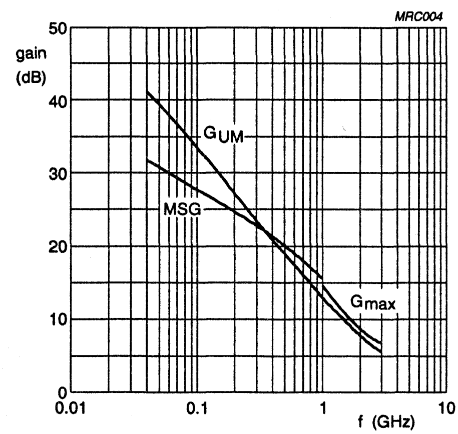
f = 900 MHz; T_{amb} = 25 °C.

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



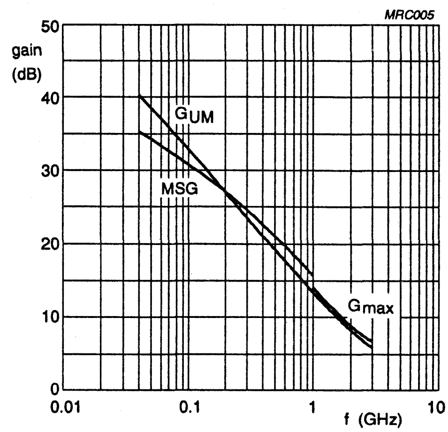
V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



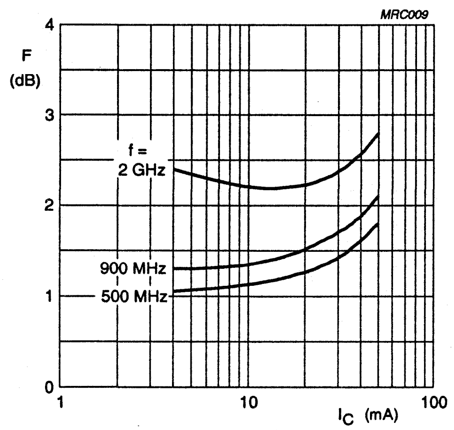
I_C = 10 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



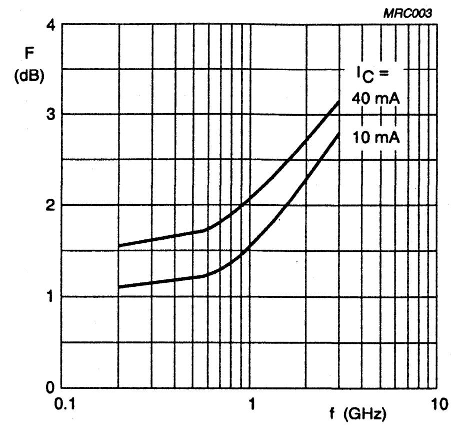
I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



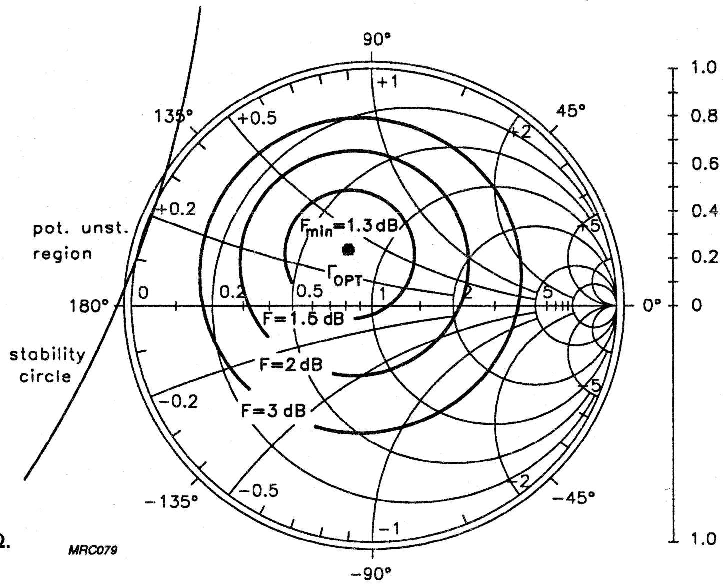
V_{CE} = 8 V; T_{amb} = 25 °C.

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



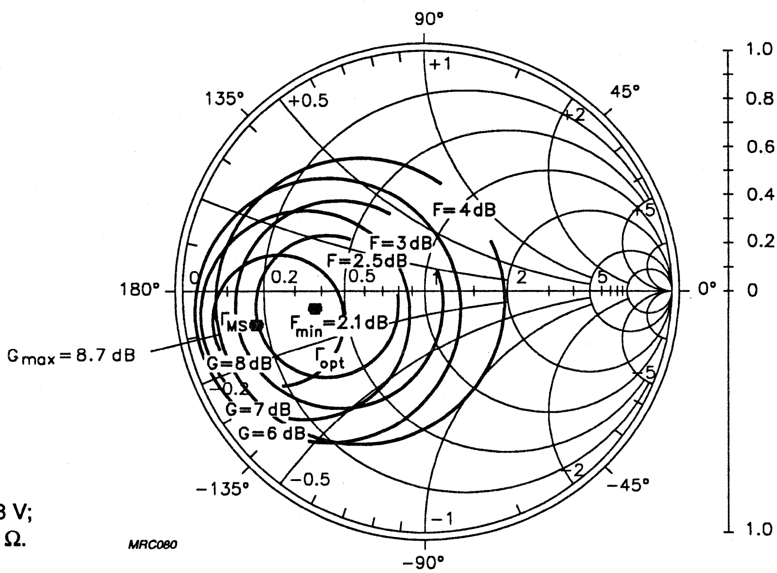
V_{CE} = 8 V; T_{amb} = 25 °C.

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.

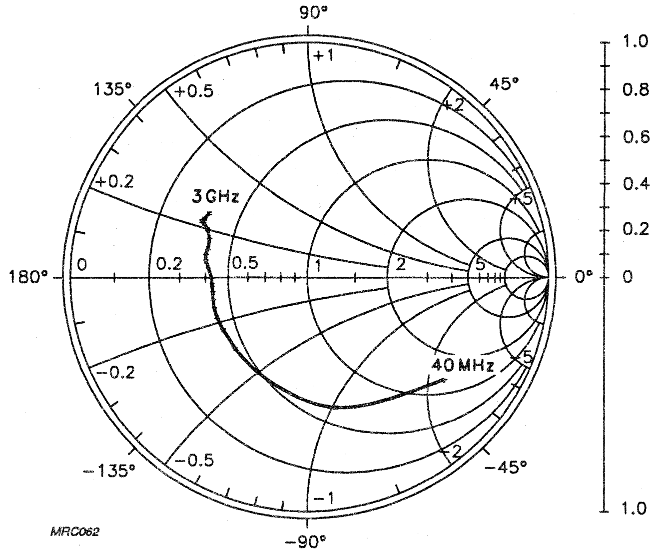
Fig.12 Noise circle.



I_C = 10 mA; V_{CE} = 8 V;
f = 2 GHz; Z_O = 50 Ω.

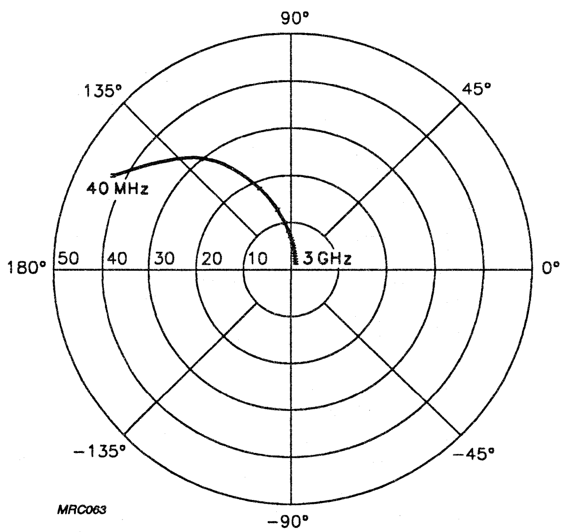
Fig.13 Noise circle.

NPN 9 GHz wideband transistor | BFS540



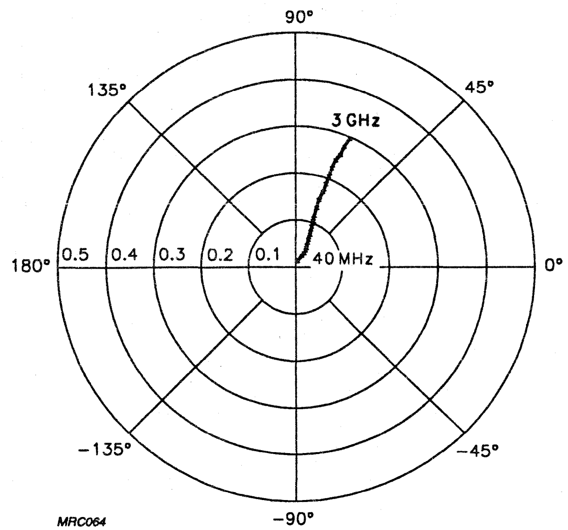
I_C = 40 mA; V_{CE} = 8 V;
Z_O = 50 Ω.

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



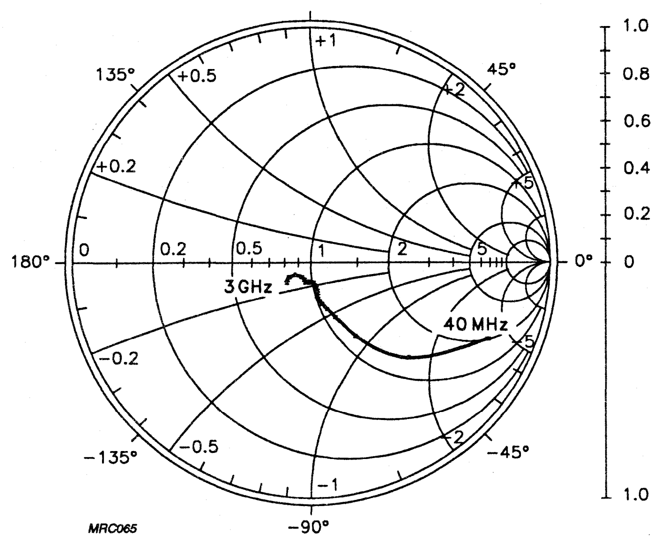
I_C = 40 mA; V_{CE} = 8 V.

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

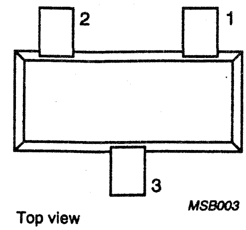


Fig.1 SOT23.

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_j = 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.

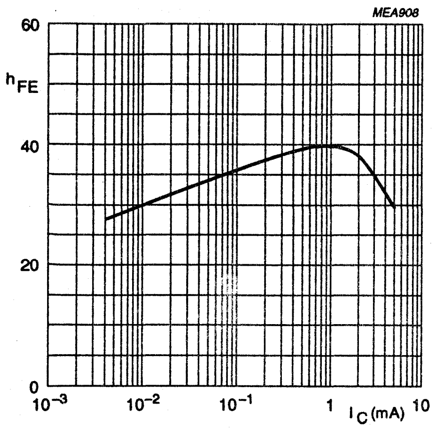
CHARACTERISTICS

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

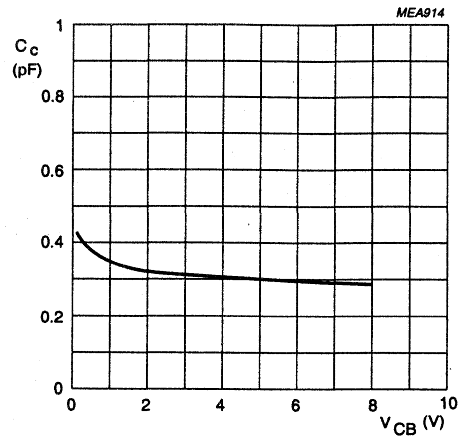
Note

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



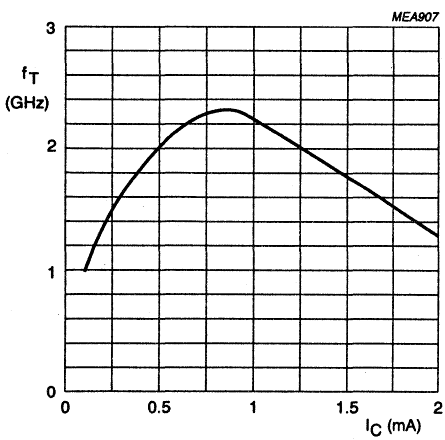
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



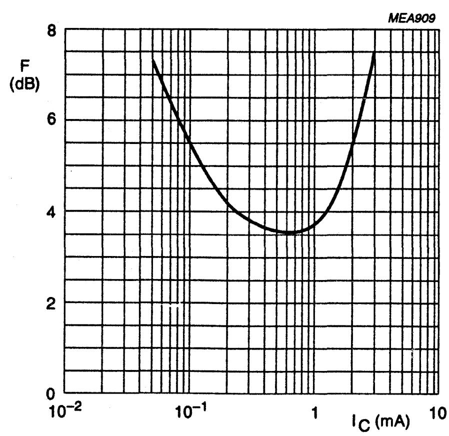
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



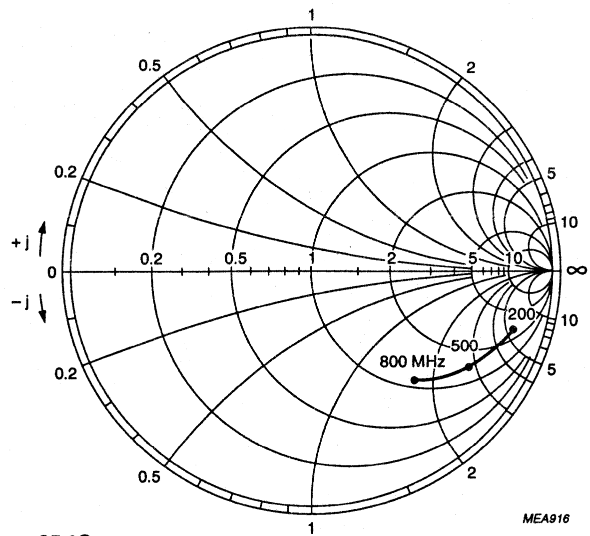
V_{CE} = 1 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.



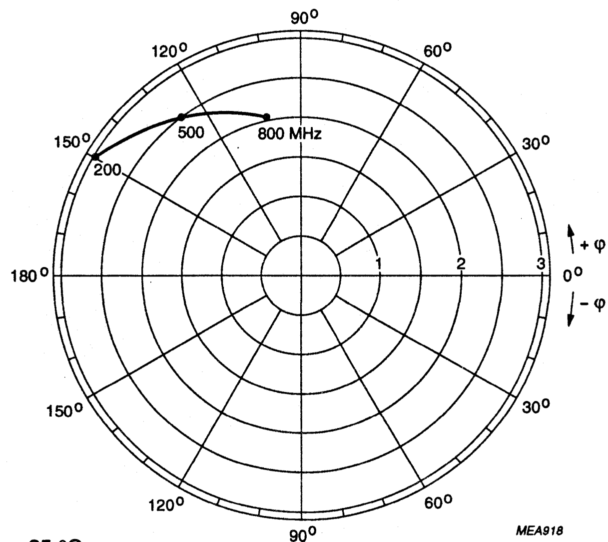
V_{CE} = 1 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C.

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



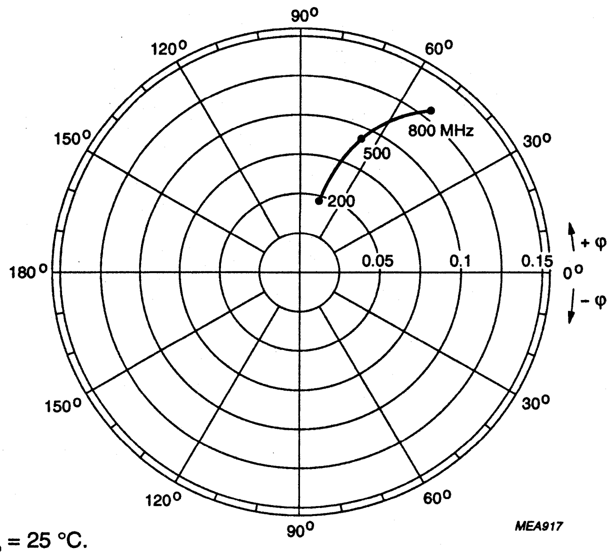
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

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



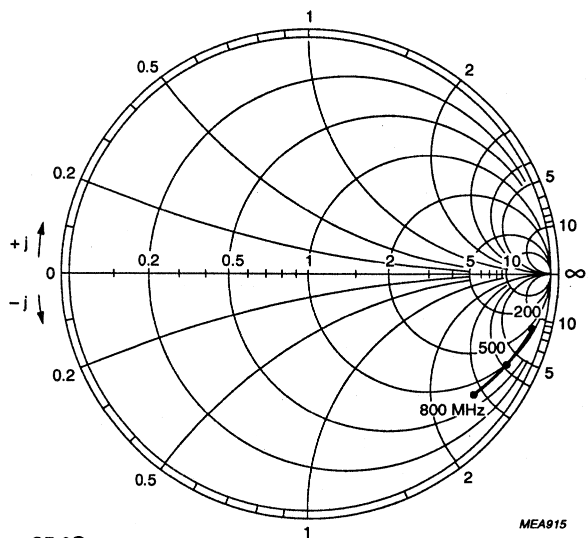
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

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

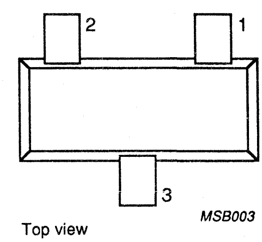


Fig.1 SOT23.

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	µA
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 $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.

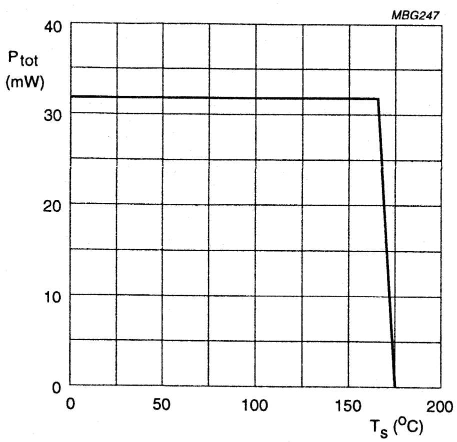
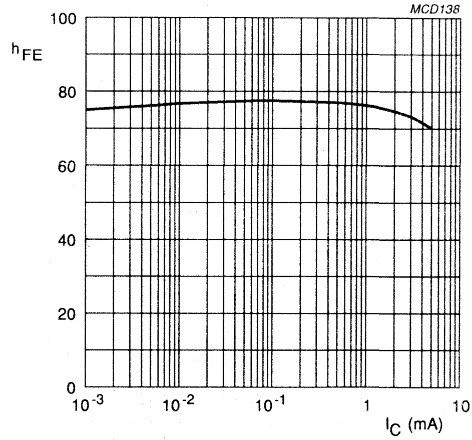
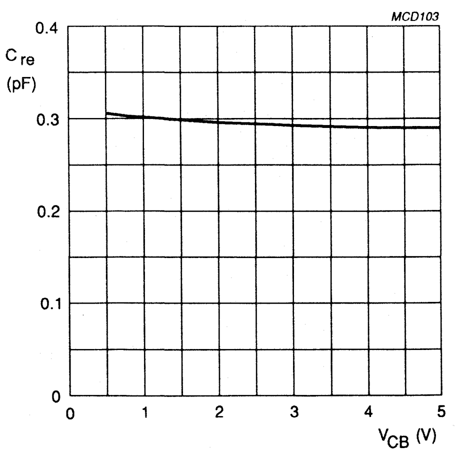


Fig.2 Power derating curve.



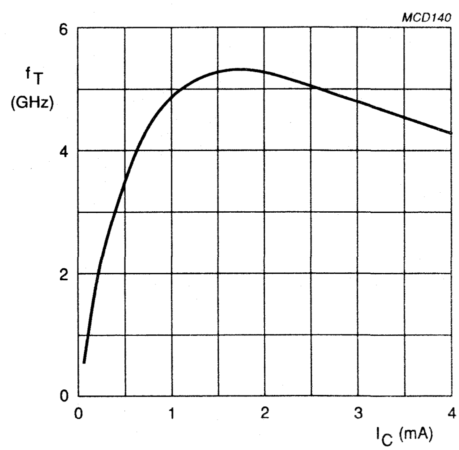
V_{CE} = 1 V.

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



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

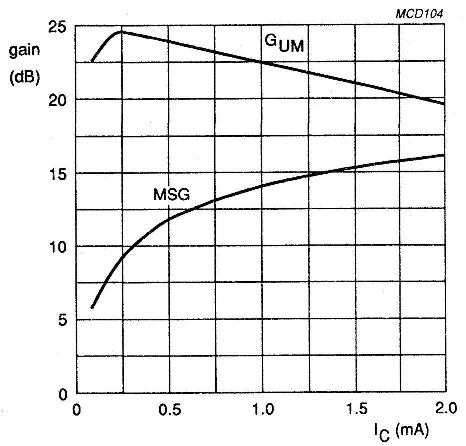
Fig.4 Feedback capacitance as a function of collector-base voltage.



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

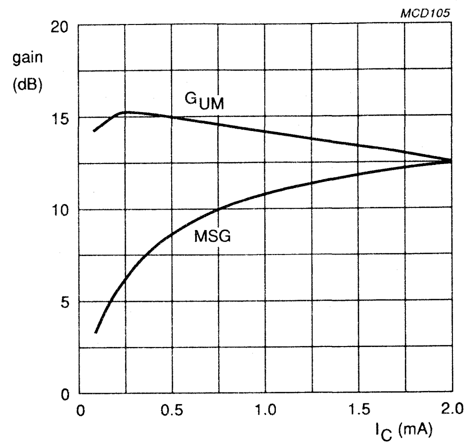
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



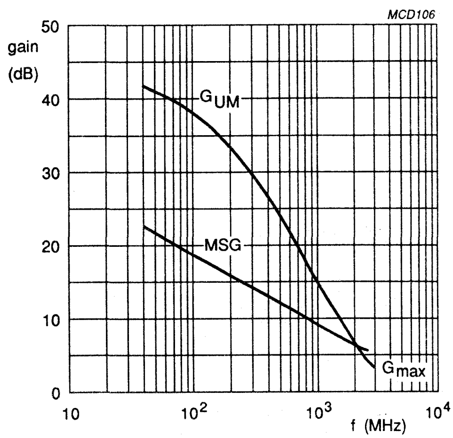
V_{CE} = 1 V; f = 500 MHz.

Fig.6 Gain as a function of collector current.



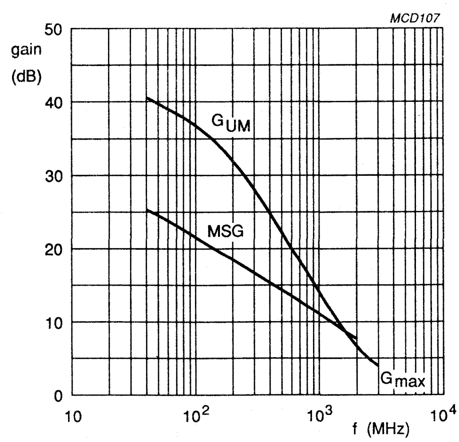
V_{CE} = 1 V; f = 1 GHz.

Fig.7 Gain as a function of collector current.



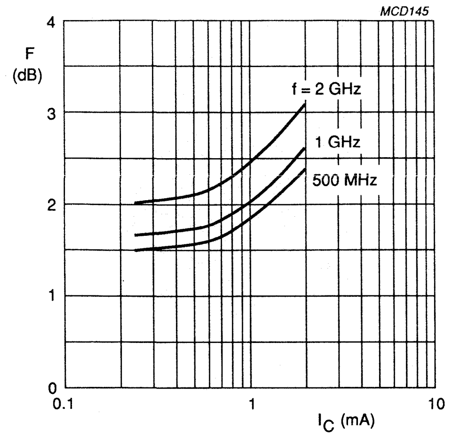
V_{CE} = 1 V; I_C = 0.5 mA.

Fig.8 Gain as a function of frequency.



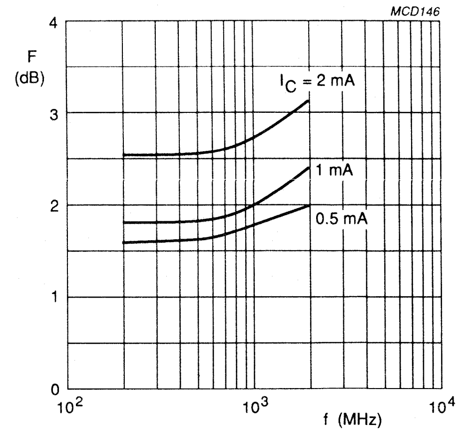
V_{CE} = 1 V; I_C = 1 mA.

Fig.9 Gain as a function of frequency.



V_{CE} = 1 V.

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



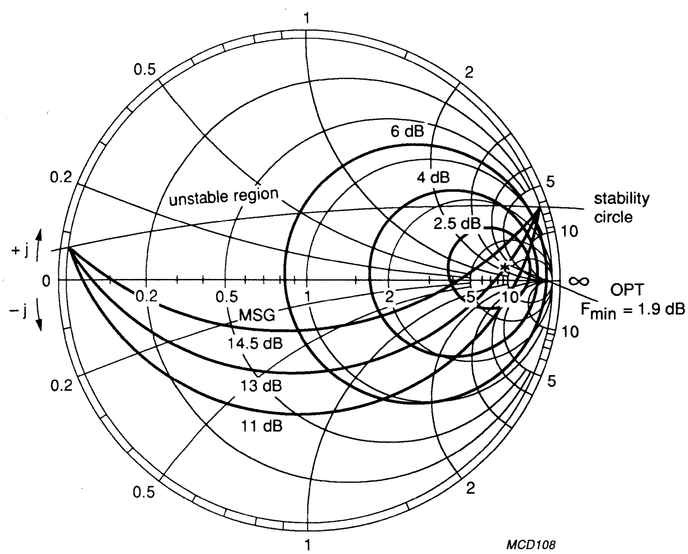
V_{CE} = 1 V.

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.

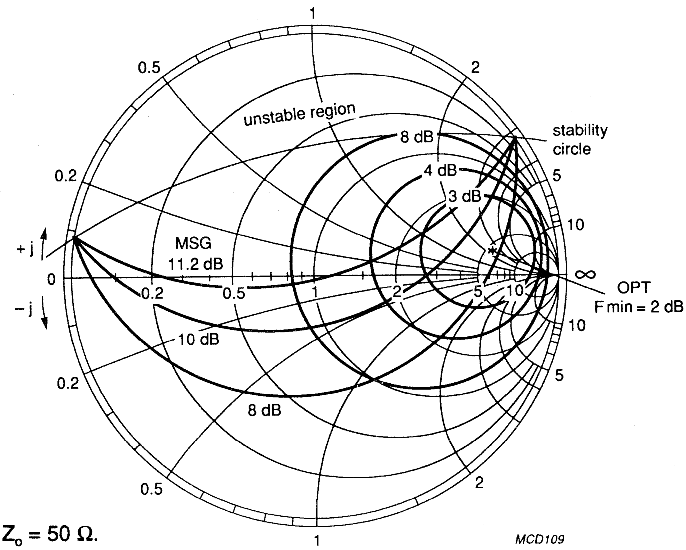
Average gain parameter: MSG = 14.5 dB.

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



$Z_o = 50\ \Omega$.

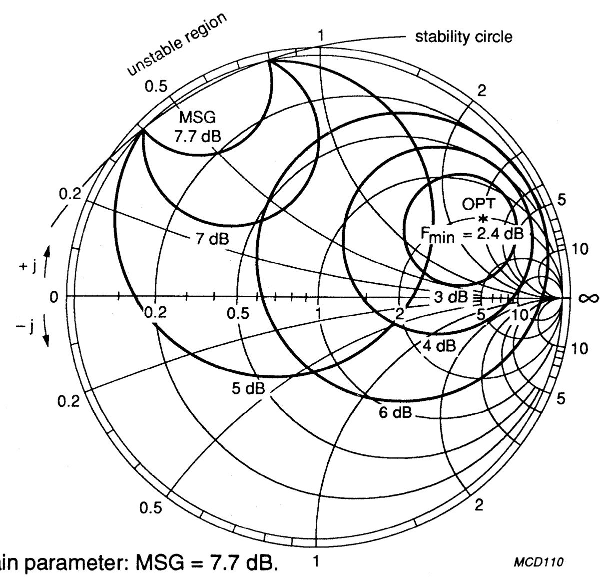
Average gain parameter: MSG = 11.2 dB.

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

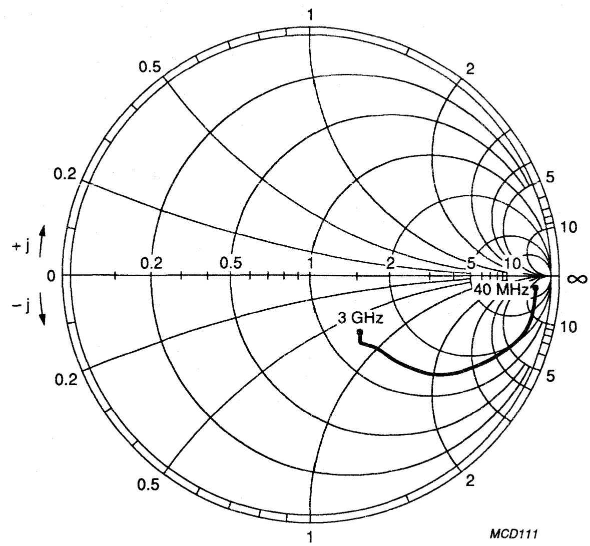


$Z_o = 50\ \Omega$.

Average gain parameter: MSG = 7.7 dB.

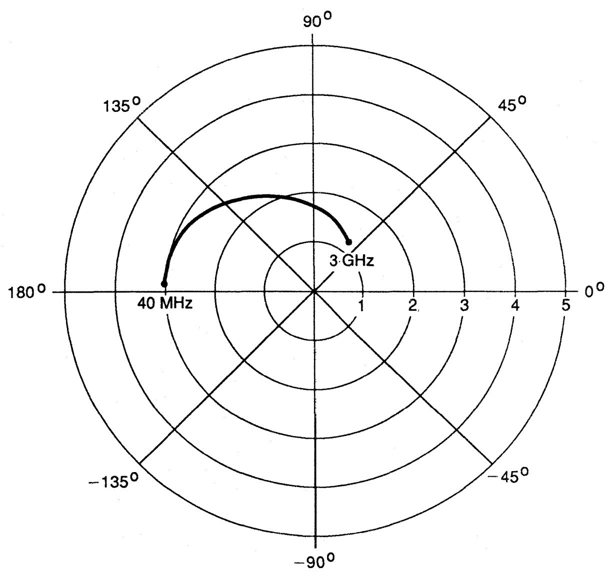
Fig.14 Noise circle figure.

NPN 5 GHz wideband transistor | BFT25A



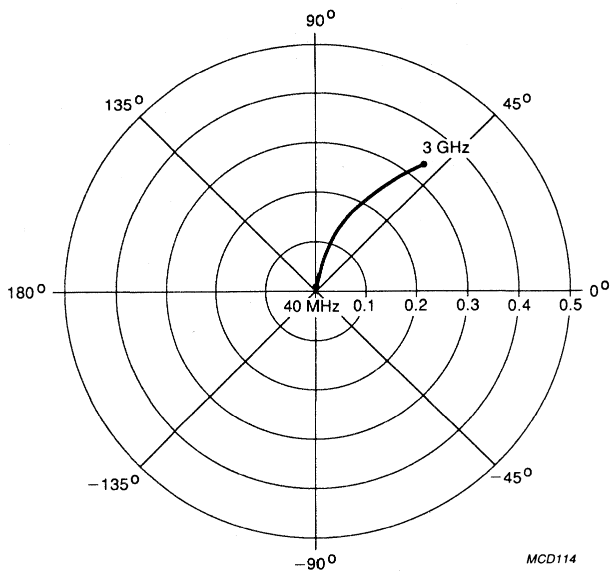
V_{CE} = 1 V; I_C = 1 mA.
Z_o = 50 Ω.

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



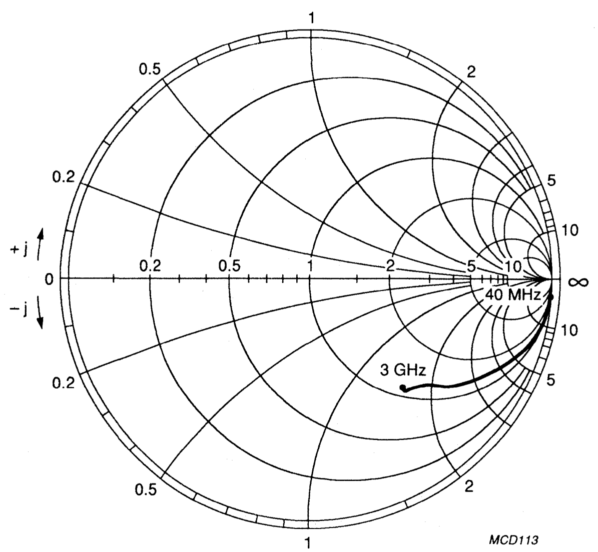
V_{CE} = 1 V; I_C = 1 mA.

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.
$Z_o = 50\ \Omega$.

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

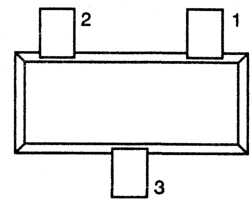


Fig.1 SOT23.

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.

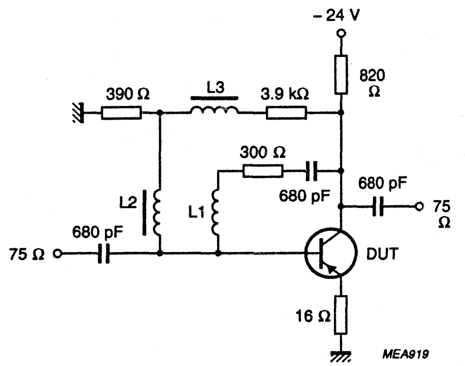
CHARACTERISTICS

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

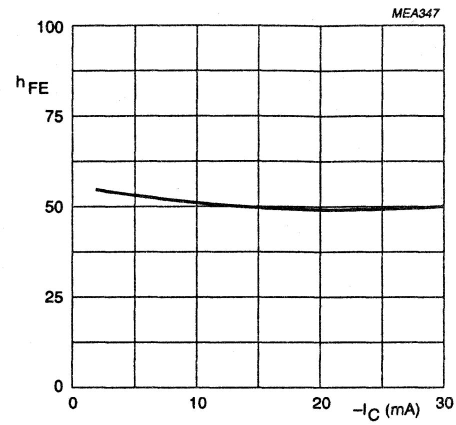
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -14$ mA; $V_{CE} = -10$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ at $d_{im} = -60$ dB; f_p = 495.25 MHz;
   $V_q = V_O$ –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.

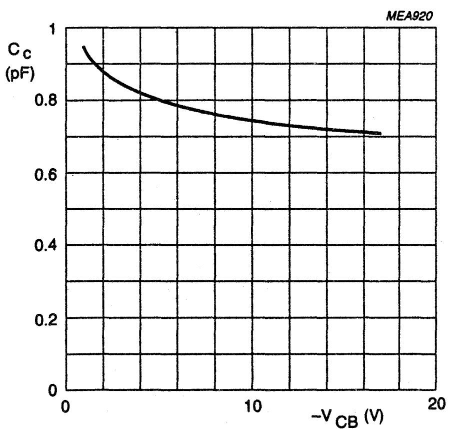
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



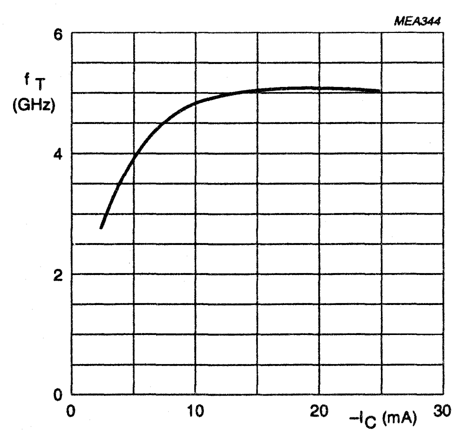
$V_{CE} = -10$ V; $T_j = 25$ °C.

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



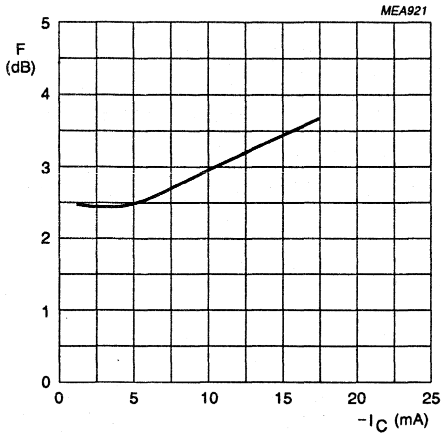
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

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



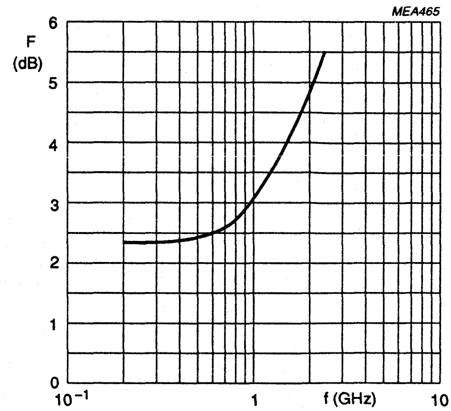
$V_{CE} = -10$ V; f = 500 MHz; $T_j = 25$ °C.

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

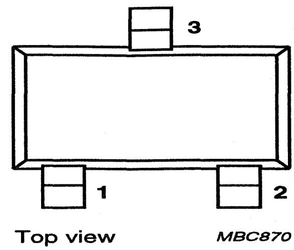
It is intended as a general purpose transistor for wideband applications up to 2 GHz.

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.

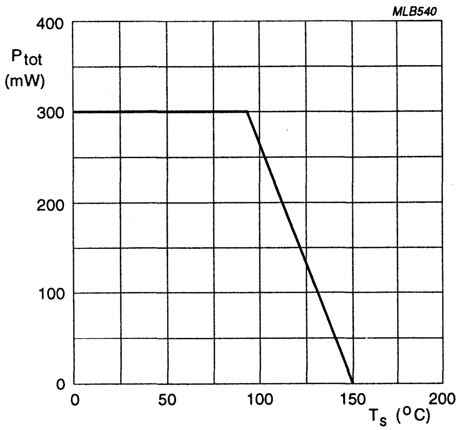
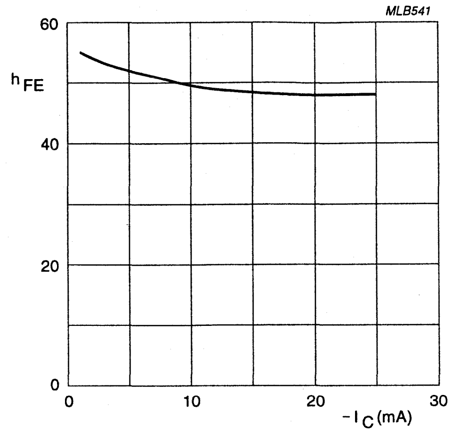
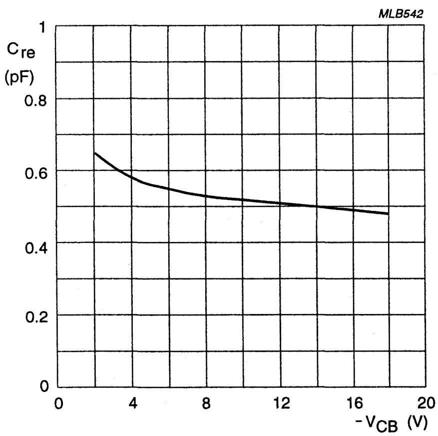


Fig.2 Power derating curve.



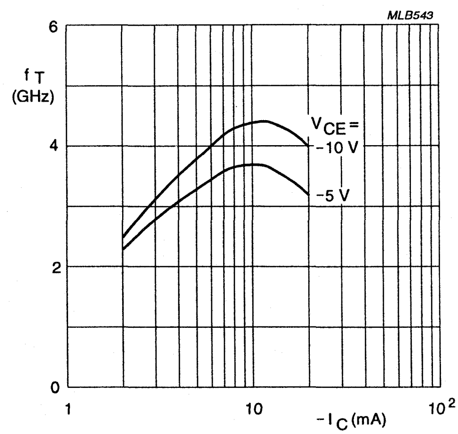
V_{CE} = −10 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

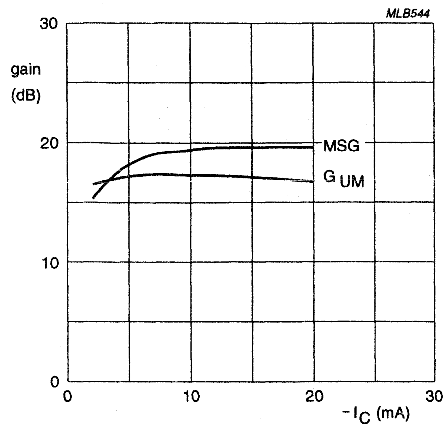
Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.



f = 500 MHz; T_{amb} = 25 °C.

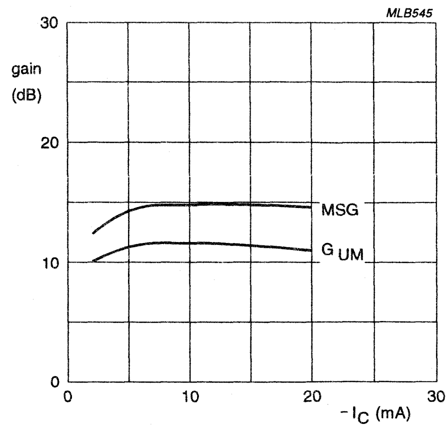
Fig.5 Transition frequency as a function of collector current, typical values.

PNP 4 GHz wideband transistor BFT92W



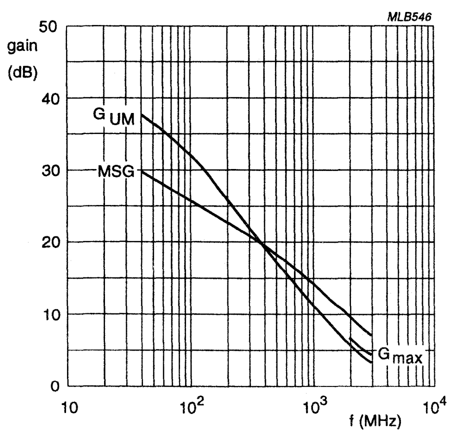
f = 500 MHz; V_{CE} = −10 V.
MSG = maximum stable gain.

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



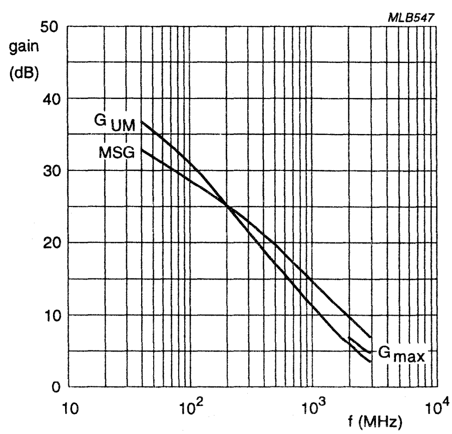
f = 1 GHz; V_{CE} = −10 V.
MSG = maximum stable gain.

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



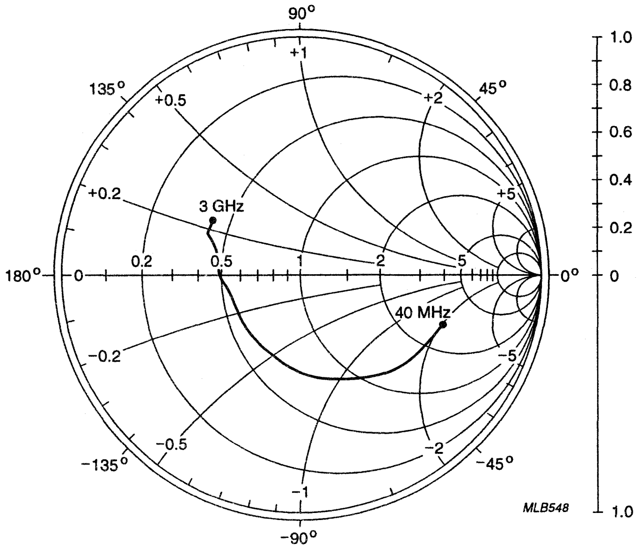
I_C = −5 mA; V_{CE} = −10 V.
MSG = maximum stable gain.

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



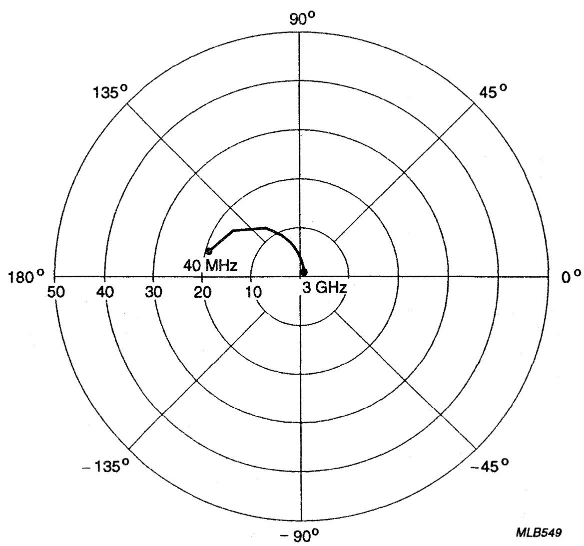
I_C = −15 mA; V_{CE} = −10 V.
MSG = maximum stable gain.

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



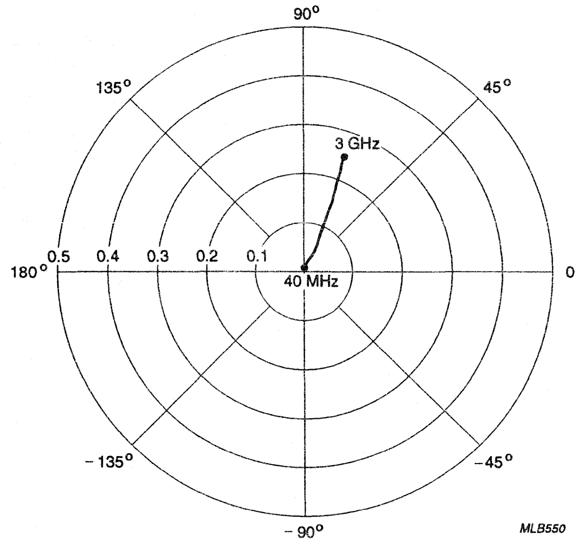
$V_{CE} = -10$ V; $I_C = -15$ mA.

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



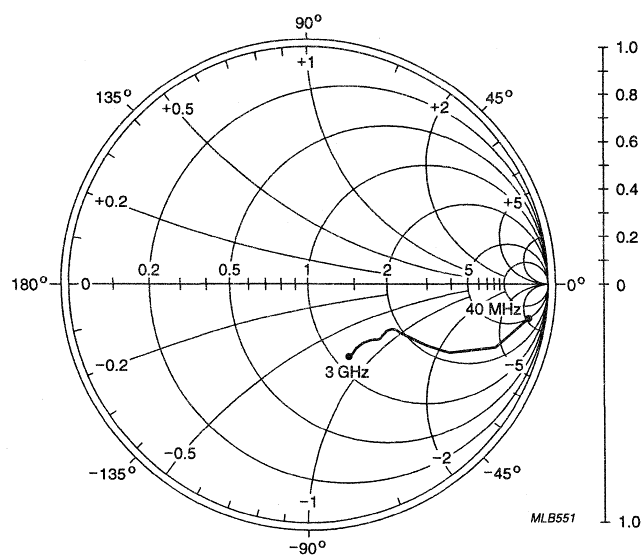
$V_{CE} = -10$ V; $I_C = -15$ mA.

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



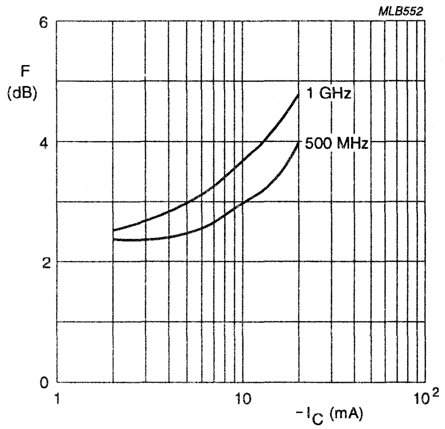
$V_{CE} = -10$ V; $I_C = -15$ mA.

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



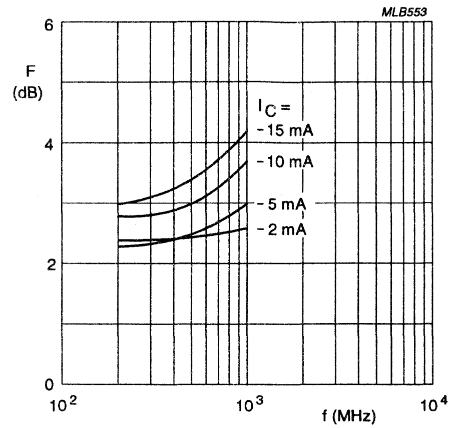
$V_{CE} = -10$ V; $I_C = -15$ mA.

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



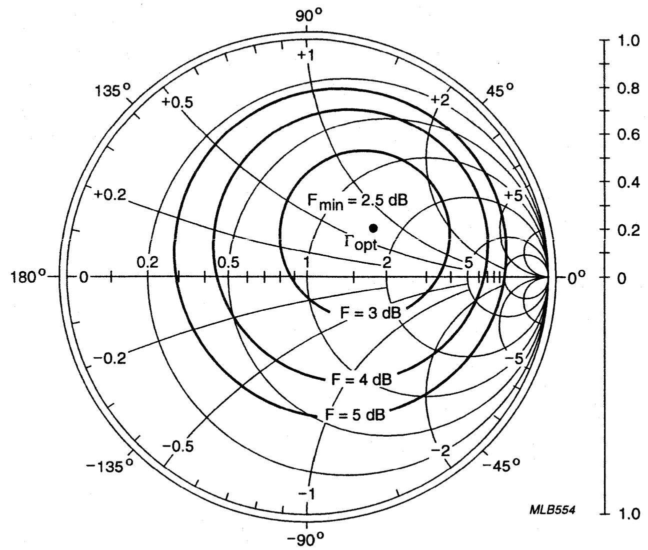
$V_{CE} = -10$ V.

Fig.14 Minimum noise figure as a function of collector current, typical values.



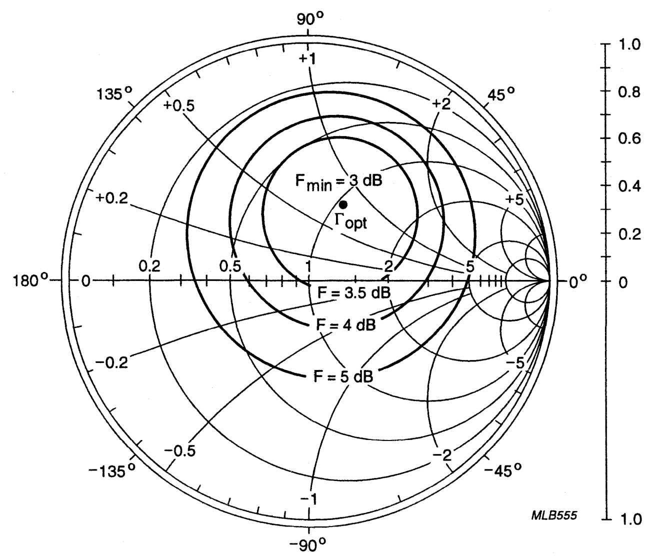
$V_{CE} = -10$ V.

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.

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

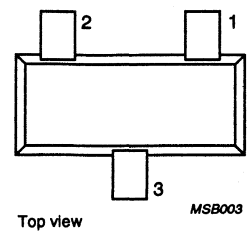


Fig.1 SOT23.

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.

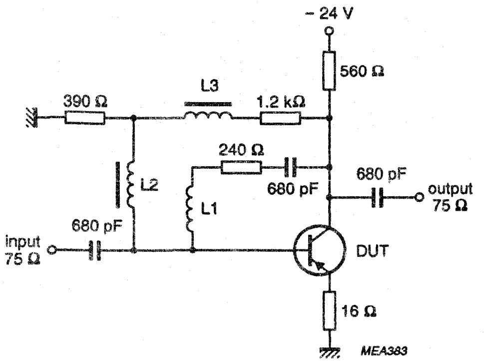
CHARACTERISTICS

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

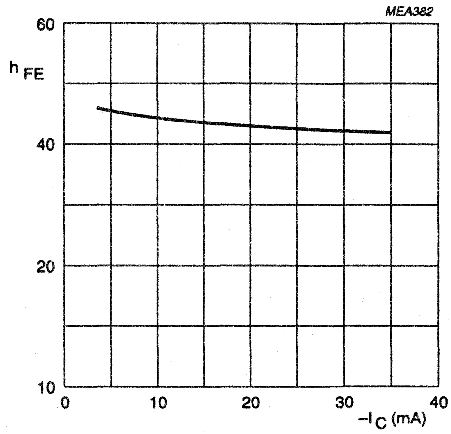
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -30$ mA; $V_{CE} = -5$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 495.25$ MHz;
   $V_q = V_O -6$ 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.

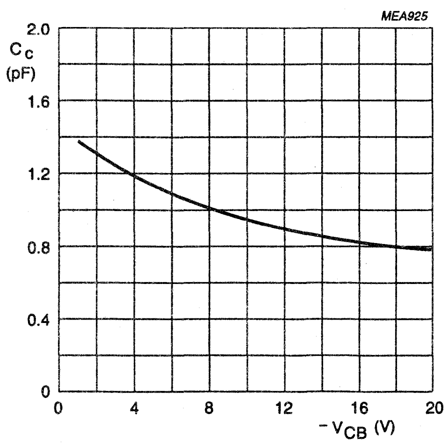
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



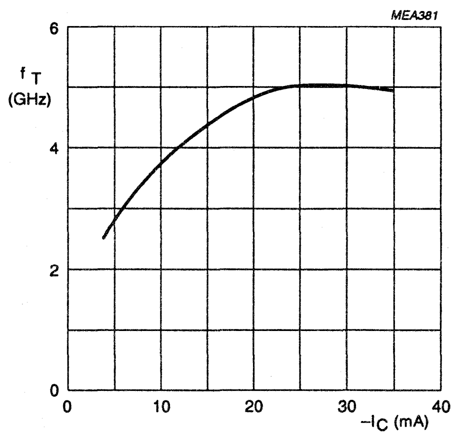
V_{CE} = –5 V; T_j = 25 °C.

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



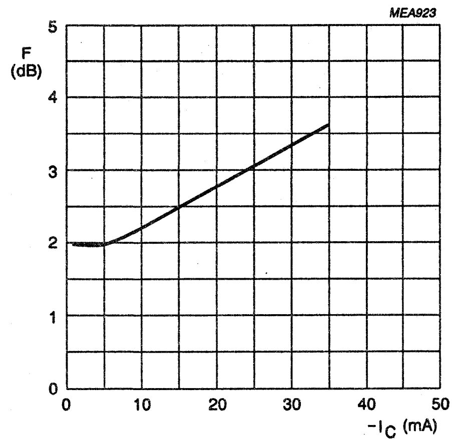
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



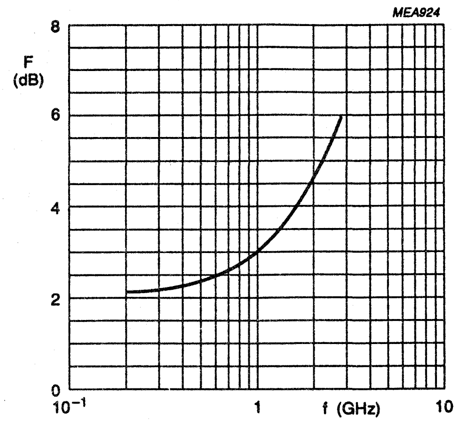
V_{CE} = –5 V; f = 500 MHz; T_j = 25 °C.

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

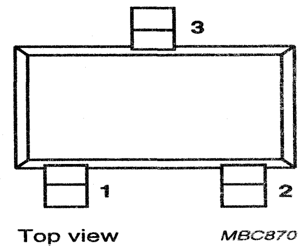
It is intended as a general purpose transistor for wideband applications up to 2 GHz.

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.

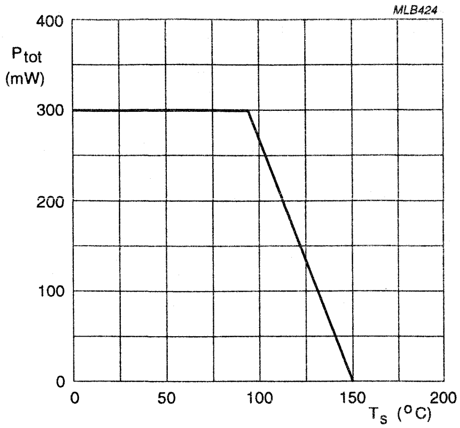
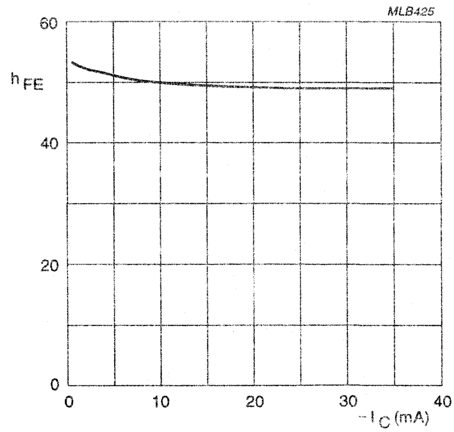
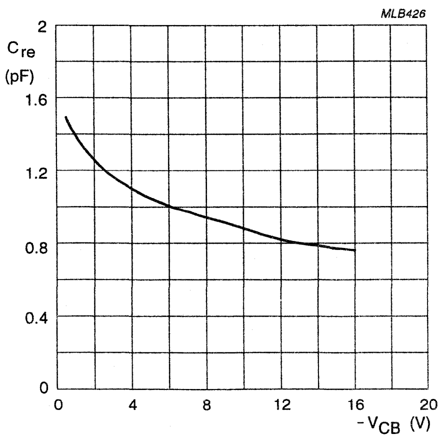


Fig.2 Power derating as a function of the soldering point temperature.



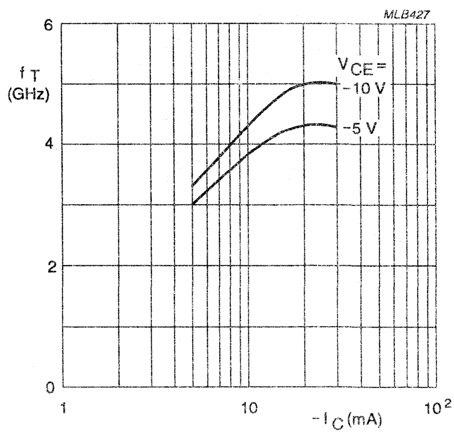
$V_{CE} = -5$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

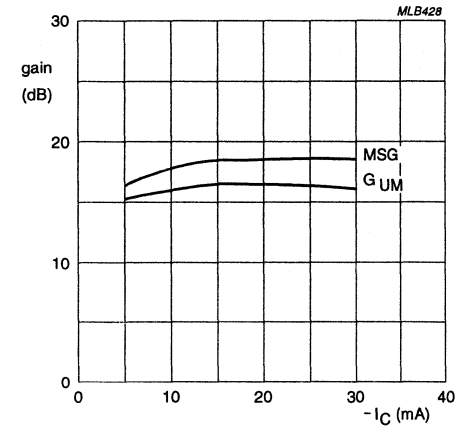
Fig.4 Feedback capacitance as a function of collector-base voltage, typical values.



f = 500 MHz; $T_{amb} = 25$ °C.

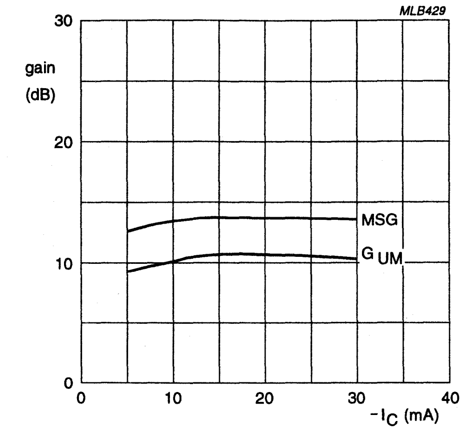
Fig.5 Transition frequency as a function of collector current, typical values.

PNP 4 GHz wideband transistor BFT93W



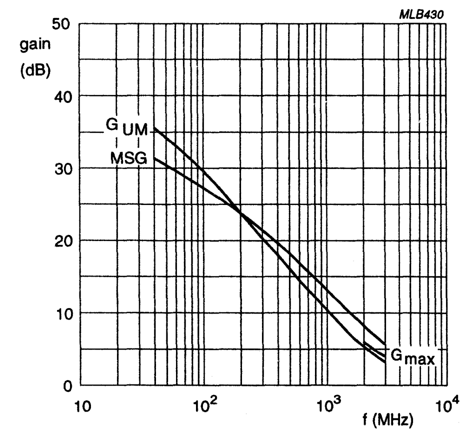
V_{CE} = –5 V; f = 500 MHz.

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



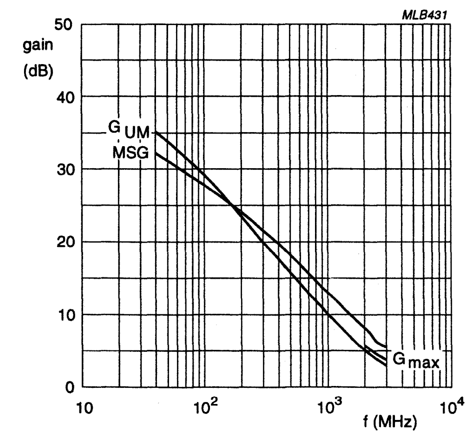
V_{CE} = –5 V; f = 1 GHz.

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



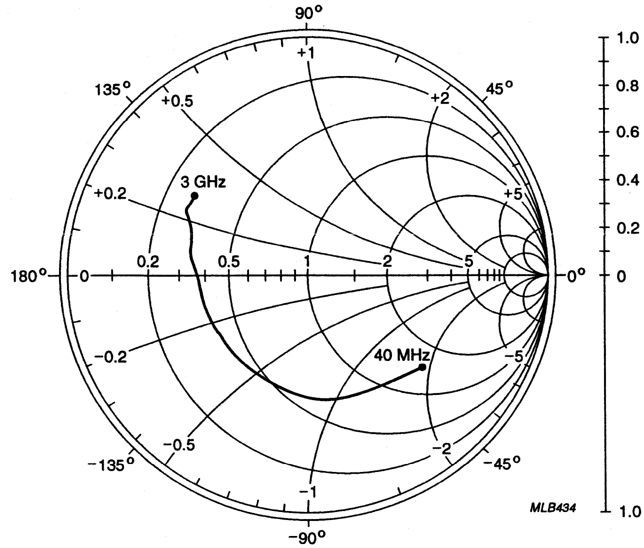
V_{CE} = –5 V; I_C = –10 mA.

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



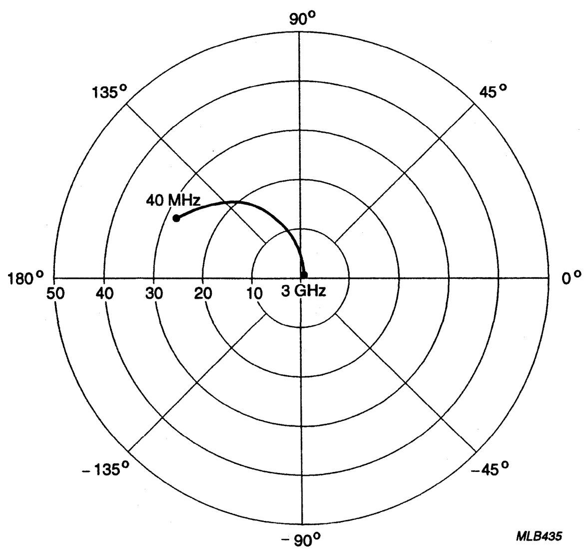
V_{CE} = –5 V; I_C = –30 mA.

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



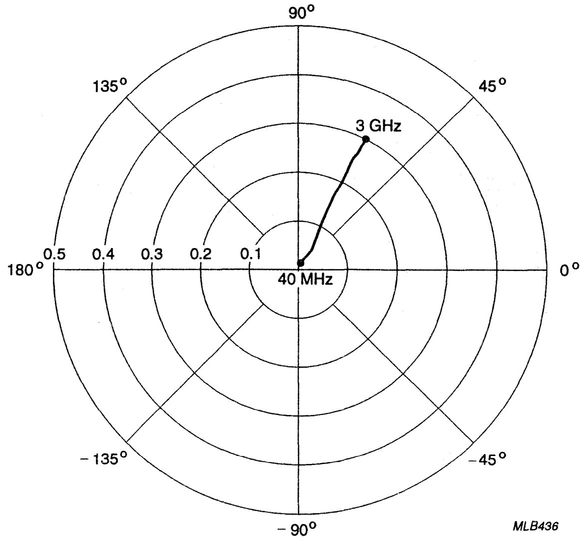
$V_{CE} = -10$ V; $I_C = -30$ mA.

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



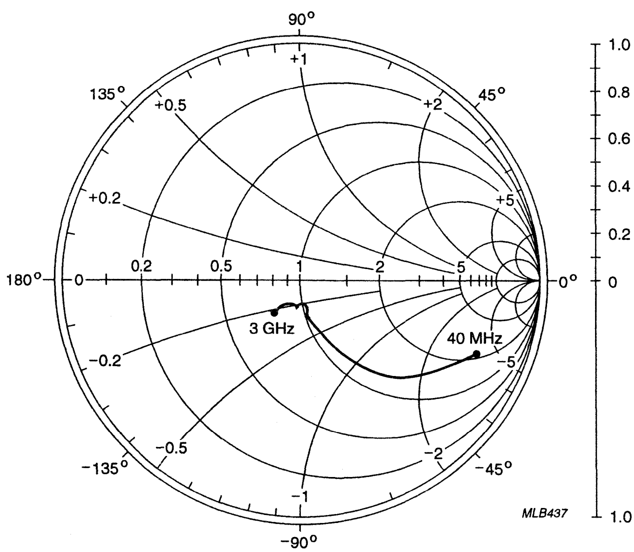
$V_{CE} = -10$ V; $I_C = -30$ mA.

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



V_{CE} = −10 V; I_C = −30 mA.

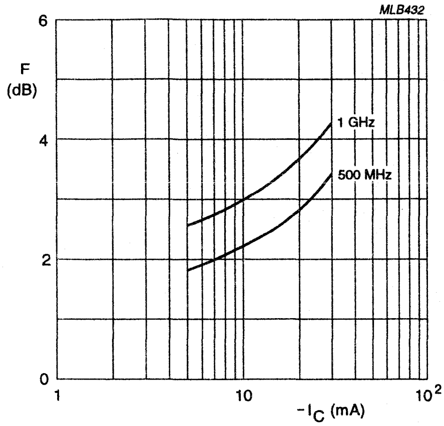
Fig.12 Common emitter reverse transmission coefficient (s_{12}), typical values.



V_{CE} = −10 V; I_C = −30 mA.

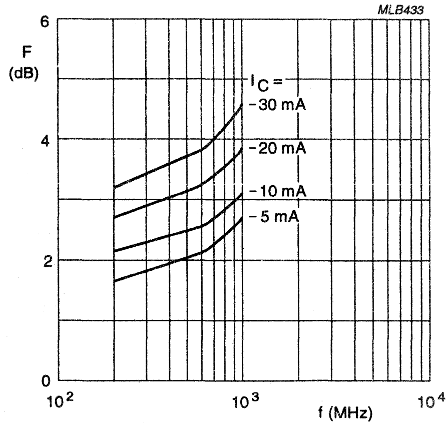
Fig.13 Common emitter output reflection coefficient (s_{22}), typical values.

PNP 4 GHz wideband transistor BFT93W



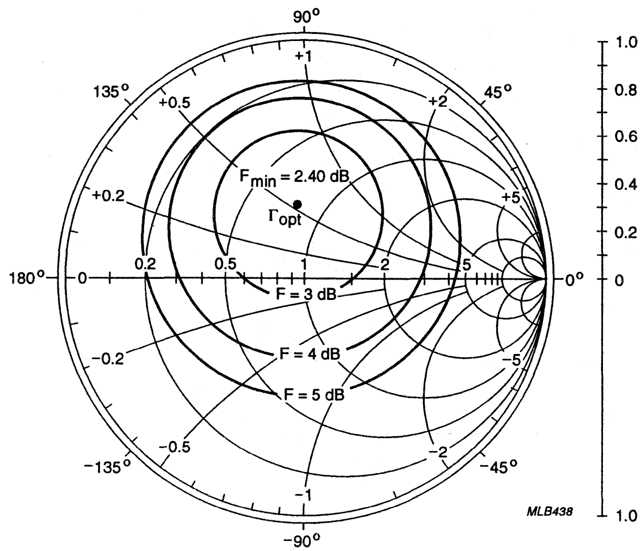
$V_{CE} = -5$ V.

Fig.14 Minimum noise figure as a function of collector current, typical values.



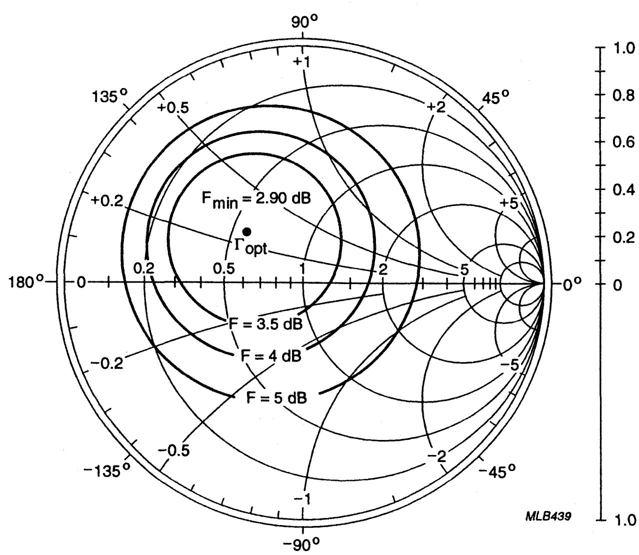
$V_{CE} = -5$ V.

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.

NPN 1 GHz wideband transistor BFW16A

DESCRIPTION

NPN transistor in a SOT5 (TO-39) metal envelope, with the collector connected to the case.

The transistor has extremely good intermodulation properties and a high power gain. It is primarily intended for the final and driver stages of channel and band aerial amplifiers with high output power for bands I, II, III and IV/V (40 to 860 MHz) and for the final stage of the wideband vertical amplifier in high speed oscilloscopes.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

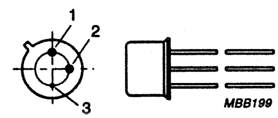


Fig.1 SOT5.

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	f > 1 MHz	–	300	mA
P_{tot}	total power dissipation	up to T_s = 125 °C (note 1)	–	1.5	W
f_T	transition frequency	I_C = 150 mA; V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C	1.2	–	GHz
C_{re}	feedback capacitance	I_C = 10 mA; V_{CE} = 15 V; f = 1 MHz; T_{amb} = 25 °C	1.7	–	pF
G_p	power gain	I_C = 70 mA; V_{CE} = 18 V; f = 800 MHz; T_{amb} = 25 °C	6.5	–	dB
P_O	output power	d_{im} = –30 dB; VSWR at output < 2; I_C = 70 mA; V_{CE} = 18 V; f = 800 MHz; T_{amb} = 25 °C	90	–	mW

Note

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

NPN 1 GHz wideband transistor BFW16A

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_{CER}	collector-emitter voltage	$R_{BE} \leq 50\ \Omega$	–	40	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 = 125 °C (note 1)	–	1.5	W
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

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 lead.

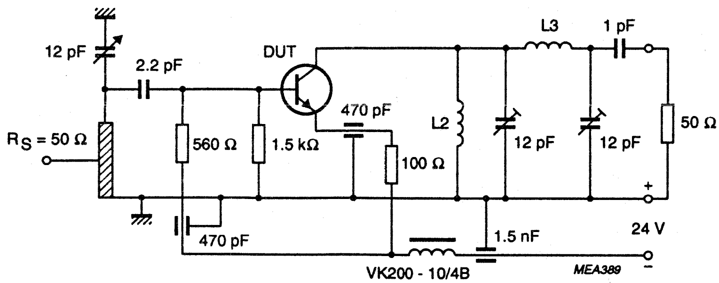
CHARACTERISTICS

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} = 20 V; T_j = 150 °C	–	–	20	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	25	80	–	
		I_C = 150 mA; V_{CE} = 5 V	25	80	–	
f_T	transition frequency	I_C = 150 mA; V_{CE} = 15 V; f = 500 MHz	–	1.2	–	GHz
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	–	1.7	–	pF
G_p	power gain	I_C = 70 mA; V_{CE} = 18 V; f = 800 MHz; T_{amb} = 25 °C	–	6.5	–	dB
P_O	output power	note 1	70	90	–	mW

Note

1. I_C = 70 mA; V_{CE} = 18 V; VSWR at output < 2; d_{im} = –30 dB; f = 800 MHz; T_{amb} = 25 °C;
   f_p = 798 MHz; f_q = 802 MHz;
   measured at $f_{(2p-q)}$ = 806 MHz (Channel 62).

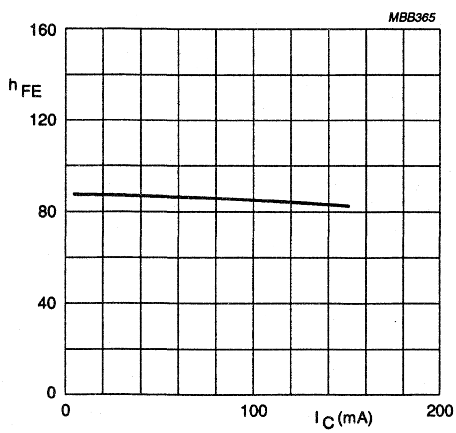


L1 = 25 mm x 7 mm x 0.85 mm silver plated copper strip. Tap of the input at 5 mm from earth.

L2 = 13 turns enamelled 0.6 mm copper wire; internal diameter 8 mm.

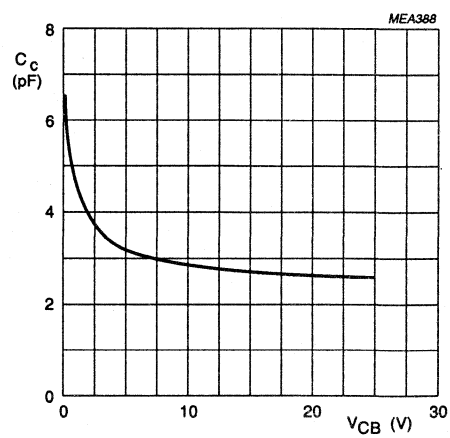
L3 = 1.5 turns 1.3 mm copper wire; internal diameter 8 mm.

Fig.2 Intermodulation distortion test circuit.



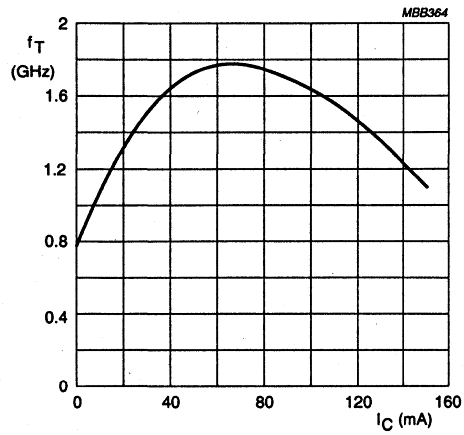
V_{CE} = 5 V; T_j = 25 °C.

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} = 15 V; f = 500 MHz; T_j = 25 °C.

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

NPN 2 GHz wideband transistor BFW30

DESCRIPTION

NPN transistor in a TO-72 metal envelope, with insulated electrodes and a shield lead connected to the case.

The transistor has very low intermodulation distortion and very high power gain. It is primarily intended for wideband vertical amplifiers in high speed oscilloscopes, wideband aerial amplifiers (40 to 860 MHz) and television distribution amplifiers.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

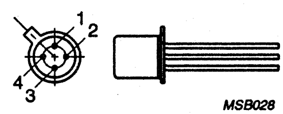


Fig.1 TO-72.

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	–	10	V
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	up to T_s = 25 °C (note 1)	–	250	mW
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	1.6	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz	0.8	–	pF
G_p	power gain	I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	7.5	–	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
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	up to T_s = 25 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

Note

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

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 25 °C (note 1)	500 K/W

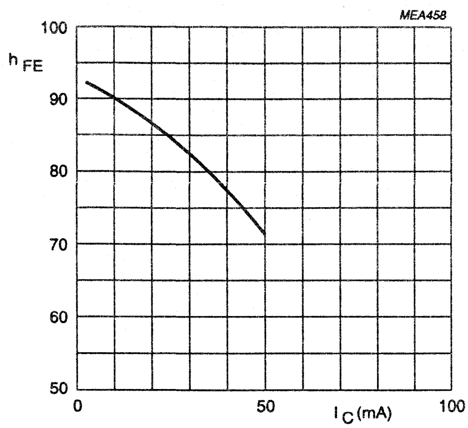
Note

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

CHARACTERISTICS

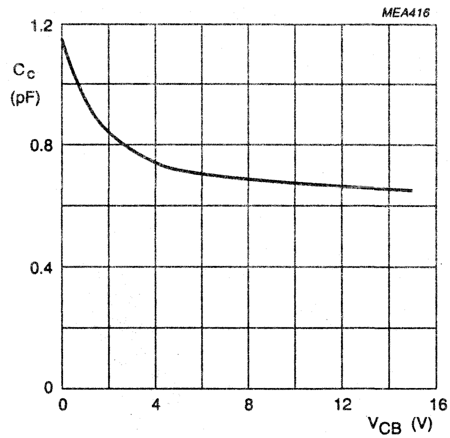
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 5 V	25	–	–	
		I_C = 50 mA; V_{CE} = 5 V	25	–	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 500 MHz	–	1.6	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 5 V; f = 1 MHz	–	–	1.5	pF
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz	–	0.8	–	pF
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; Z_S = 50 Ω; f = 500 MHz	–	–	5	dB
G_p	power gain	I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	–	7.5	–	dB



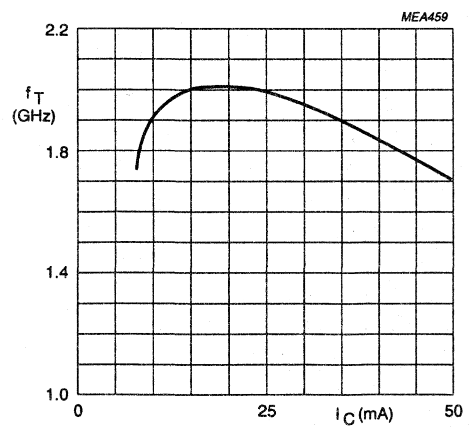
V_{CE} = 5 V; T_j = 25 °C.

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} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.4 Transition frequency as a function of collector current.

NPN 1 GHz wideband transistor BFY90

DESCRIPTION

NPN transistor in a TO-72 metal envelope, with insulated electrodes and a shield lead connected to the case.

The transistor has very low noise over a wide current range, a very high power gain and excellent intermodulation properties.

It is primarily intended for channel and band aerial amplifiers for band I, II, III and IV/V (40 to 860 MHz), wideband aerial amplifiers (40 to 860 MHz), television distribution amplifiers and low noise wideband vertical amplifiers in high speed oscilloscopes.

It is also suitable for military and industrial applications, such as RF amplifiers and mixers for communication equipment, microwave telephony link systems, wideband IF amplifiers and large bandwidth radar IF amplifiers.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector
4	shield lead (connected to case)

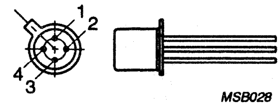


Fig.1 TO-72.

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	–	15	V
I_{CM}	peak collector current	f > 1 MHz	–	50	mA
P_{tot}	total power dissipation	up to T_s = 25 °C (note 1)	–	200	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	1.4	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	0.6	–	pF
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; Z_S = opt.; f = 800 MHz; T_{amb} = 25 °C	5.5	–	dB
G_p	power gain	I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	8	–	dB
P_O	output power	d_{im} = –30 dB; VSWR at output < 2; I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	12	–	mW

Note

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

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	–	15	V
V_{CER}	collector-emitter voltage	$R_{BE} \leq 50\ \Omega$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current	f > 1 MHz	–	50	mA
P_{tot}	total power dissipation	up to T_s = 25 °C (note 1)	–	200	mW
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 25 °C (note 1)	580 K/W

Note

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

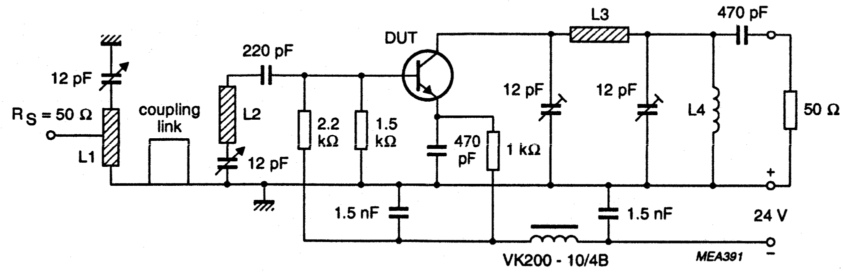
CHARACTERISTICS

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} = 15 V	10	–	–	nA
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V	25	150	–	
		I_C = 25 mA; V_{CE} = 1 V	20	125	–	
f_T	transition frequency	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz	1	1.1	–	GHz
		I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	1.3	1.4	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 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	–	0.6	0.8	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	22	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; Z_S = opt.; f = 800 MHz; T_{amb} = 25 °C	–	5.5	–	dB
G_p	power gain	I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	8	–	dB
P_O	output power	note 2	–	12	–	mW

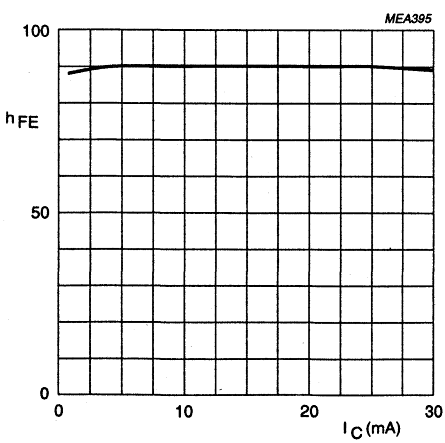
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. I_C = 14 mA; V_{CE} = 10 V; VSWR at output < 2; T_{amb} = 25 °C; f = 800 MHz; d_{im} = –30 dB;
   f_p = 798 MHz; f_q = 802 MHz;
   measured at $f_{(2p-q)}$ = 806 MHz (Channel 62).



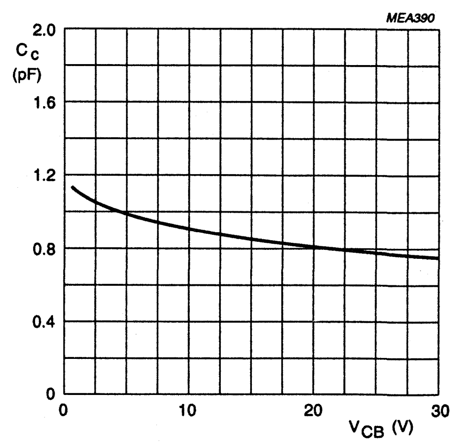
L1 = 24 mm x 6 mm x 0.5 mm silver plated copper strip. Tap of the input at 5 mm from earth.
L2 = 15 mm x 6 mm x 0.5 mm silver plated copper strip.
L3 = 20 mm x 8 mm x 0.5 mm silver plated copper strip.
L4 = 4 turns enamelled 0.5 mm copper wire; winding pitch 1.5 mm; internal diameter 4 mm.
Coupling link: 42 mm silver plated 1 mm copper wire.

Fig.2 Intermodulation distortion test circuit.



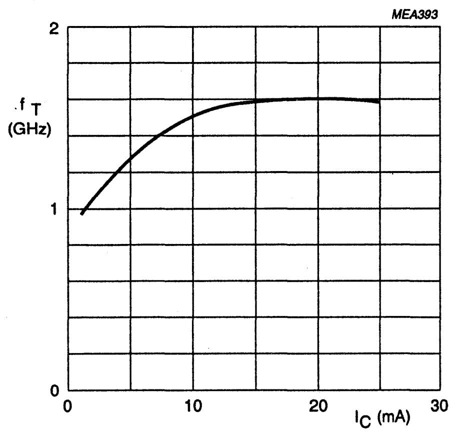
V_{CE} = 1 V; T_j = 25 °C.

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



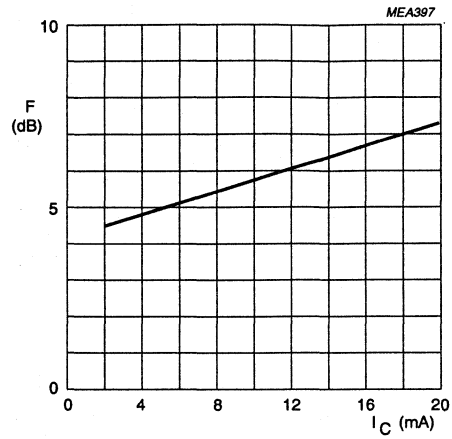
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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 = 50 Ω; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Minimum noise figure as a function of collector current.

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) envelope. PNP complement is the MPSH81.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

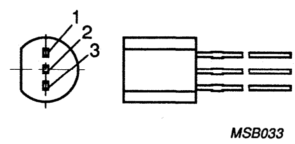


Fig.1 SOT54.

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

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	$T_s = 25$ °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.

NPN 1 GHz general purpose switching transistor

MPSH10

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	125 K/W
$R_{th\ j\text{-}a}$	from junction to ambient	250 K/W

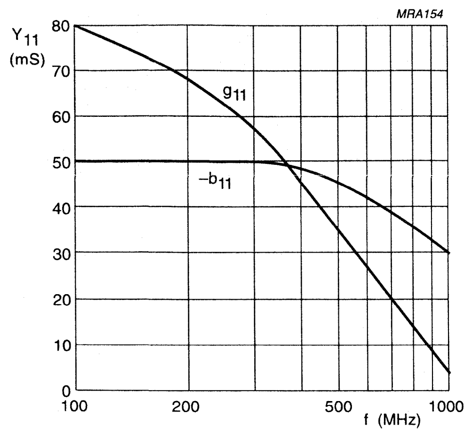
Note

1. T_s is the temperature at the soldering point of the collector lead, 4 mm from the body.

CHARACTERISTICS

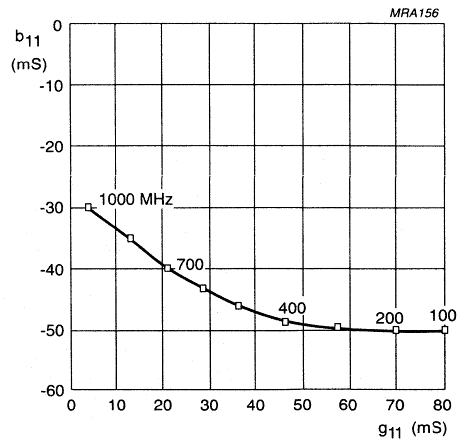
T_j = 25 °C.

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



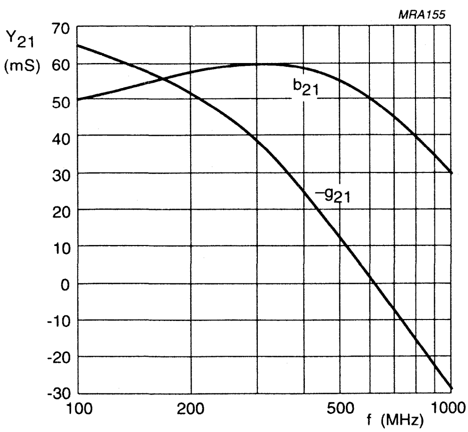
V_{CB} = 10 V; I_C = 4 mA.

Fig.2 Common base input admittance (Y_{11}) as a function of frequency.



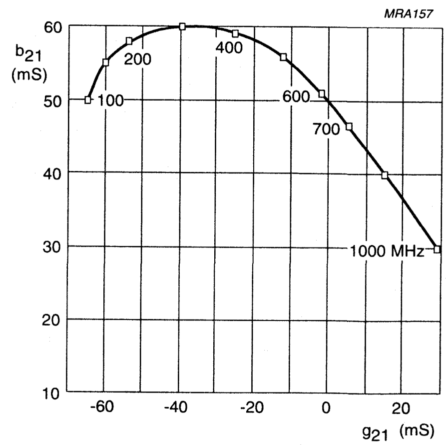
V_{CB} = 10 V; I_C = 4 mA.

Fig.3 Common base input admittance (Y_{11}).



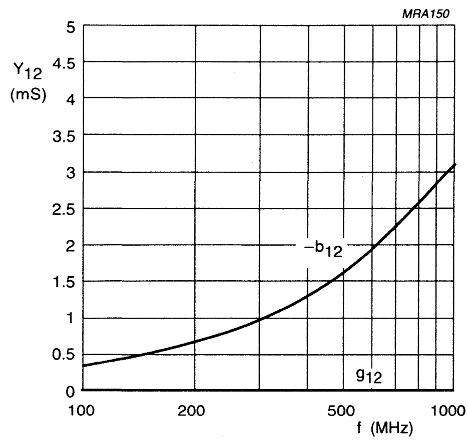
V_{CB} = 10 V; I_C = 4 mA.

Fig.4 Common base forward transfer admittance (Y_{21}) as a function of frequency.



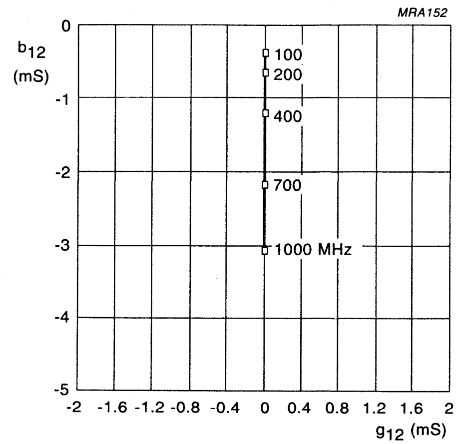
V_{CB} = 10 V; I_C = 4 mA.

Fig.5 Common base forward transfer admittance (Y_{21}).



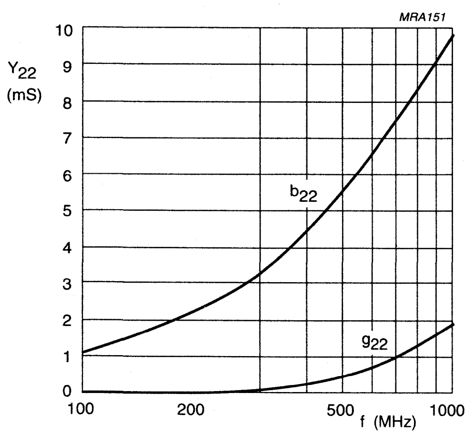
V_{CB} = 10 V; I_C = 4 mA.

Fig.6 Common base reverse transfer admittance (Y_{12}) as a function of frequency.



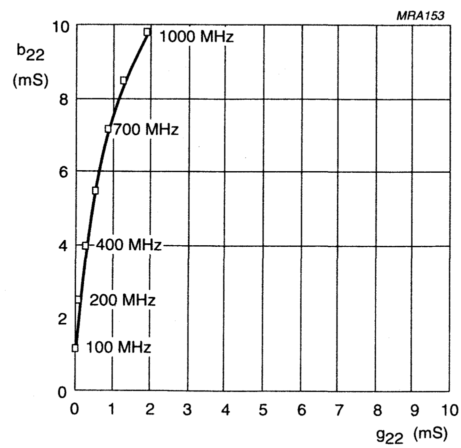
V_{CB} = 10 V; I_C = 4 mA.

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 | PMBT3640

DESCRIPTION

PNP general purpose switching transistor in a SOT23 package.

PINNING

PIN	DESCRIPTION
	Code: V25
1	base
2	emitter
3	collector

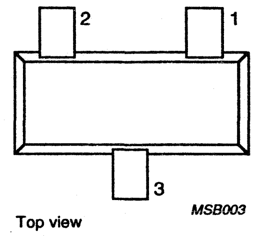


Fig.1 SOT23.

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.

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 μA; I_E = 0	12	–	V
$-V_{(BR)CES}$	collector-emitter breakdown voltage	$-I_C$ = 100 μA; V_{BE} = 0	12	–	V
$-V_{(BR)EBO}$	emitter-base breakdown voltage	$-I_E$ = 100 μA; 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_{EB} = 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

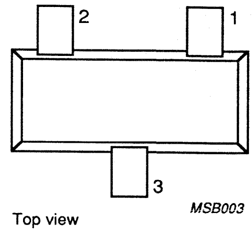


Fig.1 SOT23.

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

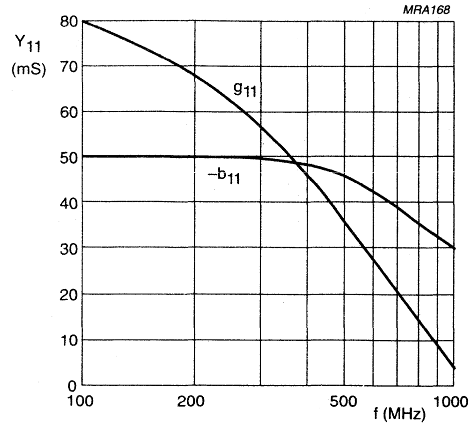
Note

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

CHARACTERISTICS

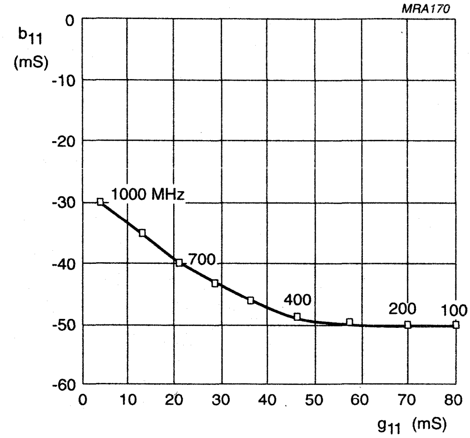
T_j = 25 °C.

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



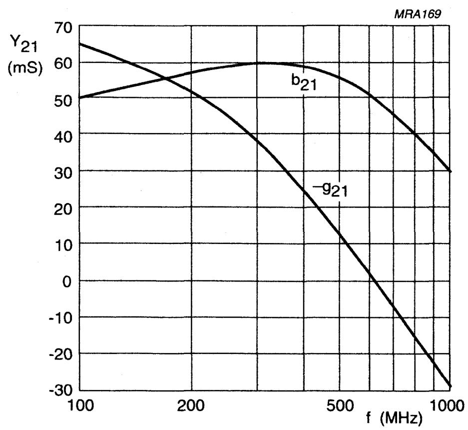
V_{CB} = 10 V; I_C = 4 mA.

Fig.2 Common base input admittance (Y_{11}) as a function of frequency.



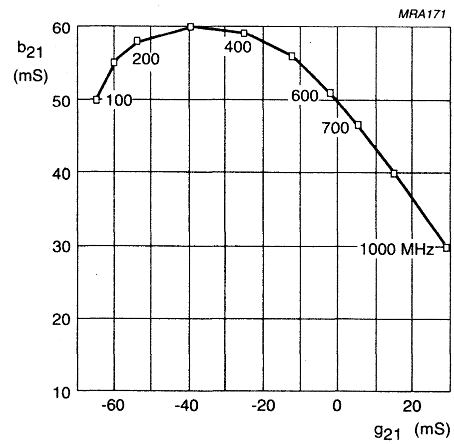
V_{CB} = 10 V; I_C = 4 mA.

Fig.3 Common base input admittance (Y_{11}).



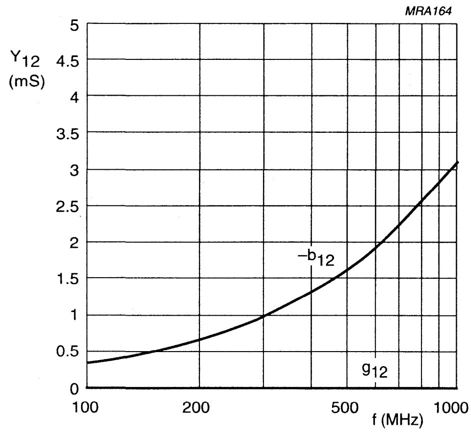
V_{CB} = 10 V; I_C = 4 mA.

Fig.4 Common base forward transfer admittance (Y_{21}) as a function of frequency.



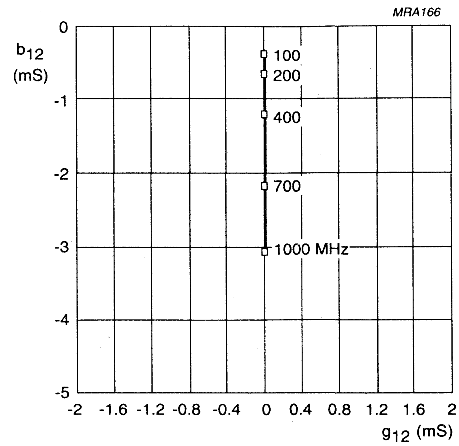
V_{CB} = 10 V; I_C = 4 mA.

Fig.5 Common base forward transfer admittance (Y_{21}).



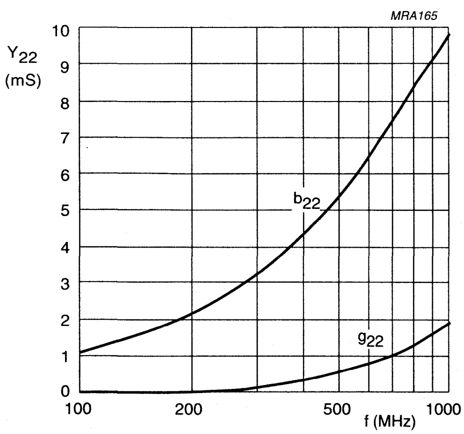
V_{CB} = 10 V; I_C = 4 mA.

Fig.6 Common base reverse transfer admittance (Y_{12}) as a function of frequency.



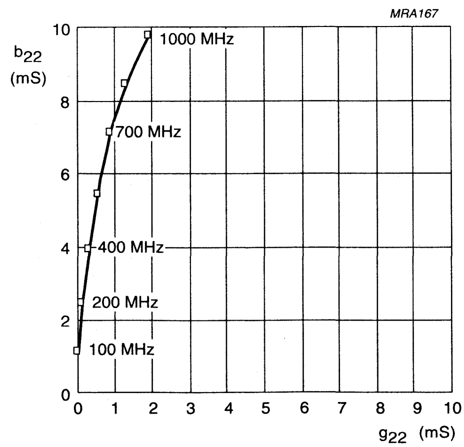
V_{CB} = 10 V; I_C = 4 mA.

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

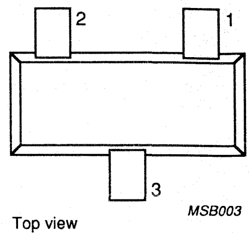


Fig.1 SOT23.

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

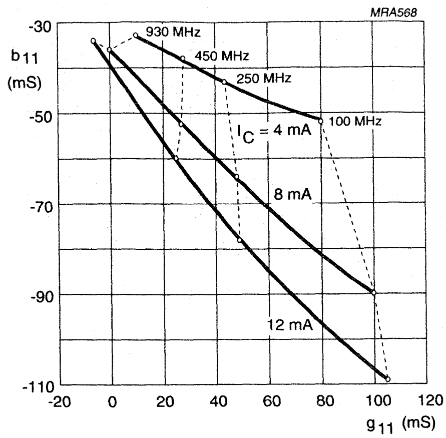
1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C.

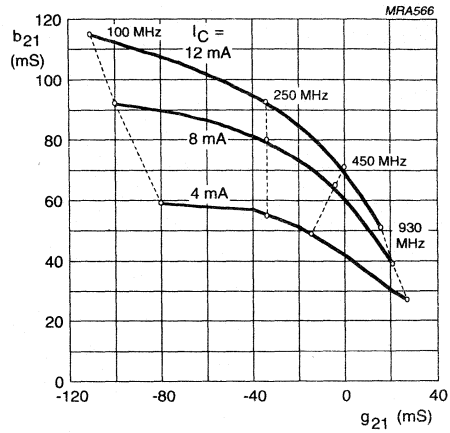
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 µA; I_E = 0	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0	20	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 µA; I_C = 0	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

PNP 1 GHz switching transistor PMBTH81



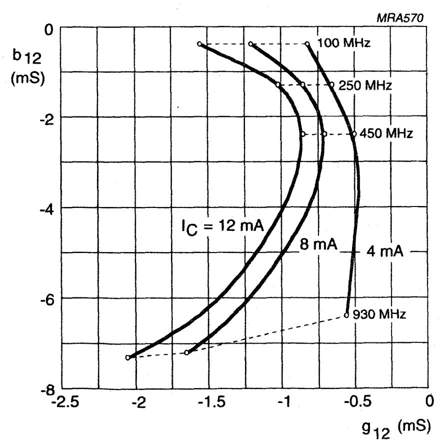
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.2 Common base input admittance (Y_{11}).



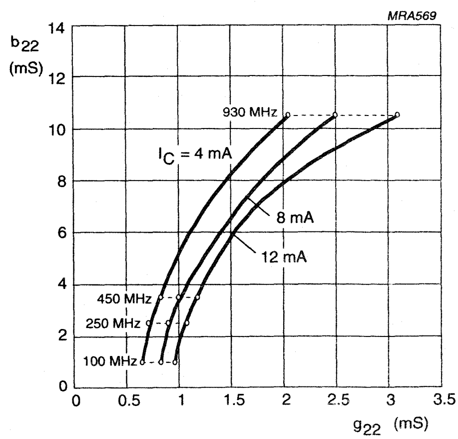
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.3 Forward transfer admittance (Y_{21}).



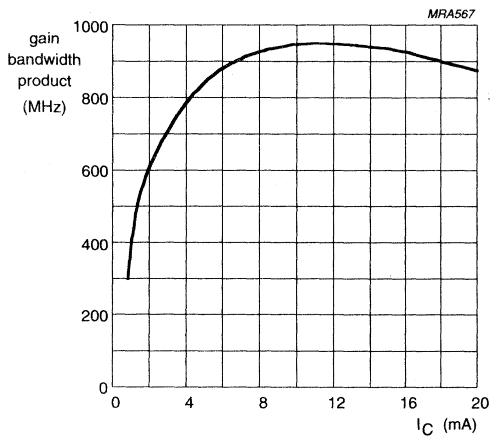
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.4 Reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; T_{amb} = 25 °C.

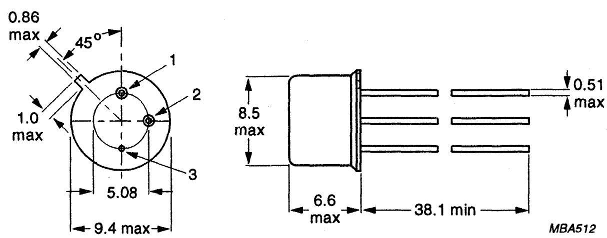
Fig.5 Common base output admittance (Y_{22}).



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

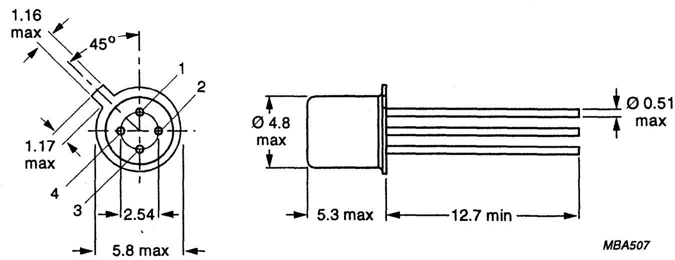
Fig.6 Current gain-bandwidth product as a function of collector current.

PACKAGE OUTLINES



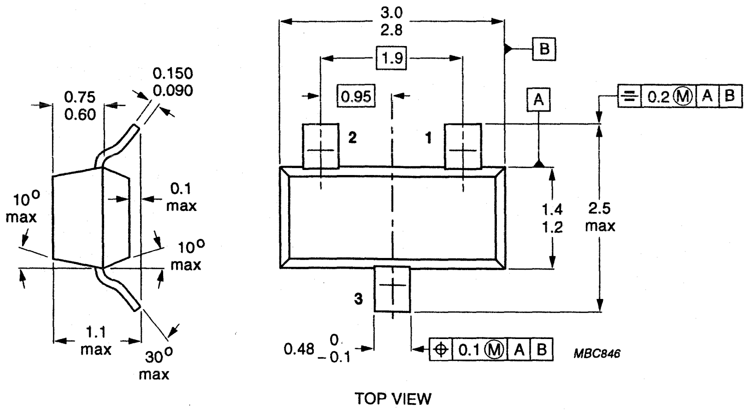
Dimensions in mm.

Fig.1 SOT5 (TO-39).



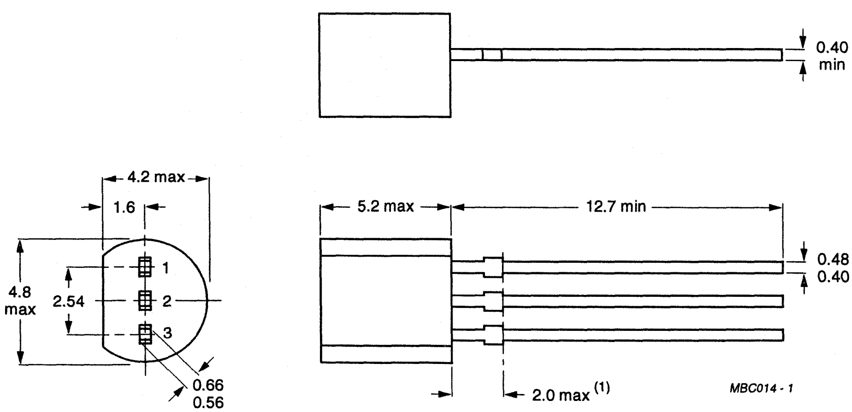
Dimensions in mm.

Fig.2 SOT18 (TO-72).



Dimensions in mm.

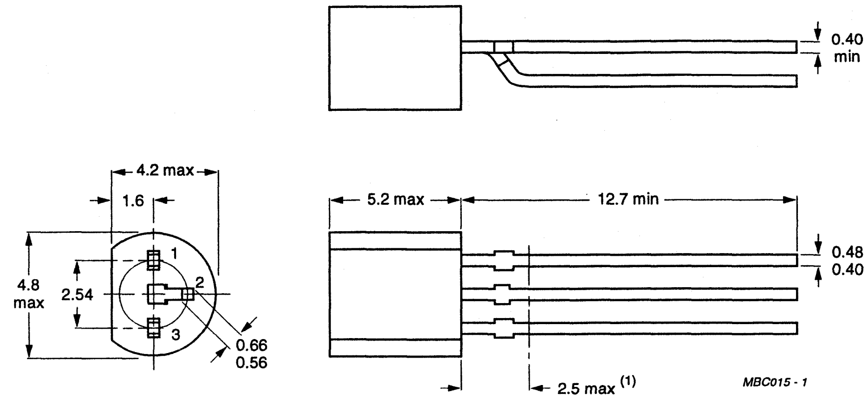
Fig.3 SOT23.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

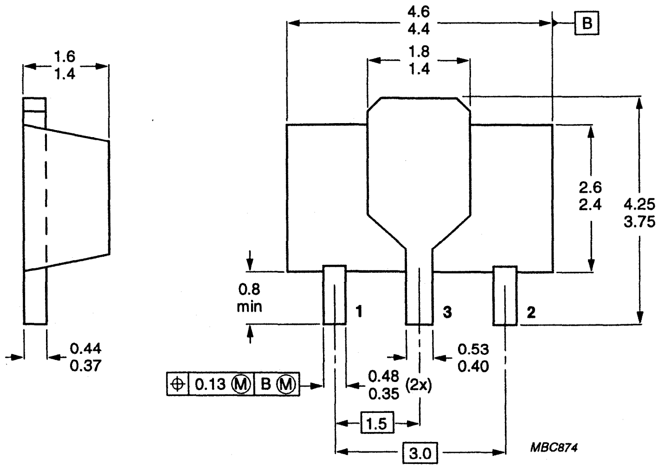
Fig.4 SOT54 (TO-92).



Dimensions in mm.

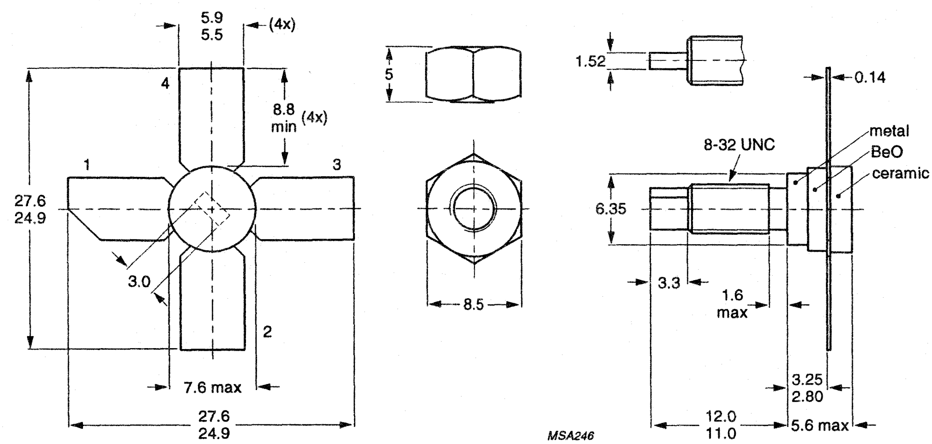
(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.5 SOT54 (TO-92) variant.



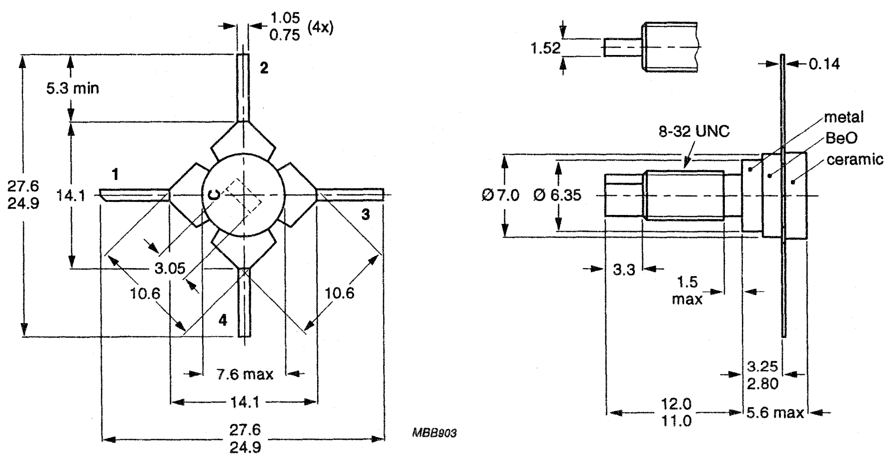
Dimensions in mm.

Fig.6 SOT89.



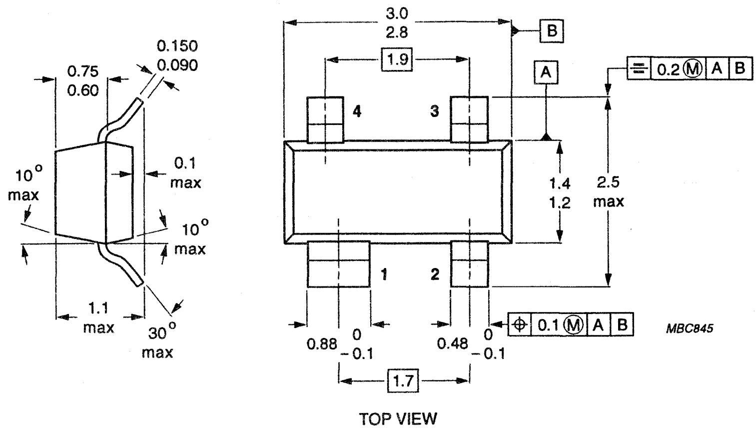
Dimensions in mm.

Fig.7 SOT122A.



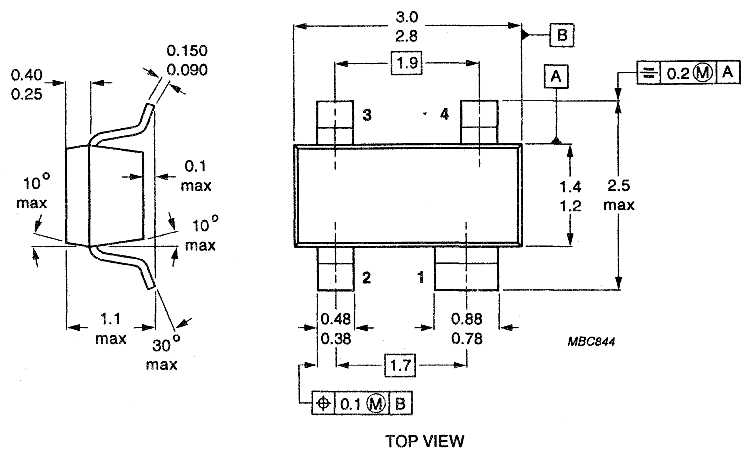
Dimensions in mm.

Fig.8 SOT122E.



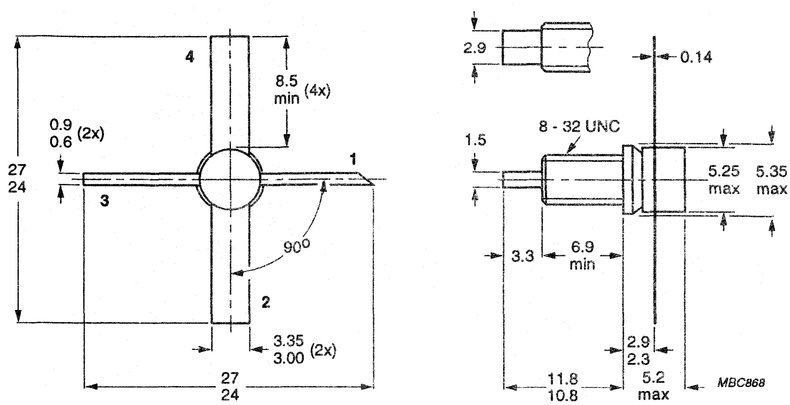
Dimensions in mm.

Fig.9 SOT143.



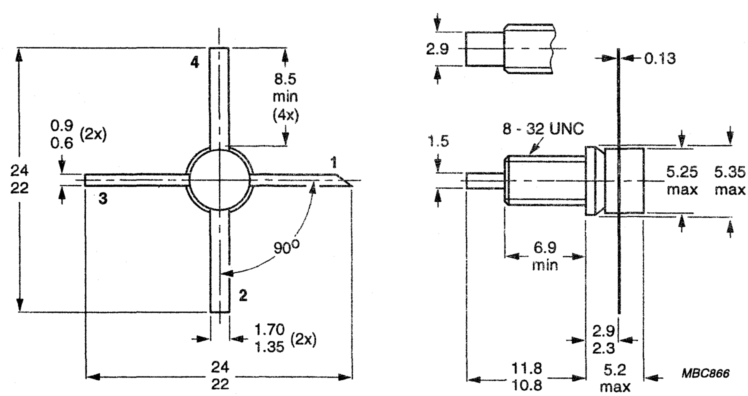
Dimensions in mm.

Fig.10 SOT143R.



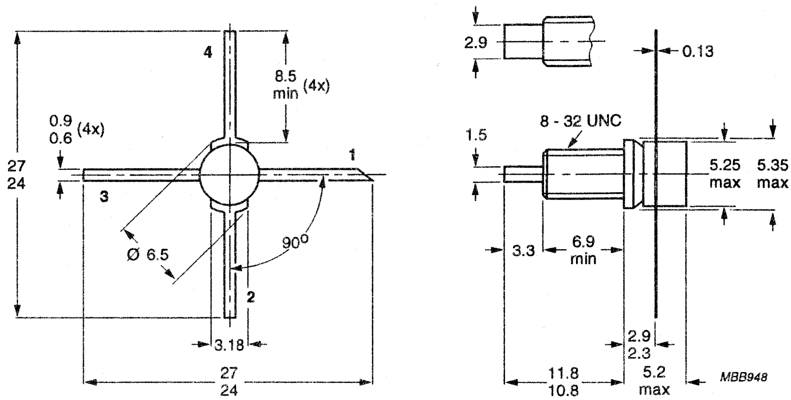
Dimensions in mm.

Fig.11 SOT172A1.



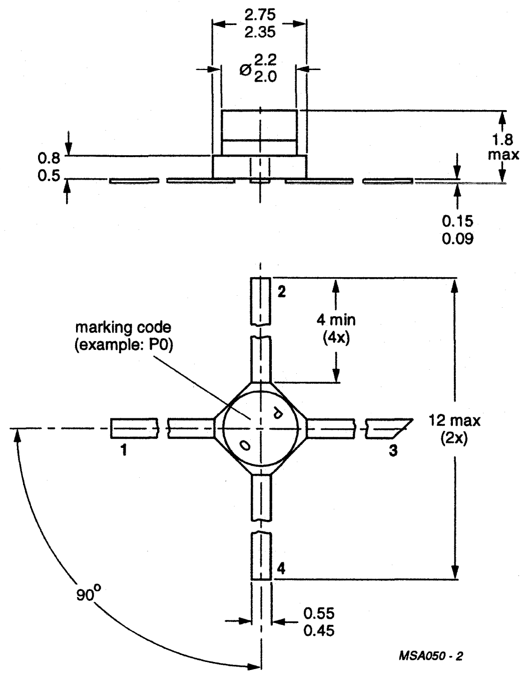
Dimensions in mm.

Fig.12 SOT172A2.



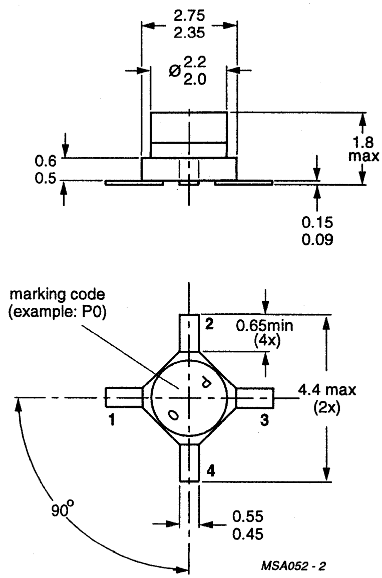
Dimensions in mm.

Fig.13 SOT172A3.



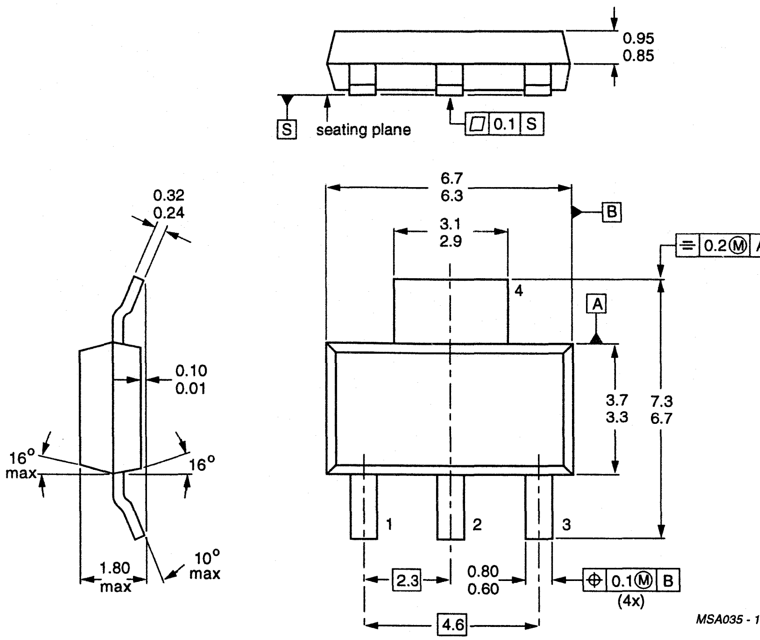
Dimensions in mm.

Fig.14 SOT173.



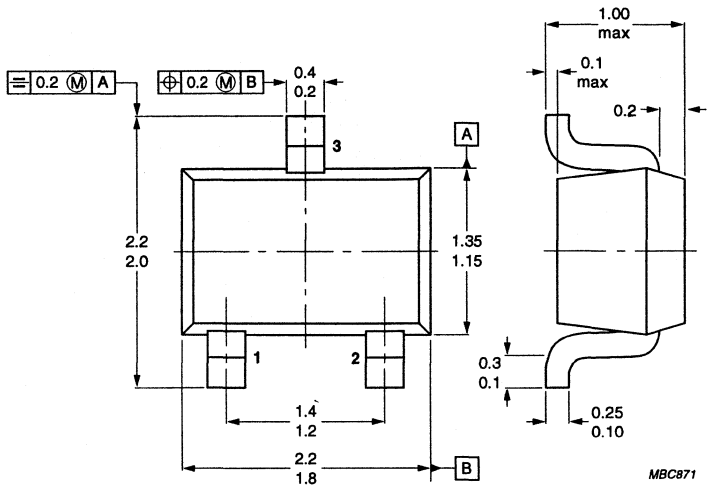
Dimensions in mm.

Fig.15 SOT173X.



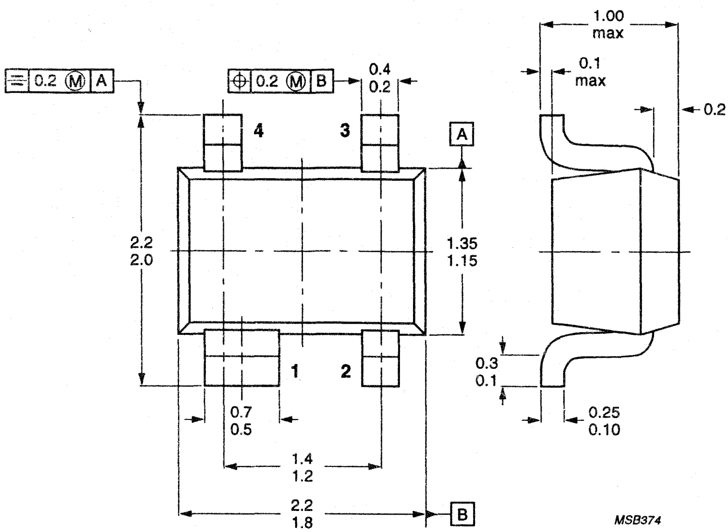
Dimensions in mm.

Fig.16 SOT223.



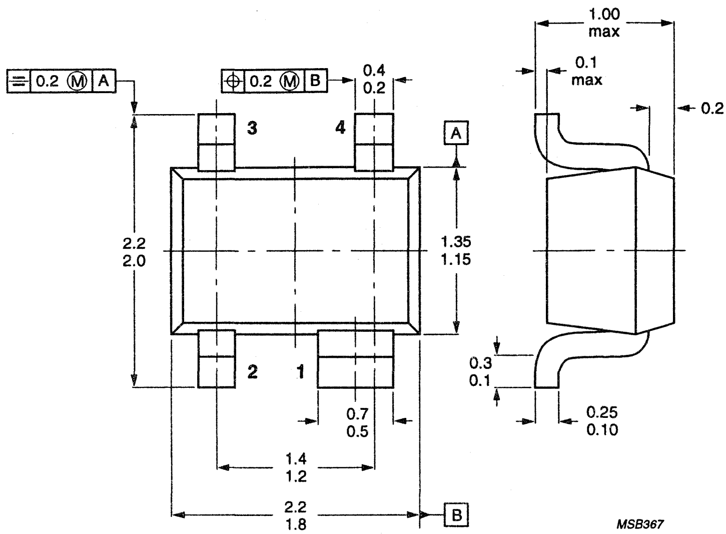
Dimensions in mm.

Fig.17 SOT323.



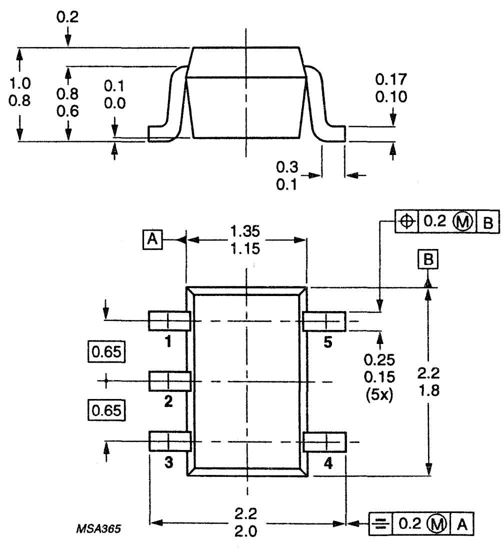
Dimensions in mm.

Fig.18 SOT343.



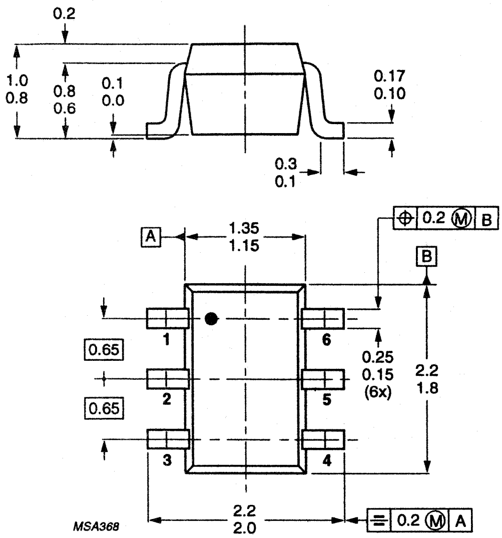
Dimensions in mm.

Fig.19 SOT343R.



Dimensions in mm.

Fig.20 SOT353.



Dimensions in mm.

Fig.21 SOT363.

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Data handbook system

DATA HANDBOOK SYSTEM

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Data handbook system

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