

# BFG540; BFG540/X; BFG540/XR

NPN 9 GHz wideband transistor

Rev. 05 — 21 November 2007

Product data sheet

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NXP Semiconductors

**NPN 9 GHz wideband transistor**

**BFG540; BFG540/X;  
BFG540/XR**

**FEATURES**

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

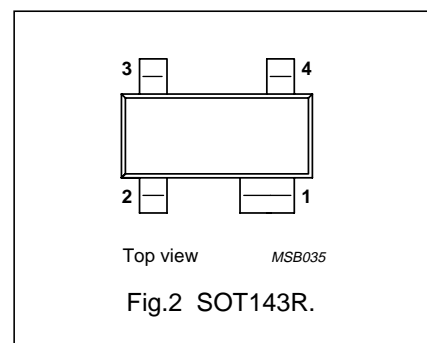
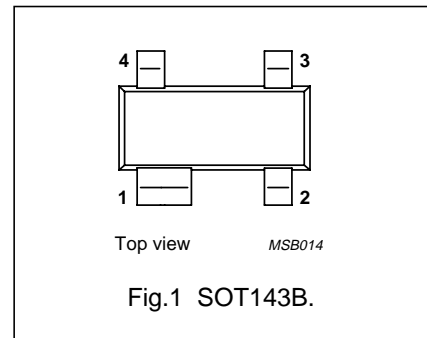
**DESCRIPTION**

NPN silicon planar epitaxial transistors, intended for wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optical systems.

The transistors are mounted in plastic SOT143B and SOT143R packages.

**PINNING**

PIN	DESCRIPTION
BFG540 (Fig.1) Code: %MG	
1	collector
2	base
3	emitter
4	emitter
BFG540/X (Fig.1) Code: %MM	
1	collector
2	emitter
3	base
4	emitter
BFG540/XR (Fig.2) Code: %MR	
1	collector
2	emitter
3	base
4	emitter



## NPN 9 GHz wideband transistor

BFG540; BFG540/X;  
BFG540/XR

## 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	$T_s \leq 60\text{ °C}$ ; note 1	–	–	400	mW
$h_{FE}$	DC current gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_j = 25\text{ °C}$	100	120	250	
$C_{re}$	feedback capacitance	$I_C = 0$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ MHz}$	–	0.5	–	pF
$f_T$	transition frequency	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	18	–	dB
		$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	11	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	2.1	–	dB

## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134).

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	$T_s \leq 60\text{ °C}$ ; note 1	–	400	mW
$T_{stg}$	storage temperature		–65	+150	°C
$T_j$	junction temperature		–	150	°C

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

## THERMAL CHARACTERISTICS

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

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

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## CHARACTERISTICS

 $T_j = 25\text{ °C}$  unless otherwise specified.

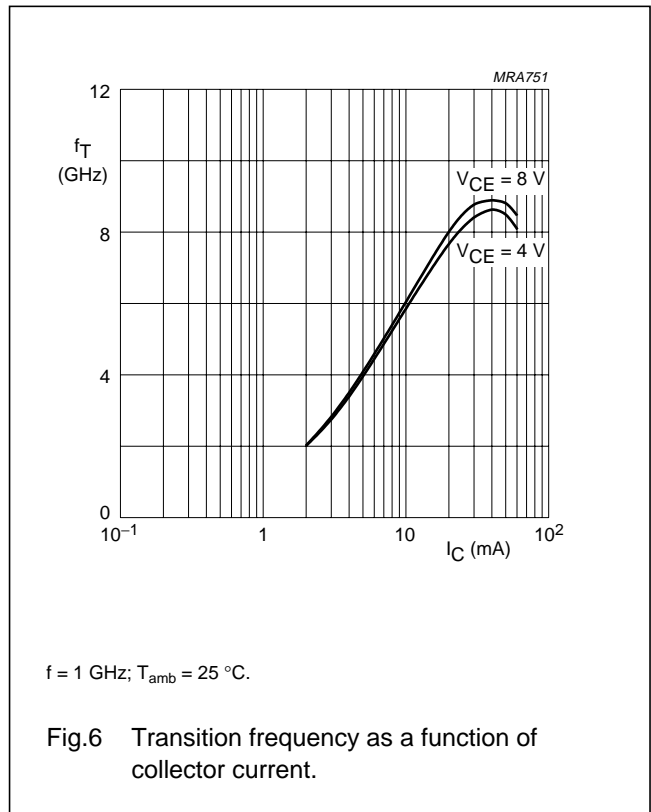
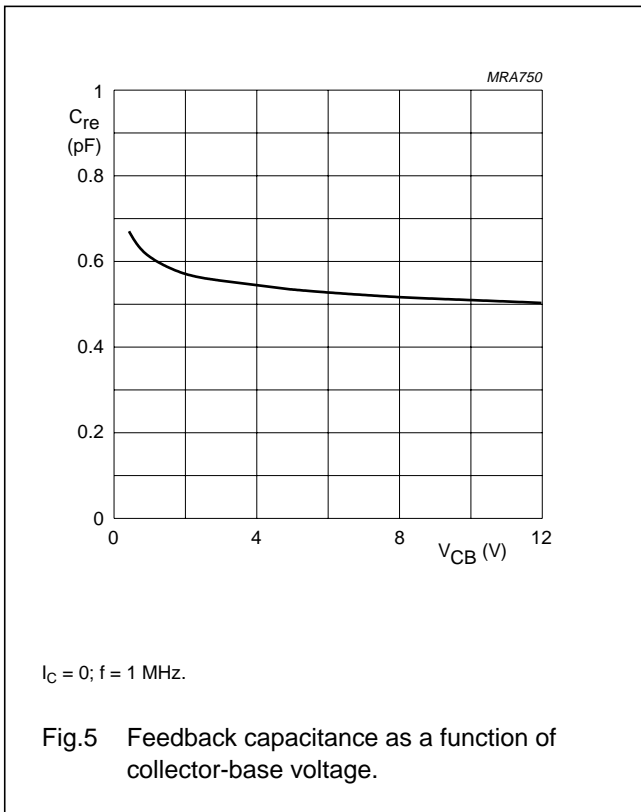
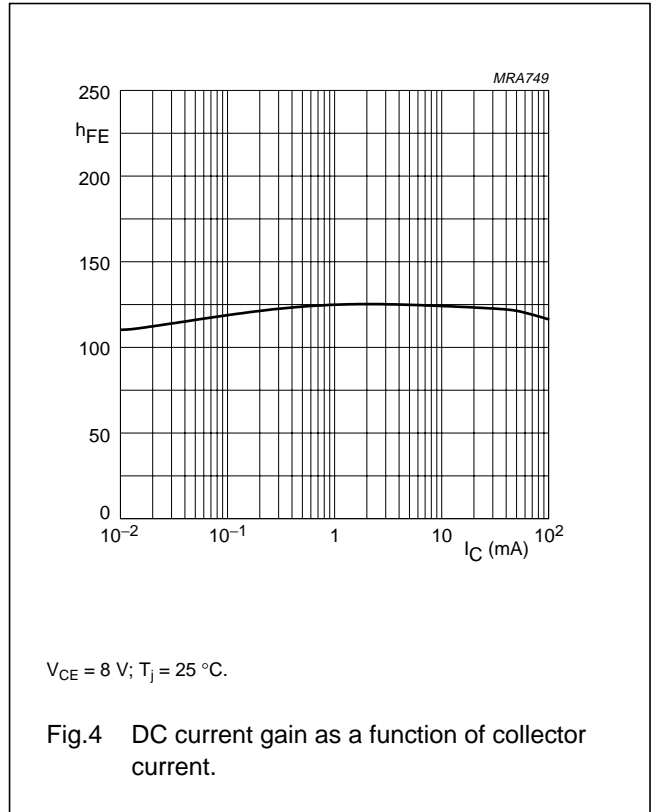
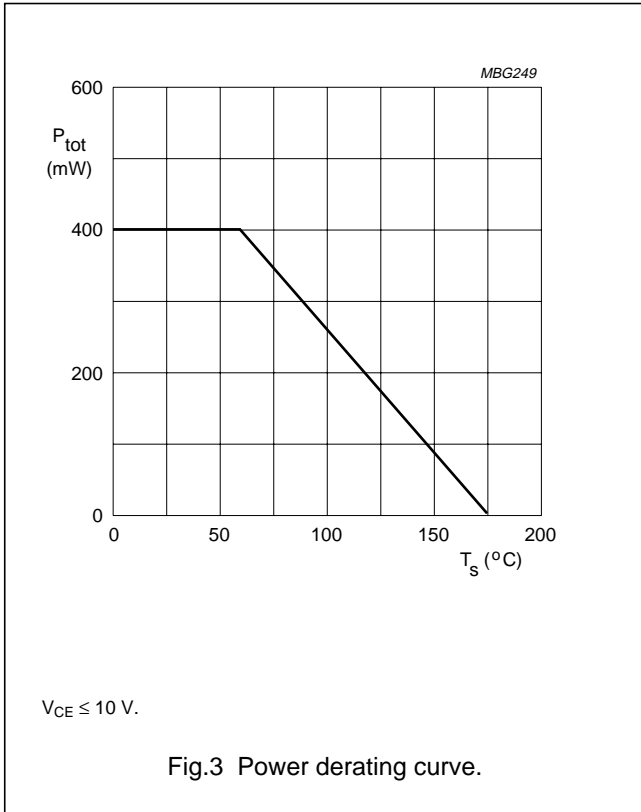
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0$ ; $V_{CB} = 8\text{ V}$	–	–	50	nA
$h_{FE}$	DC current gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$	60	120	250	
$C_e$	emitter capacitance	$I_C = I_C = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$	–	2	–	pF
$C_c$	collector capacitance	$I_E = I_E = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$	–	0.9	–	pF
$C_{re}$	feedback capacitance	$I_C = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$	–	0.5	–	pF
$f_T$	transition frequency	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain (note 1)	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	18	–	dB
		$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	11	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	2.1	–	dB
$PL_1$	output power at 1 dB gain compression	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $R_L = 50\text{ }\Omega$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	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

- $G_{UM}$  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.
- $V_{CE} = 8\text{ V}$ ;  $I_C = 40\text{ mA}$ ;  $R_L = 50\text{ }\Omega$ ;  $T_{amb} = 25\text{ °C}$ ;  
 $f_p = 900\text{ MHz}$ ;  $f_q = 902\text{ MHz}$ ;  
measured at  $f_{(2p-q)} = 898\text{ MHz}$  and  $f_{(2q-p)} = 904\text{ MHz}$ .
- $d_{im} = -60\text{ dB}$  (DIN 45004B);  $I_C = 40\text{ mA}$ ;  $V_{CE} = 8\text{ V}$ ;  $Z_L = Z_S = 75\text{ }\Omega$ ;  $T_{amb} = 25\text{ °C}$ ;  
 $V_p = V_O$ ;  $V_q = V_O - 6\text{ dB}$ ;  $V_r = V_O - 6\text{ dB}$ ;  
 $f_p = 795.25\text{ MHz}$ ;  $f_q = 803.25\text{ MHz}$ ;  $f_r = 805.25\text{ MHz}$ ;  
measured at  $f_{(p+q-r)} = 793.25\text{ MHz}$ .
- $I_C = 40\text{ mA}$ ;  $V_{CE} = 8\text{ V}$ ;  $V_O = 275\text{ mV}$ ;  $T_{amb} = 25\text{ °C}$ ;  
 $f_p = 250\text{ MHz}$ ;  $f_q = 560\text{ MHz}$ ; measured at  $f_{(p+q)} = 810\text{ MHz}$ .

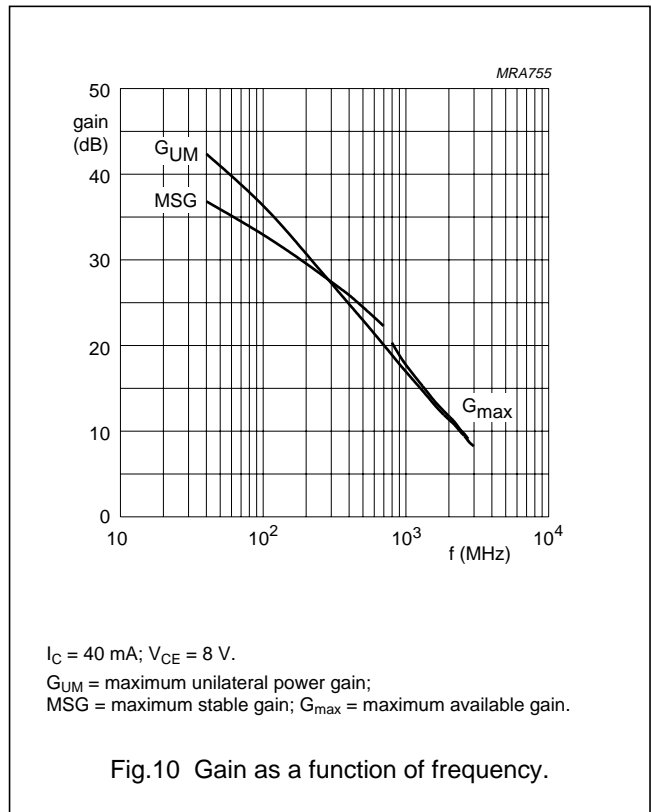
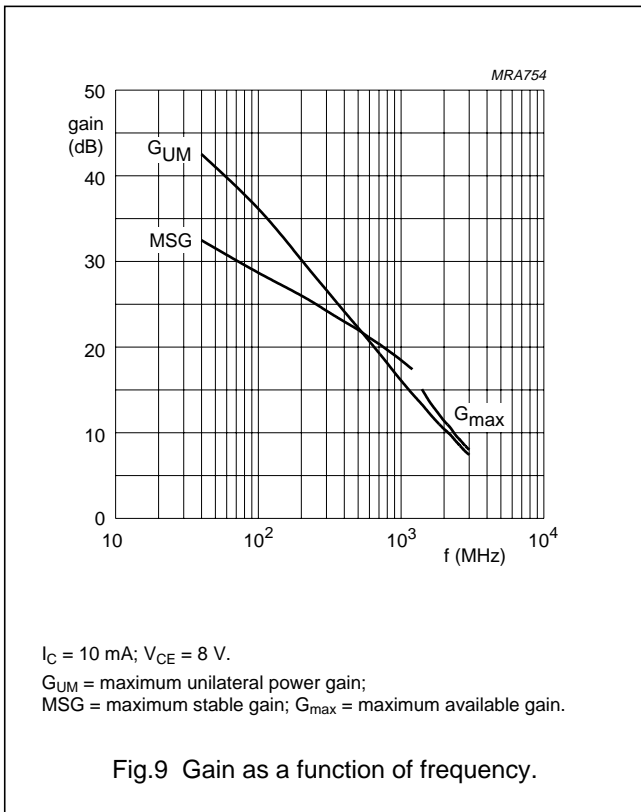
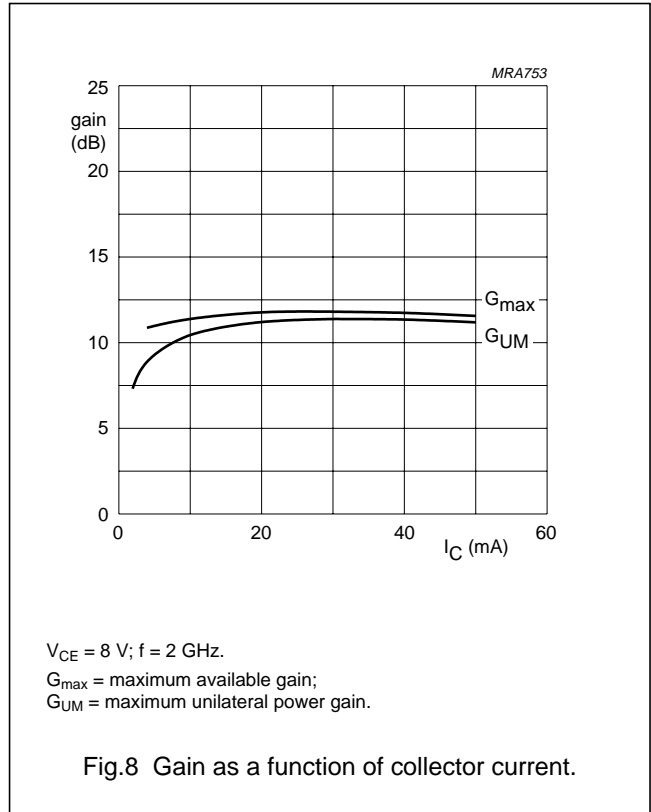
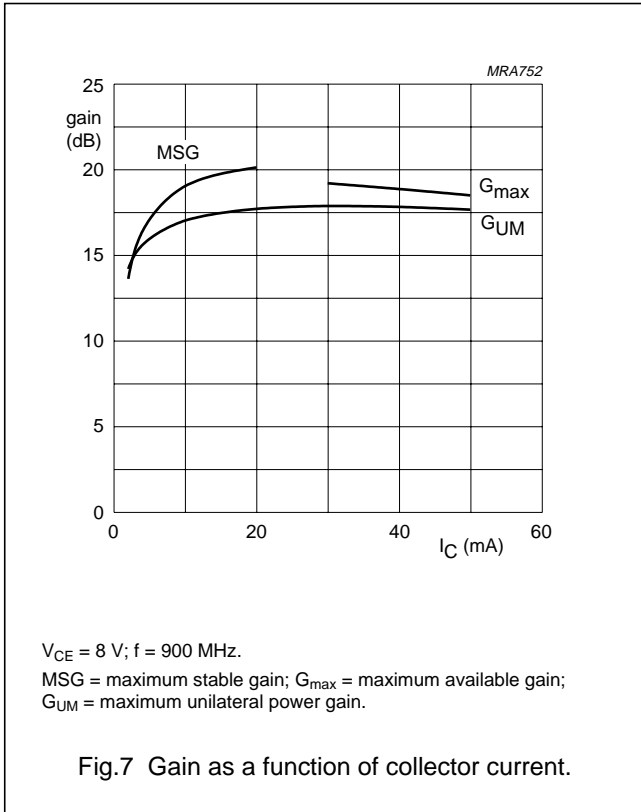
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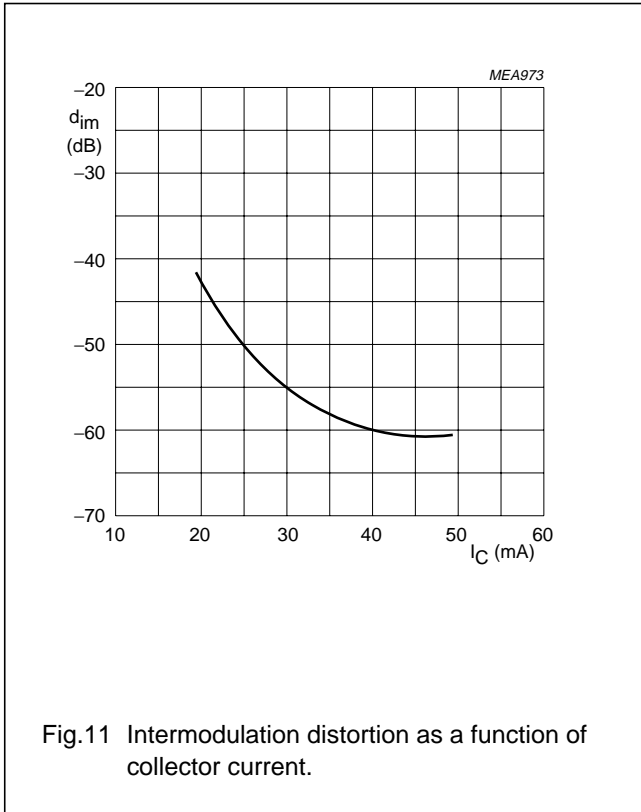


Fig.11 Intermodulation distortion as a function of collector current.

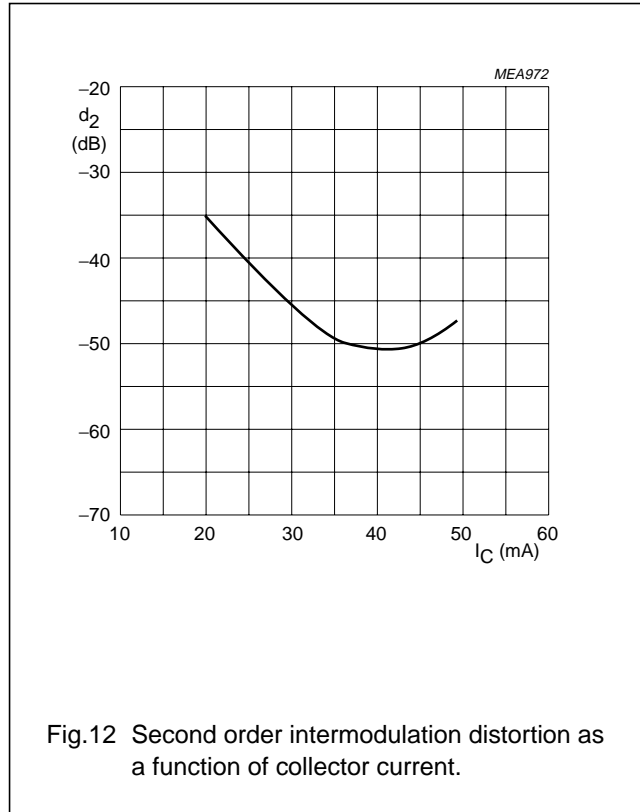
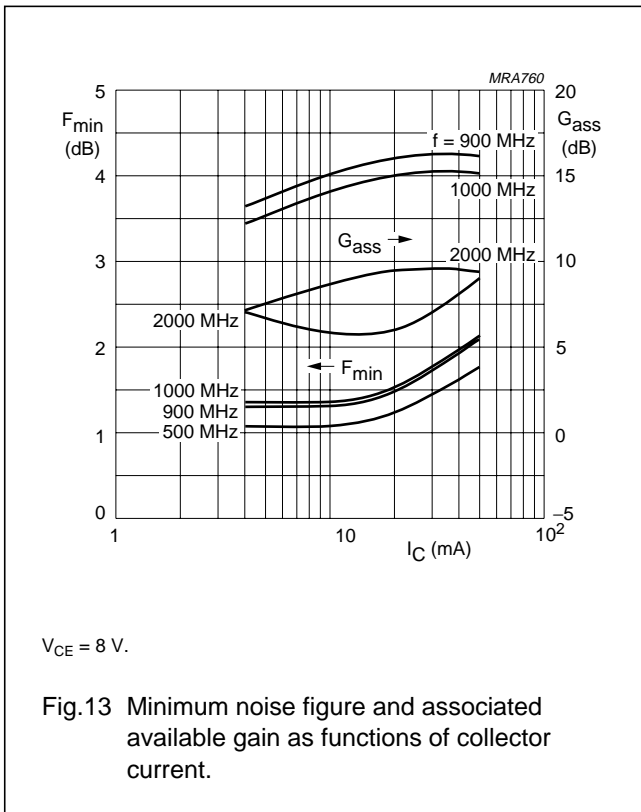
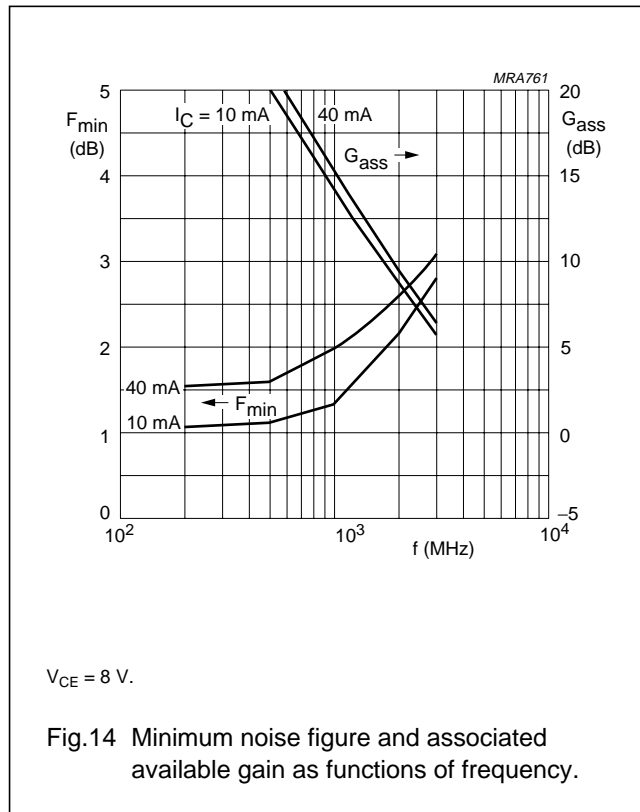


Fig.12 Second order intermodulation distortion as a function of collector current.



$V_{CE} = 8$  V.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.

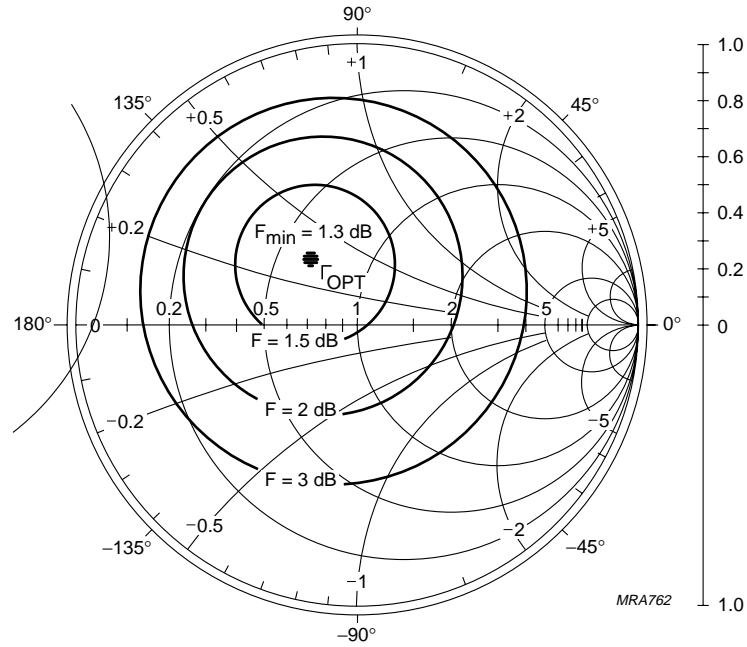


$V_{CE} = 8$  V.

Fig.14 Minimum noise figure and associated available gain as functions of frequency.

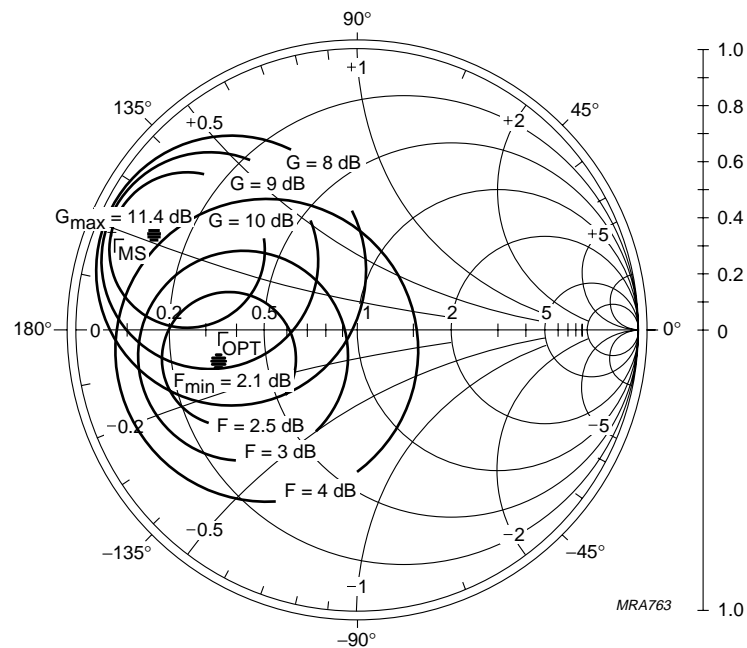
NPN 9 GHz wideband transistor

BFG540; BFG540/X;  
BFG540/XR



$I_C = 10 \text{ mA}$ ;  $V_{CE} = 8 \text{ V}$ ;  $Z_0 = 50 \Omega$ ;  $f = 900 \text{ MHz}$ .

Fig.15 Noise circle figure.



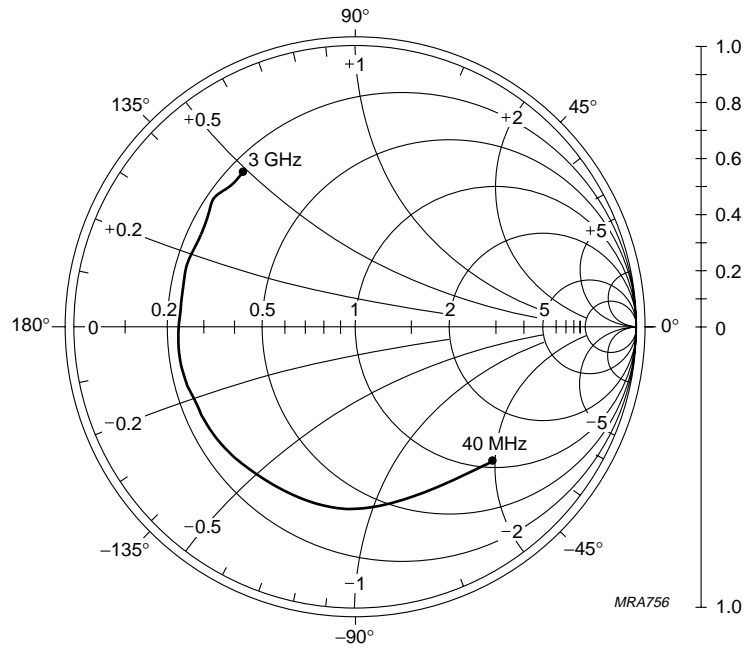
$I_C = 10 \text{ mA}$ ;  $V_{CE} = 8 \text{ V}$ ;  $Z_0 = 50 \Omega$ ;  $f = 2 \text{ GHz}$ .

Fig.16 Noise circle figure.



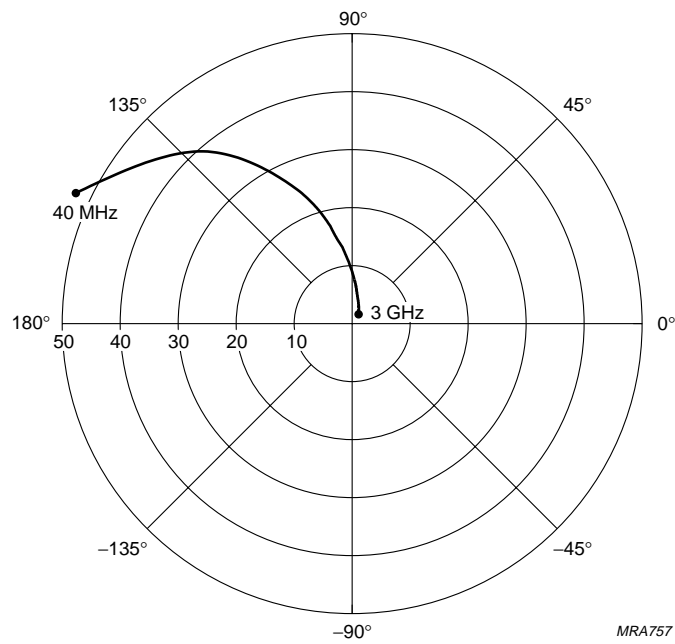
NPN 9 GHz wideband transistor

BFG540; BFG540/X;  
BFG540/XR



$I_C = 40 \text{ mA}$ ;  $V_{CE} = 8 \text{ V}$ ;  $Z_0 = 50 \Omega$ .

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

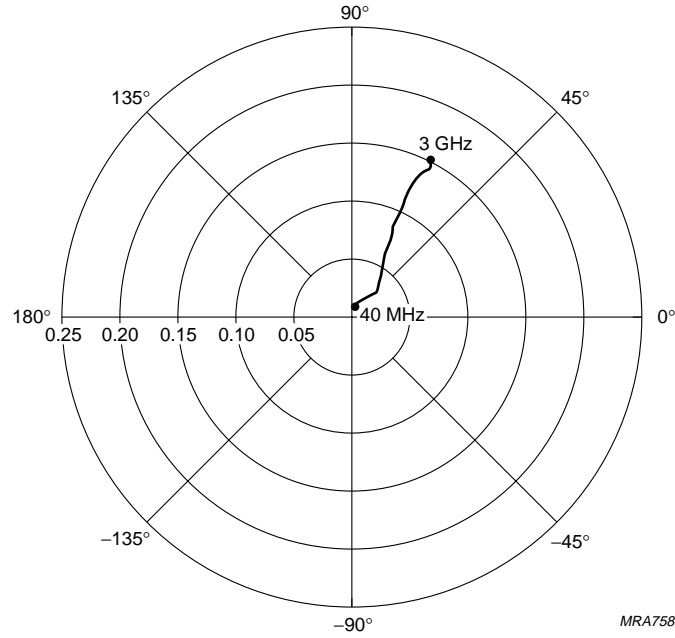


$I_C = 40 \text{ mA}$ ;  $V_{CE} = 8 \text{ V}$ .

Fig.18 Common emitter forward transmission coefficient ( $s_{21}$ ).

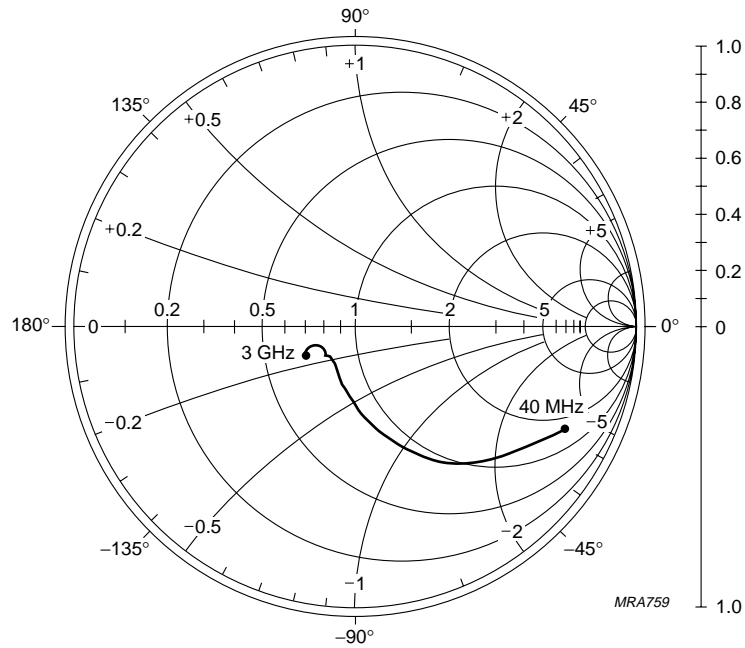
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BFG540; BFG540/X;  
BFG540/XR



$I_C = 40 \text{ mA}; V_{CE} = 8 \text{ V}.$

Fig.19 Common emitter reverse transmission coefficient ( $s_{12}$ ).



$I_C = 40 \text{ mA}; V_{CE} = 8 \text{ V}; Z_0 = 50 \Omega.$

Fig.20 Common emitter output reflection coefficient ( $s_{22}$ ).

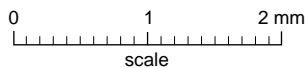
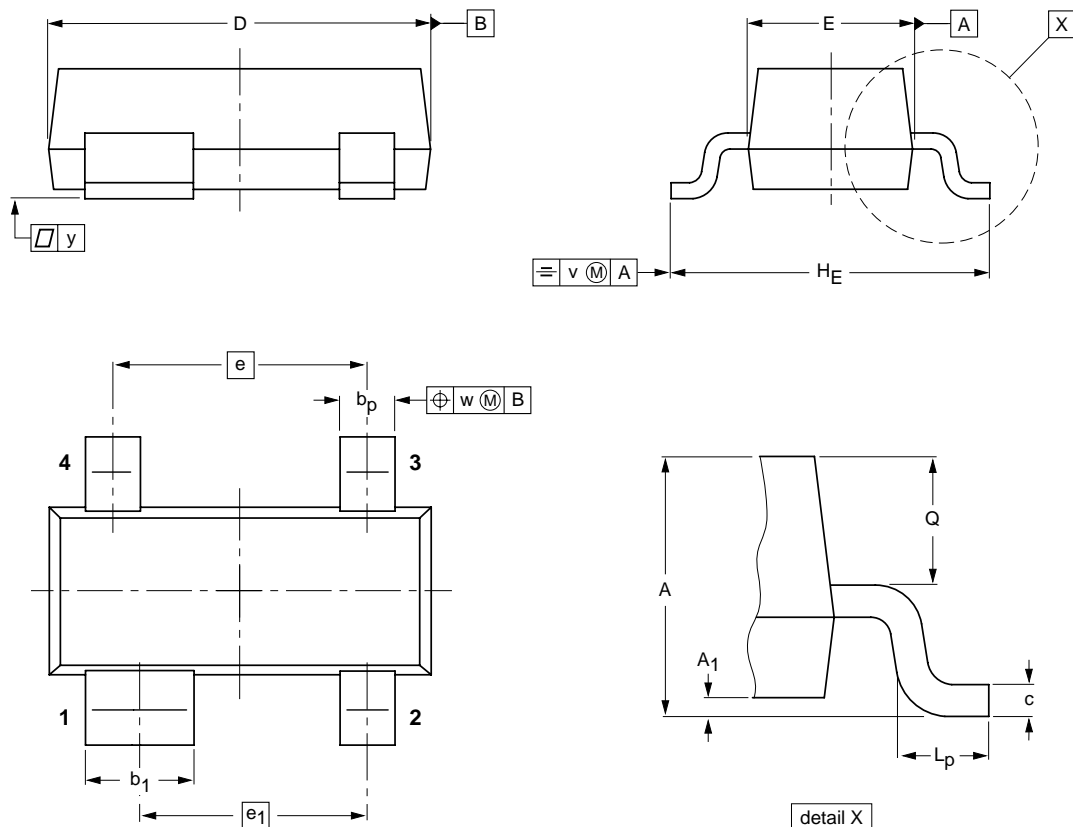
NPN 9 GHz wideband transistor

BFG540; BFG540/X;  
BFG540/XR

PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1	0.1

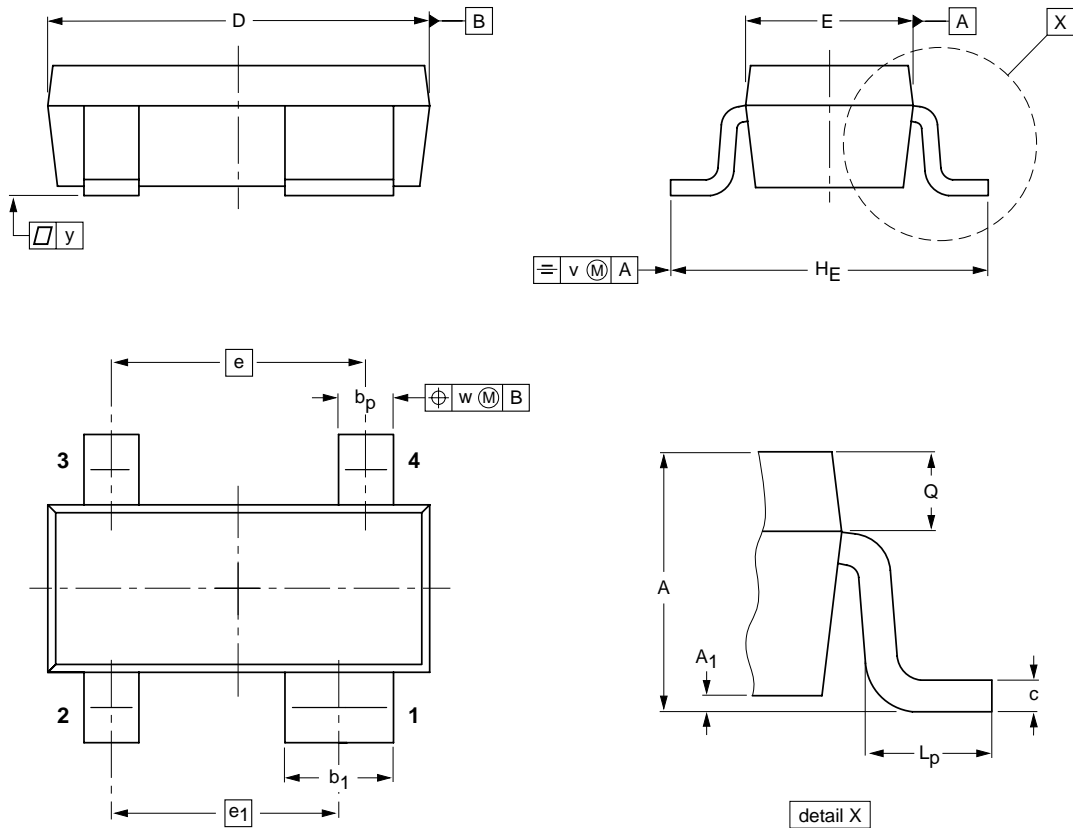
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

NPN 9 GHz wideband transistor

BFG540; BFG540/X;  
BFG540/XR

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.55 0.25	0.45 0.25	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143R			SC-61B			97-03-10 99-09-13

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### Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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## Revision history

### Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFG540_X_XR_N_5	20071121	Product data sheet	-	BFG540_X_XR_4
Modifications:	<ul style="list-style-type: none"> <li>• Pinning table on page 2; changed code</li> </ul>			
BFG540_X_XR_4 (9397 750 07059)	20000523	Product specification	-	BFG540XR_3
BFG540XR_3 (9397 750 03144)	19950901	Product specification	-	BFG540XR_2
BFG540XR_2	-	Product specification	-	BFG540XR_1
BFG540XR_1	-	-	-	-

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Date of release: 21 November 2007

Document identifier: BFG540\_X\_XR\_N\_5