

# BFG424F

NPN 25 GHz wideband transistor

Rev. 2 — 13 September 2011

Product data sheet

## 1. Product profile

### 1.1 General description

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a plastic, 4-pin dual-emitter SOT343F package.

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

### 1.2 Features and benefits

- Very high power gain
- Low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance

### 1.3 Applications

- Radio Frequency (RF) front end wideband applications such as:
  - ◆ analog and digital cellular telephones
  - ◆ cordless telephones (Cordless Telephone (CT), Personal Handy-phone System (PHS), Digital Enhanced Cordless Telecommunications (DECT), etc.)
  - ◆ radar detectors
  - ◆ pagers
  - ◆ Satellite Antenna TeleVison (SATV) tuners
  - ◆ high frequency oscillators e.g. Dielectric Resonator Oscillator (DRO) for Low Noise Block (LNB)

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	-	10	V
$V_{CEO}$	collector-emitter voltage	open base	-	-	4.5	V
$I_C$	collector current		-	25	30	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ }^\circ\text{C}$	[1]	-	135	mW



**Table 1. Quick reference data ...continued**

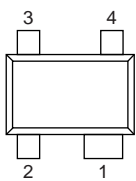
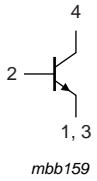
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$h_{FE}$	DC current gain	$I_C = 25 \text{ mA}; V_{CE} = 2 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	50	80	120	
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2 \text{ V}; f = 1 \text{ MHz}$	-	102	-	fF
$f_T$	transition frequency	$I_C = 25 \text{ mA}; V_{CE} = 2 \text{ V}; f = 2 \text{ GHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	25	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 25 \text{ mA}; V_{CE} = 2 \text{ V}; f = 2 \text{ GHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	[2]	-	23	dB
NF	noise figure	$I_C = 2 \text{ mA}; V_{CE} = 2 \text{ V}; f = 2 \text{ GHz}; \Gamma_S = \Gamma_{opt}$	-	1.2	-	dB

[1]  $T_{sp}$  is the temperature at the soldering point of the emitter pins.

[2]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)}$  = Maximum Stable Gain (MSG), see [Figure 8](#).

## 2. Pinning information

**Table 2. Pinning**

Pin	Description	Simplified outline	Symbol
1	emitter		
2	base		
3	emitter		
4	collector		

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
BFG424F	-	plastic surface mounted flat pack package; reverse pinning; 4 leads	SOT343F

## 4. Marking

**Table 4. Marking**

Type number	Marking code <sup>[1]</sup>
BFG424F	NE*

[1] \* = p: made in Hong Kong.

## 5. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	10	V
$V_{CEO}$	collector-emitter voltage	open base	-	4.5	V
$V_{EBO}$	emitter-base voltage	open collector	-	1	V
$I_C$	collector current		-	30	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ }^\circ\text{C}$	[1]	135	mW
$T_{stg}$	storage temperature		-65	+150	$^\circ\text{C}$
$T_j$	junction temperature		-	150	$^\circ\text{C}$

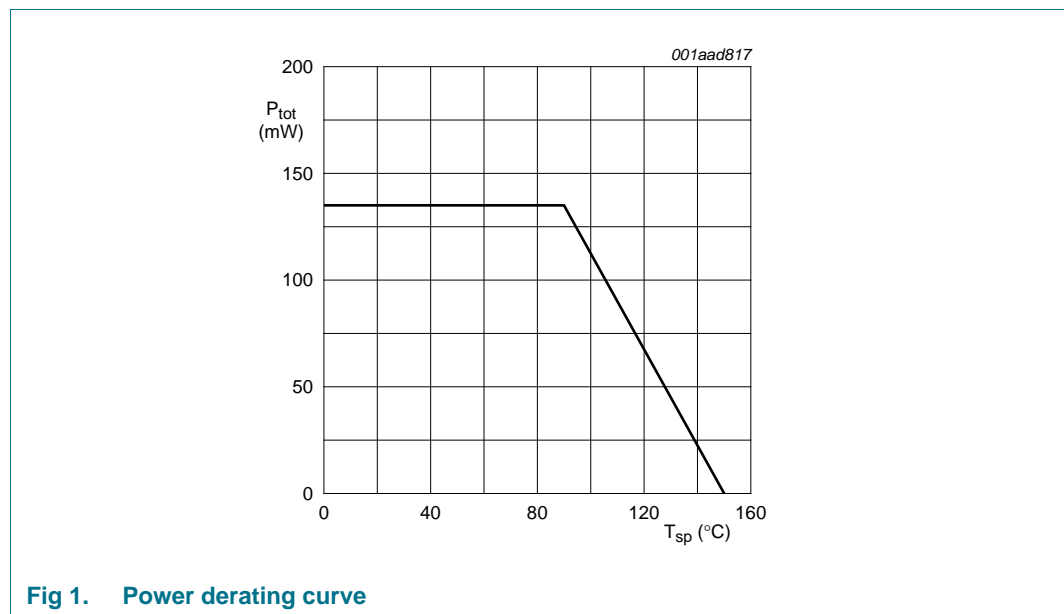
[1]  $T_{sp}$  is the temperature at the soldering point of the emitter pins.

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$T_{sp} \leq 90\text{ }^\circ\text{C}$	[1] 340	K/W

[1]  $T_{sp}$  is the temperature at the soldering point of the emitter pins.



**Fig 1. Power derating curve**

## 7. Characteristics

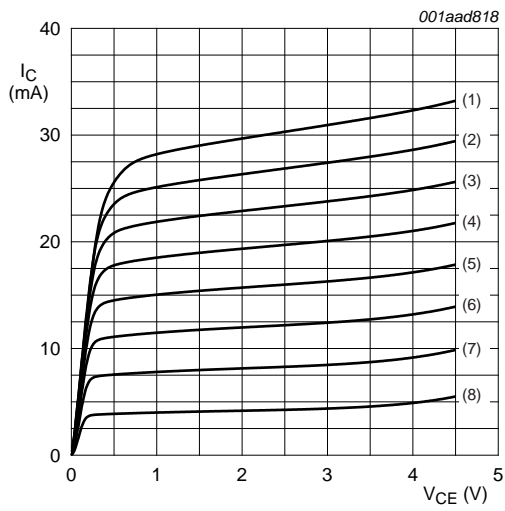
**Table 7. Characteristics**

$T_j = 25\text{ }^\circ\text{C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\text{ }\mu\text{A}$ ; $I_E = 0\text{ mA}$	10	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1\text{ mA}$ ; $I_B = 0\text{ mA}$	4.5	-	-	V
$V_{(BR)EBO}$	open-collector emitter-base breakdown voltage	$I_E = 2.5\text{ }\mu\text{A}$ ; $I_C = 0\text{ mA}$	1	-	-	V
$I_{CBO}$	collector-base cut-off current	$I_E = 0\text{ mA}$ ; $V_{CB} = 4.5\text{ V}$	-	-	15	nA
$h_{FE}$	DC current gain	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$	50	80	120	
$C_{CES}$	collector-emitter capacitance	$V_{CB} = 2\text{ V}$ ; $f = 1\text{ MHz}$	-	363	-	fF
$C_{EBS}$	emitter-base capacitance	$V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$	-	475	-	fF
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\text{ V}$ ; $f = 1\text{ MHz}$	-	102	-	fF
$f_T$	transition frequency	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	25	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	[1]	23	-	dB
$ S_{21} ^2$	insertion power gain	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	18.5	-	dB
NF	noise figure	$I_C = 2\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 900\text{ MHz}$ ; $\Gamma_S = \Gamma_{opt}$	-	0.8	-	dB
		$I_C = 2\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $\Gamma_S = \Gamma_{opt}$	-	1.2	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $Z_S = Z_{S(opt)}$ ; $Z_L = Z_{L(opt)}$	[2]	12	-	dBm
IP3	third-order intercept point	$I_C = 25\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $f = 2\text{ GHz}$ ; $Z_S = Z_{S(opt)}$ ; $Z_L = Z_{L(opt)}$	[2]	22	-	dBm

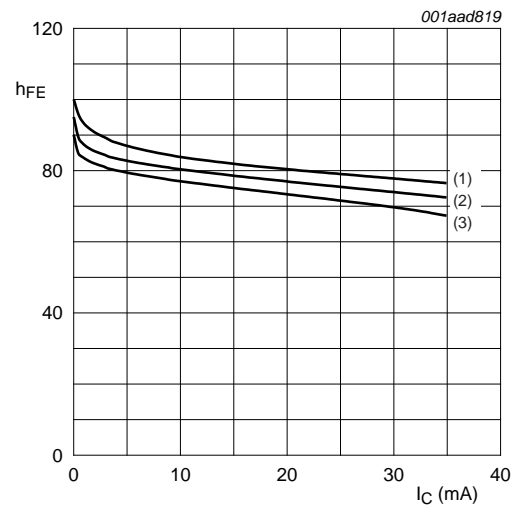
[1]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)} = \text{MSG}$ , see [Figure 8](#).

[2]  $Z_S$  is optimized for noise;  $Z_L$  is optimized for gain.



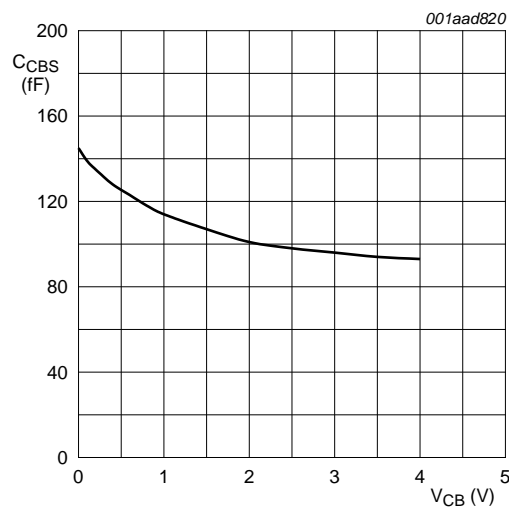
- (1)  $I_B = 400 \mu A$
- (2)  $I_B = 350 \mu A$
- (3)  $I_B = 300 \mu A$
- (4)  $I_B = 250 \mu A$
- (5)  $I_B = 200 \mu A$
- (6)  $I_B = 150 \mu A$
- (7)  $I_B = 100 \mu A$
- (8)  $I_B = 50 \mu A$

**Fig 2. Collector current as a function of collector-emitter voltage; typical values**



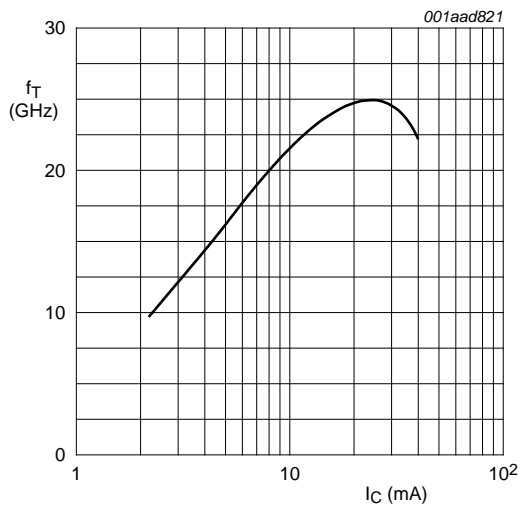
- (1)  $V_{CE} = 3 V$
- (2)  $V_{CE} = 2 V$
- (3)  $V_{CE} = 1 V$

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



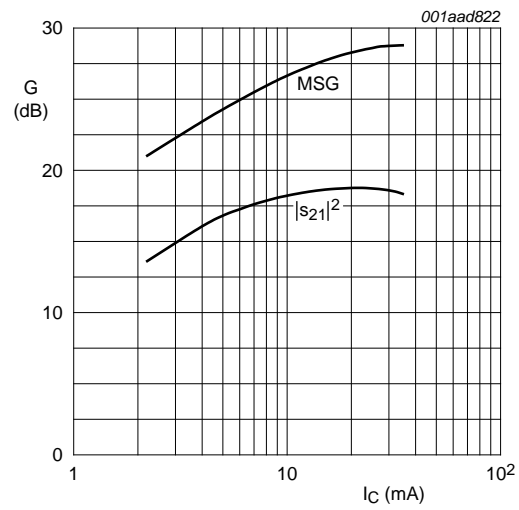
$f = 1 \text{ MHz}$

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



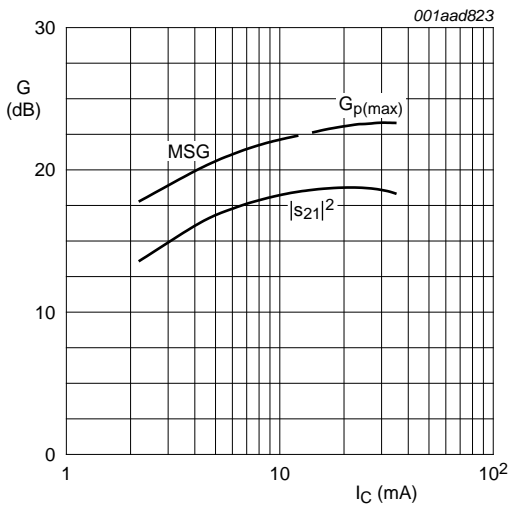
$V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



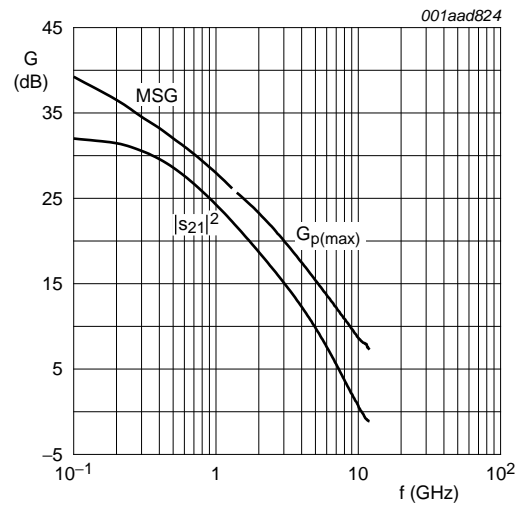
$V_{CE} = 2\text{ V}; f = 0.9\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



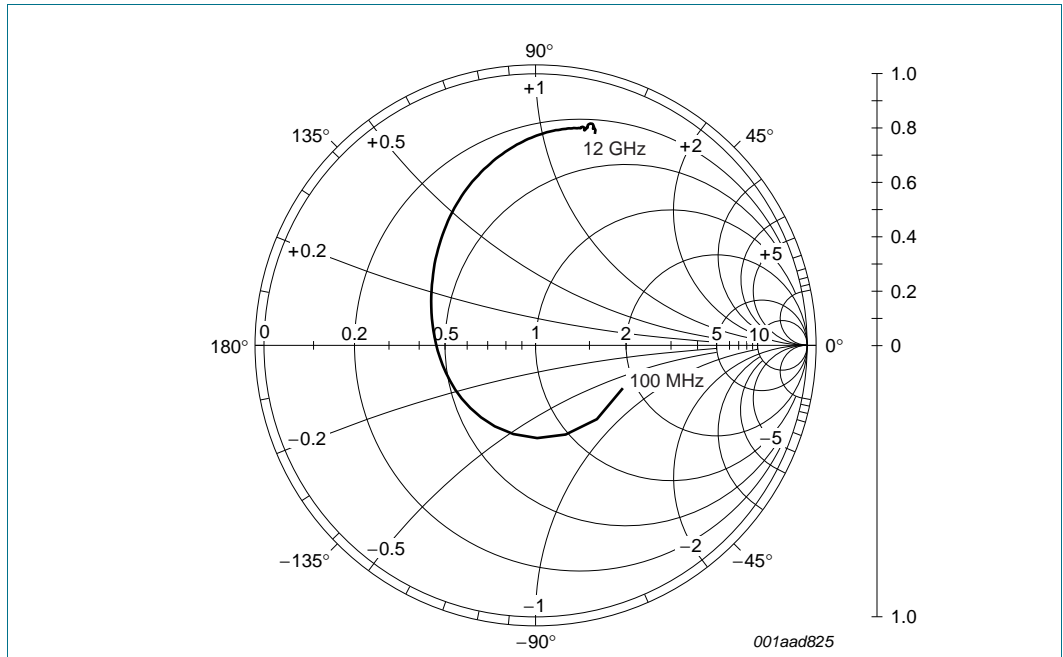
$V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



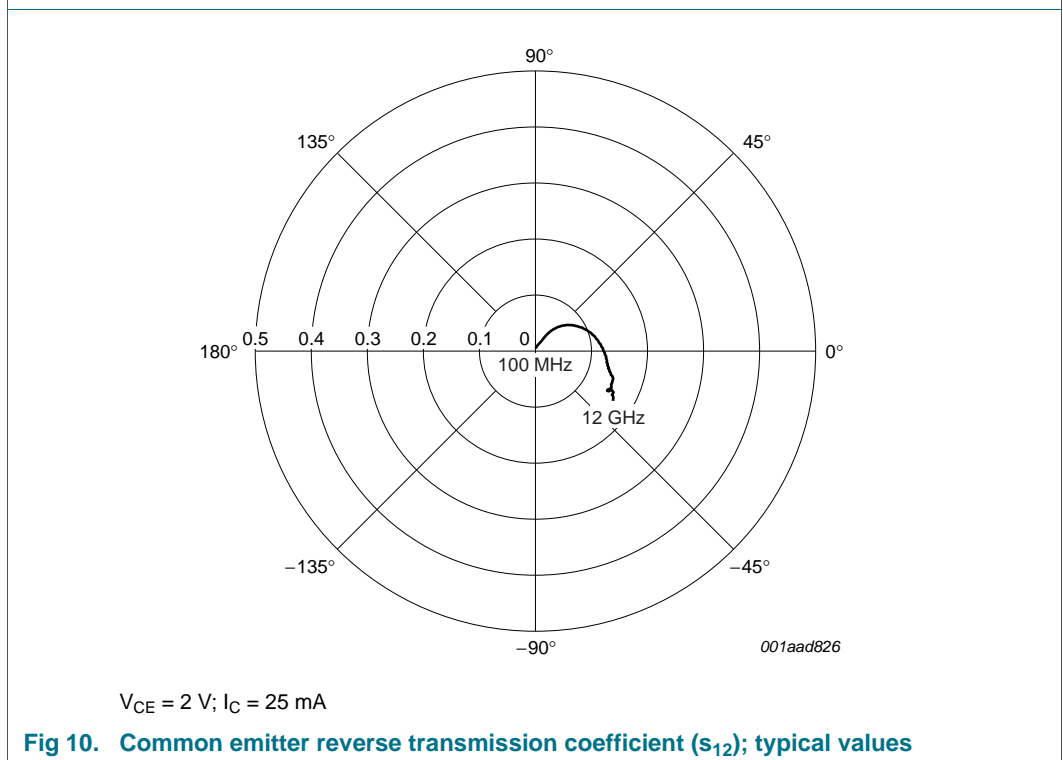
$V_{CE} = 2\text{ V}; I_C = 25\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$

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



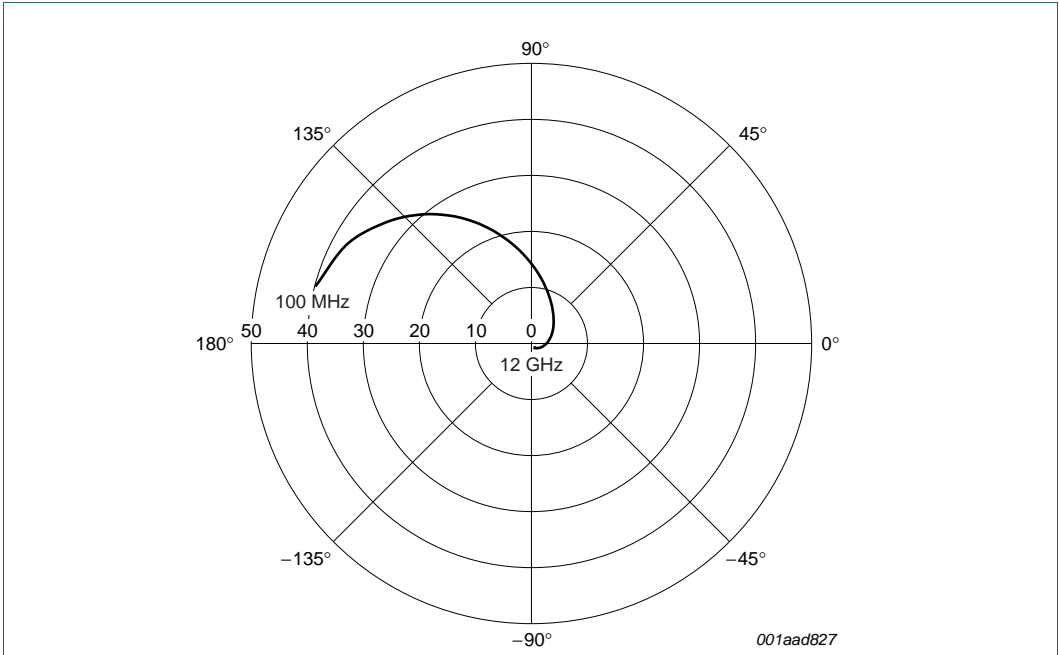
$V_{CE} = 2\text{ V}; I_C = 25\text{ mA}; Z_o = 50\ \Omega$

**Fig 9. Common emitter input reflection coefficient ( $s_{11}$ ); typical values**



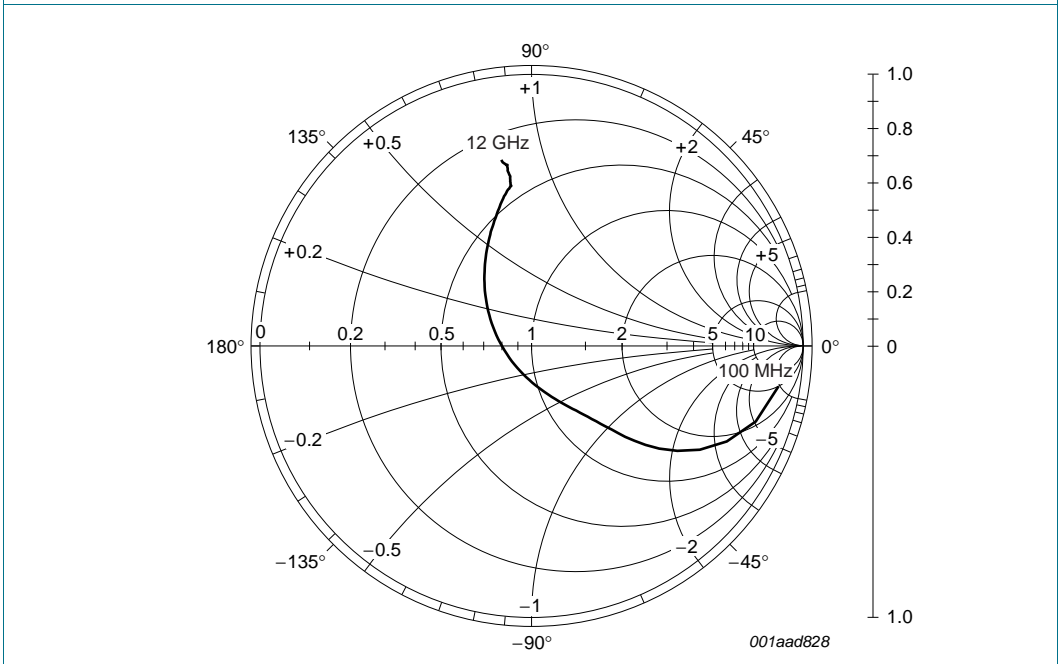
$V_{CE} = 2\text{ V}; I_C = 25\text{ mA}$

**Fig 10. Common emitter reverse transmission coefficient ( $s_{12}$ ); typical values**



$V_{CE} = 2\text{ V}; I_C = 25\text{ mA}$

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



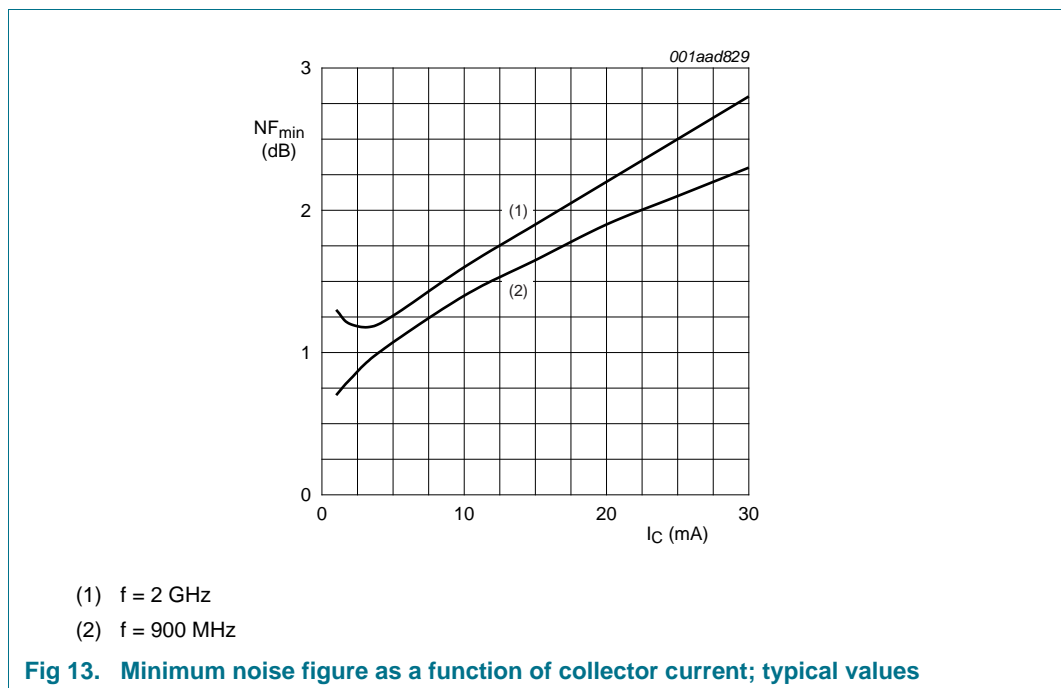
$V_{CE} = 2\text{ V}; I_C = 25\text{ mA}; Z_o = 50\ \Omega$

Fig 12. Common emitter input reflection coefficient ( $s_{22}$ ); typical values

**7.1 Noise data**

**Table 8. Noise data**  
 $V_{CE} = 2\text{ V}$ ; typical values.

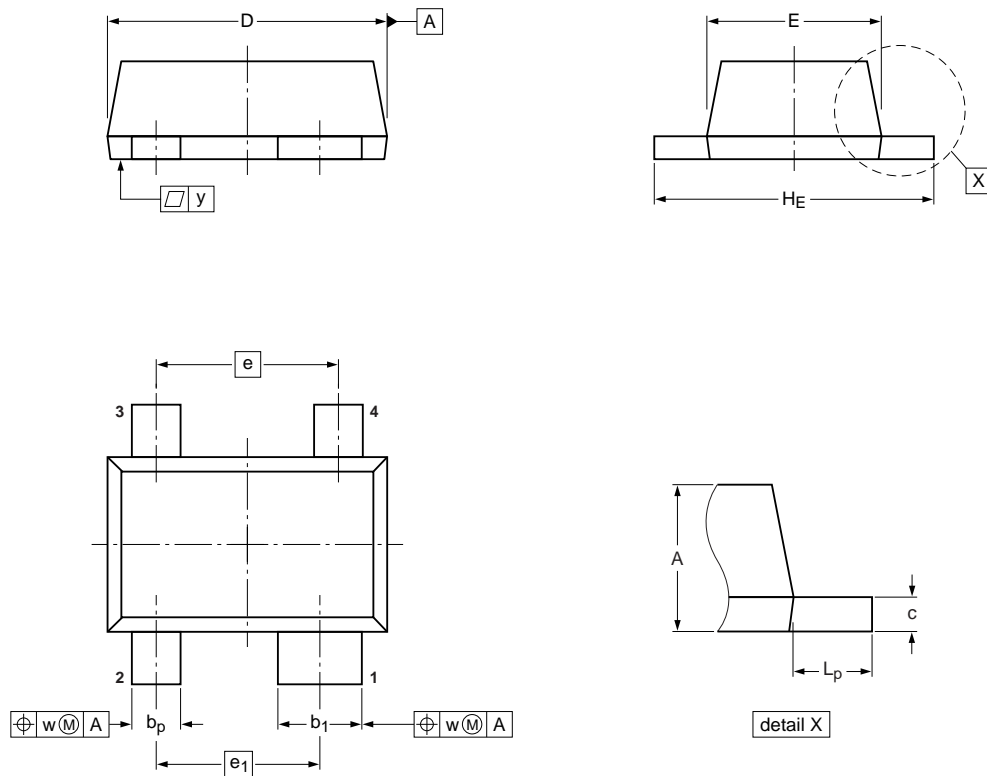
f (MHz)	I <sub>C</sub> (mA)	NF <sub>min</sub> (dB)	Γ <sub>opt</sub>		r <sub>n</sub> (Ω)
			ratio	(deg)	
900	1	0.7	0.67	19.1	0.40
	2	0.81	0.48	17.8	0.27
	4	1	0.28	11.7	0.24
	10	1.4	0.02	-63.9	0.19
	15	1.65	0.11	-162.4	0.18
	20	1.9	0.19	-165.5	0.18
	25	2.1	0.25	-166.3	0.19
	30	2.3	0.29	-166.5	0.19
2000	1	1.3	0.56	57.5	0.36
	2	1.2	0.43	57.2	0.25
	4	1.2	0.22	60.8	0.18
	10	1.6	0.06	137.4	0.19
	15	1.9	0.13	-162.1	0.20
	20	2.2	0.17	-155.5	0.20
	25	2.5	0.22	-152.2	0.21
	30	2.8	0.27	-150.8	0.25



## 8. Package outline

Plastic surface-mounted flat pack package; reverse pinning; 4 leads

SOT343F



DIMENSIONS (mm are the original dimensions)

UNIT	A 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>	w	y
mm	0.75 0.65	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.48 0.38	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT343F						05-07-12 06-03-16

Fig 14. Package outline SOT343F

## 9. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFG424F v.2	20110913	Product data sheet	-	BFG424F v.1
Modifications:		<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li></ul>		
BFG424F v.1	20060321	Product data sheet	-	-

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### 10.1 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.

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

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Date of release: 13 September 2011

Document identifier: BFG424F

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