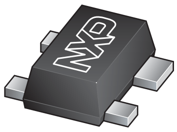


BFG424F

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	$T_{sp} \leq 90$ °C [1]	-	-	135	mW

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

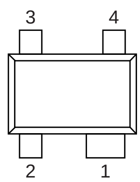
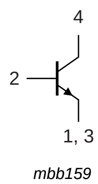
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 2 V; T_j = 25 °C	50	80	120	
C_{CBS}	collector-base capacitance	V_{CB} = 2 V; f = 1 MHz	-	102	-	fF
f_T	transition frequency	I_C = 25 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C	-	25	-	GHz
$G_{p(max)}$	maximum power gain	I_C = 25 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C [2]	-	23	-	dB
NF	noise figure	I_C = 2 mA; V_{CE} = 2 V; f = 2 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[1]
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	$T_{sp} \leq 90$ °C	[1]	-	135	mW
T_{stg}	storage temperature			–65	+150	°C
T_j	junction temperature			-	150	°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	$T_{sp} \leq 90$ °C	[1]	340	K/W

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

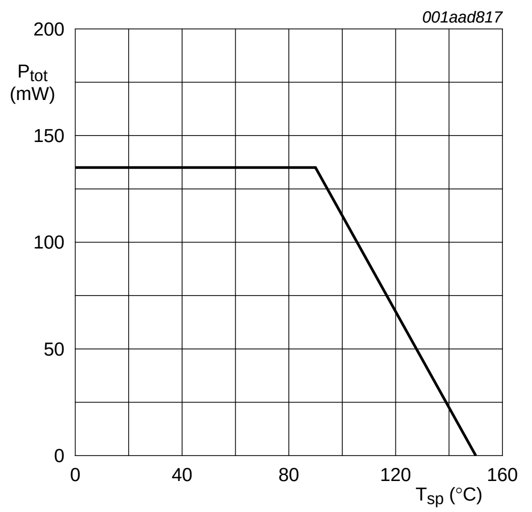


Fig 1. Power derating curve

7. Characteristics

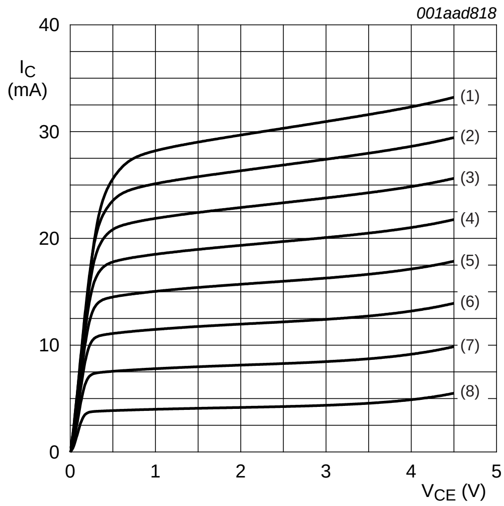
Table 7. Characteristics

T_j = 25 °C; unless otherwise specified.

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

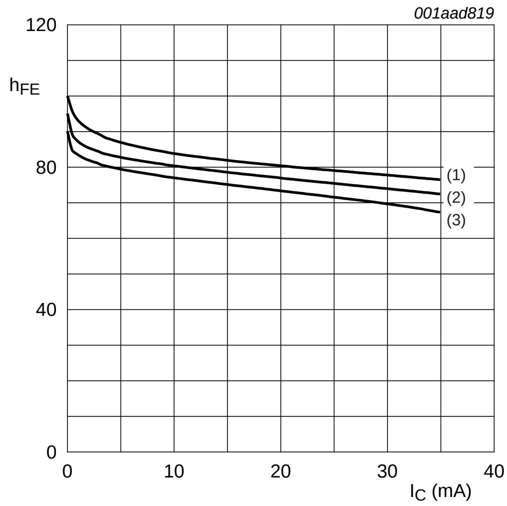
[1] $G_{p(max)}$ is the maximum power gain, if K > 1. If K < 1 then $G_{p(max)}$ = MSG, see Figure 8.

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



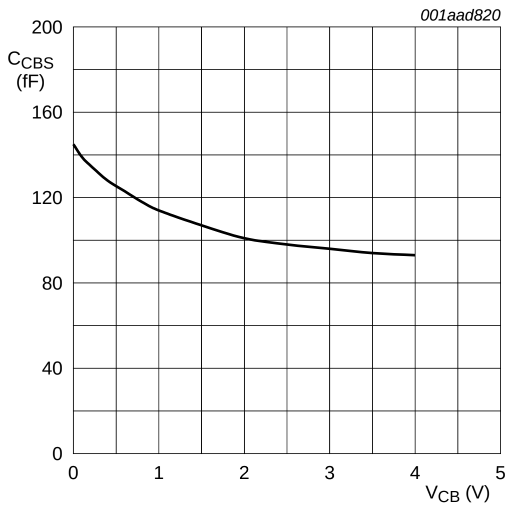
(1) I_B = 400 μA
(2) I_B = 350 μA
(3) I_B = 300 μA
(4) I_B = 250 μA
(5) I_B = 200 μA
(6) I_B = 150 μA
(7) I_B = 100 μA
(8) I_B = 50 μA

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



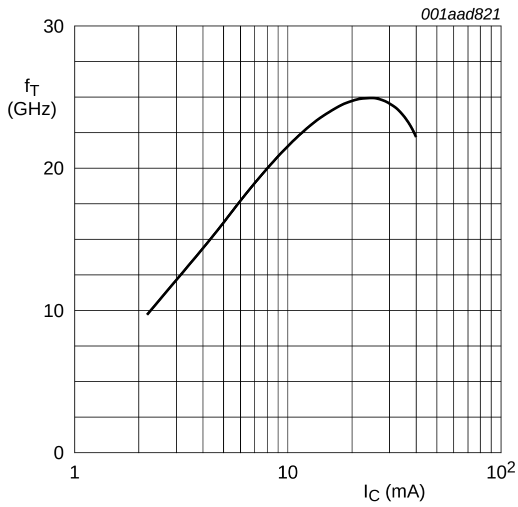
(1) V_{CE} = 3 V
(2) V_{CE} = 2 V
(3) V_{CE} = 1 V

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



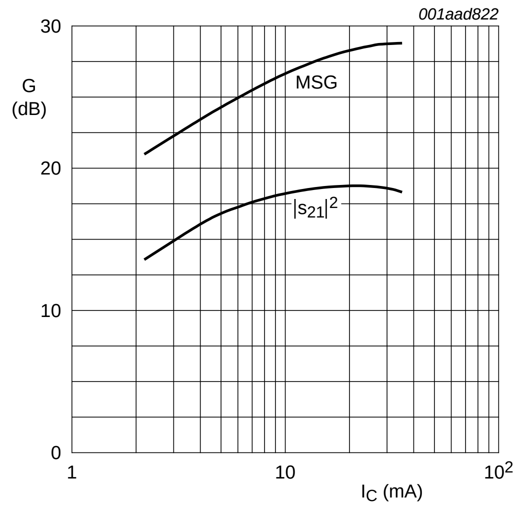
f = 1 MHz

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



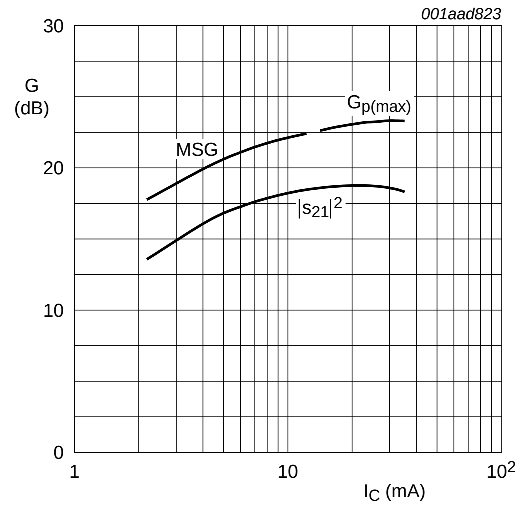
V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C

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



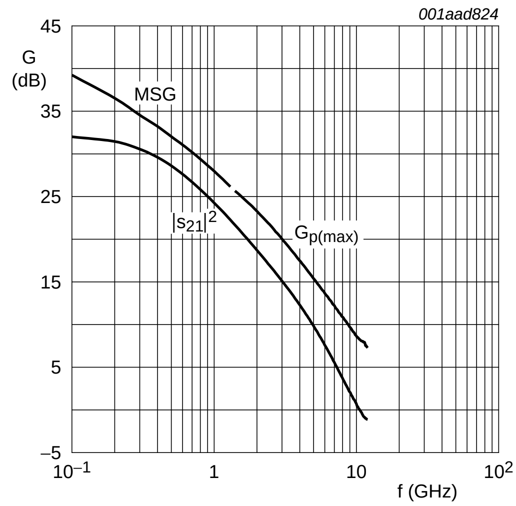
V_{CE} = 2 V; f = 0.9 GHz; T_{amb} = 25 °C

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



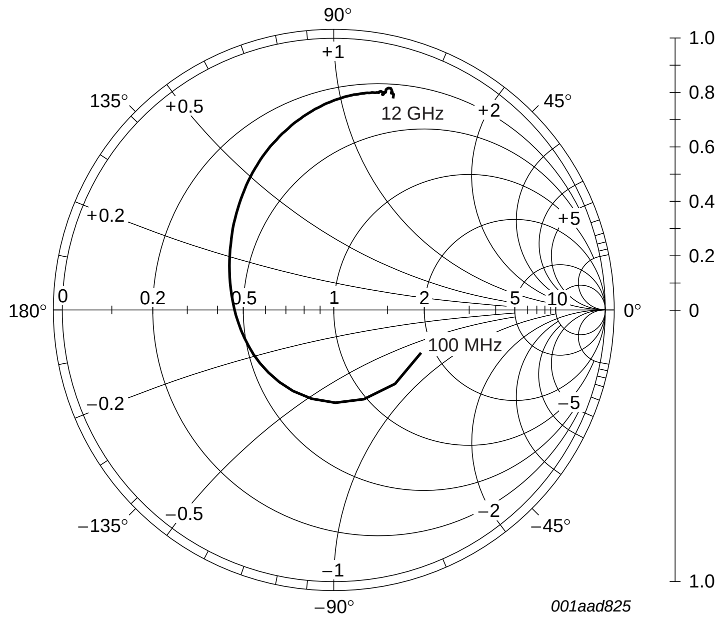
V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C

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



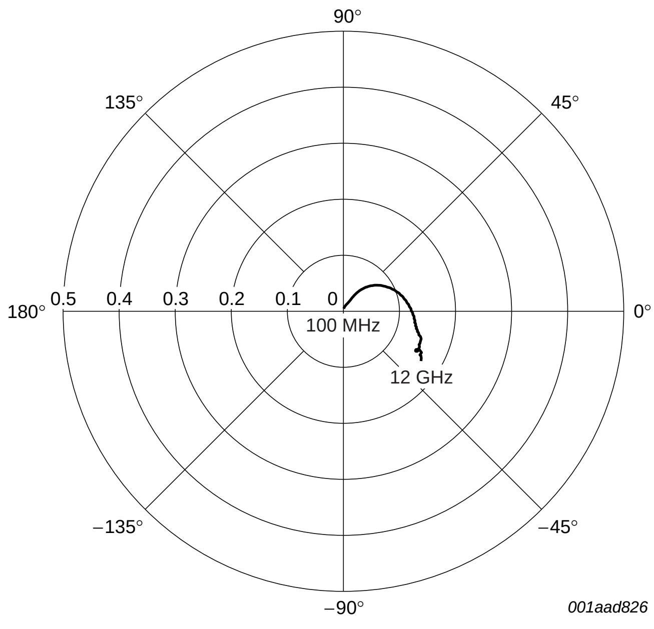
V_{CE} = 2 V; I_C = 25 mA; T_{amb} = 25 °C

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



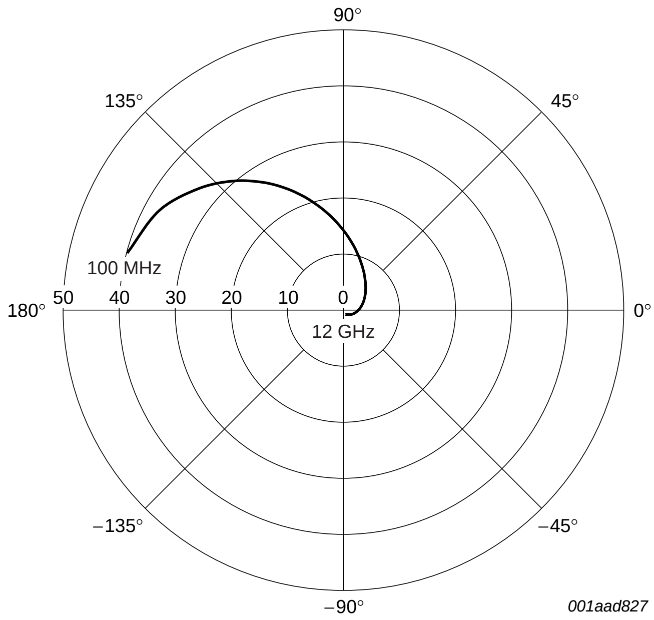
V_{CE} = 2 V; I_C = 25 mA; Z_o = 50 Ω

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



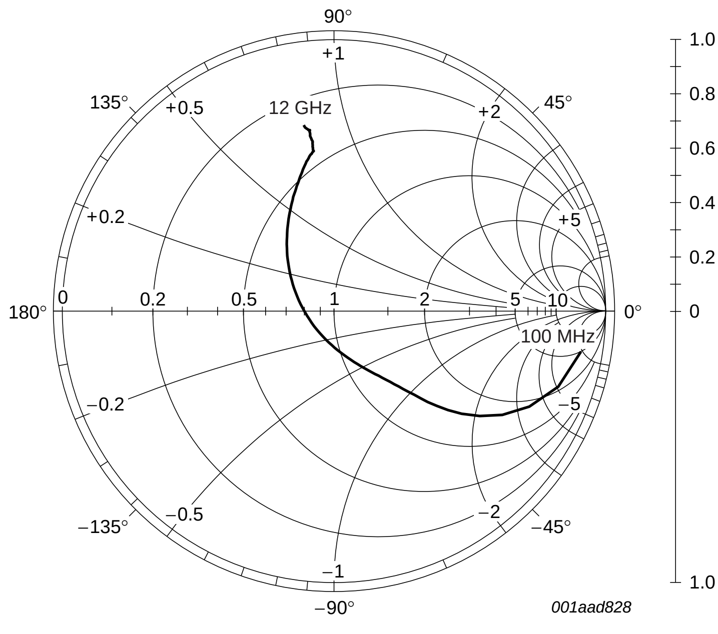
V_{CE} = 2 V; I_C = 25 mA

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



V_{CE} = 2 V; I_C = 25 mA

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



V_{CE} = 2 V; I_C = 25 mA; Z_o = 50 Ω

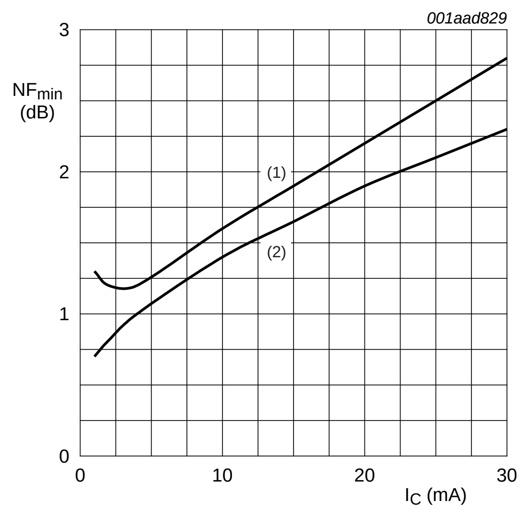
Fig 12. Common emitter input reflection coefficient (s_{22}); typical values

7.1 Noise data

Table 8. Noise data

V_{CE} = 2 V; typical values.

f (MHz)	I_C (mA)	NF_{min} (dB)	Γ_{opt} ratio	Γ_{opt} (deg)	r_n (Ω)
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



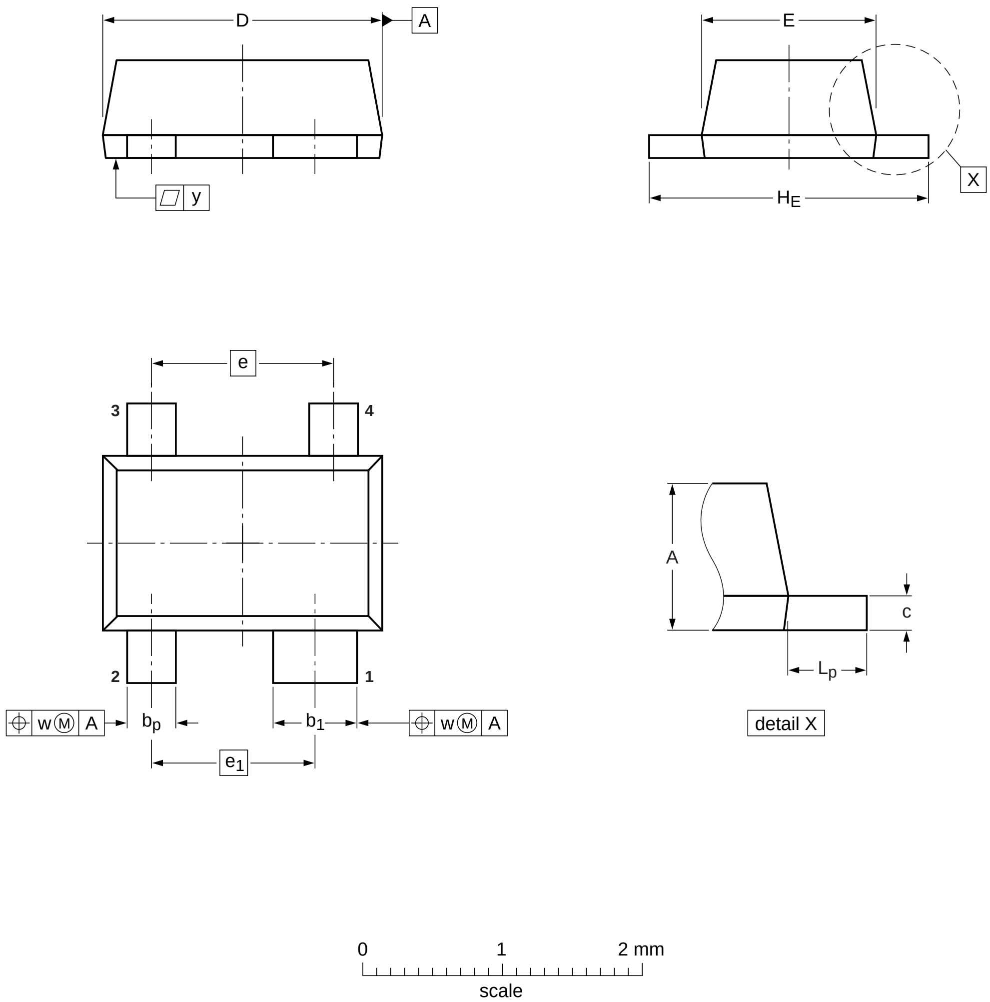
(1) f = 2 GHz

(2) f = 900 MHz

Fig 13. Minimum noise figure as a function of collector current; typical values

8. Package outline

Plastic surface-mounted flat pack package; reverse pinning; 4 leads **SOT343F**



DIMENSIONS (mm are the original dimensions)

UNIT	A max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	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:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
BFG424F v.1	20060321	Product data sheet	-	-

10. Legal information

10.1 Data sheet status

Document status[1][2]	Product status[3]	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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

10.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

10.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

10.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

11. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

12. Contents

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 13 September 2011

Document identifier: BFG424F