

# BFU725F/N1

NPN wideband silicon germanium RF transistor

Rev. 01 — 13 July 2009

Product data sheet

## 1. Product profile

### 1.1 General description

NPN silicon germanium microwave transistor for high speed, low noise applications in a plastic, 4-pin dual-emitter SOT343F package.

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

### 1.2 Features

- Low noise high gain microwave transistor
- Noise figure (NF) = 0.7 dB at 5.8 GHz
- High maximum stable gain 27 dB at 1.8 GHz
- 110 GHz  $f_T$  silicon germanium technology

### 1.3 Applications

- 2nd LNA stage and mixer stage in DBS LNB's
- Satellite radio
- Low noise amplifiers for microwave communications systems
- WLAN and CDMA applications
- Analog/digital cordless applications
- Ka band oscillators (DRO's)

### 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	-	-	2.8	V
$V_{EBO}$	emitter-base voltage	open collector	-	-	0.55	V
$I_C$	collector current		-	25	40	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ °C}$	[1]	-	136	mW
$h_{FE}$	DC current gain	$I_C = 10\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ; $T_j = 25\text{ °C}$	160	280	400	

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

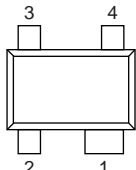
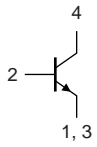
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\text{ V}; f = 1\text{ MHz}$	-	70	-	fF
$f_T$	transition frequency	$I_C = 25\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$	-	55	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 25\text{ mA}; V_{CE} = 2\text{ V}; f = 5.8\text{ GHz}; T_{amb} = 25\text{ °C}$	[2]	18	-	dB
NF	noise figure	$I_C = 5\text{ mA}; V_{CE} = 2\text{ V}; f = 5.8\text{ GHz}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$	-	0.7	-	dB

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

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

## 2. Pinning information

**Table 2. Discrete pinning**

Pin	Description	Simplified outline	Graphic symbol
1	emitter		 mbb159
2	base		
3	emitter		
4	collector		

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		Version
	Name	Description	
BFU725F/N1	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

## 4. Marking

**Table 4. Marking**

Type number	Marking	Description
BFU725F/N1	B7*	* = p : made in Hong Kong * = t : made in Malaysia * = W : made in China

## 5. Limiting values

**Table 5. Limiting values**

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

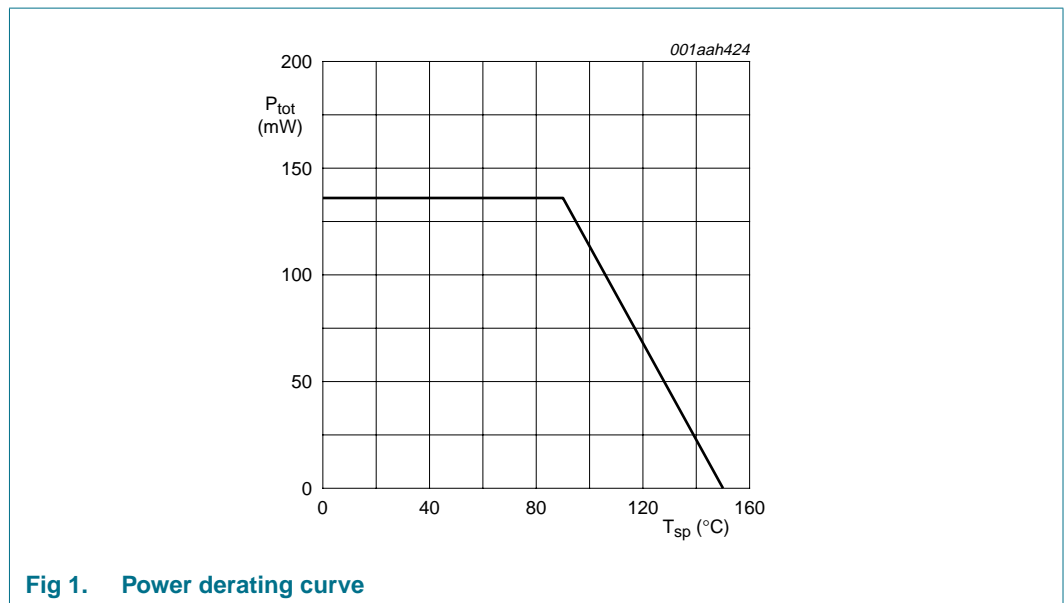
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	10	V
$V_{CEO}$	collector-emitter voltage	open base	-	2.8	V
$V_{EBO}$	emitter-base voltage	open collector	-	0.55	V
$I_C$	collector current		-	40	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ °C}$	[1]	136	mW
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	150	°C

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

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		440	K/W



**Fig 1. Power derating curve**

## 7. Characteristics

**Table 7. Characteristics**

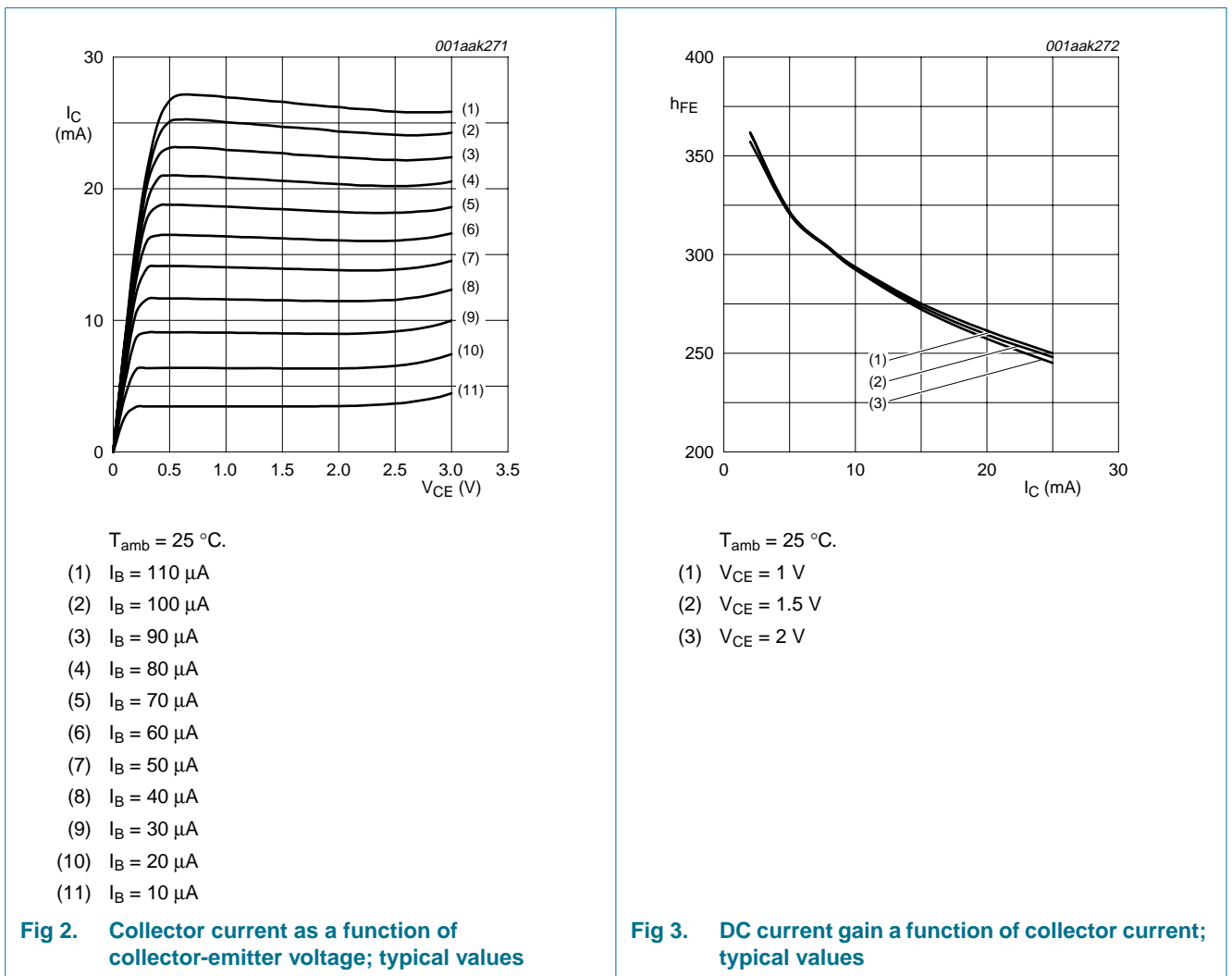
$T_j = 25\text{ °C}$  unless otherwise specified.

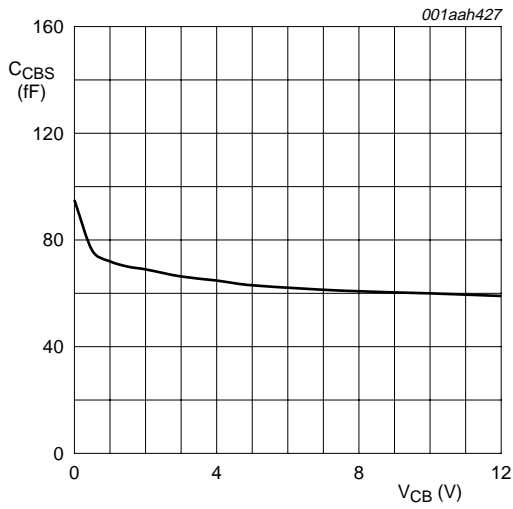
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu\text{A}; I_E = 0\ \text{mA}$	10	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1\ \text{mA}; I_B = 0\ \text{mA}$	2.8	-	-	V
$I_C$	collector current		-	25	40	mA
$I_{CBO}$	collector-base cut-off current	$I_E = 0\ \text{mA}; V_{CB} = 4.5\ \text{V}$	-	-	100	nA
$h_{FE}$	DC current gain	$I_C = 10\ \text{mA}; V_{CE} = 2\ \text{V}$	160	280	400	
$C_{CES}$	collector-emitter capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	268	-	fF
$C_{EBS}$	emitter-base capacitance	$V_{EB} = 0.5\ \text{V}; f = 1\ \text{MHz}$	-	400	-	fF
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	70	-	fF
$f_T$	transition frequency	$I_C = 25\ \text{mA}; V_{CE} = 2\ \text{V}; f = 2\ \text{GHz}; T_{amb} = 25\text{ °C}$	-	55	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 25\ \text{mA}; V_{CE} = 2\ \text{V}; T_{amb} = 25\text{ °C}$	[1]			
		$f = 1.5\ \text{GHz}$	-	28	-	dB
		$f = 1.8\ \text{GHz}$	-	27	-	dB
		$f = 2.4\ \text{GHz}$	-	25.5	-	dB
		$f = 5.8\ \text{GHz}$	-	18	-	dB
		$f = 12\ \text{GHz}$	-	13	-	dB
$ S_{21} ^2$	insertion power gain	$I_C = 25\ \text{mA}; V_{CE} = 2\ \text{V}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	26.7	-	dB
		$f = 1.8\ \text{GHz}$	-	25.4	-	dB
		$f = 2.4\ \text{GHz}$	-	23	-	dB
		$f = 5.8\ \text{GHz}$	-	16	-	dB
		$f = 12\ \text{GHz}$	-	9.3	-	dB
NF	noise figure	$I_C = 5\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	0.42	-	dB
		$f = 1.8\ \text{GHz}$	-	0.43	-	dB
		$f = 2.4\ \text{GHz}$	-	0.47	-	dB
		$f = 5.8\ \text{GHz}$	-	0.7	-	dB
		$f = 12\ \text{GHz}$	-	1.1	-	dB
$G_{ass}$	associated gain	$I_C = 5\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	24	-	dB
		$f = 1.8\ \text{GHz}$	-	22	-	dB
		$f = 2.4\ \text{GHz}$	-	20	-	dB
		$f = 5.8\ \text{GHz}$	-	13.5	-	dB
		$f = 12\ \text{GHz}$	-	10	-	dB

**Table 7. Characteristics ...continued**  
 $T_j = 25\text{ }^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 25\text{ mA}; V_{CE} = 2\text{ V}; Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ }^\circ\text{C}$				
		$f = 1.5\text{ GHz}$	-	8.5	-	dBm
		$f = 1.8\text{ GHz}$	-	9	-	dBm
		$f = 2.4\text{ GHz}$	-	8.5	-	dBm
IP3	third-order intercept point	$I_C = 25\text{ mA}; V_{CE} = 2\text{ V}; Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ }^\circ\text{C}; f_2 = f_1 + 1\text{ MHz}$				
		$f_1 = 1.5\text{ GHz}$	-	17	-	dBm
		$f_1 = 1.8\text{ GHz}$	-	17	-	dBm
		$f_1 = 2.4\text{ GHz}$	-	17	-	dBm
		$f_1 = 5.8\text{ GHz}$	-	19	-	dBm

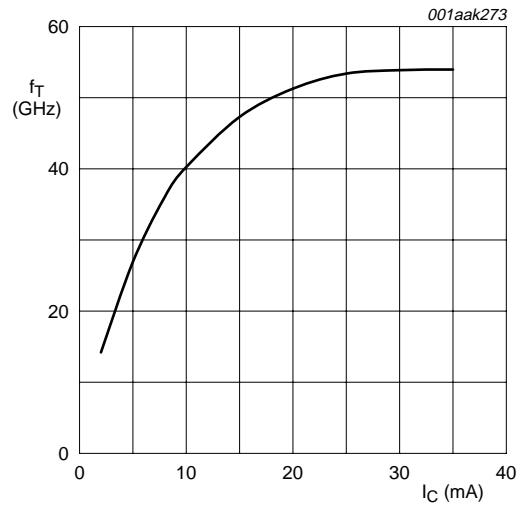
[1]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)} = \text{MSG}$ .





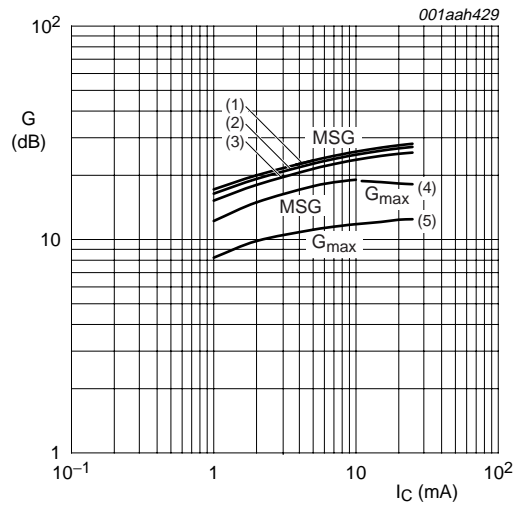
$f = 1 \text{ MHz}$ ,  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

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



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

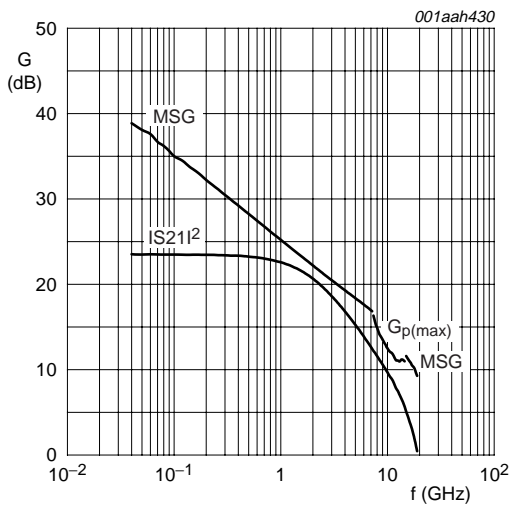
**Fig 5. Transition frequency as a function of collector current; typical values**



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

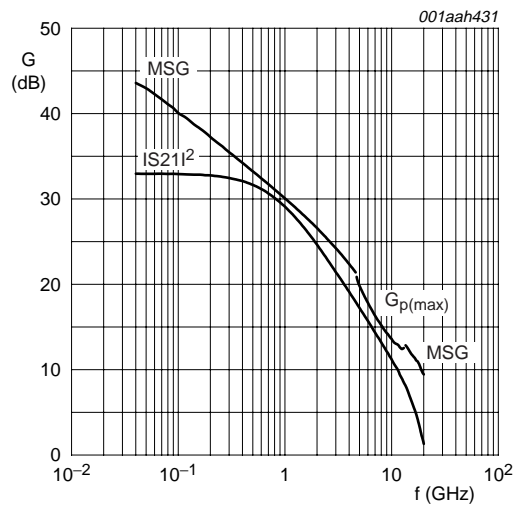
- (1)  $f = 1.5 \text{ GHz}$
- (2)  $f = 1.8 \text{ GHz}$
- (3)  $f = 2.4 \text{ GHz}$
- (4)  $f = 5.8 \text{ GHz}$
- (5)  $f = 12 \text{ GHz}$

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



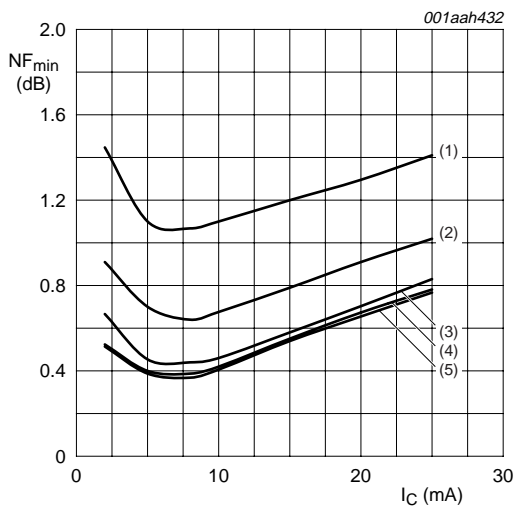
$V_{CE} = 2\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}.$

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



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

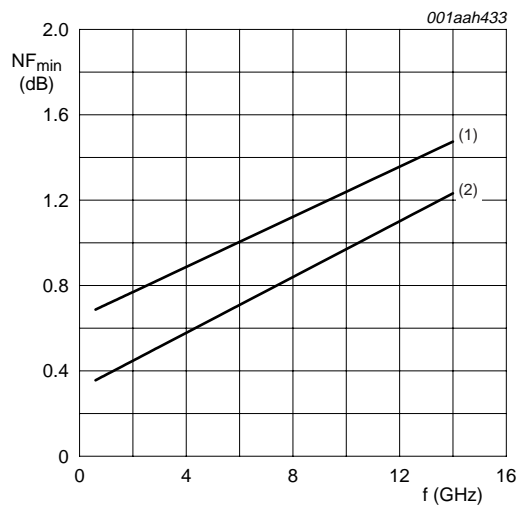
Fig 8. Gain as a function of frequency; typical values



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

- (1)  $f = 12\text{ GHz}$
- (2)  $f = 5.8\text{ GHz}$
- (3)  $f = 2.4\text{ GHz}$
- (4)  $f = 1.8\text{ GHz}$
- (5)  $f = 1.5\text{ GHz}$

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



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

- (1)  $I_C = 25\text{ mA}$
- (2)  $I_C = 5\text{ mA}$

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

**8. Package outline**

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

SOT343F

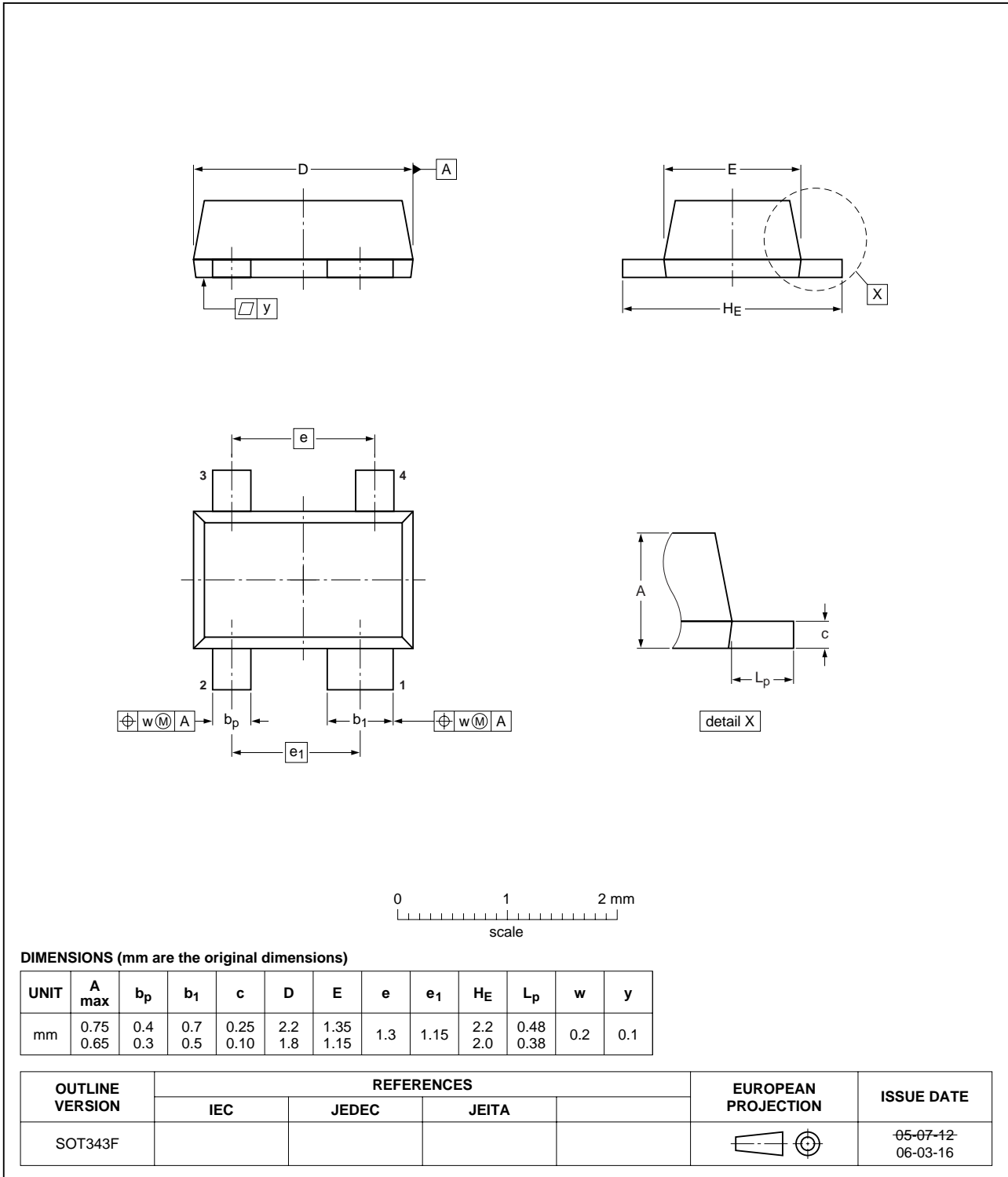


Fig 11. Package outline SOT343F



## 9. Abbreviations

**Table 8. Abbreviations**

Acronym	Description
CDMA	Code Division Multiple Access
DBS	Direct Broadcast Satellite
DC	Direct Current
DRO	Dielectric Resonator Oscillator
LNA	Low Noise Amplifier
LNB	Low Noise Block
Ka	Kurtz above
NPN	Negative-Positive-Negative
RF	Radio Frequency
WLAN	Wireless Local Area Network

## 10. Revision history

**Table 9. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU725F_N1_1	20090713	Product data sheet	-	-

## 11. Legal information

### 11.1 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.

[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>.

### 11.2 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.

### 11.3 Disclaimers

**General** — 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.

**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 medical, military, aircraft, space or life support 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.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

**Terms and conditions of 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>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**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.

### 11.4 Trademarks

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

## 12. Contact information

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

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

**13. Contents**

**1 Product profile . . . . . 1**

1.1 General description . . . . . 1

1.2 Features . . . . . 1

1.3 Applications . . . . . 1

1.4 Quick reference data . . . . . 1

**2 Pinning information . . . . . 2**

**3 Ordering information . . . . . 2**

**4 Marking . . . . . 2**

**5 Limiting values . . . . . 3**

**6 Thermal characteristics . . . . . 3**

**7 Characteristics . . . . . 4**

**8 Package outline . . . . . 8**

**9 Abbreviations . . . . . 9**

**10 Revision history . . . . . 9**

**11 Legal information . . . . . 10**

11.1 Data sheet status . . . . . 10

11.2 Definitions . . . . . 10

11.3 Disclaimers . . . . . 10

11.4 Trademarks . . . . . 10

**12 Contact information . . . . . 10**

**13 Contents . . . . . 11**

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.



© NXP B.V. 2009.

All rights reserved.

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

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

Date of release: 13 July 2009

Document identifier: BFU725F\_N1\_1