

# BFU660F

NPN wideband silicon RF transistor

Rev. 1 — 11 January 2011

Product data sheet

## 1. Product profile

### 1.1 General description

NPN silicon 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 and benefits

- Low noise high linearity RF transistor
- High output third-order intercept point 27 dBm at 1.8 GHz
- 40 GHz  $f_T$  silicon technology

### 1.3 Applications

- Analog/digital cordless applications
- X-band high output buffer amplifier
- ZigBee
- SDARS second stage LNA
- LTE, cellular, UMTS



### 1.4 Quick reference data

**Table 1. Quick reference data**

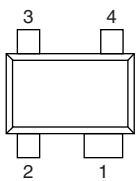
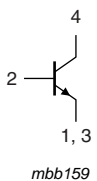
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	-	16	V
$V_{CEO}$	collector-emitter voltage	open base	-	-	5.5	V
$V_{EBO}$	emitter-base voltage	open collector	-	-	2.5	V
$I_C$	collector current		-	30	60	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ }^\circ\text{C}$	[1]	-	225	mW
$h_{FE}$	DC current gain	$I_C = 10\text{ mA}; V_{CE} = 2\text{ V}; T_j = 25\text{ }^\circ\text{C}$	90	135	180	
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\text{ V}; f = 1\text{ MHz}$	-	138	-	fF
$f_T$	transition frequency	$I_C = 20\text{ mA}; V_{CE} = 1\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	21	-	GHz
$IP3O$	output third-order intercept point	$I_C = 40\text{ mA}; V_{CE} = 4\text{ V}; f = 5.8\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	28	-	dBm
$G_{p(max)}$	maximum power gain	$I_C = 30\text{ mA}; V_{CE} = 1\text{ V}; f = 1.8\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	[2]	24	-	dB
NF	noise figure	$I_C = 6\text{ mA}; V_{CE} = 2\text{ V}; f = 1.8\text{ GHz}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.65	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 60\text{ mA}; V_{CE} = 4\text{ V}; Z_S = Z_L = 50\text{ }\Omega; f = 1.8\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	17	-	dBm

[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  $G_{p(max)} = MSG$ .

## 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	
BFU660F	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

## 4. Marking

**Table 4. Marking**

Type number	Marking	Description
BFU660F	D3*	* = 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).

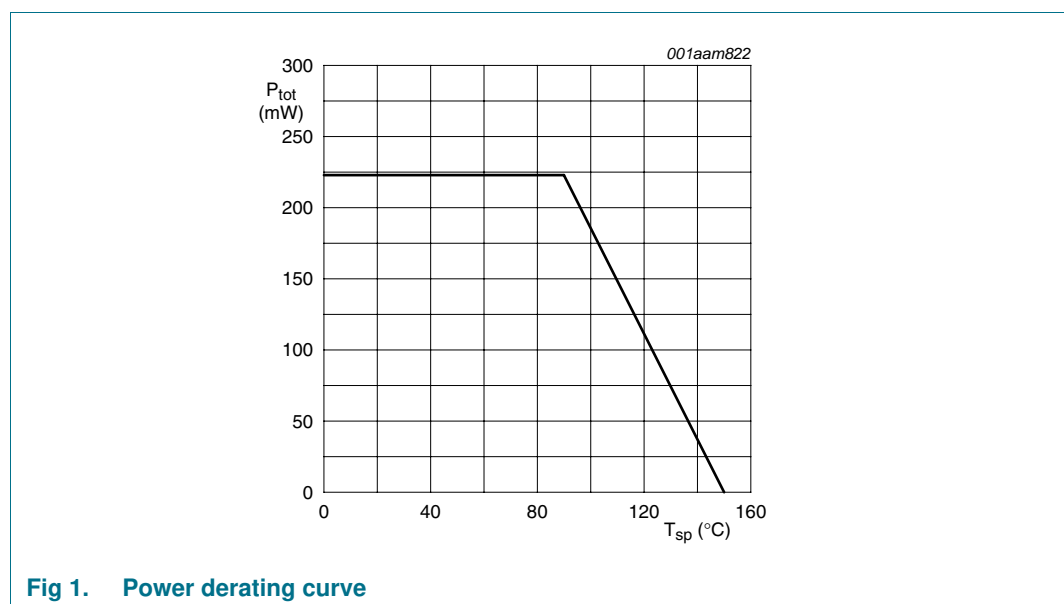
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	16	V
$V_{CEO}$	collector-emitter voltage	open base	-	5.5	V
$V_{EBO}$	emitter-base voltage	open collector	-	2.5	V
$I_C$	collector current		-	60	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90\text{ °C}$	[1]	225	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		270	K/W



**Fig 1. Power derating curve**

## 7. Characteristics

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

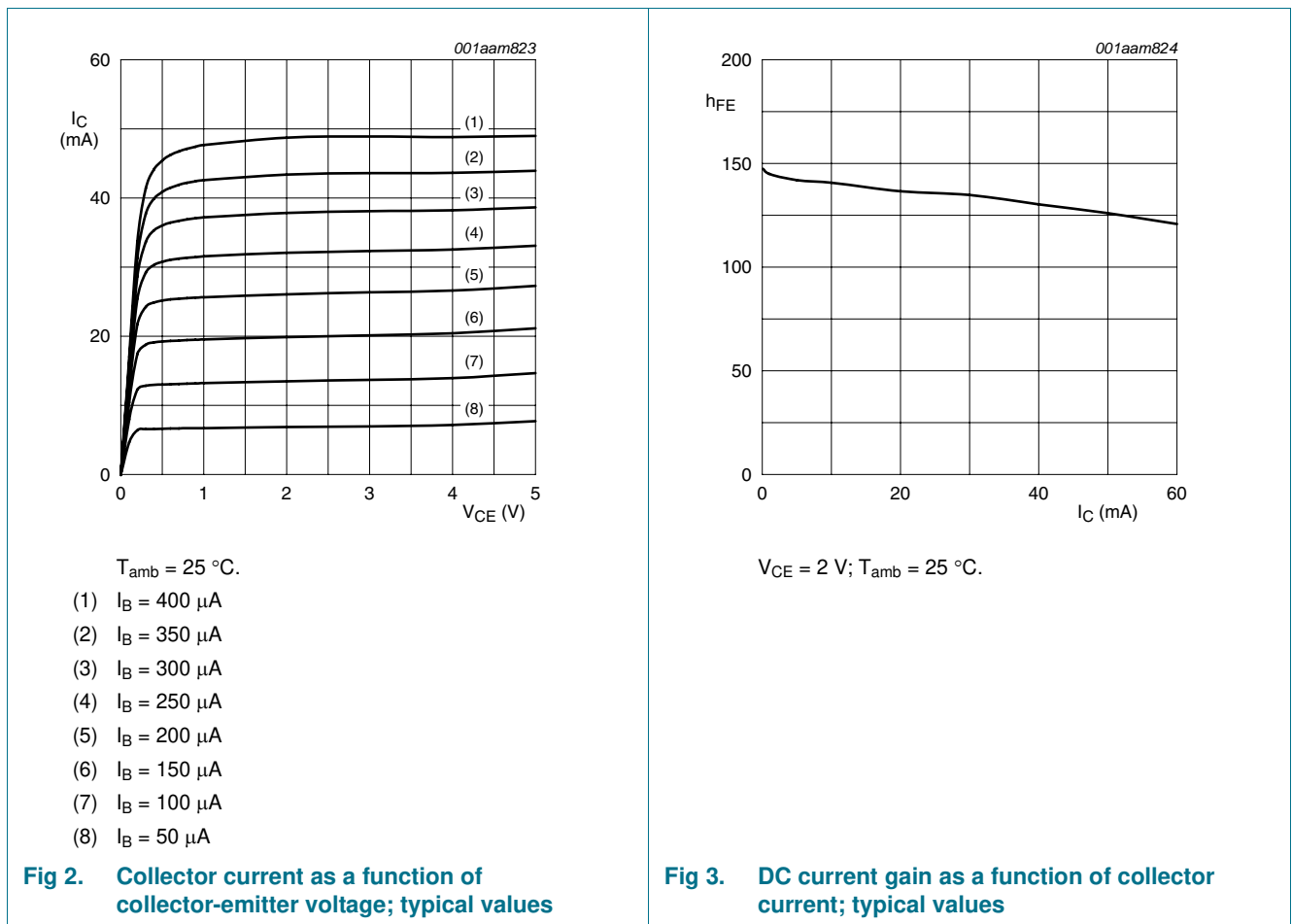
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu\text{A}; I_E = 0\ \text{mA}$	16	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1\ \text{mA}; I_B = 0\ \text{mA}$	5.5	-	-	V
$I_C$	collector current		-	30	60	mA
$I_{CBO}$	collector-base cut-off current	$I_E = 0\ \text{mA}; V_{CB} = 8\ \text{V}$	-	-	100	nA
$h_{FE}$	DC current gain	$I_C = 10\ \text{mA}; V_{CE} = 2\ \text{V}$	90	135	180	
$C_{CES}$	collector-emitter capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	297	-	fF
$C_{EBS}$	emitter-base capacitance	$V_{EB} = 0.5\ \text{V}; f = 1\ \text{MHz}$	-	664	-	fF
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	138	-	fF
$f_T$	transition frequency	$I_C = 20\ \text{mA}; V_{CE} = 1\ \text{V}; f = 2\ \text{GHz}; T_{amb} = 25\text{ °C}$	-	21	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 30\ \text{mA}; V_{CE} = 1\ \text{V}; T_{amb} = 25\text{ °C}$	<a href="#">11</a>			
		$f = 1.5\ \text{GHz}$	-	25	-	dB
		$f = 1.8\ \text{GHz}$	-	24	-	dB
		$f = 2.4\ \text{GHz}$	-	22	-	dB
		$f = 5.8\ \text{GHz}$	-	12.5	-	dB
$ S_{21} ^2$	insertion power gain	$I_C = 30\ \text{mA}; V_{CE} = 1\ \text{V}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	20	-	dB
		$f = 1.8\ \text{GHz}$	-	18.5	-	dB
		$f = 2.4\ \text{GHz}$	-	16	-	dB
		$f = 5.8\ \text{GHz}$	-	8.5	-	dB
NF	noise figure	$I_C = 6\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	0.60	-	dB
		$f = 1.8\ \text{GHz}$	-	0.65	-	dB
		$f = 2.4\ \text{GHz}$	-	0.70	-	dB
		$f = 5.8\ \text{GHz}$	-	1.20	-	dB
$G_{ass}$	associated gain	$I_C = 6\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	21	-	dB
		$f = 1.8\ \text{GHz}$	-	20	-	dB
		$f = 2.4\ \text{GHz}$	-	17.5	-	dB
		$f = 5.8\ \text{GHz}$	-	12	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 60\ \text{mA}; V_{CE} = 4\ \text{V}; Z_S = Z_L = 50\ \Omega; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	17	-	dBm
		$f = 1.8\ \text{GHz}$	-	17	-	dBm
		$f = 2.4\ \text{GHz}$	-	16	-	dBm
		$f = 5.8\ \text{GHz}$	-	18.5	-	dBm

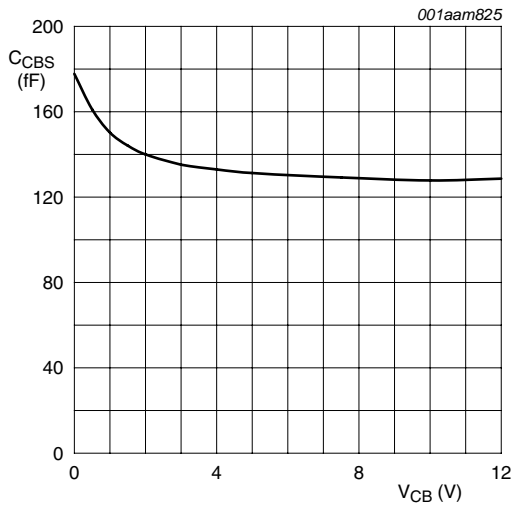
**Table 7. Characteristics ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IP3 <sub>O</sub>	output third-order intercept point	$I_C = 40\text{ mA}; V_{CE} = 4\text{ V};$ $Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ }^\circ\text{C}$				
		$f = 1.5\text{ GHz}$	-	27	-	dBm
		$f = 1.8\text{ GHz}$	-	27	-	dBm
		$f = 2.4\text{ GHz}$	-	27	-	dBm
		$f = 5.8\text{ GHz}$	-	28	-	dBm

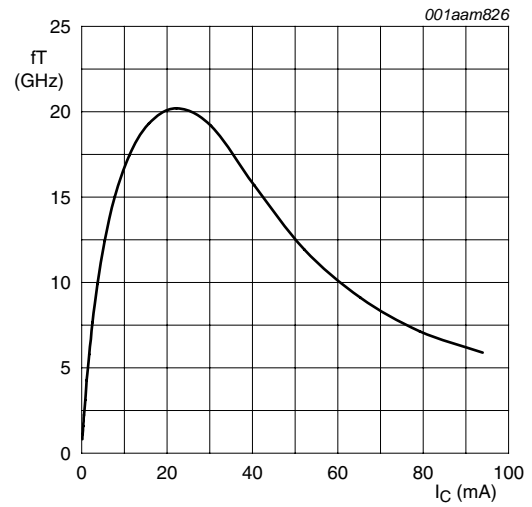
[1]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)} = MSG$ .





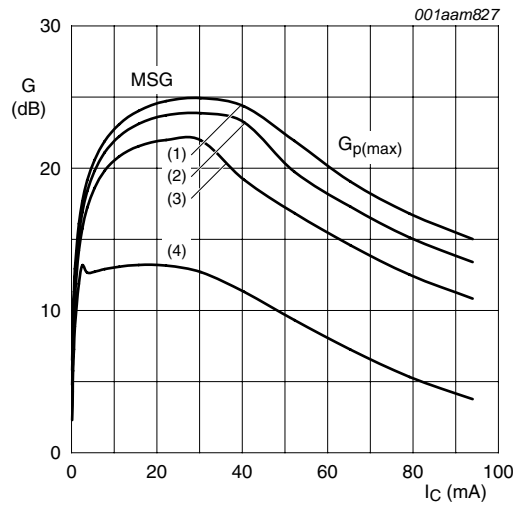
$f = 1 \text{ MHz}$ ,  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

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



$V_{CE} = 1 \text{ V}$ ;  $f = 2 \text{ GHz}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

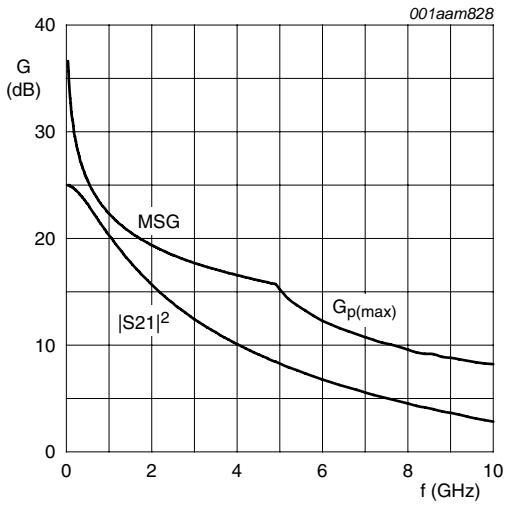
**Fig 5. Transition frequency as a function of collector current; typical values**



$V_{CE} = 1 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

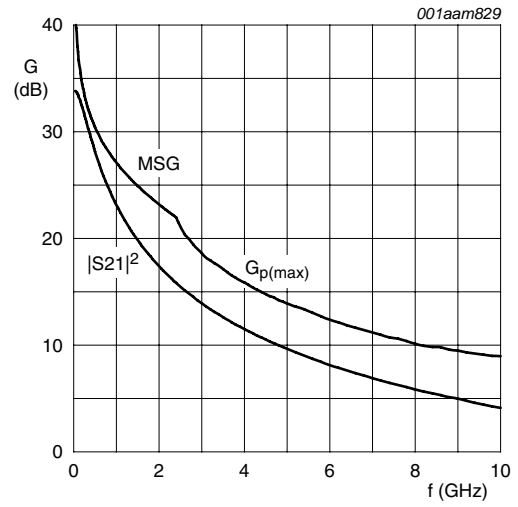
- (1)  $f = 1.5 \text{ GHz}$
- (2)  $f = 1.8 \text{ GHz}$
- (3)  $f = 2.4 \text{ GHz}$
- (4)  $f = 5.8 \text{ GHz}$
- (5)  $f = 12 \text{ GHz}$

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



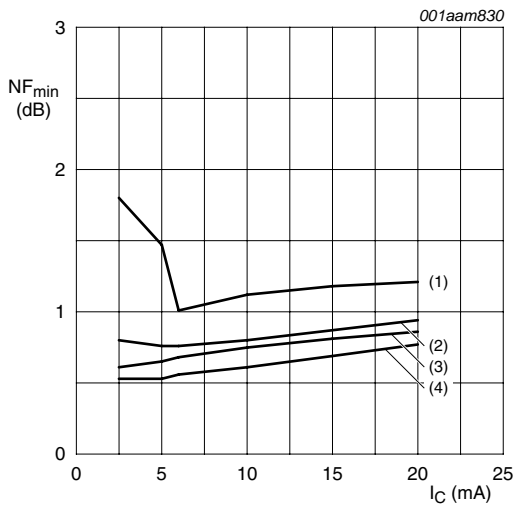
$V_{CE} = 1\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}.$

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



$V_{CE} = 1\text{ V}; I_C = 30\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}.$

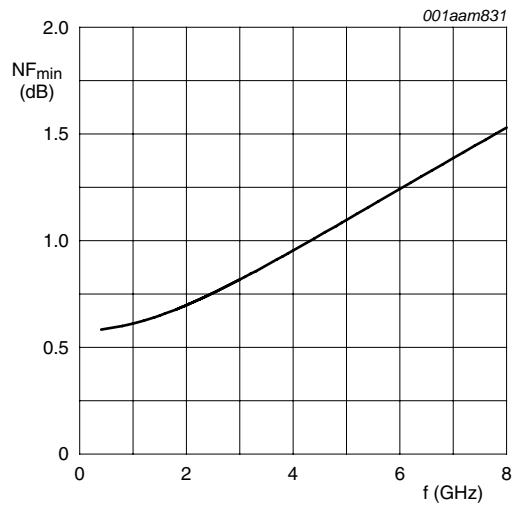
**Fig 8. Gain as a function of frequency; typical values**



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

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

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



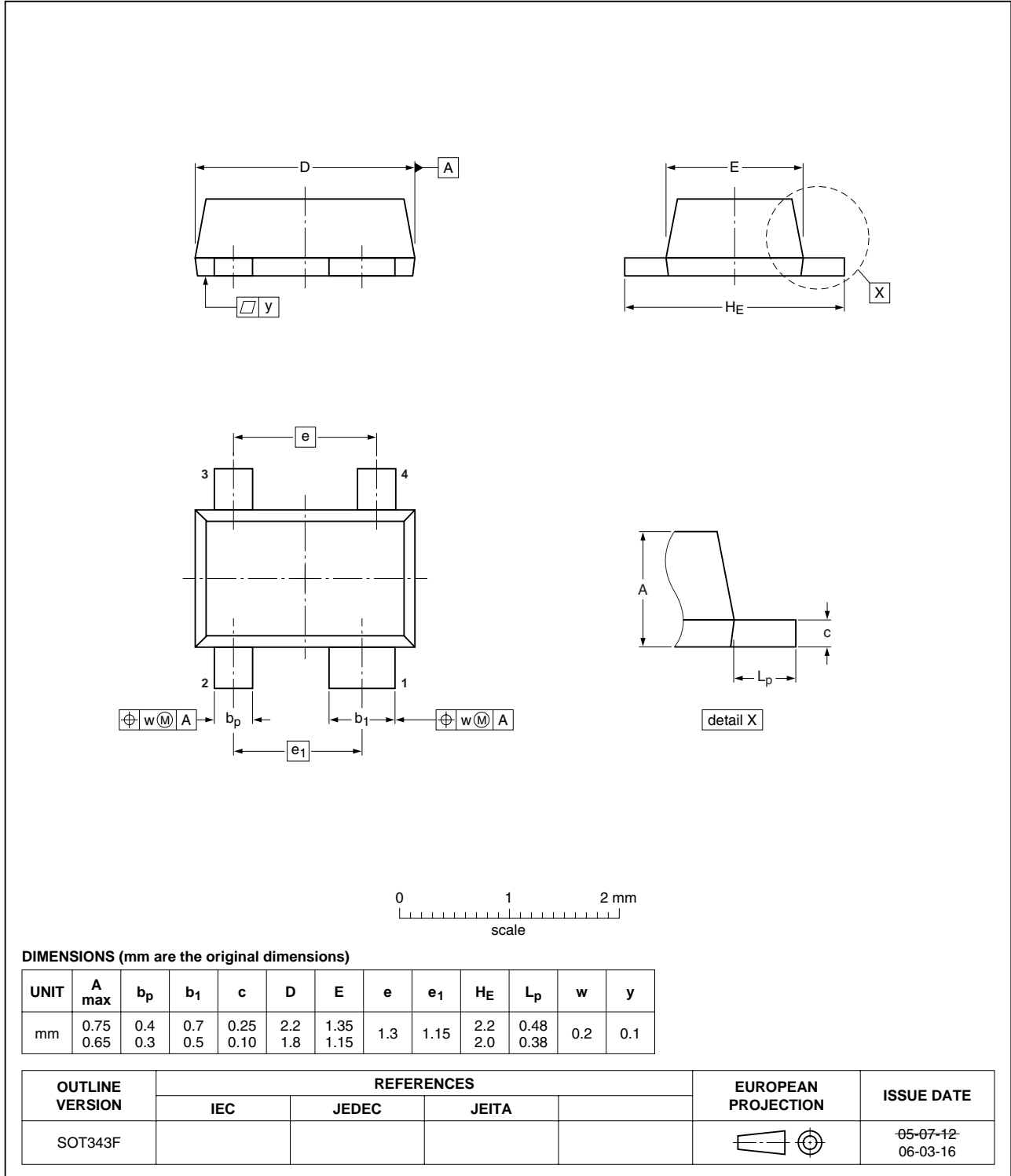
$V_{CE} = 2\text{ V}; I_C = 6\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}.$

**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
DC	Direct Current
LNA	Low Noise Amplifier
LTE	Long Term Evolution
NPN	Negative-Positive-Negative
RF	Radio Frequency
SDARS	Satellite Digital Audio Radio Service
UMTS	Universal Mobile Telecommunications System

## 10. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU660F v.1	20110111	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.

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

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