

# BFU610F

NPN wideband silicon RF transistor

Rev. 2 — 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 gain microwave transistor
- Noise figure (NF) = 1.7 dB at 5.8 GHz
- High associated gain 13.5 dB at 5.8 GHz
- 40 GHz  $f_T$  silicon technology

### 1.3 Applications

- Low current battery equipped applications
- Low noise amplifiers for microwave communications systems
- Analog/digital cordless applications
- RKE
- AMR
- GPS
- ZigBee
- LTE, cellular, UMTS
- FM radio
- Mobile TV
- Bluetooth



## 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		-	2	10	mA	
$P_{tot}$	total power dissipation	$T_{sp} \leq 90^\circ\text{C}$	[1]	-	-	mW	
$h_{FE}$	DC current gain	$I_C = 1 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$ ; $T_j = 25^\circ\text{C}$	90	135	180		
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2 \text{ V}$ ; $f = 1 \text{ MHz}$	-	19	-	fF	
$f_T$	transition frequency	$I_C = 4 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$ ; $f = 2 \text{ GHz}$ ; $T_{amb} = 25^\circ\text{C}$	-	15	-	GHz	
$G_{p(max)}$	maximum power gain	$I_C = 5 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$ ; $f = 5.8 \text{ GHz}$ ; $T_{amb} = 25^\circ\text{C}$	[2]	-	17.0	-	dB
NF	noise figure	$I_C = 2 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$ ; $f = 5.8 \text{ GHz}$ ; $\Gamma_S = \Gamma_{opt}$ ; $T_{amb} = 25^\circ\text{C}$	-	1.7	-	dB	
$P_{L(1\text{dB})}$	output power at 1 dB gain compression	$I_C = 10 \text{ mA}$ ; $V_{CE} = 1.5 \text{ V}$ ; $Z_S = Z_L = 50 \Omega$ ; $f = 5.8 \text{ GHz}$ ; $T_{amb} = 25^\circ\text{C}$	-	3	-	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  $G_{p(max)} = \text{Maximum Stable Gain (MSG)}$ .

## 2. Pinning information

Table 2. Discrete pinning

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

mbb159

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BFU610F	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

## 4. Marking

**Table 4. Marking**

Type number	Marking	Description
BFU610F	D1*	* = 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).

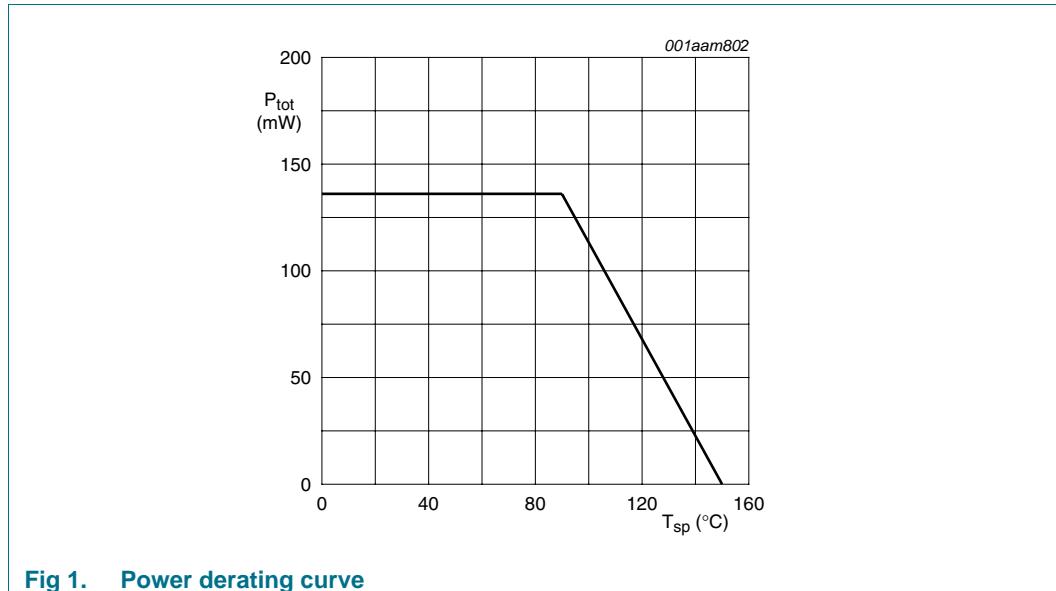
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	16	V
$V_{CEO}$	collector-emitter voltage	open base	-	5.5	V
$V_{EBO}$	emitter-base voltage	open collector	-	2.5	V
$I_C$	collector current		-	10	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 90^\circ\text{C}$	[1]	-	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

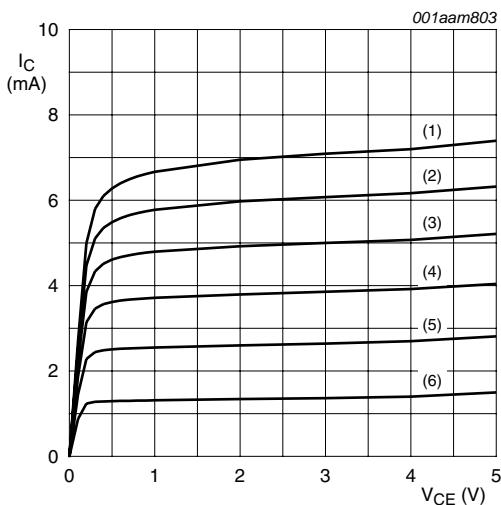
**Table 7. Characteristics** $T_j = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(\text{BR})\text{CBO}}$	collector-base breakdown voltage	$I_C = 2.5 \mu\text{A}; I_E = 0 \text{ mA}$	16	-	-	V
$V_{(\text{BR})\text{CEO}}$	collector-emitter breakdown voltage	$I_C = 1 \text{ mA}; I_B = 0 \text{ mA}$	5.5	-	-	V
$I_C$	collector current		-	2	10	mA
$I_{\text{CBO}}$	collector-base cut-off current	$I_E = 0 \text{ mA}; V_{\text{CB}} = 8 \text{ V}$	-	-	100	nA
$h_{\text{FE}}$	DC current gain	$I_C = 1 \text{ mA}; V_{\text{CE}} = 2 \text{ V}$	90	135	180	
$C_{\text{CES}}$	collector-emitter capacitance	$V_{\text{CB}} = 2 \text{ V}; f = 1 \text{ MHz}$	-	187	-	fF
$C_{\text{EBS}}$	emitter-base capacitance	$V_{\text{EB}} = 0.5 \text{ V}; f = 1 \text{ MHz}$	-	227	-	fF
$C_{\text{CBS}}$	collector-base capacitance	$V_{\text{CB}} = 2 \text{ V}; f = 1 \text{ MHz}$	-	19	-	fF
$f_T$	transition frequency	$I_C = 4 \text{ mA}; V_{\text{CE}} = 2 \text{ V}; f = 2 \text{ GHz}; T_{\text{amb}} = 25^\circ\text{C}$	-	15	-	GHz
$G_{\text{p(max)}}$	maximum power gain	$I_C = 5 \text{ mA}; V_{\text{CE}} = 2 \text{ V}; T_{\text{amb}} = 25^\circ\text{C}$	[1]			
		$f = 1.5 \text{ GHz}$	-	26	-	dB
		$f = 1.8 \text{ GHz}$	-	25	-	dB
		$f = 2.4 \text{ GHz}$	-	24	-	dB
		$f = 5.8 \text{ GHz}$	-	17	-	dB
$ \text{s}_{21} ^2$	insertion power gain	$I_C = 5 \text{ mA}; V_{\text{CE}} = 2 \text{ V}; T_{\text{amb}} = 25^\circ\text{C}$	[1]			
		$f = 1.5 \text{ GHz}$	-	17.5	-	dB
		$f = 1.8 \text{ GHz}$	-	17	-	dB
		$f = 2.4 \text{ GHz}$	-	16	-	dB
		$f = 5.8 \text{ GHz}$	-	10.5	-	dB
NF	noise figure	$I_C = 2 \text{ mA}; V_{\text{CE}} = 2 \text{ V}; \Gamma_S = \Gamma_{\text{opt}}; T_{\text{amb}} = 25^\circ\text{C}$	[1]			
		$f = 1.5 \text{ GHz}$	-	0.9	-	dB
		$f = 1.8 \text{ GHz}$	-	0.95	-	dB
		$f = 2.4 \text{ GHz}$	-	1.1	-	dB
		$f = 5.8 \text{ GHz}$	-	1.7	-	dB
$G_{\text{ass}}$	associated gain	$I_C = 2 \text{ mA}; V_{\text{CE}} = 2 \text{ V}; \Gamma_S = \Gamma_{\text{opt}}; T_{\text{amb}} = 25^\circ\text{C}$	[1]			
		$f = 1.5 \text{ GHz}$	-	23.5	-	dB
		$f = 1.8 \text{ GHz}$	-	23	-	dB
		$f = 2.4 \text{ GHz}$	-	20.5	-	dB
		$f = 5.8 \text{ GHz}$	-	13.5	-	dB
$P_{\text{L(1dB)}}$	output power at 1 dB gain compression	$I_C = 10 \text{ mA}; V_{\text{CE}} = 1.5 \text{ V}; Z_S = Z_L = 50 \Omega; T_{\text{amb}} = 25^\circ\text{C}$	[1]			
		$f = 1.5 \text{ GHz}$	-	3.5	-	dBm
		$f = 1.8 \text{ GHz}$	-	3	-	dBm
		$f = 2.4 \text{ GHz}$	-	3	-	dBm
		$f = 5.8 \text{ GHz}$	-	3	-	dBm

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IP3	third-order intercept point	$I_C = 10 \text{ mA}; V_{CE} = 1.5 \text{ V}; Z_S = Z_L = 50 \Omega; T_{amb} = 25^\circ\text{C}$				
		$f = 1.5 \text{ GHz}$	-	14.5	-	dBm
		$f = 1.8 \text{ GHz}$	-	15	-	dBm
		$f = 2.4 \text{ GHz}$	-	15	-	dBm
		$f = 5.8 \text{ GHz}$	-	18	-	dBm

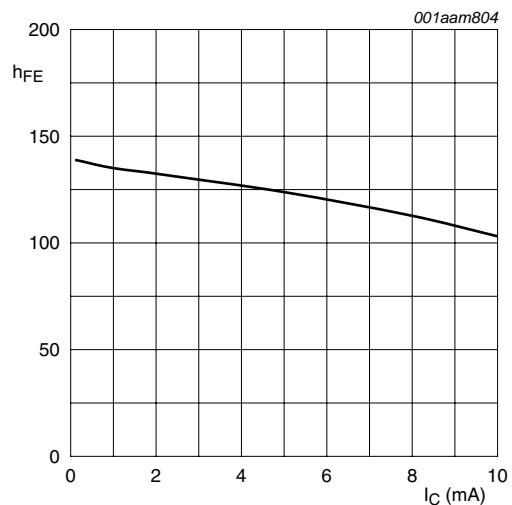
[1]  $G_{p(\max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(\max)} = \text{MSG}$ .



$T_{amb} = 25^\circ\text{C}$ .

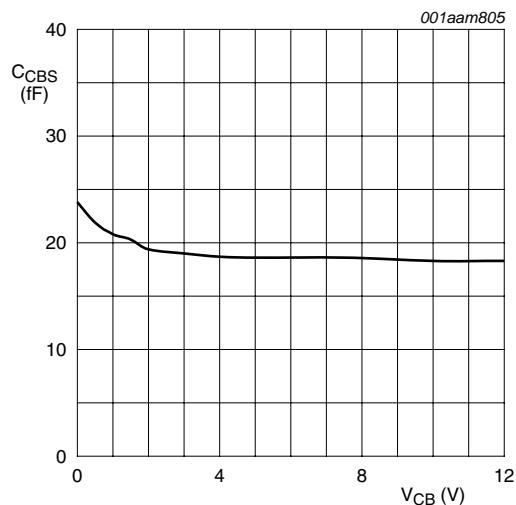
- (1)  $I_B = 60 \mu\text{A}$
- (2)  $I_B = 50 \mu\text{A}$
- (3)  $I_B = 40 \mu\text{A}$
- (4)  $I_B = 30 \mu\text{A}$
- (5)  $I_B = 20 \mu\text{A}$
- (6)  $I_B = 10 \mu\text{A}$

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



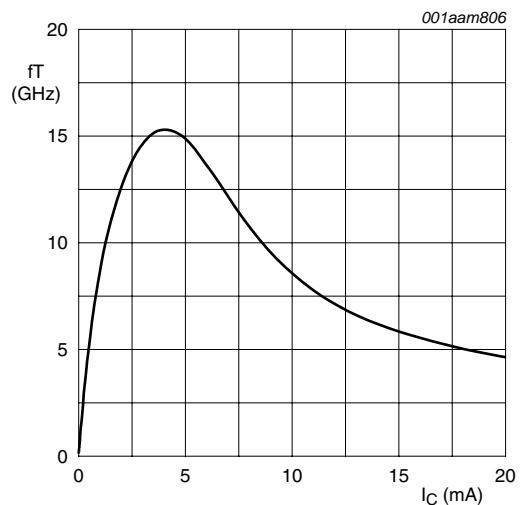
$V_{CE} = 2 \text{ V}; T_{amb} = 25^\circ\text{C}$ .

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



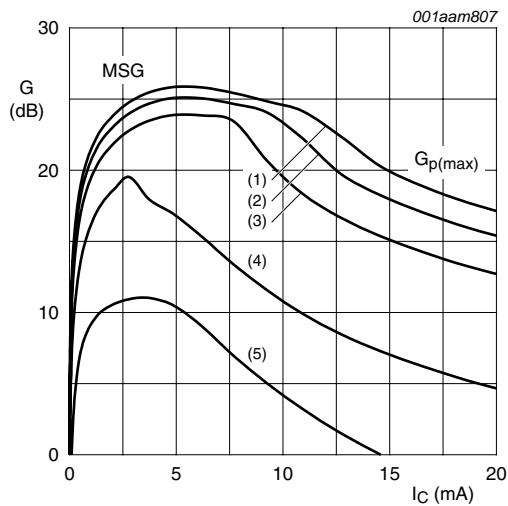
$f = 1$  MHz,  $T_{amb} = 25$  °C.

**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.

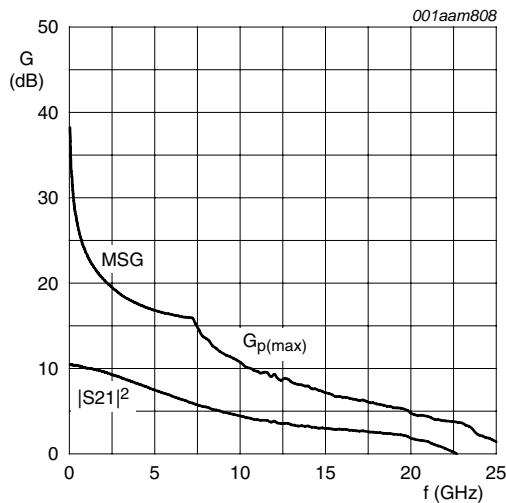
**Fig 5. Transition frequency as a function of collector current; typical values**



$V_{CE} = 2$  V;  $T_{amb} = 25$  °C.

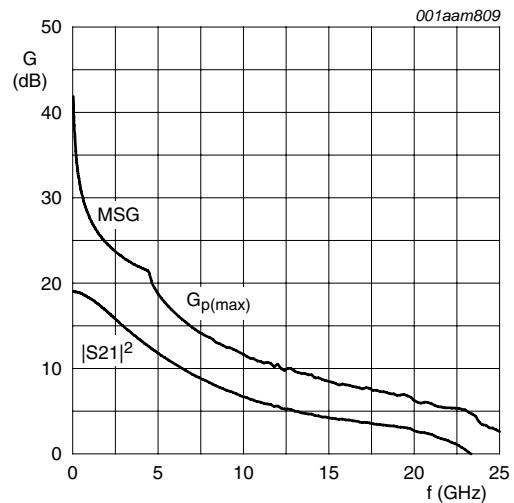
- (1)  $f = 1.5$  GHz
- (2)  $f = 1.8$  GHz
- (3)  $f = 2.4$  GHz
- (4)  $f = 5.8$  GHz
- (5)  $f = 12$  GHz

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



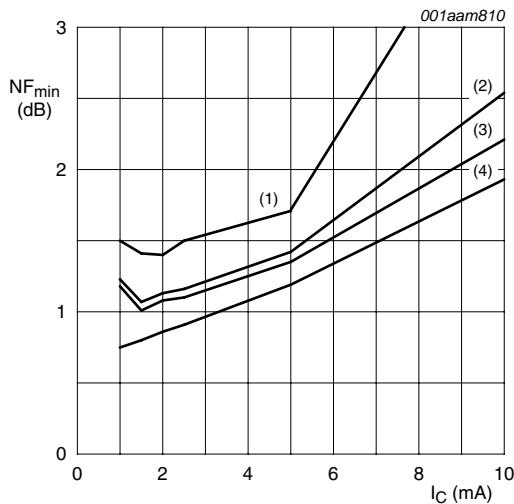
$V_{CE} = 2$  V;  $I_C = 1$  mA;  $T_{amb} = 25$  °C.

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



$V_{CE} = 2$  V;  $I_C = 5$  mA;  $T_{amb} = 25$  °C.

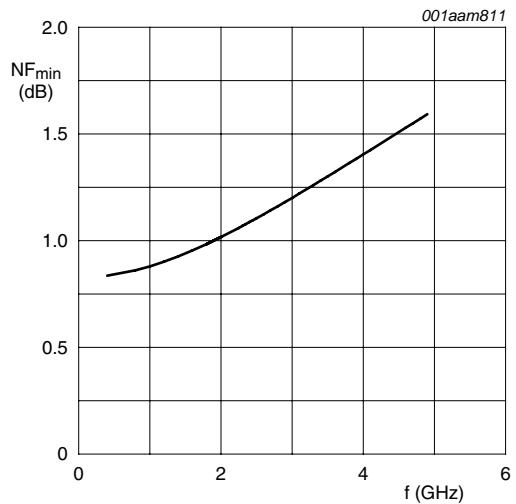
**Fig 8. Gain as a function of frequency; typical values**



$V_{CE} = 2$  V;  $T_{amb} = 25$  °C.

- (1)  $f = 5.8$  GHz
- (2)  $f = 2.4$  GHz
- (3)  $f = 1.8$  GHz
- (4)  $f = 1.5$  GHz

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



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

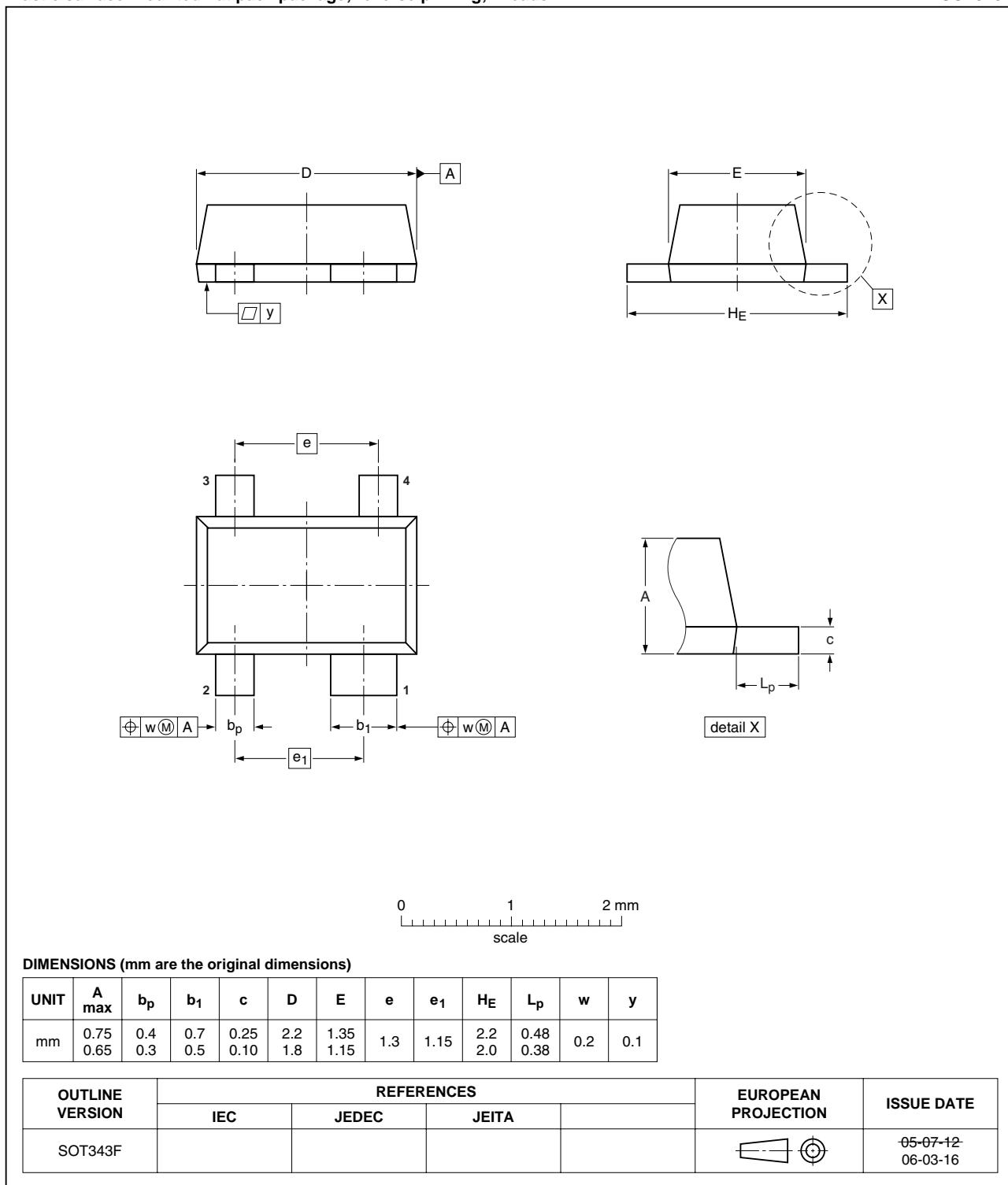


Fig 11. Package outline SOT343F

## 9. Abbreviations

**Table 8. Abbreviations**

Acronym	Description
AMR	Automatic Meter Reading
DC	Direct Current
DRO	Dielectric Resonator Oscillator
FM	Frequency Modulation
GPS	Global Positioning System
Ka	Kurtz above
LTE	Long Term Evolution
NPN	Negative-Positive-Negative
RF	Radio Frequency
RKE	Remote Keyless Entry
UMTS	Universal Mobile Telecommunications System

## 10. Revision history

**Table 9. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU610F v.2	20110111	Product data sheet	-	BFU610F v.1
BFU610F v.1	20100617	Objective 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".

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