

# BFU690F

NPN wideband silicon RF transistor

Rev. 2 — 14 March 2014

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.

### 1.2 Features and benefits

- Low noise high linearity microwave transistor
- High output third-order intercept point 34 dBm at 1.8 GHz
- 40 GHz  $f_T$  silicon technology

### 1.3 Applications

- Ka band oscillators DRO's
- C-band high output buffer amplifier
- ZigBee
- 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		-	70	100	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 85\text{ °C}$ <a href="#">[1]</a>	-	-	490	mW
$h_{FE}$	DC current gain	$I_C = 20\text{ mA}; V_{CE} = 2\text{ V}; T_j = 25\text{ °C}$	90	135	180	
$C_{CBS}$	collector-base capacitance	$V_{CB} = 2\text{ V}; f = 1\text{ MHz}$	-	404	-	fF
$f_T$	transition frequency	$I_C = 60\text{ mA}; V_{CE} = 1\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$	-	18	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 60\text{ mA}; V_{CE} = 1\text{ V}; f = 1.8\text{ GHz}; T_{amb} = 25\text{ °C}$ <a href="#">[2]</a>	-	20.5	-	dB
NF	noise figure	$I_C = 15\text{ mA}; V_{CE} = 2\text{ V}; f = 1.8\text{ GHz}; \Gamma_S = \Gamma_{opt}$	-	0.65	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 70\text{ mA}; V_{CE} = 4\text{ V}; Z_S = Z_L = 50\text{ }\Omega; f = 1.8\text{ GHz}; T_{amb} = 25\text{ °C}$	-	22	-	dBm

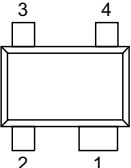
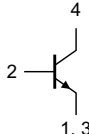
[1]  $T_{sp}$  is the temperature at the solder point of the emitter lead.

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



## 2. Pinning information

Table 2. Discrete pinning

Pin	Description	Simplified outline	Graphic symbol
1	emitter		 <i>mbb159</i>
2	base		
3	emitter		
4	collector		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BFU690F	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

## 4. Marking

Table 4. Marking

Type number	Marking	Description
BFU690F	D4*	* = 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		-	100	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 85\text{ °C}$ [1]	-	490	mW
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	150	°C

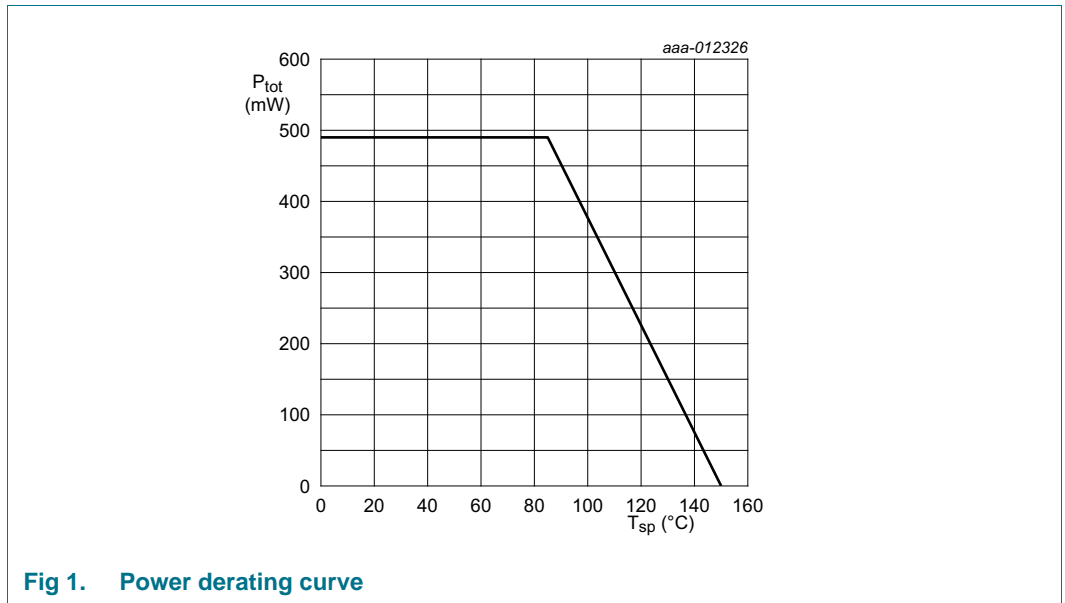
[1]  $T_{sp}$  is the temperature at the solder point of the emitter lead.

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[1] 132	K/W

[1] Determined by simulation.



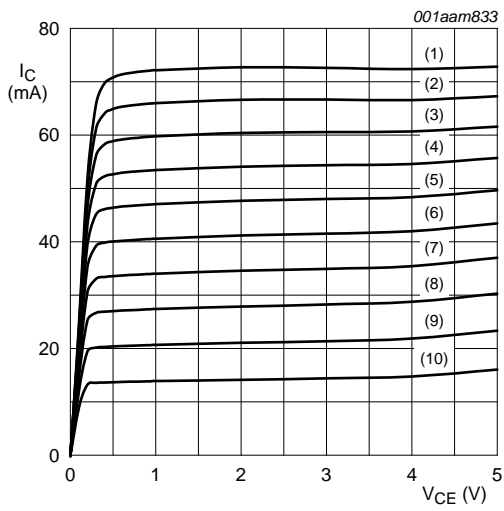
**Fig 1. Power derating curve**

## 7. Characteristics

**Table 7. Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>(BR)CBO</sub>	collector-base breakdown voltage	I <sub>C</sub> = 2.5 μA; I <sub>E</sub> = 0 mA	16	-	-	V
V <sub>(BR)CEO</sub>	collector-emitter breakdown voltage	I <sub>C</sub> = 1 mA; I <sub>B</sub> = 0 mA	5.5	-	-	V
I <sub>C</sub>	collector current		-	70	100	mA
I <sub>CBO</sub>	collector-base cut-off current	I <sub>E</sub> = 0 mA; V <sub>CB</sub> = 8 V	-	-	100	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 2 V	90	135	180	
C <sub>CEs</sub>	collector-emitter capacitance	V <sub>CB</sub> = 2 V; f = 1 MHz	-	527	-	fF
C <sub>EBS</sub>	emitter-base capacitance	V <sub>EB</sub> = 0.5 V; f = 1 MHz	-	1699	-	fF
C <sub>CBS</sub>	collector-base capacitance	V <sub>CB</sub> = 2 V; f = 1 MHz	-	404	-	fF
f <sub>T</sub>	transition frequency	I <sub>C</sub> = 60 mA; V <sub>CE</sub> = 1 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	-	18	-	GHz
G <sub>p(max)</sub>	maximum power gain	I <sub>C</sub> = 60 mA; V <sub>CE</sub> = 1 V; T <sub>amb</sub> = 25 °C <a href="#">[1]</a>				
		f = 1.5 GHz	-	22	-	dB
		f = 1.8 GHz	-	20.5	-	dB
		f = 2.4 GHz	-	17	-	dB
s <sub>21</sub>   <sup>2</sup>	insertion power gain	I <sub>C</sub> = 60 mA; V <sub>CE</sub> = 1 V; T <sub>amb</sub> = 25 °C				
		f = 1.5 GHz	-	15	-	dB
		f = 1.8 GHz	-	13.5	-	dB
		f = 2.4 GHz	-	11	-	dB
NF	noise figure	I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 2 V; Γ <sub>S</sub> = Γ <sub>opt</sub> ; T <sub>amb</sub> = 25 °C				
		f = 1.5 GHz	-	0.60	-	dB
		f = 1.8 GHz	-	0.65	-	dB
		f = 2.4 GHz	-	0.70	-	dB
G <sub>ass</sub>	associated gain	I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 2 V; Γ <sub>S</sub> = Γ <sub>opt</sub> ; T <sub>amb</sub> = 25 °C				
		f = 1.5 GHz	-	18.5	-	dB
		f = 1.8 GHz	-	17.5	-	dB
		f = 2.4 GHz	-	15.5	-	dB
P <sub>L(1dB)</sub>	output power at 1 dB gain compression	I <sub>C</sub> = 70 mA; V <sub>CE</sub> = 4 V; Z <sub>S</sub> = Z <sub>L</sub> = 50 Ω; T <sub>amb</sub> = 25 °C				
		f = 1.5 GHz	-	22	-	dBm
		f = 1.8 GHz	-	22	-	dBm
		f = 2.4 GHz	-	20	-	dBm
IP3	third-order intercept point	I <sub>C</sub> = 70 mA; V <sub>CE</sub> = 4 V; Z <sub>S</sub> = Z <sub>L</sub> = 50 Ω; T <sub>amb</sub> = 25 °C				
		f = 1.5 GHz	-	34	-	dBm
		f = 1.8 GHz	-	34	-	dBm
		f = 2.4 GHz	-	33	-	dBm

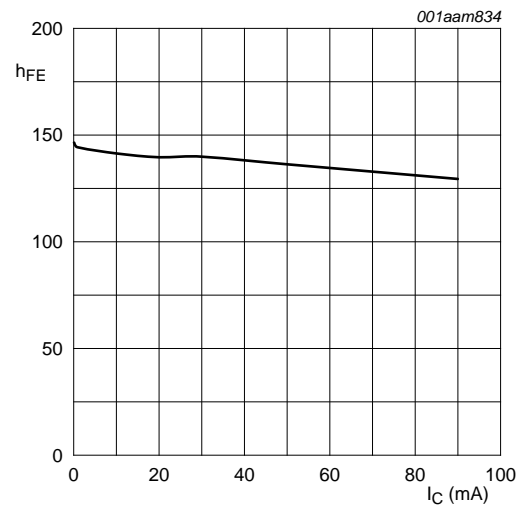
[1] G<sub>p(max)</sub> is the maximum power gain, if K > 1. If K < 1 then G<sub>p(max)</sub> = MSG.



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

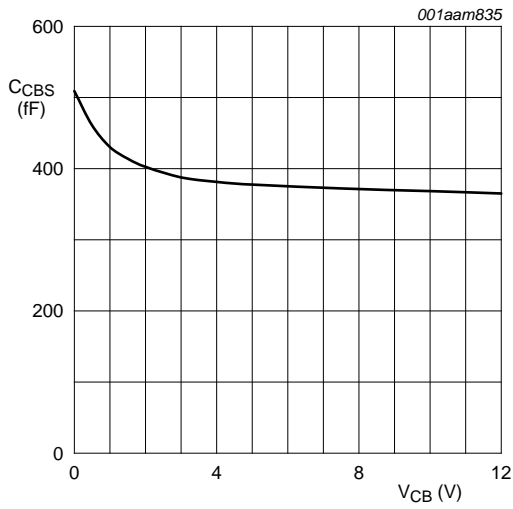
- (1)  $I_B = 550\text{ }\mu\text{A}$
- (2)  $I_B = 500\text{ }\mu\text{A}$
- (3)  $I_B = 450\text{ }\mu\text{A}$
- (4)  $I_B = 400\text{ }\mu\text{A}$
- (5)  $I_B = 350\text{ }\mu\text{A}$
- (6)  $I_B = 300\text{ }\mu\text{A}$
- (7)  $I_B = 250\text{ }\mu\text{A}$
- (8)  $I_B = 200\text{ }\mu\text{A}$
- (9)  $I_B = 150\text{ }\mu\text{A}$
- (10)  $I_B = 100\text{ }\mu\text{A}$

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



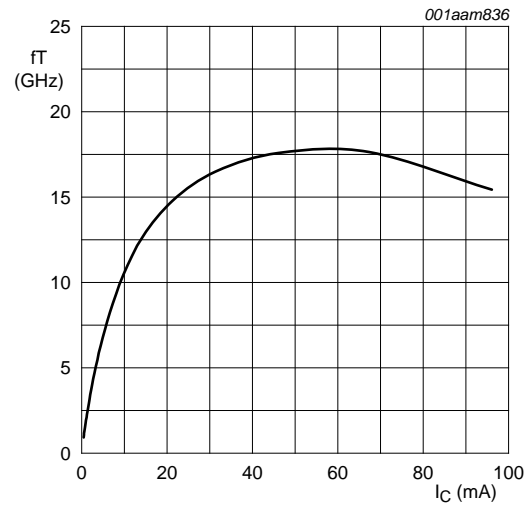
$V_{CE} = 2\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$ .

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



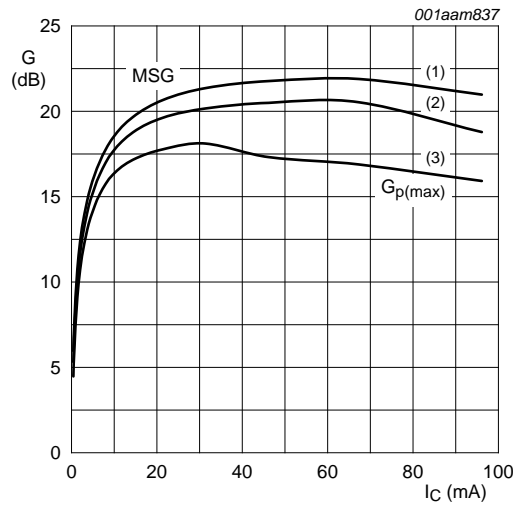
$f = 1 \text{ MHz}$ ,  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ .

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



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

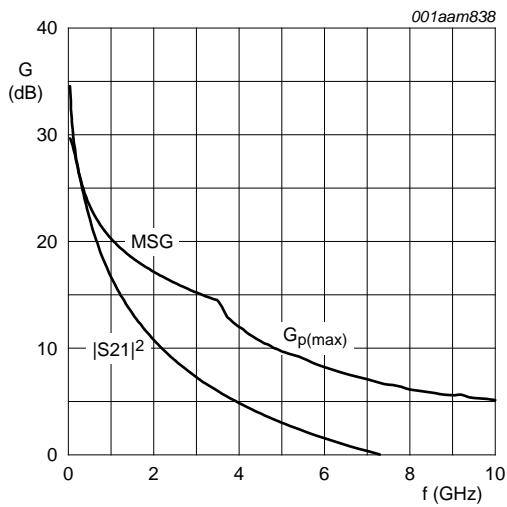
**Fig 5. Transition frequency as a function of collector current; typical values**



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

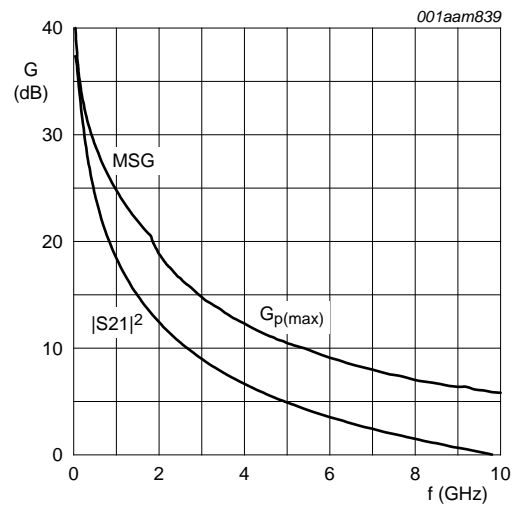
- (1)  $f = 1.5 \text{ GHz}$
- (2)  $f = 1.8 \text{ GHz}$
- (3)  $f = 2.4 \text{ GHz}$

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



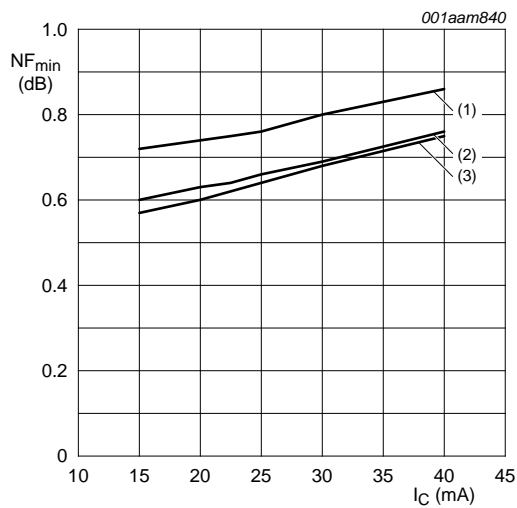
$V_{CE} = 1 \text{ V}; I_C = 10 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}.$

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



$V_{CE} = 1 \text{ V}; I_C = 60 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}.$

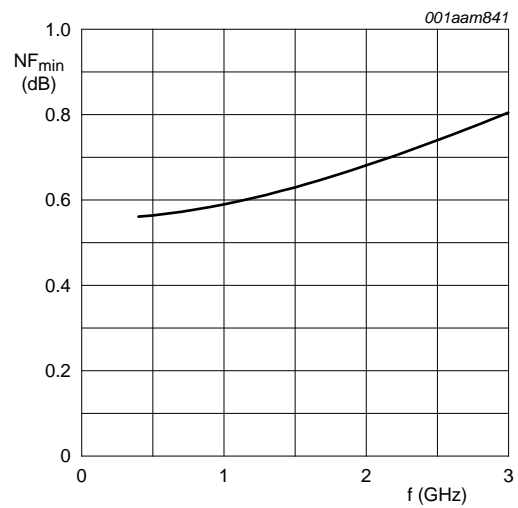
**Fig 8. Gain as a function of frequency; typical values**



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

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

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



$V_{CE} = 2 \text{ V}; I_C = 15 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}.$

**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

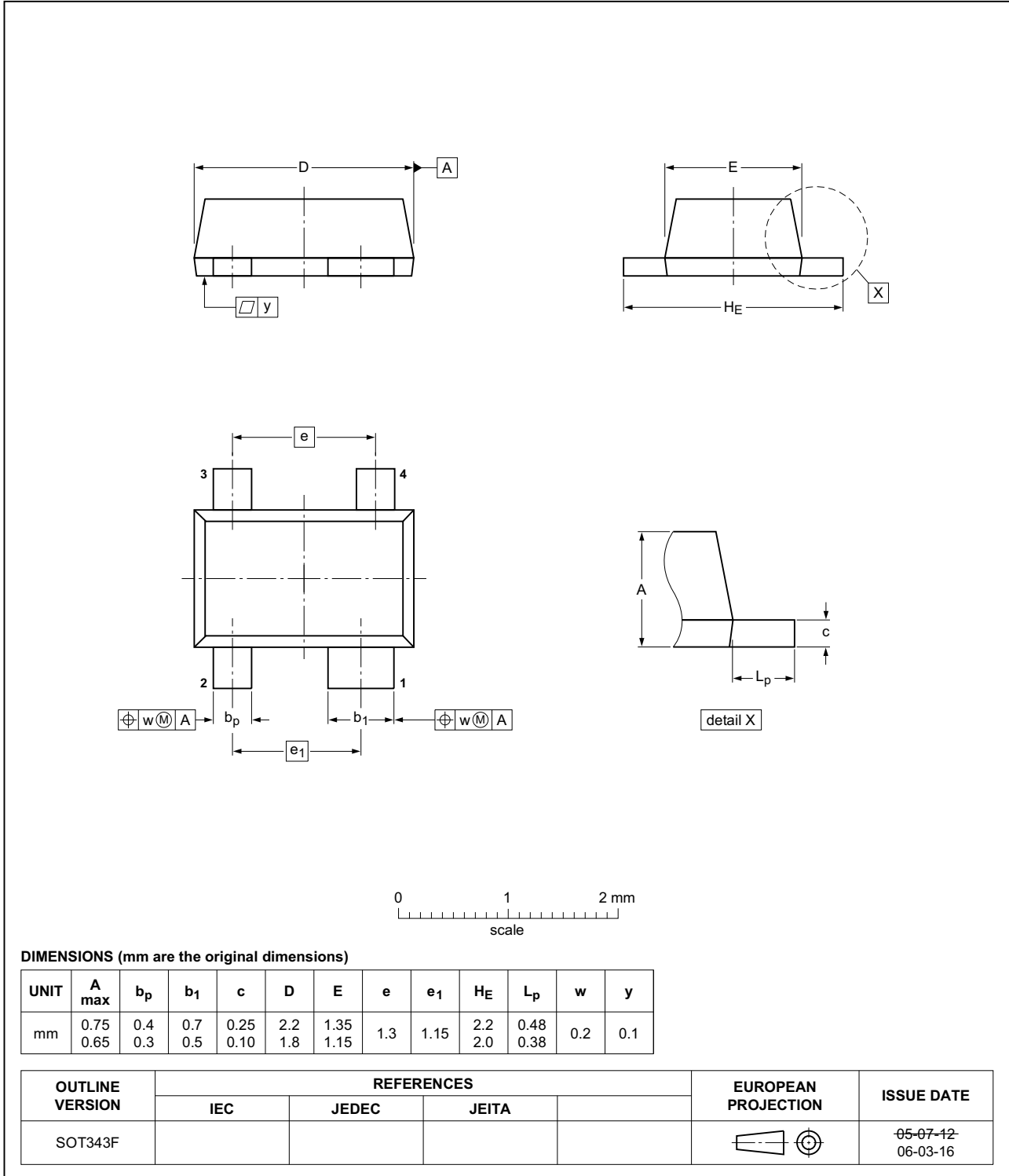


Fig 11. Package outline SOT343F



## 9. Handling information

### 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.

## 10. Abbreviations

Table 8. Abbreviations

Acronym	Description
DRO	Dielectric Resonator Oscillator
Ka	Kurtz above
LTE	Long Term Evolution
NPN	Negative-Positive-Negative
UMTS	Universal Mobile Telecommunications System

## 11. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU690F v.2	20140314	Product data sheet	-	BFU690F v.1
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Table 1 on page 1</a>: The value and conditions for <math>P_{tot}</math> have been updated.</li> <li>• <a href="#">Table 5 on page 2</a>: The value and conditions for <math>P_{tot}</math> have been updated.</li> <li>• <a href="#">Table 6 on page 3</a>: The value and conditions for <math>R_{th(j-sp)}</math> have been updated.</li> <li>• <a href="#">Figure 1 on page 3</a>: The graph has been updated.</li> <li>• <a href="#">Section 9 on page 9</a>: The ESD caution has been moved here from <a href="#">Section 1.1 on page 1</a>.</li> </ul>			
BFU690F v.1	20101216	Product data sheet	-	-

## 12. Legal information

### 12.1 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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Date of release: 14 March 2014

Document identifier: BFU690F

# AMEYA360

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