

# 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	$T_{sp} \leq 85\text{ °C}$ [1]	-	-	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	$I_C = 60\text{ mA}$ ; $V_{CE} = 1\text{ V}$ ; $f = 1.8\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$ [2]	-	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

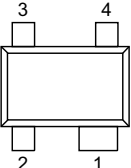
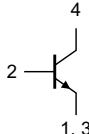
[1]  $T_{sp}$  is the temperature at the solder point of the emitter lead.

[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

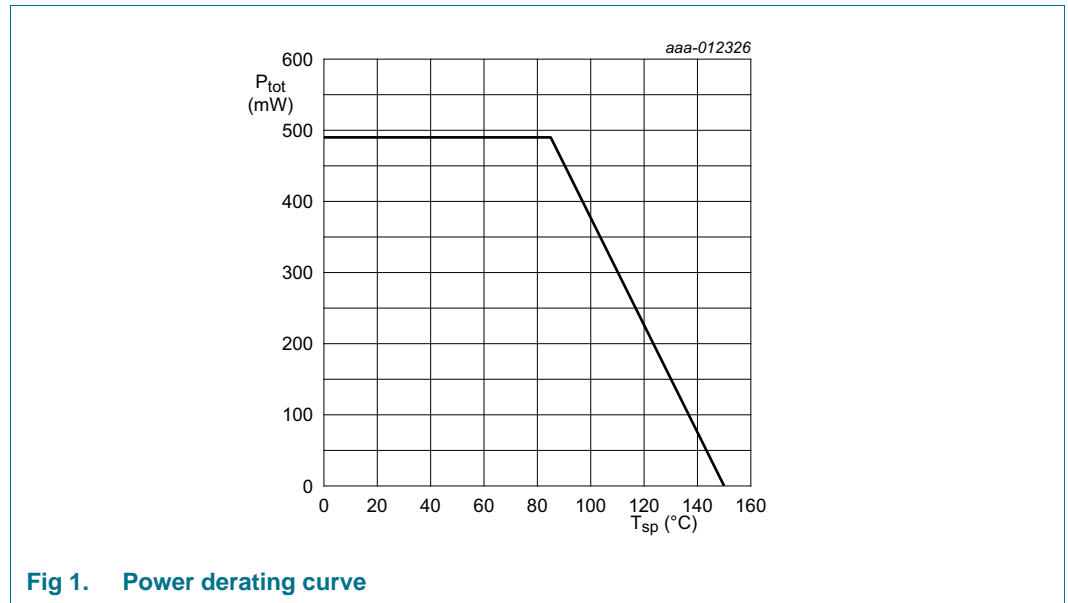
[1]  $T_{sp}$  is the temperature at the solder point of the emitter lead.

## 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**

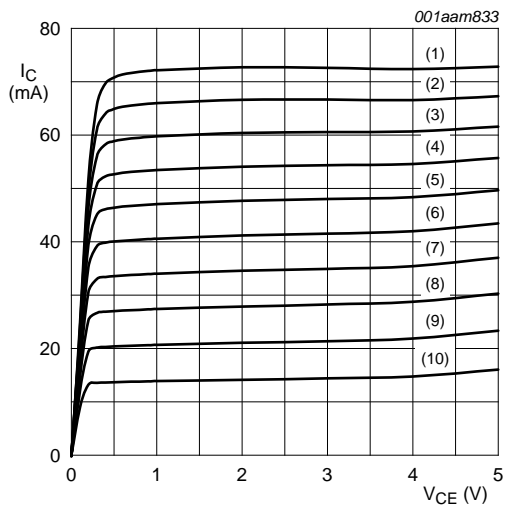
## 7. Characteristics

**Table 7. Characteristics**

$T_j = 25\text{ °C}$  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		-	70	100	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	$I_C = 20\ \text{mA}; V_{CE} = 2\ \text{V}$	90	135	180	
$C_{CES}$	collector-emitter capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	527	-	fF
$C_{EBS}$	emitter-base capacitance	$V_{EB} = 0.5\ \text{V}; f = 1\ \text{MHz}$	-	1699	-	fF
$C_{CBS}$	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	$I_C = 60\ \text{mA}; V_{CE} = 1\ \text{V}; T_{amb} = 25\text{ °C}$ [1]				
		$f = 1.5\ \text{GHz}$	-	22	-	dB
		$f = 1.8\ \text{GHz}$	-	20.5	-	dB
		$f = 2.4\ \text{GHz}$	-	17	-	dB
$ s_{21} ^2$	insertion power gain	$I_C = 60\ \text{mA}; V_{CE} = 1\ \text{V}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	15	-	dB
		$f = 1.8\ \text{GHz}$	-	13.5	-	dB
		$f = 2.4\ \text{GHz}$	-	11	-	dB
NF	noise figure	$I_C = 15\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	0.60	-	dB
		$f = 1.8\ \text{GHz}$	-	0.65	-	dB
		$f = 2.4\ \text{GHz}$	-	0.70	-	dB
$G_{ass}$	associated gain	$I_C = 15\ \text{mA}; V_{CE} = 2\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	18.5	-	dB
		$f = 1.8\ \text{GHz}$	-	17.5	-	dB
		$f = 2.4\ \text{GHz}$	-	15.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 70\ \text{mA}; V_{CE} = 4\ \text{V}; Z_S = Z_L = 50\ \Omega; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	22	-	dBm
		$f = 1.8\ \text{GHz}$	-	22	-	dBm
		$f = 2.4\ \text{GHz}$	-	20	-	dBm
IP3	third-order intercept point	$I_C = 70\ \text{mA}; V_{CE} = 4\ \text{V}; Z_S = Z_L = 50\ \Omega; T_{amb} = 25\text{ °C}$				
		$f = 1.5\ \text{GHz}$	-	34	-	dBm
		$f = 1.8\ \text{GHz}$	-	34	-	dBm
		$f = 2.4\ \text{GHz}$	-	33	-	dBm

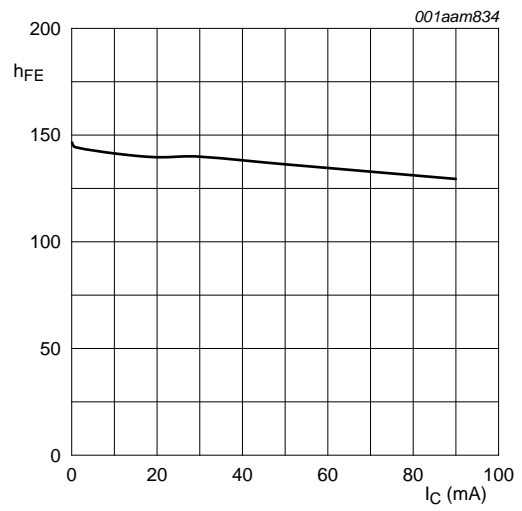
[1]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)} = \text{MSG}$ .



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

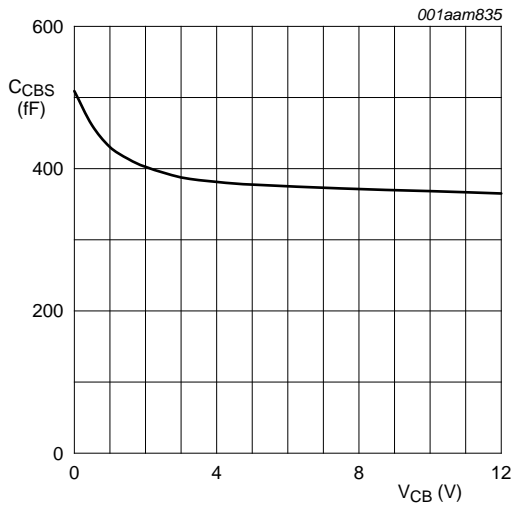
- (1)  $I_B = 550\text{ }\mu\text{A}$
- (2)  $I_B = 500\text{ }\mu\text{A}$
- (3)  $I_B = 450\text{ }\mu\text{A}$
- (4)  $I_B = 400\text{ }\mu\text{A}$
- (5)  $I_B = 350\text{ }\mu\text{A}$
- (6)  $I_B = 300\text{ }\mu\text{A}$
- (7)  $I_B = 250\text{ }\mu\text{A}$
- (8)  $I_B = 200\text{ }\mu\text{A}$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



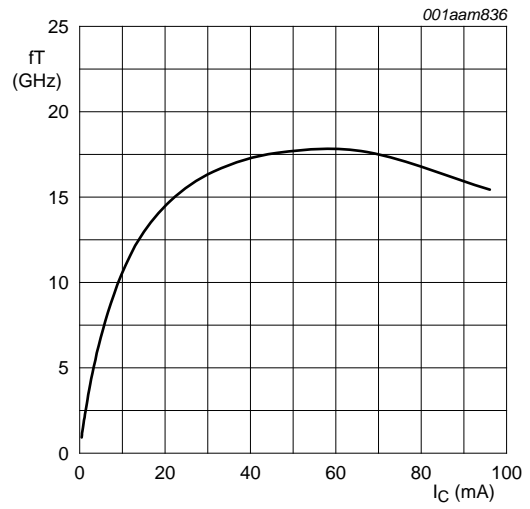
$V_{CE} = 2\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$

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



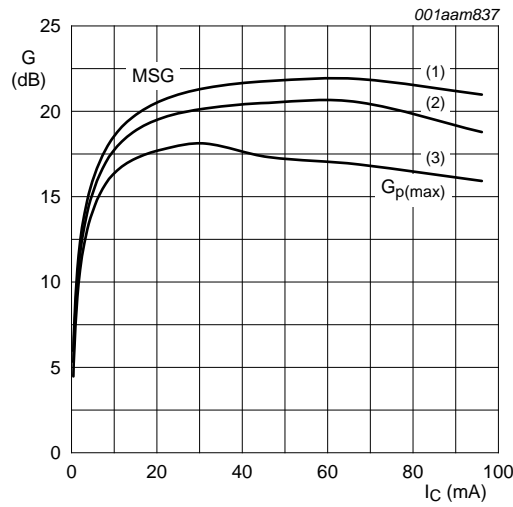
$f = 1 \text{ MHz}$ ,  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ .

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



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

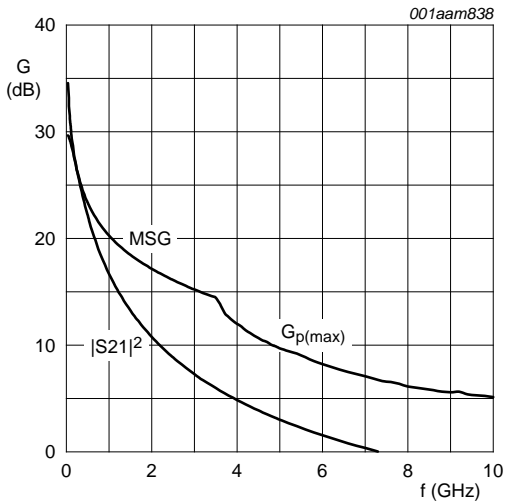
**Fig 5. Transition frequency as a function of collector current; typical values**



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

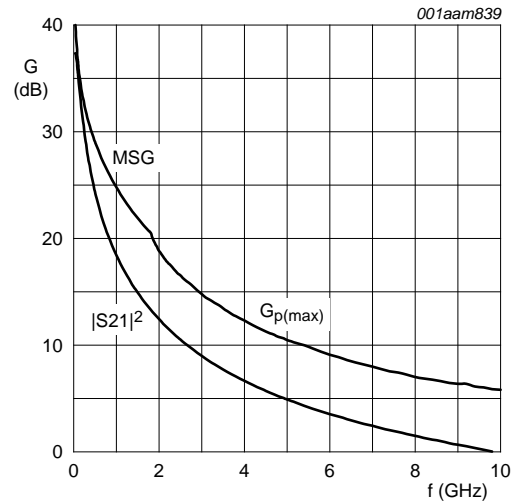
- (1)  $f = 1.5 \text{ GHz}$
- (2)  $f = 1.8 \text{ GHz}$
- (3)  $f = 2.4 \text{ GHz}$

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



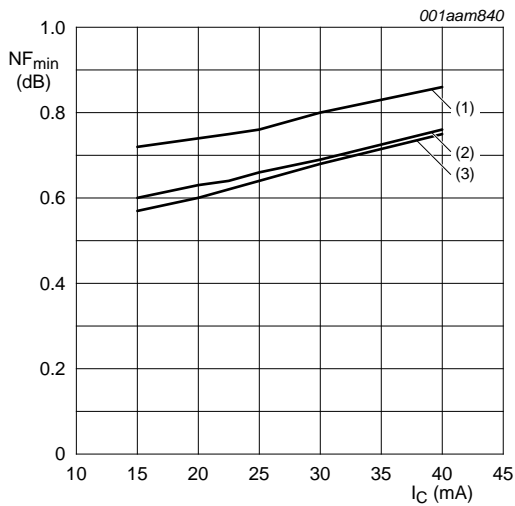
$V_{CE} = 1\text{ V}; I_C = 10\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}.$

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



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

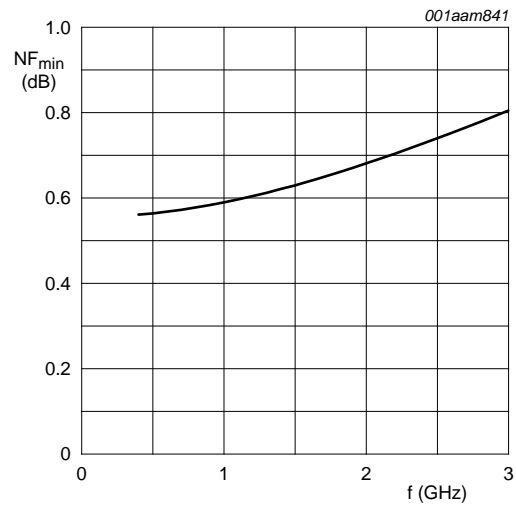
**Fig 8. Gain as a function of frequency; typical values**



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

- (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

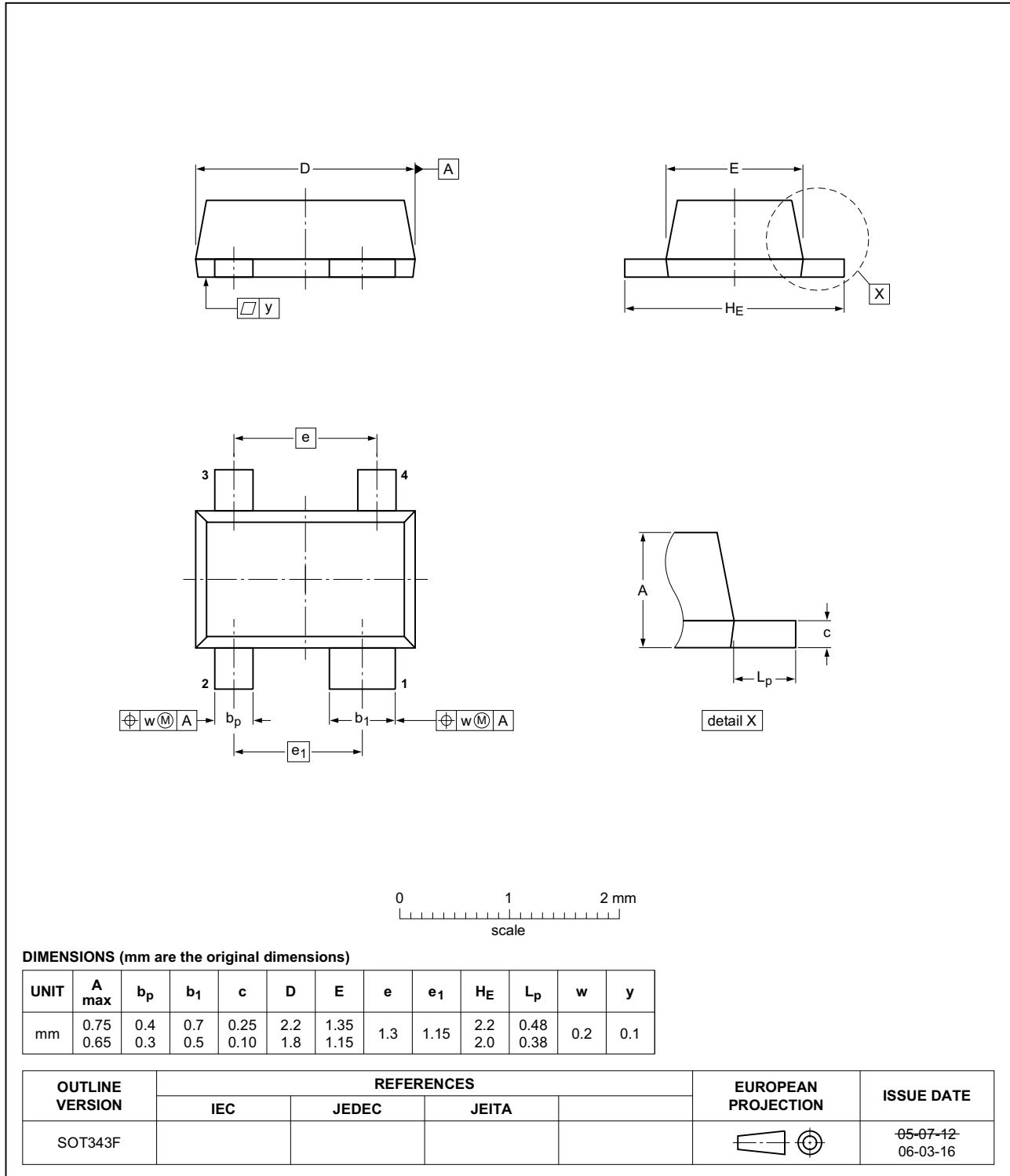


Fig 11. Package outline SOT343F



## 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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## 14. Contents

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- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».



## JONHON

«**JONHON**» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«**FORSTAR**» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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