

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

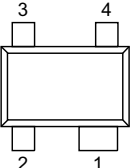
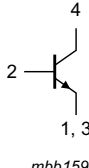
[1] T_{sp} is the temperature at the solder point of the emitter lead.

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



2. Pinning information

Table 2. Discrete pinning

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

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

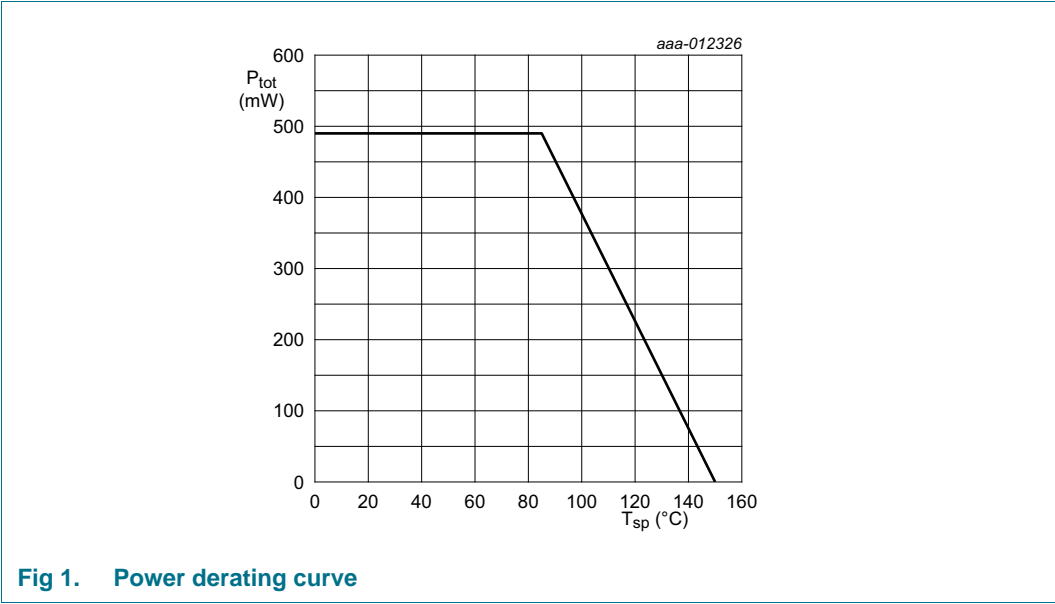
[1] T_{sp} is the temperature at the solder point of the emitter lead.

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.



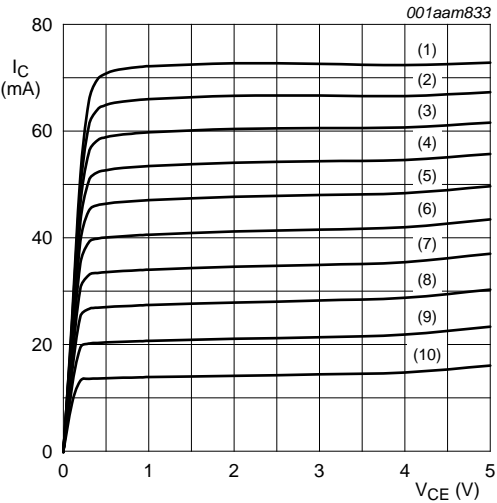
7. Characteristics

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	$I_C = 2.5\text{ }\mu\text{A}$; $I_E = 0\text{ mA}$	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	$I_C = 70\text{ mA}$; $V_{CE} = 4\text{ V}$; $Z_S = Z_L = 50\text{ }\Omega$; $T_{amb} = 25\text{ °C}$				
		$f = 1.5\text{ GHz}$	-	22	-	dBm
		$f = 1.8\text{ GHz}$	-	22	-	dBm
		$f = 2.4\text{ GHz}$	-	20	-	dBm
IP3	third-order intercept point	$I_C = 70\text{ mA}$; $V_{CE} = 4\text{ V}$; $Z_S = Z_L = 50\text{ }\Omega$; $T_{amb} = 25\text{ °C}$				
		$f = 1.5\text{ GHz}$	-	34	-	dBm
		$f = 1.8\text{ GHz}$	-	34	-	dBm
		$f = 2.4\text{ GHz}$	-	33	-	dBm

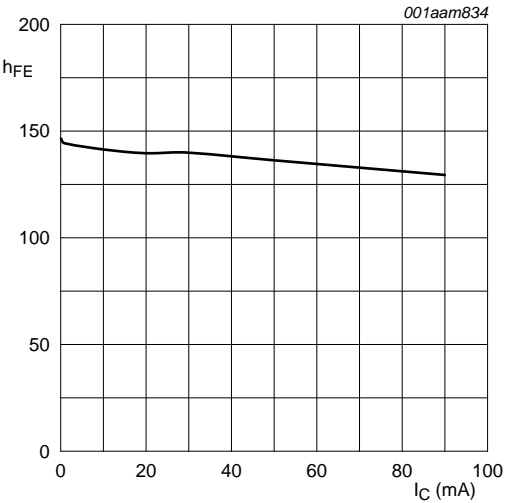
[1] $G_{p(max)}$ is the maximum power gain, if $K > 1$. If $K < 1$ then $G_{p(max)} = MSG$.



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

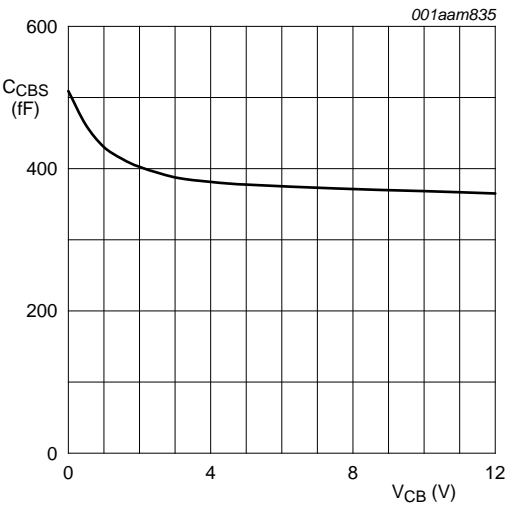
- (1) $I_B = 550\text{ }\mu A$
- (2) $I_B = 500\text{ }\mu A$
- (3) $I_B = 450\text{ }\mu A$
- (4) $I_B = 400\text{ }\mu A$
- (5) $I_B = 350\text{ }\mu A$
- (6) $I_B = 300\text{ }\mu A$
- (7) $I_B = 250\text{ }\mu A$
- (8) $I_B = 200\text{ }\mu A$
- (9) $I_B = 150\text{ }\mu A$
- (10) $I_B = 100\text{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

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



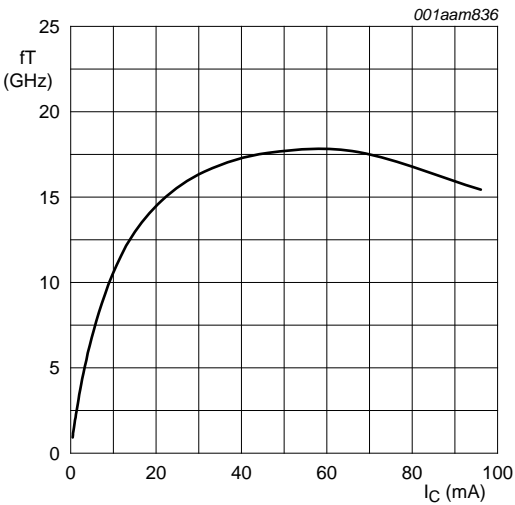
$V_{CE} = 2\text{ V}$; $T_{amb} = 25\text{ }^{\circ}C$.

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



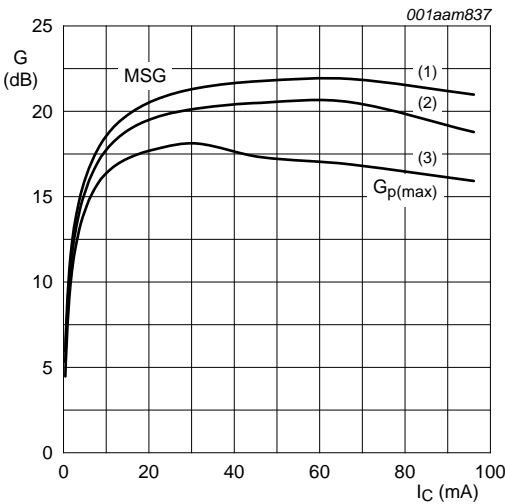
$f = 1 \text{ MHz}$, $T_{amb} = 25 \text{ }^{\circ}\text{C}$.

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



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

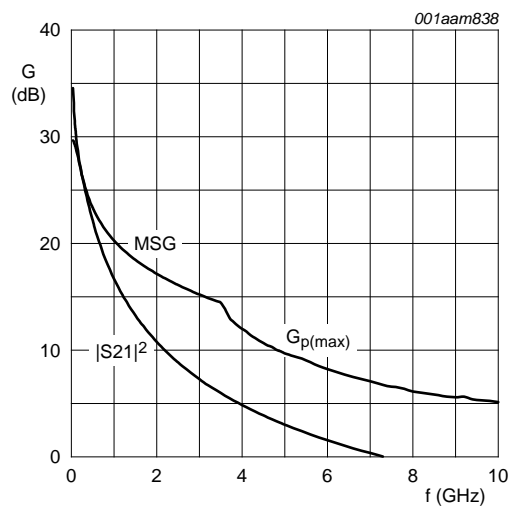
Fig 5. Transition frequency as a function of collector current; typical values



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

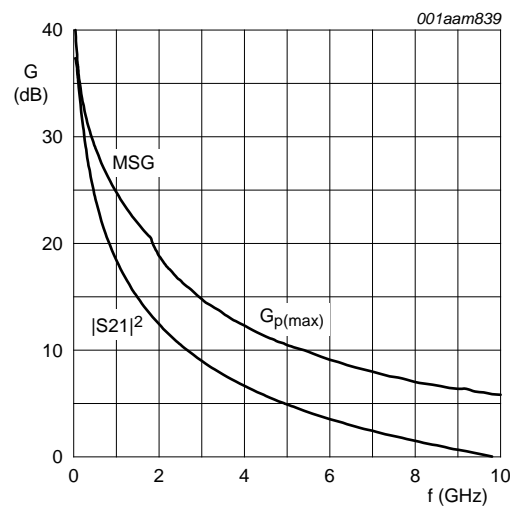
- (1) $f = 1.5 \text{ GHz}$
- (2) $f = 1.8 \text{ GHz}$
- (3) $f = 2.4 \text{ GHz}$

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



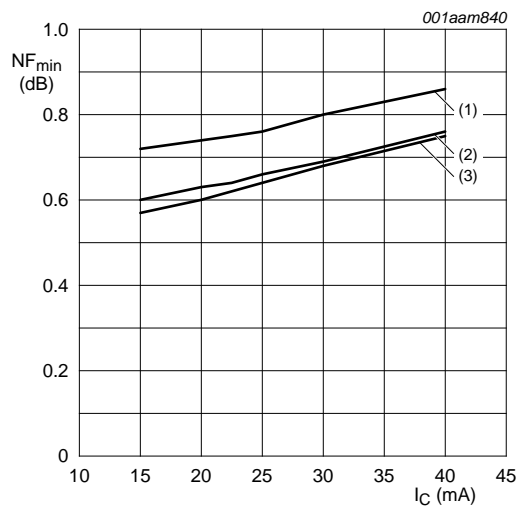
$V_{CE} = 1\text{ V}$; $I_C = 10\text{ mA}$; $T_{amb} = 25\text{ °C}$.

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



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

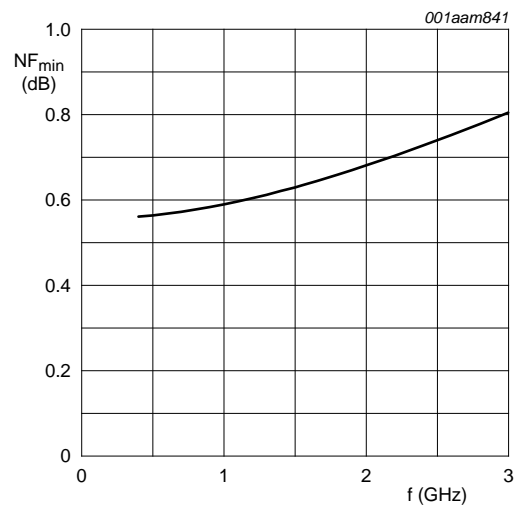
Fig 8. Gain as a function of frequency; typical values



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

- (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

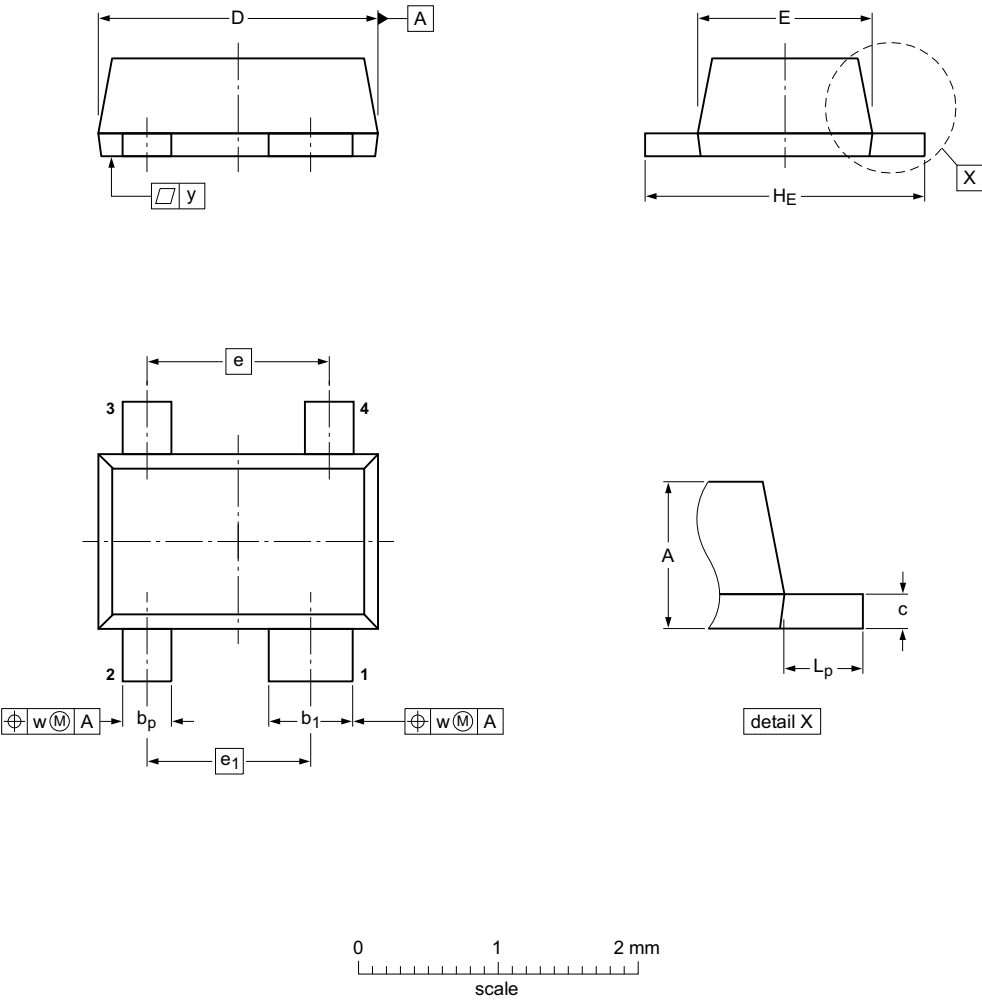


$V_{CE} = 2\text{ V}$; $I_C = 15\text{ mA}$; $T_{amb} = 25\text{ °C}$.

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

8. Package outline

Plastic surface-mounted flat pack package; reverse pinning; 4 leadsSOT343F



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max}	b _p	b ₁	c	D	E	e	e ₁	H _E	L _p	w	y
mm	0.75 0.65	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.48 0.38	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT343F						05-07-12 06-03-16

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">Table 1 on page 1: The value and conditions for P_{tot} have been updated.Table 5 on page 2: The value and conditions for P_{tot} have been updated.Table 6 on page 3: The value and conditions for $R_{th(j-sp)}$ have been updated.Figure 1 on page 3: The graph has been updated.Section 9 on page 9: The ESD caution has been moved here from Section 1.1 on page 1.			
BFU690F v.1	20101216	Product data sheet	-	-

12. Legal information

12.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	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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