BFU668F

NPN wideband silicon RF transistor

Rev. 3 — 24 January 2012 Product data sheet

1. Product profile

1.1 General description

NPN silicon microwave transistor in a plastic, 4-pin dual-emitter SOT343F package offering an innovative Ku-band DRO solution.

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

- DROs with good output power and low phase noise at very low current consumption: 5 dBm and −55 dBc/Hz/1 kHz at 12 mA
- Low-noise, high gain for low cost LNA solutions
- 40 GHz f_T silicon technology

1.3 Applications

- Ku-band DROs in Ku-band LNBs
- C-band, low current LNAs

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			-	15	40	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90$ °C	[1]	-	-	200	mW
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 3.5 V; T_j = 25 °C		90	135	200	
C_{CBS}	collector-base capacitance	V_{CB} = 2 V; f = 1 MHz		-	138	-	fF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 3.5 V; f = 2 GHz; T_{amb} = 25 °C		-	20	-	GHz
$IP3_{o(max)}$	maximum output third-order intercept point	I_C = 15 mA; V_{CE} = 3.5 V; f = 10 GHz; T_{amb} = 25 °C; $Z_S = Z_L$ = 50 Ω;		-	24	-	dBm
$G_{p(max)}$	maximum power gain	I_C = 15 mA; V_{CE} = 3.5 V; f = 10.0 GHz; T_{amb} = 25 °C	[2]	-	10.5	-	dB
NF	noise figure	I_C = 15 mA; V_{CE} = 3.5 V; f = 10.0 GHz; $\Gamma_S = \Gamma_{opt}$; T_{amb} = 25 °C		-	1.7	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	I_C = 15 mA; V_{CE} = 3.5 V; $Z_S = Z_L$ = 50 Ω; f = 10 GHz; T_{amb} = 25 °C		-	12	-	dBm

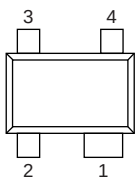
[1] T_{sp} is the temperature at the solder point of the emitter lead.

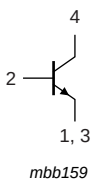
[2] $G_{p(max)}$ is the maximum power gain, if K > 1. If K < 1 then $G_{p(max)}$ = MSG.

2. Pinning information

Table 2. Discrete pinning

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





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3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BFU668F	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

4. Marking

Table 4. Marking

Type number	Marking	Description
BFU668F	ZA*	* = 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			-	40	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90$ °C	[1]	-	200	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

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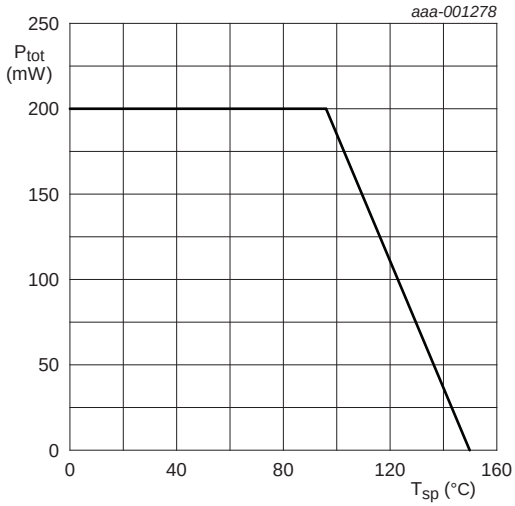

Fig 1. Power derating curve

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7. Characteristics

Table 7. Characteristics

T_j = 25 °C unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 μA; I_E = 0 mA	16	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0 mA	5.5	-	-	V
I_C	collector current		-	15	40	mA
I_{CBO}	collector-base cut-off current	I_E = 0 mA; V_{CB} = 8 V	-	-	100	nA
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 3.5 V	90	135	200	
C_{CES}	collector-emitter capacitance	V_{CB} = 2 V; f = 1 MHz	-	297	-	fF
C_{EBS}	emitter-base capacitance	V_{EB} = 0.5 V; f = 1 MHz	-	664	-	fF
C_{CBS}	collector-base capacitance	V_{CB} = 2 V; f = 1 MHz	-	138	-	fF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 3.5 V; f = 2 GHz; T_{amb} = 25 °C	-	20	-	GHz
$G_{p(max)}$	maximum power gain	I_C = 15 mA; V_{CE} = 3.5 V; T_{amb} = 25 °C [1]				
		f = 5.8 GHz	-	14.5	-	dB
		f = 10.0 GHz	-	10.5	-	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 15 mA; V_{CE} = 3.5 V; T_{amb} = 25 °C				
		f = 5.8 GHz	-	9.5	-	dB
		f = 10.0 GHz	-	5.0	-	dB
NF	noise figure	I_C = 15 mA; V_{CE} = 3.5 V; $\Gamma_S = \Gamma_{opt}$; T_{amb} = 25 °C				
		f = 5.8 GHz	-	1.3	-	dB
		f = 10.0 GHz	-	1.7	-	dB
G_{ass}	associated gain	I_C = 15 mA; V_{CE} = 3.5 V; $\Gamma_S = \Gamma_{opt}$; T_{amb} = 25 °C				
		f = 5.8 GHz	-	13	-	dB
		f = 10.0 GHz	-	9.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	I_C = 15 mA; V_{CE} = 3.5 V; $Z_S = Z_L$ = 50 Ω; T_{amb} = 25 °C				
		f = 5.8 GHz	-	13	-	dBm
		f = 10.0 GHz	-	12	-	dBm
$IP3_{o(max)}$	maximum output third-order intercept point	I_C = 15 mA; V_{CE} = 3.5 V; $Z_S = Z_L$ = 50 Ω; T_{amb} = 25 °C				
		f = 5.8 GHz	-	24	-	dBm
		f = 10.0 GHz	-	24	-	dBm

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

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8. Application information

8.1 BFU668F Ku-band Dielectric Resonator Oscillator (DRO)

Figure 2 shows a typical DRO circuit using BFU668F as active device. The schematic highlights the bias elements. Evaluation tests, done by replacing the existing transistor with BFU668F, on three different DRO LNBs / configurations, have proven:

- BFU668F achieves similar Phase Noise and RF power as the replaced transistor
- BFU668F achieves same RF performances at approximately half of the bias current

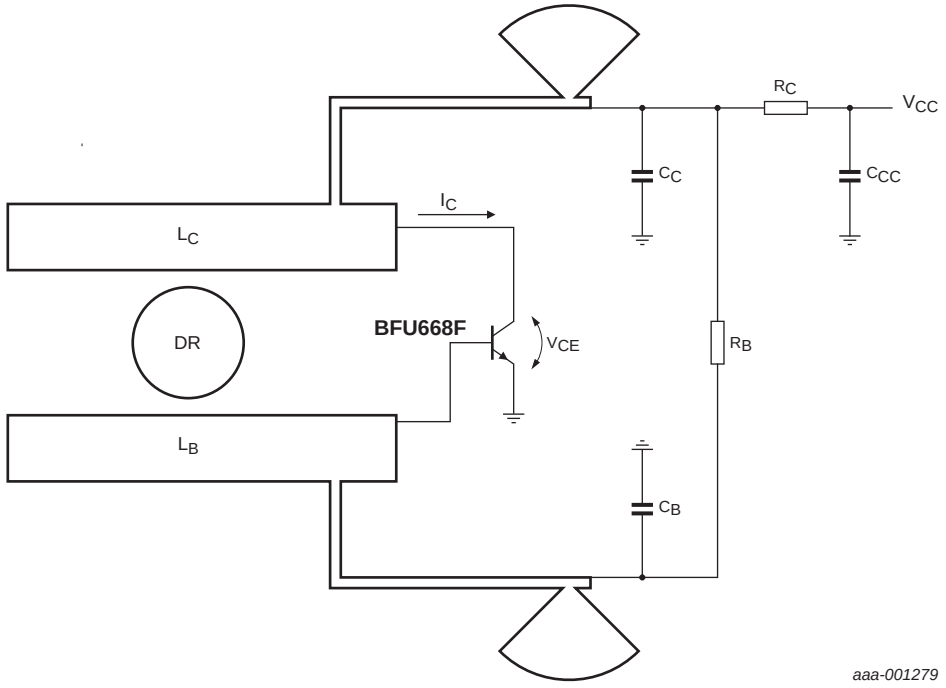

Fig 2. Generic schematic / bias

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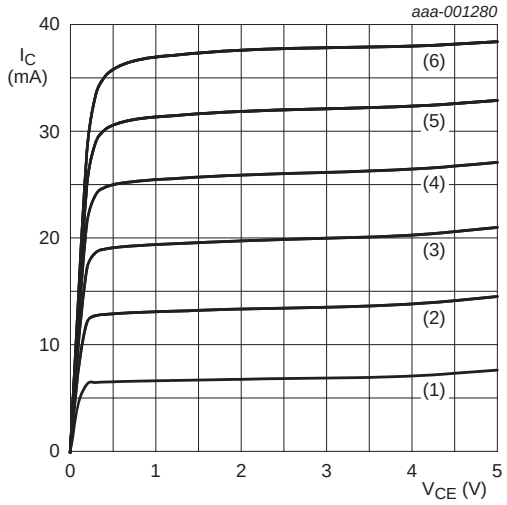
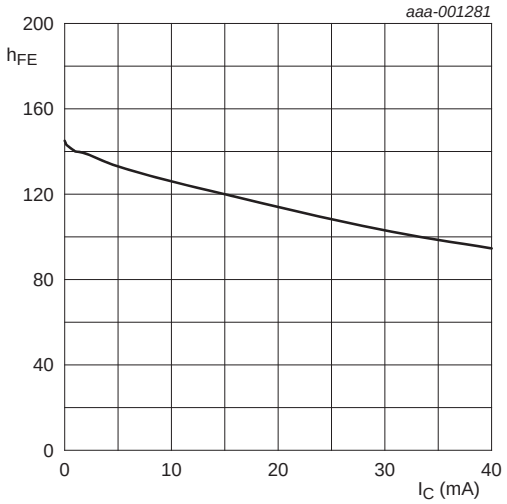
8.2 Graphs



T_{amb} = 25 °C.

(1) I_B = 50 μA
(2) I_B = 100 μA
(3) I_B = 150 μA
(4) I_B = 200 μA
(5) I_B = 250 μA
(6) I_B = 300 μA

Fig 3. Collector current as a function of collector-emitter voltage; typical values



V_{CE} = 2 V; T_{amb} = 25 °C.

Fig 4. DC current gain as a function of collector current; typical values

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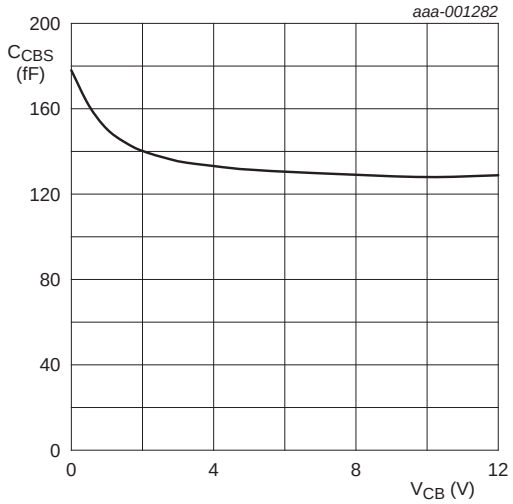
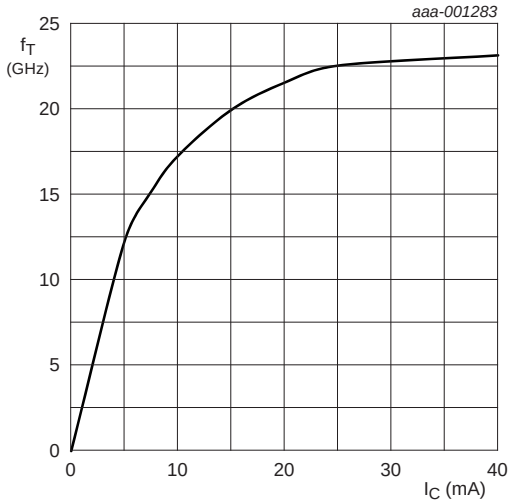


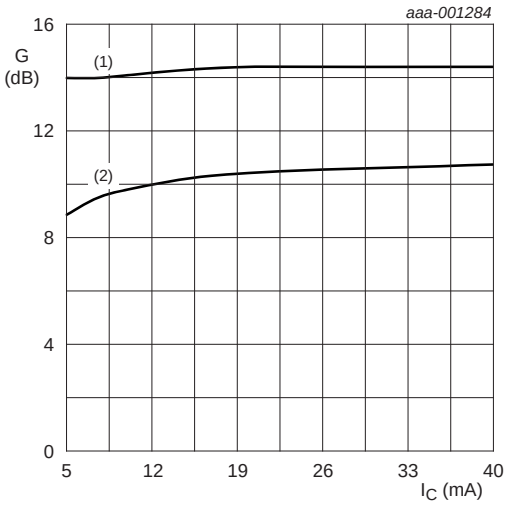
f = 1 MHz, T_{amb} = 25 °C.

Fig 5. Collector-base capacitance as a function of collector-base voltage; typical values



V_{CE} = 3.5 V; f = 2 GHz; T_{amb} = 25 °C.

Fig 6. Transition frequency as a function of collector current; typical values



V_{CE} = 3.5 V; T_{amb} = 25 °C.

(1) f = 5.8 GHz

(2) f = 10.0 GHz

Fig 7. Gain as a function of collector current; typical value

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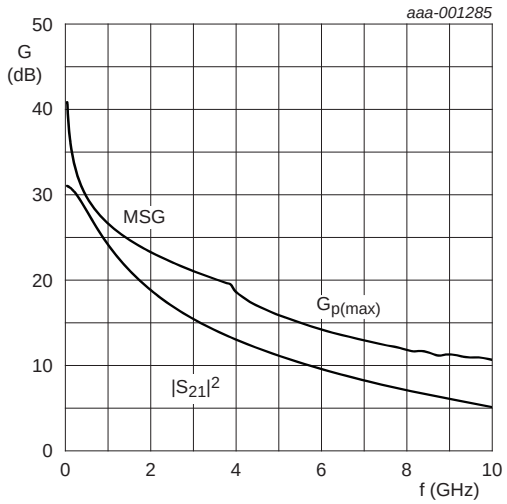
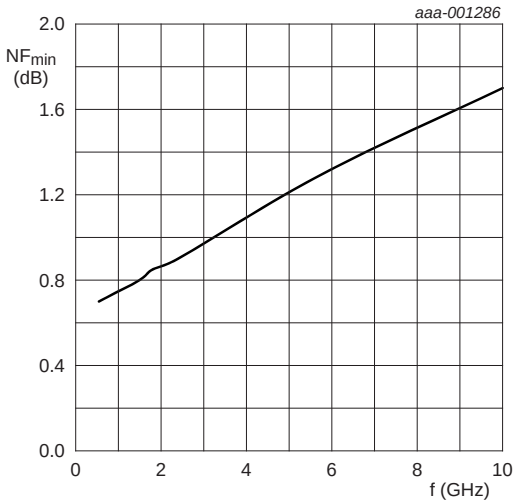


V_{CE} = 3.5 V; I_C = 15 mA; T_{amb} = 25 °C.

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



V_{CE} = 3.5 V; I_C = 15 mA; T_{amb} = 25 °C.

Fig 9. Minimum noise figure as a function of frequency; typical values

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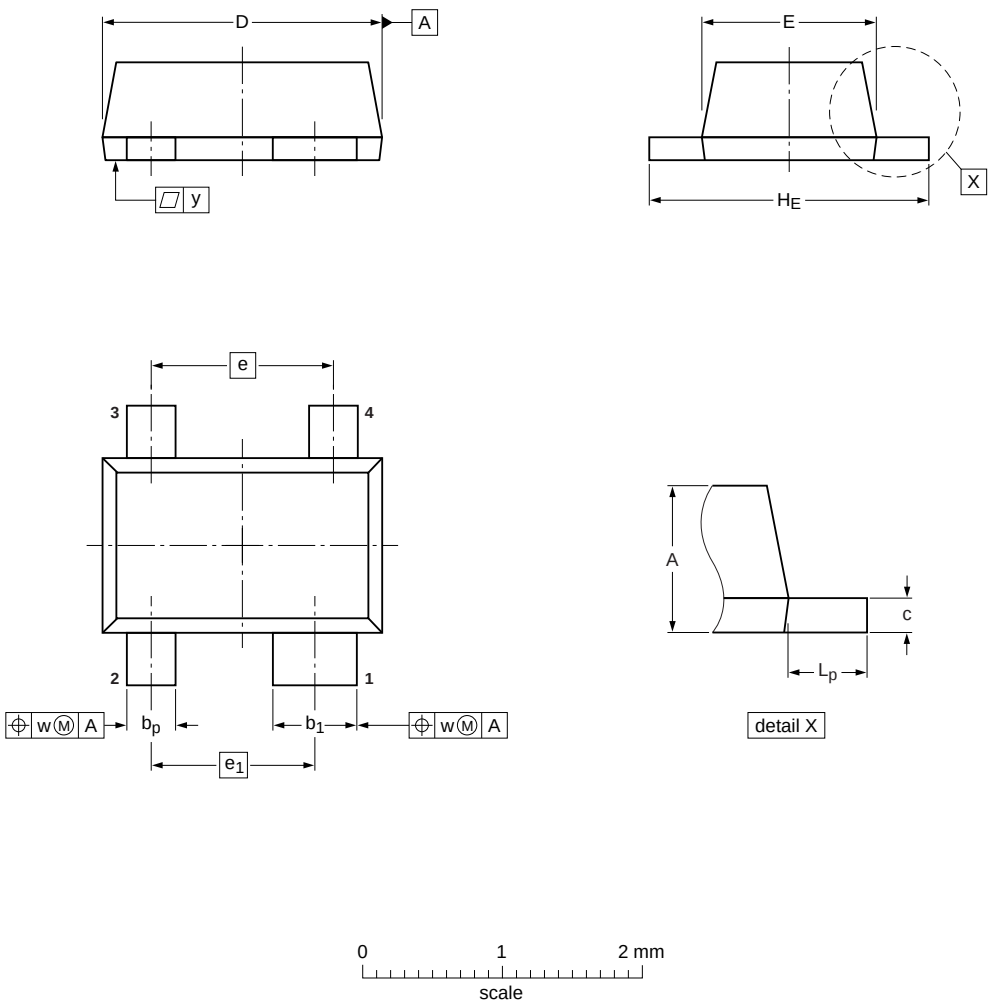
9. Package outline

Plastic surface-mounted flat pack package; reverse pinning; 4 leads **SOT343F**



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 10. Package outline SOT343F

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10. Abbreviations

Table 8. Abbreviations

Acronym	Description
DC	Direct Current
DRO	Dielectric Resonator Oscillator
Ku	Kurtz under
LNA	Low Noise Amplifier
LNB	Low Noise Block
NPN	Negative-Positive-Negative
RF	Radio Frequency

11. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU668F v.3	20120124	Product data sheet	-	BFU668F v.2
Modifications:	• Table 1 on page 2: maximum value for h_{FE} has been changed. • Table 7 on page 5: maximum value for h_{FE} has been changed.			
BFU668F v.2	20120120	Product data sheet	-	BFU668F v.1
BFU668F v.1	20111108	Product data sheet	-	-

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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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