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

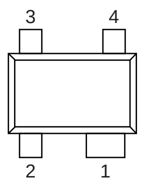
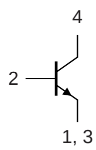
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter		-	-	16	V
V_{CEO}	collector-emitter voltage	open base		-	-	5.5	V
V_{EBO}	emitter-base voltage	open collector		-	-	2.5	V
I_C	collector current			-	15	40	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90$ °C	[1]	-	-	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; $Z_S = Z_L = 50\ \Omega$;		-	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; $Z_S = Z_L = 50\ \Omega$; 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		 mbb159
2	base		
3	emitter		
4	collector		

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

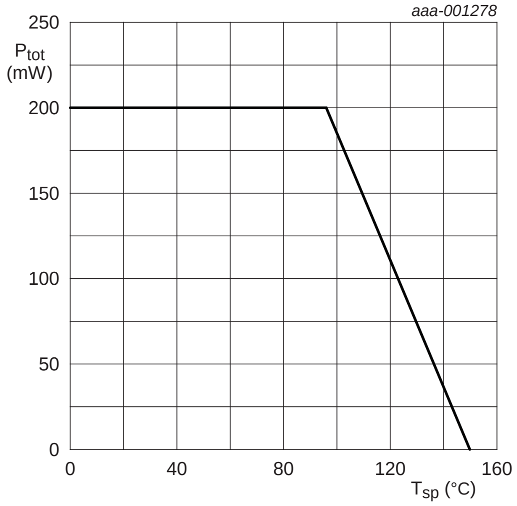


Fig 1. Power derating curve

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.

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

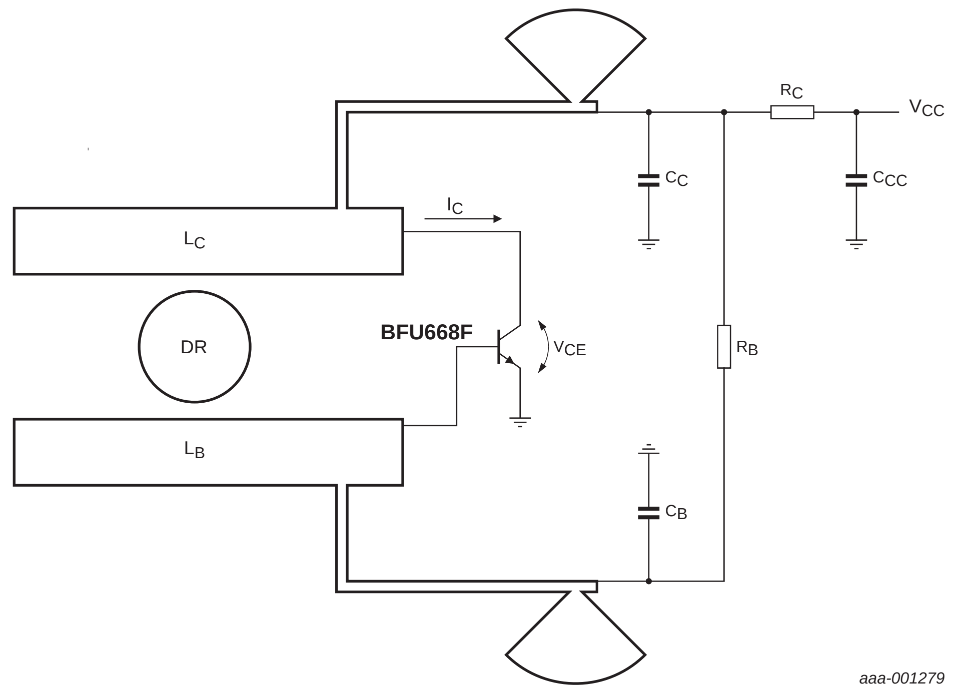
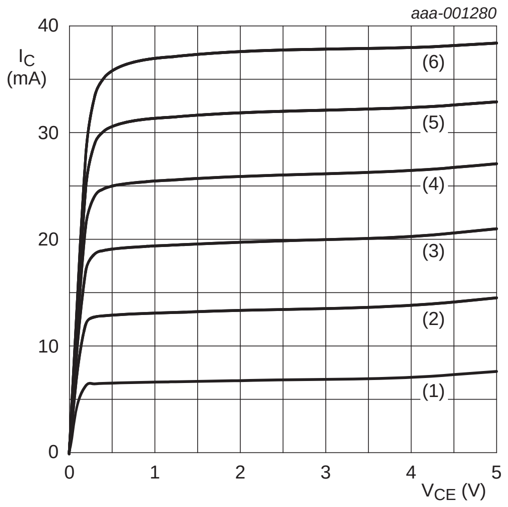


Fig 2. Generic schematic / bias

8.2 Graphs



T_{amb} = 25 °C.

(1) I_B = 50 μA

(2) I_B = 100 μA

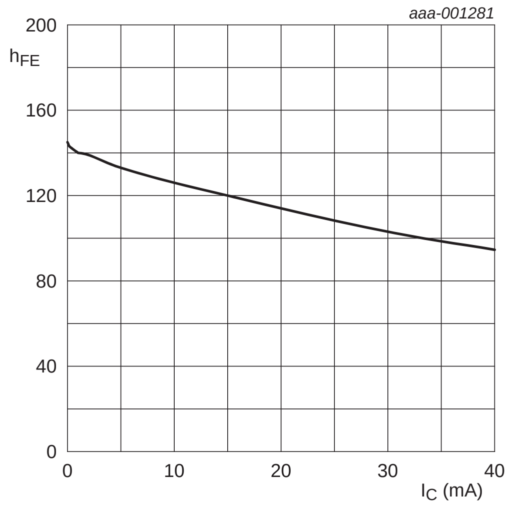
(3) I_B = 150 μA

(4) I_B = 200 μA

(5) I_B = 250 μA

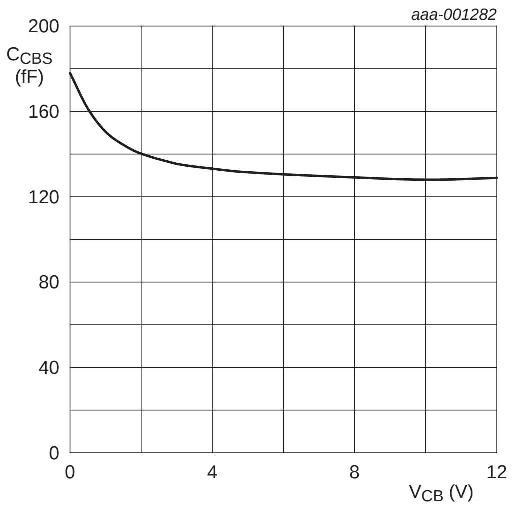
(6) I_B = 300 μA

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



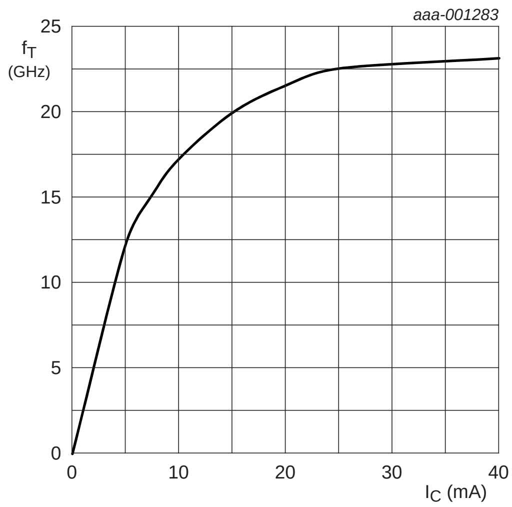
V_{CE} = 2 V; T_{amb} = 25 °C.

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



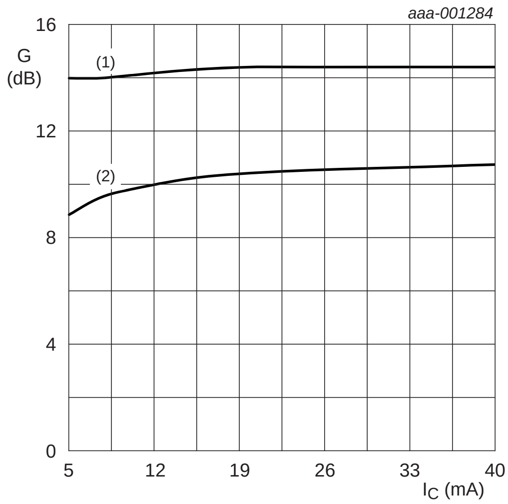
f = 1 MHz, T_{amb} = 25 °C.

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

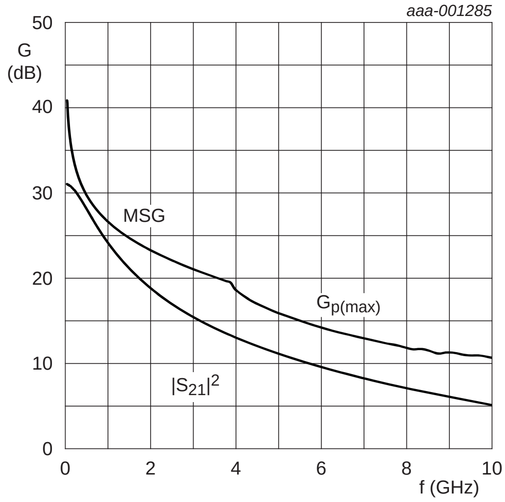


V_{CE} = 3.5 V; T_{amb} = 25 °C.

(1) f = 5.8 GHz

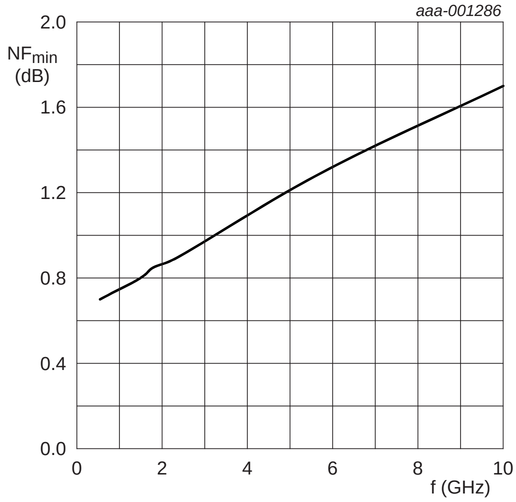
(2) f = 10.0 GHz

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



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

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

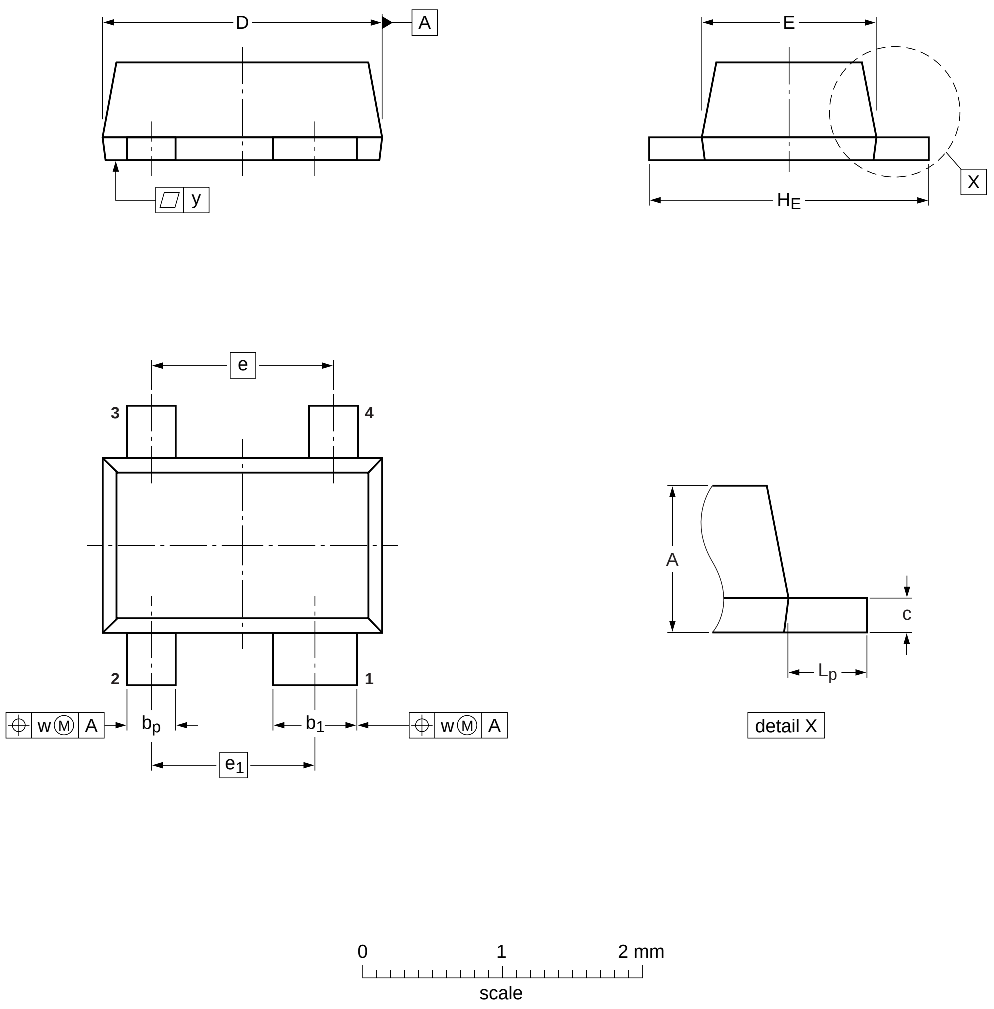


V_{CE} = 3.5 V; I_C = 15 mA; T_{amb} = 25 °C.

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

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

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	-	-

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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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14. Contents

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