

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

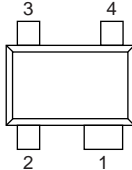
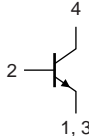
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	-	16	V
V_{CEO}	collector-emitter voltage	open base	-	-	5.5	V
V_{EBO}	emitter-base voltage	open collector	-	-	2.5	V
I_C	collector current		-	15	40	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90\text{ }^\circ\text{C}$	[1]	-	200	mW
h_{FE}	DC current gain	$I_C = 10\text{ mA}; V_{CE} = 3.5\text{ V}; T_j = 25\text{ }^\circ\text{C}$	90	135	200	
C_{CBS}	collector-base capacitance	$V_{CB} = 2\text{ V}; f = 1\text{ MHz}$	-	138	-	fF
f_T	transition frequency	$I_C = 15\text{ mA}; V_{CE} = 3.5\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	20	-	GHz
$IP3_{o(max)}$	maximum output third-order intercept point	$I_C = 15\text{ mA}; V_{CE} = 3.5\text{ V}; f = 10\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}; Z_S = Z_L = 50\text{ }\Omega;$	-	24	-	dBm
$G_{p(max)}$	maximum power gain	$I_C = 15\text{ mA}; V_{CE} = 3.5\text{ V}; f = 10.0\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	[2]	-	10.5	dB
NF	noise figure	$I_C = 15\text{ mA}; V_{CE} = 3.5\text{ V}; f = 10.0\text{ GHz}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ }^\circ\text{C}$	-	1.7	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 15\text{ mA}; V_{CE} = 3.5\text{ V}; Z_S = Z_L = 50\text{ }\Omega; f = 10\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	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 $G_{p(max)} = \text{MSG}$.

2. Pinning information

Table 2. Discrete pinning

Pin	Description	Simplified outline	Graphic symbol
1	emitter		 <p style="text-align: center;"><i>mbb159</i></p>
2	base		
3	emitter		
4	collector		

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
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	$T_{sp} \leq 90\text{ °C}$	[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

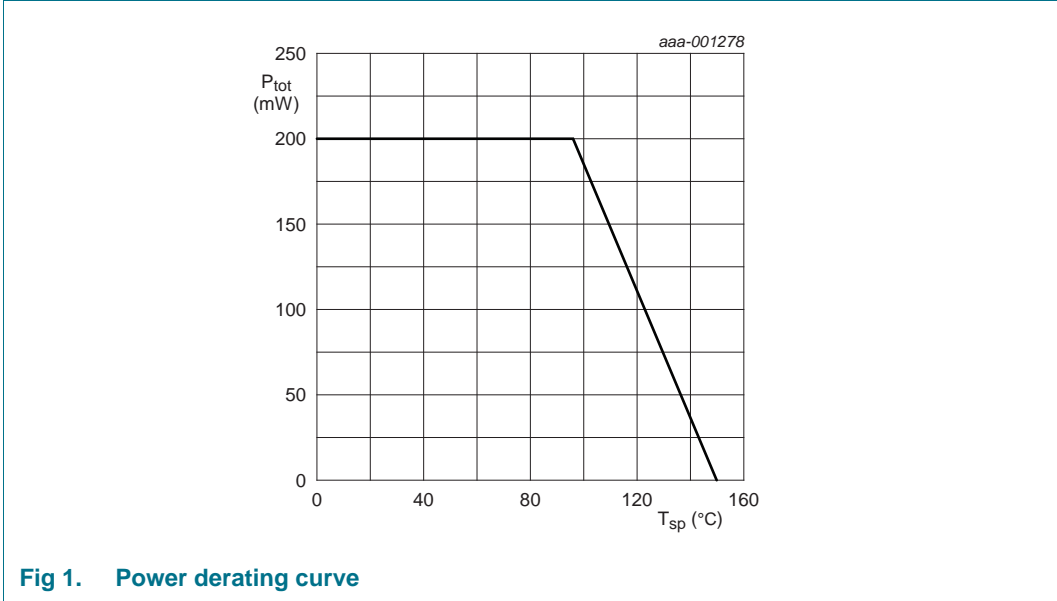


Fig 1. Power derating curve

7. Characteristics

Table 7. Characteristics
 $T_j = 25\text{ °C}$ 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		-	15	40	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	$I_C = 10\ \text{mA}; V_{CE} = 3.5\ \text{V}$	90	135	200	
C_{CES}	collector-emitter capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	297	-	fF
C_{EBS}	emitter-base capacitance	$V_{EB} = 0.5\ \text{V}; f = 1\ \text{MHz}$	-	664	-	fF
C_{CBS}	collector-base capacitance	$V_{CB} = 2\ \text{V}; f = 1\ \text{MHz}$	-	138	-	fF
f_T	transition frequency	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; f = 2\ \text{GHz}; T_{amb} = 25\text{ °C}$	-	20	-	GHz
$G_{p(max)}$	maximum power gain	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; T_{amb} = 25\text{ °C}$ [1]				
		$f = 5.8\ \text{GHz}$	-	14.5	-	dB
		$f = 10.0\ \text{GHz}$	-	10.5	-	dB
$ S_{21} ^2$	insertion power gain	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; T_{amb} = 25\text{ °C}$				
		$f = 5.8\ \text{GHz}$	-	9.5	-	dB
		$f = 10.0\ \text{GHz}$	-	5.0	-	dB
NF	noise figure	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 5.8\ \text{GHz}$	-	1.3	-	dB
		$f = 10.0\ \text{GHz}$	-	1.7	-	dB
G_{ass}	associated gain	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$				
		$f = 5.8\ \text{GHz}$	-	13	-	dB
		$f = 10.0\ \text{GHz}$	-	9.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; Z_S = Z_L = 50\ \Omega; T_{amb} = 25\text{ °C}$				
		$f = 5.8\ \text{GHz}$	-	13	-	dBm
		$f = 10.0\ \text{GHz}$	-	12	-	dBm
$IP3_{o(max)}$	maximum output third-order intercept point	$I_C = 15\ \text{mA}; V_{CE} = 3.5\ \text{V}; Z_S = Z_L = 50\ \Omega; T_{amb} = 25\text{ °C}$				
		$f = 5.8\ \text{GHz}$	-	24	-	dBm
		$f = 10.0\ \text{GHz}$	-	24	-	dBm

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

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

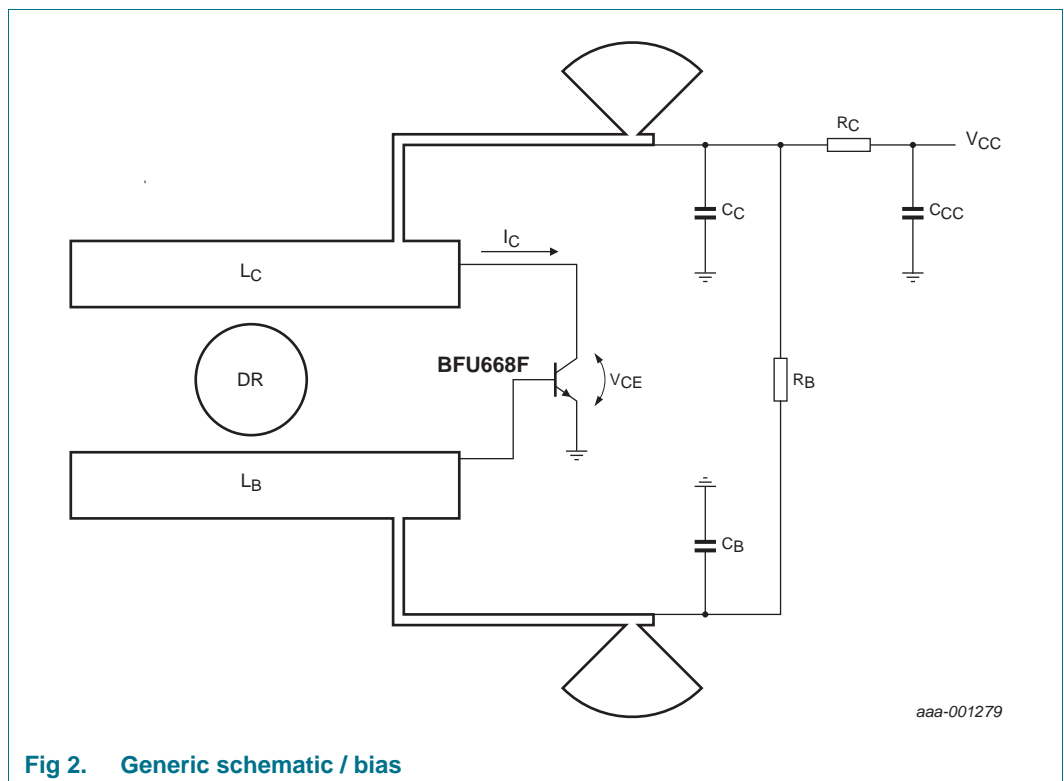
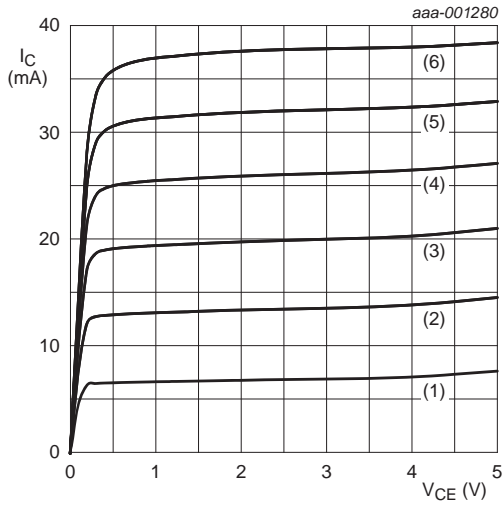


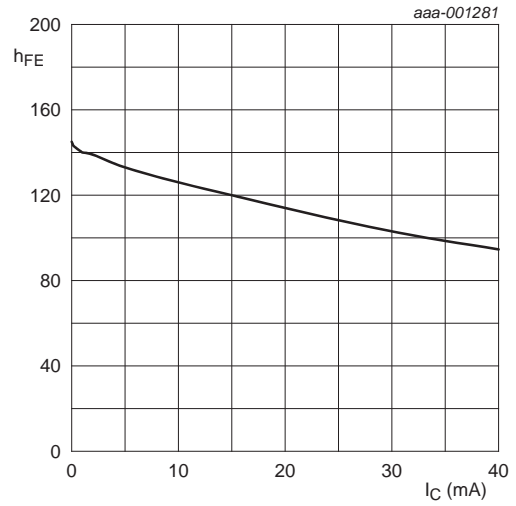
Fig 2. Generic schematic / bias

8.2 Graphs



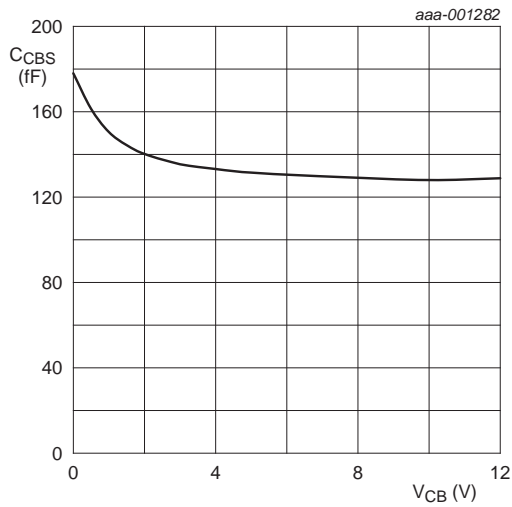
- $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (1) $I_B = 50\text{ }\mu\text{A}$
 - (2) $I_B = 100\text{ }\mu\text{A}$
 - (3) $I_B = 150\text{ }\mu\text{A}$
 - (4) $I_B = 200\text{ }\mu\text{A}$
 - (5) $I_B = 250\text{ }\mu\text{A}$
 - (6) $I_B = 300\text{ }\mu\text{A}$

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



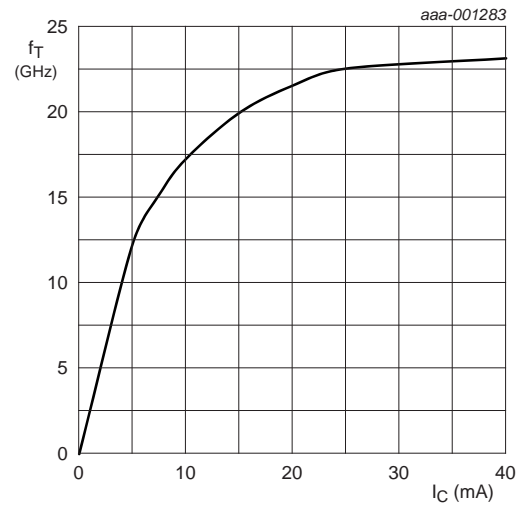
$V_{CE} = 2\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$

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



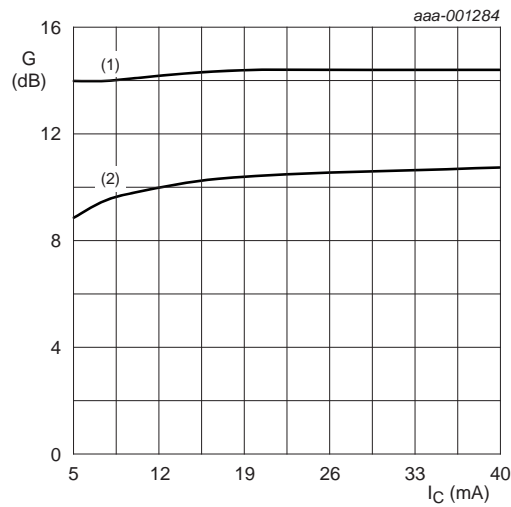
$f = 1 \text{ MHz}$, $T_{amb} = 25 \text{ }^\circ\text{C}$.

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



$V_{CE} = 3.5 \text{ V}$; $f = 2 \text{ GHz}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

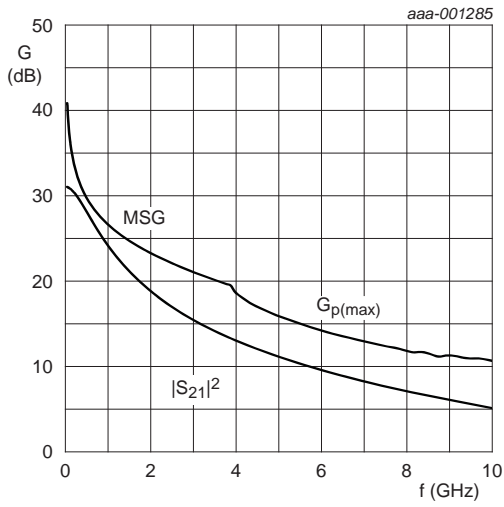
Fig 6. Transition frequency as a function of collector current; typical values



$V_{CE} = 3.5 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

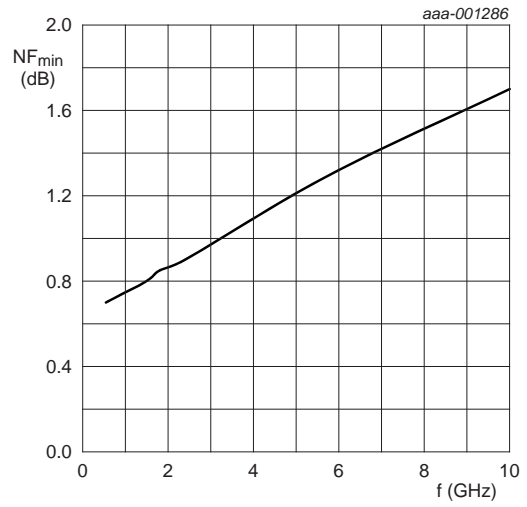
- (1) $f = 5.8 \text{ GHz}$
- (2) $f = 10.0 \text{ GHz}$

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



$V_{CE} = 3.5 \text{ V}$; $I_C = 15 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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



$V_{CE} = 3.5 \text{ V}$; $I_C = 15 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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

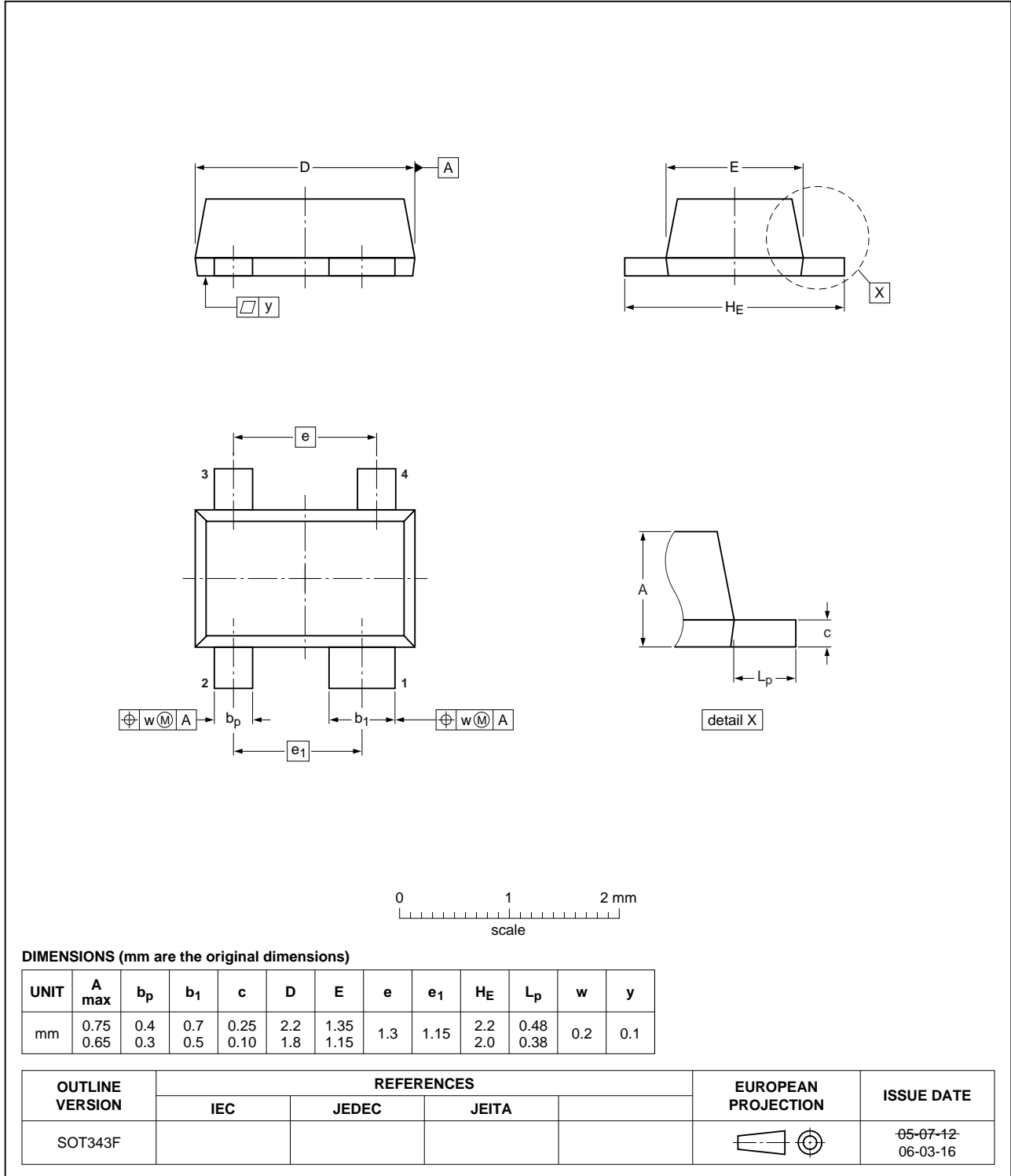


Fig 10. Package outline SOT343F

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:				
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.
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