BGU8007

SiGe:C Low Noise Amplifier MMIC for GPS, GLONASS, Galileo and Compass

Rev. 2 — 30 March 2012

Product data sheet

1. Product profile

1.1 General description

The BGU8007 is a Low Noise Amplifier (LNA) for GNSS receiver applications in a plastic leadless 6-pin, extremely small SOT886 package. The BGU8007 requires only one external matching inductor and one external decoupling capacitor.

The BGU8007 adapts itself to the changing environment resulting from co-habitation of different radio systems in modern cellular handsets. It has been designed for low power consumption and optimal performance when jamming signals from co-existing cellular transmitters are present. At low jamming power levels it delivers 19 dB gain at a noise figure of 0.75 dB. During high jamming power levels, resulting for example from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

1.2 Features and benefits

- Covers full GNSS L1 band, from 1559 MHz to 1610 MHz
- Noise figure (NF) = 0.75 dB
- Excellent low NF < 1 dB in the presence of strong jamming signals
- Gain 19 dB
- High input 1 dB compression point P_{i(1dB)} of -11 dBm
- High out of band IP3_i of 4 dBm
- Supply voltage 1.5 V to 2.5 V
- Power-down mode current consumption < 1 μA</p>
- Optimized performance at low supply current of 4.6 mA
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor and one supply decoupling capacitor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Small 6-pin leadless package 1 mm × 1.45 mm × 0.5 mm
- 110 GHz transit frequency SiGe:C technology



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1.3 Applications

 LNA for GPS, GLONASS, Galileo and Compass (BeiDou) in smart phones, feature phones, tablet PCs, Personal Navigation Devices, Digital Still Cameras, Digital Video Cameras, RF Front End modules, complete GPS chipset modules and theft protection (laptop, ATM)

1.4 Quick reference data

Table 1. Quick reference data

f = 1559 MHz to 1610 MHz; V_{CC} = 1.8 V; P_i < -40 dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 5.6 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		1.5	-	2.5	V
I _{CC}	supply current	$V_{\text{ENABLE}} \ge 0.8 \text{ V}$					
		$P_i < -40 \text{ dBm}$		3.3	4.6	5.9	mA
		$P_i = -20 \text{ dBm}$		8.4	11.9	14.7	mΑ
Gp	power gain	$P_i < -40$ dBm, no jammer		17.0	19.0	20.5	dB
		$P_i = -20 \text{ dBm}$, no jammer		18.5	20.5	21.5	dB
NF	noise figure	$P_i < -40$ dBm, no jammer	[1]	-	0.75	1.1	dB
		$P_i < -40$ dBm, no jammer	[2]	-	0.80	1.2	dB
		$P_i = -20$ dBm, no jammer	[2]	-	1.0	1.4	dB
P _{i(1dB)}	input power at 1 dB	f = 1559 MHz to 1610 MHz					
	gain compression	V _{CC} = 1.5 V		-15	-12	-	dBm
		$V_{CC} = 1.8 \text{ V}$		-14	-11	-	dBm
		$V_{CC} = 2.2 \text{ V}$		-13	-10	-	dBm
IP3 _i	input third-order intercept point	f = 1.575 GHz					
		V _{CC} = 1.5 V	[3]	1	4	-	dBm
		V _{CC} = 1.8 V	[3]	1	4	-	dBm
		V _{CC} = 2.2 V	[3]	2	5	-	dBm

^[1] PCB losses are subtracted.

2. Pinning information

Table 2. Pinning

	3		
Pin	Description	Simplified outline	Graphic symbol
1	GND		
2	GND	6 5 4	4 5
3	RF_IN		3—6
4	V_{CC}		
5	ENABLE		2 1 sym129
6	RF_OUT	1 2 3 Transparent top view	<i>-</i>

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^[2] Including PCB losses.

^[3] $f_1 = 1713 \text{ MHz}$; $f_2 = 1851 \text{ MHz}$; $P_1 = P_2 = -30 \text{ dBm}$.

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3. Ordering information

Table 3. Ordering information

Type number	number Package				
	Name	Description	Version		
BGU8007	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 \times 1.45 \times 0.5 mm	SOT886		

4. Marking

Table 4. Marking codes

Type number	Marking code
BGU8007	UZ

5. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage	RF input AC coupled	-0.5	+4.0	V
V_{ENABLE}	voltage on pin ENABLE	$V_{ENABLE} < V_{CC} + 0.6$	<u>[2]</u> -0.5	+4.0	V
V_{RF_IN}	voltage on pin RF_IN	DC; $V_{RF_{IN}} < V_{CC} + 0.6$	[2][3] -0.5	+4.0	V
V_{RF_OUT}	voltage on pin RF_OUT	DC; $V_{RF_OUT} < V_{CC} + 0.6$	[2][3] -0.5	+4.0	V
Pi	input power		-	0	dBm
P _{tot}	total power dissipation	T _{sp} ≤ 130 °C	<u>[1]</u>	55	mW
T _{stg}	storage temperature		-65	+150	°C
Tj	junction temperature		-	150	°C
V _{ESD}	electrostatic discharge voltage	Human Body Model (HBM); According JEDEC standard 22-A114E	-	2	kV
		Charged Device Model (CDM); According JEDEC standard 22-C101B	-	1	kV

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

6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Тур	Unit
R _{th(j-sp)}	thermal resistance from junction to solder point		225	K/W

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^[2] Warning: due to internal ESD diode proctection, the applied DC voltage should not exceed V_{CC} + 0.6 and shall not exceed 5.0 V in order to avoid excess current.

^[3] The RF input and RF output are AC coupled through internal DC blocking capacitors.

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7. Characteristics

Table 7. Characteristics

f = 1559 MHz to 1610 MHz; V_{CC} = 1.8 V; V_{ENABLE} >= 0.8 V; P_i < -40 dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 5.6 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		1.5	-	2.5	V
I _{CC}	supply current	V _{ENABLE} ≥ 0.8 V					
		P _i < -40 dBm		3.3	4.6	5.9	mΑ
		$P_i = -20 \text{ dBm}$		8.4	11.9	14.7	mΑ
		$V_{\text{ENABLE}} \leq 0.3 \text{ V}$		-	-	1	μΑ
T _{amb}	ambient temperature			-40	+25	+85	°C
Gp	power gain	T _{amb} = 25 °C					
		$P_i < -40$ dBm, no jammer		17.0	19.0	20.5	dB
		$P_i = -20 \text{ dBm}$, no jammer		18.5	20.5	21.5	dB
		$P_{jam} = -20 \text{ dBm}$; $f_{jam} = 850 \text{ MHz}$		18.5	20.5	21.5	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 1850 \text{ MHz}$		18.5	20.5	21.5	dB
		$-40 ^{\circ}\text{C} \le T_{amb} \le +85 ^{\circ}\text{C}$					
		$P_i < -40$ dBm, no jammer		16	-	21	dB
		P _i = −20 dBm, no jammer		17	-	22	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 850 \text{ MHz}$		17	-	22	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 1850 \text{ MHz}$		17	-	22	dB
RL_in	input return loss	$P_i < -40 \text{ dBm}$		4	5.5	-	dB
		$P_i = -20 \text{ dBm}$		6	9	-	dB
RL_{out}	output return loss	$P_i < -40 \text{ dBm}$		15	26	-	dB
		$P_i = -20 \text{ dBm}$		15	27	-	dB
ISL	isolation			22	24	-	dB
NF	noise figure	$T_{amb} = 25 ^{\circ}C$					
		$P_i < -40$ dBm, no jammer	[1]	-	0.75	1.1	dB
		P _i < −40 dBm, no jammer	[2]	-	0.80	1.2	dB
		$P_i = -20 \text{ dBm}$, no jammer	[2]	-	1.0	1.4	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 850 \text{ MHz}$	[2]	-	8.0	1.2	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 1850 \text{ MHz}$	[2]	-	1.1	1.5	dB
		$-40 ^{\circ}\text{C} \le T_{amb} \le +85 ^{\circ}\text{C}$					
		P _i < −40 dBm, no jammer	[2]	-	-	1.5	dB
		P _i = −20 dBm, no jammer	[2]	-	-	1.7	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 850 \text{ MHz}$	[2]	-	-	1.5	dB
		$P_{jam} = -20 \text{ dBm}; f_{jam} = 1850 \text{ MHz}$	[2]	-	-	1.8	dB

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Table 7. Characteristics ... continued

f = 1559 MHz to 1610 MHz; $V_{CC} = 1.8$ V; $V_{ENABLE} >= 0.8$ V; $P_i < -40$ dBm; $T_{amb} = 25$ °C; input matched to 50 Ω using a 5.6 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
P _{i(1dB)}	input power at 1 dB gain compression	f = 1559 MHz to 1610 MHz					
		V _{CC} = 1.5 V		-15	-12	-	dBm
		V _{CC} = 1.8 V		-14	-11	-	dBm
		$V_{CC} = 2.2 \text{ V}$		-13	-10	-	dBm
	f = 806 MHz to 928 MHz						
		V _{CC} = 1.5 V	<u>[3]</u>	-13	-10	-	dBm
		V _{CC} = 1.8 V	<u>[3]</u>	-13	-10	-	dBm
		$V_{CC} = 2.2 \text{ V}$	<u>[3]</u>	-12	-9	-	dBm
		f = 1612 MHz to 1909 MHz					
		V _{CC} = 1.5 V	<u>[3]</u> .	-12	-9	-	dBm
		V _{CC} = 1.8 V	<u>[3]</u>	–11	-8	-	dBm
		$V_{CC} = 2.2 \text{ V}$	<u>[3]</u>	-10	-7	-	dBm
IP3 _i	input third-order intercept point	f = 1.575 GHz					
		V _{CC} = 1.5 V	<u>[4]</u>	1	4	-	dBm
		V _{CC} = 1.8 V	<u>[4]</u>	1	4	-	dBm
		$V_{CC} = 2.2 \text{ V}$	<u>[4]</u>	2	5	-	dBm
t _{on}	turn-on time		<u>[5]</u>	-	-	2	μS
t _{off}	turn-off time		<u>[5]</u> .	-	-	1	μS

^[1] PCB losses are subtracted.

Table 8. ENABLE (pin 5)

 $-40~^{\circ}\text{C} \le T_{amb} \le +85~^{\circ}\text{C}$; 1.5 V \le V_{CC} \le 2.5 V

V _{ENABLE} (V)	State
≤ 0.3	OFF
≥ 0.8	ON

^[2] Including PCB losses.

^[3] Out of band.

^[4] $f_1 = 1713 \text{ MHz}$; $f_2 = 1851 \text{ MHz}$; $P_1 = P_2 = -30 \text{ dBm}$.

^[5] Within 10 % of the final gain.

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8. Application information

8.1 GNSS LNA

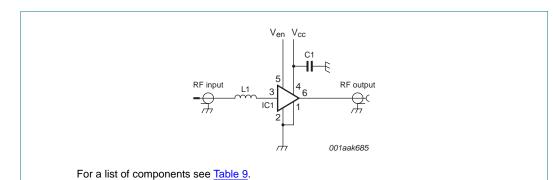
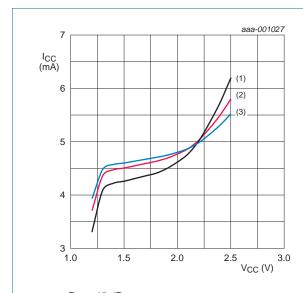


Fig 1. Schematics GNSS LNA evaluation board

Table 9. List of components

For schematics see Figure 1.

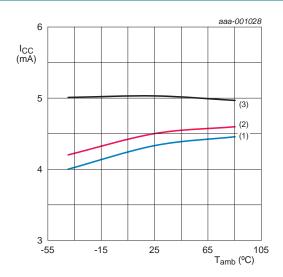
Component	Description	Value	Supplier	Remarks
C1	decoupling capacitor	1 nF	various	
IC1	BGU8007	-	NXP	
L1	high quality matching inductor	5.6 nH	Murata LQW15A	





- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 2. Supply current as a function of supply voltage; typical values

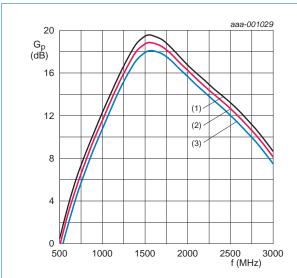


 $P_i = -45 \text{ dBm}.$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

Fig 3. Supply current as a function of ambient temperature; typical values

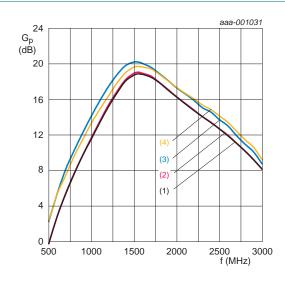
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$$V_{CC} = 1.8 \text{ V}; P_i = -45 \text{ dBm}.$$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

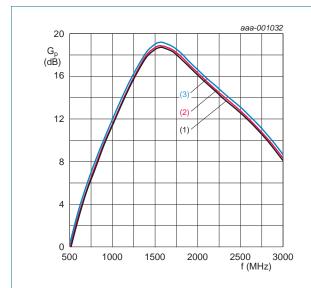
Fig 4. Power gain as a function of frequency; typical values



$$V_{CC} = 1.8 \text{ V}; T_{amb} = 25 ^{\circ}\text{C}.$$

- (1) $P_i = -45 \text{ dBm}$
- (2) $P_i = -30 \text{ dBm}$
- (3) $P_i = -20 \text{ dBm}$
- (4) $P_i = -15 \text{ dBm}$

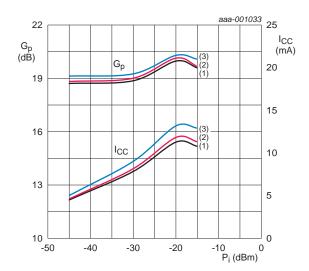
Fig 5. Power gain as a function of frequency; typical values



 $P_i = -45 \text{ dBm}; T_{amb} = 25 \text{ }^{\circ}\text{C}.$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

Fig 6. Power gain as a function of frequency; typical values



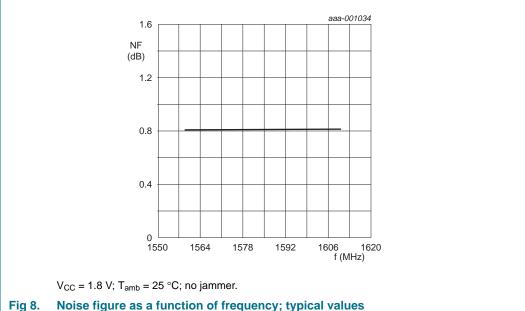
 T_{amb} = 25 °C; f = 1575 MHz.

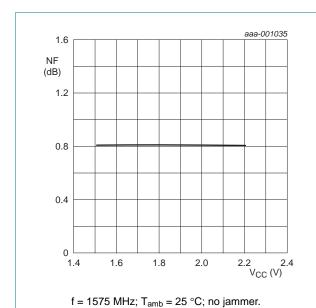
- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

Fig 7. Power gain as a function of input power; typical values

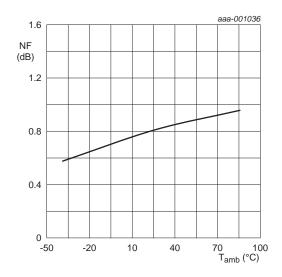
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Noise figure as a function of supply voltage; Fig 9. typical values

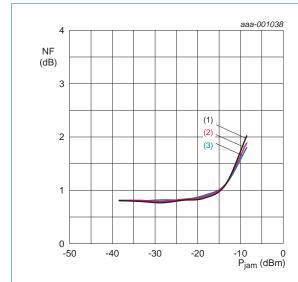


f = 1575 MHz; $V_{CC} = 1.8 \text{ V}$; no jammer.

Fig 10. Noise figure as a function of ambient temperature; typical values

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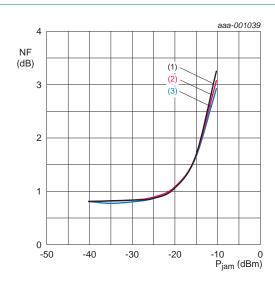
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 f_{jam} = 850 MHz; T_{amb} = 25 °C; f = 1575 MHz.

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2V$

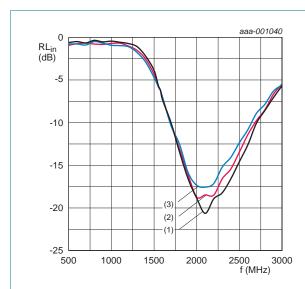
Fig 11. Noise figure as a function of jamming power; typical values



 f_{jam} = 1850 MHz; T_{amb} = 25 °C; f = 1575 MHz.

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

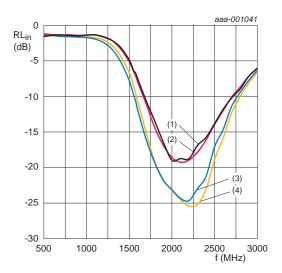
Fig 12. Noise figure as a function of jamming power; typical values



 $V_{CC} = 1.8 \text{ V}; P_i = -45 \text{ dBm}.$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 13. Input return loss as a function of frequency; typical values

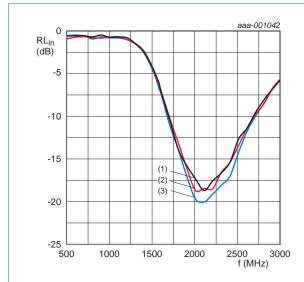


 $V_{CC} = 1.8 \text{ V}; T_{amb} = 25 \,^{\circ}\text{C}.$

- (1) $P_i = -45 \text{ dBm}$
- (2) $P_i = -30 \text{ dBm}$
- (3) $P_i = -20 \text{ dBm}$
- (4) $P_i = -15 \text{ dBm}$

Fig 14. Input return loss as a function of frequency; typical values

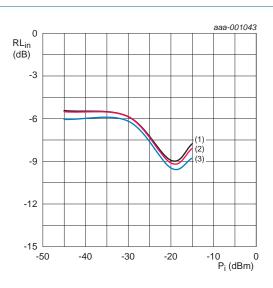
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$$P_i = -45 \text{ dBm}$$
; $T_{amb} = 25 \,^{\circ}\text{C}$.

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

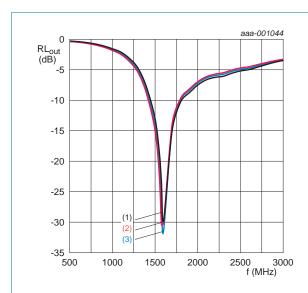
Fig 15. Input return loss as a function of frequency; typical values



$$T_{amb} = 25 \, ^{\circ}C; f = 1575 \, MHz.$$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

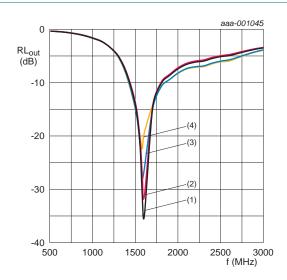
Fig 16. Input return loss as a function of input power; typical values



 $V_{CC} = 1.8 \text{ V}; P_i = -45 \text{ dBm}.$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 17. Output return loss as a function of frequency; typical values

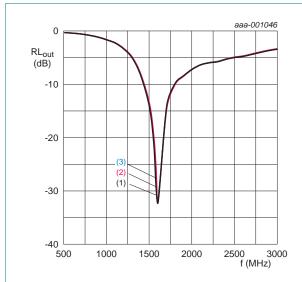


 $V_{CC} = 1.8 \text{ V}; T_{amb} = 25 \,^{\circ}\text{C}.$

- (1) $P_i = -45 \text{ dBm}$
- (2) $P_i = -30 \text{ dBm}$
- (3) $P_i = -20 \text{ dBm}$
- (4) $P_i = -15 \text{ dBm}$

Fig 18. Output return loss as a function of frequency; typical values

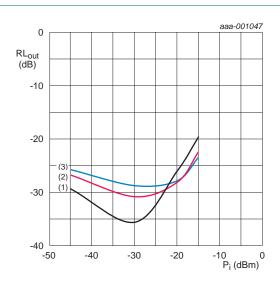
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$$P_i = -45 \text{ dBm}; T_{amb} = 25 \,^{\circ}\text{C}.$$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

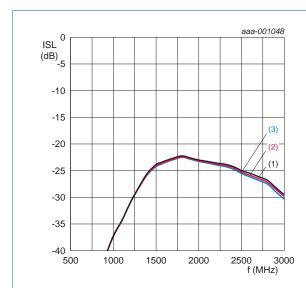
Fig 19. Output return loss as a function of frequency; typical values



$$T_{amb} = 25 \, ^{\circ}\text{C}; f = 1575 \, \text{MHz}.$$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

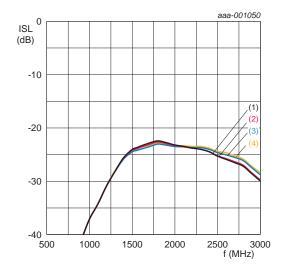
Fig 20. Output return loss as a function of input power; typical values



$$V_{CC} = 1.8 \text{ V}; P_i = -45 \text{ dBm}.$$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 21. Isolation as a function of frequency; typical values

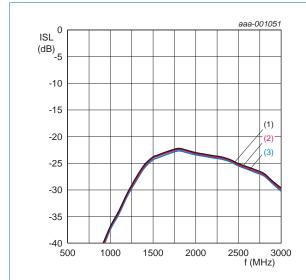


$$V_{CC}$$
 = 1.8 V; T_{amb} = 25 °C.

- (1) $P_i = -45 \text{ dBm}$
- (2) $P_i = -30 \text{ dBm}$
- (3) $P_i = -20 \text{ dBm}$
- (4) $P_i = -15 \text{ dBm}$

Fig 22. Isolation as a function of frequency; typical values

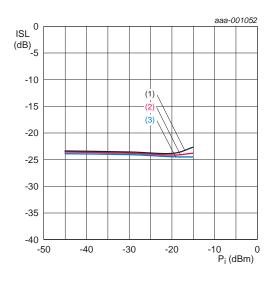
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$$P_i = -45 \text{ dBm}; T_{amb} = 25 \,^{\circ}\text{C}.$$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

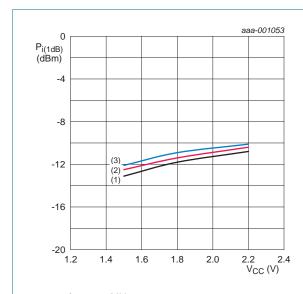
Fig 23. Isolation as a function of frequency; typical values



$$T_{amb} = 25 \, ^{\circ}C; f = 1575 \, MHz.$$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

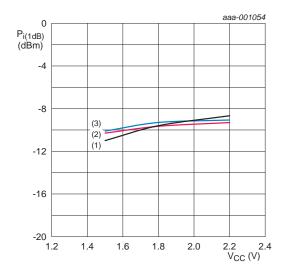
Fig 24. Isolation as a function of input power; typical values



f = 1575 MHz.

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 25. Input power at 1 dB gain compression as a function of supply voltage; typical values

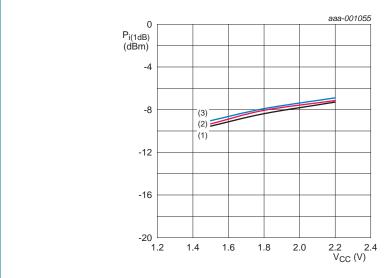


f = 850 MHz.

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 26. Input power at 1 dB gain compression as a function of supply voltage; typical values

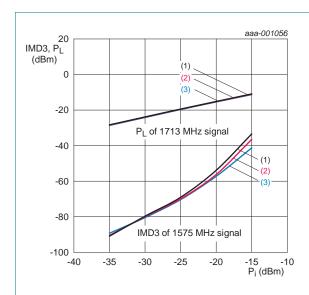
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f = 1850 MHz.

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

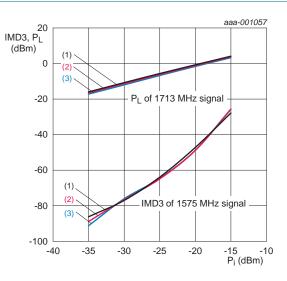
Fig 27. Input power at 1 dB gain compression as a function of supply voltage; typical values



f = 1575 MHz; $f_1 = 1713 \text{ MHz}$; $f_2 = 1851 \text{ MHz}$; $T_{amb} = 25 \,^{\circ}\text{C}$.

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

Fig 28. Third order intermodulation distortion and output power as function of input power; typical values

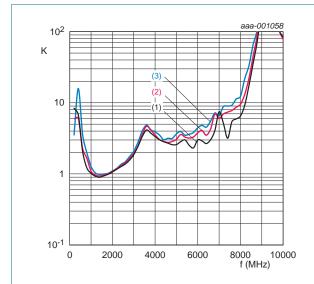


 $f = 1575 \text{ MHz}; f_1 = 1713 \text{ MHz}; f_2 = 1851 \text{ MHz}; V_{CC} = 1.8 \text{ V}.$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 29. Third order intermodulation distortion and output power as function of input power; typical values

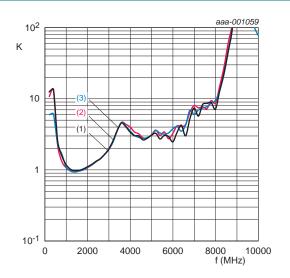
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$$V_{CC} = 1.8 \text{ V}; P_i = -45 \text{ dBm}.$$

- (1) $T_{amb} = -40 \, ^{\circ}C$
- (2) $T_{amb} = +25 \, ^{\circ}C$
- (3) $T_{amb} = +85 \, ^{\circ}C$

Fig 30. Rollett stability factor as a function of frequency; typical values



 $T_{amb} = 25 \, ^{\circ}C; P_i = -45 \, dBm.$

- (1) $V_{CC} = 1.5 \text{ V}$
- (2) $V_{CC} = 1.8 \text{ V}$
- (3) $V_{CC} = 2.2 \text{ V}$

Fig 31. Rollett stability factor as a function of frequency; typical values

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9. Package outline

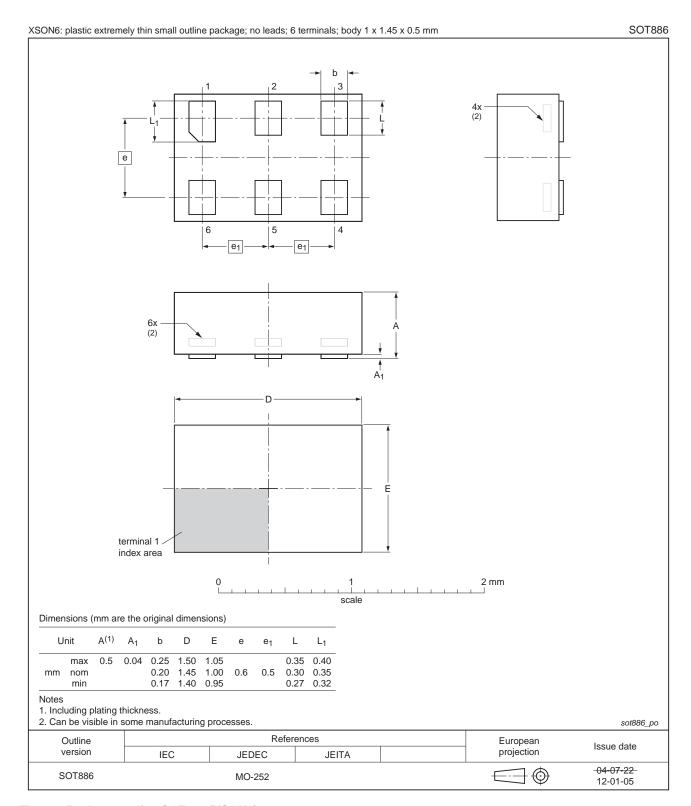


Fig 32. Package outline SOT886 (XSON6)

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10. Abbreviations

Table 10. Abbreviations

Description
Alternating Current
Automated Teller Machine (cash dispenser)
Direct Current
GLObal NAvigation Satellite System
Global Navigation Satellite System
Global Positioning System
Human Body Model
Monolithic Microwave Integrated Circuit
Personal Computer
Printed Circuit Board
Radio Frequency
Silicon Germanium Carbon

11. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
BGU8007 v.2	20120330	Product data sheet	-	BGU8007 v.1	
Modifications:	Section 1.3 on page	to descriptive title ge 2: added 'Compass' to text ge 1: row 7, changed 2.2 V to 2.5	V		
	 <u>Table 1 on page 2</u>: changed max. value V_{CC} from 2.2 V to 2.5 V <u>Table 7 on page 4</u>: changed max. value V_{CC} from 2.2 V to 2.5 V <u>Table 8 on page 5</u>: changed max. value V_{CC} from 2.2 V to 2.5 V <u>Table 5 on page 3</u>: Several additions and changes 				
BGU8007 v.1	20111011	Product data sheet	-	-	

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12. Legal information

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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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