



# BGU8051

## Low noise high linearity amplifier

Rev. 7 — 8 June 2017

Product data sheet  
COMPANY PUBLIC

## 1 General description

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The BGU8051 is, also known as the BTS1001L, a low noise high linearity amplifier for wireless infrastructure applications, equipped with fast shutdown to support TDD systems. The LNA has a high input and output return loss and is designed to operate between 0.3 GHz and 1.5 GHz. It is housed in a 2 mm × 2 mm × 0.75 mm 8-terminal plastic thin small outline package. The LNA is ESD protected on all terminals.

## 2 Features and benefits

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- Low noise performance: NF = 0.43 dB
- High linearity performance: IP3<sub>O</sub> = 39 dBm
- High input return loss > 15 dB
- High output return loss > 20 dB
- Unconditionally stable
- Programmable bias current (via resistor)
- Small 8-terminal leadless package 2 mm × 2 mm × 0.75 mm
- ESD protection on all terminals
- Moisture sensitivity level 1
- Fast shut down to support TDD systems
- 3 V to 5 V single supply

## 3 Applications

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- Wireless infrastructure
- Low noise and high linearity applications
- LTE, W-CDMA, CDMA, GSM
- General-purpose wireless applications
- TDD or FDD systems
- Suitable for small cells



4 Quick reference data

Table 1. Quick reference data  
*f* = 900 MHz, *V*<sub>CC</sub> = 5 V, *T*<sub>amb</sub> = 25 °C, input and output 50 Ω; *R*<sub>bias</sub> = 5.1 kΩ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 16 with components listed in Table 9 optimized for *f* = 900 MHz.

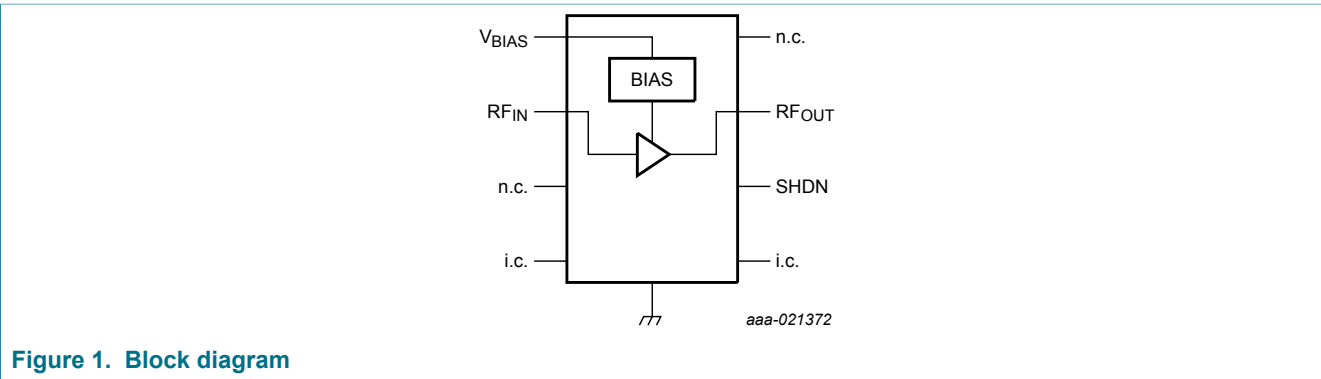
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CC</sub>	supply current	on state	36	48	60	mA
		off state	-	2.8	-	mA
G <sub>ass</sub>	associated gain	on state	17	18.3	20	dB
		off state	-	-21	-	dB
NF	noise figure		-	0.43	0.63	dB
P <sub>L(1dB)</sub>	output power at 1 dB gain compression		-	19	-	dBm
IP3 <sub>O</sub>	output third-order intercept point	2-tone; tone spacing = 1 MHz; P <sub>i</sub> = -15 dBm per tone	35	39	-	dBm

5 Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
BGU8051	HWSO8	plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 × 2 × 0.75 mm	SOT1327-1

6 Block diagram



7 Pinning information

7.1 Pinning

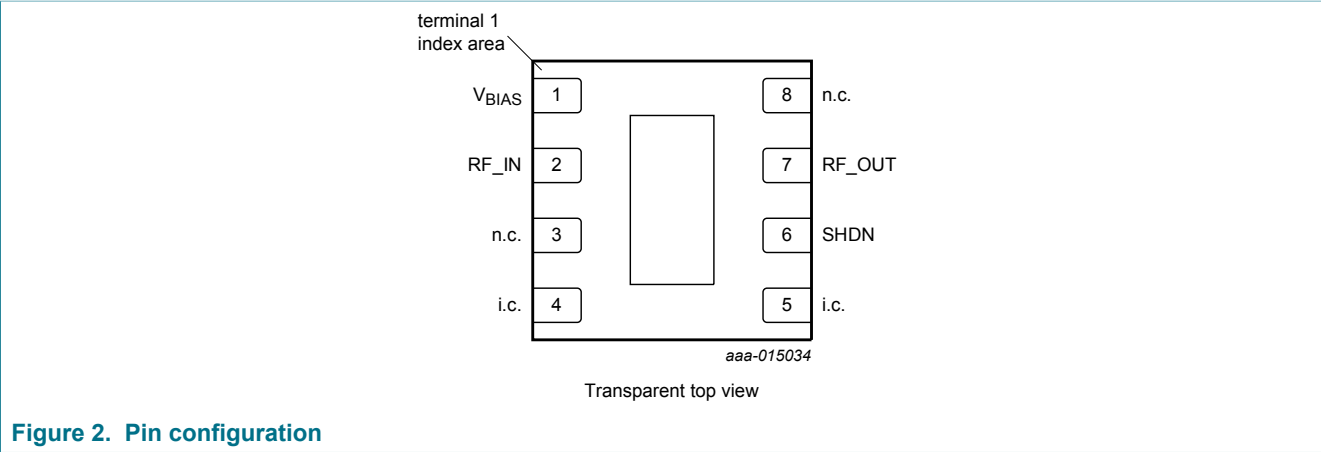


Figure 2. Pin configuration

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
V <sub>BIAS</sub>	1	bias voltage
RF_IN	2	RF input
n.c.	3, 8	not connected
i.c.	4, 5	internally connected. Can be grounded or left open in the application
SHDN	6	shutdown
RF_OUT	7	RF output
GND	exposed die pad	ground

## 8 Limiting values

**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		-	6	V
V <sub>ctrl(sd)</sub>	shutdown control voltage		-	3	V
I <sub>CC</sub>	supply current		-	85	mA
P <sub>I(RF)CW</sub>	continuous waveform RF input power		-	20	dBm
T <sub>stg</sub>	storage temperature		-40	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
P	power dissipation	T <sub>case</sub> ≤ 125 °C [1]	-	510	mW
V <sub>ESD</sub>	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001-2010	-	1.5	kV
		Charged Device Model (CDM); According to JEDEC standard 22-C101B	-	2	kV

[1] Case is ground solder pad.

## 9 Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		3.3	5	5.25	V
Z <sub>0</sub>	characteristic impedance		-	50	-	Ω
T <sub>case</sub>	case temperature		-40	-	+85	°C

## 10 Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
R <sub>th(j-case)</sub>	thermal resistance from junction to case	[1] [2]	50	K/W

[1] Case is ground solder pad.

[2] Thermal resistance measured using infrared measurement technique, device mounted on application board and placed in still air.

## 11 Characteristics

**Table 7. Characteristics**

$f = 900\text{ MHz}$ ,  $V_{CC} = 5\text{ V}$ ,  $T_{amb} = 25\text{ °C}$ , input and output  $50\text{ }\Omega$ ;  $R_{bias} = 5.1\text{ k}\Omega$ ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 16 with components listed in Table 9 optimized for  $f = 900\text{ MHz}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	supply current	on state	36	48	60	mA
		off state	-	2.8	-	mA
$G_{ass}$	associated gain	on state	17	18.3	20	dB
		off state	-	-21	-	dB
NF	noise figure		-	0.43	0.63	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	19	-	dBm
$IP3O$	output third-order intercept point	2-tone; tone spacing = 1 MHz; $P_i = -15\text{ dBm}$ per tone	35	39	-	dBm
		2-tone; tone spacing = 1 MHz; $P_i = -15\text{ dBm}$ per tone <sup>[1]</sup>	33	37	-	dBm
$RL_{in}$	input return loss	on state	-	15.9	-	dB
		off state	-	12.5	-	dB
$RL_{out}$	output return loss		-	29	-	dB
ISL	isolation		-	21	-	dB
$t_{s(pon)}$	power-on settling time	$P_i = -20\text{ dBm}$ ; SHDN (pin 6) from HIGH to LOW <sup>[1]</sup>	-	1.4	-	$\mu\text{s}$
$t_{s(poff)}$	power-off settling time	$P_i = -20\text{ dBm}$ ; SHDN (pin 6) from LOW to HIGH <sup>[1]</sup>	-	0.4	-	$\mu\text{s}$
K	Rollett stability factor	both on state and off state up to $f = 20\text{ GHz}$	1	-	-	
$R_{pd(SHDN)}$	pull-down resistance on pin SHDN		-	10	-	k $\Omega$

[1] For applications where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

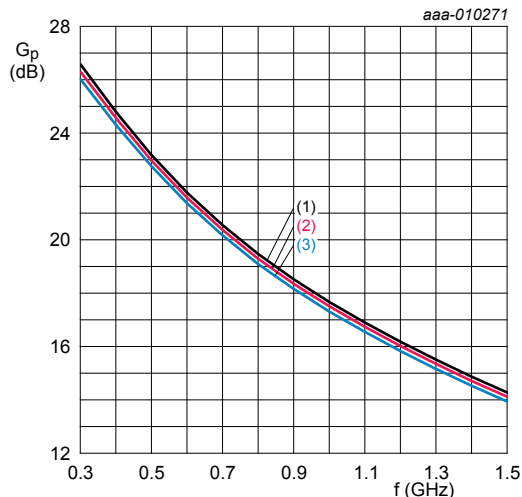
**Table 8. Shutdown control**

$V_{CC} = 5\text{ V}$ ,  $T_{amb} = 25\text{ °C}$ , input and output  $50\text{ }\Omega$ ;  $R_{bias} = 5.1\text{ k}\Omega$ ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 16 with components listed in Table 9 optimized for  $f = 900\text{ MHz}$ .

State	$V_{ctrl(sd)}$ <sup>[1]</sup>	Unit
on state	$\leq 0.6$	V
off state	$\geq 1.2$	V

[1] Voltage on pin 6 (SHDN).

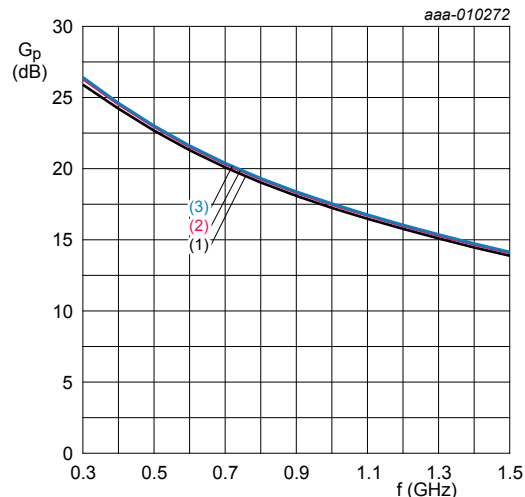
## 11.1 Graphics



$V_{CC} = 5\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ .

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

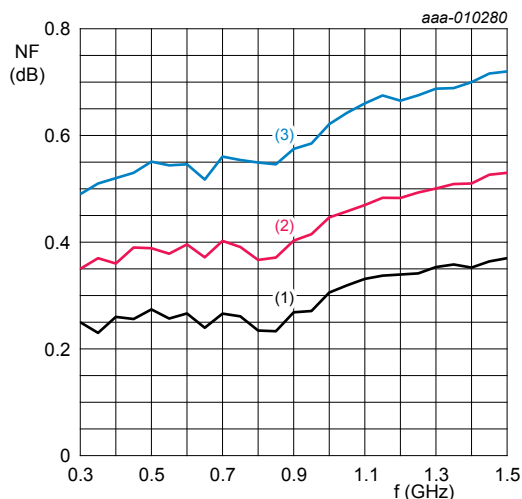
**Figure 3. Power gain as a function of frequency; typical values**



$V_{CC} = 5\text{ V}$ ;  $T_{amb} = 25^\circ\text{C}$ .

- (1)  $I_{CC} = 30\text{ mA}$
- (2)  $I_{CC} = 45\text{ mA}$
- (3)  $I_{CC} = 60\text{ mA}$

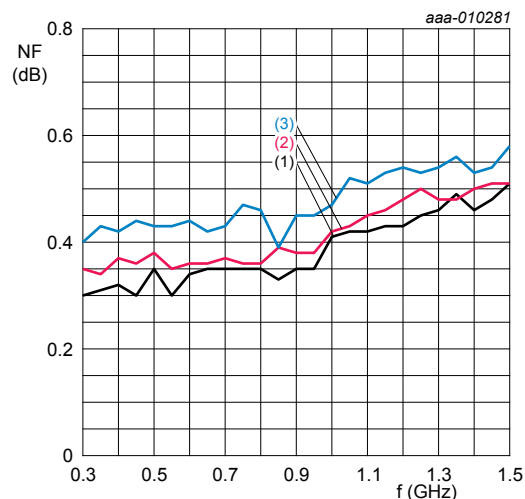
**Figure 4. Power gain as a function of frequency; typical values**



$V_{CC} = 5\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ .

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

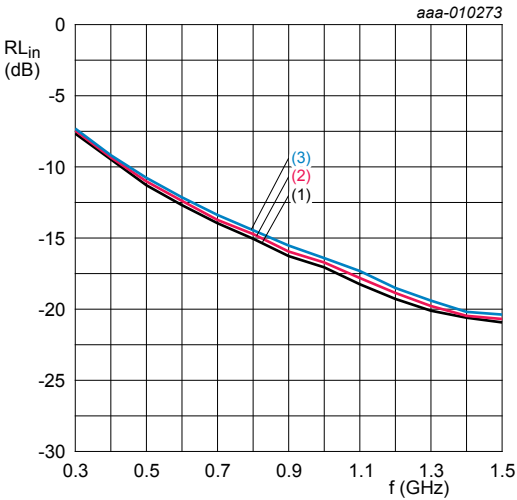
**Figure 5. Noise figure as a function of frequency; typical values**



$V_{CC} = 5\text{ V}$ ;  $T_{amb} = 25^\circ\text{C}$ .

- (1)  $I_{CC} = 30\text{ mA}$
- (2)  $I_{CC} = 45\text{ mA}$
- (3)  $I_{CC} = 60\text{ mA}$

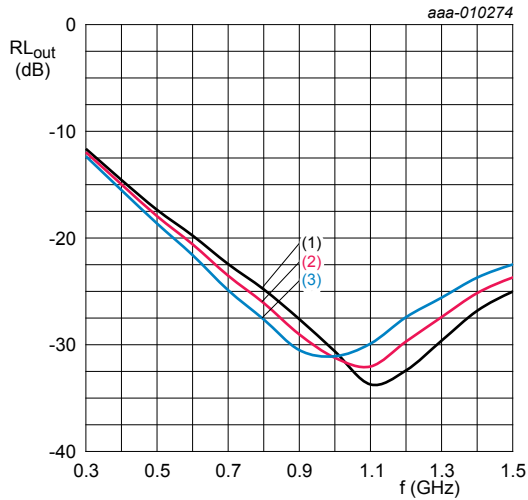
**Figure 6. Noise figure as a function of frequency; typical values**



$V_{CC} = 5\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ .

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

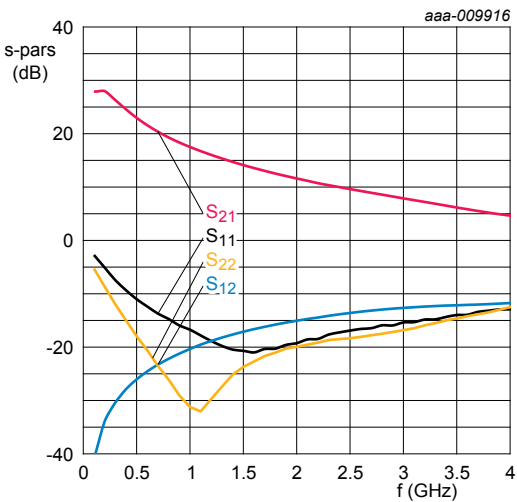
Figure 7. Input return loss as a function of frequency; typical values



$V_{CC} = 5\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ .

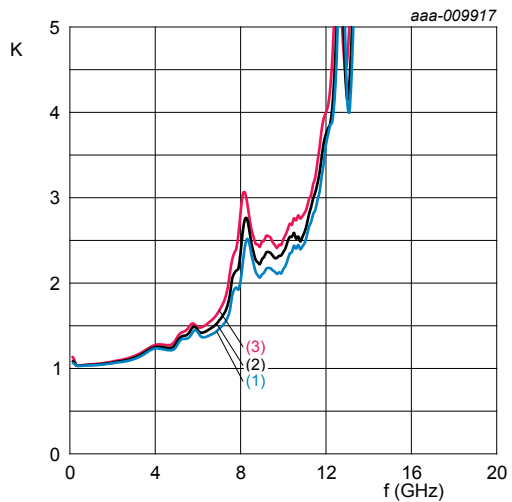
- (1)  $T_{amb} = -40^{\circ}\text{C}$
- (2)  $T_{amb} = +25^{\circ}\text{C}$
- (3)  $T_{amb} = +85^{\circ}\text{C}$

Figure 8. Output return loss as a function of frequency; typical values



$V_{CC} = 5\text{ V}$ ;  $T_{amb} = 25^{\circ}\text{C}$ ;  $I_{CC} = 48\text{ mA}$ .

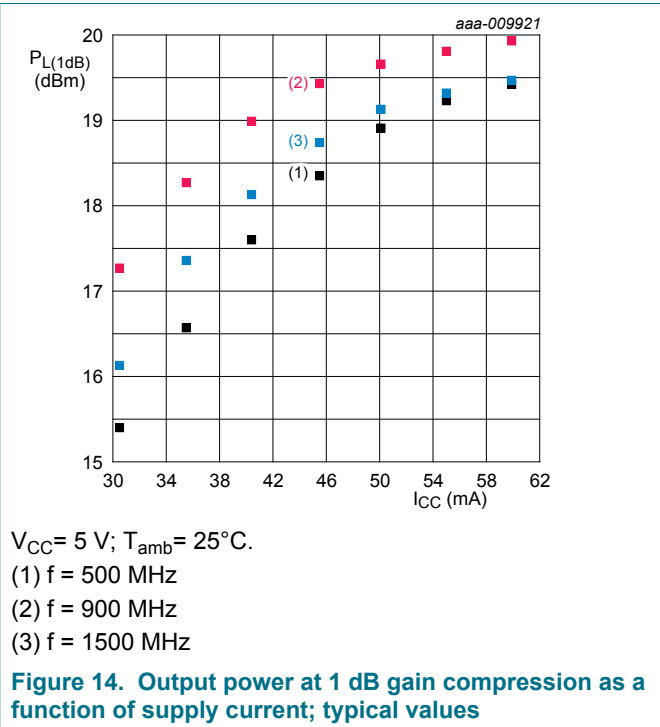
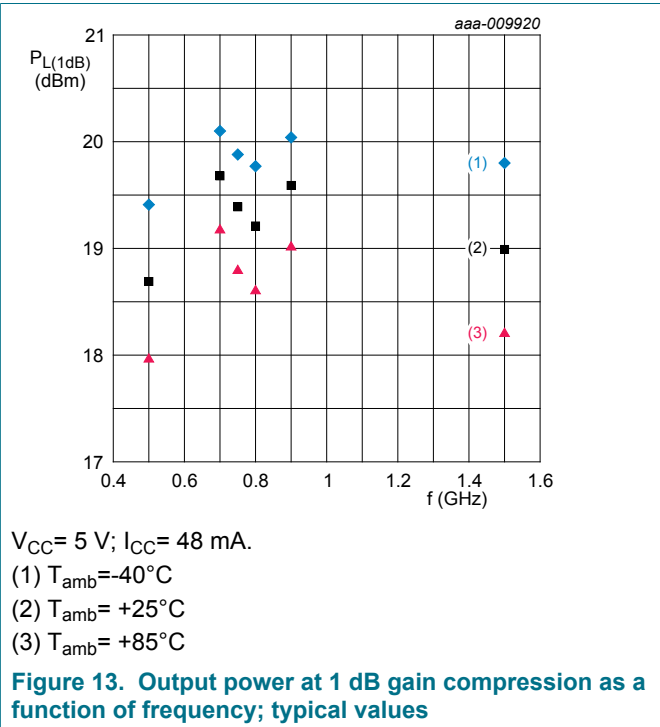
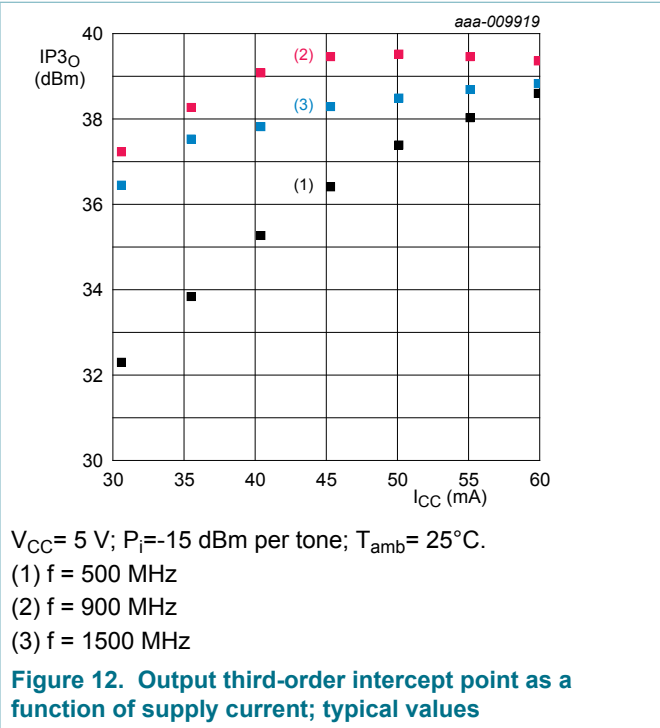
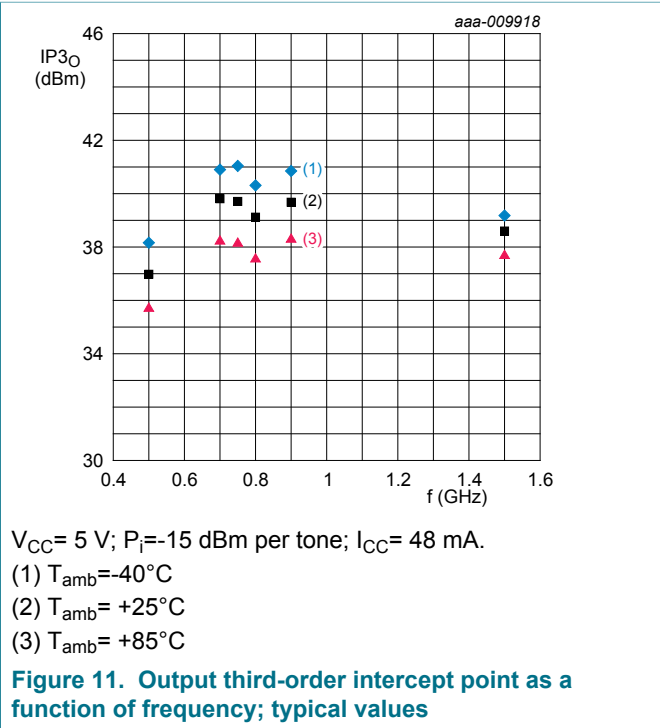
Figure 9. Wideband S-parameters as function of frequency; typical values



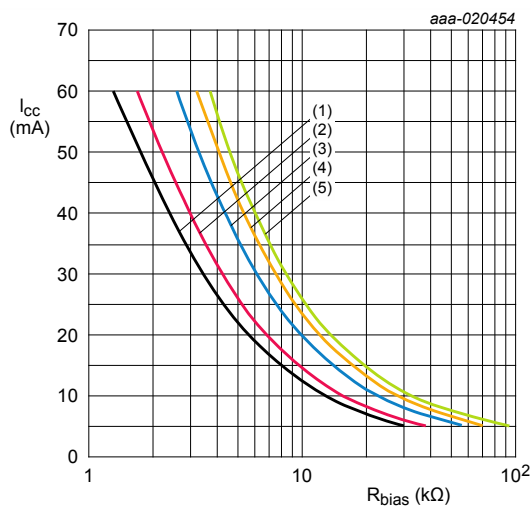
$V_{CC} = 5\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ .

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

Figure 10. Rollett stability factor as a function of frequency; typical values







$T_{amb} = 25\text{ °C}$

(1)  $V_{CC} = 3.0\text{ V}$

(2)  $V_{CC} = 3.3\text{ V}$

(3)  $V_{CC} = 4.0\text{ V}$

(4)  $V_{CC} = 4.5\text{ V}$

(5)  $V_{CC} = 5\text{ V}$

**Figure 15.**  $I_{CC}$  as a function of  $R_{bias}$ ; typical values

12 Application information

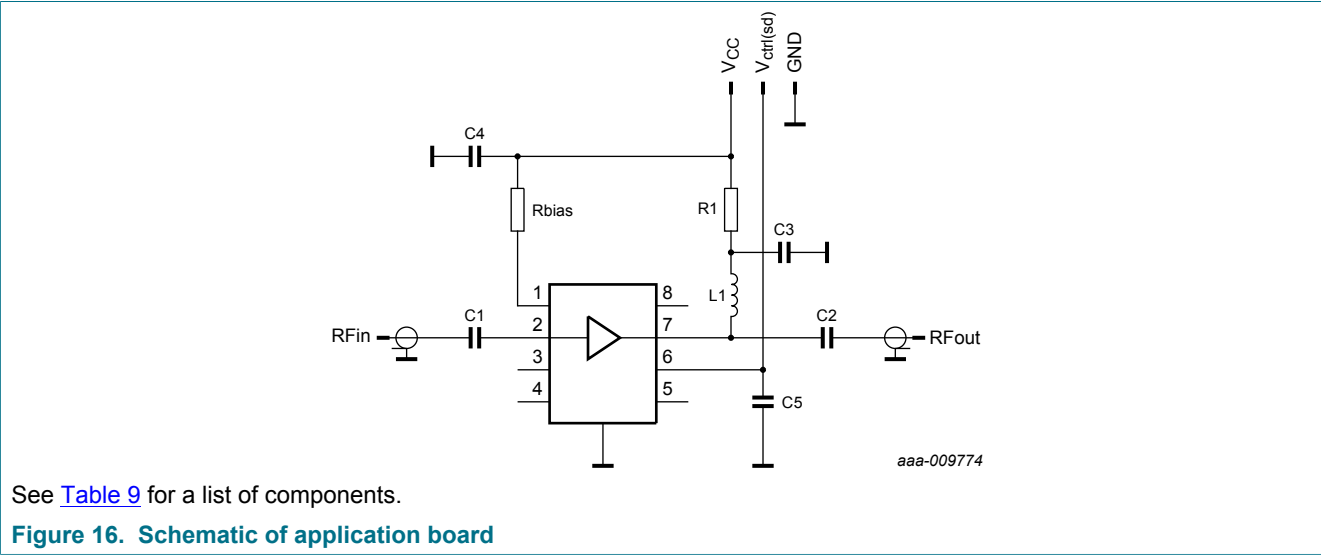


Table 9. List of components

See [Figure 16](#) for schematics.

Component	Description	Value	Remarks
C1, C2	capacitor	100 nF	
		100 pF	recommended for TDD systems
C3, C5	capacitor	10 pF	
C4	capacitor	10 nF	
L1	inductor	33 nH	
R1	resistor	10 Ω	
R <sub>bias</sub>	resistor	5.1 kΩ	V <sub>CC</sub> = 5 V
		2.3 kΩ	V <sub>CC</sub> = 3.3 V

**Table 10. Typical performance BGU8051 application board  $V_{CC} = 5\text{ V}$** 

All RF parameters are measured at the application board as shown in Figure 16 with the components as listed in Table 9 while optimized for:  $f = 900\text{ MHz}$ ,  $V_{CC} = 5\text{ V}$ ,  $I_{CC} = 48\text{ mA}$  and  $T_{amb} = 25\text{ }^{\circ}\text{C}$ . Unless otherwise specified.

Symbol	Parameter	Conditions	f (MHz)							
			400	500	700	750	800	900	1500	
G	gain		24.6	23.0	20.4	19.8	19.3	18.3	14.1	
RL <sub>in</sub>	input return loss		9.3	11.0	13.7	14.2	14.7	15.9	20.7	
RL <sub>out</sub>	output return loss		15.0	18.0	23.5	24.8	26.1	29.0	23.7	
P <sub>L(1dB)</sub>	output power at 1 dB gain compression		17.9	18.8	19.8	18.7	19.4	19.4	18.5	
IP3 <sub>O</sub>	output third-order intercept point	[1]	35.5	37.9	39.5	39.6	39.8	39.9	39.2	
		[1] [2]	35.6	37.2	38.8	39.3	39.1	39.8	38.2	
NF	noise figure	[3]	0.41	0.39	0.40	0.39	0.37	0.40	0.43	

[1] For 2 Tone: tone spacing = 1MHz, Po=5 dBm per tone

[2] For applications where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

[3] Connector and board losses not de-embedded.

**Table 11. Typical performance BGU8051 application board  $V_{CC} = 3.3\text{ V}$** 

All RF parameters measured at application board shown in Figure 16. The components listed in Table 9 optimized for 1900 MHz;  $V_{CC} = 3.3\text{ V}$ ;  $I_{CC} = 48\text{ mA}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	f (MHz)						
			400	500	700	750	800	900	1500
G	gain		24.5	22.9	20.4	19.8	19.3	18.2	14.0
RL <sub>in</sub>	input return loss		9.1	10.5	14.1	13.5	14.1	14.3	19.2
RL <sub>out</sub>	output return loss		16.8	18.1	22.3	22.4	24.1	25.0	26.5
P <sub>L(1dB)</sub>	output power at 1 dB gain compression		15.9	16.4	16.6	16.1	16.3	16.3	15.4
IP3 <sub>O</sub>	output third-order intercept point	[1]	32.4	34.3	35.5	34.5	34.1	35.3	31.6
		[1] [2]	32.4	33.1	33.6	33.6	33.1	33.2	30.2
NF	noise figure	[3]	0.39	0.40	0.42	0.43	0.44	0.44	0.43

[1] For 2 Tone: tone spacing = 1MHz, Po=5 dBm per tone

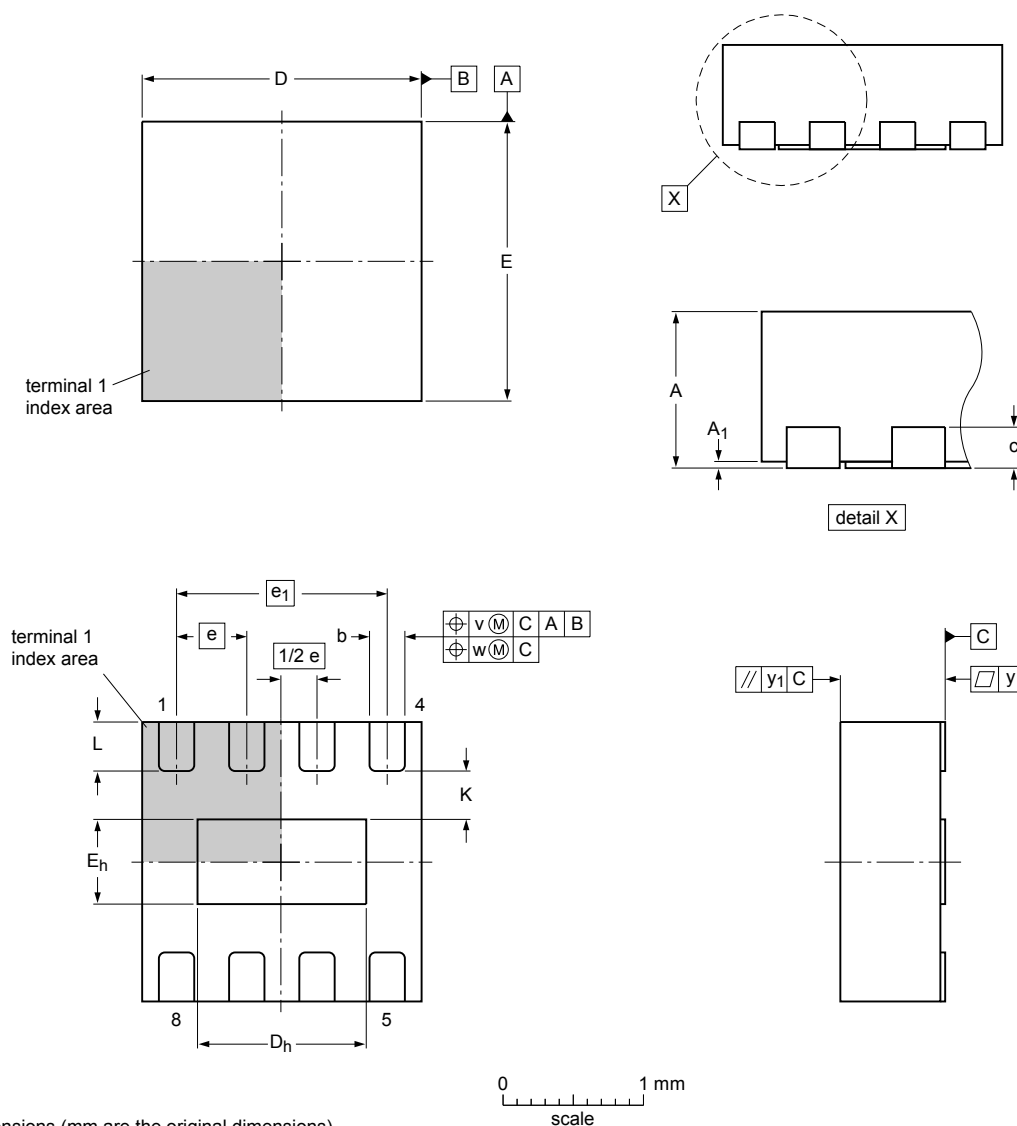
[2] For applications where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

[3] Connector and board losses not de-embedded.

## 13 Package outline

**HWSON8: plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 x 2 x 0.75 mm**

**SOT1327-1**




Dimensions (mm are the original dimensions)

Unit	A	A <sub>1</sub>	b	c	D <sup>(1)</sup>	D <sub>h</sub>	E <sup>(1)</sup>	E <sub>h</sub>	e	e <sub>1</sub>	K	L	v	w	y	y <sub>1</sub>
mm	max	0.80	0.05	0.30	0.2	2.05	1.25	2.05	0.65	0.5	1.5	0.40	0.1	0.05	0.05	0.1
	nom	0.75	0.03	0.25		2.00	1.20	2.00	0.60			0.35				
	min	0.70	0.00	0.20		1.95	1.15	1.95	0.55			0.30				

### Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot1327-1 po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1327-1		MO-229				12-04-11 12-04-15

**Figure 17. Package outline SOT1327-1 (HWSON8)**

## 14 Abbreviations

Table 12. Abbreviations

Acronym	Description
CDMA	Code Division Multiple Access
ESD	ElectroStatic Discharge
FDD	Frequency-Division Duplexing
GSM	Global System for Mobile Communication
LNA	Low Noise Amplifier
LTE	Long-Term Evolution
RF	Radio Frequency
TDD	Time-Division Duplexing
W-CDMA	Wideband Code Division Multiple Access

## 15 Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGU8051 v.7	20170608	Product data sheet	-	BGU8051 v.6
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 4</a>: the maximum value of <math>V_{ESD}</math> has been changed into 1.5 kV</li> </ul>			
BGU8051 v.6	20170502	Product data sheet	-	BGU8051 v.5
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 5 "Recommended operating conditions"</a>: the minimum value of <math>V_{CC}</math> has been changed into 3.3 V</li> </ul>			
BGU8051 v.5	20170120	Product data sheet	-	BGU8051 v.4
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 1 "General description"</a>: added BTS1001L according to our new naming convention</li> </ul>			
BGU8051 v.4	20160418	Product data sheet	-	BGU8051 v.3
Modifications:	<ul style="list-style-type: none"> <li>3 V to 5 V single supply, added to <a href="#">Section 2 "Features and benefits"</a></li> <li>An additional curve added to <a href="#">Figure "Output power at 1 dB gain compression as a function of supply current; typical values" on page 8</a></li> <li>Added <a href="#">Table 11 "Typical performance BGU8051 application board VCC = 3.3 V" on page 11</a></li> <li>Added <a href="#">Figure 1 "Block diagram" on page 2</a></li> <li>Added remark to <math>R_{bias}</math> in <a href="#">Table 9 "List of components"</a></li> </ul>			
BGU8051 v.3	20140929	Product data sheet	-	BGU8051 v.2
Modifications:	<ul style="list-style-type: none"> <li>Figure 1 on page 2: figure has been corrected</li> </ul>			
BGU8051 v.2	20131230	Product data sheet	-	BGU8051 v.1
BGU8051 v.1	20131127	Product data sheet	-	-

## 16 Legal information

### 16.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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