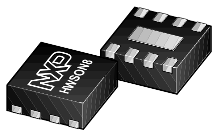


BGU8051

Low noise high linearity amplifier

Rev. 5 — 20 January 2017 — Product data sheet

1. General description

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

- Low noise performance: NF = 0.43 dB
- High linearity performance: $IP3_O$ = 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

- 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_{CC} = 5 V, T_{amb} = 25 °C, input and output 50 Ω; R_{bias} = 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_{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
$IP3_O$	output third-order intercept point	2-tone; tone spacing = 1 MHz; P_i = –15 dBm per tone	35	39	-	dBm

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
BGU8051	HWSON8	plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 × 2 × 0.75 mm	SOT1327-1

6. Block diagram

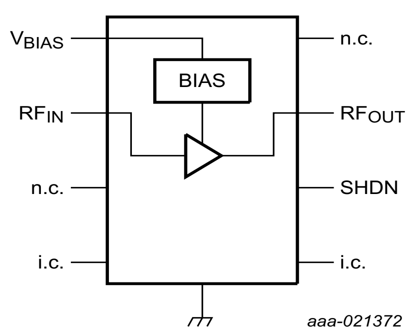


Fig 1. Block diagram

7. Pinning information

7.1 Pinning

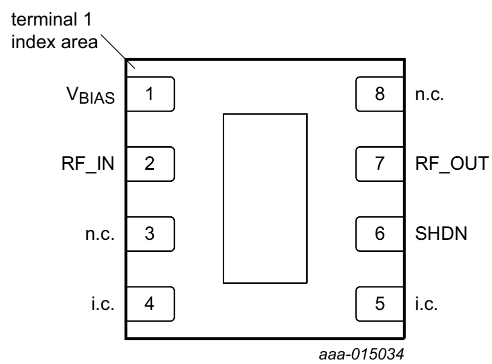


Fig 2. Pin configuration

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
V_{BIAS}	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_{CC}	supply voltage		-	6	V
$V_{ctrl(sd)}$	shutdown control voltage		-	3	V
I_{CC}	supply current		-	85	mA
$P_{i(RF)CW}$	continuous waveform RF input power		-	20	dBm
T_{stg}	storage temperature		−40	+150	°C
T_j	junction temperature		-	150	°C

Table 4. Limiting values *...continued*

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

Symbol	Parameter	Conditions	Min	Max	Unit
P	power dissipation	$T_{case} \leq 125$ °C [1]	-	510	mW
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001-2010	-	0.9	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. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.75	5	5.25	V
Z_0	characteristic impedance		-	50	-	Ω
T_{case}	case temperature		–40	-	+85	°C

10. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j\text{-}case)}$	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 MHz, V_{CC} = 5 V, T_{amb} = 25 °C, input and output 50 Ω; R_{bias} = 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_{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
$IP3_O$	output third-order intercept point	2-tone; tone spacing = 1 MHz; P_i = –15 dBm per tone	35	39	-	dBm
		2-tone; tone spacing = 1 MHz; P_i = –15 dBm per tone [1]	33	37	-	dBm
RL_{in}	input return loss	on state	-	15.9	-	dB
		off state	-	12.5	-	dB

Table 7. Characteristics *…continued*

f = 900 MHz, V_{CC} = 5 V, T_{amb} = 25 °C, input and output 50 Ω; R_{bias} = 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
RL_{out}	output return loss		-	29	-	dB
ISL	isolation		-	21	-	dB
$t_{s(pon)}$	power-on settling time	P_i = –20 dBm; SHDN (pin 6) from HIGH to LOW [1]	-	1.4	-	μs
$t_{s(poff)}$	power-off settling time	P_i = –20 dBm; SHDN (pin 6) from LOW to HIGH [1]	-	0.4	-	μs
K	Rollett stability factor	both on state and off state up to f = 20 GHz	1	-	-	
$R_{pd(SHDN)}$	pull-down resistance on pin SHDN		-	10	-	kΩ

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

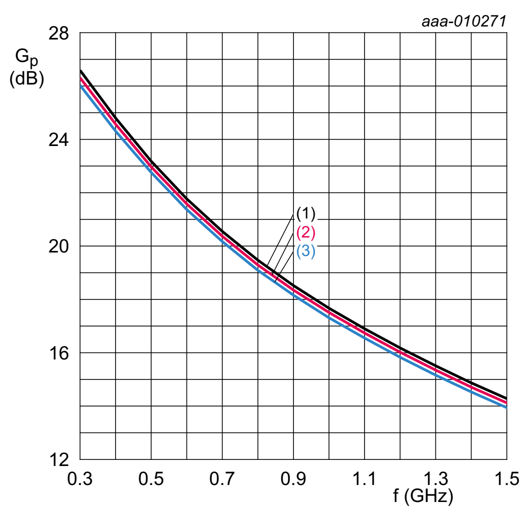
Table 8. Shutdown control

V_{CC} = 5 V, T_{amb} = 25 °C, input and output 50 Ω; R_{bias} = 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.

State	$V_{ctrl(sd)}$ [1]	Unit
on state	≤ 0.6	V
off state	≥ 1.2	V

[1] Voltage on pin 6 (SHDN).

11.1 Graphs



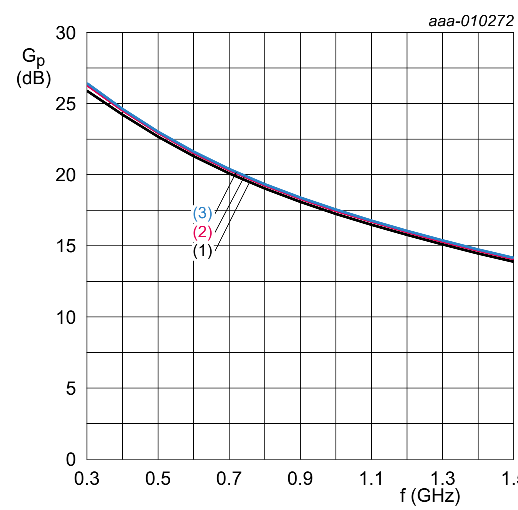
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = –40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

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



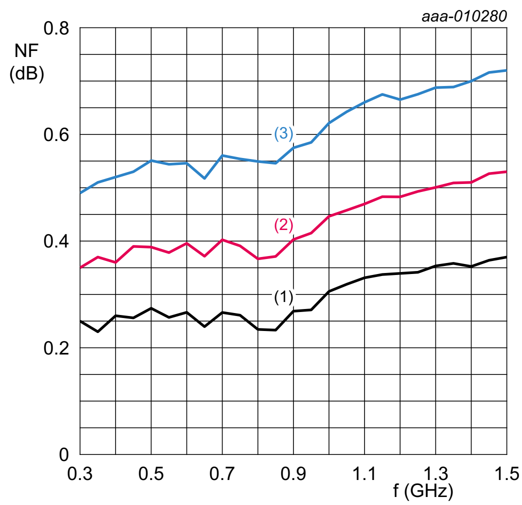
V_{CC} = 5 V; T_{amb} = 25 °C.

(1) I_{CC} = 30 mA

(2) I_{CC} = 45 mA

(3) I_{CC} = 60 mA

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



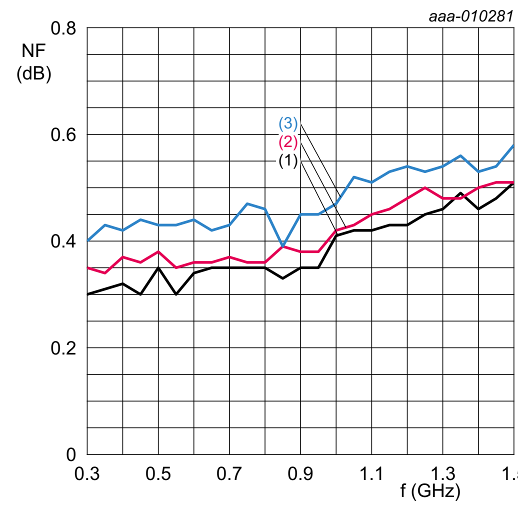
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = −40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

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



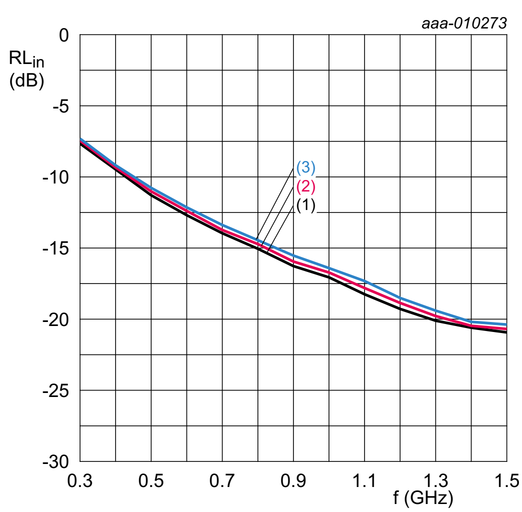
V_{CC} = 5 V; T_{amb} = 25 °C.

(1) I_{CC} = 30 mA

(2) I_{CC} = 45 mA

(3) I_{CC} = 60 mA

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



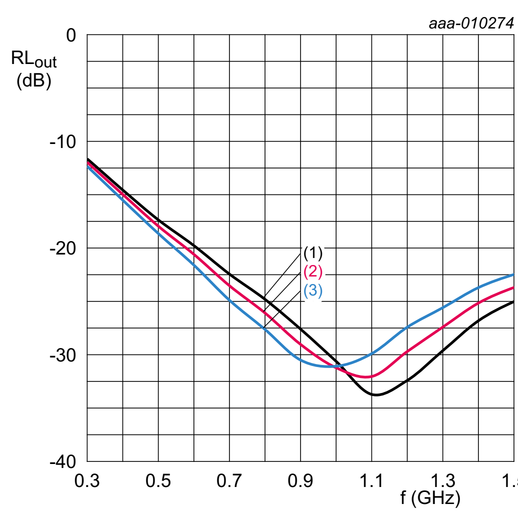
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = −40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

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



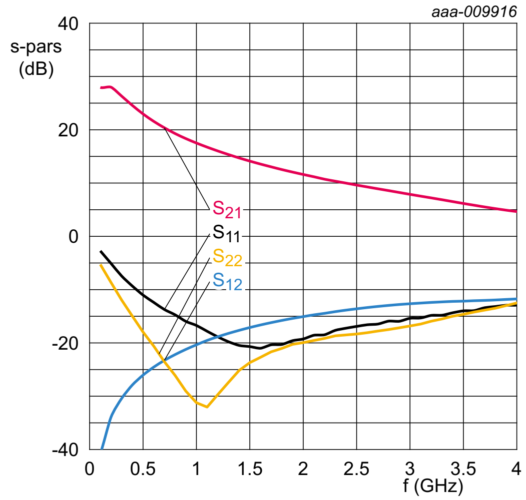
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = −40 °C

(2) T_{amb} = +25 °C

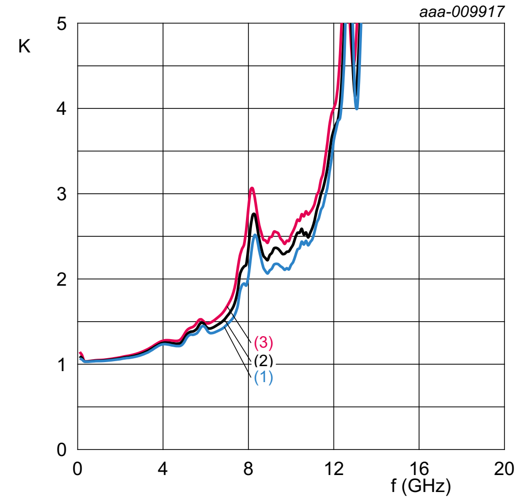
(3) T_{amb} = +85 °C

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



V_{CC} = 5 V; T_{amb} = 25 °C; I_{CC} = 48 mA.

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



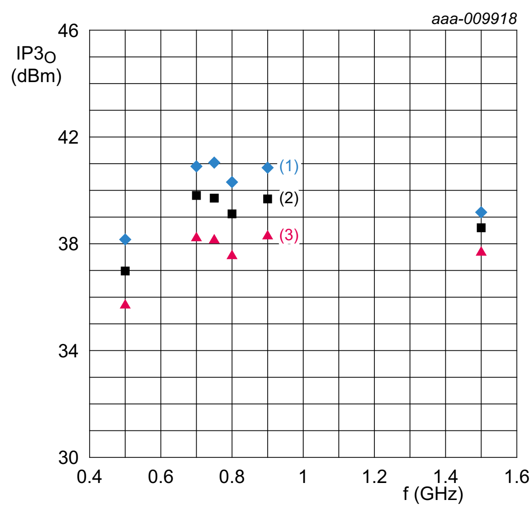
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = –40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

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



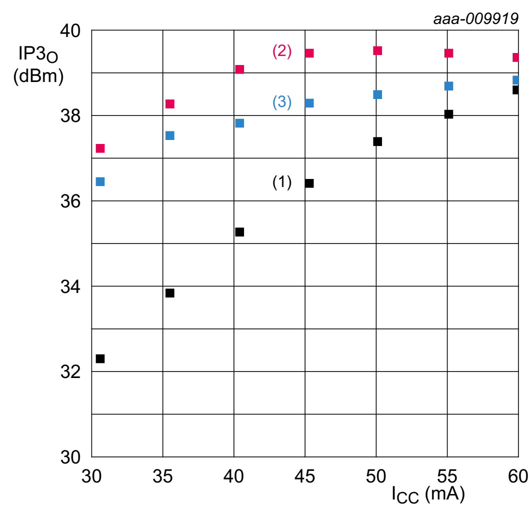
V_{CC} = 5 V; P_i = –15 dBm per tone; I_{CC} = 48 mA.

(1) T_{amb} = –40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

Fig 11. Output third-order intercept point as a function of frequency; typical values



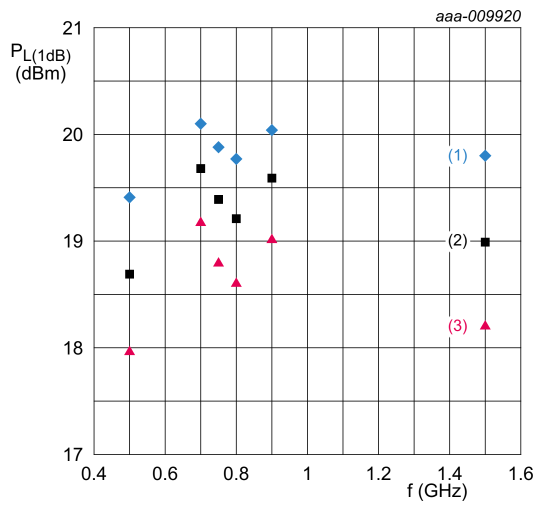
V_{CC} = 5 V; P_i = –15 dBm per tone; T_{amb} = 25 °C.

(1) f = 500 MHz

(2) f = 900 MHz

(3) f = 1500 MHz

Fig 12. Output third-order intercept point as a function of supply current; typical values



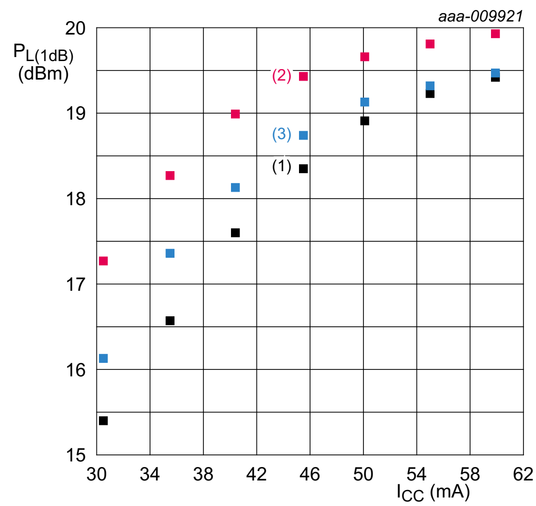
V_{CC} = 5 V; I_{CC} = 48 mA.

(1) T_{amb} = −40 °C

(2) T_{amb} = +25 °C

(3) T_{amb} = +85 °C

Fig 13. Output power at 1 dB gain compression as a function of frequency; typical values



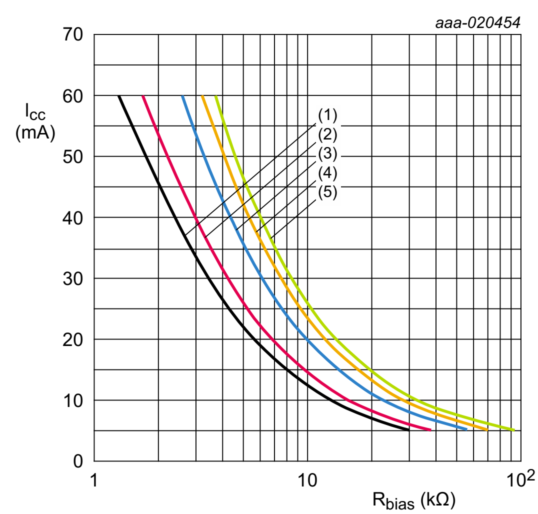
V_{CC} = 5 V; T_{amb} = 25 °C.

(1) f = 500 MHz

(2) f = 900 MHz

(3) f = 1500 MHz

Fig 14. Output power at 1 dB gain compression as a function of supply current; typical values



T_{amb} = 25 °C

(1) V_{CC} = 3.0 V

(2) V_{CC} = 3.3 V

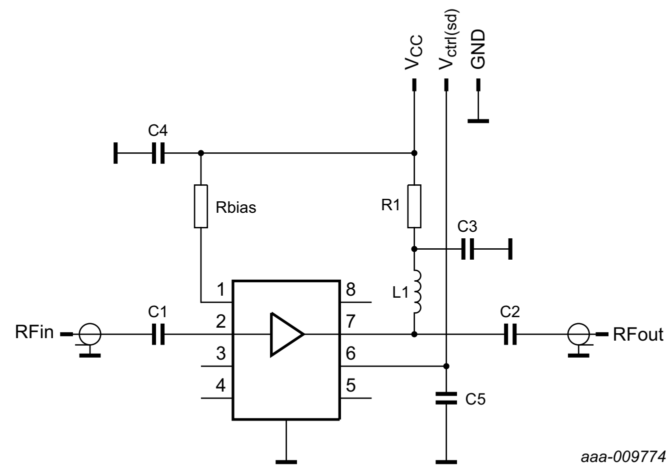
(3) V_{CC} = 4.0 V

(4) V_{CC} = 4.5 V

(5) V_{CC} = 5 V

Fig 15. I_{CC} as a function of R_{bias}; typical values

12. Application information



See Table 9 for a list of components.

Fig 16. Schematic of application board

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_{bias}	resistor	5.1 kΩ	V_{CC} = 5 V
		2.3 kΩ	V_{CC} = 3.3 V

Table 10. Typical performance BGU8051 application board V_{CC} = 5 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 MHz, V_{CC} = 5 V, I_{CC} = 48 mA and T_{amb} = 25 °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_{in}	input return loss		9.3	11.0	13.7	14.2	14.7	15.9	20.7
RL_{out}	output return loss		15.0	18.0	23.5	24.8	26.1	29.0	23.7
$P_{L(1dB)}$	output power at 1 dB gain compression		17.9	18.8	19.8	18.7	19.4	19.4	18.5
$IP3_O$	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 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 V; I_{CC}= 48 mA; T_{amb} = 25 °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_{in}	input return loss		9.1	10.5	14.1	13.5	14.1	14.3	19.2
RL_{out}	output return loss		16.8	18.1	22.3	22.4	24.1	25.0	26.5
$P_{L(1dB)}$	output power at 1 dB gain compression		15.9	16.4	16.6	16.1	16.3	16.3	15.4
$IP3_O$	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

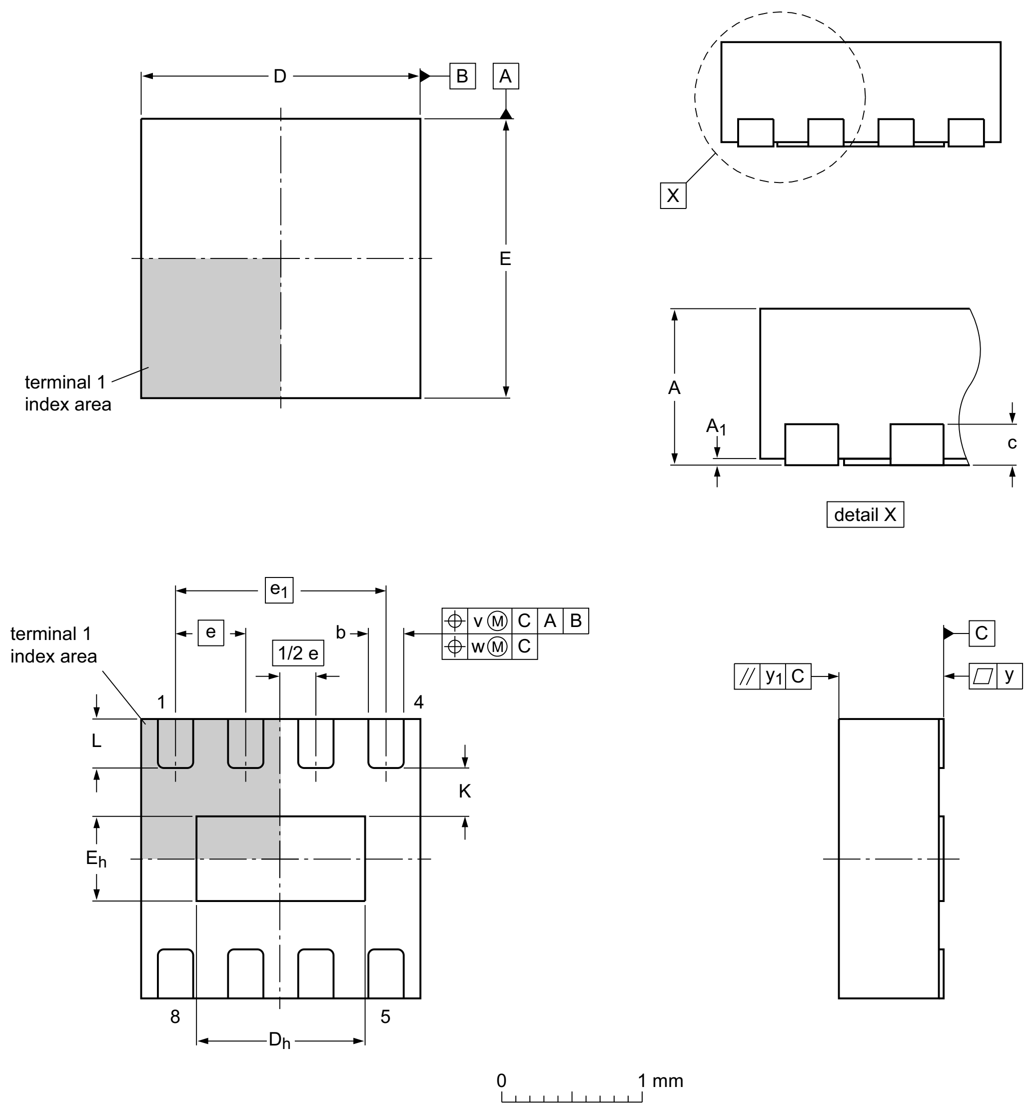
[1] For 2 Tone: tone spacing = 1MHZ, Po=5 dBm per tone.

[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_1	b	c	D(1)	D_h	E(1)	E_h	e	e_1	K	L	v	w	y	y_1
mm	max	0.80	0.05	0.30		2.05	1.25	2.05	0.65				0.40				
	nom	0.75	0.03	0.25	0.2	2.00	1.20	2.00	0.60	0.5	1.5		0.35	0.1	0.05	0.05	0.1
	min	0.70	0.00	0.20		1.95	1.15	1.95	0.55			0.35	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

Fig 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.5	20170120	Product data sheet	-	BGU8051 v.4
Modifications:	• Section 1 on page 1: added BTS1001L according to our new naming convention			
BGU8051 v.4	20160418	Product data sheet	-	BGU8051 v.3
Modifications:	• 3 V to 5 V single supply, added to features and benefits • An additional curve added to Figure 15 on page 8 • Table 11 on page 10 added • Figure 1 “Block diagram” on page 2 added • Added remark to R_{bias} in Table 9 on page 9			
BGU8051 v.3	20140929	Product data sheet	-	BGU8051 v.2
Modifications:	• Figure 1 on page 2: figure has been corrected			
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[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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17. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

18. Contents

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