BGA6589

MMIC wideband medium power amplifier

Rev. 3 — 28 November 2011 Product data sheet

1. Product profile

1.1 General description

The BGA6589 is a silicon Monolithic Microwave Integrated Circuit (MMIC) wideband medium power amplifier with internal matching circuit in a 3-pin SOT89 plastic low thermal resistance SMD package.

The BGA6x89 series of medium power gain blocks are resistive feedback Darlington configured amplifiers. Resistive feedback provides large bandwidth with high accuracy.

CAUTION

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

1.2 Features and benefits

- Broadband 50 Ω gain block
- 20 dBm output power
- SOT89 package
- Single supply voltage needed

1.3 Applications

- Broadband medium power gain blocks
- Small signal high linearity amplifiers
- Variable gain and high output power in combination with the BGA2031
- Cellular, PCS and CDPD
- IF/RF buffer amplifier
- Wireless data SONET
- Oscillator amplifier, final PA
- Drivers for CATV amplifier

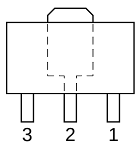
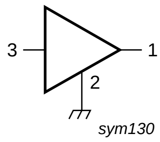
1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_D	DC device voltage	on pin 1; I_S = 81 mA	-	4.8	-	V
I_S	DC supply current	V_S = 9 V; R_{bias} = 51 Ω; T_j = 25 °C	-	81	-	mA
$\|s_{21}\|^2$	insertion power gain	f = 1950 MHz	-	17	-	dB
NF	noise figure	f = 1950 MHz	-	3.3	-	dB
P_{L1dB}	load power at 1 dB gain compression	f = 850 MHz	-	21	-	dBm
		f = 1950 MHz	-	20	-	dBm

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	RF_OUT/BIAS		
2	GND		
3	RF_IN		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGA6589	SC-62	plastic surface-mounted package; collector pad for good heat transfer; 3 leads	SOT89

4. Marking

Table 4. Marking codes

Type number	Marking code
BGA6589	5A

5. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_D	DC device voltage	on pin 1; RF input AC coupled		-	6	V
I_S	DC supply current			-	150	mA
P_{tot}	total power dissipation	$T_{sp} \leq 70$ °C	[1]	-	800	mW
T_{stg}	storage temperature			–65	+150	°C
T_j	junction temperature			-	150	°C
P_D	drive power			-	15	dBm
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM); According JEDEC standard 22-A114E		-	200	V
		Charged Device Model (CDM); According JEDEC standard 22-C101B		-	2	kV

[1] T_{sp} is the temperature at the solder point of the ground lead, pin 2.

6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$T_{sp} \leq 70$ °C	[1]	100	K/W

[1] T_{sp} is the temperature at the solder point of the ground lead, pin 2.

7. Characteristics

Table 7. Static characteristics

$V_S = 9$ V; $T_j = 25$ °C; $R_{bias} = 51\ \Omega$.[1]

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_D	DC device voltage	on pin 1; $I_S = 81$ mA	-	4.8	-	V
I_S	DC supply current		73	81	89	mA

[1] V_S = DC operating supply voltage applied to R_{bias}; see Figure 10.

Table 8. Characteristics

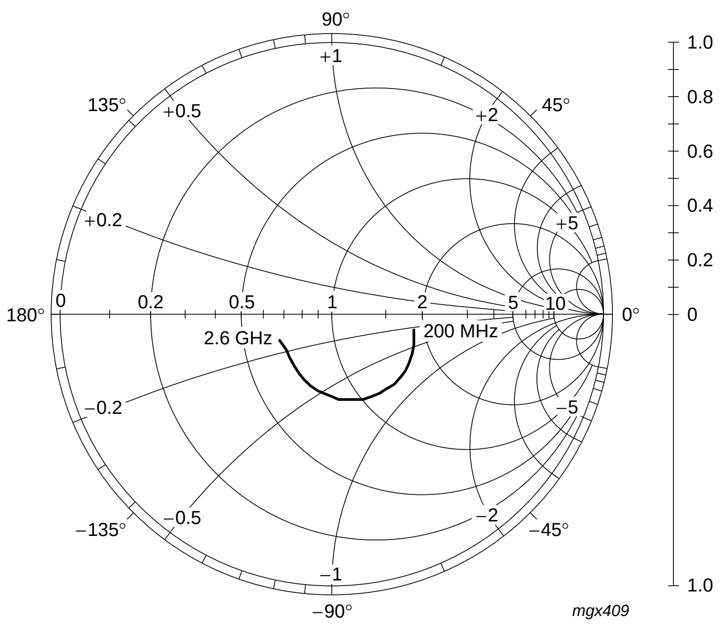
$V_S = 9$ V; $I_S = 81$ mA; $T_{amb} = 25$ °C; $R_{bias} = 51\ \Omega$; $IP3_{(out)}$ tone spacing = 1 MHz; $P_L = 0$ dBm per tone (see Figure 10); $Z_L = Z_S = 50\ \Omega$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\|s_{21}\|^2$	insertion power gain	f = 850 MHz	-	22	-	dB
		f = 1950 MHz	-	17	-	dB
		f = 2500 MHz	-	15	-	dB
R_{LIN}	return losses input	f = 850 MHz	-	9	-	dB
		f = 1950 MHz	-	11	-	dB
		f = 2500 MHz	-	15	-	dB

Table 8. Characteristics *...continued*

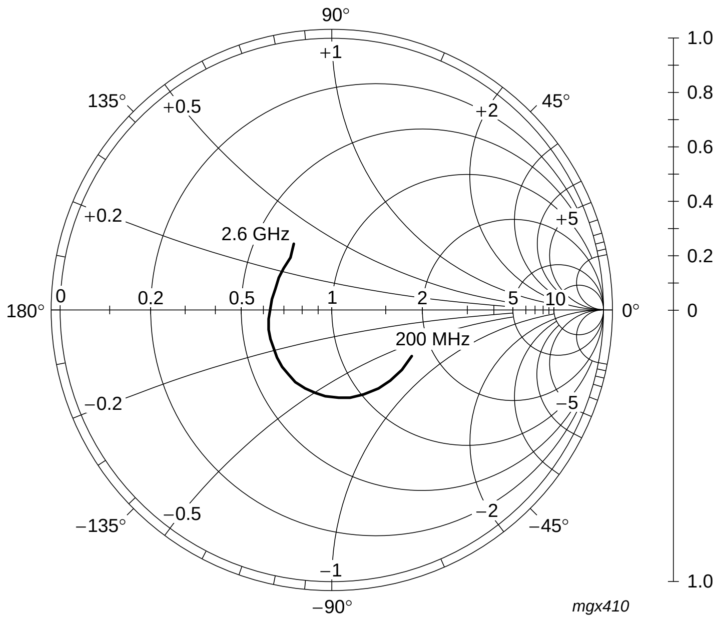
V_S = 9 V; I_S = 81 mA; T_{amb} = 25 °C; R_{bias} = 51 Ω; $IP3_{(out)}$ tone spacing = 1 MHz; P_L = 0 dBm per tone (see Figure 10); Z_L = Z_S = 50 Ω; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{LOUT}	return losses output	f = 850 MHz	-	10	-	dB
		f = 1950 MHz	-	13	-	dB
		f = 2500 MHz	-	13	-	dB
NF	noise figure	f = 850 MHz	-	3.0	-	dB
		f = 1950 MHz	-	3.3	-	dB
		f = 2500 MHz	-	3.4	-	dB
K	stability factor	f = 850 MHz	-	1.1	-	
		f = 2500 MHz	-	1.1	-	
P_{L1dB}	load power at 1 dB gain compression	f = 850 MHz	-	21	-	dBm
		f = 1950 MHz	-	20	-	dBm
$IP3_{(in)}$	input intercept point	f = 850 MHz	-	11	-	dBm
		f = 2500 MHz	-	15	-	dBm
$IP3_{(out)}$	output intercept point	f = 850 MHz	-	33	-	dBm
		f = 2500 MHz	-	30	-	dBm



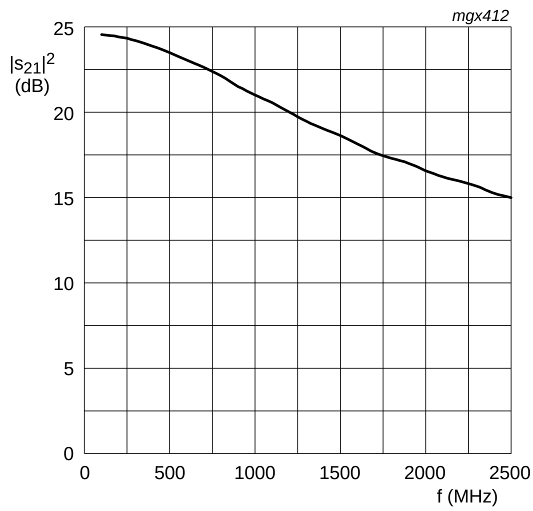
I_S = 81 mA; V_S = 9 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig 1. Input reflection coefficient (S_{11}); typical values



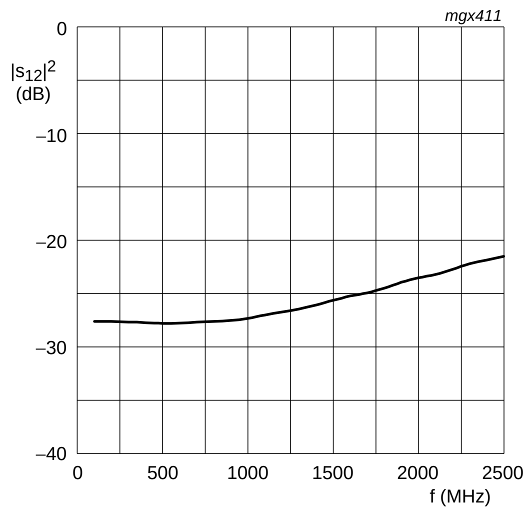
I_S = 81 mA; V_S = 9 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig 2. Output reflection coefficient (s_{22}); typical values



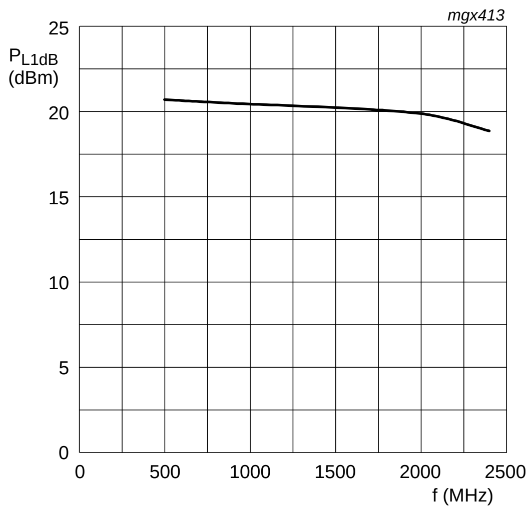
I_S = 81 mA; V_S = 9 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig 3. Insertion gain ($|s_{21}|^2$) as a function of frequency; typical values



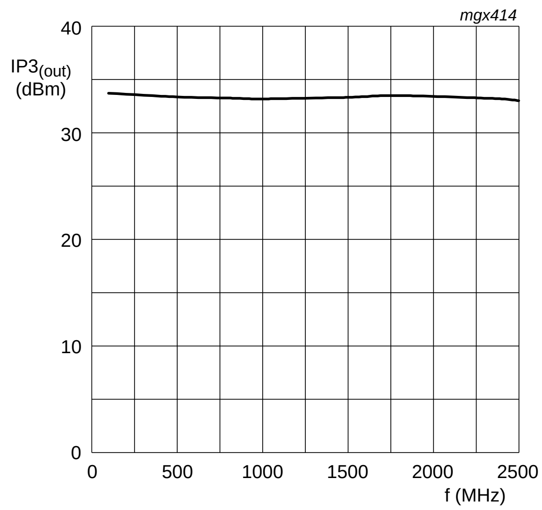
I_S = 81 mA; V_S = 9 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig 4. Isolation ($|s_{12}|^2$) as a function of frequency; typical values



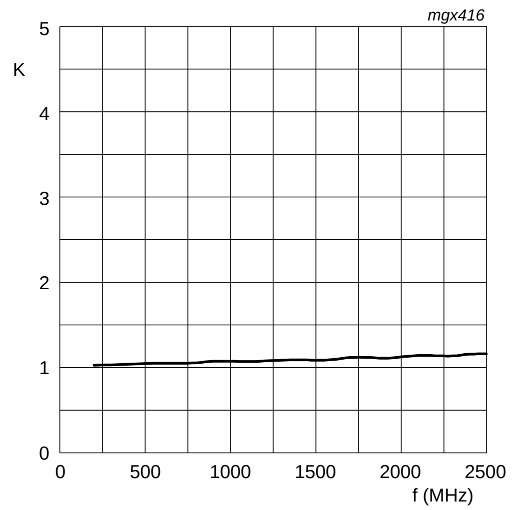
I_S = 81 mA; V_S = 9 V; Z_O = 50 Ω.

Fig 5. Load power as a function of frequency; typical values



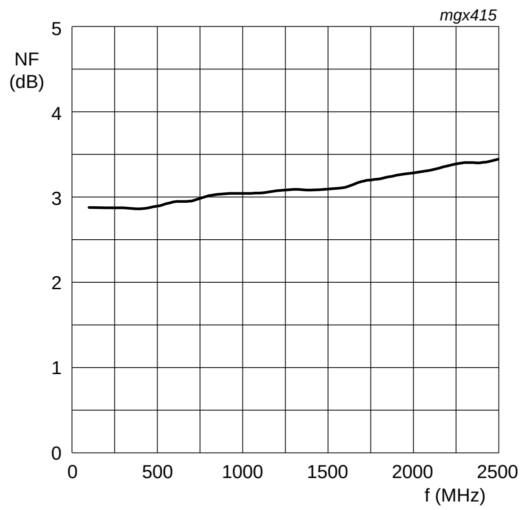
I_S = 81 mA; V_S = 9 V; P_L = 0 dBm; Z_O = 50 Ω.

Fig 6. Output intercept as a function of frequency; typical values



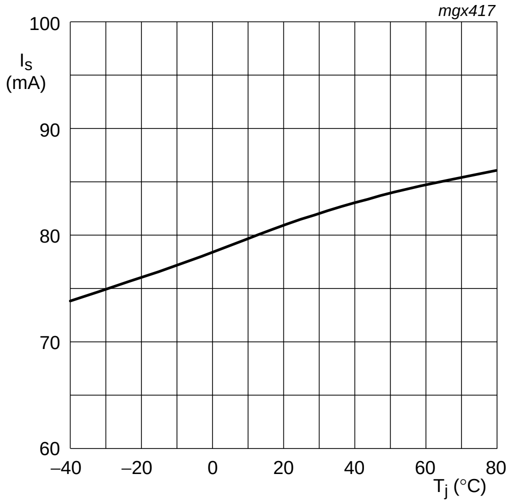
I_S = 81 mA; V_S = 9 V; Z_O = 50 Ω.

Fig 7. Stability factor as a function of frequency; typical values



I_S = 81 mA; V_S = 9 V; Z_O = 50 Ω.

Fig 8. Noise figure as a function of frequency; typical values

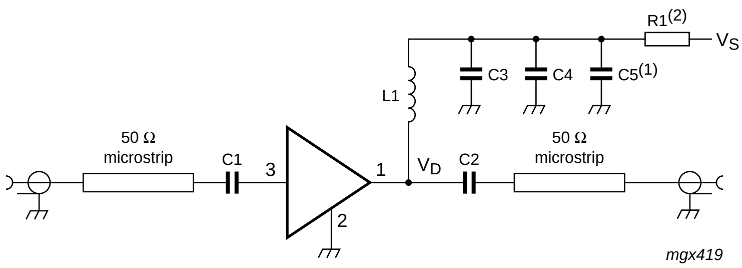


V_S = 9 V; R_{bias} 51 Ω.

Fig 9. Supply current as a function of operating junction temperature; typical values

8. Application information

Figure 10 shows a typical application circuit for the BGA6589 MMIC. The device is internally matched to 50 Ω, and therefore does not require any external matching. The value of the input and output DC blocking capacitors C1 and C2 depends on the operating frequency; see Table 9. Capacitors C1 and C2 are used in conjunction with L1 and C3 to fine tune the input and output impedance. Capacitor C4 is a supply decoupling capacitor. A 1 μF capacitor (C5) can be added for optimum supply decoupling. The external components should be placed as close as possible to the MMIC. When using via holes, use multiple via holes per pin in order to limit ground path induction. Resistor R1 is a bias resistor providing DC current stability with temperature.



(1) Optional capacitor for optimum supply decoupling.

(2) R1 values at operating supply voltage (V_S):

V_S = 6 V; R1 = 15 Ω.

V_S = 9 V; R1 = 51 Ω.

V_S = 11.5 V; R1 = 82 Ω.

Fig 10. Typical application circuit

Table 9. List of components

See Figure 10 for circuit.

Component	Description	Type	Value at operating frequency				
			500 MHz	800 MHz	1950 MHz	2400 MHz	3500 MHz
C1, C2	multilayer ceramic chip capacitor	0603	220 pF	100 pF	68 pF	56 pF	39 pF
C3	multilayer ceramic chip capacitor	0603	100 pF	68 pF	22 pF	22 pF	15 pF
C4	multilayer ceramic chip capacitor	0603	1 nF	1 nF	1 nF	1 nF	1 nF
C5[1]	electrolytic or tantalum capacitor	0603	1 μF	1 μF	1 μF	1 μF	1 μF
L1	SMD inductor	0603	68 nH	33 nH	22 nH	18 nH	15 nH
R1	SMD resistor, 0.5 W; V_S = 9 V	-	51 Ω	51 Ω	51 Ω	51 Ω	51 Ω

[1] Optional.

Table 10. Scattering parameters

I_S = 81 mA; V_S = 9 V; P_D = −30 dBm; Z_O = 50 Ω; T_{amb} = 25 °C.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		K factor
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	
200	0.30	−6.87	16.61	161.86	0.04	2.38	0.34	−20.03	1.0
300	0.31	−10.91	16.18	153.02	0.04	3.66	0.34	−30.50	1.0
400	0.32	−15.72	15.59	144.39	0.04	5.17	0.34	−40.74	1.1
500	0.33	−21.0	14.91	136.01	0.04	6.75	0.34	−50.56	1.1
600	0.33	−26.44	14.19	128.12	0.04	8.67	0.34	−60.07	1.1
700	0.34	−32.08	13.51	120.88	0.04	10.94	0.33	−69.21	1.1
800	0.34	−37.75	12.77	114.19	0.04	13.65	0.33	−77.91	1.1
900	0.35	−43.18	11.88	107.40	0.04	15.15	0.32	−86.13	1.1
1000	0.35	−48.9	11.22	101.34	0.04	17.89	0.32	−94.01	1.1
1100	0.35	−54.2	10.64	95.86	0.04	19.93	0.31	−101.7	1.1
1200	0.35	−59.55	10.0	90.82	0.05	22.11	0.30	−109.1	1.1
1300	0.34	−64.78	9.39	85.46	0.05	24.10	0.30	−116.4	1.1
1400	0.34	−69.93	8.93	80.15	0.05	24.62	0.29	−123.6	1.1
1500	0.33	−74.81	8.54	75.95	0.05	25.98	0.28	−130.9	1.1
1600	0.33	−79.82	8.07	72.26	0.05	27.67	0.27	−138.2	1.1
1700	0.32	−84.88	7.60	67.95	0.06	28.69	0.26	−145.7	1.1
1800	0.31	−89.81	7.32	63.43	0.06	28.33	0.25	−153.6	1.1
1900	0.30	−94.89	7.08	59.81	0.06	28.44	0.24	−162.0	1.1
2000	0.29	−100.3	6.74	56.09	0.07	29.27	0.23	−170.7	1.1
2100	0.28	−105.9	6.46	51.84	0.07	29.17	0.23	179.99	1.1
2200	0.26	−111.8	6.28	48.02	0.07	28.46	0.22	170.17	1.2
2300	0.25	−118.0	6.07	45.0	0.08	28.37	0.22	160.16	1.2
2400	0.24	−125.2	5.78	41.33	0.08	28.17	0.22	149.59	1.1

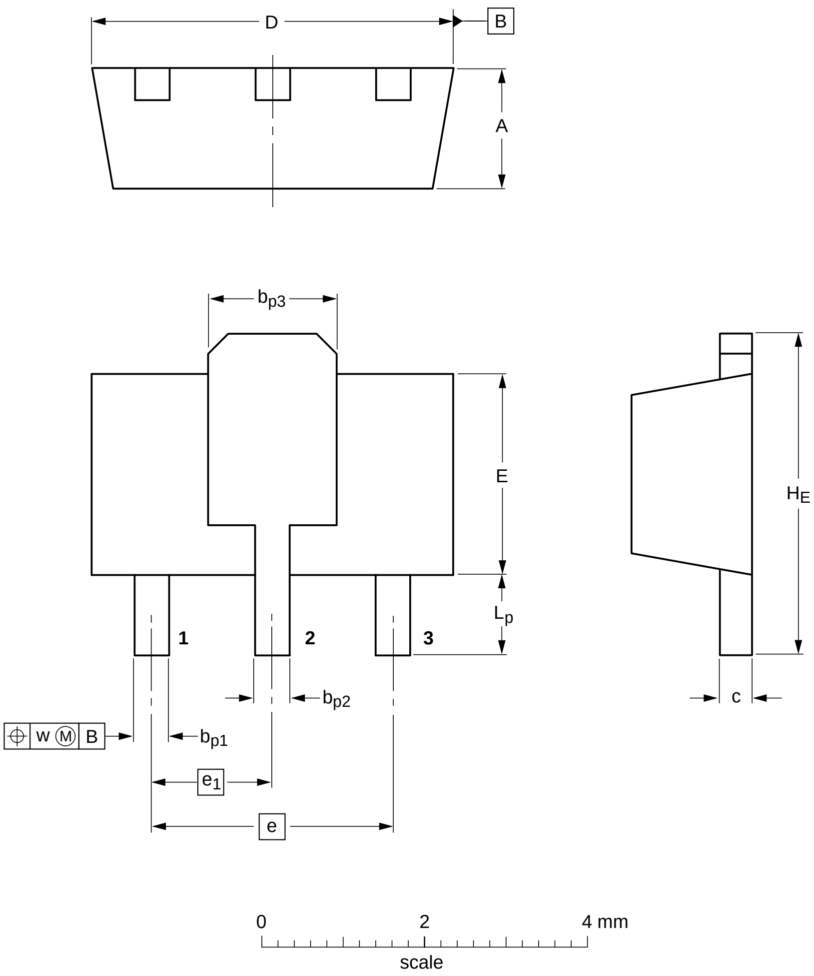
Table 10. Scattering parameters *…continued*

I_S = 81 mA; V_S = 9 V; P_D = –30 dBm; Z_O = 50 Ω; T_{amb} = 25 °C.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		K factor
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	
2500	0.22	–132.8	5.61	36.72	0.08	26.46	0.23	139.39	1.2
2600	0.21	–141.3	5.51	33.15	0.09	24.85	0.24	129.67	1.0
2700	0.21	–153.3	5.33	30.04	0.09	24.72	0.28	120.55	1.2
2800	0.07	–127.7	6.44	28.98	0.12	24.46	0.28	80.88	1.2
2900	0.19	–167.20	4.88	19.14	0.10	20.48	0.27	105.15	1.2
3000	0.18	178.11	4.78	16.89	0.10	19.71	0.30	96.35	1.2
3100	0.18	165.13	4.57	16.56	0.11	18.98	0.32	89.48	1.0

9. Package outline

Plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads **SOT89**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_{p1}	b_{p2}	b_{p3}	c	D	E	e	e_1	H_E	L_p	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.23	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	1.2 0.8	0.13

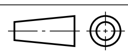
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT89		TO-243	SC-62			~~06-03-16~~ 06-08-29

Fig 11. Package outline SOT89 (SC-62)

10. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDPD	Cellular Digital Packet Data
IF	Intermediate Frequency
PCS	Power Center Substation
SMD	Surface-Mounted Device
SONET	Synchronous Optical NETwork

11. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA6589 v.3	20111128	Product data sheet	-	BGA6589 v.2
Modifications:	• Table 5 “Limiting values” on page 3: Electrostatic discharge voltage data added.			
BGA6589 v.2	20090525	Product data sheet	-	BGA6589 v.1
BGA6589 v.1	20030919	Product specification	-	-

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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Date of release: 28 November 2011

Document identifier: BGA6589