

# 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  $\Omega$  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



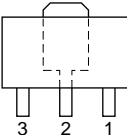
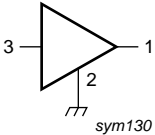
## 1.4 Quick reference data

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; $R_{bias} = 51$ $\Omega$ ; $T_j = 25$ °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 $f = 1950$ MHz	-	21 20	-	dBm dBm

## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	RF_OUT/BIAS		 sym130
2	GND		
3	RF_IN		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
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	$T_{sp} \leq 70\text{ °C}$	[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	$T_{sp} \leq 70\text{ °C}$	[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**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_D$	DC device voltage	on pin 1; $I_S = 81\text{ mA}$	-	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**

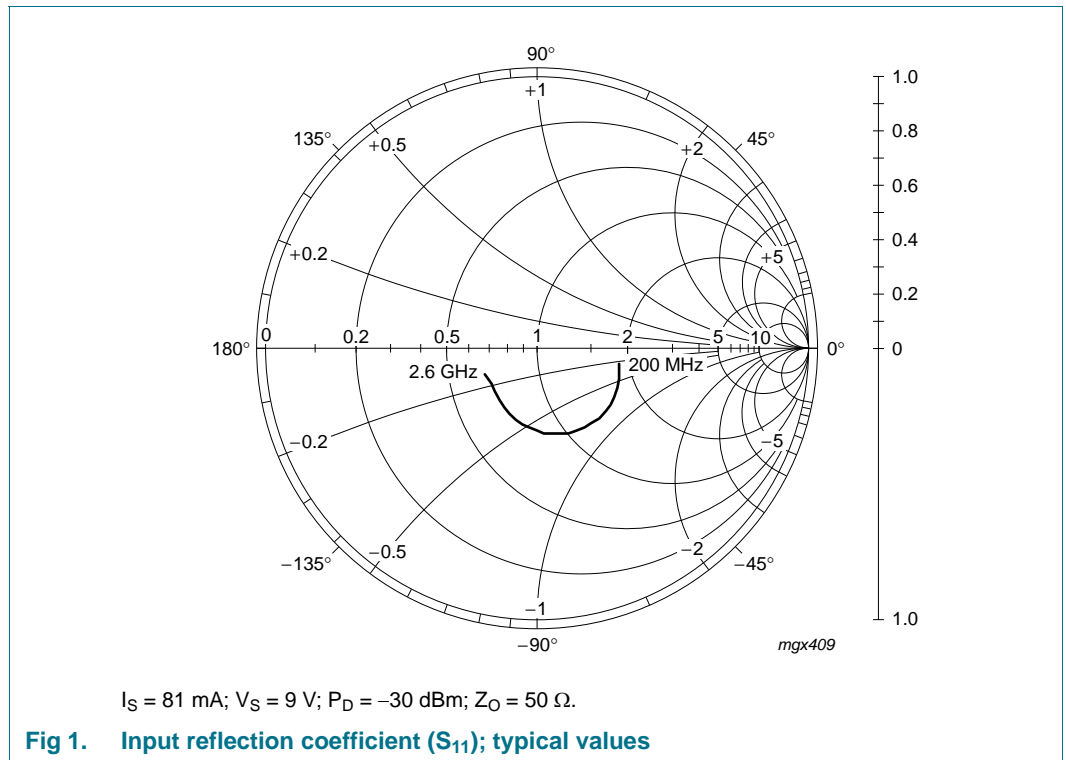
$V_S = 9\text{ V}$ ;  $I_S = 81\text{ mA}$ ;  $T_{amb} = 25\text{ °C}$ ;  $R_{bias} = 51\ \Omega$ ;  $IP3_{(out)}$  tone spacing = 1 MHz;  $P_L = 0\text{ dBm}$  per tone (see [Figure 10](#));  $Z_L = Z_S = 50\ \Omega$ ; unless otherwise specified.

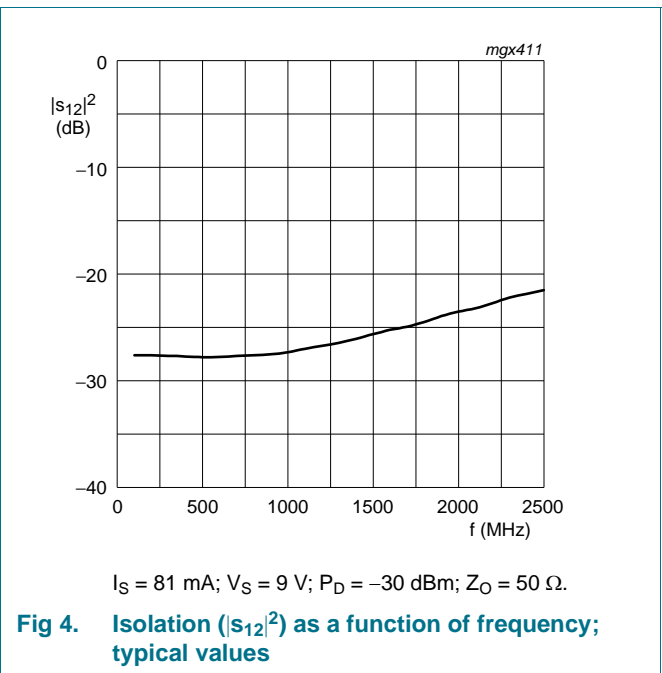
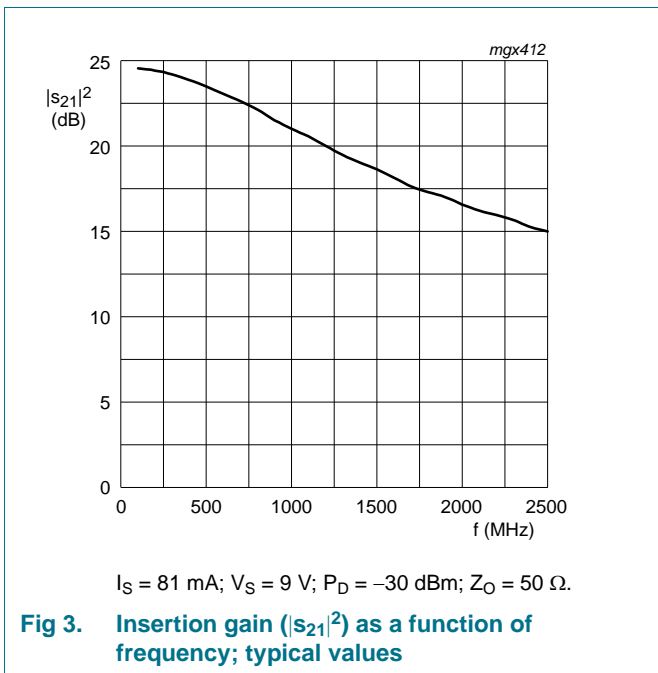
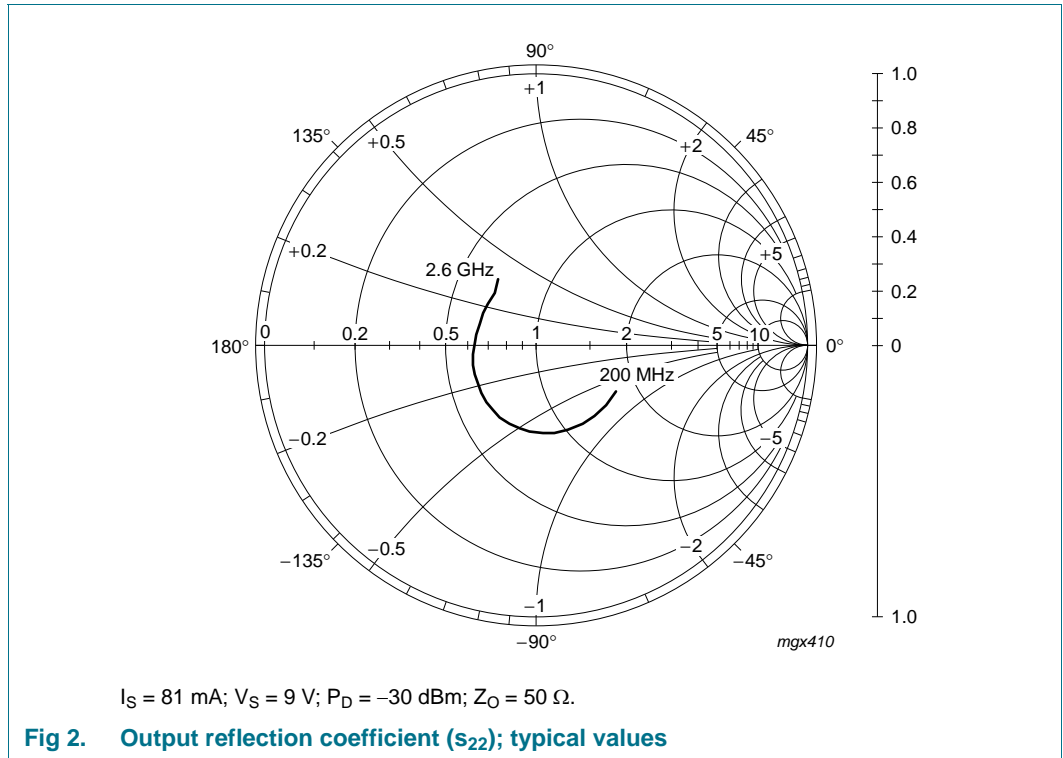
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ S_{21} ^2$	insertion power gain	$f = 850\text{ MHz}$	-	22	-	dB
		$f = 1950\text{ MHz}$	-	17	-	dB
		$f = 2500\text{ MHz}$	-	15	-	dB
$R_{LIN}$	return losses input	$f = 850\text{ MHz}$	-	9	-	dB
		$f = 1950\text{ MHz}$	-	11	-	dB
		$f = 2500\text{ MHz}$	-	15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

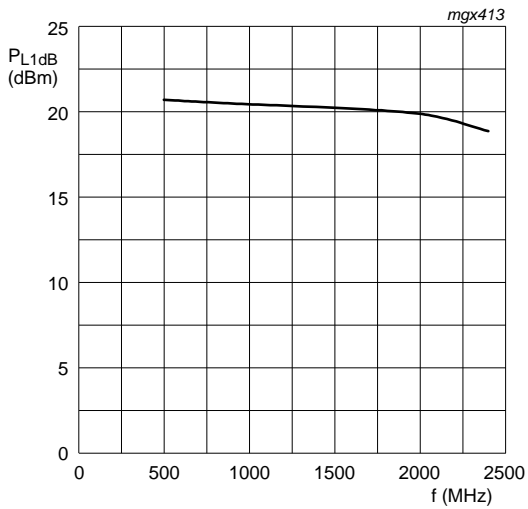
**Table 8. Characteristics ...continued**

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

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

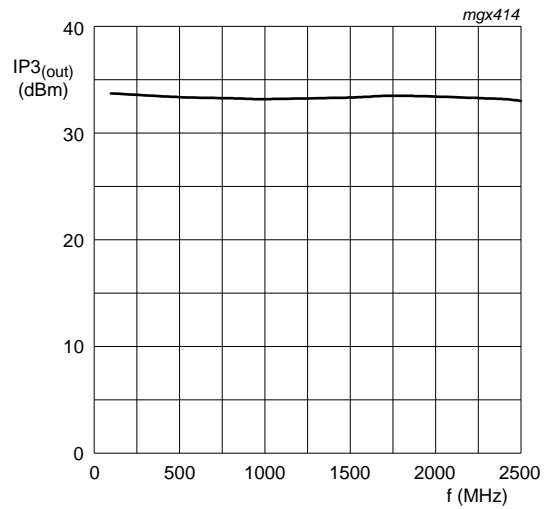






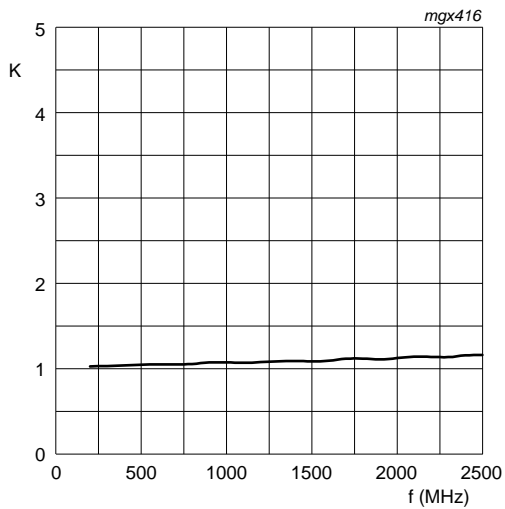
$I_S = 81 \text{ mA}$ ;  $V_S = 9 \text{ V}$ ;  $Z_O = 50 \Omega$ .

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



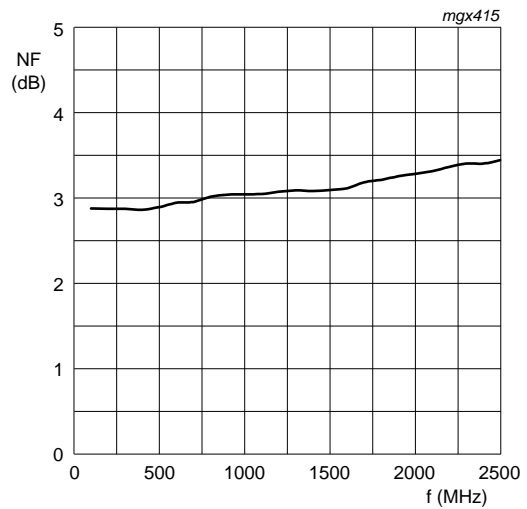
$I_S = 81 \text{ mA}$ ;  $V_S = 9 \text{ V}$ ;  $P_L = 0 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

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



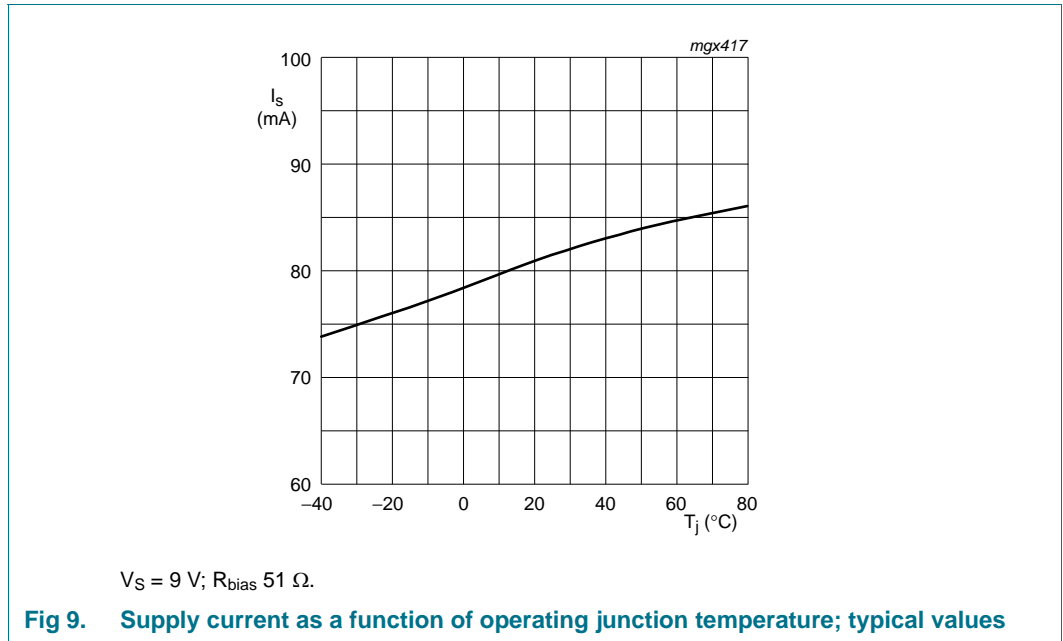
$I_S = 81 \text{ mA}$ ;  $V_S = 9 \text{ V}$ ;  $Z_O = 50 \Omega$ .

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



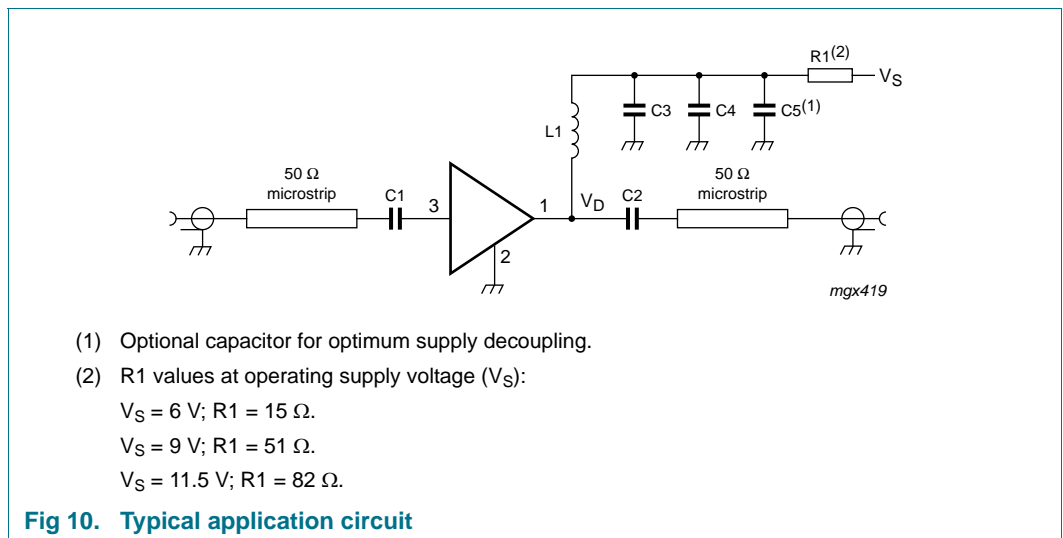
$I_S = 81 \text{ mA}$ ;  $V_S = 9 \text{ V}$ ;  $Z_O = 50 \Omega$ .

**Fig 8. Noise figure as a function of frequency; 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.



**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 <sup>[1]</sup>	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 <sub>S</sub> = 9 V	-	51 Ω	51 Ω	51 Ω	51 Ω	51 Ω

[1] Optional.

**Table 10. Scattering parameters**

I<sub>S</sub> = 81 mA; V<sub>S</sub> = 9 V; P<sub>D</sub> = -30 dBm; Z<sub>O</sub> = 50 Ω; T<sub>amb</sub> = 25 °C.

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		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** $I_S = 81\text{ mA}$ ;  $V_S = 9\text{ V}$ ;  $P_D = -30\text{ dBm}$ ;  $Z_O = 50\ \Omega$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ .

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		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

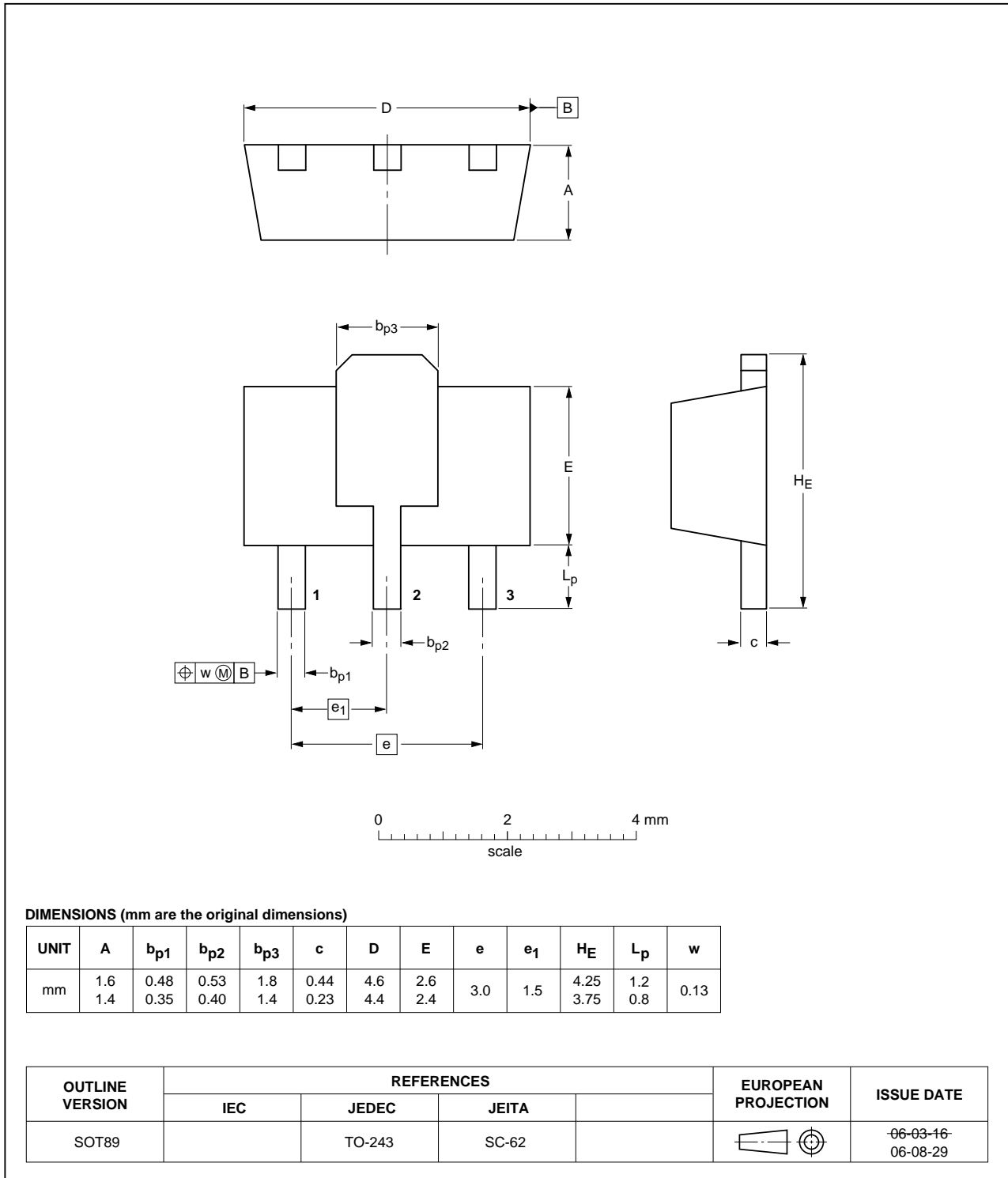


Fig 11. Package outline SOT89 (SC-62)

## 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:				
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 <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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