



# BGM1014

## MMIC wideband amplifier

Rev. 01 — 11 March 2005

Product data sheet

## 1. Product profile

### 1.1 General description

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband amplifier with internal matching circuit in a 6-pin SOT363 SMD plastic package.

#### CAUTION



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

### 1.2 Features

- Internally matched to 50  $\Omega$
- Good output match to 75  $\Omega$
- 32 dB to 34 dB positive sloped gain for Low Noise Block (LNB) application
- 12.9 dBm saturated load power at 1 GHz
- 40 dB isolation

### 1.3 Applications

- LNB Intermediate Frequency (IF) amplifiers
- Cable systems
- General purpose

### 1.4 Quick reference data

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_S$	DC supply voltage	RF input; AC coupled	-	5	6	V
$I_S$	DC supply current		17	21.0	25	mA
$ S_{21} ^2$	insertion power gain	$f = 1$ GHz	31.5	32.3	33.0	dB
NF	noise figure	$f = 1$ GHz	-	4.2	4.3	dB
$P_{L(sat)}$	saturated load power	$f = 1$ GHz	12.5	12.9	-	dBm

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## 2. Pinning information

Table 2: Pinning

Pin	Description	Simplified outline	Symbol
1	V <sub>S</sub>		
2, 5	GND2		
3	RF_OUT		
4	GND1		
6	RF_IN		

## 3. Ordering information

Table 3: Ordering information

Type number	Package		
	Name	Description	Version
BGM1014	SC-88	plastic surface mounted package; 6 leads	SOT363

## 4. Marking

Table 4: Marking

Type number	Marking code
BGM1014	C5-

## 5. Limiting values

Table 5: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>S</sub>	DC supply voltage	RF input; AC coupled	-	6	V
I <sub>S</sub>	supply current		-	30	mA
P <sub>tot</sub>	total power dissipation	T <sub>sp</sub> ≤ 90 °C	-	200	mW
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
P <sub>D</sub>	maximum drive power		-	-10	dBm

## 6. Recommended operating conditions

Table 6: Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>S</sub>	DC supply voltage		4.5	5.0	5.5	V
T <sub>amb</sub>	ambient temperature		-40	+25	+85	°C

## 7. Thermal characteristics

**Table 7: Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$P_{tot} = 200 \text{ mW}; T_{sp} \leq 90 \text{ }^\circ\text{C}$	300	K/W

## 8. Characteristics

**Table 8: Characteristics**

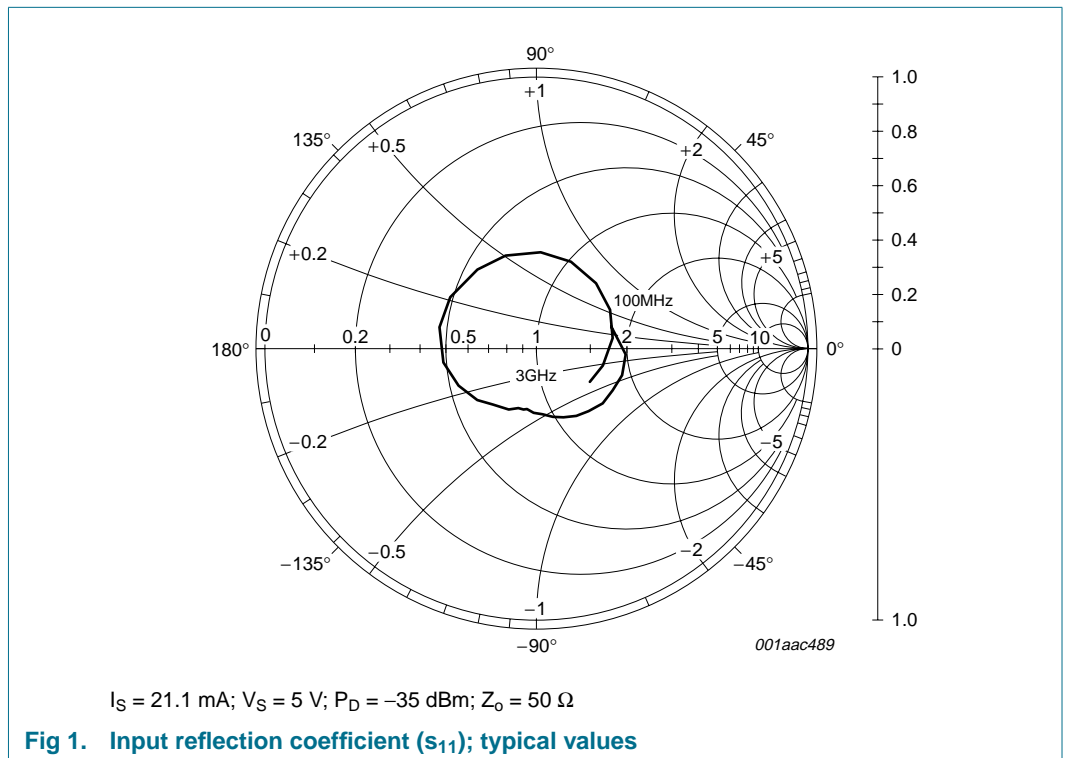
$V_S = 5 \text{ V}; I_S = 21.1 \text{ mA}; T_j = 25 \text{ }^\circ\text{C};$  measured on demo board; unless otherwise specified.

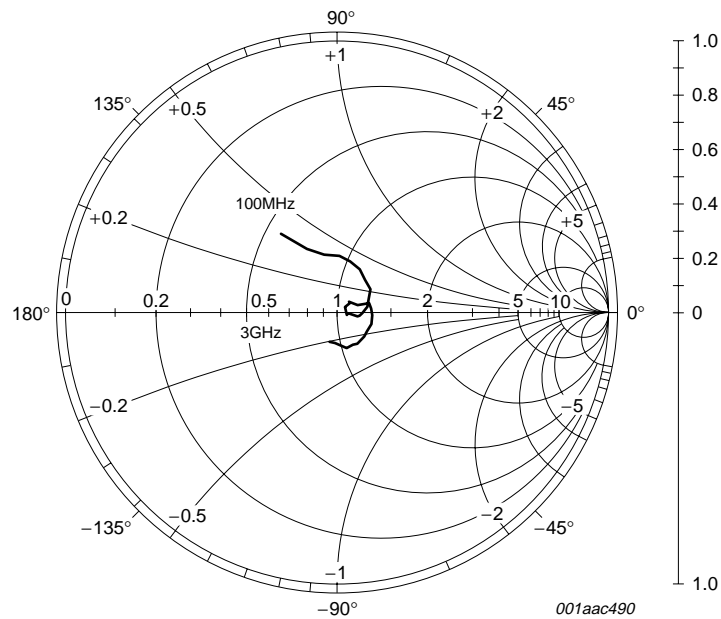
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_S$	DC supply voltage	RF input; AC coupled	-	5	6	V
$I_S$	supply current		17	21.0	25	mA
$ S_{21} ^2$	insertion power gain	see <a href="#">Figure 4</a>				
		$f = 100 \text{ MHz}$	29.0	30.0	31.0	dB
		$f = 1 \text{ GHz}$	31.5	32.3	33.0	dB
		$f = 1.8 \text{ GHz}$	34.0	35.2	36.5	dB
		$f = 2.2 \text{ GHz}$	33.0	34.1	35.5	dB
		$f = 2.6 \text{ GHz}$	29.0	30.5	32.0	dB
		$f = 3 \text{ GHz}$	25.0	26.4	28.0	dB
$ S_{11} ^2$	input return loss	$f = 1 \text{ GHz}$	11	12.2	-	dB
		$f = 2.2 \text{ GHz}$	7.5	8.8	-	dB
$ S_{22} ^2$	output return loss	$Z_L = 50 \text{ } \Omega$				
		$f = 1 \text{ GHz}$	15	18.9	-	dB
		$f = 2.2 \text{ GHz}$	12	16.7	-	dB
		$Z_L = 75 \text{ } \Omega$				
		$f = 1 \text{ GHz}$	12	16.8	-	dB
		$f = 2.2 \text{ GHz}$	12	17.7	-	dB
$ S_{12} ^2$	isolation	see <a href="#">Figure 3</a>				
		$f = 1 \text{ GHz}$	40	42	-	dB
		$f = 2.2 \text{ GHz}$	35	37	-	dB
NF	noise figure	see <a href="#">Figure 7</a>				
		$f = 1 \text{ GHz}$	-	4.2	4.3	dB
		$f = 2.2 \text{ GHz}$	-	4.1	4.3	dB
B	bandwidth	3 dB below flat gain at $f = 1 \text{ GHz}$	-	2.5	-	GHz
K	stability factor	see <a href="#">Figure 8</a>				
		$f = 1 \text{ GHz}$	1.5	1.6	-	
		$f = 2.2 \text{ GHz}$	0.9	1.0	-	
$P_{L(sat)}$	saturated load power	$f = 1 \text{ GHz}$	12.5	12.9	-	dBm
		$f = 2.2 \text{ GHz}$	8.8	9.3	-	dBm
$P_{L(1dB)}$	load power at 1 dB gain compression	$f = 1 \text{ GHz}$	10.5	11.2	-	dBm
		$f = 2.2 \text{ GHz}$	5.0	5.7	-	dBm

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

$V_S = 5\text{ V}$ ;  $I_S = 21.1\text{ mA}$ ;  $T_j = 25\text{ }^\circ\text{C}$ ; measured on demo board; unless otherwise specified.

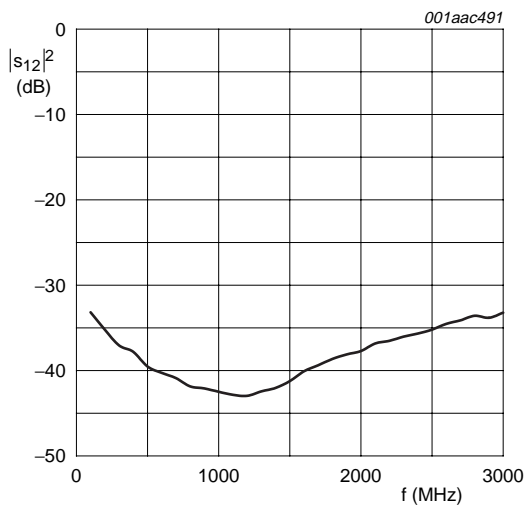
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IP3 <sub>in</sub>	input third order intercept point	f = 1 GHz	-13	-11.8	-	dBm
		f = 2.2 GHz	-21	-19	-	dBm
IP3 <sub>out</sub>	output third order intercept point	f = 1 GHz	19.5	20.5	-	dBm
		f = 2.2 GHz	14	15.1	-	dBm
IM2	second order intermodulation distortion	f <sub>0</sub> = 1 GHz; P <sub>L</sub> = -10 dBm	36	37	-	dBc
		f <sub>0</sub> = 1 GHz; P <sub>L</sub> = -5 dBm	33	34	-	dBc





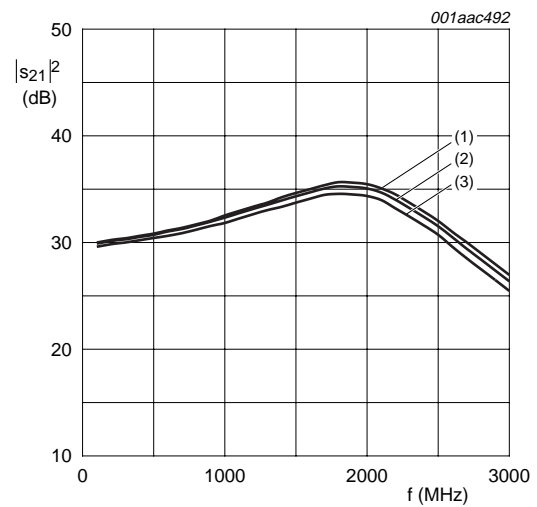
$I_S = 21.1 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $P_D = -35 \text{ dBm}$ ;  $Z_o = 50 \Omega$

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



$I_S = 21.1 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $P_D = -35 \text{ dBm}$ ;  $Z_o = 50 \Omega$

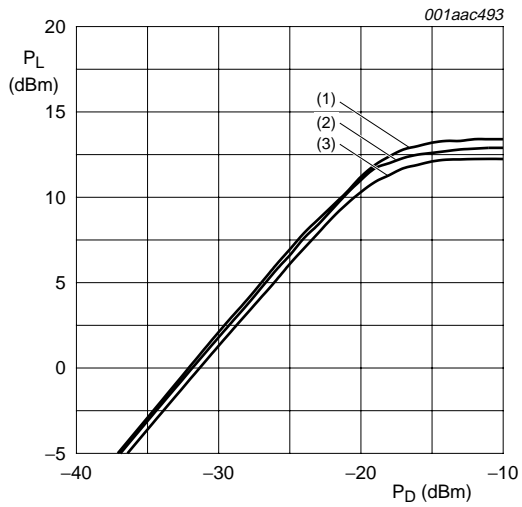
Fig 3. Isolation ( $|s_{12}|^2$ ) as a function of frequency; typical values



$P_D = -35 \text{ dBm}$ ;  $Z_o = 50 \Omega$

- (1)  $I_S = 25.6 \text{ mA}$ ;  $V_S = 5.5 \text{ V}$
- (2)  $I_S = 21.5 \text{ mA}$ ;  $V_S = 5 \text{ V}$
- (3)  $I_S = 16.6 \text{ mA}$ ;  $V_S = 4.5 \text{ V}$

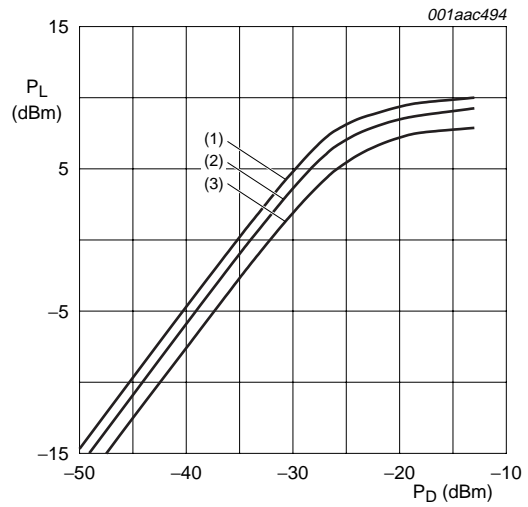
Fig 4. Insertion gain ( $|s_{21}|^2$ ) as a function of frequency; typical values



$f = 1 \text{ GHz}; Z_o = 50 \Omega$

- (1)  $V_S = 5.5 \text{ V}$
- (2)  $V_S = 5 \text{ V}$
- (3)  $V_S = 4.5 \text{ V}$

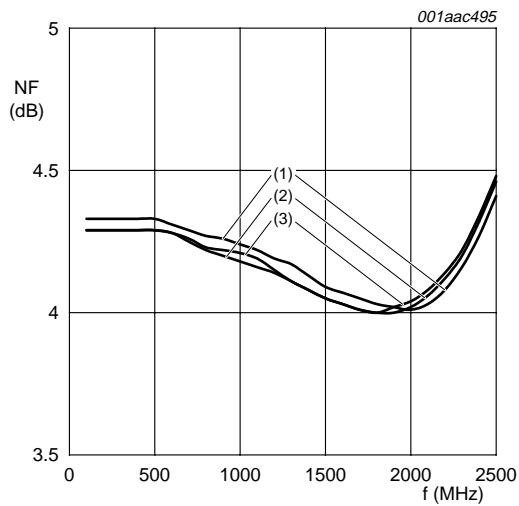
**Fig 5. Load power as a function of drive power at 1 GHz; typical values**



$f = 2.2 \text{ GHz}; Z_o = 50 \Omega$

- (1)  $V_S = 5.5 \text{ V}$
- (2)  $V_S = 5 \text{ V}$
- (3)  $V_S = 4.5 \text{ V}$

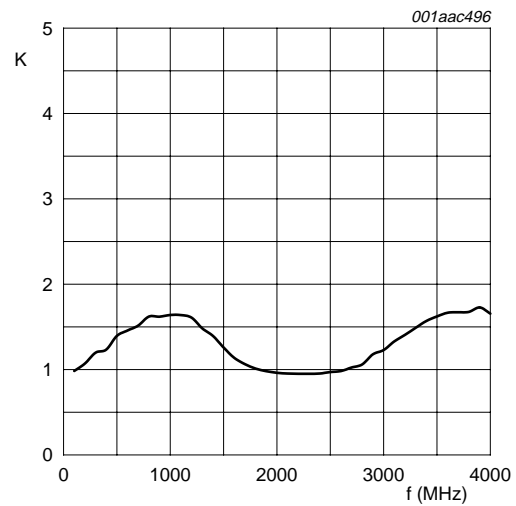
**Fig 6. Load power as a function of drive power at 2.2 GHz; typical values**



$Z_o = 50 \Omega$

- (1)  $V_S = 5.5 \text{ V}$
- (2)  $V_S = 5 \text{ V}$
- (3)  $V_S = 4.5 \text{ V}$

**Fig 7. Noise figure as a function of frequency; typical values**



$I_S = 21.1 \text{ mA}; V_S = 5 \text{ V}; Z_o = 50 \Omega$

**Fig 8. Stability factor as a function of frequency; typical values**

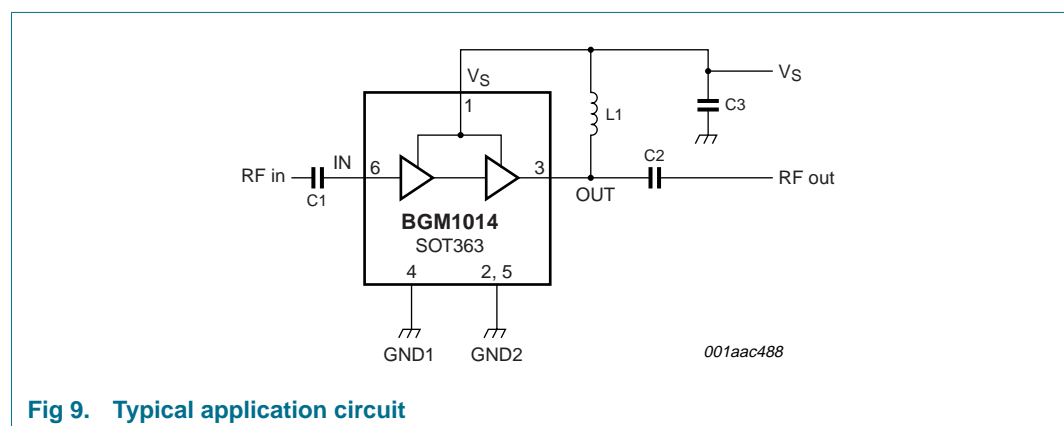
## 9. Application information

[Figure 9](#) shows a typical application circuit for the BGM1014 MMIC. The device is internally matched to  $50\ \Omega$  and therefore does not need any external matching. Good impedance matching is also achieved with a  $75\ \Omega$  load. The value of the input and output DC blocking capacitors C1 and C2 should be not more than 100 pF for applications above 100 MHz. Their values can be used to fine-tune the input and output impedance.

For the RF choke, optimal results are obtained with a good quality chip inductor like the TDK MLG1608 (0603) or a wire-wound SMD. The value of the inductor can be used to fine-tune the output impedance.

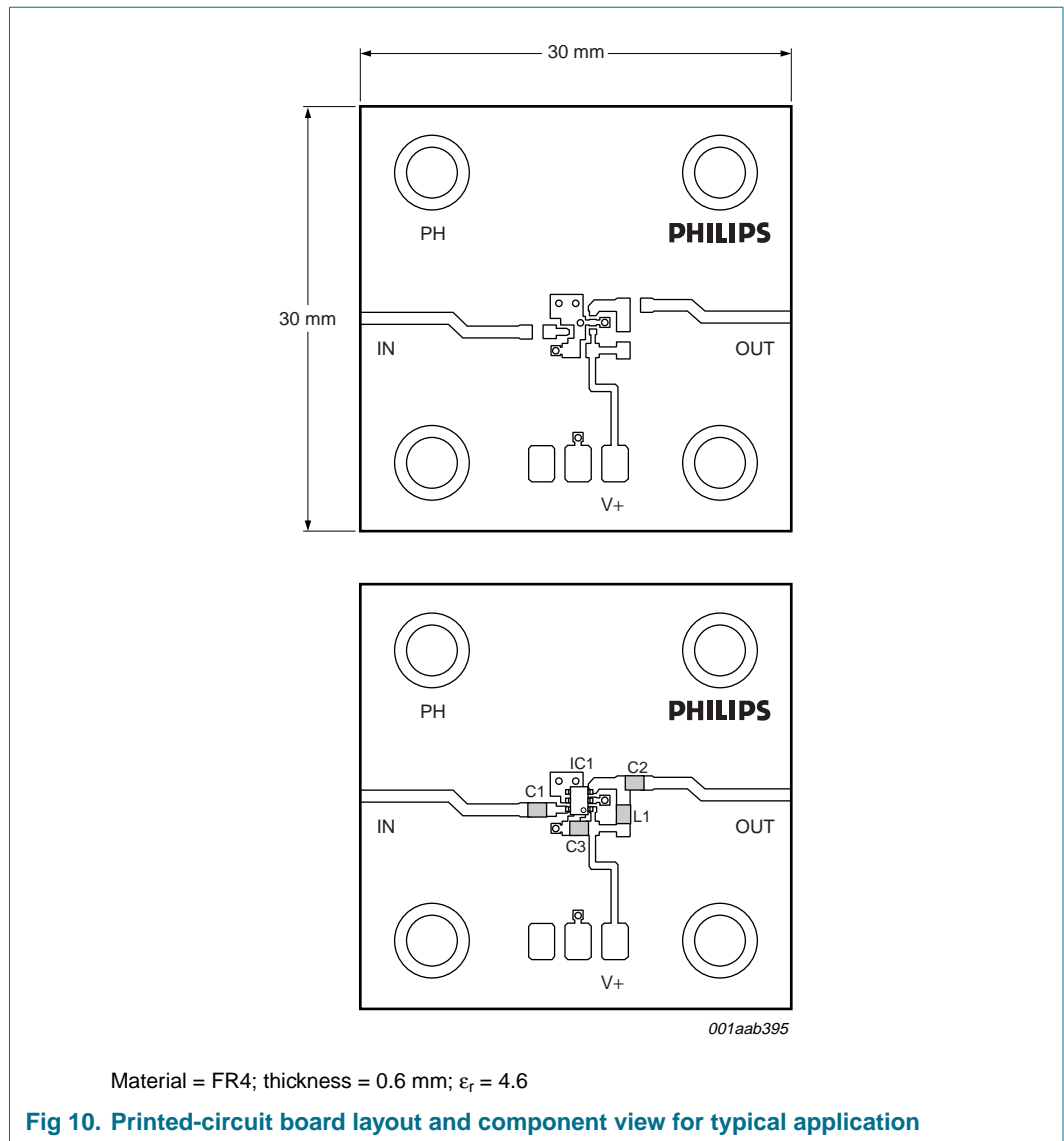
The RF choke and supply decoupling components should be located as close as possible to the MMIC.

Ground paths must be as short as possible. The printed-circuit board (PCB) top ground plane must be as close as possible to the MMIC, and ideally directly beneath it. When using vias, use at least 3 vias for the top ground plane in order to limit ground path inductance. Supply decoupling with C3 should be from pin 1 to the same top ground plane.



**Fig 9. Typical application circuit**

Figure 10 shows the PCB layout used for the typical application.



**Table 9: List of components used for the typical application**

Component	Description	Value	Dimensions
C1, C2	multilayer ceramic chip capacitor	100 pF	0603
C3	multilayer ceramic chip capacitor	22 nF	0603
L1	SMD inductor	100 nH	0603



**Table 10: Scattering parameters** $V_S = 5\text{ V}$ ;  $I_S = 21.1\text{ mA}$ ;  $P_D = -35\text{ dBm}$ ;  $Z_o = 50\ \Omega$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; measured on demo board.

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		K-factor
	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	
100	0.287	16.1	31.28	9.1	0.02196	9.4	0.355	125.5	1.0
200	0.328	-3.9	32.14	-7.1	0.01734	-3.3	0.258	115.3	1.1
400	0.319	-28.8	33.57	-30.9	0.01287	-21.1	0.208	87.6	1.2
600	0.299	-50.3	35.61	-52.3	0.00969	-35.3	0.179	62.1	1.5
800	0.272	-68.6	38.05	-73.3	0.00808	-42.7	0.149	34.7	1.6
1000	0.243	-84.7	41.37	-95.5	0.00751	-44.8	0.113	10.3	1.6
1200	0.225	-98.9	45.48	-119.1	0.00711	-43.7	0.084	-8.1	1.6
1400	0.229	-106.9	49.78	-144.8	0.00792	-37.3	0.042	-4.5	1.4
1600	0.261	-127.8	54.37	-173.0	0.00991	-37.9	0.042	34.4	1.1
1800	0.317	-154.4	57.96	154.4	0.01171	-37.2	0.059	41.5	1.0
2000	0.364	167.7	56.65	120.1	0.01302	-45.7	0.123	15.9	1.0
2200	0.362	126.7	50.11	85.0	0.01493	-60.5	0.130	-4.6	1.0
2400	0.354	87.5	41.68	54.6	0.01647	-69.8	0.130	-32.5	1.0
2600	0.325	47.6	33.47	25.9	0.01878	-81.7	0.137	-57.1	1.0
2800	0.282	7.7	26.34	1.4	0.02094	-94.0	0.135	-74.9	1.1
3000	0.231	-32.0	20.81	-20.3	0.02184	-112.2	0.112	-104.3	1.2

10. Package outline

Plastic surface mounted package; 6 leads

SOT363

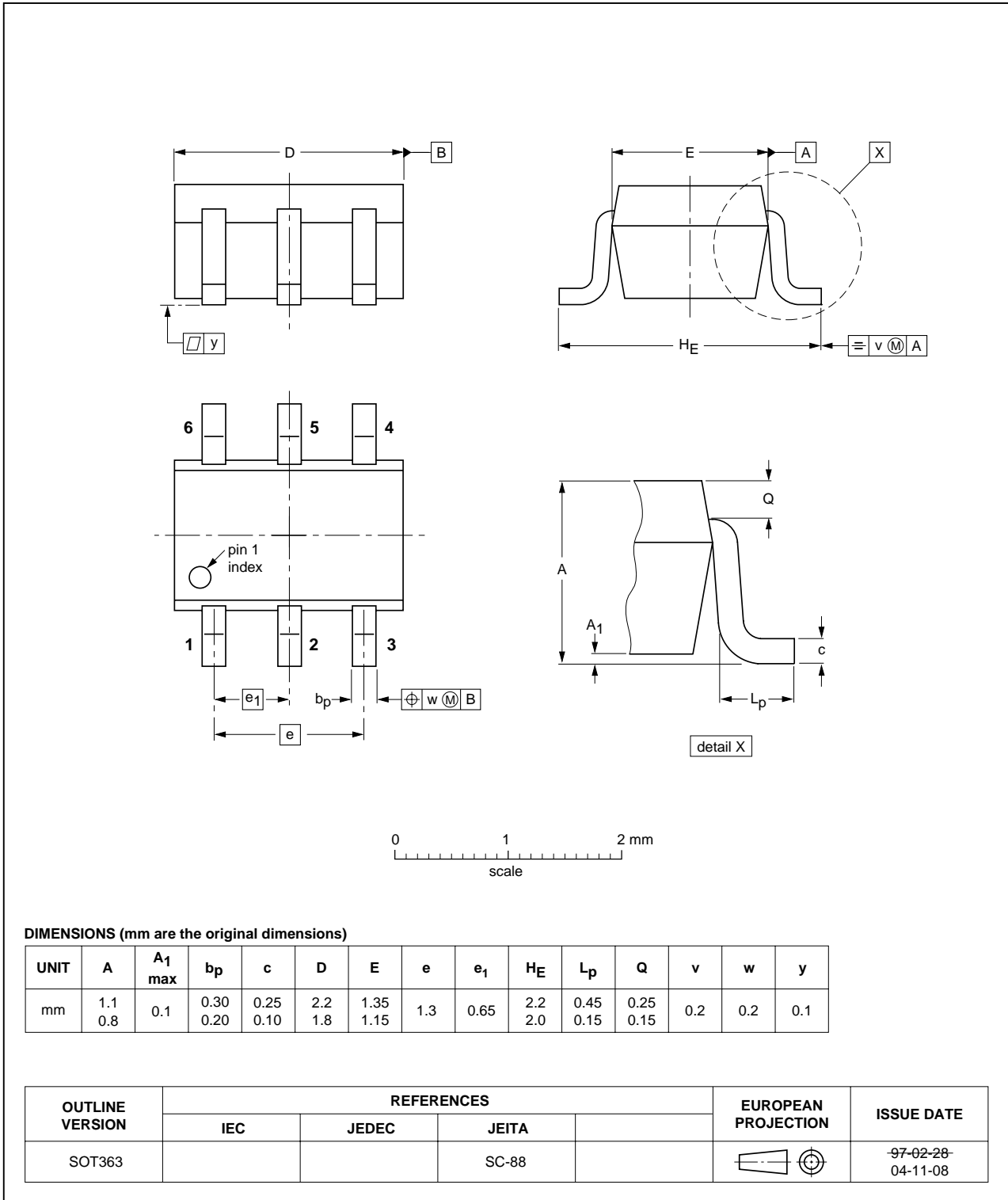


Fig 11. Package outline SOT363 (SC-88)

## 11. Revision history

Table 11: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BGM1014_1	20050311	product data sheet	-	9370 750 14499	-

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Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[3]</sup>	Definition
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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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