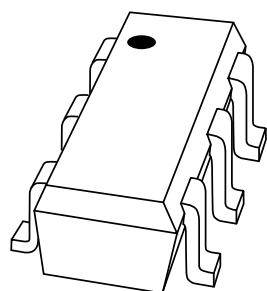


# DATA SHEET



## **BGM1012** MMIC wideband amplifier

Product specification  
Supersedes data of 2002 May 16

2002 Sep 06



MMIC wideband amplifier

BGM1012

FEATURES

- Internally matched to 50  $\Omega$
- Very wide frequency range (4 GHz at 3 dB bandwidth)
- Very flat 20 dB gain (DC to 2.9 GHz at 1 dB flatness)
- 10 dBm saturated output power at 1 GHz
- High linearity (18 dBm IP3<sub>(out)</sub> at 1 GHz)
- Low current (14.6 mA)
- Unconditionally stable.

APPLICATIONS

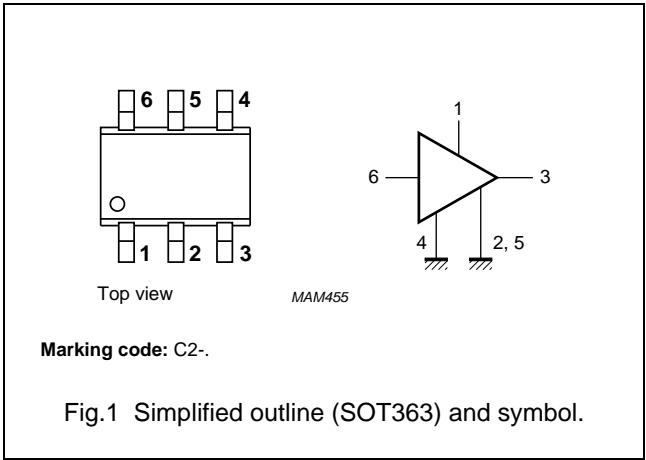
- LNB IF amplifiers
- Cable systems
- ISM
- General purpose.

DESCRIPTION

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

PINNING

PIN	DESCRIPTION
1	V <sub>S</sub>
2, 5	GND2
3	RF out
4	GND1
6	RF in



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V <sub>S</sub>	DC supply voltage		3	4	V
I <sub>S</sub>	DC supply current		14.6	–	mA
s <sub>21</sub>   <sup>2</sup>	insertion power gain	f = 1 GHz	20.1	–	dB
NF	noise figure	f = 1 GHz	4.8	–	dB
P <sub>L(sat)</sub>	saturated load power	f = 1 GHz	9.7	–	dBm

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling.

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**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	–	4	V
I <sub>S</sub>	supply current		–	50	mA
P <sub>tot</sub>	total power dissipation	T <sub>s</sub> ≤ 90 °C	–	200	mW
T <sub>stg</sub>	storage temperature		–65	+150	°C
T <sub>j</sub>	operating junction temperature		–	150	°C
P <sub>D</sub>	maximum drive power		–	10	dBm

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R <sub>th j-s</sub>	thermal resistance from junction to solder point	P <sub>tot</sub> = 200 mW; T <sub>s</sub> ≤ 90 °C	300	K/W

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## CHARACTERISTICS

$V_S = 3\text{ V}$ ;  $I_S = 14.6\text{ mA}$ ;  $T_j = 25\text{ °C}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_S$	supply current		11	14.6	19	mA
$ s_{21} ^2$	insertion power gain	$f = 100\text{ MHz}$	19	19.5	20	dB
		$f = 1\text{ GHz}$	19	20.1	21	dB
		$f = 1.8\text{ GHz}$	19	20.4	21	dB
		$f = 2.2\text{ GHz}$	19	20.4	22	dB
		$f = 2.6\text{ GHz}$	18	19.9	21	dB
		$f = 3\text{ GHz}$	16	18.7	20	dB
$R_{L\text{ IN}}$	return losses input	$f = 1\text{ GHz}$	9	11	–	dB
		$f = 2.2\text{ GHz}$	13	15	–	dB
$R_{L\text{ OUT}}$	return losses output	$f = 1\text{ GHz}$	11	14	–	dB
		$f = 2.2\text{ GHz}$	10	13	–	dB
$ s_{12} ^2$	isolation	$f = 1\text{ GHz}$	30	33	–	dB
		$f = 2.2\text{ GHz}$	35	38	–	dB
NF	noise figure	$f = 1\text{ GHz}$	–	4.8	5.1	dB
		$f = 2.2\text{ GHz}$	–	4.9	5.3	dB
BW	bandwidth	at $ s_{21} ^2 - 3\text{ dB}$ below flat gain at 1 GHz	3.1	3.6	–	GHz
K	stability factor	$f = 1\text{ GHz}$	1.5	2.1	–	–
		$f = 2.2\text{ GHz}$	3	3.4	–	–
$P_{L(\text{sat})}$	saturated load power	$f = 1\text{ GHz}$	8	9.7	–	dBm
		$f = 2.2\text{ GHz}$	3.5	5.6	–	dBm
$P_{L\text{ 1 dB}}$	load power	at 1 dB gain compression; $f = 1\text{ GHz}$	4	6.0	–	dBm
		at 1 dB gain compression; $f = 2.2\text{ GHz}$	1.5	3.4	–	dBm
IP3(in)	input intercept point	$f = 1\text{ GHz}$	–4	–2	–	dBm
		$f = 2.2\text{ GHz}$	–9	–7	–	dBm
IP3(out)	output intercept point	$f = 1\text{ GHz}$	16	18	–	dBm
		$f = 2.2\text{ GHz}$	11	13	–	dBm

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## APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGM1012 MMIC. The device is internally matched to  $50\ \Omega$ , and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2 and C3 should not be more than 100 pF for applications above 100 MHz. However, when the device is operated below 100 MHz, the capacitor value should be increased.

The nominal value of the RF choke L1 is 100 nH. At frequencies below 100 MHz this value should be increased to 220 nH. At frequencies above 1 GHz a much lower value (e.g. 10 nH) can be used to improve return losses. For optimal results, a good quality chip inductor such as the TDK MLG 1608 (0603), or a wire-wound SMD type should be chosen.

Both the RF choke L1 and the 22 nF supply decoupling capacitor C1 should be located as closely as possible to the MMIC.

Separate paths must be used for the ground planes of the ground pins GND1 and GND2, and these paths must be as short as possible. When using vias, use multiple vias per pin in order to limit ground path inductance.

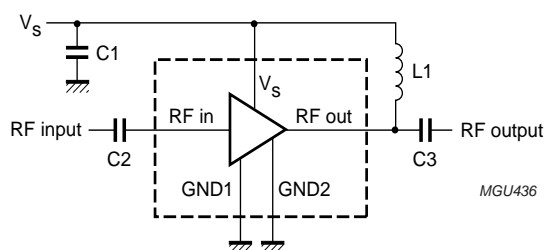


Fig.2 Typical application circuit.

Figure 3 shows two cascaded MMICs. This configuration doubles overall gain while preserving broadband characteristics. Supply decoupling and grounding conditions for each MMIC are the same as those for the circuit of Fig.2.

The excellent wideband characteristics of the MMIC make it an ideal building block in IF amplifier applications such as LBNs (see Fig.4).

As a buffer amplifier between an LNA and a mixer in a receiver circuit, the MMIC offers an easy matching, low noise solution (see Fig.5).

In Fig.6 the MMIC is used as a driver to the power amplifier as part of a transmitter circuit. Good linear performance and matched input and output offer quick design solutions in such applications.

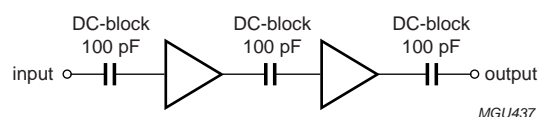


Fig.3 Easy cascading application circuit.

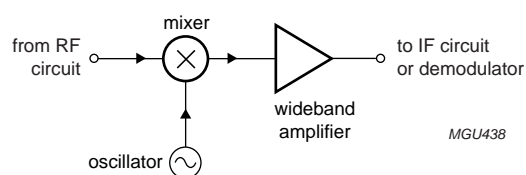


Fig.4 Application as IF amplifier.

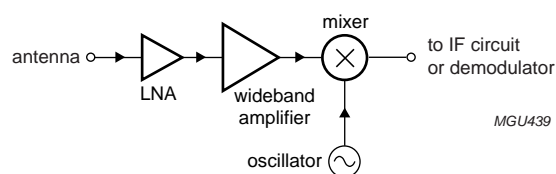


Fig.5 Application as RF amplifier.

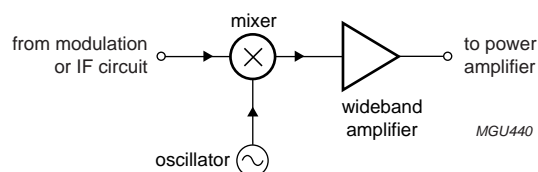
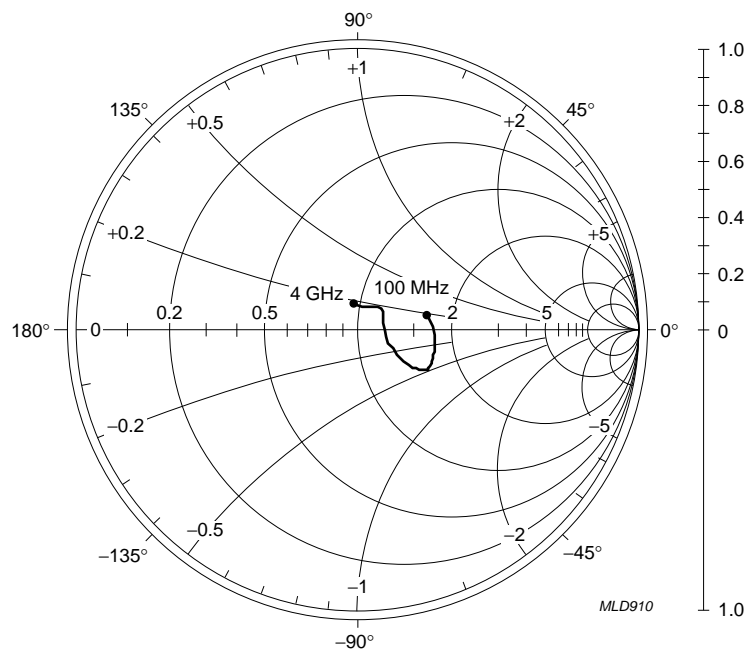


Fig.6 Application as driver amplifier.

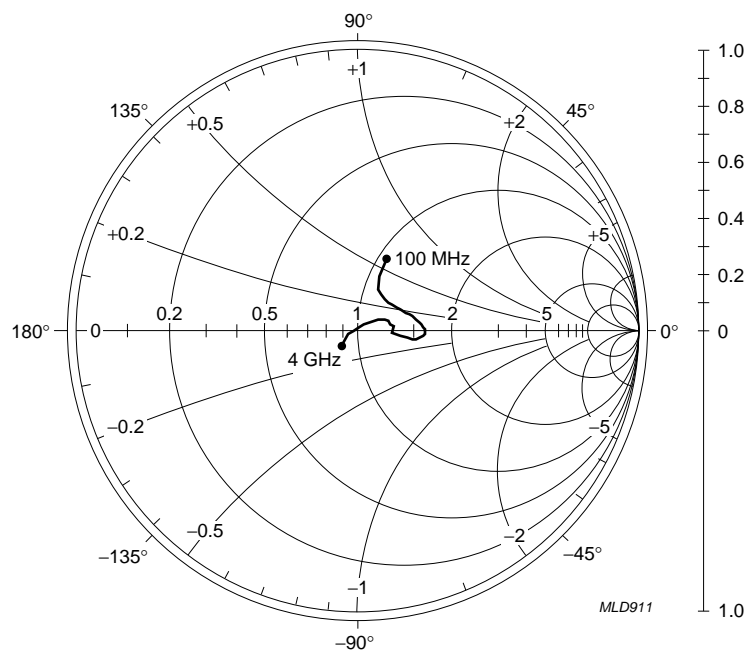
## MMIC wideband amplifier

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$I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.7 Input reflection coefficient ( $s_{11}$ ); typical values.

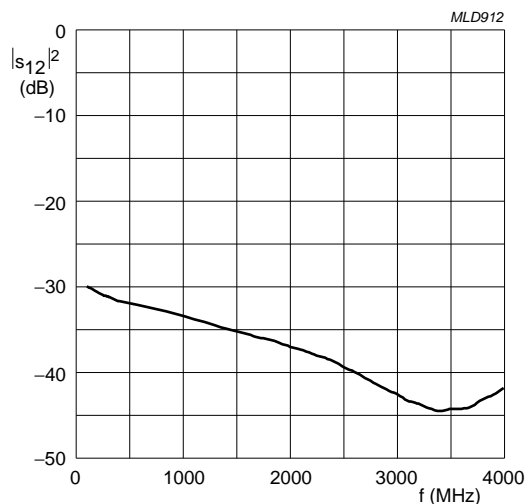


$I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.8 Output reflection coefficient ( $s_{22}$ ); typical values.

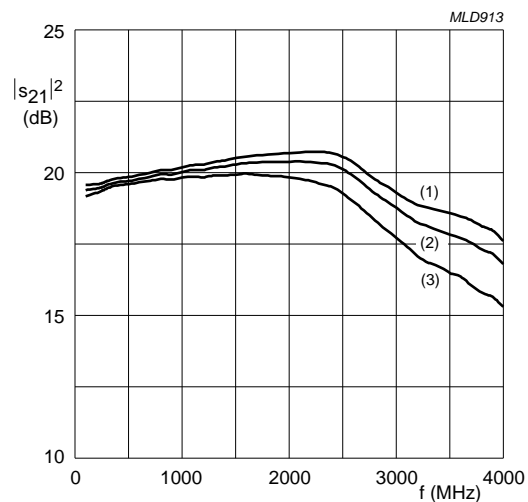
## MMIC wideband amplifier

## BGM1012



$I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.9 Isolation ( $|s_{12}|^2$ ) as a function of frequency; typical values.



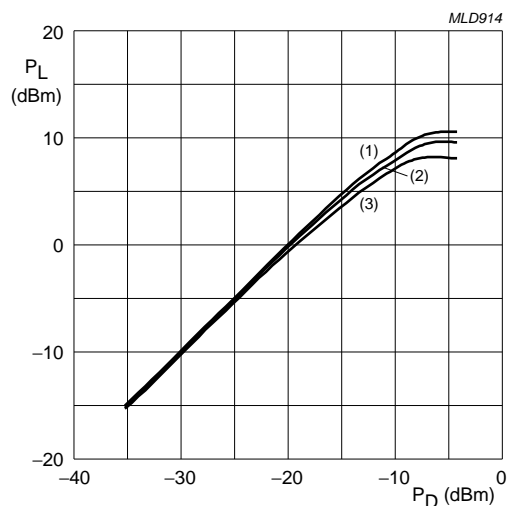
$P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

(1)  $I_S = 18.7 \text{ mA}$ ;  $V_S = 3.3 \text{ V}$ .

(2)  $I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ .

(3)  $I_S = 10.6 \text{ mA}$ ;  $V_S = 2.7 \text{ V}$ .

Fig.10 Insertion gain ( $|s_{21}|^2$ ) as a function of frequency; typical values.



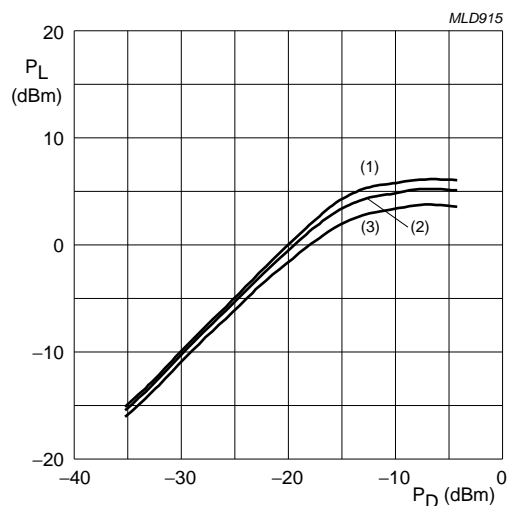
$f = 1 \text{ GHz}$ ;  $Z_O = 50 \Omega$ .

(1)  $V_S = 3.3 \text{ V}$ .

(2)  $V_S = 3 \text{ V}$ .

(3)  $V_S = 2.7 \text{ V}$ .

Fig.11 Load power as a function of drive power at 1 GHz; typical values.



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

(1)  $V_S = 3.3 \text{ V}$ .

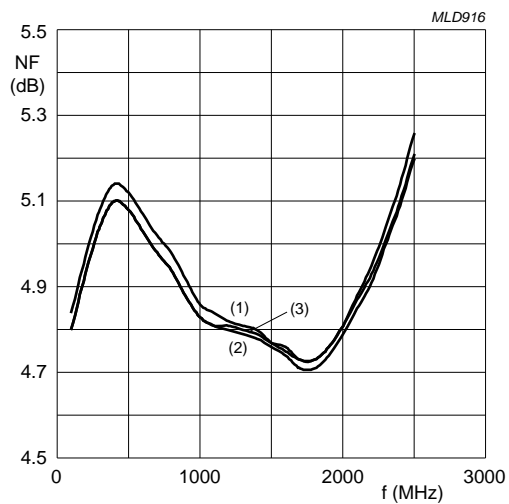
(2)  $V_S = 3 \text{ V}$ .

(3)  $V_S = 2.7 \text{ V}$ .

Fig.12 Load power as a function of drive power at 2.2 GHz; typical values.

## MMIC wideband amplifier

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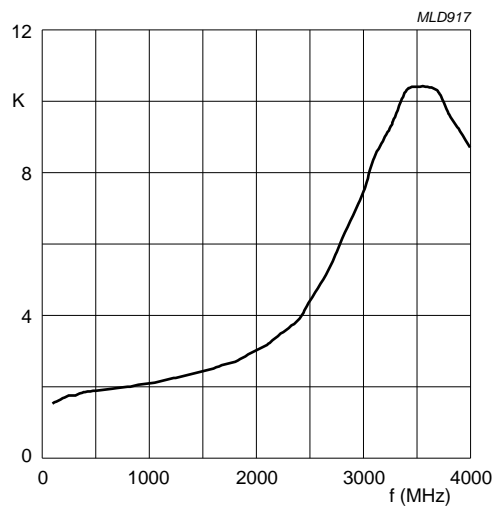
$Z_O = 50 \Omega$ .

(1)  $I_S = 10.6 \text{ mA}$ ;  $V_S = 2.7 \text{ V}$ .

(2)  $I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ .

(3)  $I_S = 18.7 \text{ mA}$ ;  $V_S = 3.3 \text{ V}$ .

Fig.13 Noise figure as a function of frequency; typical values.



$I_S = 14.6 \text{ mA}$ ;  $V_S = 3 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.14 Stability factor as a function of frequency; typical values.



## MMIC wideband amplifier

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## Scattering parameters

 $V_S = 3\text{ V}$ ;  $I_S = 14.6\text{ mA}$ ;  $P_D = -30\text{ dBm}$ ;  $Z_O = 50\text{ }\Omega$ ;  $T_{\text{amb}} = 25\text{ }^\circ\text{C}$ .

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		K-FACTOR
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
100	0.25122	14.607	9.33681	12.018	0.032124	16.445	0.26458	64.156	1.6
200	0.27070	2.759	9.42458	5.676	0.028303	6.37	0.20645	64.153	1.8
400	0.27979	-7.969	9.63627	-8.447	0.026297	-4.545	0.1543	52.558	1.9
600	0.28323	-14.78	9.76543	-19.02	0.024833	-10.24	0.15203	39.347	1.9
800	0.28557	-20.13	9.93782	-27.93	0.023234	-14.62	0.16867	27.926	2.0
1000	0.28673	-24.14	10.03633	-36.88	0.021523	-17.42	0.19196	19.293	2.1
1200	0.28517	-27.57	10.11638	-46.47	0.019830	-19.83	0.21421	12.703	2.2
1400	0.27902	-29.93	10.26450	-56.05	0.018230	-21.14	0.23292	7.154	2.4
1600	0.26682	-31.81	10.40572	-65.76	0.016902	-21.62	0.24605	2.582	2.5
1800	0.24746	-33.12	10.44088	-76.97	0.015759	-22.32	0.25113	-1.26	2.7
2000	0.21894	-33.8	10.46224	-88.33	0.014310	-22.64	0.24367	-4.817	3.0
2200	0.18164	-32.67	10.45202	-100.3	0.013012	-23.13	0.22184	-7.573	3.4
2400	0.14000	-26.75	10.34342	-112.6	0.011826	-23.27	0.18787	-8.489	3.9
2600	0.10418	-10.16	9.87989	-122.9	0.010171	-23.23	0.13049	-4.601	4.9
2800	0.09469	15.051	9.20393	-129.5	0.008664	-16.9	0.1294	9.578	6.2
3000	0.10595	33.415	8.68177	-135.4	0.007541	-9.957	0.1127	18.402	7.5
3200	0.11609	42.888	8.18809	-142.2	0.006655	-0.835	0.092234	23.406	9.0
3400	0.10827	50.017	7.93039	-151.5	0.006042	12.444	0.059268	26.453	10.3
3600	0.09866	60.967	7.77538	-162.2	0.006205	29.297	0.015829	38.211	10.3
3800	0.08693	80.355	7.33775	-172.6	0.007039	40.351	0.028159	-152.8	9.6
4000	0.10090	102.07	6.90878	177.1	0.008241	46.053	0.075298	-133.1	8.7

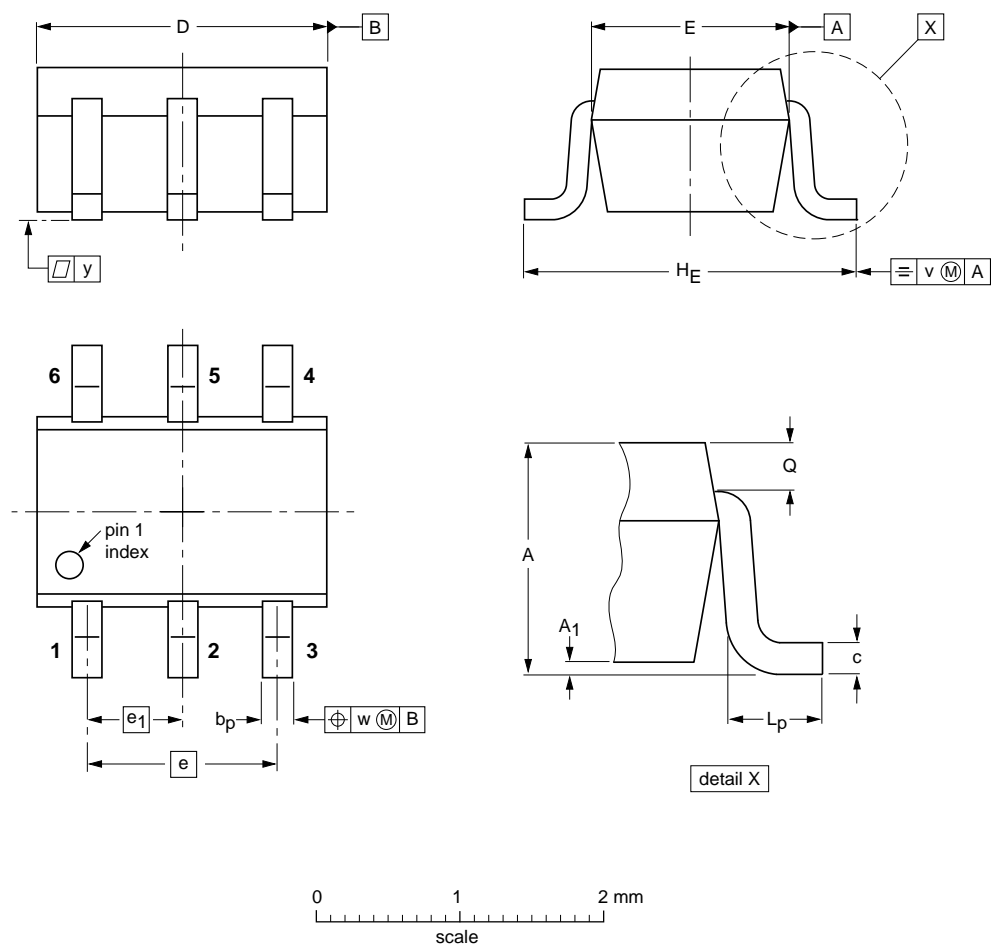
MMIC wideband amplifier

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PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads

SOT363



DIMENSIONS (mm are the original dimensions)

UNIT	A	A1 max	bp	c	D	E	e	e1	HE	Lp	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			04-11-08 06-03-16

## MMIC wideband amplifier

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## DATA SHEET STATUS

DOCUMENT STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)</sup>	DEFINITION
Objective data sheet	Development	This document contains data from the objective specification for product development.
Preliminary data sheet	Qualification	This document contains data from the preliminary specification.
Product data sheet	Production	This document contains the product specification.

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## MMIC wideband amplifier

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***provides High Performance Mixed Signal and Standard Product solutions that leverage its leading RF, Analog, Power Management, Interface, Security and Digital Processing expertise***

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## **Contact information**

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Printed in The Netherlands

R77/03/pp13

Date of release: 2002 Sep 06