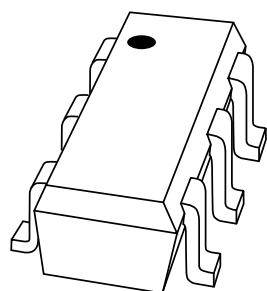


# DATA SHEET



## **BGA2712** MMIC wideband amplifier

Product specification  
Supersedes data of 2002 Jan 31

2002 Sep 10



## MMIC wideband amplifier

## BGA2712

## FEATURES

- Internally matched to 50  $\Omega$
- Wide frequency range (3.2 GHz at 3 dB bandwidth)
- Flat 21 dB gain (DC to 2.6 GHz at 1 dB flatness)
- 5 dBm saturated output power at 1 GHz
- Good linearity (11 dBm IP3<sub>(out)</sub> at 1 GHz)
- Unconditionally stable ( $K > 1.5$ ).

## APPLICATIONS

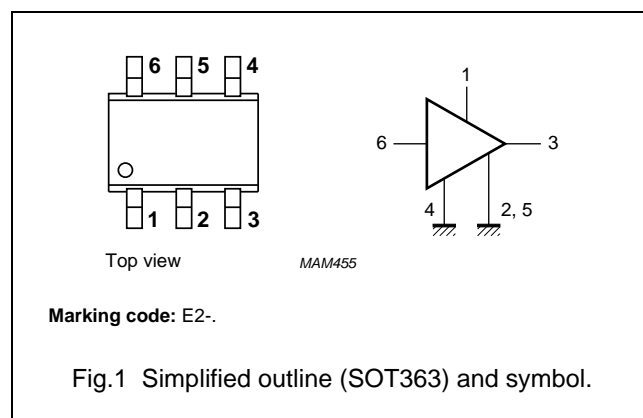
- LNB IF amplifiers
- Cable systems
- ISM
- General purpose.

## 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		5	6	V
I <sub>S</sub>	DC supply current		12.3	–	mA
S <sub>21</sub>   <sup>2</sup>	insertion power gain	f = 1 GHz	21.3	–	dB
NF	noise figure	f = 1 GHz	3.9	–	dB
P <sub>L(sat)</sub>	saturated load power	f = 1 GHz	4.8	–	dBm

## 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		–	35	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

## CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

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## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to solder point	$P_{tot} = 200\text{ mW}$ ; $T_s \leq 90\text{ }^{\circ}\text{C}$	300	K/W

## CHARACTERISTICS

$V_S = 5\text{ V}$ ;  $I_S = 12.3\text{ mA}$ ;  $T_j = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_S$	supply current		9	12.3	15	mA
$ s_{21} ^2$	insertion power gain	$f = 100\text{ MHz}$	20	20.8	22	dB
		$f = 1\text{ GHz}$	20	21.3	22	dB
		$f = 1.8\text{ GHz}$	20	22	23	dB
		$f = 2.2\text{ GHz}$	20	22	23	dB
		$f = 2.6\text{ GHz}$	19	21.2	22	dB
		$f = 3\text{ GHz}$	16	19.3	21	dB
$R_{L\ IN}$	return losses input	$f = 1\text{ GHz}$	12	14	–	dB
		$f = 2.2\text{ GHz}$	8	10	–	dB
$R_{L\ OUT}$	return losses output	$f = 1\text{ GHz}$	17	20	–	dB
		$f = 2.2\text{ GHz}$	15	18	–	dB
$ s_{12} ^2$	isolation	$f = 1.6\text{ GHz}$	31	33	–	dB
		$f = 2.2\text{ GHz}$	36	39	–	dB
NF	noise figure	$f = 1\text{ GHz}$	–	3.9	4.3	dB
		$f = 2.2\text{ GHz}$	–	4.3	4.7	dB
BW	bandwidth	at $ s_{21} ^2 - 3\text{ dB}$ below flat gain at 1 GHz	2.8	3.2	–	GHz
K	stability factor	$f = 1\text{ GHz}$	1.5	2	–	–
		$f = 2.2\text{ GHz}$	2.5	3	–	–
$P_{L(sat)}$	saturated load power	$f = 1\text{ GHz}$	3	4.8	–	dBm
		$f = 2.2\text{ GHz}$	0	1.3	–	dBm
$P_{L\ 1\text{ dB}}$	load power	at 1 dB gain compression; $f = 1\text{ GHz}$	–2	0.2	–	dBm
		at 1 dB gain compression; $f = 2.2\text{ GHz}$	–4	–2	–	dBm
IP3 <sub>(in)</sub>	input intercept point	$f = 1\text{ GHz}$	–12	–10	–	dBm
		$f = 2.2\text{ GHz}$	–14	–16	–	dBm
IP3 <sub>(out)</sub>	output intercept point	$f = 1\text{ GHz}$	9	11	–	dBm
		$f = 2.2\text{ GHz}$	4	6	–	dBm

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## APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2712 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 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.

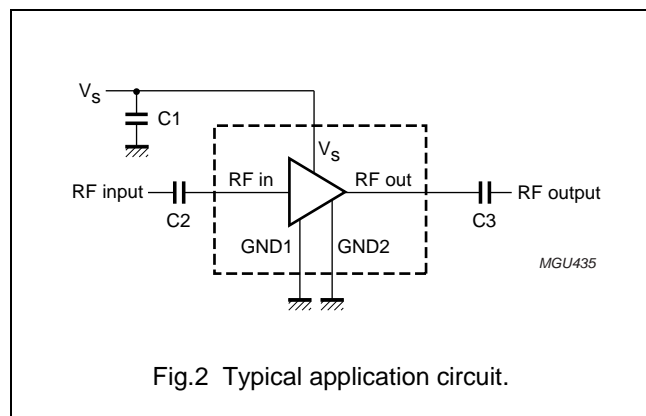


Fig.2 Typical application circuit.

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.

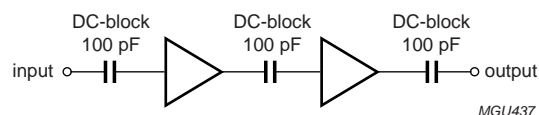


Fig.3 Easy cascading application circuit.

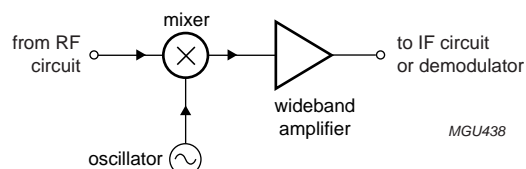


Fig.4 Application as IF amplifier.

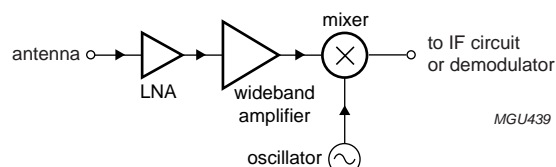


Fig.5 Application as RF amplifier.

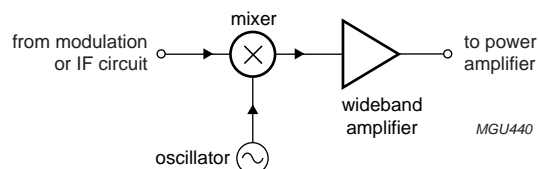
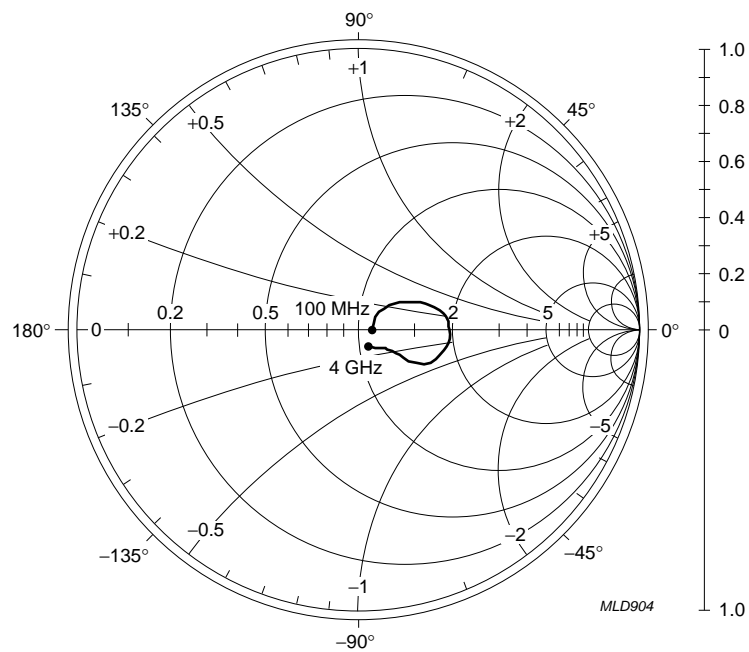


Fig.6 Application as driver amplifier.

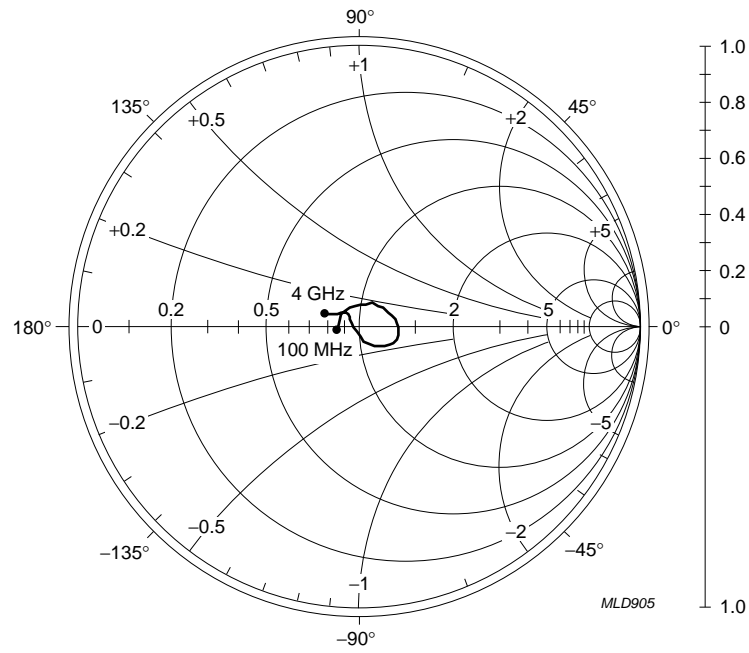
MMIC wideband amplifier

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$I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

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

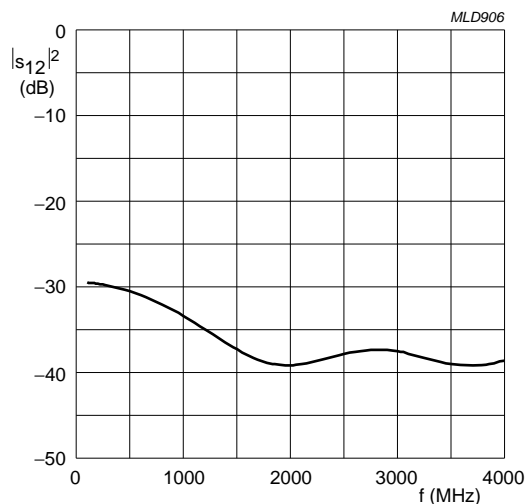


$I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

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

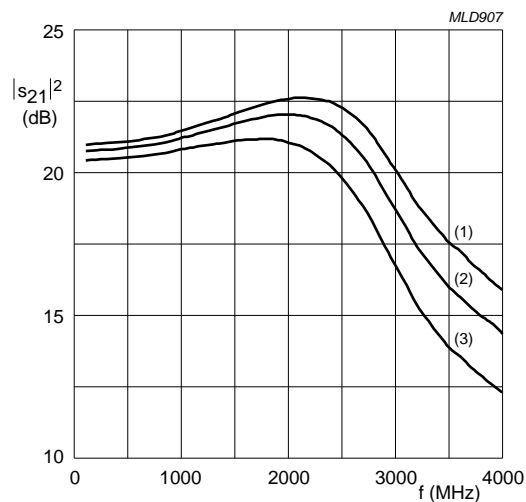
## MMIC wideband amplifier

## BGA2712



$I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

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



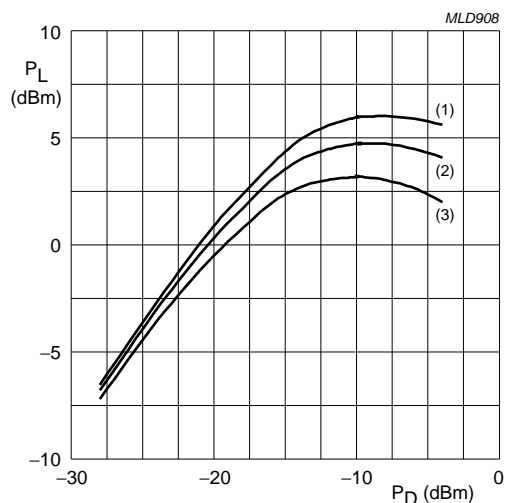
$P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

(1)  $I_S = 15.1 \text{ mA}$ ;  $V_S = 5.5 \text{ V}$ .

(2)  $I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ .

(3)  $I_S = 10.1 \text{ mA}$ ;  $V_S = 4.5 \text{ V}$ .

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



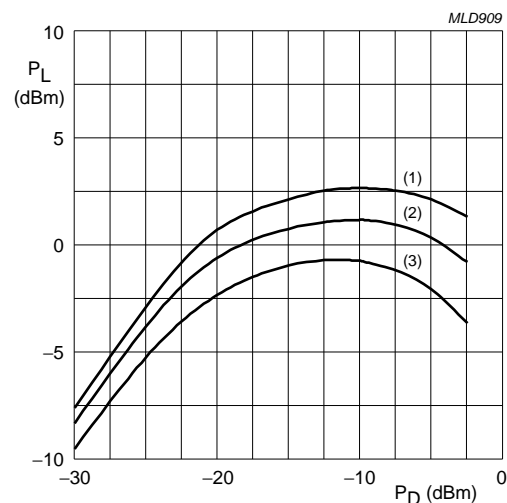
$f = 1 \text{ GHz}$ ;  $Z_O = 50 \Omega$ .

(1)  $V_S = 5.5 \text{ V}$ .

(2)  $V_S = 5 \text{ V}$ .

(3)  $V_S = 4.5 \text{ V}$ .

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)  $V_S = 5.5 \text{ V}$ .

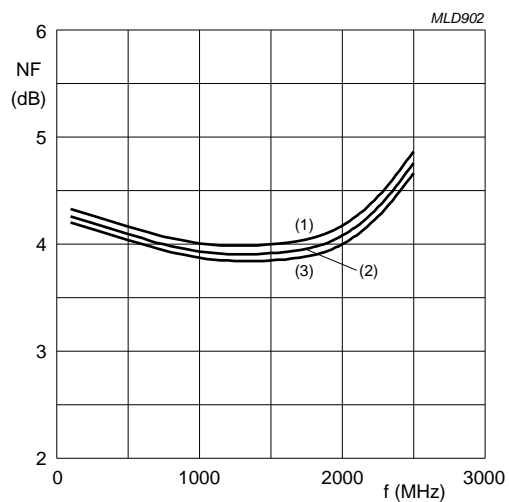
(2)  $V_S = 5 \text{ V}$ .

(3)  $V_S = 4.5 \text{ V}$ .

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

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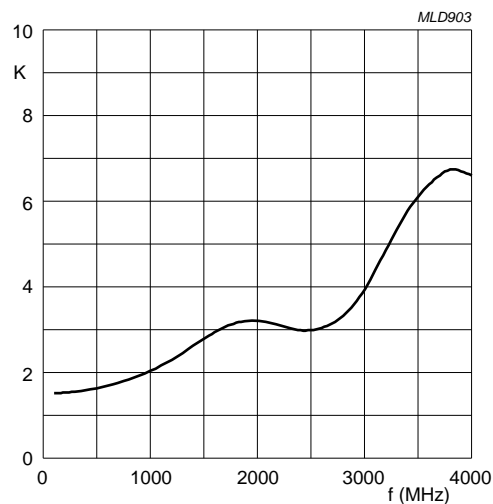
$Z_O = 50 \Omega$ .

(1)  $I_S = 15.1 \text{ mA}$ ;  $V_S = 5.5 \text{ V}$ .

(2)  $I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ .

(3)  $I_S = 10.1 \text{ mA}$ ;  $V_S = 4.5 \text{ V}$ .

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



$I_S = 12.3 \text{ mA}$ ;  $V_S = 5 \text{ V}$ ;  $Z_O = 50 \Omega$ .

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

## MMIC wideband amplifier

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## Scattering parameters

 $V_S = 5\text{ V}$ ;  $I_S = 12.3\text{ mA}$ ;  $P_D = -30\text{ dBm}$ ;  $Z_O = 50\text{ }\Omega$ ;  $T_{\text{amb}} = 25\text{ }^\circ\text{C}$ ;

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	0.04752	-13.48	10.9826	-1.753	0.03355	-2.342	0.07706	-170.0	1.5
200	0.05643	22.73	11.0172	-6.898	0.03308	-7.340	0.07237	164.8	1.5
400	0.09546	39.62	11.0842	-15.64	0.03111	-15.47	0.07314	130.7	1.6
600	0.13547	37.16	11.1812	-24.08	0.02829	-21.84	0.07471	101.8	1.7
800	0.17466	32.62	11.3239	-32.64	0.02501	-26.57	0.08218	72.30	1.9
1000	0.20739	27.40	11.5760	-41.38	0.02145	-30.44	0.10113	47.04	2.0
1200	0.24036	23.23	11.8439	-50.97	0.01788	-31.20	0.11792	25.82	2.3
1400	0.26469	18.36	12.1222	-61.14	0.01489	-28.60	0.13314	10.96	2.6
1600	0.29368	13.54	12.3892	-72.07	0.01262	-22.41	0.14376	-1.624	3.0
1800	0.31261	8.127	12.5808	-83.89	0.01132	-12.86	0.14606	-13.51	3.2
2000	0.31986	1.984	12.6359	-96.79	0.01102	-2.369	0.13749	-24.90	3.2
2200	0.32544	-4.878	12.4802	-110.7	0.01151	5.585	0.11928	-37.21	3.1
2400	0.31554	-13.05	12.2649	-125.2	0.01238	9.990	0.08992	-51.50	3.0
2600	0.29374	-21.53	11.5087	-139.8	0.01322	11.44	0.05626	-68.53	3.1
2800	0.26599	-28.39	10.4126	-152.8	0.01362	10.70	0.02424	-110.2	3.3
3000	0.21222	-31.80	9.17830	-163.8	0.01335	9.622	0.02731	159.1	4.0
3200	0.17076	-31.52	8.12024	-171.0	0.01239	10.22	0.04752	135.0	4.9
3400	0.14479	-32.14	7.38827	-176.5	0.01150	15.36	0.06279	132.1	5.8
3600	0.11730	-35.25	6.96284	177.3	0.01108	19.97	0.07643	142.1	6.4
3800	0.08946	-46.06	6.62125	171.3	0.01107	27.62	0.09760	153.5	6.7
4000	0.06606	-64.65	6.32249	165.6	0.01178	34.46	0.12925	160.6	6.6



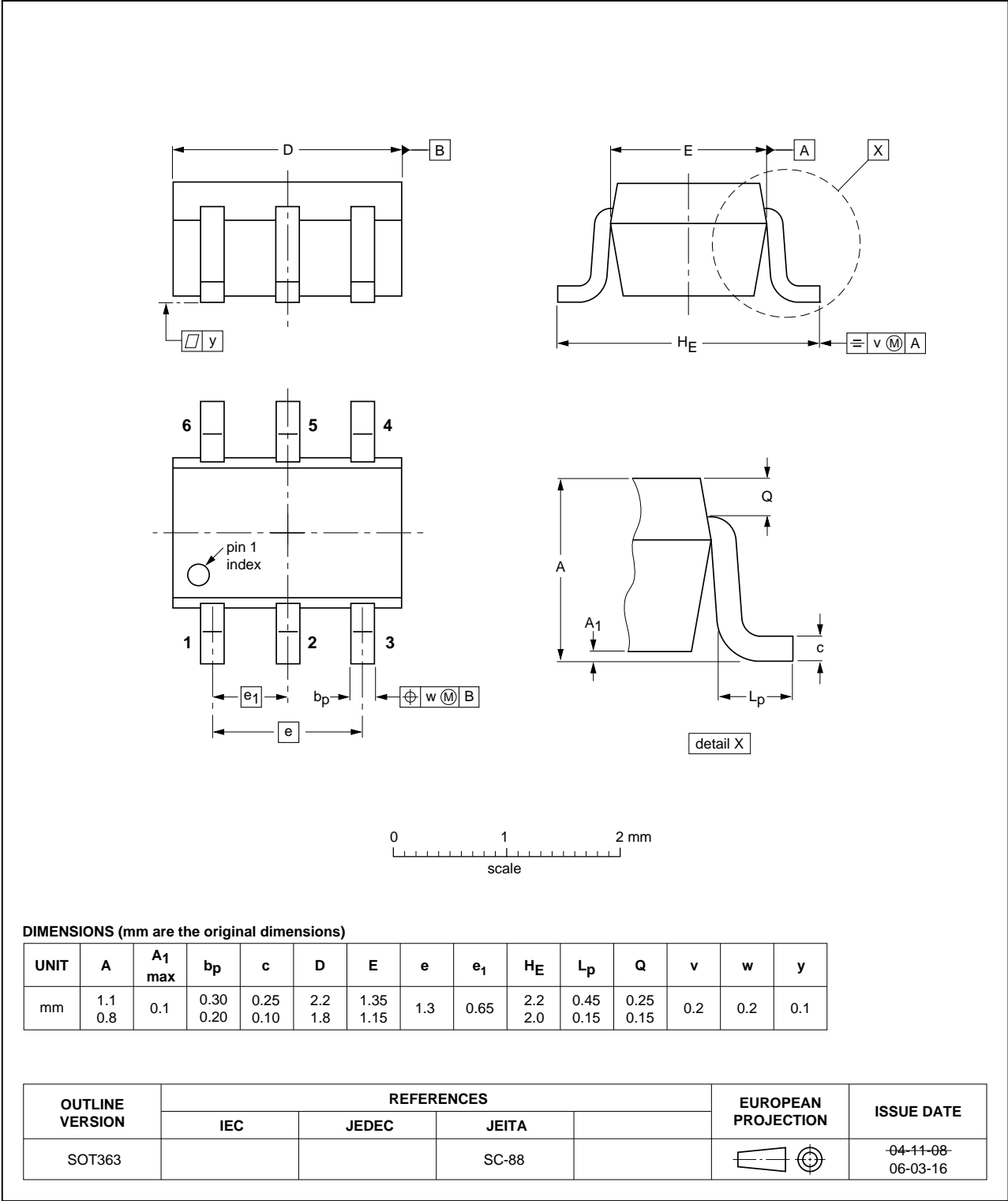
MMIC wideband amplifier

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PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads

SOT363



## 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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