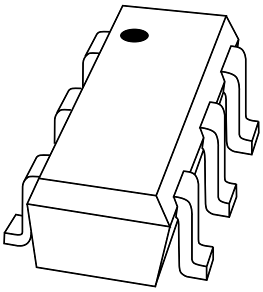
DATA SHEET



BGA2709
MMIC wideband amplifier

Product specification
Supersedes data of 2002 Feb 05

2002 Aug 06

MMIC wideband amplifier — BGA2709

FEATURES

- Internally matched to 50 Ω
- Very wide frequency range (3.6 GHz at 3 dB bandwidth)
- Flat 23 dB gain (DC to 2.6 GHz at 1 dB flatness)
- 12.5 dBm saturated output power at 1 GHz
- High linearity (22 dBm OIP3 at 1 GHz)
- Unconditionally stable (K > 1.2).

APPLICATIONS

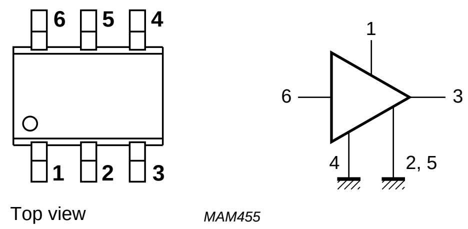
- Cable systems
- LNB IF amplifiers
- General purpose
- ISM.

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_S
2, 5	GND2
3	RF out
4	GND1
6	RF in



Marking code: E3-.

Fig.1 Simplified outline (SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_S	DC supply voltage		5	6	V
I_S	DC supply current		23.5	–	mA
$\|s_{21}\|^2$	insertion power gain	f = 1 GHz	22.7	–	dB
NF	noise figure	f = 1 GHz	4	–	dB
$P_{L(sat)}$	saturated load power	f = 1 GHz	12.5	–	dBm

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	DC supply voltage	RF input AC coupled	–	6	V
I_S	supply current		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 90$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C
P_D	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.

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

V_S = 5 V; I_S = 23.5 mA; T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current		19	23.5	32	mA
$\|s_{21}\|^2$	insertion power gain	f = 100 MHz	21	22.2	23	dB
		f = 1 GHz	21	22.7	24	dB
		f = 1.8 GHz	22	23.0	24	dB
		f = 2.2 GHz	21	23.0	24	dB
		f = 2.6 GHz	20	22.1	23	dB
		f = 3 GHz	18	21.1	22	dB
$R_{L\ IN}$	return losses input	f = 1 GHz	9	11	–	dB
		f = 2.2 GHz	9	11	–	dB
$R_{L\ OUT}$	return losses output	f = 1 GHz	17	20	–	dB
		f = 2.2 GHz	20	24	–	dB
$\|s_{12}\|^2$	isolation	f = 1.6 GHz	31	33	–	dB
		f = 2.2 GHz	34	36	–	dB
NF	noise figure	f = 1 GHz	–	4.0	4.4	dB
		f = 2.2 GHz	–	4.4	4.9	dB
BW	bandwidth	at $\|s_{21}\|^2$ –3 dB below flat gain at 1 GHz	3.1	3.6	–	GHz
K	stability factor	f = 1 GHz	1.3	1.7	–	–
		f = 2 GHz	1.8	2.2	–	–
$P_{L(sat)}$	saturated load power	f = 1 GHz	11	12.5	–	dBm
		f = 2.2 GHz	5	7.5	–	dBm
$P_{L\ 1\ dB}$	load power	at 1 dB gain compression; f = 1 GHz	7	8.3	–	dBm
		at 1 dB gain compression; f = 2.2 GHz	3	5.4	–	dBm
$IP3_{(in)}$	input intercept point	f = 1 GHz	–3	–1	–	dBm
		f = 2.2 GHz	–7	–9	–	dBm
$IP3_{(out)}$	output intercept point	f = 1 GHz	20	22	–	dBm
		f = 2.2 GHz	12	14	–	dBm

APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2709 MMIC. The device is internally matched to 50 Ω, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2, C3 should be not 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 must be used (e.g. 10 nH) 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, 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.

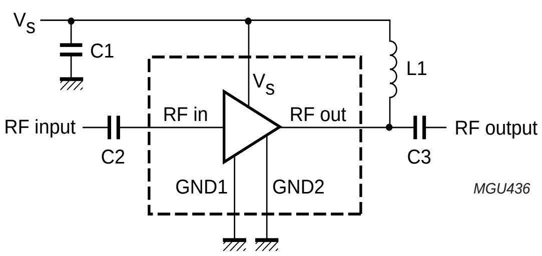


Fig.2 Typical application circuit.

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 and 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 in part of a transmitter circuit. Good linear performance and matched input and output offer quick design solutions in such applications.

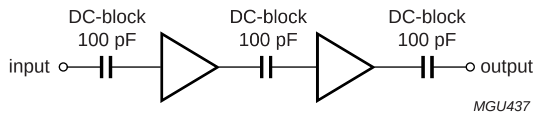


Fig.3 Simple cascade circuit.

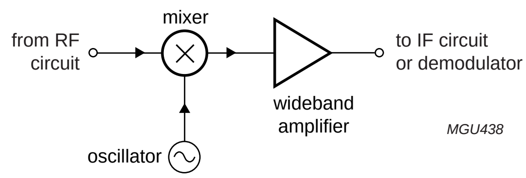


Fig.4 IF amplifier application.

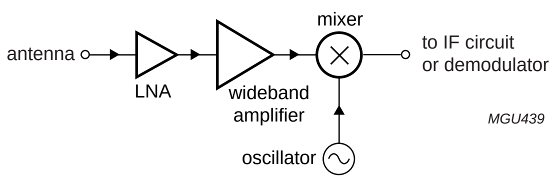


Fig.5 RF amplifier application.

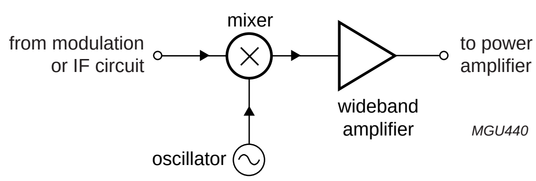
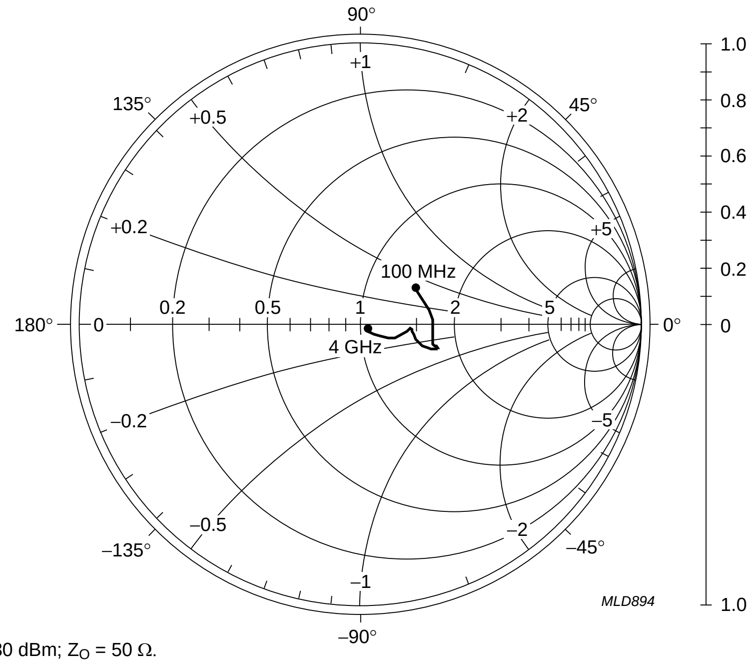
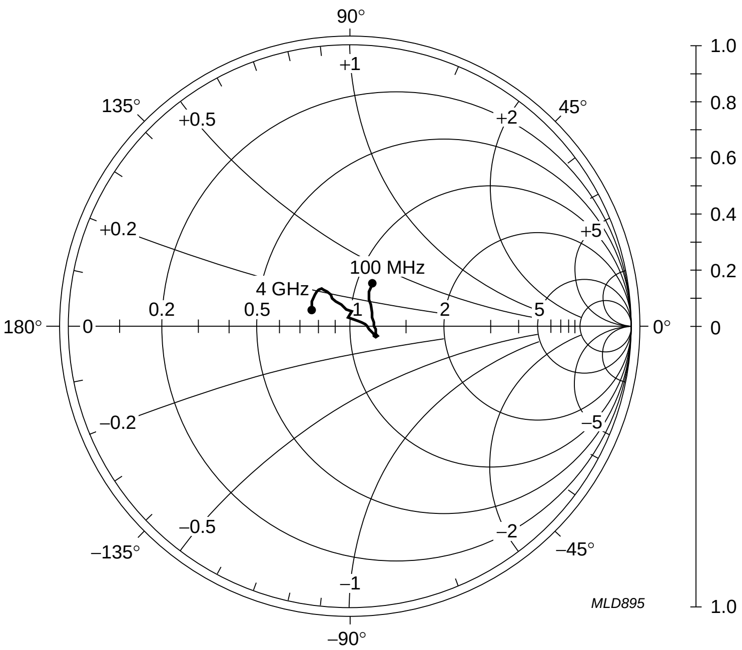


Fig.6 Power amplifier driver application.



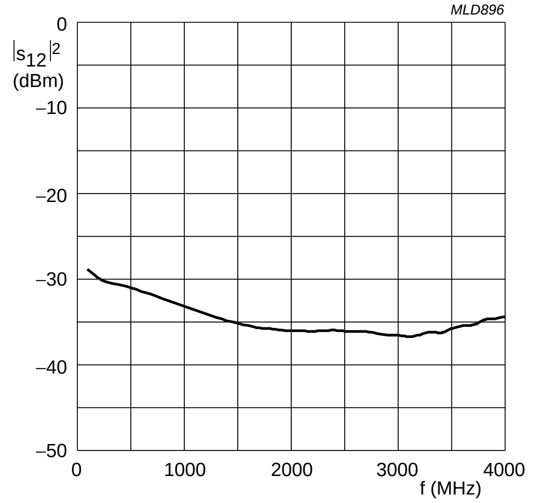
I_S = 23.5 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

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



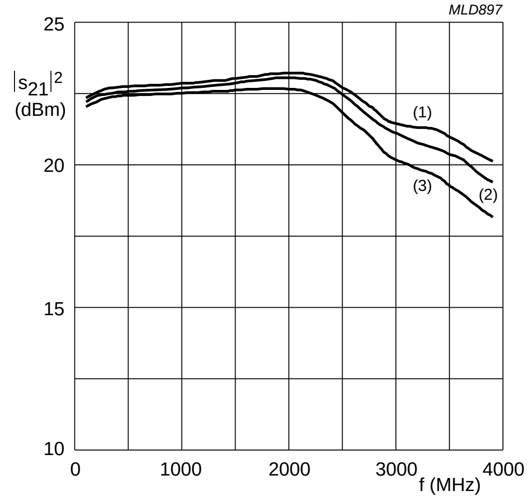
I_S = 23.5 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

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



I_S = 23.5 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

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



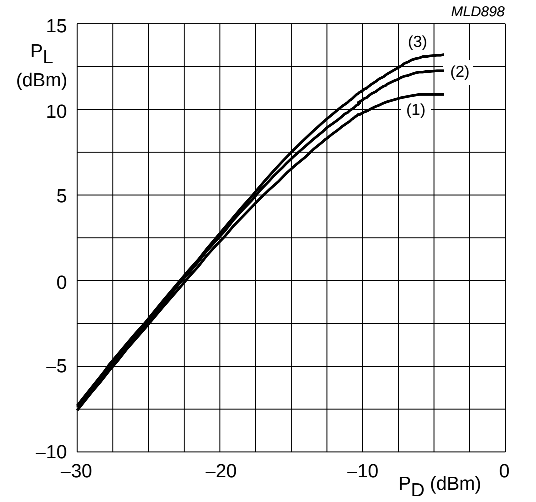
P_D = −30 dBm; Z_O = 50 Ω.

(1) I_S = 28.4 mA; V_S = 5.5 V

(2) I_S = 23.5 mA; V_S = 5 V

(3) I_S = 18.8 mA; V_S = 4.5 V

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



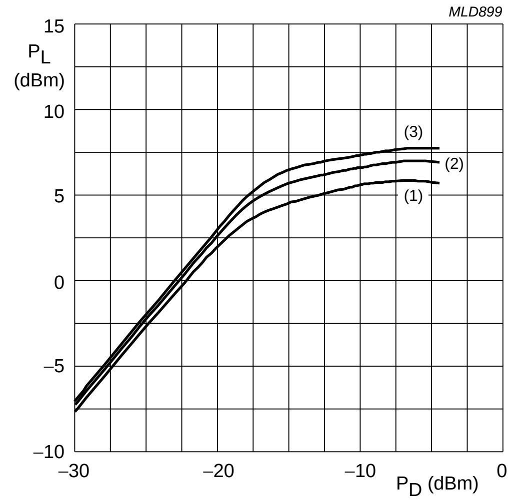
f = 1 GHz; Z_O = 50 Ω.

(1) V_S = 4.5 V

(2) V_S = 5 V

(3) V_S = 5.5 V

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



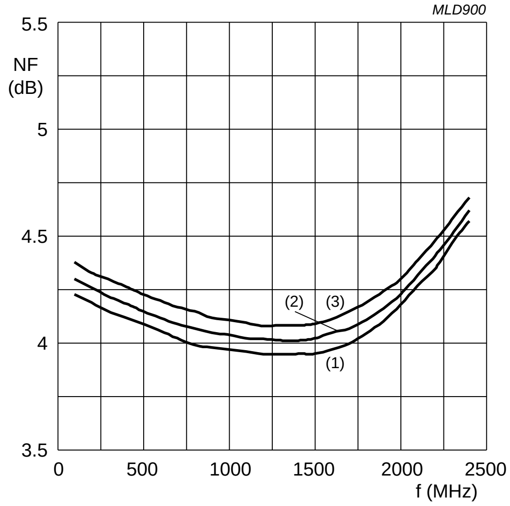
f = 2.2 GHz; Z_O = 50 Ω.

(1) V_S = 4.5 V

(2) V_S = 5 V

(3) V_S = 5.5 V

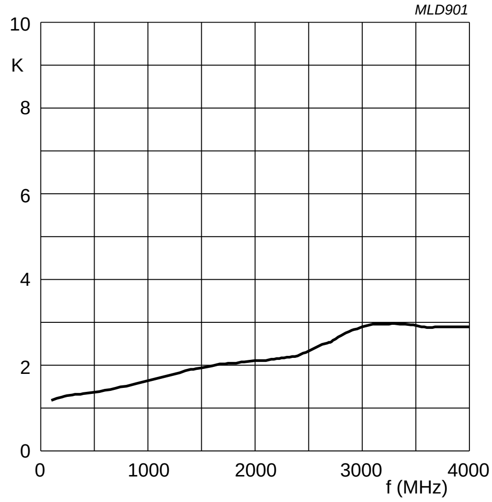
Fig.12 Load power as a function of drive power at 2.2 GHz; typical values.



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

(1) $I_S = 18.8$ mA; $V_S = 4.5$ V
(2) $I_S = 23.5$ mA; $V_S = 5$ V
(3) $I_S = 28.4$ mA; $V_S = 5.5$ V

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



$I_S = 23.5$ mA; $V_S = 5$ V; $Z_O = 50\ \Omega$.

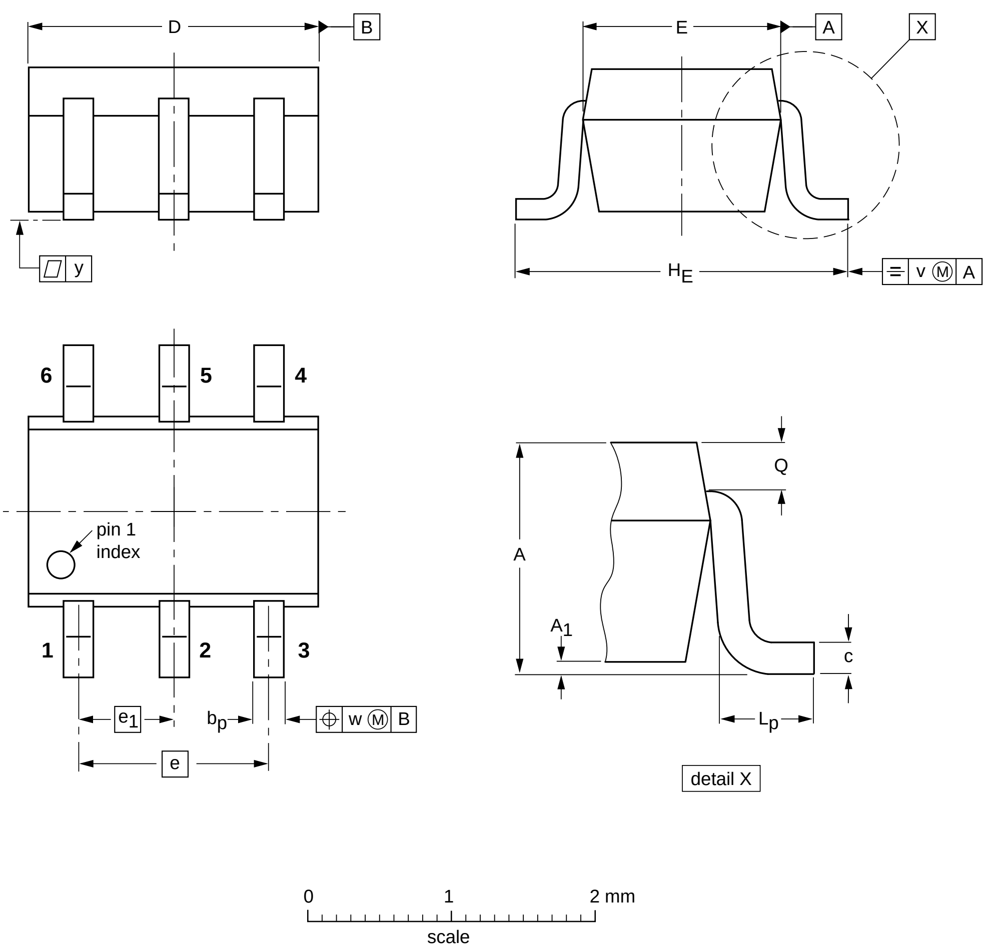
Fig.14 Stability factor as a function of frequency; typical values.

Table 1 Scattering parameters: I_S = 23.5 mA; V_S = 5 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(deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
100	0.23362	32.281	12.90523	21.565	0.036496	16.408	0.16296	61.578	1.2
200	0.25252	11.824	13.22858	4.852	0.032314	5.728	0.13501	60.573	1.3
400	0.25838	–2.149	13.43580	–10.31	0.029604	–5.865	0.10353	41.717	1.3
600	0.25990	–8.784	13.51088	–21.14	0.027122	–11.45	0.085075	16.95	1.4
800	0.26278	–12.76	13.56715	–30.93	0.024611	–15.08	0.088892	–1.879	1.5
1000	0.26695	–14.88	13.65916	–40.37	0.022107	–16.33	0.09716	–13.36	1.7
1200	0.27404	–16.30	13.74736	–49.83	0.019986	–15.67	0.10279	–20.25	1.8
1400	0.27921	–16.51	13.85661	–59.47	0.018217	–13.42	0.10385	–23.24	1.9
1600	0.28486	–16.78	14.03414	–69.50	0.017049	–9.927	0.099148	–24.08	2.0
1800	0.28749	–17.25	14.16012	–80.23	0.016409	–5.968	0.089633	–20.58	2.1
2000	0.28601	–17.76	14.23586	–91.65	0.015912	–2.04	0.076785	–14.48	2.1
2200	0.27487	–18.98	14.14430	–103.9	0.015829	1.077	0.062455	–4.507	2.2
2400	0.25176	–19.94	13.70546	–117.0	0.016054	3.361	0.044552	11.808	2.2
2600	0.21405	–17.09	12.75365	–129.7	0.015801	3.145	0.023668	98.126	2.5
2800	0.19288	–11.85	11.96153	–138.7	0.015406	7.602	0.057779	104.35	2.7
3000	0.18347	–6.228	11.33015	–147.6	0.015049	11.411	0.094848	119.98	2.9
3200	0.17459	–6.327	10.94943	–156.3	0.015098	15.52	0.12948	123.28	3.0
3400	0.15344	–14.14	10.65459	–167.3	0.015529	20.649	0.15325	126.56	3.0
3600	0.10799	–26.12	10.28106	–179.1	0.017107	23.92	0.16627	131.67	2.8
3800	0.05984	–39.66	9.56897	170.0	0.018529	23.226	0.16317	140.54	2.8
4000	0.025953	–28.87	8.97718	157.3	0.019276	18.403	0.14602	157.03	2.9

PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	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

DATA SHEET STATUS

DOCUMENT STATUS(1)	PRODUCT STATUS(2)	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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