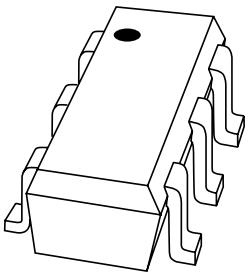
DATA SHEET



BGA2716
MMIC wideband amplifier

Preliminary specification

2004 Feb 02

Philips
Semiconductors

PHILIPS

MMIC wideband amplifier BGA2716

FEATURES

- Internally matched to 50 Ω
- Wide frequency range (3.2 GHz at 3 dB bandwidth)
- Flat 23 dB gain (± 1 dB up to 2.7 GHz)
- 9 dBm output power at 1dB compression point
- Good linearity for low current ($IP3_{(out)}$ = 22 dBm)
- Low second harmonic, –38 dBc at P_{Load} = –5 dBm
- Unconditionally stable (K ≥ 1.2).

APPLICATIONS

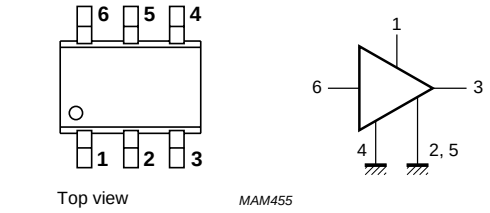
- LNB IF amplifiers
- Cable systems
- ISM
- General purpose.

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



Marking code: B7-.

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		15.9	–	mA
$\lvert s_{21}\rvert^2$	insertion power gain	f = 1 GHz	22.9	–	dB
NF	noise figure	f = 1 GHz	5.3	–	dB
$P_{L(sat)}$	saturated load power	f = 1 GHz	11.6	–	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		–	30	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 = 4.3 mA; T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current		13	15.9	21	mA
$\lvert s_{21}\rvert^2$	insertion power gain	f = 100 MHz	21	22.1	23	dB
		f = 1 GHz	22	22.9	24	dB
		f = 1.8 GHz	22	23.1	25	dB
		f = 2.2 GHz	21	22.8	24	dB
		f = 2.6 GHz	20	22.1	24	dB
		f = 3 GHz	19	20.8	22	dB
$R_{L\ IN}$	return losses input	f = 1 GHz	15	17	–	dB
		f = 2.2 GHz	10	12	–	dB
$R_{L\ OUT}$	return losses output	f = 1 GHz	10	12	–	dB
		f = 2.2 GHz	9	11	–	dB
$\lvert s_{12}\rvert^2$	isolation	f = 1.6 GHz	30	31	–	dB
		f = 2.2 GHz	33	35	–	dB
NF	noise figure	f = 1 GHz	–	5.3	5.4	dB
		f = 2.2 GHz	–	5.5	5.6	dB
BW	bandwidth	at $\lvert s_{21}\rvert^2$ –3 dB below flat gain at 1 GHz	3	3.2	–	GHz
K	stability factor	f = 1 GHz	–	1.4	–	–
		f = 2.2 GHz	–	1.9	–	–
$P_{L(sat)}$	saturated load power	f = 1 GHz	10	11.6	–	dBm
		f = 2.2 GHz	6	7.5	–	dBm
$P_{L\ 1\ dB}$	load power	at 1 dB gain compression; f = 1 GHz	8	8.9	–	dBm
		at 1 dB gain compression; f = 2.2 GHz	5	6.1	–	dBm
IM2	second order intermodulation	at P_D = –5 dBm, f_0 = 1 GHz	36	38	–	dBc
$IP3_{(in)}$	input intercept point	f = 1 GHz	–2	–0.7	–	dBm
		f = 2.2 GHz	–8	–6.9	–	dBm
$IP3_{(out)}$	output intercept point	f = 1 GHz	21	22.2	–	dBm
		f = 2.2 GHz	15	15.9	–	dBm

APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2716 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 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 the frequencies below 100 MHz this value should be increased. At frequencies above 1 GHz, a lower value can be used to tune the output return loss. For optimal results, a good quality chip inductor or a wire-wound SMD type should be chosen.

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

The PCB top ground plane, connected to the pins 2,4 and 5 must be as close as possible to the MMIC, preferably also below the MMIC. When using via holes, use multiple via holes, as close as possible to the MMIC.

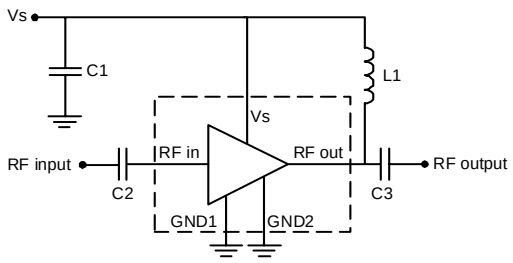
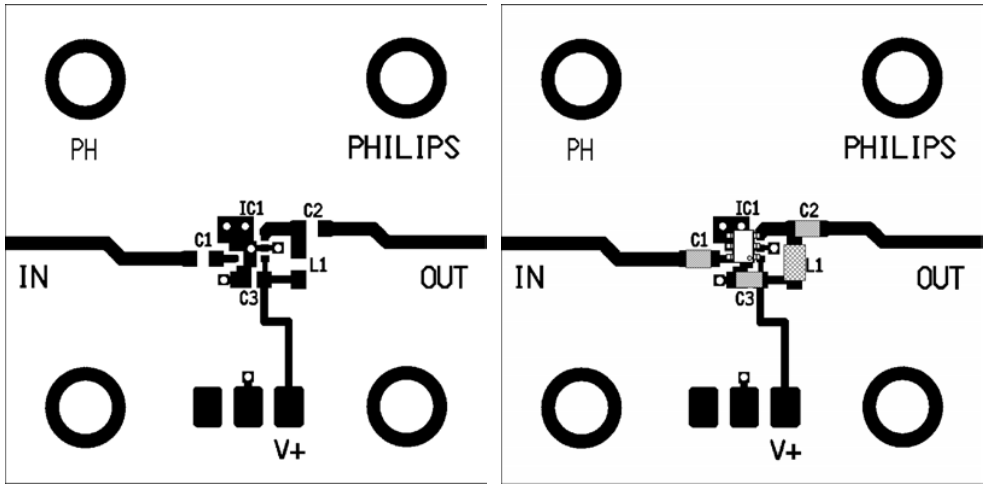


Fig.2 Typical application circuit.

Figure 3 show the PCB layout, used for the standaard demo board.



PCB layout, true size = 30 X 30 mm

Demo board with components

Fig.3 PCB layout.

Application examples

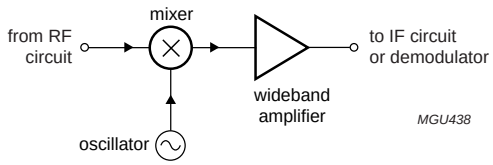


Fig.4 Application as IF amplifier.

The MMIC is very suitable as IF amplifier in e.g. LNB's. The excellent wideband characteristics make it an ideal building block (figure 4).

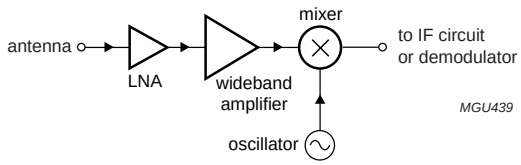


Fig.5 Application as RF amplifier.

As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution (figure 5).

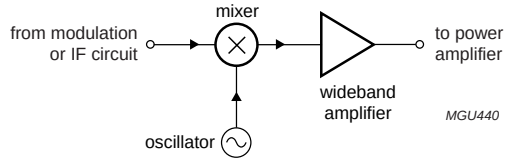
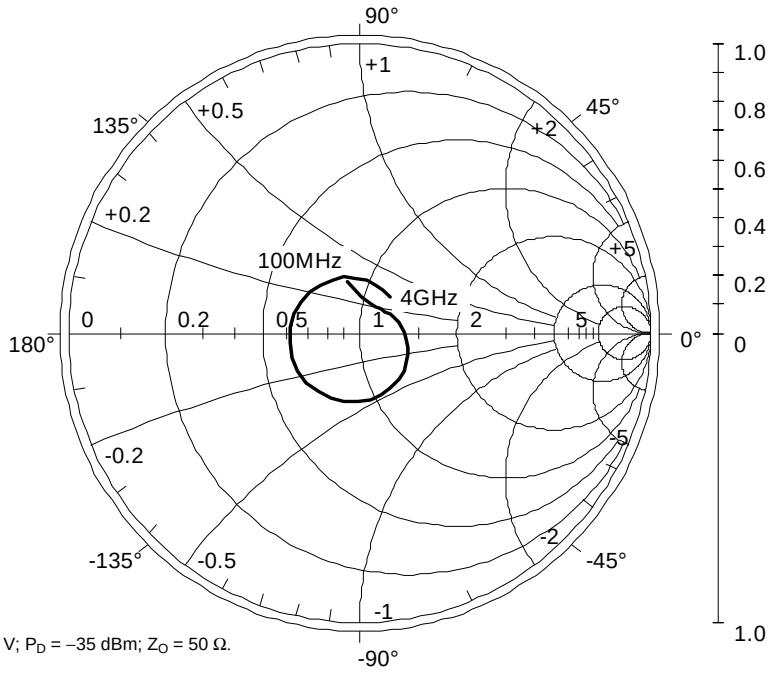


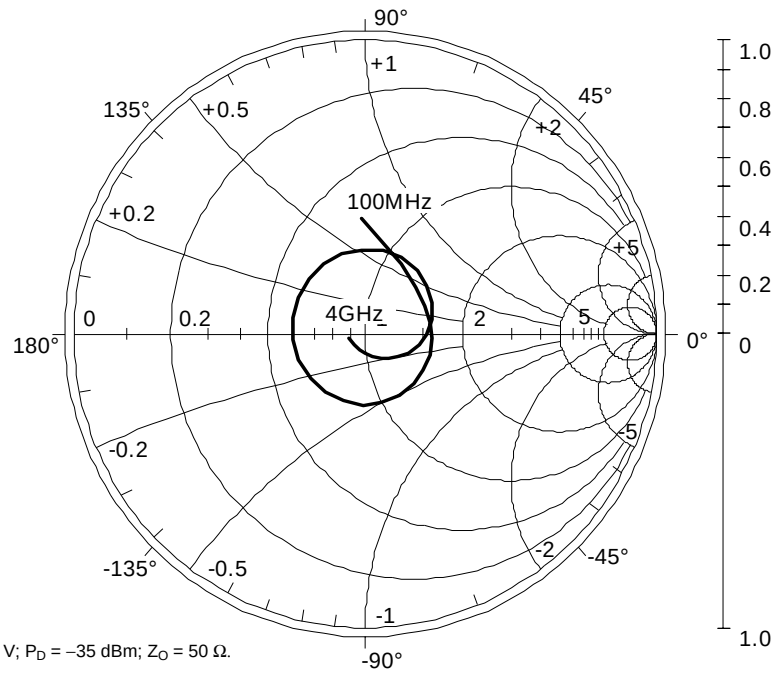
Fig.6 Application as driver amplifier.

As driver amplifier in the TX path, the good lineair performance and matched in/-output offer quick design (figure 6).



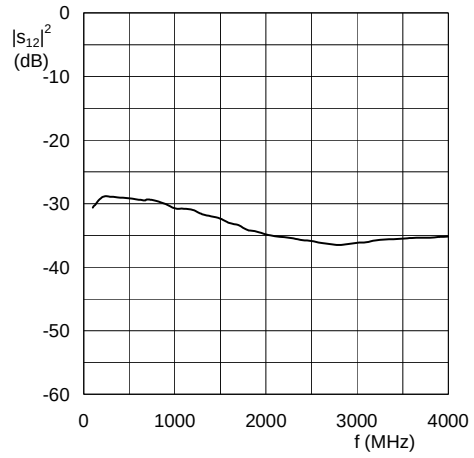
I_S = 15.9 mA; V_S = 5.0 V; P_D = –35 dBm; Z_O = 50 Ω.

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



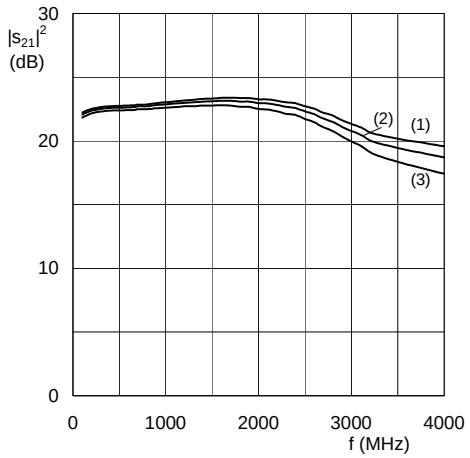
I_S = 15.9 mA; V_S = 5.0 V; P_D = –35 dBm; Z_O = 50 Ω.

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



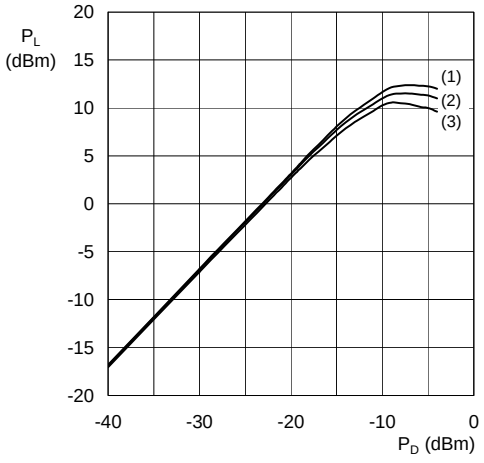
I_S = 15.9 mA; V_S = 5.0 V; P_D = –35 dBm; Z_O = 50 Ω.

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



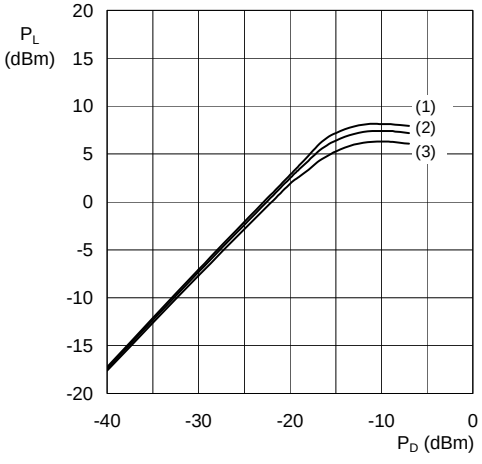
P_D = –35 dBm; Z_O = 50 Ω.
(1) I_S = 19.5 mA; V_S = 5.5 V.
(2) I_S = 15.9 mA; V_S = 5 V.
(3) I_S = 12.4 mA; V_S = 4.5 V.

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



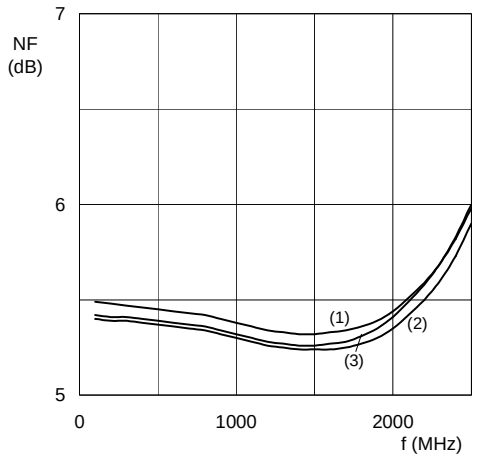
f = 1 GHz; Z_O = 50 Ω.
(1) V_S = 5.5 V.
(2) V_S = 5 V.
(3) V_S = 4.5 V.

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



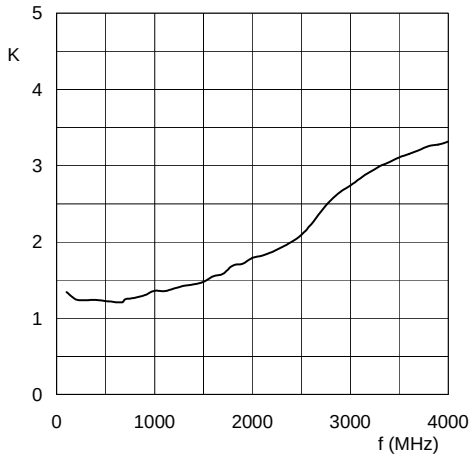
f = 2.2 GHz; Z_O = 50 Ω.
(1) V_S = 5.5 V.
(2) V_S = 5 V.
(3) V_S = 4.5 V.

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



Z_O = 50 Ω.
(1) I_S = 19.5 mA; V_S = 5.5 V.
(2) I_S = 15.9 mA; V_S = 5 V.
(3) I_S = 12.4 mA; V_S = 4.5 V.

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



I_S = 15.9 mA; V_S = 5.0 V; Z_O = 50 Ω.

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

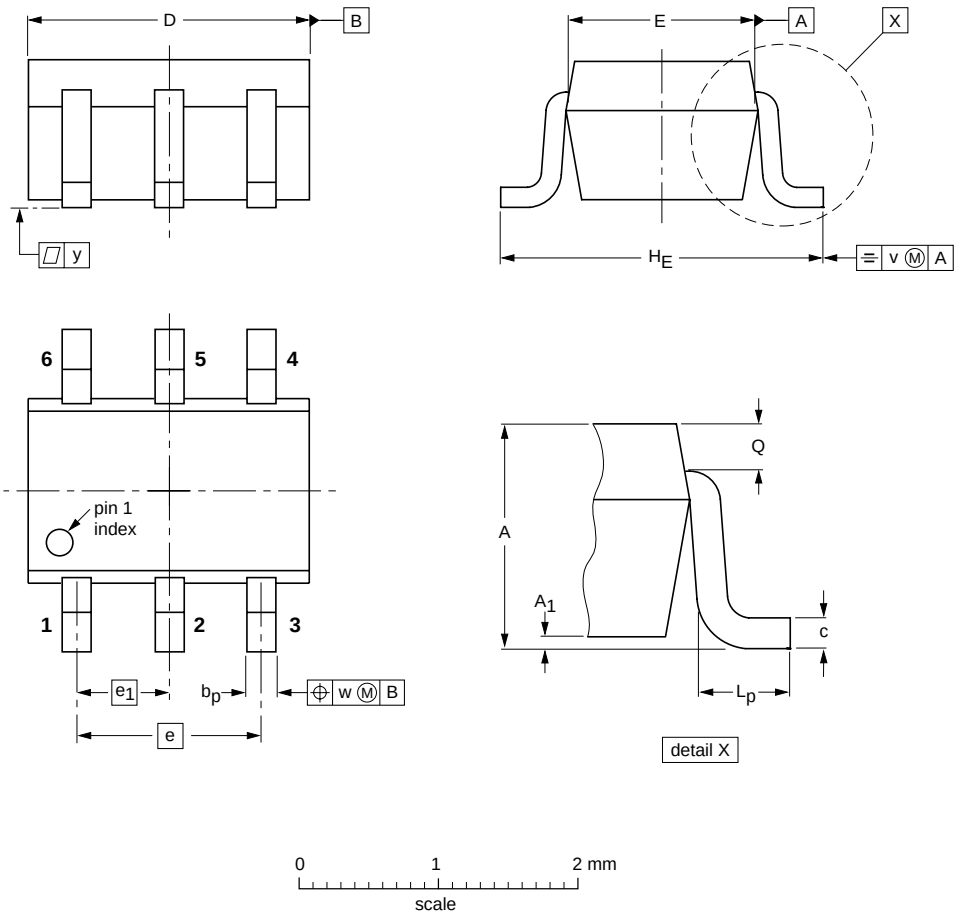
Scattering parameters

V_S = 5.0 V; I_S = 15.9 mA; P_D = –35 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	0.182562	102.7794	12.69581	13.48682	0.029472	28.74955	0.39239	91.48628	1.3
200	0.123465	87.55274	13.13419	–5.272917	0.035438	–2.202361	0.267851	62.37296	1.2
400	0.107855	58.58513	13.47149	–31.7377	0.035299	–22.54301	0.227252	24.6455	1.2
600	0.114731	40.14071	13.57901	–53.09631	0.033167	–43.06353	0.227993	–3.493572	1.3
800	0.130176	24.28555	13.67457	–73.60665	0.033194	–59.63503	0.234967	–31.11084	1.3
1000	0.144984	9.657616	13.91705	–94.01973	0.029047	–76.09972	0.239818	–60.54722	1.4
1200	0.160922	–7.518892	14.10949	–114.55	0.028188	–88.34045	0.242141	–91.56898	1.4
1400	0.179351	–23.35989	14.2808	–135.3117	0.025188	–101.2729	0.243087	–124.5484	1.4
1600	0.20199	–41.01349	14.3825	–156.7041	0.022257	–110.3342	0.24499	–158.6224	1.5
1800	0.218268	–60.71294	14.26935	–178.3843	0.019611	–121.0192	0.255598	167.5983	1.7
2000	0.233965	–81.48254	14.0667	160.1504	0.018087	–127.6765	0.269829	136.117	1.8
2200	0.242904	–103.1109	13.83968	138.2379	0.017203	–137.8213	0.283613	106.0987	1.9
2400	0.246576	–125.52	13.46447	115.7594	0.016318	–138.8717	0.29058	77.95189	2.0
2600	0.249069	–148.8707	12.74638	93.38644	0.015514	–147.6622	0.281505	50.68612	2.2
2800	0.243665	–172.646	11.87558	71.02792	0.014954	–152.1988	0.25135	24.40624	2.5
3000	0.233266	163.9035	10.94049	50.42722	0.015522	–163.8718	0.211425	–0.674037	2.7
3200	0.222055	140.7754	10.05626	30.75908	0.016261	–170.5637	0.165534	–23.9944	2.9
3400	0.207486	117.0531	9.576357	11.98315	0.016664	–176.5407	0.118726	–46.28101	3.0
3600	0.191654	94.64431	9.199166	–7.677643	0.016982	176.9385	0.083354	–72.36691	3.2
3800	0.175783	71.9551	8.912598	–27.73098	0.017094	165.8227	0.058549	–109.9804	3.3
4000	0.163768	49.89436	8.618058	–48.90874	0.017414	157.6095	0.055225	–163.7132	3.3

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	EIAJ			
SOT363			SC-88			97-02-28

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS(1)	PRODUCT STATUS(2)(3)	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

DISCLAIMERS

Life support applications — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status ‘Production’), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no licence or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors – a worldwide company

Contact information

For additional information please visit **http://www.semiconductors.philips.com**. Fax: **+31 40 27 24825**
For sales offices addresses send e-mail to: **sales.addresses@www.semiconductors.philips.com**.

Printed in The Netherlands 613516/02/pp12 Date of release: 2004 Feb 02 Document order number: 9397 750 12827

Let's make things better.

Philips Semiconductors

PHILIPS