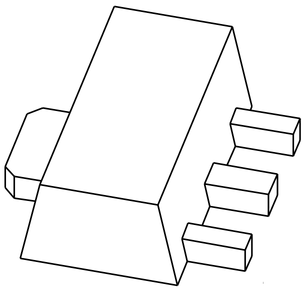
DATA SHEET



BGA6489
MMIC wideband medium power amplifier

Product specification 2003 Sep 18

Philips
Semiconductors

PHILIPS

MMIC wideband medium power amplifier BGA6489

FEATURES

- Broadband 50 Ω gain block
- 20 dBm output power
- SOT89 package
- Single supply voltage needed.

APPLICATIONS

- Broadband medium power gain blocks
- Small signal high linearity amplifiers
- Variable gain and high output power in combination with the BGA2031
- Cellular, PCS and CDPD
- IF/RF buffer amplifier
- Wireless data SONET
- Oscillator amplifier, final PA
- Drivers for CATV amplifier.

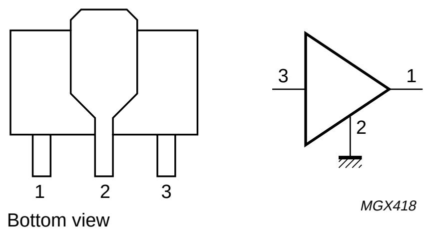
DESCRIPTION

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband medium power amplifier with internal matching circuit in a 4-pin SOT89 plastic low thermal resistance SMD package.

The BGA6x89 series of medium power gain blocks are resistive feedback Darlington configured amplifiers. Resistive feedback provides large bandwidth with high accuracy.

PINNING

PIN	DESCRIPTION
1	RF out/bias
2	GND
3	RF in



Marking code: 4A.

Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
V_S	DC supply voltage	I_S = 74 mA	5.1	V
I_S	DC supply current	V_S = 8 V; R1 = 39 Ω; T_j = 25 °C	78	mA
$\|s_{21}\|^2$	insertion power gain	f = 1.95 GHz	16	dB
NF	noise figure	f = 1.95 GHz	3.3	dB
$P_{L\ 1\ dB}$	load power at 1 dB compression	f = 850 MHz	20	dBm
		f = 1.95 GHz	17	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.

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	DC supply current		–	150	mA
P_{tot}	total power dissipation	$T_s \leq 70$ °C; note 1	–	800	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C
P_D	maximum drive power		–	15	dBm

Note

1. T_s is the temperature at the soldering point of pin 2.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point	$T_s \leq 70$ °C; note 1	100	K/W

Note

1. T_s is the temperature at the soldering point of pin 2.

STATIC CHARACTERISTICS

$T_j = 25$ °C; $V_S = 8$ V; R1 = 39 Ω; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current		70	78	86	mA

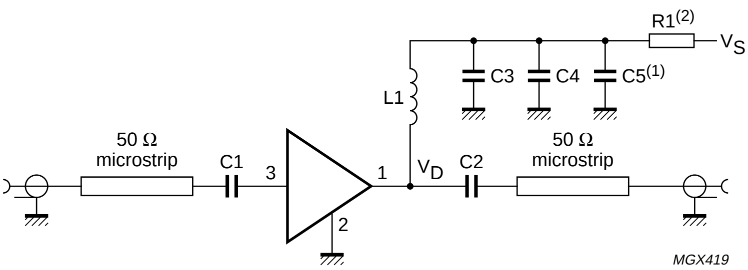
CHARACTERISTICS

V_S = 8 V; I_S = 74 mA; T_{amb} = 25 °C; $IP3_{(out)}$ tone spacing = 1 MHz; P_L = 0 dBm per tone (see Fig.2); R1 = 39 Ω; $Z_L = Z_S$ = 50 Ω; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$\|s_{21}\|^2$	insertion power gain	f = 850 MHz	20	dB
		f = 1.95 GHz	16	dB
		f = 2.5 GHz	15	dB
$R_{L\ IN}$	return losses input	f = 850 MHz	14	dB
		f = 1.95 GHz	16	dB
		f = 2.5 GHz	19	dB
$R_{L\ OUT}$	return losses output	f = 850 MHz	16	dB
		f = 1.95 GHz	12	dB
		f = 2.5 GHz	10	dB
NF	noise figure	f = 850 MHz	3.1	dB
		f = 1.95 GHz	3.3	dB
		f = 2.5 GHz	3.4	dB
K	stability factor	f = 850 MHz	1.2	–
		f = 2.5 GHz	1.3	–
$P_{L\ 1\ dB}$	load power	at 1 dB gain compression; f = 850 MHz	20	dBm
		at 1 dB gain compression; f = 1.95 GHz	17	dBm
$IP3_{(in)}$	input intercept point	f = 850 MHz	13	dBm
		f = 2.5 GHz	12	dBm
$IP3_{(out)}$	output intercept point	f = 850 MHz	33	dBm
		f = 2.5 GHz	27	dBm

APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA6489 MMIC. The device is internally matched to 50 Ω, and therefore does not require any external matching. The value of the input and output DC blocking capacitors C1 and C2 depends on the operating frequency; see the tables below. Capacitors C1 and C2 are used in conjunction with L1 and C3 to fine tune the input and output impedance. For optimum supply decoupling, a 1 µF capacitor (C5) can be added. The external components should be placed as close as possible to the MMIC. When using via holes, use multiple via holes per pin in order to limit ground path induction. Resistor R1 is a bias resistor providing DC current stability with temperature.

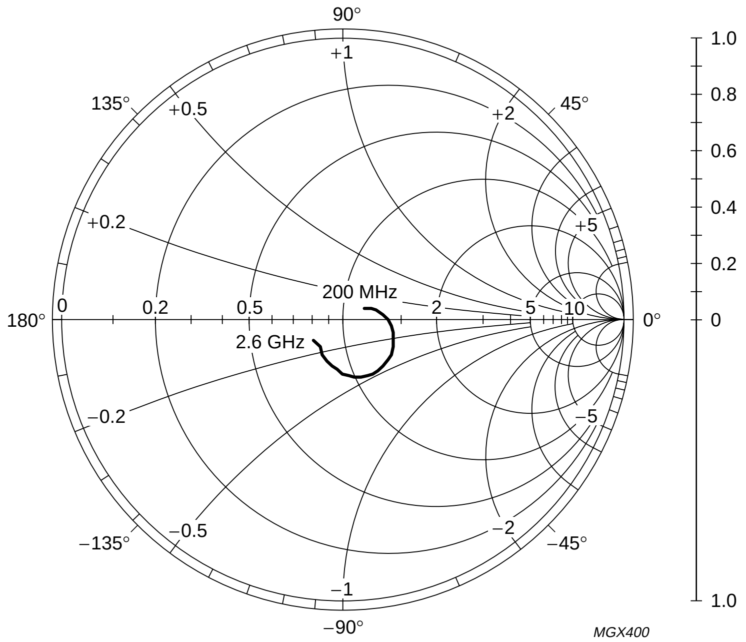


(1) Optional capacitor for optimum supply decoupling.
(2) R1 values at operating supply voltage:
V_S = 6 V; R1 = 15 Ω.
V_S = 9 V; R1 = 51 Ω.
V_S = 11.5 V; R1 = 82 Ω.

Fig.2 Typical application circuit.

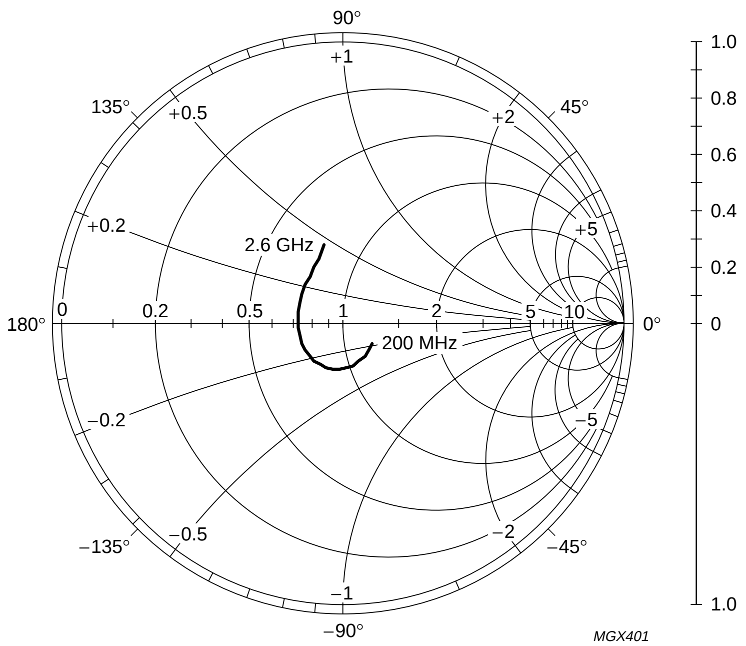
Table 1 Component descriptions (see Fig.2)

COMPONENT	DESCRIPTION	DIMENSIONS	VALUE AT OPERATING FREQUENCY				
			500 MHz	**800 MHz**	**1950 MHz**	**2400 MHz**	**3500 MHz**
C1, C2	multilayer ceramic chip capacitor	0603	220 pF	100 pF	68 pF	56 pF	39 pF
C3	multilayer ceramic chip capacitor	0603	1 nF	1 nF	1 nF	1 nF	1 nF
C4	multilayer ceramic chip capacitor	0603	100 pF	68 pF	22 pF	22 pF	15 pF
C5 (optional)	electrolytic or tantalum capacitor	0603	1 µF	1 µF	1 µF	1 µF	1 µF
L1	SMD inductor	0603	68 nH	33 nH	22 nH	18 nH	15 nH
R1	SMD resistor 0.5 W; V_S = 9 V	–	–	–	–	–	–



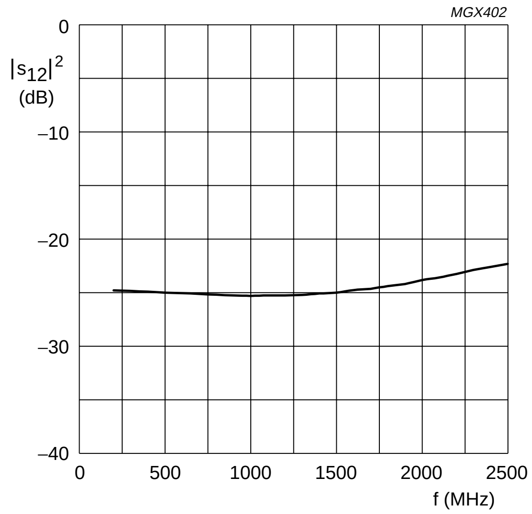
I_S = 74 mA; V_S = 8 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.3 Input reflection coefficient (s_{11}); typical values.



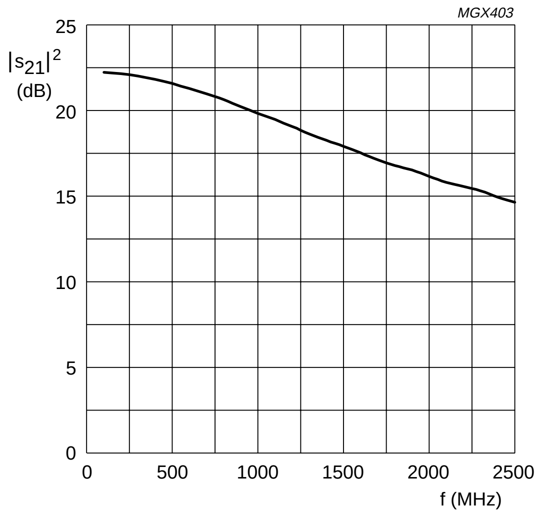
I_S = 74 mA; V_S = 8 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.4 Output reflection coefficient (s_{22}); typical values.



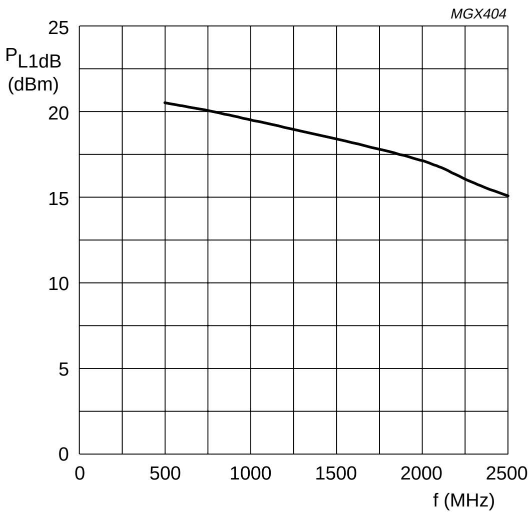
I_S = 74 mA; V_S = 8 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.5 Isolation ($|s_{12}|^2$) as a function of frequency; typical values.



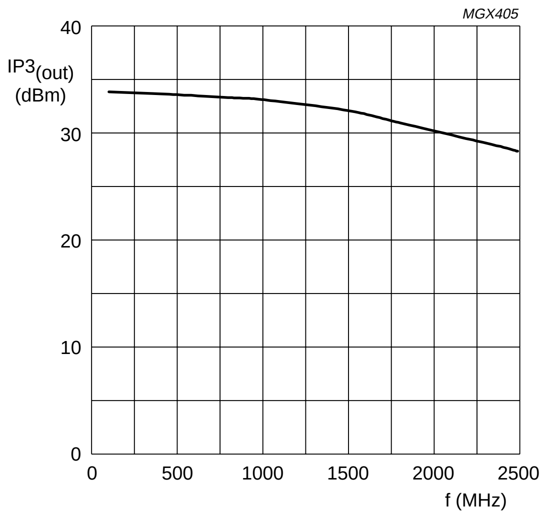
I_S = 74 mA; V_S = 8 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.6 Insertion gain ($|s_{21}|^2$) as a function of frequency; typical values.



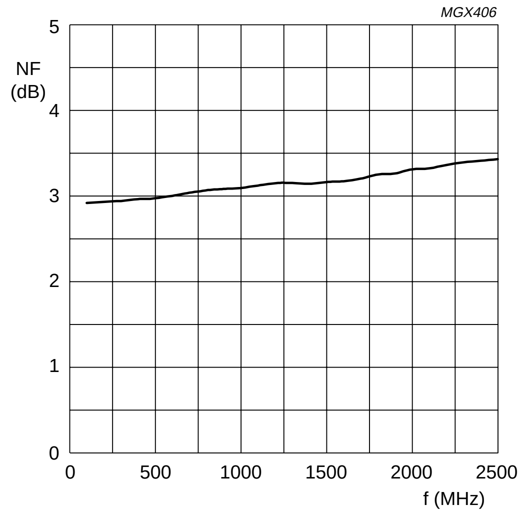
I_S = 74 mA; V_S = 8 V; Z_O = 50 Ω.

Fig.7 Load power as a function of frequency; typical values.



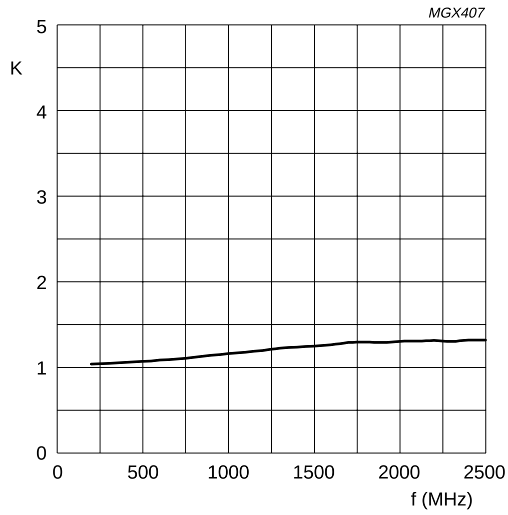
I_S = 74 mA; V_S = 8 V; P_L = 0 dBm; Z_O = 50 Ω.

Fig.8 Output intercept as a function of frequency; typical values.



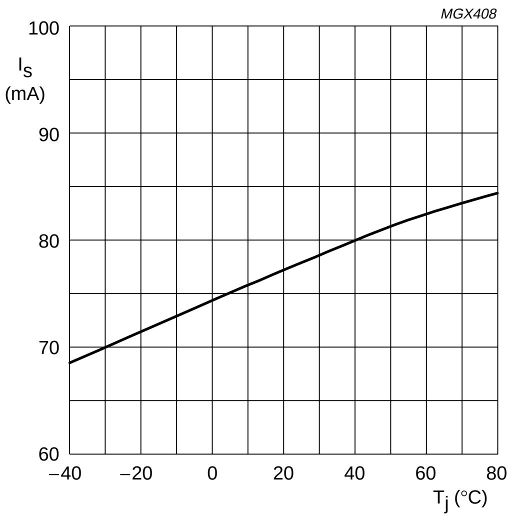
I_S = 74 mA; V_S = 8 V; Z_O = 50 Ω.

Fig.9 Noise figure as a function of frequency; typical values.



I_S = 74 mA; V_S = 8 V; Z_0 = 50 Ω.

Fig.10 Stability factor as a function of frequency; typical values.



V_S = 8 V; R1 = 39 Ω.

Fig.11 Supply current as a function of operating junction temperature; typical values.

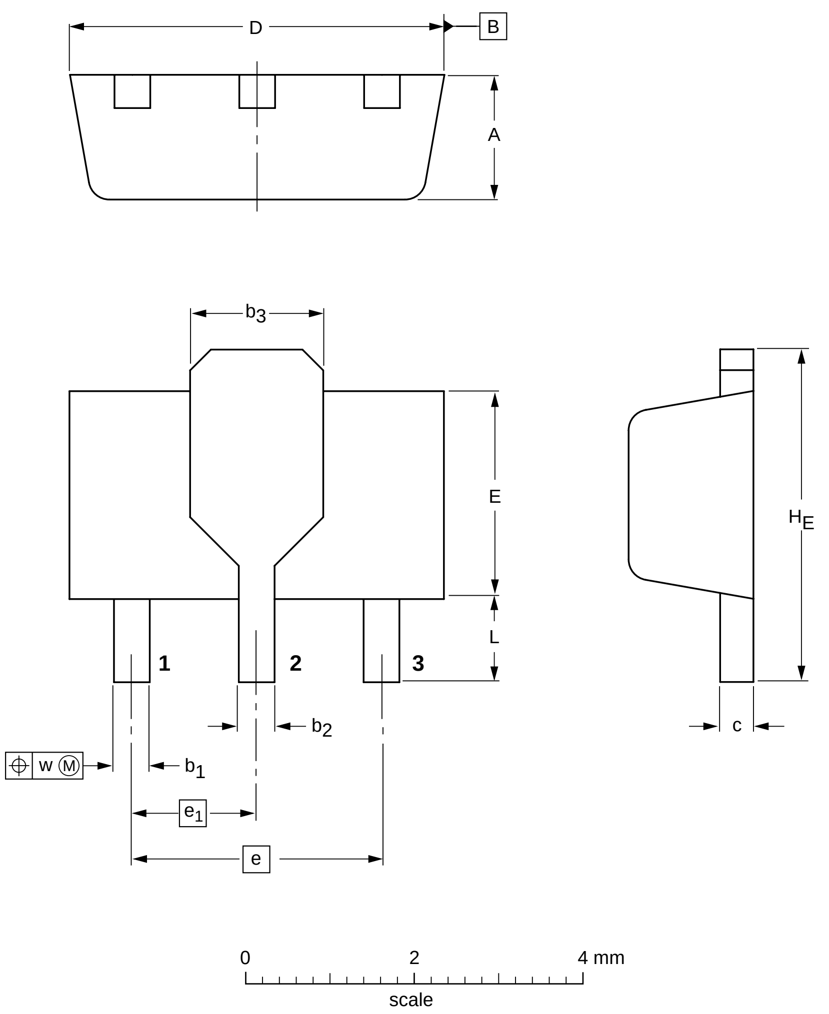
Scattering parameters

V_S = 8 V; I_S = 74 mA; 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)	
200	0.06	28.11	12.79	164.42	0.06	–0.30	0.12	–22.91	1.1
300	0.09	27.41	12.59	156.85	0.06	–0.39	0.13	–35.38	1.1
400	0.11	21.64	12.31	149.28	0.06	–0.35	0.14	–46.54	1.1
500	0.12	15.28	11.97	141.88	0.06	–0.32	0.14	–57.20	1.1
600	0.14	8.01	11.57	134.79	0.06	0.04	0.15	–61.41	1.1
700	0.16	0.34	11.18	127.97	0.06	0.63	0.16	–76.76	1.1
800	0.17	–7.27	10.75	121.56	0.05	1.57	0.16	–85.75	1.2
900	0.18	–14.78	10.24	115.06	0.05	1.85	0.17	–94.28	1.2
1000	0.19	–22.18	9.80	109.18	0.05	3.16	0.17	–102.4	1.2
1100	0.20	–29.33	9.40	103.40	0.05	4.29	0.17	–110.3	1.2
1200	0.21	–36.41	8.96	98.12	0.05	5.64	0.17	–118.5	1.2
1300	0.21	–42.47	8.53	92.76	0.05	7.03	0.17	–126.7	1.2
1400	0.22	–49.06	8.16	87.50	0.06	7.74	0.17	–134.8	1.2
1500	0.22	–55.46	7.85	82.76	0.06	9.08	0.17	–143.5	1.3
1600	0.22	–61.20	7.51	78.52	0.06	10.76	0.16	–152.7	1.3
1700	0.22	–67.02	7.16	74.16	0.06	11.89	0.16	–161.8	1.3
1800	0.21	–73.40	6.90	69.37	0.06	12.34	0.16	–171.9	1.3
1900	0.21	–78.99	6.69	65.14	0.06	13.16	0.16	177.4	1.3
2000	0.20	–84.54	6.42	61.15	0.06	14.33	0.16	166.81	1.3
2100	0.19	–91.32	6.16	56.80	0.07	14.84	0.17	156.07	1.3
2200	0.18	–97.58	5.99	52.55	0.07	15.05	0.17	145.29	1.3
2300	0.17	–103.60	5.83	49.08	0.07	15.72	0.19	135.65	1.3
2400	0.16	–111.90	5.58	45.43	0.07	15.96	0.20	126.23	1.3
2500	0.14	–120.80	5.39	40.67	0.08	15.27	0.22	117.62	1.3
2600	0.13	–129.80	5.30	36.66	0.08	14.68	0.24	110.35	1.3
2700	0.13	–143.80	5.18	33.88	0.08	15.64	0.28	104.05	1.3
2800	0.12	–154.47	5.08	30.28	0.08	15.56	0.31	97.10	1.3
2900	0.11	–164.40	4.71	22.43	0.09	11.60	0.28	91.75	1.3
3000	0.11	178.65	4.66	18.90	0.09	11.05	0.31	84.80	1.3
3100	0.12	160.01	4.45	18.63	0.10	10.63	0.33	80.37	1.3

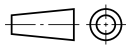
PACKAGE OUTLINE

Plastic surface mounted package; collector pad for good heat transfer; 3 leads **SOT89**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_1	b_2	b_3	c	D	E	e	e_1	H_E	L min.	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.37	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT89		TO-243	SC-62			~~97-02-28~~ 99-09-13

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**.

SCA75

Printed in The Netherlands R77/01/pp12 Date of release: 2003 Sep 18 Document order number: 9397 750 11767

Let's make things better.

Philips Semiconductors

PHILIPS