查询BF1212供应商 捷多邦，专业PCB打样工厂，24小时加急出货



# DATA SHEET

# BF1212; BF1212R; BF1212WR
## N-channel dual-gate MOS-FETs

Product specification

2003 Nov 14

找PDF 维库一下 pdf.dzsc.com

# N-channel dual-gate MOS-FETs BF1212; BF1212R; BF1212WR

## FEATURES

- Short channel transistor with high forward transfer admittance to input capacitance ratio
- Low noise gain controlled amplifier
- Excellent low frequency noise performance
- Partly internal self-biasing circuit to ensure good cross-modulation performance during AGC and good DC stabilization.

## APPLICATIONS

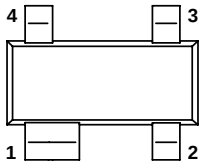
- Gain controlled low noise VHF and UHF amplifiers for 5 V digital and analog television tuner applications.

## DESCRIPTION

Enhancement type N-channel field-effect transistor with source and substrate interconnected. Integrated diodes between gates and source protect against excessive input voltage surges. The BF1212, BF1212R and BF1212WR are encapsulated in the SOT143B, SOT143R and SOT343R plastic packages respectively.

## PINNING

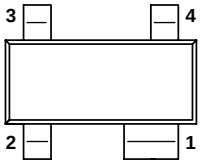
| PIN | DESCRIPTION |
|---|---|
| 1 | source |
| 2 | drain |
| 3 | gate 2 |
| 4 | gate 1 |




Top view MSB014

**BF1212; marking code:** LGp

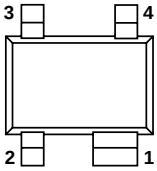
Fig.1 Simplified outline (SOT143B).




Top view MSB035

**BF1212R; marking code:** LKp

Fig.2 Simplified outline (SOT143R).




Top view MSB842

**BF1212WR; marking code:** ML

Fig.3 Simplified outline (SOT343R).

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | – | 6 | V |
| $I_D$ | drain current | | – | – | 30 | mA |
| $P_{tot}$ | total power dissipation | | – | – | 180 | mW |
| $\lvert y_{fs} \rvert$ | forward transfer admittance | | 28 | 33 | 43 | mS |
| $C_{ig1\text{-}ss}$ | input capacitance at gate 1 | | – | 1.7 | 2.2 | pF |
| $C_{rss}$ | reverse transfer capacitance | f = 1 MHz | – | 15 | 30 | fF |
| F | noise figure | f = 800 MHz | – | 1.1 | 1.8 | dB |
| $X_{mod}$ | cross-modulation | input level for k = 1 % at 40 dB AGC | 100 | 104 | – | dBµV |
| $T_j$ | junction temperature | | – | – | 150 | °C |

| 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. |

## ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|---|---|---|---|
| | NAME | DESCRIPTION | VERSION |
| BF1212 | – | plastic surface mounted package; 4 leads | SOT143B |
| BF1212R | – | plastic surface mounted package; reverse pinning; 4 leads | SOT143R |
| BF1212WR | – | plastic surface mounted package; reverse pinning; 4 leads | SOT343R |

## LIMITING VALUES

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

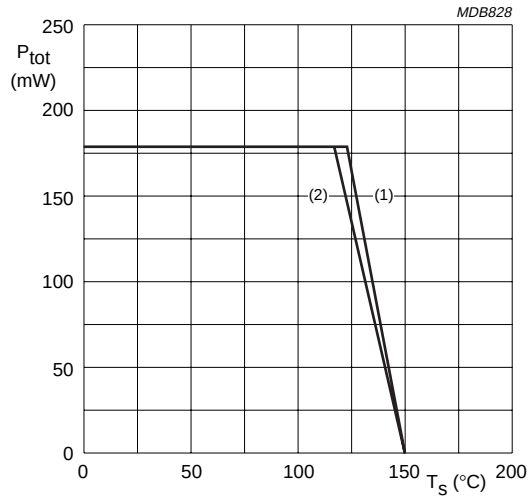
| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | 6 | V |
| $I_D$ | drain current (DC) | | – | 30 | mA |
| $I_{G1}$ | gate 1 current | | – | ±10 | mA |
| $I_{G2}$ | gate 2 current | | – | ±10 | mA |
| $P_{tot}$ | total power dissipation | | | | |
| | BF1212; BF1212R | $T_s \leq 116$ °C; note 1 | – | 180 | mW |
| | BF1212WR | $T_s \leq 122$ °C; note 1 | – | 180 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 150 | °C |

**Note**

1. $T_s$ is the temperature of the soldering point of the source lead.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | | |
| | BF1212; BF1212R | 185 | K/W |
| | BF1212WR | 155 | K/W |




(1) BF1212WR.
(2) BF1212; BF1212R.

Fig.4 Power derating curve.

**STATIC CHARACTERISTICS**

$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{G1-S} = V_{G2-S} = 0$ V; $I_D = 10$ µA | 6 | – | V |
| $V_{(BR)G1-SS}$ | gate 1-source breakdown voltage | $V_{G2-S} = V_{DS} = 0$ V; $I_{G1-S} = 10$ mA | 6 | 10 | V |
| $V_{(BR)G2-SS}$ | gate 2-source breakdown voltage | $V_{G1-S} = V_{DS} = 0$ V; $I_{G2-S} = 10$ mA | 6 | 10 | V |
| $V_{(F)S-G1}$ | forward source-gate 1 voltage | $V_{G2-S} = V_{DS} = 0$ V; $I_{S-G1} = 10$ mA | 0.5 | 1.5 | V |
| $V_{(F)S-G2}$ | forward source-gate 2 voltage | $V_{G1-S} = V_{DS} = 0$ V; $I_{S-G2} = 10$ mA | 0.5 | 1.5 | V |
| $V_{G1-S(th)}$ | gate 1-source threshold voltage | $V_{G2-S} = 4$ V; $V_{DS} = 5$ V; $I_D = 100$ µA | 0.3 | 1.0 | V |
| $V_{G2-S(th)}$ | gate 2-source threshold voltage | $V_{G1-S} = 5$ V; $V_{DS} = 5$ V; $I_D = 100$ µA | 0.35 | 1.0 | V |
| $I_{DSX}$ | drain-source current | $V_{G2-S} = 4$ V; $V_{DS} = 5$ V; $R_{G1} = 150$ kΩ; note 1 | 8 | 16 | mA |
| $I_{G1-S}$ | gate 1 cut-off current | $V_{G2-S} = V_{DS} = 0$ V; $V_{G1-S} = 5$ V | – | 50 | nA |
| $I_{G2-S}$ | gate 2 cut-off current | $V_{G1-S} = V_{DS} = 0$ V; $V_{G2-S} = 4$ V | – | 20 | nA |

**Note**

1. $R_{G1}$ connects $G_1$ to $V_{GG} = 5$ V.

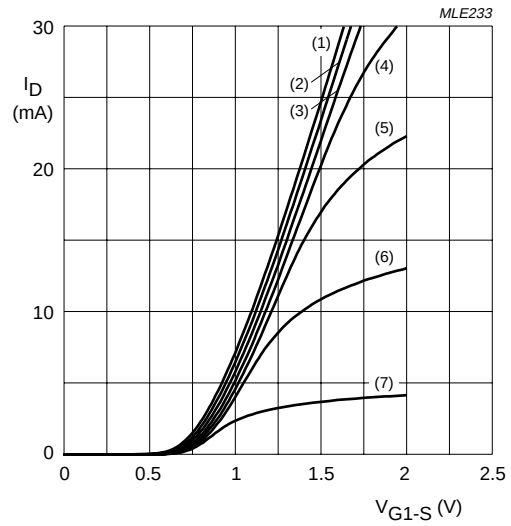
**DYNAMIC CHARACTERISTICS**

Common source; $T_{amb}$ = 25 °C; $V_{G2-S}$ = 4 V; $V_{DS}$ = 5 V; $I_D$ = 12 mA; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $\lvert y_{fs} \rvert$ | forward transfer admittance | pulsed; $T_j$ = 25 °C | 28 | 33 | 43 | mS |
| $C_{ig1-ss}$ | input capacitance at gate 1 | f = 1 MHz | – | 1.7 | 2.2 | pF |
| $C_{ig2-ss}$ | input capacitance at gate 2 | f = 1 MHz | – | 1.1 | – | pF |
| $C_{oss}$ | output capacitance | f = 1 MHz | – | 0.9 | – | pF |
| $C_{rss}$ | reverse transfer capacitance | f = 1 MHz | – | 15 | 30 | fF |
| F | noise figure | f = 11 MHz; $G_S$ = 20 mS; $B_S$ = 0 | – | 4 | – | dB |
| | | f = 400 MHz; $Y_S = Y_{S\ (opt)}$ | – | 0.9 | 1.6 | dB |
| | | f = 800 MHz; $Y_S = Y_{S\ (opt)}$ | – | 1.1 | 1.8 | dB |
| $G_{tr}$ | power gain | f = 200 MHz; $G_S$ = 2 mS; $B_S = B_{S\ (opt)}$; $G_L$ = 0.5 mS; $B_L = B_{L\ (opt)}$ | – | 35 | – | dB |
| | | f = 400 MHz; $G_S$ = 2 mS; $B_S = B_{S\ (opt)}$; $G_L$ = 1 mS; $B_L = B_{L\ (opt)}$ | – | 30 | – | dB |
| | | f = 800 MHz; $G_S$ = 3.3 mS; $B_S = B_{S\ (opt)}$; $G_L$ = 1 mS; $B_L = B_{L\ (opt)}$ | – | 25 | – | dB |
| $X_{mod}$ | cross-modulation | input level for k = 1%; $f_w$ = 50 MHz; $f_{unw}$ = 60 MHz; note 1 | | | | |
| | | at 0 dB AGC | 90 | – | – | dBµV |
| | | at 10 dB AGC | – | 89 | – | dBµV |
| | | at 40 dB AGC | 100 | 104 | – | dBµV |

**Note**

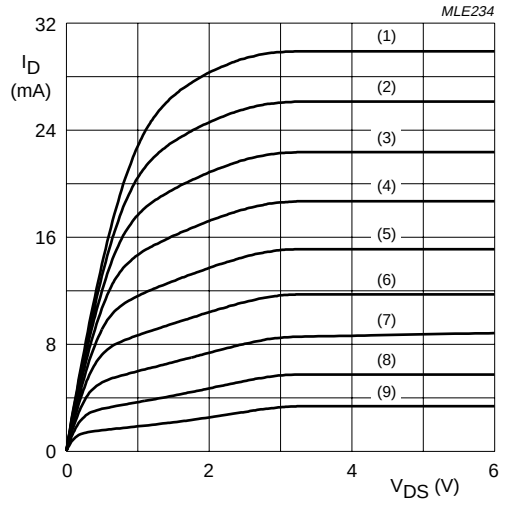
1. Measured in test circuit Fig.21.




(1) $V_{G2-S}$ = 4 V.
(2) $V_{G2-S}$ = 3.5 V.
(3) $V_{G2-S}$ = 3 V.
(4) $V_{G2-S}$ = 2.5 V.
(5) $V_{G2-S}$ = 2 V.
(6) $V_{G2-S}$ = 1.5 V.
(7) $V_{G2-S}$ = 1 V.

$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

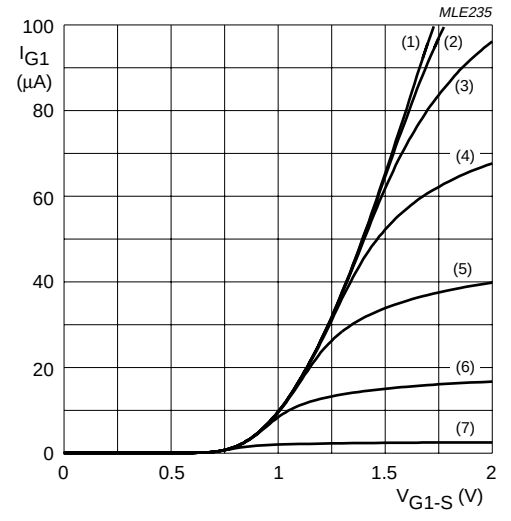
Fig.5 Transfer characteristics; typical values.




(1) $V_{G1-S}$ = 1.6 V.
(2) $V_{G1-S}$ = 1.5 V.
(3) $V_{G1-S}$ = 1.4 V.
(4) $V_{G1-S}$ = 1.3 V.
(5) $V_{G1-S}$ = 1.2 V.
(6) $V_{G1-S}$ = 1.1 V.
(7) $V_{G1-S}$ = 1.0 V.
(8) $V_{G1-S}$ = 0.9 V.
(9) $V_{G1-S}$ = 0.8 V.

$V_{G2-S}$ = 4 V.
$T_j$ = 25 °C.

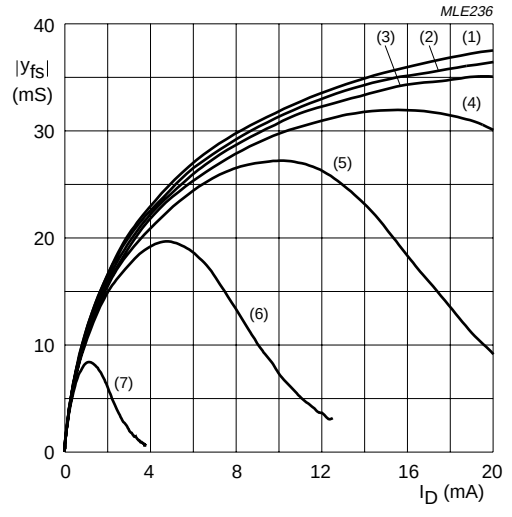
Fig.6 Output characteristics; typical values.




(1) $V_{G2-S}$ = 4 V.
(2) $V_{G2-S}$ = 3.5 V.
(3) $V_{G2-S}$ = 3 V.
(4) $V_{G2-S}$ = 2.5 V.
(5) $V_{G2-S}$ = 2 V.
(6) $V_{G2-S}$ = 1.5 V.
(7) $V_{G2-S}$ = 1 V.

$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

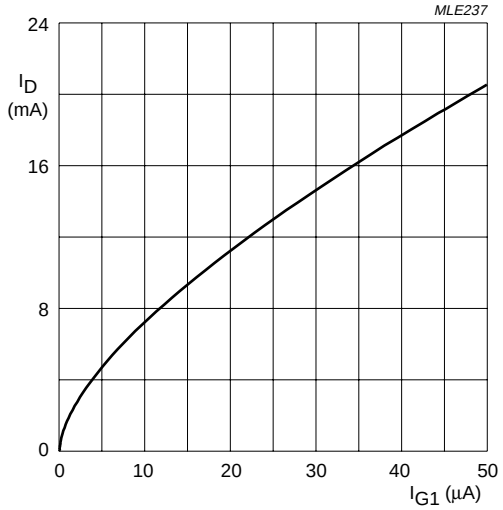
Fig.7 Gate 1 current as a function of gate 1 voltage; typical values.




(1) $V_{G2-S}$ = 4 V.
(2) $V_{G2-S}$ = 3.5 V.
(3) $V_{G2-S}$ = 3 V.
(4) $V_{G2-S}$ = 2.5 V.
(5) $V_{G2-S}$ = 2 V.
(6) $V_{G2-S}$ = 1.5 V.
(7) $V_{G2-S}$ = 1 V.

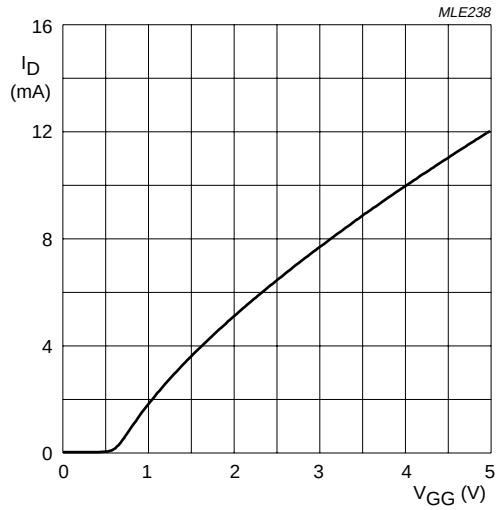
$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

Fig.8 Forward transfer admittance as a function of drain current; typical values.



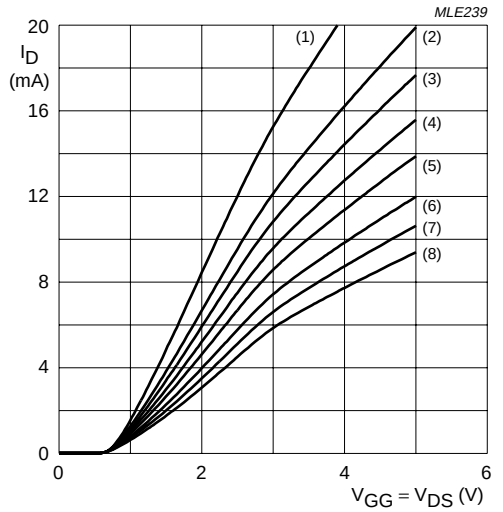

$V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V.
$T_j$ = 25 °C.

Fig.9 Drain current as a function of gate 1 current; typical values.




$V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $T_j$ = 25 °C.
$R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21.

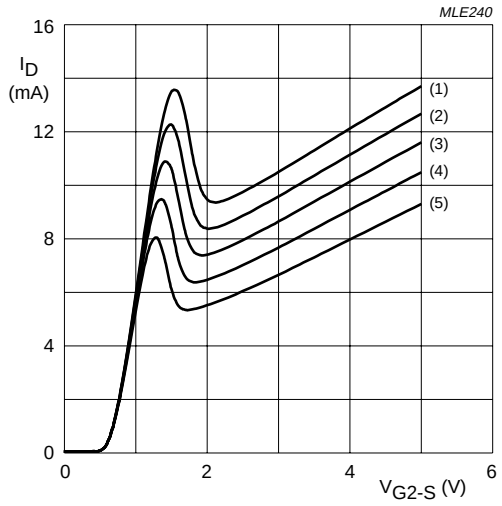
Fig.10 Drain current as a function of gate 1 supply voltage; typical values.




(1) $R_{G1}$ = 47 kΩ.
(2) $R_{G1}$ = 56 kΩ.
(3) $R_{G1}$ = 82 kΩ.
(4) $R_{G1}$ = 100 kΩ.
(5) $R_{G1}$ = 120 kΩ.
(6) $R_{G1}$ = 150 kΩ.
(7) $R_{G1}$ = 180 kΩ.
(8) $R_{G1}$ = 220 kΩ.

$V_{G2\text{-}S}$ = 4 V; $T_j$ = 25 °C.
$R_{G1}$ connected to $V_{GG}$; see Fig.21.

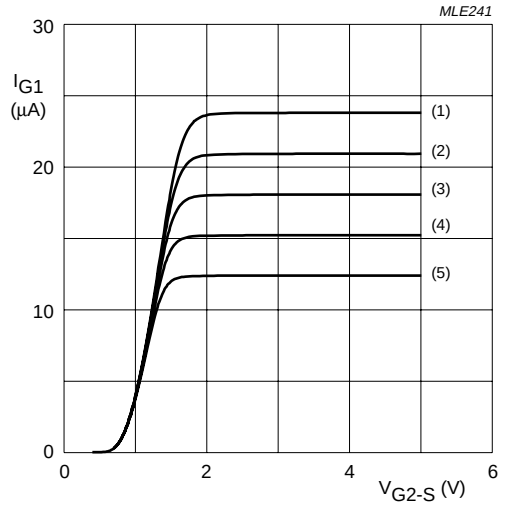
Fig.11 Drain current as a function of gate 1 and drain supply voltage; typical values.




(1) $V_{GG}$ = 5 V.
(2) $V_{GG}$ = 4.5 V.
(3) $V_{GG}$ = 4 V.
(4) $V_{GG}$ = 3.5 V.
(5) $V_{GG}$ = 3 V.

$V_{DS}$ = 5 V; $T_j$ = 25 °C.
$R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21.

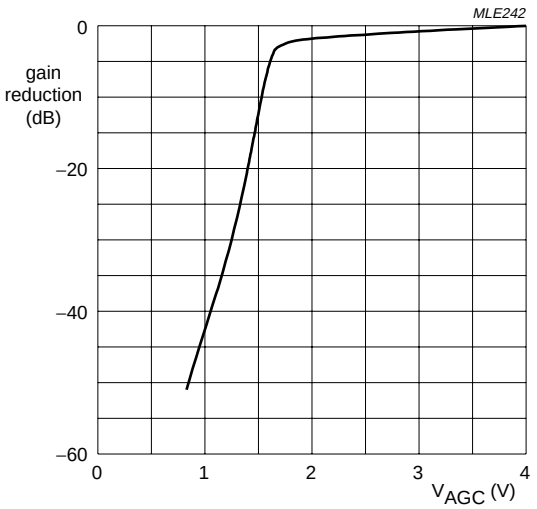
Fig.12 Drain current as a function of gate 2 voltage; typical values.




(1) $V_{GG}$ = 5 V.
(2) $V_{GG}$ = 4.5 V.
(3) $V_{GG}$ = 4 V.
(4) $V_{GG}$ = 3.5 V.
(5) $V_{GG}$ = 3 V.

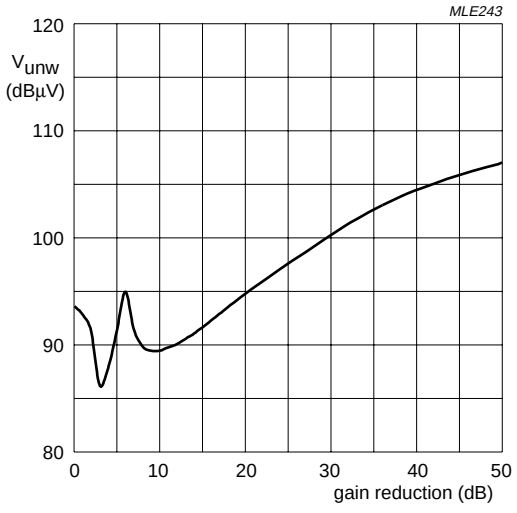
$V_{DS}$ = 5 V; $T_j$ = 25 °C.
$R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21.

Fig.13 Gate 1 current as a function of gate 2 voltage; typical values.



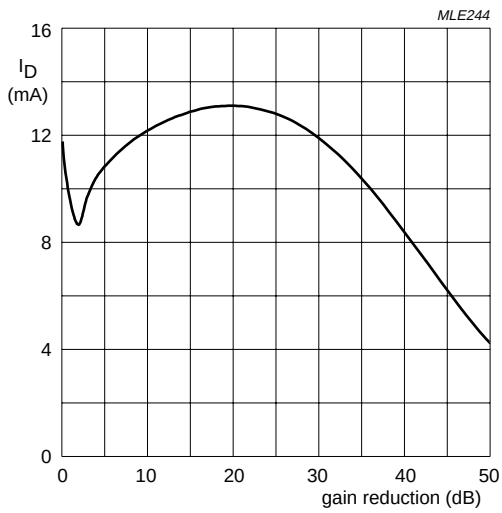

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; $R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21; f = 50 MHz; $T_{amb}$ = 25 °C.

Fig.14 Typical gain reduction as a function of AGC voltage.



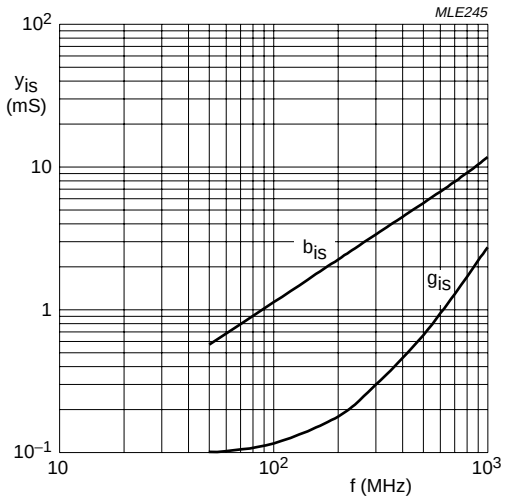

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; $R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21; f= 50 MHz; $f_{unw}$ = 60 MHz; $T_{amb}$ = 25 °C.

Fig.15 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values.



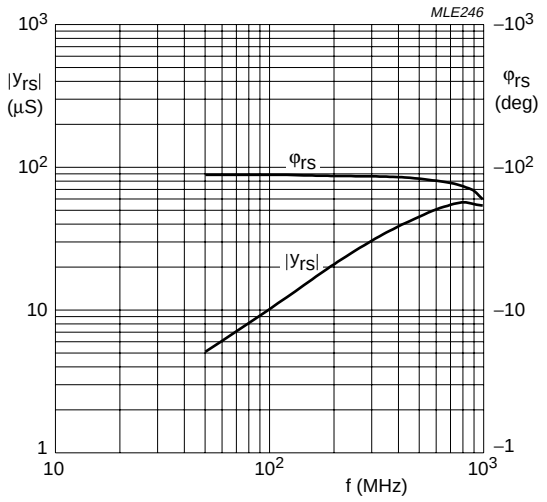

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; $R_{G1}$ = 150 kΩ (connected to $V_{GG}$); see Fig.21; f= 50 MHz; $T_{amb}$ = 25 °C.

Fig.16 Drain current as a function of gain reduction; typical values.



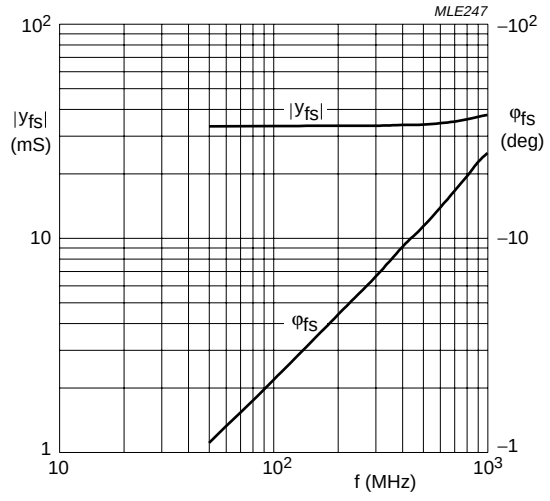

$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.17 Input admittance as a function of frequency; typical values.



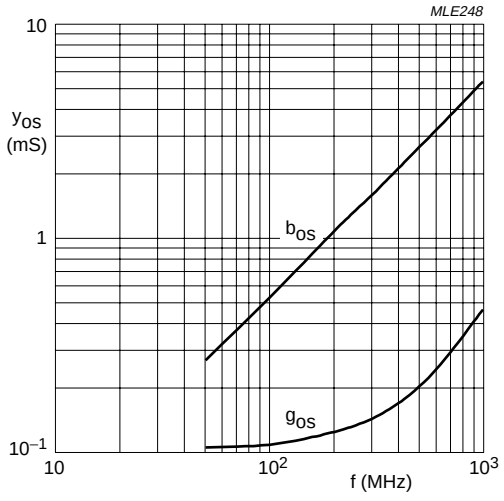

$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.18 Reverse transfer admittance and phase as functions of frequency; typical values.




$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.19 Forward transfer admittance and phase as functions of frequency; typical values.




$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.20 Output admittance as a function of frequency; typical values.

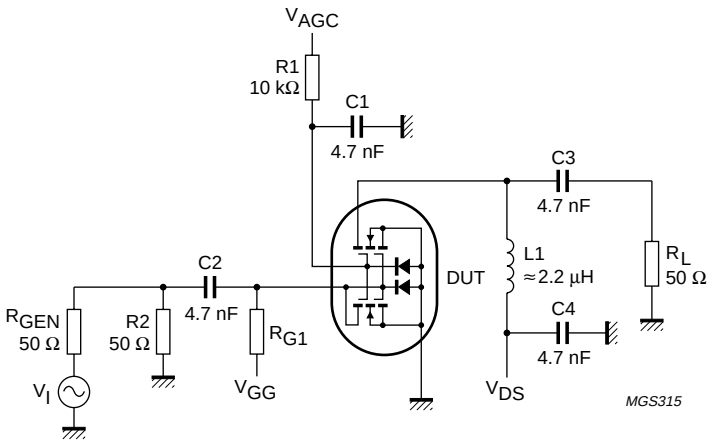



Fig.21 Cross-modulation test set-up.

**Table 1** Scattering parameters: $V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $I_D$ = 12 mA; $T_{amb}$ = 25 °C

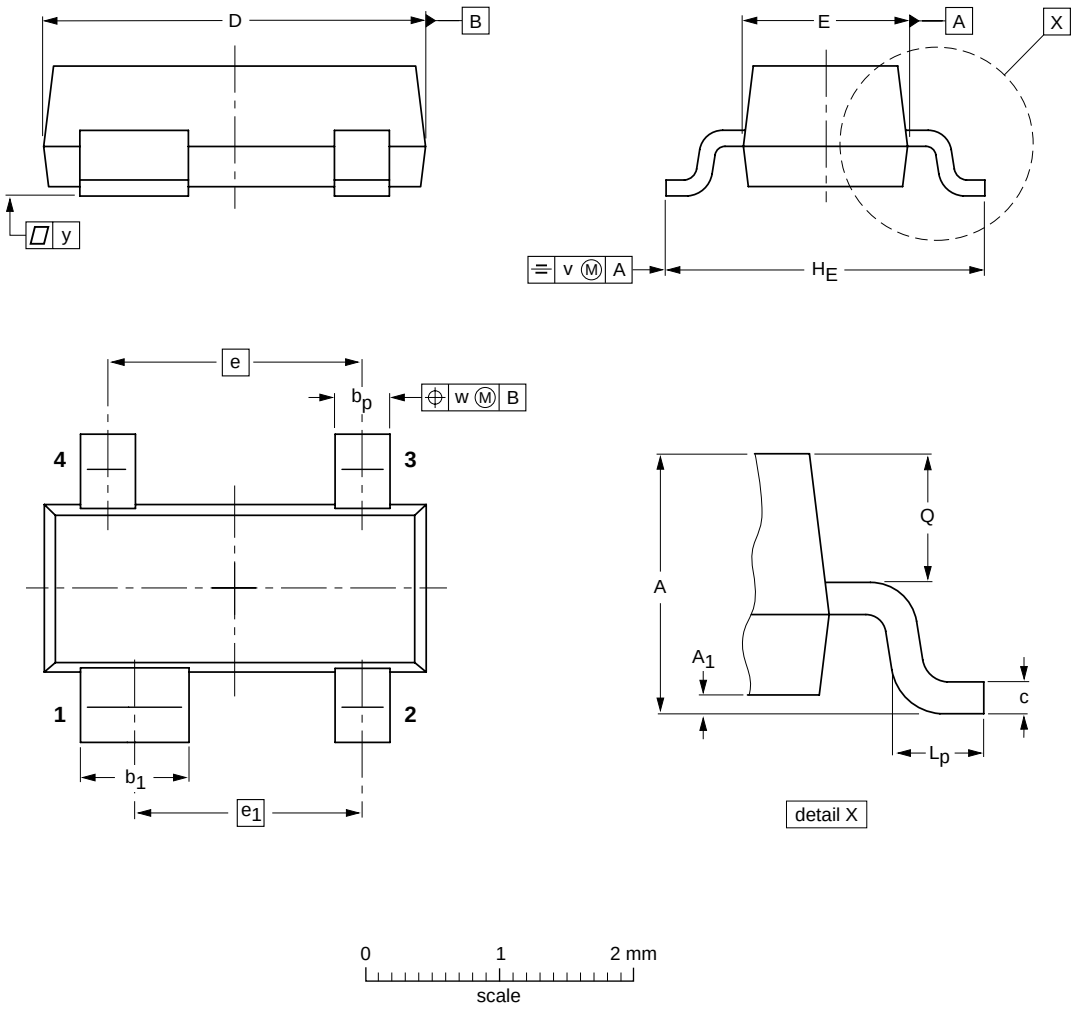
| f (MHz) | $s_{11}$ | | $s_{21}$ | | $s_{12}$ | | $s_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) |
| 50 | 0.990 | –3.39 | 3.288 | 176.5 | 0.0005 | 86.9 | 0.990 | –1.66 |
| 100 | 0.988 | –6.76 | 3.280 | 173.0 | 0.0011 | 85.6 | 0.990 | –3.30 |
| 200 | 0.983 | –13.40 | 3.261 | 166.1 | 0.0021 | 81.2 | 0.991 | –6.62 |
| 300 | 0.974 | –19.86 | 3.218 | 159.0 | 0.0030 | 77.5 | 0.991 | –9.92 |
| 400 | 0.969 | –26.46 | 3.205 | 152.6 | 0.0039 | 74.6 | 0.994 | –13.30 |
| 500 | 0.958 | –32.73 | 3.141 | 145.9 | 0.0045 | 72.4 | 0.994 | –16.56 |
| 600 | 0.947 | –38.83 | 3.086 | 139.5 | 0.0049 | 70.9 | 0.993 | –19.77 |
| 700 | 0.936 | –44.75 | 3.017 | 133.1 | 0.0051 | 69.5 | 0.991 | –22.78 |
| 800 | 0.924 | –50.51 | 2.949 | 126.9 | 0.0051 | 69.9 | 0.981 | –25.77 |
| 900 | 0.910 | –56.18 | 2.870 | 120.5 | 0.0049 | 69.8 | 0.984 | –28.72 |
| 1000 | 0.896 | –61.64 | 2.785 | 114.7 | 0.0045 | 72.7 | 0.980 | –31.77 |

**Table 2** Noise data: $V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $I_D$ = 12 mA; $T_{amb}$ = 25 °C

| f (MHz) | $F_{min}$ (dB) | $\Gamma_{opt}$ | | $R_n$ (Ω) |
|---|---|---|---|---|
| | | (ratio) | (deg) | |
| 400 | 0.9 | 0.695 | 13.87 | 28.5 |
| 800 | 1.1 | 0.634 | 30.30 | 32.85 |

## PACKAGE OUTLINES

**Plastic surface mounted package; 4 leads** **SOT143B**

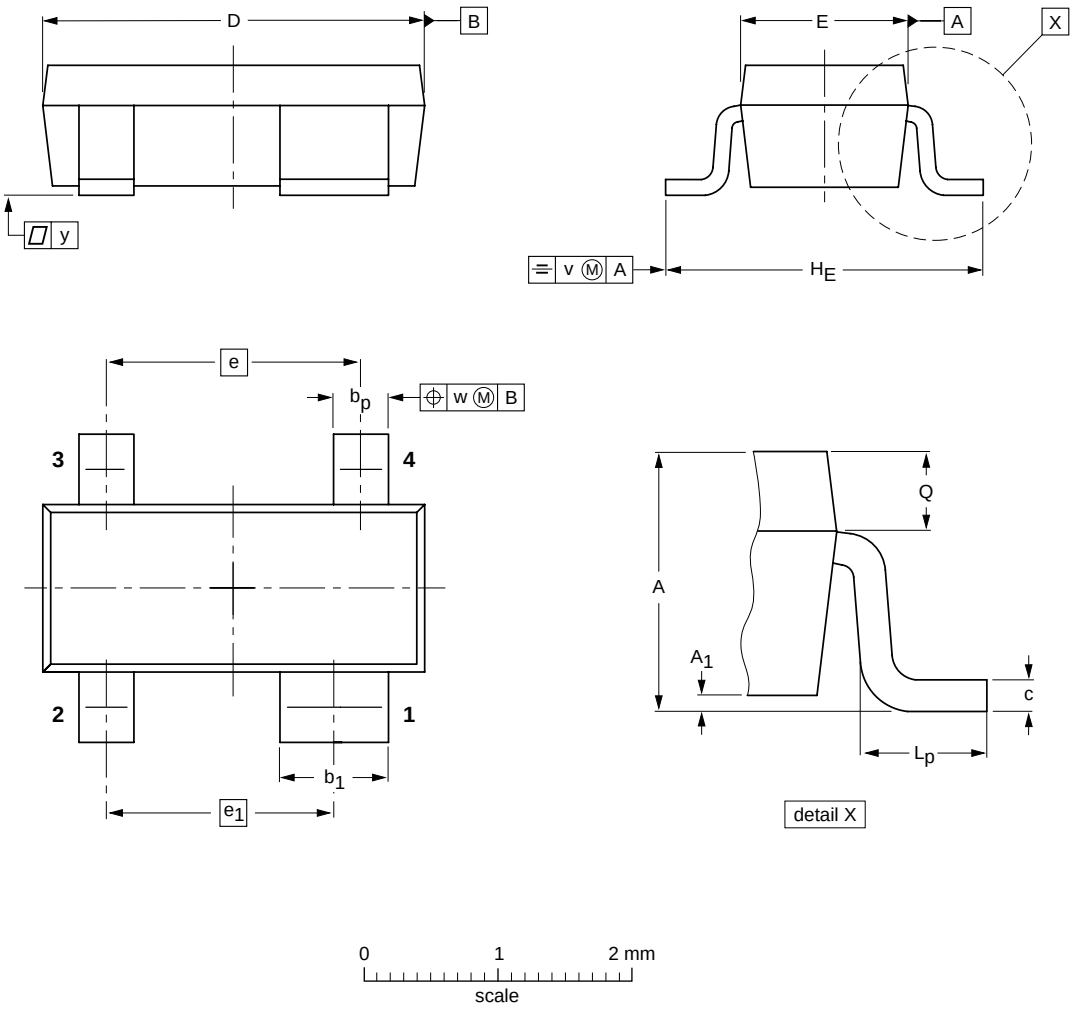



**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.88<br>0.78 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7 | 2.5<br>2.1 | 0.45<br>0.15 | 0.55<br>0.45 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT143B | | | | | | 97-02-28 |

**Plastic surface mounted package; reverse pinning; 4 leads** **SOT143R**

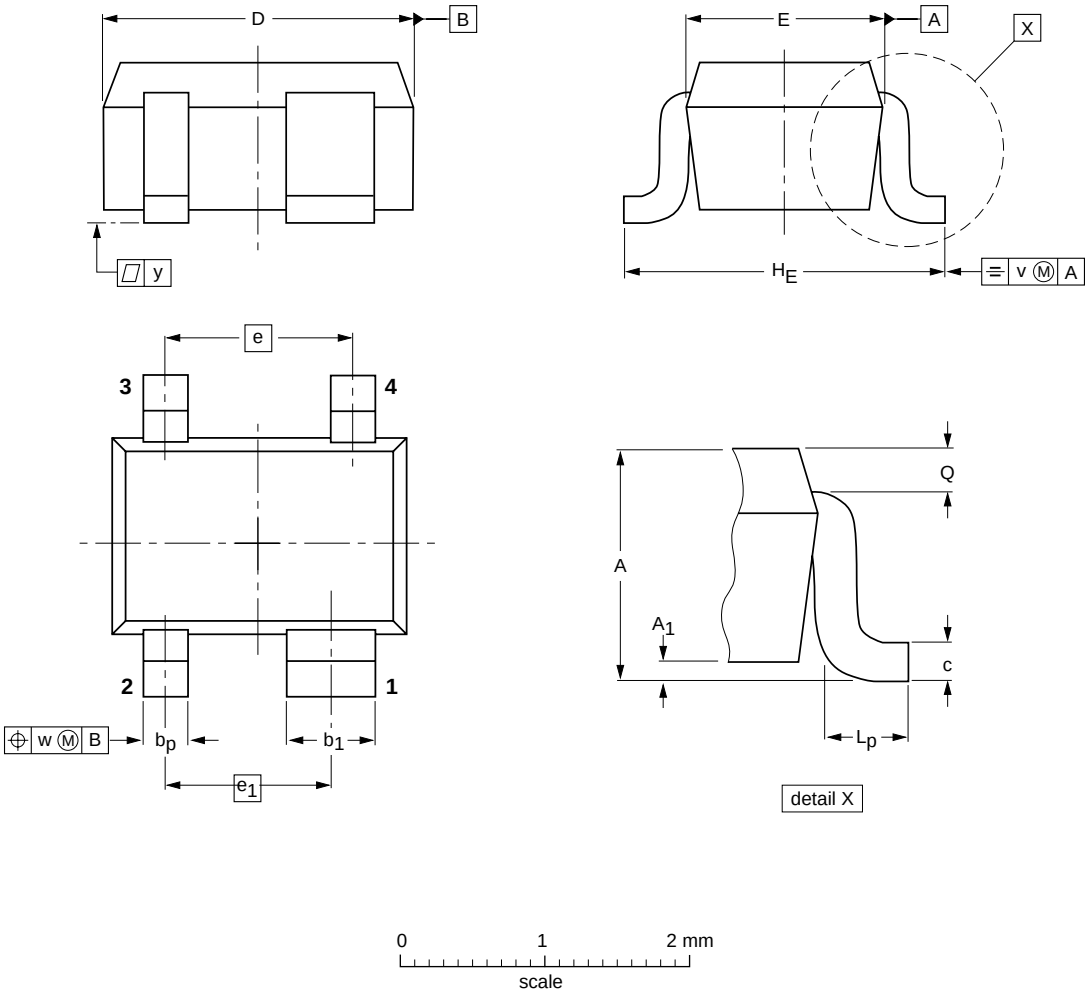



**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.88<br>0.78 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7 | 2.5<br>2.1 | 0.55<br>0.25 | 0.45<br>0.25 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT143R | | | SC-61B | | | ~~97-03-10~~<br>99-09-13 |

**Plastic surface mounted package; reverse pinning; 4 leads** **SOT343R**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.8 | 0.1 | 0.4<br>0.3 | 0.7<br>0.5 | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15 | 1.3 | 1.15 | 2.2<br>2.0 | 0.45<br>0.15 | 0.23<br>0.13 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT343R | | | | | | 97-05-21 |

**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**.

© Koninklijke Philips Electronics N.V. 2003 SCA75

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands R77/02/pp15 Date of release: 2003 Nov 14 Document order number: 9397 750 12308

*Let's make things better.*

Philips