# DATA SHEET

# BSP250
## P-channel enhancement mode vertical D-MOS transistor

Product specification
Supersedes data of November 1994
File under Discrete Semiconductors, SC13b

1997 Jun 20

Philips
Semiconductors

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# P-channel enhancement mode vertical D-MOS transistor

# BSP250

## FEATURES

- High-speed switching
- No secondary breakdown
- Very low on-resistance.

## APPLICATIONS

- Low-loss motor and actuator drivers
- Power switching.

## DESCRIPTION

P-channel enhancement mode vertical D-MOS transistor in a SOT223 plastic SMD package.

| CAUTION |
| --- |
| The device is supplied in an antistatic package. The gate-source input must be protected against static discharge during transport or handling. |

## PINNING - SOT223

| PIN | SYMBOL | DESCRIPTION |
| --- | --- | --- |
| 1 | g | gate |
| 2 | d | drain |
| 3 | s | source |
| 4 | d | drain |

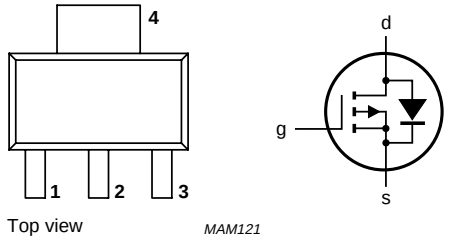



Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
| --- | --- | --- | --- | --- | --- |
| $V_{DS}$ | drain-source voltage (DC) | | – | –30 | V |
| $V_{SD}$ | source-drain diode forward voltage | $I_S$ = –1.25 A | – | –1.6 | V |
| $V_{GSO}$ | gate-source voltage (DC) | open drain | – | ±20 | V |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = –1 mA; $V_{DS}$ = $V_{GS}$ | –1 | –2.8 | V |
| $I_D$ | drain current (DC) | | – | –3 | A |
| $R_{DSon}$ | drain-source on-state resistance | $I_D$ = –1 A; $V_{GS}$ = –10 V | – | 0.25 | Ω |
| $P_{tot}$ | total power dissipation | $T_s$ = 100 °C | – | 5 | W |

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage (DC) | | – | –30 | V |
| $V_{GSO}$ | gate-source voltage (DC) | open drain | – | ±20 | V |
| $I_D$ | drain current (DC) | $T_s \leq 100$ °C | – | –3 | A |
| $I_{DM}$ | peak drain current | note 1 | – | –12 | A |
| $P_{tot}$ | total power dissipation | $T_s = 100$ °C | – | 5 | W |
| | | $T_{amb} = 25$ °C; note 2 | – | 1.65 | W |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | operating junction temperature | | – | 150 | °C |
| **Source-drain diode** | | | | | |
| $I_S$ | source current (DC) | $T_s \leq 100$ °C | – | –1.5 | A |
| $I_{SM}$ | peak pulsed source current | note 1 | – | –6 | A |

**Notes**

1. Pulse width and duty cycle limited by maximum junction temperature.
2. Device mounted on an epoxy printed-circuit board, 40 × 40 × 1.5 mm; mounting pad for drain lead minimum 6 $cm^2$.

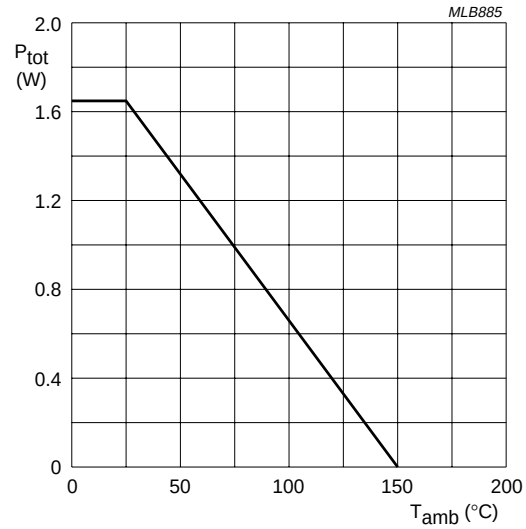
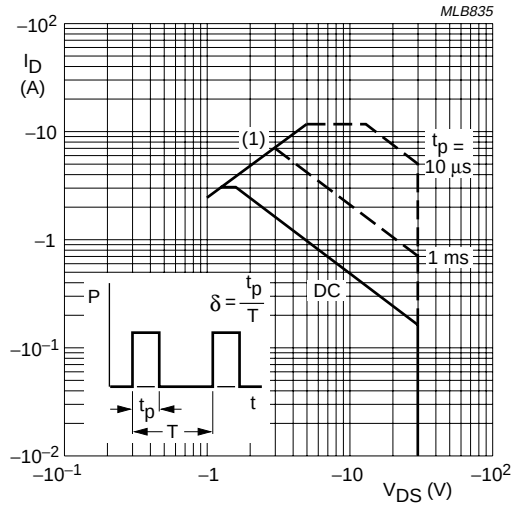



Fig.2 Power derating curve.




δ = 0.01.
Soldering point temperature $T_s = 100$ °C.
(1) $R_{DSon}$ limitation.

Fig.3 SOAR.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | note 1 | 75 | K/W |
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | | 10 | K/W |

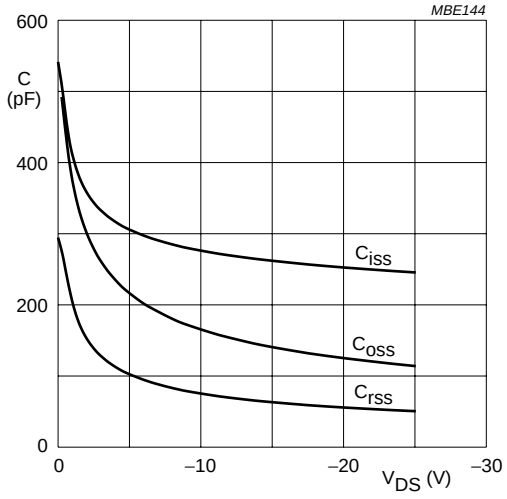
**Note**

1. Device mounted on an epoxy printed-circuit board, $40 \times 40 \times 1.5$ mm; mounting pad for drain lead minimum 6 $cm^2$.

## CHARACTERISTICS

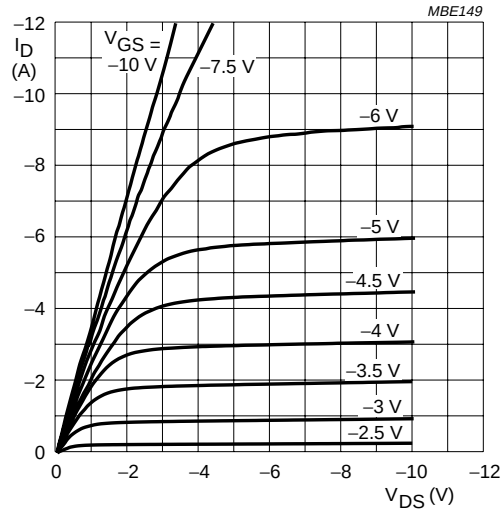
$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0; $I_D$ = –10 μA | –30 | – | – | V |
| $V_{GSth}$ | gate-source threshold voltage | $V_{GS}$ = $V_{DS}$; $I_D$ = –1 mA | –1 | – | –2.8 | V |
| $I_{DSS}$ | drain-source leakage current | $V_{GS}$ = 0; $V_{DS}$ = –24 V | – | – | –100 | nA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = ±20 V; $V_{DS}$ = 0 | – | – | ±100 | nA |
| $I_{Don}$ | on-state drain current | $V_{GS}$ = –10 V; $V_{DS}$ = –1 V | –3 | – | – | A |
| | | $V_{GS}$ = –4.5 V; $V_{DS}$ = –5 V | –1 | – | – | A |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = –4.5 V; $I_D$ = –0.5 A | – | 0.33 | 0.4 | Ω |
| | | $V_{GS}$ = –10 V; $I_D$ = –1 A | – | 0.22 | 0.25 | Ω |
| $\lvert y_{fs} \rvert$ | forward transfer admittance | $V_{DS}$ = –20 V; $I_D$ = –1 A | 1 | 2 | – | S |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0; $V_{DS}$ = –20 V; f = 1 MHz | – | 250 | – | pF |
| $C_{oss}$ | output capacitance | $V_{GS}$ = 0; $V_{DS}$ = –20 V; f = 1 MHz | – | 140 | – | pF |
| $C_{rss}$ | reverse transfer capacitance | $V_{GS}$ = 0; $V_{DS}$ = –20 V; f = 1 MHz | – | 50 | – | pF |
| $Q_G$ | total gate charge | $V_{GS}$ = –10 V; $V_{DS}$ = –15 V; $I_D$ = –2.3 A | – | 10 | 25 | nC |
| $Q_{GS}$ | gate-source charge | $V_{GS}$ = –10 V; $V_{DS}$ = –15 V; $I_D$ = –2.3 A | – | 1 | – | nC |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = –10 V; $V_{DS}$ = –15 V; $I_D$ = –2.3 A | – | 3 | – | nC |
| **Switching times** | | | | | | |
| $t_{on}$ | turn-on time | $V_{GS}$ = 0 to –10 V; $V_{DD}$ = –20 V; $I_D$ = –1 A; $R_L$ = 20 Ω | – | 20 | 80 | ns |
| $t_{off}$ | turn-off time | $V_{GS}$ = –10 to 0 V; $V_{DD}$ = –20 V; $I_D$ = –1 A; $R_L$ = 20 Ω | – | 50 | 140 | ns |
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain diode forward voltage | $V_{GD}$ = 0; $I_S$ = –1.25 A | – | – | –1.6 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = –1.25 A; di/dt = 100 A/μs | – | 150 | 200 | ns |



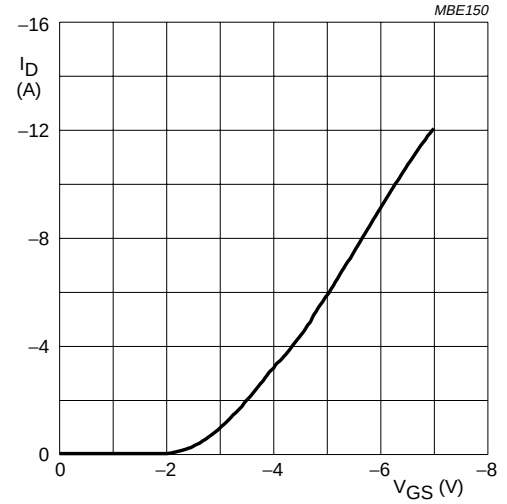

$V_{GS}$ = 0.
$T_j$ = 25 °C.

Fig.4 Capacitance as a function of drain source voltage; typical values.



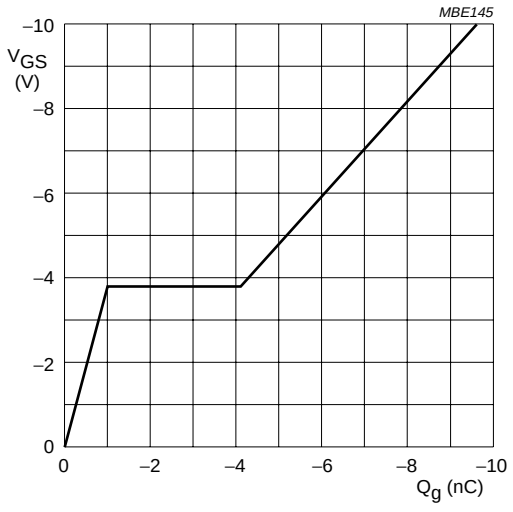

$T_j$ = 25 °C.

Fig.5 Output characteristics; typical values.



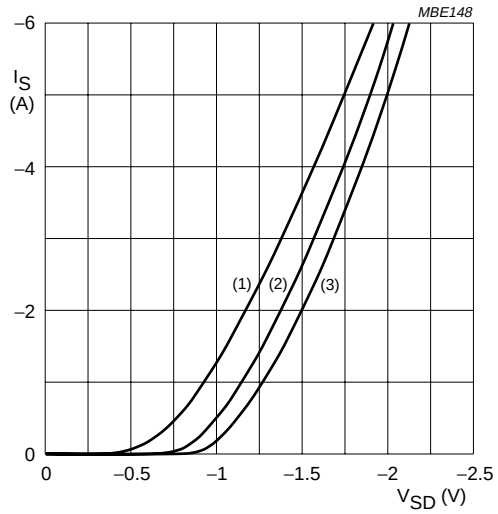

$V_{DS}$ = −10 V.
$T_j$ = 25 °C.

Fig.6 Transfer characteristic, typical values.



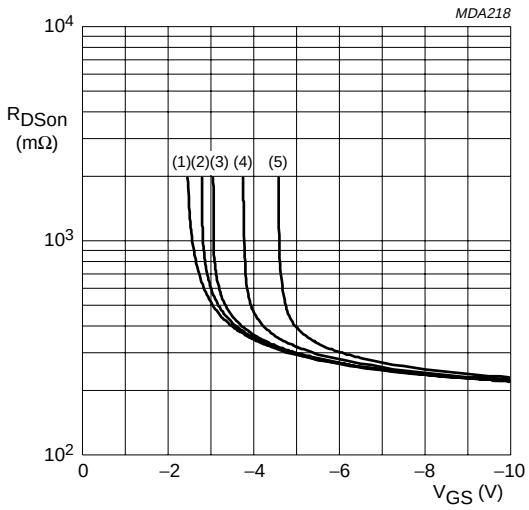

$V_{DD}$ = −15 V.
$I_D$ = −3 A.

Fig.7 Gate-source voltage as a function of total gate charge.



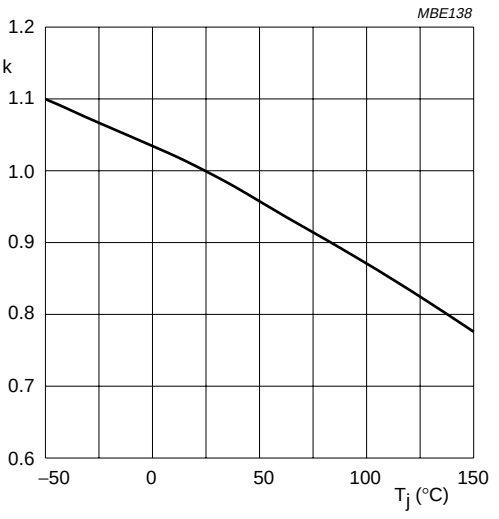

$V_{GD}$ = 0.
(1) $T_j$ = 150 °C.
(2) $T_j$ = 25 °C.
(3) $T_j$ = −55 °C.

Fig.8 Source current as a function of source-drain diode forward voltage.




$-V_{DS} \geq -I_D \times R_{DSon}$; $T_j$ = 25 °C.
(1) $I_D$ = −0.1 A.
(2) $I_D$ = −0.5 A.
(3) $I_D$ = −1 A.
(4) $I_D$ = −3 A.
(5) $I_D$ = −6 A.

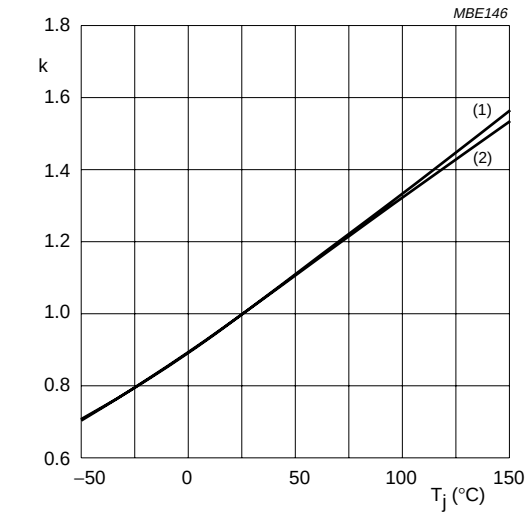
Fig.9 Drain-source on-state resistance as a function of gate-source voltage; typical values.




$$k = \frac{V_{GSth} \text{ at } T_j}{V_{GSth} \text{ at } 25°C}$$

Typical $V_{GSth}$ at $I_D$ = −1 mA; $V_{DS}$ = $V_{GS}$ = $V_{GSth}$.

Fig.10 Temperature coefficient of gate-source threshold voltage.




$$k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25\ °C}$$

Typical $R_{DSon}$ at:
(1) $I_D$ = −1 A; $V_{GS}$ = −10 V.
(2) $I_D$ = −0.5 A; $V_{GS}$ = −4.5 V.

Fig.11 Temperature coefficient of drain-source on-resistance.

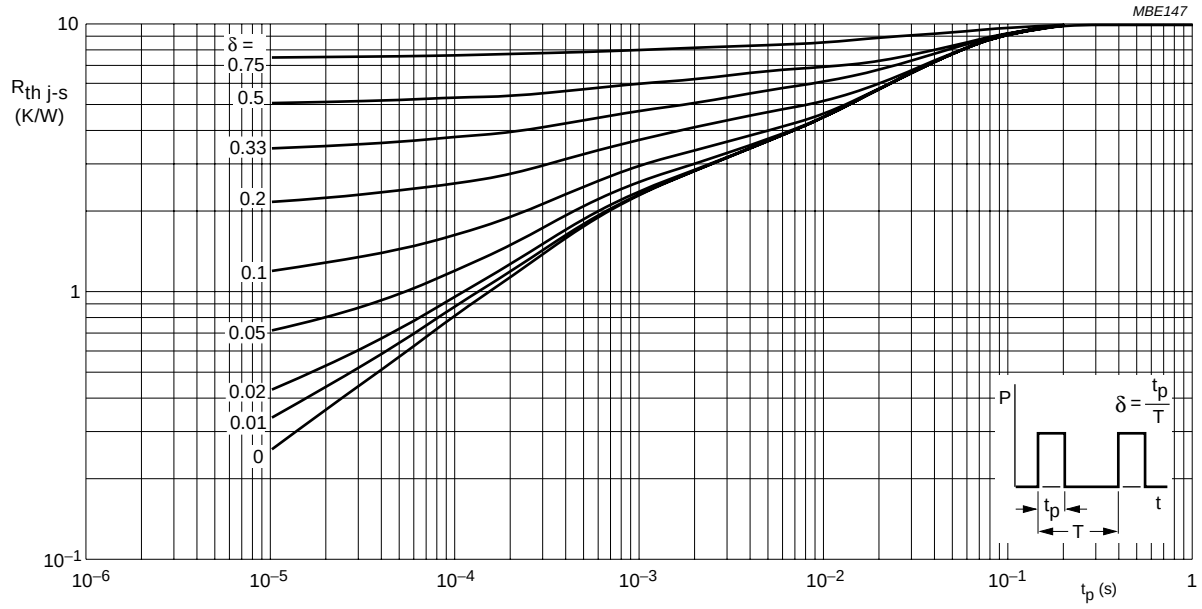
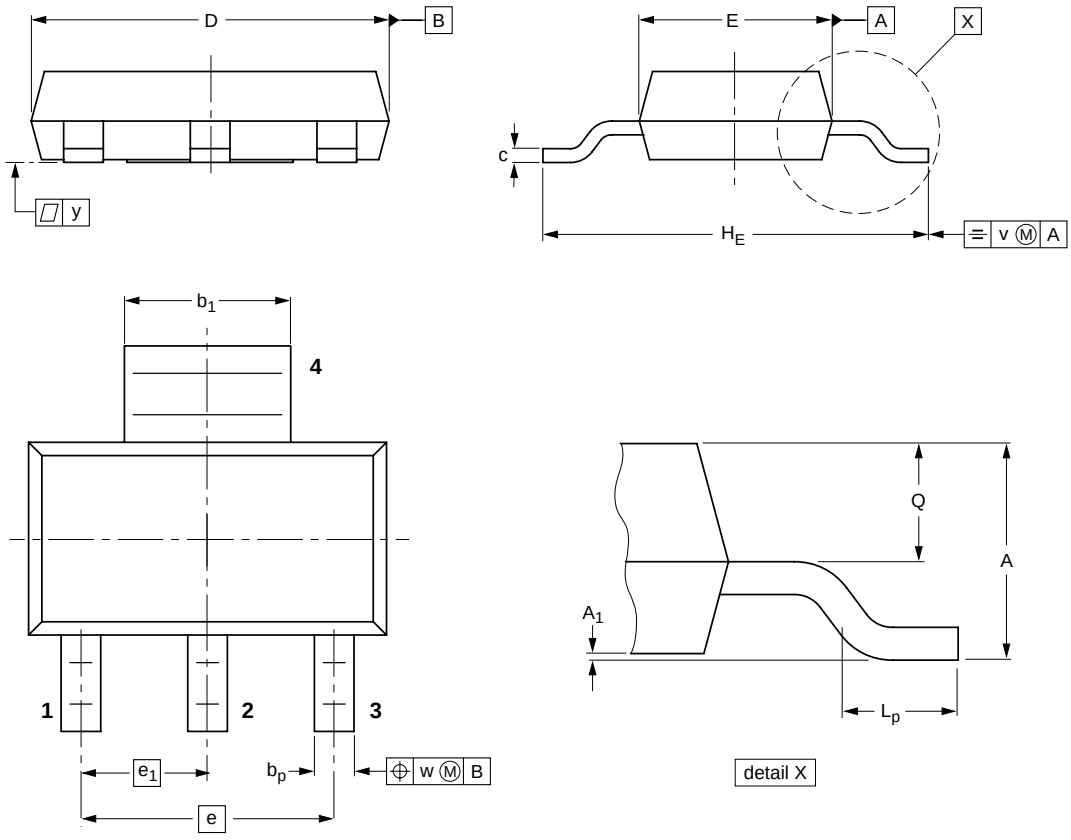



Fig.12 Transient thermal resistance from junction to soldering point as a function of pulse time; typical values.

## PACKAGE OUTLINE

**Plastic surface mounted package; collector pad for good heat transfer; 4 leads** **SOT223**




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

| UNIT | A | $A_1$ | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.8<br>1.5 | 0.10<br>0.01 | 0.80<br>0.60 | 3.1<br>2.9 | 0.32<br>0.22 | 6.7<br>6.3 | 3.7<br>3.3 | 4.6 | 2.3 | 7.3<br>6.7 | 1.1<br>0.7 | 0.95<br>0.85 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT223 | | | | | | ~~96-11-11~~<br>97-02-28 |

## DEFINITIONS

| **Data Sheet Status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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**NOTES**

**NOTES**

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Tel. +43 1 60 101, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

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51 James Bourchier Blvd., 1407 SOFIA,
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**Denmark:** Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 0044

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580920

**France:** 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

**Greece:** No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
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**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

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**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

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Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Philippines:** Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

**Portugal:** see Spain

**Romania:** see Italy

**Russia:** Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

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2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
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**South America:** Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
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**Spain:** Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

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**Taiwan:** Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd.,
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**Turkey:** Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
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**Ukraine**: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

**Uruguay:** see South America

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**Yugoslavia:** PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax.+381 11 635 777

**For all other countries apply to:** Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

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