

PowerMOS transistor Logic level TOPFET

BUK127-50GT

DESCRIPTION

Monolithic temperature and overload protected logic level power MOSFET in **TOPFET2** technology assembled in a 3 pin surface mount plastic package.

APPLICATIONS

General purpose switch for driving

- lamps
- motors
- solenoids
- heaters

in automotive systems and other applications.

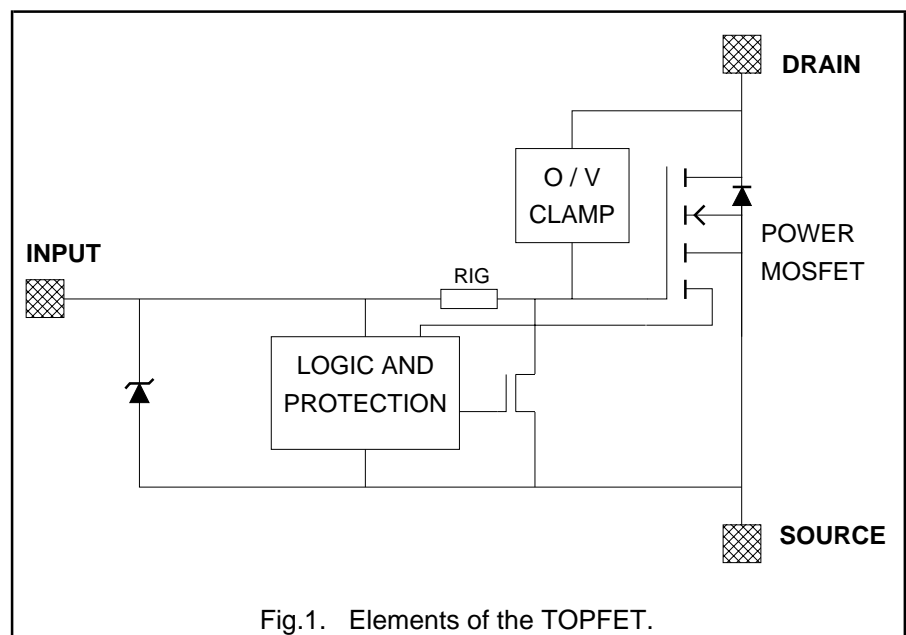
FEATURES

- TrenchMOS output stage
- Current trip protection
- Overload protection
- Overtemperature protection
- Protection latched reset by input
- 5 V logic compatible input level
- Control of output stage and supply of overload protection circuits derived from input
- Low operating input current permits direct drive by micro-controller
- ESD protection on all pins
- Overvoltage clamping for turn off of inductive loads

QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MAX. | UNIT |
|--------------|----------------------------------|------|------|
| V_{DS} | Continuous drain source voltage | 50 | V |
| I_D | Continuous drain current | 2.1 | A |
| P_D | Total power dissipation | 1.8 | W |
| T_j | Continuous junction temperature | 150 | °C |
| $R_{DS(ON)}$ | Drain-source on-state resistance | 200 | mΩ |

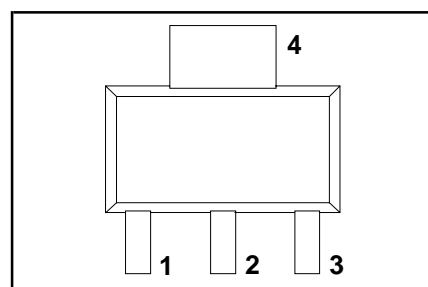
FUNCTIONAL BLOCK DIAGRAM



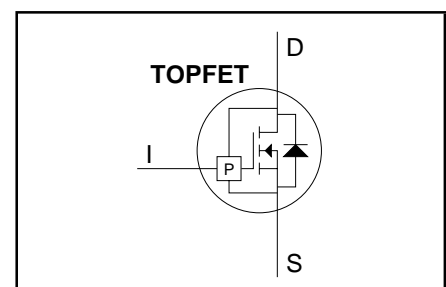
PINNING - SOT223

| PIN | DESCRIPTION |
|-----|-------------|
| 1 | input |
| 2 | drain |
| 3 | source |
| 4 | drain (tab) |

PIN CONFIGURATION



SYMBOL



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LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|--|-------------------------------|------|--------------|------------------|
| V_{DS} | Continuous drain source voltage ¹ | - | - | 50 | V |
| I_D | Drain current ² | - | - | current trip | A |
| I_D | Continuous drain current | $T_a = 25^\circ\text{C}$ | - | 2.1 | A |
| I_I | Continuous input current | clamping | - | 3 | mA |
| I_{IRM} | Non-repetitive peak input current | $t_p \leq 1 \text{ ms}$ | - | 10 | mA |
| P_D | Total power dissipation | $T_a = 25^\circ\text{C}$ | - | 1.8 | W |
| T_{stg} | Storage temperature | - | -55 | 150 | $^\circ\text{C}$ |
| T_j | Continuous junction temperature | normal operation ³ | - | 150 | $^\circ\text{C}$ |

ESD LIMITING VALUE

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|--------|---|---|------|------|------|
| V_C | Electrostatic discharge capacitor voltage | Human body model; $C = 250 \text{ pF}$; $R = 1.5 \text{ k}\Omega$ | - | 2 | kV |

OVERVOLTAGE CLAMPING LIMITING VALUES

At a drain source voltage above 50 V the power MOSFET is actively turned on to clamp overvoltage transients.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|--------------------------------|--|------|------|------|
| E_{DSM} | Non-repetitive clamping energy | $T_a \leq 25^\circ\text{C}$; $I_{DM} \leq I_{D(TO)}$; inductive load | - | 100 | mJ |
| E_{DRM} | Repetitive clamping energy | $T_{sp} \leq 125^\circ\text{C}$; $I_{DM} = 1 \text{ A}$; $f = 250 \text{ Hz}$ | - | 5 | mJ |

OVERLOAD PROTECTION LIMITING VALUES

With the protection supply provided via the input pin, TOPFET can protect itself from short circuit loads. Overload protection operates by means of drain current trip or by activating the overtemperature protection.

| SYMBOL | PARAMETER | REQUIRED CONDITION | MIN. | MAX. | UNIT |
|-----------|---------------------------------------|---------------------------|------|------|------|
| V_{DDP} | Protected drain source supply voltage | $V_{IS} \geq 4 \text{ V}$ | - | 35 | V |

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|----------------|---|--------------------------|------|------|------|------|
| $R_{th\ j-sp}$ | Thermal resistance Junction to solder point | | - | 12 | 18 | K/W |
| $R_{th\ j-b}$ | Junction to board ⁴ | Mounted on any PCB | - | 40 | - | K/W |
| $R_{th\ j-a}$ | Junction to ambient | Mounted on PCB of fig. 4 | - | - | 70 | K/W |

¹ Prior to the onset of overvoltage clamping. For voltages above this value, safe operation is limited by the overvoltage clamping energy.

² Refer to OVERLOAD PROTECTION CHARACTERISTICS.

³ **Not** in an overload condition with drain current limiting.

⁴ Temperature measured 1.3 mm from tab.

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OUTPUT CHARACTERISTICS

Limits are for $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$; typicals are for $T_{\text{mb}} = 25^{\circ}\text{C}$ unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------------------------|---|---|------|------|------|------------------|
| $V_{(\text{CL})\text{DSS}}$ | Off-state Drain-source clamping voltage | $V_{\text{IS}} = 0\text{ V}$ | 50 | - | - | V |
| | | $I_{\text{D}} = 10\text{ mA}$ $I_{\text{D}} = 200\text{ mA}; t_{\text{p}} \leq 300\text{ }\mu\text{s}; \delta \leq 0.01$ | 50 | 60 | 70 | V |
| I_{DSS} | Drain source leakage current | $V_{\text{DS}} = 40\text{ V}$ | - | - | 100 | μA |
| | | $T_{\text{mb}} = 25^{\circ}\text{C}$ | - | 0.1 | 10 | μA |
| $R_{\text{DS(ON)}}$ | On-state Drain-source resistance | $V_{\text{IS}} \geq 4\text{ V}; t_{\text{p}} \leq 300\text{ }\mu\text{s}; \delta \leq 0.01$ | - | - | 380 | $\text{m}\Omega$ |
| | | $I_{\text{D}} = 100\text{ mA}$ $T_{\text{mb}} = 25^{\circ}\text{C}$ | - | 150 | 200 | $\text{m}\Omega$ |

INPUT CHARACTERISTICS

The supply for the logic and overload protection is taken from the input.

Limits are for $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$; typicals are for $T_{\text{mb}} = 25^{\circ}\text{C}$ unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT | |
|----------------------------|---|--|------------------------------|------|------|---------------|---------------|
| $V_{\text{IS(TO)}}$ | Input threshold voltage | $V_{\text{DS}} = 5\text{ V}; I_{\text{D}} = 1\text{ mA}$ | 0.6 | - | 2.4 | V | |
| | | $T_{\text{mb}} = 25^{\circ}\text{C}$ | 1.1 | 1.6 | 2.1 | V | |
| I_{IS} | Input supply current | normal operation; | $V_{\text{IS}} = 5\text{ V}$ | 100 | 220 | 400 | μA |
| | | | $V_{\text{IS}} = 4\text{ V}$ | 80 | 195 | 330 | μA |
| I_{ISL} | Input supply current | protection latched; | $V_{\text{IS}} = 5\text{ V}$ | 1.4 | 2 | 2.5 | mA |
| | | | $V_{\text{IS}} = 3\text{ V}$ | 0.7 | 1.1 | 1.5 | mA |
| V_{ISR} | Protection reset voltage ¹ | reset time $t_{\text{r}} \geq 100\text{ }\mu\text{s}$ | 1.5 | 2 | 2.5 | V | |
| t_{r} | Latch reset time | $V_{\text{IS1}} = 5\text{ V}, V_{\text{IS2}} < 1\text{ V}$ | 10 | 40 | 100 | μs | |
| $V_{(\text{CL})\text{IS}}$ | Input clamping voltage | $I_{\text{I}} = 1.5\text{ mA}$ | 5.5 | - | 8.5 | V | |
| R_{IG} | Input series resistance ² to gate of power MOSFET | $T_{\text{mb}} = 25^{\circ}\text{C}$ | - | 2.5 | - | k Ω | |

OVERLOAD PROTECTION CHARACTERISTICS

TOPFET switches off to protect itself when one of the overload thresholds is exceeded. It remains latched off until reset by the input.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------------|---|---|------|------|------|--------------------|
| $I_{\text{D(TO)}}$ | Overload protection Drain current trip threshold | $V_{\text{IS}} = 4\text{ V to }5.5\text{ V}$ | 4 | - | 8 | A |
| | | $T_{\text{J}} = 25^{\circ}\text{C}$ $-40^{\circ}\text{C} \leq T_{\text{J}} \leq 150^{\circ}\text{C}$ | 3 | - | 9 | A |
| $T_{\text{J(TO)}}$ | Overtemperature protection Threshold junction temperature | $V_{\text{IS}} = 4\text{ V to }5.5\text{ V}$ | 150 | 170 | - | $^{\circ}\text{C}$ |

¹ The input voltage below which the overload protection circuits will be reset.

² Not directly measurable from device terminals.

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SWITCHING CHARACTERISTICS

$T_a = 25\text{ }^\circ\text{C}$; resistive load $R_L = 50\ \Omega$; adjust V_{DD} to obtain $I_D = 250\text{ mA}$; refer to test circuit and waveforms

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------|---------------------|---|------|------|------|---------------|
| $t_{d\ on}$ | Turn-on delay time | $V_{IS} = 0\text{ V to } V_{IS} = 5\text{ V}$ | - | 0.5 | 0.9 | μs |
| t_r | Rise time | | - | 0.7 | 1.5 | μs |
| $t_{d\ off}$ | Turn-off delay time | $V_{IS} = 5\text{ V to } V_{IS} = 0\text{ V}$ | - | 3.2 | 6.5 | μs |
| t_f | Fall time | | - | 1.6 | 3.5 | μs |

REVERSE DIODE LIMITING VALUE

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|--------|----------------------------|---|------|------|------|
| I_S | Continuous forward current | $T_{mb} \leq 25\text{ }^\circ\text{C}; V_{IS} = 0\text{ V}$ | - | 2 | A |

REVERSE DIODE CHARACTERISTICS

Limits are for $-40\text{ }^\circ\text{C} \leq T_{mb} \leq 150\text{ }^\circ\text{C}$; typicals are for $T_{mb} = 25\text{ }^\circ\text{C}$ unless otherwise specified

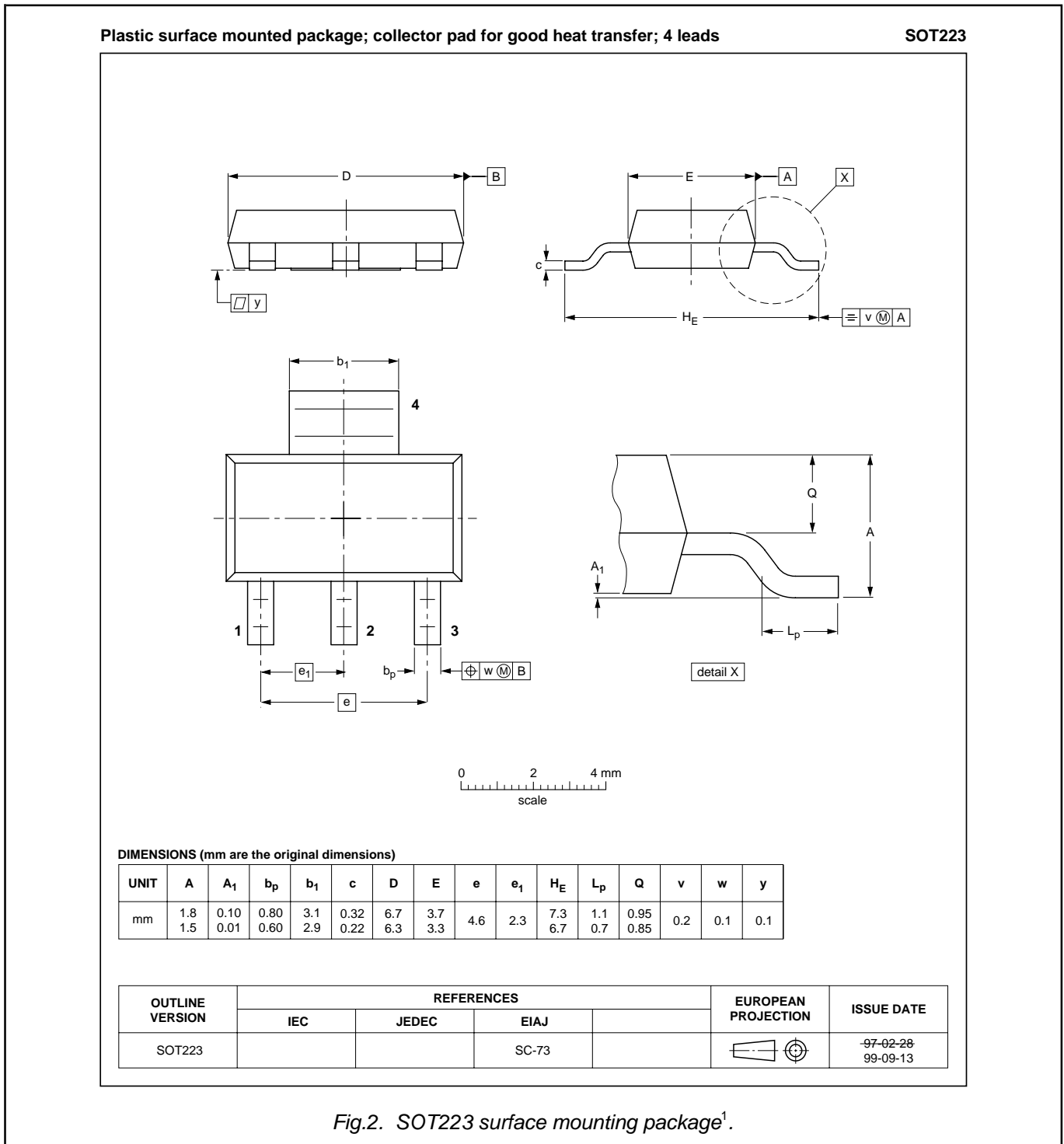
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------|-----------------------|---|------|------|------|------|
| V_{SDO} | Forward voltage | $I_S = 2\text{ A}; V_{IS} = 0\text{ V}; t_p = 300\ \mu\text{s}$ | - | 0.83 | 1.1 | V |
| t_{rr} | Reverse recovery time | not applicable ¹ | - | - | - | - |

¹ The reverse diode of this type is not intended for applications requiring fast reverse recovery.

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MECHANICAL DATA

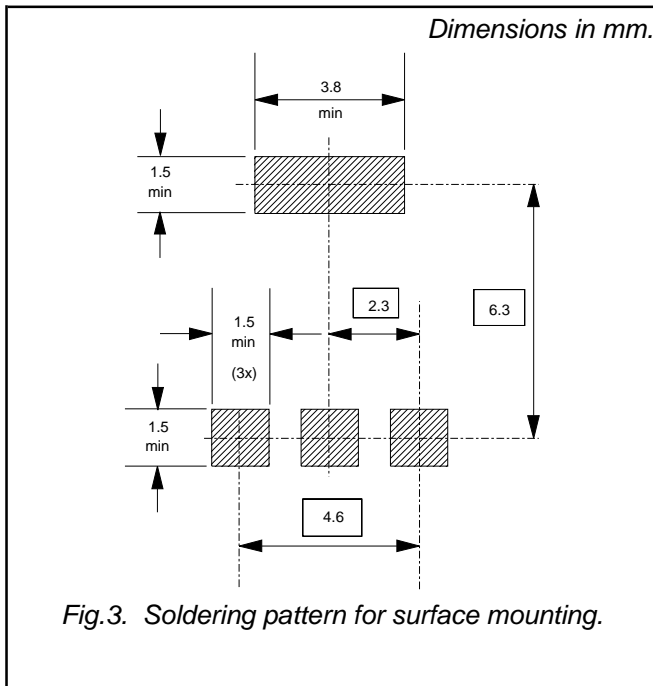


¹ For further information, refer to surface mounting instructions for SOT223 envelope. Epoxy meets UL94 V0 at 1/8". Net Mass: 0.11 g

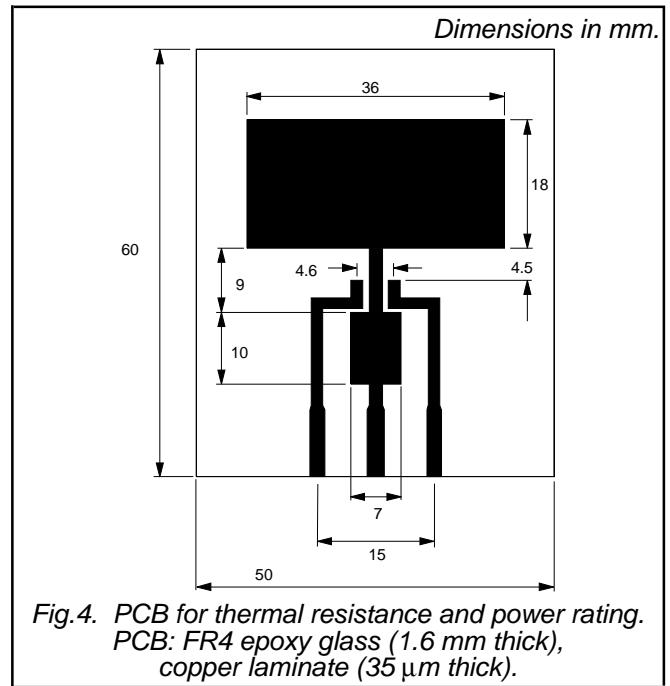
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MOUNTING INSTRUCTIONS



PRINTED CIRCUIT BOARD



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DEFINITIONS

| DATA SHEET STATUS | | |
|--|-----------------------------------|---|
| DATA SHEET STATUS¹ | PRODUCT STATUS² | DEFINITIONS |
| 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 |
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| Limiting values | | |
| Limiting values are given 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 this 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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¹ Please consult the most recently issued datasheet before initiating or completing a design.

² The product status of the device(s) described in this datasheet may have changed since this datasheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

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