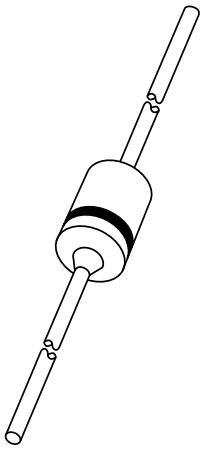
# DATA SHEET



# BZD23 series
## Voltage regulator diodes

Product specification
Supersedes data of October 1991

1996 Jun 10

Philips
Semiconductors

PHILIPS

# Voltage regulator diodes BZD23 series

## FEATURES

- Glass passivated
- High maximum operating temperature
- Low leakage current
- Excellent stability
- Zener working voltage range: 3.6 to 270 V for 46 types
- Transient suppressor stand-off voltage range: 6.2 to 430 V for 45 types
- Available in ammo-pack.

## DESCRIPTION

Cavity free cylindrical glass package through Implotec™(1) technology. This package is hermetically sealed and fatigue free as coefficients of expansion of all used parts are matched.

(1) Implotec is a trademark of Philips.

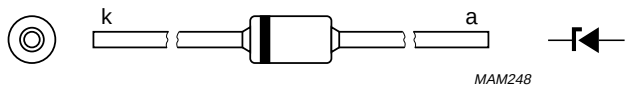



Fig.1 Simplified outline (SOD81) and symbol.

## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $P_{tot}$ | total power dissipation | $T_{tp}$ = 25 °C; lead length 10 mm; see Figs 2 and 3 | | | |
| | BZD23-C3V6 to -C6V8 | | – | 2.0 | W |
| | BZD23-C7V5 to -C510 | | – | 2.5 | W |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = 55 °C; see Figs 2 and 3; PCB mounted (see Fig.7) | | | |
| | BZD23-C3V6 to -C6V8 | | – | 1.0 | W |
| | BZD23-C7V5 to -C510 | | – | 1.0 | W |
| $P_{ZSM}$ | non-repetitive peak reverse power dissipation | $t_p$ = 100 µs; square pulse; $T_j$ = 25 °C prior to surge; see Figs 4 and 5 | | | |
| | BZD23-C3V6 to -C6V8 | | – | 300 | W |
| | BZD23-C7V5 to -C510 | | – | 300 | W |
| $P_{RSM}$ | non-repetitive peak reverse power dissipation | 10/1000 µs exponential pulse (see Fig.8); $T_j$ = 25 °C prior to surge | | | |
| | BZD23-C7V5 to -C510 | | – | 150 | W |
| $T_{stg}$ | storage temperature | | | | |
| | BZD23-C3V6 to -C6V8 | | –65 | +200 | °C |
| | BZD23-C7V5 to -C510 | | –65 | +175 | °C |
| $T_j$ | junction temperature | | | | |
| | BZD23-C3V6 to -C6V8 | | –65 | +200 | °C |
| | BZD23-C7V5 to -C510 | | –65 | +175 | °C |

## ELECTRICAL CHARACTERISTICS

### Total series

$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MAX. | UNIT |
|---|---|---|---|---|
| $V_F$ | forward voltage | $I_F$ = 0.2 A; see Fig.6 | 1.2 | V |

### Per type when used as voltage regulator diodes

$T_j$ = 25 °C unless otherwise specified.

| TYPE No. SUFFIX (1) | WORKING VOLTAGE | | | DIFFERENTIAL RESISTANCE | | TEMPERATURE COEFFICIENT | | TEST CURRENT | REVERSE CURRENT at REVERSE VOLTAGE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_Z$ (V) at $I_Z$ | | | $r_{dif}$ (Ω) at $I_Z$ | | $S_Z$ (%/K) at $I_Z$ | | $I_Z$ (mA) | $I_R$ (μA) | $V_R$ (V) |
| | MIN. | NOM. | MAX. | TYP. | MAX. | MIN. | MAX. | | MAX. | |
| C3V6 | 3.4 | 3.6 | 3.8 | 4 | 8 | –0.14 | –0.04 | 100 | 100 | 1 |
| C3V9 | 3.7 | 3.9 | 4.1 | 4 | 8 | –0.14 | –0.04 | 100 | 50 | 1 |
| C4V3 | 4.0 | 4.3 | 4.6 | 4 | 7 | –0.12 | –0.02 | 100 | 25 | 1 |
| C4V7 | 4.4 | 4.7 | 5.0 | 3 | 7 | –0.10 | 0.00 | 100 | 10 | 1 |
| C5V1 | 4.8 | 5.1 | 5.4 | 3 | 6 | –0.08 | –0.02 | 100 | 5 | 1 |
| C5V6 | 5.2 | 5.6 | 6.0 | 2 | 4 | –0.04 | 0.04 | 100 | 10 | 2 |
| C6V2 | 5.8 | 6.2 | 6.6 | 2 | 3 | –0.01 | 0.06 | 100 | 5 | 2 |
| C6V8 | 6.4 | 6.8 | 7.2 | 1 | 3 | 0.00 | 0.07 | 100 | 10 | 3 |
| C7V5 | 7.0 | 7.5 | 7.9 | 1 | 2 | 0.00 | 0.07 | 100 | 50 | 3 |
| C8V2 | 7.7 | 8.2 | 8.7 | 1 | 2 | 0.03 | 0.08 | 100 | 10 | 3 |
| C9V1 | 8.5 | 9.1 | 9.6 | 2 | 4 | 0.03 | 0.08 | 50 | 10 | 5 |
| C10 | 9.4 | 10 | 10.6 | 2 | 4 | 0.05 | 0.09 | 50 | 7 | 7.5 |
| C11 | 10.4 | 11 | 11.6 | 4 | 7 | 0.05 | 0.10 | 50 | 4 | 8.2 |
| C12 | 11.4 | 12 | 12.7 | 4 | 7 | 0.05 | 0.10 | 50 | 3 | 9.1 |
| C13 | 12.4 | 13 | 14.1 | 5 | 10 | 0.05 | 0.10 | 50 | 2 | 10 |
| C15 | 13.8 | 15 | 15.6 | 5 | 10 | 0.05 | 0.10 | 50 | 1 | 11 |
| C16 | 15.3 | 16 | 17.1 | 6 | 15 | 0.06 | 0.11 | 25 | 1 | 12 |
| C18 | 16.8 | 18 | 19.1 | 6 | 15 | 0.06 | 0.11 | 25 | 1 | 13 |
| C20 | 18.8 | 20 | 21.2 | 6 | 15 | 0.06 | 0.11 | 25 | 1 | 15 |
| C22 | 20.8 | 22 | 23.3 | 6 | 15 | 0.06 | 0.11 | 25 | 1 | 16 |
| C24 | 22.8 | 24 | 25.6 | 7 | 15 | 0.06 | 0.11 | 25 | 1 | 18 |
| C27 | 25.1 | 27 | 28.9 | 7 | 15 | 0.06 | 0.11 | 25 | 1 | 20 |
| C30 | 28 | 30 | 32 | 8 | 15 | 0.06 | 0.11 | 25 | 1 | 22 |
| C33 | 31 | 33 | 35 | 8 | 15 | 0.06 | 0.11 | 25 | 1 | 24 |
| C36 | 34 | 36 | 38 | 21 | 40 | 0.06 | 0.11 | 10 | 1 | 27 |
| C39 | 37 | 39 | 41 | 21 | 40 | 0.06 | 0.11 | 10 | 1 | 30 |
| C43 | 40 | 43 | 46 | 24 | 45 | 0.07 | 0.12 | 10 | 1 | 33 |
| C47 | 44 | 47 | 50 | 24 | 45 | 0.07 | 0.12 | 10 | 1 | 36 |

| TYPE No. SUFFIX (1) | WORKING VOLTAGE | | | DIFFERENTIAL RESISTANCE | | TEMPERATURE COEFFICIENT | | TEST CURRENT | REVERSE CURRENT at REVERSE VOLTAGE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_Z$ (V) at $I_Z$ | | | $r_{dif}$ (Ω) at $I_Z$ | | $S_Z$ (%/K) at $I_Z$ | | $I_Z$ (mA) | $I_R$ (μA) | $V_R$ (V) |
| | MIN. | NOM. | MAX. | TYP. | MAX. | MIN. | MAX. | | MAX. | |
| C51 | 48 | 51 | 54 | 25 | 60 | 0.07 | 0.12 | 10 | 1 | 39 |
| C56 | 52 | 56 | 60 | 25 | 60 | 0.07 | 0.12 | 10 | 1 | 43 |
| C62 | 58 | 62 | 66 | 25 | 80 | 0.08 | 0.13 | 10 | 1 | 47 |
| C68 | 64 | 68 | 72 | 25 | 80 | 0.08 | 0.13 | 10 | 1 | 51 |
| C75 | 70 | 75 | 79 | 30 | 100 | 0.08 | 0.13 | 10 | 1 | 56 |
| C82 | 77 | 82 | 87 | 30 | 100 | 0.08 | 0.13 | 10 | 1 | 62 |
| C91 | 85 | 91 | 96 | 60 | 200 | 0.09 | 0.13 | 5 | 1 | 68 |
| C100 | 94 | 100 | 106 | 60 | 200 | 0.09 | 0.13 | 5 | 1 | 75 |
| C110 | 104 | 110 | 116 | 80 | 250 | 0.09 | 0.13 | 5 | 1 | 82 |
| C120 | 114 | 120 | 127 | 80 | 250 | 0.09 | 0.13 | 5 | 1 | 91 |
| C130 | 124 | 130 | 141 | 110 | 300 | 0.09 | 0.13 | 5 | 1 | 100 |
| C150 | 138 | 150 | 156 | 130 | 300 | 0.09 | 0.13 | 5 | 1 | 110 |
| C160 | 153 | 160 | 171 | 150 | 350 | 0.09 | 0.13 | 5 | 1 | 120 |
| C180 | 168 | 180 | 191 | 180 | 400 | 0.09 | 0.13 | 5 | 1 | 130 |
| C200 | 188 | 200 | 212 | 200 | 500 | 0.09 | 0.13 | 5 | 1 | 150 |
| C220 | 208 | 220 | 233 | 350 | 750 | 0.09 | 0.13 | 2 | 1 | 160 |
| C240 | 228 | 240 | 256 | 400 | 850 | 0.09 | 0.13 | 2 | 1 | 180 |
| C270 | 251 | 270 | 289 | 450 | 1000 | 0.09 | 0.13 | 2 | 1 | 200 |

**Note**

1. To complete the type number the suffix is added to the basic type number, e.g. BZD23-C51.

**Per type when used as transient suppressor diodes**

$T_j$ = 25 °C unless otherwise specified.

| TYPE NUMBER | REVERSE BREAKDOWN VOLTAGE | TEMPERATURE COEFFICIENT | | TEST CURRENT | CLAMPING VOLTAGE | | REVERSE CURRENT at STAND-OFF VOLTAGE | |
|---|---|---|---|---|---|---|---|---|
| | $V_{(BR)R}$ (V) at $I_{test}$ | $S_Z$ (%/K) at $I_{test}$ | | $I_{test}$ (mA) | $V_{(CL)R}$ (V) | at $I_{RSM}$ (A) note 1 | $I_R$ (μA) | at $V_R$ (V) |
| | MIN. | MIN. | MAX. | | MAX. | | MAX. | |
| BZD23-C7V5 | 7.0 | 0.00 | 0.07 | 100 | 11.3 | 13.3 | 1500 | 6.2 |
| BZD23-C8V2 | 7.7 | 0.03 | 0.08 | 100 | 12.3 | 12.2 | 1200 | 6.8 |
| BZD23-C9V1 | 8.5 | 0.03 | 0.08 | 50 | 13.3 | 11.3 | 100 | 7.5 |
| BZD23-C10 | 9.4 | 0.05 | 0.09 | 50 | 14.8 | 10.1 | 20 | 8.2 |
| BZD23-C11 | 10.4 | 0.05 | 0.10 | 50 | 15.7 | 9.6 | 5 | 9.1 |
| BZD23-C12 | 11.4 | 0.05 | 0.10 | 50 | 17.0 | 8.8 | 5 | 10 |
| BZD23-C13 | 12.4 | 0.05 | 0.10 | 50 | 18.9 | 7.9 | 5 | 11 |
| BZD23-C15 | 13.8 | 0.05 | 0.10 | 50 | 20.9 | 7.2 | 5 | 12 |
| BZD23-C16 | 15.3 | 0.06 | 0.11 | 25 | 22.9 | 6.6 | 5 | 13 |
| BZD23-C18 | 16.8 | 0.06 | 0.11 | 25 | 25.6 | 5.9 | 5 | 15 |
| BZD23-C20 | 18.8 | 0.06 | 0.11 | 25 | 28.4 | 5.3 | 5 | 16 |
| BZD23-C22 | 20.8 | 0.06 | 0.11 | 25 | 31.0 | 4.8 | 5 | 18 |
| BZD23-C24 | 22.8 | 0.06 | 0.11 | 25 | 33.8 | 4.4 | 5 | 20 |
| BZD23-C27 | 25.1 | 0.06 | 0.11 | 25 | 38.1 | 3.9 | 5 | 22 |
| BZD23-C30 | 28 | 0.06 | 0.11 | 25 | 42.2 | 3.6 | 5 | 24 |
| BZD23-C33 | 31 | 0.06 | 0.11 | 25 | 46.2 | 3.2 | 5 | 27 |
| BZD23-C36 | 34 | 0.06 | 0.11 | 10 | 50.1 | 3.0 | 5 | 30 |
| BZD23-C39 | 37 | 0.06 | 0.11 | 10 | 54.1 | 2.8 | 5 | 33 |
| BZD23-C43 | 40 | 0.07 | 0.12 | 10 | 60.7 | 2.5 | 5 | 36 |
| BZD23-C47 | 44 | 0.07 | 0.12 | 10 | 65.5 | 2.3 | 5 | 39 |
| BZD23-C51 | 48 | 0.07 | 0.12 | 10 | 70.8 | 2.1 | 5 | 43 |
| BZD23-C56 | 52 | 0.07 | 0.12 | 10 | 78.6 | 1.9 | 5 | 47 |
| BZD23-C62 | 58 | 0.08 | 0.13 | 10 | 86.5 | 1.7 | 5 | 51 |
| BZD23-C68 | 64 | 0.08 | 0.13 | 10 | 94.4 | 1.6 | 5 | 56 |
| BZD23-C75 | 70 | 0.08 | 0.13 | 10 | 103.5 | 1.5 | 5 | 62 |
| BZD23-C82 | 77 | 0.08 | 0.13 | 10 | 114 | 1.3 | 5 | 68 |
| BZD23-C91 | 85 | 0.09 | 0.13 | 5 | 126 | 1.2 | 5 | 75 |
| BZD23-C100 | 94 | 0.09 | 0.13 | 5 | 139 | 1.1 | 5 | 82 |
| BZD23-C110 | 104 | 0.09 | 0.13 | 5 | 152 | 1.0 | 5 | 91 |
| BZD23-C120 | 114 | 0.09 | 0.13 | 5 | 167 | 0.90 | 5 | 100 |
| BZD23-C130 | 124 | 0.09 | 0.13 | 5 | 185 | 0.81 | 5 | 110 |
| BZD23-C150 | 138 | 0.09 | 0.13 | 5 | 204 | 0.73 | 5 | 120 |
| BZD23-C160 | 153 | 0.09 | 0.13 | 5 | 224 | 0.67 | 5 | 130 |

| TYPE NUMBER | REVERSE BREAKDOWN VOLTAGE | TEMPERATURE COEFFICIENT | | TEST CURRENT | CLAMPING VOLTAGE | | REVERSE CURRENT at STAND-OFF VOLTAGE | |
|---|---|---|---|---|---|---|---|---|
| | $V_{(BR)R}$ (V) at $I_{test}$ | $S_Z$ (%/K) at $I_{test}$ | | $I_{test}$ (mA) | $V_{(CL)R}$ (V) | at $I_{RSM}$ (A) note 1 | $I_R$ (μA) | at $V_R$ (V) |
| | MIN. | MIN. | MAX. | | MAX. | | MAX. | |
| BZD23-C180 | 168 | 0.09 | 0.13 | 5 | 249 | 0.60 | 5 | 150 |
| BZD23-C200 | 188 | 0.09 | 0.13 | 5 | 276 | 0.54 | 5 | 160 |
| BZD23-C220 | 208 | 0.09 | 0.13 | 2 | 305 | 0.50 | 5 | 180 |
| BZD23-C240 | 228 | 0.09 | 0.13 | 2 | 336 | 0.45 | 5 | 200 |
| BZD23-C270 | 251 | 0.09 | 0.13 | 2 | 380 | 0.40 | 5 | 220 |
| BZD23-C300 | 280 | 0.09 | 0.13 | 2 | 419 | 0.36 | 5 | 240 |
| BZD23-C330 | 310 | 0.09 | 0.13 | 2 | 459 | 0.33 | 5 | 270 |
| BZD23-C360 | 340 | 0.09 | 0.13 | 2 | 498 | 0.30 | 5 | 300 |
| BZD23-C390 | 370 | 0.09 | 0.13 | 2 | 537 | 0.28 | 5 | 330 |
| BZD23-C430 | 400 | 0.09 | 0.13 | 2 | 603 | 0.25 | 5 | 360 |
| BZD23-C470 | 440 | 0.09 | 0.13 | 2 | 655 | 0.23 | 5 | 390 |
| BZD23-C510 | 480 | 0.09 | 0.13 | 2 | 707 | 0.21 | 5 | 430 |

**Note**

1. Non-repetitive peak reverse current in accordance with *"IEC 60-1, Section 8"* (10/1000 μs pulse); see Fig.8.

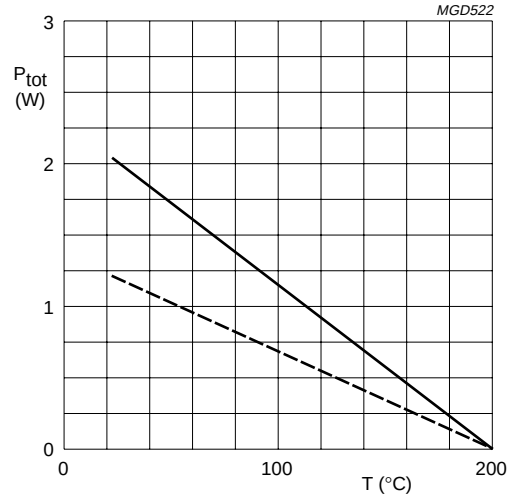
**THERMAL CHARACTERISTICS**

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}tp}$ | thermal resistance from junction to tie-point | lead length = 10 mm | | |
| | BZD23-C3V6 to -C6V8 | | 87 | K/W |
| | BZD23-C7V5 to -C510 | | 60 | K/W |
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | note 1 | | |
| | BZD23-C3V6 to -C6V8 | | 145 | K/W |
| | BZD23-C7V5 to -C510 | | 120 | K/W |

**Note**

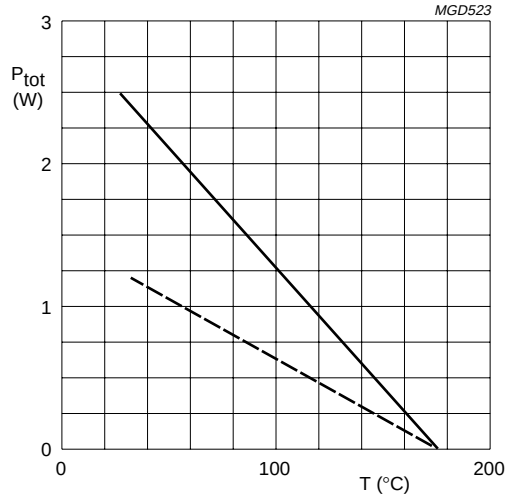
1. Device mounted on an epoxy-glass printed-circuit board, 1.5 mm thick; thickness of Cu-layer ≥40 μm, see Fig.7. For more information please refer to the *"General Part of associated Handbook"*.

## GRAPHICAL DATA



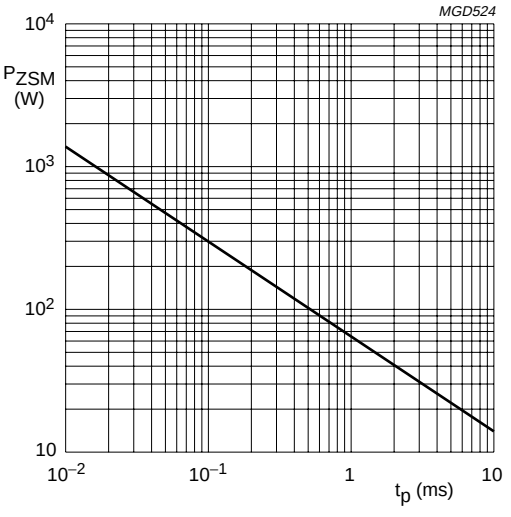

**Types BZD23-C3V6 to -C6V8**
Solid line: tie-point temperature; lead length = 10 mm.
Dotted line: ambient temperature; PCB mounted as shown in Fig.7.

Fig.2 Maximum total power dissipation as a function of temperature.



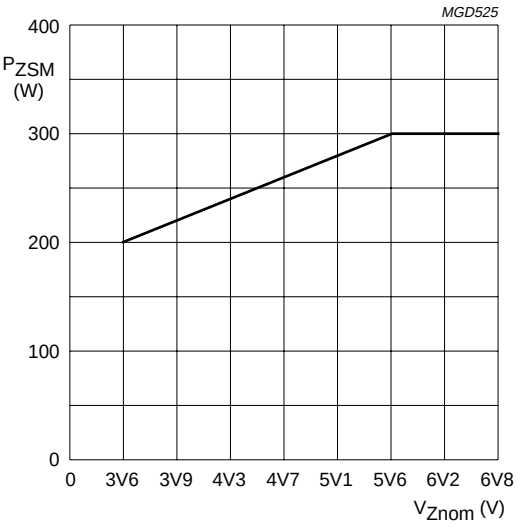

**Types BZD23-C7V5 to -C510**
Solid line: tie-point temperature; lead length = 10 mm.
Dotted line: ambient temperature; PCB mounted as shown in Fig.7.

Fig.3 Maximum total power dissipation as a function of temperature.



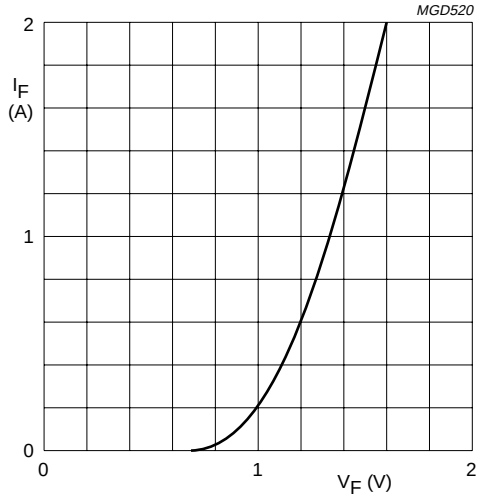

$T_j$ = 25 °C prior to surge.
See also Fig.5.

Fig.4 Maximum non-repetitive peak reverse power dissipation as a function of pulse duration (square pulse).



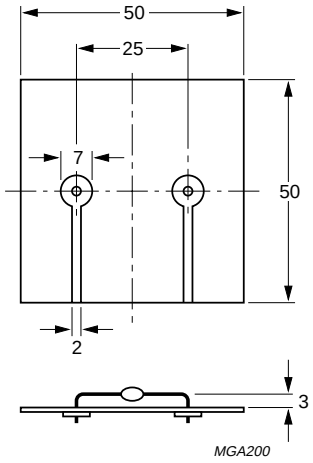

$T_j$ = 25 °C prior to surge.

Fig.5 Maximum non-repetitive peak reverse power dissipation as a function of nominal working voltage.



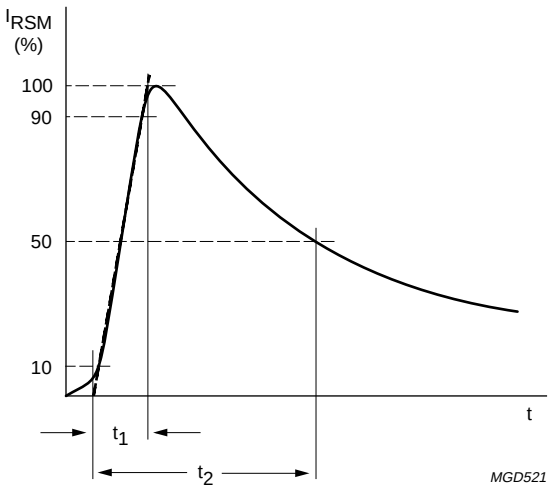

$T_j$ = 25 °C.

Fig.6 Forward current as a function of forward voltage; typical values.




Dimensions in mm.

Fig.7 Device mounted on a printed-circuit board.



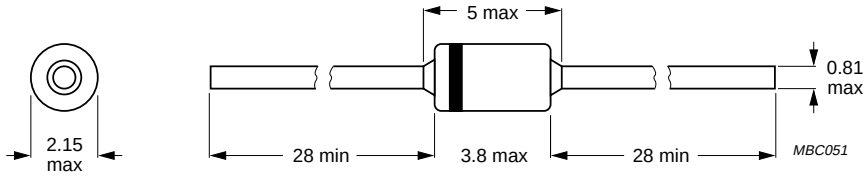

In accordance with *"IEC 60-1, Section 8"*.

$t_1$ = 10 µs.

$t_2$ = 1000 µs.

Fig.8 Non-repetitive peak reverse current pulse definition.

## PACKAGE OUTLINE




Dimensions in mm.

The marking band indicates the cathode.

Fig.9 SOD81.

## 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. | |

## 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 customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.