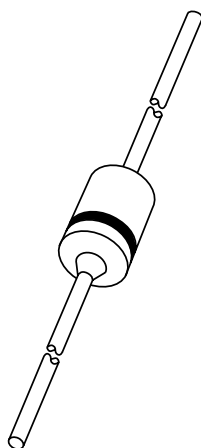


# DATA SHEET



## **BZD23 series** Voltage regulator diodes

Product specification  
Supersedes data of October 1991

1996 Jun 10

## Voltage regulator diodes

## BZD23 series

## FEATURES

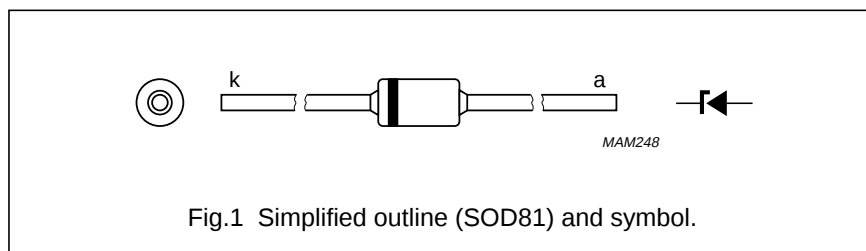
- Glass passivated
- High maximum operating temperature
- Low leakage current
- Excellent stability
- Zener working voltage range:  
3.6 to 270 V for 46 types
- Transient suppressor stand-off  
voltage range:  
6.2 to 430 V for 45 types
- Available in ammo-pack.

## DESCRIPTION

Cavity free cylindrical glass package through Implotec™<sup>(1)</sup> 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.



## LIMITING VALUES

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

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

## Voltage regulator diodes

## BZD23 series

## ELECTRICAL CHARACTERISTICS

## Total series

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

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

## Per type when used as voltage regulator diodes

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| TYPE<br>No.<br>SUFFIX<br>(1) | WORKING VOLTAGE                      |      |      | DIFFERENTIAL<br>RESISTANCE             |      | TEMPERATURE<br>COEFFICIENT             |       | TEST<br>CURRENT     | REVERSE CURRENT<br>at REVERSE VOLTAGE |                    |
|------------------------------|--------------------------------------|------|------|----------------------------------------|------|----------------------------------------|-------|---------------------|---------------------------------------|--------------------|
|                              | V <sub>Z</sub> (V) at I <sub>Z</sub> |      |      | r <sub>dif</sub> (Ω) at I <sub>Z</sub> |      | S <sub>Z</sub> (%/K) at I <sub>Z</sub> |       | I <sub>Z</sub> (mA) | I <sub>R</sub> (μA)                   | V <sub>R</sub> (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                 |

## Voltage regulator diodes

## BZD23 series

| TYPE<br>No.<br>SUFFIX<br>(1) | WORKING VOLTAGE    |      |      | DIFFERENTIAL<br>RESISTANCE      |      | TEMPERATURE<br>COEFFICIENT |      | TEST<br>CURRENT | REVERSE CURRENT<br>at REVERSE VOLTAGE |           |
|------------------------------|--------------------|------|------|---------------------------------|------|----------------------------|------|-----------------|---------------------------------------|-----------|
|                              | $V_Z$ (V) at $I_Z$ |      |      | $r_{dif}$ ( $\Omega$ ) at $I_Z$ |      | $S_Z$ (%/K) at $I_Z$       |      | $I_Z$ (mA)      | $I_R$ ( $\mu$ A)                      | $V_R$ (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.

## Voltage regulator diodes

## BZD23 series

Per type when used as transient suppressor diodes

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| TYPE<br>NUMBER | REVERSE<br>BREAKDOWN<br>VOLTAGE  | TEMPERATURE<br>COEFFICIENT |      | TEST<br>CURRENT    | CLAMPING<br>VOLTAGE |                               | REVERSE CURRENT<br>at STAND-OFF<br>VOLTAGE |                 |
|----------------|----------------------------------|----------------------------|------|--------------------|---------------------|-------------------------------|--------------------------------------------|-----------------|
|                | $V_{(BR)R}$ (V)<br>at $I_{test}$ | $S_z$ (%/K) at $I_{test}$  |      | $I_{test}$<br>(mA) | $V_{(CL)R}$ (V)     | at $I_{RSM}$<br>(A)<br>note 1 | $I_R$ ( $\mu$ A)                           | at $V_R$<br>(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             |

## Voltage regulator diodes

## BZD23 series

| TYPE<br>NUMBER | REVERSE<br>BREAKDOWN<br>VOLTAGE  | TEMPERATURE<br>COEFFICIENT |      | TEST<br>CURRENT    | CLAMPING<br>VOLTAGE |                               | REVERSE CURRENT<br>at STAND-OFF<br>VOLTAGE |                 |
|----------------|----------------------------------|----------------------------|------|--------------------|---------------------|-------------------------------|--------------------------------------------|-----------------|
|                | $V_{(BR)R}$ (V)<br>at $I_{test}$ | $S_Z$ (%/K) at $I_{test}$  |      | $I_{test}$<br>(mA) | $V_{(CL)R}$ (V)     | at $I_{RSM}$<br>(A)<br>note 1 | $I_R$ ( $\mu$ A)                           | at $V_R$<br>(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  $\mu$ s pulse); see Fig.8.

**THERMAL CHARACTERISTICS**

| SYMBOL         | PARAMETER                                     | CONDITIONS          | VALUE | UNIT |
|----------------|-----------------------------------------------|---------------------|-------|------|
| $R_{th\ j-tp}$ | 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  |
| $R_{th\ j-a}$  | thermal resistance from junction to ambient   | note 1              |       |      |
|                | BZD23-C3V6 to -C6V8                           |                     | 145   | K/W  |
|                | BZD23-C7V5 to -C510                           |                     | 120   | K/W  |

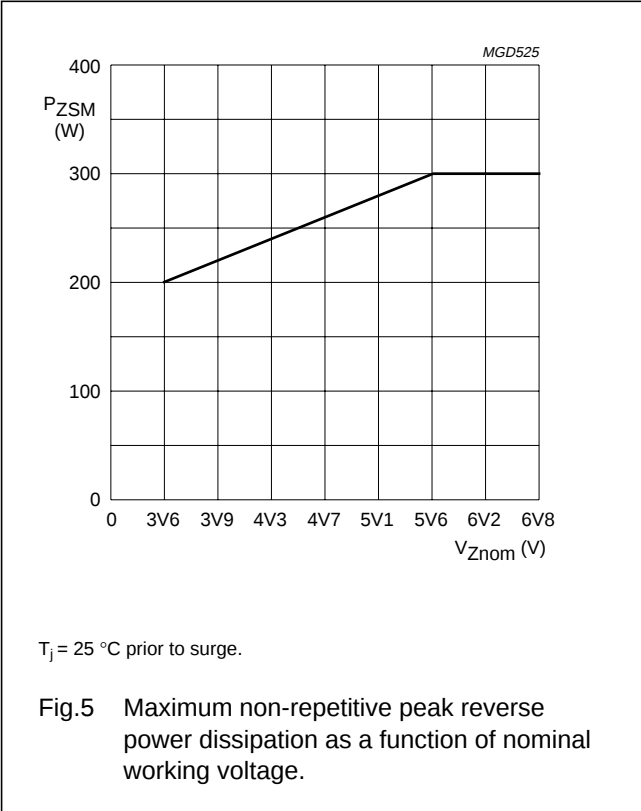
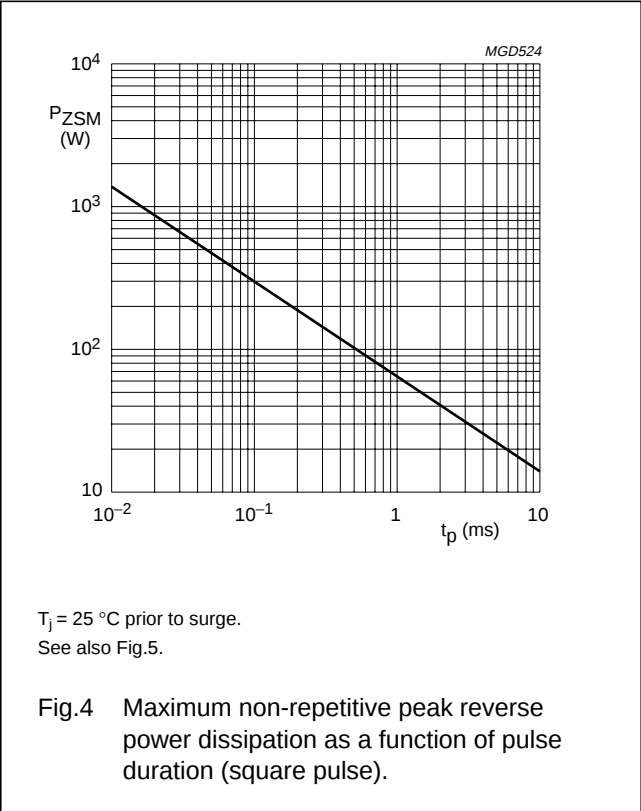
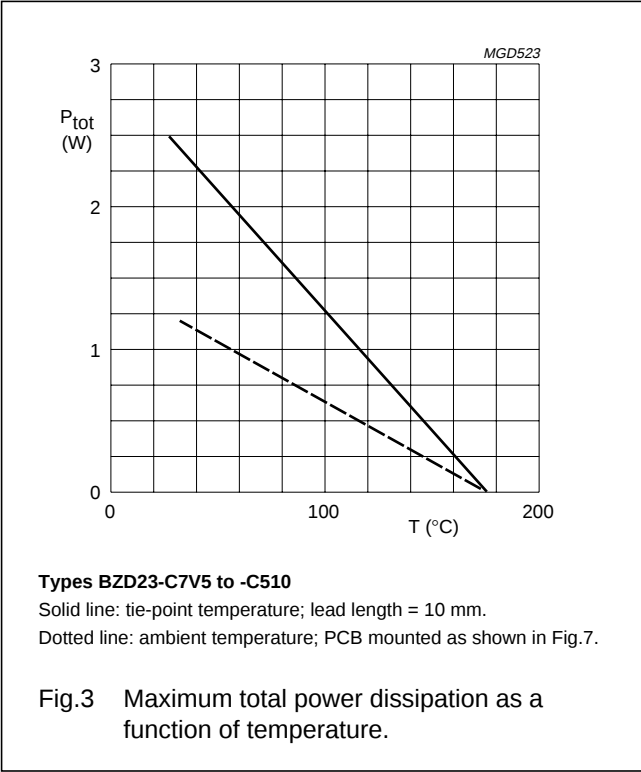
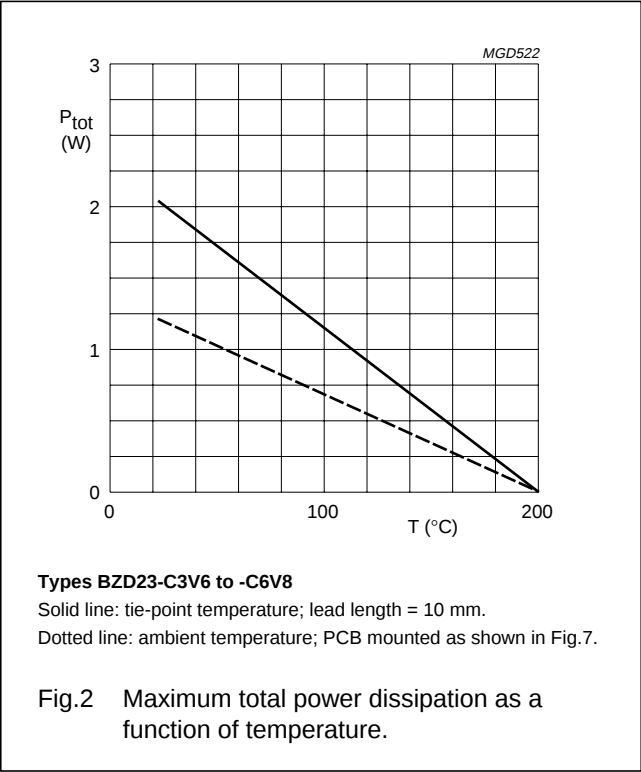
**Note**

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

Voltage regulator diodes

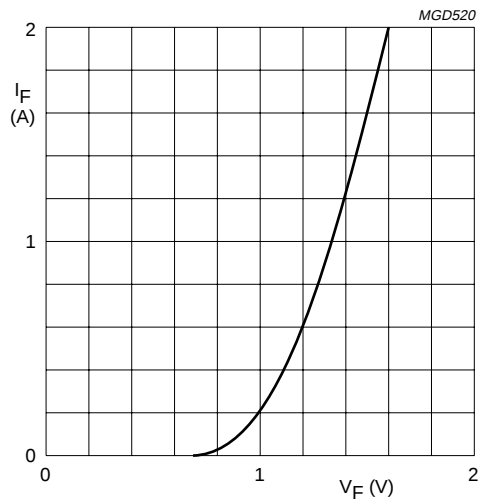
BZD23 series

GRAPHICAL DATA



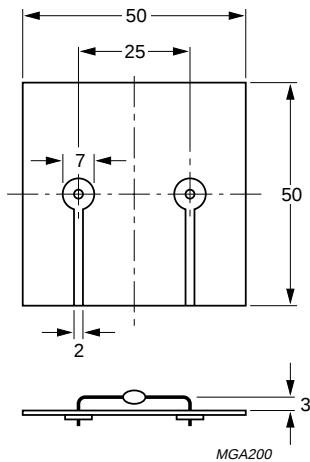
Voltage regulator diodes

BZD23 series



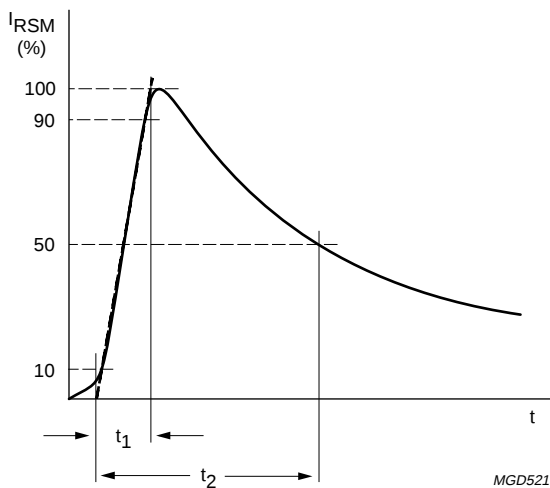
$T_j = 25\text{ }^{\circ}\text{C}$ .

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".

$t_1 = 10\text{ }\mu\text{s}$ .

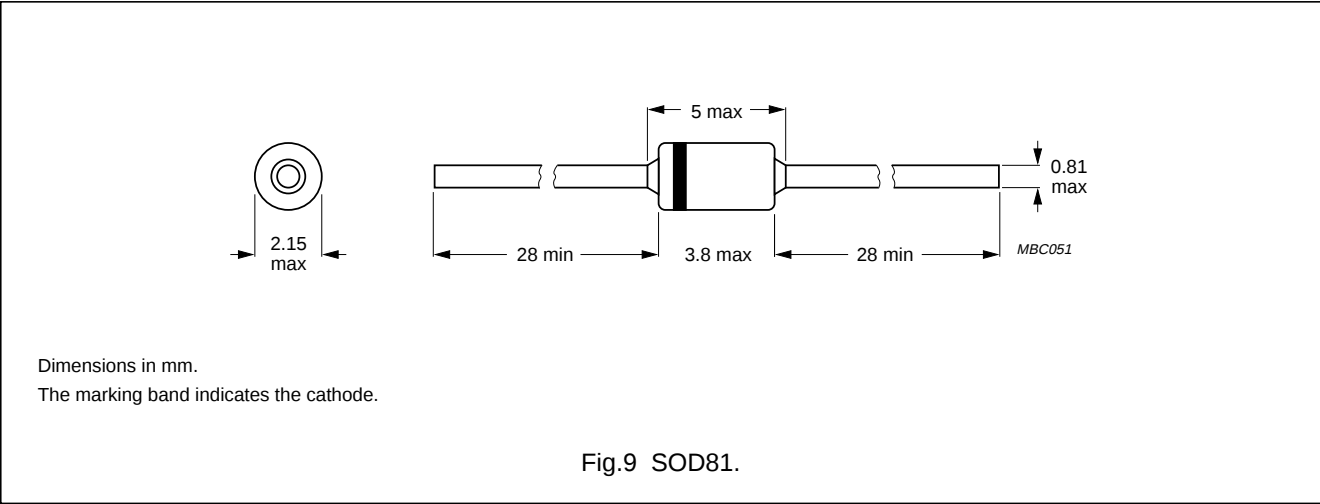
$t_2 = 1000\text{ }\mu\text{s}$ .

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

Voltage regulator diodes

BZD23 series

PACKAGE OUTLINE



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.