

# Small and Medium Diodes



# Small and Medium Diodes

Recently, many products ranging from computers and home appliances to automobiles and industrial equipment have been driving the need for effective solutions to reduce size and weight. Semiconductor requirements differ from application to application. Take power supplies for example, which are being required to accommodate higher capacity in smaller dimensions. This increases the temperature at which systems are operated.

To address this problem, Toshiba offers an extensive portfolio of small, high-efficiency diodes, including Schottky barrier diodes (SBDs) featuring high-speed operation and low forward loss.

## Diodes

### Schottky Barrier Diodes (SBDs)

Toshiba offers low-loss SBDs fabricated with a next-generation process. These SBDs will help increase the performance of equipment that requires a small form factor and high efficiency, such as mobile devices and switching power supplies.

SBDs with a reverse voltage of 20 V to 60 V and an average forward current of 0.7 A to 10 A are available in small surface-mount packages. You will find SBDs that best suit your applications.

### Rectifier Diodes

Diodes for general rectification and reverse-current protection

Super-Fast-Recovery Diodes (S-FRDs)

High-Efficiency Diodes (HEDs)

Diodes with a reverse voltage of 200 V to 1000 V and an average forward current of 0.5 A to 5 A are available in small surface-mount packages. Toshiba's product portfolio also includes diodes with high ESD performance ideal for automotive applications.

### Zener Diodes

Zener diodes are available with a wide range of Zener voltage specifications from 6.2 V to 390 V. They can be used for a wide range of applications such as consumer, automotive and industrial electronics.

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This brochure contains information on small and medium diodes only. For switching diodes, small-signal Schottky barrier diodes and ESD protection diodes, see the following brochure or our homepage:

- ◆ Homepage <http://www.semicon.toshiba.co.jp/eng>
- ◆ Brochure General-Purpose Small-Signal Surface-Mount Devices

# 1. Key Features

## ▶ SMALL & MEDIUM DIODES

### 1 Schottky Barrier Diodes (SBDs)

#### Schottky Barrier Diodes (SBDs)

- ▶ Voltage rating:  $V_{RRM} = 20\text{ V}, 30\text{ V}, 40\text{ V}, 60\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.7\text{ A to } 10\text{ A}$
- ▶ Peak forward voltage:  
(Shown only as examples)  $V_{FM} = 0.32\text{ V typ. (0.37 V max) } \dots\dots\dots V_{RRM} = 30\text{ V}$   
 $V_{FM} = 0.35\text{ V typ. (0.39 V max) } \dots\dots\dots V_{RRM} = 30\text{ V}$   
 $V_{FM} = 0.42\text{ V typ. (0.45 V max) } \dots\dots\dots V_{RRM} = 30\text{ V}$   
 $V_{FM} = 0.48\text{ V typ. (0.55 V max) } \dots\dots\dots V_{RRM} = 40\text{ V}$   
 $V_{FM} = 0.52\text{ V typ. (0.58 V max) } \dots\dots\dots V_{RRM} = 60\text{ V}$

### 2 Rectification Diodes (Diodes for General Rectification and Reverse-Current Protection)

- ▶ Voltage rating:  $V_{RRM} = 400\text{ V to } 800\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ A to } 2\text{ A}$
- ▶ Diodes with high ESD performance are available.

### 3 Super-Fast-Recovery Diodes (S-FRDs)

#### Super-Fast-Recovery Diodes (S-FRDs)

- ▶ Voltage rating:  $V_{RRM} = 400\text{ V}, 600\text{ V}, 800\text{ V}, 900\text{ V}, 1000\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ A to } 2\text{ A}$
- ▶ High-speed switching: Reverse recovery time ( $t_{rr}$ )  $\leq 100\text{ ns}$

### 4 High-Efficiency Diodes (HEDs)

#### High-Efficiency Diodes (HEDs)

- ▶ Voltage rating:  $V_{RRM} = 200\text{ V}, 300\text{ V}, 400\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ to } 5\text{ A}$
- ▶ High-speed switching: Reverse recovery time ( $t_{rr}$ )  $\leq 35\text{ ns}$  or  $\leq 50\text{ ns}$

### 5 Zener Diodes

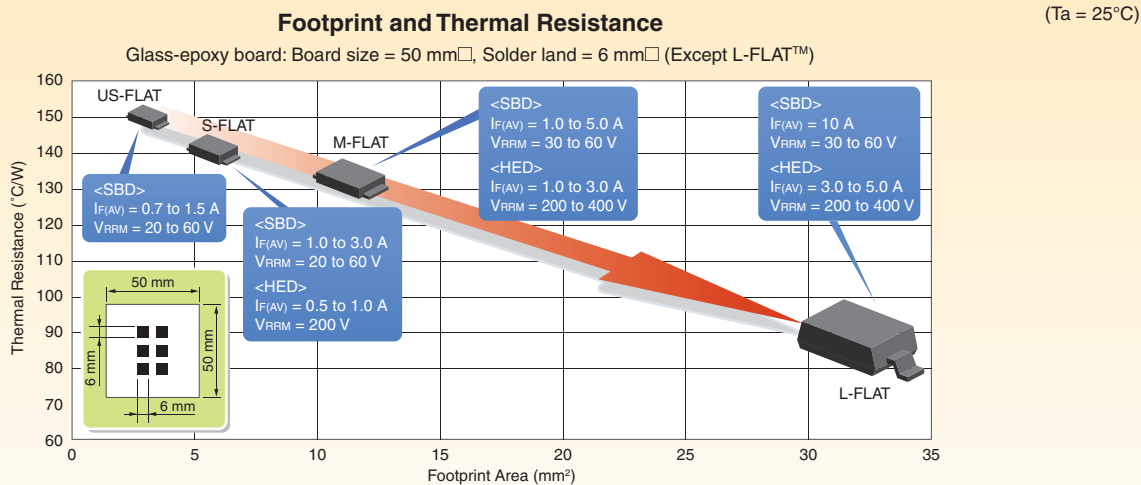
- ▶  $V_z = 6.2\text{ V to } 390\text{ V}$
- ▶ Power dissipation:  $P = 0.7\text{ W}, 1.0\text{ W}, 2.0\text{ W}$  (S-FLAT™ and M-FLAT™ packages)

# 2. Product Lineup

## SMALL & MEDIUM DIODES

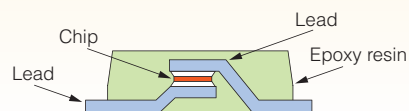
### Surface-Mount Package Trend for Diodes

Toshiba has been working to develop the most compact surface-mount packages which allow communication equipment to be miniaturized.



#### Internal Structure of FLAT Packages

The FLAT packages feature reduced wire inductance and resistance and an enhanced thermal property compared to wire-bonded packages.

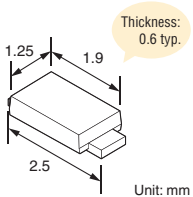


### FLAT Package Series

#### US-FLAT™

Ultra-Small Flat Package

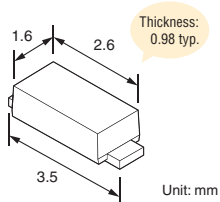
Typical product: CUS01, CUS10I30A



#### S-FLAT™

Small Flat Package

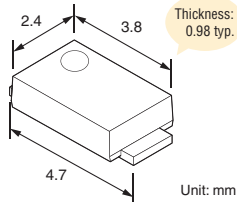
Typical product: CRS01, CRS10I30A



#### M-FLAT™

Middle Flat Package

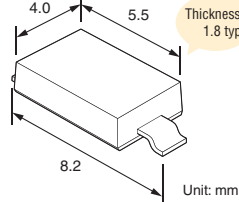
Typical product: CMS01, CMS10I30A



#### L-FLAT™

Large Flat Package

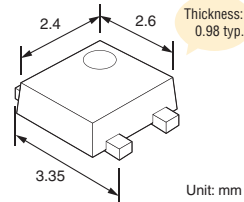
Typical product: CLS01



#### HM-FLAT

Hybrid Middle Flat Package

Typical product: HMG01





# 3. Selection Guide

## ► SMALL & MEDIUM DIODES

### Schottky Barrier Diodes (SBDs)

| Average Forward Current | Package  | Peak Repetitive Reverse Voltage |   |                                 |                | Package Number | Reference Page |
|-------------------------|----------|---------------------------------|---|---------------------------------|----------------|----------------|----------------|
|                         |          | 20 V                            | 30 V  | 40 V                            | 60 V           |                |                |
| 0.7 A                   | US-FLAT™ |                                 |   | CUS03                           | CUS04          | ①              | 8              |
| 1 A                     | US-FLAT™ | CUS05<br>CUS06                  | CUS01<br>CUS02<br>CUS10I30A   | CUS10I40A                       |                | ①              | 8              |
|                         | S-FLAT™  | CRS06                           | CRS01<br>CRS03<br>CRS05<br>CRS11<br>CRS10I30A<br>CRS10I30B<br>CRS10I30C | CRS04<br>CRS10I40A<br>CRS10I40B | CRS12<br>CRS13 | ②              | 8              |
|                         | M-FLAT™  |                                 | CMS08<br>CMS09<br>CMS10I30A   | CMS10<br>CMS10I40A              |                | ③              | 9              |
| 1.5 A                   | US-FLAT™ |                                 | CUS15I30A   |                                 |                | ①              | 8              |
|                         | S-FLAT™  |                                 | CRS08<br>CRS09<br>CRS15I30A<br>CRS15I30B                                | CRS15I40A                       |                | ②              | 8              |
|                         | M-FLAT™  |                                 |   | CMS15I40A                       |                | ③              | 9              |
| 2 A                     | S-FLAT™  |                                 | CRS14<br>CRS20I30A<br>CRS20I30B   | CRS20I40A<br>CRS20I40B          |                | ②              | 8              |
|                         | M-FLAT™  |                                 | CMS06<br>CMS07<br>CMS17<br>CMS20I30A                                    | CMS11<br>CMS20I40A              | CMS14          | ③              | 9              |
| 3 A                     | S-FLAT™  |                                 | CRS15◇<br>CRS30I30A   |                                 |                | ②              | 8              |
|                         | M-FLAT™  |                                 | CMS01<br>CMS03<br>CMS30I30A   | CMS16<br>CMS21<br>CMS30I40A     | CMS15          | ③              | 9              |
| 5 A                     | M-FLAT™  |                                 | CMS04<br>CMS05  |                                 |                | ③              | 9              |
| 10 A                    | L-FLAT™  |                                 | CLS01   | CLS02                           | CLS03          | ④              | 9              |

◆: Dual (Two separate diodes) ◇: I<sub>F(DC)</sub> = 3A

### Rectification Diodes

#### ► Diodes for General Rectification and Reverse-Current Protection

| Average Forward Current | Package | Peak Repetitive Reverse Voltage |                |        | Package Number | Reference Page |
|-------------------------|---------|---------------------------------|----------------|--------|----------------|----------------|
|                         |         | 400 V                           | 600 V          | 800 V  |                |                |
| 0.5 A                   | HM-FLAT | HMG01◆                          |                |        | ⑤              | 10             |
| 0.7 A                   | S-FLAT™ | CRG02○<br>CRG07○                |                |        | ②              |                |
|                         | HM-FLAT | HMG02◆                          |                |        | ⑤              |                |
| 1 A                     | S-FLAT™ | CRG03○<br>CRG09★○               | CRG04○         | CRG05○ | ②              |                |
|                         | M-FLAT™ | CMC02*<br>CMG05<br>CMG07        | CMG06<br>CMG08 |        | ③              |                |
| 2 A                     | M-FLAT™ | CMG02                           | CMG03          |        | ③              |                |

○: Based on AEC-Q101 \* : Designed for strobe discharge applications. ◆: Dual ★: High ESD protection

# 3. Selection Guide

## ▶ SMALL & MEDIUM DIODES

### Super-Fast-Recovery Diodes (S-FRDs) and High-Efficiency Diodes (HEDs)

#### ▶ Super-Fast-Recovery Diodes (S-FRDs)

| Average Forward Current | Package | Reverse Recovery Time (Max) | Peak Repetitive Reverse Voltage |       |       |        | Package Number | Reference Page |
|-------------------------|---------|-----------------------------|---------------------------------|-------|-------|--------|----------------|----------------|
|                         |         |                             | 600 V                           | 800 V | 900 V | 1000 V |                |                |
| 0.5 A                   | S-FLAT™ | 100 ns                      | CRF03(0.7 A)                    | CRF02 |       |        | ②              | 11             |
|                         | M-FLAT™ | 100 ns                      |                                 | CMF04 | CMF03 | CMF05  | ③              |                |
| 1 A                     | M-FLAT™ | 100 ns                      | CMF02                           |       |       |        | ③              |                |
| 2 A                     | M-FLAT™ | 100 ns                      | CMF01                           |       |       |        | ③              |                |

#### ▶ High-Efficiency Diodes (HEDs)

| Average Forward Current | Package | Reverse Recovery Time (Max) | Peak Repetitive Reverse Voltage |       |       | Package Number | Reference Page |    |
|-------------------------|---------|-----------------------------|---------------------------------|-------|-------|----------------|----------------|----|
|                         |         |                             | 200 V                           | 300 V | 400 V |                |                |    |
| Single Type             | 0.5 A   | S-FLAT™                     | 35 ns                           | CRH02 |       |                | ②              | 12 |
|                         |         | 1 A                         | S-FLAT™                         | 35 ns | CRH01 |                |                |    |
|                         | M-FLAT™ |                             | 35 ns                           | CMH04 |       | CMH05A         | ③              |    |
|                         |         | 50 ns                       |                                 |       | CMH05 |                |                |    |
|                         | 2 A     | M-FLAT™                     | 35 ns                           | CMH07 |       | CMH08A         | ③              |    |
|                         |         |                             | 50 ns                           |       |       | CMH08          |                |    |
|                         | 3 A     | M-FLAT™                     | 35 ns                           | CMH01 |       | CMH02A         | ③              |    |
|                         |         |                             | 50 ns                           |       |       | CMH02          |                |    |
|                         | 5 A     | L-FLAT™                     | 35 ns                           | CLH01 | CLH02 | CLH03          | ④              |    |
|                         |         |                             | 35 ns                           | CLH05 | CLH06 | CLH07          |                |    |

### Zener Diodes

#### ▶ Zener Diodes

| Power Dissipation | 0.7 W   | 1 W     | 2 W   |
|-------------------|---------|---------|-------|
| Package Vz(V)     | S-FLAT™ | M-FLAT™ |       |
| 6.2               | CRY62   |         |       |
| 6.8               | CRY68   |         |       |
| 7.5               | CRY75   |         |       |
| 8.2               | CRY82   |         |       |
| 9.1               | CRY91   |         |       |
| 10                | CRZ10   |         |       |
| 11                | CRZ11   |         |       |
| 12                | CRZ12   | CMZB12  | CMZ12 |
| 13                | CRZ13   | CMZB13  | CMZ13 |
| 15                | CRZ15   | CMZB15  | CMZ15 |
| 16                | CRZ16   | CMZB16  | CMZ16 |
| 18                | CRZ18   | CMZB18  | CMZ18 |
| 20                | CRZ20   | CMZB20  | CMZ20 |
| 22                | CRZ22   | CMZB22  | CMZ22 |
| 24                | CRZ24   | CMZB24  | CMZ24 |
| 27                | CRZ27   | CMZB27  | CMZ27 |
| 30                | CRZ30   | CMZB30  | CMZ30 |
| 33                | CRZ33   | CMZB33  | CMZ33 |
| 36                | CRZ36   | CMZB36  | CMZ36 |
| Package Number    | ②       | ③       |       |
| Reference Page    | 13      | 14      | 13    |

| Power Dissipation | 0.7 W   | 1 W     | 2 W   |
|-------------------|---------|---------|-------|
| Package Vz(V)     | S-FLAT™ | M-FLAT™ |       |
| 39                | CRZ39   | CMZB39  | CMZ39 |
| 43                | CRZ43   | CMZB43  | CMZ43 |
| 47                | CRZ47   | CMZB47  | CMZ47 |
| 51                |         | CMZB51  | CMZ51 |
| 53                |         | CMZB53  | CMZ53 |
| 68                |         | CMZB68  |       |
| 75                |         | CMZB75  |       |
| 82                |         | CMZB82  |       |
| 100               |         | CMZB100 |       |
| 110               |         | CMZB110 |       |
| 150               |         | CMZB150 |       |
| 180               |         | CMZB180 |       |
| 200               |         | CMZB200 |       |
| 220               |         | CMZB220 |       |
| 240               |         | CMZB240 |       |
| 270               |         | CMZB270 |       |
| 300               |         | CMZB300 |       |
| 330               |         | CMZB330 |       |
| 390               |         | CMZB390 |       |
| Package Number    | ②       | ③       |       |
| Reference Page    | 13      | 14      | 13    |

# 4. Product Characteristics

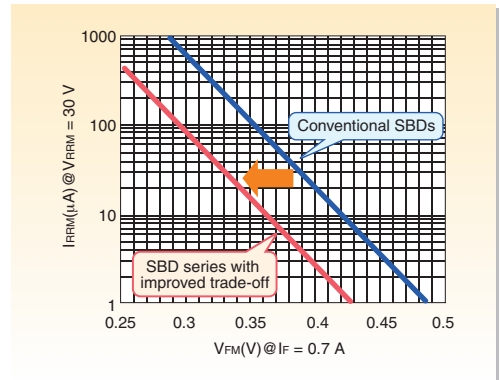
## ▶ SMALL & MEDIUM DIODES

### Schottky-Barrier Diodes (SBDs) with Improved Trade-Off

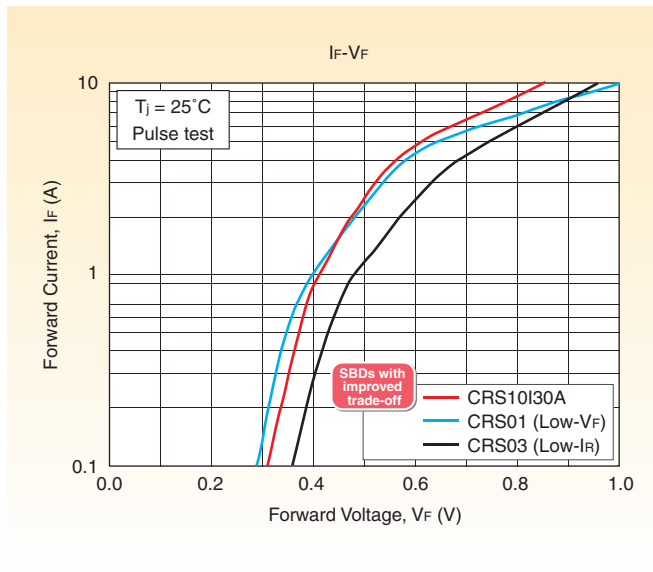
Toshiba now offers small to medium Schottky barrier diodes (SBDs) fabricated with a next-generation process. Owing to low peak forward voltage ( $V_{FM}$ ) and low peak repetitive forward voltage ( $I_{RRM}$ ) characteristics, these SBDs provide low power loss, help reduce the size and improve the power efficiency of mobile handsets, switching power supplies, etc., thereby improving their overall performance.

- ▶ Voltage rating:  $V_{RRM} = 30\text{ V}, 40\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 1\text{ A to }3\text{ A}$
- ▶ Peak forward voltage (Typical characteristics: CRS10I30A)  
 $V_{FM} = 0.35\text{ V typ. (}0.39\text{ V max (}@I_{FM} = 0.7\text{ A))}$
- ▶ Small surface-mount packages (US-FLAT™, S-FLAT™, M-FLAT™)

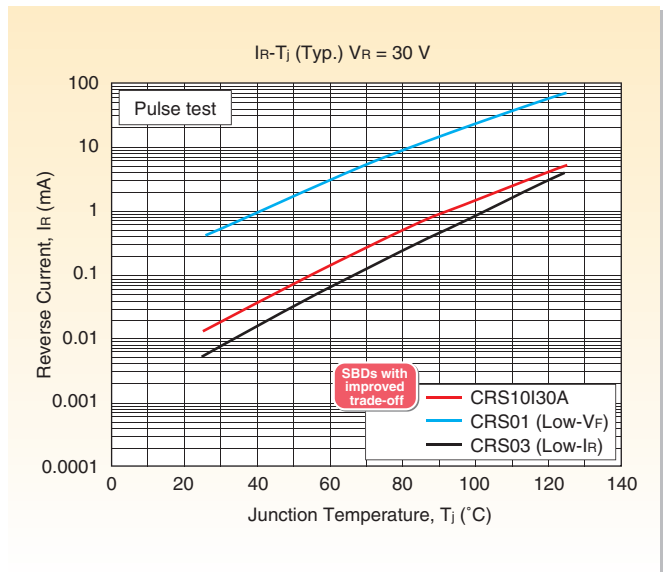
### ▶ Tradeoff Relationship between the Forward Voltage and Reverse Leakage Current (Example)



### ▶ Forward Voltage ( $V_F$ ) Curves (Example)



### ▶ Reverse Leakage Current ( $I_R$ ) Curves (Example)



### ▶ Product Naming Conventions

The product naming conventions shown below are used for SBDs with improved trade-off. Product names denote packaging, current rating, voltage rating and so on.

#### Product Naming Conventions

|            |           |          |           |          |
|------------|-----------|----------|-----------|----------|
| <u>CRS</u> | <u>10</u> | <u>I</u> | <u>30</u> | <u>A</u> |
| (1)        | (2)       | (3)      | (4)       | (5)      |

- (1) Toshiba Schottky barrier diode/package style  
CRS: S-FLAT package  
CMS: M-FLAT package  
CUS: US-FLAT package

- (2) Average forward current,  $I_{F(AV)}$   
Example: 10: 1.0 A
- (3) Product feature  
I: Low forward voltage & low leakage current (New SBD series)  
F: Low forward voltage  
R: Low leakage current
- (4) Reverse voltage,  $V_{RRM}$   
Example: 30: 30 V
- (5) Suffix that indicates an additional feature



# 4. Product Characteristics

## ▶ SMALL & MEDIUM DIODES

### 4.1 Schottky Barrier Diodes (SBDs)

- ▶ Voltage rating:  $V_{RRM} = 20\text{ V}, 30\text{ V}, 40\text{ V}, 60\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.7\text{ A to }10\text{ A}$
- ▶ Available in surface-mount packages.



#### Single

| Package   | Part Number      | Absolute Maximum Ratings |                 |               |            |                | Electrical Characteristics (Max) |              |                |                   |  | Conditions |
|---|------------------|--------------------------|-----------------|---------------|------------|----------------|----------------------------------|--------------|----------------|-------------------|--|------------|
|   |                  | $V_{RRM}$ (V)            | $I_{F(AV)}$ (A) | $I_{FSM}$ (A) | $T_j$ (°C) | $T_{stg}$ (°C) | $I_{RRM}$ (mA)                   | $V_{FM}$ (V) | @ $I_{FM}$ (A) | $C_j$ (pF) (Typ.) |  |            |
| <br><b>US-FLAT™</b>  | <b>CUS05</b>     | 20                       | 1.0             | 20            | 125        | -40 to 150     | 1.0                              | 0.37         | 0.7            | 40                | $V_R = 10\text{ V},$<br>$f = 1\text{ MHz}$ |            |
|   | <b>CUS06</b>     | 20                       | 1.0             | 20            | 150        | -40 to 150     | 0.03                             | 0.45         | 0.7            | 40                |  |            |
|   | <b>CUS01</b>     | 30                       | 1.0             | 20            | 125        | -40 to 150     | 1.5                              | 0.37         | 0.7            | 40                |  |            |
|   | <b>CUS02</b>     | 30                       | 1.0             | 20            | 150        | -40 to 150     | 0.1                              | 0.45         | 0.7            | 40                |  |            |
|   | <b>CUS10I30A</b> | 30                       | 1.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.39         | 0.7            | 50                |  |            |
|   | <b>CUS15I30A</b> | 30                       | 1.5             | 20            | 150        | -55 to 150     | 0.06                             | 0.46         | 1.5            | 50                |  |            |
|   | <b>CUS03</b>     | 40                       | 0.7             | 20            | 150        | -40 to 150     | 0.1                              | 0.52         | 0.7            | 45                |  |            |
|   | <b>CUS10I40A</b> | 40                       | 1.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.49         | 0.7            | 35                |  |            |
|   | <b>CUS04</b>     | 60                       | 0.7             | 20            | 150        | -40 to 150     | 0.1                              | 0.58         | 0.7            | 38                |  |            |
| <br><b>S-FLAT™</b> | <b>CRS06</b>     | 20                       | 1.0             | 20            | 125        | -40 to 150     | 1                                | 0.36         | 1.0            | 60                | $V_R = 10\text{ V},$<br>$f = 1\text{ MHz}$ |            |
|   | <b>CRS01</b>     | 30                       | 1.0             | 20            | 125        | -40 to 150     | 1.5                              | 0.37         | 0.7            | 40                |  |            |
|   | <b>CRS03</b>     | 30                       | 1.0             | 20            | 150        | -40 to 150     | 0.1                              | 0.45         | 0.7            | 40                |  |            |
|   | <b>CRS05</b>     | 30                       | 1.0             | 20            | 150        | -40 to 150     | ▽                                | 0.45         | 1.0            | 60                |  |            |
|   | <b>CRS11</b>     | 30                       | 1.0             | 20            | 125        | -40 to 150     | 1.5                              | 0.36         | 1.0            | 60                |  |            |
|   | <b>CRS10I30A</b> | 30                       | 1.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.39         | 0.7            | 50                |  |            |
|   | <b>CRS10I30B</b> | 30                       | 1.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.42         | 1.0            | 50                |  |            |
|   | <b>CRS10I30C</b> | 30                       | 1.0             | 30            | 150        | -55 to 150     | 0.10                             | 0.36         | 1.0            | 82                |  |            |
|   | <b>CRS08</b>     | 30                       | 1.5             | 30            | 125        | -40 to 150     | 1                                | 0.36         | 1.5            | 90                |  |            |
|   | <b>CRS09</b>     | 30                       | 1.5             | 30            | 150        | -40 to 150     | 0.05                             | 0.46         | 1.5            | 90                |  |            |
|   | <b>CRS15I30A</b> | 30                       | 1.5             | 20            | 150        | -55 to 150     | 0.06                             | 0.46         | 1.5            | 50                |  |            |
|   | <b>CRS15I30B</b> | 30                       | 1.5             | 30            | 150        | -55 to 150     | 0.10                             | 0.40         | 1.5            | 82                |  |            |
|   | <b>CRS14</b>     | 30                       | 2.0             | 30            | 150        | -40 to 150     | 0.05                             | 0.49         | 2.0            | 90                |  |            |
|   | <b>CRS20I30A</b> | 30                       | 2.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.49         | 2.0            | 50                |  |            |
|   | <b>CRS20I30B</b> | 30                       | 2.0             | 30            | 150        | -55 to 150     | 0.10                             | 0.45         | 2.0            | 82                |  |            |
|   | <b>CRS15◇</b>    | 30                       | 3.0             | 30            | 150        | -40 to 150     | 0.05                             | 0.52         | 3.0            | 90                |  |            |
|   | <b>CRS30I30A</b> | 30                       | 3.0             | 30            | 150        | -55 to 150     | 0.10                             | 0.49         | 3.0            | 82                |  |            |
|   | <b>CRS04</b>     | 40                       | 1.0             | 20            | 150        | -40 to 150     | 0.1                              | 0.49         | 0.7            | 47                |  |            |
|   | <b>CRS10I40A</b> | 40                       | 1.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.49         | 0.7            | 35                |  |            |
|   | <b>CRS10I40B</b> | 40                       | 1.0             | 25            | 150        | -55 to 150     | 0.10                             | 0.45         | 1.0            | 62                |  |            |
|   | <b>CRS15I40A</b> | 40                       | 1.5             | 20            | 150        | -55 to 150     | 0.06                             | 0.55         | 1.5            | 35                |  |            |
|   | <b>CRS20I40A</b> | 40                       | 2.0             | 20            | 150        | -55 to 150     | 0.06                             | 0.60         | 2.0            | 35                |  |            |
|   | <b>CRS20I40B</b> | 40                       | 2.0             | 25            | 150        | -55 to 150     | 0.10                             | 0.52         | 2.0            | 62                |  |            |
| <b>CRS12</b>  | 60               | 1.0                      | 20              | 150           | -40 to 150 | 0.1            | 0.58                             | 1.0          | 40             |                   |  |            |
| <b>CRS13</b>  | 60               | 1.0                      | 20              | 150           | -40 to 150 | 0.05           | 0.55                             | 1.0          | 40             |                   |  |            |

▽:  $I_{RRM} = 5\ \mu\text{A Max}$  ( $V_R = 5\text{ V}$ ) ◇:  $I_{F(DC)} = 3\text{ A}$

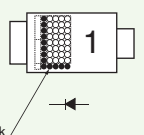
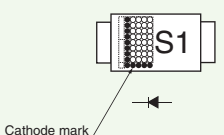
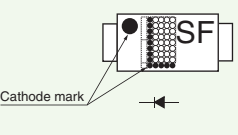
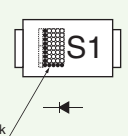
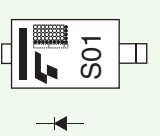


## Single

| Package   | Part Number | Absolute Maximum Ratings |                        |                      |                     |                       | Electrical Characteristics (Max) |                     |                       |                            |                                     | Conditions |
|---|-------------|--------------------------|------------------------|----------------------|---------------------|-----------------------|----------------------------------|---------------------|-----------------------|----------------------------|-------------------------------------|------------|
|   |             | V <sub>RRM</sub> (V)     | I <sub>F(AV)</sub> (A) | I <sub>FSM</sub> (A) | T <sub>j</sub> (°C) | T <sub>stg</sub> (°C) | I <sub>RRM</sub> (mA)            | V <sub>FM</sub> (V) | @ I <sub>FM</sub> (A) | C <sub>j</sub> (pF) (Typ.) |                                     |            |
| <br>M-FLAT™  | CMS08       | 30                       | 1.0                    | 25                   | 125                 | -40 to 150            | 1.5                              | 0.37                | 1.0                   | 70                         | V <sub>R</sub> = 10 V,<br>f = 1 MHz |            |
|   | CMS09       | 30                       | 1.0                    | 25                   | 150                 | -40 to 150            | 0.5                              | 0.45                | 1.0                   | 70                         |                                     |            |
|   | CMS10I30A   | 30                       | 1.0                    | 30                   | 150                 | -55 to 150            | 0.10                             | 0.36                | 1.0                   | 82                         |                                     |            |
|   | CMS06       | 30                       | 2.0                    | 40                   | 125                 | -40 to 150            | 3.0                              | 0.37                | 2.0                   | 130                        |                                     |            |
|   | CMS07       | 30                       | 2.0                    | 40                   | 150                 | -40 to 150            | 0.5                              | 0.45                | 2.0                   | 130                        |                                     |            |
|   | CMS17       | 30                       | 2.0                    | 30                   | 150                 | -40 to 150            | 0.1                              | 0.48                | 2.0                   | 90                         |                                     |            |
|   | CMS20I30A   | 30                       | 2.0                    | 30                   | 150                 | -55 to 150            | 0.10                             | 0.45                | 2.0                   | 82                         |                                     |            |
|   | CMS01       | 30                       | 3.0                    | 40                   | 125                 | -40 to 150            | 5.0                              | 0.37                | 3.0                   | 190                        |                                     |            |
|   | CMS03       | 30                       | 3.0                    | 40                   | 150                 | -40 to 150            | 0.5                              | 0.45                | 3.0                   | 190                        |                                     |            |
|   | CMS30I30A   | 30                       | 3.0                    | 30                   | 150                 | -55 to 150            | 0.10                             | 0.49                | 3.0                   | 82                         |                                     |            |
|   | CMS04       | 30                       | 5.0                    | 70                   | 125                 | -40 to 150            | 8.0                              | 0.37                | 5.0                   | 330                        |                                     |            |
|   | CMS05       | 30                       | 5.0                    | 70                   | 150                 | -40 to 150            | 0.8                              | 0.45                | 5.0                   | 330                        |                                     |            |
|   | CMS10       | 40                       | 1.0                    | 25                   | 150                 | -40 to 150            | 0.5                              | 0.55                | 1.0                   | 50                         |                                     |            |
|   | CMS10I40A   | 40                       | 1.0                    | 25                   | 150                 | -55 to 150            | 0.10                             | 0.45                | 1.0                   | 62                         |                                     |            |
|   | CMS15I40A   | 40                       | 1.5                    | 25                   | 150                 | -55 to 150            | 0.10                             | 0.49                | 1.5                   | 62                         |                                     |            |
|   | CMS11       | 40                       | 2.0                    | 30                   | 150                 | -40 to 150            | 0.5                              | 0.55                | 2.0                   | 95                         |                                     |            |
|   | CMS20I40A   | 40                       | 2.0                    | 25                   | 150                 | -55 to 150            | 0.10                             | 0.52                | 2.0                   | 62                         |                                     |            |
|   | CMS16       | 40                       | 3.0                    | 30                   | 150                 | -40 to 150            | 0.2                              | 0.55                | 3.0                   | 95                         |                                     |            |
|   | CMS30I40A   | 40                       | 3.0                    | 25                   | 150                 | -55 to 150            | 0.10                             | 0.55                | 3.0                   | 62                         |                                     |            |
| CMS14   | 60          | 2.0                      | 40                     | 150                  | -40 to 150          | 0.2                   | 0.58                             | 2.0                 | 77                    |                            |                                     |            |
| CMS15   | 60          | 3.0                      | 60                     | 150                  | -40 to 150          | 0.3                   | 0.58                             | 3.0                 | 102                   |                            |                                     |            |
| <br>L-FLAT™ | CLS01       | 30                       | 10                     | 100                  | 125                 | -40 to 150            | 1.0                              | 0.47                | 10                    | 530                        | V <sub>R</sub> = 10 V,<br>f = 1 MHz |            |
|   | CLS02       | 40                       | 10                     | 100                  | 125                 | -40 to 150            | 1.0                              | 0.55                | 10                    | 420                        |                                     |            |
|   | CLS03       | 60                       | 10                     | 100                  | 125                 | -40 to 150            | 1.0                              | 0.58                | 10                    | 345                        |                                     |            |

▽: I<sub>RRM</sub> = 5 μA Max (V<sub>R</sub> = 5 V) ◇: I<sub>F(DC)</sub> = 3 A

### ▶ Marking

| US-FLAT™  | S-FLAT™   | S-FLAT™   |
|---|---|---|
| <br>Example: CUS01 | <br>Example: CRS01 | <br>Example: CRS10I30A |
| M-FLAT™   | L-FLAT™   |   |
| <br>Example: CMS01 | <br>Example: CLS01 |   |

# 4. Product Characteristics



## ▶ SMALL & MEDIUM DIODES

### 4.2 Rectification Diodes

#### (Diodes for General Rectification and Reverse-Current Protection)


- ▶ Voltage rating:  $V_{RRM} = 400\text{ V}, 600\text{ V}, 800\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ A to }2\text{ A}$
- ▶ Available in surface-mount packages.

#### Single

| Package  | Part Number | Absolute Maximum Ratings |                 |               |            |                | Electrical Characteristics (Max) |              |                |
|--|-------------|--------------------------|-----------------|---------------|------------|----------------|----------------------------------|--------------|----------------|
|  |             | $V_{RRM}$ (V)            | $I_{F(AV)}$ (A) | $I_{FSM}$ (A) | $T_j$ (°C) | $T_{stg}$ (°C) | $I_{RRM}$ (μA)                   | $V_{FM}$ (V) | @ $I_{FM}$ (A) |
| <br>S-FLAT™ | CRG02○      | 400                      | 0.7             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 0.7            |
|  | CRG07○      | 400                      | 0.7             | 15            | 175        | -40 to 175     | 10                               | 1.1          | 0.7            |
|  | CRG03○      | 400                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 0.7            |
|  | CRG09★○     | 400                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 0.7            |
|  | CRG04○      | 600                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 1.0            |
|  | CRG05○      | 800                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.2          | 1.0            |
| <br>M-FLAT™ | CMC02*      | 400                      | 1.0             | 30            | 150        | -40 to 150     | 10                               | 1.0          | 1.0            |
|  | CMG05       | 400                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 1.0            |
|  | CMG07       | 400                      | 1.0             | 30            | 150        | -40 to 150     | 10                               | 1.1          | 1.0            |
|  | CMG02       | 400                      | 2.0             | 80            | 150        | -40 to 150     | 10                               | 1.1          | 2.0            |
|  | CMG06       | 600                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 1.1          | 1.0            |
|  | CMG08       | 600                      | 1.0             | 30            | 150        | -40 to 150     | 10                               | 1.1          | 1.0            |
|  | CMG03       | 600                      | 2.0             | 80            | 150        | -40 to 150     | 10                               | 1.1          | 2.0            |

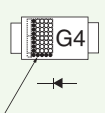
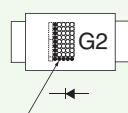
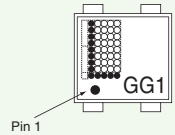
○: Based on AEC-Q101 ★: High ESD protection \*: Designed for strobe discharge applications

#### Dual

| Package  | Part Number | Absolute Maximum Ratings |                 |               |            |                | Electrical Characteristics (Max) |              |                |
|--|-------------|--------------------------|-----------------|---------------|------------|----------------|----------------------------------|--------------|----------------|
|  |             | $V_{RRM}$ (V)            | $I_{F(AV)}$ (A) | $I_{FSM}$ (A) | $T_j$ (°C) | $T_{stg}$ (°C) | $I_{RRM}$ (μA)                   | $V_{FM}$ (V) | @ $I_{FM}$ (A) |
| <br>HM-FLAT | HMG01       | 400                      | 0.5             | 10            | 150        | -40 to 150     | 10                               | 1.0          | 0.5            |
|  | HMG02       | 400                      | 0.7             | 10            | 175        | -40 to 175     | 10                               | 1.0          | 0.5            |

Note:  $I_{F(AV)}$ ,  $I_{FSM}$ ,  $I_{RRM}$  and  $V_{FM}$  are specified per diode.

#### ▶ Marking

| S-FLAT™   | M-FLAT™   | HM-FLAT  |
|---|---|--|
| <br>Cathode mark | <br>Cathode mark | <br>Pin 1 |
| Example: CRG04  | Example: CMG02  | Example: HMG01   |



## 4.3 High-Speed Rectifiers

### Super-Fast-Recovery Diode (S-FRDs)

- ▶ Voltage rating:  $V_{RRM} = 600\text{ V}, 800\text{ V}, 900\text{ V}, 1000\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ A to }2\text{ A}$
- ▶ High-speed switching: Reverse recovery time ( $t_{rr}$ )  $\leq 100\text{ ns}$

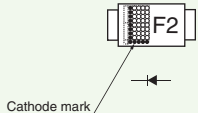
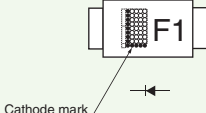
### (1) Super-Fast-Recovery Diodes (S-FRDs)

#### Single

| Package   | Part Number  | Absolute Maximum Ratings |                 |               |            |                | Electrical Characteristics (Max) |              |                |               |   |
|---|--------------|--------------------------|-----------------|---------------|------------|----------------|----------------------------------|--------------|----------------|---------------|---|
|   |              | $V_{RRM}$ (V)            | $I_{F(AV)}$ (A) | $I_{FSM}$ (A) | $T_j$ (°C) | $T_{stg}$ (°C) | $I_{RRM}$ (μA)                   | $V_{FM}$ (V) | @ $I_{FM}$ (A) | $t_{rr}$ (ns) | Conditions  |
| <br><b>S-FLAT™</b> | <b>CRF02</b> | 800                      | 0.5             | 10            | 150        | -40 to 150     | 50                               | 3.0          | 0.5            | 100           | $I_F = 1\text{ A},$<br>$di/dt = -30\text{ A}/\mu\text{s}$ |
|   | <b>CRF03</b> | 600                      | 0.7             | 10            | 150        | -40 to 150     | 50                               | 2.0          | 0.7            | 100           |   |
| <br><b>M-FLAT™</b> | <b>CMF01</b> | 600                      | 2.0             | 30            | 150        | -40 to 150     | 50                               | 2.0          | 2.0            | 100           | $I_F = 1\text{ A},$<br>$di/dt = -30\text{ A}/\mu\text{s}$ |
|   | <b>CMF02</b> | 600                      | 1.0             | 10            | 150        | -40 to 150     | 50                               | 2.0          | 1.0            | 100           |   |
|   | <b>CMF04</b> | 800                      | 0.5             | 10            | 150        | -40 to 150     | 50                               | 2.5          | 0.5            | 100           |   |
|   | <b>CMF03</b> | 900                      | 0.5             | 10            | 125        | -40 to 150     | 50                               | 2.5          | 0.5            | 100           |   |
|   | <b>CMF05</b> | 1000                     | 0.5             | 10            | 125        | -40 to 150     | 50                               | 2.7          | 0.5            | 100           |   |

#### ▶ Marking

#### ■ S-FRD

| S-FLAT™  | M-FLAT™  |
|--|--|
|  <p>Cathode mark</p> <p>Example: <b>CRF02</b></p> |  <p>Cathode mark</p> <p>Example: <b>CMF01</b></p> |

# 4. Product Characteristics



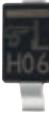
## ▶ SMALL & MEDIUM DIODES

### High-Efficiency Diode (HEDs)

- ▶ Voltage rating:  $V_{RRM} = 200\text{ V}, 300\text{ V}, 400\text{ V}$
- ▶ Current rating:  $I_{F(AV)} = 0.5\text{ to }5\text{ A}$
- ▶ High-speed switching: Reverse recovery time ( $t_{rr}$ )  $\leq 35\text{ ns}$  or  $\leq 50\text{ ns}$
- ▶ Available in surface-mount packages.

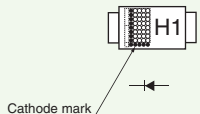
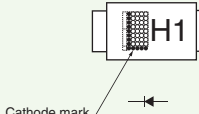
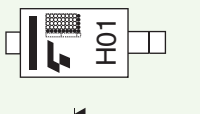
## (2) High-Efficiency Diodes (HEDs)

### Single

| Package   | Part Number   | Absolute Maximum Ratings |                 |               |            |                | Electrical Characteristics (Max) |              |                |               |   |
|---|---------------|--------------------------|-----------------|---------------|------------|----------------|----------------------------------|--------------|----------------|---------------|---|
|   |               | $V_{RRM}$ (V)            | $I_{F(AV)}$ (A) | $I_{FSM}$ (A) | $T_j$ (°C) | $T_{stg}$ (°C) | $I_{RRM}$ (μA)                   | $V_{FM}$ (V) | @ $I_{FM}$ (A) | $t_{rr}$ (ns) | Conditions  |
| <br><b>S-FLAT™</b>   | <b>CRH02</b>  | 200                      | 0.5             | 10            | 150        | -40 to 150     | 10                               | 0.95         | 0.5            | 35            | $I_F = 1\text{ A},$<br>$di/dt = -30\text{ A}/\mu\text{s}$ |
|   | <b>CRH01</b>  | 200                      | 1.0             | 15            | 150        | -40 to 150     | 10                               | 0.98         | 1.0            | 35            |   |
| <br><b>M-FLAT™</b>  | <b>CMH04</b>  | 200                      | 1.0             | 20            | 150        | -40 to 150     | 10                               | 0.98         | 1.0            | 35            | $I_F = 1\text{ A},$<br>$di/dt = -30\text{ A}/\mu\text{s}$ |
|   | <b>CMH07</b>  | 200                      | 2.0             | 40            | 150        | -40 to 150     | 10                               | 0.98         | 2.0            | 35            |   |
|   | <b>CMH01</b>  | 200                      | 3.0             | 40            | 150        | -40 to 150     | 10                               | 0.98         | 3.0            | 35            |   |
|   | <b>CMH05</b>  | 400                      | 1.0             | 20            | 150        | -40 to 150     | 10                               | 1.3          | 1.0            | 50            |   |
|   | <b>CMH05A</b> | 400                      | 1.0             | 10            | 150        | -40 to 150     | 10                               | 1.8          | 1.0            | 35            |   |
|   | <b>CMH08</b>  | 400                      | 2.0             | 30            | 150        | -40 to 150     | 10                               | 1.3          | 2.0            | 50            |   |
|   | <b>CMH08A</b> | 400                      | 2.0             | 20            | 150        | -40 to 150     | 10                               | 1.8          | 2.0            | 35            |   |
|   | <b>CMH02</b>  | 400                      | 3.0             | 40            | 150        | -40 to 150     | 10                               | 1.3          | 3.0            | 50            |   |
| <br><b>L-FLAT™</b> | <b>CMH02A</b> | 400                      | 3.0             | 30            | 150        | -40 to 150     | 10                               | 1.8          | 3.0            | 35            | $I_F = 2\text{ A},$<br>$di/dt = -50\text{ A}/\mu\text{s}$ |
|   | <b>CLH01</b>  | 200                      | 3.0             | 60            | 150        | -40 to 150     | 10                               | 0.98         | 3.0            | 35            |   |
|   | <b>CLH05</b>  | 200                      | 5.0             | 100           | 150        | -40 to 150     | 10                               | 0.98         | 5.0            | 35            |   |
|   | <b>CLH02</b>  | 300                      | 3.0             | 50            | 150        | -40 to 150     | 10                               | 1.3          | 3.0            | 35            |   |
|   | <b>CLH06</b>  | 300                      | 5.0             | 60            | 150        | -40 to 150     | 10                               | 1.3          | 5.0            | 35            |   |
|   | <b>CLH03</b>  | 400                      | 3.0             | 30            | 150        | -40 to 150     | 10                               | 1.8          | 3.0            | 35            |   |
|   | <b>CLH07</b>  | 400                      | 5.0             | 50            | 150        | -40 to 150     | 10                               | 1.8          | 5.0            | 35            |   |

### ▶ Marking

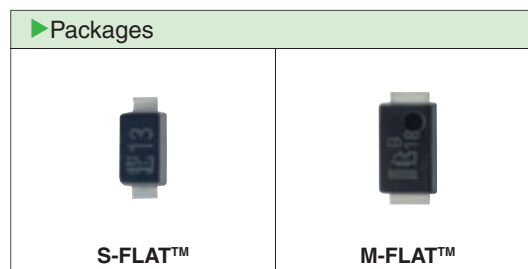
#### ■ HED

| S-FLAT™  | M-FLAT™  | L-FLAT™   |
|--|--|---|
|  <p>Cathode mark</p> <p>Example: <b>CRH01</b></p> |  <p>Cathode mark</p> <p>Example: <b>CMH01</b></p> |  <p>Cathode mark</p> <p>Example: <b>CLH01</b></p> |



## 4.4 Zener Diodes

- ▶  $V_z = 6.2\text{ V to }390\text{ V}$
- ▶ Power dissipation:  $P = 0.7\text{ W, }1.0\text{ W, }2.0\text{ W}$   
(S-FLAT™ and M-FLAT™ packages)



### CRY62 and CRZ10 Series (S-FLAT™)

Ta = 25°C

| Part Number | Power Dissipation (mW) | Zener Characteristics   |      |      |                                       |                                | Temperature Coefficient of Zener Voltage $\alpha_T$ (mV/°C) |     | Forward Voltage $V_F$ (V) | Measurement Current $I_F$ (A) | Reverse Current $I_R$ ( $\mu$ A) | Measurement Voltage $V_R$ (V) |
|-------------|------------------------|-------------------------|------|------|---------------------------------------|--------------------------------|---|-----|---------------------------|-------------------------------|----------------------------------|-------------------------------|
|             |                        | Zener Voltage $V_z$ (V) |      |      | Dynamic Resistance $r_d$ ( $\Omega$ ) | Measurement Current $I_z$ (mA) | Typ.  | Max |                           |                               |                                  |                               |
|             |                        | Min                     | Typ. | Max  |                                       |                                |   |     | Max                       | Max                           |                                  |                               |
| CRY62       | 700                    | 5.6                     | 6.2  | 6.8  | 60                                    | 10                             | 2   | 3   | 1.0                       | 0.2                           | 10                               | 3.0                           |
| CRY68       | 700                    | 6.2                     | 6.8  | 7.4  | 60                                    | 10                             | 3   | 4   | 1.0                       | 0.2                           | 10                               | 3.0                           |
| CRY75       | 700                    | 6.8                     | 7.5  | 8.3  | 30                                    | 10                             | 4   | 5   | 1.0                       | 0.2                           | 10                               | 4.5                           |
| CRY82       | 700                    | 7.4                     | 8.2  | 9.0  | 30                                    | 10                             | 4   | 6   | 1.0                       | 0.2                           | 10                               | 4.9                           |
| CRY91       | 700                    | 8.2                     | 9.1  | 10.0 | 30                                    | 10                             | 5   | 8   | 1.0                       | 0.2                           | 10                               | 5.5                           |
| CRZ10       | 700                    | 9.0                     | 10.0 | 11.0 | 30                                    | 10                             | 6   | 9   | 1.0                       | 0.2                           | 10                               | 6.0                           |
| CRZ11       | 700                    | 9.9                     | 11.0 | 12.1 | 30                                    | 10                             | 7   | 11  | 1.0                       | 0.2                           | 10                               | 7.0                           |
| CRZ12       | 700                    | 10.8                    | 12.0 | 13.2 | 30                                    | 10                             | 8   | 13  | 1.0                       | 0.2                           | 10                               | 8.0                           |
| CRZ13       | 700                    | 11.7                    | 13.0 | 14.3 | 30                                    | 10                             | 9   | 14  | 1.0                       | 0.2                           | 10                               | 9.0                           |
| CRZ15       | 700                    | 13.5                    | 15.0 | 16.5 | 30                                    | 10                             | 11  | 17  | 1.0                       | 0.2                           | 10                               | 10.0                          |
| CRZ16       | 700                    | 14.4                    | 16.0 | 17.6 | 30                                    | 10                             | 12  | 19  | 1.0                       | 0.2                           | 10                               | 11.0                          |
| CRZ18       | 700                    | 16.2                    | 18.0 | 19.8 | 30                                    | 10                             | 14  | 23  | 1.0                       | 0.2                           | 10                               | 13.0                          |
| CRZ20       | 700                    | 18.0                    | 20.0 | 22.0 | 30                                    | 10                             | 16  | 26  | 1.0                       | 0.2                           | 10                               | 14.0                          |
| CRZ22       | 700                    | 19.8                    | 22.0 | 24.2 | 30                                    | 10                             | 18  | 28  | 1.0                       | 0.2                           | 10                               | 16.0                          |
| CRZ24       | 700                    | 21.6                    | 24.0 | 26.4 | 30                                    | 10                             | 20  | 32  | 1.0                       | 0.2                           | 10                               | 17.0                          |
| CRZ27       | 700                    | 24.3                    | 27.0 | 29.7 | 30                                    | 10                             | 23  | 36  | 1.0                       | 0.2                           | 10                               | 19.0                          |
| CRZ30       | 700                    | 27.0                    | 30.0 | 33.0 | 30                                    | 10                             | 25  | 40  | 1.0                       | 0.2                           | 10                               | 21.0                          |
| CRZ33       | 700                    | 29.7                    | 33.0 | 36.3 | 30                                    | 10                             | 26  | 41  | 1.0                       | 0.2                           | 10                               | 26.4                          |
| CRZ36       | 700                    | 32.4                    | 36.0 | 39.6 | 30                                    | 9                              | 28  | 45  | 1.0                       | 0.2                           | 10                               | 28.8                          |
| CRZ39       | 700                    | 35.1                    | 39.0 | 42.9 | 35                                    | 8                              | 30  | 48  | 1.0                       | 0.2                           | 10                               | 31.2                          |
| CRZ43       | 700                    | 38.7                    | 43.0 | 47.3 | 40                                    | 7                              | 33  | 53  | 1.0                       | 0.2                           | 10                               | 34.4                          |
| CRZ47       | 700                    | 42.3                    | 47.0 | 51.7 | 65                                    | 6                              | 38  | 60  | 1.0                       | 0.2                           | 10                               | 37.6                          |

### CMZ12 Series (M-FLAT™)

Ta = 25°C

| Part Number | Power Dissipation (W) | Zener Characteristics   |      |      |                                       |                                | Temperature Coefficient of Zener Voltage $\alpha_T$ (mV/°C) |     | Forward Voltage $V_F$ (V) | Measurement Current $I_F$ (A) | Reverse Current $I_R$ ( $\mu$ A) | Measurement Voltage $V_R$ (V) |
|-------------|-----------------------|-------------------------|------|------|---------------------------------------|--------------------------------|---|-----|---------------------------|-------------------------------|----------------------------------|-------------------------------|
|             |                       | Zener Voltage $V_z$ (V) |      |      | Dynamic Resistance $r_d$ ( $\Omega$ ) | Measurement Current $I_z$ (mA) | Typ.  | Max |                           |                               |                                  |                               |
|             |                       | Min                     | Typ. | Max  |                                       |                                |   |     | Max                       | Max                           |                                  |                               |
| CMZ12       | 2.0                   | 10.8                    | 12   | 13.2 | 30                                    | 10                             | 8   | 13  | 1.2                       | 0.2                           | 10                               | 8                             |
| CMZ13       | 2.0                   | 11.7                    | 13   | 14.3 | 30                                    | 10                             | 9   | 14  | 1.2                       | 0.2                           | 10                               | 9                             |
| CMZ15       | 2.0                   | 13.5                    | 15   | 16.5 | 30                                    | 10                             | 11  | 17  | 1.2                       | 0.2                           | 10                               | 10                            |
| CMZ16       | 2.0                   | 14.4                    | 16   | 17.6 | 30                                    | 10                             | 12  | 19  | 1.2                       | 0.2                           | 10                               | 11                            |
| CMZ18       | 2.0                   | 16.2                    | 18   | 19.8 | 30                                    | 10                             | 14  | 23  | 1.2                       | 0.2                           | 10                               | 13                            |
| CMZ20       | 2.0                   | 18.0                    | 20   | 22.0 | 30                                    | 10                             | 16  | 26  | 1.2                       | 0.2                           | 10                               | 14                            |
| CMZ22       | 2.0                   | 19.8                    | 22   | 24.2 | 30                                    | 10                             | 18  | 28  | 1.2                       | 0.2                           | 10                               | 16                            |
| CMZ24       | 2.0                   | 21.6                    | 24   | 26.4 | 30                                    | 10                             | 20  | 32  | 1.2                       | 0.2                           | 10                               | 17                            |
| CMZ27       | 2.0                   | 24.3                    | 27   | 29.7 | 30                                    | 10                             | 23  | 36  | 1.2                       | 0.2                           | 10                               | 19                            |
| CMZ30       | 2.0                   | 27.0                    | 30   | 33.0 | 30                                    | 10                             | 25  | 40  | 1.2                       | 0.2                           | 10                               | 21                            |
| CMZ33       | 2.0                   | 29.7                    | 33   | 36.3 | 30                                    | 10                             | 26  | 41  | 1.2                       | 0.2                           | 10                               | 26.4                          |
| CMZ36       | 2.0                   | 32.4                    | 36   | 39.6 | 30                                    | 9                              | 28  | 45  | 1.2                       | 0.2                           | 10                               | 28.8                          |
| CMZ39       | 2.0                   | 35.1                    | 39   | 42.9 | 35                                    | 8                              | 30  | 48  | 1.2                       | 0.2                           | 10                               | 31.2                          |
| CMZ43       | 2.0                   | 38.7                    | 43   | 47.3 | 40                                    | 7                              | 33  | 53  | 1.2                       | 0.2                           | 10                               | 34.4                          |
| CMZ47       | 2.0                   | 42.3                    | 47   | 51.7 | 65                                    | 6                              | 38  | 60  | 1.2                       | 0.2                           | 10                               | 37.6                          |
| CMZ51       | 2.0                   | 45.9                    | 51   | 56.1 | 65                                    | 6                              | 43  | 68  | 1.2                       | 0.2                           | 10                               | 40.8                          |
| CMZ53       | 2.0                   | 47.7                    | 53   | 58.3 | 85                                    | 5                              | 49  | 77  | 1.2                       | 0.2                           | 10                               | 42.4                          |

# 4. Product Characteristics

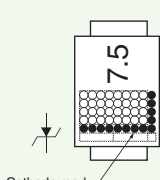
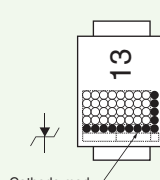
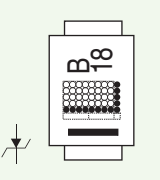
## ▶ SMALL & MEDIUM DIODES

### CMZB12 Series (M-FLAT™)

Ta = 25°C

| Part Number | Power Dissipation (W) | Zener Characteristics            |      |      |                                       |      | Measurement Current I <sub>Z</sub> (mA) | Temperature Coefficient of Zener Voltage α <sub>ZT</sub> (mV/°C) |     | Forward Voltage V <sub>F</sub> (V) | Measurement Current I <sub>F</sub> (A) | Reverse Current I <sub>R</sub> (μA) | Measurement Voltage V <sub>R</sub> (V) |     |
|-------------|-----------------------|----------------------------------|------|------|---------------------------------------|------|---|--|-----|------------------------------------|--|-------------------------------------|--|-----|
|             |                       | Zener Voltage V <sub>Z</sub> (V) |      |      | Dynamic Resistance r <sub>d</sub> (Ω) | Typ. |   | Max  | Max |                                    |  |                                     |  | Max |
|             |                       | Min                              | Typ. | Max  |                                       |      |   |  |     |                                    |  |                                     |  |     |
| CMZB12      | 1.0                   | 10.8                             | 12   | 13.2 | 30                                    | 10   | 8                                       | 13   | 1.2 | 0.2                                | 10                                     | 8                                   |  |     |
| CMZB13      | 1.0                   | 11.7                             | 13   | 14.3 | 30                                    | 10   | 9                                       | 14   | 1.2 | 0.2                                | 10                                     | 9                                   |  |     |
| CMZB15      | 1.0                   | 13.5                             | 15   | 16.5 | 30                                    | 10   | 11                                      | 17   | 1.2 | 0.2                                | 10                                     | 10                                  |  |     |
| CMZB16      | 1.0                   | 14.4                             | 16   | 17.6 | 30                                    | 10   | 12                                      | 19   | 1.2 | 0.2                                | 10                                     | 11                                  |  |     |
| CMZB18      | 1.0                   | 16.2                             | 18   | 19.8 | 30                                    | 10   | 14                                      | 23   | 1.2 | 0.2                                | 10                                     | 13                                  |  |     |
| CMZB20      | 1.0                   | 18.0                             | 20   | 22.0 | 30                                    | 10   | 16                                      | 26   | 1.2 | 0.2                                | 10                                     | 14                                  |  |     |
| CMZB22      | 1.0                   | 19.8                             | 22   | 24.2 | 30                                    | 10   | 18                                      | 28   | 1.2 | 0.2                                | 10                                     | 16                                  |  |     |
| CMZB24      | 1.0                   | 21.6                             | 24   | 26.4 | 30                                    | 10   | 20                                      | 32   | 1.2 | 0.2                                | 10                                     | 17                                  |  |     |
| CMZB27      | 1.0                   | 24.3                             | 27   | 29.7 | 30                                    | 10   | 23                                      | 36   | 1.2 | 0.2                                | 10                                     | 19                                  |  |     |
| CMZB30      | 1.0                   | 27.0                             | 30   | 33.0 | 30                                    | 10   | 25                                      | 40   | 1.2 | 0.2                                | 10                                     | 21                                  |  |     |
| CMZB33      | 1.0                   | 29.7                             | 33   | 36.3 | 30                                    | 10   | 26                                      | 41   | 1.2 | 0.2                                | 10                                     | 26.4                                |  |     |
| CMZB36      | 1.0                   | 32.4                             | 36   | 39.6 | 30                                    | 9    | 28                                      | 45   | 1.2 | 0.2                                | 10                                     | 28.8                                |  |     |
| CMZB39      | 1.0                   | 35.1                             | 39   | 42.9 | 35                                    | 8    | 30                                      | 48   | 1.2 | 0.2                                | 10                                     | 31.2                                |  |     |
| CMZB43      | 1.0                   | 38.7                             | 43   | 47.3 | 40                                    | 7    | 33                                      | 53   | 1.2 | 0.2                                | 10                                     | 34.4                                |  |     |
| CMZB47      | 1.0                   | 42.3                             | 47   | 51.7 | 65                                    | 6    | 38                                      | 60   | 1.2 | 0.2                                | 10                                     | 37.6                                |  |     |
| CMZB51      | 1.0                   | 45.9                             | 51   | 56.1 | 65                                    | 6    | 43                                      | 68   | 1.2 | 0.2                                | 10                                     | 40.8                                |  |     |
| CMZB53      | 1.0                   | 47.7                             | 53   | 58.3 | 85                                    | 5    | 49                                      | 77   | 1.2 | 0.2                                | 10                                     | 42.4                                |  |     |
| CMZB68      | 1.0                   | 61.2                             | 68   | 74.8 | 120                                   | 4    | 57                                      | 90   | 1.2 | 0.2                                | 10                                     | 54.4                                |  |     |
| CMZB75      | 1.0                   | 67.5                             | 75   | 82.5 | 150                                   | 4    | 66                                      | 104  | 1.2 | 0.2                                | 10                                     | 60                                  |  |     |
| CMZB82      | 1.0                   | 73.8                             | 82   | 90.2 | 170                                   | 3    | 71                                      | 113  | 1.2 | 0.2                                | 10                                     | 65.6                                |  |     |
| CMZB100     | 1.0                   | 90                               | 100  | 110  | 300                                   | 3    | 87                                      | 138  | 1.2 | 0.2                                | 10                                     | 80                                  |  |     |
| CMZB110     | 1.0                   | 99                               | 110  | 121  | 300                                   | 3    | 96                                      | 152  | 1.2 | 0.2                                | 10                                     | 88                                  |  |     |
| CMZB150     | 1.0                   | 135                              | 150  | 165  | 450                                   | 2    | 136                                     | 210  | 1.2 | 0.2                                | 10                                     | 120                                 |  |     |
| CMZB180     | 1.0                   | 162                              | 180  | 198  | 500                                   | 1.5  | 161                                     | 254  | 1.2 | 0.2                                | 10                                     | 144                                 |  |     |
| CMZB200     | 1.0                   | 180                              | 200  | 220  | 500                                   | 1.5  | 170                                     | 269  | 1.2 | 0.2                                | 10                                     | 160                                 |  |     |
| CMZB220     | 1.0                   | 198                              | 220  | 242  | 5000                                  | 0.5  | 200                                     | 309  | 1.2 | 0.2                                | 10                                     | 176                                 |  |     |
| CMZB240     | 1.0                   | 216                              | 240  | 264  | 5000                                  | 0.5  | 215                                     | 343  | 1.2 | 0.2                                | 10                                     | 192                                 |  |     |
| CMZB270     | 1.0                   | 243                              | 270  | 297  | 5000                                  | 0.5  | 243                                     | 385  | 1.2 | 0.2                                | 10                                     | 216                                 |  |     |
| CMZB300     | 1.0                   | 270                              | 300  | 330  | 5000                                  | 0.5  | 270                                     | 428  | 1.2 | 0.2                                | 10                                     | 240                                 |  |     |
| CMZB330     | 1.0                   | 297                              | 330  | 363  | 5000                                  | 0.5  | 296                                     | 473  | 1.2 | 0.2                                | 10                                     | 264                                 |  |     |
| CMZB390     | 1.0                   | 351                              | 390  | 429  | 10000                                 | 0.5  | 350                                     | 555  | 1.2 | 0.2                                | 10                                     | 312                                 |  |     |

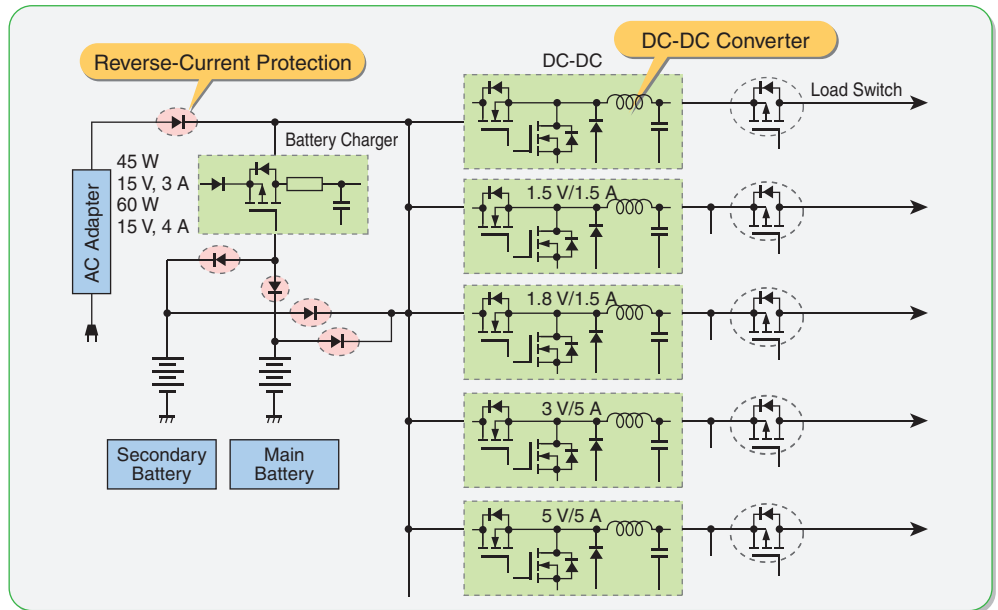
### ▶ Marking

| CRY62, CRZ10 Series  | CMZ12 Series   | CMZB12 Series   |
|--|--|---|
|  <p>Example: <b>CRY75</b></p> |  <p>Example: <b>CRZ13</b></p> |  <p>Example: <b>CMZB18</b></p> |

# 5. Application Examples and Toshiba's Recommended Diodes

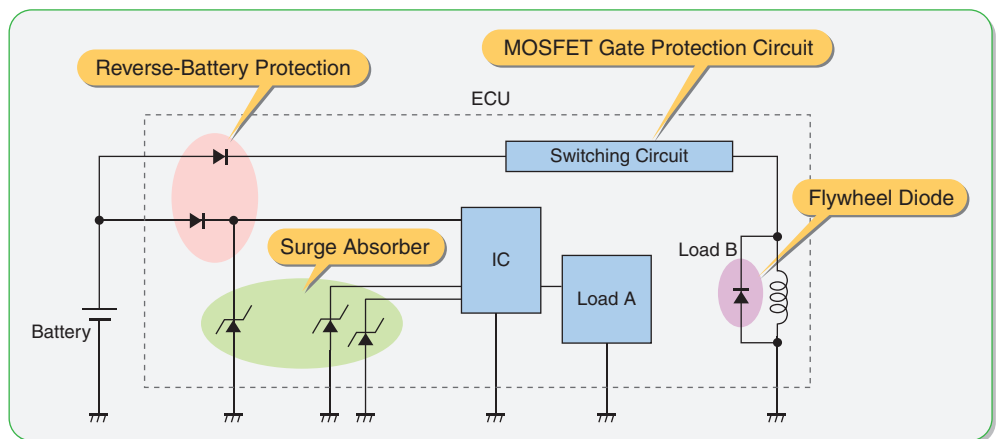
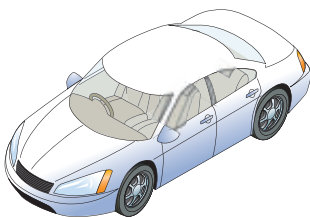
## SMALL & MEDIUM DIODES

### Notebook PCs



| Applications                                   | Package  | Recommended Diodes   |
|--|----------|--|
| Reverse-battery and reverse-current protection | US-FLAT™ | CUS01, CUS02, CUS10I30A, CUS15I30A                                     |
|  | S-FLAT™  | CRS01, CRS03, CRS05, CRS06, CRS08, CRS09, CRS11, CRS14                 |
|  | M-FLAT™  | CMS01, CMS03, CMS06, CMS07, CMS08, CMS09, CMS16                        |
| DC-DC converters                               | S-FLAT™  | CRS03, CRS04, CRS05, CRS09, CRS13, CRS10I30A, CRS15I30A, CRS20I30A     |
|  | M-FLAT™  | CMS03, CMS05, CMS14, CMS15, CMS20I30A, CMS30I30A, CMS20I40A, CMS30I40A |

### Automotive



| Applications                                   | Package | Recommended Diodes                              |
|--|---------|---|
| Reverse-battery and reverse-current protection | S-FLAT™ | CRG04, CRG05, CRG07, CRG09, CRG02, CRG03, HMG02 |
|  | M-FLAT™ | CMG02, CMG03, CMG05, CMG06, CMG07, CMG08        |
| Surge absorbers                                | S-FLAT™ | CRZ Series                                      |
|  | M-FLAT™ | CMZB Series, CMZ Series                         |
| Flywheeling                                    | S-FLAT™ | CRH01, CRH02                                    |
|  | M-FLAT™ | CMH01, CMH04, CMH07                             |
| MOSFET gate protection                         | S-FLAT™ | CRZ Series                                      |
|  | M-FLAT™ | CMZB Series, CMZ Series                         |

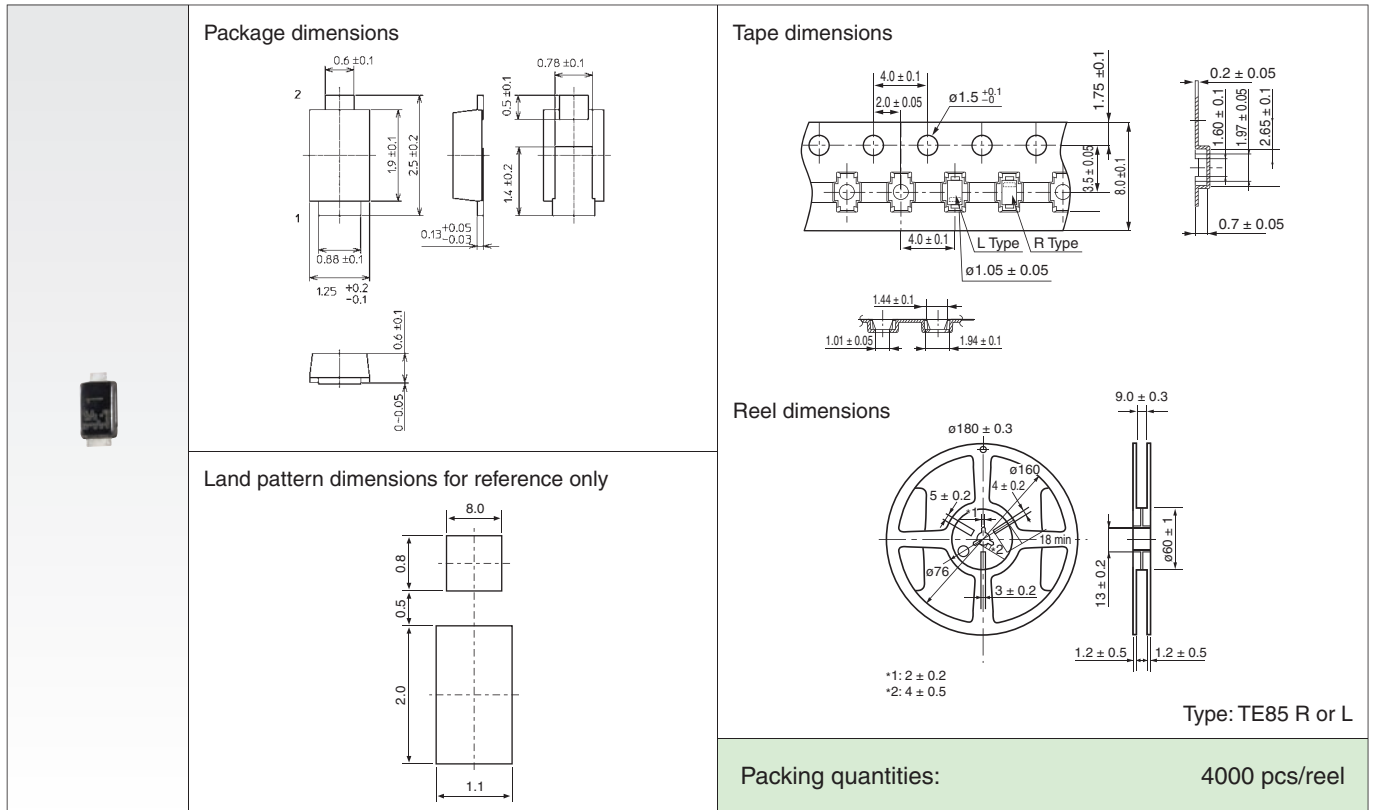
# 6. Packaging and Packing Information

## ▶ SMALL & MEDIUM DIODES

### 6.1 Surface-Mount Packages

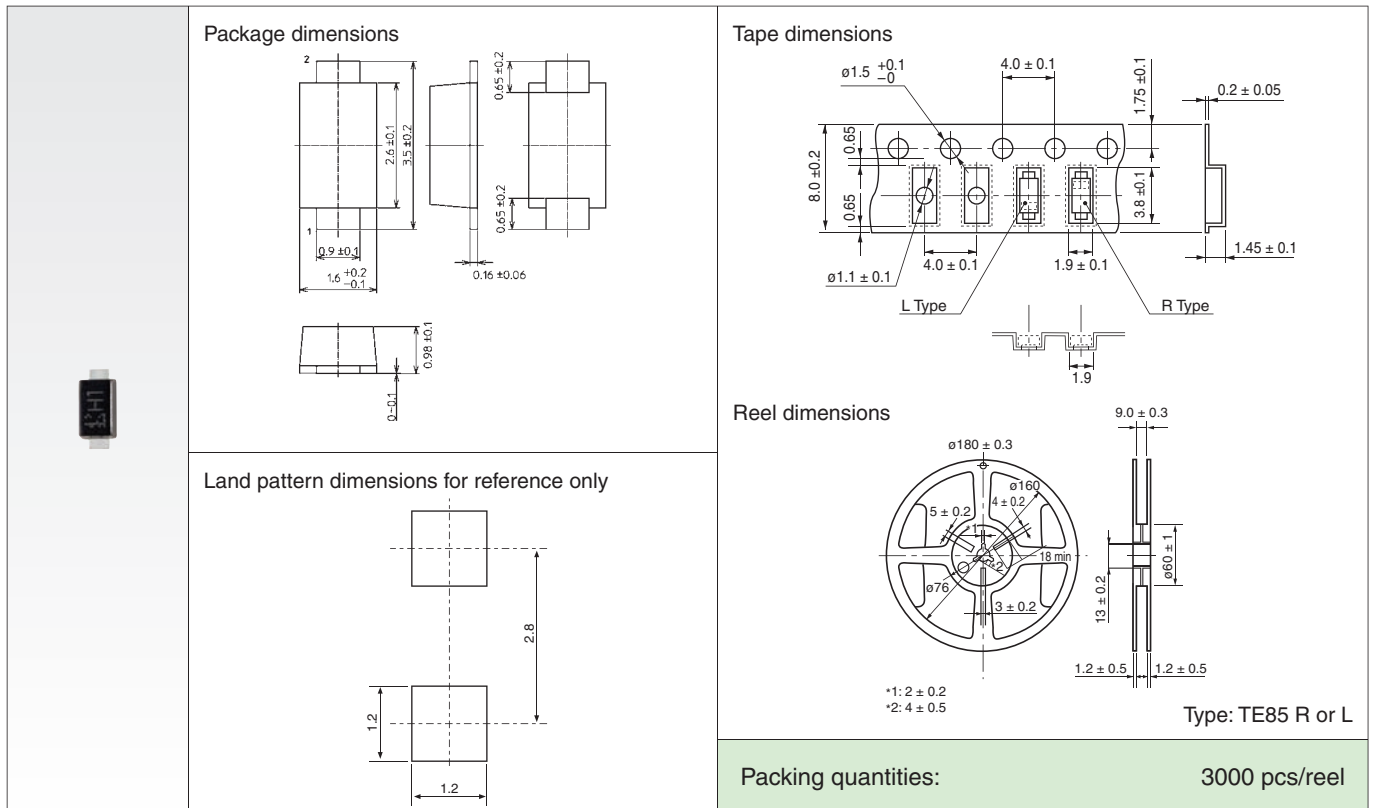
#### ① US-FLAT™

Unit: mm



#### ② S-FLAT™

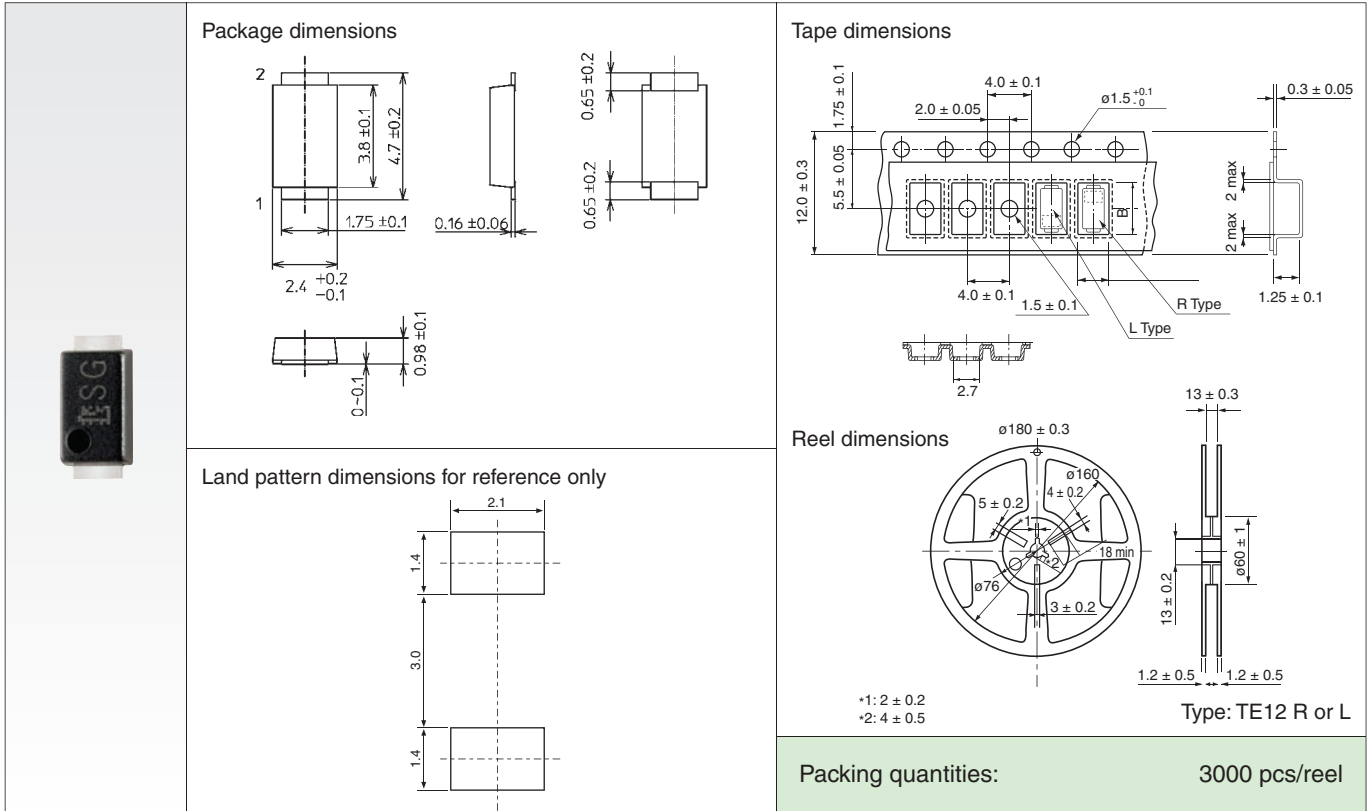
Unit: mm





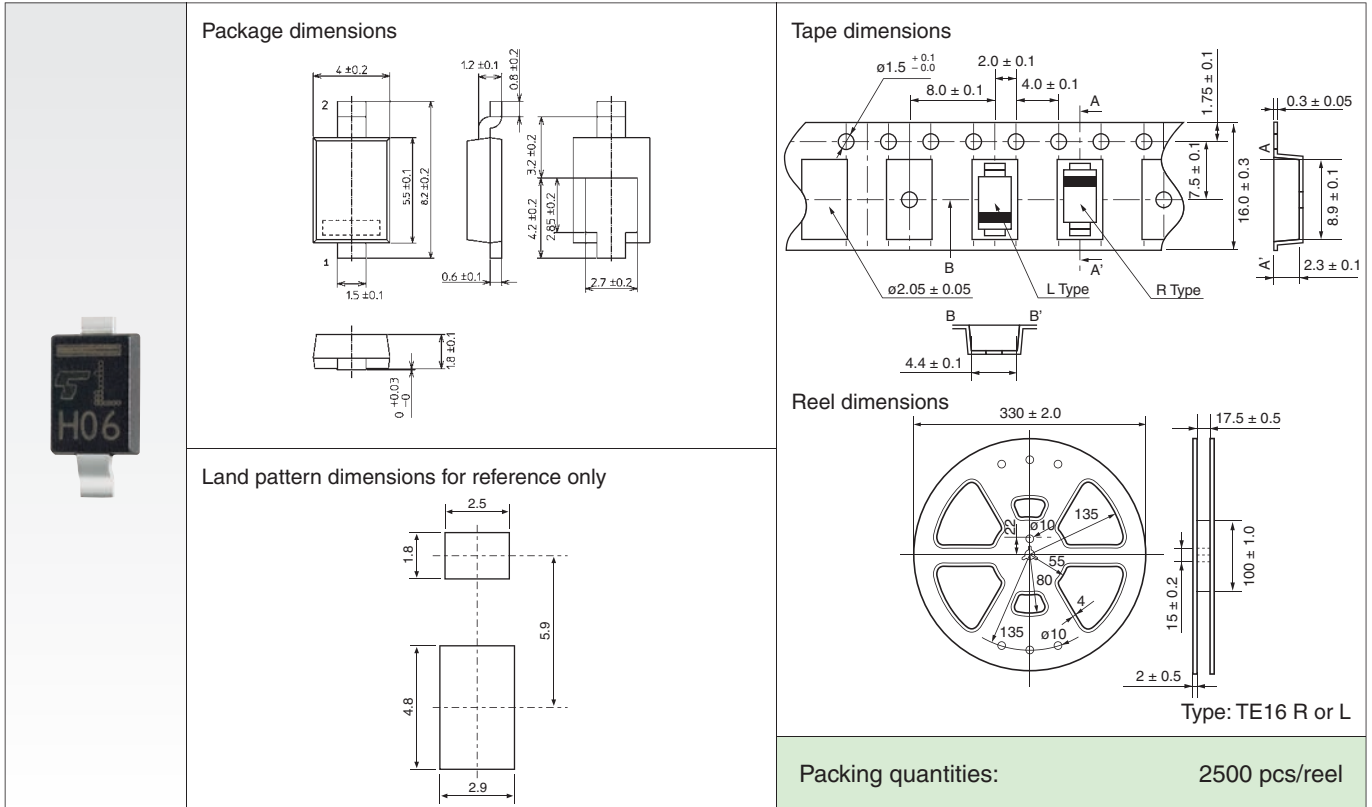
③ M-FLAT™

Unit: mm



④ L-FLAT™

Unit: mm



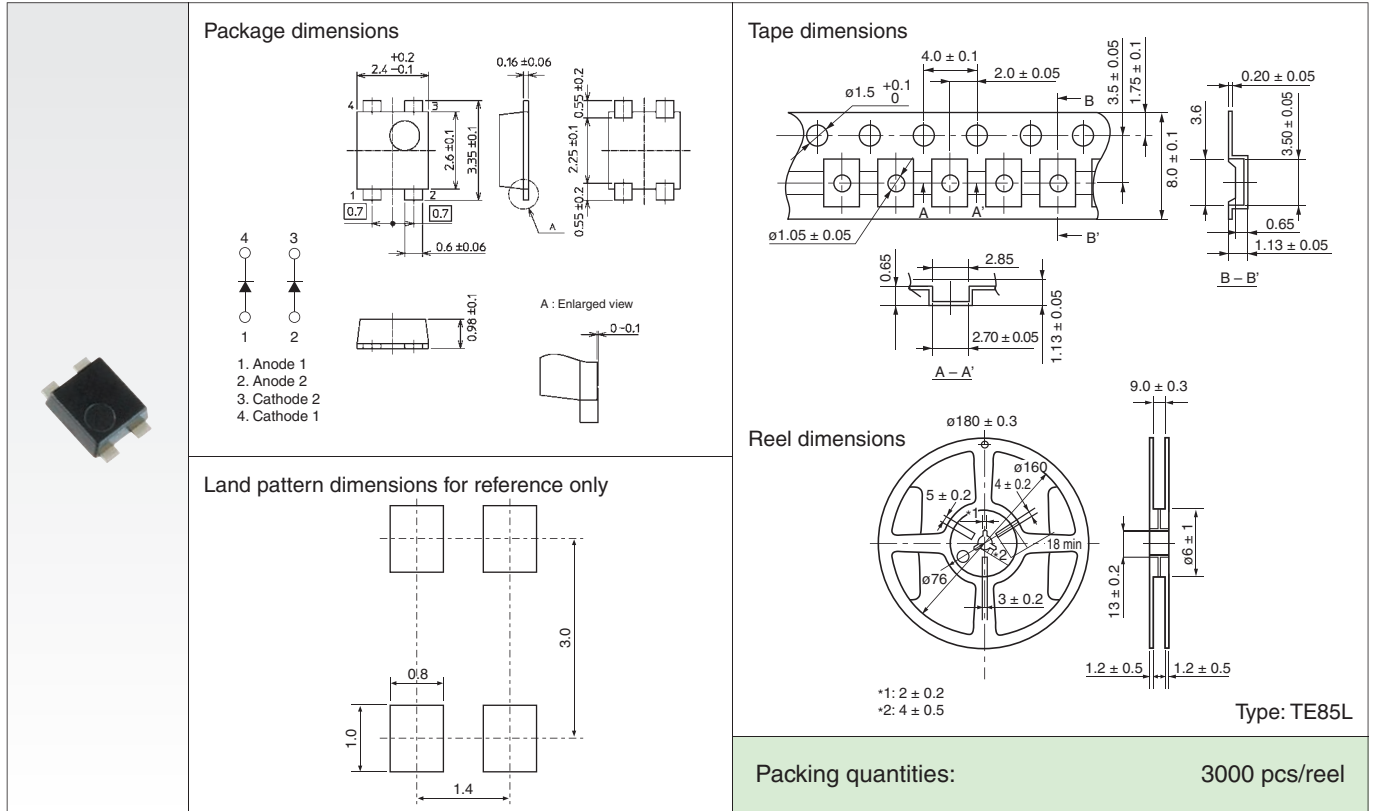
# 6. Packaging and Packing Information

## SMALL & MEDIUM DIODES

### 6.1 Surface-Mount Packages

#### ⑤ HM-FLAT

Unit: mm



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