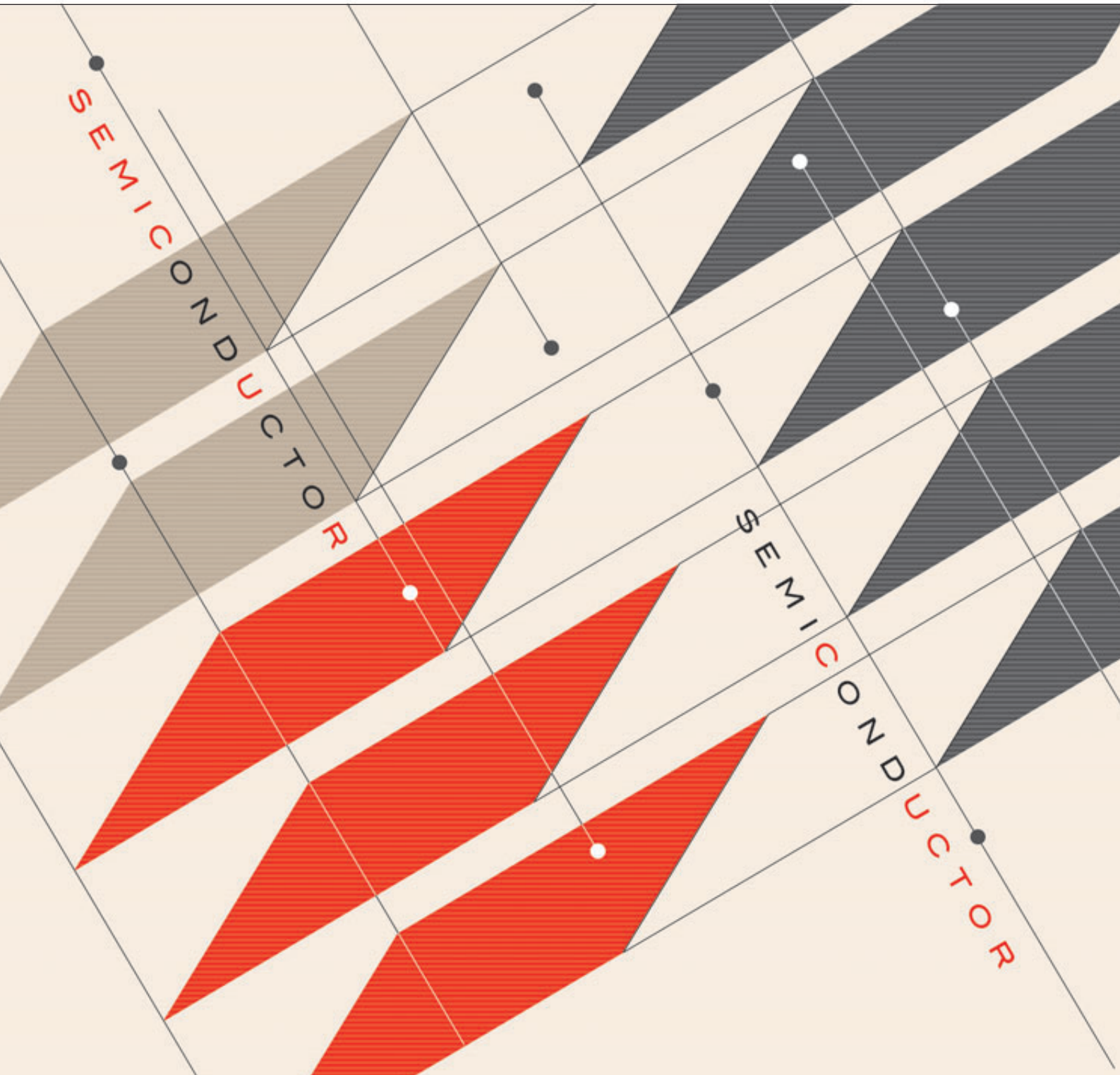


PRODUCT GUIDE

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 0.3 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.

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) $V_{FM} = 0.32\text{ V typ. (0.37 V max)}$ $V_{RRM} = 30\text{ V}$
 $V_{FM} = 0.35\text{ V typ. (0.39 V max)}$ $V_{RRM} = 30\text{ V}$
 $V_{FM} = 0.42\text{ V typ. (0.45 V max)}$ $V_{RRM} = 30\text{ V}$
 $V_{FM} = 0.48\text{ V typ. (0.55 V max)}$ $V_{RRM} = 40\text{ V}$
 $V_{FM} = 0.52\text{ V typ. (0.58 V max)}$ $V_{RRM} = 60\text{ V}$

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

- ▶ Voltage rating: $V_{RRM} = 400\text{ V to }800\text{ V}$
- ▶ Current rating: $I_{F(AV)} = 0.3\text{ A to }2\text{ A}$
- ▶ 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

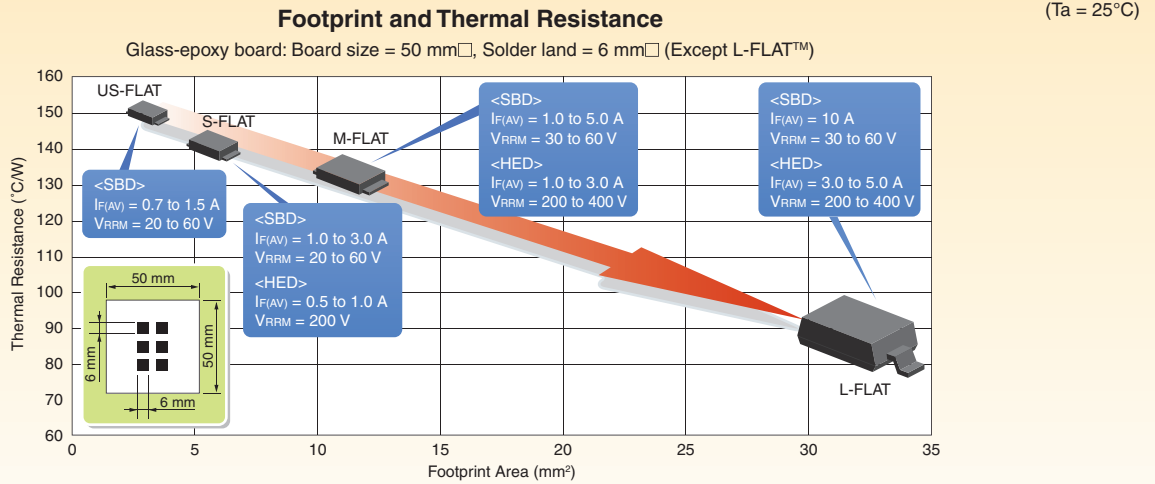
- ▶ $V_z = 6.2\text{ V to }390\text{ V}$
- ▶ Power dissipation: $P = 0.7\text{ W}, 1.0\text{ W}, 2.0\text{ W}$ (S-FLAT™ and M-FLAT™ packages)
- ▶ Available in a bidirectional configuration for diodes with $V_z = 16\text{ V}$ (M-FLAT™ package; $P = 1.0\text{ W}$).

2. New Small & Medium Diodes

SMALL & MEDIUM DIODES

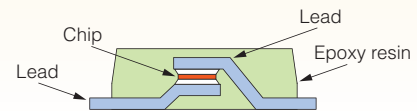
Surface-Mount Package Trend for Diodes

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.

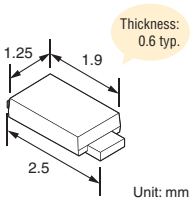


FLAT Package Series

US-FLAT™

Ultra-Small Flat Package

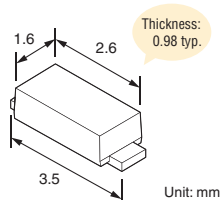
Typical product: CUS01, CUS10I30A



S-FLAT™

Small Flat Package

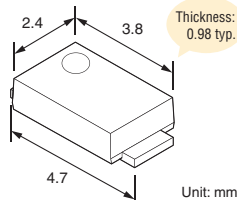
Typical product: CRS01, CRS10I30A



M-FLAT™

Middle Flat Package

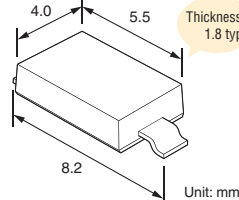
Typical product: CMS01, CMS10I30A



L-FLAT™

Large Flat Package

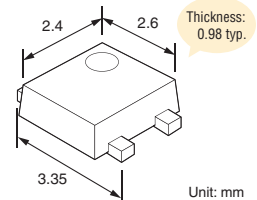
Typical product: CLS01



HM-FLAT

Hybrid Middle Flat Package

Typical product: HMG01



New Diodes

HMG Series (Diodes for General Rectification and Reverse-Current Protection in an HM-FLAT Package)

The HMG02, a new addition to the portfolio of the HMG Series, contains two diodes in an HM-FLAT package.

Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)		
	VRRM (V)	IF(AV) (A)	IFSM (A)	Tj (°C)	Tstg (°C)	IRRM (µA)	VFM (V)	@IFM (A)
HMG02	400	0.7	10	175	-40 to 175	10	1.0	0.5

Note: Dual diode. VRRM, IF(AV), IFSM, IRRM and VFM are specified per diode.

CMZB Series (Zener diodes in an M-FLAT™ Package)

Toshiba has expanded its product portfolio with Zener diodes with a power dissipation of 1 W and a Zener voltage of 68 V to 390 V.

Part Number	Zener Characteristics			
	Zener Voltage, Vz (V)			Measurement Current Iz (mA)
	Min	Typ.	Max	
CMZB68	61.2	68	74.8	4
CMZB75	67.5	75	82.5	4
CMZB82	73.8	82	90.2	3
CMZB100	90	100	110	3
CMZB110	99	110	121	3
CMZB150	135	150	165	2
CMZB180	162	180	198	1.5

Part Number	Zener Characteristics			
	Zener Voltage, Vz (V)			Measurement Current Iz (mA)
	Min	Typ.	Max	
CMZB200	180	200	220	1.5
CMZB220	198	220	242	0.5
CMZB240	216	240	264	0.5
CMZB270	243	270	297	0.5
CMZB300	270	300	330	0.5
CMZB330	297	330	363	0.5
CMZB390	351	390	429	0.5

2. New Small & Medium Diodes

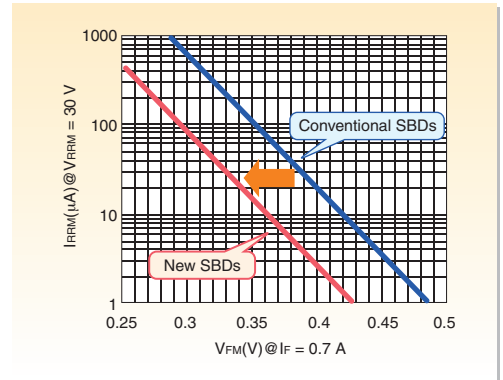
▶ SMALL & MEDIUM DIODES

New Series of Schottky Barrier Diodes

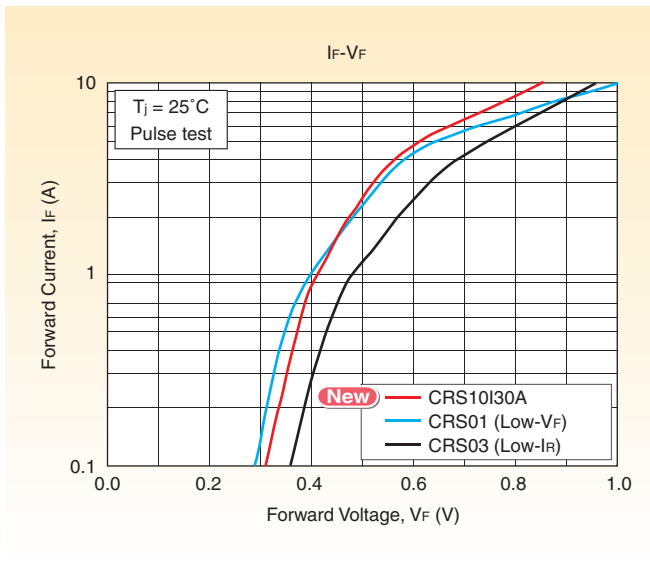
Toshiba now offers small to medium Schottky barrier diodes (SBDs) fabricated with a next-generation process. The second-generation SBD portfolio now consists of 23 SBDs with 17 new devices added. Owing to low peak forward voltage (V_{FM}) and low peak repetitive forward voltage (I_{RRM}) characteristics, 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™)

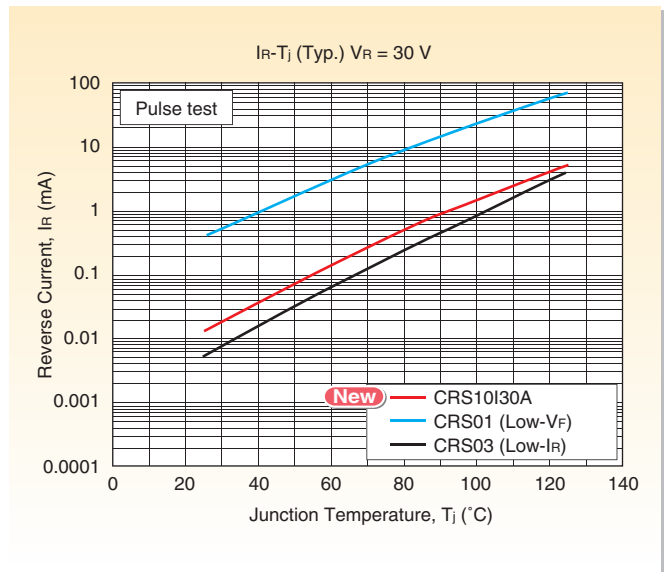
▶ Tradeoff Relationship between the Forward Voltage and Reverse Leakage Current (Example)



▶ Forward Voltage (V_F) Curves (Example)



▶ Reverse Leakage Current (I_R) Curves (Example)



▶ Product Naming Conventions

Starting with the new SBD series, the product naming conventions have been changed as shown below. Product names denote packaging, current rating, voltage rating and go 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

► Product Lineup

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} (mA)	V _{FM} (V)	@ I _{FM} (A)				
US-FLAT™	CUS10I30A	30	1.0	20	150	-55 to 150	0.06	0.39	0.7				
	CUS15I30A		1.5	20	150					-55 to 150	0.06	0.46	1.5
	New CUS10I40A	40	1.0	20	150	-55 to 150	0.06	0.49	0.7				
S-FLAT™	CRS10I30A	30	1.0	20	150	-55 to 150	0.06	0.39	0.7				
	CRS10I30B			20	150					-55 to 150	0.06	0.42	1.0
	New CRS10I30C			30	150					-55 to 150	0.10	0.36	1.0
	CRS15I30A		1.5	20	150	-55 to 150	0.06	0.46	1.5				
	New CRS15I30B			30	150					-55 to 150	0.10	0.40	1.5
	New CRS20I30A			2.0	20					150	-55 to 150	0.06	0.49
	New CRS20I30B	30	150		-55 to 150	0.10	0.45	2.0					
	New CRS30I30A	3.0	30	150	-55 to 150	0.10	0.49	3.0					
	New CRS10I40A	40	1.0	20	150	-55 to 150	0.06	0.49	0.7				
	New CRS10I40B			25	150					-55 to 150	0.10	0.45	1.0
	New CRS15I40A		1.5	20	150	-55 to 150	0.06	0.55	1.5				
	New CRS20I40A		2.0	20	150	-55 to 150	0.06	0.60	2.0				
	New CRS20I40B			25	150					-55 to 150	0.10	0.52	2.0
	M-FLAT™		New CMS10I30A	30	1.0	30	150	-55 to 150	0.10	0.36	1.0		
		New CMS20I30A	2.0		30	150	-55 to 150					0.10	0.45
New CMS30I30A		3.0	30		150	-55 to 150	0.10					0.49	3.0
New CMS10I40A		40	1.0	25	150	-55 to 150	0.10	0.45	1.0				
New CMS15I40A			1.5	25	150					-55 to 150	0.10	0.49	1.5
New CMS20I40A			2.0	25	150					-55 to 150	0.10	0.52	2.0
New CMS30I40A			3.0	25	150					-55 to 150	0.10	0.55	3.0

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	10
1 A	US-FLAT™	CUS05 CUS06	CUS01 CUS02 CUS10I30A	CUS10I40A		①	10
	S-FLAT™	CRS06	CRS01 CRS03 CRS05 CRS11 CRS10I30A CRS10I30B CRS10I30C	CRS04 CRS10I40A CRS10I40B	CRS12 CRS13	②	10
	M-FLAT™		CMS08 CMS09 CMS10I30A	CMS10 CMS10I40A		③	11
	VS-8		TPCF8E02◆			⑥	11
1.5 A	US-FLAT™		CUS15I30A			①	10
	S-FLAT™		CRS08 CRS09 CRS15I30A CRS15I30B	CRS15I40A		②	10
	M-FLAT™			CMS15I40A		③	11
2 A	S-FLAT™		CRS14 CRS20I30A CRS20I30B	CRS20I40A CRS20I40B		②	10
	M-FLAT™		CMS06 CMS07 CMS17 CMS20I30A	CMS11 CMS20I40A	CMS14	③	11
3 A	S-FLAT™		CRS15◇ CRS30I30A			②	10
	M-FLAT™		CMS01 CMS03 CMS18 CMS30I30A	CMS16 CMS19 CMS21 CMS30I40A	CMS15 CMS20	③	11
5 A	M-FLAT™		CMS04 CMS05			③	11
10 A	L-FLAT™		CLS01	CLS02	CLS03	④	11

◆: Dual (Two separate diodes) ◇: $I_{F(DC)} = 3A$

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		
0.3 A	VS-6	TPC6K01◆			⑤	12
0.5 A	HM-FLAT	HMG01◆ HMG02◆			⑦	
0.7 A	S-FLAT™	CRG02 CRG07○			②	
1 A	S-FLAT™	CRG03 CRG09★	CRG04	CRG05	②	
	M-FLAT™	CMC02* CMG05 CMG07	CMG06 CMG08		③	
2 A	M-FLAT™	CMG02	CMG03		③	

○: AEC-Q101-qualified at $T_j = 175^\circ C$ * : Designed for strobe discharge applications. ◆: Dual ★: High ESD protection

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	13
	M-FLAT™	100 ns		CMF04	CMF03	CMF05	③	
1 A	M-FLAT™	100 ns	CMF02				③	
2 A	M-FLAT™	100 ns	CMF01				③	

*: Designed for strobe charge applications

► 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	14
		S-FLAT™	35 ns	CRH01				
	1 A	M-FLAT™	35 ns	CMH04		CMH05A	③	
			50 ns			CMH05		
	2 A	M-FLAT™	35 ns	CMH07		CMH08A		
			50 ns			CMH08		
	3 A	M-FLAT™	35 ns	CMH01		CMH02A		
			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	Power Dissipation	0.7 W	1 W	2 W
Package Vz(V)	S-FLAT™	M-FLAT™		Package Vz(V)	S-FLAT™	M-FLAT™	
6.2	CRY62			39	CRZ39	CMZB39	CMZ39
6.8	CRY68			43	CRZ43	CMZB43	CMZ43
7.5	CRY75			47	CRZ47	CMZB47	CMZ47
8.2	CRY82			51		CMZB51	CMZ51
9.1	CRY91			53		CMZB53	CMZ53
10	CRZ10			68		CMZB68	
11	CRZ11			75		CMZB75	
12	CRZ12	CMZB12	CMZ12	82		CMZB82	
13	CRZ13	CMZB13	CMZ13	100		CMZB100	
15	CRZ15	CMZB15	CMZ15	110		CMZB110	
16	CRZ16	CMZB16	CMZ16	150		CMZB150	
18	CRZ18	CMZB18	CMZ18	180		CMZB180	
20	CRZ20	CMZB20	CMZ20	200		CMZB200	
22	CRZ22	CMZB22	CMZ22	220		CMZB220	
24	CRZ24	CMZB24	CMZ24	240		CMZB240	
27	CRZ27	CMZB27	CMZ27	270		CMZB270	
30	CRZ30	CMZB30	CMZ30	300		CMZB300	
33	CRZ33	CMZB33	CMZ33	330		CMZB330	
36	CRZ36	CMZB36	CMZ36	390		CMZB390	
Package Number	②	③		Package Number	②	③	
Reference Page	15	16	15	Reference Page	15	16	15

► Bidirectional Zener Diode

Part Number	Power Dissipation	Package	Vz (V)	Package Number	Reference Page
CMZM16	1 W	M-FLAT™	16	③	16



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.)		
 US-FLAT™	CUS05	20	1.0	20	125	-40 to 150	1.0	0.37	0.7	40	$V_R = 10\text{ V},$ $f = 1\text{ MHz}$	
	CUS06	20	1.0	20	150	-40 to 150	0.03	0.45	0.7	40		
	CUS01	30	1.0	20	125	-40 to 150	1.5	0.37	0.7	40		
	CUS02	30	1.0	20	150	-40 to 150	0.1	0.45	0.7	40		
	CUS10I30A	30	1.0	20	150	-55 to 150	0.06	0.39	0.7	50		
	CUS15I30A	30	1.5	20	150	-55 to 150	0.06	0.46	1.5	50		
	CUS03	40	0.7	20	150	-40 to 150	0.1	0.52	0.7	45		
	CUS10I40A	40	1.0	20	150	-55 to 150	0.06	0.49	0.7	35		
	CUS04	60	0.7	20	150	-40 to 150	0.1	0.58	0.7	38		
 S-FLAT™	CRS06	20	1.0	20	125	-40 to 150	1	0.36	1.0	60	$V_R = 10\text{ V},$ $f = 1\text{ MHz}$	
	CRS01	30	1.0	20	125	-40 to 150	1.5	0.37	0.7	40		
	CRS03	30	1.0	20	150	-40 to 150	0.1	0.45	0.7	40		
	CRS05	30	1.0	20	150	-40 to 150	∇	0.45	1.0	60		
	CRS11	30	1.0	20	125	-40 to 150	1.5	0.36	1.0	60		
	CRS10I30A	30	1.0	20	150	-55 to 150	0.06	0.39	0.7	50		
	CRS10I30B	30	1.0	20	150	-55 to 150	0.06	0.42	1.0	50		
	CRS10I30C	30	1.0	30	150	-55 to 150	0.10	0.36	1.0	82		
	CRS08	30	1.5	30	125	-40 to 150	1	0.36	1.5	90		
	CRS09	30	1.5	30	150	-40 to 150	0.05	0.46	1.5	90		
	CRS15I30A	30	1.5	20	150	-55 to 150	0.06	0.46	1.5	50		
	CRS15I30B	30	1.5	30	150	-55 to 150	0.10	0.40	1.5	82		
	CRS14	30	2.0	30	150	-40 to 150	0.05	0.49	2.0	90		
	CRS20I30A	30	2.0	20	150	-55 to 150	0.06	0.49	2.0	50		
	CRS20I30B	30	2.0	30	150	-55 to 150	0.10	0.45	2.0	82		
	CRS15◇	30	3.0	30	150	-40 to 150	0.05	0.52	3.0	90		
	CRS30I30A	30	3.0	30	150	-55 to 150	0.10	0.49	3.0	82		
	CRS04	40	1.0	20	150	-40 to 150	0.1	0.49	0.7	47		
	CRS10I40A	40	1.0	20	150	-55 to 150	0.06	0.49	0.7	35		
	CRS10I40B	40	1.0	25	150	-55 to 150	0.10	0.45	1.0	62		
CRS15I40A	40	1.5	20	150	-55 to 150	0.06	0.55	1.5	35			
CRS20I40A	40	2.0	20	150	-55 to 150	0.06	0.60	2.0	35			
CRS20I40B	40	2.0	25	150	-55 to 150	0.10	0.52	2.0	62			
CRS12	60	1.0	20	150	-40 to 150	0.1	0.58	1.0	40			
CRS13	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)				
		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.)	Conditions
 M-FLAT™	CMS08	30	1.0	25	125	-40 to 150	1.5	0.37	1.0	70	V _R = 10 V, 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	
	CMS18	30	3.0	40	150	-40 to 150	0.01	0.64	3.0	170	
	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	
	CMS19	40	3.0	40	150	-40 to 150	0.01	0.68	3.0	125	
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		
CMS20	60	3.0	40	150	-40 to 150	0.01	0.72	3.0	105		
 L-FLAT™	CLS01	30	10	100	125	-40 to 150	1.0	0.47	10	530	V _R = 10 V, 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	

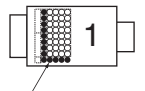
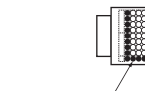

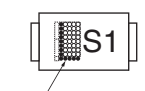
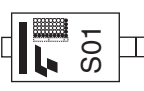
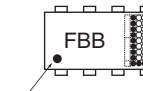
▽: I_{RRM} = 5 μA Max (V_R = 5 V) ◇: I_{F(DC)} = 3 A

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} (mA)	V _{FM} (V)	@ I _{FM} (A)	C _j (pF) (Typ.)	Conditions
 VS-8	TPCF8E02	30	1.0	7	150	-40 to 150	0.1	0.49	1.0	54	V _R = 10 V f = 1 MHz

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

▶ Marking

US-FLAT™	S-FLAT™	S-FLAT™
 Cathode mark Example: CUS01	 Cathode mark Example: CRS01	 Cathode mark Example: CRS10I30A
M-FLAT™	L-FLAT™	VS-8
 Cathode mark Example: CMS01	 Cathode mark Example: CLS01	 Pin 1 Example: TPCF8E02

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: $I_{F(AV)} = 0.3\text{ A to }2\text{ A}$
- ▶ 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)
 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
 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



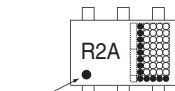

○: AEC-Q101-qualified at $T_J = 175^\circ\text{C}$ ★: High ESD protection *: Designed for strobe discharge applications

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)
 VS-6	TPC6K01	400	0.3	3	150	-55 to 150	10	1.1	0.3
 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™	VS-6	HM-FLAT
 Cathode mark → Example: CRG04	 Cathode mark → Example: CMG02	 Pin 1 → Example: TPC6K01	 Pin 1 → 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}) $\leq 100\text{ ns}$

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.

(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
 S-FLAT™	CRF02*	800	0.5	10	150	-40 to 150	50	3.0	0.5	100	$I_F = 1\text{ A},$ $di/dt = -30\text{ A}/\mu\text{s}$
	CRF03	600	0.7	10	150	-40 to 150	50	2.0	0.7	100	
 M-FLAT™	CMF01	600	2.0	30	150	-40 to 150	50	2.0	2.0	100	$I_F = 1\text{ A},$ $di/dt = -30\text{ A}/\mu\text{s}$
	CMF02	600	1.0	10	150	-40 to 150	50	2.0	1.0	100	
	CMF04	800	0.5	10	150	-40 to 150	50	2.5	0.5	100	
	CMF03	900	0.5	10	125	-40 to 150	50	2.5	0.5	100	
	CMF05	1000	0.5	10	125	-40 to 150	50	2.7	0.5	100	




*: Designed for strobe discharge applications

4. Product Characteristics

▶ SMALL & MEDIUM DIODES

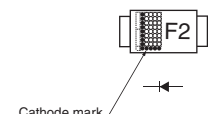
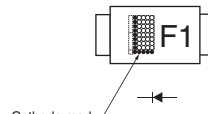
(2) High-Efficiency Diodes (HEDs)

Single

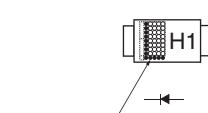
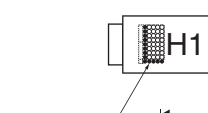
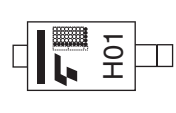
Package	Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)				
		V _{RRM} (V)	I _{F(AV)} (A)	I _{FSM} (A)	T _j (°C)	T _{stg} (°C)	I _{RRM} (μA)	V _{FM} (V)	@ I _{FM} (A)	t _{rr} (ns)	Conditions
 S-FLAT™	CRH02	200	0.5	10	150	-40 to 150	10	0.95	0.5	35	I _F = 1 A, di/dt = -30 A/μs
	CRH01	200	1.0	15	150	-40 to 150	10	0.98	1.0	35	
 M-FLAT™	CMH04	200	1.0	20	150	-40 to 150	10	0.98	1.0	35	I _F = 1 A, di/dt = -30 A/μs
	CMH07	200	2.0	40	150	-40 to 150	10	0.98	2.0	35	
	CMH01	200	3.0	40	150	-40 to 150	10	0.98	3.0	35	
	CMH05	400	1.0	20	150	-40 to 150	10	1.3	1.0	50	
	CMH05A	400	1.0	10	150	-40 to 150	10	1.8	1.0	35	
	CMH08	400	2.0	30	150	-40 to 150	10	1.3	2.0	50	
	CMH08A	400	2.0	20	150	-40 to 150	10	1.8	2.0	35	
	CMH02	400	3.0	40	150	-40 to 150	10	1.3	3.0	50	
 L-FLAT™	CLH01	200	3.0	60	150	-40 to 150	10	0.98	3.0	35	I _F = 2 A, di/dt = -50 A/μs
	CLH05	200	5.0	100	150	-40 to 150	10	0.98	5.0	35	
	CLH02	300	3.0	50	150	-40 to 150	10	1.3	3.0	35	
	CLH06	300	5.0	60	150	-40 to 150	10	1.3	5.0	35	
	CLH03	400	3.0	30	150	-40 to 150	10	1.8	3.0	35	
	CLH07	400	5.0	50	150	-40 to 150	10	1.8	5.0	35	

▶ Marking

■ S-FRDs

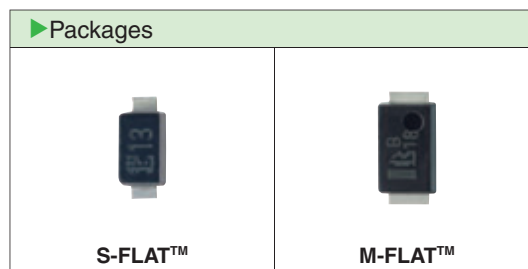
S-FLAT™	M-FLAT™
	
Example: CRF02	Example: CMF01

■ HEDs

S-FLAT™	M-FLAT™	L-FLAT™
		
Example: CRH01	Example: CMH01	Example: CLH01

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)
- ▶ Available in a bidirectional configuration for diodes with $V_z = 16\text{ V}$
(M-FLAT™ package; $P = 1.0\text{ W}$).



CRY62 and CRZ10 Series (S-FLAT™)

$T_a = 25^\circ\text{C}$

Part Number	Power Dissipation (mW)	Zener Characteristics					Temperature Coefficient of Zener Voltage α_T (mV/°C)		Forward Voltage V_F (V)	Measurement Current I_F (A)	Reverse Current I_R (μA)		Measurement Voltage V_R (V)
		Zener Voltage V_z (V)			Dynamic Resistance r_d (Ω)	Measurement Current I_z (mA)	Typ.	Max			Max	Max	
		Min	Typ.	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™)

$T_a = 25^\circ\text{C}$

Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage α_T (mV/°C)		Forward Voltage V_F (V)	Measurement Current I_F (A)	Reverse Current I_R (μA)		Measurement Voltage V_R (V)
		Zener Voltage V_z (V)			Dynamic Resistance r_d (Ω)	Measurement Current I_z (mA)	Typ.	Max			Max	Max	
		Min	Typ.	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

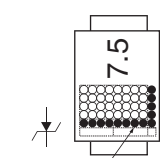
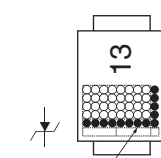
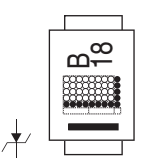
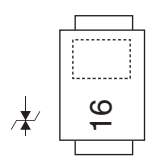
Part Number	Power Dissipation (W)	Zener Characteristics					Measurement Current I _Z (mA)	Temperature Coefficient of Zener Voltage α _T (mV/°C)		Forward Voltage V _F (V)	Measurement Current I _F (A)	Reverse Current I _R (μA)	Measurement Voltage V _R (V)	
		Zener Voltage V _Z (V)			Dynamic Resistance r _d (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		

CMZM16 Bidirectional Zener Diode Series (M-FLAT™)

Ta = 25°C

Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage α _T (mV/°C)		Reverse Current I _R (μA)	Measurement Voltage V _R (V)
		Zener Voltage V _Z (V)			Dynamic Resistance r _d (Ω)	Measurement Current I _Z (mA)	Typ.	Max		
		Min	Typ.	Max						
CMZM16	1.0	14.4	16	17.6	30	10	12	19	10	11

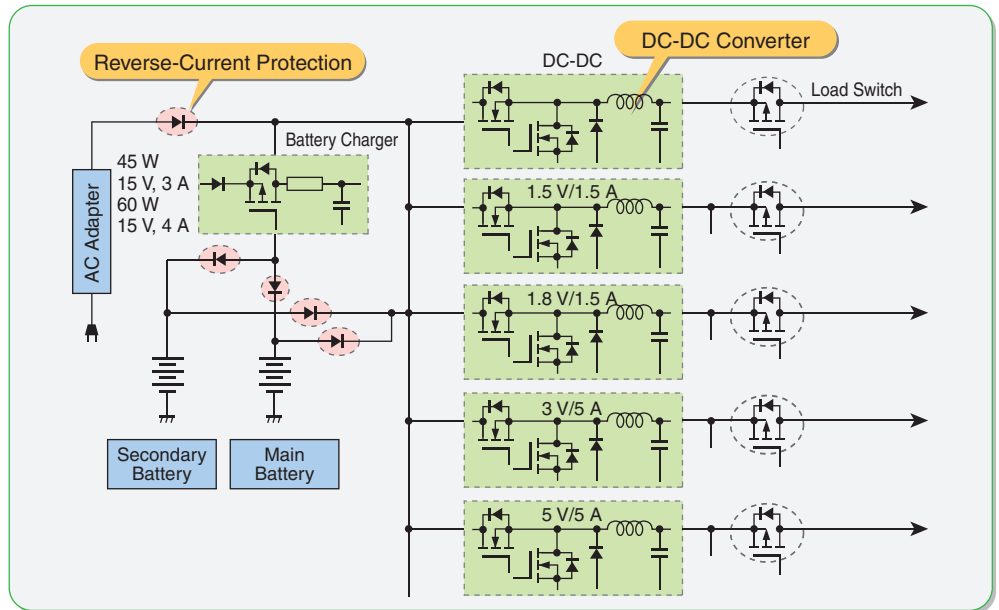
▶ Marking

CRY62, CRZ10 Series	CMZ12 Series	CMZB12 Series	CMZM16 Series
 <p>Example: CRY75</p>	 <p>Example: CRZ13</p>	 <p>Example: CMZB18</p>	 <p>Example: CMZM16</p>

5. Application Examples and Toshiba's Recommended Diodes

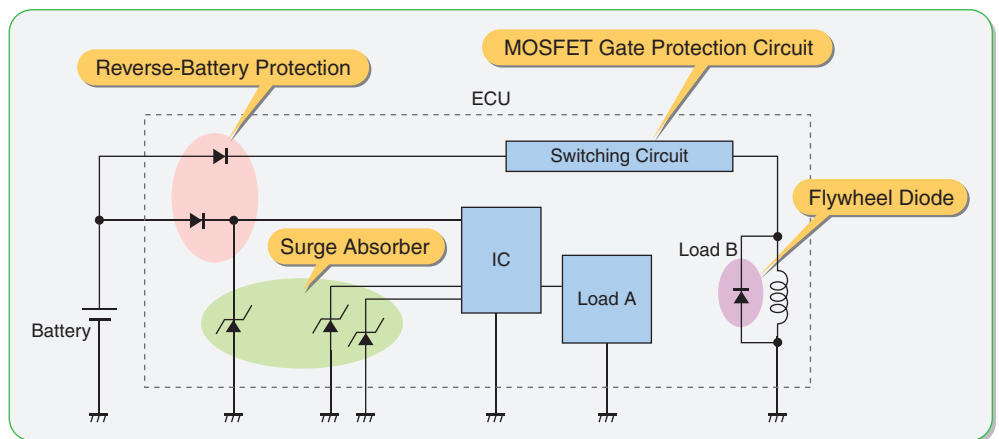
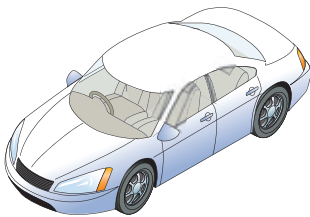
SMALL & MEDIUM DIODES

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, CMZM16
DC-DC converters	M-FLAT™	CMS18, CMS19, CMS20

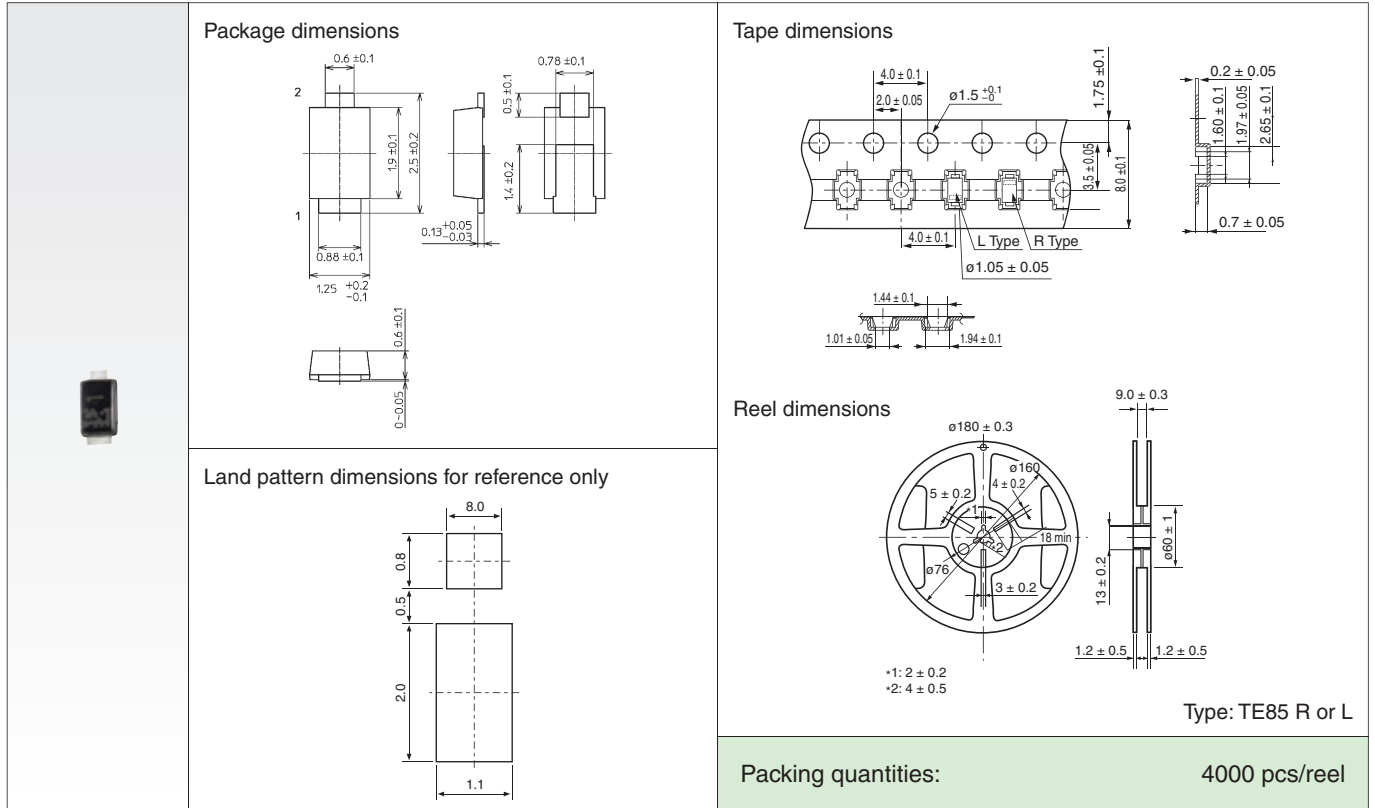
6. Packaging and Packing Information

▶ SMALL & MEDIUM DIODES

6.1 Surface-Mount Packages

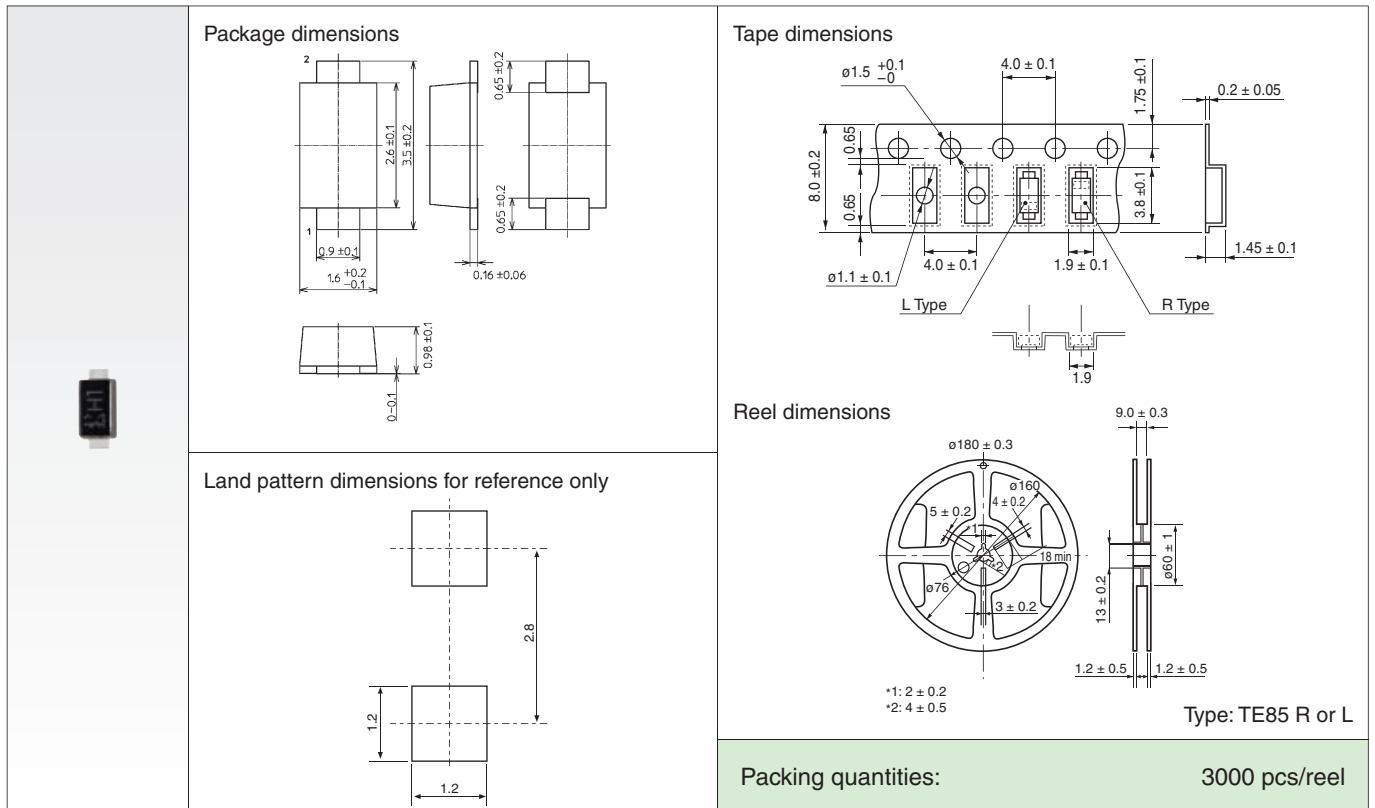
① US-FLAT™

Unit: mm



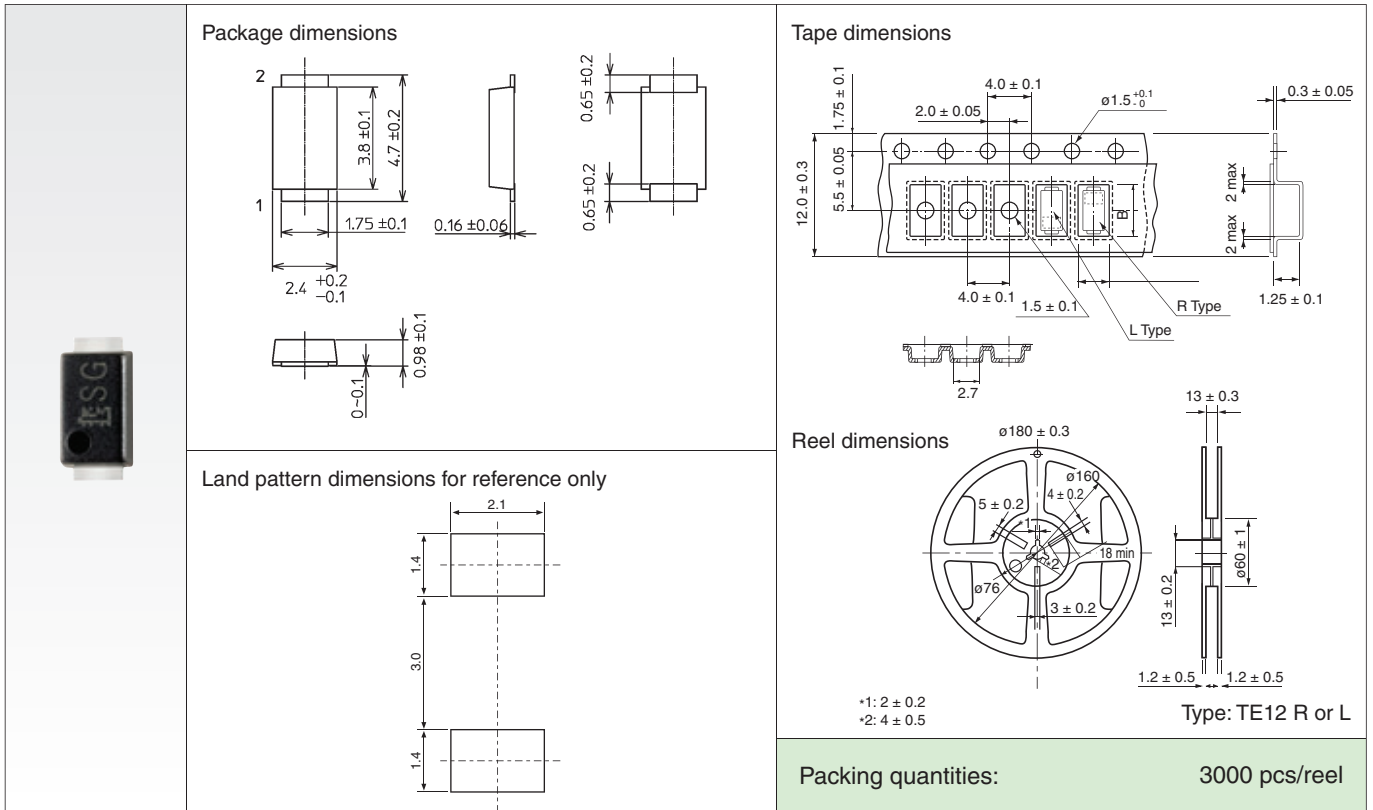
② S-FLAT™

Unit: mm



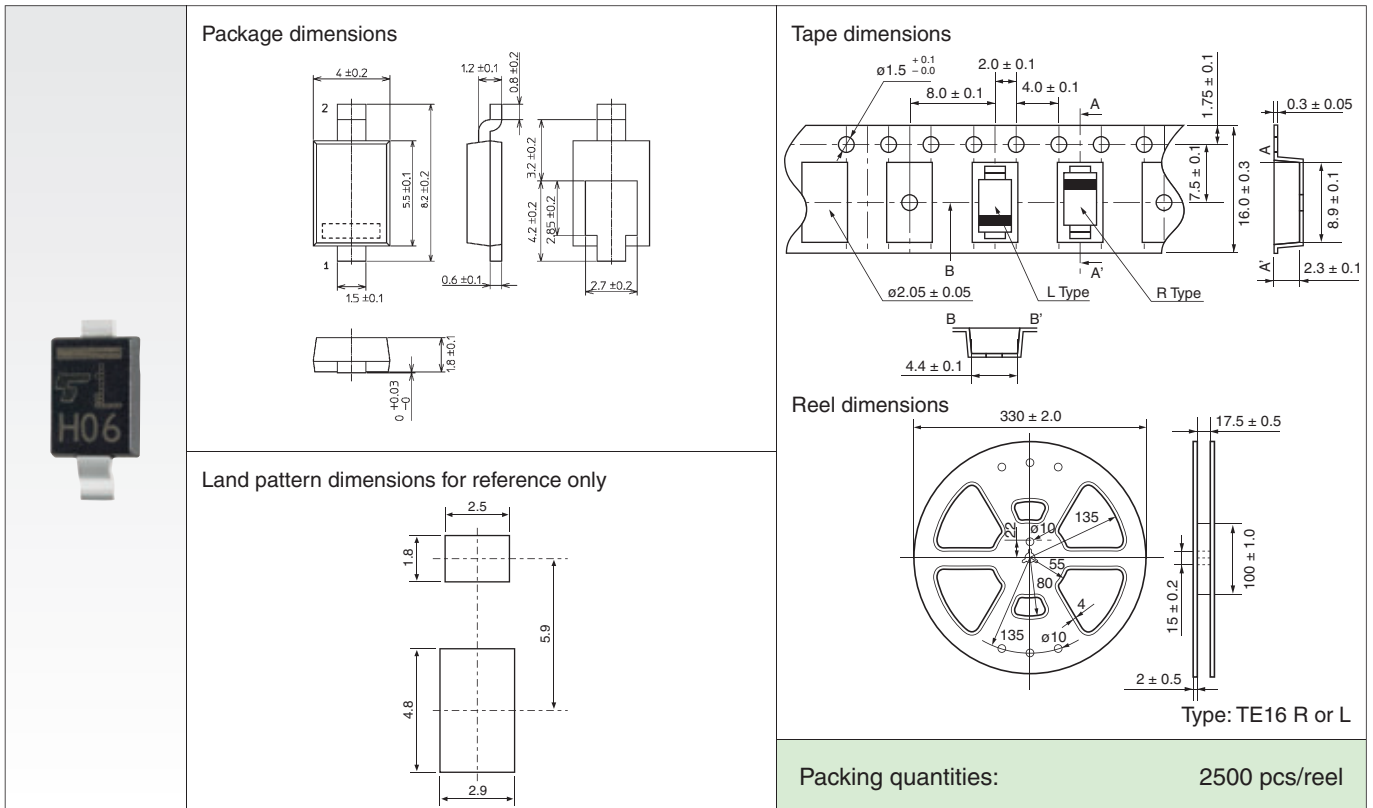
③ M-FLAT™

Unit: mm



④ L-FLAT™

Unit: mm



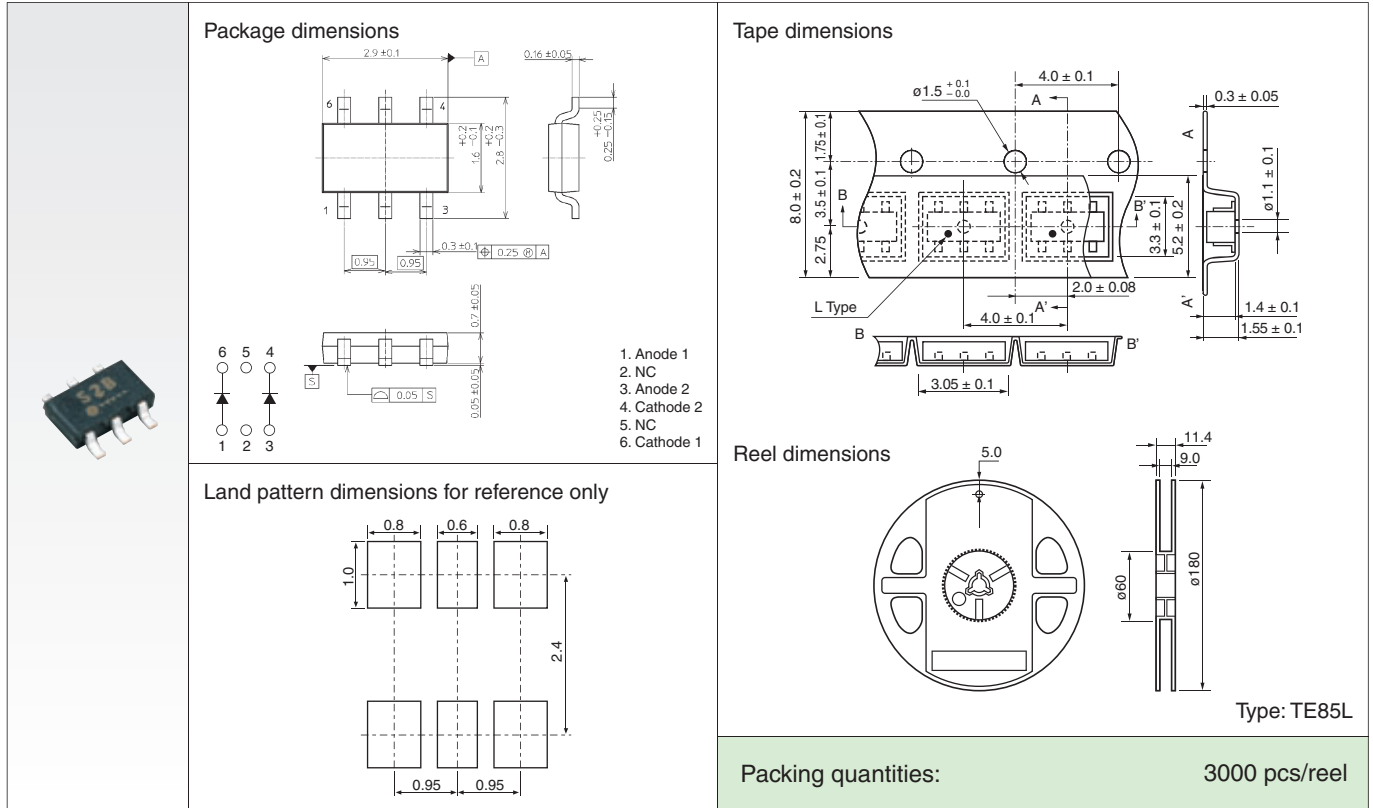
6. Packaging and Packing Information

SMALL & MEDIUM DIODES

6.1 Surface-Mount Packages

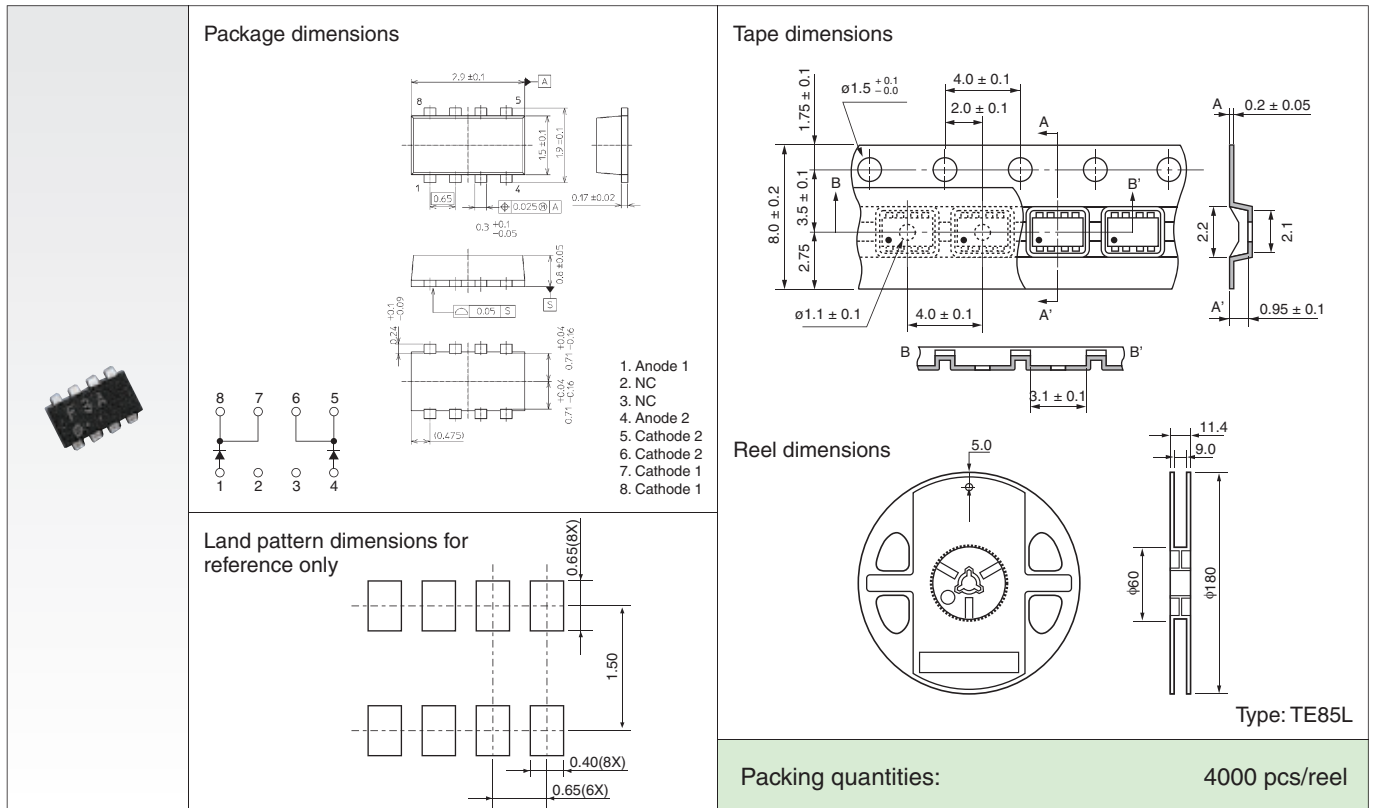
⑤ VS-6

Unit: mm



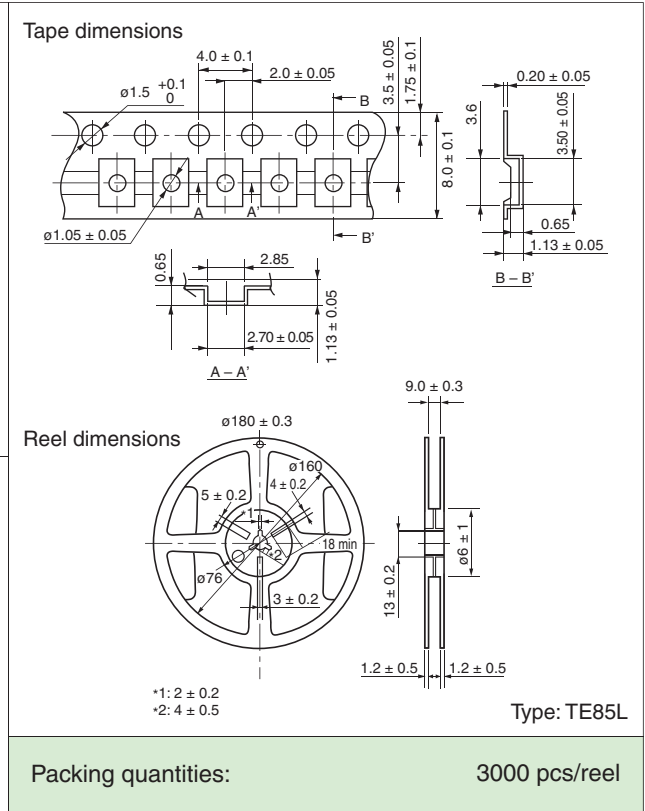
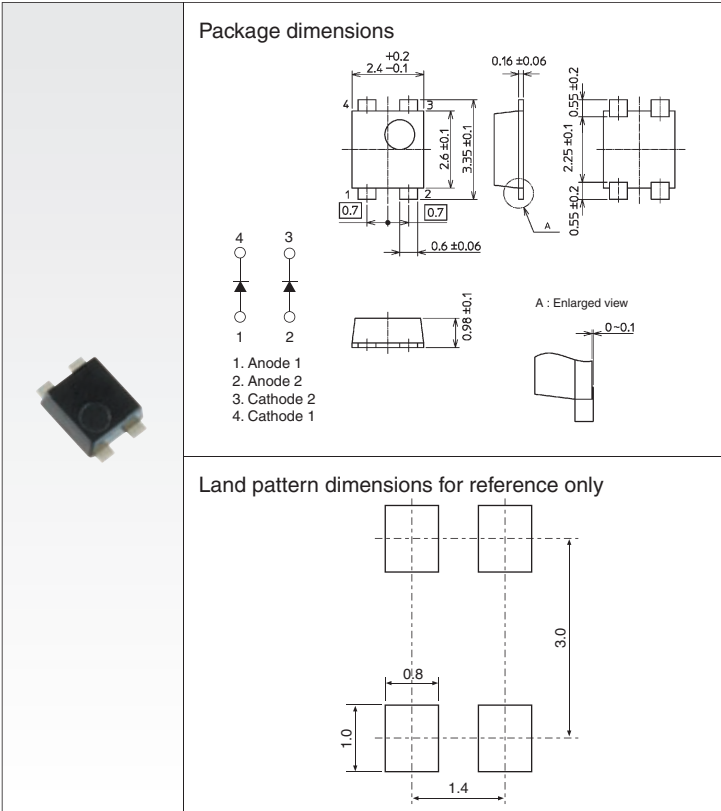
⑥ VS-8

Unit: mm



⑦ HM-FLAT

Unit: mm



7. Symbols, Terms and Definitions

▶ SMALL & MEDIUM DIODES

Symbol	Term	Definition
$I_{F(AV)}$	Average forward current	The maximum average current value of a half sine wave (180° conduction angle) at the 50/60-Hz utility frequency that can flow in a diode under specified conditions, or the average forward current value of a square wave under specified conditions.
I_o	Average output current	The maximum average current value of a full sine wave (360° conduction angle) at the 50/60-Hz utility frequency that can flow in a diode under specified conditions.
V_{RRM}	Peak repetitive reverse voltage	The instantaneous maximum allowable value (peak value) of the reverse voltage that can be applied repeatedly to a diode.
I_{FSM}	Non-repetitive peak surge current	The non-repetitive maximum allowable peak current in one cycle of a 50-Hz sine wave (180° conduction angle) that can flow in the forward direction of a diode at a specified junction temperature. This rating applies only to abnormal operation, which seldom occurs during the lifetime of the diode.
$T_{j(max)}$	Junction temperature	The junction temperature at which the reliability and lifetime of the device can be guaranteed.
T_{stg}	Storage temperature	Ambient temperature range within which the device can be stored while not operating.
I_{RRM}	Peak repetitive reverse current	The maximum reverse leakage current value (peak value) when a specified reverse voltage, V_{RRM} , is applied.
V_{FM}	Peak forward voltage	The maximum value of voltage drop when a specified forward current, I_{FM} , flows.
t_{rr}	Reverse recovery time	The time required for the current to reach a specified reverse current after instantaneous switching from forward to reverse.
V_z	Zener voltage	The voltage value when a specified I_z current flows in reverse between the anode and cathode of a Zener diode.
r_d	Dynamic resistance	The ratio of change in a Zener voltage to the corresponding change in a specified current, I_z , in the Zener area.
α_T	Temperature coefficient of Zener voltage	The ratio of change in a Zener voltage to the corresponding change in a junction temperature.
P	Zener power dissipation	The maximum power dissipation under specified conditions.
t_{fr}	Forward recovery time	When a forward voltage is applied to a diode under specified conditions, the time required for the applied power to propagate across the whole area of the diode.
I_{FM}	Peak forward current	The forward current under specified conditions.
C_j	Junction capacitance	The junction capacitance when a reverse voltage is applied to a diode under specified conditions.
V_R	Reverse voltage	Reverse voltage that is applied to a diode.
I_R	Reverse current	The reverse leakage current when a specified reverse voltage is applied to a diode.
I_{RSM}	Non-repetitive peak reverse surge current	The non-repetitive peak reverse surge current that can flow in the reverse direction of a diode under specified conditions. This rating applies only to abnormal operation, which seldom occurs during the lifetime of the diode.

Right here and now!

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▶ Web pages by product type



Easy to Understand

You can search for parts, based on product types, specs, packages and so on.

Visible LEDs: High-Brightness LED Lamps (optem package) by package

- Clicking on a part number jumps to the Product Detail page.
- You can also see a list of products by series color.
- You can also see a list of products by lead wire LED lamps.

Series Color	Ball value Angle (°)	Part Number	Series Color	Lead Color	Diameter (mm)	Lead Length (mm)	Lead Spacing (mm)	Viewing Angle
Yellow	90°	TL2512P10	Yellow	Cathode clear	5.0	4.00	2.54	Ball value Angle 9°
		TL2512P15	Yellow	Cathode clear	5.0	4.00	2.54	
		TL2512P20	Yellow	Cathode clear	5.0	4.00	2.54	
		TL2512P25	Yellow	Cathode clear	5.0	4.00	2.54	
Green	90°	TL2512G10	Green	Cathode clear	5.0	4.00	2.54	Ball value Angle 9°
		TL2512G15	Green	Cathode clear	5.0	4.00	2.54	
Pink	90°	TL2512P10	Pink	Cathode clear	5.0	4.00	2.54	Ball value Angle 9°
		TL2512P15	Pink	Cathode clear	5.0	4.00	2.54	
Red	90°	TL2512R10	Red	Cathode clear	5.0	4.00	2.54	Ball value Angle 9°
		TL2512R15	Red	Cathode clear	5.0	4.00	2.54	

Product List

Easy to Search

You can find Toshiba's parts functionally equivalent to our competitors' by entering their part number.

Cross Reference Search: Transistors

By entering a competitor's Transistor part number, you can find an operation part from Toshiba.

Product: M30T02, Bipolar Transistors, NPN Resistor Built-in Transistor (RBT)

Cross Reference Search:

Manufacturer:

Part Number:

* Input 7 characters or more.
* Cross Reference Search is possible only in a part of the manufacturer part number.

Manufacturer	Manufacturer Part Number	Toshiba Part Number	Category	Package (Toshiba)	Package
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21

[Jump to Cross Reference Search](#)

Cross-Reference Search

Easy to Use

You can narrow your search, based on functions, characteristics and so on.

Cross Reference Search: Transistors

By entering a competitor's Transistor part number, you can find an operation part from Toshiba.

Product: M30T02, Bipolar Transistors, NPN Resistor Built-in Transistor (RBT)

Cross Reference Search:

Manufacturer:

Part Number:

* Input 7 characters or more.
* Cross Reference Search is possible only in a part of the manufacturer part number.

Manufacturer	Manufacturer Part Number	Toshiba Part Number	Category	Package (Toshiba)	Package
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21
ON Semiconductor	NTE30V02G	55M30T02G	Small-signal MJEFT	VS04	90T-21

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