TOSHIBA
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Small and Medium Diodes

SEMICONDUCTOR & STORAGE PRODUCTS

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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.

CONTENTS

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 V, 30 V, 40 V, 60 V
- ▶ Current rating: $I_{F(AV)}$ = 0.7 A to 10 A
- ▶ Peak forward voltage: V_{FM} = 0.32 V typ. (0.37 V max) ····· V_{RRM} = 30 V

(Shown only as examples)

V_{FM} = 0.35 V typ. (0.39 V max) ····· V_{RRM} = 30 V
V_{FM} = 0.42 V typ. (0.45 V max) ····· V_{RRM} = 30 V
V_{FM} = 0.48 V typ. (0.55 V max) ····· V_{RRM} = 40 V
V_{FM} = 0.52 V typ. (0.58 V max) ····· V_{RRM} = 60 V

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

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

4 High-Efficiency Diodes (HEDs)

High-Efficiency Diodes (HEDs)

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

5 Zener Diodes

- ▶ Vz = 6.2 V to 390 V
- ▶ Power dissipation: P = 0.7 W, 1.0 W, 2.0 W (S-FLAT™ and M-FLAT™ packages)

2. Product Lineup

▶ SMALL & MEDIUM DIODES

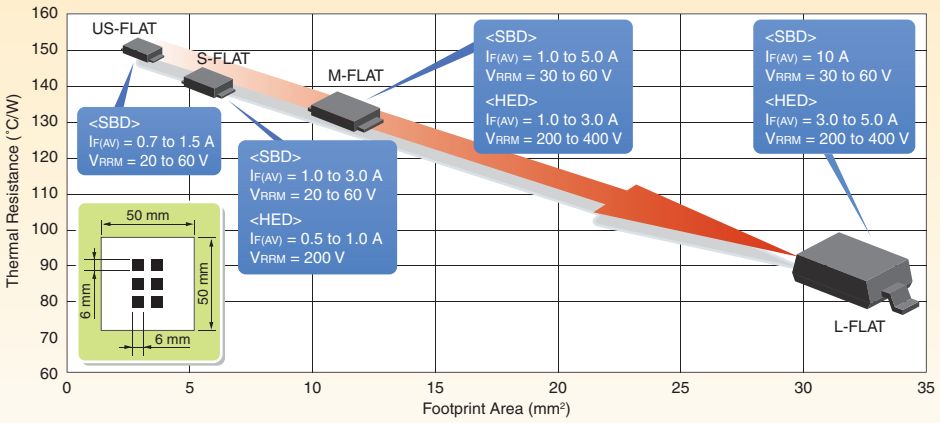
Surface-Mount Package Trend for Diodes

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

(Ta = 25°C)

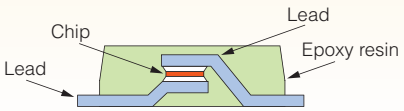
Footprint and Thermal Resistance

Glass-epoxy board: Board size = 50 mm□, Solder land = 6 mm□ (Except L-FLAT™)



■ Internal Structure of FLAT Packages

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

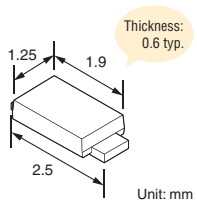


FLAT Package Series

US-FLAT™

Ultra-Small Flat Package

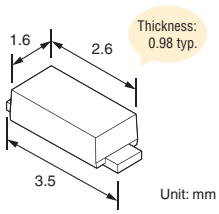
Typical product: CUS01, CUS10I30A



S-FLAT™

Small Flat Package

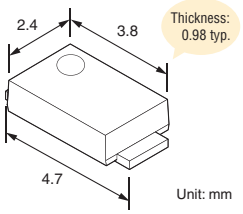
Typical product: CRS01, CRS10I30A



M-FLAT™

Middle Flat Package

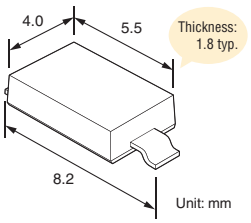
Typical product: CMS01, CMS10I30A



L-FLAT™

Large Flat Package

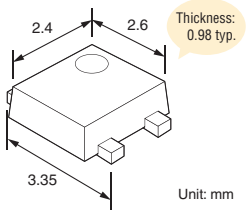
Typical product: CLS01



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 CUS06	CUS01 CUS02 CUS10I30A	CUS10I40A		①	8
	S-FLAT™	CRS06	CRS01 CRS03 CRS05 CRS11 CRS10I30A CRS10I30B CRS10I30C	CRS04 CRS10I40A CRS10I40B	CRS12 CRS13	②	8
	M-FLAT™		CMS08 CMS09 CMS10I30A	CMS10 CMS10I40A		③	9
1.5 A	US-FLAT™		CUS15I30A			①	8
	S-FLAT™		CRS08 CRS09 CRS15I30A CRS15I30B	CRS15I40A		②	8
	M-FLAT™			CMS15I40A		③	9
2 A	S-FLAT™		CRS14 CRS20I30A CRS20I30B	CRS20I40A CRS20I40B		②	8
	M-FLAT™		CMS06 CMS07 CMS17 CMS20I30A	CMS11 CMS20I40A	CMS14	③	9
3 A	S-FLAT™		CRS15♢ CRS30I30A			②	8
	M-FLAT™		CMS01 CMS03 CMS30I30A	CMS16 CMS21 CMS30I40A	CMS15	③	9
5 A	M-FLAT™		CMS04 CMS05			③	9
10 A	L-FLAT™		CLS01	CLS02	CLS03	④	9

♦: 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		
0.5 A	HM-FLAT	HMG01♦			⑤	10
0.7 A	S-FLAT™	CRG02○ CRG07○			②	
	HM-FLAT	HMG02♦			⑤	
1 A	S-FLAT™	CRG03○ CRG09★○	CRG04○	CRG05○	②	
	M-FLAT™	CMC02✻ CMG05 CMG07	CMG06 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		
			50 ns			CMH08		
	3 A	M-FLAT™	35 ns	CMH01		CMH02A		
			50 ns			CMH02		
		L-FLAT™	35 ns	CLH01	CLH02	CLH03	④	
	5 A	L-FLAT™	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

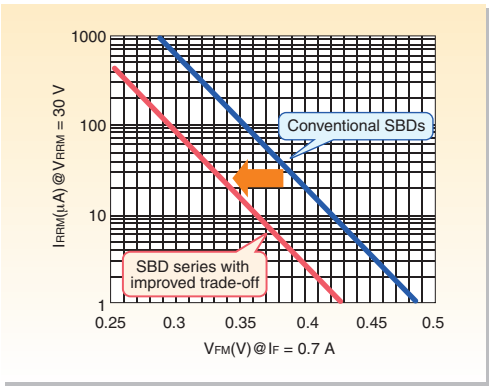
Power Dissipation	0.7 W	1 W	2 W
Package / Vz(V)	S-FLAT™	M-FLAT™	
39	CRZ39	CMZB39	CMZ39
43	CRZ43	CMZB43	CMZ43
47	CRZ47	CMZB47	CMZ47
51		CMZB51	CMZ51
53		CMZB53	CMZ53
68		CMZB68	
75		CMZB75	
82		CMZB82	
100		CMZB100	
110		CMZB110	
150		CMZB150	
180		CMZB180	
200		CMZB200	
220		CMZB220	
240		CMZB240	
270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

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

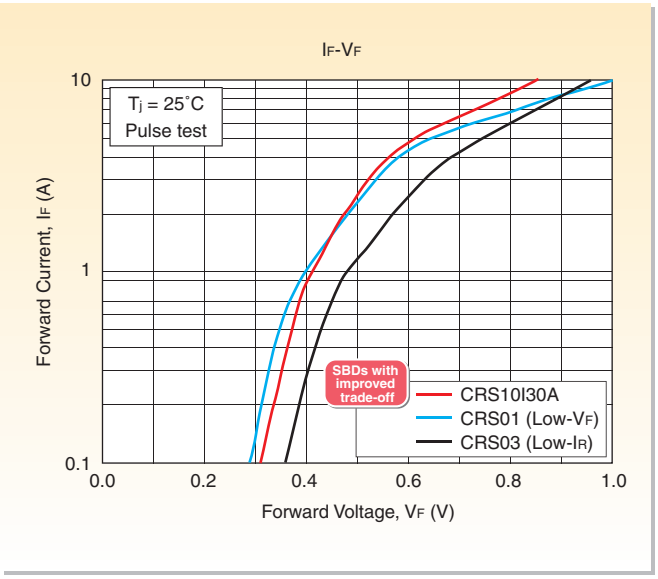
Toshiba now offers small to medium Schottky barrier diodes (SBDs) fabricated with a next-generation process.
Owing to low peak forward voltage (V_{FM}) and low peak repetitive forward voltage (I_{RRM}) characteristics, these SBDs provide low power loss, help reduce the size and improve the power efficiency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

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

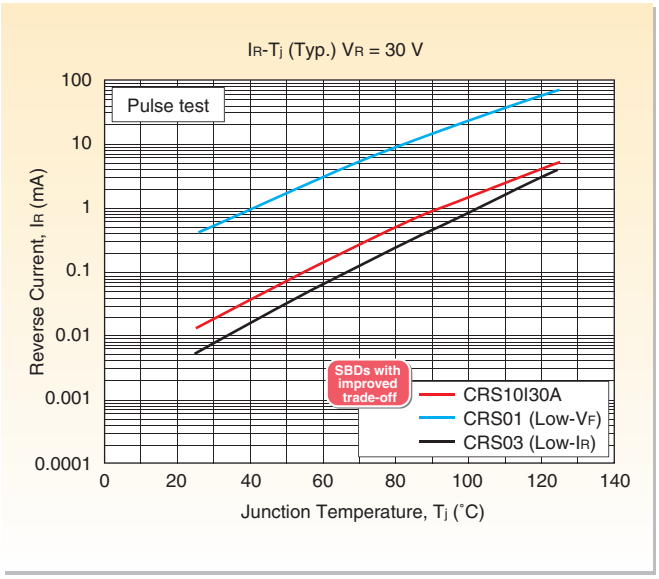
Tradeoff Relationship between the Forward Voltage and Reverse Leakage Current (Example)



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 packageing, current rating, voltage rating andf so on.

Product Naming Conventions

CRS	10	I	30	A
(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

4.1 Schottky Barrier Diodes (SBDs)

- Voltage rating: V_{RRM} = 20 V, 30 V, 40 V, 60 V
- Current rating: $I_{F(AV)}$ = 0.7 A to 10 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} (mA)	V_{FM} (V)	@I_{FM} (A)	C_j (pF) (Typ.)	Conditions
 US-FLAT™	**CUS05**	20	1.0	20	125	–40 to 150	1.0	0.37	0.7	40	V_R = 10 V, f = 1 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 V, f = 1 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 μA Max (V_R = 5 V) ◇: $I_{F(DC)}$ = 3 A

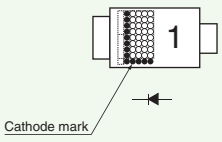
Single

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	
	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	
 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

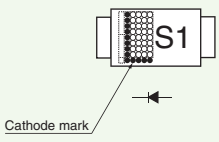
▶ Marking

US-FLAT™



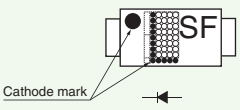
Example: **CUS01**

S-FLAT™



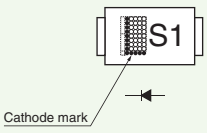
Example: **CRS01**

S-FLAT™



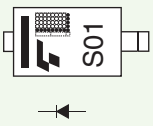
Example: **CRS10I30A**

M-FLAT™



Example: **CMS01**

L-FLAT™



Example: **CLS01**

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

- Voltage rating: V_{RRM} = 400 V, 600 V, 800 V
- Current rating: $I_{F(AV)}$ = 0.5 A to 2 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

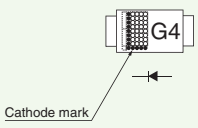
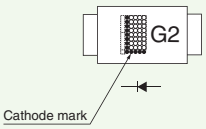
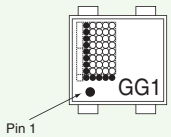
○: Based on AEC-Q101 ★: High ESD protection ✻: Designed for strobe discharge applications

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)
 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
 Example: **CRG04**	 Example: **CMG02**	 Example: **HMG01**

4.3 High-Speed Rectifiers

Super-Fast-Recovery Diode (S-FRDs)

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

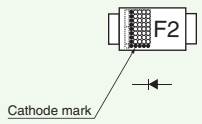
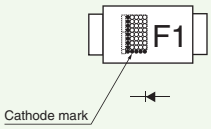
(1) Super-Fast-Recovery Diodes (S-FRDs)

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
 S-FLAT™	**CRF02**	800	0.5	10	150	–40 to 150	50	3.0	0.5	100	I_F = 1 A, di/dt = –30 A/μs
	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 A, di/dt = –30 A/μs
	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	

- Marking

■ **S-FRD**

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

High-Efficiency Diode (HEDs)

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

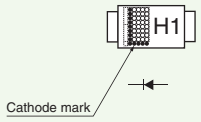
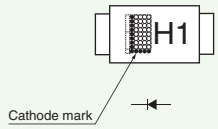
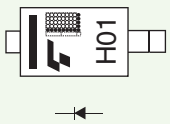
(2) High-Efficiency Diodes (HEDs)

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
 **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	
	CMH02A	400	3.0	30	150	–40 to 150	10	1.8	3.0	35	
 **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

■ **HED**

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

4.4 Zener Diodes

- V_Z = 6.2 V to 390 V
- Power dissipation: P = 0.7 W, 1.0 W, 2.0 W (S-FLAT™ and M-FLAT™ packages)

Packages

S-FLAT™

M-FLAT™

CRY62 and CRZ10 Series (S-FLAT™)

Ta = 25˚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)						
		Min	Typ.	Max	Max		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

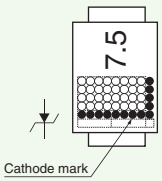
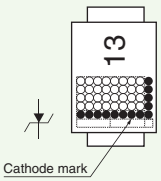
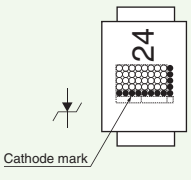
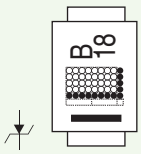
Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage α_T (mV/˚C)		Forward Voltage V_F (V)	Measurement Current I_F (A)	Reverse Current I_R (μA)	Measurement Voltage V_R (V)
		Zener Voltage V_Z (V)			Dynamic Resistance r_d (Ω)	Measurement Current I_Z (mA)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

CMZB12 Series (M-FLAT™)

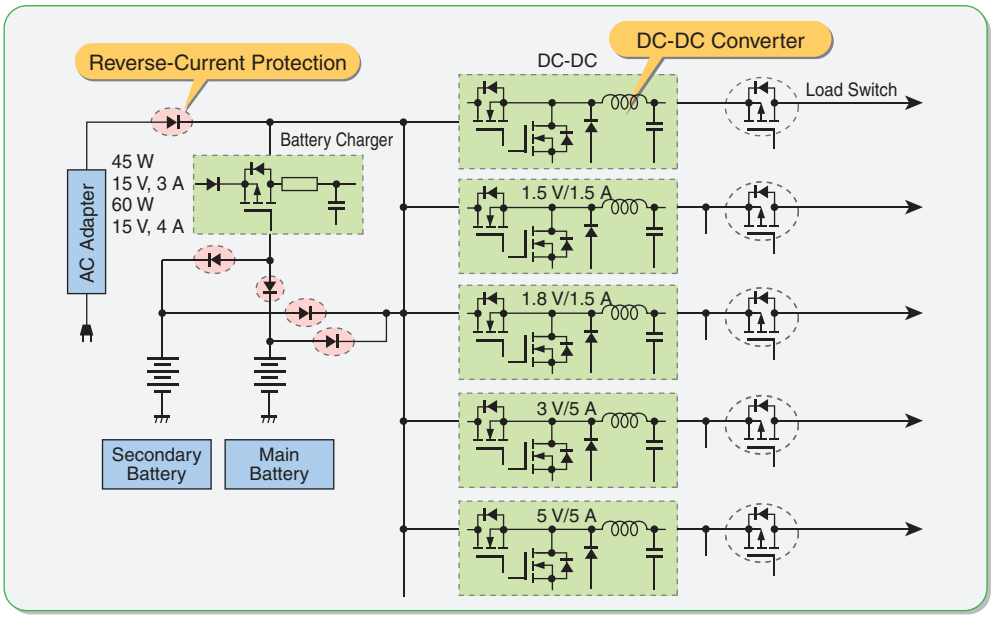
Ta = 25˚C

Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage αT (mV/˚C)		Forward Voltage VF (V)	Measurement Current IF (A)	Reverse Current IR (μA)	Measurement Voltage VR (V)
		Zener Voltage Vz (V)			Dynamic Resistance rd (Ω)	Measurement Current Iz (mA)						
		Min	Typ.	Max	Max		Typ.	Max	Max		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

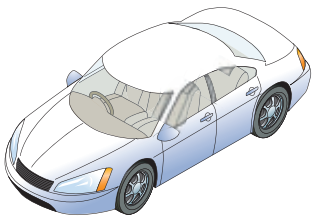
CRY62, CRZ10 Series		**CMZ12** Series	**CMZB12** Series
			
Example: **CRY75**	Example: **CRZ13**	Example: **CMZ24**	Example: **CMZB18**

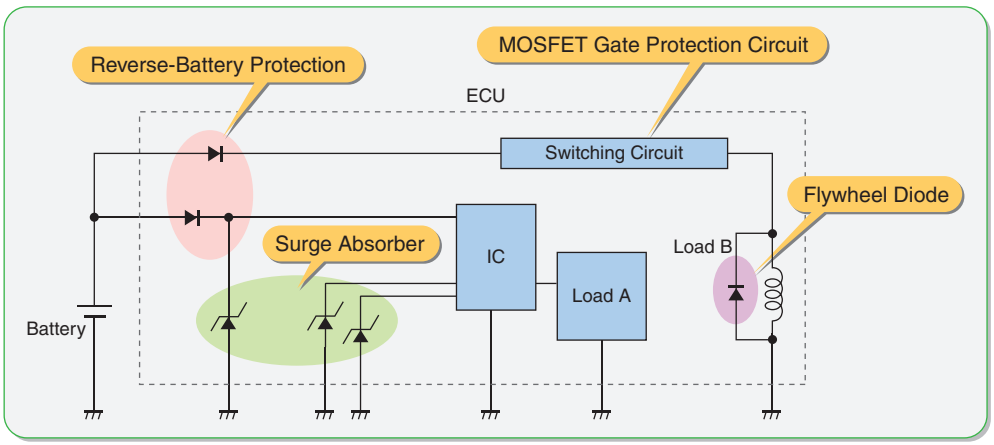
Notebook PCs



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





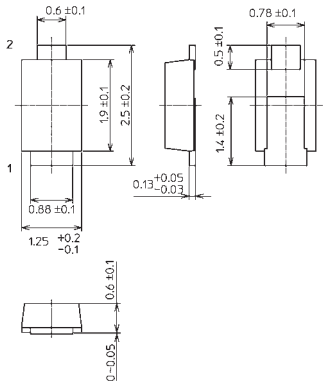
Applications	Package	Recommended Diodes
Reverse-battery and reverse-current protection	S-FLAT™	CRG04, CRG05, CRG07, CRG09, CRG02, CRG03, HMG02
	M-FLAT™	CMG02, CMG03, CMG05, CMG06, CMG07, CMG08
Surge absorbers	S-FLAT™	CRZ Series
	M-FLAT™	CMZB Series, CMZ Series
Flywheeling	S-FLAT™	CRH01, CRH02
	M-FLAT™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

6.1 Surface-Mount Packages

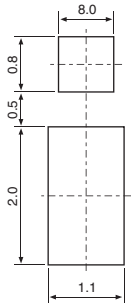
① US-FLAT™

Unit: mm

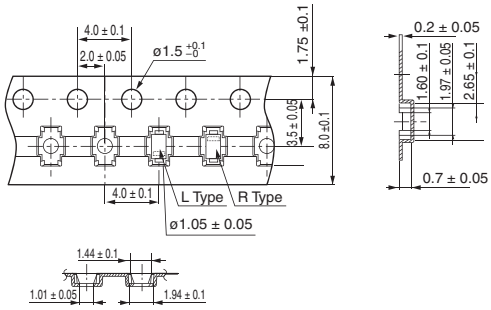
Package dimensions



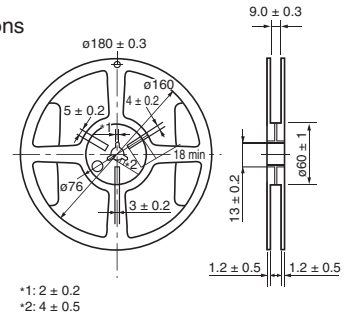
Land pattern dimensions for reference only



Tape dimensions



Reel dimensions



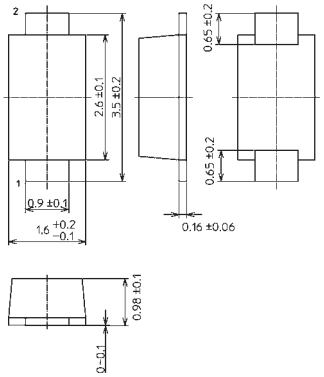
Type: TE85 R or L

Packing quantities:	4000 pcs/reel

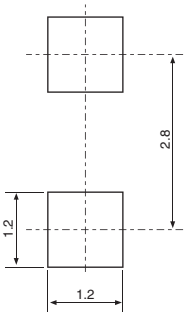
② S-FLAT™

Unit: mm

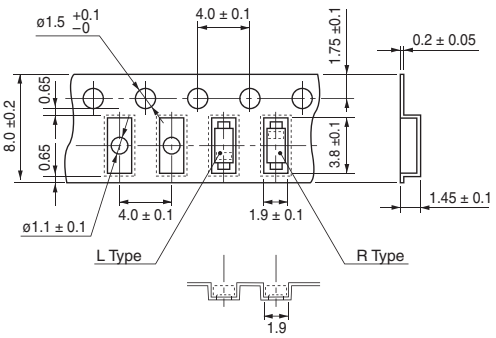
Package dimensions



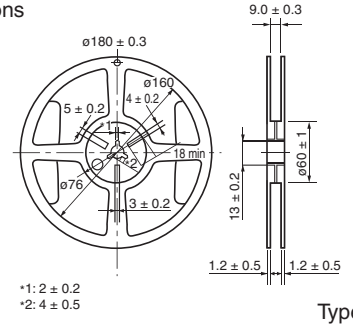
Land pattern dimensions for reference only



Tape dimensions



Reel dimensions



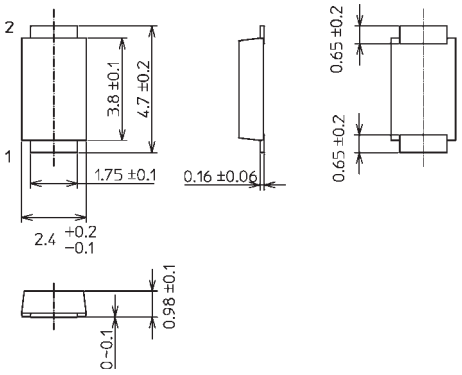
Type: TE85 R or L

Packing quantities:	3000 pcs/reel

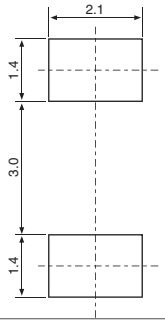
③ M-FLAT™

Unit: mm

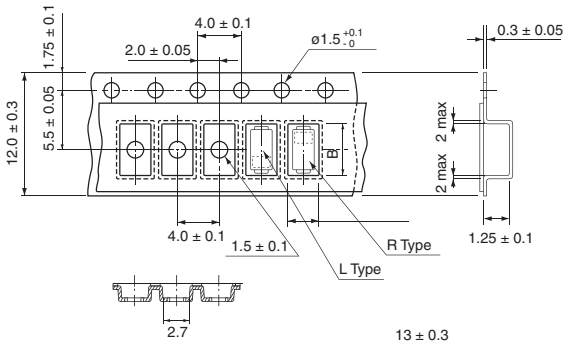
Package dimensions



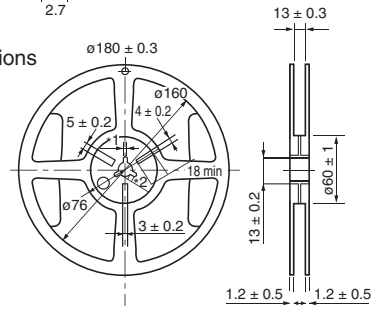
Land pattern dimensions for reference only



Tape dimensions



Reel dimensions



*1: 2 ± 0.2
*2: 4 ± 0.5

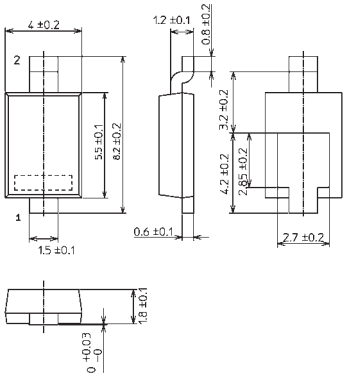
Type: TE12 R or L

Packing quantities: 3000 pcs/reel

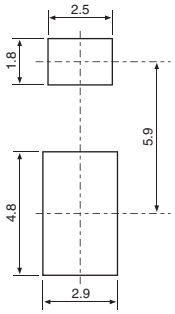
④ L-FLAT™

Unit: mm

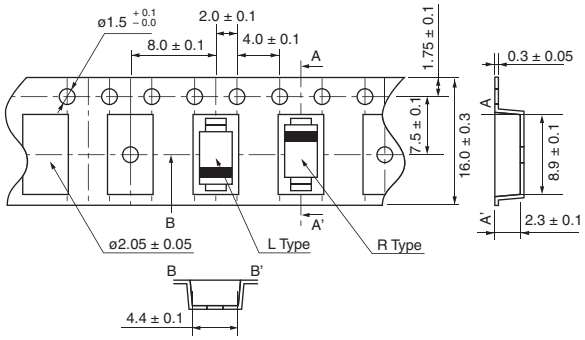
Package dimensions



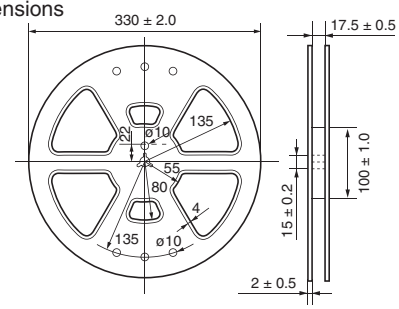
Land pattern dimensions for reference only



Tape dimensions



Reel dimensions



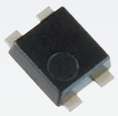
Type: TE16 R or L

Packing quantities: 2500 pcs/reel

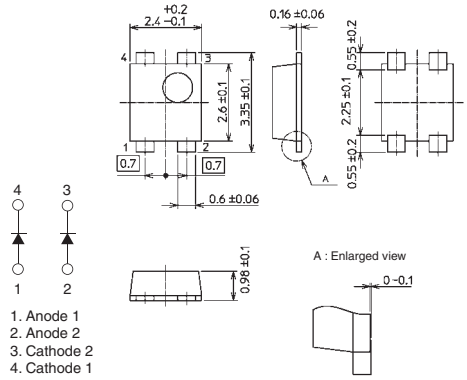
6.1 Surface-Mount Packages

⑤ HM-FLAT

Unit: mm

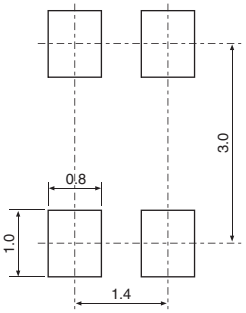


Package dimensions

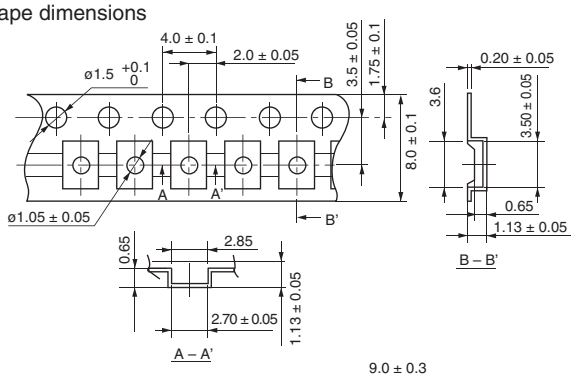


1. Anode 1
2. Anode 2
3. Cathode 2
4. Cathode 1

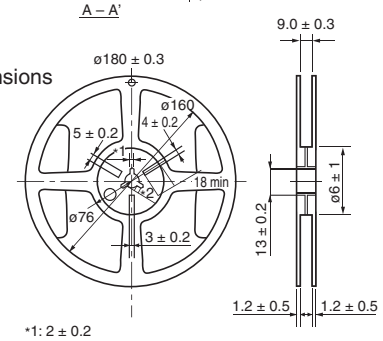
Land pattern dimensions for reference only



Tape dimensions



Reel dimensions



*1: 2 ± 0.2
*2: 4 ± 0.5

Type: TE85L

Packing quantities:	3000 pcs/reel

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