

PRODUCT GUIDE

Small and Medium Diodes



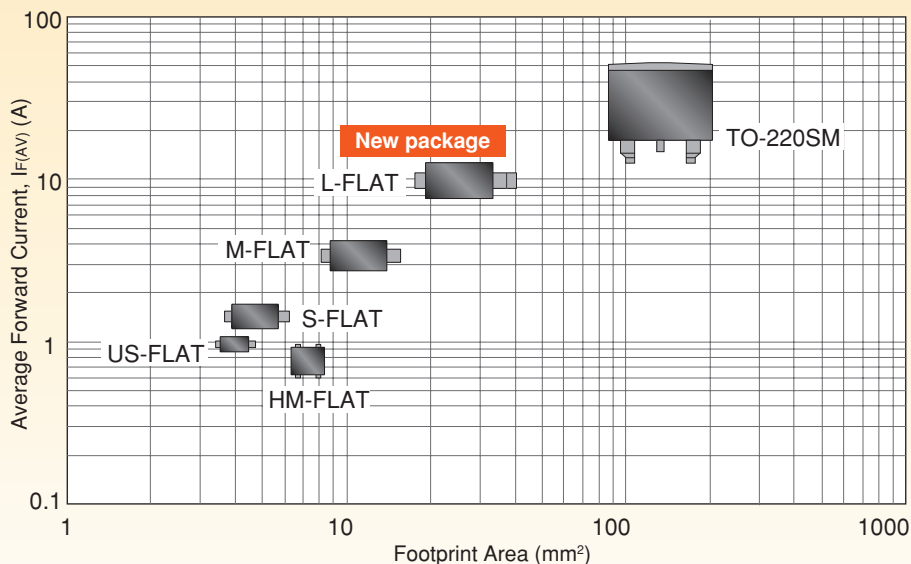
1. New Small & Medium Diodes

▶ SMALL & MEDIUM DIODES

Surface-Mount Packages for Diodes

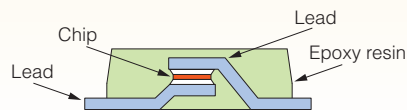
Toshiba has been working to develop diodes in compact and high-efficiency packages to help improve the performance of information and communication equipment.

▶ Package Footprint Area vs. Average Forward Current (SBDs)



■ Internal Structure of FLAT Packages

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



▶ CRS Series (in S-FLAT Packages) – Schottky Barrier Diodes

The following SBDs have been launched to further broaden the offerings of diodes with 30-V V_{RRM} .

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)
CRS14	30	2.0	30	150	-40 to 150	50	0.49	2.0
CRS15	30	3.0(DC)	30	150	-40 to 150	50	0.52	3.0

▶ CMG Series (in M-FLAT Packages) – General-Purpose Rectifier Diodes

The following diodes are designed as replacements for Toshiba's U1GC44 and U1JC44.

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)
CMG07	400	1.0	30	150	-40 to 150	10	1.1	1.0
CMG08	600	1.0	30	150	-40 to 150	10	1.1	1.0

▶ CRH Series (in S-FLAT Packages) – High-Efficiency Diodes (HEDs)

Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)		
	V_{RRM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A)	T_j (°C)	T_{stg} (°C)	t_{rr} (ns)	V_{FM} (V)	@ I_{FM} (A)
CRH02	200	0.5	10	150	-40 to 150	35	0.95	0.5

▶ CRG Series (in S-FLAT Packages) – General-Purpose Diodes

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)
CRG09	400	1.0	15	150	-55 to 150	10	1.1	0.7

2. Selection Guide

▶ SMALL & MEDIUM DIODES

General-Purpose Rectifiers

▶ General-Purpose Rectifiers

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	6
0.5 A	HM-FLAT	HMG01◆			⑦	
0.7 A	S-FLAT	CRG07○			②	
1 A	S-FLAT	CRG09	CRG04	CRG05	②	
	M-FLAT	CMC02* CMG05 CMG07	CMG06 CMG08		③	
2 A	M-FLAT	CMG02	CMG03		③	
10 A	TO-220SM			U10LC48	⑧	

○: AEC-Q101-qualified at Tj = 175°C *: Designed for strobe discharge applications. ◆: Dual

Super-Fast and Very-Fast Recovery Diodes (S-FRDs/V-FRD) 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	
			400 V	600 V	800 V	900 V			1000 V
0.5 A	S-FLAT	100 ns		CRF03(0.7 A)	CRF02*			②	7
	M-FLAT	100 ns			CMF04	CMF03	CMF05	③	
1 A	M-FLAT	100 ns		CMF02				③	
2 A	M-FLAT	100 ns		CMF01				③	
5 A	TO-220NIS#	100 ns	5GUZ47	5JUZ47				⑨	

#: Center leadless *: Designed for strobe charge applications

▶ Very-Fast Recovery Diodes (V-FRDs)

Average Forward Current	Package	Reverse Recovery Time (Max)	Peak Repetitive Reverse Voltage				Package Number	Reference page
			400 V	600 V	800 V	1200 V		
12 A	TO-3P(N)IS	300 ns				12QHZ51	⑫	7

▶ High-Efficiency Diodes (HEDs)

		Package	Reverse Recovery Time (Max)	Peak Repetitive Reverse Voltage				Package Number	Reference page	
				200 V	300 V	400 V	600 V			
Single type	Average Forward Current	0.5 A	S-FLAT	35 ns	CRH02				②	8
			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 A	M-FLAT	35 ns	CMH01		CMH02A		④		
			50 ns			CMH02				
		L-FLAT	35 ns	CLH01	CLH02	CLH03				
	5 A	L-FLAT	35 ns	CLH05	CLH06	CLH07		④		
		TO-220NIS#	35 ns	5DLZ47A		5GLZ47A	5JLZ47A		⑨	
Center-tap type	Average Output Current	5 A	TO-220NIS	35 ns	5DL2CZ47A	5FL2CZ47A	5GL2CZ47A		⑩	
			50 ns				5JL2CZ47			
		TO-220SM	35 ns	U5DL2C48A	U5FL2C48A			⑧		
		10 A	TO-220NIS	35 ns	10DL2CZ47A	10FL2CZ47A	10GL2CZ47A	10JL2CZ47A	⑩	
			50 ns				10JL2CZ47			
		TO-220SM	35 ns	U10DL2C48A	U10FL2C48A			⑧		
	16 A	TO-3P(N)	35 ns	16DL2C41A	16FL2C41A			⑪	9	
		TO-220NIS	35 ns	16DL2CZ47A	16FL2CZ47A			⑩	8	
	20 A	TO-3P(N)	35 ns	20DL2C41A	20FL2C41A	20GL2C41A	20JL2C41A	⑪	9	
			50 ns				20JL2C41			
		TO-220NIS	35 ns	20DL2CZ47A	20FL2CZ47A			⑩	8	
		TO-220SM	35 ns	U20DL2C48A	U20FL2C48A	U20GL2C48A	U20JL2C48A	⑧		
TO-3P(N)IS		35 ns	20DL2CZ51A	20FL2CZ51A				⑫	9	
40 ns (typ.)					20JL2CZ51					
30 A	TO-3P(N)	50 ns				30JL2C41	⑪			

#: Center leadless

Schottky Barrier Diodes (SBDs)

	Package	Peak Repetitive Reverse Voltage					Package Number	Reference page	
		20 V	30 V	40 V	60 V	120 V			
Average Forward Current	0.7 A	US-FLAT			CUS03	CUS04		①	10
	1 A	US-FLAT	CUS05, CUS06	CUS01, CUS02				①	
		S-FLAT	CRS06	CRS01, CRS02* CRS03, CRS05, CRS11	CRS04	CRS12 CRS13		②	
		M-FLAT		CMS08, CMS09	CMS10			③	
		VS-8		TPCF8E02◆				⑥	
	1.5 A	S-FLAT		CRS08, CRS09				②	10
	2 A	S-FLAT		CRS14				②	
		M-FLAT		CMS06, CMS07, CMS17	CMS11	CMS14		③	
	3 A	S-FLAT		CRS15◇				②	
		M-FLAT		CMS01, CMS02* CMS03, CMS18	CMS16, CMS19	CMS15 CMS20		③	
5 A	M-FLAT		CMS04, CMS05						
10 A	L-FLAT		CLS01	5GWJZ47#			⑨	10	
Average Output Current (Center-Tap Type)	5 A	TO-220NIS		5FWJ2CZ47M	5GWJ2CZ47C			⑩	11
		TO-220SM		U5FWJ2C48M	U5GWJ2C48C			⑧	
	10 A	TO-220NIS		10FWJ2CZ47M	10GWJ2CZ47C			⑩	
		TO-220SM		U10FWJ2C48M	U10GWJ2C48C			⑧	
	20 A	TO-220NIS		20FWJ2CZ47M				⑩	
		TO-220SM		U20FWJ2C48M				⑧	
	30 A	TO-3P(N)			30GWJ2C42C			⑪	
		TO-220NIS		30FWJ2CZ47M	30GWJ2CZ47C		30QWK2CZ47*	⑩	
		TO-220SM		U30FWJ2C48M	U30GWJ2C48C			⑧	

#: Center leadless *: Trench structure ◆: Dual ◇: $I_{F(DC)} = 3A$

Zener Diodes

► Zener Diodes

Power Dissipation	0.7 W	1 W	2 W	Power Dissipation	0.7 W	1 W	2 W	Power Dissipation	0.7 W	1 W	2 W
Package Vz(V)	S-FLAT (SMD)	M-FLAT (SMD)	M-FLAT (SMD)	Package Vz(V)	S-FLAT (SMD)	M-FLAT (SMD)	M-FLAT (SMD)	Package Vz(V)	S-FLAT (SMD)	M-FLAT (SMD)	M-FLAT (SMD)
6.2	CRY62			15	CRZ15	CMZB15	CMZ15	36	CRZ36	CMZB36	CMZ36
6.8	CRY68			16	CRZ16	CMZB16	CMZ16	39	CRZ39	CMZB39	CMZ39
7.5	CRY75			18	CRZ18	CMZB18	CMZ18	43	CRZ43	CMZB43	CMZ43
8.2	CRY82			20	CRZ20	CMZB20	CMZ20	47	CRZ47	CMZB47	CMZ47
9.1	CRY91			22	CRZ22	CMZB22	CMZ22	51		CMZB51	CMZ51
10	CRZ10			24	CRZ24	CMZB24	CMZ24	53		CMZB53	CMZ53
11	CRZ11			27	CRZ27	CMZB27	CMZ27	Package Number	②	③	③
12	CRZ12	CMZB12	CMZ12	30	CRZ30	CMZB30	CMZ30	Reference page	12	12	13
13	CRZ13	CMZB13	CMZ13	33	CRZ33	CMZB33	CMZ33				

Note 1: For constant-voltage regulation

► Bidirectional Zener Diode

Part Number	Power Dissipation	Package	Vz(V)	Package Number	Reference page
CMZM16	1 W	M-FLAT	16	③	13




3. Product Characteristics

▶ SMALL & MEDIUM DIODES

3.1 General-Purpose Rectifiers



- Voltage rating: $V_{RRM} = 400\text{ V}, 600\text{ V}, 800\text{ V}$
- Current rating: $I_{F(AV)} = 0.3\text{ A to }10\text{ A}$
- 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™	CRG07○	400	0.7	15	175	-40 to 175	10	1.1	0.7
	New CRG09	400	1.0	15	150	-55 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
	New 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
	New 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
 TO-220SM	U10LC48	800	10	180	150	-40 to 150	30	1.2	10



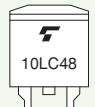
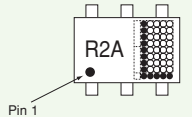
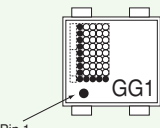
○: AEC-Q101-qualified at $T_j = 175^\circ\text{C}$ *: For strobe discharge applications

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

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

▶ Marking

S-FLAT™	M-FLAT™	TO-220SM	VS-6	HM-FLAT
				
Example: CRG04	Example: CMG02	Example: U10LC48	Example: TPC6K01	Example: HMG01

3.2 High-Speed Rectifiers

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: $I_{F(AV)} = 0.5\text{ A to } 5\text{ A}$
- High-speed switching: Reverse recovery time (t_{rr}) $\leq 100\text{ ns}$

High-Efficiency Diodes (HEDs)

- Voltage rating: $V_{RRM} = 200\text{ V}, 300\text{ V}, 400\text{ V}, 600\text{ V}$
- Current rating: $I_{F(AV)} = 1\text{ A to } 30\text{ A}$
- High-speed switching: Reverse recovery time (t_{rr}) $\leq 35\text{ ns}$ or $\leq 50\text{ ns}$
- Balanced current: Center-tapped diodes are monolithically integrated on the same substrate, allowing a parallel load configuration.
- Packaging: Available in small surface-mount packages, TO-220 and TO-3P.

(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	
 TO-220NIS (Center leadless)	5GUZ47	400	5.0	50	150	-40 to 150	100	1.2	5.0	100	$I_F = 2\text{ A},$ $di/dt = -20\text{ A}/\mu\text{s}$
	5JUZ47	600	5.0	50	150	-40 to 150	100	1.5	5.0	100	

*: For strobe charge applications.

(2) Very-Fast Recovery Diodes (V-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
 TO-3P(N)IS	12QHZ51	1200	12	120	150	-40 to 150	50	2.5	12	300	$I_F = 1\text{ A}$

3. Product Characteristics

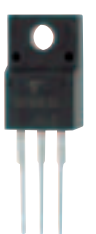
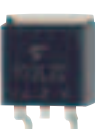
▶ SMALL & MEDIUM DIODES

(3) High-Efficiency Diodes (HEDs)

Single

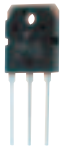
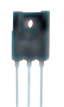
Package	Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)					Conditions
		V _{RRM} (V)	I _{F(AV)} (A)	I _{FSM} (A)	T _j (°C)	T _{stg} (°C)	I _{RRM} (μA)	V _{FM} (V)	@I _{FM} (A)	t _{tr} (ns)		
 S-FLAT™	New CRH02	200	0.5	10	150	-40 to 150	10	0.95	0.5	35	I _F = 1 A, di/dt = -30 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™	CMH02A	400	3.0	30	150	-40 to 150	10	1.8	3.0	35	I _F = 2 A, di/dt = -50 A/μs	
	CLH01	200	3.0	60	150	-40 to 150	10	0.98	3.0	35		
	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		
 TO-220NIS (Center leadless)	CLH07	400	5.0	50	150	-40 to 150	10	1.8	5.0	35	I _F = 2 A, di/dt = -20 A/μs	
	5DLZ47A	200	5.0	50	150	-40 to 150	10	0.98	5.0	35		
	5GLZ47A	400	5.0	50	150	-40 to 150	50	1.8	5.0	35		
	5JLZ47	600	5.0	50	150	-40 to 150	50	2.0	5.0	50		
	5JLZ47A	600	5.0	40	150	-40 to 150	50	4.0	5.0	35		

Center Tap

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} (μA)	V _{FM} (V)	@I _{FM} (A)	t _{tr} (ns)		
 TO-220NIS	5DL2CZ47A	200	5.0	25	150	-40 to 150	10	0.98	2.5	35	I _F = 2 A, di/dt = -20 A/μs	
	5FL2CZ47A	300	5.0	25	150	-40 to 150	10	1.3	2.5	35		
	5GL2CZ47A	400	5.0	25	150	-40 to 150	50	1.8	2.5	35		
	5JL2CZ47	600	5.0	25	150	-40 to 150	50	2.0	2.5	50		
	10DL2CZ47A	200	10	50	150	-40 to 150	10	0.98	5.0	35		
	10FL2CZ47A	300	10	50	150	-40 to 150	10	1.3	5.0	35		
	10GL2CZ47A	400	10	50	150	-40 to 150	50	1.8	5.0	35		
	10JL2CZ47	600	10	50	150	-40 to 150	50	2.0	5.0	50		
	10JL2CZ47A	600	10	40	150	-40 to 150	50	4.0	5.0	35		
	16DL2CZ47A	200	16	80	150	-40 to 150	50	0.98	8.0	35		
	16FL2CZ47A	300	16	80	150	-40 to 150	50	1.3	8.0	35		
	20DL2CZ47A	200	20	100	150	-40 to 150	50	0.98	10	35		
	20FL2CZ47A	300	20	100	150	-40 to 150	50	1.3	10	35		
	 TO-220SM	U5DL2C48A	200	5.0	25	150	-40 to 150	10	0.98	2.5		35
U5FL2C48A		300	5.0	25	150	-40 to 150	10	1.3	2.5	35		
U10DL2C48A		200	10	50	150	-40 to 150	10	0.98	5.0	35		
U10FL2C48A		300	10	50	150	-40 to 150	10	1.3	5.0	35	I _F = 2 A, di/dt = -50 A/μs	
U10JL2C48A		600	10	40	150	-40 to 150	50	4.0	5.0	35		
U20DL2C48A		200	20	100	150	-40 to 150	50	0.98	10	35		
U20FL2C48A		300	20	100	150	-40 to 150	50	1.3	10	35		
U20GL2C48A		400	20	100	150	-40 to 150	50	1.8	10	35		
U20JL2C48A		600	20	80	150	-40 to 150	50	3.2	10	35		

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



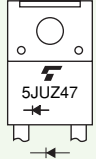
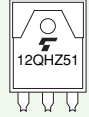
Center Tap

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_r (ns)	Conditions
 TO-3P(N)	16DL2C41A	200	16	80	150	-40 to 150	50	0.98	8.0	35	$I_F = 2\text{ A}$, $di/dt = -50\text{ A}/\mu\text{s}$
	16FL2C41A	300	16	80	150	-40 to 150	50	1.3	8.0	35	
	20DL2C41A	200	20	100	150	-40 to 150	50	0.98	10	35	
	20FL2C41A	300	20	100	150	-40 to 150	50	1.3	10	35	
	20GL2C41A	400	20	100	150	-40 to 150	50	1.8	10	35	
	20JL2C41	600	20	100	150	-40 to 150	50	2.0	10	50	
	20JL2C41A	600	20	80	150	-40 to 150	100	3.2	10	35	
30JL2C41	600	30	150	150	-40 to 150	50	2.0	15	50		
 TO-3P(N)IS	20DL2CZ51A	200	20	100	150	-40 to 150	50	0.98	10	35	$I_F = 2\text{ A}$, $di/dt = -50\text{ A}/\mu\text{s}$
	20FL2CZ51A	300	20	100	150	-40 to 150	50	1.3	10	35	
	20JL2CZ51	600	20	100	150	-40 to 150	50	2.0	10	40 (typ.)	

Note: I_{FSM} , I_{RRM} and V_{FM} are specified per diode.


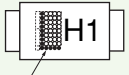
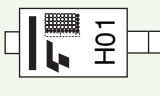
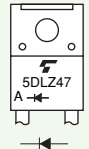
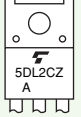
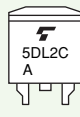
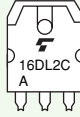
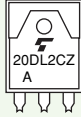
▶ Marking

■ S-FRD

S-FLAT™	M-FLAT™	TO-220NIS (Center leadless)	TO-3P(N)IS
 Cathode mark Example: CRF02	 Cathode mark Example: CMF01	 Example: 5JUZ47	 Example: 12QH251

■ V-FRD

■ HED

S-FLAT™	M-FLAT™	L-FLAT™	TO-220NIS (Center leadless)
 Cathode mark Example: CRH01	 Cathode mark Example: CMH01	 Example: CLH01	 Example: 5DLZ47A
TO-220NIS	TO-220SM	TO-3P(N)	TO-3P(N)IS
 Example: 5DL2CZ47A	 Example: U5DL2C48A	 Example: 16DL2C41A	 Example: 20DL2CZ51A






3. Product Characteristics

▶ SMALL & MEDIUM DIODES

3.3 Schottky Barrier Diodes (SBDs)


- Voltage rating: $V_{RRM} = 20\text{ V}, 30\text{ V}, 40\text{ V}, 60\text{ V}, 120\text{ V}$
- Current rating: $I_{F(AV)} = 0.7\text{ A to }30\text{ A}$
- Packaging: Available in small surface-mount packages, TO-220 and TO-3P.
- Balanced current : Center-tapped diodes are monolithically integrated on the same substrate, allowing a parallel load configuration.

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		
	CUS03	40	0.7	20	150	-40 to 150	0.1	0.52	0.7	45		
 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		
	CRS02	30	1.0	20	125	-40 to 150	0.05	0.4	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		
	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		
	New CRS14	30	2.0	30	150	-40 to 150	0.05	0.49	2.0	90		
	New CRS15◇	30	3.0	30	150	-40 to 150	0.05	0.52	3.0	90		
	CRS04	40	1.0	20	150	-40 to 150	0.1	0.49	0.7	47		
	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		
 M-FLAT™	CMS08	30	1.0	25	125	-40 to 150	1.5	0.37	1.0	70	$V_R = 10\text{ V},$ $f = 1\text{ MHz}$	
	CMS09	30	1.0	25	150	-40 to 150	0.5	0.45	1.0	70		
	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		
	CMS01	30	3.0	40	125	-40 to 150	5.0	0.37	3.0	190		
	CMS02	30	3.0	40	125	-40 to 150	0.5	0.4	3.0	170		
	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	0.66	3.0	–		
	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		
	CMS11	40	2.0	30	150	-40 to 150	0.5	0.55	2.0	95		
	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	–		
	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	–			
 L-FLAT™	CLS01	30	10	100	125	-40 to 150	1.0	0.47	10	530	$V_R = 10\text{ V},$ $f = 1\text{ MHz}$	
	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		
 TO-220NIS (Center leadless)	5GWJZ47	40	5.0	50	125	-40 to 150	3.5	0.55	5.0	200	$V_R = 10\text{ V},$ $f = 1\text{ MHz}$	




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

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 _i (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

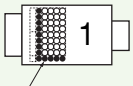
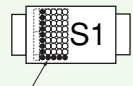
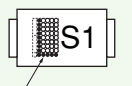

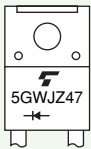
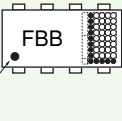

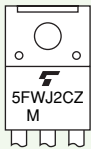
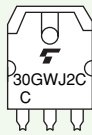
Note: I_{FSM}, I_{RRM} and V_{FM} are specified per diode.

Center Tap

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 _i (pF) (Typ.)	Conditions
 TO-220SM	U5FWJ2C48M	30	5.0	50	125	-40 to 150	3.5	0.47	2.5	138	V _R = 10 V, f = 1 MHz
	U5GWJ2C48C	40	5.0	50	125	-40 to 150	3.5	0.55	2.5	100	
	U10FWJ2C48M	30	10	100	125	-40 to 150	3.5	0.47	5.0	290	
	U10GWJ2C48C	40	10	100	125	-40 to 150	3.5	0.55	5.0	195	
	U20FWJ2C48M	30	20	200	125	-40 to 150	10	0.47	10	680	
	U30FWJ2C48M	30	30	300	125	-40 to 150	15	0.47	15	820	
 TO-220NIS	U30GWJ2C48C	40	30	300	125	-40 to 150	15	0.55	15	600	V _R = 10 V, f = 1 MHz
	5FWJ2CZ47M	30	5.0	50	125	-40 to 150	3.5	0.47	2.5	138	
	5GWJ2CZ47C	40	5.0	50	125	-40 to 150	3.5	0.55	2.5	100	
	10FWJ2CZ47M	30	10	100	125	-40 to 150	3.5	0.47	5.0	290	
	10GWJ2CZ47C	40	10	100	125	-40 to 150	3.5	0.55	5.0	195	
	20FWJ2CZ47M	30	20	200	125	-40 to 150	10	0.47	10	680	
	30FWJ2CZ47M	30	30	300	125	-40 to 150	15	0.47	15	820	
30GWJ2CZ47C	40	30	300	125	-40 to 150	15	0.55	15	600		
 TO-3P(N)	30QWK2CZ47	120	30	250	150	-40 to 150	0.05	0.85	15	227	V _R = 10 V f = 1 MHz
	30GWJ2C42C	40	30	300	125	-40 to 150	15	0.55	15	600	

Note: I_{FSM}, I_{RRM} and V_{FM} are specified per diode.

▶ Marking

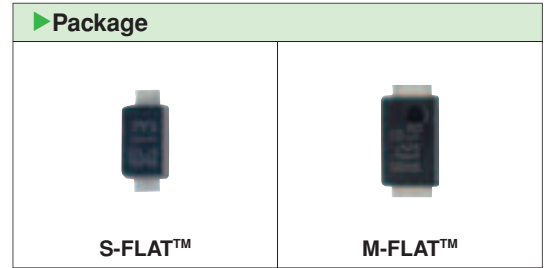
US-FLAT™	S-FLAT™	M-FLAT™	L-FLAT™	TO-220NIS (Center leadless)
 Cathode mark ← Example: CUS01	 Cathode mark ← Example: CRS01	 Cathode mark ← Example: CMS01	 ← Example: CLS01	 Example: 5GWJZ47
 Pin 1 Example: TPCF8E02	 Example: U5FWJ2C48M	 Example: 5FWJ2CZ47M	 Example: 30GWJ2C42C	

3. Product Characteristics

▶ SMALL & MEDIUM DIODES

3.4 Zener Diodes

- $V_z = 6.2\text{ V to }53\text{ V}$
- 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™)

Electrical Characteristics ($T_a = 25^\circ\text{C}$)

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)			Zener Impedance r_d (Ω)	Measurement Current I_z (mA)	Typ.	Max				
		Min	Typ.	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

CMZB12 Series (M-FLAT™)

Electrical Characteristics ($T_a = 25^\circ\text{C}$)

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)			Zener Impedance r_d (Ω)	Measurement Current I_z (mA)	Typ.	Max				
		Min	Typ.	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

CMZ12 Series (M-FLAT™)

Electrical Characteristics (Ta = 25°C)

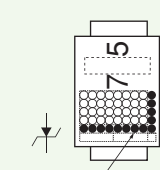
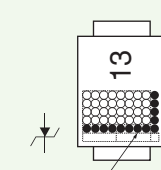
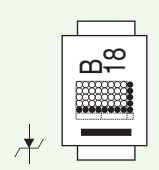
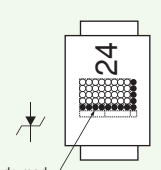
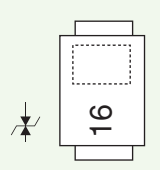
Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage α_T (mV/°C)		Forward Voltage V_F (V)	Measurement Current I_F (A)	Reverse Current I_R (μ A)	Measurement Voltage V_R (V)
		Zener Voltage V_Z (V)			Zener Impedance r_d (Ω)	Measurement Current I_Z (mA)	Typ.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

CMZM16 Bidirectional Zener Diode Series (M-FLAT™)

Electrical Characteristics (Ta = 25°C)

Part Number	Power Dissipation (W)	Zener Characteristics					Temperature Coefficient of Zener Voltage α_T (mV/°C)		Reverse Current I_R (μ A)	Measurement Voltage V_R (V)
		Zener Voltage V_Z (V)			Zener Impedance r_d (Ω)	Measurement Current I_Z (mA)	Typ.	Max		
		Min	Typ.	Max	Max					
CMZM16	1.0	14.4	16	17.6	30	10	12	19	10	11

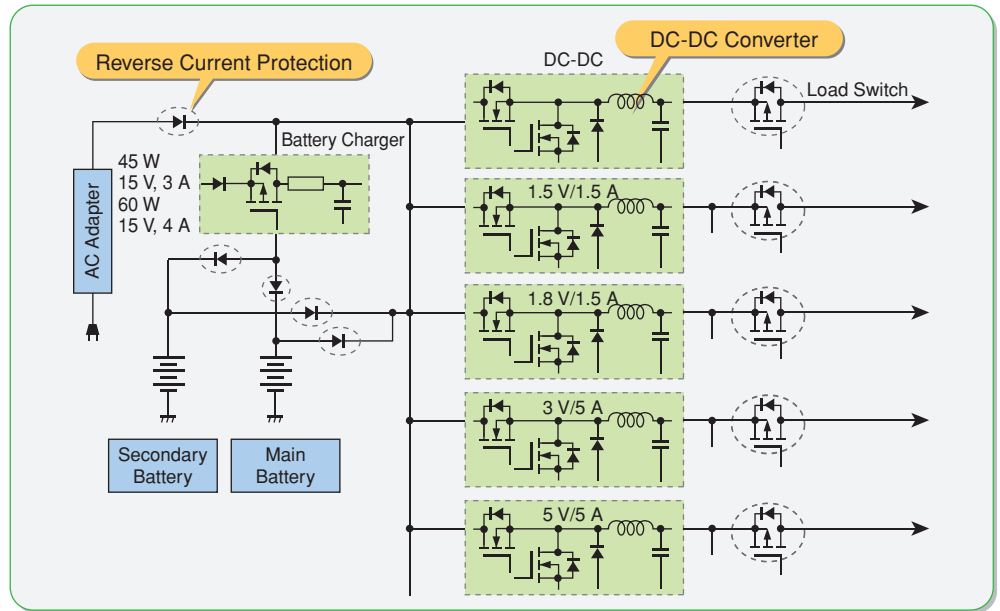
► Marking

CRY62, CRZ10 Series	CMZB12 Series	CMZ12 Series	CMZM16 Series
 <p>Example: CRY75</p>	 <p>Example: CRZ13</p>	 <p>Example: CMZB18</p>	 <p>Example: CMZ24</p>
 <p>Example: CMZM16</p>			

4. Application Examples and Toshiba's Recommended Diodes

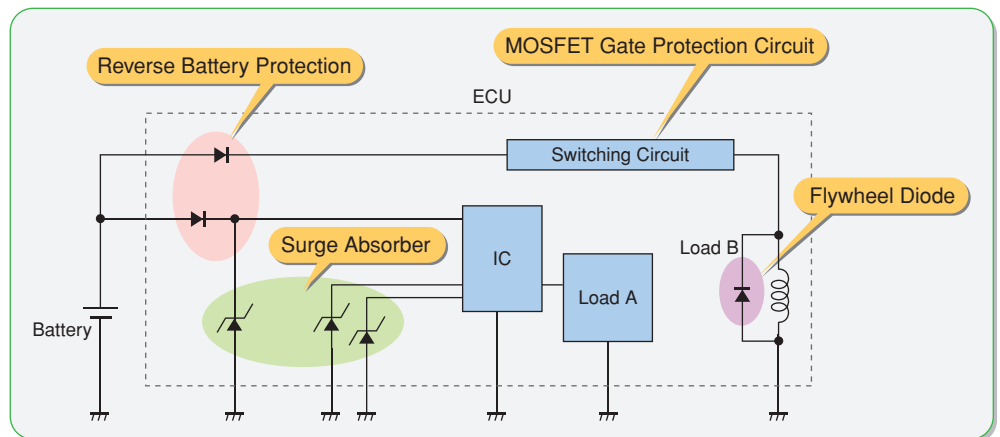
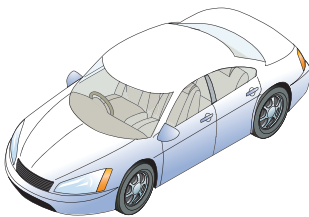
SMALL & MEDIUM DIODES

Notebook PCs



Applications	Package	Recommended Diodes
Reverse-battery and reverse-current protection	US-FLAT	CUS01, CUS02
	S-FLAT	CRS01, CRS02, CRS03, CRS05, CRS06, CRS08, CRS09, CRS11, CRS14
	M-FLAT	CMS01, CMS02, CMS03, CMS06, CMS07, CMS08, CMS09, CMS16
DC-DC converters	S-FLAT	CRS03, CRS04, CRS05, CRS09, CRS12, CRS14
	M-FLAT	CMS03, CMS05, CMS07, CMS09, CMS10, CMS11, CMS14, CMS15, CMS16

Automotive



Applications	Package	Recommended Diodes
Reverse-battery and reverse-current protection	S-FLAT	CRG04, CRG05, CRG07, CRG09
	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

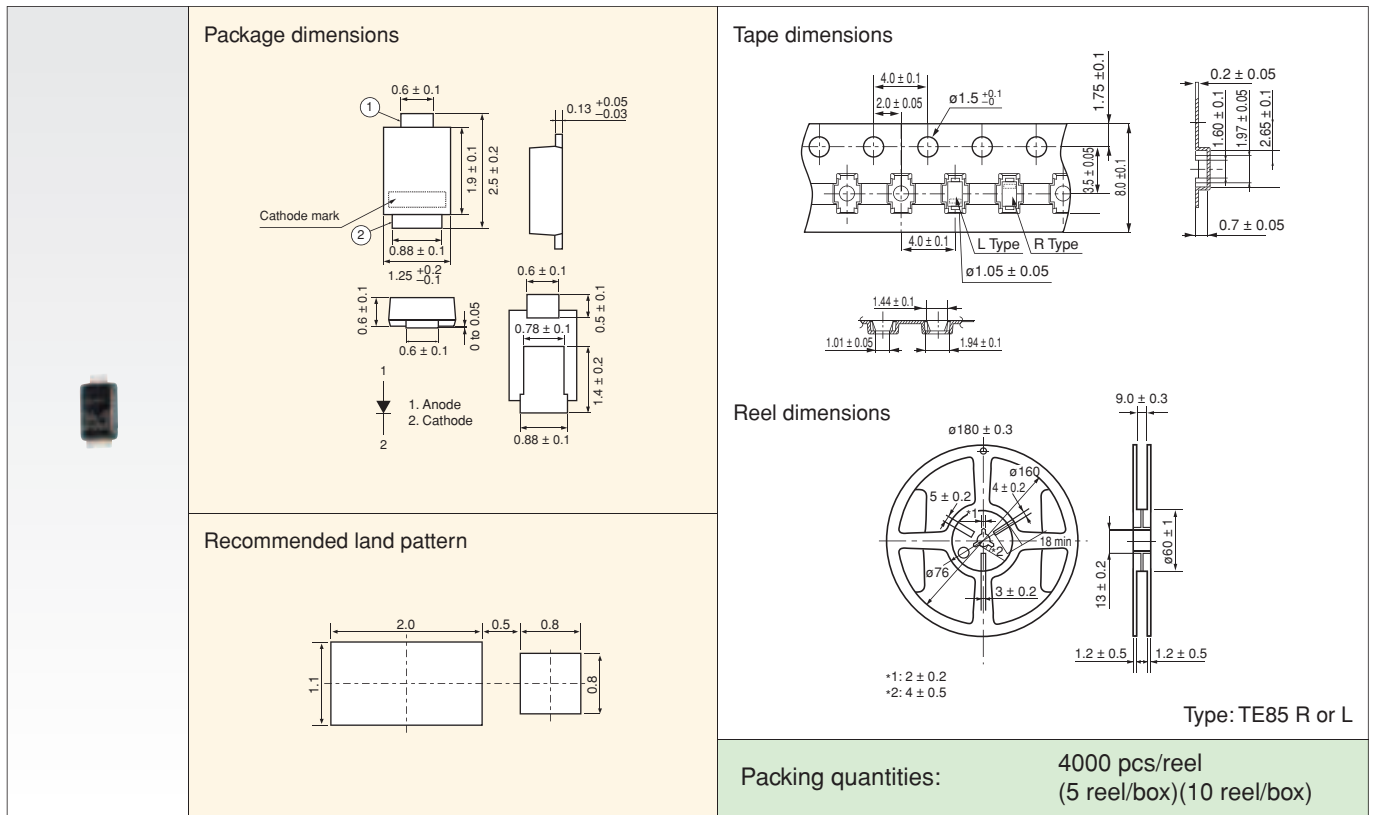
5. Packaging and Packing Information

SMALL & MEDIUM DIODES

5.1 Surface-Mount Packages

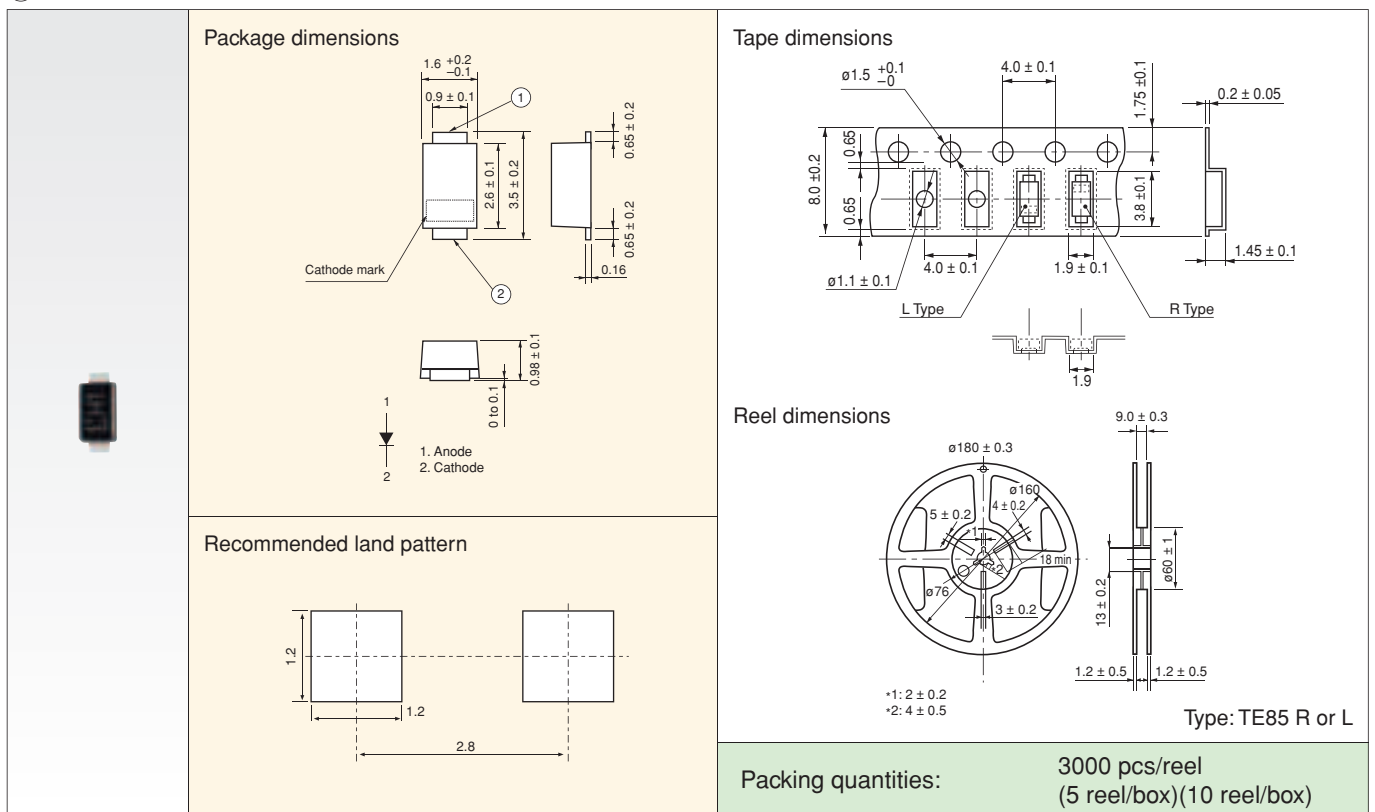
① US-FLAT™

Unit: mm



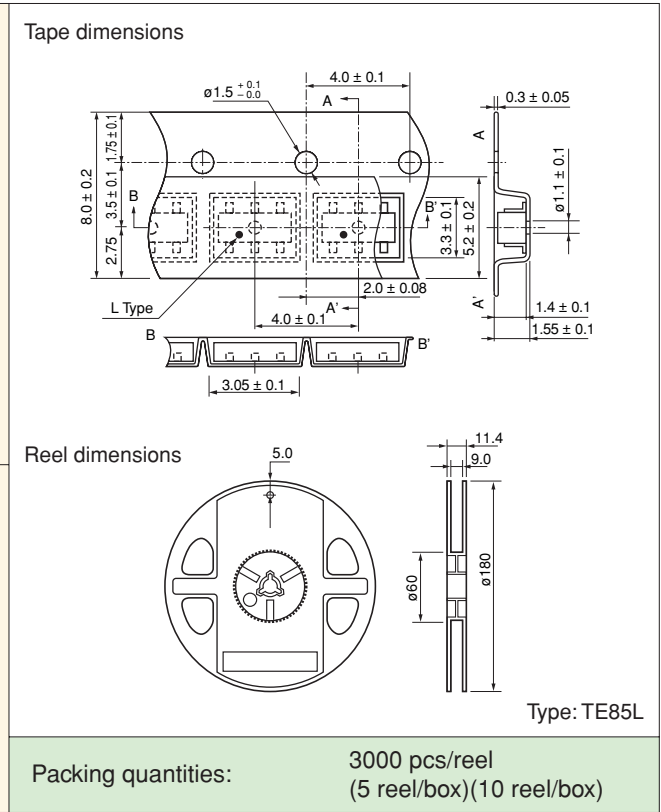
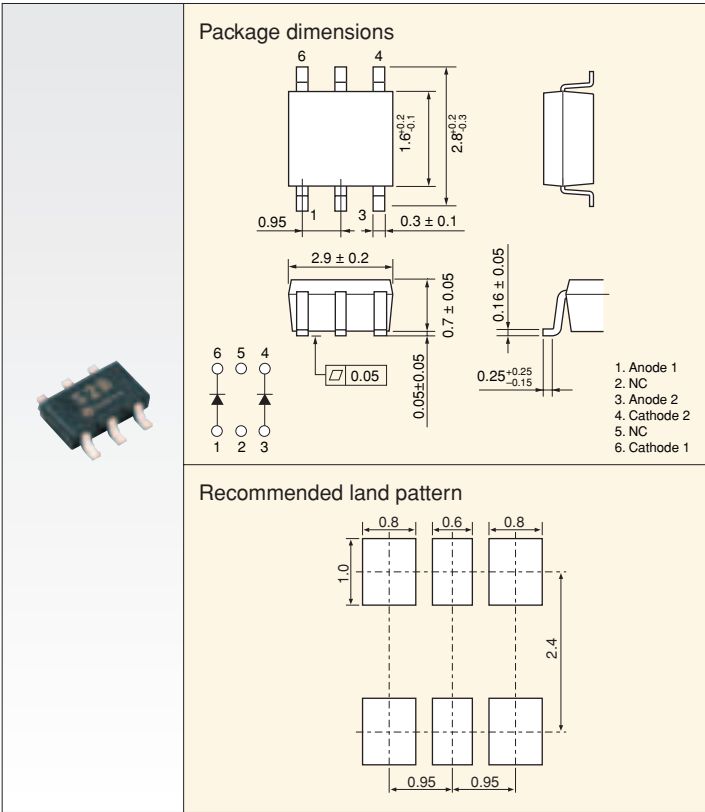
② S-FLAT™

Unit: mm



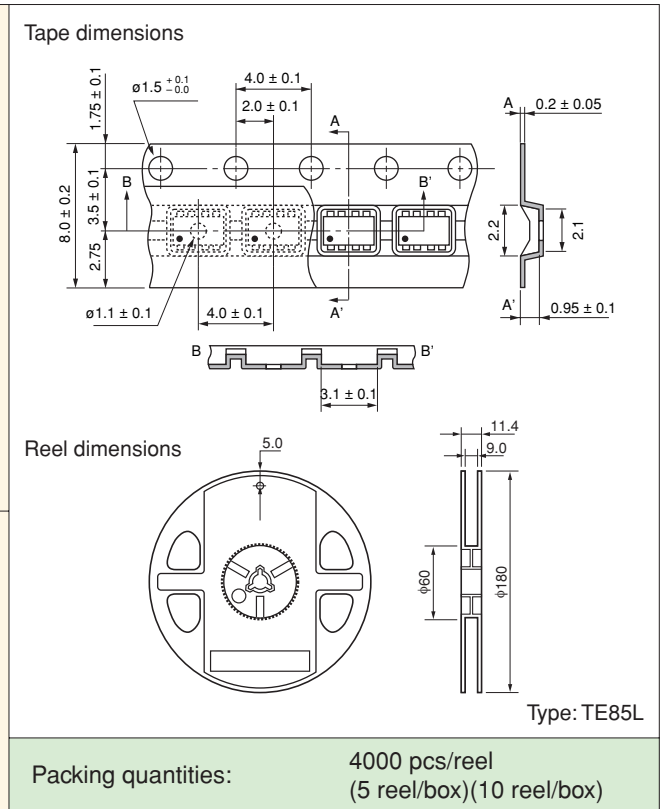
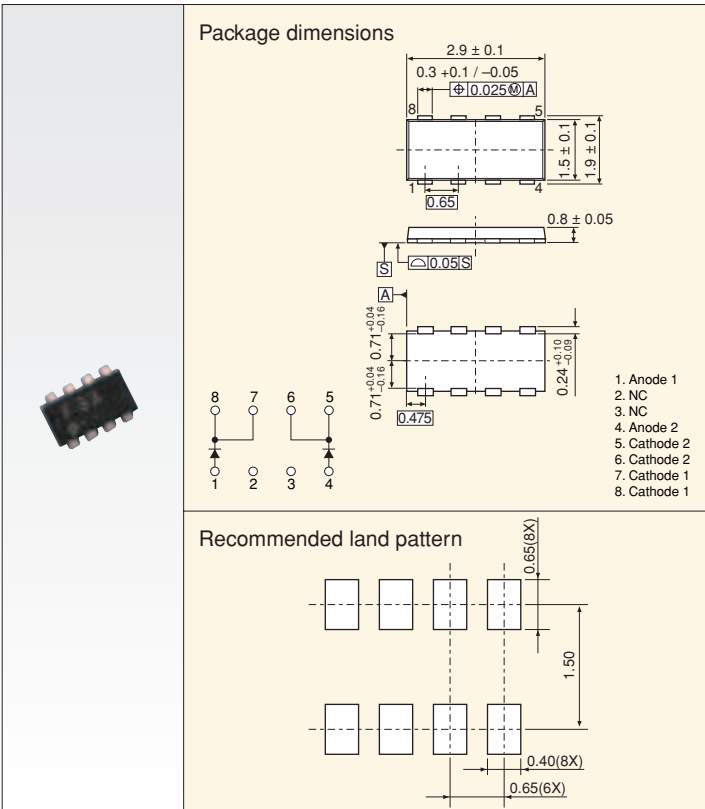
⑤ VS-6

Unit: mm



⑥ VS-8

Unit: mm



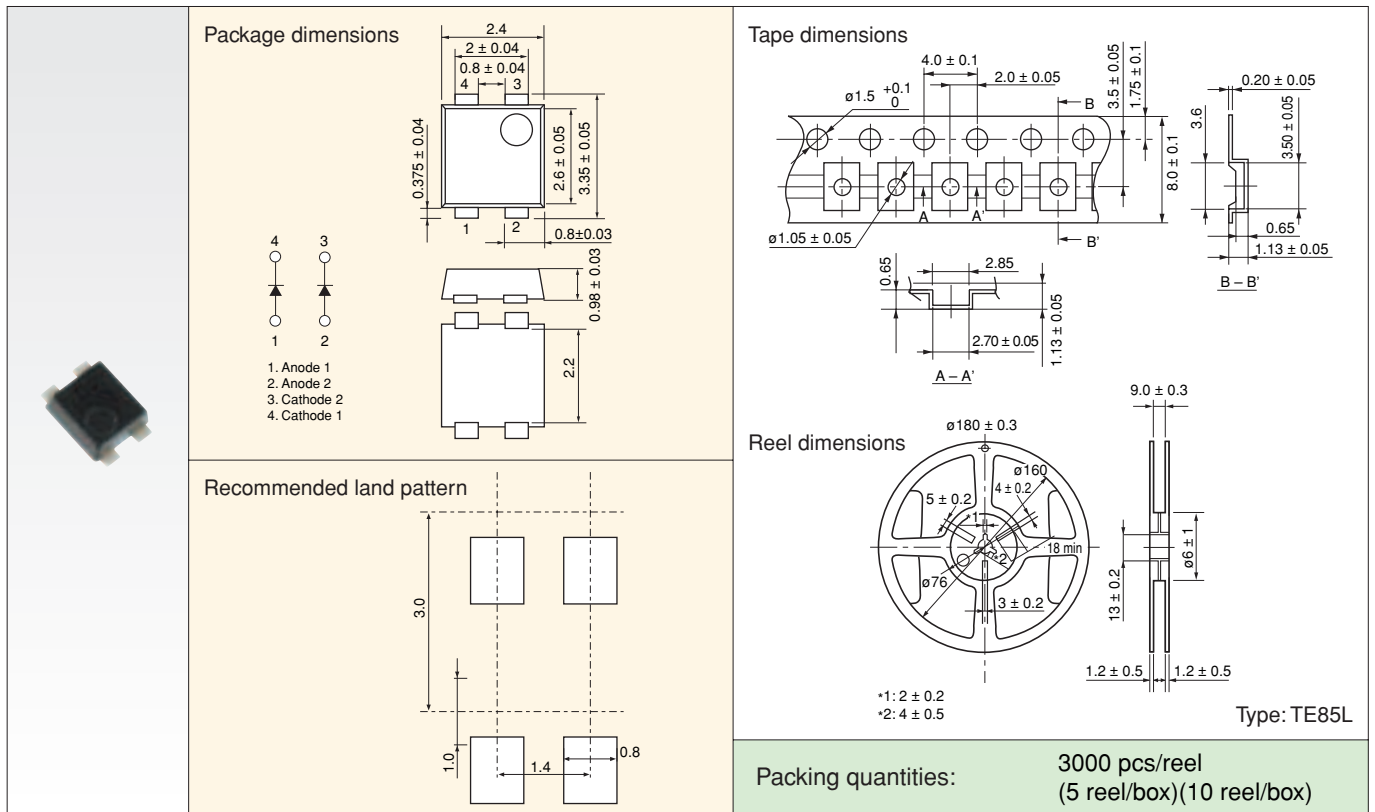
5. Packaging and Packing Information

SMALL & MEDIUM DIODES

5.1 Surface-Mount Packages

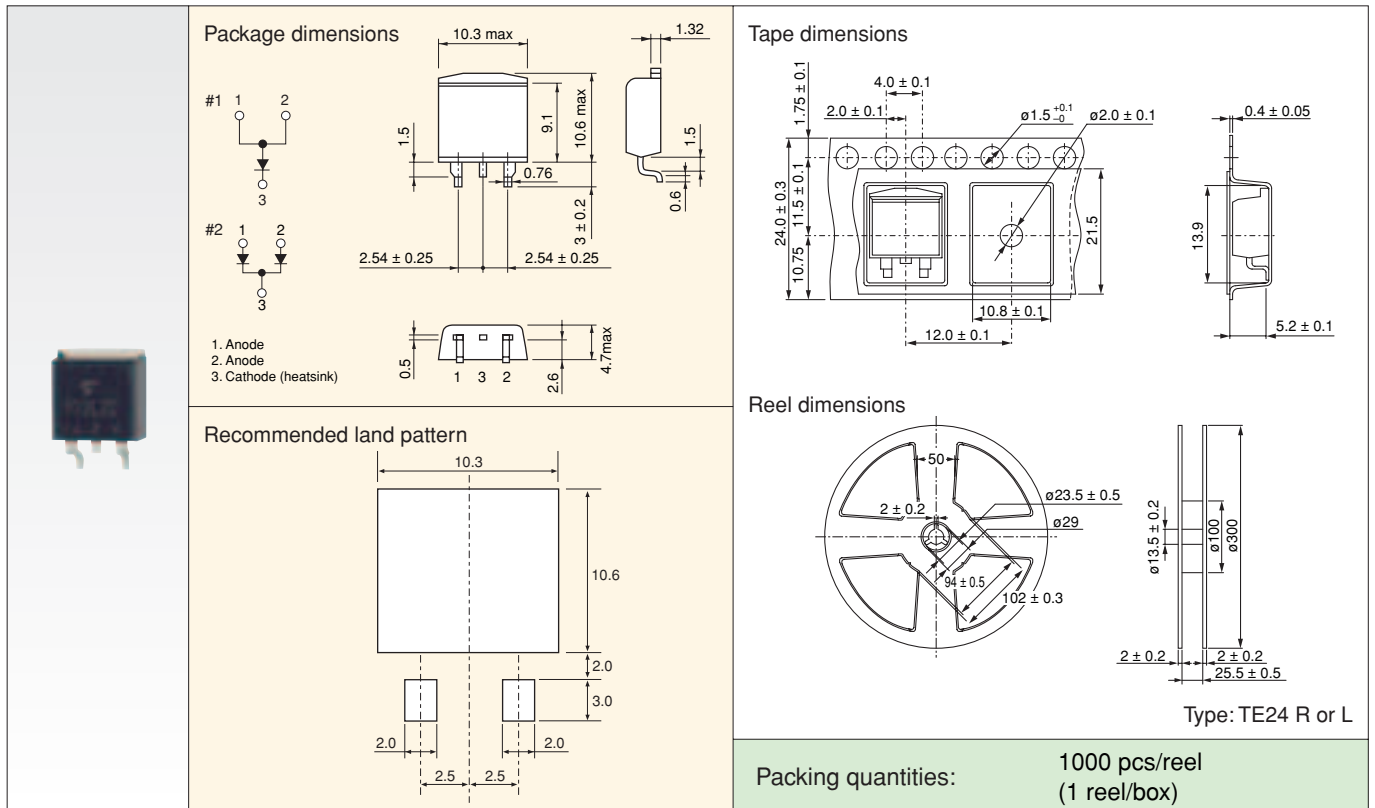
⑦ HM-FLAT

Unit: mm



⑧ TO-220SM

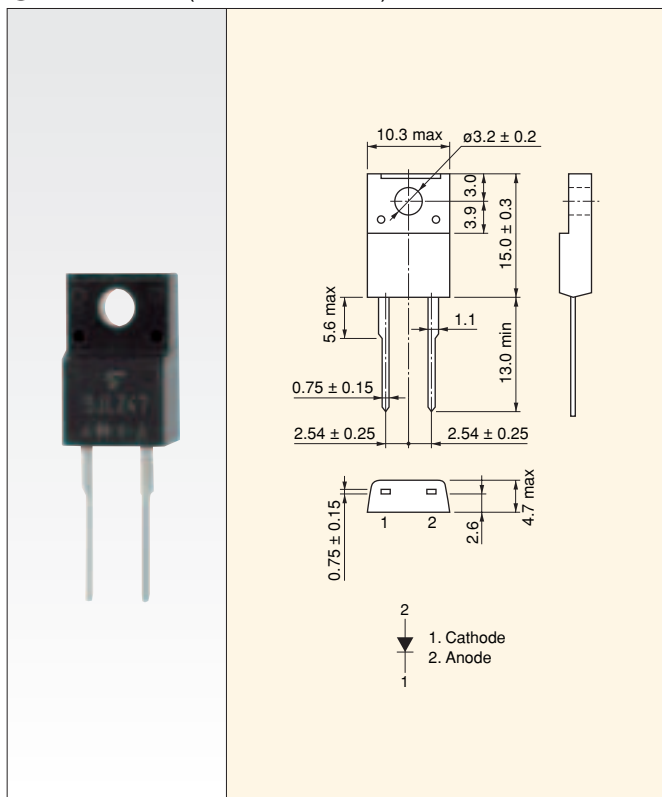
Unit: mm



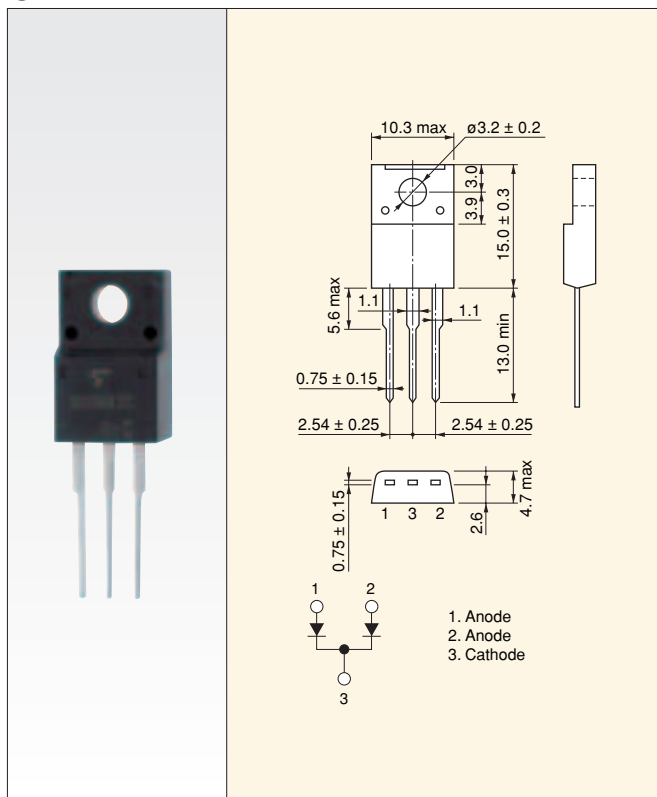
Note: The U10LC48 is configured as shown in #1 above. The other diodes in TO-220SM are configured as shown in #2. For details, see technical datasheets.

5.2 Through-Hole Packages

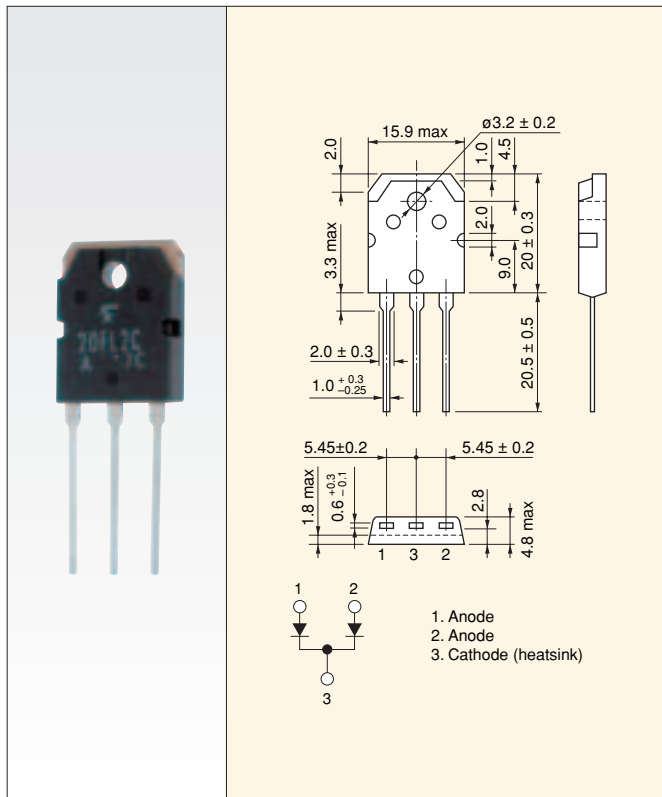
⑨ TO-220NIS (Center leadless)



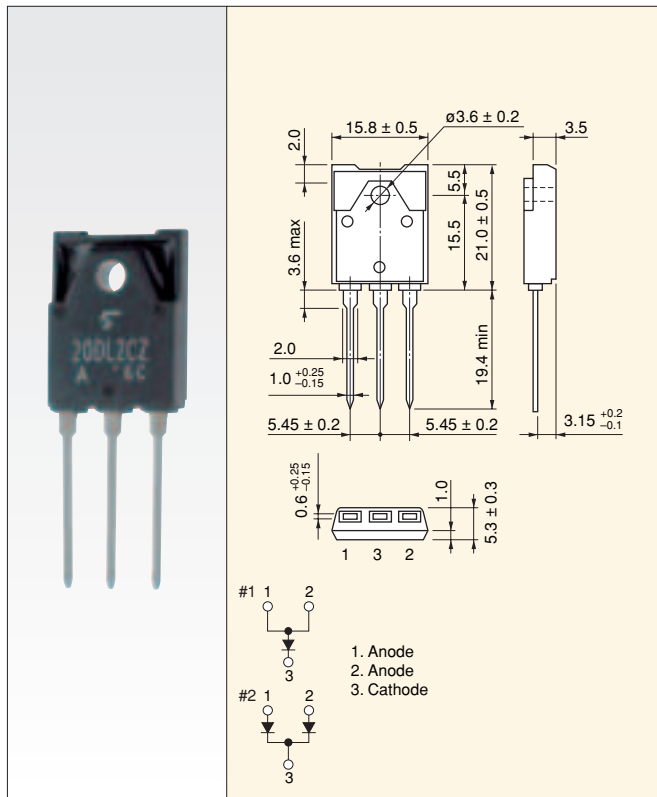
⑩ TO-220NIS



⑪ TO-3P(N)



⑫ TO-3P(N)IS



Note: The 12QHZ51 is configured as shown in #1 above. The other diodes in TO-3P(N)IS are configured as shown in #2. For details, see technical datasheets.

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