

TOSHIBA

Small Surface-Mount Rectifiers

S-FLAT™ and M-FLAT™ Series

Today's mobile and office automation equipment is becoming ever smaller and slimmer. In response to this market trend, Toshiba have developed an ultra-small surface-mount S-Flat package rectifier which allows high-density mounting. Toshiba offer a slim, miniature S-FLAT package with a height of 0.98 mm (typ.) and a mounting area 50% smaller than that of existing Toshiba products. The M-FLAT package has been achieved the height of 0.98 mm (approximately the half of existing I-FLAT package) and high current capacity (up to 5 A).



Applications

General-Purpose

- Rectification
- Reverse connection protection
- Free-wheeling

SBD/HED

- portable products
- Reverse-current protection
- Secondary rectification
- DC-DC converter

Power Zener Diodes

- Approx. 7.5 V: Voltage regulation
- 12 V~18 V: Gate protection for power MOSFETs
- 24 V~47 V: Surge absorption

Features

● S-FLAT™ Features

Toshiba offer a slim, miniature S-FLAT package with a height of 0.98 mm (typ.) and a mounting area 50% smaller than an existing I-FLAT package.

● M-FLAT™ Features

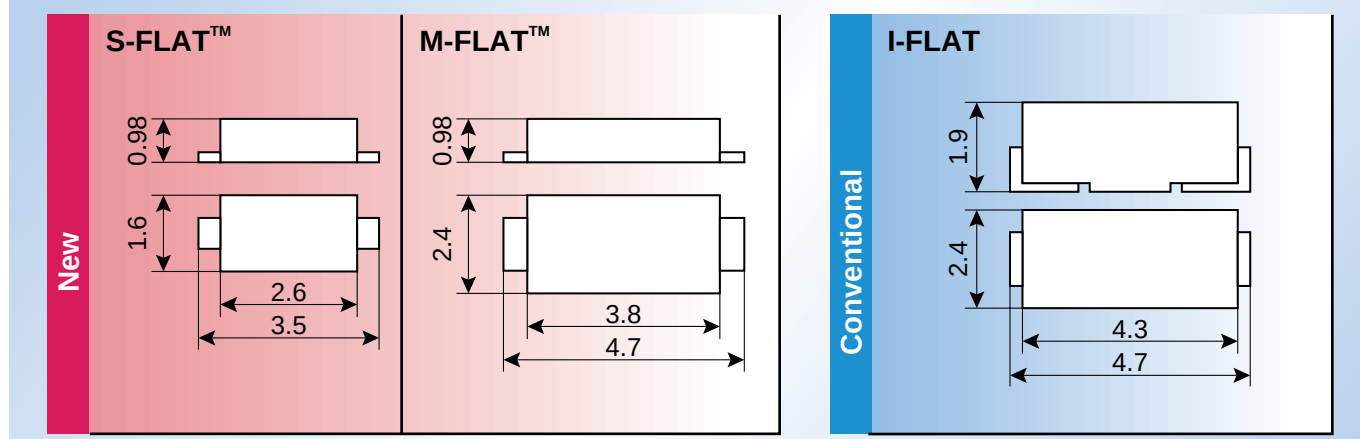
The M-FLAT package has been developed the I-FLAT as a base. By reducing the height to 0.98 mm (approximately the half of existing I-FLAT package) and optimizing the internal package frame, Toshiba have produced a device which offers high current capacity (up to 5 A) and lower power dissipation.

● Common Features

High surge current capability due to solder clamp structure.
Flat pins allow stable mounting on the PCB

■ Package comparison (Toshiba products only)

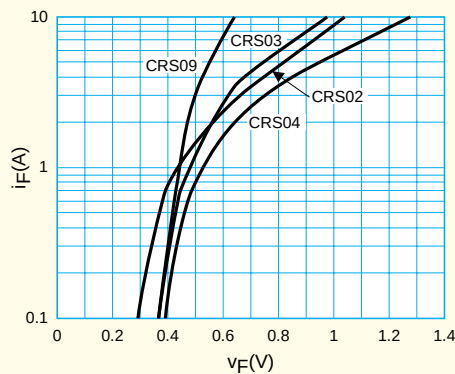
(Unit: mm)



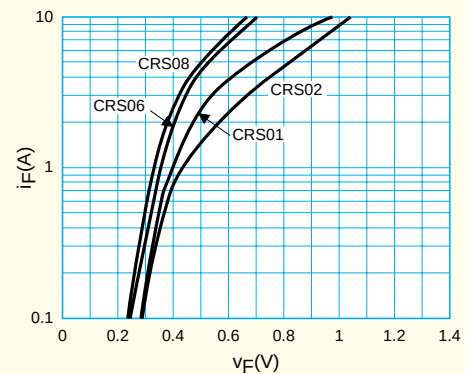
Line-up

Type	Product Number	Ratings	Features
General - Purpose	CRG01	0.7A/100V	Small package
	CRG02	0.7A/400V	Small package
SBDs	CRS01	1A/30V	Low - V_F Type ($V_{FM} = 0.37$ V@0.7 A, $I_{RRM} = 1.5$ mA@30 V)
	CRS02	1A/30V	Trench-SBD ($V_{FM} = 0.40$ V@0.7 A, $I_{RRM} = 0.05$ mA@30 V)
	CRS03	1A/30V	Low - I_R Type ($V_{FM} = 0.45$ V@0.7 A, $I_{RRM} = 0.1$ mA@30 V)
	CRS04	1A/40V	40 V withstand voltage SBD ($V_{FM} = 0.49$ V@0.7 A, $I_{RRM} = 0.1$ mA@40 V)
	CRS05	1A/30V	Low - I_R Type ($V_{FM} = 0.45$ V@1 A, $I_{RRM} = 5\mu$ A@5 V)
	CRS06	1A/20V	Low - V_F Type ($V_{FM} = 0.36$ V@1 A, $I_{RRM} = 1$ mA@20 V)
	CRS07	1A/20V	Low - V_F Type ($V_{FM} = 0.33$ V@1 A, $I_{RRM} = 1$ mA@20 V)
	CRS08	1.5A/30V	Low - V_F Type ($V_{FM} = 0.36$ V@1.5 A, $I_{RRM} = 1.0$ mA@30 V)
	CRS09	1.5A/30V	Low - I_R Type ($V_{FM} = 0.46$ V@1.5 A, $I_{RRM} = 0.05$ mA@30 V)
Power zener diodes	CRZ ser	0.7W/7.5~47V	High surge-protection capability
HEDs	CRH01	1A/200V	High-speed, high-efficiency rectifiers ($t_{rr} = 35$ ns max $V_{FM} = 0.98$ V@1.0 A)

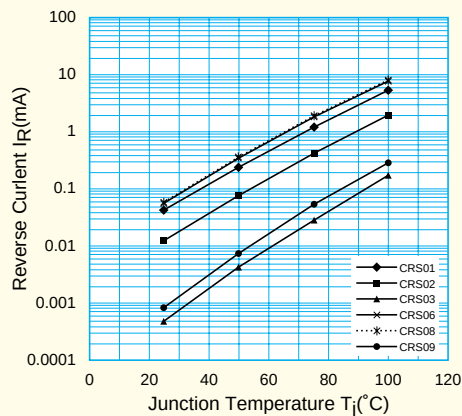
Low - I_R Type SBD
 i_F - v_F characteristics ($T_j = 25^\circ\text{C}$) (max)



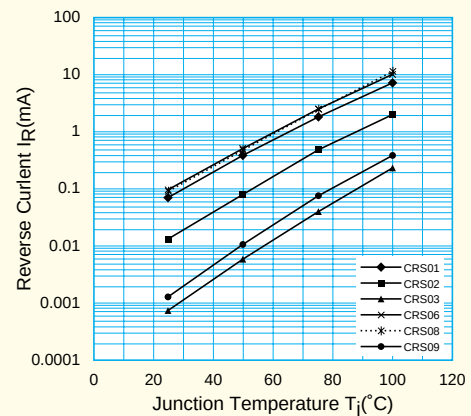
Low - V_F Type SBD
 i_F - v_F characteristics ($T_j = 25^\circ\text{C}$) (max)



SBD I_R - T_j @ $V_R = 5$ V ($T_j = 25^\circ\text{C}$)
(actual data for reference only)



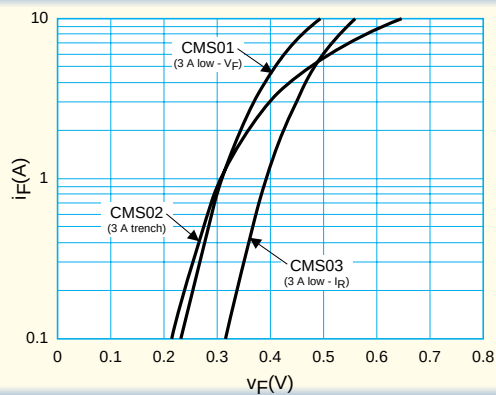
SBD I_R - T_j @ $V_R = 10$ V ($T_j = 25^\circ\text{C}$)
(actual data for reference only)



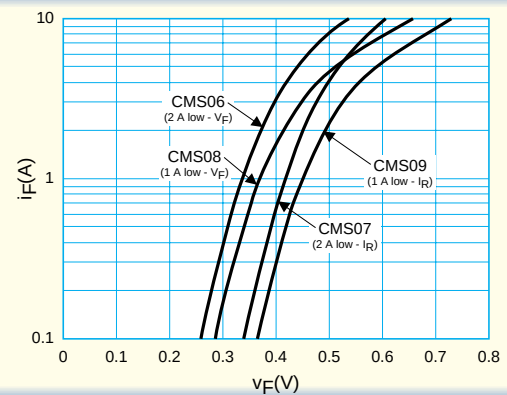
Line-up

Type	Product Number	Ratings	Features
SBDs	CMS01	3A/30V Low - V_F SBD	$V_{FM} = 0.37 \text{ V}@3 \text{ A}, I_{RRM} = 5 \text{ mA}@30 \text{ V}$
	CMS02	3A/30V Trench SBD	$V_{FM} = 0.40 \text{ V}@3 \text{ A}, I_{RRM} = 0.5 \text{ mA}@30 \text{ V}$
	CMS03	3A/30V Low - I_R SBD	$V_{FM} = 0.45 \text{ V}@3 \text{ A}, I_{RRM} = 0.5 \text{ mA}@30 \text{ V}$
	CMS04	5A/30V Low - V_F SBD	$V_{FM} = 0.37 \text{ V}@5 \text{ A}, I_{RRM} = 8 \text{ mA}@30 \text{ V}$
	CMS05	5A/30V Low - I_R SBD	$V_{FM} = 0.45 \text{ V}@5 \text{ A}, I_{RRM} = 0.8 \text{ mA}@30 \text{ V}$
	CMS06	2A/30V Low - V_F SBD	$V_{FM} = 0.37 \text{ V}@2 \text{ A}, I_{RRM} = 3 \text{ mA}@30 \text{ V}$
	CMS07	2A/30V Low - I_R SBD	$V_{FM} = 0.45 \text{ V}@2 \text{ A}, I_{RRM} = 0.5 \text{ mA}@30 \text{ V}$
	CMS08	1A/30V Low - V_F SBD	$V_{FM} = 0.37 \text{ V}@1 \text{ A}, I_{RRM} = 1.5 \text{ mA}@30 \text{ V}$
	CMS09	1A/30V Low - I_R SBD	$V_{FM} = 0.45 \text{ V}@1 \text{ A}, I_{RRM} = 0.5 \text{ mA}@30 \text{ V}$
	CMS10	1A/40V Normal SBD	$V_{FM} = 0.55 \text{ V}@1 \text{ A}, I_{RRM} = 0.5 \text{ mA}@40 \text{ V}$
	CMS11	2A/40V Normal SBD	$V_{FM} = 0.55 \text{ V}@2 \text{ A}, I_{RRM} = 0.5 \text{ mA}@40 \text{ V}$

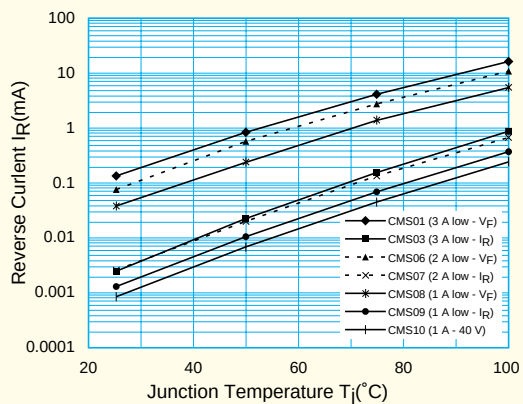
CMS01/CMS02/CMS03
 $i_F - v_F$ Characteristics ($T_j = 25^\circ\text{C}$) (max)



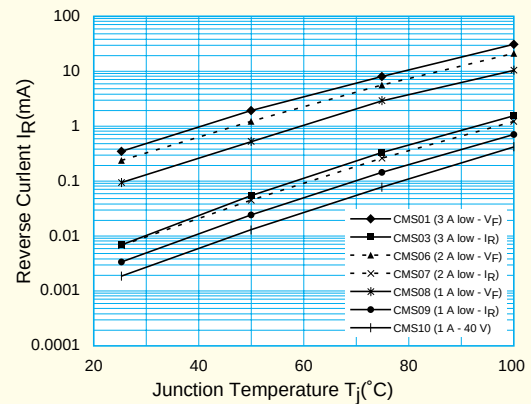
CMS06/CMS07/CMS08/CMS09
 $i_F - v_F$ Characteristics ($T_j = 25^\circ\text{C}$) (max)



SBD $I_R - T_j@V_R = 5 \text{ V}$ ($T_j = 25^\circ\text{C}$)
(actual data for reference only)



SBD $I_R - T_j@V_R = 15 \text{ V}$ ($T_j = 25^\circ\text{C}$)
(actual data for reference only)



M-FLAT™ Electrical Characteristics of SBDs

Product Number	Maximum Ratings					Electrical Characteristics			
	I _F (AV) (A)	V _{RRM} (V)	I _{FSM} (A)	T _j (°C)	T _{stg} (°C)	V _{FM} (V)	I _{FM} (A)	I _{RRM} (mA)	V _{RRM} (V)
CMS01	3	30	40	-40~125	-40~150	0.37	3	5	30
CMS02	3	30	40	-40~125	-40~150	0.4	3	0.5	30
CMS03	3	30	40	-40~150	-40~150	0.45	3	0.5	30
CMS04	5	30	60	-40~125	-40~150	0.37	5	8	30
CMS05	5	30	60	-40~150	-40~150	0.45	5	0.8	30
CMS06	2	30	40	-40~125	-40~150	0.37	2	3	30
CMS07	2	30	40	-40~150	-40~150	0.45	2	0.5	30
CMS08	1	30	25	-40~125	-40~150	0.37	1	1.5	30
CMS09	1	30	25	-40~150	-40~150	0.45	1	0.5	30
CMS10	1	40	25	-40~150	-40~150	0.55	1	0.5	40
CMS11	2	40	40	-40~150	-40~150	0.55	2	0.5	40

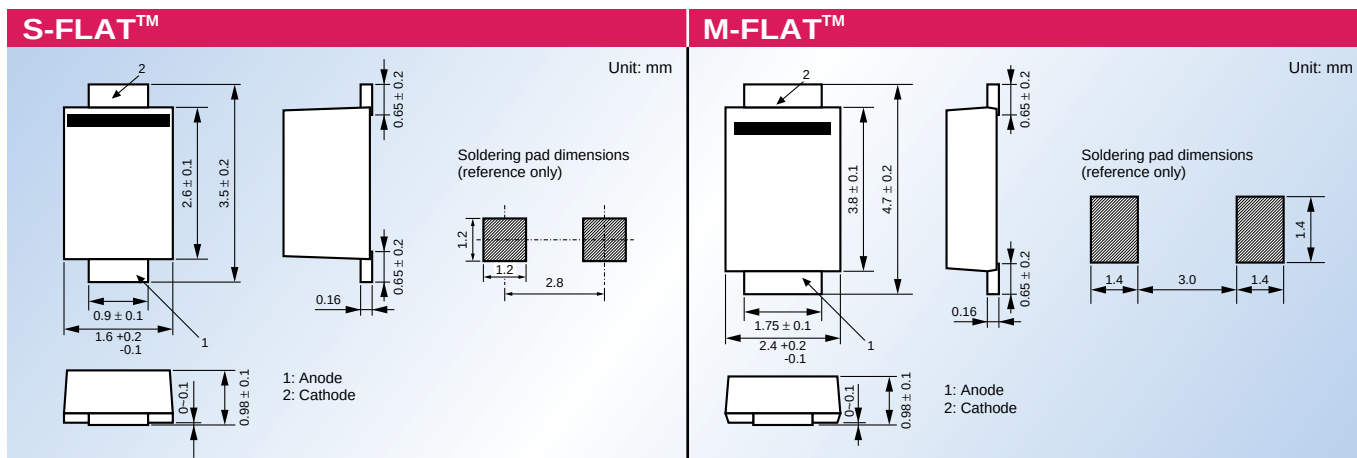
S-FLAT™ Electrical Characteristics of Rectifiers

Type	Product Number	Maximum Ratings					Electrical Characteristics				
		I _F (AV) (A)	V _{RRM} (V)	I _{FSM} (A)	T _j (°C)	T _{stg} (°C)	V _{FM} (V)	I _{FM} (A)	I _{RRM} (mA)	V _{RRM} (V)	t _{rr} (ns)
SBDs	CRS01	1	30	20	-40~125	-40~125	0.37	0.7	1.5	30	-
	CRS02	1	30	20	-40~125	-40~125	0.4	0.7	0.05	30	-
	CRS03	1	30	20	-40~150	-40~150	0.45	0.7	0.1	30	-
	CRS04	1	40	20	-40~150	-40~150	0.49	0.7	0.1	40	-
	CRS05	1	30	20	-40~150	-40~150	0.45	1	0.005	5	-
	CRS06	1	20	20	-40~125	-40~125	0.36	1	1	20	-
	CRS07	1	20	30	-40~125	-40~150	0.33	1	1	20	-
	CRS08	1.5	30	30	-40~125	-40~150	0.36	1.5	1	30	-
	CRS09	1.5	30	30	-40~150	-40~150	0.46	1.5	0.05	30	-
HEDs	CRH01	1	200	15	-40~150	-40~150	0.98	1	0.01	200	35
General-purpose rectifiers	CRG01	0.7	100	15	-40~150	-40~150	1.1	0.7	0.01	100	-
	CRG02	0.7	400	15	-40~150	-40~150	1.1	0.7	0.01	400	-

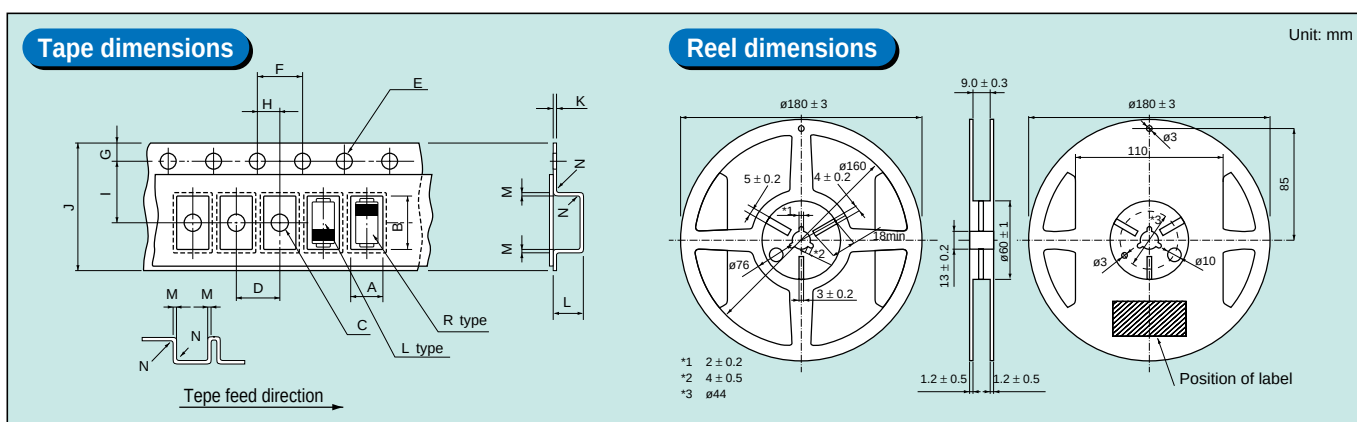
S-FLAT™ Electrical Characteristics of Zener Diodes

Product Number	Zener Voltage				Forward Voltage		Reverse Current	
	V _Z (V)			measuring current I _Z (mA)	V _F (V) max	measuring current I _F (A)	I _R (μA) max	measuring current V _R (V)
	min	typ.	max					
CRY7.5	6.75	7.5	8.25	10	1.0	0.2	10	4.5
CRY8.2	7.38	8.2	9.02	10	1.0	0.2	10	4.9
CRY9.1	8.19	9.1	10.01	10	1.0	0.2	10	5.5
CRZ10	9	10	11	10	1.0	0.2	10	6
CRZ11	9.9	11	12.1	10	1.0	0.2	10	7
CRZ12	10.8	12	13.2	10	1.0	0.2	10	8
CRZ13	11.7	13	14.3	10	1.0	0.2	10	9
CRZ15	13.5	15	16.5	10	1.0	0.2	10	10
CRZ16	14.4	16	17.6	10	1.0	0.2	10	11
CRZ18	16.2	18	19.8	10	1.0	0.2	10	13
CRZ20	18	20	22	10	1.0	0.2	10	14
CRZ22	19.8	22	24.2	10	1.0	0.2	10	16
CRZ24	21.6	24	26.4	10	1.0	0.2	10	17
CRZ27	24.3	27	29.7	10	1.0	0.2	10	19
CRZ30	27	30	33	10	1.0	0.2	10	21
CRZ33	29.7	33	36.3	10	1.0	0.2	10	26.4
CRZ36	32.4	36	39.6	9	1.0	0.2	10	28.8
CRZ39	35.1	39	42.9	8	1.0	0.2	10	31.2
CRZ43	38.7	43	47.3	7	1.0	0.2	10	34.4
CRZ47	42.3	47	51.7	6	1.0	0.2	10	37.6

Package Dimensions

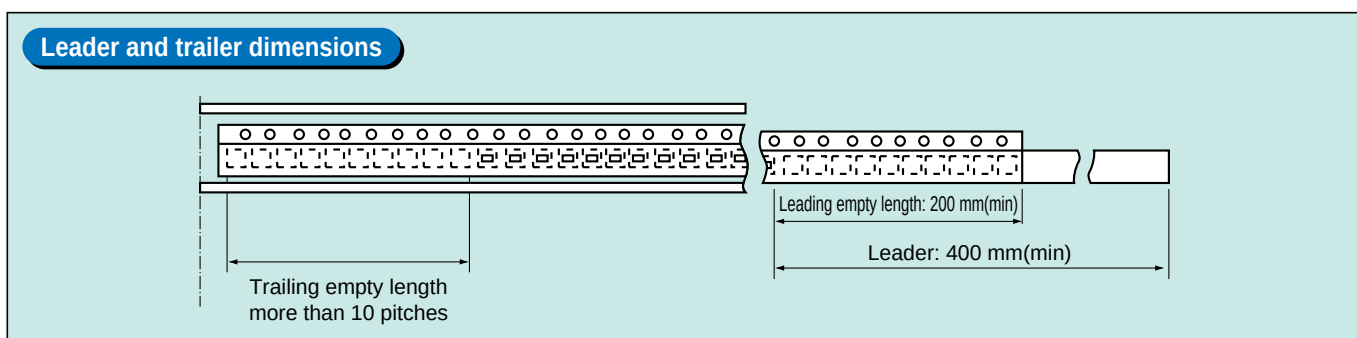


S-FLAT™ Embossed Tape Packing (TE85R, TE85L)



Unit: mm

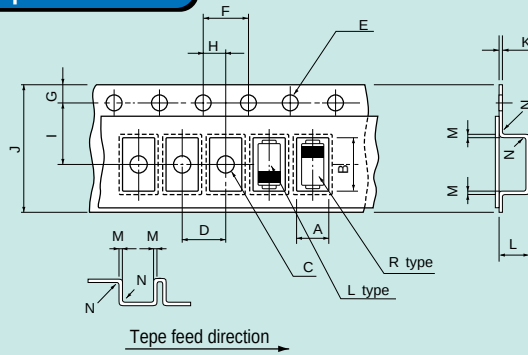
Item	Symbol	Dimension	Remarks
Device Recess	Length	A	1.9 ± 0.1
	Width	B	3.8 ± 0.1
	Diameter	C	ø1.1 ± 0.1
	Pitch	D	4.0 ± 0.1
Feed Hole	Diameter	E	ø1.5 ^{+0.1} / ₋₀
	Pitch	F	4.0 ± 0.1
	Lateral position	G	1.75 ± 0.1
Center - line Gap	Lengthwise direction	H	2.0 ± 0.1
	Crosswise direction	I	3.5 ± 0.1
Carrier Tape	Width	J	8.0 ± 0.3
	Thickness	K	0.2 ± 0.05
	Depth	L	1.25 ± 0.1
	Angle	M	5° max
	Curvature	N	R0.3 max



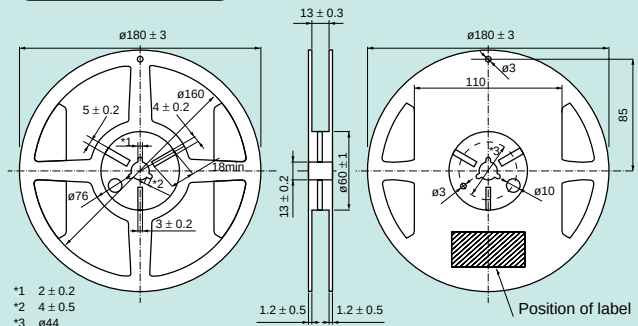
M-FLAT™ Embossed Tape Packing(TE12R,TE12L)

Unit: mm

Tape dimensions



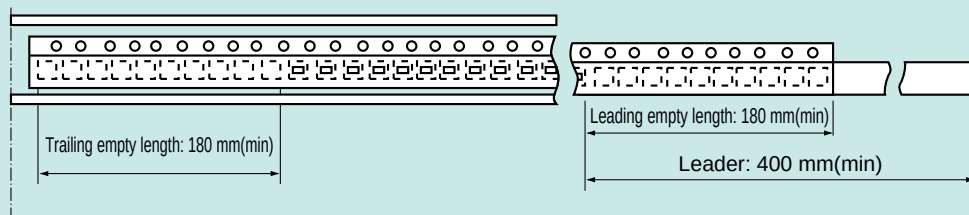
Reel dimensions



Unit: mm

Item	Symbol	Dimension	Remarks
Device Recess	Length	A	2.7 ± 0.1
	Width	B	5.0 ± 0.1
	Diameter	C	ø1.5 ± 0.1
	Pitch	D	4.0 ± 0.1
Feed Hole	Diameter	E	ø1.5 ± 0.1
	Pitch	F	4.0 ± 0.1
	Lateral position	G	1.75 ± 0.1
Center - line Gap	Lengthwise direction	H	2.0 ± 0.05
	Crosswise direction	I	5.5 ± 0.05
Carrier Tape	Width	J	12.0 ± 0.3
	Thickness	K	0.3 ± 0.05
	Depth	L	1.25 ± 0.1
	Angle	M	2° max
	Curvature	N	R0.2 max

Leader and trailer dimensions



**Toshiba America
Electronic Components, Inc.**

Headquarters-Irvine, CA
9775 Toledo Way, Irvine, CA 92618, U.S.A.
Tel: (949)455-2000 Fax: (949)859-3963

Boulder, CO
3100 Arapahoe Avenue, Ste. 500,
Boulder, CO 80303, U.S.A.
Tel: (303)442-3801 Fax: (303)442-7216

Boynton Beach, FL(Orlando)
11924 W. Forest Hill Blvd., Ste. 22-337,
Boynton Beach, FL 33414, U.S.A.
Tel: (561)374-6193 Fax: (561)374-6194

Deerfield, IL(Chicago)
One Pkwy., North, Suite 500, Deerfield,
IL 60015-2547, U.S.A.
Tel: (847)945-1500 Fax: (847)945-1044

Duluth, GA(Atlanta)
3700 Crestwood Parkway, Ste. 460,
Duluth, GA 30096, U.S.A.
Tel: (770)931-3363 Fax: (770)931-7602

Edison, NJ
2035 Lincoln Hwy. Ste. #3000, Edison
NJ 08817, U.S.A.
Tel: (732)248-8070 Fax: (732)248-8030

Orange County, CA
2 Venture Plaza, #500 Irvine, CA 92618, U.S.A.
Tel: (949)453-0224 Fax: (949)453-0125

Portland, OR
1700 NW 167th Place, #240,
Beaverton, OR 97006, U.S.A.
Tel: (503)629-0818 Fax: (503)629-0827

Richardson, TX(Dallas)
777 East Campbell Rd., Suite 650, Richardson,
TX 75081, U.S.A.
Tel: (972)480-0470 Fax: (972)235-4114

San Jose Engineering Center, CA
1060 Rincon Circle, San Jose, CA 95131, U.S.A.
Tel: (408)526-2400 Fax: (408)526-2410

Wakefield, MA(Boston)
401 Edgewater Place, Suite #360, Wakefield,
MA 01880-6229, U.S.A.
Tel: (781)224-0074 Fax: (781)224-1095

Toshiba Do Brasil S.A.

Electronic Components Div.
Estrada Dos Alvarengas, 5. 500-Bairro Alvarenga
09850-550-Sao Bernardo do campo - SP
Tel: (011)7689-7171 Fax: (011)7689-7189

**Toshiba Electronics Europe GmbH
Düsseldorf Head Office**

Hansaallee 181, D-40549 Düsseldorf
Germany
Tel: (0211)5296-0 Fax: (0211)5296-400

München Office
Büro München Hofmannstrasse 52,
D-81378, München, Germany
Tel: (089)748595-0 Fax: (089)748595-42

Toshiba Electronics France SARL
Immeuble Robert Schumann 3 Rue de Rome,
F-93561, Rosny-Sous-Bois, Cedex, France
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

Toshiba Electronics Italiana S.R.L.
Centro Direzionale Colleoni
Palazzo Perseo Ingr. 2-Piano 6,
Via Paracelso n.12,
1-20041 Agrate Brianza Milan, Italy
Tel: (039)68701 Fax: (039)6870205

Toshiba Electronics España, S.A.
Parque Empresarial San Fernando Edificio Europa,
1ª Planta, ES-28831 Madrid, Spain
Tel: (91)660-6700 Fax: (91)660-6799

Toshiba Electronics(UK) Limited
Riverside Way, Camberley Surrey,
GU15 3YA, U.K.
Tel: (01276)69-4600 Fax: (01276)69-4800

Toshiba Electronics Scandinavia AB
Gustavslundsvägen 12, 2nd Floor
S-161 15 Bromma, Sweden
Tel: (08)704-0900 Fax: (08)80-8459

**Toshiba Electronics Asia
(Singapore) Pte. Ltd.**

Singapore Head Office
438B Alexandra Road, #06-08/12 Alexandra
Technopark, Singapore.119968
Tel: (278)5252 Fax: (271)5155

Bangkok Office
135 Moo 5 Bangkadi Industrial Park, Tivanon Rd.,
Bangkadi Amphur Muang Pathumthani, Bangkok, 12000,
Thailand
Tel: (02)501-1635 Fax: (02)501-1638

**Toshiba Electronics Trading
(Malaysia)Sdn. Bhd.**

Kuala Lumpur Head Office
Suite W1203, Wisma Consplant, No.2,
Jalan SS 16/4, Subang Jaya, 47500 Petaling Jaya,
Selangor Darul Ehsan, Malaysia
Tel: (3)731-6311 Fax: (3)731-6307

Penang Office
Suite 13-1, 13th Floor, Menard Penang Garden,
42-A, Jalan Sultan Ahmad Shah,
100 50 Penang, Malaysia
Tel: 4-226-8523 Fax: 4-226-8515

Toshiba Electronics Philippines, Inc.

26th Floor, Citibank Tower, Valero Street, Makati,
Manila, Philippines
Tel: (02)750-5510 Fax: (02)750-5511

Toshiba Electronics Asia, Ltd.

Hong Kong Head Office
Level 11, Top Glory Insurance Building, Grand Century
Place, No.193, Prince Edward Road West,
Mong Kok, Kowloon, Hong Kong
Tel: 2375-6111 Fax: 2375-0969

Beijing Office
Rm 714, Beijing Fortune Building,
No.5 Dong San Huan Bei-Lu, Chao Yang District,
Beijing, 100004, China
Tel: (010)6590-8795 Fax: (010)6590-8791

Chengdu Office
Unit F, 18th Floor, New Times Plaza, 42 Wenwu Road,
Xinhua Avenue, Chengdu, 610017, China
Tel: (028)675-1773 Fax: (028)675-1065

Shenzhen Office
Rm 3010-3012, Office Tower Shun Hing Square,
Di Wang Commercial Centre, 333 ShenNan
East Road, Shenzhen, 518008, China
Tel: (0755)246-1582 Fax: (0755)246-1581

Toshiba Electronics Korea Corporation

Seoul Head Office
14/F, KEC B/D, 257-7 Yangjae-Dong,
Seocho-ku, Seoul, Korea
Tel: (02)589-4334 Fax: (02)589-4302

Gumi Office
6/F, Ssangyong Investment Securities B/D,
56 Songjung-Dong, Gumi City
Kyeongbuk, Korea
Tel: (82)54-456-7613 Fax: (82)54-456-7617

**Toshiba Technology Development
(Shanghai) Co., Ltd.**

23F, Shanghai Senmao International Building, 101
Yin Cheng East Road, Pudong New Area, Shanghai,
200120, China
Tel: (021)6841-0666 Fax: (021)6841-5002

**Tsurong Xiamen Xiangyu Trading
Co., Ltd.**

8N, Xiamen SEZ Bonded Goods Market Building,
Xiamen, Fujian, 361006, China
Tel: (0592)562-3798 Fax: (0592)562-3799

**Toshiba Electronics Taiwan
Corporation**

Taipei Head Office
17F, Union Enterprise Plaza Bldg. 109
Min Sheng East Rd., Section 3, 0446 Taipei,
Taiwan
Tel: (02)514-9988 Fax: (02)514-7892

Kaohsiung Office
16F-A, Chung-Cheng Bldg., Chung-Cheng 3Rd.,
80027, Kaohsiung, Taiwan
Tel: (07)222-0826 Fax: (07)223-0046

The information contained herein is subject to change without notice.

The information contained herein is presented only as a guide for the applications of our products.
No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.

TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..

The Toshiba products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These Toshiba products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of Toshiba products listed in this document shall be made at the customer's own risk.

In Touch with Tomorrow
TOSHIBA

TOSHIBA CORPORATION

Electronic Devices Sales & Marketing Group
1-1, Shibaura 1-chome, Minato-ku, Tokyo, 105-8001, Japan
Tel: (03)3457-3405 Fax: (03)5444-9431