TOSHIBA

Thyristors and Triacs

PRODUCT GUIDE

1 Overview

Features

Thyristors

General-Purpose Thyristors

A variety of non-insulated and insulated thyristors is available.
Non-insulated thyristors range from 0.3 A to 10 A and insulated thyristors range from 3 A to 25 A. These can be applied to tape packing, lead forming and other applications.
In the insulated thyristors, there is no exposed metal on the resin surface. The standard products have an isolation voltage of 1500 V and a high-isolation voltage of 2500 V.

Special-Purpose Thyristor

Thyristor for high-speed, stroboscopic, TV and discharge lamp applications

Triacs

General-Purpose Triacs

A variety of non-insulated and insulated triacs is available.
Non-insulated thyristors range from 0.8 A to 16 A and insulated thyristors range from 2 A to 25 A. In the insulated thyristors, there is no exposed metal on the resin surface. The standard products have an isolation voltage of 1,500 V and a high-isolation voltage of 2,500 V.

Special-Purpose Triacs

We have triacs for high-rush-current loads, too, with greatly improved ability to withstand repetitive rush currents.

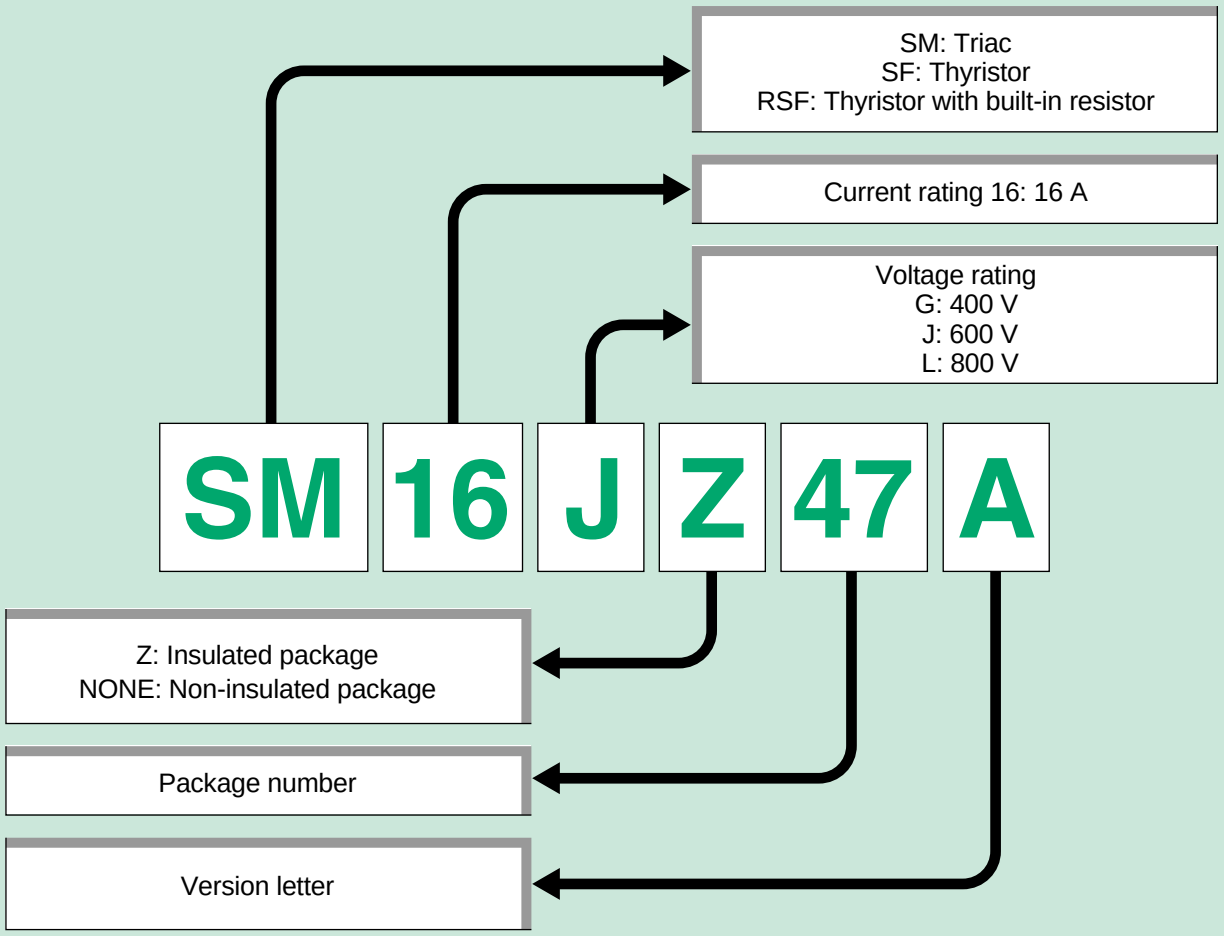
Symbols and Terms

Symbols	Usage	Definition
V_{RRM}	Repetitive peak reverse voltage	Maximum allowable instantaneous value of reverse voltage repeatedly applicable between anode and cathode
V_{DRM}	Repetitive peak OFF-state voltage	Maximum allowable instantaneous value of OFF-state voltage repeatedly applicable between anode and cathode (betweer T1 and T2 for triacs)
$I_{T(AV)}$	Average ON-state current	Average value of continuously conductible ON-state current (applied to thyristors and stipulated by a half sine wave of commercial frequency)
$I_{T(RMS)}$	RMS ON-state current	RMS value of continuously conductible ON-state current (applied to triacs and stipulated by whole sine waves of commercial frequency)
di/dt	Critical rate of rise of ON-state current	Maximum rate of rise of ON-state current allowable when a device is turned on
I_{TSM}	Peak one-cycle surge ON-state current	Peak one-cycle ON-state current allowable for non-repetitive conduction
I_{TRM}	Repetitive peak surge ON-state current	Peak ON-state current allowable for repetitive conduction
V_{FGM} (V_{GM})	Peak forward gate voltage (peak gate voltage)	Maximum allowable instantaneous value of forward gate voltage repeatedly applicable between gate and cathode (between gate and T1 for triacs)
V_{RGM}	Peak reverse gate voltage	Maximum allowable instantaneous value of reverse gate voltage repeatedly applicable between gate and cathode
I_{GM}	Peak forward gate current	Maximum allowable instantaneous value of forward gate current repeatedly applicable between gate and cathode (between gate and T1 for triacs)
P_{GM}	Peak gate power dissipation	Maximum allowable instantaneous value of gate power dissipation
$P_{G(AV)}$	Average gate power dissipation	Allowable average value of gate power dissipation
I_{RRM}	Repetitive peak reverse current	Leakage current flowing at the time of reverse voltage application between anode and cathode
I_{DRM}	Repetitive peak OFF-state current	Leakage current flowing at the time of OFF-state voltage application between anode and cathode (between T1 and T2 for triacs)
V_{TM}	Peak ON-state voltage	Peak ON-state voltage value between anode and cathode (between T1 and T2 for triacs) when the device is in ON-state.
V_{GT}	Gate trigger voltage	Minimum gate voltage necessary to turn on devices
I_{GT}	Gate trigger current	Minimum gate current necessary to turn on devices
tgt	Turn-ON time	Duration from gate current conduction to ON state of devices
tq	Turn-OFF time	Duration to device's recovery of its forward current blocking ability after ON-state current decreases and becomes zero
dv/dt	Critical rate of rise of OFF-state voltage	Maximum rate of rise of OFF-state voltage which can be applied without switching to ON-state
(dv/dt)c	Critical rate of rise of OFF-state voltage at the time of commutation	Maximum rate of rise of OFF-state voltage not allowing a device to switch ON state even when reverse voltage is applied immediately after the ON-state current decreases and becomes zero
$R_{th(j-a)}$, $R_{th(j-c)}$	Thermal resistance	Temperature difference per watt between two points (between junction and surrounding space and between junction and case) when a device is thermally balanced
V_{ISOL}	Isolation voltage	Voltage applicable between lead and case when the device has an insulated package (usually AC, and indicated by its r.m.s.)

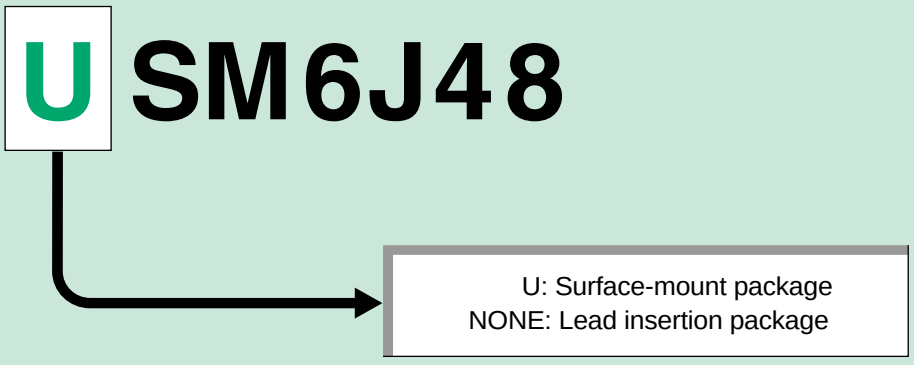
* Every item is specified under particular conditions which are stated in the technical data sheet for each product. For the conditions, please refer to each.

Identification

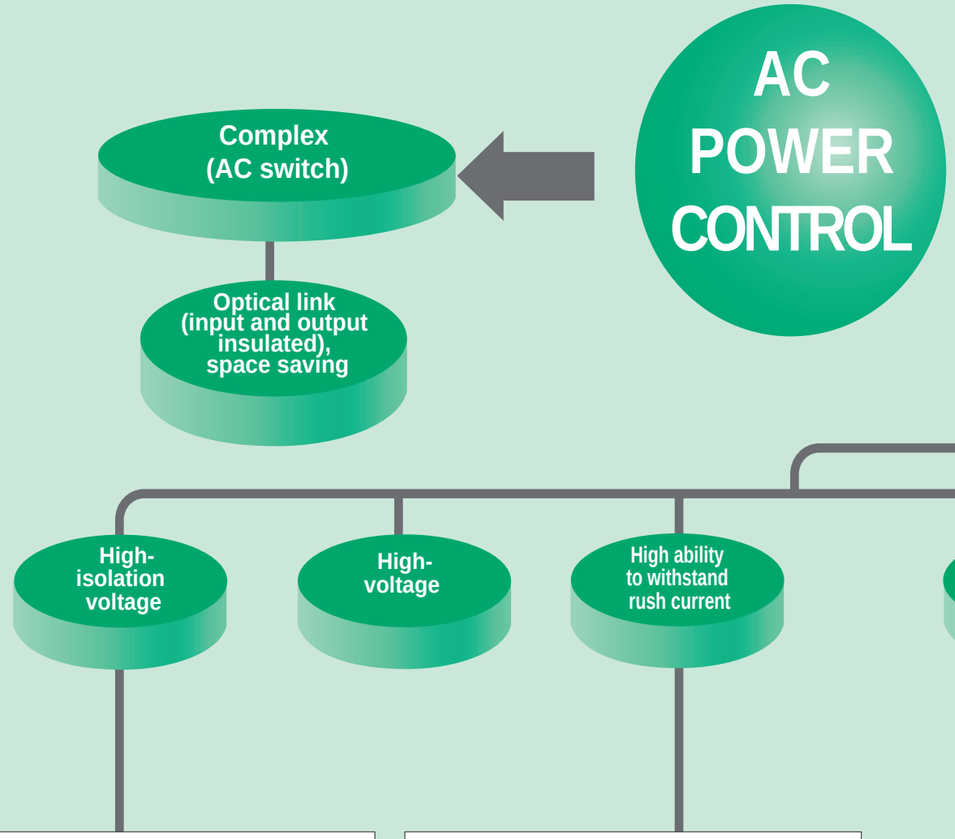
Example 1. SM16JZ47A (Insulated 16A Triac)



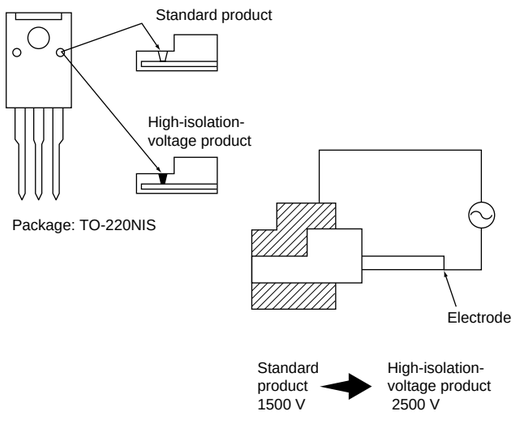
Example 2. USM6J48 (Surface-Mounting 6A Triac)



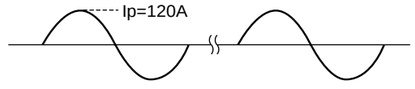
2 Development Trends



Improved isolation voltage performance (resin potting)

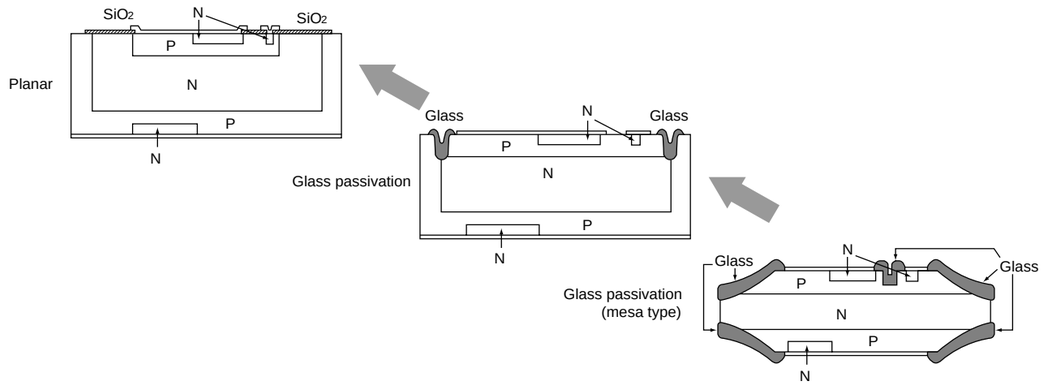


High-rush-current-withstanding triac



- Strong ability to withstand repetitive surge currents
- Assured number of repetitive cycles
  I p = 120 A
  n = 100 kcycle

Pellet evolution (illustration)



3 New Product Information

High-Sensitivity Triac SM2GZ47A Series for 1 A Loads

High-Sensitivity with Insulated Package

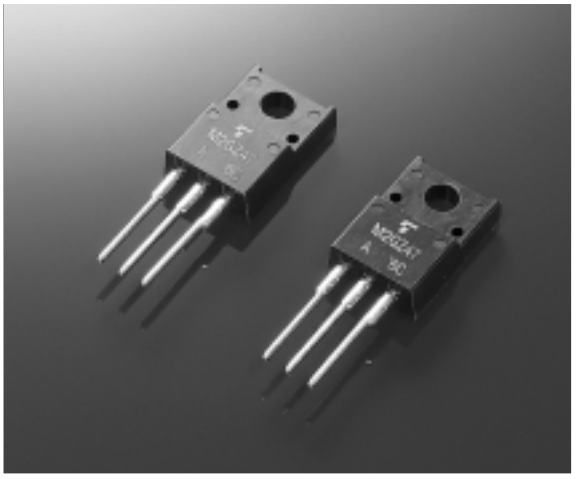
Overview

Toshiba has developed a high-sensitivity triac capable of controlling 1 A RMS; without a heat sink.
It is most suitable for controlling apparatus such as heaters rated less than 100 W.

Features

- High-sensitivity: I_{GT} = 5 mA max (SM2GZ47A)
- Capable of controlling 1 A RMS; without a heat sink.
  $I_{T\,(RMS)}$ = 1 A @Ta = 65°C; without a heat sink.
- Insulated package: model TO-220NIS

Package Appearance

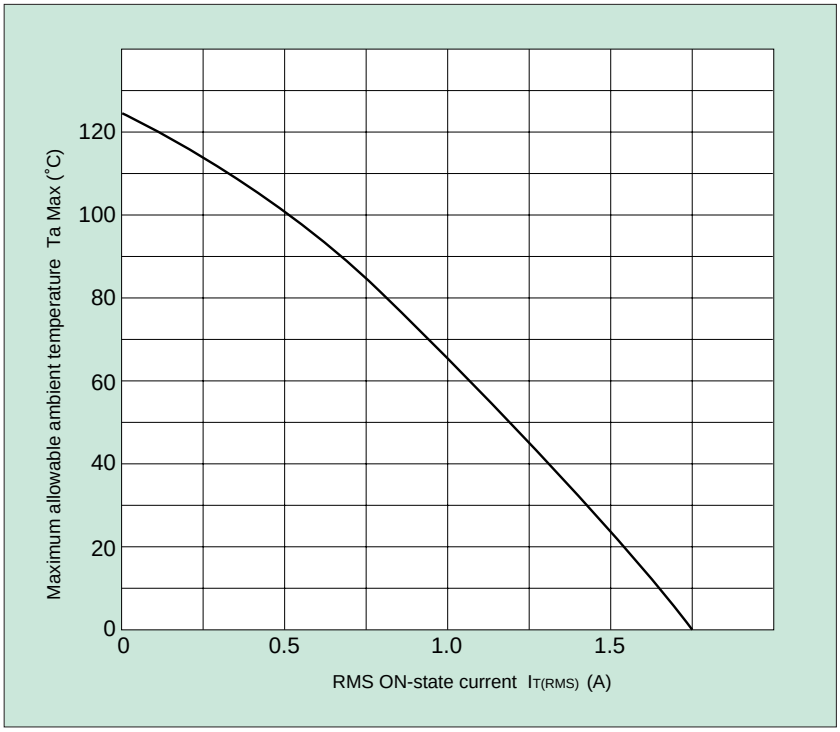


TO-220NIS

Main Ratings and Characteristics

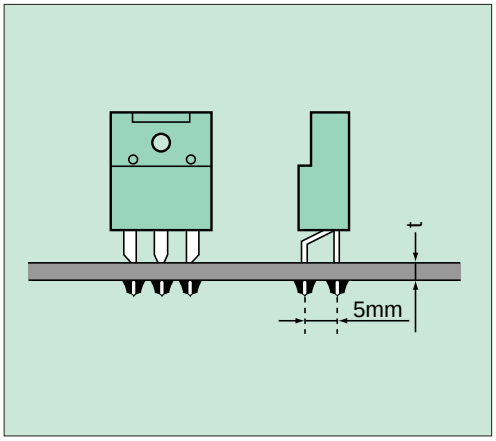
Item		Symbol	Rating and Characteristics	Condition
RMS ON-state current		$I_{T(RMS)}$	1 A	Ta = 65°C; without a heat sink
Gate trigger current	SM2GZ47	I_{GT}	8 mA max	V_D = 12 V, I, II, III quadrants
	SM2GZ47A		5 mA max	
Repetitive peak OFF-state voltage		V_{DRM}	400 V/600 V	———
Peak one-cycle surge ON-state current		I_{TSM}	8 A	f = 50 Hz

Ta Max - $I_{T\,(RMS)}$ without a heat sink



Conditions

- No heat sink; device itself radiates heat
- Leadforming: LB107
- Paper Epoxy board used
- t = 1.6 mm
- Soldering land: 2 mmø



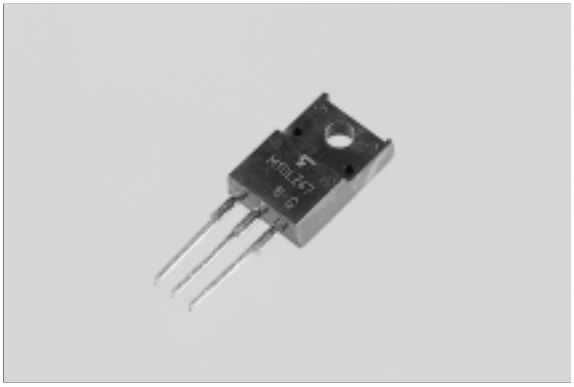
High-Voltage (800 V) Triac 1A~10A Series

High-Voltage: V_{DRM} = 800 V

Overview

Toshiba has developed a high-voltage triac with 800V-OFF-state- voltage rating, which is most suitable for high-voltage applications, including reversible rotation motor in 200V-line-voltage.

Package Appearance

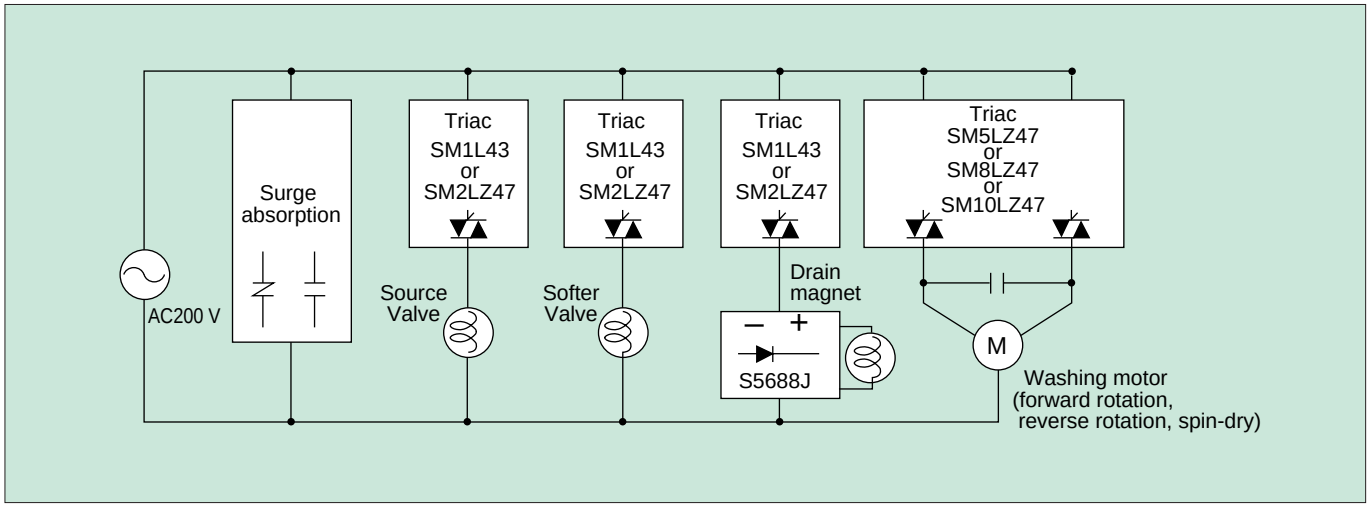


Features

- High-voltage: V_{DRM} = 800 V
- Insulated package: TO-220NIS type (2A, *5A, 8A, 10A)
  V_{ISOL} = 1500 V (AC, t = 60 s)
- Compact package: TO-92 type (1A)

*Under development

Example Application (washing machine)



Main Ratings and Characteristics: SM10LZ47

Item	Symbol	Rating and Characteristics	Condition
Repetitive peak OFF-state voltage	V_{DRM}	800 V	
RMS ON-state current	$I_{T(RMS)}$	10 A	
Peak one-cycle surge ON-state current	I_{TSM}	100 A	f = 50 Hz, non-repetitive
Gate trigger current	I_{GT}	30 mA (max)	V_D = 12 V, R_L = 20Ω
Peak ON-state voltage	V_{TM}	1.5 V (max)	I_{TM} = 15 A
Repetitive peak OFF-state current	I_{DRM}	20 μA (max)	V_{DRM} = 800 V

3 New Product Information

High-Isolation-Voltage Version TO-220NIS (E) Series

TO-220NIS package with improved insulation performance

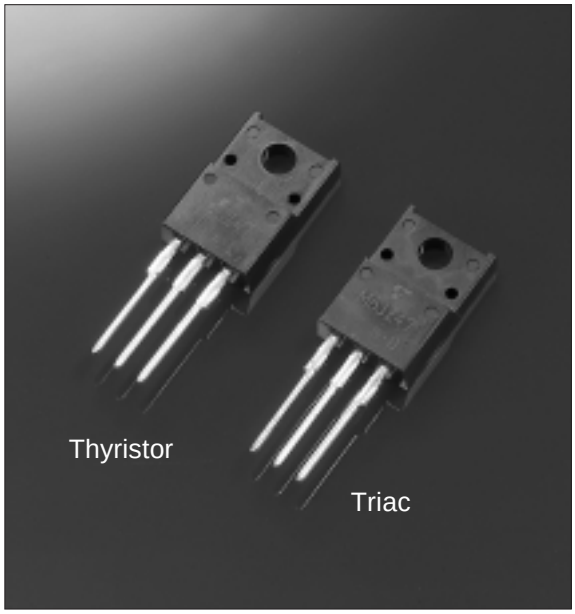
Overview

Toshiba has developed a high-isolation-voltage version of the TO-220NIS insulated package.
This is known as the (E) Series package.
The new package boasts insulation performance far superior to that of the standard package, yet is the same size.

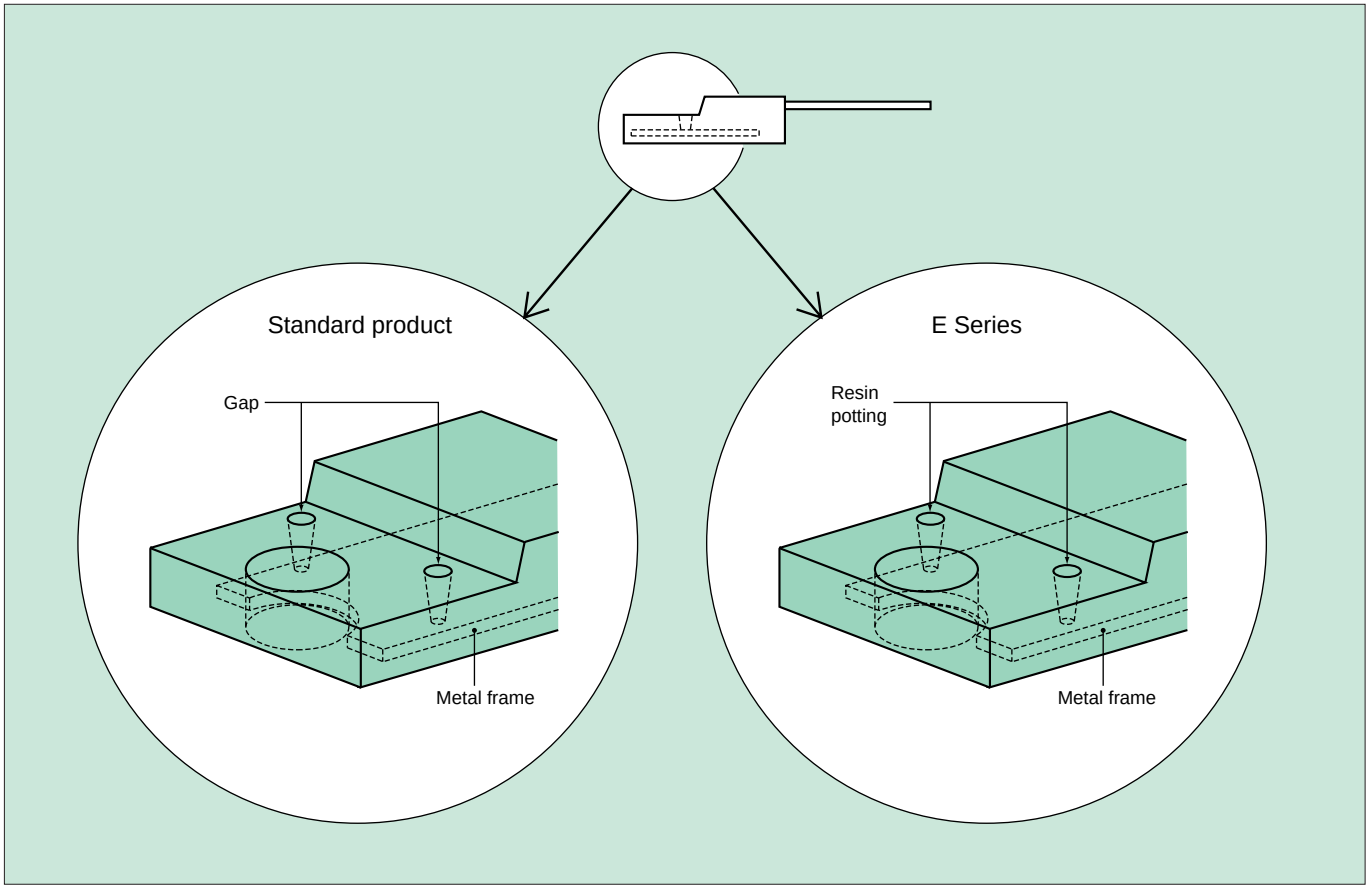
Features

- High-isolation-voltage is assured
  Isolation voltage: V_{ISOL} = 2500 V RMS (AC, t = 60 s)
  Lightning surge: 1.2 x 50 μs V_P = 6 kV
- Corresponds to all TO-220NIS Model basically
  For example, SM16JZ47 (E)

Package Appearance



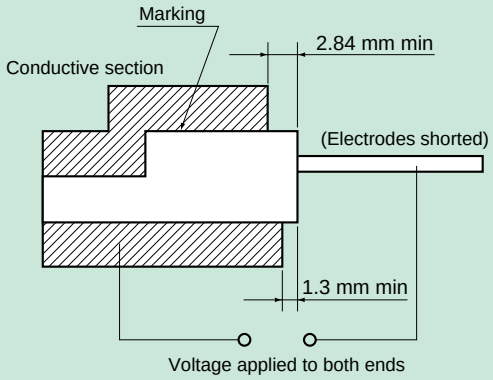
Structural Comparison



Insulation Performance Test

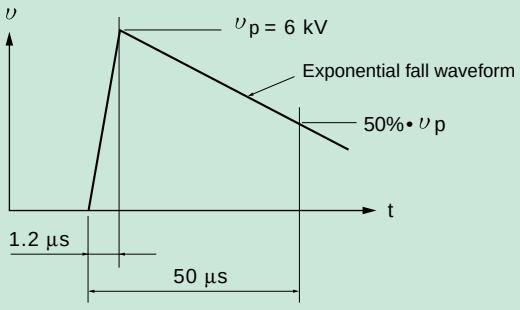
AC insulation test

- Ta = 25˚C
- RH ≦ 60%
- AC 2500 VRMS applied, t = 60 s



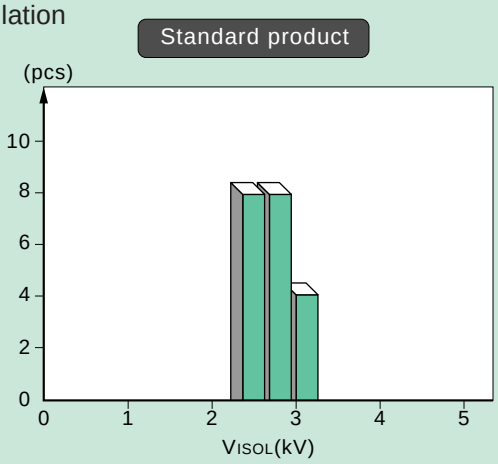
Lightning surge test

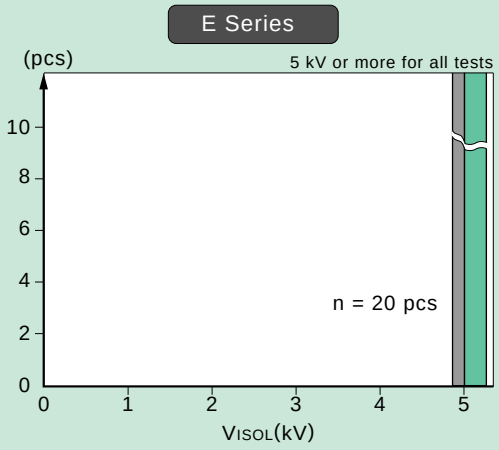
- Ta = 25˚C
- RH ≦ 60%
- One cycle applied as shown below



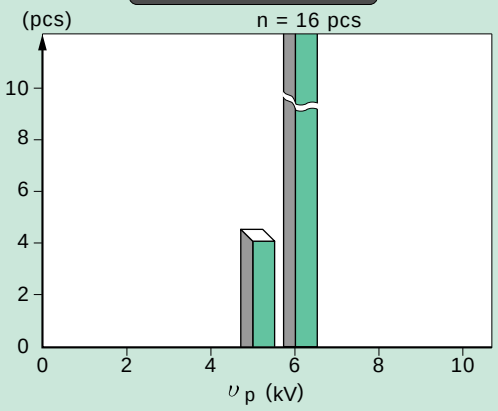
Test Data 1 (reference)

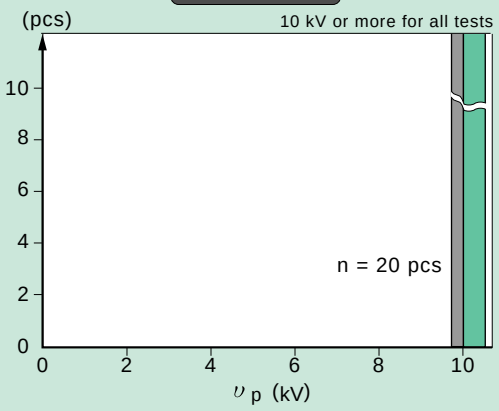
AC Insulation Test





Lightning Surge Test





(Note: Test results may differ depending upon the surrounding environment, measuring jigs, etc.
Standard products are tested during installation with M3 screws; there is no metal plate on the mark surface.)

3 New Product Information

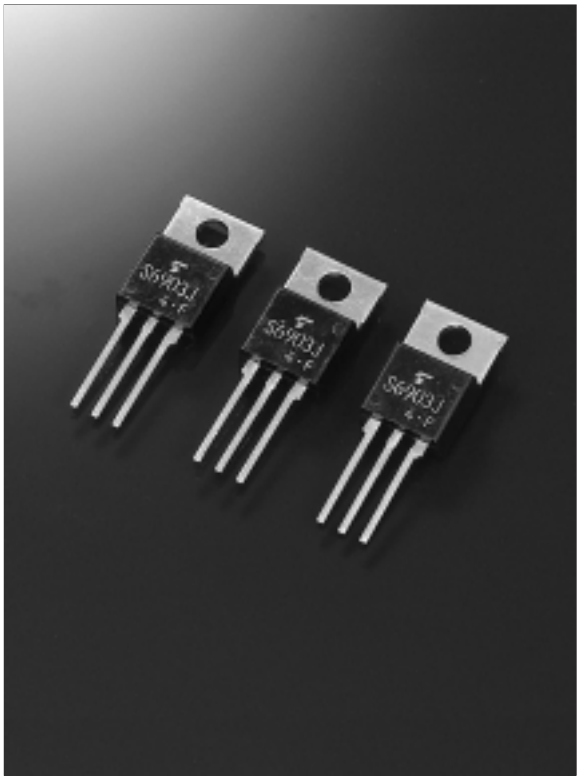
High-Rush-Current-Withstanding Triac S6903G Series

Enhanced ability to withstand repetitive rush currents

Overview

Toshiba has developed a high-rush-current-withstanding triac with greatly enhanced repetitive rush-current-withstanding ability. It is now possible to provide assurances (previously difficult) as to the level of repetitive surge current and the number of repetitive cycles. This triac is most suitable for controlling actuators that generates high-rush current.

Package Appearance



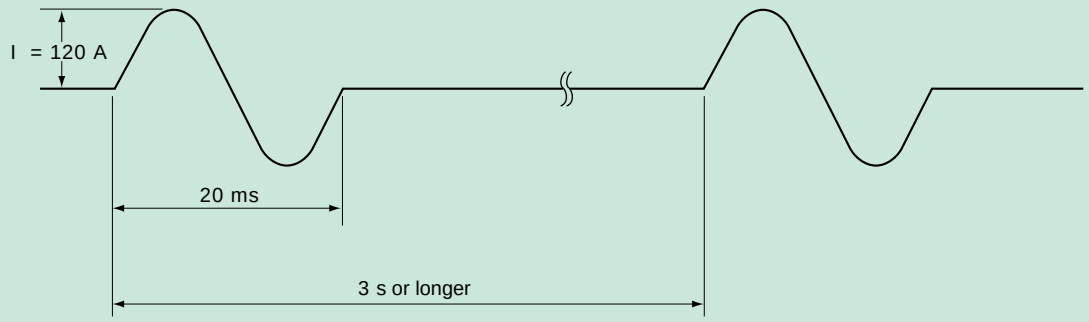
Features

- Strong ability to withstand repetitive surge current
- Assurance of the number of repetitive cycles is available

Main Ratings and Characteristics

Item	Symbol	Rating and Characteristics	Condition
Repetitive surge ON-state current (Figure 1)	I_{TRM}	120 A	n = 100 kcycle, Tc = 45˚C
Non-repetitive surge On-state current	I_{TSM}	200 A	f = 60 Hz, Tc = 125˚C
RMS ON-state current	$I_{T(RMS)}$	20 A	Whole sine waves Tc = 100˚C
Gate trigger current	I_{GT}	30 mA max	V_D = 12 V, R_L = 20Ω
Thermal resistance (between junction and case)	Rth(j-c)	1˚C/W max	Alternating current

Figure 1. Repetitive Surge ON-State Current



Ip = 120 A (f = 50 Hz) at Tc = 45˚C
Maximum repetitive frequency n = 100 kcycles
(Repetitive cycle T = 3 s or longer)

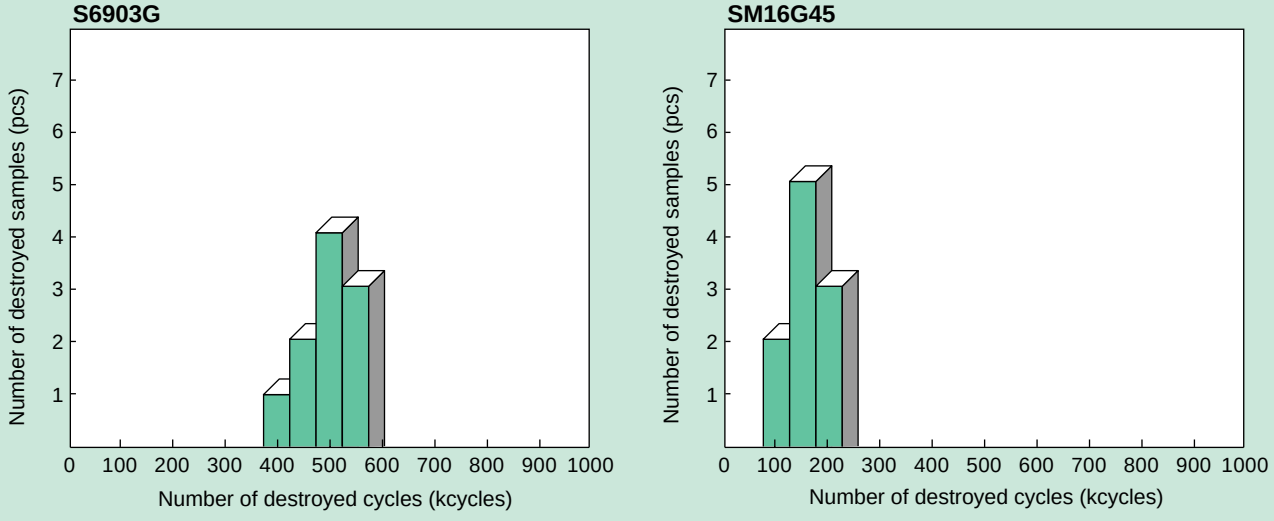
Handling Precautions

When used under conditions other than those recommended, devices may be damaged.
They may even ignite. Please use devices within their recommended conditions.
If they must be used under other conditions, add protective circuits (such as phase controls to lessen starting stresses) and provide a warranty when shipping.
Please note that if the devices are used under conditions that are not recommended, loss of human life, bodily injury or damage to property to third parties must be settled between you and the third party.

Repetitive Surge Current Test Data (reference)

Test conditions

- I_P = 130 A (f = 50 Hz)
- Tc = 40˚C
- T = 3 s



4 Selection Chart

General-Purpose Thyristors

→ Repetitive peak OFF-state voltage and repetitive peak reverse voltage

↓ Average ON-state current

$I_{T(AV)}$ (A)	V_{DRM} and V_{DRM} (V)		I_{GT} (mA)	Packeage Dimensions	Page
	400	600			
0.3	**SF0R3G42**	–	0.2	①	18
0.5	**SF0R5G43**	**SF0R5J43**	0.2	①	18
	(Note 1) **RSF05G1-1P/3P/5P**	–	1/0.4/0.25	①	18
	USF05G49	–	0.2	②	19
	(Note 1) **URSF05G49-1P/3P/5P**	–	1/0.4/0.25	②	19
3	**SF3G48**	**SF3J48**	10	⑤	18
	USF3G48	**USF3J48**	10	⑥	19
5	**SF5G42**	**SF5J42**	0.2	③	18
	SF5G41A	**SF5J41A**	15	③	18
	SF5G48	**SF5J48**	10	⑤	18
	SF5G49	**SF5J49**	0.07	⑧	18
	USF5G48	**USF5J48**	10	⑥	19
	USF5G49	**USF5J49**	0.07	⑨	19
8	**SF8G41A**	**SF8G41A**	15	③	18
	SF8G48	**SF8J48**	10	⑤	18
	USF8G48	**USF8J48**	10	⑥	19
10	**SF10G41A**	**SF10J41A**	15	③	18
	SF10G48	**SF10J48**	10	⑤	18
	USF10G48	**USF10J48**	10	⑥	19

(Note 1) Resistance (R_{GK}) built-in Thyristor
-1P : R_{GK} = 1 kΩ
-3P : R_{GK} = 2.7 kΩ
-5P : R_{GK} = 5.1 kΩ

Insulated Thyristors

→ Repetitive peak OFF-state voltage and repetitive peak reverse voltage

↓ Average ON-state current

$I_{T(AV)}$ (A)	V_{DRM} and V_{DRM} (V)		I_{GT} (mA)	Packeage Dimensions	Page
	400	600			
3	**SF3GZ47**	**SF3JZ47**	10	④	19
5	**SF5GZ47**	**SF5JZ47**	10	④	19
8	**SF8GZ47**	**SF8JZ47**	10	④	19
10	**SF10GZ47**	**SF10JZ47**	10	④	19
16	**SF16GZ51**	**SF16JZ51**	15	⑦	19
25	**SF25GZ51**	**SF25JZ51**	20	⑦	19

Special-Purpose Thyristors

Usage		$I_{T(AV)}$ (A)	V_{DRM} and V_{DRM} (V)			Main Features	Packeage Dimensions	Page
			200	400	800			
High speed		0.3	**SH0R3D42**	–	–	tq ≦ 6 µs	①	24
Strobe	Trigger	0.3	–	**S6370**	–	tgt ≦1.5 µs	①	24
	Chopper	8	–	**SH8G41**	–	I_{TRM} = 350 A	③	24
	Bypass	8	–	**S6744**	–	I_{TRM} = 1300 A	⑤	24
		–	–	**S6A35**	–	I_{TRM} = 900 A	⑨	24
TV		3	–	**S6785G**	–	tq ≦ 3.5 µs	④	24
Discharge Lamp		–	–	–	**S6992**	I_P = 500 A, di/dt = 750 A/µs	⑤	24
		–	–	–	**S6A13**	I_P = 500 A, di/dt = 750 A/µs Diode included between cathode and anode		24

Triacs

→ Repetitive peak OFF-state voltage

↓ RMS ON-state current

$I_{T\ (RMS)}$ (A)	V_{DRM} and V_{DRM} (V)			I_{GT} (mA)	Packeage Dimensions	Page
	400	600	800			
0.8	**SM08G43**	–	–	3	①	20
1	**SM1G43**	**SM1J43**	**SM1L43**	*5 (400 V, 600 V) 10 (800 V)	①	20
3	**SM3G45**	**SM3J45**	–	20	③	20
	SM3G48	**SM3J48**	–	20	⑤	21
	USM3G48	**USM3J48**	–	20	⑥	23
6	**SM6G45/A**	**SM6J45/A**	–	30/20	③	20
	SM6G48/A	**SM6J48/A**	–	30/20	⑤	21
	USM6G45/A	**USM6J45/A**	–	30/20	⑥	23
8	**SM8G45/A**	**SM8J45/A**	–	30/20	③	20
	SM8G48/A	**SM8J48/A**	–	30/20	⑤	21
	USM8G45/A	**USM8J45/A**	–	30/20	⑥	23
12	**SM12G45/A**	**SM12J45/A**	–	30/20	③	20
	SM12G48/A	**SM12J48/A**	–	30/20	⑤	21
	USM12G45/A	**USM12J45/A**	–	30/20	⑥	23
16	**SM16G45/A**	**SM16J45/A**	–	30/20	③	20
	SM16G48/A	**SM16J48/A**	–	30/20	⑤	21
	USM16G45/A	**USM16J45/A**	–	30/20	⑥	23

* I_{GT} = 3 mA, 7 mA models are also available.

Insulation Triac

→ Repetitive peak OFF-state voltage

↓ RMS ON-state current

$I_{T\ (RMS)}$ (A)	V_{DRM} and V_{DRM} (V)			I_{GT} (mA)	Packeage Dimensions	Page
	400	600	800			
2	**SM2GZ47/A**	**SM2JZ47/A**	**SM2LZ47**	8/5 (400 V, 600 V) 10 (800 V)	④	22
3	**SM3GZ47**	**SM3JZ47**	–	20	④	22
5	–	–	**SM5LZ47 ***	30	④	22
6	**SM6GZ47/A**	**SM6JZ47/A**	–	30/20	④	22
8	**SM8GZ47/A**	**SM8JZ47/A**	**SM8LZ47**	30/20 (400 V, 600 V) 30 (800 V)	④	22
10	–	–	**SM10LZ47**	30	④	22
12	**SM12GZ47/A**	**SM12JZ47/A**	–	30/20	④	22
16	**SM16GZ47/A**	**SM16JZ47/A**	–	30/20	④	22
	SM16GZ51	**SM16JZ51**	–	30	⑦	22
25	**SM25GZ51**	**SM25JZ51**	–	30	⑦	22

* Under development

Special-Purpose Triacs

Usage	$I_{T\ (RMS)}$ (A)	V_{DRM} and V_{DRM} (V)		Main Features	Packeage Dimensions	Page
		200	400			
High speed	20	**S6903G**	**S6903J**	I_{TRM} = 120 A	③	31

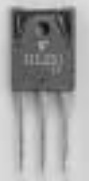
5 Product Lines

5.1 General-Purpose Thyristors (Non-insulated)

$I_{T(AV)}$ (A)	Maximum Ratings					Electrical Characteristics (Ta=25˚C)							Package Dimensions	Package Number	Package Appearance
	V_{DRM}, V_{RRM} (V)		I_{TSM} (A)		T_j (˚C)	I_{DRM}, I_{RRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)	I_{TM} (A)	dv/dt (V/ms)	TC (˚C)			
	400	600	50 Hz	60 Hz											
0.3	**SF0R3G42**	–	9	9.9	-40 to 125	Note 1 0.1	0.2	0.8	2.0	2	–	–	①	13-5A1A	 TO-92
0.5	**SF0R5G43**	**SF0R5J43**	7	8	-40 to 125	Note 1 0.05	0.2	0.8	1.5	1	–	–	①	13-5A1D	
	Note 2 **RSF05G1-1P**	–	9	10	-40 to 125	0.01	1	0.8	1.5	1	200 (typ.)	25	①	13-5A1A	
	Note 3 **RSF05G1-3P**	–	9	10	-40 to 125	0.01	0.4	0.8	1.5	1	70 (typ.)	25	①	13-5A1A	
	Note 4 **RSF05G1-5P**	–	9	10	-40 to 125	0.01	0.25	0.8	1.5	1	40 (typ.)	25	①	13-5A1A	
5	**SF5G42**	**SF5J42**	80	88	-40 to 125	Note 1 2	0.2	0.8	1.6	15	50 (typ.)	75	③	13-10G1B	 TO-220AB
	SF5G41A	**SF5J41A**	80	88	-40 to 125	0.01	15	1.0	1.6	15	100	125	③	13-10G1B	
8	**SF8G41A**	**SF8J41A**	120	132	-40 to 125	0.01	15	1.0	1.6	25	100	125	③	13-10G1B	
10	**SF10G41A**	**SF10J41A**	160	176	-40 ot 125	0.01	15	1.0	1.6	30	100	125	③	13-10G1B	
3	**SF3G48**	**SF3J48**	50	55	-40 to 125	0.01	10	1.0	1.5	12	50 (typ.)	125	⑤	13-10J1B	 TO-220FL
5	**SF5G48**	**SF5J48**	80	88	-40 to 125	0.01	10	1.0	1.5	15	50 (typ.)	125	⑤	13-10J1B	
8	**SF8G48**	**SF8J48**	120	132	-40 to 125	0.01	10	1.0	1.5	25	50 (typ.)	125	⑤	13-10J1B	
10	**SF10G48**	**SF10J48**	160	176	-40 to 125	0.01	10	1.0	1.5	30	50 (typ.)	125	⑤	13-10J1B	
5	**SF5G49**	**SF5J49**	65	–	-40 to 125	0.02	0.07	0.8	1.6	12	50 (typ.)	75	⑧	13-7F1A	 DP

Note 1: Tj = 125°C Note 2: R_{GK} = 1 kΩ Note 3: R_{GK} = 2.7 kΩ Note 4: R_{GK} = 5.1 kΩ

5.1 General-Purpose Thyristors (Insulated and surface-mount)

$I_{T(AV)}$ (A)	Maximum Ratings						Electrical Characteristics (Ta=25˚C)							Package Dimensions	Package Number	UL Listing Number	Package Appearance
	V_{DRM}, V_{RRM} (V)		I_{TSM} (A)		V_{ISOL} (V)	T_j (˚C)	I_{DRM}, I_{RRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)		dv/dt (V/ms)					
	400	600	50 Hz	60 Hz							I_{TM} (A)		TC (˚C)				
3	**SF3GZ47**	**SF3JZ47**	50	55	1500	-40 to 125	0.01	10	1.0	1.5	12	50 (typ.)	125	④	13-10H1B	E87989	 TO-220NIS
5	**SF5GZ47**	**SF5JZ47**	80	88	1500	-40 to 125	0.01	10	1.0	1.5	15	50 (typ.)	125	④	13-10H1B	E87989	
8	**SF8GZ47**	**SF8JZ47**	120	132	1500	-40 to 125	0.01	10	1.0	1.5	25	50 (typ.)	125	④	13-10H1B	E87989	
10	**SF10GZ47**	**SF10JZ47**	160	176	1500	-40 to 125	0.01	10	1.0	1.5	30	50 (typ.)	125	④	13-10H1B	E87989	
16	**SF16GZ51**	**SF16JZ51**	250	275	1500	-40 to 125	0.02	15	1.5	1.5	50	50 (typ.)	125	⑦	13-16A1B	Under application	 TO-3P (N)IS
25	**SF25GZ51**	**SF25JZ51**	350	385	1500	-40 to 125	0.02	20	1.5	1.5	80	50 (typ.)	125	⑦	13-16A1B	Under application	
0.5	**USF05G49**	–	9	10	–	-40 to 125	0.01	0.2	0.8	1.5	1	200 (typ.)	25	②	13-5B1A	–	 PW-MINI
	Note 1 **URSF05G49-1P**	–	9	10	–	-40 to 125	0.01	1	0.8	1.5	1	200 (typ.)	25	②	13-5B1A	–	
	Note 2 **URSF05G49-3P**	–	9	10	–	-40 to 125	0.01	0.4	0.8	1.5	1	70 (typ.)	25	②	13-5B1A	–	
	Note 3 **URSF05G49-5P**	–	9	10	–	-40 to 125	0.01	0.25	0.8	1.5	1	40 (typ.)	25	②	13-5B1A	–	
3	**USF3G48**	**USF3J48**	50	55	–	-40 to 125	0.01	10	1.0	1.5	12	50 (typ.)	125	⑥	13-10J2B	–	 TO-220SM
5	**USF5G48**	**USF5J48**	80	88	–	-40 to 125	0.01	10	1.0	1.5	15	50 (typ.)	125	⑥	13-10J2B	–	
8	**USF8G48**	**USF8J48**	120	132	–	-40 to 125	0.01	10	1.0	1.5	25	50 (typ.)	125	⑥	13-10J2B	–	
10	**USF10G48**	**USF10J48**	160	176	–	-40 to 125	0.01	10	1.0	1.5	30	50 (typ.)	125	⑥	13-10J2B	–	
5	**USF5G49**	**USF5J49**	65	–	–	-40 to 125	0.02	0.07	0.8	1.6	12	50 (typ.)	75	⑨	13-7F2A	–	 DP

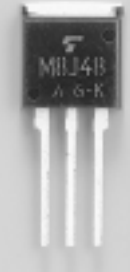
Note 1: R_{GK} = 1 kΩ Note 2: R_{GK} = 2.7 kΩ Note 3: R_{GK} = 5.1 kΩ

5.2 General-Purpose Triacs (Non-insulated)

$I_{T(RMS)}$ (A)	Maximum Ratings						Electrical Characteristics (Ta=25˚C)						Package Dimensions	Package Number	Package Appearance
	V_{DRM} (V)			I_{TSM} (A)		T_j (˚C)	I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)		(dv/dt)c (V/ms)			
	400	600	800	50 Hz	60 Hz			I, II, III	I, II, III		I_{TM} (A)				
0.8	**SM08G43**	–	–	6	6.6	-40 to 125	0.01	3 Note 2	1.5 Note 2	1.5	1.2	–	①	13-5A1E	 TO-92
1	**SM1G43**	**SM1J43**	**SM1L43**	8	8.8	-40 to 125	0.01	5 (400 V, 600 V) 10 (800 V)	2	1.5	1.5	–	①	13-5A1E	
3	**SM3G45**	**SM3J45**	–	30	33	-40 to 125	0.02	20	1.5	1.5	4.5	10	③	13-10G1A	 TO-220AB
6	**SM6G45**	**SM6J45**	–	60	66	-40 to 125	Note 1 2	30	2	1.5	9	10	③	13-10G1A	
	SM6G45A	**SM6J45A**	–	60	66	-40 to 125	Note 1 2	20	1.5	1.5	9	4	③	13-10G1A	
8	**SM8G45**	**SM8J45**	–	80	88	-40 to 125	Note 1 2	30	2	1.5	12	10	③	13-10G1A	
	SM8G45A	**SM8J45A**	–	80	88	-40 to 125	Note 1 2	20	1.5	1.5	12	4	③	13-10G1A	
12	**SM12G45**	**SM12J45**	–	120	132	-40 to 125	Note 1 2	30	2	1.5	17	10	③	13-10G1A	
	SM12G45A	**SM12J45A**	–	120	132	-40 to 125	Note 1 2	20	1.5	1.5	17	4	③	13-10G1A	
16	**SM16G45**	**SM16J45**	–	150	165	-40 to 125	0.02	30	1.5	1.5	25	10	③	13-10G1A	
	SM16G45A	**SM16J45A**	–	150	165	-40 to 125	0.02	20	1.5	1.5	25	4	③	13-10G1A	

Note 1: Tj = 125°C Note 2: II, III mode only

5.2 General-Purpose Triacs (Non-insulated)

$I_{T(RMS)}$ (A)	Maximum Ratings					Electrical Characteristics (Ta=25˚C)						Package Dimensions	Package Number	Package Appearance
	V_{DRM} (V)		I_{TSM} (A)		T_j (˚C)	I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)		(dv/dt)c (V/ms)			
	400	600	50 Hz	60 Hz			I, II, III	I, II, III		I_{TM} (A)				
3	**SM3G48**	**SM3J48**	30	33	-40 to 125	0.02	20	1.5	1.5	4.5	10	⑤	13-10J1A	 TO-220FL
6	**SM6G48**	**SM6J48**	60	66	-40 to 125	0.02	30	1.5	1.5	9	10	⑤	13-10J1A	
	SM6G48A	**SM6J48A**	60	66	-40 to 125	0.02	20	1.5	1.5	9	4	⑤	13-10J1A	
8	**SM8G48**	**SM8J48**	80	88	-40 to 125	0.02	30	1.5	1.5	12	10	⑤	13-10J1A	
	SM8G48A	**SM8J48A**	80	80	-40 to 125	0.02	20	1.5	1.5	12	4	⑤	13-10J1A	
12	**SM12G48**	**SM12J48**	120	132	-40 to 125	0.02	30	1.5	1.5	17	10	⑤	13-10J1A	
	SM12G48A	**SM12J48A**	120	132	-40 to 125	0.02	20	1.5	1.5	17	4	⑤	13-10J1A	
16	**SM16G48**	**SM16J48**	150	165	-40 to 125	0.02	30	1.5	1.5	25	10	⑤	13-10J1A	
	SM16G48A	**SM16J48A**	150	165	-40 to 125	0.02	20	1.5	1.5	25	4	⑤	13-10J1A	

5.2 General-Purpose Triacs (Insulated)

$I_{T(RMS)}$ (A)	Maximum Ratings						Electrical Characteristics (Ta = 25°C)						Package Dimensions	Package Number	UL Listing Number	Package Appearance
	V_{DRM} (V)			I_{TSM} (A)		T_j (°C)	I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)		(dv/dt)c (V/ms)				
	400	600	800	50 Hz	60 Hz			I, II, III	I, II, III		I_{TM} (A)					
2	SM2GZ47	SM2JZ47	–	8	8.8	-40 to 125	0.02	8	1.5	1.7	3	–	④	13-10H1A	–	
	SM2GZ47A	SM2JZ47A	–	8	8.8	-40 to 125	0.02	5	1.5	1.7	3	–	④	13-10H1A	–	
	–	–	SM2LZ47	8	8.8	-40 to 125	0.02	10	1.5	2.0	3	5	④	13-10H1A	–	
3	SM3GZ47	SM3JZ47	–	30	33	-40 to 125	0.02	20	1.5	1.5	4.5	10	④	13-10H1A	E87989	
5	–	–	SM5LZ47*	50	–	-40 to 125	0.02	30	1.5	1.5	8	10	④	13-10H1A	–	
6	SM6GZ47	SM6JZ47	–	60	66	-40 to 125	0.02	30	1.5	1.5	9	10	④	13-10H1A	E87989	
	SM6GZ47A	SM6JZ47A	–	60	66	-40 to 125	0.02	20	1.5	1.5	9	4	④	13-10H1A	E87989	 TO-220NIS
8	SM8GZ47	SM8JZ47	–	80	88	-40 to 125	0.02	30	1.5	1.5	12	10	④	13-10H1A	E87989	
	SM8GZ47A	SM8JZ47A	–	80	88	-40 to 125	0.02	20	1.5	1.5	12	4	④	13-10H1A	E87989	
	–	–	SM8LZ47	70	80	-40 to 125	0.02	30	1.5	1.5	12	10	④	13-10H1A	–	
10	–	–	SM10LZ47	100	110	-40 to 125	0.02	30	1.5	1.5	15	10	④	13-10H1A	–	
12	SM12GZ47	SM12JZ47	–	120	132	-40 to 125	0.02	30	1.5	1.5	17	10	④	13-10H1A	E87989	
	SM12GZ47A	SM12JZ47A	–	120	132	-40 to 125	0.02	20	1.5	1.5	17	4	④	13-10H1A	E87989	
16	SM16GZ47	SM16JZ47	–	150	165	-40 to 125	0.02	30	1.5	1.5	25	10	④	13-10H1A	E87989	
	SM16GZ47A	SM16JZ47A	–	150	165	-40 to 125	0.02	20	1.5	1.5	25	4	④	13-10H1A	E87989	
	SM16GZ51	SM16JZ51	–	150	165	-40 to 125	0.02	30	1.5	1.5	25	10	⑦	13-16A1A	E87989	 TO-3P(N)IS
25	SM25GZ51	SM25JZ51	–	230	253		0.02	30	1.5	1.5	40	10	⑦	13-16A1A	E87989	

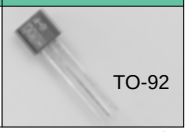
* Under development

5.2 General-Purpose Triacs (Surface-mount)

$I_{T(RMS)}$ (A)	Maximum Ratings					Electrical Characteristics (Ta = 25°C)						Package Dimensions	Package Number	Package Appearance
	V_{DRM} (V)		I_{TSM} (A)		T_j (°C)	I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)		(dv/dt)c (V/ms)			
	400	600	50 Hz	60 Hz			I, II, III	I, II, III		I_{TM} (A)				
3	**USM3G48**	**USM3J48**	30	33	-40 to 125	0.02	20	1.5	1.5	4.5	10	⑥	13-10J2A	 TO-220SM
6	**USM6G48**	**USM6J48**	60	66	-40 to 125	0.02	30	1.5	1.5	9	10	⑥	13-10J2A	
	USM6G48A	**USM6J48A**	60	66	-40 to 125	0.02	20	1.5	1.5	9	4	⑥	13-10J2A	
8	**USM8G48**	**USM8J48**	80	88	-40 to 125	0.02	30	1.5	1.5	12	10	⑥	13-10J2A	
	USM8G48A	**USM3J48A**	80	88	-40 to 125	0.02	20	1.5	1.5	12	4	⑥	13-10J2A	
12	**USM12G48**	**USM12J48**	120	132	-40 to 125	0.02	30	1.5	1.5	17	10	⑥	13-10J2A	
	USM12G48A	**USM12J48A**	120	132	-40 to 125	0.02	20	1.5	1.5	17	4	⑥	13-10J2A	
16	**USM16G48**	**USM16J48**	150	165	-40 to 125	0.02	30	1.5	1.5	25	10	⑥	13-10J2A	
	USM16G48A	**USM16J48A**	150	165	-40 to 125	0.02	20	1.5	1.5	25	4	⑥	13-10J2A	

5.3 Special-Purpose Thyristors

● High-Speed

$I_{T(AV)}$ (A)	Maximum Ratings: V_{DRM}, V_{RRM} (V) 200	400	V_{DSM} (V)	I_{TSM} (A) 50 Hz	60 Hz	T_j (°C)	Electrical Characteristics (Ta = 25°C): I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	tq (ms)	V_{TM} (V)	I_{TM} (A)	dv/dt (V/ms)	T_C (°C)	Package Dimensions	Package Number	Package Appearance
0.3	**SH0R3D42**	–	250	7	7.7	-40 to 125	Note 1 0.1	1	0.9	6	1.8	2	15	110	①	13-5A1A	 TO-92

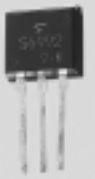
Note 1 : Tj = 125°C

● TV

$I_{T(AV)}$ (A)	Maximum Ratings: V_{DRM}, V_{RRM} (V) 400	I_{TSM} (A) 50 Hz	60 Hz	T_j (°C)	Electrical Characteristics (Ta = 25°C): I_{DRM}, I_{RRM} (mA) (Tj=125°C)	I_{GT} (mA)	V_{GT} (V)	tqt (ms)	tq (ms)	V_{TM} (V)	I_{TM} (A)	dv/dt (V/ms)	T_C (°C)	Package Dimensions	Package Number	Package Appearance
3	S6785G	60	66	-40 to 125	Note 1 1 2	25	1.5	3	3.5	2	20	100	125 V_G=-2.5V	④	13-10H1B	 TO-220NIS

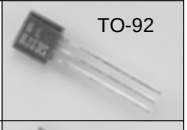
Note 1: upper value = I_{DRM}, lower value = I_{RRM}

● High-di/dt

	Maximum Ratings: V_{DRM} (V) 800	I_{TRM} (A)	di/dt (A/ms)	T_j (°C)	Electrical Characteristics (Ta = 25°C): I_{DRM} (mA)	I_{GT} (mA)	V_{GT} (V)	V_{TM} (V)	I_{TM} (A)	dv/dt (V/ms)	T_C (°C)	Package Dimensions	Package Number	Package Appearance
	S6992	500	750	-40 to 125	0.01	20	1.0	1.5	25	–	–	⑤	13-10J1B	 TO-220FL
	Note 1 **S6A13**	500	750	-40 to 125	0.01	30	1.0	1.5	25	50	125	⑤	13-10J1B	

Note 1: Diode included between cathode and anode

● Strobe

Application	Maximum Ratings: V_{DRM}, V_{RRM} (V) 400	I_{TSM} (A) 50 Hz	60 Hz	I_{TRM} (A)	di/dt (A/ms)	T_j (°C)	Electrical Characteristics (Ta = 25°C): I_{GT} (mA)	V_{GT} (V)	I_H (mA)	V_{TM} (V)	I_{TM} (A)	Cc (mF)	Package Dimensions	Package Number	Package Appearance
Note 1 Trigger	**S6730**	9	9.9	–	–	-40 to 125	0.2	0.8	4 (typ.)	2	2	–	①	13-5A1A	 TO-92
Chopper	**SH8G41**	–	–	350 (CM ≦ 1000 µF)	100	-40 to 125	50	1.5	150	2.3	25	2.7 (I_{TM} = 230 A)	③	13-10G1B	 TO-220AB
Bypass	**S6744**	200	220	1300	100	-40 to 125	20	1.0	40	1.5	25	–	⑤	13-10J1B	 TO-220FL
	S6A35	80	–	900	500	-40 to 125	8.0	1.0	10	1.7	25	–	⑨	13-7F2A	DP 

Notes 1: The following products are also suitable for use as triggers: RSF05G1-1P (P.18), USF05G49 (P.19), URSF05G49-1P (P.19)

5.4 Special-Purpose Triacs

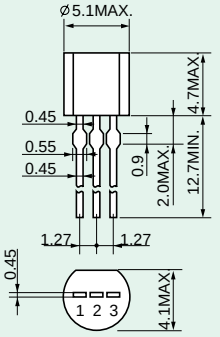
● High-Rush Current

$I_{T(RMS)}$ (A)	Maximum Ratings: V_{DRM} (V) 400	600	I_{TRM} (A)	I_{TSM} (A) 50 Hz	60 Hz	T_j (°C)	Electrical Characteristics (Ta = 25°C): I_{DRM} (mA)	I_{GT} (mA) I, II, III	V_{GT} (V) I, II, III	tq (ms)	V_{TM} (V)	I_{TM} (A)	(dv/dt)c (V/ms)	Package Dimensions	Package Number	Package Appearance
20	**S6903G**	**S6903J**	120	180	200	-40 to 125	0.02	30	1.5	1.6	30	10	5	③	13-10G1A	 TO-220AB

6 Package Dimensions

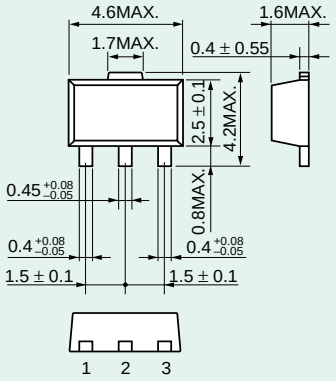
Unit: mm

① TO-92



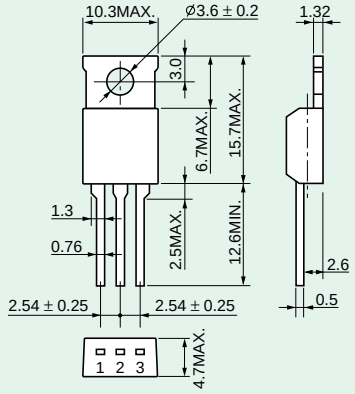
Pin Number	1	2	3
13-5A1A	Gate	Anode	Cathode
13-5A1D	Cathode	Gate	Anode
13-5A1E	T1	Gate	T2

② PW-MINI



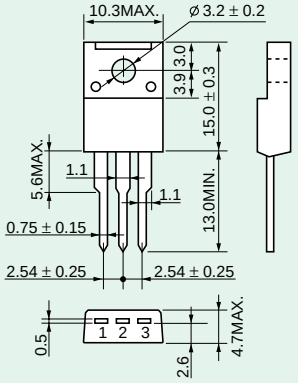
Pin Number	1	2	3
13-5B1A	Gate	Anode	Cathode

③ TO-220AB



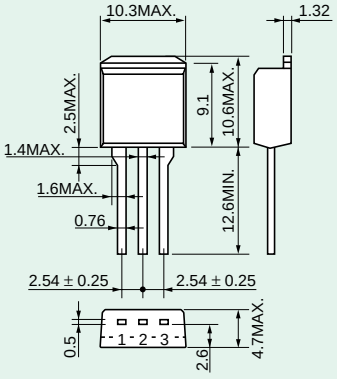
Pin Number	1	2	3
13-10G1B	Cathode	Anode	Gate
13-10G1A	T1	T2	Gate

④ TO-220NIS



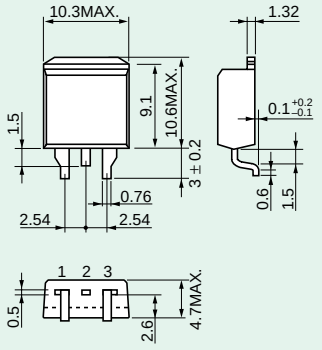
Pin Number	1	2	3
13-10H1B	Cathode	Anode	Gate
13-10H1A	T1	T2	Gate

⑤ TO-220FL



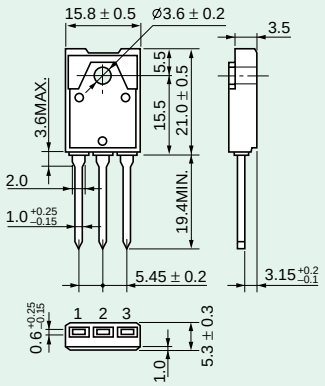
Pin Number	1	2	3
13-10J1B	Cathode	Anode	Gate
13-10J1A	T1	T2	Gate

⑥ TO-220SM



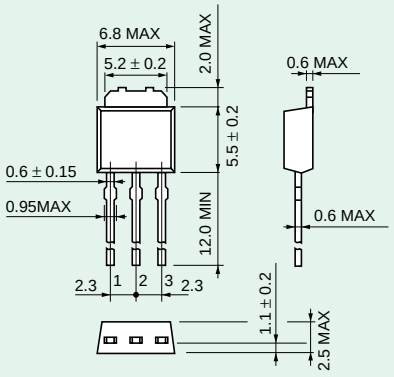
Pin Number	1	2	3
13-10J2B	Cathode	Anode	Gate
13-10J2A	T1	T2	Gate

⑦ TO-3P(N)IS



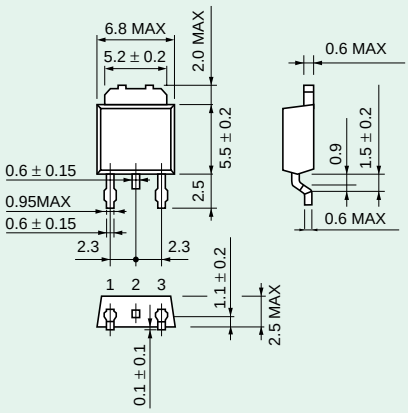
Pin Number	1	2	3
13-16A1B	Cathode	Anode	Gate
13-16A1A	T1	T2	Gate

⑧ DP



Pin Number	1	2	3
13-7F1A	Cathode	Anode (heat sink)	Gate

⑨ DP (Surface-mount)

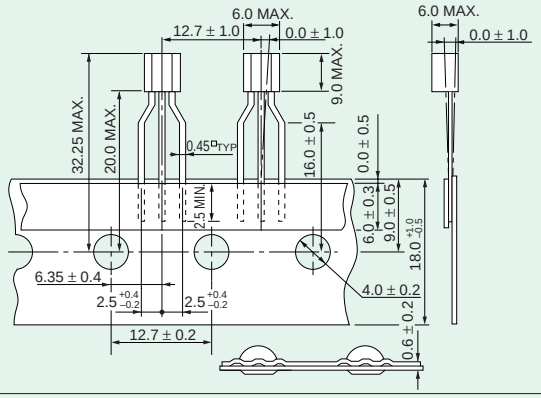
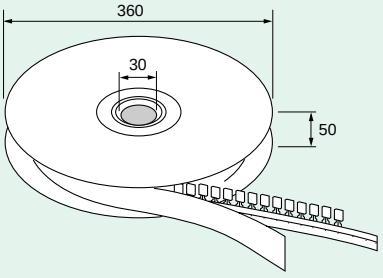
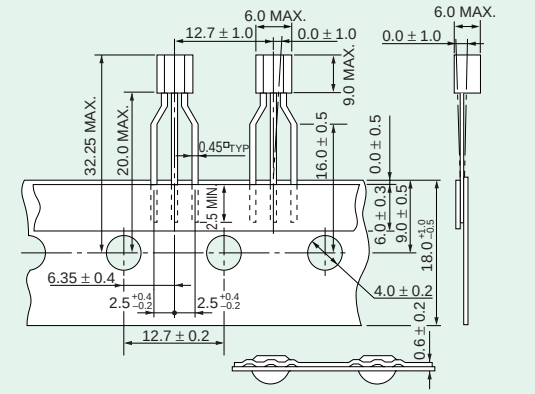
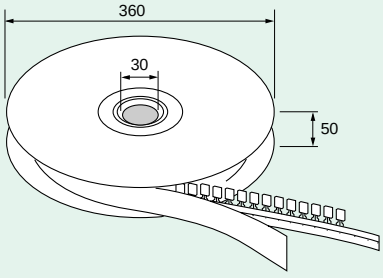
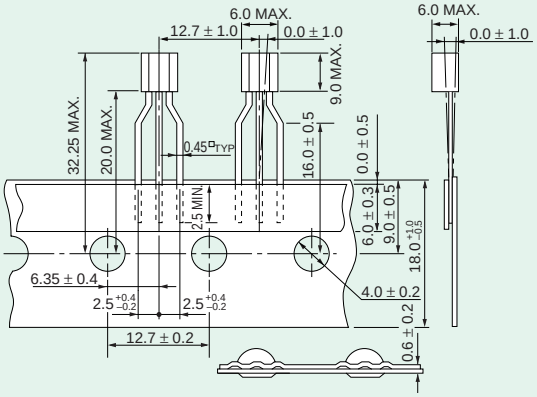
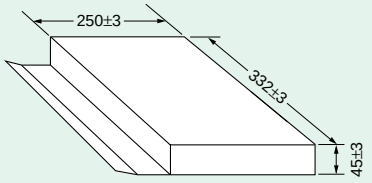
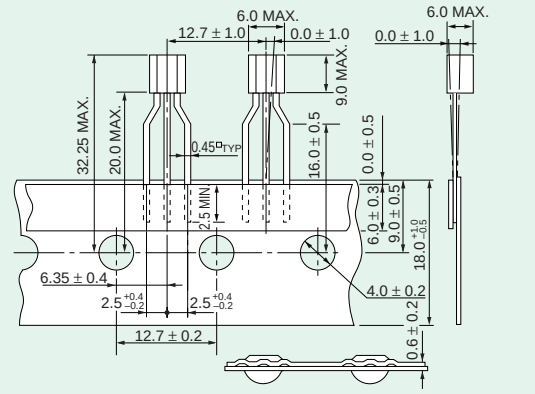
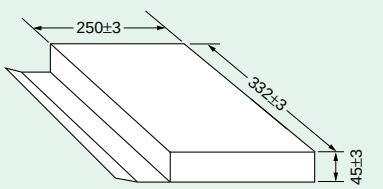


Pin Number	1	2	3
13-7F2A	Cathode	Anode (heat sink)	Gate

7 Tape Packing

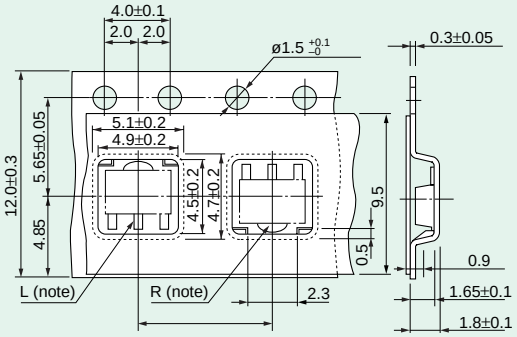
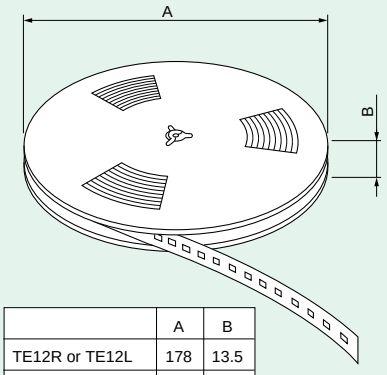
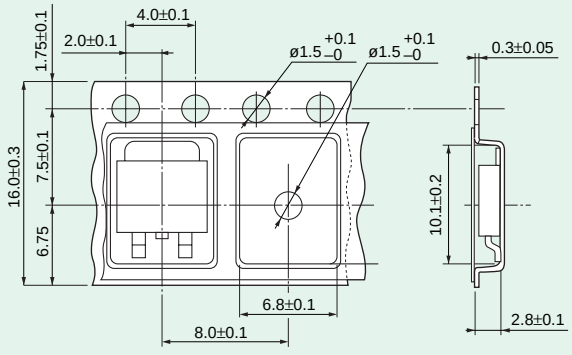
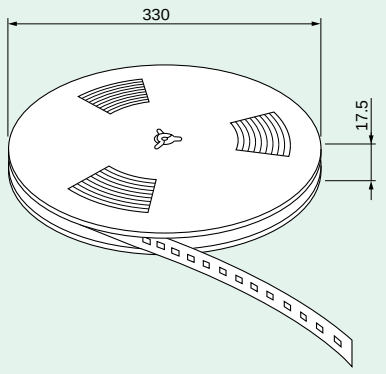
7.1 Packing of TO-92

Unit: mm

Type No.	Tape Dimensions	Packing Quantity	Packing Method
TPE1		2000 pcs/reel	Reel 
TPER1		2000 pcs/reel	Reel 
TPE2		3000 pcs/box	Box (Ammo Pack) 
TPER2		3000 pcs/box	Box (Ammo Pack) 

7.2 Packing of PW-MINI and DP

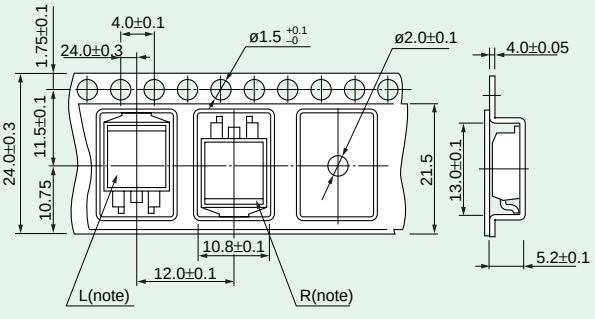
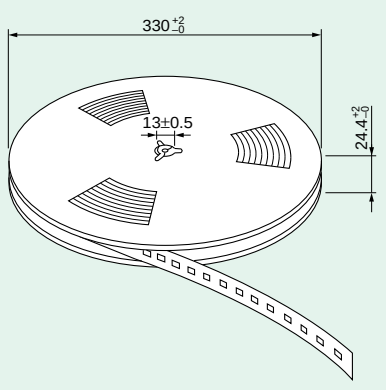
Unit: mm

Type No.	Tape Dimensions	Packing Quantity	Packing Method
TE12R or TE12L	PW-MINI  Note: L = Leeds to Left R = Leeds to Right	1000 pcs/reel (5 reels/box)	Reel 
TE12R1 or TE12L1		5000 pcs/reel (1 reel/box)	
TE16R1 or TE16L1	DP  Note: L = Leeds to Left R = Leeds to Right	2000 pcs/reel (1 reel/box)	Reel 

	A	B
TE12R or TE12L	178	13.5
TE12R1 or TE12L1	330	12.5

7.3 Packing of TO-220SM

Unit: mm

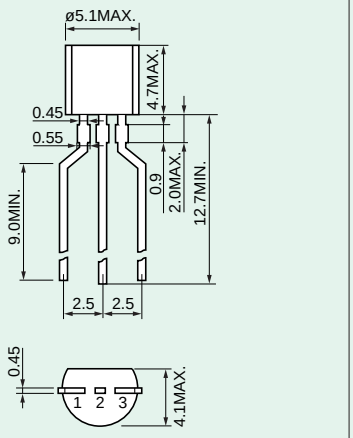
Type No.	Tape Dimensions	Packing Quantity	Packing Method
TE24R or TE24L	 Note: L = Leeds to Left R = Leeds to Right	1000 pcs/reel (4 reels/box)	Reel 

8 Leadforming

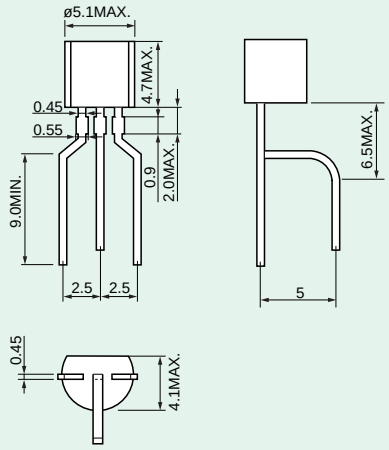
8.1 Leadforming of TO-92

Unit: mm

① LC-1



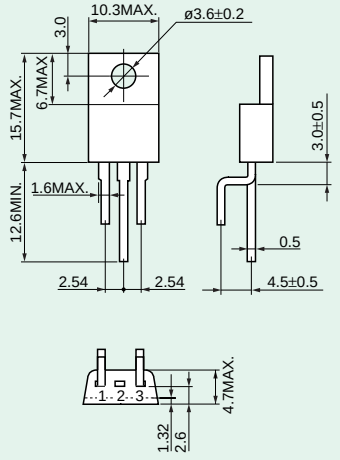
② LC-3



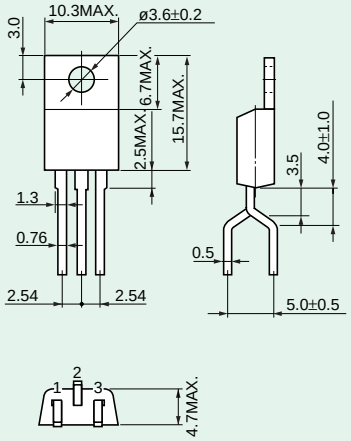
8.2 Leadforming of TO-220AB

Unit: mm

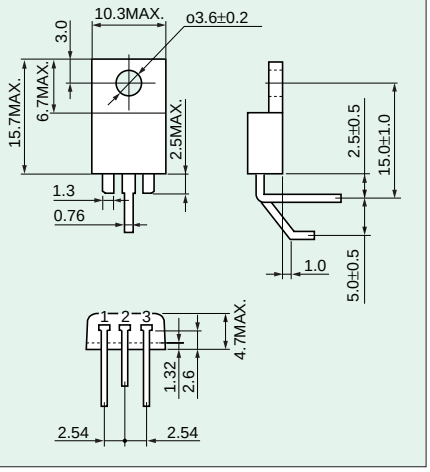
① LB109



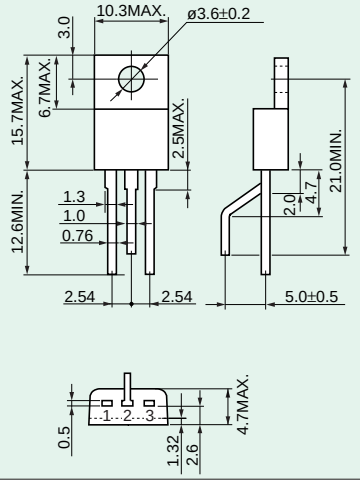
② LB111



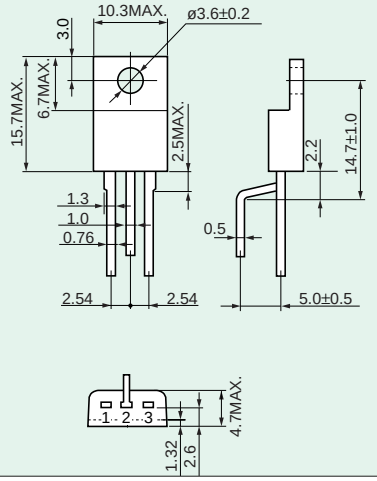
③ LB119



④ LB143



⑤ LB155

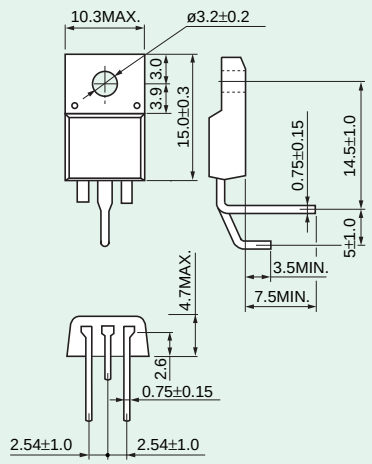


Note: For more detailed information about the leadforming, please contact your local Toshiba distributor.

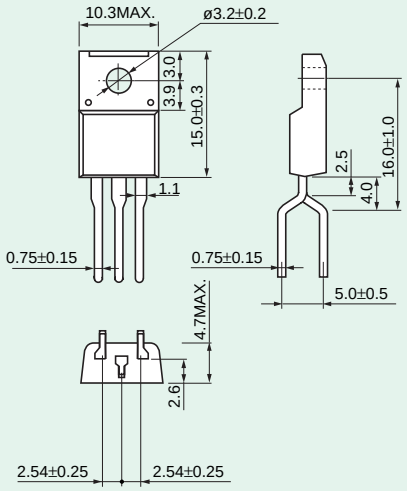
8.3 Leadforming of TO-220NIS

Unit: mm

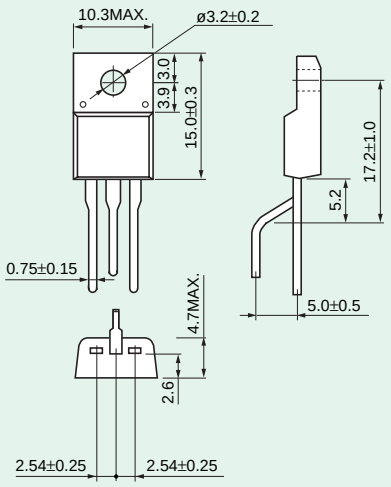
① LB180



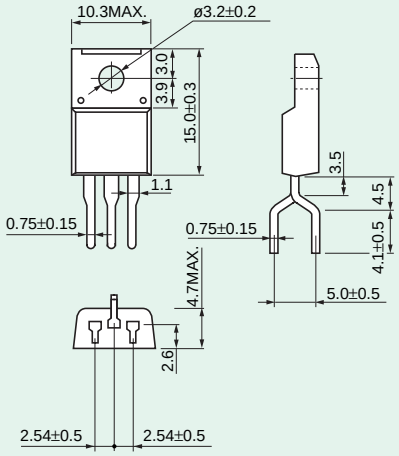
② LB181



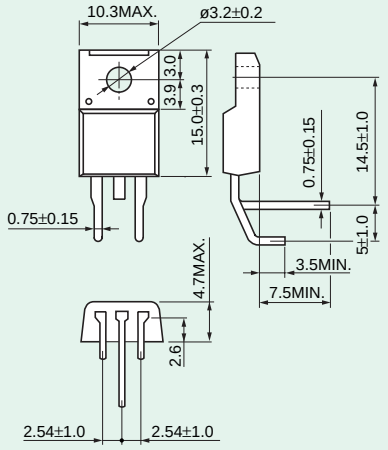
③ LB182



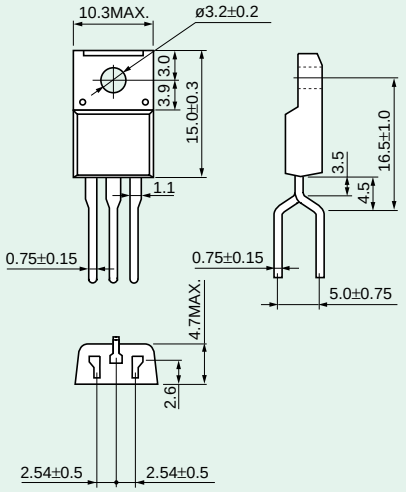
④ LB183



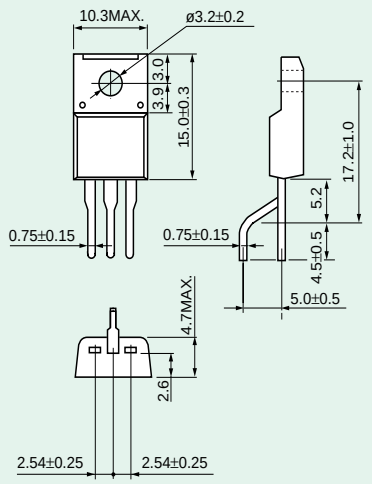
⑤ LB184



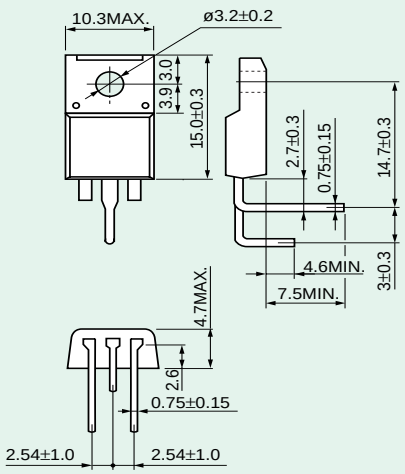
⑥ LB185



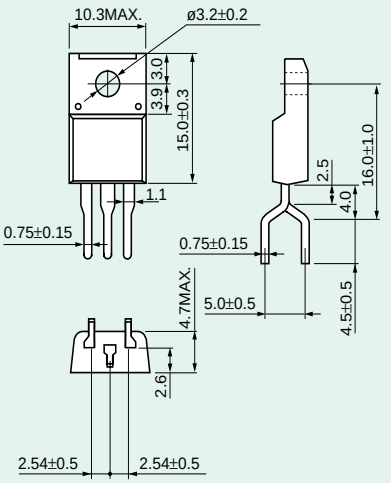
⑦ LB186



⑧ LB187



⑨ LB188



Note 1: For more detailed information about the leadforming, please contact your local Toshiba distributor.
Note 2: For more detailed information about the SM2GZ47 and SM2GZ47A, please contact your local Toshiba distributor.

9 Recommended Soldering Method

9.1 PCB Insertion Devices

9.1.1. Temperature Profile Using a Soldering Iron

Complete soldering within 10 seconds for lead temperature up to 260°C, or within three seconds for lead temperature up to 350°C.

9.1.2. Temperature Conditions for Flow Soldering

(1) Lead temperature must be not more than 260°C, and flow time must be not more than 10 seconds.

(2) Preheat leads at 150°C ± 10°C, for 60^{+30}_{-0} seconds.

(3) Keep the package resin surface temperature suppressed to 210°C or lower.

(4) The recommended thermal profile is as shown on Figure 1.

(5) Notes on heating
Allowing device package resin to remain at high temperatures for a long time may adversely affect reliability. Solder in as short time as possible so as not to heat the resin.

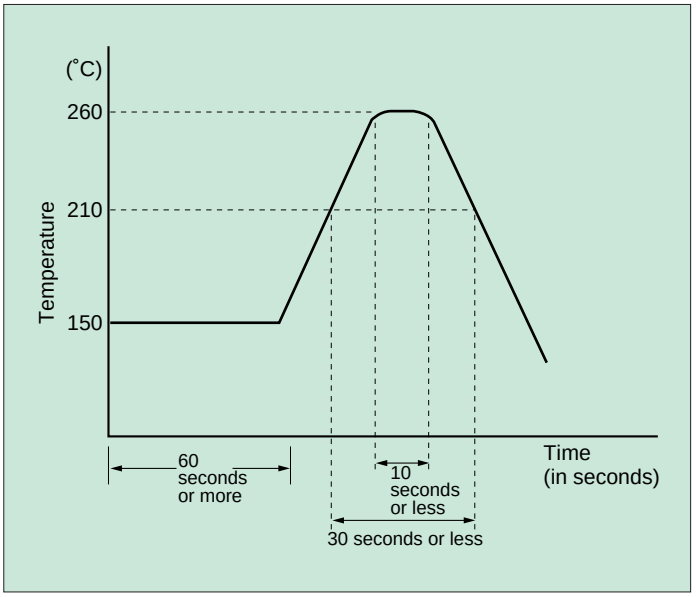


Figure 1

9.2 Surface-Mount Devices

9.2.1. Temperature Profile Using a Soldering Iron

Complete soldering within 10 seconds for lead temperature up to 260°C, or within three seconds for lead temperature up to 350°C.

9.2.2. Using Long or Medium Infrared Ray Reflow

There are three different types of infrared ray reflow, classified by wavelength. Short-wave near infrared ray reflow tends to penetrate the resin and heat up the internal device as well as the surface of resin.

The resulting heat stress may cause device degradation. Since long and medium infrared rays are of longer wavelength, they generally heat only the resin surface, causing little temperature fluctuation or heat stress in the internal device. Thus, the use of either long- or medium-infrared ray reflow is recommended for solder-mounting.

(1) Top and bottom heating with long or medium infrared rays is recommended. (Figure 2)

(2) Complete the infrared ray reflow process within 30 seconds at a package surface temperature between 210°C and 240°C.

(3)Refer to Figure 3 or an example of the recommended temperature profile.

(4) Near infrared ray reflow soldering produces thermal stress equivalent to that of dip soldering, so take care when using this method.

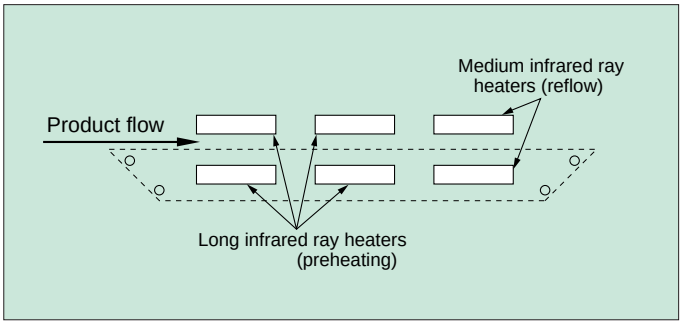


Figure 2

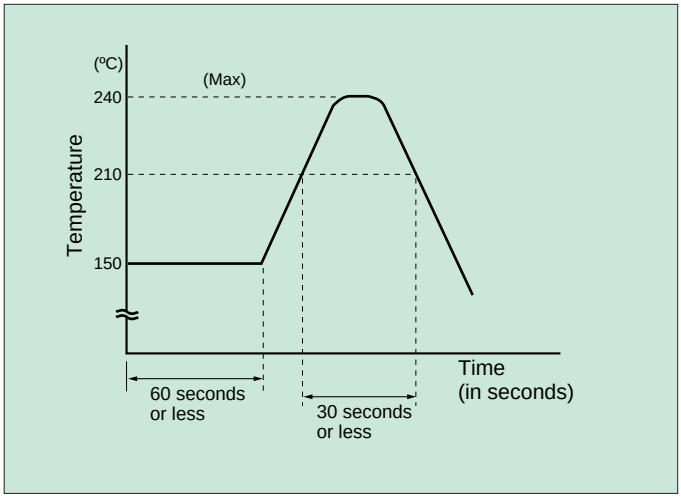


Figure 3

9.2.3. Using Hot Air Reflow

For an example of a recommended temperature profile, refer to 9.2.2. Using long or medium infrared ray reflow.

(1) Complete hot air reflow within 30 seconds at a package surface temperature between 210°C and 240°C.

9.2.4. Using Vapor Phase Reflow

(1) The recommended solvent is Fluorinate FC-70 or equivalent.

(2) Complete hot air reflow within 20 seconds at an ambient atmospheric temperature of 215°C, or within 60 seconds at an ambient atmospheric temperature of 200°C.

(3) Refer to Figure 4 for an example of a recommended temperature profile for vapor phase reflow soldering.

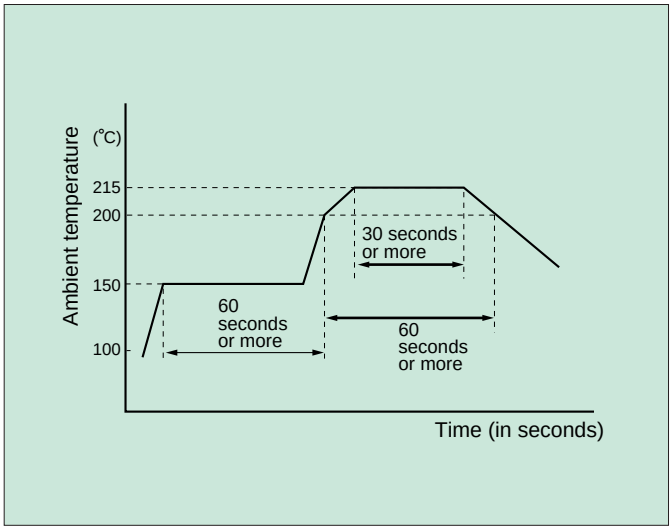


Figure 4

10 Gate Trigger Current Selection Table

	Selection spec.	I_{GT}		Unit	Available Product Numbers
		Min	Max		
10.1	**IG1**	—	20	μA	SF0R3G42 SF0R5J43 Series SF5J42 Series
	IG2	—	100		
	IG3	3	40		
	IG4	20	200		
	IG5	10	50		
	IG7	3	30		
10.2	**A1**	—	3*	mA	SM1G43
	A3	—	7	mA	SM1J43

* Only applies to II and III quadrants

Note: I_{GT} values may differ from what is listed in the table. For further details, please refer to the technical data sheets available for each product.

11 Holding Current Selection Table

Selection spec.	I_H		Unit	Available Product Numbers
	Min	Max		
HC1	—	3	mA	SF0R3G42 SF0R5J43 Series

(R_{GK} = 1 kΩ)

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