

**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.



# 1 Overview

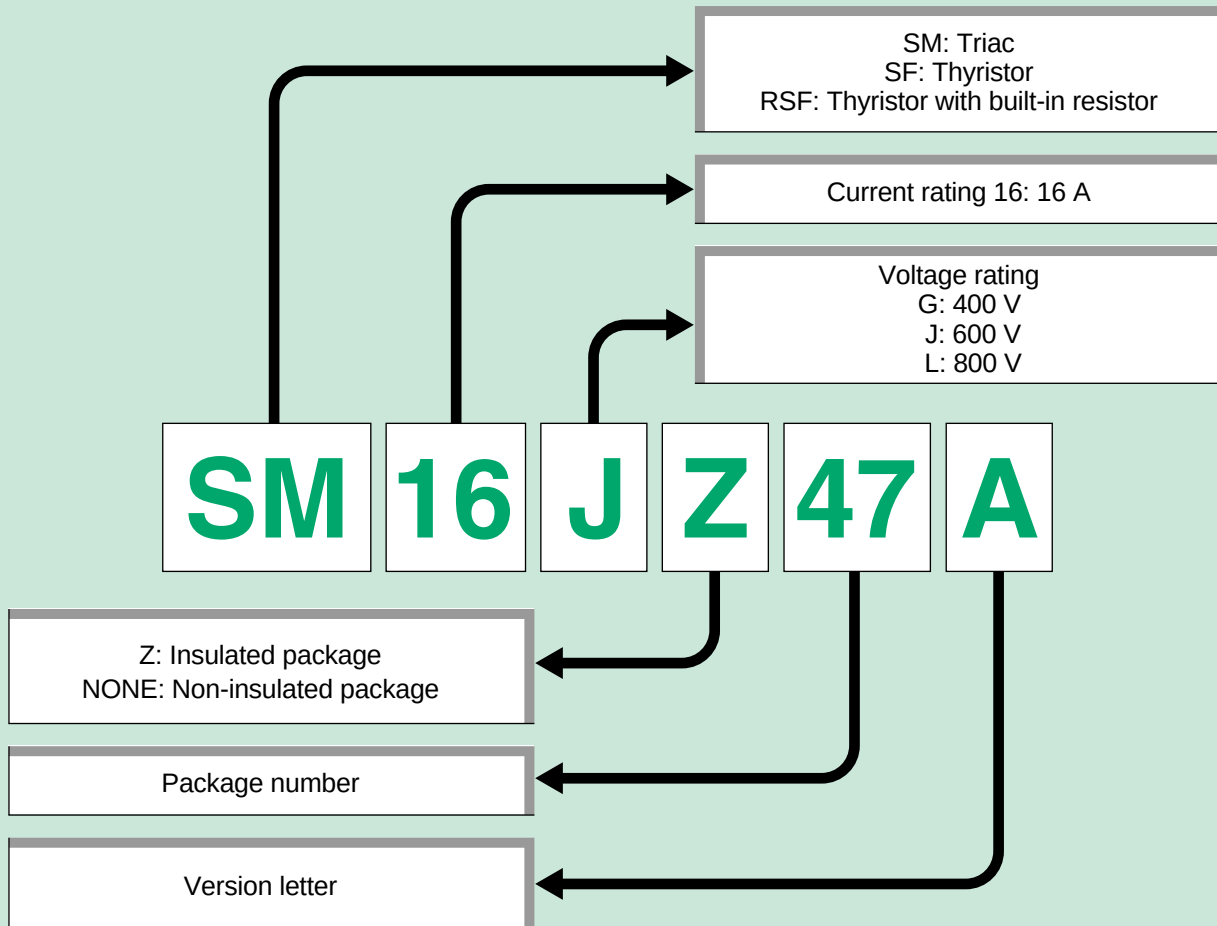
## Symbols and Terms

| 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 (between 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                                                                                                                                 |
| $V_{FGM}$<br>( $V_{GM}$ )        | Peak forward gate voltage<br>(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                                                                                                                                         |
| $t_{gt}$                         | Turn-ON time                                                          | Duration from gate current conduction to ON state of devices                                                                                                                              |
| $t_q$                            | 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 |
| $R_{th(j-a)}$ ,<br>$R_{th(j-c)}$ | 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.)                                                               |

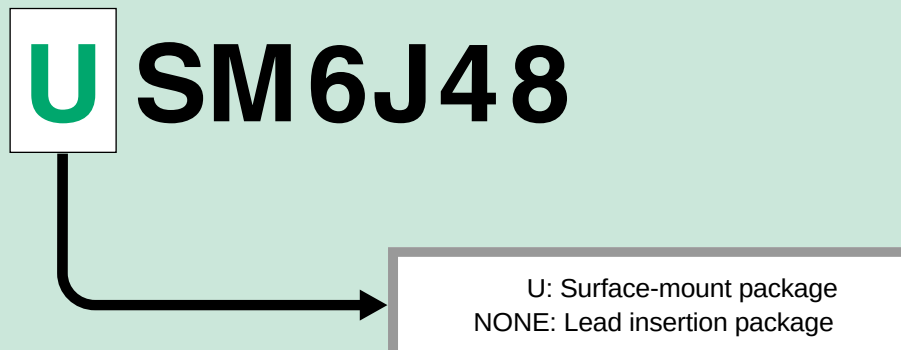
\* Every item is specified under particular conditions which are stated in the technical data sheet for each product. For the conditions, please refer to each.

## Identification

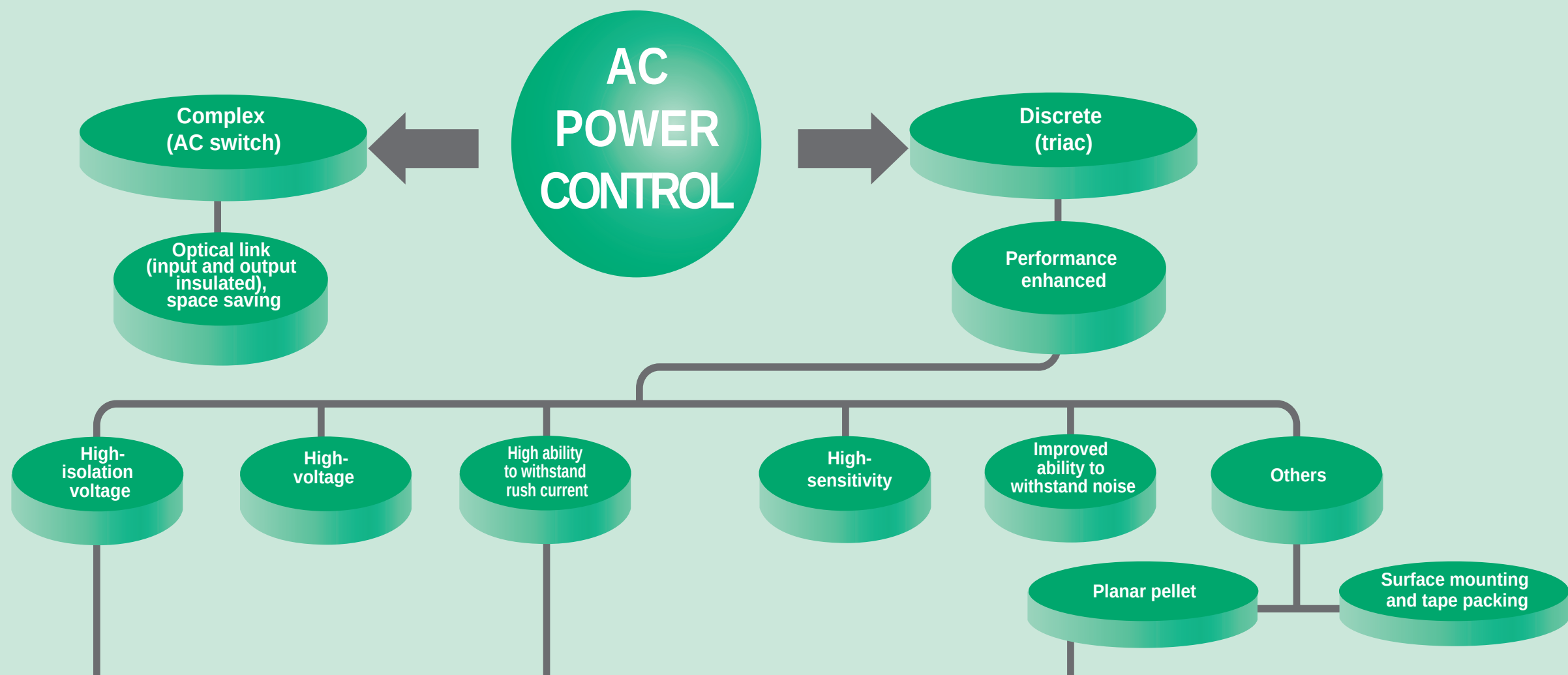
### Example 1. SM16JZ47A (Insulated 16A Triac)



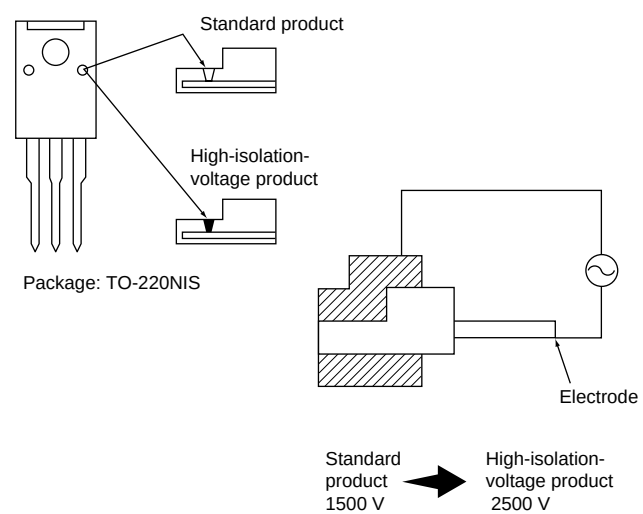
### Example 2. USM6J48 (Surface-Mounting 6A Triac)



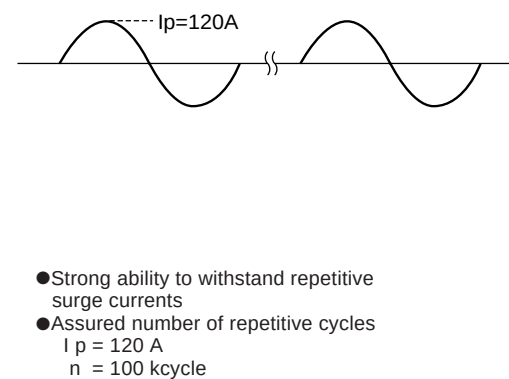
## 2 Development Trends



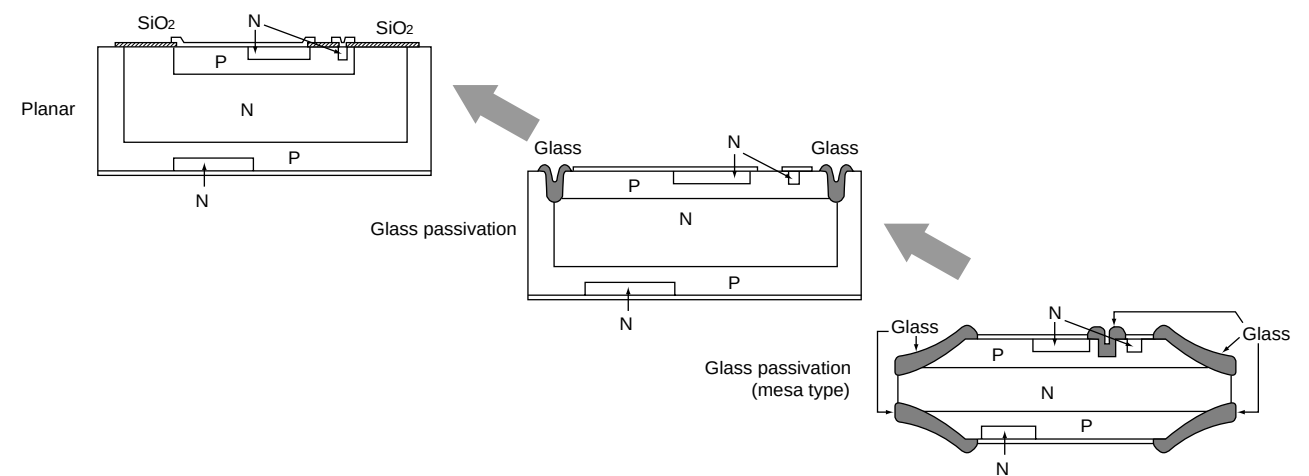
Improved isolation voltage performance (resin potting)



High-rush-current-withstanding triac



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 100W.

#### Features

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

#### Package Appearance

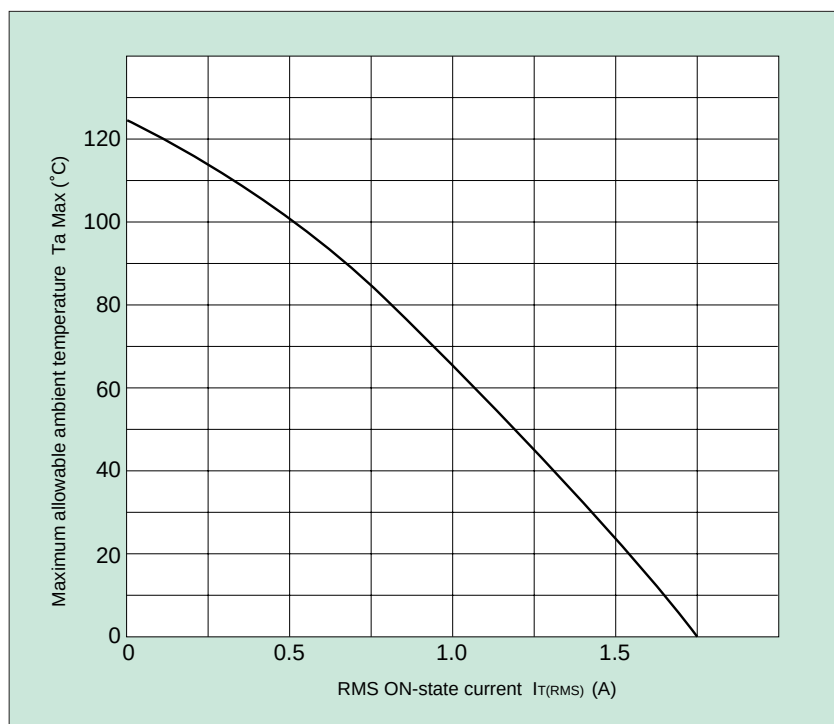


TO-220NIS

#### Main Ratings and Characteristics

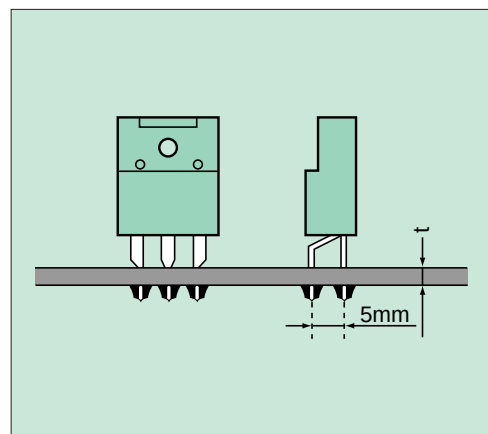
| Item                                  | Symbol       | Rating and Characteristics | Condition                                     |
|---------------------------------------|--------------|----------------------------|-----------------------------------------------|
| RMS ON-state current                  | $I_{T(RMS)}$ | 1 A                        | $T_a = 65^\circ\text{C; without a heat sink}$ |
| Gate trigger current                  | $I_{GT}$     | 8 mA max                   | $V_D = 12 \text{ V, I, II, III quadrants}$    |
|                                       |              | 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                        | $f = 50 \text{ Hz}$                           |

#### $T_a \text{ Max} - I_{T(RMS)}$ without a heat sink



#### Conditions

- ✱ No heat sink; device itself radiates heat
- ✱ Leadforming: LB107
- ✱ Paper Epoxy board used
- ✱  $t = 1.6 \text{ mm}$
- ✱ Soldering land:  $2 \text{ mm}\varnothing$



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

**High-Voltage:  $V_{\text{DRM}} = 800 \text{ V}$**

### Overview

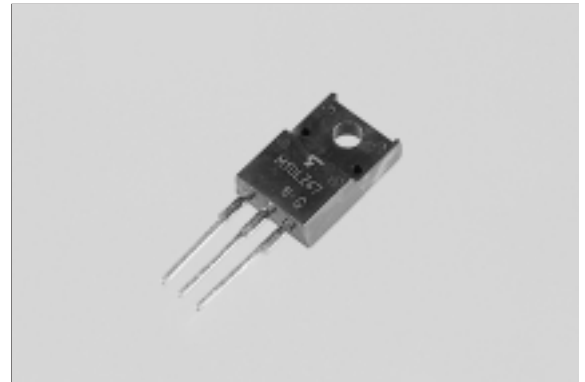
Toshiba has developed a high-voltage triac with 800V-OFF-state-voltage rating, which is most suitable for high-voltage applications, including reversible rotation motor in 200V-line-voltage.

### Features

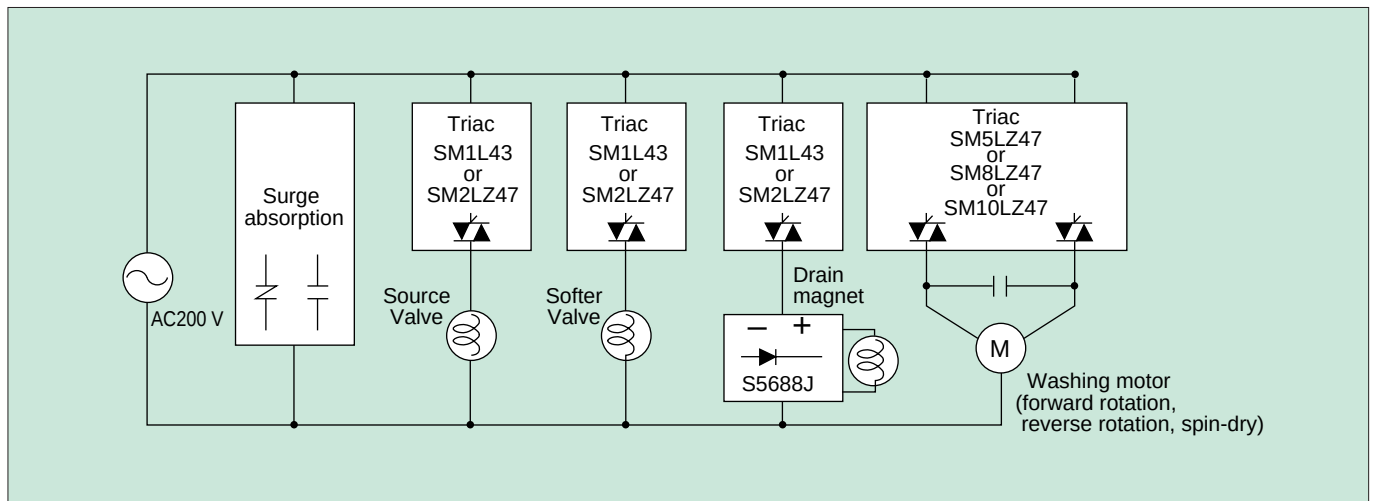
- High-voltage:  $V_{\text{DRM}} = 800 \text{ V}$
- Insulated package: TO-220NIS type (2A, \*5A, 8A, 10A)  
 $V_{\text{ISOL}} = 1500 \text{ V (AC, } t = 60 \text{ s)}$
- Compact package: TO-92 type (1A)

\*Under development

### Package Appearance



### Example Application (washing machine)



### Main Ratings and Characteristics: SM10LZ47

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





# 3 New Product Information

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

### TO-220NIS package with improved insulation performance

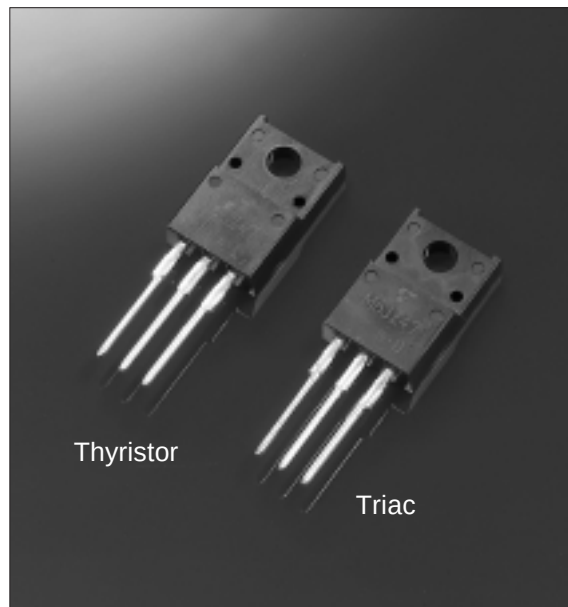
#### Overview

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.

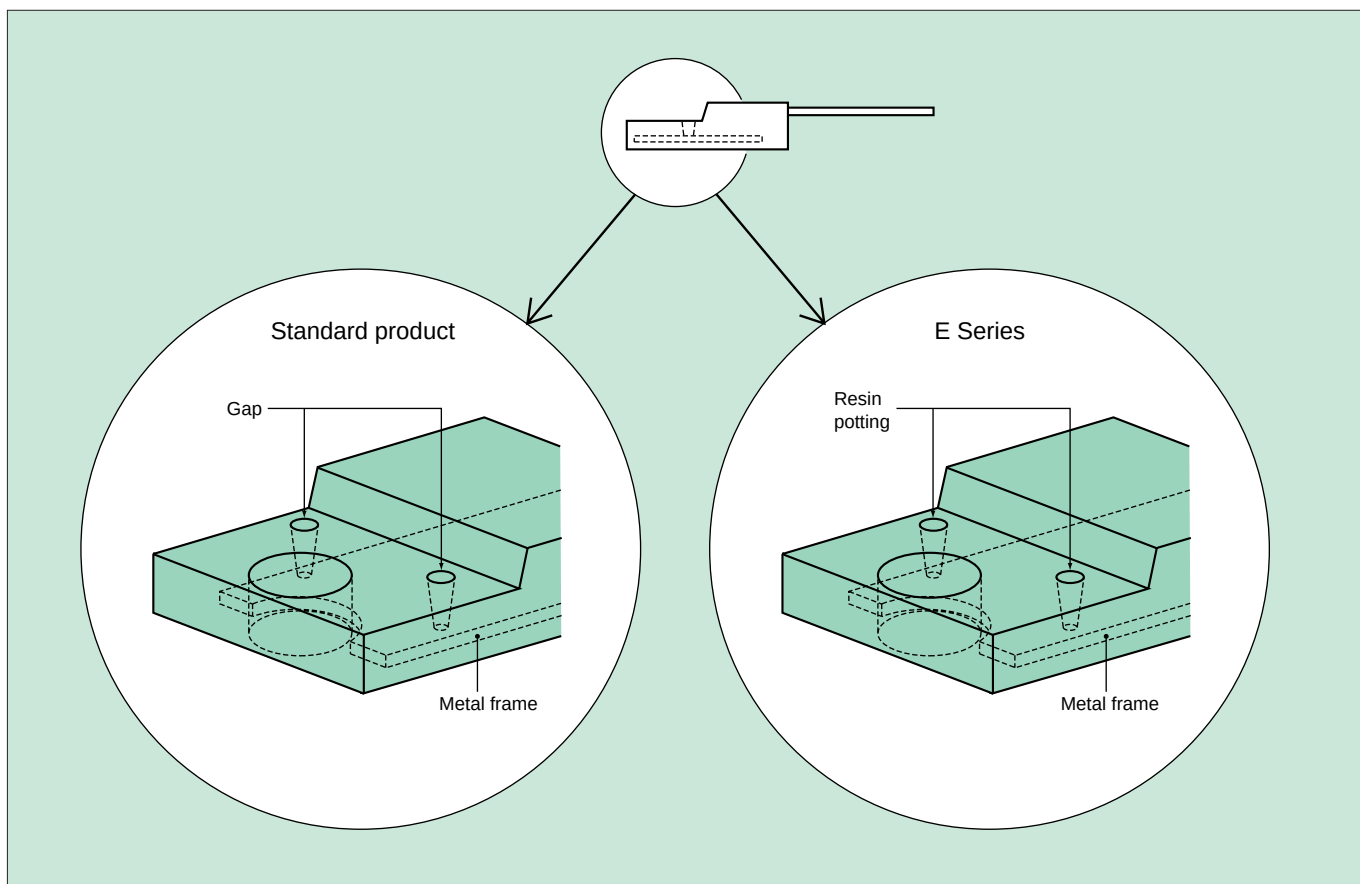
#### Features

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

#### Package Appearance



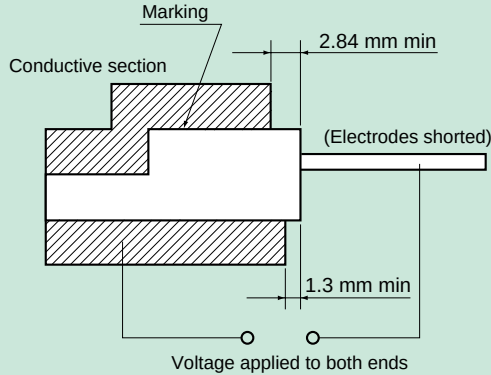
#### Structural Comparison



## Insulation Performance Test

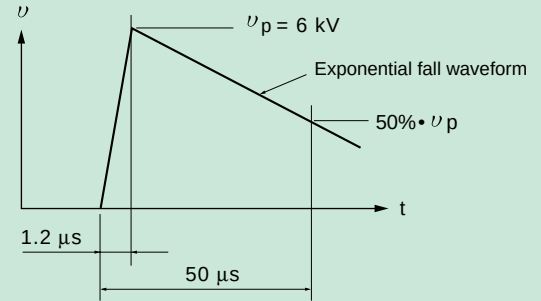
### AC insulation test

- $T_a = 25^\circ\text{C}$
- $RH \leq 60\%$
- AC 2500 VRMS applied,  $t = 60\text{ s}$



### Lightning surge test

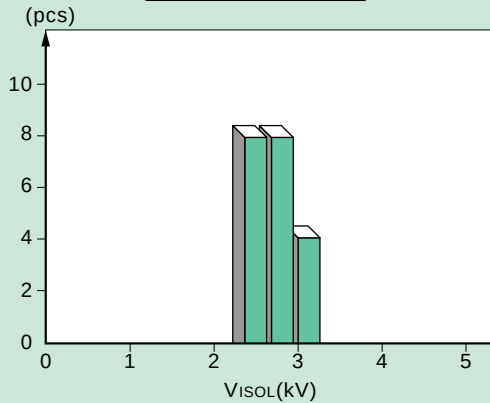
- $T_a = 25^\circ\text{C}$
- $RH \leq 60\%$
- One cycle applied as shown below



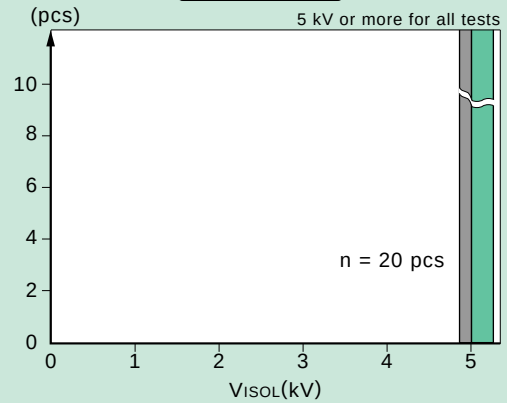
## Test Data 1 (reference)

### AC Insulation Test

#### Standard product

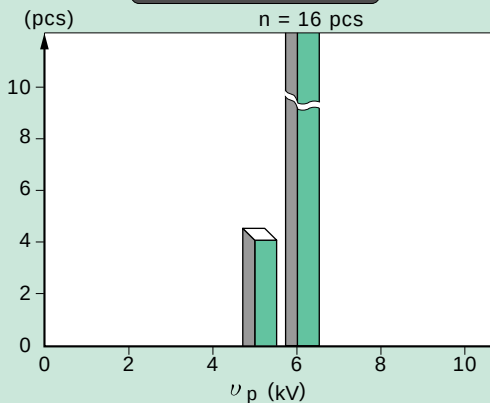


#### E Series

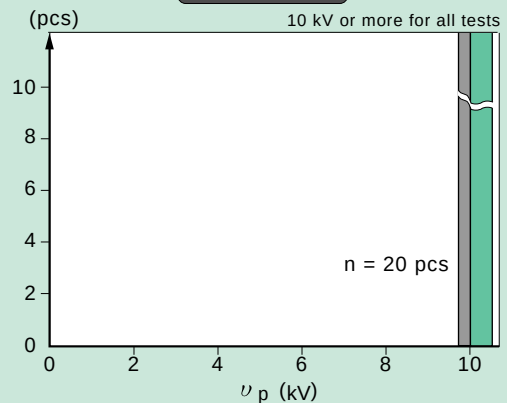


### Lightning Surge Test

#### Standard product



#### E Series



(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

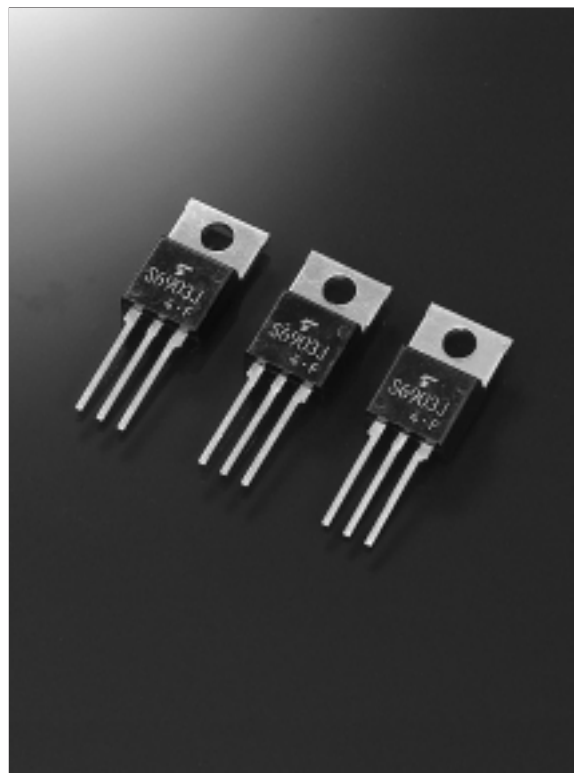
#### Overview

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.

#### Features

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

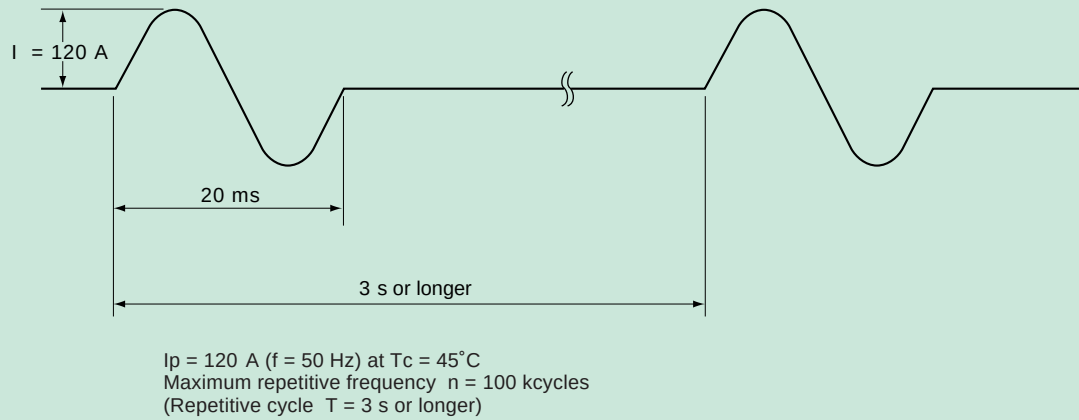
#### Package Appearance



#### Main Ratings and Characteristics

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

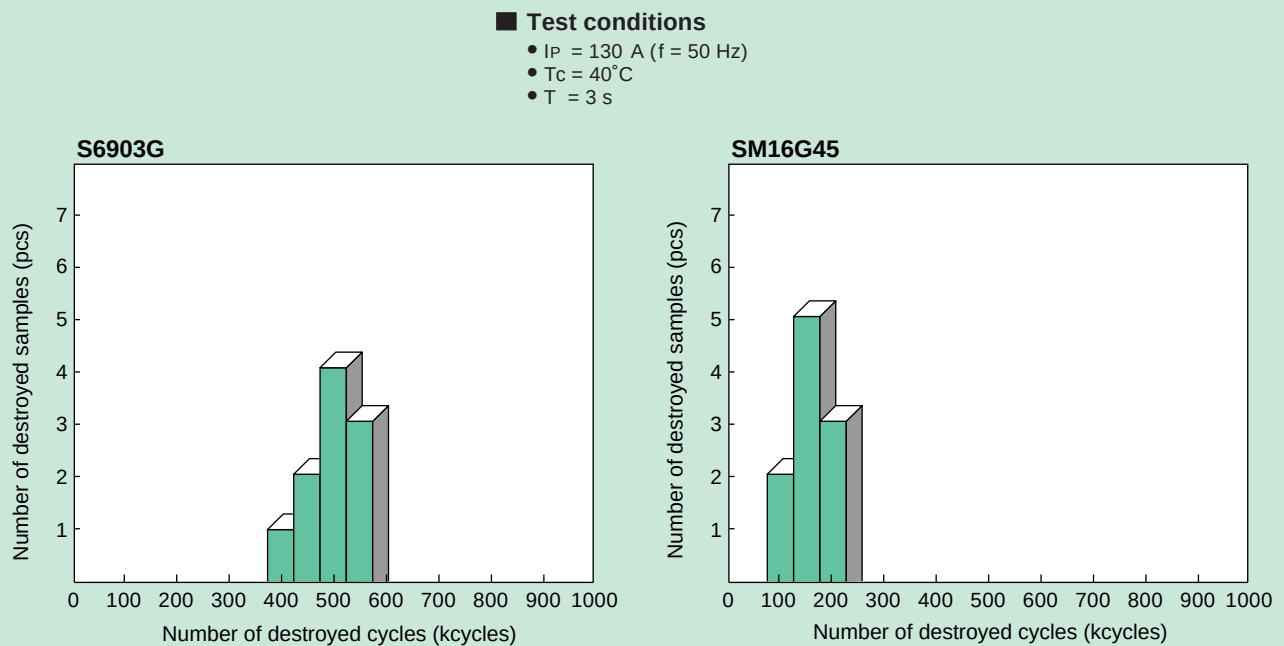
**Figure 1. Repetitive Surge ON-State Current**



### 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)





# 4 Selection Chart

## General-Purpose Thyristors

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

| $I_T$ (AV)<br>(A) | $V_{DRM}$ and $V_{DRM}$ (V) |          | $I_{GT}$<br>(mA) | Package 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 :  $R_{GK} = 1 \text{ k}\Omega$   
 -3P :  $R_{GK} = 2.7 \text{ k}\Omega$   
 -5P :  $R_{GK} = 5.1 \text{ k}\Omega$

## Insulated Thyristors

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

| $I_T$ (AV)<br>(A) | $V_{DRM}$ and $V_{DRM}$ (V) |          | $I_{GT}$<br>(mA) | Package 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 <sub>T(AV)</sub><br>(A) | V <sub>DRM</sub> and V <sub>DRM</sub> (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 <sub>TRM</sub> = 350 A                                                             | ③                   | 24   |
|                | Bypass  | 8                         | —                                         | S6744  | —     | I <sub>TRM</sub> = 1300 A                                                            | ⑤                   | 24   |
|                |         | —                         | —                                         | S6A35  | —     | I <sub>TRM</sub> = 900 A                                                             | ⑨                   | 24   |
| TV             |         | 3                         | —                                         | S6785G | —     | tq ≤ 3.5 μs                                                                          | ④                   | 24   |
| Discharge Lamp |         | —                         | —                                         | —      | S6992 | I <sub>P</sub> = 500 A, di/dt = 750 A/μs                                             | ⑤                   | 24   |
|                |         | —                         | —                                         | —      | S6A13 | I <sub>P</sub> = 500 A, di/dt = 750 A/μs<br>Diode included between cathode and anode |                     | 24   |

## Triacs

—▶ Repetitive peak OFF-state voltage

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

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

## Insulation Triac

—▶ Repetitive peak OFF-state voltage

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

\* Under development

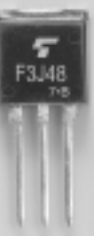
## Special-Purpose Triacs

| Usage      | $I_T$ (RMS)<br>(A) | $V_{DRM}$ and $V_{DRM}$ (V) |               | Main Features     | Package Dimensions | Page |
|------------|--------------------|-----------------------------|---------------|-------------------|--------------------|------|
|            |                    | 200                         | 400           |                   |                    |      |
| High speed | 20                 | <b>S6903G</b>               | <b>S6903J</b> | $I_{TRM}$ = 120 A | ③                  | 31   |



# 5 Product Lines

## 5.1 General-Purpose Thyristors (Non-insulated)

| I <sub>T(AV)</sub><br>(A) | Maximum Ratings                         |          |                      |       |                        | Electrical Characteristics (Ta=25°C)        |                         |                        |                        |                     |                 |         |   | Package<br>Dimensions | Package<br>Number                                                                                 | Package<br>Appearance |
|---------------------------|-----------------------------------------|----------|----------------------|-------|------------------------|---------------------------------------------|-------------------------|------------------------|------------------------|---------------------|-----------------|---------|---|-----------------------|---------------------------------------------------------------------------------------------------|-----------------------|
|                           | V <sub>DRM</sub> , V <sub>RRM</sub> (V) |          | I <sub>TSM</sub> (A) |       | T <sub>J</sub><br>(°C) | I <sub>DRM</sub> ,<br>I <sub>RRM</sub> (mA) | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | V <sub>TM</sub><br>(V) | I <sub>TM</sub> (A) | dv/dt<br>(V/ms) | TC (°C) |   |                       |                                                                                                   |                       |
|                           | 400                                     | 600      | 50 Hz                | 60 Hz |                        |                                             |                         |                        |                        |                     |                 |         |   |                       |                                                                                                   |                       |
| 0.3                       | SF0R3G42                                | —        | 9                    | 9.9   | -40 to 125             | Note 1<br>0.1                               | 0.2                     | 0.8                    | 2.0                    | 2                   | —               | —       | ① | 13-5A1A               | <br>TO-92      |                       |
| 0.5                       | SF0R5G43                                | SF0R5J43 | 7                    | 8     | -40 to 125             | Note 1<br>0.05                              | 0.2                     | 0.8                    | 1.5                    | 1                   | —               | —       | ① | 13-5A1D               |                                                                                                   |                       |
|                           | Note 2<br>RSF05G1-1P                    | —        | 9                    | 10    | -40 to 125             | 0.01                                        | 1                       | 0.8                    | 1.5                    | 1                   | 200 (typ.)      | 25      | ① | 13-5A1A               |                                                                                                   |                       |
|                           | Note 3<br>RSF05G1-3P                    | —        | 9                    | 10    | -40 to 125             | 0.01                                        | 0.4                     | 0.8                    | 1.5                    | 1                   | 70 (typ.)       | 25      | ① | 13-5A1A               |                                                                                                   |                       |
|                           | Note 4<br>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<br>2                                 | 0.2                     | 0.8                    | 1.6                    | 15                  | 50 (typ.)       | 75      | ③ | 13-10G1B              | <br>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 to 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              | <br>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: T<sub>J</sub> = 125°C

Note 2: R<sub>GK</sub> = 1 kΩ

Note 3: R<sub>GK</sub> = 2.7 kΩ

Note 4: R<sub>GK</sub> = 5.1 kΩ

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

| I <sub>T(AV)</sub><br>(A) | Maximum Ratings                         |          |                      |       |                          |                        | Electrical Characteristics (Ta=25°C)        |                         |                        |                        |                     |                 |         | Package<br>Dimensions | Package<br>Number | UL<br>Listing<br>Number | Package<br>Appearance                                                                               |
|---------------------------|-----------------------------------------|----------|----------------------|-------|--------------------------|------------------------|---------------------------------------------|-------------------------|------------------------|------------------------|---------------------|-----------------|---------|-----------------------|-------------------|-------------------------|-----------------------------------------------------------------------------------------------------|
|                           | V <sub>DRM</sub> , V <sub>RRM</sub> (V) |          | I <sub>TSM</sub> (A) |       | V <sub>ISOL</sub><br>(V) | T <sub>J</sub><br>(°C) | I <sub>DRM</sub> ,<br>I <sub>RRM</sub> (mA) | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | V <sub>TM</sub><br>(V) | I <sub>TM</sub> (A) | dv/dt<br>(V/ms) | TC (°C) |                       |                   |                         |                                                                                                     |
|                           | 400                                     | 600      | 50 Hz                | 60 Hz |                          |                        |                                             |                         |                        |                        |                     |                 |         |                       |                   |                         |                                                                                                     |
| 3                         | SF3GZ47                                 | SF3JZ47  | 50                   | 55    | 1500                     | -40 to 125             | 0.01                                        | 10                      | 1.0                    | 1.5                    | 12                  | 50 (typ.)       | 125     | ④                     | 13-10H1B          | E87989                  | <br>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       | <br>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           | —                       | <br>PW-MINI    |
|                           | <small>Note 1</small><br>URSF05G49-1P   | —        | 9                    | 10    | —                        | -40 to 125             | 0.01                                        | 1                       | 0.8                    | 1.5                    | 1                   | 200 (typ.)      | 25      | ②                     | 13-5B1A           | —                       |                                                                                                     |
|                           | <small>Note 2</small><br>URSF05G49-3P   | —        | 9                    | 10    | —                        | -40 to 125             | 0.01                                        | 0.4                     | 0.8                    | 1.5                    | 1                   | 70 (typ.)       | 25      | ②                     | 13-5B1A           | —                       |                                                                                                     |
|                           | <small>Note 3</small><br>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          | —                       | <br>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           | —                       | <br>DP         |

Note 1: R<sub>GK</sub> = 1 kΩ

Note 2: R<sub>GK</sub> = 2.7 kΩ

Note 3: R<sub>GK</sub> = 5.1 kΩ





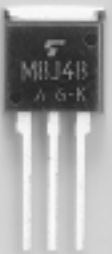
# 5 Product Lines

## 5.2 General-Purpose Triacs (Non-insulated)

| I <sub>T(RMS)</sub><br>(A) | Maximum Ratings      |          |        |                      |       |                        | Electrical Characteristics (Ta=25°C) |                                |                        |                 |                     |                                | Package<br>Dimensions | Package<br>Number | Package<br>Appearance                                                                             |
|----------------------------|----------------------|----------|--------|----------------------|-------|------------------------|--------------------------------------|--------------------------------|------------------------|-----------------|---------------------|--------------------------------|-----------------------|-------------------|---------------------------------------------------------------------------------------------------|
|                            | V <sub>DRM</sub> (V) |          |        | I <sub>TSM</sub> (A) |       | T <sub>J</sub><br>(°C) | I <sub>DRM</sub><br>(mA)             | I <sub>GT</sub><br>(mA)        | V <sub>GT</sub><br>(V) | V <sub>TM</sub> |                     | (dv/dt) <sub>c</sub><br>(V/ms) |                       |                   |                                                                                                   |
|                            | 400                  | 600      | 800    | 50 Hz                | 60 Hz |                        |                                      |                                |                        | (V)             | I <sub>TM</sub> (A) |                                |                       |                   |                                                                                                   |
| 0.8                        | SM08G43              | –        | –      | 6                    | 6.6   | –40 to 125             | 0.01                                 | Note 2<br>3                    | Note 2<br>1.5          | 1.5             | 1.2                 | –                              | ①                     | 13-5A1E           | <br>TO-92      |
| 1                          | SM1G43               | SM1J43   | SM1L43 | 8                    | 8.8   | –40 to 125             | 0.01                                 | 5 (400 V, 600 V)<br>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          | <br>TO-220AB |
| 6                          | SM6G45               | SM6J45   | –      | 60                   | 66    | –40 to 125             | Note 1<br>2                          | 30                             | 2                      | 1.5             | 9                   | 10                             | ③                     | 13-10G1A          |                                                                                                   |
|                            | SM6G45A              | SM6J45A  | –      | 60                   | 66    | –40 to 125             | Note 1<br>2                          | 20                             | 1.5                    | 1.5             | 9                   | 4                              | ③                     | 13-10G1A          |                                                                                                   |
| 8                          | SM8G45               | SM8J45   | –      | 80                   | 88    | –40 to 125             | Note 1<br>2                          | 30                             | 2                      | 1.5             | 12                  | 10                             | ③                     | 13-10G1A          |                                                                                                   |
|                            | SM8G45A              | SM8J45A  | –      | 80                   | 88    | –40 to 125             | Note 1<br>2                          | 20                             | 1.5                    | 1.5             | 12                  | 4                              | ③                     | 13-10G1A          |                                                                                                   |
| 12                         | SM12G45              | SM12J45  | –      | 120                  | 132   | –40 to 125             | Note 1<br>2                          | 30                             | 2                      | 1.5             | 17                  | 10                             | ③                     | 13-10G1A          |                                                                                                   |
|                            | SM12G45A             | SM12J45A | –      | 120                  | 132   | –40 to 125             | Note 1<br>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: T<sub>J</sub> = 125°C    Note 2: II, III mode only

## 5.2 General-Purpose Triacs (Non-insulated)

| I <sub>T(RMS)</sub><br>(A) | Maximum Ratings      |          |                      |       |                        | Electrical Characteristics (T <sub>a</sub> =25°C) |                         |                        |                     |     |                                | Package<br>Dimensions | Package<br>Number | Package<br>Appearance                                                                            |
|----------------------------|----------------------|----------|----------------------|-------|------------------------|---------------------------------------------------|-------------------------|------------------------|---------------------|-----|--------------------------------|-----------------------|-------------------|--------------------------------------------------------------------------------------------------|
|                            | V <sub>DRM</sub> (V) |          | I <sub>TSM</sub> (A) |       | T <sub>J</sub><br>(°C) | I <sub>DRM</sub><br>(mA)                          | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | V <sub>TM</sub> (V) |     | (dv/dt) <sub>C</sub><br>(V/ms) |                       |                   |                                                                                                  |
|                            | 400                  | 600      | 50 Hz                | 60 Hz |                        |                                                   |                         |                        | I <sub>TM</sub> (A) |     |                                |                       |                   |                                                                                                  |
| 3                          | SM3G48               | SM3J48   | 30                   | 33    | -40 to 125             | 0.02                                              | 20                      | 1.5                    | 1.5                 | 4.5 | 10                             | ⑤                     | 13-10J1A          | <br>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 Product Lines

## 5.2 General-Purpose Triacs (Insulated)

| I <sub>T(RMS)</sub><br>(A) | Maximum Ratings      |           |          |                      |       |                        | Electrical Characteristics (Ta = 25°C) |                                       |                                      |                        |                                |    | Package<br>Dimensions | Package<br>Number | UL<br>Listing<br>Number | Package<br>Appearance                                                                               |
|----------------------------|----------------------|-----------|----------|----------------------|-------|------------------------|----------------------------------------|---------------------------------------|--------------------------------------|------------------------|--------------------------------|----|-----------------------|-------------------|-------------------------|-----------------------------------------------------------------------------------------------------|
|                            | V <sub>DRM</sub> (V) |           |          | I <sub>TSM</sub> (A) |       | T <sub>j</sub><br>(°C) | I <sub>DRM</sub><br>(mA)               | I <sub>GT</sub><br>(mA)<br>I, II, III | V <sub>GT</sub><br>(V)<br>I, II, III | V <sub>TM</sub><br>(V) | (dv/dt) <sub>C</sub><br>(V/ms) |    |                       |                   |                         |                                                                                                     |
|                            | 400                  | 600       | 800      | 50 Hz                | 60 Hz |                        |                                        |                                       |                                      |                        |                                |    |                       |                   |                         |                                                                                                     |
| 2                          | SM2GZ47              | SM2JZ47   | -        | 8                    | 8.8   | -40 to 125             | 0.02                                   | 8                                     | 1.5                                  | 1.7                    | 3                              | -  | ④                     | 13-10H1A          | -                       | <br>TO-220NIS   |
|                            | 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                  |                                                                                                     |
| 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                  |                                                                                                     |
| 25                         | SM25GZ51             | SM25JZ51  | -        | 230                  | 253   |                        | 0.02                                   | 30                                    | 1.5                                  | 1.5                    | 40                             | 10 | ⑦                     | 13-16A1A          | E87989                  | <br>TO-3P(N)IS |

\* Under development

## 5.2 General-Purpose Triacs (Surface-mount)

| I <sub>T(RMS)</sub><br>(A) | Maximum Ratings      |           |                      |       |                        | Electrical Characteristics (Ta = 25°C) |                         |                        |                        |                                |                     | Package<br>Dimensions | Package<br>Number | Package<br>Appearance                                                                           |
|----------------------------|----------------------|-----------|----------------------|-------|------------------------|----------------------------------------|-------------------------|------------------------|------------------------|--------------------------------|---------------------|-----------------------|-------------------|-------------------------------------------------------------------------------------------------|
|                            | V <sub>DRM</sub> (V) |           | I <sub>TSM</sub> (A) |       | T <sub>j</sub><br>(°C) | I <sub>DRM</sub><br>(mA)               | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | V <sub>TM</sub><br>(V) | (dv/dt) <sub>c</sub><br>(V/ms) |                     |                       |                   |                                                                                                 |
|                            | 400                  | 600       | 50 Hz                | 60 Hz |                        |                                        |                         |                        |                        |                                | I <sub>TM</sub> (A) |                       |                   |                                                                                                 |
| 3                          | USM3G48              | USM3J48   | 30                   | 33    | -40 to 125             | 0.02                                   | 20                      | 1.5                    | 1.5                    | 4.5                            | 10                  | ⑥                     | 13-10J2A          | <br>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 <sub>T(AV)</sub><br>(A) | Maximum Ratings                         |     |                         |                      |       |                        | Electrical Characteristics (Ta = 25°C) |                         |                        |                        |                        |                     |                 |                     | Package<br>Dimensions | Package<br>Number | Package<br>Appearance                                                                     |
|---------------------------|-----------------------------------------|-----|-------------------------|----------------------|-------|------------------------|----------------------------------------|-------------------------|------------------------|------------------------|------------------------|---------------------|-----------------|---------------------|-----------------------|-------------------|-------------------------------------------------------------------------------------------|
|                           | V <sub>DRM</sub> , V <sub>RRM</sub> (V) |     | V <sub>DSM</sub><br>(V) | I <sub>TSM</sub> (A) |       | T <sub>j</sub><br>(°C) | I <sub>DRM</sub><br>(mA)               | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | t <sub>q</sub><br>(ms) | V <sub>TM</sub><br>(V) | I <sub>TM</sub> (A) | dv/dt<br>(V/ms) | T <sub>c</sub> (°C) |                       |                   |                                                                                           |
|                           | 200                                     | 400 |                         | 50 Hz                | 60 Hz |                        |                                        |                         |                        |                        |                        |                     |                 |                     |                       |                   |                                                                                           |
| 0.3                       | SH0R3D42                                | —   | 250                     | 7                    | 7.7   | -40 to 125             | Note 1<br>0.1                          | 1                       | 0.9                    | 6                      | 1.8                    | 2                   | 15              | 110                 | ①                     | 13-5A1A           |  TO-92 |

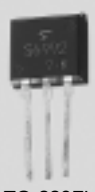
Note 1 : T<sub>J</sub> = 125°C

### • TV

| IT(AV)<br>(A) | Maximum Ratings |       |          |            | Electrical Characteristics (Ta = 25°C) |                               |             |            |             |            |            |         |                 |         | Package<br>Dimensions | Package<br>Number                                                                             | Package<br>Appearance |
|---------------|-----------------|-------|----------|------------|----------------------------------------|-------------------------------|-------------|------------|-------------|------------|------------|---------|-----------------|---------|-----------------------|-----------------------------------------------------------------------------------------------|-----------------------|
|               | VDRM, VRRM (V)  |       | ITSM (A) |            | Tj<br>(°C)                             | IDRM, IRRM (mA)<br>(Tj=125°C) | IGT<br>(mA) | VGT<br>(V) | tqt<br>(ms) | tq<br>(ms) | VTM<br>(V) | ITM (A) | dv/dt<br>(V/ms) | TC (°C) |                       |                                                                                               |                       |
|               | 400             | 50 Hz | 60 Hz    |            |                                        |                               |             |            |             |            |            |         |                 |         |                       |                                                                                               |                       |
| 3             | S6785G          | 60    | 66       | -40 to 125 | Note 1<br>1<br>2                       | 25                            | 1.5         | 3          | 3.5         | 2          | 20         | 100     | 125<br>Vc=-2.5V | ④       | 13-10H1B              |  TO-220NIS |                       |

### • High-di/dt

Note 1: upper value = I<sub>DRM</sub>, lower value = I<sub>RRM</sub>

|  | Maximum Ratings      |                         |                 |                        | Electrical Characteristics (Ta = 25°C) |                         |                        |                        |                 |                     |     |   | Package<br>Dimensions | Package<br>Number                                                                                    | Package<br>Appearance |
|--|----------------------|-------------------------|-----------------|------------------------|----------------------------------------|-------------------------|------------------------|------------------------|-----------------|---------------------|-----|---|-----------------------|------------------------------------------------------------------------------------------------------|-----------------------|
|  | V <sub>DRM</sub> (V) | I <sub>TRM</sub><br>(A) | di/dt<br>(A/ms) | T <sub>j</sub><br>(°C) | I <sub>DRM</sub><br>(mA)               | I <sub>GT</sub><br>(mA) | V <sub>GT</sub><br>(V) | V <sub>TM</sub><br>(V) | dv/dt<br>(V/ms) | T <sub>C</sub> (°C) |     |   |                       |                                                                                                      |                       |
|  | 800                  |                         |                 |                        |                                        |                         |                        |                        |                 |                     |     |   |                       |                                                                                                      |                       |
|  | S6992                | 500                     | 750             | -40 to 125             | 0.01                                   | 20                      | 1.0                    | 1.5                    | 25              | —                   | —   | ⑤ | 13-10J1B              | <br><br>TO-220FL |                       |
|  | Note 1<br>S6A13      | 500                     | 750             | -40 to 125             | 0.01                                   | 30                      | 1.0                    | 1.5                    | 25              | 50                  | 125 | ⑤ | 13-10J1B              |                                                                                                      |                       |

### • Strobe

Note 1: Diode included between cathode and anode

| Application       | Maximum Ratings                         |                      |       |                                   |              |                     | Electrical Characteristics (Ta = 25°C) |                     |                     |                     |                     |                                  | Package Dimensions | Package Number | Package Appearance                                                                             |
|-------------------|-----------------------------------------|----------------------|-------|-----------------------------------|--------------|---------------------|----------------------------------------|---------------------|---------------------|---------------------|---------------------|----------------------------------|--------------------|----------------|------------------------------------------------------------------------------------------------|
|                   | V <sub>DRM</sub> , V <sub>RRM</sub> (V) | I <sub>TSM</sub> (A) |       | I <sub>TRM</sub> (A)              | di/dt (A/ms) | T <sub>J</sub> (°C) | I <sub>GT</sub> (mA)                   | V <sub>GT</sub> (V) | I <sub>H</sub> (mA) | V <sub>TM</sub> (V) | C <sub>c</sub> (mF) |                                  |                    |                |                                                                                                |
|                   | 400                                     | 50 Hz                | 60 Hz |                                   |              |                     |                                        |                     |                     | I <sub>TM</sub> (A) |                     |                                  |                    |                |                                                                                                |
| Note 1<br>Trigger | S6730                                   | 9                    | 9.9   | —                                 | —            | -40 to 125          | 0.2                                    | 0.8                 | 4 (typ.)            | 2                   | 2                   | —                                | ①                  | 13-5A1A        |  TO-92    |
| Chopper           | SH8G41                                  | —                    | —     | 350<br>(C <sub>M</sub> ≤ 1000 μF) | 100          | -40 to 125          | 50                                     | 1.5                 | 150                 | 2.3                 | 25                  | 2.7<br>(I <sub>TM</sub> = 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)

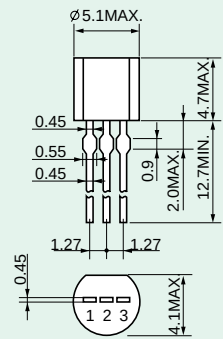
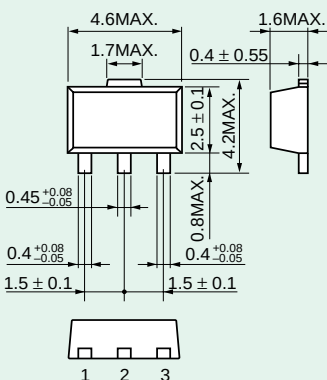
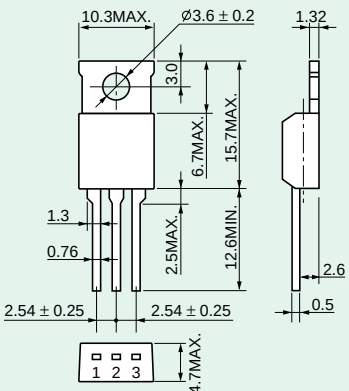
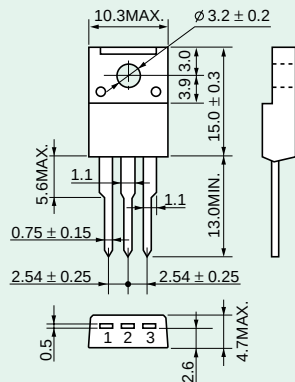
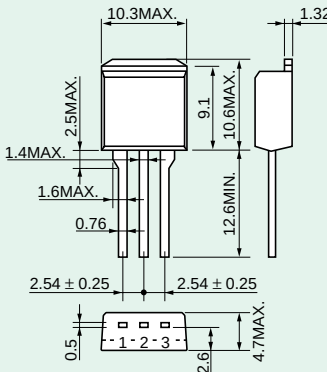
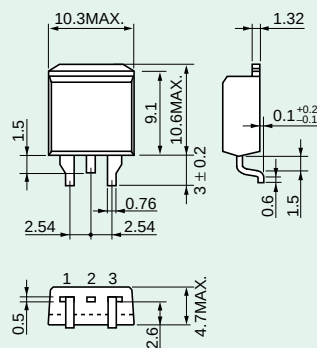
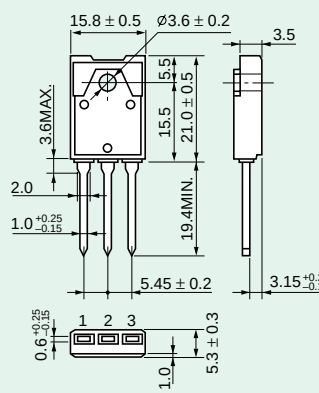
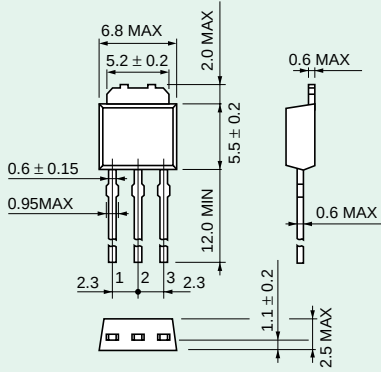
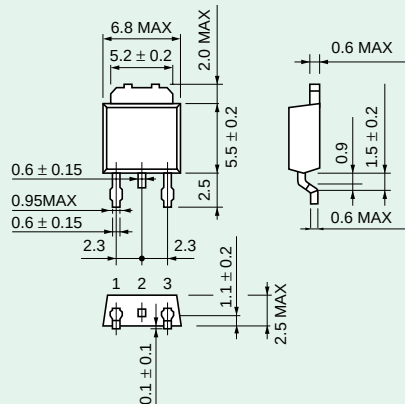
## 5.4 Special-Purpose Triacs

### • High-Rush Current

| Maximum Ratings |          |        |             |          |       |            | Electrical Characteristics (Ta = 25°C) |                        |                       |            |            |         |                    | Package Dimensions | Package Number | Package Appearance                                                                             |
|-----------------|----------|--------|-------------|----------|-------|------------|----------------------------------------|------------------------|-----------------------|------------|------------|---------|--------------------|--------------------|----------------|------------------------------------------------------------------------------------------------|
| IT(RMS)<br>(A)  | VDRM (V) |        | ITRM<br>(A) | ITSM (A) |       | Tj<br>(°C) | IDRM<br>(mA)                           | IGT (mA)<br>I, II, III | VGT (V)<br>I, II, III | tq<br>(ms) | VTM<br>(V) | ITM (A) | (dv/dt)c<br>(V/ms) |                    |                |                                                                                                |
|                 | 400      | 600    |             | 50 Hz    | 60 Hz |            |                                        |                        |                       |            |            |         |                    |                    |                |                                                                                                |
| 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

| <div>①</div> <div>TO-92</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-5A1A</td><td>Gate</td><td>Anode</td><td>Cathode</td></tr><tr><td>13-5A1D</td><td>Cathode</td><td>Gate</td><td>Anode</td></tr><tr><td>13-5A1E</td><td>T1</td><td>Gate</td><td>T2</td></tr></table></div> | Pin Number | 1                 | 2       | 3 | 13-5A1A  | Gate    | Anode | Cathode | 13-5A1D  | Cathode | Gate | Anode | 13-5A1E                                                                                                                                                                                                                                                                                                                                               | T1         | Gate | T2 | <div>②</div> <div>PW-MINI</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-5B1A</td><td>Gate</td><td>Anode</td><td>Cathode</td></tr></table></div> | Pin Number | 1       | 2                 | 3    | 13-5B1A                                                                                                                                                                                                                                                                                                          | Gate       | Anode | Cathode | <div>③</div> <div>TO-220AB</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-10G1B</td><td>Cathode</td><td>Anode</td><td>Gate</td></tr><tr><td>13-10G1A</td><td>T1</td><td>T2</td><td>Gate</td></tr></table></div>  | Pin Number | 1       | 2                 | 3    | 13-10G1B | Cathode | Anode | Gate | 13-10G1A | T1 | T2 | Gate |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|---------|---|----------|---------|-------|---------|----------|---------|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|-------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|-------------------|------|----------|---------|-------|------|----------|----|----|------|
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-5A1A                                                                                                                                                                                                                                                                                                                                                                                                             | Gate       | Anode             | Cathode |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-5A1D                                                                                                                                                                                                                                                                                                                                                                                                             | Cathode    | Gate              | Anode   |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-5A1E                                                                                                                                                                                                                                                                                                                                                                                                             | T1         | Gate              | T2      |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-5B1A                                                                                                                                                                                                                                                                                                                                                                                                             | Gate       | Anode             | Cathode |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10G1B                                                                                                                                                                                                                                                                                                                                                                                                            | Cathode    | Anode             | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10G1A                                                                                                                                                                                                                                                                                                                                                                                                            | T1         | T2                | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| <div>④</div> <div>TO-220NIS</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-10H1B</td><td>Cathode</td><td>Anode</td><td>Gate</td></tr><tr><td>13-10H1A</td><td>T1</td><td>T2</td><td>Gate</td></tr></table></div>                                                              | Pin Number | 1                 | 2       | 3 | 13-10H1B | Cathode | Anode | Gate    | 13-10H1A | T1      | T2   | Gate  | <div>⑤</div> <div>TO-220FL</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-10J1B</td><td>Cathode</td><td>Anode</td><td>Gate</td></tr><tr><td>13-10J1A</td><td>T1</td><td>T2</td><td>Gate</td></tr></table></div> | Pin Number | 1    | 2  | 3                                                                                                                                                                                                                                                                                     | 13-10J1B   | Cathode | Anode             | Gate | 13-10J1A                                                                                                                                                                                                                                                                                                         | T1         | T2    | Gate    | <div>⑥</div> <div>TO-220SM</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-10J2B</td><td>Cathode</td><td>Anode</td><td>Gate</td></tr><tr><td>13-10J2A</td><td>T1</td><td>T2</td><td>Gate</td></tr></table></div> | Pin Number | 1       | 2                 | 3    | 13-10J2B | Cathode | Anode | Gate | 13-10J2A | T1 | T2 | Gate |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10H1B                                                                                                                                                                                                                                                                                                                                                                                                            | Cathode    | Anode             | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10H1A                                                                                                                                                                                                                                                                                                                                                                                                            | T1         | T2                | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10J1B                                                                                                                                                                                                                                                                                                                                                                                                            | Cathode    | Anode             | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10J1A                                                                                                                                                                                                                                                                                                                                                                                                            | T1         | T2                | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10J2B                                                                                                                                                                                                                                                                                                                                                                                                            | Cathode    | Anode             | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-10J2A                                                                                                                                                                                                                                                                                                                                                                                                            | T1         | T2                | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| <div>⑦</div> <div>TO-3P(N)IS</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-16A1B</td><td>Cathode</td><td>Anode</td><td>Gate</td></tr><tr><td>13-16A1A</td><td>T1</td><td>T2</td><td>Gate</td></tr></table></div>                                                            | Pin Number | 1                 | 2       | 3 | 13-16A1B | Cathode | Anode | Gate    | 13-16A1A | T1      | T2   | Gate  | <div>⑧</div> <div>DP</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-7F1A</td><td>Cathode</td><td>Anode (heat sink)</td><td>Gate</td></tr></table></div>                                                        | Pin Number | 1    | 2  | 3                                                                                                                                                                                                                                                                                     | 13-7F1A    | Cathode | Anode (heat sink) | Gate | <div>⑨</div> <div>DP (Surface-mount)</div> <div></div> <div><table><tr><th>Pin Number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>13-7F2A</td><td>Cathode</td><td>Anode (heat sink)</td><td>Gate</td></tr></table></div> | Pin Number | 1     | 2       | 3                                                                                                                                                                                                                                                                                                                                                       | 13-7F2A    | Cathode | Anode (heat sink) | Gate |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-16A1B                                                                                                                                                                                                                                                                                                                                                                                                            | Cathode    | Anode             | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-16A1A                                                                                                                                                                                                                                                                                                                                                                                                            | T1         | T2                | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| Pin Number                                                                                                                                                                                                                                                                                                                                                                                                          | 1          | 2                 | 3       |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 13-7F1A                                                                                                                                                                                                                                                                                                                                                                                                             | Cathode    | Anode (heat sink) | Gate    |   |          |         |       |         |          |         |      |       |                                                                                                                                                                                                                                                                                                                                                       |            |      |    |                                                                                                                                                                                                                                                                                       |            |         |                   |      |                                                                                                                                                                                                                                                                                                                  |            |       |         |                                                                                                                                                                                                                                                                                                                                                         |            |         |                   |      |          |         |       |      |          |    |    |      |
| 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<br>               |
| TPER1    |                 | 2000 pcs/reel    | Reel<br>               |
| TPE2     |                 | 3000 pcs/box     | Box<br>(Ammo Pack)<br> |
| TPER2    |                 | 3000 pcs/box     | Box<br>(Ammo Pack)<br> |

## 7.2 Packing of PW-MINI and DP

Unit: mm

| Type No.               | Tape Dimensions                                                          | Packing Quantity               | Packing Method                                                                                                                                                                            |   |   |   |                |     |      |                  |     |      |
|------------------------|--------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|----------------|-----|------|------------------|-----|------|
| TE12R<br>or<br>TE12L   | <div>PW-MINI</div> <p>Note: L = Leads to Left<br/>R = Leads to Right</p> | 1000 pcs/reel<br>(5 reels/box) | <div>Reel</div> <table><tr><td></td><td>A</td><td>B</td></tr><tr><td>TE12R or TE12L</td><td>178</td><td>13.5</td></tr><tr><td>TE12R1 or TE12L1</td><td>330</td><td>12.5</td></tr></table> |   | A | B | TE12R or TE12L | 178 | 13.5 | TE12R1 or TE12L1 | 330 | 12.5 |
|                        |                                                                          | A                              |                                                                                                                                                                                           | B |   |   |                |     |      |                  |     |      |
| TE12R or TE12L         | 178                                                                      | 13.5                           |                                                                                                                                                                                           |   |   |   |                |     |      |                  |     |      |
| TE12R1 or TE12L1       | 330                                                                      | 12.5                           |                                                                                                                                                                                           |   |   |   |                |     |      |                  |     |      |
| TE12R1<br>or<br>TE12L1 |                                                                          | 5000 pcs/reel<br>(1 reel/box)  |                                                                                                                                                                                           |   |   |   |                |     |      |                  |     |      |
| TE16R1<br>or<br>TE16L1 | <div>DP</div> <p>Note: L = Leads to Left<br/>R = Leads to Right</p>      | 2000 pcs/reel<br>(1 reel/box)  | <div>Reel</div>                                                                                                                                                                           |   |   |   |                |     |      |                  |     |      |

## 7.3 Packing of TO-220SM

Unit: mm

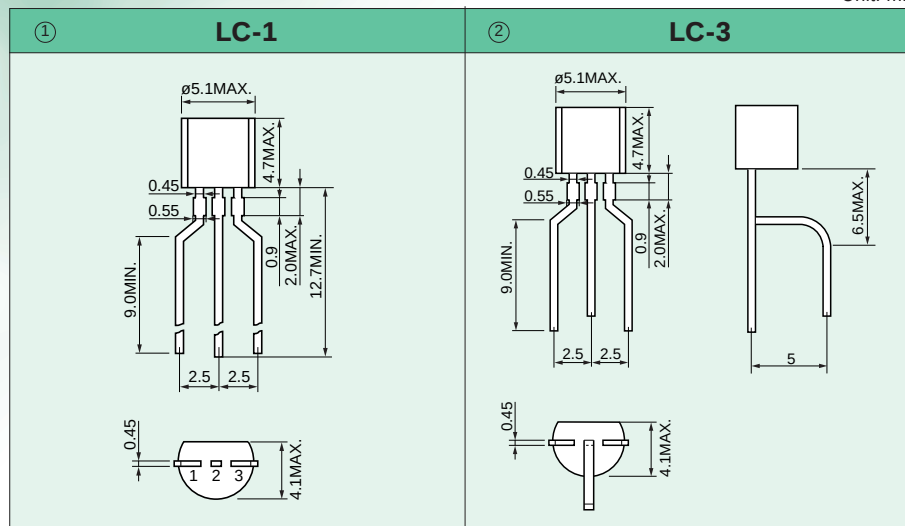
| Type No.             | Tape Dimensions                                       | Packing Quantity               | Packing Method |
|----------------------|-------------------------------------------------------|--------------------------------|----------------|
| TE24R<br>or<br>TE24L | <p>Note: L = Leads to Left<br/>R = Leads to Right</p> | 1000 pcs/reel<br>(4 reels/box) | <b>Reel</b>    |



# 8 Leadforming

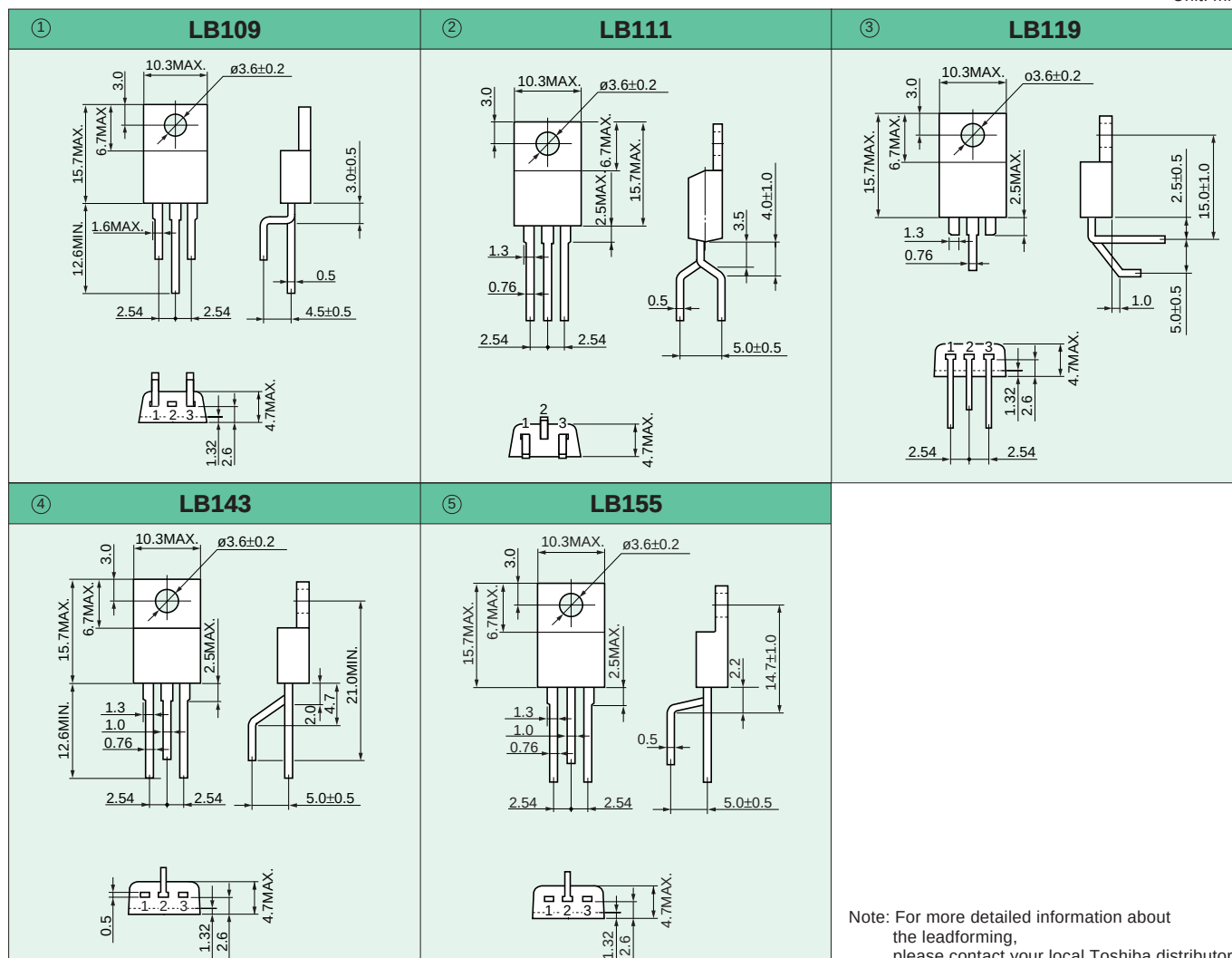
## 8.1 Leadforming of TO-92

Unit: mm



## 8.2 Leadforming of TO-220AB

Unit: mm



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

# 8.3 Leadforming of TO-220NIS

Unit: mm

|                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| <p>① <b>LB180</b></p> | <p>② <b>LB181</b></p> | <p>③ <b>LB182</b></p> |
| <p>④ <b>LB183</b></p> | <p>⑤ <b>LB184</b></p> | <p>⑥ <b>LB185</b></p> |
| <p>⑦ <b>LB186</b></p> | <p>⑧ <b>LB187</b></p> | <p>⑨ <b>LB188</b></p> |

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  $\pm$  10°C, for 60 $\pm$ 30 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.

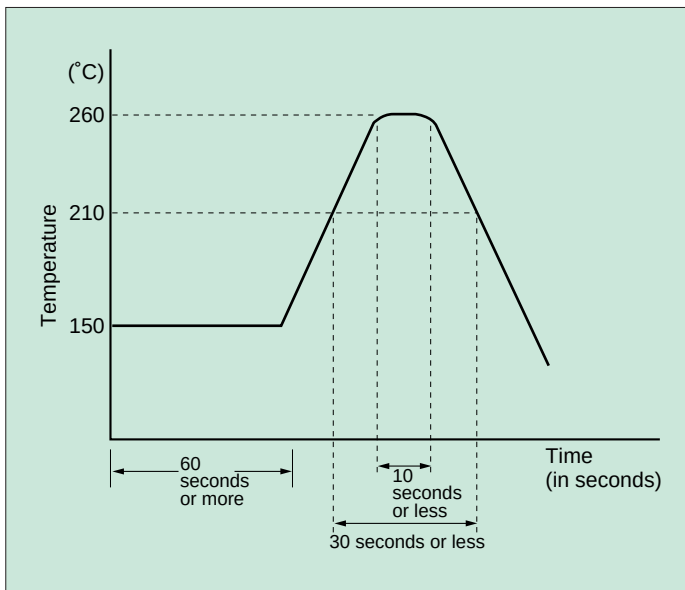


Figure 1

## 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.

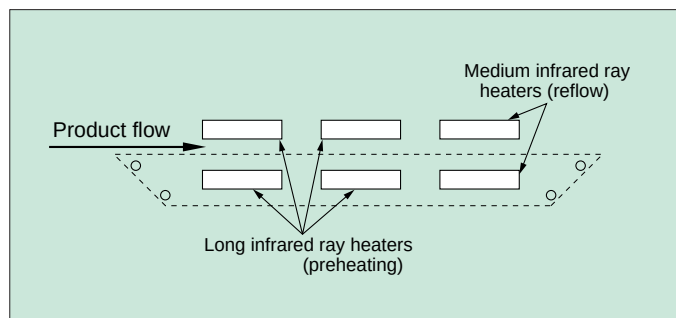


Figure 2

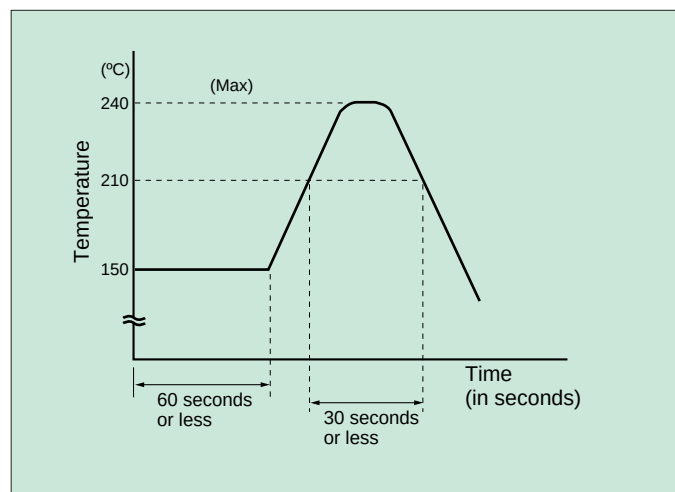


Figure 3

### 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.

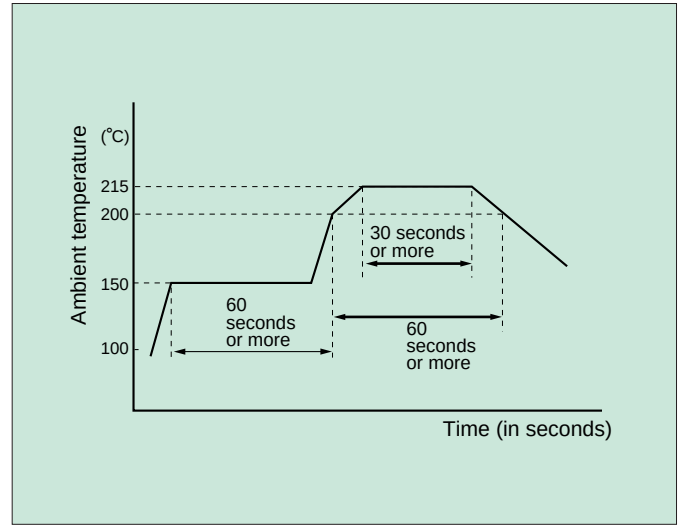


Figure 4

## 10 Gate Trigger Current Selection Table

|      | Selection spec. | I <sub>GT</sub> |     | Unit | Available Product Numbers                    |
|------|-----------------|-----------------|-----|------|----------------------------------------------|
|      |                 | Min             | Max |      |                                              |
| 10.1 | IG1             | —               | 20  | μA   | SF0R3G42<br>SF0R5J43 Series<br>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<sub>GT</sub> 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 <sub>H</sub> |     | Unit | Available Product Numbers   |
|-----------------|----------------|-----|------|-----------------------------|
|                 | Min            | Max |      |                             |
| HC1             | —              | 3   | mA   | SF0R3G42<br>SF0R5J43 Series |

(R<sub>GK</sub> = 1 kΩ)

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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.

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