

# SEMICONDUCTOR Products Catalog



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## ◆ POWER MODULE

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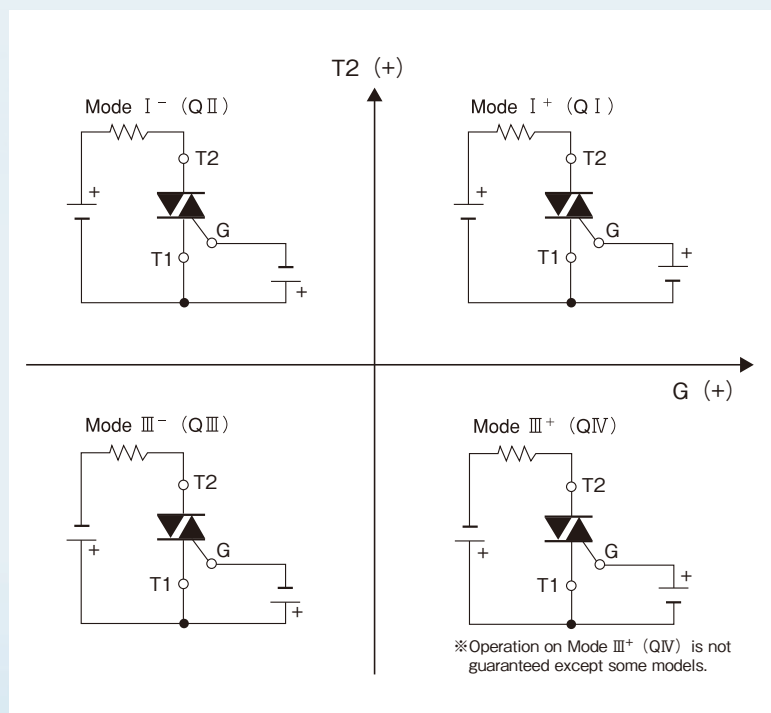
# SYMBOLS & TERMS

| FRD           |                                 | DIODE         |                                 | THYRISTOR     |  | TRIAC         |   |
|---------------|---------------------------------|---------------|---------------------------------|---------------|--|---------------|---|
| Symbol        | Terminology                     | Symbol        | Terminology                     | Symbol        | Terminology                                | Symbol        | Terminology   |
| $V_{RRM}$     | Repetitive Peak Reverse Voltage | $V_{RRM}$     | Repetitive Peak Reverse Voltage | $V_{DRM}$     | Repetitive Peak Off-State Voltage          | $V_{DRM}$     | Repetitive Peak Off-State Voltage                         |
| $I_{F(AV)}$   | Average Forward Current         | $I_{F(AV)}$   | Average Forward Current         | $V_{RRM}$     | Repetitive Peak Reverse Voltage            | $I_T$ (RMS)   | RMS On-State Current                                      |
| $I_{FSM}$     | Surge Forward Current           | $I_D$         | Output Current (D.C.)           | $I_{T(AV)}$   | Average On-State Current                   | $I_D$         | Repetitive Peak Off-State Current                         |
| $I^2t$        | $I^2t$ (for fusing)             | $I_{FSM}$     | Surge Forward Current           | $I_T$ (RMS)   | RMS On-State Current                       | $V_T$         | Peak On-State Voltage                                     |
| $V_F$         | Forward Voltage                 | $I^2t$        | $I^2t$ (for fusing)             | $I_{TSM}$     | Surge On-State Current                     | $I_{GT}$      | Gate Trigger Current                                      |
| $I_R$         | Reverse Current                 | $V_F$         | Forward Voltage                 | $I^2t$        | $I^2t$ (for fusing)                        | $V_{GT}$      | Gate Trigger Voltage                                      |
| $t_{rr}$      | Reverse Recovery Time           | $I_R$         | Reverse Current                 | $I_{GT}$      | Gate Trigger Current                       | $T_j$         | Operating Junction Temperature                            |
| $T_j$         | Operating Junction Temperature  | $T_j$         | Operating Junction Temperature  | $V_{GT}$      | Gate Trigger Voltage                       | $[dv/dt]$ (c) | Critical Rate of Rise of Off-State Voltage at Commutation |
| $R_{th(j-c)}$ | Thermal Resistance              | $R_{th(j-c)}$ | Thermal Resistance              | $I_D$         | Off-State Current                          | $R_{th(j-c)}$ | 熱抵抗   |
|               |                                 |               |                                 | $I_R$         | Reverse Current                            |               |   |
|               |                                 |               |                                 | $dv/dt$       | Critical Rate of Rise of Off-State Voltage |               |   |
|               |                                 |               |                                 | $di/dt$       | Critical Rate of Rise of On-State Current  |               |   |
|               |                                 |               |                                 | $T_j$         | Operating Junction Temperature             |               |   |
|               |                                 |               |                                 | $R_{th(j-c)}$ | Thermal Resistance                         |               |   |

| IGBT   |               |                                      |
|--------|---------------|--------------------------------------|
| Symbol | Terminology   |                                      |
| IGBT   | $V_{CES}$     | Collector-Emitter Voltage            |
|        | $V_{GES}$     | Gate-Emitter Voltage                 |
|        | $I_c$         | Collector Current                    |
|        | $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage |
|        | $V_{GE(th)}$  | Gate-Source Threshold Voltage        |
|        | $t_{on}$      | Turn-On Time: $t_{d(on)} + t_r$      |
|        | $t_{off}$     | Turn-Off Time: $t_{d(off)} + t_r$    |
| FWD    | $t_{rr}$      | Reverse Recovery Time                |

| SiC MOSFET    |                    |                                  |
|---------------|--------------------|----------------------------------|
| Symbol        | Terminology        |                                  |
| MOSFET        | $V_{DSS}$          | Drain-Source Breakdown Voltage   |
|               | $I_D$              | Continuous Drain-Source Current  |
|               | $V_{GSS}$          | Gate-Source Voltage              |
|               | $R_{DS(on)}$       | Drain-Source On-State Resistance |
|               | $V_{GS(th)}$       | Gate Threshold Voltage           |
| Channel Diode | $I_S$              | Continuous Diode Forward Current |
|               | $V_{SD}$           | Diode Forward Voltage            |
| $R_{th(j-c)}$ | Thermal Resistance |                                  |

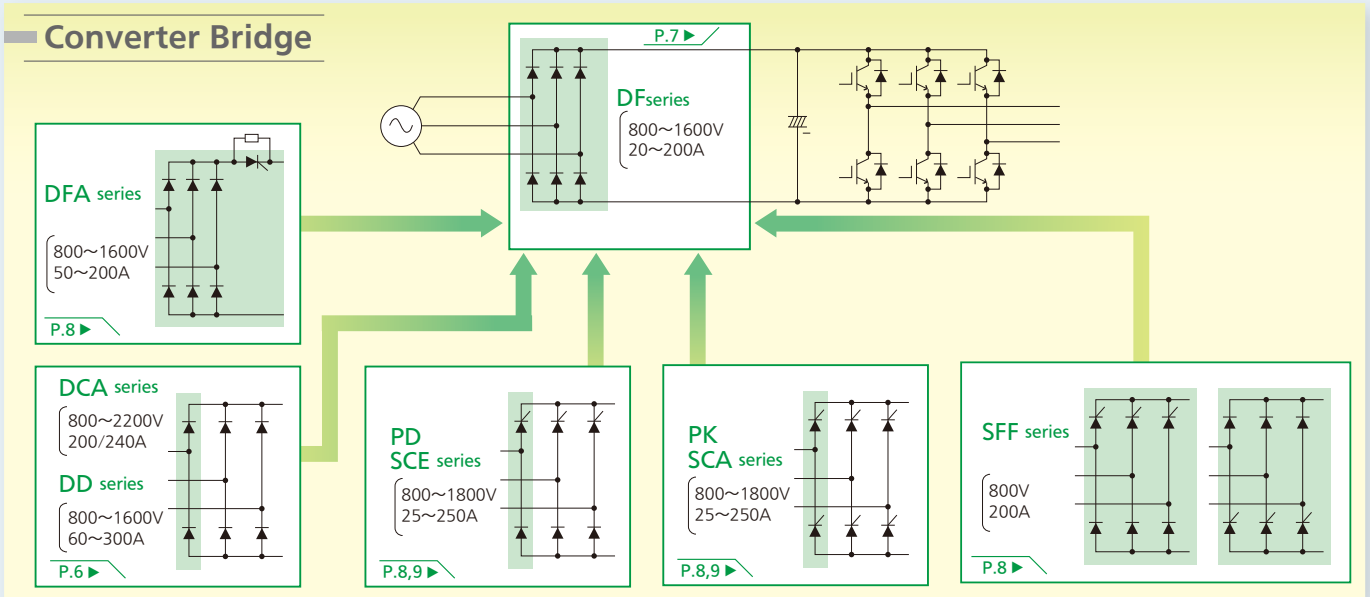
## ◆ GATE TRIGGER MODE for TRIACS (Quadrant definitions)



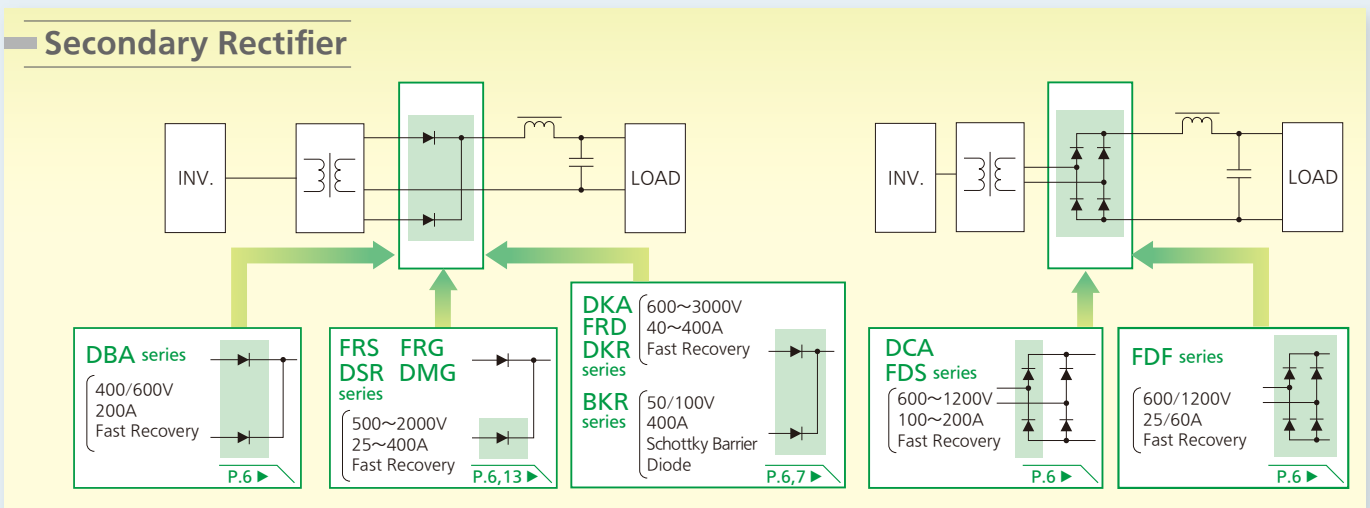


# SELECTION GUIDE

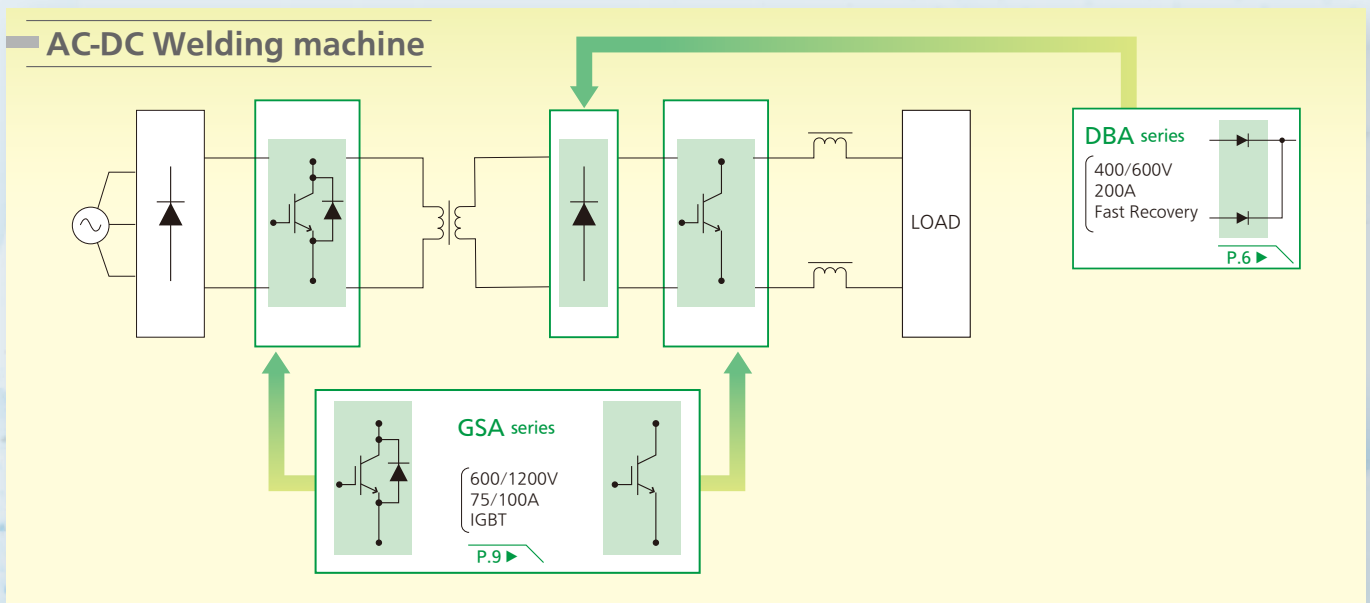
## Converter Bridge

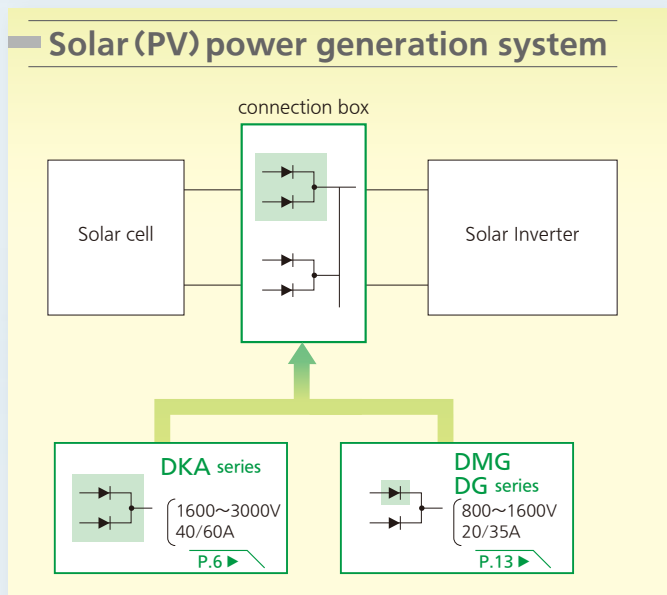
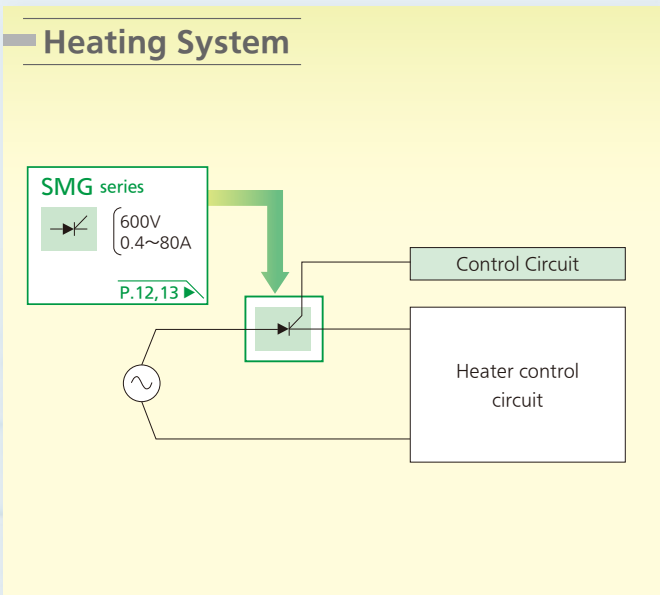
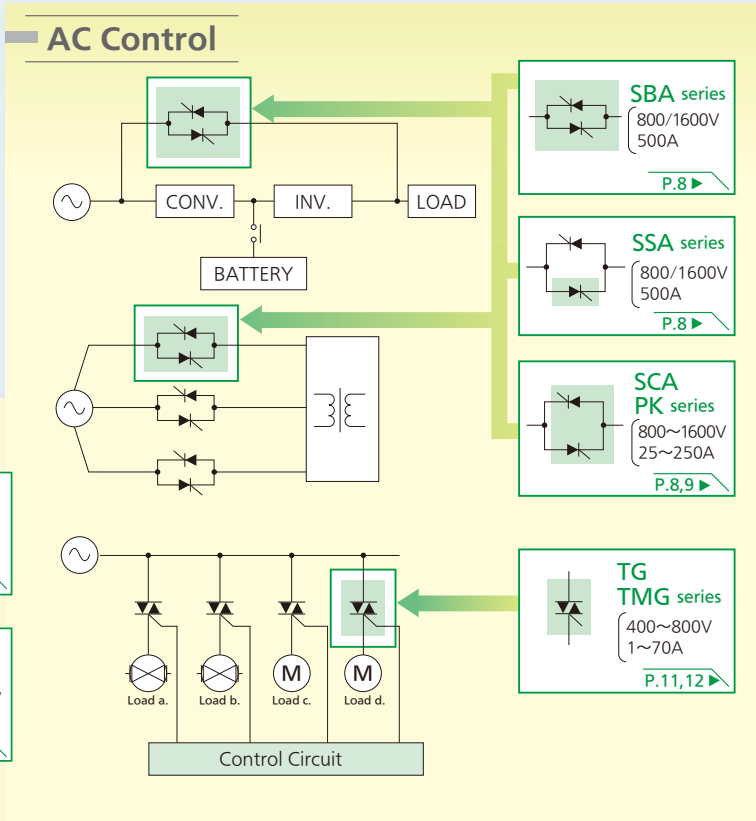
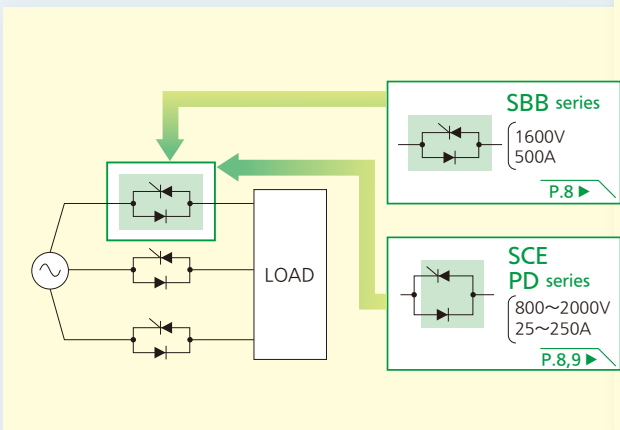
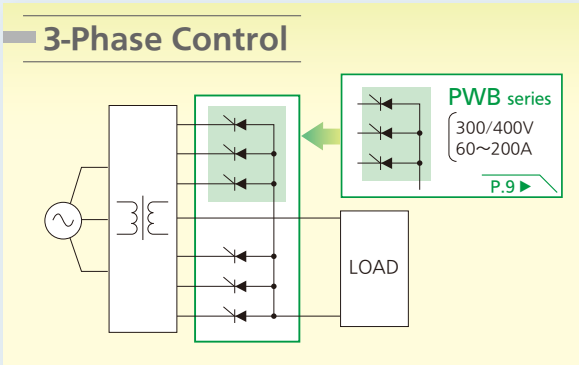


## Secondary Rectifier

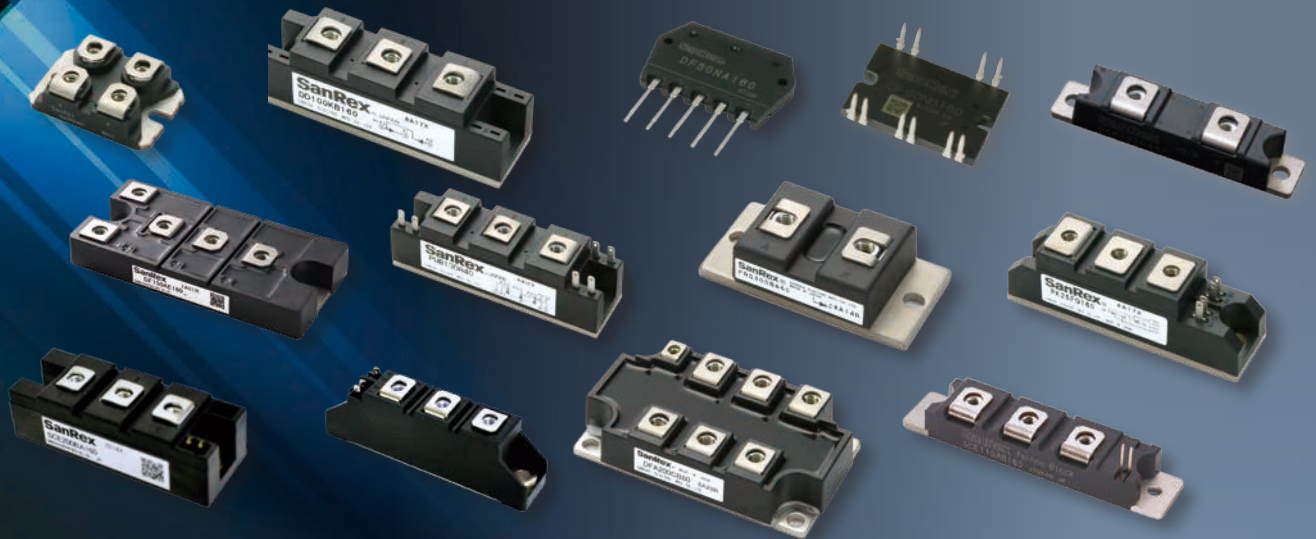


## AC-DC Welding machine





# POWER MODULE



## PRODUCT FEATURES

### Fast Recovery Diode

Our products are designed to minimize switching losses. We added low-noise soft recovery diode models to the lineup, and can meet any requirement for high efficiency and sustainability in your applications.

### Soft Recovery Series

- DCA Series** Two recovery times
- DBA Series** Three recovery times
- DKA Series** Common cathode type

### Fast Recovery Series

- FDF Series** Single phase bridge rectifier
- FRS Series** High current diode up to 400A
- DBA Series** High speed type
- DKR Series** Compact non-isolated package, dual diode common cathode
- FRD FDS Series** Dual diode module

### Diode / Thyristor rectifier

Thyristor: available in 800V, 1600V and 1800V. The characteristics of  $dv/dt$  and surge current are suitable for 200V/400V input rectification. 3-phase bridge rectifiers are available in different package heights to meet virtually all customers' requirements in design.

#### DF Series

Various configurations for 3-phase bridge rectifiers  
 DF\_AA/BA : Standard models  
 DF\_CA : High surge current withstand models  
 DF\_NA/NB : Compact SIP (=Single-In-line Package) /DIP (=Dual- In-line Package) modules  
 DF\_AC/AE : 17mm low profile modules  
 DF\_LA/LB : Choose between LA type (without partition) and LB type (partitioned terminals for increased creepage distance).

#### DFA Series

3-phase bridge rectifier with built-in thyristor for inrush protection at the positive DC terminal

#### DD KD DKA Series

Standard dual diode modules, in series (DD), and common cathode (KD)

#### BKA BKR Series

Schottky barrier diode

#### SFF Series

Diode/Thyristor 3-phase bridge modules

#### PK/SCA PD/SCE Series

Standard dual thyristor and thyristor-diode modules

#### PWB Series

Standard 3-phase thyristor module

### IGBT

Includes high-speed model for high-speed operation, and a low  $V_{ce(sat)}$  model for low conduction loss.

#### GSA Series

### SiC

We achieved high reliability and perfect switching by combining our original packaging technology with Panasonic Corporation's SiC-MOSFET chip.

#### FCA Series

2in1 SiC MOSFET module

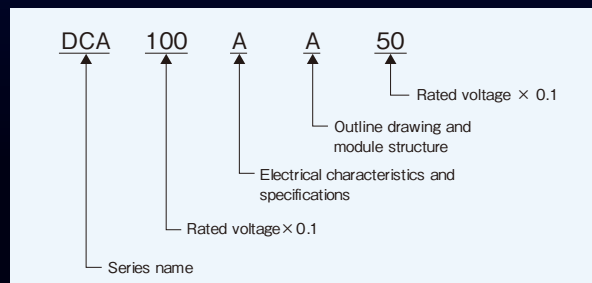
### RoHS Compliance

All the modules presented in this catalog are RoHS compliant.

### UL Recognized Component

Except for the modules "Non Isolated Type", "DKA40AA220" and "DKA40BA300", all the modules presented in this catalog comply with UL standard. File No.E76102

## TYPE DESIGNATION

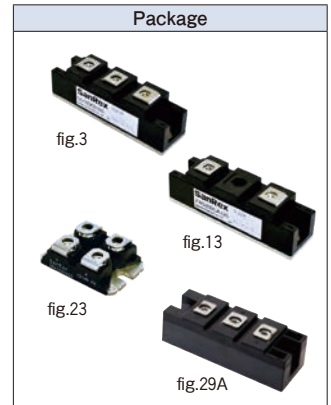


# DIODE / FRD / SBD

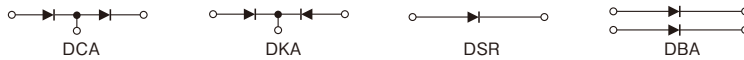
## Soft Recovery Diode

Viso : 2500V (RMS) Tj (max) : 150°C

| Type       | VRRM<br>V | IF (AV) |    | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VFM<br>V (25°C) | IRRM<br>mA (125°C) | trr<br>ns | Rthj-c<br>°C / W | Fig<br>No. |
|------------|-----------|---------|----|------------------|--------------------------------------|-----------------|--------------------|-----------|------------------|------------|
|            |           | A       | °C |                  |                                      |                 |                    |           |                  |            |
| DCA100AA60 | 600       | 100     | 85 | 2000             | 16700                                | 1.3             | 100                | 300       | 0.5              | 3          |
| DCA150AA60 | 600       | 150     | 72 | 2500             | 26000                                | 1.3             | 150                | 300       | 0.4              | 3          |
| DCA100BA60 | 600       | 100     | 80 | 1350             | 7500                                 | 1.55            | 100                | 200       | 0.45             | 3          |
| DCA150BA65 | 650       | 150     | 63 | 1500             | 9300                                 | 1.7             | 150                | 200       | 0.34             | 3          |
| DCA200UA65 | 650       | 200     | 85 | 1350             | 7500                                 | 1.7             | 50 (150°C)         | 360       | 0.19             | 29A        |
| DKA200AA60 | 600       | 100     | 85 | 2000             | 16700                                | 1.3             | 100                | 300       | 0.5              | 3          |
| DKA300AA60 | 600       | 150     | 72 | 2500             | 26000                                | 1.3             | 150                | 300       | 0.4              | 3          |
| DSR200BA60 | 600       | 200     | 85 | 3300             | 45000                                | 1.3             | 200                | 300       | 0.25             | 13         |
| DBA200UA40 | 400       | 100     | 96 | 700              | 2100                                 | 1.2             | 100 (150°C)        | 130       | 0.45             | 23         |
| DBA200UA60 | 600       | 100     | 89 | 700              | 2100                                 | 1.35            | 100 (150°C)        | 250       | 0.45             | 23         |
| DBA200WA40 | 400       | 100     | 96 | 700              | 2100                                 | 1.2             | 4                  | 110       | 0.45             | 23         |
| DBA200WA60 | 600       | 100     | 89 | 700              | 2100                                 | 1.5             | 4                  | 130       | 0.45             | 23         |



### Connections



## Fast Recovery Diode

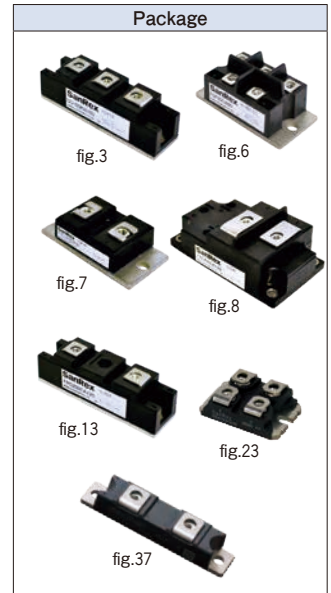
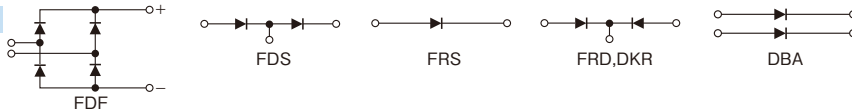
Viso : 2500V (RMS) Tj (max) : 150°C

| Type        | VRRM<br>V | IF (AV) |     | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VFM<br>V (25°C) | IRRM<br>mA (125°C) | trr<br>ns | Rthj-c<br>°C / W | Fig<br>No. |
|-------------|-----------|---------|-----|------------------|--------------------------------------|-----------------|--------------------|-----------|------------------|------------|
|             |           | A       | °C  |                  |                                      |                 |                    |           |                  |            |
| fdf25CA120  | 1200      | 25      | 114 | 400              | 660                                  | 1.8             | 2 (150°C)          | 200       | 0.4              | 6          |
| fdf60BA60   | 600       | 60      | 80  | 600              | 1490                                 | 1.6             | 60                 | 100       | 0.36             | 6          |
| FRD100CA120 | 1200      | 100     | 78  | 2000             | 16600                                | 1.8             | 5 (150°C)          | 300       | 0.4              | 3          |
| FDS100CA120 | 1200      | 100     | 78  | 2000             | 16600                                | 1.8             | 5 (150°C)          | 300       | 0.4              | 3          |
| FRS150BA50  | 500       | 150     | 85  | 3000             | 37500                                | 1.3             | 150                | 200       | 0.33             | 7          |
| FRS200CA120 | 1200      | 200     | 78  | 3300             | 45000                                | 1.8             | 10 (150°C)         | 350       | 0.2              | 13         |
| FRS300BA50  | 500       | 300     | 85  | 4000             | 66600                                | 1.3             | 300                | 200       | 0.165            | 7          |
| FRS300BA60  | 600       | 300     | 85  | 4000             | 66600                                | 1.3             | 300                | 200       | 0.165            | 7          |
| FRS400BA60  | 600       | 400     | 94  | 4000             | 66640                                | 1.4             | 400                | 200       | 0.1              | 8          |
| FRS400CA120 | 1200      | 400     | 78  | 4000             | 66640                                | 1.8             | 20 (150°C)         | 400       | 0.1              | 8          |
| FRS400EA200 | 2000      | 400     | 79  | 5000             | 104000                               | 2.2 (125°C)     | 100 (150°C)        | 700       | 0.08             | 8          |
| DKR400CA60* | 600       | 200     | 105 | 5600             | 130000                               | 1.6             | 100                | 200       | 0.14             | 37         |
| DBA200YA40  | 400       | 100     | 89  | 1100             | 5000                                 | 1.35            | 6 (150°C)          | 85        | 0.45             | 23         |

New

\*Non isolated type

### Connections



## Rectifier Diode

Viso : 2500V (RMS) Tj (max) : 150°C

| Type           | VRRM<br>V | IF (AV) |     | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VFM<br>V (25°C) | IRRM<br>mA (150°C) | Rthj-c<br>°C / W | Fig<br>No. |
|----------------|-----------|---------|-----|------------------|--------------------------------------|-----------------|--------------------|------------------|------------|
|                |           | A       | °C  |                  |                                      |                 |                    |                  |            |
| DKA40AA220     | 2200      | 20      | 125 | 1080             | 4860                                 | 1.15            | 10                 | 0.65             | 31         |
| DKA40BA300     | 3000      | 20      | 125 | 910              | 3440                                 | 1.15            | 10                 | 0.09             | 38         |
| DD60KB80/160   | 800, 1600 | 60      | 110 | 1200             | 6000                                 | 1.35            | 20                 | 0.52             | 3          |
| KD60GB80       | 800       | 60      | 114 | 1200             | 6000                                 | 1.25            | 20                 | 0.5              | 3          |
| KD60HB160      | 1600      | 60      | 111 | 1200             | 6000                                 | 1.35            | 20                 | 0.5              | 3          |
| DKA60KB80/160  | 800, 1600 | 60      | 110 | 1200             | 6000                                 | 1.35            | 20                 | 0.52             | 3          |
| DD100KB80/160  | 800, 1600 | 100     | 105 | 2000             | 16500                                | 1.35            | 30                 | 0.35             | 3          |
| DD160KB80/160  | 800, 1600 | 160     | 90  | 3200             | 42600                                | 1.35            | 30                 | 0.3              | 3          |
| KD160KB80/160  | 800, 1600 | 160     | 90  | 3200             | 42600                                | 1.35            | 30                 | 0.3              | 3          |
| DAF160AA40*    | 400       | 160     | 90  | 3200             | 42600                                | 1.3             | 30                 | 0.29             | 35         |
| DCA200DB80/160 | 800, 1600 | 200     | 113 | 5500             | 125000                               | 1.3             | 50                 | 0.15             | 29C        |
| DCA200DB220    | 2200      | 200     | 113 | 5500             | 125000                               | 1.4             | 50                 | 0.15             | 29C        |
| DCA240DB80/160 | 800, 1600 | 240     | 110 | 5500             | 125000                               | 1.35            | 50                 | 0.15             | 29C        |
| DCA240EB80/160 | 800, 1600 | 240     | 110 | 5500             | 125000                               | 1.35            | 50                 | 0.12             | 29C        |
| DD300KB80/160  | 800, 1600 | 300     | 91  | 6000             | 150000                               | 1.5             | 50                 | 0.14             | 4          |

New

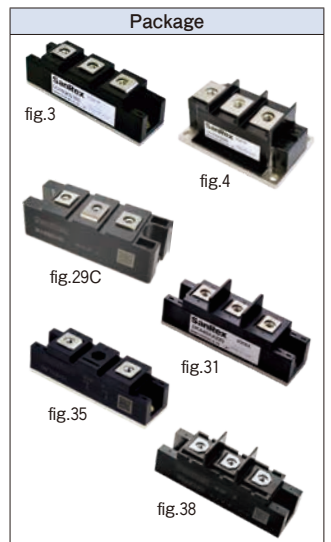
New

New

New

\*Non isolated type

### Connections



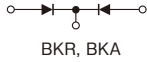
## Schottky Barrier Diode

Viso : 2500V (RMS) Tj (max) : 150°C

| Type         | VRRM<br>V | IF(AV) |     | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VFM<br>V (25°C) | IRRM<br>mA (125°C) | Rthj-c<br>°C / W | Fig<br>No. |
|--------------|-----------|--------|-----|------------------|--------------------------------------|-----------------|--------------------|------------------|------------|
|              |           | A      | °C  |                  |                                      |                 |                    |                  |            |
| BKR400ABZ50* | 50        | 200    | 127 | 7600             | 240000                               | 0.57            | 2000               | 0.2              | 16         |
| BKR400AB10*  | 100       | 200    | 112 | 3620             | 54450                                | 0.82            | 40                 | 0.2              | 16         |
| BKA400AA10   | 100       | 200    | 83  | 3620             | 54450                                | 0.82            | 140                | 0.4              | 1          |

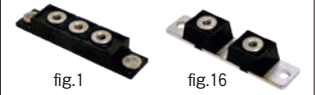
\*Non isolated type

### Connections



BKR, BKA

### Package

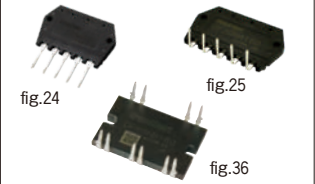


## 3-Phase Diode DF-NA/NB Series

Viso : 2500V (RMS) Tj (max) : 150°C

| Type                  | VRRM<br>V | ID  |     | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VF<br>V (25°C) | IR<br>mA (150°C) | Rthj-c<br>°C / W | Fig<br>No. |
|-----------------------|-----------|-----|-----|------------------|--------------------------------------|----------------|------------------|------------------|------------|
|                       |           | A   | °C  |                  |                                      |                |                  |                  |            |
| DF20NA80/160 S        | 800, 1600 | 20  | 111 | 350              | 500                                  | 1.2            | 4/8              | 0.8              | 24         |
| DF20NA80/160 F1       | 800, 1600 | 20  | 111 | 350              | 500                                  | 1.2            | 4/8              | 0.8              | 25         |
| DF30NA80/160 S        | 800, 1600 | 30  | 92  | 400              | 660                                  | 1.2            | 5/14             | 0.8              | 24         |
| DF30NA80/160 F1       | 800, 1600 | 30  | 92  | 400              | 660                                  | 1.2            | 5/14             | 0.8              | 25         |
| <b>New</b> DF60NB160  | 1600      | 60  | 110 | 800              | 2600                                 | 1.3            | 8                | 0.25             | 36         |
| <b>New</b> DF75NB160  | 1600      | 75  | 112 | 1000             | 4100                                 | 1.3            | 8                | 0.2              | 36         |
| <b>New</b> DF100NB160 | 1600      | 100 | 98  | 1000             | 4100                                 | 1.3            | 8                | 0.2              | 36         |

### Package



## 3-Phase Diode DF-AC/AE Series

Viso : 2500V (RMS) Tj (max) : 150°C

| Type          | VRRM<br>V | ID  |     | IFSM<br>A (60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | VF<br>V (25°C) | IR<br>mA (150°C) | Rthj-c<br>°C / W | Fig<br>No. |
|---------------|-----------|-----|-----|------------------|--------------------------------------|----------------|------------------|------------------|------------|
|               |           | A   | °C  |                  |                                      |                |                  |                  |            |
| DF75AC80/160  | 800, 1600 | 75  | 100 | 1000             | 4100                                 | 1.4            | 10               | 0.24             | 26         |
| DF100AC80/160 | 800, 1600 | 100 | 102 | 1300             | 7000                                 | 1.2            | 15               | 0.2              | 26         |
| DF150AE80/160 | 800, 1600 | 150 | 106 | 2000             | 17000                                | 1.31           | 15               | 0.11             | 34A        |
| DF200AE80/160 | 800, 1600 | 200 | 106 | 2500             | 26000                                | 1.32           | 20               | 0.08             | 34A        |

### Package

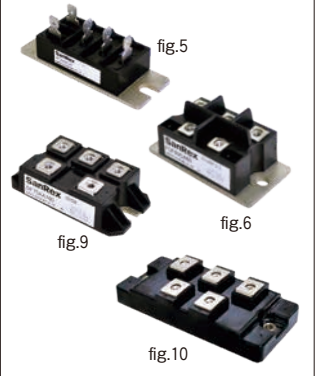


## 3-Phase Diode DF-AA/BA/CA Series

Viso : 2500V (RMS) Tj (max) : 150°C

| Type           | VRRM<br>V  | ID  |     | IFSM<br>A (60Hz) | VF<br>V (25°C) | IR<br>mA (150°C) | Rthj-c<br>°C / W | Fig<br>No. |
|----------------|------------|-----|-----|------------------|----------------|------------------|------------------|------------|
|                |            | A   | °C  |                  |                |                  |                  |            |
| DF20CA80/160   | 800, 1600  | 20  | 123 | 600              | 1.1            | 8                | 0.6              | 5          |
| DF20AA120/160  | 1200, 1600 | 20  | 119 | 240              | 1.25           | 3                | 0.6              | 5          |
| DF30CA80/160   | 800, 1600  | 30  | 122 | 850              | 1.1            | 12               | 0.42             | 5          |
| DF30AA120/160  | 1200, 1600 | 30  | 117 | 300              | 1.3            | 3                | 0.42             | 5          |
| DF40BA80       | 800        | 40  | 119 | 700              | 1.2            | 4                | 0.32             | 6          |
| DF40AA120/160  | 1200, 1600 | 40  | 116 | 700              | 1.3            | 3                | 0.32             | 6          |
| DF50BA80       | 800        | 50  | 114 | 700              | 1.2            | 4                | 0.3              | 9          |
| DF50AA120/160  | 1200, 1600 | 50  | 114 | 700              | 1.2            | 8                | 0.3              | 9          |
| DF60BA80       | 800        | 60  | 115 | 1000             | 1.2            | 6                | 0.24             | 6          |
| DF60AA120/160  | 1200, 1600 | 60  | 112 | 1000             | 1.3            | 12               | 0.24             | 6          |
| DF75BA80       | 800        | 75  | 107 | 1000             | 1.2            | 10               | 0.24             | 9          |
| DF75AA120/160  | 1200, 1600 | 75  | 100 | 1000             | 1.4            | 10               | 0.24             | 9          |
| DF100BA80      | 800        | 100 | 102 | 1000             | 1.2            | 15               | 0.2              | 9          |
| DF100AA120/160 | 1200, 1600 | 100 | 102 | 1000             | 1.2            | 15               | 0.2              | 9          |
| DF150AB80/160  | 800, 1600  | 150 | 100 | 1200             | 1.2            | 15               | 0.14             | 10         |
| DF200AB80/160  | 800, 1600  | 200 | 102 | 2000             | 1.2            | 20               | 0.1              | 10         |

### Package

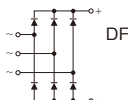


## 3-Phase Diode DF-LA/LB Series

Viso : 2500V (RMS) Tj (max) : 150°C

| Type          | VRRM<br>V | ID  |     | IFSM<br>A (60Hz) | VF<br>V (25°C) | IR<br>mA (150°C) | Rthj-c<br>°C / W | Fig<br>No. |
|---------------|-----------|-----|-----|------------------|----------------|------------------|------------------|------------|
|               |           | A   | °C  |                  |                |                  |                  |            |
| DF60LA80/160  | 800, 1600 | 60  | 111 | 800              | 1.3            | 8                | 0.25             | 19         |
| DF60LB80/160  | 800, 1600 | 60  | 111 | 800              | 1.3            | 8                | 0.25             | 20         |
| DF75LA80/160  | 800, 1600 | 75  | 101 | 1000             | 1.3            | 8                | 0.25             | 19         |
| DF75LB80/160  | 800, 1600 | 75  | 101 | 1000             | 1.3            | 8                | 0.25             | 20         |
| DF100LA80/160 | 800, 1600 | 100 | 90  | 1300             | 1.3            | 12               | 0.23             | 19         |
| DF100LB80/160 | 800, 1600 | 100 | 90  | 1300             | 1.3            | 12               | 0.23             | 20         |

### Connections



### Package







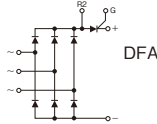
### 3-Phase Diode+Thyristor

V<sub>ISO</sub> : 2500V (RMS)

| Type           | V <sub>DRM</sub> / V <sub>RRM</sub><br>V | I <sub>D</sub> |     | I <sub>FSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | V <sub>FM</sub> (D)<br>V (25°C) | I <sub>RRM</sub> (D)<br>mA (150°C) | R <sub>thj-c</sub> (D)<br>°C/W | V <sub>TM</sub> (THY)<br>V (25°C) | I <sub>RRM</sub> (THY)<br>mA (135°C) | R <sub>thj-c</sub> (THY)<br>°C/W | T <sub>j</sub> (max) |         | Fig No. |
|----------------|--|----------------|-----|------------------------------|---|---------------------------------|------------------------------------|--------------------------------|-----------------------------------|--------------------------------------|----------------------------------|----------------------|---------|---------|
|                |  | A              | °C  |                              |   |                                 |                                    |                                |                                   |                                      |                                  | (thy)                | (Diode) |         |
| DFA50BA80/160  | 800, 1600                                | 50             | 117 | 800                          | 2660  | 1.3                             | 8                                  | 0.25                           | 1.25                              | 50                                   | 0.8                              | 135°C                | 150°C   | 15      |
| DFA75BA80/160  | 800, 1600                                | 75             | 101 | 1000                         | 4150  | 1.3                             | 8                                  | 0.25                           | 1.2                               | 60                                   | 0.4                              | 135°C                | 150°C   | 15      |
| DFA100BA80/160 | 800, 1600                                | 100            | 98  | 1300                         | 7030  | 1.3                             | 12                                 | 0.2                            | 1.2                               | 70                                   | 0.36                             | 135°C                | 150°C   | 15      |
| DFA150BA80/160 | 800, 1600                                | 150            | 105 | 1600                         | 10670   | 1.35                            | 15                                 | 0.09                           | 1.35                              | 100                                  | 0.22                             | 150°C                | 150°C   | 15      |
| DFA150AA80/160 | 800, 1600                                | 150            | 93  | 1600                         | 10670   | 1.35                            | 15                                 | 0.14                           | 1.35                              | 100                                  | 0.21                             | 135°C                | 150°C   | 28      |
| DFA200AA80/160 | 800, 1600                                | 200            | 96  | 2000                         | 17000   | 1.35                            | 20                                 | 0.1                            | 1.15                              | 50                                   | 0.18                             | 135°C                | 150°C   | 28      |
| DFA250AA80/160 | 800, 1600                                | 250            | 96  | 2000                         | 17000   | 1.4                             | 20                                 | 0.077                          | 1.25                              | 100                                  | 0.132                            | 135°C                | 150°C   | 28      |
| DFA150CB80/160 | 800, 1600                                | 150            | 113 | 1600                         | 10670   | 1.35                            | 15                                 | 0.09                           | 1.35                              | 100                                  | 0.18                             | 150°C                | 150°C   | 17      |
| DFA200CB80/160 | 800, 1600                                | 200            | 96  | 2000                         | 17000   | 1.35                            | 20                                 | 0.1                            | 1.15                              | 50                                   | 0.15                             | 150°C                | 150°C   | 17      |

New

Connections



Package

### Diode/Thyristor 3-Phase Bridge

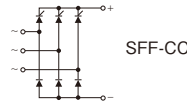
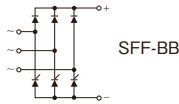
V<sub>ISO</sub> : 2500V (RMS) dv/dt : 500V/μs T<sub>j</sub> (max) : 125°C

| Type       | V <sub>DRM</sub> / V <sub>RRM</sub><br>V | I <sub>D</sub> |    | I <sub>TSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | I <sub>GT</sub><br>mA (25°C) | V <sub>GT</sub><br>V (25°C) | V <sub>T</sub><br>V (25°C) | I <sub>D</sub> /I <sub>R</sub><br>mA | R <sub>thj-c</sub><br>°C/W | T <sub>j</sub> (max)<br>°C | Fig No. |
|------------|--|----------------|----|------------------------------|---|------------------------------|-----------------------------|----------------------------|--------------------------------------|----------------------------|----------------------------|---------|
|            |  | A              | °C |                              |   |                              |                             |                            |                                      |                            |                            |         |
| SFF200BB80 | 800                                      | 200            | 92 | 2300                         | 22000   | 150                          | 3                           | 1.35                       | 15                                   | 0.06                       | 125                        | 34B     |
| SFF200CC80 | 800                                      | 200            | 92 | 2300                         | 22000   | 150                          | 3                           | 1.35                       | 15                                   | 0.06                       | 125                        | 34B     |

New

New

Connections



Package

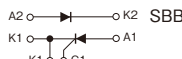
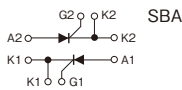
## THYRISTOR

### High Current Thyristor

V<sub>ISO</sub> : 2500V (RMS) dv/dt : 500V/μs T<sub>j</sub> (max) : 125°C

| Type           | V <sub>DRM</sub> / V <sub>RRM</sub><br>V | I <sub>T</sub> (AV) |    | I <sub>TSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | I <sub>GT</sub><br>mA (25°C) | V <sub>GT</sub><br>V (25°C) | V <sub>TM</sub><br>V (25°C) | I <sub>DRM</sub> /I <sub>RRM</sub><br>mA (125°C) | R <sub>thj-c</sub><br>°C/W | Fig No. |
|----------------|--|---------------------|----|------------------------------|---|------------------------------|-----------------------------|-----------------------------|--|----------------------------|---------|
|                |  | A                   | °C |                              |   |                              |                             |                             |  |                            |         |
| SBA500AA80/160 | 800, 1600                                | 500                 | 66 | 10000                        | 4.16 × 10 <sup>5</sup>                          | 200                          | 3                           | 1.45                        | 150  | 0.085                      | 14      |
| SBB500AA160    | 1600                                     | 500                 | 66 | 10000                        | 4.16 × 10 <sup>5</sup>                          | 200                          | 3                           | 1.45                        | 150  | 0.085                      | 14      |
| SSA500AA80/160 | 800, 1600                                | 500                 | 66 | 10000                        | 4.16 × 10 <sup>5</sup>                          | 200                          | 3                           | 1.45                        | 150  | 0.085                      | 22      |

Connections



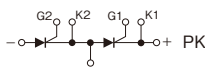
Package

### Thyristor PK/PD Series

V<sub>ISO</sub> : 2500V (RMS) dv/dt : 500V/μs T<sub>j</sub> (max) : 125°C

| Type            | V <sub>DRM</sub> / V <sub>RRM</sub><br>V | I <sub>T</sub> (AV) |    | I <sub>TSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | I <sub>GT</sub><br>mA (25°C) | V <sub>GT</sub><br>V (25°C) | V <sub>TM</sub><br>V (25°C) | I <sub>DRM</sub> /I <sub>RRM</sub><br>mA (125°C) | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-----------------|--|---------------------|----|------------------------------|---|------------------------------|-----------------------------|-----------------------------|--|----------------------------|---------|
|                 |  | A                   | °C |                              |   |                              |                             |                             |  |                            |         |
| PK25FG80/160    | 800, 1600                                | 25                  | 81 | 700                          | 2870  | 50                           | 3                           | 1.6                         | 5  | 1.1                        | 2       |
| PD25FG80/160    | 800, 1600                                | 25                  | 81 | 700                          | 2870  | 50                           | 3                           | 1.6                         | 5  | 1.1                        | 2       |
| PK40FG80/160    | 800, 1600                                | 40                  | 83 | 950                          | 3760  | 50                           | 3                           | 1.6                         | 10   | 0.65                       | 2       |
| PD40FG80/160    | 800, 1600                                | 40                  | 83 | 950                          | 3760  | 50                           | 3                           | 1.6                         | 10   | 0.65                       | 2       |
| PK55FG80/160    | 800, 1600                                | 55                  | 81 | 1300                         | 7040  | 50                           | 3                           | 1.6                         | 15   | 0.5                        | 2       |
| PD55FG80/160    | 800, 1600                                | 55                  | 81 | 1300                         | 7040  | 50                           | 3                           | 1.6                         | 15   | 0.5                        | 2       |
| PK70FG80/160    | 800, 1600                                | 70                  | 84 | 1600                         | 10660   | 50                           | 3                           | 1.6                         | 20   | 0.37                       | 2       |
| PD70FG80/160    | 800, 1600                                | 70                  | 84 | 1600                         | 10660   | 50                           | 3                           | 1.6                         | 20   | 0.37                       | 2       |
| PK90FG80/160    | 800, 1600                                | 90                  | 82 | 2300                         | 22040   | 50                           | 3                           | 1.6                         | 25   | 0.3                        | 2       |
| PD90FG80/160    | 800, 1600                                | 90                  | 82 | 2300                         | 22040   | 50                           | 3                           | 1.6                         | 25   | 0.3                        | 2       |
| PK110FG80/160   | 800, 1600                                | 110                 | 81 | 3000                         | 37500   | 50                           | 3                           | 1.6                         | 30   | 0.25                       | 2       |
| PD110FG80/160   | 800, 1600                                | 110                 | 81 | 3000                         | 37500   | 50                           | 3                           | 1.6                         | 30   | 0.25                       | 2       |
| PK130FG80/160   | 800, 1600                                | 130                 | 83 | 3500                         | 51040   | 50                           | 3                           | 1.6                         | 35   | 0.2                        | 2       |
| PD130FG80/160   | 800, 1600                                | 130                 | 83 | 3500                         | 51040   | 50                           | 3                           | 1.6                         | 35   | 0.2                        | 2       |
| PK160FG80/160   | 800, 1600                                | 160                 | 84 | 5400                         | 125000  | 100                          | 3                           | 1.5                         | 100  | 0.18                       | 21      |
| PD160FG80/160   | 800, 1600                                | 160                 | 84 | 5400                         | 125000  | 100                          | 3                           | 1.5                         | 100  | 0.18                       | 21      |
| PK200FG80/160   | 800, 1600                                | 200                 | 73 | 6500                         | 180000  | 100                          | 3                           | 1.5                         | 100  | 0.167                      | 21      |
| PD200FG80/160   | 800, 1600                                | 200                 | 73 | 6500                         | 180000  | 100                          | 3                           | 1.5                         | 100  | 0.167                      | 21      |
| PK250GB80/HB160 | 800, 1600                                | 250                 | 72 | 5500                         | 125000  | 100                          | 3                           | 1.6                         | 50   | 0.14                       | 4       |
| PD250GB80/HB160 | 800, 1600                                | 250                 | 72 | 5500                         | 125000  | 100                          | 3                           | 1.6                         | 50   | 0.14                       | 4       |

Connections



Package

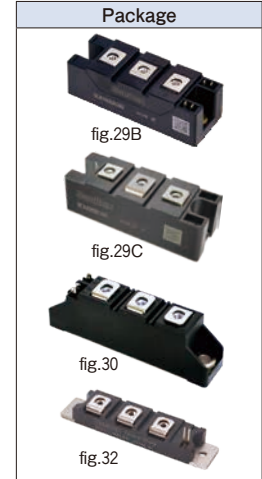


### Thyristor SCA/SCE Series

Viso : 2500V/3000V (RMS) dv/dt : 1000V/μs

**New**  
**New**  
**New**  
**New**

| Type           | VDRM / VRRM<br>V | IT(AV) |     | ITSM<br>A(60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | IGT<br>mA(25°C) | VGT<br>V(25°C) | VTM<br>V(25°C) | IDRM/IRRM<br>mA | Rthj-c<br>°C/W | Tj(max)<br>°C | Fig No. |
|----------------|------------------|--------|-----|-----------------|--------------------------------------|-----------------|----------------|----------------|-----------------|----------------|---------------|---------|
|                |                  | A      | °C  |                 |                                      |                 |                |                |                 |                |               |         |
| SCA55AA160     | 1600             | 55     | 95  | 1500            | 9380                                 | 100             | 2.5            | 1.65           | 20(130°C)       | 0.4            | 130           | 30      |
| SCE55AA160     | 1600             | 55     | 95  | 1500            | 9380                                 | 100             | 2.5            | 1.65           | 20(130°C)       | 0.4            | 130           | 30      |
| SCA70AA160     | 1600             | 70     | 101 | 1750            | 12800                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.25           | 130           | 30      |
| SCE70AA160     | 1600             | 70     | 101 | 1750            | 12800                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.25           | 130           | 30      |
| SCA90AA160     | 1600             | 90     | 100 | 2300            | 22040                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.2            | 130           | 30      |
| SCE90AA160     | 1600             | 90     | 100 | 2300            | 22040                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.2            | 130           | 30      |
| SCA110AA160    | 1600             | 110    | 95  | 2500            | 25000                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.19           | 130           | 30      |
| SCE110AA160    | 1600             | 110    | 95  | 2500            | 25000                                | 100             | 2.5            | 1.7            | 20(130°C)       | 0.19           | 130           | 30      |
| SCE110AB160    | 1600             | 110    | 89  | 2300            | 22000                                | 150             | 3.2            | 2.0            | 70(150°C)       | 0.28           | 150           | 32      |
| SCA160DB80/160 | 800, 1600        | 160    | 88  | 5900            | 145000                               | 100             | 3              | 1.4            | 100(125°C)      | 0.17           | 125           | 29C     |
| SCE160CA200    | 2000             | 160    | 85  | 4500            | 84000                                | 100             | 3              | 1.65           | 40(130°C)       | 0.17           | 130           | 29B     |
| SCE160DB80/160 | 800, 1600        | 160    | 88  | 5900            | 145000                               | 100             | 3              | 1.4            | 100(125°C)      | 0.17           | 125           | 29C     |
| SCA200DB80/160 | 800, 1600        | 200    | 83  | 6500            | 180000                               | 100             | 3              | 1.34           | 100(125°C)      | 0.155          | 125           | 29C     |
| SCE200CA200    | 2000             | 200    | 76  | 5500            | 125000                               | 100             | 3              | 1.7            | 50(130°C)       | 0.155          | 130           | 29B     |
| SCE200DB80/160 | 800, 1600        | 200    | 83  | 6500            | 180000                               | 100             | 3              | 1.34           | 100(125°C)      | 0.155          | 125           | 29C     |
| SCA240DA160    | 1600             | 240    | 86  | 6500            | 180000                               | 100             | 3              | 1.5            | 100(125°C)      | 0.105          | 125           | 29B     |
| SCE240DA160    | 1600             | 240    | 86  | 6500            | 180000                               | 100             | 3              | 1.5            | 100(125°C)      | 0.105          | 125           | 29B     |



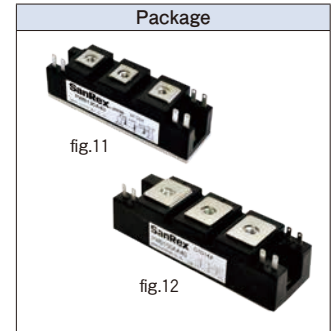
Connections



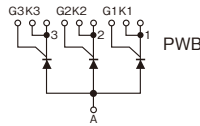
### Thyristor

Non isolated type di/dt : 50A/μs, VGT : 2V (25°C), Tj (max) : 150°C

| Type          | VDRM / VRRM<br>V | IT(AV) |     | IT(RMS) |     | ITSM<br>A(60Hz) | I <sup>2</sup> t<br>A <sup>2</sup> s | dv/dt<br>V/μs(150°C) | IGT<br>mA(25°C) | VTM<br>V(25°C) | IDRM/IRRM<br>mA(150°C) | Rthj-c<br>°C/W | Fig No. |
|---------------|------------------|--------|-----|---------|-----|-----------------|--------------------------------------|----------------------|-----------------|----------------|------------------------|----------------|---------|
|               |                  | A      | °C  | A       | °C  |                 |                                      |                      |                 |                |                        |                |         |
| PWB60A30/40   | 300, 400         | 60     | 123 | 94      | 123 | 1800            | 13500                                | 50                   | 150             | 1.25           | 10                     | 0.35           | 11      |
| PWB80A30/40   | 300, 400         | 80     | 116 | 125     | 116 | 2500            | 26000                                | 50                   | 150             | 1.2            | 12                     | 0.35           | 11      |
| PWB100A30/40  | 300, 400         | 100    | 114 | 157     | 114 | 3500            | 51000                                | 50                   | 150             | 1.2            | 15                     | 0.3            | 11      |
| PWB130A30/40  | 300, 400         | 130    | 120 | 204     | 112 | 3500            | 51000                                | 50                   | 150             | 1.2            | 30                     | 0.2            | 11      |
| PWB150AA30/40 | 300, 400         | 150    | 121 | 230     | 121 | 3500            | 51000                                | 200                  | 100             | 1.2            | 40                     | 0.15           | 12      |
| PWB200AA40    | 400              | 200    | 121 | 314     | 121 | 6000            | 149940                               | 200                  | 150             | 1.2            | 60                     | 0.12           | 12      |



Connections



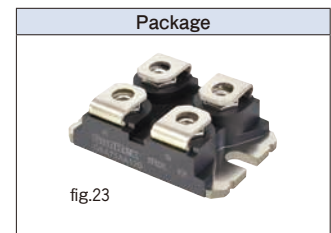
## IGBT/SiC MOSFET

### IGBT GSA Series

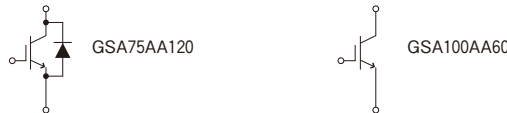
Tj (max) : 150°C

**New**  
**New**

| Type       | IGBT      |           |     |     |               |              |           |            |           | FWD<br>trr<br>ns | Rthj-c<br>°C/W | Fig No. |
|------------|-----------|-----------|-----|-----|---------------|--------------|-----------|------------|-----------|------------------|----------------|---------|
|            | VCES<br>V | VGES<br>V | IC  |     | VCE(sat)<br>V | VGE(th)<br>V | ton<br>μs | toff<br>μs | trr<br>ns |                  |                |         |
|            |           |           | A   | °C  |               |              |           |            |           |                  |                |         |
| GSA75AA120 | 1200      | ±20       | 75  | 57  | 3.90          | 6.3          | 115       | 275        | 125       | 0.25(IGBT)       | 23             |         |
| GSA100AA60 | 600       | ±20       | 100 | 113 | 1.50          | 6.7          | 1260      | 8780       | -         | 0.25             | 23             |         |



Connections

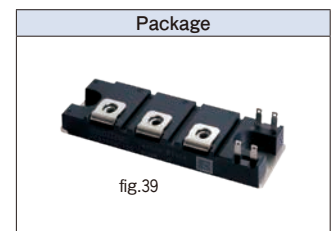


### SiC MOSFET FCA Series

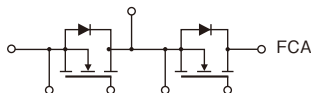
Viso : 2500V (RMS), Tj (max) : 150°C

**New**

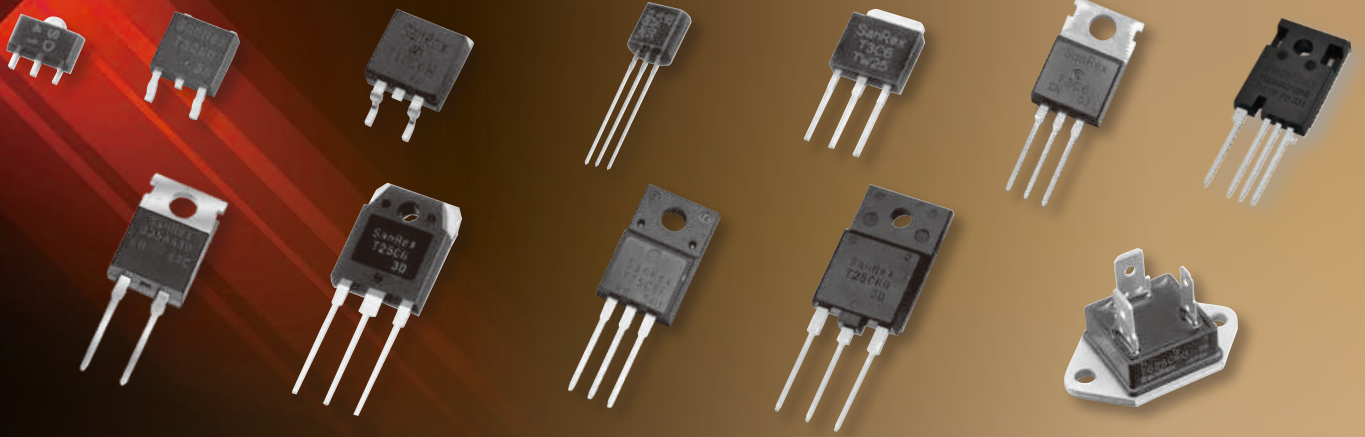
| Type        | MOSFET    |        |     |           |               |              | Channel Diode |     |          | Rthj-c<br>°C/W | Fig No. |
|-------------|-----------|--------|-----|-----------|---------------|--------------|---------------|-----|----------|----------------|---------|
|             | VDSS<br>V | IT(AV) |     | VGSS<br>V | RDS(on)<br>mΩ | VGS(th)<br>V | IS            |     | VSD<br>V |                |         |
|             |           | A      | °C  |           |               |              | A             | °C  |          |                |         |
| FCA100AC120 | 1200      | 100    | 100 | -7~22     | 14.0          | 3~5          | 100           | 100 | 2.90     | 0.16           | 39      |
| FCA150AC120 | 1200      | 150    | 90  | -7~22     | 9.3           | 3~5          | 150           | 90  | 2.90     | 0.11           | 39      |



Connections



# DISCRETE



## PRODUCT FEATURES

- Triac **TMG TG Series**
- Thyristor **SMG SG Series**
- DIODE **DMG DG FRG Series**
- SiC MOSFET **FMG Series**

### Broad Product Lineup

#### 8 models of Through Hole type

TO-92, TO-251, TO-220AB, TO-220AB-2L, TO-220F, TO-3P, TO-3PF, TO-247, TO-247-4L

#### 3 models of Surface Mount type

SOT-89, TO-252, TO-263

#### 1 Tab Terminal package

TO-3

| Triac                | Standard Gate                                      |                  | Sensitive Gate                                     |                  |
|----------------------|--|------------------|--|------------------|
|                      | I <sup>+</sup> , I <sup>-</sup> , III <sup>-</sup> | III <sup>+</sup> | I <sup>+</sup> , I <sup>-</sup> , III <sup>-</sup> | III <sup>+</sup> |
| TMG1C_               |  |                  | 5  | 10               |
| TMG2C_               | 15   | —                |  |                  |
| TMG2D_               |  |                  | 5  | 10               |
| TMG3C_               | 15   | —                |  |                  |
| TMG3D_               |  |                  | 5  | 10               |
| TMG5C_               | 20   | —                |  |                  |
| TMG8/12/16/20/25C_   | 30   | —                |  |                  |
| TMG5/8/12/16/20/25D_ |  |                  | 10   | —                |
| TMG40C_              | 50   | —                |  |                  |

(mA)

### Triac / Thyristor - High sensitivity models lineup

#### RoHS Compliance

All the products presented in this catalog are RoHS compliant.

#### Low loss ( $V_T=1.4V$ ) models available

### Triac - Q series : Guaranteed $T_{jmax}=150^{\circ}C$

You can reduce total cost thanks to smaller heatsink or no heatsink design.

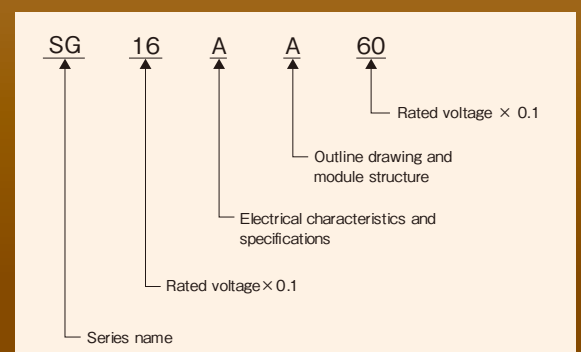
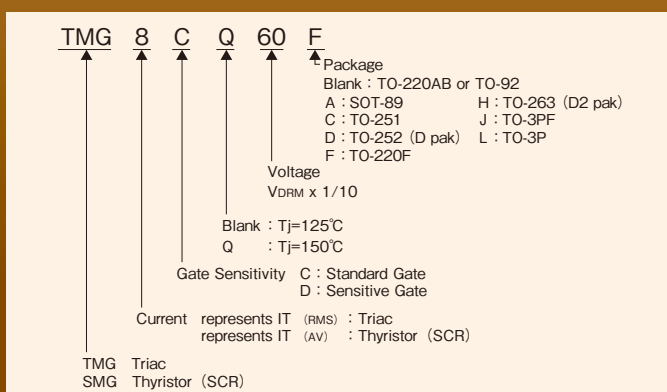
#### SiC MOSFET

Isolated package with good heat dissipation.

| Thyristor     | Standard Gate | Sensitive Gate |
|---------------|---------------|----------------|
| SMG04/05/08C_ |               | 0.1            |
| SMG3D_        |               | 0.2            |
| SMG5/8C_      | 10            |                |
| SMG12/16C_    | 30            |                |
| SMG5F_        |               | 0.2            |

(mA)

## TYPE DESIGNATION



## Through Hole/Standard Gate

| Package   | Type          | V <sub>DRM</sub><br>V | I <sub>T(RMS)</sub><br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-----------|---------------|-----------------------|--------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|           |               |                       |                          |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-251    | TMG3C60/80C*  | 600, 800              | 3                        | 1                      | 1.4                  | 15                 | —     | 1.5               | —     | 125                  | 5                               | 1.5                | 3.8                        | D2      |
| TO-220AB  | TMG5C60*      | 600                   | 5                        | 1                      | 1.4                  | 20                 | —     | 1.5               | —     | 125                  | 5                               | 2.5                | 3                          | D3      |
|           | TMG8C60*      | 600                   | 8                        | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 4                  | 2                          |         |
|           | TMG12C60*     | 600                   | 12                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 6                  | 1.8                        |         |
|           | TMG16C60*     | 600                   | 16                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 1.4                        |         |
| TO-220AB2 | TMG20C60*     | 600                   | 20                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 1                          | D5      |
| TO-220F   | TMG2C80F5     | 800                   | 2                        | 1                      | 1.6                  | 15                 | —     | 1.5               | —     | 125                  | 3                               | 1                  | 7.5                        | * D6B   |
|           | TMG3C80F5     | 800                   | 3                        | 1                      | 1.4                  | 15                 | —     | 1.5               | —     | 125                  | 5                               | 1.5                | 5                          |         |
|           | TMG5C80F5     | 800                   | 5                        | 1                      | 1.4                  | 20                 | —     | 1.5               | —     | 125                  | 5                               | 2.5                | 4                          |         |
|           | TMG8C80F5     | 800                   | 8                        | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 4                  | 3.7                        |         |
|           | TMG10C80F5    | 800                   | 10                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 5                  | 3.5                        |         |
|           | TMG12C80F5    | 800                   | 12                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 6                  | 3.3                        |         |
|           | TMG16C80F5    | 800                   | 16                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 3                          |         |
|           | TMG20C80F5    | 800                   | 20                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 2.5                        |         |
| TO-3P     | TMG25C60/80F  | 600, 800              | 25                       | 5                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 12.5               | 1.9                        | * D6C   |
|           | TMG40C60/80L* | 600, 800              | 40                       | 5                      | 1.4                  | 50                 | —     | 1.5               | —     | 125                  | 10                              | 20                 | 0.6                        | D7      |
| TO-3PF    | TMG25C60/80J  | 600, 800              | 25                       | 5                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 12.5               | 1.4                        | * D8    |
|           | TMG40C60/80J  | 600, 800              | 40                       | 5                      | 1.4                  | 50                 | —     | 1.5               | —     | 125                  | 10                              | 20                 | 1.1                        |         |

\*Non isolated type

\*UL File No.E76102

## Through Hole/Sensitive Gate

| Package    | Type         | V <sub>DRM</sub><br>V | I <sub>T(RMS)</sub><br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|------------|--------------|-----------------------|--------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|            |              |                       |                          |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-92      | TMG1C60/80 5 | 600/800               | 1                        | 0.5                    | 1.6                  | 5                  | 10    | 1.8               | 2     | 125                  | 2                               | 0.5                | 50                         | D1B     |
| TO-251     | TMG3D60/80C* | 600, 800              | 3                        | 1                      | 1.4                  | 5                  | 10    | 1.5               | 2     | 125                  | 5                               | 1.5                | 3.8                        | D2      |
| TO-220F    | TMG2D60F5    | 600                   | 2                        | 1                      | 1.6                  | 5                  | 10    | 1.5               | 2     | 125                  | 3                               | 1                  | 7.5                        | * D6B   |
|            | TMG2DQ60F5   | 600                   | 2                        | 1                      | 1.6                  | 5                  | —     | 1.5               | —     | 150                  | 1                               | 1                  | 7.5                        |         |
|            | TMG3D60F5    | 600                   | 3                        | 1                      | 1.4                  | 5                  | 10    | 1.5               | 2     | 125                  | 5                               | 1.5                | 5                          |         |
|            | TMG5D60F5    | 600                   | 5                        | 1                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 5                               | 2.5                | 4                          |         |
|            | TMG8D60F5    | 600                   | 8                        | 2                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 10                              | 4                  | 3.7                        |         |
|            | TMG10D60F5   | 600                   | 10                       | 2                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 10                              | 5                  | 3.5                        |         |
|            | TMG12D60F5   | 600                   | 12                       | 2                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 10                              | 6                  | 3.3                        |         |
|            | TMG16D60F5   | 600                   | 16                       | 2                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 3                          |         |
| TMG20D60F5 | 600          | 20                    | 2                        | 1.4                    | 10                   | —                  | 1.5   | —                 | 125   | 10                   | 8                               | 2.5                |                            |         |

\*Non isolated type

\*UL File No.E76102 \*\* Rth(j-a)

## Through Hole/T<sub>j</sub>=150°C

| Package    | Type        | V <sub>DRM</sub><br>V | I <sub>T(RMS)</sub><br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|------------|-------------|-----------------------|--------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|            |             |                       |                          |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =150°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-220AB   | TMG16CQ60*  | 600                   | 16                       | 3                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 8                  | 1.4                        | D3      |
| TO-220AB2  | TMG20CQ60*  | 600                   | 20                       | 3                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 10                 | 1                          | D5      |
| TO-220F    | TMG2CQ60F5  | 600                   | 2                        | 1                      | 1.6                  | 15                 | —     | 1.5               | —     | 150                  | 1                               | 1                  | 7.5                        | * D6B   |
|            | TMG3CQ60F5  | 600                   | 3                        | 2                      | 1.4                  | 15                 | —     | 1.5               | —     | 150                  | 1                               | 1.5                | 5                          |         |
|            | TMG5CQ60F5  | 600                   | 5                        | 2                      | 1.4                  | 20                 | —     | 1.5               | —     | 150                  | 2                               | 2.5                | 4                          |         |
|            | TMG8CQ60F5  | 600                   | 8                        | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 4                  | 3.7                        |         |
|            | TMG10CQ60F5 | 600                   | 10                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 5                  | 3.5                        |         |
|            | TMG12CQ60F5 | 600                   | 12                       | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 6                  | 3.3                        |         |
|            | TMG16CQ60F5 | 600                   | 16                       | 3                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 8                  | 3                          |         |
|            | TMG20CQ60F5 | 600                   | 20                       | 3                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 10                 | 2.5                        |         |
|            | TMG2DQ60F5  | 600                   | 2                        | 1                      | 1.6                  | 5                  | —     | 1.5               | —     | 150                  | 1                               | 1                  | 7.5                        |         |
|            | TMG3DQ60F5  | 600                   | 3                        | 2                      | 1.4                  | 5                  | 10    | 1.5               | 2     | 150                  | 1                               | 1.5                | 5                          |         |
| TMG25CQ60F | 600         | 25                    | 5                        | 1.4                    | 30                   | —                  | 1.5   | —                 | 150   | 5                    | 12.5                            | 1.9                | * D6C                      |         |
| TO-3P      | TMG25CQ60L* | 600                   | 25                       | 5                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 12.5               | 1.2                        | D7      |
|            | TMG40CQ60L* | 600                   | 40                       | 8                      | 1.4                  | 50                 | —     | 1.5               | —     | 150                  | 5                               | 20                 | 0.6                        |         |
| TO-3PF     | TMG25CQ60J  | 600                   | 25                       | 5                      | 1.4                  | 30                 | —     | 1.5               | —     | 150                  | 5                               | 12.5               | 1.4                        | * D8    |
|            | TMG40CQ60J  | 600                   | 40                       | 8                      | 1.4                  | 50                 | —     | 1.5               | —     | 150                  | 5                               | 20                 | 1.1                        |         |

\*Non isolated type

\*UL File No.E76102

**SMD (Surface Mount Device) / Standard Gate**

| Package            | Type       | V <sub>DRM</sub><br>V | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|--------------------|------------|-----------------------|---------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|                    |            |                       |                           |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-252<br>(D pak)  | TMG3C60D*  | 600                   | 3                         | 1                      | 1.4                  | 15                 | —     | 1.5               | —     | 125                  | 5                               | 1.5                | 3.8                        | D10     |
|                    | TMG5C60D*  | 600                   | 5                         | 1                      | 1.4                  | 20                 | —     | 1.5               | —     | 125                  | 5                               | 2.5                | 3                          |         |
| TO-263<br>(D2 pak) | TMG16C60H* | 600                   | 16                        | 2                      | 1.4                  | 30                 | —     | 1.5               | —     | 125                  | 10                              | 8                  | 1.4                        | D11     |
| TO-92              | TMG1D60 5  | 600                   | 1                         | 0.5                    | 1.75                 | 20                 | —     | 1.5               | —     | 125                  | 4                               | 0.5                | 50                         | D1B     |

\*Non isolated type

**SMD (Surface Mount Device) / Sensitive Gate**

| Package           | Type        | V <sub>DRM</sub><br>V | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-------------------|-------------|-----------------------|---------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|                   |             |                       |                           |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| SOT-89            | TMG1C60A 5* | 600                   | 1                         | 0.5                    | 1.6                  | 5                  | 10    | 1.8               | 2     | 125                  | 2                               | 0.5                | **65                       | D9A     |
| TO-252<br>(D pak) | TMG3D60D*   | 600                   | 3                         | 1                      | 1.4                  | 5                  | 10    | 1.5               | 2     | 125                  | 5                               | 1.5                | 3.8                        | D10     |
|                   | TMG5D60D*   | 600                   | 5                         | 1                      | 1.4                  | 10                 | —     | 1.5               | —     | 125                  | 5                               | 2.5                | 3                          |         |

\*Non isolated type

\*\* R<sub>th</sub>(j-a)

**SMD (Surface Mount Device) / T<sub>j</sub>=150°C**

| Package           | Type       | V <sub>DRM</sub><br>V | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-------------------|------------|-----------------------|---------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|                   |            |                       |                           |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-252<br>(D pak) | TMG3CQ60D* | 600                   | 3                         | 2                      | 1.4                  | 15                 | —     | 1.5               | —     | 150                  | 1                               | 1.5                | 3.8                        | D10     |
|                   | TMG5CQ60D* | 600                   | 5                         | 2                      | 1.4                  | 20                 | —     | 1.5               | —     | 150                  | 2                               | 2.5                | 3                          |         |

\*Non isolated type

\*UL File No.E76102

**Tab Terminal / Standard Gate**

| Package      | Type        | V <sub>DRM</sub><br>V | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub> mA |       | V <sub>GT</sub> V |       | T <sub>j</sub><br>°C | [dv/dt]c                        |                    | R <sub>thj-c</sub><br>°C/W | Fig No. |
|--------------|-------------|-----------------------|---------------------------|------------------------|----------------------|--------------------|-------|-------------------|-------|----------------------|---------------------------------|--------------------|----------------------------|---------|
|              |             |                       |                           |                        |                      | I+,I-,II-          | III + | I+,I-,II-         | III + |                      | V/μs<br>(T <sub>j</sub> =125°C) | -A/ms<br>[-di/dt]c |                            |         |
| TO-3         | TG16C40/60  | 400, 600              | 16                        | 3                      | 1.5                  | 50                 | —     | 3                 | —     | 125                  | 6                               | 8                  | 2                          | *D12    |
|              | TG25C40/60  | 400, 600              | 25                        | 5                      | 1.4                  | 50                 | —     | 3                 | —     | 125                  | 6                               | 15                 | 1.6                        |         |
|              | TG35C60     | 600                   | 35                        | 5                      | 1.4                  | 50                 | —     | 3                 | —     | 125                  | 5                               | 15                 | 1.5                        |         |
|              | TG40E60/80  | 600, 800              | 40                        | 5                      | 1.4                  | 50                 | —     | 1.5               | —     | 125                  | 6                               | 10                 | 1.3                        |         |
| not standard | TG70AA40/60 | 400, 600              | 70                        | 10                     | 1.35                 | 50                 | —     | 3                 | —     | 125                  | 6                               | 8                  | 0.83                       | D14     |

\*UL File No.E76102

# THYRISTOR

**Through Hole / Standard Gate**

| Package  | Type        | V <sub>DRM</sub><br>V | I <sub>T</sub> (AV)<br>A | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub><br>mA | V <sub>GT</sub><br>V | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|----------|-------------|-----------------------|--------------------------|---------------------------|------------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|---------|
| TO-220AB | SMG16C60*   | 600                   | 16                       | 25.1                      | 2                      | 1.5                  | 30                    | 1.4                  | 125                  | 1.4                        | D3      |
| TO-220F  | SMG5C60F5   | 600                   | 5                        | 7.8                       | 2                      | 1.5                  | 10                    | 1.4                  | 125                  | 4                          | *D6B    |
|          | SMG8C60F5   | 600                   | 8                        | 12.6                      | 2                      | 1.5                  | 10                    | 1.4                  | 125                  | 3.7                        |         |
|          | SMG12C60F5  | 600                   | 12                       | 18.8                      | 2                      | 1.5                  | 30                    | 1.4                  | 125                  | 3.3                        |         |
|          | SMG16C60F5  | 600                   | 16                       | 25.1                      | 2                      | 1.5                  | 30                    | 1.4                  | 125                  | 3                          |         |
| TO-247   | SMG50A160M* | 1600                  | 50                       | 79                        | 10                     | 1.86                 | 100                   | 1.5                  | 125                  | 0.25                       | D16     |
|          | SMG80A160M* | 1600                  | 80                       | 126                       | 15                     | 1.87                 | 100                   | 1.5                  | 125                  | 0.17                       |         |

New  
New

\*Non isolated type

\*UL File No.E76102

**SMD (Surface Mount Device) / Sensitive Gate**

| Package | Type       | V <sub>DRM</sub><br>V | I <sub>T</sub> (AV)<br>A | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub><br>mA | V <sub>GT</sub><br>V | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|---------|------------|-----------------------|--------------------------|---------------------------|------------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|---------|
| TO-92   | SMG04C60 5 | 600                   | 0.4                      | 0.63                      | 0.5                    | 1.2                  | 0.1                   | 0.8                  | 125                  | **150                      | D1B     |
|         | SMG05C60 5 | 600                   | 0.5                      | 0.78                      | 0.5                    | 1.2                  | 0.1                   | 0.8                  | 125                  | **150                      |         |
| TO-251  | SMG3D60C*  | 600                   | 3                        | 4.7                       | 1                      | 1.5                  | 0.2                   | 0.8                  | 125                  | 3.8                        | D2      |

\*Non isolated type

\*\* R<sub>th</sub>(j-a)

**SMD (Surface Mount Device) / Standard Gate**

| Package         | Type      | V <sub>DRM</sub><br>V | I <sub>T</sub> (AV)<br>A | I <sub>T</sub> (RMS)<br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub><br>mA | V <sub>GT</sub><br>V | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-----------------|-----------|-----------------------|--------------------------|---------------------------|------------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|---------|
| TO-263 (D2 pak) | SMG5C60H* | 600                   | 5                        | 7.8                       | 2                      | 1.5                  | 10                    | 1.4                  | 125                  | 3                          | D11     |

\*Non isolated type



**SMD (Surface Mount Device) / Sensitive Gate**

| Package        | Type         | V <sub>DRM</sub><br>V | I <sub>T(AV)</sub><br>A | I <sub>T(RMS)</sub><br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub><br>mA | V <sub>GT</sub><br>V | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|----------------|--------------|-----------------------|-------------------------|--------------------------|------------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|---------|
| SOT-89         | SMG08C60A 5* | 600                   | 0.8                     | 1.3                      | 0.5                    | 1.5                  | 0.1                   | 0.8                  | 125                  | **65                       | D9A     |
| TO-252 (D pak) | SMG3D60D*    | 600                   | 3                       | 4.7                      | 1                      | 1.5                  | 0.2                   | 0.8                  | 125                  | 3.8                        | D10     |
|                | SMG5F60D*    | 600                   | 5                       | 7.8                      | 2                      | 1.8                  | 0.2                   | 0.8                  | 125                  | 3                          |         |

\*Non isolated type

\*\* R<sub>th(j-a)</sub>

**Tab Terminal / Standard Gate**

| Package | Type        | V <sub>DRM</sub><br>V | I <sub>T(AV)</sub><br>A | I <sub>T(RMS)</sub><br>A | I <sub>DRM</sub><br>mA | V <sub>TM</sub><br>V | I <sub>GT</sub><br>mA | V <sub>GT</sub><br>V | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|---------|-------------|-----------------------|-------------------------|--------------------------|------------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|---------|
| TO-3    | SG16AA40/60 | 400, 600              | 16                      | 25                       | 3                      | 1.5                  | 40                    | 3                    | 125                  | 2                          | *D12    |
|         | SG25AA40/60 | 400, 600              | 25                      | 39                       | 5                      | 1.4                  | 40                    | 3                    | 125                  | 1.6                        |         |

\*UL File No.E76102

**FRD**

**Through Hole**

| Package | Type       | V <sub>RRM</sub><br>V | I <sub>F(AV)</sub> |     | I <sub>FSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | V <sub>FM</sub><br>V (25°C) | I <sub>RRM</sub><br>mA (125°C) | tr <sub>ns</sub> | R <sub>thj-c</sub><br>°C/W | Fig No. |
|---------|------------|-----------------------|--------------------|-----|------------------------------|---|-----------------------------|--------------------------------|------------------|----------------------------|---------|
|         |            |                       | A                  | °C  |                              |   |                             |                                |                  |                            |         |
| TO-3P   | DMG60UL20* | 200                   | 60                 | 105 | 900                          | 3375  | 1.05                        | 2.0 (150°C)                    | 60               | 0.7                        | D7      |

\*Non isolated type

**Tab Terminal**

| Package | Type       | V <sub>RRM</sub><br>V | I <sub>F(AV)</sub> |    | I <sub>FSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | V <sub>FM</sub><br>V (25°C) | I <sub>RRM</sub><br>mA (125°C) | tr <sub>ns</sub> | R <sub>thj-c</sub><br>°C/W | Fig No. |
|---------|------------|-----------------------|--------------------|----|------------------------------|---|-----------------------------|--------------------------------|------------------|----------------------------|---------|
|         |            |                       | A                  | °C |                              |   |                             |                                |                  |                            |         |
| TO-3    | FRG25BA60  | 600                   | 25                 | 94 | 450                          | 840   | 1.3                         | 30 (150°C)                     | 100              | 1.6                        | *D13    |
|         | FRG25CA120 | 1200                  | 25                 | 78 | 400                          | 660   | 1.8                         | 1 (150°C)                      | 200              | 1.6                        |         |

\*UL File No.E76102

**DIODE**

**Through Hole**

| Package     | Type        | V <sub>RRM</sub><br>V | I <sub>F(AV)</sub><br>A | I <sub>FSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | V <sub>FM</sub><br>V (25°C) | I <sub>RRM</sub><br>mA (125°C) | T <sub>j</sub><br>°C | R <sub>thj-c</sub><br>°C/W | Fig No. |
|-------------|-------------|-----------------------|-------------------------|------------------------------|---|-----------------------------|--------------------------------|----------------------|----------------------------|---------|
| TO-220AB-2L | DMG35AA100* | 1000                  | 35                      | 300                          | 380   | 1.2                         | 100                            | 180                  | 1.0                        | D4      |

\*Non isolated type

**Tab Terminal**

| Package | Type             | V <sub>RRM</sub><br>V | I <sub>F(AV)</sub> |     | I <sub>FSM</sub><br>A (60Hz) | I <sup>2</sup> <sub>t</sub><br>A <sup>2</sup> s | V <sub>FM</sub><br>V (25°C) | I <sub>RRM</sub><br>mA (150°C) | R <sub>thj-c</sub><br>°C/W | Fig No. |
|---------|------------------|-----------------------|--------------------|-----|------------------------------|---|-----------------------------|--------------------------------|----------------------------|---------|
|         |                  |                       | A                  | °C  |                              |   |                             |                                |                            |         |
| TO-3    | DG20AA80/120/160 | 800, 1200, 1600       | 20                 | 101 | 450                          | 840   | 1.65                        | 8                              | 1.6                        | *D13    |

\*UL File No.E76102

**SiC MOSFET**

**SiC MOSFET FMG Series**

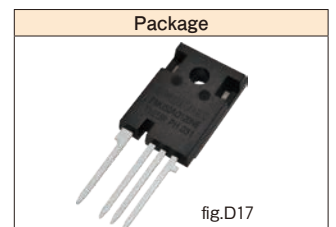
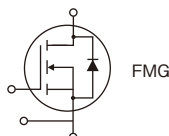
V<sub>iso</sub> : 2500V (RMS), T<sub>j (max)</sub> : 150°C

| Package  | Type         | MOSFET                |                    |     |                       |                           |                          | Channel Diode  |     |                      | R <sub>thj-c</sub><br>°C/W | Fig No. |
|----------|--------------|-----------------------|--------------------|-----|-----------------------|---------------------------|--------------------------|----------------|-----|----------------------|----------------------------|---------|
|          |              | V <sub>DSS</sub><br>V | I <sub>T(AV)</sub> |     | V <sub>GSS</sub><br>V | R <sub>DS(on)</sub><br>mΩ | V <sub>GS(th)</sub><br>V | I <sub>S</sub> |     | V <sub>SD</sub><br>V |                            |         |
|          |              |                       | A                  | °C  |                       |                           |                          | A              | °C  |                      |                            |         |
| TO-247-4 | FMG50AQ120N6 | 1200                  | 50                 | 108 | -7~22                 | 28.0                      | 3~5                      | 50             | 108 | 2.90                 | 0.28                       | *D17    |

New

\*UL File No.E76102

Connections



# OUTLINE DRAWINGS POWER MODULE

fig. 1

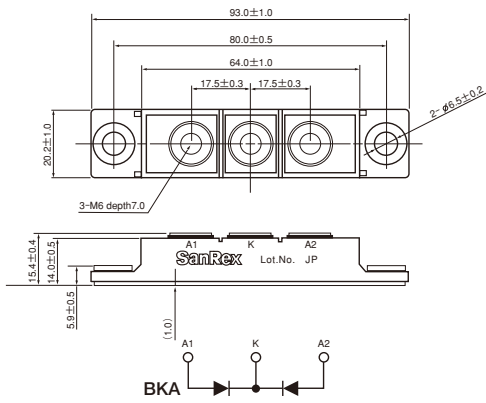


fig. 2

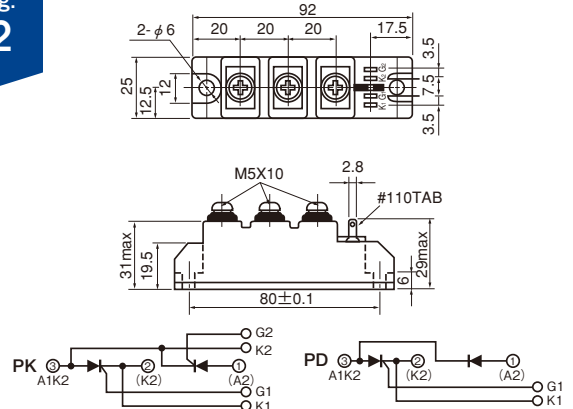


fig. 3

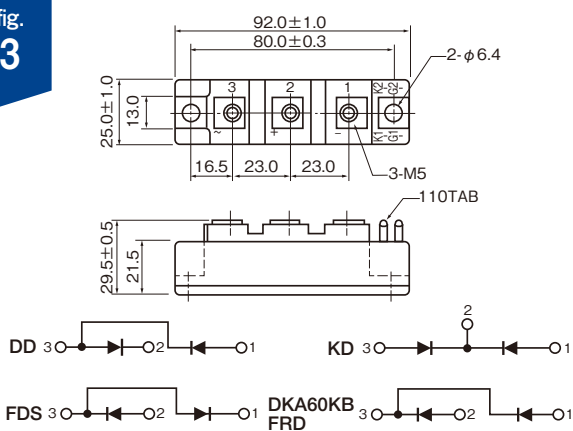


fig. 4

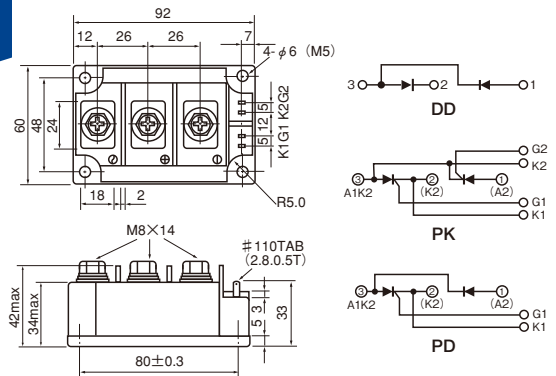


fig. 5

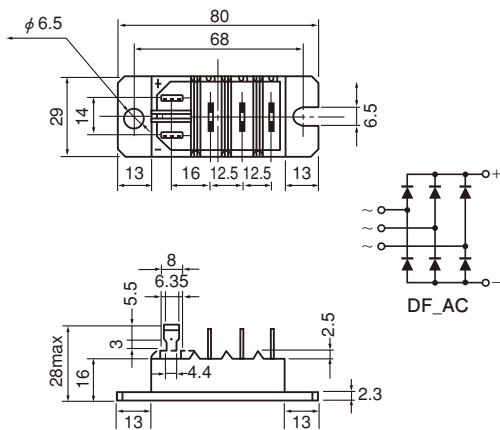


fig. 6

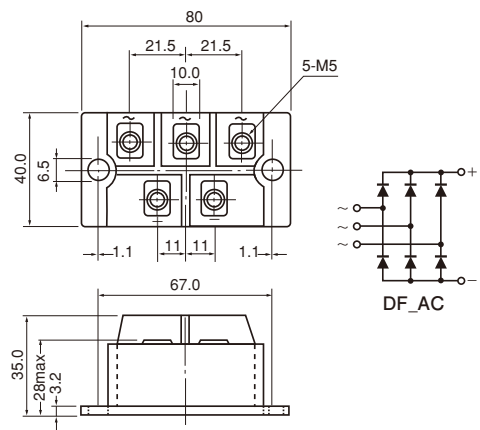


fig. 7

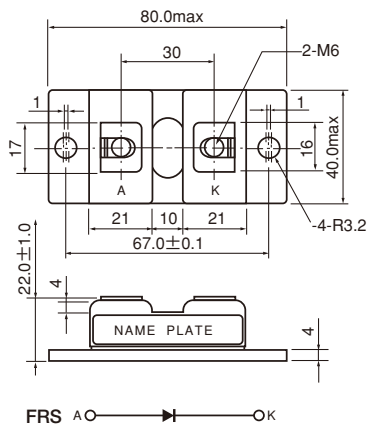


fig. 8

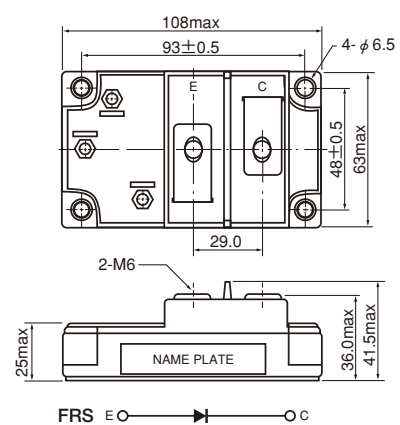


fig. 9

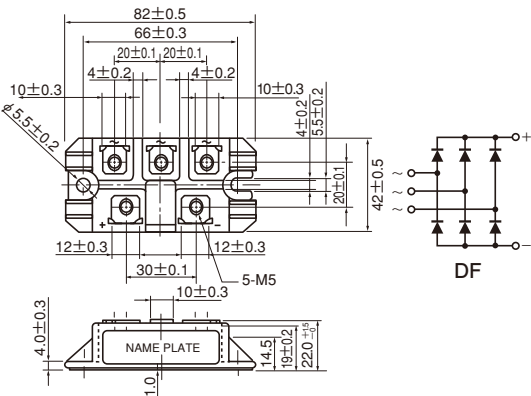


fig. 10

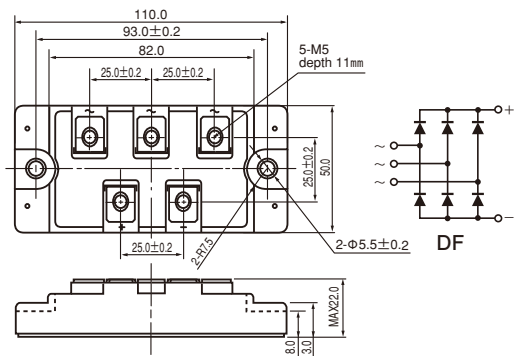


fig. 11

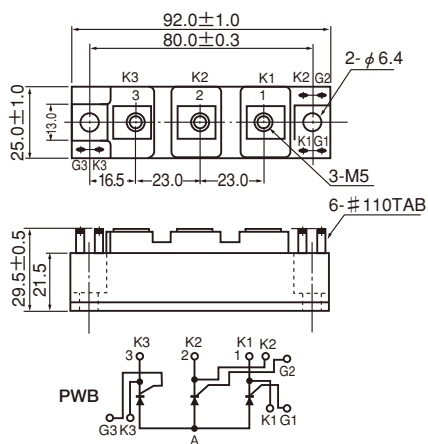


fig. 12

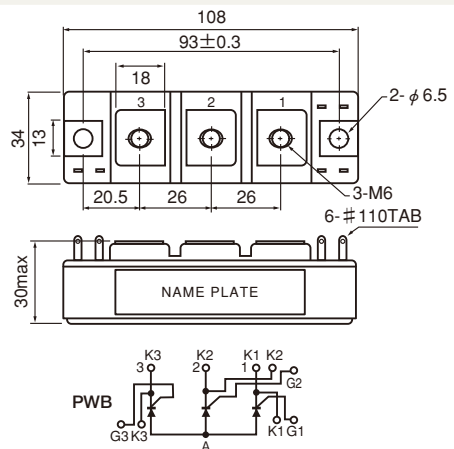


fig. 13

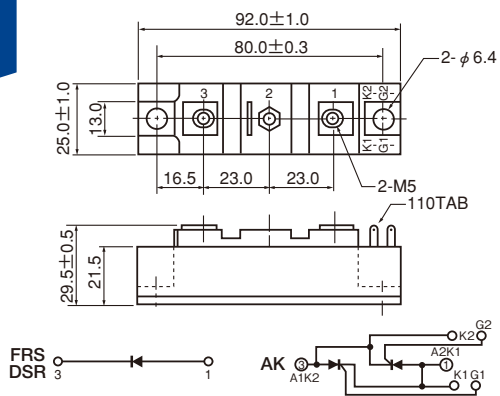


fig. 14

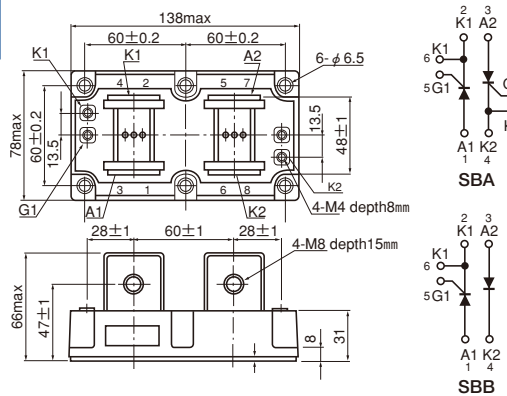


fig. 15

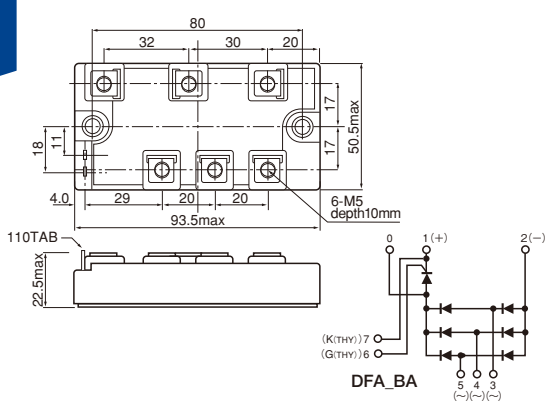


fig. 16

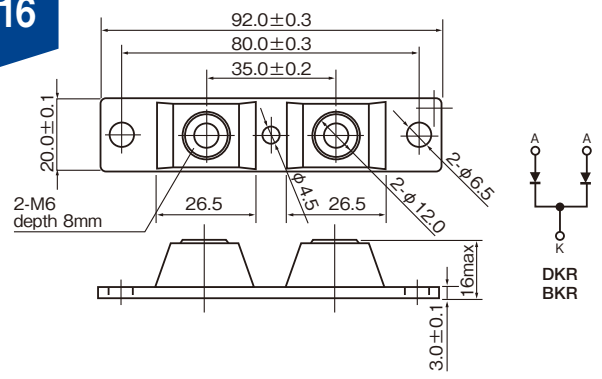






fig. 25

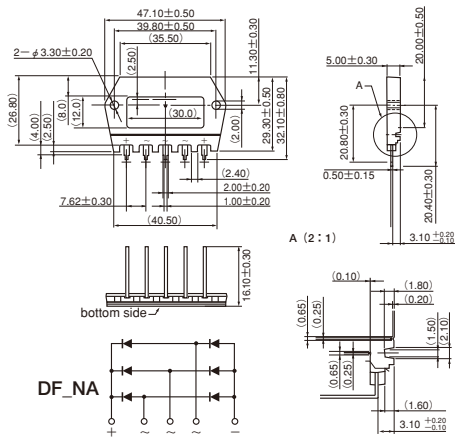


fig. 26

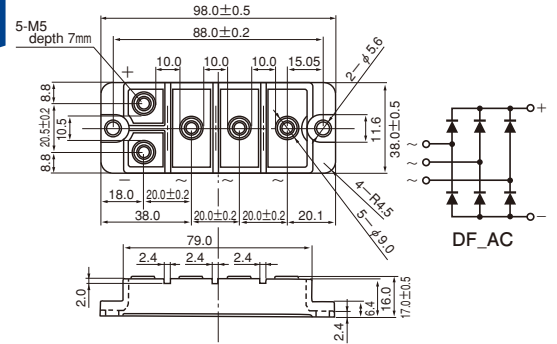


fig. 28

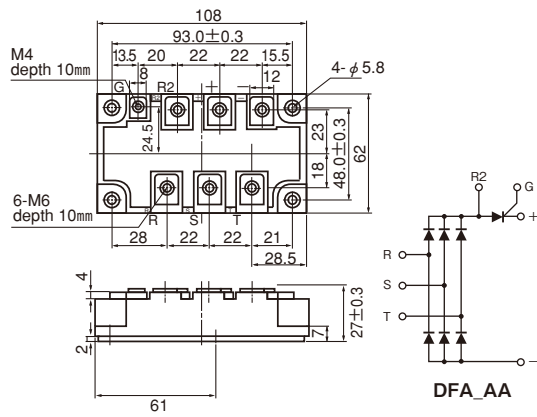


fig. 29A

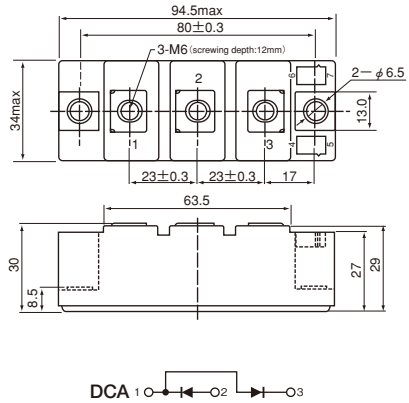


fig. 29B

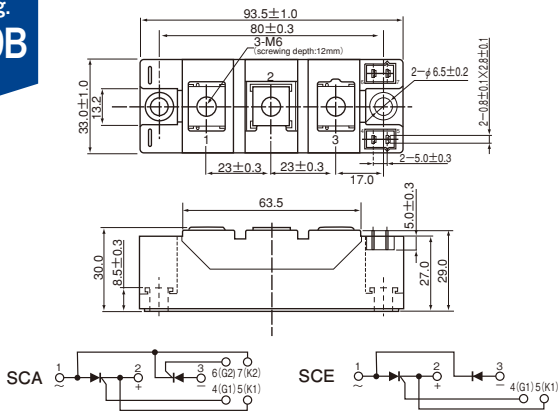


fig. 29C

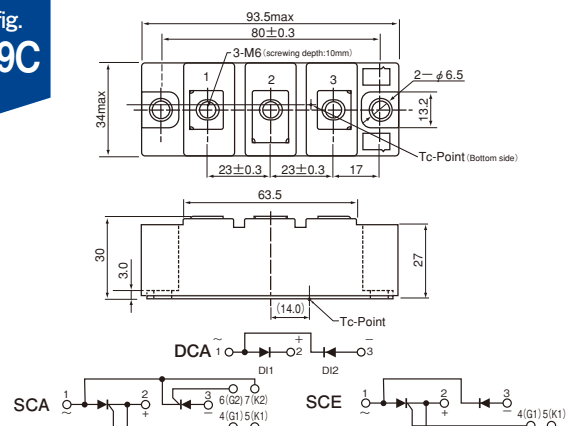


fig. 30

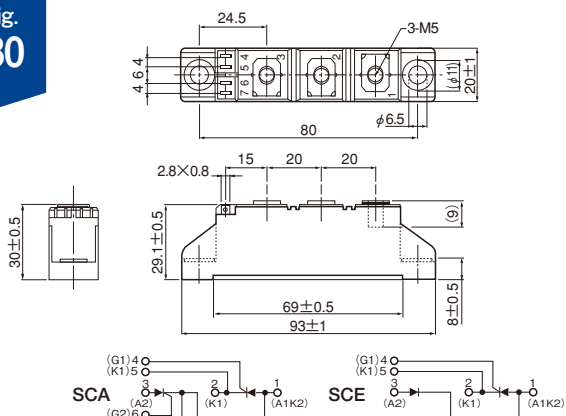
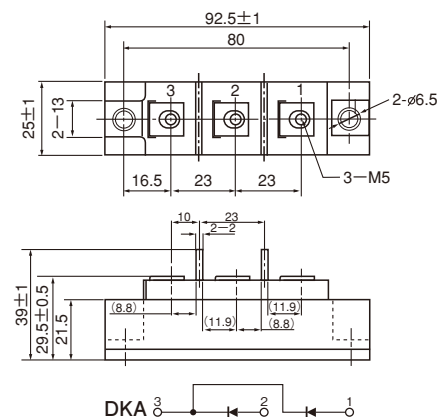


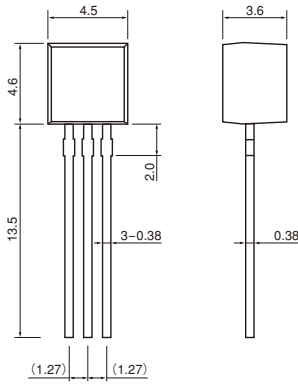
fig. 31





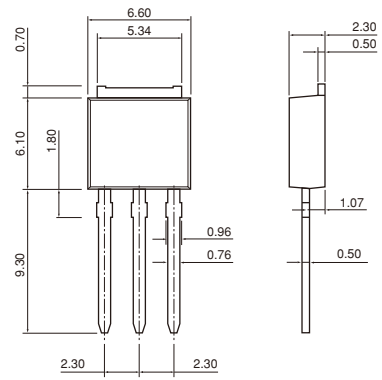
# DISCRETE

fig.  
D1B



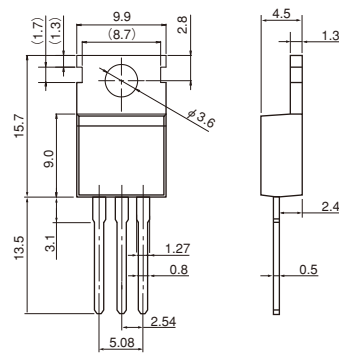
TO-92 5

fig.  
D2



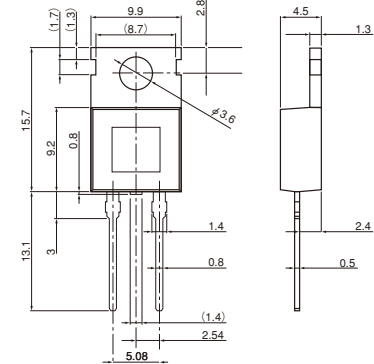
TO-251

fig.  
D3



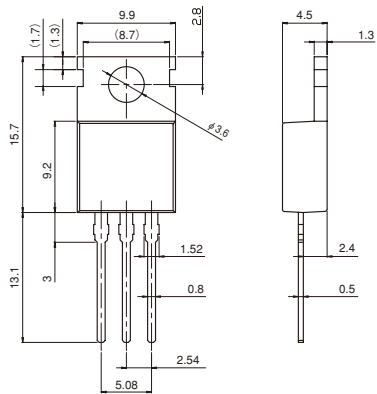
TO-220AB

fig.  
D1A



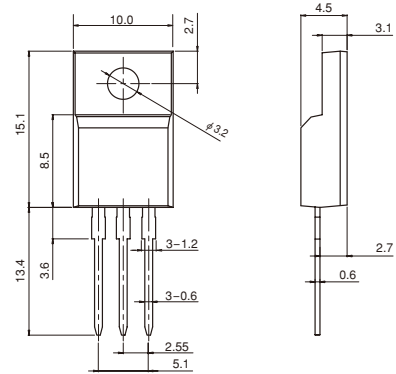
TO-220AB-2L

fig.  
D5



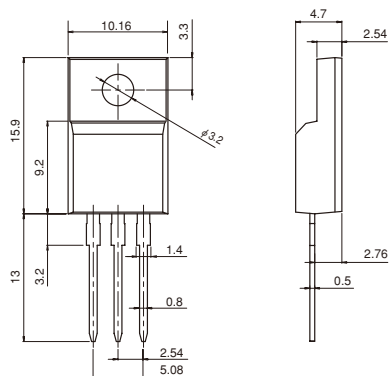
TO-220AB2

fig.  
D6B



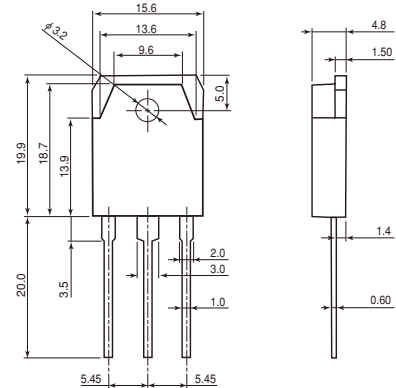
TO-220F5

fig.  
D6C

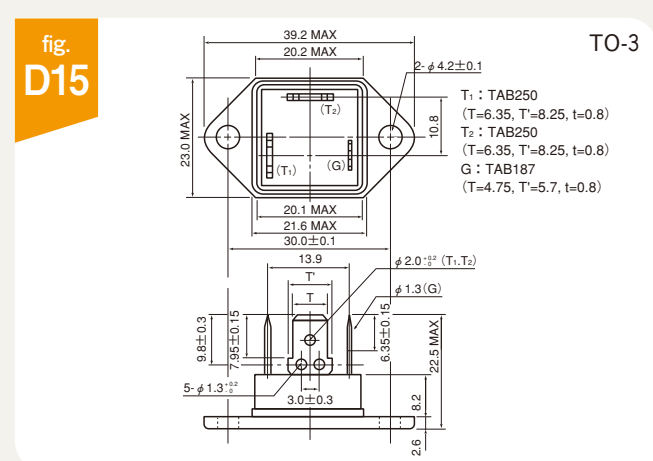
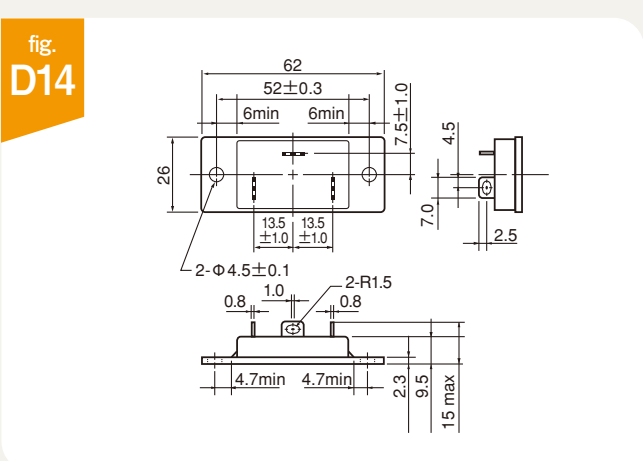
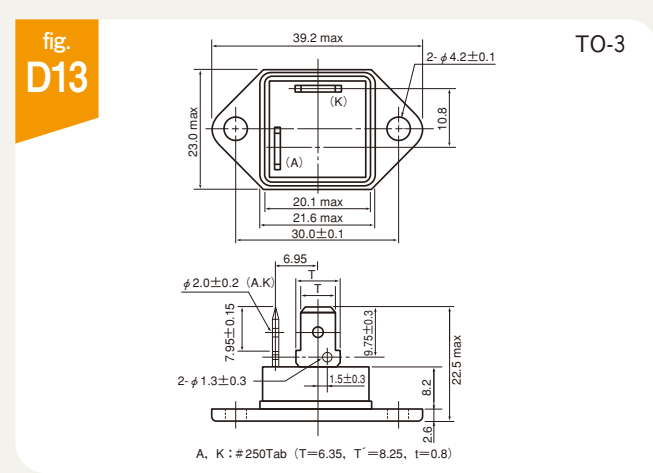
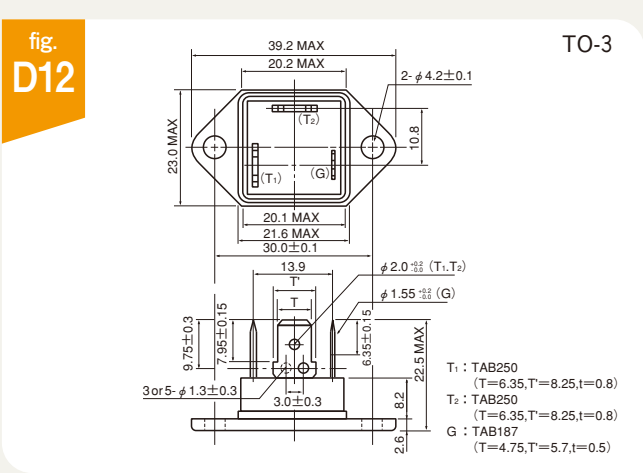
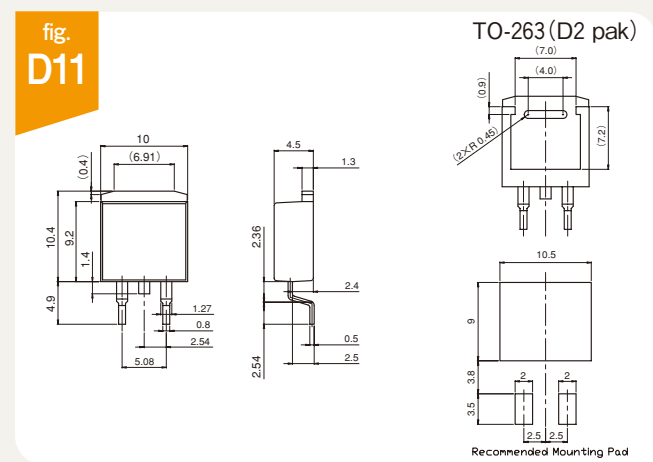
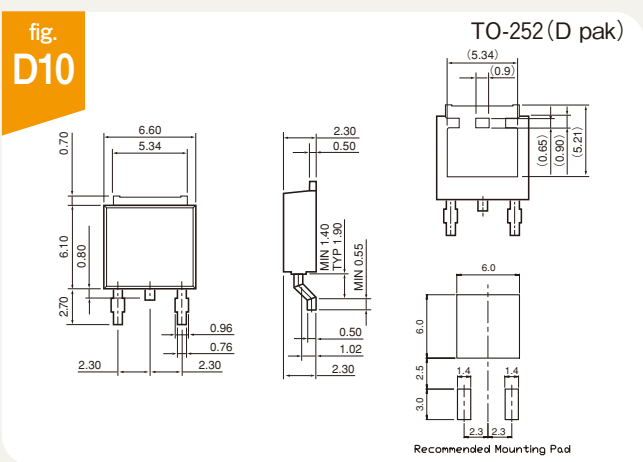
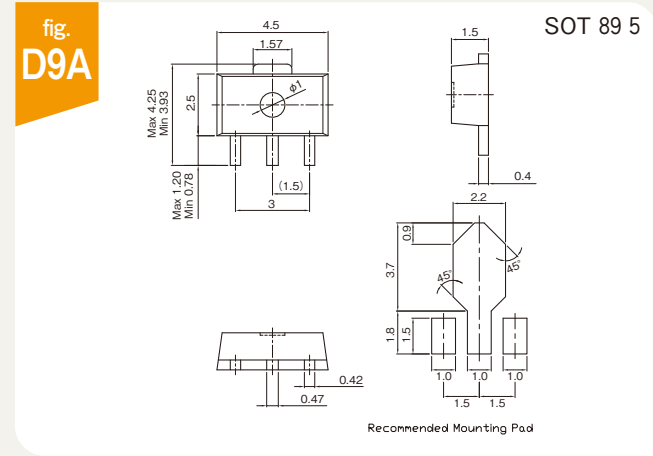
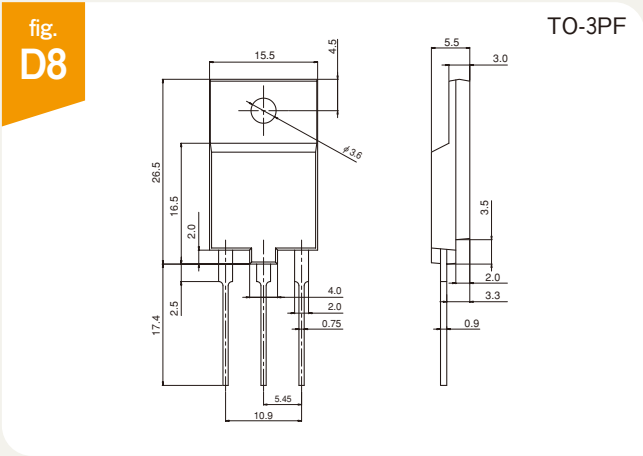


TO-220F2

fig.  
D7



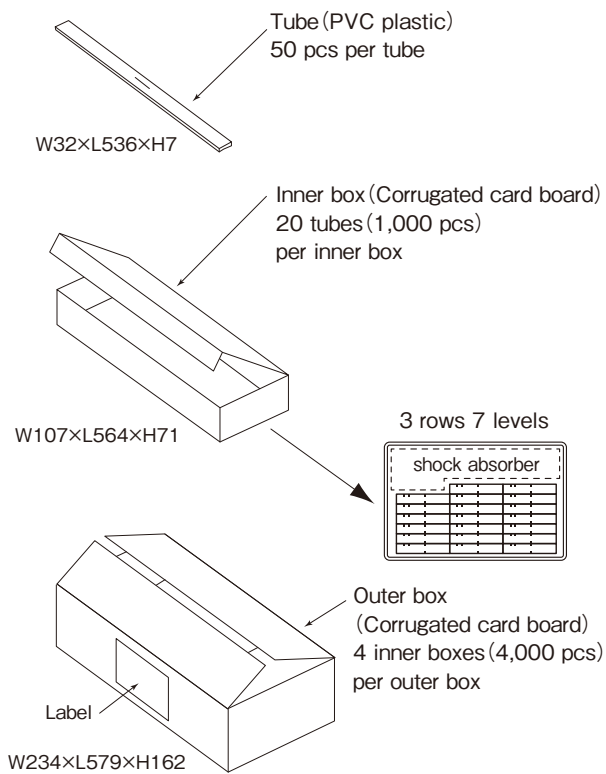
TO-3P





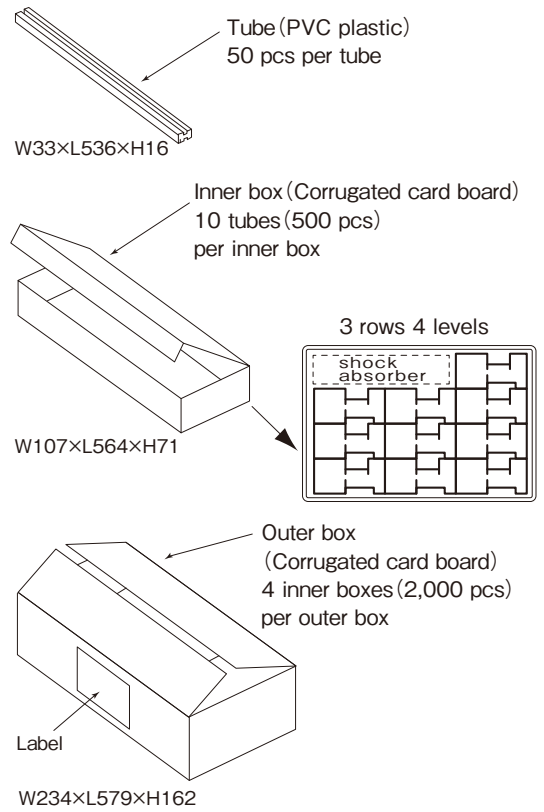


**TO-220F5 (Straight Lead)**



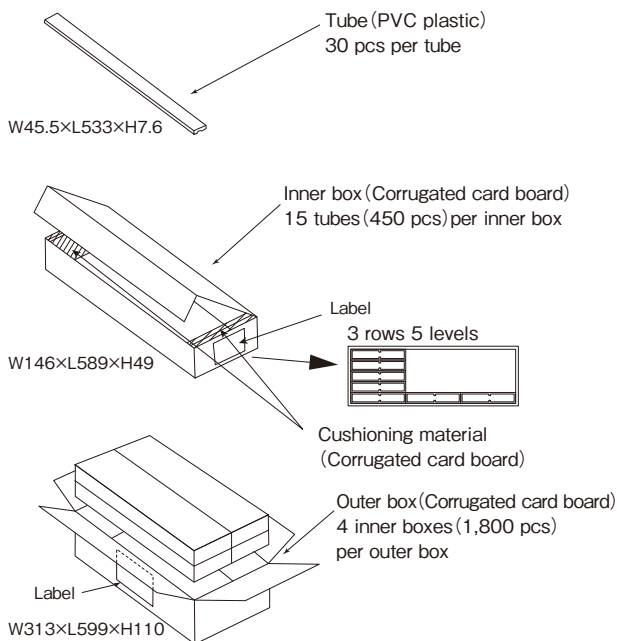
Note) Type and quantity are indicated on the outer box.

**TO-220F5 (Formed Lead)**



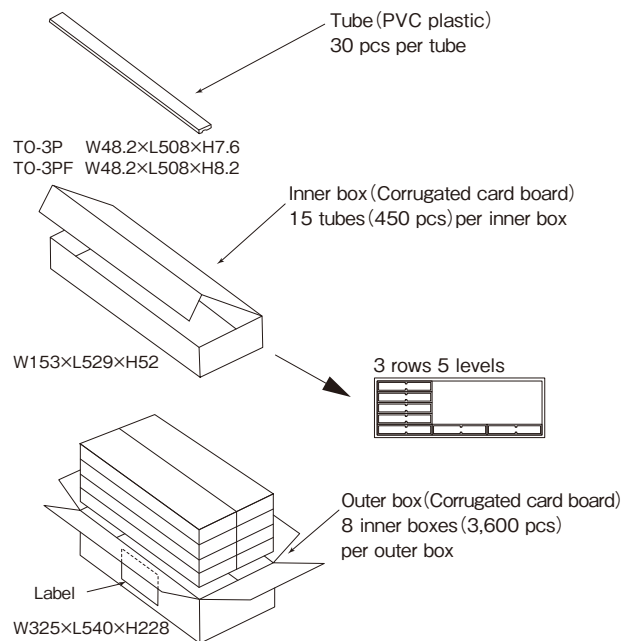
Note) Type and quantity are indicated on the outer box.

**TO-247**



Note) Type and quantity are indicated on the outer box.

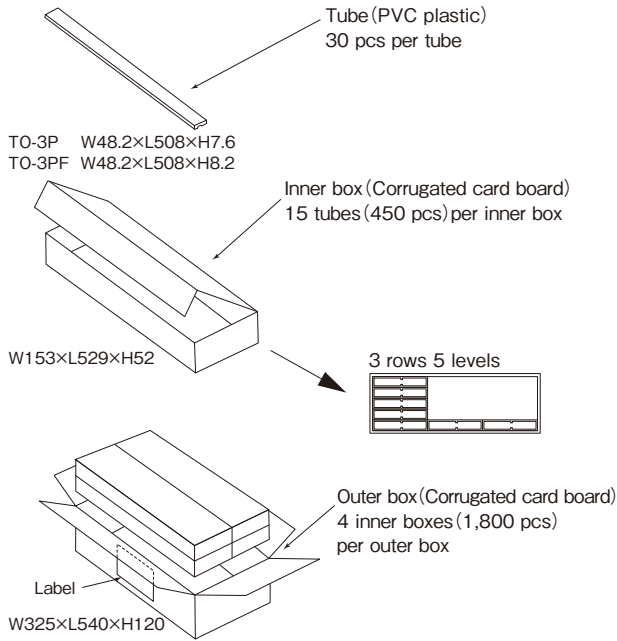
**TO-247-4L**



Note) Type and quantity are indicated on the outer box.



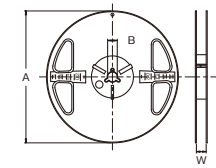
TO-3P / TO-3PF



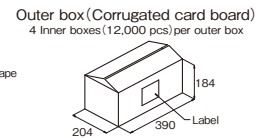
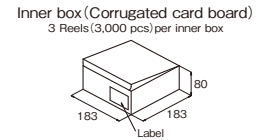
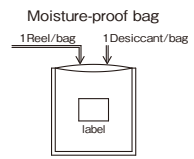
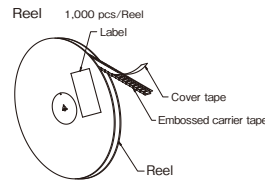
Note) Type and quantity are indicated on the outer box.

SOT-89 5

SOT-89 5 Reel outline

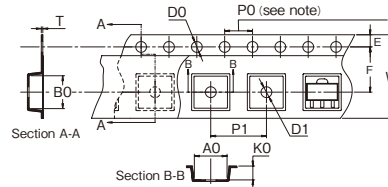


| Dimensions are in millimeter |                     |                      |                                     |
|------------------------------|---------------------|----------------------|-------------------------------------|
| Tape Size                    | A                   | B                    | W<br><small>Measured at Hub</small> |
| 12mm                         | 178 <sup>±1.0</sup> | 13.0 <sup>±1.2</sup> | 13.2 <sup>±1.5</sup>                |



Notes Type, lot number and quantity are indicated on the reel, moisture-proof bag, inner box and outer box.

SOT-89 5 Embossed carrier tape outline

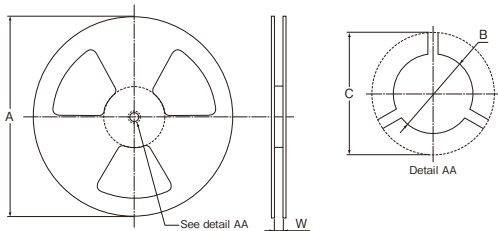


| Dimensions are in millimeter |                        |                        |                         |                          |                        |                        |                          |                        |                        |                        |                          |
|------------------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|------------------------|--------------------------|------------------------|------------------------|------------------------|--------------------------|
|                              | A0                     | B0                     | W                       | D0                       | D1                     | E                      | F                        | P0                     | P1                     | K0                     | T                        |
| SOT-89 5<br>(12mm)           | 4.9<br><sup>±0.1</sup> | 4.5<br><sup>±0.1</sup> | 12.0<br><sup>±0.2</sup> | 1.55<br><sup>±0.05</sup> | 1.6<br><sup>±0.1</sup> | 1.5<br><sup>±0.1</sup> | 5.65<br><sup>±0.05</sup> | 4.0<br><sup>±0.1</sup> | 8.0<br><sup>±0.1</sup> | 1.8<br><sup>±0.1</sup> | 0.25<br><sup>±0.05</sup> |

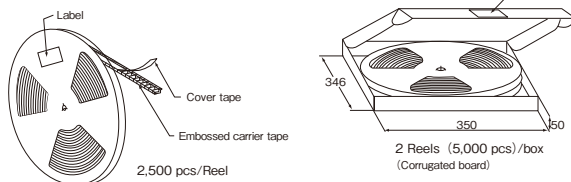
Notes 10 sprocket hole pitch cumulative tolerance ±0.2.

TO-252

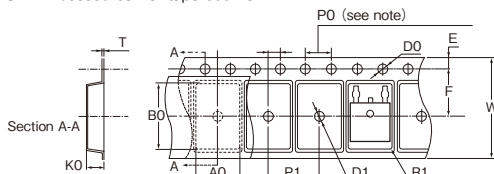
TO-252 Reel outline



| Dimensions are in millimeter |     |   |      |                                       |
|------------------------------|-----|---|------|---------------------------------------|
| Tape Size                    | A   | B                                       | C    | W                                     |
| 16mm                         | 330 | 13.0 <sup>+0.5</sup><br><sub>-0.2</sub> | 20.2 | 16.4 <sup>+2.0</sup><br><sub>-0</sub> |



TO-252 Embossed carrier tape outline

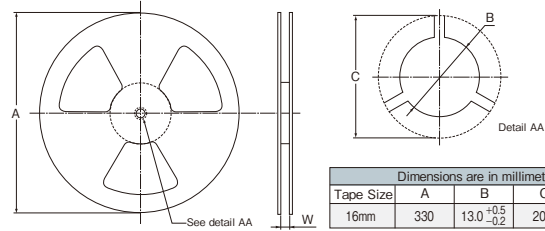


| Dimensions are in millimeter |                        |                         |                         |   |                        |                         |                        |                        |                        |                          |                          |
|------------------------------|------------------------|-------------------------|-------------------------|---|------------------------|-------------------------|------------------------|------------------------|------------------------|--------------------------|--------------------------|
|                              | A0                     | B0                      | W                       | D0                                      | D1                     | E                       | F                      | P0                     | P1                     | K0                       | T                        |
| TO-252<br>(16mm)             | 7.1<br><sup>±0.1</sup> | 10.5<br><sup>±0.1</sup> | 16.0<br><sup>±0.3</sup> | 1.5<br><sup>+0.1</sup><br><sub>-0</sub> | 1.7<br><sup>±0.1</sup> | 1.75<br><sup>±0.1</sup> | 7.5<br><sup>±0.1</sup> | 4.0<br><sup>±0.1</sup> | 8.0<br><sup>±0.1</sup> | 2.85<br><sup>±0.10</sup> | 0.30<br><sup>±0.05</sup> |

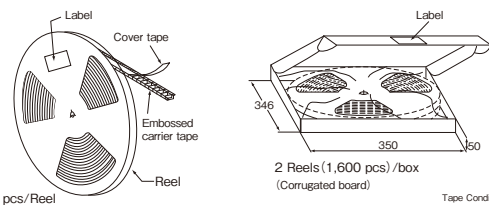
Notes 10 sprocket hole pitch cumulative tolerance ±0.2.

TO-263

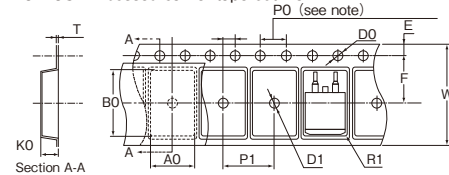
TO-263 Reel outline



| Dimensions are in millimeter |     |   |      |                                       |
|------------------------------|-----|---|------|---------------------------------------|
| Tape Size                    | A   | B                                       | C    | W                                     |
| 16mm                         | 330 | 13.0 <sup>+0.5</sup><br><sub>-0.2</sub> | 20.2 | 24.4 <sup>+2.0</sup><br><sub>-0</sub> |



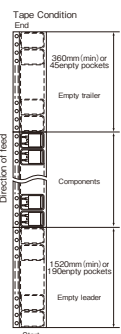
TO-263 Embossed carrier tape outline



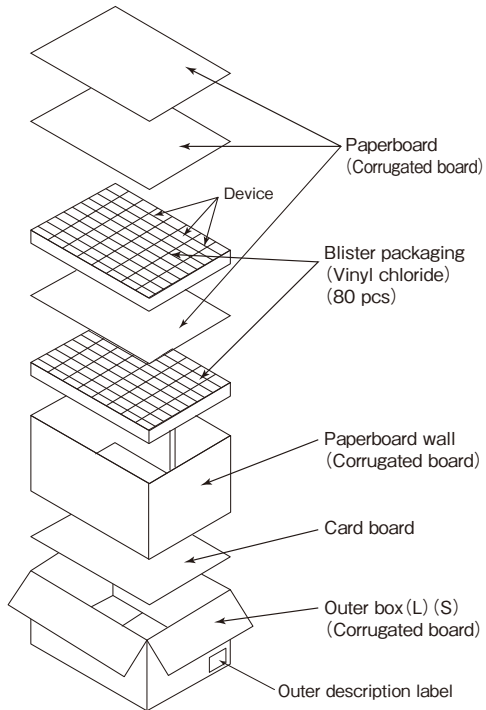
| Dimensions are in millimeter |                         |                         |                         |   |                        |                         |                         |                        |                         |                          |                          |
|------------------------------|-------------------------|-------------------------|-------------------------|---|------------------------|-------------------------|-------------------------|------------------------|-------------------------|--------------------------|--------------------------|
|                              | A0                      | B0                      | W                       | D0                                      | D1                     | E                       | F                       | P0                     | P1                      | K0                       | T                        |
| TO-263<br>(24mm)             | 10.6<br><sup>±0.1</sup> | 15.8<br><sup>±0.1</sup> | 24.0<br><sup>±0.3</sup> | 1.5<br><sup>+0.1</sup><br><sub>-0</sub> | 1.6<br><sup>±0.1</sup> | 1.75<br><sup>±0.1</sup> | 11.5<br><sup>±0.1</sup> | 4.0<br><sup>±0.1</sup> | 16.0<br><sup>±0.1</sup> | 4.90<br><sup>±0.10</sup> | 0.30<br><sup>±0.05</sup> |

Notes

- 10 sprocket hole pitch cumulative tolerance ±0.2.
- A0, B0 and K0 dimensions are determined with respect to EIA RS-481.
- K0 measured from the inside bottom of the pocket to the top surface of the carrier.



# Tab Terminal

**TO-3**


- For Outer carton (L) ; Maximum 5 stacks of partition tray (400 pcs)  
W395×L295×H185mm
- For Outer carton (S) ; Maximum 2 stacks of partition tray (160 pcs)  
W395×L295×H105mm

### 〈Attention〉

- Although we make every effort to improve quality and reliability, semiconductor products may fail or malfunction due to various factors.

When using this product, safety measures should be taken for the equipment on which the product will be used, such as redundancy design, design for prevention of the spread of fire, design for prevention of malfunction, etc. in which safety is taken into consideration, so that no accident resulting in personal injury or death, or no damages due to fire, will occur.

- We will not be held responsible for any accidents or damages that have occurred due to use exceeding the rated values or non-observance of precautions.
- If a product described in this material is subject to regulations under the Foreign Exchange and Foreign Trade Act, permission for export is required to be obtained from the Government of Japan under the said Act, in order to export the product.
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## Main R&D and Manufacturing Facilities



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Shiga Plant (Power supplies)



SUWA SANSHA ELECTRIC CO., LTD.  
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Okayama Plant  
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[China]  
SANSHA ELECTRIC MFG.(GUANGDONG) CO., LTD.  
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Sansha Electric Manufacturing Co., Ltd.  
<https://www.sansha.co.jp/>



Headquarters / branches / sales offices

**Headquarters (International Sales Department)**  
TEL: +81-6-6325-6621 FAX: +81-6-6325-0503  
**Tokyo Branch**  
TEL: +81-3-3834-1700 FAX: +81-3-3834-1702

**Chubu Sales Office**  
TEL: +81-52-955-5600 FAX: +81-52-955-5650  
**Kyushu Sales Office**  
TEL: +81-92-431-7586 FAX: +81-92-474-9643  
**Hokuriku Office**  
TEL: +81-76-293-1725 FAX: +81-76-293-1881

Plants

**Shiga Plant**  
TEL: +81-77-583-8632 FAX: +81-77-583-5395  
**Okayama Plant**  
TEL: +81-868-36-3111 FAX: +81-868-36-3065

### Helsinki Branch (Finland)

Atomitie 5, Helsinki, 00370, Finland  
TEL: +358-40-1668580 E-mail: info@sanrex.fi

### Seoul Branch (Korea)

#706, 6, Samseong-ro 96-gil, Gangnam-gu  
Seoul 06168 Korea  
TEL: +82-2-552-2803 FAX: +82-2-552-8441

### Taipei Branch (Taiwan)

8F-3, No.46, Chung Shan N. Road, Sec. 2, Taipei,  
Taiwan, R.O.C.  
TEL: +886-2-2543-5689 FAX: +886-2-2536-7876

### SANSHA SOLUTION SERVICE CO., LTD. (Japan)

2-14-3, Awaji, Higashiyodogawa-ku, Osaka 533-0032, Japan  
TEL: +81-6-6321-0616 FAX: +81-6-6321-0618

Service branches: Osaka, Tokyo, Nagoya, Fukuoka

### SUWA SANSHA ELECTRIC CO., LTD. (Japan)

5335, Toyohira, Chino-shi, Nagano 391-0213, Japan  
TEL: +81-266-82-6600 FAX: +81-266-73-3322  
<https://www.suwa.sansha.co.jp/>

### OSAKA DENSO INDUSTRY CO.,LTD. (Japan)

3-1-47 Nishiwajji Higashiyodogawa-ku, Osaka-shi,  
Osaka-fu 533-0031, Japan  
TEL: +81-6-6322-4116 FAX: +81-6-6322-3785  
<https://osakadensho.jp/>

### SANREX CORPORATION (U.S.A.)

50 Seaview Boulevard Port Washington, NY 11050-4618, U.S.A.  
TEL: +1-516-625-1313 FAX: +1-516-625-8845  
<https://www.sanrex.com/>

### SANREX ASIA PACIFIC PTE. LTD. (Singapore)

Block 5000, Ang Mo Kio Ave 5, #05-08 TechPlace II, Singapore 569870  
TEL: +65-6457-8867 FAX: +65-6459-6425  
<https://www.sanrex.sg/>

### SANREX LIMITED (Hong Kong)

9A, Tin On Industrial Building, 777-779 Cheung Sha Wan Road,  
Kowloon, Hong Kong  
TEL: +852-2744-1310 FAX: +852-2785-6009

### SANSHA ELECTRIC MFG. (SHANGHAI) CO., LTD. (China)

Unit C, 13th Floor, Huaxin Haixin Building, No.666 Fuzhou Road,  
Huangpu District, Shanghai, 200001, P.R.China  
TEL: +86-21-5868-1058 FAX: +86-21-5868-1056

### SANSHA ELECTRIC MFG. (GUANGDONG) CO., LTD. (China)

Construction Road 16# South, Sanzhou Industry Zone, Longzhou Road,  
Lunjiao Town, Shunde District, Foshan City, Guangdong Province,  
528308 P.R.China  
TEL: +86-757-2733-3688 FAX: +86-757-2783-3547  
<http://www.sanrex.cn/>

### DONGGUAN EASTERN ELECTRONICS CO., LTD. (China)

No.31 Zhongkeng Road, Qingxi Township Donguan,  
Guandong Province, 523651 P.R.China  
TEL: +86-769-8733-8301 FAX: +86-769-8733-8306

If you have any questions,  
please contact the following or our branches or sales offices.