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# SPECIFICATION

Device Name : SILICON DIODE

Type Name : PH967C6

Spec.No. : MS5D1445

Fuji Electric Co.,Ltd.  
Matsumoto Factory

|         | DATE          | NAME             | APPROVED            | Fu ji Electric Co.,Ltd. |               |  |
|---------|---------------|------------------|---------------------|-------------------------|---------------|--|
| DRAWN   | Jan. -28- '02 | <i>K.Sakurai</i> | <i>H. Shiraishi</i> | DWG. NO.                | MS5D1445 1/12 |  |
| CHECKED | Jan. -28- '02 | <i>T. HOSER</i>  |                     |                         |               |  |
|         | Jan. -28- '02 | <i>m. Wabasa</i> |                     |                         |               |  |

## Revised Records

[illegible]

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## 1. SCOPE

This specification provides the ratings and the test requirement for FUJI SILICON DIODE PH967C6

## 2. Application

PFC circuit(current continuous mode)

This diode is a product which optimizes the diode characteristic for the PFC circuit. This product is a product by which the trr characteristic was valued more than VF though there is a relation of the trade-off up to VF and Trr. The total loss of the PFC circuit can be suppressed by shortening trr.

## 3. OUT VIEW, MARKING, MOLDING RESIN, CHARACTERISTICS

- (1) Out view is shown MS5D1445 9/12
- (2) Marking is shown MS5D1445 9/12  
It is marked to type name or abbreviated type name, polarity and Lot No.
- (3) Molding resin  
Epoxy resin UL:V-0
- (4) Characteristics is shown MS5D1445 10/12~12/12

## 4. RATINGS

### 4.1 MAXIMUM RATINGS

| ITEM                                | SYMBOL    | CONDITIONS                        | RATINGS    | UNITS |
|-------------------------------------|-----------|-----------------------------------|------------|-------|
| Repetitive peak reverse voltage     | $V_{RRM}$ |                                   | 600        | V     |
| Non-repetitive peak reverse voltage | $V_{RSM}$ |                                   | 600        | V     |
| Surge peak forward current          | $I_{ps}$  | tw 200ns                          | 40 *       | A     |
| Peak forward current                | $I_p$     |                                   | 30 *       | A     |
| Average output current              | $I_o$     | Square wave duty =1/2<br>Tc = 110 | 10 *       | A     |
| Non-repetitive surge current        | $I_{FSM}$ | Sine wave 10ms 1shot              | 40         | A     |
| Operating junction temperature      | $T_j$     |                                   | -40~ + 150 | °C    |
| Storage temperature                 | $T_{stg}$ |                                   | -40~ + 150 | °C    |

\* Out put current of centertap full wave connection.

### 4.2 ELECTRICAL CHARACTERISTICS (at Ta=25 unless otherwise specified.)

| ITEM                            | SYMBOL        | CONDITIONS                                    | MAXIMUM   | UNITS   |
|---------------------------------|---------------|-----------------------------------------------|-----------|---------|
| Reverse recovery peak current** | $I_{RP}$      | $I_F=5A, -di/dt=200A/\mu s, V_R=380V T_j=100$ | Typ. 2.0  | A       |
| Reverse recovery time **        | trr           | $I_F=0.1A, I_R=0.2, I_{rec}=0.05A$            | Max. 30.0 | ns      |
| Forward voltage **              | $V_F$         | $I_F = 15 A$                                  | Max. 5.0  | V       |
| Reverse current**               | $I_R$         | $V_R = V_{RRM}$                               | Max. 50.0 | $\mu A$ |
| Thermal resistance              | $R_{th(j-c)}$ | Junction to case                              | Max. 1.5  | °C/W    |

\*\*Rating per element

### 4.3 MECHANICAL CHARACTERISTICS

|                  |                    |           |     |
|------------------|--------------------|-----------|-----|
| Mounting torque  | Recommended torque | 0.4 ~ 0.6 | N·m |
| Approximate mass |                    | 4.9       | g   |

**Fuji Electric Co.,Ltd.**

DWG. NO.

MS5D1445 3/12

## 5.TEST

|                 | Test No. | Test Items                   | Testing methods and Conditions                                                                                                               | Reference Standard<br>EIAJ ED4701 | Sampling number | Acceptance number |
|-----------------|----------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|-------------------|
| Mechanical test | 1        | Terminal Strength (Tensile)  | Pull force<br>TO-220,TO-220F : 10N<br>TO-3P,TO-3PF,TO-247 : 25N<br>TO-3PL : 45N<br>T-Pack,K-Pack : 10N<br>Force maintaining duration :30±1s  | A-111A<br>method 1                | 5               | (0:1)             |
|                 | 2        | Terminal Strength (Bending)  | Load force<br>TO-220,TO-220F : 5N<br>TO-3P,TO-3PF,TO-247 : 10N<br>TO-3PL : 15N<br>T-Pack,K-Pack : 5N<br>Number of times :2times(90deg./time) | A-111A<br>method 3                | 5               |                   |
|                 | 3        | Mounting Strength            | Screwing torque value: (M3)<br>TO-220,TO-220F : 40±10N<br>TO-3P,TO-3PF,TO-247 : 50±10N<br>TO-3PL : 70±10N                                    | A-112<br>method 2                 | 5               |                   |
|                 | 4        | Vibration                    | frequency : 100Hz to 2kHz<br>Acceleration : 100m/s <sup>2</sup><br>Sweeping time : 4min./1 cycle<br>4times for each X,Y&Z directions.        | A-121                             | 5               |                   |
|                 | 5        | Shock                        | Peak amplitude: 15km/s <sup>2</sup><br>Duration time : 0.5ms<br>3times for each X,Y&Z directions.                                            | A-122<br>test code D              | 5               |                   |
|                 | 6        | Solderability                | Solder temp. : 235±5°C<br>Immersion time : 5±0.5s<br>Each terminal shall be immersed in the solder bath within 1 to 3.0mm from the body.     | A-131A<br>test code A             | 5               |                   |
|                 | 7        | Resistance to Soldering Heat | Solder temp. : 260±5°C<br>Immersion time : 10±1s<br>Number of times : 1times                                                                 | A-132                             | 5               |                   |

|                | Test No. | Test Items                    | Testing methods and Conditions                                                                                                                                    | Reference Standard<br>EIAJ ED4701 | Sampling number | Acceptance number |
|----------------|----------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|-------------------|
| Endurance test | 1        | High Temp. Storage            | Temperature : Tstg max<br>Test duration : 1000h                                                                                                                   | B-111A                            | 22              | (0:1)             |
|                | 2        | Low Temp. Storage             | Temperature : Tstg min<br>Test duration : 1000h                                                                                                                   | B-112A                            | 22              |                   |
|                | 3        | Temperature Humidity Storage  | Temperature : 85±2°C<br>Relative humidity : 85±5%<br>Test duration : 1000h                                                                                        | B-121A<br>test code C             | 22              |                   |
|                | 4        | Temperature Humidity Bias     | Temperature : 85±2°C<br>Relative humidity : 85±5%<br>Bias Voltage : $V_{RRM} \times 0.8$<br>Test duration : 1000h                                                 | B-122A<br>test code C             | 22              |                   |
|                | 5        | Unsaturated Pressurized Vapor | Temperature : 120±2°C<br>Relative humidity : 85±5%<br>Vapor pressure : 170kPa<br>Test duration : 96h                                                              | B-123A<br>test code B             | 22              |                   |
|                | 6        | Temperature Cycle             | High temp.side : Tstg max<br>Room temp. : 5 ~ 35<br>Low temp.side : Tstg min<br>Duration time : HT 30min, RT 5min LT 30min<br>Number of cycles : 100 cycles       | B-131A                            | 22              |                   |
|                | 7        | Thermal Shock                 | Fluid : pure water(running water)<br>High temp.side : 100+0/-5°C<br>Low temp.side : 0+5/-0°C<br>Duration time : HT 5min, LT 5min<br>Number of cycles : 100 cycles | B-141A<br>test code A             | 22              |                   |
|                | 8        | Steady state Operating life   | Ta=25±5°C<br>Rated load<br>Test duration : 1000h                                                                                                                  | D-402                             | 22              | (0:1)             |
|                | 9        | Intermittent Operating Life   | Tj=Tjmax ~ 50<br>3min ON, 3min OFF<br>Test duration : 10000cy                                                                                                     | D-403                             | 22              |                   |
|                | 10       | High Temp. Reverse Bias       | Temperature : Ta= 100 °C<br>Bias Voltage : $V_R=V_{RRM}$ duty=1/2<br>Test duration : 1000h                                                                        | D-404                             | 22              |                   |

|                  |                 |                               |
|------------------|-----------------|-------------------------------|
| Failure Criteria | $I_R$ USL x 5   | USL:Upper specification Limit |
|                  | $V_F$ USL x 1.1 |                               |

## 6.Cautions

- Although Fuji Electric is continually improving product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your are requested to take adequate safety measures to prevent the equipment from causing physical injury, fire, or other problem in case any of the products fail. It is recommended to make your design fail-safe, flame retardant, and free of malfunction.
- The products described in this Specification are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
  - Computers    · OA equipment    · Communications equipment(Terminal devices)
  - Measurement equipment    · Machine tools    · AV equipment
  - Electrical home appliances    · Personal equipment    · Industrial robots
  - etc.
- The products described in this Specification are not designed or manufactured to be used in equipment or systems used under life-threatening situations. If you are considering using these products in the equipment listed below, first check the system construction and required reliability.
  - Transportation equipment(automobiles, trains, ships, etc.)
  - Backbone network equipment    · Traffic-signal control equipment
  - Gas alarms, leakage gas auto breakers    · Submarine repeater equipment
  - Burglar alarms, fire alarms, emergency equipment    · Medical equipment
  - Nuclear control equipment
  - etc.

Do not use the products in this Specification for equipment requiring strict reliability such as (but not limited to):

- Aerospace equipment    · Aeronautical equipment

## 7.Warnings

- The Diodes should be used in products within their absolute maximum rating (voltage, current, temperature, etc.). The Diodes may be destroyed if used beyond the rating.
- The equipment containing Diodes should have adequate fuses or protection to prevent the equipment from causing secondary destruction.
- Use the Diodes within their reliability and lifetime under certain environments or conditions. The Diodes may fail before the target lifetime of your products if used under certain reliability conditions.
- You must design the Diodes to be operated within the specified maximum ratings (voltage, current, temperature, etc.) to prevent possible failure or destruction of devices.
- Consider the possible temperature rise not only for the junction and case, but also for the leads.
- Do not directly touch the leads or package of the Diodes while power is supplied or during operation, to avoid electric shock and burns.

- The Diodes are made of incombustible material. However, if a Diode fails, it may emit smoke or flame. Also, operating the Diodes near any flammable place or material may cause the Diodes to emit smoke or flame in case the Diodes become even hotter during operation. Design the arrangement to prevent the spread of fire.
- The Diodes should not be used in an environment in the presence of acid, organic matter, or corrosive gas (hydrogen sulfide, sulfurous acid gas.)
- The Diodes should not be used in an irradiated field since they are not radiation-proof.

#### Installation

- Soldering involves temperatures which exceed the device storage temperature rating. To avoid device damage and to ensure reliability, observe the following guidelines from the quality assurance standard.
- Solder temperature and duration (through-hole package)

| Solder temperature | Duration         |
|--------------------|------------------|
| 260 ± 5            | 10 ± 1 second    |
| 350 ± 10           | 3.0 ± 0.5 second |

- The immersion depth of the lead should basically be up to the lead stopper and the distance should be a maximum of 1.5mm from the device.
- When flow-soldering, take care to avoid immersing the package in the solder bath.
- Refer to the following torque reference When mounting the device on a heat sink. Excess torque applied to the mounting screw causes damage to the device and weak torque will increase the thermal resistance, both of which conditions may destroy the device.

Table 1: Recommended tightening torque

| Package style             | Screw | Recommended tightening torque |
|---------------------------|-------|-------------------------------|
| TO-220<br>TO-220F         | M3    | 30-50Ncm                      |
| TO-3P<br>TO-3PF<br>TO-247 | M3    | 40-60Ncm                      |
| TO-3PL                    | M3    | 60-80Ncm                      |

- The heat sink should have a flatness within  $\pm 50 \mu m$  and roughness within  $10 \mu m$ . Also, keep the tightening torque within the limits of this specification.
- Improper handling may cause isolation breakdown leading to a critical accident.
- We recommend the use of thermal compound to optimize the efficiency of heat radiation. It is important to evenly apply the compound and to eliminate any air voids.

#### Storage

- The Diodes must be stored at a standard temperature of 5 to 35 °C and relative humidity of 45 to 75%. If the storage area is very dry, a humidifier may be required. In such a case, use only deionized water or boiled water, since the chlorine in tap water may corrode the leads.
- The Diodes should not be subjected to rapid changes in temperature to avoid condensation on the surface of the Diodes. Therefore, store the Diodes in a place where the temperature is steady.
- The Diodes should not be stored on top of each other, since this may cause excessive external force on the case.
- The Diodes should not be stored with the lead terminals remaining unprocessed. Rust may cause presoldered connections to go fail during later processing.
- The Diodes should be stored in antistatic containers or shipping bags.

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8. Appendix

- These products do not contain PBDs or PBBs.
- These products, assemblies, or components do not contain any of the above-mentioned substances.

Prohibited substances:

CFCs, halon, carbon tetrachloride, 1,1,1-trichloroethane (methyl chloroform)

These products, assemblies, or components are not manufactured using any of the above-mentioned substances.

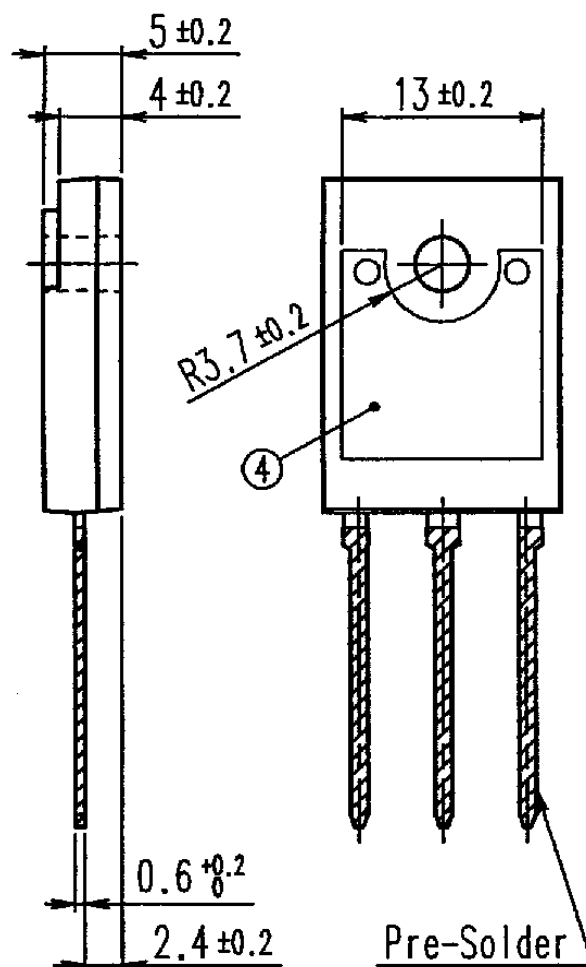
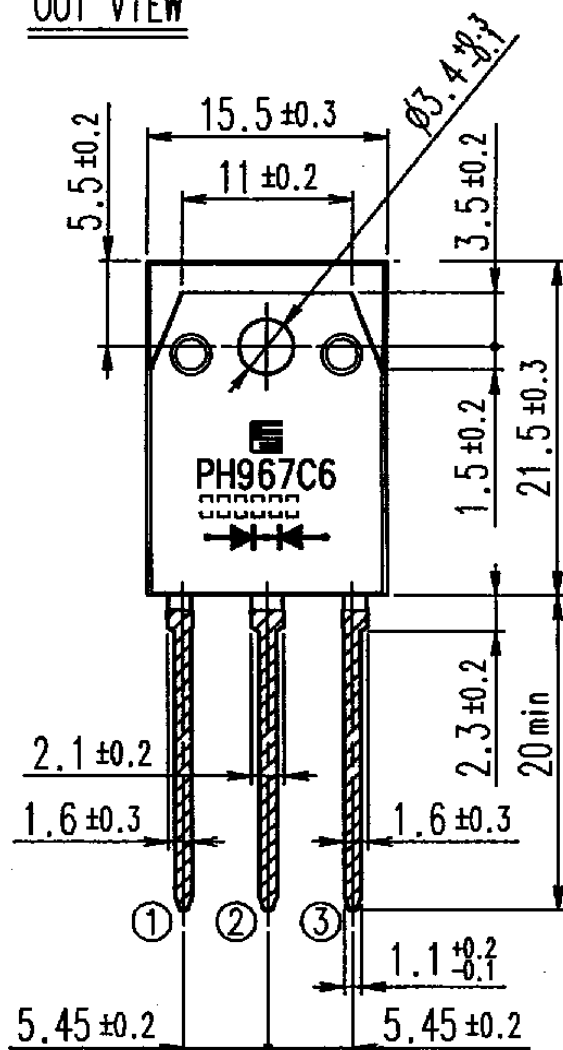
Prohibited substances:

CFCs, halon, carbon tetrachloride, 1,1,1-trichloroethane (methyl chloroform)

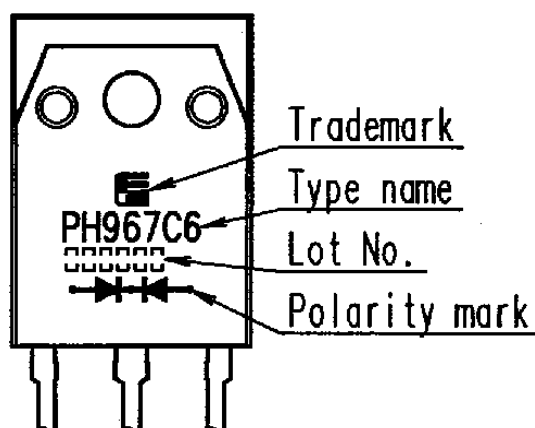
- If you have any questions about any part of this Specification, please contact Fuji Electric or its sales agent before using the product
  - Neither Fuji nor its agents shall be held liable for any injury caused by using the products not in accordance with the instructions.
  - The application examples described in this specification are merely typical uses of Fuji Electric products.
- This specification does not confer any industrial property rights or other rights, nor constitute a license for such rights.

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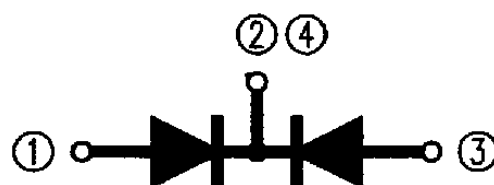
## OUT VIEW



## MARKING

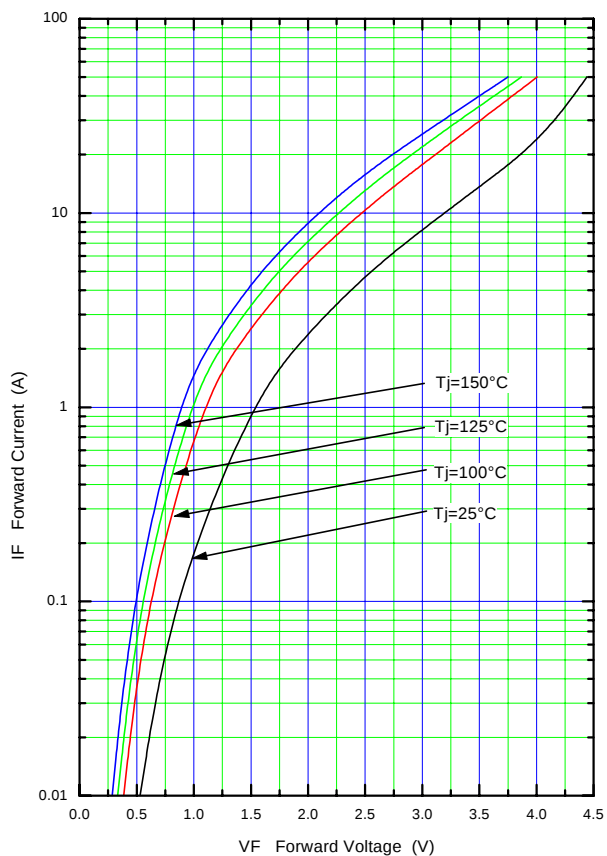


## CONNECTION

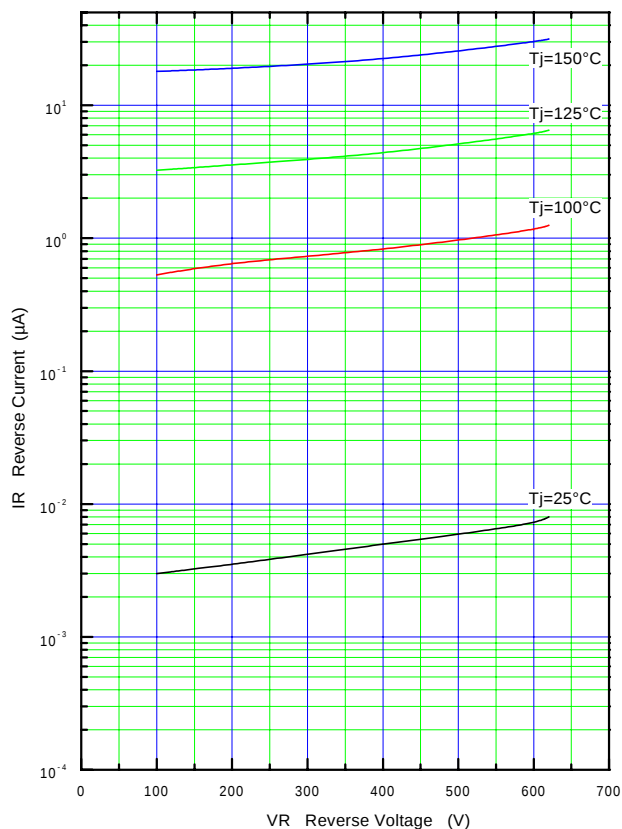


DIMENSIONS ARE IN MILLIMETERS.

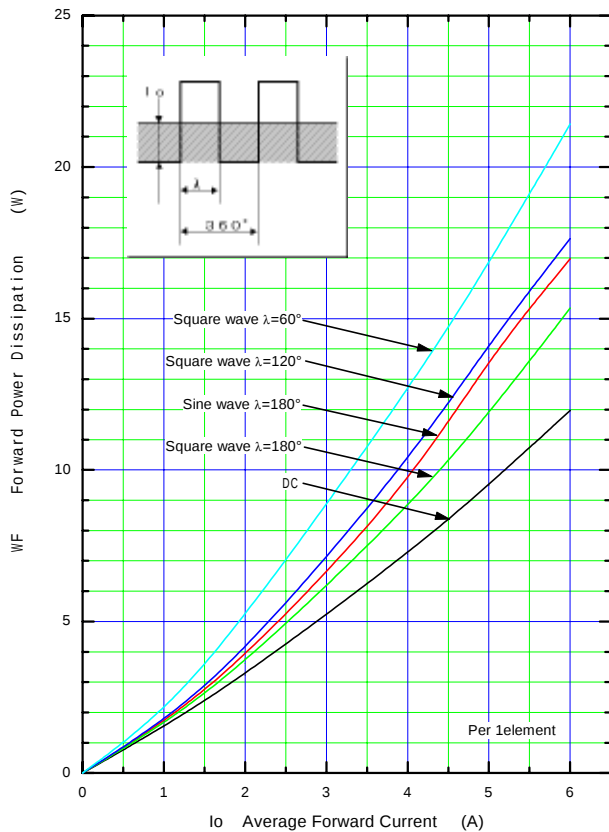
Forward Characteristic (typ.)



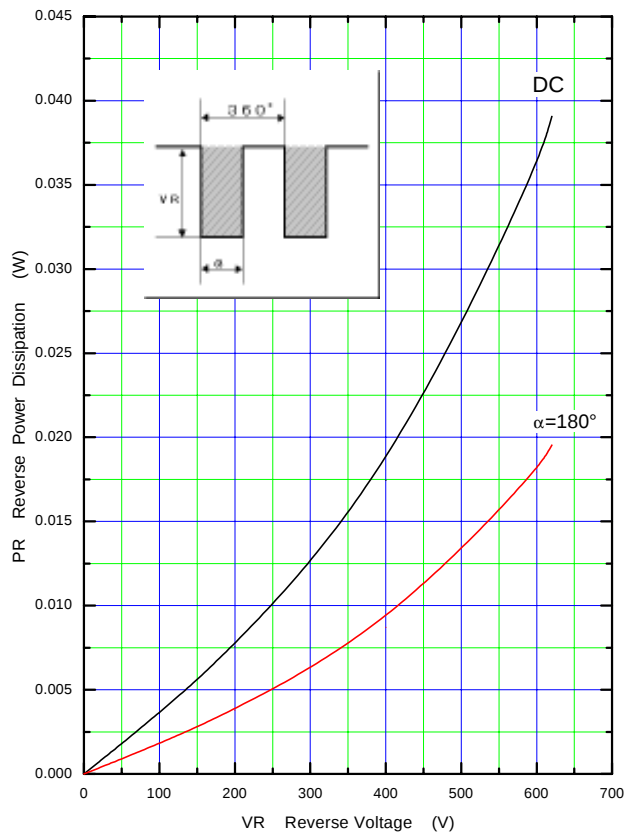
Reverse Characteristic (typ.)



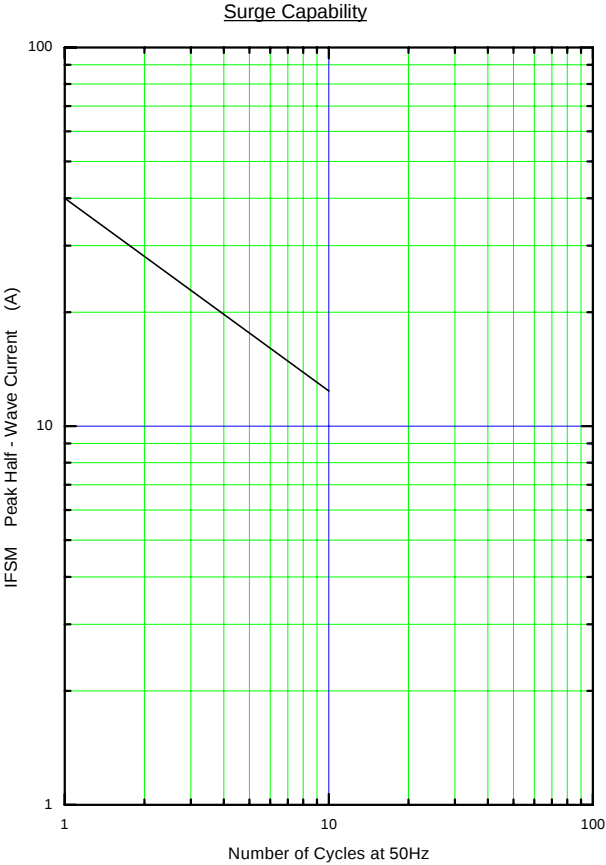
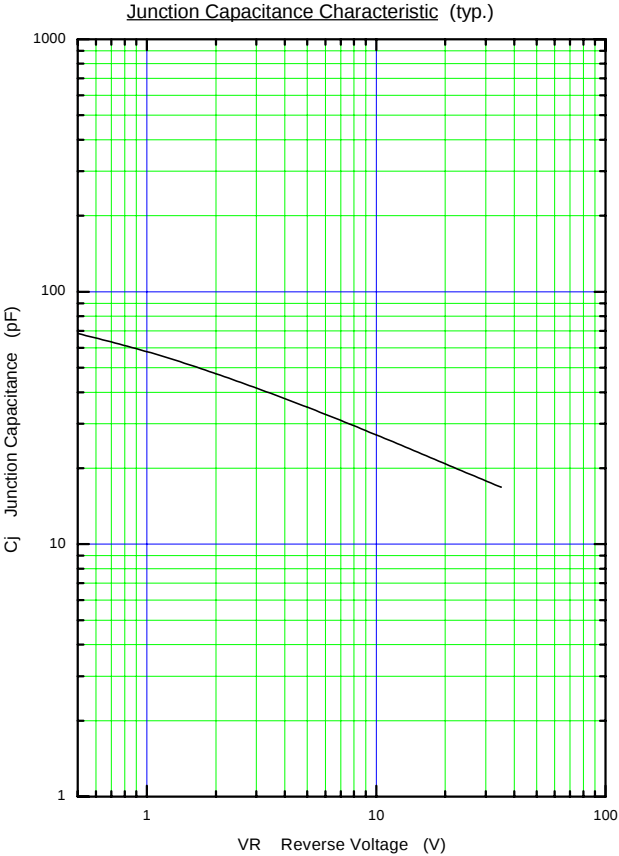
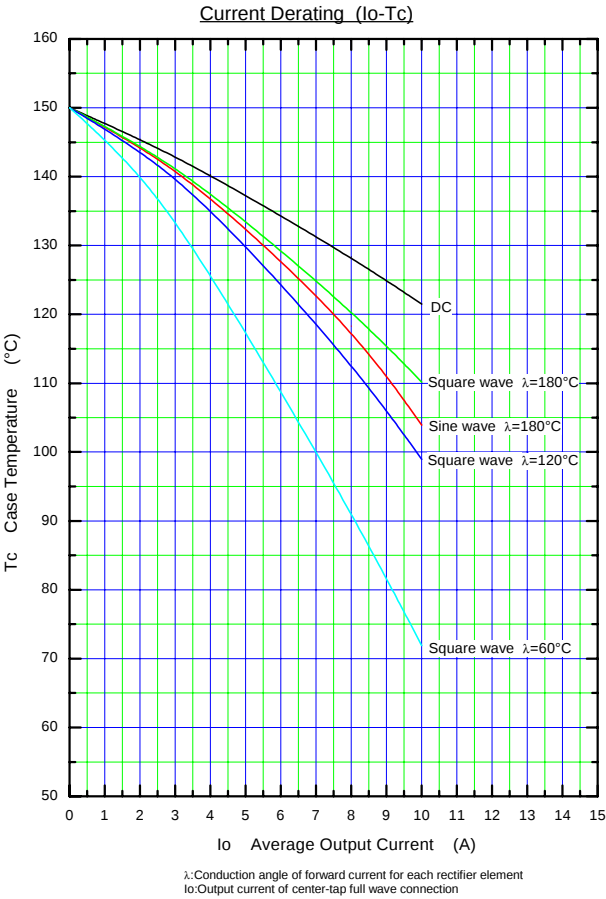
Forward Power Dissipation



Reverse Power Dissipation



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