100 V, 18 A, 34.7 mΩ Low RDS(ON)
N ch Trench Power MOSFET

FKI10531

Features

- $V_{(BR)DSS}$ --------------------------------100 V (I_D = 100 µA)
- I_D --18 A
- $R_{DS(ON)}$ -------- 54.5 mΩ max. (V_{GS} = 10 V, I_D = 11.9 A)
- Q_g------- 9.0 nC (V_{GS} = 4.5 V, V_{DS} = 50 V, I_D = 11.9 A)

- Low Total Gate Charge
- High Speed Switching
- Low On-Resistance
- Capable of 4.5 V Gate Drive
- 100 % UIL Tested
- RoHS Compliant

Package

TO-220F

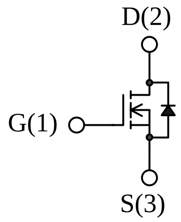
(1) (2) (3)
G D S

Not to scale

Applications

- DC-DC converters
- Synchronous Rectification
- Power Supplies

Equivalent circuit



Absolute Maximum Ratings

- Unless otherwise specified, T_A = 25 °C

Parameter	Symbol	Test conditions	Rating	Unit
Drain to Source Voltage	V_{DS}		100	V
Gate to Source Voltage	V_{GS}		± 20	V
Continuous Drain Current	I_D	T_C = 25 °C	18	A
Pulsed Drain Current	I_{DM}	PW ≤ 100µs Duty cycle ≤ 1 %	35	A
Continuous Source Current (Body Diode)	I_S		18	A
Pulsed Source Current (Body Diode)	I_{SM}	PW ≤ 100µs Duty cycle ≤ 1 %	35	A
Single Pulse Avalanche Energy	E_{AS}	V_{DD} = 50 V, L = 1 mH, I_{AS} = 6.8 A, unclamped, R_G = 4.7 Ω Refer to Figure 1	47	mJ
Avalanche Current	I_{AS}		13.3	A
Power Dissipation	P_D	T_C = 25 °C	32	W
Operating Junction Temperature	T_J		150	°C
Storage Temperature Range	T_{STG}		− 55 to 150	°C

Thermal Characteristics

- Unless otherwise specified, T_A = 25 °C

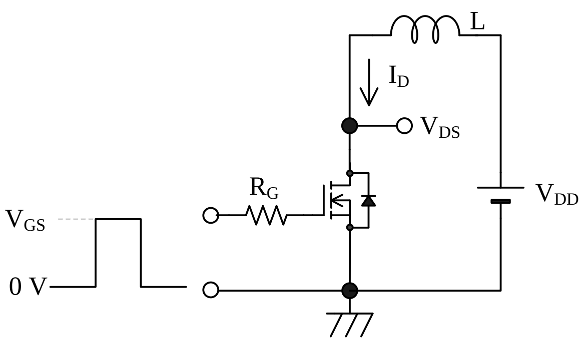
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Thermal Resistance (Junction to Case)	$R_{\theta JC}$		−	−	3.9	°C/W
Thermal Resistance (Junction to Ambient)	$R_{\theta JA}$		−	−	62.5	°C/W

Electrical Characteristics

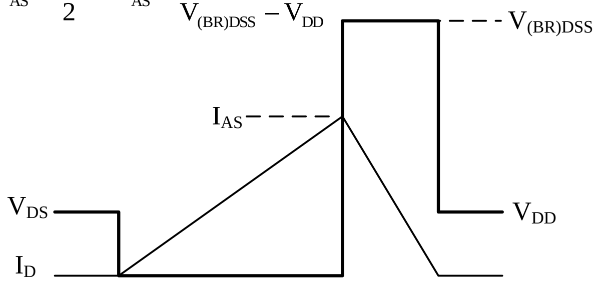
- Unless otherwise specified, T_A = 25 °C

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	I_D = 100 μA, V_{GS} = 0 V	100	−	−	V
Drain to Source Leakage Current	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V	−	−	100	μA
Gate to Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V	−	−	± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 350 μA	1.0	2.0	2.5	V
Static Drain to Source On-Resistance	$R_{DS(ON)}$	I_D = 11.9 A, V_{GS} = 10 V	−	34.7	54.5	mΩ
		I_D = 6.0 A, V_{GS} = 4.5 V	−	36.5	56.5	mΩ
Gate Resistance	R_G	f = 1 MHz	−	2.3	−	Ω
Input Capacitance	C_{iss}	V_{DS} = 25 V V_{GS} = 0 V f = 1 MHz	−	1530	−	pF
Output Capacitance	C_{oss}		−	125	−	
Reverse Transfer Capacitance	C_{rss}		−	51	−	
Total Gate Charge (V_{GS} = 10 V)	Q_{g1}	V_{DS} = 50 V I_D = 11.9 A	−	19.9	−	nC
Total Gate Charge (V_{GS} = 4.5 V)	Q_{g2}		−	9.0	−	
Gate to Source Charge	Q_{gs}		−	3.6	−	
Gate to Drain Charge	Q_{gd}		−	2.6	−	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 50 V I_D = 11.9 A V_{GS} = 10 V, R_G = 4.7 Ω Refer to Figure 2	−	3.0	−	ns
Rise Time	t_r		−	2.8	−	
Turn-Off Delay Time	$t_{d(off)}$		−	13.7	−	
Fall Time	t_f		−	6.0	−	
Source to Drain Diode Forward Voltage	V_{SD}	I_S = 11.9 A, V_{GS} = 0 V	−	0.9	1.5	V
Source to Drain Diode Reverse Recovery Time	t_{rr}	I_F = 11.9 A di/dt = 100 A/μs Refer to Figure 3	−	40.7	−	ns
Source to Drain Diode Reverse Recovery Charge	Q_{rr}		−	68.2	−	nC

Test Circuits and Waveforms



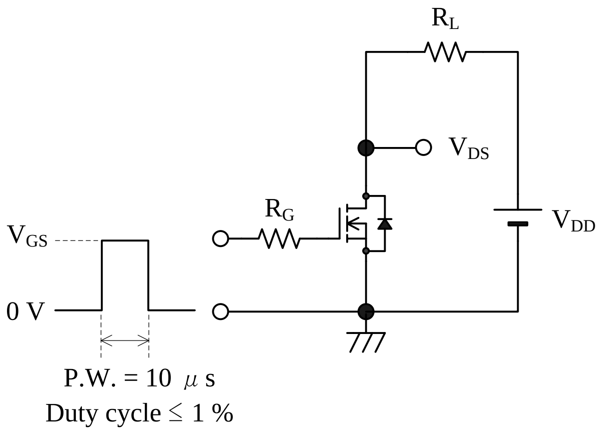
$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}{}^2 \cdot \frac{V_{(BR)DSS}}{V_{(BR)DSS} - V_{DD}}$$

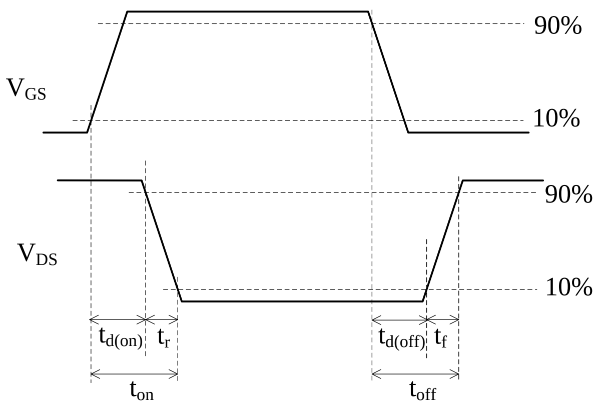


(a) Test Circuit

(b) Waveform

Figure 1 Unclamped Inductive Switching

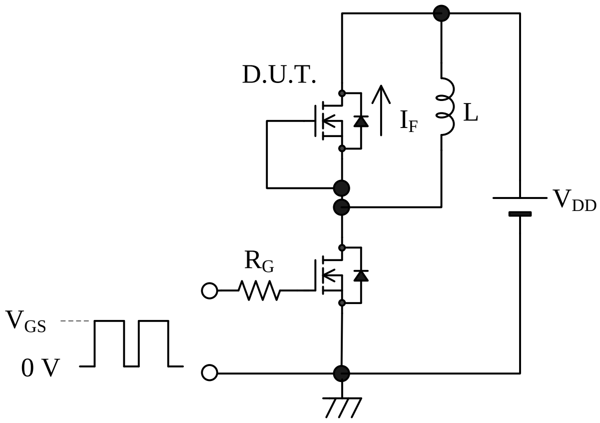


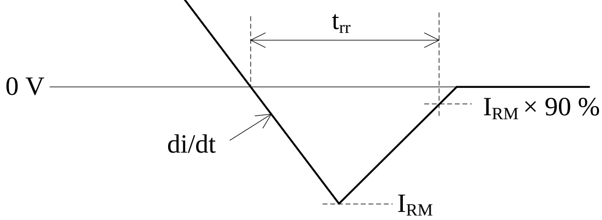


(a) Test Circuit

(b) Waveform

Figure 2 Switching Time



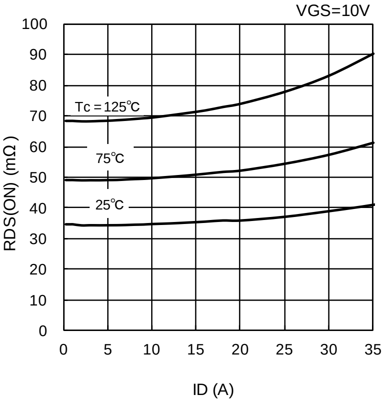


(a) Test Circuit

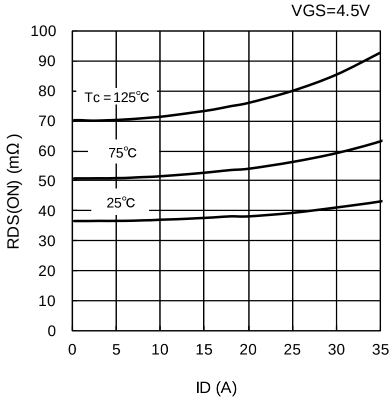
(b) Waveform

Figure 3 Diode Reverse Recovery Time

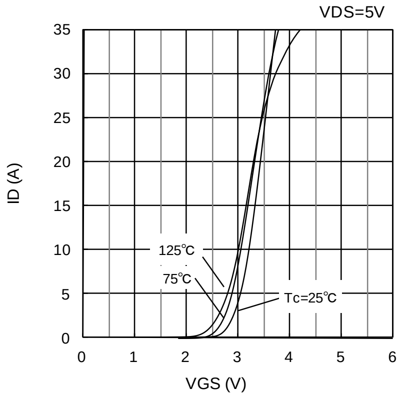
RDS(ON)-ID characteristics (typical)



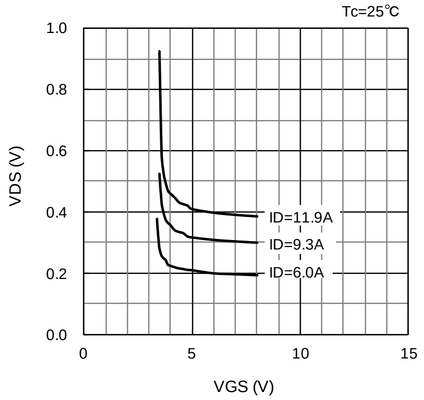
RDS(ON)-ID characteristics (typical)



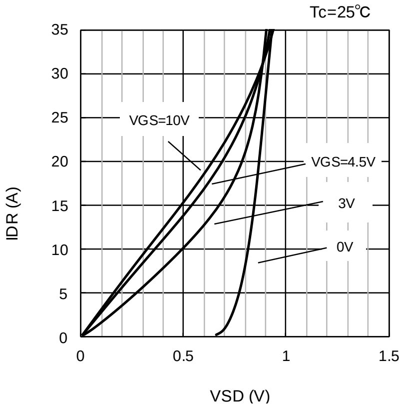
ID-VGS characteristics (typical)



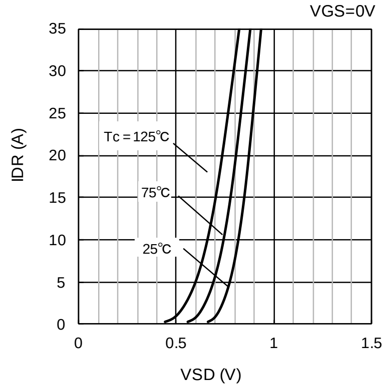
VDS-VGS characteristics (typical)



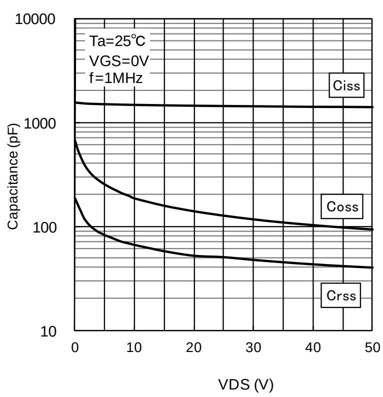
IDR-VSD characteristics (typical)



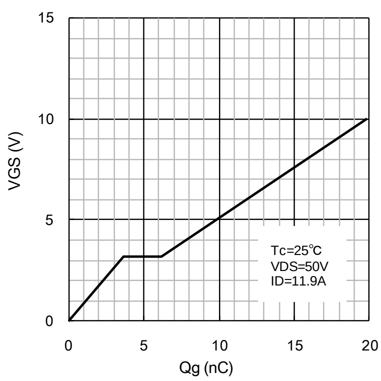
IDR-VSD characteristics (typical)



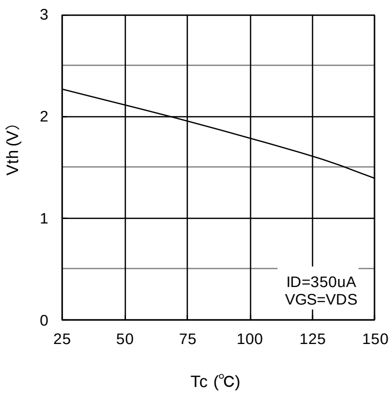
Capacitance-VDS characteristics (typical)



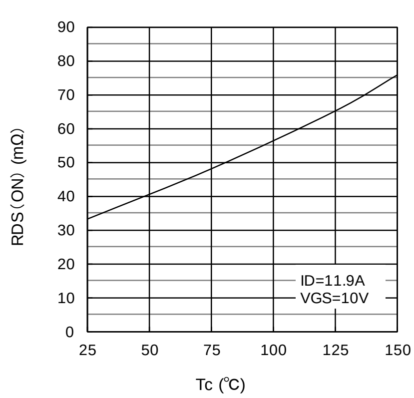
VGS - Qg characteristics (typical)



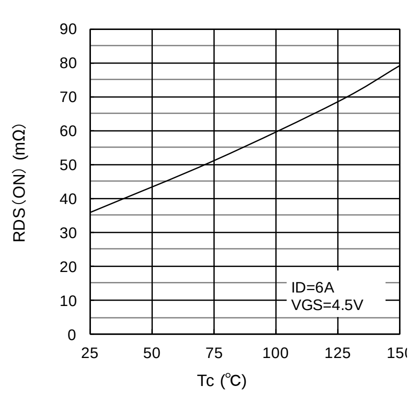
Vth-Tc characteristics (typical)



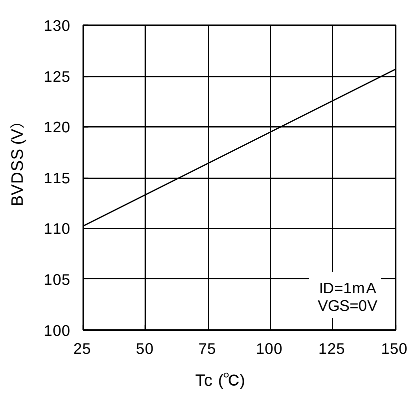
RDS(ON)-Tc characteristics (typical)



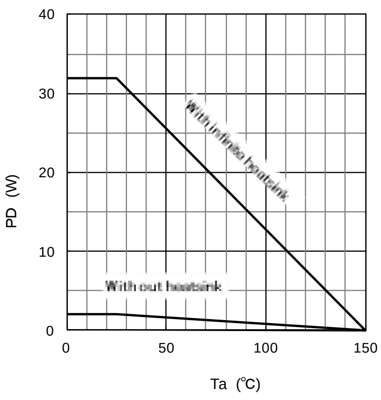
RDS(ON)-Tc characteristics (typical)



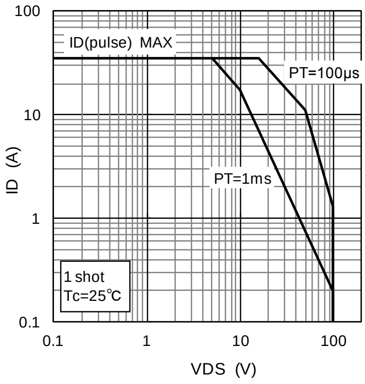
BVDSS-Tc characteristics (typical)



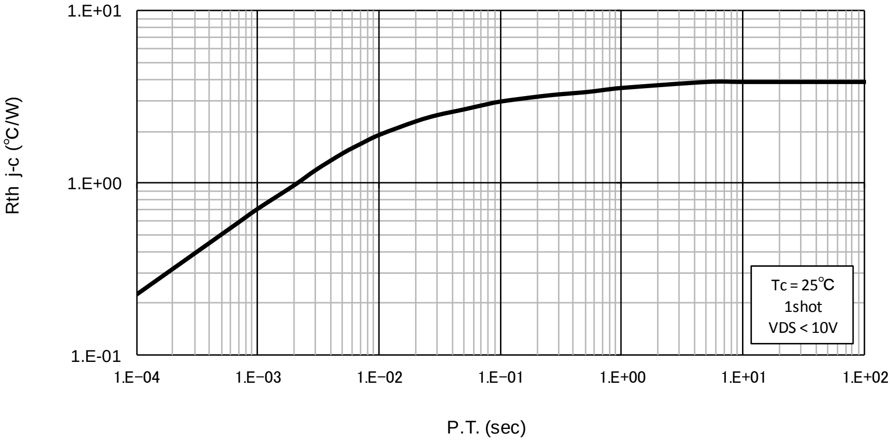
PD-Ta Derating



SAFE OPERATING AREA

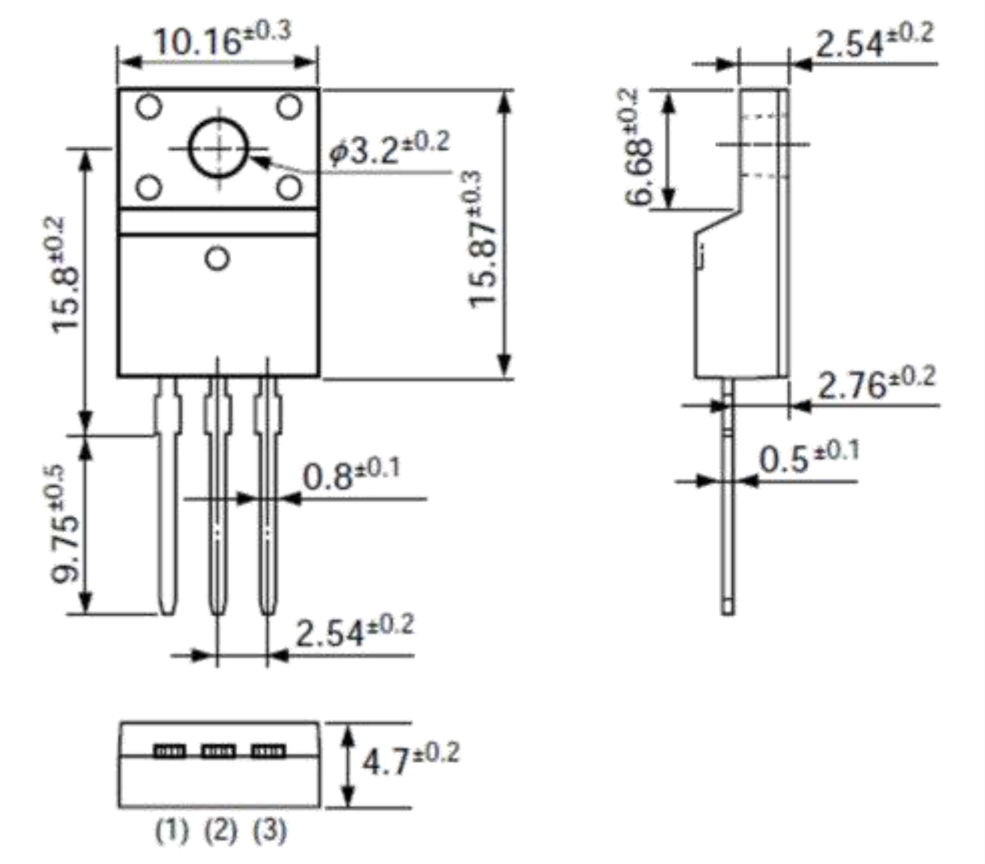


TRANSIENT THERMAL RESISTANCE - PULSE WIDTH



Package Outline

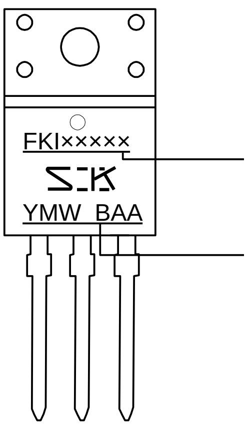
TO-220F



NOTES:

1) Dimension is in millimeters
2) Pb-free. Device composition compliant with the RoHS directive

Marking Diagram



Part Number

Lot Number

Y is the Last digit of the year (0 to 9)

M is the Month (1 to 9, O, N or D)

W is the Week (1st to 5th week of every month)

B expresses Pb free pins

A is the suffix No.

OPERATING PRECAUTIONS

In the case that you use Sanken products or design your products by using Sanken products, the reliability largely depends on the degree of derating to be made to the rated values. Derating may be interpreted as a case that an operation range is set by derating the load from each rated value or surge voltage or noise is considered for derating in order to assure or improve the reliability. In general, derating factors include electric stresses such as electric voltage, electric current, electric power etc., environmental stresses such as ambient temperature, humidity etc. and thermal stress caused due to self-heating of semiconductor products. For these stresses, instantaneous values, maximum values and minimum values must be taken into consideration. In addition, it should be noted that since power devices or IC's including power devices have large self-heating value, the degree of derating of junction temperature affects the reliability significantly.

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

Cautions for Storage

- Ensure that storage conditions comply with the standard temperature (5 to 35°C) and the standard relative humidity (around 40 to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of the products that have been stored for a long time.

Cautions for Testing and Handling

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between the product pins, and wrong connections. Ensure all test parameters are within the ratings specified by Sanken for the products.

Remarks About Using Thermal Silicone Grease

- When thermal silicone grease is used, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce excess stress.
- The thermal silicone grease that has been stored for a long period of time may cause cracks of the greases, and it cause low radiation performance. In addition, the old grease may cause cracks in the resin mold when screwing the products to a heatsink.
- Fully consider preventing foreign materials from entering into the thermal silicone grease. When foreign material is immixed, radiation performance may be degraded or an insulation failure may occur due to a damaged insulating plate.
- The thermal silicone greases that are recommended for the resin molded semiconductor should be used. Our recommended thermal silicone grease is the following, and equivalent of these.

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	Momentive Performance Materials Japan LLC
SC102	Dow Corning Toray Co., Ltd.

Cautions for Mounting to a Heatsink

- When the flatness around the screw hole is insufficient, such as when mounting the products to a heatsink that has an extruded (burred) screw hole, the products can be damaged, even with a lower than recommended screw torque. For mounting the products, the mounting surface flatness should be 0.05mm or less.
- Please select suitable screws for the product shape. Do not use a flat-head machine screw because of the stress to the products. Self-tapping screws are not recommended. When using self-tapping screws, the screw may enter the hole diagonally, not vertically, depending on the conditions of hole before threading or the work situation. That may stress the products and may cause failures.
- Recommended screw torque:

Package	Recommended Screw Torque
TO-220, TO-220F	0.490 to 0.686 N・m (5 to 7 kgf・cm)
TO-3P, TO-3PF, TO-247	0.686 to 0.882 N・m (7 to 9 kgf・cm)
SLA	0.588 to 0.784 N・m (6 to 8 kgf・cm)

- For tightening screws, if a tightening tool (such as a driver) hits the products, the package may crack, and internal stress fractures may occur, which shorten the lifetime of the electrical elements and can cause catastrophic failure. Tightening with an air driver makes a substantial impact. In addition, a screw torque higher than the set torque can be applied and the package may be damaged. Therefore, an electric driver is recommended.
  When the package is tightened at two or more places, first pre-tighten with a lower torque at all places, then tighten with the specified torque. When using a power driver, torque control is mandatory.

- Please pay special attention about the slack of the press mold. In case that the hole diameter of the heatsink is less than 4 mm, it may cause the resin crack at tightening.

Soldering

- When soldering the products, please be sure to minimize the working time, within the following limits:
  - 260 ± 5 °C　10 ± 1 s (Flow, 2 times)
  - 380 ± 10 °C　3.5 ± 0.5 s (Soldering iron, 1 time)
- Soldering should be at a distance of at least 1.5 mm from the body of the products.

Electrostatic Discharge

- When handling the products, the operator must be grounded. Grounded wrist straps worn should have at least 1MΩ of resistance from the operator to ground to prevent shock hazard, and it should be placed near the operator.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in order to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in Sanken shipping containers or conductive containers, or be wrapped in aluminum foil.

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