$V_{CE}$ = 600 V, $I_C$ = 37 A
Trench IGBT with Fast Recovery Diode

# MGD623N

Data Sheet

## Description

The MGD623N is 600 V trench IGBT. Sanken original trench structure decreases gate capacitance, and achieves high speed switching and switching loss reduction. Thus, the IGBT can improve the efficiency of your circuit.

## Features

- Low Saturation Voltage
- High Speed Switching
- With Integrated Low $V_F$ Fast Recovery Diode
- Bare Lead Frame: Pb-free (RoHS Compliant)

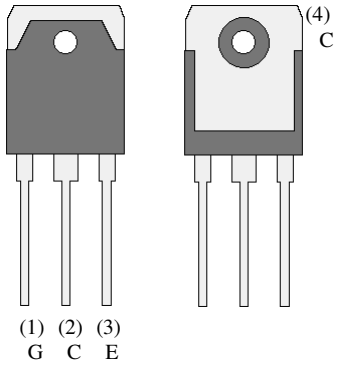
- $V_{CE}$ ---------- 600 V
- $I_C$ ($T_C$ = 100 °C) ---------- 37 A
- $V_{CE(sat)}$ ---------- 1.7 V typ.
- $t_f$ ($T_J$ = 25 °C) ---------- 200 ns typ.
- $V_F$ ---------- 1.2 V typ.

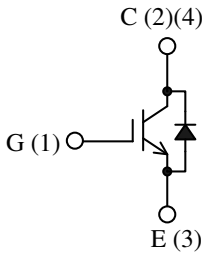
## Applications

- Microwave Oven
- IH Cooker
- Inverter Circuit

## Package

TO3P-3L




Not to scale

## Absolute Maximum Ratings

Unless otherwise specified, $T_A$ = 25 °C.

| Parameter | Symbol | Conditions | Rating | Unit | Remarks |
|---|---|---|---|---|---|
| Collector to Emitter Voltage | $V_{CE}$ | | 600 | V | |
| Gate to Emitter Voltage | $V_{GE}$ | | ±30 | V | |
| Continuous Collector Current | $I_C$ | $T_C$ = 25 °C | 50 | A | |
| | | $T_C$ = 100 °C | 37 | A | |
| Pulsed Collector Current | $I_{C(PULSE)}$ | $P_W \leq 1$ ms, duty cycle ≤ 1% | 100 | A | |
| Diode Continuous Forward Current | $I_F$ | $T_C$ = 25 °C | 30 | A | |
| Diode Pulsed Forward Current | $I_{F(PULSE)}$ | $P_W \leq 1$ ms, duty cycle ≤ 1% | 60 | A | |
| Maximum Collector to Emitter dv/dt | dv/dt | $T_C \leq 125$ °C, see Figure 1 | 5 | V/ns | |
| Power Dissipation | $P_D$ | $T_C$ = 25 °C | 150 | W | |
| Operating Junction Temperature | $T_J$ | | 150 | °C | |
| Storage Temperature | $T_{STG}$ | | −55 to 150 | °C | |

## Thermal Characteristics

Unless otherwise specified, $T_A$ = 25 °C.

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Thermal Resistance of IGBT (Junction to Case) | $R_{\theta JC(IGBT)}$ | | — | — | 0.833 | °C/W | |
| Thermal Resistance of Diode (Junction to Case) | $R_{\theta JC(Di)}$ | | — | — | 1.67 | °C/W | |

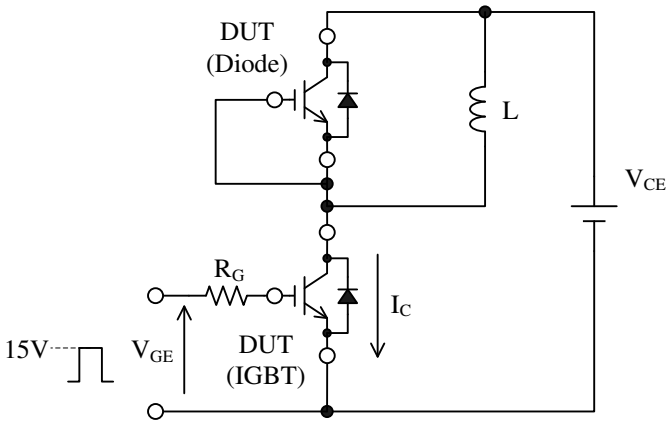
## Electrical Characteristics

Unless otherwise specified, $T_A$ = 25 °C.

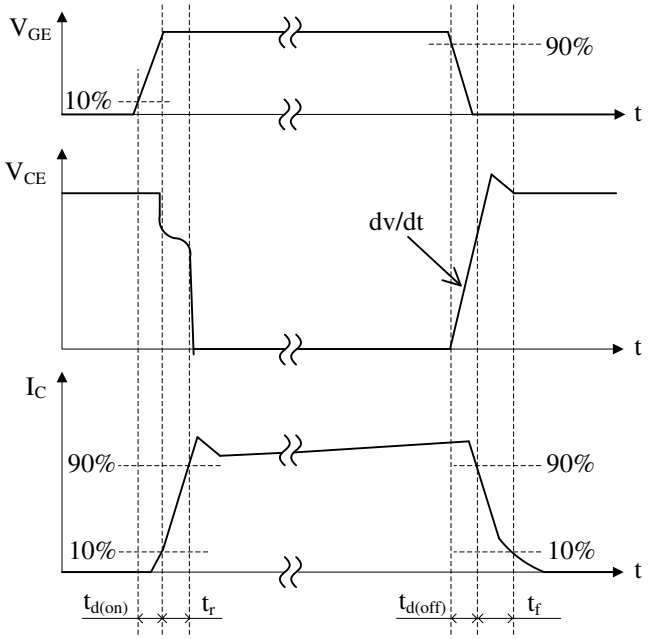
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Collector to Emitter Breakdown Voltage | $V_{(BR)CES}$ | $I_C$ = 100 µA, $V_{GE}$ = 0 V | 600 | — | — | V |
| Collector to Emitter Leakage Current | $I_{CES}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 0 V | — | — | 100 | µA |
| Gate to Emitter Leakage Current | $I_{GES}$ | $V_{GE}$ = ±30 V | — | — | ±500 | nA |
| Gate Threshold Voltage | $V_{GE(TH)}$ | $V_{CE}$ = 10 V, $I_C$ = 1 mA | 3 | 4.5 | 6 | V |
| Collector to Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15 V, $I_C$ = 50 A | — | 1.7 | 2.3 | V |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 20 V, $V_{GE}$ = 0 V, f = 1.0 MHz | — | 2500 | — | pF |
| Output Capacitance | $C_{oes}$ | | — | 150 | — | |
| Reverse Transfer Capacitance | $C_{res}$ | | — | 80 | — | |
| Total Gate Charge | $Q_G$ | $V_{CE}$ = 300 V, $I_C$ = 50 A, $V_{GE}$ = 15 V | — | 65 | — | nC |
| Gate to Emitter Charge | $Q_{GE}$ | | — | 20 | — | |
| Gate to Collector Charge | $Q_{GC}$ | | — | 20 | — | |
| Turn-on Delay Time | $t_{d(on)}$ | $T_J$ = 25 °C, see Figure 1 | — | 75 | — | ns |
| Rise Time | $t_r$ | | — | 100 | — | |
| Turn-off Delay Time | $t_{d(off)}$ | | — | 300 | — | |
| Fall Time | $t_f$ | | — | 200 | — | |
| Turn-on Delay Time | $t_{d(on)}$ | $T_J$ = 125 °C, see Figure 1 | — | 75 | — | ns |
| Rise Time | $t_r$ | | — | 100 | — | |
| Turn-off Delay Time | $t_{d(off)}$ | | — | 300 | — | |
| Fall Time | $t_f$ | | — | 350 | — | |
| Emitter to Collector Diode Forward Voltage | $V_F$ | $I_F$ = 30 A | — | 1.2 | 1.6 | V |
| Emitter to Collector Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 30 A, di/dt = 100 A/µs | — | 300 | — | ns |

## Test Circuits and Waveforms

Conditions:
$V_{CE}$ = 300 V
$I_C$ = 50 A
$V_{GE}$ = 15 V
$R_G$ = 39 Ω
L = 100 μH




(a) Test Circuit




(b) Waveform

Figure 1. Test Circuits and Waveforms of dv/dt and Switching Time

## Rating and Characteristic Curves

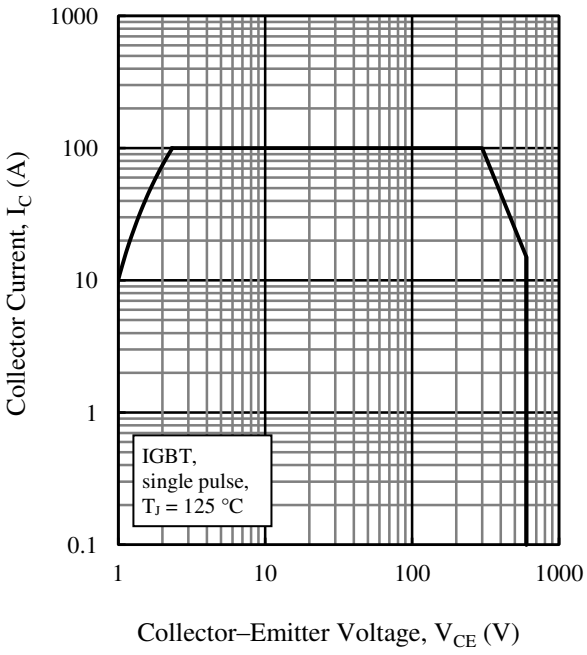



Figure 2. IGBT Reverse Bias Safe Operating Area

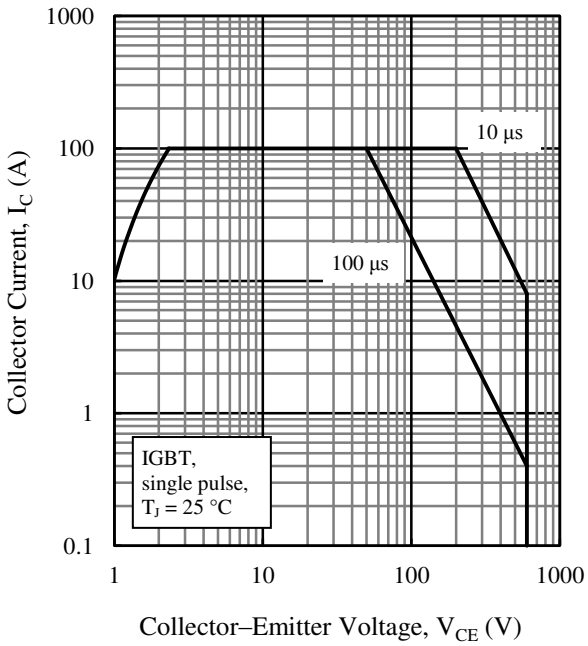



Figure 3. IGBT Safe Operating Area

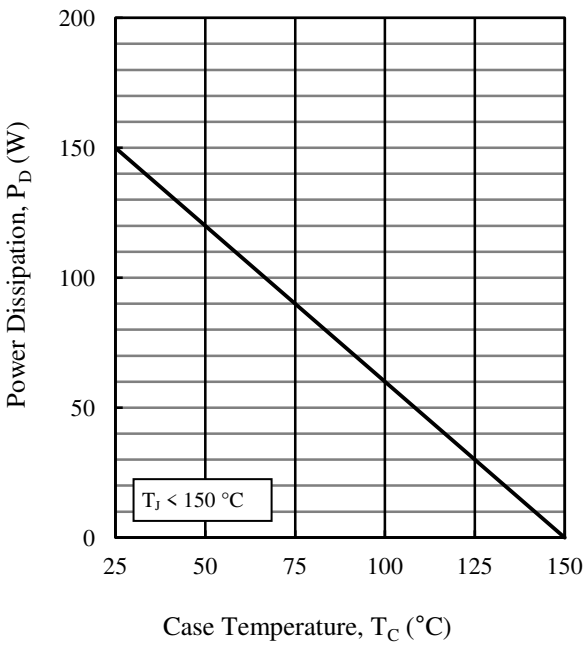



Figure 4. Power Dissipation vs. Case Temperature

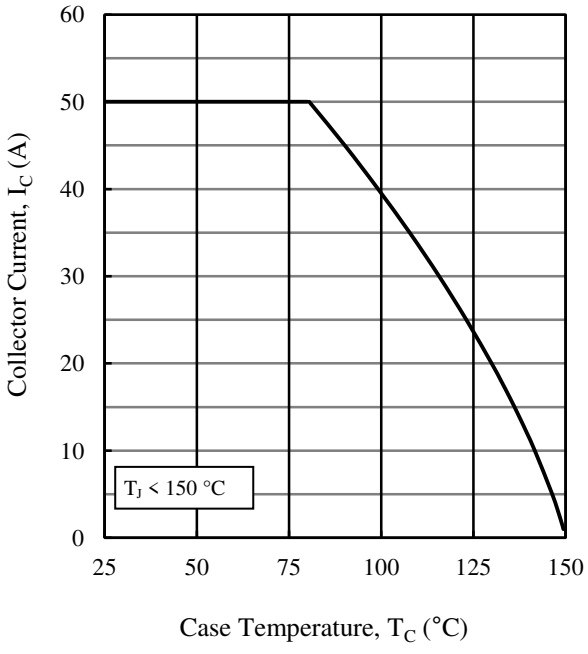



Figure 5. Collector Current vs. Case Temperature

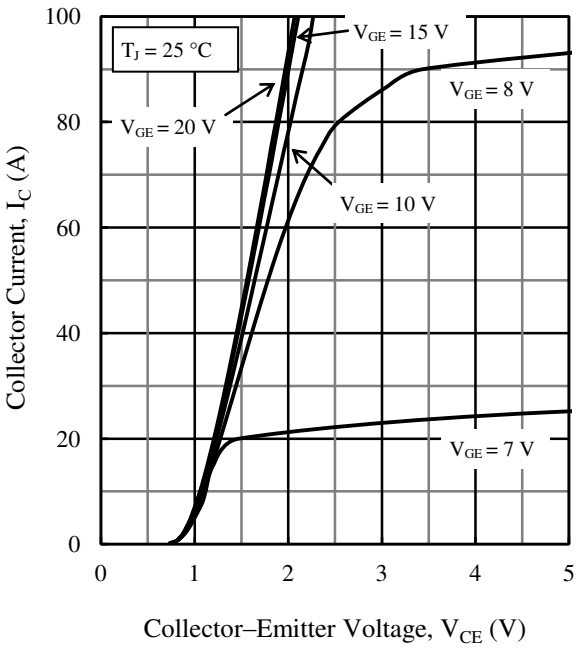



Figure 6. Output Characteristics ($T_J$ = 25 °C)

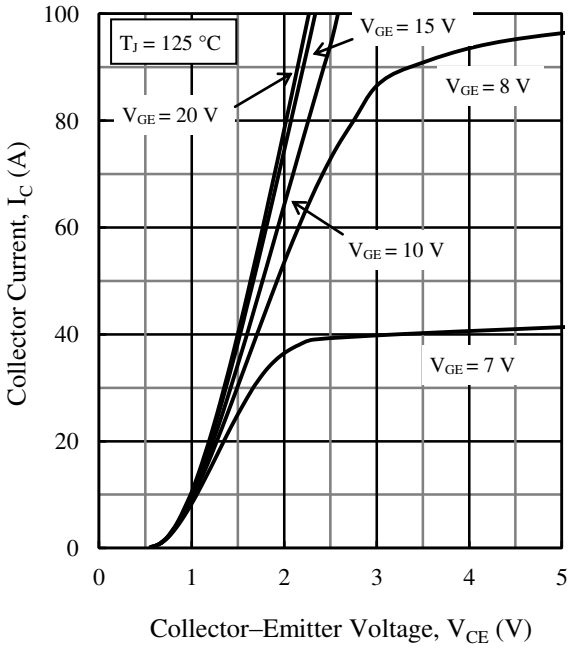



Figure 7. Output Characteristics ($T_J$ = 125 °C)

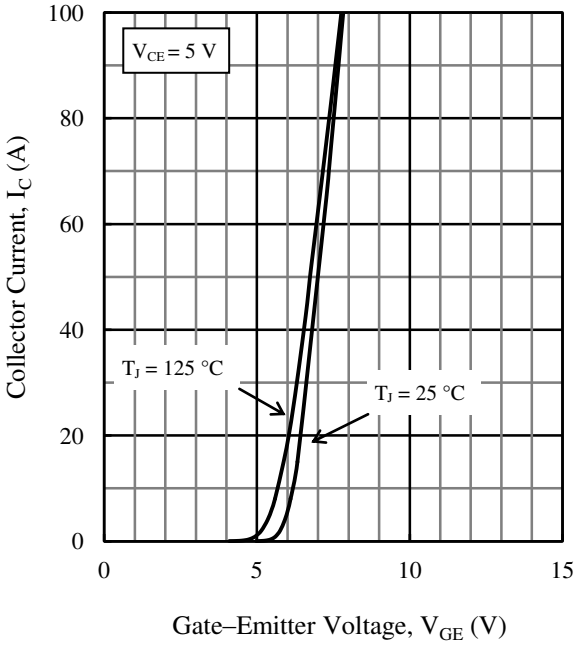



Figure 8. Transfer Characteristics

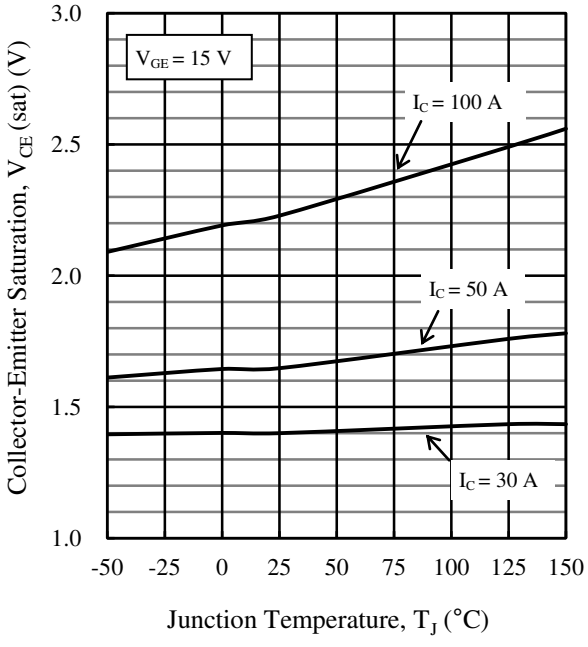



Figure 9. Saturation Voltage vs. Junction Temperature

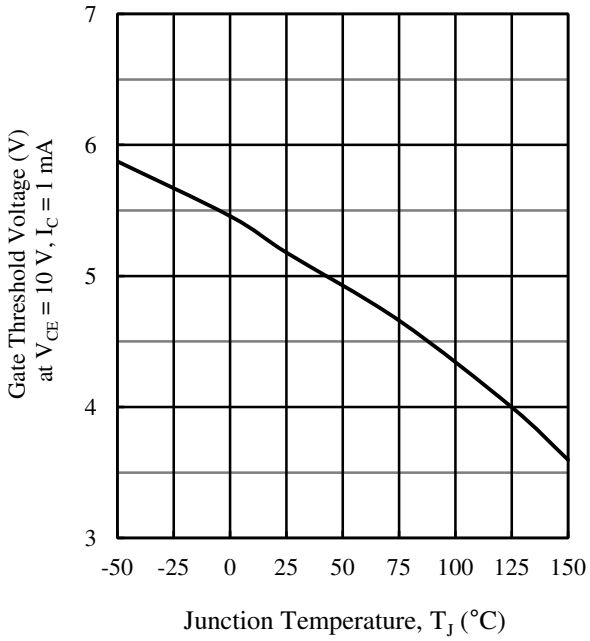



Figure 10. Gate Threshold Voltage vs. Junction Temperature

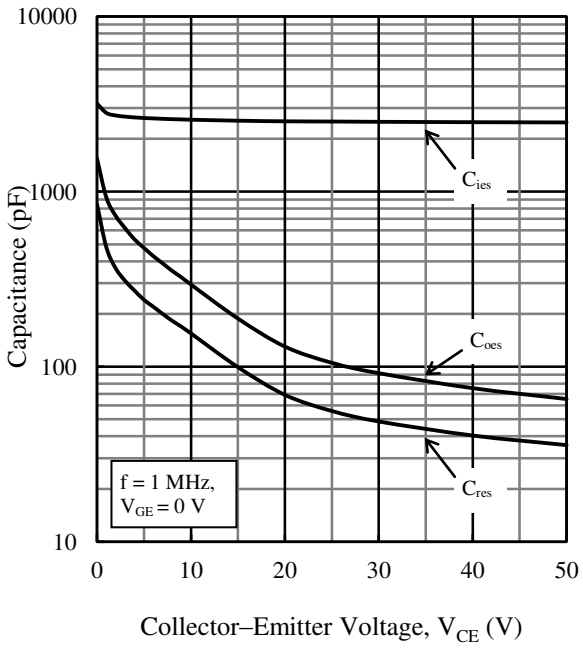



Figure 11. Capacitance Characteristics

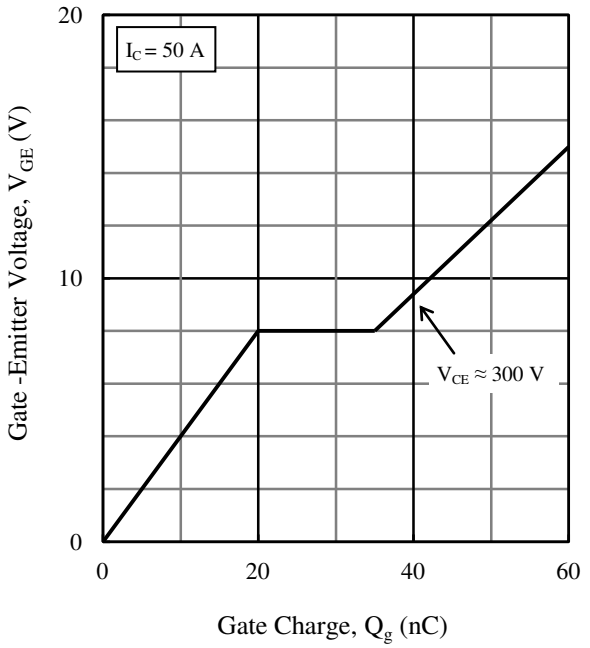



Figure 12. Typical Gate Charge

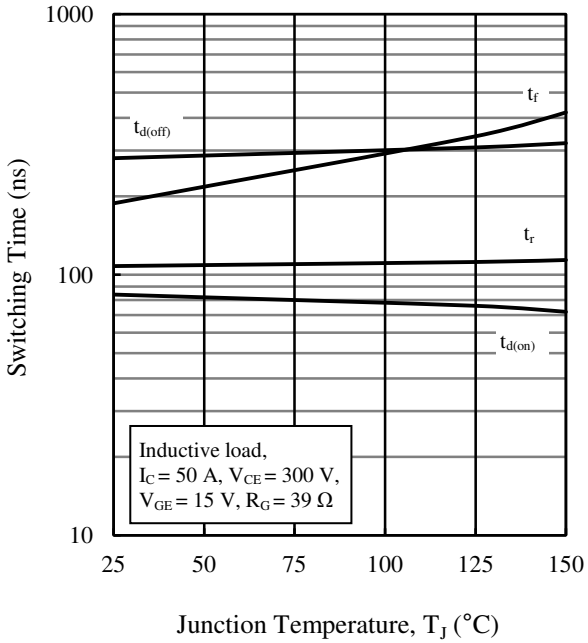



Figure 13. Switching Time vs. Junction Temperature

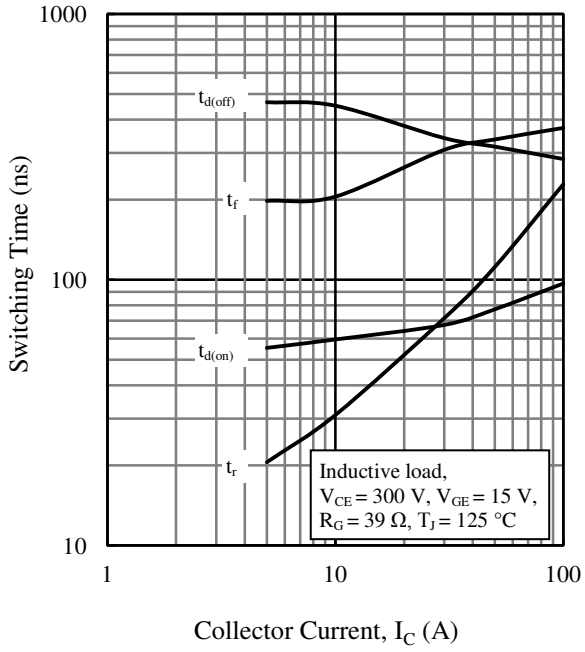



Figure 14. Switching Time vs. Collector Current

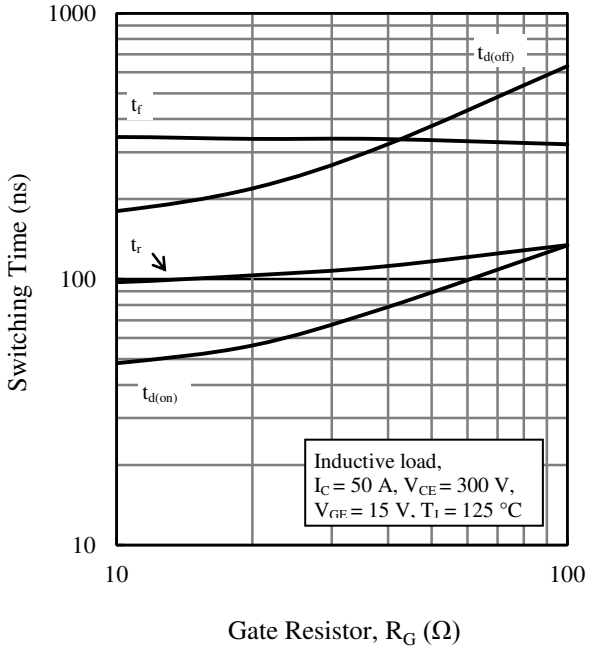



Figure 15. Switching Time vs. Gate Resistor

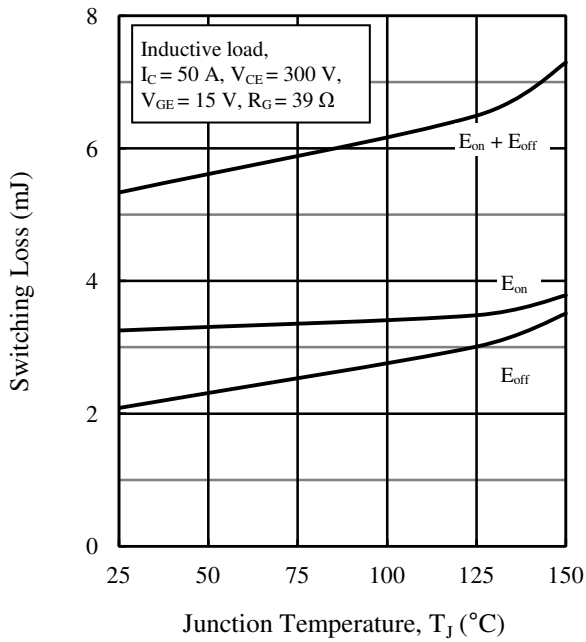



Figure 16. Switching Loss vs. Junction Temperature

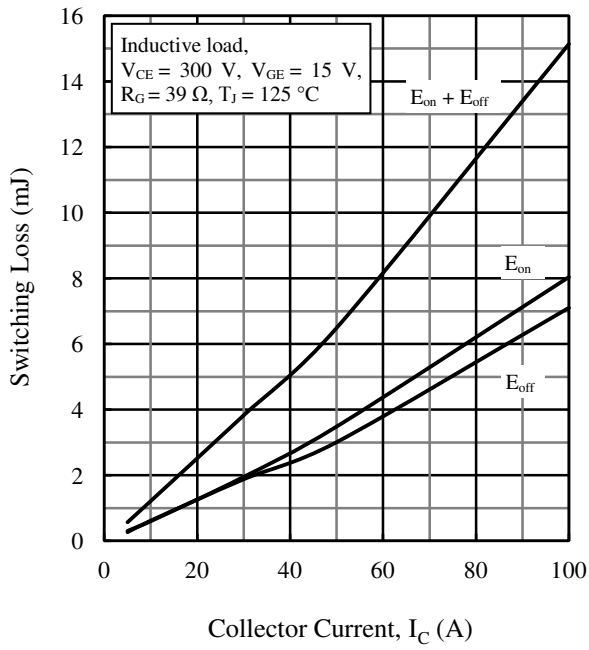



Figure 17. Switching Loss vs. Collector Current

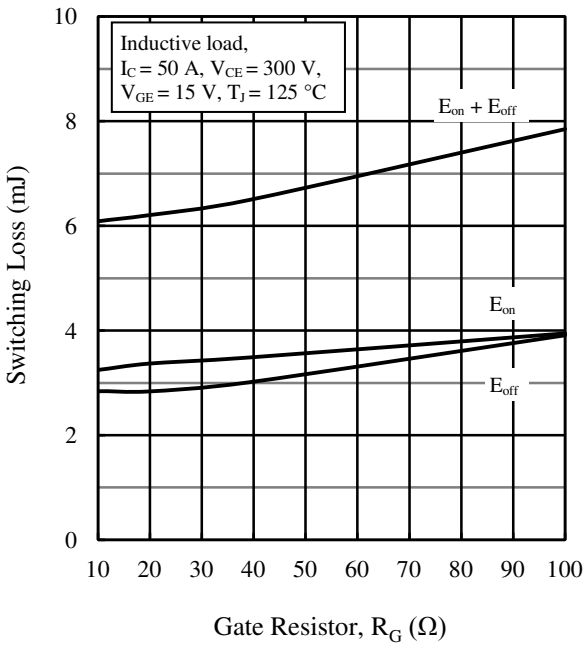



Figure 18. Switching Loss vs. Gate Resistor

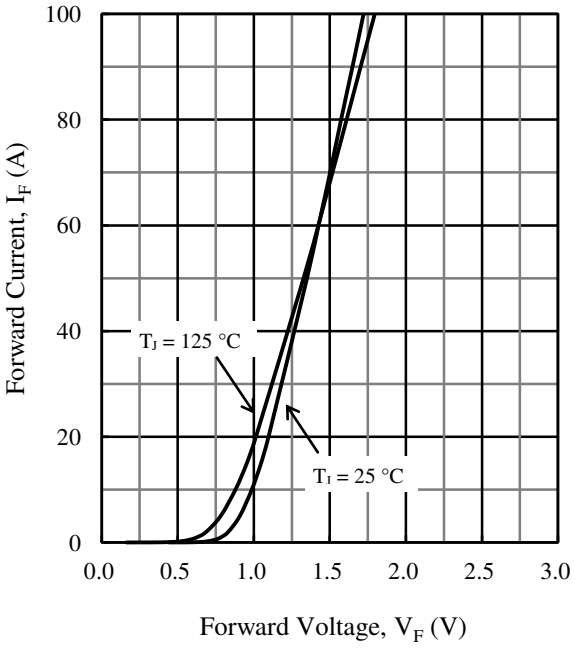



Figure 19. Diode Forward Characteristics

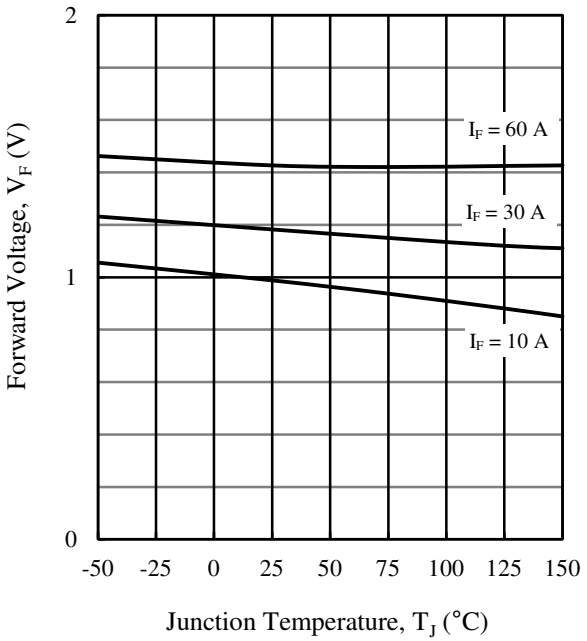



Figure 20. Diode Forward Voltage vs. Junction Temperature

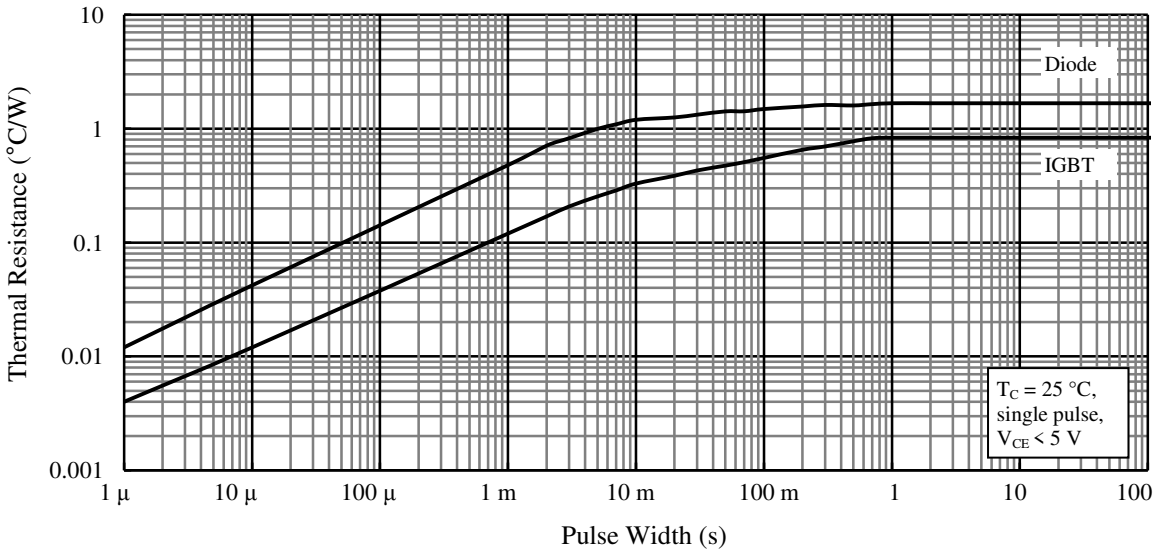
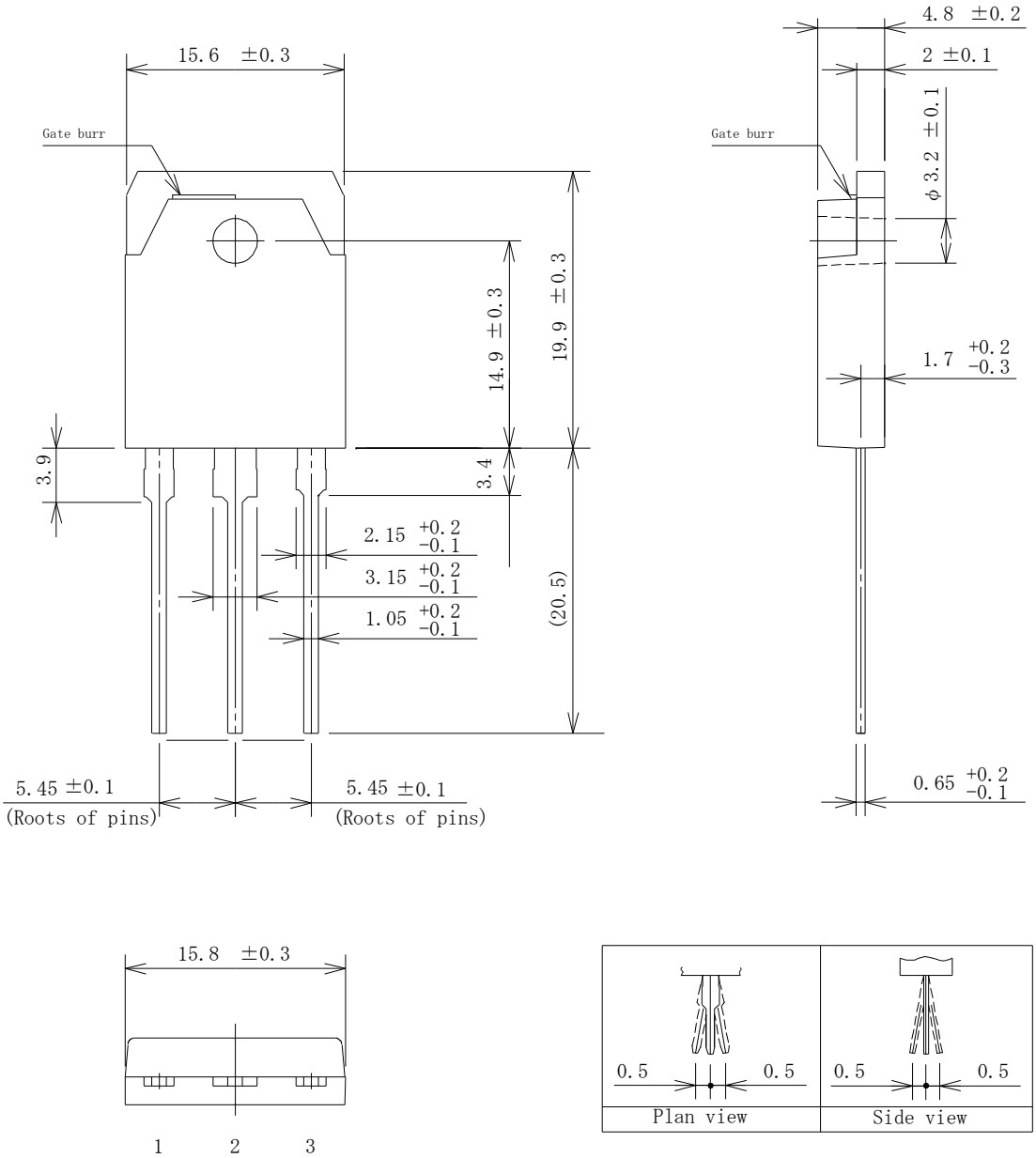



Figure 21. Transient Thermal Resistance

## Physical Dimension

● **TO3P-3L**



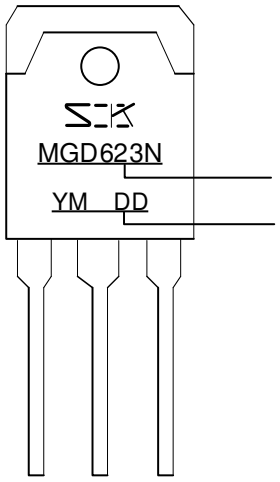

**NOTES:**

- Dimensions in millimeters
- Maximum gate burr height is 0.3 mm
- Bare lead frame: Pb-free (RoHS compliant)
- When soldering the products, be sure to minimize the working time within the following limits:

  Flow: 260 ± 5 °C / 10 ± 1 s, 2 times
  Soldering iron: 380 ± 10 °C / 3.5 ± 0.5 s, 1 time (Soldering should be at a distance of at least 1.5 mm from the body of the product.)

- Recommended screw torque: 0.686 N·m to 0.882 N·m (7 kgf·cm to 9 kgf·cm)

## Marking Diagram




Part Number

Lot Number

Y is the last digit of the year of manufacture (0 to 9)

M is the month of the year (1 to 9, O, N, or D)

DD is the date of the month (01 to 31)

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DSGN-CEZ-16003