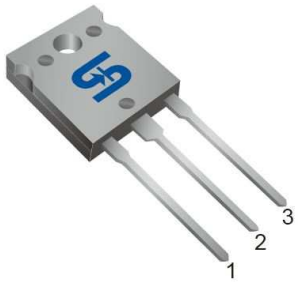
TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

# TSG60N100CE

N-Channel IGBT with FRD.

**TO-264**




**Pin Definition:**
1. Gate
2. Collector
3. Emitter

## PRODUCT SUMMARY

| $V_{CES}$ (V) | $V_{GES}$ (V) | $I_C$ (A) |
|---|---|---|
| 1000 | ±20 | 60 |

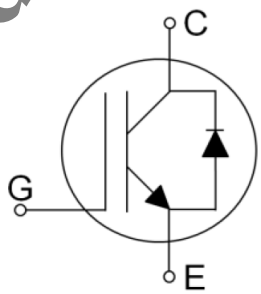
## General Description

The TSG60N100CE using proprietary trench design and advanced NPT technology, the 1000V NPT IGBT offers superior conduction and switching performances, high avalanche ruggedness and easy parallel operation. This device is well suited for the resonant or soft switching application such as induction heating, microwave oven, etc.

## Features

- 1000V NPT Trench Technology
- High Speed Switching
- Low Conduction Loss

## Block Diagram




NPT Trench IGBT

## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TSG60N100CE C0 | TO-264 | 25pcs / Tube |



## Absolute Maximum Rating ($T_A$=25°C unless otherwise noted)

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | | $V_{CES}$ | 1000 | V |
| Gate-Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Continuous Current | $T_C$=25°C | $I_C$ | 60 | A |
| | $T_C$=100°C | | 42 | A |
| Pulsed Collector Current * | | $I_{CM}$ | 200 | A |
| Diode Continuous Forward Current ($T_C$=100℃) | | $I_F$ | 15 | A |
| Max Power Dissipation | $T_J$=25°C | $P_D$ | 208 | W |
| | $T_J$=100°C | | 83 | |
| Operating Junction Temperature | | $T_J$ | -55 to +150 | °C |
| Storage Temperature Range | | $T_{STG}$ | -55 to +150 | °C |

* Repetitive rating: Pulse width limited by max. junction temperature

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## Thermal Performance

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Thermal Resistance - Junction to Case | IGBT | $R\Theta_{JC}$ | 0.6 | °C/W |
| | DIODE | | 2.2 | |
| Thermal Resistance - Junction to Ambient | | $R\Theta_{JA}$ | 25 | |

## Electrical Specifications (Tc=25°C unless otherwise noted)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Collector-Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 1mA | $BV_{CES}$ | 1000 | -- | -- | V |
| Zero Gate Voltage Collector Current | $V_{CE}$ = 1000V, $V_{GE}$ = 0V | $I_{CES}$ | -- | -- | 1 | mA |
| Gate-Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | $I_{GES}$ | -- | -- | ±250 | nA |
| Gate-Emitter Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 60mA | $V_{GE(TH)}$ | 3.5 | 5.5 | 7.5 | V |
| Collector-Emitter Saturation Voltage | $V_{GE}$ = 15V,$I_C$ =60A, $T_J$=25ºC | $V_{CE(SAT)}$ | -- | 2.1 | 2.5 | V |
| | $V_{GE}$ = 15V,$I_C$ =60A, $T_J$=125ºC | $V_{CE(SAT)}$ | -- | 2.6 | -- | V |
| **Dynamic** | | | | | | |
| Input Capacitance | $V_{CE}$ = 30V, $V_{GE}$ = 0V, f = 1.0MHz | $C_{IES}$ | -- | 5600 | -- | pF |
| Output Capacitance | | $C_{OES}$ | -- | 150 | -- | |
| Reverse Transfer Capacitance | | $C_{RES}$ | -- | 115 | -- | |
| **Switching** | | | | | | |
| Turn-On Delay Time | $V_{CC}$ = 600V, $I_C$ = 60A, $R_G$ = 10Ω, $V_{GE}$ = 15V Inductive Load, $T_J$=25°C | $t_{d(on)}$ | -- | 230 | -- | nS |
| Rise Time | | $t_r$ | -- | 210 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 1250 | -- | |
| Fall Time | | $t_f$ | -- | 120 | 230 | |
| Turn-On Switching Loss | | $E_{on}$ | -- | 14.5 | 22 | mJ |
| Turn-Off Switching Loss | | $E_{off}$ | -- | 7.0 | 11 | |
| Total Switching Loss | | $E_{ts}$ | -- | 21.5 | 33 | |
| Turn-On Delay Time | $V_{CC}$ = 600V, $I_C$ = 60A, $R_G$ = 10Ω, $V_{GE}$ = 15V Inductive Load, $T_J$=125°C | $t_{d(on)}$ | -- | 210 | -- | nS |
| Rise Time | | $t_r$ | -- | 260 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 1350 | -- | |
| Fall Time | | $t_f$ | -- | 160 | -- | |
| Turn-On Switching Loss | | $E_{on}$ | -- | 16 | 24 | mJ |
| Turn-Off Switching Loss | | $E_{off}$ | -- | 8.0 | 12 | |
| Total Switching Loss | | $E_{ts}$ | -- | 24 | 36 | |
| Total Gate Charge | $V_{CC}$ = 600V, $I_C$ = 60A, $V_{GE}$ = 15V | $Q_g$ | -- | 270 | 405 | nC |
| Gate-Emitter Charge | | $Q_{ge}$ | -- | 45 | 68 | |
| Gate-Collector Charge | | $Q_{gc}$ | -- | 100 | 150 | |

## Electrical Specifications of the DIODE (Tc=25°C unless otherwise noted)

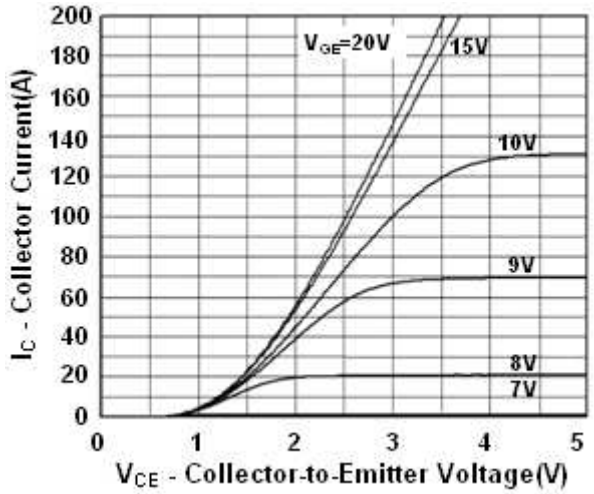
| Parameter | Conditions | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Diode Forward Voltage | $I_F$ = 60A, | $T_J$=25°C | $V_{FM}$ | -- | 2.9 | 3.4 | V |
| | | $T_J$=125°C | | -- | 3.3 | -- | V |
| Reverse Recovery Time | $I_F$ = 60A, dI/dt=200A/us | $T_J$=25°C | $t_{fr}$ | -- | 310 | 465 | ns |
| | | $T_J$=125°C | | -- | 320 | -- | |
| Reverse Recovery Current | | $T_J$=25°C | $I_{fr}$ | -- | 34 | 51 | A |
| | | $T_J$=125°C | | -- | 35 | -- | |
| Reverse Recovery Charge | | $T_J$=25°C | $Q_{fr}$ | -- | 5270 | 7900 | nC |
| | | $T_J$=125°C | | -- | 5600 | -- | |

# TSG60N100CE

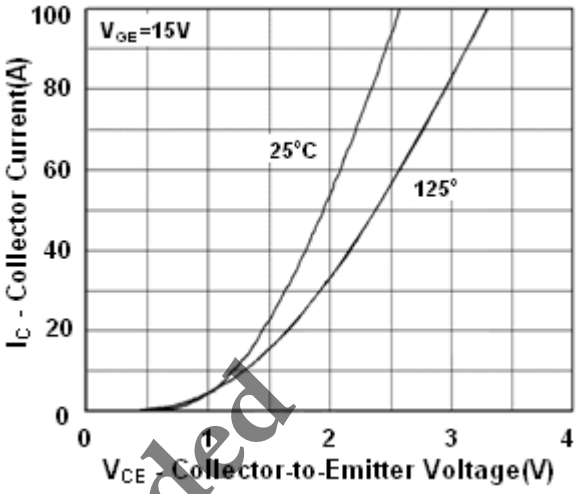
N-Channel IGBT with FRD.

## Electrical Characteristics Curve (Tc = 25°C, unless otherwise noted)

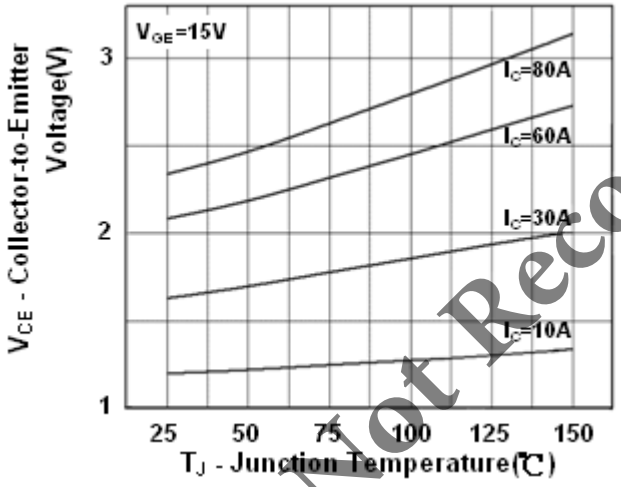
### Output Characteristics



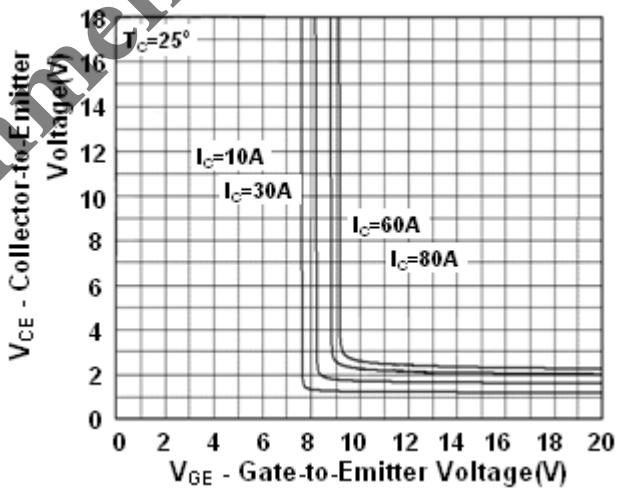

### Saturation voltage characteristics



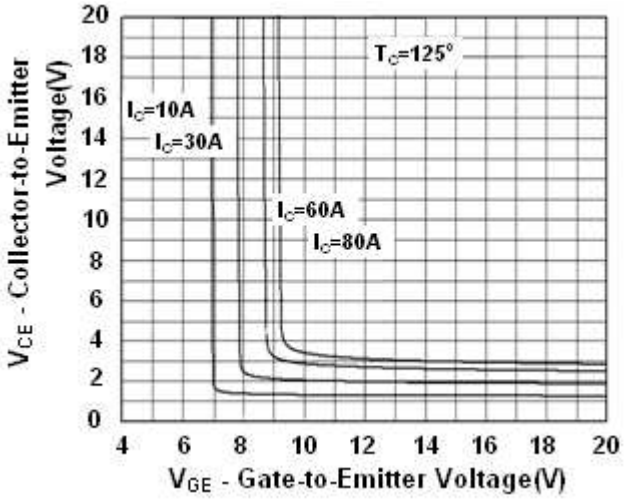

### Saturation voltage vs. collector current



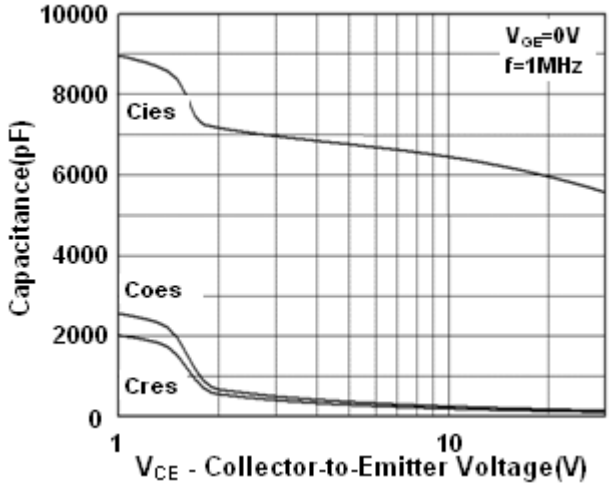

### Saturation voltage vs. gate bias




### Saturation voltage vs. gate bias




### Capacitance characteristics

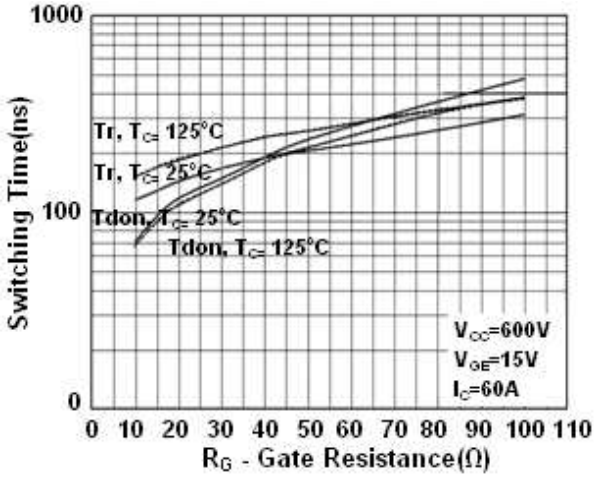


# TSG60N100CE

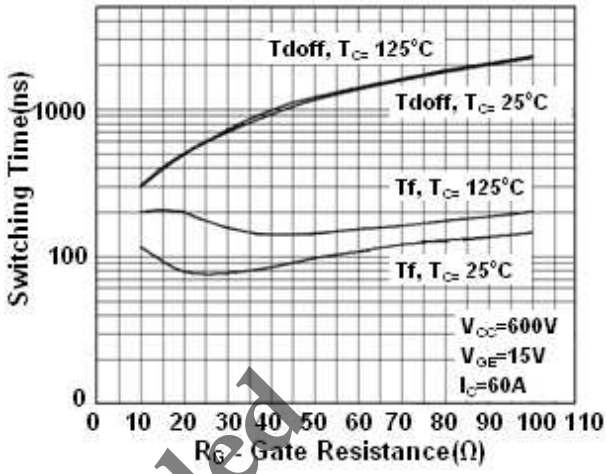
N-Channel IGBT with FRD.

## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

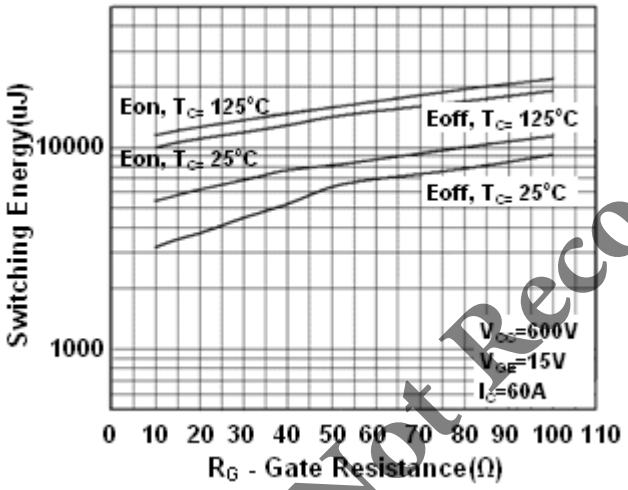
### Turn on time vs. gate resistance



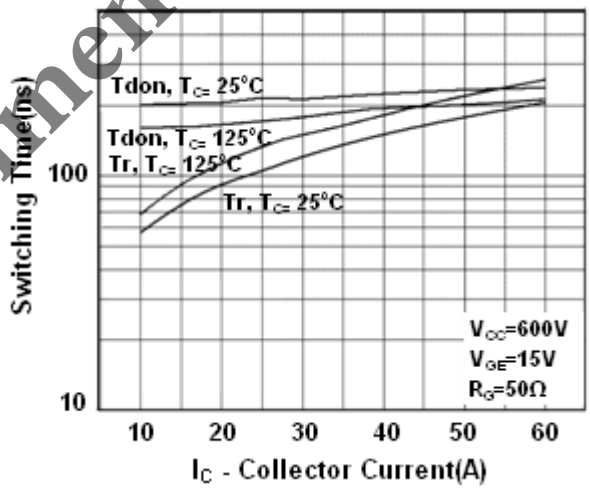

### Turn off time vs. gate resistance



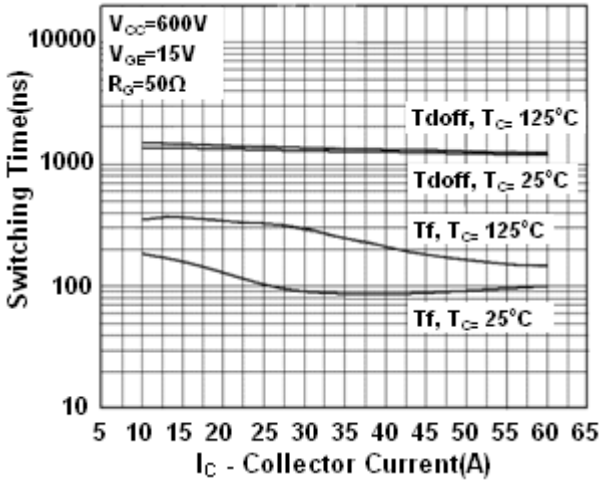

### Switching loss vs. gate resistance



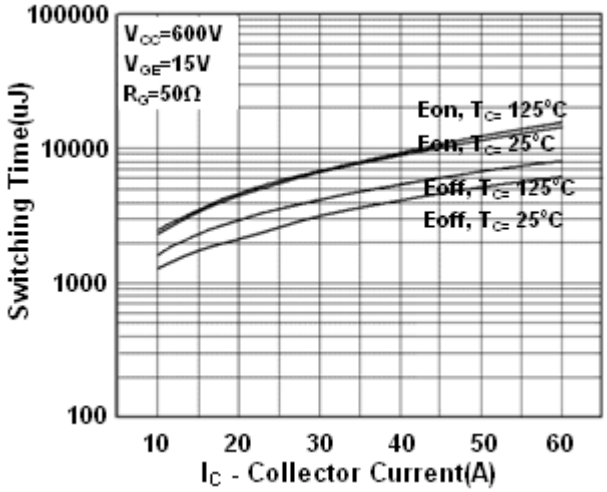

### Turn on time vs. collector current




### Turn off time vs. collector current




### Switching loss vs. collector current

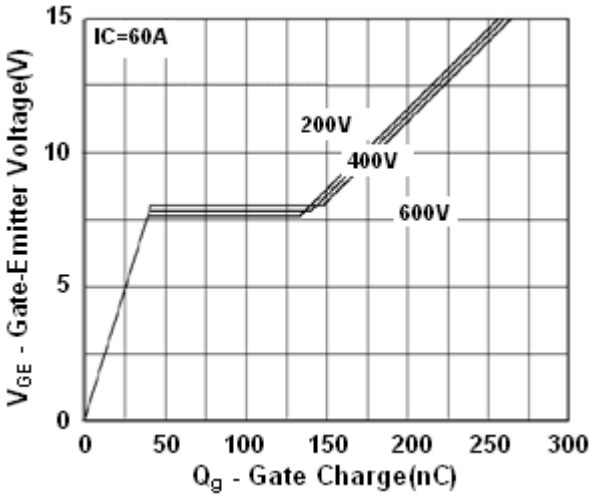


# TSG60N100CE

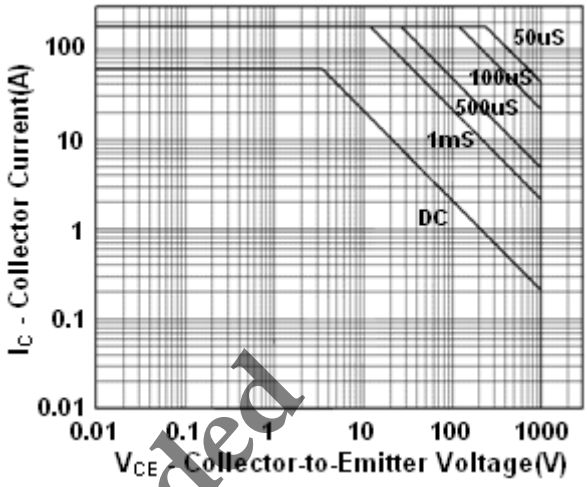
N-Channel IGBT with FRD.

## Electrical Characteristics Curve (Tc = 25°C, unless otherwise noted)

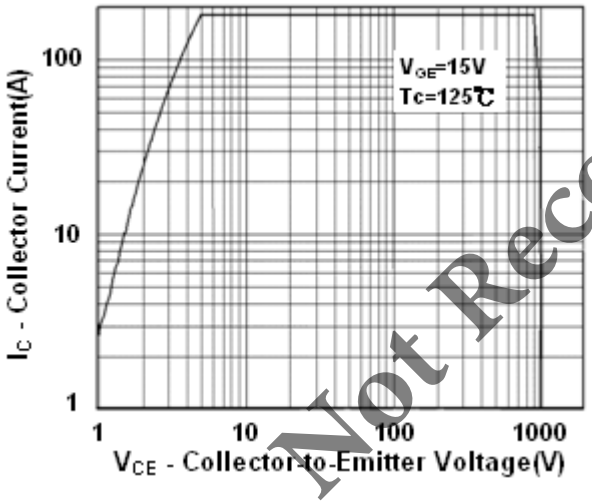
### Gate charge characteristics



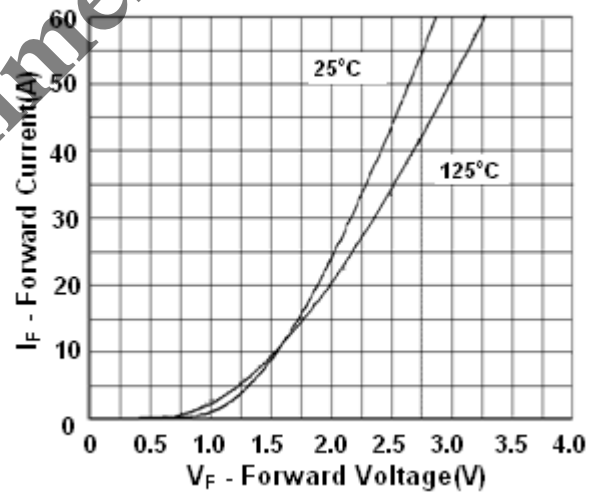

### SOA Characteristics



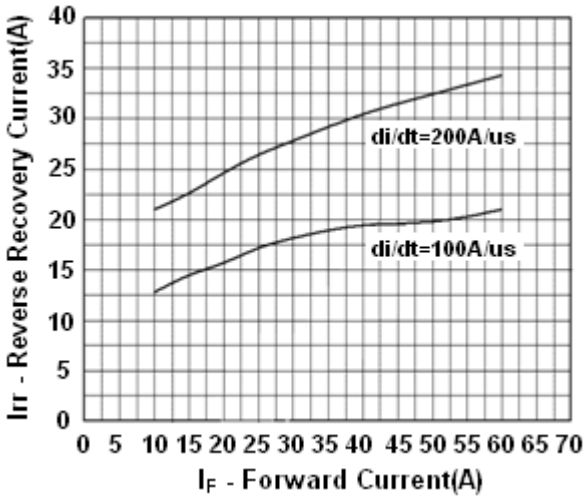

### RBSOA



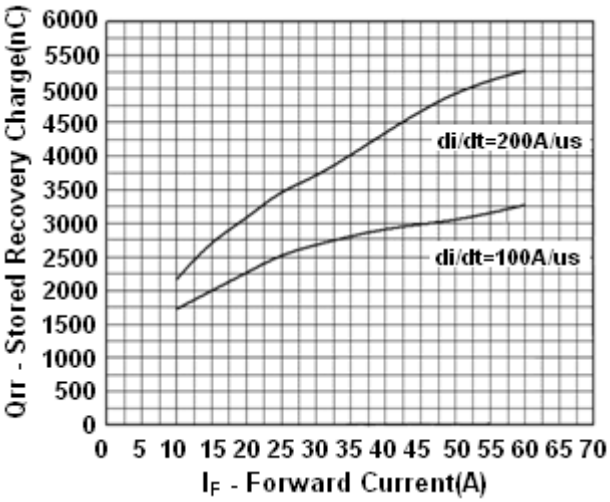

### Conduction characteristics




### Reverse recovery current vs. forward current

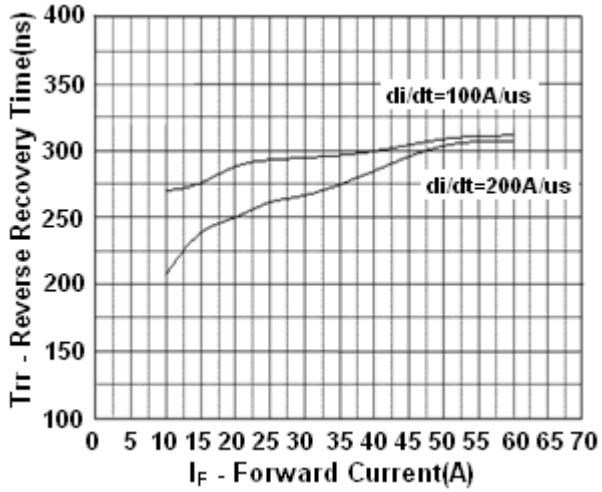



### Stored recovery charge vs. forward current

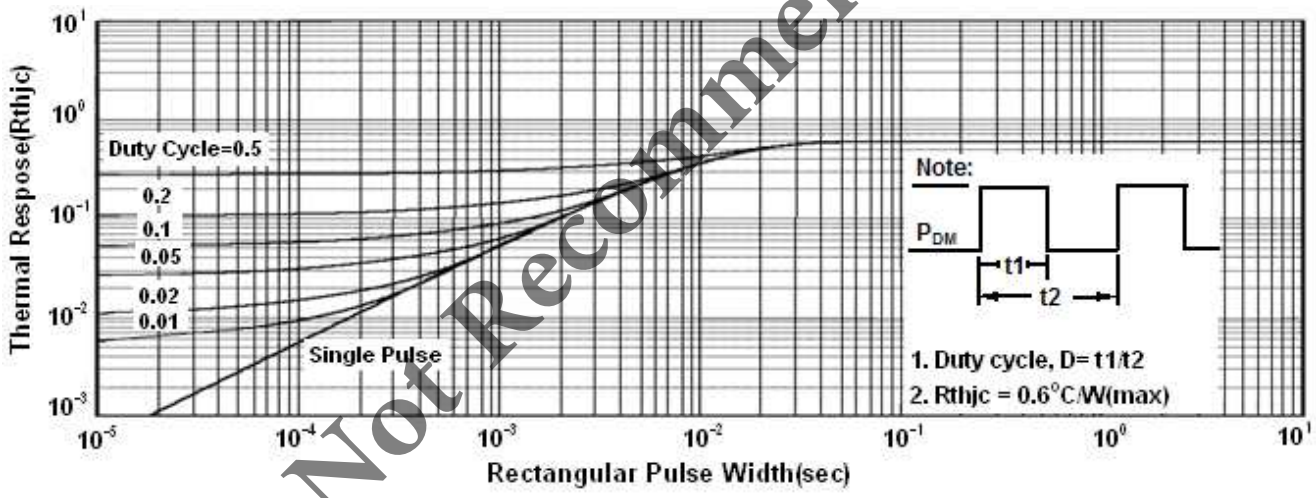


## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

**Reverse recovery time vs. forward current**



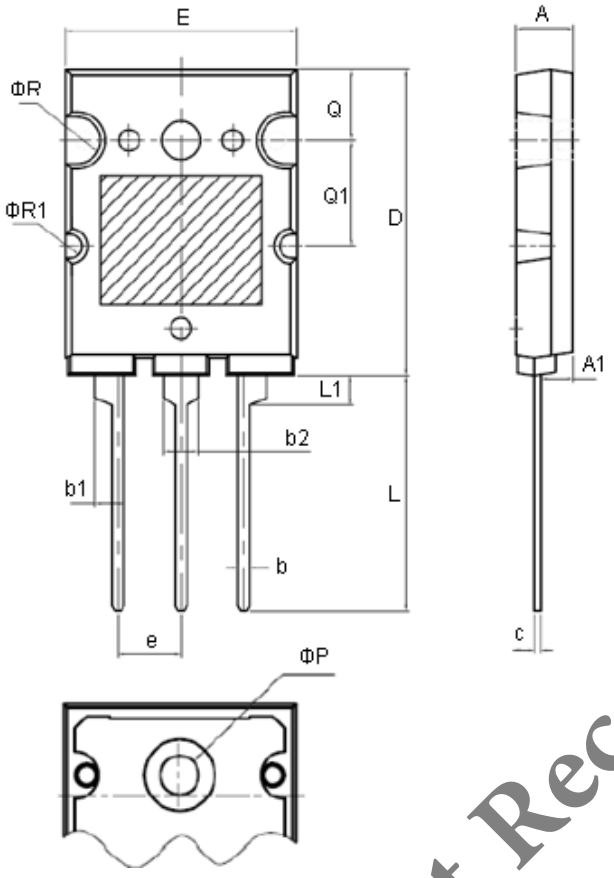

**Normalized Thermal Transient Impedance, Junction-to-Ambient**



# TSG60N100CE

N-Channel IGBT with FRD.

## TO-264 Mechanical Drawing




| TO-264 DIMENSION | | | | | | |
|---|---|---|---|---|---|---|
| DIM | MILLIMETERS | | | INCHES | | |
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 4.8 | 5.0 | 5.2 | 0.189 | 0.197 | 0.205 |
| A1 | 2.5 | 2.8 | 3.1 | 0.098 | 0.110 | 0.122 |
| b | 0.90 | 1.00 | 1.25 | 0.035 | 0.039 | 0.049 |
| b1 | 2.3 | 2.5 | 2.7 | 0.091 | 0.098 | 0.106 |
| b2 | 2.8 | 3.0 | 3.2 | 0.110 | 0.118 | 0.126 |
| c | 0.50 | 0.60 | 0.85 | 0.020 | 0.024 | 0.033 |
| D | 25.58 | 26.09 | 26.59 | 1.007 | 1.027 | 1.047 |
| E | 19.30 | 19.81 | 20.29 | 0.760 | 0.780 | 0.799 |
| e | 5.15 | 5.45 | 5.75 | 0.203 | 0.215 | 0.226 |
| L | 19.5 | 20.0 | 20.5 | 0.768 | 0.787 | 0.807 |
| L1 | 2.4 | 2.5 | 2.6 | 0.094 | 0.098 | 0.102 |
| ΦP | 3.10 | 3.30 | 3.51 | 0.122 | 0.130 | 0.138 |
| Q | 5.8 | 6.0 | 6.2 | 0.228 | 0.236 | 0.244 |
| Q1 | 8.8 | 9.0 | 9.2 | 0.346 | 0.354 | 0.362 |
| ΦR | -- | 2.0 | -- | -- | 0.079 | -- |
| ΦR1 | -- | 1.0 | -- | -- | 0.039 | -- |

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