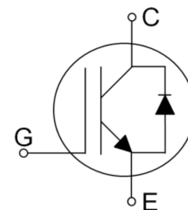
## Features

- 650V Field Stop Trench IGBT Technology
- Low Switching Loss for a Wide Temperature Range
- Positive Temperature Coefficient
- Easy Parallel Operation
- RoHS Compliant
- JEDEC Qualification
- 175℃ Operating Temperature

TO-247

G C E




## Applications

- UPS, Inverter, Solar, Welder

| Device | Package | Marking | Remark |
|---|---|---|---|
| TGH80N65F2DS | TO-247 | TGH80N65F2DS | RoHS |

## Absolute Maximum Ratings

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | | $V_{CES}$ | 650 | V |
| Gate-Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Continuous Collector Current | $T_C$ = 25 ℃ | $I_C$ | 160 | A |
| | $T_C$ = 100 ℃ | | 80 | A |
| Pulsed Collector Current (Note 1) | | $I_{CM}$ | 240 | A |
| Diode Continuous Forward Current | $T_C$ = 100 ℃ | $I_F$ | 80 | A |
| Diode Pulsed Forward Current (Note 1) | | $I_{FM}$ | 300 | A |
| Power Dissipation | $T_C$ = 25 ℃ | $P_D$ | 577 | W |
| | $T_C$ = 100 ℃ | | 288 | W |
| Operating Junction Temperature | | $T_{vj}$ | -55 ~ 175 | ℃ |
| Storage Temperature Range | | $T_{STG}$ | -55 ~ 150 | ℃ |
| Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | | $T_L$ | 300 | ℃ |

Notes :
(1) Repetitive rating : Pulse width limited by maximum junction temperature.

## Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (IGBT) | 0.26 | ℃/W |
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (DIODE) | 1.0 | ℃/W |
| Maximum Thermal resistance, Junction-to-Ambient | $R_{\theta JA}$ | 40 | ℃/W |

## Electrical Characteristics of the IGBT $T_{vj}$=25℃, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF** | | | | | | |
| Collector – Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$ = 0V, $I_C$ = 1mA | 650 | -- | -- | V |
| Zero Gate Voltage Collector Current | $I_{CES}$ | $V_{CE}$ = 650V, $V_{GE}$ = 0V | -- | -- | 1 | mA |
| Gate – Emitter Leakage Current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = ± 20V | -- | -- | ± 250 | nA |
| Integrated Gate Resistance | $R_{G(int)}$ | f = 1MHz, Open Collector | -- | 2.3 | -- | Ω |
| **ON** | | | | | | |
| Gate – Emitter Threshold Voltage | $V_{GE(TH)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 80mA | 4.0 | 6.0 | 7.5 | V |
| Collector – Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{GE}$ = 15V, $I_C$ = 80A, $T_{vj}$ = 25 ℃ | -- | 1.85 | 2.25 | V |
| | | $V_{GE}$ = 15V, $I_C$ = 80A, $T_{vj}$ = 125 ℃ | -- | 2.19 | -- | V |
| | | $V_{GE}$ = 15V, $I_C$ = 80A, $T_{vj}$ = 175 ℃ | -- | 2.40 | -- | V |
| **DYNAMIC** | | | | | | |
| Input Capacitance | $C_{IES}$ | $V_{CE}$ = 30V<br>$V_{GE}$ = 0V<br>f = 1MHz | -- | 5000 | -- | pF |
| Output Capacitance | $C_{OES}$ | | -- | 230 | -- | pF |
| Reverse Transfer Capacitance | $C_{RES}$ | | -- | 150 | -- | pF |
| Total Gate Charge | $Q_g$ | $V_{CC}$ = 400V, $I_C$ = 80A<br>$V_{GE}$ = 15V | -- | 216 | 324 | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | -- | 30 | 46 | nC |
| Gate-Collector Charge | $Q_{gc}$ | | -- | 106 | 159 | nC |
| **SWITCHING** (Note 2) | | | | | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400V, $I_C$ = 40A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 25 ℃ | -- | 36 | -- | ns |
| Rise Time | $t_r$ | | -- | 69 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 140 | -- | ns |
| Fall Time | $t_f$ | | -- | 21 | -- | ns |
| Turn-On Switching Loss | $E_{ON}$ | | -- | 1.28 | -- | mJ |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.24 | -- | mJ |
| Total Switching Loss | $E_{TS}$ | | -- | 1.52 | -- | mJ |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400V, $I_C$ = 80A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 25 ℃ | -- | 57 | -- | ns |
| Rise Time | $t_r$ | | -- | 139 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 118 | -- | ns |
| Fall Time | $t_f$ | | -- | 65 | -- | ns |
| Turn-On Switching Loss | $E_{ON}$ | | -- | 3.05 | 4.58 | mJ |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 1.11 | 1.67 | mJ |
| Total Switching Loss | $E_{TS}$ | | -- | 4.16 | 6.24 | mJ |

## Electrical Characteristics of the IGBT $T_{vj}$=25℃, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **SWITCHING** (Note 2) | | | | | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400V, $I_C$ = 40A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 175 ℃ | -- | 41 | -- | ns |
| Rise Time | $t_r$ | | -- | 63 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 149 | -- | ns |
| Fall Time | $t_f$ | | -- | 21 | -- | ns |
| Turn-On Switching Loss | $E_{ON}$ | | -- | 1.91 | -- | mJ |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.41 | -- | mJ |
| Total Switching Loss | $E_{TS}$ | | -- | 2.32 | -- | mJ |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400V, $I_C$ = 80A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 175 ℃ | -- | 47 | -- | ns |
| Rise Time | $t_r$ | | -- | 136 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 126 | -- | ns |
| Fall Time | $t_f$ | | -- | 62 | -- | ns |
| Turn-On Switching Loss | $E_{ON}$ | | -- | 4.94 | 7.41 | mJ |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 1.26 | 1.89 | mJ |
| Total Switching Loss | $E_{TS}$ | | -- | 6.20 | 9.30 | mJ |

Notes :
(2) Not subject to production test – verified by design/characterization

## Electrical Characteristics of the DIODE $T_{vj}$=25℃, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Diode Forward Voltage | $V_{FM}$ | $I_F$ = 40A, $T_{vj}$ = 25 ℃ | -- | 2.30 | -- | V |
| | | $I_F$ = 40A, $T_{vj}$ = 125 ℃ | -- | 2.09 | -- | V |
| | | $I_F$ = 40A, $T_{vj}$ = 175 ℃ | -- | 1.93 | -- | V |
| | | $I_F$ = 80A, $T_{vj}$ = 25 ℃ | -- | 2.93 | -- | V |
| | | $I_F$ = 80A, $T_{vj}$ = 125 ℃ | -- | 2.88 | -- | V |
| | | $I_F$ = 80A, $T_{vj}$ = 175 ℃ | -- | 2.78 | -- | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 40A, di/dt = 200A/μs, $T_{vj}$ = 25 ℃ | -- | 62 | -- | ns |
| Reverse Recovery Current | $I_{rr}$ | | -- | 5.2 | -- | A |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 196 | -- | nC |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 40A, di/dt = 200A/μs, $T_{vj}$ = 175 ℃ | -- | 168 | -- | ns |
| Reverse Recovery Current | $I_{rr}$ | | -- | 9.9 | -- | A |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 1102 | -- | nC |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 80A, di/dt = 200A/μs, $T_{vj}$ = 25 ℃ | -- | 74 | -- | ns |
| Reverse Recovery Current | $I_{rr}$ | | -- | 6.0 | -- | A |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 280 | -- | nC |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 80A, di/dt = 200A/μs, $T_{vj}$ = 175 ℃ | -- | 171 | -- | ns |
| Reverse Recovery Current | $I_{rr}$ | | -- | 11.0 | -- | A |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 1218 | -- | nC |

# IGBT Characteristics

Fig. 1 IGBT Output Characteristics

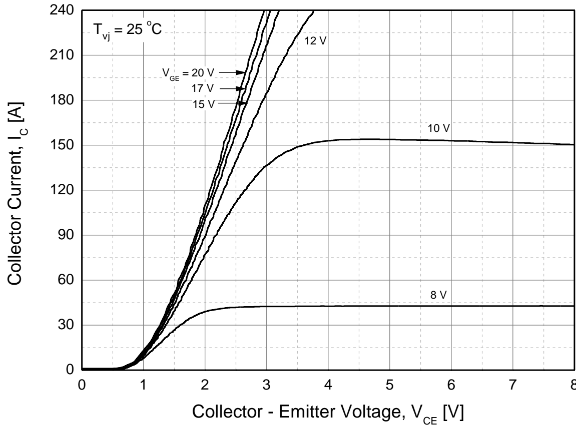



Fig. 2 IGBT Output Characteristics

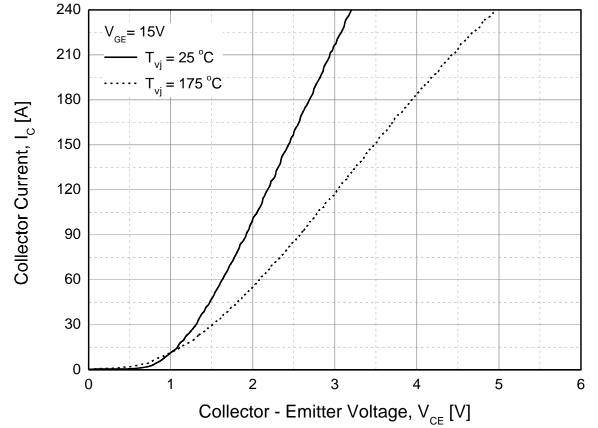



Fig. 3 IGBT Saturation Voltage vs. Junction Temperature

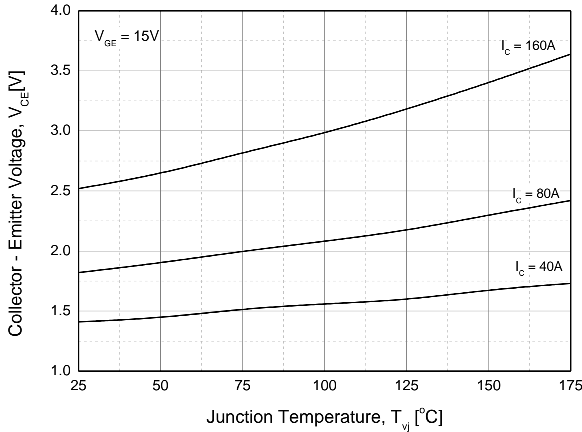



Fig. 4 IGBT Saturation Voltage vs. Gate Bias

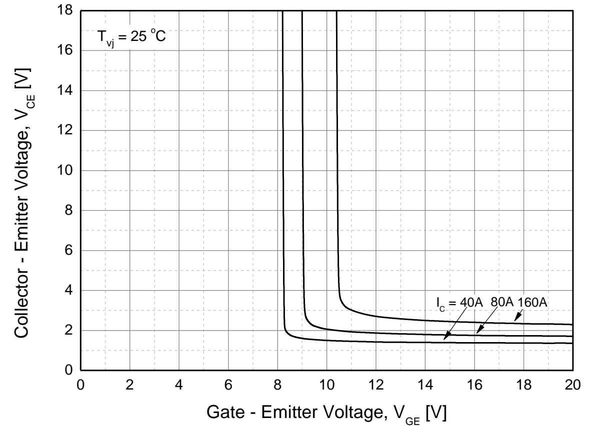



Fig. 5 IGBT Saturation Voltage vs. Gate Bias

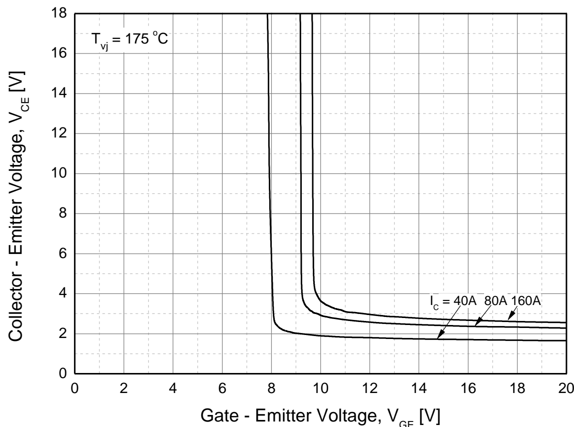
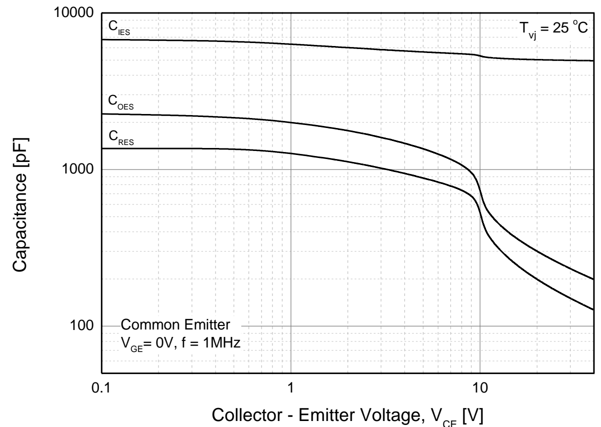



Fig. 6 IGBT Capacitance Characteristics



# IGBT Characteristics

Fig. 7 Turn-on Time vs. Gate Resistor

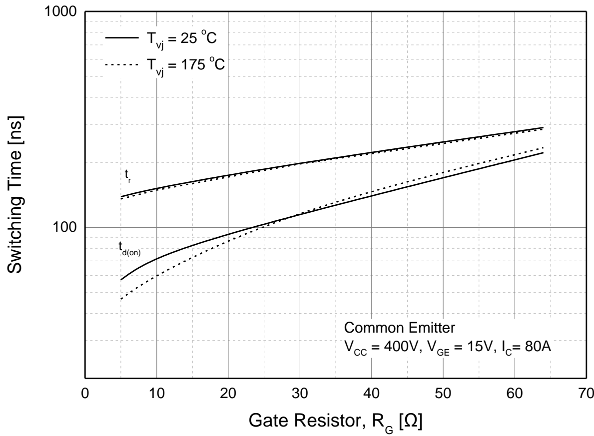



Fig. 8 Turn-off Time vs. Gate Resistor

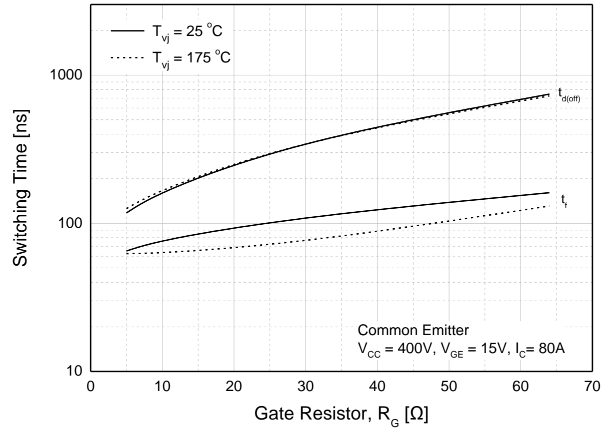



Fig. 9 Switching Loss vs. Gate Resistor

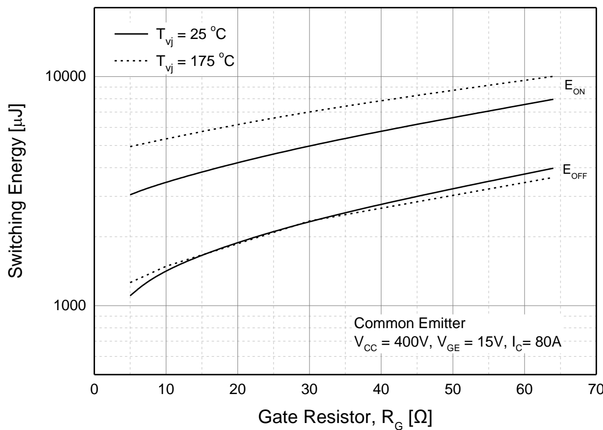



Fig. 10 Turn-on Time vs. Collector Current

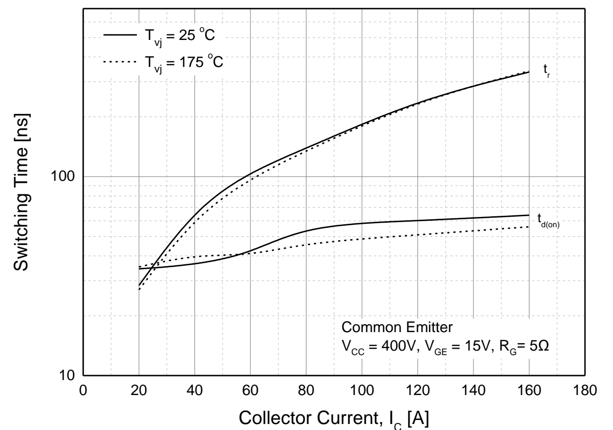



Fig. 11 Turn-off Time vs. Collector Current

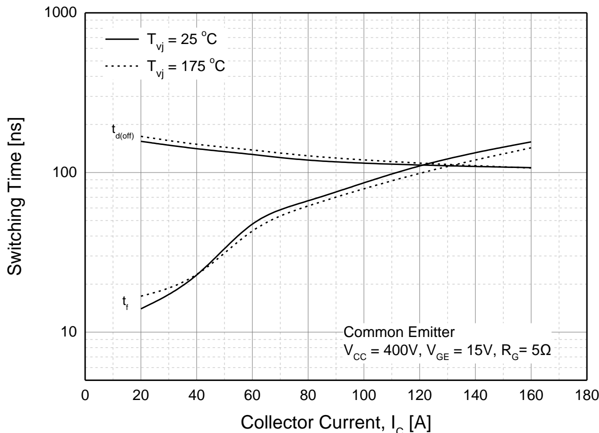
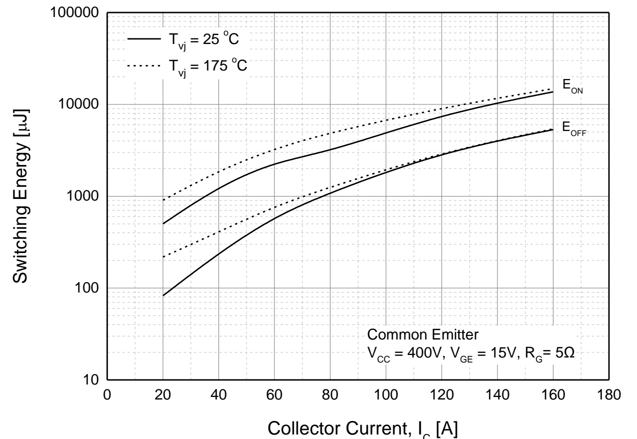



Fig. 12 Switching Loss vs. Collector Current



# IGBT Characteristics

Fig. 13 Gate Charge Characteristics

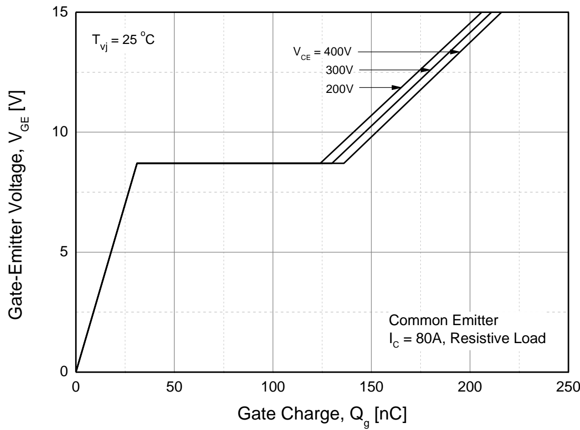



Fig. 14 SOA

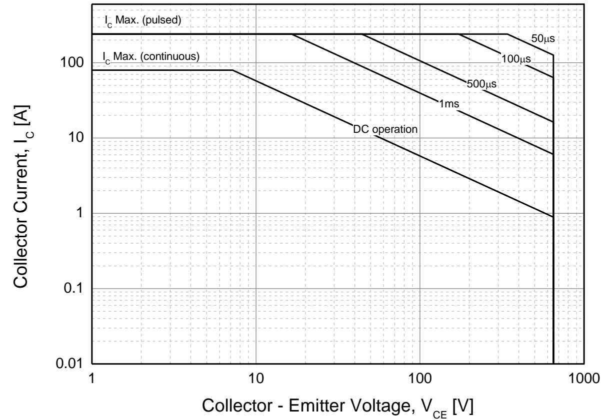



Fig. 15 RBSOA

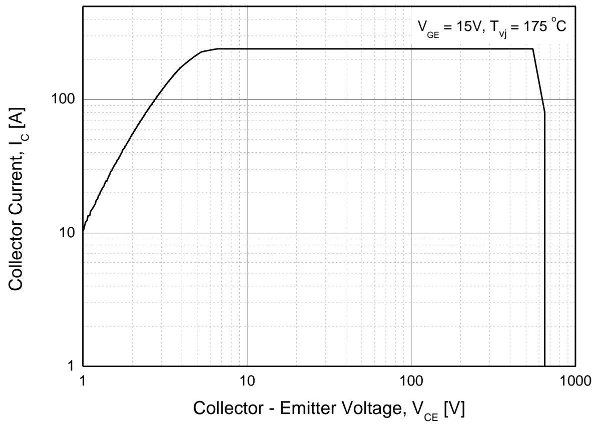



Fig. 16 Transient Thermal Impedance of IGBT

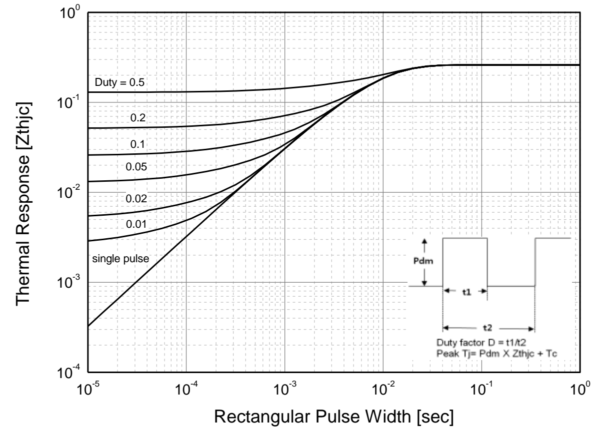
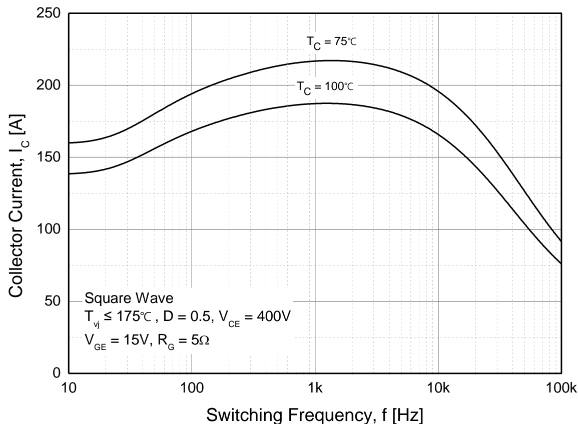



Fig. 17 Load Current vs. Frequency



# DIODE Characteristics

Fig. 18 Diode Conduction Characteristics

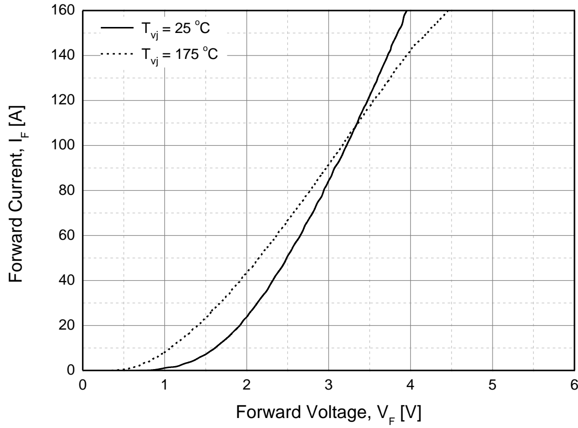



Fig. 19 Reverse Recovery Current vs. Forward Current

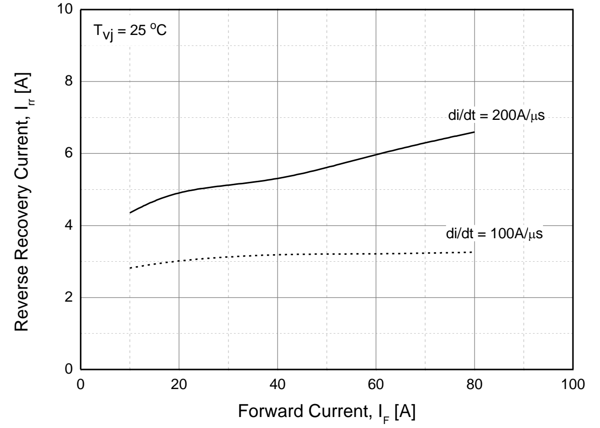



Fig. 20 Reverse Recovery Charge vs. Forward Current

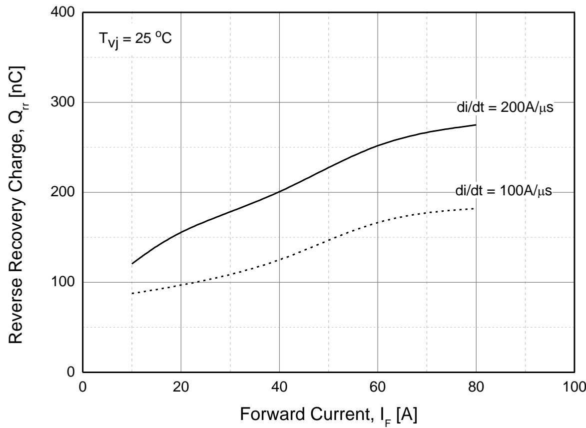
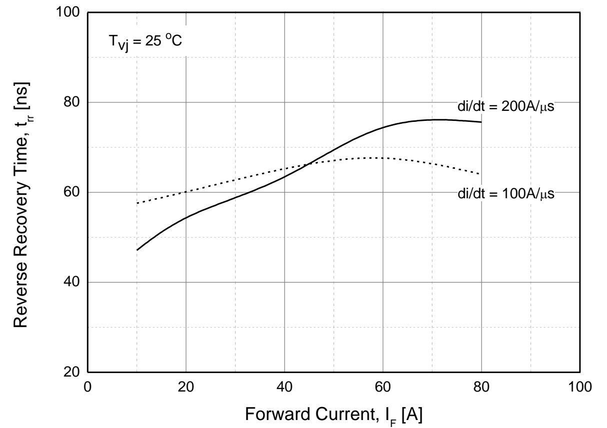
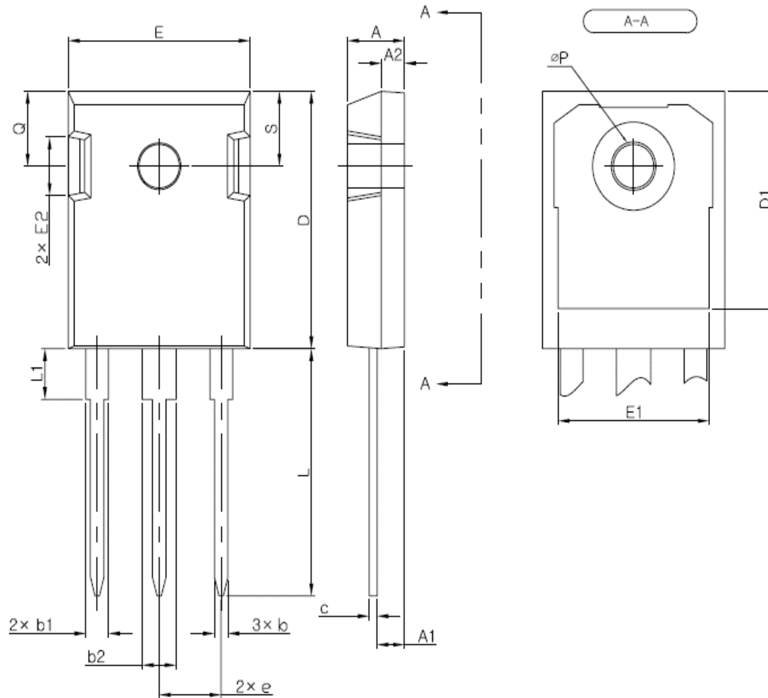



Fig. 21 Reverse Recovery Time vs. Forward Current



## TO-247 MECHANICAL DATA




| symbol | mm | |
|---|---|---|
| | MIN | MAX |
| A | 4.80 | 5.21 |
| A1 | 2.21 | 2.59 |
| A2 | 1.85 | 2.16 |
| b | 1.07 | 1.40 |
| b1 | 1.91 | 2.41 |
| b2 | 2.87 | 3.38 |
| c | 0.51 | 0.80 |
| D | 20.80 | 21.34 |
| D1 | 17.20 | 18.90 |
| E | 15.50 | 16.13 |
| E1 | 12.38 | 13.60 |
| E2 | 3.68 | 5.20 |
| e | 5.44 | 5.45 |
| L | 19.62 | 20.57 |
| L1 | 3.81 | 4.40 |
| ΦP | 3.40 | 3.80 |
| Q | 5.49 | 6.20 |
| S | 6.04 | 6.30 |

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