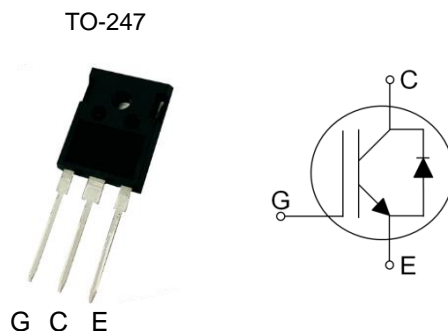


Features

- 1350V Field Stop Trench Technology
- High Speed Switching
- Low Conduction Loss
- Positive Temperature Coefficient
- Easy Parallel Operation
- 175°C Operating Temperature
- RoHS Compliant
- JEDEC Qualification

Applications

- Induction Heating
- Inverterized microwave ovens
- Soft Switching Applications



| Device | Package | Marking | Remark |
|-------------|---------|-------------|--------|
| TGH40N135FD | TO-247 | TGH40N135FD | RoHS |

Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|-----------|-----------------------------------|------------------|
| Collector-Emitter Voltage | V_{CES} | 1350 | V |
| Gate-Emitter Voltage | V_{GES} | ± 25 | V |
| Continuous Collector Current | I_C | $T_C = 25\text{ }^\circ\text{C}$ | 80 |
| | | $T_C = 100\text{ }^\circ\text{C}$ | 40 |
| Pulsed Collector Current (Note 1) | I_{CM} | 160 | A |
| Diode Continuous Forward Current | I_F | 40 | A |
| Power Dissipation | P_D | $T_C = 25\text{ }^\circ\text{C}$ | 625 |
| | | $T_C = 100\text{ }^\circ\text{C}$ | 313 |
| Operating Junction Temperature | T_{vj} | -55 ~ 175 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{STG} | -55 ~ 150 | $^\circ\text{C}$ |
| Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | T_L | 300 | $^\circ\text{C}$ |

Notes :

- (1) Repetitive rating : Pulse width limited by maximum junction temperature , During production, high current switching capability is 100% verified with the inductive load single-pulse switching test. ($I_C=160A$)

Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|-------------------------|-------|--------------------|
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (IGBT) | 0.24 | $^\circ\text{C/W}$ |
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (DIODE) | 0.95 | $^\circ\text{C/W}$ |
| Maximum Thermal resistance, Junction-to-Ambient | $R_{\theta JA}$ | 40 | $^\circ\text{C/W}$ |

Electrical Characteristics of the IGBT $T_{vj}=25^{\circ}\text{C}$, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|--|---------------|--|------|------|-----------|------|
| OFF | | | | | | |
| Collector – Emitter Breakdown Voltage | BV_{CES} | $V_{GE} = 0V, I_C = 1mA$ | 1350 | -- | -- | V |
| Zero Gate Voltage Collector Current | I_{CES} | $V_{CE} = 1350V, V_{GE} = 0V$ | -- | -- | 1 | mA |
| Gate – Emitter Leakage Current | I_{GES} | $V_{CE} = 0V, V_{GE} = \pm 25V$ | -- | -- | ± 500 | nA |
| ON | | | | | | |
| Gate – Emitter Threshold Voltage | $V_{GE(TH)}$ | $V_{GE} = V_{CE}, I_C = 40mA$ | 4.0 | 6.0 | 8.0 | V |
| Collector – Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{GE} = 15V, I_C = 40A, T_{vj} = 25^{\circ}\text{C}$ | -- | 1.70 | 2.20 | V |
| | | $V_{GE} = 15V, I_C = 40A, T_{vj} = 125^{\circ}\text{C}$ | -- | 2.00 | -- | |
| | | $V_{GE} = 15V, I_C = 40A, T_{vj} = 175^{\circ}\text{C}$ | -- | 2.17 | -- | |
| DYNAMIC | | | | | | |
| Input Capacitance | C_{IES} | $V_{CE} = 30V,$ $V_{GE} = 0V$ $f = 1MHz$ | -- | 4735 | -- | pF |
| Output Capacitance | C_{OES} | | -- | 92 | -- | |
| Reverse Transfer Capacitance | C_{RES} | | -- | 61 | -- | |
| SWITCHING (Note 2) | | | | | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC} = 600V, I_C = 40A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_{vj} = 25^{\circ}\text{C}$ | -- | 55 | -- | ns |
| Rise Time | t_r | | -- | 51 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 379 | -- | ns |
| Fall Time | t_f | | -- | 105 | 157 | ns |
| Turn-On Switching Loss | E_{ON} | | -- | 3.93 | 5.90 | mJ |
| Turn-Off Switching Loss | E_{OFF} | | -- | 2.17 | 3.26 | mJ |
| Total Switching Loss | E_{TS} | | -- | 6.10 | 9.16 | mJ |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC} = 600V, I_C = 40A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_{vj} = 175^{\circ}\text{C}$ | -- | 56 | -- | ns |
| Rise Time | t_r | | -- | 52 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 413 | -- | ns |
| Fall Time | t_f | | -- | 350 | -- | ns |
| Turn-On Switching Loss | E_{ON} | | -- | 5.27 | 7.91 | mJ |
| Turn-Off Switching Loss | E_{OFF} | | -- | 3.37 | 5.06 | mJ |
| Total Switching Loss | E_{TS} | | -- | 8.64 | 12.97 | mJ |
| Total Gate Charge | Q_g | $V_{CC} = 600V, I_C = 40A$ $V_{GE} = 15V$ | -- | 227 | 340 | nC |
| Gate-Emitter Charge | Q_{ge} | | -- | 35 | 53 | |
| Gate-Collector Charge | Q_{gc} | | -- | 101 | 151 | |

Notes :

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

Electrical Characteristics of the DIODE $T_{vj}=25^{\circ}\text{C}$, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|--------------------------|----------|---|------|------|------|------|
| Diode Forward Voltage | V_{FM} | $I_F = 20\text{A}, T_{vj} = 25^{\circ}\text{C}$ | -- | 1.58 | -- | V |
| | | $I_F = 20\text{A}, T_{vj} = 175^{\circ}\text{C}$ | -- | 1.63 | -- | V |
| | | $I_F = 40\text{A}, T_{vj} = 25^{\circ}\text{C}$ | -- | 1.95 | -- | V |
| | | $I_F = 40\text{A}, T_{vj} = 175^{\circ}\text{C}$ | -- | 2.13 | -- | V |
| Reverse Recovery Time | t_{rr} | $I_F = 20\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 25^{\circ}\text{C}$ | -- | 307 | -- | ns |
| Reverse Recovery Current | I_{rr} | | -- | 14.5 | -- | A |
| Reverse Recovery Charge | Q_{rr} | | -- | 2790 | -- | nC |
| Reverse Recovery Time | t_{rr} | $I_F = 20\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 175^{\circ}\text{C}$ | -- | 434 | -- | ns |
| Reverse Recovery Current | I_{rr} | | -- | 20.5 | -- | A |
| Reverse Recovery Charge | Q_{rr} | | -- | 5680 | -- | nC |
| Reverse Recovery Time | t_{rr} | $I_F = 40\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 25^{\circ}\text{C}$ | -- | 358 | -- | ns |
| Reverse Recovery Current | I_{rr} | | -- | 16.6 | -- | A |
| Reverse Recovery Charge | Q_{rr} | | -- | 3910 | -- | nC |
| Reverse Recovery Time | t_{rr} | $I_F = 40\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 175^{\circ}\text{C}$ | -- | 529 | -- | ns |
| Reverse Recovery Current | I_{rr} | | -- | 23.1 | -- | A |
| Reverse Recovery Charge | Q_{rr} | | -- | 8120 | -- | nC |

IGBT Characteristics

Figure 1. IGBT Output Characteristics

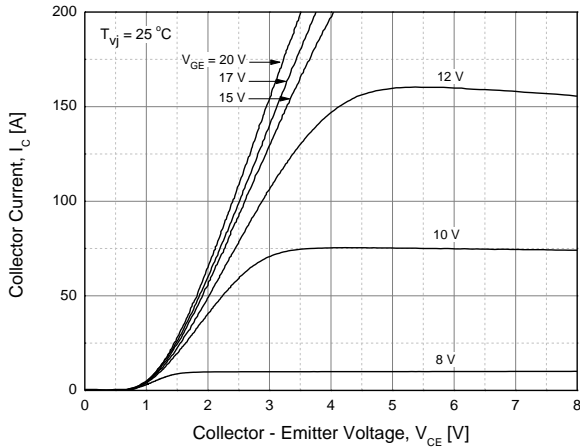


Figure 2. IGBT Output Characteristics

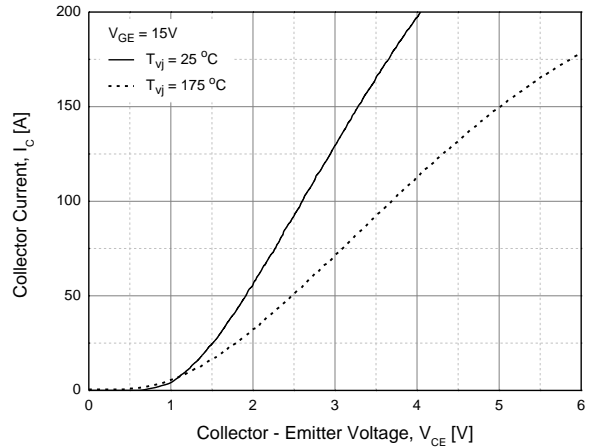


Figure 3. IGBT Saturation Voltage vs. Junction Temperature

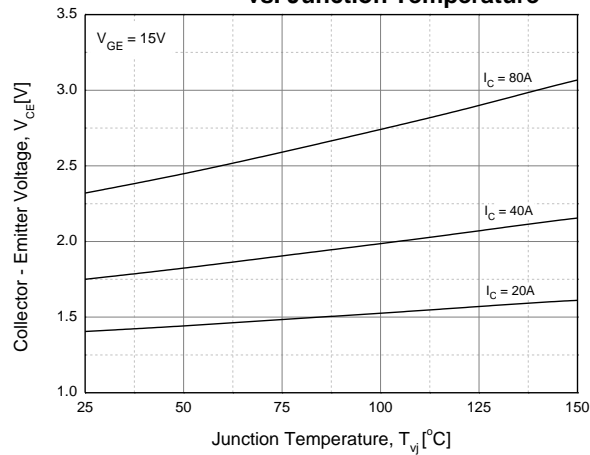


Figure 4. IGBT Saturation Voltage vs. Gate Bias

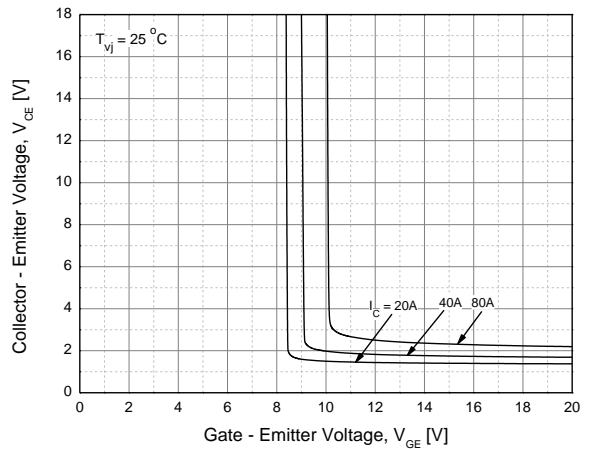


Figure 5. IGBT Saturation Voltage vs. Gate Bias

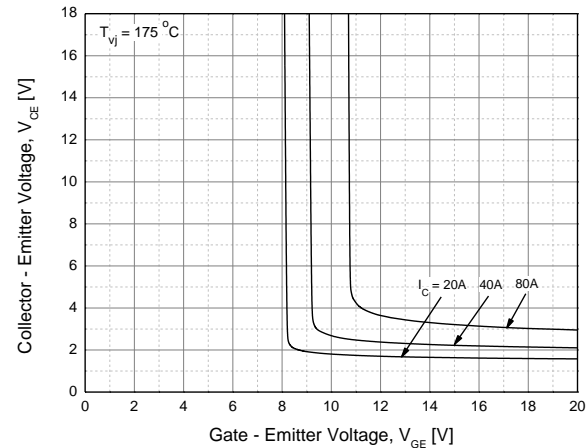
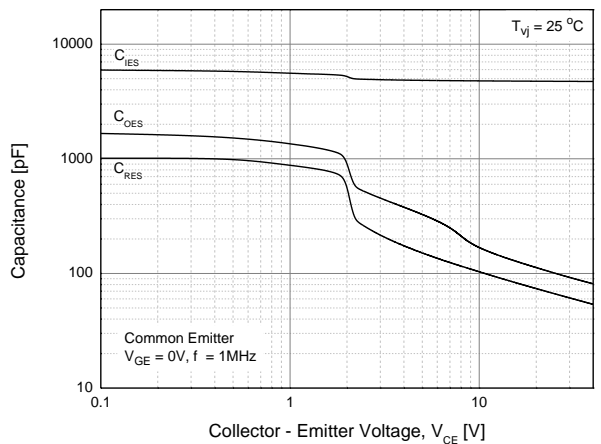


Figure 6. IGBT Capacitance Characteristics



IGBT Characteristics

Figure 7. Turn-on Time vs. Gate Resistor

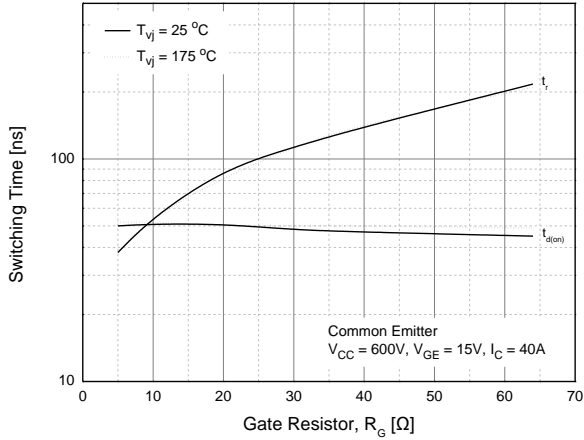


Figure 8. Turn-off Time vs. Gate Resistor

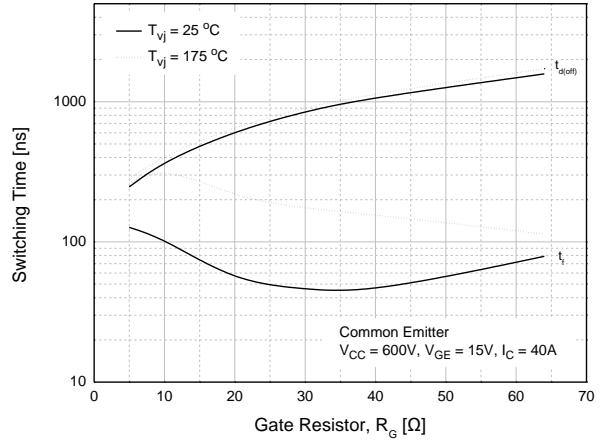


Figure 9. Switching Loss vs. Gate Resistor

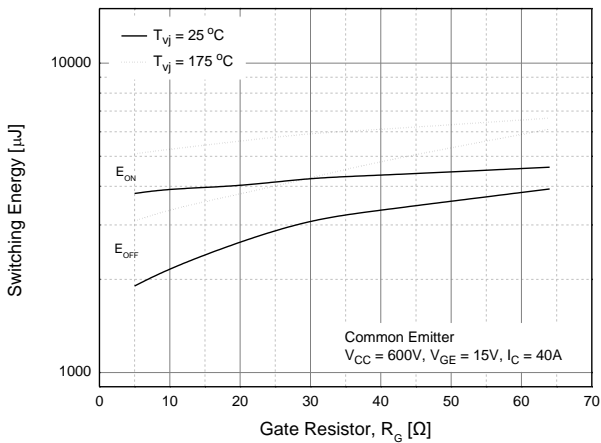


Figure 10. Turn-on Time vs. Collector Current

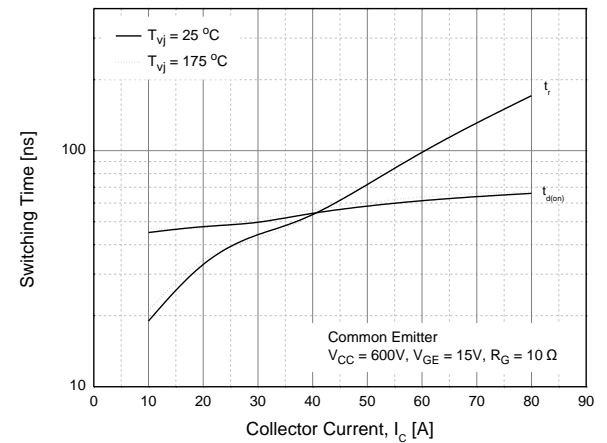


Figure 11. Turn-off Time vs. Collector Current

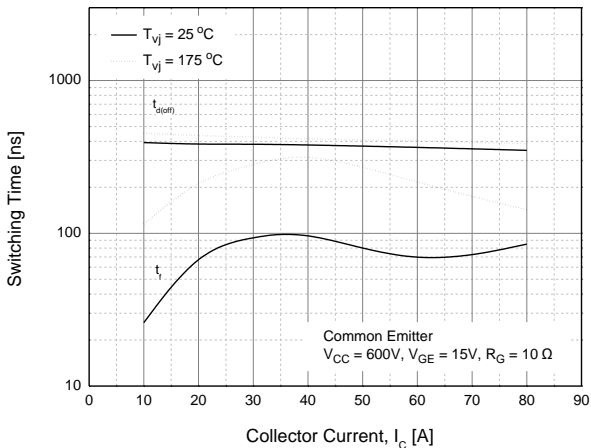
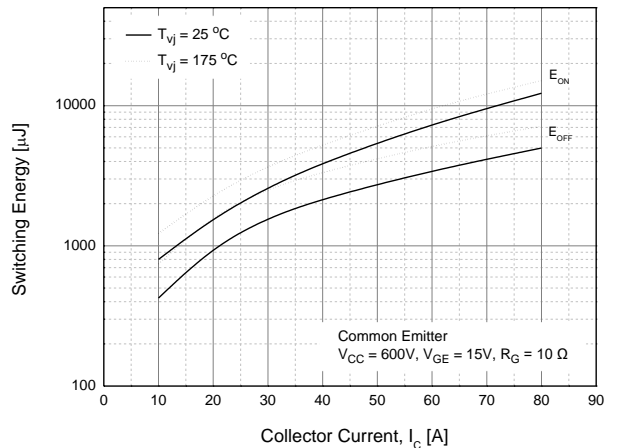


Figure 12. Switching Loss vs. Collector Current



IGBT Characteristics

Figure 13. Gate Charge Characteristics

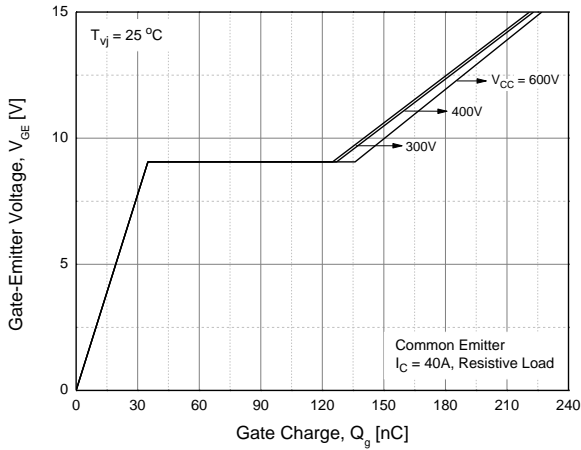


Figure 14. SOA

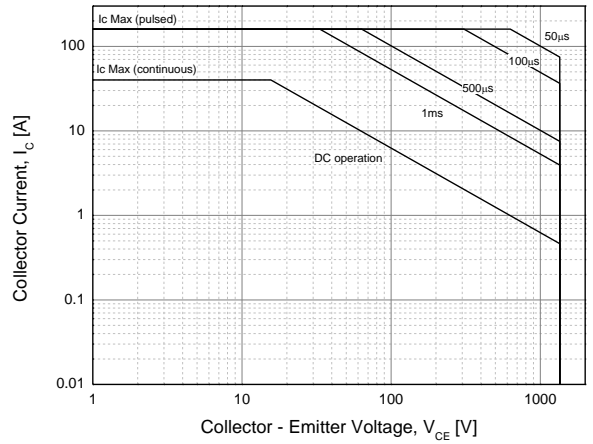


Figure 15. RBSOA

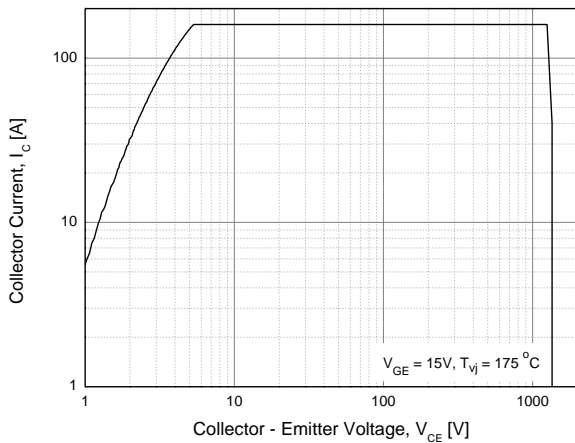


Figure 16. Transient Thermal Impedance of IGBT

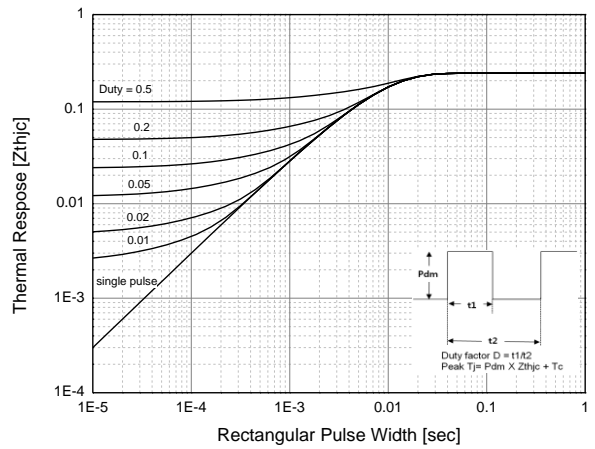
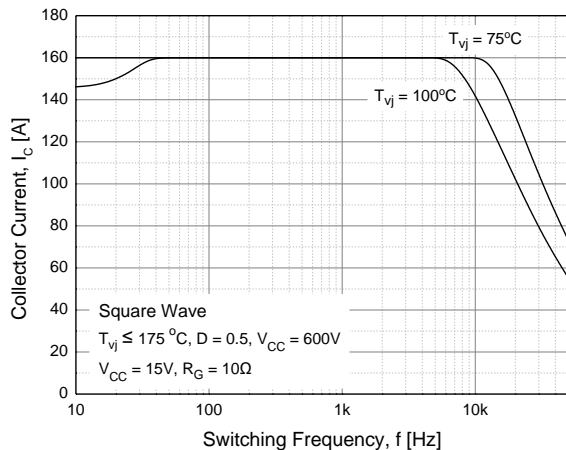


Figure 17. Load Current vs. Frequency



DIODE Characteristics

Figure 18. Diode Conduction Characteristics

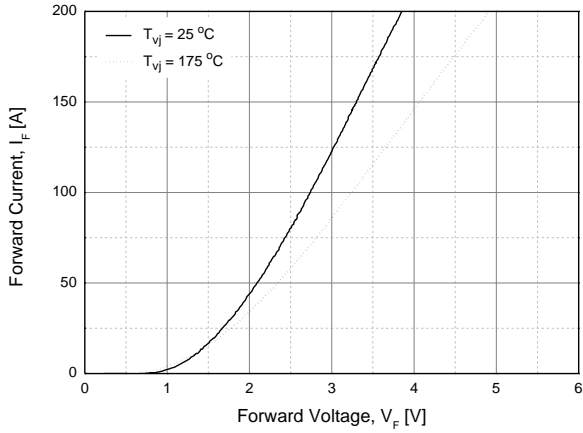


Figure 19. Reverse Recovery Current vs. Forward Current

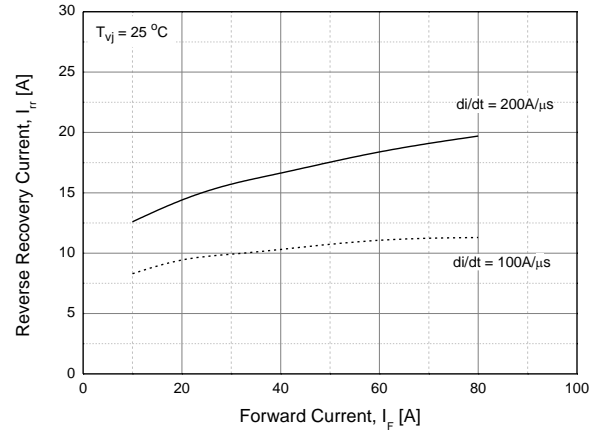


Figure 20. Reverse Recovery Charge vs. Forward Current

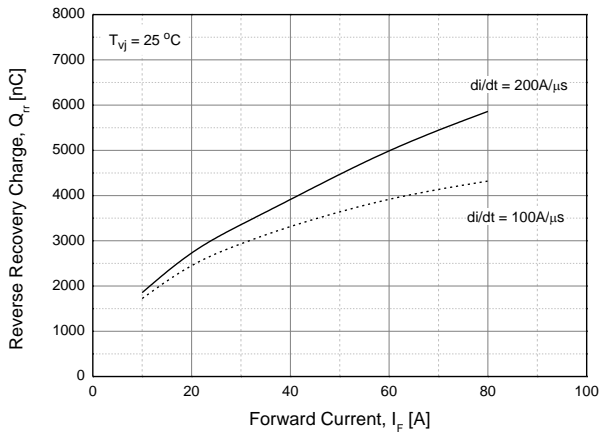
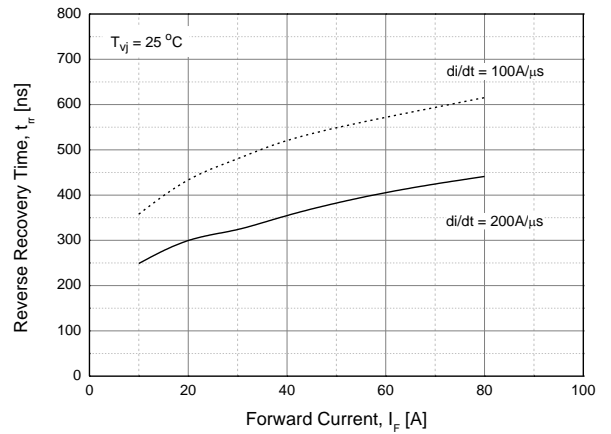
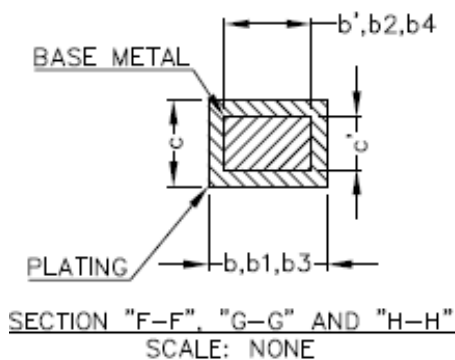
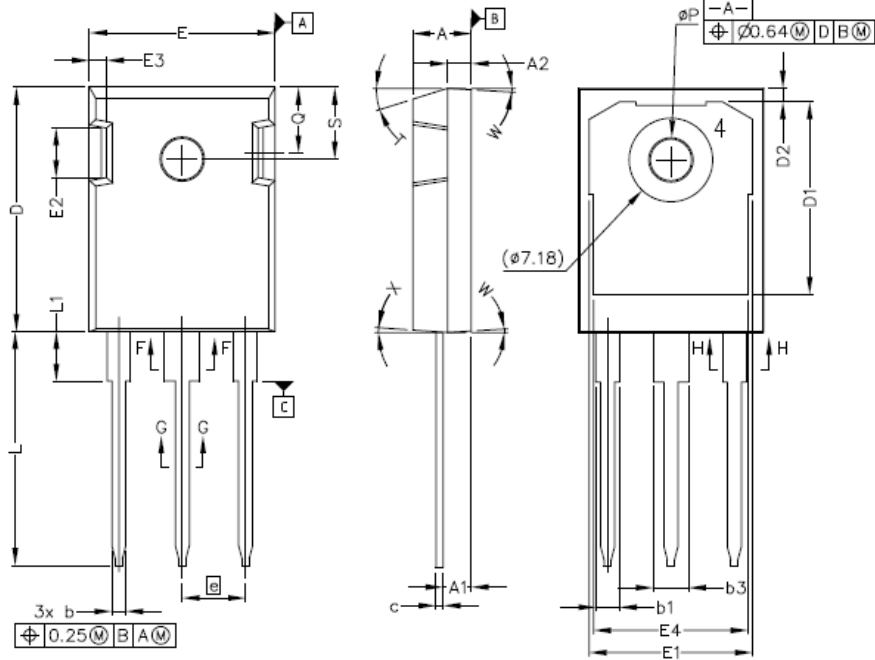


Figure 21. Reverse Recovery Time vs. Forward Current



TO-247 MECHANICAL DATA



| SYM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|----------|------|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | .190 | .205 |
| A1 | 2.29 | 2.54 | .090 | .100 |
| A2 | 1.91 | 2.16 | .075 | .085 |
| b' | 1.07 | 1.28 | .042 | .050 |
| b | 1.07 | 1.33 | .042 | .052 |
| b1 | 1.91 | 2.41 | .075 | .095 |
| b2 | 1.91 | 2.16 | .075 | .085 |
| b3 | 2.87 | 3.38 | .113 | .133 |
| b4 | 2.87 | 3.13 | .113 | .123 |
| c' | 0.55 | 0.65 | .022 | .026 |
| c | 0.55 | 0.68 | .022 | .027 |
| D | 20.80 | 21.10 | .819 | .831 |
| D1 | 16.25 | 17.65 | .640 | .695 |
| D2 | 0.95 | 1.25 | .037 | .049 |
| E | 15.75 | 16.13 | .620 | .635 |
| E1 | 13.10 | 14.15 | .516 | .557 |
| E2 | 3.68 | 5.10 | .145 | .201 |
| E3 | 1.00 | 1.90 | .039 | .075 |
| E4 | 12.38 | 13.43 | .487 | .529 |
| e | 5.44 BSC | | .214 BSC | |
| N | 3 | | 3 | |
| L | 19.81 | 20.32 | .780 | .800 |
| L1 | 4.10 | 4.40 | .161 | .173 |
| φP | 3.51 | 3.65 | .138 | .144 |
| Q | 5.49 | 6.00 | .216 | .236 |
| S | 6.04 | 6.30 | .238 | .248 |
| T | 17.5° REF. | | | |
| W | 3.5° REF. | | | |
| X | 4° REF. | | | |

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