



ON Semiconductor®

FGB20N60SFD-F085 600V, 20A Field Stop IGBT

Features

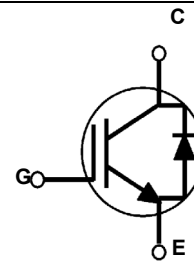
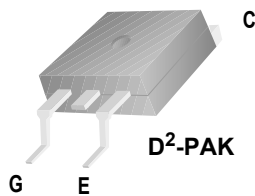
- High current capability
- Low saturation voltage: $V_{CE(sat)} = 2.2V @ I_C = 20A$
- High input impedance
- Fast switching
- Qualified to Automotive Requirements of AEC-Q101
- RoHS compliant

Applications

- Inverters, SMPS, PFC, UPS
- Automotive Chargers, Converters, High Voltage Auxiliaries

General Description

Using novel field-stop IGBT technology, ON Semiconductor's new series of field-stop IGBTs offers the optimum performance for automotive chargers, inverters, and other applications where low conduction and switching losses are essential.



Absolute Maximum Ratings

| Symbol | Description | Ratings | Units |
|-------------|---|-------------|------------|
| V_{CES} | Collector to Emitter Voltage | 600 | V |
| V_{GES} | Gate to Emitter Voltage | ± 20 | V |
| I_C | Collector Current @ $T_C = 25^\circ C$ | 40 | A |
| | Collector Current @ $T_C = 100^\circ C$ | 20 | A |
| $I_{CM(1)}$ | Pulsed Collector Current @ $T_C = 25^\circ C$ | 60 | A |
| I_F | Diode Forward Current @ $T_C = 25^\circ C$ | 20 | A |
| | Diode Forward Current @ $T_C = 100^\circ C$ | 10 | A |
| $I_{FM(1)}$ | Pulsed Diode Maximum Forward Current | 60 | A |
| P_D | Maximum Power Dissipation @ $T_C = 25^\circ C$ | 208 | W |
| | Maximum Power Dissipation @ $T_C = 100^\circ C$ | 83 | W |
| T_J | Operating Junction Temperature | -55 to +150 | $^\circ C$ |
| T_{stg} | Storage Temperature Range | -55 to +150 | $^\circ C$ |
| T_L | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | 300 | $^\circ C$ |

Thermal Characteristics

| Symbol | Parameter | Ratings | Units |
|--------------------------|--------------------------------------|---------|--------------|
| $R_{\theta JC}(IGBT)(2)$ | Thermal Resistance, Junction to Case | 0.6 | $^\circ C/W$ |
| $R_{\theta JC}(Diode)$ | Thermal Resistance, Junction to Case | 2.6 | $^\circ C/W$ |

| Symbol | Parameter | Typ. | Units |
|-----------------|--|------|--------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (PCB Mount)(2) | 75 | $^\circ C/W$ |

FGB20N60SFD-F085 600V, 20A Field Stop IGBT

Package Marking and Ordering Information

| Device Marking | Device | Package | Packaging Type | Qty per Tube | Max Qty per Box |
|----------------|------------------|---------|----------------|--------------|-----------------|
| FGB20N60SFD | FGB20N60SFD-F085 | TO-263 | Tube | 50ea | - |

Electrical Characteristics of the IGBT T_C = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|-------------------------------------|--|--|------|------|------|---------|
| Off Characteristics | | | | | | |
| V_{CES} | Collector to Emitter Breakdown Voltage | $V_{GE} = 0V, I_C = 250\mu A$ | 600 | - | - | V |
| $\frac{\Delta V_{CES}}{\Delta T_J}$ | Temperature Coefficient of Breakdown Voltage | $V_{GE} = 0V, I_C = 250\mu A$ | - | 0.79 | - | V/°C |
| I_{CES} | Collector Cut-Off Current | $V_{CE} = V_{CES}, V_{GE} = 0V$ | - | - | 250 | μA |
| | | ICES at 80%*BV _{CES} , 150°C | - | - | 250 | |
| I_{GES} | G-E Leakage Current | $V_{GE} = V_{GES}, V_{CE} = 0V$ | - | - | ±400 | nA |
| On Characteristics | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C = 250\mu A, V_{CE} = V_{GE}$ | 4.0 | 4.8 | 6.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C = 20A, V_{GE} = 15V$ | - | 2.2 | 2.85 | V |
| | | $I_C = 20A, V_{GE} = 15V, T_C = 125^\circ C$ | - | 2.4 | - | V |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ | - | 940 | 1250 | pF |
| C_{oes} | Output Capacitance | | - | 110 | 146 | pF |
| C_{res} | Reverse Transfer Capacitance | | - | 40 | 53 | pF |
| Switching Characteristics | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 400V, I_C = 20A, R_G = 10\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 25^\circ C$ | - | 10 | 13 | ns |
| t_r | Rise Time | | - | 16 | 21 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 90 | 120 | ns |
| t_f | Fall Time | | - | 24 | 36 | ns |
| E_{on} | Turn-On Switching Loss | | - | 0.31 | 0.41 | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 0.13 | 0.21 | mJ |
| E_{ts} | Total Switching Loss | - | 0.44 | 0.59 | mJ | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 400V, I_C = 20A, R_G = 10\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 125^\circ C$ | - | 12 | 16 | ns |
| t_r | Rise Time | | - | 16 | 21 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 95 | 126 | ns |
| t_f | Fall Time | | - | 28 | 43 | ns |
| E_{on} | Turn-On Switching Loss | | - | 0.45 | 0.60 | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 0.21 | 0.38 | mJ |
| E_{ts} | Total Switching Loss | - | 0.66 | 0.88 | mJ | |
| Q_g | Total Gate Charge | $V_{CE} = 400V, I_C = 20A, V_{GE} = 15V$ | - | 63 | 95 | nC |
| Q_{ge} | Gate to Emitter Charge | | - | 7 | 11 | nC |
| Q_{gc} | Gate to Collector Charge | | - | 32 | 48 | nC |

Electrical Characteristics of the Diode $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max | Units | |
|----------|-------------------------------|---|---------------------------|------|-----|-------|----|
| V_{FM} | Diode Forward Voltage | $I_F = 10A$ | $T_C = 25^\circ\text{C}$ | - | 1.9 | 2.5 | V |
| | | | $T_C = 125^\circ\text{C}$ | - | 1.7 | - | |
| t_{rr} | Diode Reverse Recovery Time | $I_{ES} = 10A, dI_{ES}/dt = 200A/\mu\text{s}$ | $T_C = 25^\circ\text{C}$ | - | 111 | - | ns |
| | | | $T_C = 125^\circ\text{C}$ | - | 204 | - | |
| Q_{rr} | Diode Reverse Recovery Charge | $I_{ES} = 10A, dI_{ES}/dt = 200A/\mu\text{s}$ | $T_C = 25^\circ\text{C}$ | - | 174 | 244 | nC |
| | | | $T_C = 125^\circ\text{C}$ | - | 463 | - | |

Notes:

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

2: R_{thjc} for D2-PAK: according to Mil standard 883-1012 test method.

R_{thja} for D2-PAK: according to JESD51-2, test method environmental condition and JESD51-3, low effective thermal conductivity test board for leaded surface mount package. thermal measurements. JESD51-2: Integrated Circuits Thermal Test Method Environmental Conditions - Natural Convection (Still Air).

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

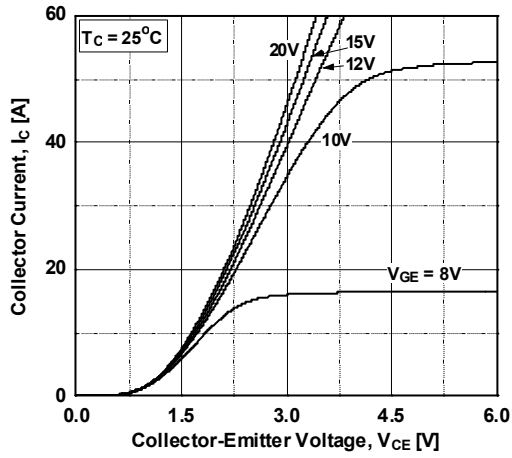


Figure 2. Typical Output Characteristics

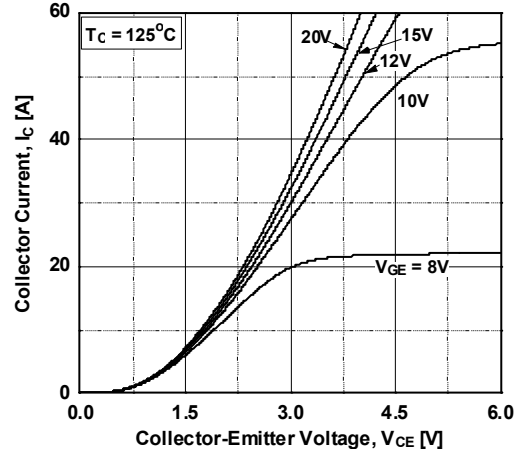


Figure 3. Typical Saturation Voltage Characteristics

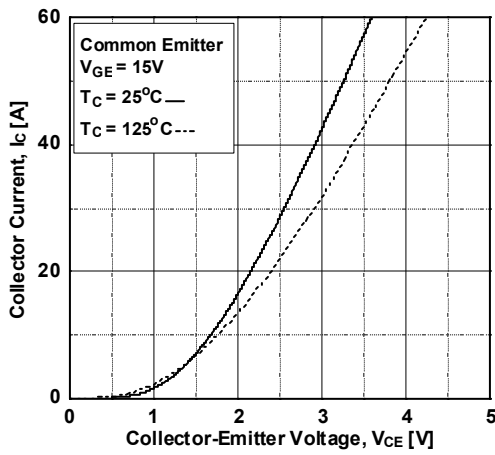


Figure 4. Transfer Characteristics

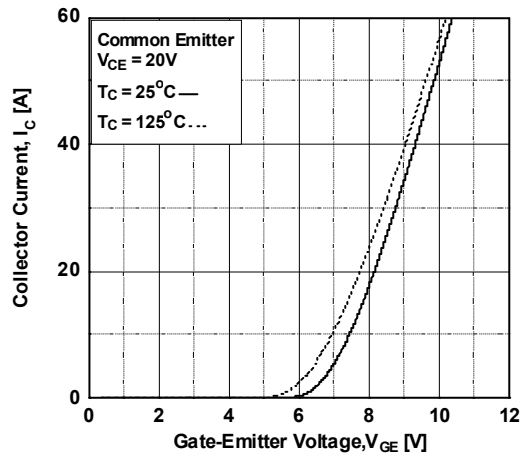


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

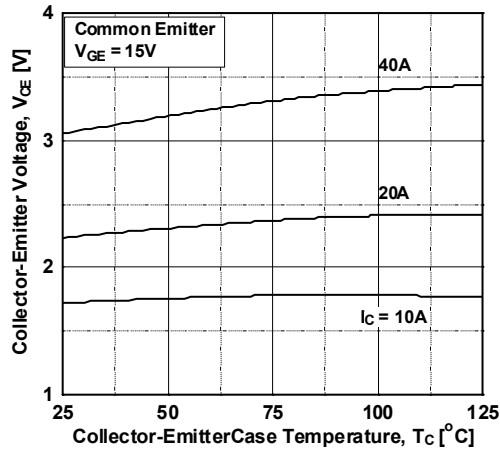
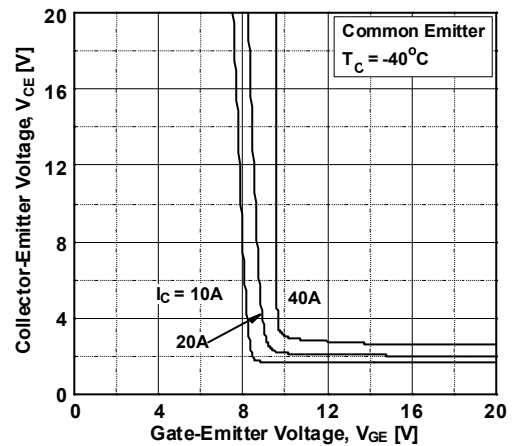


Figure 6. Saturation Voltage vs. Vge



Typical Performance Characteristics

Figure 7. Saturation Voltage vs. V_{GE}

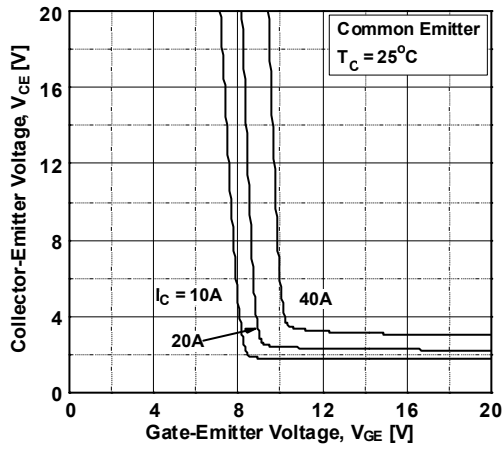


Figure 8. Saturation Voltage vs. V_{GE}

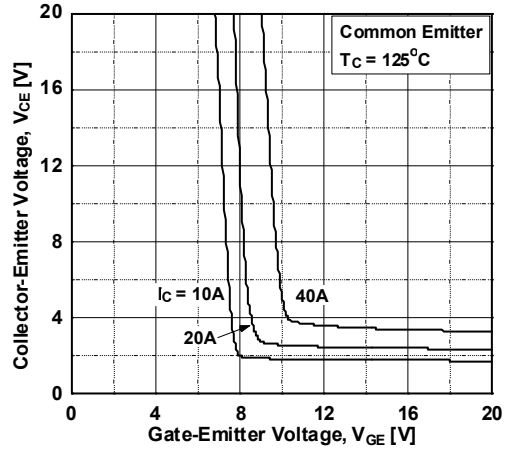


Figure 9. Capacitance Characteristics

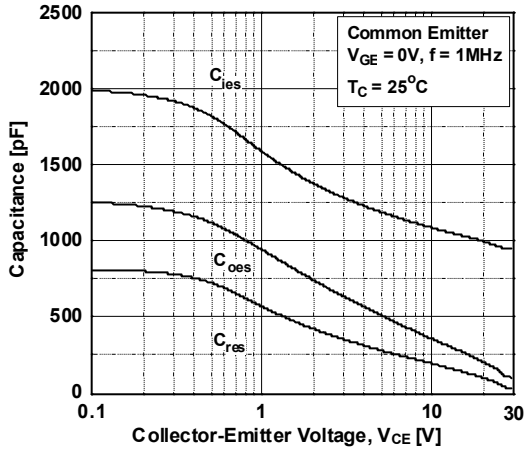


Figure 10. Gate charge Characteristics

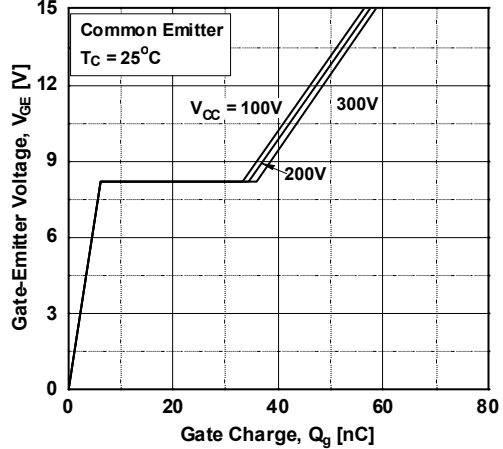


Figure 11. SOA Characteristics

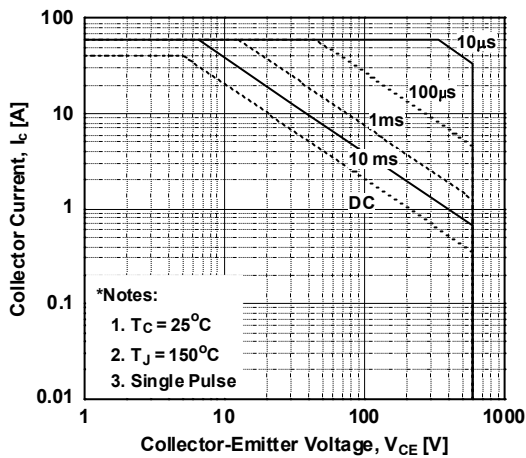
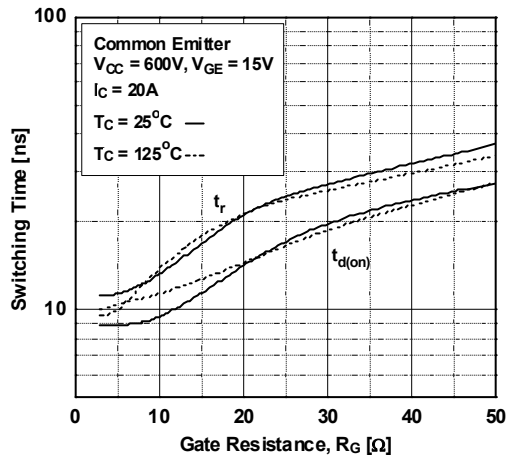


Figure 12. Turn-on Characteristics vs. Gate Resistance



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Gate Resistance

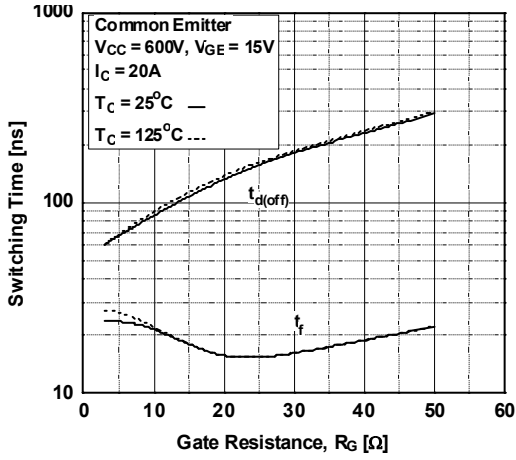


Figure 14. Turn-on Characteristics vs. Collector Current

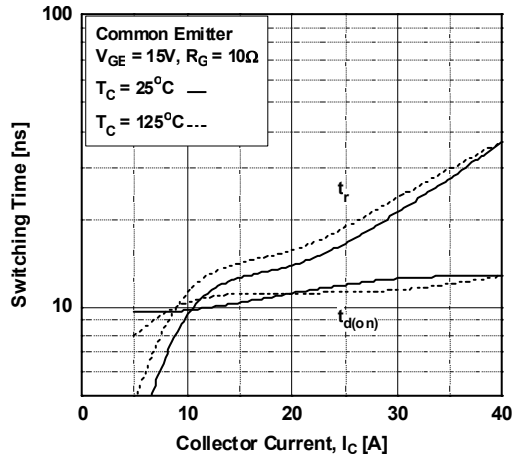


Figure 15. Turn-off Characteristics vs. Collector Current

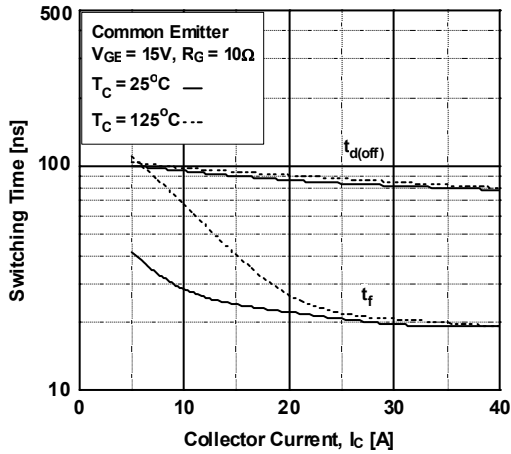


Figure 16. Switching Loss vs. Gate Resistance

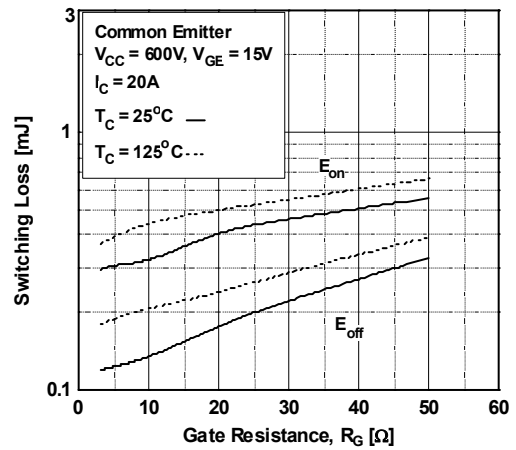


Figure 17. Switching Loss vs. Collector Current

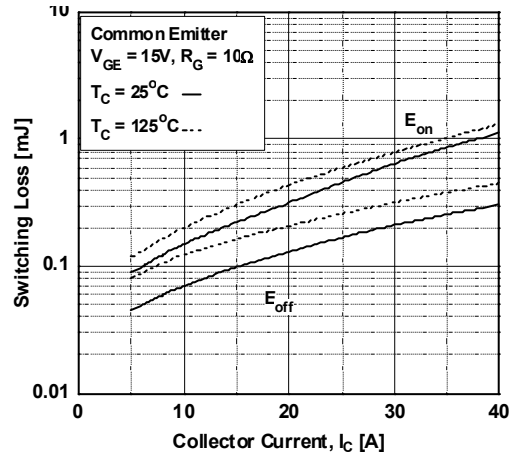
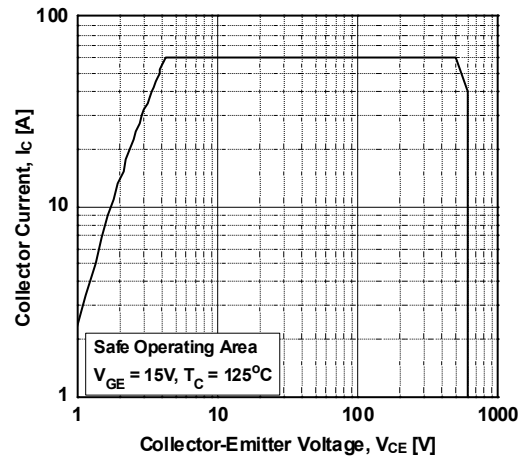


Figure 18. Turn off Switching SOA Characteristics



Typical Performance Characteristics

Figure 19. Forward Characteristics

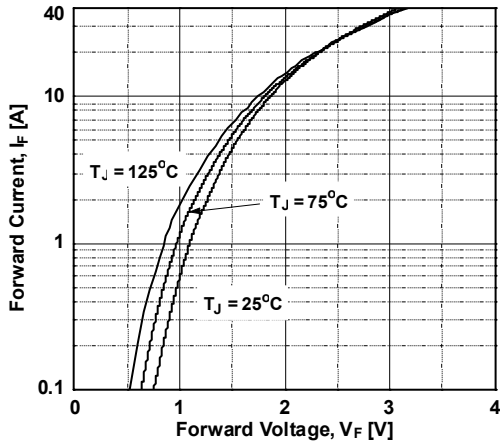


Figure 20. Typical Reverse Current vs. Reverse Voltage

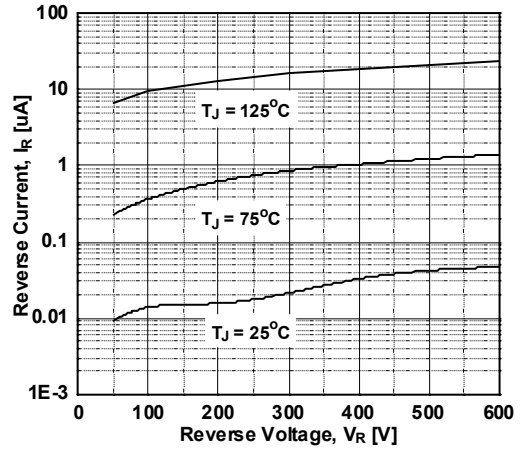


Figure 21. Stored Charge

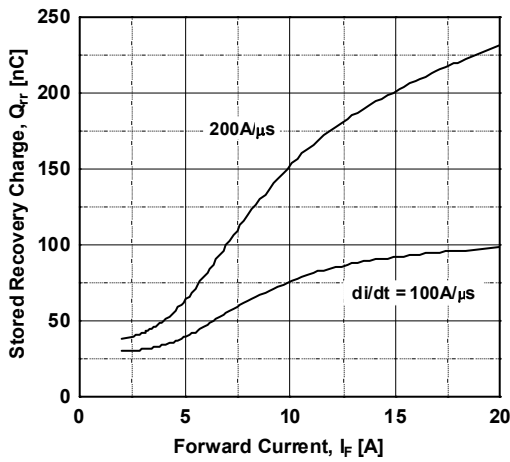


Figure 22. Reverse Recovery Time

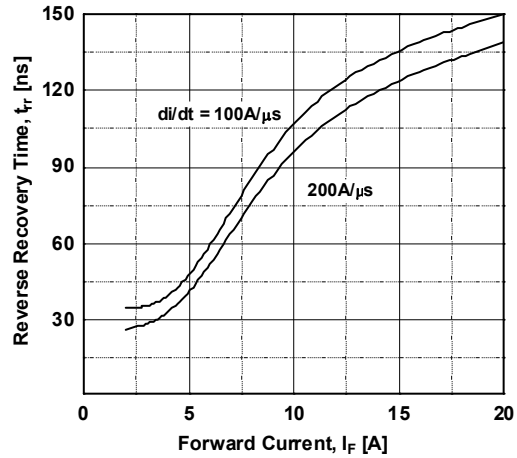
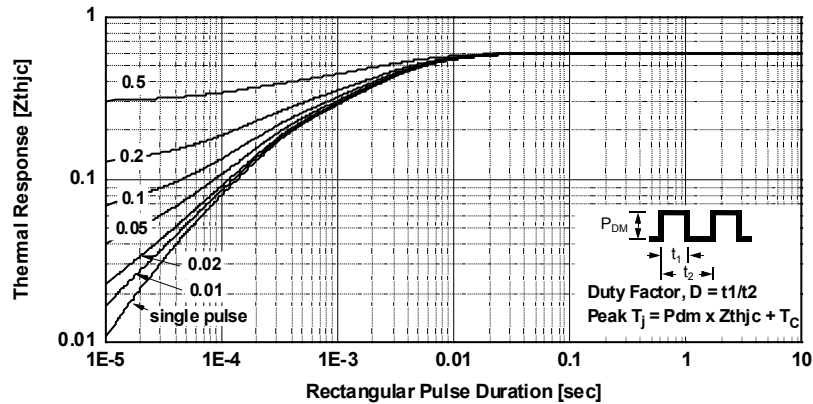
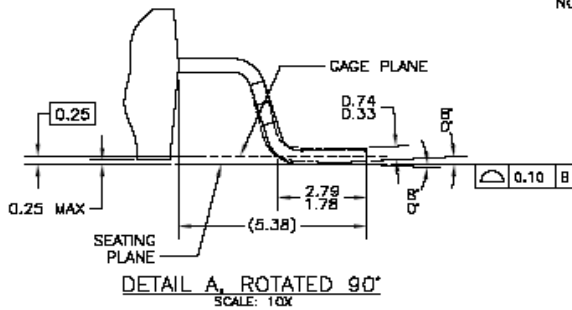
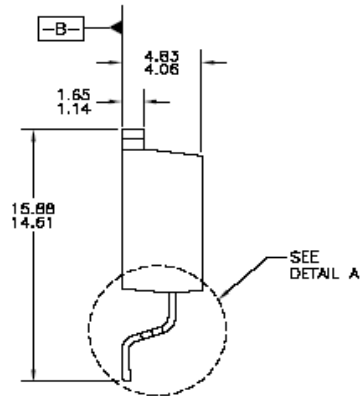
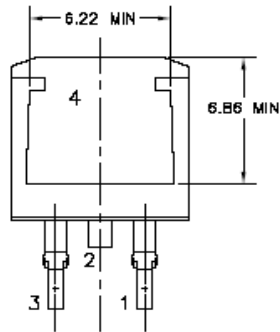
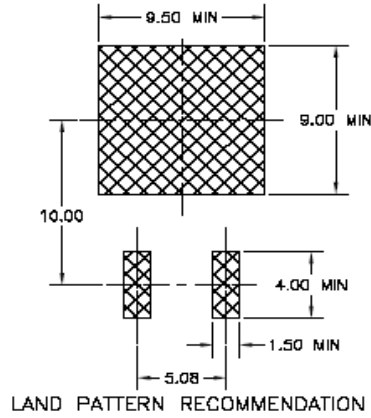
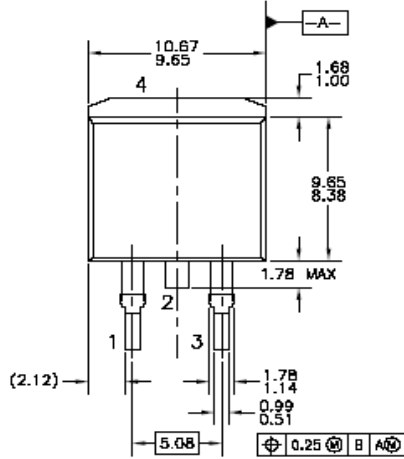


Figure 23. Transient Thermal Impedance of IGBT



Mechanical Dimensions

D²PAK



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) ALL DIMENSIONS ARE IN MILLIMETERS.
 - B) REFERENCE JEDEC, TO-263, ISSUE D, VARIATION AB, DATED JULY 2003.
 - C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1982.
 - D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE).
 - E) PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL.

T02B3AD2REV D

Dimensions in Millimeters

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