FAIRCHILD SEMICONDUCTOR®

September 2013

# FGB7N60UNDF

## 600 V, 7 A
## Short Circuit Rated IGBT

### Features

- Short Circuit Rated 10 us
- High Current Capability
- High Input Impedance
- Fast Switching
- RoHS Compliant

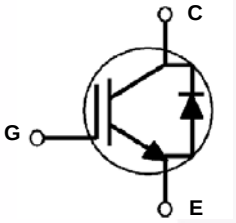
### Applications

- Sewing Machine, CNC, Home Appliances, Motor Control

### General Description

Using advanced NPT IGBT technology, Fairchild's the NPT IGBTs offer the optimum performance for low-power inverter-driven applications where low-losses and short-circuit ruggedness features are essential, such as sewing machine, CNC, motor control and home appliances.


TO-263AB/D$^2$-PAK




### Absolute Maximum Ratings

| Symbol | Description | | Ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 600 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ± 20 | V |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 14 | A |
| | Collector Current | @ $T_C$ = 100°C | 7 | A |
| $I_{CM\ (1)}$ | Pulsed Collector Current | @ $T_C$ = 25°C | 21 | A |
| $I_F$ | Diode Forward Current | @ $T_C$ = 25°C | 7 | A |
| | Diode Forward Current | @ $T_C$ = 100°C | 3.5 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 83 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 33 | W |
| $T_J$ | Operating Junction Temperature | | -55 to +150 | °C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | | 300 | °C |

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

### Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | | 1.5 | °C/W |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | | 3.5 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (PCB Mount)(2) | | 40 | °C/W |

**Notes:**
2: Mounted on 1" square PCB (FR4 or G-10 material)

## Package Marking and Ordering Information

| Device Marking | Device | Package | Rel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FGB7N60UNDF | FGB7N60UNDF | TO-263AB($D^2$-PAK) | | - | 50 |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 250μA | 600 | - | - | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | - | - | 1 | mA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0V | - | - | ±10 | uA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 7mA, $V_{CE}$ = $V_{GE}$ | 5.5 | 6.8 | 8.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 7A, $V_{GE}$ = 15V | - | 1.9 | 2.3 | V |
| | | $I_C$ = 7A, $V_{GE}$ = 15V, $T_C$ = 125°C | - | 2.1 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30V, $V_{GE}$ = 0V, f = 1MHz | - | 275 | | pF |
| $C_{oes}$ | Output Capacitance | | - | 41 | | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 10 | | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400V, $I_C$ = 7A, $R_G$ = 10Ω, $V_{GE}$ = 15V, Inductive Load, $T_C$ = 25°C | - | 5.9 | | ns |
| $t_r$ | Rise Time | | - | 4.2 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 32.3 | | ns |
| $t_f$ | Fall Time | | - | 68 | 89 | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 99 | | uJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 104 | | uJ |
| $E_{ts}$ | Total Switching Loss | | - | 203 | | uJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400V, $I_C$ = 7A, $R_G$ = 10Ω, $V_{GE}$ = 15V, Inductive Load, $T_C$ = 125°C | - | 6 | | ns |
| $t_r$ | Rise Time | | - | 4.3 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 33.8 | | ns |
| $t_f$ | Fall Time | | - | 113 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 181 | | uJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 144 | | uJ |
| $E_{ts}$ | Total Switching Loss | | - | 325 | | uJ |
| $T_{sc}$ | Short Circuit Withstand Time | $V_{CC}$ = 350V, $R_G$ = 100Ω, $V_{GE}$ = 15V, $T_C$ = 150°C | 10 | | | us |

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

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400V, $I_C$ = 7A, $V_{GE}$ = 15V | - | 18 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 3 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 13 | - | nC |

## Electrical Characteristics of the Diode $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 7A | $T_C$ = 25°C | - | 1.7 | 2.2 | V |
| | | | $T_C$ = 125°C | - | 1.6 | | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ =7A, $dI_F/dt$ = 200A/µs | $T_C$ = 25°C | - | 32.3 | | ns |
| | | | $T_C$ = 125°C | - | 70 | | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 59 | | nC |
| | | | $T_C$ = 125°C | - | 172 | - | |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

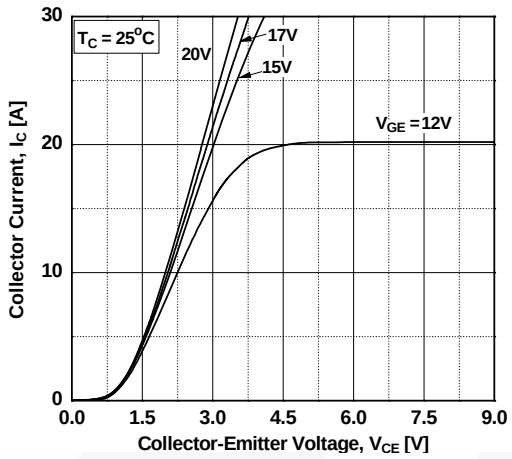



**Figure 2. Typical Output Characteristics**

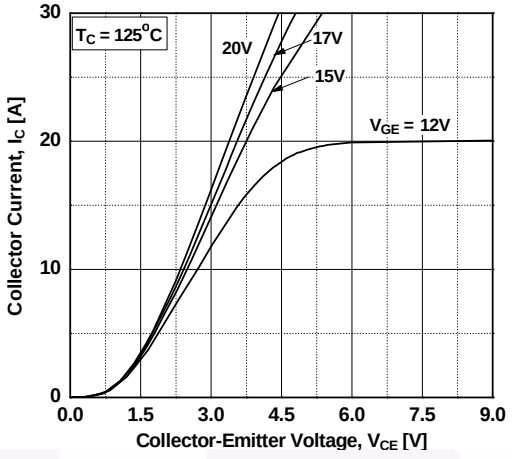



**Figure 3. Typical Saturation Voltage Characteristics**

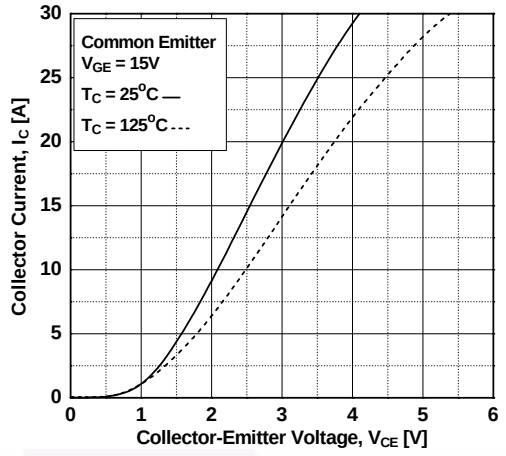



**Figure 4. Transfer Characteristics**

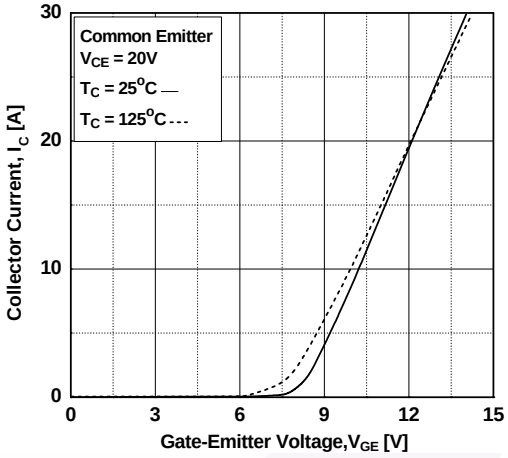



**Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level**

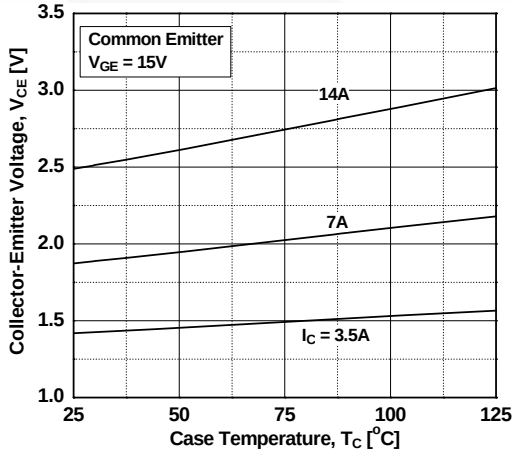
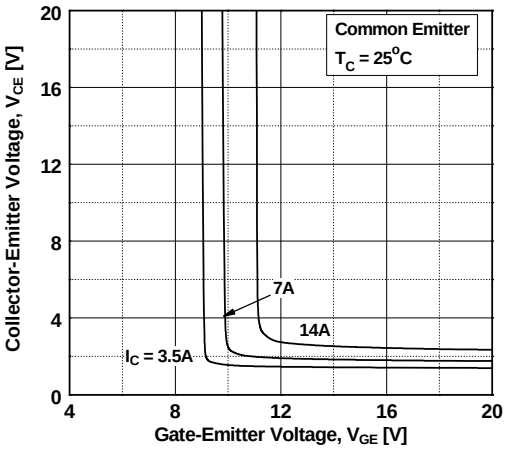
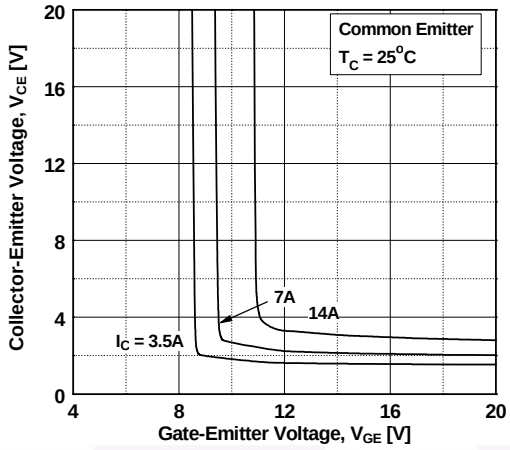



**Figure 6. Saturation Voltage vs. $V_{GE}$**

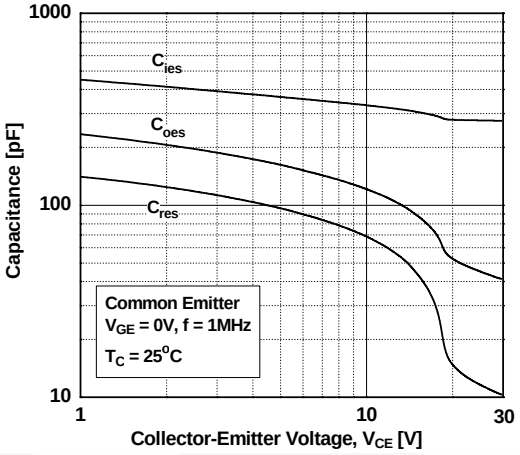


## Typical Performance Characteristics

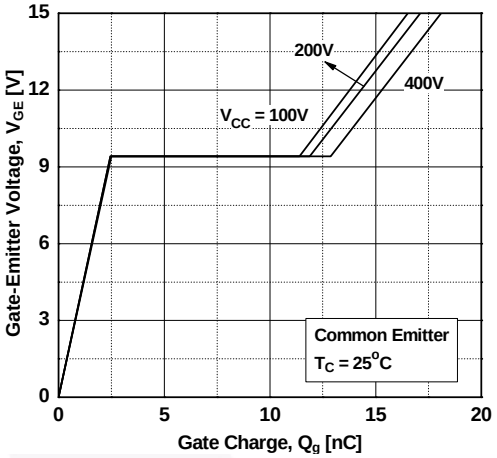
### Figure 7. Saturation Voltage vs. $V_{GE}$



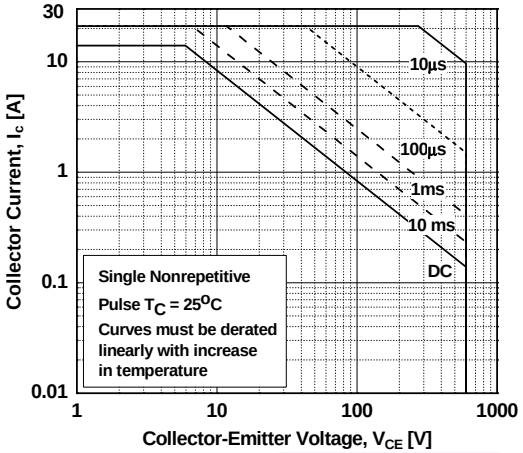

### Figure 8. Capacitance Characteristics



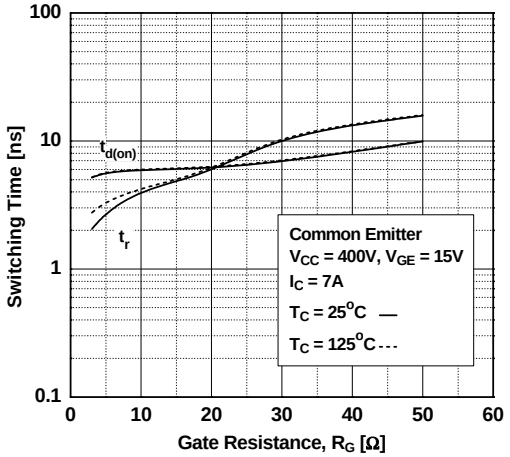

### Figure 9. Gate charge Characteristics



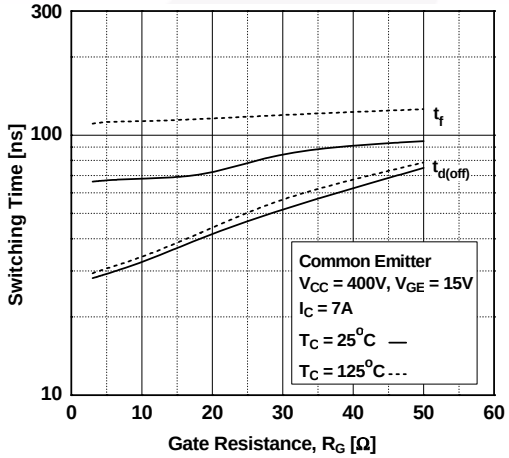

### Figure 10. SOA Characteristics




### Figure 11. Turn-on Characteristics vs. Gate Resistance




### Figure 12. Turn-off Characteristics vs. Gate Resistance



## Typical Performance Characteristics

**Figure 13. Turn-on Characteristics vs. Collector Current**

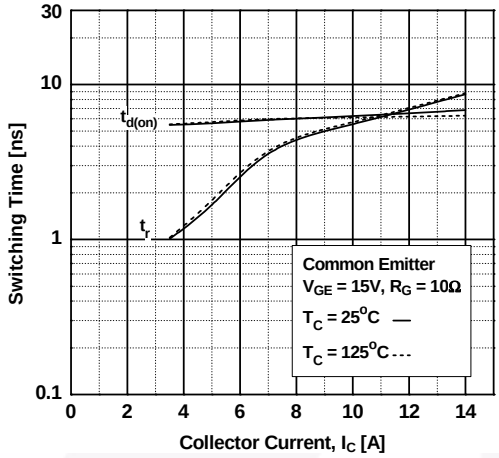



**Figure 14. Turn-off Characteristics vs. Collector Current**

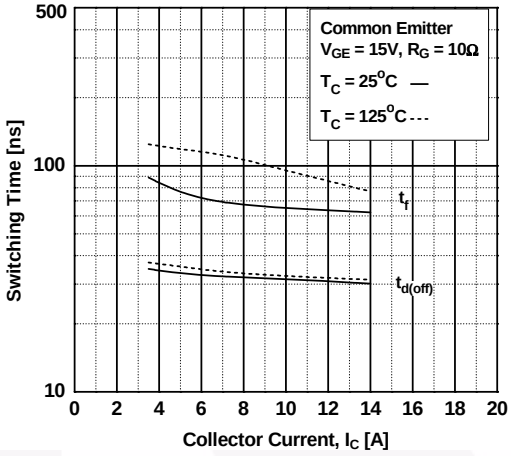



**Figure 15. Switching Loss vs. Gate Resistance**

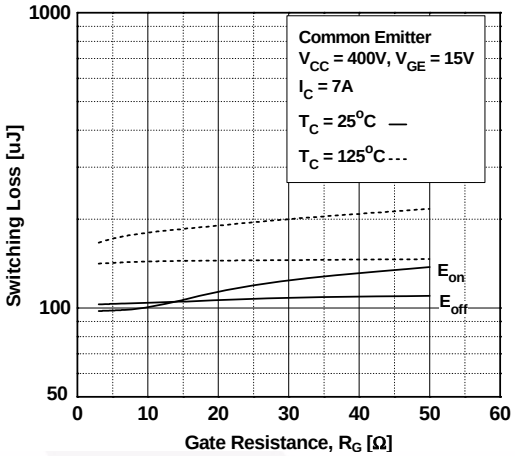



**Figure 16. Switching Loss vs Collector Current**

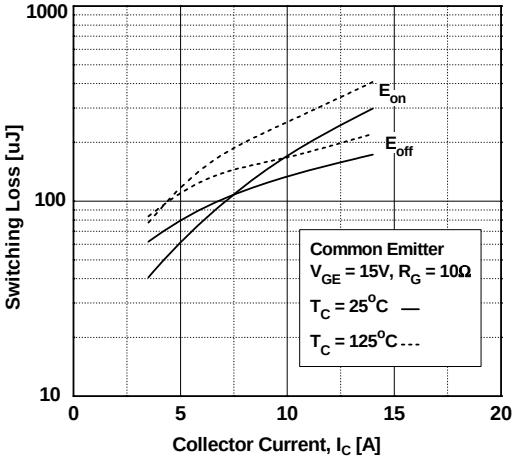



**Figure 17. Turn off Switching SOA Characteristics**

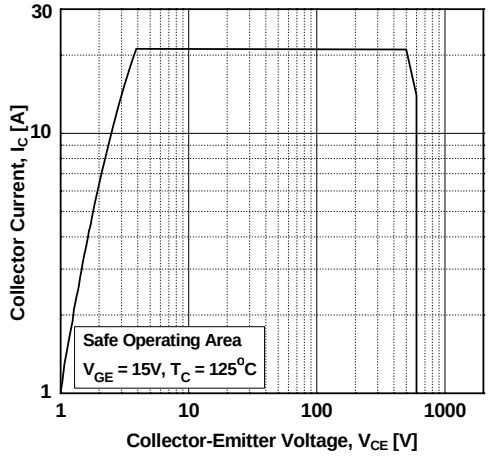
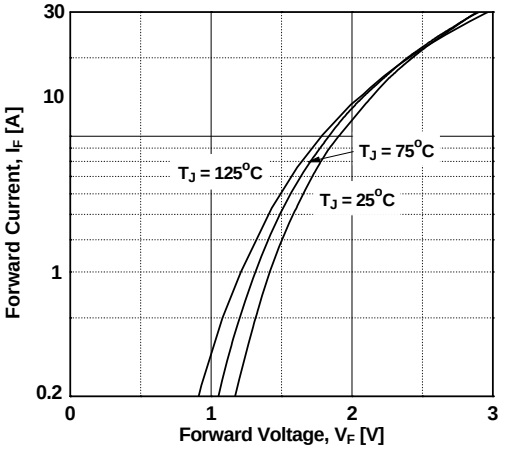



**Figure 18. Forward Characteristics**



## Typical Performance Characteristics

**Figure 19. Reverse Current**

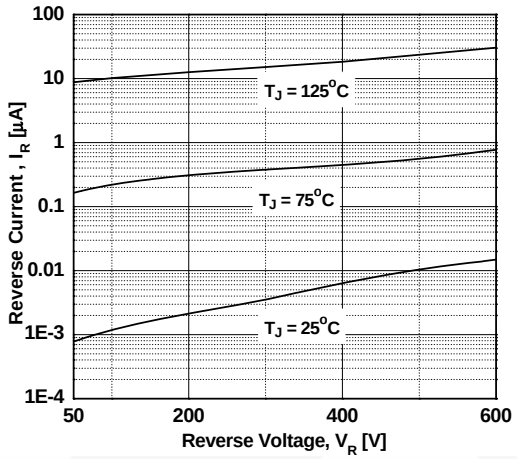



**Figure 20. Stored Charge**

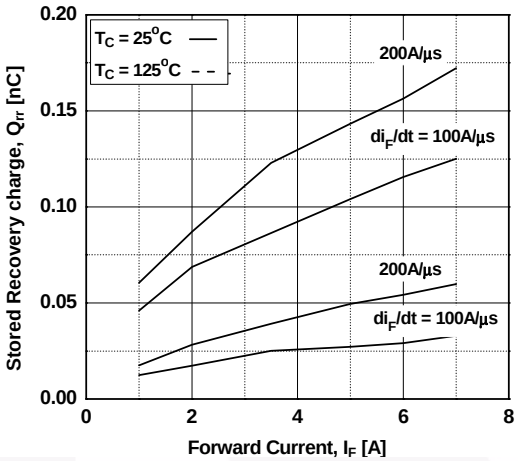



**Figure 21. Reverse Recovery Time**

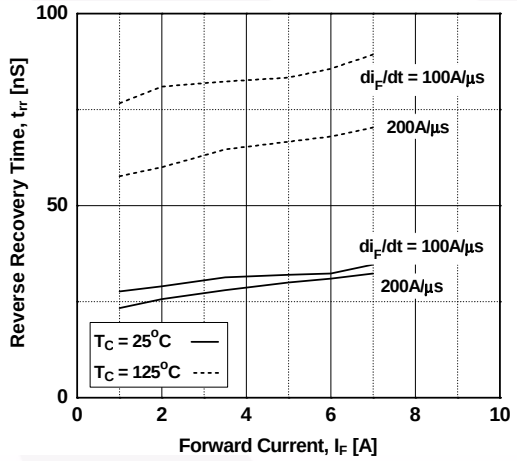
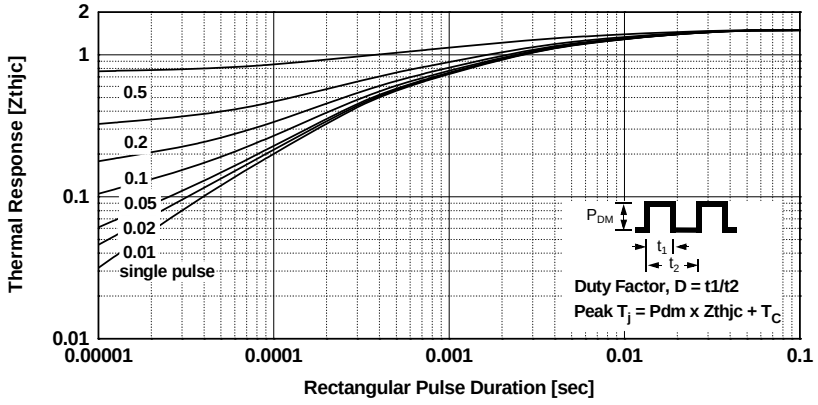



**Figure 22.Transient Thermal Impedance of IGBT**



## Mechanical Dimensions

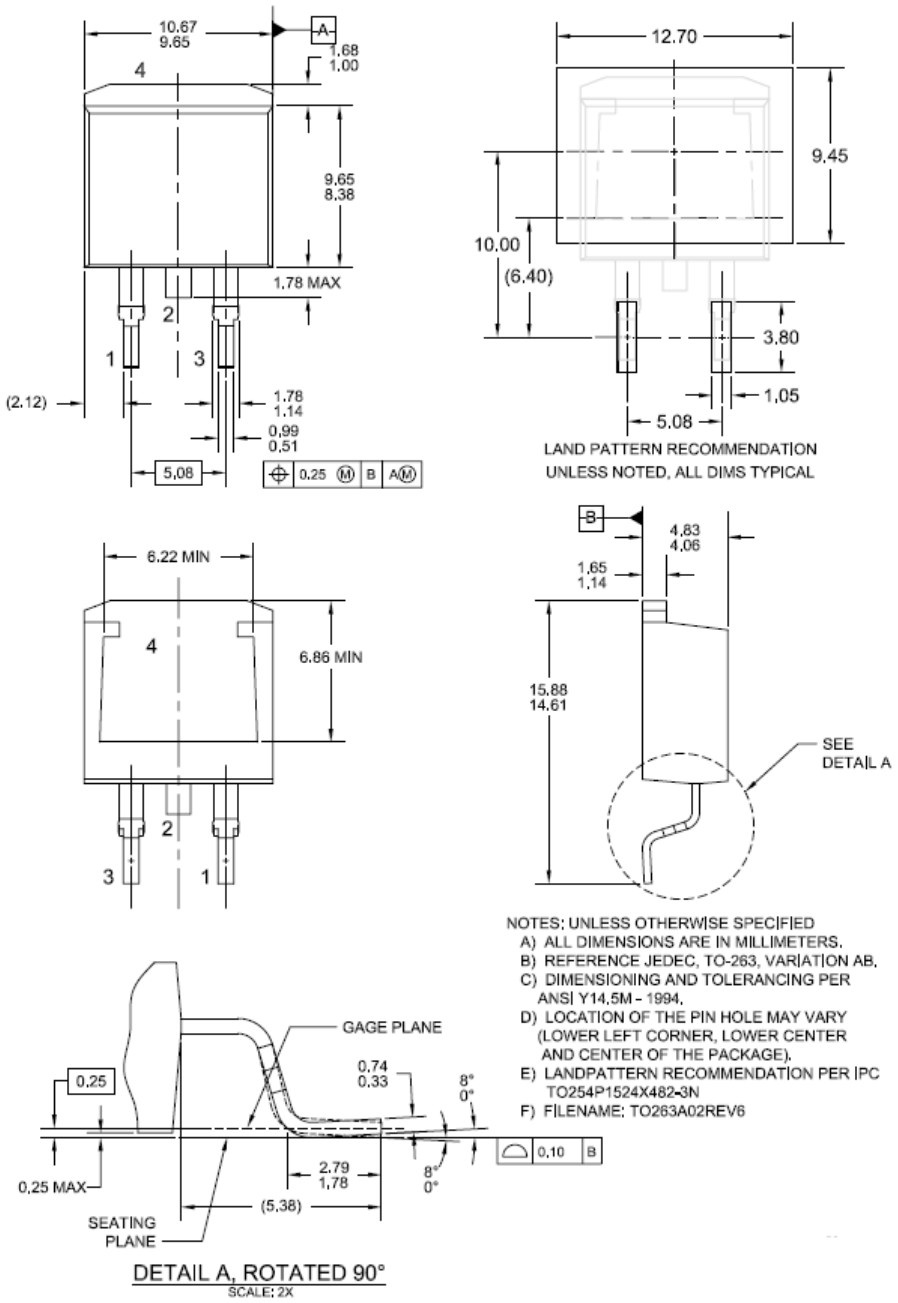



**Figure 23. TO-263 2L (D2PAK) - 2LD,TO263, SURFACE MOUNT**

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Dimensions in Millimeters

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|---|---|---|
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