March 2015

# FGB20N60SFD
## 600 V, 20 A Field Stop IGBT

### Features

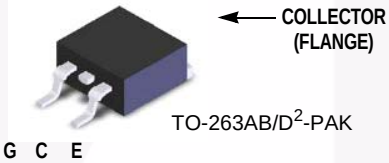
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 2.2 V @ $I_C$ = 20 A
- High Input Impedance
- Fast Switching : $E_{OFF}$ = 8 uJ/A
- RoHS Compliant

### Applications

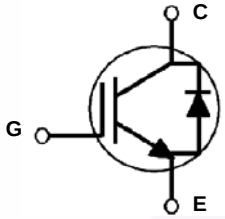
- Solar Inverter, UPS, Welder, PFC

### General Description

Using novel field stop IGBT technology, Fairchild's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switching losses are essential.




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 |
| | Transient Gate-to-Emitter Voltage | | ±30 | |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 40 | A |
| | Collector Current | @ $T_C$ = 100°C | 20 | A |
| $I_{CM\ (1)}$ | Pulsed Collector Current | @ $T_C$ = 25°C | 60 | A |
| $I_F$ | Diode Forward Current | @ $T_C$ = 25°C | 20 | A |
| | Diode Forward Current | @ $T_C$ = 100°C | 10 | A |
| $I_{FM(1)}$ | Pulsed Diode Maximum Forward Current | | 60 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 208 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 83 | 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 | - | 0.6 | $^oC/W$ |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | - | 2.6 | $^oC/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (PCB Mount)(2) | - | 40 | $^oC/W$ |

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

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGB20N60SFD | FGB20N60SFD | $D^2$-PAK | Reel | 13” Dia | N/A | 800 |

## 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 | $V_{GE}$ = 0 V, $I_C$ = 250 µA | 600 | - | - | V |
| $\Delta BV_{CES}$ / $\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 250 µA | - | 0.6 | - | $V/^oC$ |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | - | - | 250 | µA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | - | - | ±400 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 250 µA, $V_{CE}$ = $V_{GE}$ | 4.0 | 5.0 | 6.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 20 A, $V_{GE}$ = 15 V | - | 2.2 | 2.8 | V |
| | | $I_C$ = 20 A, $V_{GE}$ = 15 V, $T_C$ = 125°C | - | 2.4 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | - | 940 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 110 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 40 | - | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | - | 13 | - | ns |
| $t_r$ | Rise Time | | - | 16 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 90 | - | ns |
| $t_f$ | Fall Time | | - | 24 | 48 | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.37 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.16 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 0.53 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 125°C | - | 12 | - | ns |
| $t_r$ | Rise Time | | - | 16 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 95 | - | ns |
| $t_f$ | Fall Time | | - | 28 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.4 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.28 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 0.69 | - | mJ |

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

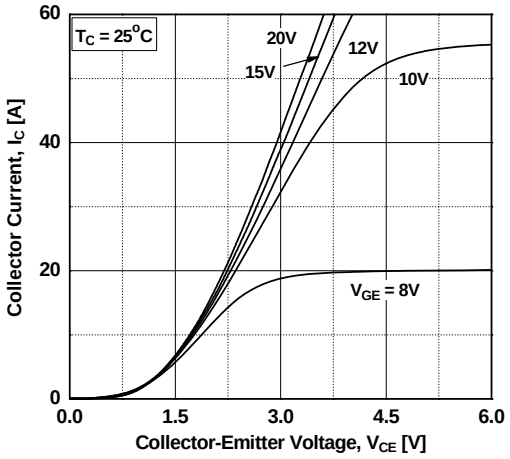
| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 20 A, $V_{GE}$ = 15 V | - | 65 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 7 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 33 | - | nC |

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

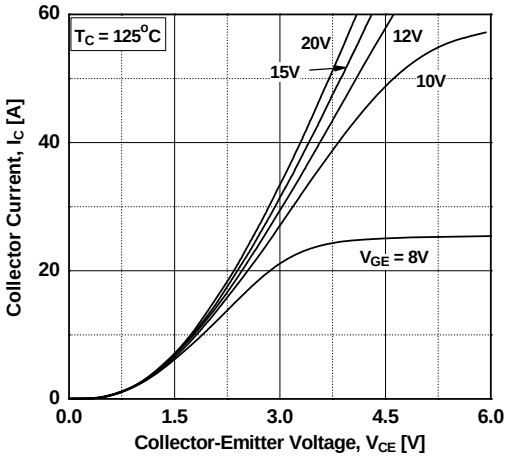
| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 10 A | $T_C$ = 25°C | - | 1.9 | 2.5 | V |
| | | | $T_C$ = 125°C | - | 1.7 | - | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ =10 A, $di_F/dt$ = 200 A/µs | $T_C$ = 25°C | - | 34 | - | ns |
| | | | $T_C$ = 125°C | - | 57 | - | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 41 | - | nC |
| | | | $T_C$ = 125°C | - | 96 | - | |

## Typical Performance Characteristics

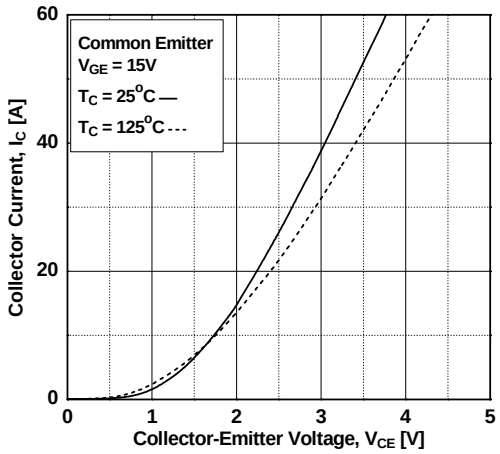
### Figure 1. Typical Output Characteristics



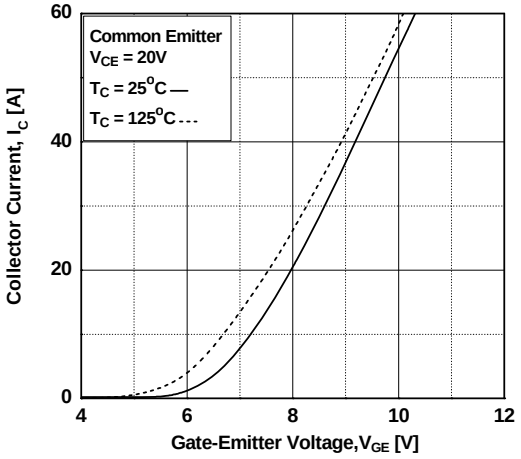

### Figure 2. Typical Output Characteristics



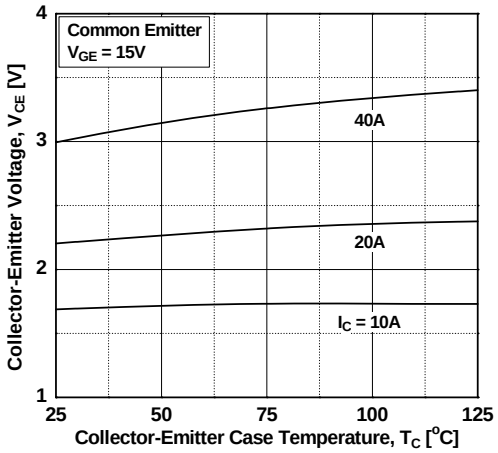

### Figure 3. Typical Saturation Voltage Characteristics



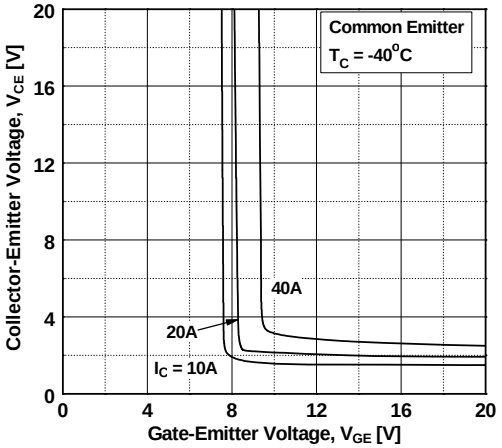

### Figure 4. Transfer Characteristics




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

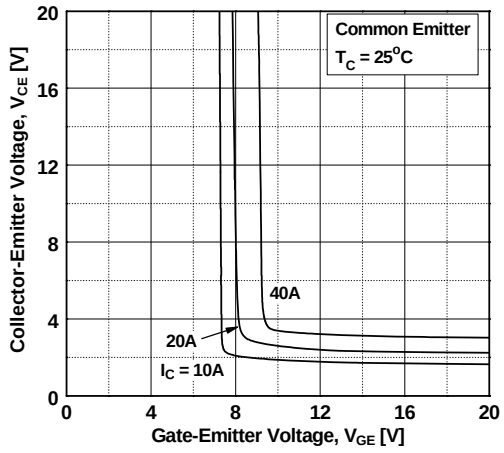



### Figure 6. Saturation Voltage vs. $V_{GE}$

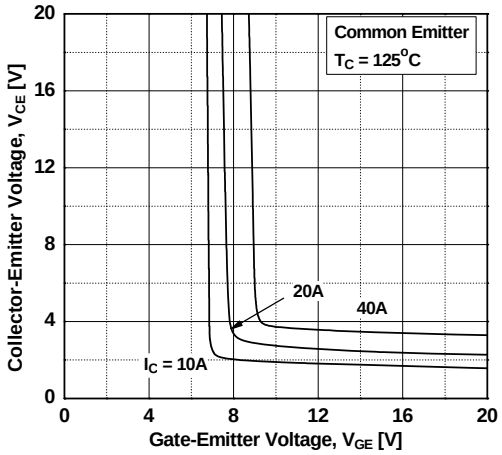


## Typical Performance Characteristics

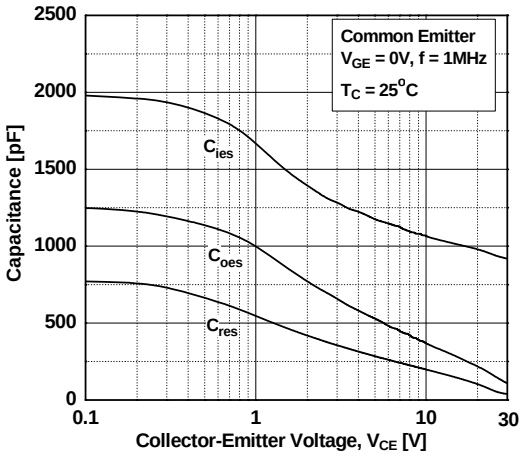
### Figure 7. Saturation Voltage vs. $V_{GE}$



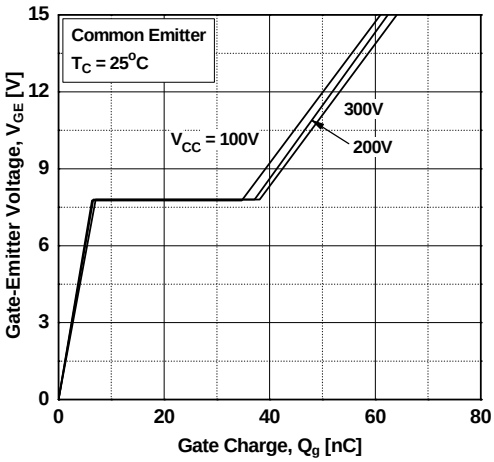

### Figure 8. Saturation Voltage vs. $V_{GE}$



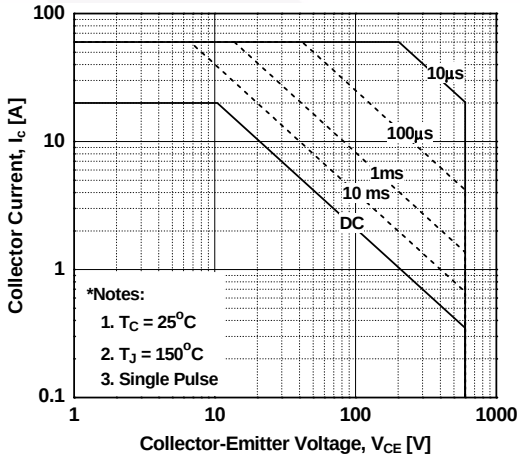

### Figure 9. Capacitance Characteristics



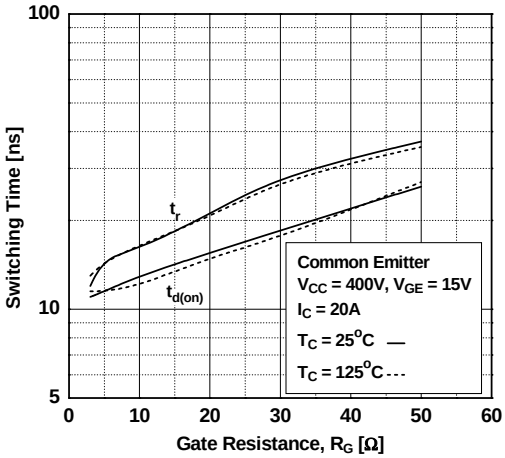

### Figure 10. Gate charge Characteristics




### Figure 11. SOA Characteristics




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



## Typical Performance Characteristics

**Figure 13. Turn-off Characteristics vs. Gate Resistance**

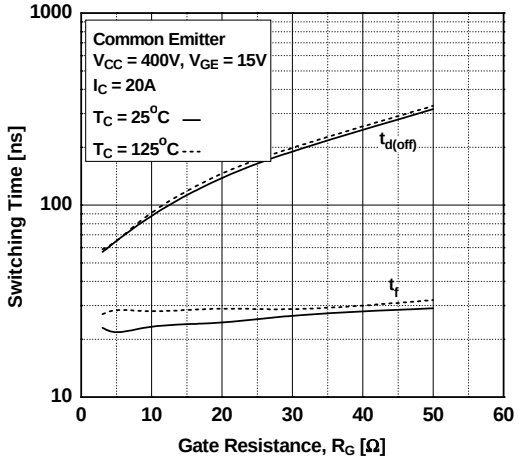



**Figure 14. Turn-on Characteristics vs. Collector Current**

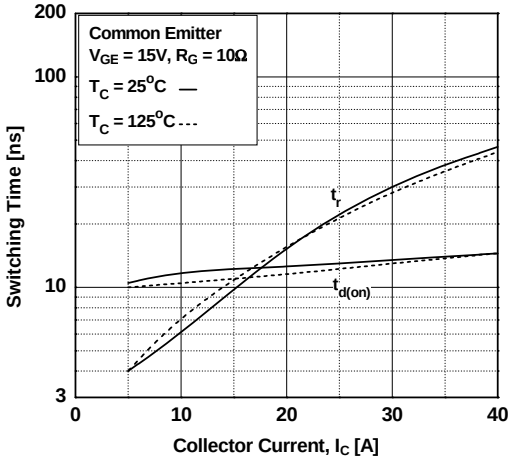



**Figure 15. Turn-off Characteristics vs. Collector Current**

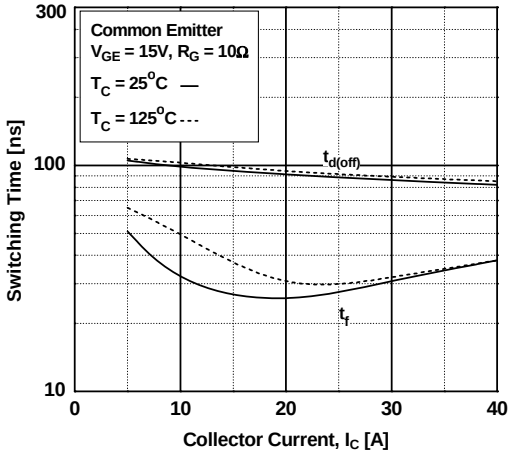



**Figure 16. Switching Loss vs. Gate Resistance**

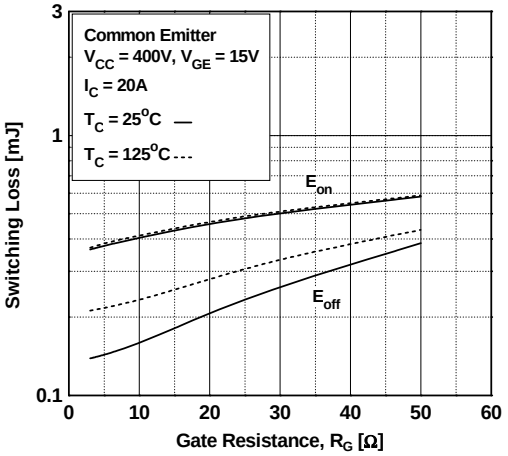



**Figure 17. Switching Loss vs. Collector Current**

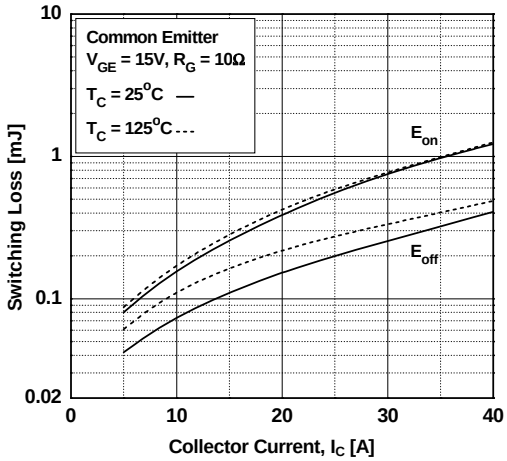
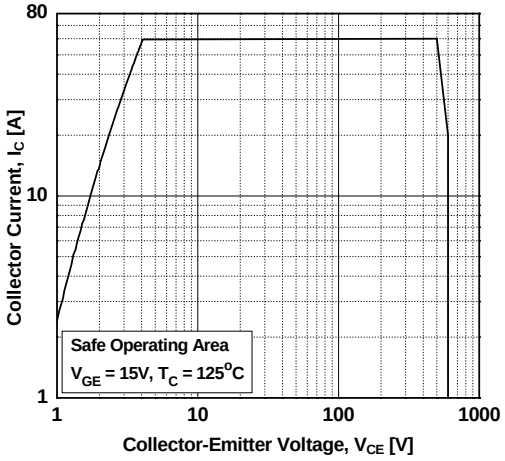
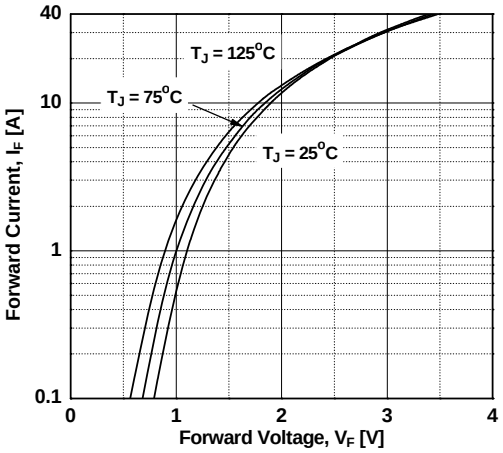



**Figure 18. Turn off Switching SOA Characteristics**

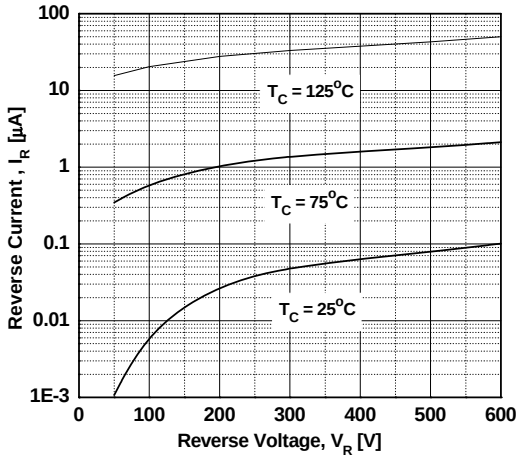


## Typical Performance Characteristics

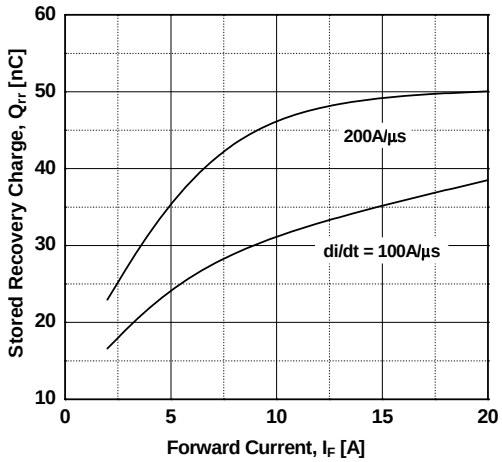
### Figure 19. Forward Characteristics



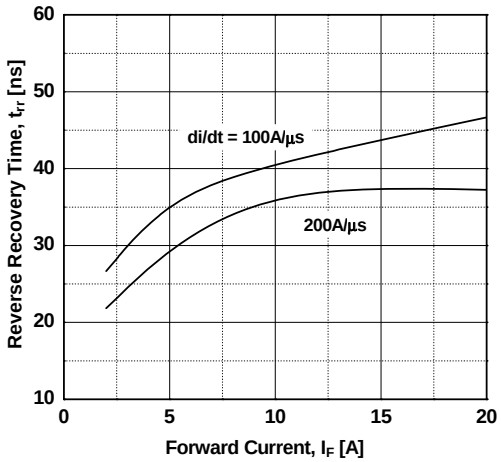

### Figure 20. Reverse Current



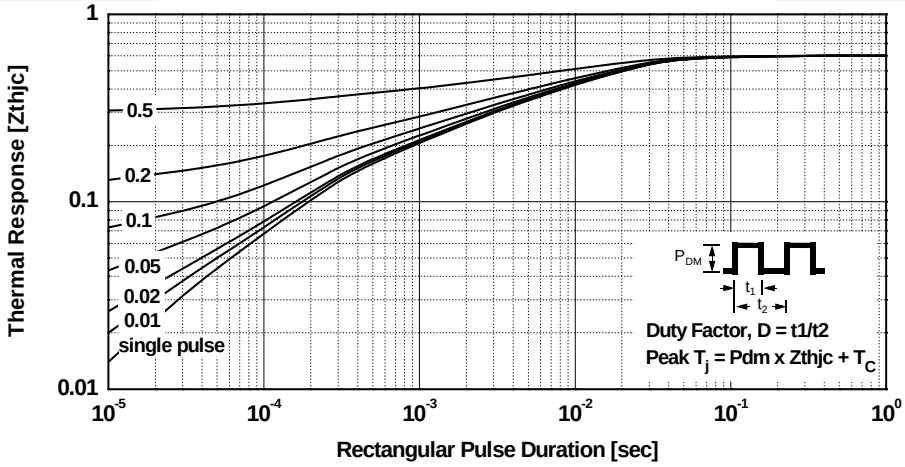

### Figure 21. Stored Charge




### Figure 22. Reverse Recovery Time




### Figure 23.Transient Thermal Impedance of IGBT



## Mechanical Dimensions

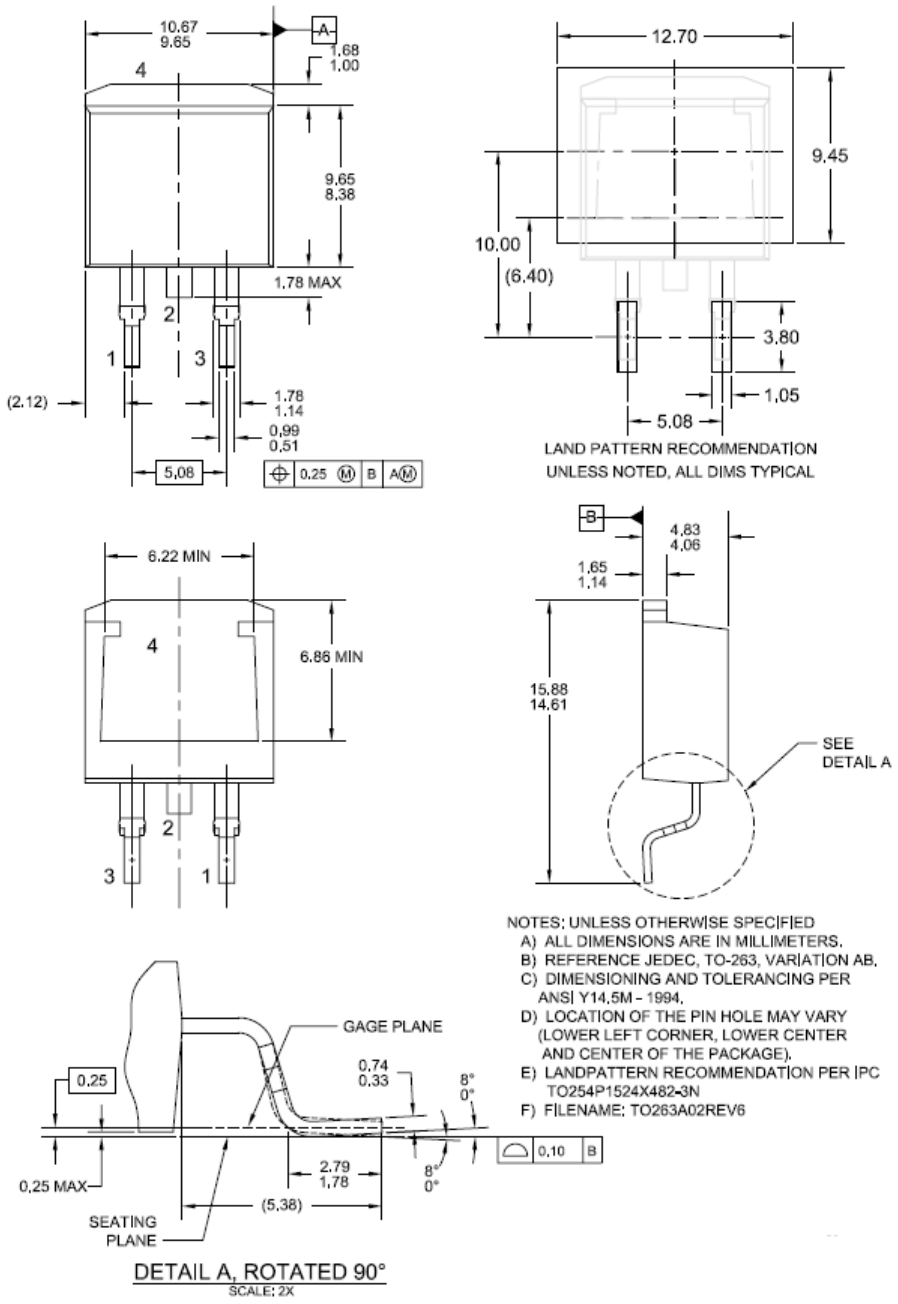



**Figure 24. TO-263 2L (D2PAK) - 2LD,TO263, SURFACE MOUNT**

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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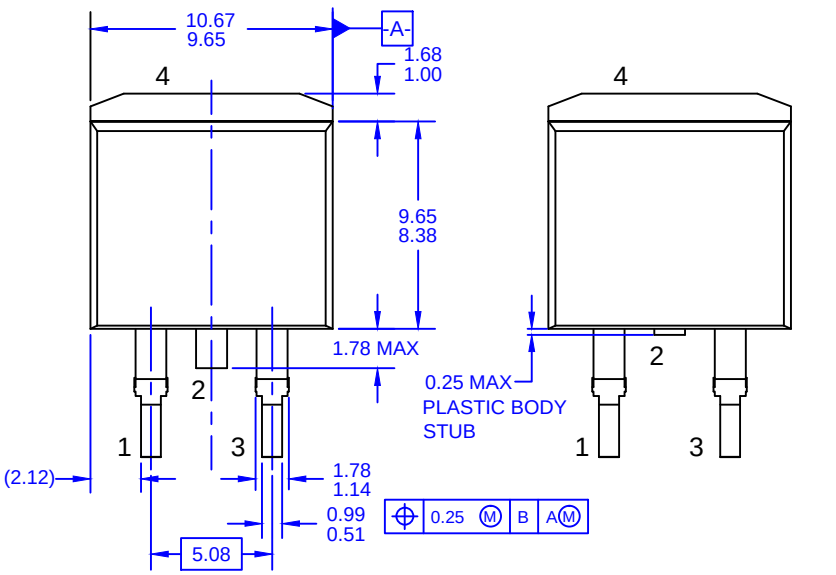
**PRODUCT STATUS DEFINITIONS**

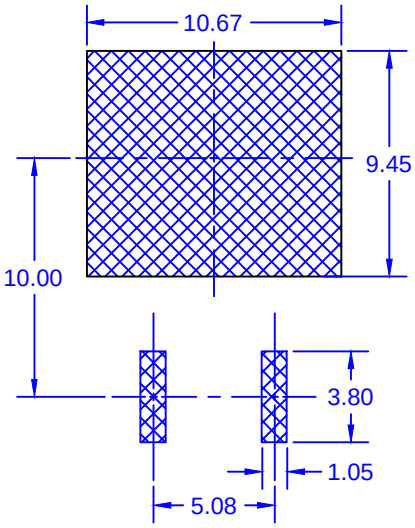
**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

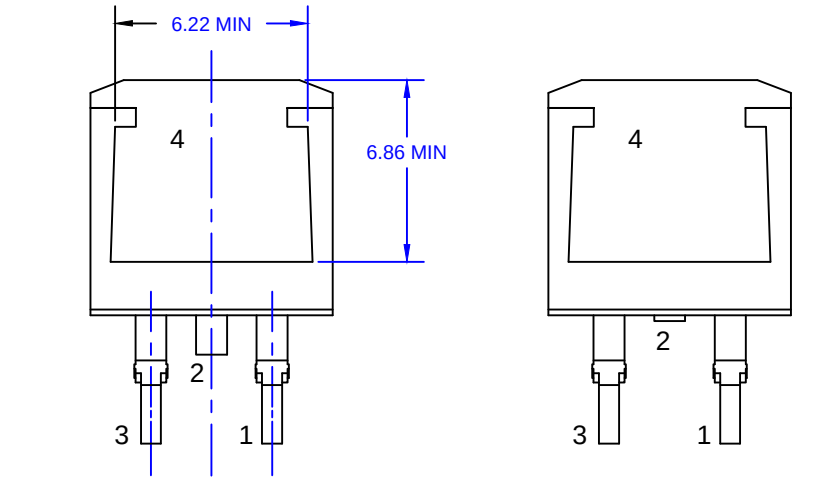
Rev. I73



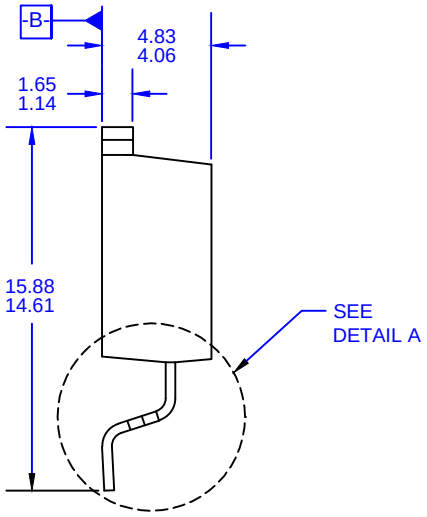

FRONT VIEW - DIODE PRODUCTS VERSION
ALTERNATIVE SUPPLIER DETAIL




LAND PATTERN RECOMMENDATION
UNLESS NOTED, ALL DIMS TYPICAL

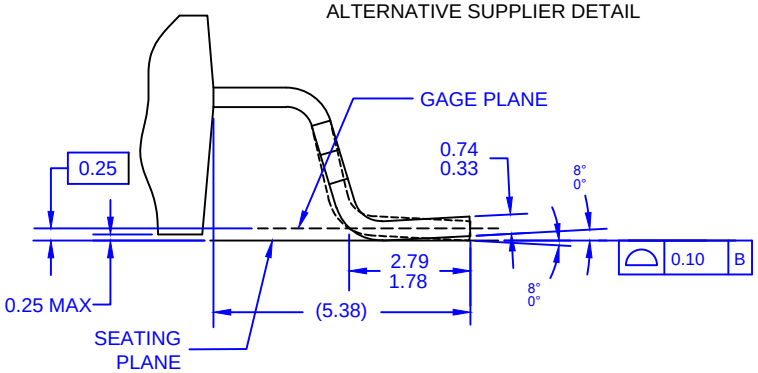



BACK VIEW - DIODE PRODUCTS VERSION
ALTERNATIVE SUPPLIER DETAIL




NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) REFERENCE JEDEC, TO-263, VARIATION AB.
C) DIMENSIONING AND TOLERANCING PER DIMENSIONING AND TOLERANCING PER ASME Y14.5 - 2009.
D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE).
E) LANDPATTERN RECOMMENDATION PER IPC TO254P1524X482-3N
F) FILENAME: TO263A02REV8




DETAIL A, ROTATED 90°
SCALE: 2X

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