March 2015

# FGH20N60UFD

## 600 V, 20 A Field Stop IGBT

### Features

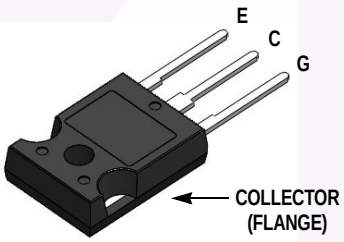
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ =1.8 V @ $I_C$ = 20 A
- High Input Impedance
- Fast Switching
- RoHS Compliant

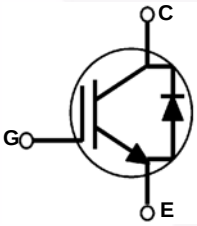
### Applications

- 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.




### 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 | 165 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 66 | 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

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGH20N60UFDTU | FGH20N60UFD | TO-247 | Tube | N/A | N/A | 30 |

## 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/°C |
| $I_{CES}$ | 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 | - | 1.8 | 2.4 | V |
| | | $I_C$ = 20 A, $V_{GE}$ = 15 V, $T_C$ = 125°C | - | 2.0 | - | 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 | | - | 17 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 87 | - | ns |
| $t_f$ | Fall Time | | - | 32 | 64 | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.38 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.26 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 0.64 | - | 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 | - | 13 | - | ns |
| $t_r$ | Rise Time | | - | 16 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 92 | - | ns |
| $t_f$ | Fall Time | | - | 63 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.41 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.36 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 0.77 | - | mJ |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 20 A, $V_{GE}$ = 15 V | - | 63 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 7 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 32 | - | nC |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | - | 0.76 | $^oC/W$ |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | - | 2.51 | $^oC/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 40 | $^oC/W$ |

## 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$^o$C | - | 1.9 | 2.5 | V |
| | | | $T_C$ = 125$^o$C | - | 1.7 | - | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ =10 A, $di_F/dt$ = 200 A/µs | $T_C$ = 25$^o$C | - | 34 | - | ns |
| | | | $T_C$ = 125$^o$C | - | 57 | - | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25$^o$C | - | 41 | - | nC |
| | | | $T_C$ = 125$^o$C | - | 96 | - | |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

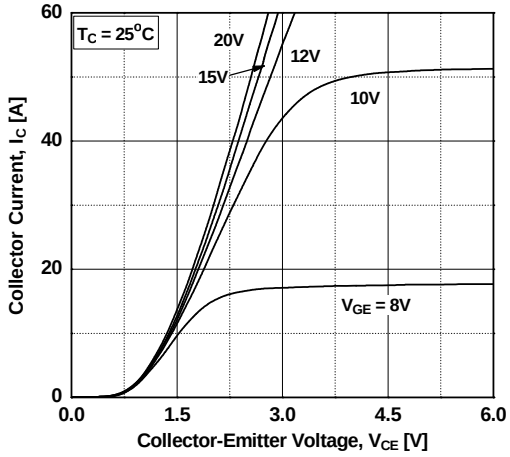



**Figure 2. Typical Output Characteristics**

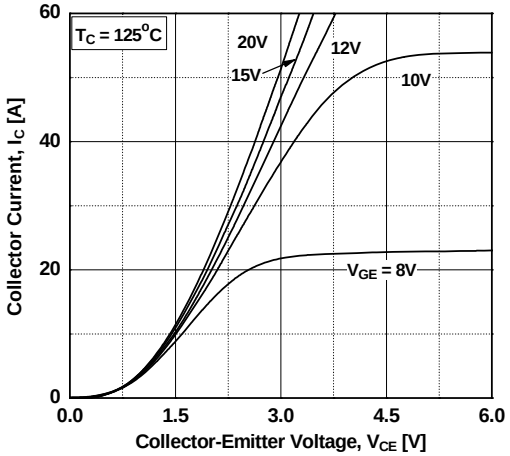



**Figure 3. Typical Saturation Voltage Characteristics**

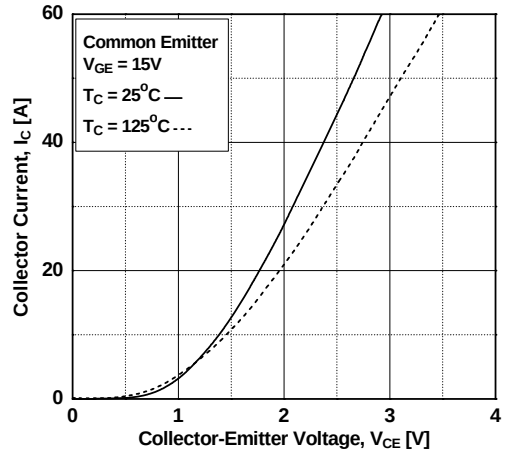



**Figure 4. Transfer Characteristics**

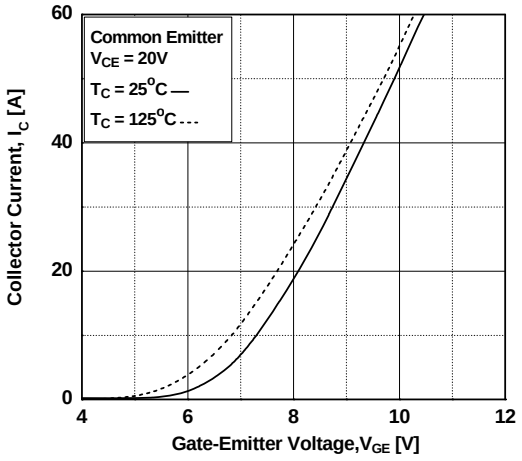



**Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level**

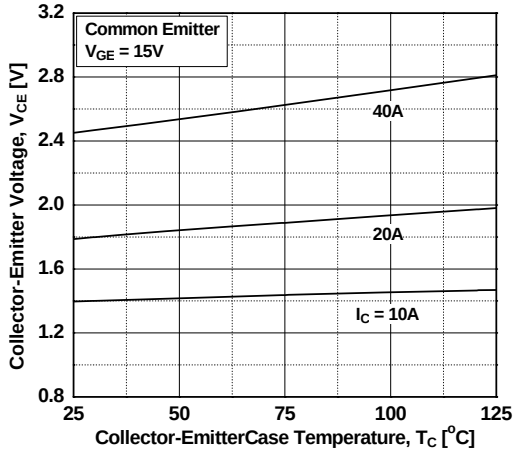
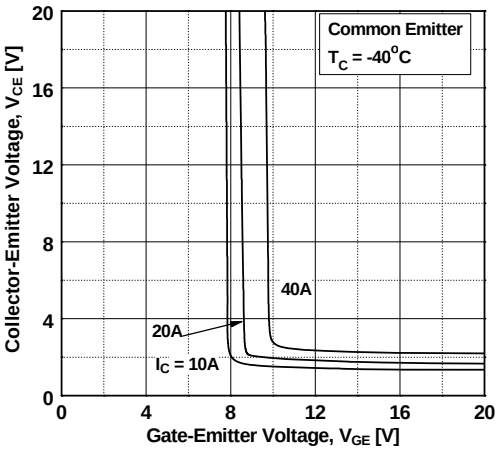



**Figure 6. Saturation Voltage vs. $V_{GE}$**



## Typical Performance Characteristics

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

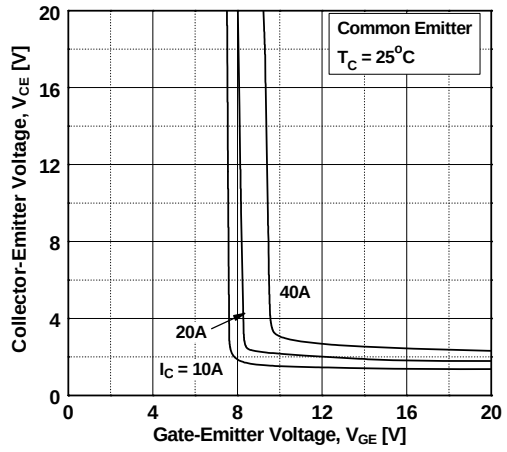



**Figure 8. Saturation Voltage vs. $V_{GE}$**

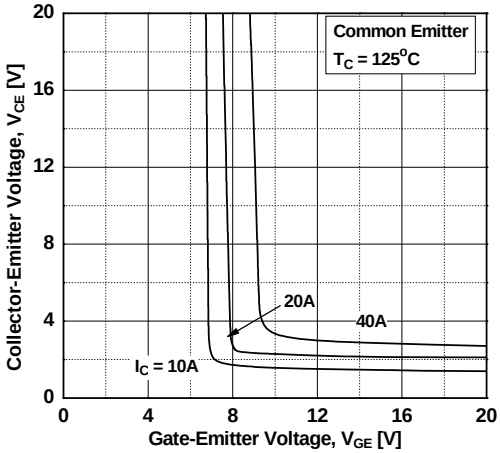



**Figure 9. Capacitance Characteristics**

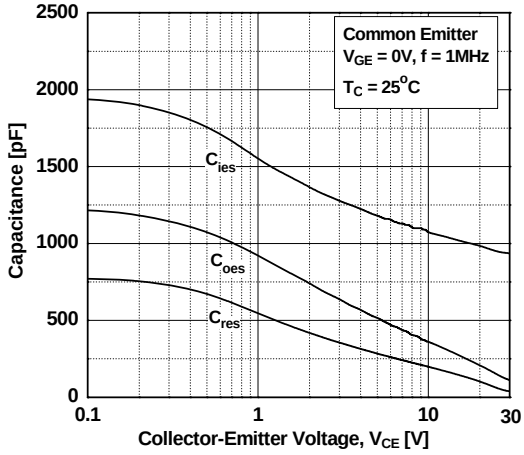



**Figure 10. Gate charge Characteristics**

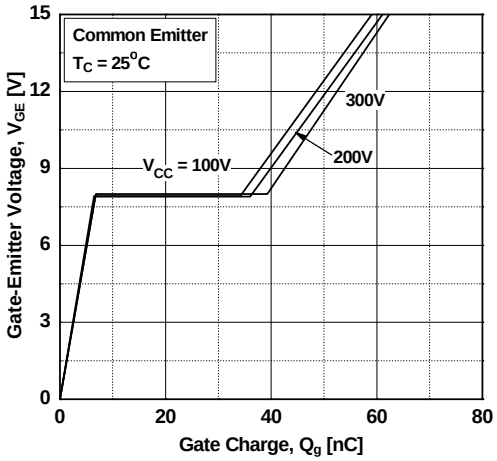



**Figure 11. SOA Characteristics**

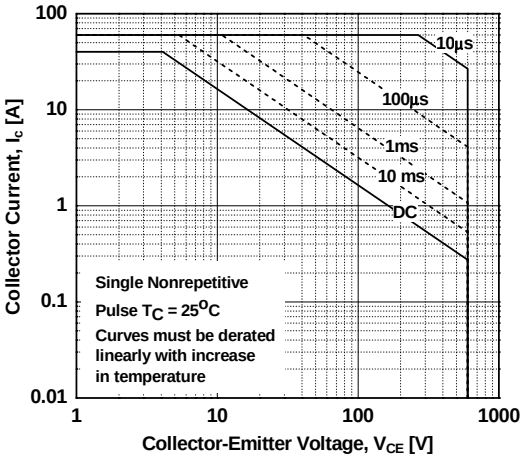
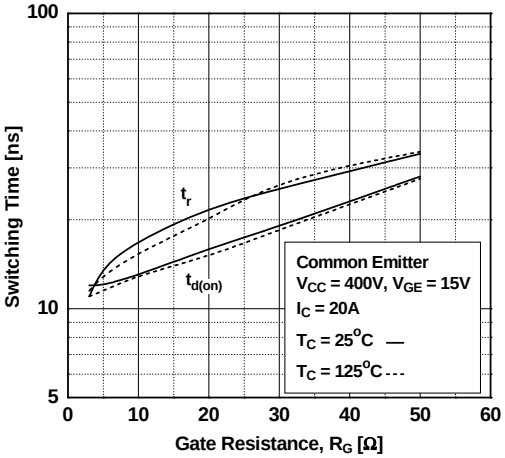



**Figure 12. Turn-on Characteristics vs. Gate Resistance**



## Typical Performance Characteristics

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

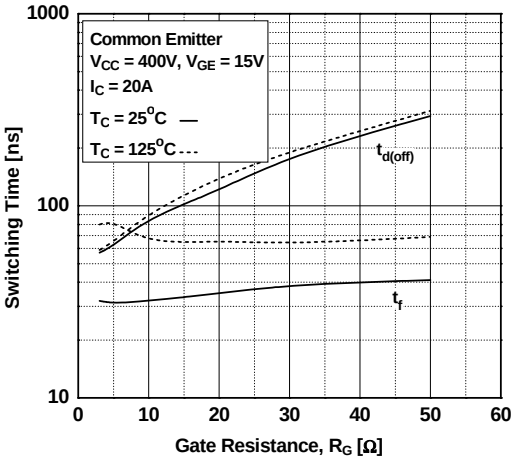



**Figure 14. Turn-on Characteristics vs. Collector Current**

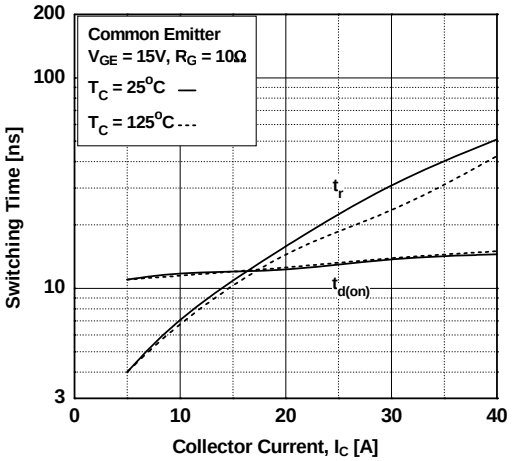



**Figure 15. Turn-off Characteristics vs. Collector Current**

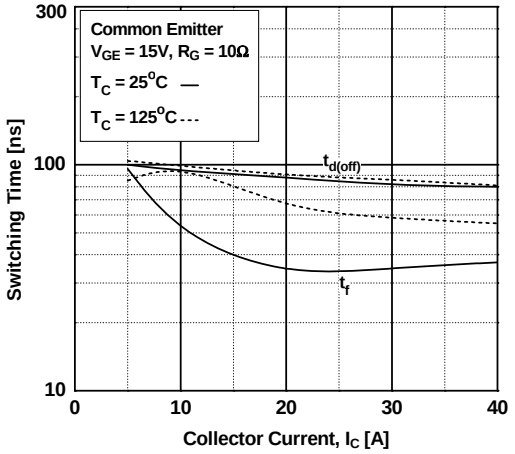



**Figure 16. Switching Loss vs. Gate Resistance**

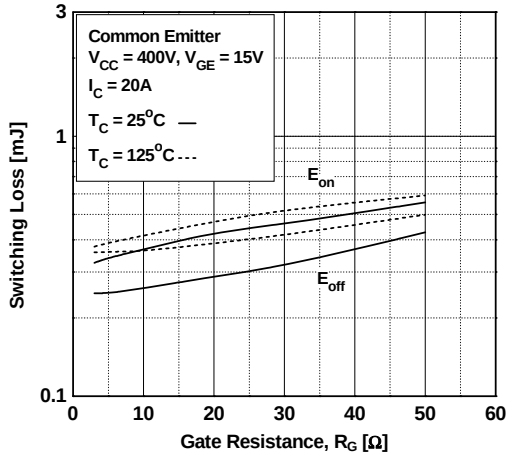



**Figure17. Switching Loss vs. Collector Current**

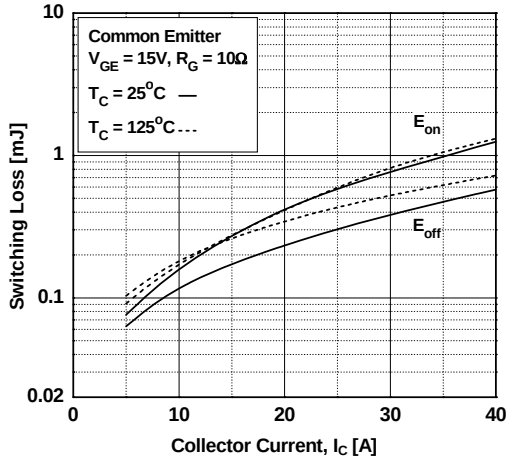
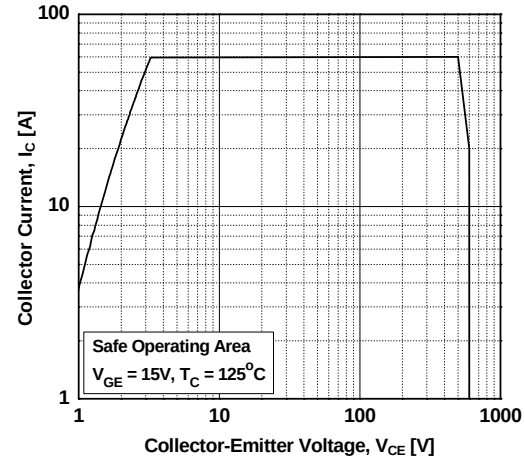



**Figure18. Turn off Switching SOA Characteristics**



## Typical Performance Characteristics

**Figure 19. Forward Characteristics**

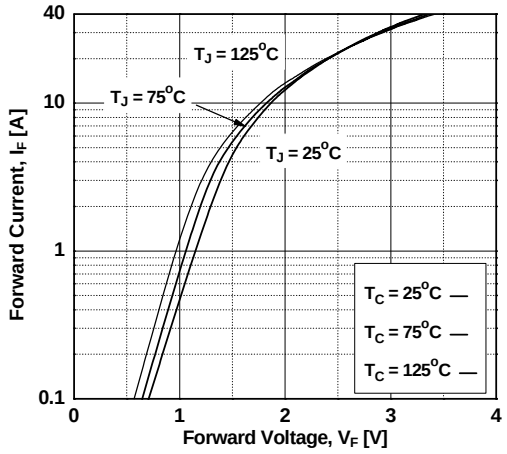



**Figure 20. Reverse Current**

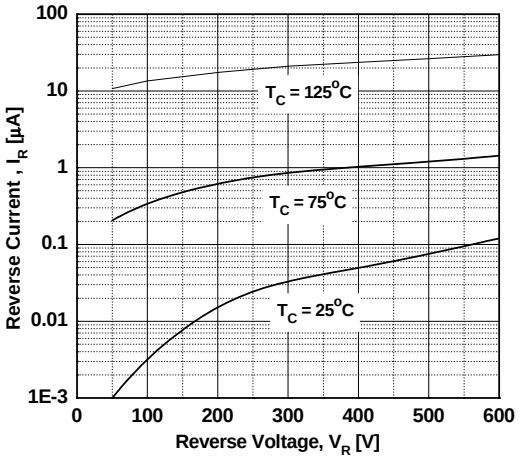



**Figure 21. Stored Charge**

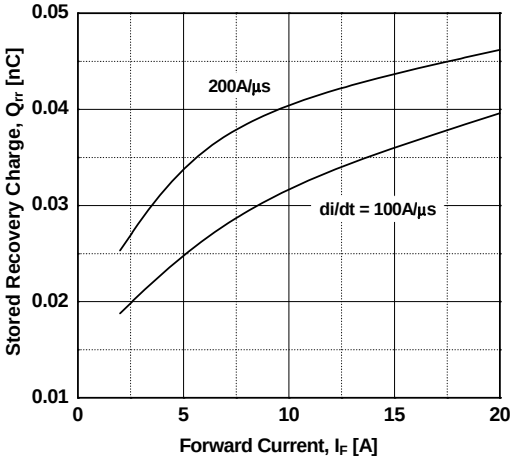



**Figure 22. Reverse Recovery Time**

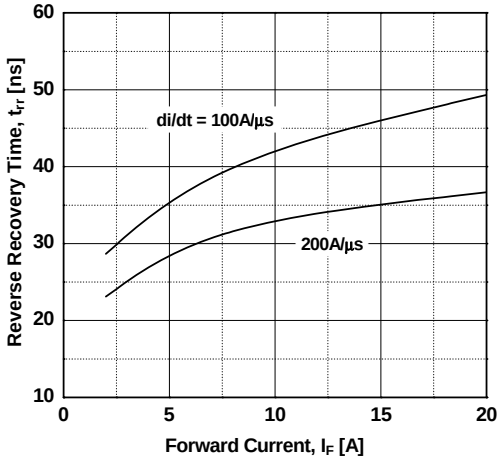
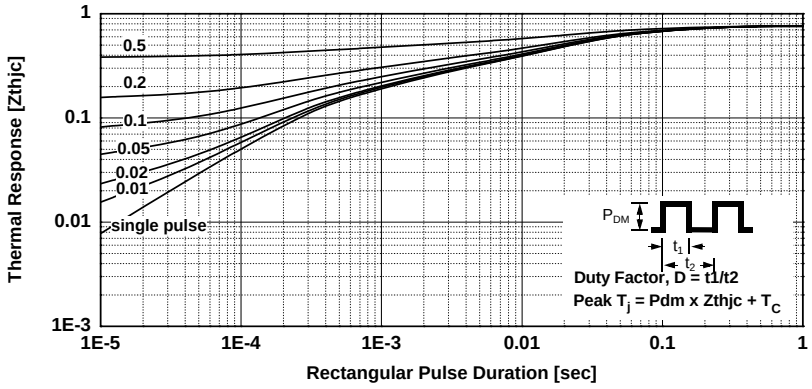
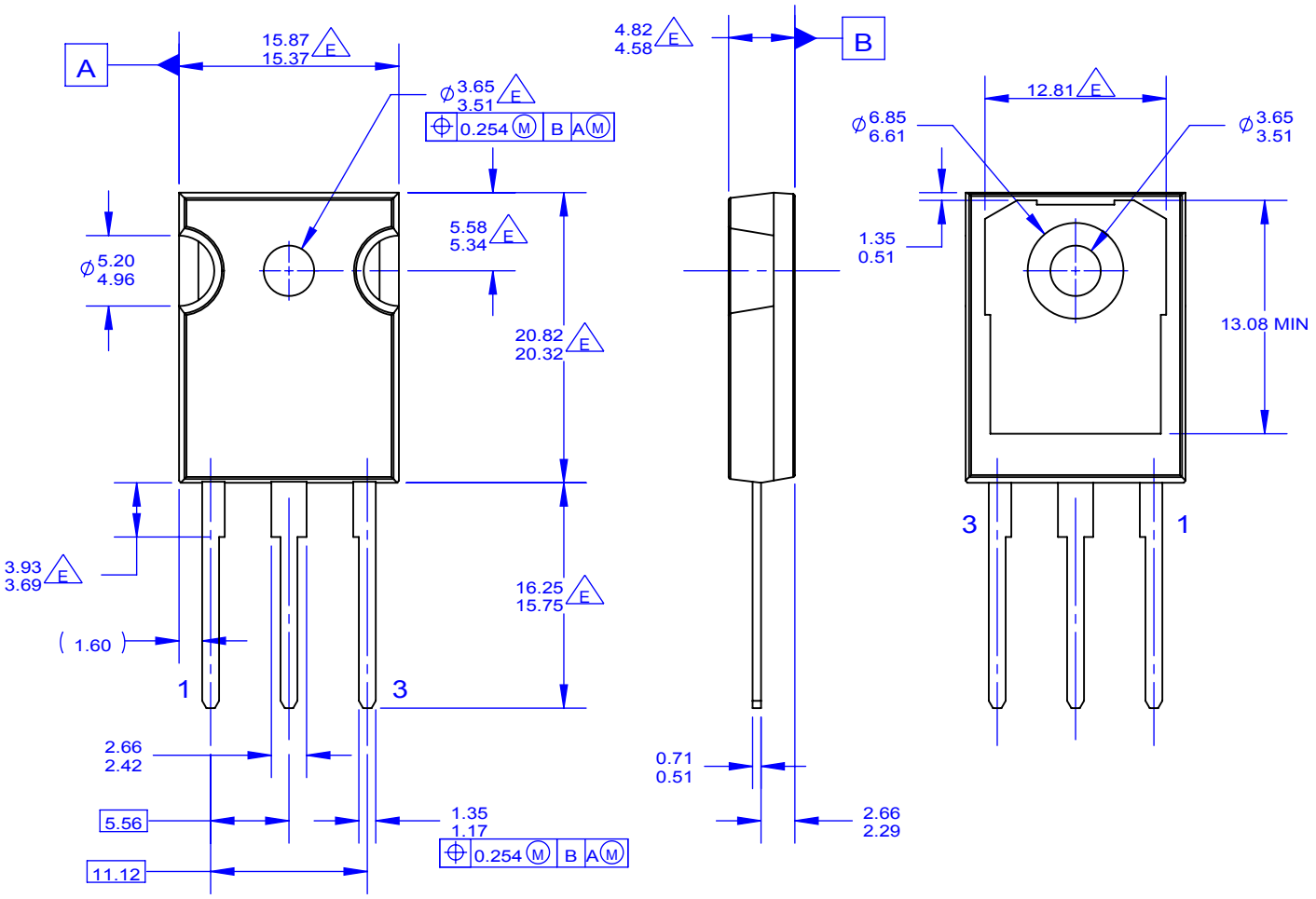



**Figure 23.Transient Thermal Impedance of IGBT**



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### 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. |
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