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FAIRCHILD SEMICONDUCTOR®

November 2013

# FGH30T65UPDT

## 650V, 30A Field Stop Trench IGBT

### Features

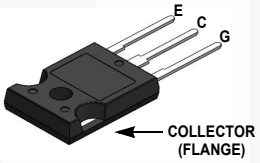
- Maximum Junction Temperature : $T_J$ = 175°C
- Positive Temperaure Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.65 V (Typ.) @ $I_C$ = 30 A
- 100% of Parts Tested $I_{LM(2)}$
- High Input Impedance
- Tightened Parameter Distribution
- RoHS Compliant
- Short Circuit Ruggedness > 5 us @ 25°C

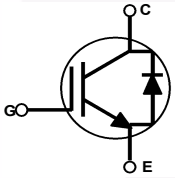
### General Description

Using novel field stop trench IGBT technology, Fairchild's new series of field stop trench IGBTs offer the optimum performance for solar inverter , UPS and digital power generator where low conduction and switching losses are essential.

### Applications

- Solar Inverter, UPS, Digital Power Generator




### Absolute Maximum Ratings

| Symbol | Description | | Ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 650 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ± 20 | V |
| | Transient Gate to Emitter Voltage | | ± 25 | V |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 60 | A |
| | Collector Current | @ $T_C$ = 100°C | 30 | A |
| $I_{CM(1)}$ | Pulsed Collector Current | | 90 | A |
| $I_{LM(2)}$ | Clamped Inductive Load Current | | 90 | A |
| $I_F$ | Diode Forward Current | @ $T_C$ = 25°C | 60 | A |
| | Diode Forward Current | @ $T_C$ = 100°C | 30 | A |
| $I_{FM(1)}$ | Pulsed Diode Maximum Forward Current | | 150 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 250 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 125 | W |
| SCWT | Short Circuit Withstand Time | @ $T_C$ = 25°C | 5 | us |
| $T_J$ | Operating Junction Temperature | | -55 to +175 | °C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +175 | °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
2: $I_C$ = 90 A, $V_{CC}$ = 400 V, $R_g$ = 20 Ω

### Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | - | 0.60 | °C/W |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | - | 1.2 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 40 | °C/W |

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## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGH30T65UPD_F155 | FGH30T65UPD | TO-247 G03 | 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, $I_C$ = 1 mA | 650 | - | - | V |
| $\frac{\Delta BV_{CES}}{\Delta T_J}$ | Temperature Coefficient of Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 250 uA | - | 0.65 | - | 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 | $I_C$ = 30 mA, $V_{CE}$ = $V_{GE}$ | 4.0 | 6.0 | 7.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 30 A, $V_{GE}$ = 15 V | - | 1.65 | 2.3 | V |
| | | $I_C$ = 30 A, $V_{GE}$ = 15 V, $T_C$ = 175°C | - | 2.1 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | - | 2280 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 85 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 40 | - | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 30 A, $R_G$ = 8 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | - | 22 | - | ns |
| $t_r$ | Rise Time | | - | 26 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 139 | - | ns |
| $t_f$ | Fall Time | | - | 18 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.76 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.40 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.16 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 30 A, $R_G$ = 8 Ω, $V_{GE}$ = 15V, Inductive Load, $T_C$ = 175°C | - | 22 | - | ns |
| $t_r$ | Rise Time | | - | 30 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 151 | - | ns |
| $t_f$ | Fall Time | | - | 19 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1.20 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.53 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.73 | - | mJ |
| Tsc | Short Circuit Withstand Time | $V_{GE}$ = 15 V, $V_{CC}$ ≤ 400 V, Rg = 10 Ω | 5 | - | - | us |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 30 A, $V_{GE}$ = 15 V | - | 155 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 21 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 91 | - | 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 | $I_F$ = 30 A | $T_C$ = 25°C | - | 2.3 | 3.0 | V |
| | | | $T_C$ = 175°C | - | 1.9 | - | |
| $E_{rec}$ | Reverse Recovery Energy | $I_F$ = 30 A, $di_F/dt$ = 200 A/μs | $T_C$ = 175°C | - | 35 | - | uJ |
| $t_{rr}$ | Diode Reverse Recovery Time | | $T_C$ = 25°C | - | 33 | 43 | ns |
| | | | $T_C$ = 175°C | - | 148 | | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 57 | 80 | nC |
| | | | $T_C$ = 175°C | - | 560 | | |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

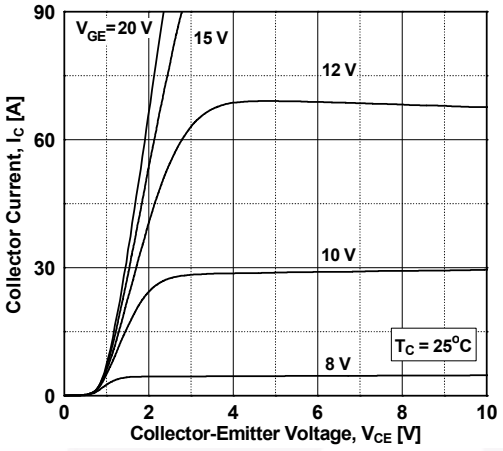



**Figure 2. Typical Output Characteristics**

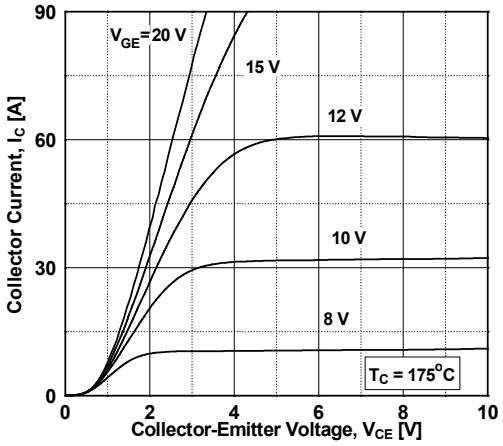



**Figure 3. Typical Saturation Voltage Characteristics**

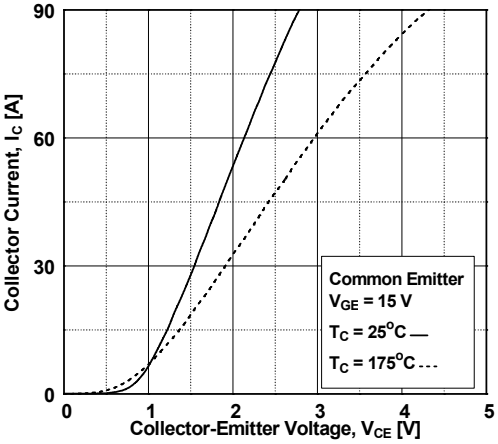



**Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Leve**

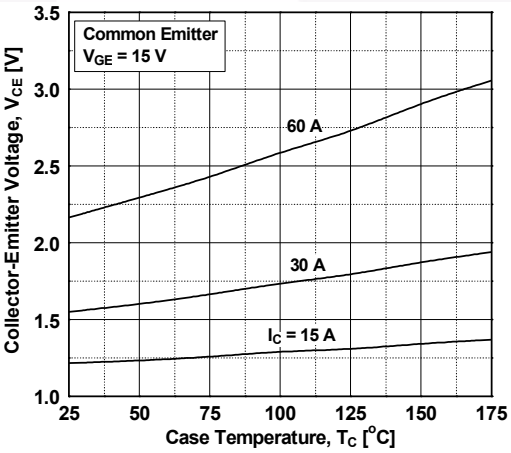



**Figure 5. Saturation Voltage vs. $V_{GE}$**

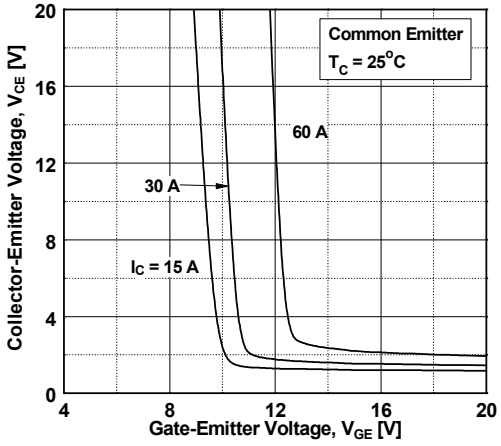
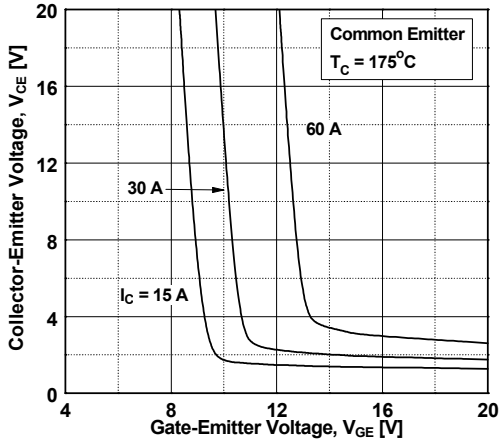



**Figure 6. Saturation Voltage vs. $V_{GE}$**



## Typical Performance Characteristics

**Figure 7. Capacitance Characteristic**

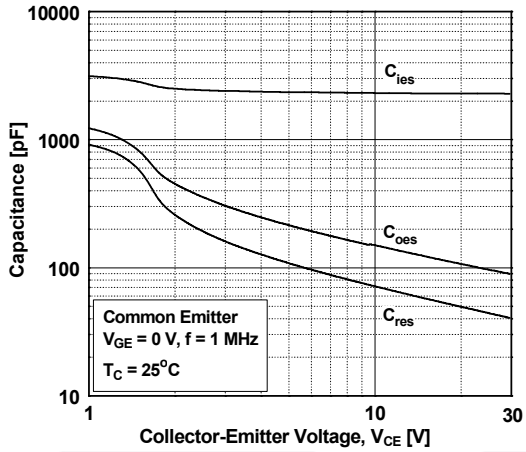



**Figure 8. Gate charge Characteristics**

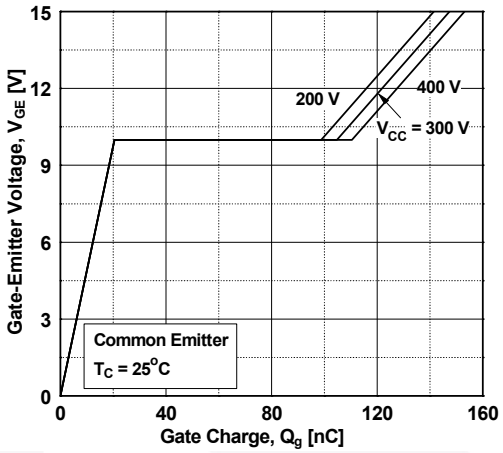



**Figure 9. Turn-on Characteristics vs. Gate Resistance**

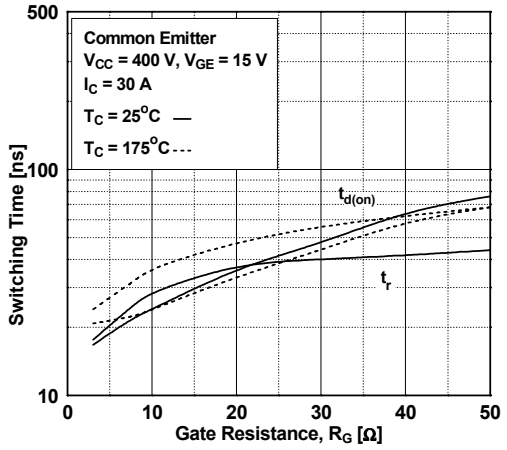



**Figure 10. Turn-off Characteristics vs. Gate Resistance**

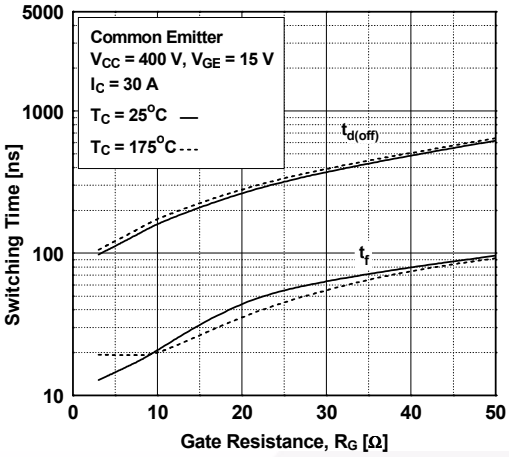



**Figure 11. Switching Loss vs. Gate Resistance**

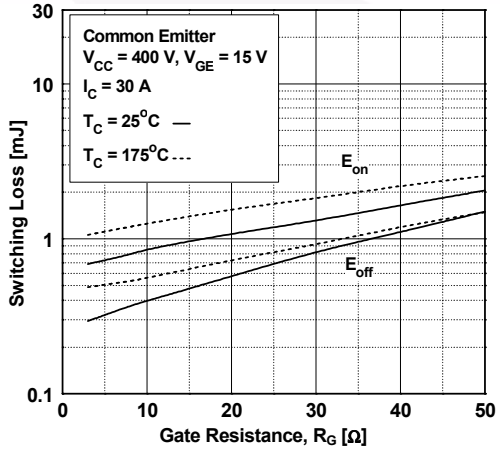
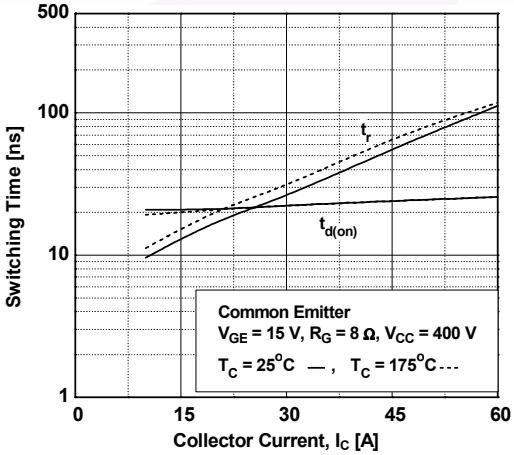



**Figure 12. Turn-on Characteristics vs. Collector Current**



## Typical Performance Characteristics

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

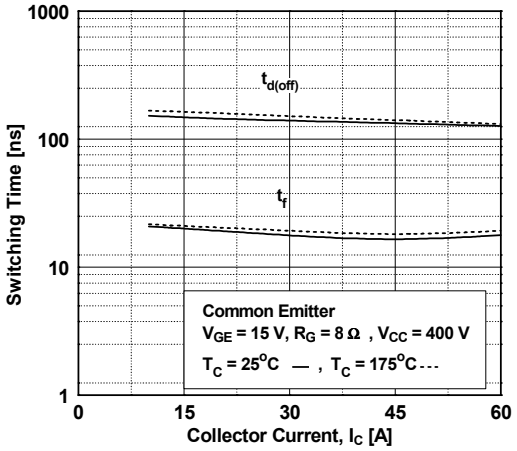



**Figure 14. Switching Loss vs. Collector Current**

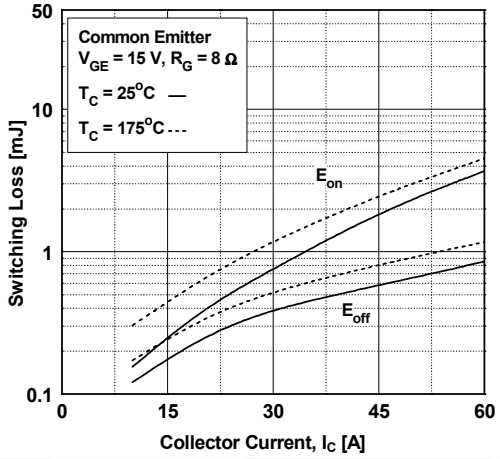



**Figure 15. Load Current vs. Frequency**

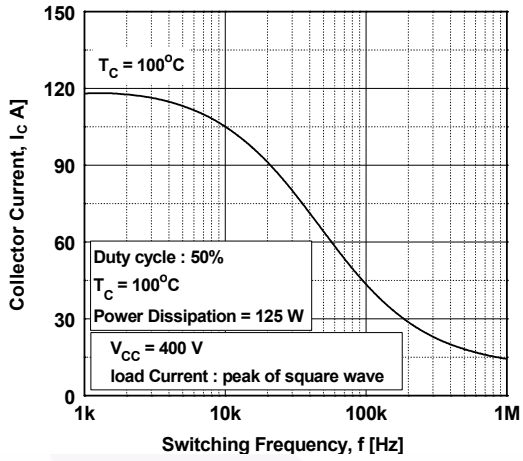



**Figure 16. SOA Characteristics**

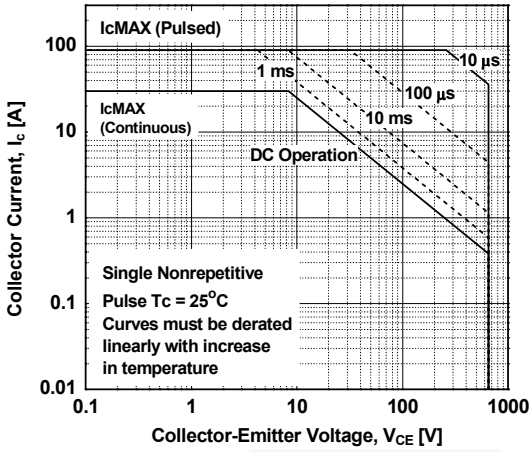



**Figure 17. Forward Characteristics**

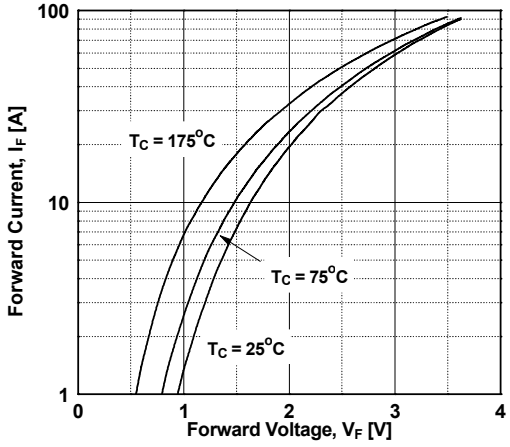
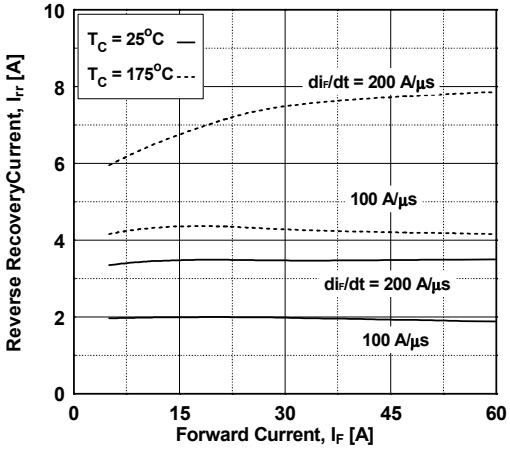



**Figure 18. Reverse Revovery Current**



## Typical Performance Characteristics

**Figure 19. Reverse Recovery Time**

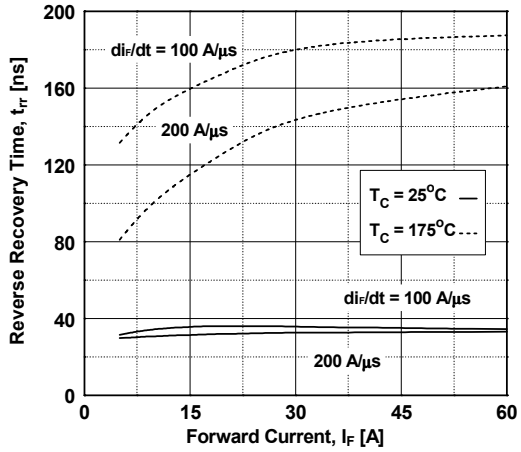



**Figure 20. Stored Charge**

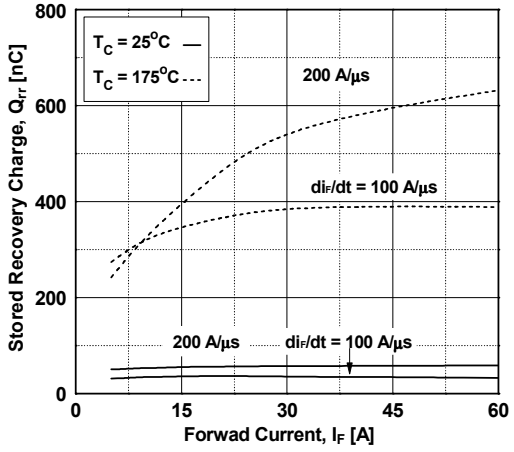



**Figure 21. Transient Thermal Impedance of IGBT**

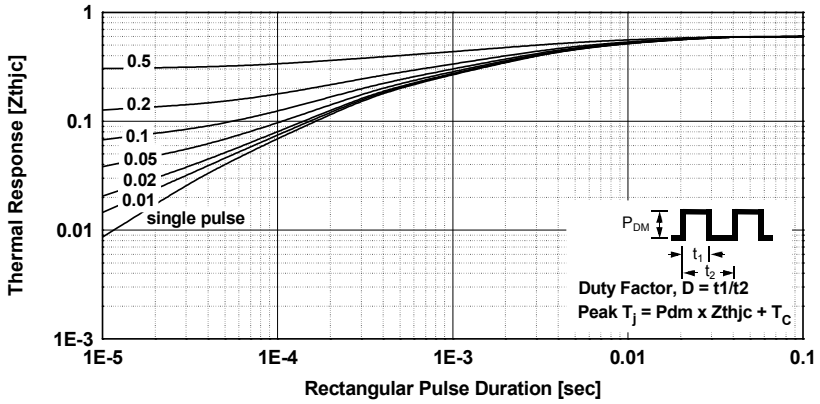
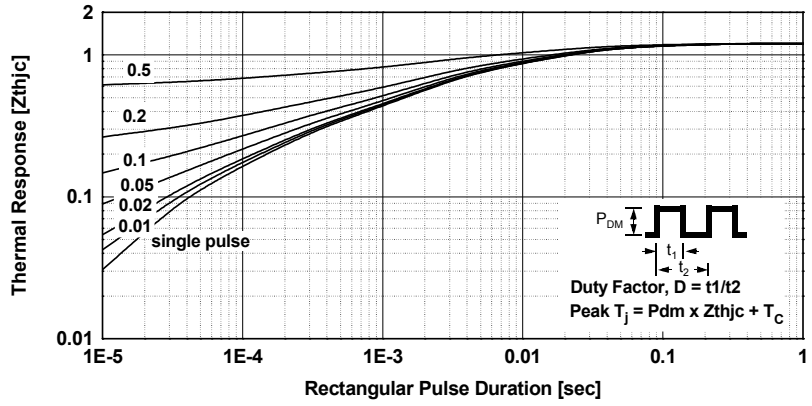
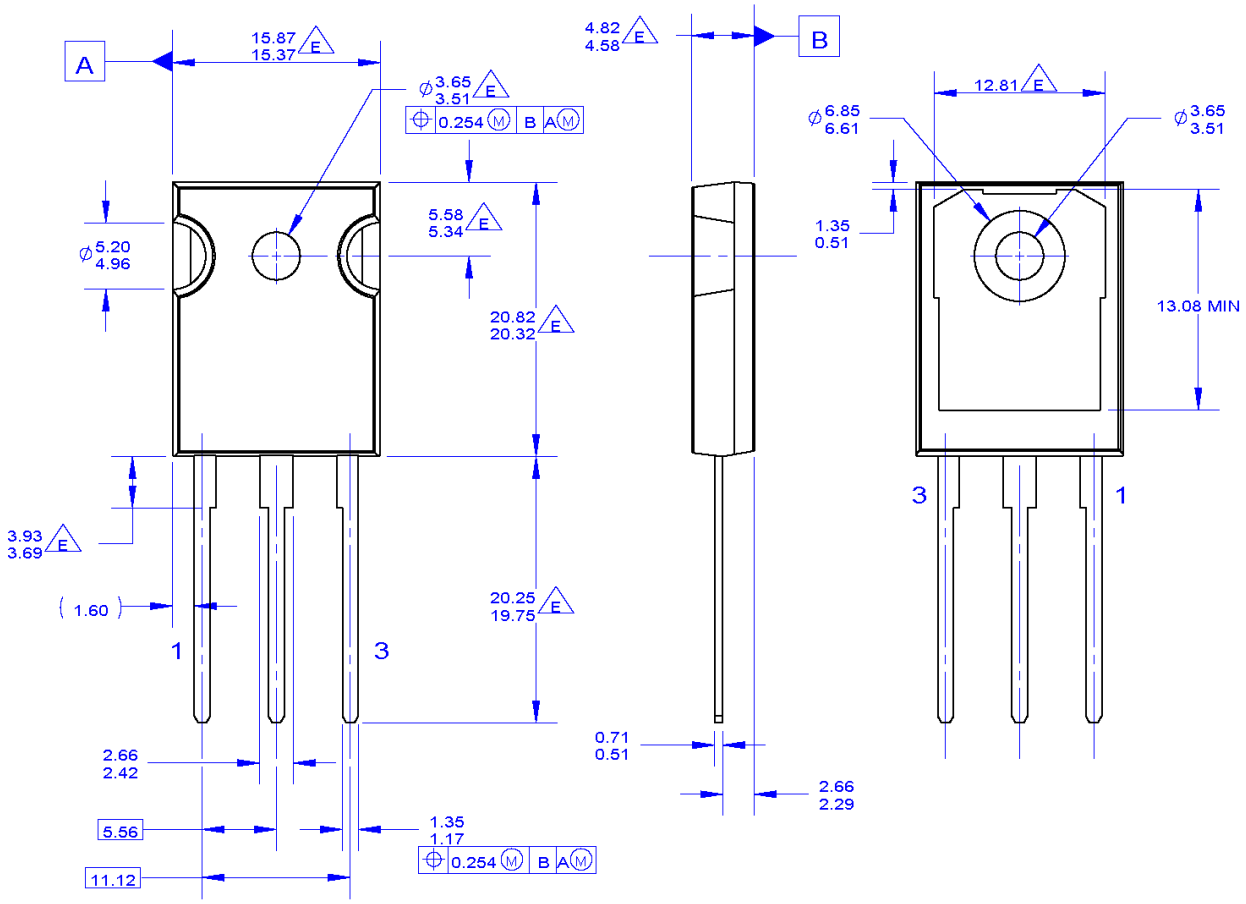



**Figure 22. Transient Thermal Impedance of Diode**



## Mechanical Dimensions

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C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5 - 1994

E DOES NOT COMPLY JEDEC STANDARD VALUE
F. DRAWING FILENAME: MKT-TO247G03_REV01

**Figure 23. TO247, Molded, 3-Lead, JEDEC AB Long Lead**

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Dimensions in Millimeters

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