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# FGP15N60UNDF

## 600 V, 15 A

### Short Circuit Rated IGBT

#### Features

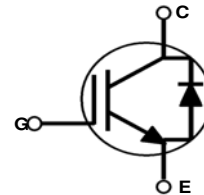
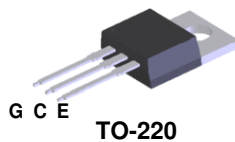
- Short Circuit Rated 10us
- High Current Capability
- High Input Impedance
- Fast Switching
- RoHS Compliant

#### 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.



#### Absolute Maximum Ratings

| Symbol      | Description   | Ratings     | Unit             |
|-------------|---|-------------|------------------|
| $V_{CES}$   | Collector to Emitter Voltage                          | 600         | V                |
| $V_{GES}$   | Gate to Emitter Voltage                               | $\pm 20$    | V                |
| $I_C$       | Collector Current @ $T_C = 25^\circ\text{C}$          | 30          | A                |
|             | Collector Current @ $T_C = 100^\circ\text{C}$         | 15          | A                |
| $I_{CM(1)}$ | Pulsed Collector Current @ $T_C = 25^\circ\text{C}$   | 45          | A                |
| $I_F$       | Diode Forward Current @ $T_C = 25^\circ\text{C}$      | 15          | A                |
|             | Diode Forward Current @ $T_C = 100^\circ\text{C}$     | 7.5         | A                |
| $P_D$       | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$  | 178         | W                |
|             | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$ | 71          | W                |
| $T_J$       | Operating Junction Temperature                        | -55 to +150 | $^\circ\text{C}$ |
| $T_{stg}$   | Storage Temperature Range                             | -55 to +150 | $^\circ\text{C}$ |

**Notes:**

1: Repetitive test , Pulse width=100 usec , Duty=0.2,  $V_{GE}=13.5\text{ V}$

#### Thermal Characteristics

| Symbol                        | Parameter  | Typ. | Max. | Unit                      |
|-------------------------------|--|------|------|---------------------------|
| $R_{\theta JC}(\text{IGBT})$  | Thermal Resistance, Junction to Case                   |      | 0.7  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}(\text{Diode})$ | Thermal Resistance, Junction to Case                   |      | 2.3  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$               | Thermal Resistance, Junction to Ambient (PCB Mount)(2) |      | 62.5 | $^\circ\text{C}/\text{W}$ |

## Package Marking and Ordering Information

| Device Marking | Device       | Package | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|-----------|------------|----------|
| FGP15N60UNDF   | FGP15N60UNDF | TO-220  | -         | -          | 50ea     |

## Electrical Characteristics of the IGBT T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                           | Parameter                               | Test Conditions  | Min. | Typ.  | Max. | Unit |
|----------------------------------|---|--|------|-------|------|------|
| <b>Off Characteristics</b>       |   |  |      |       |      |      |
| $V_{CES}$                        | Collector to Emitter Breakdown Voltage  | $V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$  | 600  | -     | -    | V    |
| $I_{CES}$                        | Collector Cut-Off Current               | $V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$  | -    | -     | 1    | mA   |
| $I_{GES}$                        | G-E Leakage Current                     | $V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$  | -    | -     | ±10  | μA   |
| <b>On Characteristics</b>        |   |  |      |       |      |      |
| $V_{GE(th)}$                     | G-E Threshold Voltage                   | $I_C = 15\text{ mA}, V_{CE} = V_{GE}$  | 5.5  | 6.8   | 8.5  | V    |
| $V_{CE(sat)}$                    | Collector to Emitter Saturation Voltage | $I_C = 15\text{ A}, V_{GE} = 15\text{ V}$  | -    | 2.2   | 2.7  | V    |
|                                  |   | $I_C = 15\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$   | -    | 2.7   | -    | V    |
| <b>Dynamic Characteristics</b>   |   |  |      |       |      |      |
| $C_{ies}$                        | Input Capacitance                       | $V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$  | -    | 619   | -    | pF   |
| $C_{oes}$                        | Output Capacitance                      |  | -    | 80    | -    | pF   |
| $C_{res}$                        | Reverse Transfer Capacitance            |  | -    | 24    | -    | pF   |
| <b>Switching Characteristics</b> |   |  |      |       |      |      |
| $t_{d(on)}$                      | Turn-On Delay Time                      | $V_{CC} = 400\text{ V}, I_C = 15\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 25^\circ\text{C}$  | -    | 9.3   | -    | ns   |
| $t_r$                            | Rise Time                               |  | -    | 9.8   | -    | ns   |
| $t_{d(off)}$                     | Turn-Off Delay Time                     |  | -    | 54.8  | -    | ns   |
| $t_f$                            | Fall Time                               |  | -    | 9.9   | 12.8 | ns   |
| $E_{on}$                         | Turn-On Switching Loss                  |  | -    | 0.37  | -    | mJ   |
| $E_{off}$                        | Turn-Off Switching Loss                 |  | -    | 0.067 | -    | mJ   |
| $E_{ts}$                         | Total Switching Loss                    |  | -    | 0.44  | -    | mJ   |
| $t_{d(on)}$                      | Turn-On Delay Time                      | $V_{CC} = 400\text{ V}, I_C = 15\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 125^\circ\text{C}$ | -    | 8.9   | -    | ns   |
| $t_r$                            | Rise Time                               |  | -    | 9.9   | -    | ns   |
| $t_{d(off)}$                     | Turn-Off Delay Time                     |  | -    | 56.6  | -    | ns   |
| $t_f$                            | Fall Time                               |  | -    | 13.2  | -    | ns   |
| $E_{on}$                         | Turn-On Switching Loss                  |  | -    | 0.54  | -    | mJ   |
| $E_{off}$                        | Turn-Off Switching Loss                 |  | -    | 0.11  | -    | mJ   |
| $E_{ts}$                         | Total Switching Loss                    |  | -    | 0.65  | -    | mJ   |
| $T_{sc}$                         | Short Circuit Withstand Time            | $V_{CC} = 350\text{ V}, R_G = 100\ \Omega, V_{GE} = 15\text{ V}, T_C = 150^\circ\text{C}$  | 10   | -     | -    | μs   |

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

|          |                          |   |   |    |   |    |
|----------|--------------------------|---|---|----|---|----|
| $Q_g$    | Total Gate Charge        | $V_{CE} = 400\text{ V}, I_C = 15\text{ A},$<br>$V_{GE} = 15\text{ V}$ | - | 43 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge   |   | - | 6  | - | nC |
| $Q_{gc}$ | Gate to Collector Charge |   | - | 26 | - | nC |

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

| Symbol   | Parameter                     | Test Conditions   | Min.                      | Typ. | Max  | Unit |    |
|----------|-------------------------------|---|---------------------------|------|------|------|----|
| $V_{FM}$ | Diode Forward Voltage         | $I_F = 15\text{ A}$                                     | $T_C = 25^\circ\text{C}$  | -    | 1.6  | 2.2  | V  |
|          |                               |   | $T_C = 125^\circ\text{C}$ | -    | 1.5  | -    |    |
| $t_{rr}$ | Diode Reverse Recovery Time   | $I_F = 15\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$  | -    | 82.4 | -    | ns |
|          |                               |   | $T_C = 125^\circ\text{C}$ | -    | 142  | -    |    |
| $Q_{rr}$ | Diode Reverse Recovery Charge | $I_F = 15\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$  | -    | 213  | -    | nC |
|          |                               |   | $T_C = 125^\circ\text{C}$ | -    | 541  | -    |    |

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

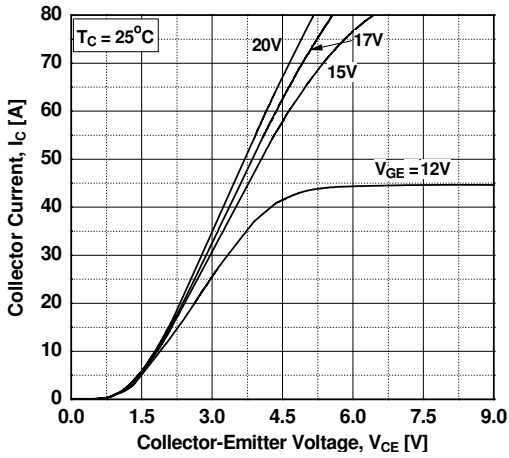


Figure 2. Typical Output Characteristics

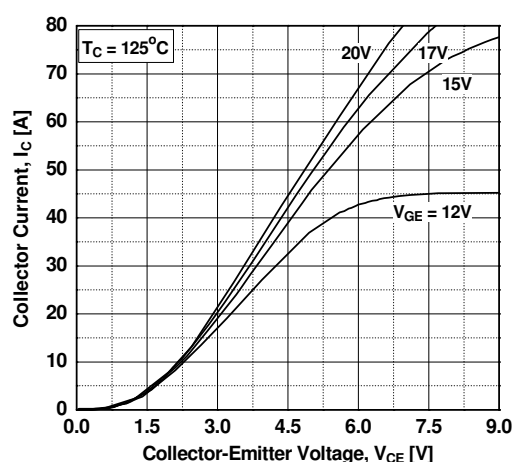


Figure 3. Typical Saturation Voltage Characteristics

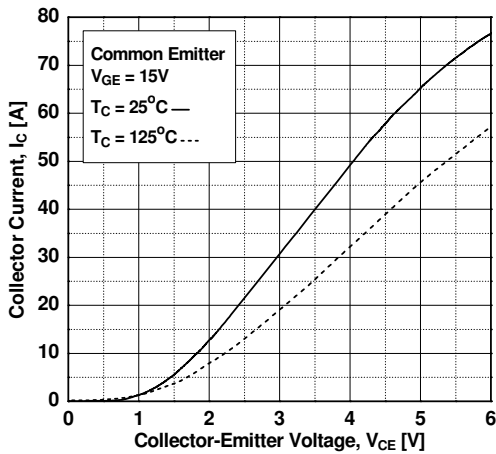


Figure 4. Transfer Characteristics

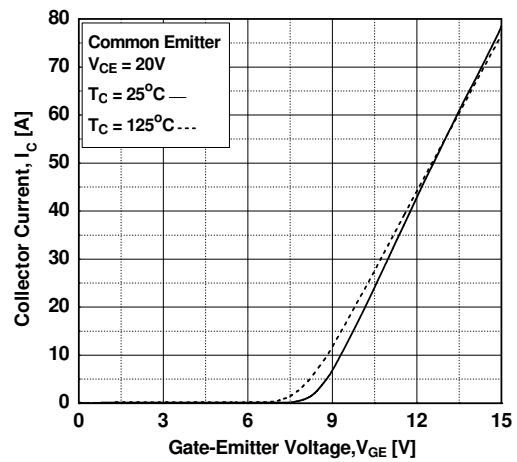


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

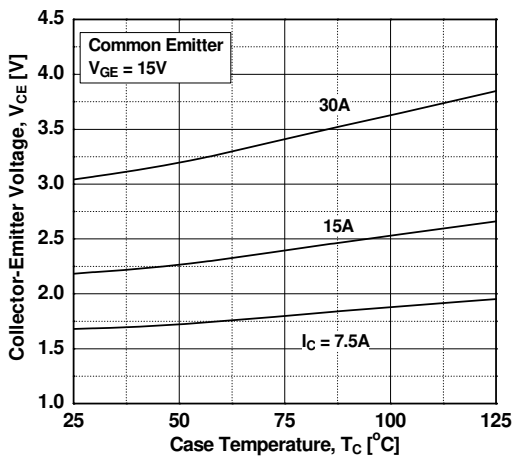
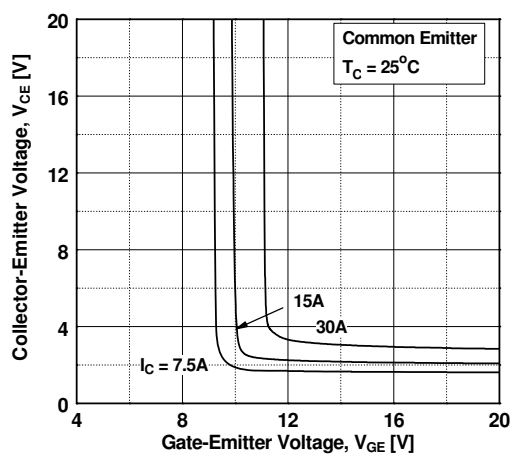


Figure 6. Saturation Voltage vs. Vge



## Typical Performance Characteristics

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

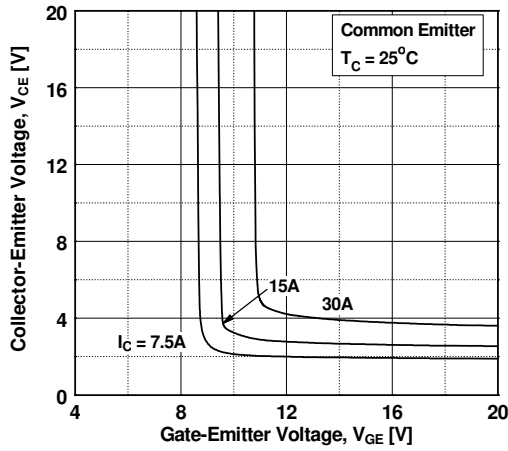


Figure 8. Capacitance Characteristics

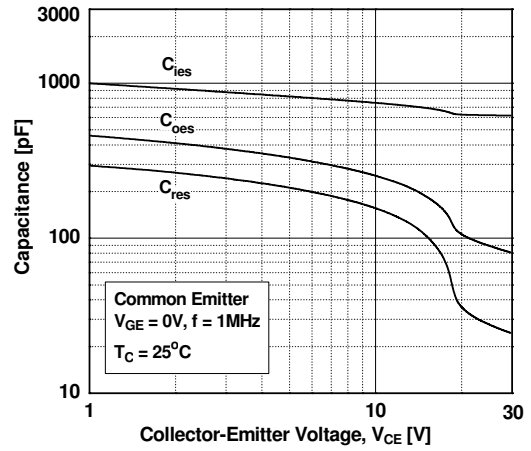


Figure 9. Gate charge Characteristics

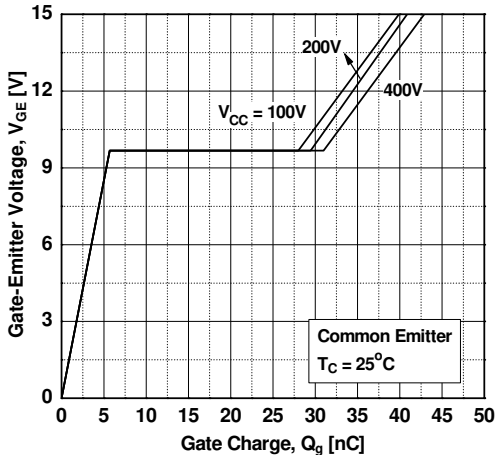


Figure 10. SOA Characteristics

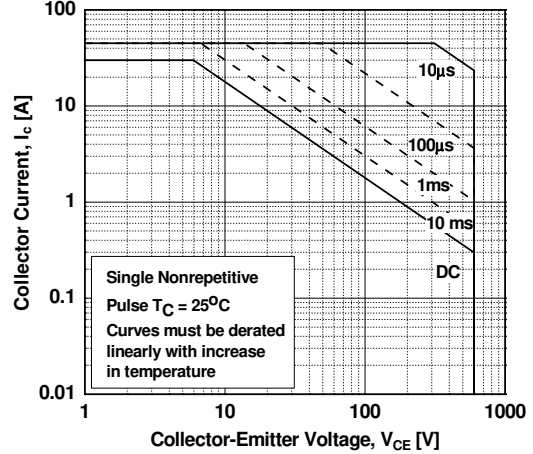


Figure 11. Turn-on Characteristics vs. Gate Resistance

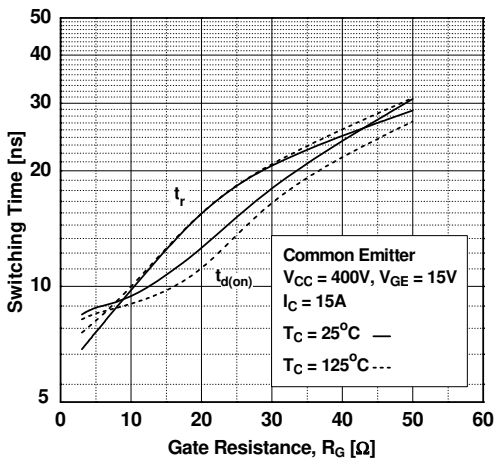
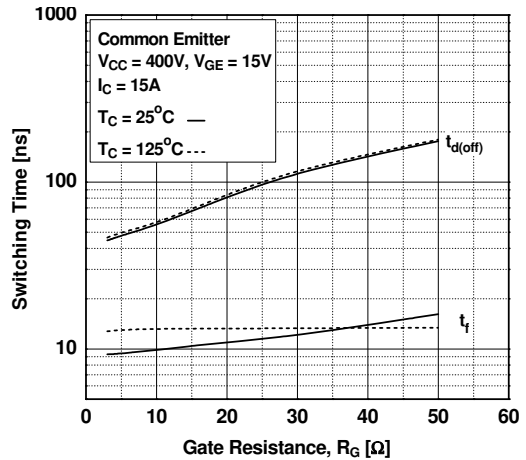
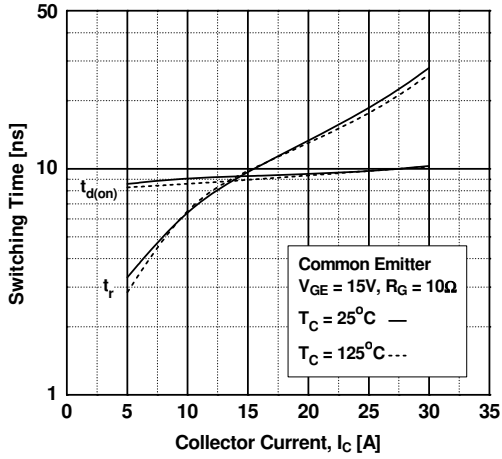


Figure 12. Turn-off Characteristics vs. Gate Resistance

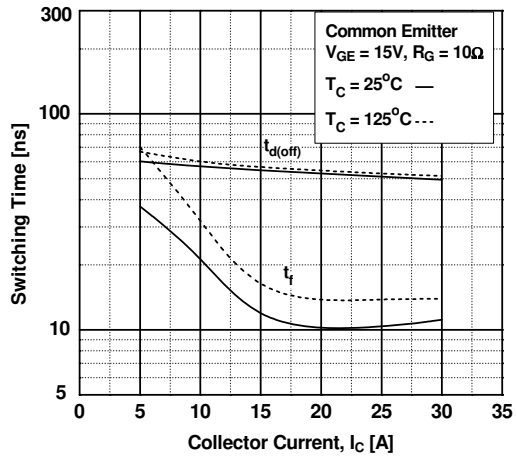


## Typical Performance Characteristics

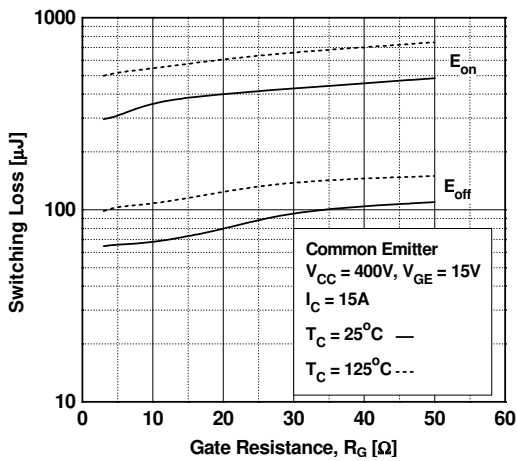
**Figure 13. Turn-on Characteristics vs. Collector Current**



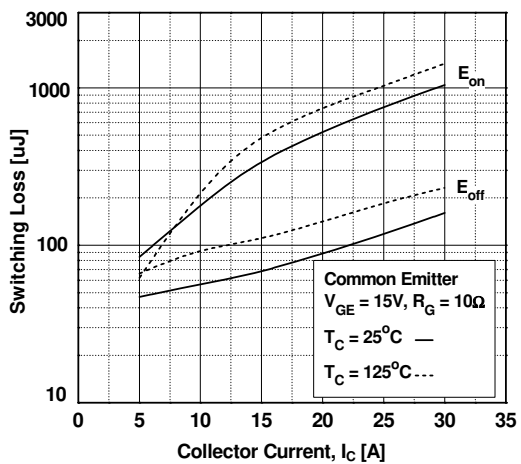
**Figure 14. Turn-off Characteristics vs. Collector Current**



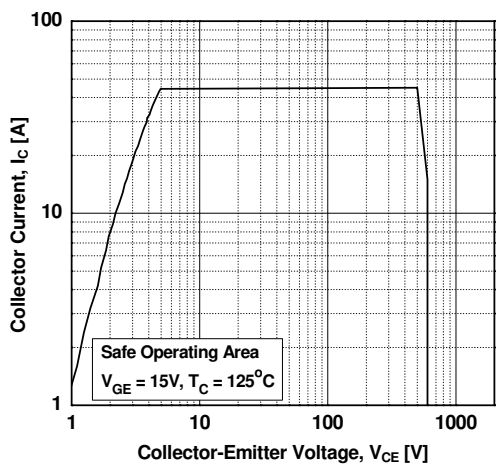
**Figure 15. Switching Loss vs. Gate Resistance**



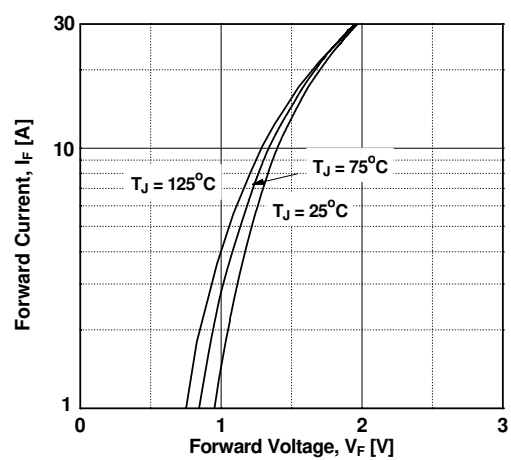
**Figure 16. Switching Loss vs. Collector Current**



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



**Figure 18. Forward Characteristics**



## Typical Performance Characteristics

Figure 19. Reverse Current

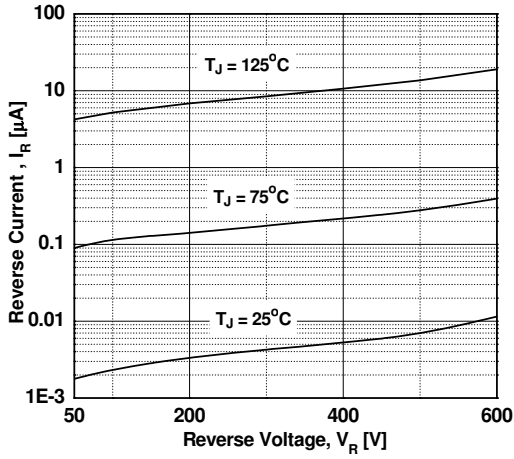


Figure 20. Stored Charge

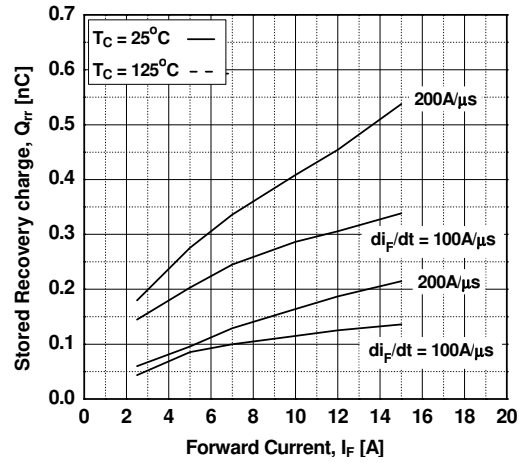


Figure 21. Reverse Recovery Time

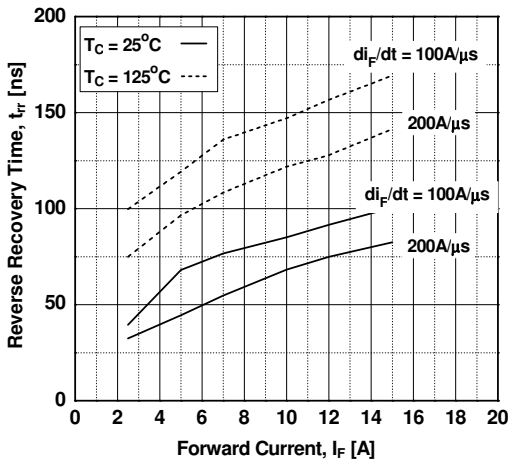
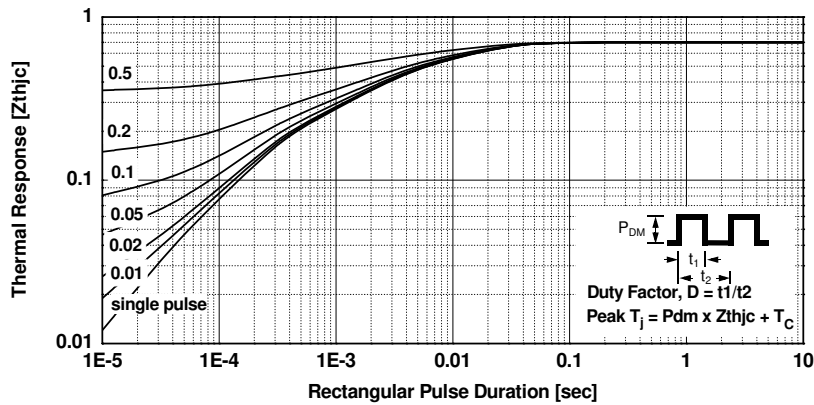
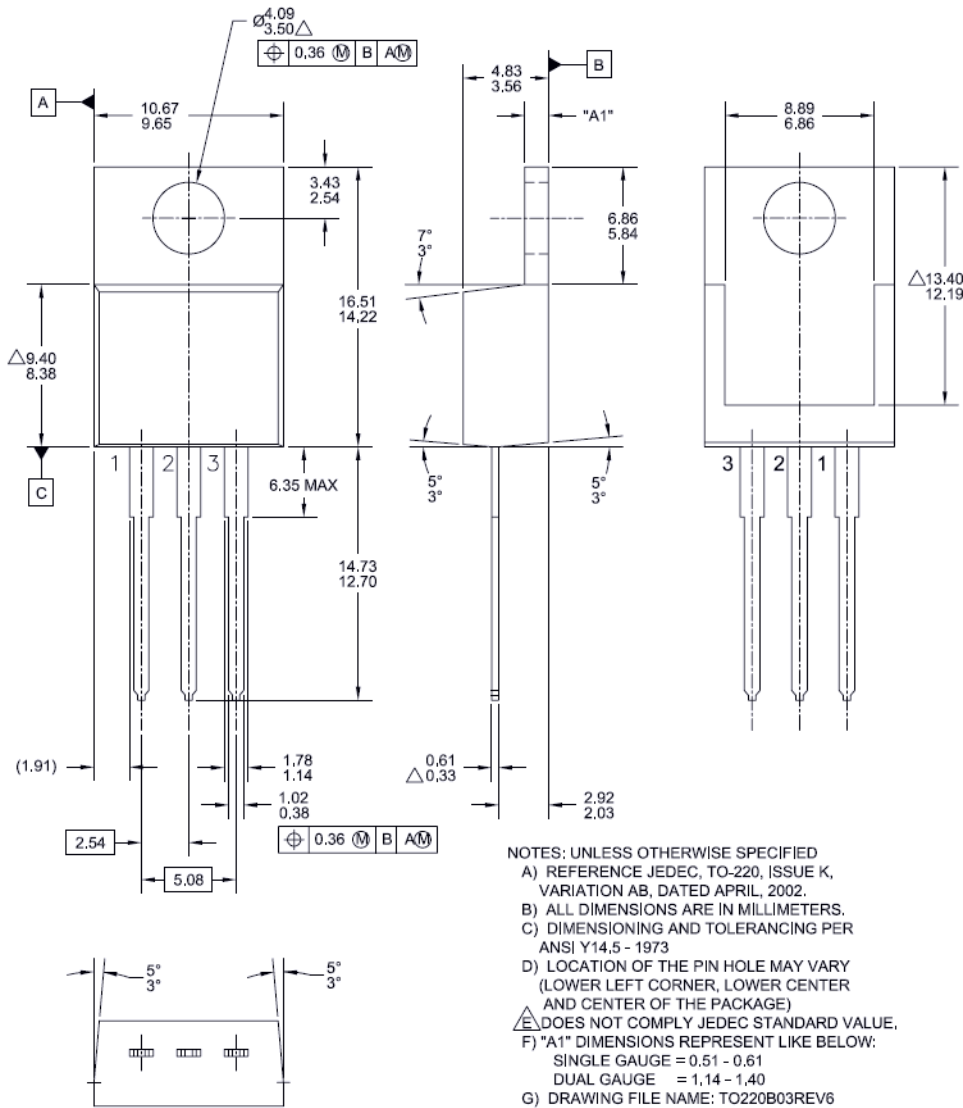


Figure 22. Transient Thermal Impedance of IGBT





## Mechanical Dimensions



**Figure 23. TO-220 3L - TO-220, MOLDED, 3LEAD, JEDEC VARIATION AB**

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Dimensions in Millimeters



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| AX-CAP®*   | FRFET®  | PowerXS™  |  SYSTEM®* |
| BitSiC™  | Global Power ResourceSM                         | Programmable Active Droop™  | TinyBoost®   |
| Build it Now™  | GreenBridge™                                    | QFET®   | TinyBuck®  |
| CorePLUS™  | Green FPS™                                      | QS™   | TinyCalc™  |
| CorePOWER™   | Green FPS™ e-Series™                            | Quiet Series™   | TinyLogic®   |
| CROSSVOLT™   | Gmax™   | RapidConfigure™   | TINYOPTO™  |
| CTL™   | GTO™  |  Saving our world, 1mW/W/kW at a time™ | TinyPower™   |
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| DEUXPEED®  | ISOPLANAR™                                      | SmartMax™   | TinyWire™  |
| Dual Cool™   | Marking Small Speakers Sound Louder and Better™ | SMART START™  | TranSiC™   |
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|  Fairchild® | MicroPak™                                       | SuperFET®   |  SerDes®  |
| Fairchild Semiconductor®   | MicroPak2™                                      | SuperSOT™-3   | UHC®   |
| FACT Quiet Series™   | MillerDrive™                                    | SuperSOT™-6   | Ultra FRFET™   |
| FACT®  | MotionMax™                                      | SuperSOT™-8   | UniFET™  |
| FAST®  | mWSaver®  | SupreMOS®   | VCX™   |
| FastvCore™   | OptoHiT™  | SyncFET™  | VisualMax™   |
| FETBench™  | OPTOLOGIC®                                      |   | VoltagePlus™   |
| FPS™   | OPTOPLANAR®                                     |   | XS™  |

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| Datasheet Identification | Product Status        | Definition  |
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