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# FGPF10N60UNDF

600 V, 10 A

Short Circuit Rated IGBT

## Features

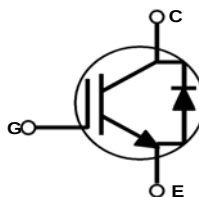
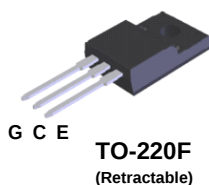
- Short Circuit Rated 10us
- High Current Capability
- High Input Impedance
- Fast Switching
- RoHS Compliant

## 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.

## Applications

- Sewing Machine, CNC, Home Appliances, Motor Control



## 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 @ $T_C = 25^\circ\text{C}$          | 20          | A                |
|             | Collector Current @ $T_C = 100^\circ\text{C}$         | 10          | A                |
| $I_{CM(1)}$ | Pulsed Collector Current @ $T_C = 25^\circ\text{C}$   | 30          | A                |
| $I_F$       | Diode Forward Current @ $T_C = 25^\circ\text{C}$      | 10          | A                |
|             | Diode Forward Current @ $T_C = 100^\circ\text{C}$     | 5           | A                |
| $P_D$       | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$  | 42          | W                |
|             | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$ | 17          | 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 rating: Pulse width limited by max. junction temperature

## Thermal Characteristics

| Symbol                        | Parameter                                              | Typ. | Max. | Unit               |
|-------------------------------|--------------------------------------------------------|------|------|--------------------|
| $R_{\theta JC}(\text{IGBT})$  | Thermal Resistance, Junction to Case                   | -    | 3.0  | $^\circ\text{C/W}$ |
| $R_{\theta JC}(\text{Diode})$ | Thermal Resistance, Junction to Case                   | -    | 5.6  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$               | Thermal Resistance, Junction to Ambient (PCB Mount)(2) | -    | 62.5 | $^\circ\text{C/W}$ |

### Notes:

2: Mountde on 1" square PCB (FR4 or G-10 material)

## Package Marking and Ordering Information

| Device Marking | Device        | Package | Reel Size | Tape Width | Quantity |
|----------------|---------------|---------|-----------|------------|----------|
| FGPF10N60UNDF  | FGPF10N60UNDF | TO-220F | -         | -          | 50ea     |

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

| Symbol                    | Parameter                               | Test Conditions                                                                                                                       | Min. | Typ. | Max. | Unit |
|---------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics       |                                         |                                                                                                                                       |      |      |      |      |
| BV <sub>CES</sub>         | Collector to Emitter Breakdown Voltage  | V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA                                                                                        | 600  | -    | -    | V    |
| I <sub>CES</sub>          | Collector Cut-Off Current               | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V                                                                            | -    | -    | 1    | mA   |
| I <sub>GES</sub>          | G-E Leakage Current                     | V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V                                                                            | -    | -    | ±10  | uA   |
| On Characteristics        |                                         |                                                                                                                                       |      |      |      |      |
| V <sub>GE(th)</sub>       | G-E Threshold Voltage                   | I <sub>C</sub> = 10 mA, V <sub>CE</sub> = V <sub>GE</sub>                                                                             | 5.5  | 6.8  | 8.5  | V    |
| V <sub>CE(sat)</sub>      | Collector to Emitter Saturation Voltage | I <sub>C</sub> = 10 A, V <sub>GE</sub> = 15 V                                                                                         | -    | 2    | 2.45 | V    |
|                           |                                         | I <sub>C</sub> = 10 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 125°C                                                                 | -    | 2.3  | -    | V    |
| Dynamic Characteristics   |                                         |                                                                                                                                       |      |      |      |      |
| C <sub>ies</sub>          | Input Capacitance                       | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 1 MHz                                                                              | -    | 517  |      | pF   |
| C <sub>oes</sub>          | Output Capacitance                      |                                                                                                                                       | -    | 65   |      | pF   |
| C <sub>res</sub>          | Reverse Transfer Capacitance            |                                                                                                                                       | -    | 20   |      | pF   |
| Switching Characteristics |                                         |                                                                                                                                       |      |      |      |      |
| t <sub>d(on)</sub>        | Turn-On Delay Time                      | V <sub>CC</sub> = 400 V, I <sub>C</sub> = 10 A, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 25°C  | -    | 8.0  |      | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                       | -    | 6.3  |      | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                       | -    | 52.2 |      | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                       | -    | 19.1 | 24.8 | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                       | -    | 0.15 |      | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                       | -    | 0.05 |      | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    |                                                                                                                                       | -    | 0.2  |      | mJ   |
| t <sub>d(on)</sub>        | Turn-On Delay Time                      | V <sub>CC</sub> = 400 V, I <sub>C</sub> = 10 A, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 125°C | -    | 8.1  |      | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                       | -    | 7.3  |      | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                       | -    | 55.1 |      | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                       | -    | 34.2 |      | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                       | -    | 0.22 |      | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                       | -    | 0.08 |      | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    |                                                                                                                                       | -    | 0.3  |      | mJ   |
| T <sub>sc</sub>           | Short Circuit Withstand Time            | V <sub>CC</sub> = 350 V, R <sub>G</sub> = 100 Ω, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 150°C                                       | 10   | -    | -    | μs   |

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

| Symbol   | Parameter                | Test Conditions                                                       | Min. | Typ. | Max | Unit |
|----------|--------------------------|-----------------------------------------------------------------------|------|------|-----|------|
| $Q_g$    | Total Gate Charge        | $V_{CE} = 400\text{ V}, I_C = 10\text{ A},$<br>$V_{GE} = 15\text{ V}$ | -    | 37   |     | nC   |
| $Q_{ge}$ | Gate to Emitter Charge   |                                                                       | -    | 5    |     | nC   |
| $Q_{gc}$ | Gate to Collector Charge |                                                                       | -    | 21   |     | 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         | $I_F = 10\text{ A}$                                     | $T_C = 25^\circ\text{C}$  | -    | 1.8  | 2.2 | V    |
|          |                               |                                                         | $T_C = 125^\circ\text{C}$ | -    | 1.7  |     |      |
| $t_{rr}$ | Diode Reverse Recovery Time   | $I_F = 10\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$  | -    | 37.7 |     | ns   |
|          |                               |                                                         | $T_C = 125^\circ\text{C}$ | -    | 78.9 |     |      |
| $Q_{rr}$ | Diode Reverse Recovery Charge |                                                         | $T_C = 25^\circ\text{C}$  | -    | 75   |     | nC   |
|          |                               |                                                         | $T_C = 125^\circ\text{C}$ | -    | 221  |     |      |



## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

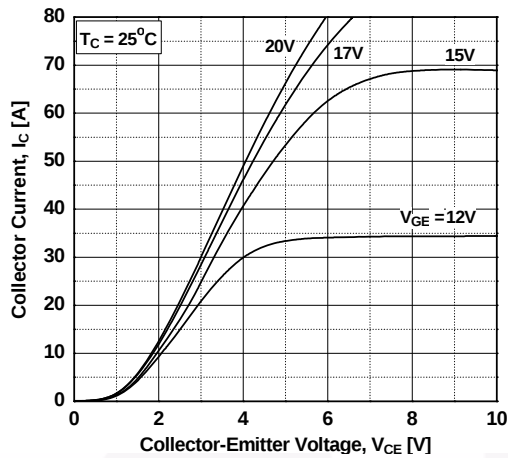


Figure 2. Typical Output Characteristics

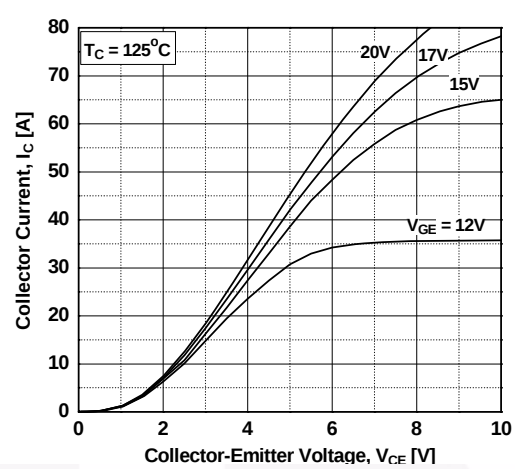


Figure 3. Typical Saturation Voltage Characteristics

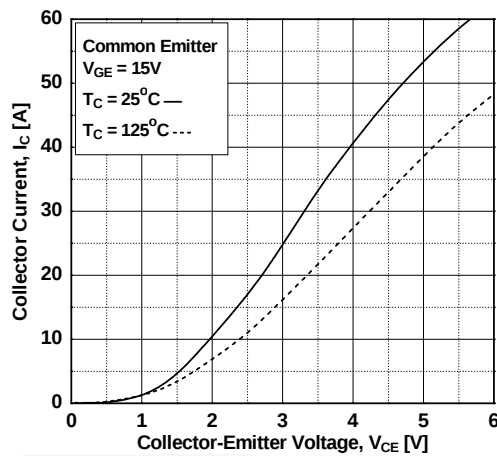


Figure 4. Transfer Characteristics

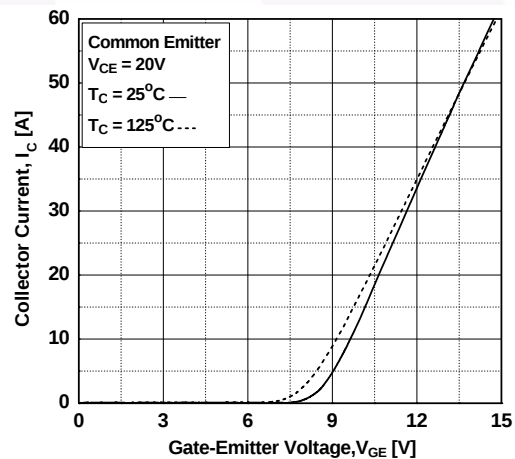


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

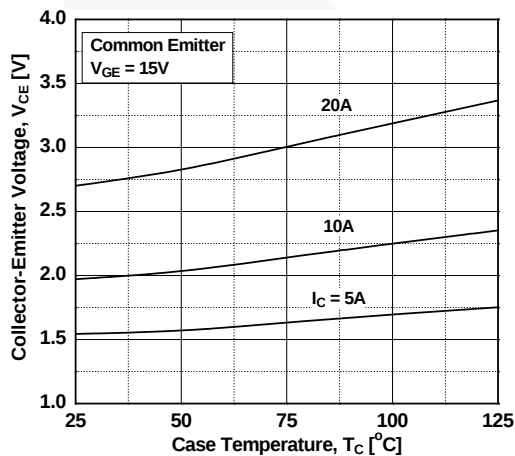
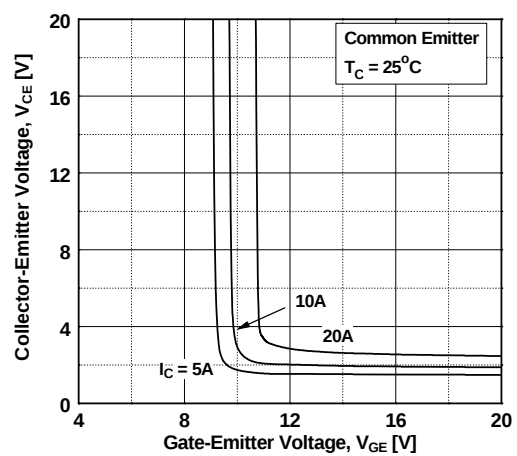


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics

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

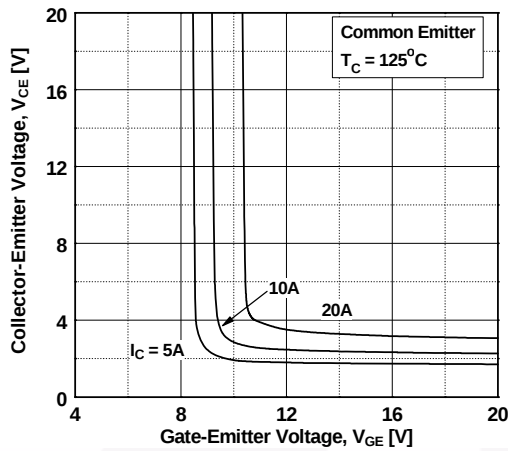


Figure 8. Capacitance Characteristics

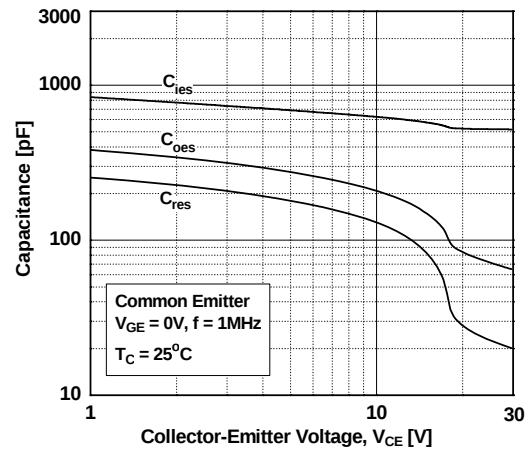


Figure 9. Gate charge Characteristics

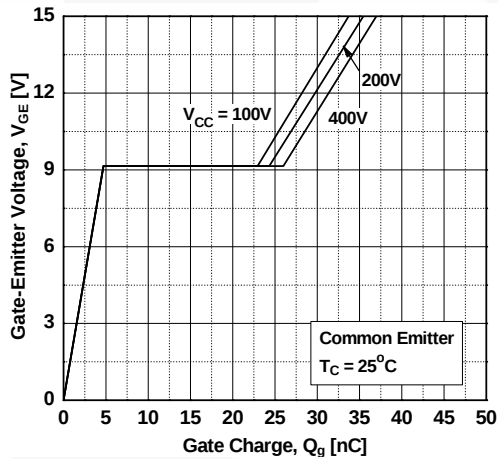


Figure 10. SOA Characteristics

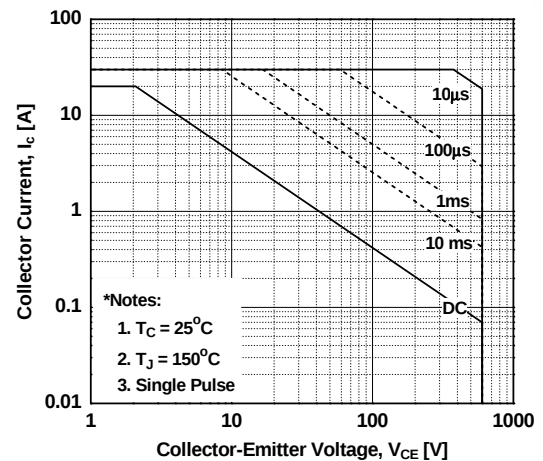


Figure 11. Turn-on Characteristics vs. Gate Resistance

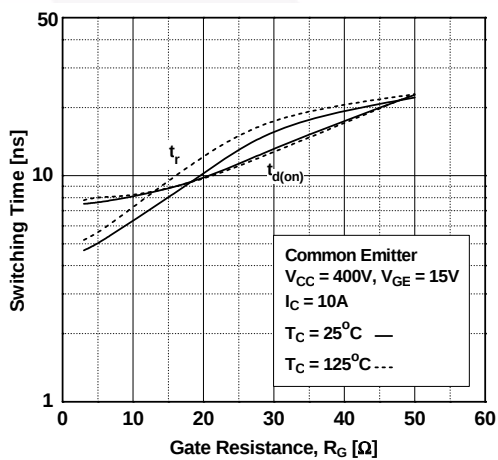
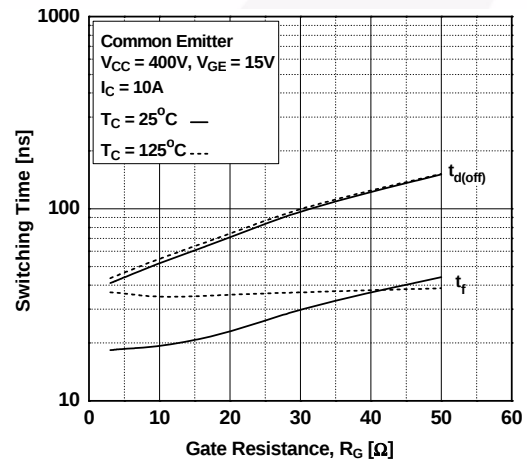


Figure 12. Turn-off Characteristics vs. Gate Resistance



## Typical Performance Characteristics

Figure 13. Turn-on Characteristics vs. Collector Current

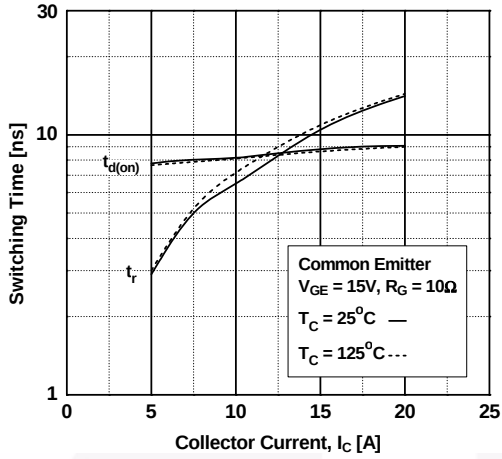


Figure 14. Turn-off Characteristics vs. Collector Current

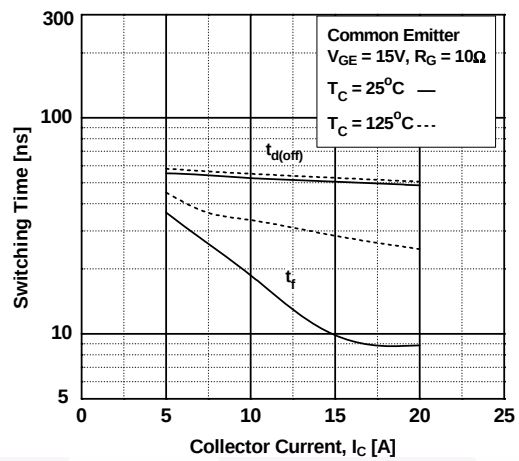


Figure 15. Switching Loss vs. Gate Resistance

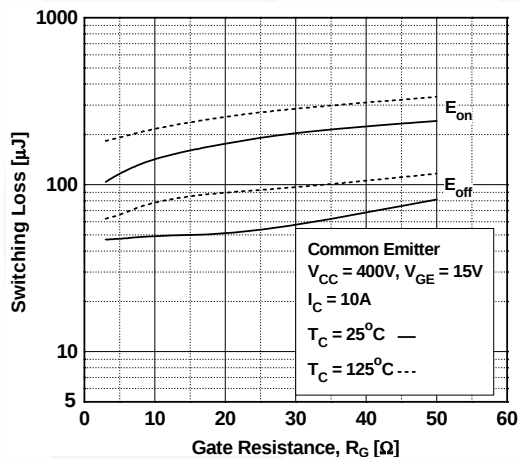


Figure 16. Switching Loss vs. Collector Current

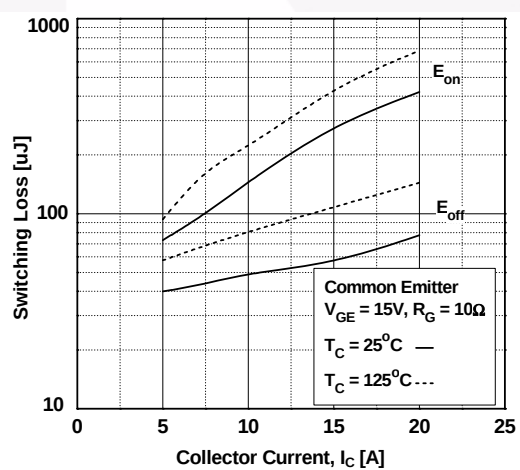


Figure 17. Turn off Switching SOA Characteristics

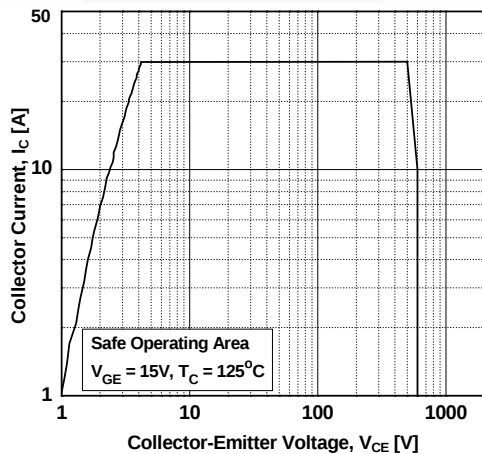
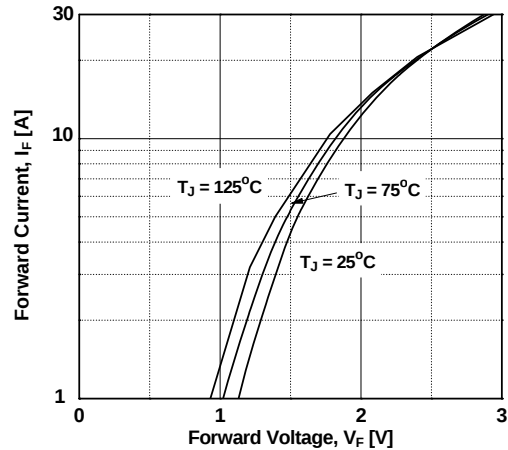


Figure 18. Forward Characteristics



## Typical Performance Characteristics

Figure 19. Reverse Current

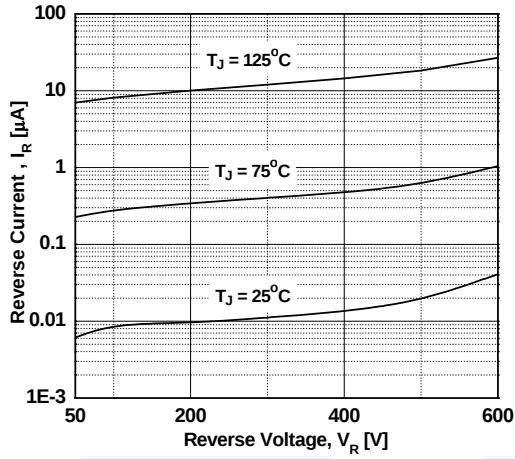


Figure 20. Stored Charge

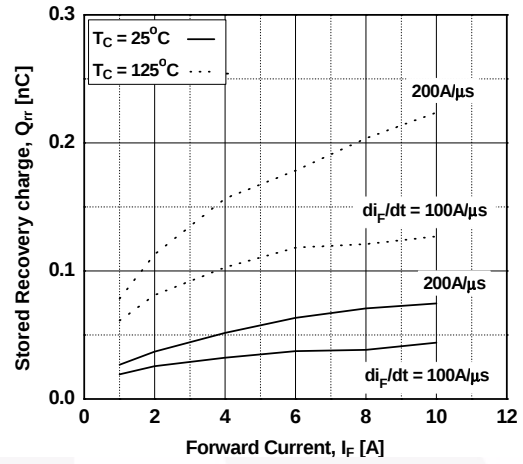


Figure 21. Reverse Recovery Time

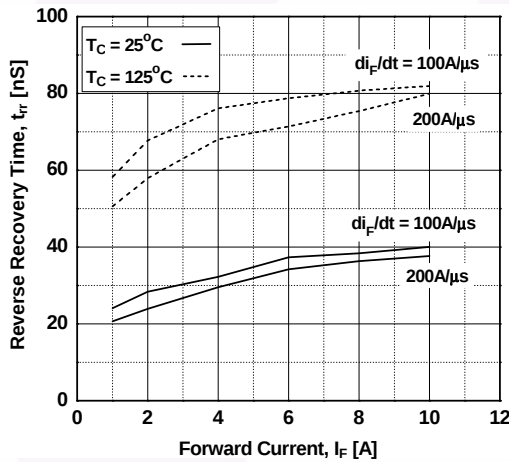
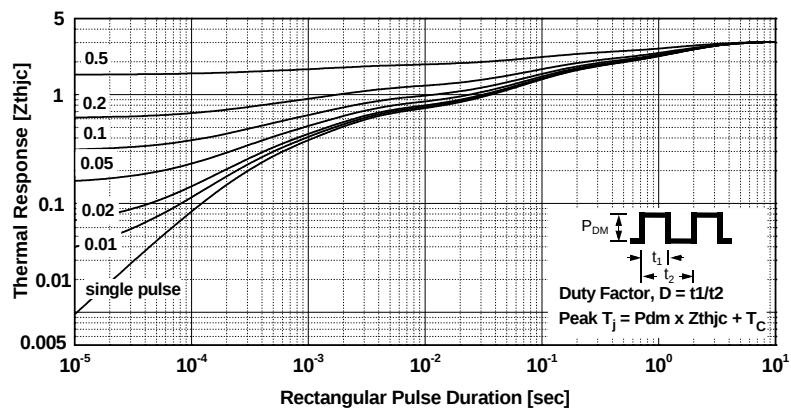


Figure 22. Transient Thermal Impedance of IGBT







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