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March 2015

FGA60N60UFD

600 V, 60 A Field Stop IGBT

Features

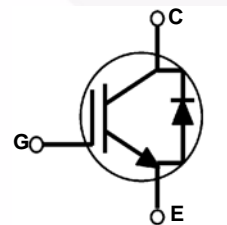
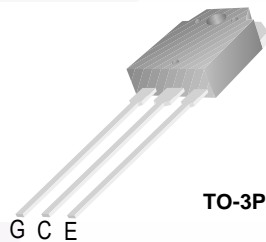
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.9\text{ V @ } I_C = 60\text{ A}$
- High Input Impedance
- Fast Switching
- RoHS Compliant

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 @ $T_C = 25^\circ\text{C}$ | 120 | A |
| | Collector Current @ $T_C = 100^\circ\text{C}$ | 60 | A |
| $I_{CM(1)}$ | Pulsed Collector Current @ $T_C = 25^\circ\text{C}$ | 180 | A |
| P_D | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$ | 298 | W |
| | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$ | 119 | W |
| T_J | Operating Junction Temperature | -55 to +150 | $^\circ\text{C}$ |
| T_{stg} | Storage Temperature Range | -55 to +150 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | 300 | $^\circ\text{C}$ |

Notes:

1: Repetitive test, Pulse width limited by max. junction temperature

Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|-------------------------------|---|------|------|--------------------|
| $R_{\theta JC}(\text{IGBT})$ | Thermal Resistance, Junction to Case | - | 0.33 | $^\circ\text{C/W}$ |
| $R_{\theta JC}(\text{Diode})$ | Thermal Resistance, Junction to Case | - | 1.1 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 40 | $^\circ\text{C/W}$ |

Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-------------|---------|----------------|-----------|------------|----------|
| FGA60N60UFD | FGA60N60UFD | TO-3P | 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 | $V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$ | 600 | - | - | V |
| $\Delta BV_{CES} / \Delta T_J$ | Temperature Coefficient of Breakdown Voltage | $V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$ | - | 0.67 | - | V/°C |
| I_{CES} | Collector Cut-Off Current | $V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$ | - | - | 250 | μA |
| I_{GES} | G-E Leakage Current | $V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$ | - | - | ±400 | nA |
| On Characteristics | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C = 250\ \mu\text{A}, V_{CE} = V_{GE}$ | 4.0 | 5.0 | 6.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C = 60\text{ A}, V_{GE} = 15\text{ V}$ | - | 1.9 | 2.4 | V |
| | | $I_C = 60\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$ | - | 2.1 | - | V |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$ | - | 2855 | - | pF |
| C_{oes} | Output Capacitance | | - | 325 | - | pF |
| C_{res} | Reverse Transfer Capacitance | | - | 110 | - | pF |
| Switching Characteristics | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 400\text{ V}, I_C = 60\text{ A}, R_G = 5\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 25^\circ\text{C}$ | - | 23 | - | ns |
| t_r | Rise Time | | - | 58 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 130 | - | ns |
| t_f | Fall Time | | - | 40 | 80 | ns |
| E_{on} | Turn-On Switching Loss | | - | 1.81 | - | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 0.81 | - | mJ |
| E_{ts} | Total Switching Loss | - | 2.62 | - | mJ | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 400\text{ V}, I_C = 60\text{ A}, R_G = 5\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 125^\circ\text{C}$ | - | 22 | - | ns |
| t_r | Rise Time | | - | 61 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 141 | - | ns |
| t_f | Fall Time | | - | 63 | - | ns |
| E_{on} | Turn-On Switching Loss | | - | 1.92 | - | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 1.23 | - | mJ |
| E_{ts} | Total Switching Loss | - | 3.15 | - | mJ | |
| Q_g | Total Gate Charge | $V_{CE} = 400\text{ V}, I_C = 60\text{ A}, V_{GE} = 15\text{ V}$ | - | 188 | - | nC |
| Q_{ge} | Gate to Emitter Charge | | - | 21 | - | nC |
| Q_{gc} | Gate to Collector Charge | | - | 97 | - | 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 | $I_F = 30\text{ A}$ | $T_C = 25^\circ\text{C}$ | - | 2.0 | 2.6 | V |
| | | | $T_C = 125^\circ\text{C}$ | - | 1.8 | - | |
| t_{rr} | Diode Reverse Recovery Time | $I_F = 30\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$ | - | 47 | - | ns |
| | | | $T_C = 125^\circ\text{C}$ | - | 179 | - | |
| Q_{rr} | Diode Reverse Recovery Charge | $I_F = 30\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$ | - | 83 | - | nC |
| | | | $T_C = 125^\circ\text{C}$ | - | 567 | - | |



Typical Performance Characteristics

Figure 1. Typical Output Characteristics

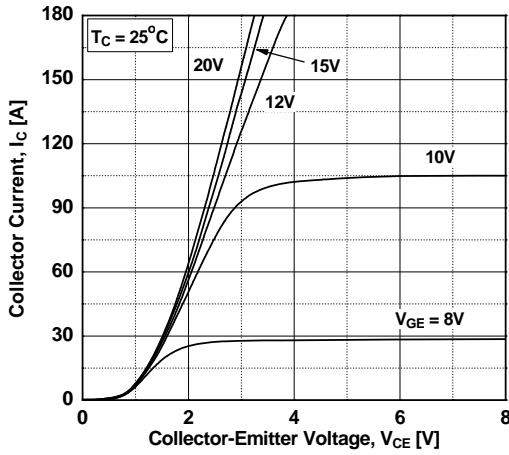


Figure 2. Typical Output Characteristics

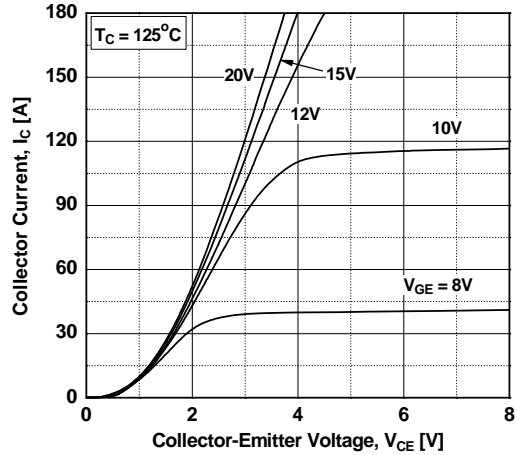


Figure 3. Typical Saturation Voltage Characteristics

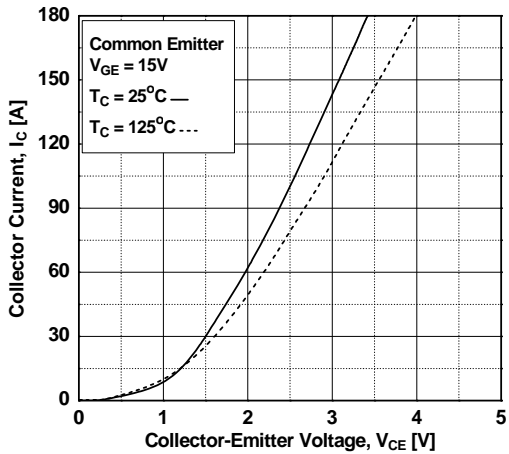


Figure 4. Transfer Characteristics

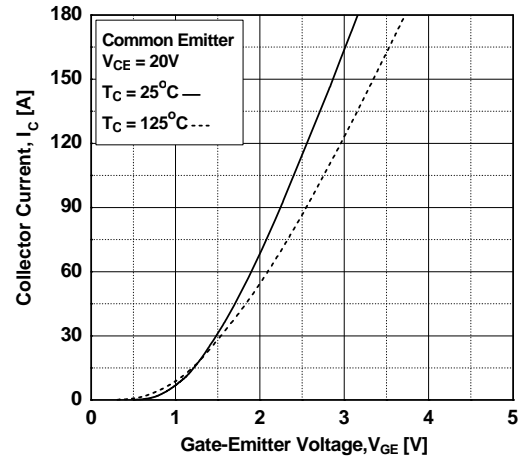


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

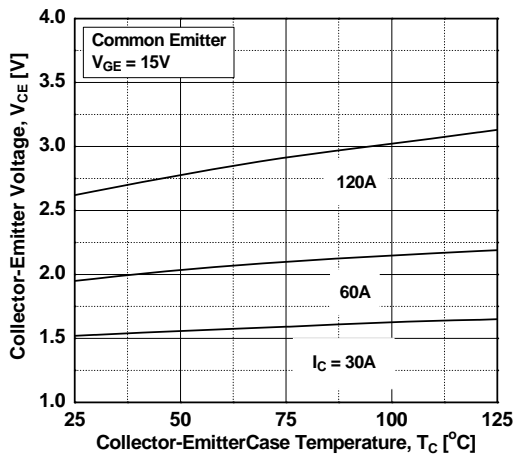
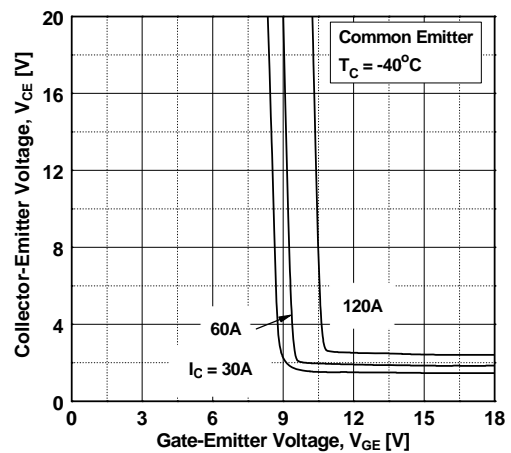


Figure 6. Saturation Voltage vs. Vge



Typical Performance Characteristics

Figure 7. Saturation Voltage vs. V_{GE}

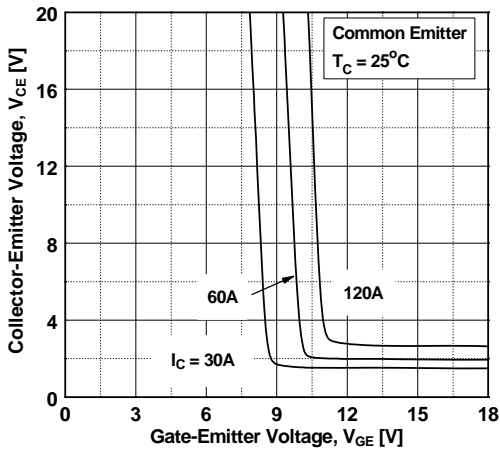


Figure 8. Saturation Voltage vs. V_{GE}

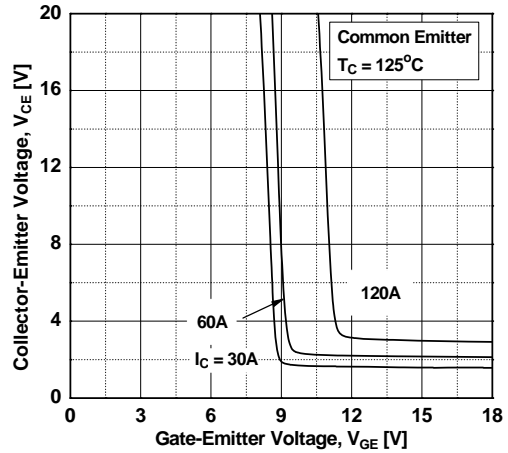


Figure 9. Capacitance Characteristics

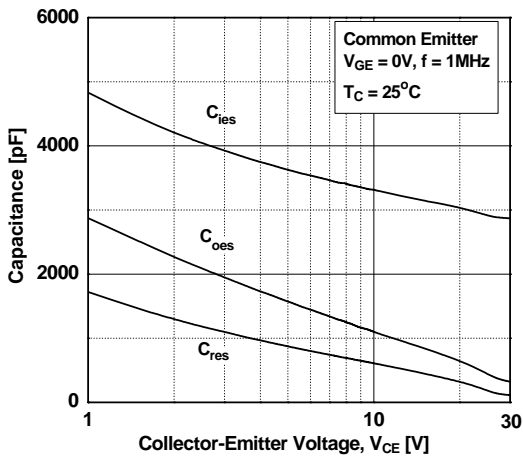


Figure 10. Gate charge Characteristics

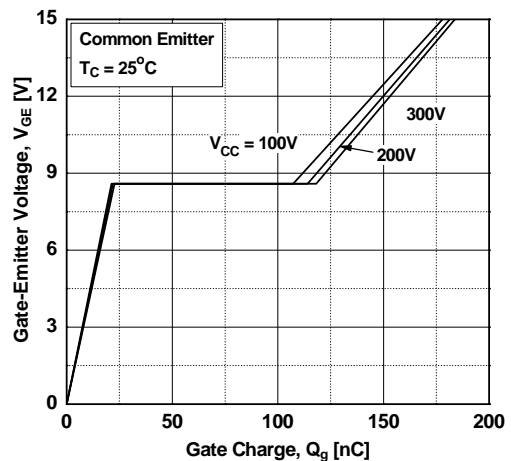


Figure 11. SOA Characteristics

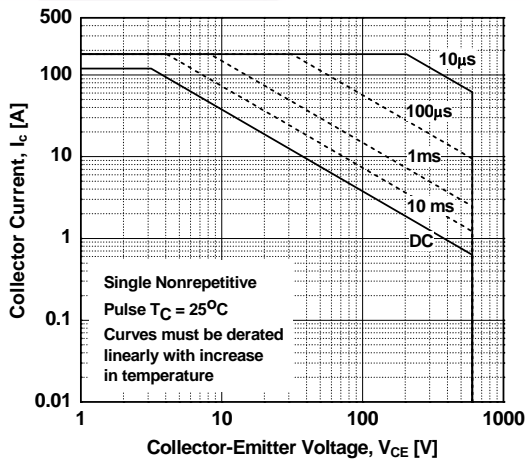
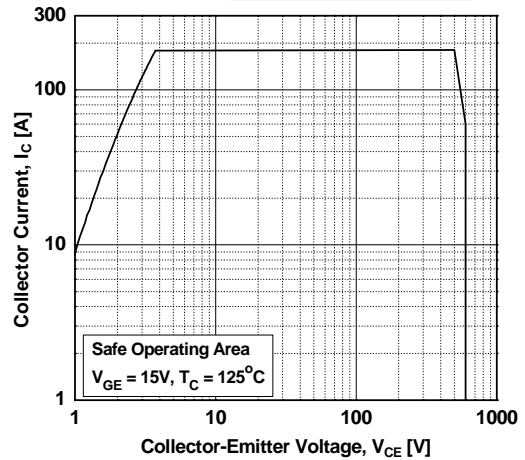


Figure 12. Turn off Switching SOA Characteristics



Typical Performance Characteristics

Figure 13. Turn-on Characteristics vs. Gate Resistance

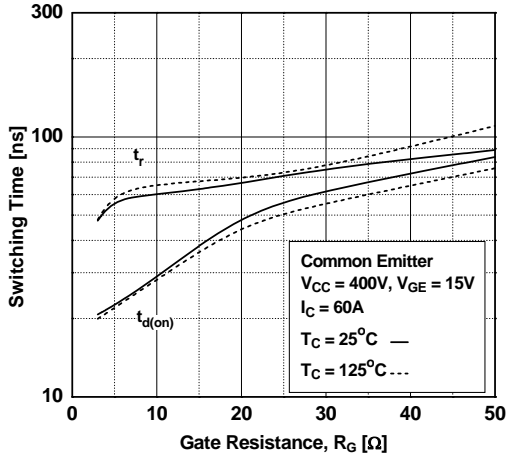


Figure 14. Turn-off Characteristics vs. Gate Resistance

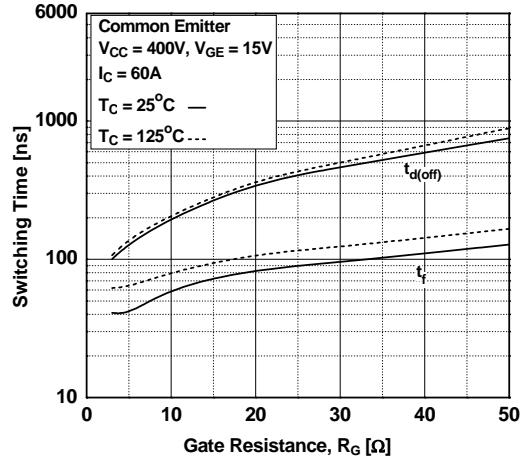


Figure 15. Turn-on Characteristics vs. Collector Current

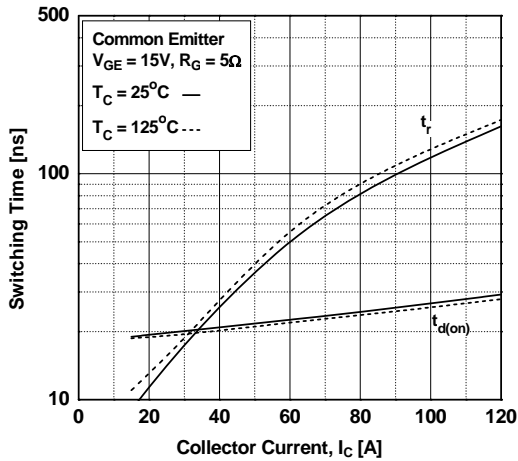


Figure 16. Turn-off Characteristics vs. Collector Current

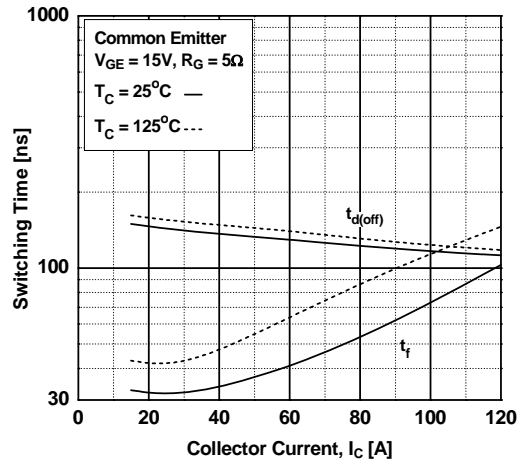


Figure 17. Switching Loss vs. Gate Resistance

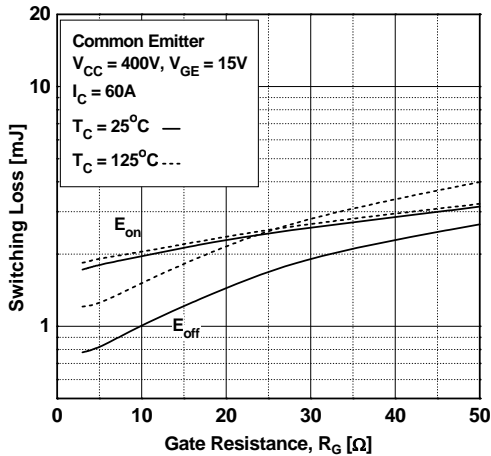
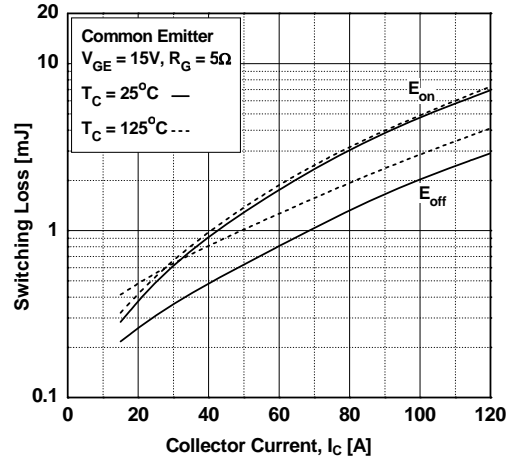


Figure 18. Switching Loss vs. Collector Current



Typical Performance Characteristics

Figure 19. Forward Characteristics

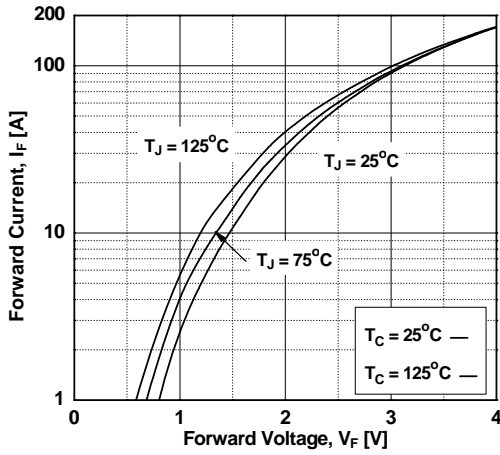


Figure 20. Reverse Current

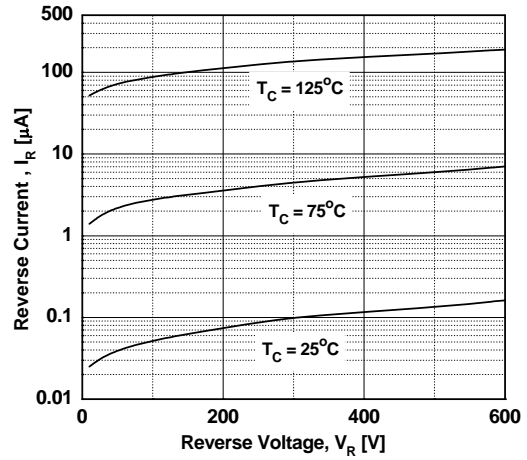


Figure 21. Stored Charge

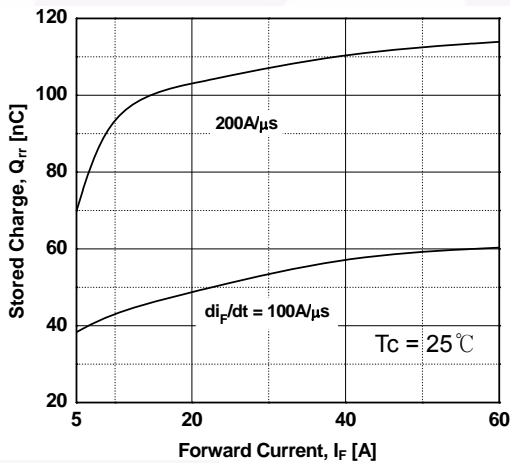


Figure 22. Reverse Recovery Time

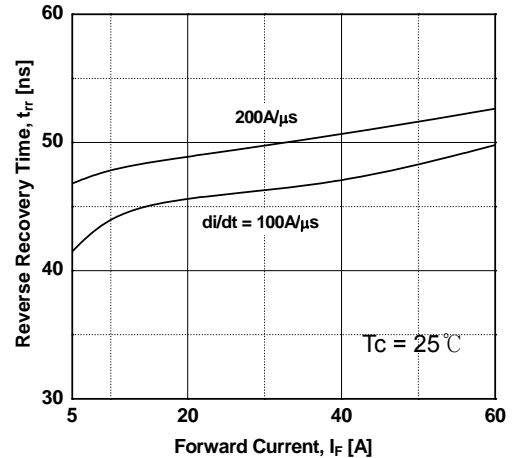
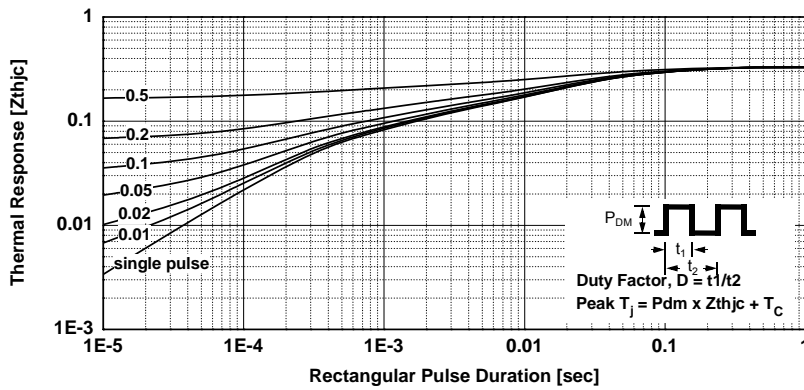


Figure 23. Transient Thermal Impedance of IGBT



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