



General Description

The AlphaIGBT™ line of products offers best-in-class performance in conduction and switching losses, with robust short circuit capability. They are designed for ease of paralleling, minimal gate spike under high dV/dt conditions and resistance to oscillations. The soft co-package diode is targeted for minimal losses in motor control applications.

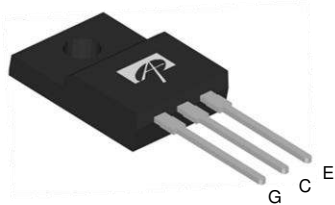
Product Summary

| | |
|--|------|
| V_{CE} | 600V |
| I_C ($T_C=100^\circ\text{C}$) | 15A |
| $V_{CE(sat)}$ ($T_C=25^\circ\text{C}$) | 1.6V |

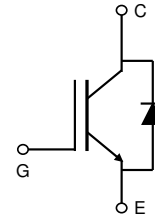


Top View

TO-220F



AOTF15B60D



Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | AOTF15B60D | Units |
|--|----------------|-------------------------|------------------|
| Collector-Emitter Voltage | V_{CE} | 600 | V |
| Gate-Emitter Voltage | V_{GE} | ± 20 | V |
| Continuous Collector Current | I_C | $T_C=25^\circ\text{C}$ | 30^S |
| | | $T_C=100^\circ\text{C}$ | 15^S |
| Pulsed Collector Current, Limited by T_{Jmax} | I_{CM} | 60 | A |
| Turn off SOA, $V_{CE} \leq 600\text{V}$, Limited by T_{Jmax} | I_{LM} | 60 | A |
| Continuous Diode Forward Current | I_F | $T_C=25^\circ\text{C}$ | 30 |
| | | $T_C=100^\circ\text{C}$ | 15 |
| Diode Pulsed Current, Limited by T_{Jmax} | I_{FM} | 60 | A |
| Short circuit withstanding time $V_{GE} = 15\text{V}$, $V_{CE} \leq 400\text{V}$, Delay between short circuits $\geq 1.0\text{s}$, $T_C=25^\circ\text{C}$ | t_{SC} | 10 | μs |
| Power Dissipation | P_D | $T_C=25^\circ\text{C}$ | 50 |
| | | $T_C=100^\circ\text{C}$ | 25 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | $^\circ\text{C}$ |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | T_L | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Parameter | Symbol | AOTF15B60D | Units |
|--------------------------------|-----------------|------------|--------------------|
| Maximum Junction-to-Ambient | $R_{\theta JA}$ | 65 | $^\circ\text{C/W}$ |
| Maximum IGBT Junction-to-Case | $R_{\theta JC}$ | 3 | $^\circ\text{C/W}$ |
| Maximum Diode Junction-to-Case | $R_{\theta JC}$ | 4 | $^\circ\text{C/W}$ |

\$.TO220F I_C Follow TO220

Electrical Characteristics (T_J=25°C unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units | |
|--|--|---|--|------|-----------|----------|---------|
| STATIC PARAMETERS | | | | | | | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $I_C=250\mu A, V_{GE}=0V, T_J=25^\circ C$ | 600 | - | - | V | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}=15V, I_C=15A$ | $T_J=25^\circ C$ | - | 1.6 | 1.8 | V |
| | | | $T_J=125^\circ C$ | - | 1.85 | - | |
| | | | $T_J=150^\circ C$ | - | 1.92 | - | |
| V_F | Diode Forward Voltage | $V_{GE}=0V, I_C=15A$ | $T_J=25^\circ C$ | - | 1.43 | 1.72 | V |
| | | | $T_J=125^\circ C$ | - | 1.39 | - | |
| | | | $T_J=150^\circ C$ | - | 1.36 | - | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{CE}=V_{GE}, I_C=250\mu A$ | - | 5.6 | - | V | |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE}=600V, V_{GE}=0V$ | $T_J=25^\circ C$ | - | - | 10 | μA |
| | | | $T_J=125^\circ C$ | - | - | 300 | |
| | | | $T_J=150^\circ C$ | - | - | 1500 | |
| I_{GES} | Gate-Emitter leakage current | $V_{CE}=0V, V_{GE}=\pm 20V$ | - | - | ± 100 | nA | |
| g_{FS} | Forward Transconductance | $V_{CE}=20V, I_C=15A$ | - | 7.7 | - | S | |
| DYNAMIC PARAMETERS | | | | | | | |
| C_{ies} | Input Capacitance | $V_{GE}=0V, V_{CE}=25V, f=1MHz$ | - | 1290 | - | pF | |
| C_{oes} | Output Capacitance | | - | 97 | - | pF | |
| C_{res} | Reverse Transfer Capacitance | | - | 3.1 | - | pF | |
| Q_g | Total Gate Charge | $V_{GE}=15V, V_{CE}=480V, I_C=15A$ | - | 25.4 | - | nC | |
| Q_{ge} | Gate to Emitter Charge | | - | 9.5 | - | nC | |
| Q_{gc} | Gate to Collector Charge | | - | 8.3 | - | nC | |
| $I_{C(SC)}$ | Short circuit collector current, Max. 1000 short circuits, Delay between short circuits $\geq 1.0s$ | $V_{GE}=15V, V_{CE}=400V, R_G=20\Omega$ | - | 74 | - | A | |
| R_g | Gate resistance | $V_{GE}=0V, V_{CE}=0V, f=1MHz$ | - | 2.4 | - | Ω | |
| SWITCHING PARAMETERS, (Load Inductive, T_J=25°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=25^\circ C$ $V_{GE}=15V, V_{CE}=400V, I_C=15A,$ $R_G=20\Omega,$ Parasitic Inductance=100nH | - | 21 | - | ns | |
| t_r | Turn-On Rise Time | | - | 19 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 73 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 10 | - | ns | |
| E_{on} | Turn-On Energy | | - | 0.42 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.11 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 0.53 | - | mJ | |
| t_{rr} | Diode Reverse Recovery Time | | $T_J=25^\circ C$ | - | 196 | - | ns |
| Q_{rr} | Diode Reverse Recovery Charge | | $I_F=15A, dl/dt=200A/\mu s, V_{CE}=400V$ | - | 0.48 | - | μC |
| I_{rm} | Diode Peak Reverse Recovery Current | | | - | 5.8 | - | A |
| SWITCHING PARAMETERS, (Load Inductive, T_J=150°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=150^\circ C$ $V_{GE}=15V, V_{CE}=400V, I_C=15A,$ $R_G=20\Omega,$ Parasitic Inductance=100nH | - | 21 | - | ns | |
| t_r | Turn-On Rise Time | | - | 19 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 91 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 8 | - | ns | |
| E_{on} | Turn-On Energy | | - | 0.54 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.19 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 0.73 | - | mJ | |
| t_{rr} | Diode Reverse Recovery Time | | $T_J=150^\circ C$ | - | 235 | - | ns |
| Q_{rr} | Diode Reverse Recovery Charge | | $I_F=15A, dl/dt=200A/\mu s, V_{CE}=400V$ | - | 1.1 | - | μC |
| I_{rm} | Diode Peak Reverse Recovery Current | | | - | 8.5 | - | A |

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

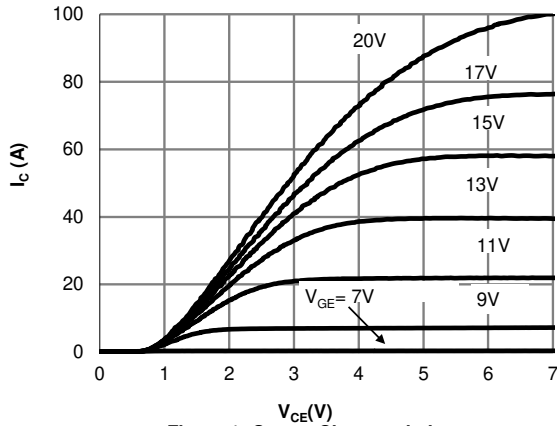


Figure 1: Output Characteristic
($T_j=25^\circ\text{C}$)

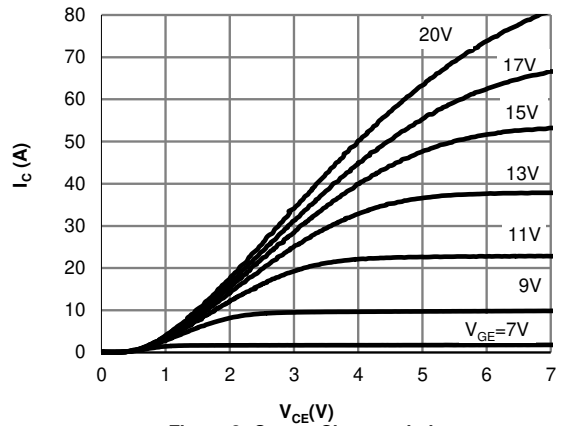


Figure 2: Output Characteristic
($T_j=150^\circ\text{C}$)

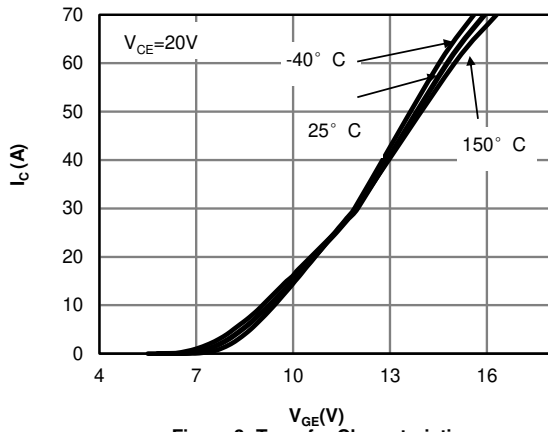


Figure 3: Transfer Characteristic

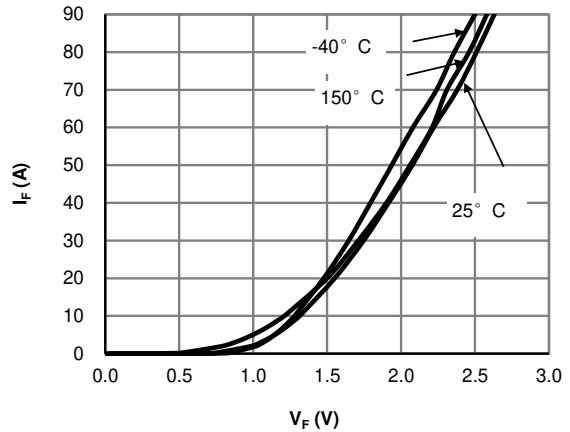


Figure 4: Diode Characteristic

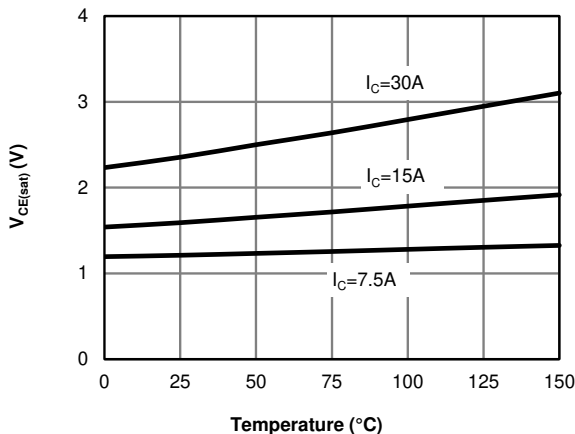


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

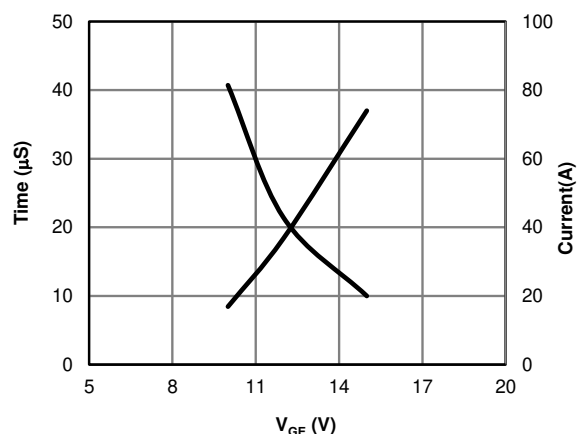


Figure 6: V_{GE} vs. Short Circuit Time
($V_{CE}=400\text{V}, T_C=25^\circ\text{C}$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

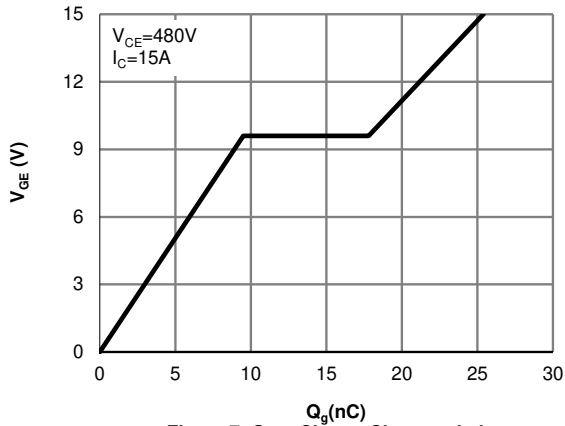


Figure 7: Gate-Charge Characteristics

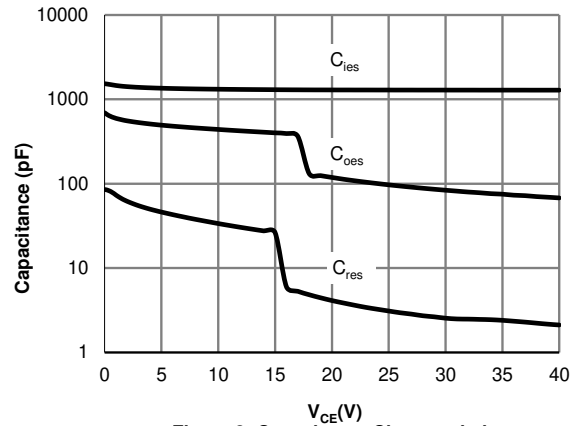


Figure 8: Capacitance Characteristic

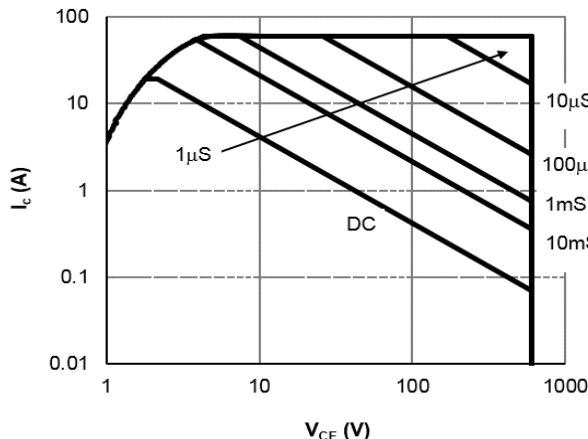


Figure 9: Forward Bias Safe Operating Area
($T_C=25^\circ\text{C}, V_{GE}=15\text{V}$)

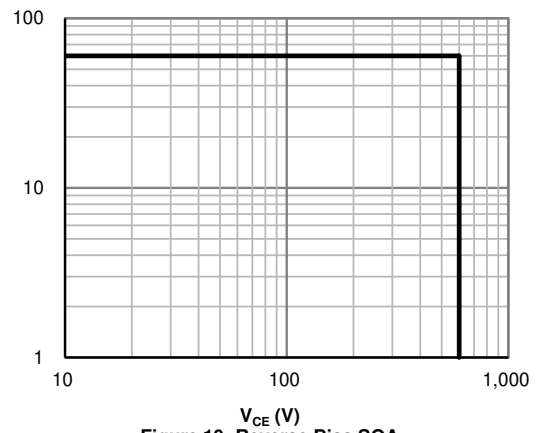


Figure 10: Reverse Bias SOA
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}$)

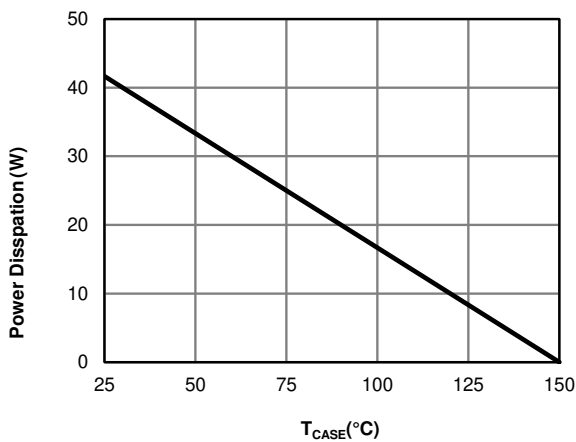


Figure 11: Power Dissipation as a Function of Case

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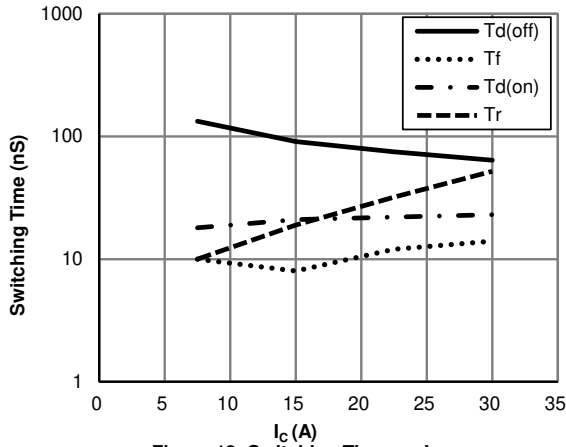


Figure 12: Switching Time vs. I_C
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=20\Omega$)

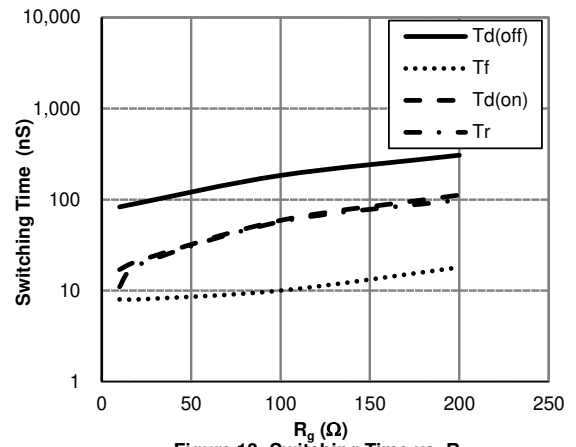


Figure 13: Switching Time vs. R_g
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}$)

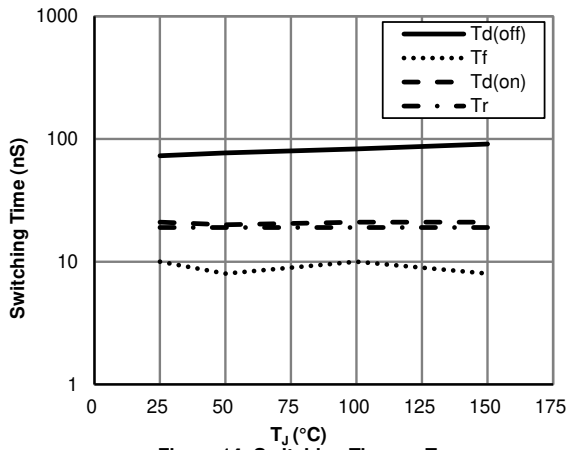


Figure 14: Switching Time vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}, R_g=20\Omega$)

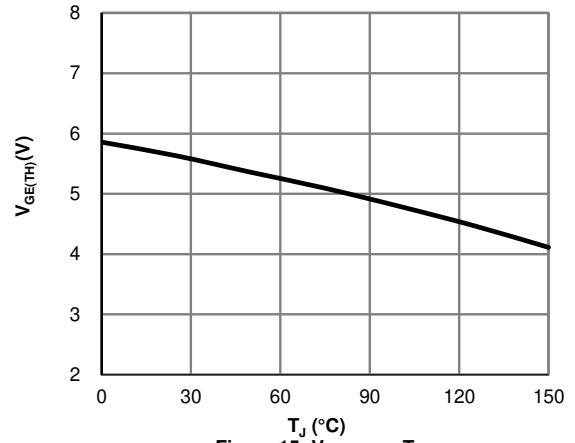


Figure 15: $V_{GE(TH)}$ vs. T_J

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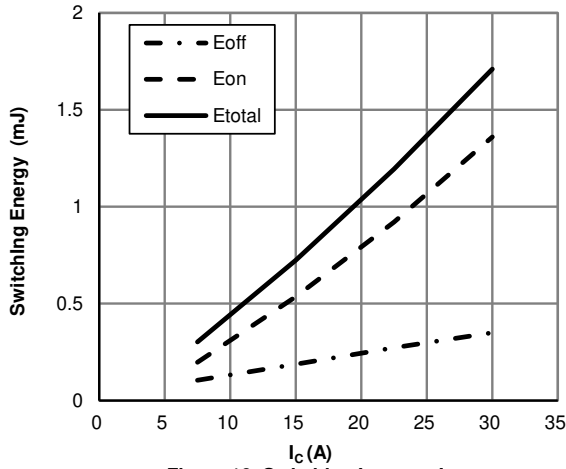


Figure 16: Switching Loss vs. I_C
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=20\Omega$)

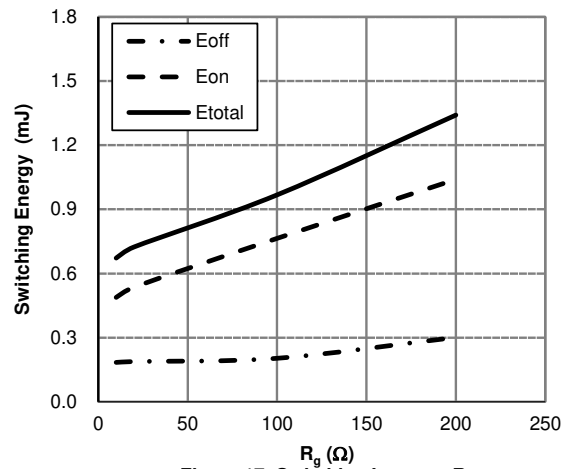


Figure 17: Switching Loss vs. R_g
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}$)

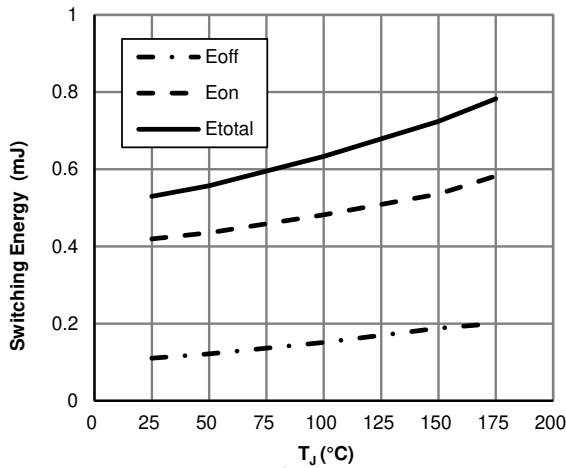


Figure 18: Switching Loss vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}, R_g=20\Omega$)

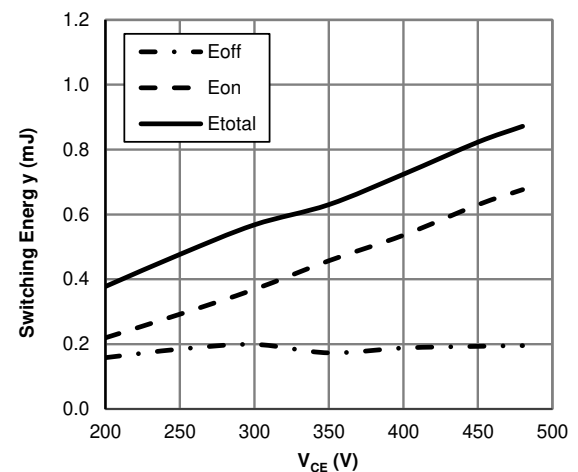


Figure 19: Switching Loss vs. V_{CE}
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, I_C=15\text{A}, R_g=20\Omega$)

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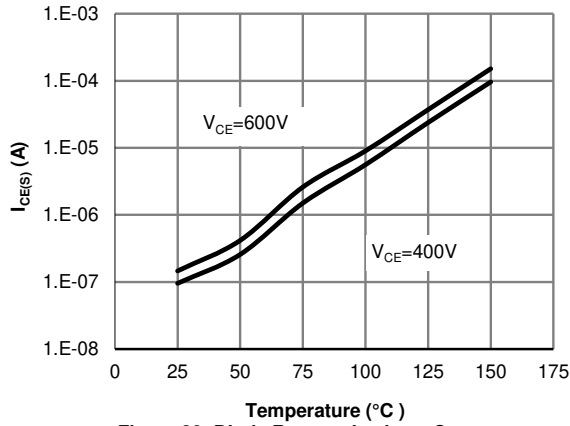


Figure 20: Diode Reverse Leakage Current vs. Junction Temperature

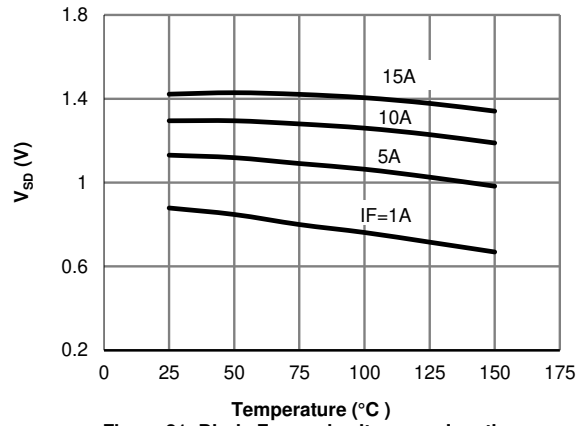


Figure 21: Diode Forward voltage vs. Junction Temperature

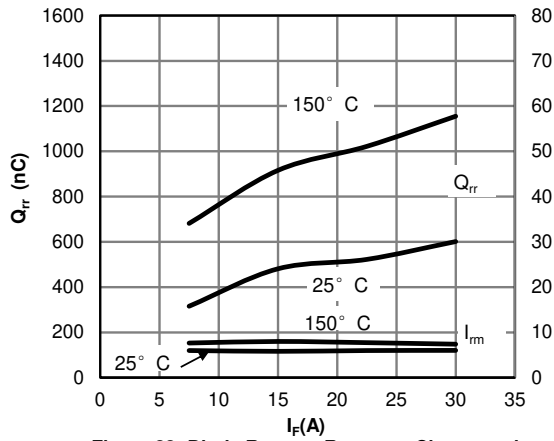


Figure 22: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

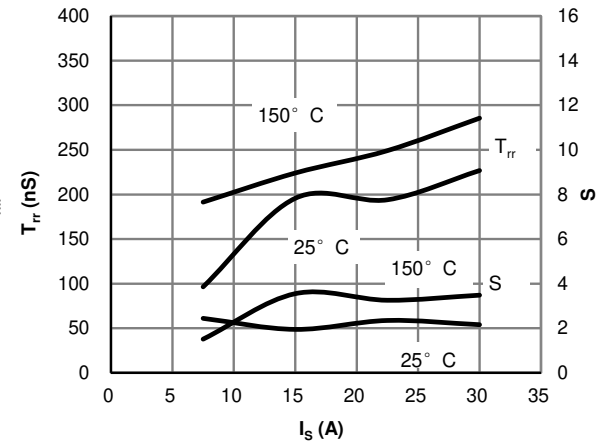


Figure 23: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

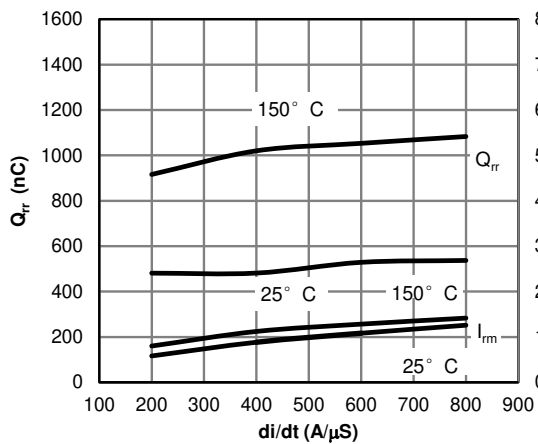


Figure 24: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=15A$)

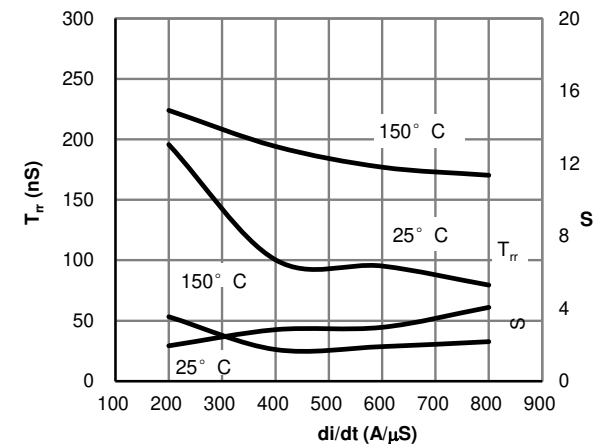


Figure 25: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=15A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

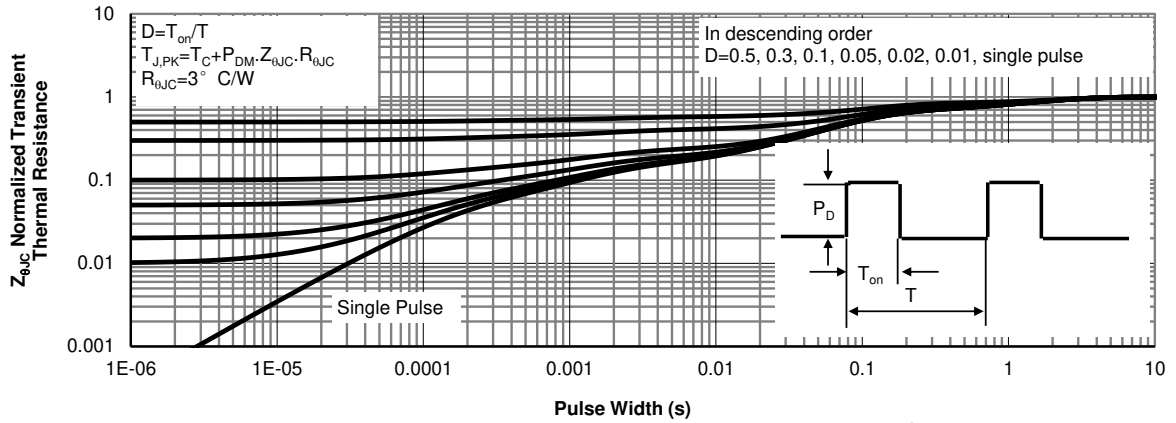


Figure 26: Normalized Maximum Transient Thermal Impedance for IGBT

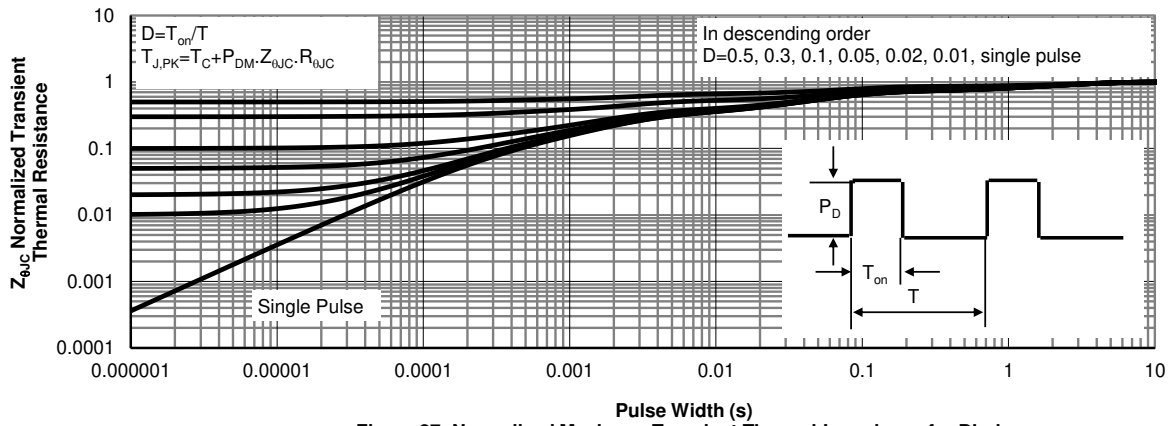
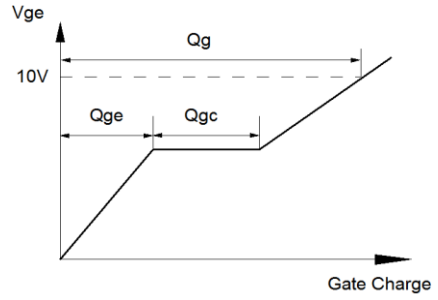
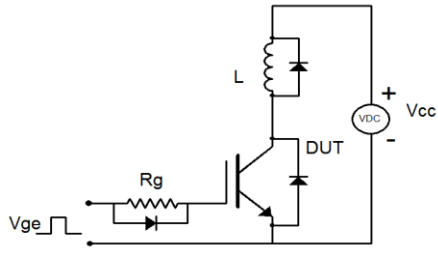
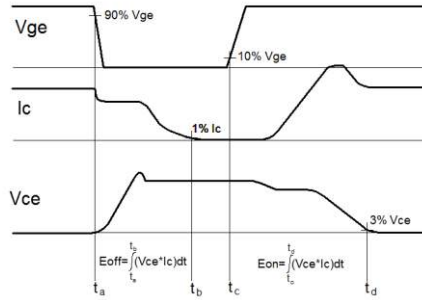
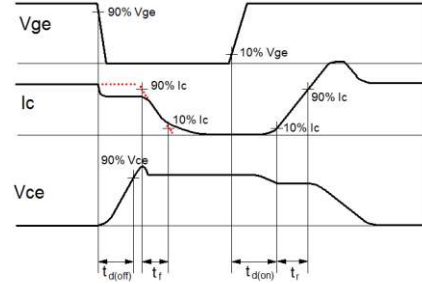
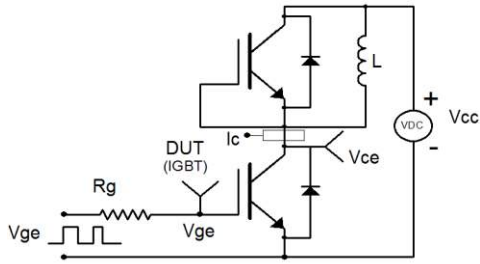


Figure 27: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

