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General Description

The Alpha IGBT™ 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

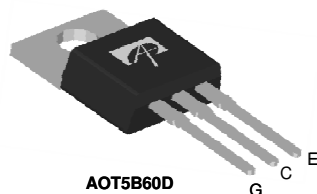
| | |
|------------------------------------------|-------|
| V_{CE} | 600V |
| I_C ($T_C=100^\circ\text{C}$) | 5A |
| $V_{CE(sat)}$ ($T_C=25^\circ\text{C}$) | 1.55V |

100% E_{on}/E_{off} Tested
 100% Q_{rr} Tested
 100% Short Circuit Current Tested*

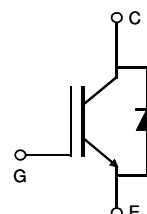


Top View

TO-220



AOT5B60D



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

| Parameter | Symbol | AOT5B60D | Units |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------|------------------|
| Collector-Emitter Voltage | V_{CE} | 600 | V |
| Gate-Emitter Voltage | V_{GE} | ± 20 | V |
| Continuous Collector Current | I_C | $T_C=25^\circ\text{C}$ | 10 |
| | | $T_C=100^\circ\text{C}$ | 5 |
| Pulsed Collector Current, Limited by T_{Jmax} | I_{CM} | 20 | A |
| Turn off SOA, $V_{CE} \leq 600\text{V}$, Limited by T_{Jmax} | I_{LM} | 20 | A |
| Continuous Diode Forward Current | I_F | $T_C=25^\circ\text{C}$ | 10 |
| | | $T_C=100^\circ\text{C}$ | 5 |
| Diode Pulsed Current, Limited by T_{Jmax} | I_{FM} | 20 | A |
| Short circuit withstanding time $V_{GE} = 15\text{V}$, $V_{CE} \leq 400\text{V}$, Delay between short circuits $\geq 1.0\text{s}$, $T_C=150^\circ\text{C}$ | t_{SC} | 10 | μs |
| Power Dissipation | P_D | $T_C=25^\circ\text{C}$ | 82.4 |
| | | $T_C=100^\circ\text{C}$ | 41.2 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 175 | $^\circ\text{C}$ |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | T_L | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Parameter | Symbol | AOT5B60D | Units |
|--------------------------------|-----------------|----------|---------------------------|
| Maximum Junction-to-Ambient | $R_{\theta JA}$ | 65 | $^\circ\text{C}/\text{W}$ |
| Maximum IGBT Junction-to-Case | $R_{\theta JC}$ | 1.82 | $^\circ\text{C}/\text{W}$ |
| Maximum Diode Junction-to-Case | $R_{\theta JC}$ | 3 | $^\circ\text{C}/\text{W}$ |

* V_{CE} equal to 50V

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Units | |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------|-----------|----------|---------------|
| STATIC PARAMETERS | | | | | | | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $I_C=1\text{mA}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$ | 600 | - | - | V | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}=15\text{V}, I_C=5\text{A}$ | $T_J=25^\circ\text{C}$ | - | 1.55 | 1.8 | V |
| | | | $T_J=125^\circ\text{C}$ | - | 1.78 | - | |
| | | | $T_J=175^\circ\text{C}$ | - | 1.91 | - | |
| V_F | Diode Forward Voltage | $V_{GE}=0\text{V}, I_C=5\text{A}$ | $T_J=25^\circ\text{C}$ | - | 1.46 | 1.75 | V |
| | | | $T_J=125^\circ\text{C}$ | - | 1.36 | - | |
| | | | $T_J=175^\circ\text{C}$ | - | 1.25 | - | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{CE}=V_{GE}, I_C=1\text{mA}$ | - | 6 | - | V | |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE}=600\text{V}, V_{GE}=0\text{V}$ | $T_J=25^\circ\text{C}$ | - | - | 10 | μA |
| | | | $T_J=125^\circ\text{C}$ | - | - | 100 | |
| | | | $T_J=175^\circ\text{C}$ | - | - | 1000 | |
| I_{GES} | Gate-Emitter Leakage Current | $V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}$ | - | - | ± 100 | nA | |
| g_{FS} | Forward Transconductance | $V_{CE}=20\text{V}, I_C=5\text{A}$ | - | 2.3 | - | S | |
| DYNAMIC PARAMETERS | | | | | | | |
| C_{ies} | Input Capacitance | $V_{GE}=0\text{V}, V_{CE}=25\text{V}, f=1\text{MHz}$ | - | 367 | - | pF | |
| C_{oes} | Output Capacitance | | - | 34 | - | pF | |
| C_{res} | Reverse Transfer Capacitance | | - | 1.47 | - | pF | |
| Q_g | Total Gate Charge | $V_{GE}=15\text{V}, V_{CE}=480\text{V}, I_C=5\text{A}$ | - | 9.4 | - | nC | |
| Q_{ge} | Gate to Emitter Charge | | - | 3.15 | - | nC | |
| Q_{gc} | Gate to Collector Charge | | - | 3.6 | - | nC | |
| $I_{C(SC)}$ | Short circuit collector current, Max. 1000 short circuits, Delay between short circuits $\geq 1.0\text{s}$ | $V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_G=60\Omega$ | - | 21 | - | A | |
| R_g | Gate Resistance | $V_{GE}=0\text{V}, V_{CE}=0\text{V}, f=1\text{MHz}$ | - | 3 | - | Ω | |
| SWITCHING PARAMETERS, (Load Inductive, T_J=25°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=25^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A},$ $R_G=60\Omega,$ Parasitic Inductance=100nH | - | 12 | - | ns | |
| t_r | Turn-On Rise Time | | - | 15 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 83 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 12 | - | ns | |
| E_{on} | Turn-On Energy | | - | 0.14 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.04 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 0.18 | - | mJ | |
| t_{rr} | Diode Reverse Recovery Time | | $T_J=25^\circ\text{C}$ | - | 98 | - | ns |
| Q_{rr} | Diode Reverse Recovery Charge | | $I_F=5\text{A}, dl/dt=200\text{A}/\mu\text{s}, V_{CE}=400\text{V}$ | - | 0.23 | - | μC |
| I_{rm} | Diode Peak Reverse Recovery Current | | | - | 4.4 | - | A |
| SWITCHING PARAMETERS, (Load Inductive, T_J=175°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=175^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A},$ $R_G=60\Omega,$ Parasitic Inductance=100nH | - | 10 | - | ns | |
| t_r | Turn-On Rise Time | | - | 16 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 113 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 14 | - | ns | |
| E_{on} | Turn-On Energy | | - | 0.19 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.09 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 0.28 | - | mJ | |
| t_{rr} | Diode Reverse Recovery Time | | $T_J=175^\circ\text{C}$ | - | 195 | - | ns |
| Q_{rr} | Diode Reverse Recovery Charge | | $I_F=5\text{A}, dl/dt=200\text{A}/\mu\text{s}, V_{CE}=400\text{V}$ | - | 0.48 | - | μC |
| I_{rm} | Diode Peak Reverse Recovery Current | | | - | 5.6 | - | A |

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

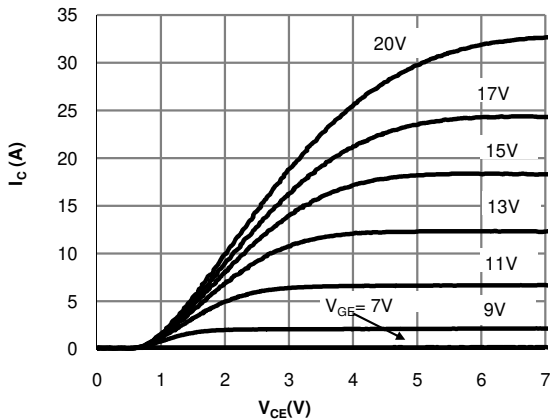


Fig 1: Output Characteristic
($T_j=25^\circ\text{C}$)

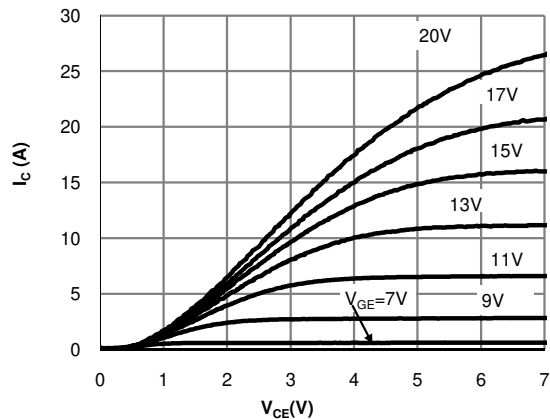


Fig 2: Output Characteristic
($T_j=175^\circ\text{C}$)

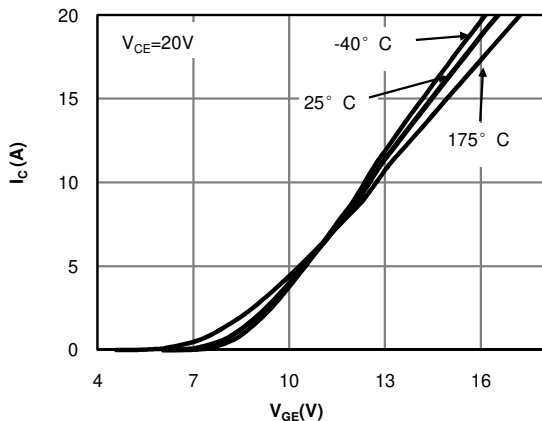


Fig 3: Transfer Characteristic

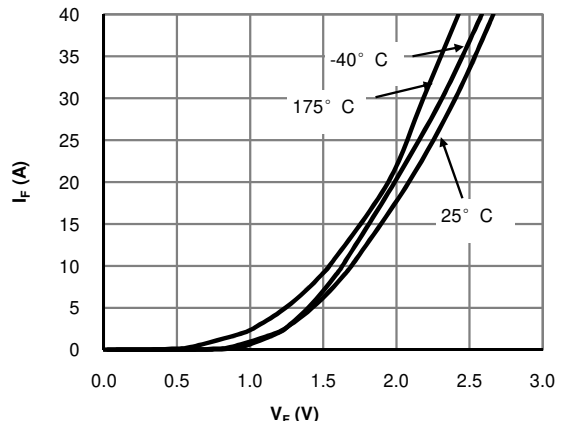


Fig 4: Diode Characteristic

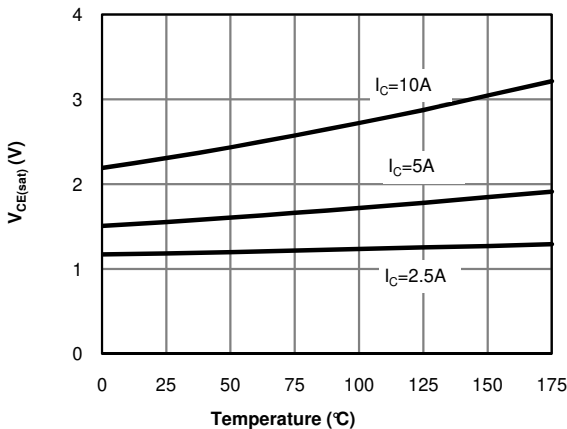


Fig 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

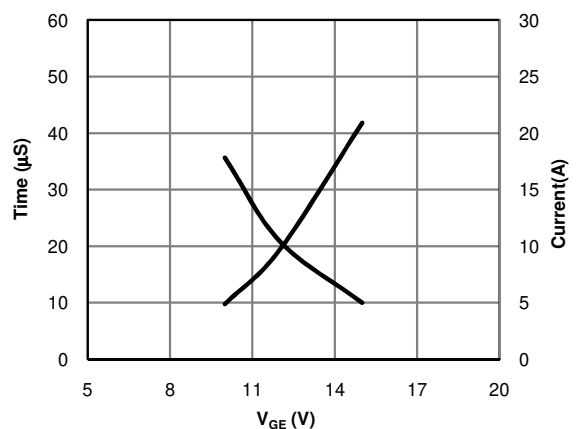
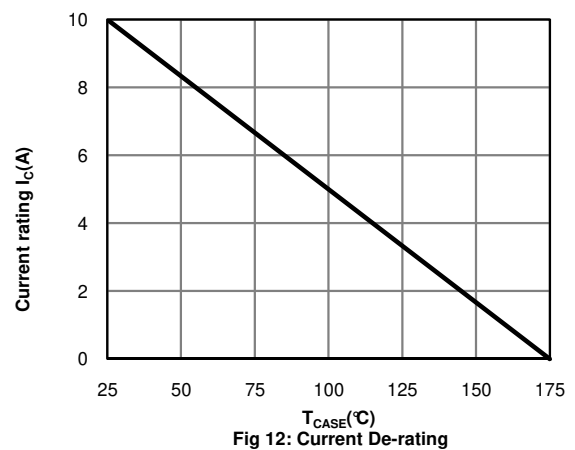
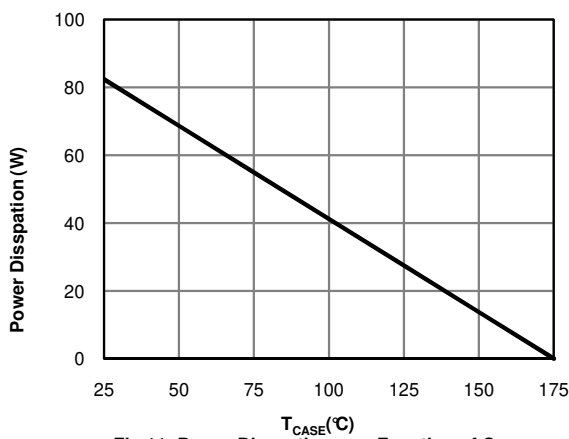
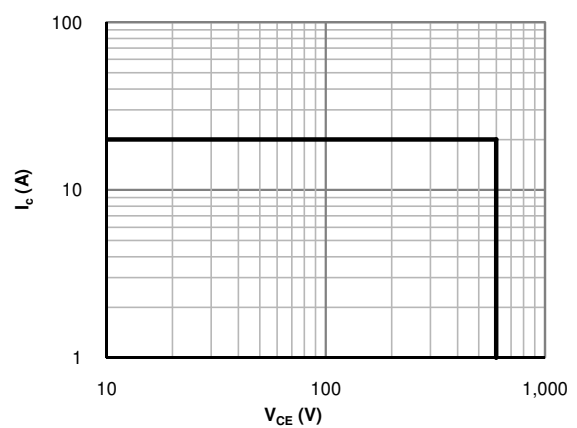
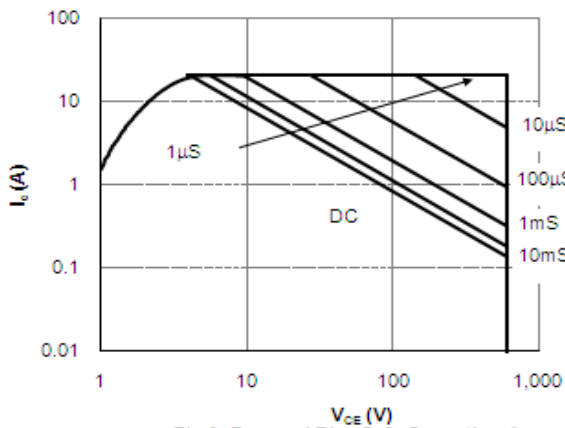
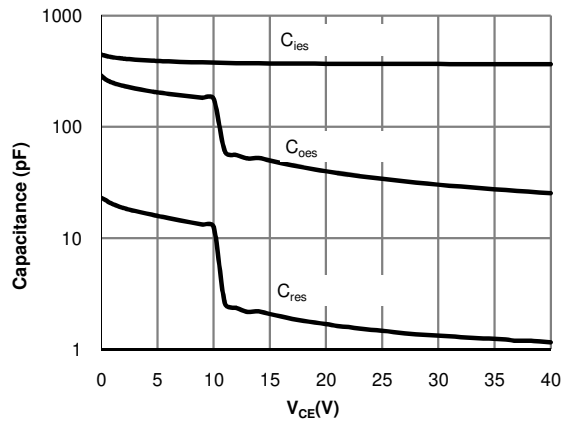
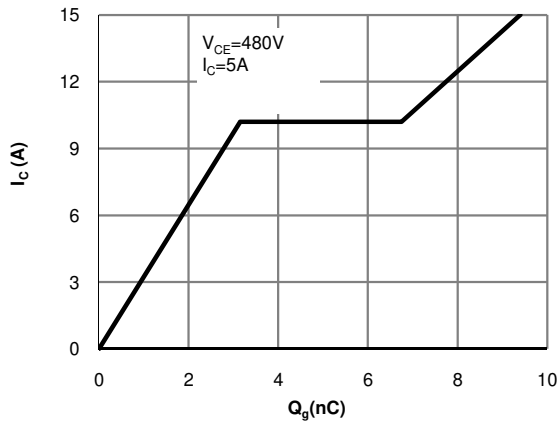


Fig 6: V_{GE} vs. Short Circuit Time
($V_{CE}=400V, T_C=25^\circ\text{C}$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

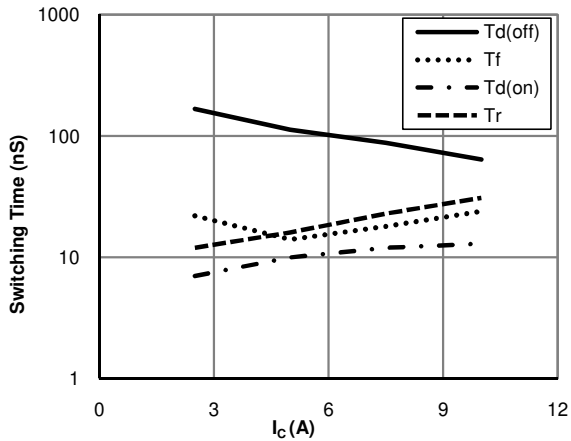


Figure 13: Switching Time vs. I_C
($T_J=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=60\Omega$)

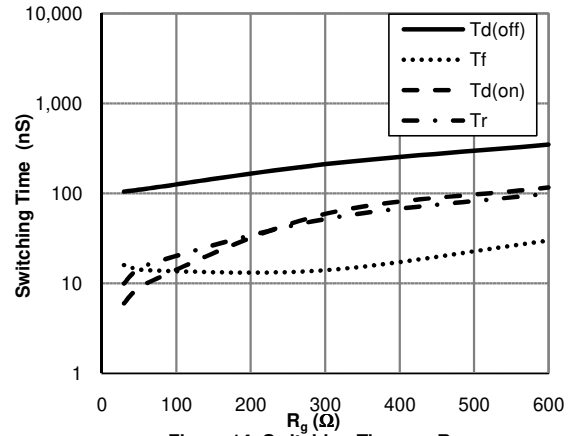


Figure 14: Switching Time vs. R_g
($T_J=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}$)

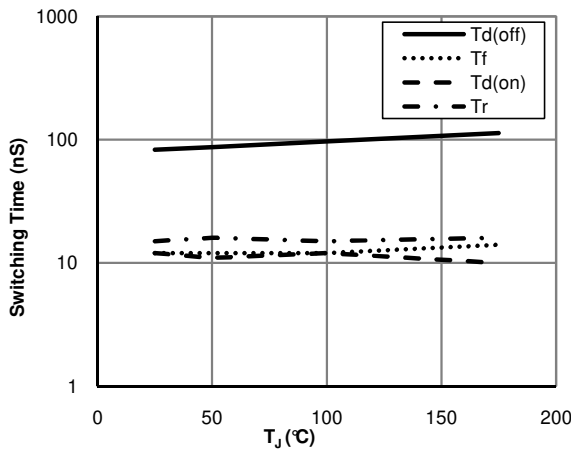


Figure 15: Switching Time vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}, R_g=60\Omega$)

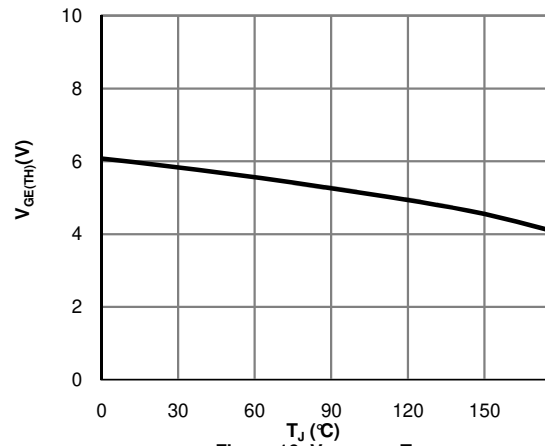


Figure 16: $V_{GE(TH)}$ vs. T_J

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

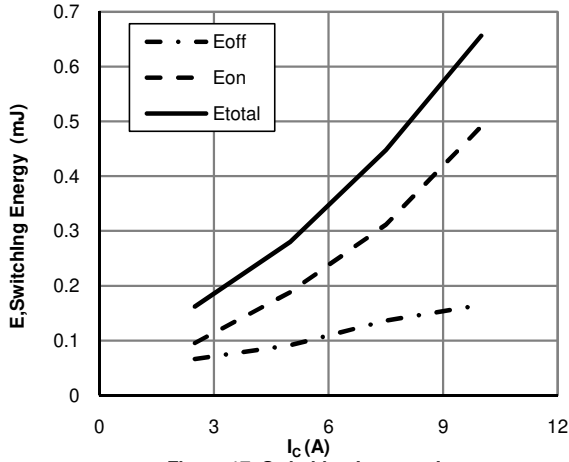


Figure 17: Switching Loss vs. I_C
($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=60\Omega$)

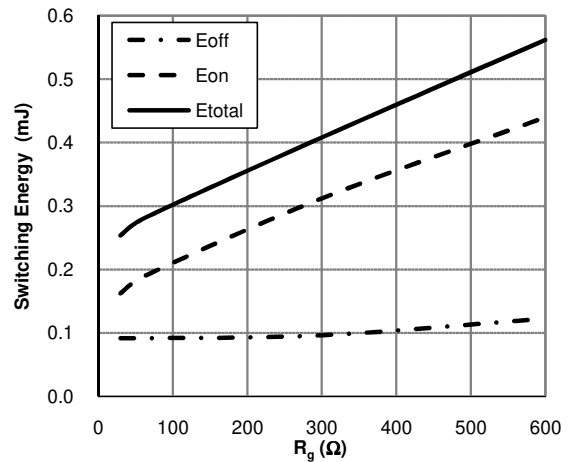


Figure 18: Switching Loss vs. R_g
($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}$)

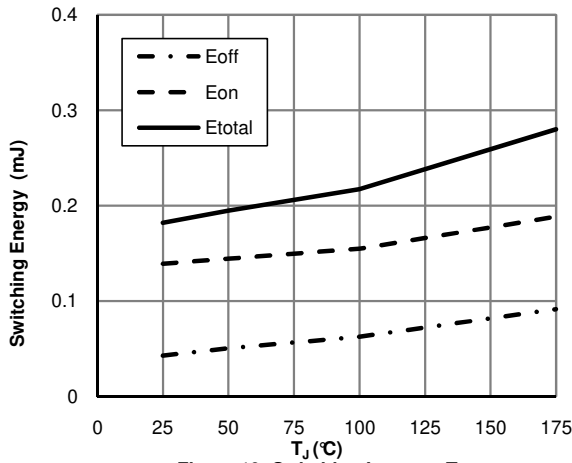


Figure 19: Switching Loss vs. T_j
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}, R_g=60\Omega$)

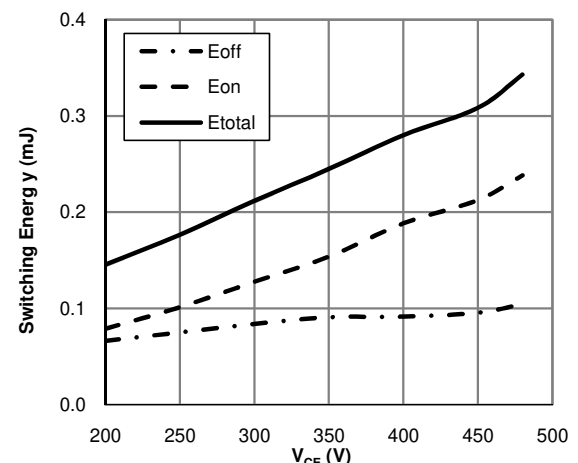


Figure 20: Switching Loss vs. V_{CE}
($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, I_C=5\text{A}, R_g=60\Omega$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

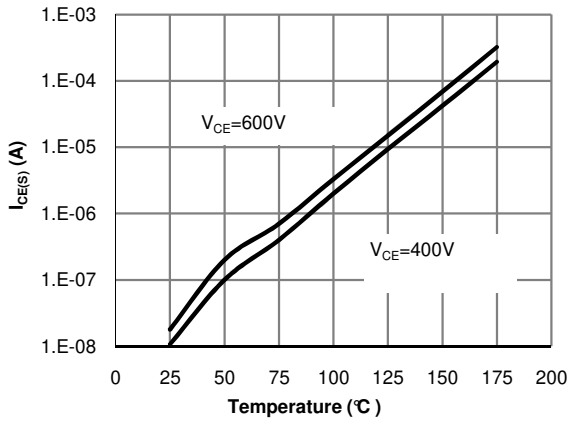


Fig 21: Diode Reverse Leakage Current vs. Junction Temperature

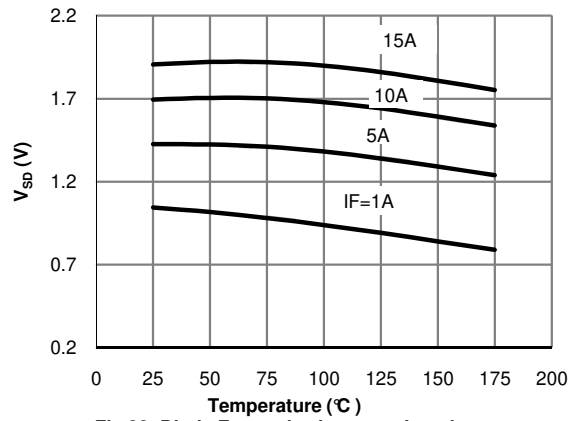


Fig 22: Diode Forward Voltage vs. Junction Temperature

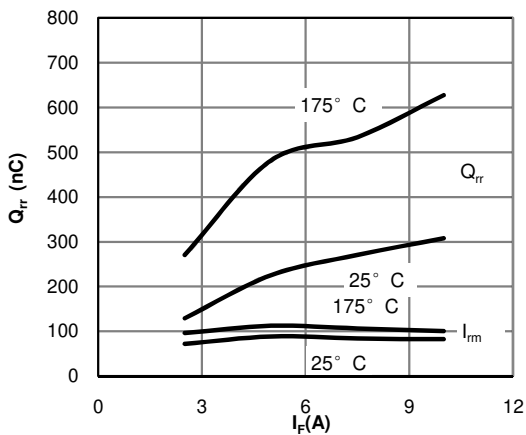


Fig 23: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

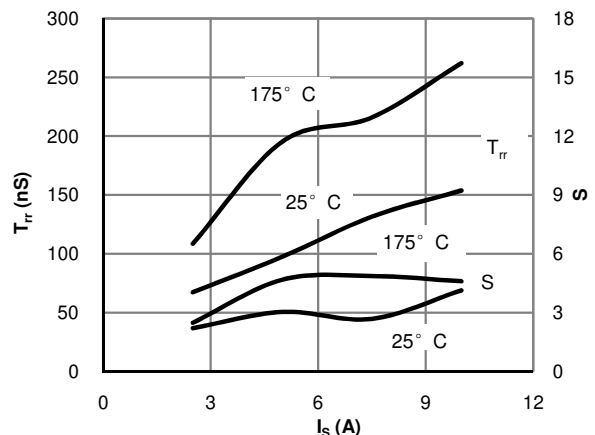


Fig 24: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

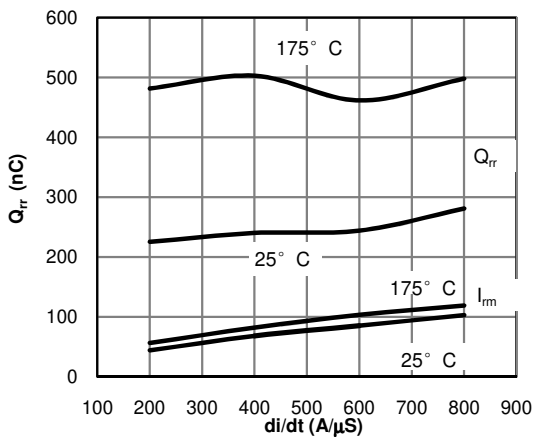


Fig 25: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

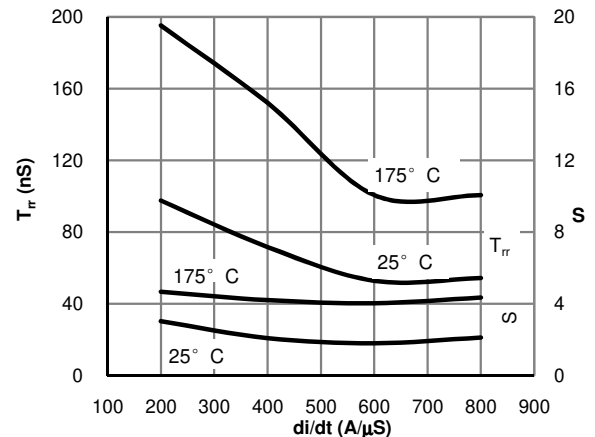


Fig 26: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

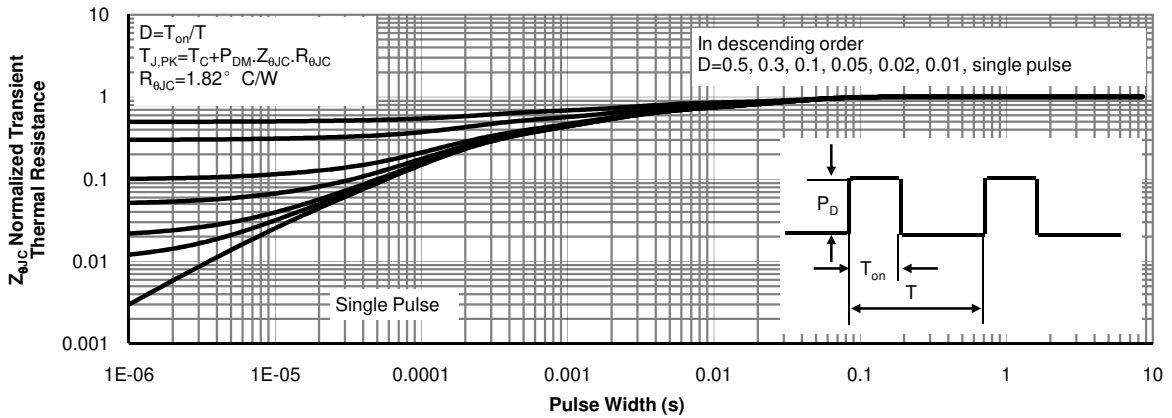


Figure 27: Normalized Maximum Transient Thermal Impedance for IGBT

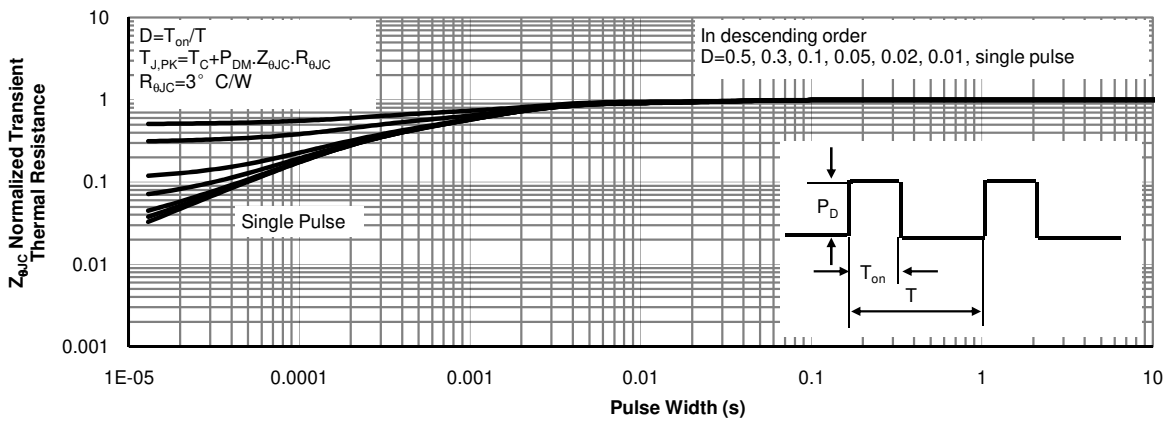
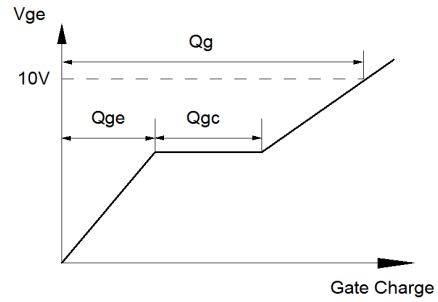
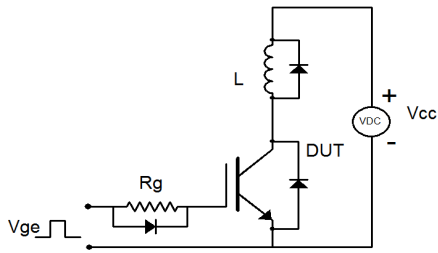
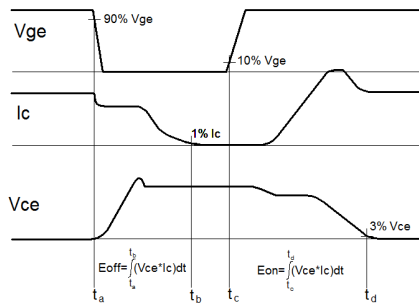
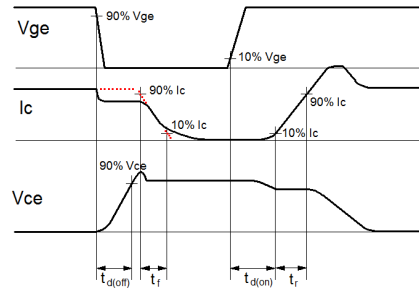
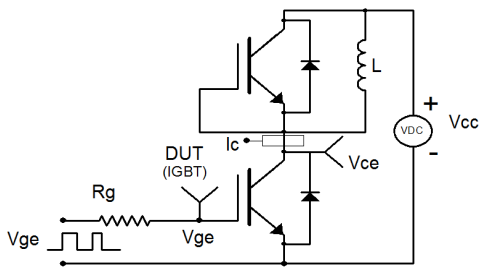


Figure 28: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

