

General Description

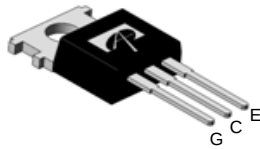
The Alpha IGBT™ line of products offers best-in-class performance in conduction and switching losses, with robust short circuit capability. They are designed for ease of paralleling, minimal gate spike under high dV/dt conditions and resistance to oscillations. The co-packaged soft diode is optimized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

Product Summary

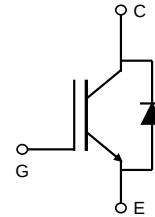
V_{CE}	600V
I_C ($T_C=100^\circ\text{C}$)	5A
$V_{CE(sat)}$ ($T_C=25^\circ\text{C}$)	1.55V



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 ^A	I_C	$T_C=25^\circ\text{C}$ 23	A
		$T_C=100^\circ\text{C}$ 18	
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	A
		$T_C=100^\circ\text{C}$ 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 $\geq 1.0\text{s}$, $T_C=25^\circ\text{C}$	t_{SC}	10	μs
Power Dissipation	P_D	$T_C=25^\circ\text{C}$ 82.4	W
		$T_C=100^\circ\text{C}$ 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	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	1.82	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	3	$^\circ\text{C/W}$

* V_{CE} equal to 50V

Note A: I_C limited by package limitation

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
STATIC PARAMETERS							
BV_{CES}	Collector-Emitter Breakdown Voltage	$I_C=1mA, V_{GE}=0V, T_J=25^{\circ}C$	600	-	-	V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=5A$	$T_J=25^{\circ}C$	-	1.55	1.8	V
			$T_J=125^{\circ}C$	-	1.78	-	
			$T_J=175^{\circ}C$	-	1.91	-	
V_F	Diode Forward Voltage	$V_{GE}=0V, I_C=5A$	$T_J=25^{\circ}C$	-	1.46	1.75	V
			$T_J=125^{\circ}C$	-	1.36	-	
			$T_J=175^{\circ}C$	-	1.25	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=V_{GE}, I_C=1mA$	-	6	-	V	
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=600V, V_{GE}=0V$	$T_J=25^{\circ}C$	-	-	10	μA
			$T_J=125^{\circ}C$	-	-	100	
			$T_J=175^{\circ}C$	-	-	1000	
I_{GES}	Gate-Emitter Leakage Current	$V_{CE}=0V, V_{GE}=\pm 20V$	-	-	± 100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20V, I_C=5A$	-	2.3	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0V, V_{CE}=25V, f=1MHz$	-	367	-	pF	
C_{oes}	Output Capacitance		-	34	-	pF	
C_{res}	Reverse Transfer Capacitance		-	1.47	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15V, V_{CE}=480V, I_C=5A$	-	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 $\geq 1.0s$	$V_{GE}=15V, V_{CE}=400V, R_G=60\Omega$	-	21	-	A	
R_g	Gate Resistance	$V_{GE}=0V, V_{CE}=0V, f=1MHz$	-	3	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, $T_J=25^{\circ}C$)							
$t_{D(on)}$	Turn-On DelayTime	$T_J=25^{\circ}C$ $V_{GE}=15V, V_{CE}=400V, I_C=5A,$ $R_G=60\Omega,$ 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		-	98	-	ns	
Q_{rr}	Diode Reverse Recovery Charge	$T_J=25^{\circ}C$ $I_F=5A, dI/dt=200A/\mu s, V_{CE}=400V$	-	0.23	-	μC	
I_{rm}	Diode Peak Reverse Recovery Current		-	4.4	-	A	
SWITCHING PARAMETERS, (Load Inductive, $T_J=175^{\circ}C$)							
$t_{D(on)}$	Turn-On DelayTime	$T_J=175^{\circ}C$ $V_{GE}=15V, V_{CE}=400V, I_C=5A,$ $R_G=60\Omega,$ 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		$T_J=175^{\circ}C$ $I_F=5A, dI/dt=200A/\mu s, V_{CE}=400V$	-	195	-	ns
Q_{rr}	Diode Reverse Recovery Charge	-		0.48	-	μC	
I_{rm}	Diode Peak Reverse Recovery Current	-		5.6	-	A	

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

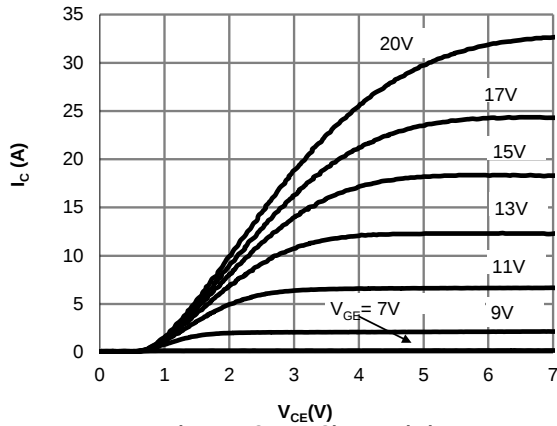


Figure 1: Output Characteristic
($T_j=25^\circ\text{C}$)

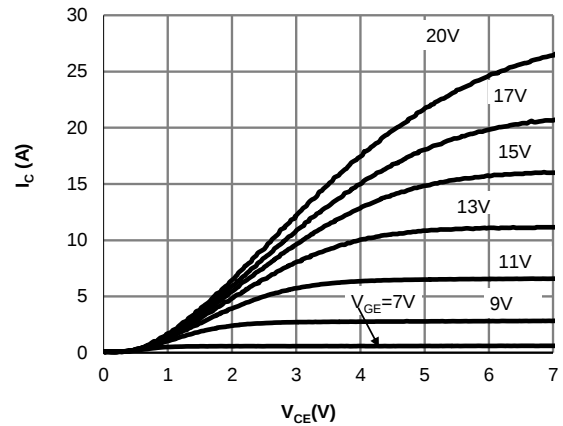


Figure 2: Output Characteristic
($T_j=175^\circ\text{C}$)

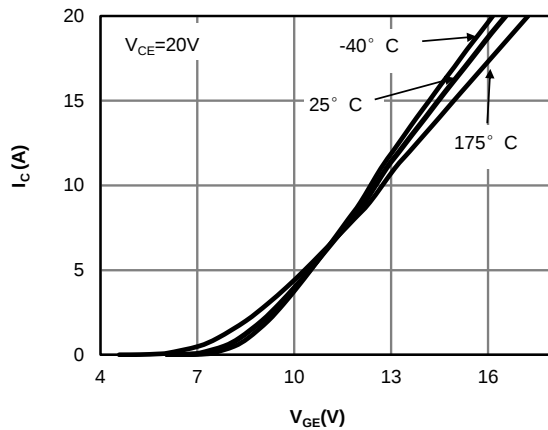


Figure 3: Transfer Characteristic

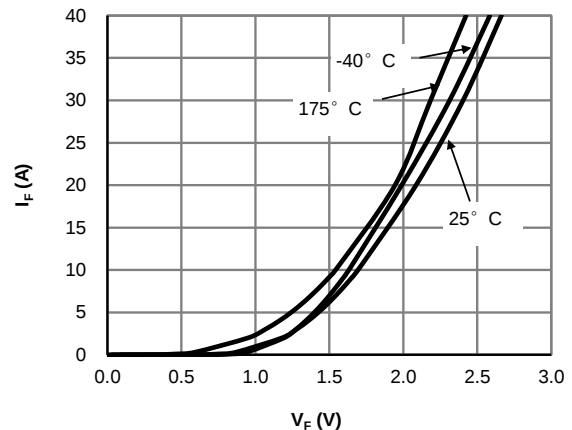


Figure 4: Diode Characteristic

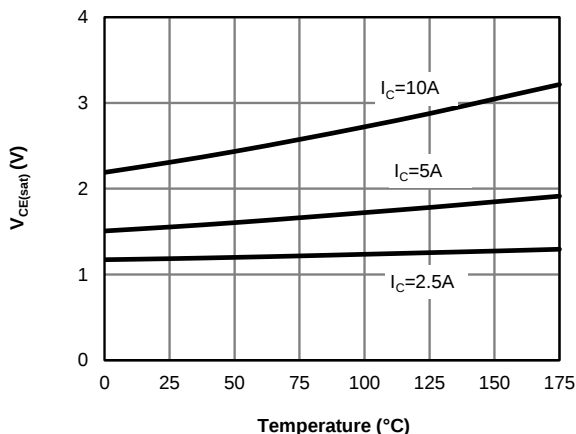


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

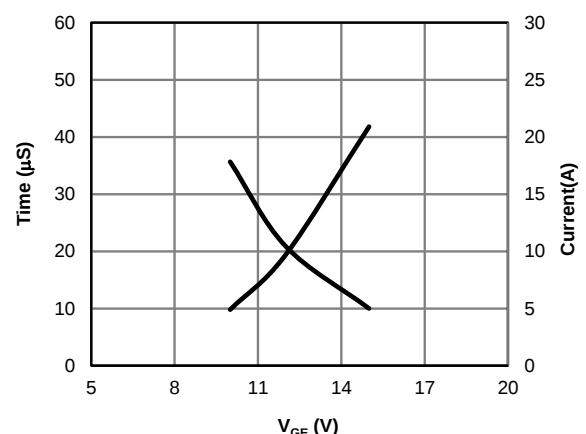


Figure 6: V_{GE} vs. Short Circuit Time
($V_{CE}=400\text{V}, T_C=25^\circ\text{C}$)

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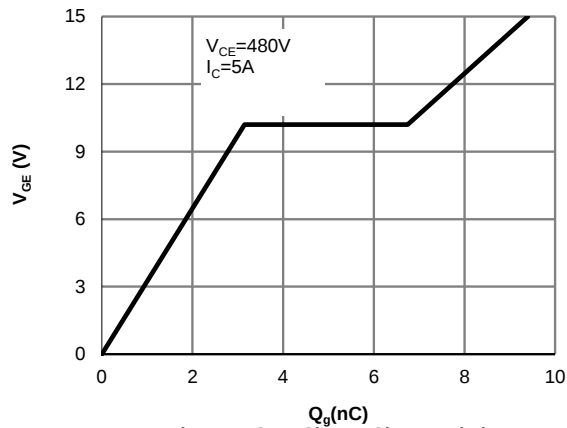


Figure 7: Gate-Charge Characteristics

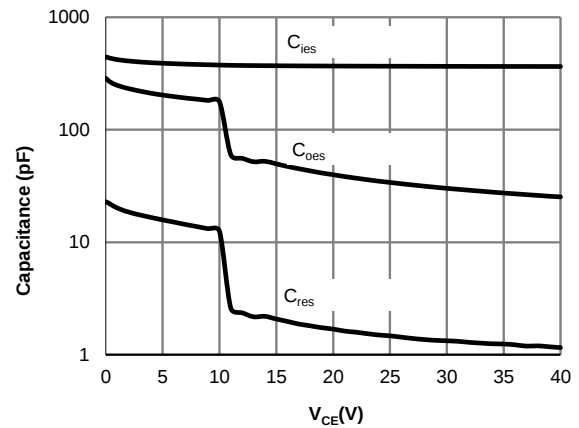


Figure 8: Capacitance Characteristic

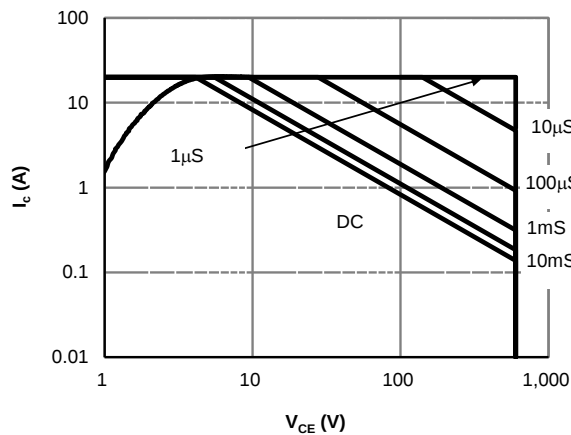


Figure 9: Forward Bias Safe Operating Area
($T_C = 25^\circ\text{C}$, $V_{GE} = 15\text{V}$)

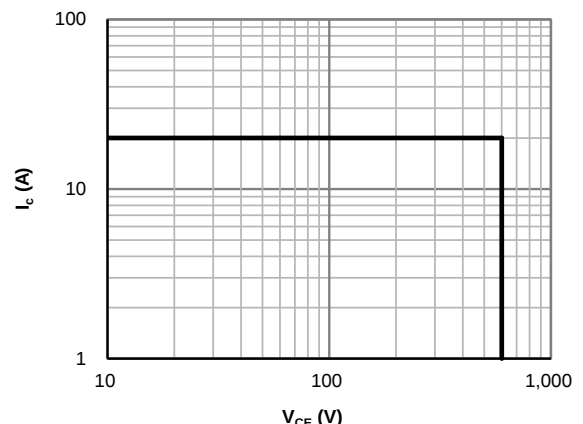


Figure 10: Reverse Bias SOA
($T_J = 175^\circ\text{C}$, $V_{GE} = 15\text{V}$)

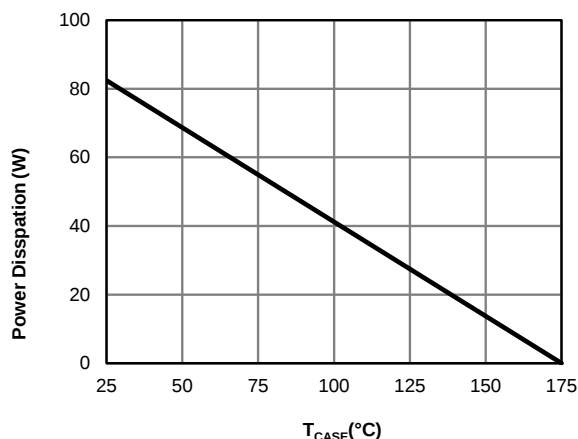


Figure 11: Power Dissipation as a Function of Case

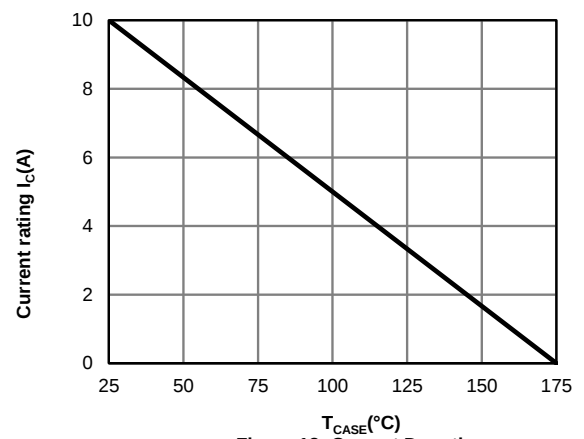
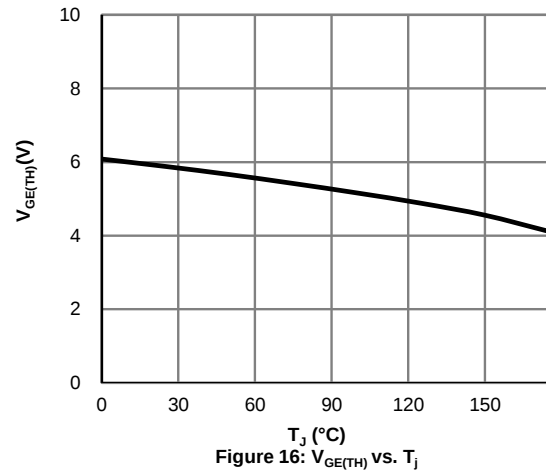
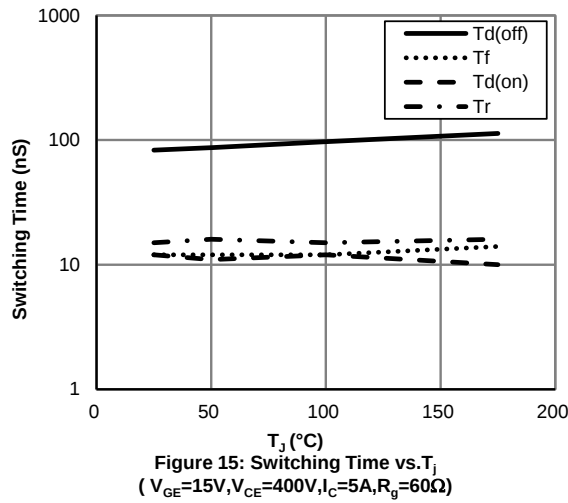
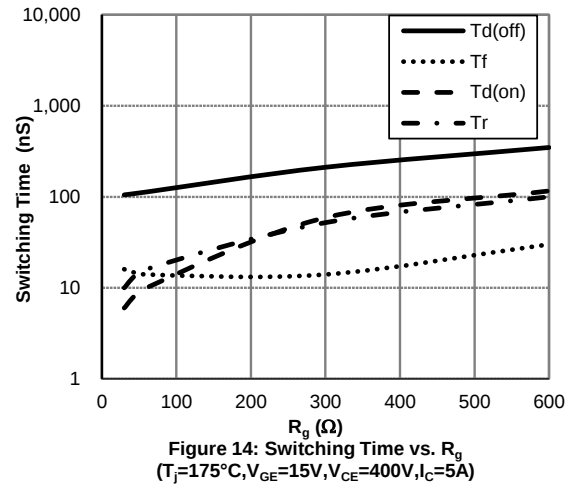
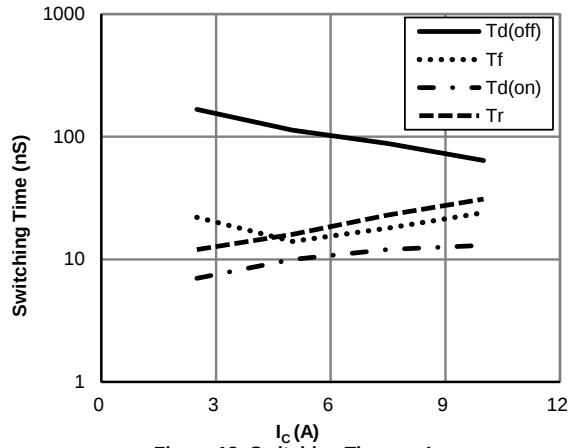


Figure 12: Current De-rating

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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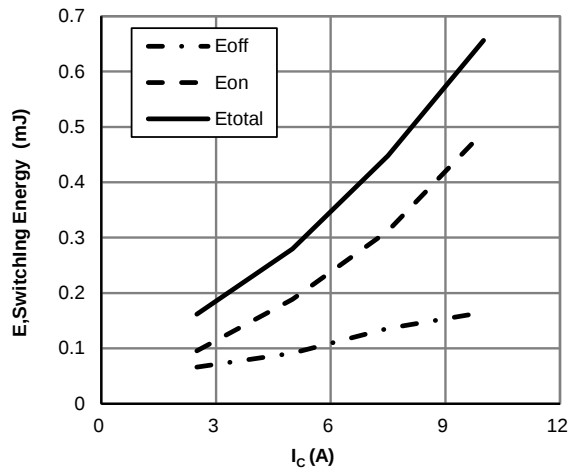


Figure 17: Switching Loss vs. I_C
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $R_g=60\Omega$)

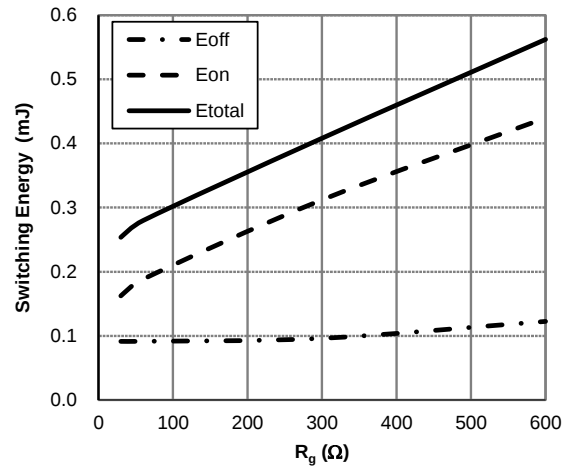


Figure 18: Switching Loss vs. R_g
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $I_C=5\text{A}$)

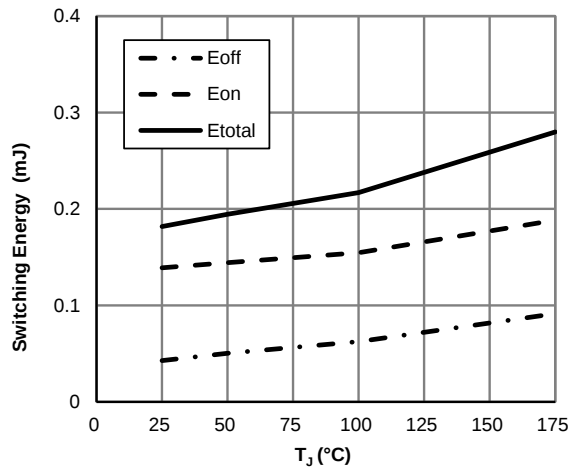


Figure 19: Switching Loss vs. T_J
($V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $I_C=5\text{A}$, $R_g=60\Omega$)

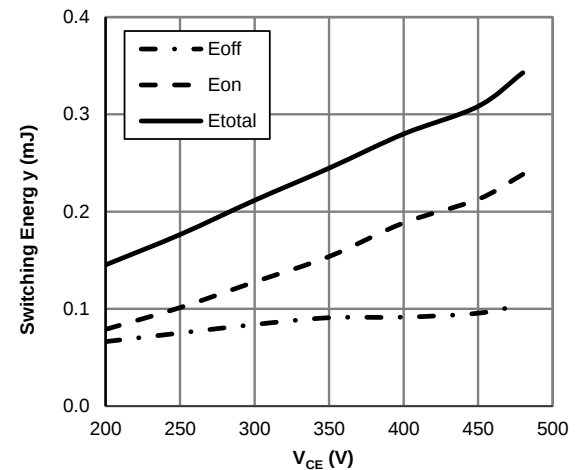


Figure 20: Switching Loss vs. V_{CE}
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $I_C=5\text{A}$, $R_g=60\Omega$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

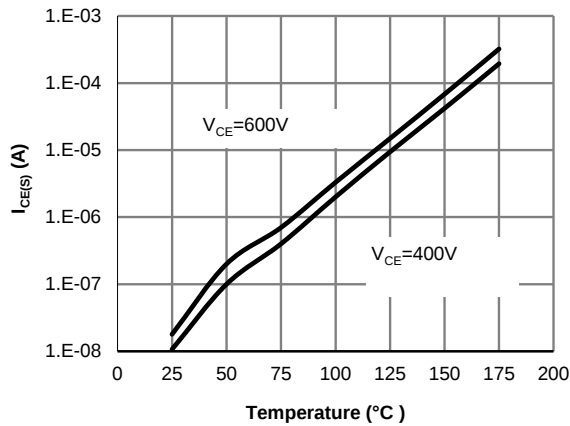


Figure 21: Diode Reverse Leakage Current vs. Junction Temperature

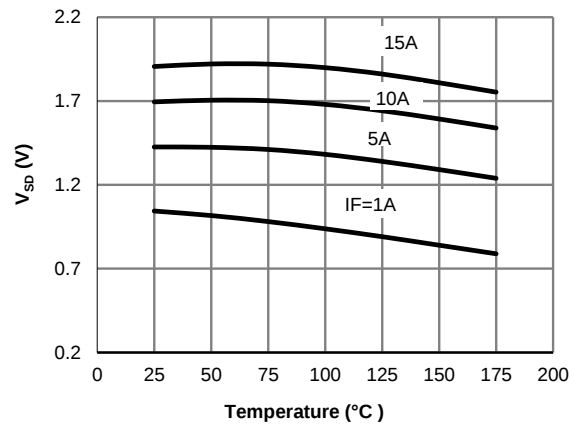


Figure 22: Diode Forward voltage vs. Junction Temperature

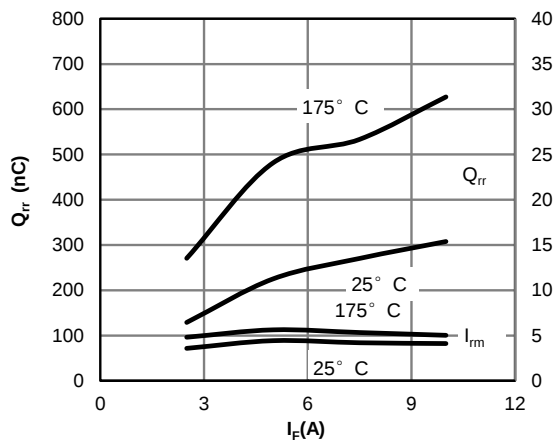


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

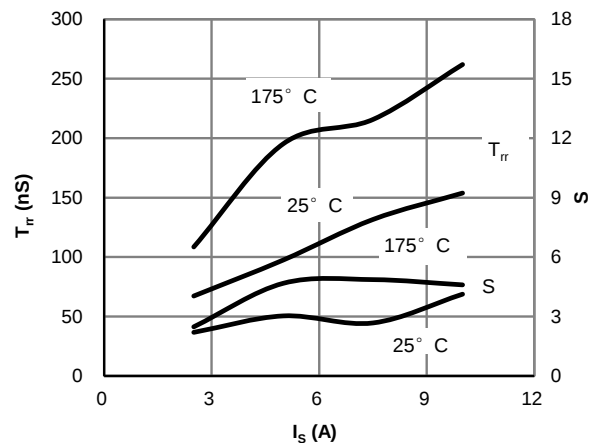


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

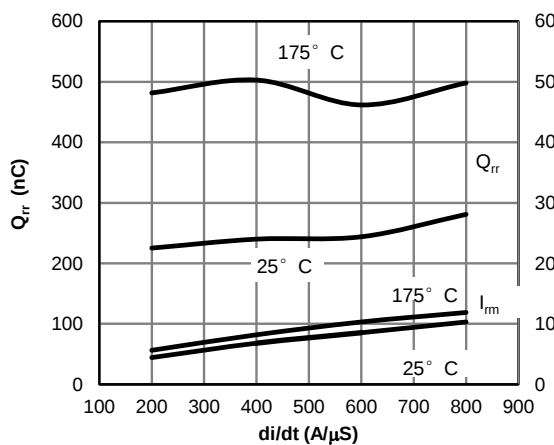


Figure 25: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

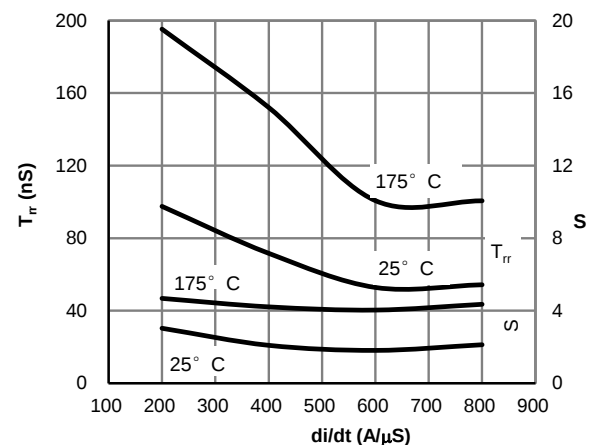
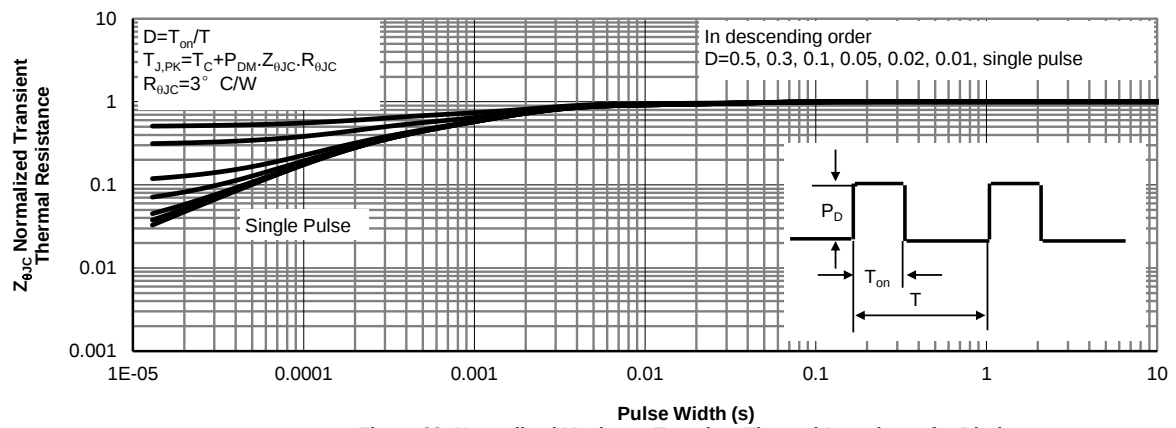
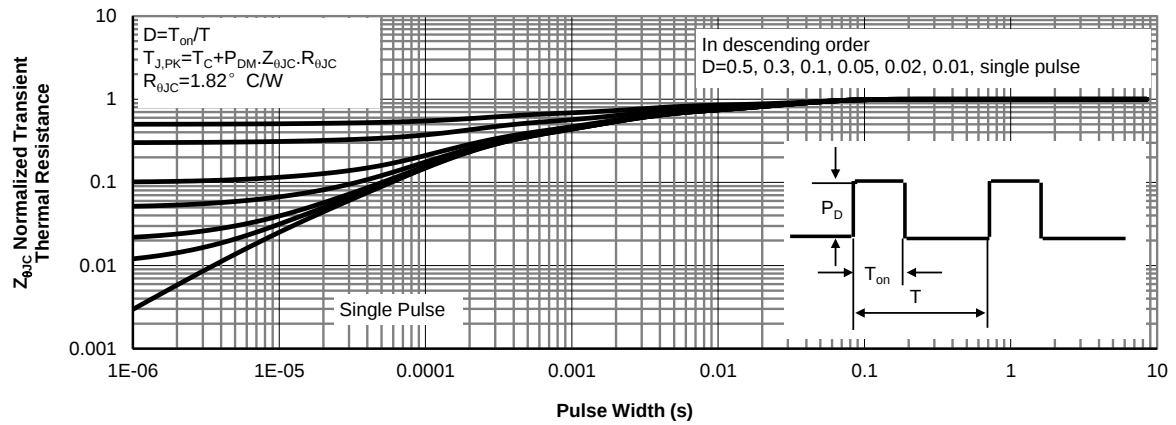
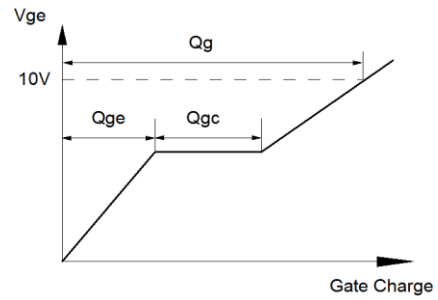
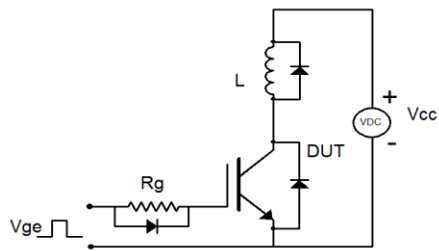


Figure 26: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

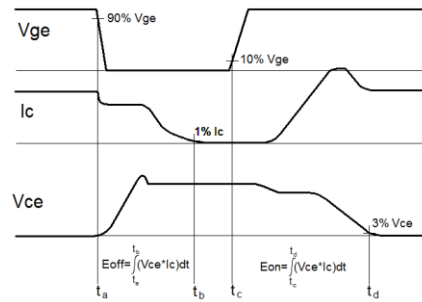
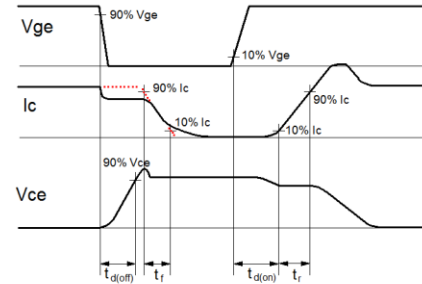
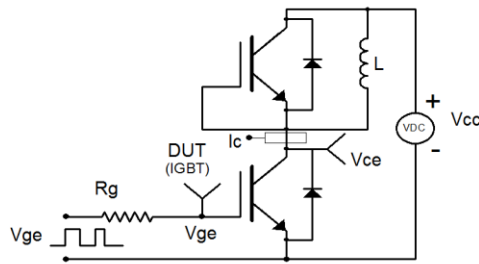
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Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

