

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-packaged diode is targeted for minimal losses in Welding machines, Solar Inverter and UPS applications.

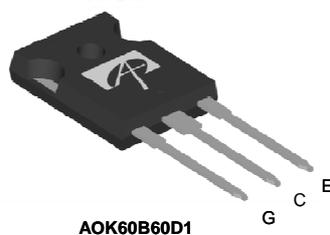
Product Summary

V_{CE}	600V
I_C ($T_C=100^\circ\text{C}$)	60A
$V_{CE(sat)}$ ($T_C=25^\circ\text{C}$)	1.85V

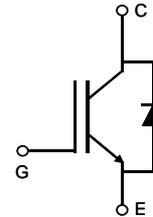


Top View

TO-247



AOK60B60D1



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

Parameter	Symbol	AOK60B60D1	Units	
Collector-Emitter Voltage	V_{CE}	600	V	
Gate-Emitter Voltage	V_{GE}	± 20	V	
V_{GE} Spike	500ns	V_{SPIKE}	24	V
Continuous Collector Current	I_C	$T_C=25^\circ\text{C}$	120	A
		$T_C=100^\circ\text{C}$	60	
Pulsed Collector Current, Limited by T_{Jmax}	I_{CM}	210	A	
Turn off SOA, $V_{CE} \leq 600\text{V}$, Limited by T_{Jmax}	I_{LM}	210	A	
Continuous Diode Forward Current	I_F	$T_C=25^\circ\text{C}$	60	A
		$T_C=100^\circ\text{C}$	30	
Diode Pulsed Current, Limited by T_{Jmax}	I_{FM}	210	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	$T_C=25^\circ\text{C}$	417	W
		$T_C=100^\circ\text{C}$	167	
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	AOK60B60D1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.3	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	0.95	$^\circ\text{C/W}$

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	$V_{GE}=15\text{V}, I_C=60\text{A}$	$T_J=25^\circ\text{C}$	-	1.85	2.4	V
			$T_J=125^\circ\text{C}$	-	2.2	-	
			$T_J=150^\circ\text{C}$	-	2.3	-	
V_F	Diode Forward Voltage	$V_{GE}=0\text{V}, I_C=30\text{A}$	$T_J=25^\circ\text{C}$	-	1.34	1.9	V
			$T_J=125^\circ\text{C}$	-	1.31	-	
			$T_J=150^\circ\text{C}$	-	1.28	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=5\text{V}, I_C=1\text{mA}$	-	5.4	-	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
			$T_J=125^\circ\text{C}$	-	-	1000	
			$T_J=150^\circ\text{C}$	-	-	5000	
I_{GES}	Gate-Emitter leakage current	$V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}$	-	-	± 100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20\text{V}, I_C=60\text{A}$	-	25	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0\text{V}, V_{CE}=25\text{V}, f=1\text{MHz}$	-	3288	-	pF	
C_{oes}	Output Capacitance		-	369	-	pF	
C_{res}	Reverse Transfer Capacitance		-	11.3	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15\text{V}, V_{CE}=480\text{V}, I_C=60\text{A}$	-	75	-	nC	
Q_{ge}	Gate to Emitter Charge		-	27.3	-	nC	
Q_{gc}	Gate to Collector Charge		-	24.7	-	nC	
$I_{C(SC)}$	Short circuit collector current, Max. 1000 short circuits, Delay between short circuits $\geq 1.0\text{s}$	$V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_G=25\Omega$	-	210	-	A	
R_g	Gate resistance	$f=1\text{MHz}$	-	1.4	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=25^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A},$ $R_G=5\Omega,$ Parasitic Inductance=150nH	-	32	-	ns	
t_r	Turn-On Rise Time		-	76	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	74	-	ns	
t_f	Turn-Off Fall Time		-	16	-	ns	
E_{on}	Turn-On Energy		-	3.1	-	mJ	
E_{off}	Turn-Off Energy		-	0.73	-	mJ	
E_{total}	Total Switching Energy		-	3.8	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=25^\circ\text{C}$	-	137	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=30\text{A}, dl/dt=200\text{A}/\mu\text{s}, V_{CE}=400\text{V}$	-	0.84	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	10	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=150°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=150^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A},$ $R_G=5\Omega,$ Parasitic Inductance=150nH	-	31	-	ns	
t_r	Turn-On Rise Time		-	78	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	89	-	ns	
t_f	Turn-Off Fall Time		-	16	-	ns	
E_{on}	Turn-On Energy		-	3.5	-	mJ	
E_{off}	Turn-Off Energy		-	1.2	-	mJ	
E_{total}	Total Switching Energy		-	4.7	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=150^\circ\text{C}$	-	234	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=30\text{A}, dl/dt=200\text{A}/\mu\text{s}, V_{CE}=400\text{V}$	-	1.7	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	13.8	-	A

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

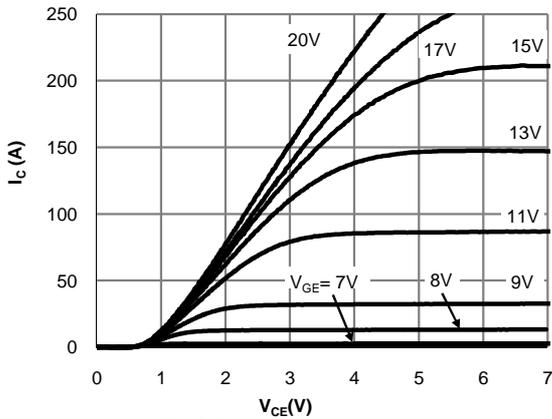


Fig 1: Output Characteristic
($T_j=25^\circ\text{C}$)

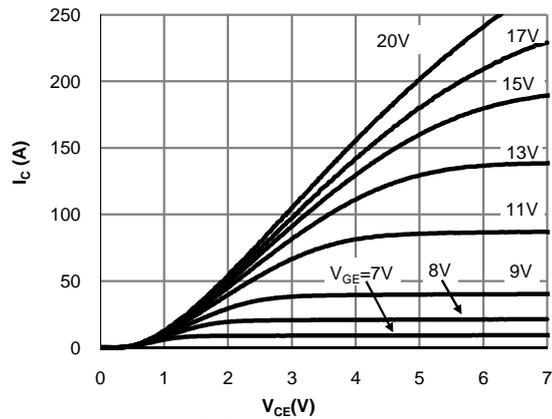


Fig 2: Output Characteristic
($T_j=150^\circ\text{C}$)

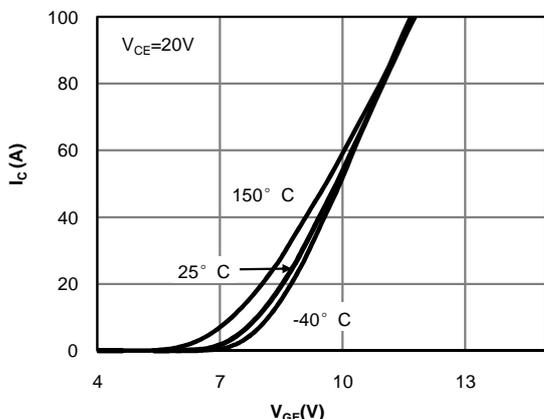


Fig 3: Transfer Characteristic

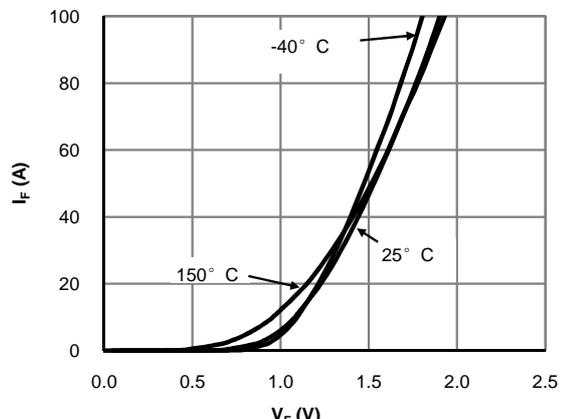


Fig 4: Diode Characteristic

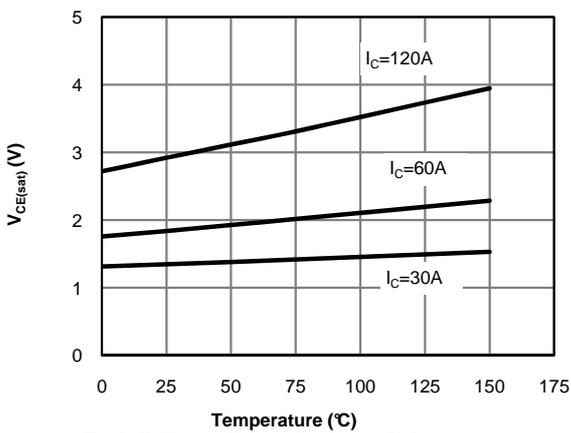


Fig 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

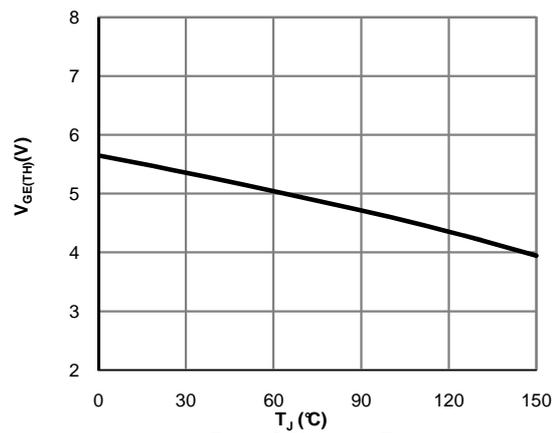


Figure 6: $V_{GE(th)}$ vs. T_j

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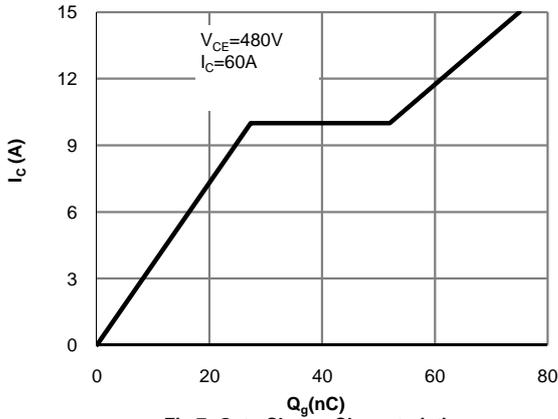


Fig 7: Gate-Charge Characteristics

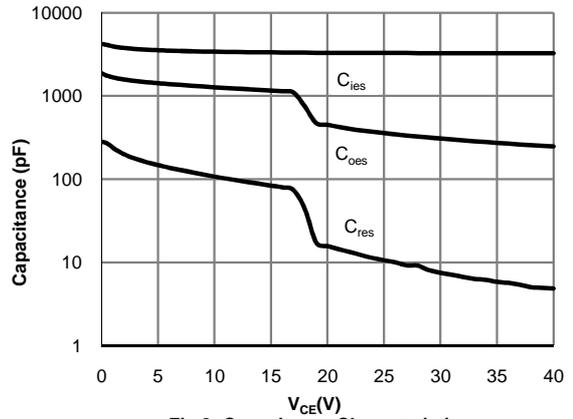


Fig 8: Capacitance Characteristic

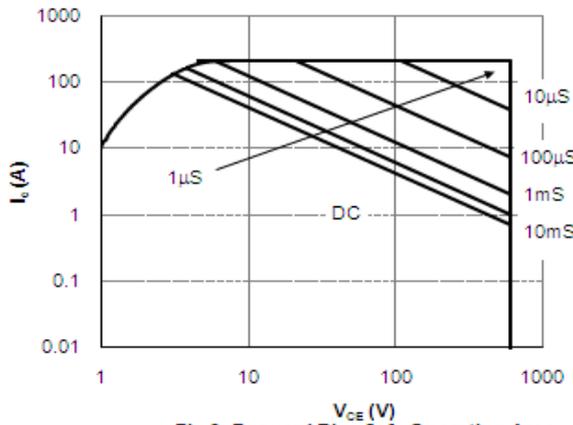


Fig 9: Forward Bias Safe Operating Area
($T_c=25C, V_{CE}=15V$)

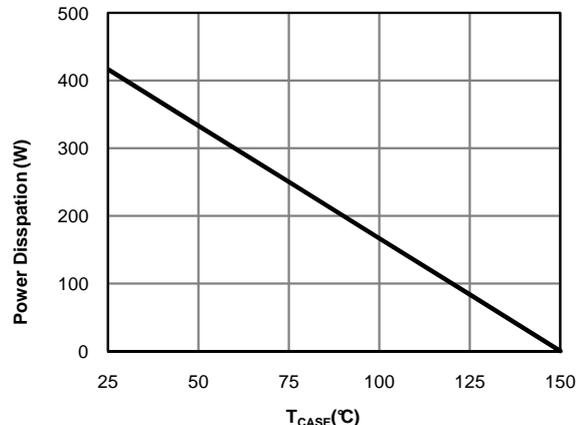


Fig 10: Power Dissipation as a Function of Case

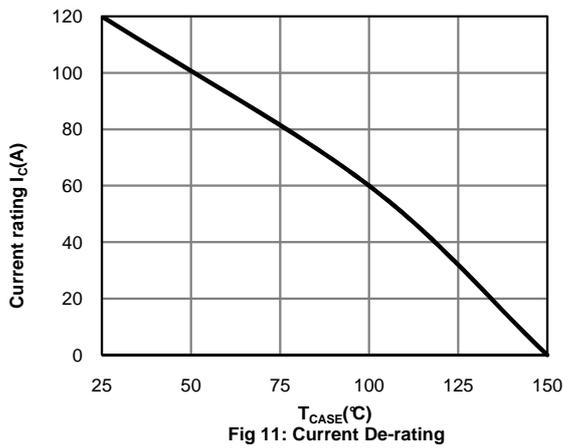


Fig 11: Current De-rating

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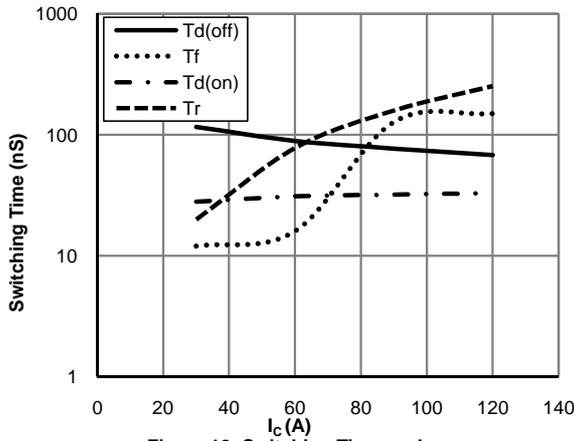


Figure 12: Switching Time vs. I_C
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=5\Omega$)

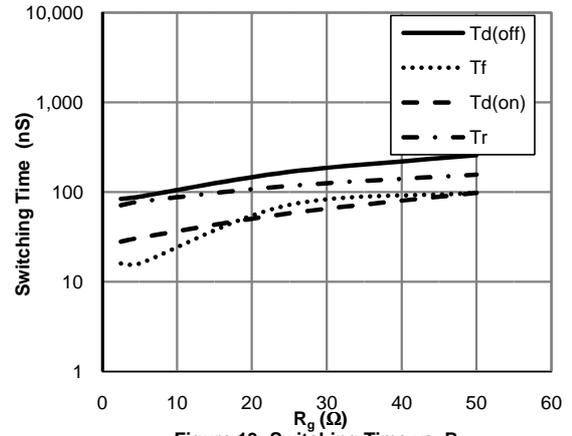


Figure 13: Switching Time vs. R_g
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A}$)

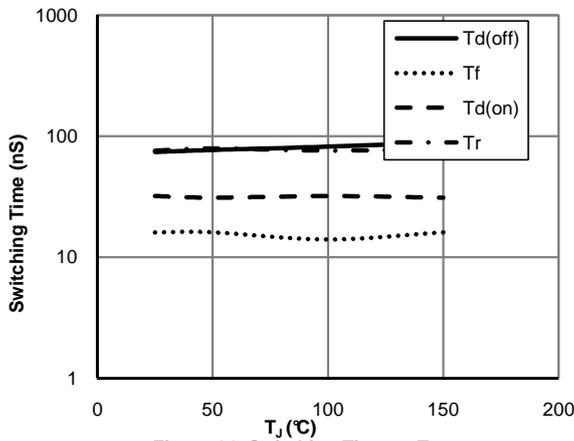


Figure 14: Switching Time vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A}, R_g=5\Omega$)

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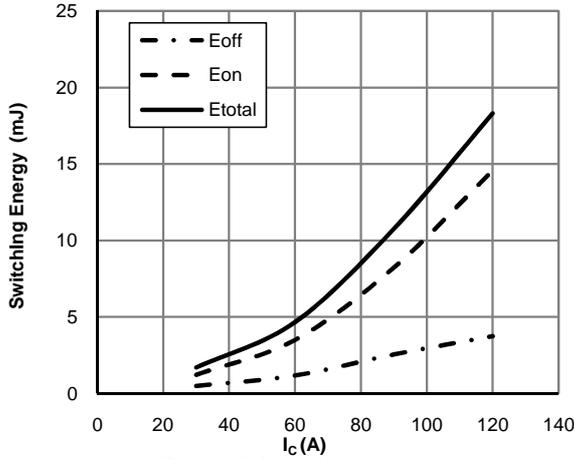


Figure 15: Switching Loss vs. I_C
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=5\Omega$)

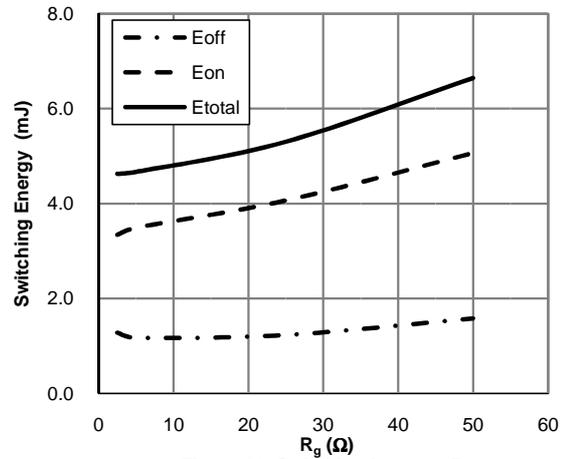


Figure 16: Switching Loss vs. R_g
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A}$)

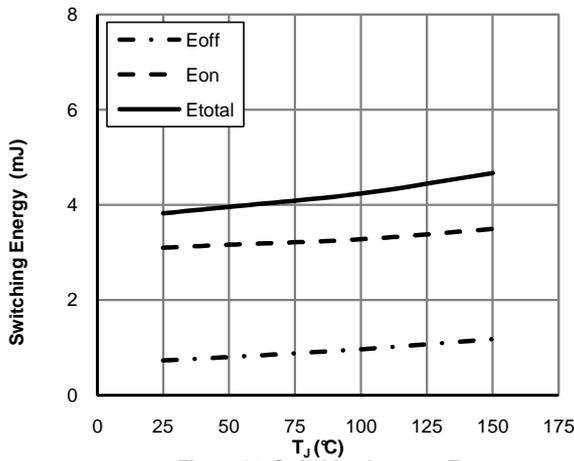


Figure 17: Switching Loss vs. T_j
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=60\text{A}, R_g=5\Omega$)

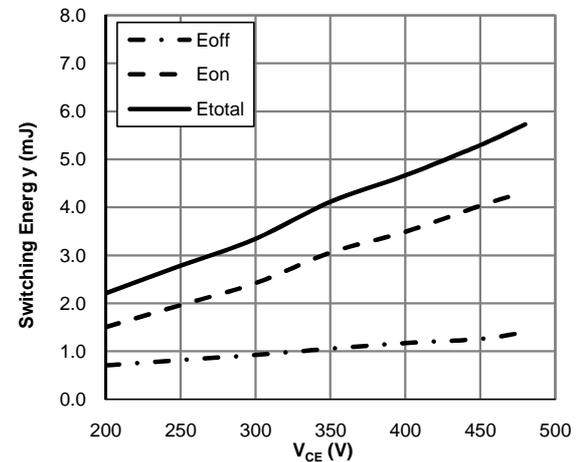


Figure 18: Switching Loss vs. V_{CE}
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, I_C=60\text{A}, R_g=5\Omega$)

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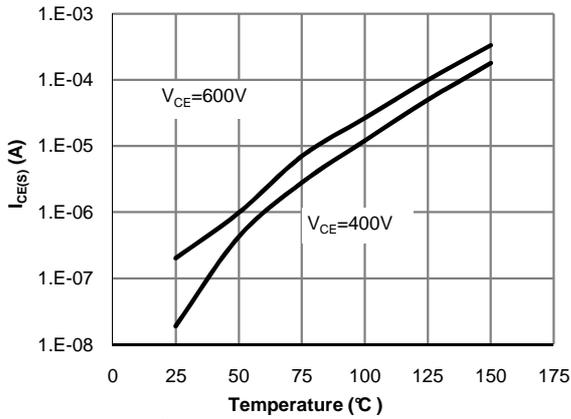


Fig 19: Diode Reverse Leakage Current vs. Junction Temperature

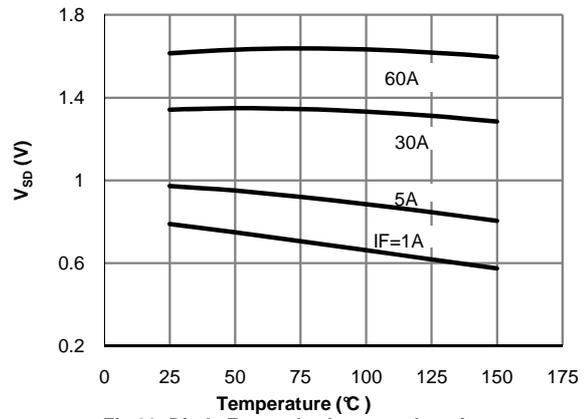


Fig 20: Diode Forward Voltage vs. Junction Temperature

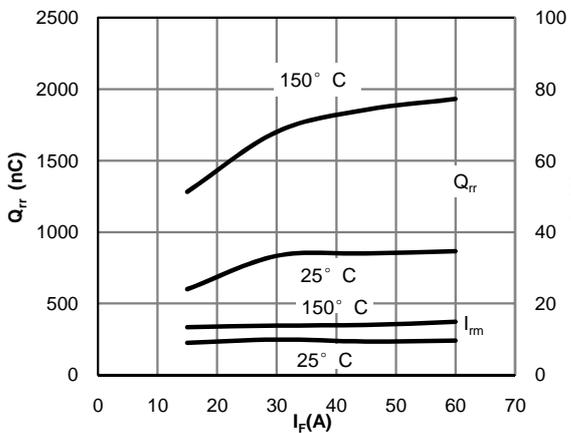


Fig 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

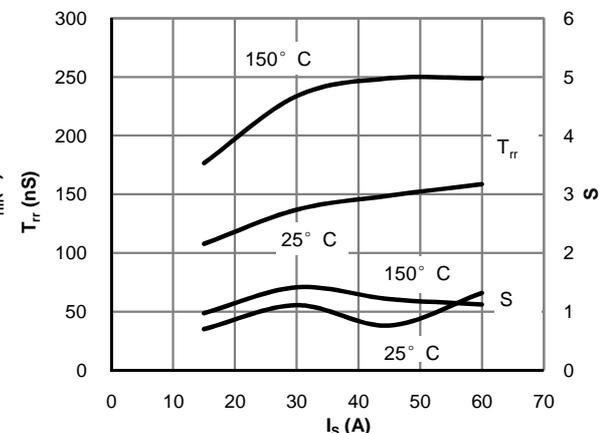


Fig 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

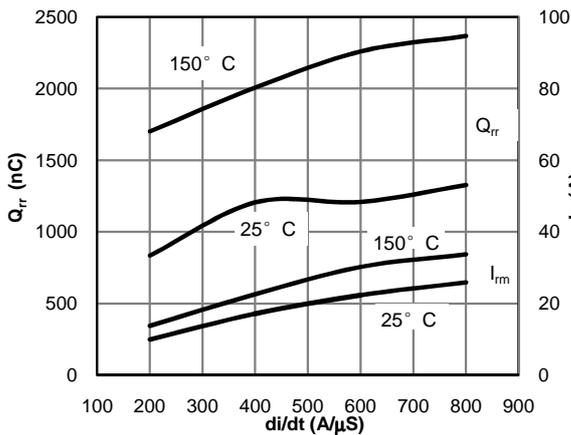


Fig 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=30A$)

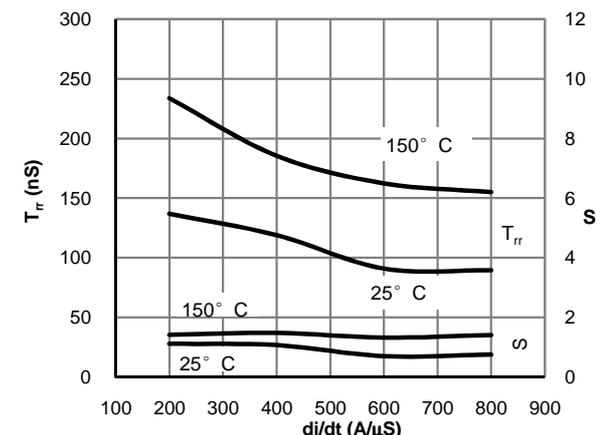


Fig 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=30A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

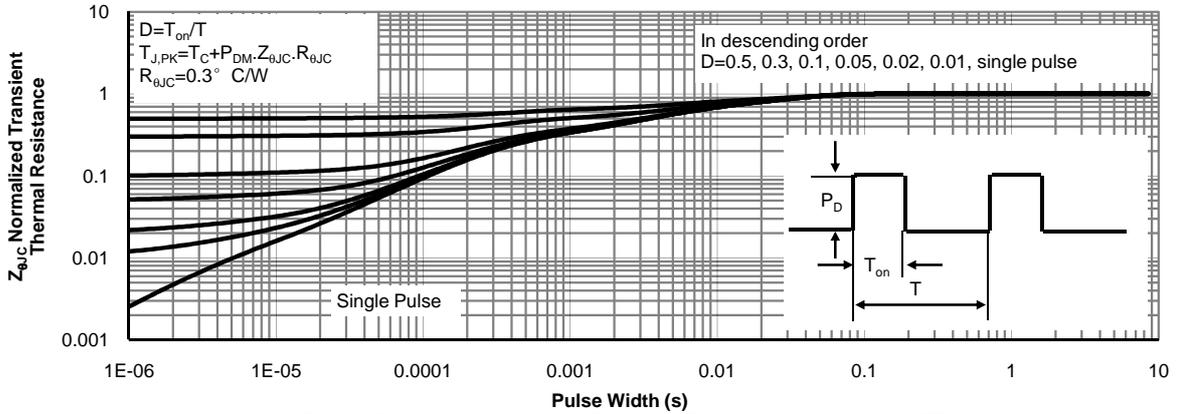


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

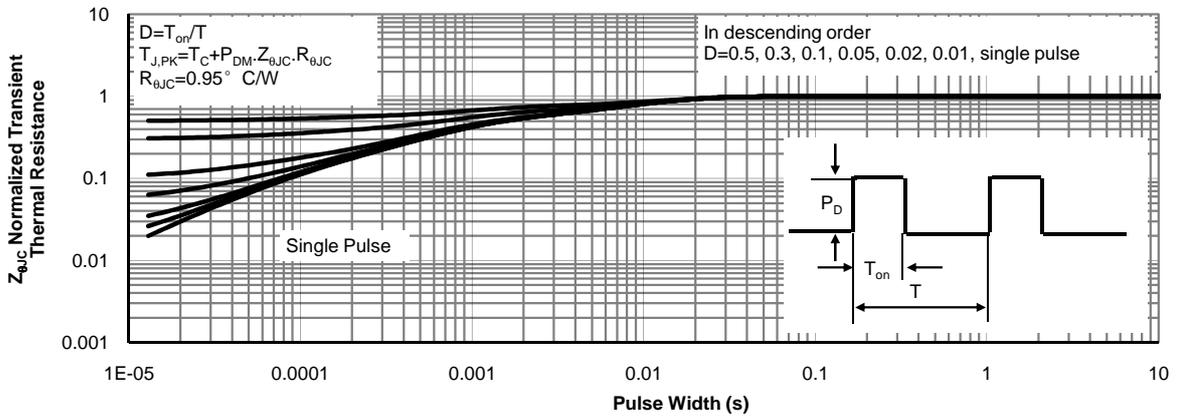
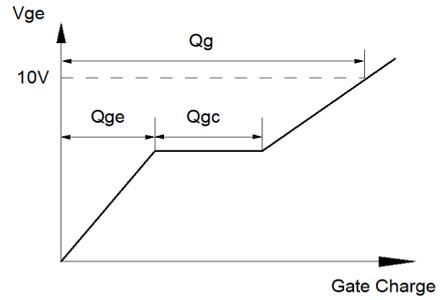
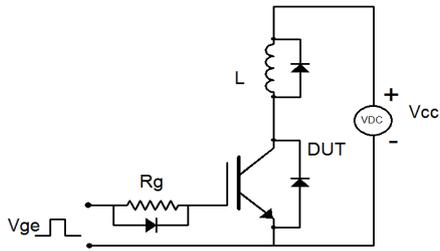
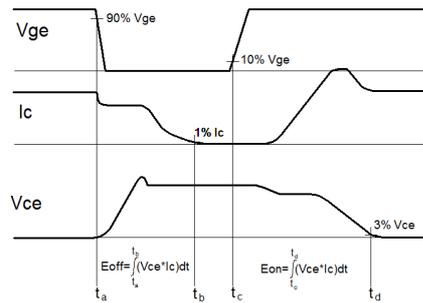
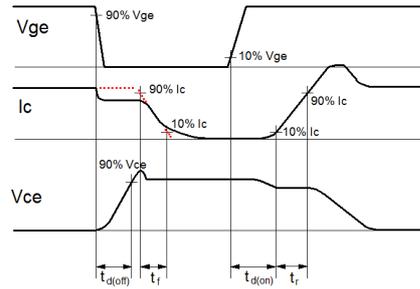
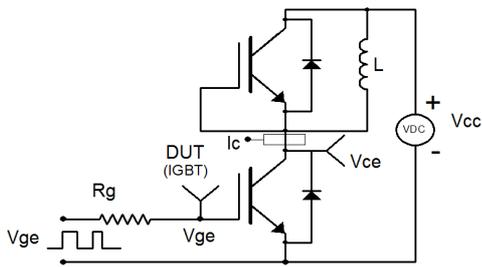


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

