

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.

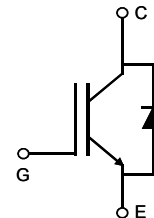
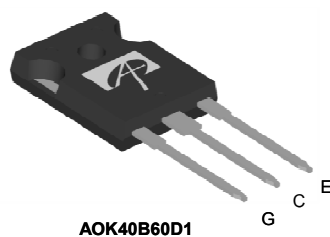
Product Summary

V_{CE}	600V
I_C ($T_C=100^\circ\text{C}$)	40A
$V_{CE(sat)}$ ($T_C=25^\circ\text{C}$)	1.85V



Top View

TO-247



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

Parameter		Symbol	AOK40B60D1	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	$T_C=25^{\circ}\text{C}$	I_C	80	A
	$T_C=100^{\circ}\text{C}$		40	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	140	A
Turn off SOA, $V_{CE} \leq 600\text{V}$, Limited by T_{Jmax}		I_{LM}	140	A
Continuous Diode Forward Current	$T_C=25^{\circ}\text{C}$	I_F	40	A
	$T_C=100^{\circ}\text{C}$		20	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	140	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	$T_C=25^{\circ}\text{C}$	P_D	278	W
	$T_C=100^{\circ}\text{C}$		111	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		T_L	300	°C

Thermal Characteristics

Parameter	Symbol	AOK40B60D1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.45	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	1.5	$^\circ\text{C/W}$

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
STATIC PARAMETERS							
BV_{CES}	Collector-Emitter Breakdown Voltage	$I_C=1mA, V_{GE}=0V, T_J=25^{\circ}C$	600	-	-	V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=40A$	$T_J=25^{\circ}C$	-	1.85	2.4	V
			$T_J=125^{\circ}C$	-	2.2	-	
			$T_J=150^{\circ}C$	-	2.3	-	
V_F	Diode Forward Voltage	$V_{GE}=0V, I_C=20A$	$T_J=25^{\circ}C$	-	1.42	1.95	V
			$T_J=125^{\circ}C$	-	1.4	-	
			$T_J=150^{\circ}C$	-	1.36	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=5V, I_C=1mA$	-	5.5	-	V	
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=600V, V_{GE}=0V$	$T_J=25^{\circ}C$	-	-	10	μA
			$T_J=125^{\circ}C$	-	-	600	
			$T_J=150^{\circ}C$	-	-	3000	
I_{GES}	Gate-Emitter leakage current	$V_{CE}=0V, V_{GE}=\pm 20V$	-	-	± 100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20V, I_C=40A$	-	16	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0V, V_{CE}=25V, f=1MHz$	-	1950	-	pF	
C_{oes}	Output Capacitance		-	250	-	pF	
C_{res}	Reverse Transfer Capacitance		-	9	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15V, V_{CE}=480V, I_C=40A$	-	45	-	nC	
Q_{ge}	Gate to Emitter Charge		-	17	-	nC	
Q_{gc}	Gate to Collector Charge		-	15.6	-	nC	
$I_{C(SC)}$	Short circuit collector current, Max. 1000 short circuits, Delay between short circuits $\geq 1.0s$	$V_{GE}=15V, V_{CE}=400V, R_G=25\Omega$	-	140	-	A	
R_g	Gate resistance	$f=1MHz$	-	1.45	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, $T_J=25^{\circ}C$)							
$t_{D(on)}$	Turn-On DelayTime	$T_J=25^{\circ}C$ $V_{GE}=15V, V_{CE}=400V, I_C=40A,$ $R_G=7.5\Omega,$ Parasitic Inductance=150nH	-	29	-	ns	
t_r	Turn-On Rise Time		-	22	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	74	-	ns	
t_f	Turn-Off Fall Time		-	15	-	ns	
E_{on}	Turn-On Energy		-	1.55	-	mJ	
E_{off}	Turn-Off Energy		-	0.3	-	mJ	
E_{total}	Total Switching Energy		-	1.85	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=25^{\circ}C$ $I_F=20A, dI/dt=200A/\mu s, V_{CE}=400V$	-	127	-	ns
Q_{rr}	Diode Reverse Recovery Charge	-		0.63	-	μC	
I_{rm}	Diode Peak Reverse Recovery Current	-		8	-	A	
SWITCHING PARAMETERS, (Load Inductive, $T_J=150^{\circ}C$)							
$t_{D(on)}$	Turn-On DelayTime	$T_J=150^{\circ}C$ $V_{GE}=15V, V_{CE}=400V, I_C=40A,$ $R_G=7.5\Omega,$ Parasitic Inductance=150nH	-	29	-	ns	
t_r	Turn-On Rise Time		-	24	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	85	-	ns	
t_f	Turn-Off Fall Time		-	17	-	ns	
E_{on}	Turn-On Energy		-	1.7	-	mJ	
E_{off}	Turn-Off Energy		-	0.49	-	mJ	
E_{total}	Total Switching Energy		-	2.19	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=150^{\circ}C$ $I_F=20A, dI/dt=200A/\mu s, V_{CE}=400V$	-	204	-	ns
Q_{rr}	Diode Reverse Recovery Charge	-		1.2	-	μC	
I_{rm}	Diode Peak Reverse Recovery Current	-		11	-	A	

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

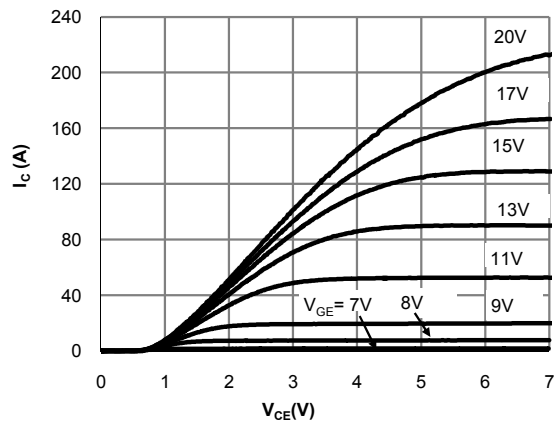


Fig 1: Output Characteristic
($T_J = 25^\circ\text{C}$)

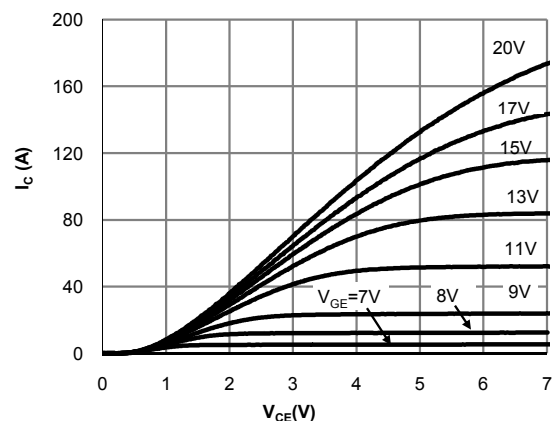


Fig 2: Output Characteristic
($T_J = 150^\circ\text{C}$)

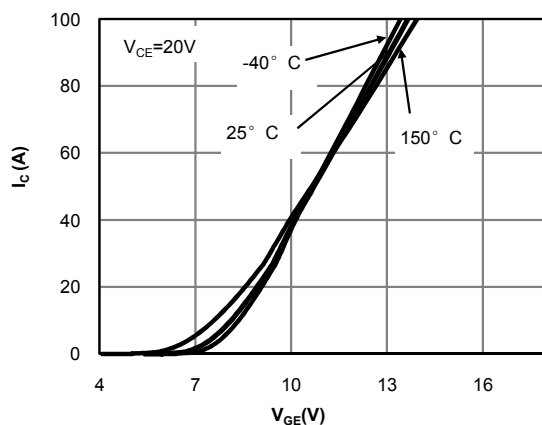


Fig 3: Transfer Characteristic

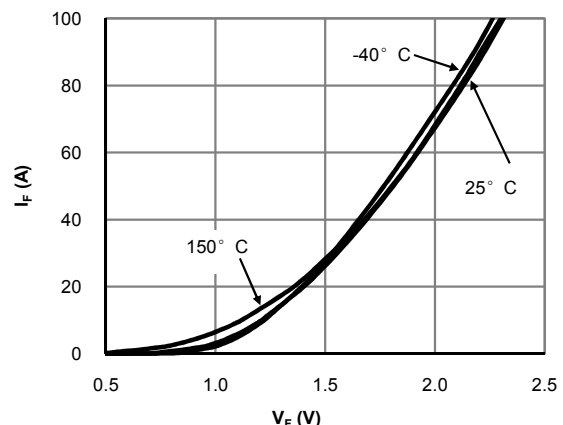


Fig 4: Diode Characteristic

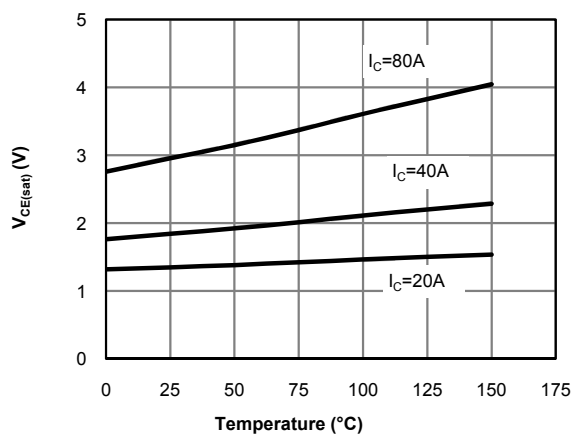


Fig 5: Collector-Emitter Saturation Voltage vs.
Junction Temperature

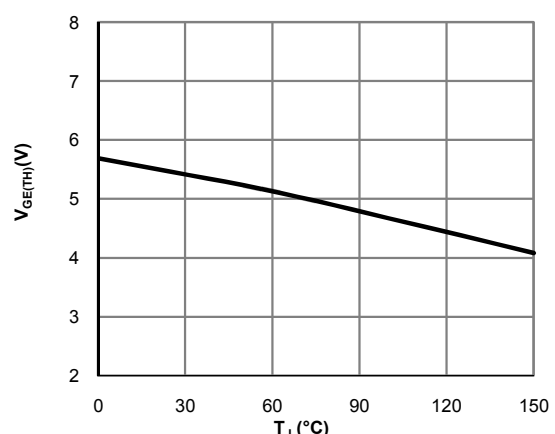


Figure 6: $V_{GE(TH)}$ vs. T_J

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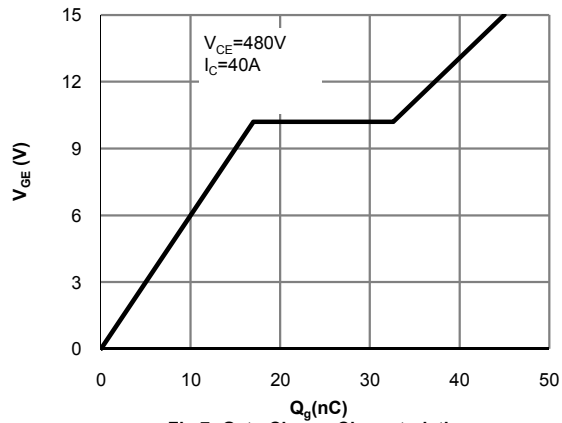


Fig 7: Gate-Charge Characteristics

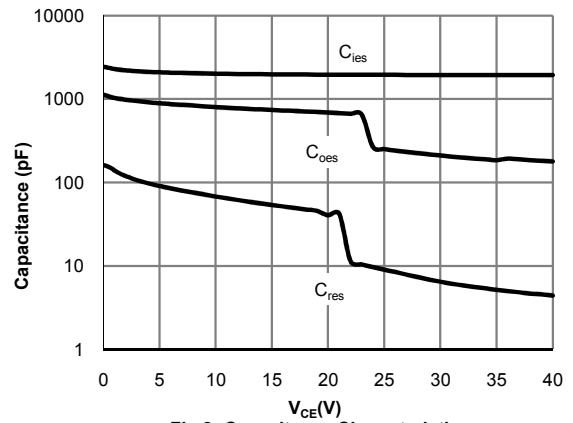


Fig 8: Capacitance Characteristic

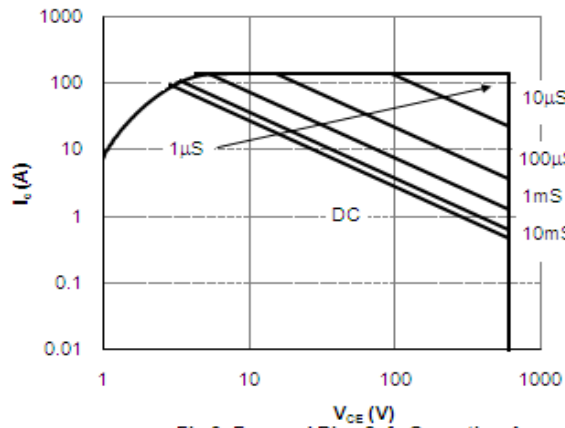


Fig 9: Forward Bias Safe Operating Area
($T_C = 25^\circ\text{C}$, $V_{GE} = 15\text{V}$)

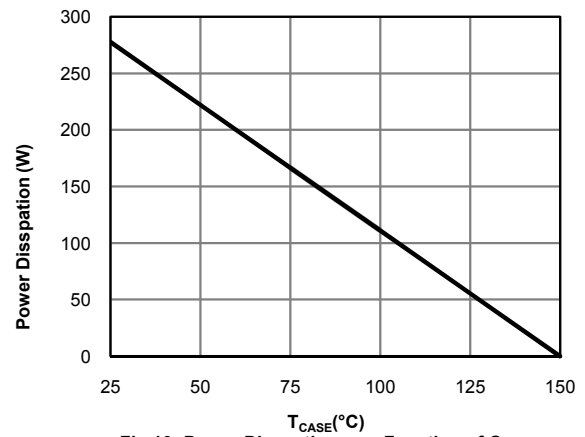


Fig 10: Power Dissipation as a Function of Case

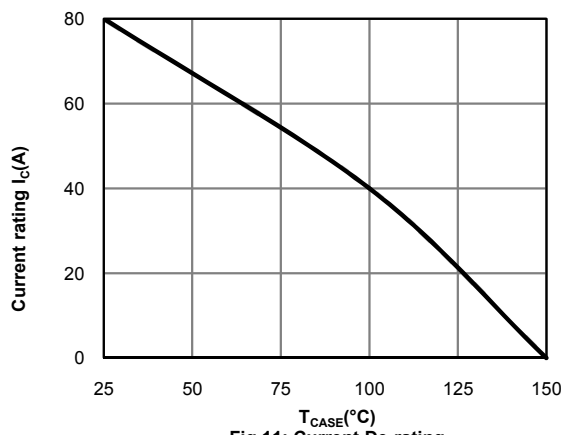
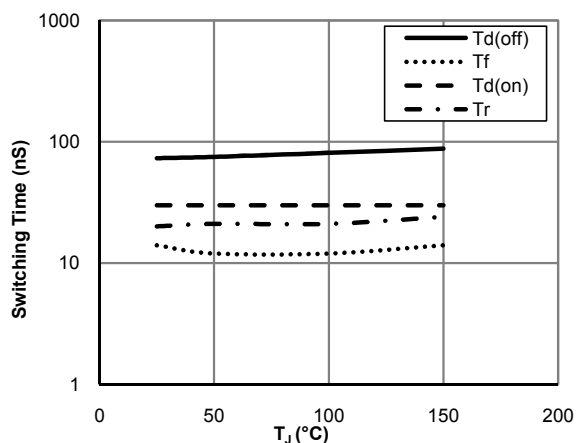
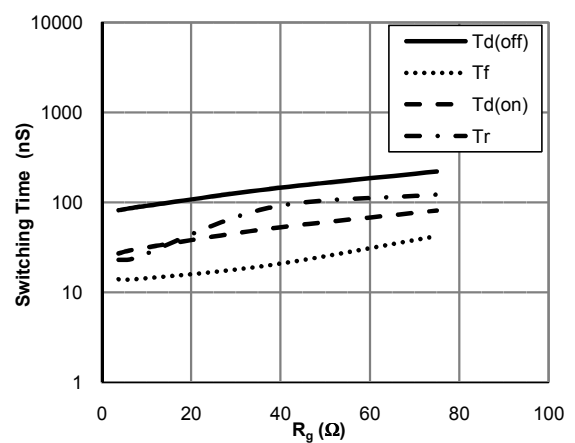
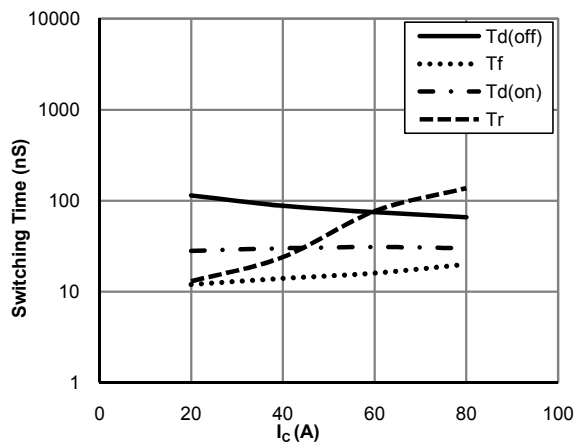


Fig 11: Current De-rating

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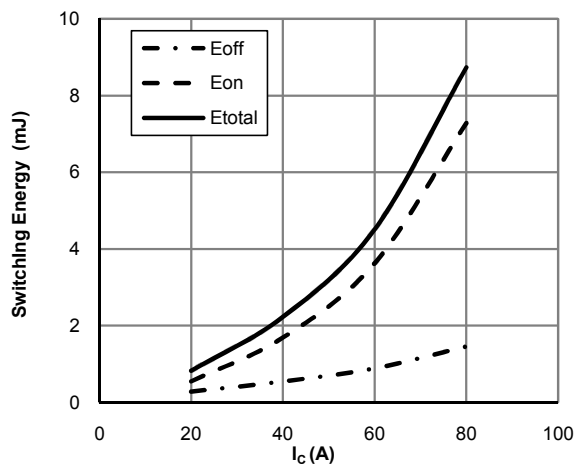


Figure 15: Switching Loss vs. I_C
($T_J=150^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $R_g=7.5\Omega$)

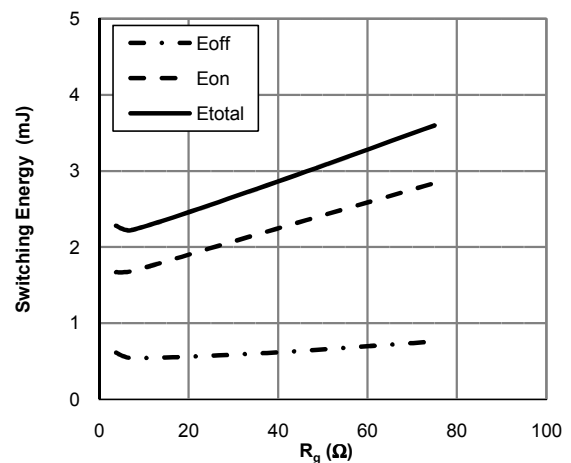


Figure 16: Switching Loss vs. R_g
($T_J=150^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $I_C=40\text{A}$)

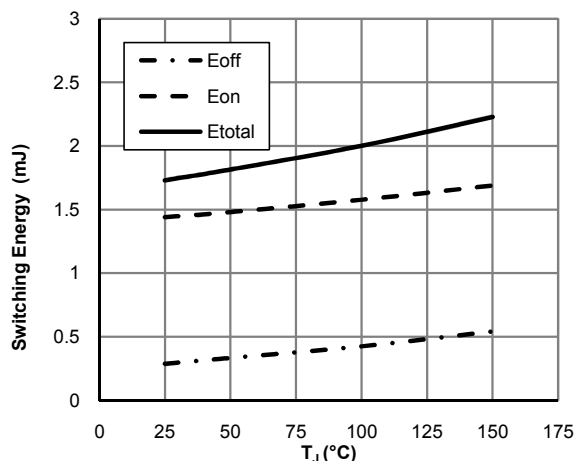


Figure 17: Switching Loss vs. T_J
($V_{GE}=15\text{V}$, $V_{CE}=400\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

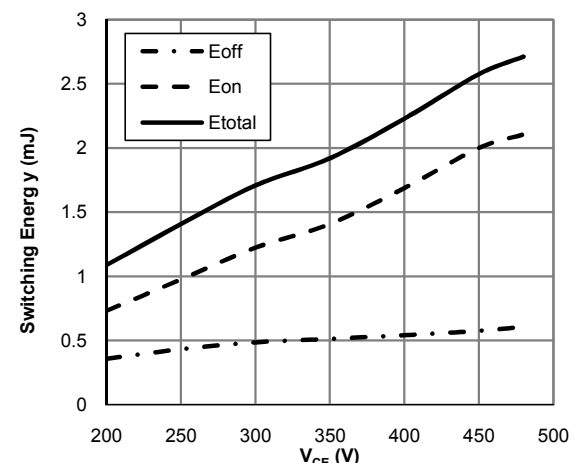


Figure 18: Switching Loss vs. V_{CE}
($T_J=150^\circ\text{C}$, $V_{GE}=15\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

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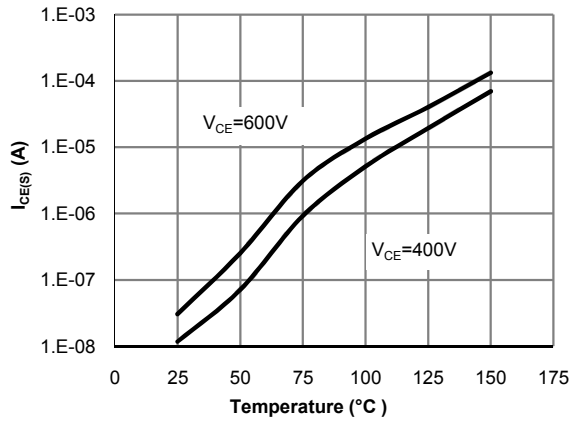


Fig 19: Diode Reverse Leakage Current vs. Junction Temperature

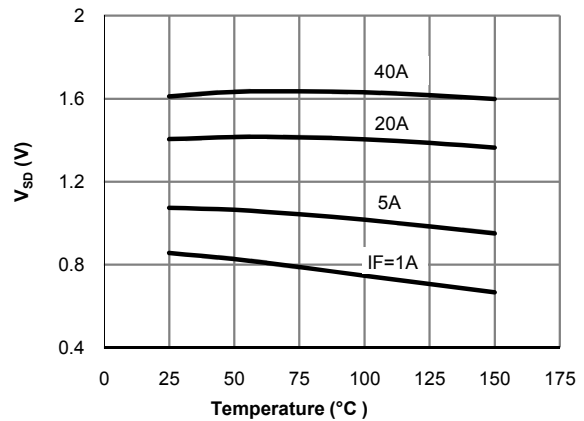


Fig 20: Diode Forward voltage vs. Junction Temperature

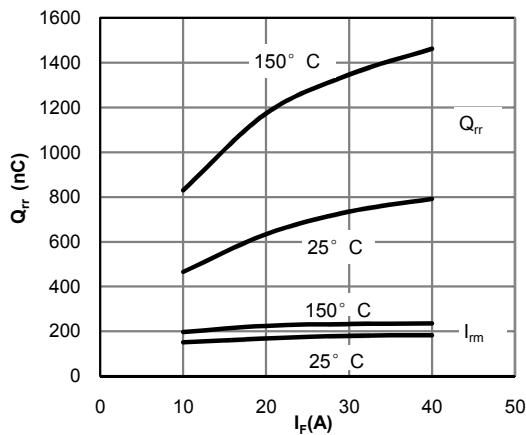


Fig 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

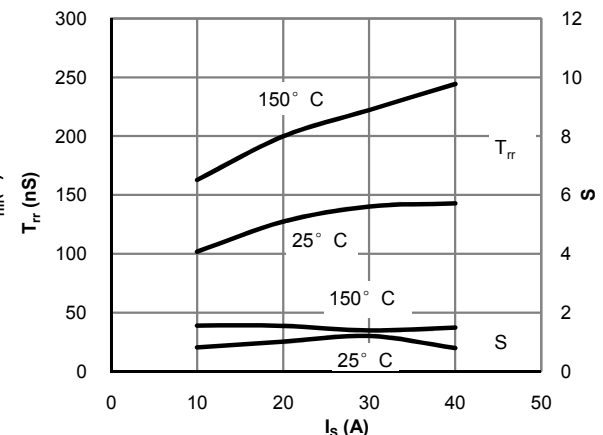


Fig 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

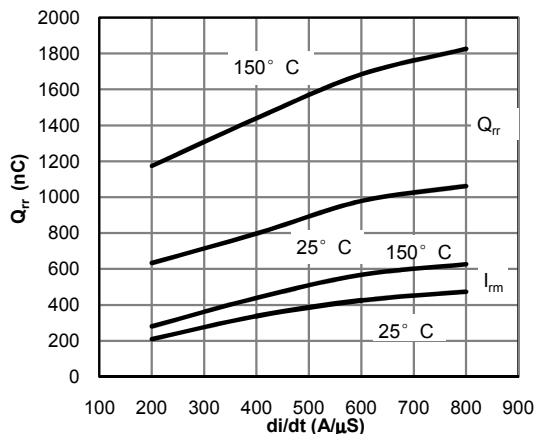


Fig 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=20A$)

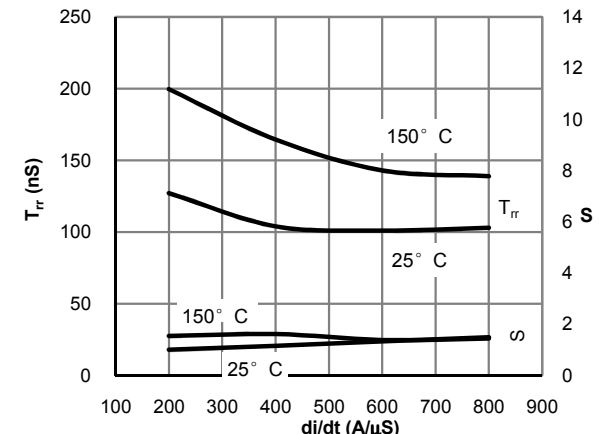


Fig 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=20A$)

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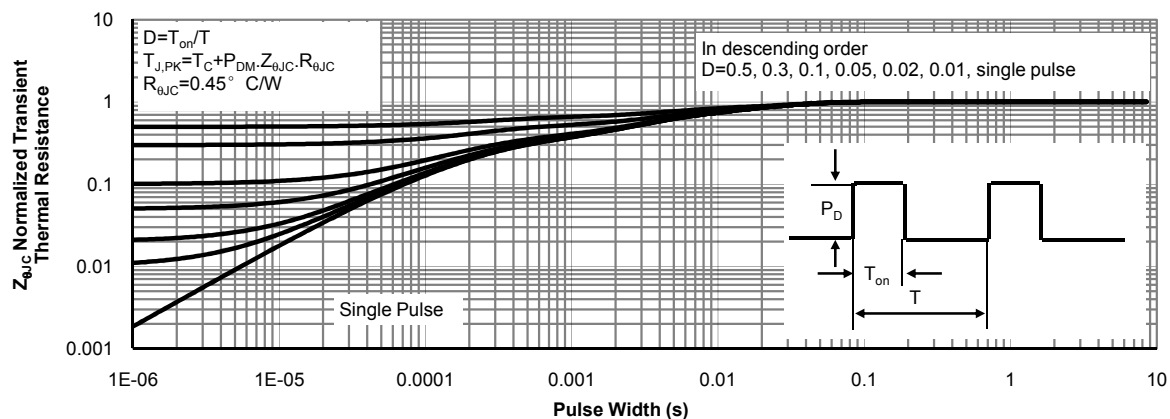


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

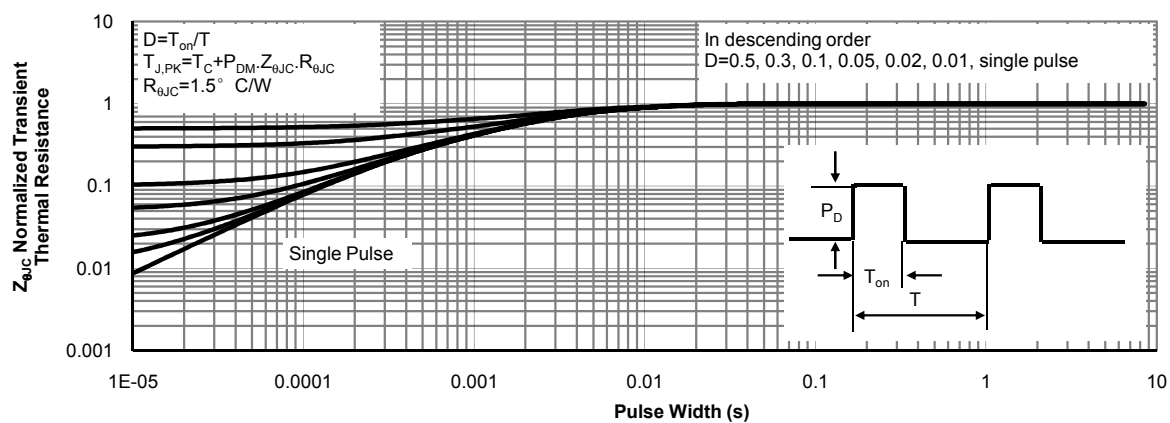
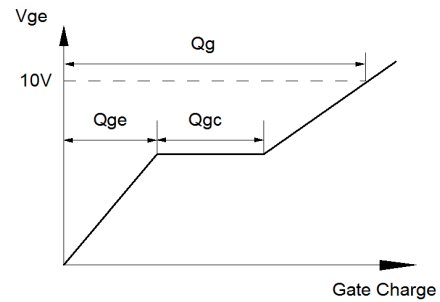
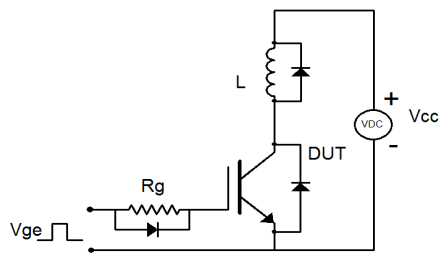
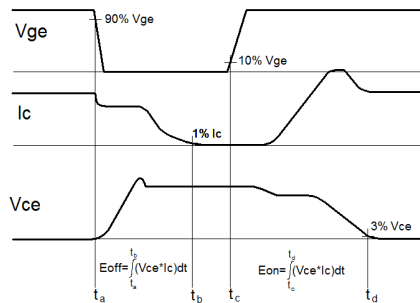
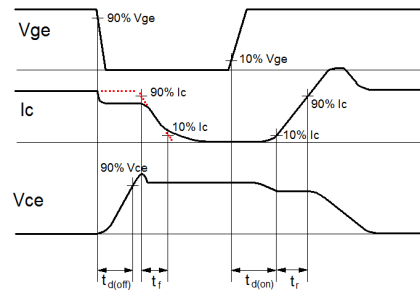
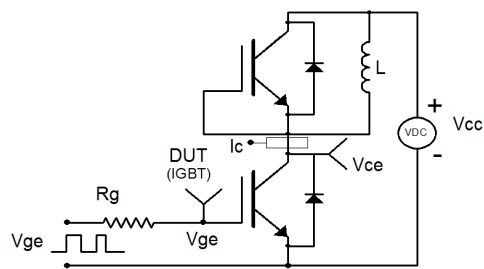


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

