ALPHA & OMEGA SEMICONDUCTOR

AOK60B60D1

600V, 60A Alpha IGBT™ with Diode

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.

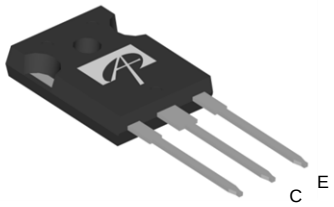
Product Summary

V_{CE}	600V
I_C (T_C=100°C)	60A
$V_{CE(sat)}$ (T_C=25°C)	1.85V

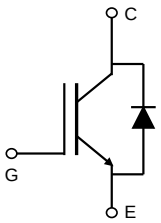
RoHS Compliant

Top View

TO-247



AOK60B60D1



Absolute Maximum Ratings T_A=25°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	T_C=25°C	I_C	120	A
	T_C=100°C		60	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	210	A
Turn off SOA, $V_{CE} \leqslant$ 600V, Limited by T_{Jmax}		I_{LM}	210	A
Continuous Diode Forward Current	T_C=25°C	I_F	60	A
	T_C=100°C		30	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	210	A
Short circuit withstanding time V_{GE} = 15V, $V_{CE} \leqslant$ 400V, Delay between short circuits $\geqslant$ 1.0s, T_C=25°C		t_{SC}	10	µs
Power Dissipation	T_C=25°C	P_D	417	W
	T_C=100°C		167	
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	AOK60B60D1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.3	°C/W
Maximum Diode Junction-to-Case	$R_{\theta JC}$	0.95	°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°C		600	-	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=60A	T_J=25°C	-	1.85	2.4	V
			T_J=125°C	-	2.2	-	
			T_J=150°C	-	2.3	-	
V_F	Diode Forward Voltage	V_{GE}=0V, I_C=30A	T_J=25°C	-	1.34	1.9	V
			T_J=125°C	-	1.31	-	
			T_J=150°C	-	1.28	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE}=5V, I_C=1mA		-	5.4	-	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE}=600V, V_{GE}=0V	T_J=25°C	-	-	10	µA
			T_J=125°C	-	-	1000	
			T_J=150°C	-	-	5000	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±20V		-	-	±100	nA
g_{FS}	Forward Transconductance	V_{CE}=20V, I_C=60A		-	25	-	S
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CE}=25V, f=1MHz		-	3288	-	pF
C_{oes}	Output Capacitance			-	369	-	pF
C_{res}	Reverse Transfer Capacitance			-	11.3	-	pF
Q_g	Total Gate Charge	V_{GE}=15V, V_{CE}=480V, I_C=60A		-	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 ⩾ 1.0s	V_{GE}=15V, V_{CE}=400V, R_G=25Ω		-	210	-	A
R_g	Gate resistance	f=1MHz		-	1.4	-	Ω
SWITCHING PARAMETERS, (Load Iductive, T_J=25°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=25°C V_{GE}=15V, V_{CE}=400V, I_C=60A, R_G=5Ω, 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°C I_F=30A,dI/dt=200A/µs,V_{CE}=400V		-	137	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.84	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	10	-	A
SWITCHING PARAMETERS, (Load Iductive, T_J=150°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=150°C V_{GE}=15V, V_{CE}=400V, I_C=60A, R_G=5Ω, 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°C I_F=30A,dI/dt=200A/µs,V_{CE}=400V		-	234	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	1.7	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	13.8	-	A

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 MAKE CHANGES TO PRODUCT SPECIFICATIONS WITHOUT NOTICE. IT IS THE RESPONSIBILITY OF THE CUSTOMER TO EVALUATE SUITABILITY OF THE PRODUCT FOR THEIR INTENDED APPLICATION. CUSTOMER SHALL COMPLY WITH APPLICABLE LEGAL REQUIREMENTS, INCLUDING ALL APPLICABLE EXPORT CONTROL RULES, REGULATIONS AND LIMITATIONS.

AOS' products are provided subject to AOS' terms and conditions of sale which are set forth at:
http://www.aosmd.com/terms_and_conditions_of_sale

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

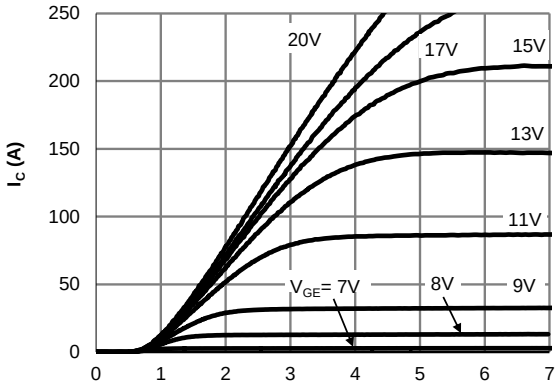


Fig 1: Output Characteristic (T_j=25°C)

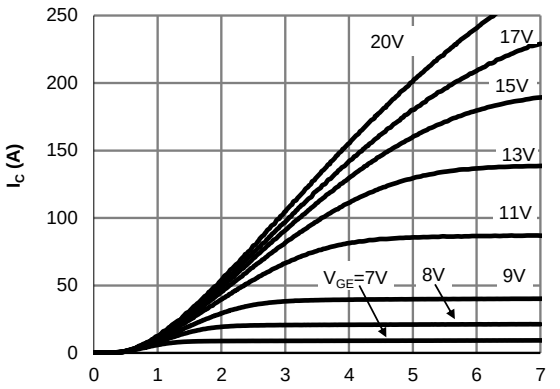


Fig 2: Output Characteristic (T_j=150°C)

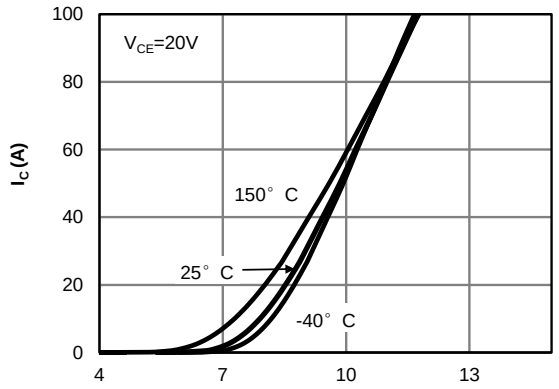


Fig 3: Transfer Characteristic

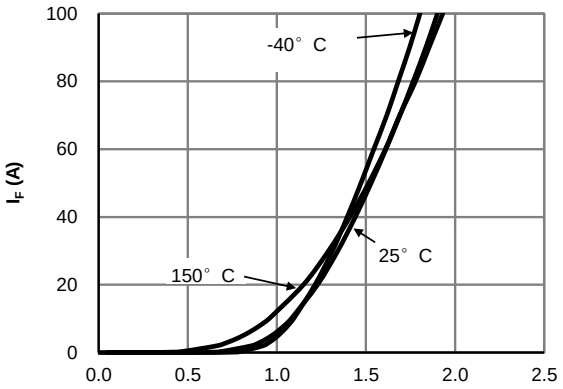


Fig 4: Diode Characteristic

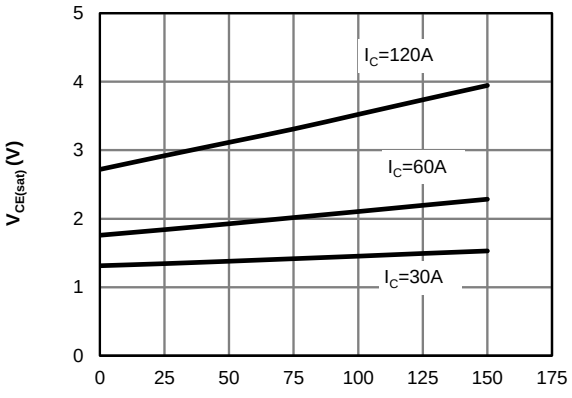


Fig 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

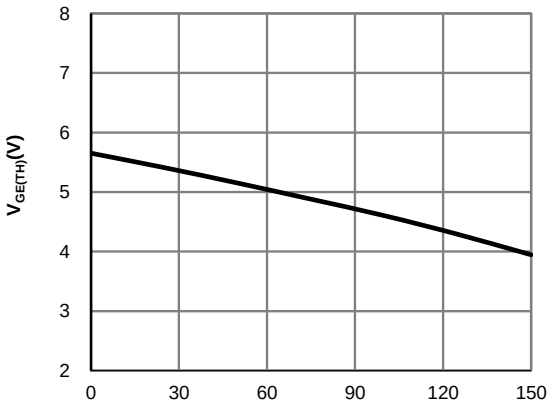


Figure 6: $V_{GE(TH)}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

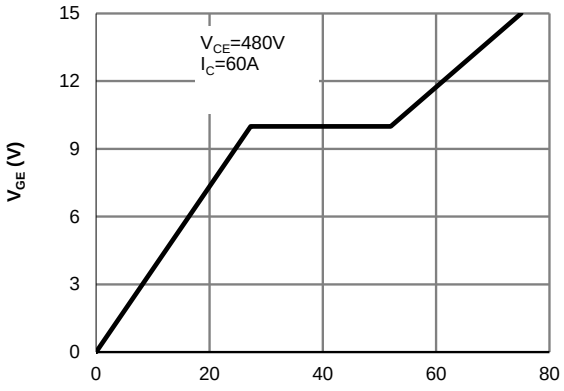


Fig 7: Gate-Charge Characteristics

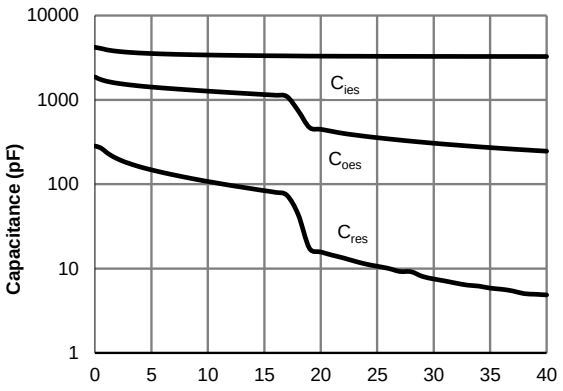


Fig 8: Capacitance Characteristic

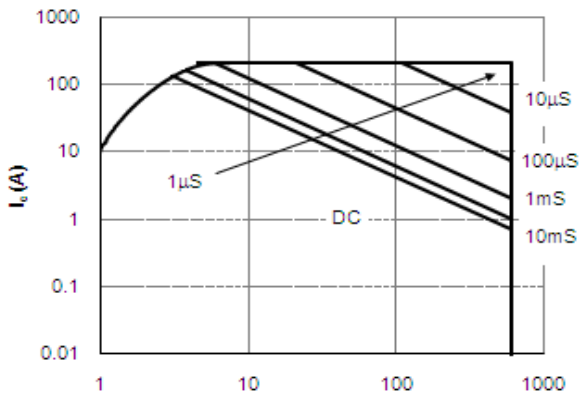


Fig 9: Forward Bias Safe Operating Area
(T_C=25C,V_{GE}=15V)

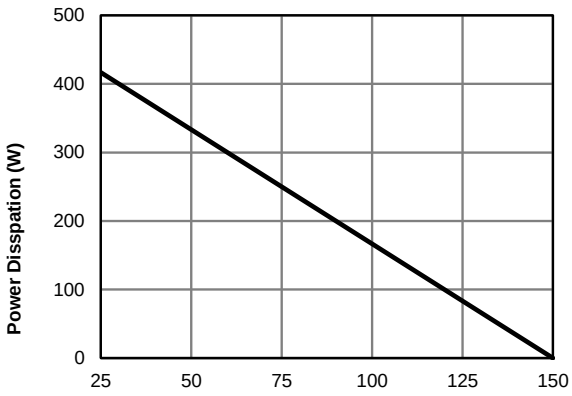


Fig 10: Power Disspation as a Function of Case

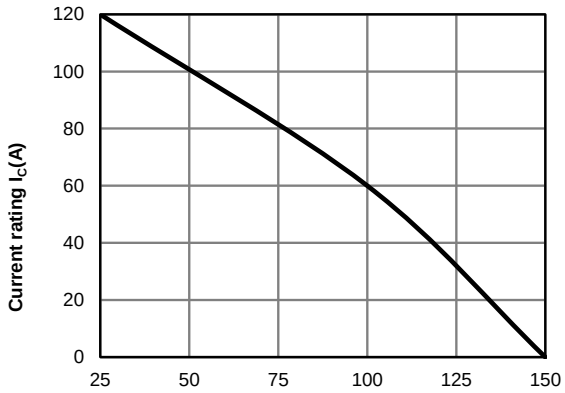


Fig 11: Current De-rating

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

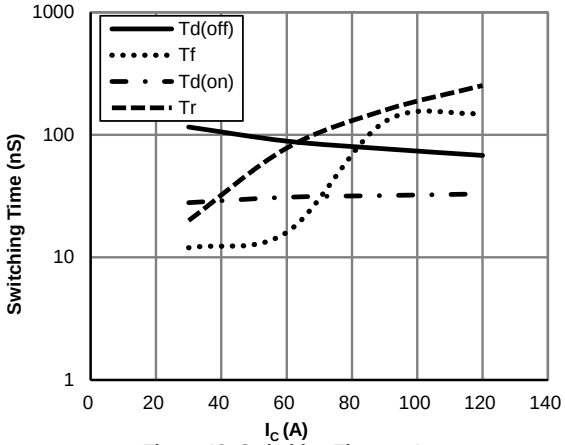


Figure 12: Switching Time vs. I_C
(T_j=150°C,V_{GE}=15V,V_{CE}=400V,R_g=5Ω)

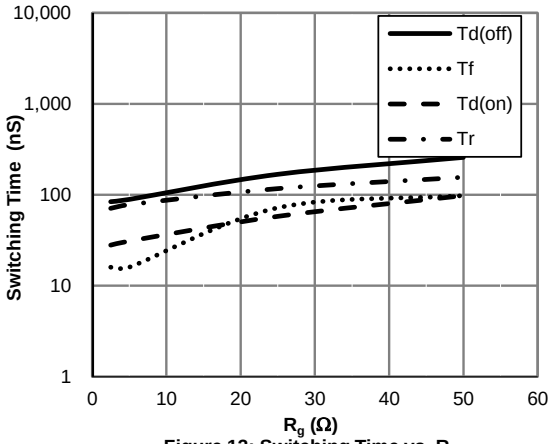


Figure 13: Switching Time vs. R_g
(T_j=150°C,V_{GE}=15V,V_{CE}=400V,I_C=60A)

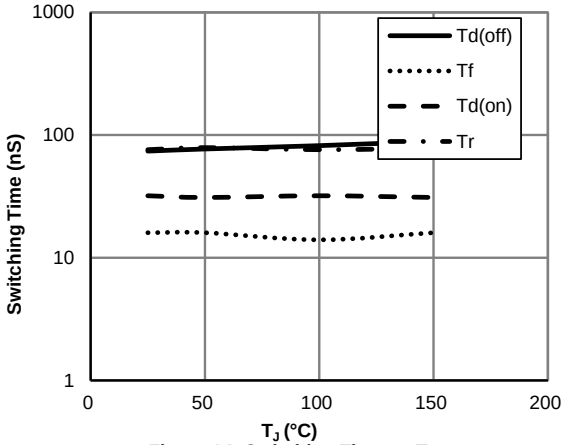


Figure 14: Switching Time vs.T_j
(V_{GE}=15V,V_{CE}=400V,I_C=60A,R_g=5Ω)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

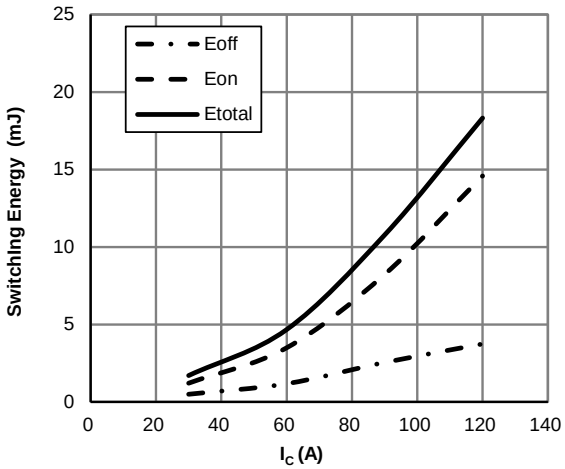


Figure 15: Switching Loss vs. I_C
(T_j=150°C,V_{GE}=15V,V_{CE}=400V,R_g=5Ω)

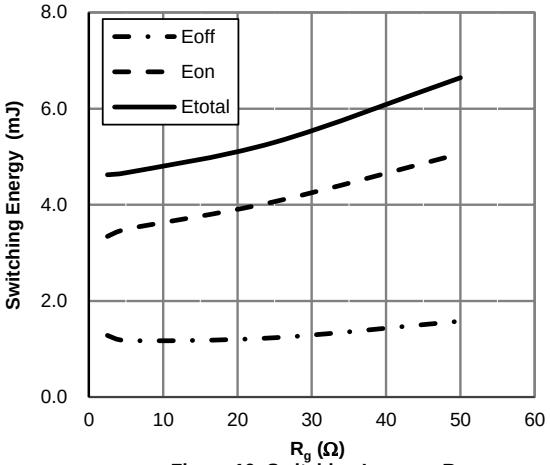


Figure 16: Switching Loss vs. R_g
(T_j=150°C,V_{GE}=15V,V_{CE}=400V,I_C=60A)

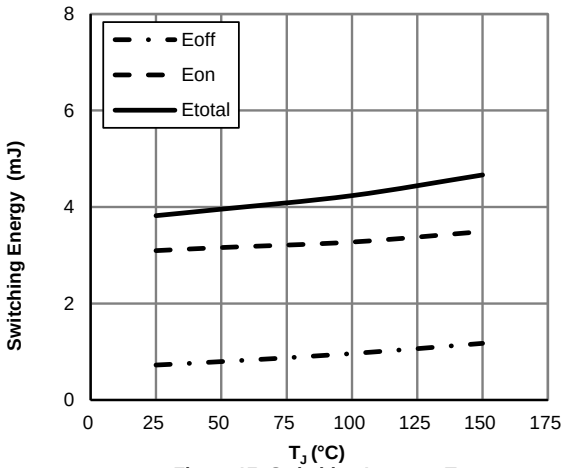


Figure 17: Switching Loss vs. T_j
(V_{GE}=15V,V_{CE}=400V,I_C=60A,R_g=5Ω)

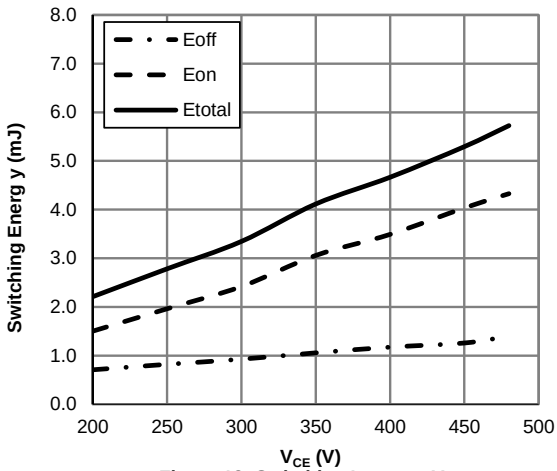


Figure 18: Switching Loss vs. V_{CE}
(T_j=150°C,V_{GE}=15V,I_C=60A,R_g=5Ω)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

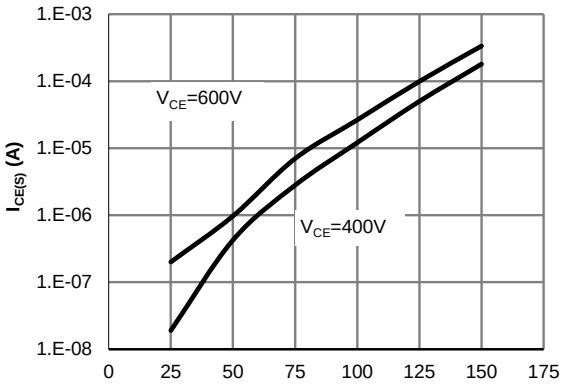


Fig 19: Diode Reverse Leakage Current vs. Junction Temperature

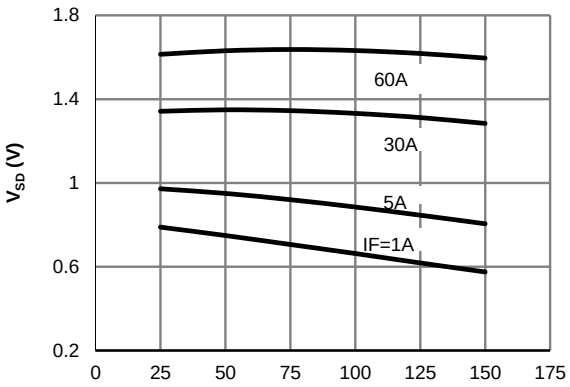


Fig 20: Diode Forward voltage vs. Junction Temperature

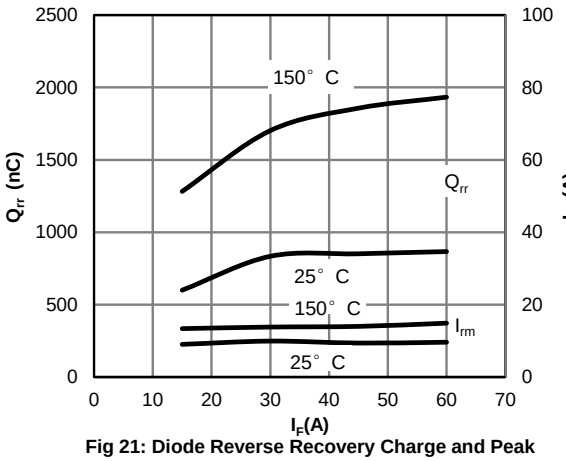


Fig 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current (V_{GE}=15V,V_{CE}=400V, di/dt=200A/µs)

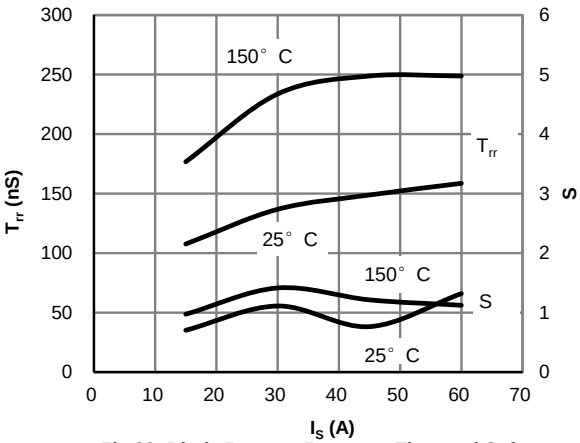


Fig 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current (V_{GE}=15V,V_{CE}=400V, di/dt=200A/µs)

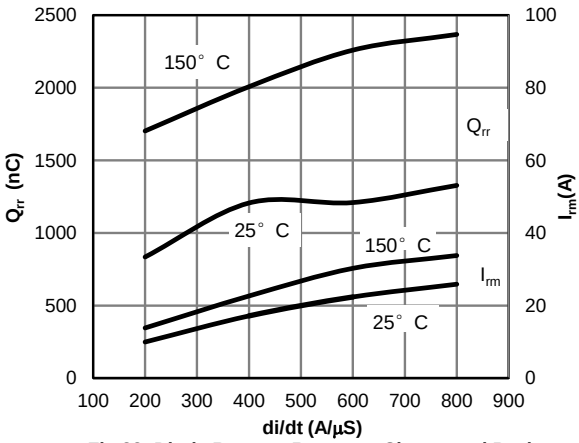


Fig 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt (V_{GE}=15V,V_{CE}=400V,I_F=30A)

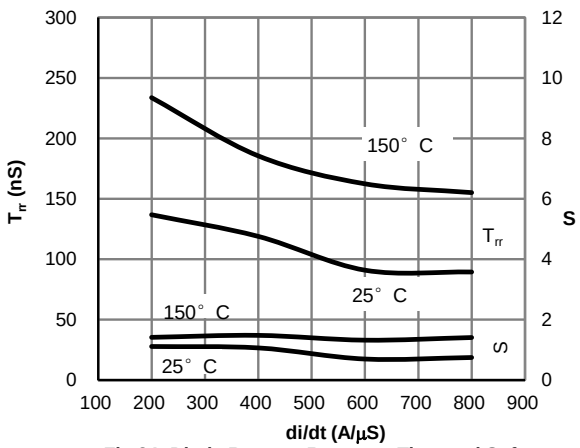


Fig 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt (V_{GE}=15V,V_{CE}=400V,I_F=30A)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

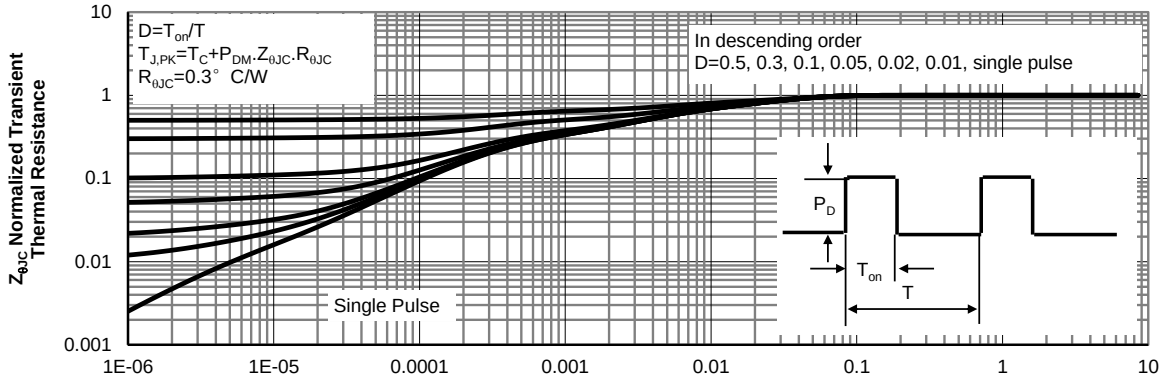


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

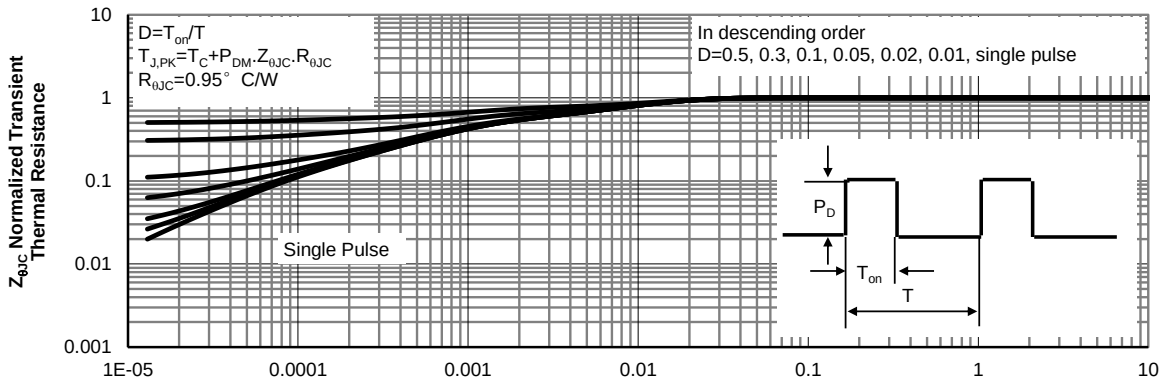
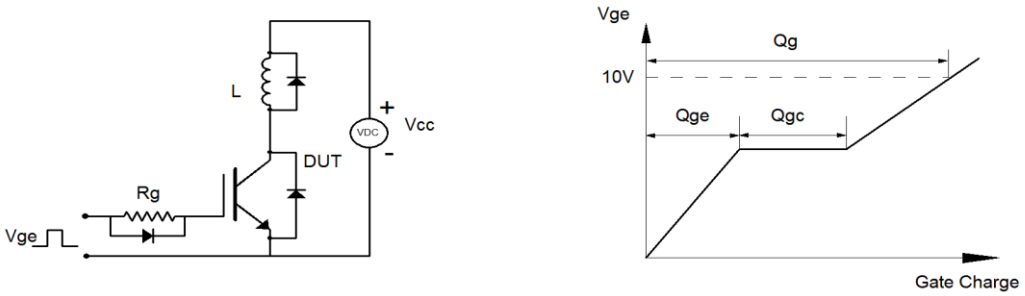
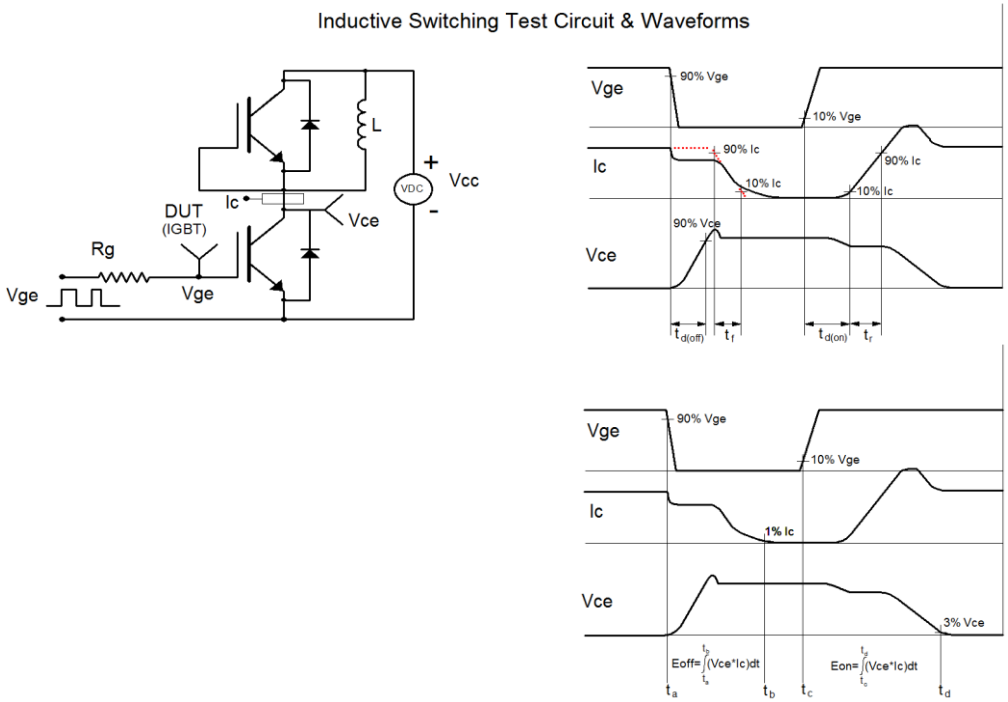


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms