ALPHA & OMEGA SEMICONDUCTOR

AOK10B60D

600V, 10A 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-package diode is targeted for minimal losses in motor control applications.

Product Summary

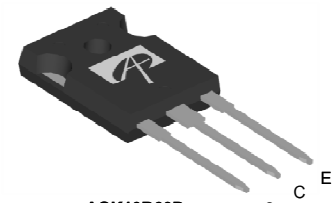
V_{CE}	600V
I_C (T_C=100°C)	10A
$V_{CE(sat)}$ (T_C=25°C)	1.53V

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

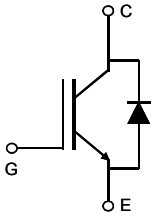
RoHS Compliant

Top View

TO-247



AOK10B60D



Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOK10B60D	Units
Collector-Emitter Voltage		V_{CE}	600	V
Gate-Emitter Voltage		V_{GE}	±20	V
Continuous Collector Current	T_C=25°C	I_C	20	A
	T_C=100°C		10	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	40	A
Turn off SOA, V_{CE} ⩽ 600V, Limited by T_{Jmax}		I_{LM}	40	A
Continuous Diode Forward Current	T_C=25°C	I_F	20	A
	T_C=100°C		10	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	40	A
Short circuit withstanding time V_{GE} = 15V, V_{CE} ⩽ 400V, Delay between short circuits ⩾ 1.0s, T_C=25°C		t_{SC}	10	µs
Power Dissipation	T_C=25°C	P_D	163	W
	T_C=100°C		82	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 175	°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		T_L	300	°C

Thermal Characteristics

Parameter	Symbol	AOK10B60D	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.92	°C/W
Maximum Diode Junction-to-Case	$R_{\theta JC}$	1.7	°C/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=250µA, V_{GE}=0V, T_J=25°C		600	-	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=10A	T_J=25°C	-	1.53	1.8	V
			T_J=125°C	-	1.75	-	
			T_J=175°C	-	1.88	-	
V_F	Diode Forward Voltage	V_{GE}=0V, I_C=10A	T_J=25°C	-	1.52	1.85	V
			T_J=125°C	-	1.48	-	
			T_J=175°C	-	1.39	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE}=V_{GE}, I_C=250µA		-	5.6	-	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE}=600V, V_{GE}=0V	T_J=25°C	-	-	10	µA
			T_J=125°C	-	-	200	
			T_J=175°C	-	-	2000	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±20V		-	-	±100	nA
g_{FS}	Forward Transconductance	V_{CE}=20V, I_C=10A		-	4.8	-	S
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CE}=25V, f=1MHz		-	824	-	pF
C_{oes}	Output Capacitance			-	68	-	pF
C_{res}	Reverse Transfer Capacitance			-	2.7	-	pF
Q_g	Total Gate Charge	V_{GE}=15V, V_{CE}=480V, I_C=10A		-	17.4	-	nC
Q_{ge}	Gate to Emitter Charge			-	6.2	-	nC
Q_{gc}	Gate to Collector Charge			-	6.3	-	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=30Ω		-	43	-	A
R_g	Gate resistance	V_{GE}=0V, V_{CE}=0V, f=1MHz		-	3.2	-	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=10A, R_G=30Ω, Parasitic Inductance=150nH		-	10	-	ns
t_r	Turn-On Rise Time			-	15	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	72	-	ns
t_f	Turn-Off Fall Time			-	8.8	-	ns
E_{on}	Turn-On Energy			-	0.26	-	mJ
E_{off}	Turn-Off Energy			-	0.07	-	mJ
E_{total}	Total Switching Energy			-	0.33	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=25°C I_F=10A,dI/dt=200A/µs,V_{CE}=400V		-	105	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.25	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	5	-	A
SWITCHING PARAMETERS, (Load Iductive, T_J=175°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=175°C V_{GE}=15V, V_{CE}=400V, I_C=10A, R_G=30Ω, Parasitic Inductance=150nH		-	10.4	-	ns
t_r	Turn-On Rise Time			-	15.6	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	95	-	ns
t_f	Turn-Off Fall Time			-	11.2	-	ns
E_{on}	Turn-On Energy			-	0.37	-	mJ
E_{off}	Turn-Off Energy			-	0.17	-	mJ
E_{total}	Total Switching Energy			-	0.54	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=175°C I_F=10A,dI/dt=200A/µs,V_{CE}=400V		-	196	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.63	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	6.8	-	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

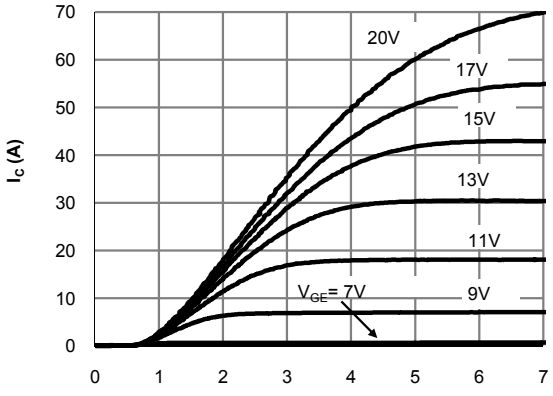


Fig 1: Output Characteristic (T_j=25°C)

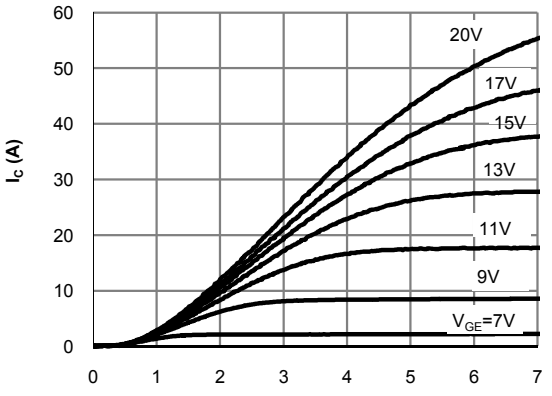


Fig 2: Output Characteristic (T_j=175°C)

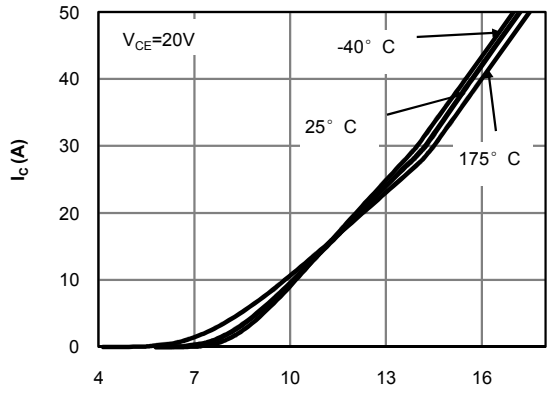


Fig 3: Transfer Characteristic

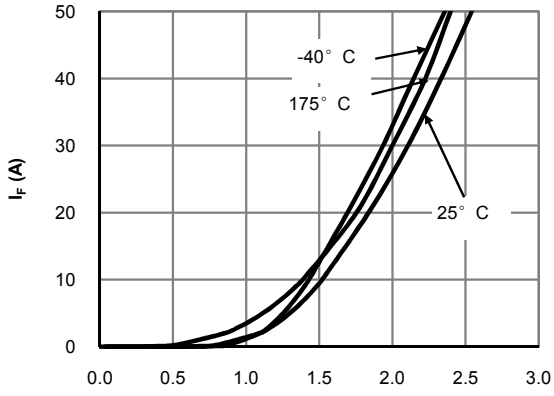


Fig 4: Diode Characteristic

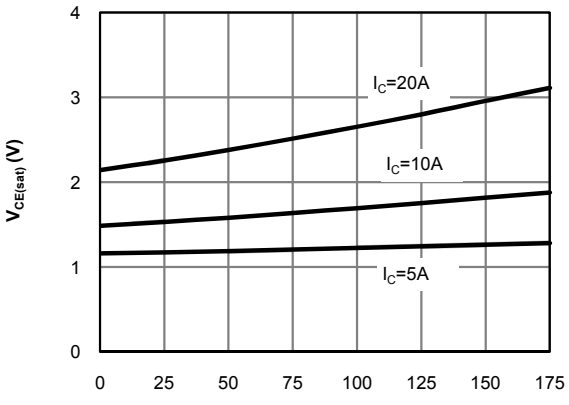


Fig 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

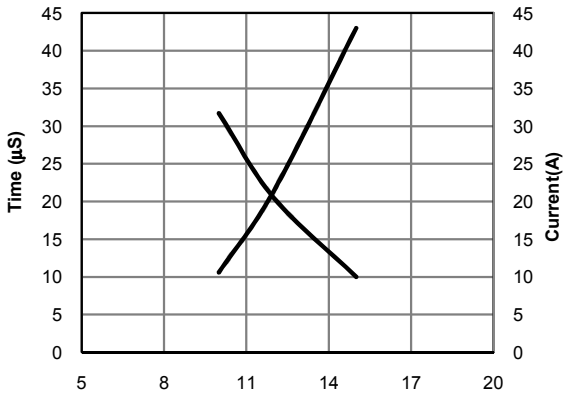


Fig 6: V_{GE} vs. Short Circuit Time (V_{CE}=400V,T_C=25°C)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

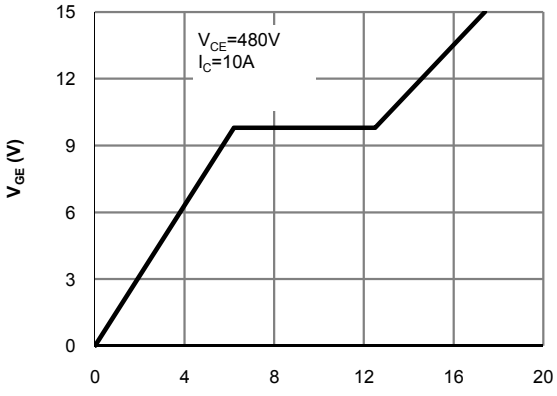


Fig 7: Gate-Charge Characteristics

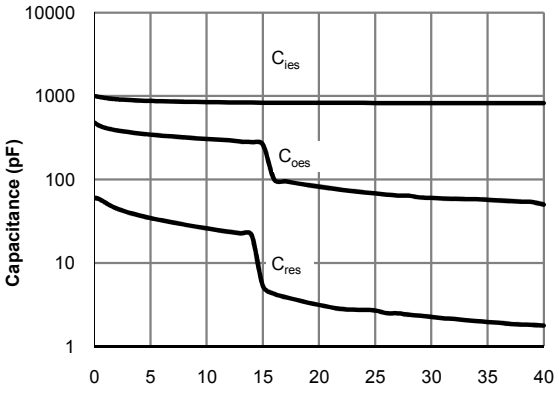


Fig 8: Capacitance Characteristic

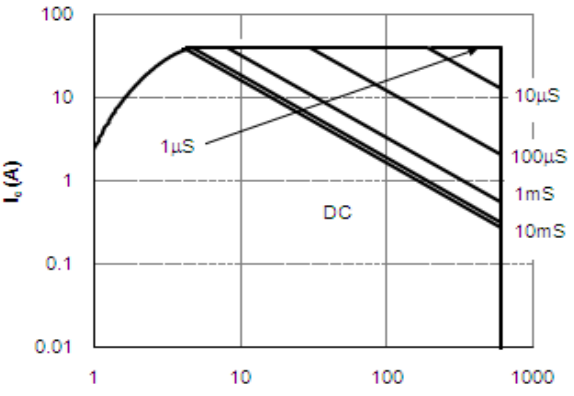


Fig 9: Forward Bias Safe Operating Area
(T_C=25C,V_{GE}=15V)

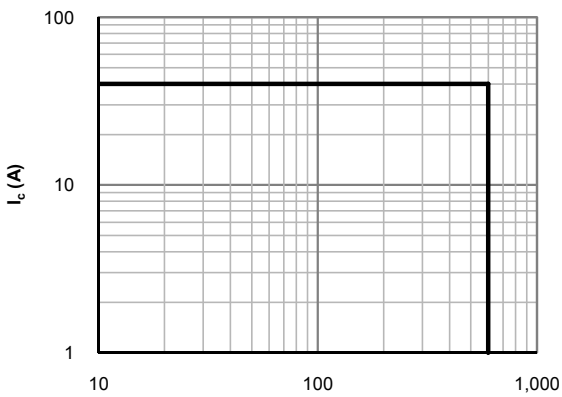


Fig 10: Reverse Bias SOA
(T_j=175°C,V_{GE}=15V)

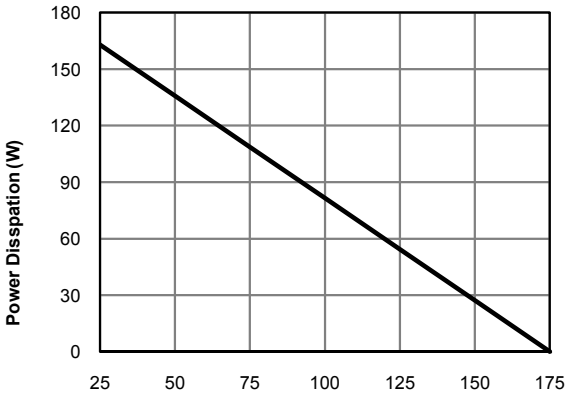


Fig 11: Power Disspation as a Function of Case

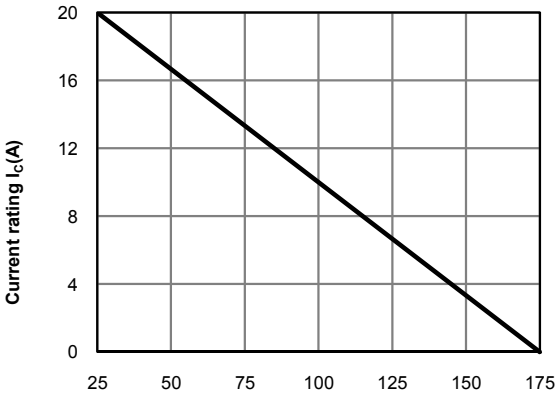


Fig 12: Current De-rating

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

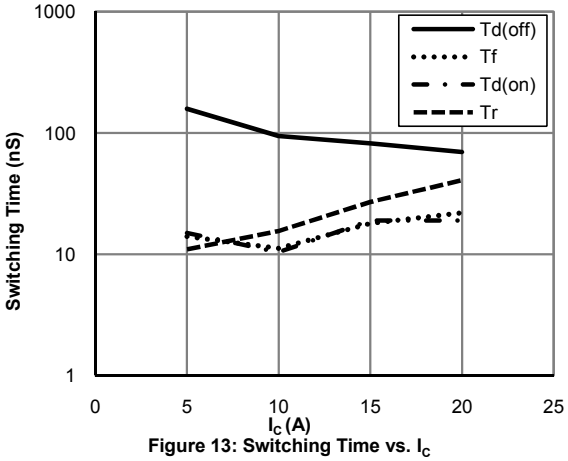


Figure 13: Switching Time vs. I_C
(T_j=175°C,V_{GE}=15V,V_{CE}=400V,R_g=30Ω)

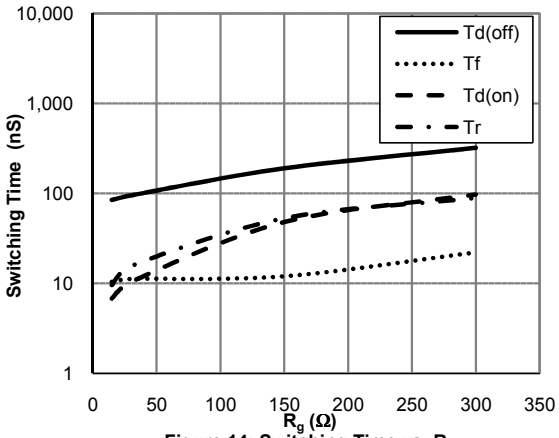


Figure 14: Switching Time vs. R_g
(T_j=175°C,V_{GE}=15V,V_{CE}=400V,I_C=10A)

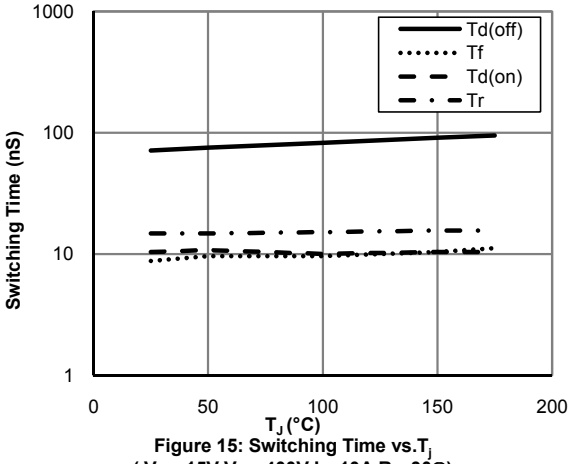


Figure 15: Switching Time vs.T_j
(V_{GE}=15V,V_{CE}=400V,I_C=10A,R_g=30Ω)

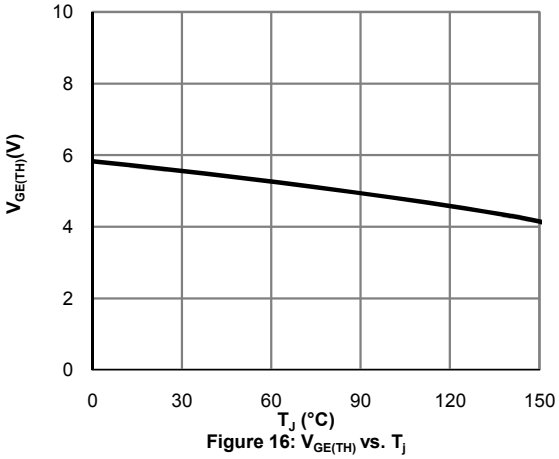


Figure 16: $V_{GE(TH)}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

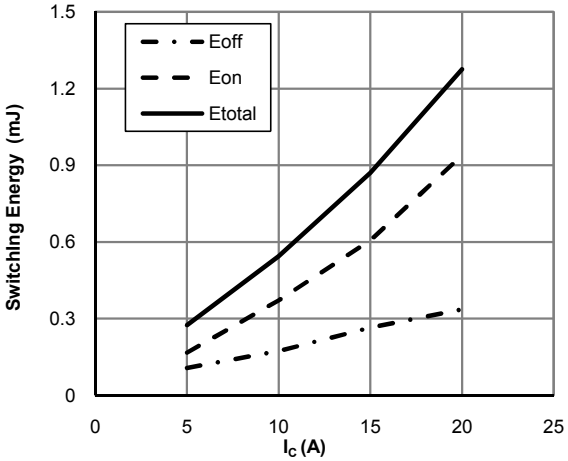


Figure 17: Switching Loss vs. I_C
(T_j=175°C,V_{GE}=15V,V_{CE}=400V,R_g=30Ω)

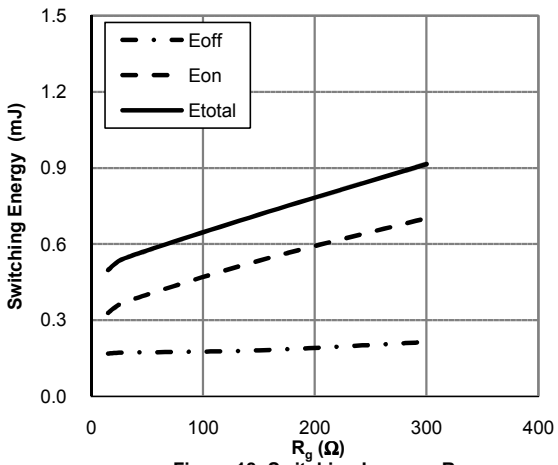


Figure 18: Switching Loss vs. R_g
(T_j=175°C,V_{GE}=15V,V_{CE}=400V,I_C=10A)

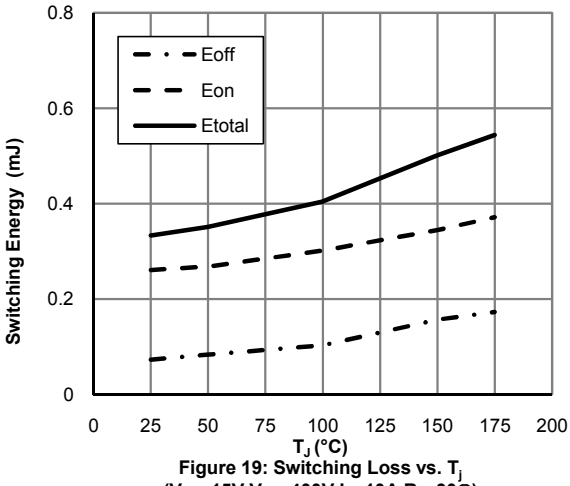


Figure 19: Switching Loss vs. T_j
(V_{GE}=15V,V_{CE}=400V,I_C=10A,R_g=30Ω)

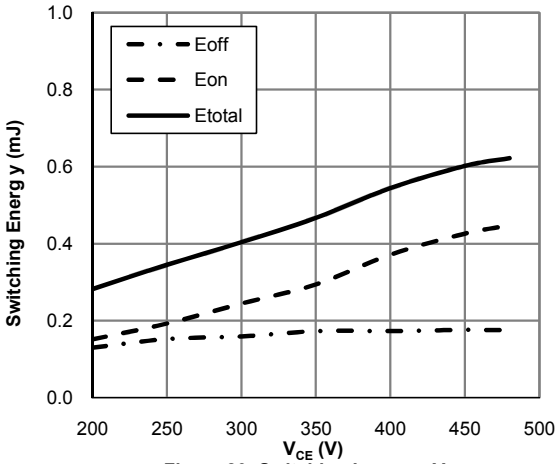


Figure 20: Switching Loss vs. V_{CE}
(T_j=175°C,V_{GE}=15V,I_C=10A,R_g=30Ω)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

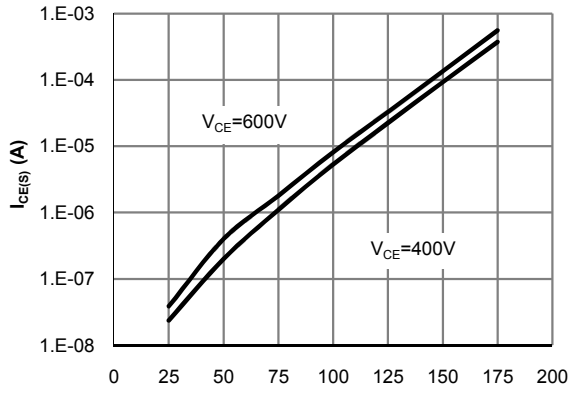


Fig 21: Diode Reverse Leakage Current vs. Junction Temperature

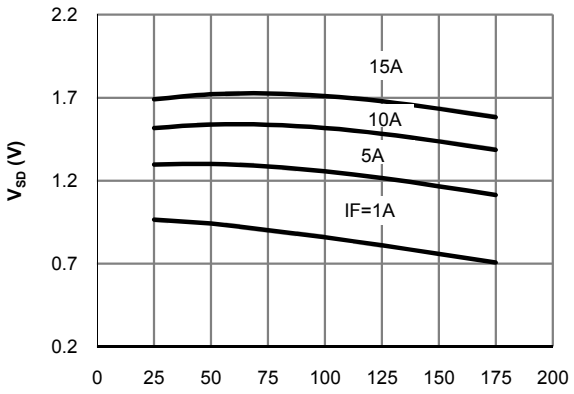


Fig 22: Diode Forward voltage vs. Junction Temperature

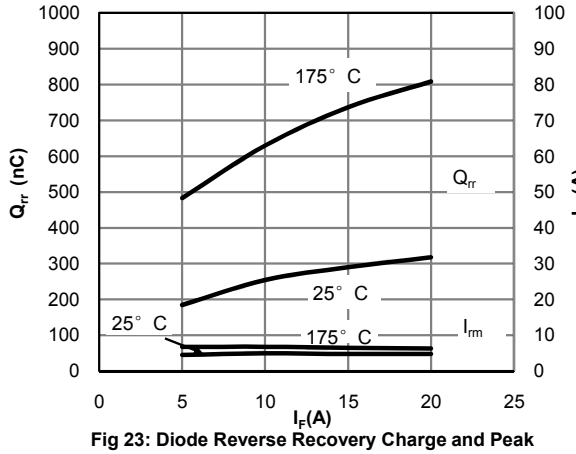


Fig 23: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current (V_{GE}=15V,V_{CE}=400V, di/dt=200A/µs)

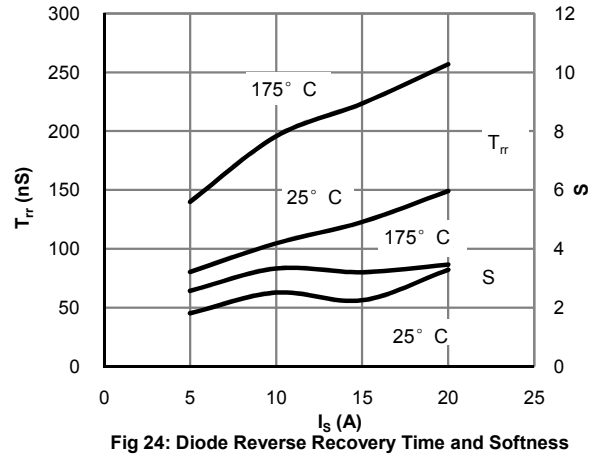


Fig 24: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current (V_{GE}=15V,V_{CE}=400V, di/dt=200A/µs)

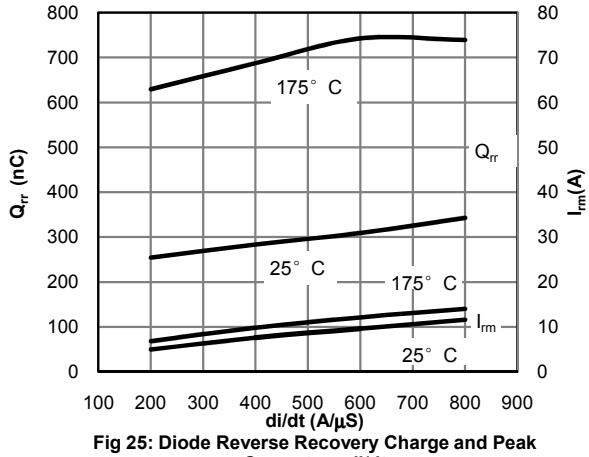


Fig 25: Diode Reverse Recovery Charge and Peak Current vs. di/dt (V_{GE}=15V,V_{CE}=400V,I_F=10A)

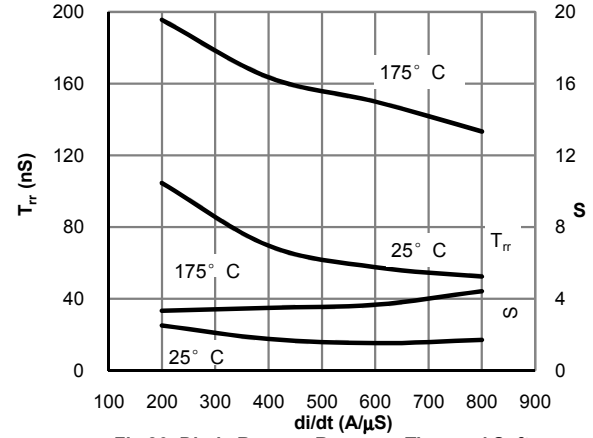


Fig 26: Diode Reverse Recovery Time and Softness Factor vs. di/dt (V_{GE}=15V,V_{CE}=400V,I_F=10A)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

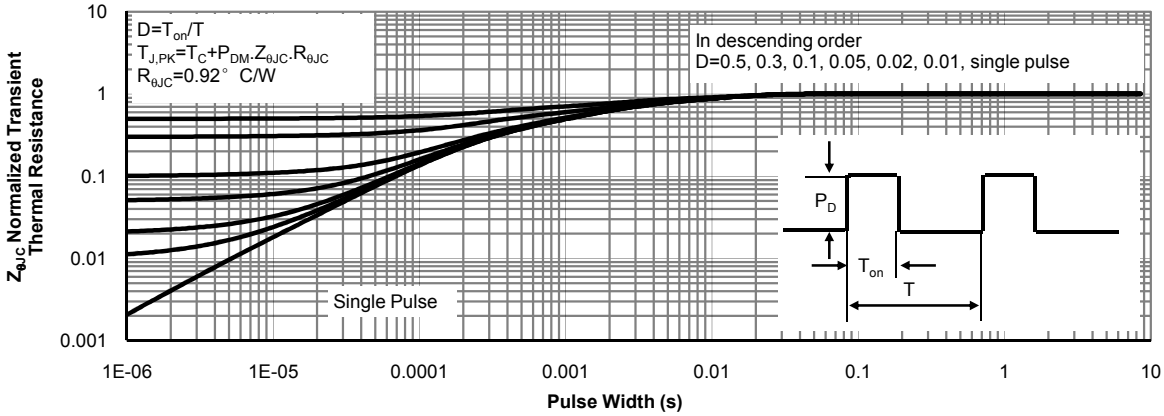


Figure 27: Normalized Maximum Transient Thermal Impedance for IGBT

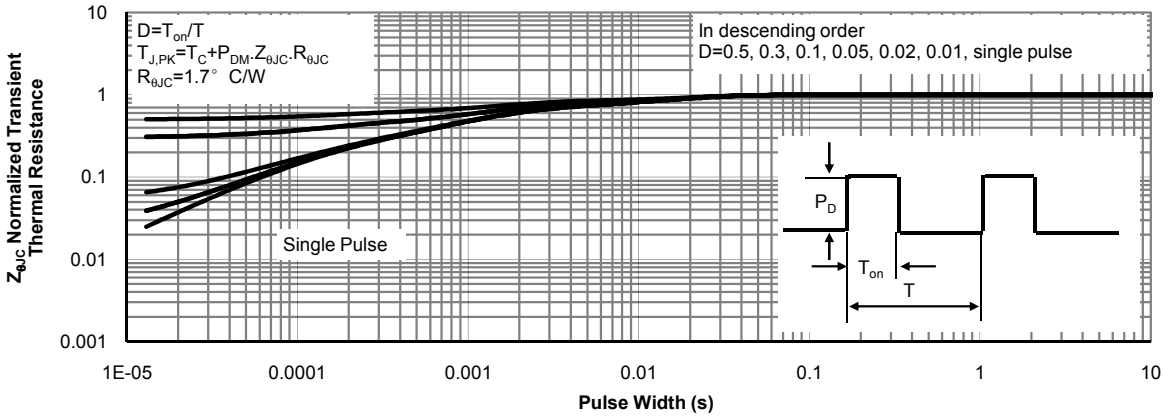
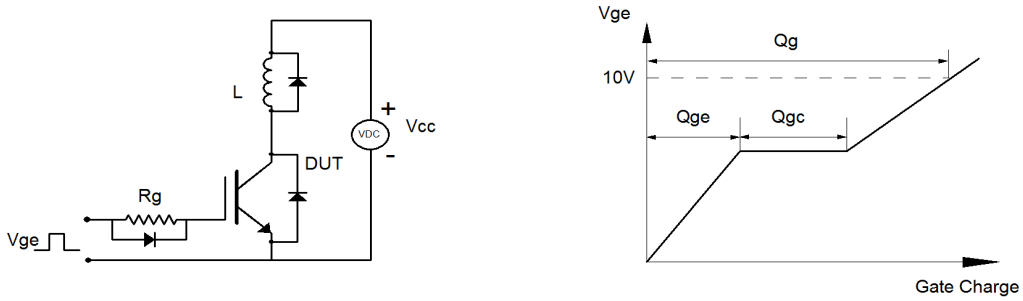
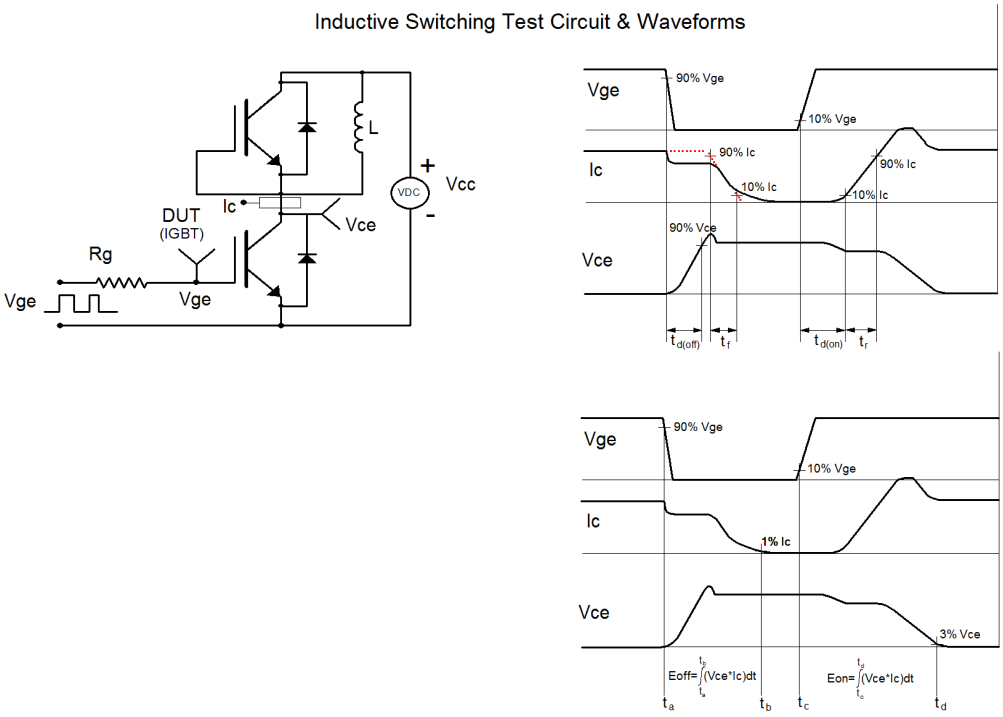


Figure 28: Normalized Maximum Transient Thermal Impedance for Diode

Gate Charge Test Circuit & Waveform



Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms