ALPHA & OMEGA SEMICONDUCTOR

AOKS40B60D1

600V, 40A Alpha IGBT™

General Description

- Latest Alpha IGBT (α IGBT) technology
- High efficient turn-on di/dt controllability
- Very high switching speed
- Low turn-off switching loss and softness
- Very good EMI behavior
- Short-circuit ruggedness

Applications

- Power factor correction
- UPS & Solar Inverters
- Very High Switching Frequency Applications
- Welding Machines

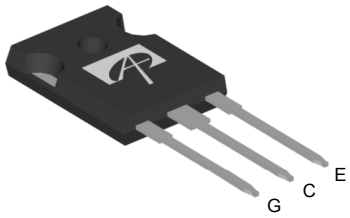
Product Summary

V_{CE}	600V
I_C (T_C=100°C)	40A
$V_{CE(sat)}$ (T_C=25°C)	1.85V

RoHS Compliant

Top View

TO-247



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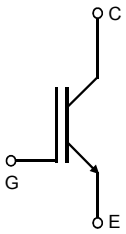

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOKS40B60D1	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	80	A
	T_C=100°C		40	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	140	A
Turn off SOA, $V_{CE} \leqslant$ 600V, Limited by T_{Jmax}		I_{LM}	140	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	278	W
	T_C=100°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	AOKS40B60D1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.45	°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=40A	T_J=25°C	-	1.85	2.4	V
			T_J=125°C	-	2.2	-	
			T_J=150°C	-	2.3	-	
$V_{GE(th)}$	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°C	-	-	10	µA
			T_J=125°C	-	-	600	
			T_J=150°C	-	-	3000	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±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			-	200	-	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 ⩾ 1.0s	V_{GE}=15V, V_{CE}=400V, R_G=25Ω		-	140	-	A
R_g	Gate resistance	f=1MHz		-	1.45	-	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=40A, R_G=7.5Ω, Parasitic Inductance=150nH Eon and Etotal include diode (AOK40B60D1) reverse recovery		-	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
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=40A, R_G=7.5Ω, Parasitic Inductance=150nH Eon and Etotal include diode (AOK40B60D1) reverse recovery		-	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

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

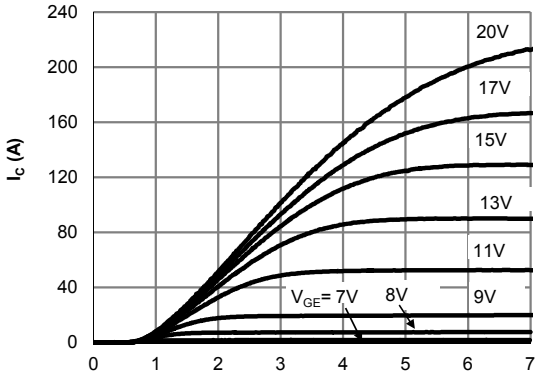

Figure 1: Output Characteristic (T_j=25°C)

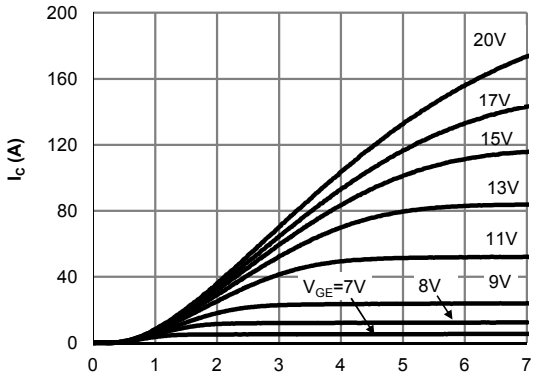

Figure 2: Output Characteristic (T_j=150°C)

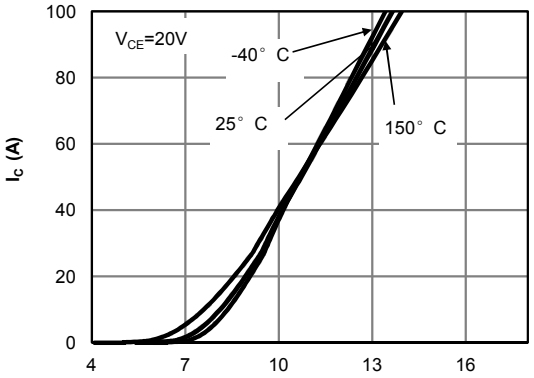

Figure 3: Transfer Characteristic

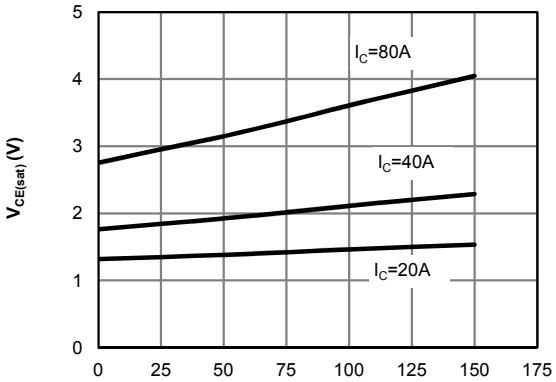

Figure 4: Collector-Emitter Saturation Voltage vs. Junction Temperature

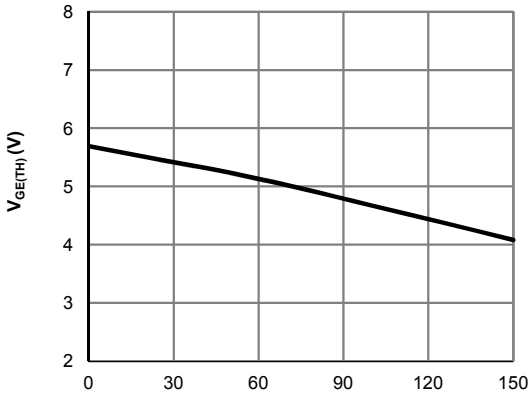

Figure 5: $V_{GE(TH)}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

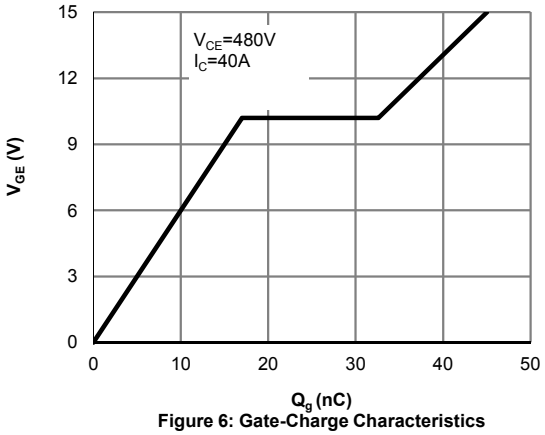

Figure 6: Gate-Charge Characteristics

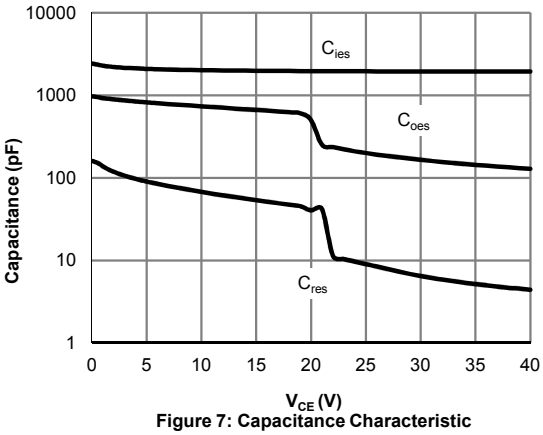

Figure 7: Capacitance Characteristic

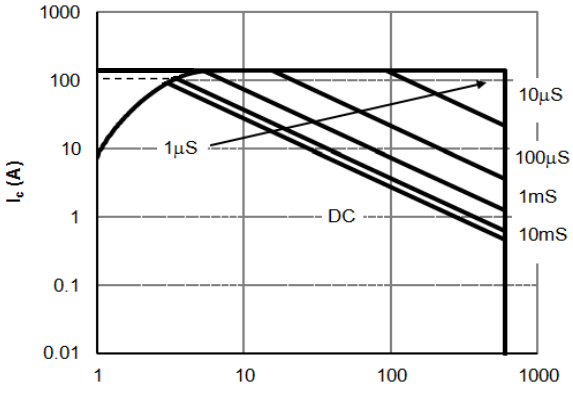

Figure 8: Forward Bias Safe Operating Area
(T_C=25C, V_{GE}=15V)

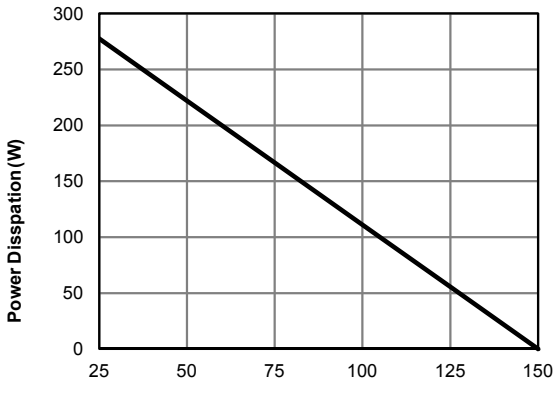

Figure 9: Power Disspation as a Function of Case

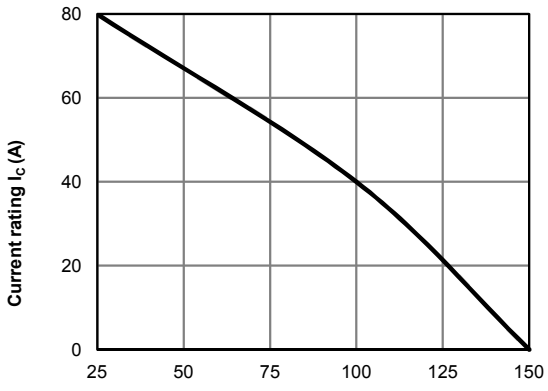

Figure 10: Current De-rating

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

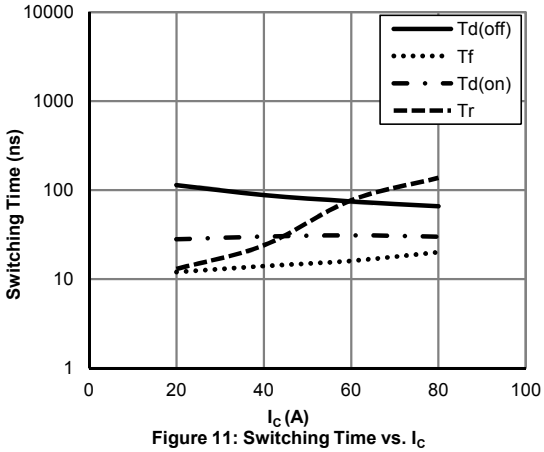

Figure 11: Switching Time vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=7.5Ω)

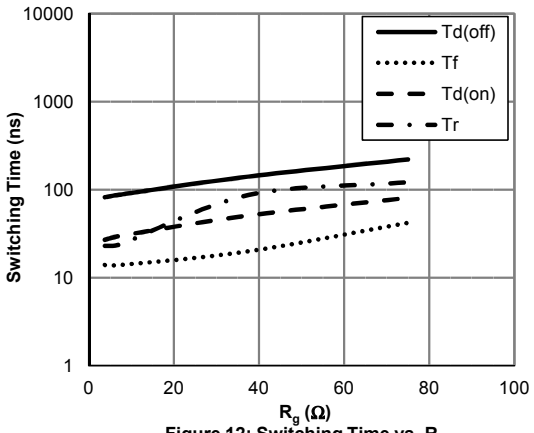

Figure 12: Switching Time vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=40A)

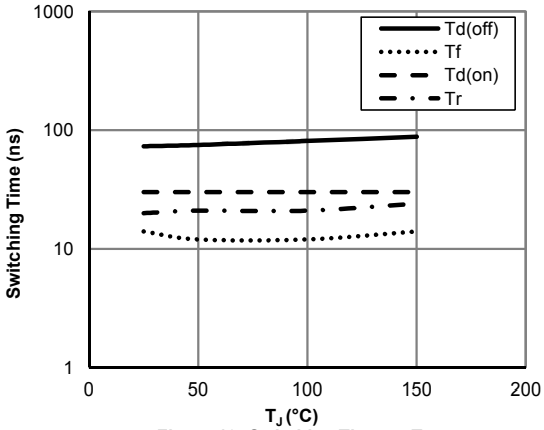

Figure 13: Switching Time vs.T_j
(V_{GE}=15V, V_{CE}=400V, I_C=40A, R_g=7.5Ω)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

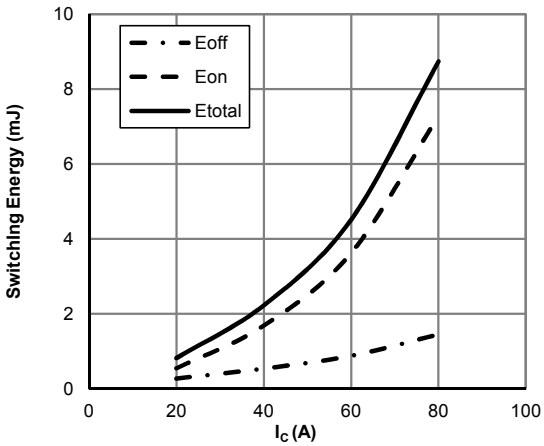

Figure 14: Switching Loss vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=7.5Ω)

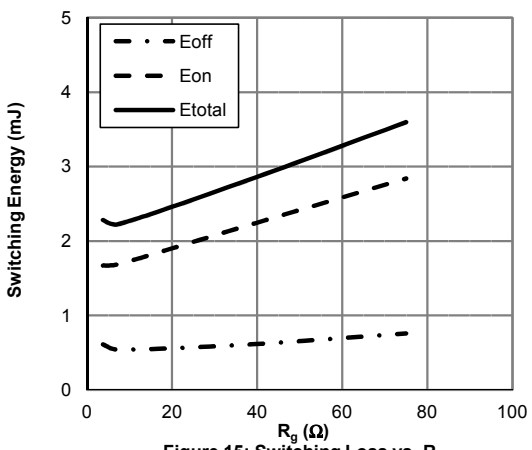

Figure 15: Switching Loss vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=40A)

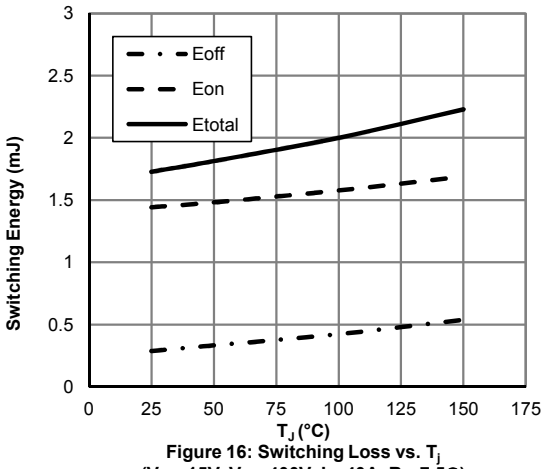

Figure 16: Switching Loss vs. T_j
(V_{GE}=15V, V_{CE}=400V, I_C=40A, R_g=7.5Ω)

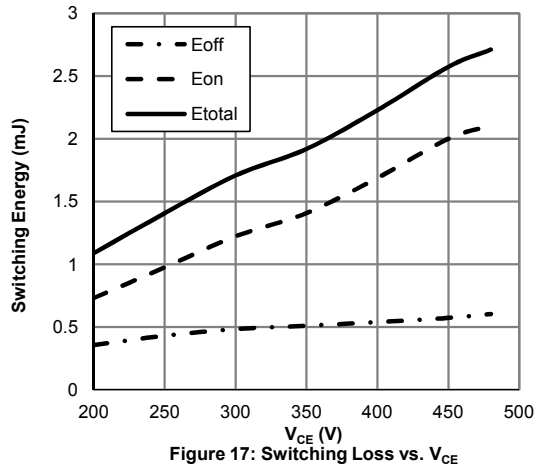

Figure 17: Switching Loss vs. V_{CE}
(T_j=150°C, V_{GE}=15V, I_C=40A, R_g=7.5Ω)

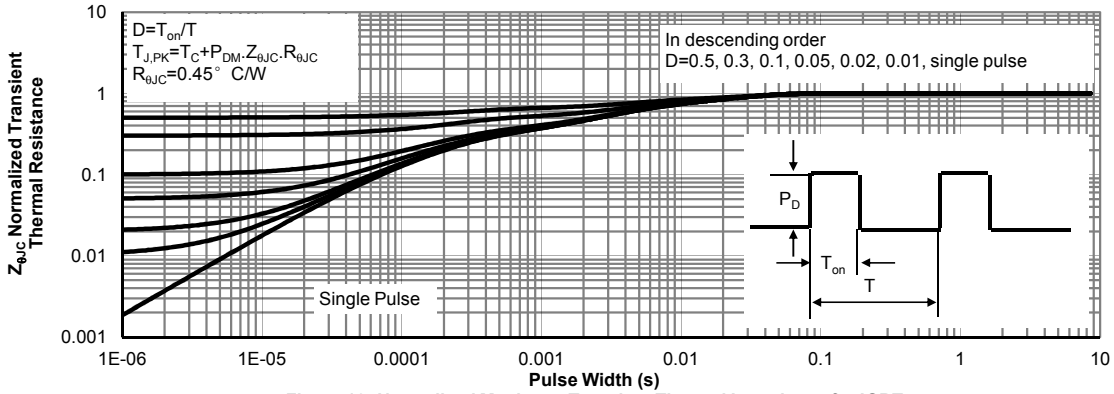

Figure 18: Normalized Maximum Transient Thermal Impedance for IGBT

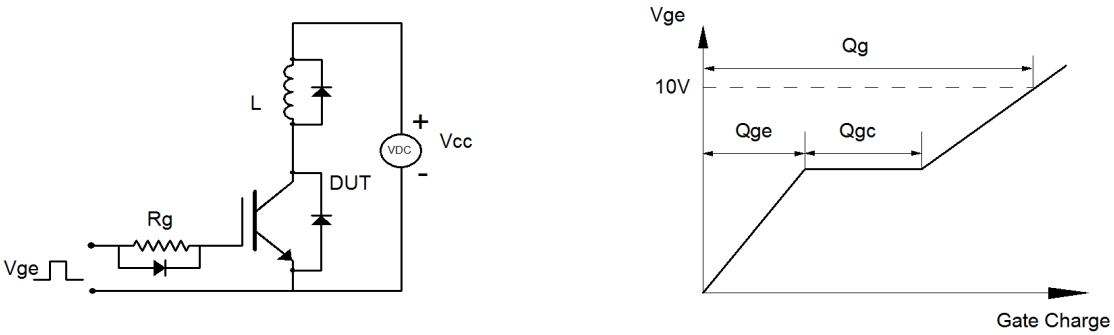

Figure A: Gate Charge Test Circuit & Waveforms

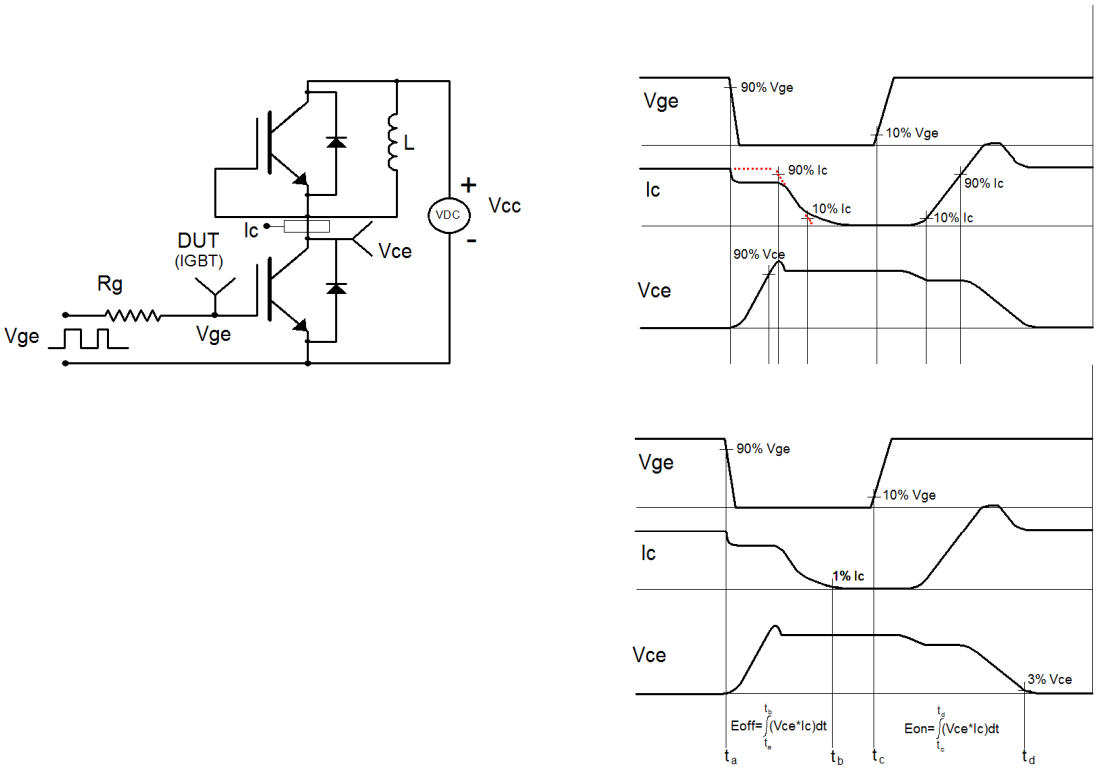

Figure B: Inductive Switching Test Circuit & Waveforms