ALPHA & OMEGA SEMICONDUCTOR

AOK40R65H3

650V, 40A Alpha RC-IGBT™ with Monolithic Body Diode

General Description

- Latest Alpha RC-IGBT (α RC-IGBT) technology
- Best in class $V_{CE(SAT)}$ enables high efficiencies
- Low turn-off switching loss
- Very smooth turn-off current waveforms reduce EMI
- Better thermal management
- High surge current capability
- Minimal gate spike due to high input capacitance

General PFC Applications

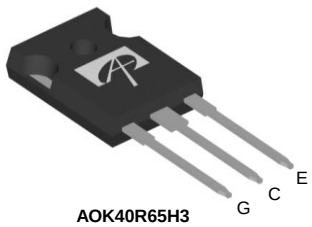
- PFC for Heat-pump
- PFC for Air-conditioner

Product Summary

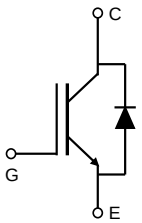
V_{CE}	650V
I_C (T_C=100°C)	40A
$V_{CE(sat)}$ (T_J=25°C)	1.78V

RoHS Compliant

TO-247



AOK40R65H3



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK40R65H3	TO247	Tube	240

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOK40R65H3	Units
Collector-Emitter Voltage		V_{CE}	650	V
Gate-Emitter Voltage		V_{GE}	±30	V
Continuous Collector Current	T_C=25°C	I_C	69	A
	T_C=100°C		40	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	120	A
Turn off SOA, V_{CE}≤650V, Limited by T_{Jmax}		I_{LM}	120	A
Continuous Diode Forward Current	T_C=25°C	I_F	10	A
	T_C=100°C		5	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	15	A
Power Dissipation	T_C=25°C	P_D	200	W
	T_C=100°C		100	
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	AOK40R65H3	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.75	°C/W
Maximum Diode Junction-to-Case	$R_{\theta JC}$	1	°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		650	-	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=40A	T_J=25°C	-	1.78	2.1	V
			T_J=125°C	-	2	-	
			T_J=175°C	-	2.1	-	
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=5A	T_J=25°C	-	1.79	2.2	V
			T_J=125°C	-	2.06	-	
			T_J=175°C	-	2.26	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE}=5V, I_C=1mA		-	4.4	-	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE}=650V, V_{GE}=0V	T_J=25°C	-	-	10	µA
			T_J=150°C	-	-	200	
			T_J=175°C	-	-	1500	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±30V		-	-	±100	nA
g_{FS}	Forward Transconductance	V_{CE}=20V, I_C=40A		-	42	-	S
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CC}=25V, f=1MHz		-	3140	-	pF
C_{oes}	Output Capacitance			-	46	-	pF
C_{res}	Reverse Transfer Capacitance			-	40	-	pF
Q_g	Total Gate Charge	V_{GE}=15V, V_{CC}=520V, I_C=40A		-	158	-	nC
Q_{ge}	Gate to Emitter Charge			-	20	-	nC
Q_{gc}	Gate to Collector Charge			-	55	-	nC
R_g	Gate Resistance	V_{GE}=0V, V_{CC}=0V, f=1MHz		-	6.8	-	Ω
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=25°C V_{GE}=15V, V_{CC}=400V, I_C=40A, R_G=7.5Ω Include diode (AOGF30D65L1L) reverse recovery		-	36	-	ns
t_r	Turn-On Rise Time			-	27	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	252	-	ns
t_f	Turn-Off Fall Time			-	16	-	ns
E_{on}	Turn-On Energy			-	0.83	-	mJ
E_{off}	Turn-Off Energy			-	0.41	-	mJ
E_{total}	Total Switching Energy			-	1.24	-	mJ
SWITCHING PARAMETERS, (Load Inductive, T_J=175°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=175°C V_{GE}=15V, V_{CC}=400V, I_C=40A, R_G=7.5Ω Include diode (AOGF30D65L1L) reverse recovery		-	36	-	ns
t_r	Turn-On Rise Time			-	29	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	275	-	ns
t_f	Turn-Off Fall Time			-	21	-	ns
E_{on}	Turn-On Energy			-	1.03	-	mJ
E_{off}	Turn-Off Energy			-	0.55	-	mJ
E_{total}	Total Switching Energy			-	1.57	-	mJ

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

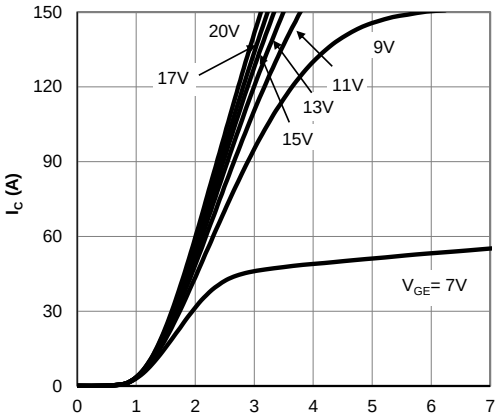

Figure 1: Output Characteristic (T_j=25°C)

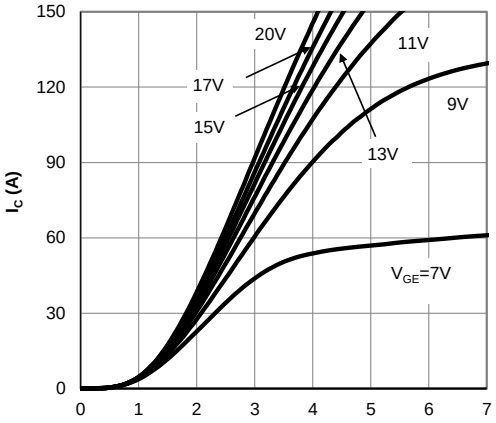

Figure 2: Output Characteristic (T_j=175°C)

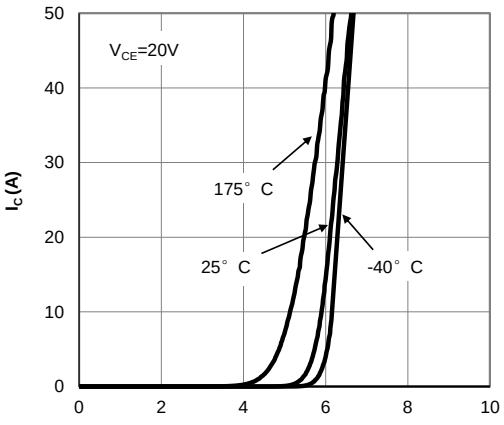

Figure 3: Transfer Characteristic

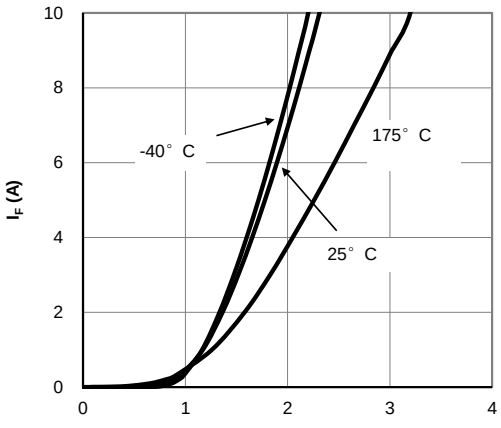

Figure 4: Diode Characteristic

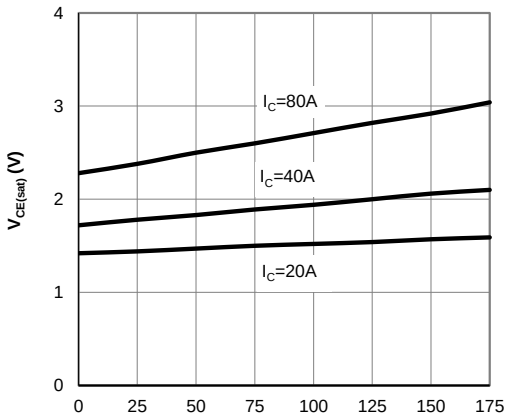

Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

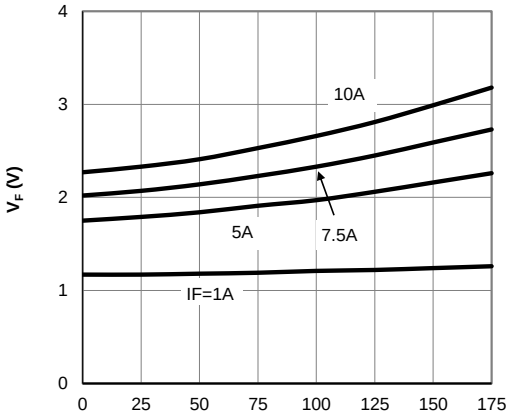

Figure 6: Diode Forward voltage vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

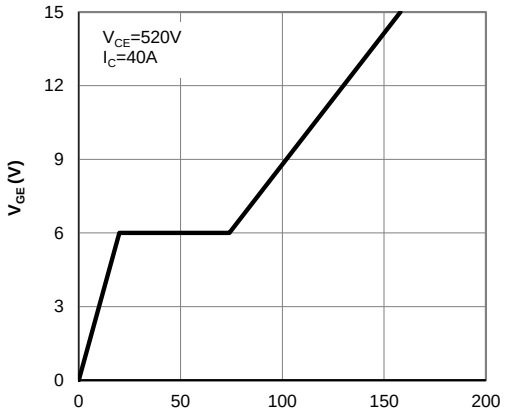

Figure 7: Gate-Charge Characteristics

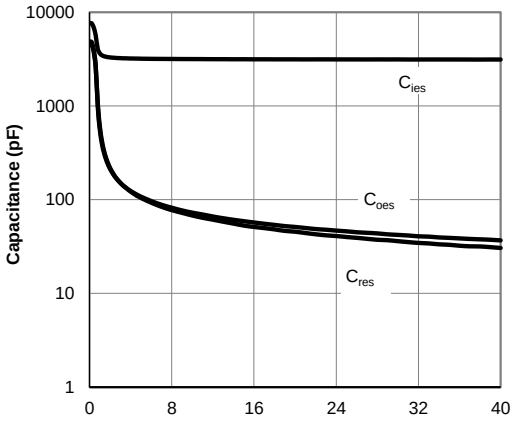

Figure 8: Capacitance Characteristic

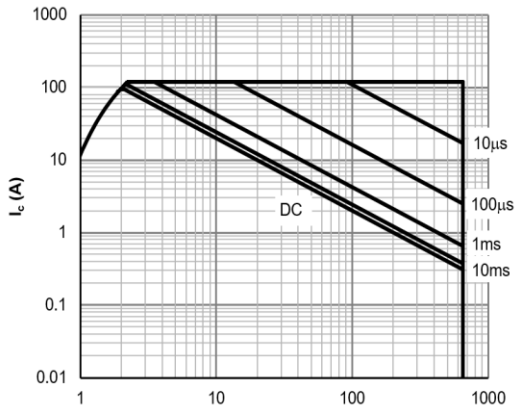

Figure 9: Forward Bias Safe Operating Area (T_C=25°C, V_{GE}=15V)

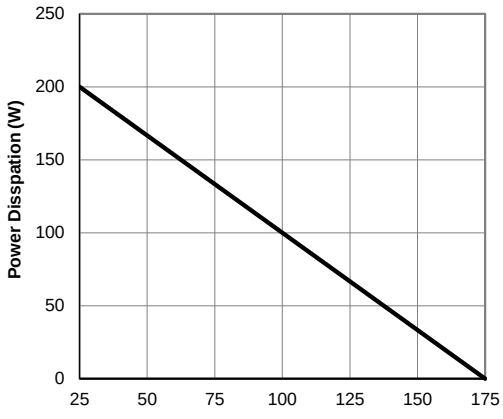

Figure 10: Power Disspation as a Function of

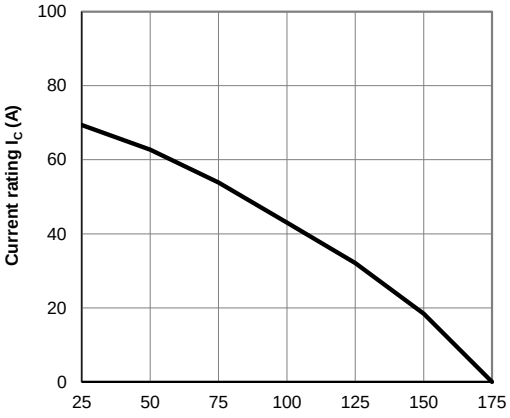

Figure 11: Current De-rating

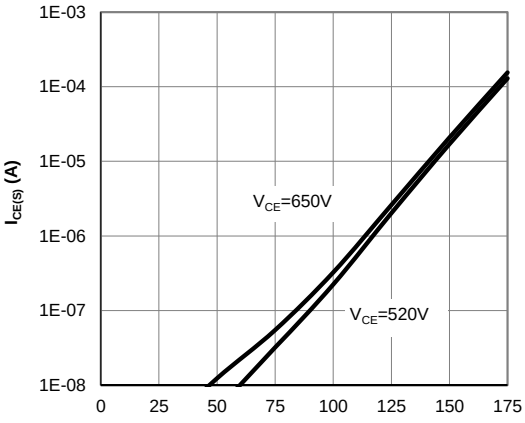

Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

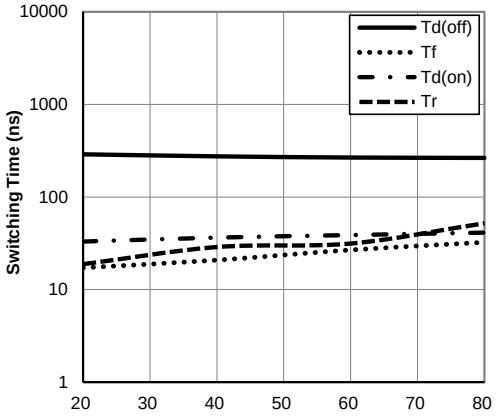

Figure 13: Switching Time vs. I_C
(T_j=175°C, V_{GE}=15V, V_{CE}=400V, R_g=7.5Ω)

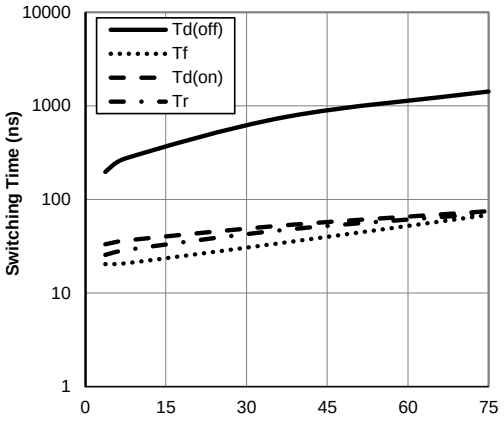

Figure 14: Switching Time vs. R_g
(T_j=175°C, V_{GE}=15V, V_{CE}=400V, I_C=40A)

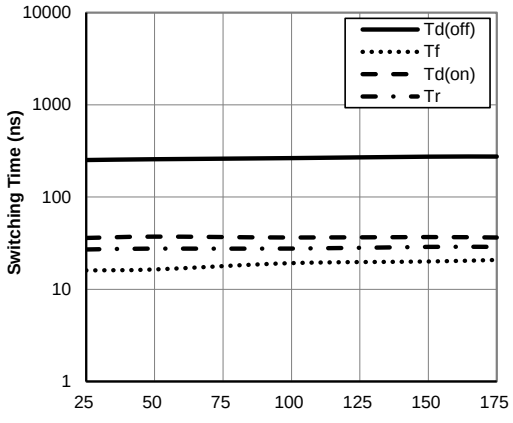

Figure 15: Switching Time vs.T_j
(V_{GE}=15V, V_{CE}=400V, I_C=40A, R_g=7.5Ω)

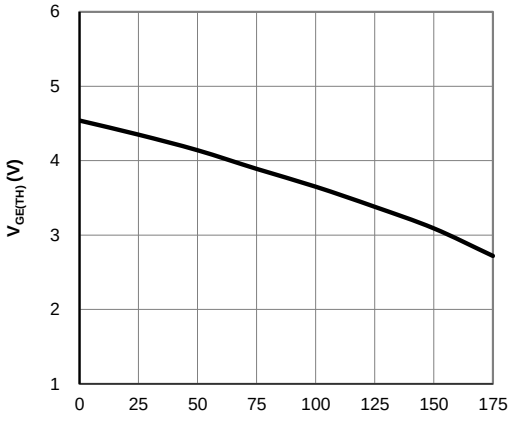

Figure 16: $V_{GE(TH)}$ vs. T_j

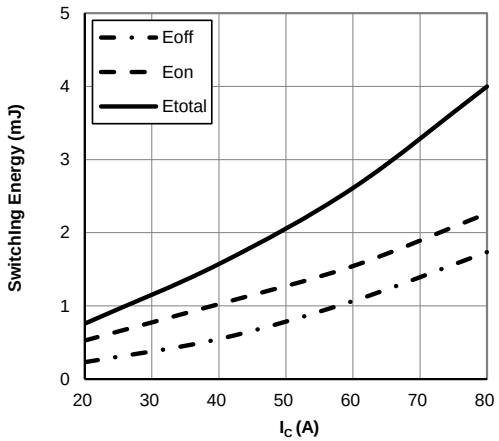

Figure 17: Switching Loss vs. I_C
(T_j=175°C, V_{GE}=15V, V_{CE}=400V, R_g=7.5Ω)

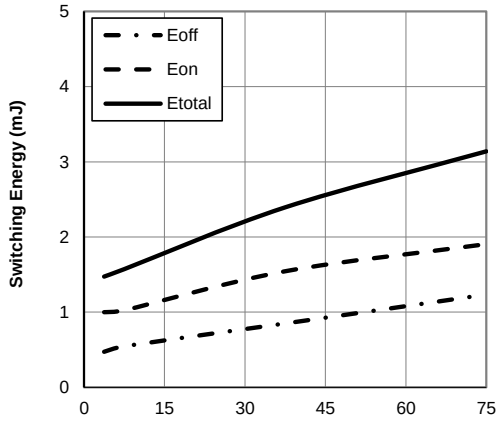

Figure 18: Switching Loss vs. R_g
(T_j=175°C, V_{GE}=15V, V_{CE}=400V, I_C=40A)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

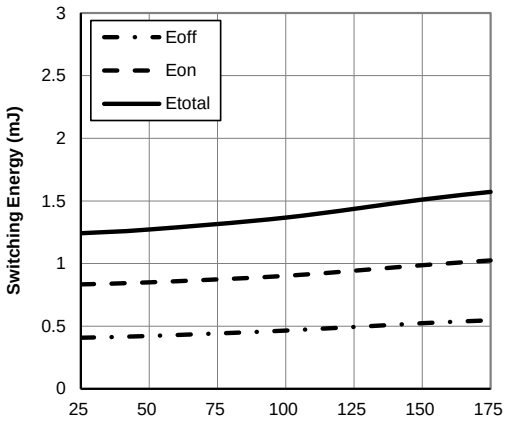

Figure 19: Switching Loss vs. T_j
(V_{GE}=15V, V_{CE}=400V, I_C=40A, R_g=7.5Ω)

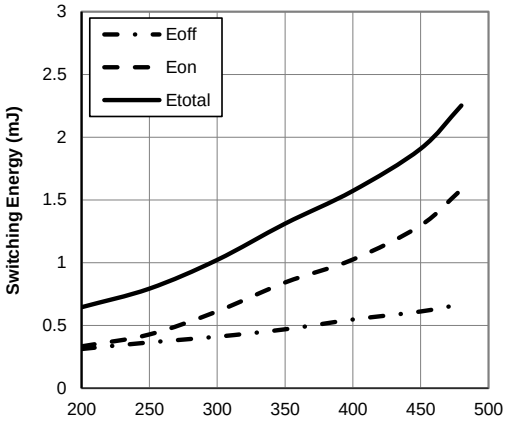

Figure 20: Switching Loss vs. V_{CE}
(T_j=175°C, V_{GE}=15V, I_C=40A, R_g=7.5Ω)

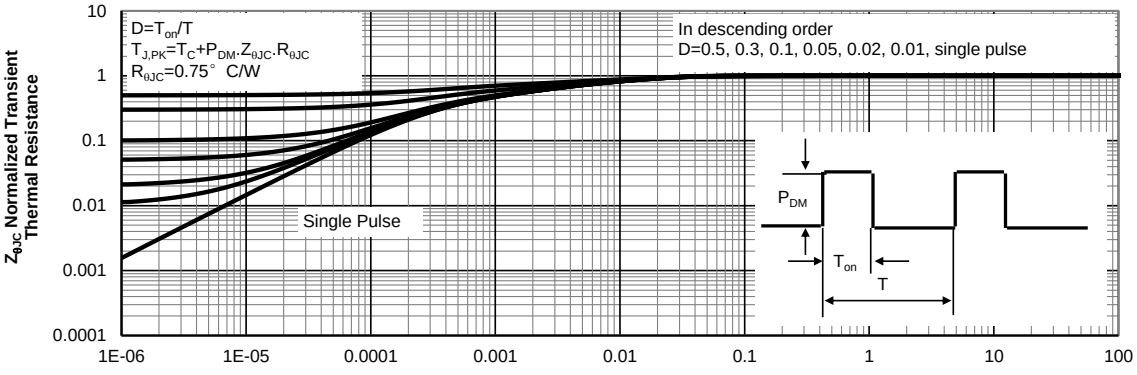

Figure 21: Normalized Maximum Transient Thermal Impedance for IGBT

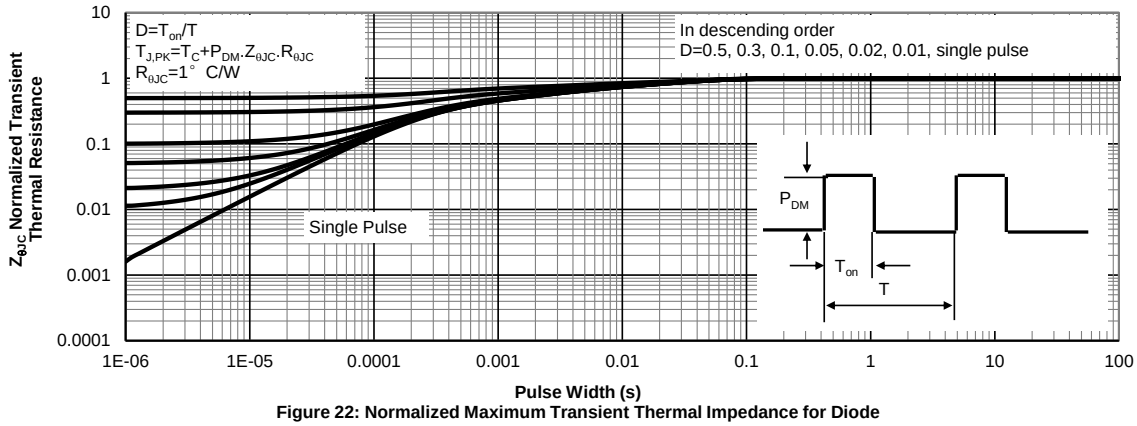

Figure 22: Normalized Maximum Transient Thermal Impedance for Diode

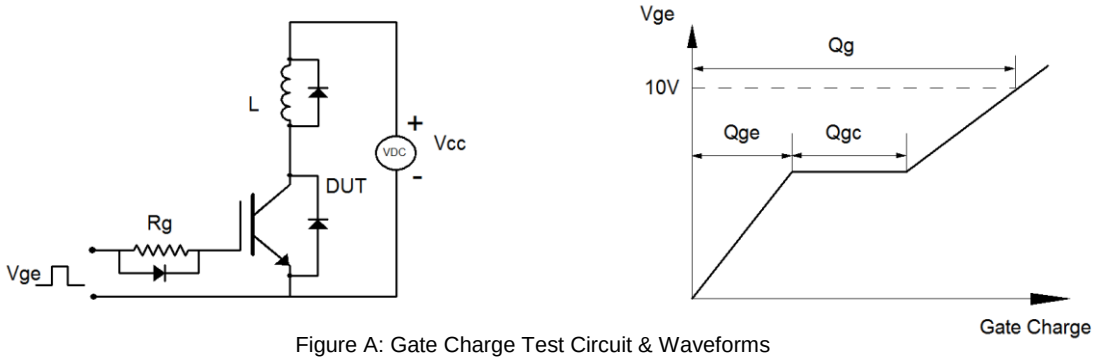

Figure A: Gate Charge Test Circuit & Waveforms

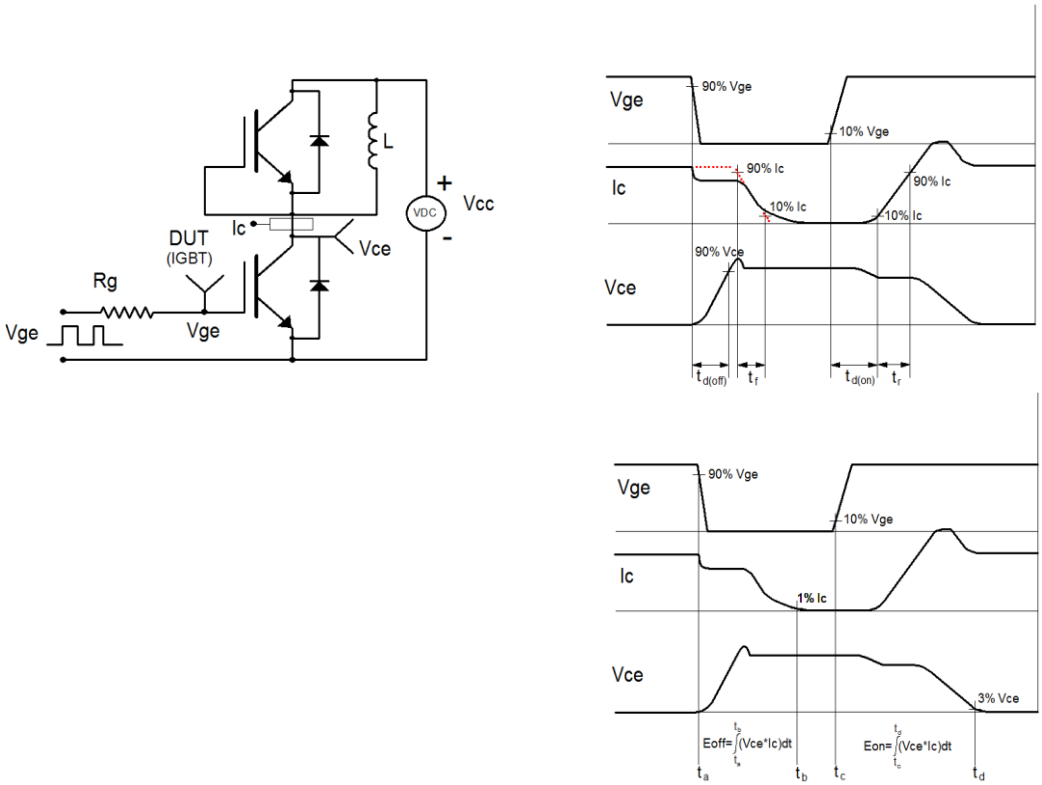

Figure B: Inductive Switching Test Circuit & Waveforms

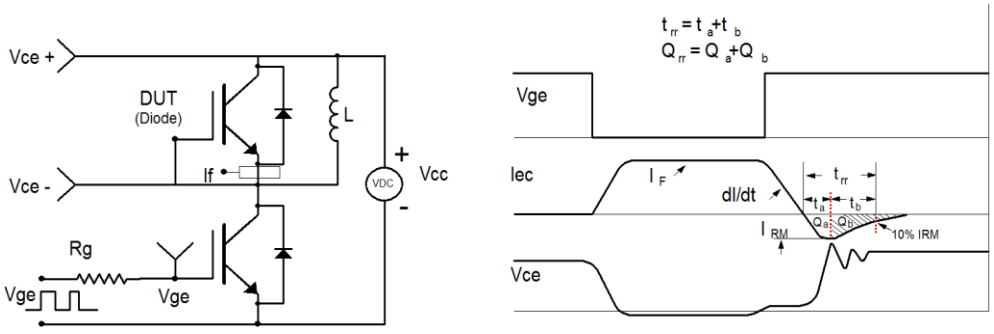

Figure C: Diode Recovery Test Circuit & Waveforms