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AOD5B65MQ1E

650V, 5A AlphaIGBT™

With Soft and Fast Recovery Anti-Parallel Diode

General Description

- Latest AlphaIGBT (αIGBT) technology
- 650V breakdown voltage
- IGBT copacked with very fast and soft antiparallel diode
- Very good EMI performance with lower turn-on switching losses
- High short-circuit ruggedness
- High HBM class

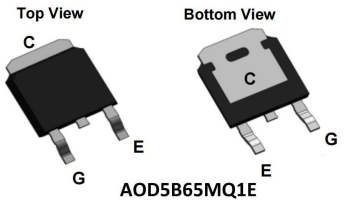
Applications

- Motor drives
- Home appliance applications
- Other hard switching applications

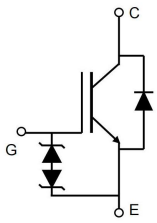
Product Summary

V_{CE}	650V
I_C (T_C=100°C)	5A
$V_{CE(sat)}$ (T_J=25°C)	2.15V
Typical ESD protection	**HBM Class 2**

TO-252
DPAK



AOD5B65MQ1E



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOD5B65MQ1E	TO252	Tape & Reel	2500

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOD5B65MQ1E	Units
Collector-Emitter Voltage		V_{CE}	650	V
Gate-Emitter Voltage		V_{GE}	±20	V
Continuous Collector Current	T_C=25°C	I_C	10	A
	T_C=100°C		5	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	15	A
Turn-Off SOA, V_{CE}≤650V, Limited by T_{Jmax}		I_{LM}	15	A
Continuous Diode Forward Current	T_C=25°C	I_F	10	A
	T_C=100°C		4	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	15	A
Short Circuit Withstanding Time (1) V_{GE}=15V, V_{CC}≤400V, T_J≤150°C		t_{SC}	5	μs
Power Dissipation	T_C=25°C	P_D	52	W
	T_C=100°C		21	
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	AOD5B65MQ1E	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	55	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	2.4	°C/W
Maximum Diode Junction-to-Case	$R_{\theta JC}$	6.8	°C/W

(1) Allowed number of short circuits: <1000; time between short circuits: >1s.

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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=5A	T_J=25°C	-	2.15	2.7	V
			T_J=125°C	-	2.74	-	
			T_J=150°C	-	2.89	-	
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=5A	T_J=25°C	-	2.06	2.6	V
			T_J=125°C	-	2.17	-	
			T_J=150°C	-	2.13	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE}=5V, I_C=1mA		4.2	5.1	5.6	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE}=650V, V_{GE}=0V	T_J=25°C	-	-	10	μA
			T_J=125°C	-	-	100	
			T_J=150°C	-	-	500	
I_{GES}	Gate-Emitter Leakage Current	V_{CE}=0V, V_{GE}=±20V		-	-	±10	μA
g_{FS}	Forward Transconductance	V_{CE}=20V, I_C=5A		-	2	-	S
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CC}=25V, f=1MHz		-	235	-	pF
C_{oes}	Output Capacitance			-	22	-	pF
C_{res}	Reverse Transfer Capacitance			-	5	-	pF
Q_g	Total Gate Charge	V_{GE}=15V, V_{CC}=520V, I_C=5A		-	8.8	-	nC
Q_{ge}	Gate to Emitter Charge			-	2.6	-	nC
Q_{gc}	Gate to Collector Charge			-	3.4	-	nC
$I_{C(SC)}$	Short Circuit Collector Current	V_{GE}=15V, V_{CC}=400V, t_{sc}≤5us, T_J≤150°C		-	20	-	A
R_g	Gate Resistance	V_{GE}=0V, V_{CC}=0V, f=1MHz		-	20	-	Ω
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On Delay Time	T_J=25°C, V_{GE}=15V, V_{CC}=400V, I_C=5A, R_G=60Ω		-	7	-	ns
t_r	Turn-On Rise Time			-	13	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	78	-	ns
t_f	Turn-Off Fall Time			-	20	-	ns
E_{on}	Turn-On Energy			-	0.09	-	mJ
E_{off}	Turn-Off Energy			-	0.06	-	mJ
E_{total}	Total Switching Energy			-	0.15	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=25°C, I_F=5A, di/dt=200A/μs, V_{CC}=400V		-	74	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.11	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	2.46	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=150°C)							
$t_{D(on)}$	Turn-On Delay Time	T_J=150°C, V_{GE}=15V, V_{CC}=400V, I_C=5A, R_G=60Ω		-	6.5	-	ns
t_r	Turn-On Rise Time			-	14	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	96	-	ns
t_f	Turn-Off Fall Time			-	34	-	ns
E_{on}	Turn-On Energy			-	0.10	-	mJ
E_{off}	Turn-Off Energy			-	0.10	-	mJ
E_{total}	Total Switching Energy			-	0.20	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=150°C, I_F=5A, di/dt=200A/μs, V_{CC}=400V		-	161	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.21	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	2.83	-	A

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

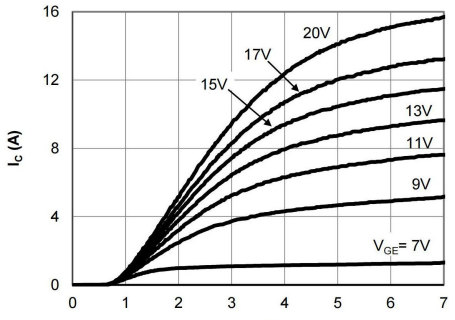


Figure 1: Output Characteristic (T_j=25°C)

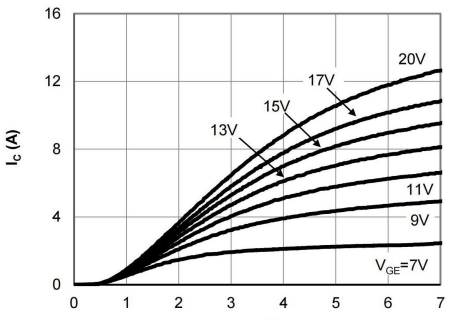


Figure 2: Output Characteristic (T_j=150°C)

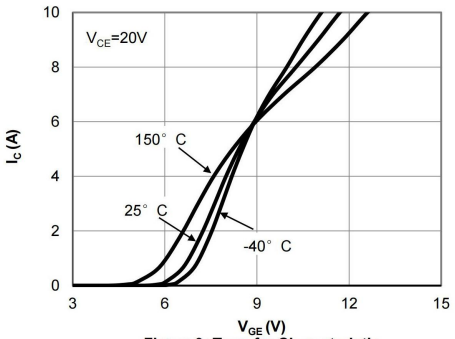


Figure 3: Transfer Characteristic

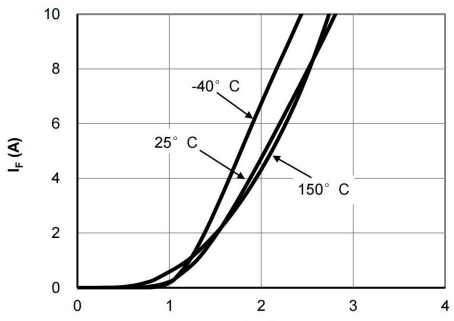


Figure 4: Diode Characteristic

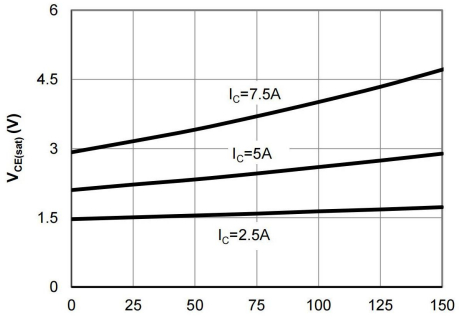


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

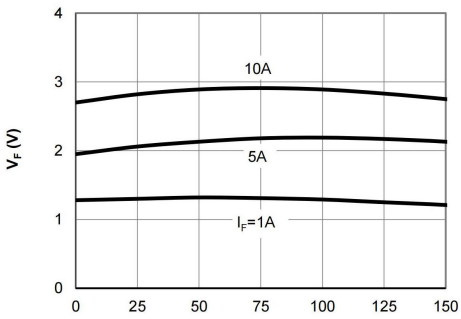


Figure 6: Diode Forward voltage vs. Junction Temperature

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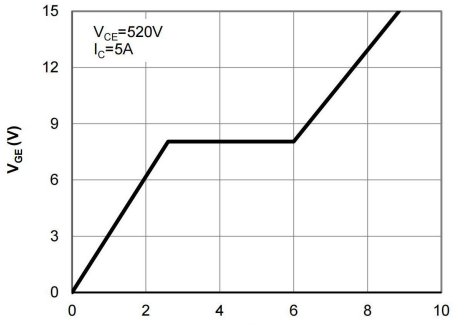


Figure 7: Gate-Charge Characteristics

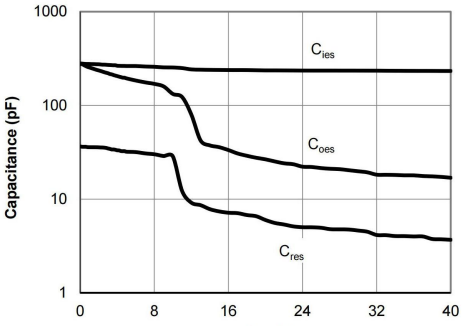


Figure 8: Capacitance Characteristic

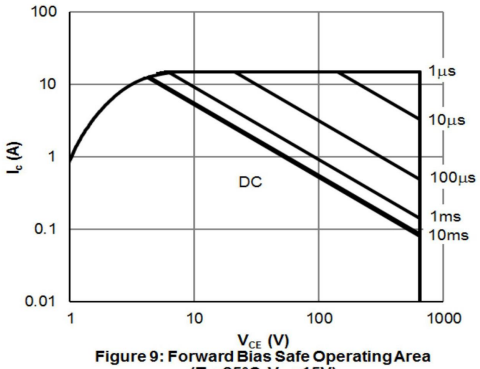


Figure 9: Forward Bias Safe Operating Area
(T_C=25°C, V_{GE}=15V)

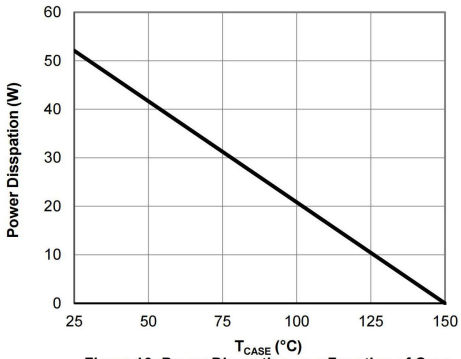


Figure 10: Power Disspation as a Function of Case

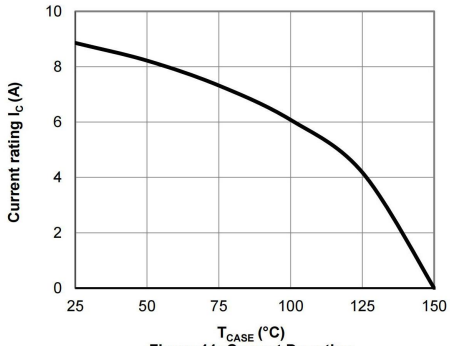


Figure 11: Current De-rating

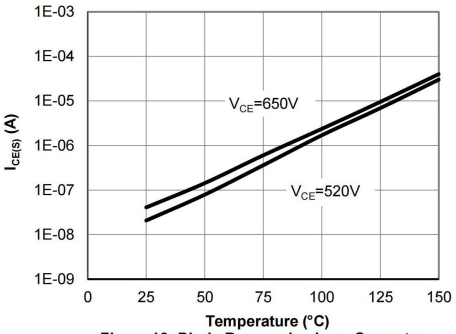


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

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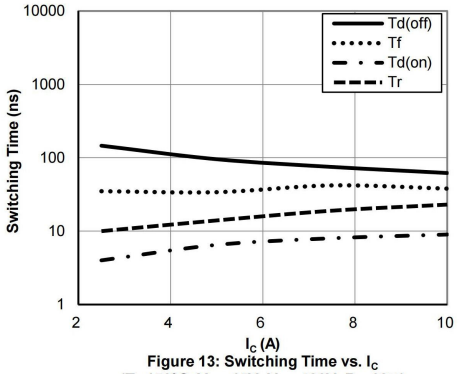


Figure 13: Switching Time vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=60Ω)

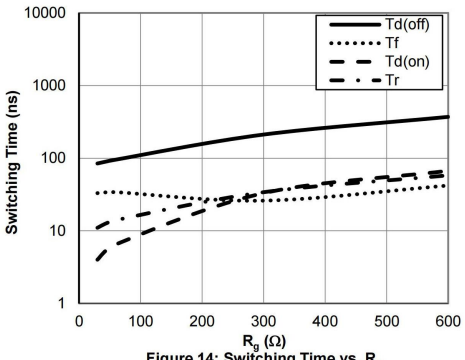


Figure 14: Switching Time vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=5A)

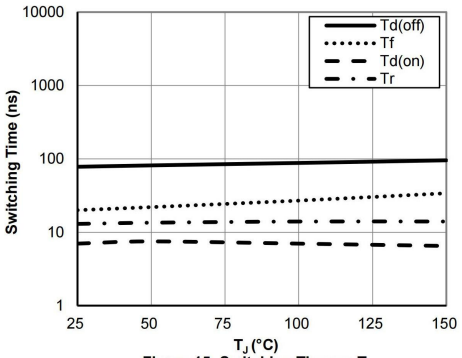


Figure 15: Switching Time vs.T_j
(V_{GE}=15V, V_{CE}=400V, I_C=5A, R_g=60Ω)

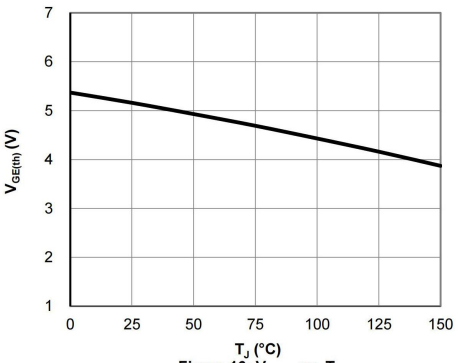


Figure 16: $V_{GE(th)}$ vs. T_j

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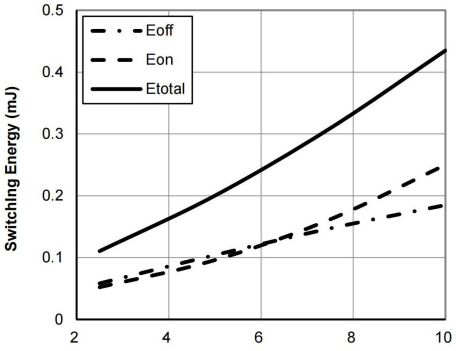


Figure 17: Switching Loss vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=60Ω)

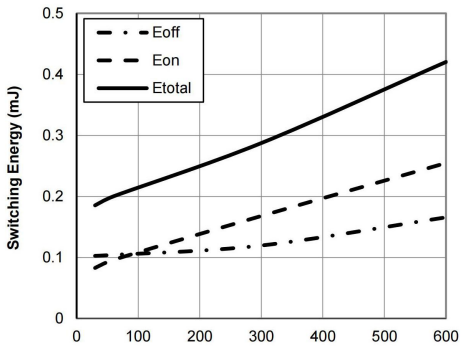


Figure 18: Switching Loss vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=5A)

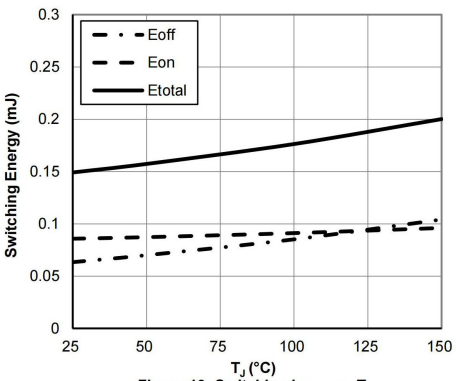


Figure 19: Switching Loss vs. T_j
(V_{GE}=15V, V_{CE}=400V, I_C=5A, R_g=60Ω)

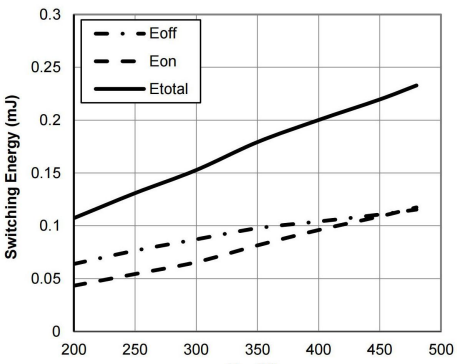


Figure 20: Switching Loss vs. V_{CE}
(T_j=150°C, V_{GE}=15V, I_C=5A, R_g=60Ω)

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

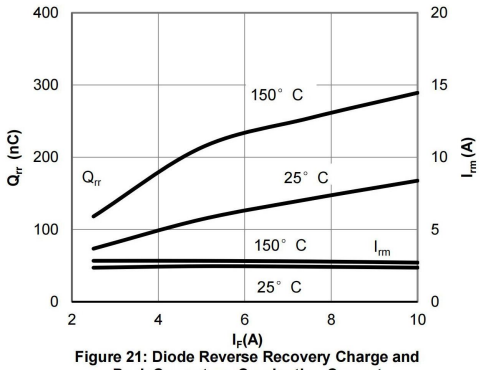


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current (V_{GE}=15V, V_{CE}=400V, di/dt=200A/μs)

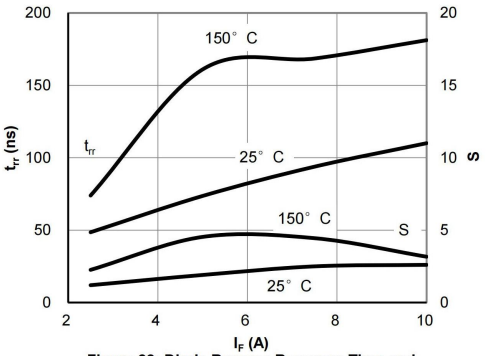


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current (V_{GE}=15V, V_{CE}=400V, di/dt=200A/μs)

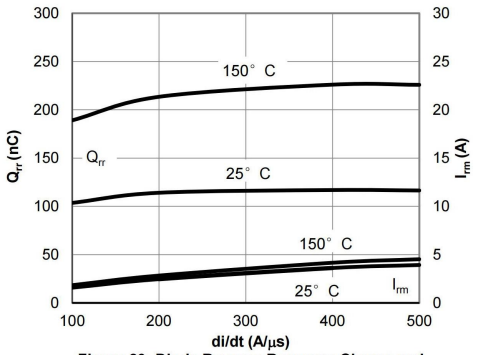


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt (V_{GE}=15V, V_{CE}=400V, I_F=5A)

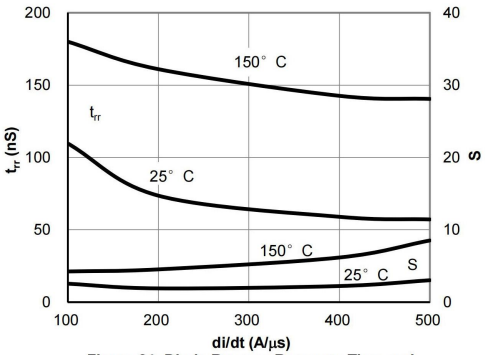


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt (V_{GE}=15V, V_{CE}=400V, I_F=5A)

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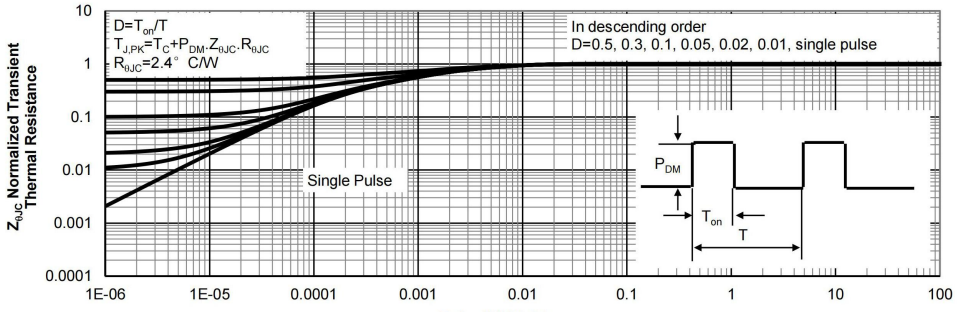


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

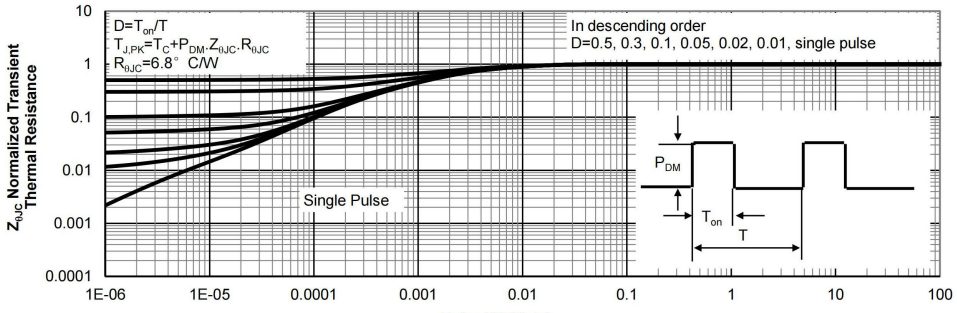


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

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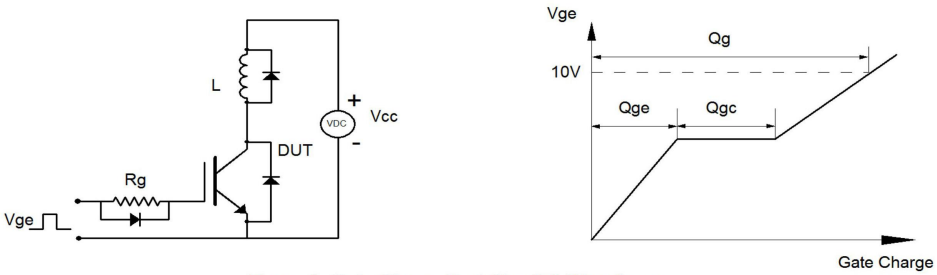


Figure A: Gate Charge Test Circuit & Waveforms

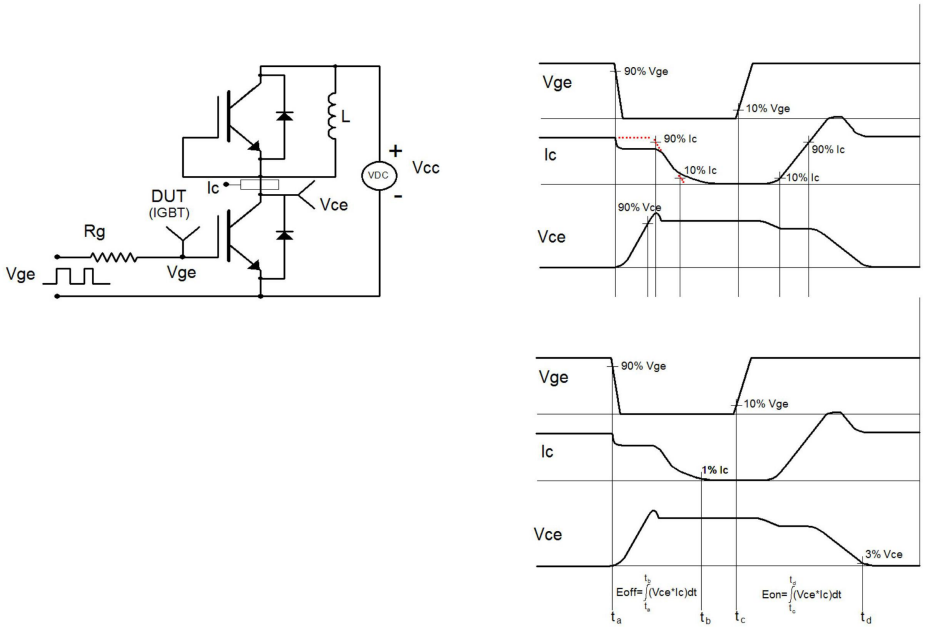


Figure B: Inductive Switching Test Circuit & Waveforms

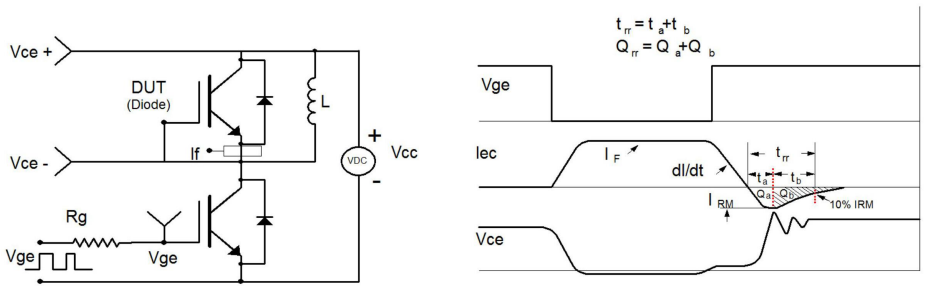


Figure C: Diode Recovery Test Circuit & Waveforms