

General Description

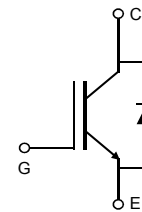
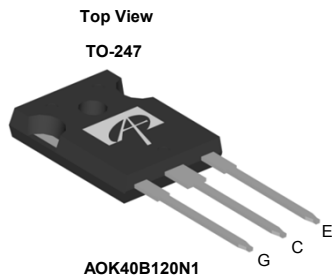
- 1200V latest Alpha IGBT (αIGBT) technology
- Very low $V_{CE(sat)}$ and V_F
- High short-circuit ruggedness
- Very low turn-on EMI
- Easy paralleling capability
- Low gate charge Q_g
- High efficiency and ruggedness in hard switching converters
- Maximum junction temperature 175°C
- Very soft and fast recovery anti-parallel diode

Applications

- Motor drives
- Industrial UPS

Product Summary

V_{CE}	1200V
I_C ($T_C=100^\circ\text{C}$)	40A
$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)	1.97V



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK40B120N1	TO247	Tube	240
Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted			
Parameter	Symbol	AOK40B120N1	Units
Collector-Emitter Voltage	V_{CE}	1200	V
Gate-Emitter Voltage	V_{GE}	± 30	V
Continuous Collector Current	I_C	$T_C=25^\circ\text{C}$	80
		$T_C=100^\circ\text{C}$	40
Pulsed Collector Current, Limited by T_{Jmax}	I_{CM}	160	A
Turn-Off SOA, $V_{CE} \leq 1200\text{V}$, Limited by T_{Jmax}	I_{LM}	160	A
Continuous Diode Forward Current	I_F	$T_C=25^\circ\text{C}$	80
		$T_C=100^\circ\text{C}$	40
Diode Pulsed Current, Limited by T_{Jmax}	I_{FM}	160	A
Short Circuit Withstanding Time ⁽¹⁾ $V_{GE}=15\text{V}$, $V_{CC} \leq 600\text{V}$, $T_J \leq 175^\circ\text{C}$	t_{SC}	10	μs
Power Dissipation	P_D	$T_C=25^\circ\text{C}$	600
		$T_C=100^\circ\text{C}$	300
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 175	$^\circ\text{C}$
Maximum Lead Temperature for Soldering Purpose, 1/8" from case for 5 seconds	T_L	300	$^\circ\text{C}$
Thermal Characteristics			
Parameter	Symbol	AOK40B120N1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	0.25	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	0.4	$^\circ\text{C/W}$

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

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	1200	-	-	V	
V _{CE(sat)}	Collector-Emitter Saturation Voltage	V _{GE} =15V, I _C =40A	T _J =25°C	-	1.97	2.5	V
			T _J =125°C	-	2.55	-	
			T _J =175°C	-	2.9	-	
V _F	Diode Forward Voltage	V _{GE} =0V, I _F =40A	T _J =25°C	-	1.53	2	V
			T _J =125°C	-	1.6	-	
			T _J =175°C	-	1.54	-	
V _{GE(th)}	Gate-Emitter Threshold Voltage	V _{CE} =5V, I _C =1mA	-	6.1	-	V	
I _{CES}	Zero Gate Voltage Collector Current	V _{CE} =1200V, V _{GE} =0V	T _J =25°C	-	-	10	μA
			T _J =125°C	-	-	2000	
			T _J =175°C	-	-	20000	
I _{GES}	Gate-Emitter Leakage Current	V _{CE} =0V, V _{GE} =±30V	-	-	±100	nA	
g _{FS}	Forward Transconductance	V _{CE} =20V, I _C =40A	-	18	-	S	
DYNAMIC PARAMETERS							
C _{ies}	Input Capacitance	V _{GE} =0V, V _{CC} =25V, f=1MHz	-	4300	-	pF	
C _{oes}	Output Capacitance		-	300	-	pF	
C _{res}	Reverse Transfer Capacitance		-	9	-	pF	
Q _g	Total Gate Charge	V _{GE} =15V, V _{CC} =960V, I _C =40A	-	100	-	nC	
Q _{ge}	Gate to Emitter Charge		-	48	-	nC	
Q _{gc}	Gate to Collector Charge		-	28	-	nC	
R _g	Gate Resistance		V _{GE} =0V, V _{CC} =0V, f=1MHz	-	4.4	-	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} =600V, I _C =40A, R _G =7.5Ω	-	57	-	ns	
t _r	Turn-On Rise Time		-	35	-	ns	
t _{D(off)}	Turn-Off Delay Time		-	146	-	ns	
t _f	Turn-Off Fall Time		-	42	-	ns	
E _{on}	Turn-On Energy		-	3.4	-	mJ	
E _{off}	Turn-Off Energy		-	1.4	-	mJ	
E _{total}	Total Switching Energy		-	4.8	-	mJ	
t _{rr}	Diode Reverse Recovery Time		T _J =25°C	-	300	-	ns
Q _{rr}	Diode Reverse Recovery Charge		I _F =40A, di/dt=200A/μs, V _{CC} =600V	-	3.0	-	μC
I _{rm}	Diode Peak Reverse Recovery Current		-	-	18.5	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=175°C)							
t _{D(on)}	Turn-On Delay Time	T _J =175°C V _{GE} =15V, V _{CC} =600V, I _C =40A, R _G =7.5Ω	-	54	-	ns	
t _r	Turn-On Rise Time		-	55	-	ns	
t _{D(off)}	Turn-Off Delay Time		-	168	-	ns	
t _f	Turn-Off Fall Time		-	73	-	ns	
E _{on}	Turn-On Energy		-	4.1	-	mJ	
E _{off}	Turn-Off Energy		-	1.9	-	mJ	
E _{total}	Total Switching Energy		-	6.0	-	mJ	
t _{rr}	Diode Reverse Recovery Time		T _J =175°C	-	490	-	ns
Q _{rr}	Diode Reverse Recovery Charge		I _F =40A, di/dt=200A/μs, V _{CC} =600V	-	6.6	-	μC
I _{rm}	Diode Peak Reverse Recovery Current		-	-	25.5	-	A

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

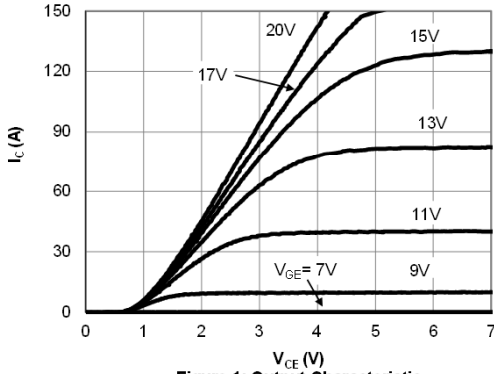


Figure 1: Output Characteristic (T_j=25°C)

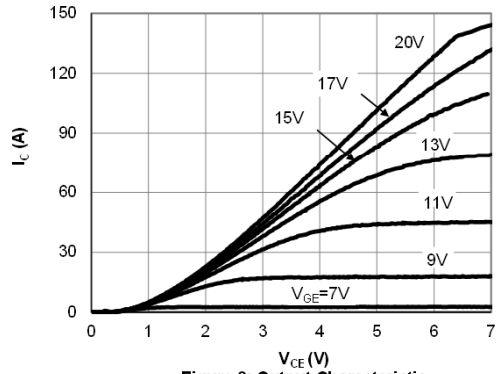


Figure 2: Output Characteristic (T_j=175°C)

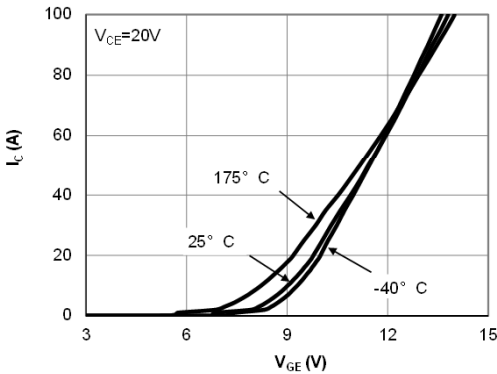


Figure 3: Transfer Characteristic

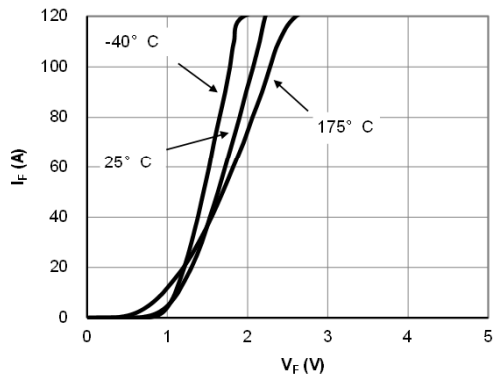


Figure 4: Diode Characteristic

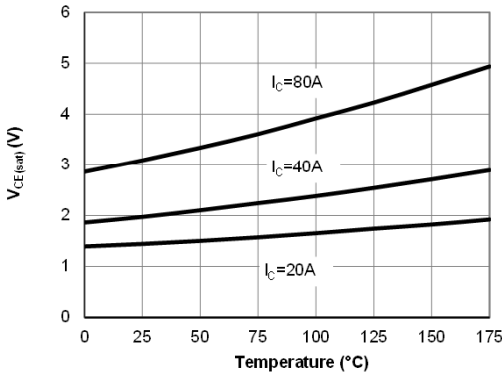


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

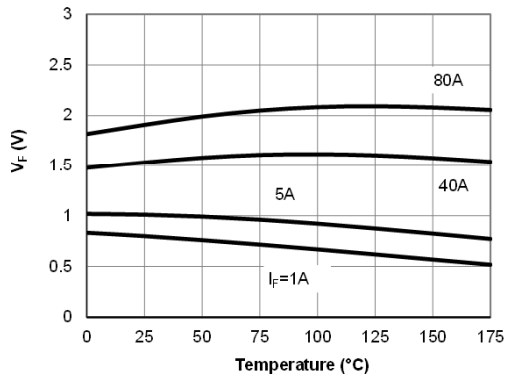


Figure 6: Diode Forward voltage vs. Junction Temperature

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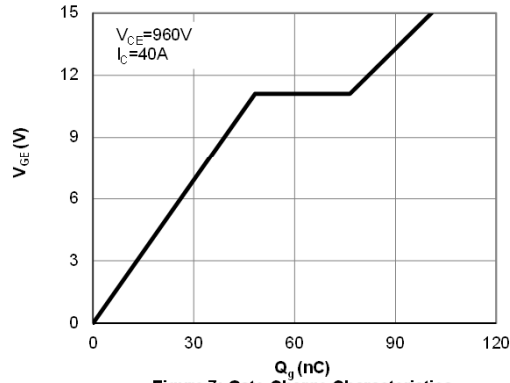


Figure 7: Gate-Charge Characteristics

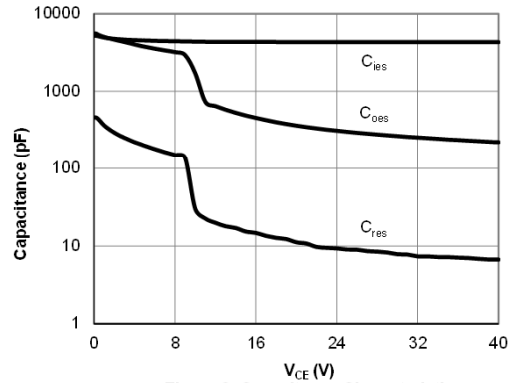


Figure 8: Capacitance Characteristic

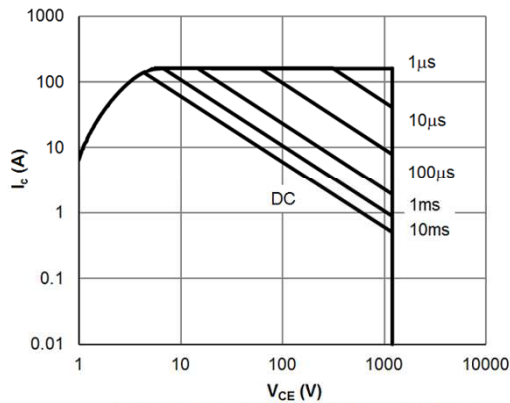


Figure 9: Forward Bias Safe Operating Area
($T_C=25^\circ\text{C}$, $V_{GE}=15\text{V}$)

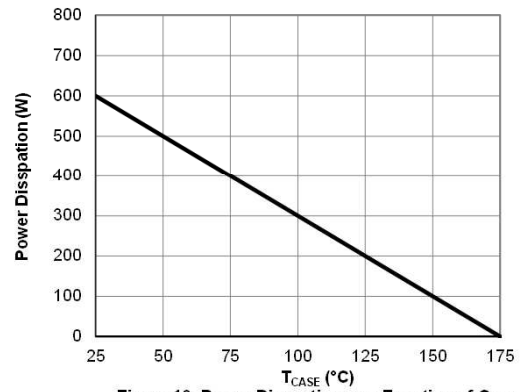


Figure 10: Power Dissipation as a Function of Case

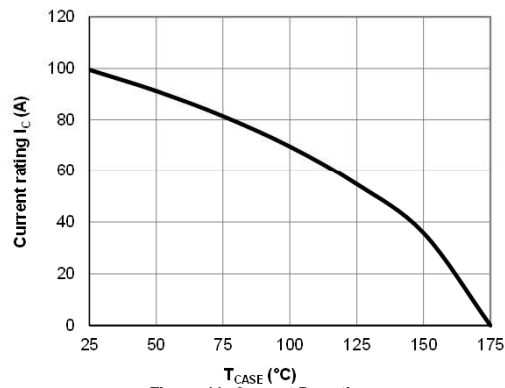


Figure 11: Current De-rating

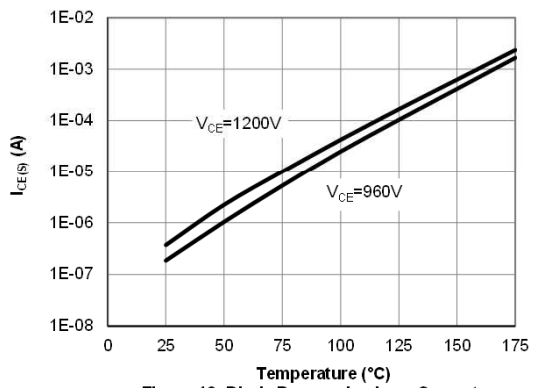


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

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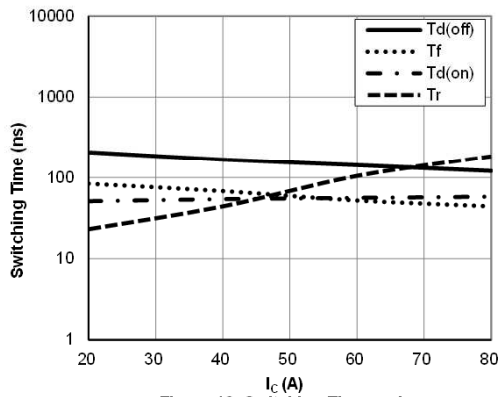


Figure 13: Switching Time vs. I_C
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $R_J=7.5\Omega$)

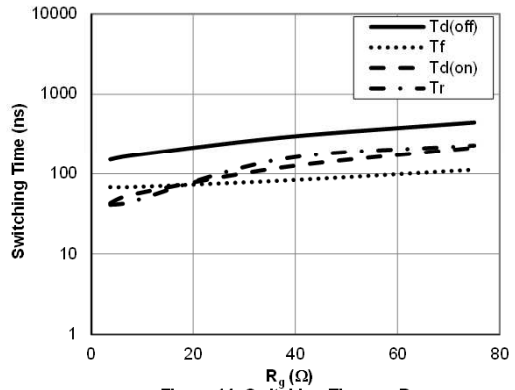


Figure 14: Switching Time vs. R_g
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$)

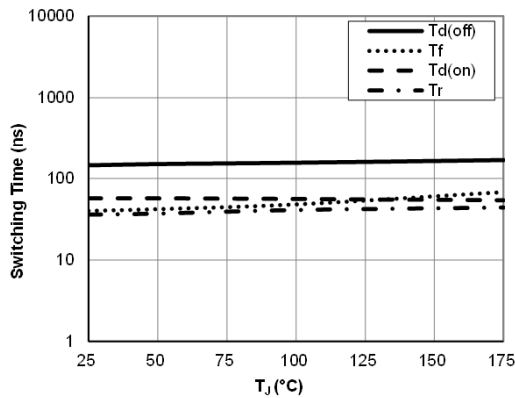


Figure 15: Switching Time vs. T_J
($V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$, $R_J=7.5\Omega$)

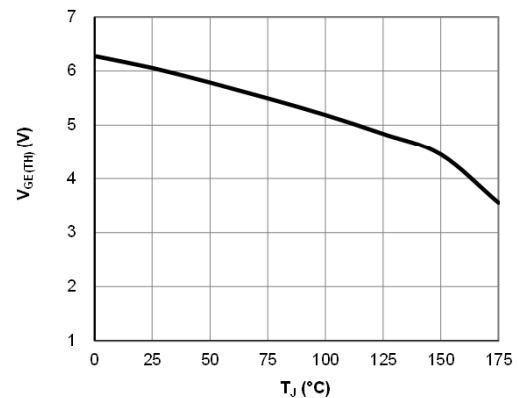


Figure 16: $V_{GE(TH)}$ vs. T_J

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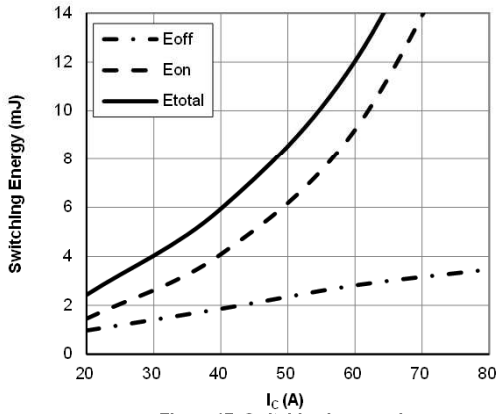


Figure 17: Switching Loss vs. I_C
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $R_g=7.5\Omega$)

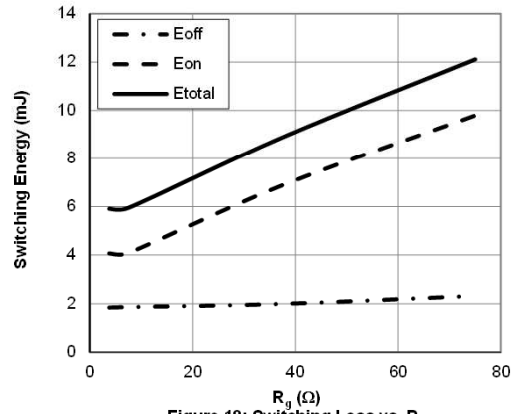


Figure 18: Switching Loss vs. R_g
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$)

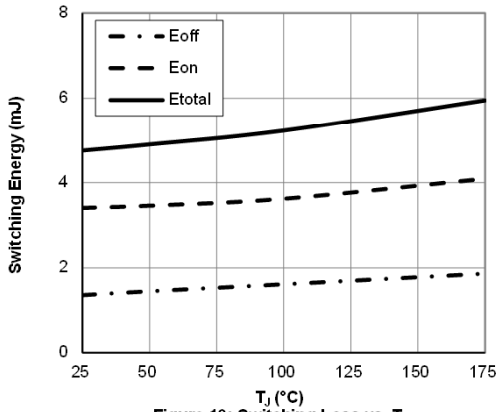


Figure 19: Switching Loss vs. T_J
($V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

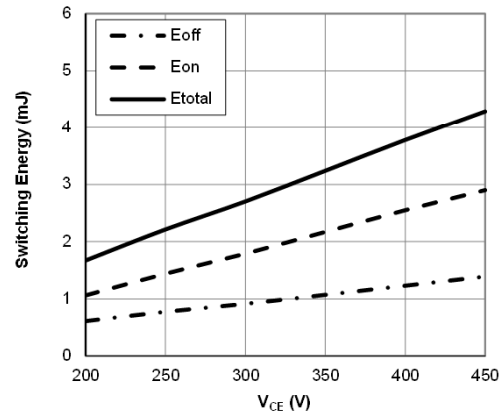


Figure 20: Switching Loss vs. V_{CE}
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

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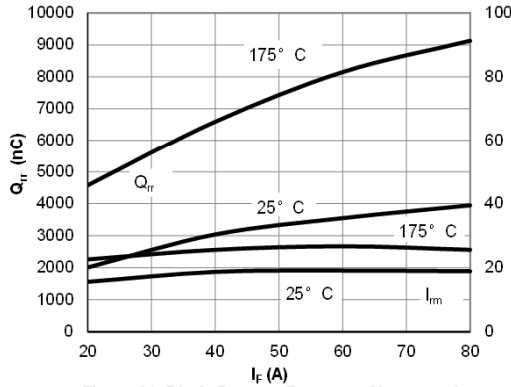


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V$, $V_{CE}=600V$, $di/dt=200A/\mu s$)

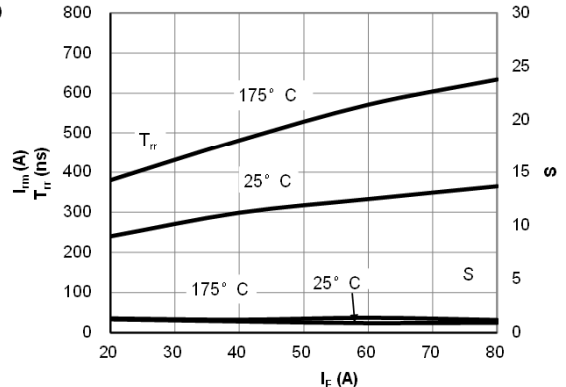


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V$, $V_{CE}=600V$, $di/dt=200A/\mu s$)

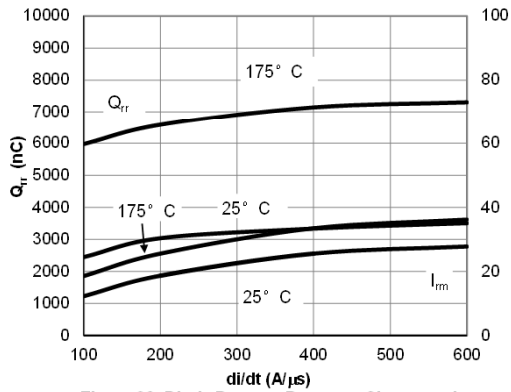


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V$, $V_{CE}=600V$, $I_F=40A$)

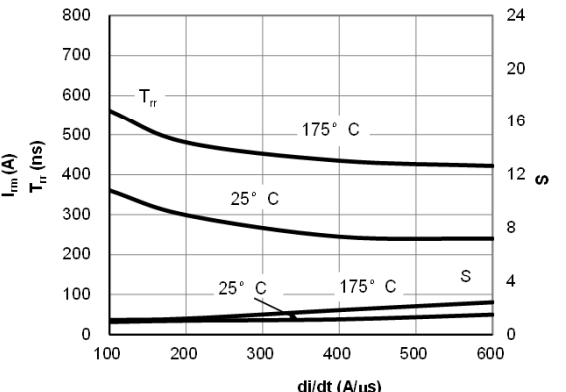


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V$, $V_{CE}=600V$, $I_F=40A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

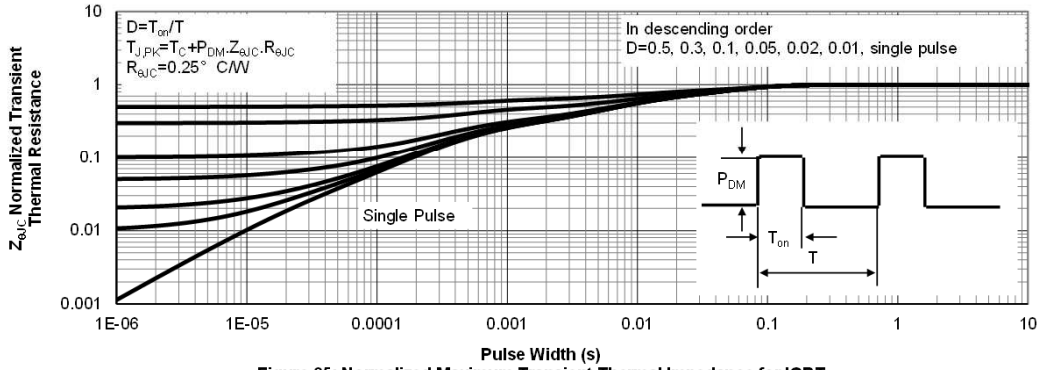


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

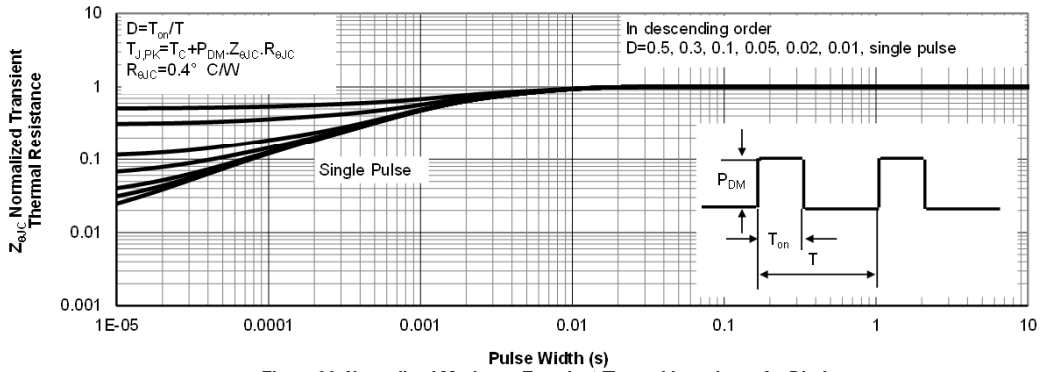


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

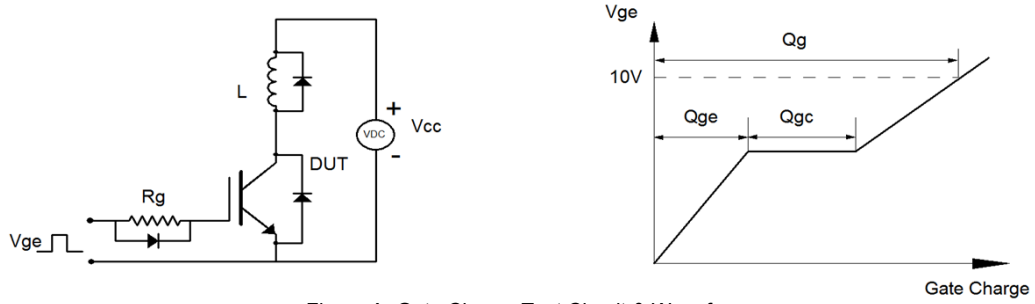


Figure A: Gate Charge Test Circuit & Waveforms

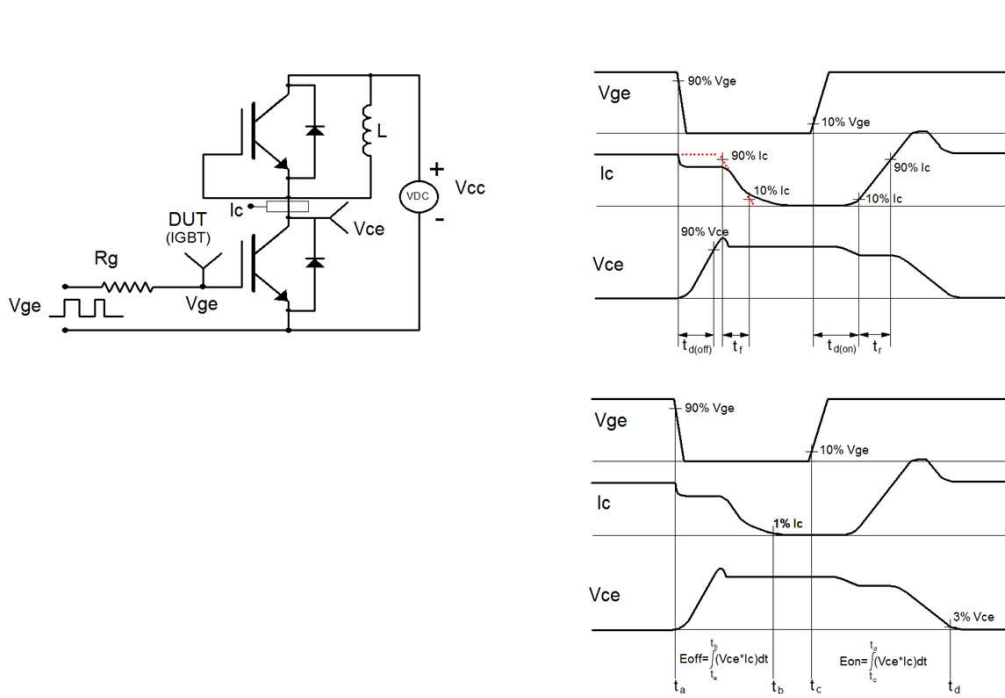


Figure B: Inductive Switching Test Circuit & Waveforms

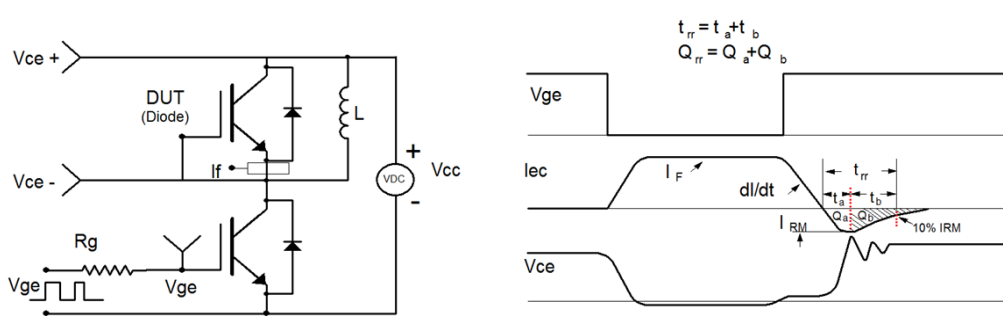


Figure C: Diode Recovery Test Circuit & Waveforms

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