



**THE DATASHEET OF
AOK40B120M1**



General Description

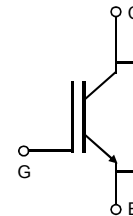
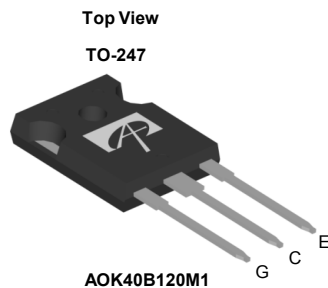
- Latest Alpha IGBT (α IGBT) technology
- 1200V breakdown voltage
- Fast and soft recovery freewheeling diode
- High efficient turn-on di/dt controllability
- High switching speed
- Low turn-off switching loss and softness
- Very good EMI behavior

Applications

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

Product Summary

V_{CE}	1200V
I_C ($T_C=100^\circ\text{C}$)	40A
$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)	1.95V

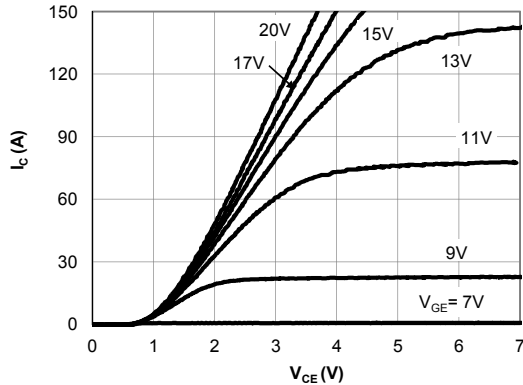
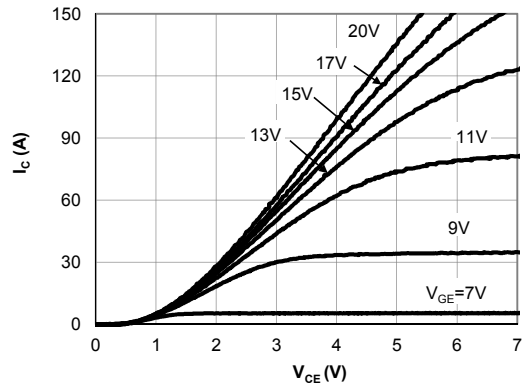
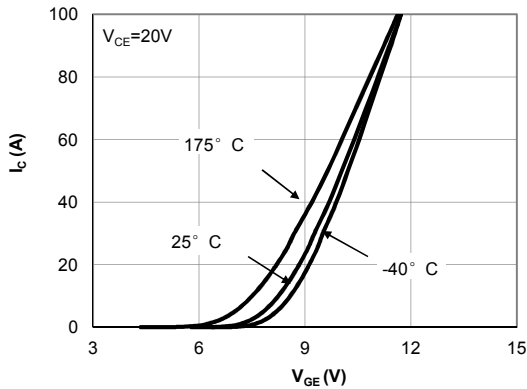
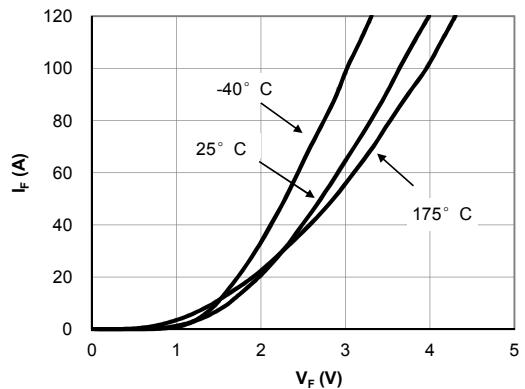
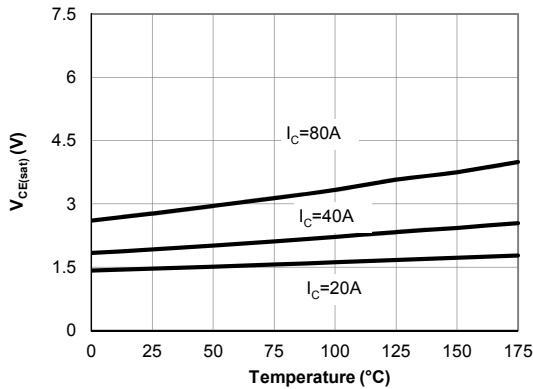
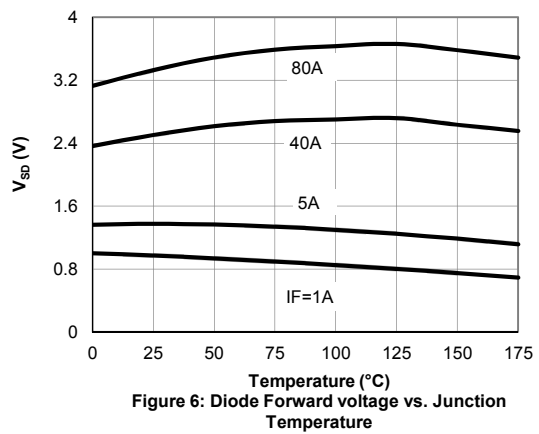


Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK40B120M1	TO247	Tube	240
Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted			
Parameter	Symbol	AOK40B120M1	Units
Collector-Emitter Voltage	V_{CE}	1200	V
Gate-Emitter Voltage	V_{GE}	± 30	V
Continuous Collector Current	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}	120	A
Turn off SOA, $V_{CE} \leq 650\text{V}$, Limited by T_{Jmax}	I_{LM}	120	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}	120	A
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	AOK40B120M1	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	$^\circ\text{C/W}$

Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
STATIC PARAMETERS							
BV_{CES}	Collector-Emitter Breakdown Voltage	$I_C=1mA, V_{GE}=0V, T_J=25^\circ C$	1200	-	-	V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=40A$	$T_J=25^\circ C$	-	1.95	2.45	V
			$T_J=125^\circ C$	-	2.35	-	
			$T_J=175^\circ C$	-	2.55	-	
V_F	Diode Forward Voltage	$V_{GE}=0V, I_C=40A$	$T_J=25^\circ C$	-	2.5	3.15	V
			$T_J=125^\circ C$	-	2.75	-	
			$T_J=175^\circ C$	-	2.55	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=5V, I_C=1mA$	-	5.8	-	V	
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=1200V, V_{GE}=0V$	$T_J=25^\circ C$	-	-	0.1	mA
			$T_J=125^\circ C$	-	-	4	
			$T_J=175^\circ C$	-	-	20	
I_{GES}	Gate-Emitter leakage current	$V_{CE}=0V, V_{GE}=\pm 30V$	-	-	± 100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20V, I_C=40A$	-	28	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0V, V_{CC}=25V, f=1MHz$	-	4770	-	pF	
C_{oes}	Output Capacitance		-	270	-	pF	
C_{res}	Reverse Transfer Capacitance		-	85	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15V, V_{CC}=960V, I_C=40A$	-	140	-	nC	
Q_{ge}	Gate to Emitter Charge		-	62	-	nC	
Q_{gc}	Gate to Collector Charge		-	48	-	nC	
R_g	Gate resistance	$V_{GE}=0V, V_{CC}=0V, f=1MHz$	-	15	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=25^\circ C$ $V_{GE}=15V, V_{CC}=600V, I_C=40A,$ $R_G=7.5\Omega$	-	90	-	ns	
t_r	Turn-On Rise Time		-	85	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	226	-	ns	
t_f	Turn-Off Fall Time		-	46	-	ns	
E_{on}	Turn-On Energy		-	3.87	-	mJ	
E_{off}	Turn-Off Energy		-	1.25	-	mJ	
E_{total}	Total Switching Energy		-	5.12	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=25^\circ C$	-	340	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=40A, di/dt=200A/\mu s, V_{CC}=600V$	-	1.5	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	9.3	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=175°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=175^\circ C$ $V_{GE}=15V, V_{CC}=600V, I_C=40A,$ $R_G=7.5\Omega$	-	86	-	ns	
t_r	Turn-On Rise Time		-	92	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	287	-	ns	
t_f	Turn-Off Fall Time		-	144	-	ns	
E_{on}	Turn-On Energy		-	4.48	-	mJ	
E_{off}	Turn-Off Energy		-	2.44	-	mJ	
E_{total}	Total Switching Energy		-	6.92	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=175^\circ C$	-	605	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=40A, di/dt=200A/\mu s, V_{CC}=600V$	-	4.7	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	15.5	-	A

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

Figure 1: Output Characteristic
 ($T_j=25^\circ\text{C}$)

Figure 2: Output Characteristic
 ($T_j=175^\circ\text{C}$)

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

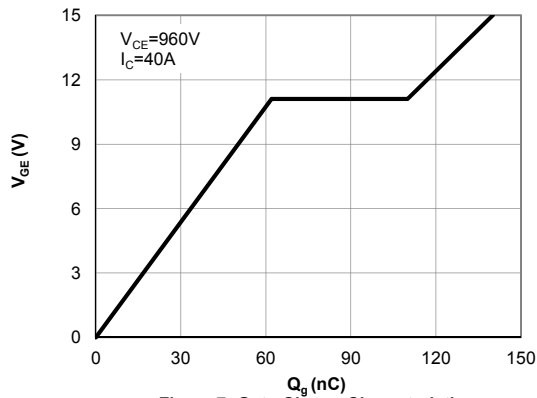


Figure 7: Gate-Charge Characteristics

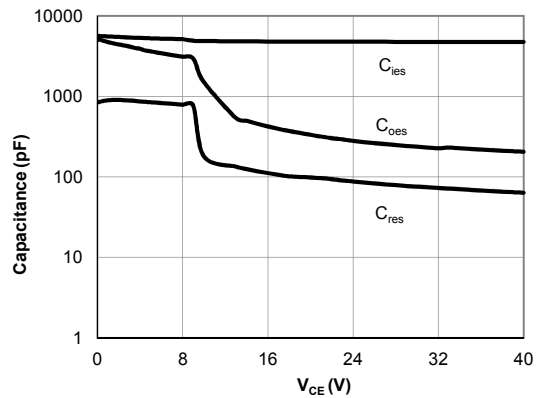


Figure 8: Capacitance Characteristic

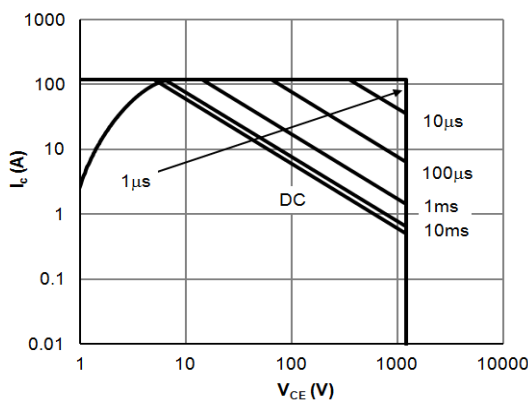


Figure 9: Forward Bias Safe Operating Area
($T_C=25^\circ\text{C}$, $V_{GE}=15\text{V}$)

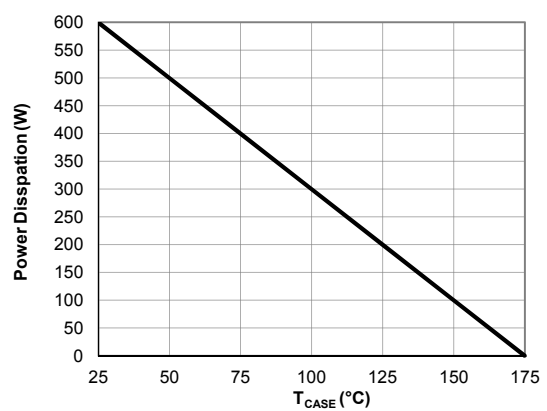


Figure 10: Power Dissipation as a Function of Case

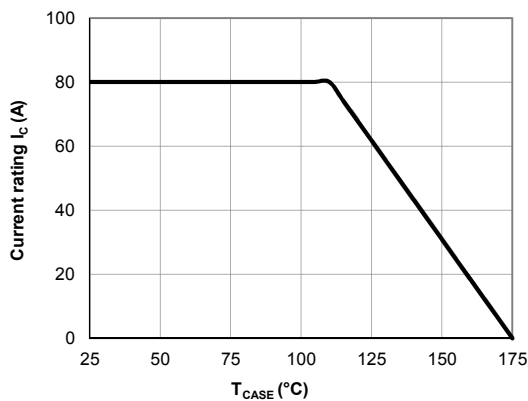


Figure 11: Current De-rating

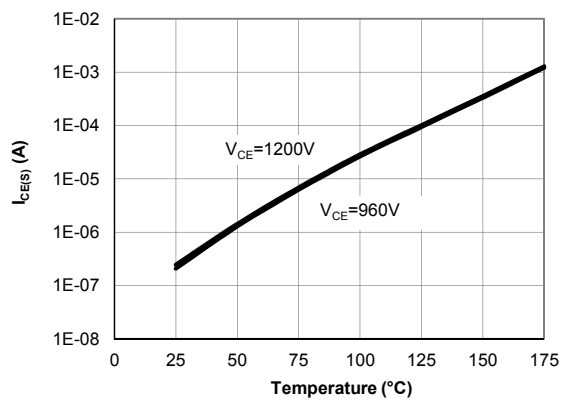


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

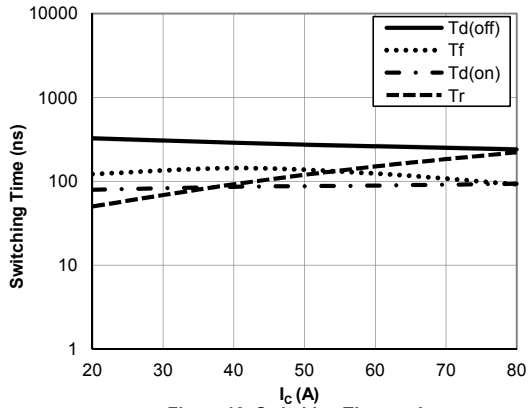


Figure 13: Switching Time vs. I_c
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $R_g=7.5\Omega$)

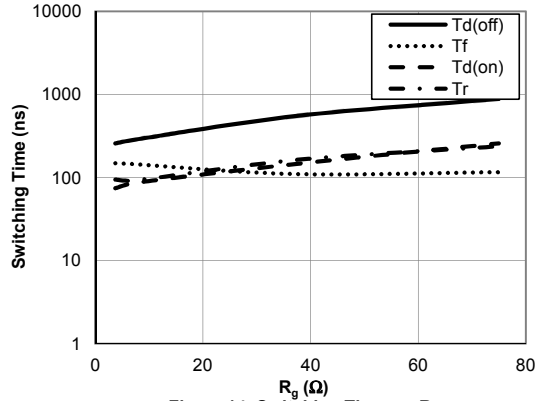


Figure 14: Switching Time vs. R_g
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_c=40\text{A}$)

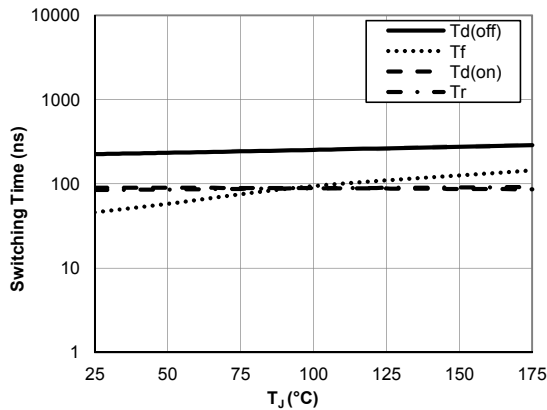


Figure 15: Switching Time vs. T_j
($V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_c=40\text{A}$, $R_g=7.5\Omega$)

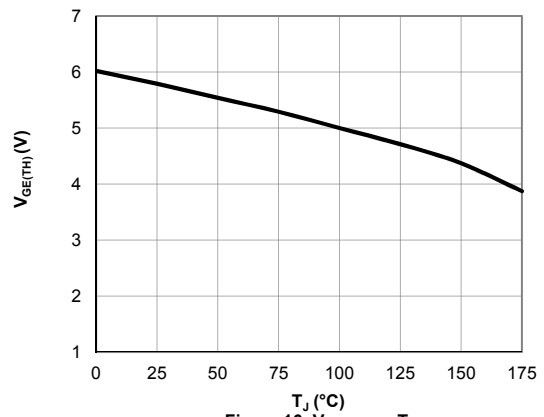


Figure 16: $V_{GE(TH)}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

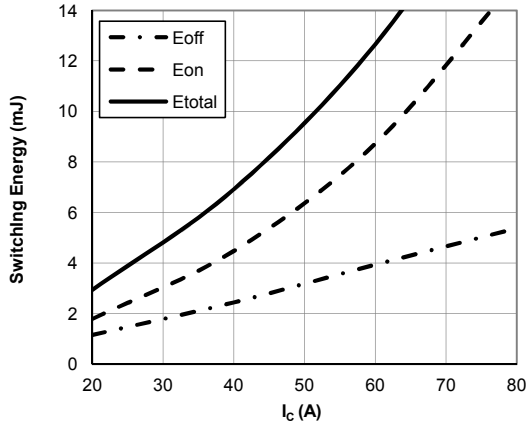


Figure 17: Switching Loss vs. I_C
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $R_g=7.5\Omega$)

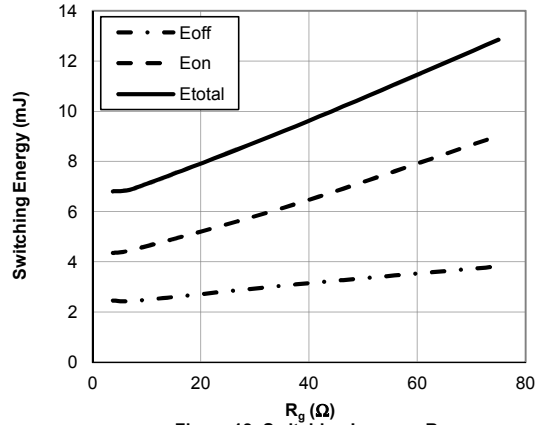


Figure 18: Switching Loss vs. R_g
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$)

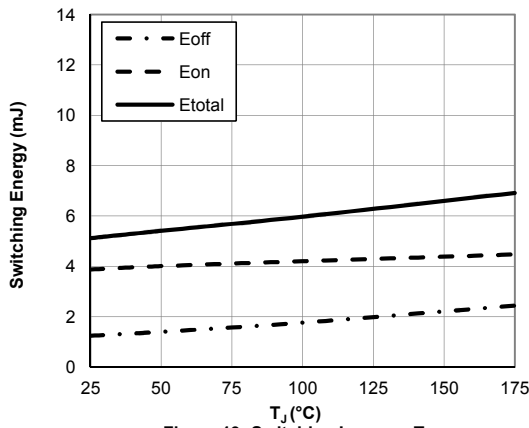


Figure 19: Switching Loss vs. T_J
($V_{GE}=15\text{V}$, $V_{CE}=600\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

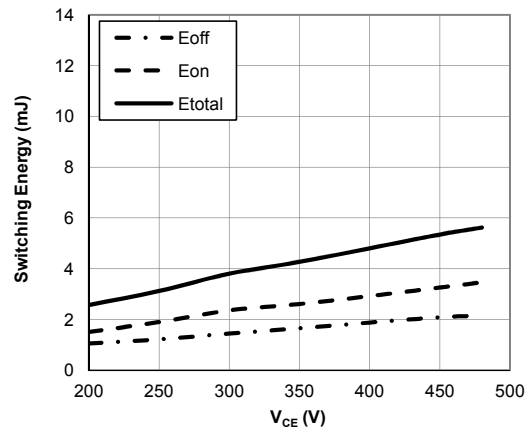


Figure 20: Switching Loss vs. V_{CE}
($T_J=175^\circ\text{C}$, $V_{GE}=15\text{V}$, $I_C=40\text{A}$, $R_g=7.5\Omega$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

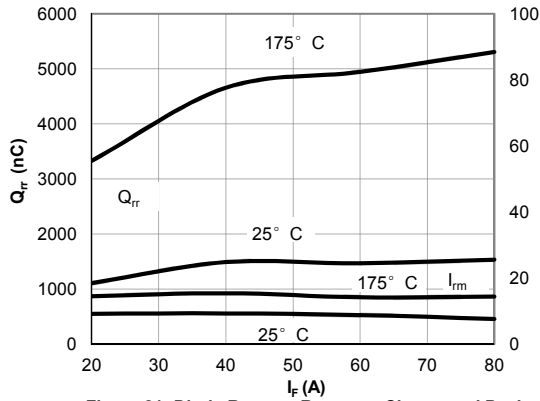


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=600V, di/dt=200A/\mu s$)

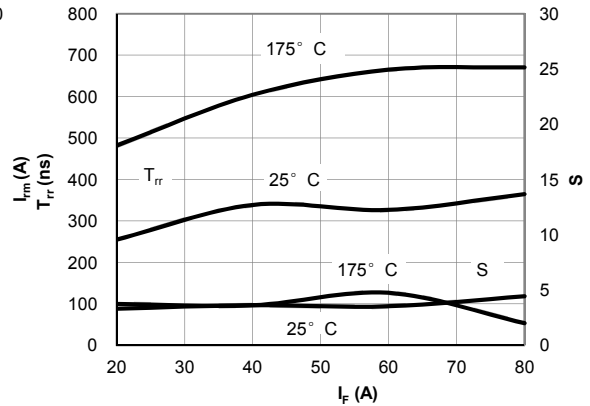


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=600V, di/dt=200A/\mu s$)

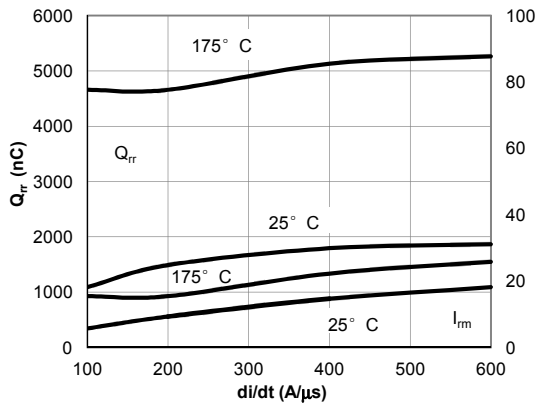


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=600V, I_F=40A$)

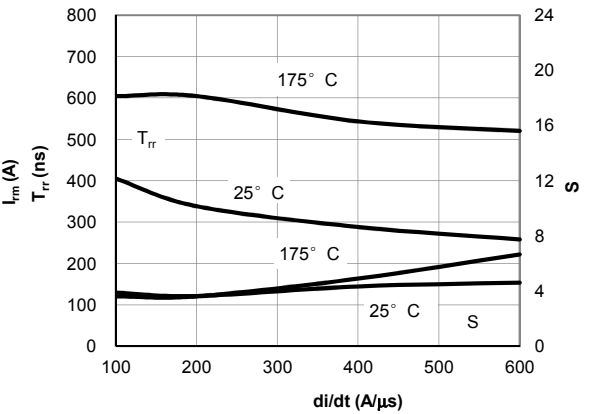


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=600V, I_F=40A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

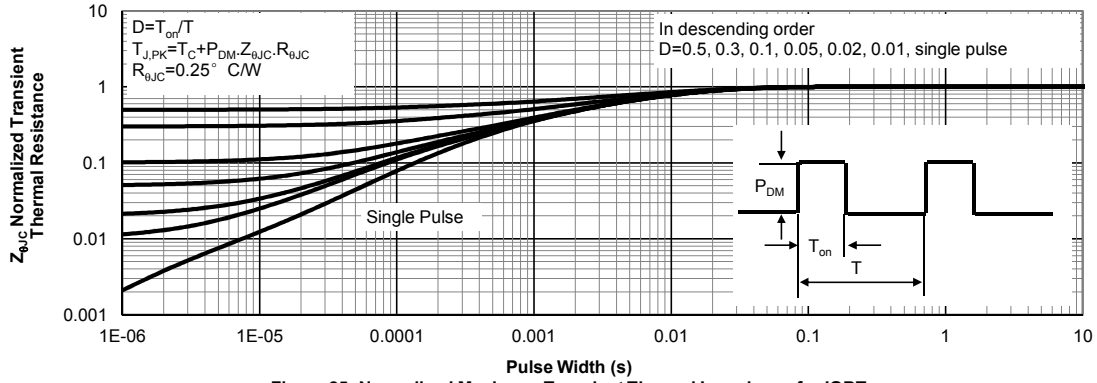


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

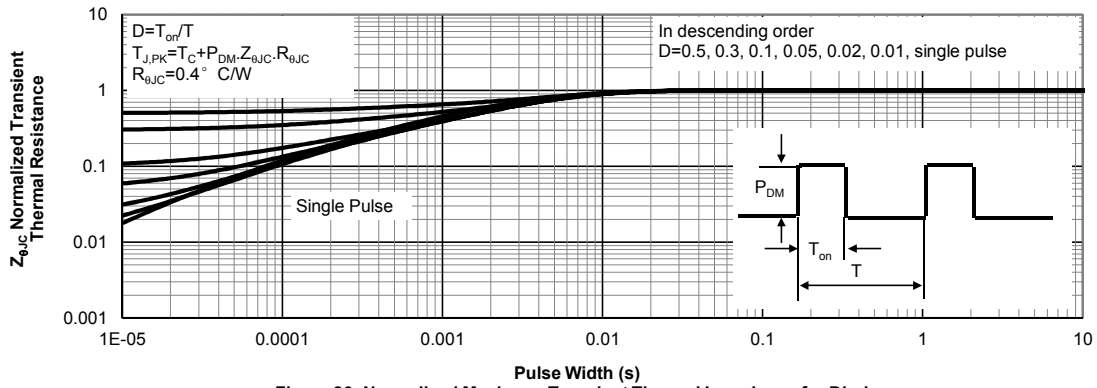


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

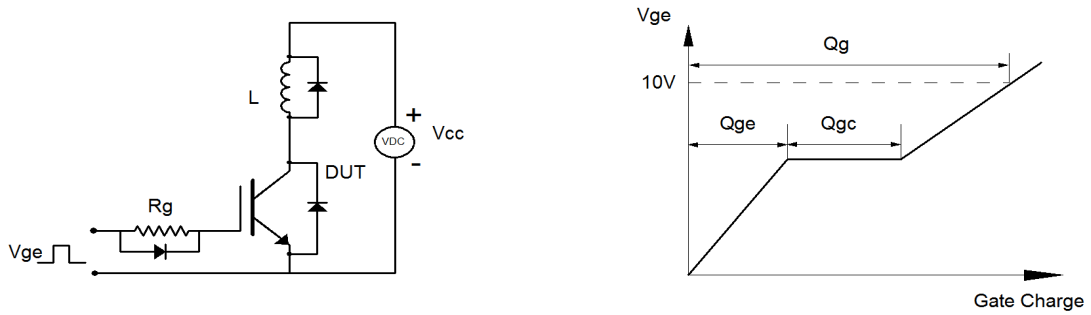


Figure A: Gate Charge Test Circuit & Waveforms

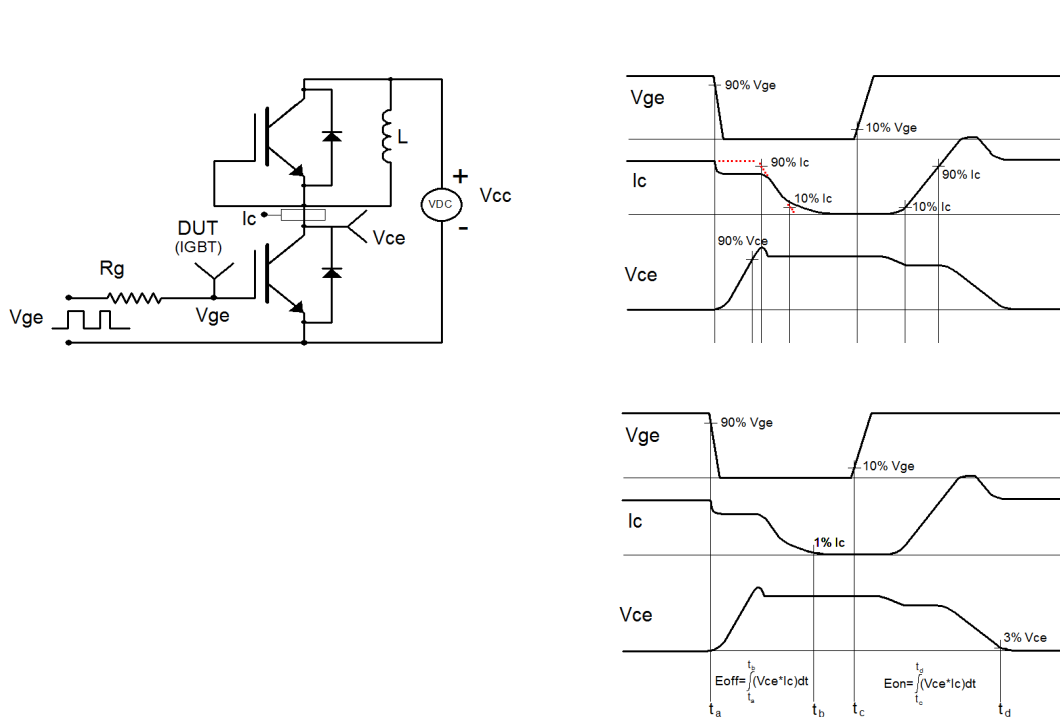


Figure B: Inductive Switching Test Circuit & Waveforms

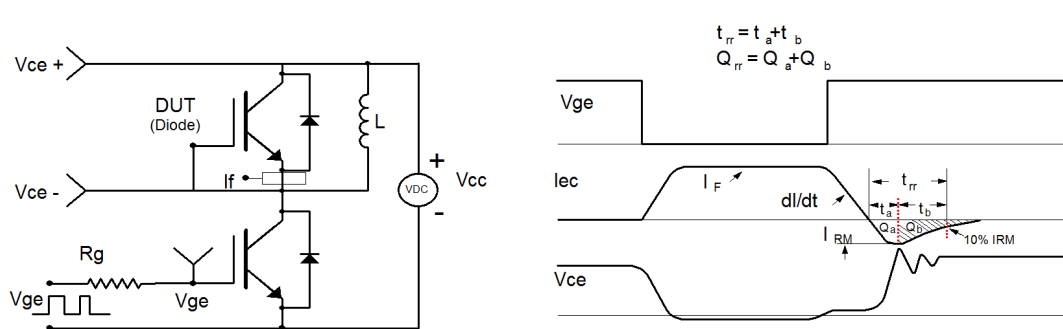


Figure C: Diode Recovery Test Circuit & Waveforms

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