

### General Description

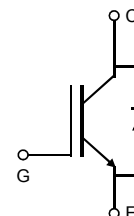
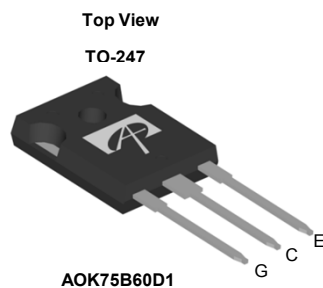
- AlphaIGBT (α IGBT) technology
- Low  $V_{CE(SAT)}$  enables high efficiencies
- Smooth Switching waveforms reduce EMI
- Better thermal management
- Minimal gate spike under high dv/dt

### Applications

- Welding Machines
- Solar Inverters
- Uninterruptible Power Supplies

### Product Summary

$V_{CE}$	600V
$I_C$ ( $T_C=100^\circ\text{C}$ )	75A
$V_{CE(sat)}$ ( $T_J=25^\circ\text{C}$ )	1.72V



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK75B60D1	TO247	Tube	240

### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	AOK75B60D1	Units
Collector-Emitter Voltage	$V_{CE}$	600	V
Gate-Emitter Voltage	$V_{GE}$	$\pm 20$	V
Continuous Collector Current	$I_C$	$T_C=25^\circ\text{C}$	150
		$T_C=100^\circ\text{C}$	75
Pulsed Collector Current, Limited by $T_{Jmax}$	$I_{CM}$	290	A
Turn off SOA, $V_{CE} \leq 600\text{V}$ , Limited by $T_{Jmax}$	$I_{LM}$	290	A
Continuous Diode Forward Current	$I_F$	$T_C=25^\circ\text{C}$	75
		$T_C=100^\circ\text{C}$	37.5
Diode Pulsed Current, Limited by $T_{Jmax}$	$I_{FM}$	290	A
Short circuit withstanding time <sup>1)</sup> $V_{GE}=15\text{V}$ , $V_{CE} \leq 400\text{V}$ , $T_J \leq 175^\circ\text{C}$	$t_{SC}$	10	$\mu\text{s}$
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	AOK75B60D1	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	$R_{\theta JC}$	0.95	$^\circ\text{C/W}$

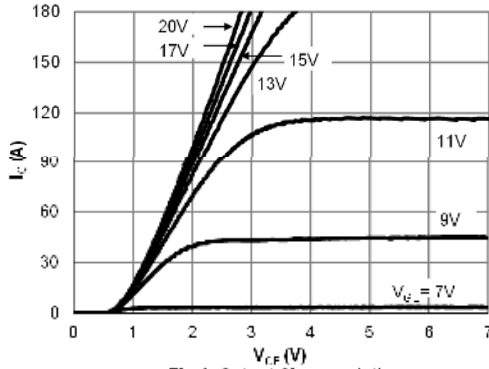
1) Allowed number of short circuits: <1000; time between short circuits: >1s.

**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

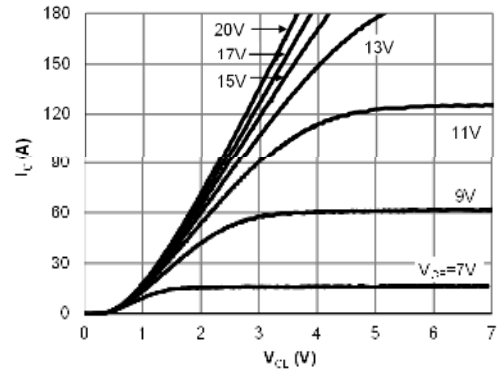
Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>STATIC PARAMETERS</b>							
BV <sub>CES</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> =1mA, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C	600	-	-	V	
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>GE</sub> =15V, I <sub>C</sub> =75A	T <sub>J</sub> =25°C	-	1.72	2.1	V
			T <sub>J</sub> =125°C	-	2	-	
			T <sub>J</sub> =175°C	-	2.3	-	
V <sub>F</sub>	Diode Forward Voltage	V <sub>GE</sub> =0V, I <sub>F</sub> =37.5A	T <sub>J</sub> =25°C	-	1.44	2	V
			T <sub>J</sub> =125°C	-	1.43	-	
			T <sub>J</sub> =175°C	-	1.37	-	
V <sub>GE(th)</sub>	Gate-Emitter Threshold Voltage	V <sub>CE</sub> =5V, I <sub>C</sub> =1mA	-	5.35	-	V	
I <sub>CES</sub>	Zero Gate Voltage Collector Current	V <sub>CE</sub> =600V, V <sub>GE</sub> =0V	T <sub>J</sub> =25°C	-	-	10	μA
			T <sub>J</sub> =125°C	-	-	1250	
			T <sub>J</sub> =175°C	-	-	15000	
I <sub>CES</sub>	Gate-Emitter leakage current	V <sub>CE</sub> =0V, V <sub>GE</sub> =±20V	-	-	±100	nA	
g <sub>F-S</sub>	Forward Transconductance	V <sub>CE</sub> =20V, I <sub>C</sub> =75A	-	36	-	S	
<b>DYNAMIC PARAMETERS</b>							
C <sub>iss</sub>	Input Capacitance	V <sub>GE</sub> =0V, V <sub>CE</sub> =25V, f=1MHz	-	4750	-	pF	
C <sub>oss</sub>	Output Capacitance		-	470	-	pF	
C <sub>res</sub>	Reverse Transfer Capacitance		-	16	-	pF	
Q <sub>g</sub>	Total Gate Charge	V <sub>GE</sub> =15V, V <sub>CE</sub> =480V, I <sub>C</sub> =75A	-	118	-	nC	
Q <sub>ge</sub>	Gate to Emitter Charge		-	48	-	nC	
Q <sub>gc</sub>	Gate to Collector Charge		-	36	-	nC	
I <sub>C(SC)</sub>	Short circuit collector current, Max. 1000 short circuits, Delay between short circuits ≥ 1.0s	V <sub>GE</sub> =15V, V <sub>CE</sub> =400V, R <sub>G</sub> =25Ω	-	290	-	A	
R <sub>g</sub>	Gate resistance	V <sub>GE</sub> =0V, V <sub>CE</sub> =0V, f=1MHz	-	1.5	-	Ω	
<b>SWITCHING PARAMETERS, (Load Inductive, T<sub>J</sub>=25°C)</b>							
t <sub>D(on)</sub>	Turn-On DelayTime	T <sub>J</sub> =25°C V <sub>GE</sub> =15V, V <sub>CE</sub> =400V, I <sub>C</sub> =75A, R <sub>G</sub> =4Ω, Parasitic Inductance=150nH	-	33	-	ns	
t <sub>r</sub>	Turn-On Rise Time		-	69	-	ns	
t <sub>D(off)</sub>	Turn-Off Delay Time		-	84	-	ns	
t <sub>f</sub>	Turn-Off Fall Time		-	18.4	-	ns	
E <sub>on</sub>	Turn-On Energy		-	3.7	-	mJ	
E <sub>off</sub>	Turn-Off Energy		-	1.3	-	mJ	
E <sub>total</sub>	Total Switching Energy		-	5	-	mJ	
t <sub>rr</sub>	Diode Reverse Recovery Time	T <sub>J</sub> =25°C I <sub>F</sub> =37.5A, dl/dt=200A/μs, V <sub>CR</sub> =400V	-	147	-	ns	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		-	0.9	-	μC	
I <sub>rrm</sub>	Diode Peak Reverse Recovery Current		-	10	-	A	
<b>SWITCHING PARAMETERS, (Load Inductive, T<sub>J</sub>=175°C)</b>							
t <sub>D(on)</sub>	Turn-On DelayTime	T <sub>J</sub> =175°C V <sub>GE</sub> =15V, V <sub>CE</sub> =400V, I <sub>C</sub> =75A, R <sub>G</sub> =4Ω, Parasitic Inductance=150nH	-	37	-	ns	
t <sub>r</sub>	Turn-On Rise Time		-	67	-	ns	
t <sub>D(off)</sub>	Turn-Off Delay Time		-	135	-	ns	
t <sub>f</sub>	Turn-Off Fall Time		-	20	-	ns	
E <sub>on</sub>	Turn-On Energy		-	3.8	-	mJ	
E <sub>off</sub>	Turn-Off Energy		-	2	-	mJ	
E <sub>total</sub>	Total Switching Energy		-	5.8	-	mJ	
t <sub>rr</sub>	Diode Reverse Recovery Time	T <sub>J</sub> =175°C I <sub>F</sub> =37.5A, dl/dt=200A/μs, V <sub>CR</sub> =400V	-	220	-	ns	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		-	1.7	-	μC	
I <sub>rrm</sub>	Diode Peak Reverse Recovery Current		-	13	-	A	

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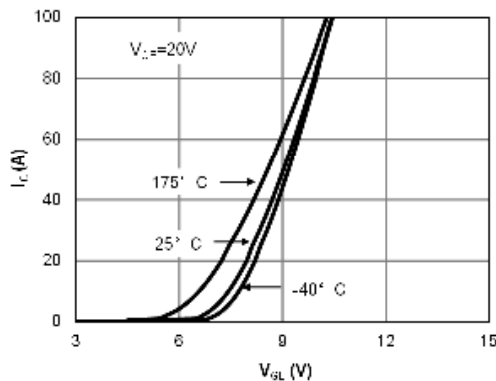
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



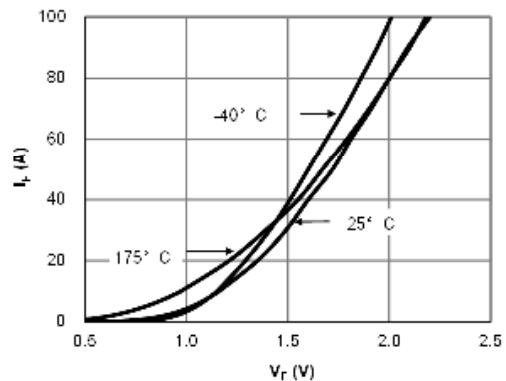
**Fig 1: Output Characteristic**  
( $T_j=25^\circ\text{C}$ )



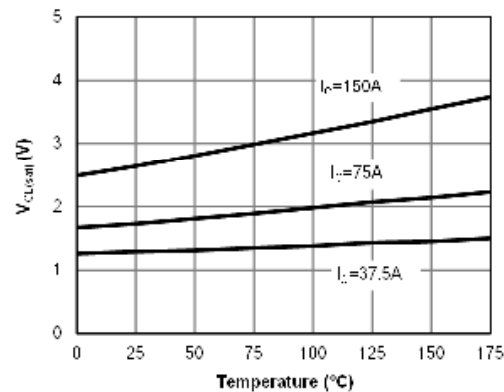
**Fig 2: Output Characteristic**  
( $T_j=175^\circ\text{C}$ )



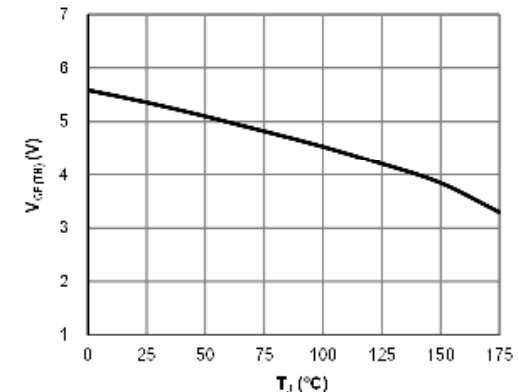
**Fig 3: Transfer Characteristic**



**Fig 4: Diode Characteristic**

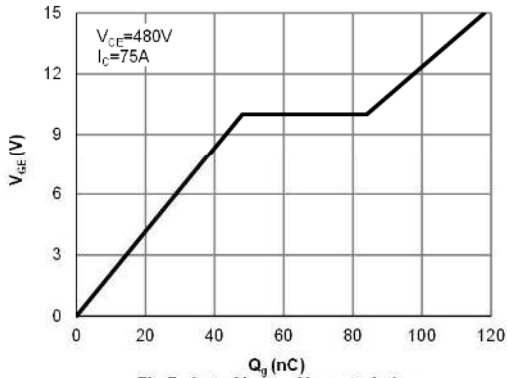


**Fig 5: Collector-Emitter Saturation Voltage vs. Junction Temperature**

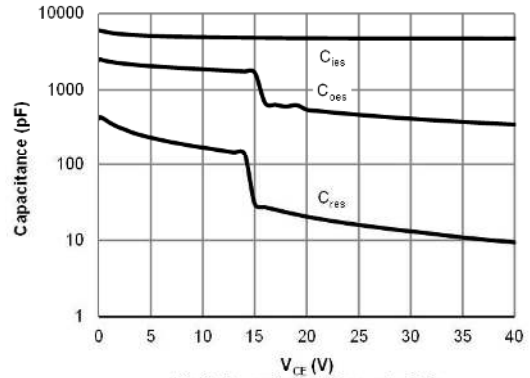


**Figure 6:  $V_{CE(sat)}$  vs.  $T_j$**

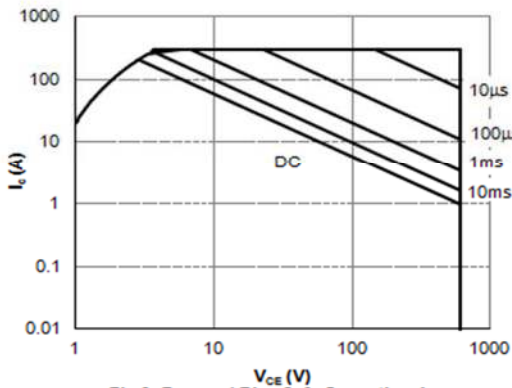
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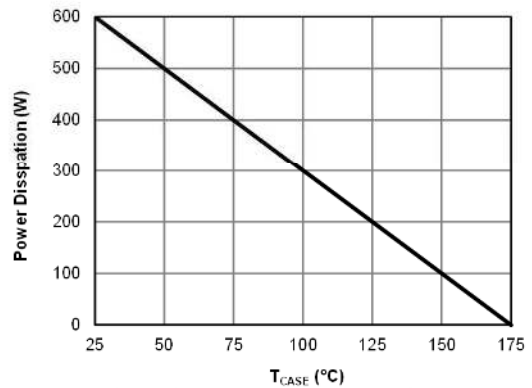
**Fig 7: Gate-Charge Characteristics**



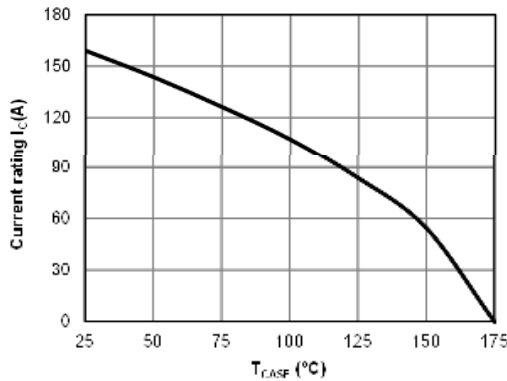
**Fig 8: Capacitance Characteristic**



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

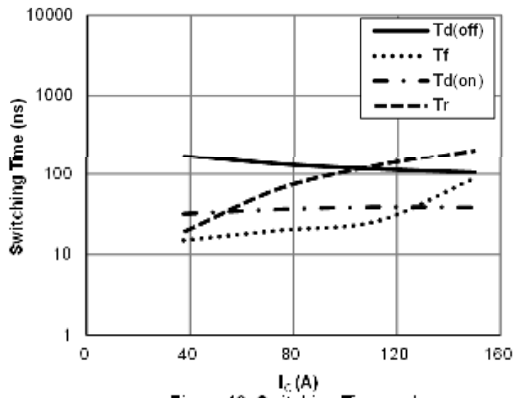


**Fig 10: Power Dissipation as a Function of Case**

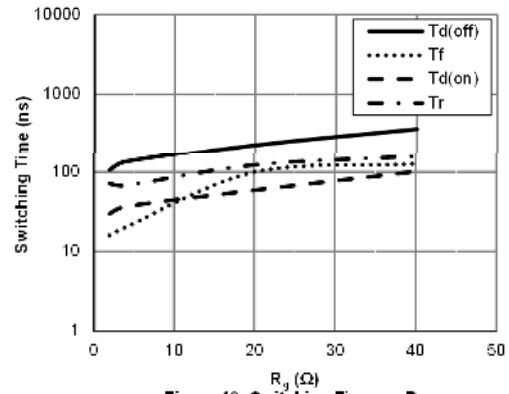


**Fig 11: Current De-rating**

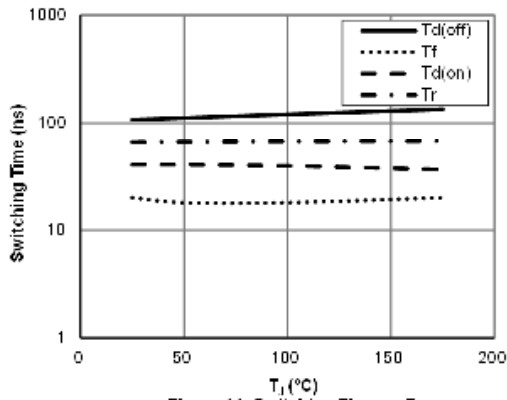
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**Figure 12: Switching Time vs.  $I_C$**   
( $T_J=175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $V_{CE}=400\text{V}$ ,  $R_g=4\Omega$ )



**Figure 13: Switching Time vs.  $R_g$**   
( $T_J=175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $V_{CE}=400\text{V}$ ,  $I_C=75\text{A}$ )



**Figure 14: Switching Time vs.  $T_J$**   
( $V_{GE}=15\text{V}$ ,  $V_{CE}=400\text{V}$ ,  $I_C=75\text{A}$ ,  $R_g=4\Omega$ )

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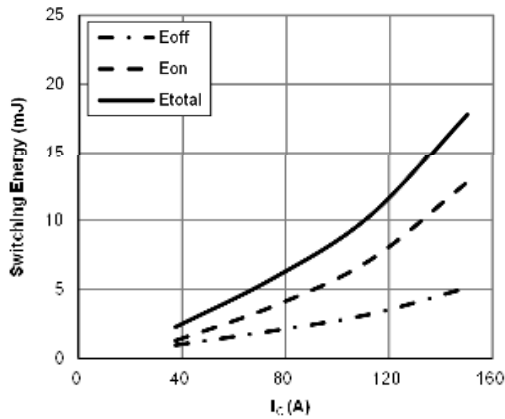


Figure 15: Switching Loss vs.  $I_C$   
( $T_J=175^\circ\text{C}, V_{GL}=15\text{V}, V_{CL}=400\text{V}, R_{\theta}=4\Omega$ )

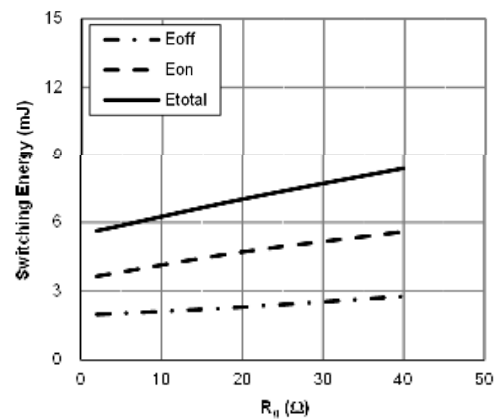


Figure 16: Switching Loss vs.  $R_{\theta}$   
( $T_J=175^\circ\text{C}, V_{GL}=15\text{V}, V_{CL}=400\text{V}, I_C=75\text{A}$ )

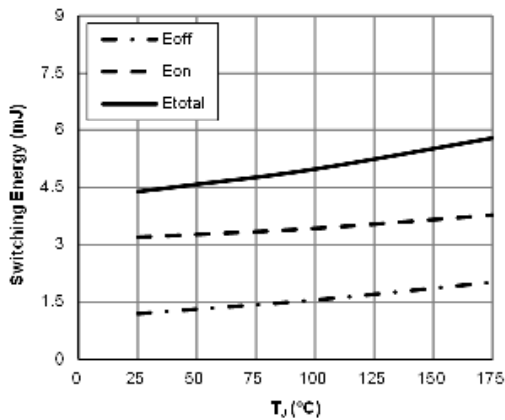


Figure 17: Switching Loss vs.  $T_J$   
( $V_{GL}=15\text{V}, V_{CL}=400\text{V}, I_C=75\text{A}, R_{\theta}=4\Omega$ )

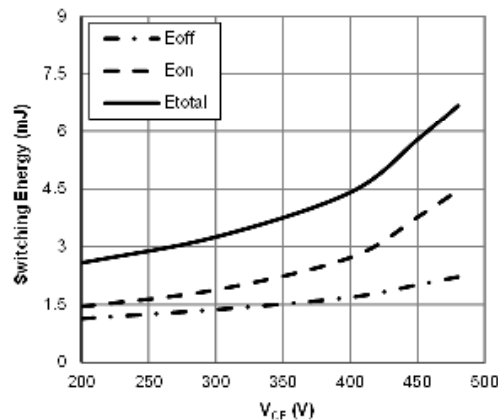
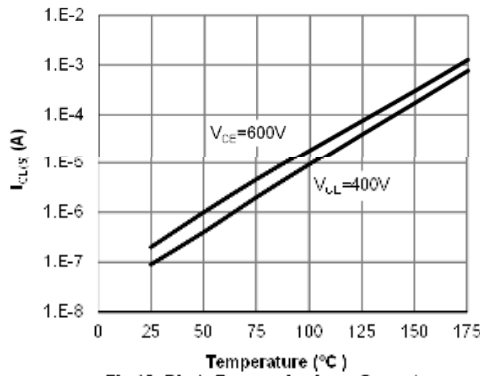
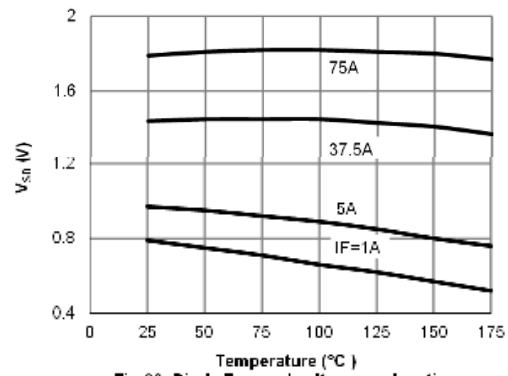


Figure 18: Switching Loss vs.  $V_{CL}$   
( $T_J=175^\circ\text{C}, V_{GL}=15\text{V}, I_C=75\text{A}, R_{\theta}=4\Omega$ )

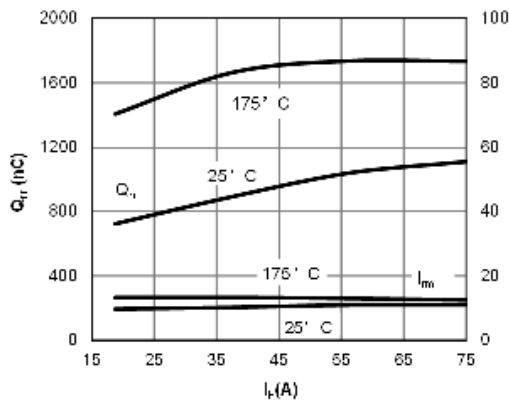
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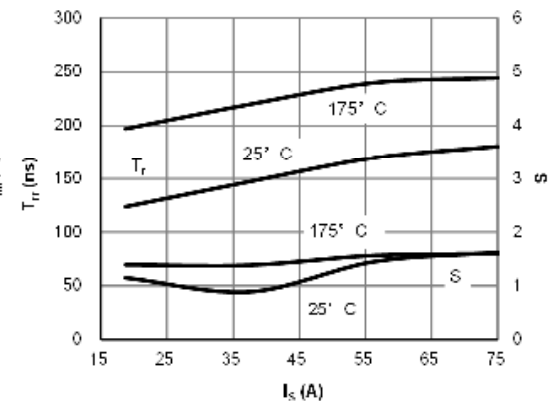
**Fig 19: Diode Reverse Leakage Current vs. Junction Temperature**



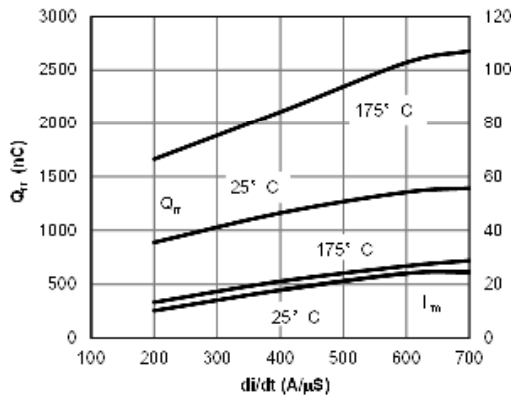
**Fig 20: Diode Forward Voltage vs. Junction Temperature**



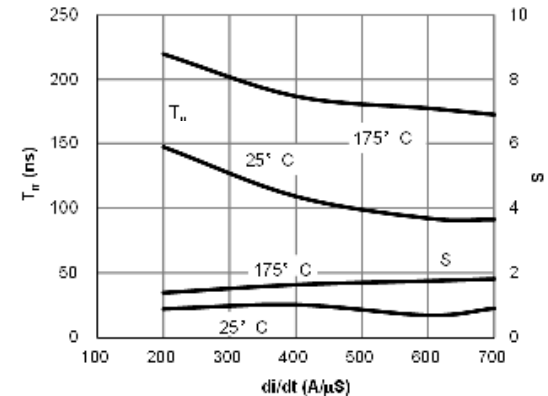
**Fig 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current**  
( $V_{CE}=15V, V_{CF}=400V, di/dt=200A/\mu s$ )



**Fig 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current**  
( $V_{CE}=15V, V_{CF}=400V, di/dt=200A/\mu s$ )

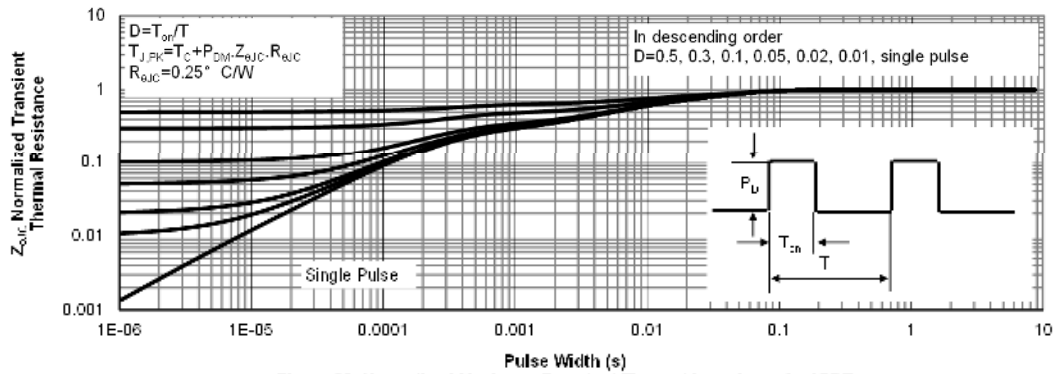


**Fig 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt**  
( $V_{GL}=15V, V_{CL}=400V, I_c=37.5A$ )

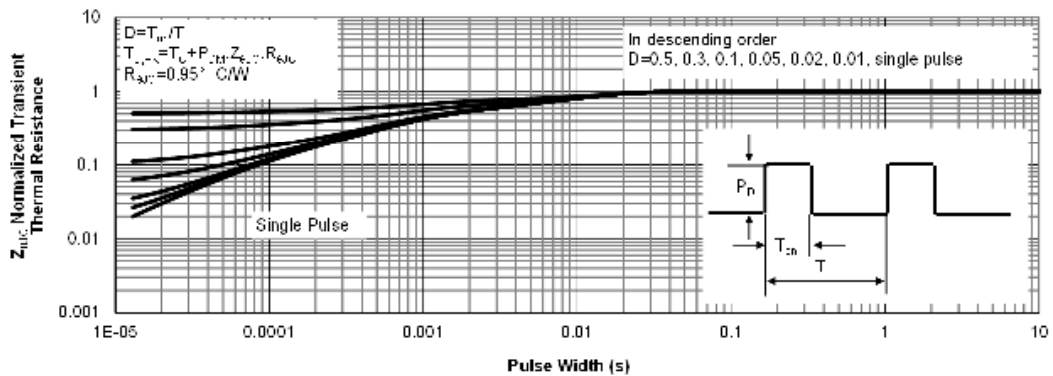


**Fig 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt**  
( $V_{GL}=15V, V_{CL}=400V, I_c=37.5A$ )

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**Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT**



**Figure 26: Normalized Maximum Transient Thermal Impedance for Diode**



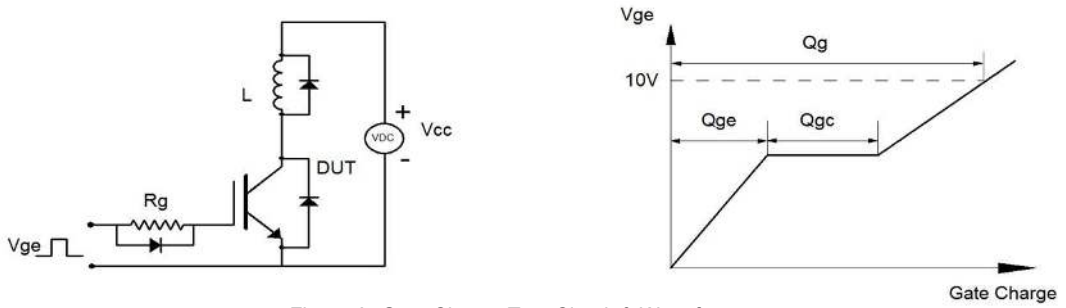


Figure A: Gate Charge Test Circuit & Waveforms

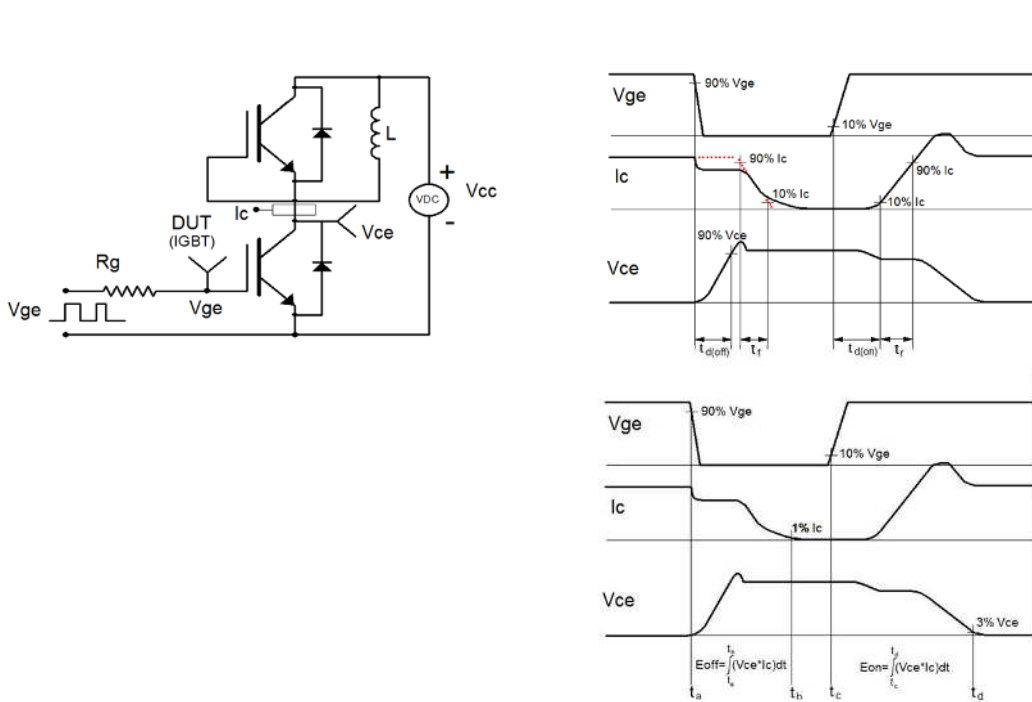


Figure B: Inductive Switching Test Circuit & Waveforms

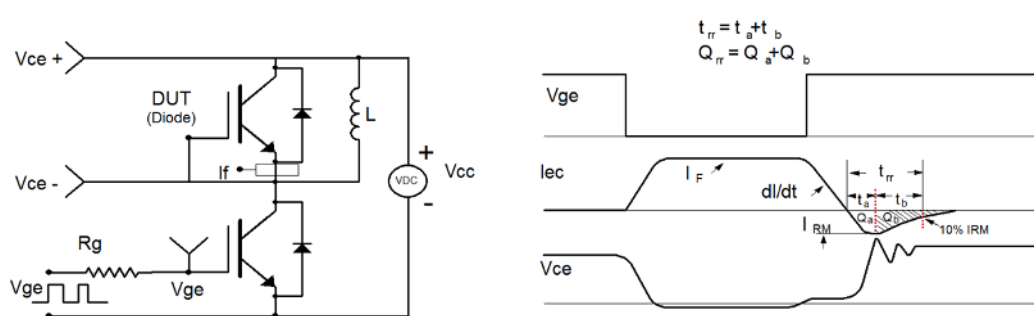


Figure C: Diode Recovery Test Circuit & Waveforms