

General Description

- Latest AlphaIGBT (αIGBT) technology
- 650V breakdown voltage
- Very fast and soft recovery freewheeling diode
- High efficient turn-on di/dt controllability
- Low $V_{CE(sat)}$ enables high efficiencies
- Low turn-off switching loss and softness
- Very good EMI behavior
- High short-circuit ruggedness

Applications

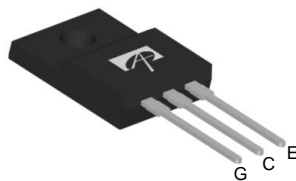
- Motor drives
- Sewing machines
- Home appliances
- Fan, pumps, vacuum cleaner
- Other hard switching applications

Product Summary

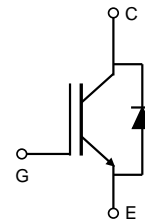
V_{CE}	650V
I_C ($T_C=100^\circ\text{C}$)	15A
$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)	1.7V



TO-220F



AOTF15B65M1



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOTF15B65M1	TO220F	Tube	1000

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

Parameter	Symbol	AOTF15B65M1	Units
Collector-Emitter Voltage	V_{CE}	650	V
Gate-Emitter Voltage	V_{GE}	± 30	V
Continuous Collector Current	I_C	$T_C=25^\circ\text{C}$	30 ²⁾
		$T_C=100^\circ\text{C}$	15 ²⁾
Pulsed Collector Current, Limited by T_{Jmax}	I_{CM}	45	A
Turn off SOA, $V_{CE} \leq 650\text{V}$, Limited by T_{Jmax}	I_{LM}	45	A
Continuous Diode Forward Current	I_F	$T_C=25^\circ\text{C}$	30 ²⁾
		$T_C=100^\circ\text{C}$	15 ²⁾
Diode Pulsed Current, Limited by T_{Jmax}	I_{FM}	45	A
Short circuit withstanding time t_1 $V_{GE} = 15\text{V}$, $V_{CC} \leq 400\text{V}$, $T_J \leq 150^\circ\text{C}$	t_{SC}	5	μs
Power Dissipation	P_D	$T_C=25^\circ\text{C}$	36
		$T_C=100^\circ\text{C}$	14
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	$^\circ\text{C}$
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds	T_L	300	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	AOTF15B65M1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	65	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	3.5	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	5	$^\circ\text{C/W}$

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

2) TO220F I_C Follow TO220/TO263.

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
STATIC PARAMETERS							
BV_{CES}	Collector-Emitter Breakdown Voltage	$I_C=1\text{mA}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$	650	-	-	V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}, I_C=15\text{A}$	$T_J=25^\circ\text{C}$	-	1.7	2.15	V
			$T_J=125^\circ\text{C}$	-	2.03	-	
			$T_J=150^\circ\text{C}$	-	2.12	-	
V_F	Diode Forward Voltage	$V_{GE}=0\text{V}, I_C=15\text{A}$	$T_J=25^\circ\text{C}$	-	1.77	2.25	V
			$T_J=125^\circ\text{C}$	-	1.82	-	
			$T_J=150^\circ\text{C}$	-	1.79	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=5\text{V}, I_C=1\text{mA}$	-	5.1	-	V	
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=650\text{V}, V_{GE}=0\text{V}$	$T_J=25^\circ\text{C}$	-	-	10	μA
			$T_J=125^\circ\text{C}$	-	-	500	
			$T_J=150^\circ\text{C}$	-	-	1000	
I_{GES}	Gate-Emitter leakage current	$V_{CE}=0\text{V}, V_{GE}=\pm 30\text{V}$	-	-	± 100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20\text{V}, I_C=15\text{A}$	-	11	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0\text{V}, V_{CC}=25\text{V}, f=1\text{MHz}$	-	923	-	pF	
C_{oes}	Output Capacitance		-	96	-	pF	
C_{res}	Reverse Transfer Capacitance		-	33	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15\text{V}, V_{CC}=520\text{V}, I_C=15\text{A}$	-	32	-	nC	
Q_{ge}	Gate to Emitter Charge		-	7.8	-	nC	
Q_{gc}	Gate to Collector Charge		-	15	-	nC	
$I_{C(SC)}$	Short circuit collector current	$V_{GE}=15\text{V}, V_{CC}=400\text{V},$ $t_{sc} \leq 5\mu\text{s}, T_J \leq 150^\circ\text{C}$	-	90	-	A	
R_g	Gate resistance	$V_{GE}=0\text{V}, V_{CC}=0\text{V}, f=1\text{MHz}$	-	6.7	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=25^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CC}=400\text{V}, I_C=15\text{A},$ $R_G=20\Omega$	-	15	-	ns	
t_r	Turn-On Rise Time		-	18	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	94	-	ns	
t_f	Turn-Off Fall Time		-	14	-	ns	
E_{on}	Turn-On Energy		-	0.29	-	mJ	
E_{off}	Turn-Off Energy		-	0.2	-	mJ	
E_{total}	Total Switching Energy		-	0.49	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=25^\circ\text{C}$	-	317	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=15\text{A}, dI/dt=200\text{A}/\mu\text{s}, V_{CC}=400\text{V}$	-	0.7	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	4.7	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=150°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=150^\circ\text{C}$ $V_{GE}=15\text{V}, V_{CC}=400\text{V}, I_C=15\text{A},$ $R_G=20\Omega$	-	14	-	ns	
t_r	Turn-On Rise Time		-	20	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	111	-	ns	
t_f	Turn-Off Fall Time		-	24	-	ns	
E_{on}	Turn-On Energy		-	0.32	-	mJ	
E_{off}	Turn-Off Energy		-	0.34	-	mJ	
E_{total}	Total Switching Energy		-	0.66	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=150^\circ\text{C}$	-	478	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=15\text{A}, dI/dt=200\text{A}/\mu\text{s}, V_{CC}=400\text{V}$	-	1.1	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	5.7	-	A

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

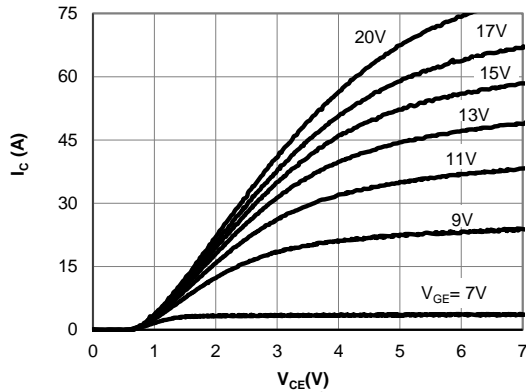


Figure 1: Output Characteristic
($T_j=25^\circ\text{C}$)

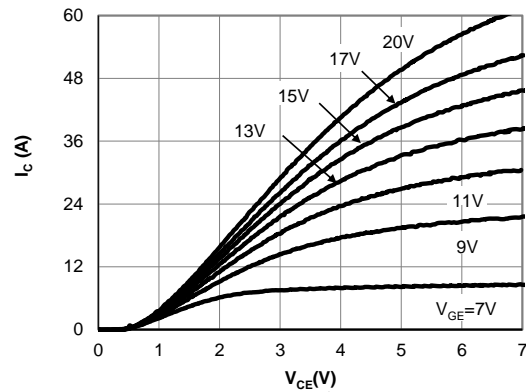


Figure 2: Output Characteristic
($T_j=150^\circ\text{C}$)

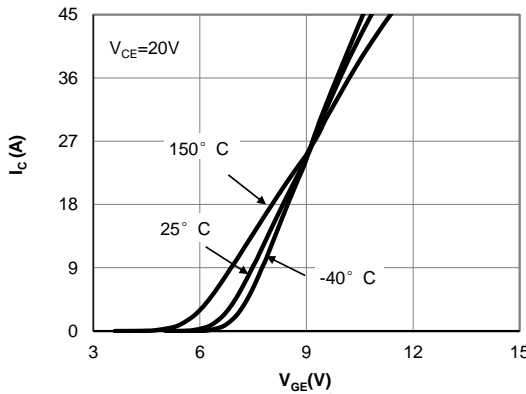


Figure 3: Transfer Characteristic

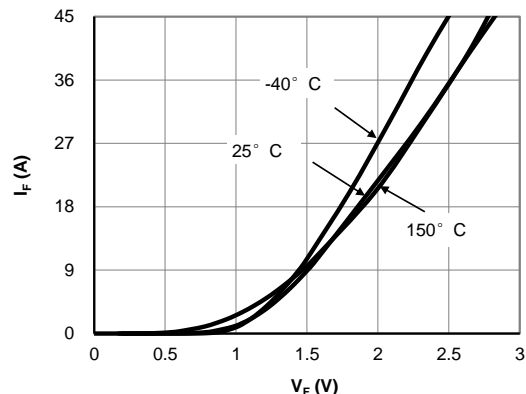


Figure 4: Diode Characteristic

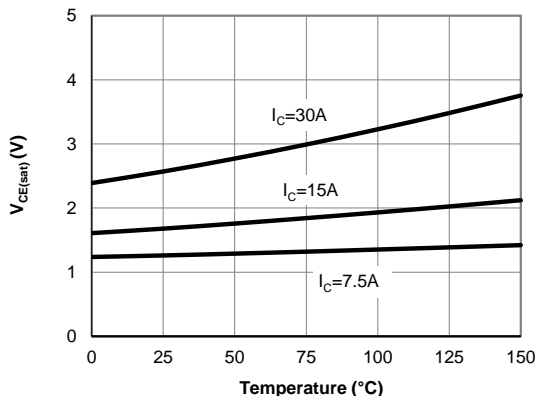


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

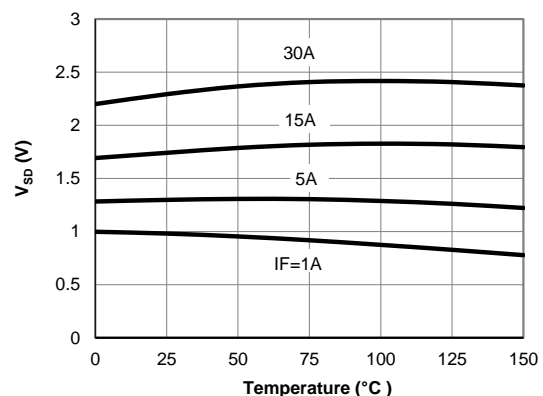


Figure 6: Diode Forward voltage vs. Junction Temperature

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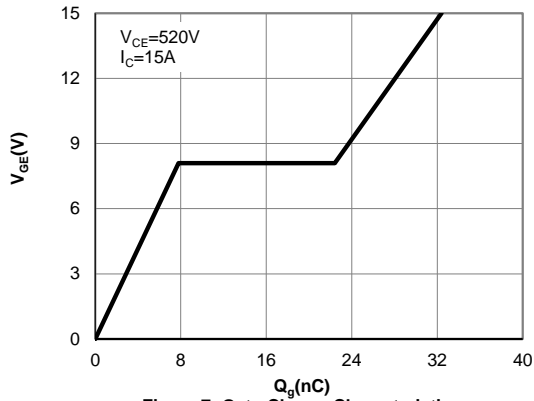


Figure 7: Gate-Charge Characteristics

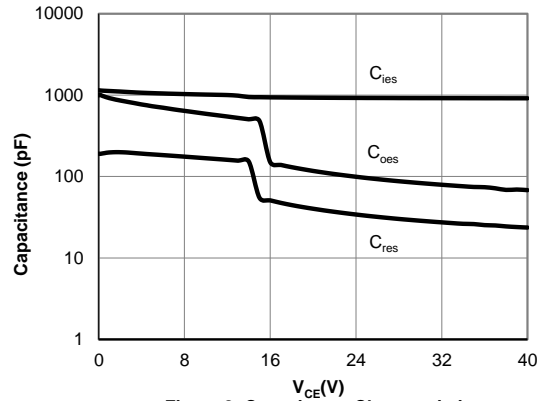


Figure 8: Capacitance Characteristic

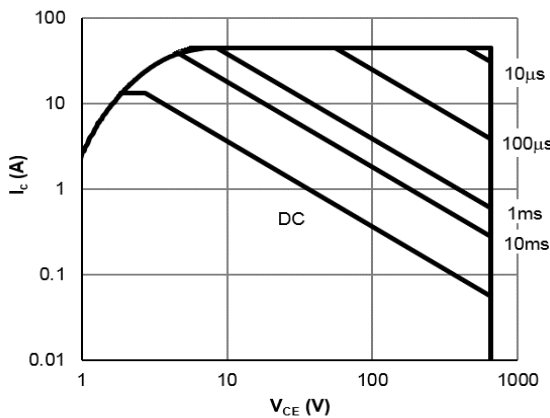


Figure 9: Forward Bias Safe Operating Area
($T_C=25^\circ\text{C}, V_{GE}=15\text{V}$)

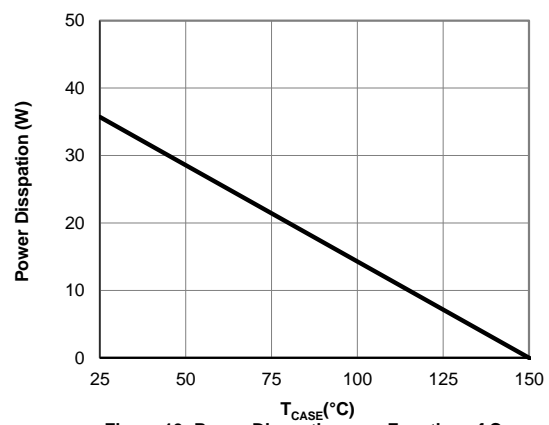


Figure 10: Power Dissipation as a Function of Case

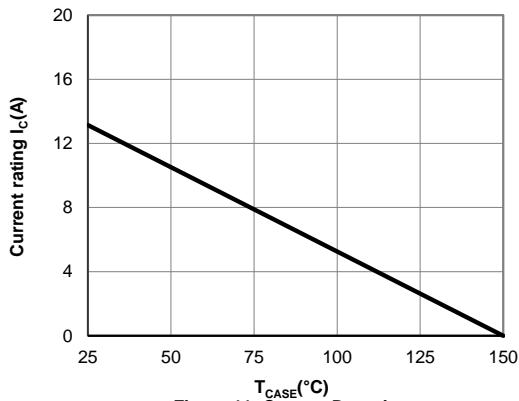


Figure 11: Current De-rating

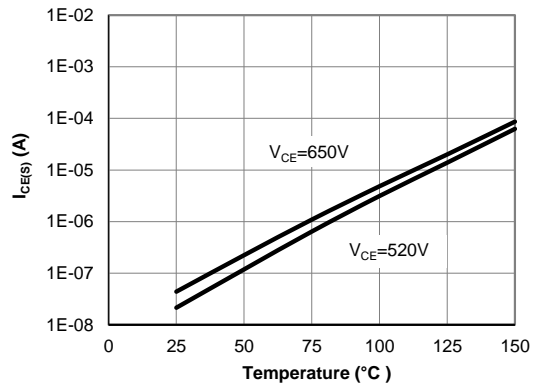


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

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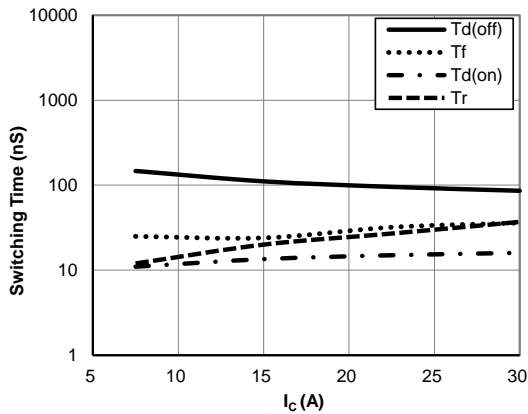


Figure 13: Switching Time vs. I_C
($T_J=150^{\circ}\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=20\Omega$)

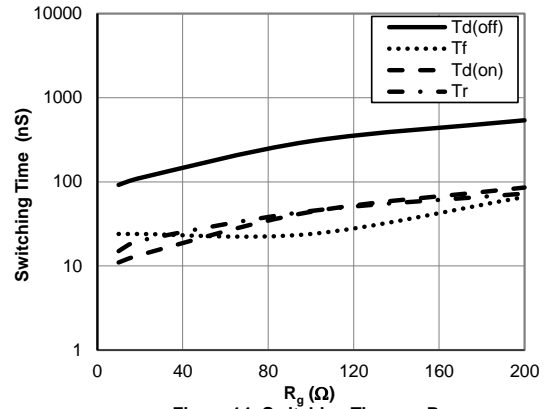


Figure 14: Switching Time vs. R_g
($T_J=150^{\circ}\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}$)

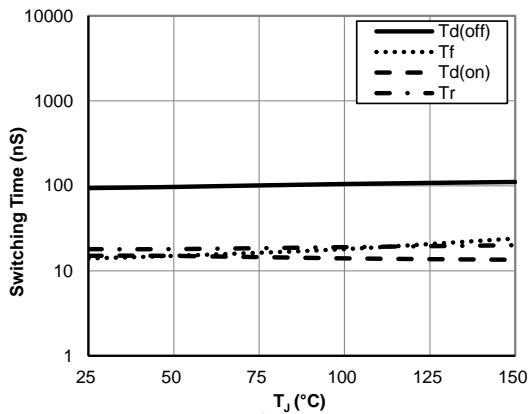


Figure 15: Switching Time vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}, R_g=20\Omega$)

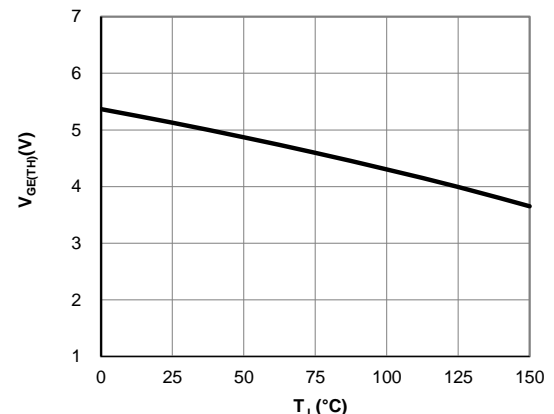


Figure 16: $V_{GE(TH)}$ vs. T_J

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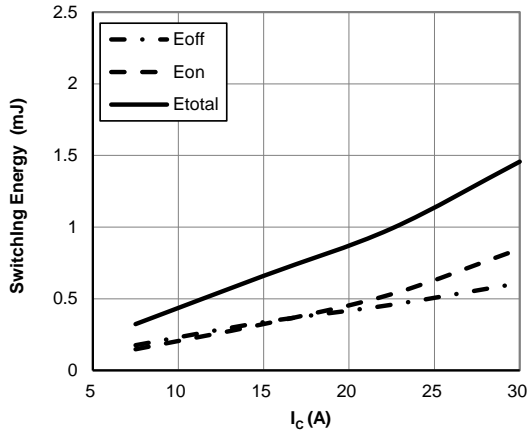


Figure 17: Switching Loss vs. I_C
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=20\Omega$)

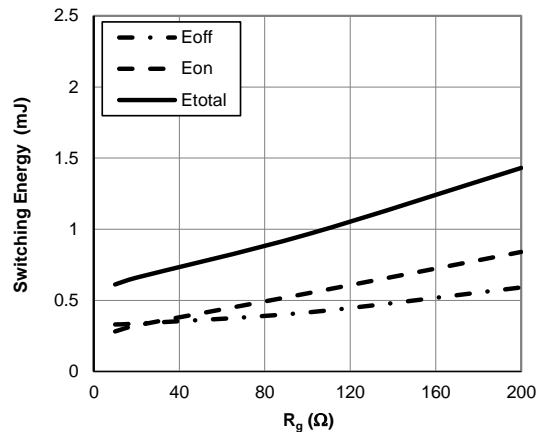


Figure 18: Switching Loss vs. R_g
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}$)

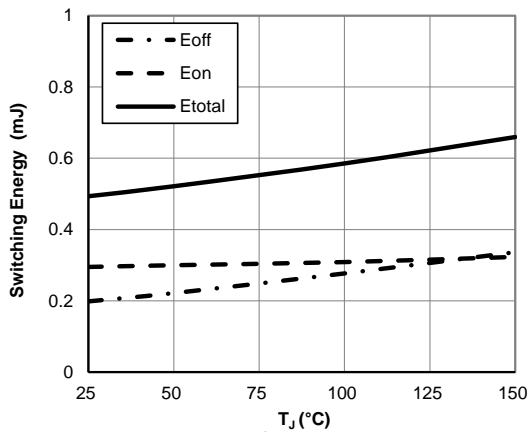


Figure 19: Switching Loss vs. T_J
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=15\text{A}, R_g=20\Omega$)

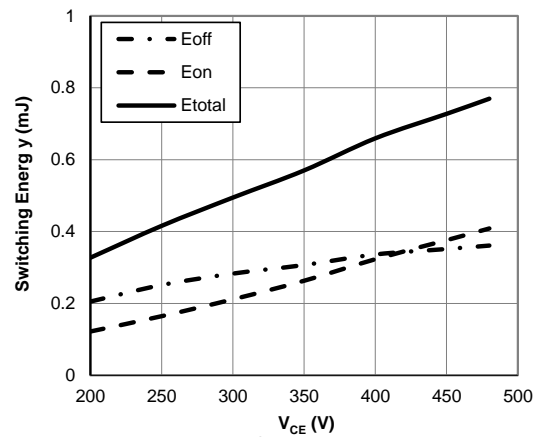


Figure 20: Switching Loss vs. V_{CE}
($T_J=150^\circ\text{C}, V_{GE}=15\text{V}, I_C=15\text{A}, R_g=20\Omega$)

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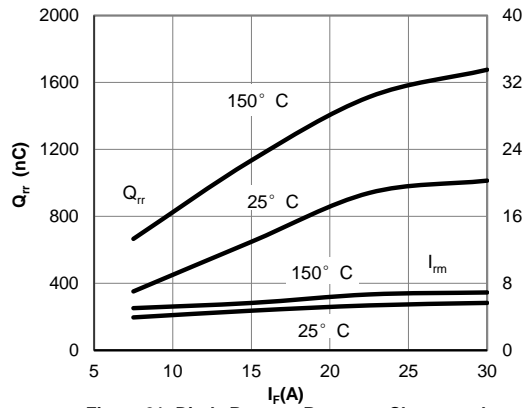


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

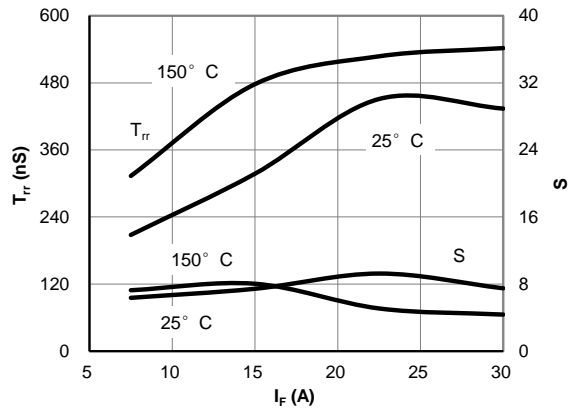


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

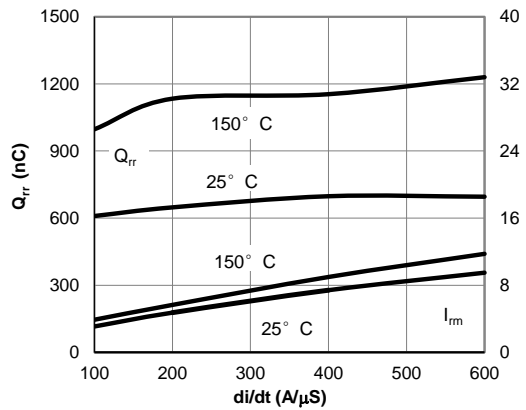


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=15A$)

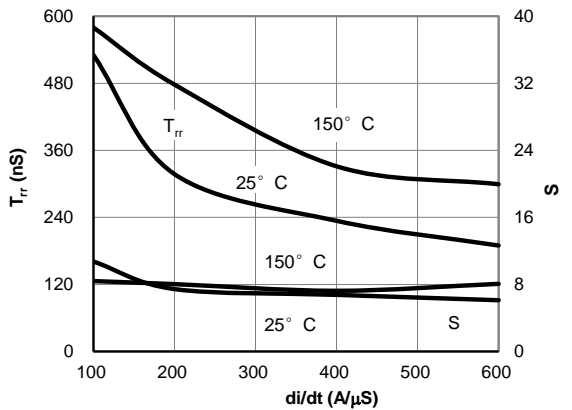


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=15A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

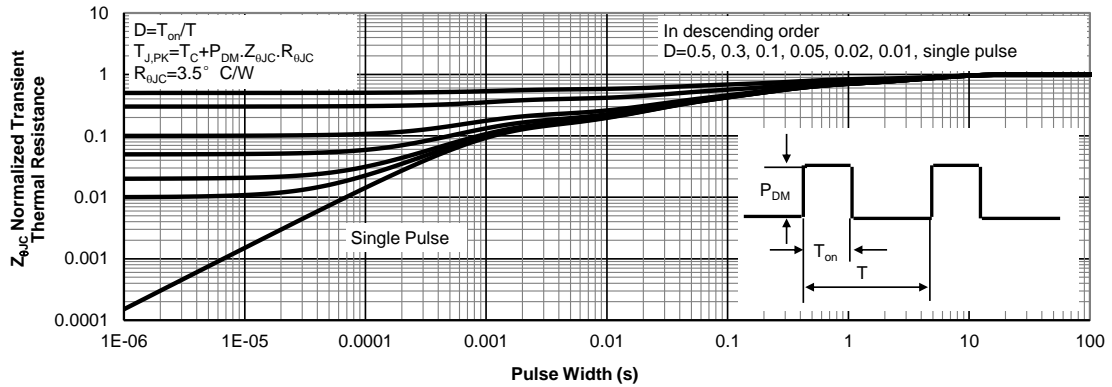


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

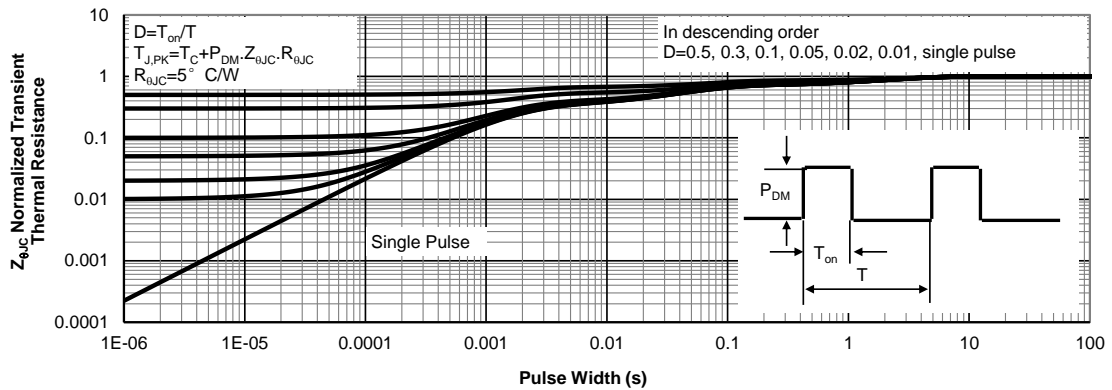


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

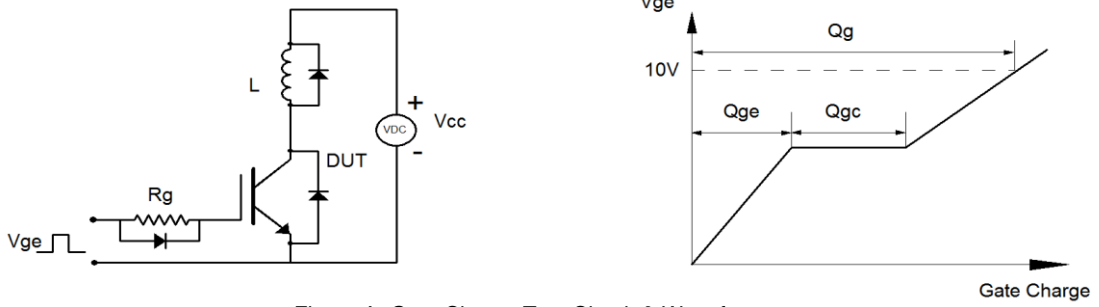


Figure A: Gate Charge Test Circuit & Waveforms

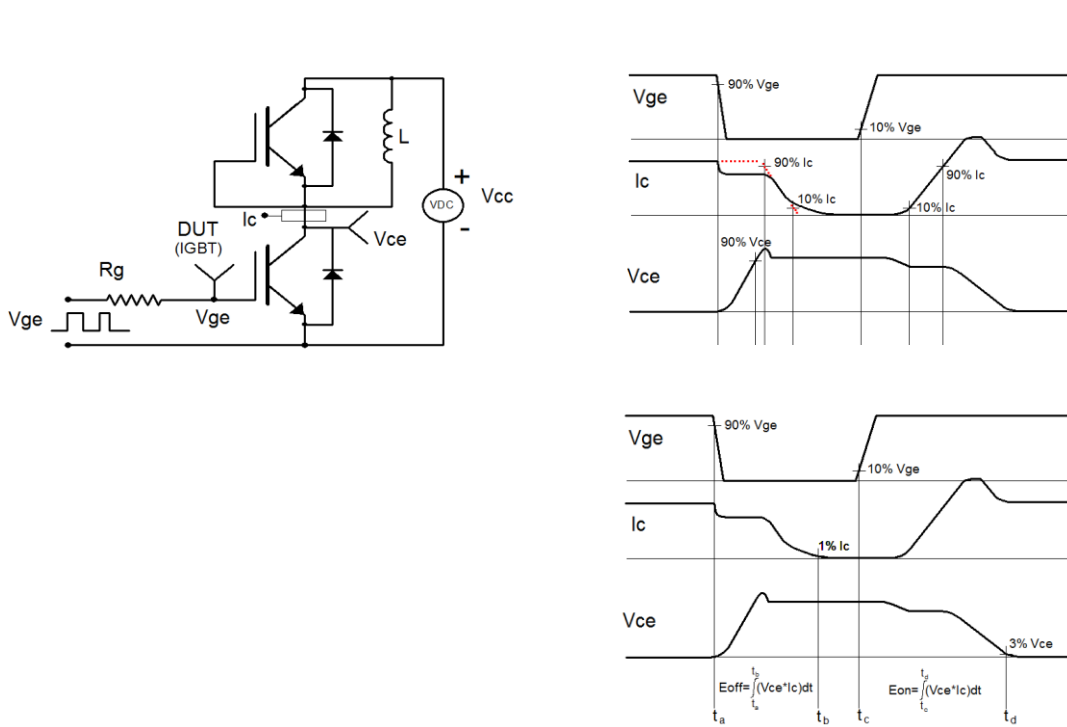


Figure B: Inductive Switching Test Circuit & Waveforms

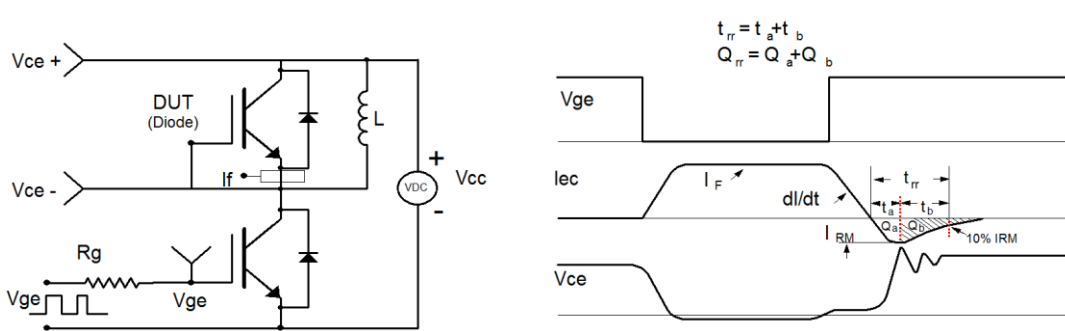


Figure C: Diode Recovery Test Circuit & Waveforms