ALPHA & OMEGA SEMICONDUCTOR

AOTF15B65M3

650V, 15A AlphaIGBT™

With soft and fast recovery anti-parallel diode

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

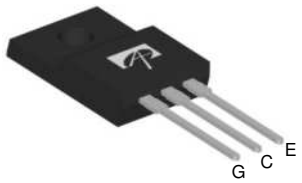
- Motor drives
- Sewing machines
- Home appliances
- Fan, pumps, vacuum cleaner
- Other hard switching applications

Product Summary

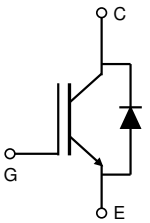
V_{CE}	650V
I_C (T_C=100°C)	15A
$V_{CE(sat)}$ (T_J=25°C)	1.95V

Green Product

TO-220F



AOTF15B65M3



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOTF15B65M3	TO220F	Tube	1000

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOTF15B65M3	Units
Collector-Emitter Voltage		V_{CE}	650	V
Gate-Emitter Voltage		V_{GE}	±30	V
Continuous Collector Current	T_C=25°C	I_C	30[2]	A
	T_C=100°C		15[2]	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	45	A
Turn off SOA, V_{CE}≤650V, Limited by T_{Jmax}		I_{LM}	45	A
Continuous Diode Forward Current	T_C=25°C	I_F	20[2]	A
	T_C=100°C		10[2]	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	30	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	30	W
	T_C=100°C		12	
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	AOTF15B65M3	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	65	°C/W
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	4.2	°C/W
Maximum Diode Junction-to-Case	$R_{\theta JC}$	7	°C/W

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

2) TO220F I_C follows 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=1mA, V_{GE}=0V, T_J=25°C		650	-	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=15A	T_J=25°C	-	1.95	2.5	V
			T_J=125°C	-	2.46	-	
			T_J=150°C	-	2.61	-	
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=10A	T_J=25°C	-	1.9	2.4	V
			T_J=125°C	-	1.96	-	
			T_J=150°C	-	1.95	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE}=5V, I_C=1mA		-	5.1	-	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}=±30V		-	-	±100	nA
g_{FS}	Forward Transconductance	V_{CE}=20V, I_C=15A		-	9	-	S
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CC}=25V, f=1MHz		-	655	-	pF
C_{oes}	Output Capacitance			-	68	-	pF
C_{res}	Reverse Transfer Capacitance			-	25	-	pF
Q_g	Total Gate Charge	V_{GE}=15V, V_{CC}=520V, I_C=15A		-	25.4	-	nC
Q_{ge}	Gate to Emitter Charge			-	7.5	-	nC
Q_{gc}	Gate to Collector Charge			-	11	-	nC
$I_{C(SC)}$	Short circuit collector current	V_{GE}=15V, V_{CC}=400V, $t_{sc}\leqslant$5us, $T_J\leqslant$150°C		-	70	-	A
R_g	Gate resistance	V_{GE}=0V, V_{CC}=0V, f=1MHz		-	5.8	-	Ω
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=25°C, V_{GE}=15V, V_{CC}=400V, I_C=15A, R_G=20Ω		-	10	-	ns
t_r	Turn-On Rise Time			-	17	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	68	-	ns
t_f	Turn-Off Fall Time			-	16	-	ns
E_{on}	Turn-On Energy			-	0.28	-	mJ
E_{off}	Turn-Off Energy			-	0.19	-	mJ
E_{total}	Total Switching Energy			-	0.47	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=25°C, I_F=10A, di/dt=200A/µs, V_{CC}=400V		-	263	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.4	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	3.8	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=150°C)							
$t_{D(on)}$	Turn-On DelayTime	T_J=150°C, V_{GE}=15V, V_{CC}=400V, I_C=15A, R_G=20Ω		-	9	-	ns
t_r	Turn-On Rise Time			-	18	-	ns
$t_{D(off)}$	Turn-Off Delay Time			-	80	-	ns
t_f	Turn-Off Fall Time			-	28	-	ns
E_{on}	Turn-On Energy			-	0.3	-	mJ
E_{off}	Turn-Off Energy			-	0.31	-	mJ
E_{total}	Total Switching Energy			-	0.61	-	mJ
t_{rr}	Diode Reverse Recovery Time	T_J=150°C, I_F=10A, di/dt=200A/µs, V_{CC}=400V		-	262	-	ns
Q_{rr}	Diode Reverse Recovery Charge			-	0.6	-	µC
I_{rm}	Diode Peak Reverse Recovery Current			-	4.5	-	A

APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO MAKE CHANGES TO PRODUCT SPECIFICATIONS WITHOUT NOTICE. IT IS THE RESPONSIBILITY OF THE CUSTOMER TO EVALUATE SUITABILITY OF THE PRODUCT FOR THEIR INTENDED APPLICATION. CUSTOMER SHALL COMPLY WITH APPLICABLE LEGAL REQUIREMENTS, INCLUDING ALL APPLICABLE EXPORT CONTROL RULES, REGULATIONS AND LIMITATIONS.

AOS' products are provided subject to AOS' terms and conditions of sale which are set forth at:
http://www.aosmd.com/terms_and_conditions_of_sale

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

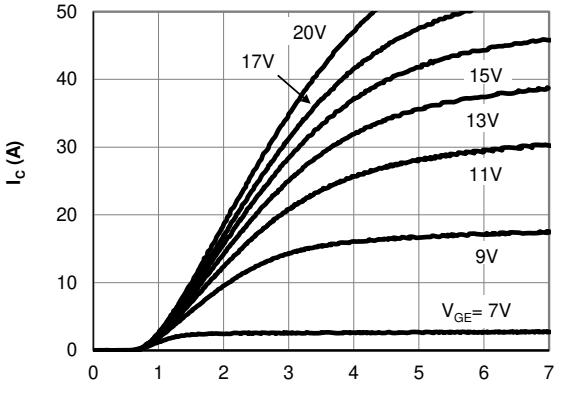


Figure 1: Output Characteristic (T_j=25°C)

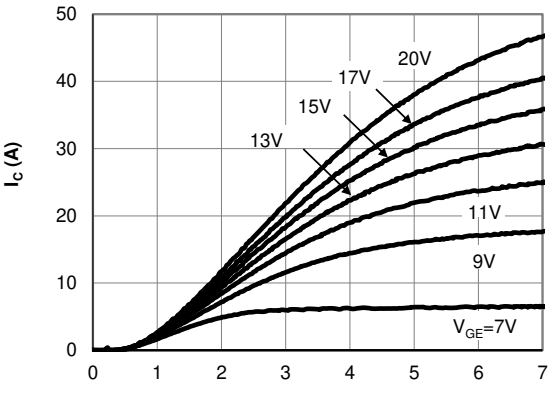


Figure 2: Output Characteristic (T_j=150°C)

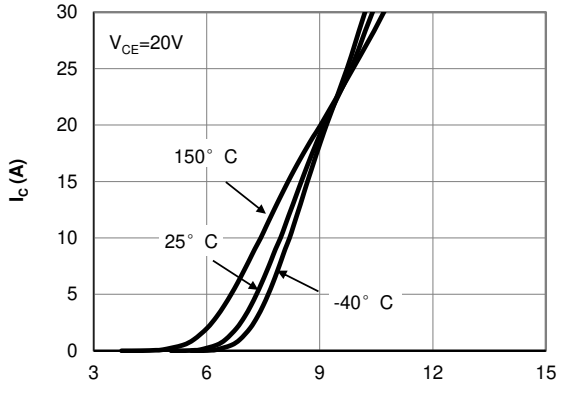


Figure 3: Transfer Characteristic

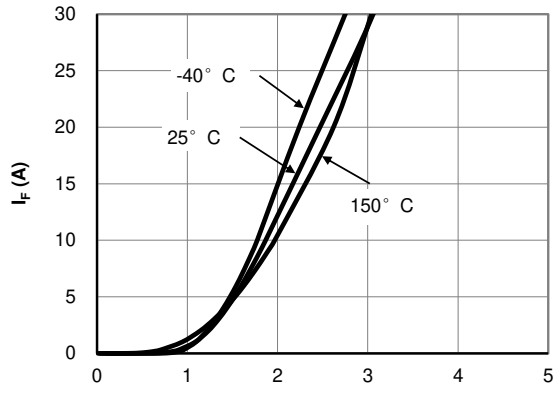


Figure 4: Diode Characteristic

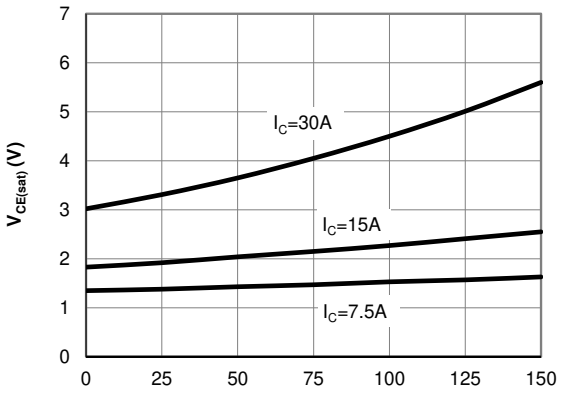


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

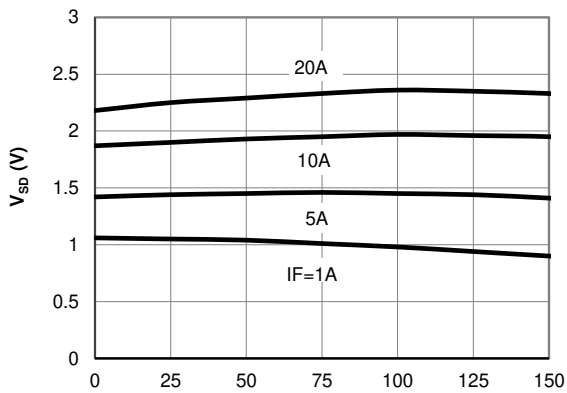


Figure 6: Diode Forward voltage vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

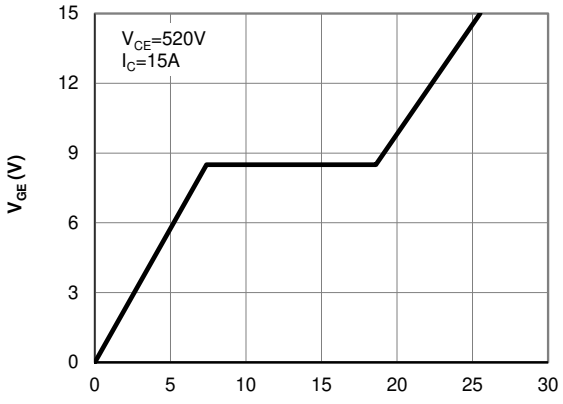


Figure 7: Gate-Charge Characteristics

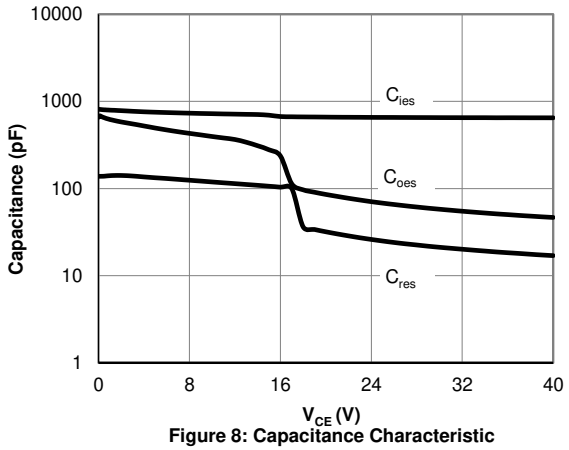


Figure 8: Capacitance Characteristic

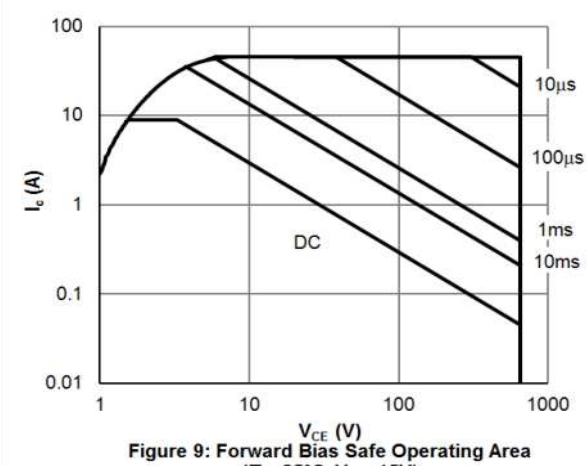


Figure 9: Forward Bias Safe Operating Area
(T_C=25°C, V_{GE}=15V)

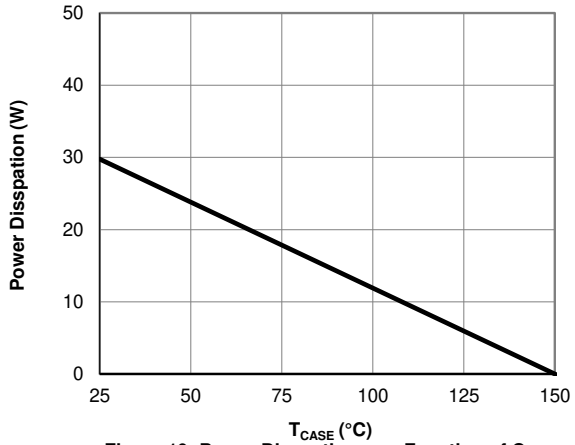


Figure 10: Power Disspation as a Function of Case

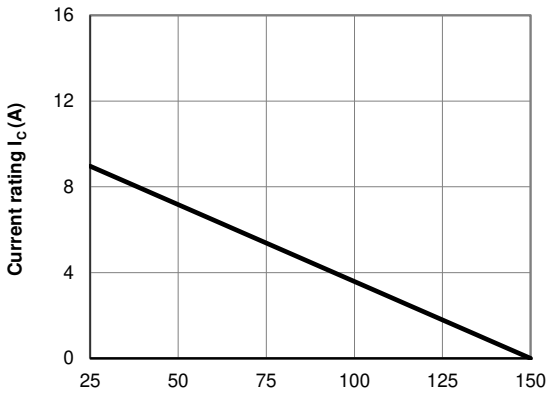


Figure 11: Current De-rating

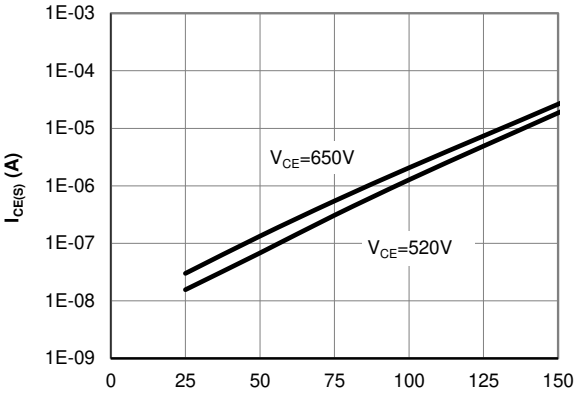


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

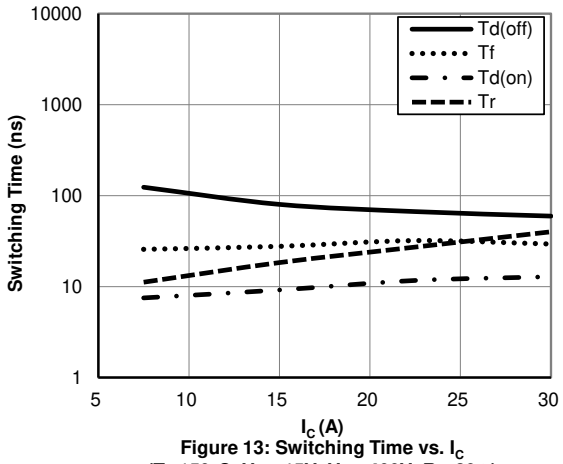


Figure 13: Switching Time vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=20Ω)

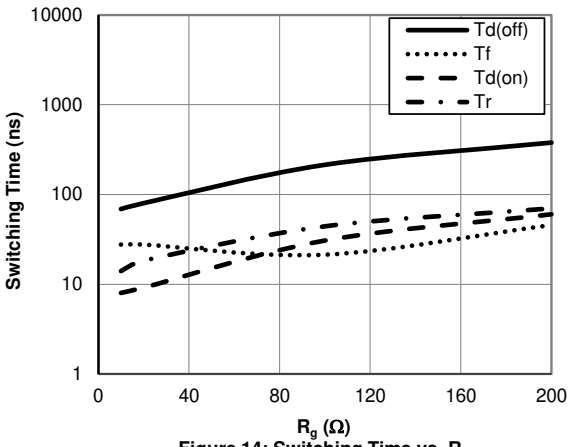


Figure 14: Switching Time vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=15A)

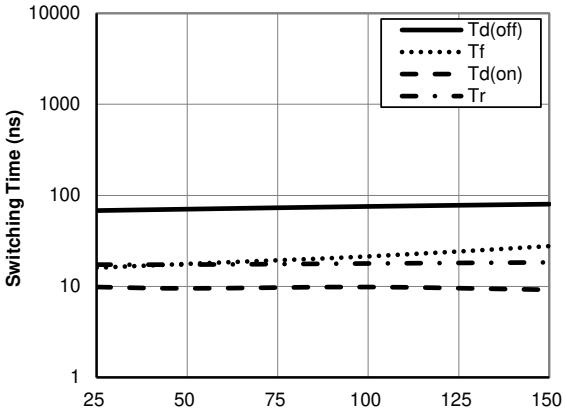


Figure 15: Switching Time vs.T_j
(V_{GE}=15V, V_{CE}=400V, I_C=15A, R_g=20Ω)

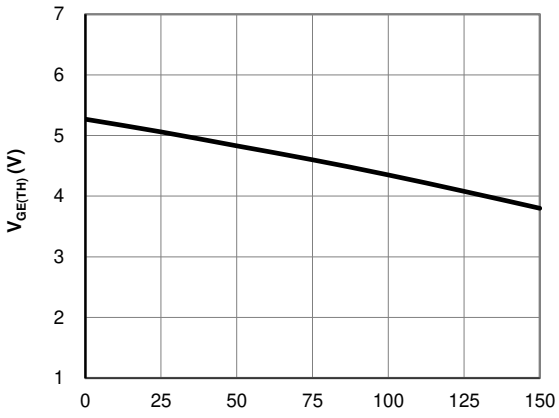


Figure 16: $V_{GE(TH)}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

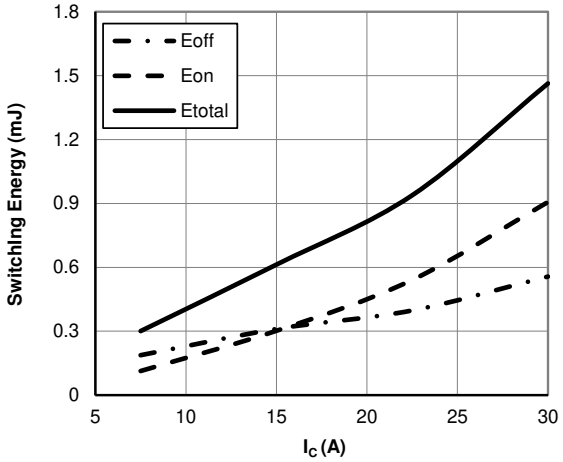


Figure 17: Switching Loss vs. I_C
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, R_g=20Ω)

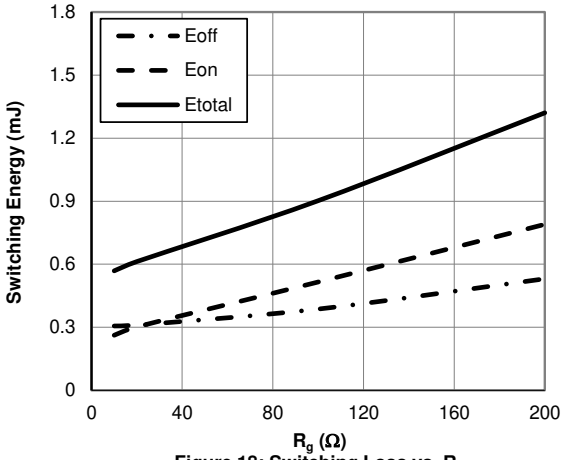


Figure 18: Switching Loss vs. R_g
(T_j=150°C, V_{GE}=15V, V_{CE}=400V, I_C=15A)

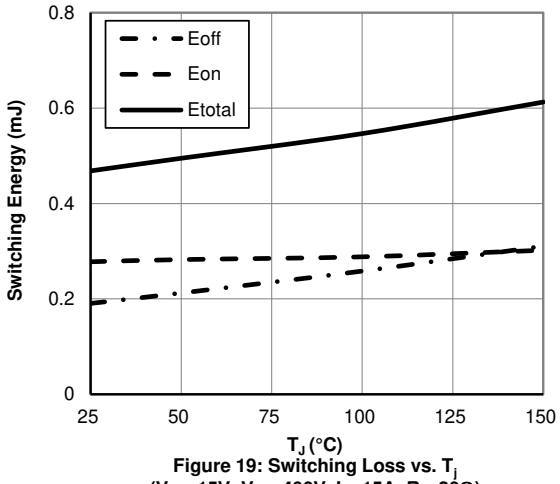


Figure 19: Switching Loss vs. T_j
(V_{GE}=15V, V_{CE}=400V, I_C=15A, R_g=20Ω)

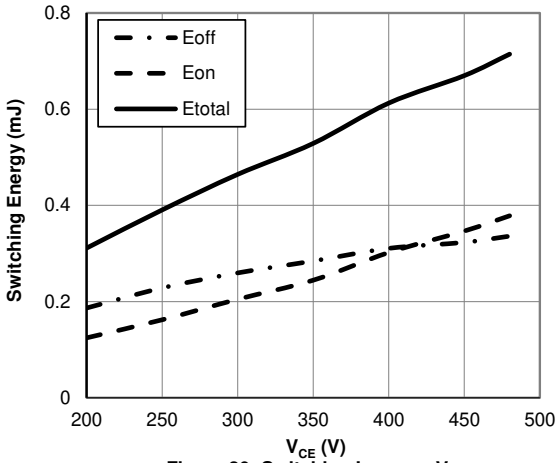


Figure 20: Switching Loss vs. V_{CE}
(T_j=150°C, V_{GE}=15V, I_C=15A, R_g=20Ω)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

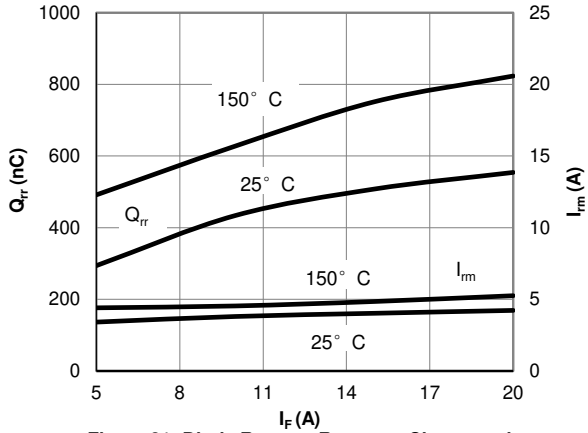


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current (V_{GE}=15V, V_{CE}=400V, di/dt=200A/µs)

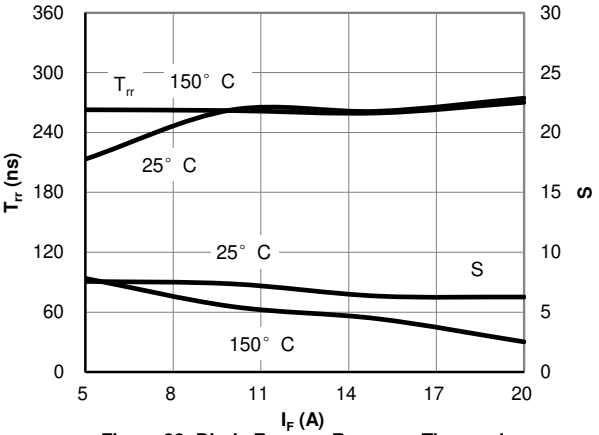


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current (V_{GE}=15V, V_{CE}=400V, di/dt=200A/µs)

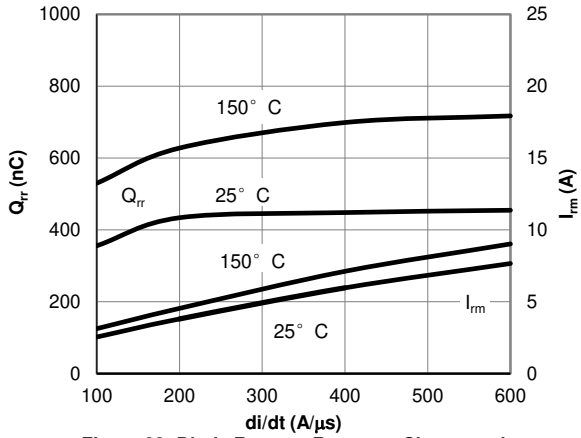


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt (V_{GE}=15V, V_{CE}=400V, I_F=10A)

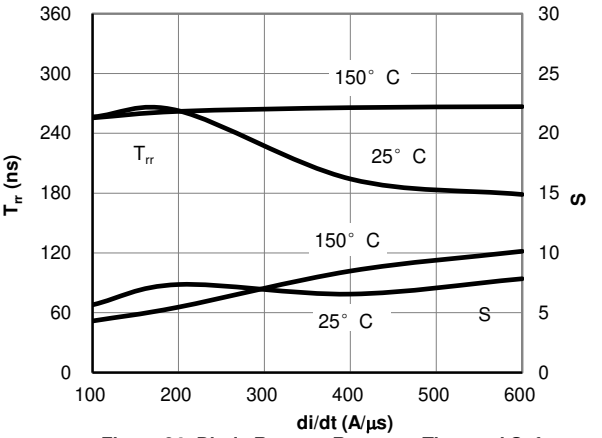


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt (V_{GE}=15V, V_{CE}=400V, I_F=10A)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

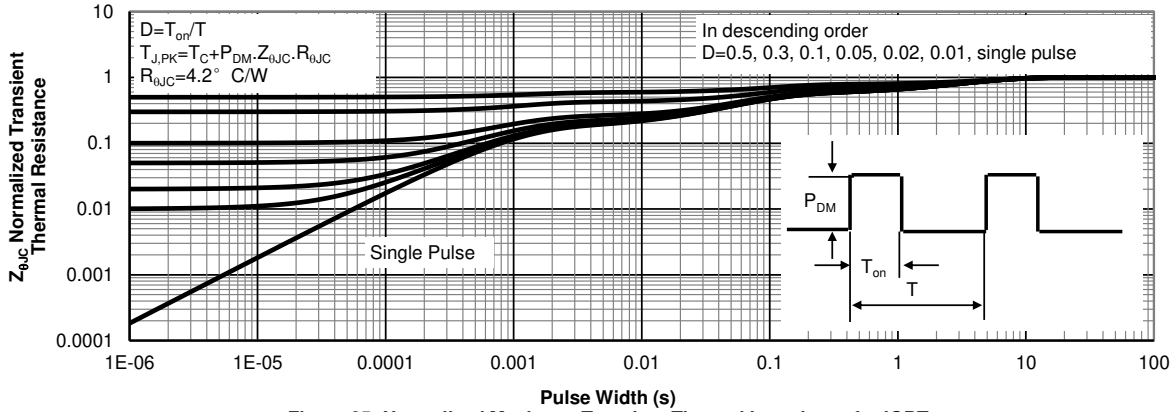


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

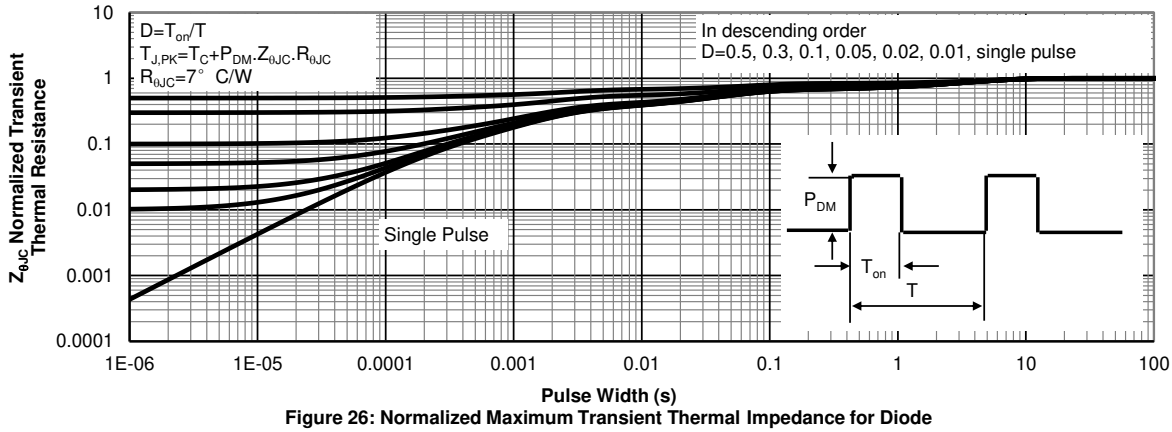


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

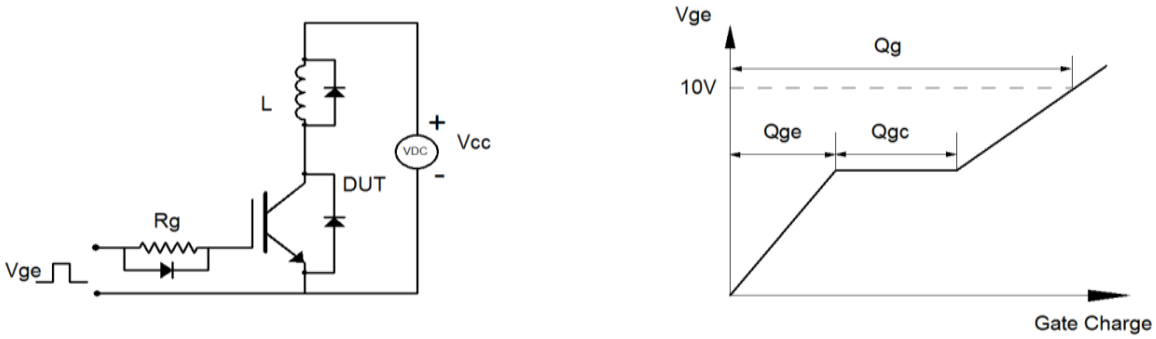


Figure A: Gate Charge Test Circuit & Waveforms

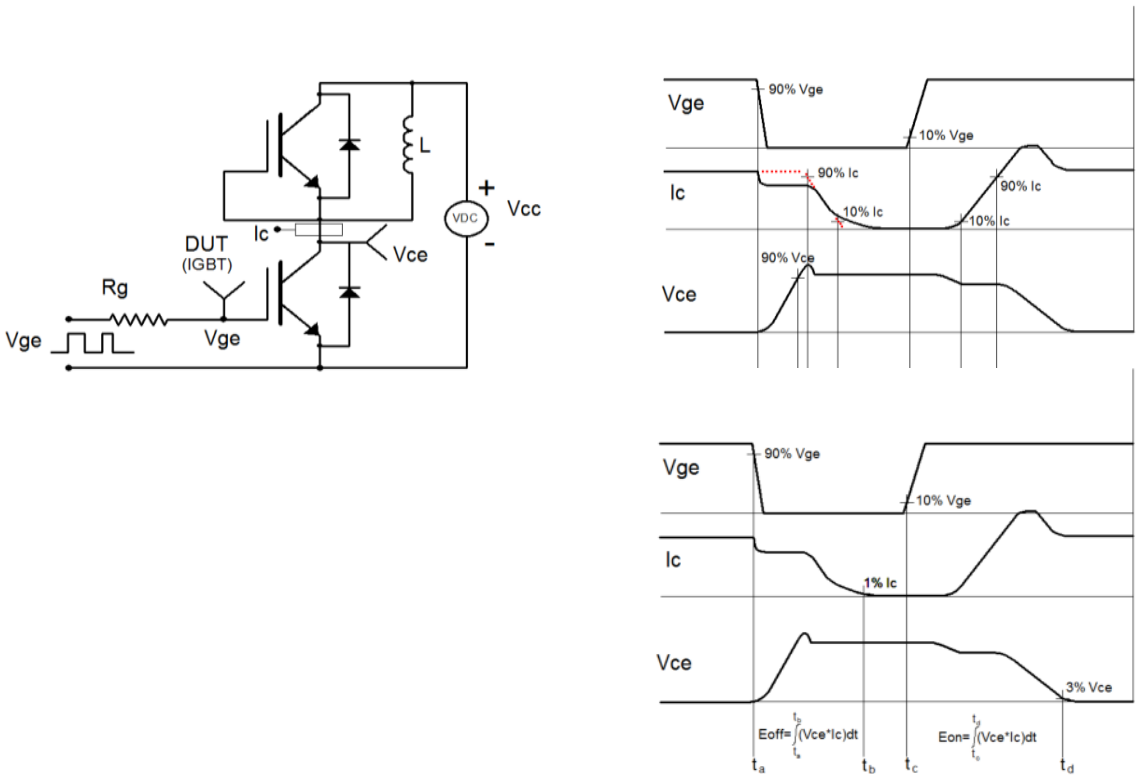


Figure B: Inductive Switching Test Circuit & Waveforms

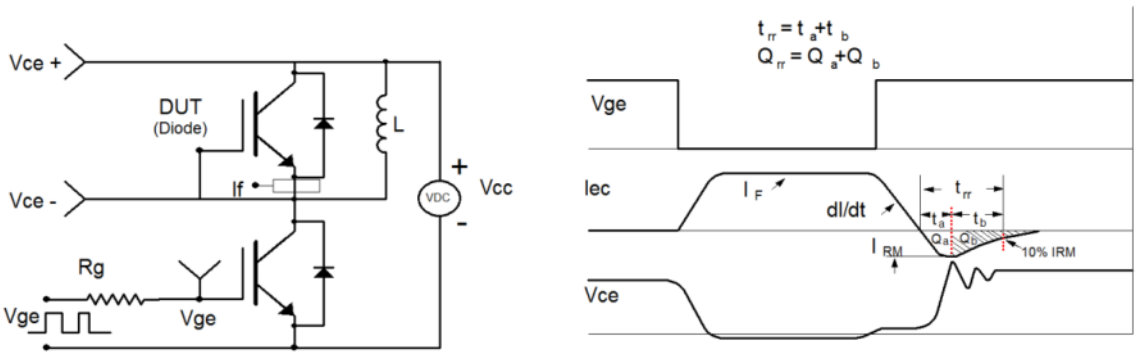


Figure C: Diode Recovery Test Circuit & Waveforms