650V 20A Insulated Gate Bipolar Transistor
AK1B65A020FHT

Description:

Gen 3 IGBT with soft, fast recovery full current rated anti-parallel Emitter Controlled diode, providing ultra-low conduction loss. They are designed for applications such as UPS, Motor Drives, etc.

Features:

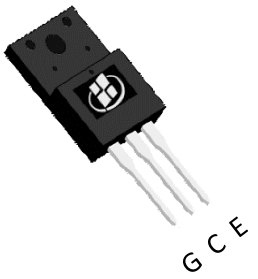
- Low V_{CESAT}
- Low EMI
- Very soft, fast recovery full current anti-parallel diode
- Maximum junction temperature T_{VJmax} = 175°C
- RoHS compliant
- Halogen-free

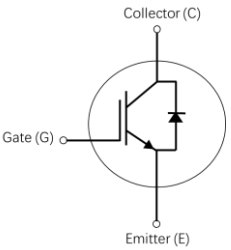
Applications:

- UPS
- Motor Drives
- Fan, Pumps, Vacuum Cleaner
- Home Appliances

Key Performance Parameters:

Parameter	Value	Unit
V_{CE}	650	V
V_{CESAT}, T_{VJ} = 25°C	1.4	V
I_C	20	A





Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AK1B65A020FHT	TO220F	1B65A020FHT	Tube	See the detail package information

Maximum Ratings (T_{VJ} = 25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V_{CE}	Collector - Emitter Voltage	650	V
I_C	Collector Current - Continuous (T_C = 25°C) (Note 1)	40	A
	Collector Current - Continuous (T_C = 100°C)	20	A
I_{CM}	Collector Current - Pulsed (Note 2)	60	A
I_F	Diode Forward Current, Limited by T_{VJmax} (T_C = 25°C)	40	A
	Diode Forward Current, Limited by T_{VJmax} (T_C = 100°C)	20	A
I_{FM}	Diode Pulsed Current - Pulsed (Note 2)	60	A
V_{GE}	Gate - Emitter Voltage	±20	V
	Transient Gate - Emitter Voltage (tp ⩽ 10μs, D < 0.010)	±30	
P_D	Power Dissipation (T_C = 25°C)	42.5	W
	Power Dissipation (T_C = 100°C)	21	W
t_{SC}	Short - circuit withstand time (V_{CC} ⩽ 400 V, V_{GE} = 15 V)	5	μs
T_{VJ}	Operating Junction Temperature Range	-55 to +175	°C
T_{STG}	Storage Temperature Range	-55 to +150	°C

Thermal Characteristics

Symbol	Parameter	Value	Units
$R_{\theta JC}$	IGBT Thermal Resistance, Junction - to - Case, Steady - State	3.5	°C/W
$R_{\theta JC}$	Diode Thermal Resistance, Junction - to - Case, Steady - State	5.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction - to - Ambient Steady State	60	°C/W

Notes:

1. The max collector current rating follow TO-220/TO-263 current limitation
2. Repetitive rating: pulse width limited by maximum junction temperature

Electrical Characteristics (T_{VJ} = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static Characteristics						
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 0.25 mA	650			V
V_{CESAT}	Collector-Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 20 A		1.4	1.8	V
		V_{GE} = 15 V, I_C = 20 A, T_{VJ} = 125°C		1.57		
		V_{GE} = 15 V, I_C = 20 A, T_{VJ} = 175°C		1.63		
V_F	Diode Forward Voltage	V_{GE} = 0 V, I_F = 20 A		1.55	2.4	V
		V_{GE} = 0 V, I_F = 20 A, T_{VJ} = 125°C		1.43		
		V_{GE} = 0 V, I_F = 20 A, T_{VJ} = 175°C		1.4		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE} = V_{GE}, I_C = 0.2 mA	4.0	6.0	7.0	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE} = 650 V, V_{GE} = 0 V			25	μA
		V_{CE} = 650 V, V_{GE} = 0 V,T_{VJ} = 175°C		500		
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = ± 20 V, V_{CE} = 0 V			±100	nA
g_{fs}	Transconductance	V_{CE} = 20 V, I_C = 20 A		17		S
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 25 V, V_{GE} = 0 V, F = 1 MHz		1720		pF
C_{oes}	Output Capacitance			54		pF
C_{res}	Reverse Transfer Capacitance			16		pF
Q_G	Total Gate Charge	V_{CC} = 520 V , I_C = 20 A, V_{GE} = 15 V		100		nC
Q_{GE}	Gate-Emitter Charge			13		nC
Q_{GC}	Gate-Collector Charge			36		nC
L_E	Internal Emitter Inductance			13		nH
Switching Characteristics, Inductive Load (T_{VJ} = 25°C)						
$t_{d(on)}$	Turn On Delay Time	V_{CC} = 400 V I_C = 20 A V_{GE} = 15 V R_{Gon} = 10 Ω R_{Goff} = 10 Ω		11		ns
t_r	Rise Time			15		ns
$t_{d(off)}$	Turn Off Delay Time			84		ns
t_f	Fall Time			90		ns
E_{on}	Turn On Energy			0.52		mJ
E_{off}	Turn Off Energy			0.36		mJ
E_{ts}	Total Switching Energy			0.88		mJ

Diode Characteristics (T_{VJ} = 25°C)						
t_{rr}	Reverse Recovery Time	V_R = 400 V, I_F = 20 A, di/dt = 1000 A/μs		100		ns
Q_{rr}	Reverse Recovery Charge			0.83		μC
I_{rrm}	Peak Reverse Recovery Current			25.2		A
dirr/dt	Diode Peak Rate of Fall of Reverse Recovery Current			1680		A/μs

Switching Characteristics, Inductive Load (T_{VJ} = 175°C)						
$t_{d(on)}$	Turn On Delay Time	V_{CC} = 400 V I_C = 20 A V_{GE} = 15 V $R_{G(on)}$ = 10 Ω $R_{G(off)}$ = 10 Ω		11		ns
t_r	Rise Time			46		ns
$t_{d(off)}$	Turn Off Delay Time			105		ns
t_f	Fall Time			150		ns
E_{on}	Turn On Energy			0.92		mJ
E_{off}	Turn Off Energy			0.56		mJ
E_{ts}	Total Switching Energy			1.48		mJ

Diode Characteristics (T_{VJ} = 175°C)						
t_{rr}	Reverse Recovery Time	V_R = 400 V, I_F = 20 A, di/dt = 1000 A/μs		252		ns
Q_{rr}	Reverse Recovery Charge			2.70		μC
I_{rrm}	Peak Reverse Recovery Current			37.2		A
dirr/dt	Diode Peak Rate of Fall of Reverse Recovery Current			666		A/μs

Electrical Characteristics Diagrams

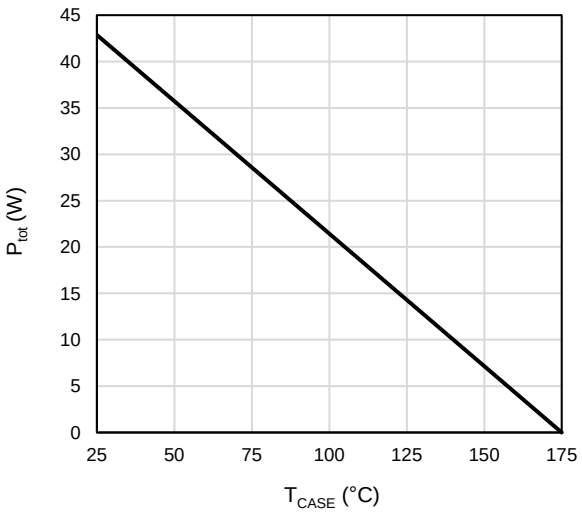


Figure 1: Power De-rating

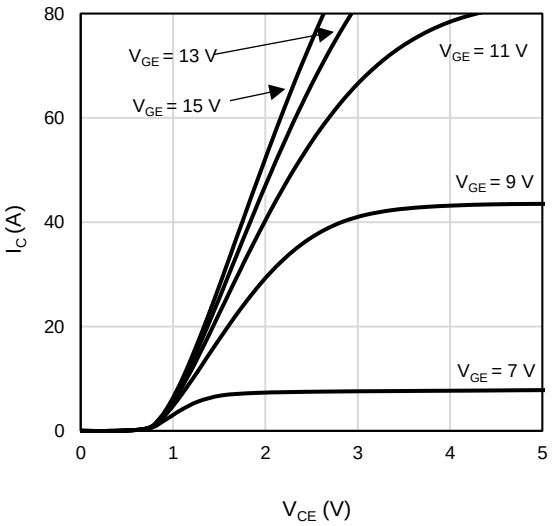


Figure 2: Typical Output Characteristics
(T_{VJ} = 25°C）

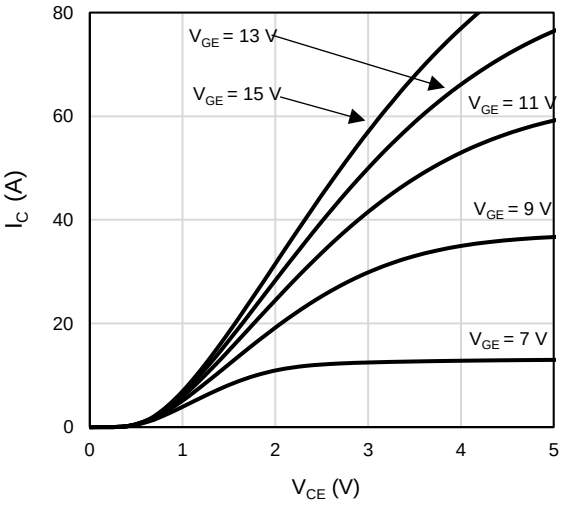


Figure 3: Typical Output Characteristics
(T_{VJ} =175°C）

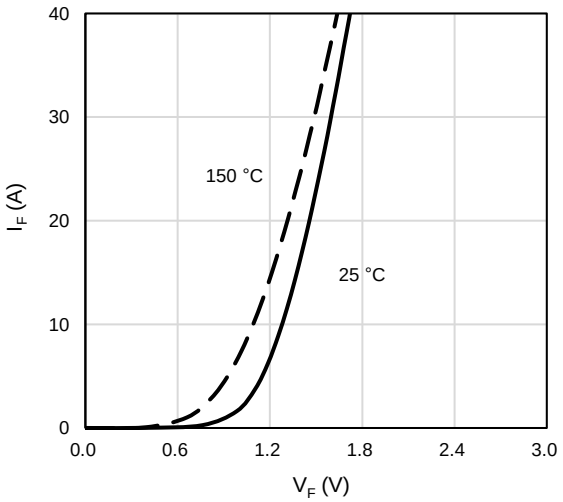


Figure 4: Diode Forward Current Characteristics

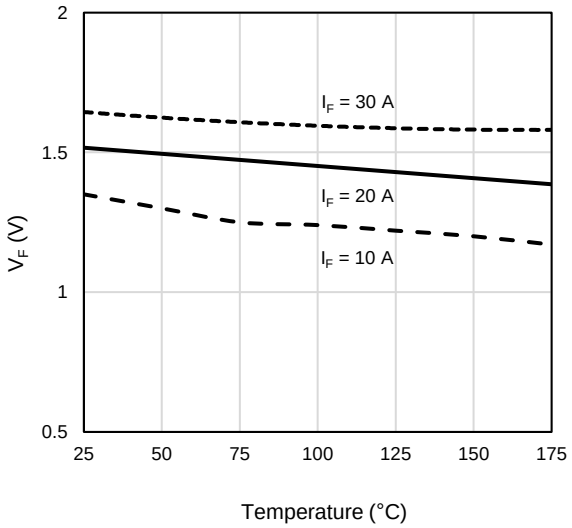


Figure 5: Diode Forward Voltage vs. Junction Temperature

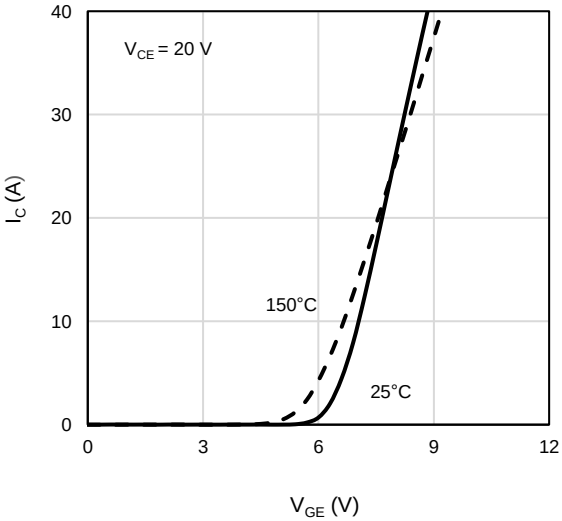


Figure 6: Transfer Characteristics

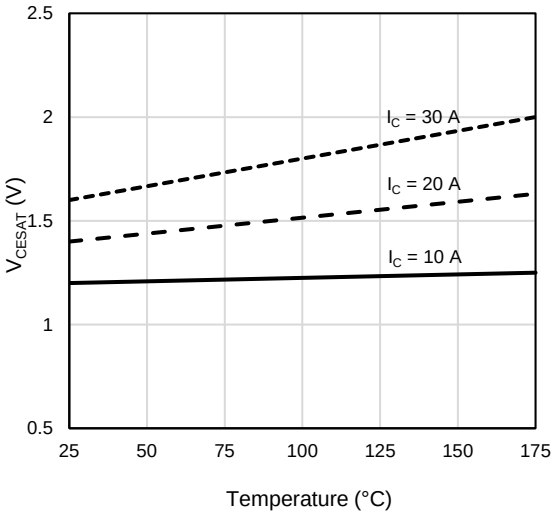


Figure 7: Collect-emitter saturation voltage vs. Junction Temperature

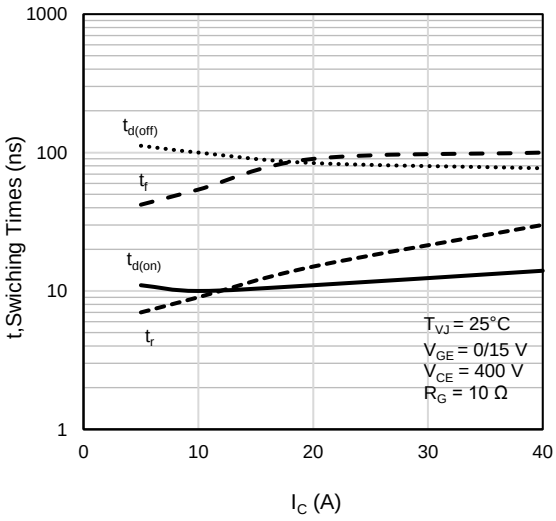


Figure 8: Swiching Times vs. Collector Current

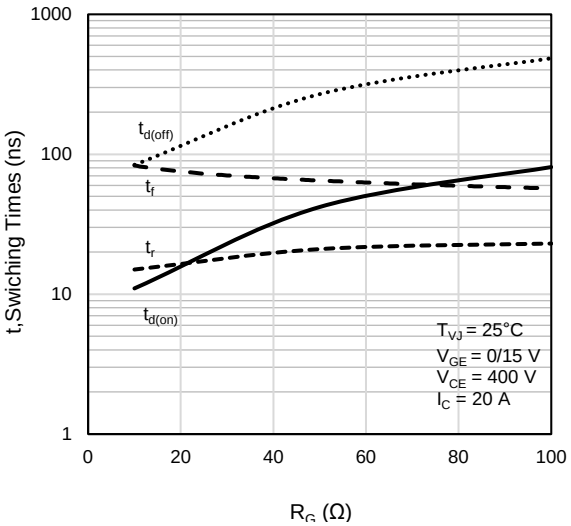


Figure 9: Swiching Times vs. Gate Resistor

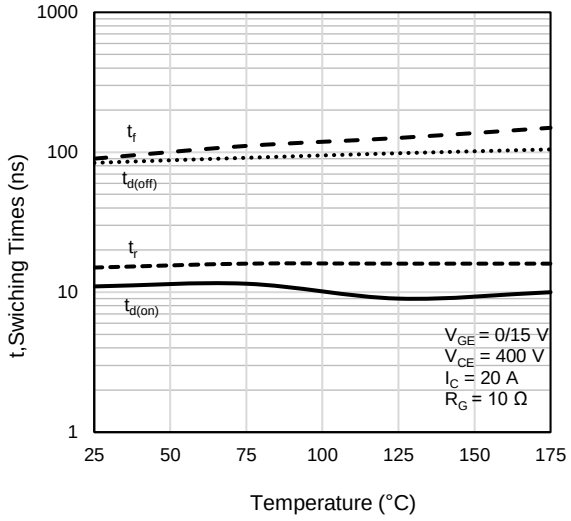


Figure 10: Swiching Times vs. Junction Temperature

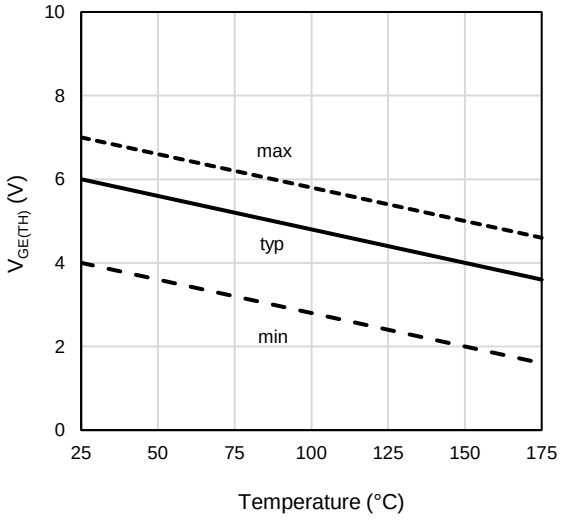


Figure 11: Threshold voltage vs. Junction Temperature

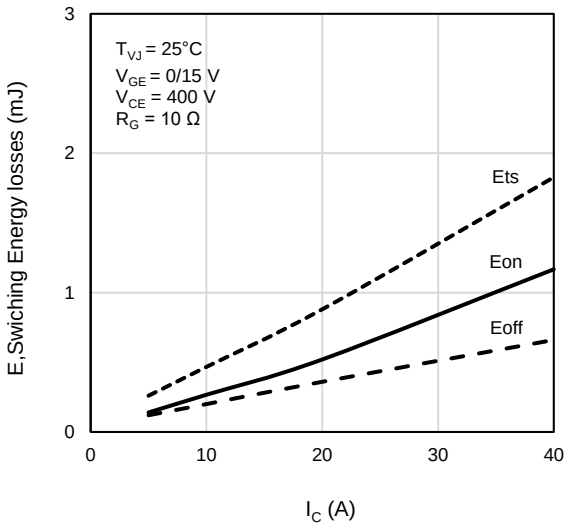


Figure 12: Swiching Energy losses vs. Collector Current

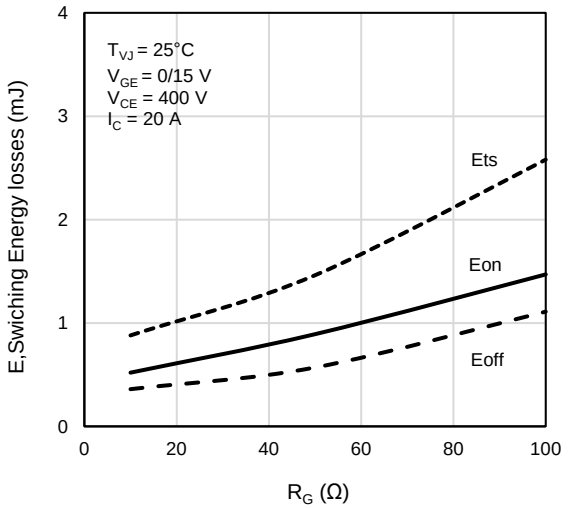


Figure 13: Swiching Energy losses vs. Gate Resistor

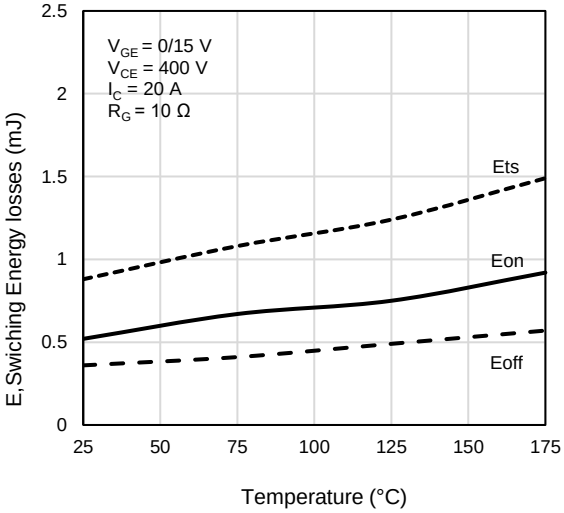


Figure 14: Swiching Energy losses vs. Junction Temperature

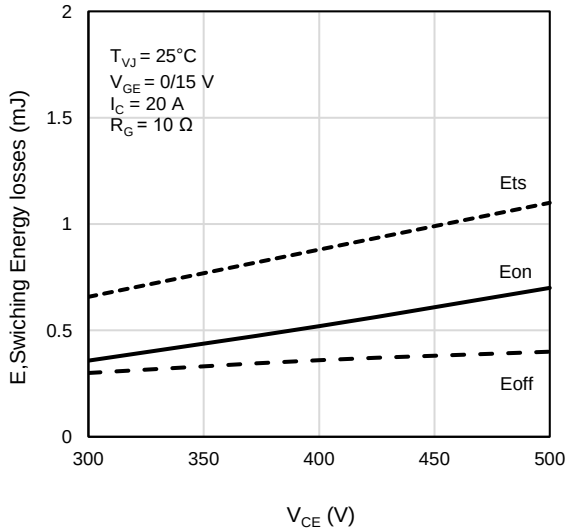


Figure 15: Swiching Energy losses vs. Collector Emitter Voltage

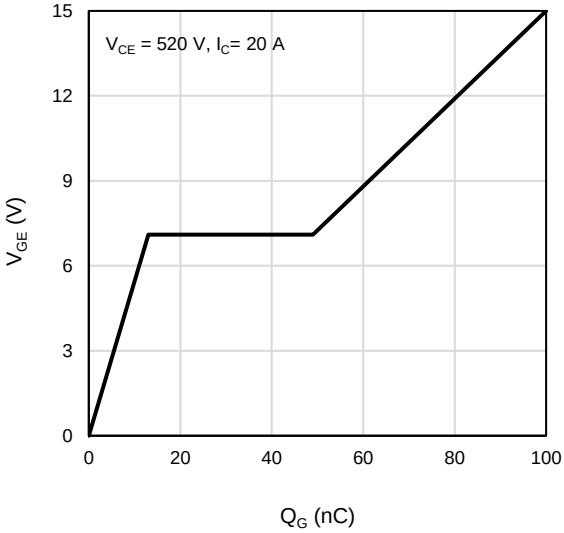


Figure 16: Gate-Charge Characteristics

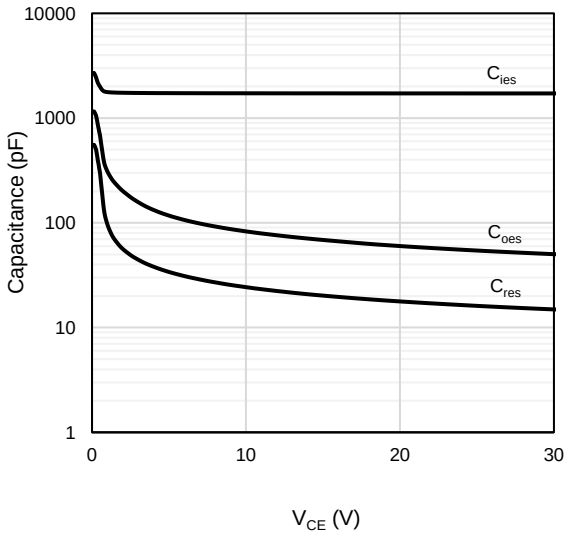


Figure 17: Capacitance Characteristics

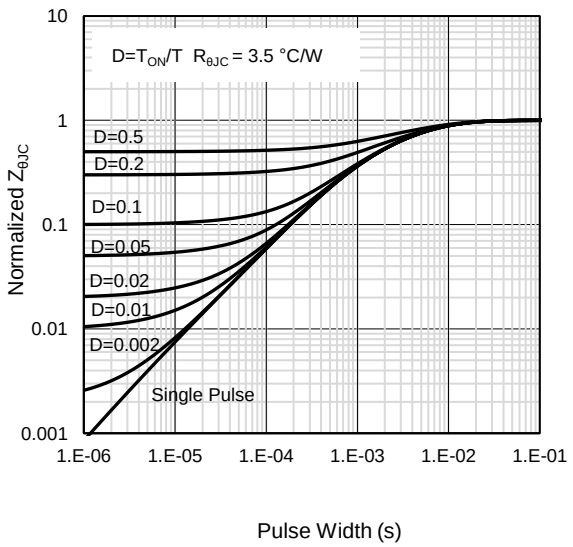


Figure 18: Normalized Maximum IGBT Transient Thermal Impedance

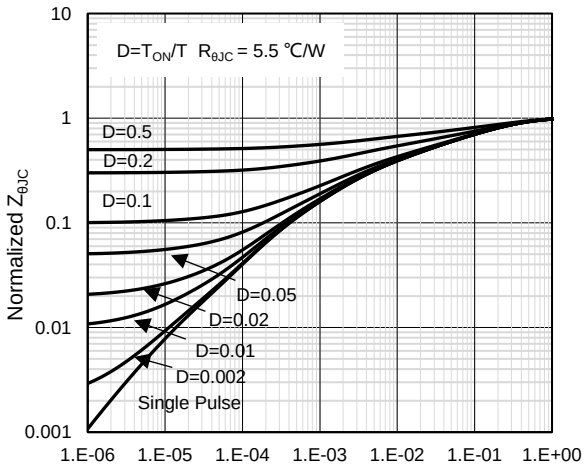


Figure 19: Normalized Maximum Diode Transient Thermal Impedance

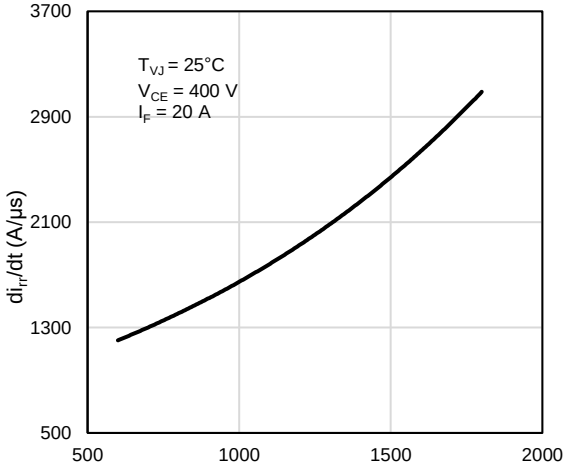


Figure 20: Diode Peak Rate of Fall of Reverse Recovery Current vs. Diode Current Slope

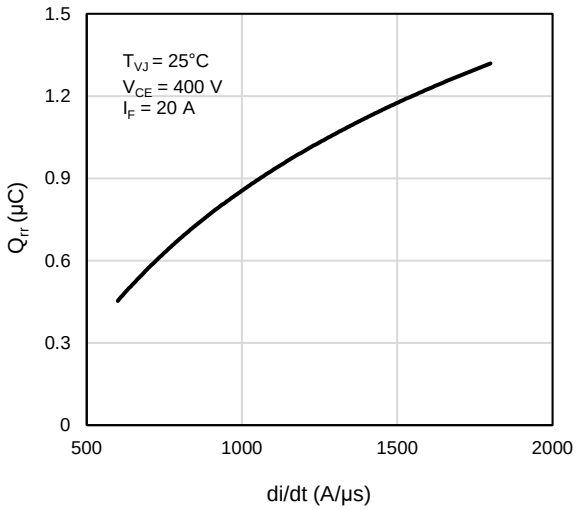


Figure 21: Reverse Recovery Charge vs. Diode Current Slope

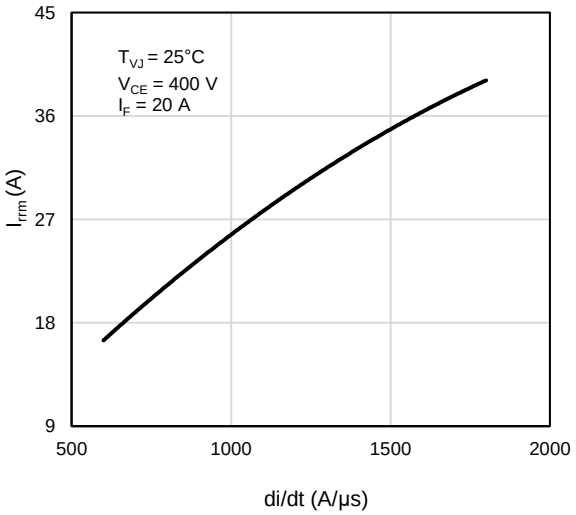


Figure 22: Reverse Recovery Current vs. Diode Current Slope

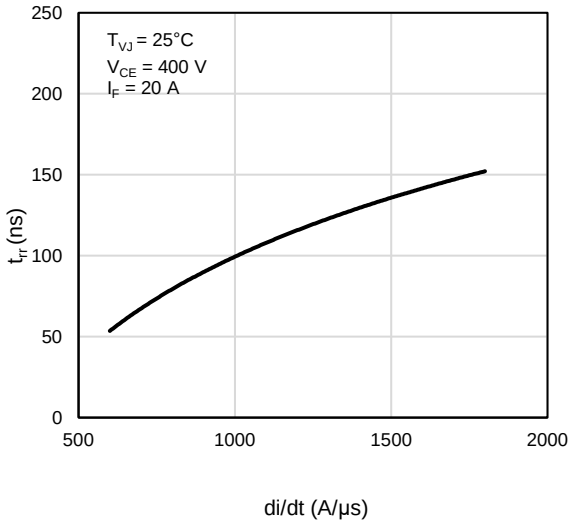
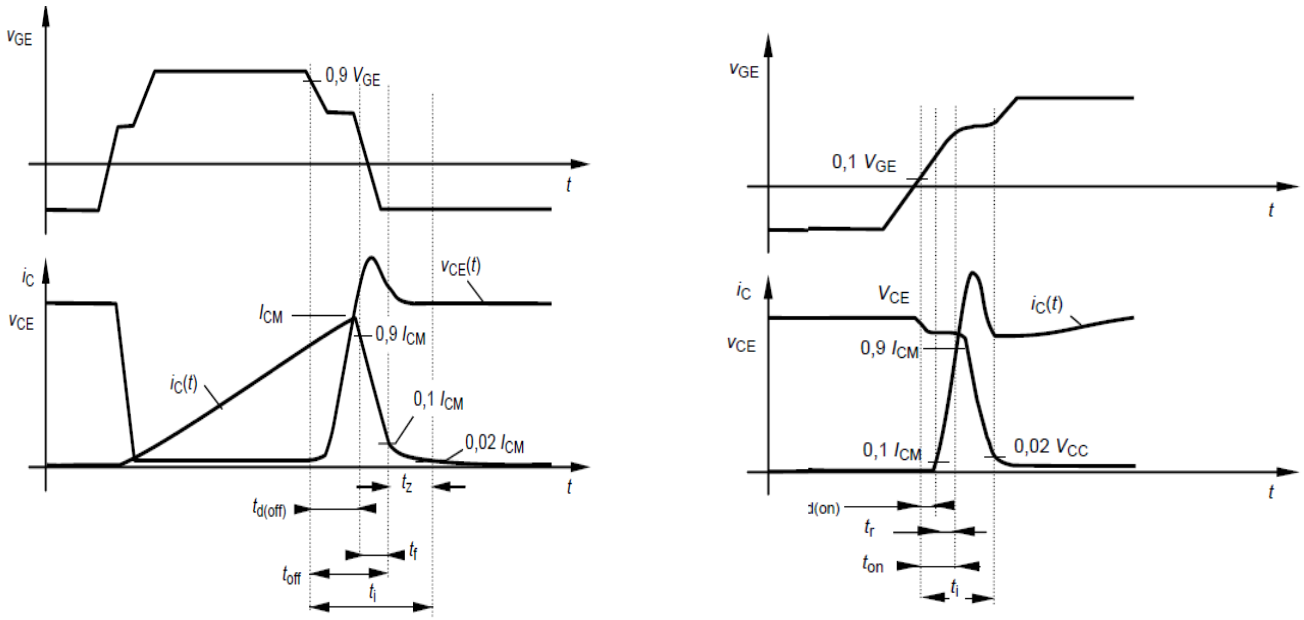


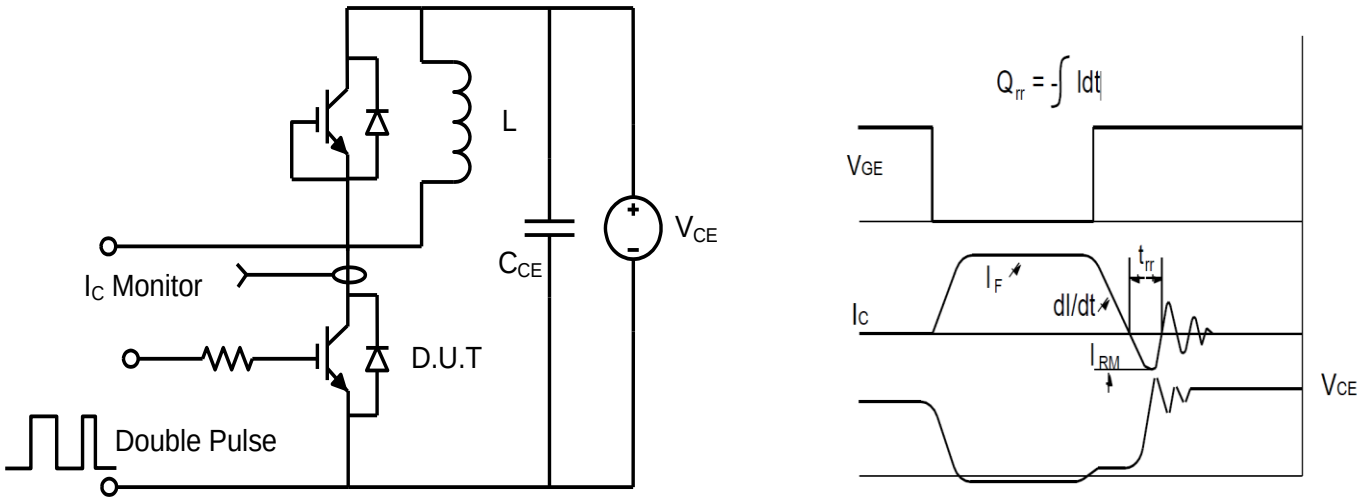
Figure 23: Reverse Recovery Time vs. Diode Current Slope

Test Circuit and Waveform

Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Revision History

Revision	Released	Remark
Rev.1.1	2025	

Disclaimer

The information given in this document describes the independent performance of the product, but similar performance is not guaranteed under other working conditions, and cannot be guaranteed when installed with other products or equipment. To achieve the required performance of the product in actual scenarios, the customer should conduct a complete application test to assess the functionality of the product.

Alkaidsemi assumes no responsibility for equipment failures result from using products at values that exceed the ratings, operating conditions, or other parameters listed in the product specifications.

The product described in this specification is not applicable for aerospace or other applications which requires high reliability. Customers using or selling these products for use in medical, life-saving, or life-sustaining applications do so at their own risk and agree to fully indemnify.

Due to product or technical improvements, the information described or contained herein may be changed without prior notice.