

650V 40A Insulated Gate Bipolar Transistor
AKB65A040WBH

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, inverters, etc.

Features:

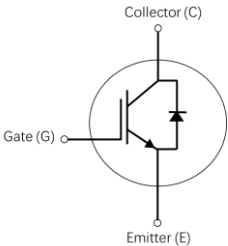
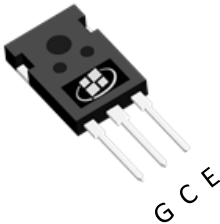
- Easy paralleling capability due to positive temperature coefficient in V_{CESAT}
- Low EMI
- Low Gate Charge
- Very soft, fast recovery full current anti-parallel diode
- Maximum junction temperature $T_{VJmax} = 175^{\circ}C$
- RoHS compliant
- Halogen-free

Applications:

- Industrial UPS
- Charger
- Energy Storage
- Three-Phase Solar String Inverter

Key Performance Parameters:

Parameter	Value	Unit
V_{CE}	650	V
$V_{CESAT}, T_{VJ} = 25^{\circ}C$	1.6	V
I_C	40	A



Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AKB65A040WBH	TO247-3L	B65A040WBH	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)	74	A
	Collector Current - Continuous (T _C = 100°C)	46	A
I _{CM}	Collector Current - Pulsed ^(Note 2)	160	A
I _F	Diode Forward Current, Limited by T _{VJmax} (T _C = 25°C)	74	A
	Diode Forward Current, Limited by T _{VJmax} (T _C = 100°C)	46	A
I _{FM}	Diode Pulsed Current - Pulsed ^(Note 2)	160	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)	250	W
	Power Dissipation (T _C = 100°C)	125	W
T _{VJ}	Operating Junction Temperature Range	-40 to +175	°C
T _{STG}	Storage Temperature Range	-55 to +150	°C

Thermal Characteristics

Symbol	Parameter	Value	Units
R _{θJC}	IGBT Thermal Resistance, Junction - to - Case, Steady - State	0.6	°C/W
R _{θJC}	Diode Thermal Resistance, Junction - to - Case, Steady - State	0.98	°C/W
R _{θJA}	Thermal Resistance, Junction - to - Ambient Steady State	40	°C/W

Notes:

- 1. The max collector current rating is package limited
- 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 = 0.2 mA	650			V
V _{CESAT}	Collector-Emitter Saturation Voltage	V _{GE} = 15 V, I _C = 40 A		1.60	2.10	V
		V _{GE} = 15 V, I _C = 40 A, T _{VJ} = 125°C		1.84		
		V _{GE} = 15 V, I _C = 40 A, T _{VJ} = 175°C		2.01		
V _F	Diode Forward Voltage	V _{GE} = 0 V, I _F = 40 A		1.45	1.90	V
		V _{GE} = 0 V, I _F = 40 A, T _{VJ} = 125°C		1.37		
		V _{GE} = 0 V, I _F = 40 A, T _{VJ} = 175°C		1.30		
V _{GE(th)}	Gate-Emitter Threshold Voltage	V _{CE} = V _{GE} , I _C = 0.4 mA	3.2	4.0	4.8	V
I _{CES}	Zero Gate Voltage Collector Current	V _{CE} = 650 V, V _{GE} = 0 V			50	µA
		V _{CE} = 650 V, V _{GE} = 0 V, T _{VJ} = 175°C		2000		
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 = 40 A		51		S
Dynamic Characteristics						
C _{ies}	Input Capacitance	V _{CE} = 25 V, V _{GE} = 0 V, F = 1 MHz		1495		pF
C _{oes}	Output Capacitance			102		pF
C _{res}	Reverse Transfer Capacitance			14		pF
Q _G	Total Gate Charge	V _{CC} = 520 V , I _C = 40 A, V _{GE} = 15 V		56		nC
Q _{GE}	Gate-Emitter Charge			8		nC
Q _{GC}	Gate-Collector Charge			19		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 = 40 A V _{GE} = 15 V R _{Gon} = 15 Ω R _{Goff} = 15 Ω		27		ns
t _r	Rise Time			28		ns
t _{d(off)}	Turn Off Delay Time			139		ns
t _f	Fall Time			22		ns
E _{on}	Turn On Energy			0.91		mJ
E _{off}	Turn Off Energy			0.44		mJ
E _{ts}	Total Switching Energy			1.35		mJ

$t_{d(on)}$	Turn On Delay Time	$V_{CC} = 400\text{ V}$ $I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}$ $R_{G(on)} = 15\ \Omega$ $R_{G(off)} = 15\ \Omega$		22		ns
t_r	Rise Time			15		ns
$t_{d(off)}$	Turn Off Delay Time			153		ns
t_f	Fall Time			6		ns
E_{on}	Turn On Energy			0.35		mJ
E_{off}	Turn Off Energy			0.20		mJ
E_{ts}	Total Switching Energy			0.55		mJ

Diode Characteristics ($T_{VJ} = 25^{\circ}\text{C}$)

t_{rr}	Reverse Recovery Time	$V_R = 400\text{ V}, I_F = 40\text{ A},$ $di/dt = 1400\text{ A}/\mu\text{s}$		54		ns
Q_{rr}	Reverse Recovery Charge			1.2		μC
I_{rrm}	Peak Reverse Recovery Current			24		A
d_{irr}/dt	Diode Peak Rate of Fall of Reverse Recovery Current			730		$\text{A}/\mu\text{s}$

t_{rr}	Reverse Recovery Time	$V_R = 400\text{ V}, I_F = 20\text{ A},$ $di/dt = 1400\text{ A}/\mu\text{s}$		66		ns
Q_{rr}	Reverse Recovery Charge			0.8		μC
I_{rrm}	Peak Reverse Recovery Current			22		A
d_{irr}/dt	Diode Peak Rate of Fall of Reverse Recovery Current			1300		$\text{A}/\mu\text{s}$

Switching Characteristics, Inductive Load ($T_{VJ} = 150^{\circ}\text{C}$)

$t_{d(on)}$	Turn On Delay Time	$V_{CC} = 400\text{ V}$ $I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}$ $R_{G(on)} = 15\ \Omega$ $R_{G(off)} = 15\ \Omega$		23		ns
t_r	Rise Time			47		ns
$t_{d(off)}$	Turn Off Delay Time			162		ns
t_f	Fall Time			69		ns
E_{on}	Turn On Energy			1.40		mJ
E_{off}	Turn Off Energy			0.58		mJ
E_{ts}	Total Switching Energy			1.98		mJ

$t_{d(on)}$	Turn On Delay Time	$V_{CC} = 400\text{ V}$ $I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}$ $R_{G(on)} = 15\text{ }\Omega$ $R_{G(off)} = 15\text{ }\Omega$		18		ns
t_r	Rise Time			16		ns
$t_{d(off)}$	Turn Off Delay Time			173		ns
t_f	Fall Time			91		ns
E_{on}	Turn On Energy			0.71		mJ
E_{off}	Turn Off Energy			0.21		mJ
E_{ts}	Total Switching Energy			0.92		mJ

Diode Characteristics ($T_{VJ} = 150^{\circ}\text{C}$)

T_{RR}	Reverse Recovery Time	$V_R = 400\text{ V}, I_F = 40\text{ A},$ $di/dt = 1400\text{ A}/\mu\text{s}$		315		ns
Q_{RR}	Reverse Recovery Charge			4.0		μC
I_{RRM}	Peak Reverse Recovery Current			28		A
di_{rr}/dt	Diode Peak Rate of Fall of Reverse Recovery Current			470		$\text{A}/\mu\text{s}$

T_{RR}	Reverse Recovery Time	$V_R = 400\text{ V}, I_F = 20\text{ A},$ $di/dt = 1400\text{ A}/\mu\text{s}$		168		ns
Q_{RR}	Reverse Recovery Charge			2.3		μC
I_{RRM}	Peak Reverse Recovery Current			30		A
di_{rr}/dt	Diode Peak Rate of Fall of Reverse Recovery Current			730		$\text{A}/\mu\text{s}$

Electrical Characteristics Diagrams

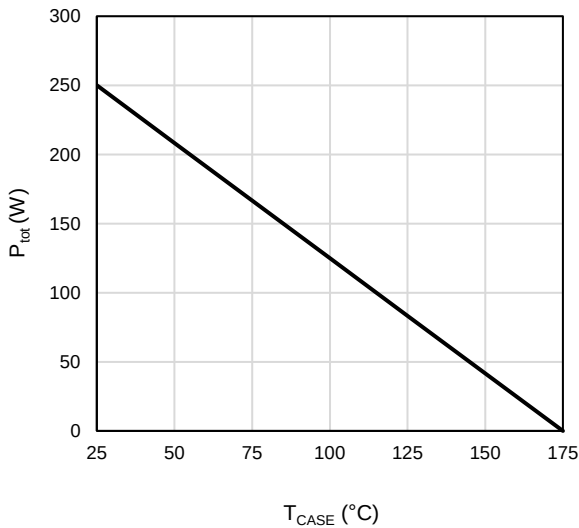


Figure 1: Power De-rating

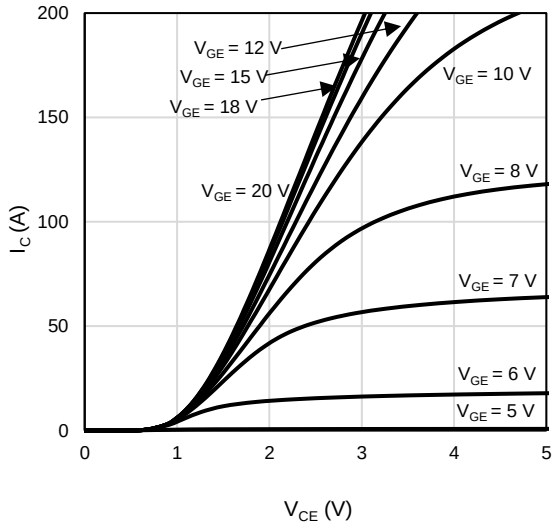


Figure 2: Typical Output Characteristics ($T_{VJ} = 25^{\circ}C$)

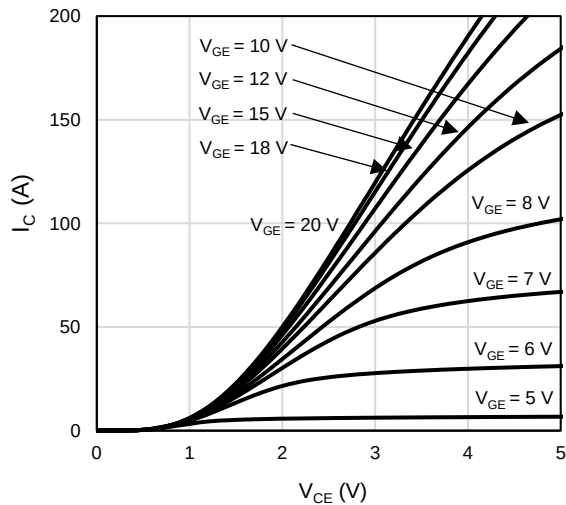


Figure 3: Typical Output Characteristics ($T_{VJ} = 150^{\circ}C$)

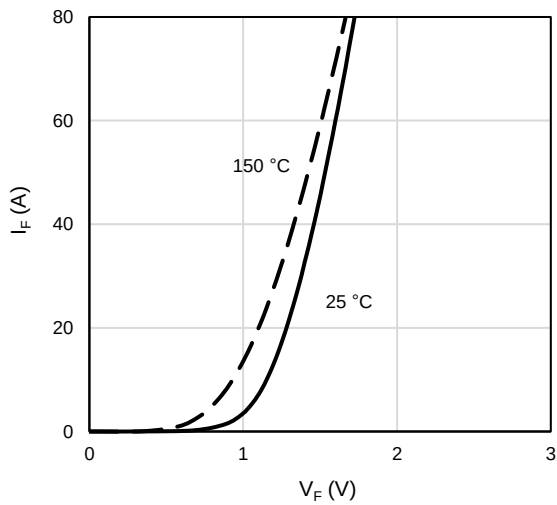


Figure 4: Diode Forward Current Characteristics

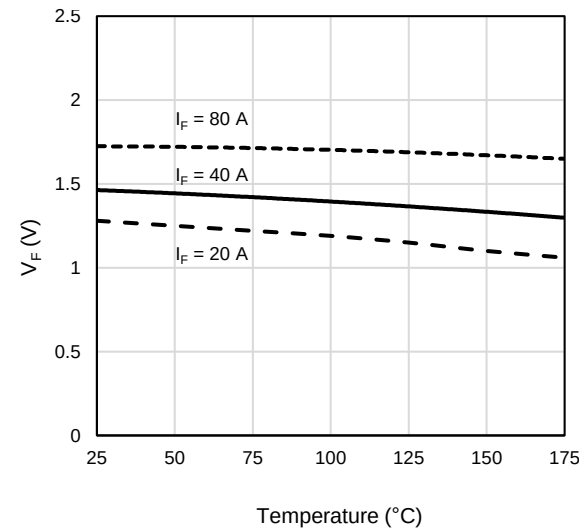


Figure 5: Diode Forward Voltage vs. Junction Temperature

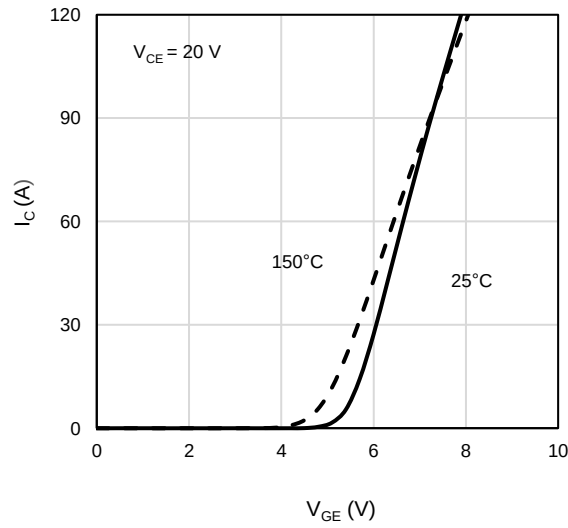


Figure 6: Transfer Characteristics

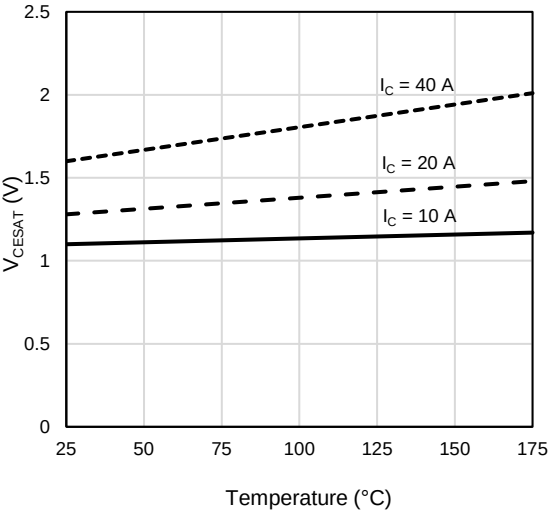


Figure 7: Collect-emitter saturation voltage vs. Junction Temperature

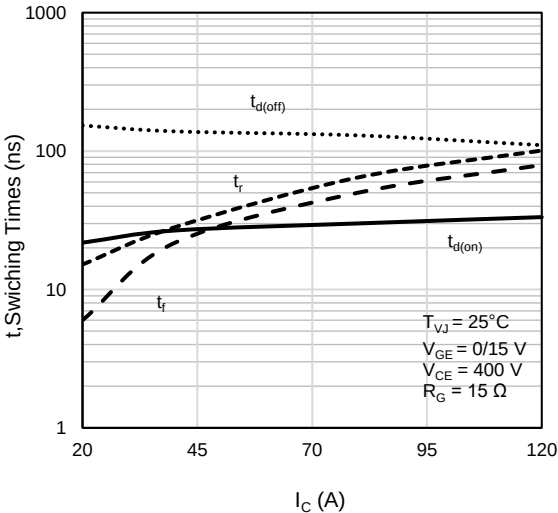


Figure 8: Switching Times vs. Collector Current

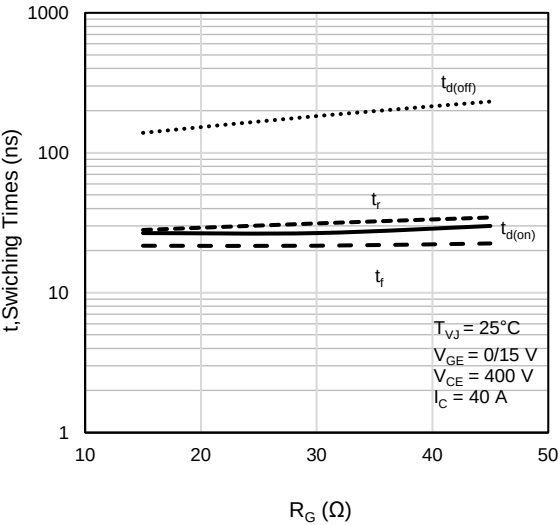


Figure 9: Switching Times vs. Gate Resistor

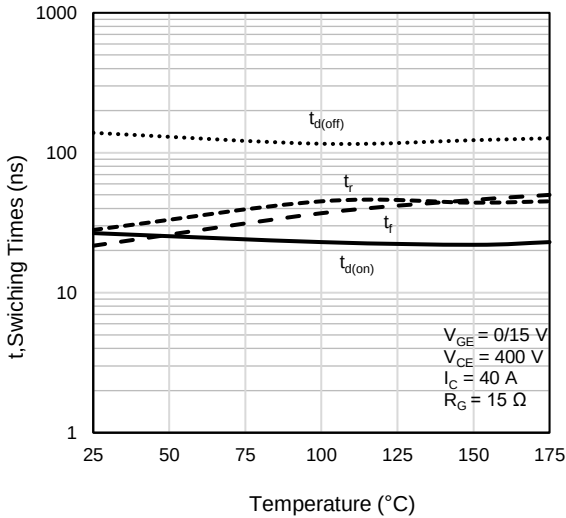


Figure 10: Switching Times vs. Junction Temperature

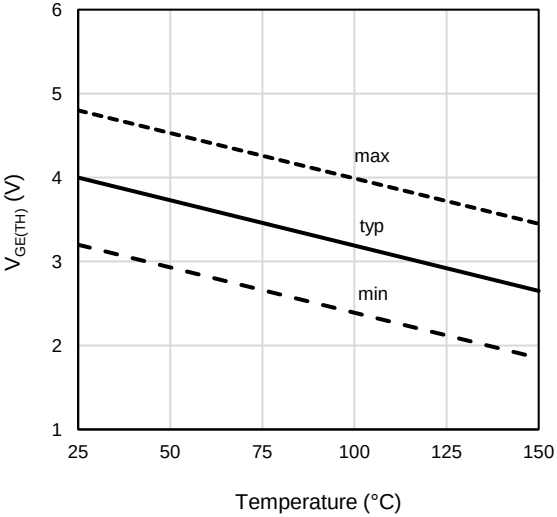


Figure 11: Threshold voltage vs. Junction Temperature

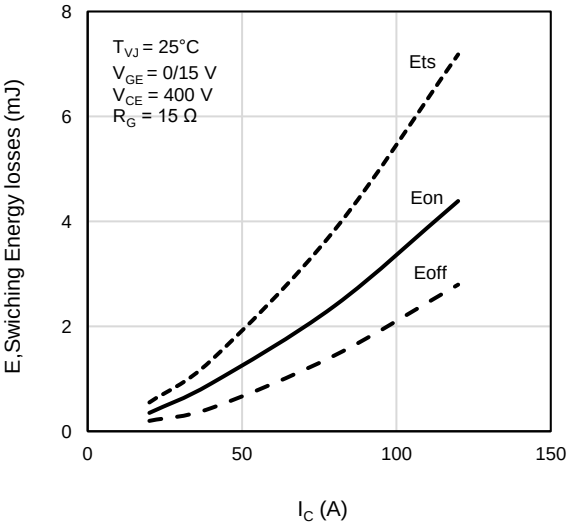


Figure 12: Switching Energy losses vs. Collector Current

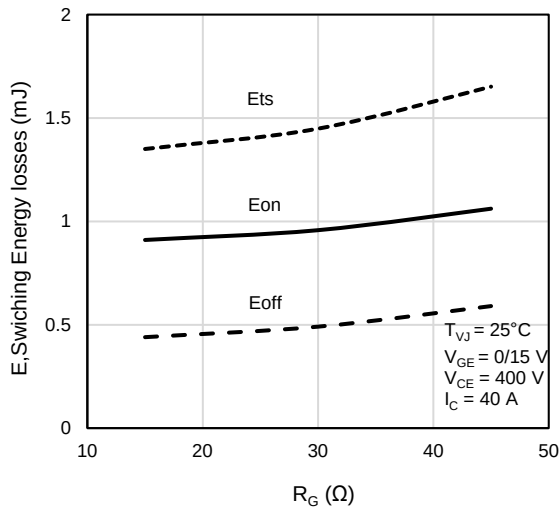


Figure 13: Switching Energy losses vs. Gate Resistor

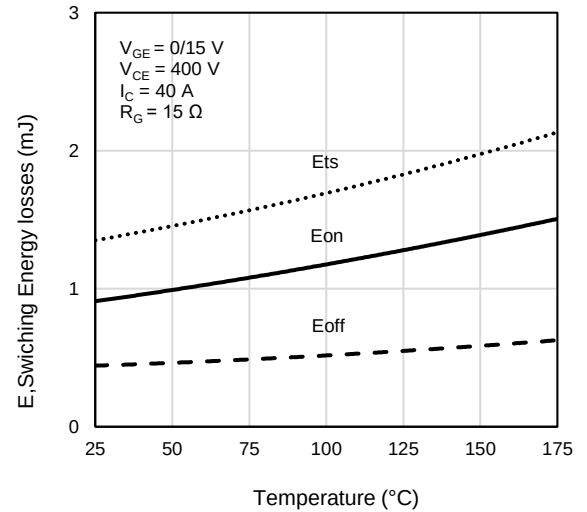


Figure 14: Switching Energy losses vs. Junction Temperature

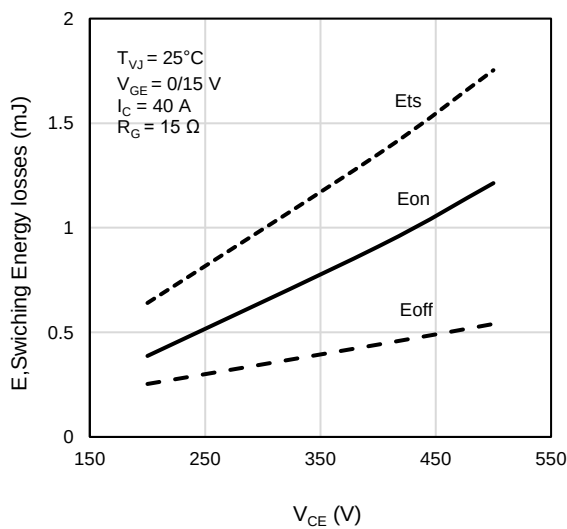


Figure 15: Switching Energy losses vs. Collector Emitter Voltage

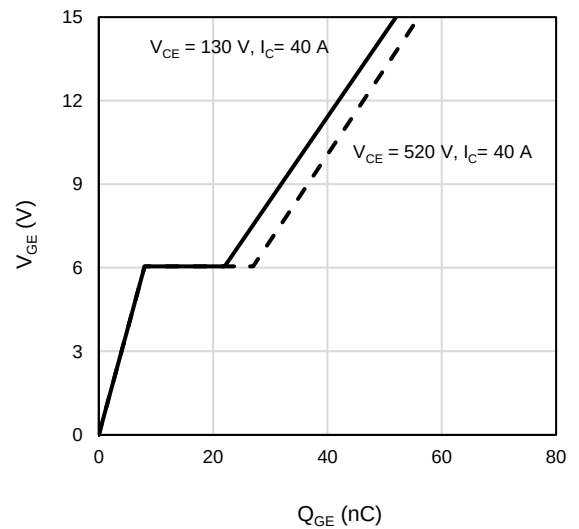


Figure 16: Gate-Charge Characteristics

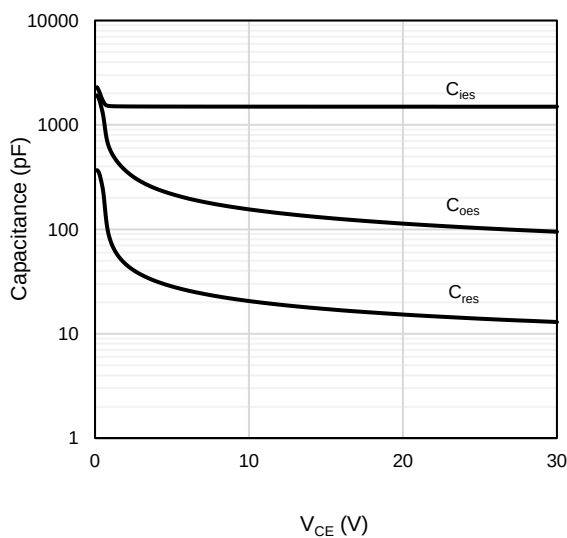


Figure 17: Capacitance Characteristics

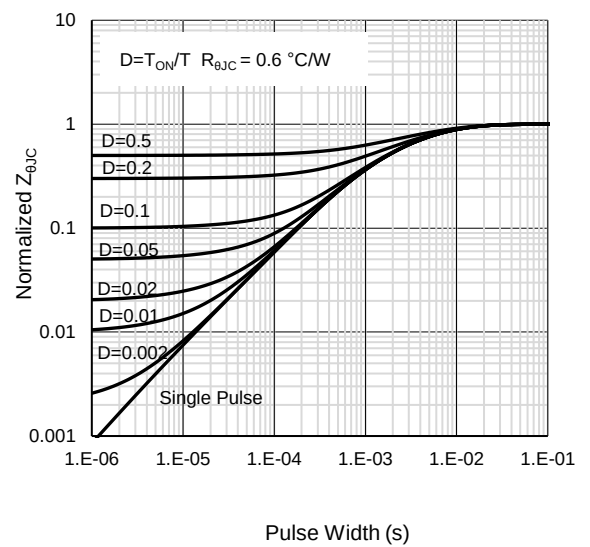


Figure 18: Normalized Maximum IGBT Transient Thermal Impedance

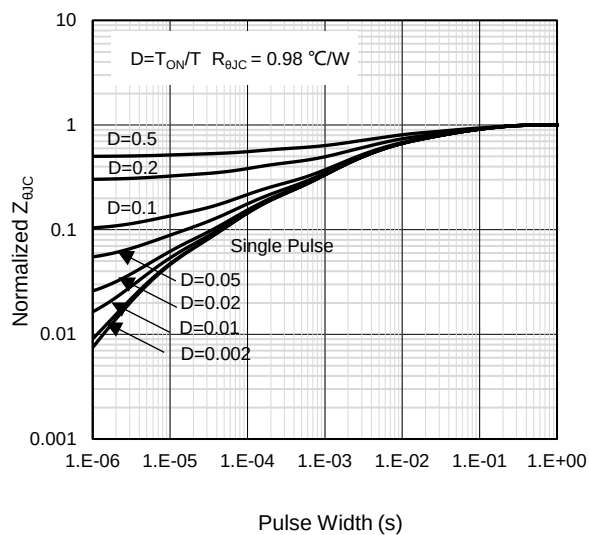


Figure 19: Normalized Maximum Diode Transient Thermal Impedance

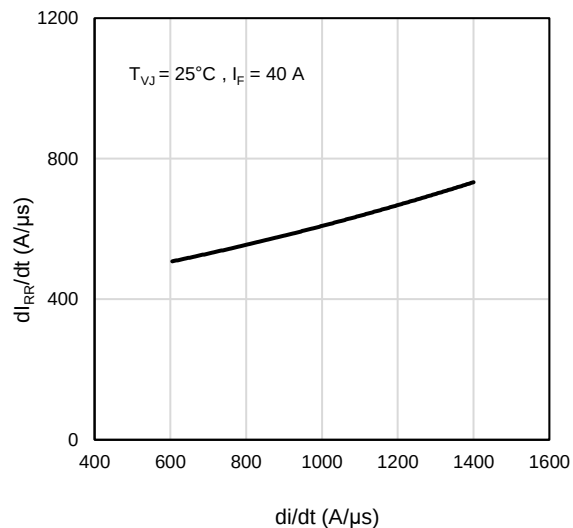


Figure 20: Diode Peak Rate of Fall of Reverse Recovery Current vs. Diode Current Slope

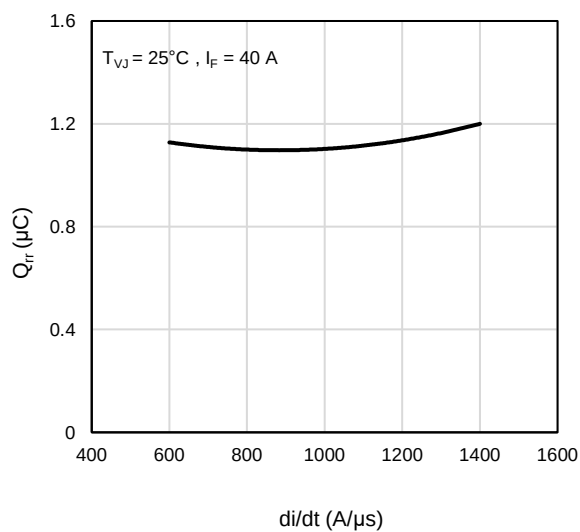


Figure 21: Reverse Recovery Charge vs. Diode Current Slope

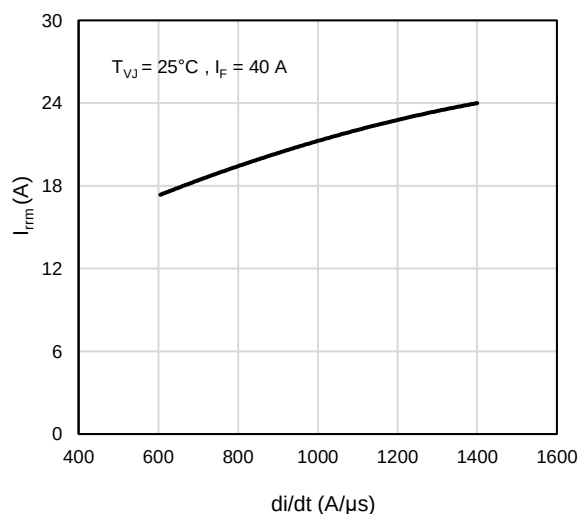


Figure 22: Reverse Recovery Current vs. Diode Current Slope

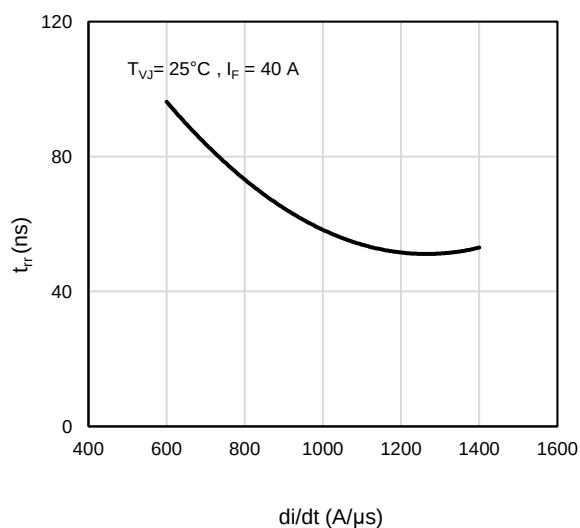
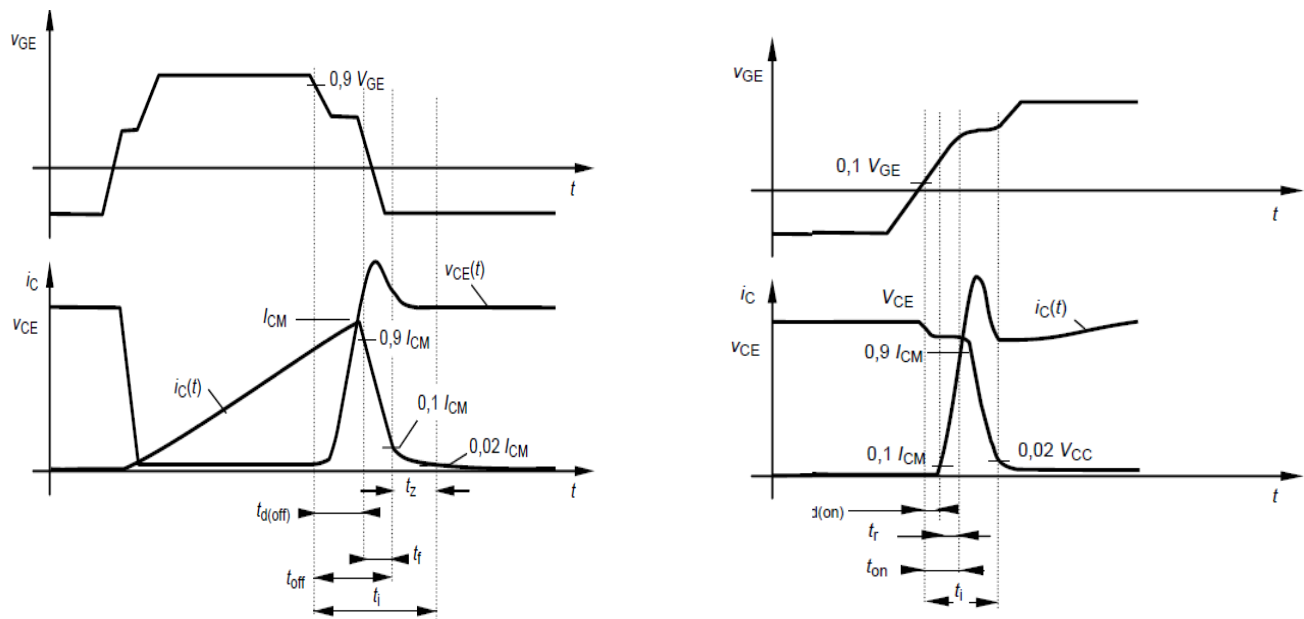


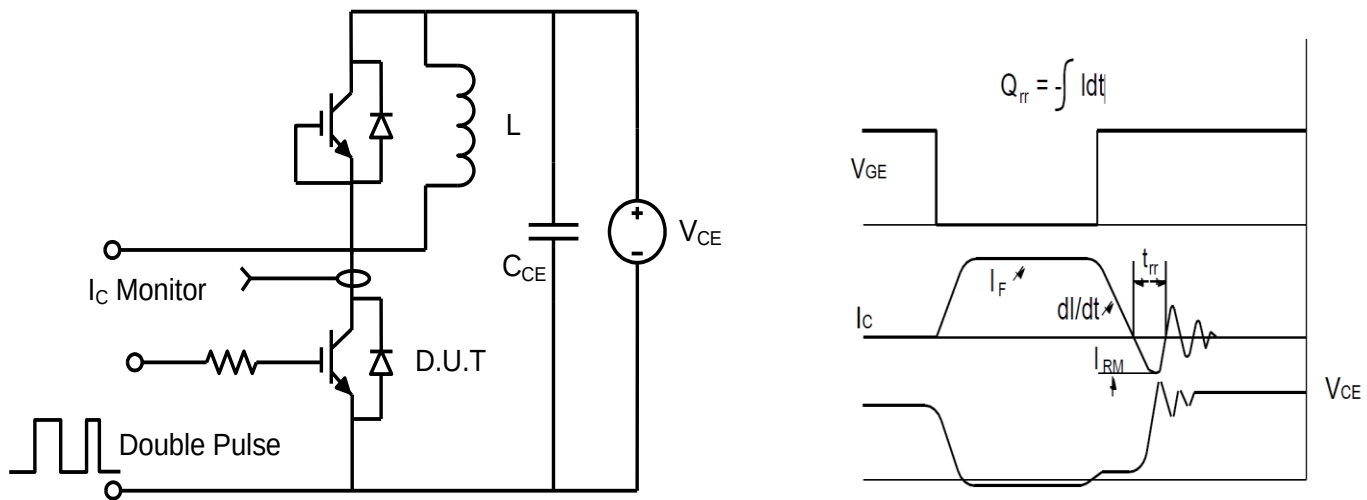
Figure 23: Reverse Recovery Time vs. Diode Current Slope

Test Circuit and Waveform

Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Revision History

Revision	Released	Remark
Rev.1.0	2024	Initial Release

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.