

650V 45mohm Silicon Carbide Power MOSFET
AKC65M045WDM

Features:

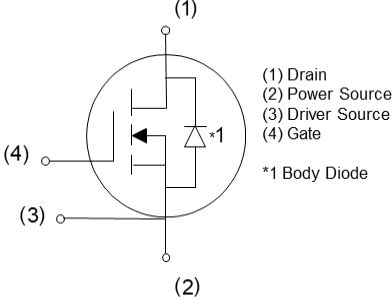
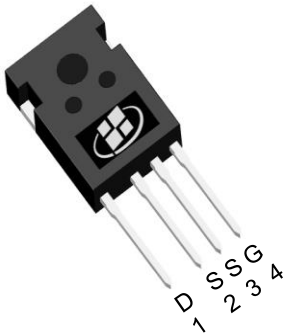
- High-speed switching performance
- Best thermal conductivity and behavior
- Fast intrinsic diode with low reverse recovery (Q_{RR})
- Halogen-free, RoHS compliant ^(Note 1)

Applications:

- Motor drives
- Switched mode power supplies

Key Performance Parameters:

Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(on)}$, TYP @ $V_{GS} = 15\text{ V}$	41	mΩ
$R_{DS(on)}$, TYP @ $V_{GS} = 18\text{ V}$	34	mΩ
I_D	50	A
P_D	214	W



Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AKC65M045WDM	TO-247LP-4L	C65M045WDM	Tube	See the detail package information

Notes:

1. Contact ALKAIDSEMI sales for detail information

Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V _{DS}	Drain-Source Voltage	650	V
I _D	Drain Current - Continuous (T _C = 25°C) ^(Note 1)	50	A
	Drain Current - Continuous (T _C = 100°C) ^(Note 1)	35	A
I _{DM}	Drain Current - Pulsed ^(Note 2)	135	A
V _{GS}	Gate-Source Voltage (dynamic)	-10/+22	V
V _{GS}	Gate-Source Voltage (static)	-6/+18	V
P _D	Power Dissipation (T _C = 25°C)	214	W
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +175	°C

Thermal Characteristics

Symbol	Parameter	Value	Units
R _{θJC}	Thermal Resistance, Junction-to-Case, Steady-State	0.7	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient, Steady-State	40	°C/W

Notes:

1. The max drain current limited by maximum junction temperature
2. Repetitive Rating: Pulse width limited by maximum junction temperature

Electrical Characteristics (T _J = 25°C unless otherwise noted)						
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0 V, I _D = 100 μA	650			V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V		5	50	μA
I _{GSS}	Gate Leakage Current	V _{GS} = + 22 V, V _{DS} = 0 V			100	nA
		V _{GS} = - 10 V, V _{DS} = 0 V			100	nA
V _{GS(TH)}	Gate Threshold voltage	V _{DS} = V _{GS} , I _D = 5 mA	1.8	2.8	4	V
		V _{DS} = V _{GS} , I _D = 5 mA, T _J = 175 °C		2.1		V
R _{DS(ON)}	Drain-Source on-state resistance	V _{GS} = 15 V, I _D = 20 A		41	60	mΩ
		V _{GS} = 15 V, I _D = 20 A, T _J = 175 °C		60		mΩ
G _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 20 A		12		S
		V _{DS} = 20 V, I _D = 20 A, T _J = 175 °C		11		S
Dynamic Characteristics						
C _{ISS}	Input Capacitance	V _{DS} = 600 V, V _{GS} = 0 V, F = 100 kHz, V _{AC} = 25 mV		2600		pF
C _{OSS}	Output Capacitance			145		pF
C _{RSS}	Reverse Transfer Capacitance			5		pF
E _{OSS}	C _{OSS} Stored Energy			32		μJ
R _G	Gate Resistance	F = 1 MHz, V _{AC} = 25 mV		1.4		Ω
Q _{GS}	Gate-Source Charge	V _{DS} = 400 V , I _D = 20 A, V _{GS} = -4/+15 V		28.5		nC
Q _{GD}	Gate-Drain Charge			18		nC
Q _G	Total Gate Charge			81		nC

Switching Characteristics (Note3)						
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = -4/+15\text{ V}$, $R_{G,EXT} = 2.5\text{ }\Omega$ $L = 99\text{ }\mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{V}$		11		ns
T_R	Rise Time			10.6		ns
$T_{D(OFF)}$	Turn Off Delay Time			29.5		ns
T_F	Fall Time			14.8		ns
E_{ON}	Turn On Energy			44.7		μJ
E_{OFF}	Turn Off Energy			21.4		μJ
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = -4/+15\text{ V}$, $R_{G,EXT} = 2.5\text{ }\Omega$ $L = 99\text{ }\mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{V}$ $T_J = 175\text{ }^\circ\text{C}$		9.5		ns
T_R	Rise Time			9.2		ns
$T_{D(OFF)}$	Turn Off Delay Time			35.5		ns
T_F	Fall Time			23.4		ns
E_{ON}	Turn On Energy			30.8		μJ
E_{OFF}	Turn Off Energy			20		μJ

Note3: All switching charateristics reference TO247-4L.

Drain-Source Diode Characteristics ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
I_S	Maximum Continuous Drain-Source Diode Forward Current				50	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current				135	A
V_{SD}	Diode Forward Voltage	$V_{GS} = -4\text{ V}$, $I_{SD} = 10\text{ A}$		4.8		V
		$V_{GS} = -4\text{ V}$, $I_{SD} = 10\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$		4.2		V
I_{RM}	Peak Reverse Recovery Current	$V_{GS} = -4\text{ V}$, $I_{SD} = 20\text{ A}$, $V_R = 400\text{ V}$, $di/dt = 5000\text{ A}/\mu\text{s}$		17		A
T_{RR}	Reverse Recovery Time			15		ns
Q_{RR}	Reverse Recovery Charge			154		nC
I_{RM}	Peak Reverse Recovery Current	$V_{GS} = -4\text{ V}$, $I_{SD} = 20\text{ A}$, $V_R = 400\text{ V}$, $di/dt = 1500\text{ A}/\mu\text{s}$ $T_J = 175\text{ }^\circ\text{C}$		22		A
T_{RR}	Reverse Recovery Time			17		ns
Q_{RR}	Reverse Recovery Charge			219		nC

Electrical Characteristics Diagrams

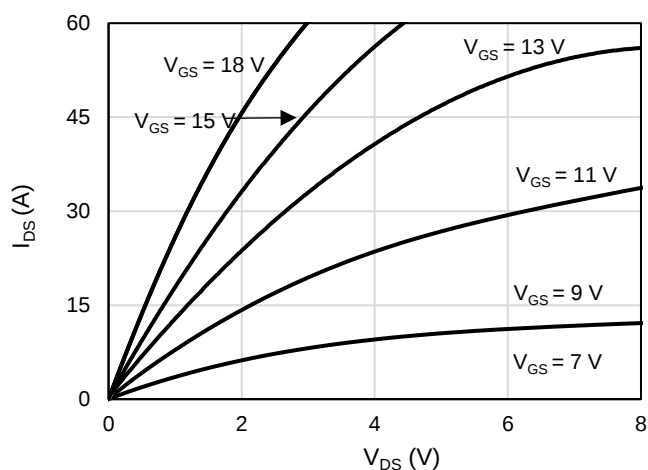
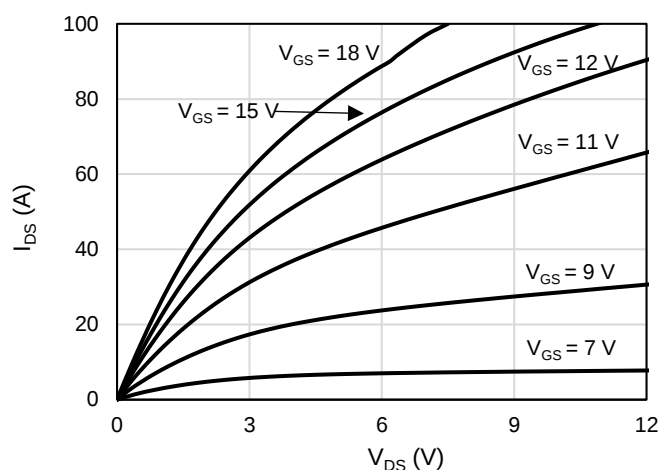
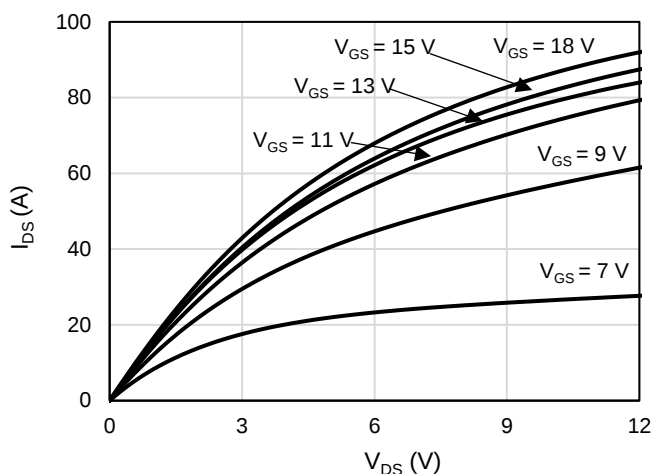
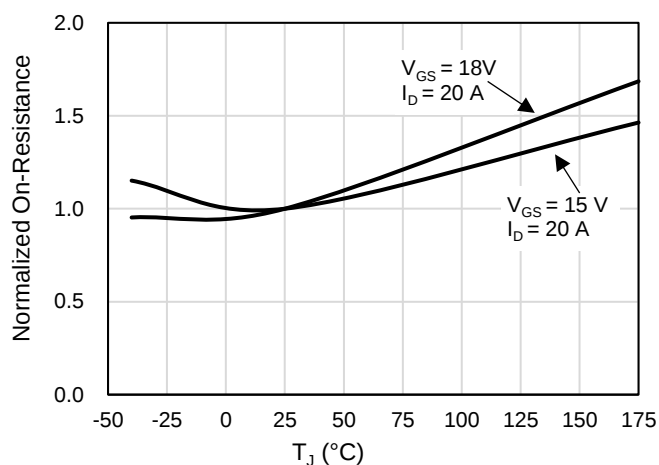
Figure 1: Output Characteristics $T_j = -40^{\circ}\text{C}$ Figure 2: Output Characteristics $T_j = 25^{\circ}\text{C}$ Figure 3: Output Characteristics $T_j = 175^{\circ}\text{C}$ 

Figure 4: Normalized On-Resistance vs. Temperature

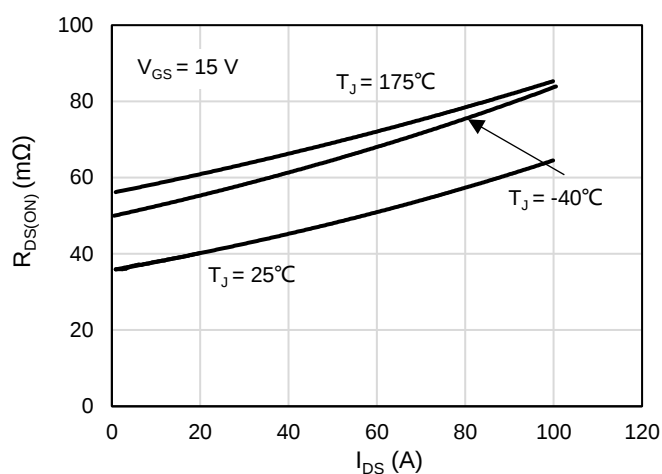


Figure 5: On-Resistance vs. Drain Current For Various Temperatures

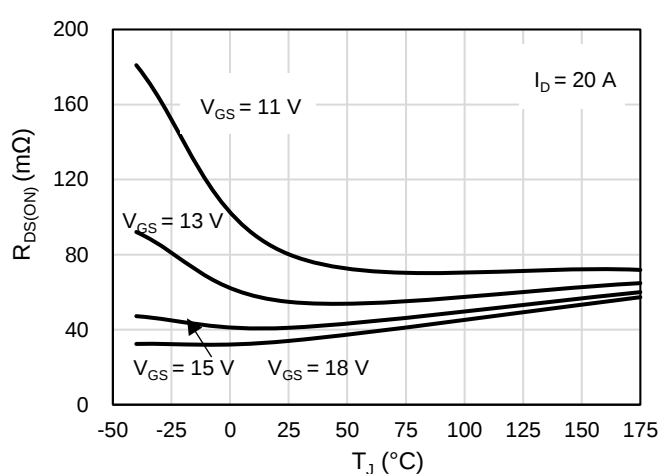
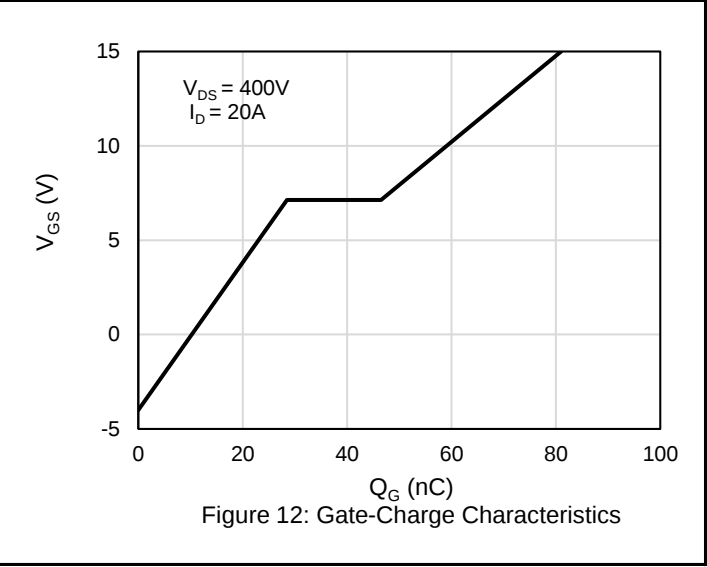
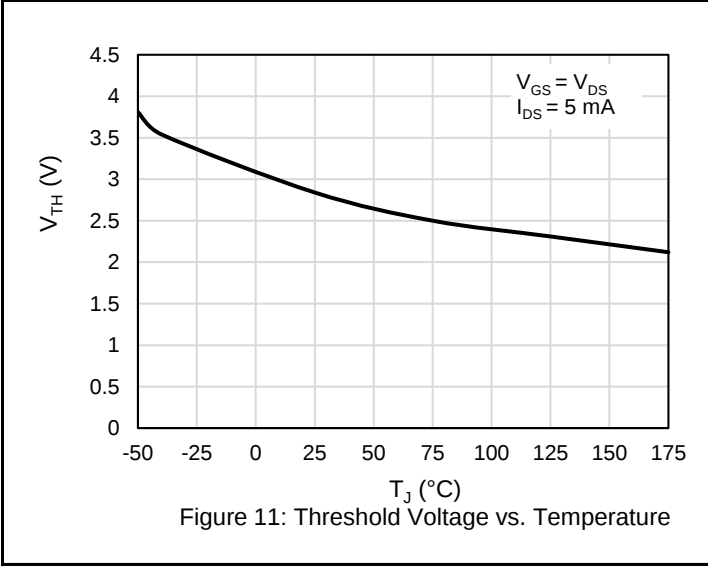
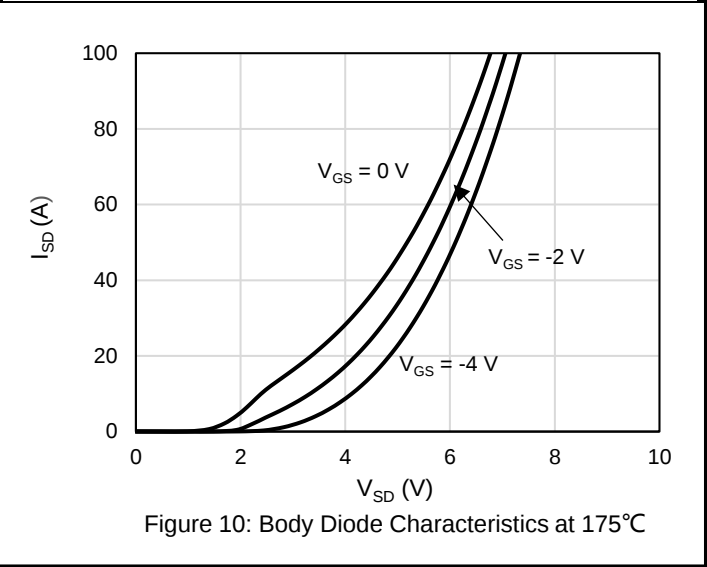
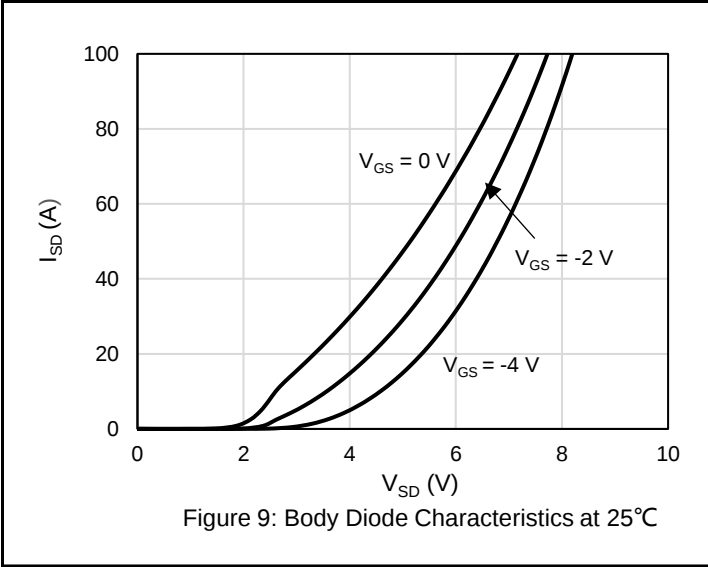
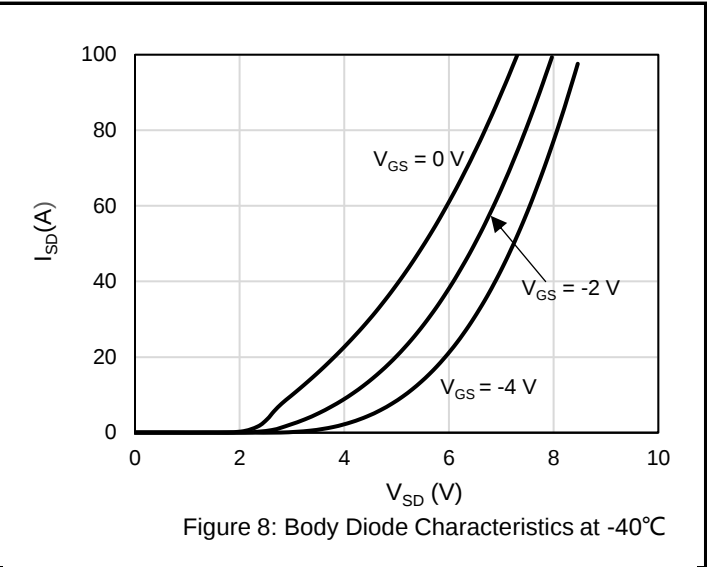
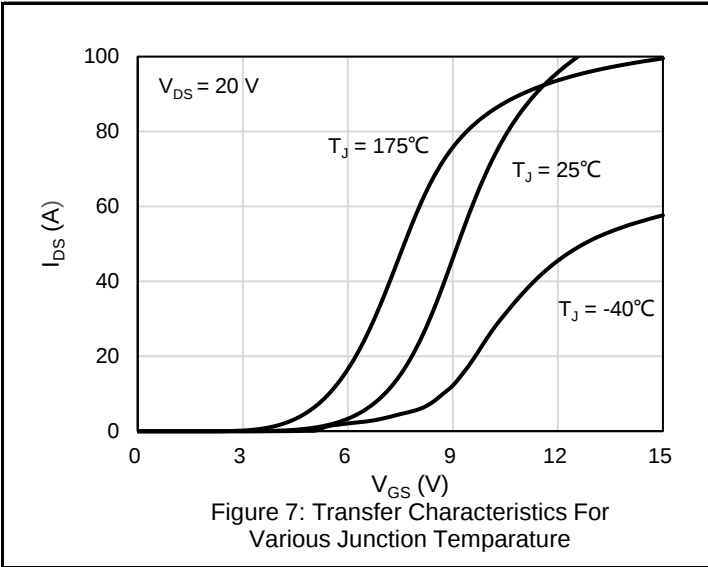
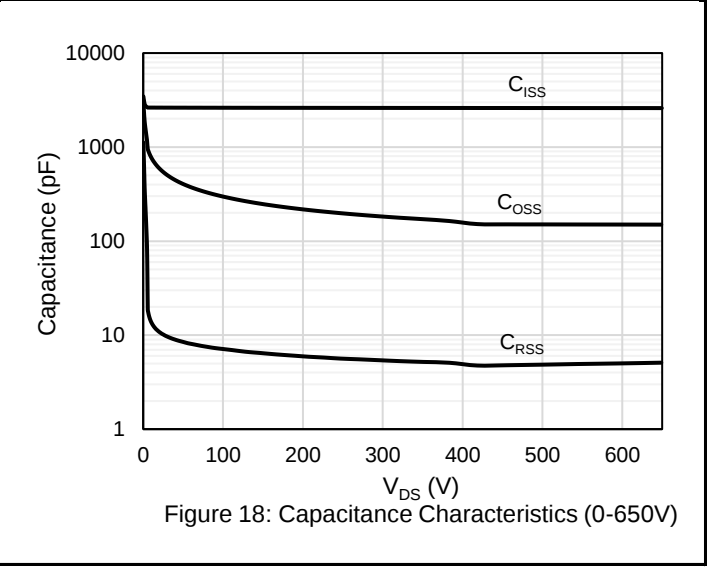
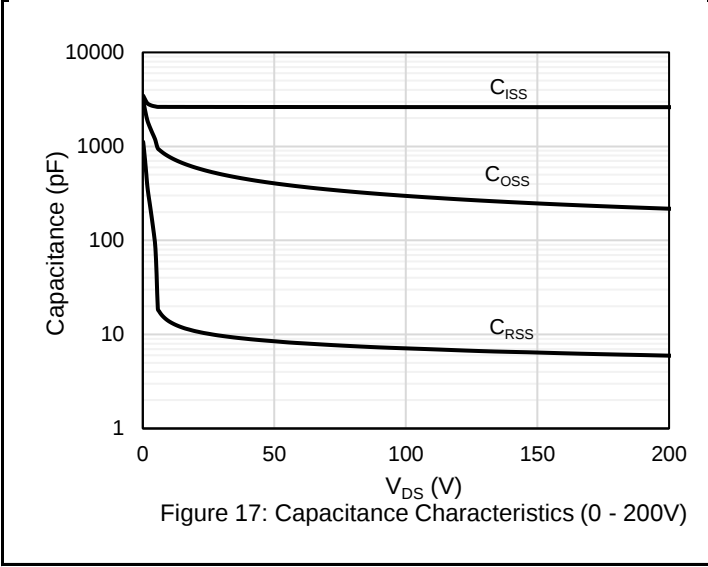
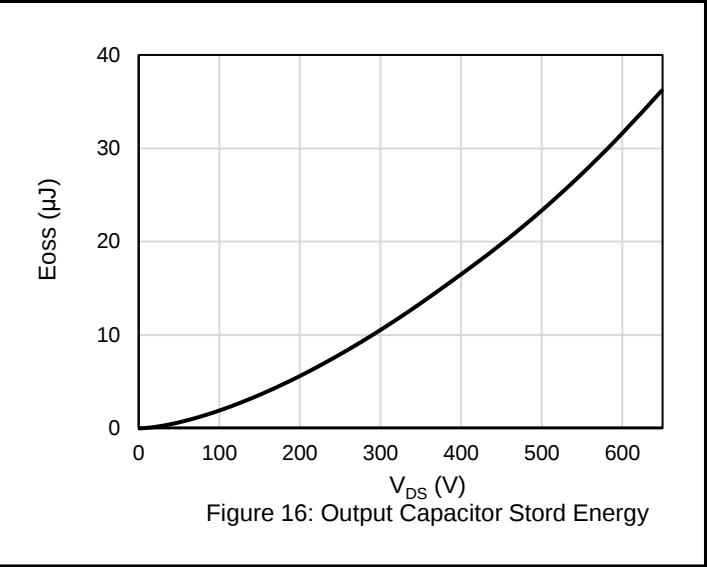
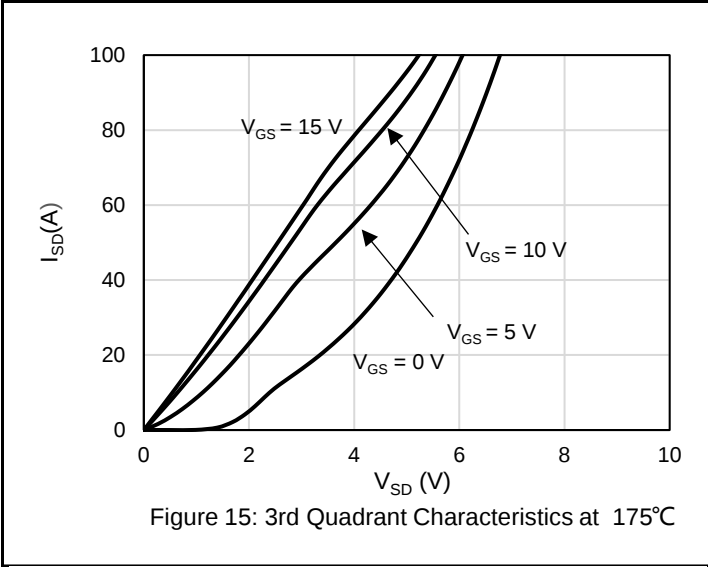
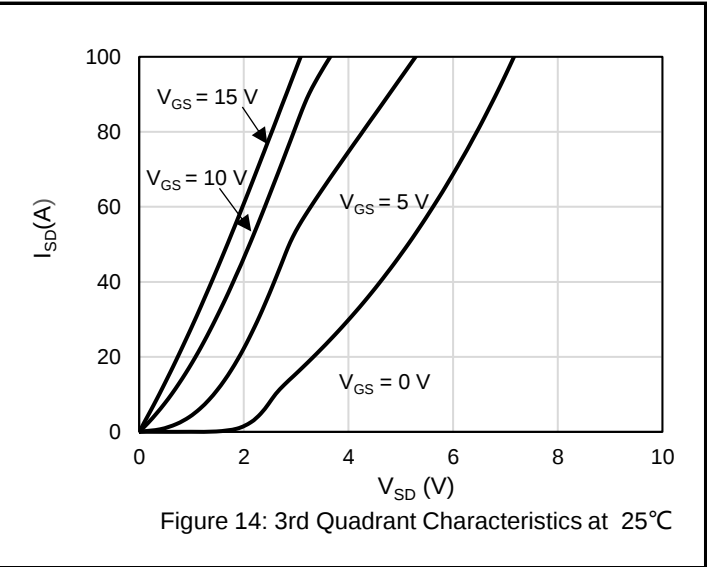
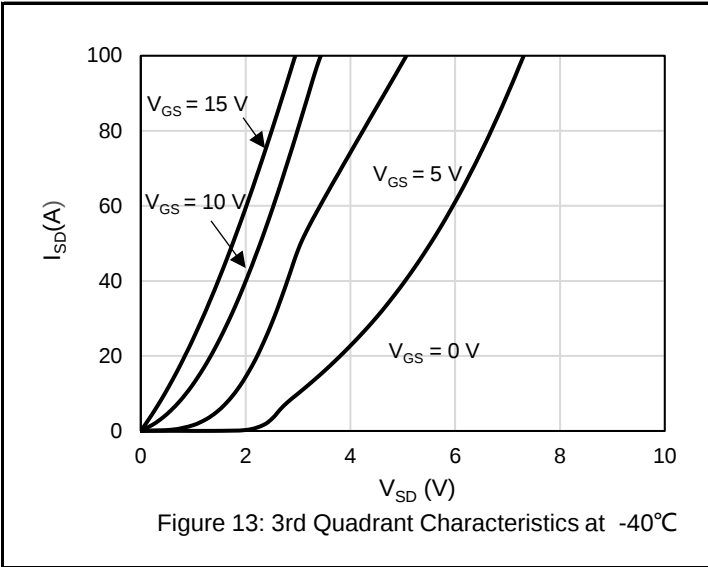


Figure 6: On-Resistance vs. Temperature For Various Gate Voltage





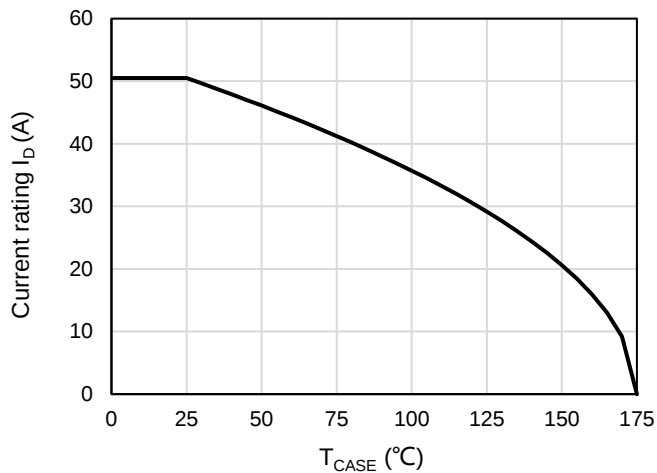


Figure 19: Current De-rating

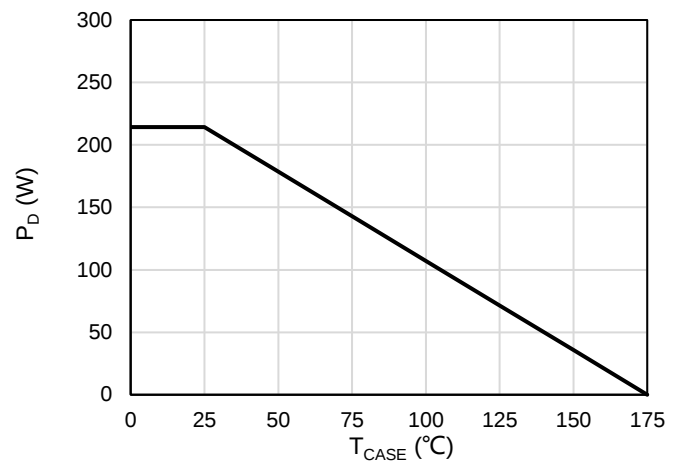


Figure 20: Maximum Power Dissipation Derating vs Case Temperature

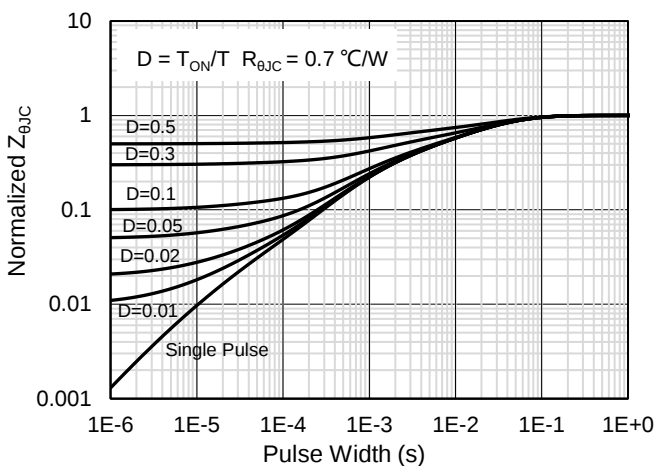


Figure 21: Normalized Maximum Transient Thermal Impedance

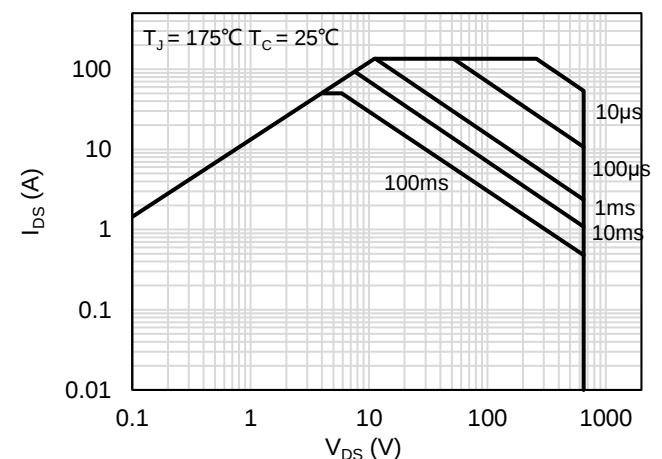


Figure 22: Maximum Forward Biased Safe Operating Area

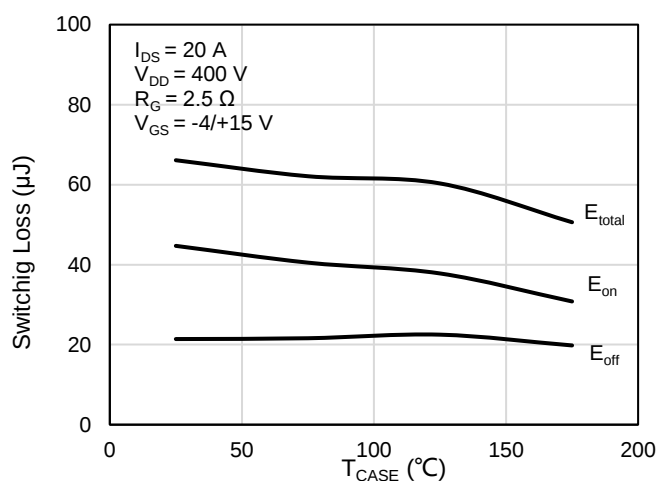
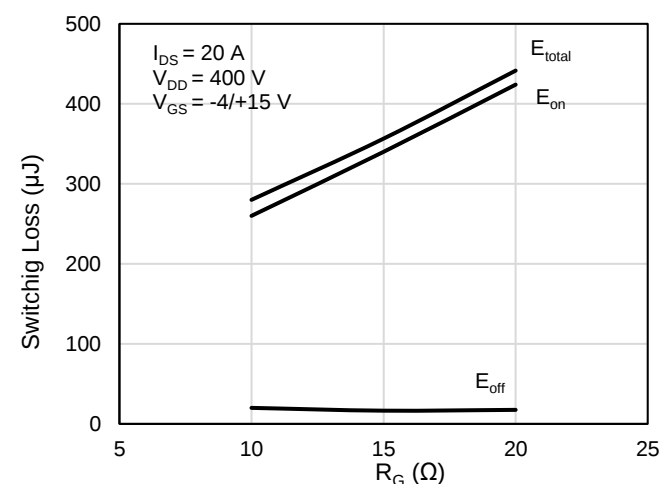
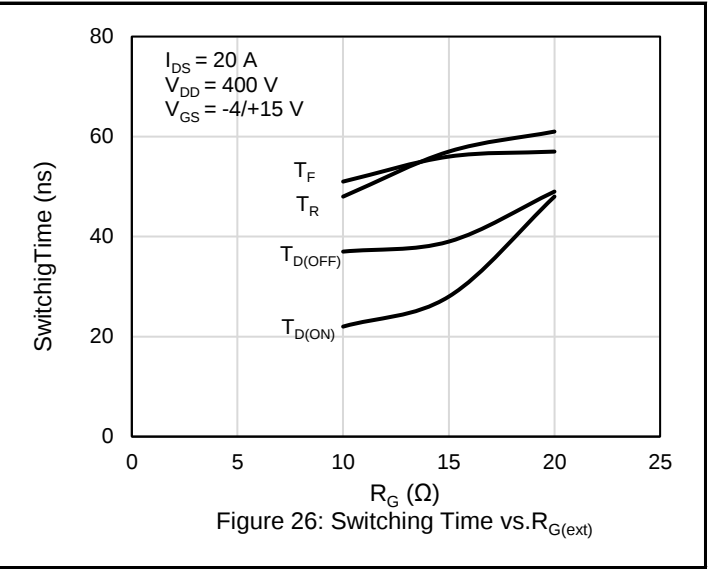
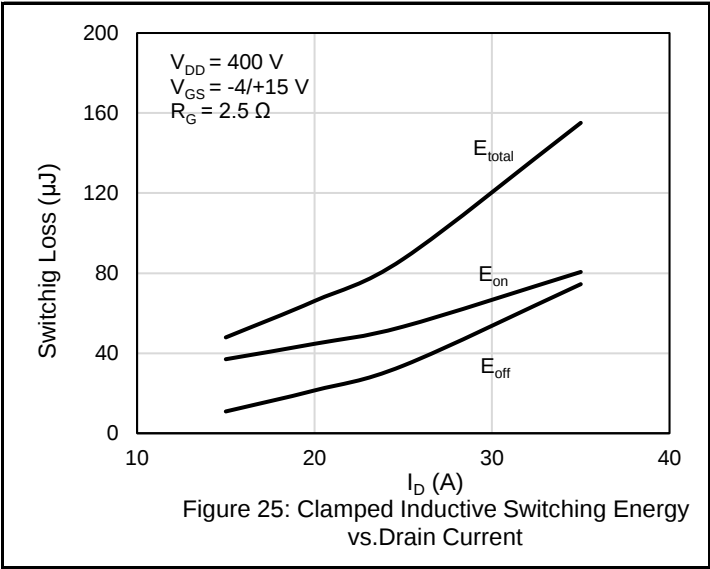


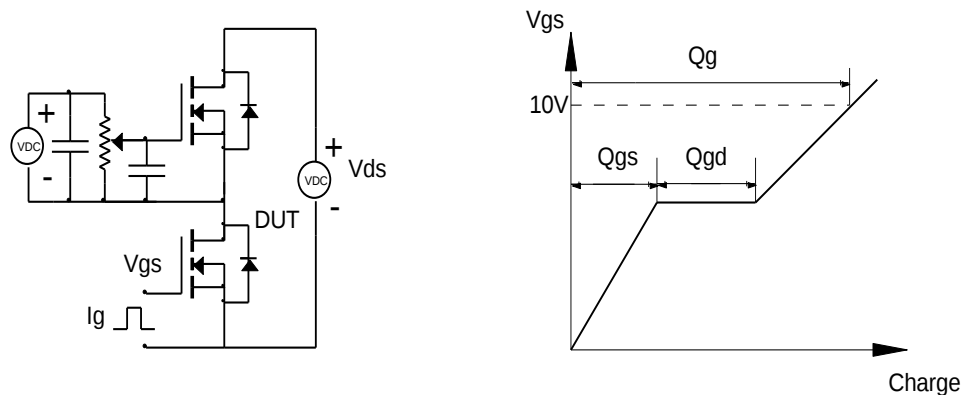
Figure 23: Clamped Inductive Switching Energy vs. Temperature

Figure 24: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

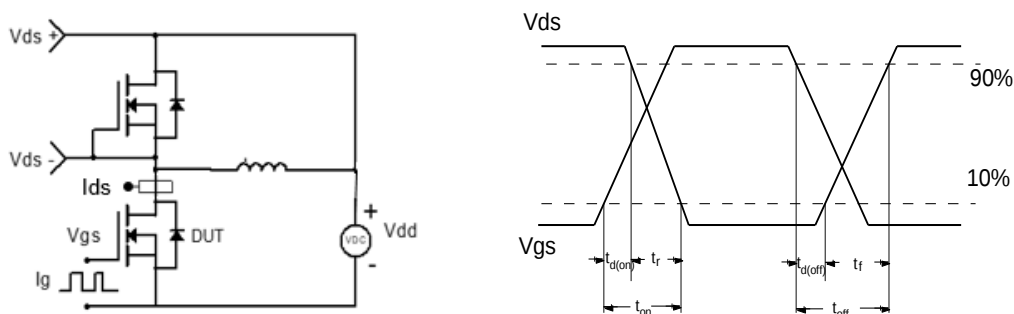


Test Circuit and Waveform

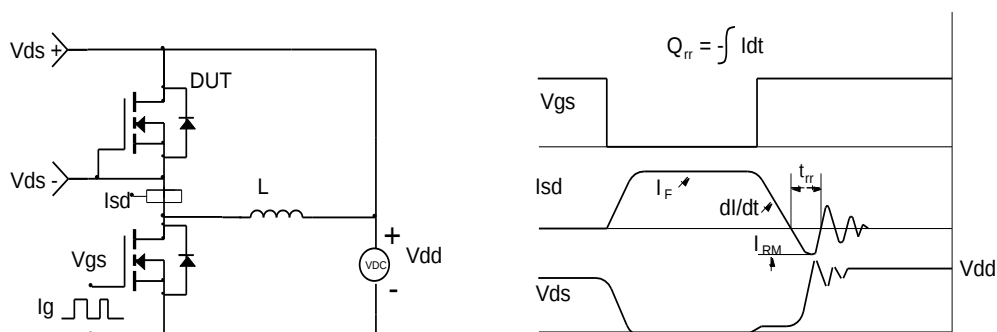
Gate Charge Test Circuit & Waveform



Clamped Inductive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Revision History

Revision	Release Date	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.