

1200V 40mohm Silicon Carbide Power MOSFET
AK1CK2M040WAM

Features:

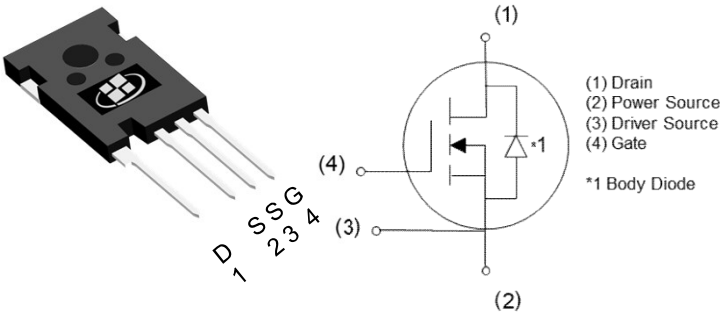
- Low on-resistance
- Fast switching speed with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{RR})
- Halogen-free, RoHS compliant ^(Note 1)

Applications:

- Motor drives
- DC/DC converters
- Switched mode power supplies
- Solar inverters

Key Performance Parameters:

Parameter	Value	Unit
V_{DS}	1200	V
$R_{DS(on)}$, TYP @ $V_{GS} = 15\text{ V}$	40	m Ω
$R_{DS(on)}$, TYP @ $V_{GS} = 18\text{ V}$	35	m Ω
I_D	62	A
P_D	333	W



Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AK1CK2M040WAM	TO-247-4L	1CK2M040WAM	Tube	300 per box

Notes:

1. Contact ALKAIDSEMI sales for detail information

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

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	1200	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$) ^(Note 1)	62	A
	Drain Current - Continuous ($T_C = 100^\circ\text{C}$) ^(Note 1)	44	A
I_{DM}	Drain Current - Pulsed ^(Note 2)	155	A
V_{GS}	Gate-Source Voltage (dynamic)	-10/+22	V
V_{GS}	Gate-Source Voltage (static)	-6/+18	V
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	333	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +175	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Steady-State	0.45	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Steady-State	40	$^\circ\text{C/W}$

Notes:

1. The max drain current limited by maximum junction temperature
2. Pulse width is limited by safe operating area

Electrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static Characteristics						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0 V, I _D = 100 μA	1200			V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 1200 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 = 11 mA	1.8	2.7	4	V
		V _{DS} = V _{GS} , I _D = 11 mA, T _J = 175 °C		1.8		V
R _{DS(ON)}	Drain-Source on-state resistance	V _{GS} = 15 V, I _D = 33 A		40	50	mΩ
		V _{GS} = 15 V, I _D = 33 A, T _J = 175 °C		66		mΩ
R _{DS(ON)}	Drain-Source on-state resistance	V _{GS} = 18 V, I _D = 33 A		35	45	mΩ
		V _{GS} = 18 V, I _D = 33 A, T _J = 175 °C		64		mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 20 A		18		S
		V _{DS} = 20 V, I _D = 20 A, T _J = 175 °C		20		S
Dynamic Characteristics						
C _{ISS}	Input Capacitance	V _{DS} = 800 V, V _{GS} = 0 V, F = 100 kHz, V _{AC} = 25 mV		2600		pF
C _{OSS}	Output Capacitance			90		pF
C _{RSS}	Reverse Transfer Capacitance			6.5		pF
E _{OSS}	C _{OSS} Stored Energy			41		μJ
R _G	Gate Resistance	F = 1 MHz, V _{AC} = 25 mV		1.4		Ω
Q _{GS}	Gate-Source Charge	V _{DS} = 800 V , I _D = 33 A, V _{GS} = -4/+15 V		27		nC
Q _{GD}	Gate-Drain Charge			46		nC
Q _G	Total Gate Charge			113		nC

Switching Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 800\text{ V}$, $I_D = 33\text{ A}$, $V_{GS} = -4/+15\text{ V}$, $R_{G,EXT} = 2.5\ \Omega$ $L = 99\ \mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{ V}$		18		ns
T_R	Rise Time			42		ns
$T_{D(OFF)}$	Turn Off Delay Time			33		ns
T_F	Fall Time			11		ns
E_{ON}	Turn On Energy			572		μJ
E_{OFF}	Turn Off Energy			56		μJ
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 800\text{ V}$, $I_D = 33\text{ A}$, $V_{GS} = -4/+15\text{ V}$, $R_{G,EXT} = 10\ \Omega$ $L = 99\ \mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{ V}$		25		ns
T_R	Rise Time			26		ns
$T_{D(OFF)}$	Turn Off Delay Time			65		ns
T_F	Fall Time			18		ns
E_{ON}	Turn On Energy			1041		μJ
E_{OFF}	Turn Off Energy			225		μJ
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 800\text{ V}$, $I_D = 33\text{ A}$, $V_{GS} = -4/+18\text{ V}$, $R_{G,EXT} = 2.5\ \Omega$ $L = 99\ \mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{ V}$		7		ns
T_R	Rise Time			22		ns
$T_{D(OFF)}$	Turn Off Delay Time			35		ns
T_F	Fall Time			9		ns
E_{ON}	Turn On Energy			525		μJ
E_{OFF}	Turn Off Energy			67		μJ
$T_{D(ON)}$	Turn On Delay Time	$V_{DD} = 800\text{ V}$, $I_D = 33\text{ A}$, $V_{GS} = -4/+18\text{ V}$, $R_{G,EXT} = 10\ \Omega$ $L = 99\ \mu\text{H}$ Diode: Body Diode at $V_{GS} = -4\text{ V}$		14		ns
T_R	Rise Time			37		ns
$T_{D(OFF)}$	Turn Off Delay Time			67		ns
T_F	Fall Time			21		ns
E_{ON}	Turn On Energy			725		μJ
E_{OFF}	Turn Off Energy			237		μJ

Drain-Source Diode Characteristics ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)					
I_S	Maximum Continuous Drain-Source Diode Forward Current			62	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current			155	A
V_{SD}	Diode Forward Voltage	$V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}$		5.5	V
		$V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}, T_J = 175\text{ }^{\circ}\text{C}$		5	V
I_{RM}	Peak Reverse Recovery Current	$V_{GS} = -4\text{ V}, I_{SD} = 33\text{ A}, V_R = 800\text{ V}, di/dt = 4200\text{ A}/\mu\text{s}$		26	A
T_{RR}	Reverse Recovery Time			17	ns
Q_{RR}	Reverse Recovery Charge			133	nC

Electrical Characteristics Diagrams

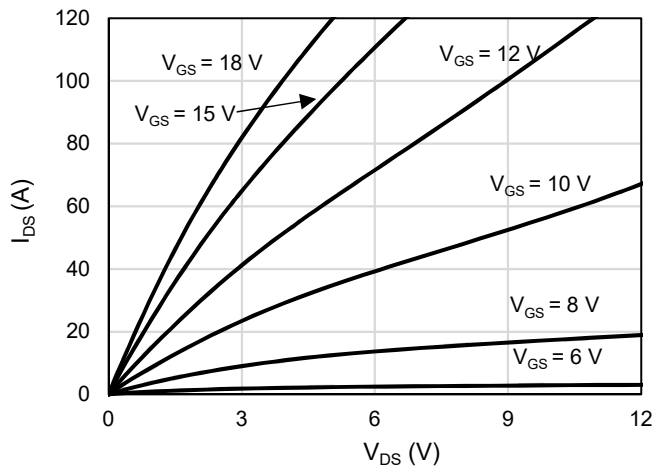
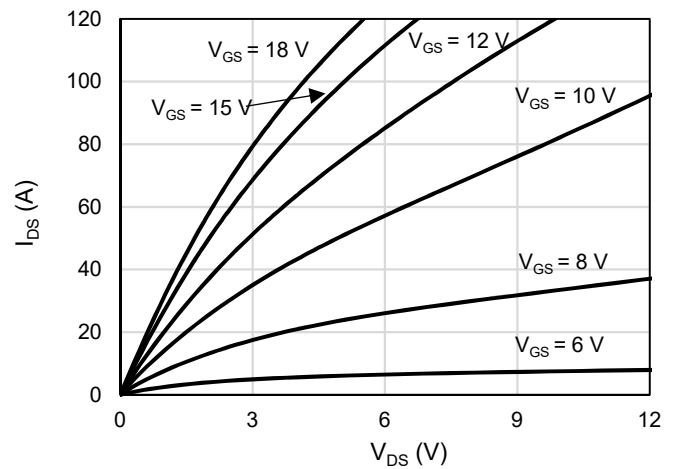
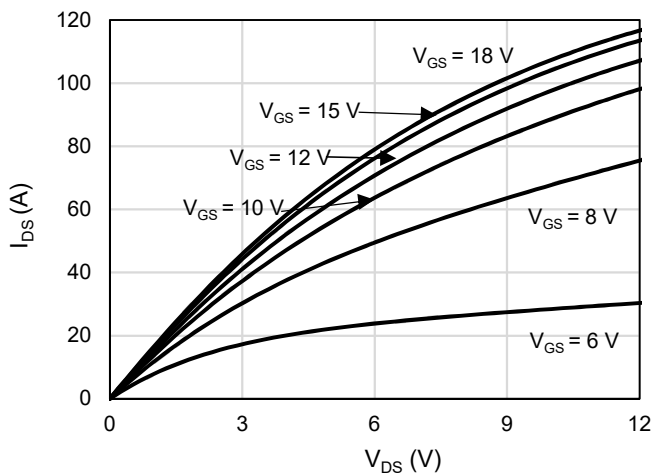
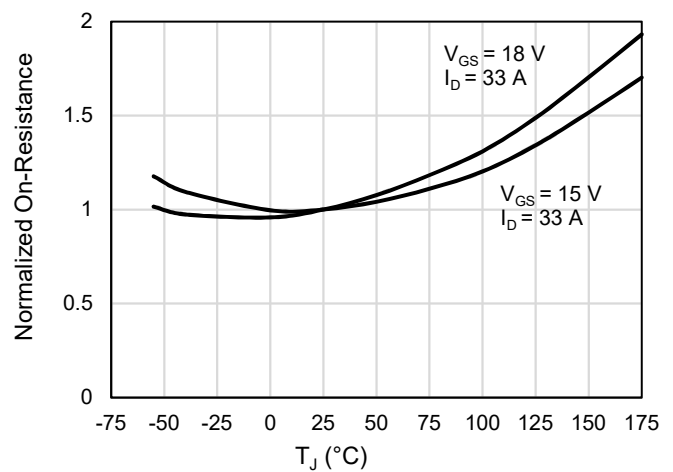
Figure 1: Output Characteristics $T_J = -40^{\circ}\text{C}$ Figure 2: Output Characteristics $T_J = 25^{\circ}\text{C}$ Figure 3: Output Characteristics $T_J = 175^{\circ}\text{C}$ 

Figure 4: Normalized On-Resistance vs. Temperature

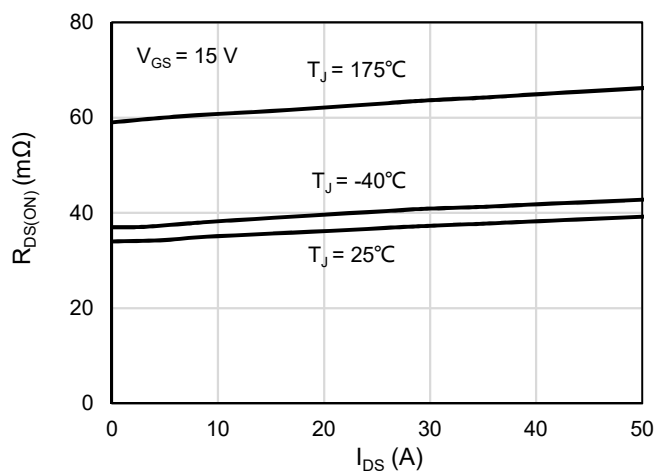


Figure 5: On-Resistance vs. Drain Current For Various Temperatures

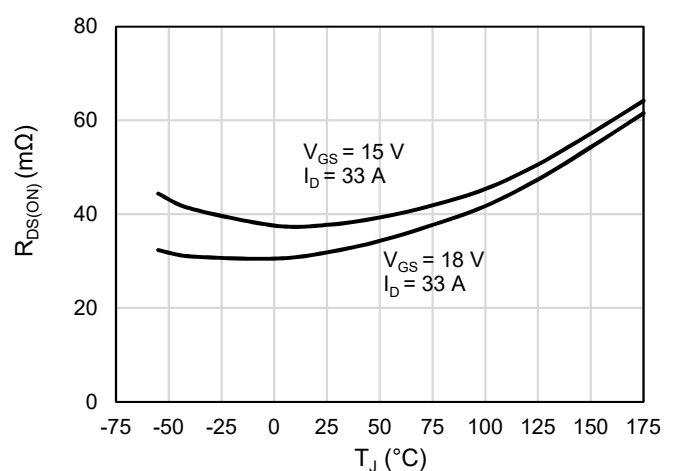
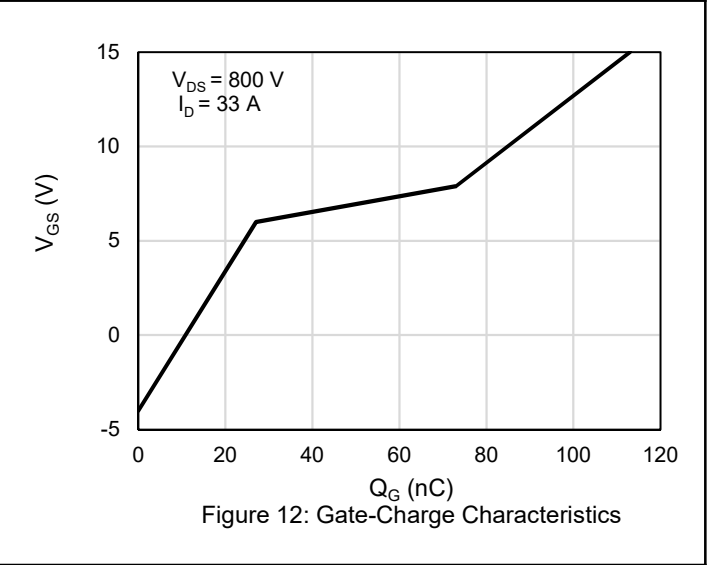
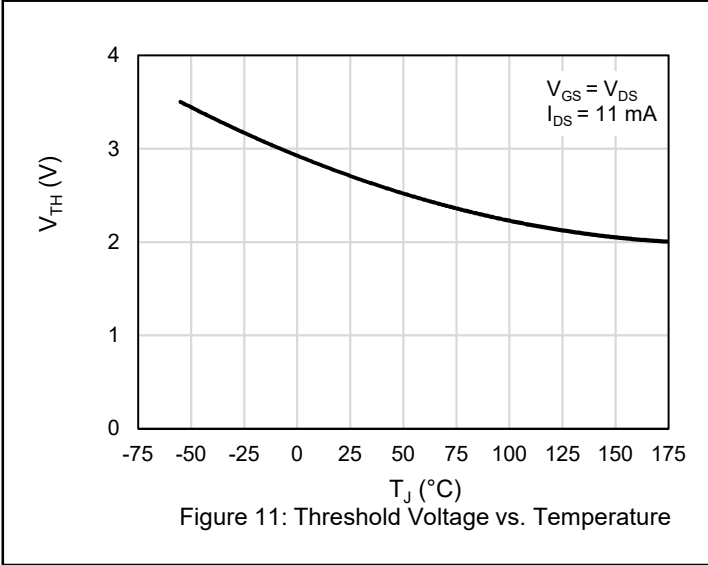
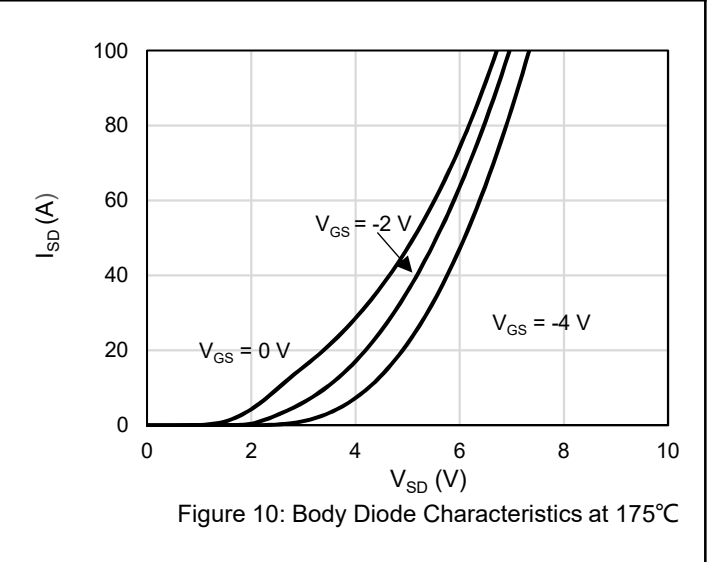
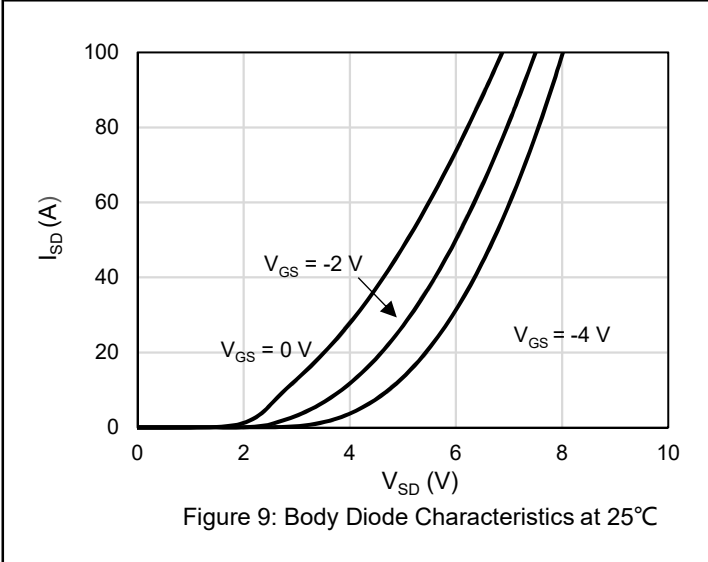
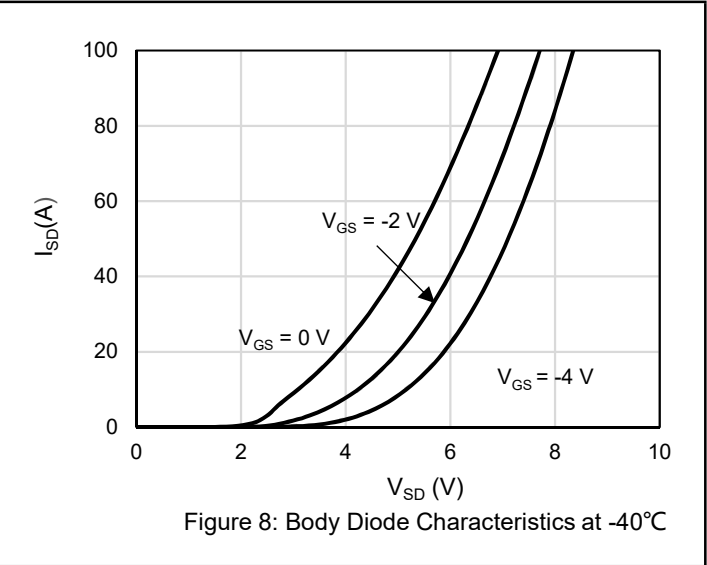
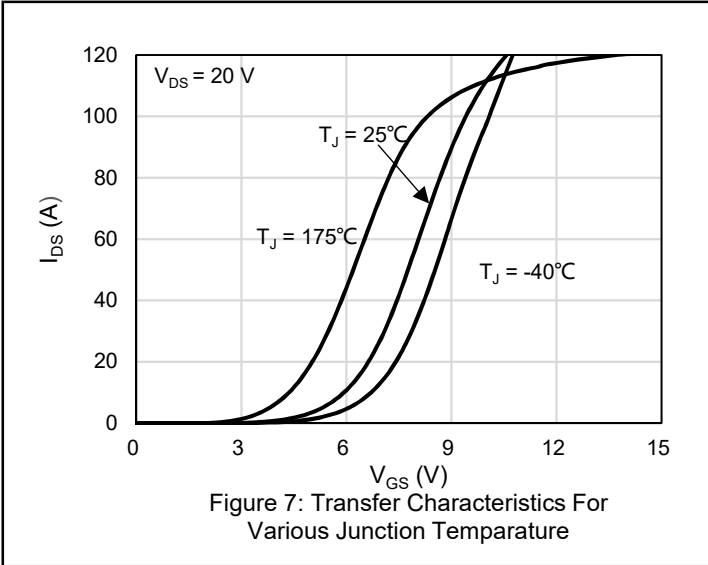


Figure 6: On-Resistance vs. Temperature For Various Gate Voltage



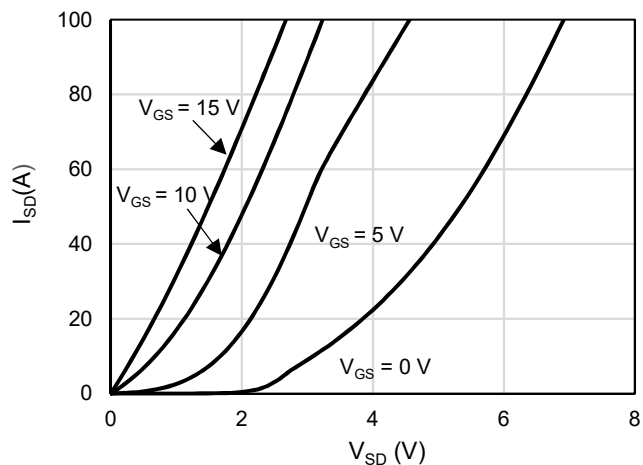


Figure 13: 3rd Quadrant Characteristics at -40°C

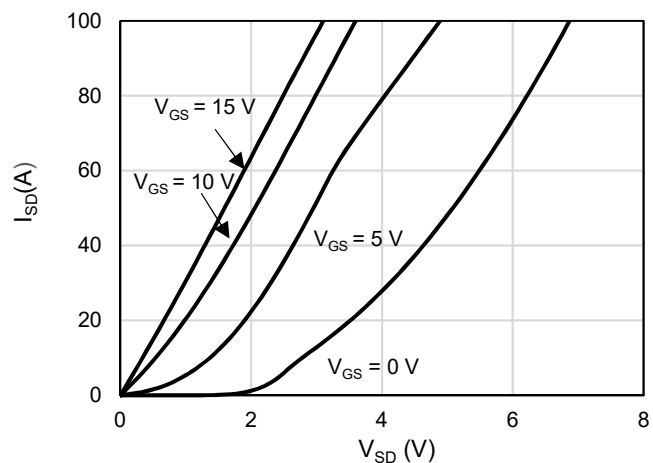


Figure 14: 3rd Quadrant Characteristics at 25°C

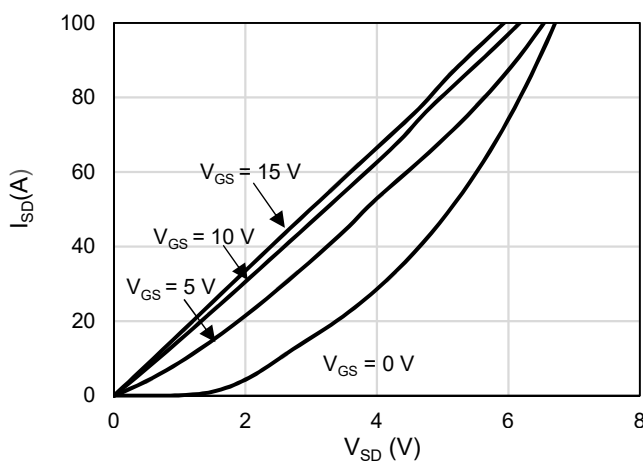


Figure 15: 3rd Quadrant Characteristics at 175°C

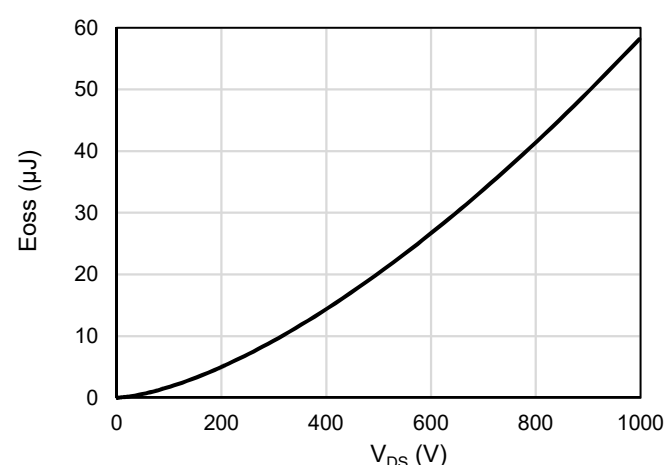


Figure 16: Output Capacitor Stord Energy

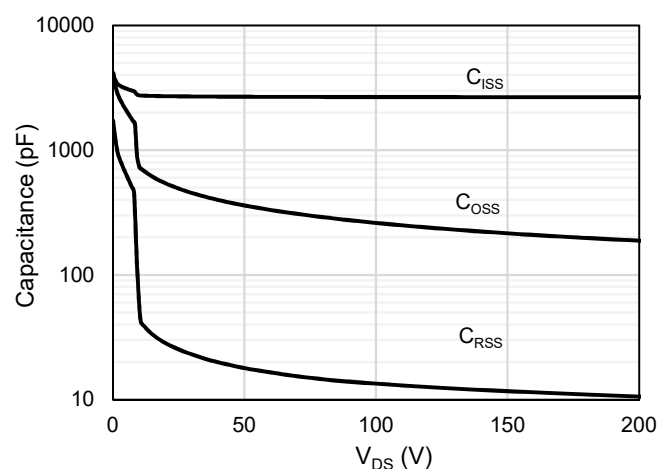


Figure 17: Capacitance Characteristics (0 - 200V)

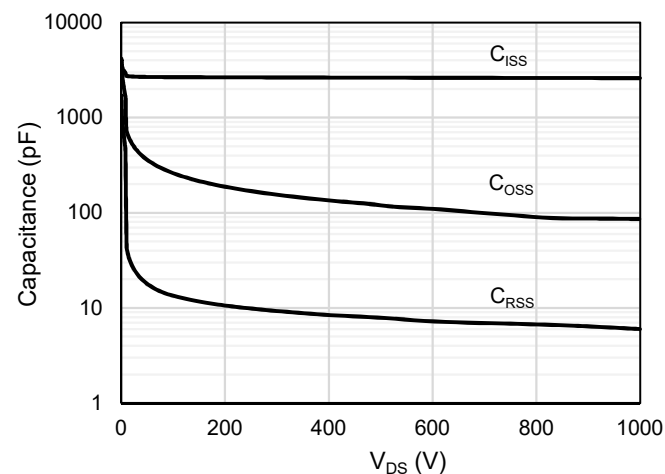


Figure 18: Capacitance Characteristics (0-1000V)

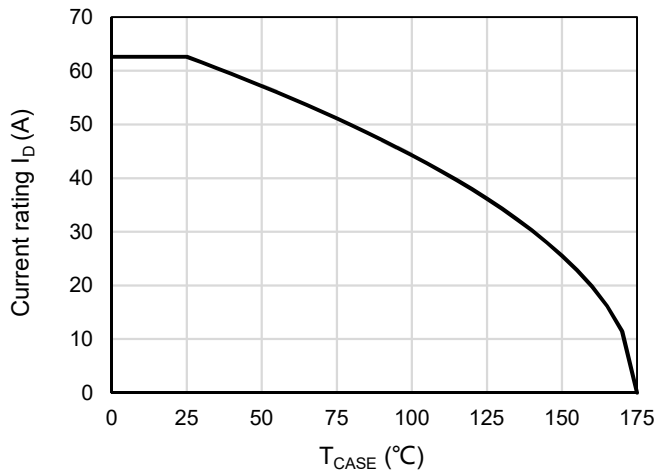


Figure 19: Current De-rating

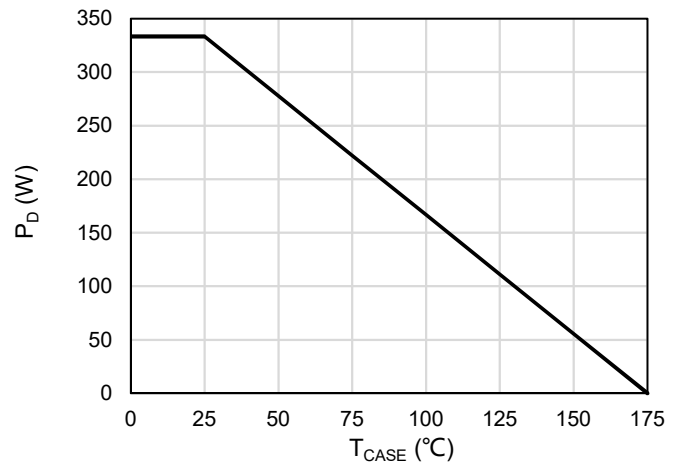


Figure 20: Maximum Power Dissipation Derating vs Case Temperature

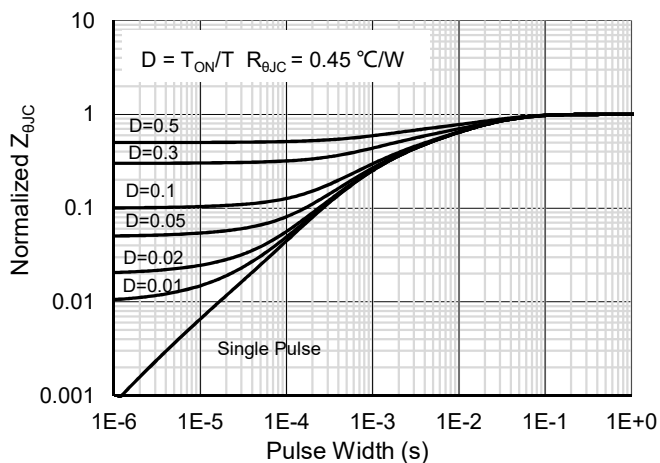


Figure 21: Normalized Maximum Transient Thermal Impedance

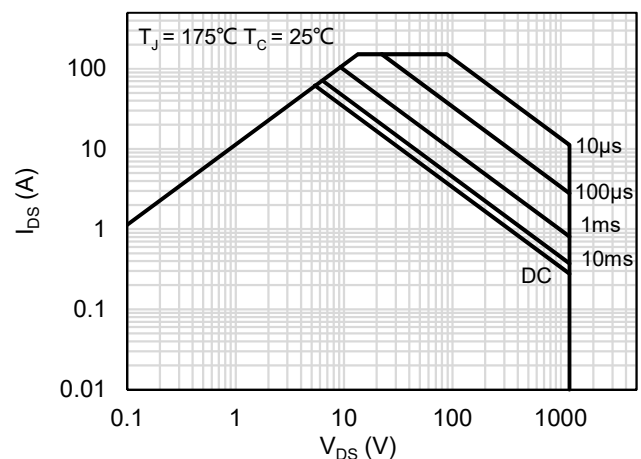
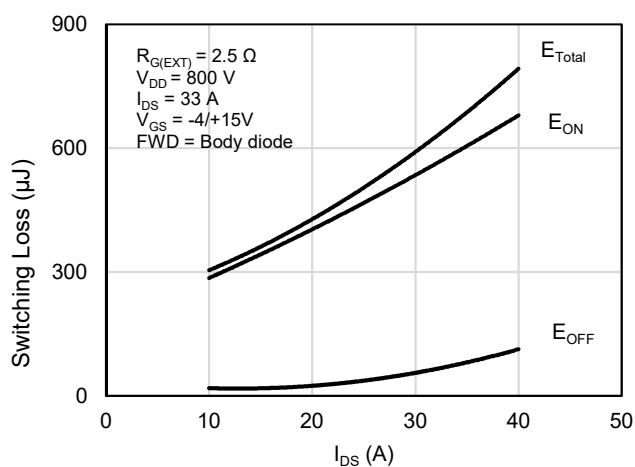
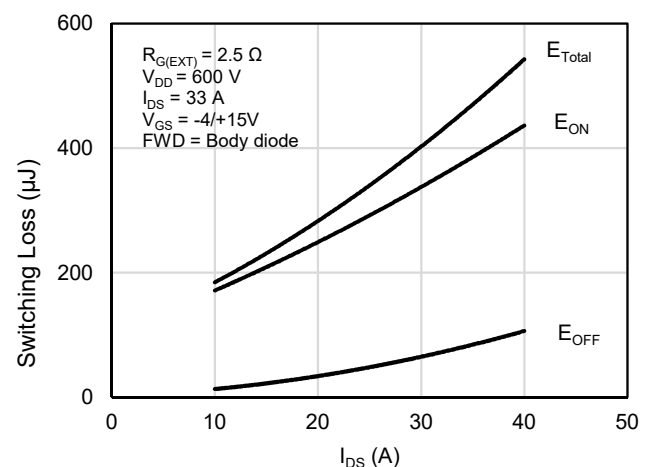
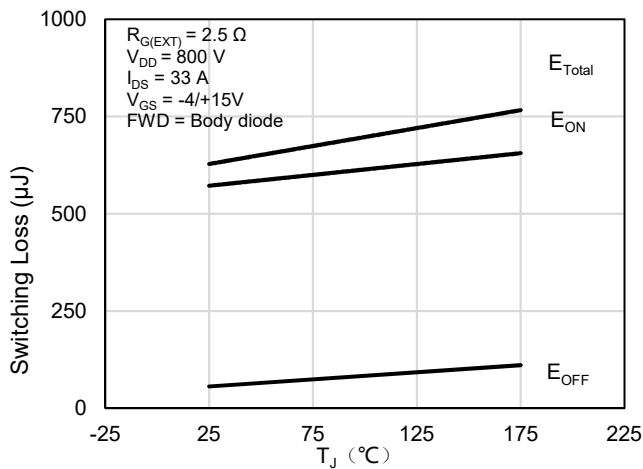
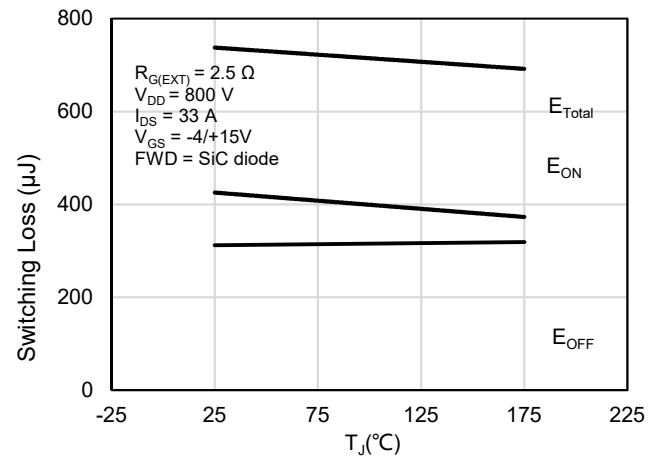
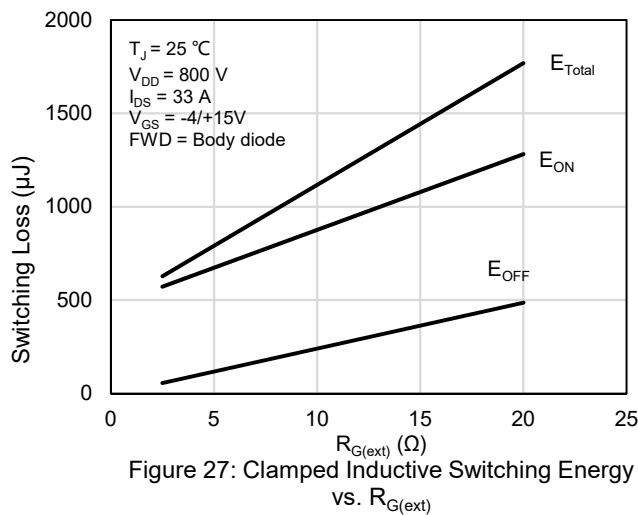
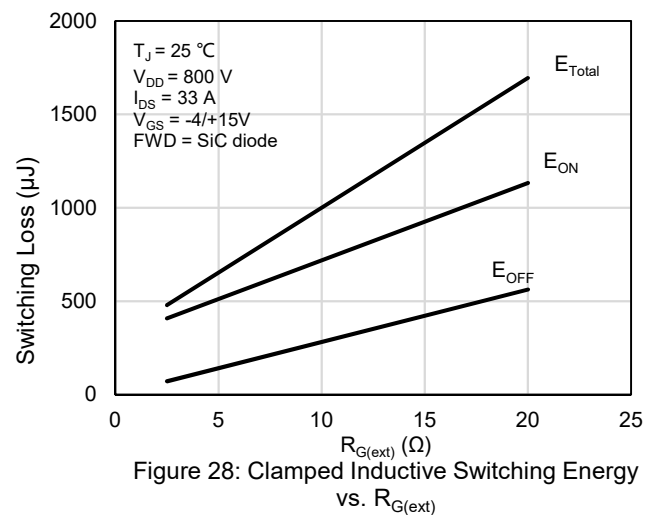
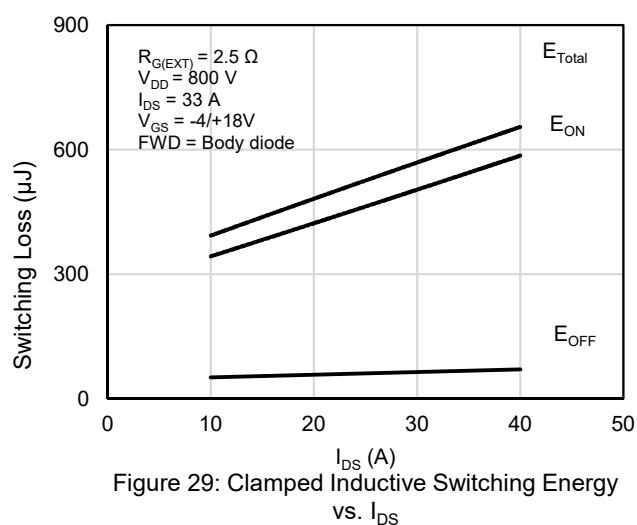
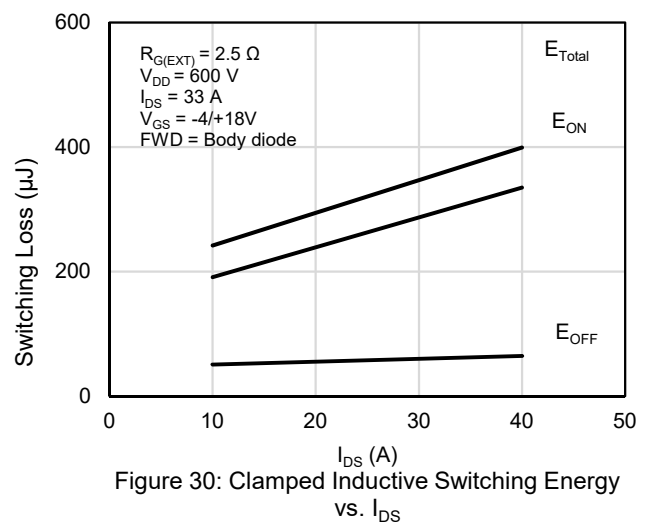
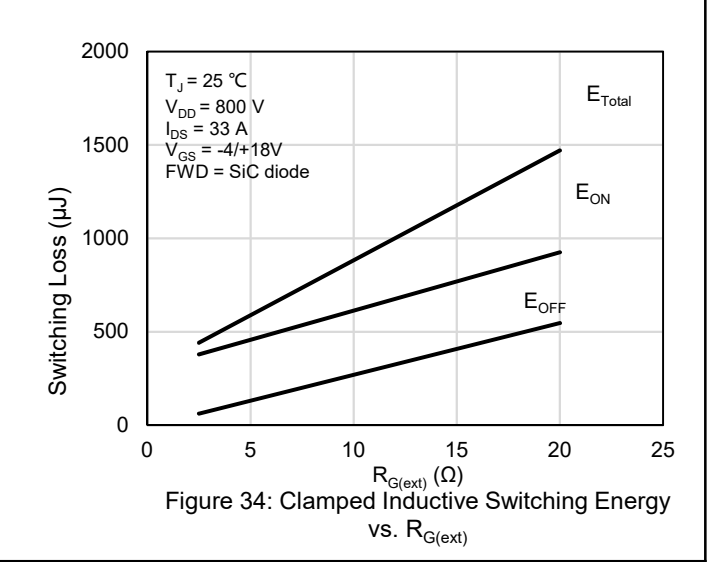
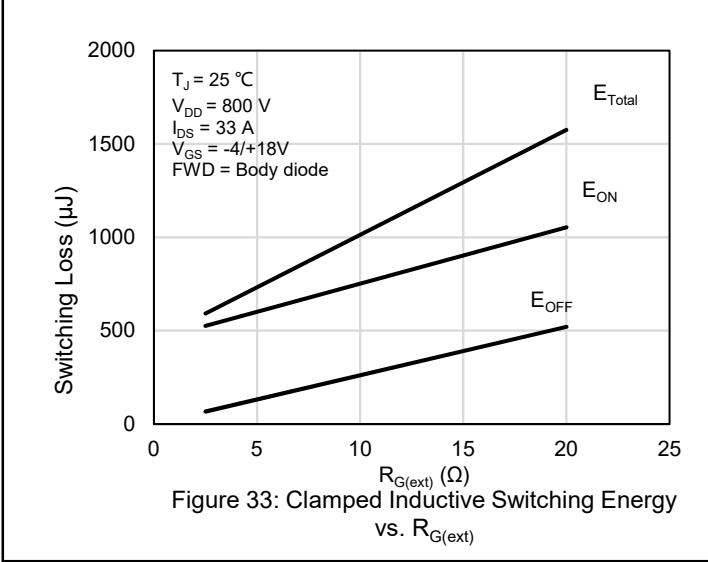
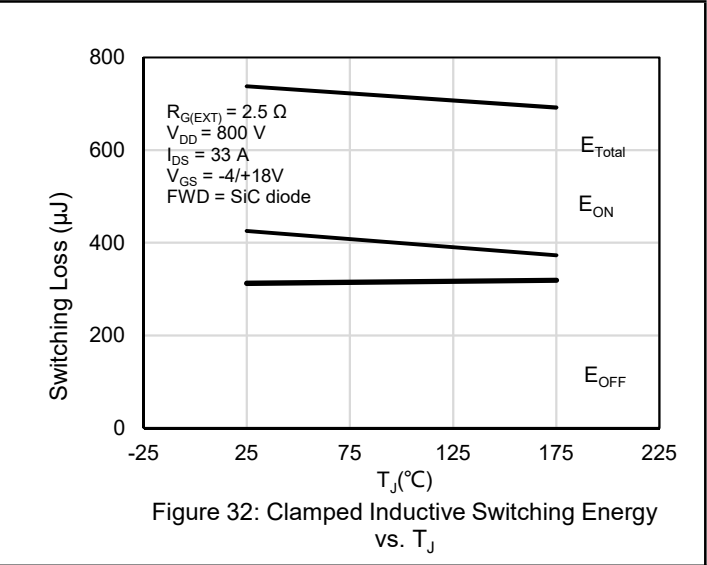
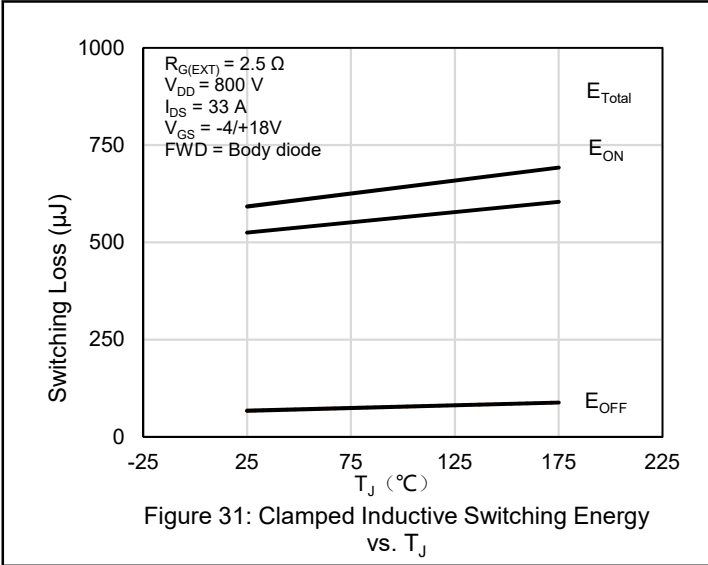


Figure 22: Maximum Forward Biased Safe Operating Area

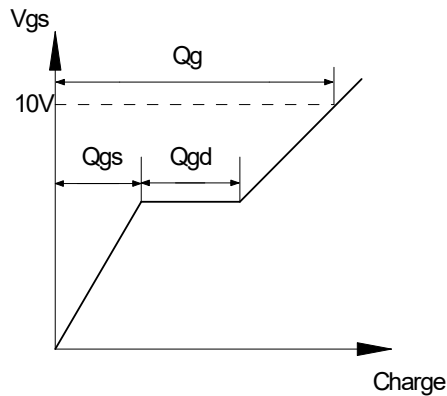
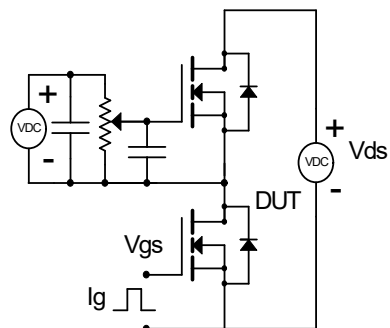
Figure 23: Clamped Inductive Switching Energy vs. I_{DS} Figure 24: Clamped Inductive Switching Energy vs. I_{DS}

Figure 25: Clamped Inductive Switching Energy vs. T_J Figure 26: Clamped Inductive Switching Energy vs. T_J Figure 27: Clamped Inductive Switching Energy vs. $R_{G(ext)}$ Figure 28: Clamped Inductive Switching Energy vs. $R_{G(ext)}$ Figure 29: Clamped Inductive Switching Energy vs. I_{DS} Figure 30: Clamped Inductive Switching Energy vs. I_{DS}

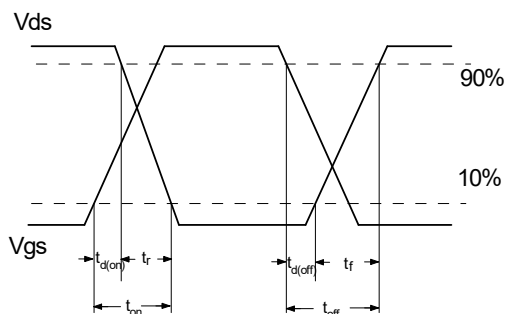
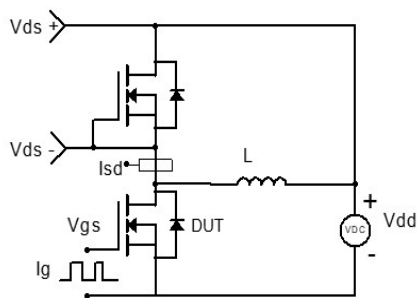


Test Circuit and Waveform

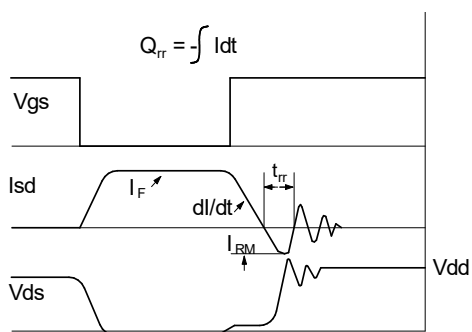
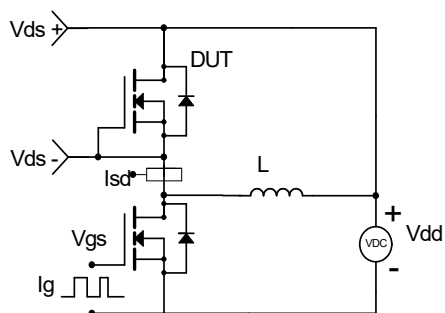
Gate Charge Test Circuit & Waveform



Clamped Inductive Switching Test Circuit & Waveforms

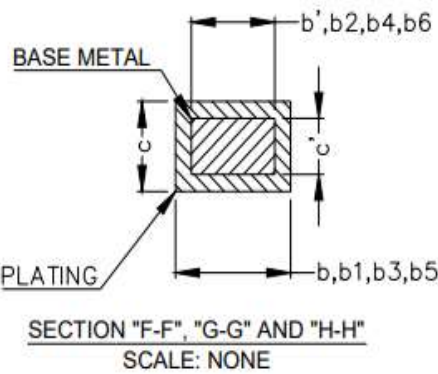
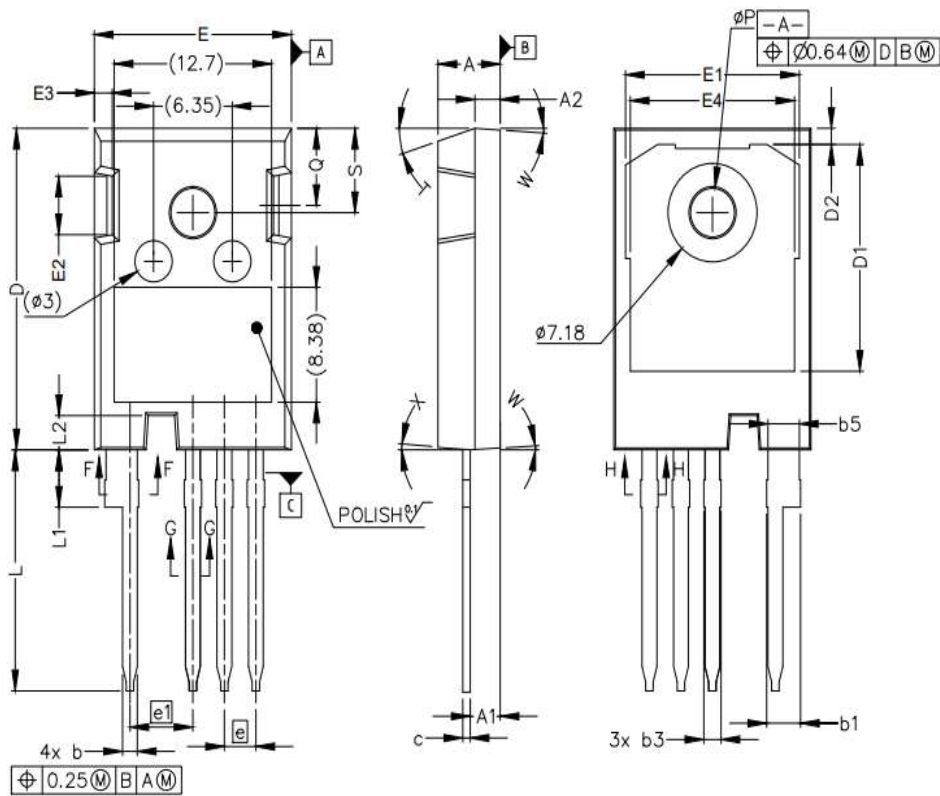


Diode Recovery Test Circuit & Waveforms



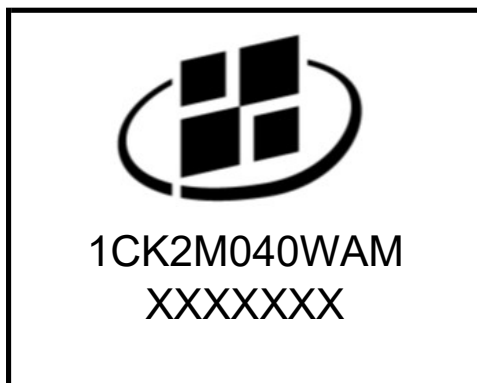
Package Outlines

TO-247-4L PKG Outlines



SYMBOL	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
c'	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
øP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

Marking Information



Note:

1CK2M040WAM = Product Name Code

XXXXXXX = Date Code

Contact ALKAIDSEMI sales for detail information

Revision History

Revision	Release Date	Remark
Rev.1.1	2024	

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.