E4M0045075K1

Silicon Carbide Power MOSFET
E-Series Automotive
N-Channel Enhancement Mode

Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant
- Automotive Qualified (AEC-Q101) and PPAP Capable

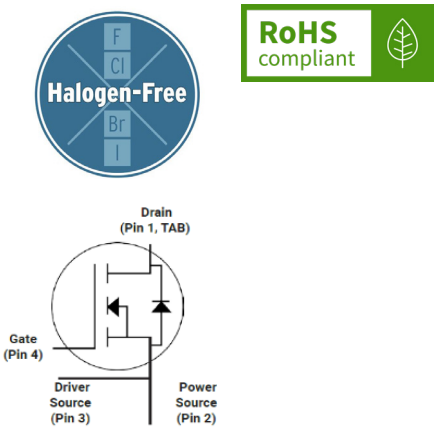
Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Applications

- Motor Control
- EV Battery Chargers
- High Voltage DC/DC Converters

Package



Part Number	Package	Marking
E4M0045075K1	TO-247-4L	E4M0045075K1

Maximum Ratings (T_C = 25 ˚C unless otherwise specified)

Symbol	Parameter		Value	Unit	Note
V_{DSmax}	Drain - Source Voltage		750	V	
V_{GSmax}	Gate - Source Voltage		-8/+19	V	Note: 1
I_D	Continuous Drain Current, V_{GS} = 15 V	T_C = 25˚C	40	A	Fig. 19 Note: 2
		T_C = 100˚C	29		
$I_{D(pulse)}$	Pulsed Drain Current, Pulse width t_P limited by T_{jmax}		132	A	Fig. 22
P_D	Power Dissipation, T_C=25˚C, T_J = 175 ˚C		139	W	Fig. 20 Note: 2
T_J , T_{stg}	Operating Junction and Storage Temperature		-55 to +175	˚C	
T_L	Solder Temperature, 1.6mm (0.063”) from case for 10s		260	˚C	
M_d	Mounting Torque , M3 or 6-32 screw		1 8.8	Nm lbf-in	

Note (1): Recommended turn off / turn on gate voltage V_{GS} - 4V...0V / +15V
Note (2): Verified by design

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Electrical Characteristics (T_C = 25˚C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	750			V	V_{GS} = 0 V, I_D = 100 μA	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.3	3.8	V	V_{DS} = V_{GS}, I_D = 4.84 mA	Fig. 11
			2.0		V	V_{DS} = V_{GS}, I_D = 4.84 mA, T_J = 175ºC	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	μA	V_{DS} = 750 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	V_{GS} = 15 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance		45	60	mΩ	V_{GS} = 15 V, I_D = 17.6 A	Fig. 4, 5, 6
			79			V_{GS} = 15 V, I_D = 17.6 A, T_J = 175ºC	
g_{fs}	Transconductance		13		S	V_{DS}= 20 V, I_{DS}= 17.6 A	Fig. 7
			13			V_{DS}= 20 V, I_{DS}= 17.6 A, T_J = 175ºC	
C_{iss}	Input Capacitance		1606		pF	V_{GS} = 0 V, V_{DS} = 0V to 500 V F = 1 MHz V_{AC} = 25 mV	Fig. 17, 18
C_{oss}	Output Capacitance		95				
C_{rss}	Reverse Transfer Capacitance		8				
E_{oss}	C_{oss} Stored Energy		16		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		118		pF	V_{GS} = 0 V, V_{DS} = 0... 500V	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		165		pF		
E_{ON}	Turn-On Switching Energy (External Diode)		68		μJ	V_{DS}= 500 V, V_{GS}= -4 V/15 V, I_D= 17.6 A, $R_{G(ext)}$ = 2.5 Ω, L= 99 μH, T_J = 175ºC FWD = External SiC Diode	Fig. 25, 27
E_{OFF}	Turn-Off Switching Energy (External Diode)		19				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		71		μJ	V_{DS}= 500 V, V_{GS}= -4 V/15 V, I_D= 17.6 A, $R_{G(ext)}$ = 2.5 Ω, L= 99 μH, T_J = 175ºC FWD = Internal Body Diode	Fig. 25, 27
E_{OFF}	Turn-Off Switching Energy (Body Diode FWD)		23				
$t_{d(on)}$	Turn-On Delay Time		8		ns	V_{DD} = 500 V, V_{GS} = -4 V/15 V I_D = 17.6 A, $R_{G(ext)}$ = 2.5 Ω, L= 99 μH Timing relative to V_{DS} Inductive load	Fig. 26, 27
t_r	Rise Time		11				
$t_{d(off)}$	Turn-Off Delay Time		19				
t_f	Fall Time		8				
$R_{G(int)}$	Internal Gate Resistance		2.9		Ω	f = 1 MHz, V_{AC} = 25 mV	
Q_{gs}	Gate to Source Charge		19		nC	V_{DS} = 500 V, V_{GS} = -4 V/15 V I_D = 17.6 A Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		21				
Q_g	Total Gate Charge		65				

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as Coss while Vds is rising from 0 to 500V
$C_{o(tr)}$, a lumped capacitance that gives same charging time as Coss while Vds is rising from 0 to 500V

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Reverse Diode Characteristics (T_C = 25˚C unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.9		V	V_{GS} = -4 V, I_{SD} = 8.8 A, T_J = 25 °C	Fig. 8, 9, 10
		4.2		V	V_{GS} = -4 V, I_{SD} = 8.8 A, T_J = 175 °C	
I_S	Continuous Diode Forward Current		24	A	V_{GS} = -4 V, T_C = 25˚C	
$I_{S, pulse}$	Diode pulse Current		132	A	V_{GS} = -4 V, pulse width t_P limited by T_{jmax}	
t_{rr}	Reverse Recovery time	12		ns	V_{GS} = -4 V, I_{SD} = 17.6 A, V_R = 500 V dif/dt = 6412 A/µs, T_J = 175 °C	
Q_{rr}	Reverse Recovery Charge	295		nC		
I_{rrm}	Peak Reverse Recovery Current	39		A		
t_{rr}	Reverse Recovery time	20		ns	V_{GS} = -4 V, I_{SD} = 17.6 A, V_R = 500 V dif/dt = 2404 A/µs, T_J = 175 °C	
Q_{rr}	Reverse Recovery Charge	217		nC		
I_{rrm}	Peak Reverse Recovery Current	18		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.83	1.08	°C/W		Fig. 21

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Typical Performance

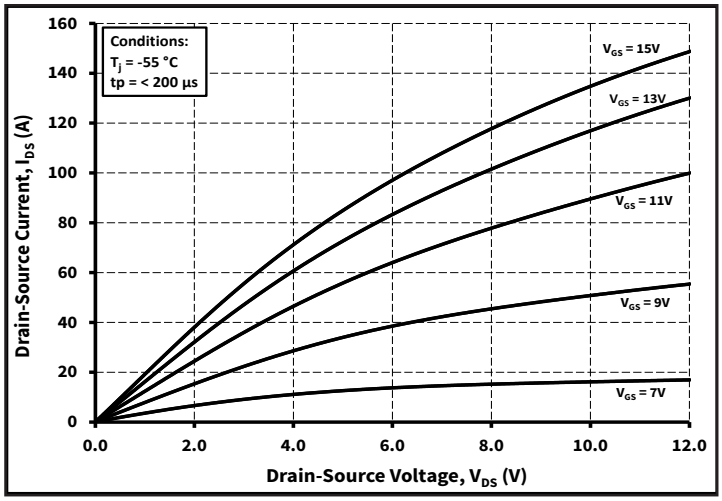

Figure 1. Output Characteristics T_J = -55 ºC

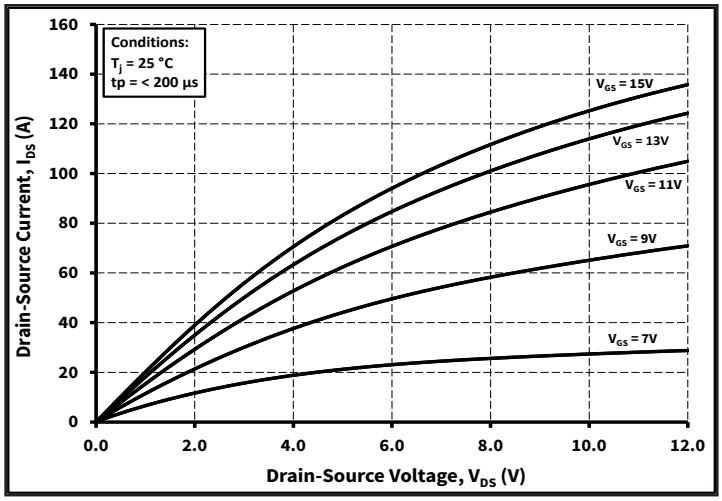

Figure 2. Output Characteristics T_J = 25 ºC

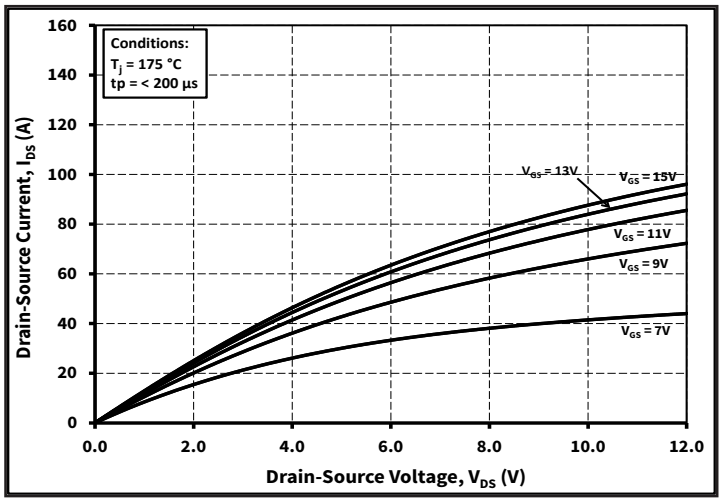

Figure 3. Output Characteristics T_J = 175 ºC

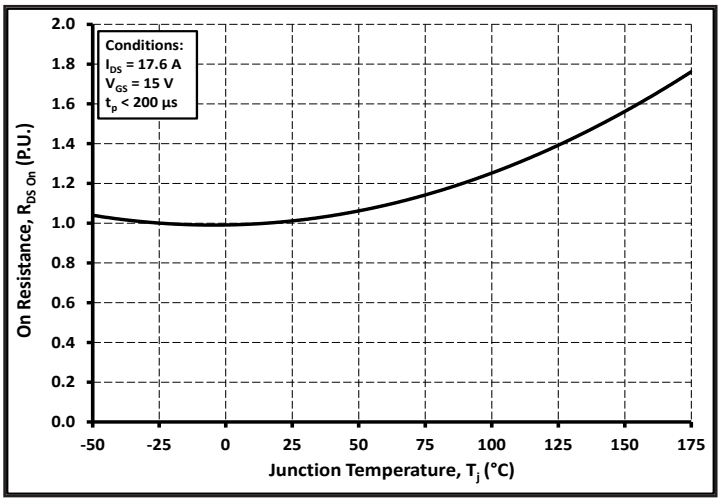

Figure 4. Normalized On-Resistance vs. Temperature

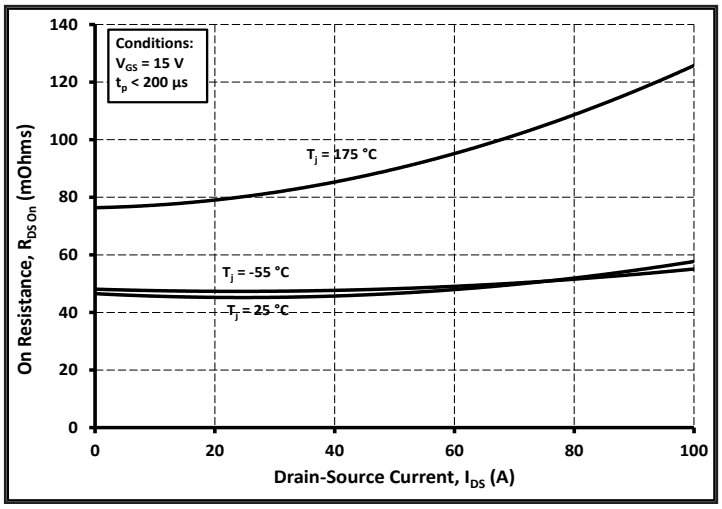

Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

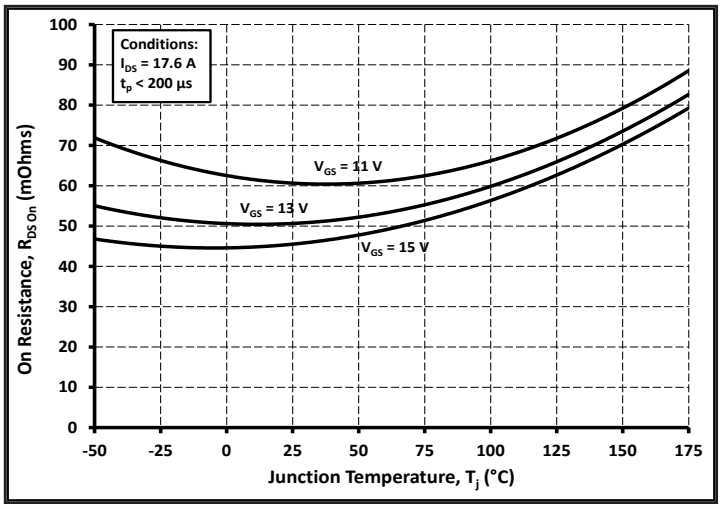

Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

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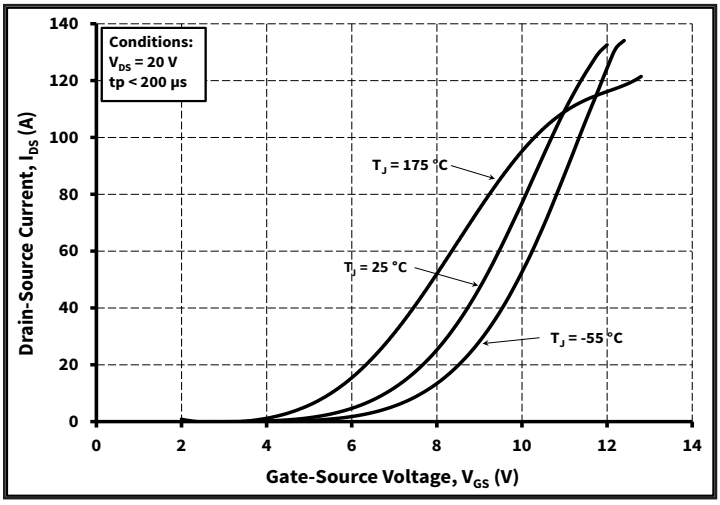

Figure 7. Transfer Characteristic for Various Junction Temperatures

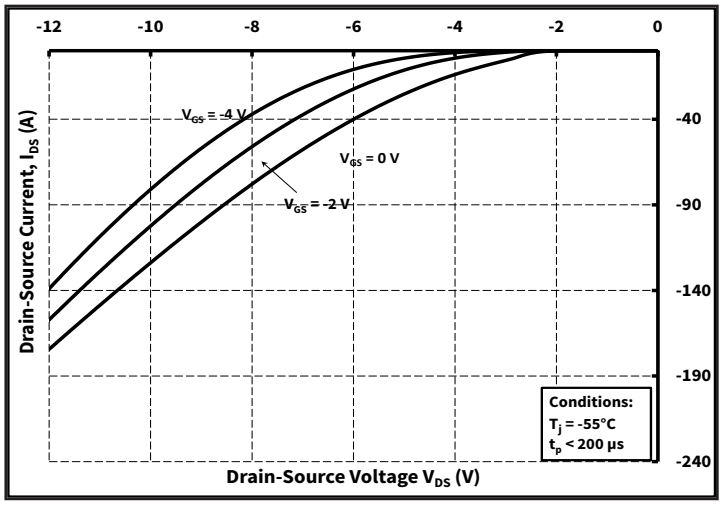

Figure 8. Body Diode Characteristic at -55 °C

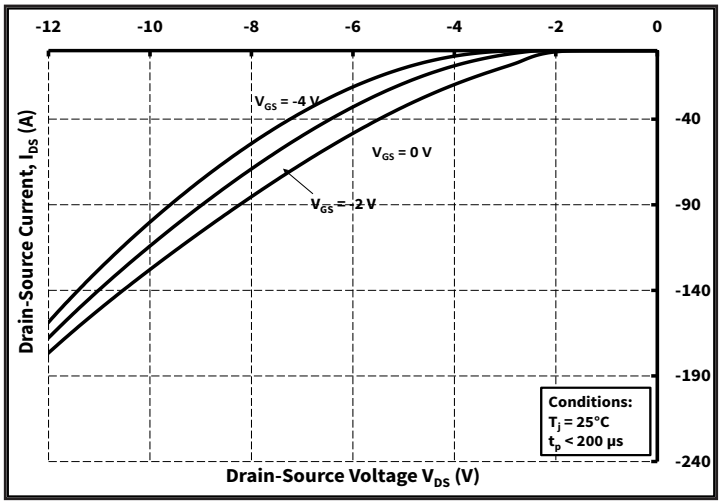

Figure 9. Body Diode Characteristic at 25 °C

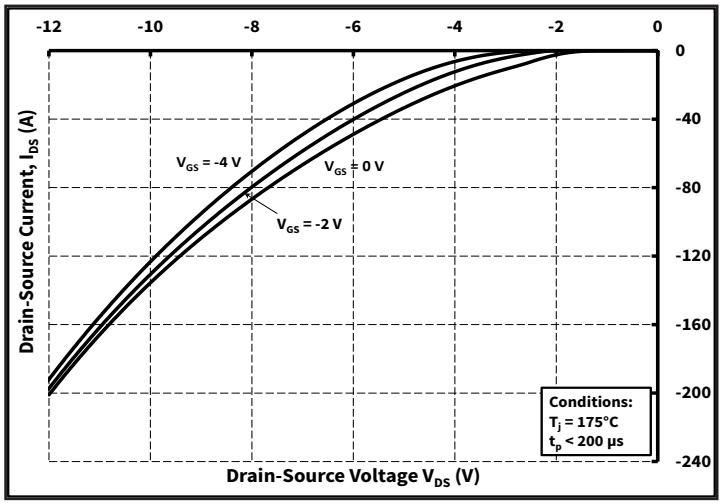

Figure 10. Body Diode Characteristic at 175 °C

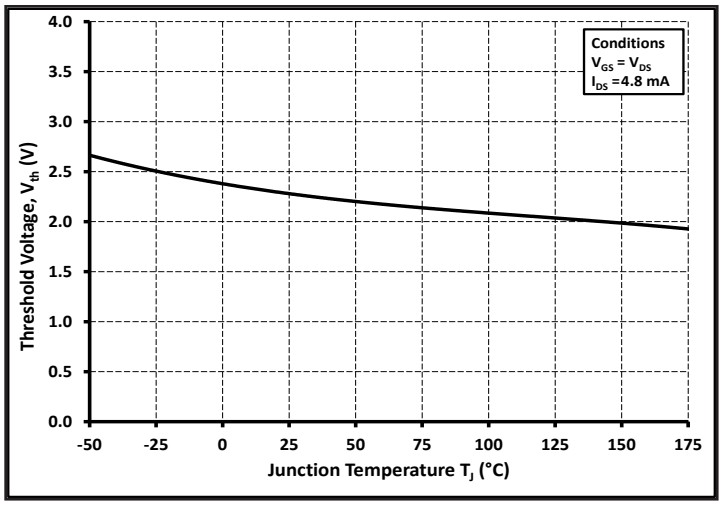

Figure 11. Threshold Voltage vs. Temperature

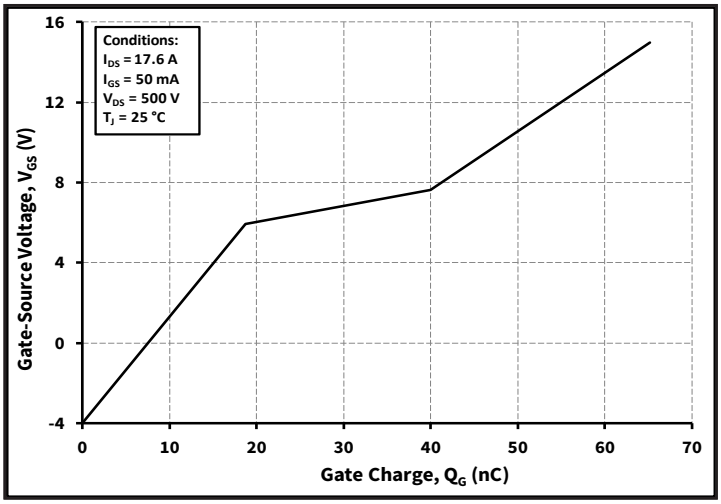

Figure 12. Gate Charge Characteristics

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Typical Performance

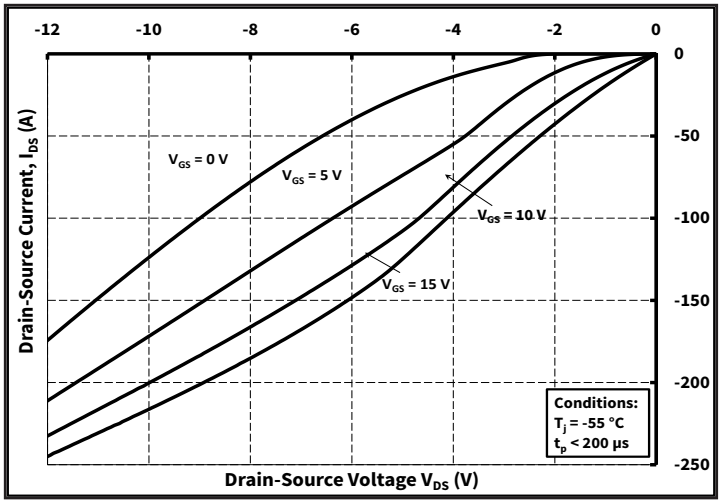

Figure 13. 3rd Quadrant Characteristic at -55 °C

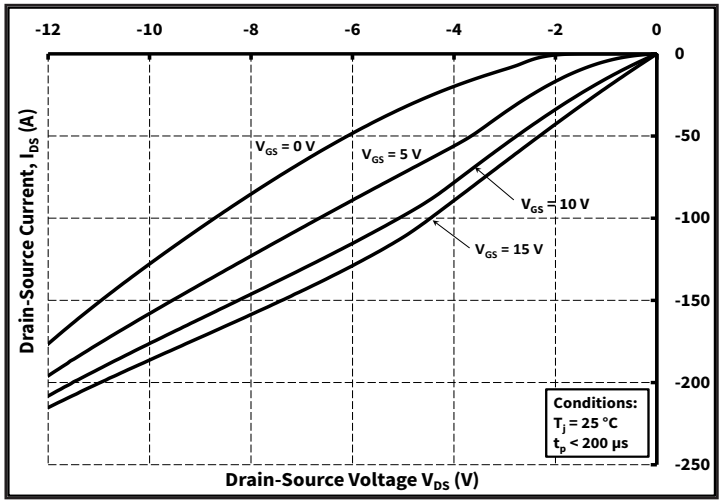

Figure 14. 3rd Quadrant Characteristic at 25 °C

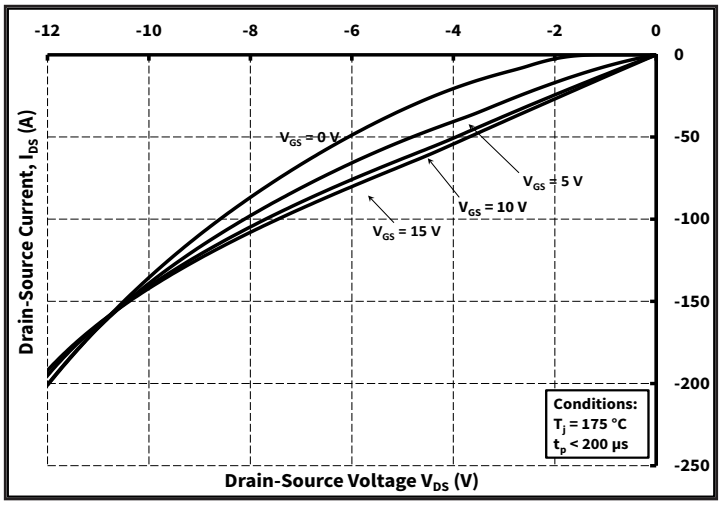

Figure 15. 3rd Quadrant Characteristic at 175 °C

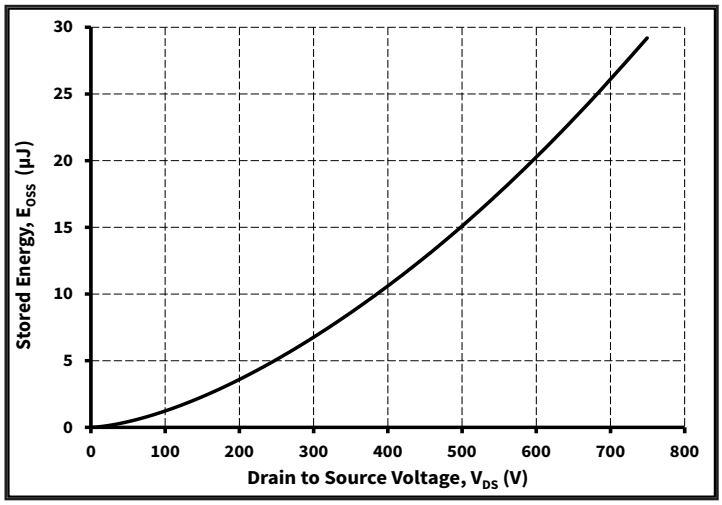

Figure 16. Output Capacitor Stored Energy

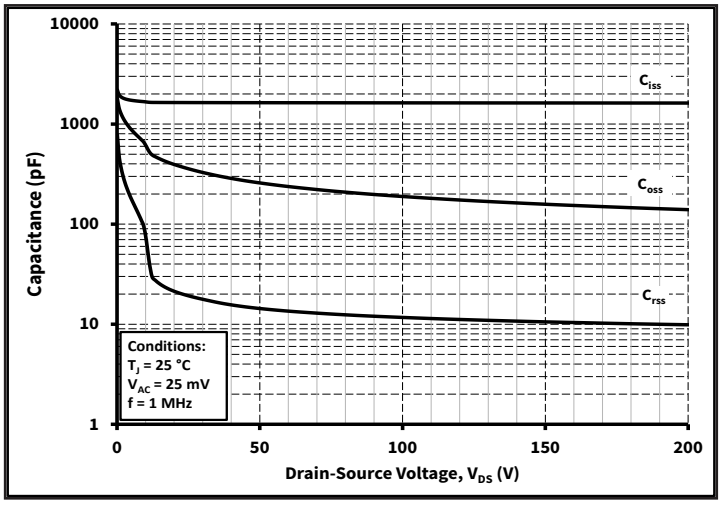

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

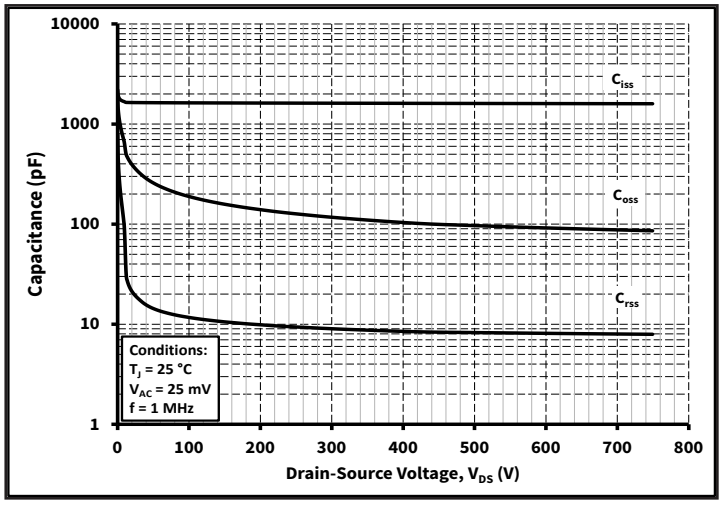

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 750V)

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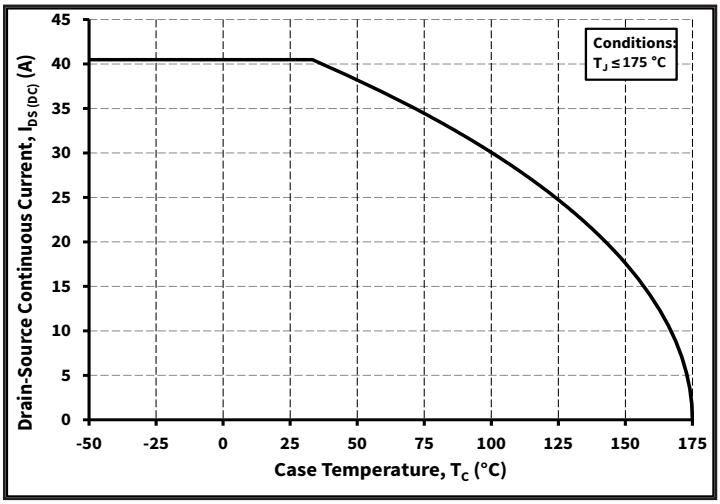

Figure 19. Continuous Drain Current Derating vs. Case Temperature

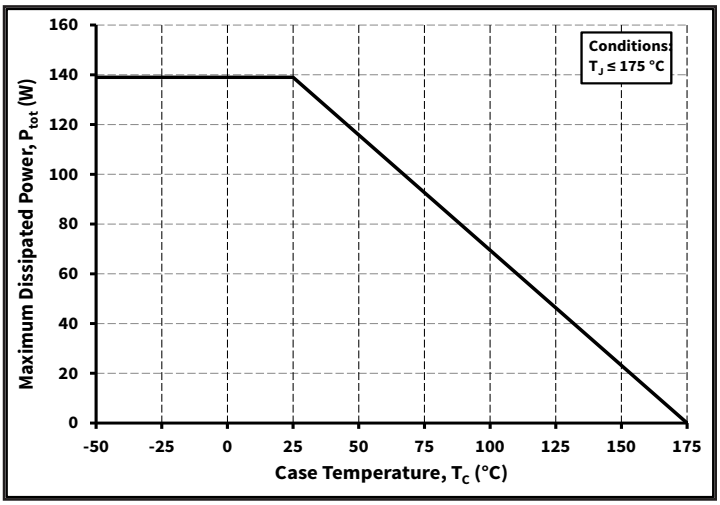

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

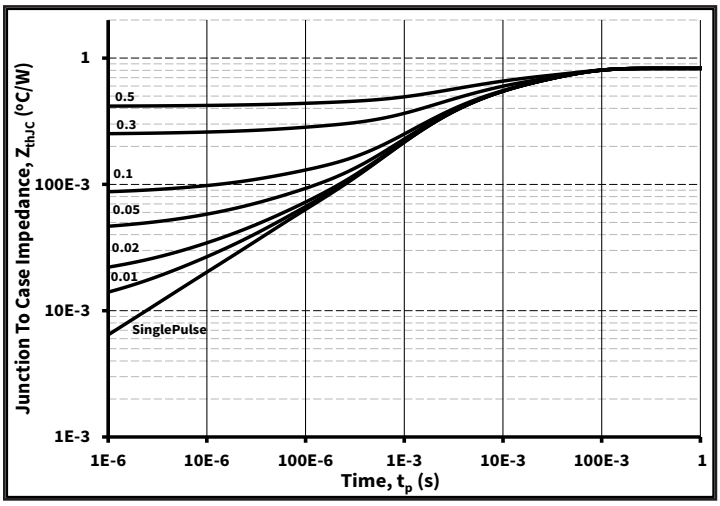

Figure 21. Transient Thermal Impedance (Junction - Case)

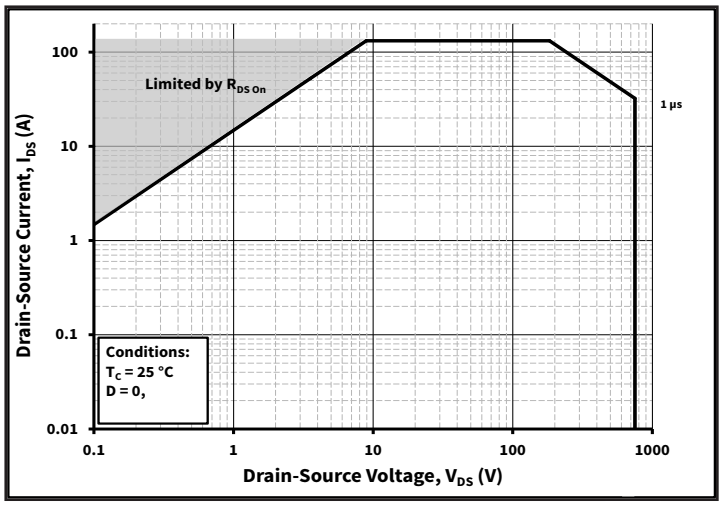

Figure 22. Safe Operating Area

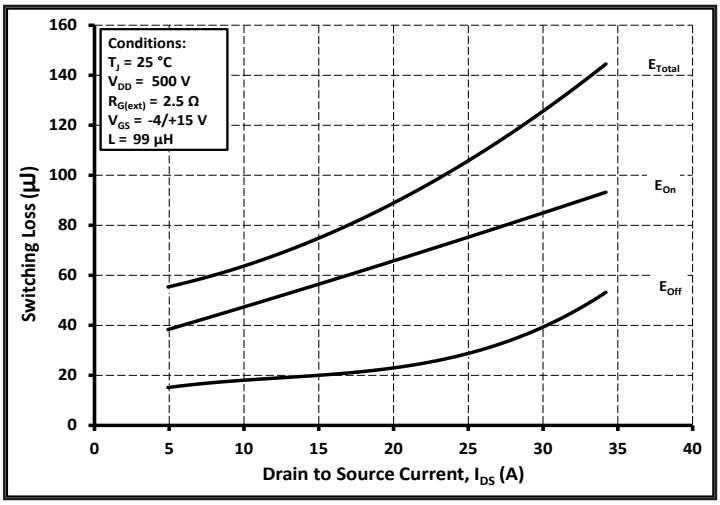

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 500V)

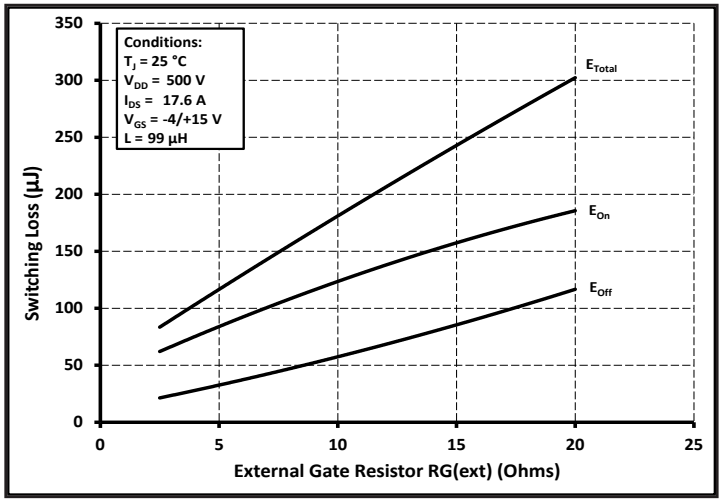

Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

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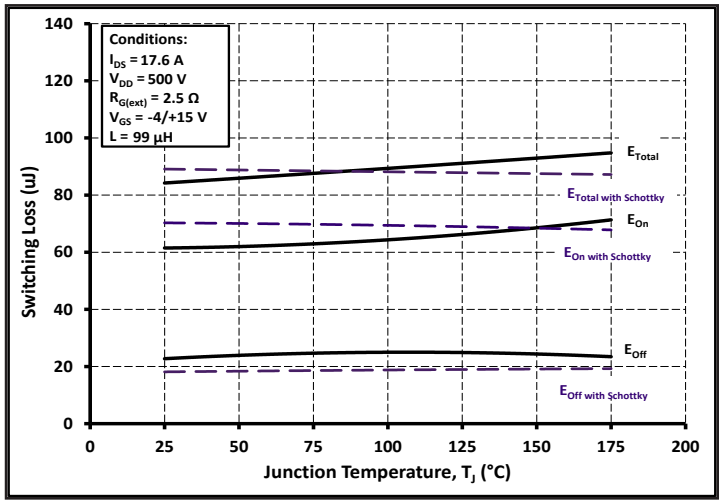

Figure 25. Clamped Inductive Switching Energy vs. Temperature

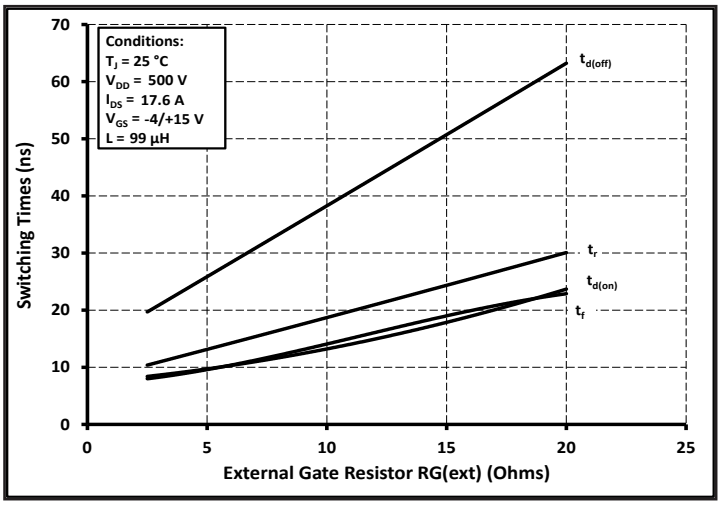

Figure 26. Switching Times vs. $R_{G(ext)}$

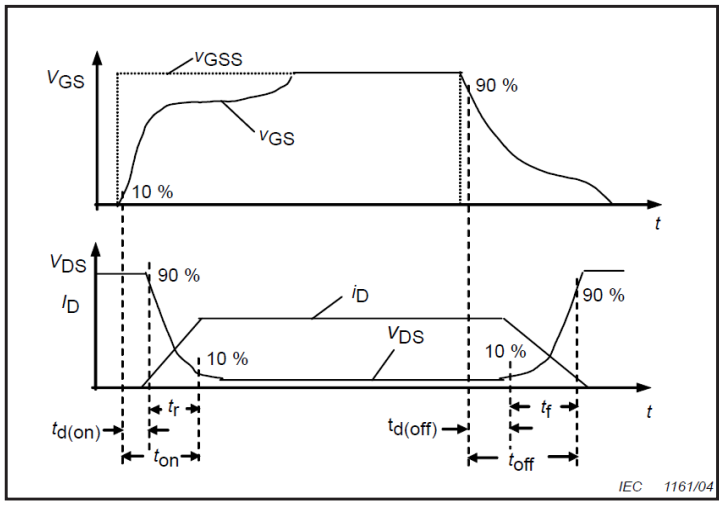

Figure 27. Switching Times Definition

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Test Circuit Schematic

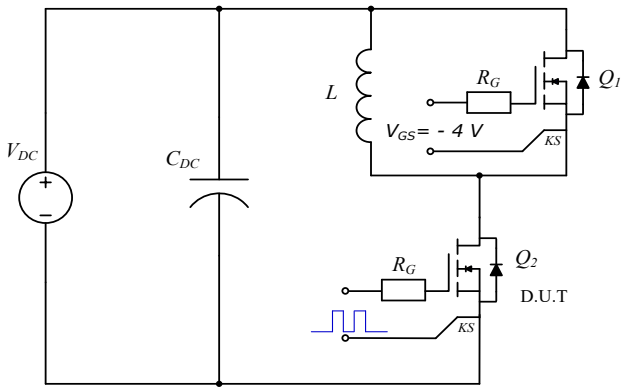

Figure 28. Clamped Inductive Switching Waveform Test Circuit

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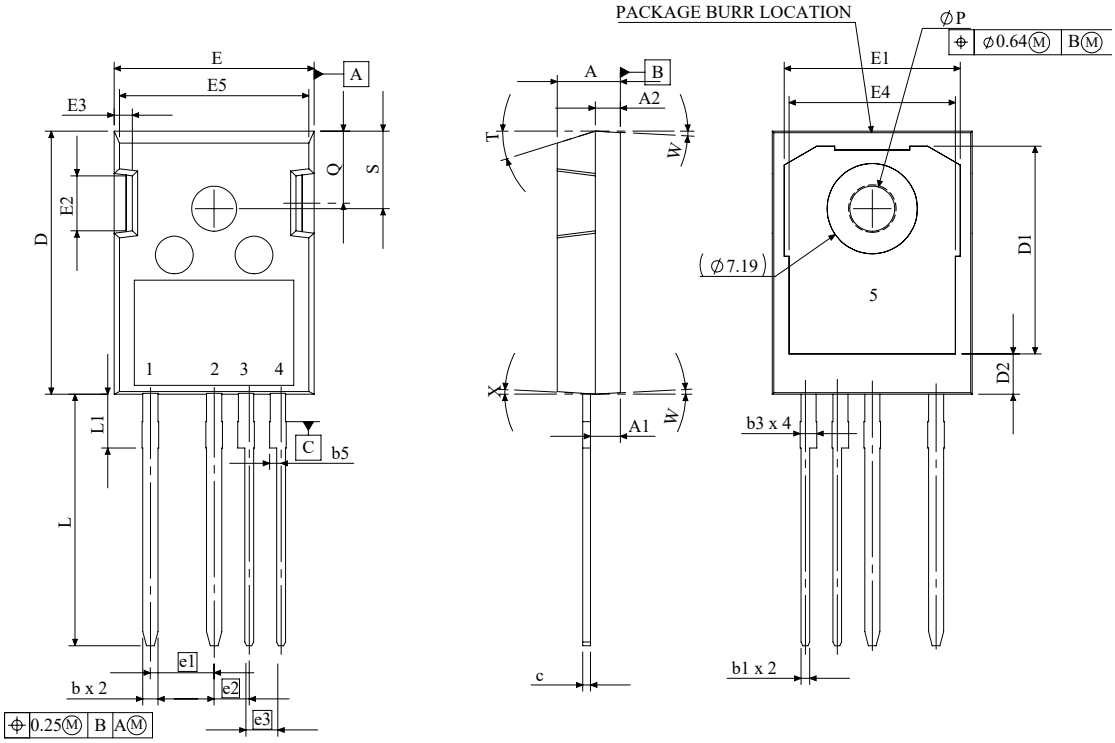
Package Dimensions



SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.22	2.6
A2	1.91	2.16
b	1.10	1.30
b1	0.65	0.79
b3	1.34	1.44
b5	0.74	1.14
c	0.55	0.68
D	20.76	21.14
D1	16.25	17.65
D2	2.95	3.35
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e1	5.08 BSC	
e2	2.79 BSC	
e3	2.54 BSC	
L	19.72	20.32
L1	3.87	4.47
∅P	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.	

1	DRAIN
2	SOURCE
3	DRIVER SOURCE
4	GATE
5	DRAIN

NOTE:
1. ALL METAL SURFACES ARE TIN PLATED (MATTE), EXCEPT AREA OF CUT.
2. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE LISTED IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. BURR OR MOLD FLASH SIZE (0.5 mm) IS NOT INCLUDED IN THE DIMENSIONS

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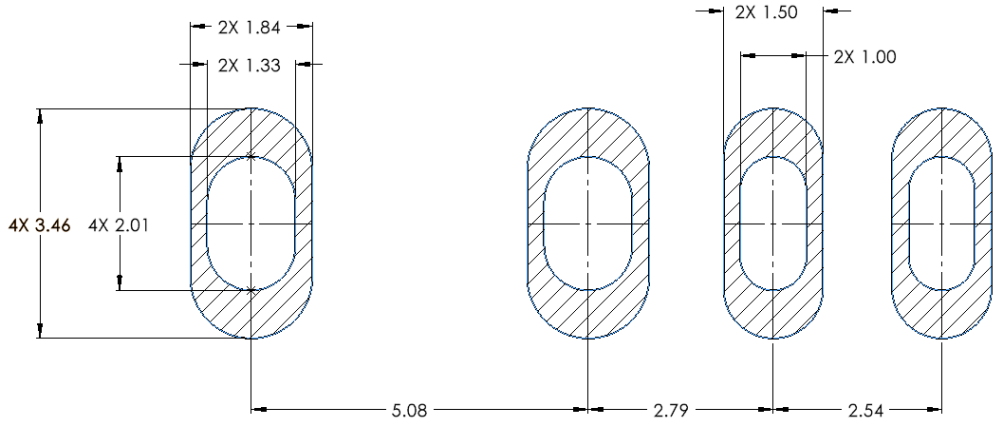
Recommended Solder Pad Layout

All dimensions in mm



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Revision history

Document Version	Date of release	Description of changes
1.0	March-2024	Initial datasheet
2	January - 2025	Legal Disclaimer Updated
3	December - 2025	Updated datasheet values for: • Continuous Drain Current • Threshold Voltage • Drain-Source On-State Resistance • Turn-On and Turn-Off Switching Energies • Continuous Diode Forward Current • Reverse Recovery Charge, Current, and Time • Datasheet Figures • Removed Figure: Clamped Inductive Switching Energy vs. Low Drain Current

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