E4MS009120K

Automotive Silicon Carbide Power MOSFET

Features

- Industry compatible drive voltage 15 V ...18 V/-4 V ...0 V
- Low $R_{DS(on)}$ at high operating temperatures
- Improved device capacitance ratio (C_{iss}/C_{rss})
- Halogen free, RoHS compliant
- Automotive Qualified (AEC-Q101) and PPAP Capable

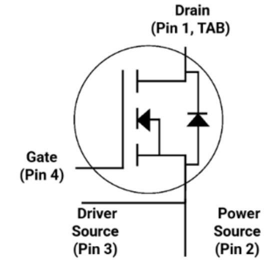
Benefits

- Higher efficiency with lower switching losses and EMI
- Faster switching operation enabling high power density
- Enables system level price performance optimization
- Reduction in system level cooling requirements

Typical Applications

- Onboard charger
- High voltage DC/DC converters
- HVAC compressors
- Battery management systems

Package



Orderable Part Number	Package Type	Marking
E4MS009120K	TO-247-4	E4MS009120K

Absolute Maximum Ratings

Stress beyond those listed under absolute maximum ratings may damage the device.

Symbol	Parameter	Min.	Max.	Unit	Conditions	Note
$V_{DS(max)}$	Drain-Source Voltage		1200	V		
$V_{GS(max)}$	Maximum Gate – Source Voltage (Transient)	-10	+23	V		Note 1
I_D	DC Continuous Drain Current		203	A	V_{GS} = 18 V, T_c = 25 °C, $T_J \leq$ 175 °C	Note 2
			144	A	V_{GS} = 18 V, T_c = 100 °C, $T_J \leq$ 175 °C	
I_{DM}	Pulsed Drain Current		700	A	V_{GS} = 18 V, T_c = 25 °C, t_{Pmax} limited by T_{jmax}	
P_D	Power Dissipation		714	W	T_c = 25 °C, T_J = 175 °C	Note 3
T_J, T_{stg}	Operating Junction and Storage Temperature	-55	+175	°C		
T_L	Solder Temperature		260	°C	According to JEDEC J-STD-020	

Note (1): Refer to AN PRD-09634
Note (2): Current limit calculated by $I_{D(max)} = \sqrt{(P_D/R_{DS(typ)}(T_{J(max)}, I_{D(max)}))}$
Note (3): $P_D = (T_J - T_C) / R_{th(JC,Max)}$

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	1200			V	V_{GS} = 0 V, I_D =100 µA	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	2.6	3.9	V	V_{DS} = V_{GS}, I_D = 30.8 mA	Fig. 11, Note 1
			2.0		V	V_{DS} = V_{GS}, I_D = 30.8 mA, T_J = 175 °C	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	µA	V_{DS} = 1200 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	V_{GS} = 18 V, V_{DS} = 0 V	
$V_{GS(op)}$	Recommended Turn on Gate-Source Voltage		+15…+18		V		Note 4
	Recommended Turn off Gate-Source Voltage		-4…0				
$R_{DS(on)}$	Drain-Source On-State Resistance		9	11.7	mΩ	V_{GS} = 18 V, I_D = 100 A	Fig. 4, 5, 6
			16.9			V_{GS} = 18 V, I_D = 100 A, T_J = 175 °C	
			10.3			V_{GS} = 15 V, I_D = 100 A	
g_{fs}	Transconductance		77		S	V_{DS} = 20 V, I_D = 100 A	Fig. 7
			75			V_{DS} = 20 V, I_D = 100 A, T_J = 175 °C	
$R_{DS(on)Tempco}$	On Resistance Temperature Coefficient		1.88			V_{GS} = 18 V, I_D = 100 A	Note 5
C_{iss}	Input Capacitance		8585		pF	V_{GS} = 0 V, V_{DS} = 1000 V f = 100 kHz V_{AC} = 25 mV	Fig. 17, 18
C_{oss}	Output Capacitance		267				
C_{rss}	Reverse Transfer Capacitance		13.6				
C_{iss}/C_{rss}	Capacitance Ratio		630				Note 6
E_{oss}	C_{OSS} Stored Energy		171		µJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		379.1		pF	V_{GS} = 0 V, V_{DS} = 0 V … 800 V	Note 7
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		629.8				
E_{on}	Turn-On Switching Energy (Body Diode FWD) T_j = 25 °C T_j = 175 °C		 1319 1649		µJ	V_{DS} = 800 V, V_{GS} = -4 V / 18 V, I_D = 100 A, $R_{G(ext)}$ = 1 Ω, $L_σ$ = 16.9 nH	Fig. 25, 27, 29
E_{off}	Turn-Off Switching Energy (Body Diode FWD) T_j = 25 °C T_j = 175 °C		 466 555				Fig. 25, 28, 29
$t_{d(on)}$	Turn-On Delay Time		14		ns	V_{DS} = 800 V, V_{GS} =-4 V / 18 V, I_D = 100 A, $R_{G(ext)}$ = 1 Ω, $L_σ$ = 16.9 nH Timing relative to I_{DS} Inductive load	Fig. 26, 27, 29
t_r	Rise Time		9.5				
$t_{d(off)}$	Turn-Off Delay Time		87.6				Fig. 26, 28, 29
t_f	Fall Time		19.8				
$R_{G(int)}$	Internal Gate Resistance		2.4		Ω	f = 1 MHz	
Q_{gs}	Gate to Source Charge		94		nC	V_{DS} = 800 V, V_{GS} = -4 V/ 18 V I_D = 100 A	Fig. 12
Q_{gd}	Gate to Drain Charge		80				
Q_g	Total Gate Charge		340				

Note (4): Refer to AN PRD-08999.
Note (5): $R_{DS(on)Tempco}$ refers to $R_{DS(on)}$ at 175 °C / $R_{DS(on)}$ at 25 °C. This is a E4MS 1200 V product family value.
Note (6): Capacitance ratio is a FOM for partial turn-on immunity AN PRD-06933. This is a E4MS 1200 V product family value.
Note (7): $C_{o(er)}$, a lumped capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 V to 800 V.
$C_{o(tr)}$, a lumped capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 V to 800 V.

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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	5.1		V	V_{GS} = -4 V, I_{SD} = 56 A, T_J = 25 °C	Fig. 8, 9, 10
		4.5			V_{GS} = -4 V, I_{SD} = 56 A, T_J = 175 °C	
I_S	Continuous Diode Forward Current		123	A	V_{GS} = -4 V, T_C = 25 °C	
I_{SM}	Diode Pulse Current		700		V_{GS} = -4 V, pulse width t_p limited by T_{jmax}	
t_{rr}	Reverse Recovery Time	34.7		ns	V_{GS} = -4 V, I_{SD} = 100 A, V_R = 800 V, T_J = 175 °C, di_f/dt = 14033 A/µs	Fig. 30
Q_{rr}	Reverse Recovery Charge	1923		nC		
I_{RRM}	Peak Reverse Recovery Current	97		A		
E_{RR}	Reverse Recovery Energy T_j = 25 °C T_j = 175 °C	 148 835		µJ	V_{DS} = 800 V, I_{DS} = 100 A, V_{GS} = -4 V / 18 V, $R_{G(ext)}$ = 1 Ω, $L_σ$ = 16.9 nH	

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{θJC}$	Thermal Resistance from Junction to Case	0.16	0.21	°C/W		

Typical Performance

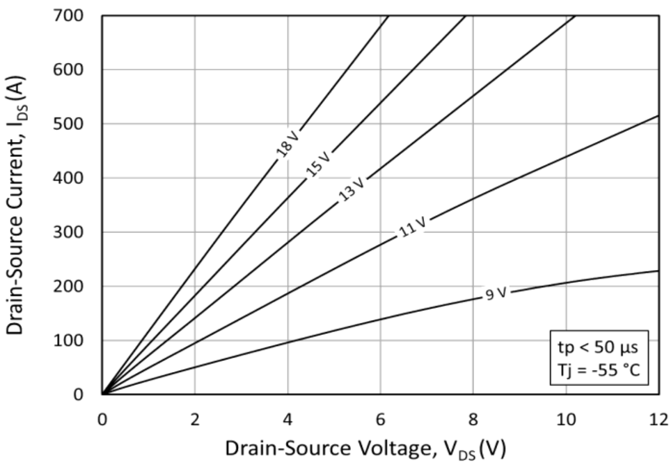


Figure 1. Output Characteristics T_{VJ} = -55 °C

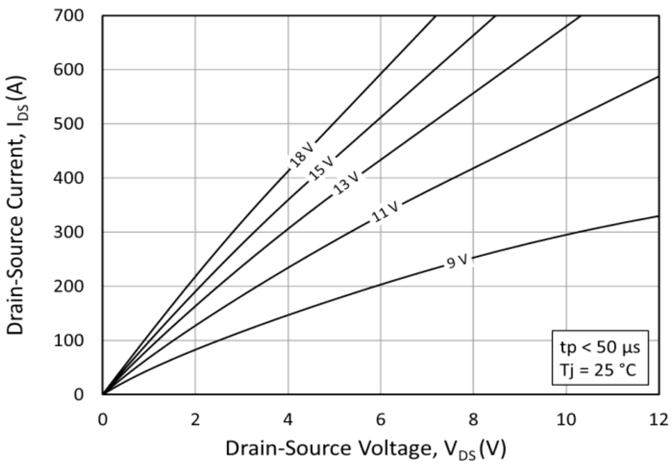


Figure 2. Output Characteristics T_{VJ} = 25 °C

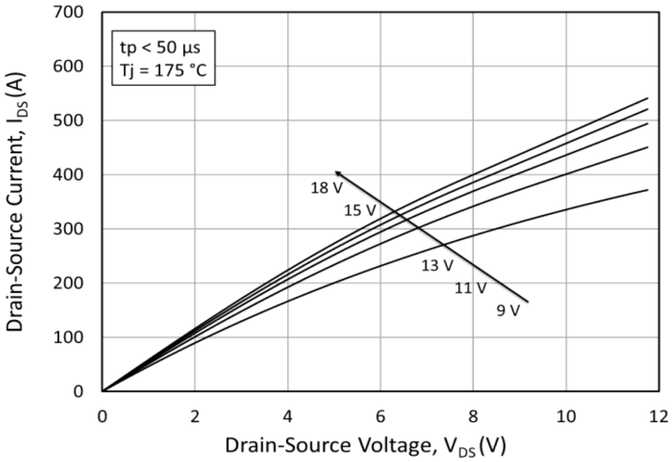


Figure 3. Output Characteristics T_{VJ} = 175 °C

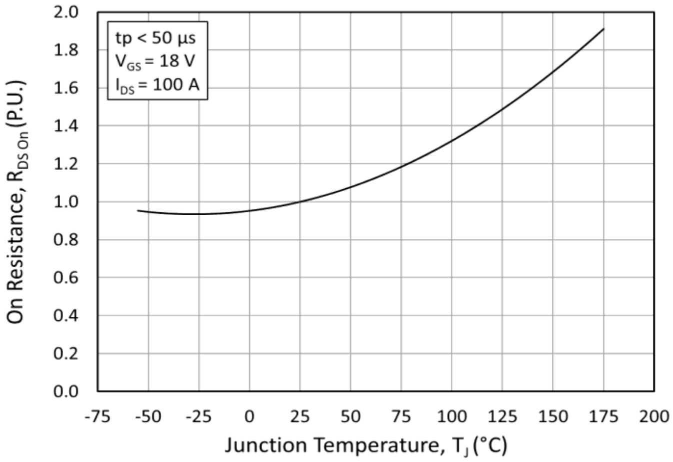


Figure 4. Normalized On-Resistance vs. Temperature

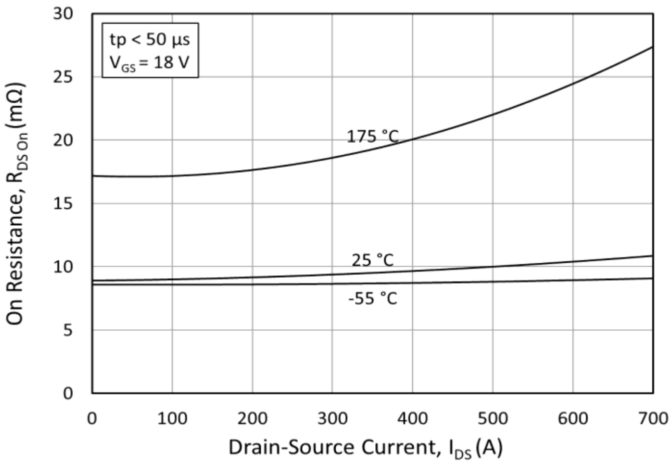


Figure 5. On-Resistance vs. Drain Current for Various Temperatures

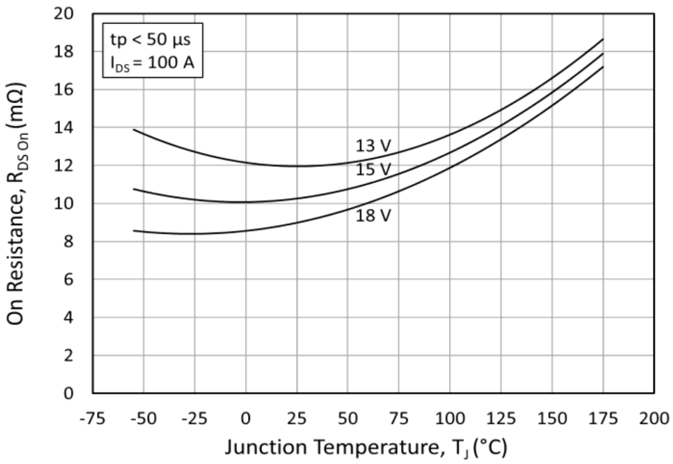


Figure 6. On-Resistance vs. Temperature for Various Gate Voltages

Typical Performance

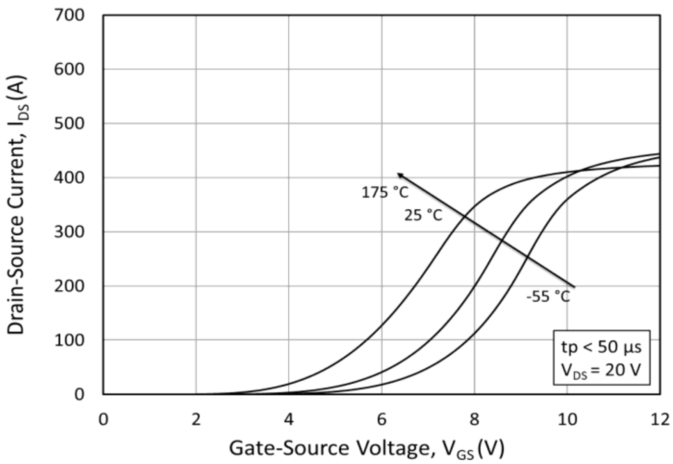


Figure 7. Transfer Characteristic for Various Junction Temperatures

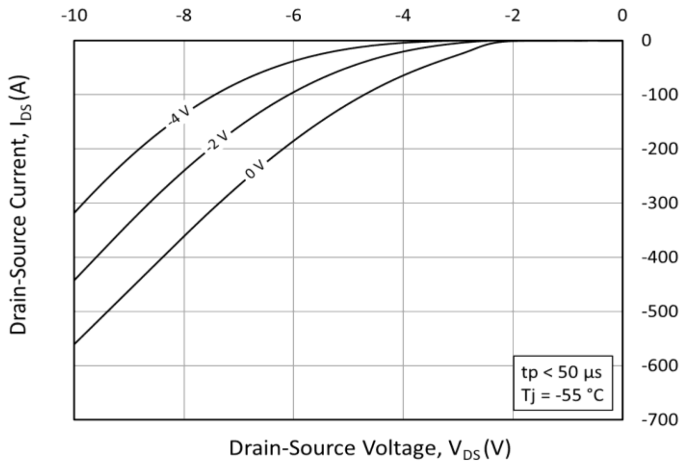


Figure 8. Body Diode Characteristic at T_{VJ} = -55 °C

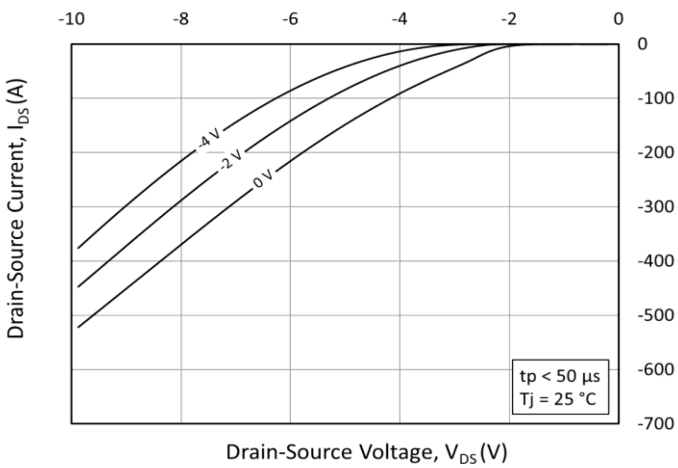


Figure 9. Body Diode Characteristic at T_{VJ} = 25 °C

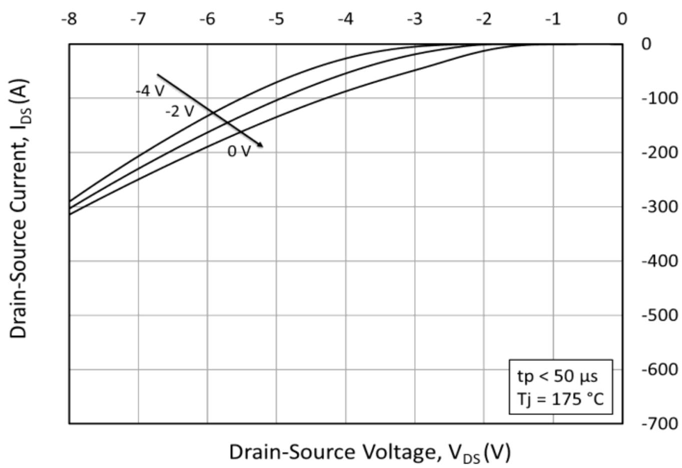


Figure 10. Body Diode Characteristic at T_{VJ} = 175 °C

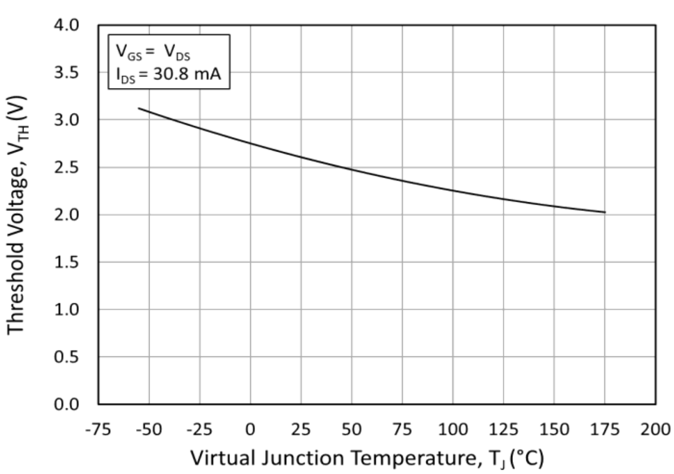


Figure 11. Threshold Voltage vs. Temperature

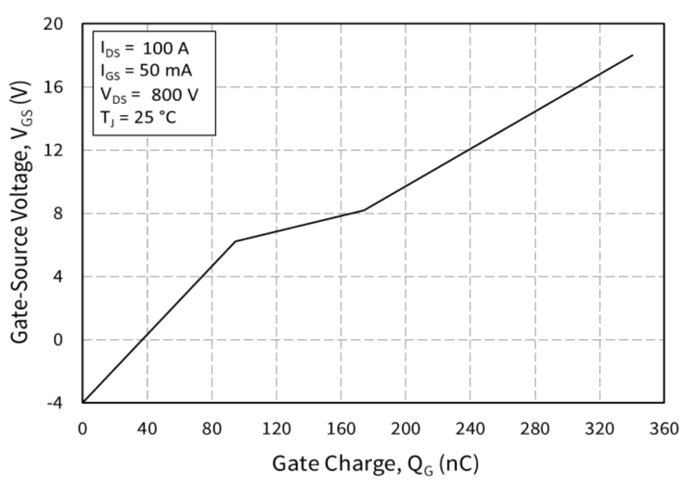


Figure 12. Gate Charge Characteristics

Typical Performance

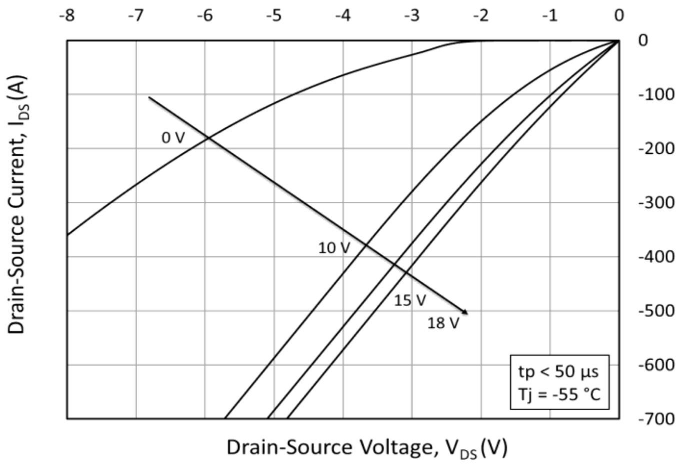


Figure 13. 3rd Quadrant Characteristic at T_{VJ} = -55 °C

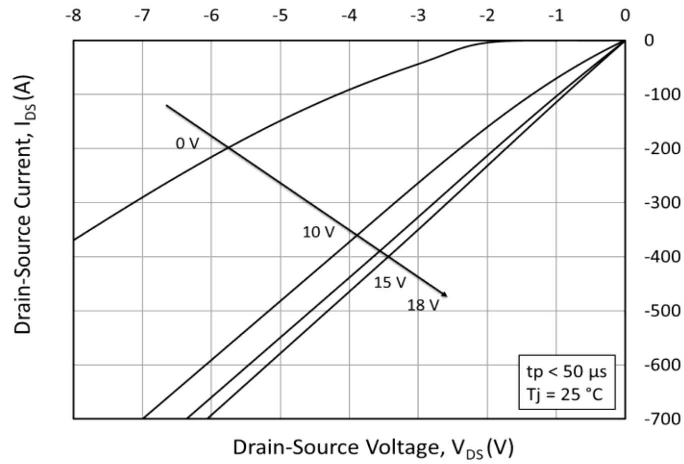


Figure 14. 3rd Quadrant Characteristic at T_{VJ} = 25 °C

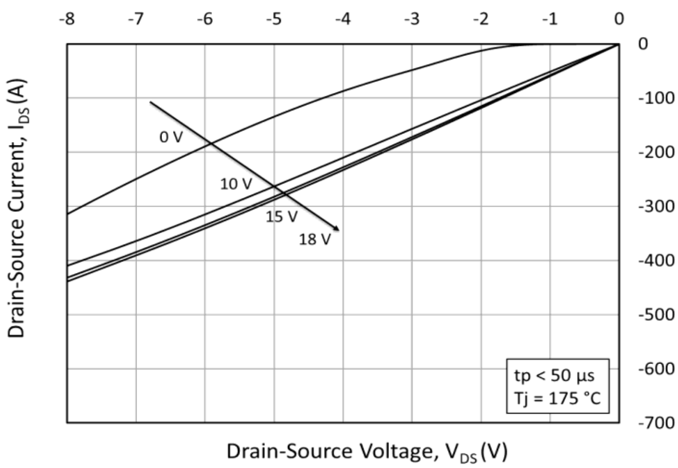


Figure 15. 3rd Quadrant Characteristic at T_{VJ} = 175 °C

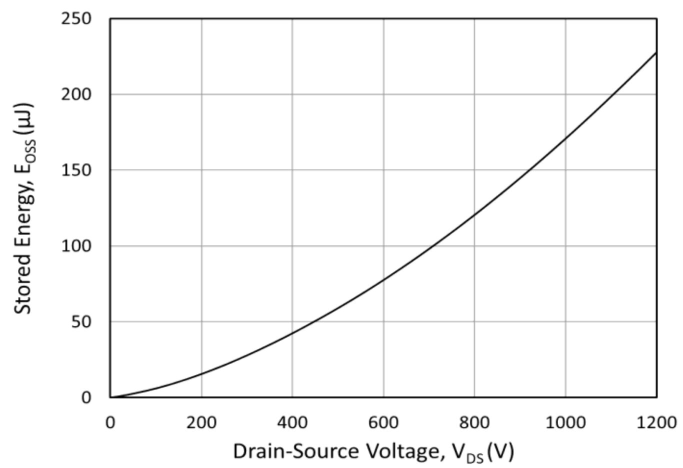


Figure 16. Output Capacitor Stored Energy

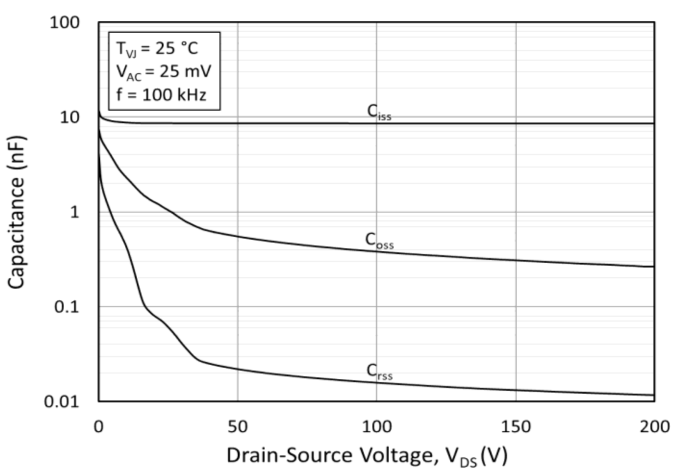


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

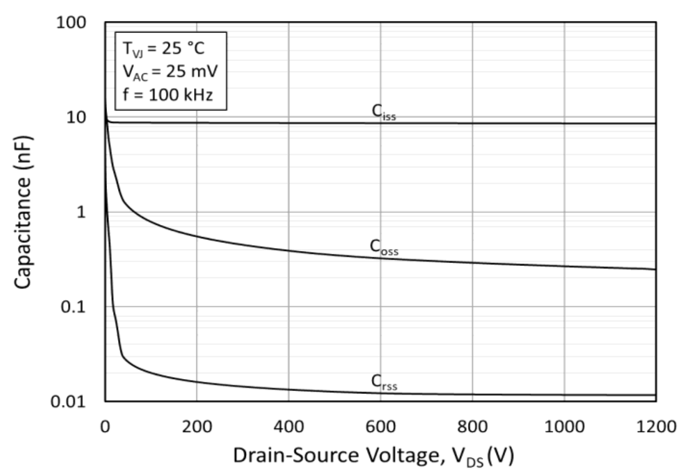


Figure 18. Capacitances vs. Drain-Source Voltage (0-1200 V)

Typical Performance

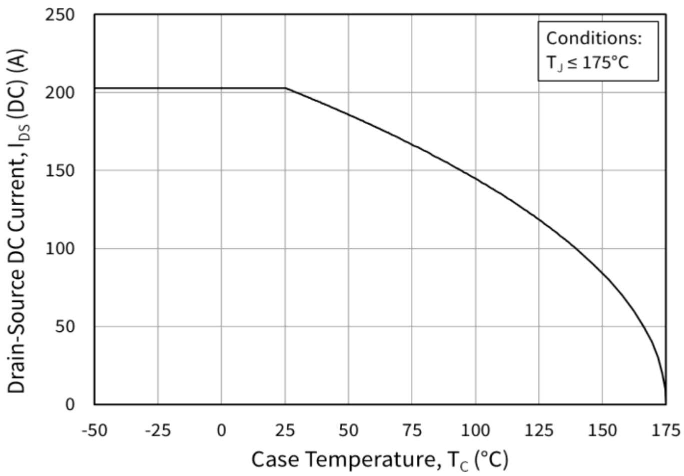


Figure 19. Continuous Drain Current Derating vs. Case Temperature

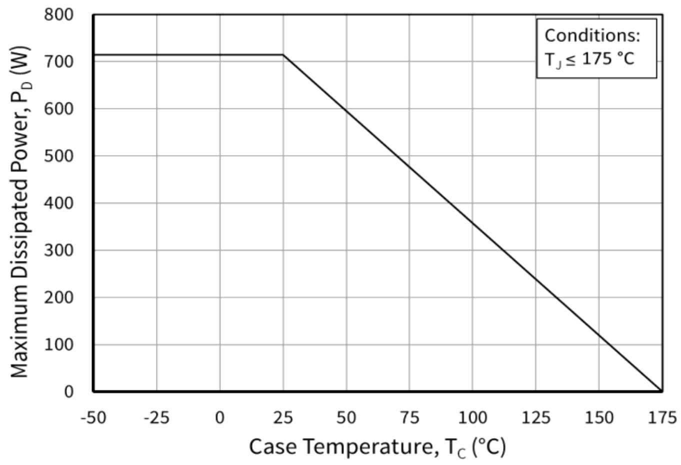


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

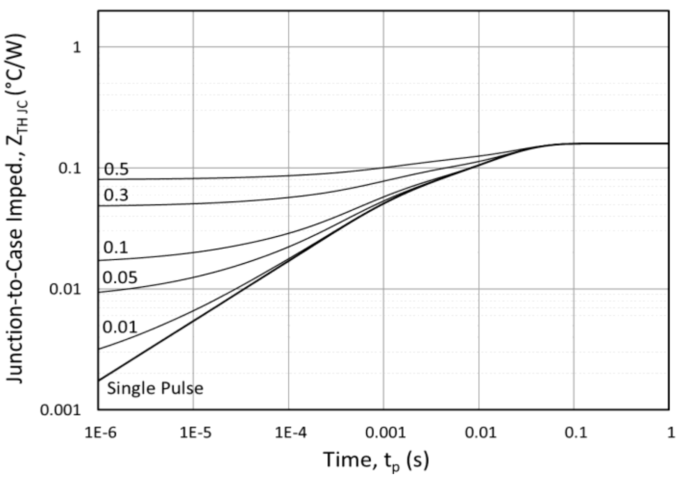


Figure 21. Transient Thermal Impedance (Junction - Case) °C

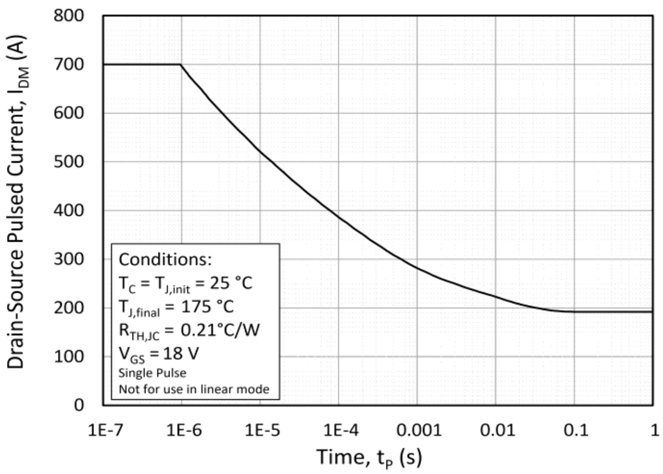


Figure 22. Safe Operating Area

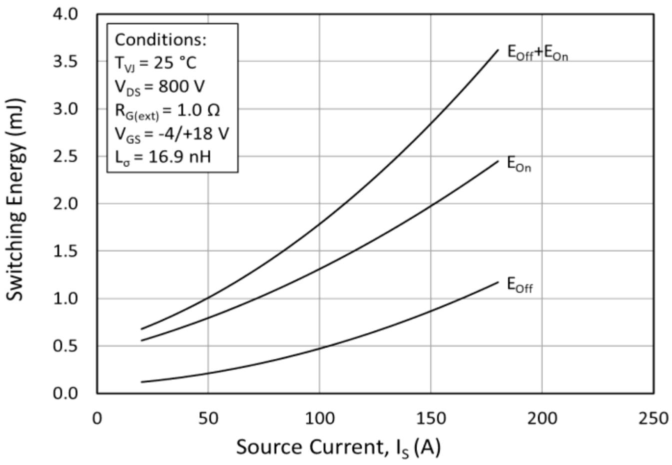


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

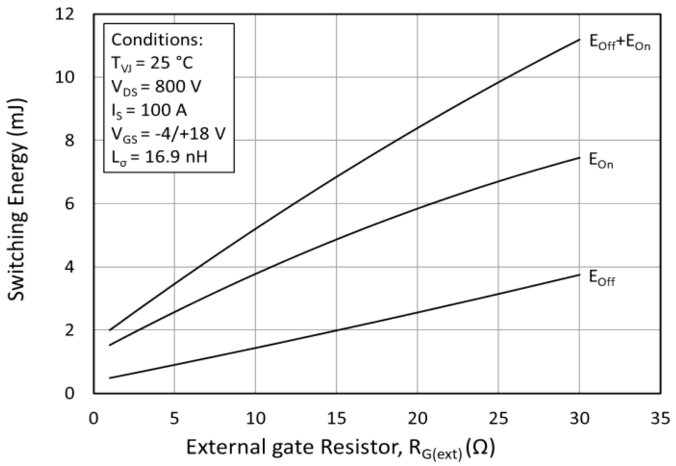


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

Typical Performance

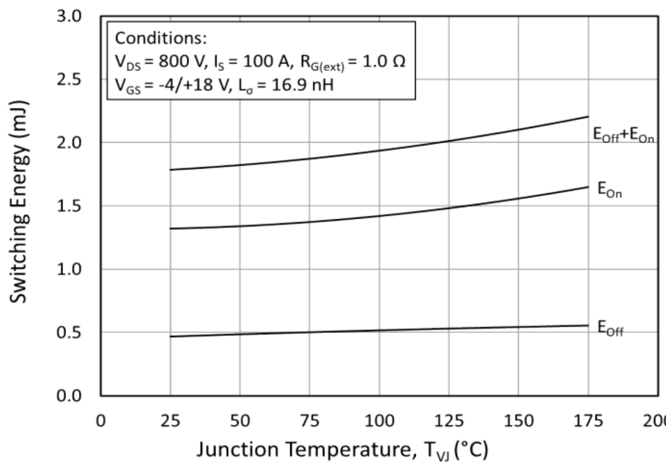


Figure 25. Clamped Inductive Switching Energy vs. Temperature

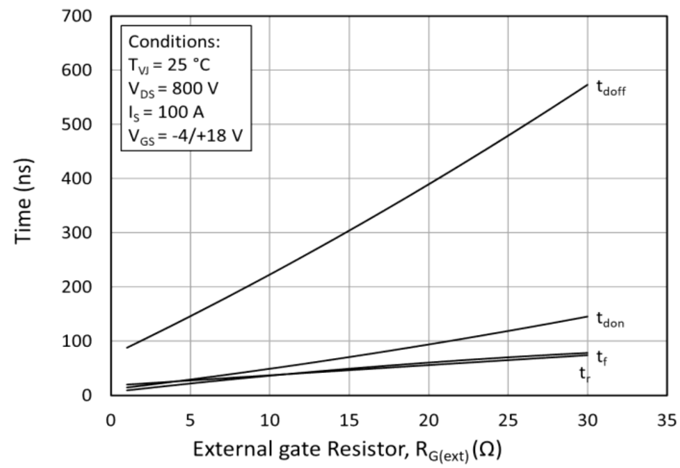


Figure 26. Switching Times vs. $R_{G(ext)}$

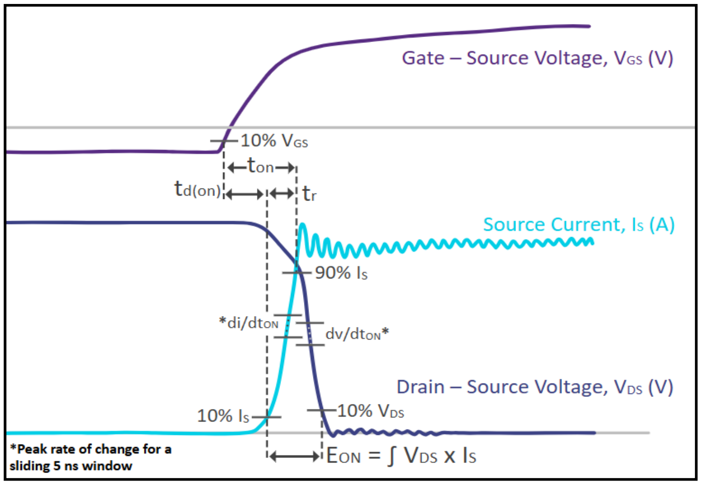


Figure 27. Turn On Switching Time Definition

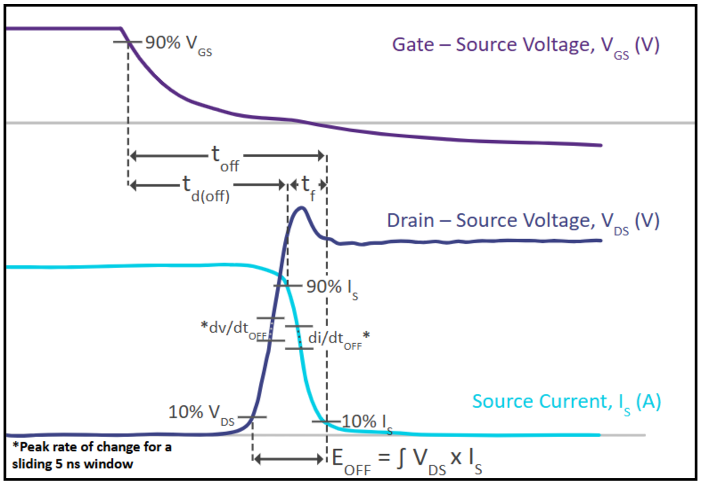


Figure 28. Turn Off Switching Time Definition

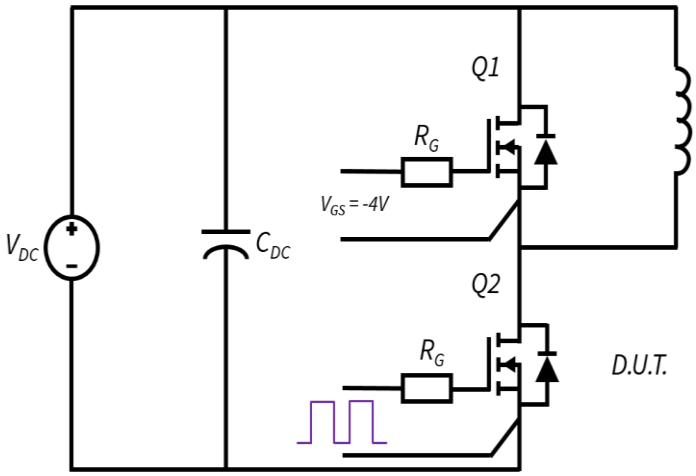


Figure 29. Clamped Inductive MOSFET Switching Waveform Test Circuit

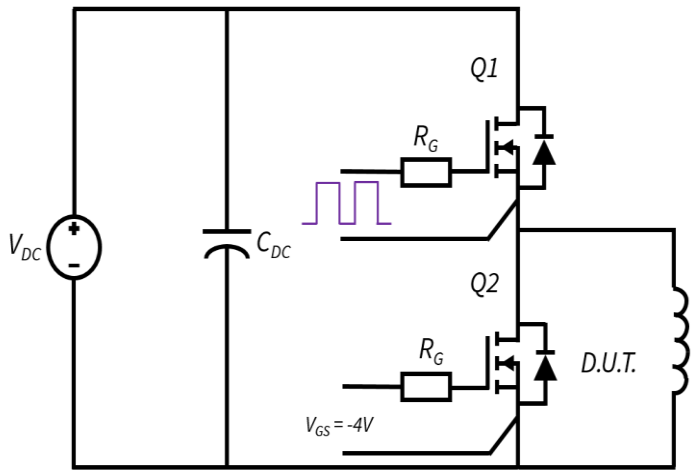
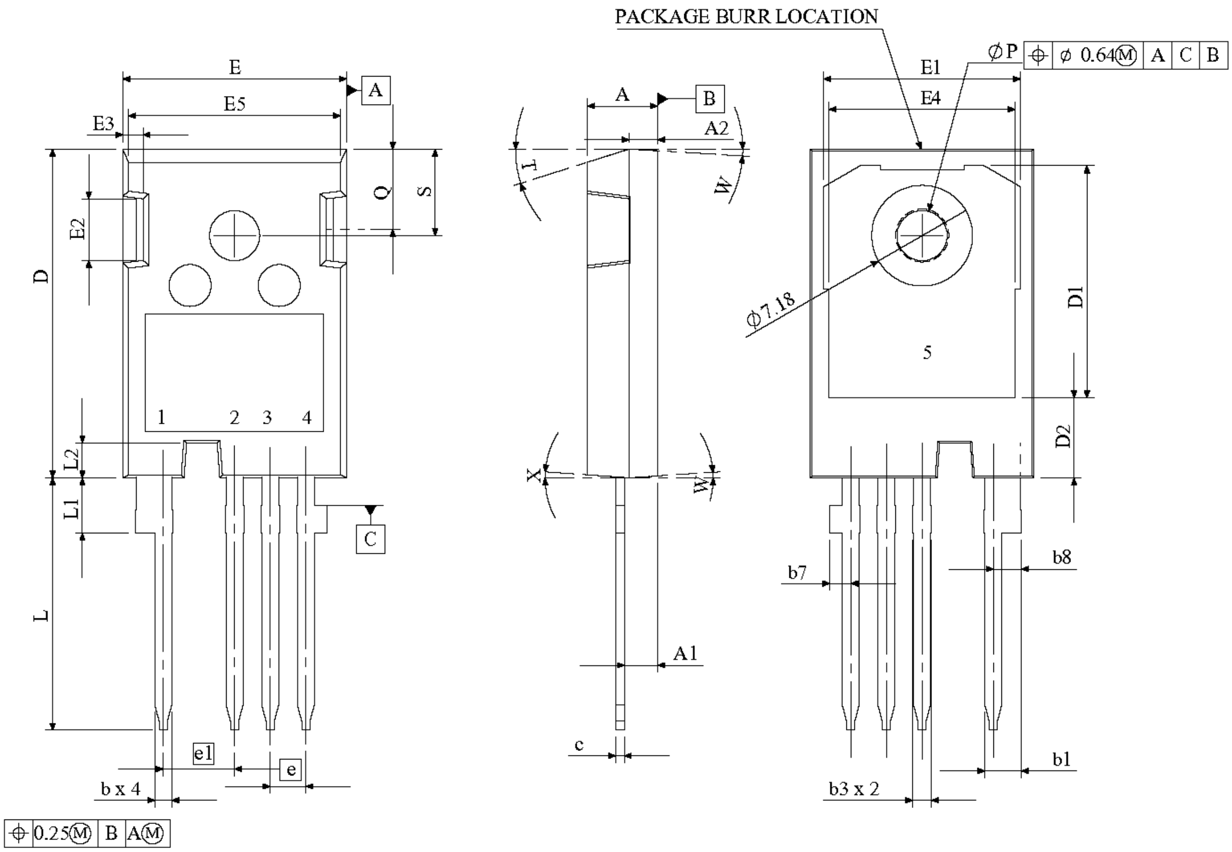


Figure 30. Clamped Inductive Body Diode Switching Waveform Test Circuit

Package Dimensions



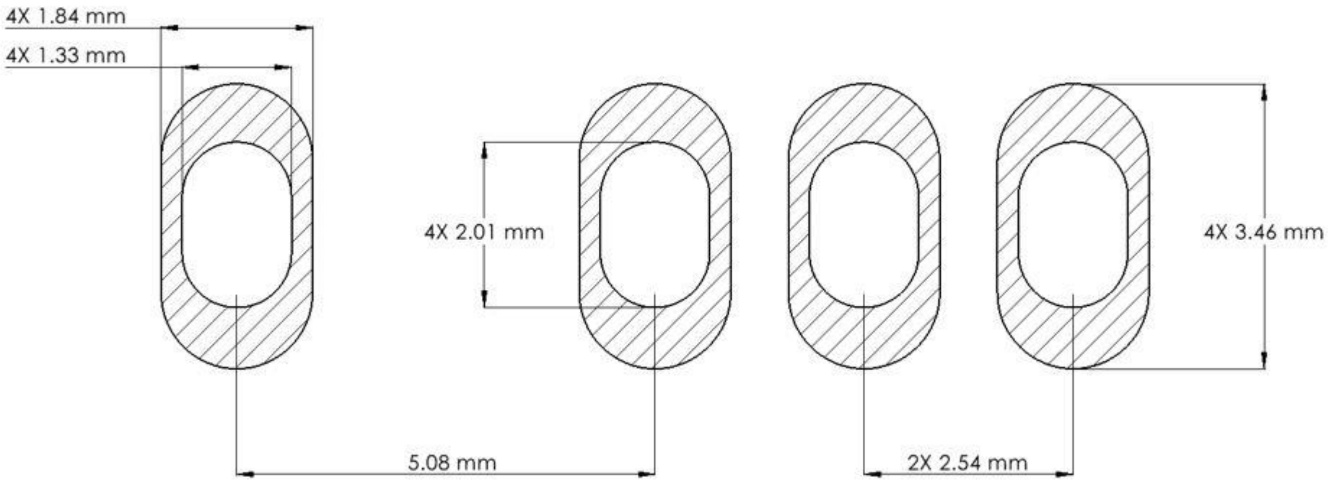
SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.23	2.54
A2	1.91	2.16
b	1.07	1.33
b1	2.39	2.94
b3	1.07	1.60
b7	1.30	1.70
b8	1.80	2.20
c	0.55	0.68
D	23.30	23.63
D1	16.25	17.65
D2	5.55	5.95
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e1	5.08 BSC	
L	17.31	17.82
L1	3.97	4.37
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.	

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

Recommended Solder Pad Layout

All dimensions in mm



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Revision History

Documents Version	Date of Change	Description of Changes
1	6/10/2026	Initial Release

Appendix

Appendix Number	Description
A1	The following are recommendations for turning off the MOSFET with 0 V: • Measure the V_{GS} spike accurately using high-CMRR probes and low common mode noise measurements. • For the safe operation of the device, the voltage spike shall remain < 5 V for a time duration of < 40 ns.

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REACh Compliance
REACh substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact your Wolfspeed representative to ensure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

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