

E4MS025120K

Silicon Carbide Power MOSFET
Switching Optimized 1200V 25mΩ Automotive
N-Channel Enhancement Mode

Features

- Industry compatible drive voltage 15V...18V/-5V...0V
- Soft body diode with low Vds overshoot and ringing
- Low Rds(on) at high operating temperatures
- Improved device capacitances ratio (Ciss/Crss)
- High transient voltage robustness with improved lifetime
- 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

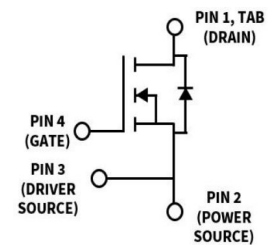
Typical Applications

- Motor Control
- EV On Board Battery Chargers (OBC)
- Automotive DC/DC Converters for EV/HEV

Package



Tab Drain



Orderable Part number	Package type	Marking
E4MS025120K	TO-247-4	E4MS025120K

Key Parameters

Parameter	Symbol	Min.	Typ.	Max	Unit	Conditions	Note
Drain - Source Voltage	V_{DS}			1200	V		
Maximum Gate - Source Voltage	$V_{GS(max)}$	-10		+23			
DC Continuous Drain Current	I_D			77	A	$V_{GS} = 18V, T_C = 25^\circ C, T_J \leq 175^\circ C$	Note 1
				55		$V_{GS} = 18V, T_C = 100^\circ C, T_J \leq 175^\circ C$	
Pulsed Drain Current	I_{DM}			274		t_{Pmax} limited by T_{Jmax} $V_{GS} = 18V, T_C = 25^\circ C$	
Power Dissipation	P_D			281	W	$T_C = 25^\circ C, T_J = 175^\circ C$	Note 2
Operating Junction and Storage Temperature	T_J, T_{stg}	-55		+175	$^\circ C$		
Solder Temperature	T_L			260			

Note (1): Current limit calculated by $I_{D(max)} = \sqrt{(P_D / R_{DS(typ)}) (T_{J(max)} - T_{D(max)})}$

Note (2): $P_D = (T_J - T_C) / R_{th(JC, max)}$


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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	2	2.6	3.9	V	$V_{DS} = V_{GS}, I_D = 10.8\text{ mA}$	Fig. 11
			2.0		V	$V_{DS} = V_{GS}, I_D = 10.8\text{ mA}, T_J = 175^\circ\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	μA	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 18\text{ V}, V_{DS} = 0\text{ V}$	
$V_{GS(op)}$	Recommended Turn on Gate-Source Voltage		+15...+18		V		Refer to PRD-09634
	Recommended Turn off Gate-Source Voltage		-5...0				
$R_{DS(on)}$	Drain-Source On-State Resistance		25	33	m Ω	$V_{GS} = 18\text{ V}, I_D = 39.2\text{ A}$	Fig. 4, 5, 6
			47			$V_{GS} = 18\text{ V}, I_D = 39.2\text{ A}, T_J = 175^\circ\text{C}$	
			28			$V_{GS} = 15\text{ V}, I_D = 39.2\text{ A}$	
g_{fs}	Transconductance		28		S	$V_{DS} = 20\text{ V}, I_D = 39.2\text{ A}, T_J = 25^\circ\text{C}$	Fig. 7
			27			$V_{DS} = 20\text{ V}, I_D = 39.2\text{ A}, T_J = 175^\circ\text{C}$	
$R_{DS(on)Tempco}$	On resistance temperature coefficient		1.88			$V_{GS} = 18\text{ V}, I_D = 39.2\text{ A}$	Note 3
C_{iss}	Input Capacitance		3087		pF	$V_{GS} = 0\text{ V}, V_{DS} = 1000\text{ V}$ $f = 100\text{ kHz}$ $V_{AC} = 25\text{ mV}$	Fig. 17, 18
C_{oss}	Output Capacitance		103				
C_{rss}	Reverse Transfer Capacitance		4.7				
C_{iss}/C_{rss}	Capacitance Ratio		630				Note 4
E_{oss}	C_{oss} Stored Energy		63		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		145		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0...800\text{ V}$	
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		238				
E_{on}	Turn-On Switching Energy (Body Diode FWD) $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$		394 470		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}, I_D = 39.2\text{ A},$ $R_{G(ext)} = 1\text{ }\Omega, L_\sigma = 25\text{ nH}$	Fig. 26, 29, 31
	Turn-Off Switching Energy (Body Diode FWD) $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$		57 64				Fig. 26, 29, 32
$t_{d(on)}$	Turn-On Delay Time		12		ns	$V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}$ $I_D = 39.2\text{ A}, R_{G(ext)} = 1\text{ }\Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		4				
$t_{d(off)}$	Turn-Off Delay Time		36				
t_f	Fall Time		11				
$R_{G(int)}$	Internal Gate Resistance		2.6		Ω	$f = 1\text{ MHz}$	
Q_{gs}	Gate to Source Charge		35		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}$ $I_D = 39.2\text{ A}, T_J = 25^\circ\text{C}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		30				
Q_g	Total Gate Charge		125				

Note (3): $R_{DS(on)Tempco}$ refers to $R_{DS(on)}$ at 175°C / $R_{DS(on)}$ at 25°C , E4MS 1200V product family value

Note (4): Capacitance ratio is a FOM for Partial turn-on immunity PRD-06933, E4MS 1200V product family value

$C_{o(er)}$, a lumped capacitance that gives the same stored energy as C_{oss} while V_{ds} is rising from 0 to 800V

$C_{o(tr)}$, a lumped capacitance that gives the same charging time as C_{oss} while V_{ds} is rising from 0 to 800V



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} = 19.6 A, T _j = 25 °C	Fig. 8, 9, 10
		4.6		V	V _{GS} = -4 V, I _{SD} = 19.6 A, T _j = 175 °C	
I _S	Continuous Diode Forward Current		48	A	V _{GS} = -4 V, T _c = 25°C	
I _{SM}	Diode Pulse Current		274	A	V _{GS} = -4 V, pulse width t _p limited by T _{jmax}	
t _{rr}	Reverse Recovery Time	14		ns	V _{GS} = -4 V, I _S = 39.2 A, V _{SD} = 800V T _j = 175°C, diF/dt = 15.8 A/ns	
Q _{rr}	Reverse Recovery Charge	742		nC		
I _{RRM}	Peak Reverse Recovery current	94		A		
E _{RR}	Reverse recovery Energy			μJ	V _{DS} = 800 V, I _D = 39.2 A,	
	T _j = 25C	102				
	T _j = 175C	256			V _{GS} = -4V/18V, R _{Gi(on)} = 1 Ω, L _σ = 25nH	

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
R _{θJC}	Thermal Resistance from Junction to Case	0.41	0.53	°C/W		

Typical Performance

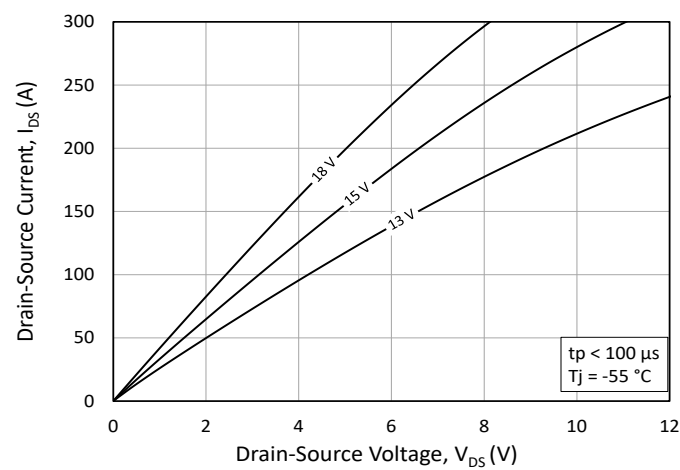


Figure 1. Output Characteristics $T_j = -55^{\circ}\text{C}$

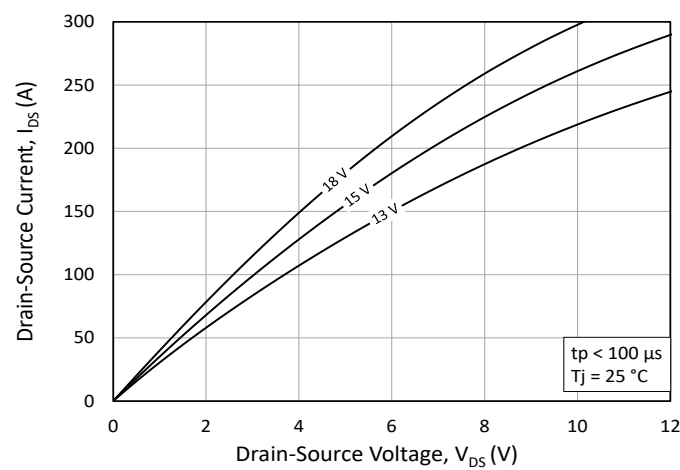


Figure 2. Output Characteristics $T_j = 25^{\circ}\text{C}$

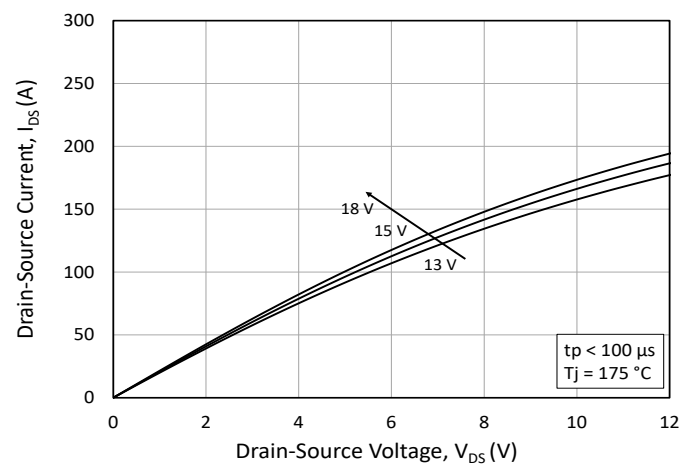


Figure 3. Output Characteristics $T_j = 175^{\circ}\text{C}$

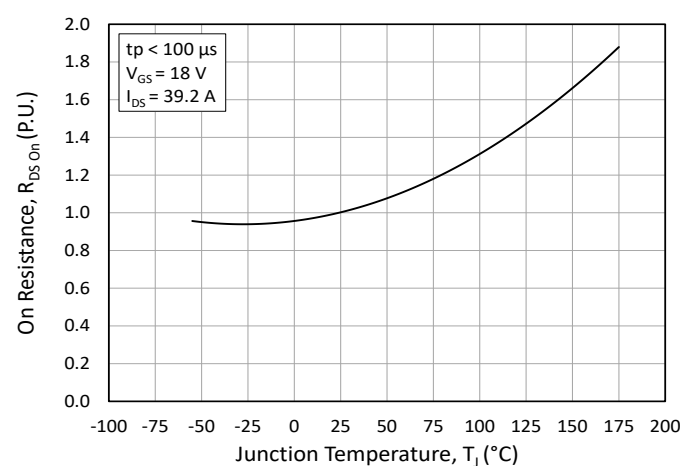


Figure 4. Normalized On-Resistance vs. Temperature

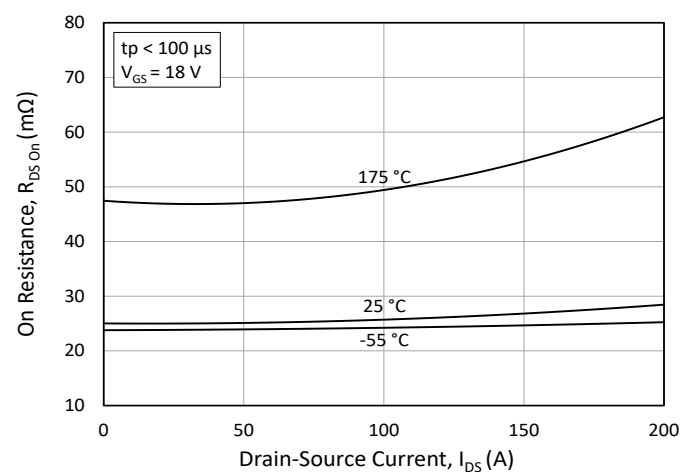


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

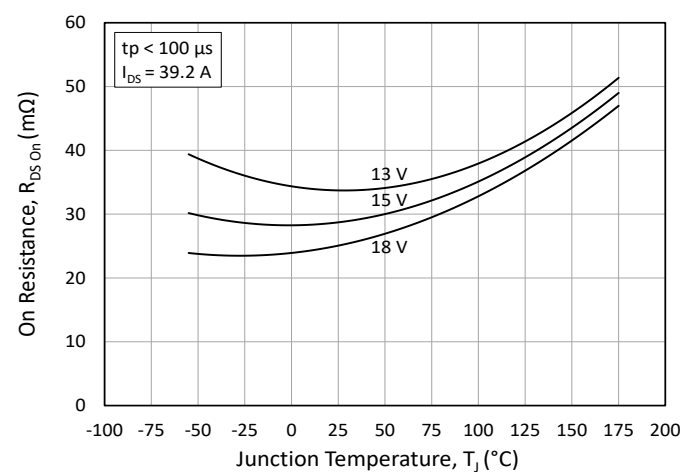


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

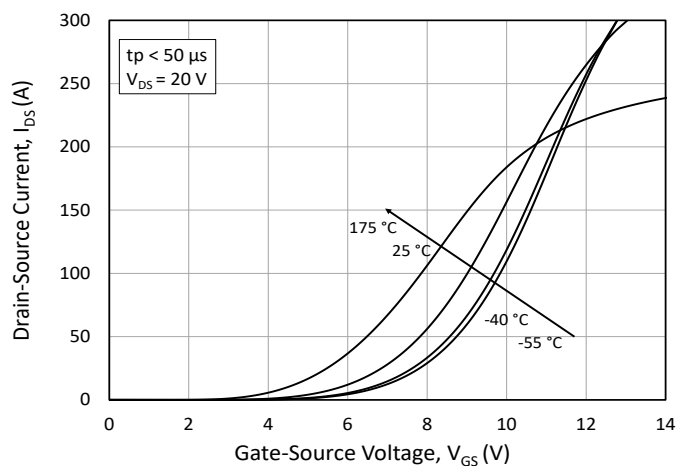


Figure 7. Transfer Characteristic for Various Junction Temperatures

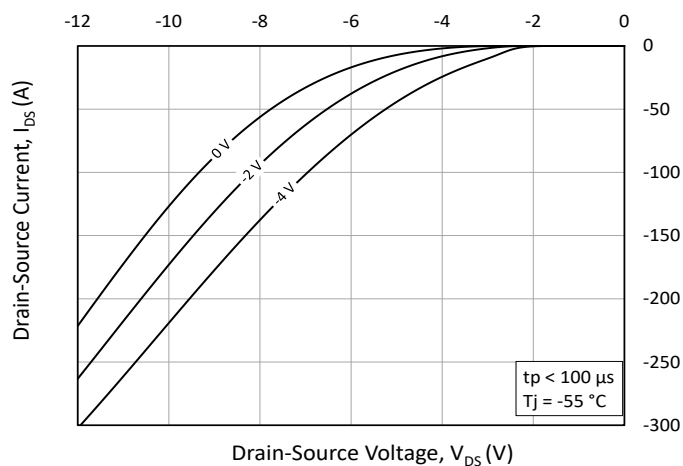


Figure 8. Body Diode Characteristic at -55 °C

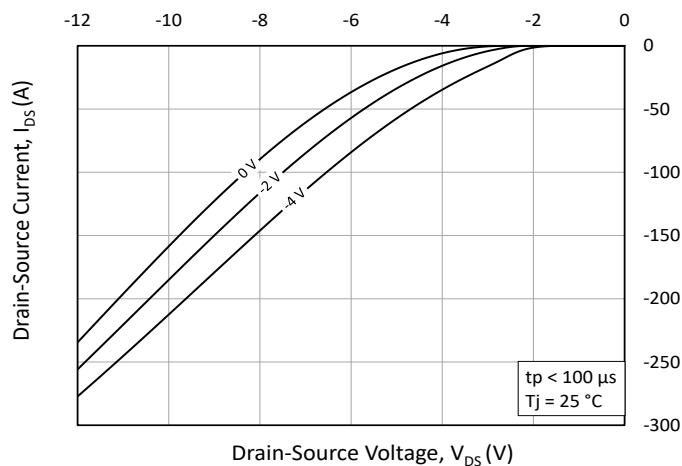


Figure 9. Body Diode Characteristic at 25 °C

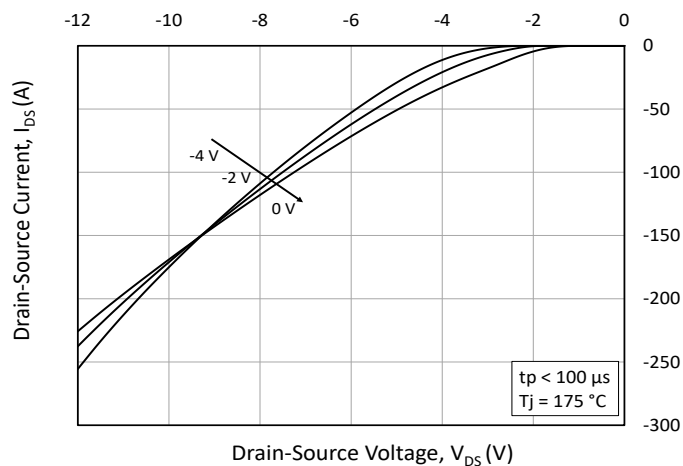


Figure 10. Body Diode Characteristic at 175 °C

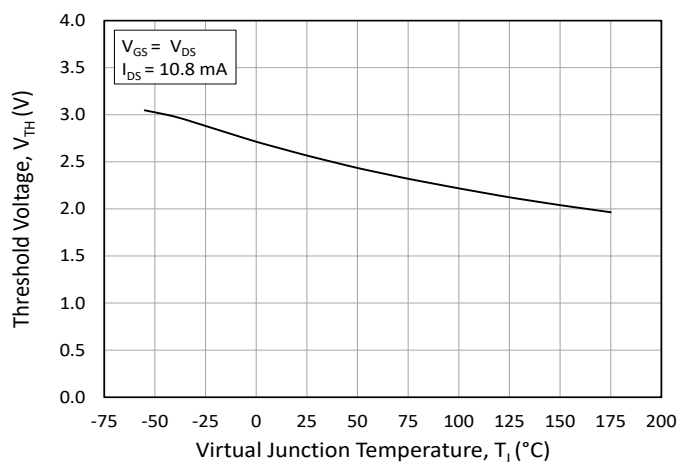


Figure 11. Threshold Voltage vs. Temperature

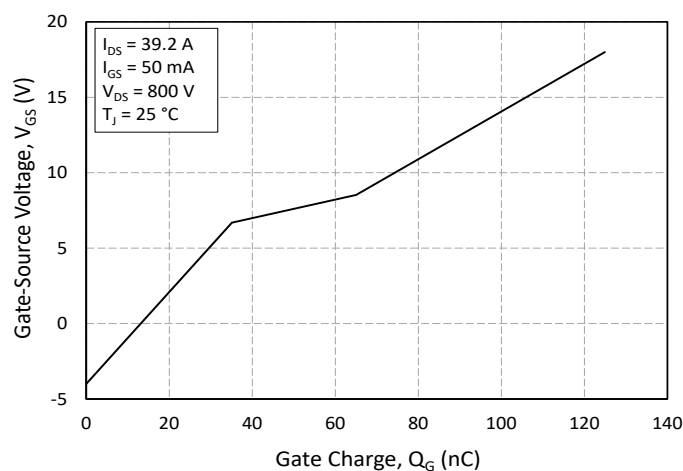


Figure 12. Gate Charge Characteristics

Typical Performance

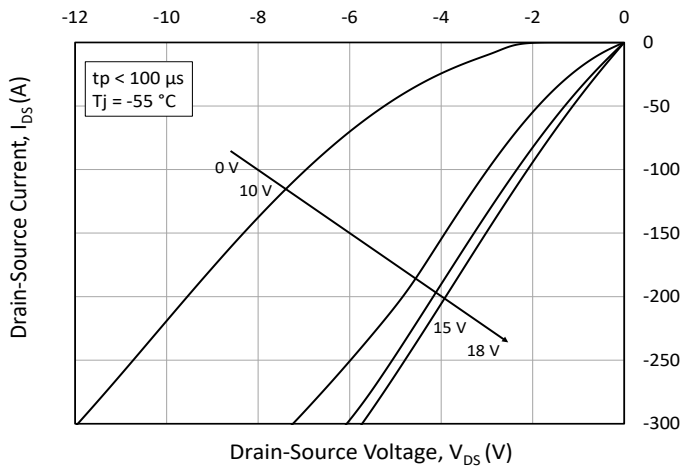


Figure 13. 3rd Quadrant Characteristic at -55°C

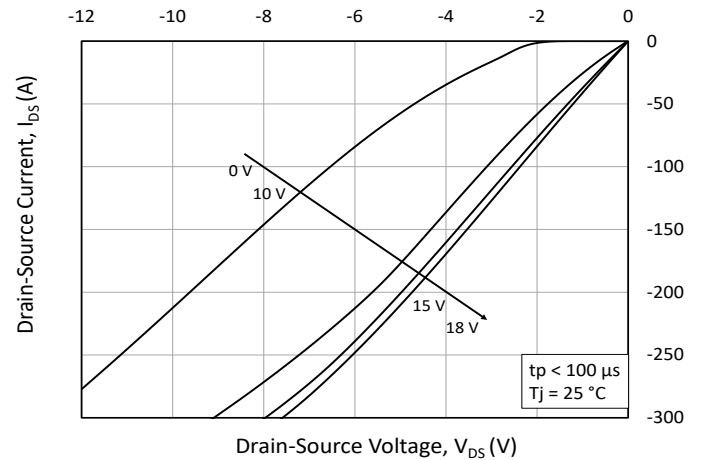


Figure 14. 3rd Quadrant Characteristic at 25°C

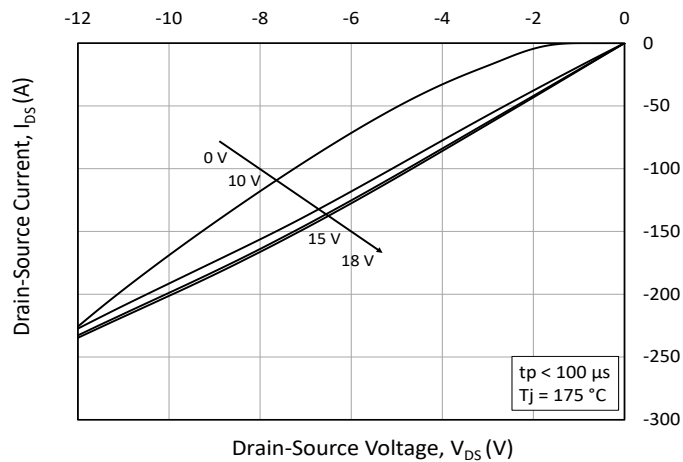


Figure 15. 3rd Quadrant Characteristic at 175°C

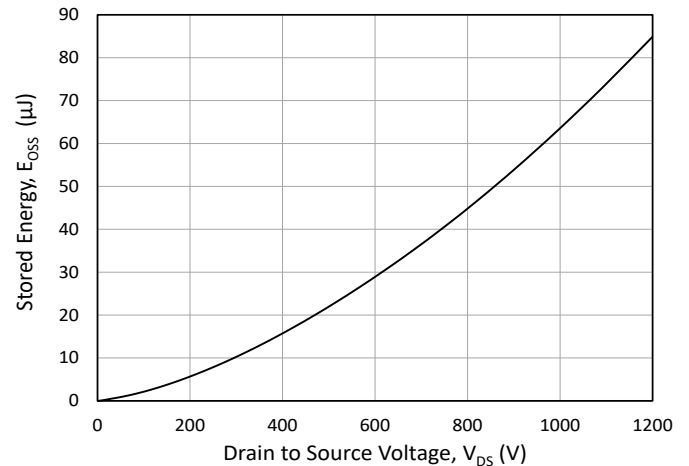


Figure 16. Output Capacitor Stored Energy

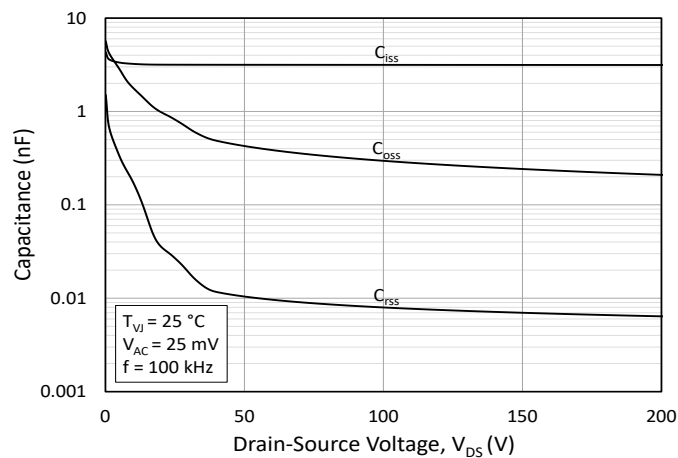


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

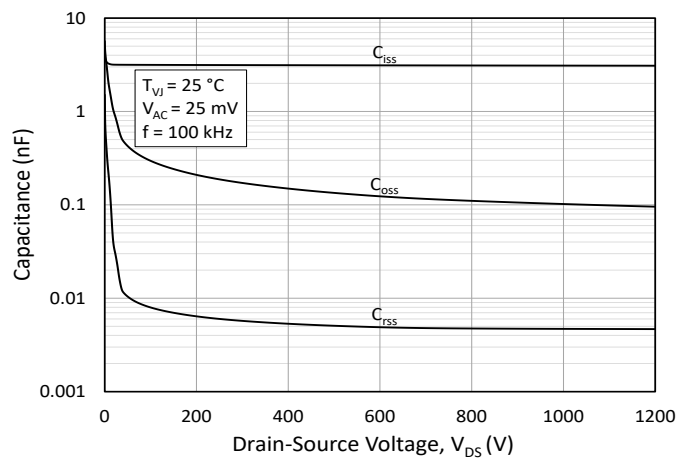


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200 V)

Typical Performance

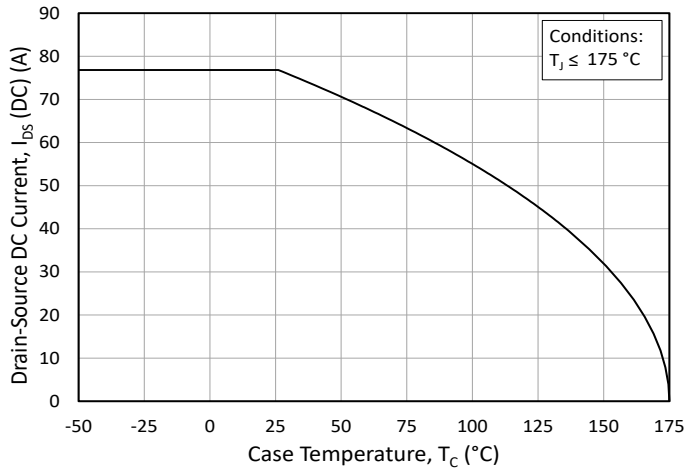


Figure 19. Continuous Drain Current Derating vs. Case Temperature

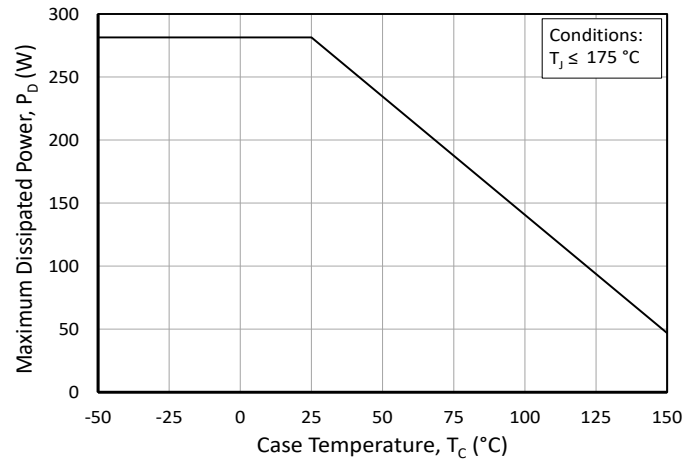


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

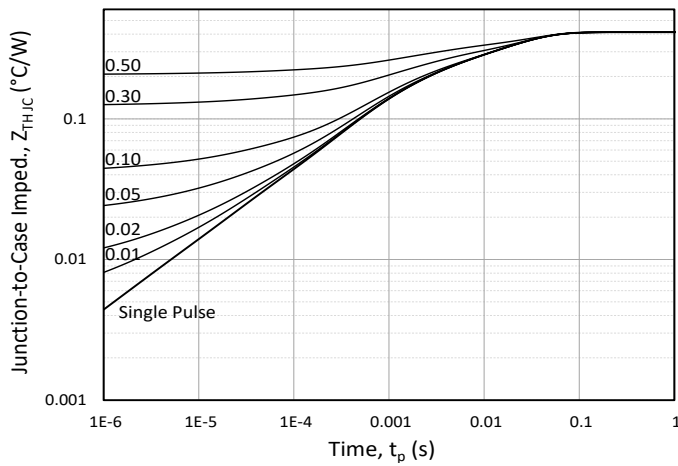


Figure 21. Transient Thermal Impedance (Junction - Case)

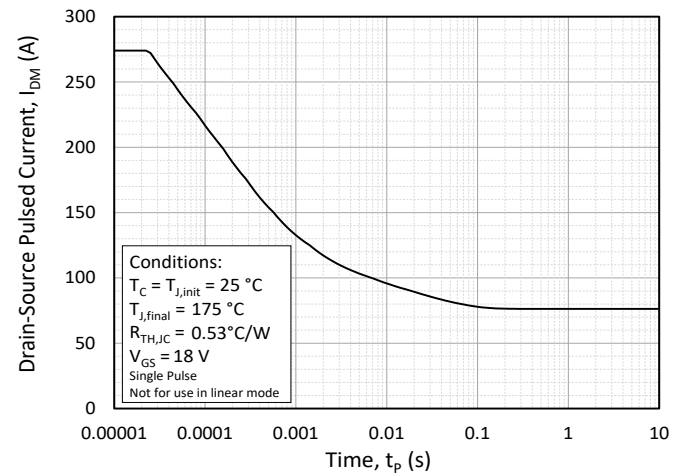
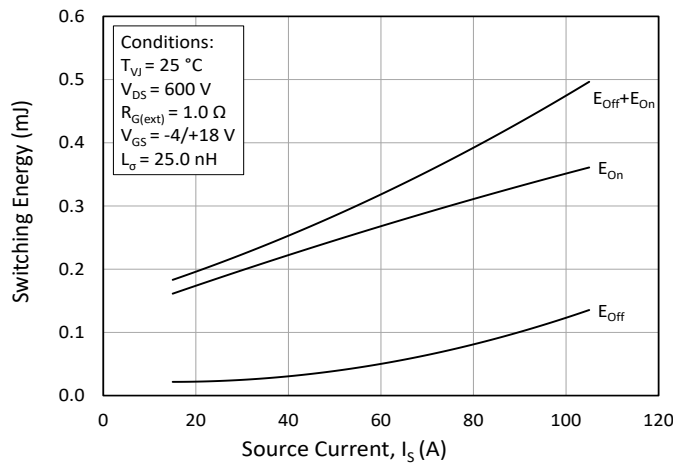
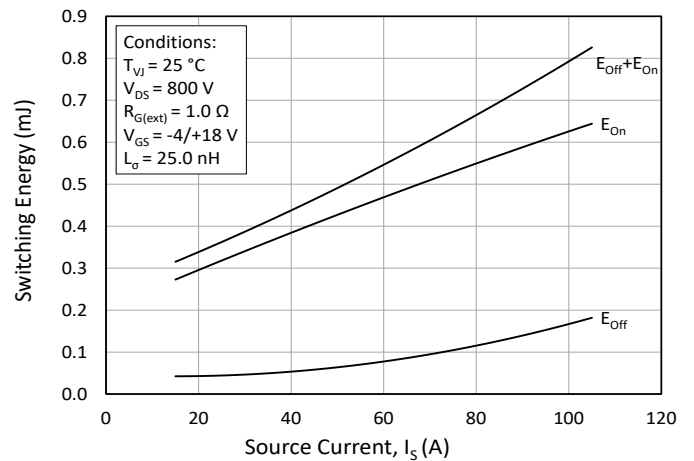


Figure 22. Safe Operating Area

Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600 \text{ V}$)Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800 \text{ V}$)

Typical Performance

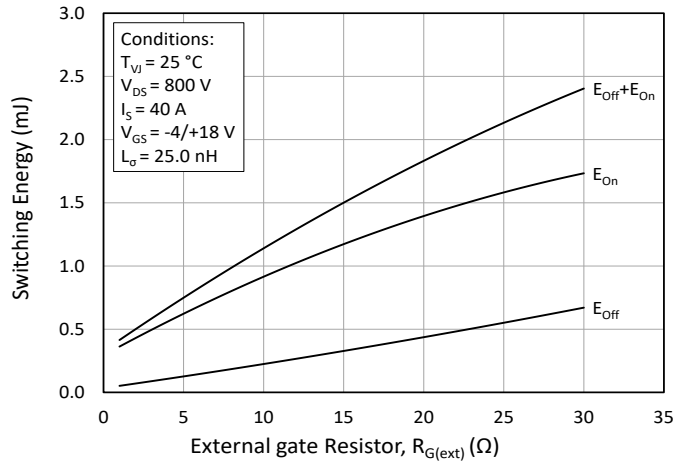
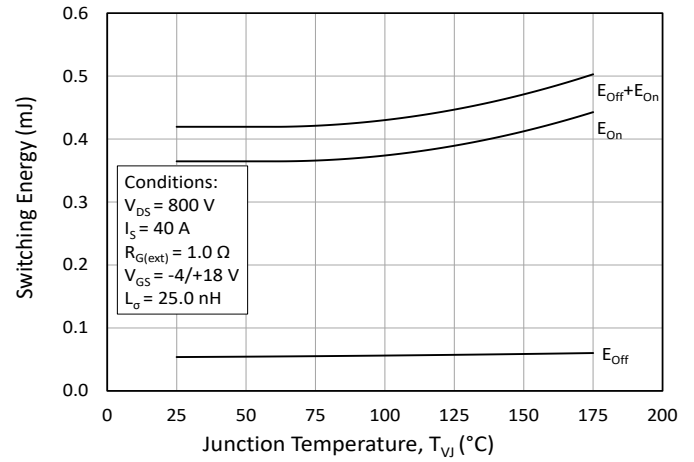
Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$ 

Figure 26. Clamped Inductive Switching Energy vs. Temperature

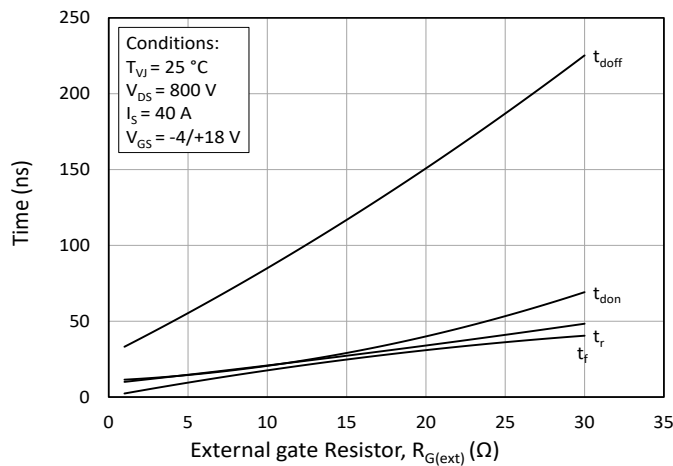
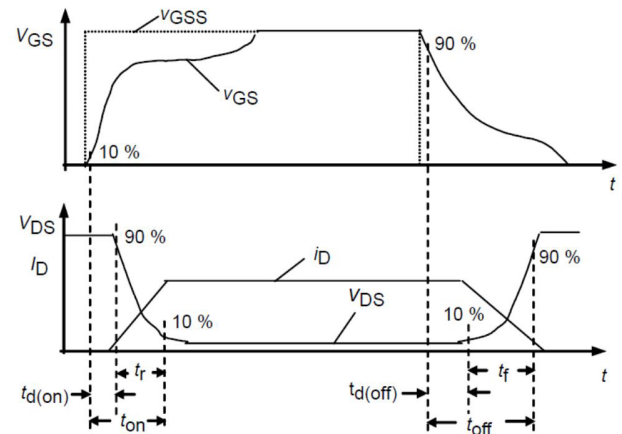
Figure 27. Switching Times vs. $R_{G(ext)}$ 

Figure 28. Switching Times Definition

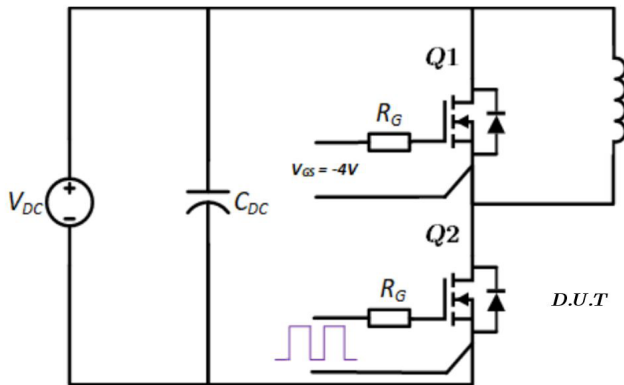


Figure 29. Clamped Inductive MOSFET Switching Waveform Test Circuit

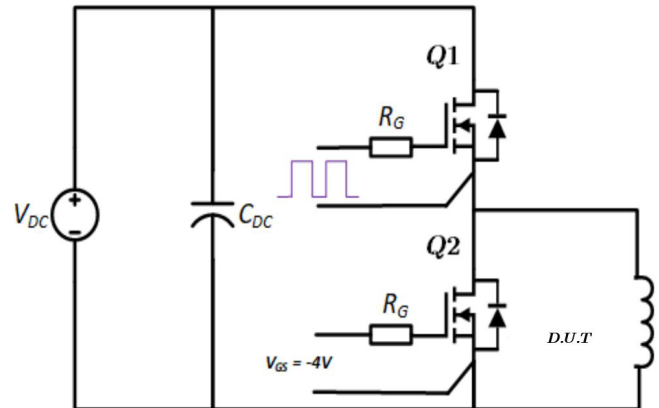
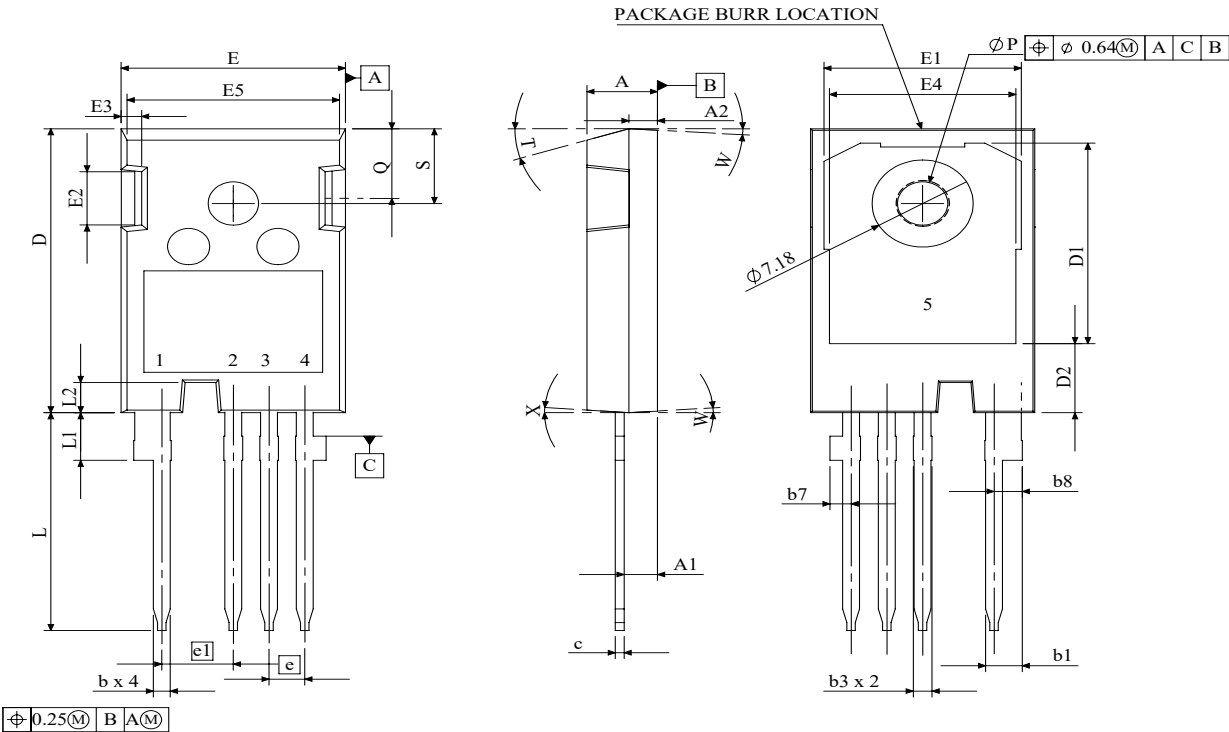


Figure 30. Clamped Inductive Body diode Switching Waveform Test Circuit

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
ϕP	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.	

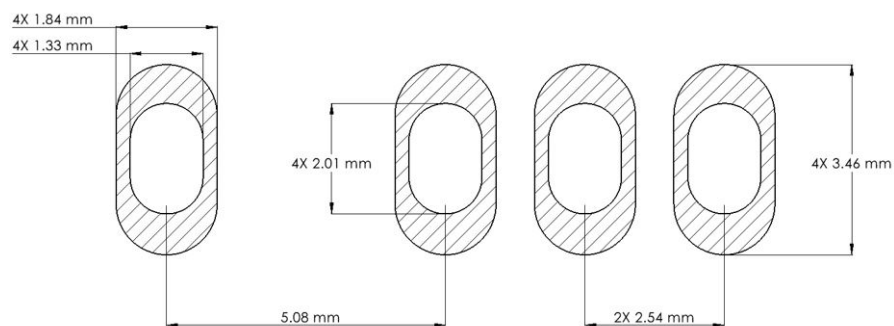
1	DRAIN
2	SOURCE
3	DRIVER SOURCE
4	GATE
5	DRAIN

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



Recommended Solder Pad Layout

All dimensions in mm



Revision history

Document Version	Date of release	Description of changes
1	November 2025	Initial release



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