

# E4MS009120QT

## 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

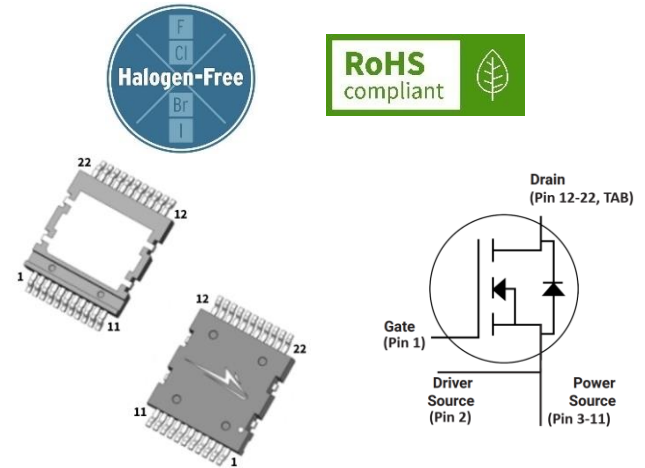
### Benefits

- 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
E4MS009120QT-TR	Q-TSC	E4MS009120QT

### 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			Note 1
$I_D$	DC Continuous Drain Current		213	A	$V_{GS} = 18\text{ V}, T_c = 25\text{ }^\circ\text{C}, T_J \leq 175\text{ }^\circ\text{C}$	Note 2
			152		$V_{GS} = 18\text{ V}, T_c = 100\text{ }^\circ\text{C}, T_J \leq 175\text{ }^\circ\text{C}$	
$I_{DM}$	Pulsed Drain Current		700		$V_{GS} = 18\text{ V}, T_c = 25\text{ }^\circ\text{C}, t_{pmax}$ limited by $T_{Jmax}$	
$P_D$	Power Dissipation		789	W	$T_c = 25\text{ }^\circ\text{C}, T_J = 175\text{ }^\circ\text{C}$	Note 3
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-55	+175	$^\circ\text{C}$		
$T_L$	Solder Temperature		260		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 ( $T_c = 25\text{ }^\circ\text{C}$ 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	2.0	2.6	3.9	V	$V_{DS} = V_{GS}$ , $I_D = 30.8\text{ mA}$	Fig. 11, Note 1
			2.0		V	$V_{DS} = V_{GS}$ , $I_D = 30.8\text{ mA}$ , $T_J = 175\text{ }^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	50	$\mu\text{A}$	$V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$	
$I_{GSS}$	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		Note 4
	Recommended Turn off Gate-Source Voltage		-4...0				
$R_{DS(on)}$	Drain-Source On-State Resistance		9	11.7	m $\Omega$	$V_{GS} = 18\text{ V}$ , $I_D = 100\text{ A}$	Fig. 4, 5, 6
			16.9			$V_{GS} = 18\text{ V}$ , $I_D = 100\text{ A}$ , $T_J = 175\text{ }^\circ\text{C}$	
			10.3			$V_{GS} = 15\text{ V}$ , $I_D = 100\text{ A}$	
$g_{fs}$	Transconductance		77		S	$V_{DS} = 20\text{ V}$ , $I_D = 100\text{ A}$	Fig. 7
			75			$V_{DS} = 20\text{ V}$ , $I_D = 100\text{ A}$ , $T_J = 175\text{ }^\circ\text{C}$	
$R_{DS(on)Tempco}$	On Resistance Temperature Coefficient		1.88			$V_{GS} = 18\text{ V}$ , $I_D = 100\text{ A}$	Note 5
$C_{iss}$	Input Capacitance		8585		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		267				
$C_{rss}$	Reverse Transfer Capacitance		13.6				
$C_{iss}/C_{rss}$	Capacitance Ratio		630				Note 6
$E_{oss}$	$C_{oss}$ Stored Energy		171				$\mu\text{J}$
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		379.1		pF	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V} \dots 800\text{ V}$	Note 7
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		629.8				
$E_{on}$	Turn-On Switching Energy (Body Diode FWD) $T_J = 25\text{ }^\circ\text{C}$ $T_J = 175\text{ }^\circ\text{C}$		1319		$\mu\text{J}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = -4\text{ V} / 18\text{ V}$ , $I_D = 100\text{ A}$ , $R_{G(ext)} = 1\text{ }\Omega$ , $L_\sigma = 16.9\text{ nH}$	Fig. 25, 27, 29
			1649				
$E_{off}$	Turn-Off Switching Energy (Body Diode FWD) $T_J = 25\text{ }^\circ\text{C}$ $T_J = 175\text{ }^\circ\text{C}$		466		$\mu\text{J}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = -4\text{ V} / 18\text{ V}$ , $I_D = 100\text{ A}$ , $R_{G(ext)} = 1\text{ }\Omega$ , $L_\sigma = 16.9\text{ nH}$	Fig. 25, 28, 29
			555				
$t_{d(on)}$	Turn-On Delay Time		14		ns	$V_{DS} = 800\text{ V}$ , $V_{GS} = -4\text{ V} / 18\text{ V}$ , $I_D = 100\text{ A}$ , $R_{G(ext)} = 1\text{ }\Omega$ , $L_\sigma = 16.9\text{ nH}$ 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		$\Omega$	$f = 1\text{ MHz}$	
$Q_{gs}$	Gate to Source Charge		94		nC	$V_{DS} = 800\text{ V}$ , $V_{GS} = -4\text{ V} / 18\text{ V}$ $I_D = 100\text{ A}$	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  $175\text{ }^\circ\text{C}$  /  $R_{DS(on)}$  at  $25\text{ }^\circ\text{C}$ . 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 0V to 800 V.

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



### Reverse Diode Characteristics ( $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	5.1		V	$V_{GS} = -4\text{ V}, I_{SD} = 56\text{ A}, T_J = 25\text{ }^\circ\text{C}$	Fig. 8, 9, 10
		4.5			$V_{GS} = -4\text{ V}, I_{SD} = 56\text{ A}, T_J = 175\text{ }^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		134	A	$V_{GS} = -4\text{ V}, T_C = 25\text{ }^\circ\text{C}$	
$I_{SM}$	Diode Pulse Current		700		$V_{GS} = -4\text{ V}$ , pulse width $t_p$ limited by $T_{jmax}$	
$t_{rr}$	Reverse Recovery Time	34.7		ns	$V_{GS} = -4\text{ V}, I_{SD} = 100\text{ A}, V_R = 800\text{ V}, T_J = 175\text{ }^\circ\text{C}, di/dt = 14033\text{ A}/\mu\text{s}$	Fig. 30
$Q_{rr}$	Reverse Recovery Charge	1923		nC		
$I_{RRM}$	Peak Reverse Recovery Current	97		A		
$E_{RR}$	Reverse Recovery Energy $T_j = 25\text{ }^\circ\text{C}$ $T_j = 175\text{ }^\circ\text{C}$	148		$\mu\text{J}$	$V_{DS} = 800\text{ V}, I_{DS} = 100\text{ A}, V_{GS} = -4\text{ V} / 18\text{ V}, R_{G(ext)} = 1\text{ }\Omega, L_G = 16.9\text{ nH}$	
		835				

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.11	0.19	$^\circ\text{C}/\text{W}$		



Typical Performance

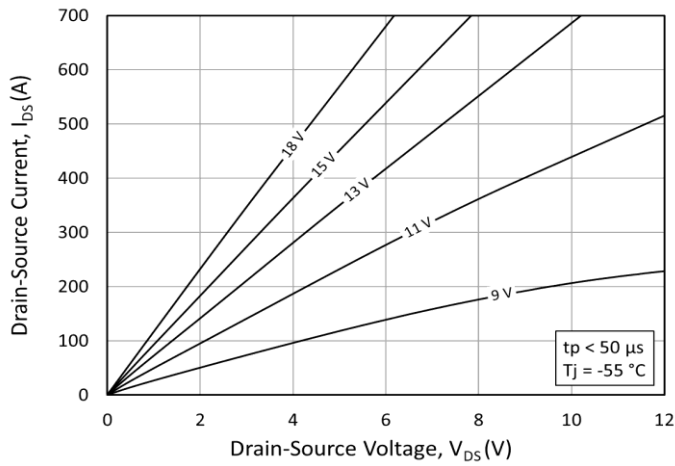


Figure 1. Output Characteristics  $T_{vj} = -55\text{ }^{\circ}\text{C}$

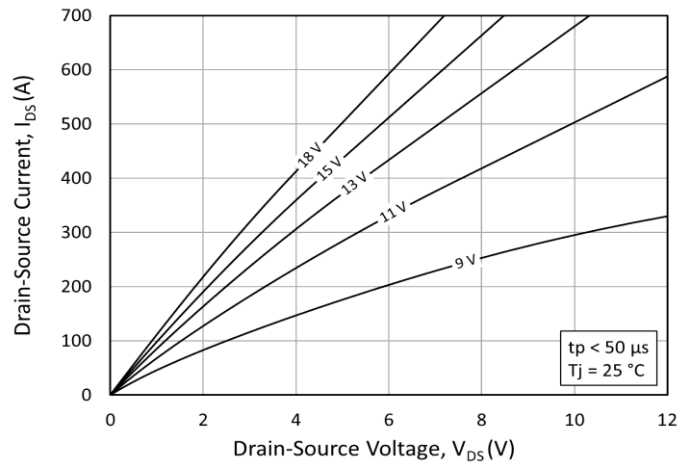


Figure 2. Output Characteristics  $T_{vj} = 25\text{ }^{\circ}\text{C}$

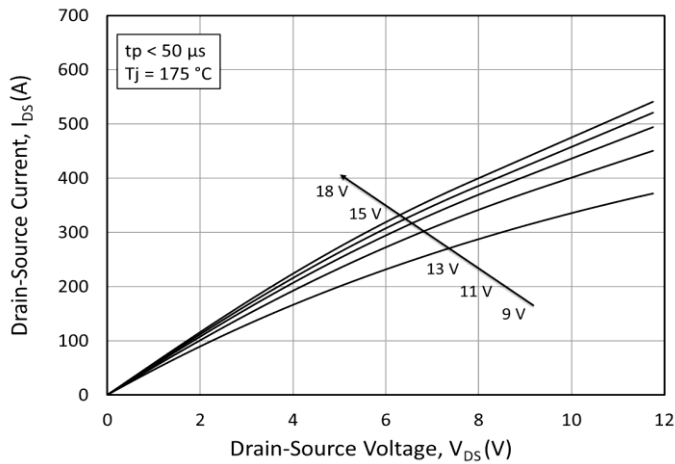


Figure 3. Output Characteristics  $T_{vj} = 175\text{ }^{\circ}\text{C}$

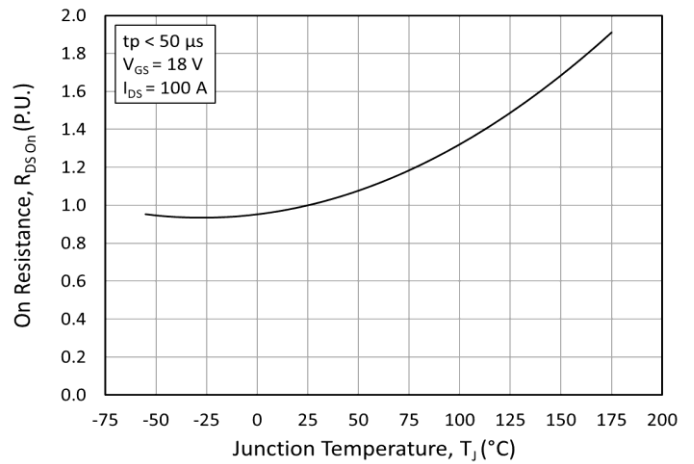


Figure 4. Normalized On-Resistance vs. Temperature

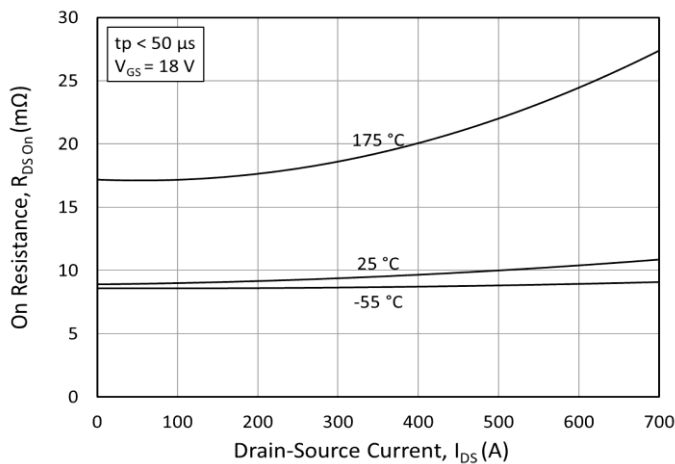


Figure 5. On-Resistance vs. Drain Current for Various Temperatures

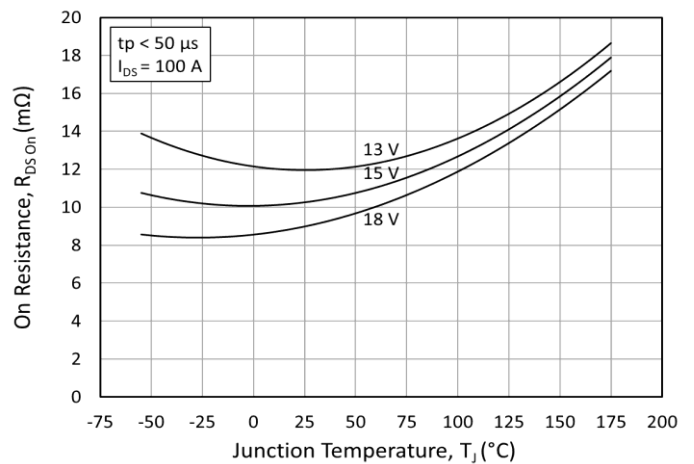


Figure 6. On-Resistance vs. Temperature for Various Gate Voltages



Typical Performance

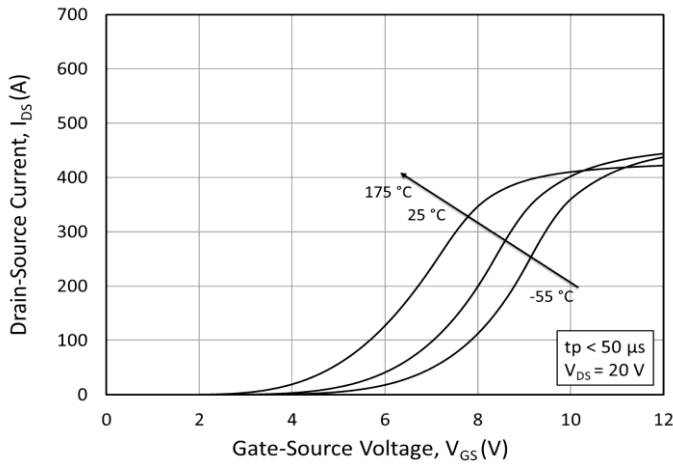


Figure 7. Transfer Characteristic for Various Junction Temperatures

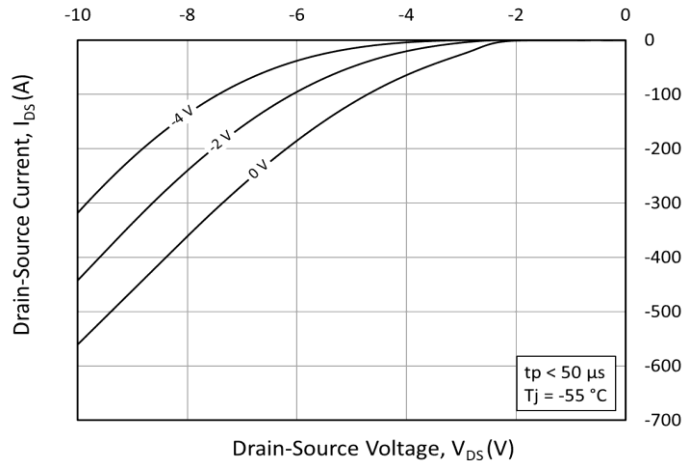


Figure 8. Body Diode Characteristic at  $T_{VJ} = -55\text{ °C}$

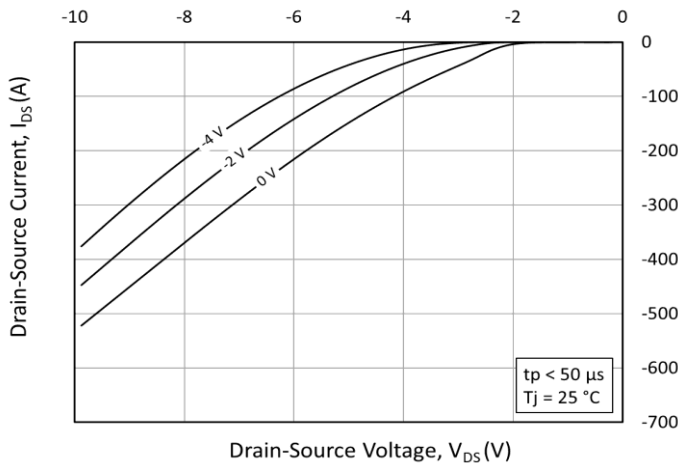


Figure 9. Body Diode Characteristic at  $T_{VJ} = 25\text{ °C}$

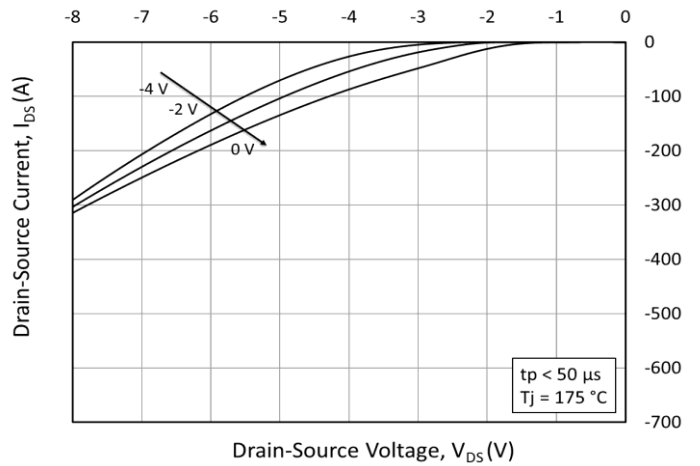


Figure 10. Body Diode Characteristic at  $T_{VJ} = 175\text{ °C}$

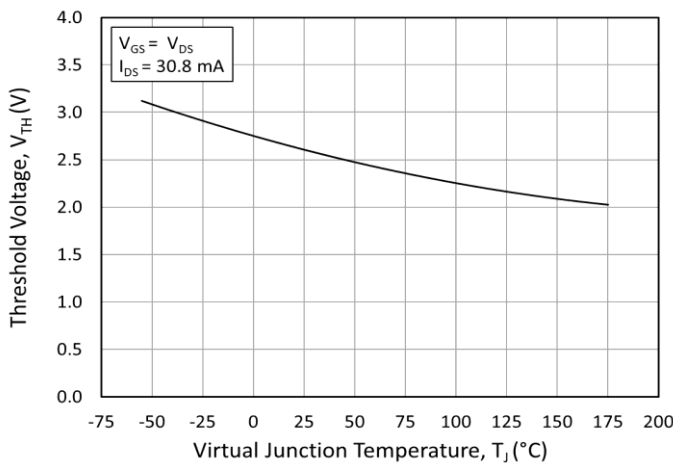


Figure 11. Threshold Voltage vs. Temperature

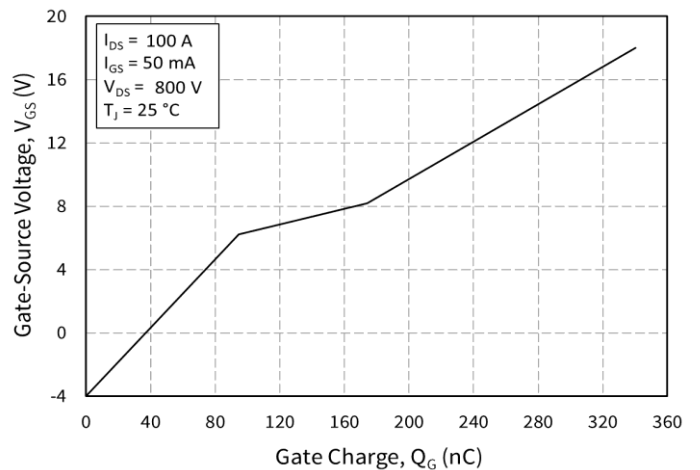


Figure 12. Gate Charge Characteristics

Typical Performance

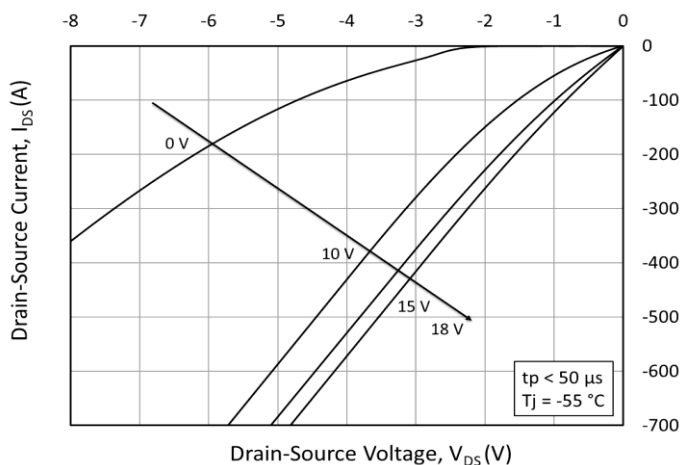


Figure 13. 3rd Quadrant Characteristic at  $T_{VJ} = -55\text{ }^{\circ}\text{C}$

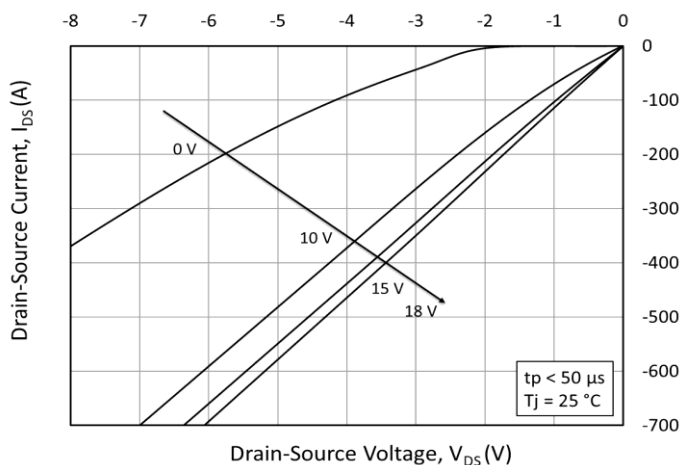


Figure 14. 3rd Quadrant Characteristic at  $T_{VJ} = 25\text{ }^{\circ}\text{C}$

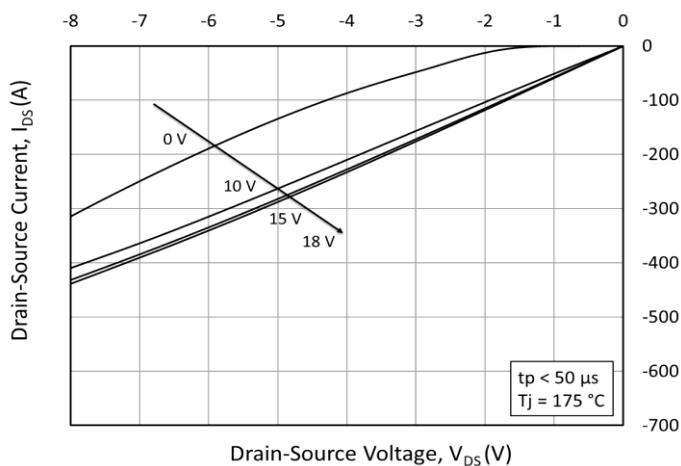


Figure 15. 3rd Quadrant Characteristic at  $T_{VJ} = 175\text{ }^{\circ}\text{C}$

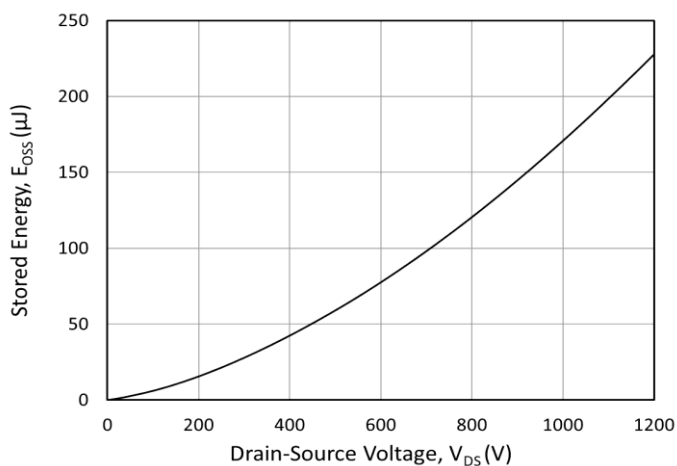


Figure 16. Output Capacitor Stored Energy

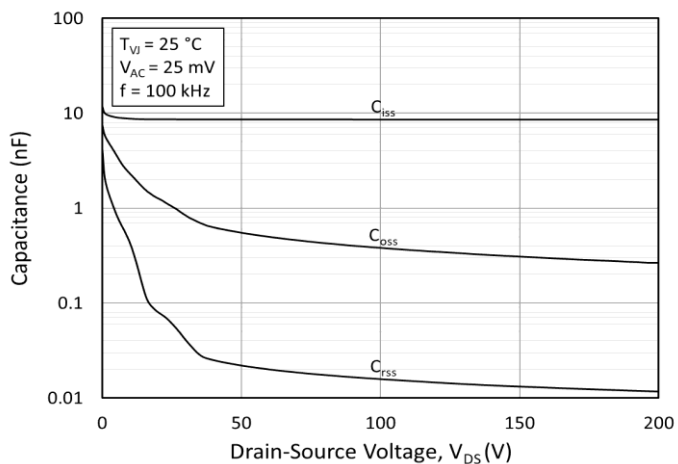


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

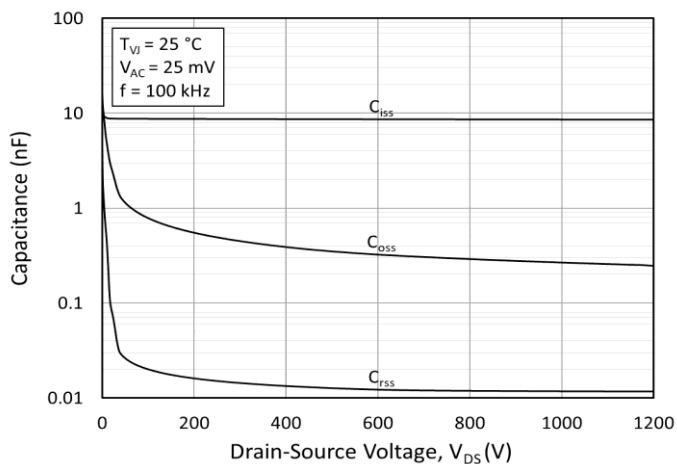


Figure 18. Capacitances vs. Drain-Source Voltage (0-1200 V)



Typical Performance

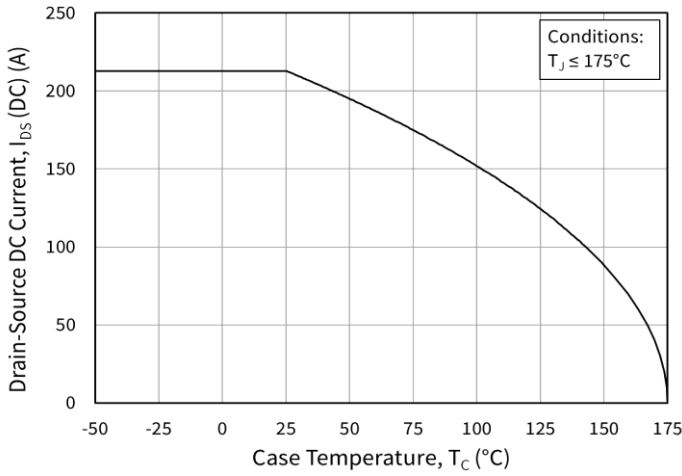


Figure 19. Continuous Drain Current Derating vs. Case Temperature

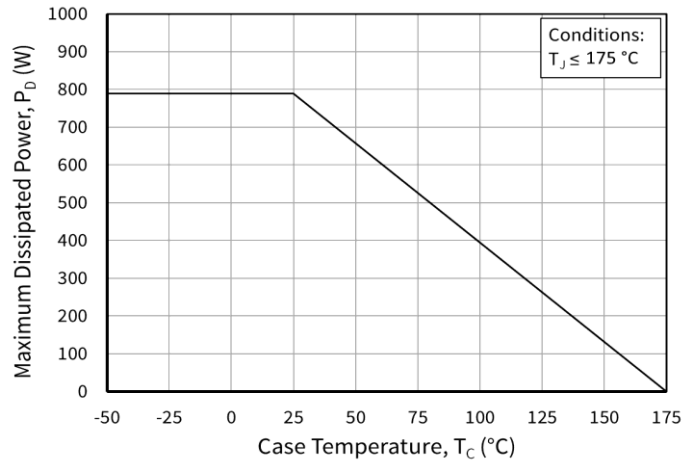


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

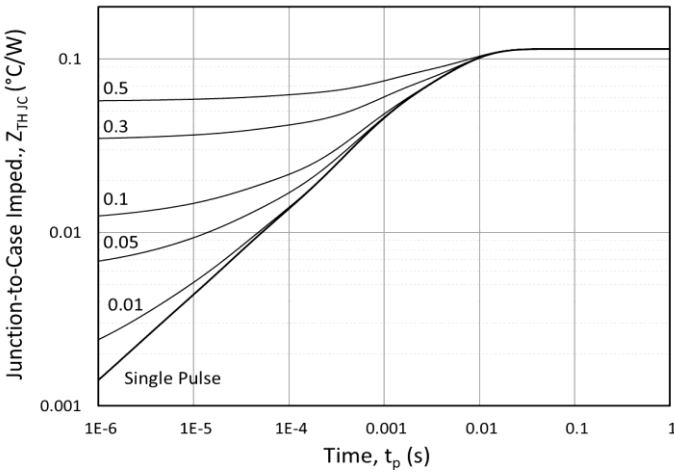


Figure 21. Transient Thermal Impedance (Junction - Case) °C/W

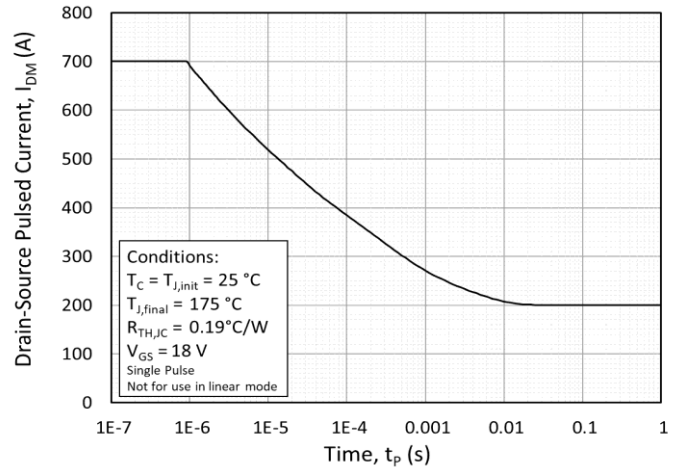


Figure 22. Safe Operating Area

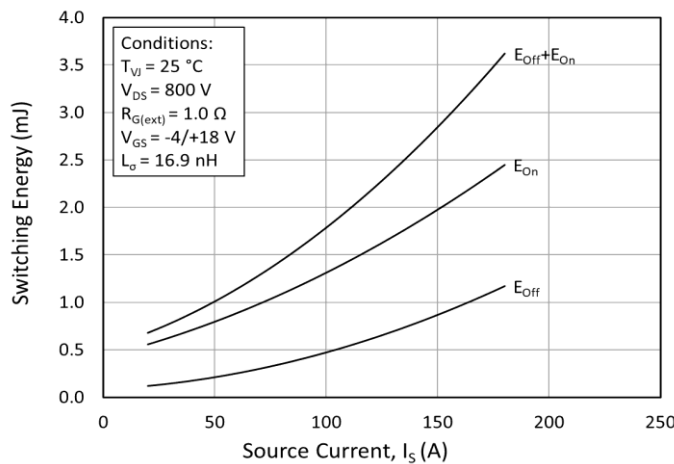


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800\text{ V}$ )

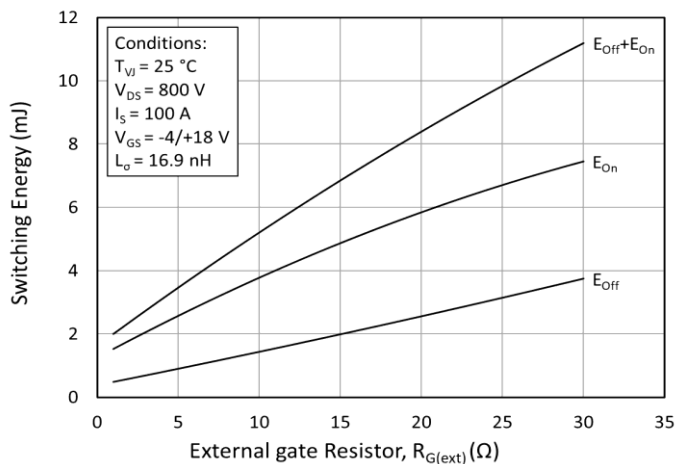


Figure 24. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

Typical Performance

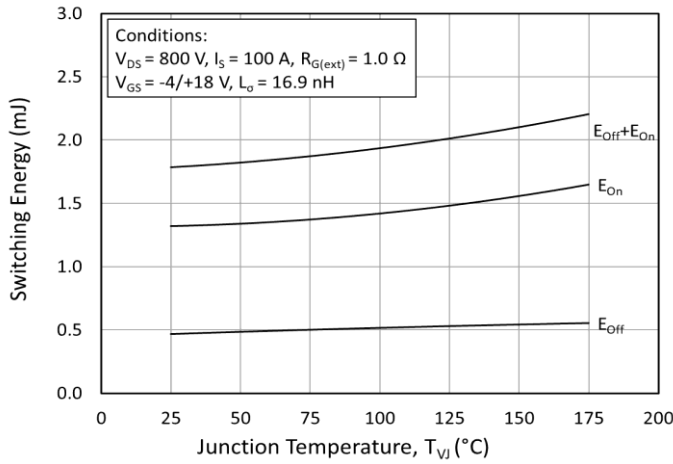


Figure 25. Clamped Inductive Switching Energy vs. Temperature

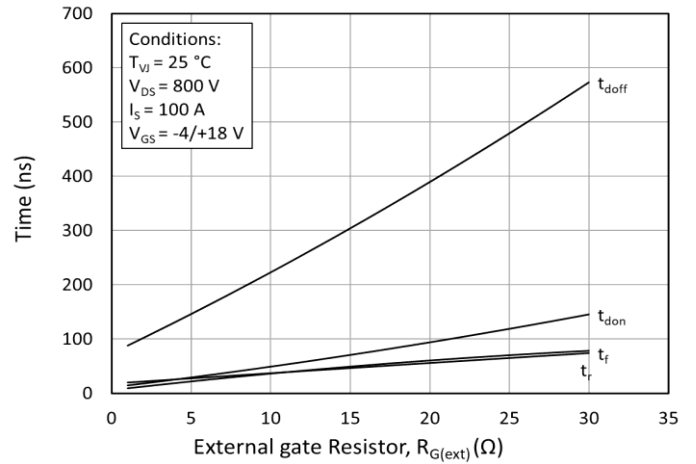


Figure 26. Switching Times vs.  $R_{G(ext)}$

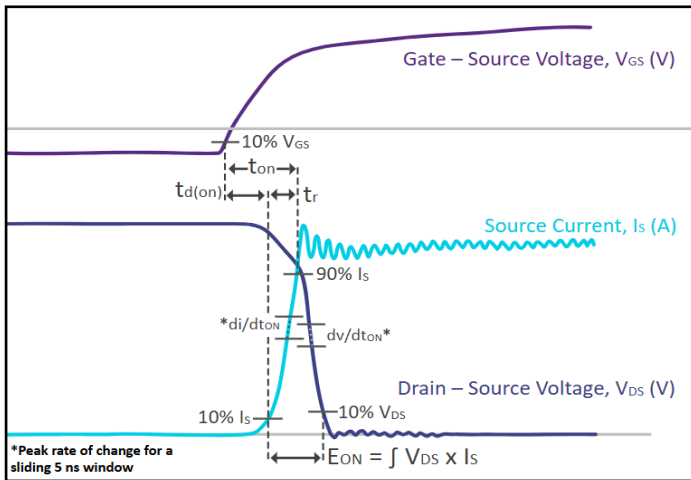


Figure 27. Turn On Switching Time Definition

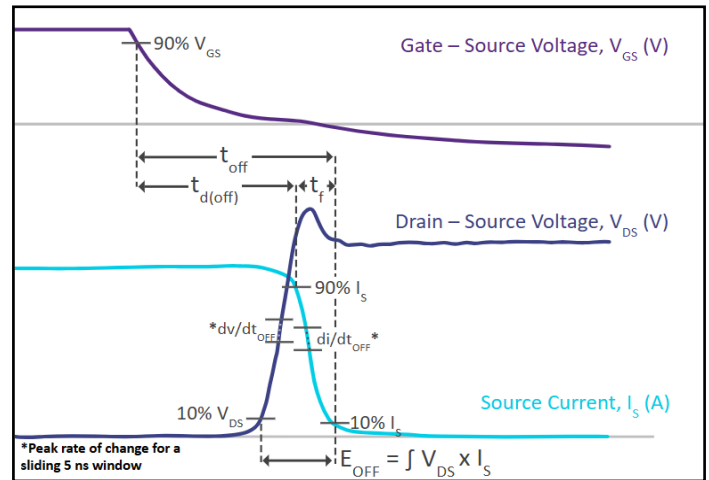


Figure 28. Turn Off Switching Time Definition

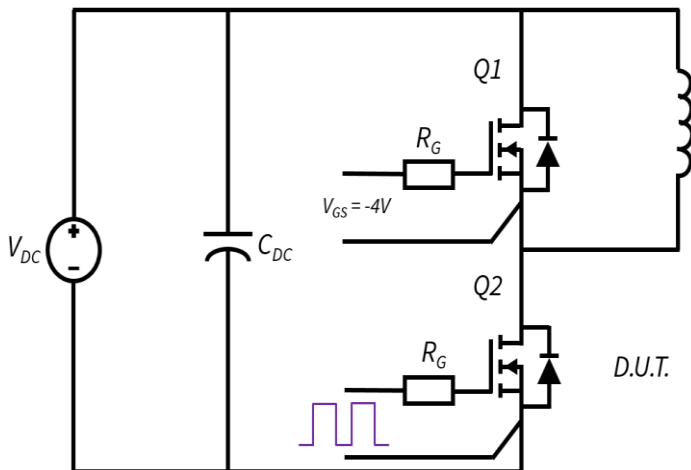


Figure 29. Clamped Inductive MOSFET Switching Waveform Test Circuit

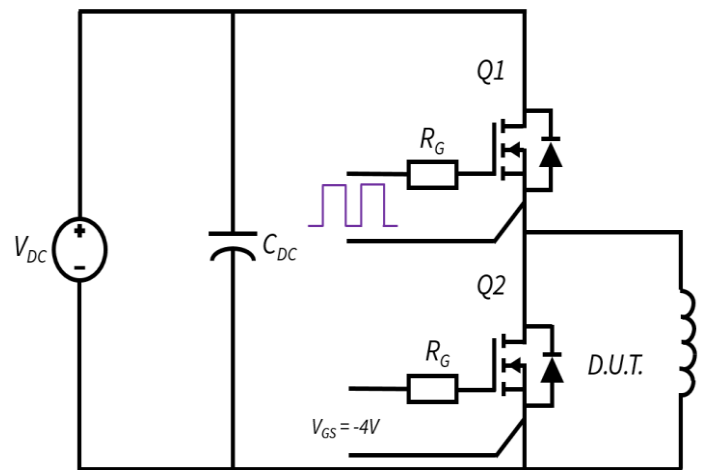
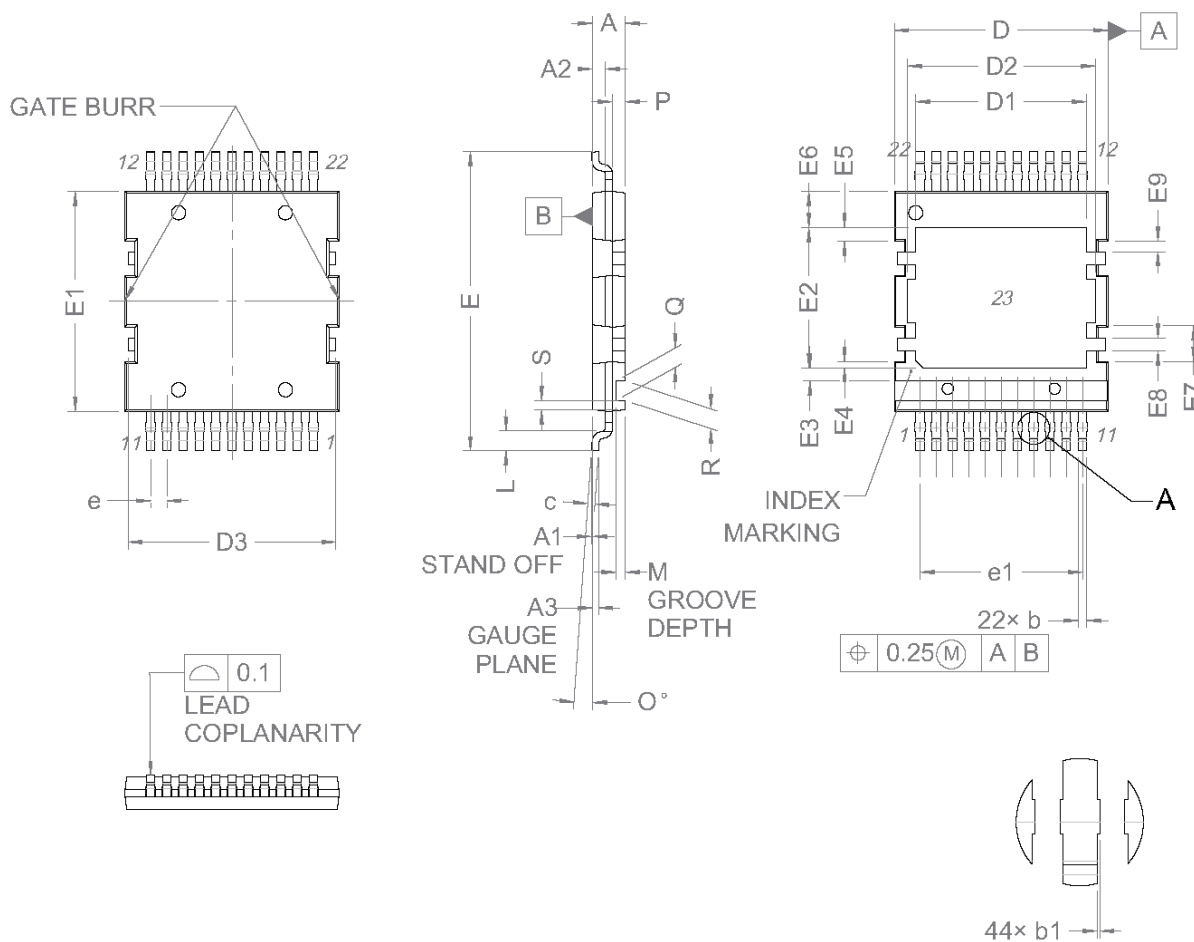


Figure 30. Clamped Inductive Body Diode Switching Waveform Test Circuit

## Package Dimensions



**DETAIL A**  
SCALE 8 : 1

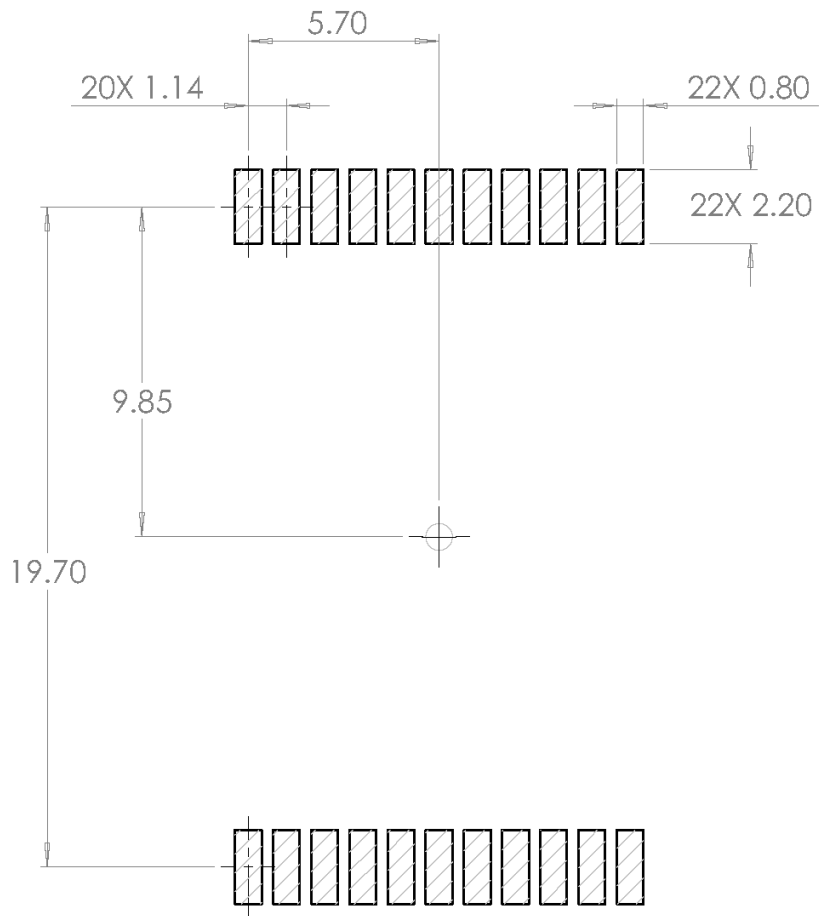
SYMBOL	MIN	MAX	SYMBOL	MIN	MAX	PIN	DESCRIPTION
A	2.2	2.35	E6	2.53		1	GATE
A1	0	0.15	E7	2.4		2	KELVIN
A2	0.9		E8	0.9		3-11	SOURCE
A3	0.5		E9	0.75		12-23	DRAIN
b	0.5	0.7	e	1.14			
b1	-	0.15	e1	11.4			
c	0.46	0.58	L	1.3			
D	14.9	15.1	M	0.6			
D1	12		N	22			
D2	13.2		O	0°	8°		
D3	14.5	14.7	P	0.9			
E	20.81	21.11	P1	0.7	0.9		
E1	15.3	15.5	P2	0.9	1.1		
E2	9.83		Q	1.6			
E3	0.625		R	1.7			
E4	0.45		S	0.631			
E5	0.95						

**NOTE:**

1. ALL METAL SURFACES ARE TIN PLATED (MATTE), EXCEPT AREA OF CUT
2. ALL DIMENSIONS ARE LISTED IN MILLIMETERS. ANGLES IN DEGREES
3. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
4. DIMENSIONS DO NOT INCLUDE MOLD FLASH (0.15mm MAX PER SIDE) OR GATE BURR (0.3mm MAX)
5. THE LEAD SIDE IS COMPREHENSIVE OF THE THICKNESS OF THE LEAD FINISH MATERIAL

### Recommended Solder Pad Layout

All dimensions in mm





## Revision History

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

## Appendix

Appendix Number	Description
A1	<p>The following are recommendations for turning off the MOSFET with 0 V:</p> <ul style="list-style-type: none"><li>• Measure the <math>V_{GS}</math> spike accurately using high-CMRR probes and low common mode noise measurements.</li><li>• For the safe operation of the device, the voltage spike shall remain &lt; 5V for a time duration of &lt; 40 ns.</li></ul>



## Notes & Disclaimers

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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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