

E3M0021120U2

1200V 21mΩ Automotive Silicon Carbide Power MOSFET
N-Channel Enhancement Mode

Features

- Industry standard Top Side Cooled (TSC) Package
- High power dissipation capability
- Optimized package with separate driver source pin
- High creepage package design
- 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

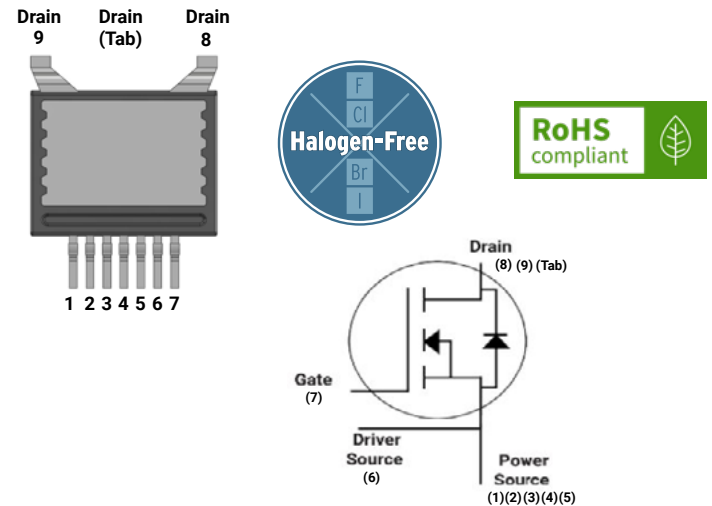
Benefits

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

Typical Applications

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

Package



Part Number	Package	Marking
E3M0021120U2	U2 (TSC)	E3M0021120U2

Key Parameters

Parameter	Symbol	Min.	Typ.	Max	Unit	Conditions	Note
Drain - Source Voltage	V_{DS}			1200	V	$T_c = 25^\circ\text{C}$	
Maximum Gate - Source Voltage	$V_{GS(max)}$	-8		+19		Transient	
Operational Gate-Source Voltage	$V_{GS op}$		-4/15			Static	Note 1
DC Continuous Drain Current	I_D			116	A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Fig. 19 Note 2
				84		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 175^\circ\text{C}$	
Pulsed Drain Current	I_{DM}			435		t_{pmax} limited by T_{Jmax} $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	P_D			500	W	$T_c = 25^\circ\text{C}, T_J = 175^\circ\text{C}$	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}			-55 to +175	$^\circ\text{C}$		
Solder Temperature	T_L			260		According to JEDEC J-STD-020	

Note (1): Recommended turn-on gate voltage is 15V with $\pm 5\%$ regulation tolerance, see Application Note PRD-04814 for additional details

Note (2): Verified by design


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				$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.9	3.8	V	$V_{DS} = V_{GS}, I_D = 17.08\text{ mA}$	Fig. 11
			2.3			$V_{DS} = V_{GS}, I_D = 17.08\text{ mA}, T_J = 175^\circ\text{C}$	
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	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		21	29	m Ω	$V_{GS} = 15\text{ V}, I_D = 62.12\text{ A}$	Fig. 4, 5, 6
			39			$V_{GS} = 15\text{ V}, I_D = 62.12\text{ A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		41		S	$V_{DS} = 20\text{ V}, I_{DS} = 62.12\text{ A}$	Fig. 7
			37			$V_{DS} = 20\text{ V}, I_{DS} = 62.12\text{ A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		5670		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to }1000\text{ V}$ $F = 100\text{ kHz}$ $V_{AC} = 25\text{ mV}$	Fig. 17, 18
C_{oss}	Output Capacitance		169				
C_{rss}	Reverse Transfer Capacitance		10				
E_{oss}	C_{oss} Stored Energy		99		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		217		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0 \dots 800\text{ V}$	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		329				
E_{ON}	Turn-On Switching Energy (MOSFET FWD)		1233		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 62.12\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 59\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode	Fig. 26, 28
E_{OFF}	Turn-Off Switching Energy (MOSFET FWD)		297				
$t_{d(on)}$	Turn-On Delay Time		16		ns	$V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 62.12\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		26				
$t_{d(off)}$	Turn-Off Delay Time		55				
t_f	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		2.9		Ω	$f = 1\text{ MHz}$	
Q_{gs}	Gate to Source Charge		60		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 62.12\text{ A}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		46				
Q_g	Total Gate Charge		179				

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as C_{oss} while V_{ds} is rising from 0 to 800V

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


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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.9		V	$V_{GS} = -4\text{ V}, I_{SD} = 31.1\text{ A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.4		V	$V_{GS} = -4\text{ V}, I_{SD} = 31.1\text{ A}, T_J = 175^\circ\text{C}$	
I_S	Continuous Diode Forward Current		91	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	
I_{SM}	Diode pulse Current		435	A	$V_{GS} = -4\text{ V}$, pulse width t_p limited by T_{Jmax}	
t_{rr}	Reverse Recovery time	23		ns	$V_{GS} = -4\text{ V}, I_{SD} = 62.12\text{ A}, V_R = 800\text{ V}$ $dif/dt = 7398\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	1224		nC		
I_{rrm}	Peak Reverse Recovery Current	81		A		
t_{rr}	Reverse Recovery time	41		ns	$V_{GS} = -4\text{ V}, I_{SD} = 62.12\text{ A}, V_R = 800\text{ V}$ $dif/dt = 2240\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	930		nC		
I_{rrm}	Peak Reverse Recovery Current	36		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.23	0.30	$^\circ\text{C}/\text{W}$		Fig. 21



Typical Performance

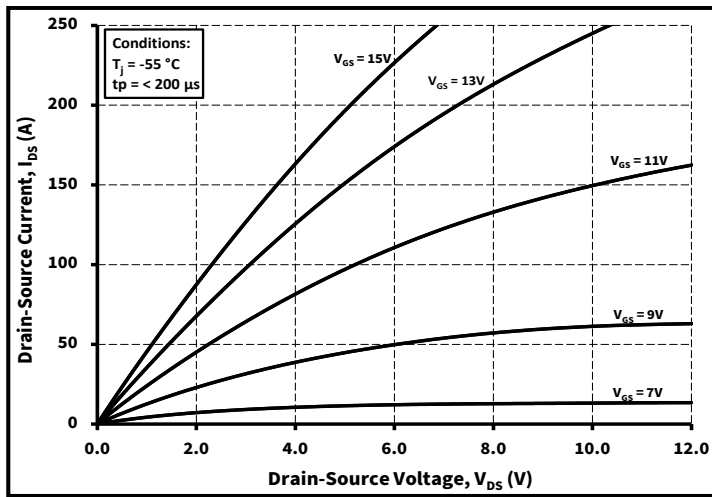


Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$

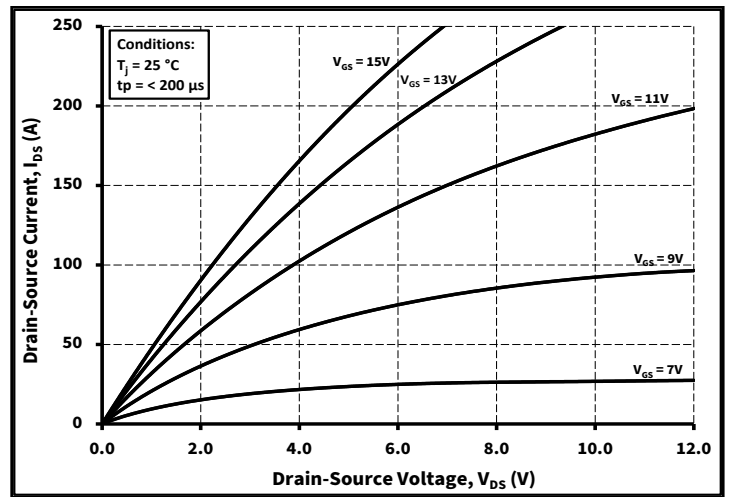


Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$

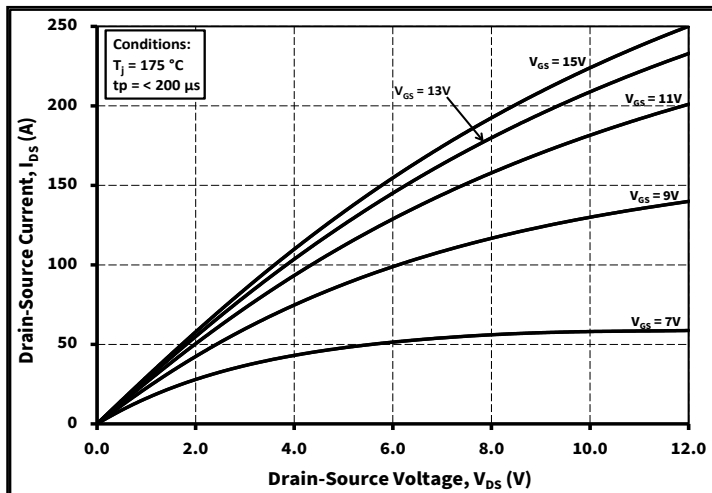


Figure 3. Output Characteristics $T_J = 175\text{ }^{\circ}\text{C}$

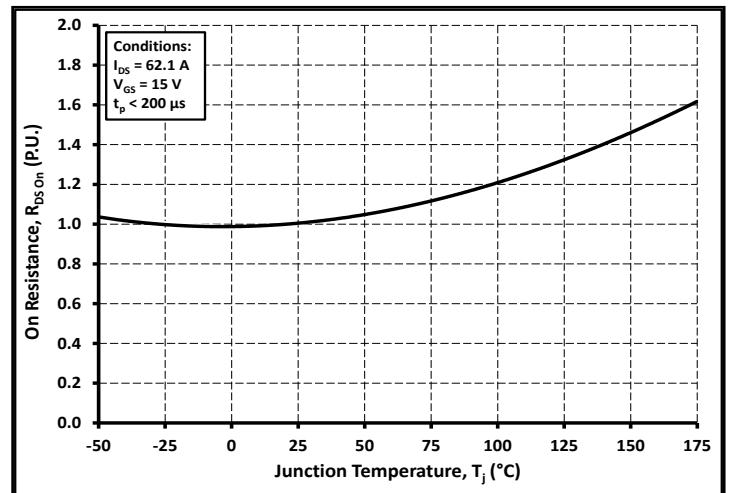


Figure 4. Normalized On-Resistance vs. Temperature

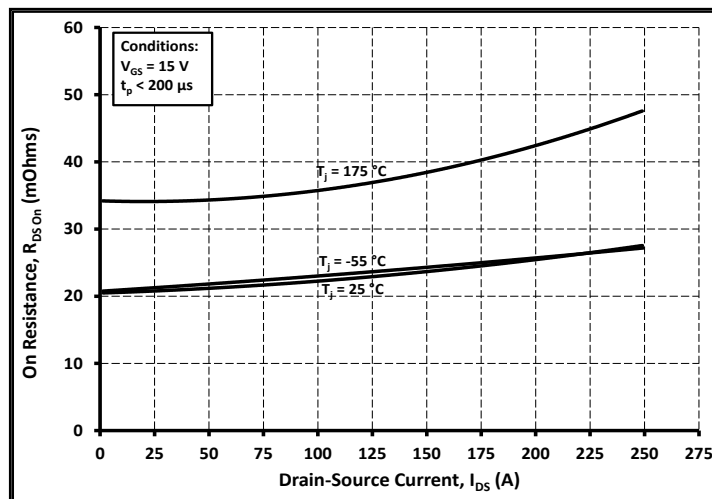


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

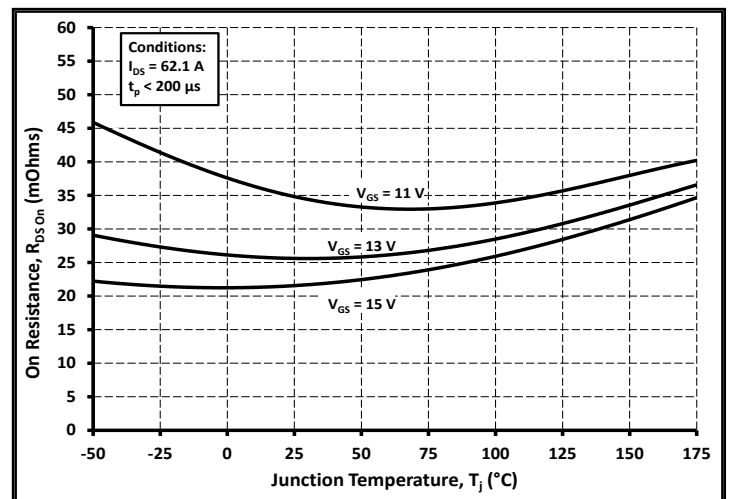


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

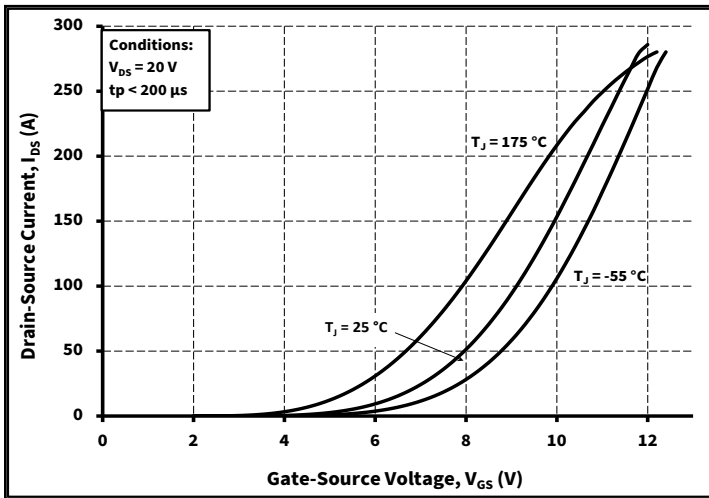


Figure 7. Transfer Characteristic for Various Junction Temperatures

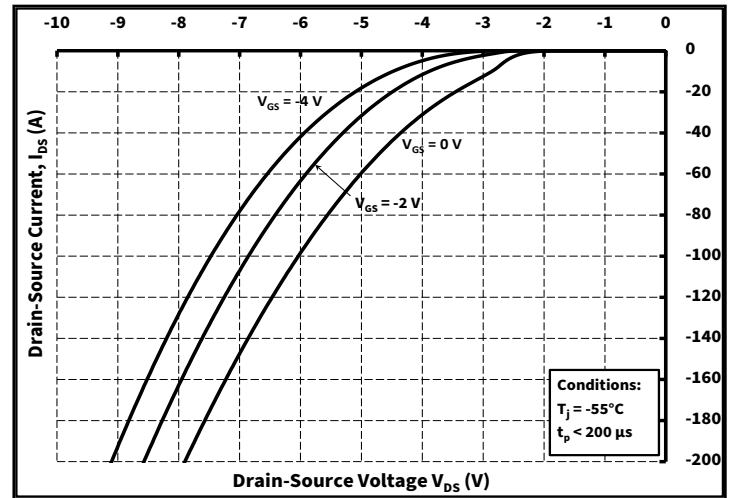
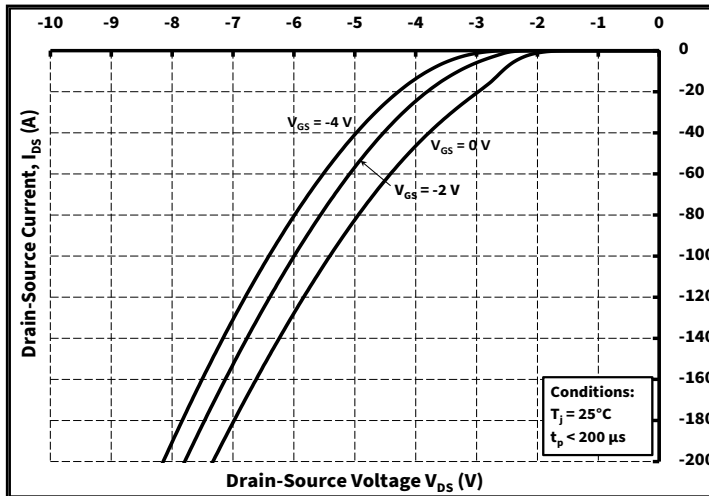
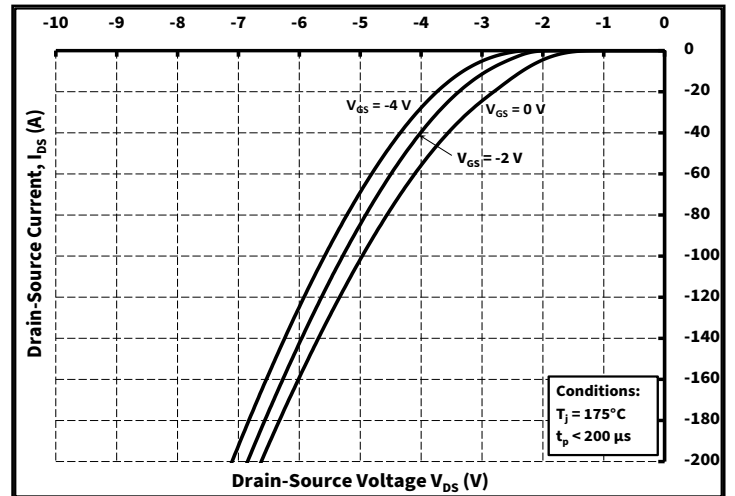
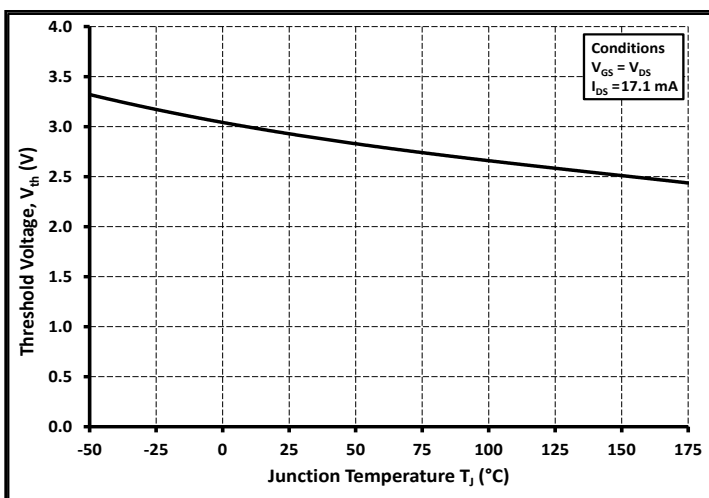
Figure 8. Body Diode Characteristic at $-55\text{ }^{\circ}\text{C}$ Figure 9. Body Diode Characteristic at $25\text{ }^{\circ}\text{C}$ Figure 10. Body Diode Characteristic at $175\text{ }^{\circ}\text{C}$ 

Figure 11. Threshold Voltage vs. Temperature

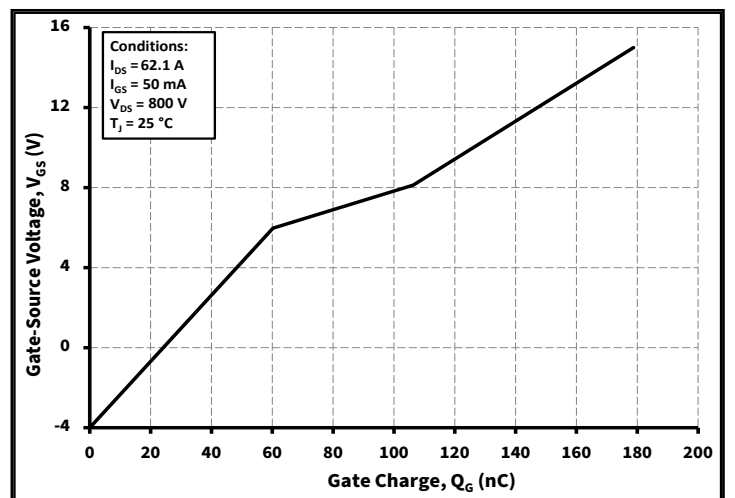


Figure 12. Gate Charge Characteristics

Typical Performance

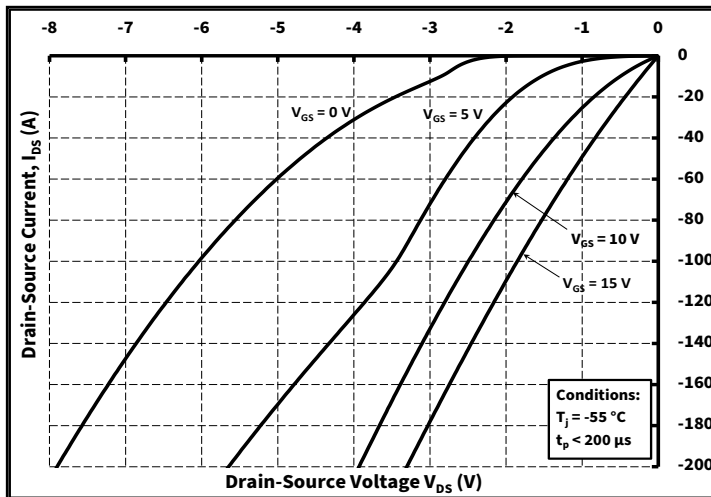
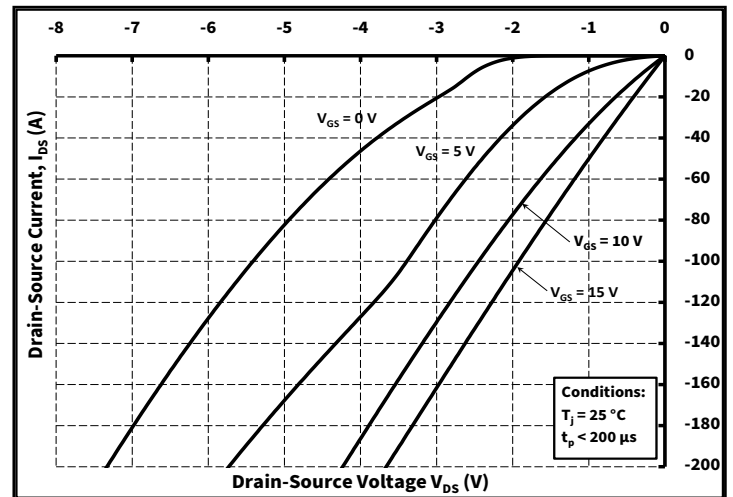
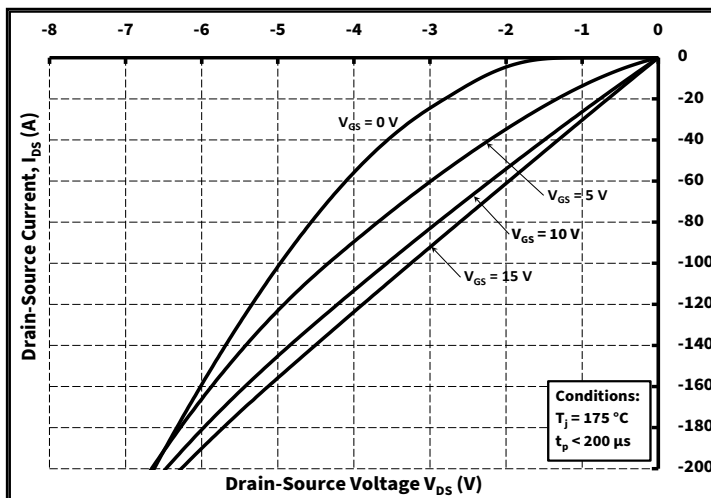
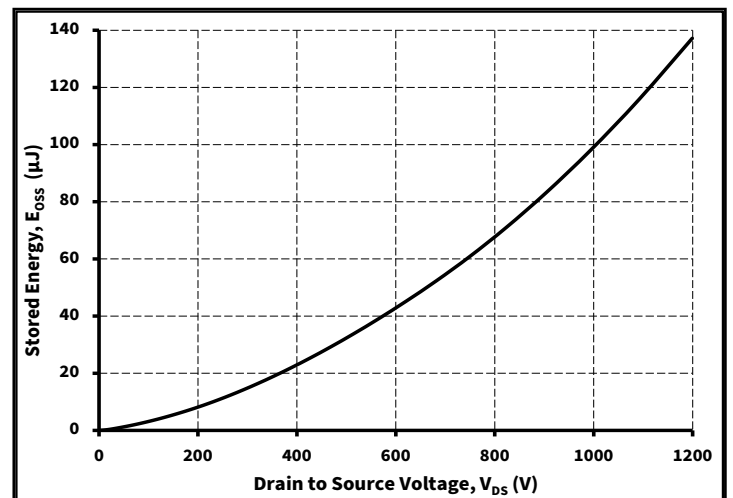
Figure 13. 3rd Quadrant Characteristic at $-55\text{ }^{\circ}\text{C}$ Figure 14. 3rd Quadrant Characteristic at $25\text{ }^{\circ}\text{C}$ Figure 15. 3rd Quadrant Characteristic at $175\text{ }^{\circ}\text{C}$ 

Figure 16. Output Capacitor Stored Energy

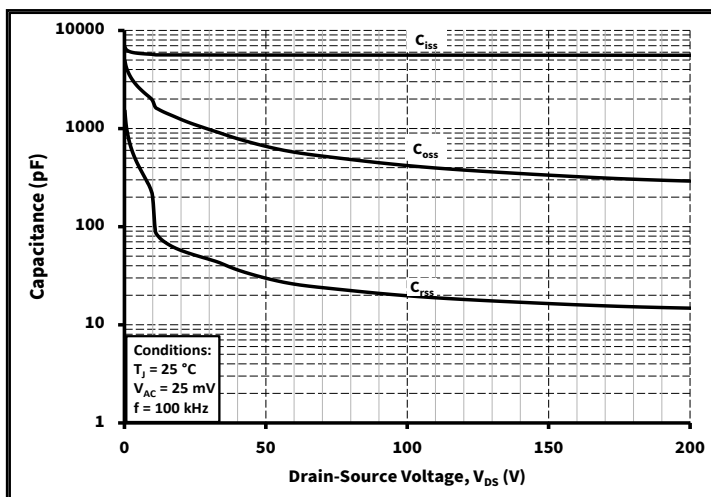


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

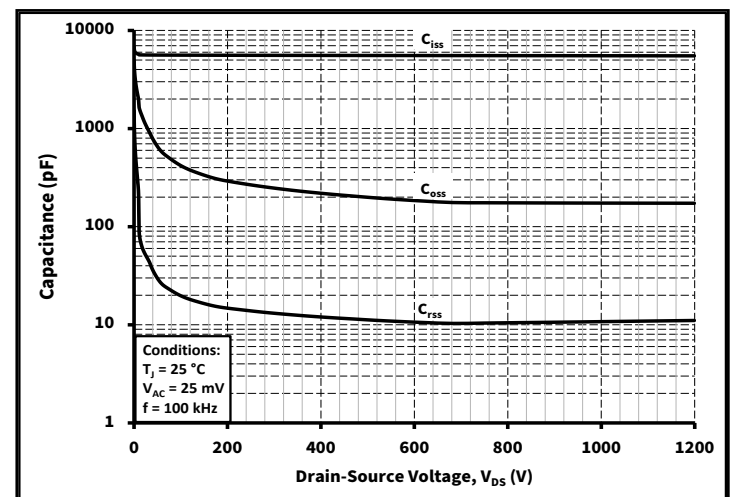


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

Typical Performance

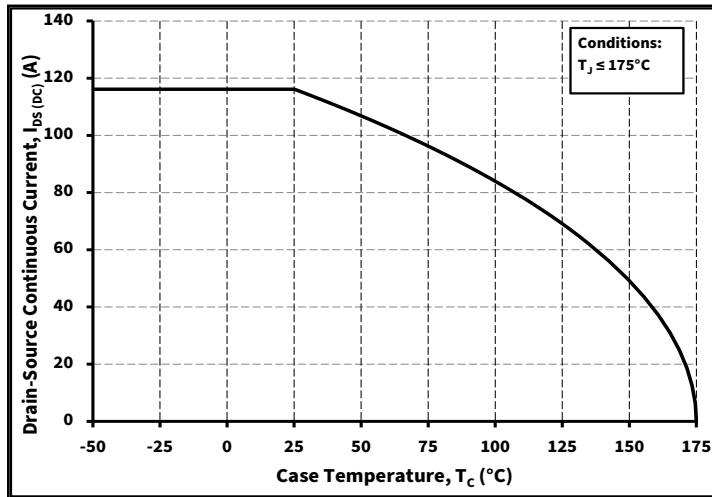


Figure 19. Continuous Drain Current Derating vs. Case Temperature

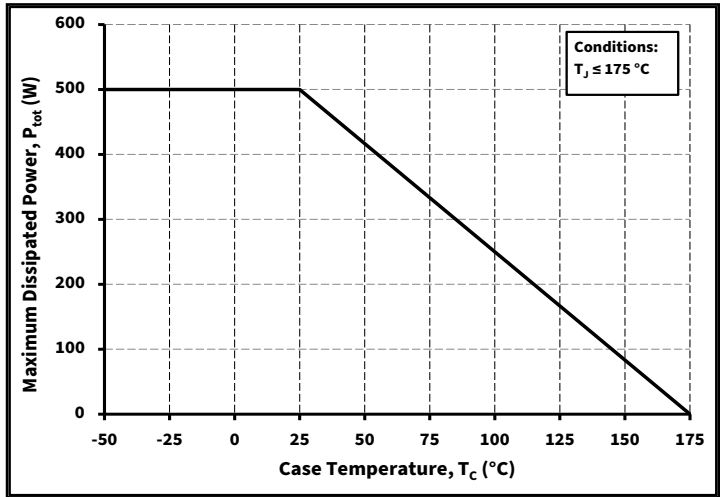


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

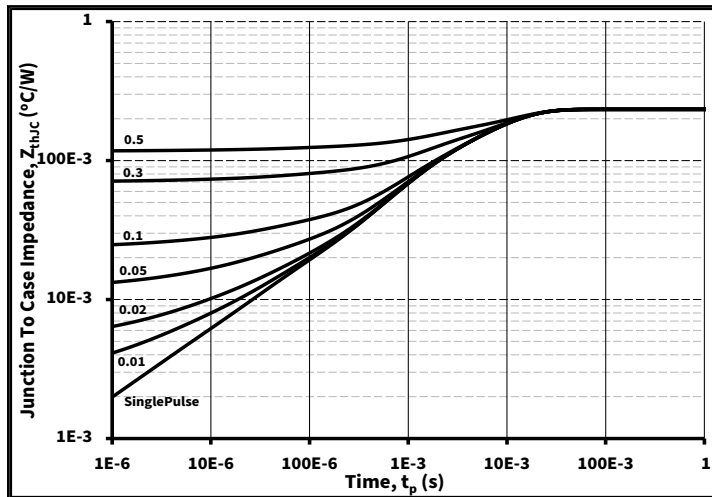


Figure 21. Transient Thermal Impedance (Junction - Case)

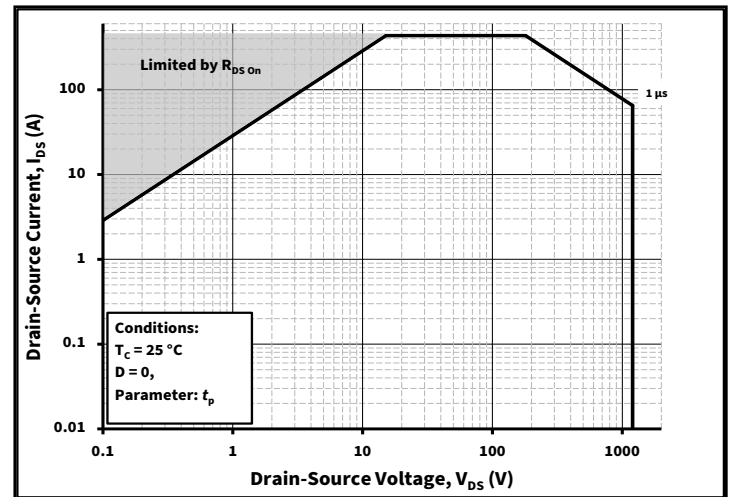
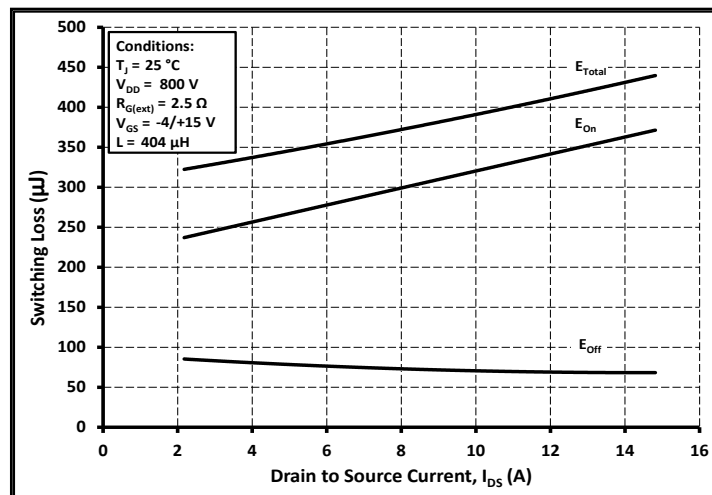
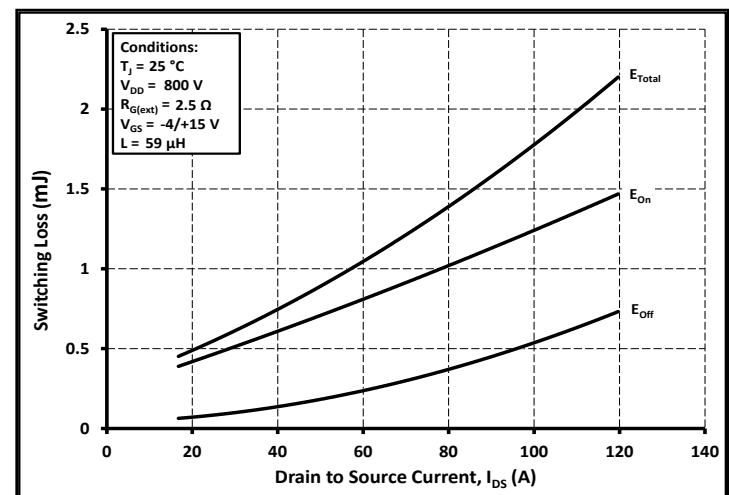


Figure 22. Safe Operating Area

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

Typical Performance

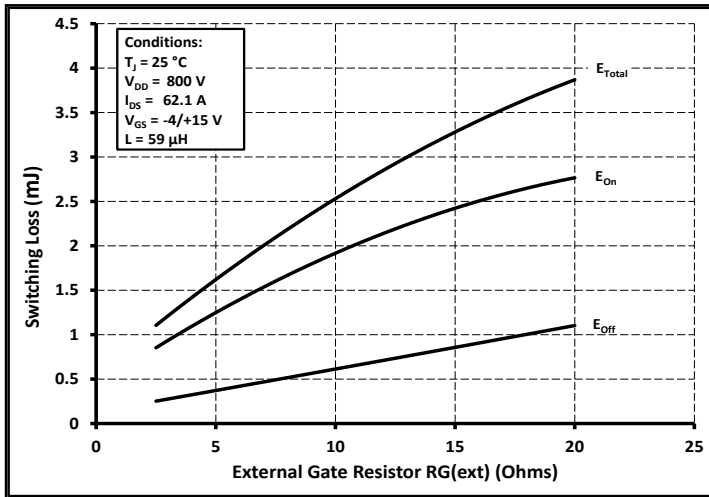
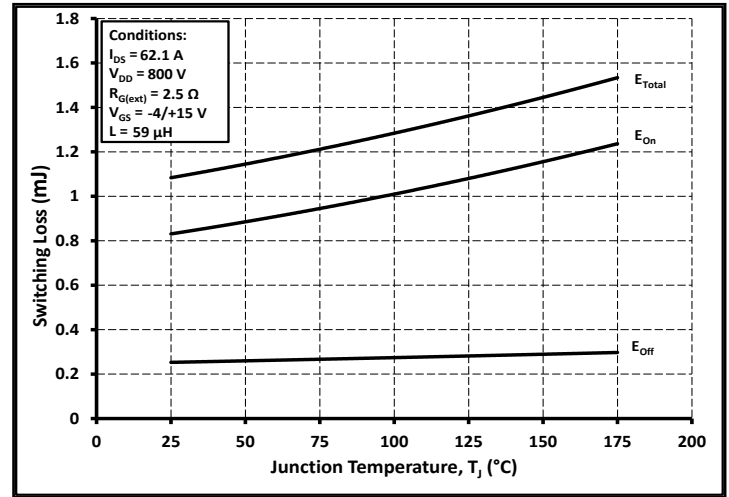
Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$ 

Figure 26. Clamped Inductive Switching Energy vs. Temperature

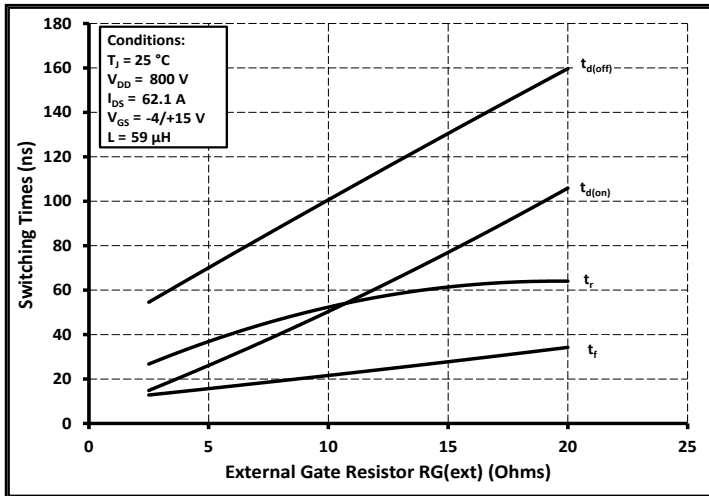
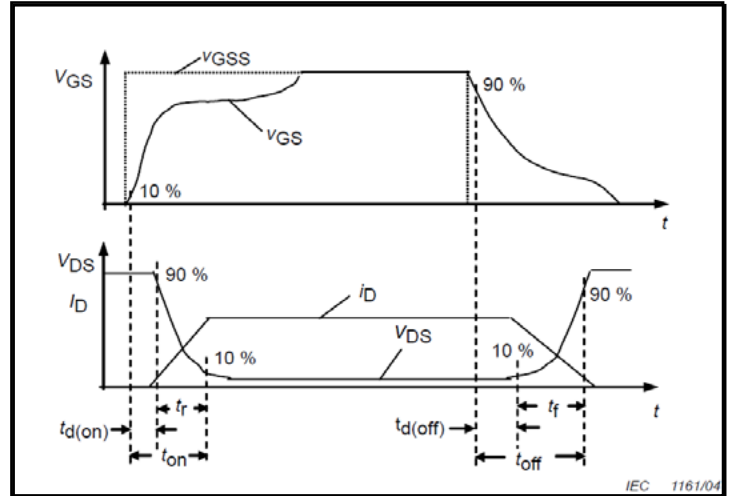
Figure 27. Switching Times vs. $R_{G(ext)}$ 

Figure 28. Switching Times Definition

Test Circuit Schematic

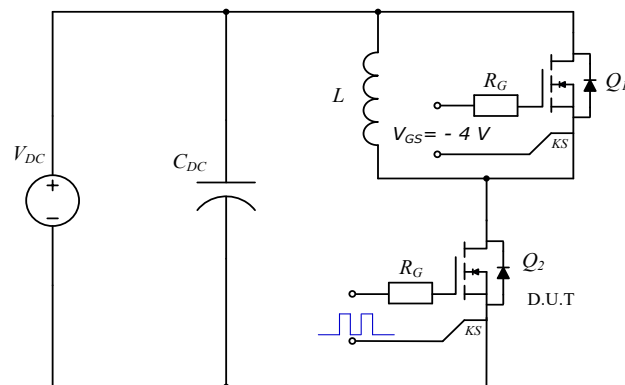
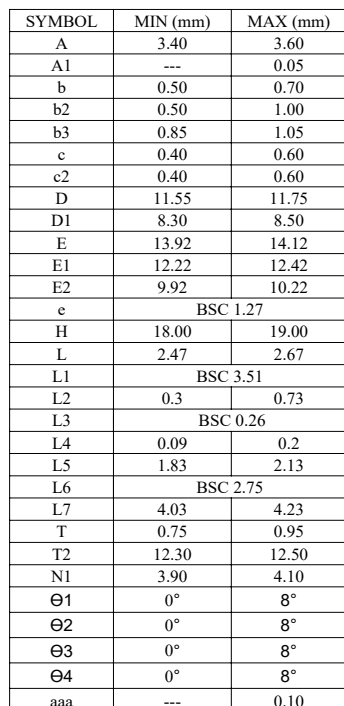


Figure 29. Clamped Inductive Switching
Waveform Test Circuit



1	SOURCE
2	
3	
4	
5	
6	DRIVER SOURCE
7	GATE
8	DRAIN
9	DRAIN
10	DRAIN

1. ALL METAL SURFACES ARE TIN PLATED (MATTE), EXCEPT AREA OF CUT.

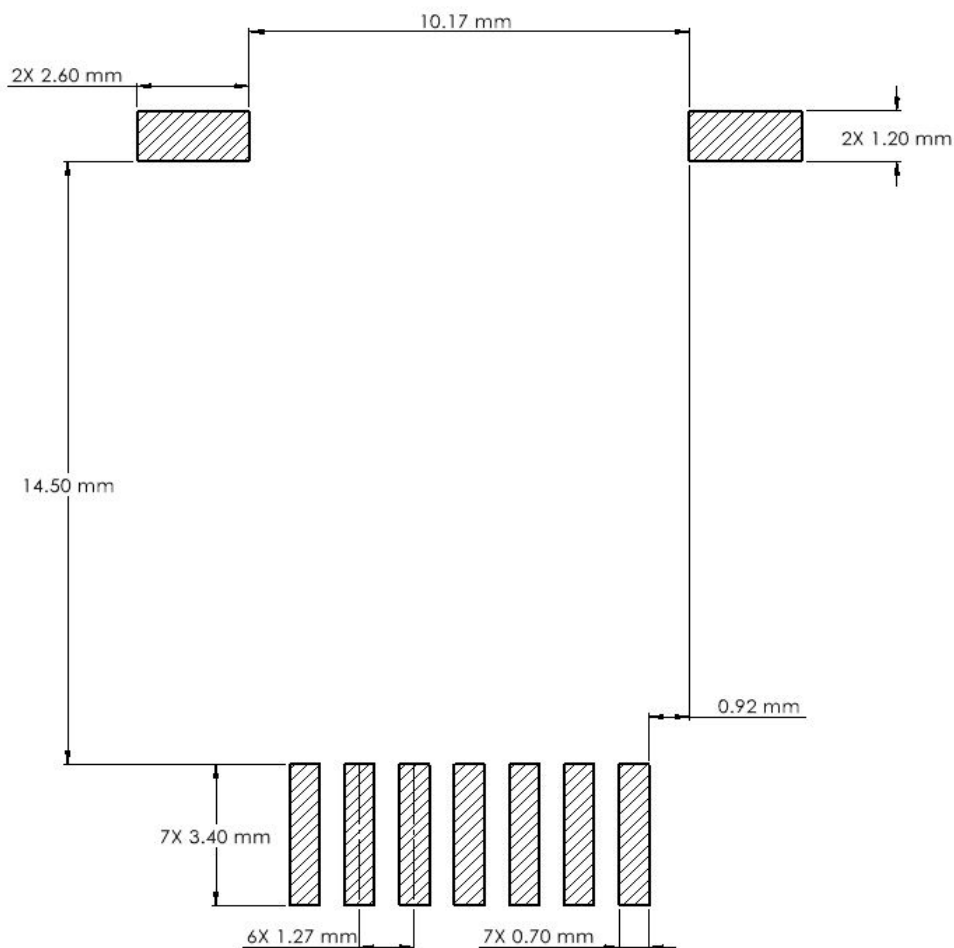
3. ALL DIMENSIONS ARE LISTED IN MILLIMETERS.
ANGLES ARE IN DEGREES.

4. PACKAGE BURR 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	Descriptiion of changes
1	September - 2025	Initial Release



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