

E3M0160120U2

1200V 160mΩ 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

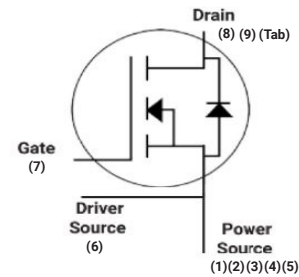
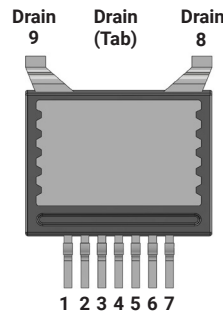
Benefits

- 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
E3M0160120U2	U2 (TSC)	E3M0160120U2

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			17	A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Fig. 19
				13		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Note 2
Pulsed Drain Current	I_{DM}			60		t_{Pmax} limited by T_{Jmax} $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	P_D			104	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				$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	3.3	3.8	V	$V_{DS} = V_{GS}, I_D = 2.34\ \text{mA}$	Fig. 11
			2.7			$V_{DS} = V_{GS}, I_D = 2.34\ \text{mA}, T_J = 175^\circ\text{C}$	
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		187	208	m Ω	$V_{GS} = 15\ \text{V}, I_D = 8.5\ \text{A}$	Fig. 4, 5, 6
			295			$V_{GS} = 15\ \text{V}, I_D = 8.5\ \text{A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		5		S	$V_{DS} = 20\ \text{V}, I_{DS} = 8.5\ \text{A}$	Fig. 7
			5			$V_{DS} = 20\ \text{V}, I_{DS} = 8.5\ \text{A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		831		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		42				
C_{riss}	Reverse Transfer Capacitance		5				
E_{oss}	C_{oss} Stored Energy		23		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		49		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 0... 800\text{V}$	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		67				
E_{oN}	Turn-On Switching Energy (MOSFET FWD)		106		μJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_D = 8.5\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 300\ \mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode	Fig. 26, 28
E_{oFF}	Turn-Off Switching Energy (MOSFET FWD)		16				
$t_{d(on)}$	Turn-On Delay Time		8		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 8.5\ \text{A}, R_{G(ext)} = 2.5\ \Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		7				
$t_{d(off)}$	Turn-Off Delay Time		11				
t_f	Fall Time		10				
$R_{G(int)}$	Internal Gate Resistance		4.2		Ω	$f = 1\ \text{MHz}$	
Q_{gs}	Gate to Source Charge		12		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 8.5\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		7				
Q_g	Total Gate Charge		27				

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	$V_{GS} = -4\text{ V}, I_{SD} = 4.3\text{ A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.2		V	$V_{GS} = -4\text{ V}, I_{SD} = 4.3\text{ A}, T_J = 175^\circ\text{C}$	
I_S	Continuous Diode Forward Current		17	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	
I_{SM}	Diode pulse Current		60	A	$V_{GS} = -4\text{ V}$, pulse width t_p limited by T_{Jmax}	
t_{rr}	Reverse Recover time	10		ns	$V_{GS} = -4\text{ V}, I_{SD} = 8.5\text{ A}, V_R = 800\text{ V}$ $dif/dt = 6128\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	250		nC		
I_{rrm}	Peak Reverse Recovery Current	39		A		
t_{rr}	Reverse Recover time	21		ns	$V_{GS} = -4\text{ V}, I_{SD} = 8.5\text{ A}, V_R = 800\text{ V}$ $dif/dt = 1818\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	183		nC		
I_{rrm}	Peak Reverse Recovery Current	13		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	1.11	1.44	$^\circ\text{C}/\text{W}$		Fig. 21



Typical Performance

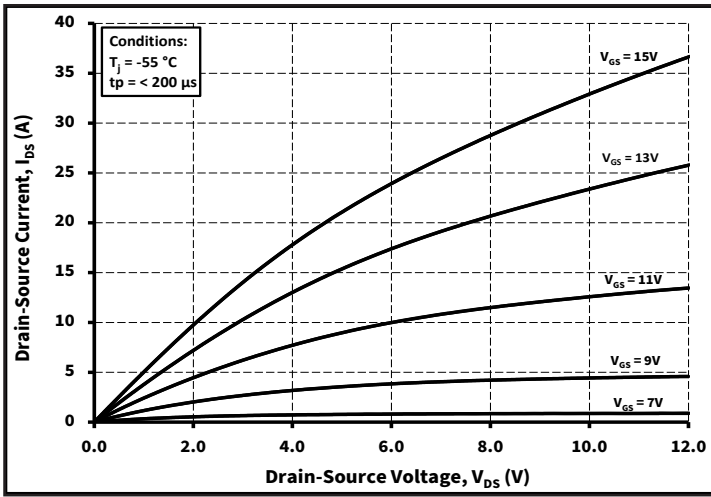


Figure 1. Output Characteristics $T_j = -55\text{ }^\circ\text{C}$

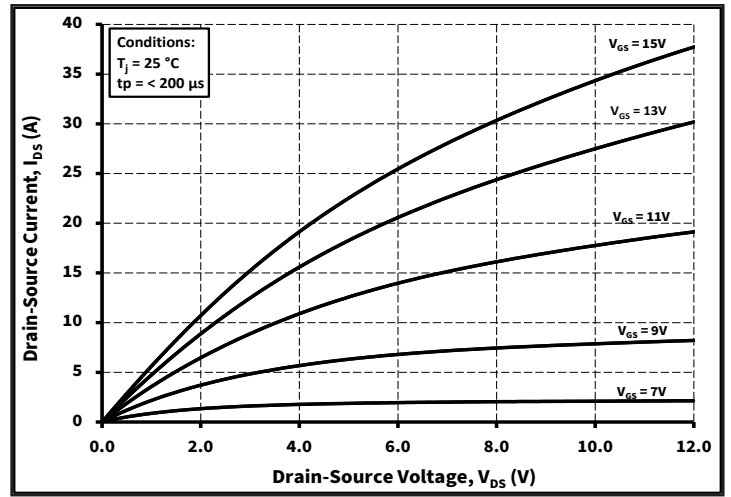


Figure 2. Output Characteristics $T_j = 25\text{ }^\circ\text{C}$

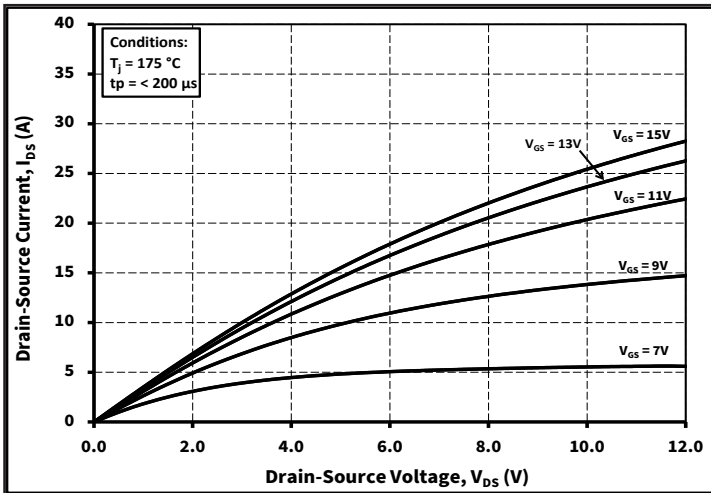


Figure 3. Output Characteristics $T_j = 175\text{ }^\circ\text{C}$

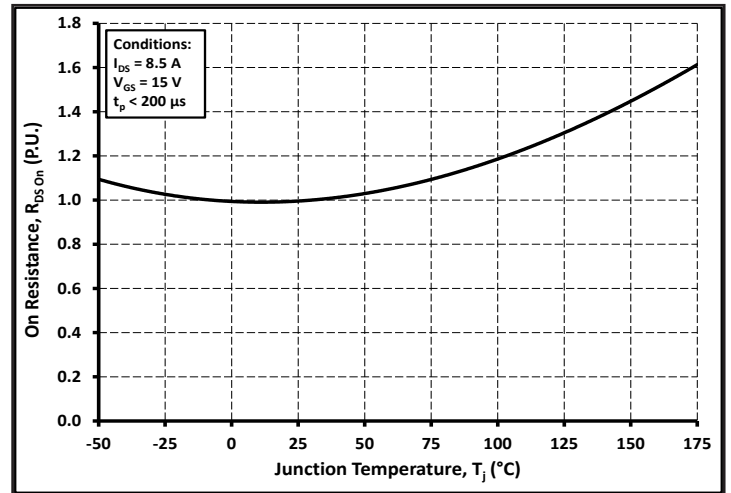


Figure 4. Normalized On-Resistance vs. Temperature

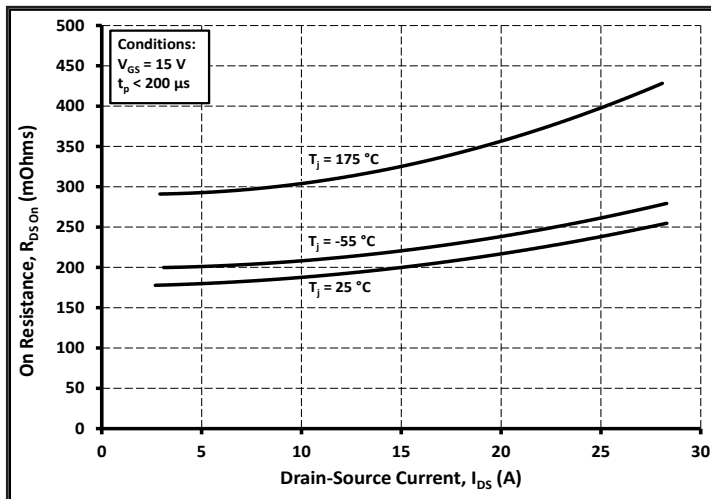


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

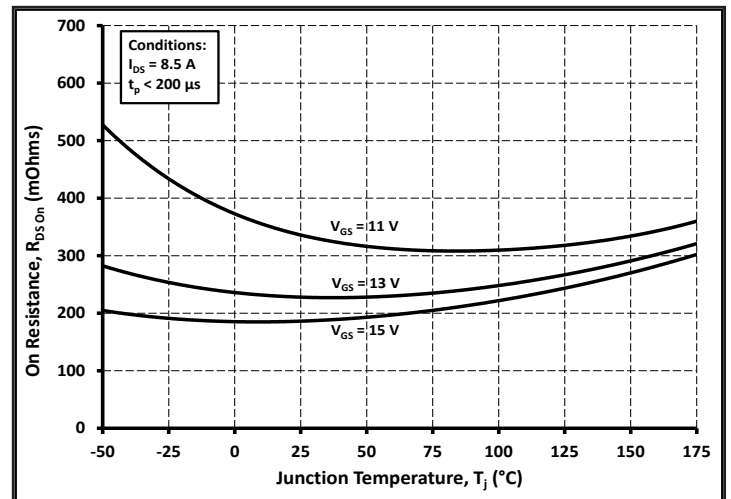


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage



Typical Performance

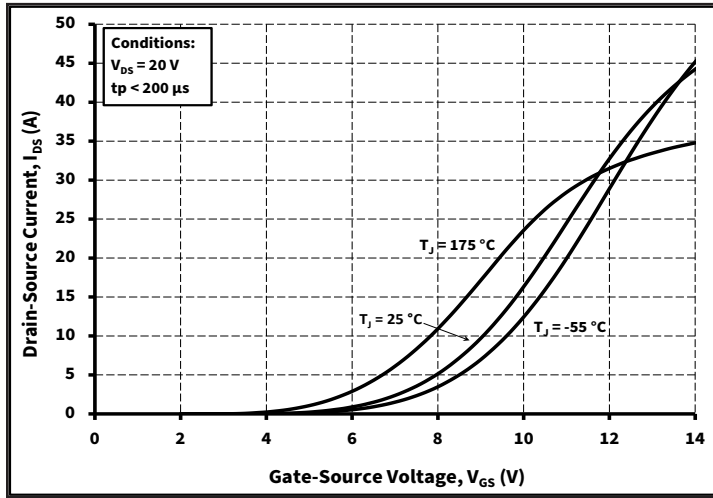


Figure 7. Transfer Characteristic for Various Junction Temperatures

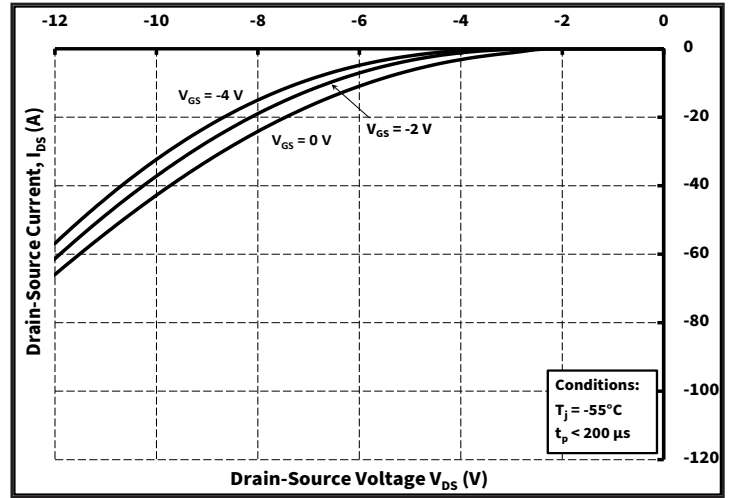


Figure 8. Body Diode Characteristic at -55 °C

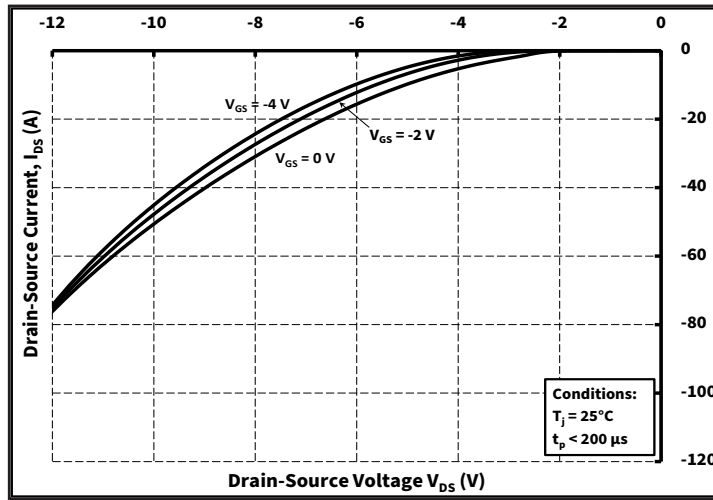


Figure 9. Body Diode Characteristic at 25 °C

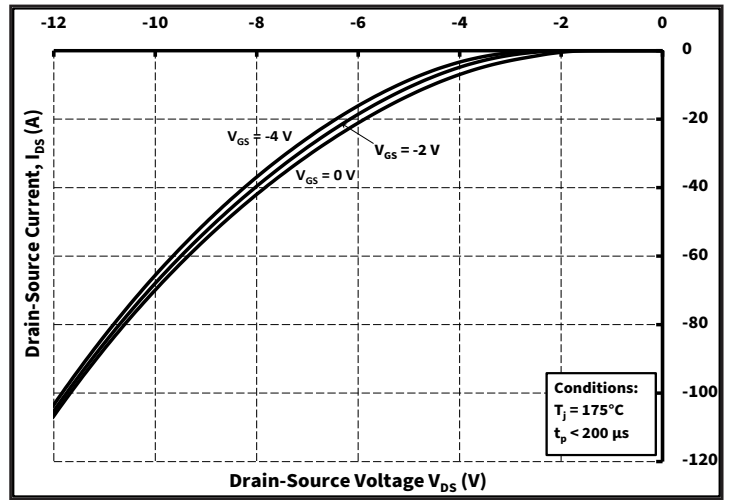


Figure 10. Body Diode Characteristic at 175 °C

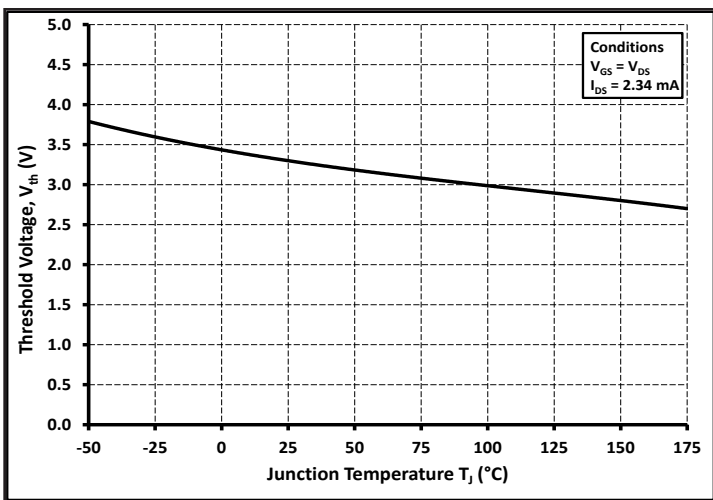


Figure 11. Threshold Voltage vs. Temperature

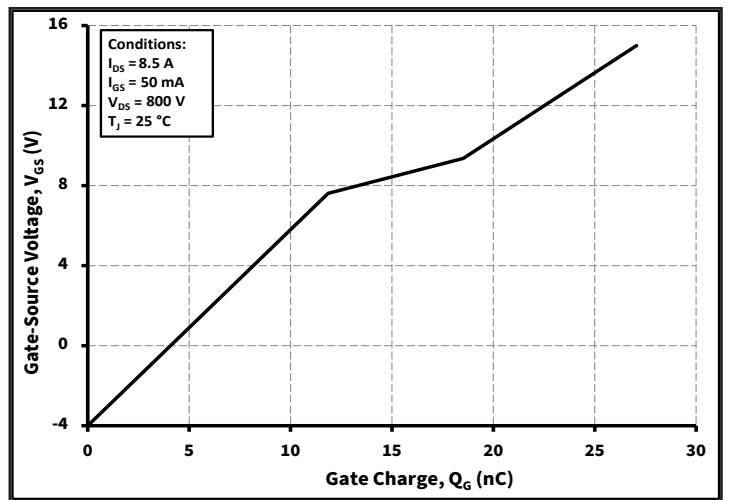


Figure 12. Gate Charge Characteristics



Typical Performance

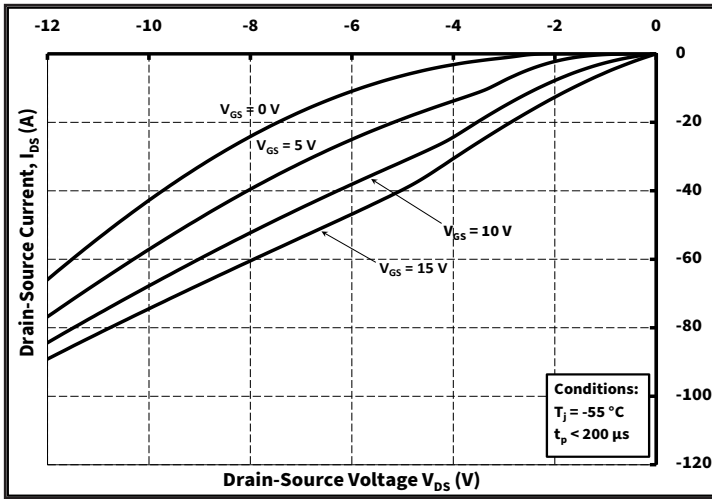


Figure 13. 3rd Quadrant Characteristic at $-55\text{ }^\circ\text{C}$

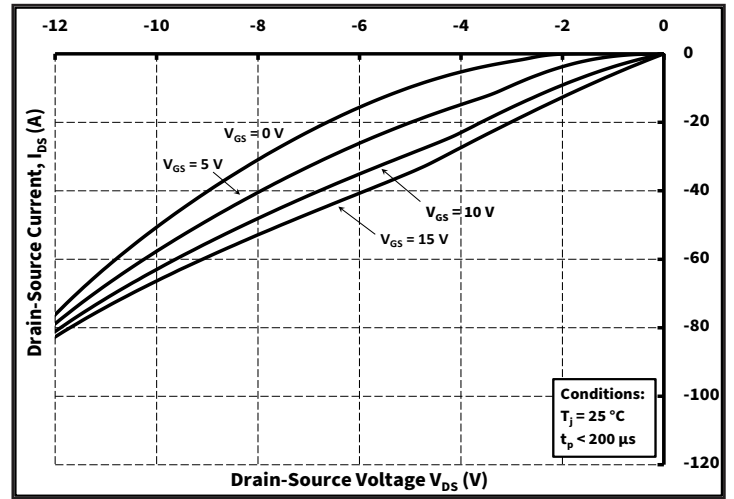


Figure 14. 3rd Quadrant Characteristic at $25\text{ }^\circ\text{C}$

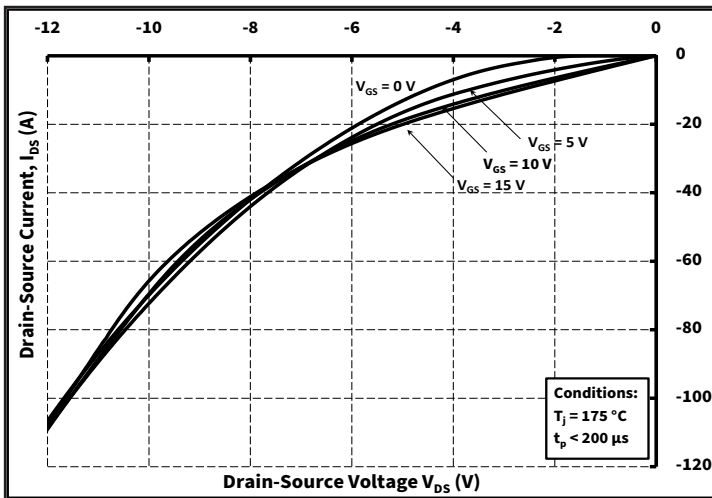


Figure 15. 3rd Quadrant Characteristic at $175\text{ }^\circ\text{C}$

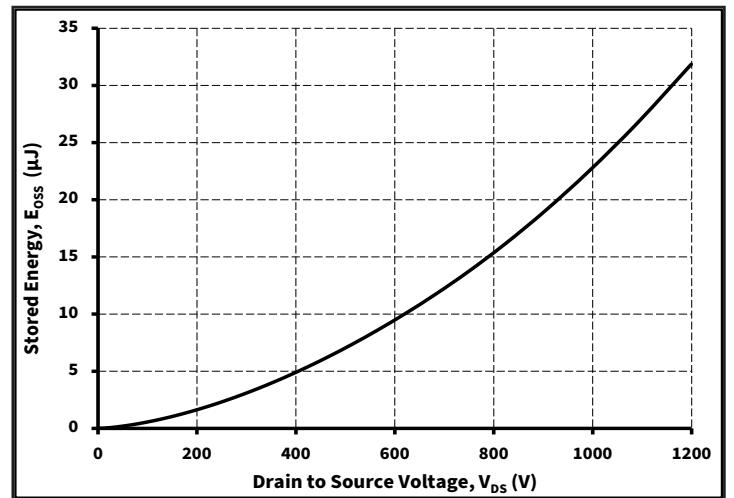


Figure 16. Output Capacitor Stored Energy

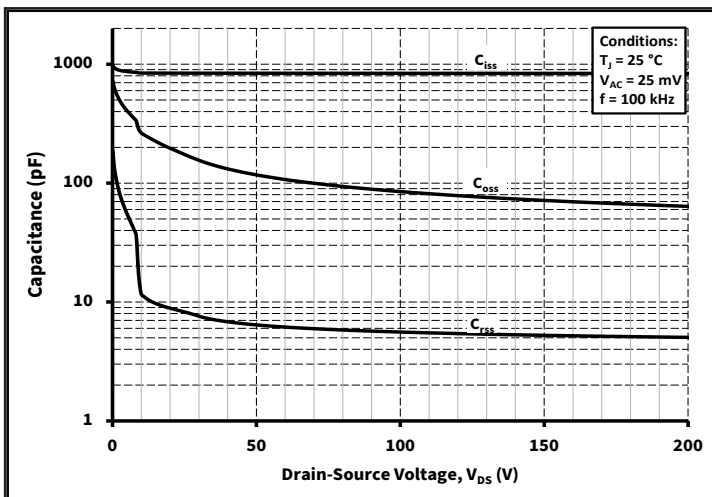


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

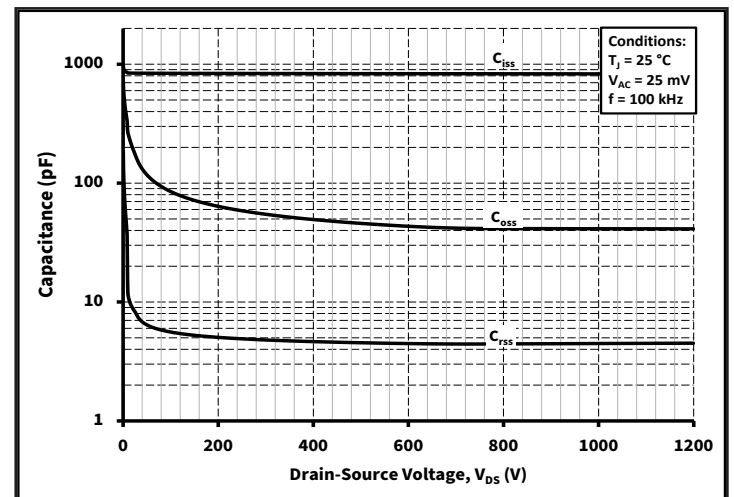


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)



Typical Performance

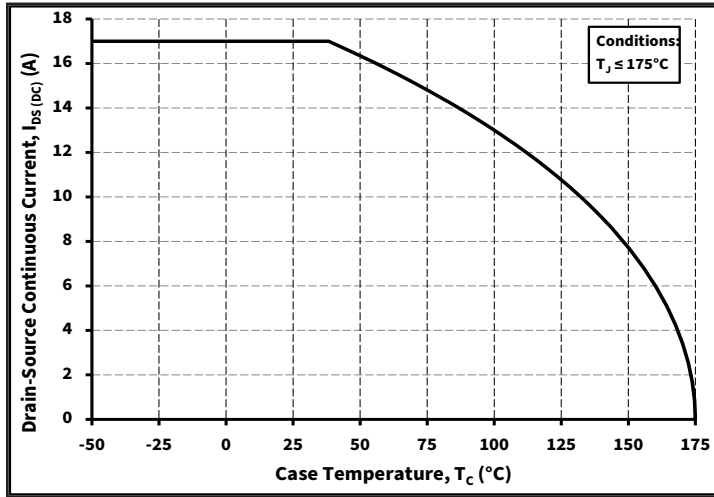


Figure 19. Continuous Drain Current Derating vs. Case Temperature

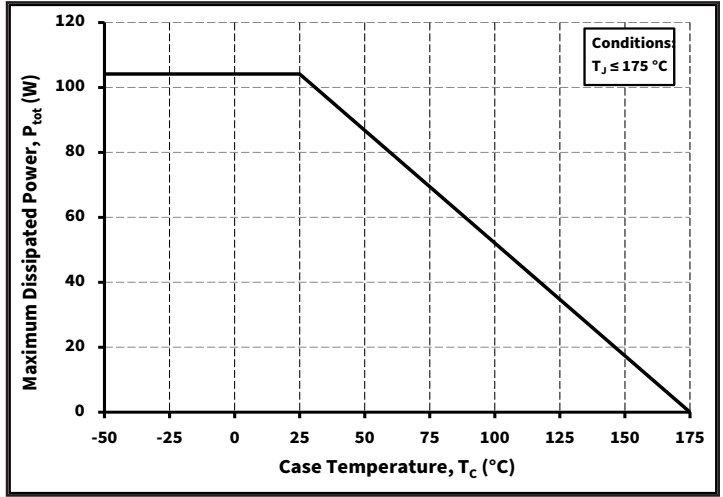


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

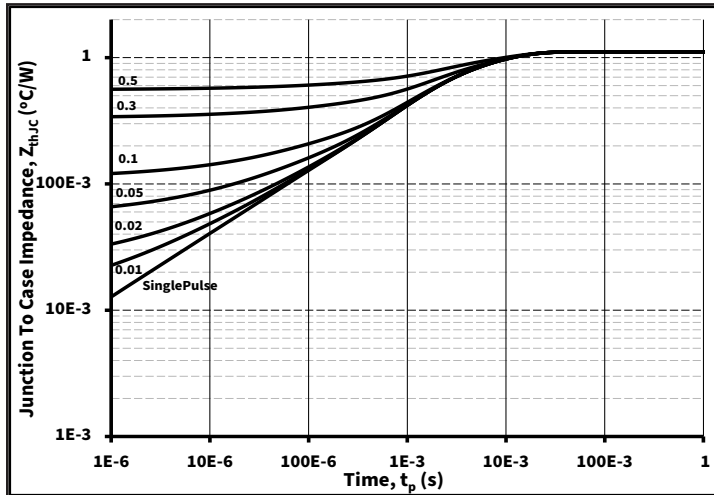


Figure 21. Transient Thermal Impedance (Junction - Case)

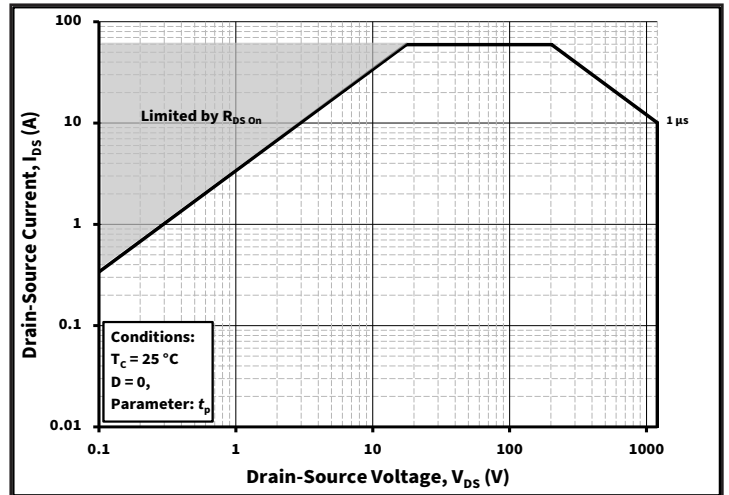


Figure 22. Safe Operating Area

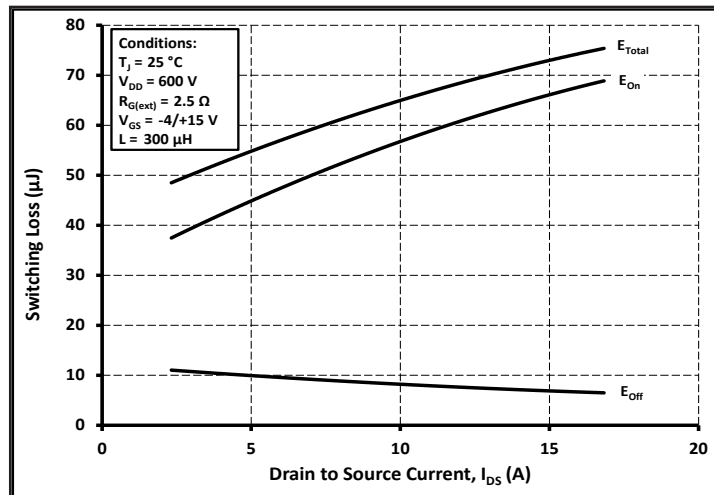


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

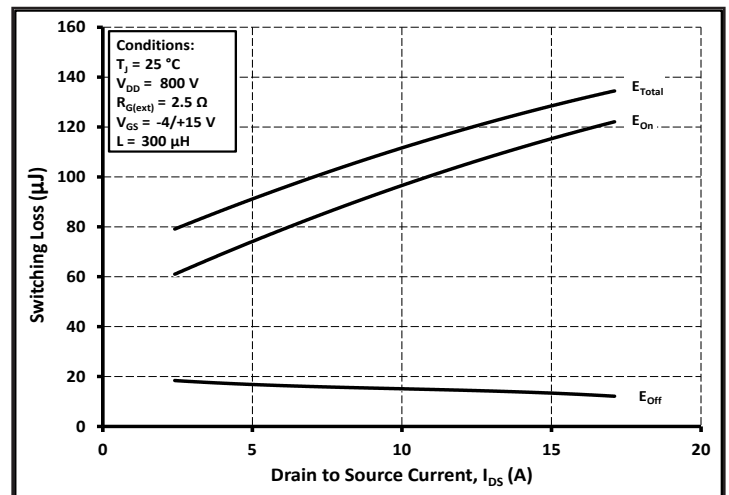


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)



Typical Performance

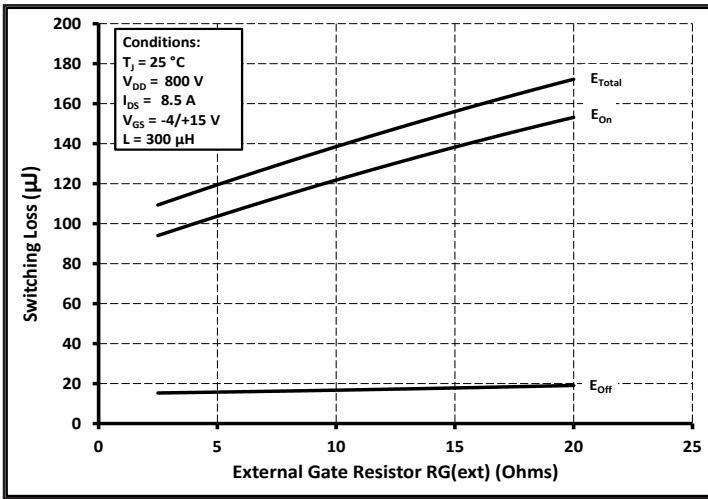


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

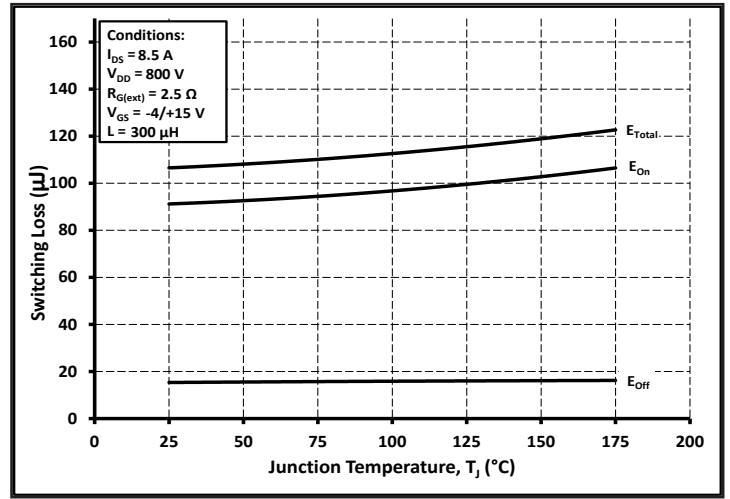


Figure 26. Clamped Inductive Switching Energy vs. Temperature

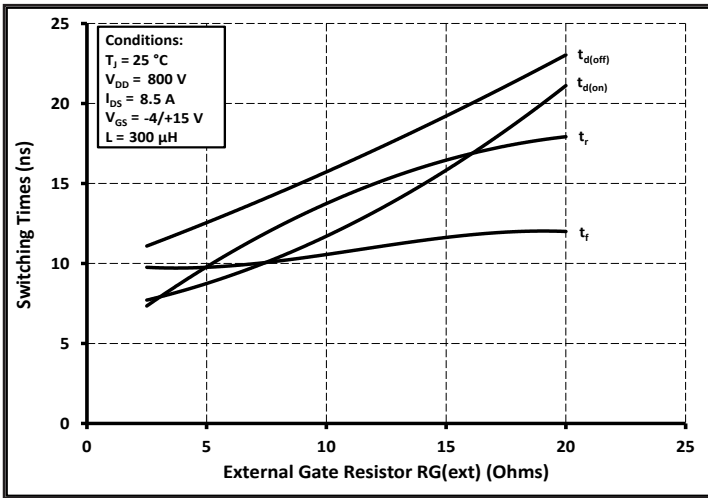


Figure 27. Switching Times vs. $R_{G(ext)}$

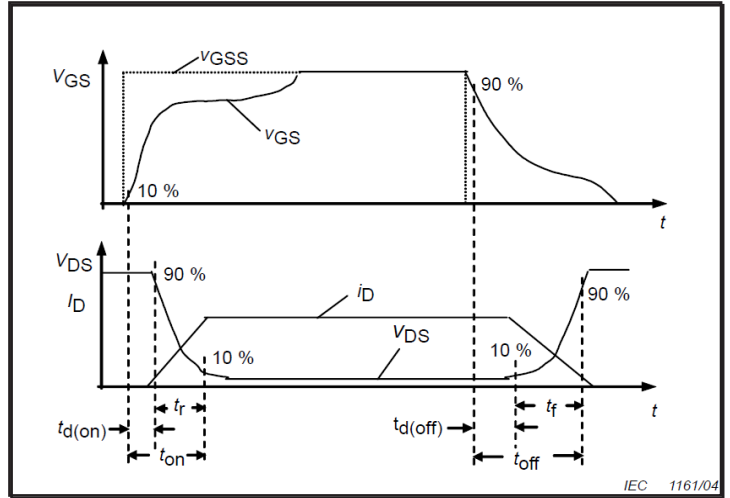


Figure 28. Switching Times Definition

Test Circuit Schematic

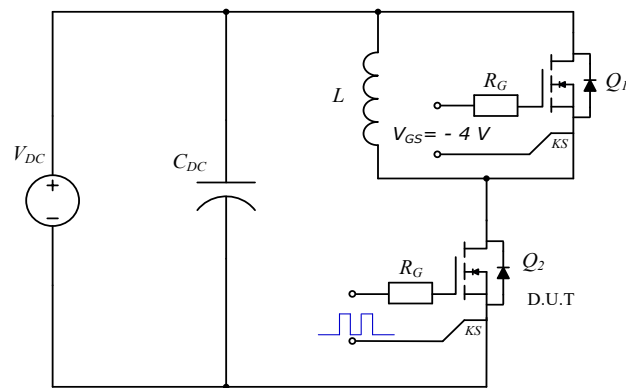
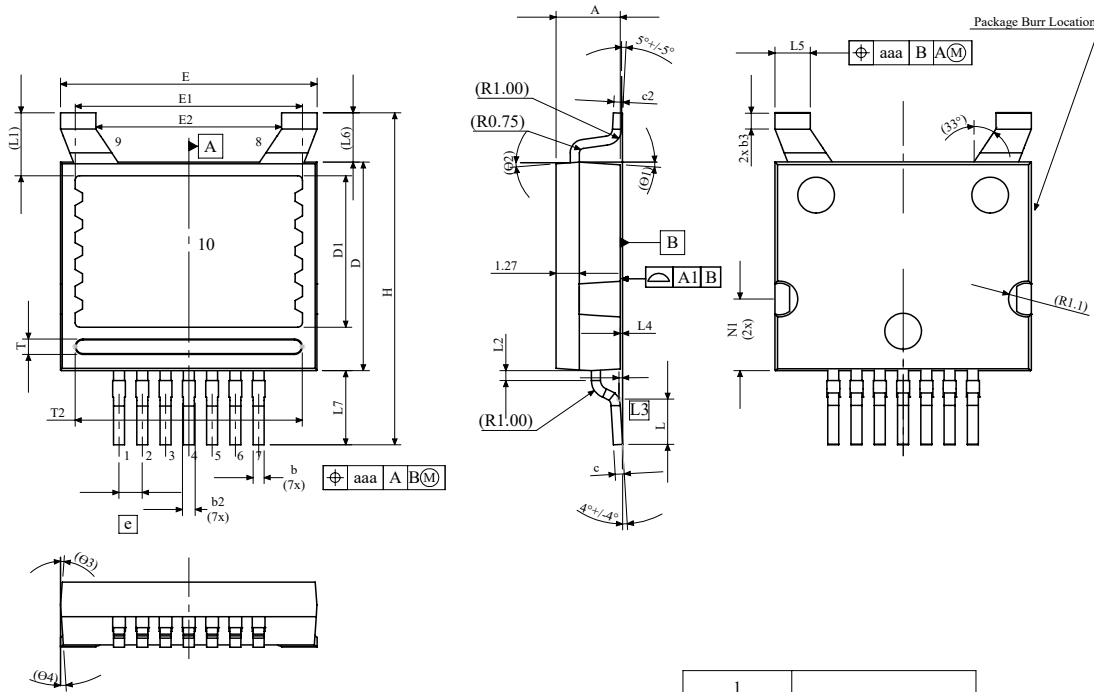


Figure 29. Clamped Inductive Switching
Waveform Test Circuit

Package Dimensions



SYMBOL	MIN (mm)	MAX (mm)
A	3.40	3.60
A1	---	0.05
b	0.50	0.70
b2	0.50	1.00
b3	0.85	1.05
c	0.40	0.60
c2	0.40	0.60
D	11.55	11.75
D1	8.30	8.50
E	13.92	14.12
E1	12.22	12.42
E2	9.92	10.22
e	BSC 1.27	
H	18.00	19.00
L	2.47	2.67
L1	BSC 3.51	
L2	0.3	0.73
L3	BSC 0.26	
L4	0.09	0.2
L5	1.83	2.13
L6	BSC 2.75	
L7	4.03	4.23
T	0.75	0.95
T2	12.30	12.50
N1	3.90	4.10
Ø1	0°	8°
Ø2	0°	8°
Ø3	0°	8°
Ø4	0°	8°
aaa	---	0.10

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

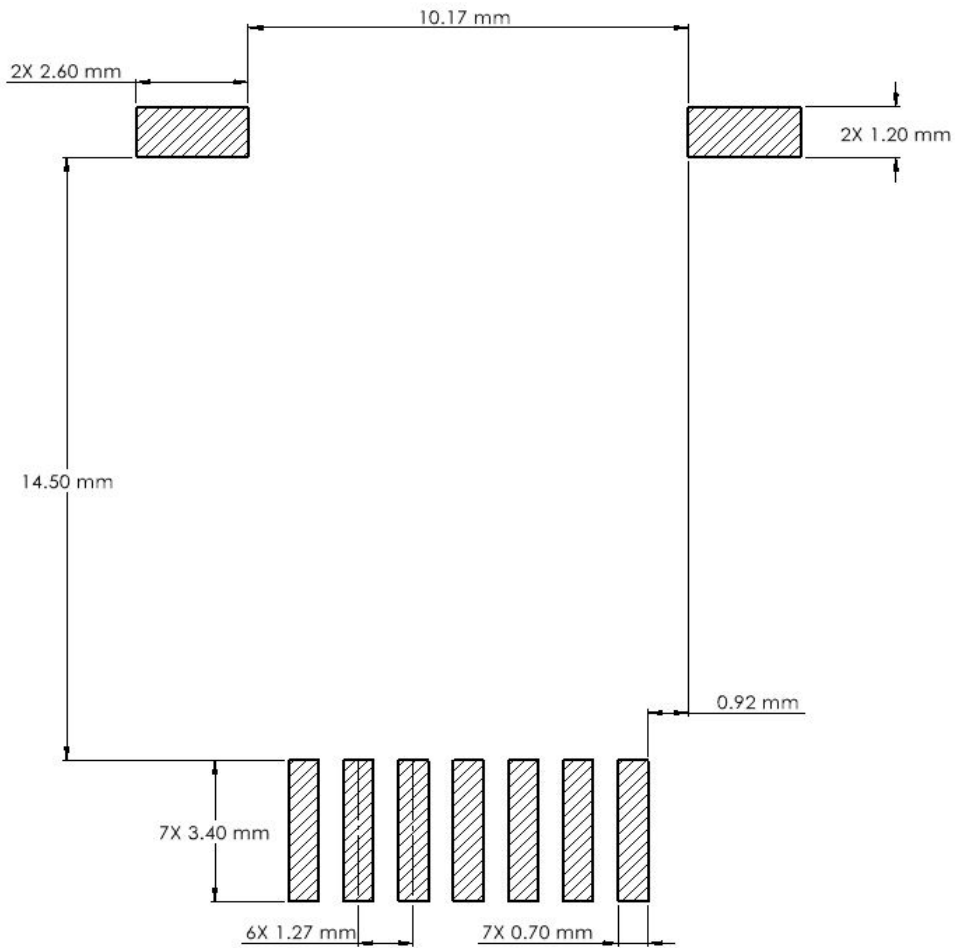
NOTE

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. 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	Description of changes
1	August - 2025	Initial Release



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