

C3M0016120K1

Silicon Carbide Power MOSFET
N-Channel Enhancement Mode

Features

- Optimized package with separate driver source pin
- Lower profile TO-247-4 package body
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant

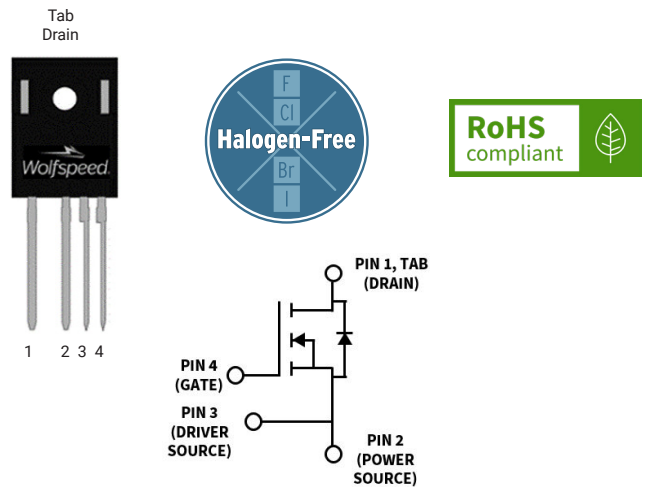
Benefits

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

Applications

- Motor Control
- EV Battery Chargers
- High Voltage DC/DC Converters
- Solar/ESS
- UPS
- Enterprise PSU

Package



Part Number	Package	Marking
C3M0016120K1	TO-247-4L LP	C3M0016120K1

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			125	A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Fig. 19
				90		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Note 2
Pulsed Drain Current	I_{DM}			321		t_{pmax} limited by T_{Jmax} $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	P_D			483	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	
Mounting Torque	M_D			1 8.8	Nm lbf-in	M3 or 6-32 screw	

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	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.5	3.8	V	$V_{DS} = V_{GS}, I_D = 22.08\text{ mA}$	Fig. 11
			2.1		V	$V_{DS} = V_{GS}, I_D = 22.08\text{ mA}, T_J = 175^\circ\text{C}$	
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		16	22	m Ω	$V_{GS} = 15\text{ V}, I_D = 80.28\text{ A}$	Fig. 4, 5, 6
			29			$V_{GS} = 15\text{ V}, I_D = 80.28\text{ A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		54		S	$V_{DS} = 20\text{ V}, I_{DS} = 80.28\text{ A}$	Fig. 7
			49			$V_{DS} = 20\text{ V}, I_{DS} = 80.28\text{ A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		6922		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		231				
C_{rss}	Reverse Transfer Capacitance		13				
E_{oss}	C_{oss} Stored Energy		127		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		268		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0 \dots 800\text{ V}$	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		404		pF		
E_{ON}	Turn-On Switching Energy (External Diode)		1287		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 80.28\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 59\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = External SiC DIODE	Fig. 26, 28
E_{OFF}	Turn Off Switching Energy (External Diode)		805				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		2552		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 80.28\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 59\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode	Fig. 26, 28
E_{OFF}	Turn-Off Switching Energy (Body Diode FWD)		788				
$t_{d(on)}$	Turn-On Delay Time		19		ns	$V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 80.28\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		40				
$t_{d(off)}$	Turn-Off Delay Time		62				
t_f	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		2.6		Ω	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
Q_{gs}	Gate to Source Charge		70		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 80.28\text{ A}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		65				
Q_g	Total Gate Charge		223				

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as C_{oss} while V_{ds} is rising from 0 to 500V
 $C_{o(tr)}$, a lumped capacitance that gives same charging time as C_{oss} while V_{ds} is rising from 0 to 500V

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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V _{SD}	Diode Forward Voltage	4.9		V	V _{GS} = -4 V, I _{SD} = 40.14 A, T _J = 25 °C	Fig. 8, 9, 10
		4.4		V	V _{GS} = -4 V, I _{SD} = 40.14 A, T _J = 175 °C	
I _S	Continuous Diode Forward Current		88	A	V _{GS} = -4 V, T _c = 25°C	
I _{SM}	Diode pulse Current		321	A	V _{GS} = -4 V, pulse width t _p limited by T _{Jmax}	
t _{rr}	Reverse Recover time	32		ns	V _{GS} = -4 V, I _{SD} = 80.28 A, V _R = 800 V dif/dt = 5180 A/μs, T _J = 175 °C	
Q _{rr}	Reverse Recovery Charge	1665		nC		
I _{rrm}	Peak Reverse Recovery Current	82		A		
t _{rr}	Reverse Recover time	46		ns	V _{GS} = -4 V, I _{SD} = 80.28 A, V _R = 800 V dif/dt = 2760 A/μs, T _J = 175 °C	
Q _{rr}	Reverse Recovery Charge	1365		nC		
I _{rrm}	Peak Reverse Recovery Current	45		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
R _{θJC}	Thermal Resistance from Junction to Case	0.23	°C/W		Fig. 21

Typical Performance

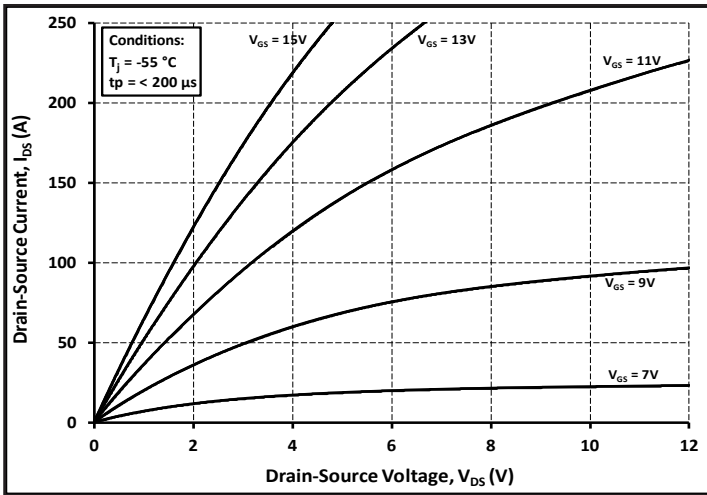
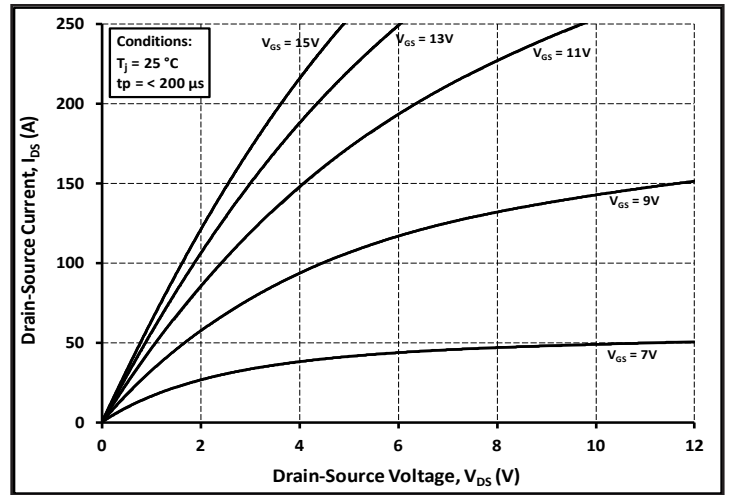
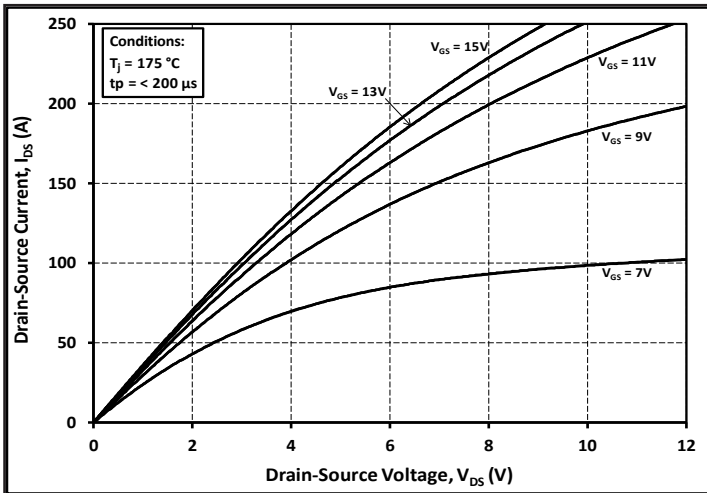
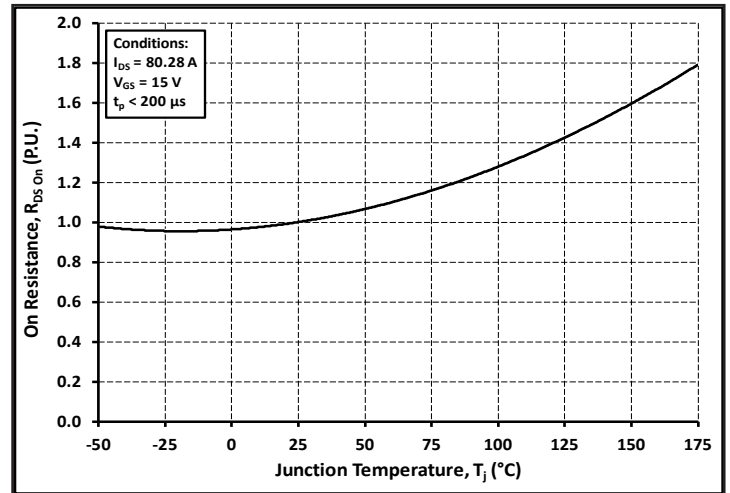
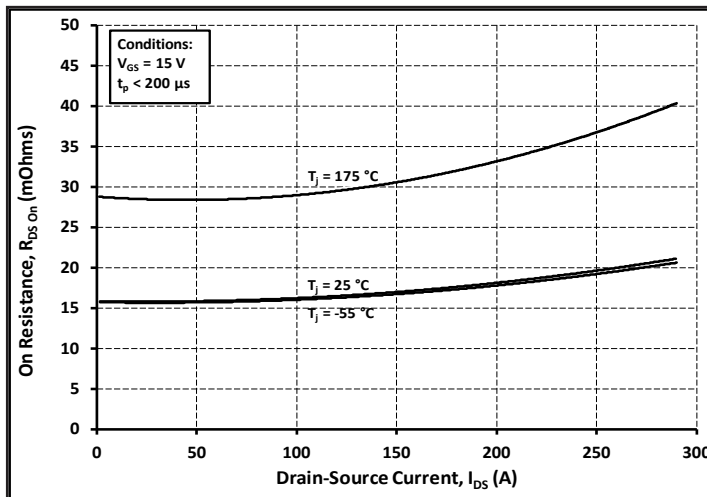
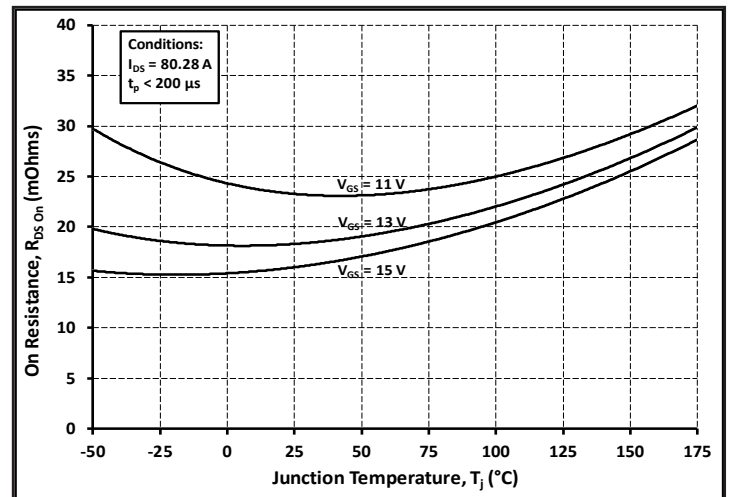
Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$ Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$ Figure 3. Output Characteristics $T_J = 175\text{ }^{\circ}\text{C}$ 

Figure 4. Normalized On-Resistance vs. Temperature

Figure 5. On-Resistance vs. Drain Current
For Various TemperaturesFigure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

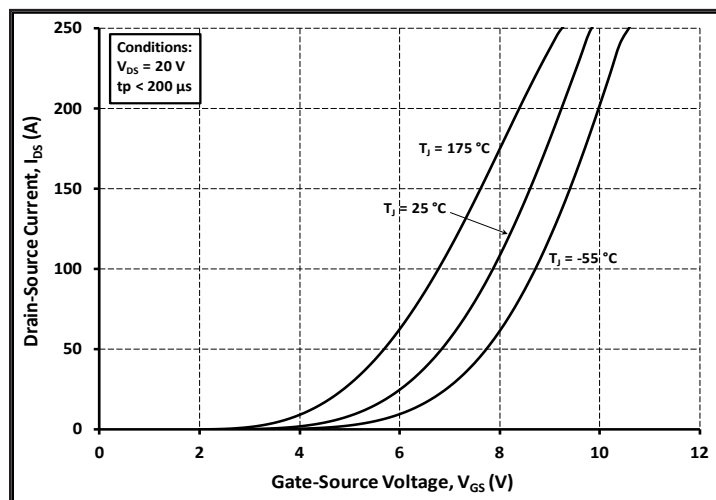


Figure 7. Transfer Characteristic for Various Junction Temperatures

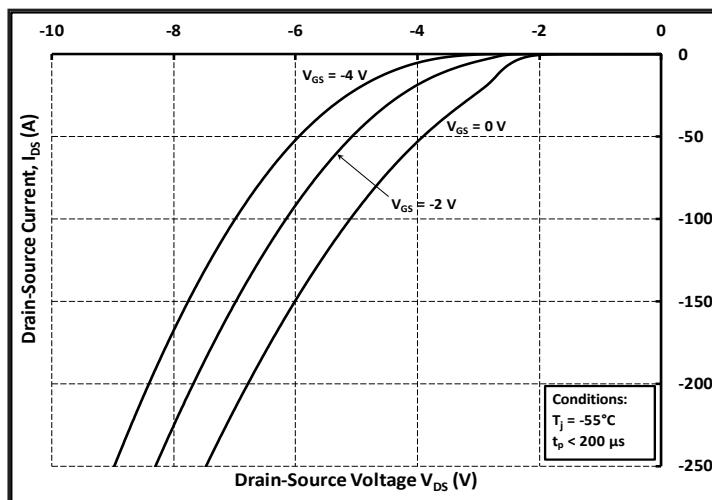


Figure 8. Body Diode Characteristic at -55 °C

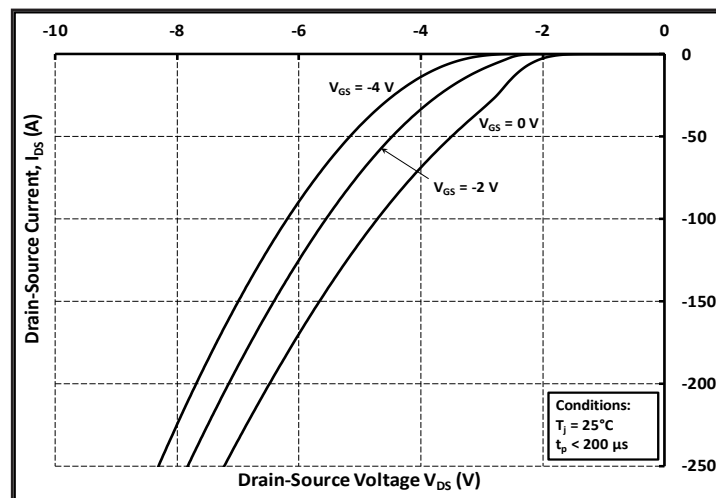


Figure 9. Body Diode Characteristic at 25 °C

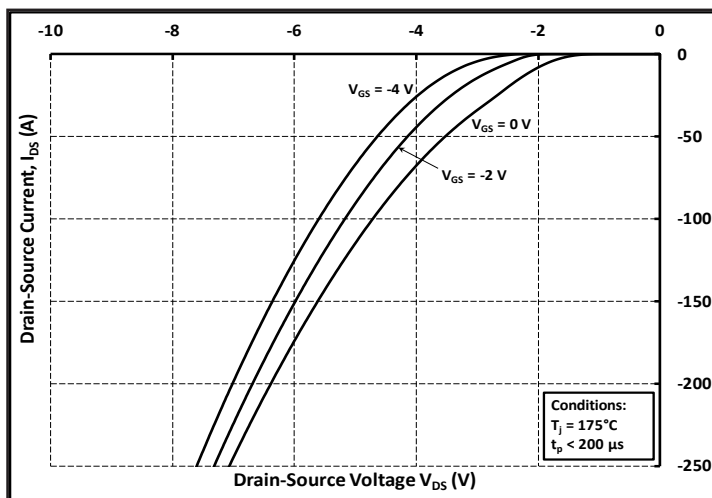


Figure 10. Body Diode Characteristic at 175 °C

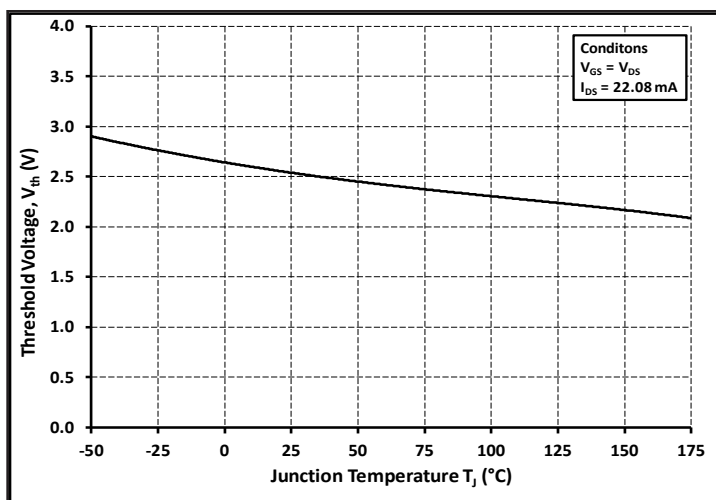


Figure 11. Threshold Voltage vs. Temperature

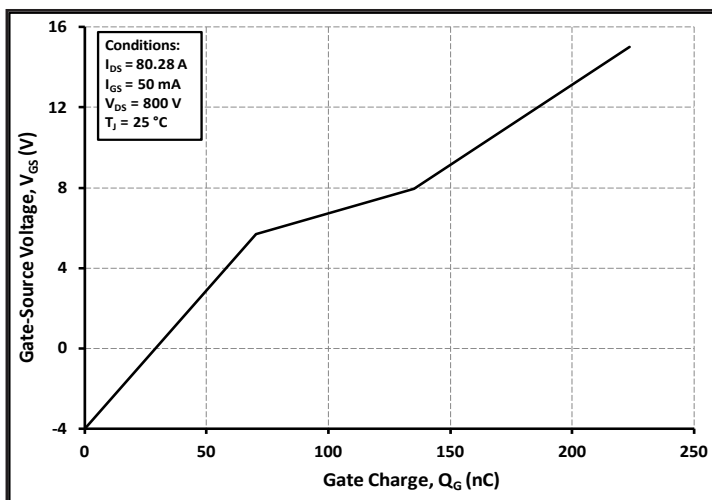


Figure 12. Gate Charge Characteristics

Typical Performance

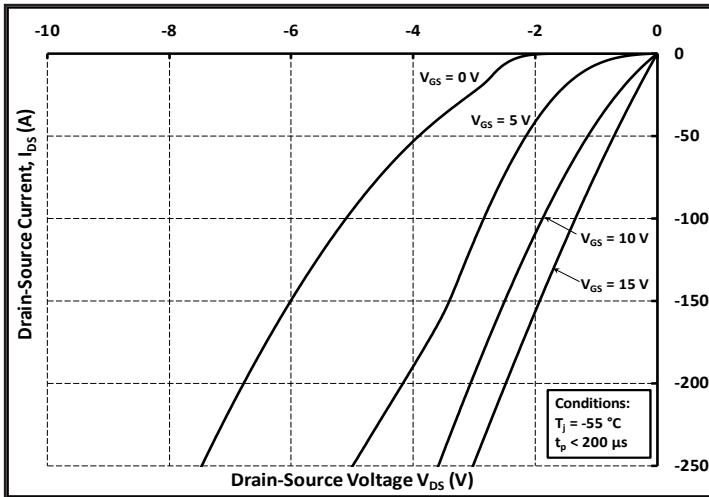
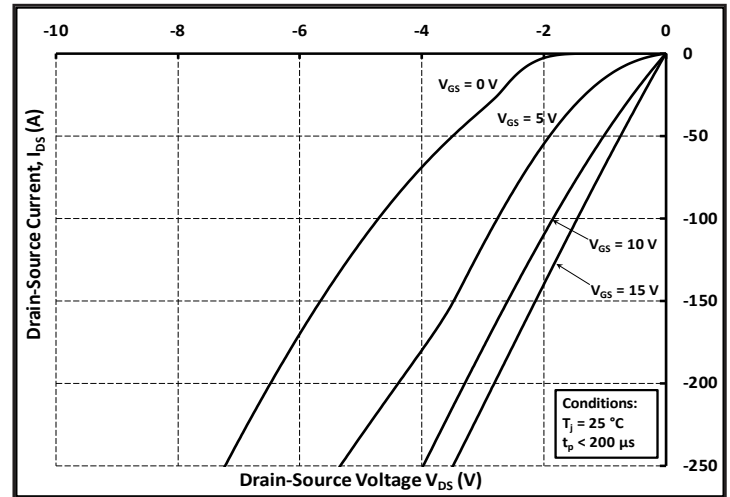
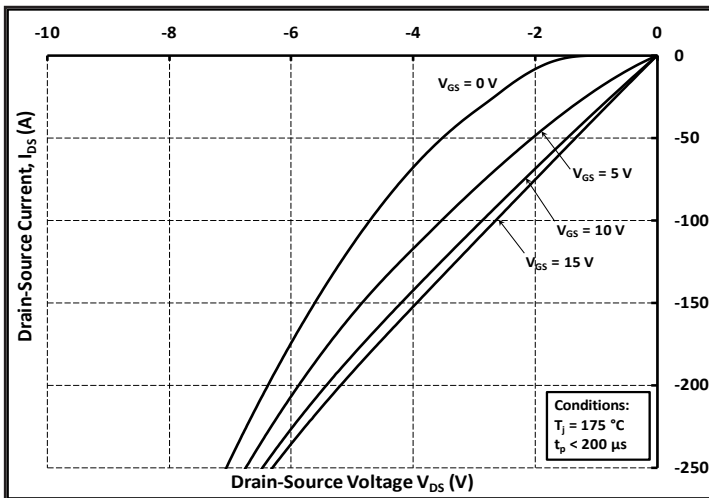
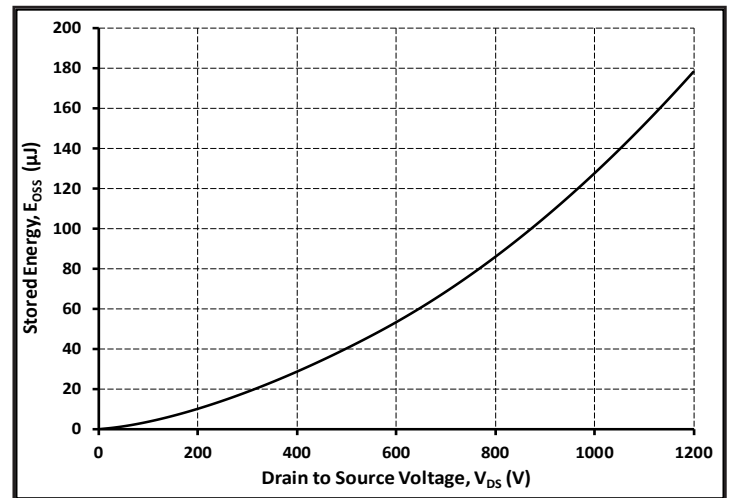
Figure 13. 3rd Quadrant Characteristic at -55°C Figure 14. 3rd Quadrant Characteristic at 25°C Figure 15. 3rd Quadrant Characteristic at 175°C 

Figure 16. Output Capacitor Stored Energy

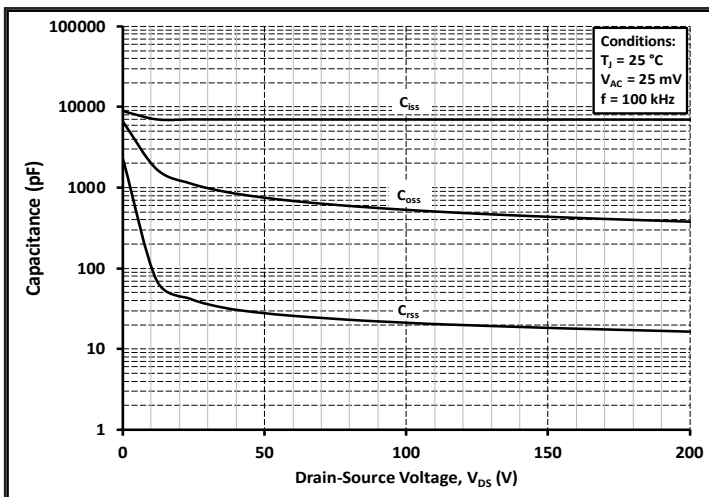


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

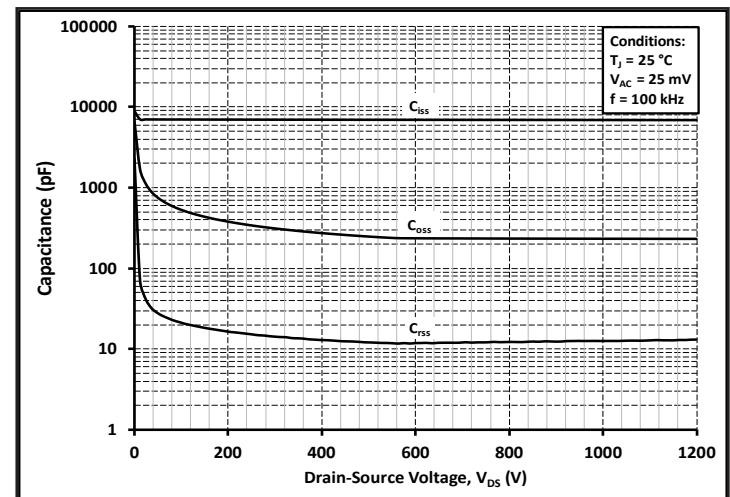


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

Typical Performance

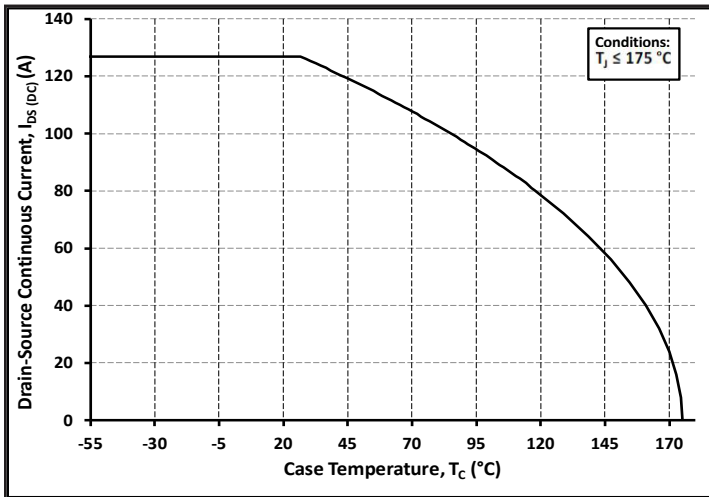


Figure 19. Continuous Drain Current Derating vs. Case Temperature

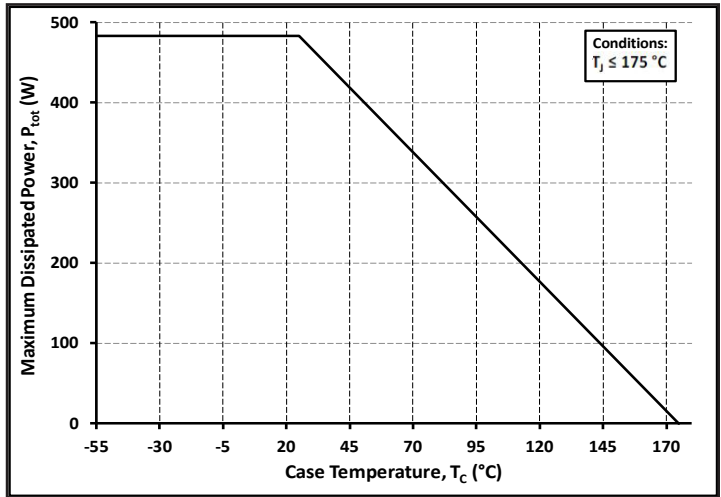


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

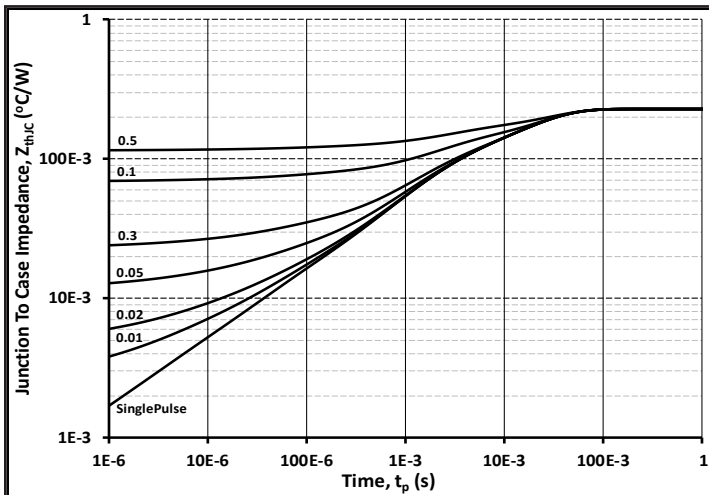


Figure 21. Transient Thermal Impedance (Junction - Case)

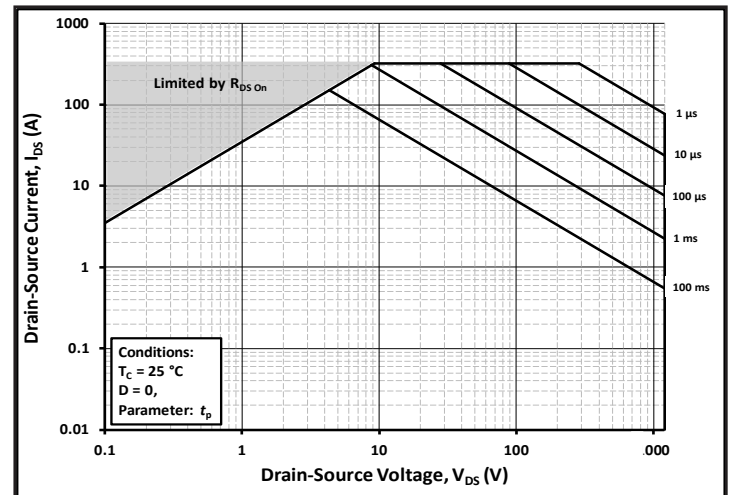
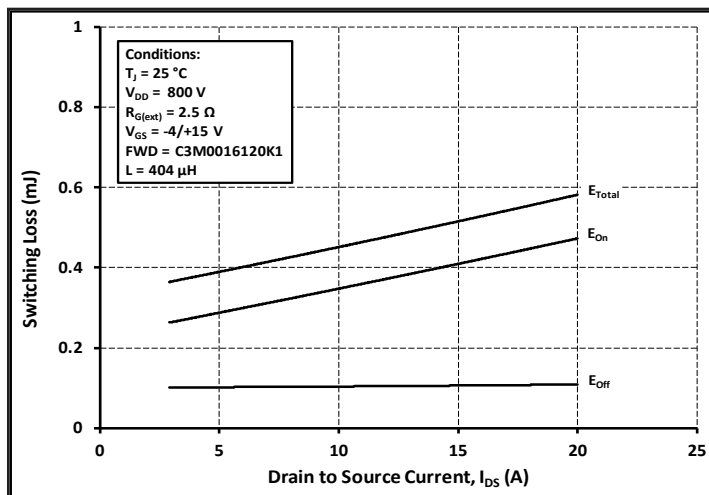
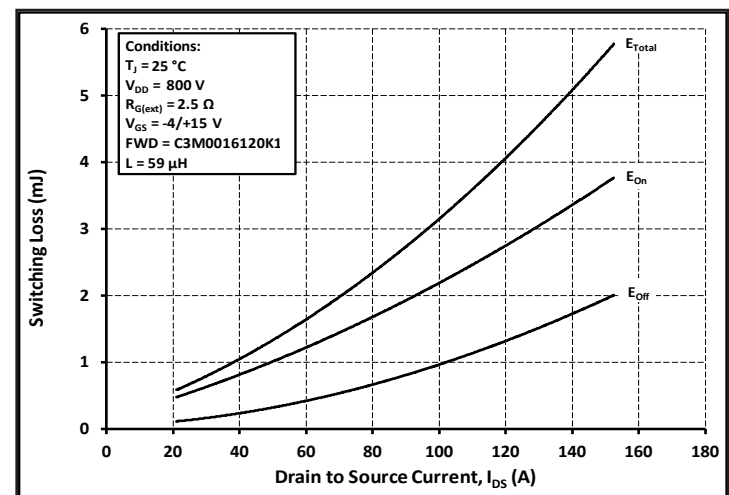


Figure 22. Safe Operating Area

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

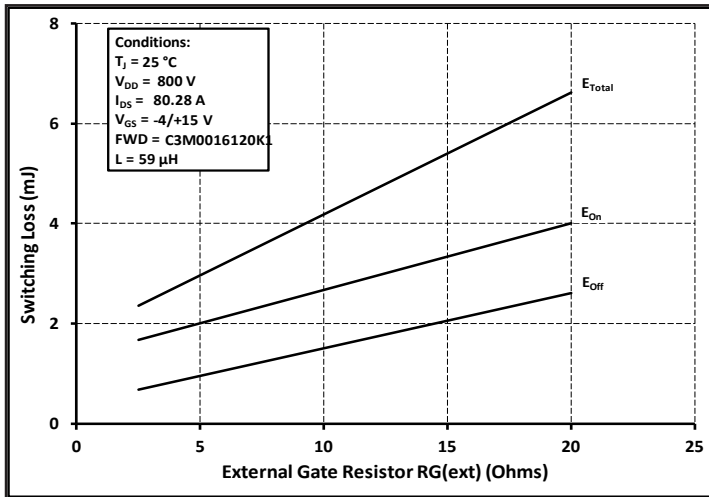
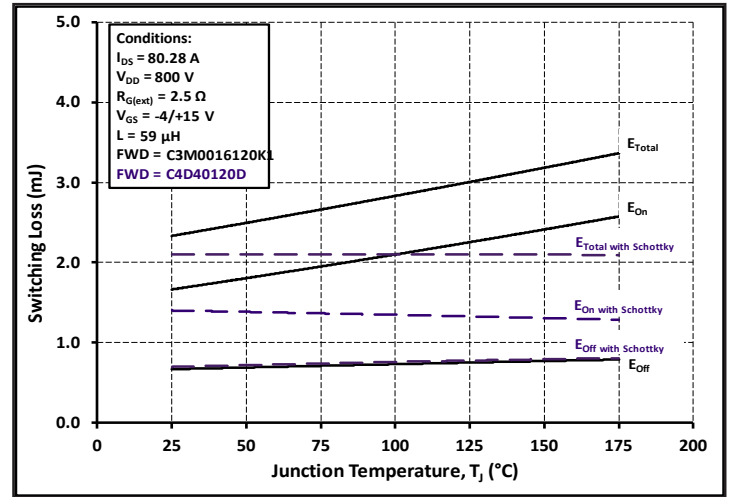
Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$ 

Figure 26. Clamped Inductive Switching Energy vs. Temperature

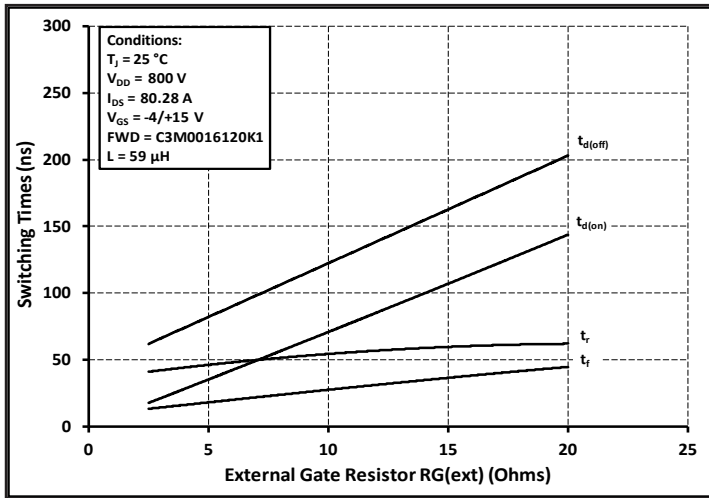
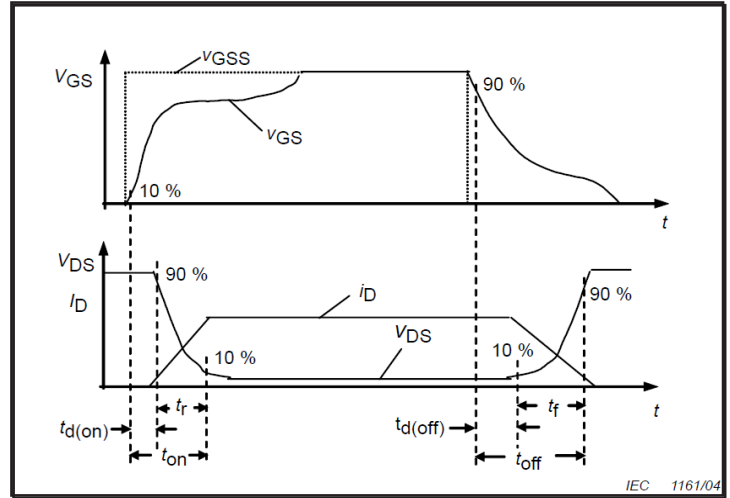
Figure 27. Switching Times vs. $R_{G(ext)}$ 

Figure 28. Switching Times Definition

Test Circuit Schematic

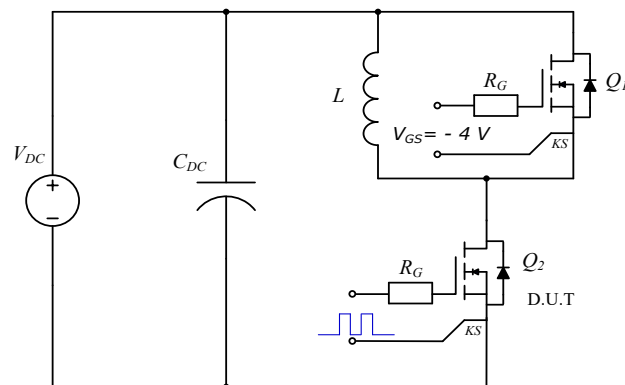
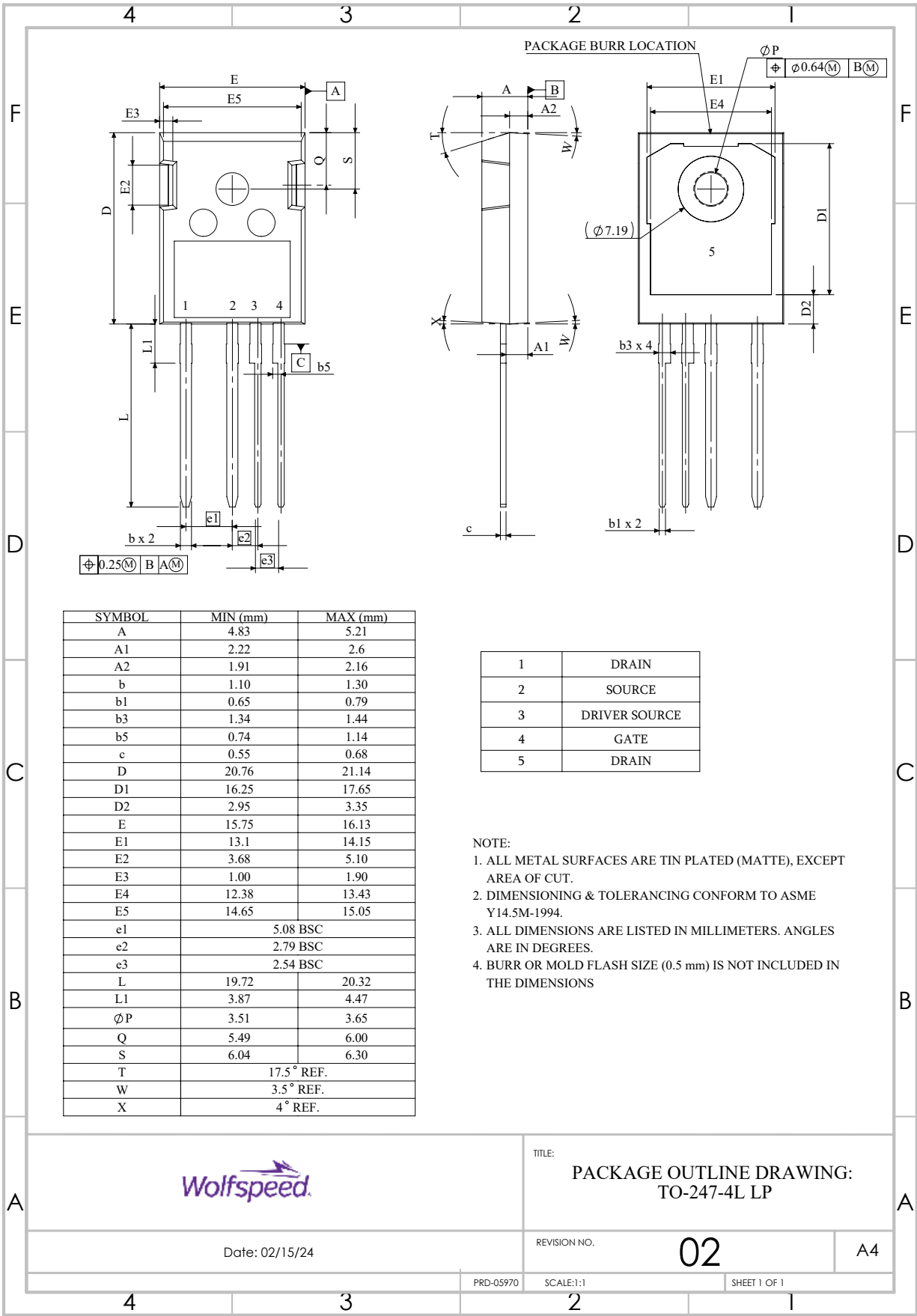


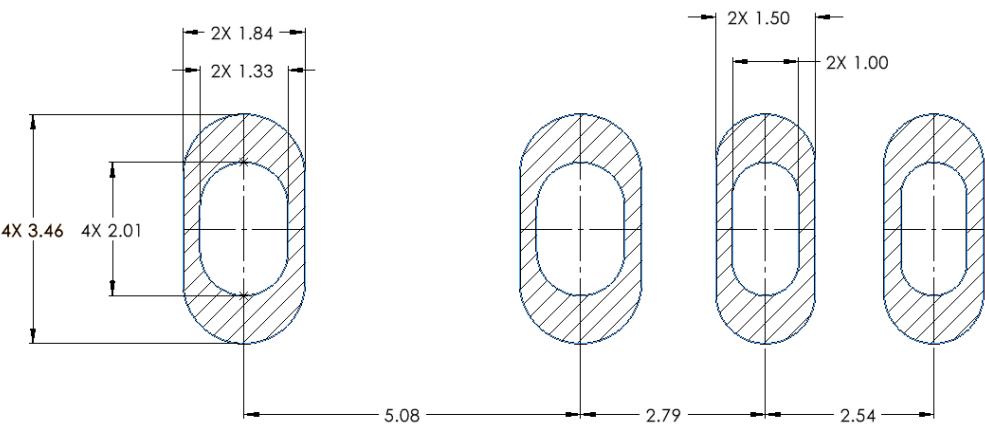
Figure 29. Clamped Inductive Switching
Waveform Test Circuit

Package Dimensions



Recommended Solder Pad Layout

All dimensions in mm



Revision history

Document Version	Date of release	Descriptiion of changes
1.0	April-2024	Initial datasheet



Notes & Disclaimer

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