



Features

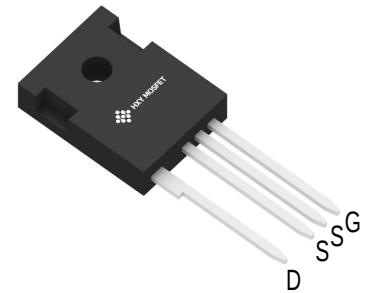
- 3rd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant

Benefits

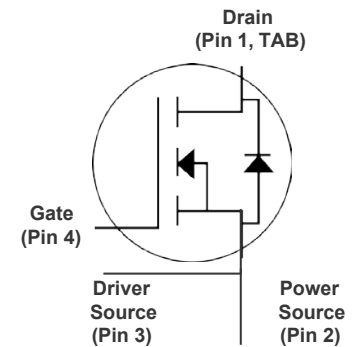
- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Applications

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



TO-247-4L
(TO-247-4)



Ordering Part Number	Package	Qty(PCS)
NVH4L160N120SC1	TO247-4L(TO-247-4)	30

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

Symbol	Parameter		Value	Unit	Note
V_{DSmax}	Drain - Source Voltage		1200	V	
V_{GSmax}	Gate - Source Voltage		-8/+19	V	Note: 1
I_D	Continuous Drain Current, $V_{GS} = 15\text{ V}$	$T_C = 25^\circ\text{C}$	17.9	A	Fig. 19 Note: 2
		$T_C = 100^\circ\text{C}$	13.5		
$I_{D(pulse)}$	Pulsed Drain Current, Pulse width t_p limited by T_{jmax}		34	A	Fig. 22
P_D	Power Dissipation, $T_c=25^\circ\text{C}$, $T_j = 175^\circ\text{C}$		103	W	Fig. 20 Note: 2
T_J, T_{stg}	Operating Junction and Storage Temperature		-55 to +175	$^\circ\text{C}$	
T_L	Solder Temperature, 1.6mm (0.063") from case for 10s		260	$^\circ\text{C}$	
M_d	Mounting Torque , M3 or 6-32 screw		1	Nm	
			8.8	lbf-in	

Note (1): Recommended turn off / turn on gate voltage $V_{GS} = -4\text{V} \dots 0\text{V} / +15\text{V}$ 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	2.8	3.6	V	$V_{DS} = V_{GS}, I_D = 2.33\text{ mA}$	Fig. 11
			2.2		V	$V_{DS} = V_{GS}, I_D = 2.33\text{ mA}, T_J = 175^\circ\text{C}$	
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		159	208	m Ω	$V_{GS} = 15\text{ V}, I_D = 8.5\text{ A}$	Fig. 4, 5, 6
			280			$V_{GS} = 15\text{ V}, I_D = 8.5\text{ A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		4.9		S	$V_{DS} = 20\text{ V}, I_{DS} = 8.5\text{ A}$	Fig. 7
			4.6			$V_{DS} = 20\text{ V}, I_{DS} = 8.5\text{ A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		730		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to }1000\text{ V}$ $F = 1\text{ MHz}$ $V_{AC} = 25\text{ mV}$	Fig. 17, 18
C_{oss}	Output Capacitance		31				
C_{rss}	Reverse Transfer Capacitance		2				
E_{oss}	C_{oss} Stored Energy		17		μJ		Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		36		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0 \dots 800\text{ V}$	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		55		pF		
E_{ON}	Turn-On Switching Energy (External Diode)		81		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 8.5\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 404\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = External SiC DIODE	Fig. 26, 28
E_{OFF}	Turn Off Switching Energy (External Diode)		16				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		134		μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 8.5\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 404\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode	Fig. 26, 28
E_{OFF}	Turn-Off Switching Energy (Body Diode FWD)		15				
$t_{d(on)}$	Turn-On Delay Time		8		ns	$V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 8.5\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		9				
$t_{d(off)}$	Turn-Off Delay Time		13				
t_f	Fall Time		12				
$R_{G(int)}$	Internal Gate Resistance		6.5		Ω	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
Q_{gs}	Gate to Source Charge		10		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		12				
Q_g	Total Gate Charge		32				

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	4.8		V	$V_{GS} = -4\text{ V}$, $I_{SD} = 4.25\text{ A}$, $T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.2		V	$V_{GS} = -4\text{ V}$, $I_{SD} = 4.25\text{ A}$, $T_J = 175^\circ\text{C}$	
I_S	Continuous Diode Forward Current		17	A	$V_{GS} = -4\text{ V}$, $T_c = 25^\circ\text{C}$	
$I_{S, \text{pulse}}$	Diode pulse Current		34	A	$V_{GS} = -4\text{ V}$, pulse width t_p limited by T_{Jmax}	
t_{rr}	Reverse Recover time	9		ns	$V_{GS} = -4\text{ V}$, $I_{SD} = 8.5\text{ A}$, $V_R = 800\text{ V}$ $\text{dif}/\text{dt} = 6080\text{ A}/\mu\text{s}$, $T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	169		nC		
I_{rm}	Peak Reverse Recovery Current	27		A		
t_{rr}	Reverse Recover time	23		ns	$V_{GS} = -4\text{ V}$, $I_{SD} = 8.5\text{ A}$, $V_R = 800\text{ V}$ $\text{dif}/\text{dt} = 1850\text{ A}/\mu\text{s}$, $T_J = 175^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	147		nC		
I_{rm}	Peak Reverse Recovery Current	11		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	1.13	1.45	$^\circ\text{C}/\text{W}$		Fig. 21



Typical Performance

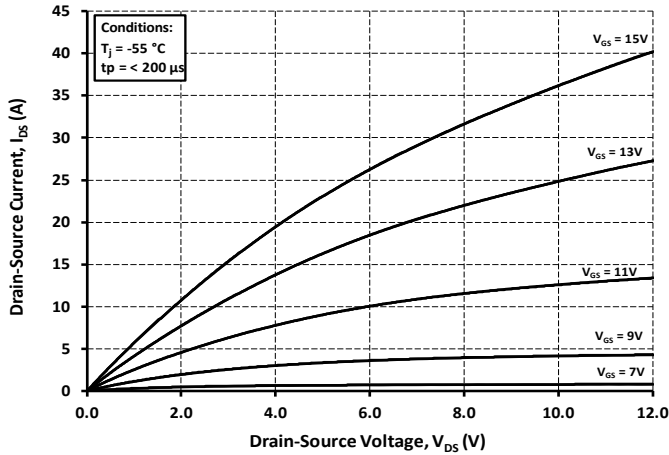


Figure 1. Output Characteristics $T_j = -55^\circ\text{C}$

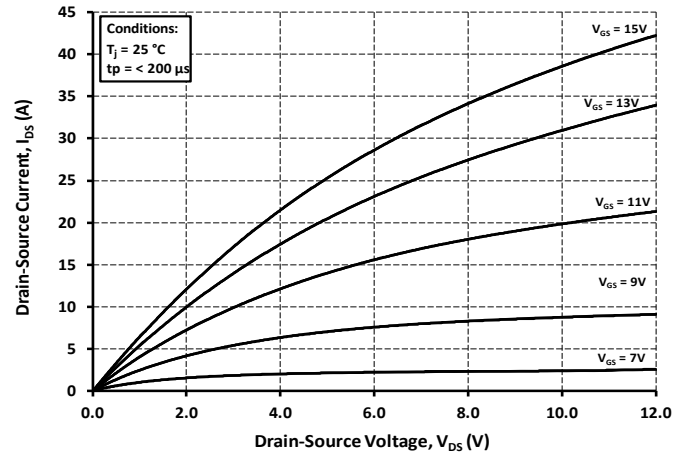


Figure 2. Output Characteristics $T_j = 25^\circ\text{C}$

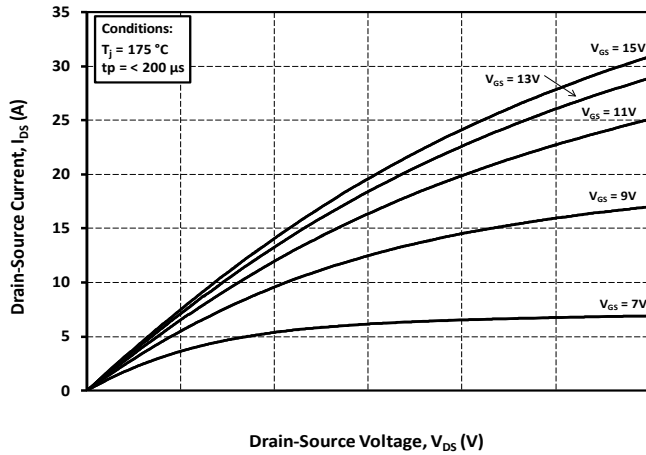


Figure 3. Output Characteristics $T_j = 175^\circ\text{C}$

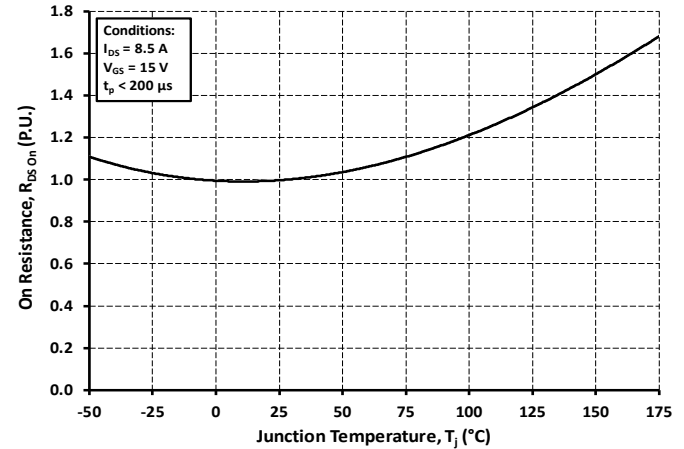


Figure 4. Normalized On-Resistance vs. Temperature

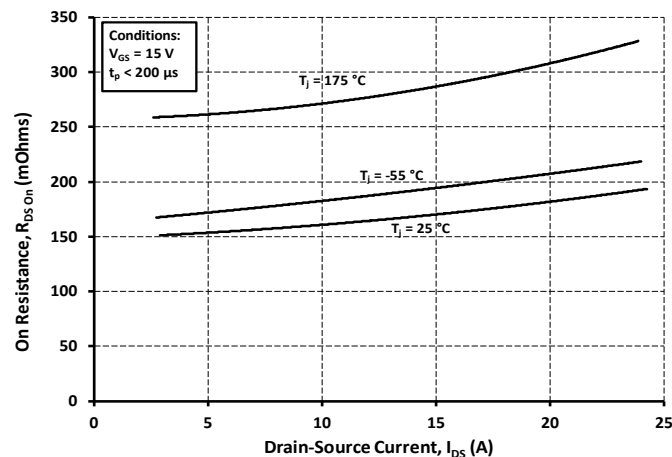


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

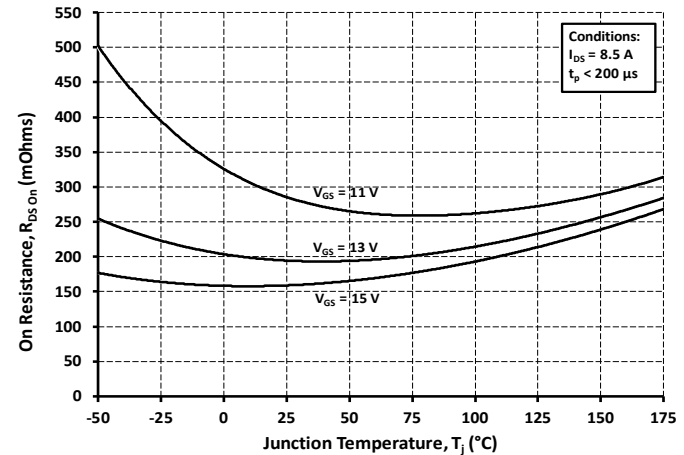


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage



Typical Performance

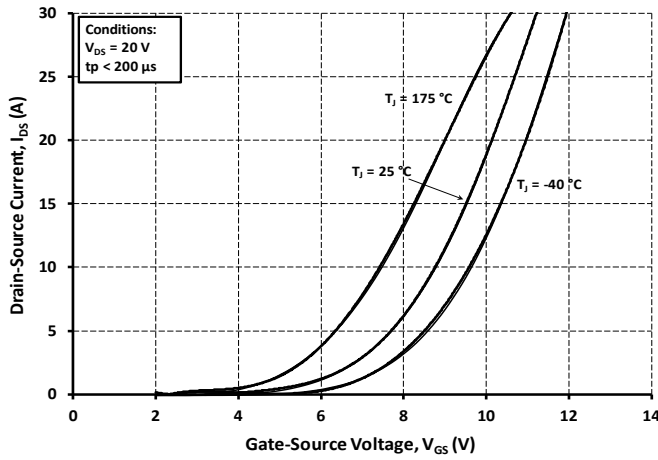


Figure 7. Transfer Characteristic for Various Junction Temperatures

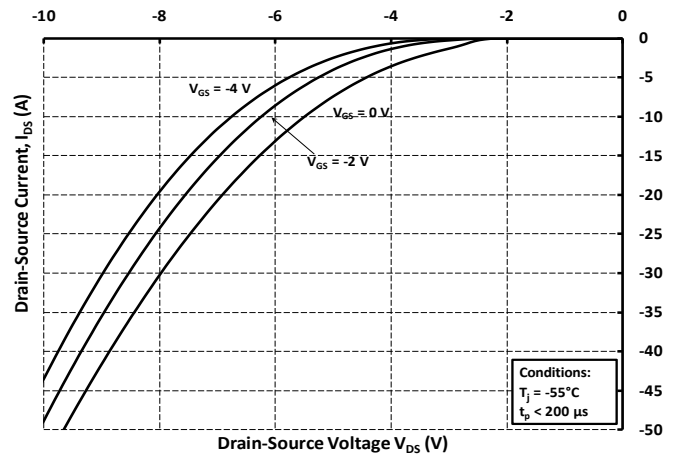


Figure 8. Body Diode Characteristic at -55°C

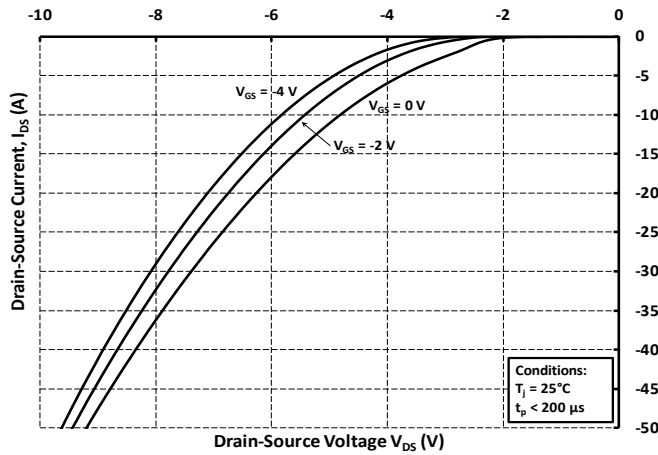


Figure 9. Body Diode Characteristic at 25°C

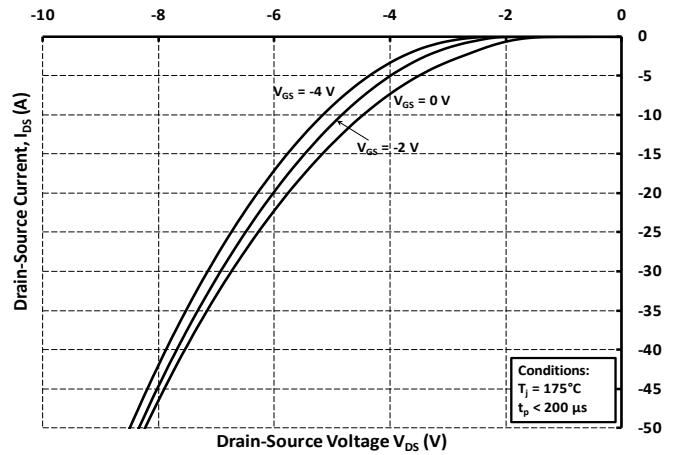


Figure 10. Body Diode Characteristic at 175°C

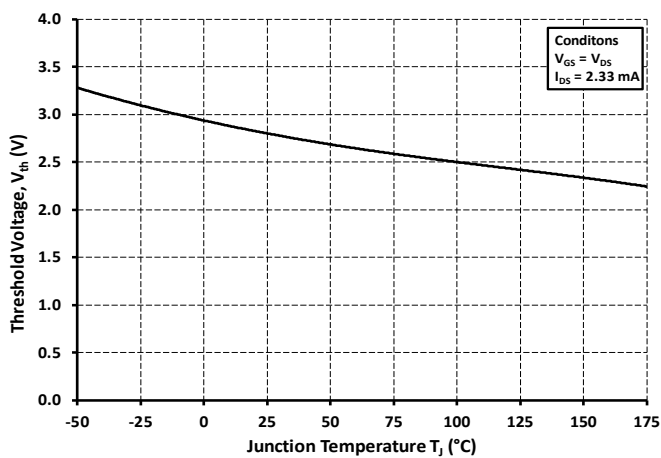


Figure 11. Threshold Voltage vs. Temperature

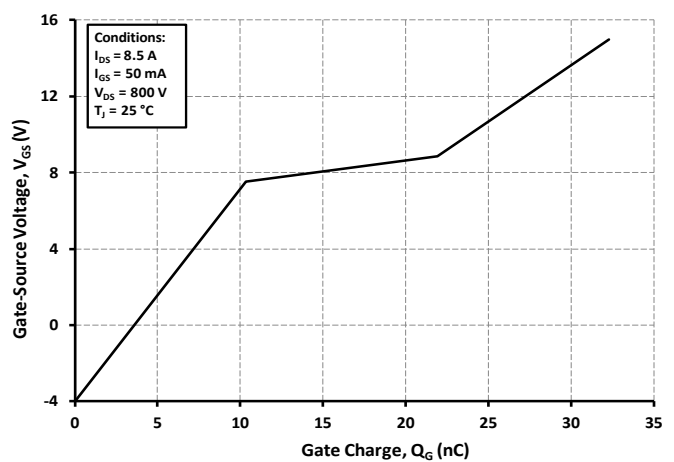


Figure 12. Gate Charge Characteristics



Typical Performance

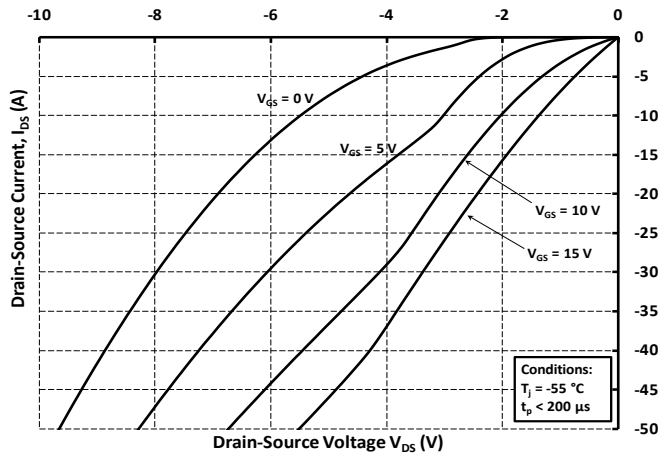


Figure 13. 3rd Quadrant Characteristic at -55 °C

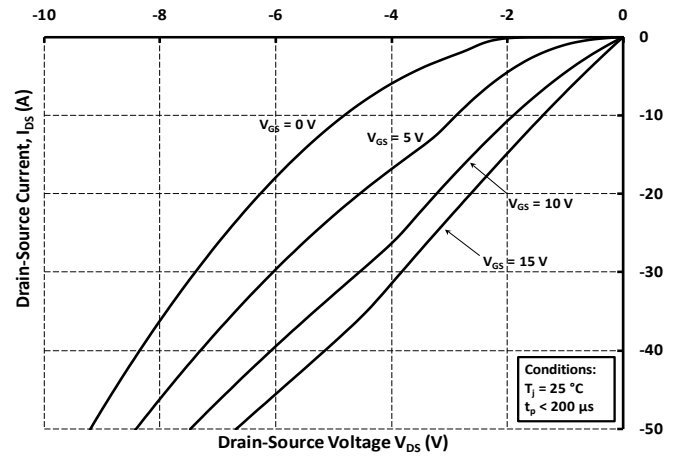


Figure 14. 3rd Quadrant Characteristic at 25 °C

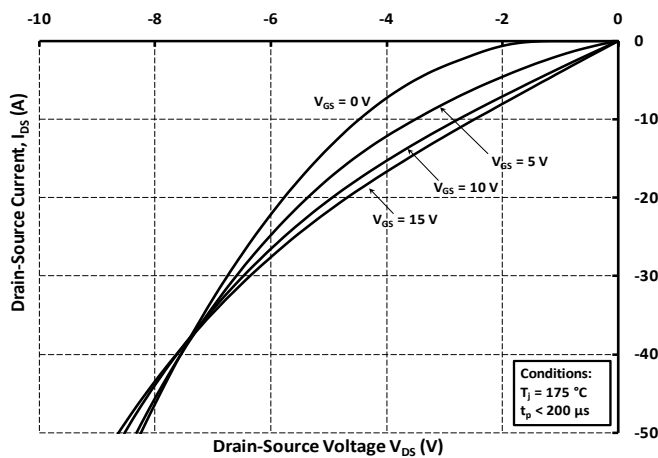


Figure 15. 3rd Quadrant Characteristic at 175 °C

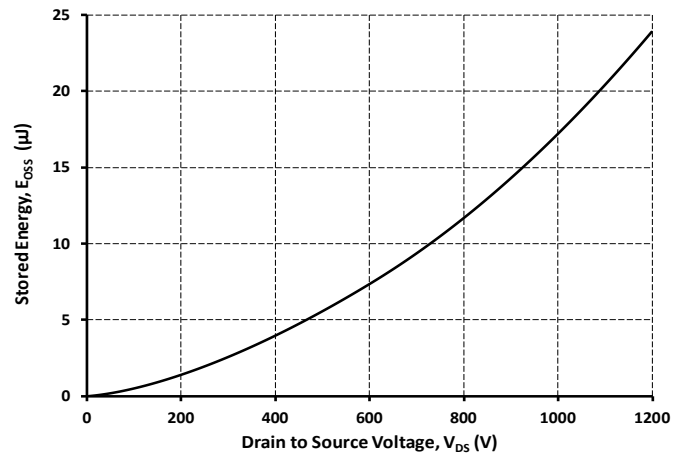


Figure 16. Output Capacitor Stored Energy

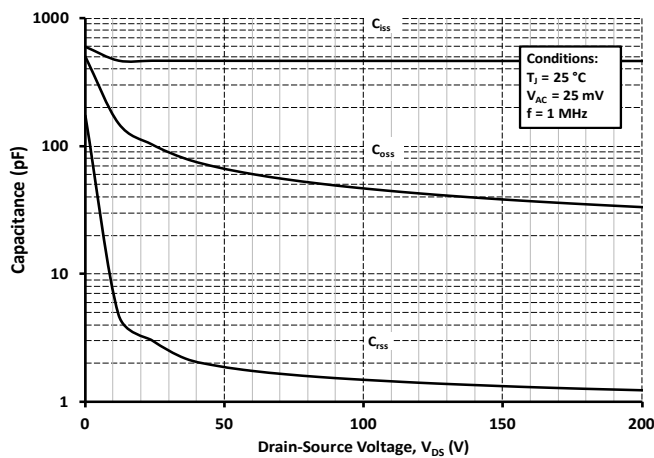


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

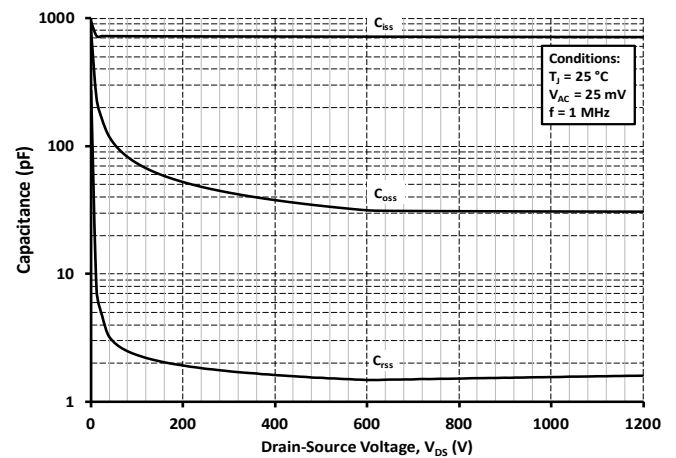


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)



Typical Performance

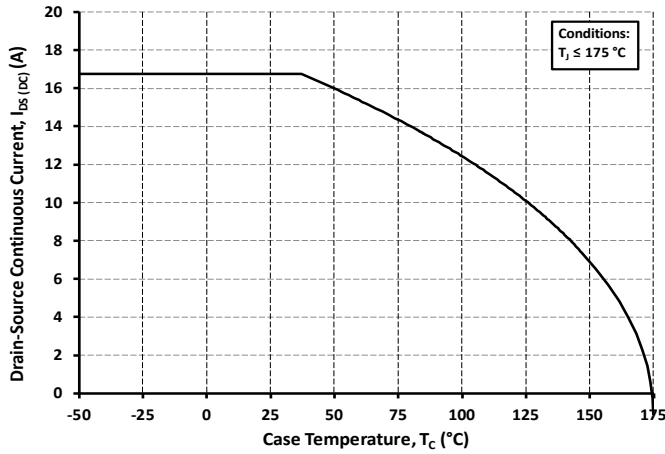


Figure 19. Continuous Drain Current Derating vs. Case Temperature

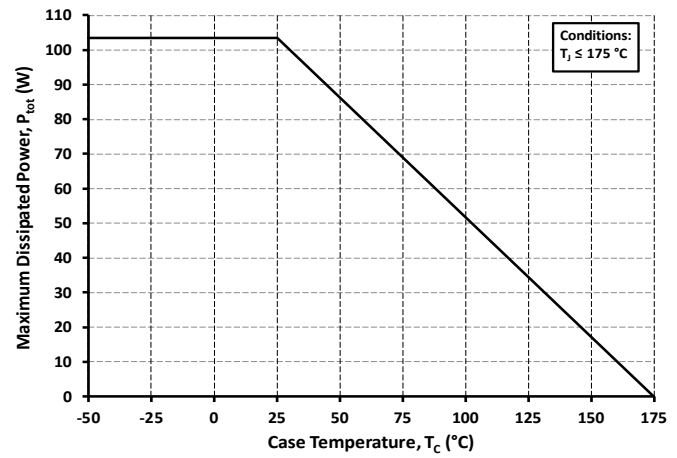


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

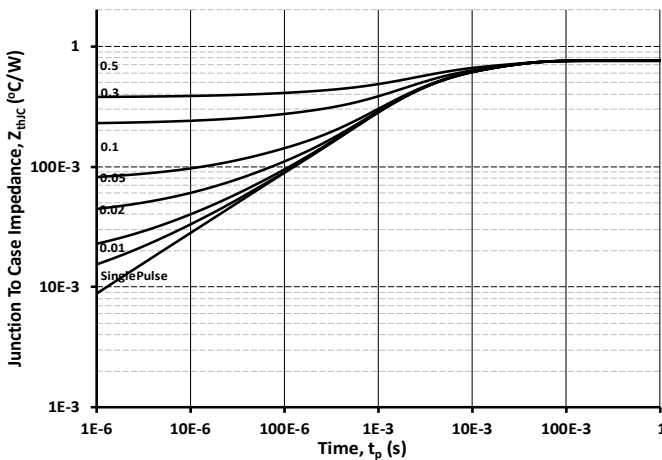


Figure 21. Transient Thermal Impedance (Junction - Case)

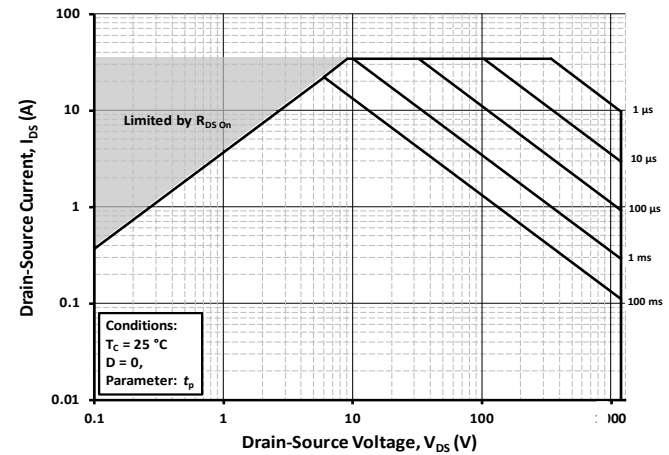


Figure 22. Safe Operating Area

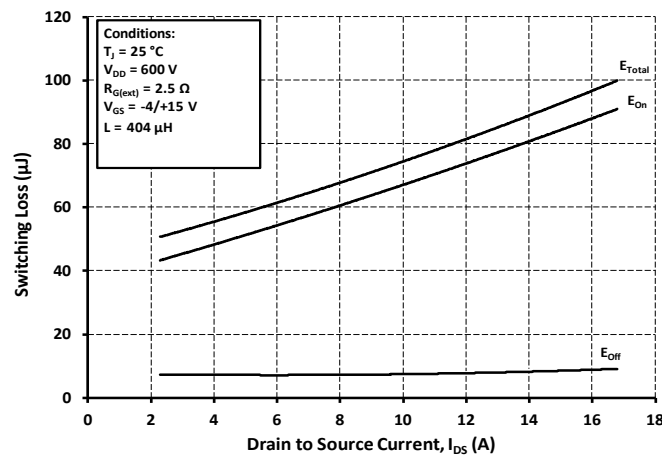


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

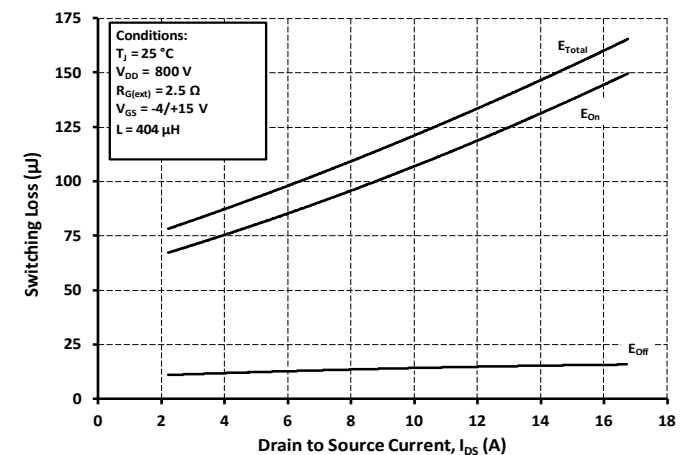


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)



Typical Performance

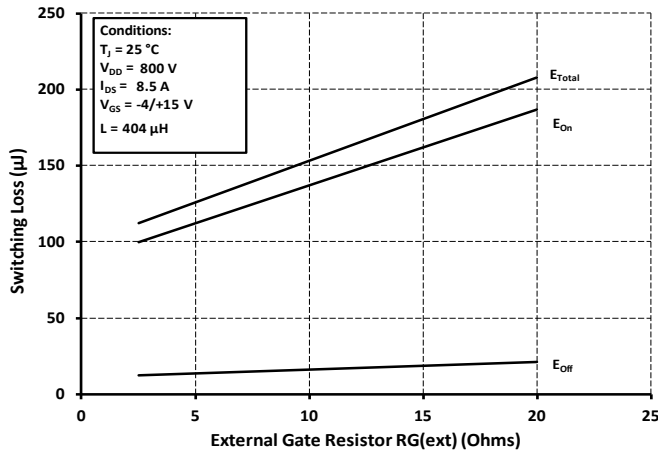


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(\text{ext})}$

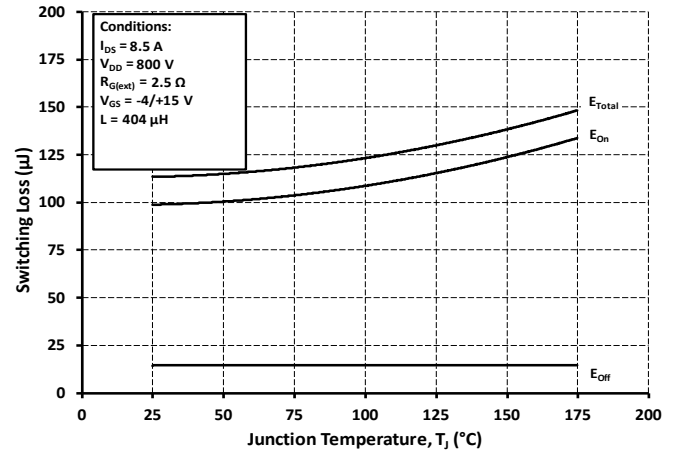


Figure 26. Clamped Inductive Switching Energy vs. Temperature

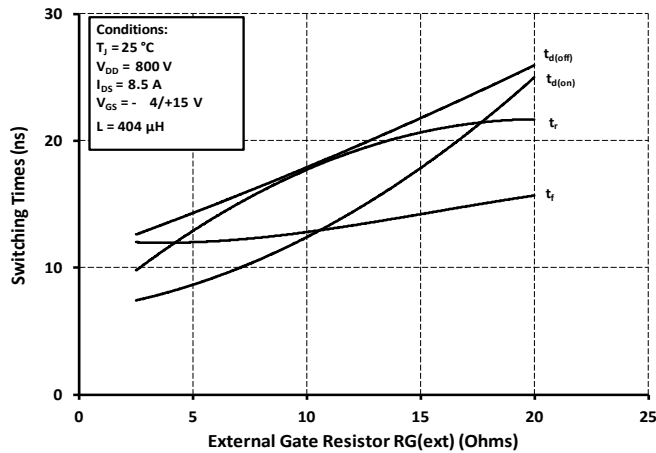


Figure 27. Switching Times vs. $R_{G(\text{ext})}$

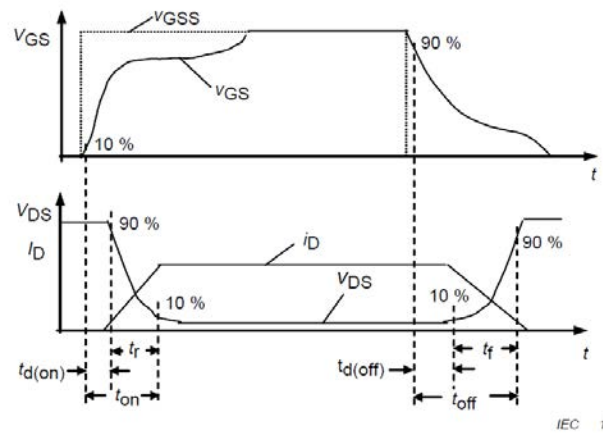


Figure 28. Switching Times Definition



Test Circuit Schematic

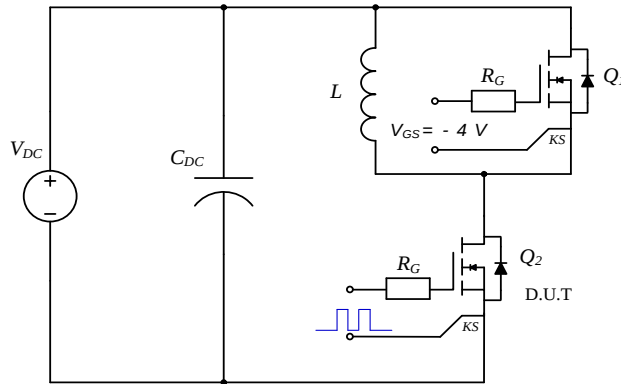
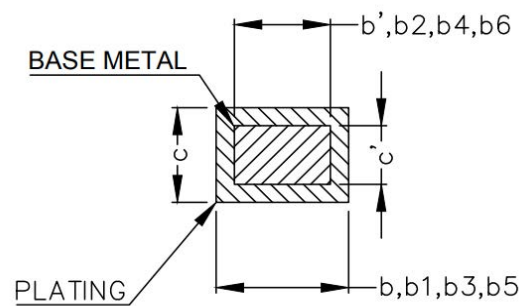
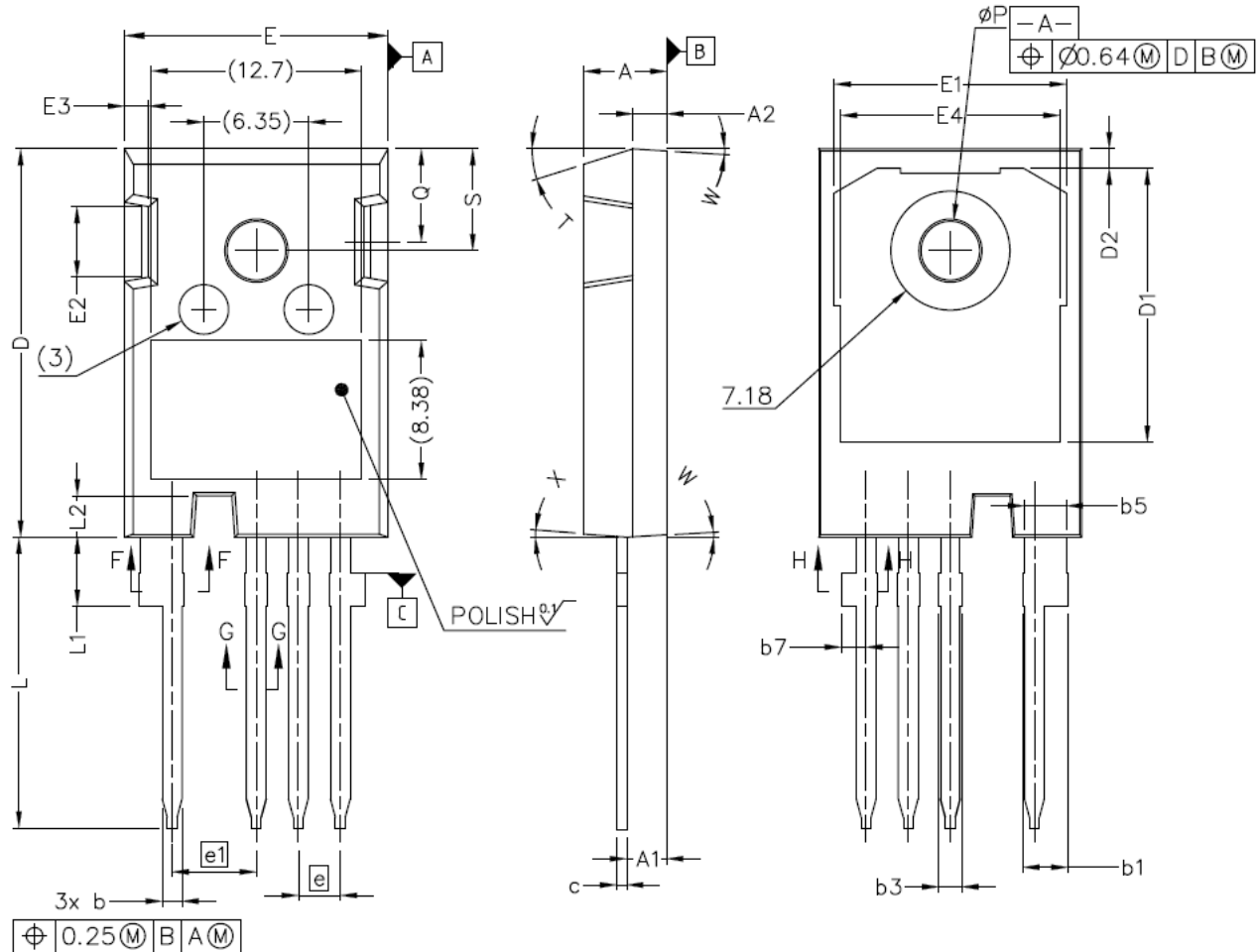


Figure 29. Clamped Inductive Switching
Waveform Test Circuit



Package Dimensions

Package T0247-4L(T0-247-4)



SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE



Package Dimensions

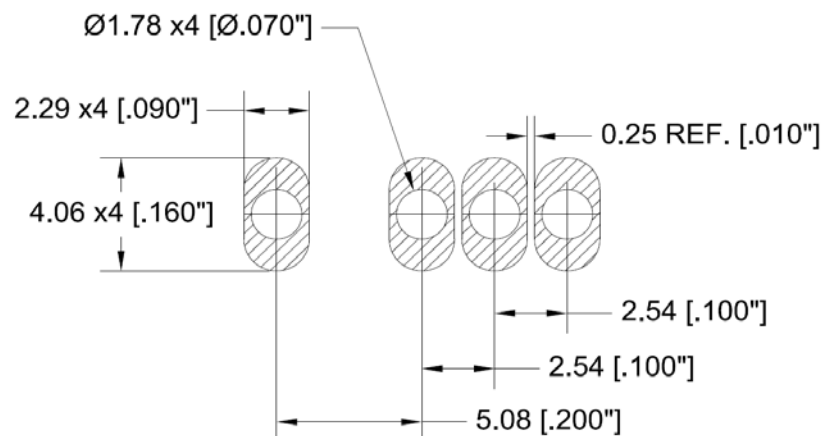
Package T0247-4L(TO-247-4)

NOTE ;

1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS.
ANGLES ARE IN DEGREES.
4. 'N' IS THE NUMBER OF TERMINAL POSITIONS

SYM	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b`	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
b7	1.30	1.70
c`	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13

SYM	MILLIMETERS	
	MIN	MAX
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N*	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
Ø P	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.	





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