NVH4L160N120SC1

SiC Power MOSFET N-Channel Enhancement Mode

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

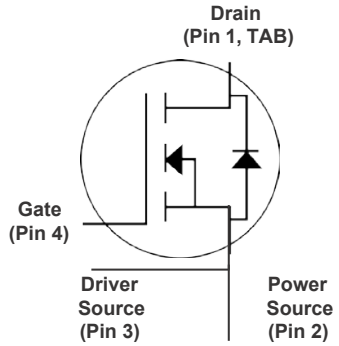
Applications

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



TO247-4L
(TO-247-4)

Package



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

Maximum Ratings (T_C = 25 ˚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 V	T_C = 25˚C	17.9	A	Fig. 19 Note: 2
		T_C = 100˚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˚C, T_J = 175 ˚C		103	W	Fig. 20 Note: 2
T_J , T_{stg}	Operating Junction and Storage Temperature		-55 to +175	˚C	
T_L	Solder Temperature, 1.6mm (0.063”) from case for 10s		260	˚C	
M_d	Mounting Torque , M3 or 6-32 screw		1 8.8	Nm lbf-in	

Note (1): Recommended turn off / turn on gate voltage V_{GS} - 4V...0V / +15V Note (2): Verified by design

Electrical Characteristics (T_C = 25˚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 V, I_D = 100 µA	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.8	3.6	V	V_{DS} = V_{GS}, I_D = 2.33 mA	Fig. 11
			2.2		V	V_{DS} = V_{GS}, I_D = 2.33 mA, T_J = 175ºC	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	µA	V_{DS} = 1200 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	V_{GS} = 15 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance		159	208	mΩ	V_{GS} = 15 V, I_D = 8.5 A	Fig. 4, 5, 6
			280			V_{GS} = 15 V, I_D = 8.5 A, T_J = 175ºC	
g_{fs}	Transconductance		4.9		S	V_{DS}= 20 V, I_{DS}= 8.5 A	Fig. 7
			4.6			V_{DS}= 20 V, I_{DS}= 8.5 A, T_J = 175ºC	
C_{iss}	Input Capacitance		730		pF	V_{GS} = 0 V, V_{DS} = 0V to 1000 V F = 1 MHz V_{AC} = 25 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 V, V_{DS} = 0... 800V	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 V, V_{GS}= -4 V/15 V, I_D= 8.5 A, $R_{G(ext)}$ = 2.5 Ω, L= 404 µH, T_J = 175ºC 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 V, V_{GS}= -4 V/15 V, I_D= 8.5 A, $R_{G(ext)}$ = 2.5 Ω, L= 404 µH, T_J = 175ºC 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 V, V_{GS} = -4 V/15 V I_D = 8.5 A, $R_{G(ext)}$ = 2.5 Ω, 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 MHz, V_{AC} = 25 mV	
Q_{gs}	Gate to Source Charge		10		nC	V_{DS} = 800 V, V_{GS} = -4 V/15 V I_D = 8.5 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 Coss while Vds is rising from 0 to 800V $C_{o(tr)}$, a lumped capacitance that gives same charging time as Coss while Vds is rising from 0 to 800V

Reverse Diode Characteristics (T_C = 25˚C unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.8		V	V_{GS} = -4 V, I_{SD} = 4.25 A, T_J = 25 °C	Fig. 8, 9, 10
		4.2		V	V_{GS} = -4 V, I_{SD} = 4.25 A, T_J = 175 °C	
I_S	Continuous Diode Forward Current		17	A	V_{GS} = -4 V, T_C = 25˚C	
$I_{S,\ pulse}$	Diode pulse Current		34	A	V_{GS} = -4 V, pulse width t_P limited by T_{jmax}	
t_{rr}	Reverse Recover time	9		ns	V_{GS} = -4 V, I_{SD} = 8.5 A, V_R = 800 V dif/dt = 6080 A/μs, T_J = 175 °C	
Q_{rr}	Reverse Recovery Charge	169		nC		
I_{rrm}	Peak Reverse Recovery Current	27		A		
t_{rr}	Reverse Recover time	23		ns	V_{GS} = -4 V, I_{SD} = 8.5 A, V_R = 800 V dif/dt = 1850 A/μs, T_J = 175 °C	
Q_{rr}	Reverse Recovery Charge	147		nC		
I_{rrm}	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	°C/W		Fig. 21

Typical Performance

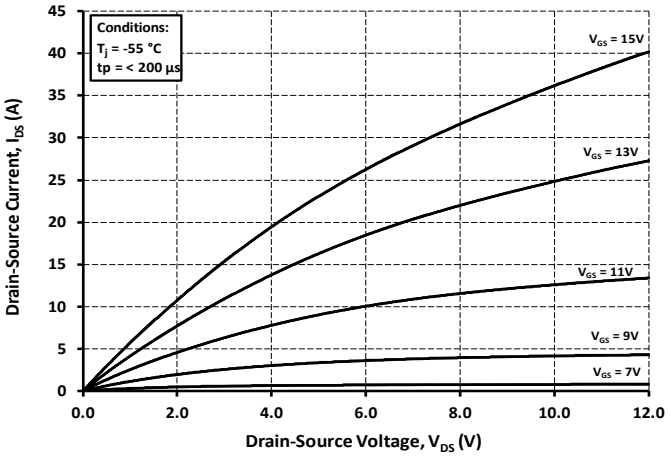


Figure 1. Output Characteristics T_J = -55 ºC

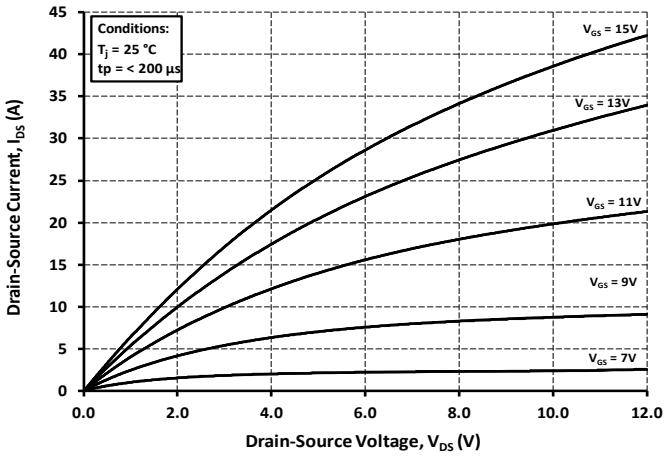


Figure 2. Output Characteristics T_J = 25 ºC

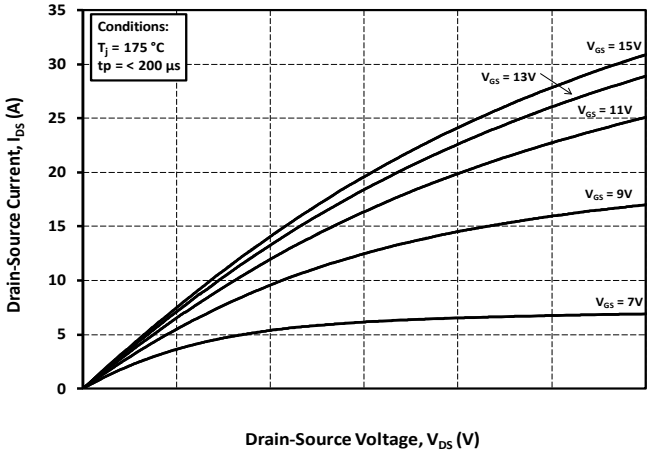


Figure 3. Output Characteristics T_J = 175 ºC

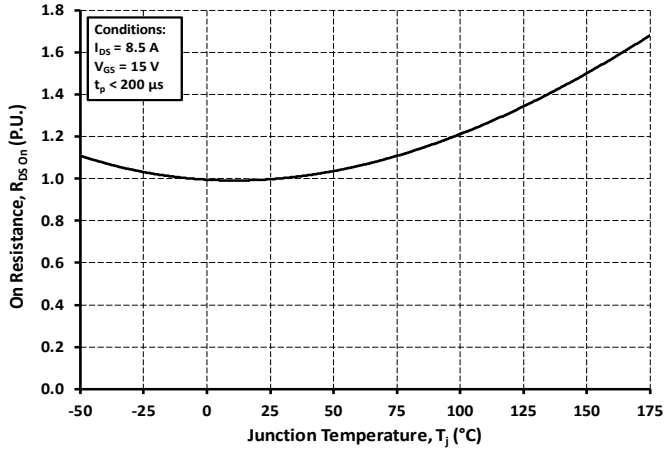


Figure 4. Normalized On-Resistance vs. Temperature

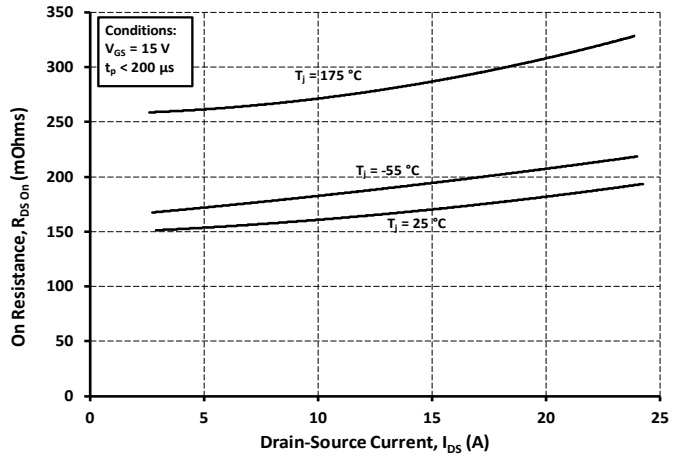


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

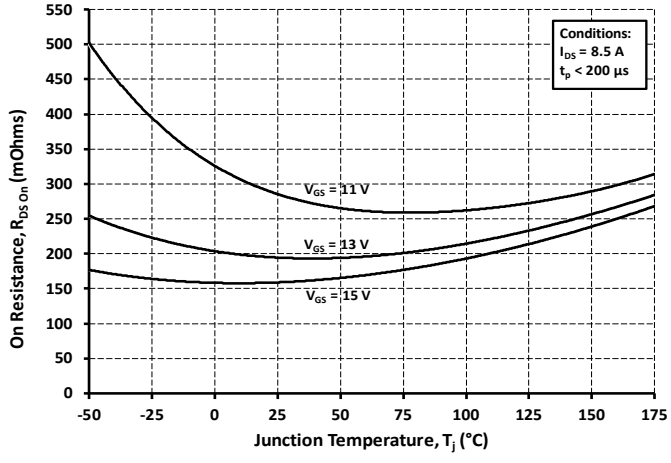


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

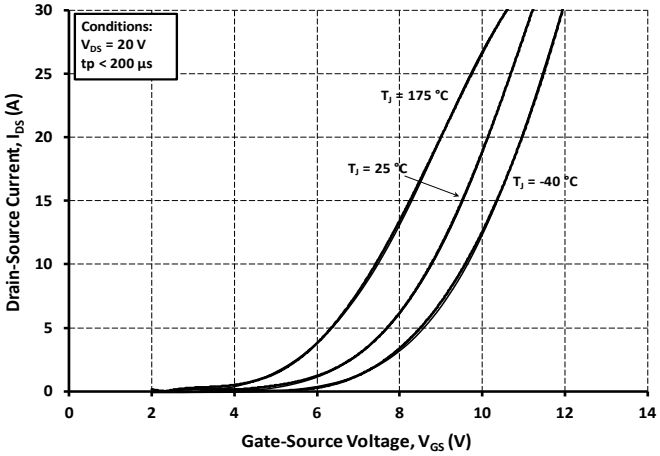


Figure 7. Transfer Characteristic for Various Junction Temperatures

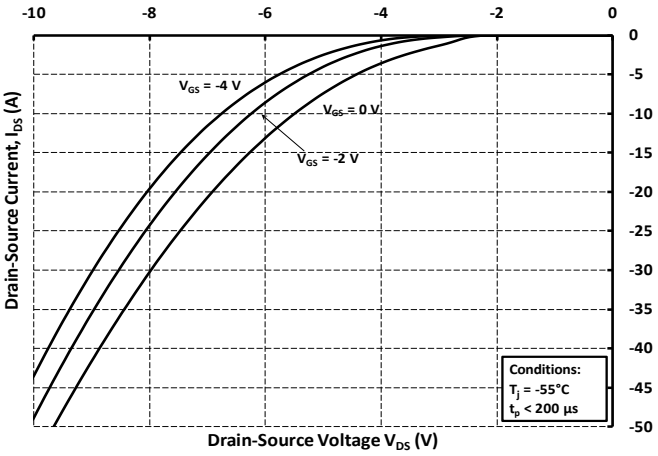


Figure 8. Body Diode Characteristic at -55 ºC

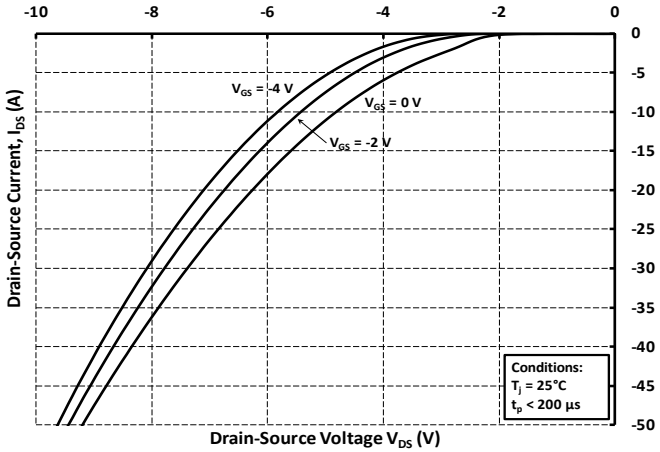


Figure 9. Body Diode Characteristic at 25 ºC

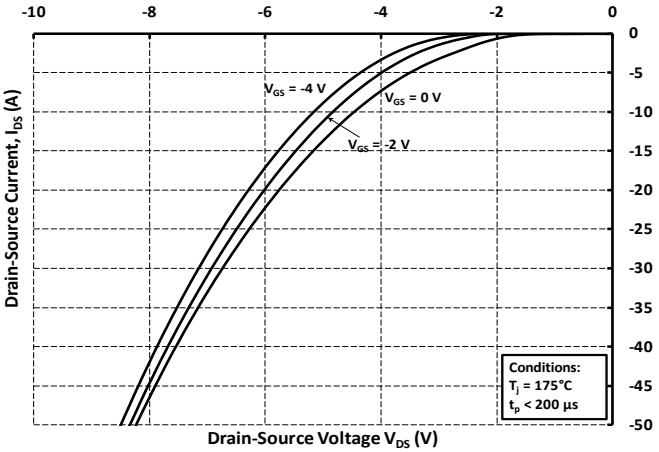


Figure 10. Body Diode Characteristic at 175 ºC

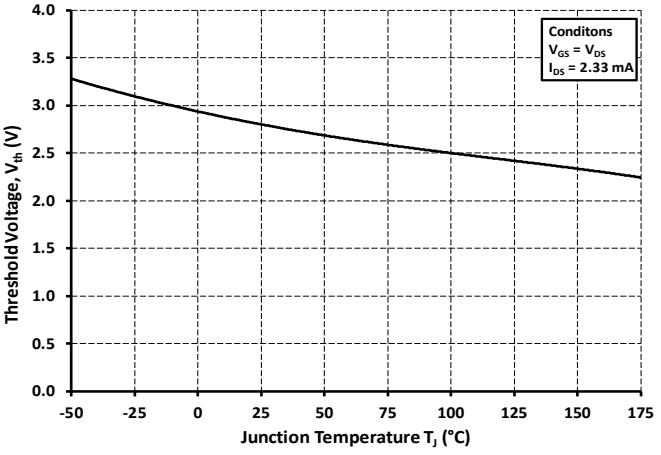


Figure 11. Threshold Voltage vs. Temperature

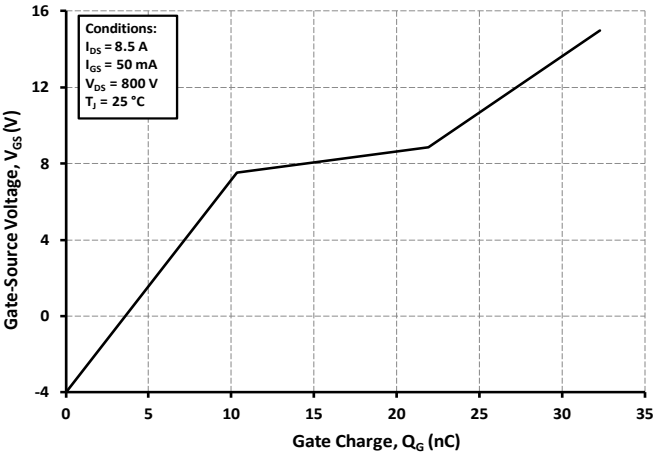


Figure 12. Gate Charge Characteristics

Typical Performance

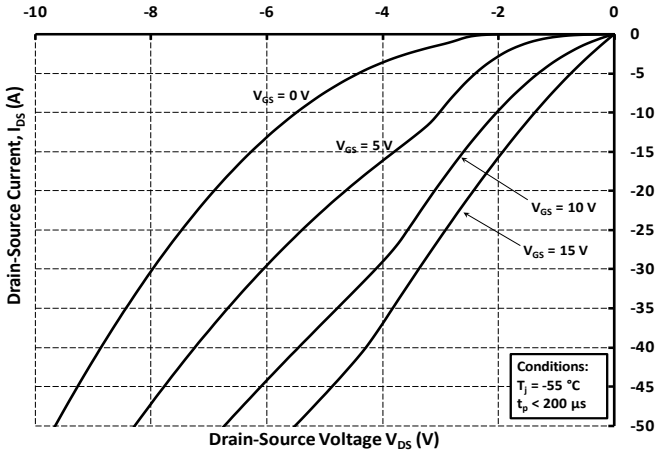


Figure 13. 3rd Quadrant Characteristic at -55 ºC

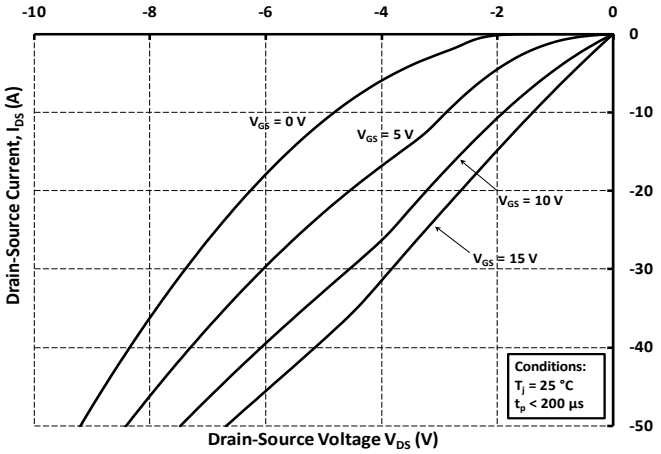


Figure 14. 3rd Quadrant Characteristic at 25 ºC

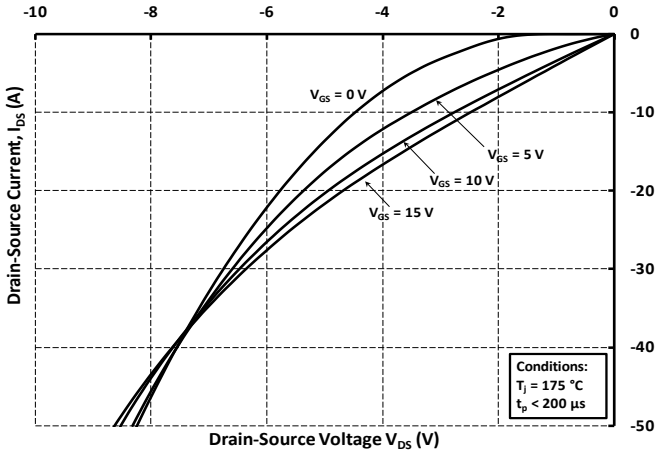


Figure 15. 3rd Quadrant Characteristic at 175 ºC

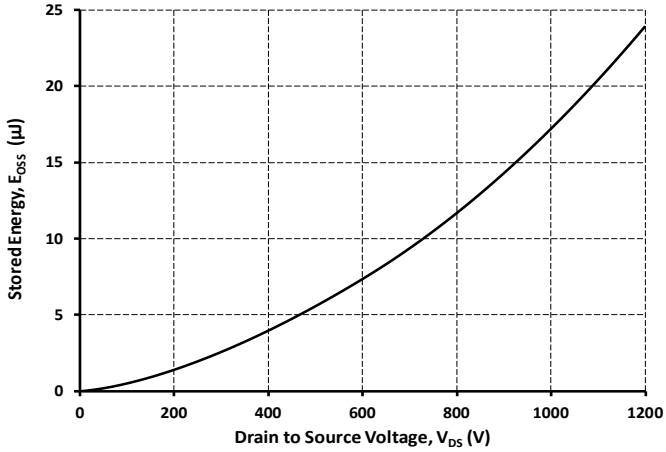


Figure 16. Output Capacitor Stored Energy

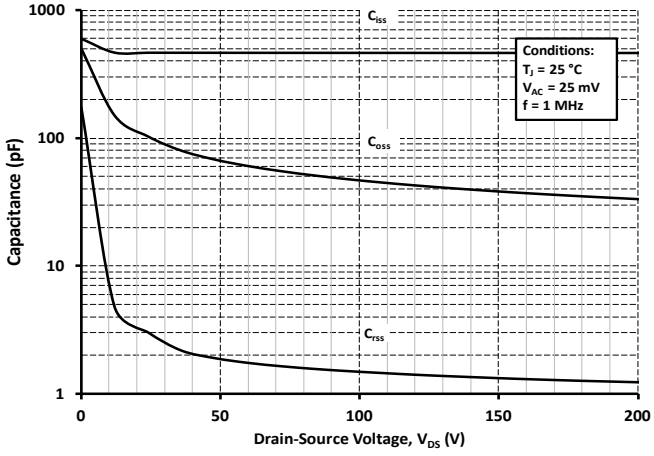


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

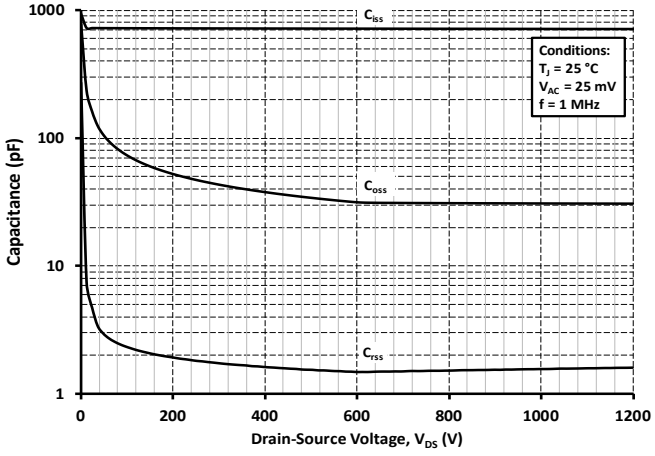


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

Typical Performance

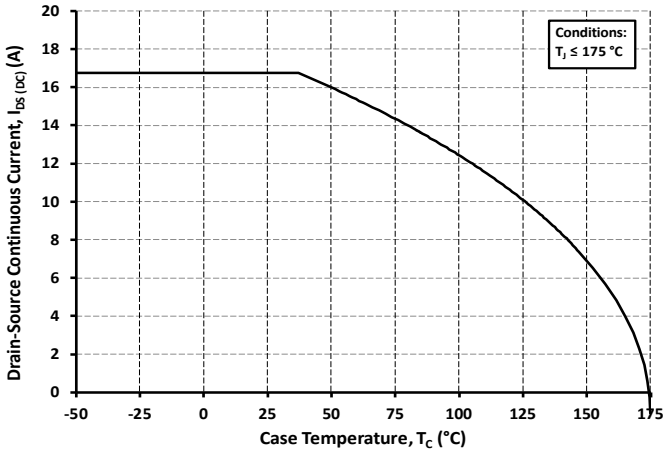


Figure 19. Continuous Drain Current Derating vs. Case Temperature

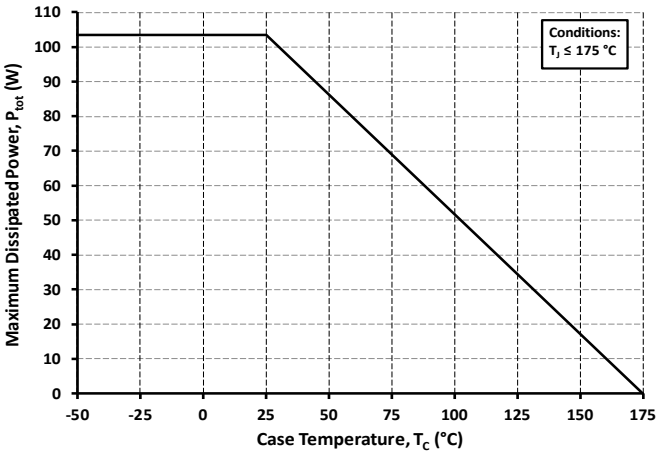


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

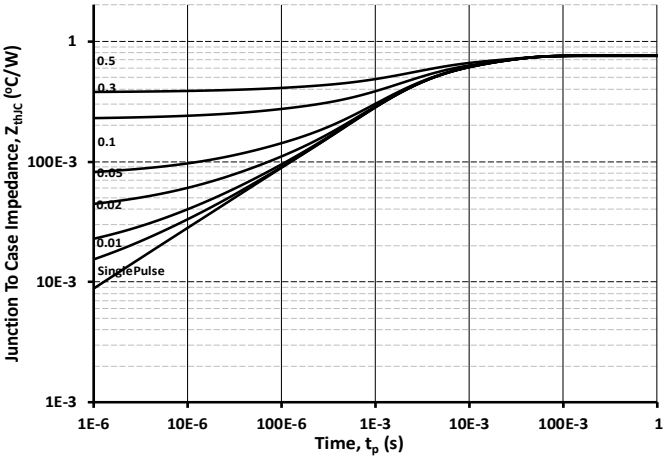


Figure 21. Transient Thermal Impedance (Junction - Case)

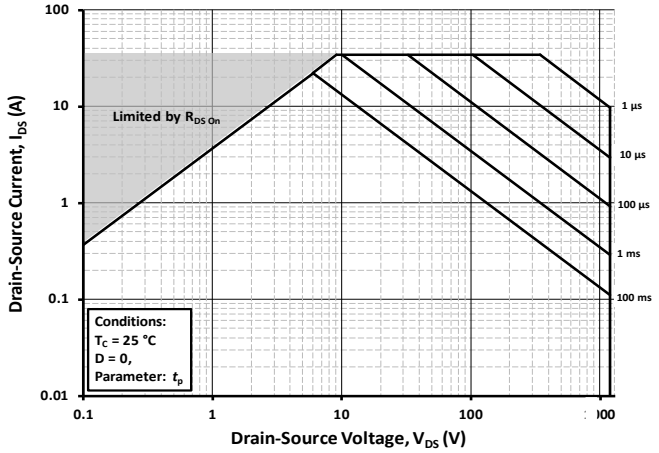


Figure 22. Safe Operating Area

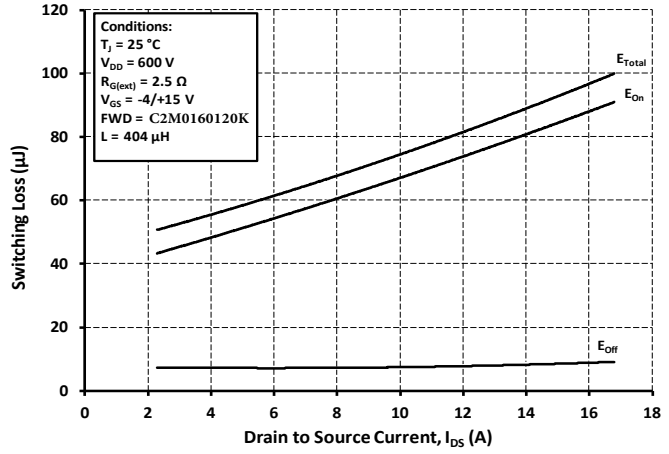


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

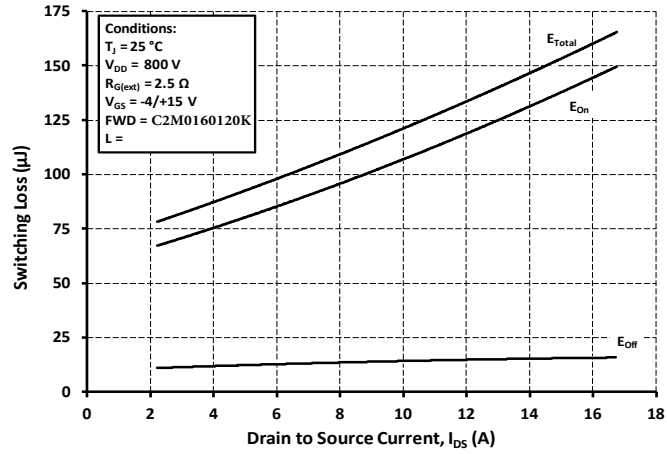


Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

Typical Performance

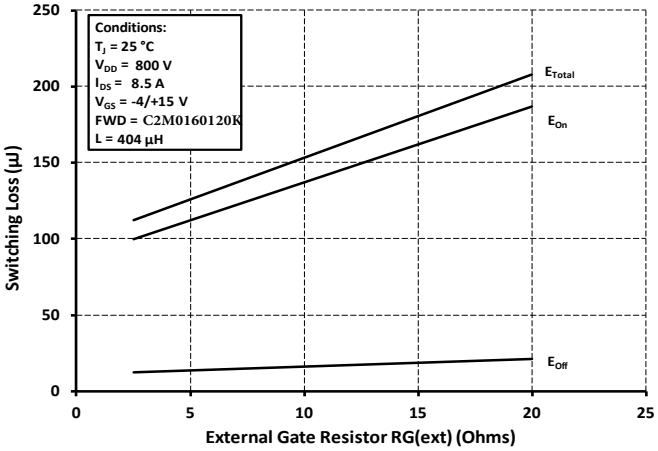


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

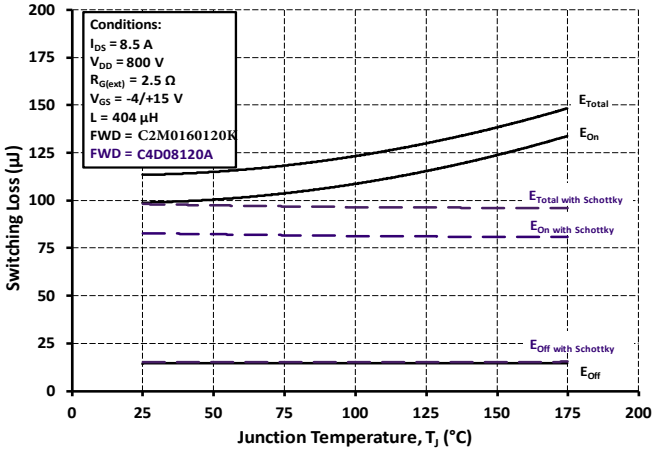


Figure 26. Clamped Inductive Switching Energy vs. Temperature

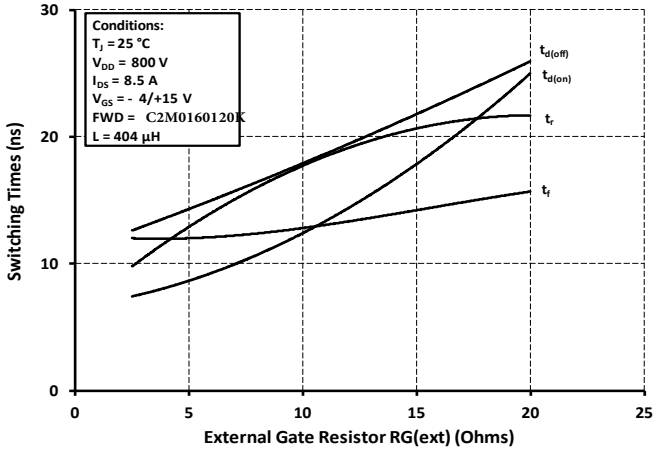


Figure 27. Switching Times vs. $R_{G(ext)}$

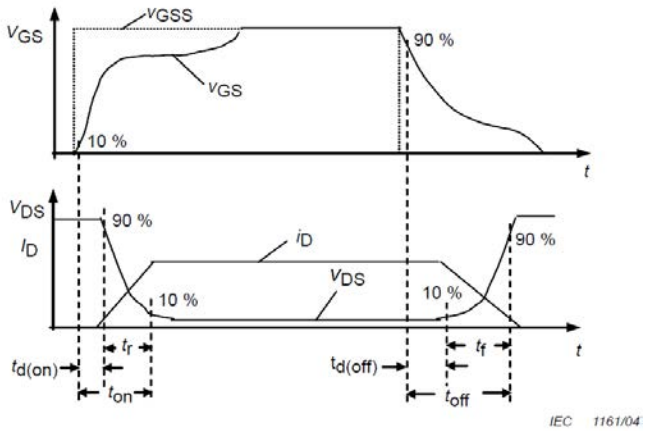


Figure 28. Switching Times Definition

Test Circuit Schematic

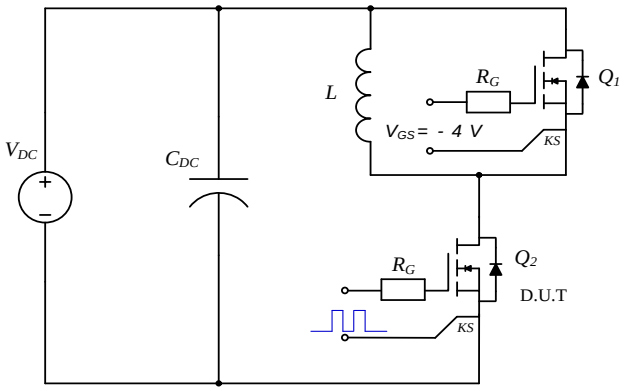
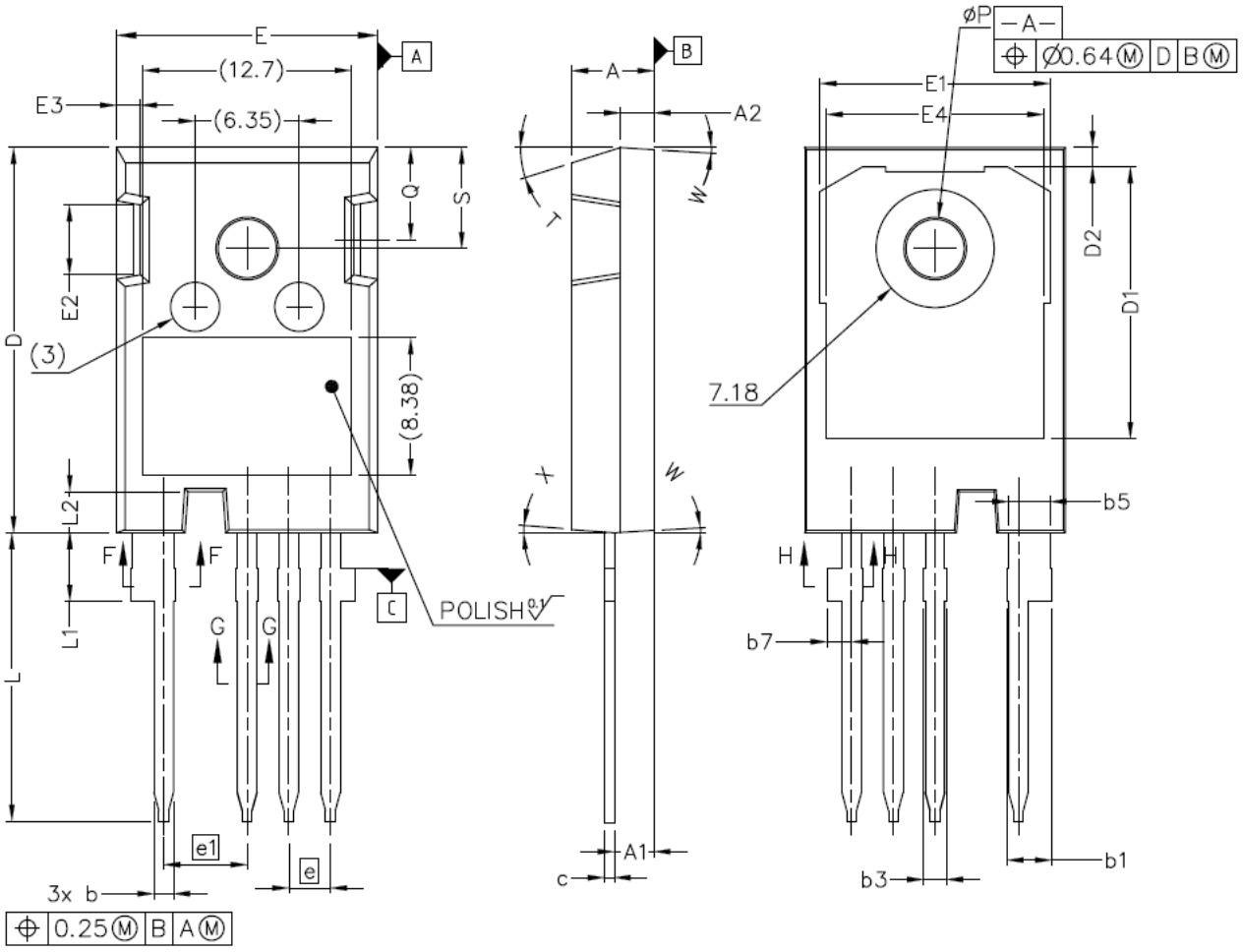
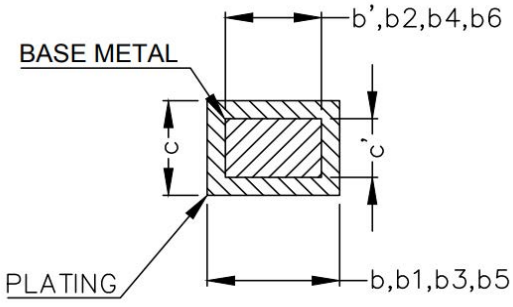


Figure 29. Clamped Inductive Switching Waveform Test Circuit

Package Dimensions

Package TO247-4L(TO-247-4)





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

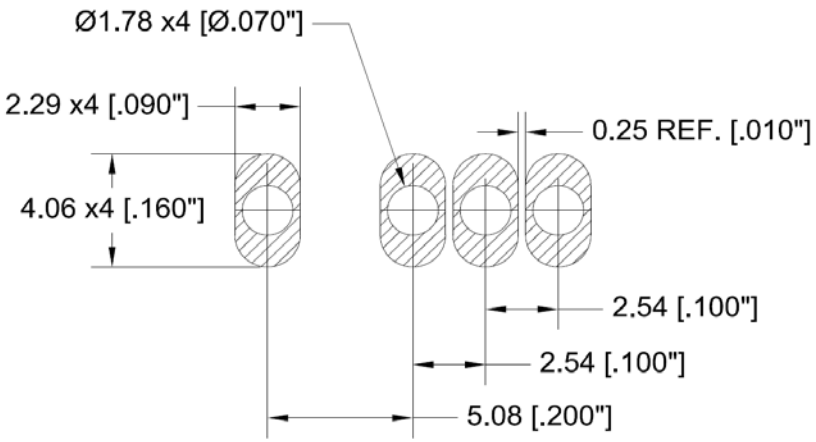
Package Dimensions

Package TO247-4L(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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HXY MOSFET:

AOD403-HXY C3M0040120D CH440G ISL28233FUZ-T7 MSC040SMA120B4 S4D15120H SG3525-HXY 2N7002-HXY MJD127G TPD1E0B04DPYR TPS7A0533PDBZR-HXY IDL10G65C5XUMA2 IRLML2244TRPBF-HXY ISL28133FHZ-T7 Si2323DS-T1-E3-HXY DSC06065 MUR1040FCT SGM3798YG/TR 1SMB5930BT3G HBAS40-05LT1G DMPH6250SQ-13 C4D08120E-TR C6D06065Q-TR E4D10120A SS5150 TLV74318PDBVR-HXY 1SMB5934B BD237STU PTVSHC3D5VU S3D08065E