

# Silicon Carbide (SiC) MOSFET – 80 mohm, 1200 V, M1, TO-247-4L NVH4L080N120SC1

## Description

Silicon Carbide (SiC) MOSFET uses a completely new technology that provide superior switching performance and higher reliability compared to Silicon. In addition, the low ON resistance and compact chip size ensure low capacitance and gate charge. Consequently, system benefits include highest efficiency, faster operation frequency, increased power density, reduced EMI, and reduced system size.

## Features

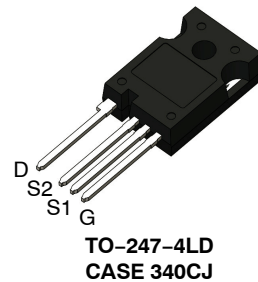
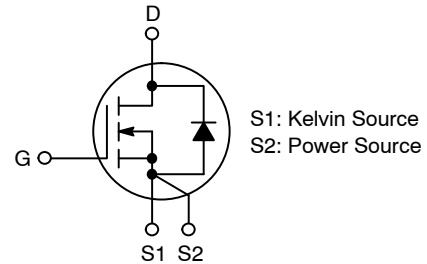
- 1200 V @  $T_J = 175^\circ\text{C}$
- Max  $R_{DS(on)} = 110\text{ m}\Omega$  at  $V_{GS} = 20\text{ V}$ ,  $I_D = 20\text{ A}$
- High Speed Switching with Low Capacitance
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb-Free 2LI (on second level interconnection)

## Applications

- Automotive Auxiliary Motor Drive
- Automotive On Board Charger
- Automotive DC-DC Converter for EV/HEV

$V_{DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
1200 V	80 m $\Omega$	29 A

## N-CHANNEL MOSFET



## MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Lot Traceability  
NVH4L080N120SC1 = Specific Device Code

## ORDERING INFORMATION

Device	Package	Shipping
NVH4L080N120SC1	TO-247-4L	30 Units / Tube

# NVH4L080N120SC1

## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Ratings	Unit
$V_{DSmax}$	Drain-to-Source Voltage		1200	V
$V_{GSmax}$	Max. Gate-to-Source Voltage	@ $T_C < 150^\circ\text{C}$	-15 / +25	V
$V_{GSop(DC)}$	Recommended operation Values of Gate - Source Voltage	@ $T_C < 150^\circ\text{C}$	-5 / +20	V
$V_{GSop(AC)}$	Recommended operation Values of Gate - Source Voltage ( $f > 1\text{ Hz}$ )	@ $T_C < 150^\circ\text{C}$	-5 / +20	V
$I_D$	Continuous Drain Current	$V_{GS} = 20\text{ V}, T_C = 25^\circ\text{C}$	29	A
		$V_{GS} = 20\text{ V}, T_C = 100^\circ\text{C}$	21	
$I_{D(Pulse)}$	Pulse Drain Current	Pulse width $t_p$ limited by $T_j$ max	125	A
$E_{AS}$	Single Pulse Avalanche Energy (Note 1)		171	mJ
$P_{tot}$	Power Dissipation	$T_C = 25^\circ\text{C}$	170	W
		$T_C = 150^\circ\text{C}$	28	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range		-55 to +175	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1.  $E_{AS}$  of 171 mJ is based on starting  $T_j = 25^\circ\text{C}$ ,  $L = 1\text{ mH}$ ,  $I_{AS} = 18.5\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ .

## THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.88	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	40	

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## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	I <sub>D</sub> = 100 μA, V <sub>GS</sub> = 0 V	1200	-	-	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 5 mA, Referenced to 25°C	-	0.3	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 1200 V, V <sub>GS</sub> = 0 V T <sub>C</sub> = 25°C T <sub>C</sub> = 150°C	- -	- -	100 1.0	μA mA
I <sub>GSS</sub>	Gate-to-Source Leakage Current	V <sub>GS</sub> = 25 V, V <sub>DS</sub> = 0 V	-	-	1	μA
I <sub>GSSR</sub>	Gate-to-Source Leakage Current, Reverse	V <sub>GS</sub> = -15 V, V <sub>DS</sub> = 0 V	-	-	-1	μA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate-to-Source Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 5 mA	1.8	2.75	4.3	V
R <sub>DS(on)</sub>	Static Drain-to-Source On Resistance	V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A	-	80	110	mΩ
		V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>C</sub> = 150°C	-	127	162	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 20 A	-	11.3	-	S
		V <sub>DS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>C</sub> = 150°C	-	9.8	-	

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	1112	1670	pF
C <sub>oss</sub>	Output Capacitance		-	80	120	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		-	6.5	10	pF
E <sub>oss</sub>	C <sub>oss</sub> Stored Energy		-	32	-	μJ

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 800 V, I <sub>C</sub> = 20 A, V <sub>GS</sub> = -5/20 V, R <sub>G</sub> = 4.7 Ω Inductive Load, T <sub>C</sub> = 25°C	-	9	18	ns
t <sub>r</sub>	Rise Time		-	4.2	10	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	26.8	43	ns
t <sub>f</sub>	Fall Time		-	5.4	11	ns
E <sub>on</sub>	Turn-on Switching Loss		-	314	-	μJ
E <sub>off</sub>	Turn-off Switching Loss		-	32	-	μJ
E <sub>ts</sub>	Total Switching Loss		-	346	-	μJ
Q <sub>g</sub>	Total Gate Charge	V <sub>DD</sub> = 600 V, I <sub>D</sub> = 20 A V <sub>GS</sub> = -5/20 V	-	56	-	nC
Q <sub>gs</sub>	Gate-to-Source Charge		-	11	-	nC
Q <sub>gd</sub>	Gate-to-Drain Charge		-	12	-	nC
R <sub>G</sub>	Gate input resistance	f = 1 MHz, D-S short	-	1.7	-	Ω

### DIODE CHARACTERISTICS

V <sub>SD</sub>	Source-to-Drain Diode Forward Voltage	V <sub>GS</sub> = -5 V, I <sub>SD</sub> = 10 A	T <sub>C</sub> = 25°C	-	3.7	-	V
			T <sub>C</sub> = 150°C	-	3.3	-	
E <sub>rec</sub>	Reverse Recovery Energy	I <sub>SD</sub> = 20 A, V <sub>GS</sub> = -5 V, V <sub>R</sub> = 600 V, di <sub>SD</sub> /dt = 1000 A/μs	T <sub>C</sub> = 150°C	-	29	-	μJ
t <sub>rr</sub>	Diode Reverse Recovery Time		T <sub>C</sub> = 25°C	-	18	-	ns
			T <sub>C</sub> = 150°C	-	31	-	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		T <sub>C</sub> = 25°C	-	80	-	nC
			T <sub>C</sub> = 150°C	-	212	-	
I <sub>rrm</sub>	Peak Reverse Recovery Current	T <sub>C</sub> = 25°C	-	9	-	A	
		T <sub>C</sub> = 150°C	-	14	-		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

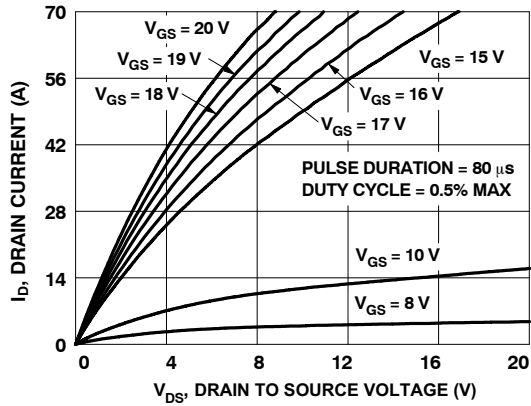


Figure 1. On Region Characteristics

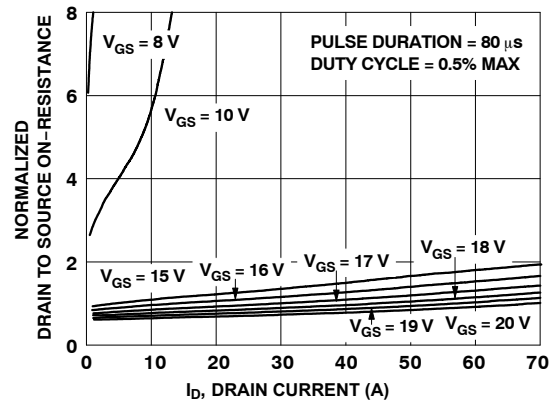


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

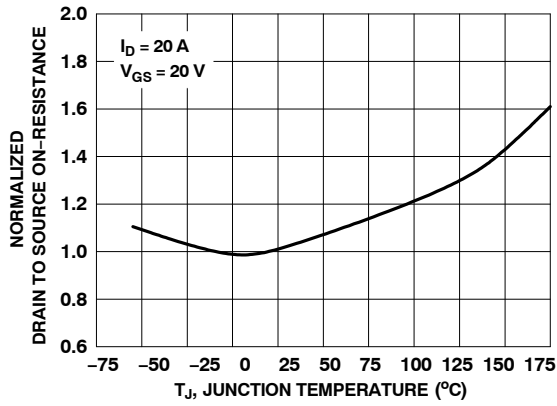


Figure 3. Normalized On Resistance vs. Junction Temperature

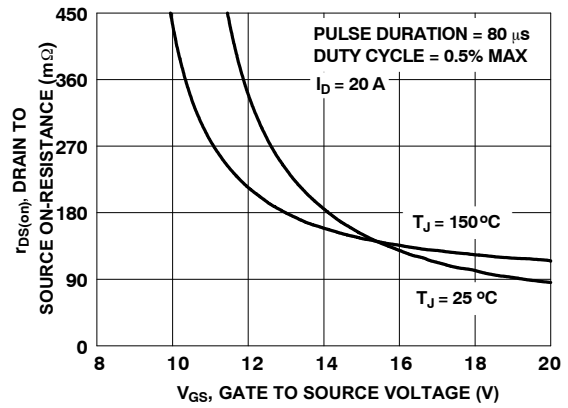


Figure 4. On-Resistance vs. Gate-to-Source Voltage

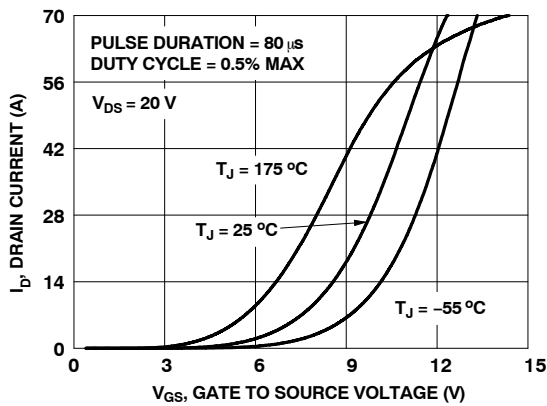


Figure 5. Transfer Characteristics

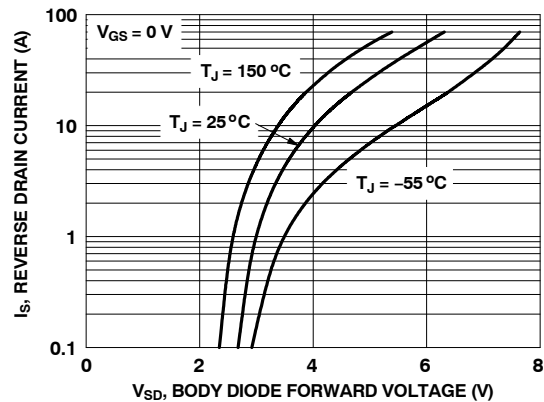


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

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## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

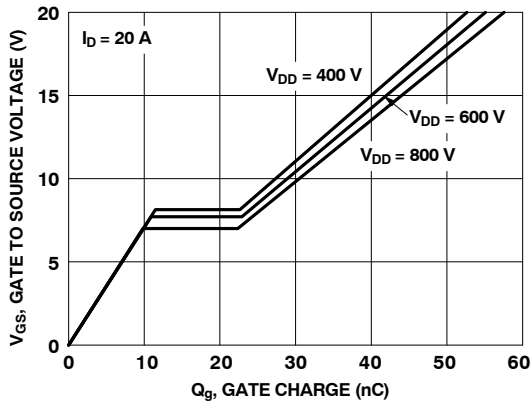


Figure 7. Gate Charge Characteristics

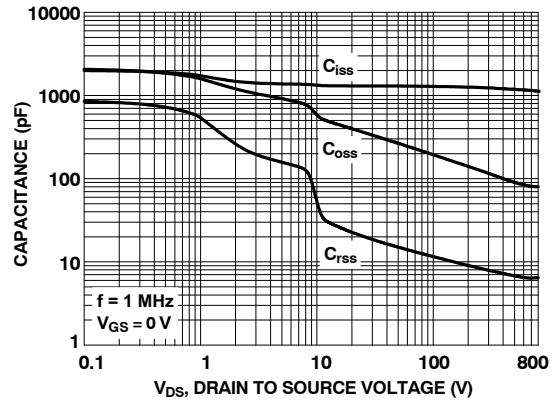


Figure 8. Capacitance vs. Drain-to-Source Voltage

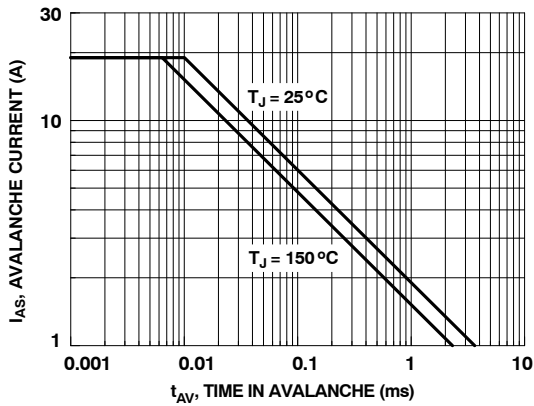


Figure 9. Unclamped Inductive Switching Capability

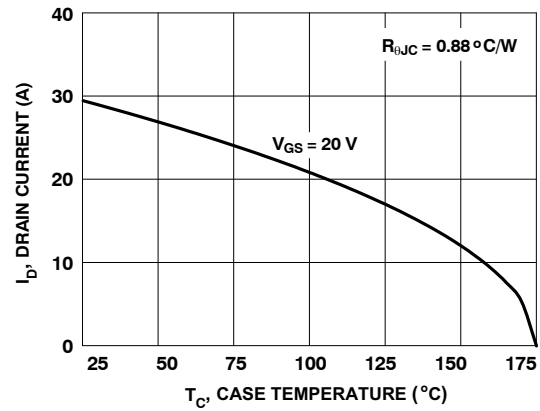


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

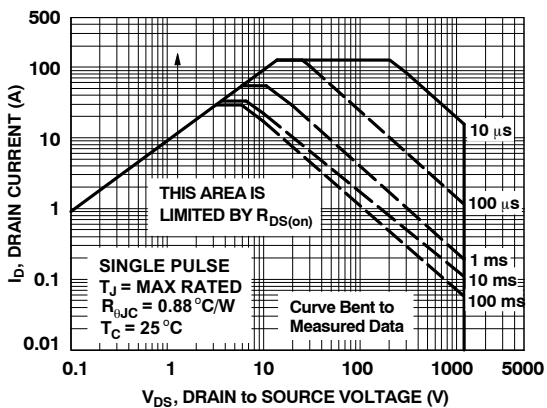


Figure 11. Forward Bias Safe Operating Area

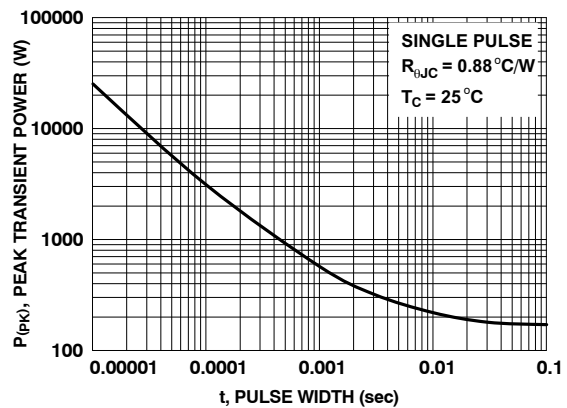


Figure 12. Single Pulse Maximum Power Dissipation

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TYPICAL CHARACTERISTICS  $T_J = 25^\circ\text{C}$  unless otherwise noted (continued)

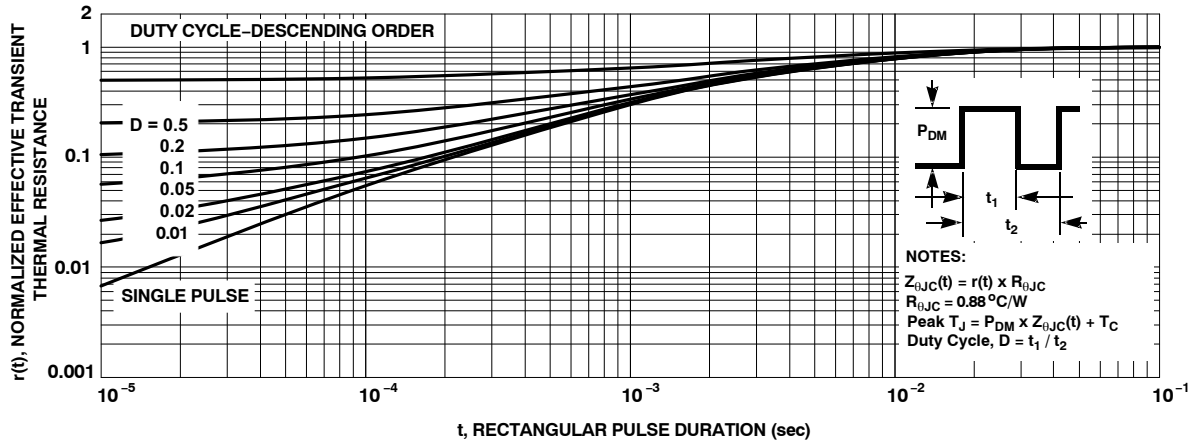


Figure 13. Junction-to-Case Transient Thermal Response Curve

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-4LD  
CASE 340CJ  
ISSUE A

DATE 16 SEP 2019



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

**NOTES:**

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- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
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