

# Silicon Carbide (SiC) MOSFET – 80 mohm, 1200 V, M1, TO-247-3L

## NTHL080N120SC1

### Features

- Typ.  $R_{DS(on)} = 80\text{ m}\Omega$
- Ultra Low Gate Charge (typ.  $Q_{G(tot)} = 56\text{ nC}$ )
- Low Effective Output Capacitance (typ.  $C_{oss} = 80\text{ pF}$ )
- 100% UIL Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb-Free 2LI (on second level interconnection)

### Typical Applications

- UPS
- DC-DC Converter
- Boost Inverter

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

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	1200	V
Gate-to-Source Voltage	$V_{GS}$	-15/+25	V
Recommended Operation Values of Gate-to-Source Voltage	$T_C < 175^\circ\text{C}$ $V_{GSop}$	-5/+20	V
Continuous Drain Current $R_{\theta JC}$	Steady State $T_C = 25^\circ\text{C}$ $I_D$	31	A
Power Dissipation $R_{\theta JC}$	$P_D$	178	W
Continuous Drain Current $R_{\theta JC}$	Steady State $T_C = 100^\circ\text{C}$ $I_D$	22	A
Power Dissipation $R_{\theta JC}$	$P_D$	89	W
Pulsed Drain Current (Note 2)	$T_A = 25^\circ\text{C}$ $I_{DM}$	132	A
Single Pulse Surge Drain Current Capability	$T_A = 25^\circ\text{C}$ , $t_p = 10\text{ }\mu\text{s}$ , $R_G = 4.7\text{ }\Omega$ $I_{DSC}$	132	A
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	18	A
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 18.5\text{ A}$ , $L = 1\text{ mH}$ ) (Note 3)	$E_{AS}$	171	mJ

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.

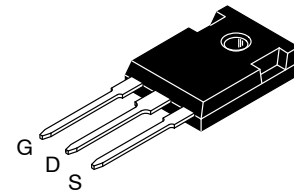
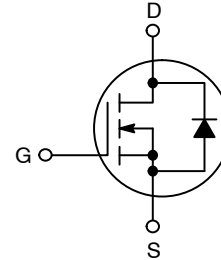
### THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Note 1)	$R_{\theta JC}$	0.84	$^\circ\text{C/W}$
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	40	$^\circ\text{C/W}$

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3.  $E_{AS}$  of 171 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1\text{ mH}$ ,  $I_{AS} = 18.5\text{ A}$ ,  $V_{DD} = 120\text{ V}$ ,  $V_{GS} = 18\text{ V}$ .

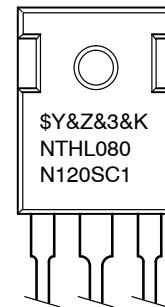
$V_{(BR)DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
1200 V	110 m $\Omega$ @ 20 V	31 A

### N-CHANNEL MOSFET



TO-247-3LD  
CASE 340CX

### MARKING DIAGRAM



\$Y = onsemi Logo  
&Z = Assembly Plant Code  
&3 = Data Code (Year & Week)  
&K = Lot  
NTHL080N120SC1 = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping
NTHL080N120SC1	TO247-3L	30 Units / Tube

# NTHL080N120SC1

## ELECTRICAL CHARACTERISTICS

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200	-	-	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$ , referenced to $25^\circ\text{C}$	-	700	-	mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 25^\circ\text{C}$	-	-	100	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 175^\circ\text{C}$	-	-	1	mA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +25/-15\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 1$	$\mu\text{A}$

### ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 5\text{ mA}$	1.8	2.7	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5	-	+20	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$	-	80	110	m $\Omega$
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 150^\circ\text{C}$	-	114	-	
Forward Transconductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 20\text{ A}$	-	13	-	S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 800\text{ V}$	-	1112	-	pF
Output Capacitance	$C_{OSS}$		-	80	-	
Reverse Transfer Capacitance	$C_{RSS}$		-	6.5	-	
Total Gate Charge	$Q_{G(tot)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 600\text{ V}, I_D = 20\text{ A}$	-	56	-	nC
Gate-to-Source Charge	$Q_{GS}$		-	11	-	
Gate-to-Drain Charge	$Q_{GD}$		-	12	-	
Gate Resistance	$R_G$	$f = 1\text{ MHz}$	-	1.7	-	$\Omega$

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 20\text{ A}, R_G = 4.7\text{ }\Omega$ , Inductive Load	-	13	-	ns
Rise Time	$t_r$		-	20	-	
Turn-Off Delay Time	$t_{d(off)}$		-	22	-	
Fall Time	$t_f$		-	10	-	
Turn-On Switching Loss	$E_{ON}$		-	258	-	$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$		-	52	-	
Total Switching Loss	$E_{TOT}$		-	311	-	

### DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-to-Source Diode Forward Current	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$	-	-	18	A
Pulsed Drain-to-Source Diode Forward Current (Note 2)	$I_{SDM}$	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$	-	-	132	A
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 10\text{ A}, T_J = 25^\circ\text{C}$	-	4	-	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5/20\text{ V}, I_{SD} = 20\text{ A}, di_S/dt = 1000\text{ A}/\mu\text{s}$	-	16	-	ns
Reverse Recovery Charge	$Q_{RR}$		-	62	-	nC
Reverse Recovery Energy	$E_{REC}$		-	5	-	$\mu\text{J}$
Peak Reverse Recovery Current	$I_{RRM}$		-	8	-	A

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.

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

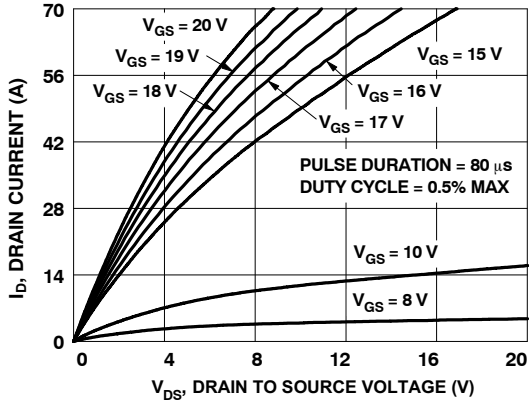


Figure 1. On Region Characteristics

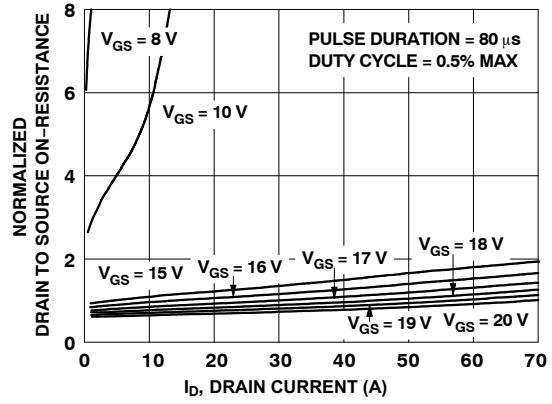


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

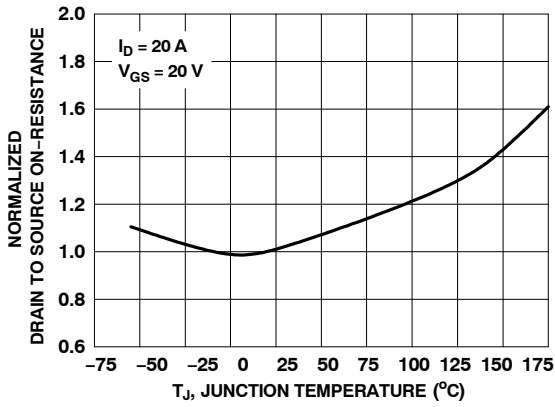


Figure 3. Normalized On Resistance vs. Junction Temperature

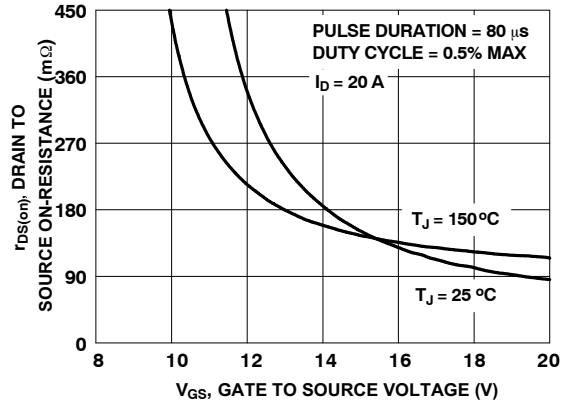


Figure 4. On-Resistance vs. Gate-to-Source Voltage

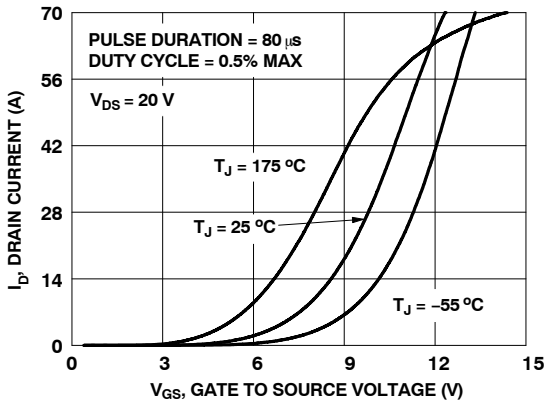


Figure 5. Transfer Characteristics

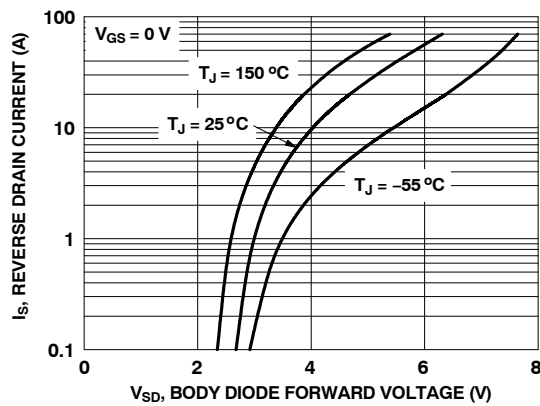


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

# NTHL080N120SC1

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

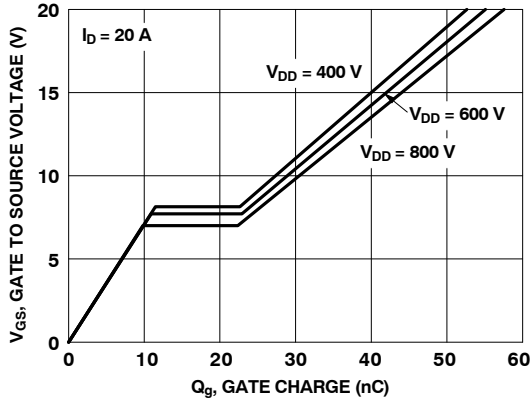


Figure 7. Gate Charge Characteristics

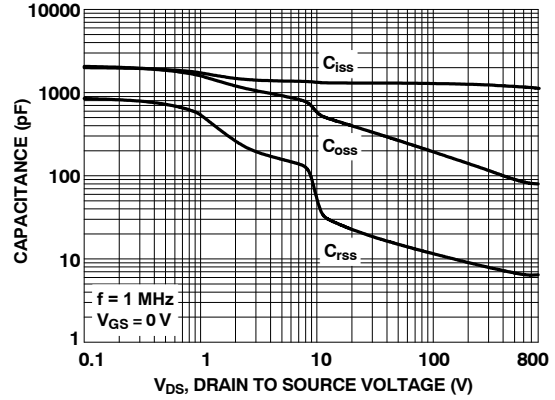


Figure 8. Capacitance vs. Drain-to-Source Voltage

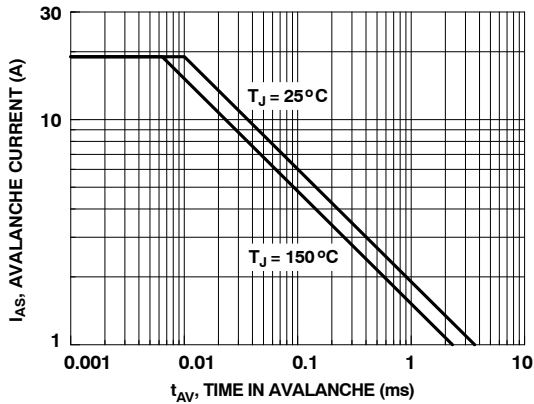


Figure 9. Unclamped Inductive Switching Capability

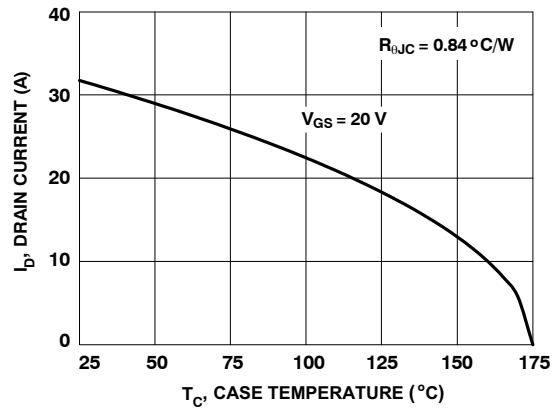


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

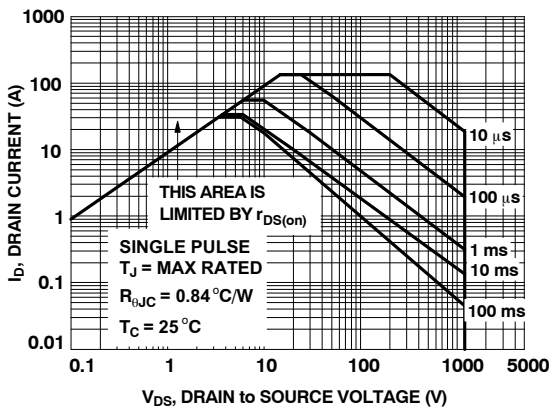


Figure 11. Forward Bias Safe Operating Area

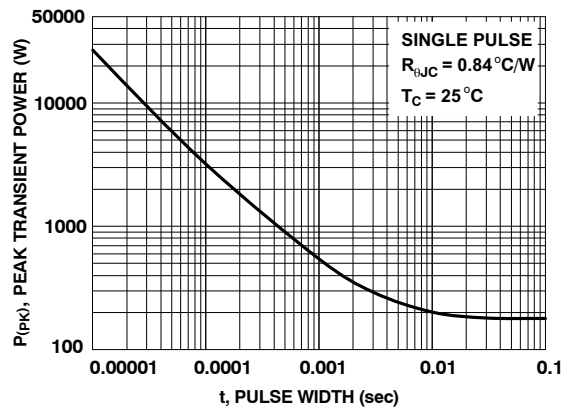


Figure 12. Single Pulse Maximum Power Dissipation

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

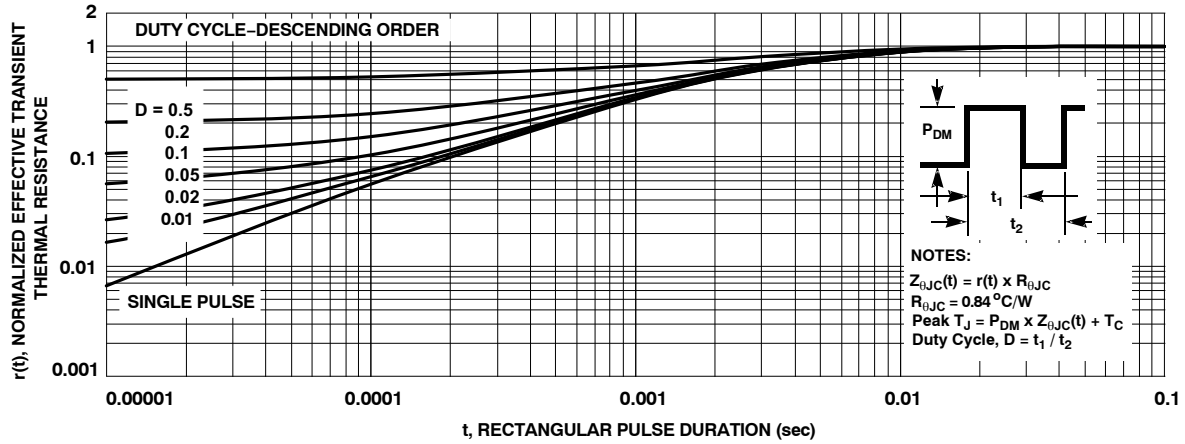


Figure 13. Junction-to-Case Transient Thermal Response Curve

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-3LD  
CASE 340CX  
ISSUE A

DATE 06 JUL 2020



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.60	6.80	7.00

### GENERIC MARKING DIAGRAM\*



- XXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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