

MOSFET - SiC Power, Single N-Channel 1200 V, 40 mΩ, 60 A

NVHL040N120SC1

Features

- Typ. $R_{DS(on)}$ = 40 mΩ
- Ultra Low Gate Charge (typ. $Q_{G(tot)}$ = 106 nC)
- Low Effective Output Capacitance (typ. C_{oss} = 140 pF)
- 100% UIL Tested
- Qualified According to AEC-Q101
- These Devices are RoHS Compliant

Typical Applications

- Automotive On Board Charger
- Automotive DC/DC converter for EV/HEV

MAXIMUM RATINGS (T_J = 25°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	V _{GSop}	-5/+20	V		
Continuous Drain Current R _{θJC}	Steady State	T _C = 25°C	I _D	60	A
Power Dissipation R _{θJC}			P _D	348	W
Continuous Drain Current R _{θJC}	Steady State	T _C = 100°C	I _D	42	A
Power Dissipation R _{θJC}			P _D	174	W
Pulsed Drain Current (Note 2)	T _A = 25°C	I _{DM}	240	A	
Single Pulse Surge Drain Current Capability	T _A = 25°C, t _p = 10 μs, R _G = 4.7 Ω	I _{DSC}	416	A	
Operating Junction and Storage Temperature Range	T _J , T _{stg}	-55 to +175	°C		
Source Current (Body Diode)	I _S	34	A		
Single Pulse Drain-to-Source Avalanche Energy (I _{L(pk)} = 23 A, L = 1 mH) (Note 3)	E _{AS}	613	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 _{θJC}	0.43	°C/W
Junction-to-Ambient (Note 1)	R _{θJA}	40	°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 613 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 35 A, V_{DD} = 120 V, V_{GS} = 20 V.

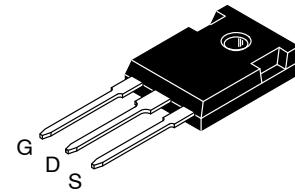
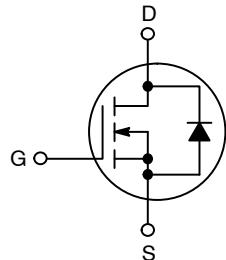


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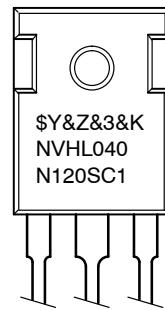
V _{(BR)DSS}	R _{DS(on)} MAX	I _D MAX
1200 V	56 mΩ @ 20 V	60 A

N-CHANNEL MOSFET



TO-247-3LD
CASE 340CX

MARKING DIAGRAM



\$Y = ON Semiconductor Logo
 &Z = Assembly Plant Code
 &3 = Data Code (Year & Week)
 &K = Lot
 NVHL040N120SC1 = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

NVHL040N120SC1

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°C	–	450	–	$\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}, T_J = 25^\circ\text{C}$	–	–	100	μA
		$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}, T_J = 175^\circ\text{C}$	–	–	250	
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +25/-15 \text{ V}, V_{DS} = 0 \text{ V}$	–	–	± 1	μA

ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(\text{th})}$	$V_{GS} = V_{DS}, I_D = 10 \text{ mA}$	1.8	2.97	4.3	V
Recommended Gate Voltage	V_{GOP}		–5	–	+20	V
Drain-to-Source On Resistance	$R_{DS(\text{on})}$	$V_{GS} = 20 \text{ V}, I_D = 35 \text{ A}, T_J = 25^\circ\text{C}$	–	39	56	$\text{m}\Omega$
		$V_{GS} = 20 \text{ V}, I_D = 35 \text{ A}, T_J = 175^\circ\text{C}$	–	67	100	
Forward Transconductance	g_{FS}	$V_{DS} = 20 \text{ V}, I_D = 35 \text{ A}$	–	20	–	S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}, V_{DS} = 800 \text{ V}$	–	1781	–	pF
Output Capacitance	C_{OSS}		–	140	–	
Reverse Transfer Capacitance	C_{RSS}		–	12	–	
Total Gate Charge	$Q_{G(\text{tot})}$	$V_{GS} = -5/20 \text{ V}, V_{DS} = 600 \text{ V}, I_D = 47 \text{ A}$	–	106	–	nC
Threshold Gate Charge	$Q_{G(\text{th})}$		–	16	–	
Gate-to-Source Charge	Q_{GS}		–	34	–	
Gate-to-Drain Charge	Q_{GD}		–	26	–	
Gate Resistance	R_G		$f = 1 \text{ MHz}$	–	2.2	–

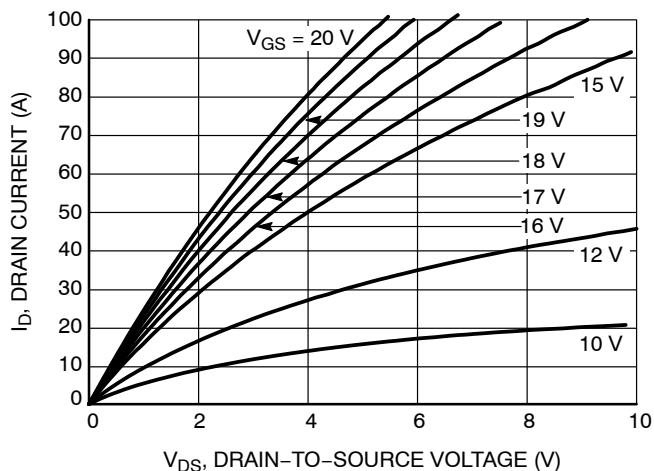
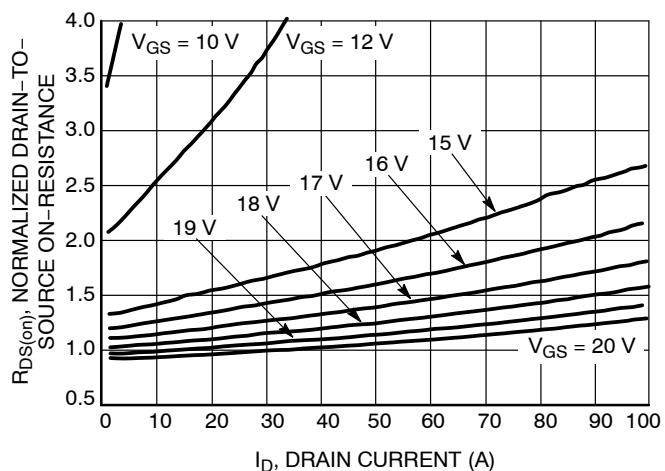
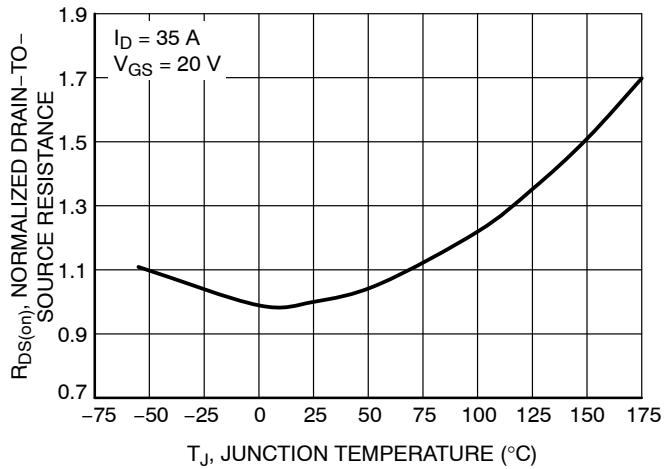
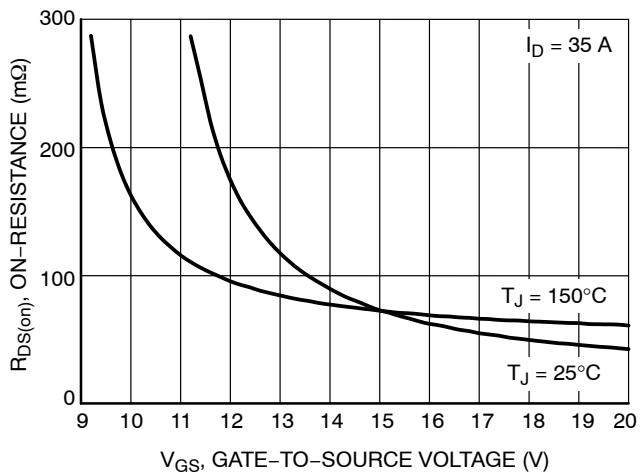
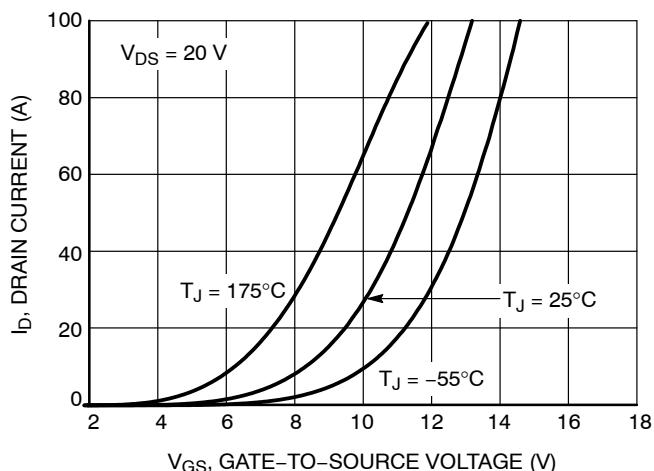
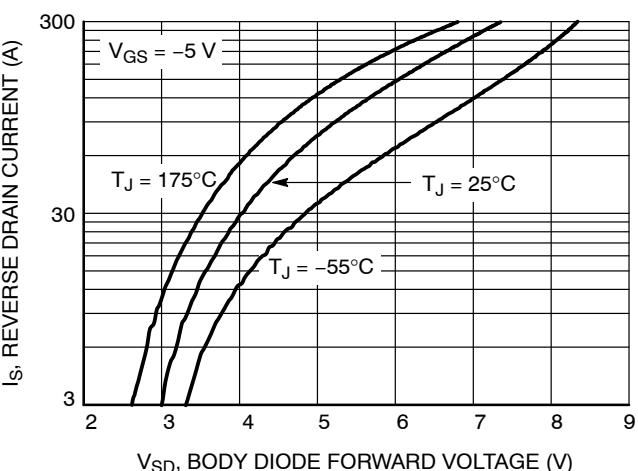
SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(\text{on})}$	$V_{GS} = -5/20 \text{ V}, V_{DS} = 800 \text{ V}, I_D = 47 \text{ A}, R_G = 4.7 \Omega, \text{Inductive Load}$	–	18	–	ns
Rise Time	t_r		–	41	–	
Turn-Off Delay Time	$t_{d(\text{off})}$		–	33	–	
Fall Time	t_f		–	10.4	–	
Turn-On Switching Loss	E_{ON}		–	1003	–	
Turn-Off Switching Loss	E_{OFF}		–	247	–	
Total Switching Loss	E_{TOT}		–	1248	–	

DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-to-Source Diode Forward Current	I_{SD}	$V_{GS} = -5 \text{ V}, T_J = 25^\circ\text{C}$	–	–	34	A
Pulsed Drain-to-Source Diode Forward Current (Note 2)	I_{SDM}	$V_{GS} = -5 \text{ V}, T_J = 25^\circ\text{C}$	–	–	240	A
Forward Diode Voltage	V_{SD}	$V_{GS} = -5 \text{ V}, I_{SD} = 17.5 \text{ A}, T_J = 25^\circ\text{C}$	–	3.8	–	V
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/20 \text{ V}, I_{SD} = 47 \text{ A}, dI_{SD}/dt = 1000 \text{ A}/\mu\text{s}$	–	24	–	ns
Reverse Recovery Charge	Q_{RR}		–	125	–	
Reverse Recovery Energy	E_{REC}		–	8.5	–	
Peak Reverse Recovery Current	I_{RRM}		–	10.4	–	
Charge Time	t_a		–	12.4	–	
Discharge Time	t_b		–	11.6	–	ns

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

Figure 1. On-Region Characteristics

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

Figure 3. On-Resistance Variation with Temperature

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

Figure 5. Transfer Characteristics

Figure 6. Diode Forward Voltage vs. Current

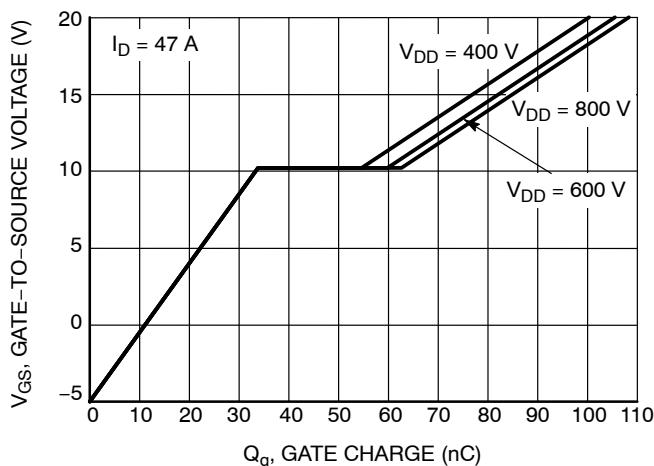
TYPICAL CHARACTERISTICS


Figure 7. Gate-to-Source Voltage vs. Total Charge

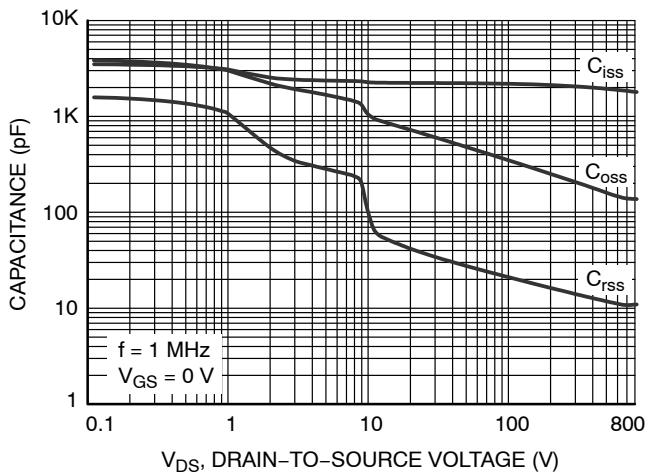


Figure 8. Capacitance vs. Drain-to-Source Voltage

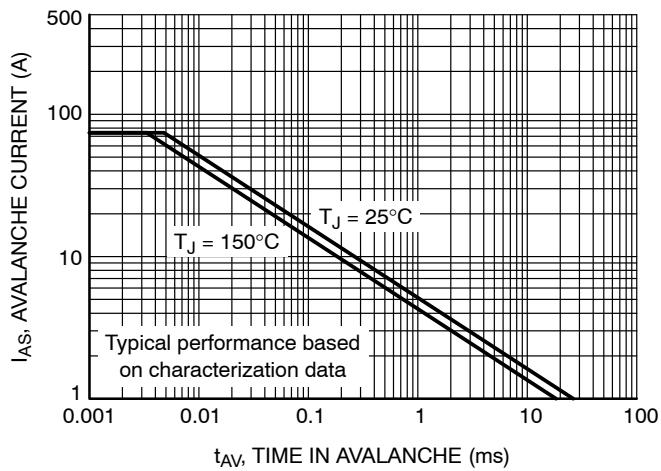


Figure 9. Unclamped Inductive Switching Capability

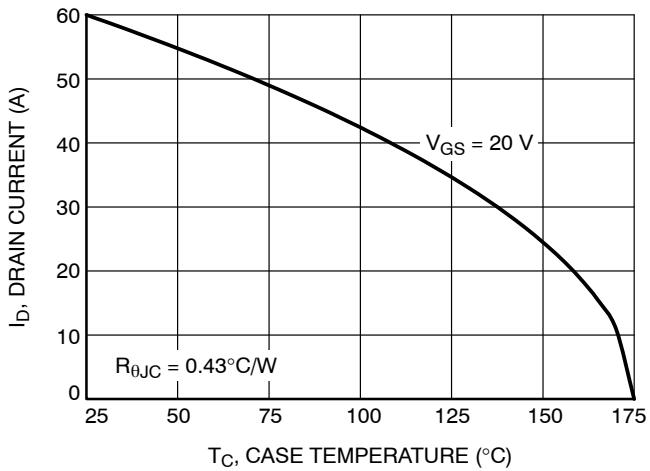


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

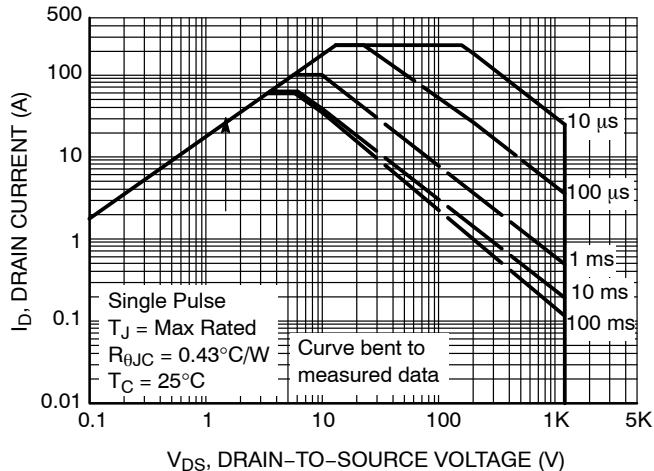


Figure 11. Safe Operating Area

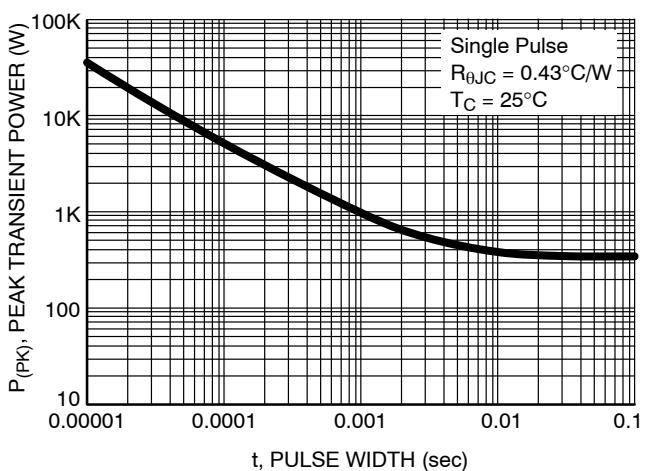


Figure 12. Single Pulse Maximum Power Dissipation

NVHL040N120SC1

TYPICAL CHARACTERISTICS

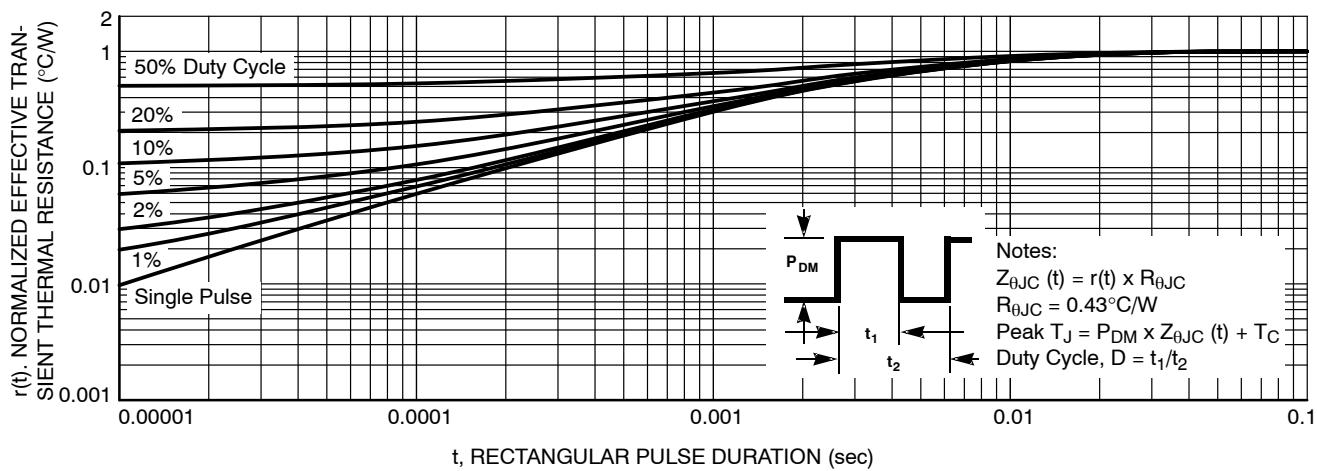


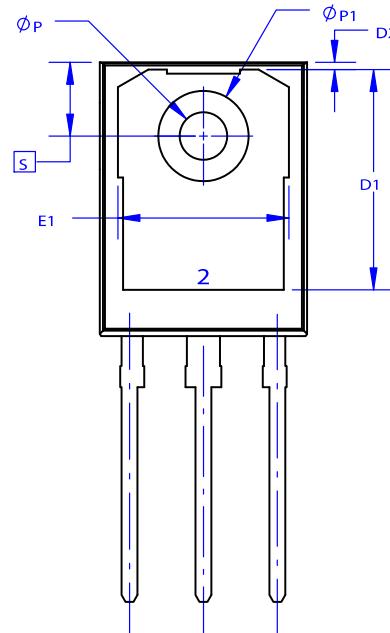
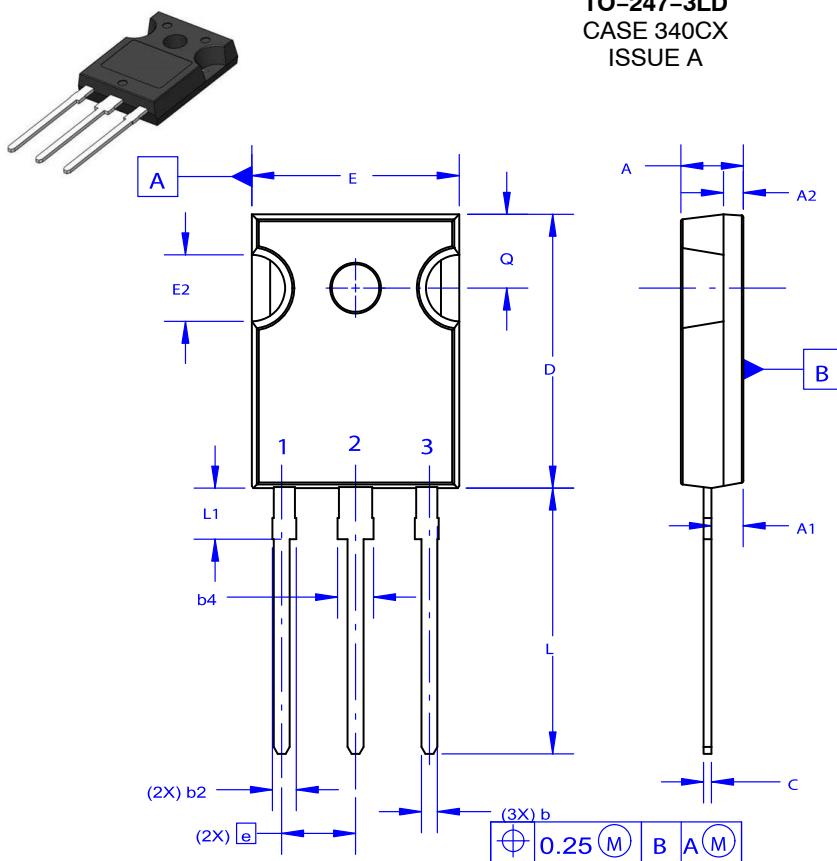
Figure 13. Junction-to-Ambient Thermal Response

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NVHL040N120SC1	NVHL040N120SC1	TO-247 Long Lead	Tube	N/A	N/A	30 Units

TO-247-3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020

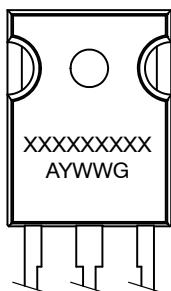


DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ΦP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ΦP1	6.60	6.80	7.00

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.

**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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