

# MOSFET - SiC Power, Single N-Channel

**900 V, 60 mΩ, 46 A****NVH4L060N090SC1****Features**

- Typ.  $R_{DS(on)} = 60 \text{ m}\Omega$  @  $V_{GS} = 15 \text{ V}$
- Typ.  $R_{DS(on)} = 43 \text{ m}\Omega$  @  $V_{GS} = 18 \text{ V}$
- Ultra Low Gate Charge (typ.  $Q_{G(tot)} = 87 \text{ nC}$ )
- Low Effective Output Capacitance (typ.  $C_{oss} = 113 \text{ pF}$ )
- 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** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	900	V	
Gate-to-Source Voltage		$V_{GS}$	+22/-8	V	
Recommended Operation Values of Gate-to-Source Voltage	$T_C < 175^\circ\text{C}$		$V_{GSop}$	-5/+15	
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	46	
Power Dissipation $R_{\theta JC}$			$P_D$	221	
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 100^\circ\text{C}$	$I_D$	32	
Power Dissipation $R_{\theta JC}$			$P_D$	110	
Pulsed Drain Current (Note 2)	$T_A = 25^\circ\text{C}$		$I_{DM}$	211	
Single Pulse Surge Drain Current Capability (Note 3)	$T_A = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$ , $R_G = 4.7 \Omega$		$I_{DSC}$	320	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$		-55 to +175	°C	
Source Current (Body Diode)	$I_S$		22	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 18 \text{ A}$ , $L = 1 \text{ mH}$ ) (Note 4)	$E_{AS}$		162	mJ	

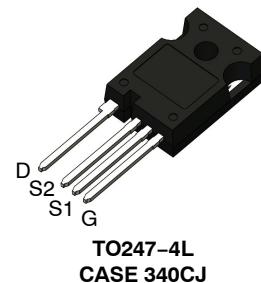
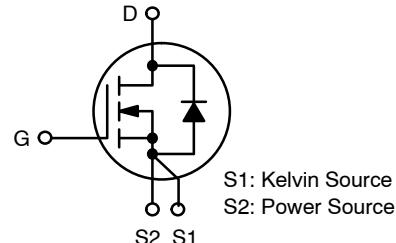
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**THERMAL RESISTANCE MAXIMUM RATINGS**

Parameter		Symbol	Value	Unit
Junction-to-Case (Note 1)		$R_{\theta JC}$	0.68	°C/W
Junction-to-Ambient (Note 1)		$R_{\theta JA}$	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. Peak current might be limited by transconductance.
4.  $E_{AS}$  of 162 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1 \text{ mH}$ ,  $I_{AS} = 18 \text{ A}$ ,  $V_{DD} = 100 \text{ V}$ ,  $V_{GS} = 15 \text{ V}$ .

$V_{(BR)DSS}$	$R_{DS(on)} \text{ MAX}$	$I_D \text{ MAX}$
900 V	84 mΩ @ 15 V	46 A

**MARKING DIAGRAM**

&Z = Assembly Plant Code  
&3 = Data Code (Year & Week)  
&K = Lot  
NVH4L060N090SC1 = Specific Device Code

**ORDERING INFORMATION**

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

# NVH4L060N090SC1

## ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}$	900			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1 \text{ mA}$ , referenced to $25^\circ\text{C}$		574		$\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0 \text{ V}, V_{DS} = 900 \text{ V}, T_J = 25^\circ\text{C}$		100		$\mu\text{A}$
		$V_{GS} = 0 \text{ V}, V_{DS} = 900 \text{ V}, T_J = 175^\circ\text{C}$		250		
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +22/-8 \text{ V}, V_{DS} = 0 \text{ V}$		$\pm 1$		$\mu\text{A}$
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(\text{th})}$	$V_{GS} = V_{DS}, I_D = 5 \text{ mA}$	1.8	2.7	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5		+15	V
Drain-to-Source On Resistance	$R_{DS(\text{on})}$	$V_{GS} = 15 \text{ V}, I_D = 20 \text{ A}, T_J = 25^\circ\text{C}$		60	84	$\text{m}\Omega$
		$V_{GS} = 18 \text{ V}, I_D = 20 \text{ A}, T_J = 25^\circ\text{C}$		43		
		$V_{GS} = 15 \text{ V}, I_D = 20 \text{ A}, T_J = 175^\circ\text{C}$		76		
Forward Transconductance	$g_{FS}$	$V_{DS} = 20 \text{ V}, I_D = 20 \text{ A}$		17		S
<b>CHARGES, CAPACITANCES &amp; GATE RESISTANCE</b>						
Input Capacitance	$C_{ISS}$	$V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}, V_{DS} = 450 \text{ V}$		1770		$\text{pF}$
Output Capacitance	$C_{OSS}$			113		
Reverse Transfer Capacitance	$C_{RSS}$			11		
Total Gate Charge	$Q_{G(\text{tot})}$	$V_{GS} = -5/15 \text{ V}, V_{DS} = 720 \text{ V}, I_D = 10 \text{ A}$		87		$\text{nC}$
Threshold Gate Charge	$Q_{G(\text{th})}$			17		
Gate-to-Source Charge	$Q_{GS}$			27		
Gate-to-Drain Charge	$Q_{GD}$			26		
Gate Resistance	$R_G$	$f = 1 \text{ MHz}$		3.0		$\Omega$
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{d(\text{on})}$	$V_{GS} = -5/15 \text{ V}, V_{DS} = 720 \text{ V}, I_D = 20 \text{ A}, R_G = 2.5 \Omega$ , Inductive Load		17	31	ns
Rise Time	$t_r$			15	27	
Turn-Off Delay Time	$t_{d(\text{off})}$			29	47	
Fall Time	$t_f$			11	20	
Turn-On Switching Loss	$E_{ON}$			183		$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$			52		
Total Switching Loss	$E_{TOT}$			235		
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Continuous Drain-to-Source Diode Forward Current	$I_{SD}$	$V_{GS} = -5 \text{ V}, T_J = 25^\circ\text{C}$			22	A
Pulsed Drain-to-Source Diode Forward Current (Note 2)	$I_{SDM}$	$V_{GS} = -5 \text{ V}, T_J = 25^\circ\text{C}$			184	A
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5 \text{ V}, I_{SD} = 10 \text{ A}, T_J = 25^\circ\text{C}$		3.9		V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5/15 \text{ V}, I_{SD} = 30 \text{ A}$ , $dI_{SD}/dt = 1000 \text{ A}/\mu\text{s}$ , $V_{DS} = 720 \text{ V}$		18		ns
Reverse Recovery Charge	$Q_{RR}$			84		$\text{nC}$
Reverse Recovery Energy	$E_{REC}$			1.0		$\mu\text{J}$
Peak Reverse Recovery Current	$I_{RRM}$			9.0		A
Charge Time	$t_a$			10		ns
Discharge Time	$t_b$			8.0		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

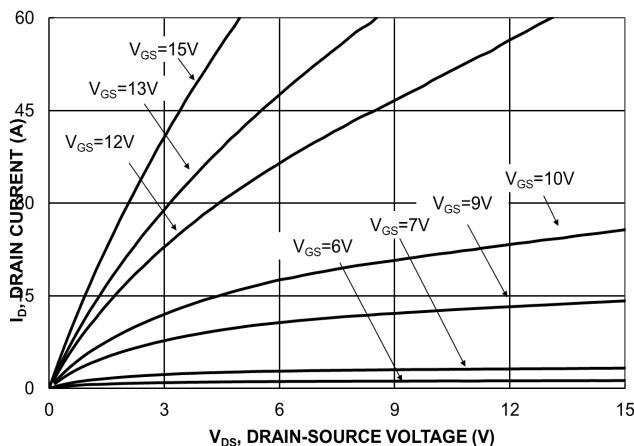


Figure 1. On-Region Characteristics

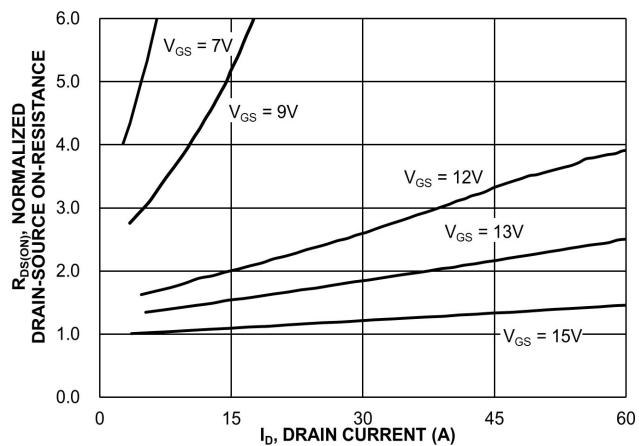


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

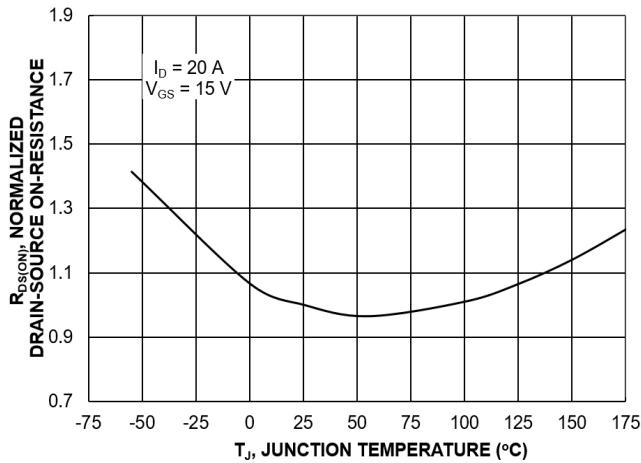


Figure 3. On-Resistance Variation with Temperature

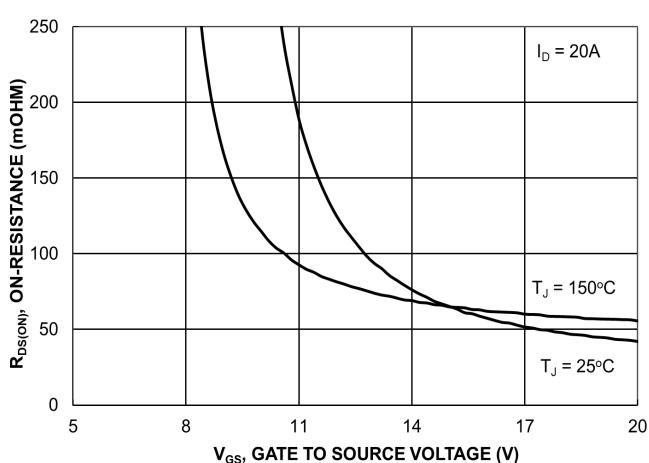


Figure 4. On-Resistance vs. Gate-to-Source Voltage

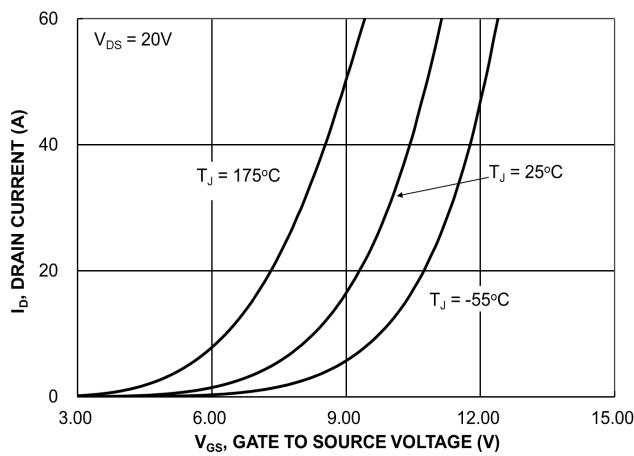


Figure 5. Transfer Characteristics

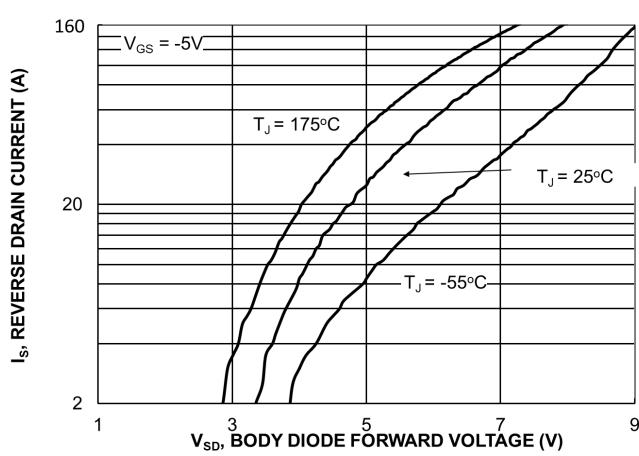


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

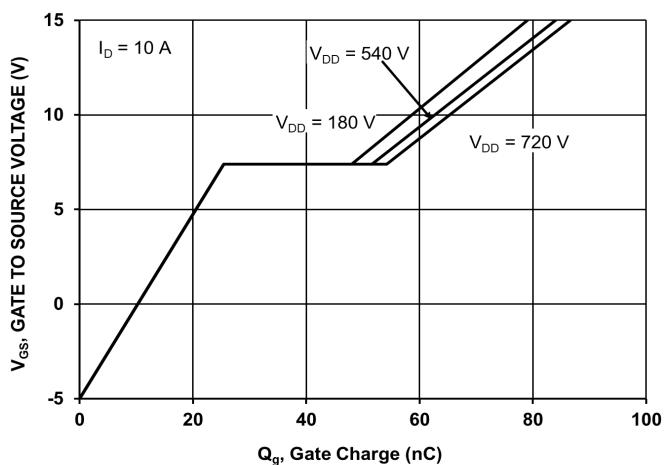


Figure 7. Gate-to-Source Voltage vs. Total Charge

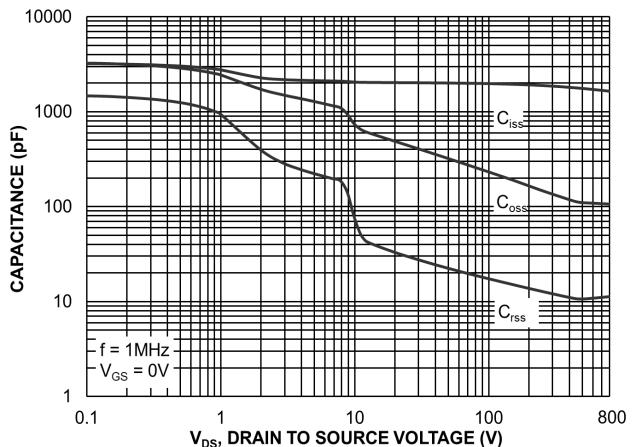


Figure 8. Capacitance vs. Drain-to-Source Voltage

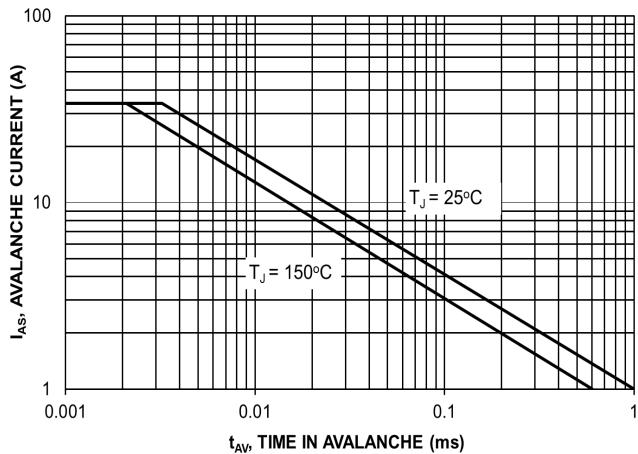


Figure 9. Unclamped Inductive Switching Capability

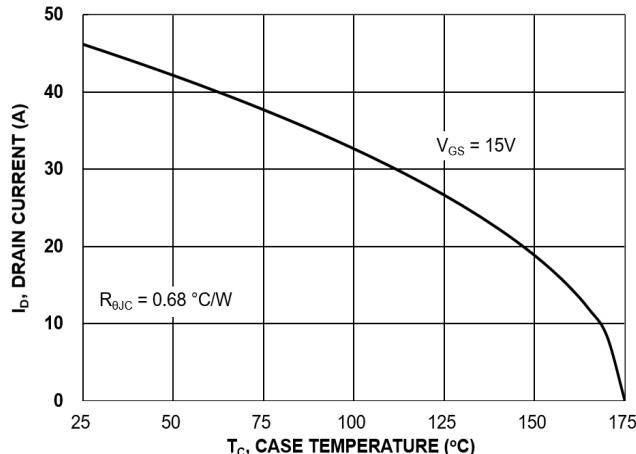


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

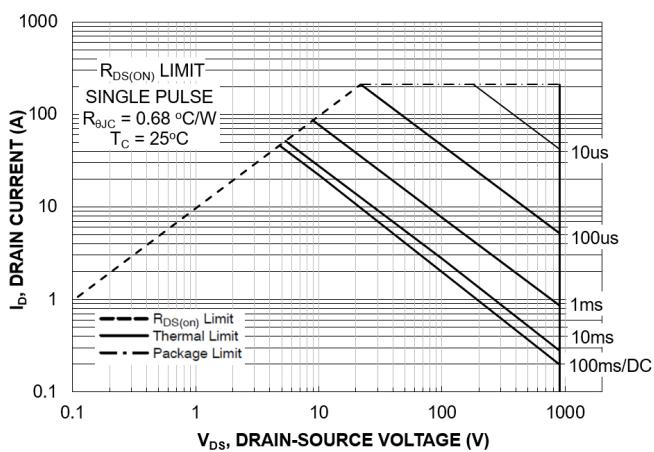


Figure 11. Safe Operating Area

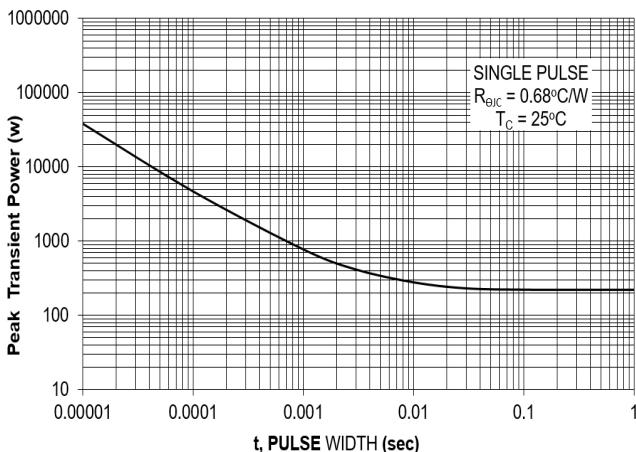


Figure 12. Single Pulse Maximum Power Dissipation

## TYPICAL CHARACTERISTICS

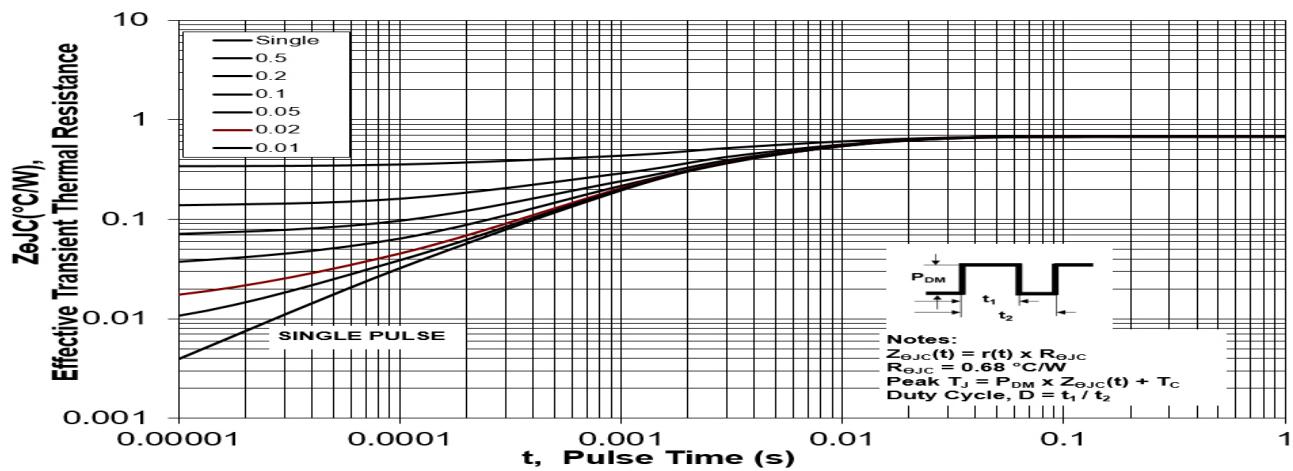


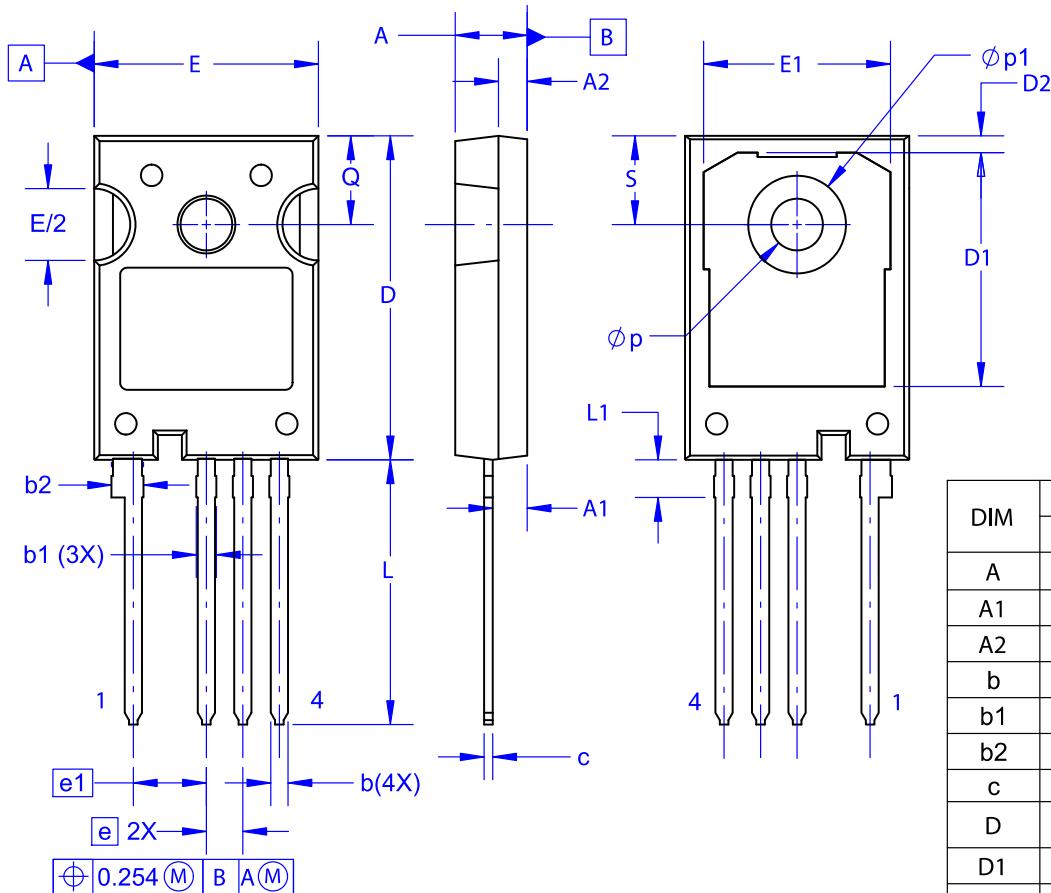
Figure 13. Junction-to-Ambient Thermal Response

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
N VH4L060N090SC1	H4L060N090SC1	TO247-4L	Tube	N/A	N/A	30 Units

## PACKAGE DIMENSIONS

TO-247-4LD  
CASE 340CJ  
ISSUE A



## NOTES:

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5-2009.

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

**onsemi, ONSEMI**, and other names, marks, and brands are registered and/or common law trademarks of Components Industries, LLC dba “**onsemi**” or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**’s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided “as-is” and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. “Typical” parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including “Typicals” must be validated for each customer application by customer’s technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

### TECHNICAL SUPPORT

#### North American Technical Support:

Voice Mail: 1 800-282-9855 Toll Free USA/Canada

Phone: 011 421 33 790 2910

#### Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[onsemi](#):

[NVH4L060N090SC1](#)