

Silicon Carbide (SiC) MOSFET – 60 mohm, 900 V, M2, TO-247-4L

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
- AEC-Q101 Qualified and PPAP Capable
- This Device is Halide Free and RoHS Compliant with exemption 7a,
Pb-Free 2LI (on second level interconnection)

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	V
Continuous Drain Current $R_{\theta JC}$	Steady State $T_C = 25^\circ\text{C}$	I_D	46	A
Power Dissipation $R_{\theta JC}$		P_D	221	W
Continuous Drain Current $R_{\theta JC}$	Steady State $T_C = 100^\circ\text{C}$	I_D	32	A
Power Dissipation $R_{\theta JC}$		P_D	110	W
Pulsed Drain Current (Note 2)	$T_A = 25^\circ\text{C}$	I_{DM}	211	A
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	A
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
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

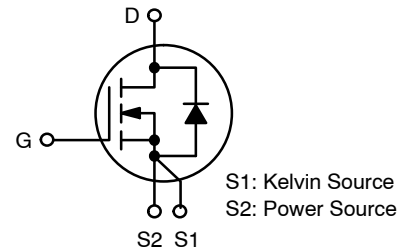
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE MAXIMUM RATINGS

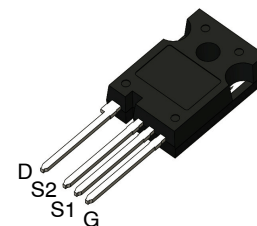
Parameter	Symbol	Value	Unit
Junction-to-Case (Note 1)	$R_{\theta JC}$	0.68	$^\circ\text{C/W}$
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	40	$^\circ\text{C/W}$

- The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
- Repetitive rating, limited by max junction temperature.
- Peak current might be limited by transconductance.
- 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 m Ω @ 15 V	46 A

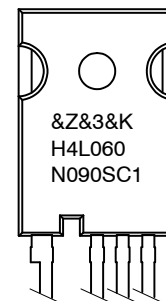


N-CHANNEL MOSFET



TO247-4L
CASE 340CJ

MARKING DIAGRAM



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

ORDERING INFORMATION

Device	Package	Shipping
NVH4L060N090SC1	TO247-4L	30 Units / Tube

NVH4L060N090SC1

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	900			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$, referenced to 25°C		574		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	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 900\text{ V}, T_J = 175^\circ\text{C}$			250	
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +22/-8\text{ V}, V_{DS} = 0\text{ V}$			± 1	μA

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		+15	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 15\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$		60	84	m Ω
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$		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

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 450\text{ V}$		1770		pF
Output Capacitance	C_{OSS}			113		
Reverse Transfer Capacitance	C_{RSS}			11		
Total Gate Charge	$Q_{G(tot)}$	$V_{GS} = -5/15\text{ V}, V_{DS} = 720\text{ V}, I_D = 10\text{ A}$		87		nC
Threshold Gate Charge	$Q_{G(th)}$			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		Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = -5/15\text{ V}, V_{DS} = 720\text{ V}, I_D = 20\text{ A}, R_G = 2.5\text{ }\Omega$, Inductive Load		17	31	ns
Rise Time	t_r			15	27	
Turn-Off Delay Time	$t_{d(off)}$			29	47	
Fall Time	t_f			11	20	
Turn-On Switching Loss	E_{ON}			183		μJ
Turn-Off Switching Loss	E_{OFF}			52		
Total Switching Loss	E_{TOT}			235		

DRAIN-SOURCE DIODE CHARACTERISTICS

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}	$V_{GS} = -5/15\text{ V}, I_{SD} = 30\text{ A}, dI_S/dt = 1000\text{ A}/\mu\text{s}, V_{DS} = 720\text{ V}$		18		ns
Reverse Recovery Charge	Q_{RR}			84		nC
Reverse Recovery Energy	E_{REC}			1.0		μJ
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

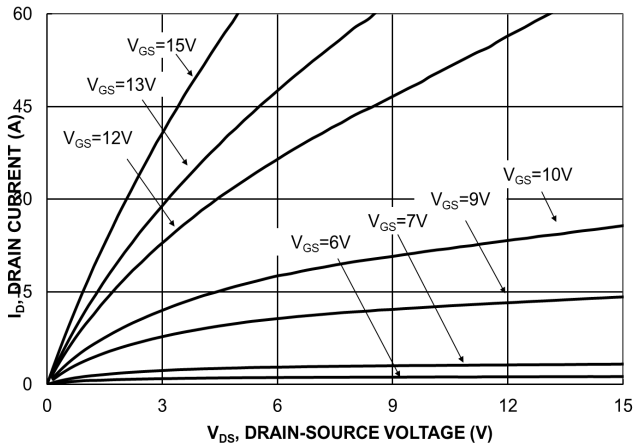


Figure 1. On-Region Characteristics

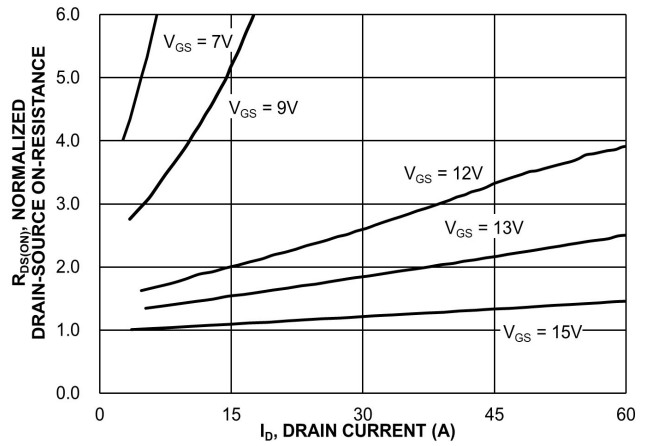


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

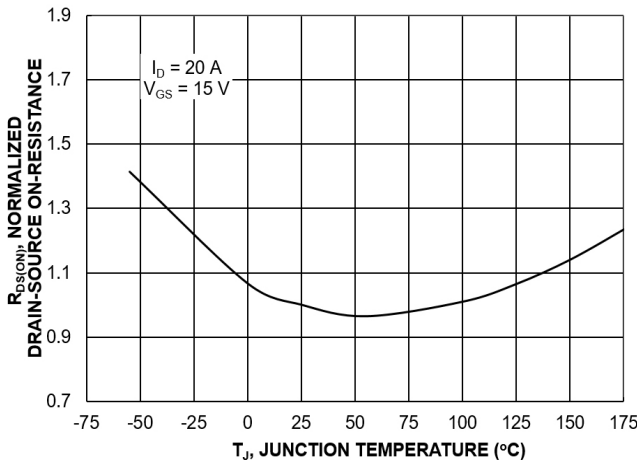


Figure 3. On-Resistance Variation with Temperature

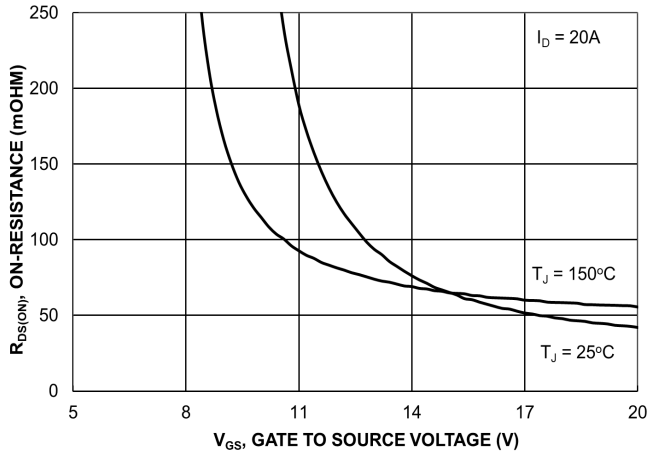


Figure 4. On-Resistance vs. Gate-to-Source Voltage

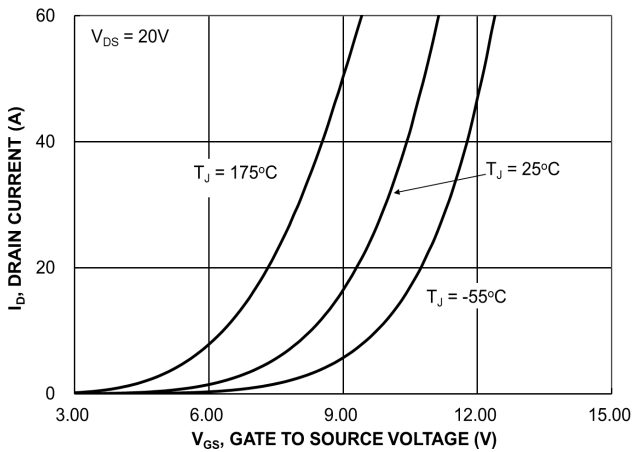


Figure 5. Transfer Characteristics

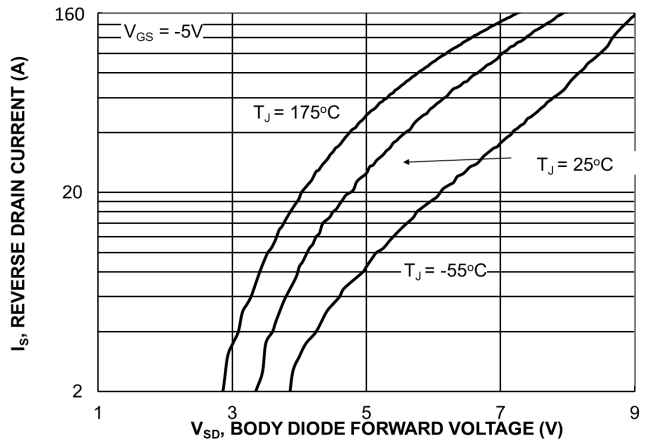


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (continued)

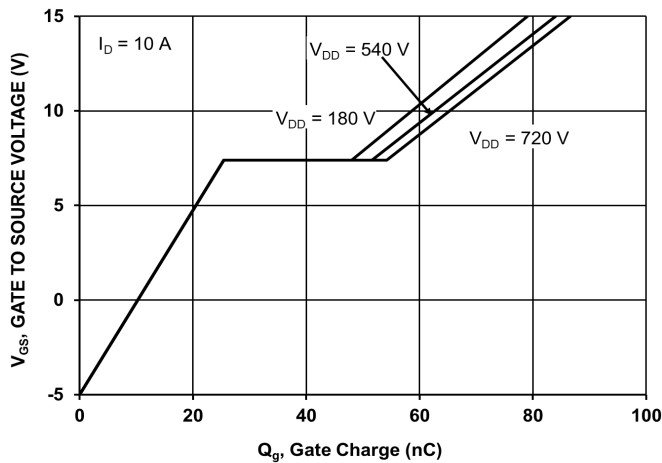


Figure 7. Gate-to-Source Voltage vs. Total Charge

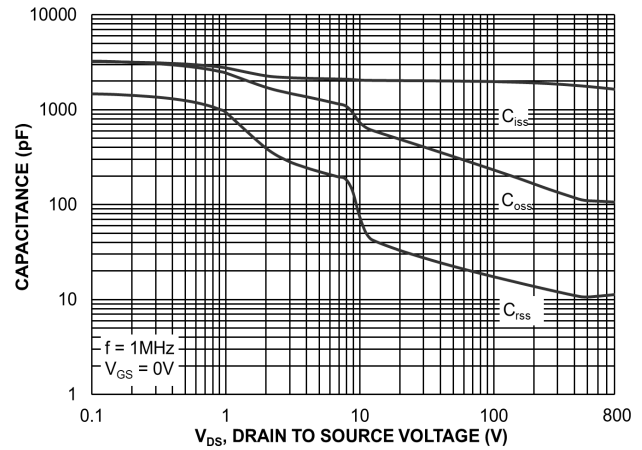


Figure 8. Capacitance vs. Drain-to-Source Voltage

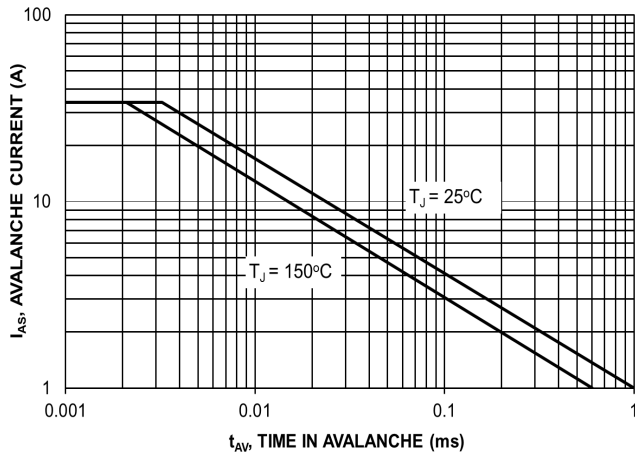


Figure 9. Unclamped Inductive Switching Capability

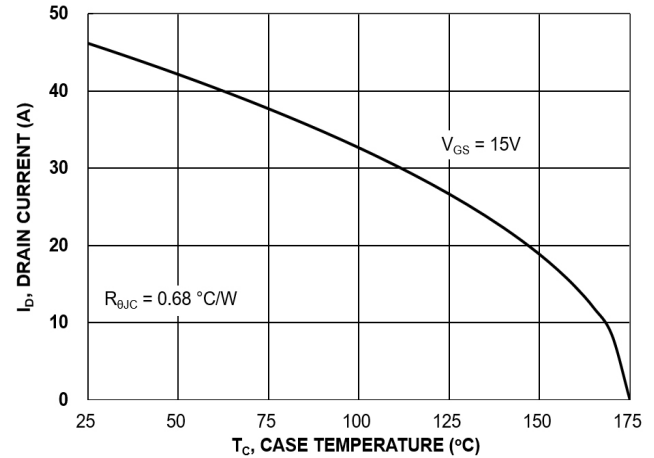


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

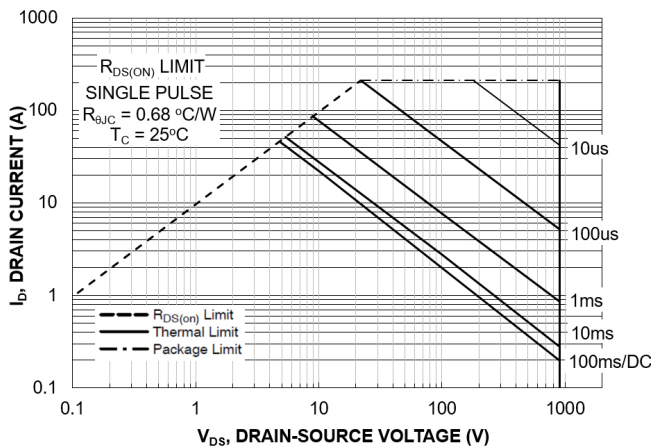


Figure 11. Safe Operating Area

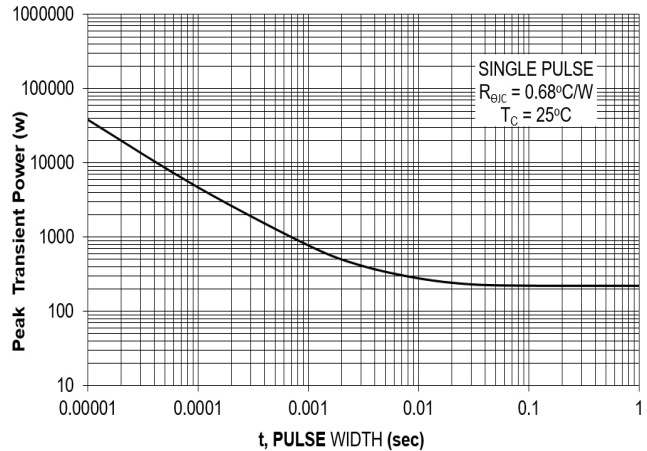


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (continued)

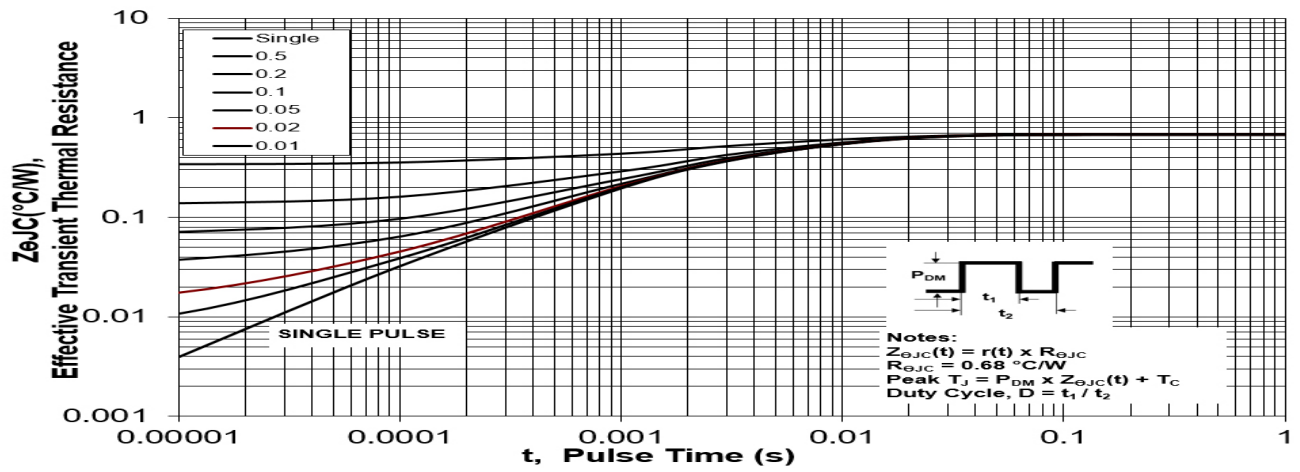
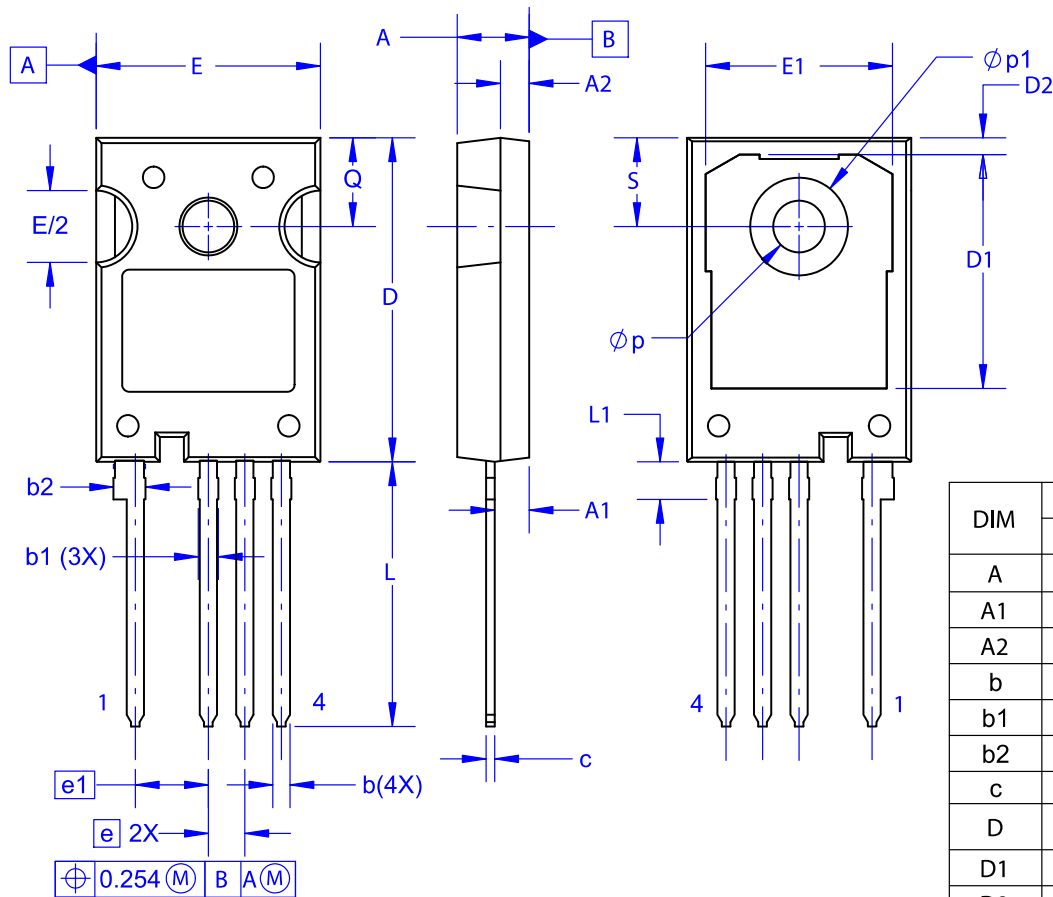


Figure 13. Junction-to-Ambient Thermal Response

TO-247-4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019


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

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