

MOSFET - SiC Power, Single N-Channel, TO247-3L

650 V, 44 mΩ, 47 A

NVHL060N065SC1

Features

- Typ. $R_{DS(on)} = 44\text{ m}\Omega @ V_{GS} = 18\text{ V}$
Typ. $R_{DS(on)} = 60\text{ m}\Omega @ V_{GS} = 15\text{ V}$
- Ultra Low Gate Charge ($Q_{G(tot)} = 74\text{ nC}$)
- High Speed Switching with Low Capacitance ($C_{oss} = 133\text{ pF}$)
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- This Device is Pb-Free and is 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)

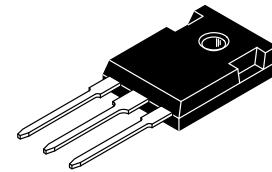
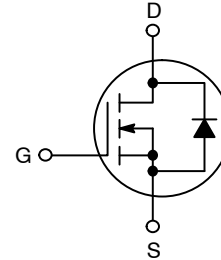
Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V_{DSS}	650	V	
Gate-to-Source Voltage		V_{GS}	-8/+22	V	
Recommended Operation Values of Gate-to-Source Voltage		$T_C < 175^\circ\text{C}$ V_{GSop}	-5/+18	V	
Continuous Drain Current (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	I_D	47	A
			P_D	176	W
Power Dissipation (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	I_D	33	A
			P_D	88	W
Continuous Drain Current (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	I_D	33	A
Power Dissipation (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	P_D	88	W
Pulsed Drain Current (Note 2)	$T_C = 25^\circ\text{C}$		I_{DM}	143	A
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)		I_S	47	A	
Single Pulse Drain-to-Source Avalanche Energy ($I_{L(pk)} = 10.1\text{ A}$, $L = 1\text{ mH}$) (Note 3)		E_{AS}	51	mJ	
Maximum Lead Temperature for Soldering (1/8" from case for 5 s)		T_L	260	$^\circ\text{C}$	

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. 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. EAS of 51 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 1\text{ mH}$, $I_{AS} = 10.1\text{ A}$, $V_{DD} = 50\text{ V}$, $V_{GS} = 18\text{ V}$.

$V_{(BR)DSS}$	$R_{DS(ON)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	70 mΩ @ 18 V	47 A

N-CHANNEL MOSFET



TO-247-3LD
CASE 340CX

MARKING DIAGRAM



HL060N065SC1 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NVHL060N065SC1	TO247-3L	30 Units / Tube

NVHL060N065SC1

THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	0.85	°C/W
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	40	

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650	-	-	V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 20\text{ mA}$, referenced to 25°C	-	0.15	-	V/°C	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$	$T_J = 25^\circ\text{C}$	-	-	10	μA
			$T_J = 175^\circ\text{C}$	-	-	1	mA
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +18/-5\text{ V}, V_{DS} = 0\text{ V}$	-	-	250	nA	

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 6.5\text{ mA}$	1.8	2.8	4.3	V
Recommended Gate Voltage	V_{GOP}		-5	-	+18	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	-	m Ω
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$	-	44	70	
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175^\circ\text{C}$	-	49	-	
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$	-	12	-	S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 325\text{ V}$	-	1473	-	pF
Output Capacitance	C_{OSS}		-	133	-	
Reverse Transfer Capacitance	C_{RSS}		-	13	-	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 520\text{ V}, I_D = 20\text{ A}$	-	74	-	nC
Gate-to-Source Charge	Q_{GS}		-	20	-	
Gate-to-Drain Charge	Q_{GD}		-	23	-	
Gate-Resistance	R_G	$f = 1\text{ MHz}$	-	3.9	-	Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 400\text{ V}, I_D = 20\text{ A}, R_G = 2.2\text{ }\Omega$ inductive load	-	12	-	ns
Rise Time	t_r		-	32	-	
Turn-Off Delay Time	$t_{d(OFF)}$		-	23	-	
Fall Time	t_f		-	8	-	
Turn-On Switching Loss	E_{ON}		-	181	-	μJ
Turn-Off Switching Loss	E_{OFF}		-	25	-	
Total Switching Loss	E_{tot}		-	206	-	

DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-Source Diode Forward Current	I_{SD}	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$	-	-	47	A
Pulsed Drain-Source Diode Forward Current (Note 2)	I_{SDM}		-	-	143	
Forward Diode Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 25^\circ\text{C}$	-	4.3	-	V

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN-SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/18\text{ V}, I_{SD} = 20\text{ A},$ $dI_S/dt = 1000\text{ A}/\mu\text{s}$	-	18	-	ns
Reverse Recovery Charge	Q_{RR}		-	85	-	nC
Reverse Recovery Energy	E_{REC}		-	11	-	μJ
Peak Reverse Recovery Current	I_{RRM}		-	10	-	A
Charge time	T_a		-	10	-	ns
Discharge time	T_b		-	7.6	-	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

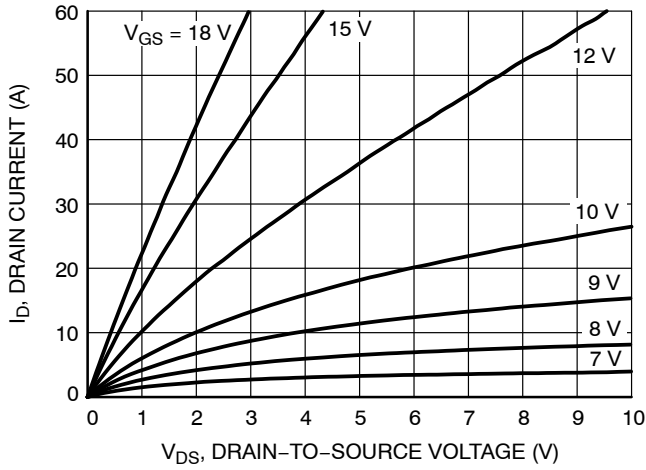


Figure 1. On-Region Characteristics

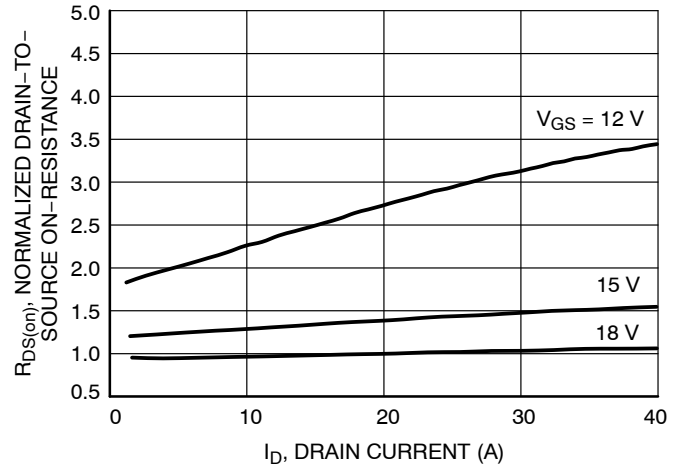


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

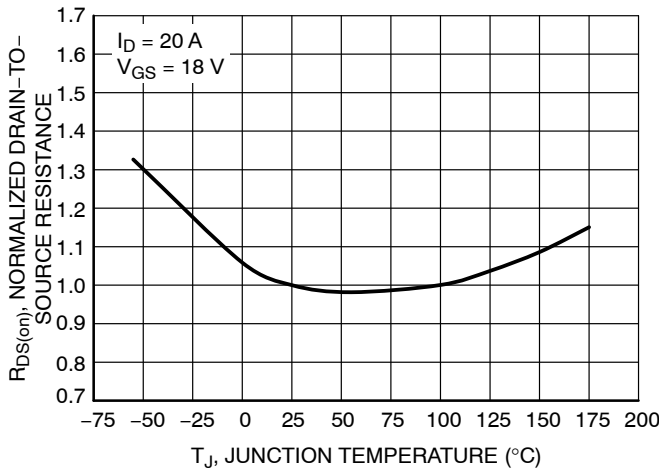


Figure 3. On-Resistance Variation with Temperature

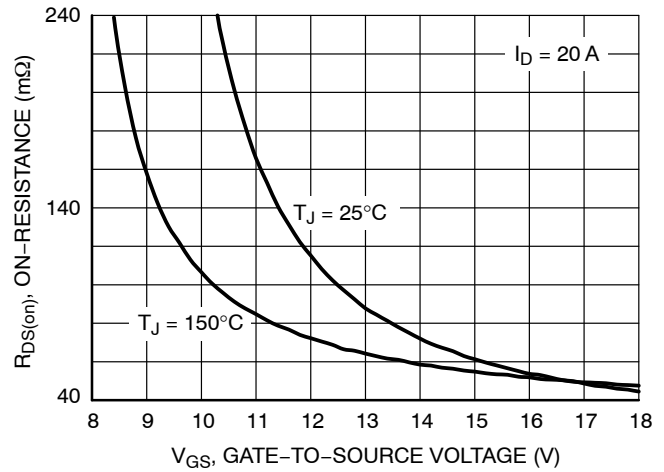


Figure 4. On-Resistance vs. Gate-to-Source Voltage

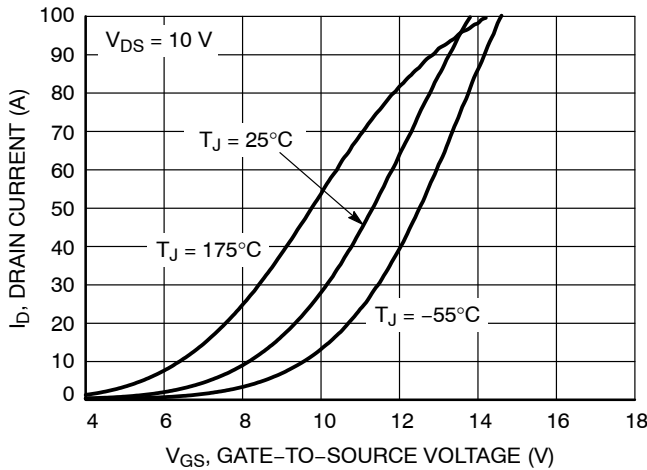


Figure 5. Transfer Characteristics

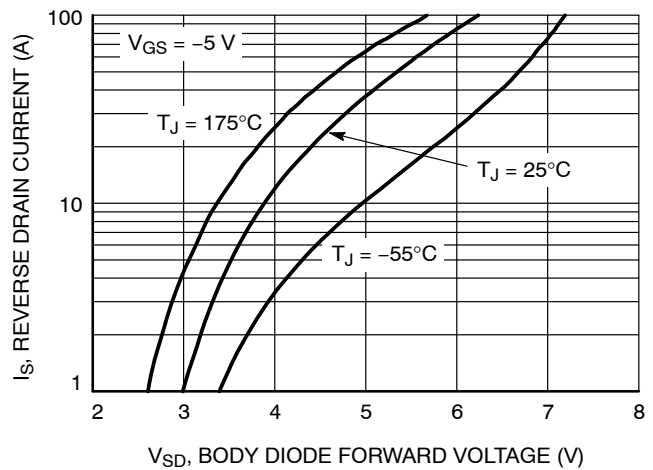


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

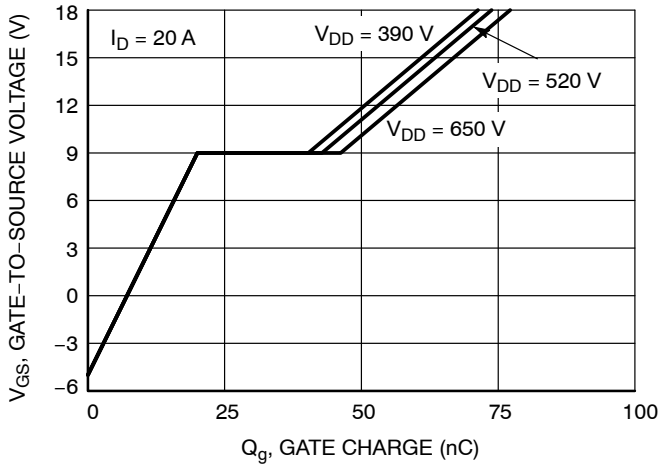


Figure 7. Gate-to-Source Voltage vs. Total Charge

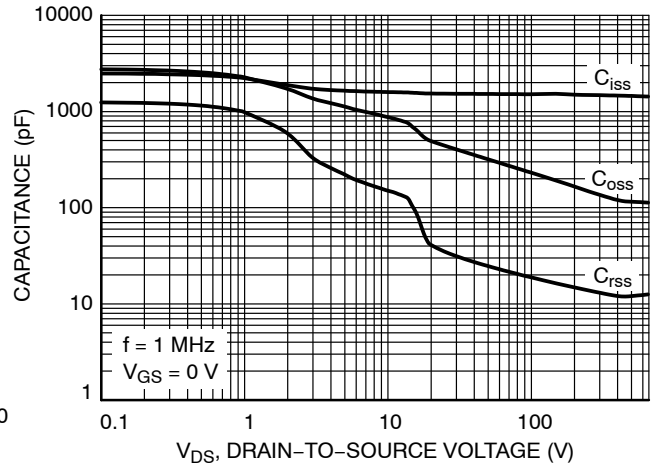


Figure 8. Capacitance vs. Drain-to-Source Voltage

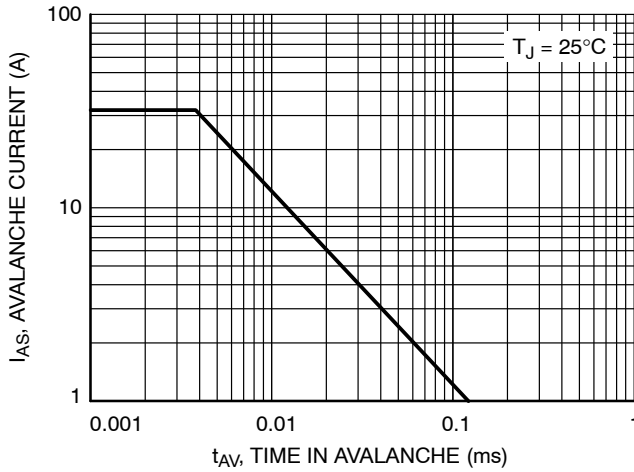


Figure 9. Unclamped Inductive Switching Capability

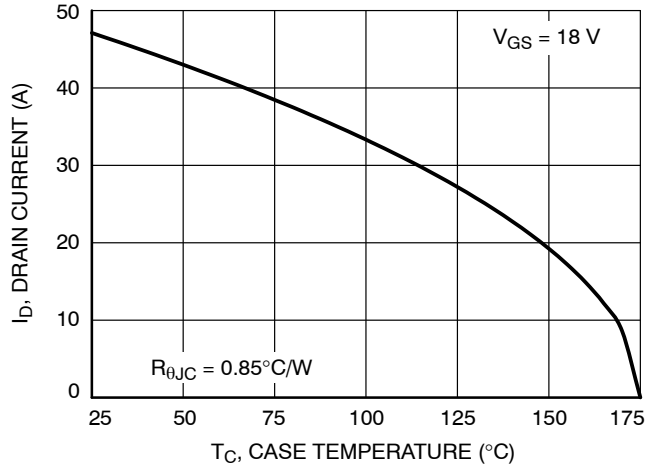


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

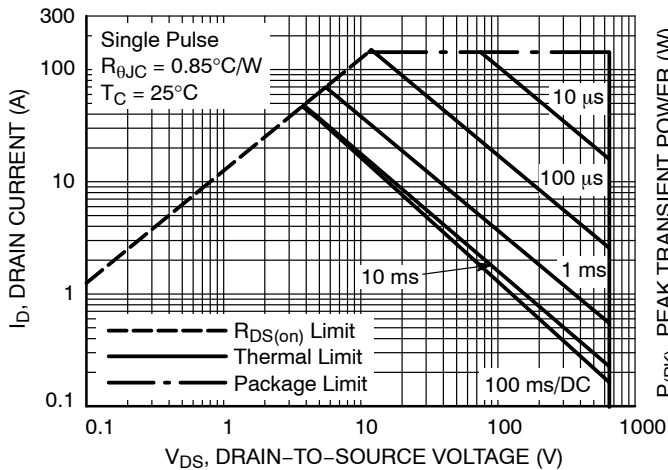


Figure 11. Safe Operating Area

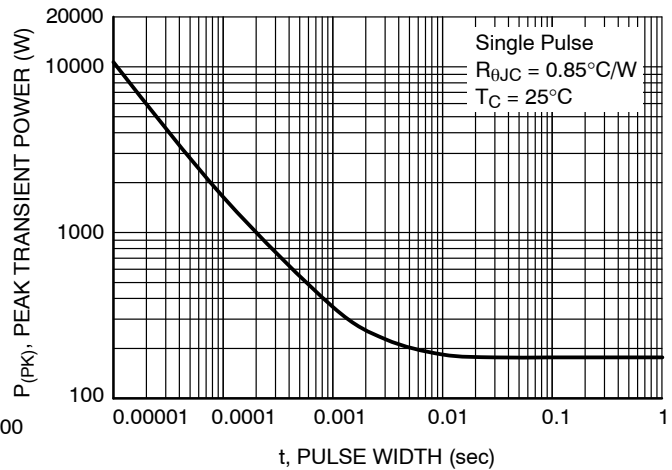


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

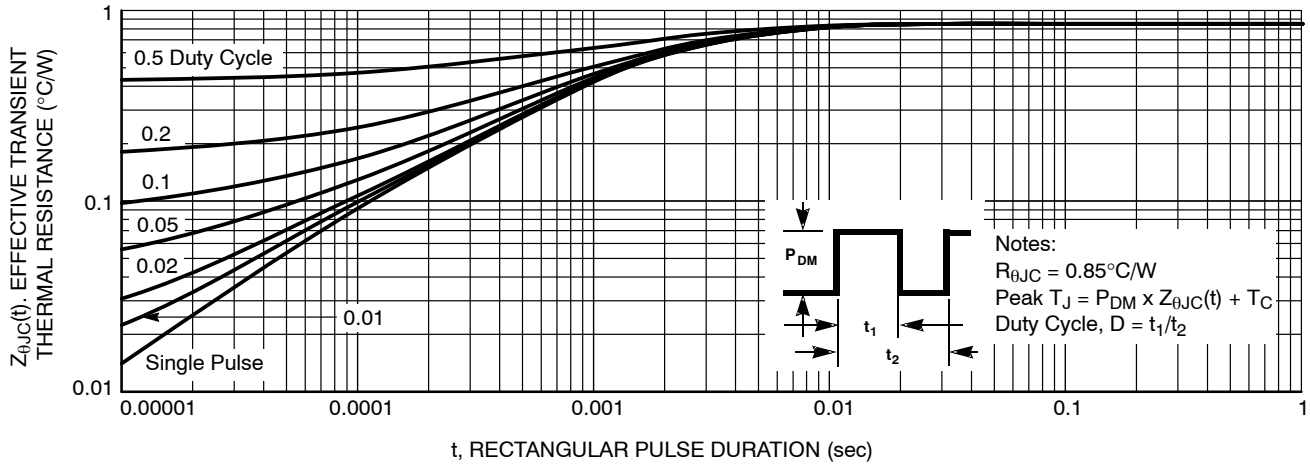
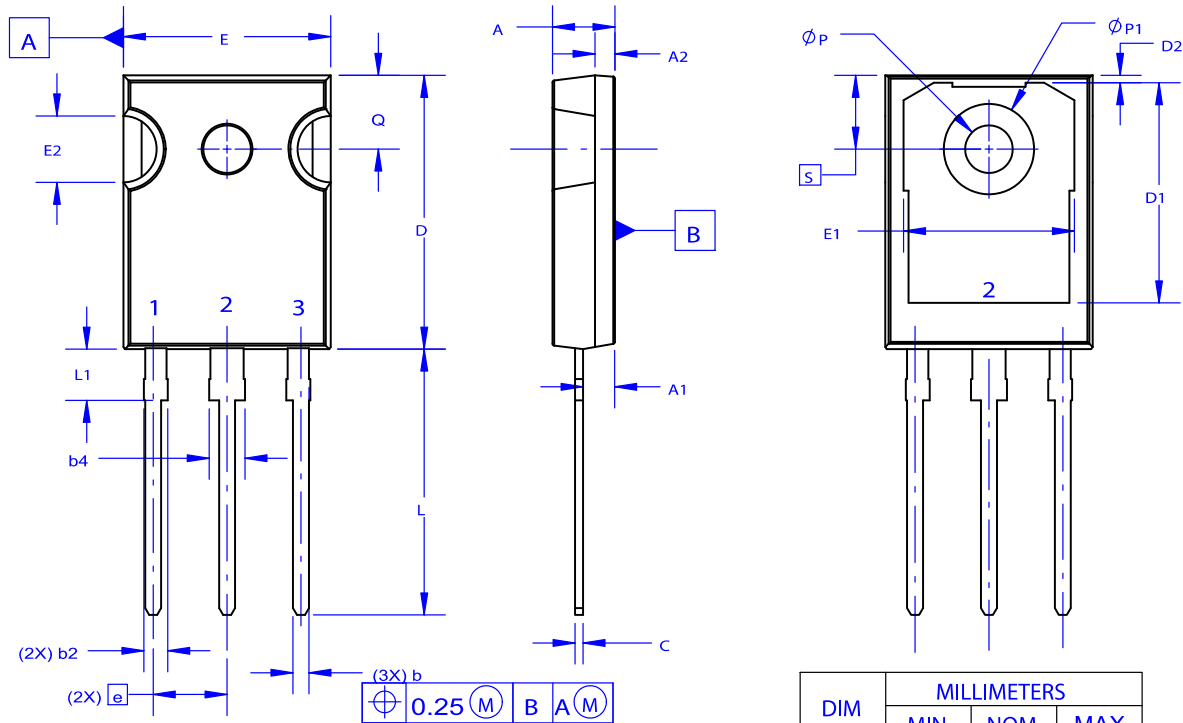


Figure 13. Junction-to-Case Thermal Response

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PACKAGE DIMENSIONS

TO-247-3LD
CASE 340CX
ISSUE A



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
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	~	~
$\phi P1$	6.60	6.80	7.00

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