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DATA SHEET
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Silicon Carbide (SiC) MOSFET – 60 mohm, 900 V, M2, TO-247-3L

NVHL060N090SC1

Features

- Typ. $R_{DS(on)}$ = 60 mΩ @ V_{GS} = 15 V
- Typ. $R_{DS(on)}$ = 43 mΩ @ V_{GS} = 18 V
- Ultra Low Gate Charge (typ. $Q_{G(tot)}$ = 87 nC)
- Low Effective Output Capacitance (typ. C_{oss} = 113 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

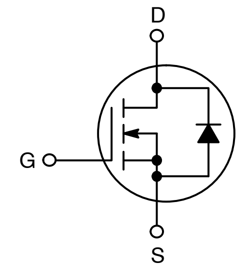
MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

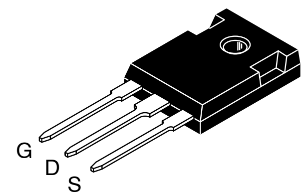
Parameter	Conditions		Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	900	V
Gate−to−Source Voltage			V_{GS}	+22/−8	V
Recommended Operation Values of Gate−to−Source Voltage	T_C < 175°C		V_{GSop}	+15/−5	V
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 25°C	I_D	46	A
Power Dissipation $R_{\theta JC}$	Steady State	T_C = 25°C	P_D	221	W
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 100°C	I_D	32	A
Power Dissipation $R_{\theta JC}$	Steady State	T_C = 100°C	P_D	110	W
Pulsed Drain Current (Note 2)	T_A = 25°C		I_{DM}	184	A
Single Pulse Surge Drain Current Capability (Note 3)	T_A = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	320	A
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 A, L = 1 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.

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

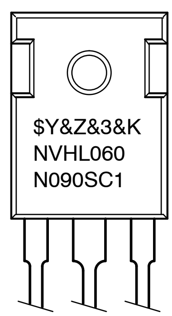
N−CHANNEL MOSFET





TO−247−3LD
CASE 340CX

MARKING DIAGRAM



$Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = Data Code (Year & Week)
&K = Lot
NVHL060N090SC1 = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
NVHL060N090SC1	TO247−3L	30 Units / Tube

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°C; L = 1 mH, I_{AS} = 18 A, V_{DD} = 100 V, V_{GS} = 15 V.

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA	900			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = 1 mA, referenced to 25°C		574		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 900 V, T_J = 25°C			100	μA
		V_{GS} = 0 V, V_{DS} = 900 V, T_J = 175°C			250	
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = +22/−8 V, V_{DS} = 0 V			±1	μA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS} = V_{DS}, I_D = 5 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 V, I_D = 20 A, T_J = 25°C		60	84	mΩ
		V_{GS} = 18 V, I_D = 20 A, T_J = 25°C		43		
		V_{GS} = 15 V, I_D = 20 A, T_J = 175°C		76	135	
Forward Transconductance	g_{FS}	V_{DS} = 20 V, I_D = 20 A		17		S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 450 V		1770		pF
Output Capacitance	C_{OSS}			113		
Reverse Transfer Capacitance	C_{RSS}			11		
Total Gate Charge	$Q_{G(tot)}$	V_{GS} = −5/15 V, V_{DS} = 720 V, I_D = 10 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 MHz		3.0		Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	V_{GS} = −5/15 V, V_{DS} = 720 V, I_D = 20 A, R_G = 2.5 Ω, Inductive Load		22	40	ns
Rise Time	t_r			33	66	
Turn−Off Delay Time	$t_{d(off)}$			31	74	
Fall Time	t_f			11	20	
Turn-On Switching Loss	E_{ON}			464		μJ
Turn-Off Switching Loss	E_{OFF}			23		
Total Switching Loss	E_{TOT}			487		
DRAIN−SOURCE DIODE CHARACTERISTICS						
Continuous Drain−to−Source Diode Forward Current	I_{SD}	V_{GS} = −5 V, T_J = 25°C			22	A
Pulsed Drain−to−Source Diode Forward Current (Note 2)	I_{SDM}	V_{GS} = −5 V, T_J = 25°C			184	A
Forward Diode Voltage	V_{SD}	V_{GS} = −5 V, I_{SD} = 10 A, T_J = 25°C		3.9		V

ELECTRICAL CHARACTERISTICS (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −5/15 V, I_{SD} = 30 A, dI_S/dt = 1000 A/μs, V_{DS} = 720 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

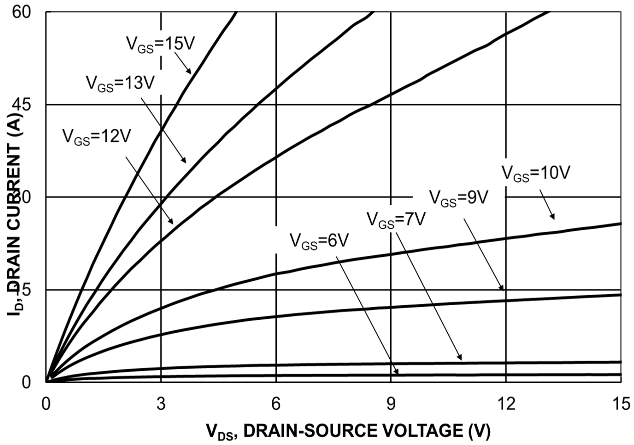


Figure 1. On−Region Characteristics

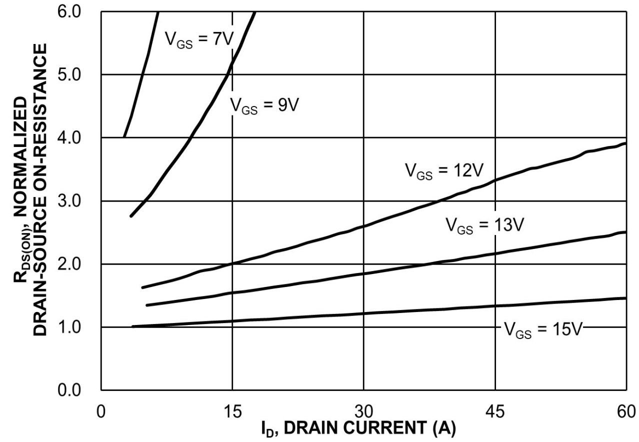


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

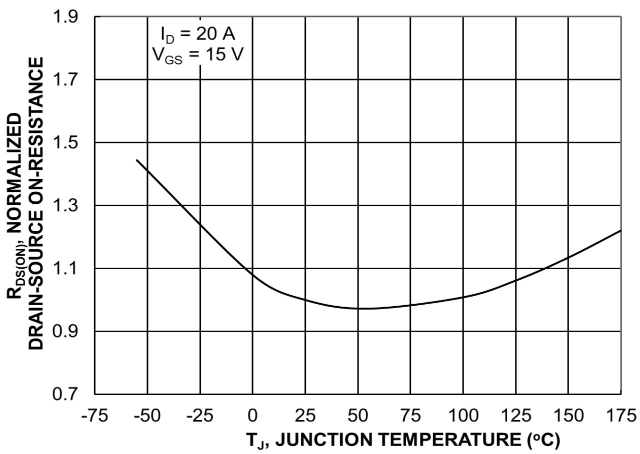


Figure 3. On−Resistance Variation with Temperature

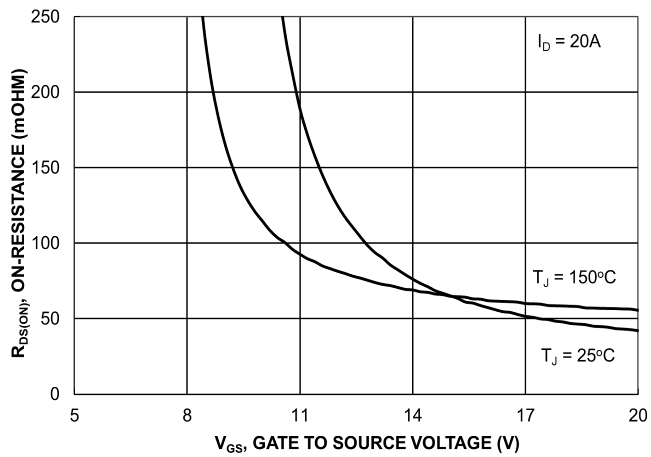


Figure 4. On−Resistance vs. Gate−to−Source Voltage

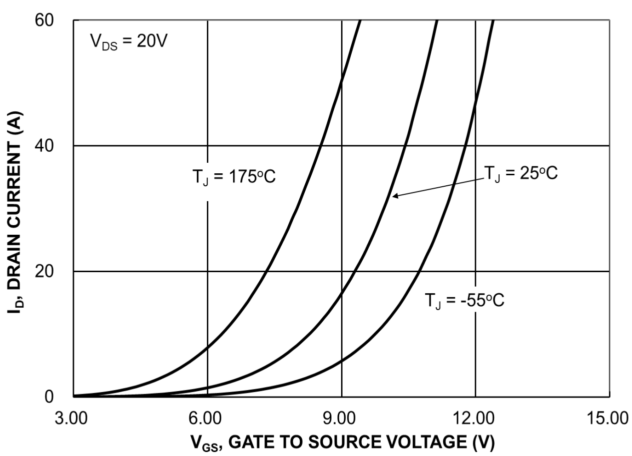


Figure 5. Transfer Characteristics

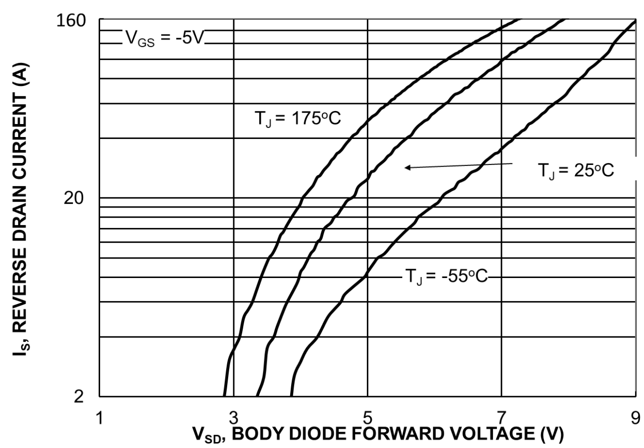


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (continued)

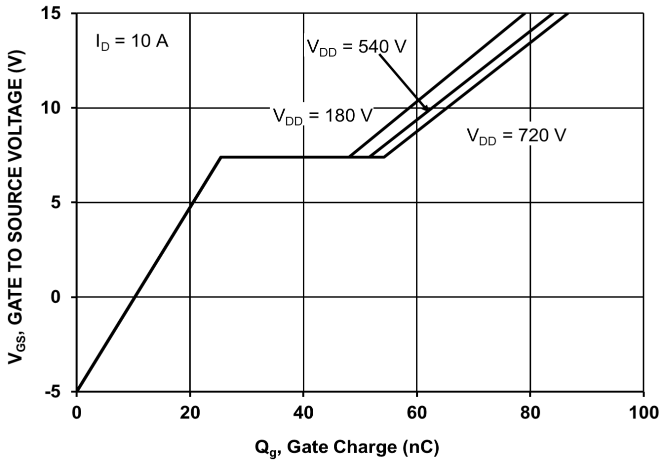


Figure 7. Gate−to−Source Voltage vs. Total Charge

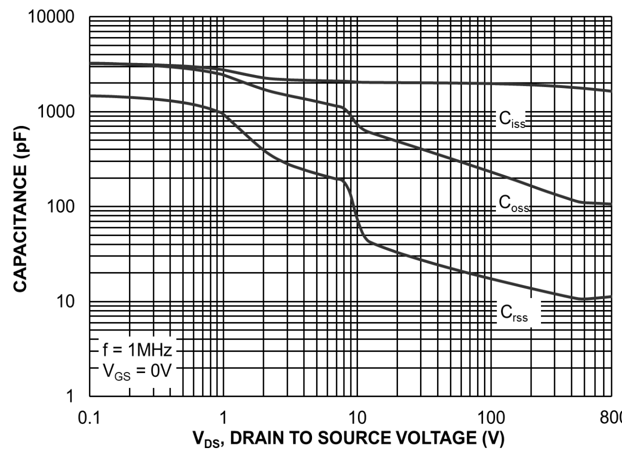


Figure 8. Capacitance vs. Drain−to−Source Voltage

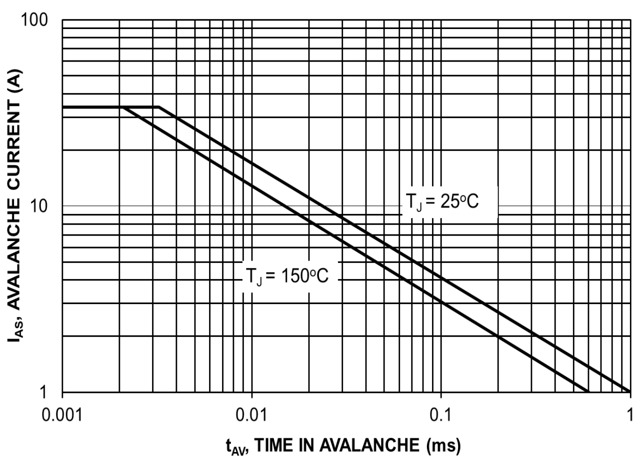


Figure 9. Unclamped Inductive Switching Capability

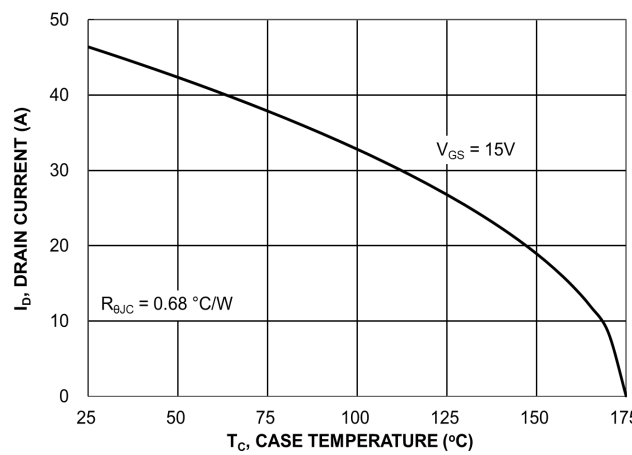


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

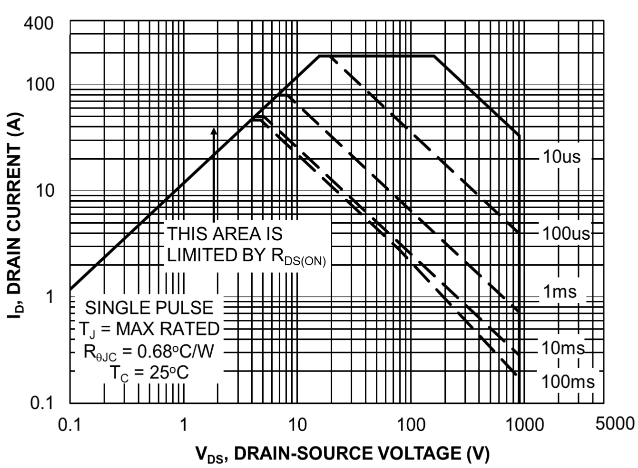


Figure 11. Safe Operating Area

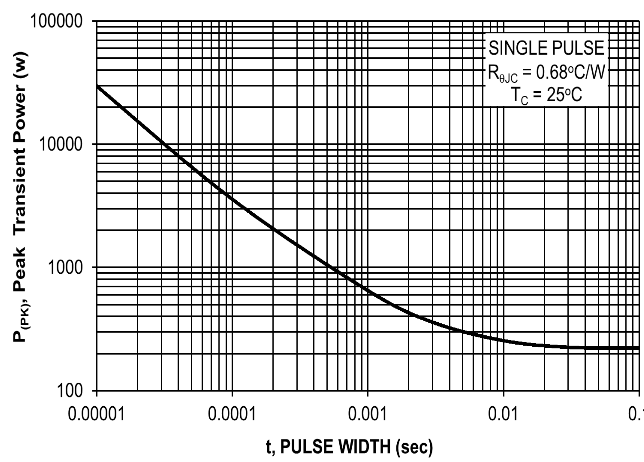


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (continued)

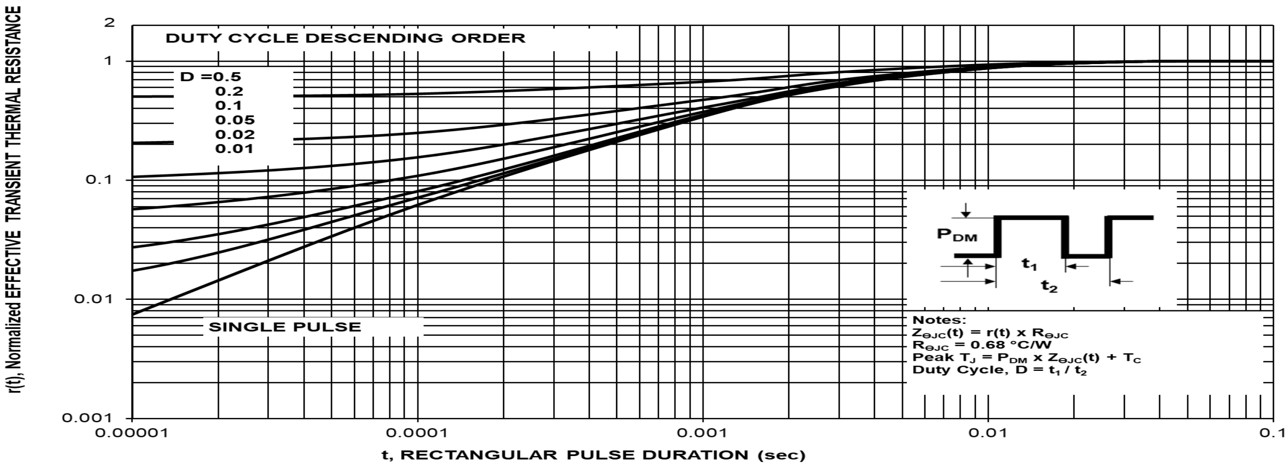
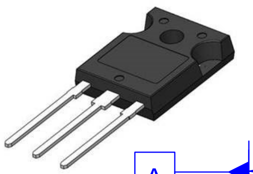
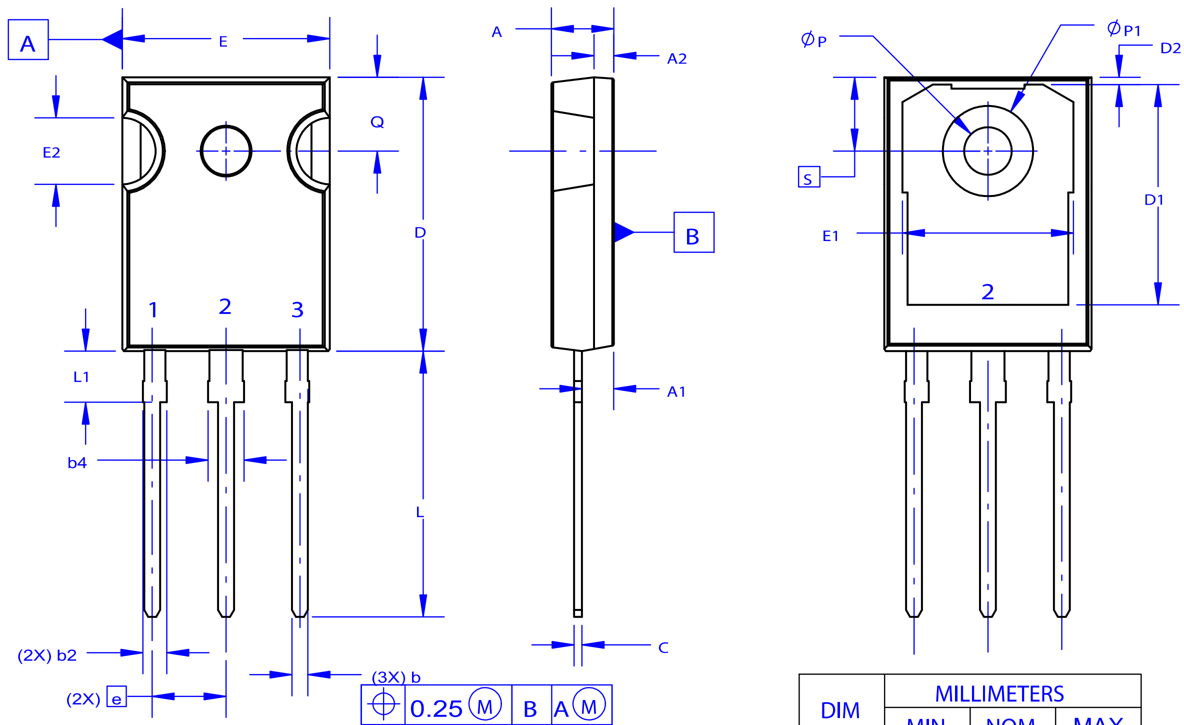


Figure 13. Junction−to−Ambient Thermal Response



TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020

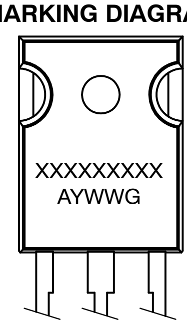


NOTES: UNLESS OTHERWISE SPECIFIED.

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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DESCRIPTION:	**TO−247−3LD**		**PAGE 1 OF 1**

ADDITIONAL INFORMATION

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