

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

900 V, 20 mΩ, 118 A



ON Semiconductor®

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NVHL020N090SC1

Features

- Typ. $R_{DS(on)} = 20\text{ m}\Omega$ @ $V_{GS} = 15\text{ V}$
- Typ. $R_{DS(on)} = 16\text{ m}\Omega$ @ $V_{GS} = 18\text{ V}$
- Ultra Low Gate Charge (typ. $Q_{G(tot)} = 196\text{ nC}$)
- Low Effective Output Capacitance (typ. $C_{oss} = 296\text{ pF}$)
- 100% UIL Tested
- Qualified According to AEC-Q101
- RoHS Compliant

Typical Applications

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

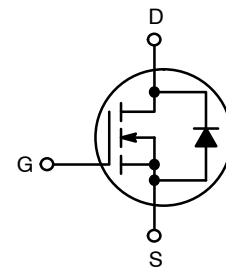
MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

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 – Source Voltage		$T_C < 175^\circ\text{C}$ V_{GSop}	+15/-5	V	
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	I_{DC}	118	A
			P_{DC}	503	W
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 100^\circ\text{C}$	I_{DC}	83	A
			P_{DC}	251	W
Pulsed Drain Current (Note 2)		$T_A = 25^\circ\text{C}$	I_{DM}	472	A
Single Pulse Surge Drain Current Capability (Note 3)	$T_A = 25^\circ\text{C}$, $t_p = 10\text{ }\mu\text{s}$, $R_G = 4.7\text{ }\Omega$		I_{DSC}	854	A
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)		I_S	153	A	
Single Pulse Drain-to-Source Avalanche Energy ($I_L = 23\text{ A}_{pk}$, $L = 1\text{ mH}$) (Note 4)		E_{AS}	264	mJ	

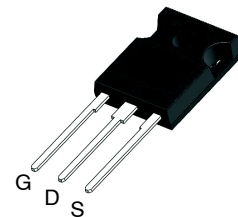
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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 264 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 1\text{ mH}$, $I_{AS} = 23\text{ A}$, $V_{DD} = 100\text{ V}$, $V_{GS} = 15\text{ V}$.

$V_{(BR)DSS}$	$R_{DS(ON)}\text{ MAX}$	$I_D\text{ MAX}$
900 V	28 mΩ @ 15 V	118 A

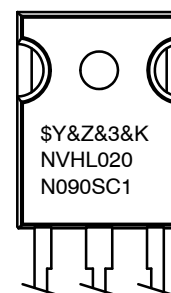


N-CHANNEL MOSFET



TO-247 LONG LEADS
CASE 340CX

MARKING DIAGRAM



$\$Y$ = ON Semiconductor Logo
 $\&Z$ = Assembly Plant Code
 $\&3$ = Date Code (Year & Week)
 $\&K$ = Lot
 NVHL020N090SC1 = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

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Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Units
Thermal Resistance Junction-to-Case (Note 1)	$R_{\theta JC}$	0.30	$^{\circ}C/W$
Thermal Resistance Junction-to-Ambient (Note 1)	$R_{\theta JA}$	40	$^{\circ}C/W$

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^{\circ}C$ unless otherwise stated)

Parameter	Symbol	Test Condition	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	$V_{(BR)DSS}/T_J$	$I_D = 1 mA$, refer to $25^{\circ}C$		500		$mV/^{\circ}C$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0 V$ $V_{DS} = 900 V$	$T_J = 25^{\circ}C$		100	μA
			$T_J = 175^{\circ}C$		250	μA
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +22/-8 V, V_{DS} = 0 V$			± 1	μA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20 mA$	1.8	2.7	4.3	V
Recommended Gate Voltage	V_{GOP}		-5		+15	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 15 V, I_D = 60 A, T_J = 25^{\circ}C$		20	28	m Ω
		$V_{GS} = 18 V, I_D = 60 A, T_J = 25^{\circ}C$		16		
		$V_{GS} = 15 V, I_D = 60 A, T_J = 175^{\circ}C$		27		
Forward Transconductance	g_{FS}	$V_{DS} = 20 V, I_D = 60 A$		49		S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	$V_{GS} = 0 V, f = 1 MHz,$ $V_{DS} = 450 V$		4415		pF
Output Capacitance	C_{OSS}			296		
Reverse Transfer Capacitance	C_{RSS}			24		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/15 V, V_{DS} = 720 V,$ $I_D = 60 A$		196		nC
Threshold Gate Charge	$Q_{G(TH)}$			42		
Gate-to-Source Charge	Q_{GS}			78		
Gate-to-Drain Charge	Q_{GD}			55		
Gate-Resistance	R_G		$f = 1 MHz$		1.6	
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/15 V, V_{DS} = 720 V,$ $I_D = 60 A, R_G = 2.5 \Omega,$ Inductive Load		40		ns
Rise Time	t_r			63		
Turn-Off Delay Time	$t_{d(OFF)}$			55		
Fall Time	t_f			13		
Turn-On Switching Loss	E_{ON}			2025		μJ
Turn-Off Switching Loss	E_{OFF}			201		
Total Switching Loss	E_{TOT}			2226		
DRAIN-SOURCE DIODE CHARACTERISTICS						
Continuous Drain-Source Diode Forward Current	I_{SD}	$V_{GS} = -5 V, T_J = 25^{\circ}C$			153	A
Pulsed Drain-Source Diode Forward Current (Note 2)	I_{SDM}	$V_{GS} = -5 V, T_J = 25^{\circ}C$			472	A
Forward Diode Voltage	V_{SD}	$V_{GS} = -5 V, I_{SD} = 30 A, T_J = 25^{\circ}C$		3.8		V

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Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN-SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/15\text{ V}, I_{SD} = 60\text{ A}, di_S/dt = 1000\text{ A}/\mu\text{s}, V_{DS} = 720\text{ V}$		28		ns
Reverse Recovery Charge	Q_{RR}			199		nC
Reverse Recovery Energy	E_{REC}			4		μJ
Peak Reverse Recovery Current	I_{RRM}			14		A
Charge time	T_a			16		ns
Discharge time	T_b			12		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

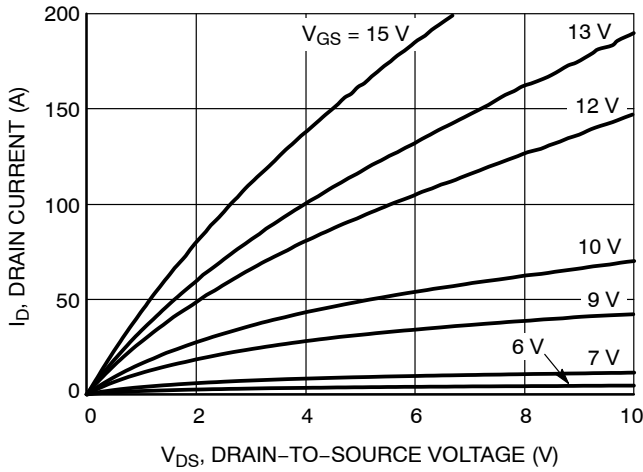


Figure 1. On-Region Characteristics

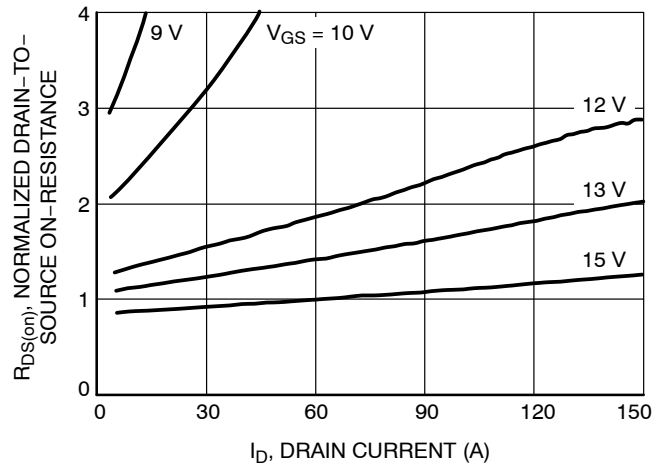


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

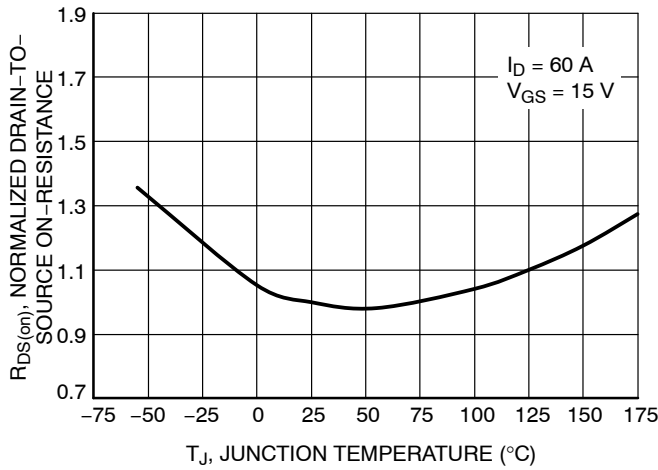


Figure 3. On-Resistance Variation with Temperature

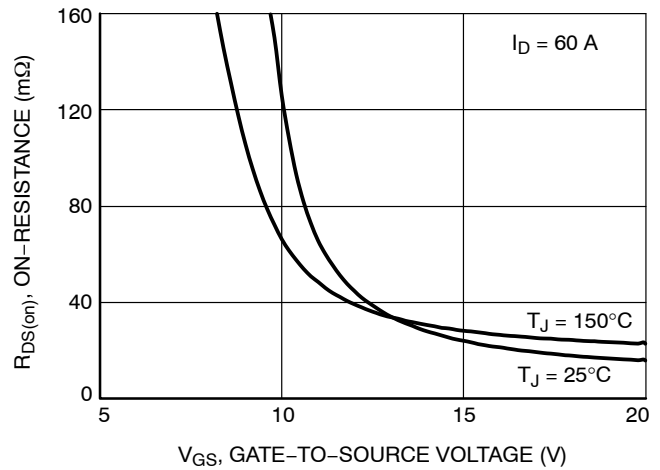


Figure 4. On-Resistance vs. Gate-to-Source Voltage

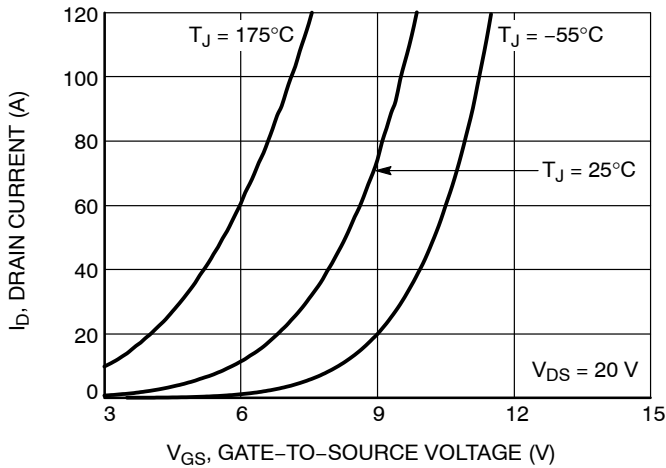


Figure 5. Transfer Characteristics

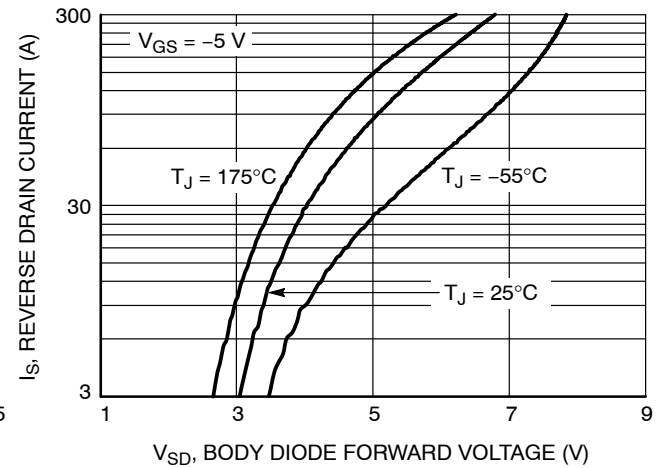


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

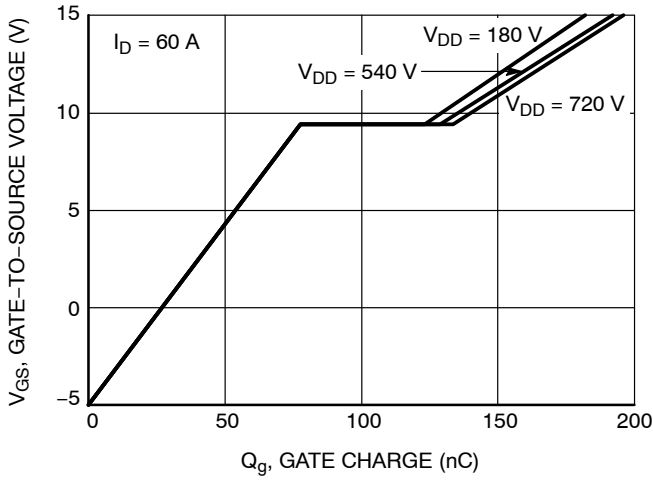


Figure 7. Gate-to-Source Voltage vs. Total Charge

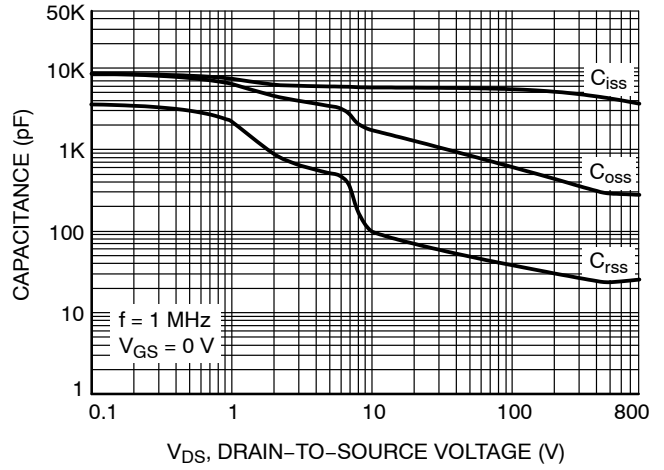


Figure 8. Capacitance vs. Drain-to-Source Voltage

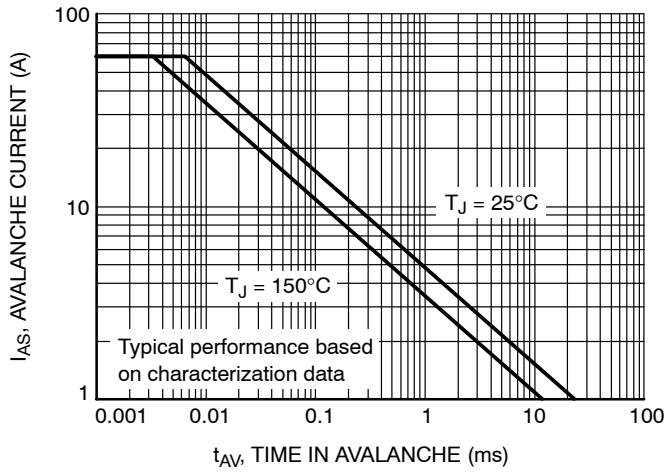


Figure 9. Unclamped Inductive Switching Capability

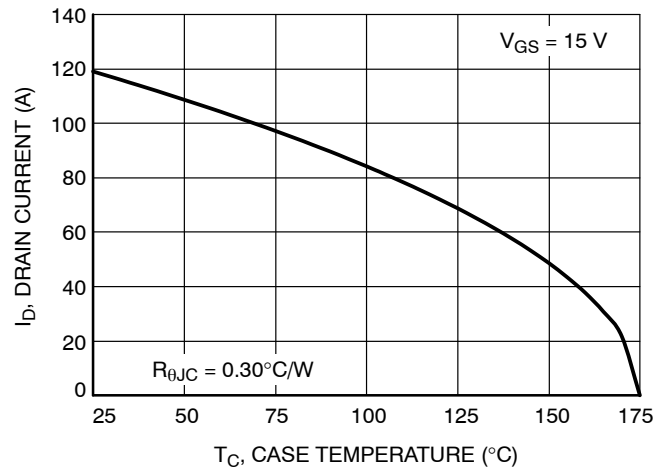


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

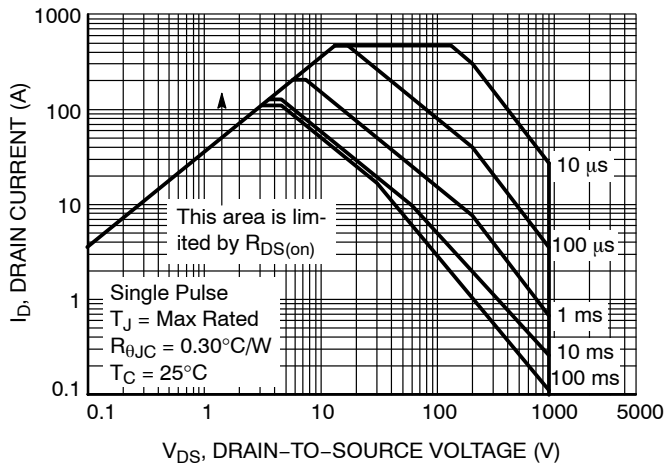


Figure 11. Safe Operating Area

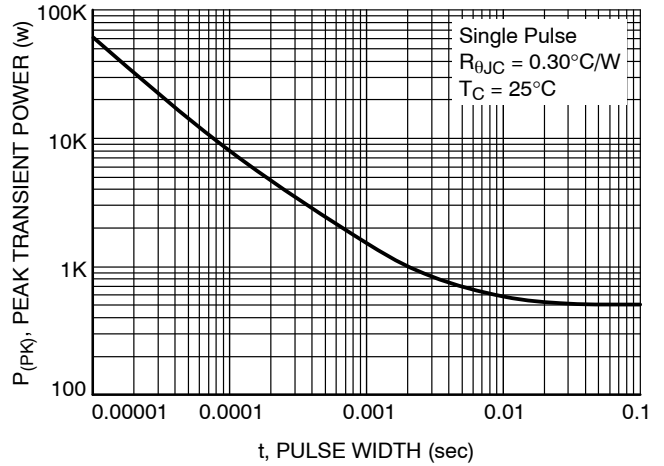


Figure 12. Single Pulse Maximum Power Dissipation

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TYPICAL CHARACTERISTICS

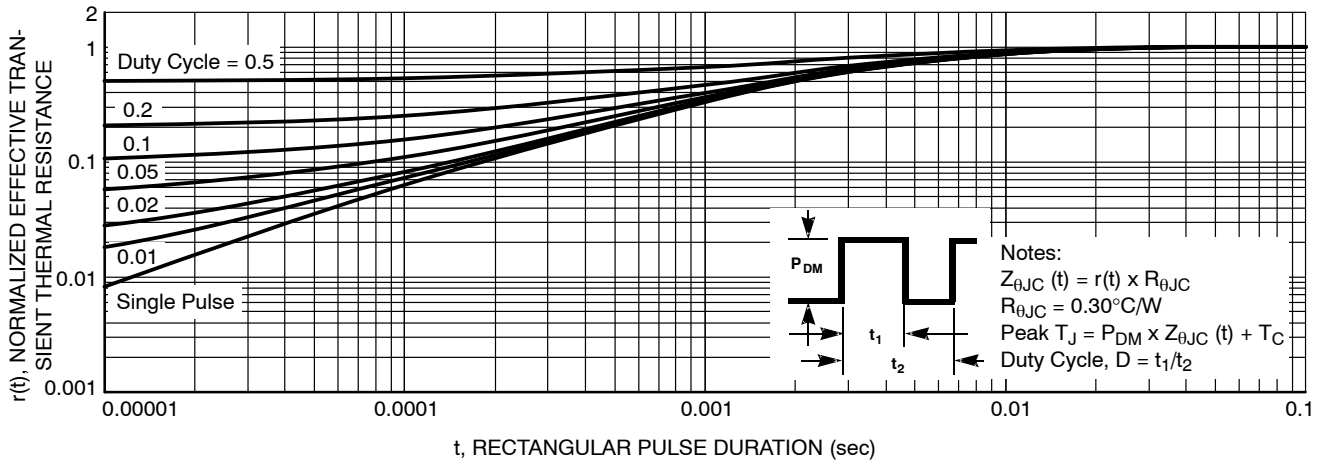


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Size	Quantity
NVHL020N090SC1	NVHL020N090SC1	TO-247 Long Lead	Tube	N/A	N/A	30 Units

MECHANICAL CASE OUTLINE

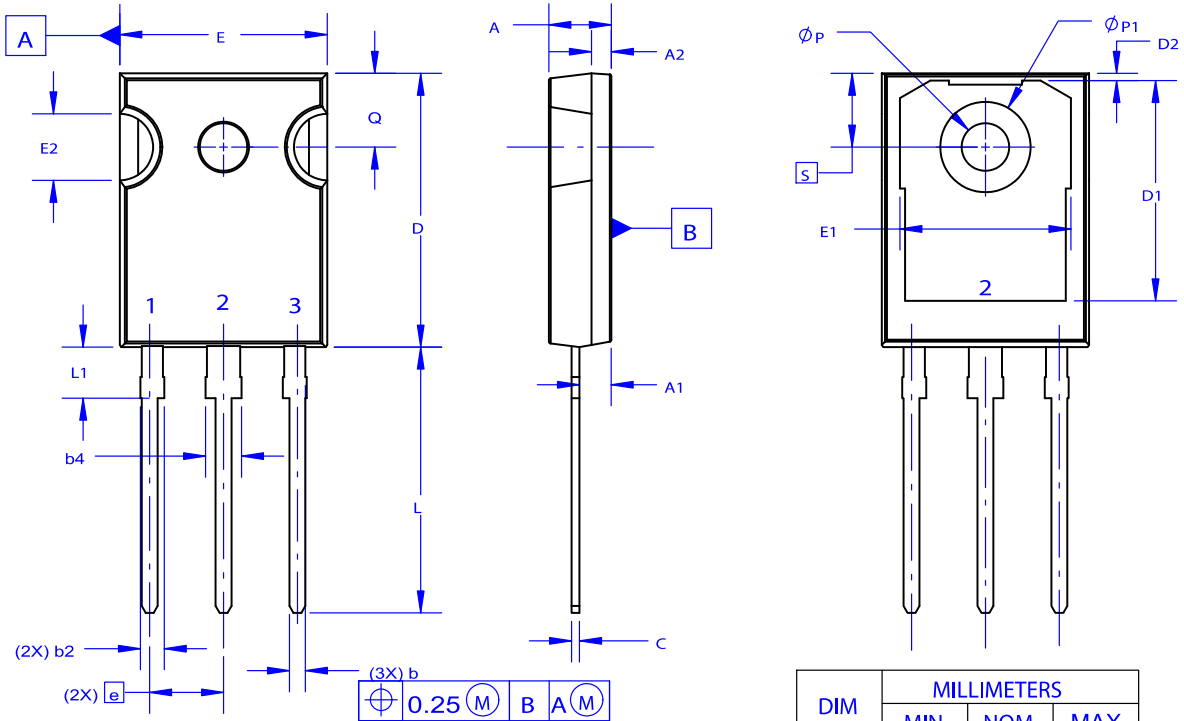
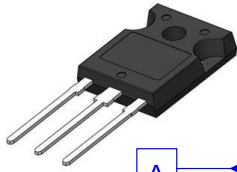
PACKAGE DIMENSIONS

ON Semiconductor®



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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