

# Silicon Carbide (SiC) MOSFET – 20 mohm, 900 V, M2, TO-247-4L

## NVH4L020N090SC1

### Features

- Typ.  $R_{DS(on)}$  = 20 mΩ @  $V_{GS} = 15$  V  
Typ.  $R_{DS(on)}$  = 16 mΩ @  $V_{GS} = 18$  V
- Ultra Low Gate Charge (typ.  $Q_{G(tot)}$  = 196 nC)
- Low Effective Output Capacitance (typ.  $C_{oss}$  = 296 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 Traction Inverters
- Automotive On Board Charger
- Automotive DC-DC Converter for EV/HEV

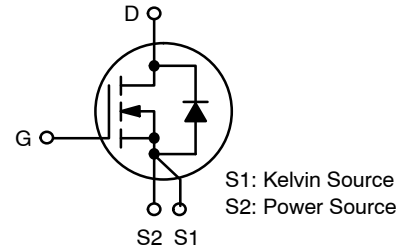
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

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	$T_C = 25^\circ\text{C}$	$I_{DC}$	116	A
			$P_{DC}$	484	W
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 100^\circ\text{C}$	$I_{DC}$	82	A
			$P_{DC}$	242	W
Pulsed Drain Current (Note 2)		$T_A = 25^\circ\text{C}$	$I_{DM}$	504	A
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)		$I_S$	106	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_L = 23$ A <sub>pk</sub> , $L = 1$ mH) (Note 3)		$E_{AS}$	264	mJ	

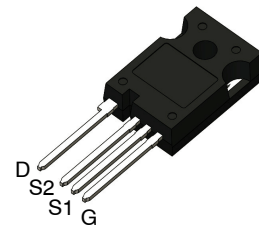
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

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

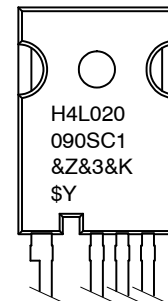


N-CHANNEL MOSFET



TO247-4L  
CASE 340CJ

### MARKING DIAGRAM



H4L020090SC1 = Specific Device Code  
&Z = Assembly Plant Code  
&3 = Date Code (Year & Week)  
&K = Lot  
\$Y = onsemi Logo

### 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	Unit
Thermal Resistance Junction-to-Case (Note 1)	$R_{\theta JC}$	0.31	°C/W
Thermal Resistance Junction-to-Ambient (Note 1)	$R_{\theta JA}$	40	°C/W

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

Parameter	Symbol	Test Condition	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	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$ , refer to $25^\circ\text{C}$		500		mV/°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
			$T_J = 175^\circ\text{C}$		250	μA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +22/-8\text{ V}, V_{DS} = 0\text{ V}$			±1	μA
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20\text{ mA}$	1.8	2.7	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5		+15	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 15\text{ V}, I_D = 60\text{ A}, T_J = 25^\circ\text{C}$		20	28	mΩ
		$V_{GS} = 18\text{ V}, I_D = 60\text{ A}, T_J = 25^\circ\text{C}$		16		
		$V_{GS} = 15\text{ V}, I_D = 60\text{ A}, T_J = 175^\circ\text{C}$		27		
Forward Transconductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 60\text{ A}$		49		S
<b>CHARGES, CAPACITANCES &amp; GATE RESISTANCE</b>						
Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 450\text{ V}$		4415		pF
Output Capacitance	$C_{OSS}$			296		
Reverse Transfer Capacitance	$C_{RSS}$			24		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/15\text{ V}, V_{DS} = 720\text{ V}, I_D = 60\text{ A}$		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	$R_G$	$f = 1\text{ MHz}$		1.6		Ω
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/15\text{ V}, V_{DS} = 720\text{ V}, I_D = 60\text{ A}, R_G = 2.5\text{ }\Omega,$ Inductive Load		29		ns
Rise Time	$t_r$			28		
Turn-Off Delay Time	$t_{d(OFF)}$			54		
Fall Time	$t_f$			14		μJ
Turn-On Switching Loss	$E_{ON}$			611		
Turn-Off Switching Loss	$E_{OFF}$			293		
Total Switching Loss	$E_{TOT}$			904		
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Continuous Drain-Source Diode Forward Current	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$			106	A
Pulsed Drain-Source Diode Forward Current (Note 2)	$I_{SDM}$	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$			504	A
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 30\text{ A}, T_J = 25^\circ\text{C}$		3.8		V

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5/15\text{ V}, I_{SD} = 60\text{ A},$ $di_S/dt = 1000\text{ A}/\mu\text{s}, V_{DS} = 720\text{ V}$		30		ns
Reverse Recovery Charge	$Q_{RR}$			244		nC
Reverse Recovery Energy	$E_{REC}$			11		$\mu\text{J}$
Peak Reverse Recovery Current	$I_{RRM}$			16		A
Charge Time	$T_a$			17		ns
Discharge Time	$T_b$			13		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

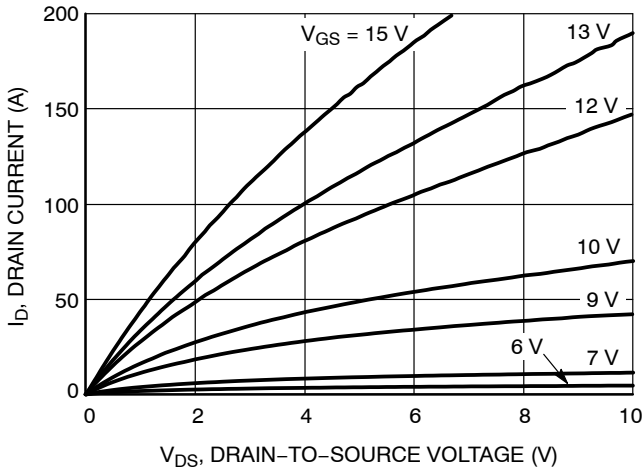


Figure 1. On-Region Characteristics

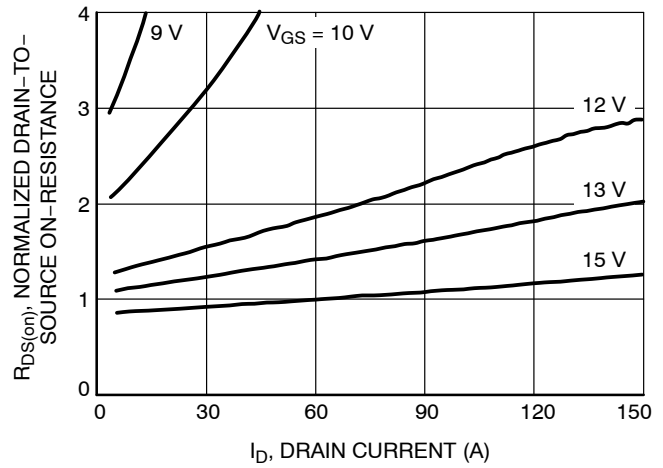


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

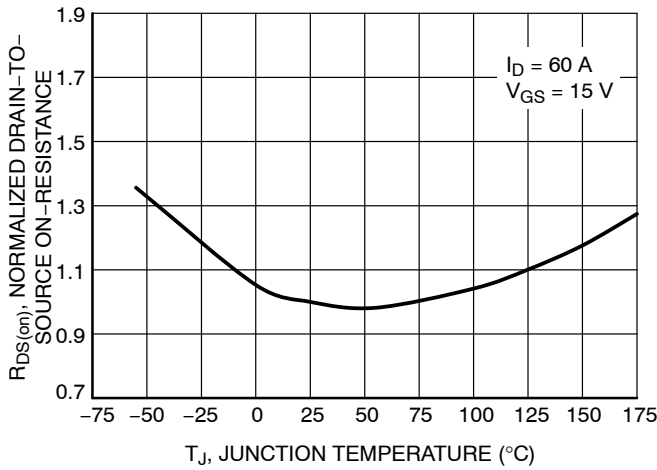


Figure 3. On-Resistance Variation with Temperature

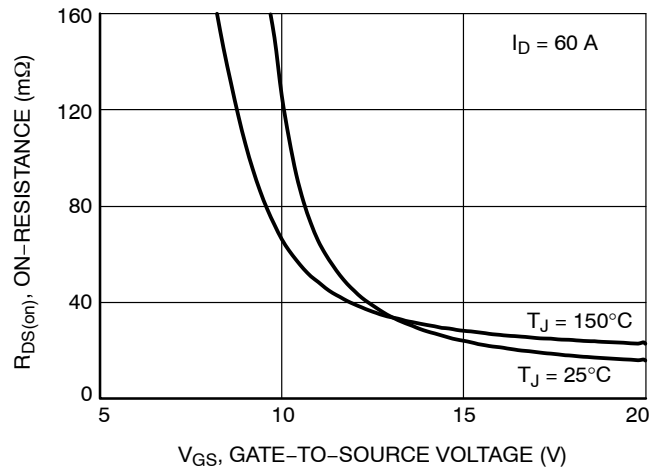


Figure 4. On-Resistance vs. Gate-to-Source Voltage

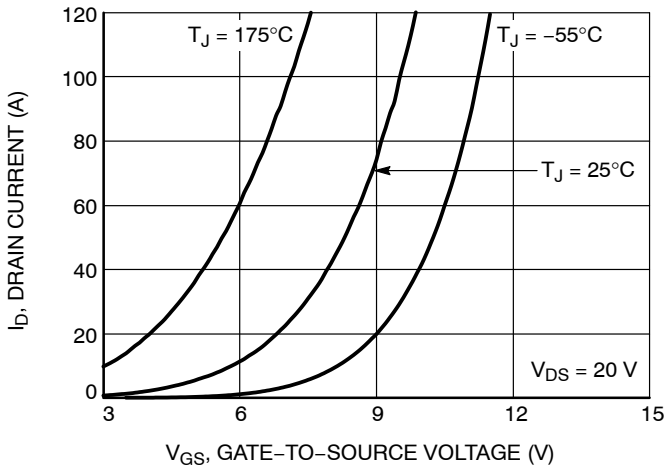


Figure 5. Transfer Characteristics

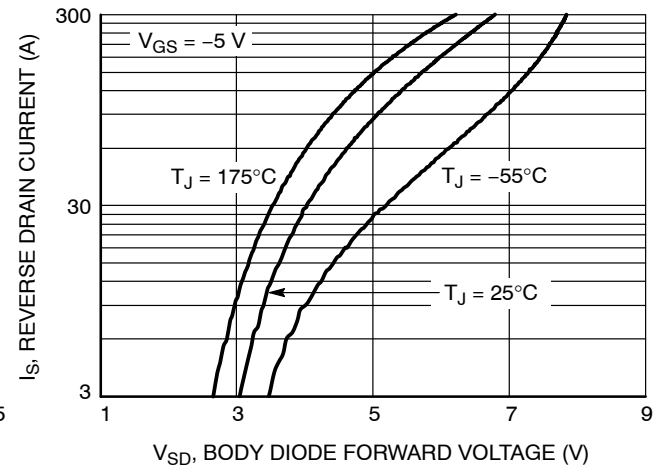


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (continued)

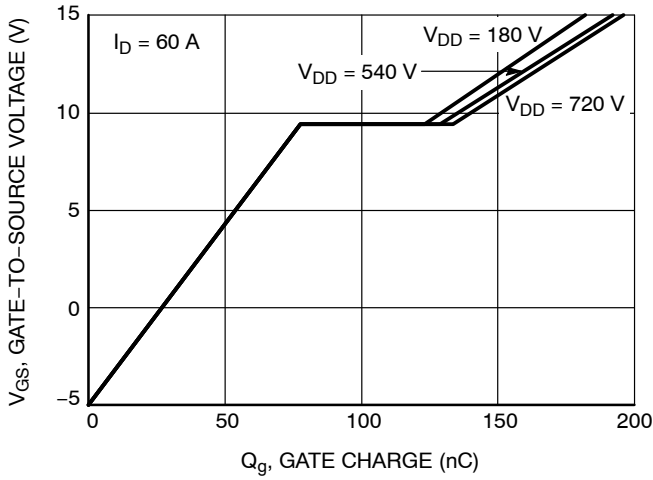


Figure 7. Gate-to-Source Voltage vs. Total Charge

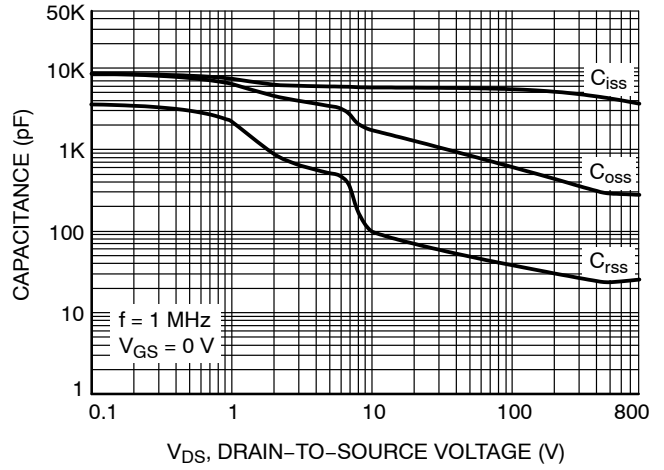


Figure 8. Capacitance vs. Drain-to-Source Voltage

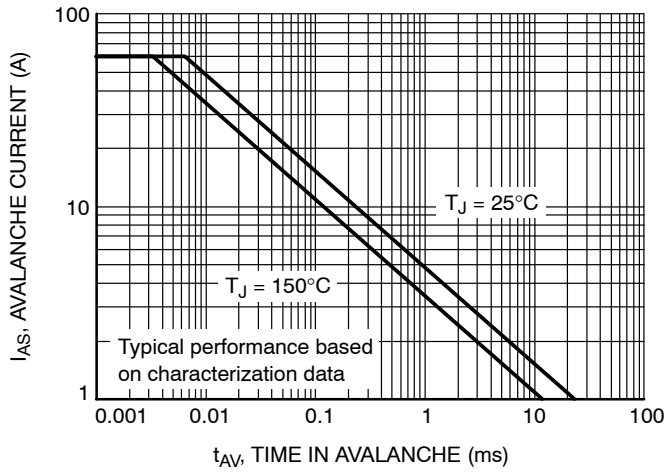


Figure 9. Unclamped Inductive Switching Capability

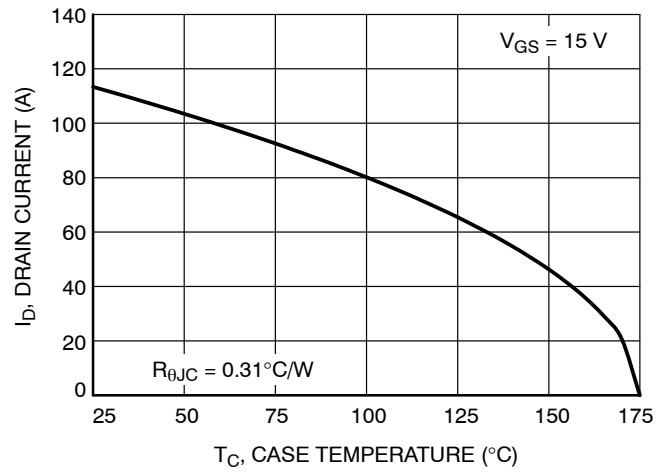


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

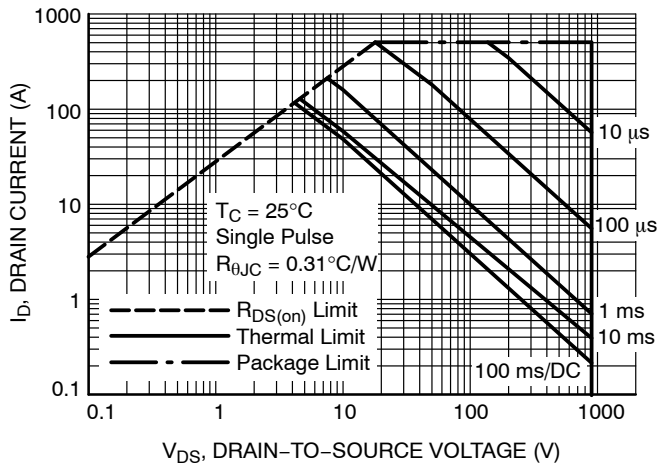


Figure 11. Safe Operating Area

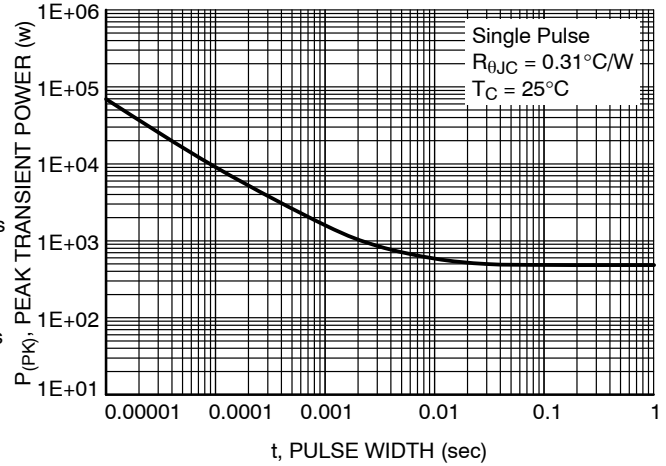


Figure 12. Single Pulse Maximum Power Dissipation

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## TYPICAL CHARACTERISTICS (continued)

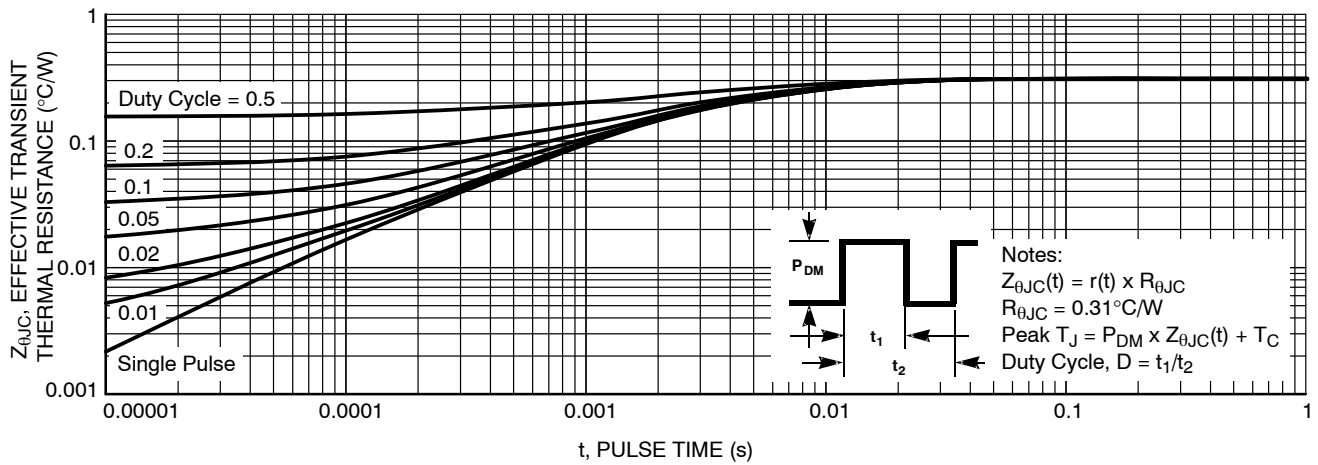


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

### PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Size	Quantity
NVH4L020N090SC1	H4L020090SC1	TO247-4L	Tube	N/A	N/A	30 Units

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-4LD  
CASE 340CJ  
ISSUE A

DATE 16 SEP 2019



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

**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.

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