

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

NVH4L020N090SC1

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
- 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

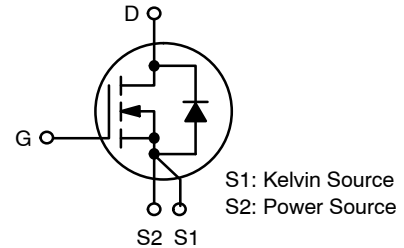
MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

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°C	V _{GSop}	+15/-5	V
Continuous Drain Current R _{θJC}	Steady State	T _C = 25°C	I _{DC}	116	A
Power Dissipation R _{θJC}			P _{DC}	484	W
Continuous Drain Current R _{θJC}	Steady State	T _C = 100°C	I _{DC}	82	A
Power Dissipation R _{θJC}			P _{DC}	242	W
Pulsed Drain Current (Note 2)		T _A = 25°C	I _{DM}	504	A
Operating Junction and Storage Temperature Range			T _J , T _{stg}	-55 to +175	°C
Source Current (Body Diode)			I _S	106	A
Single Pulse Drain-to-Source Avalanche Energy (I _L = 23 A _{pK} , L = 1 mH) (Note 3)			E _{AS}	264	mJ

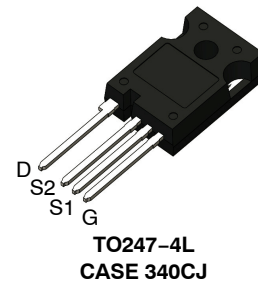
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

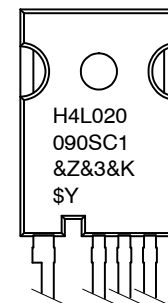
$V_{(BR)DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
900 V	28 m Ω @ 15 V	118 A



N-CHANNEL MOSFET



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	$^{\circ}\text{C/W}$
Thermal Resistance Junction-to-Ambient (Note 1)	$R_{\theta JA}$	40	$^{\circ}\text{C/W}$

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	900			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$, refer to 25°C		500		$\text{mV}/^{\circ}\text{C}$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 900\text{ V}$			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

ON CHARACTERISTICS

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	$\text{m}\Omega$
		$V_{GS} = 18\text{ V}, I_D = 60\text{ A}, T_J = 25^{\circ}\text{C}$		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

CHARGES, CAPACITANCES & GATE RESISTANCE

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

SWITCHING CHARACTERISTICS

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		
Turn-On Switching Loss	E_{ON}			611		μJ
Turn-Off Switching Loss	E_{OFF}			293		
Total Switching Loss	E_{TOT}			904		

DRAIN-SOURCE DIODE CHARACTERISTICS

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
DRAIN-SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/15\text{ V}$, $I_{SD} = 60\text{ A}$, $di_S/dt = 1000\text{ A}/\mu\text{s}$, $V_{DS} = 720\text{ V}$		30		ns
Reverse Recovery Charge	Q_{RR}			244		nC
Reverse Recovery Energy	E_{REC}			11		μJ
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

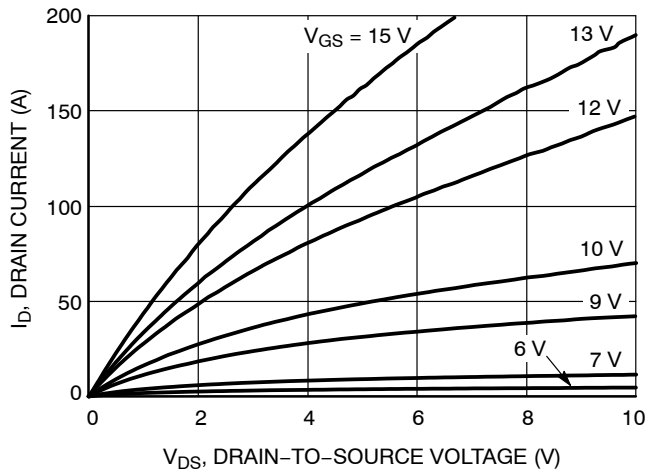


Figure 1. On-Region Characteristics

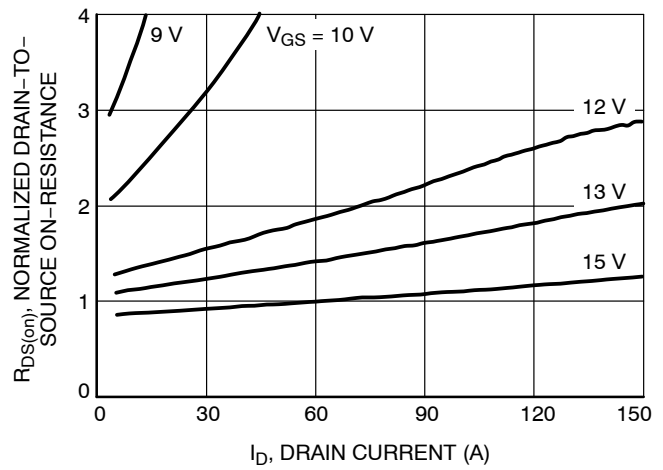


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

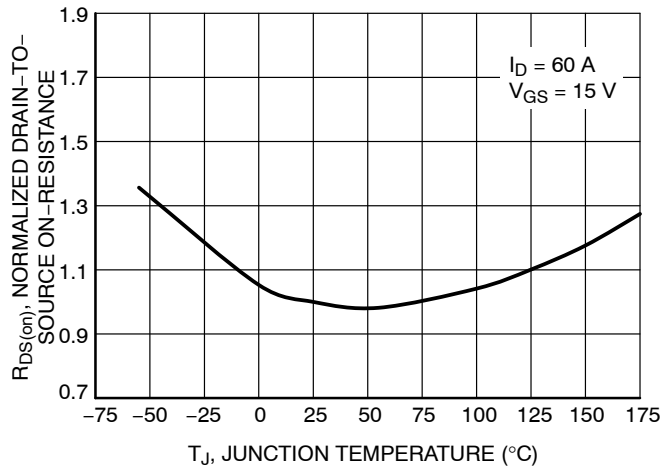


Figure 3. On-Resistance Variation with Temperature

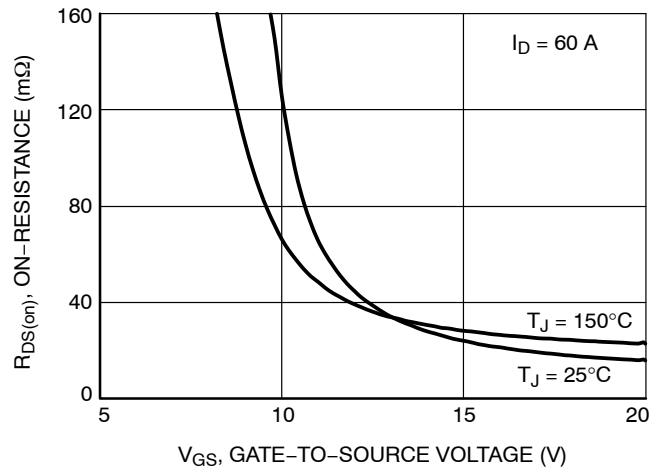


Figure 4. On-Resistance vs. Gate-to-Source Voltage

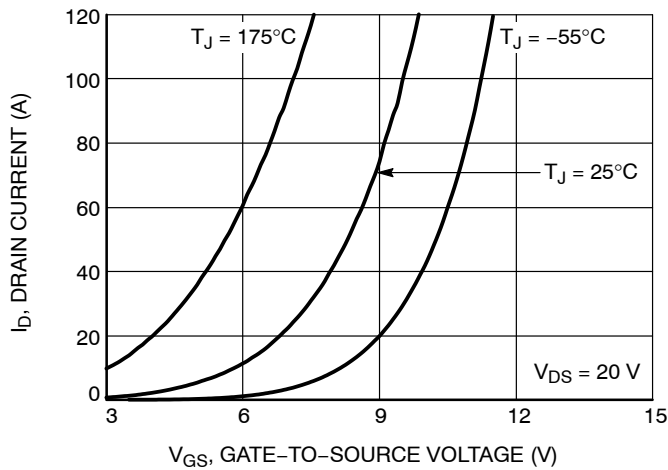


Figure 5. Transfer Characteristics

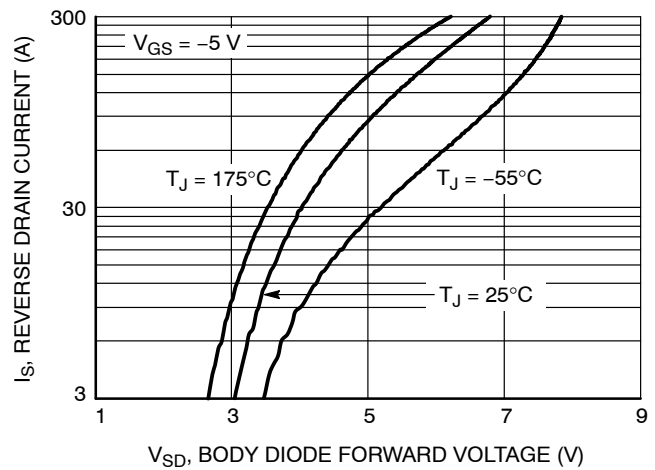


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (continued)

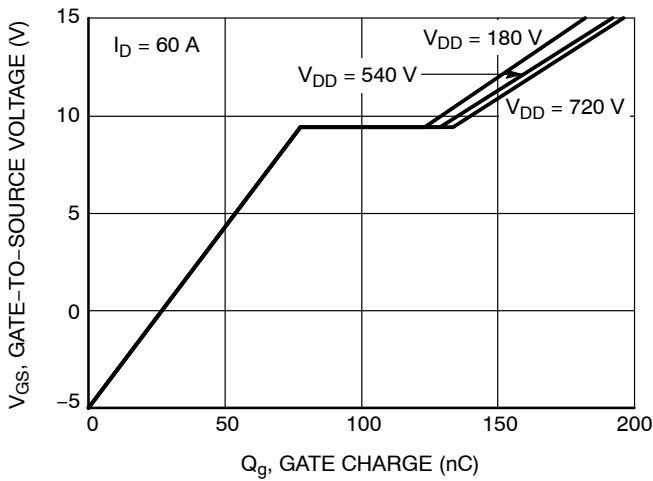


Figure 7. Gate-to-Source Voltage vs. Total Charge

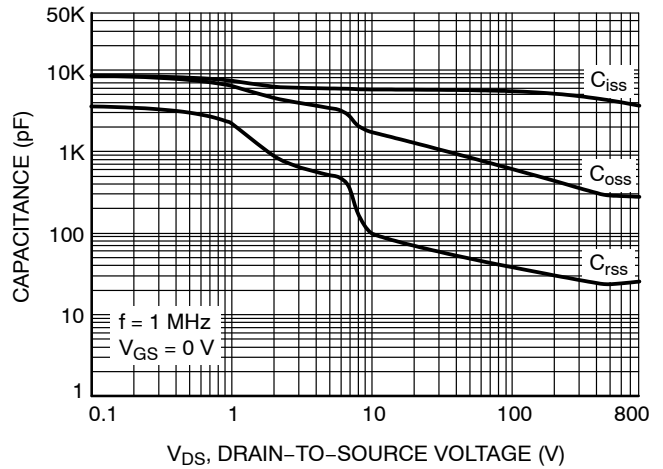


Figure 8. Capacitance vs. Drain-to-Source Voltage

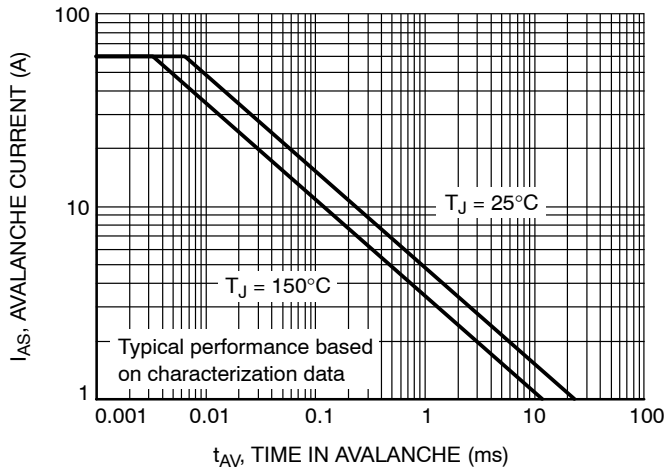


Figure 9. Unclamped Inductive Switching Capability

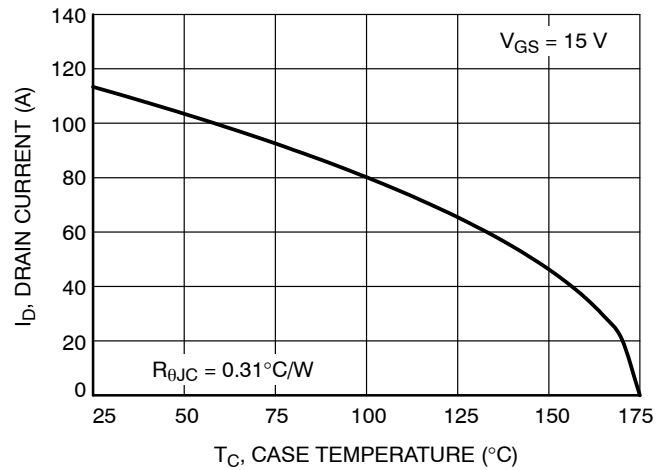


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

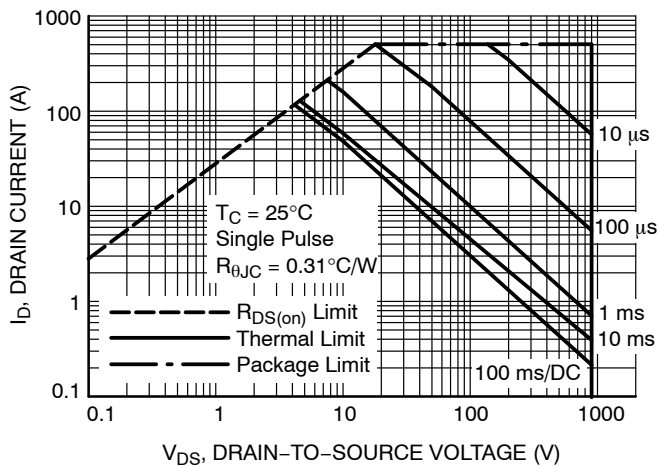


Figure 11. Safe Operating Area

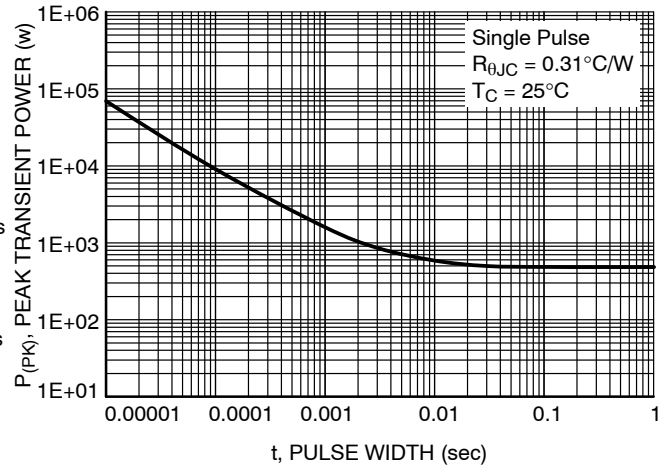


Figure 12. Single Pulse Maximum Power Dissipation

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TYPICAL CHARACTERISTICS (continued)

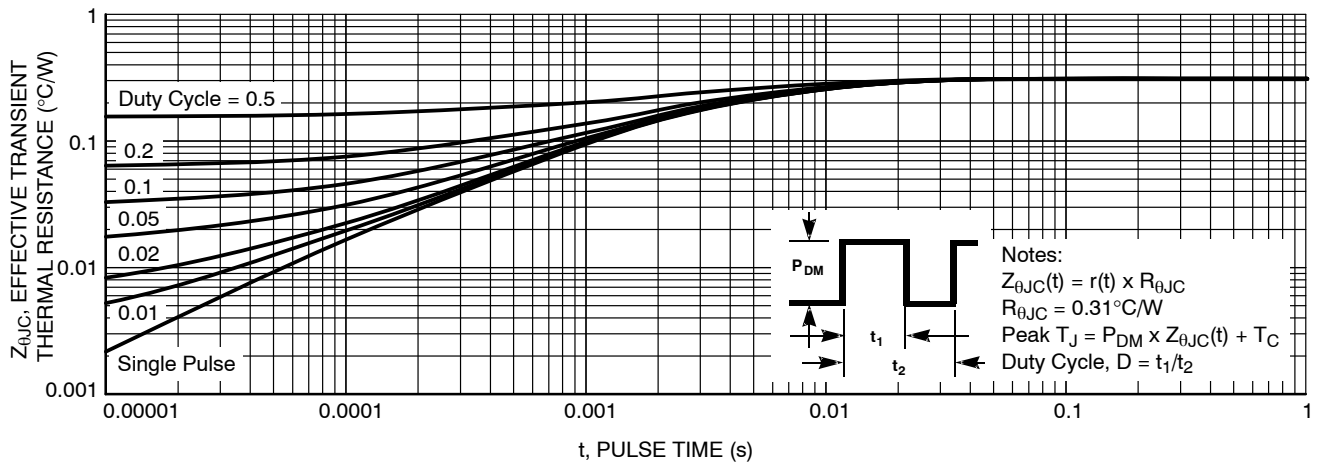


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

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

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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