

Silicon Carbide (SiC) MOSFET – 80 mohm, 1200 V, M1, TO-247-4L NVH4L080N120SC1

Description

Silicon Carbide (SiC) MOSFET uses a completely new technology that provide superior switching performance and higher reliability compared to Silicon. In addition, the low ON resistance and compact chip size ensure low capacitance and gate charge. Consequently, system benefits include highest efficiency, faster operation frequency, increased power density, reduced EMI, and reduced system size.

Features

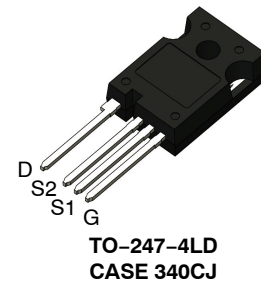
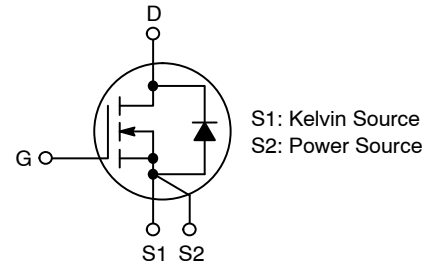
- 1200 V @ $T_J = 175^\circ\text{C}$
- Max $R_{DS(on)} = 110\text{ m}\Omega$ at $V_{GS} = 20\text{ V}$, $I_D = 20\text{ A}$
- High Speed Switching with Low Capacitance
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb-Free 2LI (on second level interconnection)

Applications

- Automotive Auxiliary Motor Drive
- Automotive On Board Charger
- Automotive DC-DC Converter for EV/HEV

| V_{DS} | $R_{DS(on)}$ TYP | I_D MAX |
|----------|------------------|-----------|
| 1200 V | 80 m Ω | 29 A |

N-CHANNEL MOSFET



MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability
NVH4L080N120SC1 = Specific Device Code

ORDERING INFORMATION

| Device | Package | Shipping |
|-----------------|-----------|-----------------|
| NVH4L080N120SC1 | TO-247-4L | 30 Units / Tube |

NVH4L080N120SC1

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

| Symbol | Parameter | | Ratings | Unit |
|-----------------------------------|--|--|-------------|------|
| V _{DSmax} | Drain-to-Source Voltage | | 1200 | V |
| V _{GSmax} | Max. Gate-to-Source Voltage | @ T _C < 150°C | -15 / +25 | V |
| V _{GSop} (DC) | Recommended operation Values of Gate – Source Voltage | @ T _C < 150°C | -5 / +20 | V |
| V _{GSop} (AC) | Recommended operation Values of Gate – Source Voltage (f > 1 Hz) | @ T _C < 150°C | -5 / +20 | V |
| I _D | Continuous Drain Current | V _{GS} = 20 V, T _C = 25°C | 29 | A |
| | | V _{GS} = 20 V, T _C = 100°C | 21 | |
| I _D (Pulse) | Pulse Drain Current | Pulse width tp limited by T _j max | 125 | A |
| E _{AS} | Single Pulse Avalanche Energy (Note 1) | | 171 | mJ |
| P _{tot} | Power Dissipation | T _C = 25°C | 170 | W |
| | | T _C = 150°C | 28 | |
| T _J , T _{STG} | Operating and Storage Junction Temperature Range | | -55 to +175 | °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. E_{AS} of 171 mJ is based on starting T_J = 25°C, L = 1 mH, I_{AS} = 18.5 A, V_{DD} = 50 V, R_G = 25 Ω.

THERMAL CHARACTERISTICS

| Symbol | Parameter | Ratings | Unit |
|------------------|---|---------|------|
| R _{θJC} | Thermal Resistance, Junction-to-Case | 0.88 | °C/W |
| R _{θJA} | Thermal Resistance, Junction-to-Ambient | 40 | |

NVH4L080N120SC1

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | | |
|------------------------------|---|---|--------|--------|------------|---------------------|
| BV_{DSS} | Drain-to-Source Breakdown Voltage | $I_D = 100\ \mu\text{A}$, $V_{GS} = 0\ \text{V}$ | 1200 | – | – | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 5\ \text{mA}$, Referenced to 25°C | – | 0.3 | – | V/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 1200\ \text{V}$, $V_{GS} = 0\ \text{V}$ $T_C = 25^\circ\text{C}$ $T_C = 150^\circ\text{C}$ | – – | – – | 100 1.0 | μA mA |
| I_{GSS} | Gate-to-Source Leakage Current | $V_{GS} = 25\ \text{V}$, $V_{DS} = 0\ \text{V}$ | – | – | 1 | μA |
| I_{GSSR} | Gate-to-Source Leakage Current, Reverse | $V_{GS} = -15\ \text{V}$, $V_{DS} = 0\ \text{V}$ | – | – | -1 | μA |

ON CHARACTERISTICS

| | | | | | | |
|--------------|--------------------------------------|--|-----|------|-----|------------|
| $V_{GS(th)}$ | Gate-to-Source Threshold Voltage | $V_{GS} = V_{DS}$, $I_D = 5\ \text{mA}$ | 1.8 | 2.75 | 4.3 | V |
| $R_{DS(on)}$ | Static Drain-to-Source On Resistance | $V_{GS} = 20\ \text{V}$, $I_D = 20\ \text{A}$ | – | 80 | 110 | m Ω |
| | | $V_{GS} = 20\ \text{V}$, $I_D = 20\ \text{A}$, $T_C = 150^\circ\text{C}$ | – | 127 | 162 | |
| g_{FS} | Forward Transconductance | $V_{DS} = 20\ \text{V}$, $I_D = 20\ \text{A}$ | – | 11.3 | – | S |
| | | $V_{DS} = 20\ \text{V}$, $I_D = 20\ \text{A}$, $T_C = 150^\circ\text{C}$ | – | 9.8 | – | |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|-----------|------------------------------|---|---|------|------|---------------|
| C_{iss} | Input Capacitance | $V_{DS} = 800\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$ | – | 1112 | 1670 | pF |
| C_{oss} | Output Capacitance | | – | 80 | 120 | pF |
| C_{rss} | Reverse Transfer Capacitance | | – | 6.5 | 10 | pF |
| E_{oss} | C_{oss} Stored Energy | | – | 32 | – | μJ |

SWITCHING CHARACTERISTICS

| | | | | | | |
|--------------|-------------------------|---|---|------|----|---------------|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 800\ \text{V}$, $I_C = 20\ \text{A}$, $V_{GS} = -5/20\ \text{V}$, $R_G = 4.7\ \Omega$ Inductive Load, $T_C = 25^\circ\text{C}$ | – | 9 | 18 | ns |
| t_r | Rise Time | | – | 4.2 | 10 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | – | 26.8 | 43 | ns |
| t_f | Fall Time | | – | 5.4 | 11 | ns |
| E_{on} | Turn-on Switching Loss | | – | 314 | – | μJ |
| E_{off} | Turn-off Switching Loss | | – | 32 | – | μJ |
| E_{ts} | Total Switching Loss | $V_{DD} = 600\ \text{V}$, $I_D = 20\ \text{A}$ $V_{GS} = -5/20\ \text{V}$ | – | 346 | – | μJ |
| Q_g | Total Gate Charge | | – | 56 | – | nC |
| Q_{gs} | Gate-to-Source Charge | | – | 11 | – | nC |
| Q_{gd} | Gate-to-Drain Charge | $f = 1\ \text{MHz}$, D-S short | – | 12 | – | nC |
| R_G | Gate input resistance | | – | 1.7 | – | Ω |

DIODE CHARACTERISTICS

| | | | | | | | |
|------------------|---------------------------------------|---|------------------------|----|-----|---|----|
| V _{SD} | Source-to-Drain Diode Forward Voltage | V _{GS} = -5 V, I _{SD} = 10 A | T _C = 25°C | – | 3.7 | – | V |
| | | | T _C = 150°C | – | 3.3 | – | |
| E _{rec} | Reverse Recovery Energy | I _{SD} = 20 A, V _{GS} = -5 V, V _R = 600 V, di _{SD} /dt = 1000 A/μs | T _C = 150°C | – | 29 | – | μJ |
| t _{rr} | Diode Reverse Recovery Time | | T _C = 25°C | – | 18 | – | ns |
| | | | T _C = 150°C | – | 31 | – | |
| Q _{rr} | Diode Reverse Recovery Charge | | T _C = 25°C | – | 80 | – | nC |
| | | | T _C = 150°C | – | 212 | – | |
| I _{rrm} | Peak Reverse Recovery Current | | T _C = 25°C | – | 9 | – | A |
| | | T _C = 150°C | – | 14 | – | | |

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

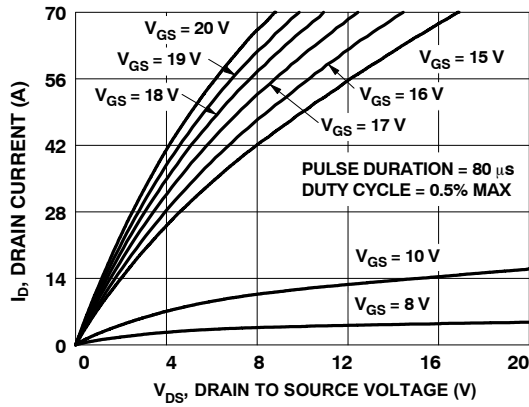


Figure 1. On Region Characteristics

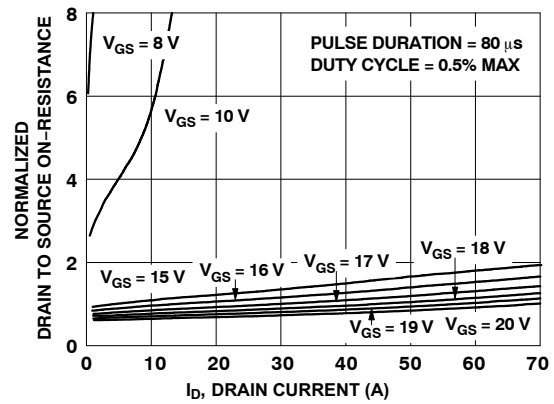


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

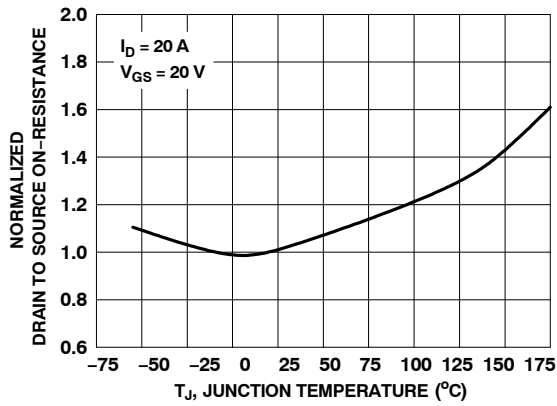


Figure 3. Normalized On Resistance vs. Junction Temperature

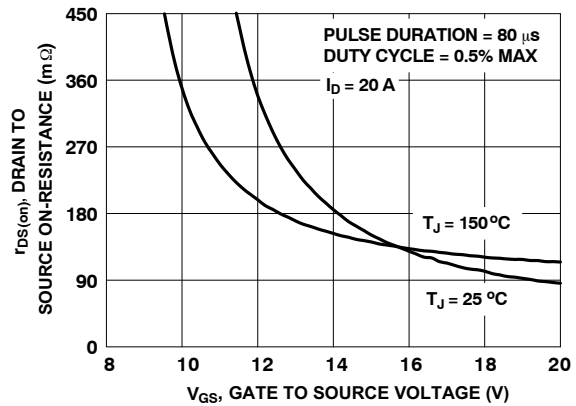


Figure 4. On-Resistance vs. Gate-to-Source Voltage

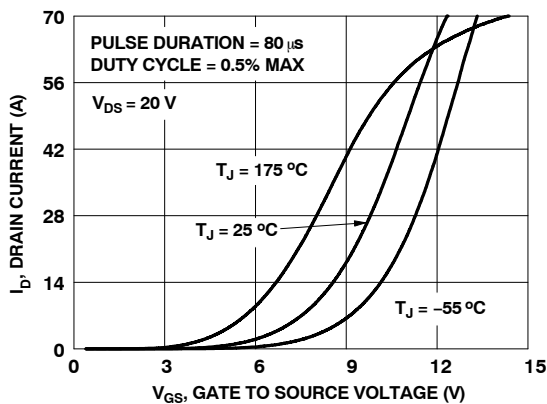


Figure 5. Transfer Characteristics

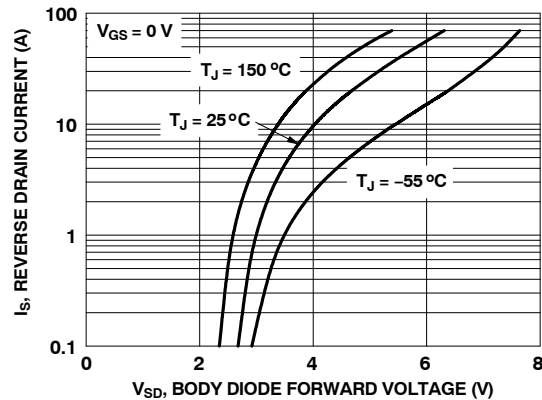


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

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

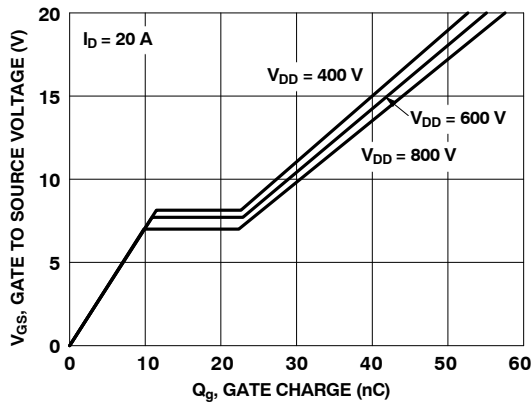


Figure 7. Gate Charge Characteristics

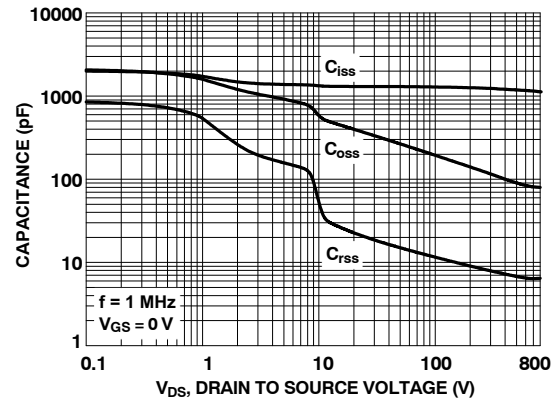


Figure 8. Capacitance vs. Drain-to-Source Voltage

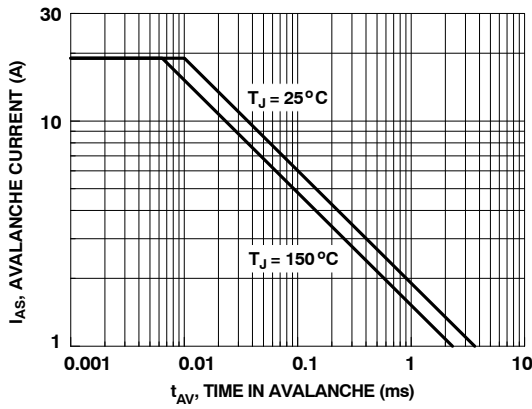


Figure 9. Unclamped Inductive Switching Capability

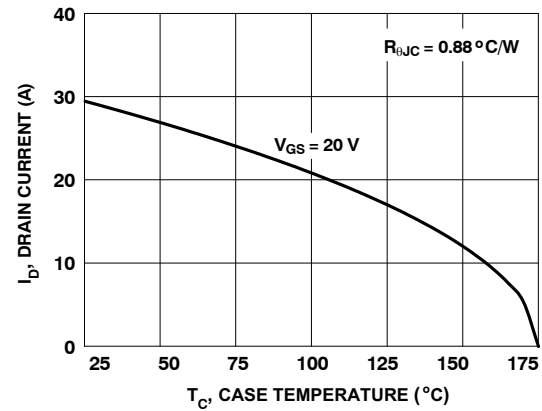


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

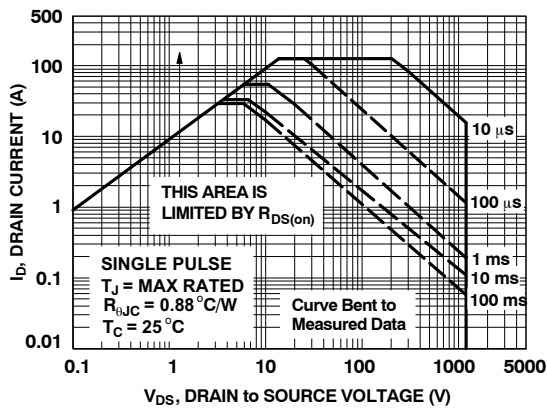


Figure 11. Forward Bias Safe Operating Area

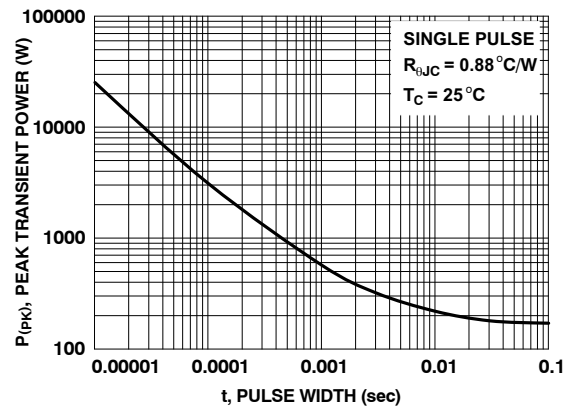


Figure 12. Single Pulse Maximum Power Dissipation

NVH4L080N120SC1

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

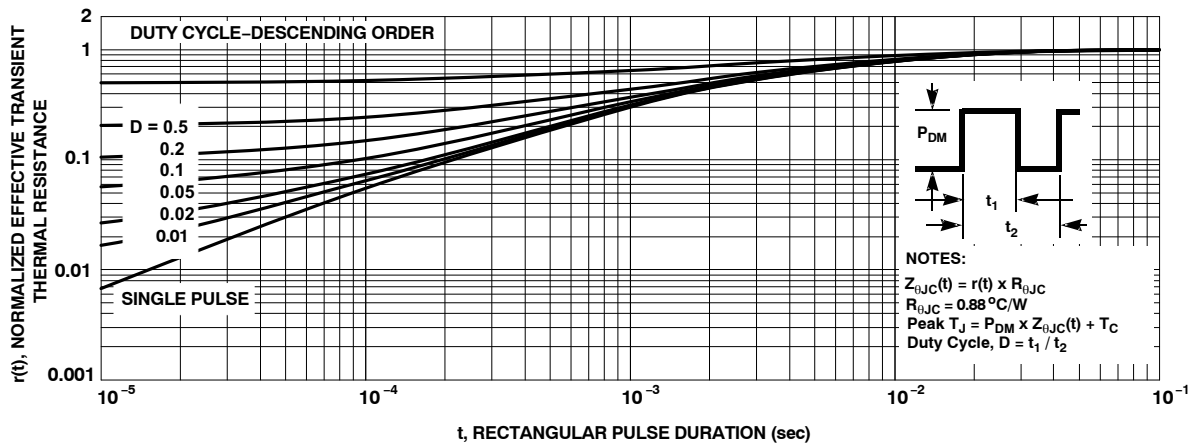
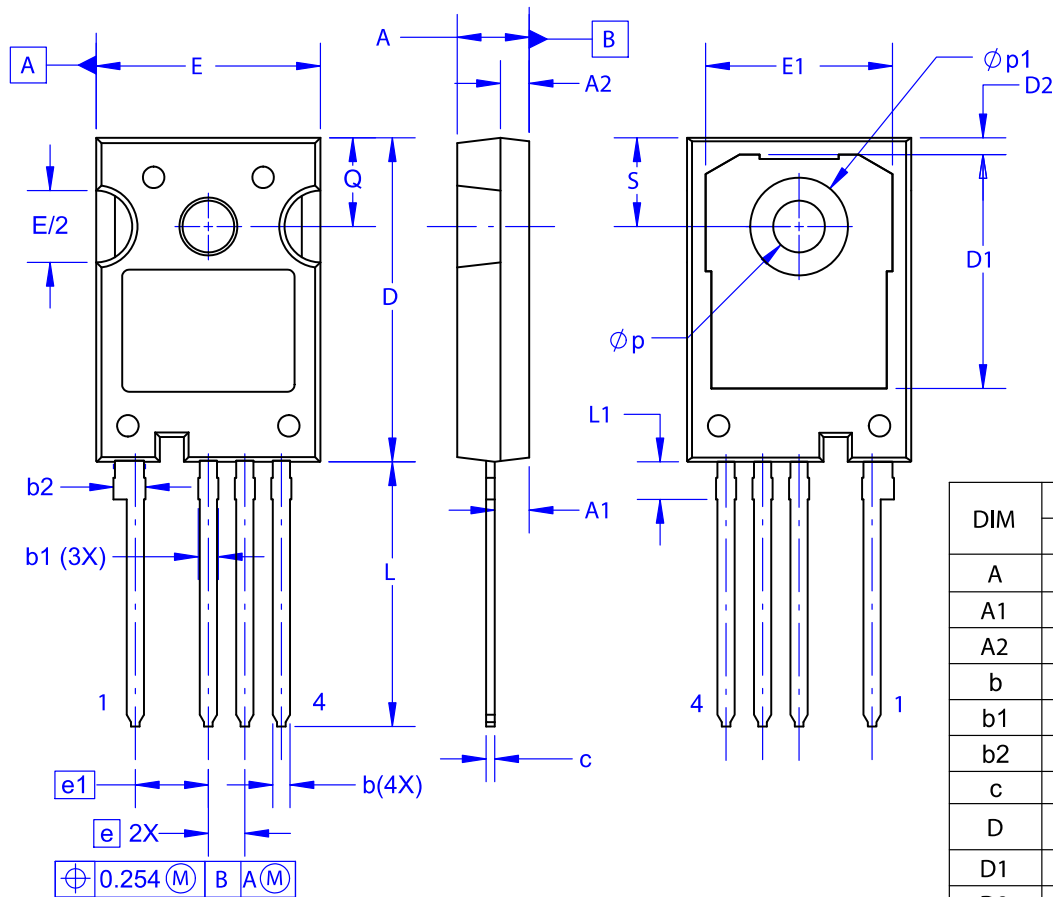


Figure 13. Junction-to-Case Transient Thermal Response Curve

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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