MOSFET – SiC Power, Single N-Channel, D2PAK-7L

1200 V, 40 mΩ, 60 A

NVBG040N120SC1

Features

- Typ. $R_{DS(on)}$ = 40 mΩ
- Ultra Low Gate Charge (Typ. $Q_{G(tot)}$ = 106 nC)
- Low Effective Output Capacitance (Typ. C_{oss} = 139 pF)
- 100% Avalanche Tested
- AEC−Q101 Qualified and PPAP Capable
- This Device is Pb−Free and is RoHS Compliant

Typical Applications

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

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

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	1200	V
Gate−to−Source Voltage			V_{GS}	+25/−15	V
Recommended Operation Values of Gate − Source Voltage		T_C < 175°C	V_{GSop}	+20/−5	V
Continuous Drain Current (Note 1)	Steady State	T_C = 25°C	I_D	60	A
Power Dissipation (Note 1)	Steady State	T_C = 25°C	P_D	357	W
Continuous Drain Current (Note 1)	Steady State	T_C = 100°C	I_D	43	A
Power Dissipation (Note 1)	Steady State	T_C = 100°C	P_D	178	W
Pulsed Drain Current (Note 2)		T_A = 25°C	I_{DM}	240	A
Single Pulse Surge Drain Current Capability	T_A = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	416	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode)			I_S	36	A
Single Pulse Drain−to−Source Avalanche Energy (I_L = 34 A_{pk}, L = 1 mH) (Note 3)			E_{AS}	578	mJ
Maximum Lead Temperature for Soldering, 1/8″ from Case for 10 Seconds			T_L	300	°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. 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 578 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 34 A, V_{DD} = 120 V, V_{GS} = 18 V.

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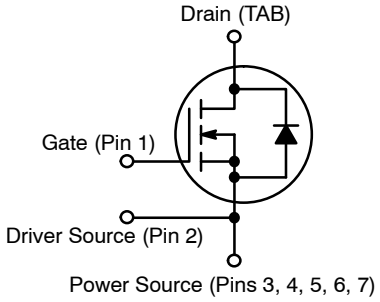
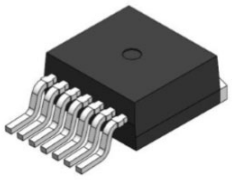
$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
1200 V	56 mΩ @ 20 V	60 A

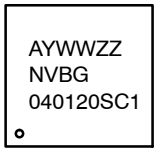


N−CHANNEL MOSFET



D2PAK−7L
CASE 418BJ

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability
NVBG040120SC1 = Specific Device Code

ORDERING INFORMATION

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

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Units
Thermal Resistance Junction−to−Case (Note 1)	$R_{\theta JC}$	0.42	°C/W
Thermal Resistance Junction−to−Ambient (Note 1)	$R_{\theta JA}$	40	°C/W

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°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		1200			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = 1 mA, refer to 25°C			0.45		V/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V	T_J = 25°C			100	μA
			T_J = 175°C			1	mA
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = +25/−15 V, V_{DS} = 0 V				±1	μA
ON CHARACTERISTICS (Note 2)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 10 mA		1.8	3	4.3	V
Recommended Gate Voltage	V_{GOP}			−5		+20	V
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 20 V, I_D = 35 A, T_J = 25°C			40	56	mΩ
		V_{GS} = 20 V, I_D = 35 A, T_J = 175°C			71	100	mΩ
Forward Transconductance	g_{FS}	V_{DS} = 20 V, I_D = 35 A			20		S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V			1789		pF
Output Capacitance	C_{OSS}				139		
Reverse Transfer Capacitance	C_{RSS}				12.5		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −5/20 V, V_{DS} = 600 V, I_D = 47 A			106		nC
Threshold Gate Charge	$Q_{G(TH)}$				18		
Gate−to−Source Charge	Q_{GS}				34		
Gate−to−Drain Charge	Q_{GD}				26		
Gate−Resistance	R_G	f = 1 MHz			2		Ω
SWITCHING CHARACTERISTICS (Note 4)							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −5/20 V, V_{DS} = 800 V, I_D = 47 A, R_G = 4.7 Ω, Inductive Load			17	30	ns
Rise Time	t_r				20	36	
Turn−Off Delay Time	$t_{d(OFF)}$				30	48	
Fall Time	t_f				9	18	
Turn−On Switching Loss	E_{ON}				366		μJ
Turn−Off Switching Loss	E_{OFF}				200		
Total Switching Loss	E_{TOT}				566		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Continuous Drain−Source Diode Forward Current	I_{SD}	V_{GS} = −5 V, T_J = 25°C				36	A
Pulsed Drain−Source Diode Forward Current (Note 2)	I_{SDM}	V_{GS} = −5 V, T_J = 25°C				240	A
Forward Diode Voltage	V_{SD}	V_{GS} = −5 V, I_{SD} = 17.5 A, T_J = 25°C			3.7		V

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −5/20 V, I_{SD} = 47 A, dI_S/dt = 1000 A/μs		24		ns
Reverse Recovery Charge	Q_{RR}			124.8		nC
Reverse Recovery Energy	E_{REC}			8.4		μJ
Peak Reverse Recovery Current	I_{RRM}			10.4		A
Charge time	Ta			12.4		ns
Discharge time	Tb			11.6		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.

4. Switching characteristics are independent of operating junction temperature

TYPICAL CHARACTERISTICS

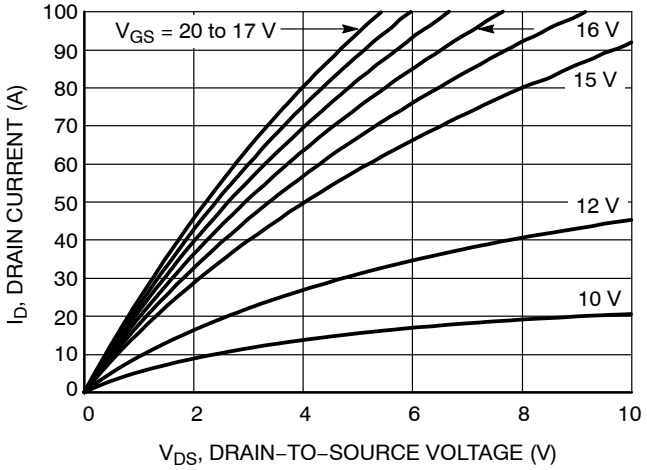


Figure 1. On−Region Characteristics

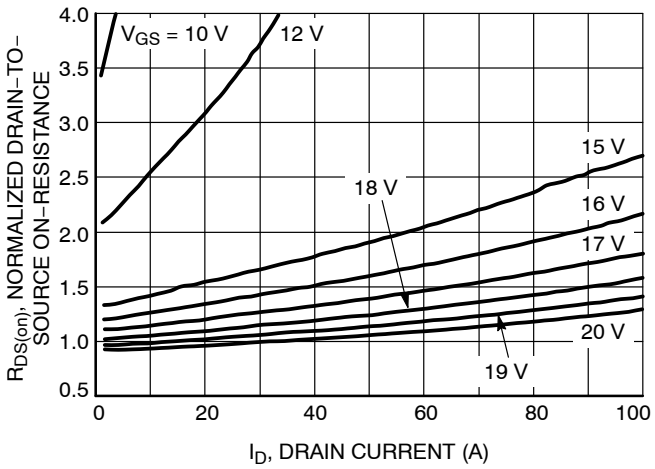


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

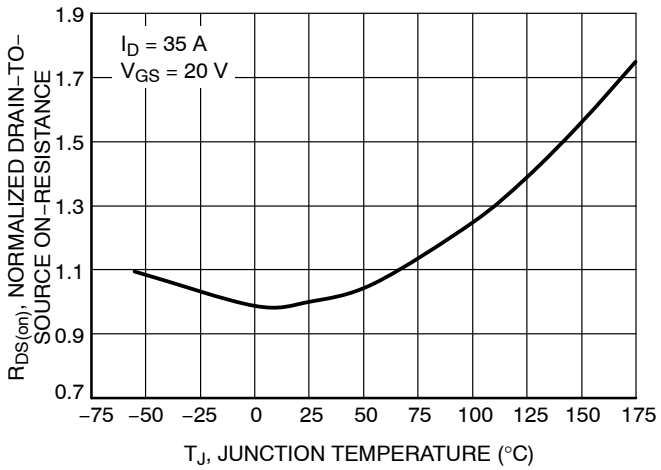


Figure 3. On−Resistance Variation with Temperature

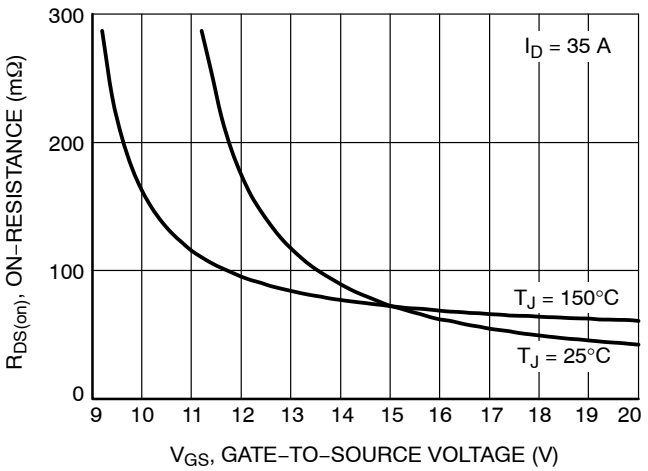


Figure 4. On−Resistance vs. Gate−to−Source Voltage

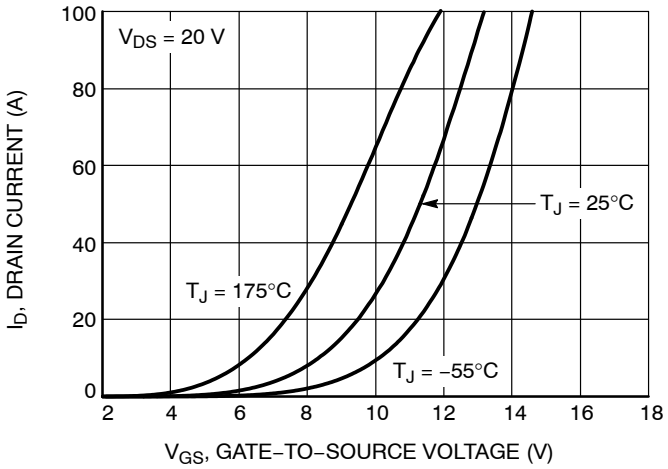


Figure 5. Transfer Characteristics

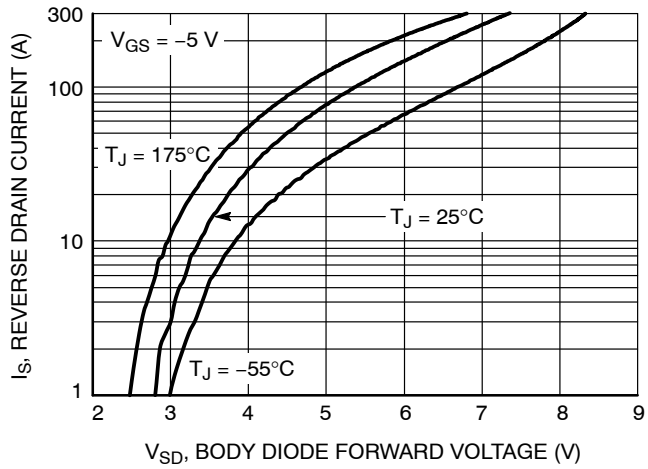


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

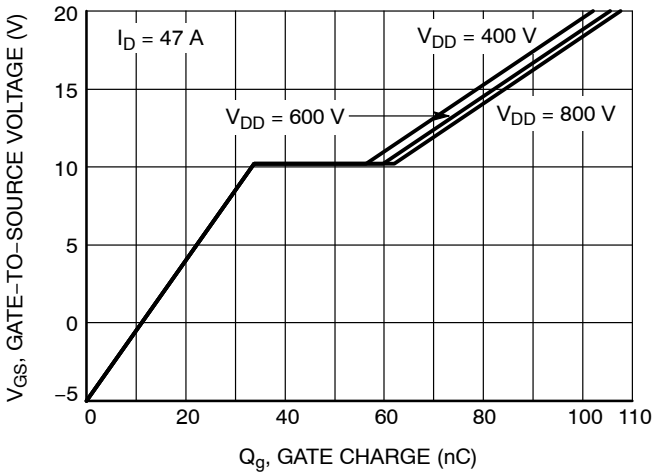


Figure 7. Gate−to−Source Voltage vs. Total Charge

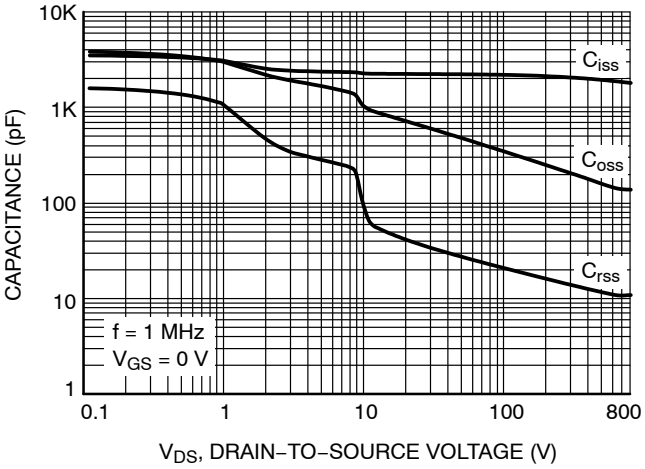


Figure 8. Capacitance vs. Drain−to−Source Voltage

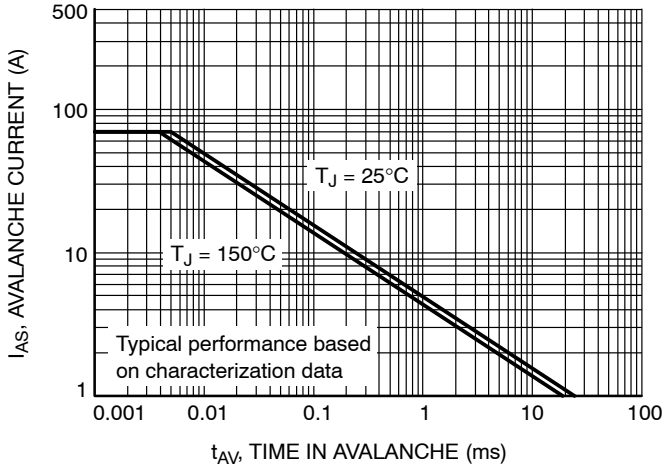


Figure 9. Unclamped Inductive Switching Capability

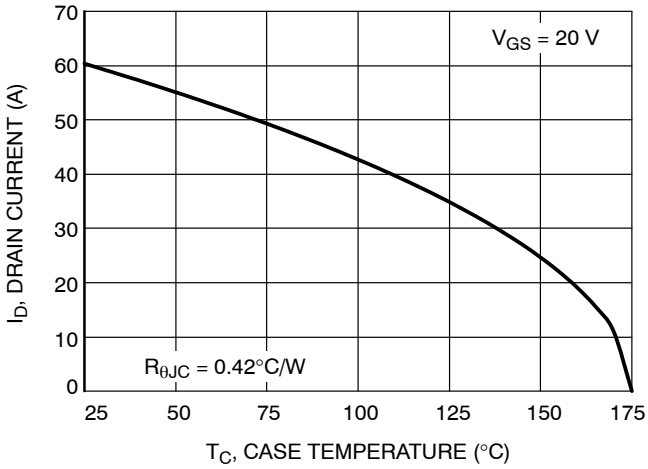


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

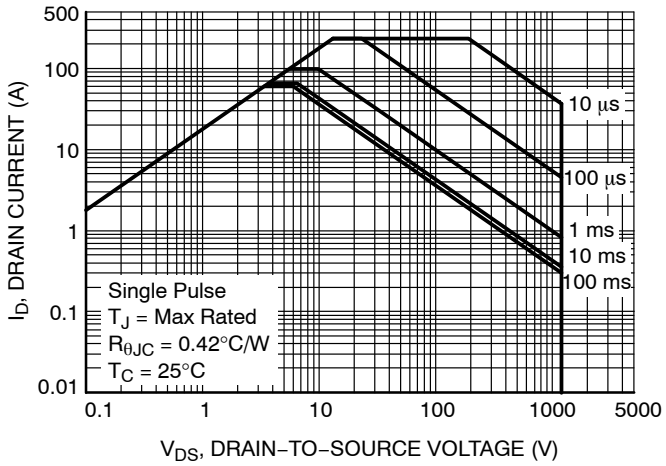


Figure 11. Safe Operating Area

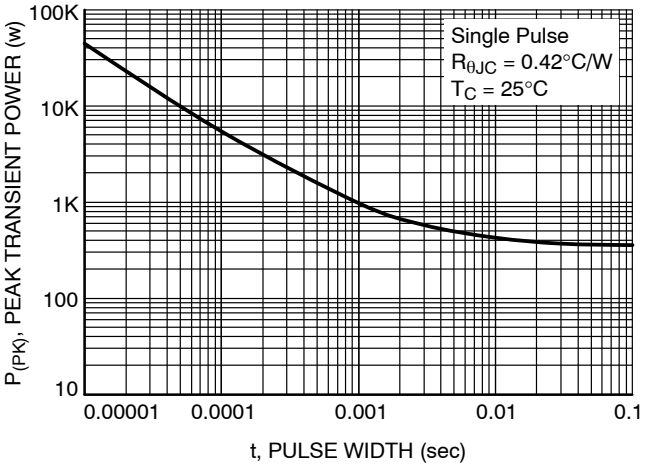


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

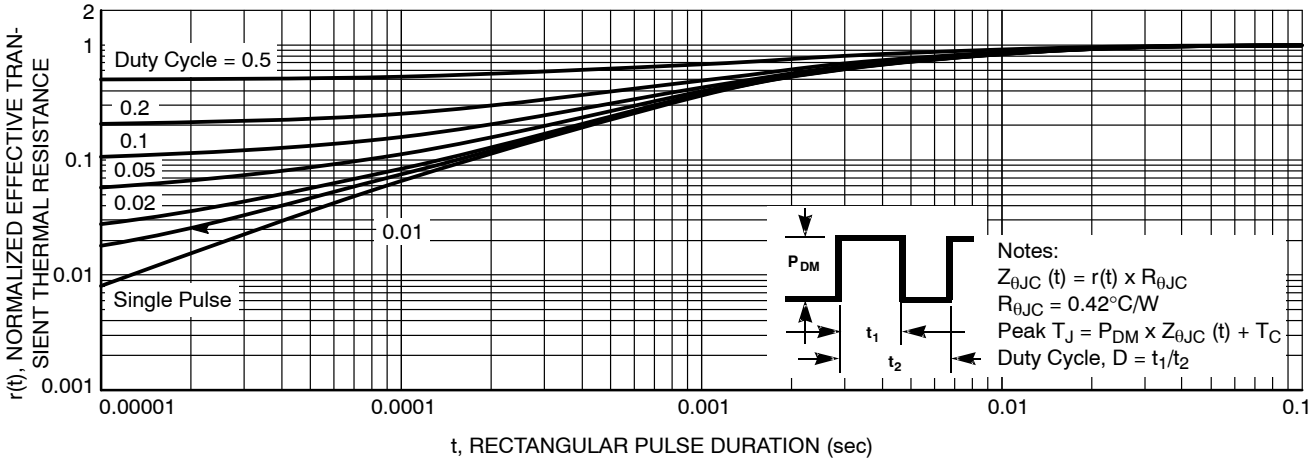


Figure 13. Junction−to−Ambient Transient Thermal Response Curve

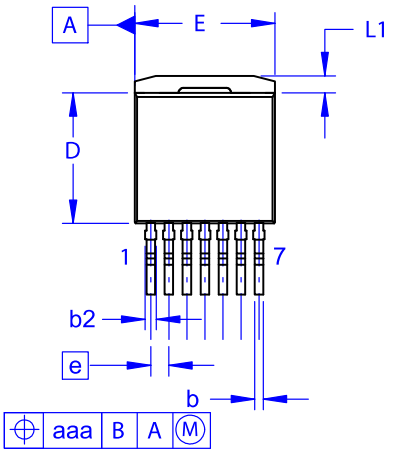
DEVICE ORDERING INFORMATION

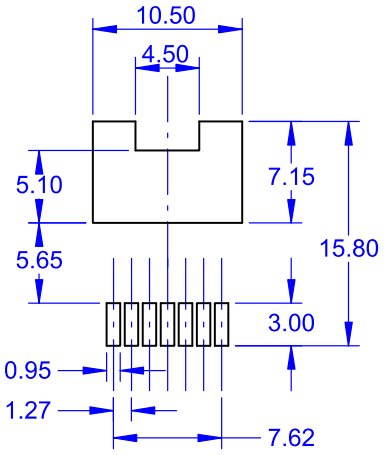
Device	Package	Shipping†
NVBG040N120SC1	D2PAK−7L	800 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

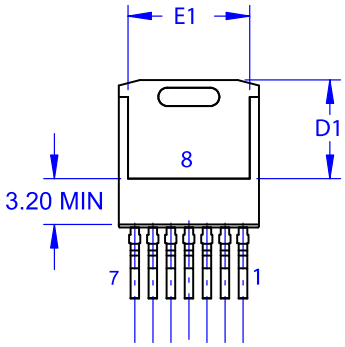
PACKAGE DIMENSIONS

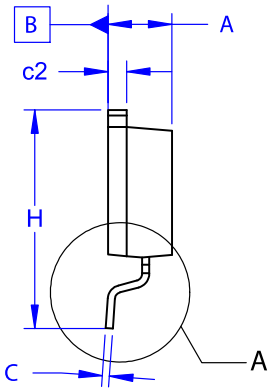
D²PAK7 (TO−263−7L HV)
CASE 418BJ
ISSUE B





LAND PATTERN RECOMMENDATION

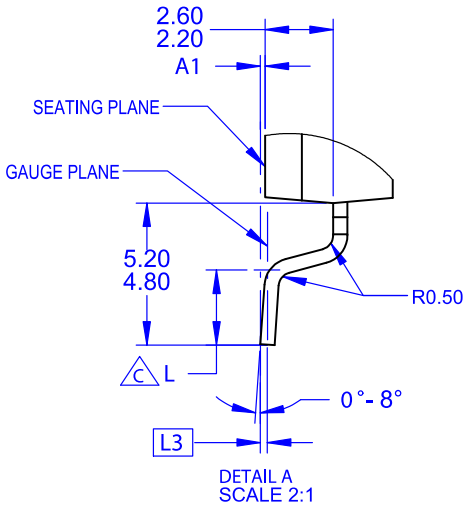




NOTES:

A. PACKAGE CONFORMS TO JEDEC TO-263 VARIATION CB EXCEPT WHERE NOTED.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. OUT OF JEDEC STANDARD VALUE.
D. DIMENSION AND TOLERANCE AS PER ASME Y14.5-2009.
E. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	0.00	0.10	0.20
b2	0.60	0.70	0.80
b	0.51	0.60	0.70
c	0.40	0.50	0.60
c2	1.20	1.30	1.40
D	9.00	9.20	9.40
D1	6.15	6.80	7.15
E	9.70	9.90	10.20
E1	7.15	7.65	8.15
e	~	1.27	~
H	15.10	15.40	15.70
L	2.44	2.64	2.84
L1	1.00	1.20	1.40
L3	~	0.25	~
aaa	~	~	0.25



PUBLICATION ORDERING INFORMATION

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