

# NVBG020N120SC1

## MOSFET - SiC Power, Single N-Channel, D2PAK-7L 1200 V, 20 mΩ, 98 A

### Features

- Typ.  $R_{DS(on)} = 20 \text{ m}\Omega$
- Ultra Low Gate Charge (typ.  $Q_{G(\text{tot})} = 220 \text{ nC}$ )
- Low Effective Output Capacitance (typ.  $C_{oss} = 258 \text{ pF}$ )
- 100% Avalanche 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		$V_{DSS}$	1200	V
Gate-to-Source Voltage		$V_{GS}$	-15/+25	V
Recommended Operation Values of Gate-to-Source Voltage		$V_{GSop}$	-5/+20	V
Continuous Drain Current (Note 2)	Steady State	$I_D$	98	A
Power Dissipation (Note 2)		$P_D$	468	W
Continuous Drain Current (Notes 1, 2)	Steady State	$I_D$	8.6	A
Power Dissipation (Notes 1, 2)		$P_D$	3.7	W
Pulsed Drain Current (Note 3)	$T_A = 25^\circ\text{C}$	$I_{DM}$	392	A
Single Pulse Surge Drain Current Capability	$T_A = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$ , $R_G = 4.7 \Omega$	$I_{DSC}$	807	A
Operating Junction and Storage Temperature Range	$T_J$ , $T_{stg}$	-55 to +175		°C
Source Current (Body Diode)	$I_S$	46	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 23 \text{ A}$ , $L = 1 \text{ mH}$ ) (Note 4)	$E_{AS}$	264	mJ	
Maximum Lead Temperature for Soldering (1/8" from case for 5 s)	$T_L$	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.

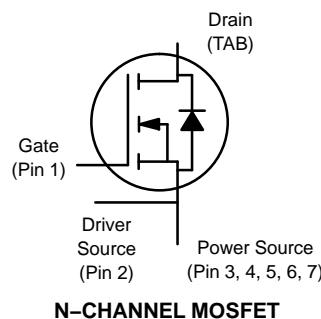
1. Surface mounted on a FR-4 board using 1 in<sup>2</sup> pad of 2 oz copper.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
3. Repetitive rating, limited by max junction temperature.
4. EAS of 264 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1 \text{ mH}$ ,  $I_{AS} = 23 \text{ A}$ ,  $V_{DD} = 120 \text{ V}$ ,  $V_{GS} = 18 \text{ V}$ .



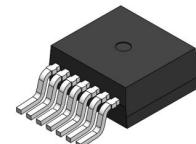
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$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
1200 V	28 mΩ @ 20 V	98 A

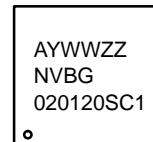


N-CHANNEL MOSFET



D2PAK-7L  
CASE 418BJ

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Lot Traceability  
NVBG020120SC1 = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NVBG020N120SC1	D2PAK-7L	800 ea/ Tape&Reel

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

# NVBG020N120SC1

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 2)	$R_{\theta JC}$	0.32	°C/W
Junction-to-Ambient – Steady State (Notes 1, 2)	$R_{\theta JA}$	41	

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(\text{BR})DSS}$	$V_{GS} = 0 \text{ V}$ , $I_D = 1 \text{ mA}$	1200			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(\text{BR})DSS}/T_J$	$I_D = 1 \text{ mA}$ , referenced to $25^\circ\text{C}$		0.5		$^\circ\text{C}/\text{V}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0 \text{ V}$ , $V_{DS} = 1200 \text{ V}$	$T_J = 25^\circ\text{C}$		100	$\mu\text{A}$
			$T_J = 175^\circ\text{C}$		1	mA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +25/-15 \text{ V}$ , $V_{DS} = 0 \text{ V}$			$\pm 1$	$\mu\text{A}$

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(\text{TH})}$	$V_{GS} = V_{DS}$ , $I_D = 20 \text{ mA}$	1.8	2.7	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5		+20	V
Drain-to-Source On Resistance	$R_{DS(\text{on})}$	$V_{GS} = 20 \text{ V}$ , $I_D = 60 \text{ A}$ , $T_J = 25^\circ\text{C}$		20	28	$\text{m}\Omega$
		$V_{GS} = 20 \text{ V}$ , $I_D = 60 \text{ A}$ , $T_J = 175^\circ\text{C}$		35	50	
Forward Transconductance	$g_{FS}$	$V_{DS} = 20 \text{ V}$ , $I_D = 60 \text{ A}$		34		S

## CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{DS} = 800 \text{ V}$	2943		pF
Output Capacitance	$C_{OSS}$		258		
Reverse Transfer Capacitance	$C_{RSS}$		24		
Total Gate Charge	$Q_{G(\text{TOT})}$	$V_{GS} = -5/20 \text{ V}$ , $V_{DS} = 600 \text{ V}$ , $I_D = 80 \text{ A}$	220		nC
Threshold Gate Charge	$Q_{G(\text{TH})}$		33		
Gate-to-Source Charge	$Q_{GS}$		66		
Gate-to-Drain Charge	$Q_{GD}$		63		
Gate-Resistance	$R_G$	$f = 1 \text{ MHz}$	1.6		$\Omega$

## SWITCHING CHARACTERISTICS, $V_{GS} = 10 \text{ V}$ (Note 5)

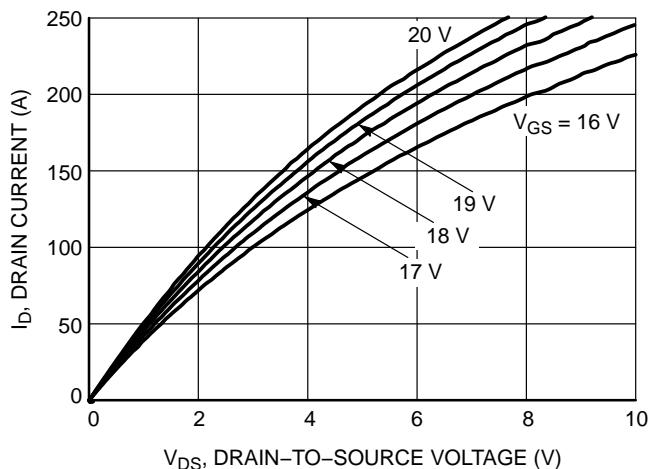
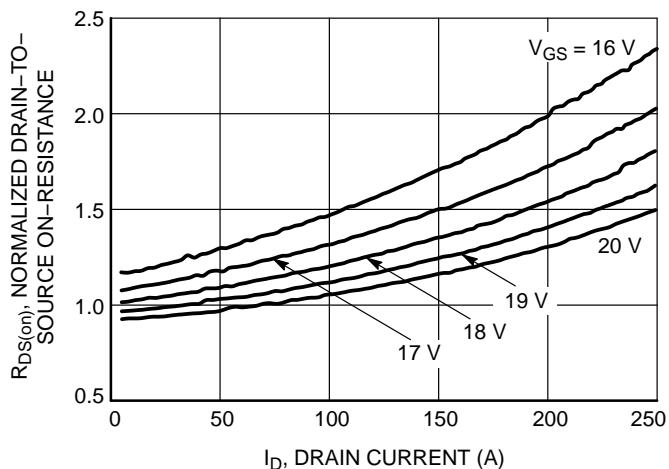
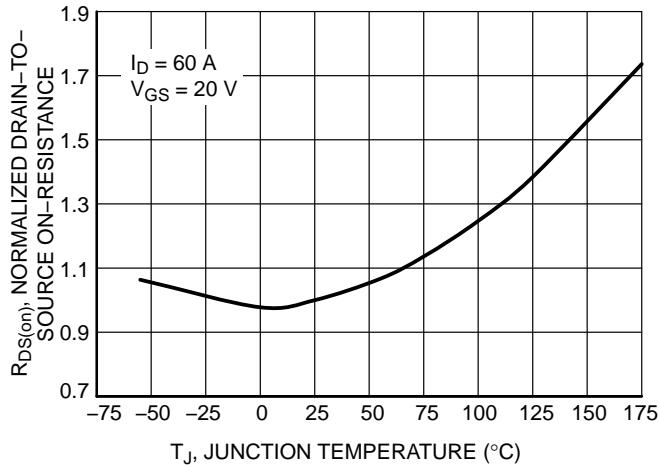
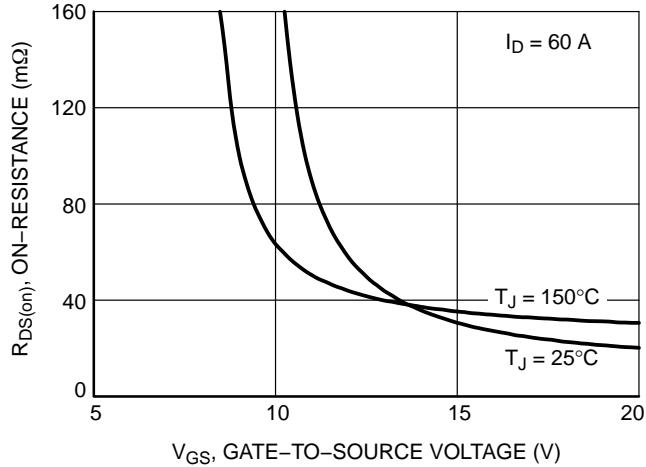
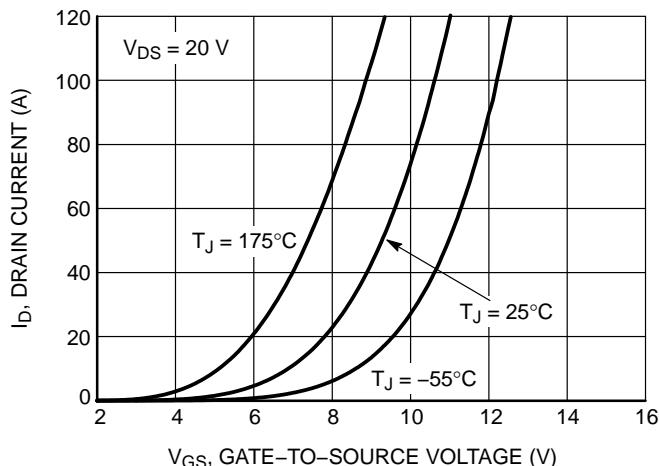
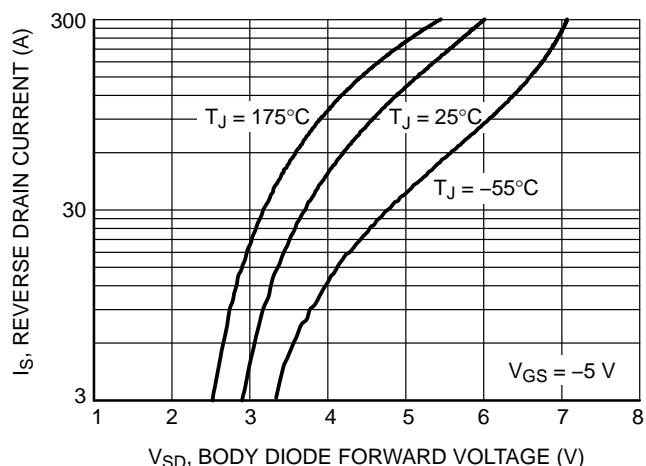
Turn-On Delay Time	$t_{d(\text{ON})}$	$V_{GS} = -5/20 \text{ V}$ , $V_{DS} = 800 \text{ V}$ , $I_D = 80 \text{ A}$ , $R_G = 2 \Omega$ inductive load	25	40	ns
Rise Time	$t_r$		41	66	
Turn-Off Delay Time	$t_{d(\text{OFF})}$		46	74	
Fall Time	$t_f$		11	20	
Turn-On Switching Loss	$E_{ON}$		1670		
Turn-Off Switching Loss	$E_{OFF}$		261		$\mu\text{J}$
Total Switching Loss	$E_{tot}$		1931		

## DRAIN-SOURCE DIODE CHARACTERISTICS

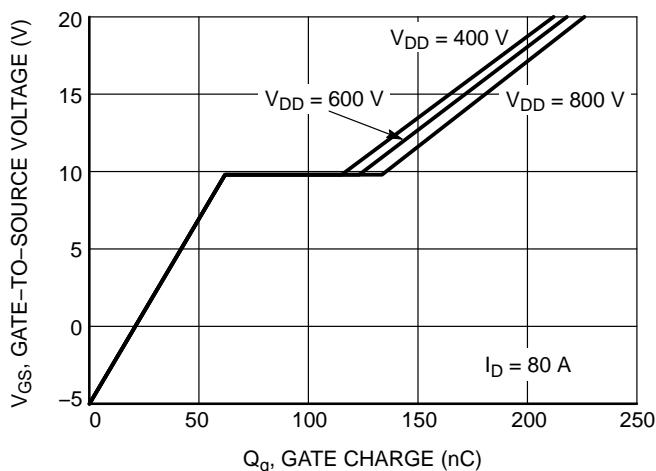
Continuous Drain-Source Diode Forward Current	$I_{SD}$	$V_{GS} = -5 \text{ V}$ , $T_J = 25^\circ\text{C}$		46	A
Pulsed Drain-Source Diode Forward Current (Note 3)	$I_{SDM}$			392	
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5 \text{ V}$ , $I_{SD} = 30 \text{ A}$ , $T_J = 25^\circ\text{C}$	3.7		V
Reverse Recovery Time	$t_{RR}$		31		
Reverse Recovery Charge	$Q_{RR}$	$V_{GS} = -5/20 \text{ V}$ , $I_{SD} = 80 \text{ A}$ , $dI_{SD}/dt = 1000 \text{ A}/\mu\text{s}$	228		nC

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.

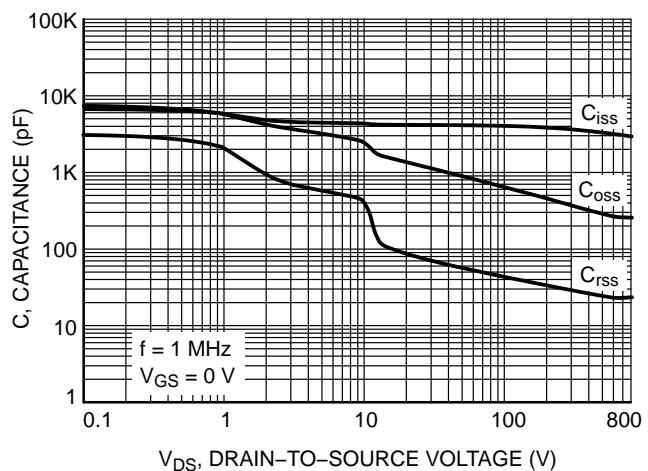
5. Switching characteristics are independent of operating junction temperature

**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**

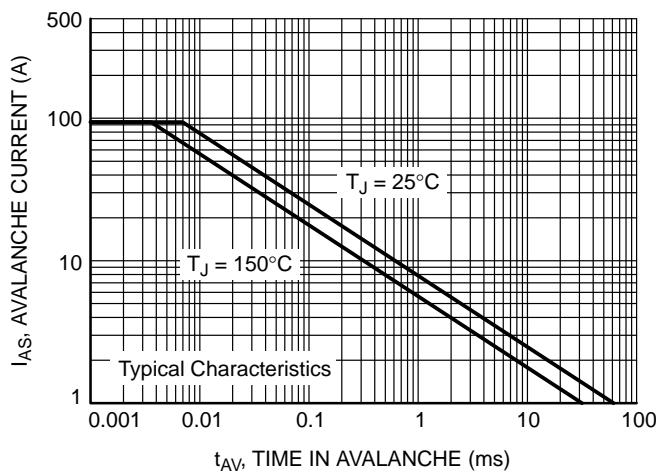
## TYPICAL CHARACTERISTICS



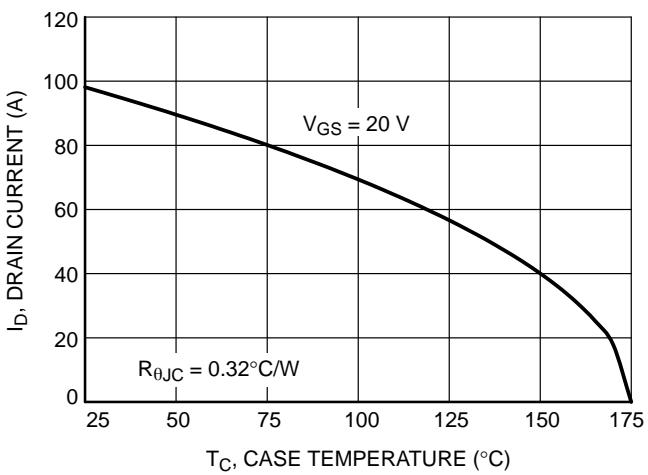
**Figure 7. Gate-to-Source Voltage vs. Total Charge**



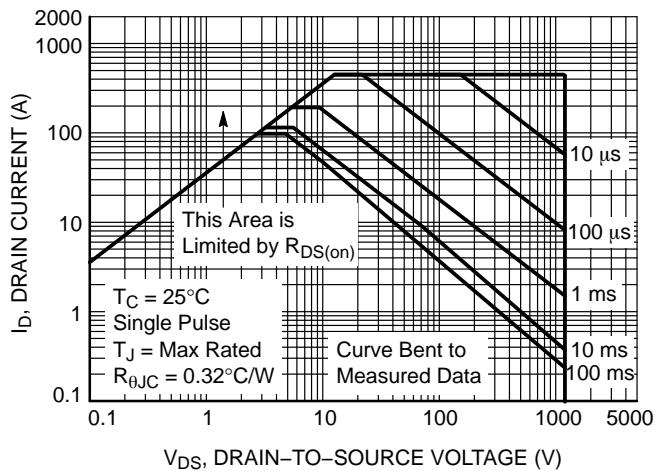
**Figure 8. Capacitance vs. Drain-to-Source Voltage**



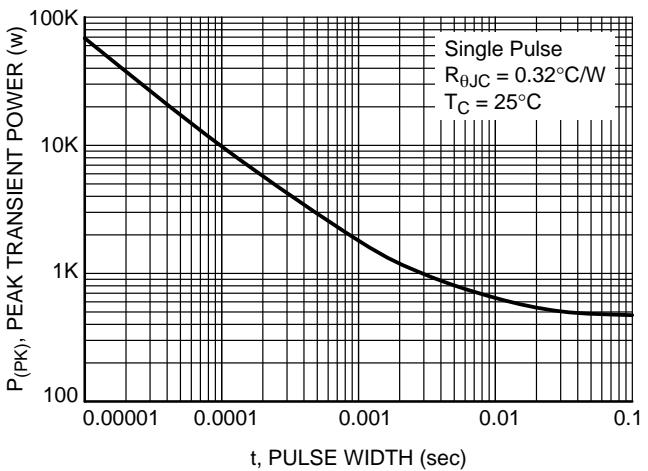
**Figure 9. Unclamped Inductive Switching Capability**



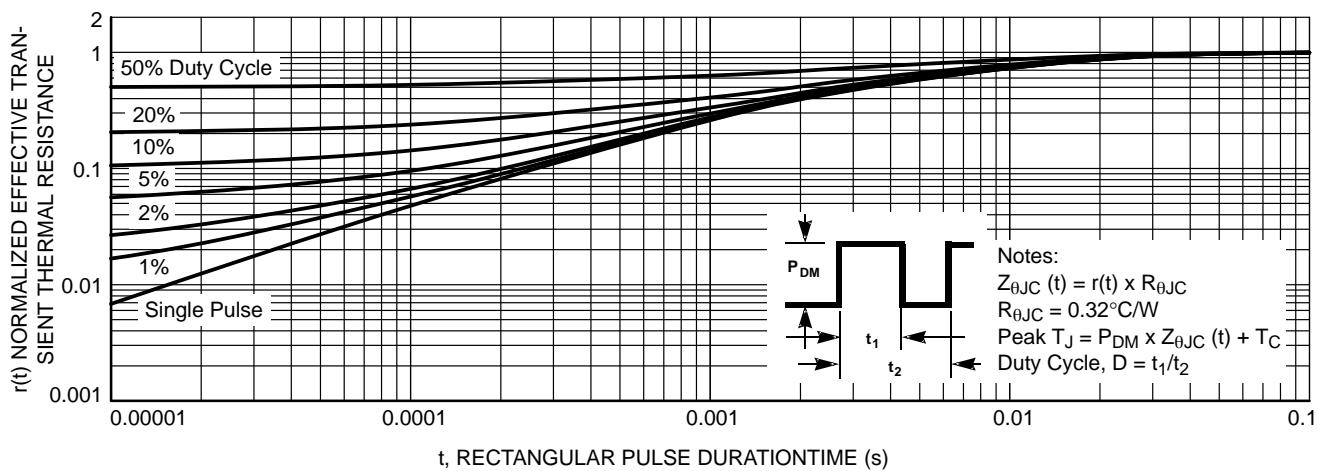
**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

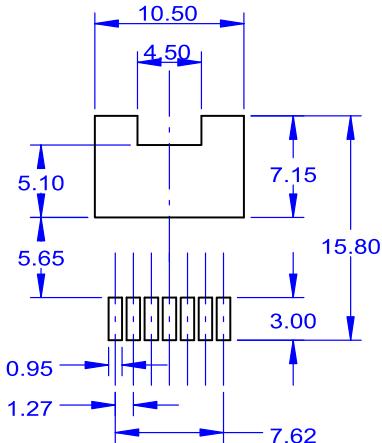
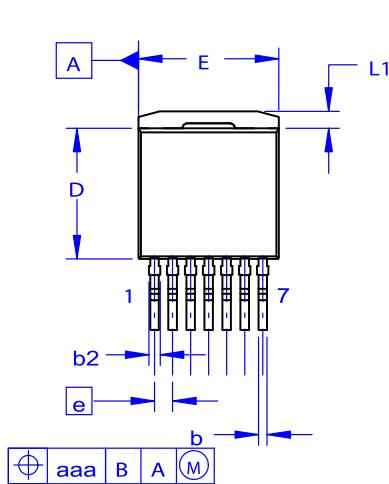


**Figure 12. Single Pulse Maximum Power Dissipation**

**TYPICAL CHARACTERISTICS****Figure 13. Junction-to-Case Transient Thermal Response Curve**

## PACKAGE DIMENSIONS

### D<sup>2</sup>PAK7 (TO-263-7L HV) CASE 418BJ ISSUE A

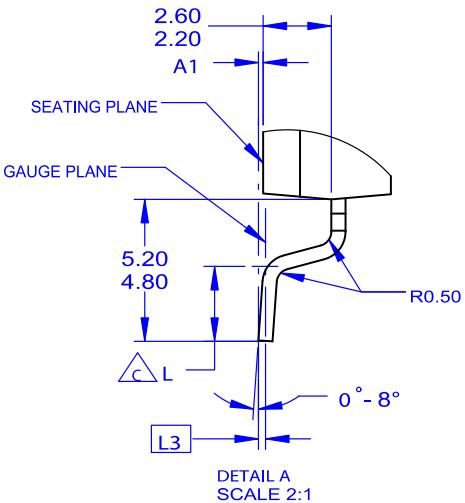
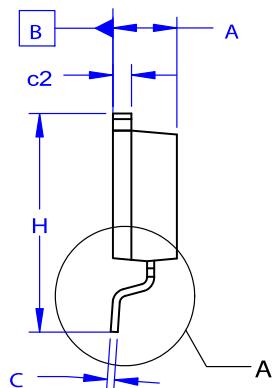
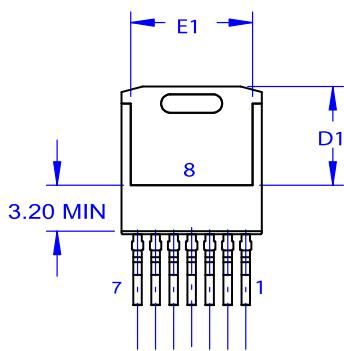


#### NOTES:

- 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	6.75	6.95	7.15
E	9.70	9.90	10.20
E1	7.70	7.90	8.10
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

#### LAND PATTERN RECOMMENDATION



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