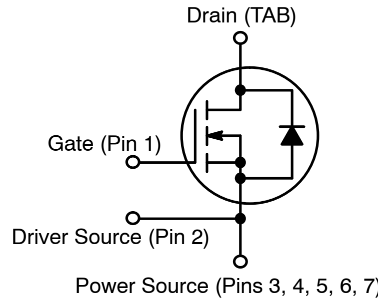
DATA SHEET
www.onsemi.com

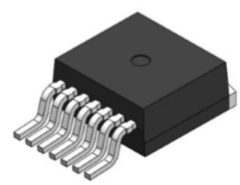
Silicon Carbide (SiC) MOSFET – EliteSiC, 40 mohm, 1200 V, M3S, D2PAK-7L

NTBG040N120M3S

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
1200 V	54 mΩ @ 18 V	57 A



N−CHANNEL MOSFET



D2PAK−7L
CASE 418BJ

Features

- Typ. $R_{DS(on)}$ = 40 mΩ @ V_{GS} = 18 V
- Ultra Low Gate Charge ($Q_{G(TOT)}$ = 75 nC)
- High Speed Switching with Low Capacitance (C_{OSS} = 80 pF)
- 100% Avalanche Tested
- This Device is Halide Free and RoHS Compliant with Exemption 7a, Pb−Free 2LI (on Second Level Interconnection)

Typical Applications

- Solar Inverters
- Electric Vehicle Charging Stations
- Uninterruptible Power Supplies (UPS)
- Energy Storage Systems
- Switch Mode Power Supplies (SMPS)

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}	−10/+22	V
Recommended Operation Values of Gate−to−Source Voltage		T_C < 175°C	V_{GSop}	−3/+18	V
Continuous Drain Current (Notes 2, 3)	Steady State	T_C = 25°C	I_D	57	A
Power Dissipation (Note 2)			P_D	263	W
Continuous Drain Current (Notes 2, 3)	Steady State	T_C = 100°C	I_D	40	A
Power Dissipation (Note 2)			P_D	131	W
Pulsed Drain Current (Note 4)	T_C = 25°C		I_{DM}	149	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode) T_C = 25°C, V_{GS} = −3 V (Note 2)			I_S	50	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 16.9 A, L = 1 mH) (Note 5)			E_{AS}	143	mJ
Maximum Temperature for Soldering (10 s)			T_L	270	°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 using1 in^2 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. The maximum current rating is based on typical RDS(on) performance.
4. Repetitive rating, limited by max junction temperature.
5. E_{AS} of 143 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 16.9 A, V_{DD} = 100 V, V_{GS} = 18 V.

MARKING DIAGRAM

BG040N
120M3S
AYWWZZ

BG040N120M3S = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NTBG040N120M3S	D2PAK−7L	800 / Tape & Reel

THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Junction–to–Case – Steady State (Note 2)	$R_{\theta JC}$	0.57	°C/W
Junction–to–Ambient – Steady State (Notes 1, 2)	$R_{\theta JA}$	40	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF–STATE 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, referenced to 25°C (Note 7)	–	0.3	–	V/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V	–	–	100	μA
Gate–to–Source Leakage Current	I_{GSS}	V_{GS} = +22/−10 V, V_{DS} = 0 V	–	–	±1	μA
ON–STATE CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 10 mA	2.04	2.9	4.4	V
Recommended Gate Voltage	V_{GOP}		−3	–	+18	V
Drain–to–Source On Resistance	$R_{DS(on)}$	V_{GS} = 18 V, I_D = 20 A, T_J = 25°C	–	40	54	mΩ
		V_{GS} = 18 V, I_D = 20 A, T_J = 175°C (Note 7)	–	80	–	
Forward Transconductance	g_{FS}	V_{DS} = 10 V, I_D = 20 A (Note 7)	–	16	–	S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V	–	1700	–	pF
Output Capacitance	C_{OSS}		–	80	–	
Reverse Transfer Capacitance	C_{RSS}		–	7	–	
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 20 A	–	75	–	nC
Threshold Gate Charge	$Q_{G(TH)}$		–	4.4	–	
Gate–to–Source Charge	Q_{GS}		–	14	–	
Gate–to–Drain Charge	Q_{GD}		–	22	–	
Gate–Resistance	R_G	f = 1 MHz	–	3.8	–	Ω
SWITCHING CHARACTERISTICS						
Turn–On Delay Time	$t_{d(ON)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 20 A, R_G = 4.7 Ω Inductive Load (Notes 6, 7)	–	13	–	ns
Rise Time	t_r		–	16	–	
Turn–Off Delay Time	$t_{d(OFF)}$		–	38	–	
Fall Time	t_f		–	10	–	
Turn–On Switching Loss	E_{ON}		–	193	–	μJ
Turn–Off Switching Loss	E_{OFF}		–	66	–	
Total Switching Loss	E_{tot}		–	259	–	
SOURCE–DRAIN DIODE CHARACTERISTICS						
Continuous Source–Drain Diode Forward Current (Note 2)	I_{SD}	V_{GS} = −3 V, T_C = 25°C (Note 7)	–	–	50	A
Pulsed Source–Drain Diode Forward Current (Note 4)	I_{SDM}		–	–	149	
Forward Diode Voltage	V_{SD}	V_{GS} = −3 V, I_{SD} = 20 A, T_J = 25°C	–	4.5	–	V

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SOURCE–DRAIN DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −3/18 V, I_{SD} = 20 A, dI_S/dt = 1000 A/μs, V_{DS} = 800 V (Note 7)	–	16.8	–	ns
Reverse Recovery Charge	Q_{RR}		–	82	–	nC
Reverse Recovery Energy	E_{REC}		–	7.9	–	μJ
Peak Reverse Recovery Current	I_{RRM}		–	9.8	–	A
Charge time	t_A		–	9.6	–	ns
Discharge time	t_B		–	7.2	–	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.

6. E_{ON}/E_{OFF} result is with body diode
7. Defined by design, not subject to production test.

TYPICAL CHARACTERISTICS

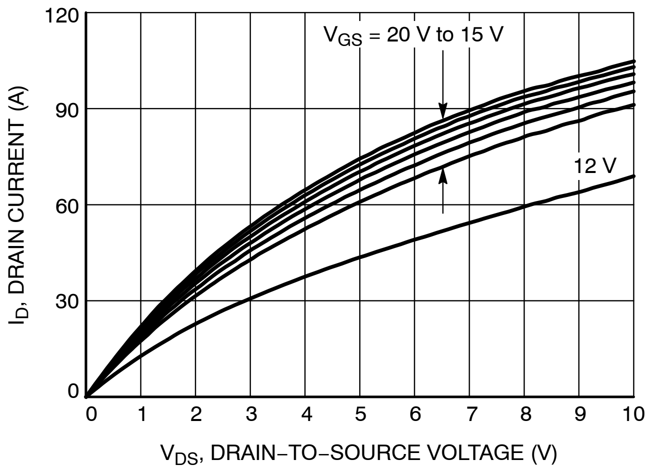


Figure 1. On−Region Characteristics

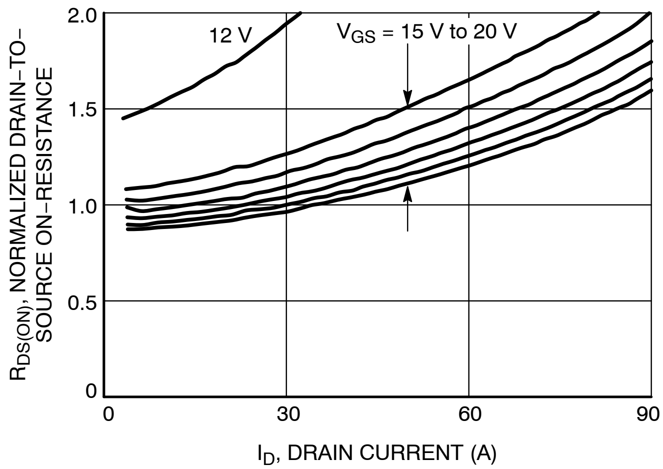


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

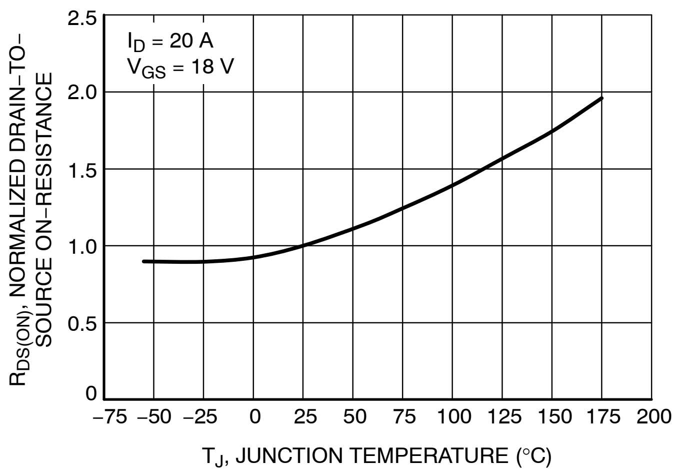


Figure 3. On−Resistance Variation with Temperature

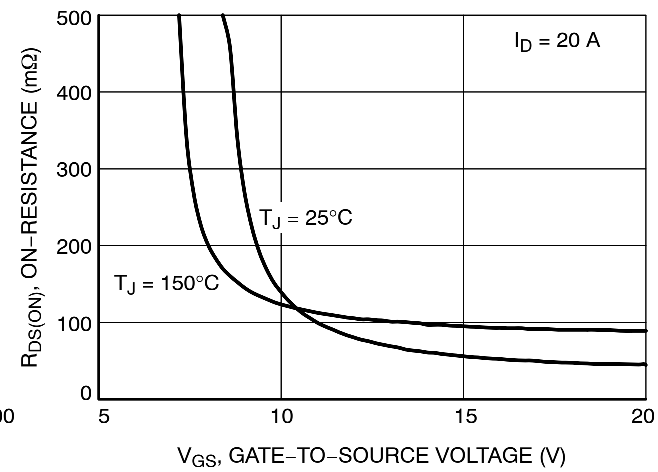


Figure 4. On−Resistance vs. Gate−to−Source Voltage

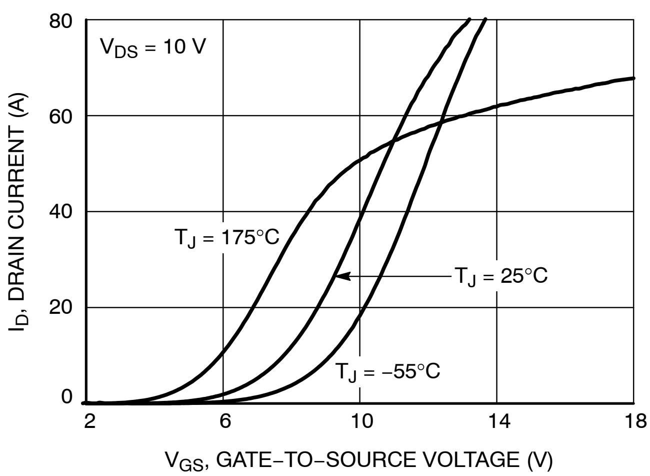


Figure 5. Transfer Characteristics

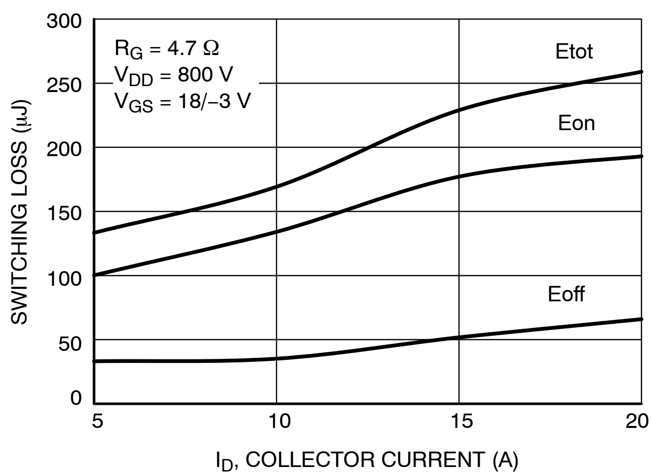


Figure 6. Switching Loss vs. Collector Current

TYPICAL CHARACTERISTICS

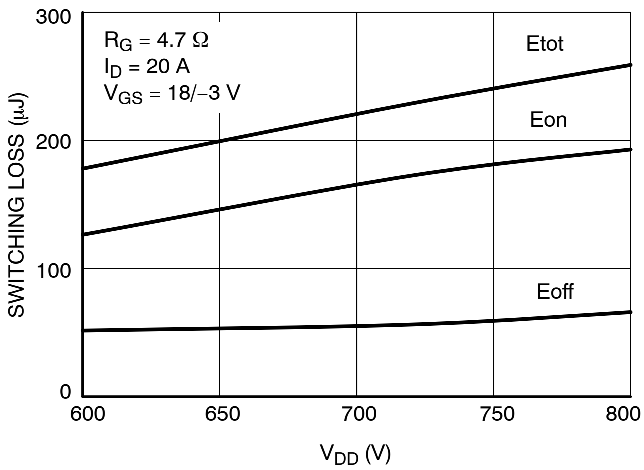


Figure 7. Switching Loss vs. Gate Resistance

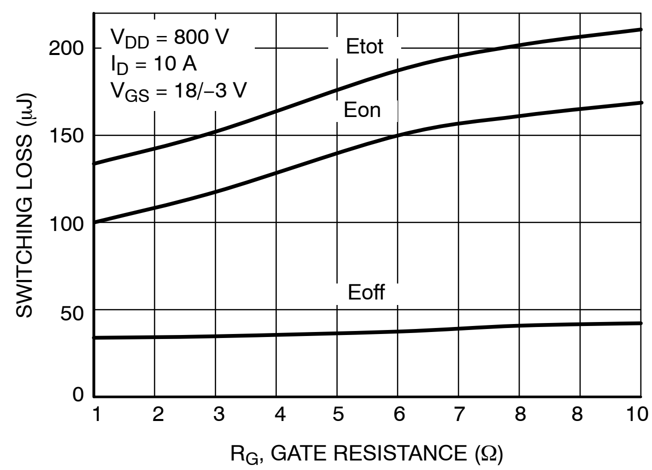


Figure 8. Switching Loss vs. Gate Resistance

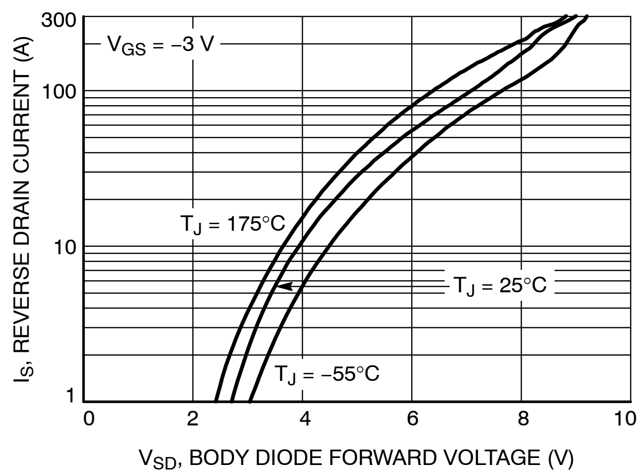


Figure 9. Reverse Drain Current vs. Body Diode Forward Voltage

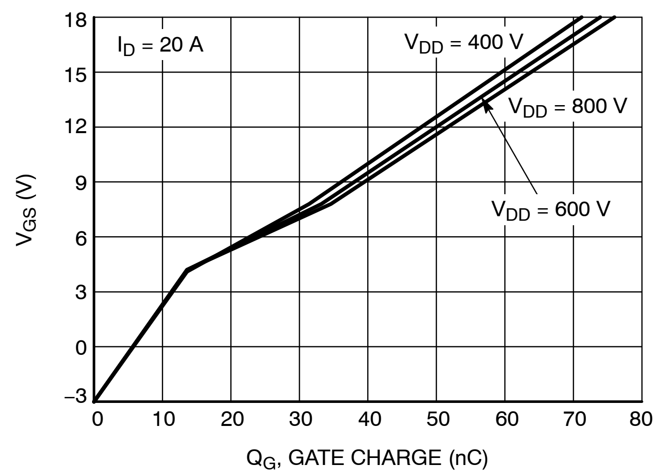


Figure 10. Gate−to−Source Voltage vs. Total Charge

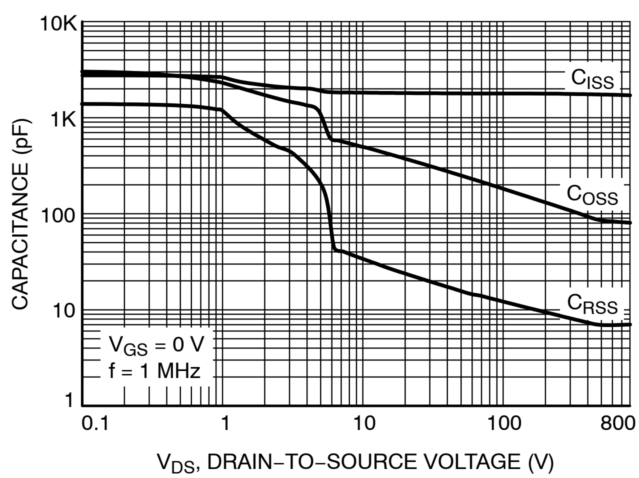


Figure 11. Capacitance vs. Drain−to−Source Voltage

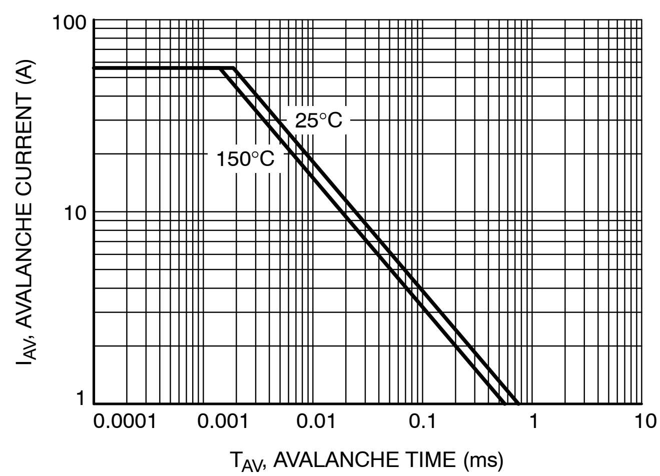


Figure 12. Unclamped Inductive Switching Capability

TYPICAL CHARACTERISTICS

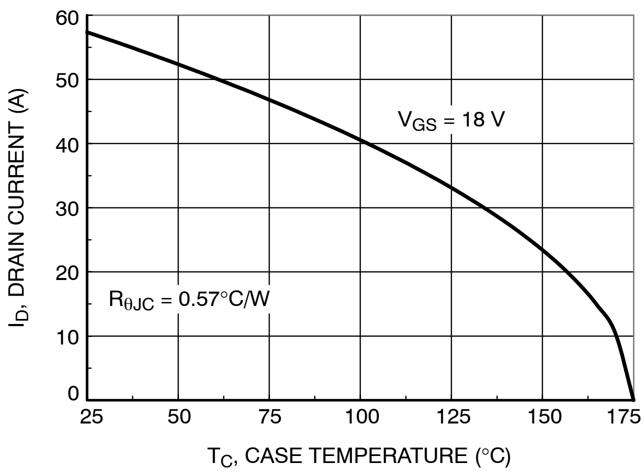


Figure 13. Maximum Continuous Drain Current vs. Case Temperature

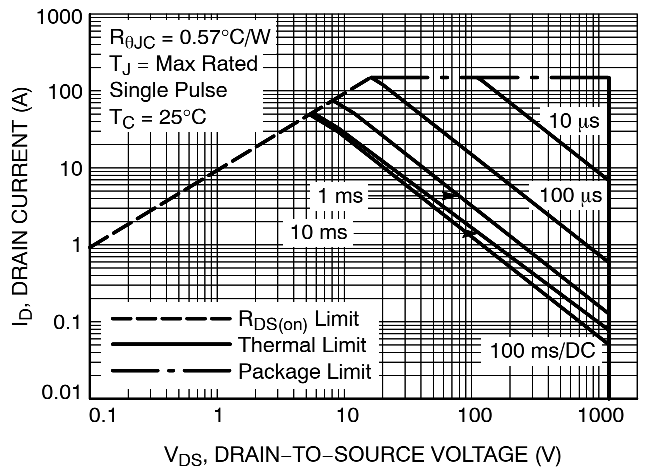


Figure 14. Safe Operating Area

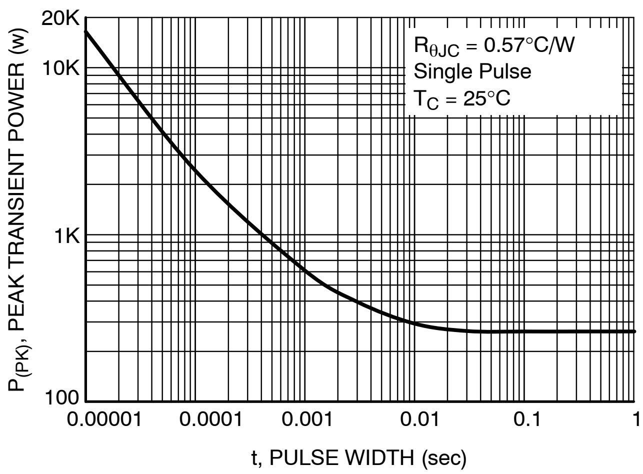


Figure 15. Single Pulse Maximum Power Dissipation

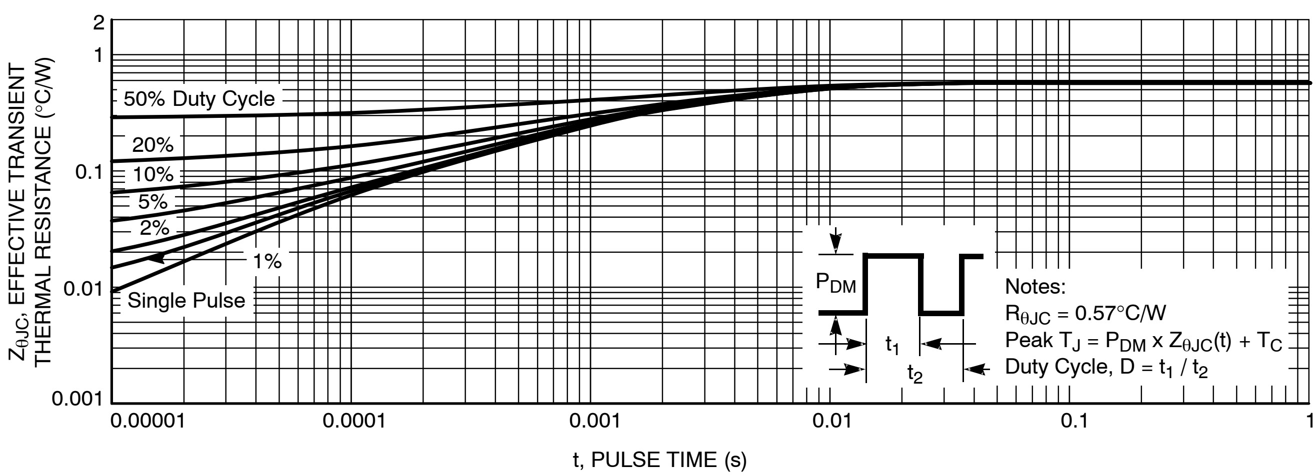
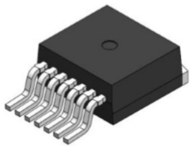
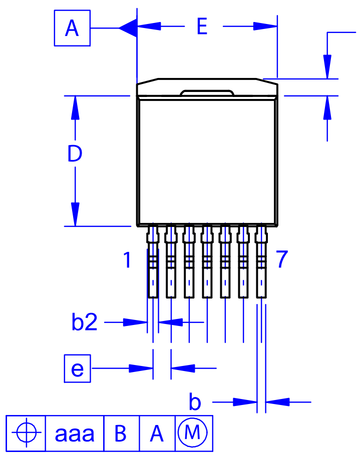


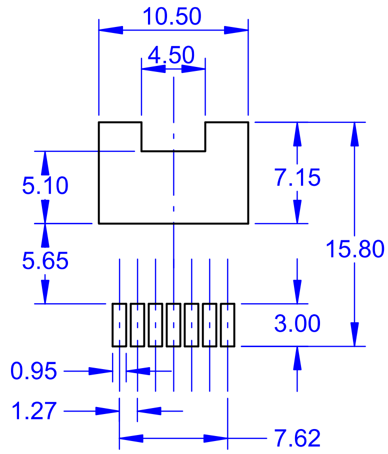
Figure 16. Junction−to−Case Transient Thermal Response



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

DATE 16 AUG 2019



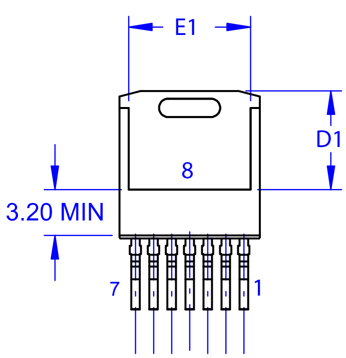


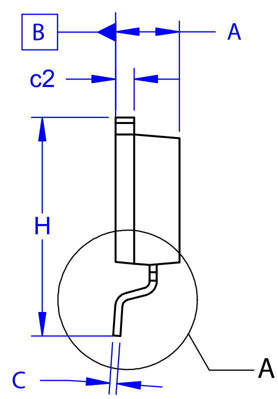
LAND PATTERN RECOMMENDATION

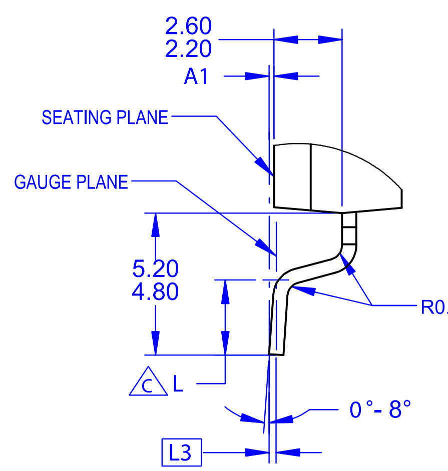
NOTES:

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

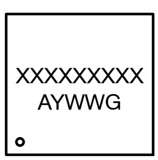






DETAIL A
SCALE 2:1

GENERIC
MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	**D²PAK7 (TO−263−7L HV)**	**PAGE 1 OF 1**

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