

Silicon Carbide (SiC) MOSFET - 44 mohm, 650 V, M2, D2PAK-7L NVBG060N065SC1

Features

- Typ. $R_{DS(on)} = 44 \text{ m}\Omega @ V_{GS} = 18 \text{ V}$
Typ. $R_{DS(on)} = 60 \text{ m}\Omega @ V_{GS} = 15 \text{ V}$
- Ultra Low Gate Charge ($Q_{G(tot)} = 74 \text{ nC}$)
- Low Output Capacitance ($C_{oss} = 133 \text{ pF}$)
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- RoHS Compliant

Typical Applications

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

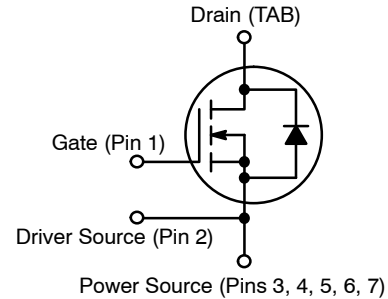
MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V_{DSS}	650	V	
Gate-to-Source Voltage		V_{GS}	-8/+22	V	
Recommended Operation Values of Gate - Source Voltage		$T_C < 175^\circ\text{C}$ V_{GSop}	-5/+18	V	
Continuous Drain Current (Note 2)	Steady State	$T_C = 25^\circ\text{C}$	I_D	46	A
			P_D	170	W
Continuous Drain Current (Notes 1, 2)	Steady State	$T_C = 100^\circ\text{C}$	I_D	33	A
			P_D	85	W
Pulsed Drain Current (Note 3)		$T_C = 25^\circ\text{C}$	I_{DM}	130	A
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)		I_S	46	A	
Single Pulse Drain-to-Source Avalanche Energy ($I_L = 10.1 \text{ A}_{pk}, L = 1 \text{ mH}$) (Note 4)		E_{AS}	51	mJ	
Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds		T_L	260	$^\circ\text{C}$	

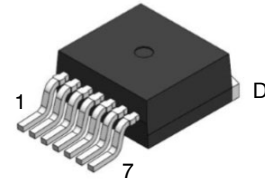
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface mounted on a FR-4 board using 1 in 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. Repetitive rating, limited by max junction temperature.
4. E_{AS} of 51 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 1 \text{ mH}$, $I_{AS} = 10.1 \text{ A}$, $V_{DD} = 50 \text{ V}$, $V_{GS} = 18 \text{ V}$.

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
650 V	70 m Ω @ 18 V	46 A

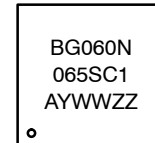


N-CHANNEL MOSFET



D2PAK-7L
CASE 418BJ

MARKING DIAGRAM



BG060N065SC1 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

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

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THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Units
Thermal Resistance Junction-to-Case (Note 2)	$R_{\theta JC}$	0.88	–	°C/W
Thermal Resistance Junction-to-Ambient (Notes 1, 2)	$R_{\theta JA}$	–	40	°C/W

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 20\text{ mA}$, refer to 25°C (Note 5)		0.15		V/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}$ $V_{DS} = 650\text{ V}$	$T_J = 25^\circ\text{C}$		10	μA
			$T_J = 175^\circ\text{C}$ (Note 5)		1	mA
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +18/-5\text{ V}, V_{DS} = 0\text{ V}$			250	nA

ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 6.5\text{ mA}$	1.8	2.8	4.3	V
Recommended Gate Voltage	V_{GOP}		–5		+18	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 15\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$		60		m Ω
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$		44	70	
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175^\circ\text{C}$ (Note 5)		50		
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$ (Note 5)		11		S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz},$ $V_{DS} = 325\text{ V}$ (Note 5)		1473		pF
Output Capacitance	C_{OSS}			133		
Reverse Transfer Capacitance	C_{RSS}			13		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 520\text{ V},$ $I_D = 20\text{ A}$ (Note 5)		74		nC
Gate-to-Source Charge	Q_{GS}			20		
Gate-to-Drain Charge	Q_{GD}			23		
Gate-Resistance	R_G	$f = 1\text{ MHz}$		3.9		Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 400\text{ V},$ $I_D = 20\text{ A}, R_G = 2.2\ \Omega,$ Inductive Load (Note 5)		11		ns
Rise Time	t_r			14		
Turn-Off Delay Time	$t_{d(OFF)}$			24		
Fall Time	t_f			11		
Turn-On Switching Loss	E_{ON}			45		μJ
Turn-Off Switching Loss	E_{OFF}			18		
Total Switching Loss	E_{TOT}			63		

SOURCE-DRAIN DIODE CHARACTERISTICS

Continuous Source-Drain Diode Forward Current	I_{SD}	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$ (Note 5)			46	A
Pulsed Source-Drain Diode Forward Current (Note 3)	I_{SDM}	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$ (Note 5)			130	A
Forward Diode Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 25^\circ\text{C}$		4.3		V

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SOURCE-DRAIN DIODE CHARACTERISTICS						
Reverse Recovery Time	t _{RR}	V _{GS} = -5/18 V, I _{SD} = 20 A, dI _S /dt = 1000 A/μs (Note 5)		17.7		ns
Reverse Recovery Charge	Q _{RR}			90.6		nC
Reverse Recovery Energy	E _{REC}			8.7		μJ
Peak Reverse Recovery Current	I _{RRM}			10.2		A
Charge time	T _a			9.8		ns
Discharge time	T _b			7.8		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.

5. Define by design, not subject to production test.

TYPICAL CHARACTERISTICS

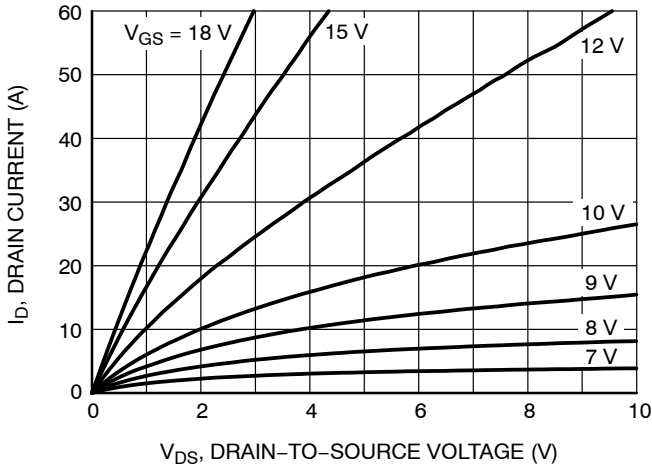


Figure 1. On-Region Characteristics

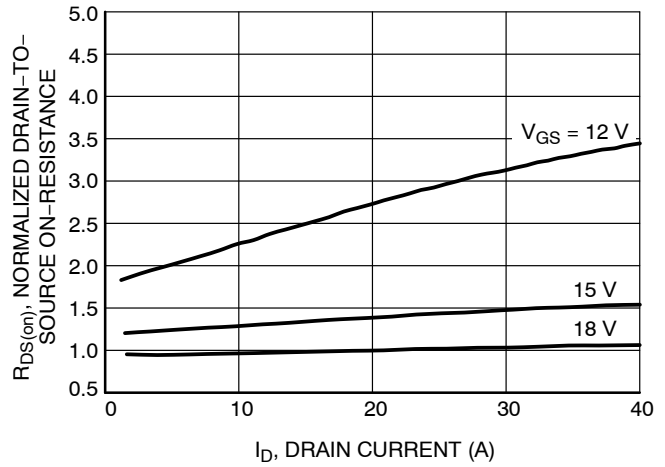


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

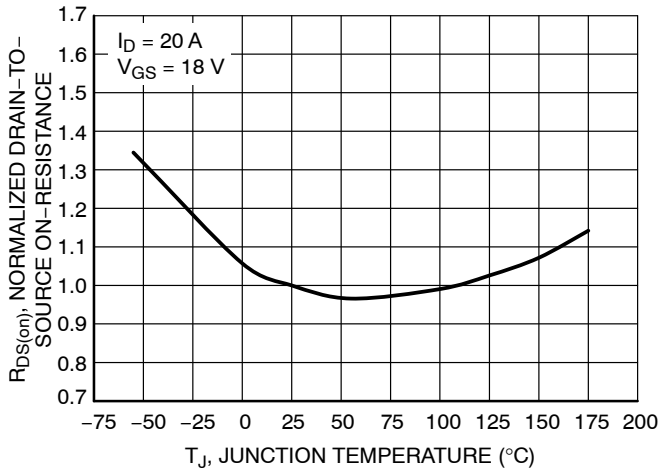


Figure 3. On-Resistance Variation with Temperature

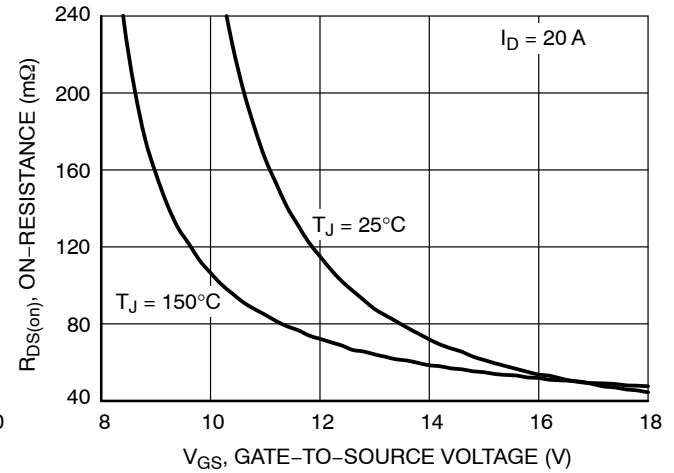


Figure 4. On-Resistance vs. Gate-to-Source Voltage

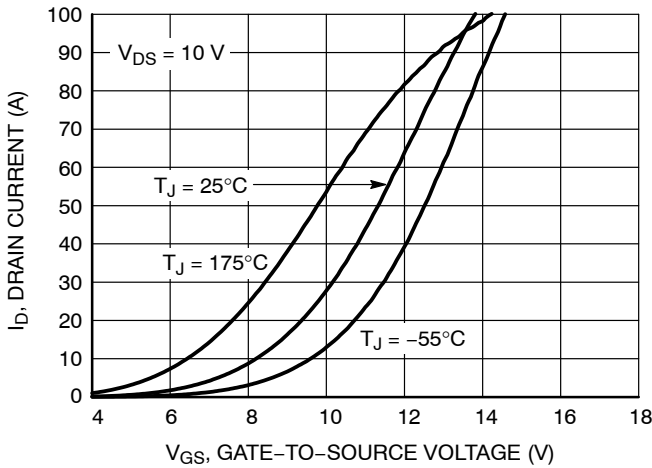


Figure 5. Transfer Characteristics

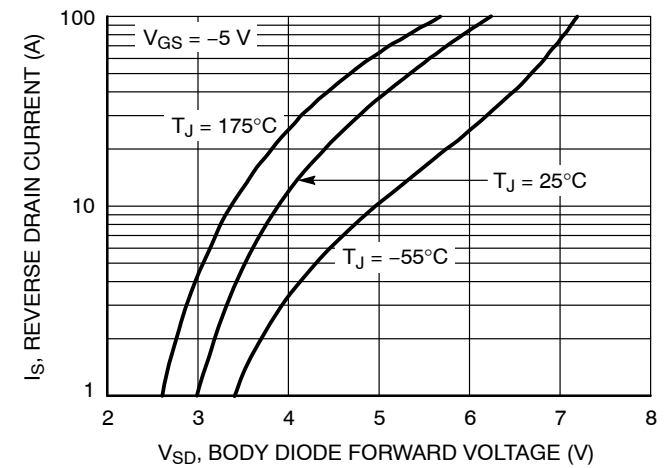


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

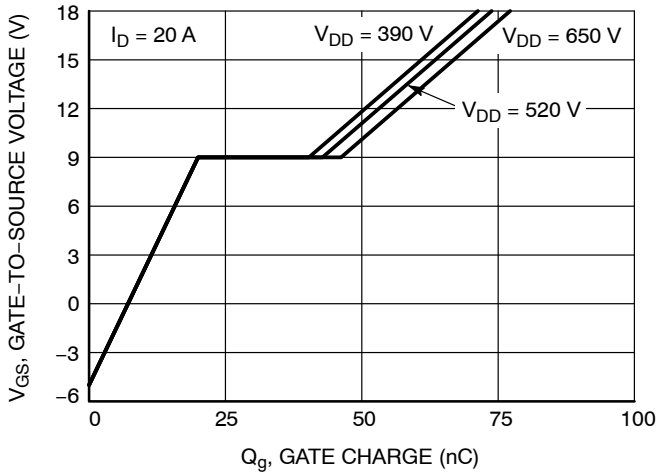


Figure 7. Gate-to-Source Voltage vs. Total Charge

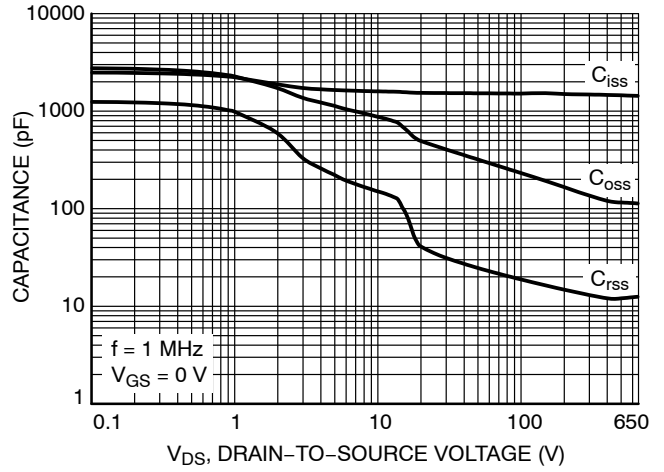


Figure 8. Capacitance vs. Drain-to-Source Voltage

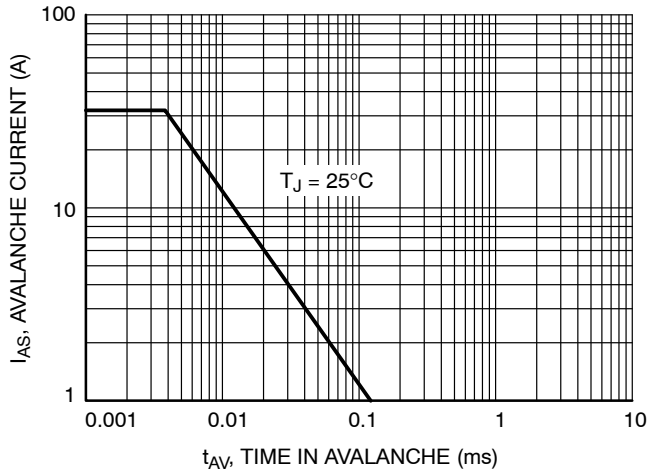


Figure 9. Unclamped Inductive Switching Capability

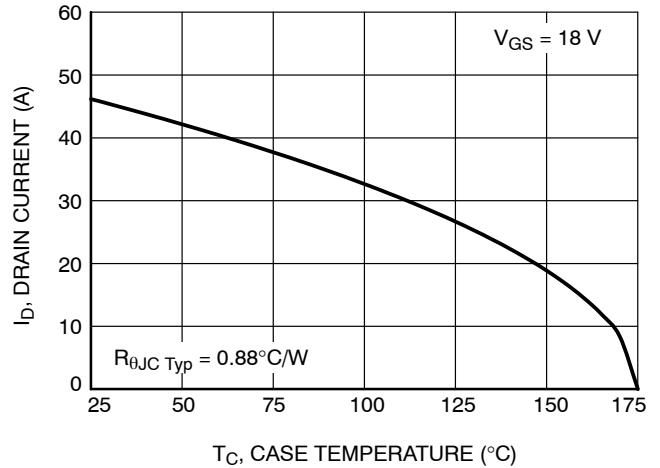


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

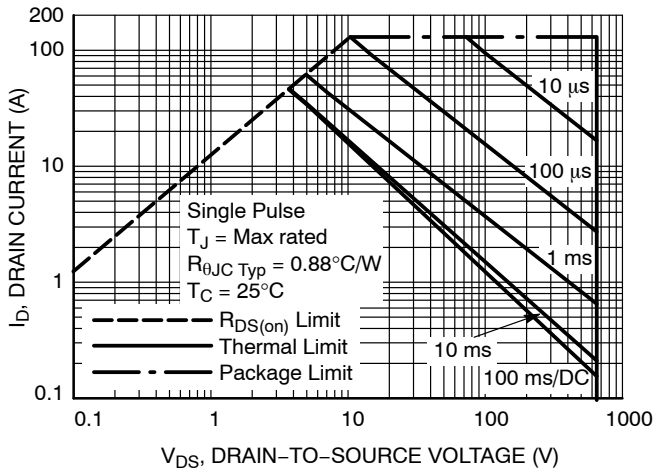


Figure 11. Safe Operating Area

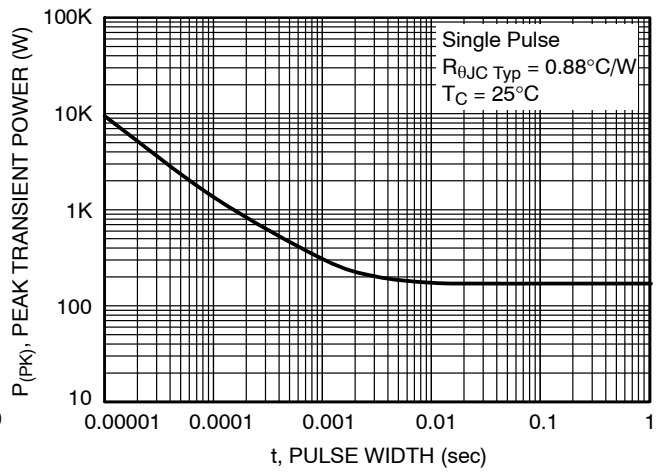


Figure 12. Single Pulse Maximum Power Dissipation

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TYPICAL CHARACTERISTICS

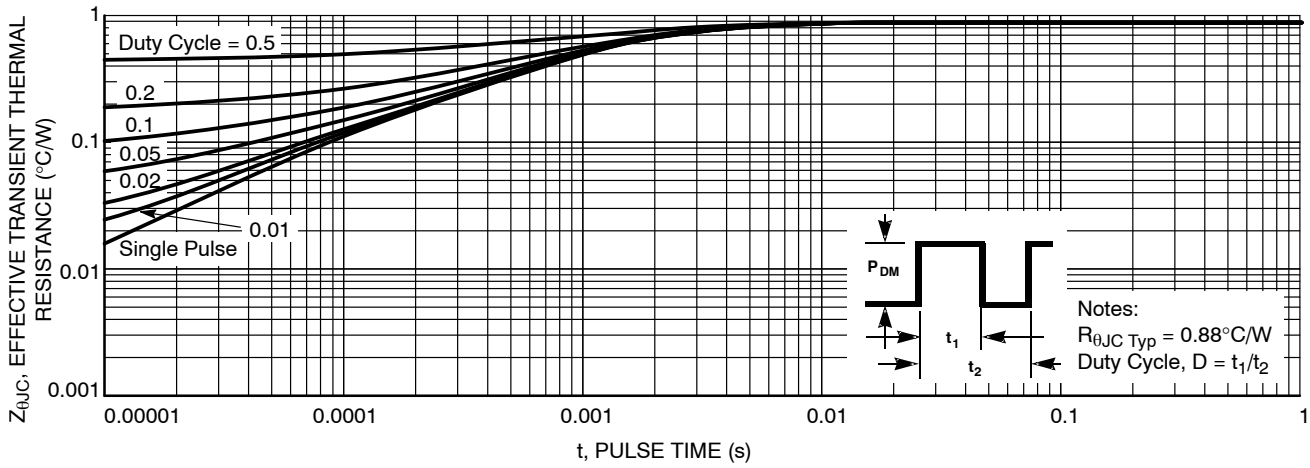


Figure 13. Junction-to-Case Transient Thermal Response

DEVICE ORDERING INFORMATION

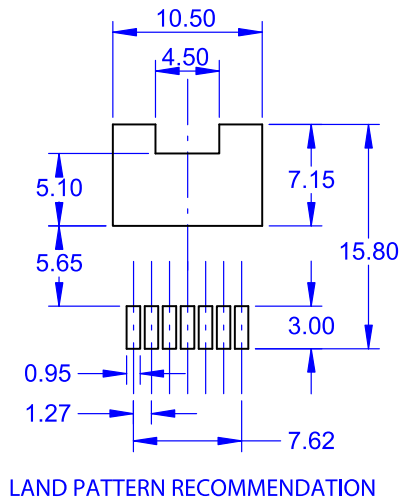
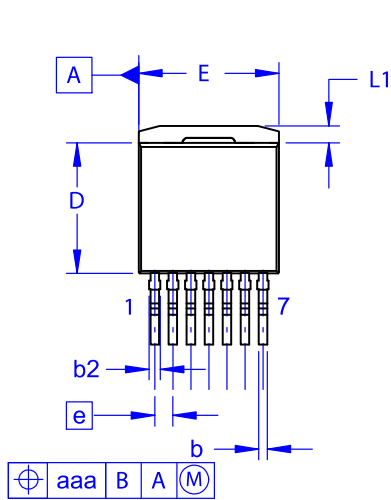
Device	Package	Shipping [†]
NVBG060N065SC1	D2PAK-7L	800 / Tape & Reel

[†]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.

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PACKAGE DIMENSIONS

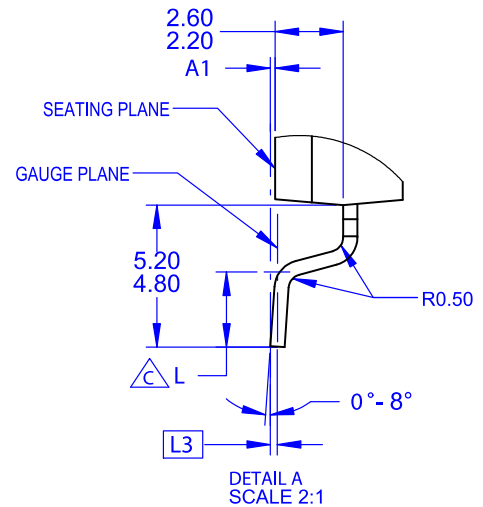
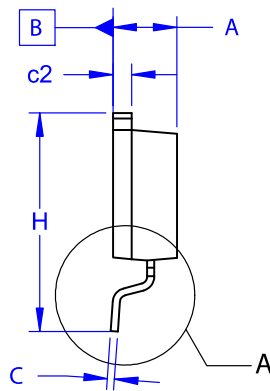
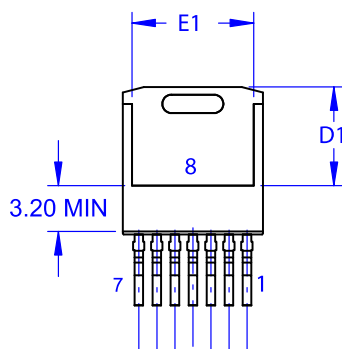
D²PAK7 (TO-263-7L HV)
CASE 418BJ
ISSUE B



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



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[PJMF380N65E1_T0_00201](#) [PJMF280N60E1_T0_00201](#)