

# Silicon Carbide (SiC) MOSFET – 70 mohm, 650 V, M2, D2PAK-7L NVBG095N065SC1

## Features

- Typ.  $R_{DS(on)} = 70\text{ m}\Omega @ V_{GS} = 18\text{ V}$   
Typ.  $R_{DS(on)} = 95\text{ m}\Omega @ V_{GS} = 15\text{ V}$
- Ultra Low Gate Charge ( $Q_{G(tot)} = 50\text{ nC}$ )
- Low Output Capacitance ( $C_{oss} = 89\text{ pF}$ )
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- RoHS Compliant

## Typical Applications

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

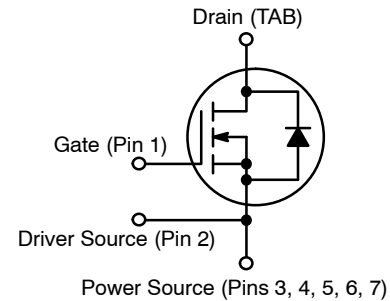
## MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| 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   |              | $T_C < 175^\circ\text{C}$<br>$V_{GSop}$ | -5/+18      | V                |   |
| Continuous Drain Current (Note 2)   | Steady State | $T_C = 25^\circ\text{C}$                | $I_D$       | 30               | A |
|   |              |   | $P_D$       | 110              | W |
| Continuous Drain Current (Notes 1, 2)   | Steady State | $T_C = 100^\circ\text{C}$               | $I_D$       | 21               | A |
|   |              |   | $P_D$       | 55               | W |
| Pulsed Drain Current (Note 3)   |              | $T_C = 25^\circ\text{C}$                | $I_{DM}$    | 79               | A |
| Operating Junction and Storage Temperature Range  |              | $T_J, T_{stg}$                          | -55 to +175 | $^\circ\text{C}$ |   |
| Source Current (Body Diode)   |              | $I_S$                                   | 24          | A                |   |
| Single Pulse Drain-to-Source Avalanche Energy ( $I_L = 9.4\text{ A}_{pk}, L = 1\text{ mH}$ ) (Note 4) |              | $E_{AS}$                                | 44          | mJ               |   |
| Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds                                 |              | $T_L$                                   | 260         | $^\circ\text{C}$ |   |

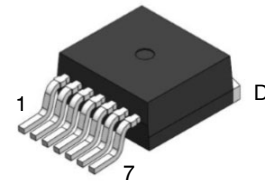
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface mounted on a FR-4 board using 1 in<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.  $E_{AS}$  of 44 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1\text{ mH}$ ,  $I_{AS} = 9.4\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $V_{GS} = 18\text{ V}$ .

| $V_{(BR)DSS}$ | $R_{DS(ON)}\text{ MAX}$ | $I_D\text{ MAX}$ |
|---------------|-------------------------|------------------|
| 650 V         | 105 m $\Omega$ @ 18 V   | 30 A             |

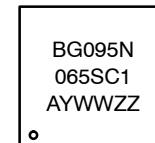


N-CHANNEL MOSFET



D2PAK-7L  
CASE 418BJ

## MARKING DIAGRAM



BG095N065SC1 = 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.

# NVBG095N065SC1

## THERMAL CHARACTERISTICS

| Parameter   | Symbol          | Typ  | Max | Units |
|---|-----------------|------|-----|-------|
| Thermal Resistance Junction-to-Case (Note 2)        | $R_{\theta JC}$ | 1.36 | –   | °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          |
|---|-------------------|---|------------------------------------|------|-----|---------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |   |                                    |      |     |               |
| 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 $25^\circ\text{C}$ (Note 5) |                                    | 0.15 |     | V/°C          |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}$<br>$V_{DS} = 650\text{ V}$            | $T_J = 25^\circ\text{C}$           |      | 10  | $\mu\text{A}$ |
|   |                   |   | $T_J = 175^\circ\text{C}$ (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        | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = 4\text{ mA}$  | 1.8 | 2.8 | 4.3 | V          |
| Recommended Gate Voltage      | $V_{GOP}$    |   | –5  |     | +18 | V          |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = 15\text{ V}, I_D = 12\text{ A}, T_J = 25^\circ\text{C}$           |     | 95  |     | m $\Omega$ |
|                               |              | $V_{GS} = 18\text{ V}, I_D = 12\text{ A}, T_J = 25^\circ\text{C}$           |     | 70  | 105 |            |
|                               |              | $V_{GS} = 18\text{ V}, I_D = 12\text{ A}, T_J = 175^\circ\text{C}$ (Note 5) |     | 85  |     |            |
| Forward Transconductance      | $g_{FS}$     | $V_{DS} = 10\text{ V}, I_D = 12\text{ A}$ (Note 5)                          |     | 6.9 |     | S          |

## CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |  |  |     |  |          |
|------------------------------|--------------|--|--|-----|--|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz},$<br>$V_{DS} = 325\text{ V}$<br>(Note 5)      |  | 956 |  | pF       |
| Output Capacitance           | $C_{OSS}$    |  |  | 89  |  |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |  |  | 7.8 |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -5/18\text{ V}, V_{DS} = 520\text{ V},$<br>$I_D = 12\text{ A}$<br>(Note 5) |  | 50  |  | nC       |
| Gate-to-Source Charge        | $Q_{GS}$     |  |  | 14  |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |  |  | 15  |  |          |
| Gate-Resistance              | $R_G$        | $f = 1\text{ MHz}$   |  | 7.6 |  | $\Omega$ |

## SWITCHING CHARACTERISTICS

|                         |              |  |  |    |  |               |
|-------------------------|--------------|--|--|----|--|---------------|
| Turn-On Delay Time      | $t_{d(ON)}$  | $V_{GS} = -5/18\text{ V}, V_{DS} = 400\text{ V},$<br>$I_D = 12\text{ A}, R_G = 2.2\text{ }\Omega,$<br>Inductive Load<br>(Note 5) |  | 8  |  | ns            |
| Rise Time               | $t_r$        |  |  | 12 |  |               |
| Turn-Off Delay Time     | $t_{d(OFF)}$ |  |  | 20 |  |               |
| Fall Time               | $t_f$        |  |  | 9  |  |               |
| Turn-On Switching Loss  | $E_{ON}$     |  |  | 34 |  | $\mu\text{J}$ |
| Turn-Off Switching Loss | $E_{OFF}$    |  |  | 11 |  |               |
| Total Switching Loss    | $E_{TOT}$    |  |  | 45 |  |               |

## SOURCE-DRAIN DIODE CHARACTERISTICS

|  |           |  |  |     |    |   |
|--|-----------|--|--|-----|----|---|
| Continuous Source-Drain Diode Forward Current      | $I_{SD}$  | $V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$<br>(Note 5)           |  |     | 24 | A |
| Pulsed Source-Drain Diode Forward Current (Note 3) | $I_{SDM}$ | $V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$<br>(Note 5)           |  |     | 79 | A |
| Forward Diode Voltage                              | $V_{SD}$  | $V_{GS} = -5\text{ V}, I_{SD} = 12\text{ A}, T_J = 25^\circ\text{C}$ |  | 4.5 |    | V |

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## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise stated)

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

### SOURCE-DRAIN DIODE CHARACTERISTICS

| Parameter                     | Symbol           | Test Condition  | Min | Typ | Max | Unit |
|-------------------------------|------------------|---|-----|-----|-----|------|
| Reverse Recovery Time         | t <sub>RR</sub>  | V <sub>GS</sub> = -5/18 V, I <sub>SD</sub> = 12 A,<br>dI <sub>S</sub> /dt = 1000 A/μs<br>(Note 5) |     | 15  |     | ns   |
| Reverse Recovery Charge       | Q <sub>RR</sub>  |   |     | 62  |     | nC   |
| Reverse Recovery Energy       | E <sub>REC</sub> |   |     | 6.5 |     | μJ   |
| Peak Reverse Recovery Current | I <sub>RRM</sub> |   |     | 8   |     | A    |
| Charge time                   | T <sub>a</sub>   |   |     | 8   |     | ns   |
| Discharge time                | T <sub>b</sub>   |   |     | 7   |     | 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

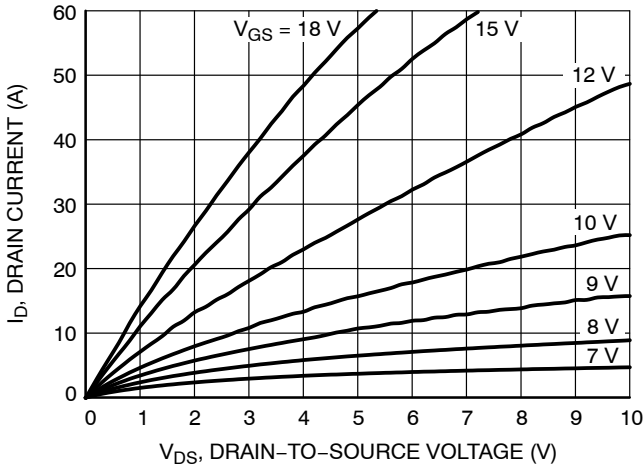


Figure 1. On-Region Characteristics

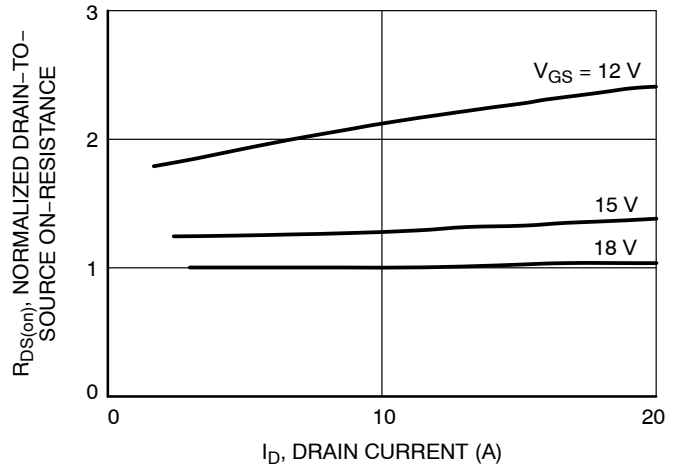


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

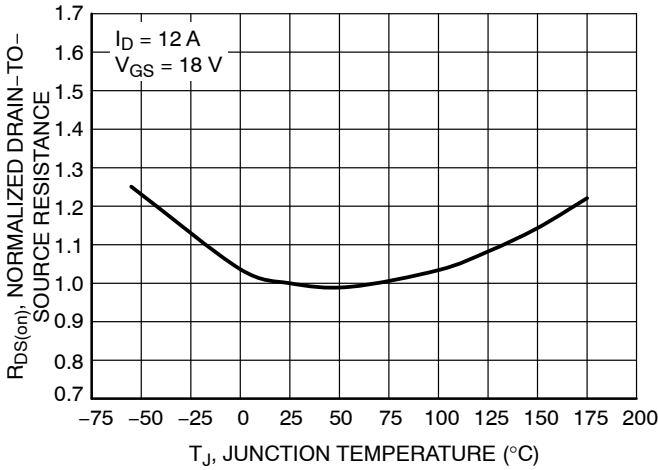


Figure 3. On-Resistance Variation with Temperature

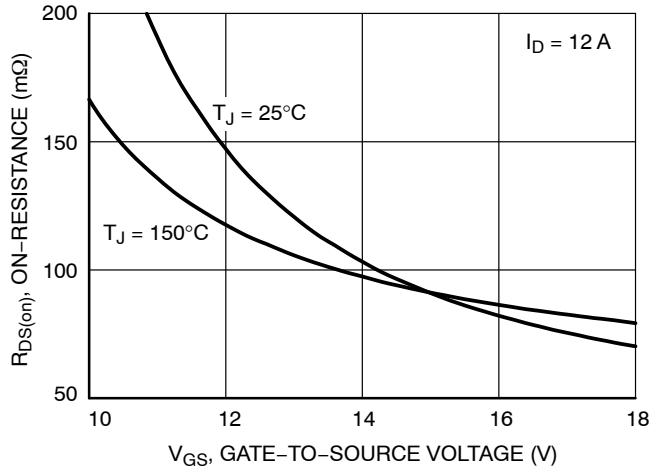


Figure 4. On-Resistance vs. Gate-to-Source Voltage

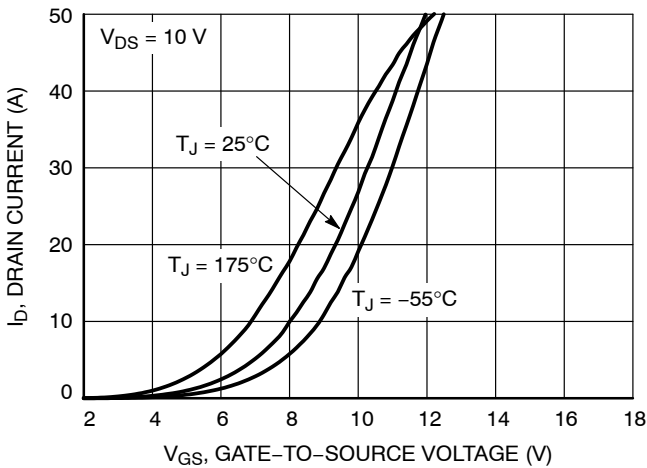


Figure 5. Transfer Characteristics

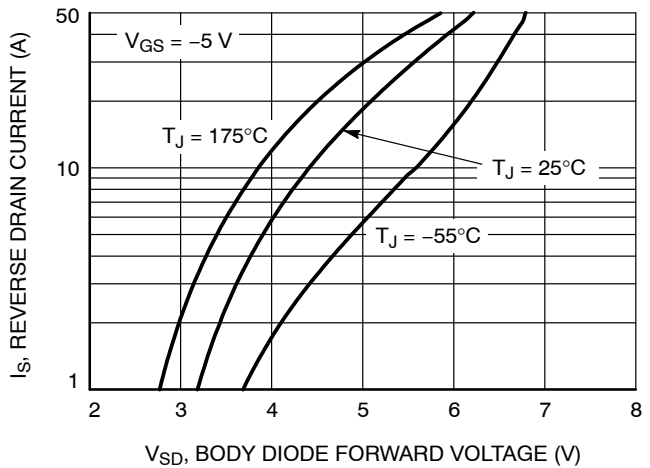


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

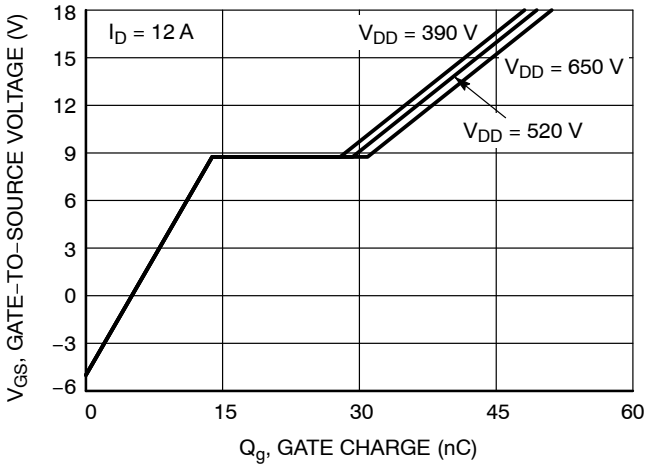


Figure 7. Gate-to-Source Voltage vs. Total Charge

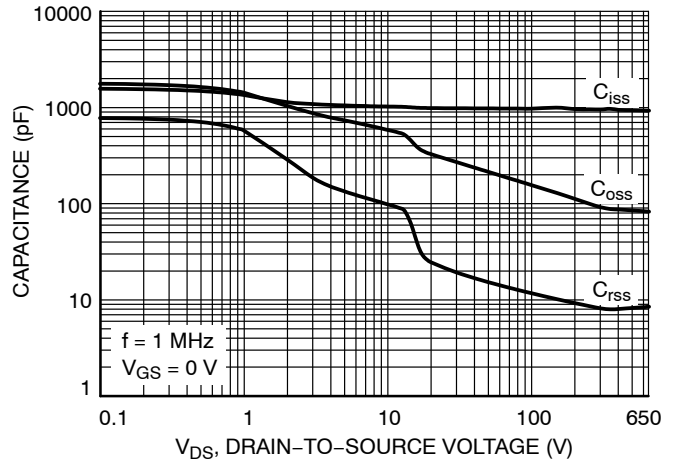


Figure 8. Capacitance vs. Drain-to-Source Voltage

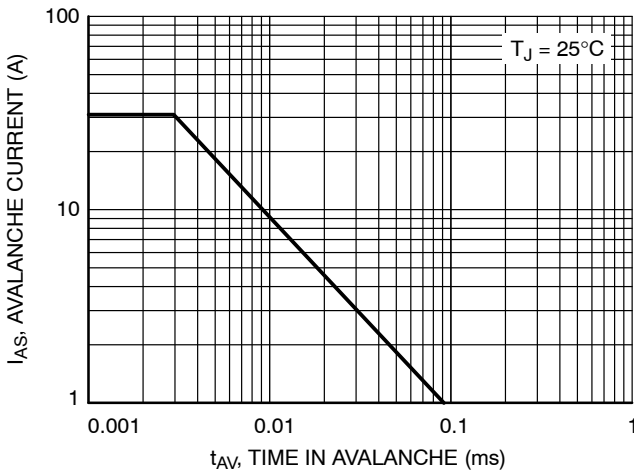


Figure 9. Unclamped Inductive Switching Capability

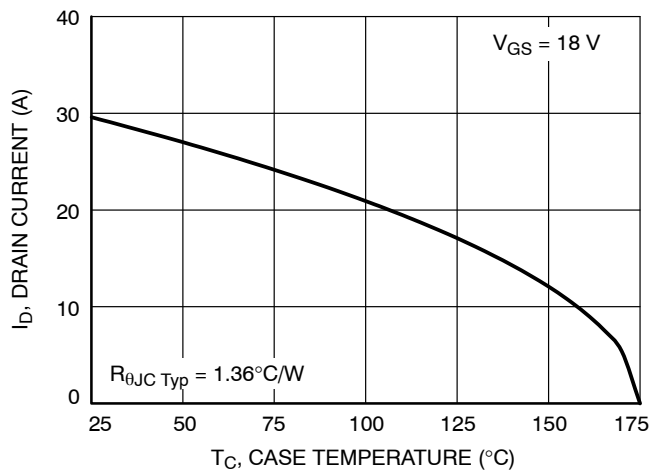


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

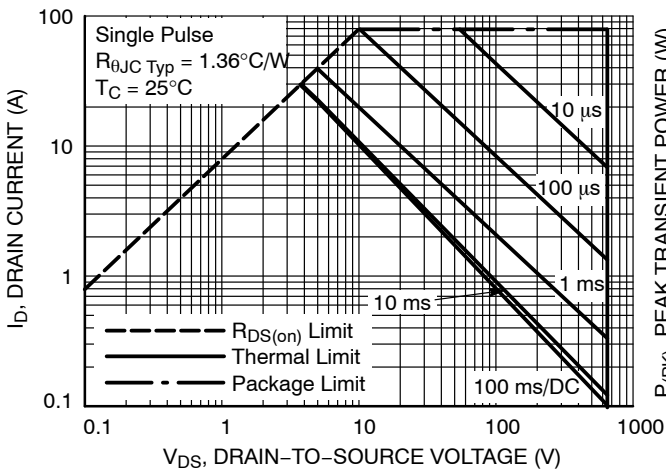


Figure 11. Safe Operating Area

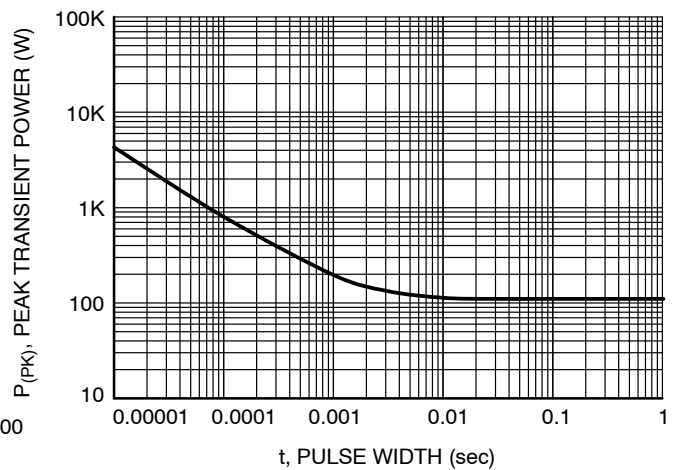


Figure 12. Single Pulse Maximum Power Dissipation

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## TYPICAL CHARACTERISTICS

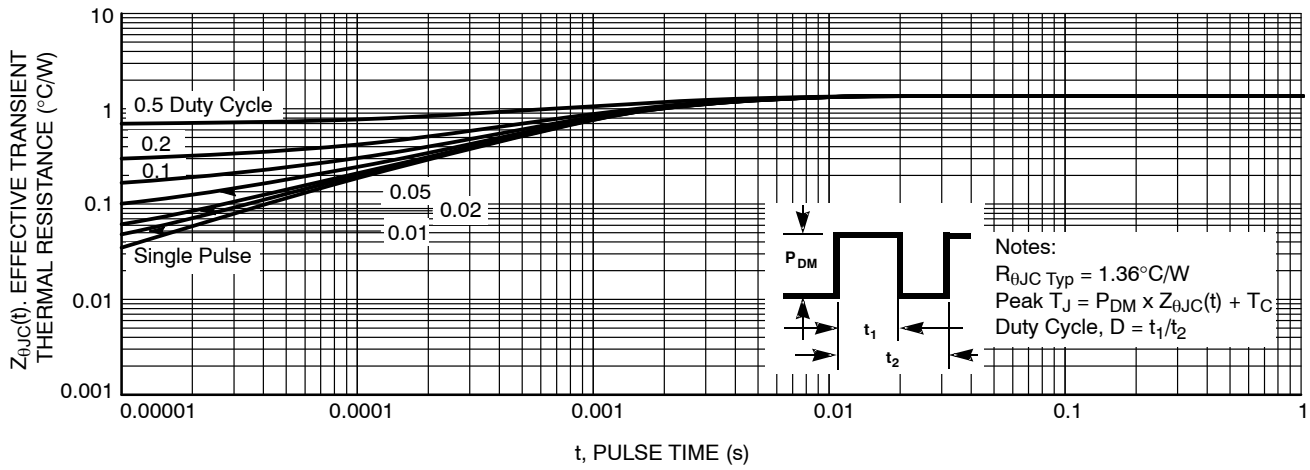


Figure 13. Junction-to-Case Thermal Response

### DEVICE ORDERING INFORMATION

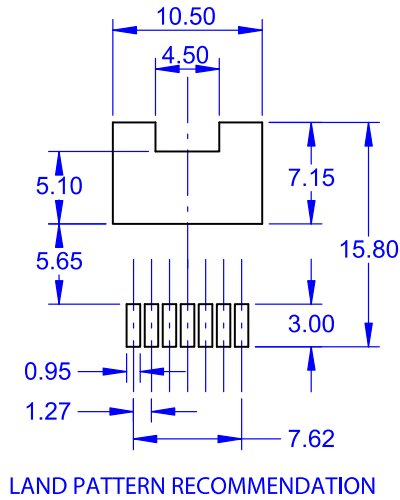
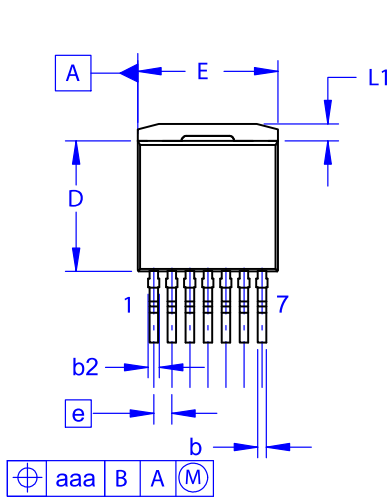
| Device         | Package  | Shipping <sup>†</sup> |
|----------------|----------|-----------------------|
| NVBG095N065SC1 | D2PAK-7L | 800 / Tape & Reel     |

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

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## PACKAGE DIMENSIONS

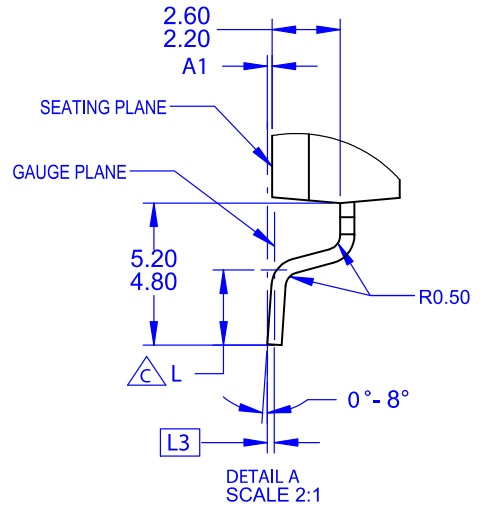
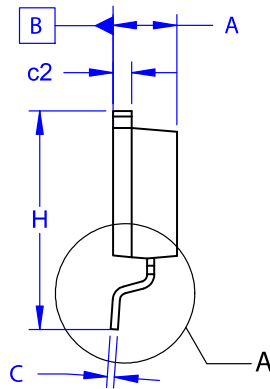
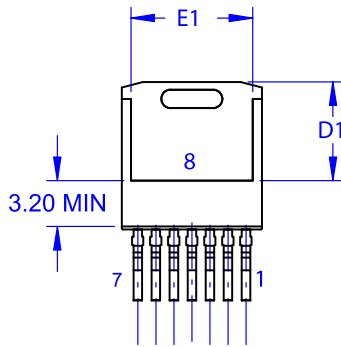
**D<sup>2</sup>PAK7 (TO-263-7L HV)**  
CASE 418BJ  
ISSUE B



**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  |



# NVVG095N065SC1

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