

# NVLUS4C12N

## MOSFET – Power, Single N-Channel, $\mu$ Cool, 2.0x2.0x0.55 mm UDFN6 30 V, 10.7 A



ON Semiconductor®

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### Features

- Low Profile UDFN 2.0 x 2.0 x 0.55 mm for Board Space Saving with Exposed Drain Pads for Excellent Thermal Conduction
- Ultra Low  $R_{DS(on)}$  to Reduce Conduction Losses
- Optimized Gate Charge to Reduce Switching Losses
- Low Capacitance to Minimize Driver Losses
- NV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Power Load Switch
- Synch DC-DC Converters
- Wireless Charging Circuit

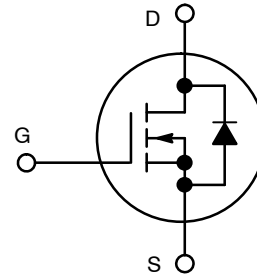
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

| Parameter   |              | Symbol                   | Value      | Unit             |
|---|--------------|--------------------------|------------|------------------|
| Drain-to-Source Voltage   |              | $V_{DSS}$                | 30         | V                |
| Gate-to-Source Voltage  |              | $V_{GS}$                 | $\pm 20$   | V                |
| Continuous Drain Current (Note 1)                                 | Steady State | $T_A = 25^\circ\text{C}$ | 10.7       | A                |
|   |              | $T_A = 85^\circ\text{C}$ | 7.7        |                  |
|   | $t \leq 5$ s | $T_A = 25^\circ\text{C}$ | 15.1       |                  |
| Power Dissipation (Note 1)  | Steady State | $T_A = 25^\circ\text{C}$ | 1.54       | W                |
|   |              | $T_A = 25^\circ\text{C}$ | 3.1        |                  |
| Continuous Drain Current (Note 2)                                 | Steady State | $T_A = 25^\circ\text{C}$ | 6.8        | A                |
|   |              | $T_A = 85^\circ\text{C}$ | 4.9        |                  |
| Power Dissipation (Note 2)  |              | $T_A = 25^\circ\text{C}$ | 0.63       | W                |
| Pulsed Drain Current  |              | $t_p = 10 \mu\text{s}$   | 43         | A                |
| MOSFET Operating Junction and Storage Temperature                 |              | $T_J, T_{STG}$           | -55 to 150 | $^\circ\text{C}$ |
| Source Current (Body Diode) (Note 1)                              |              | $I_S$                    | 1.55       | A                |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |              | $T_L$                    | 260        | $^\circ\text{C}$ |

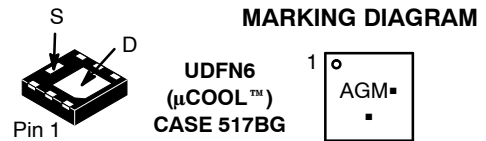
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).

| MOSFET        |                       |           |
|---------------|-----------------------|-----------|
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX      | $I_D$ MAX |
| 30 V          | 9 m $\Omega$ @ 10 V   | 10.7 A    |
|               | 12 m $\Omega$ @ 4.5 V |           |
|               | 15 m $\Omega$ @ 3.7 V |           |
|               | 19 m $\Omega$ @ 3.3 V |           |



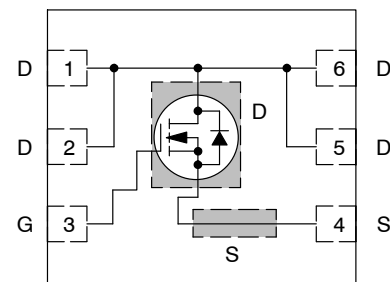
N-CHANNEL MOSFET



AG = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



(Top View)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

## NVLUS4C12N

2. Surface-mounted on FR4 board using the minimum recommended pad size,  
2 oz. Cu.

# NVLUS4C12N

## THERMAL RESISTANCE RATINGS

| Parameter   | Symbol          | Max  | Unit |
|---|-----------------|------|------|
| Junction-to-Ambient – Steady State (Note 3)         | $R_{\theta JA}$ | 81   | °C/W |
| Junction-to-Ambient – $t \leq 5$ s (Note 3)         | $R_{\theta JA}$ | 40.5 |      |
| Junction-to-Ambient – Steady State min Pad (Note 4) | $R_{\theta JA}$ | 200  |      |

3. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).  
 4. Surface-mounted on FR4 board using the minimum recommended pad size, 2 oz. Cu.

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

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

### OFF CHARACTERISTICS

|   |                   |  |                           |    |           |               |
|---|-------------------|--|---------------------------|----|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$        | 30                        |    |           | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = 250\ \mu\text{A}$ , ref to $25^\circ\text{C}$ |                           | 12 |           | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$          | $T_J = 25^\circ\text{C}$  |    | 1.0       | $\mu\text{A}$ |
|   |                   |  | $T_J = 125^\circ\text{C}$ |    | 10        |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$      |                           |    | $\pm 100$ | nA            |

### ON CHARACTERISTICS (Note 5)

|                                      |                  |   |     |      |     |            |
|--------------------------------------|------------------|---|-----|------|-----|------------|
| Gate Threshold Voltage               | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$   | 1.3 |      | 2.1 | V          |
| Negative Threshold Temp. Coefficient | $V_{GS(TH)}/T_J$ |   |     | 4.8  |     | mV/°C      |
| Drain-to-Source On Resistance        | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 9.0\text{ A}$  |     | 7.2  | 9   | m $\Omega$ |
|                                      |                  | $V_{GS} = 4.5\text{ V}, I_D = 8.0\text{ A}$ |     | 9.3  | 12  |            |
|                                      |                  | $V_{GS} = 3.7\text{ V}, I_D = 5.0\text{ A}$ |     | 10.9 | 15  |            |
|                                      |                  | $V_{GS} = 3.3\text{ V}, I_D = 5.0\text{ A}$ |     | 13   | 19  |            |
| Forward Transconductance             | $g_{FS}$         | $V_{DS} = 15\text{ V}, I_D = 9.0\text{ A}$  |     | 39   |     | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |   |  |      |  |    |
|------------------------------|--------------|---|--|------|--|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 15\text{ V}$     |  | 1172 |  | pF |
| Output Capacitance           | $C_{OSS}$    |   |  | 546  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |   |  | 26   |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}; I_D = 8.0\text{ A}$ |  | 8.4  |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |   |  | 1.1  |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |   |  | 3.0  |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |   |  | 2.2  |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}; I_D = 9.0\text{ A}$  |  | 18   |  | nC |

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 6)

|                     |              |  |  |     |  |    |
|---------------------|--------------|--|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DD} = 15\text{ V}, I_D = 8.0\text{ A}, R_G = 3\ \Omega$ |  | 9.4 |  | ns |
| Rise Time           | $t_r$        |  |  | 15  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |  |  | 14  |  |    |
| Fall Time           | $t_f$        |  |  | 3.5 |  |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 6)

|                     |              |   |  |     |  |    |
|---------------------|--------------|---|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DD} = 15\text{ V}, I_D = 9.0\text{ A}, R_G = 3\ \Omega$ |  | 6.3 |  | ns |
| Rise Time           | $t_r$        |   |  | 14  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |   |  | 18  |  |    |
| Fall Time           | $t_f$        |   |  | 2.4 |  |    |

5. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 6. Switching characteristics are independent of operating junction temperatures.

# NVLUS4C12N

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

| Parameter                                 | Symbol   | Test Condition  | Min                       | Typ  | Max | Units |
|---|----------|---|---------------------------|------|-----|-------|
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS</b> |          |   |                           |      |     |       |
| Forward Diode Voltage                     | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 1.5\text{ A}$                                     | $T_J = 25^\circ\text{C}$  | 0.72 | 1.1 | V     |
|   |          |   | $T_J = 125^\circ\text{C}$ | 0.52 |     |       |
| Reverse Recovery Time                     | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 1.5\text{ A}$ |                           | 29   |     | ns    |
| Charge Time                               | $t_a$    |   |                           | 14.1 |     |       |
| Discharge Time                            | $t_b$    |   |                           | 14.9 |     |       |
| Reverse Recovery Charge                   | $Q_{RR}$ |   |                           | 20   |     |       |

- Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

## TYPICAL CHARACTERISTICS

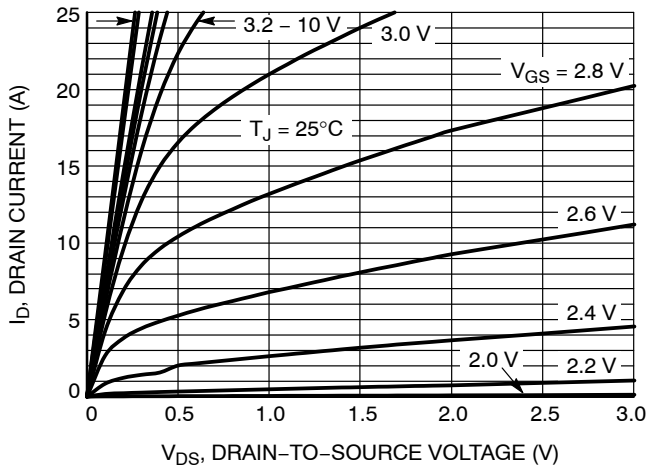


Figure 1. On-Region Characteristics

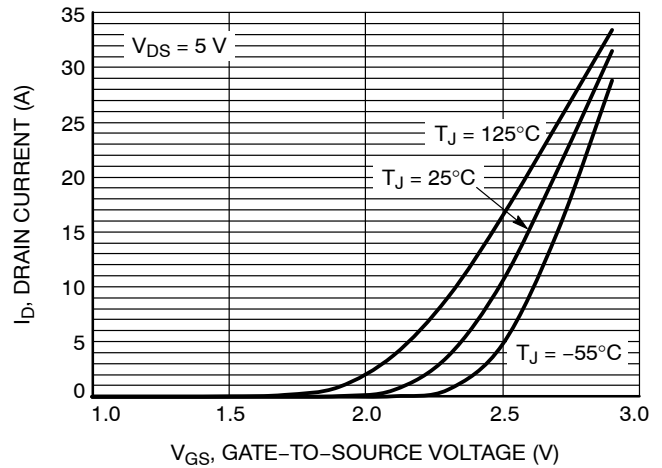


Figure 2. Transfer Characteristics

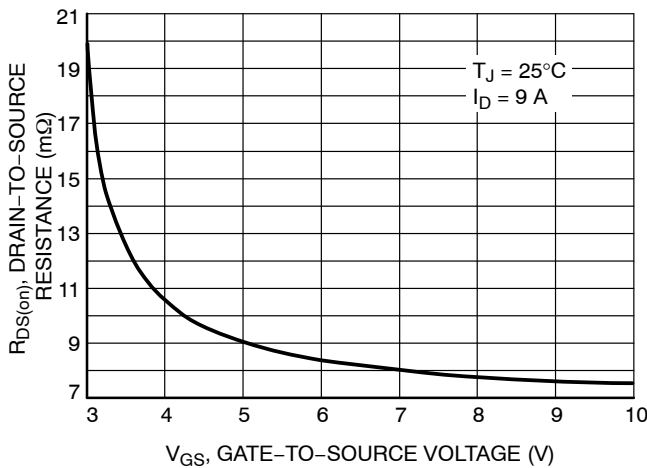


Figure 3. On-Resistance vs. Gate-to-Source Voltage

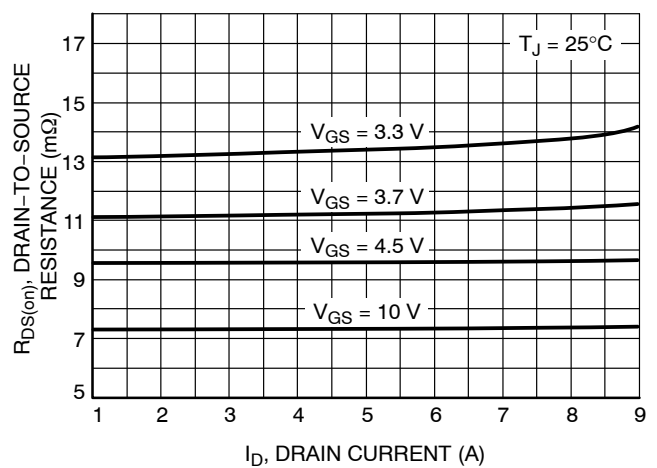


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

TYPICAL CHARACTERISTICS

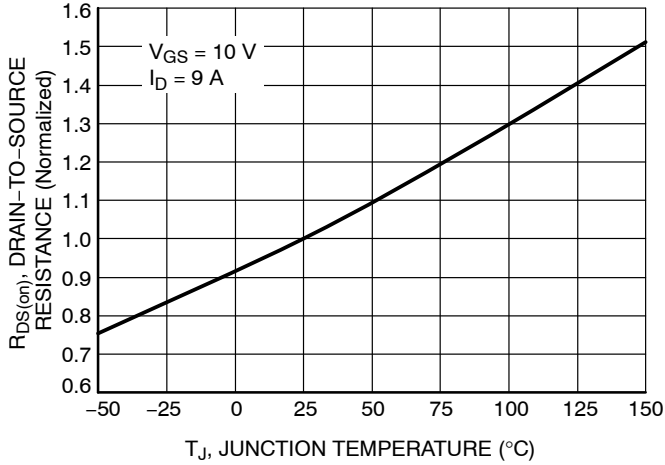


Figure 5. On-Resistance Variation with Temperature

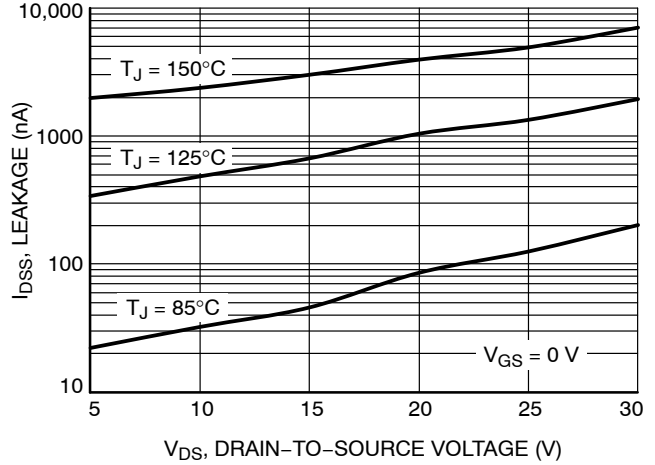


Figure 6. Drain-to-Source Leakage Current vs. Voltage

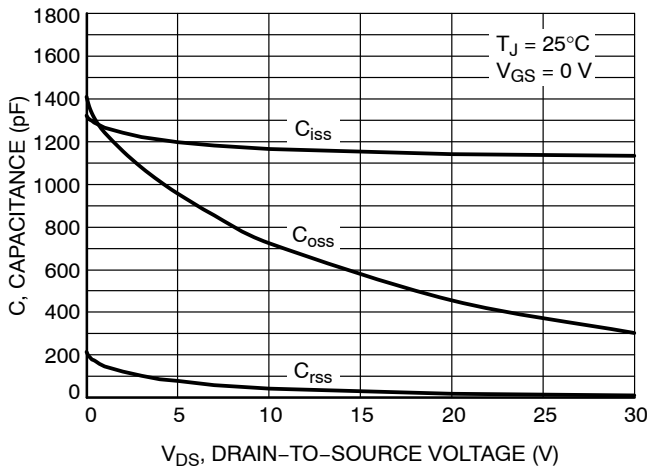


Figure 7. Capacitance Variation

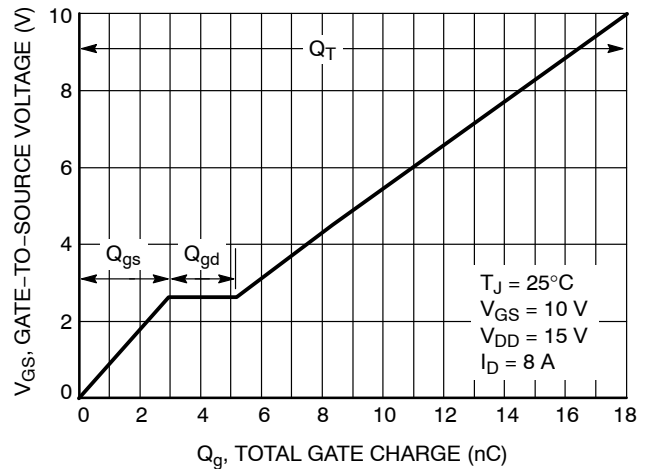


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

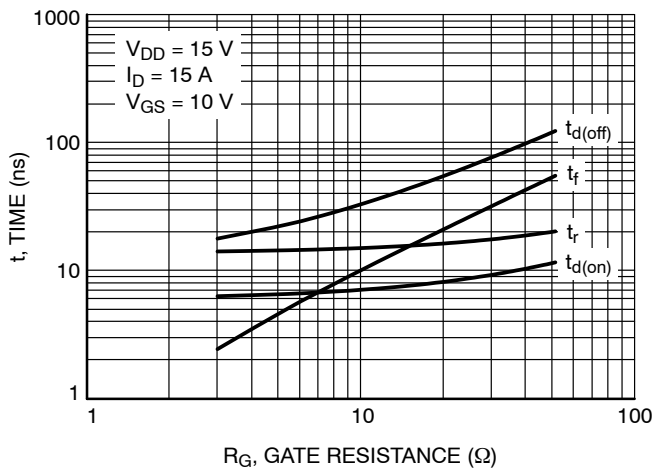


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

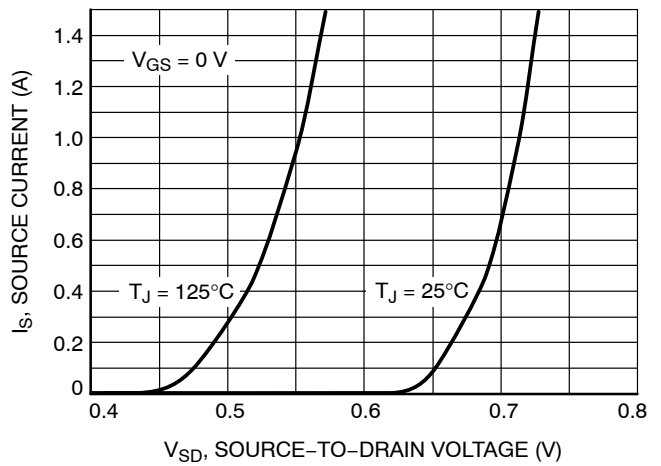


Figure 10. Diode Forward Voltage vs. Current

# NVLUS4C12N

## TYPICAL CHARACTERISTICS

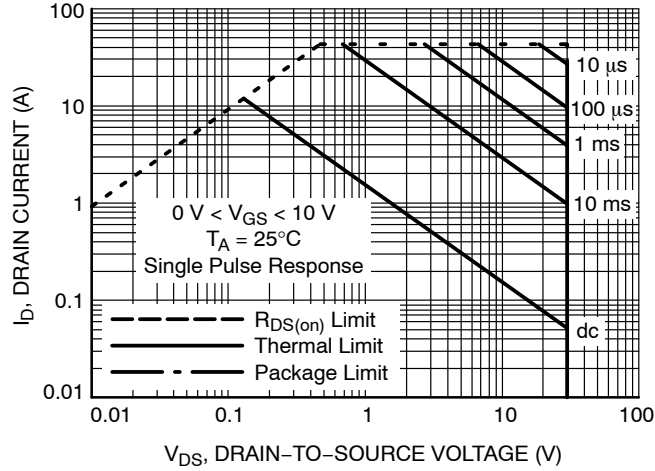


Figure 11. Maximum Rated Forward Biased Safe Operating Area

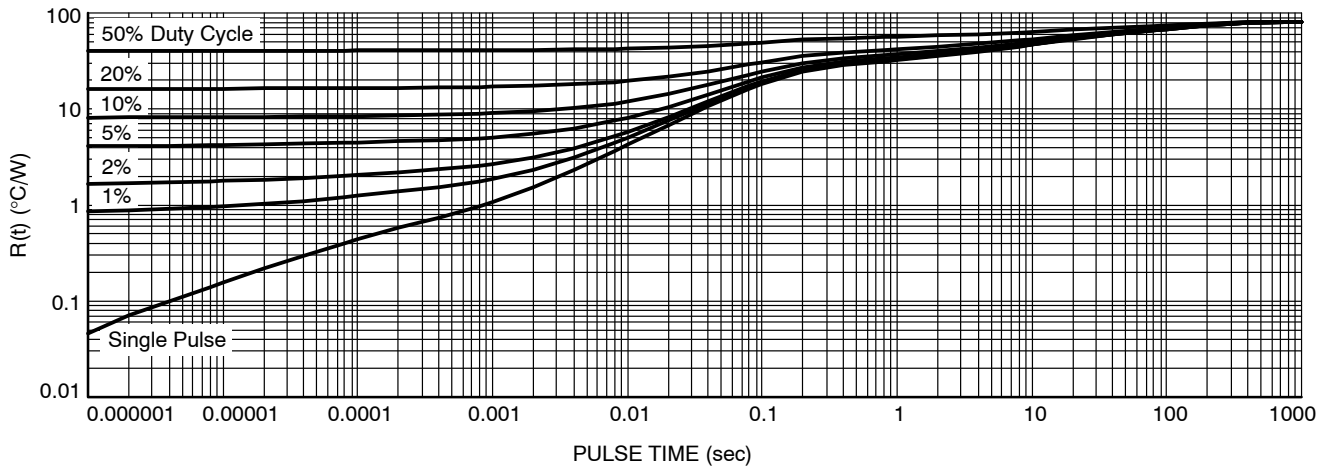


Figure 12. Thermal Response

### DEVICE ORDERING INFORMATION

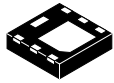
| Device        | Package            | Shipping <sup>†</sup> |
|---------------|--------------------|-----------------------|
| NVLUS4C12NTAG | UDFN6<br>(Pb-Free) | 3000 / Tape & Reel    |

<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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

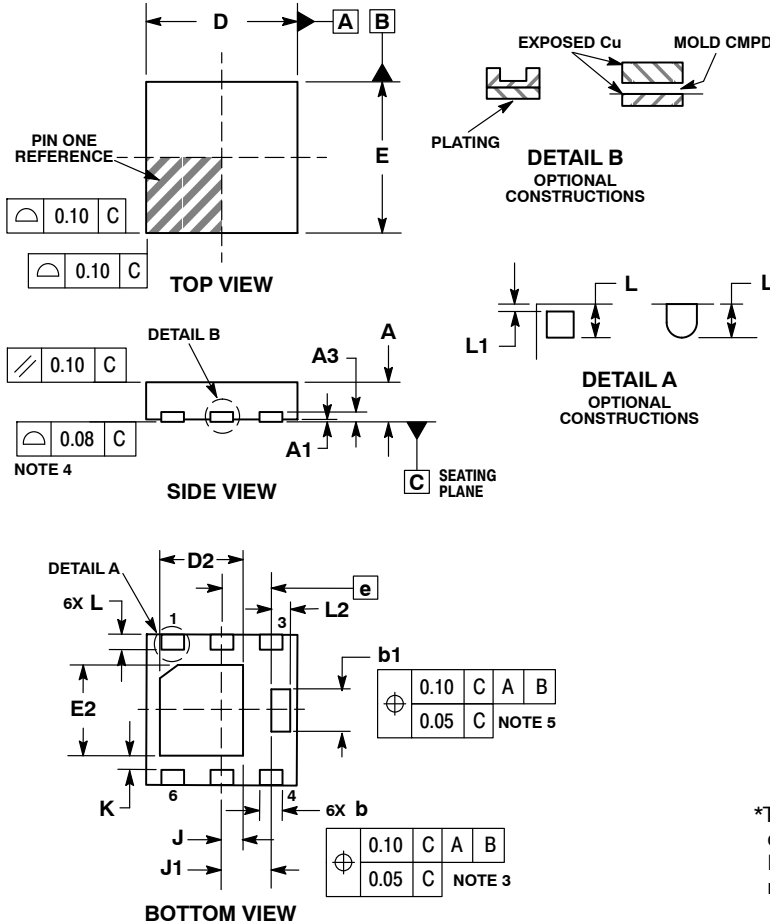
ON Semiconductor®



SCALE 4:1

UDFN6 2x2, 0.65P  
CASE 517BG-01  
ISSUE A

DATE 04 FEB 2010



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
1. CENTER TERMINAL LEAD IS OPTIONAL. CENTER TERMINAL IS CONNECTED TO TERMINAL LEAD # 4.
2. LEADS 1, 2, 5 AND 6 ARE TIED TO THE FLAG.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.45        | 0.55 |
| A1  | 0.00        | 0.05 |
| A3  | 0.13 REF    |      |
| b   | 0.25        | 0.35 |
| b1  | 0.51        | 0.61 |
| D   | 2.00 BSC    |      |
| D2  | 1.00        | 1.20 |
| E   | 2.00 BSC    |      |
| E2  | 1.10        | 1.30 |
| e   | 0.65 BSC    |      |
| K   | 0.15 REF    |      |
| J   | 0.27 BSC    |      |
| J1  | 0.65 BSC    |      |
| L   | 0.20        | 0.30 |
| L1  | ---         | 0.10 |
| L2  | 0.20        | 0.30 |

**GENERIC MARKING DIAGRAM\***

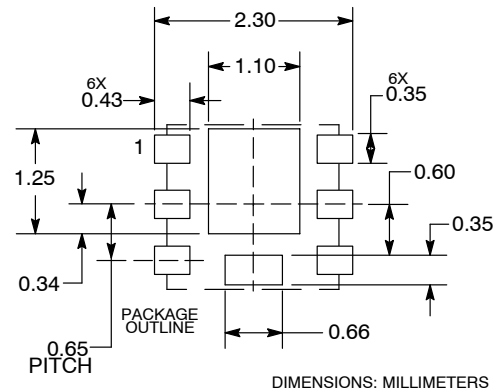


XX = Specific Device Code  
M = Date Code

(Note: Microdot may be in either location)

\*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.

**RECOMMENDED MOUNTING FOOTPRINT**



|                         |                         |  |
|-------------------------|-------------------------|--|
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| <b>DESCRIPTION:</b>     | <b>UDFN6 2X2, 0.65P</b> | <b>PAGE 1 OF 1</b>   |

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