

# NTD6416ANL, NVD6416ANL

## MOSFET – Power, N-Channel

**100 V, 19 A, 74 mΩ**

### Features

- Low  $R_{DS(on)}$
- High Current Capability
- 100% Avalanche Tested
- NVD Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

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

| Parameter                                                                                                                                                          |                        |                        | Symbol                            | Value       | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|-----------------------------------|-------------|------|
| Drain-to-Source Voltage                                                                                                                                            |                        |                        | V <sub>DSS</sub>                  | 100         | V    |
| Gate-to-Source Voltage – Continuous                                                                                                                                |                        |                        | V <sub>GS</sub>                   | ±20         | V    |
| Continuous Drain Current                                                                                                                                           | Steady State           | T <sub>C</sub> = 25°C  | I <sub>D</sub>                    | 19          | A    |
|                                                                                                                                                                    |                        | T <sub>C</sub> = 100°C |                                   | 13          |      |
| Power Dissipation                                                                                                                                                  | Steady State           | T <sub>C</sub> = 25°C  | P <sub>D</sub>                    | 71          | W    |
| Pulsed Drain Current                                                                                                                                               | t <sub>p</sub> = 10 μs |                        | I <sub>DM</sub>                   | 70          | A    |
| Operating and Storage Temperature Range                                                                                                                            |                        |                        | T <sub>J</sub> , T <sub>stg</sub> | –55 to +175 | °C   |
| Source Current (Body Diode)                                                                                                                                        |                        |                        | I <sub>S</sub>                    | 19          | A    |
| Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 50 Vdc, V <sub>GS</sub> = 10 Vdc, I <sub>L(pk)</sub> = 18.2 A, L = 0.3 mH, R <sub>G</sub> = 25 Ω) |                        |                        | E <sub>AS</sub>                   | 50          | mJ   |
| Lead Temperature for Soldering Purposes, 1/8" from Case for 10 Seconds                                                                                             |                        |                        | T <sub>L</sub>                    | 260         | °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.

### THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol          | Max | Unit               |
|---------------------------------------------|-----------------|-----|--------------------|
| Junction-to-Case (Drain) – Steady State     | $R_{\theta JC}$ | 2.1 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 47  |                    |

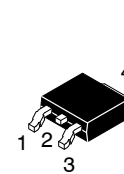
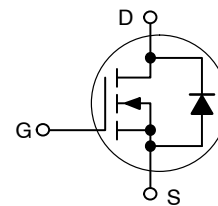
1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).



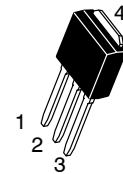
**ON Semiconductor®**

[www.onsemi.com](http://www.onsemi.com)

| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| 100 V         | 74 mΩ @ 10 V             | 19 A              |

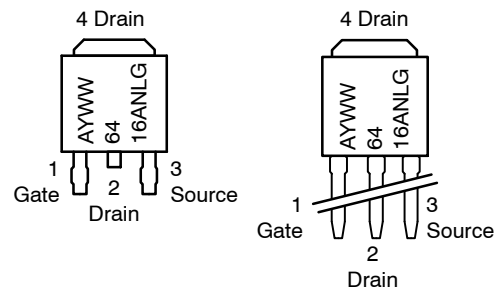


**DPAK**  
CASE 369AA  
STYLE 2



**IPAK**  
CASE 369D  
STYLE 2

### MARKING DIAGRAM & PIN ASSIGNMENTS



A = Assembly Location\*  
Y = Year  
WW = Work Week  
6416ANL = Device Code  
G = Pb-Free Package

\* The Assembly Location code (A) is front side optional. In cases where the Assembly Location is stamped in the package, the front side assembly code may be blank.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

# NTD6416ANL, NVD6416ANL

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

| Parameter                                                 | Symbol                               | Test Condition                                    | Min                    | Typ | Max  | Unit  |
|-----------------------------------------------------------|--------------------------------------|---------------------------------------------------|------------------------|-----|------|-------|
| <b>OFF CHARACTERISTICS</b>                                |                                      |                                                   |                        |     |      |       |
| Drain-to-Source Breakdown Voltage                         | V <sub>(BR)DSS</sub>                 | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA    | 100                    |     |      | V     |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | V <sub>(BR)DSS</sub> /T <sub>J</sub> |                                                   |                        | 120 |      | mV/°C |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                     | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V | T <sub>J</sub> = 25°C  |     | 1.0  | μA    |
|                                                           |                                      |                                                   | T <sub>J</sub> = 125°C |     | 10   |       |
| Gate-to-Source Leakage Current                            | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V    |                        |     | ±100 | nA    |

## ON CHARACTERISTICS (Note 2)

|                                            |                                     |                                                             |     |     |     |       |
|--------------------------------------------|-------------------------------------|-------------------------------------------------------------|-----|-----|-----|-------|
| Gate Threshold Voltage                     | V <sub>GS(TH)</sub>                 | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA | 1.0 |     | 2.2 | V     |
| Negative Threshold Temperature Coefficient | V <sub>GS(TH)</sub> /T <sub>J</sub> |                                                             |     | 5.4 |     | mV/°C |
| Drain-to-Source On-Resistance              | R <sub>DS(on)</sub>                 | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 10 A              |     | 70  | 80  | mΩ    |
|                                            |                                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A               |     | 62  | 74  |       |
|                                            |                                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19 A               |     | 68  | 74  |       |
| Forward Transconductance                   | g <sub>FS</sub>                     | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 10 A                |     | 18  |     | S     |

## CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |                     |                                                                       |  |     |      |    |
|------------------------------|---------------------|-----------------------------------------------------------------------|--|-----|------|----|
| Input Capacitance            | C <sub>ISS</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 25 V            |  | 700 | 1000 | pF |
| Output Capacitance           | C <sub>OSS</sub>    |                                                                       |  | 110 |      |    |
| Reverse Transfer Capacitance | C <sub>RSS</sub>    |                                                                       |  | 50  |      |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 80 V, I <sub>D</sub> = 19 A |  | 25  | 40   | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |                                                                       |  | 0.7 |      |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |                                                                       |  | 2.4 |      |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |                                                                       |  | 9.6 |      |    |
| Plateau Voltage              | V <sub>GP</sub>     |                                                                       |  | 3.2 |      |    |
| Gate Resistance              | R <sub>G</sub>      |                                                                       |  | 2.4 |      | Ω  |

## SWITCHING CHARACTERISTICS (Note 3)

|                     |                     |                                                                                                  |  |     |  |    |
|---------------------|---------------------|--------------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | t <sub>d(on)</sub>  | V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 80 V,<br>I <sub>D</sub> = 19 A, R <sub>G</sub> = 6.1 Ω |  | 7.0 |  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                                  |  | 16  |  |    |
| Turn-Off Delay Time | t <sub>d(off)</sub> |                                                                                                  |  | 35  |  |    |
| Fall Time           | t <sub>f</sub>      |                                                                                                  |  | 40  |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |                 |                                                                                 |                        |      |     |    |
|-------------------------|-----------------|---------------------------------------------------------------------------------|------------------------|------|-----|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 19 A                                    | T <sub>J</sub> = 25°C  | 0.9  | 1.2 | V  |
|                         |                 |                                                                                 | T <sub>J</sub> = 125°C | 0.72 |     |    |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI <sub>S</sub> /dt = 100 A/μs,<br>I <sub>S</sub> = 19 A |                        | 50   |     | ns |
| Charge Time             | T <sub>a</sub>  |                                                                                 |                        | 38   |     |    |
| Discharge Time          | T <sub>b</sub>  |                                                                                 |                        | 14   |     |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |                                                                                 |                        | 112  |     | 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.

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

3. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

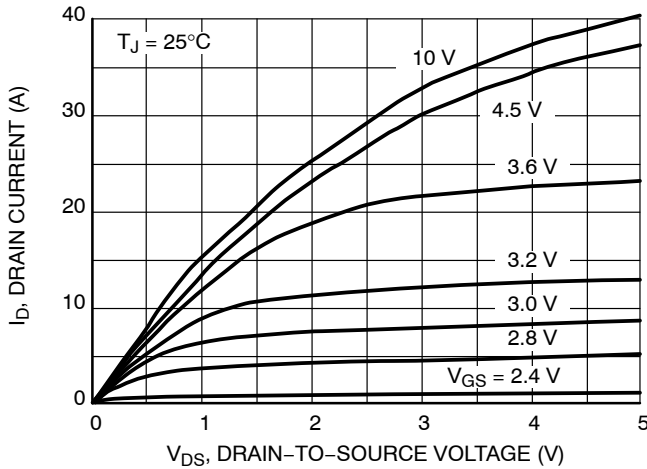


Figure 1. On-Region Characteristics

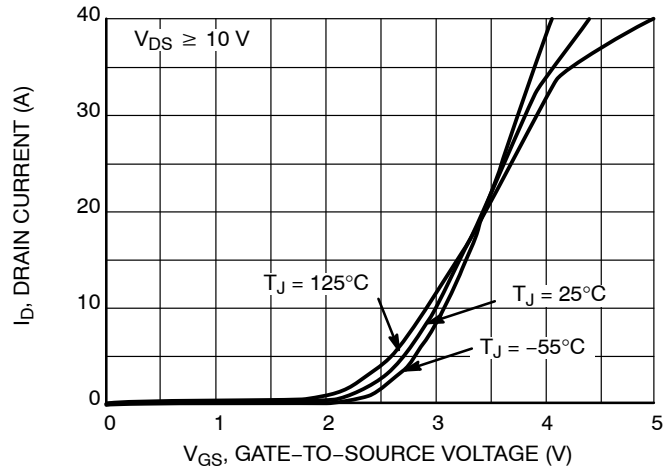


Figure 2. Transfer Characteristics

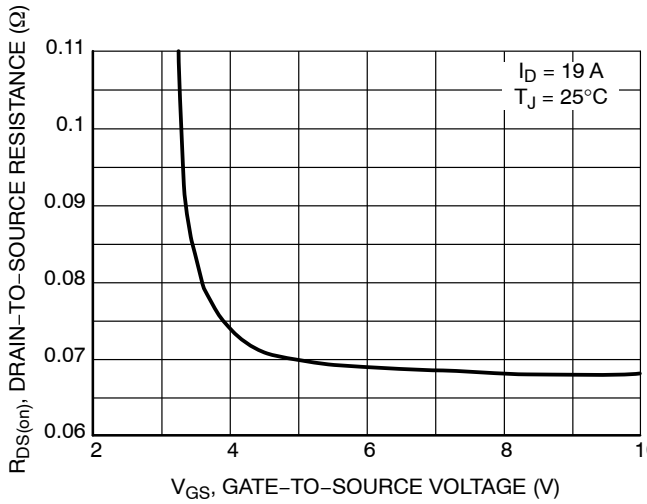


Figure 3. On-Region versus Gate-To-Source Voltage

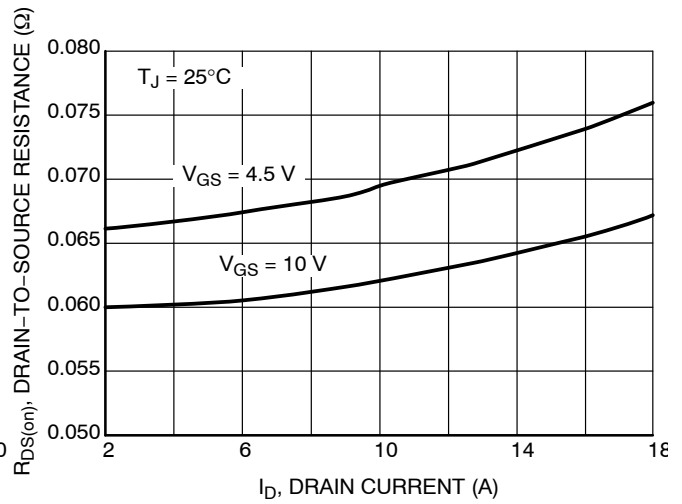


Figure 4. On-Region versus Drain Current and Gate-To-Source Voltage

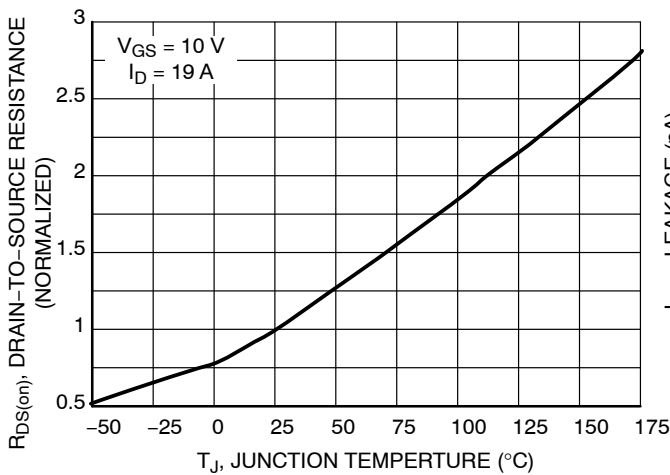


Figure 5. On-Resistance Variation with Temperature

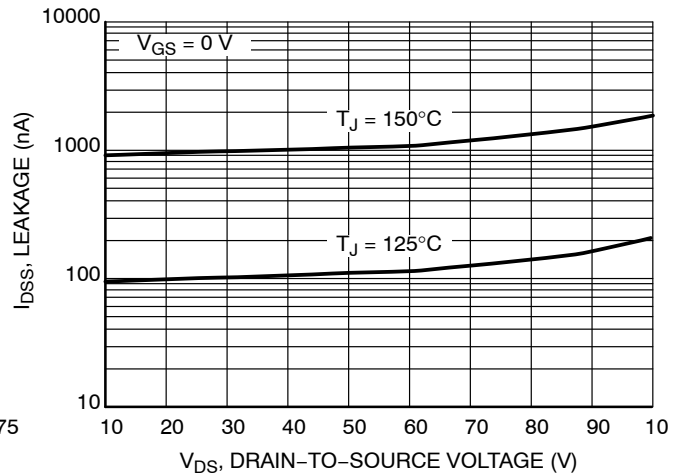


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL CHARACTERISTICS

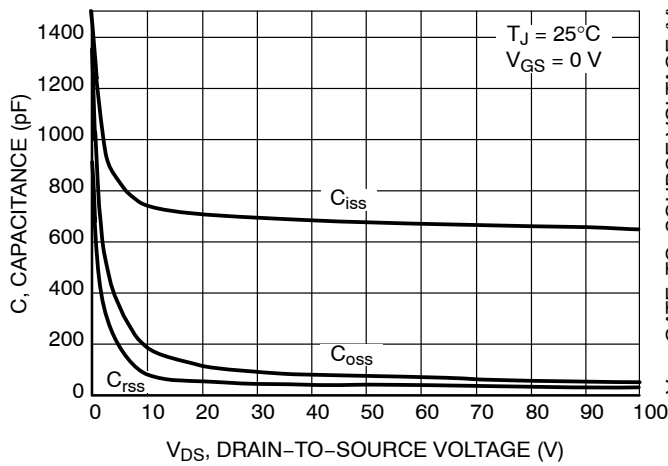


Figure 7. Capacitance Variation

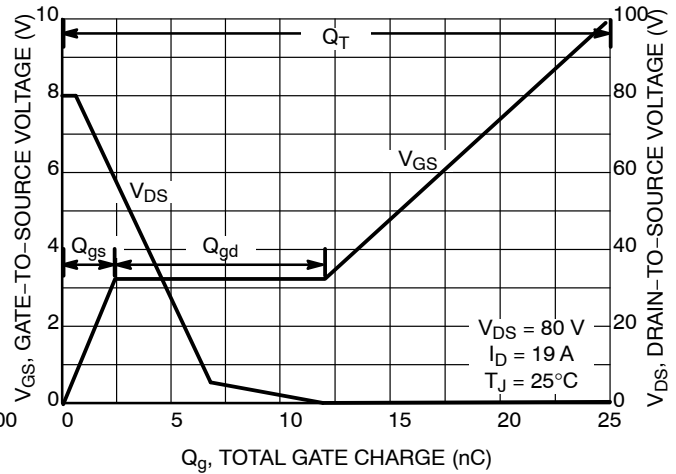


Figure 8. Gate-to-Source Voltage and Drain-to-Source Voltage versus Total Charge

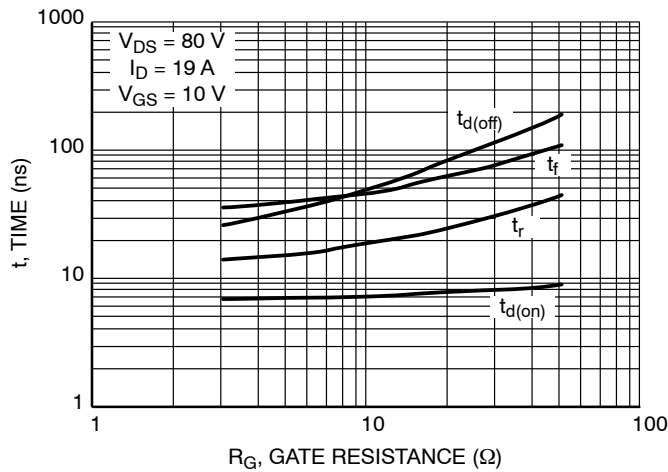


Figure 9. Resistive Switching Time Variation versus Gate Resistance

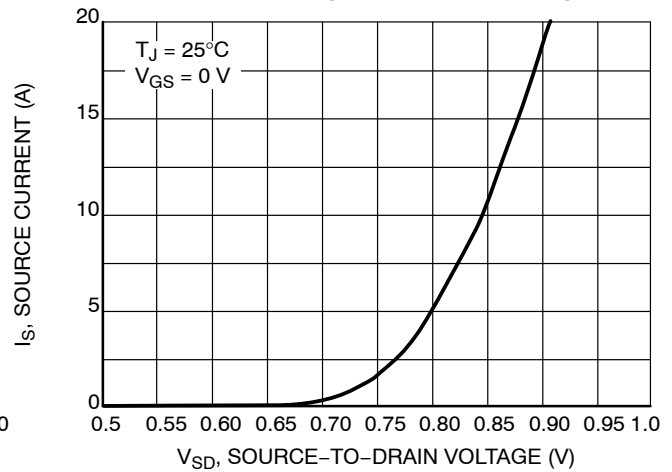


Figure 10. Diode Forward Voltage versus Current

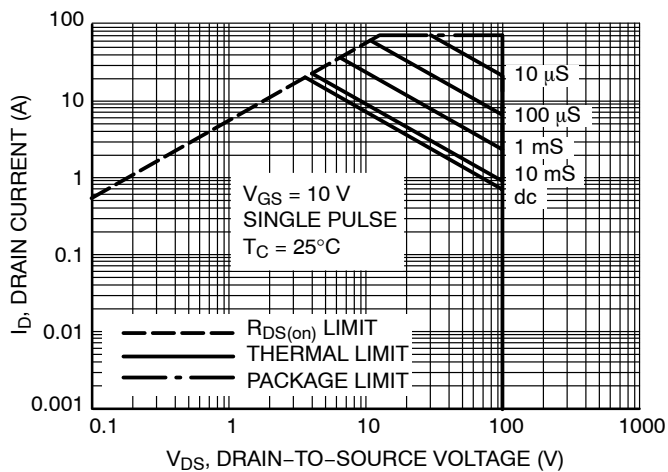


Figure 11. Maximum Rated Forward Biased Safe Operating Area

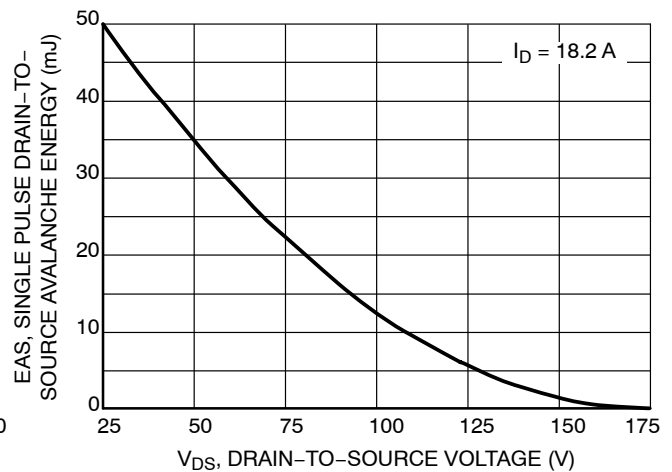


Figure 12. Resistive Switching Time Variation versus Gate Resistance

# NTD6416ANL, NVD6416ANL

## TYPICAL CHARACTERISTICS

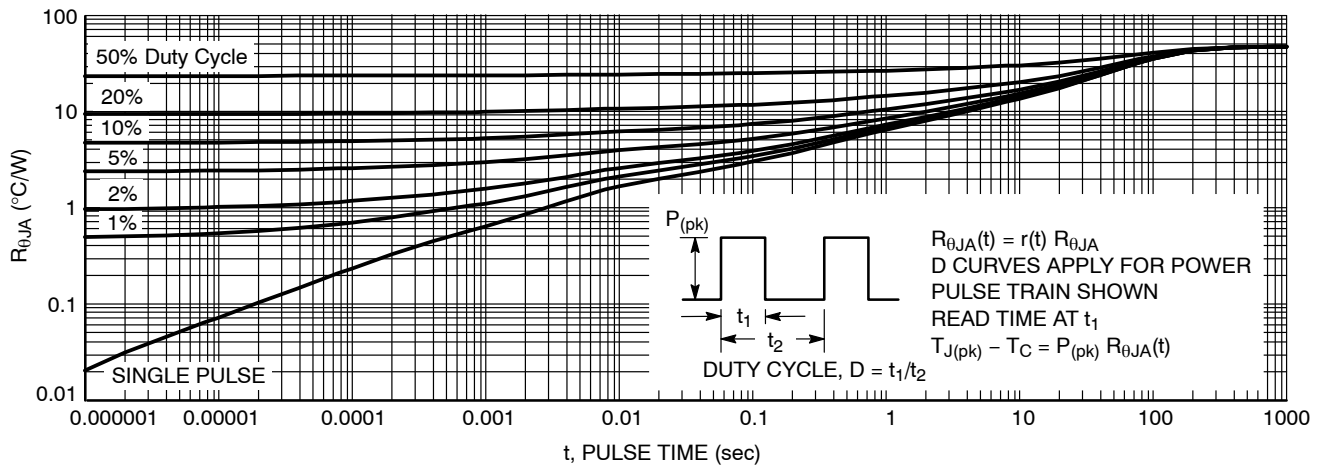


Figure 13. Thermal Response (NTD6416ANL DPAK PCB Cu Area 720 mm<sup>2</sup> PCB Cu thk 2 oz)

## ORDERING INFORMATION

| Device              | Package           | Shipping <sup>†</sup> |
|---------------------|-------------------|-----------------------|
| NTD6416ANLT4G       | DPAK<br>(Pb-Free) | 2500 / Tape & Reel    |
| NTD6416ANL-1G       | IPAK<br>(Pb-Free) | 75 Units / Rail       |
| NVD6416ANLT4G*      | DPAK<br>(Pb-Free) | 2500 / Tape & Reel    |
| NVD6416ANLT4G-VF01* | DPAK<br>(Pb-Free) | 2500 / 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.

\*NVD Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

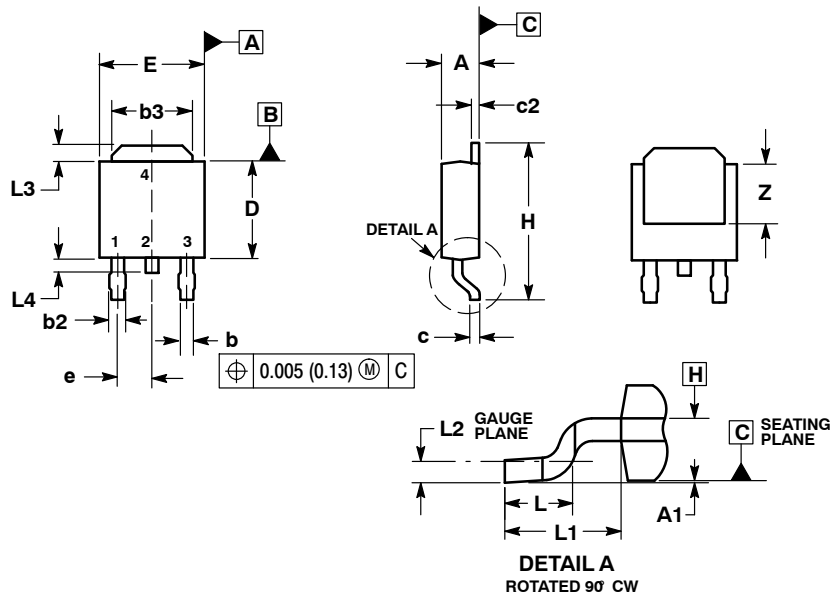
# NTD6416ANL, NVD6416ANL

## PACKAGE DIMENSIONS

### DPAK (SINGLE GUAGE)

CASE 369AA

ISSUE B

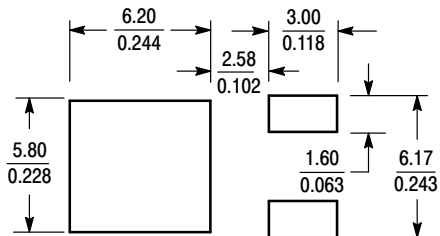


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.086     | 0.094 | 2.18        | 2.38  |
| A1  | 0.000     | 0.005 | 0.00        | 0.13  |
| b   | 0.025     | 0.035 | 0.63        | 0.89  |
| b2  | 0.030     | 0.045 | 0.76        | 1.14  |
| b3  | 0.180     | 0.215 | 4.57        | 5.46  |
| c   | 0.018     | 0.024 | 0.46        | 0.61  |
| c2  | 0.018     | 0.024 | 0.46        | 0.61  |
| D   | 0.235     | 0.245 | 5.97        | 6.22  |
| E   | 0.250     | 0.265 | 6.35        | 6.73  |
| e   | 0.090 BSC |       | 2.29 BSC    |       |
| H   | 0.370     | 0.410 | 9.40        | 10.41 |
| L   | 0.055     | 0.070 | 1.40        | 1.78  |
| L1  | 0.108 REF |       | 2.74 REF    |       |
| L2  | 0.020 BSC |       | 0.51 BSC    |       |
| L3  | 0.035     | 0.050 | 0.89        | 1.27  |
| L4  | ---       | 0.040 | ---         | 1.01  |
| Z   | 0.155     | ---   | 3.93        | ---   |

### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

#### STYLE 2:

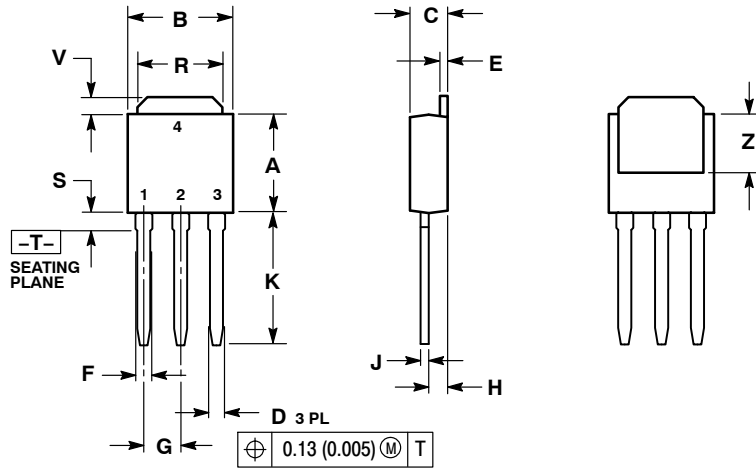
- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NTD6416ANL, NVD6416ANL

## PACKAGE DIMENSIONS

### IPAK CASE 369D ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | MIN    | MAX   | MIN         | MAX  |
| A   | 0.235  | 0.245 | 5.97        | 6.35 |
| B   | 0.250  | 0.265 | 6.35        | 6.73 |
| C   | 0.086  | 0.094 | 2.19        | 2.38 |
| D   | 0.027  | 0.035 | 0.69        | 0.88 |
| E   | 0.018  | 0.023 | 0.46        | 0.58 |
| F   | 0.037  | 0.045 | 0.94        | 1.14 |
| G   | 0.090  | BSC   | 2.29        | BSC  |
| H   | 0.034  | 0.040 | 0.87        | 1.01 |
| J   | 0.018  | 0.023 | 0.46        | 0.58 |
| K   | 0.350  | 0.380 | 8.89        | 9.65 |
| R   | 0.180  | 0.215 | 4.45        | 5.45 |
| S   | 0.025  | 0.040 | 0.63        | 1.01 |
| V   | 0.035  | 0.050 | 0.89        | 1.27 |
| Z   | 0.155  | ---   | 3.93        | ---  |

STYLE 2:

- PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marketing.pdf](http://www.onsemi.com/site/pdf/Patent-Marketing.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada  
Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910  
Japan Customer Focus Center  
Phone: 81-3-5817-1050

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.