

# NTD4806N, NVD4806N

## Power MOSFET

30 V, 76 A, Single N-Channel, DPAK/IPAK

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- AEC-Q101 Qualified and PPAP Capable – NVD4806N
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- CPU Power Delivery
- DC-DC Converters
- Low Side Switching

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

| Parameter                                                                                                                                                    |              |                       | Symbol                            | Value           | Unit |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|-----------------------------------|-----------------|------|---|
| Drain-to-Source Voltage                                                                                                                                      |              |                       | V <sub>DSS</sub>                  | 30              | V    |   |
| Gate-to-Source Voltage                                                                                                                                       |              |                       | V <sub>GS</sub>                   | ± 20            | V    |   |
| Continuous Drain Current (R <sub>θJA</sub> ) (Note 1)                                                                                                        | Steady State | T <sub>A</sub> = 25°C | I <sub>D</sub>                    | 15.6            | A    |   |
|                                                                                                                                                              |              | T <sub>A</sub> = 85°C |                                   | 12              |      |   |
| Power Dissipation (R <sub>θJA</sub> ) (Note 1)                                                                                                               |              | T <sub>A</sub> = 25°C | P <sub>D</sub>                    | 2.65            | W    |   |
| Continuous Drain Current (R <sub>θJA</sub> ) (Note 2)                                                                                                        |              | T <sub>A</sub> = 25°C | I <sub>D</sub>                    | 11.3            | A    |   |
|                                                                                                                                                              |              | T <sub>A</sub> = 85°C |                                   | 8.8             |      |   |
| Power Dissipation (R <sub>θJA</sub> ) (Note 2)                                                                                                               |              | T <sub>A</sub> = 25°C | P <sub>D</sub>                    | 1.4             | W    |   |
| Continuous Drain Current (R <sub>θJC</sub> ) (Note 1)                                                                                                        |              | T <sub>C</sub> = 25°C | I <sub>D</sub>                    | 79              | A    |   |
|                                                                                                                                                              |              | T <sub>C</sub> = 85°C |                                   | 61              |      |   |
| Power Dissipation (R <sub>θJC</sub> ) (Note 1)                                                                                                               |              | T <sub>C</sub> = 25°C | P <sub>D</sub>                    | 68              | W    |   |
| Pulsed Drain Current                                                                                                                                         |              | t <sub>p</sub> =10μs  | T <sub>A</sub> = 25°C             | I <sub>DM</sub> | 150  | A |
| Current Limited by Package                                                                                                                                   |              | T <sub>A</sub> = 25°C | I <sub>DmaxPkg</sub>              | 45              | A    |   |
| Operating Junction and Storage Temperature                                                                                                                   |              |                       | T <sub>J</sub> , T <sub>stg</sub> | -55 to 175      | °C   |   |
| Source Current (Body Diode)                                                                                                                                  |              |                       | I <sub>S</sub>                    | 50              | A    |   |
| Drain to Source dV/dt                                                                                                                                        |              |                       | dV/dt                             | 6.0             | V/ns |   |
| Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 24 V, V <sub>GS</sub> = 10 V, L = 1.0 mH, I <sub>L(pk)</sub> = 21 A, R <sub>G</sub> = 25 Ω) |              |                       | E <sub>AS</sub>                   | 220             | mJ   |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)                                                                                            |              |                       | T <sub>L</sub>                    | 260             | °C   |   |

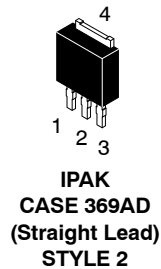
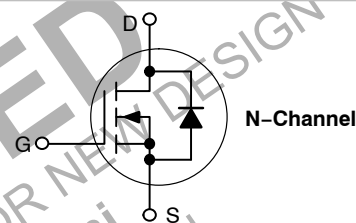
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



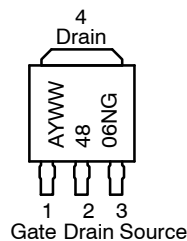
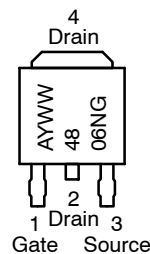
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| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX       | $I_D$ MAX |
|---------------|------------------------|-----------|
| 30 V          | 6.0 m $\Omega$ @ 10 V  | 76 A      |
|               | 9.4 m $\Omega$ @ 4.5 V |           |



### MARKING DIAGRAMS & PIN ASSIGNMENTS



A = Assembly Location\*  
Y = Year  
WW = Work Week  
4806N = 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 bottom (molding ejector pin), the front side assembly code may be blank.

### ORDERING INFORMATION

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

**THERMAL RESISTANCE MAXIMUM RATINGS**

| Parameter                                   | Symbol              | Value | Unit |
|---------------------------------------------|---------------------|-------|------|
| Junction-to-Case (Drain)                    | $R_{\theta JC}$     | 2.2   | °C/W |
| Junction-to-Tab (Drain)                     | $R_{\theta JC-TAB}$ | 3.5   |      |
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$     | 56.7  |      |
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$     | 106.8 |      |

1. Surface-mounted on FR4 board using 1 in sq pad size, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

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

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

**OFF CHARACTERISTICS**

|                                                           |                   |                                                     |                           |    |           |               |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|---------------------------|----|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 30                        |    |           | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |                           | 27 |           | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$         | $T_J = 25^\circ\text{C}$  |    | 10        | $\mu\text{A}$ |
|                                                           |                   |                                                     | $T_J = 125^\circ\text{C}$ |    | 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 3)

|                                            |                  |                                                 |                     |     |     |            |
|--------------------------------------------|------------------|-------------------------------------------------|---------------------|-----|-----|------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 1.5                 |     | 2.5 | V          |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |                     | 6.0 |     | mV/°C      |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ to }11.5\text{ V}$           | $I_D = 30\text{ A}$ | 4.9 | 6.0 | m $\Omega$ |
|                                            |                  |                                                 | $I_D = 15\text{ A}$ | 4.8 |     |            |
|                                            |                  | $V_{GS} = 4.5\text{ V}$                         | $I_D = 30\text{ A}$ | 7.9 | 9.4 |            |
|                                            |                  |                                                 | $I_D = 15\text{ A}$ | 7.5 |     |            |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 15\text{ V}, I_D = 15\text{ A}$       |                     | 14  |     | S          |

**CHARGES AND CAPACITANCES**

|                              |              |                                                                   |  |      |    |    |
|------------------------------|--------------|-------------------------------------------------------------------|--|------|----|----|
| Input Capacitance            | $C_{iss}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$   |  | 2142 |    | pF |
| Output Capacitance           | $C_{oss}$    |                                                                   |  | 480  |    |    |
| Reverse Transfer Capacitance | $C_{rss}$    |                                                                   |  | 251  |    |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$  |  | 15   | 23 | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                   |  | 3.0  |    |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                   |  | 7.0  |    |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                   |  | 7.0  |    |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$ |  | 37   |    | nC |

**SWITCHING CHARACTERISTICS** (Note 4)

|                     |              |                                                                                           |  |      |  |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$ |  | 13.9 |  | ns |
| Rise Time           | $t_r$        |                                                                                           |  | 29.7 |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                           |  | 18.3 |  |    |
| Fall Time           | $t_f$        |                                                                                           |  | 7.8  |  |    |

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.

3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
4. Switching characteristics are independent of operating junction temperatures.

# NTD4806N, NVD4806N

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

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

### SWITCHING CHARACTERISTICS (Note 4)

|                     |                     |                                                                                                    |  |      |  |    |
|---------------------|---------------------|----------------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | t <sub>d(on)</sub>  | V <sub>GS</sub> = 11.5 V, V <sub>DS</sub> = 15 V,<br>I <sub>D</sub> = 15 A, R <sub>G</sub> = 3.0 Ω |  | 8.5  |  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                                    |  | 23.8 |  |    |
| Turn-Off Delay Time | t <sub>d(off)</sub> |                                                                                                    |  | 26   |  |    |
| Fall Time           | t <sub>f</sub>      |                                                                                                    |  | 4.7  |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |                 |                                                                                 |                                                 |  |            |     |    |
|-----------------------|-----------------|---------------------------------------------------------------------------------|-------------------------------------------------|--|------------|-----|----|
| Forward Diode Voltage | V <sub>SD</sub> | V <sub>GS</sub> = 0 V,<br>I <sub>S</sub> = 30 A                                 | T <sub>J</sub> = 25°C<br>T <sub>J</sub> = 125°C |  | 0.9<br>0.8 | 1.2 | V  |
| 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> = 30 A |                                                 |  | 26         |     | ns |
| Charge Time           | t <sub>a</sub>  |                                                                                 |                                                 |  | 13         |     |    |
| Discharge Time        | t <sub>b</sub>  |                                                                                 |                                                 |  | 13         |     |    |
| Reverse Recovery Time | Q <sub>RR</sub> |                                                                                 |                                                 |  | 16         |     | nC |

### PACKAGE PARASITIC VALUES

|                        |                |                       |  |        |  |    |
|------------------------|----------------|-----------------------|--|--------|--|----|
| Source Inductance      | L <sub>S</sub> | T <sub>A</sub> = 25°C |  | 2.49   |  | nH |
| Drain Inductance, DPAK | L <sub>D</sub> |                       |  | 0.0164 |  |    |
| Drain Inductance, IPAK | L <sub>D</sub> |                       |  | 1.88   |  |    |
| Gate Inductance        | L <sub>G</sub> |                       |  | 3.46   |  |    |
| Gate Resistance        | R <sub>G</sub> |                       |  | 1.0    |  | Ω  |

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.

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

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

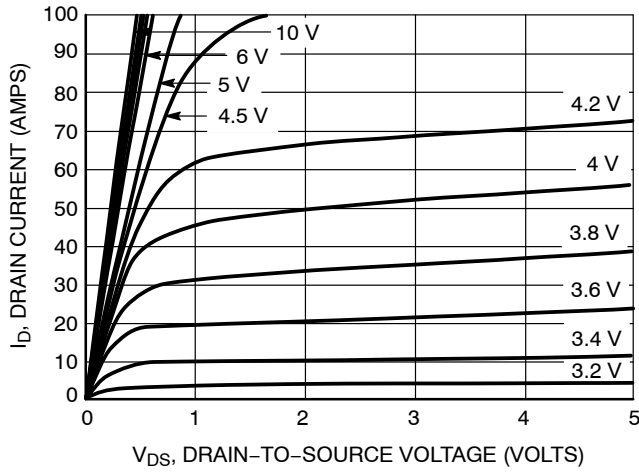


Figure 1. On-Region Characteristics

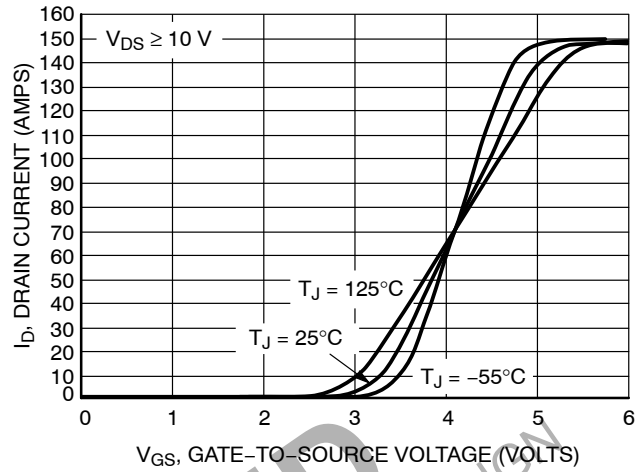


Figure 2. Transfer Characteristics

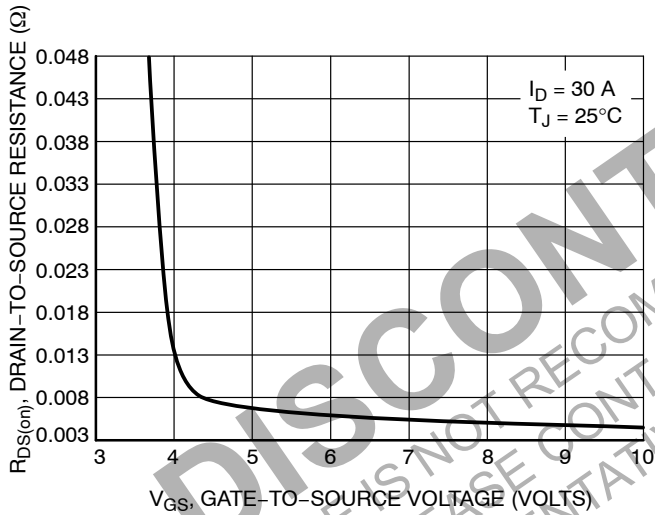


Figure 3. On-Resistance vs. Gate-to-Source Voltage

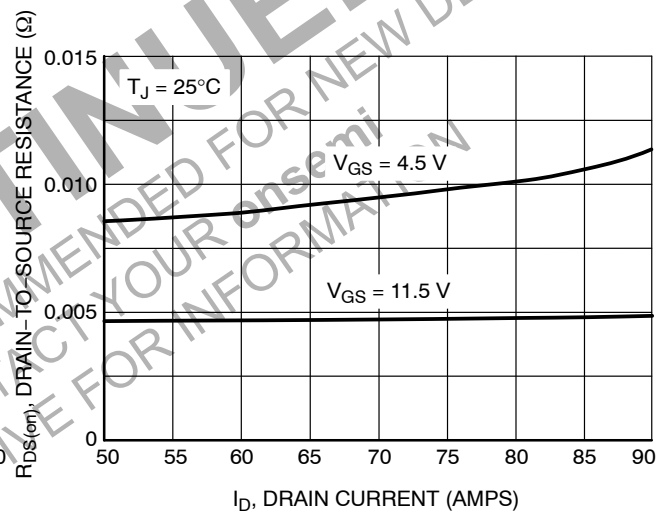


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

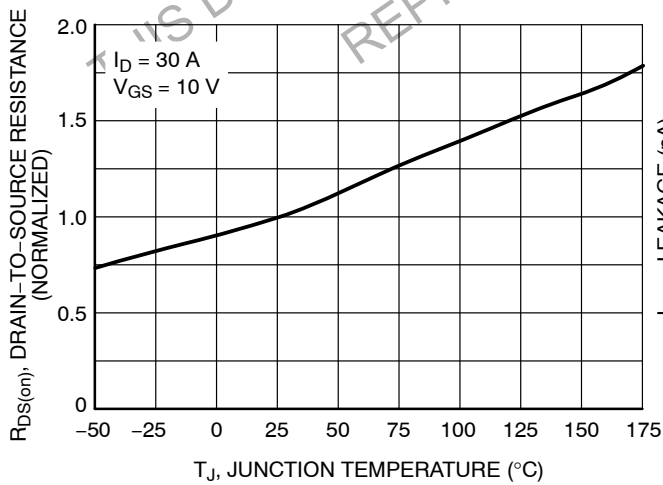


Figure 5. On-Resistance Variation with Temperature

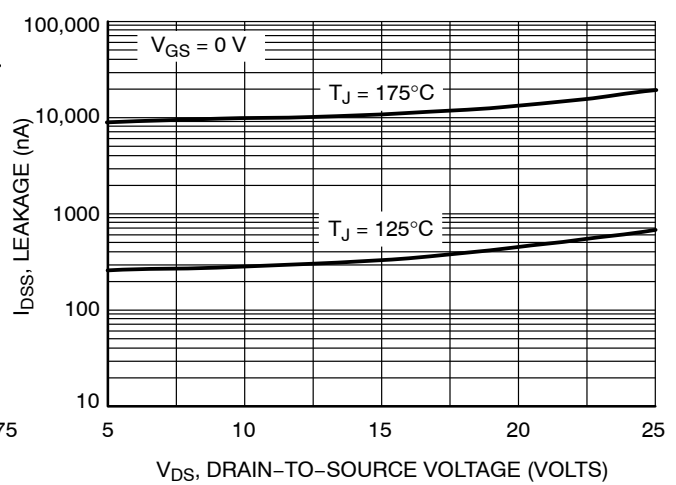


Figure 6. Drain-to-Source Leakage Current vs. Drain Voltage

TYPICAL PERFORMANCE CURVES

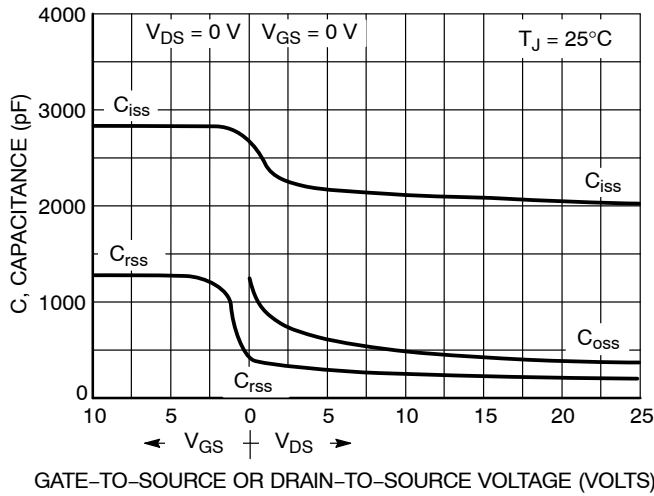


Figure 7. Capacitance Variation

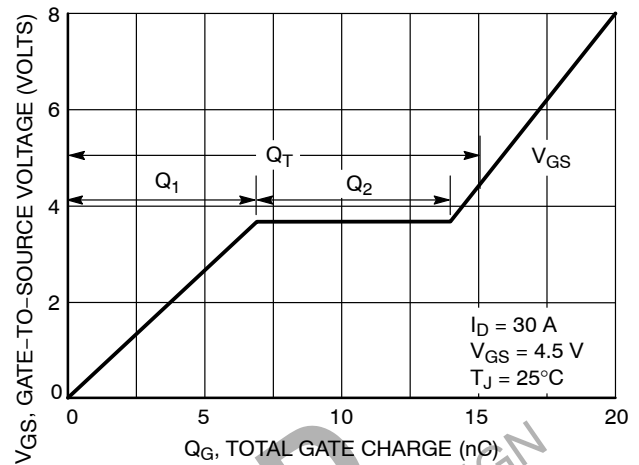


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

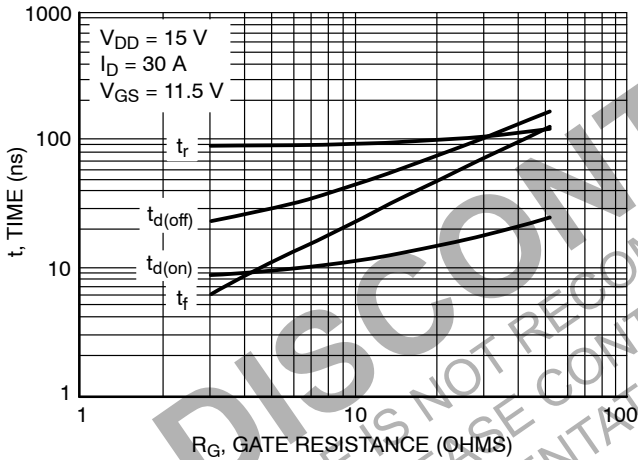


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

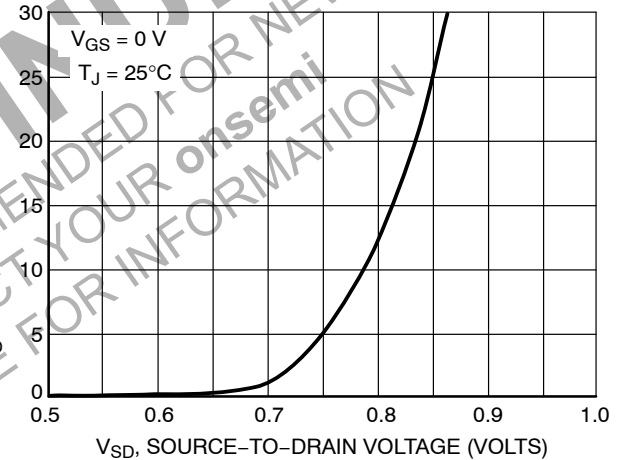


Figure 10. Diode Forward Voltage vs. Current

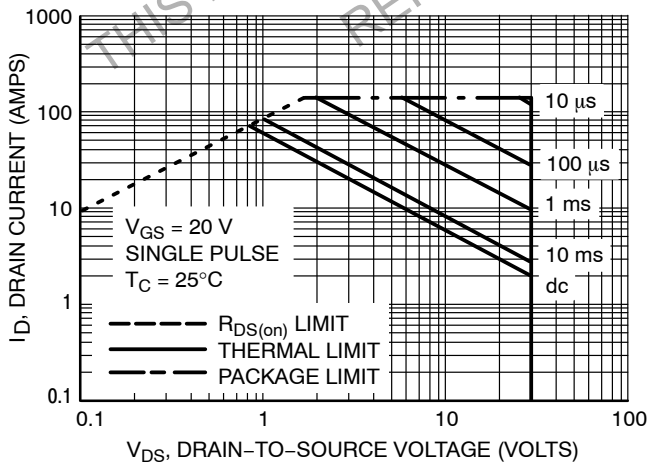


Figure 11. Maximum Rated Forward Biased Safe Operating Area

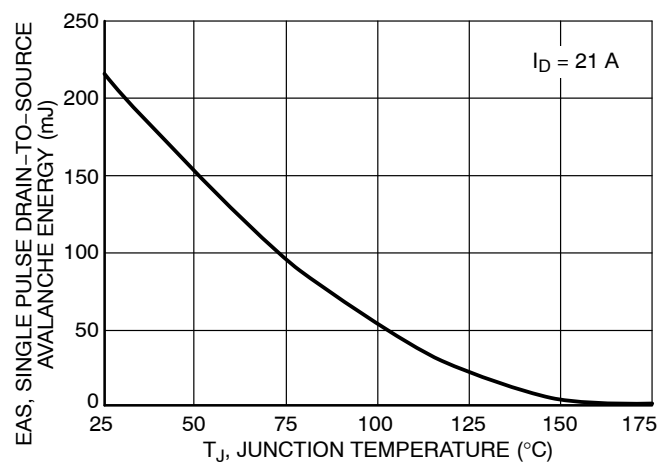


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTD4806N, NVD4806N

## TYPICAL PERFORMANCE CURVES

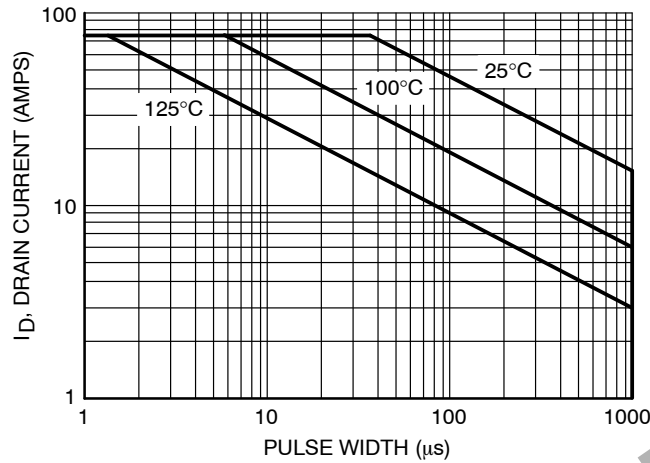


Figure 13. Avalanche Characteristics

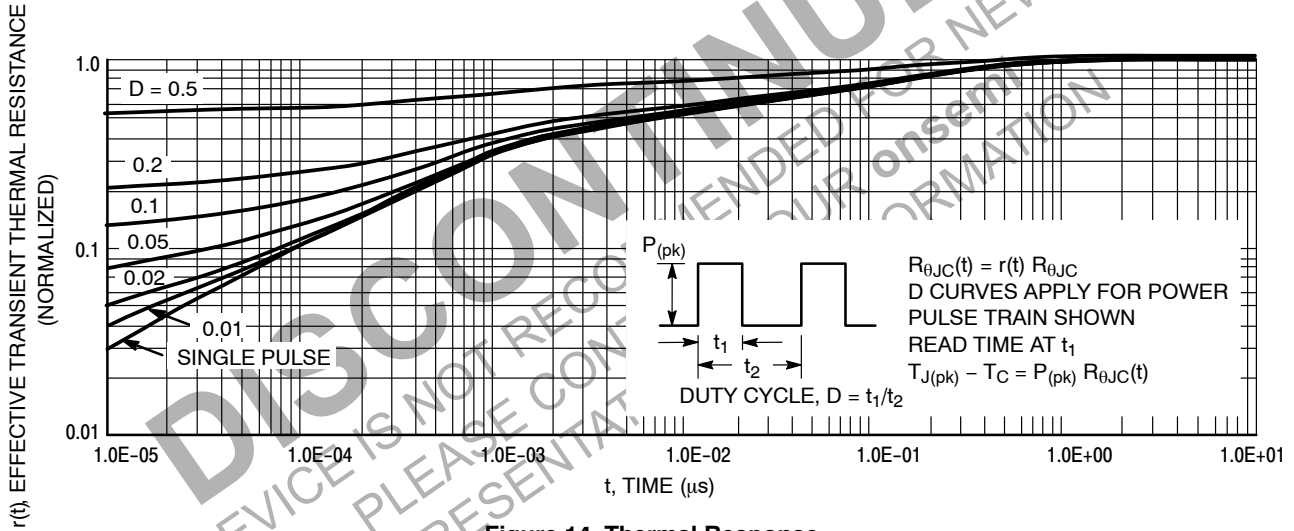
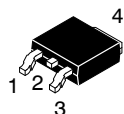


Figure 14. Thermal Response

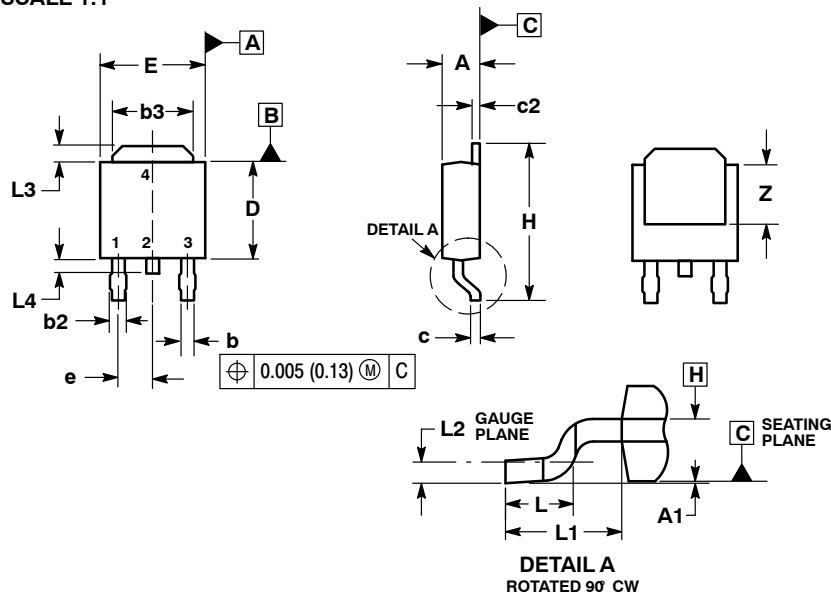
## ORDERING INFORMATION

| Order Number     | Package                                           | Shipping <sup>†</sup> |
|------------------|---------------------------------------------------|-----------------------|
| NTD4806NT4G      | DPAK<br>(Pb-Free)                                 | 2500 / Tape & Reel    |
| NTD4806N-35G     | IPAK Trimmed Lead<br>(3.5 ± 0.15 mm)<br>(Pb-Free) | 75 Units / Rail       |
| NVD4806NT4G      | DPAK<br>(Pb-Free)                                 | 2500 / Tape & Reel    |
| NVD4806NT4G-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 Specifications Brochure, BRD8011/D.



SCALE 1:1



STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

STYLE 2:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

STYLE 3:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

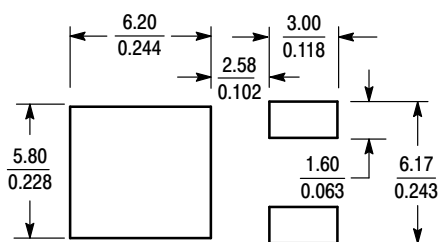
STYLE 4:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

STYLE 5:  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE

STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

STYLE 7:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

#### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

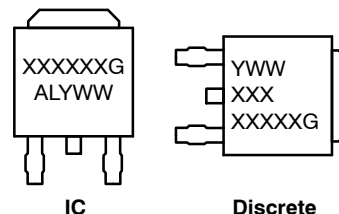
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
- 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.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 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        |       |

#### GENERIC MARKING DIAGRAM\*

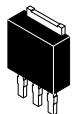


XXXXXX = Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

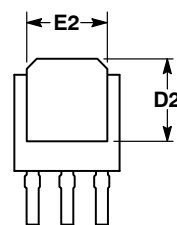
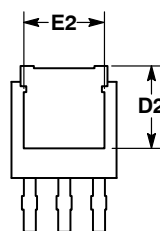
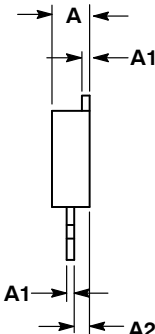
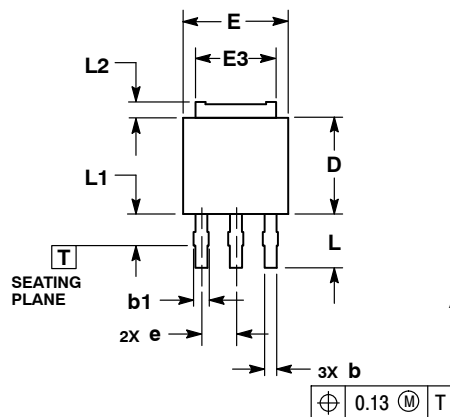
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| DESCRIPTION:     | DPAK (SINGLE GAUGE) | PAGE 1 OF 1                                                                                                                                                                         |

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**3.5 MM IPAK, STRAIGHT LEAD**  
**CASE 369AD**  
**ISSUE B**

DATE 18 APR 2013

SCALE 1:1


**OPTIONAL  
CONSTRUCTION**
**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 0.30mm FROM TERMINAL TIP.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD GATE OR MOLD FLASH.

| MILLIMETERS |          |      |
|-------------|----------|------|
| DIM         | MIN      | MAX  |
| A           | 2.19     | 2.38 |
| A1          | 0.46     | 0.60 |
| A2          | 0.87     | 1.10 |
| b           | 0.69     | 0.89 |
| b1          | 0.77     | 1.10 |
| D           | 5.97     | 6.22 |
| D2          | 4.80     | ---  |
| E           | 6.35     | 6.73 |
| E2          | 4.57     | 5.45 |
| E3          | 4.45     | 5.46 |
| e           | 2.28 BSC |      |
| L           | 3.40     | 3.60 |
| L1          | ---      | 2.10 |
| L2          | 0.89     | 1.27 |

**GENERIC MARKING  
DIAGRAMS\***
**STYLE 1:**  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

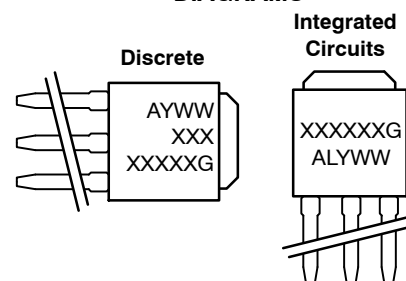
**STYLE 2:**  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

**STYLE 3:**  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

**STYLE 4:**  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

**STYLE 5:**  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE

**STYLE 6:**  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

**STYLE 7:**  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

XXXXXX = Device Code  
A = Assembly Location  
L = Wafer Lot  
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.

|                         |                                   |                                                                                                                                                                                  |
|-------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>3.5 MM IPAK, STRAIGHT LEAD</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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