

# NTD5406N, STD5406N

## Power MOSFET

40 V, 70 A, Single N-Channel, DPAK

### Features

- Low  $R_{DS(on)}$
- High Current Capability
- Low Gate Charge
- STD 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

### Applications

- Electronic Brake Systems
- Electronic Power Steering
- Bridge Circuits

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

| Parameter                                                                                                                                                 |                        |                        | Symbol                            | Value      | Unit |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|-----------------------------------|------------|------|
| Drain-to-Source Voltage                                                                                                                                   |                        |                        | V <sub>DSS</sub>                  | 40         | V    |
| Gate-to-Source Voltage                                                                                                                                    |                        |                        | V <sub>GS</sub>                   | ±20        | V    |
| Continuous Drain Current – R <sub>θJC</sub>                                                                                                               | Steady State           | T <sub>C</sub> = 25°C  | I <sub>D</sub>                    | 70         | A    |
|                                                                                                                                                           |                        | T <sub>C</sub> = 125°C |                                   | 40         |      |
| Power Dissipation – R <sub>θJC</sub>                                                                                                                      | Steady State           | T <sub>C</sub> = 25°C  | P <sub>D</sub>                    | 100        | W    |
| Continuous Drain Current – R <sub>θJA</sub> (Note 1)                                                                                                      | Steady State           | T <sub>A</sub> = 25°C  | I <sub>D</sub>                    | 12.2       | A    |
|                                                                                                                                                           |                        | T <sub>A</sub> = 125°C |                                   | 7.0        |      |
| Power Dissipation – R <sub>θJA</sub> (Note 1)                                                                                                             | Steady State           | T <sub>A</sub> = 25°C  | P <sub>D</sub>                    | 3.0        | W    |
| Pulsed Drain Current                                                                                                                                      | t <sub>p</sub> = 10 μs |                        | I <sub>DM</sub>                   | 150        | A    |
| Operating Junction and Storage Temperature                                                                                                                |                        |                        | T <sub>J</sub> , T <sub>STG</sub> | –55 to 175 | °C   |
| Source Current (Body Diode) Pulsed                                                                                                                        |                        |                        | I <sub>S</sub>                    | 63.5       | A    |
| Single Pulse Drain-to Source Avalanche Energy – (V <sub>DD</sub> = 50 V, V <sub>GS</sub> = 10 V, I <sub>PK</sub> = 30 A, L = 1 mH, R <sub>G</sub> = 25 Ω) |                        |                        | EAS                               | 450        | 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.

### THERMAL RESISTANCE RATINGS (Note 1)

| Parameter                    | Symbol          | Max | Unit               |
|------------------------------|-----------------|-----|--------------------|
| Junction-to-Case (Drain)     | $R_{\theta JC}$ | 1.5 | $^\circ\text{C/W}$ |
| Junction-to-Ambient (Note 1) | $R_{\theta JA}$ | 49  |                    |

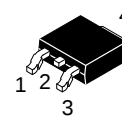
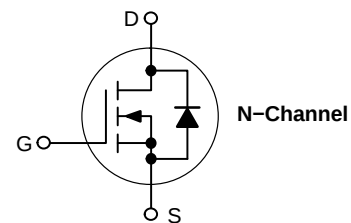
1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).



ON Semiconductor®

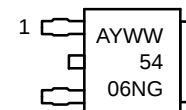
[www.onsemi.com](http://www.onsemi.com)

| $V_{(BR)DS}$ | $R_{DS(ON)}$ TYP      | $I_D$ MAX (Note 1) |
|--------------|-----------------------|--------------------|
| 40 V         | 8.7 m $\Omega$ @ 10 V | 70 A               |



DPAK  
CASE 369C  
STYLE 2

### MARKING DIAGRAM



A = Assembly Location\*  
Y = Year  
WW = Work Week  
5406N = Specific Device Code  
G = Pb-Free Device

\* 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

| Device           | Package        | Shipping†          |
|------------------|----------------|--------------------|
| NTD5406NT4G      | DPAK (Pb-Free) | 2500 / Tape & Reel |
| STD5406NT4G*     | DPAK (Pb-Free) | 2500 / Tape & Reel |
| STD5406NT4G-VF01 | DPAK (Pb-Free) | 2500 / 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.

# NTD5406N, STD5406N

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

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

### OFF CHARACTERISTICS

|                                                           |                                      |                                                |                        |    |      |       |
|-----------------------------------------------------------|--------------------------------------|------------------------------------------------|------------------------|----|------|-------|
| Drain-to-Source Breakdown Voltage                         | V <sub>(BR)DSS</sub>                 | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA | 40                     |    |      | V     |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | V <sub>(BR)DSS</sub> /T <sub>J</sub> |                                                |                        | 42 |      | mV/°C |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                     | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 40 V  | T <sub>J</sub> = 25°C  |    | 1.0  | μA    |
|                                                           |                                      |                                                | T <sub>J</sub> = 100°C |    | 10   |       |
| Gate-to-Source Leakage Current                            | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±30 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 | 1.5 |      | 3.5 | V     |
| Gate Threshold Temperature Coefficient | V <sub>GS(TH)</sub> /T <sub>J</sub> |                                                             |     | -7.0 |     | mV/°C |
| Drain-to-Source On Resistance          | R <sub>DS(on)</sub>                 | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A               |     | 8.7  | 10  | mΩ    |
|                                        |                                     | V <sub>GS</sub> = 5.0 V, I <sub>D</sub> = 10 A              |     | 13.2 | 17  |       |
| Forward Transconductance               | g <sub>FS</sub>                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A               |     | 19   |     | S     |

### CHARGES AND CAPACITANCES

|                              |                     |                                                                       |  |      |      |    |
|------------------------------|---------------------|-----------------------------------------------------------------------|--|------|------|----|
| Input Capacitance            | C <sub>ISS</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 32 V            |  | 1375 | 2500 | pF |
| Output Capacitance           | C <sub>OSS</sub>    |                                                                       |  | 370  | 700  |    |
| Reverse Transfer Capacitance | C <sub>RSS</sub>    |                                                                       |  | 160  | 300  |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 32 V, I <sub>D</sub> = 30 A |  | 45   |      | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |                                                                       |  | 2.0  |      |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |                                                                       |  | 5.4  |      |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |                                                                       |  | 20   |      |    |

### SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 10 V (Note 3)

|                     |                     |                                                                                               |  |     |  |    |
|---------------------|---------------------|-----------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | t <sub>d(ON)</sub>  | V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 32 V, I <sub>D</sub> = 30 A, R <sub>G</sub> = 2.5 Ω |  | 7.2 |  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                               |  | 57  |  |    |
| Turn-Off Delay Time | t <sub>d(OFF)</sub> |                                                                                               |  | 30  |  |    |
| Fall Time           | t <sub>f</sub>      |                                                                                               |  | 67  |  |    |

### SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 5 V (Note 3)

|                     |                     |                                                                                                |  |     |  |    |
|---------------------|---------------------|------------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | t <sub>d(ON)</sub>  | V <sub>GS</sub> = 5.0 V, V <sub>DD</sub> = 20 V, I <sub>D</sub> = 30 A, R <sub>G</sub> = 2.5 Ω |  | 15  |  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                                |  | 147 |  |    |
| Turn-Off Delay Time | t <sub>d(OFF)</sub> |                                                                                                |  | 20  |  |    |
| Fall Time           | t <sub>f</sub>      |                                                                                                |  | 29  |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |                 |                                                                                  |                        |  |      |     |    |
|-------------------------|-----------------|----------------------------------------------------------------------------------|------------------------|--|------|-----|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V,<br>I <sub>S</sub> = 10 A                                  | T <sub>J</sub> = 25°C  |  | 0.82 | 1.1 | V  |
|                         |                 |                                                                                  | T <sub>J</sub> = 125°C |  | 0.67 |     |    |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI <sub>SD</sub> /dt = 100 A/μs,<br>I <sub>S</sub> = 10 A |                        |  | 46   |     | ns |
| Charge Time             | t <sub>a</sub>  |                                                                                  |                        |  | 24   |     |    |
| Discharge Time          | t <sub>b</sub>  |                                                                                  |                        |  | 22   |     |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |                                                                                  |                        |  |      | 65  |    |

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 PERFORMANCE CURVES

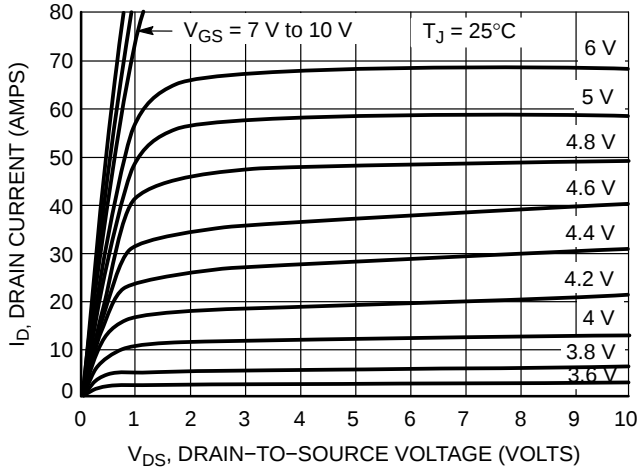


Figure 1. On-Region Characteristics

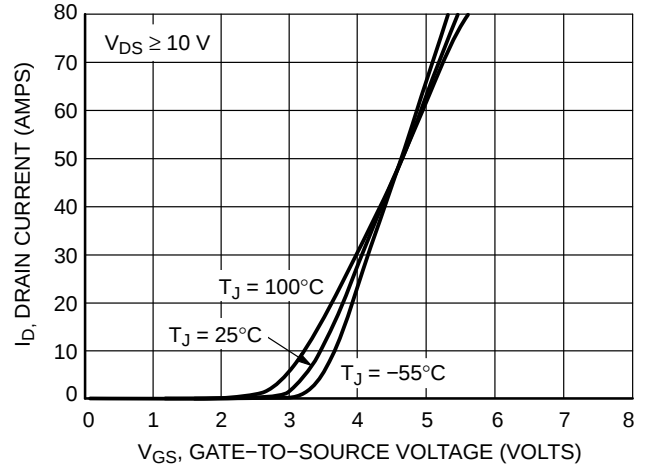


Figure 2. Transfer Characteristics

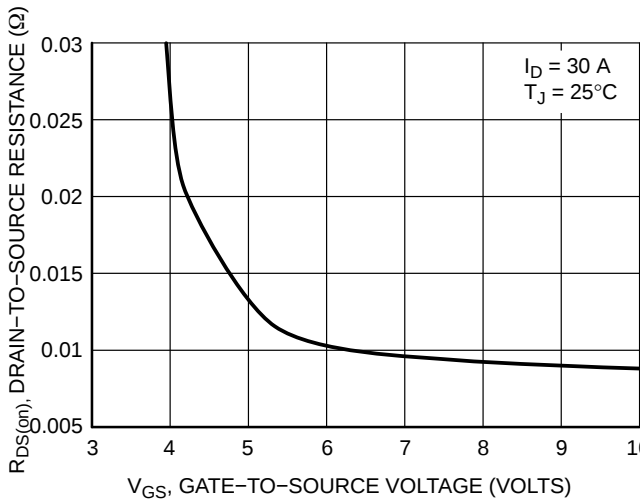


Figure 3. On-Resistance vs. Gate-to-Source Voltage

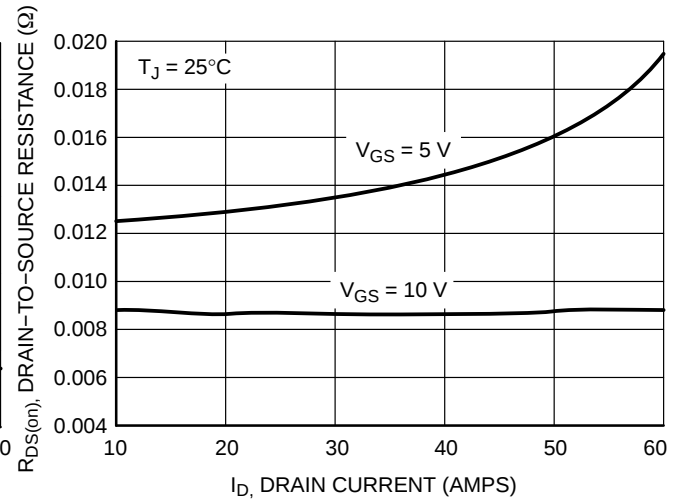


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

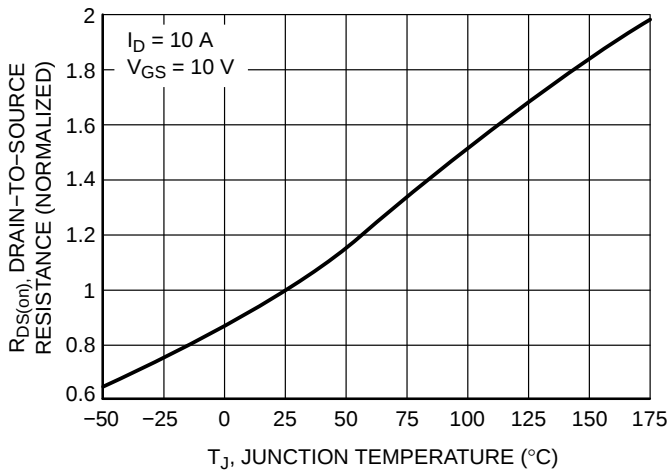


Figure 5. On-Resistance Variation with Temperature

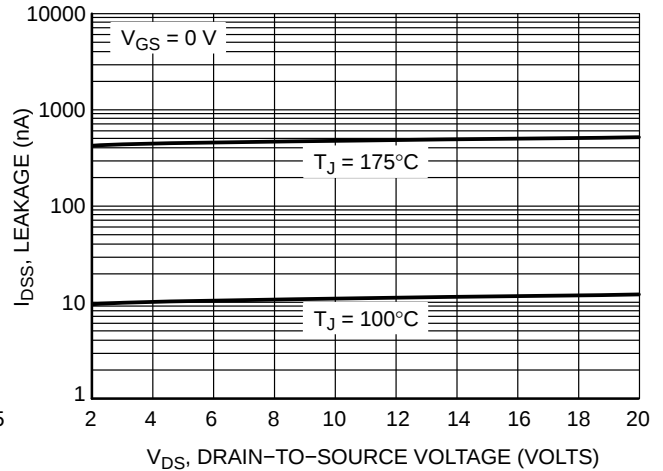


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

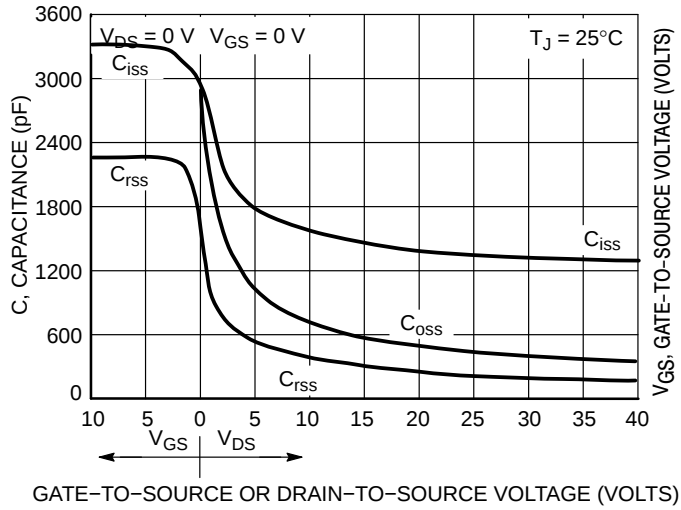


Figure 7. Capacitance Variation

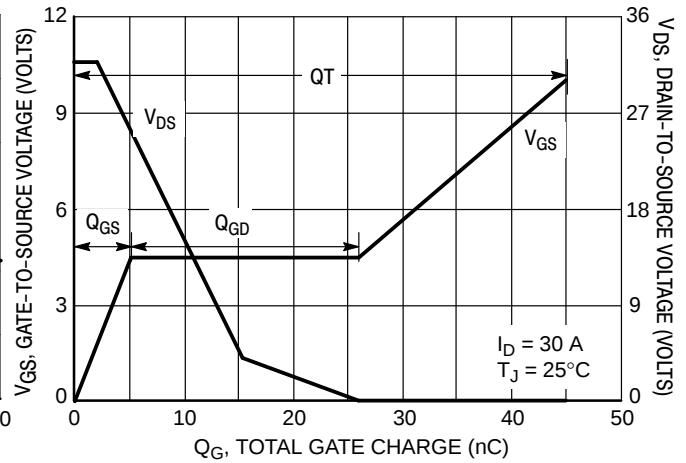


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

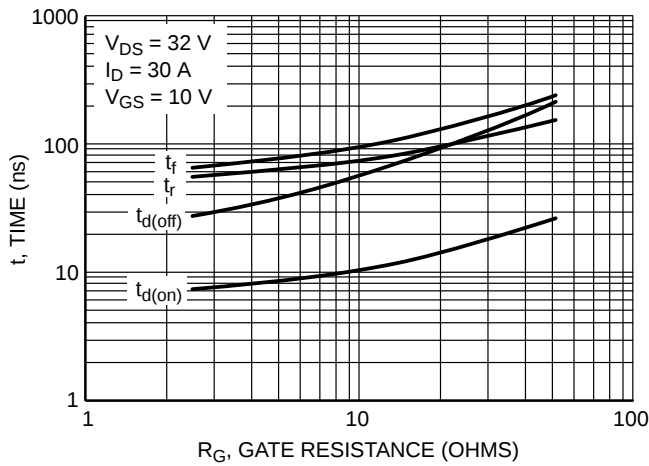


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

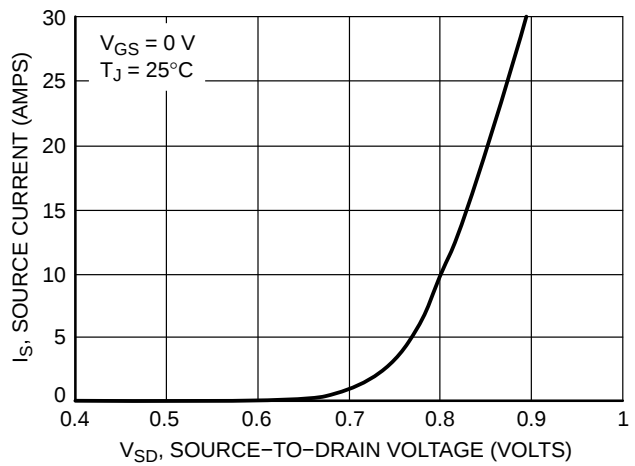


Figure 10. Diode Forward Voltage vs. Current

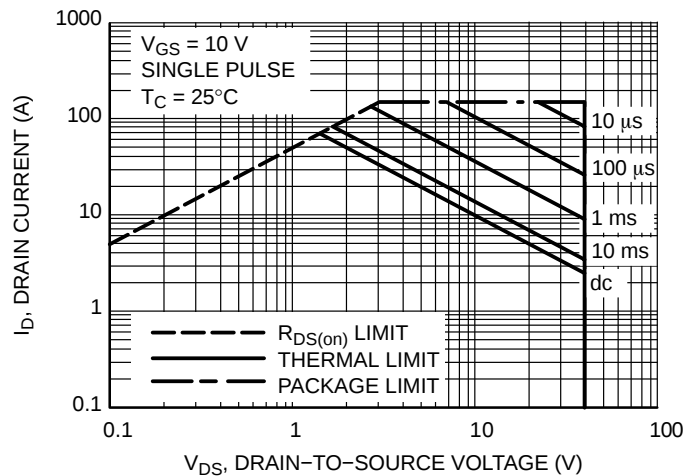


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# NTD5406N, STD5406N

## TYPICAL PERFORMANCE CURVES

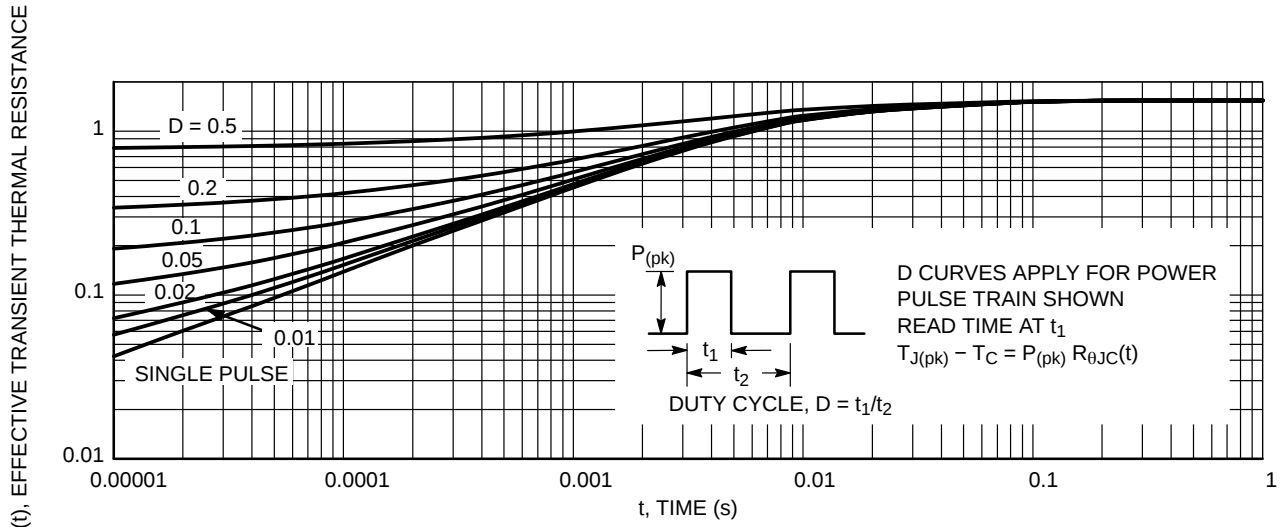
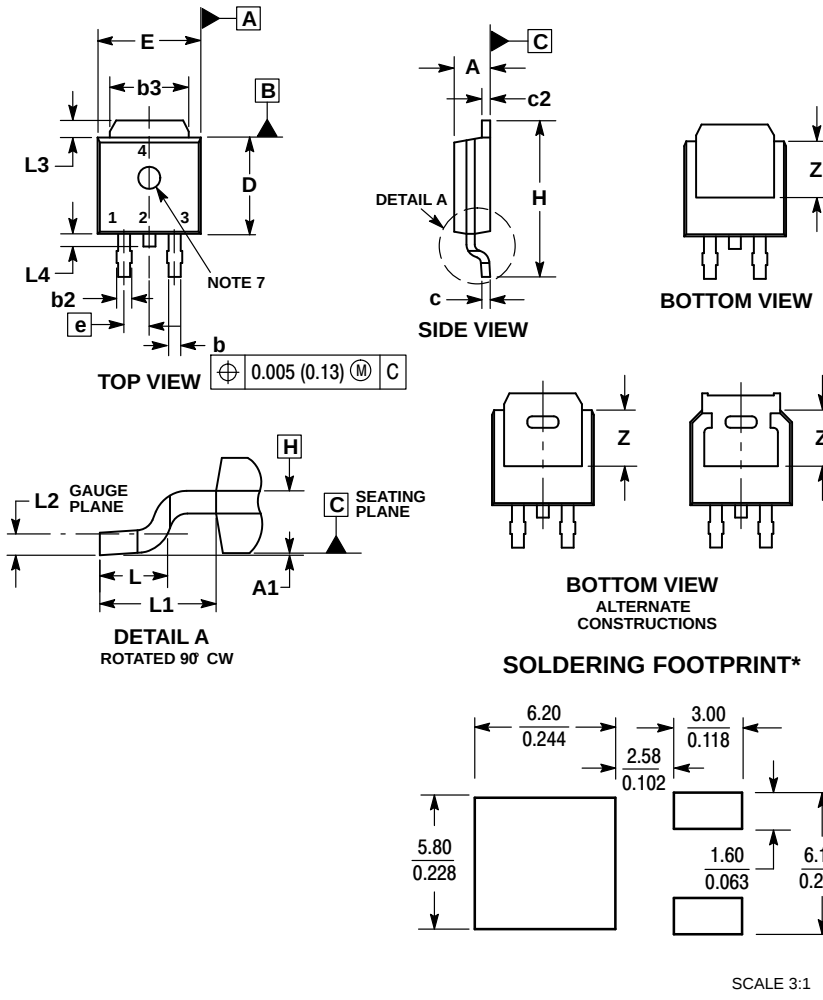


Figure 12. Thermal Response

# NTD5406N, STD5406N

## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369C ISSUE F



#### 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.
7. OPTIONAL MOLD FEATURE.

| 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  | 0.028  | 0.045 | 0.72        | 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  | 0.114  | REF   | 2.90        | 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        | ---   |

#### 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.

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