

# NTB45N06L, NTB45N06L

## **MOSFET** – Power, N-Channel, Logic Level, D<sup>2</sup>PAK

**45 A, 60 V, 28 mΩ**

Designed for low voltage, high speed switching applications in power supplies, converters and power motor controls and bridge circuits.

### Features

- Higher Current Rating
- Lower  $R_{DS(on)}$
- Lower  $V_{DS(on)}$
- Lower Capacitances
- Lower Total Gate Charge
- Tighter  $V_{SD}$  Specification
- Lower Diode Reverse Recovery Time
- Lower Reverse Recovery Stored Charge
- AEC-Q101 Qualified and PPAP Capable – NTB45N06L
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

- Power Supplies
- Converters
- Power Motor Controls
- Bridge Circuits

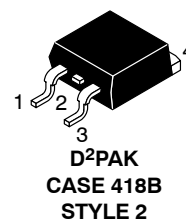
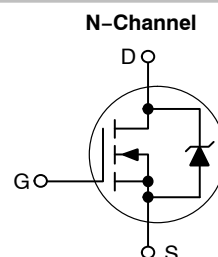


**ON Semiconductor®**

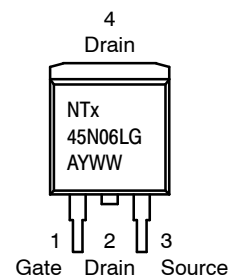
<http://onsemi.com>

**45 AMPERES, 60 VOLTS**

**$R_{DS(on)} = 28\text{ m}\Omega$**



### MARKING DIAGRAM & PIN ASSIGNMENT1



NTx45N06L = Device Code  
x = B or P  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# NTB45N06L, NTB45N06L

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

| Rating                                                                                                                                                                                                                            | Symbol                                                   | Value                     | Unit                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------|---------------------|
| Drain-to-Source Voltage                                                                                                                                                                                                           | V <sub>DSS</sub>                                         | 60                        | Vdc                 |
| Drain-to-Gate Voltage (R <sub>GS</sub> = 10 MΩ)                                                                                                                                                                                   | V <sub>DGR</sub>                                         | 60                        | Vdc                 |
| Gate-to-Source Voltage<br>– Continuous<br>– Non-Repetitive (t <sub>p</sub> ≤ 10 ms)                                                                                                                                               | V <sub>GS</sub><br>V <sub>GS</sub>                       | ± 15<br>± 20              | Vdc                 |
| Drain Current<br>– Continuous @ T <sub>A</sub> = 25°C<br>– Continuous @ T <sub>A</sub> = 100°C<br>– Single Pulse (t <sub>p</sub> ≤ 10 μs)                                                                                         | I <sub>D</sub><br>I <sub>D</sub><br>I <sub>DM</sub>      | 45<br>30<br>150           | Adc<br>Adc<br>Apk   |
| Total Power Dissipation @ T <sub>A</sub> = 25°C<br>Derate above 25°C<br>Total Power Dissipation @ T <sub>A</sub> = 25°C (Note 1)<br>Total Power Dissipation @ T <sub>A</sub> = 25°C (Note 2)                                      | P <sub>D</sub>                                           | 125<br>0.83<br>3.2<br>2.4 | W<br>W/°C<br>W<br>W |
| Operating and Storage Temperature Range                                                                                                                                                                                           | T <sub>J</sub> , T <sub>stg</sub>                        | –55 to +175               | °C                  |
| Single Pulse Drain-to-Source Avalanche Energy – Starting T <sub>J</sub> = 25°C<br>(V <sub>DD</sub> = 50 Vdc, V <sub>GS</sub> = 5.0 Vdc, L = 0.3 mH<br>I <sub>L(pk)</sub> = 40 A, V <sub>DS</sub> = 60 Vdc, R <sub>G</sub> = 25 Ω) | E <sub>AS</sub>                                          | 240                       | mJ                  |
| Thermal Resistance<br>– Junction-to-Case<br>– Junction-to-Ambient (Note 1)<br>– Junction-to-Ambient (Note 2)                                                                                                                      | R <sub>θJC</sub><br>R <sub>θJA</sub><br>R <sub>θJA</sub> | 1.2<br>46.8<br>63.2       | °C/W                |
| Maximum Lead Temperature for Soldering Purposes, 1/8 in from case for 10 seconds                                                                                                                                                  | T <sub>L</sub>                                           | 260                       | °C                  |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. When surface mounted to an FR4 board using 1" pad size, (Cu Area 1.127 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size, (Cu Area 0.412 in<sup>2</sup>).

## ORDERING INFORMATION

| Device        | Package                         | Shipping <sup>†</sup> |
|---------------|---------------------------------|-----------------------|
| NTB45N06LG    | D <sup>2</sup> PAK<br>(Pb-Free) | 50 Units / Rail       |
| NTB45N06LT4G  | D <sup>2</sup> PAK<br>(Pb-Free) | 800 / Tape & Reel     |
| NTBV45N06LT4G | D <sup>2</sup> PAK<br>(Pb-Free) | 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.

# NTB45N06L, NTB45N06L

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

| Characteristic                                                                                                                                                        | Symbol               | Min     | Typ        | Max       | Unit         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------|------------|-----------|--------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                            |                      |         |            |           |              |
| Drain-to-Source Breakdown Voltage (Note 3)<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc)<br>Temperature Coefficient (Positive)                              | V <sub>(BR)DSS</sub> | 60<br>– | 67<br>67.2 | –<br>–    | Vdc<br>mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = 60 Vdc, V <sub>GS</sub> = 0 Vdc)<br>(V <sub>DS</sub> = 60 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C) | I <sub>DSS</sub>     | –<br>–  | –<br>–     | 1.0<br>10 | μAdc         |
| Gate-Body Leakage Current (V <sub>GS</sub> = ±15 Vdc, V <sub>DS</sub> = 0 Vdc)                                                                                        | I <sub>GSS</sub>     | –       | –          | ±100      | nAdc         |

## ON CHARACTERISTICS (Note 4)

|                                                                                                                                                                                      |                     |          |              |           |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------|--------------|-----------|--------------|
| Gate Threshold Voltage (Note 4)<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc)<br>Threshold Temperature Coefficient (Negative)                                   | V <sub>GS(th)</sub> | 1.0<br>– | 1.8<br>4.7   | 2.0<br>–  | Vdc<br>mV/°C |
| Static Drain-to-Source On-Resistance (Note 4)<br>(V <sub>GS</sub> = 5.0 Vdc, I <sub>D</sub> = 22.5 Adc)                                                                              | R <sub>DS(on)</sub> | –        | 23           | 28        | mΩ           |
| Static Drain-to-Source On-Voltage (Note 4)<br>(V <sub>GS</sub> = 5.0 Vdc, I <sub>D</sub> = 45 Adc)<br>(V <sub>GS</sub> = 5.0 Vdc, I <sub>D</sub> = 22.5 Adc, T <sub>J</sub> = 150°C) | V <sub>DS(on)</sub> | –<br>–   | 1.03<br>0.93 | 1.51<br>– | Vdc          |
| Forward Transconductance (Note 4) (V <sub>DS</sub> = 8.0 Vdc, I <sub>D</sub> = 12 Adc)                                                                                               | g <sub>FS</sub>     | –        | 22.8         | –         | mhos         |

## DYNAMIC CHARACTERISTICS

|                      |                                                                     |                  |   |      |      |    |
|----------------------|---------------------------------------------------------------------|------------------|---|------|------|----|
| Input Capacitance    | (V <sub>DS</sub> = 25 Vdc, V <sub>GS</sub> = 0 Vdc,<br>f = 1.0 MHz) | C <sub>iss</sub> | – | 1212 | 1700 | pF |
| Output Capacitance   |                                                                     | C <sub>oss</sub> | – | 352  | 480  |    |
| Transfer Capacitance |                                                                     | C <sub>rss</sub> | – | 90   | 180  |    |

## SWITCHING CHARACTERISTICS (Note 5)

|                     |                                                                                                                    |                     |   |      |     |    |
|---------------------|--------------------------------------------------------------------------------------------------------------------|---------------------|---|------|-----|----|
| Turn-On Delay Time  | (V <sub>DD</sub> = 30 Vdc, I <sub>D</sub> = 45 Adc,<br>V <sub>GS</sub> = 5.0 Vdc, R <sub>G</sub> = 9.1 Ω) (Note 4) | t <sub>d(on)</sub>  | – | 13   | 30  | ns |
| Rise Time           |                                                                                                                    | t <sub>r</sub>      | – | 341  | 680 |    |
| Turn-Off Delay Time |                                                                                                                    | t <sub>d(off)</sub> | – | 36   | 75  |    |
| Fall Time           |                                                                                                                    | t <sub>f</sub>      | – | 158  | 320 |    |
| Gate Charge         | (V <sub>DS</sub> = 48 Vdc, I <sub>D</sub> = 45 Adc,<br>V <sub>GS</sub> = 5.0 Vdc) (Note 4)                         | Q <sub>T</sub>      | – | 23   | 32  | nC |
|                     |                                                                                                                    | Q <sub>1</sub>      | – | 4.6  | –   |    |
|                     |                                                                                                                    | Q <sub>2</sub>      | – | 14.1 | –   |    |

## SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                           |                 |        |              |           |     |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|--------------|-----------|-----|
| Forward On-Voltage             | (I <sub>S</sub> = 45 Adc, V <sub>GS</sub> = 0 Vdc) (Note 4)<br>(I <sub>S</sub> = 45 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C) | V <sub>SD</sub> | –<br>– | 1.01<br>0.92 | 1.15<br>– | Vdc |
| Reverse Recovery Time          | (I <sub>S</sub> = 45 Adc, V <sub>GS</sub> = 0 Vdc,<br>dI <sub>S</sub> /dt = 100 A/μs) (Note 4)                                            | t <sub>rr</sub> | –      | 56           | –         | ns  |
|                                |                                                                                                                                           | t <sub>a</sub>  | –      | 30           | –         |     |
|                                |                                                                                                                                           | t <sub>b</sub>  | –      | 26           | –         |     |
| Reverse Recovery Stored Charge |                                                                                                                                           | Q <sub>RR</sub> | –      | 0.09         | –         | μC  |

3. When surface mounted to an FR4 board using the minimum recommended pad size, (Cu Area 0.412 in<sup>2</sup>).

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

5. Switching characteristics are independent of operating junction temperatures.

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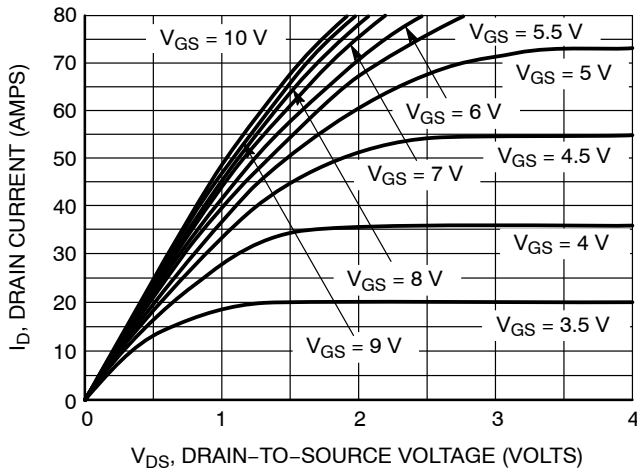


Figure 1. On-Region Characteristics

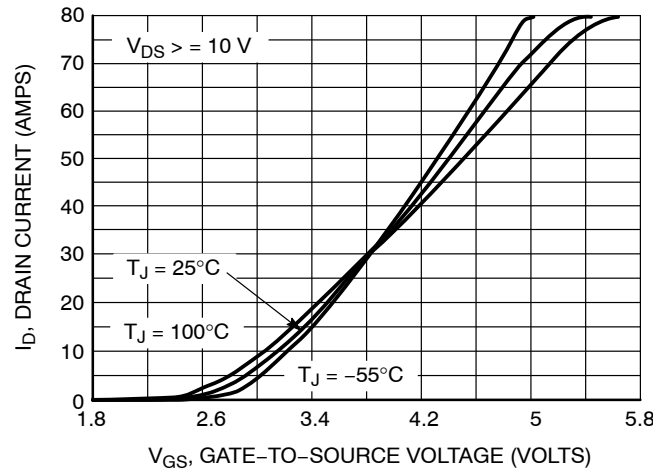


Figure 2. Transfer Characteristics

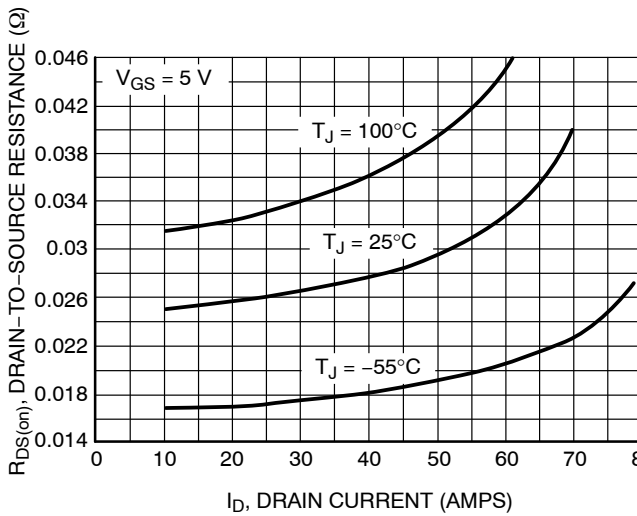


Figure 3. On-Resistance vs. Gate-to-Source Voltage

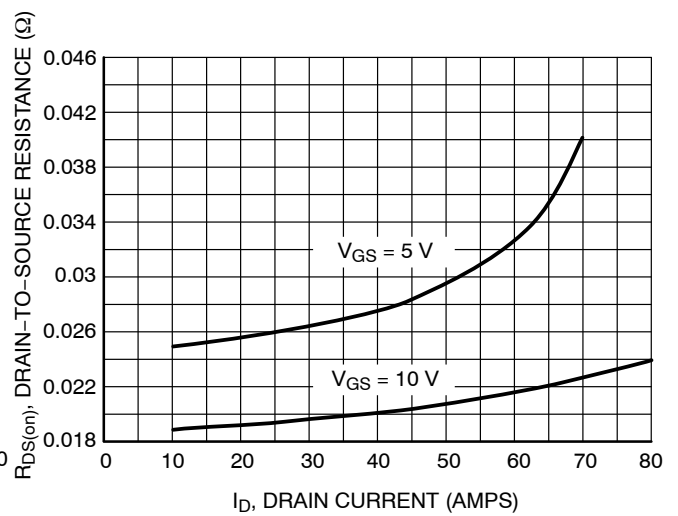


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

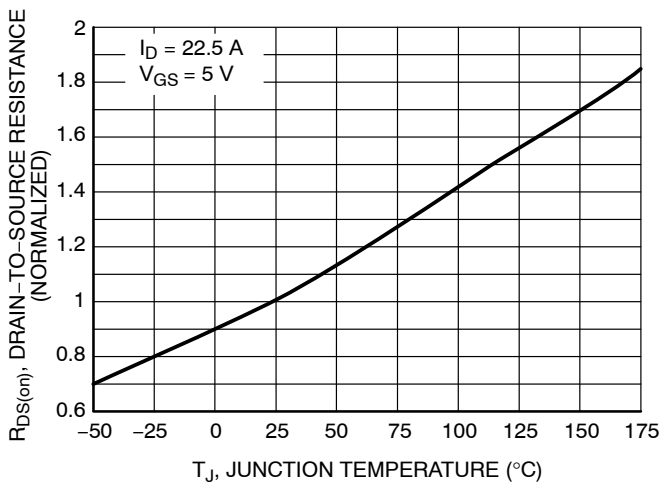


Figure 5. On-Resistance Variation with Temperature

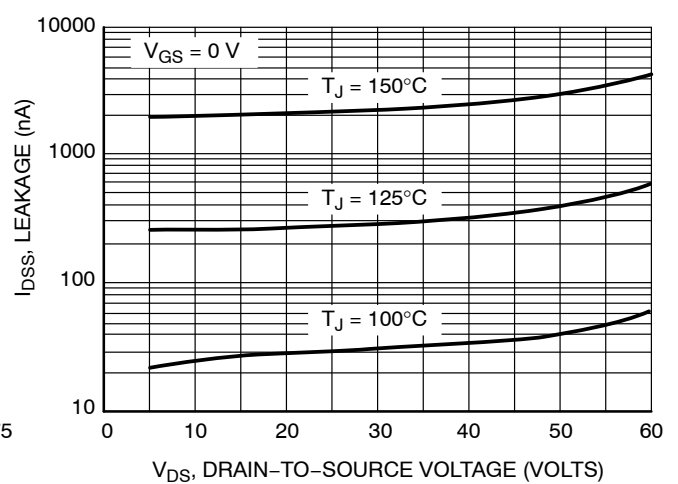
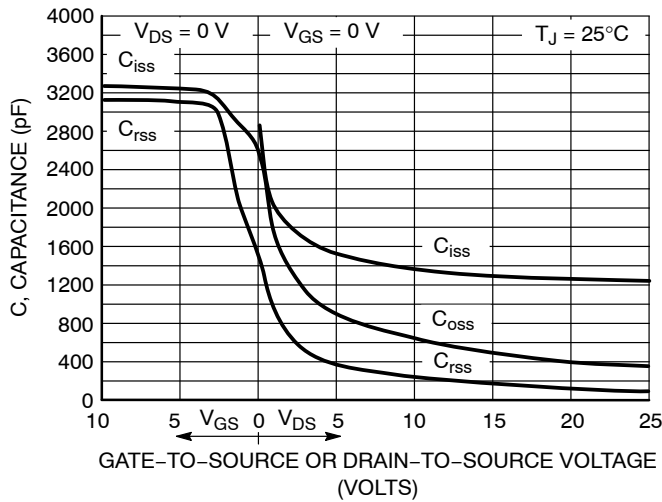
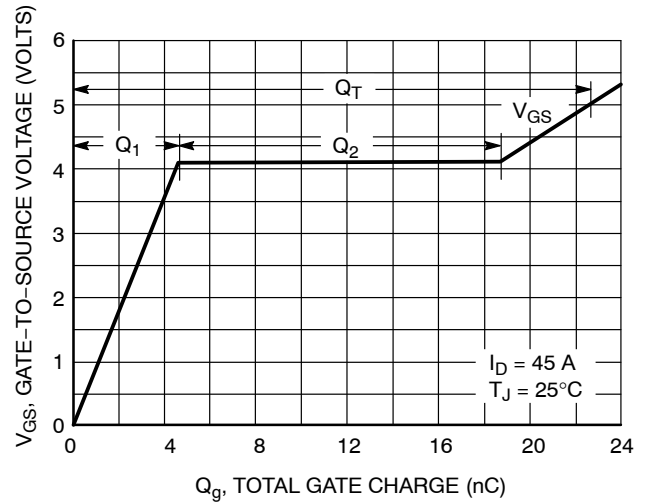


Figure 6. Drain-to-Source Leakage Current vs. Voltage

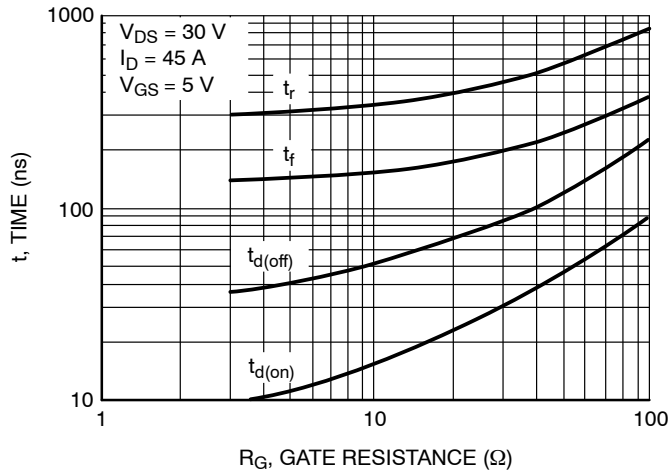
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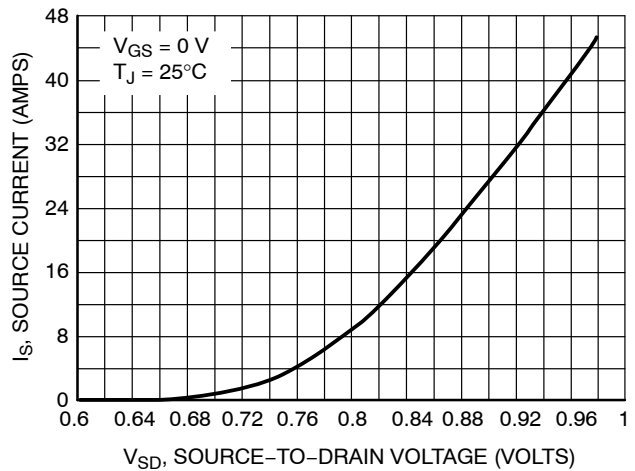
**Figure 7. Capacitance Variation**



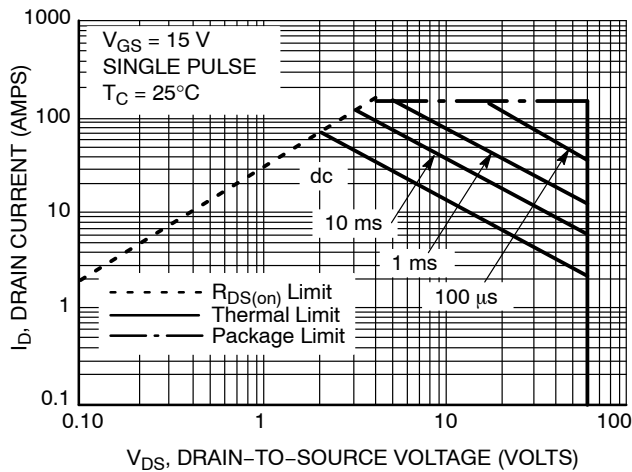
**Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



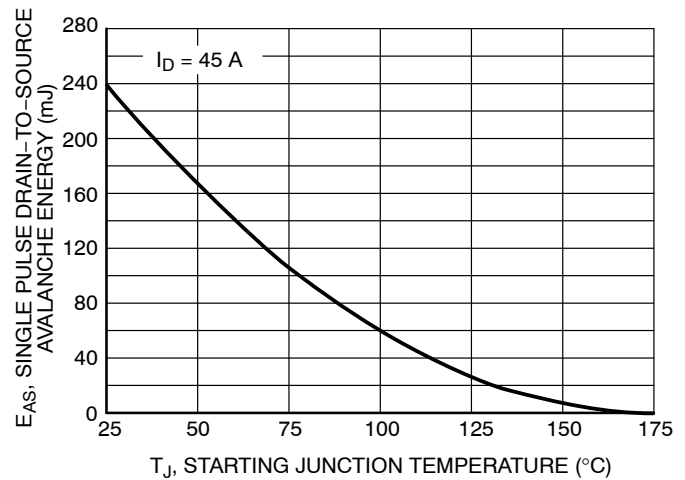
**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**



**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**

# NTB45N06L, NTB45N06L

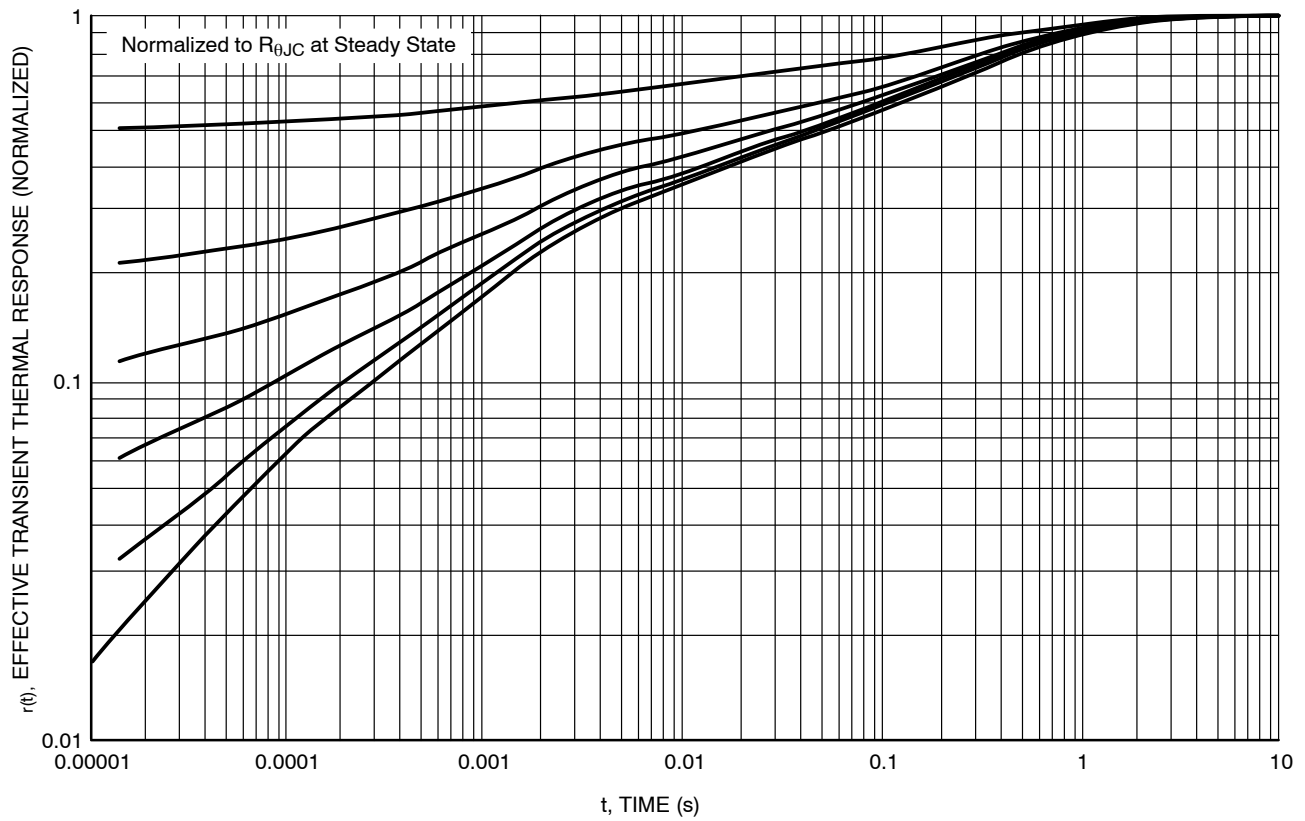


Figure 13. Thermal Response

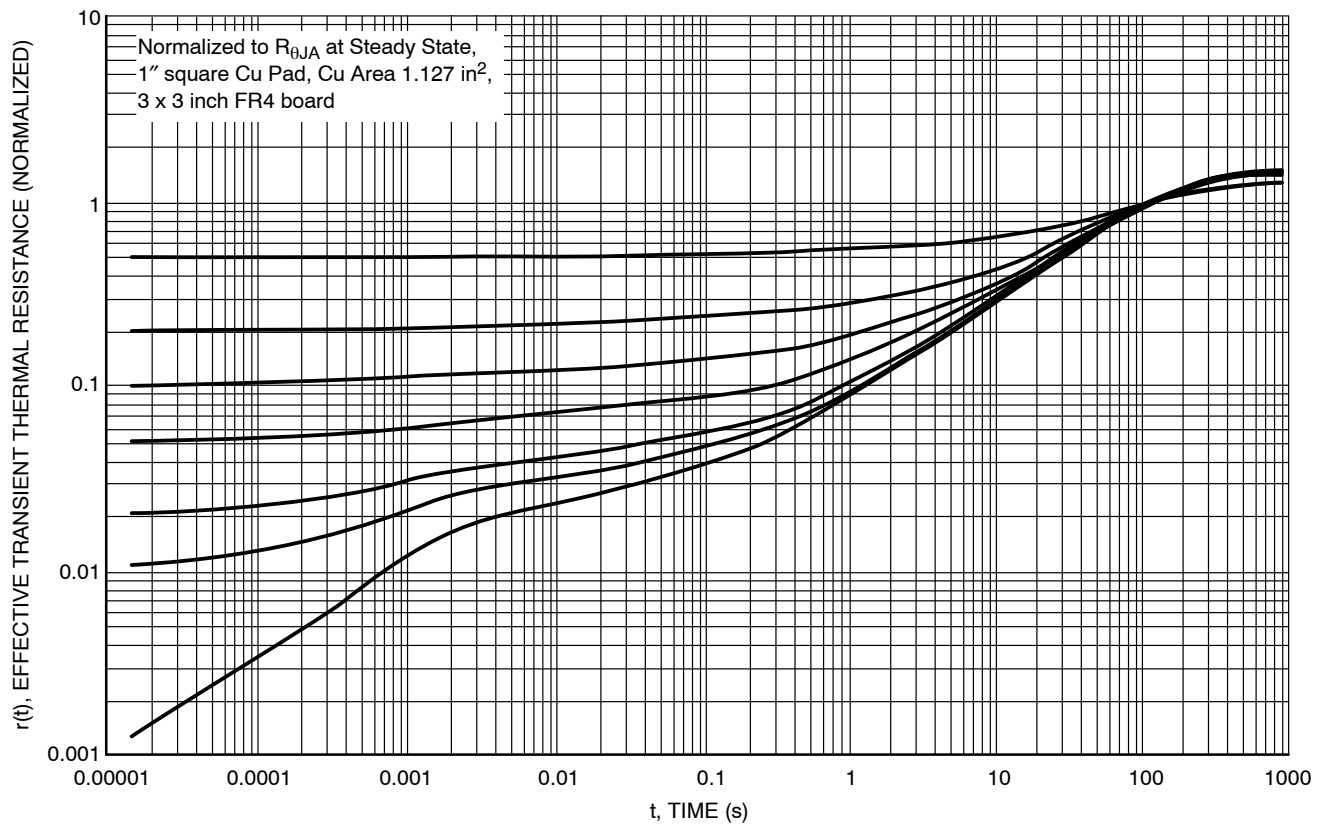
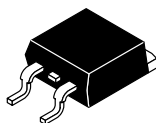


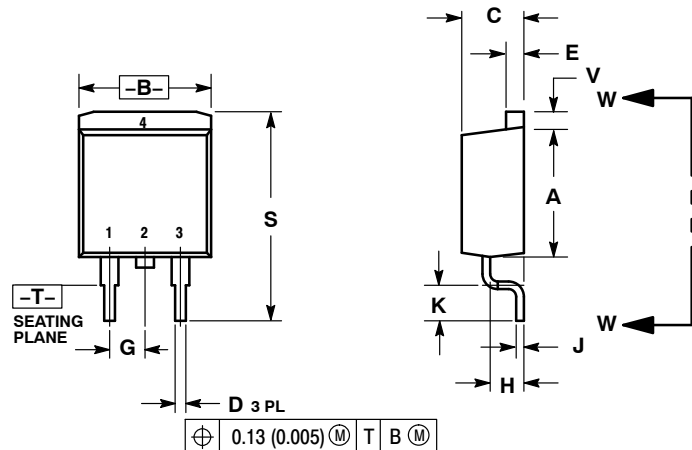
Figure 14. Thermal Response



D<sup>2</sup>PAK 3  
CASE 418B-04  
ISSUE L

DATE 17 FEB 2015

SCALE 1:1

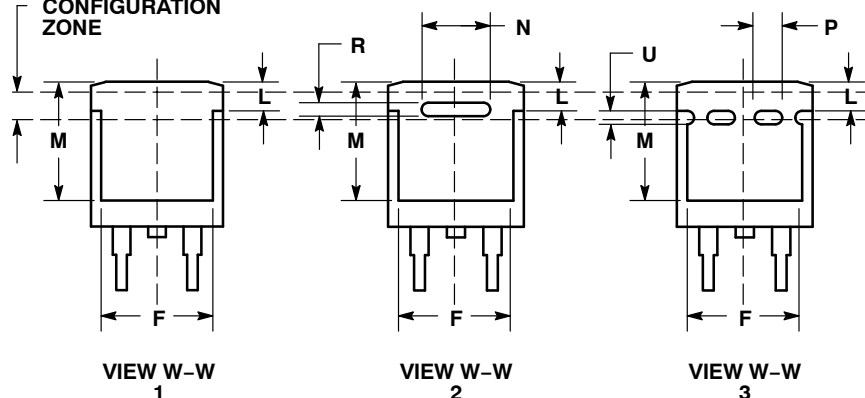


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.340  | 0.380 | 8.64        | 9.65  |
| B   | 0.380  | 0.405 | 9.65        | 10.29 |
| C   | 0.160  | 0.190 | 4.06        | 4.83  |
| D   | 0.020  | 0.035 | 0.51        | 0.89  |
| E   | 0.045  | 0.055 | 1.14        | 1.40  |
| F   | 0.310  | 0.350 | 7.87        | 8.89  |
| G   | 0.100  | BSC   | 2.54        | BSC   |
| H   | 0.080  | 0.110 | 2.03        | 2.79  |
| J   | 0.018  | 0.025 | 0.46        | 0.64  |
| K   | 0.090  | 0.110 | 2.29        | 2.79  |
| L   | 0.052  | 0.072 | 1.32        | 1.83  |
| M   | 0.280  | 0.320 | 7.11        | 8.13  |
| N   | 0.197  | REF   | 5.00        | REF   |
| P   | 0.079  | REF   | 2.00        | REF   |
| R   | 0.039  | REF   | 0.99        | REF   |
| S   | 0.575  | 0.625 | 14.60       | 15.88 |
| V   | 0.045  | 0.055 | 1.14        | 1.40  |

VARIABLE  
CONFIGURATION  
ZONE



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. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

STYLE 5:

- PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. ANODE

STYLE 6:

- PIN 1. NO CONNECT  
2. CATHODE  
3. ANODE  
4. CATHODE

MARKING INFORMATION AND FOOTPRINT ON PAGE 2

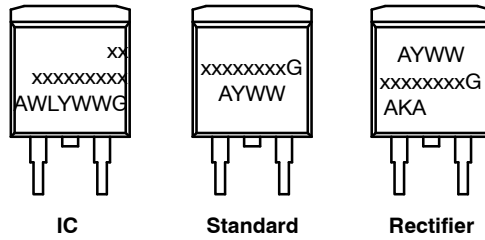
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**D<sup>2</sup>PAK 3**  
CASE 418B-04  
ISSUE L

DATE 17 FEB 2015

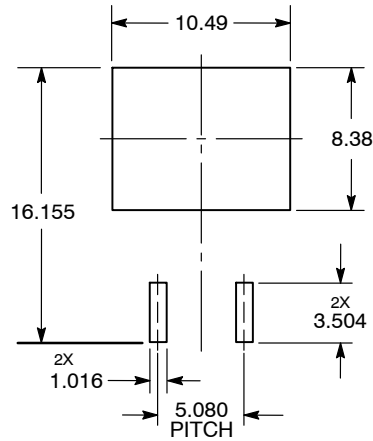
**GENERIC  
MARKING DIAGRAM\***



xx = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package  
AKA = Polarity Indicator

\*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. Some products may not follow the Generic Marking.

**SOLDERING FOOTPRINT\***



DIMENSIONS: MILLIMETERS

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

|                         |                           |                                                                                                                                                                                     |
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