

# NTB25P06, NVB25P06

## MOSFET – P-Channel, D<sup>2</sup>PAK -60 V, -27.5 A

Designed for low voltage, high speed switching applications and to withstand high energy in the avalanche and commutation modes.

### Features

- AEC Q101 Qualified – NVB25P06
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

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

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

| Rating  | Symbol                            | Value       | Unit            |
|---|-----------------------------------|-------------|-----------------|
| Drain-to-Source Voltage   | V <sub>DSS</sub>                  | -60         | V               |
| Gate-to-Source Voltage  | V <sub>GS</sub>                   | ± 15        | V               |
| – Continuous  | V <sub>GS</sub>                   | ± 15        | V               |
| – Non-Repetitive (t <sub>p</sub> ≤ 10 μs)   | V <sub>GSM</sub>                  | ± 20        | V <sub>pk</sub> |
| Drain Current   | I <sub>D</sub>                    | 27.5        | A               |
| – Continuous @ T <sub>A</sub> = 25°C  | I <sub>DM</sub>                   | 80          | A <sub>pk</sub> |
| – Single Pulse (t <sub>p</sub> ≤ 10 μs)   |                                   |             |                 |
| Total Power Dissipation @ T <sub>A</sub> = 25°C   | P <sub>D</sub>                    | 120         | 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 (V <sub>DD</sub> = 25 V, V <sub>GS</sub> = 10 V, I <sub>L(pk)</sub> = 20 A, L = 3 mH, R <sub>G</sub> = 25 Ω) | E <sub>AS</sub>                   | 600         | mJ              |
| Thermal Resistance  |                                   |             | °C/W            |
| – Junction-to-Case  | R <sub>θJC</sub>                  | 1.25        |                 |
| – Junction-to-Ambient (Note 1)  | R <sub>θJA</sub>                  | 46.8        |                 |
| – Junction-to-Ambient (Note 2)  | R <sub>θJA</sub>                  | 63.2        |                 |
| Maximum Lead Temperature for Soldering Purposes, (1/8" from case for 10 s)  | 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.

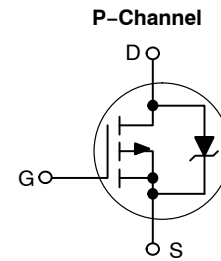
1. When surface mounted to an FR4 board using 1" pad size (Cu Area 1.127 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size (Cu Area 0.412 in<sup>2</sup>).



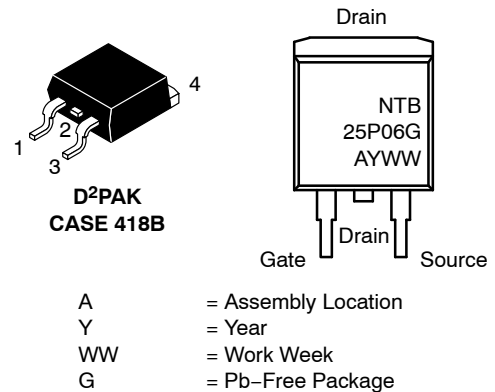
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| V <sub>(BR)DSS</sub> | R <sub>DS(on)</sub> TYP | I <sub>D</sub> MAX |
|----------------------|-------------------------|--------------------|
| -60 V                | 65 mΩ @ -10 V           | -27.5 A            |



### MARKING DIAGRAM & PIN ASSIGNMENT



### ORDERING INFORMATION

| Device      | Package                      | Shipping†         |
|-------------|------------------------------|-------------------|
| NTB25P06T4G | D <sup>2</sup> PAK (Pb-Free) | 800 / Tape & Reel |
| NVB25P06T4G | D <sup>2</sup> PAK (Pb-Free) | 800 / Tape & Reel |

†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.

# NTB25P06, NVB25P06

## ELECTRICAL CHARACTERISTICS (T<sub>C</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 V, I <sub>D</sub> = -250 μA)<br>(Positive Temperature Coefficient)  | V <sub>(BR)DSS</sub> | -60<br>- | -<br>64 | -<br>-      | V<br>mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -60 V, T <sub>J</sub> = 25°C)<br>(V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -60 V, T <sub>J</sub> = 150°C) | I <sub>DSS</sub>     | -<br>-   | -<br>-  | -10<br>-100 | μA         |
| Gate-Body Leakage Current (V <sub>GS</sub> = ±15 V, V <sub>DS</sub> = 0 V)   | I <sub>GSS</sub>     | -        | -       | ±100        | nA         |

## ON CHARACTERISTICS (Note 3)

|   |                     |           |                |                |            |
|---|---------------------|-----------|----------------|----------------|------------|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA)<br>(Negative Threshold Temperature Coefficient)            | V <sub>GS(th)</sub> | -2.0<br>- | -2.8<br>6.2    | -4.0<br>-      | V<br>mV/°C |
| Static Drain-Source On-State Resistance<br>(V <sub>GS</sub> = -10 V, I <sub>D</sub> = -12.5 A)<br>(V <sub>GS</sub> = -10 V, I <sub>D</sub> = -25 A) | R <sub>DS(on)</sub> | -<br>-    | 0.065<br>0.070 | 0.075<br>0.082 | Ω          |
| Forward Transconductance<br>(V <sub>DS</sub> = -10 V, I <sub>D</sub> = -12.5 A)   | g <sub>FS</sub>     | -         | 13             | -              | Mhos       |

## DYNAMIC CHARACTERISTICS

|                              |  |                  |   |      |      |    |
|------------------------------|--|------------------|---|------|------|----|
| Input Capacitance            | (V <sub>DS</sub> = -25 V, V <sub>GS</sub> = 0 V,<br>F = 1.0 MHz) | C <sub>iss</sub> | - | 1200 | 1680 | pF |
| Output Capacitance           |  | C <sub>oss</sub> | - | 345  | 480  |    |
| Reverse Transfer Capacitance |  | C <sub>rss</sub> | - | 90   | 180  |    |

## SWITCHING CHARACTERISTICS (Notes 3 & 4)

|                     |  |                     |   |     |     |    |
|---------------------|--|---------------------|---|-----|-----|----|
| Turn-On Delay Time  | (V <sub>DD</sub> = -30 V, I <sub>D</sub> = -25 A,<br>V <sub>GS</sub> = -10 V R <sub>G</sub> = 9.1 Ω) | t <sub>d(on)</sub>  | - | 14  | 24  | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 72  | 118 | ns |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 43  | 68  | ns |
| Fall Time           |  | t <sub>f</sub>      | - | 190 | 320 | ns |
| Gate Charge         | (V <sub>DS</sub> = -48 V, I <sub>D</sub> = -25 A,<br>V <sub>GS</sub> = -10 V)                        | Q <sub>T</sub>      | - | 33  | 50  | nC |
|                     |  | Q <sub>1</sub>      | - | 6.5 | -   |    |
|                     |  | Q <sub>2</sub>      | - | 15  | -   |    |

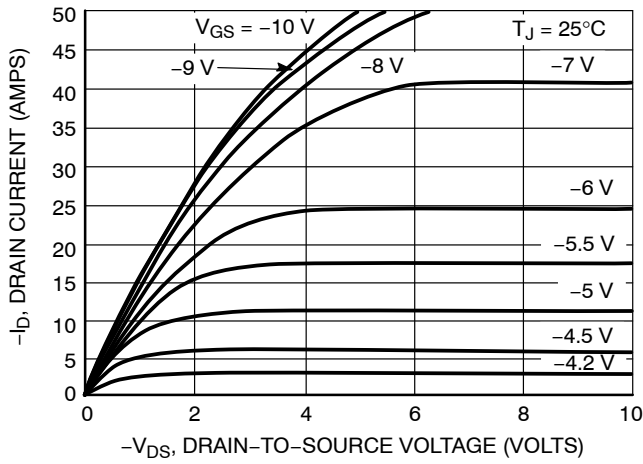
## BODY-DRAIN DIODE RATINGS (Note 3)

|  |                 |        |              |           |    |
|--|-----------------|--------|--------------|-----------|----|
| Diode Forward On-Voltage<br>(I <sub>S</sub> = -25 A, V <sub>GS</sub> = 0 V)<br>(I <sub>S</sub> = -25 A, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C) | V <sub>SD</sub> | -<br>- | -1.8<br>-1.4 | -2.5<br>- | V  |
| Reverse Recovery Time  | t <sub>rr</sub> | -      | 70           | -         | ns |
|  | t <sub>a</sub>  | -      | 50           | -         |    |
|  | t <sub>b</sub>  | -      | 20           | -         |    |
| Reverse Recovery Stored Charge   | Q <sub>RR</sub> | -      | 0.2          | -         | μC |

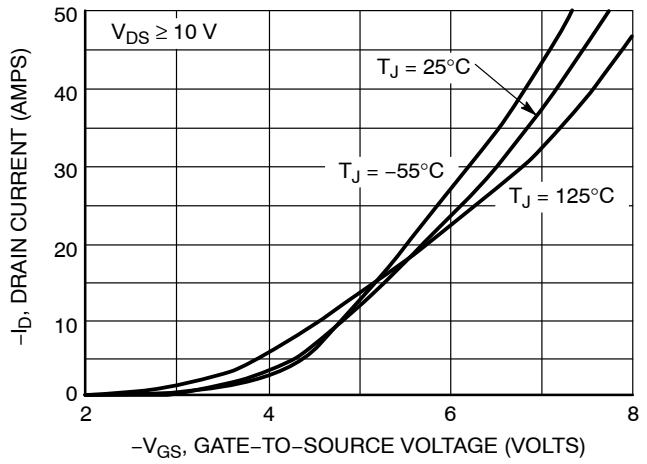
3. Indicates Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

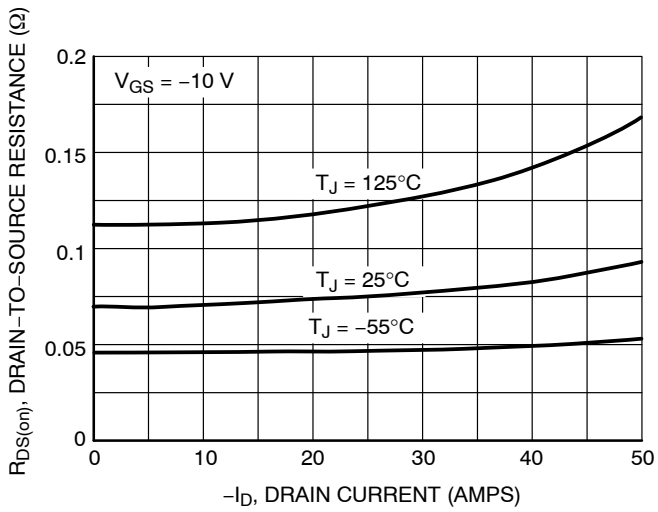
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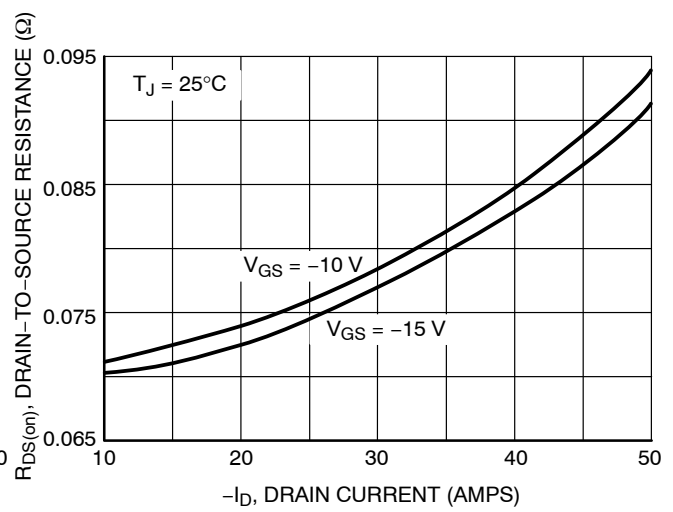
**Figure 1. On-Region Characteristics**



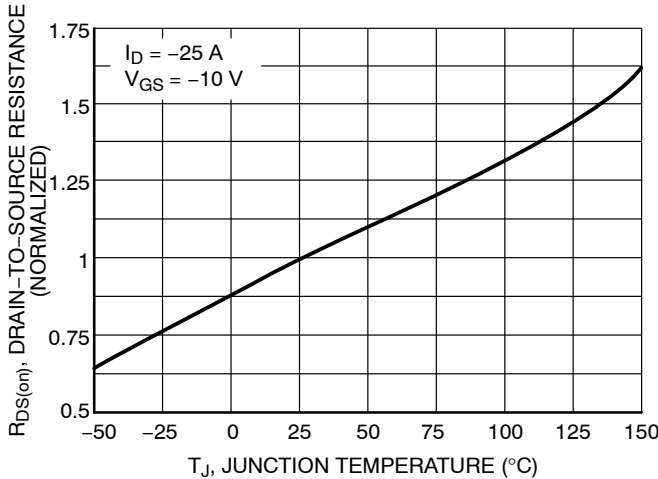
**Figure 2. Transfer Characteristics**



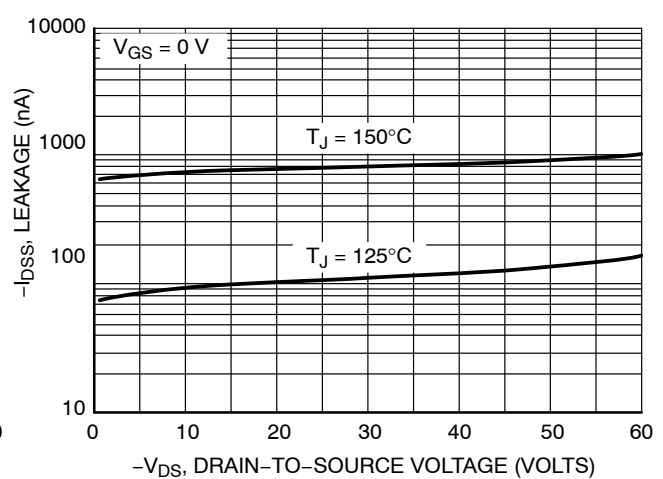
**Figure 3. On-Resistance vs. Drain Current and Temperature**



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

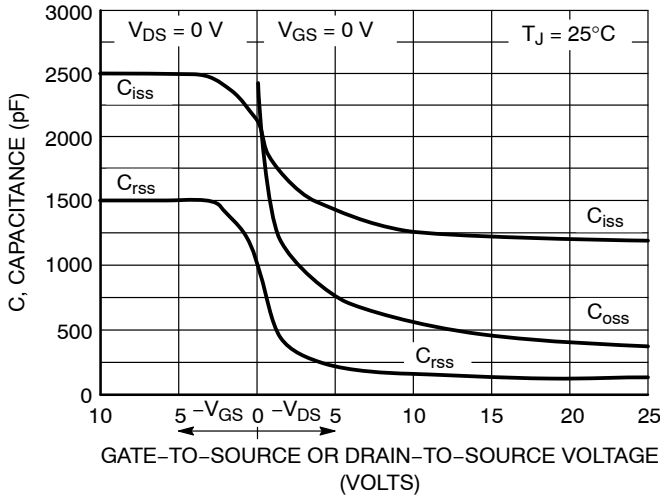


**Figure 5. On-Resistance Variation with Temperature**

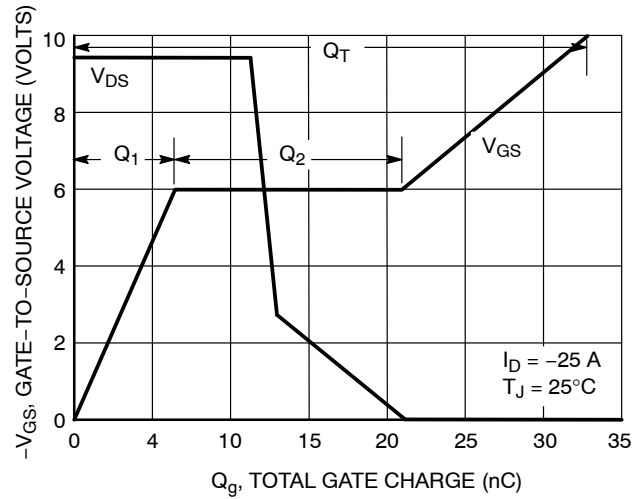


**Figure 6. Drain-to-Source Leakage Current vs. Voltage**

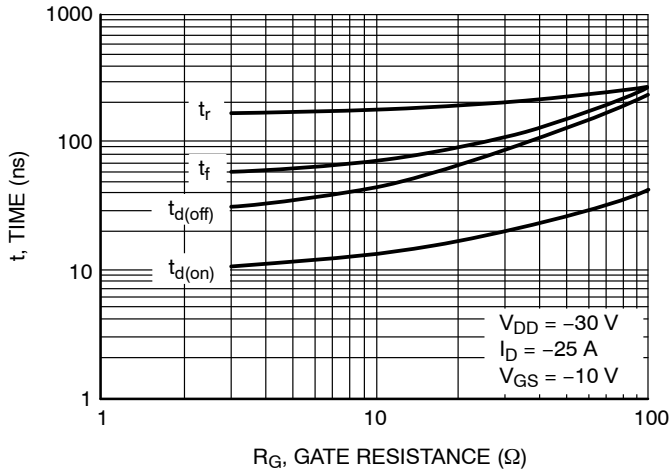
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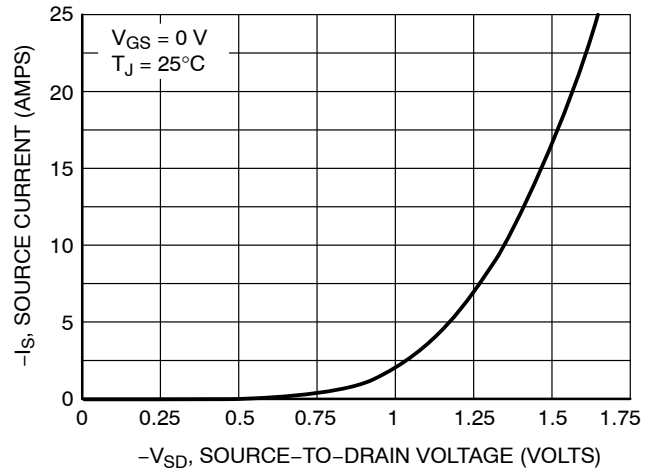
**Figure 7. Capacitance Variation**



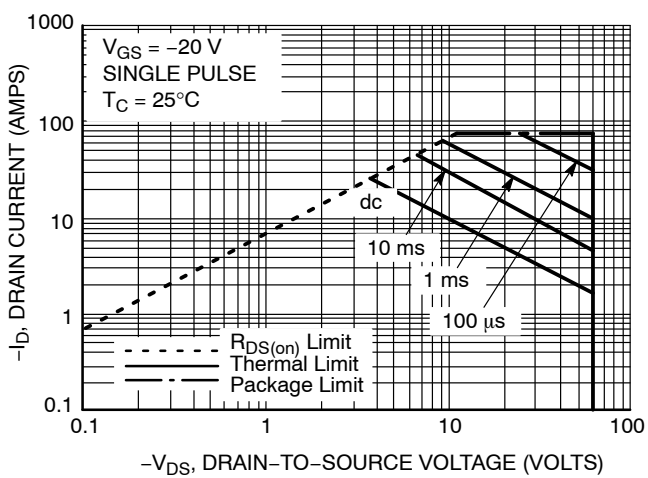
**Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



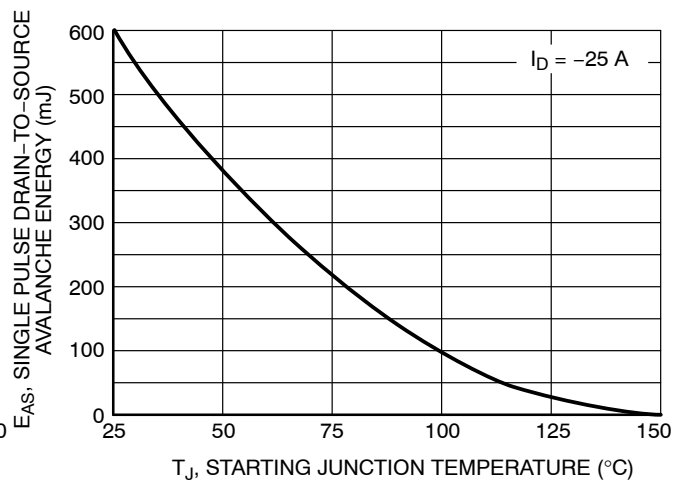
**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**



**Figure 10. Diode Forward Voltage vs. Current**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

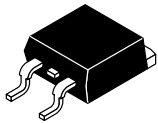


**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

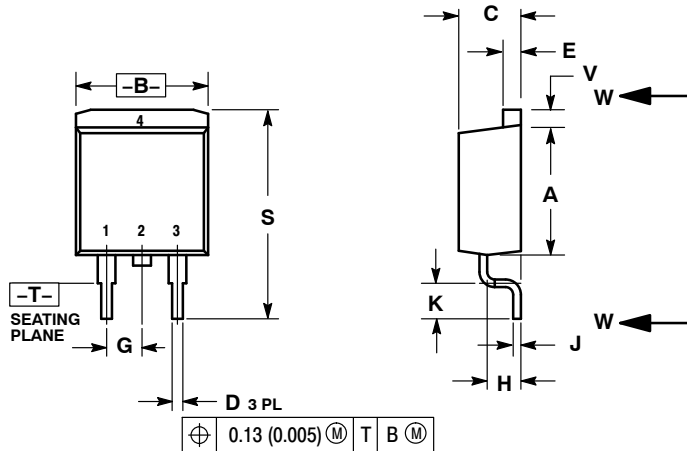
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**D<sup>2</sup>PAK 3**  
CASE 418B-04  
ISSUE L

DATE 17 FEB 2015

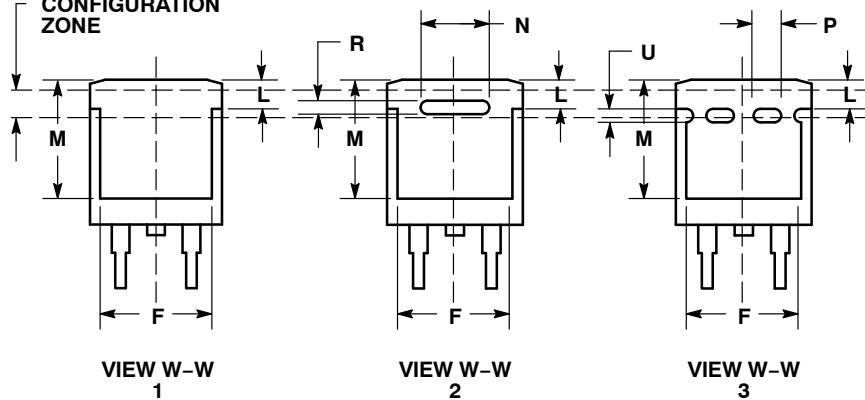
SCALE 1:1



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.
  - 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:<br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | STYLE 2:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN | STYLE 3:<br>PIN 1. ANODE<br>2. CATHODE<br>3. ANODE<br>4. CATHODE | STYLE 4:<br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | STYLE 5:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. ANODE | STYLE 6:<br>PIN 1. NO CONNECT<br>2. CATHODE<br>3. ANODE<br>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.

**SOLDERING FOOTPRINT\***



\*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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