

# NID5001N

## Self-Protected FET with Temperature and Current Limit

HDPlus devices are an advanced series of power MOSFETs which utilize ON Semiconductor's latest MOSFET technology process to achieve the lowest possible on-resistance per silicon area while incorporating smart features. Integrated thermal and current limits work together to provide short circuit protection. The devices feature an integrated Drain-to-Gate Clamp that enables them to withstand high energy in the avalanche mode. The Clamp also provides additional safety margin against unexpected voltage transients. Electrostatic Discharge (ESD) protection is provided by an integrated Gate-to-Source Clamp.

### Features

- Low  $R_{DS(on)}$
- Current Limitation
- Thermal Shutdown with Automatic Restart
- Short Circuit Protection
- $I_{DSS}$  Specified at Elevated Temperature
- Avalanche Energy Specified
- Slew Rate Control for Low Noise Switching
- Overvoltage Clamped Protection
- Pb-Free Package is Available

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

| Rating  | Symbol  | Value              | Unit               |
|---|---|--------------------|--------------------|
| Drain-to-Source Voltage Internally Clamped  | $V_{DSS}$   | 42                 | Vdc                |
| Drain-to-Gate Voltage Internally Clamped ( $R_{GS} = 1.0 \text{ M}\Omega$ )   | $V_{DGR}$   | 42                 | Vdc                |
| Gate-to-Source Voltage  | $V_{GS}$  | $\pm 14$           | Vdc                |
| Drain Current - Continuous  | $I_D$   | Internally Limited |                    |
| Total Power Dissipation<br>@ $T_A = 25^\circ\text{C}$ (Note 1)<br>@ $T_A = 25^\circ\text{C}$ (Note 1)<br>@ $T_A = 25^\circ\text{C}$ (Note 2)  | $P_D$   | 64<br>1.0<br>1.56  | W                  |
| Thermal Resistance, Junction-to-Case<br>Junction-to-Ambient (Note 1)<br>Junction-to-Ambient (Note 2)  | $R_{\theta JC}$<br>$R_{\theta JA}$<br>$R_{\theta JA}$ | 1.95<br>120<br>80  | $^\circ\text{C/W}$ |
| Single Pulse Drain-to-Source Avalanche Energy<br>( $V_{DD} = 25 \text{ Vdc}$ , $V_{GS} = 5.0 \text{ Vdc}$ ,<br>$I_L = 4.5 \text{ Apk}$ , $L = 120 \text{ mH}$ , $R_G = 25 \Omega$ ) | $E_{AS}$  | 1215               | mJ                 |
| Operating and Storage Temperature Range   | $T_J, T_{stg}$  | -55 to 150         | $^\circ\text{C}$   |

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. Minimum FR4 PCB, steady state.
2. Mounted onto a 2" square FR4 board (1" square, 2 oz. Cu 0.06" thick single-sided,  $t = \text{steady state}$ ).

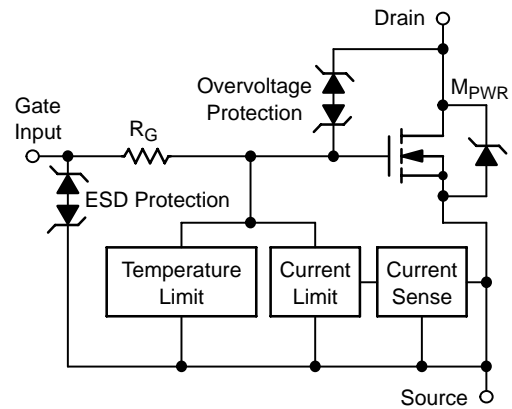


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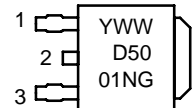
| $V_{DSS}$ (Clamped) | $R_{DS(on)}$ TYP     | $I_D$ MAX (Limited) |
|---------------------|----------------------|---------------------|
| 42 V                | 23 m $\Omega$ @ 10 V | 33 A*               |

\*Max current may be limited below this value depending on input conditions.



DPAK  
CASE 369C  
STYLE 2

### MARKING DIAGRAM



Y = Year  
WW = Work Week  
D5001N = Device Code  
G = Pb-Free Package

1 = Gate  
2 = Drain  
3 = Source

### ORDERING INFORMATION

| Device      | Package        | Shipping†        |
|-------------|----------------|------------------|
| NID5001NT4  | DPAK           | 2500/Tape & Reel |
| NID5001NT4G | 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 Specification Brochure, BRD8011/D.

# NID5001N

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|   |                      |          |            |          |      |
|---|----------------------|----------|------------|----------|------|
| Drain-to-Source Clamped Breakdown Voltage<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc)<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc, T <sub>J</sub> = 150°C) | V <sub>(BR)DSS</sub> | 42<br>42 | 46<br>44   | 50<br>50 | Vdc  |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = 32 Vdc, V <sub>GS</sub> = 0 Vdc)<br>(V <sub>DS</sub> = 32 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C)             | I <sub>DSS</sub>     |          | 1.5<br>6.5 | 5.0      | μAdc |
| Gate Input Current<br>(V <sub>GS</sub> = 5.0 Vdc, V <sub>DS</sub> = 0 Vdc)  | I <sub>GSSF</sub>    |          | 50         | 100      | μAdc |

### ON CHARACTERISTICS

|  |                     |     |            |          |               |
|--|---------------------|-----|------------|----------|---------------|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.2 mAdc)<br>Threshold Temperature Coefficient   | V <sub>GS(th)</sub> | 1.0 | 1.8<br>5.0 | 2.0      | Vdc<br>-mV/°C |
| Static Drain-to-Source On-Resistance (Note 3)<br>(V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 5.0 Adc, T <sub>J</sub> @ 25°C)<br>(V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 5.0 Adc, T <sub>J</sub> @ 150°C)   | R <sub>DS(on)</sub> |     | 23<br>43   | 29<br>55 | mΩ            |
| Static Drain-to-Source On-Resistance (Note 3)<br>(V <sub>GS</sub> = 5.0 Vdc, I <sub>D</sub> = 5.0 Adc, T <sub>J</sub> @ 25°C)<br>(V <sub>GS</sub> = 5.0 Vdc, I <sub>D</sub> = 5.0 Adc, T <sub>J</sub> @ 150°C) | R <sub>DS(on)</sub> |     | 28<br>50   | 34<br>60 | mΩ            |
| Source-Drain Forward On Voltage<br>(I <sub>S</sub> = 5 A, V <sub>GS</sub> = 0 V)   | V <sub>SD</sub>     |     | 0.80       | 1.1      | V             |

### SWITCHING CHARACTERISTICS

|               |   |                                     |      |    |      |
|---------------|---|-------------------------------------|------|----|------|
| Turn-on Time  | V <sub>GS</sub> = 5.0 Vdc, V <sub>DD</sub> = 25 Vdc<br>I <sub>D</sub> = 1.0 Adc, Ext R <sub>G</sub> = 2.5 Ω | T <sub>(on)</sub>                   | 32   | 40 | μs   |
| Turn-off Time |   | T <sub>(off)</sub>                  | 68   | 75 |      |
| Turn-on Time  | V <sub>GS</sub> = 10 Vdc, V <sub>DD</sub> = 25 Vdc,<br>I <sub>D</sub> = 1.0 Adc, Ext R <sub>G</sub> = 2.5 Ω | T <sub>(on)</sub>                   | 11   | 15 |      |
| Turn-off Time |   | T <sub>(off)</sub>                  | 86   | 95 |      |
| Slew Rate On  | R <sub>L</sub> = 4.7 Ω,<br>V <sub>in</sub> = 0 to 10 V, V <sub>DD</sub> = 12 V                              | -dV <sub>DS</sub> /dt <sub>on</sub> | 0.5  |    | V/μs |
| Slew-Rate Off | R <sub>L</sub> = 4.7 Ω,<br>V <sub>in</sub> = 10 to 0 V, V <sub>DD</sub> = 12 V                              | dV <sub>DS</sub> /dt <sub>off</sub> | 0.35 |    | V/μs |

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

|                                   |   |                       |          |          |          |     |
|-----------------------------------|---|-----------------------|----------|----------|----------|-----|
| Current Limit                     | (V <sub>GS</sub> = 5.0 Vdc)<br>V <sub>DS</sub> = 10 V (V <sub>GS</sub> = 5.0 Vdc, T <sub>J</sub> = 150°C) | I <sub>LIM</sub>      | 21<br>12 | 30<br>19 | 36<br>30 | Adc |
|                                   | (V <sub>GS</sub> = 10 Vdc)<br>V <sub>DS</sub> = 10 V (V <sub>GS</sub> = 10 Vdc, T <sub>J</sub> = 150°C)   |                       | 29<br>13 | 41<br>24 | 49<br>31 |     |
| Temperature Limit (Turn-off)      | V <sub>GS</sub> = 5.0 Vdc   | T <sub>LIM(off)</sub> | 150      | 175      | 200      | °C  |
| Temperature Limit (Circuit Reset) | V <sub>GS</sub> = 5.0 Vdc   | T <sub>LIM(on)</sub>  | 135      | 160      | 185      | °C  |
| Temperature Limit (Turn-off)      | V <sub>GS</sub> = 10 Vdc  | T <sub>LIM(off)</sub> | 150      | 165      | 185      | °C  |
| Temperature Limit (Circuit Reset) | V <sub>GS</sub> = 10 Vdc  | T <sub>LIM(on)</sub>  | 135      | 150      | 170      | °C  |

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

|   |     |             |  |  |   |
|---|-----|-------------|--|--|---|
| Electro-Static Discharge Capability<br>Human Body Model (HBM)<br>Machine Model (MM) | ESD | 4000<br>400 |  |  | V |
|---|-----|-------------|--|--|---|

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

TYPICAL PERFORMANCE CURVES

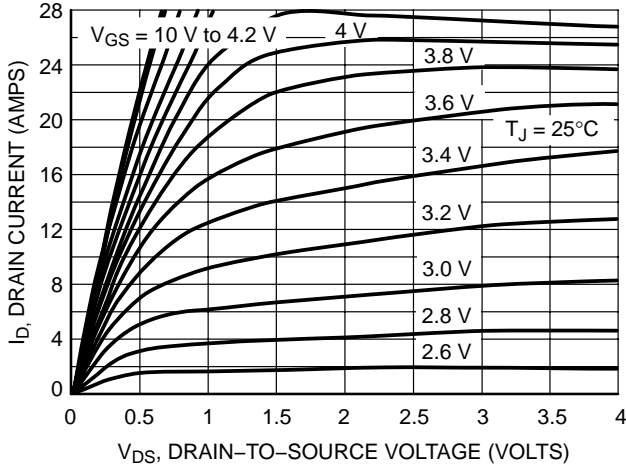


Figure 1. On-Region Characteristics

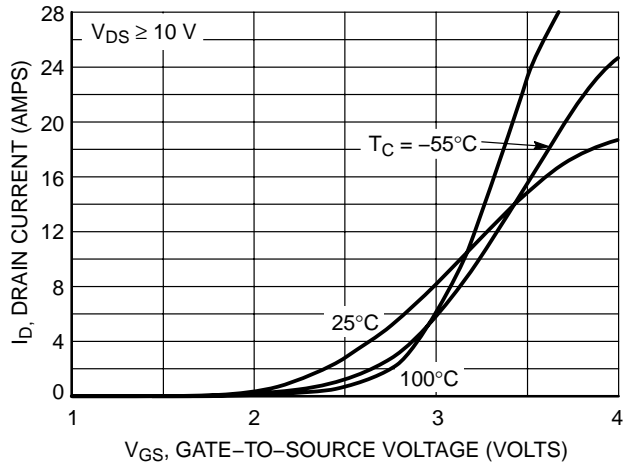


Figure 2. Transfer Characteristics

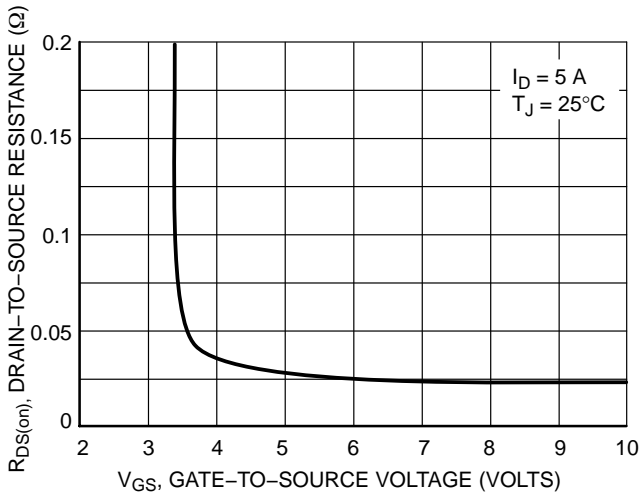


Figure 3. On-Resistance vs. Gate-to-Source Voltage

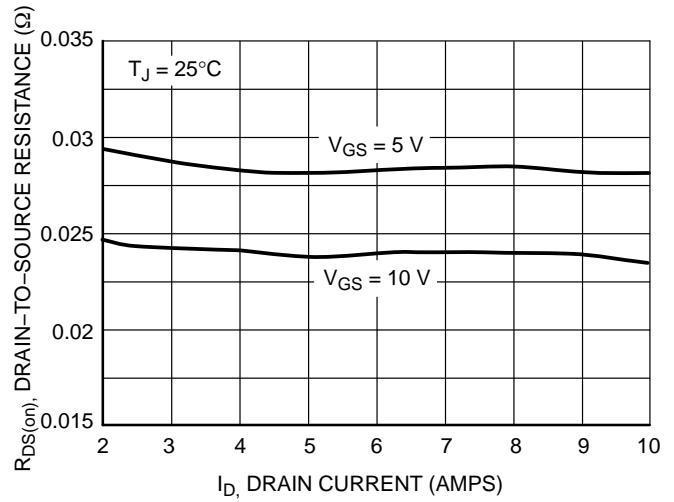


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

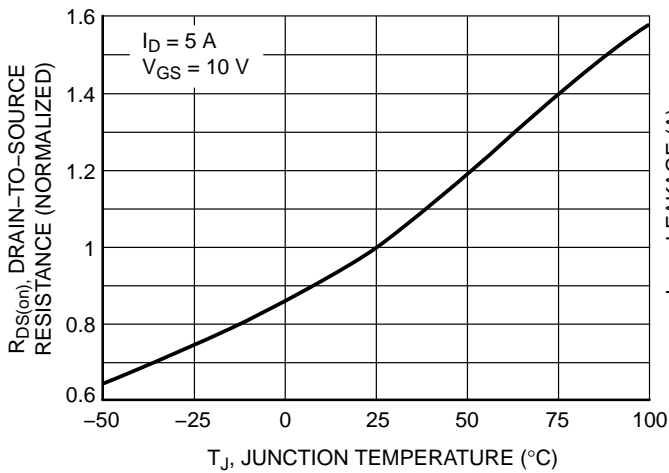


Figure 5. On-Resistance Variation with Temperature

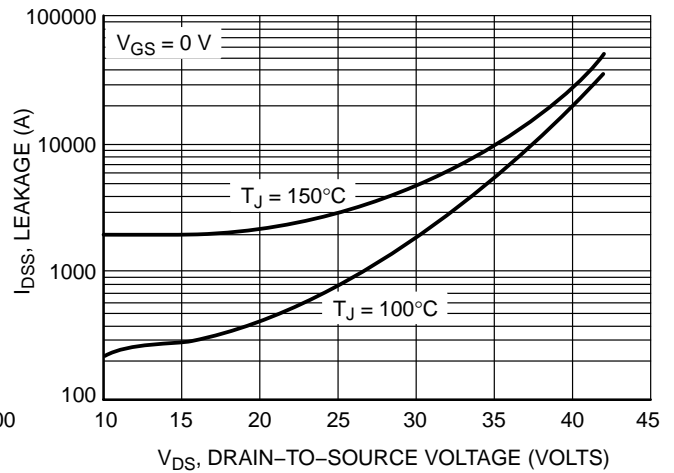


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL PERFORMANCE CURVES

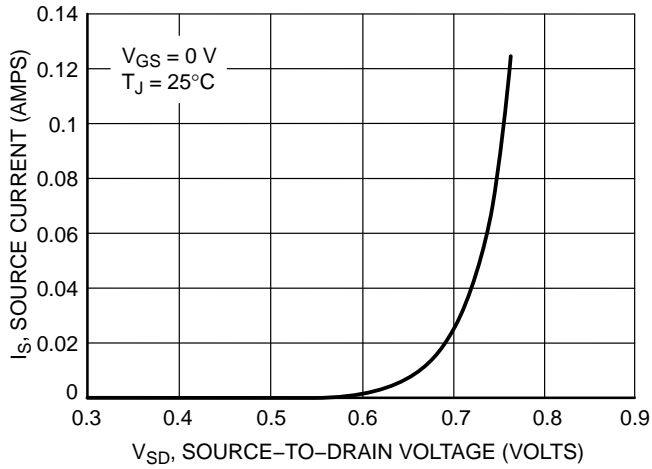


Figure 7. Diode Forward Voltage vs. Current

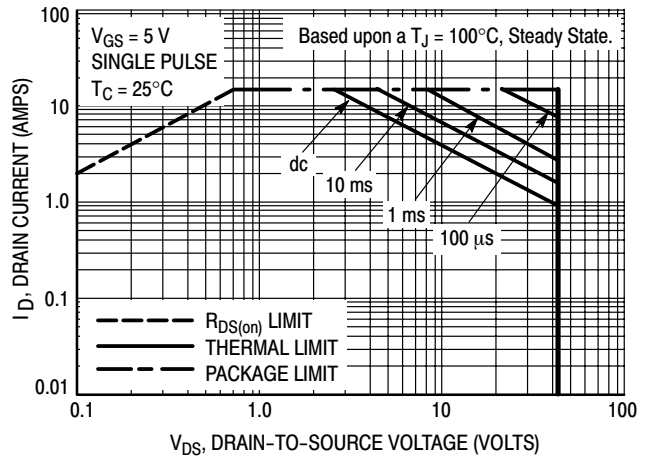
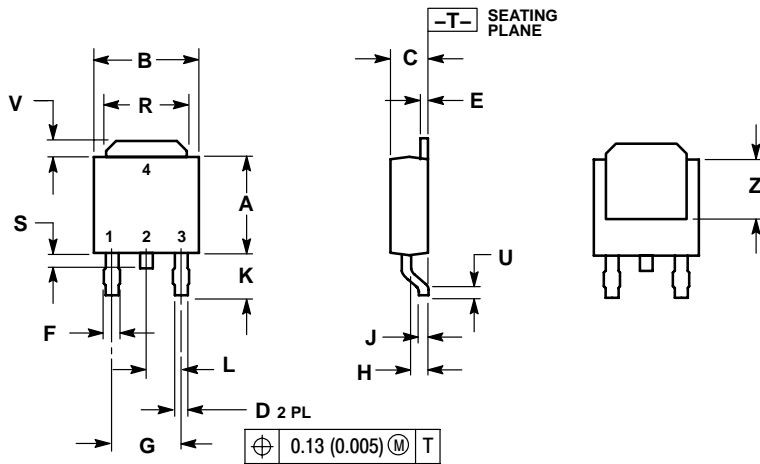


Figure 8. Maximum Rated Forward Biased Safe Operating Area

# NID5001N

## PACKAGE DIMENSIONS

DPAK  
CASE 369C-01  
ISSUE O

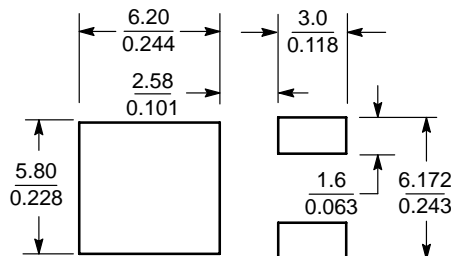


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.245 | 5.97        | 6.22 |
| 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   | 0.180 BSC |       | 4.58 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.102     | 0.114 | 2.60        | 2.89 |
| L   | 0.090 BSC |       | 2.29 BSC    |      |
| R   | 0.180     | 0.215 | 4.57        | 5.45 |
| S   | 0.025     | 0.040 | 0.63        | 1.01 |
| U   | 0.020     | ----  | 0.51        | ---- |
| 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

### SOLDERING FOOTPRINT\*



SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

\*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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