

# NDF11N50Z, NDP11N50Z

## N-Channel Power MOSFET 500 V, 0.52 $\Omega$

### Features

- Low ON Resistance
- Low Gate Charge
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

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

| Rating  | Symbol         | NDF11N50Z     | NDP11N50Z | Unit             |
|---|----------------|---------------|-----------|------------------|
| Drain-to-Source Voltage   | $V_{DSS}$      | 500           |           | V                |
| Continuous Drain Current, $R_{\theta JC}$   | $I_D$          | 10.5 (Note 2) | 10.5      | A                |
| Continuous Drain Current<br>$T_A = 100^\circ\text{C}$ , $R_{\theta JC}$   | $I_D$          | 6.7 (Note 2)  | 6.7       | A                |
| Pulsed Drain Current,<br>$V_{GS} @ 10\text{ V}$   | $I_{DM}$       | 42 (Note 2)   | 42        | A                |
| Power Dissipation, $R_{\theta JC}$<br>(Note 1)  | $P_D$          | 36            | 145       | W                |
| Gate-to-Source Voltage  | $V_{GS}$       | $\pm 30$      |           | V                |
| Single Pulse Avalanche<br>Energy, $I_D = 10.5\text{ A}$   | $E_{AS}$       | 190           |           | mJ               |
| ESD (HBM)<br>(JESD22-A114)  | $V_{esd}$      | 4000          |           | V                |
| RMS Isolation Voltage<br>( $t = 0.3\text{ sec.}$ , R.H. $\leq 30\%$ ,<br>$T_A = 25^\circ\text{C}$ ) (Figure 14) | $V_{ISO}$      | 4500          |           | V                |
| Peak Diode Recovery   | $dv/dt$        | 4.5 (Note 3)  |           | V/ns             |
| Continuous Source Current<br>(Body Diode)   | $I_S$          | 10.5          |           | A                |
| Maximum Temperature for<br>Soldering Leads  | $T_L$          | 260           |           | $^\circ\text{C}$ |
| Operating Junction and<br>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.

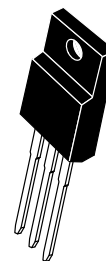
1. Surface mounted on FR4 board using 1" sq. pad size, (Cu area = 1.127 in sq [2 oz] including traces).
2. Limited by maximum junction temperature
3.  $I_D \leq 10.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .



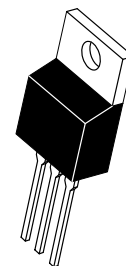
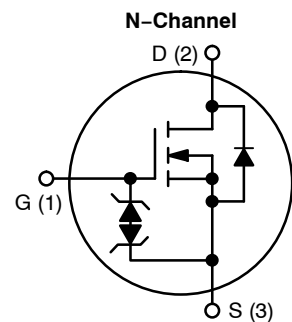
**ON Semiconductor®**

<http://onsemi.com>

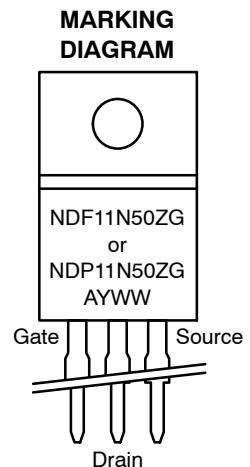
| $V_{DSS}$ | $R_{DS(ON)} (MAX) @ 4.5\text{ A}$ |
|-----------|-----------------------------------|
| 500 V     | 0.52 $\Omega$                     |



**TO-220FP  
CASE 221D  
STYLE 1**



**TO-220  
CASE 221A  
STYLE 5**



A = Location Code  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

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

# NDF11N50Z, NDP11N50Z

## THERMAL RESISTANCE

| Parameter                                 | Symbol          | NDF11N50Z | NDP11N50Z | Unit |
|---|-----------------|-----------|-----------|------|
| Junction-to-Case (Drain)                  | $R_{\theta JC}$ | 3.4       | 0.9       | °C/W |
| Junction-to-Ambient Steady State (Note 4) | $R_{\theta JA}$ | 50        | 50        |      |

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

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

### OFF CHARACTERISTICS

|   |  |                              |       |     |     |      |
|---|--|------------------------------|-------|-----|-----|------|
| Drain-to-Source Breakdown Voltage         | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$                 | $BV_{DSS}$                   | 500   |     |     | V    |
| Breakdown Voltage Temperature Coefficient | Reference to $25^\circ\text{C}$ ,<br>$I_D = 1\text{ mA}$ | $\Delta BV_{DSS}/\Delta T_J$ |       | 0.6 |     | V/°C |
| Drain-to-Source Leakage Current           | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$             | $I_{DSS}$                    | 25°C  |     | 1   | μA   |
|   |  |                              | 125°C |     | 50  |      |
| Gate-to-Source Forward Leakage            | $V_{GS} = \pm 20\text{ V}$                               | $I_{GSS}$                    |       |     | ±10 | μA   |

### ON CHARACTERISTICS (Note 5)

|                                      |   |              |     |      |      |   |
|--------------------------------------|---|--------------|-----|------|------|---|
| Static Drain-to-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$      | $R_{DS(on)}$ |     | 0.48 | 0.52 | Ω |
| Gate Threshold Voltage               | $V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$ | $V_{GS(th)}$ | 3.0 |      | 4.5  | V |
| Forward Transconductance             | $V_{DS} = 15\text{ V}, I_D = 4.5\text{ A}$      | $g_{FS}$     |     | 7.7  |      | S |

### DYNAMIC CHARACTERISTICS

|                                 |   |           |  |      |  |    |
|---------------------------------|---|-----------|--|------|--|----|
| Input Capacitance               | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$    | $C_{iss}$ |  | 1375 |  | pF |
| Output Capacitance              |   | $C_{oss}$ |  | 166  |  |    |
| Reverse Transfer Capacitance    |   | $C_{rss}$ |  | 40   |  |    |
| Total Gate Charge               | $V_{DD} = 250\text{ V}, I_D = 10.5\text{ A},$<br>$V_{GS} = 10\text{ V}$ | $Q_g$     |  | 46   |  | nC |
| Gate-to-Source Charge           |   | $Q_{gs}$  |  | 8.7  |  |    |
| Gate-to-Drain ("Miller") Charge |   | $Q_{gd}$  |  | 25   |  |    |
| Plateau Voltage                 |   | $V_{GP}$  |  | 6.2  |  | V  |
| Gate Resistance                 |   | $R_g$     |  | 1.4  |  | Ω  |

### RESISTIVE SWITCHING CHARACTERISTICS

|                     |  |              |  |    |  |    |
|---------------------|--|--------------|--|----|--|----|
| Turn-On Delay Time  | $V_{DD} = 250\text{ V}, I_D = 10.5\text{ A},$<br>$V_{GS} = 10\text{ V}, R_G = 5\text{ }\Omega$ | $t_{d(on)}$  |  | 15 |  | ns |
| Rise Time           |  | $t_r$        |  | 32 |  |    |
| Turn-Off Delay Time |  | $t_{d(off)}$ |  | 40 |  |    |
| Fall Time           |  | $t_f$        |  | 23 |  |    |

### SOURCE-DRAIN DIODE CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

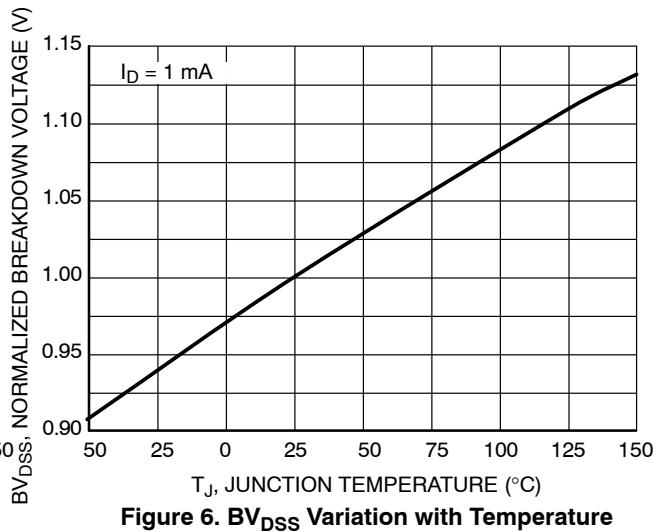
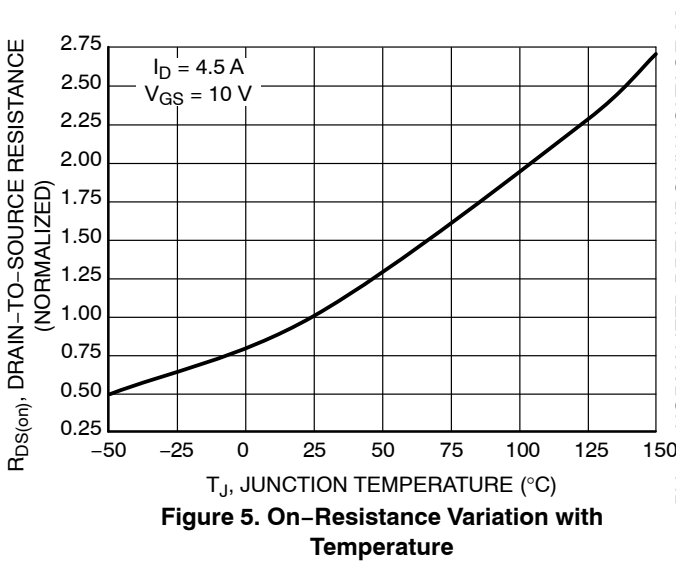
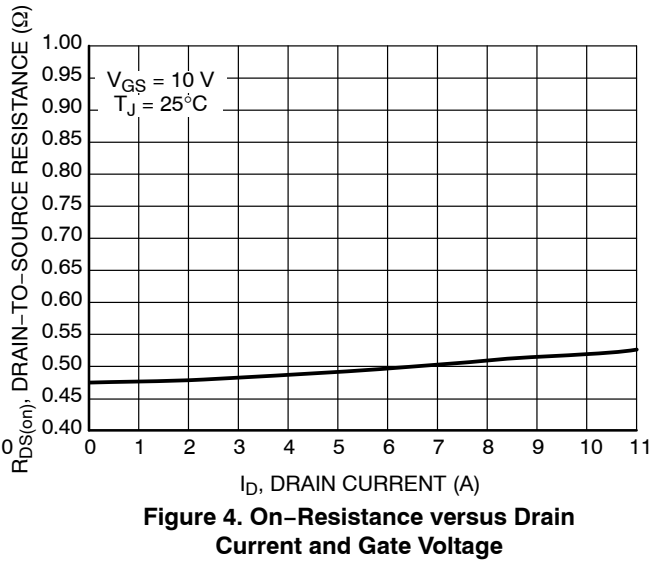
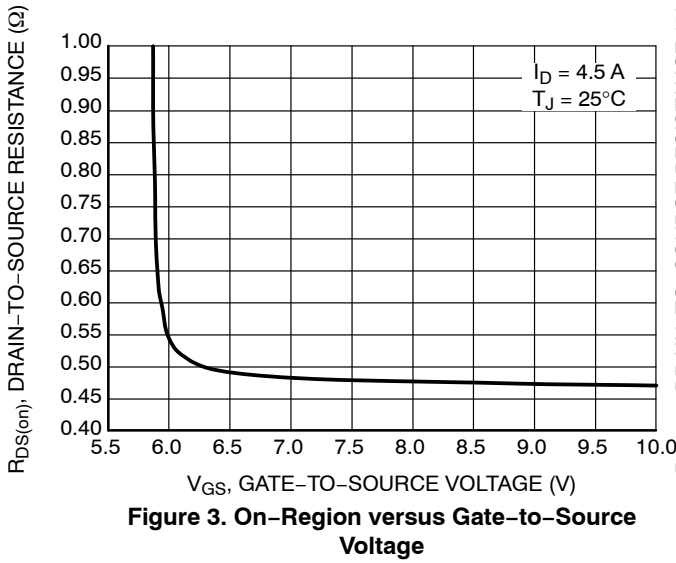
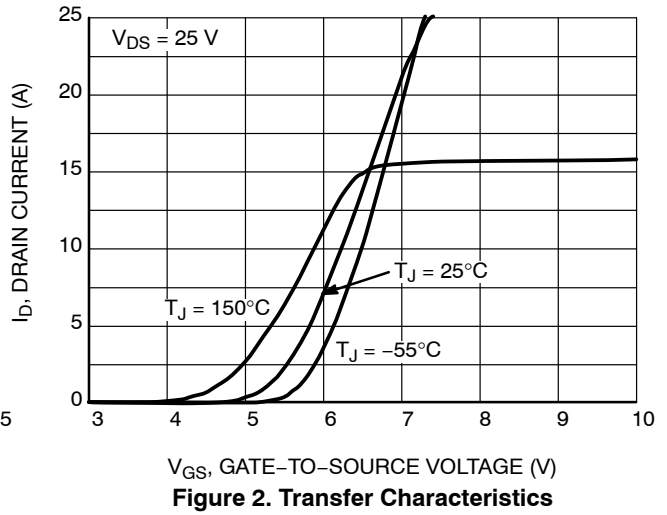
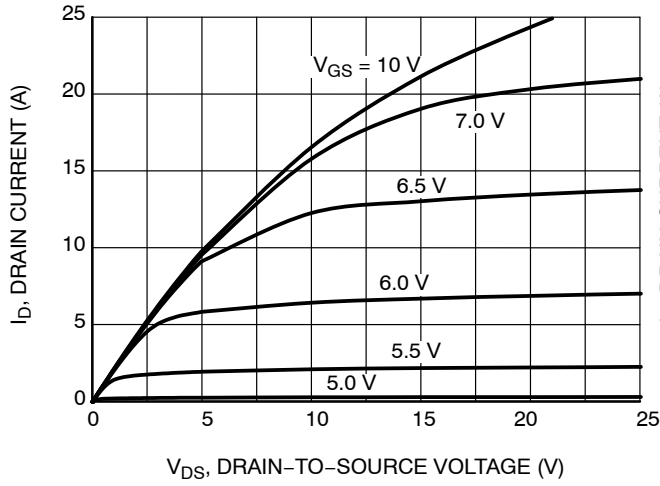
|                         |  |          |  |     |     |    |
|-------------------------|--|----------|--|-----|-----|----|
| Diode Forward Voltage   | $I_S = 10.5\text{ A}, V_{GS} = 0\text{ V}$   | $V_{SD}$ |  |     | 1.6 | V  |
| Reverse Recovery Time   | $V_{GS} = 0\text{ V}, V_{DD} = 30\text{ V}$<br>$I_S = 10.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ | $t_{rr}$ |  | 310 |     | ns |
| Reverse Recovery Charge |  | $Q_{rr}$ |  | 2.5 |     | μC |

4. Insertion mounted

5. Pulse Width  $\leq 380\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

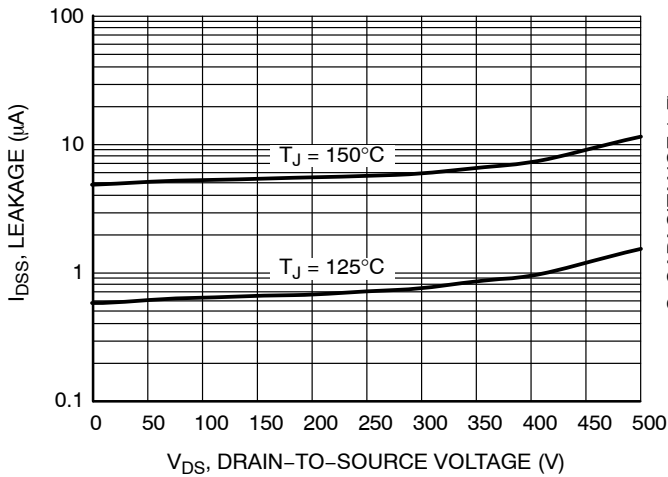
# NDF11N50Z, NDP11N50Z

## TYPICAL CHARACTERISTICS

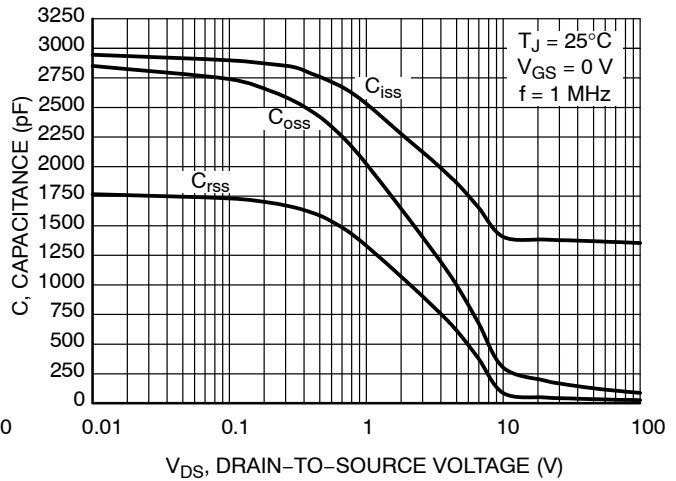


# NDF11N50Z, NDP11N50Z

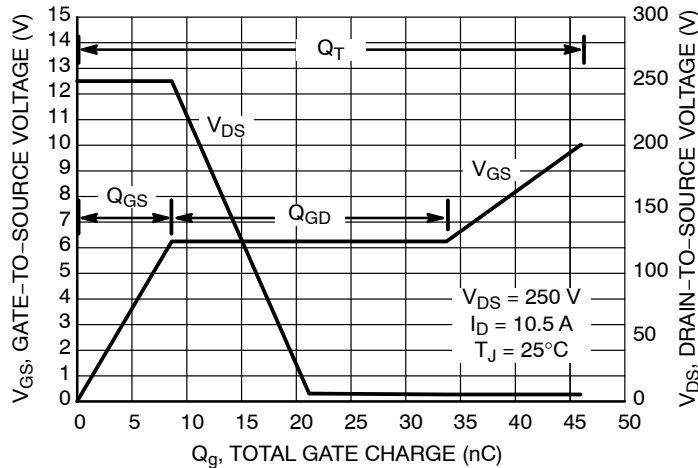
## TYPICAL CHARACTERISTICS



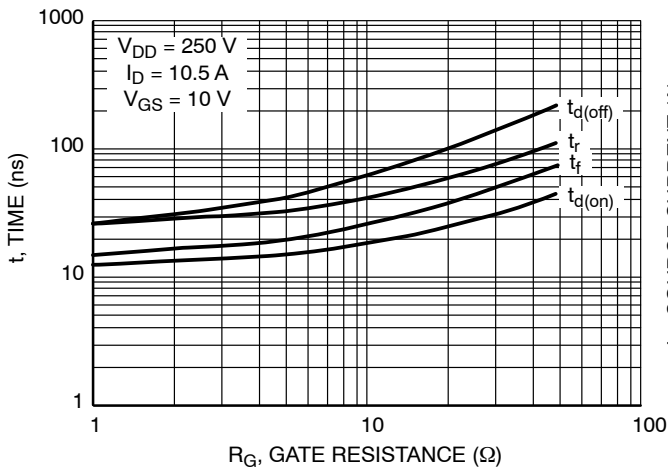
**Figure 7. Drain-to-Source Leakage Current versus Voltage**



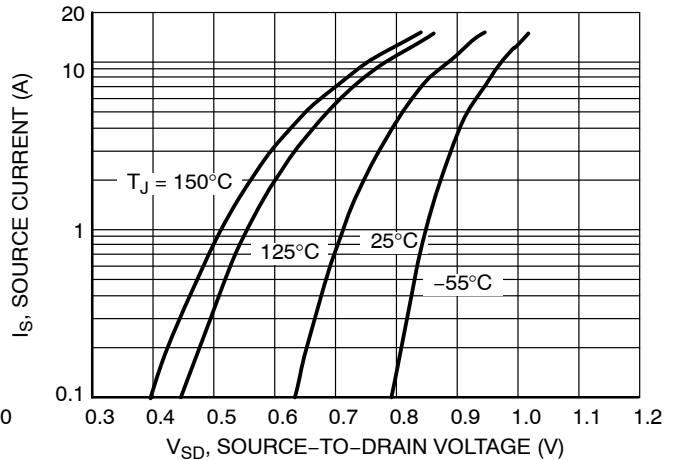
**Figure 8. Capacitance Variation**



**Figure 9. Gate-to-Source Voltage and Drain-to-Source Voltage versus Total Charge**



**Figure 10. Resistive Switching Time Variation versus Gate Resistance**



**Figure 11. Diode Forward Voltage versus Current**

# NDF11N50Z, NDP11N50Z

## TYPICAL CHARACTERISTICS

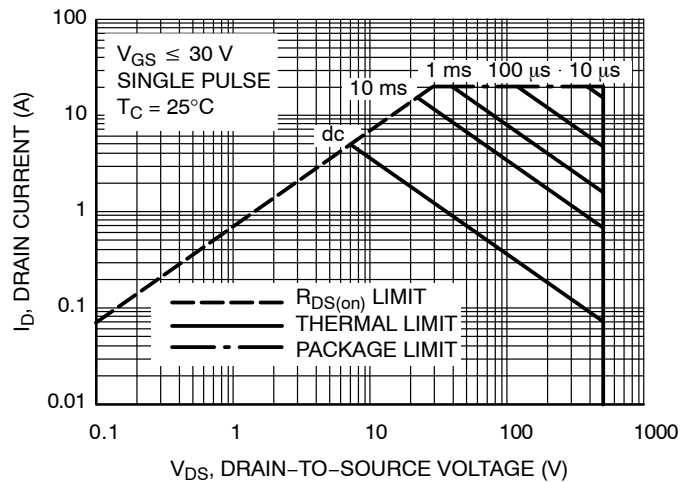


Figure 12. Maximum Rated Forward Biased Safe Operating Area NDF11N50Z

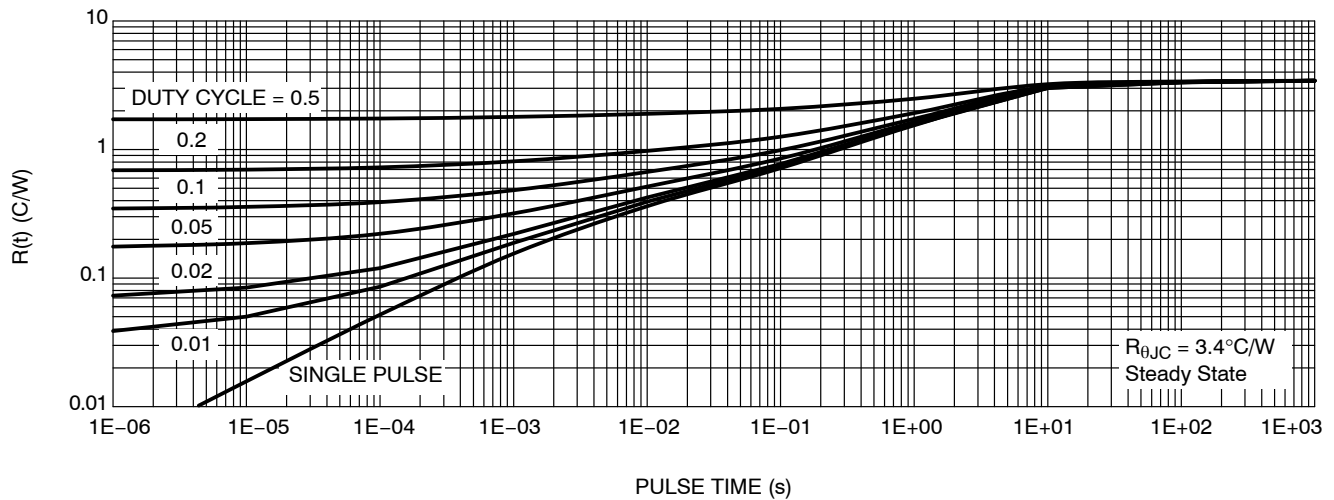


Figure 13. Thermal Impedance (Junction-to-Case) for NDF11N50Z

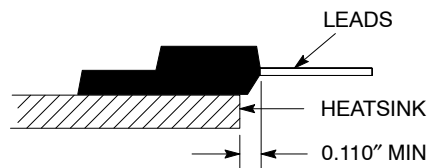


Figure 14. Isolation Test Diagram

Measurement made between leads and heatsink with all leads shorted together.

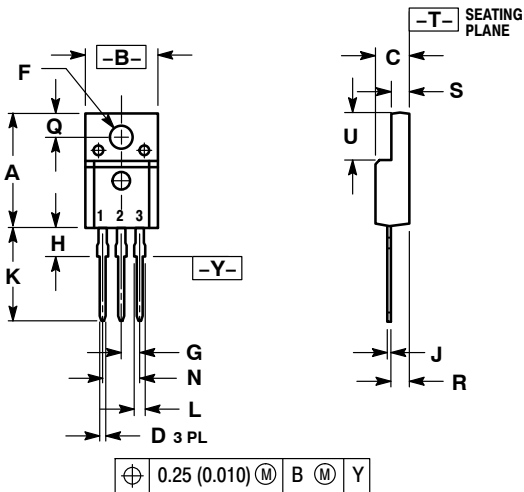
\*For additional mounting information, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**NDF11N50Z, NDP11N50Z****ORDERING INFORMATION**

| <b>Order Number</b> | <b>Package</b>        | <b>Shipping</b>                     |
|---------------------|-----------------------|-------------------------------------|
| NDF11N50ZG          | TO-220FP<br>(Pb-Free) | 50 Units / Rail                     |
| NDP11N50ZG          | TO-220AB<br>(Pb-Free) | 50 Units / Rail<br>(In Development) |

## NDF11N50Z, NDP11N50Z

## PACKAGE DIMENSIONS

TO-220FP  
CASE 221D-03  
ISSUE K

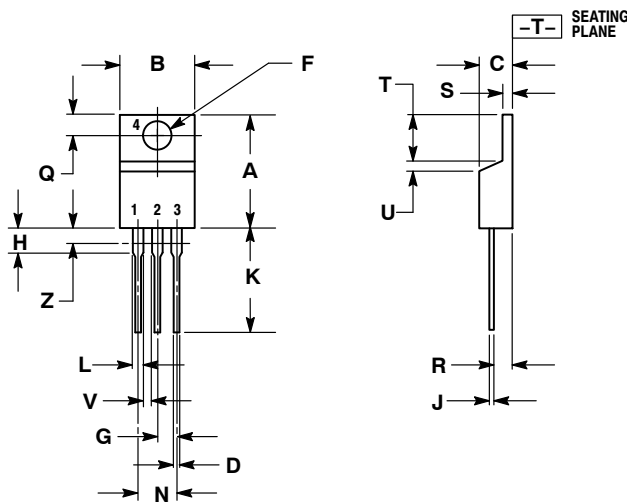
## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.617     | 0.635 | 15.67       | 16.12 |
| B   | 0.392     | 0.419 | 9.96        | 10.63 |
| C   | 0.177     | 0.193 | 4.50        | 4.90  |
| D   | 0.024     | 0.039 | 0.60        | 1.00  |
| F   | 0.116     | 0.129 | 2.95        | 3.28  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.118     | 0.135 | 3.00        | 3.43  |
| J   | 0.018     | 0.025 | 0.45        | 0.63  |
| K   | 0.503     | 0.541 | 12.78       | 13.73 |
| L   | 0.048     | 0.058 | 1.23        | 1.47  |
| N   | 0.200 BSC |       | 5.08 BSC    |       |
| Q   | 0.122     | 0.138 | 3.10        | 3.50  |
| R   | 0.099     | 0.117 | 2.51        | 2.96  |
| S   | 0.092     | 0.113 | 2.34        | 2.87  |
| U   | 0.239     | 0.271 | 6.06        | 6.88  |

## STYLE 1:

1. GATE
2. DRAIN
3. SOURCE

TO-220  
CASE 221A-09  
ISSUE AF

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.161 | 3.61        | 4.09  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.014  | 0.025 | 0.36        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | ---   | 1.15        | ---   |
| Z   | ---    | 0.080 | ---         | 2.04  |

## STYLE 5:

1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

## LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada  
Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910  
Japan Customer Focus Center  
Phone: 81-3-5773-3850

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative