

# ON Semiconductor

## Is Now



To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

onsemi and onsemi. and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi 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. Buyer is responsible for its products and applications using onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi 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. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi 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 onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

# MOSFET - Power, Single N-Channel, Shielded Gate, PowerTrench®

150 V, 22 mΩ, 37.2 A

## NTTFS022N15MC

### Features

- Small Footprint (3.3 x 3.3 mm) for Compact Design
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Primary DC-DC MOSFET
- Synchronous Rectifier in DC-DC and AC-DC
- Motor Drive
- Capable of 175°C Tj Max Rating

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

| Parameter   | Symbol                            | Value       | Unit |
|---|-----------------------------------|-------------|------|
| Drain-to-Source Voltage   | V <sub>DSS</sub>                  | 150         | V    |
| Gate-to-Source Voltage  | V <sub>GS</sub>                   | ±20         | V    |
| Continuous Drain Current R <sub>θJC</sub> (Note 5)                                | I <sub>D</sub>                    | 37.2        | A    |
| Power Dissipation R <sub>θJC</sub> (Note 5)                                       | P <sub>D</sub>                    | 71.4        | W    |
| Continuous Drain Current (Notes 1, 5)   | I <sub>D</sub>                    | 7.4         | A    |
| Power Dissipation (Notes 1, 5)  | P <sub>D</sub>                    | 2.8         | W    |
| Power Dissipation (Notes 2, 5)  | P <sub>D</sub>                    | 1.2         | W    |
| Pulsed Drain Current (Note 3)   | I <sub>DM</sub>                   | 158         | A    |
| Operating Junction and Storage Temperature Range                                  | T <sub>J</sub> , T <sub>stg</sub> | -55 to +175 | °C   |
| Single Pulse Drain-to-Source Avalanche Energy (I <sub>L(pk)</sub> = 8 A) (Note 4) | E <sub>AS</sub>                   | 96          | mJ   |
| Maximum 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.

1. Surface mounted on a FR-4 board using 1 in<sup>2</sup> pad of 2 oz copper.
2. Surface mounted on a FR-4 board using the minimum recommended pad of 2 oz copper.
3. Pulsed ID please refer to Figure 12 SOA graph for more details
4. E<sub>AS</sub> of 96 mJ is based on starting T<sub>J</sub> = 25°C; L = 3 mH, I<sub>AS</sub> = 8 A, V<sub>DD</sub> = 150 V, V<sub>GS</sub> = 10 V.
5. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

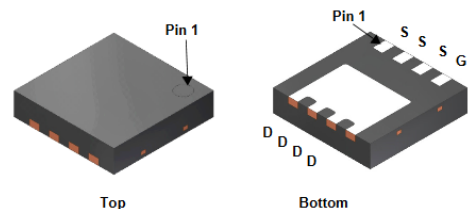
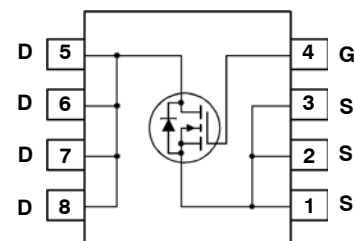


ON Semiconductor®

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

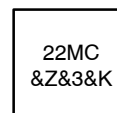
| V <sub>(BR)DSS</sub> | R <sub>DS(on)</sub> MAX | I <sub>D</sub> MAX |
|----------------------|-------------------------|--------------------|
| 150 V                | 22 mΩ @ 10 V            | 37.2 A             |

### N-CHANNEL MOSFET



WDFN8  
CASE 483AW

### MARKING DIAGRAM



22MC = Specific Device Code  
&Z = Assembly Location  
&3 = 3-Digit Date Code  
&K = Lot Traceability

### ORDERING INFORMATION

| Device        | Package         | Shipping†          |
|---------------|-----------------|--------------------|
| NTTFS022N15MC | WDFN8 (Pb-Free) | 3000 / 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.

# THERMAL CHARACTERISTICS

| Parameter  | Symbol          | Value | Unit                 |
|--|-----------------|-------|----------------------|
| Thermal Resistance Junction-to-Case – Steady State (Note 5)        | $R_{\theta JC}$ | 2.1   | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction-to-Ambient – Steady State (Notes 1, 5) | $R_{\theta JA}$ | 53    | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction-to-Ambient – Steady State (Notes 2, 5) | $R_{\theta JA}$ | 125   | $^{\circ}\text{C/W}$ |

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

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

## OFF CHARACTERISTICS

|   |                   |  |     |    |           |                              |
|---|-------------------|--|-----|----|-----------|------------------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                    | 150 |    |           | V                            |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25^{\circ}\text{C}$    |     | 75 |           | $\text{mV}/^{\circ}\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 120\text{ V}, T_J = 25^{\circ}\text{C}$ |     |    | 1         | $\mu\text{A}$                |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$                        |     |    | $\pm 100$ | nA                           |

## ON CHARACTERISTICS

|  |                  |   |     |      |      |                              |
|--|------------------|---|-----|------|------|------------------------------|
| Gate Threshold Voltage                 | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 100\text{ }\mu\text{A}$                     | 2.5 |      | 4.5  | V                            |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | $I_D = 100\text{ }\mu\text{A}$ , referenced to $25^{\circ}\text{C}$ |     | -8.4 |      | $\text{mV}/^{\circ}\text{C}$ |
| Drain-to-Source On Resistance          | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 18\text{ A}$                           |     | 17.1 | 22   | $\text{m}\Omega$             |
|  |                  | $V_{GS} = 8\text{ V}, I_D = 9\text{ A}$                             |     | 19   | 25.3 | $\text{m}\Omega$             |
| Forward Transconductance               | $g_{FS}$         | $V_{DS} = 10\text{ V}, I_D = 18\text{ A}$                           |     | 37   |      | S                            |

## CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |   |  |      |     |          |
|------------------------------|--------------|---|--|------|-----|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}$<br>$V_{DS} = 75\text{ V}$ |  | 1315 |     | pF       |
| Output Capacitance           | $C_{OSS}$    |   |  | 380  |     |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |   |  | 6    |     |          |
| Gate-Resistance              | $R_G$        |   |  | 0.6  | 1.2 | $\Omega$ |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 75\text{ V}, I_D = 18\text{ A}$   |  | 17   |     | nC       |
| Threshold Gate Charge        | $Q_{G(TH)}$  |   |  | 4.4  |     |          |
| Gate-to-Source Charge        | $Q_{GS}$     |   |  | 7.2  |     |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |   |  | 2.7  |     |          |
| Plateau Voltage              | $V_{GP}$     |   |  | 5.6  |     | V        |
| Output Charge                | $Q_{OSS}$    | $V_{GS} = 0\text{ V}, V_{DD} = 75\text{ V}$                       |  | 41   |     | nC       |

## RESISTIVE SWITCHING CHARACTERISTICS (Note 6)

|                     |              |   |  |     |  |    |
|---------------------|--------------|---|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 75\text{ V},$<br>$I_D = 18\text{ A}, R_G = 6\text{ }\Omega$ |  | 14  |  | ns |
| Rise Time           | $t_r$        |   |  | 2.8 |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |   |  | 17  |  |    |
| Fall Time           | $t_f$        |   |  | 2.9 |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |   |  |      |     |    |
|-------------------------|----------|---|--|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 18\text{ A}, T_J = 25^{\circ}\text{C}$                                      |  | 0.86 | 1.2 | V  |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, V_{DD} = 75\text{ V}$<br>$di_S/dt = 300\text{ A}/\mu\text{s}, I_S = 18\text{ A}$  |  | 45   |     | ns |
| Reverse Recovery Charge | $Q_{RR}$ |   |  | 155  |     | nC |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, V_{DD} = 75\text{ V}$<br>$di_S/dt = 1000\text{ A}/\mu\text{s}, I_S = 18\text{ A}$ |  | 28   |     | ns |
| Reverse Recovery Charge | $Q_{RR}$ |   |  | 242  |     | nC |

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.

6. Switching characteristics are independent of operating junction temperature

TYPICAL CHARACTERISTICS

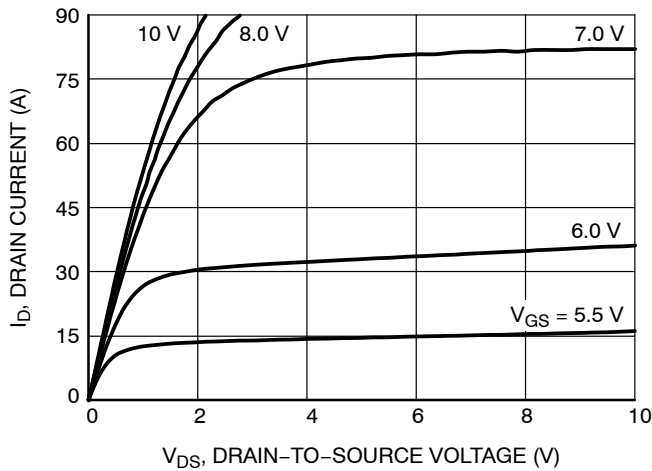


Figure 1. On-Region Characteristics

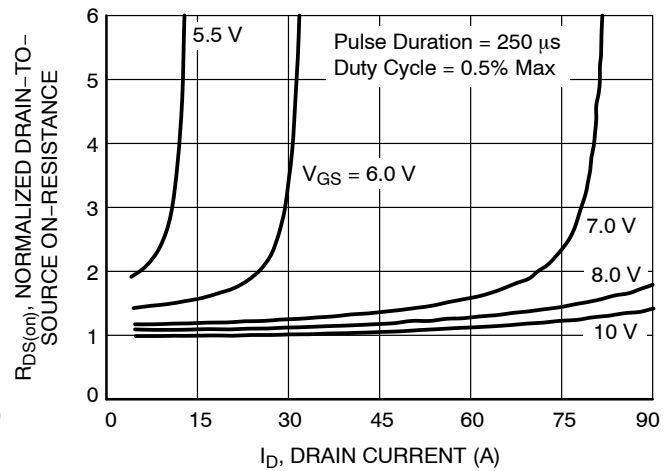


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

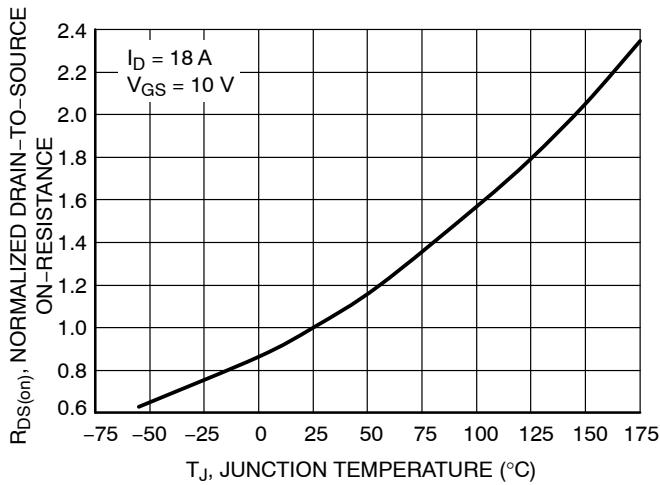


Figure 3. Normalized On-Resistance vs. Junction Temperature

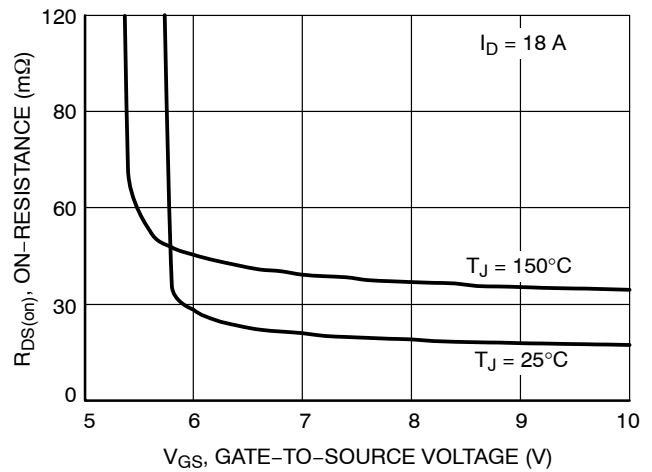


Figure 4. On-Resistance vs. Gate-to-Source Voltage

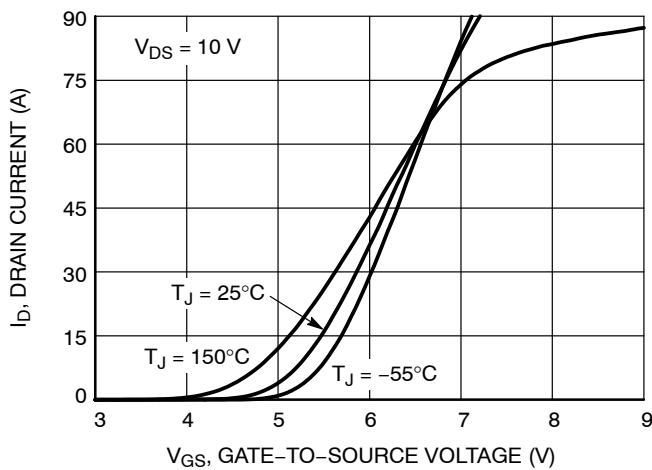


Figure 5. Transfer Characteristics

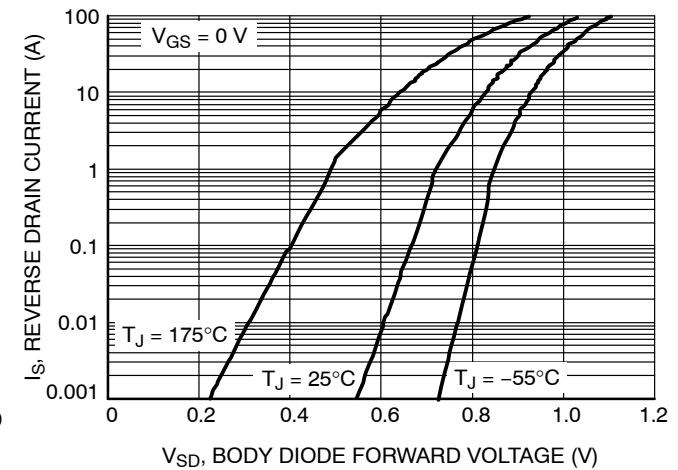


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS

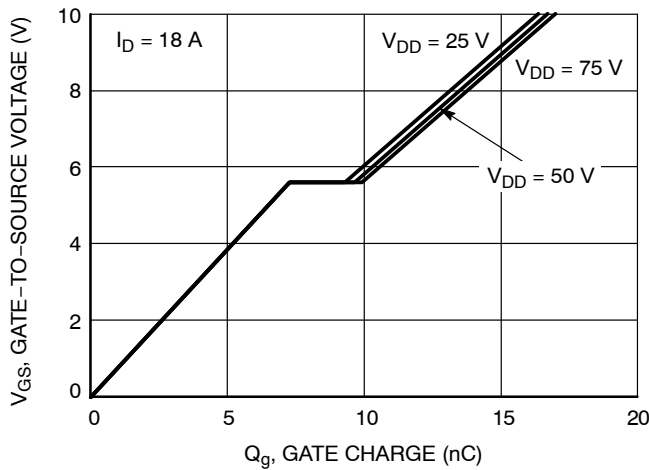


Figure 7. Gate Charge Characteristics

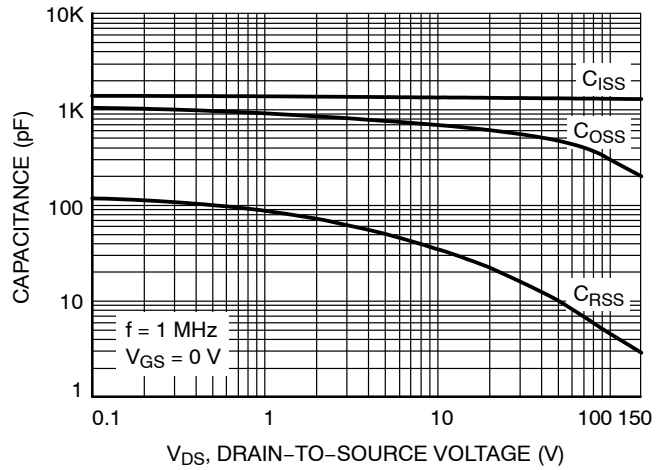


Figure 8. Capacitance vs. Drain-to-Source Voltage

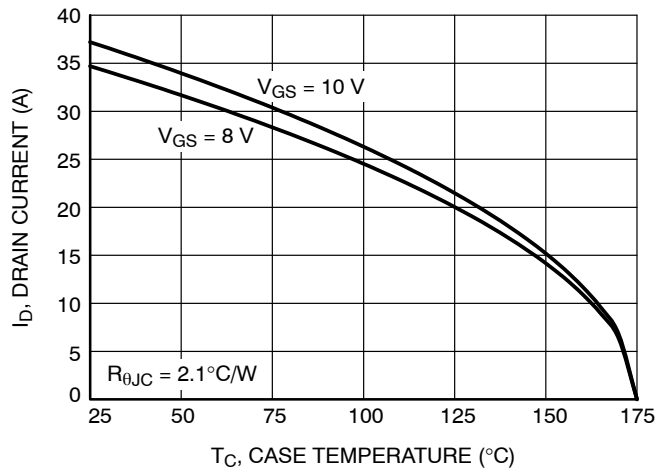


Figure 9. Drain Current vs. Case Temperature

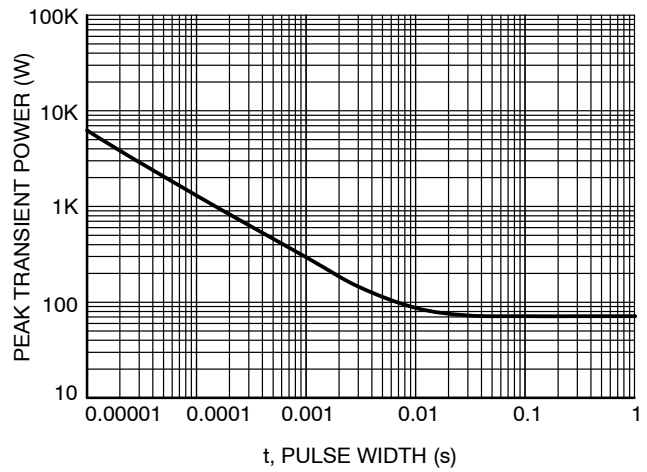


Figure 10. Peak Power

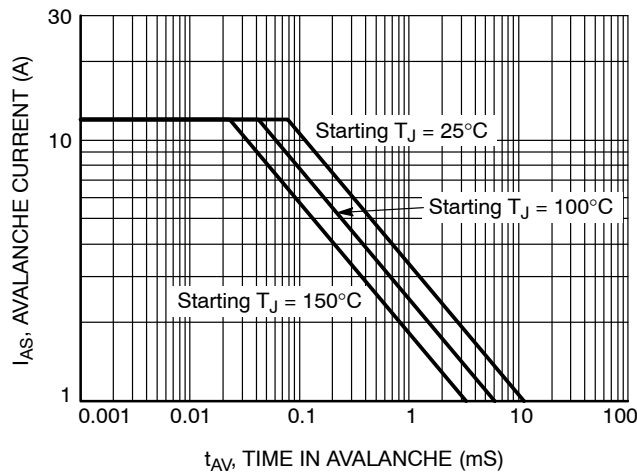


Figure 11. Unclamped Inductive Switching Capability

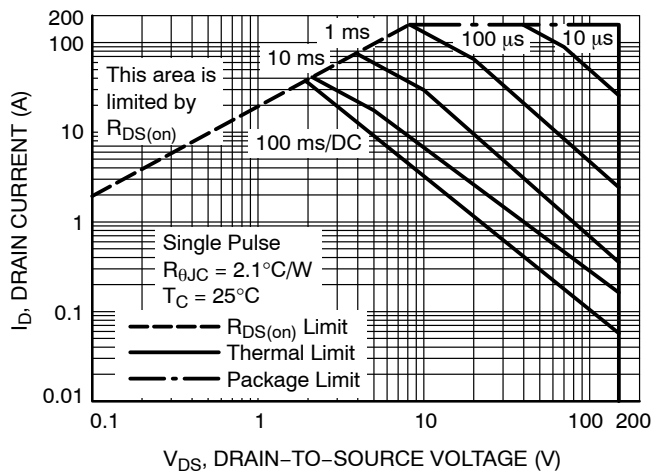


Figure 12. Forward Bias Safe Operating Area

# NTTFS022N15MC

## TYPICAL CHARACTERISTICS

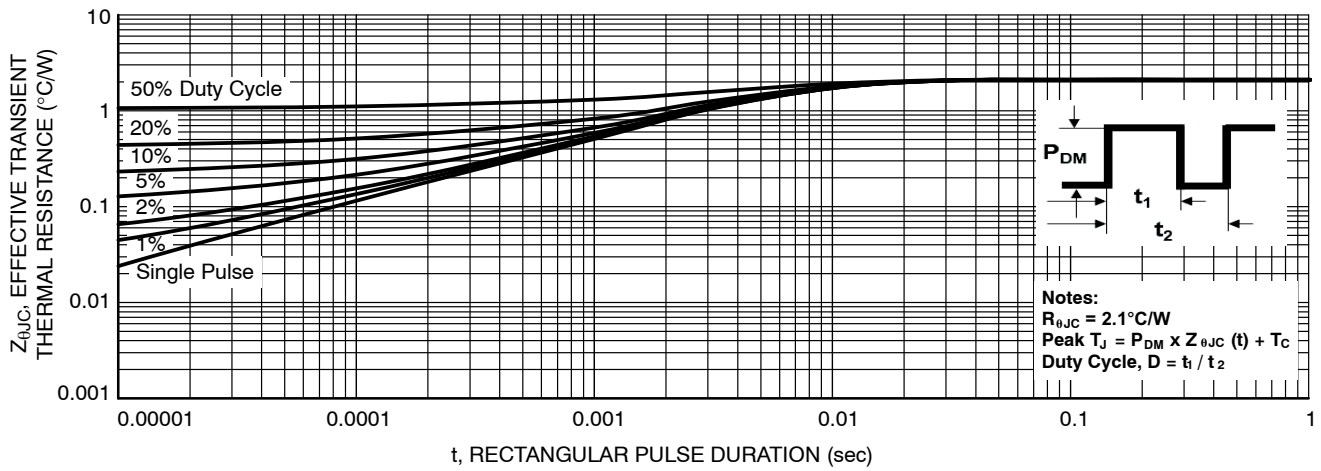
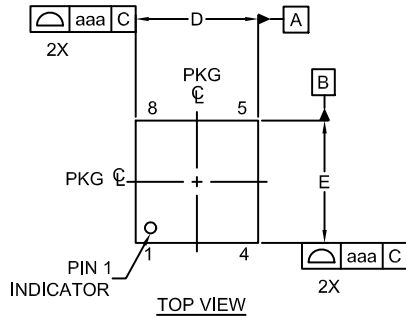


Figure 13. Transient Thermal Impedance

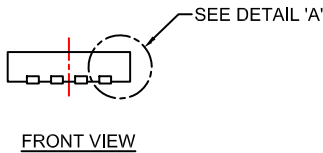
# NTTFS022N15MC

## PACKAGE DIMENSIONS

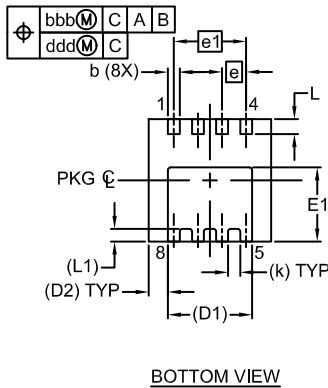
### WDFN8 3.3X3.3, 0.65P CASE 483AW ISSUE A



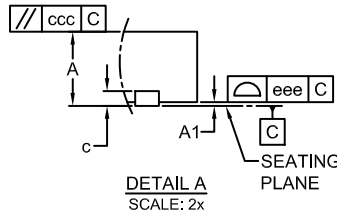
TOP VIEW



FRONT VIEW

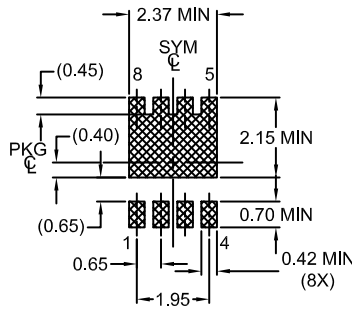


BOTTOM VIEW



DETAIL A  
SCALE: 2x

### LAND PATTERN RECOMMENDATION\*




\*FOR ADDITIONAL INFORMATION ON OUR  
PB-FREE STRATEGY AND SOLDERING DETAILS,  
PLEASE DOWNLOAD THE ON SEMICONDUCTOR  
SOLDERING AND MOUNTING TECHNIQUES  
REFERENCE MANUAL, SOLDERM/D.

### NOTES:

1. CONTROLLING DIMENSION: MILLIMETERS.
2. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. 'A1' IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN         | NOM  | MAX  |
| A   | 0.70        | 0.75 | 0.80 |
| A1  | -           | -    | 0.05 |
| b   | 0.27        | 0.32 | 0.37 |
| c   | 0.15        | 0.20 | 0.25 |
| D   | 3.20        | 3.30 | 3.40 |
| D1  | 2.27 REF    |      |      |
| D2  | 0.52 REF    |      |      |
| E   | 3.20        | 3.30 | 3.40 |
| E1  | 1.85        | 1.95 | 2.05 |
| e   | 0.65 BSC    |      |      |
| e1  | 1.95 BSC    |      |      |
| k   | 0.33 REF    |      |      |
| L   | 0.30        | 0.40 | 0.50 |
| L1  | 0.34 REF    |      |      |
| aaa | 0.10        |      |      |
| bbb | 0.10        |      |      |
| ccc | 0.10        |      |      |
| ddd | 0.05        |      |      |
| eee | 0.05        |      |      |

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marketing.pdf](http://www.onsemi.com/site/pdf/Patent-Marketing.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor 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:  
Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

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

TECHNICAL SUPPORT  
North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:  
Phone: 00421 33 790 2910  
For additional information, please contact your local Sales Representative