

# 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, N-Channel, SUPERFET® III, FAST

**650 V, 125 mΩ, 24 A**

## NTMT125N65S3H

### Description

SUPERFET III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SUPERFET III FAST MOSFET is suitable for various AC/DC power conversion for system miniaturization and higher efficiency.

The Power88 package is an ultra-slim surface-mount package (1 mm high) with a low profile and small footprint (8 x 8 mm<sup>2</sup>). SUPERFET III MOSFET in a Power88 package offers excellent switching performance due to lower parasitic source inductance and separated power and drive sources. Power88 offers Moisture Sensitivity Level 1 (MSL 1).

### Features

- 700 V @ T<sub>J</sub> = 150°C
- Typ. R<sub>DS(on)</sub> = 108 mΩ
- Ultra Low Gate Charge (Typ. Q<sub>g</sub> = 44 nC)
- Low Effective Output Capacitance (Typ. C<sub>oss(eff.)</sub> = 379 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

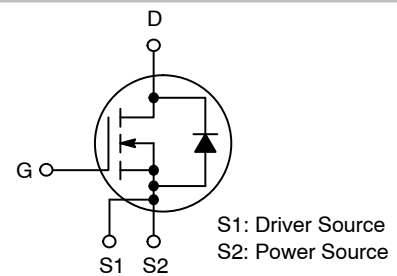
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar



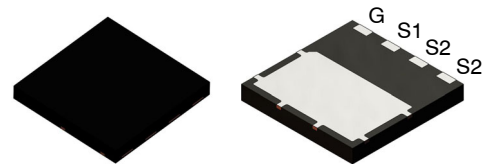
**ON Semiconductor®**

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

| V <sub>DSS</sub> | R <sub>DS(ON)</sub> MAX | I <sub>D</sub> MAX |
|------------------|-------------------------|--------------------|
| 650 V            | 125 mΩ @ 10 V           | 24 A               |

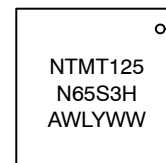


**POWER MOSFET**



**TDFN4 8X8 2P  
CASE 520AB**

### MARKING DIAGRAM



NTMT125N65S3H = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# NTMT125N65S3H

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

| Symbol         | Parameter                                                            |                                            | Value       | Unit                |
|----------------|----------------------------------------------------------------------|--------------------------------------------|-------------|---------------------|
| $V_{DSS}$      | Drain to Source Voltage                                              |                                            | 650         | V                   |
| $V_{GSS}$      | Gate to Source Voltage                                               | – DC                                       | $\pm 30$    | V                   |
|                |                                                                      | – AC ( $f > 1\text{ Hz}$ )                 | $\pm 30$    |                     |
| $I_D$          | Drain Current                                                        | – Continuous ( $T_C = 25^\circ\text{C}$ )  | 24          | A                   |
|                |                                                                      | – Continuous ( $T_C = 100^\circ\text{C}$ ) | 15          |                     |
| $I_{DM}$       | Drain Current                                                        | – Pulsed (Note 1)                          | 67          | A                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              |                                            | 216         | mJ                  |
| $I_{AS}$       | Avalanche Current (Note 2)                                           |                                            | 4.7         | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 |                                            | 1.71        | mJ                  |
| dv/dt          | MOSFET dv/dt                                                         |                                            | 120         | V/ns                |
|                | Peak Diode Recovery dv/dt (Note 3)                                   |                                            | 20          |                     |
| $P_D$          | Power Dissipation                                                    | ( $T_C = 25^\circ\text{C}$ )               | 171         | W                   |
|                |                                                                      | – Derate Above $25^\circ\text{C}$          | 1.37        | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                              |                                            | –55 to +150 | $^\circ\text{C}$    |
| $T_L$          | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds |                                            | 260         | $^\circ\text{C}$    |

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. Repetitive rating: pulse-width limited by maximum junction temperature.

2.  $I_{AS} = 4.7\text{ A}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .

3.  $I_{SD} \leq 12\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                              | Value | Unit                      |
|-----------------|--------------------------------------------------------|-------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.             | 0.73  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. (Note 4) | 45    |                           |

4. Device on 1 in<sup>2</sup> pad 2 oz copper pad on 1.5 x 1.5 in. board of FR-4 material.

## PACKAGE MARKING AND ORDERING INFORMATION

| Part Number   | Top Marking   | Package | Reel Size | Tape Width | Shipping Quantity <sup>†</sup> |
|---------------|---------------|---------|-----------|------------|--------------------------------|
| NTMT125N65S3H | NTMT125N65S3H | TDFN4   | 13"       | 13.3 mm    | 3000 Units / 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.

# NTMT125N65S3H

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

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

### OFF CHARACTERISTICS

|                                     |                                           |                                                                      |     |      |      |      |
|-------------------------------------|-------------------------------------------|----------------------------------------------------------------------|-----|------|------|------|
| BV <sub>DSS</sub>                   | Drain to Source Breakdown Voltage         | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C  | 650 | –    | –    | V    |
|                                     |                                           | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C | 700 | –    | –    | V    |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 10 mA, Referenced to 25°C                           | –   | 0.63 | –    | V/°C |
| I <sub>DSS</sub>                    | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                       | –   | –    | 10   | μA   |
|                                     |                                           | V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125°C                      | –   | 1.3  | –    |      |
| I <sub>GSS</sub>                    | Gate to Body Leakage Current              | V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V                       | –   | –    | ±100 | nA   |

### ON CHARACTERISTICS

|                     |                                      |                                                             |     |     |     |    |
|---------------------|--------------------------------------|-------------------------------------------------------------|-----|-----|-----|----|
| V <sub>GS(th)</sub> | Gate Threshold Voltage               | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 2.1 mA | 2.4 | –   | 4.0 | V  |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 12 A               | –   | 108 | 125 | mΩ |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 12 A               | –   | 26  | –   | S  |

### DYNAMIC CHARACTERISTICS

|                        |                                   |                                                                                    |   |      |   |    |
|------------------------|-----------------------------------|------------------------------------------------------------------------------------|---|------|---|----|
| C <sub>iss</sub>       | Input Capacitance                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 250 kHz                        | – | 2200 | – | pF |
| C <sub>oss</sub>       | Output Capacitance                |                                                                                    | – | 34   | – | pF |
| C <sub>oss(eff.)</sub> | Effective Output Capacitance      | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                              | – | 379  | – | pF |
| C <sub>oss(er.)</sub>  | Energy Related Output Capacitance | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                              | – | 56   | – | pF |
| Q <sub>g(tot)</sub>    | Total Gate Charge at 10V          | V <sub>DS</sub> = 400 V, I <sub>D</sub> = 12 A, V <sub>GS</sub> = 10 V<br>(Note 4) | – | 44   | – | nC |
| Q <sub>gs</sub>        | Gate to Source Gate Charge        |                                                                                    | – | 11   | – | nC |
| Q <sub>gd</sub>        | Gate to Drain "Miller" Charge     |                                                                                    | – | 12   | – | nC |
| ESR                    | Equivalent Series Resistance      | f = 1 MHz                                                                          | – | 1.1  | – | Ω  |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                                               |   |     |   |    |
|---------------------|---------------------|---------------------------------------------------------------------------------------------------------------|---|-----|---|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 12 A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 7.5 Ω<br>(Note 4) | – | 23  | – | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                                               | – | 8   | – | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                                               | – | 70  | – | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                                                               | – | 2.7 | – | ns |

### SOURCE-DRAIN DIODE CHARACTERISTICS

|                 |                                                          |                                                                                    |   |     |     |    |
|-----------------|----------------------------------------------------------|------------------------------------------------------------------------------------|---|-----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Source to Drain Diode Forward Current |                                                                                    | – | –   | 24  | A  |
| I <sub>SM</sub> | Maximum Pulsed Source to Drain Diode Forward Current     |                                                                                    | – | –   | 67  | A  |
| V <sub>SD</sub> | Source to Drain Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 12 A                                      | – | –   | 1.2 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>DD</sub> = 400 V, I <sub>SD</sub> = 12 A,<br>dI <sub>F</sub> /dt = 100 A/μs | – | 302 | –   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |                                                                                    | – | 4.3 | –   | μC |

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.

5. Essentially independent of operating temperature typical characteristics.

# NTMT125N65S3H

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

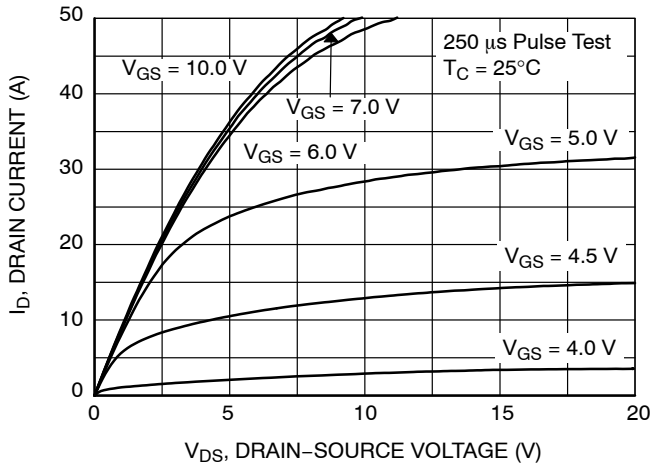


Figure 1. On-Region Characteristics

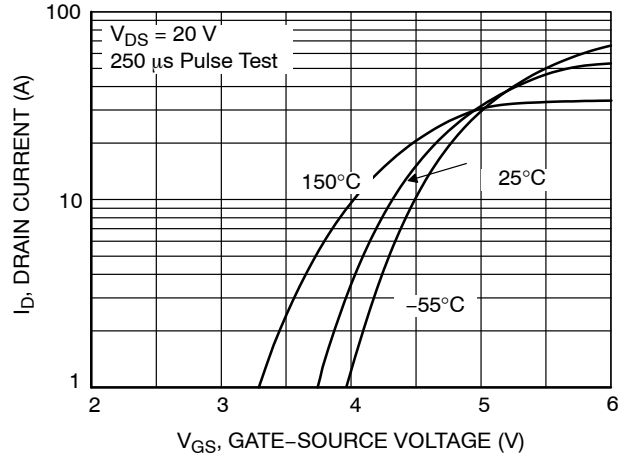


Figure 2. Transfer Characteristics

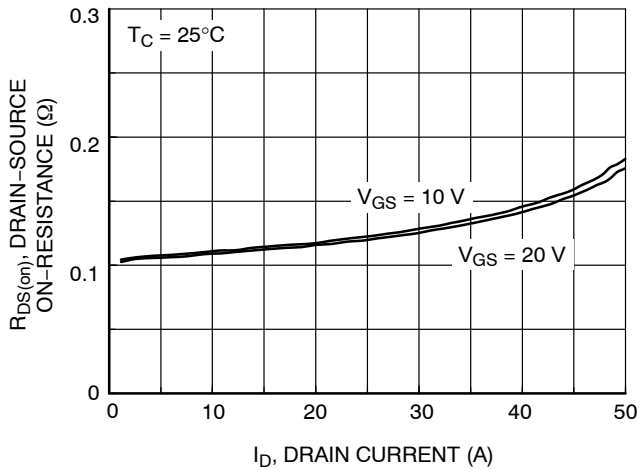


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

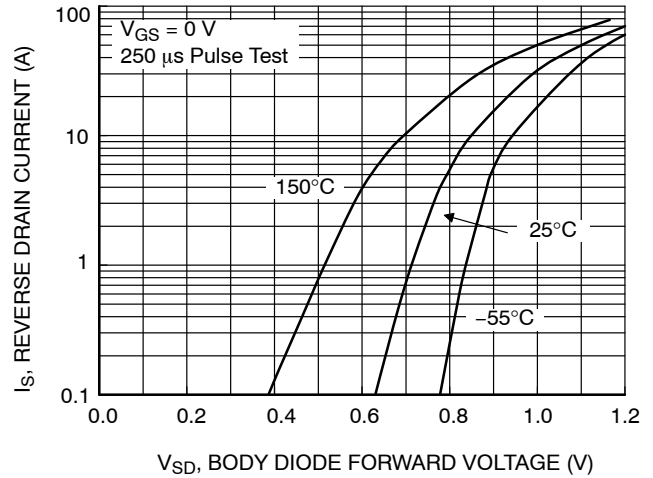


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

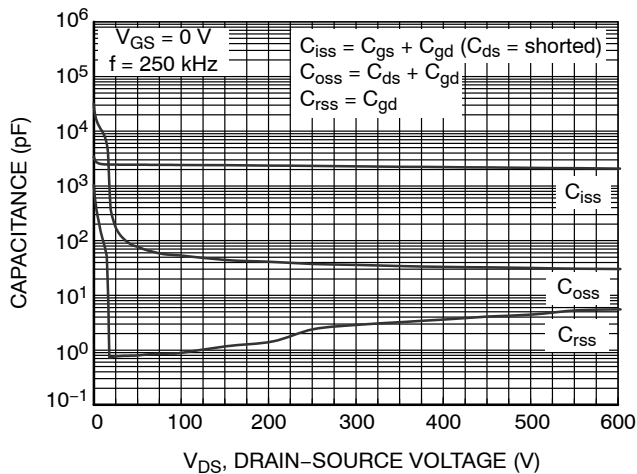


Figure 5. Capacitance Characteristics

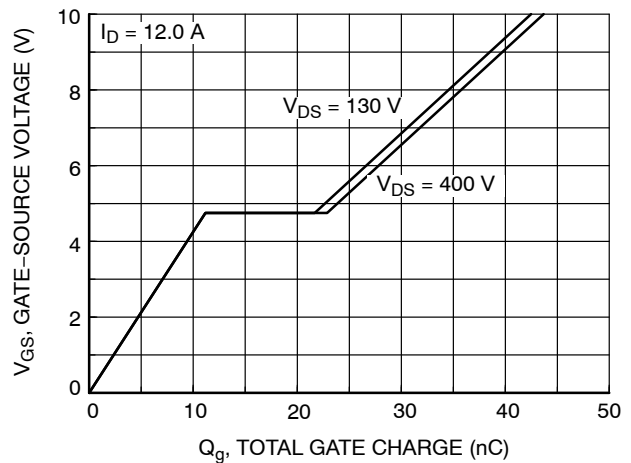


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$  unless otherwise noted) (continued)

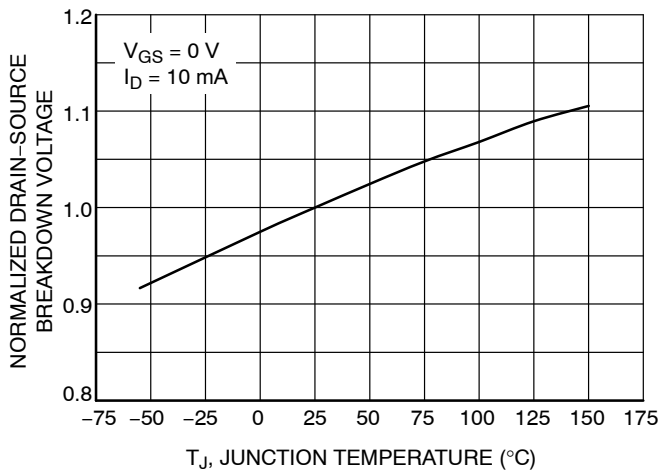


Figure 7. Breakdown Voltage Variation vs. Temperature

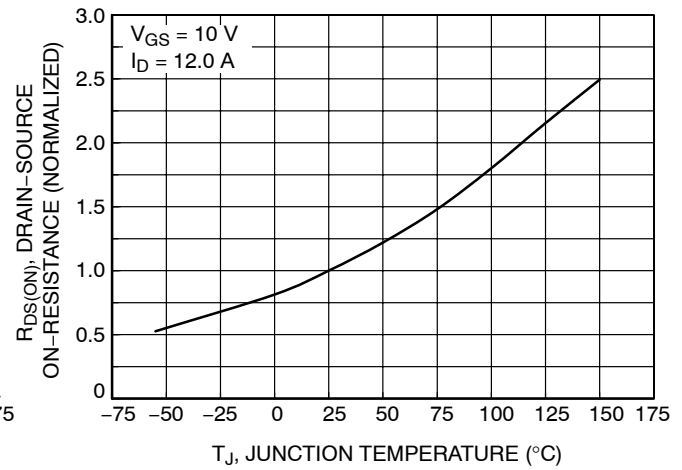


Figure 8. On-Resistance Variation vs. Temperature

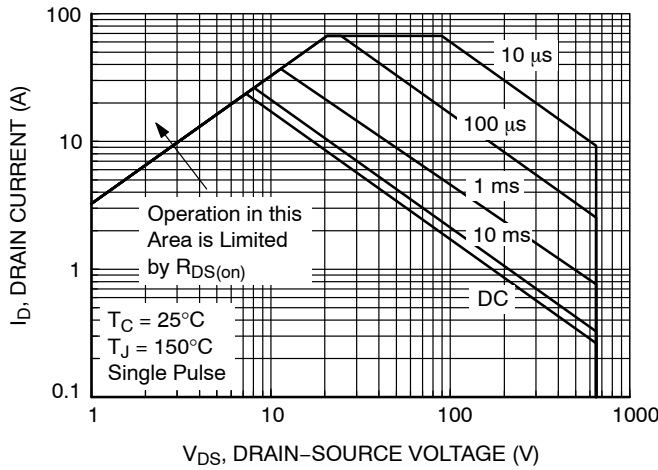


Figure 9. Maximum Safe Operating Area

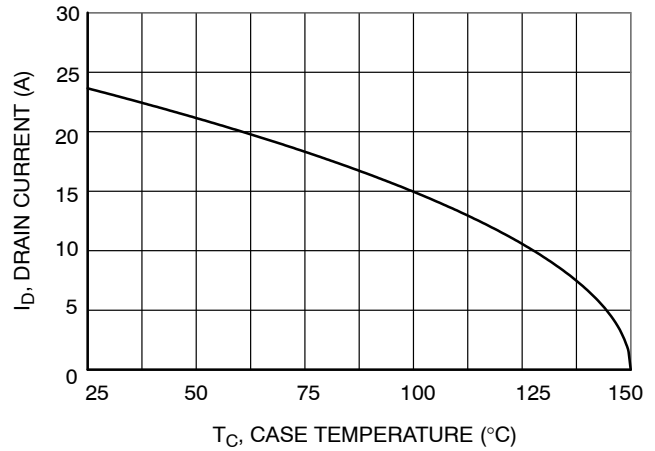


Figure 10. Maximum Drain Current vs. Case Temperature

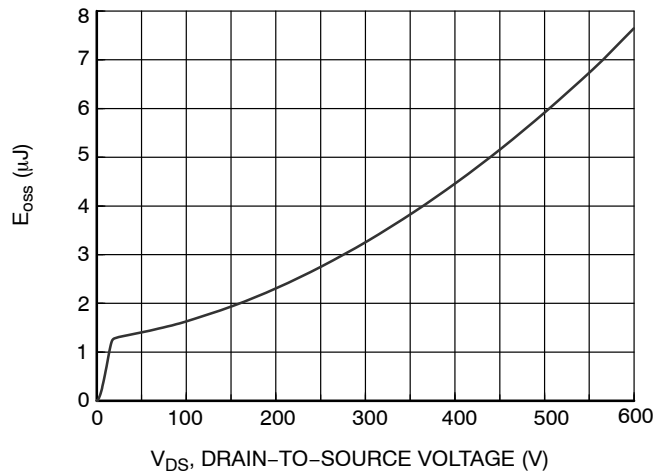
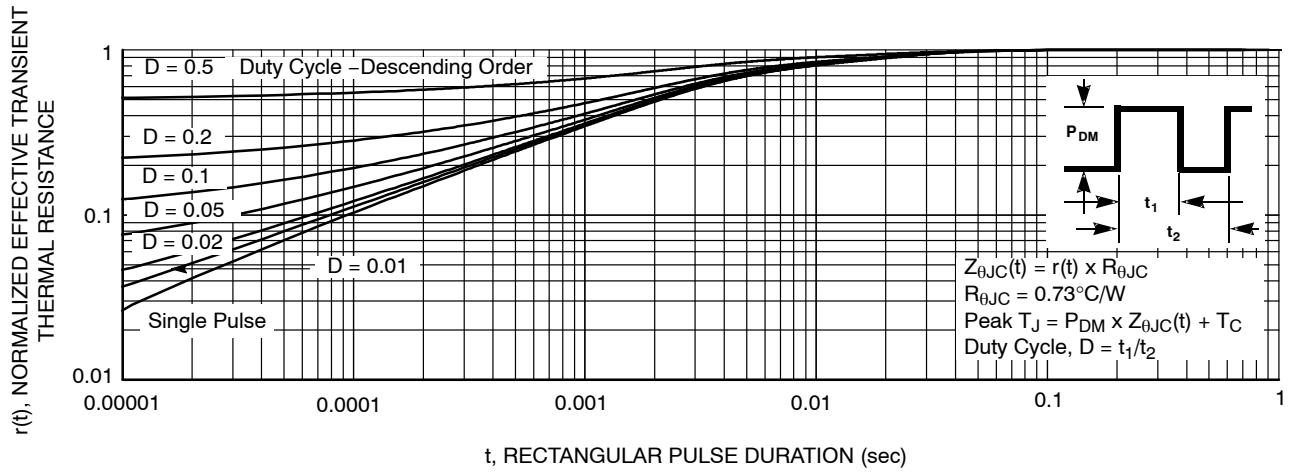


Figure 11.  $E_{OSS}$  vs. Drain to Source Voltage

# NTMT125N65S3H

## TYPICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)



**Figure 12. Transient Thermal Response Curve**

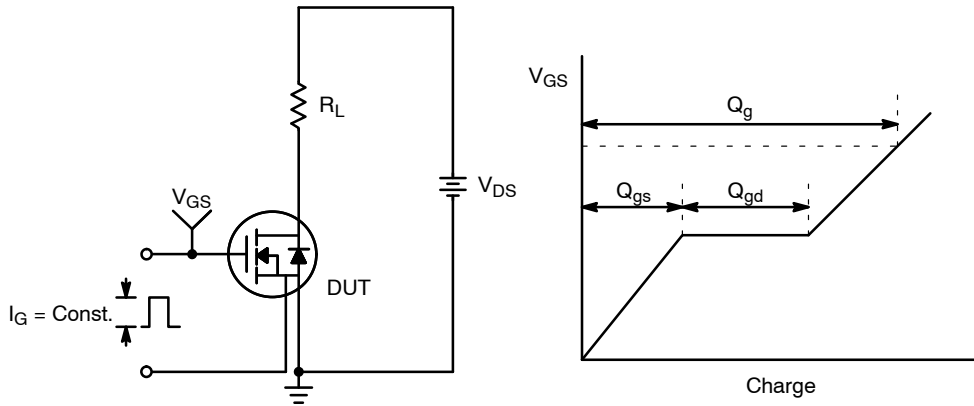


Figure 13. Gate Charge Test Circuit & Waveform

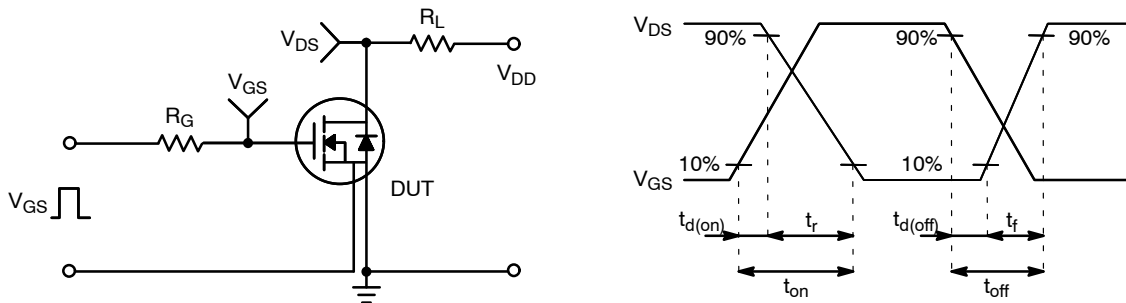


Figure 14. Resistive Switching Test Circuit & Waveforms

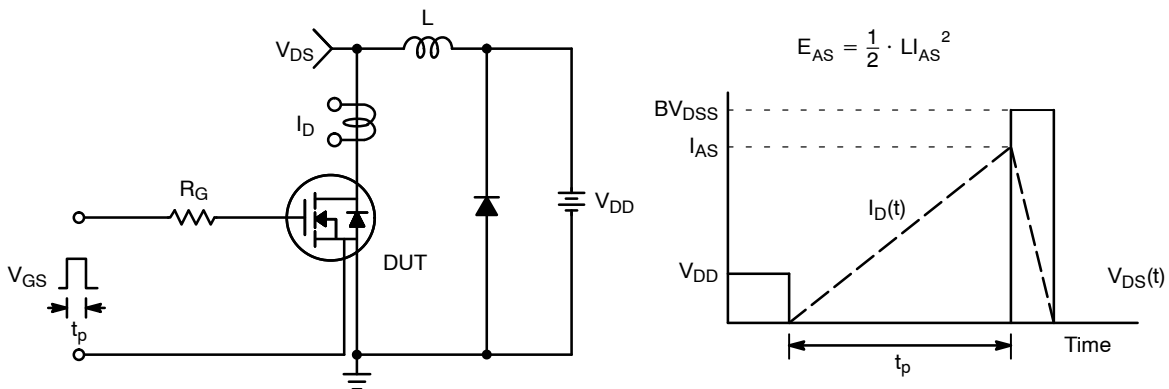
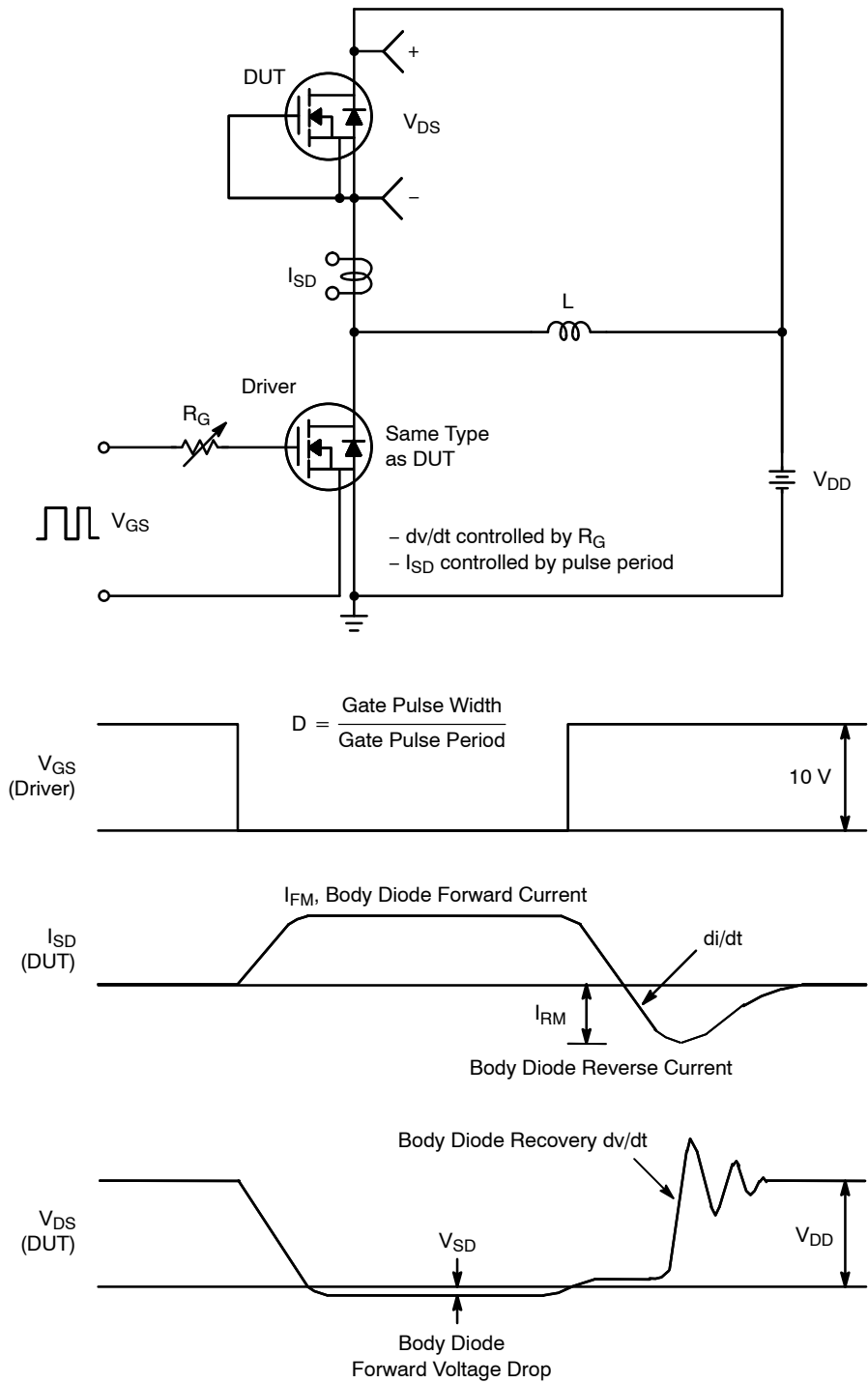


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms



**NTMT125N65S3H**



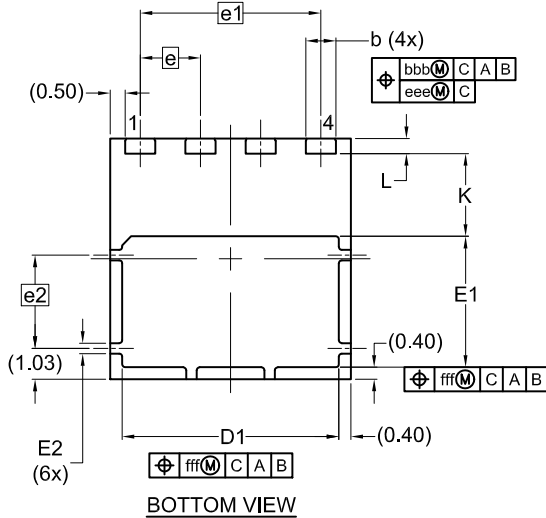
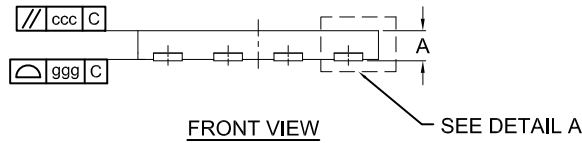
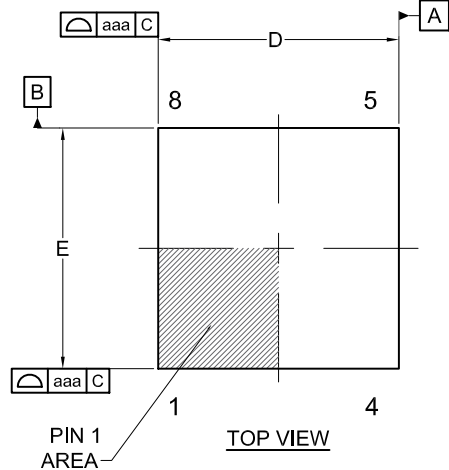
### Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

SUPERFET is a registered trademark of Semiconductor Components Industries, LLC.

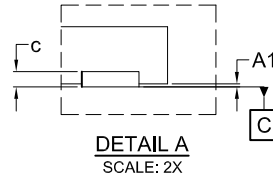
# NTMT125N65S3H

## PACKAGE DIMENSIONS

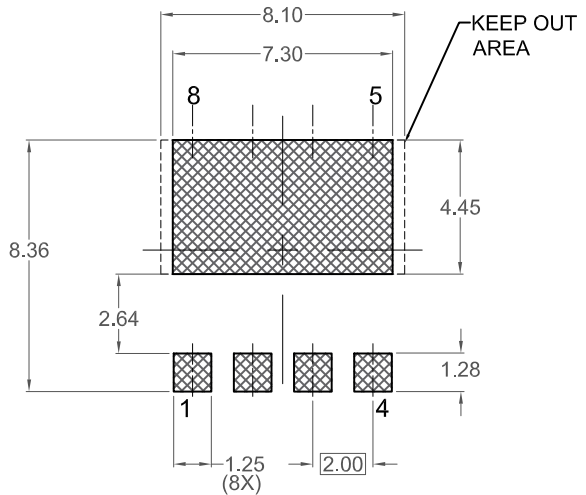
### TDFN4 8x8, 2P CASE 520AB ISSUE O



- NOTES: UNLESS OTHERWISE SPECIFIED  
A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION MO-220.  
B) ALL DIMENSIONS ARE IN MILLIMETERS.  
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.  
D) IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.



| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.90        | 1.00 | 1.10 |
| A1  | 0.00        | ---  | 0.05 |
| b   | 0.90        | 1.00 | 1.10 |
| c   | 0.10        | 0.20 | 0.30 |
| D   | 7.90        | 8.00 | 8.10 |
| D1  | 7.10        | 7.20 | 7.30 |
| E   | 7.90        | 8.00 | 8.10 |
| E1  | 4.25        | 4.35 | 4.45 |
| E2  | 0.15        | 0.25 | 0.35 |
| e   | 2.00 BSC    |      |      |
| e1  | 6.00 BSC    |      |      |
| e2  | 3.10 BSC    |      |      |
| K   | (2.75)      |      |      |
| L   | 0.40        | 0.50 | 0.60 |
| aaa | 0.10        |      |      |
| bbb | 0.10        |      |      |
| ccc | 0.05        |      |      |
| eee | 0.05        |      |      |
| fff | 0.10        |      |      |
| ggg | 0.15        |      |      |



#### RECOMMENDED LAND PATTERN

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

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-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.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