

# MOSFET - Power, N-Channel, SUPERFET<sup>®</sup> III, FAST

650 V, 190 mΩ, 16 A



ON Semiconductor<sup>®</sup>

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

## NTMT190N65S3H

### 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).

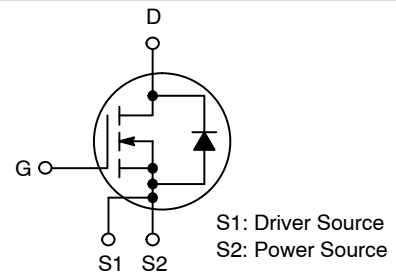
### Features

- 700 V @ T<sub>J</sub> = 150°C
- Typ. R<sub>DS(on)</sub> = 156 mΩ
- Ultra Low Gate Charge (Typ. Q<sub>g</sub> = 31 nC)
- Low Effective Output Capacitance (Typ. C<sub>oss(eff.)</sub> = 292 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

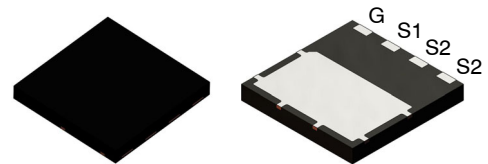
### Applications

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

V <sub>DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX
650 V	190 mΩ @ 10 V	16 A

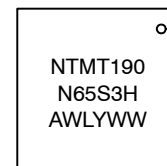


POWER MOSFET



TDFN4 8X8 2P  
CASE 520AB

### MARKING DIAGRAM



NTMT190N65S3H = 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.

# NTMT190N65S3H

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise noted)

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage	650	V
V <sub>GSS</sub>	Gate to Source Voltage	- DC	±30
		- AC (f > 1 Hz)	±30
I <sub>D</sub>	Drain Current	- Continuous (T <sub>C</sub> = 25°C)	16
		- Continuous (T <sub>C</sub> = 100°C)	10
I <sub>DM</sub>	Drain Current	- Pulsed (Note 1)	45
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	1.42	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	3.6	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	1.29	mJ
dv/dt	MOSFET dv/dt	120	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	129
		- Derate Above 25°C	1.03
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds	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. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I<sub>AS</sub> = 3.6 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 8 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.97	°C/W
R <sub>θJA</sub>	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>
NTMT190N65S3H	NTMT190N65S3H	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.

# NTMT190N65S3H

## 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	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	650			V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	700			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$		0.63		V/ $^\circ\text{C}$
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	$\mu\text{A}$
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$		0.8		
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1.4\text{ mA}$	2.4		4.0	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 8\text{ A}$		156	190	m $\Omega$
g <sub>FS</sub>	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 8\text{ A}$		18		S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$		1600		pF
C <sub>oss</sub>	Output Capacitance			23		pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		292		pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		41		pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}$ (Note 5)		31		nC
Q <sub>gs</sub>	Gate to Source Gate Charge			7.1		nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge			7.9		nC
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$		1.1		$\Omega$

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 8\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 10\ \Omega$ (Note 5)		21		ns
t <sub>r</sub>	Turn-On Rise Time			8.1		ns
t <sub>d(off)</sub>	Turn-Off Delay Time			59		ns
t <sub>f</sub>	Turn-Off Fall Time			3.7		ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current				17	A
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current				45	A
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}$			1.2	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 8\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$		225		ns
Q <sub>rr</sub>	Reverse Recovery Charge			2.7		$\mu\text{C}$

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.

# NTMT190N65S3H

## TYPICAL CHARACTERISTICS

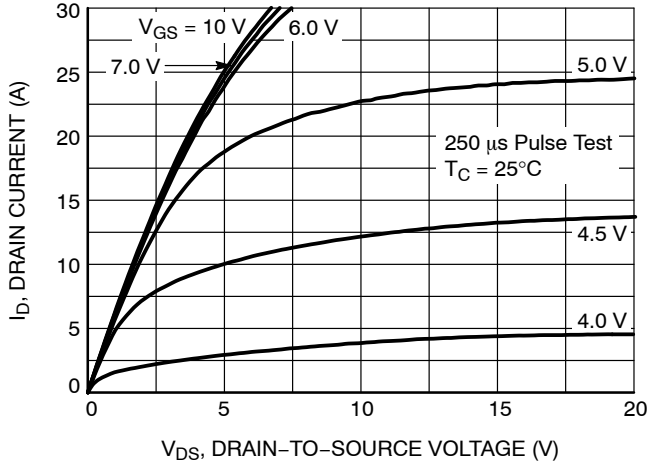


Figure 1. On-Region Characteristics

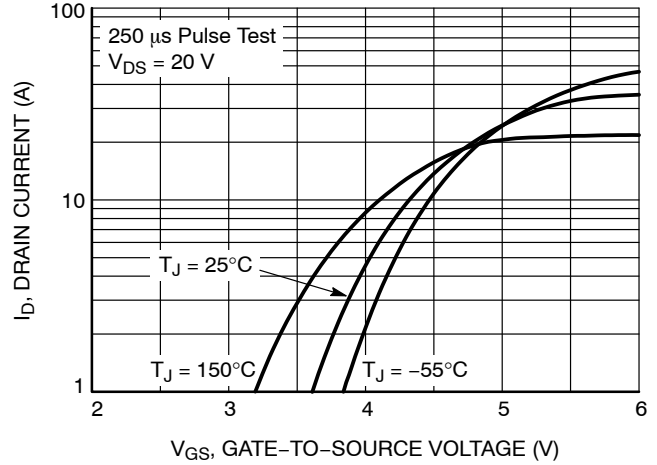


Figure 2. Transfer Characteristics

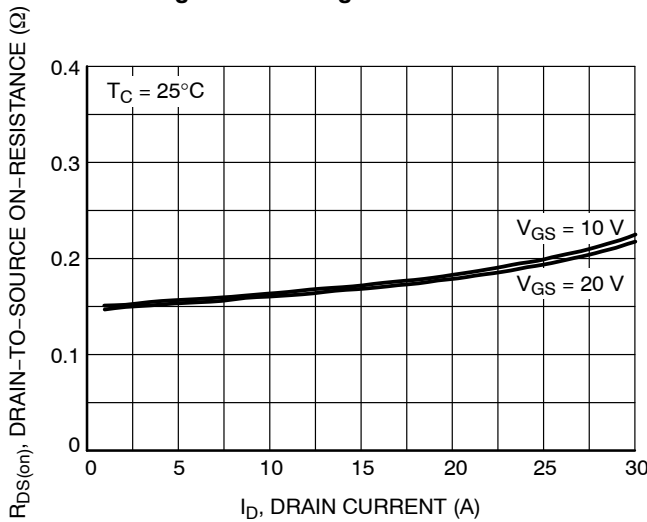


Figure 3. On Resistance Variation vs. Drain Current and Gate Voltage

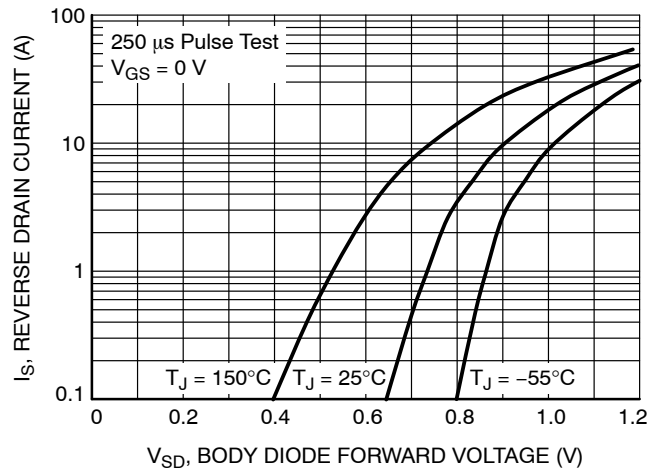


Figure 4. Diode Forward Voltage Variation vs. Source Current and Temperature

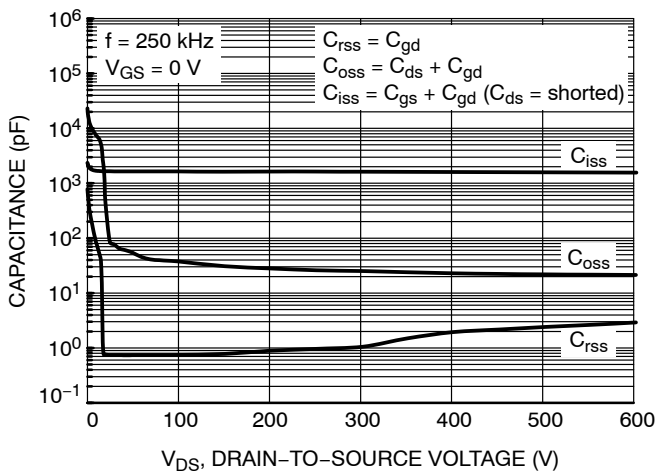


Figure 5. Capacitance Characteristics

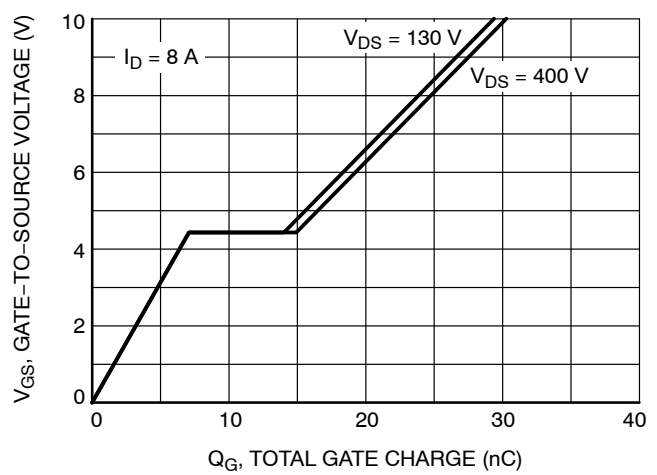


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

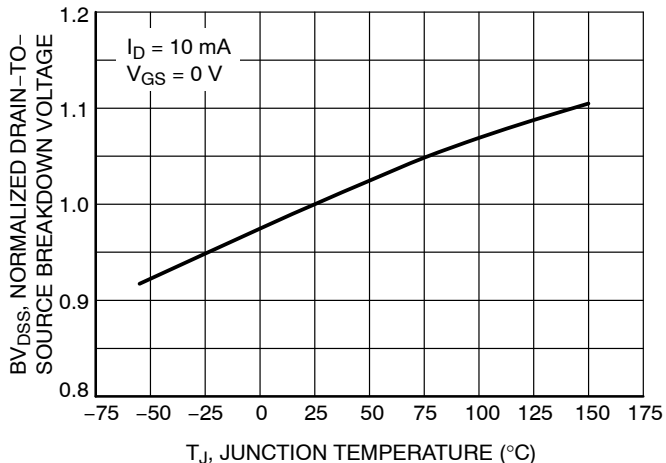


Figure 7. Breakdown Voltage Variation vs. Temperature

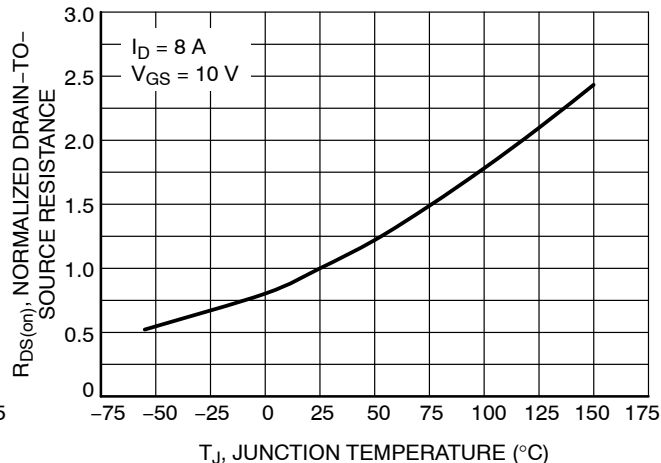


Figure 8. On-Resistance Variation vs. Temperature

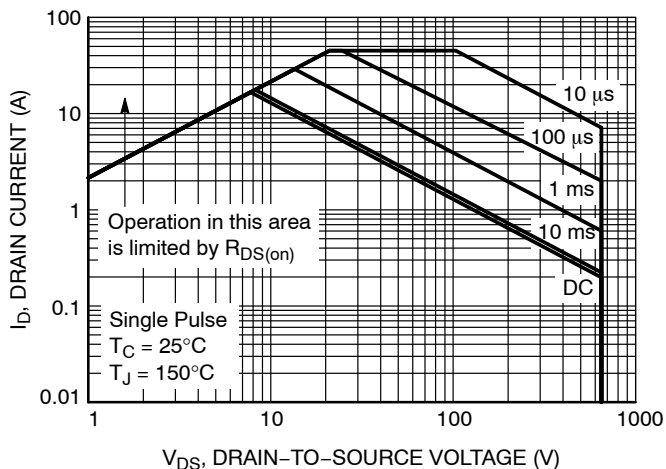


Figure 9. Maximum Safe Operating Area

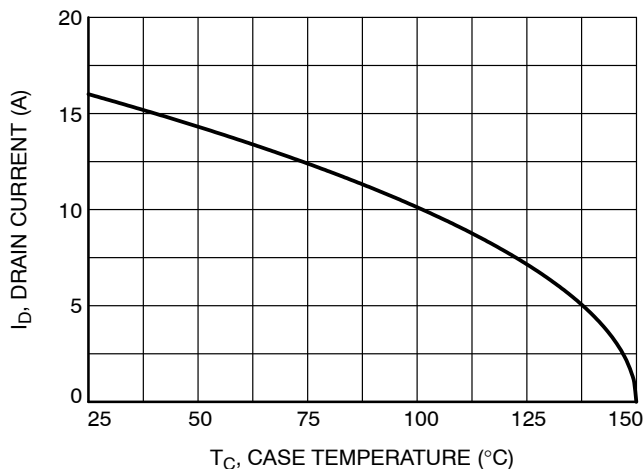


Figure 10. Maximum Drain Current vs. Case Temperature

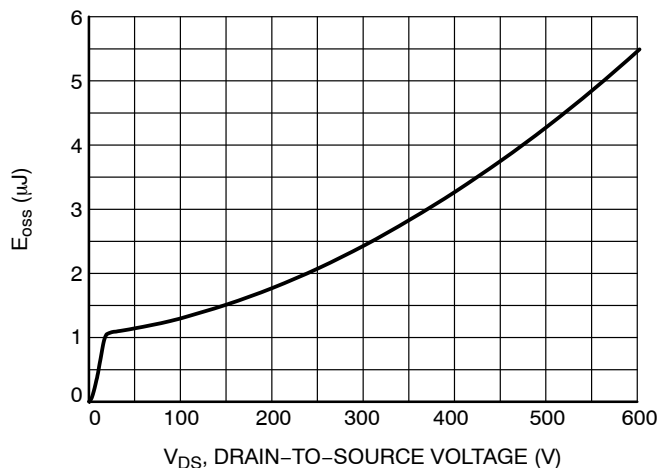


Figure 11. E<sub>oss</sub> vs. Drain-to-Source Voltage

# NTMT190N65S3H

## TYPICAL CHARACTERISTICS

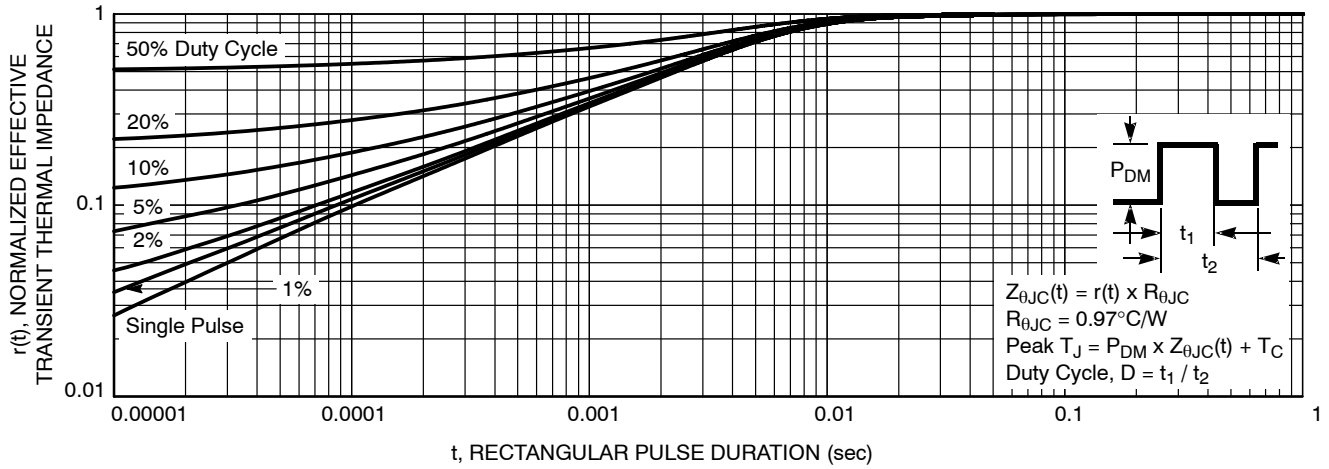


Figure 12. Transient Thermal Response Curve

# NTMT190N65S3H



Figure 13. Gate Charge Test Circuit & Waveform

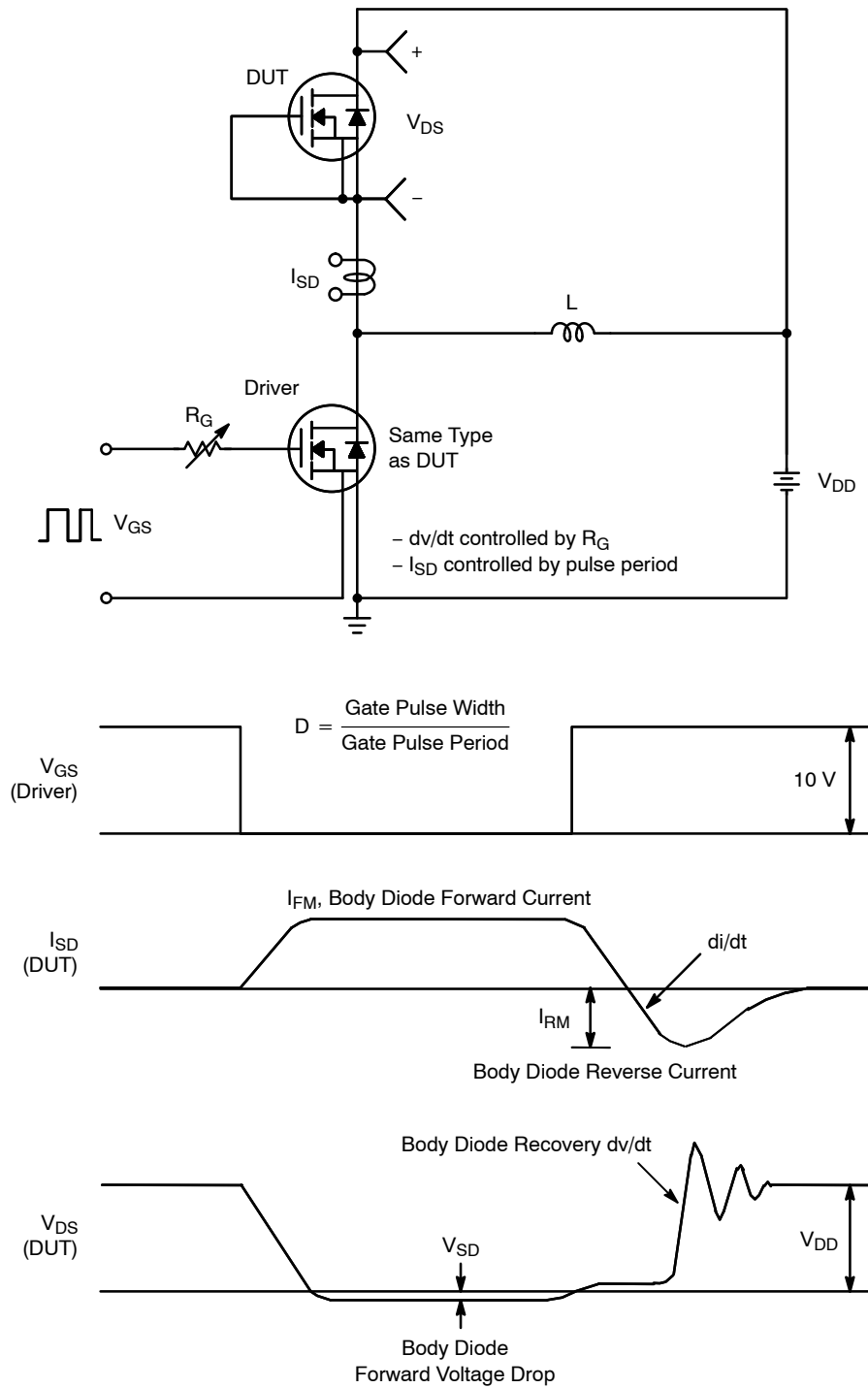


Figure 14. Resistive Switching Test Circuit & Waveforms



Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

# NTMT190N65S3H



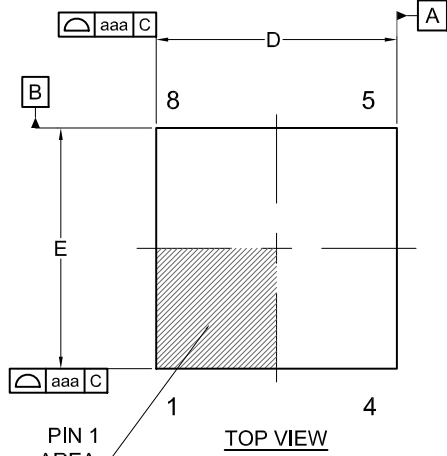
**Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**



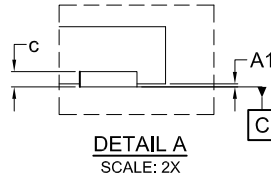
# NTMT190N65S3H

## PACKAGE DIMENSIONS

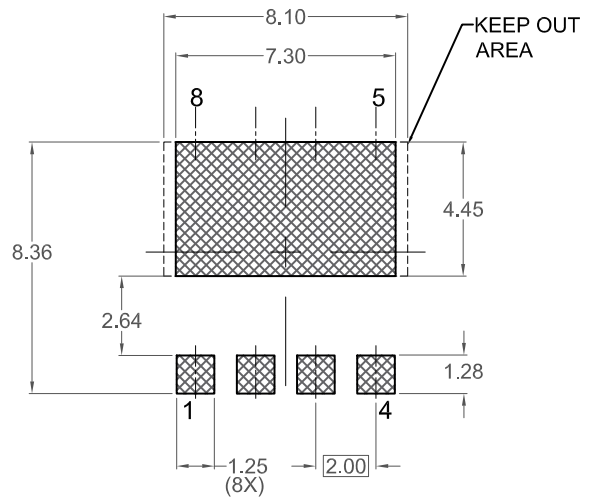
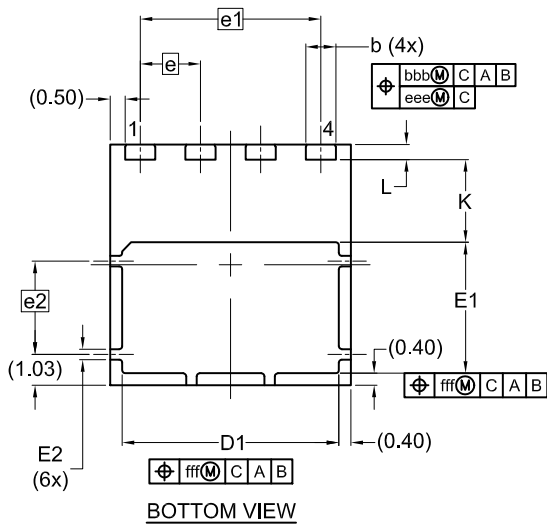
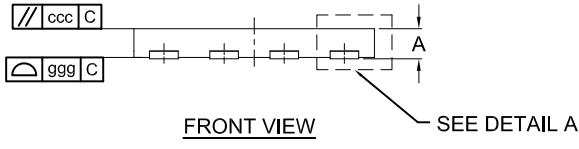
### TDFN4 8x8, 2P CASE 520AB ISSUE O



- 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		



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

**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