

MOSFET - Power, N-Channel, SUPERFET® III, FRFET® 650 V, 20 A, 190 mΩ

NTMT190N65S3HF

Description

SUPERFET III MOSFET is onsemi'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 MOSFET is very suitable for the various power systems for miniaturization and higher efficiency.

SUPERFET III FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional components and improve system reliability.

The TDFN4 package is an ultra-slim surface-mount package (1 mm high) with a low profile and small footprint (8x8 mm²). SUPERFET III MOSFET in a TDFN4 package offers excellent switching performance due to lower parasitic source inductance and separated power and drive sources. TDFN4 offers Moisture Sensitivity Level 1 (MSL 1).

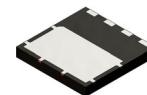
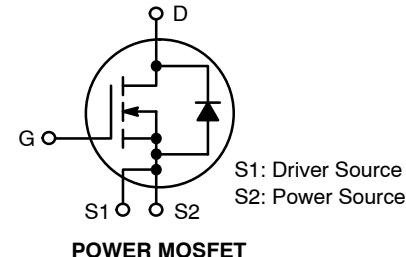
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ $R_{DS(\text{on})} = 159 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 34 \text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(\text{eff.})} = 316 \text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

Applications

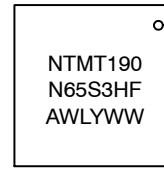
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar
- Lighting / Charger / Adapter

V_{DSS}	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
650 V	190 mΩ @ 10 V	20 A



TDFN4 8x8
CASE 520AB

MARKING DIAGRAM



NTMT190N65S3HF = 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.

NTMT190N65S3HF

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise specified)

Symbol	Parameter		Value	Unit
V _{DSS}	Drain to Source Voltage		650	V
V _{GSS}	Gate to Source Voltage	DC	±30	V
		AC (f > 1 Hz)	±30	V
I _D	Drain Current	Continuous (T _C = 25°C)	20	A
		Continuous (T _C = 100°C)	12.7	
I _{DM}	Drain Current	Pulsed (Note 1)	50	A
E _{AS}	Single Pulsed Avalanche Energy (Note 2)		220	mJ
I _{AS}	Avalanche Current (Note 2)		3.7	A
E _{AR}	Repetitive Avalanche Energy (Note 1)		1.62	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P _D	Power Dissipation	(T _C = 25°C)	162	W
		Derate Above 25°C	1.3	W/°C
T _J , T _{STG}	Operating and Storage Temperature Range		−55 to +150	°C
T _L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 s		300	°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} = 3.7 A, R_G = 25 Ω starting T_J = 25°C
3. I_{SD} ≤ 10 A, di/dt ≤ 100 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R _{θJC}	Thermal Resistance, Junction to Case, Max.	0.77	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max. (Note 4)	45	

4. Device on 1 in² pad 2 oz copper pad on 1.5 x 1.5 in. board of FR-4 material.

ORDERING INFORMATION

Part Number	Top Marking	Package	Reel Size	Tape Width	Shipping [†]
NTMT190N65S3HF	NTMT190N65S3HF	TDFN4	13"	13.3 mm	3000 / Tape & Reel

[†]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.

NTMT190N65S3HF

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

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

OFF CHARACTERISTICS

BV _{DSS}	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
$\Delta V_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10 \text{ mA}$, referenced to 25°C	–	0.65	–	$^\circ\text{C}$
I _{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650 \text{ V}, V_{GS} = 0 \text{ V}$	–	–	10	μA
		$V_{DS} = 520 \text{ V}, T_C = 125^\circ\text{C}$	–	15	–	
I _{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$	–	–	± 100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 0.43 \text{ mA}$	3.0	–	5.0	V
R _{DS(on)}	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 10 \text{ A}$	–	159	190	$\text{m}\Omega$
g _{FS}	Forward Transconductance	$V_{DS} = 20 \text{ V}, I_D = 10 \text{ A}$	–	11	–	S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	–	1610	–	pF
C _{oss}	Output Capacitance		–	30	–	pF
C _{oss(eff.)}	Effective Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	316	–	pF
C _{oss(er.)}	Energy Related Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	59	–	pF
Q _{g(tot)}	Total Gate Charge at 10 V	$V_{DS} = 400 \text{ V}, I_D = 10 \text{ A}, V_{GS} = 10 \text{ V}$ (Note 5)	–	34	–	nC
	Gate to Source Gate Charge		–	11	–	nC
	Gate to Drain "Miller" Charge		–	13	–	nC
	ESR		f = 1 MHz	–	4.1	–

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	$V_{DD} = 400 \text{ V}, I_D = 10 \text{ A}, V_{GS} = 10 \text{ V}, R_{GEN} = 4.7 \Omega$ (Note 5)	–	22	–	ns
t _r	Rise Time		–	13	–	ns
t _{d(off)}	Turn-Off Delay Time		–	53	–	ns
t _f	Fall Time		–	3.3	–	ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current	–	–	20	A	
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current	–	–	50	A	
V _{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 10 \text{ A}$	–	–	1.3	V
t _{rr}	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 10 \text{ A}, \frac{dI_F}{dt} = 100 \text{ A}/\mu\text{s}$	–	72	–	ns
	Reverse Recovery Charge		–	255	–	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.

5. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS

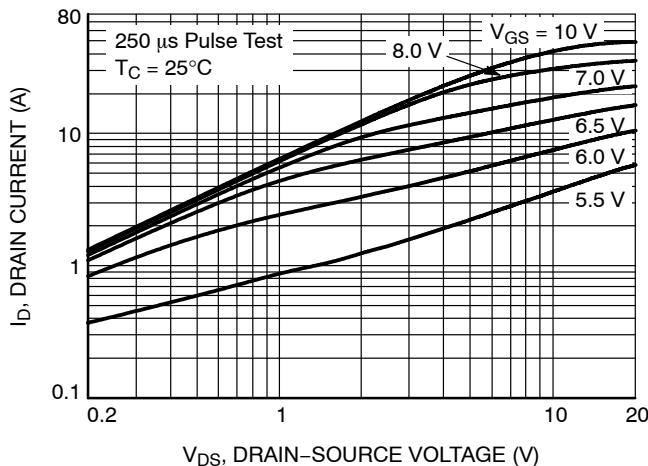


Figure 1. On-Region Characteristics

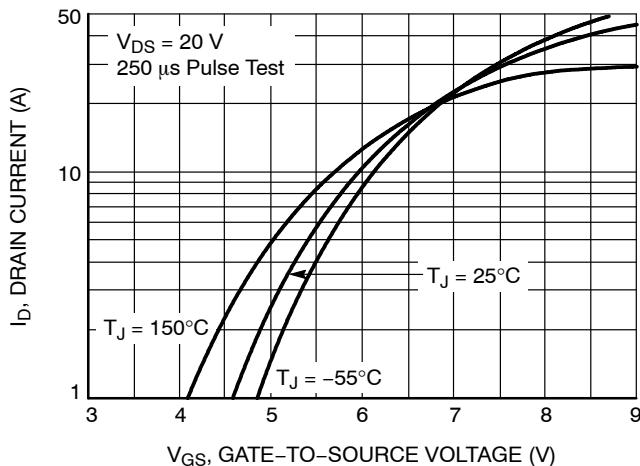


Figure 2. Transfer Characteristics

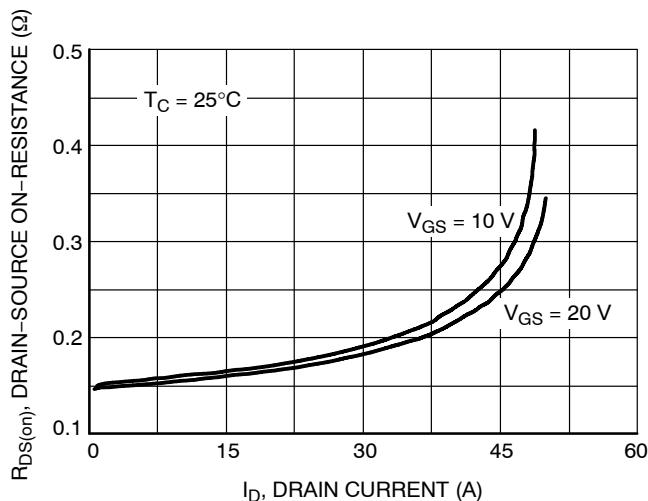


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

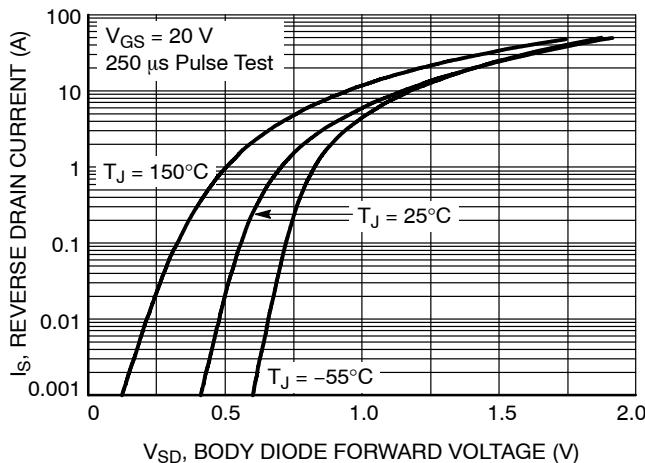


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

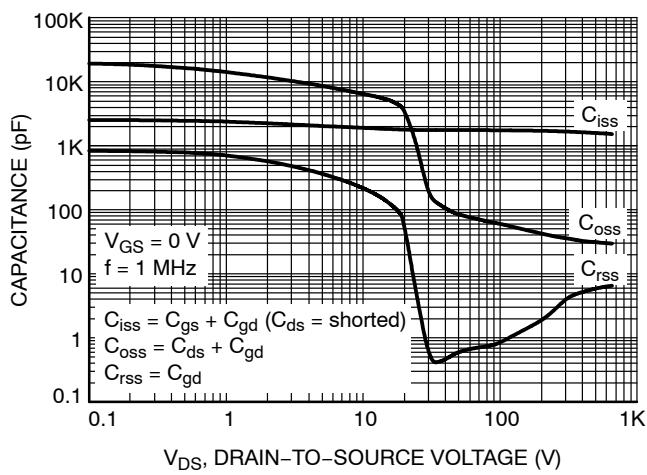


Figure 5. Capacitance Characteristics

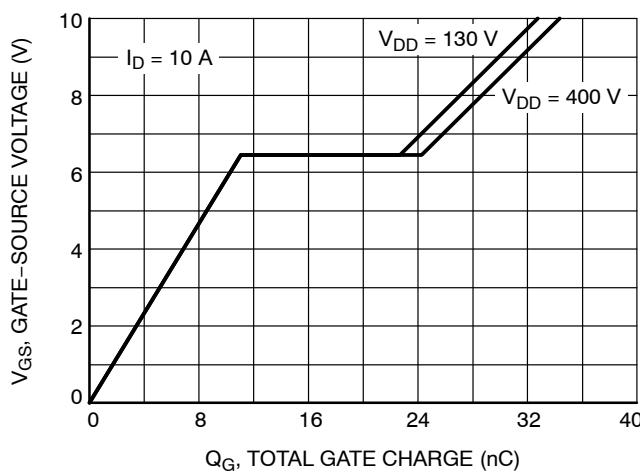
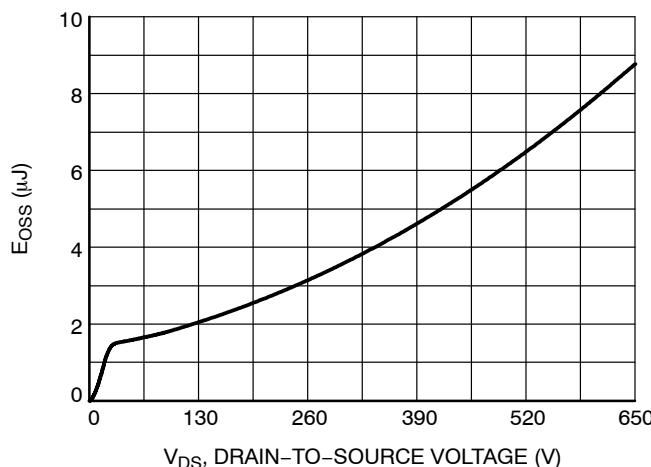
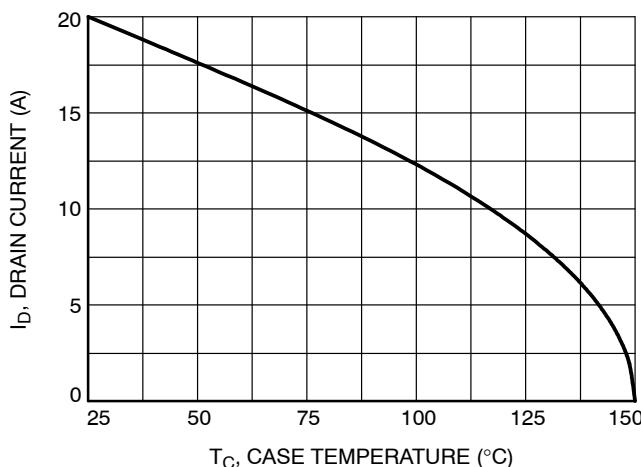
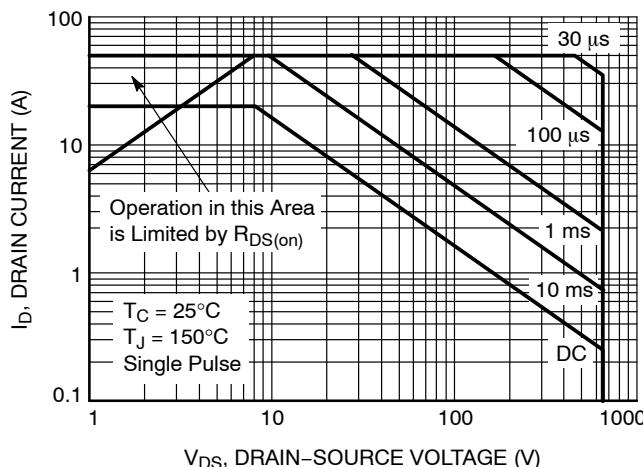
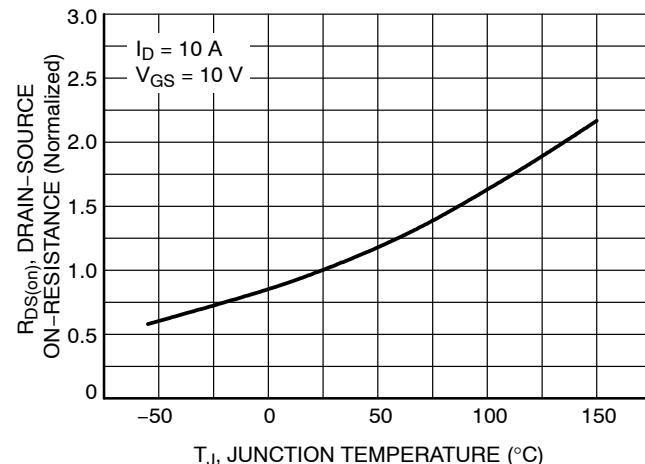
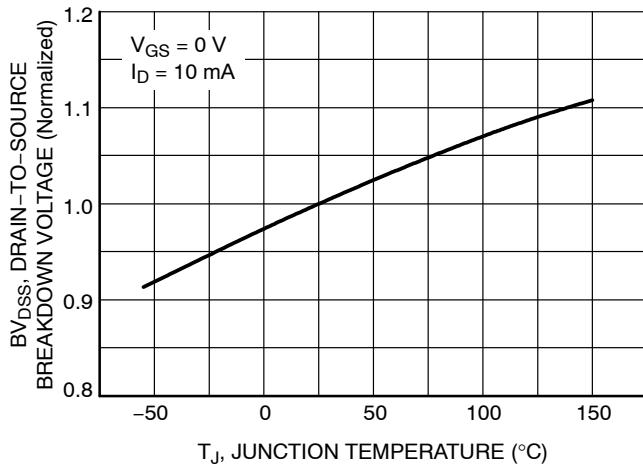


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS



NTMT190N65S3HF

TYPICAL CHARACTERISTICS

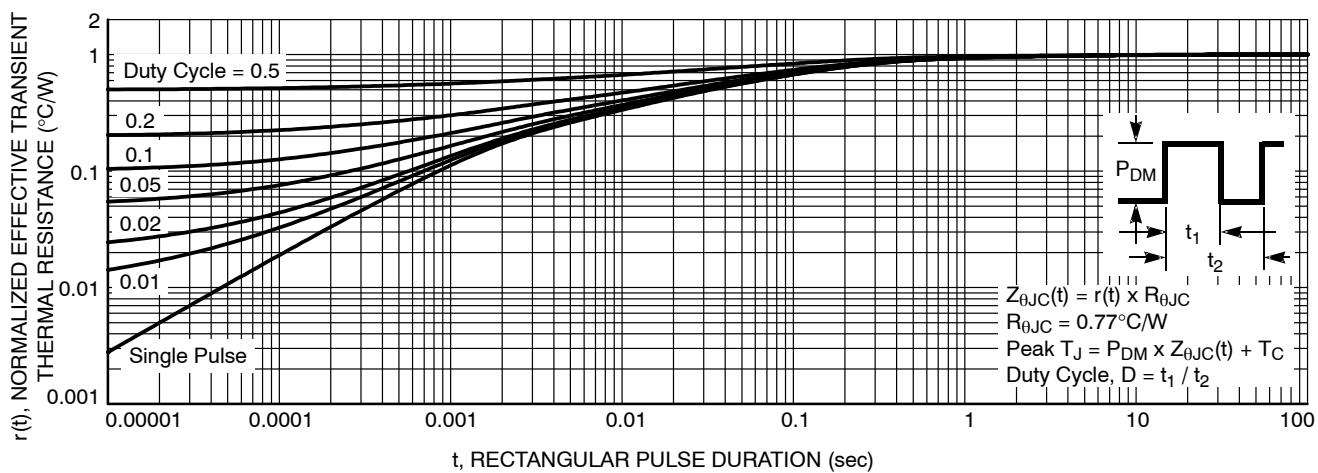


Figure 12. Transient Thermal Response Curve

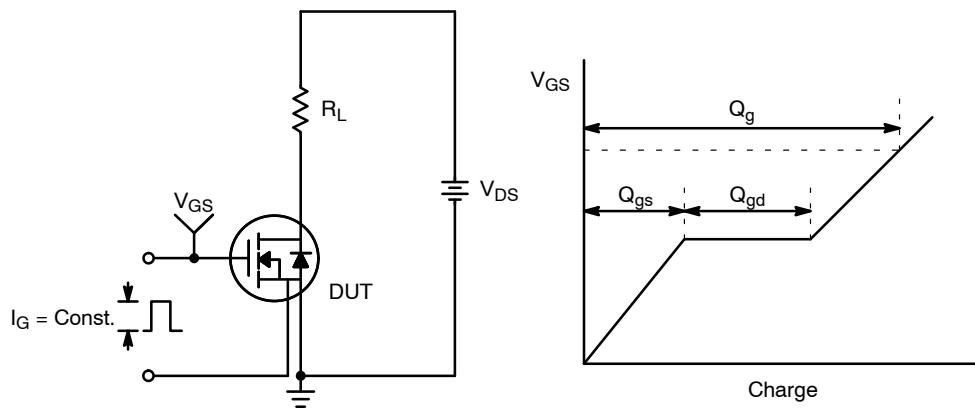


Figure 13. Gate Charge Test Circuit & Waveform

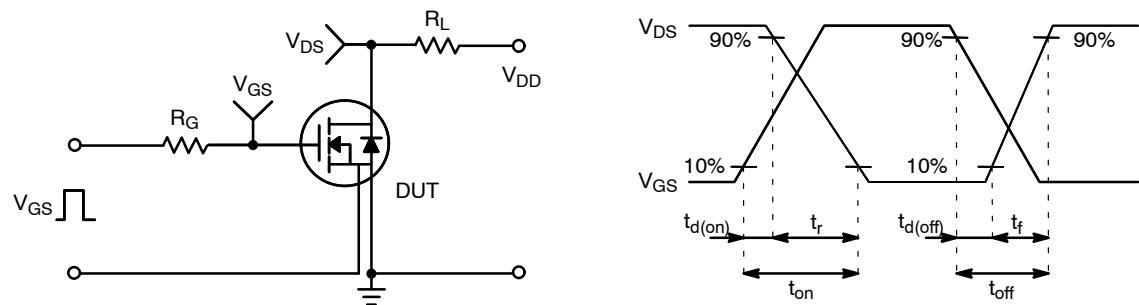


Figure 14. Resistive Switching Test Circuit & Waveforms

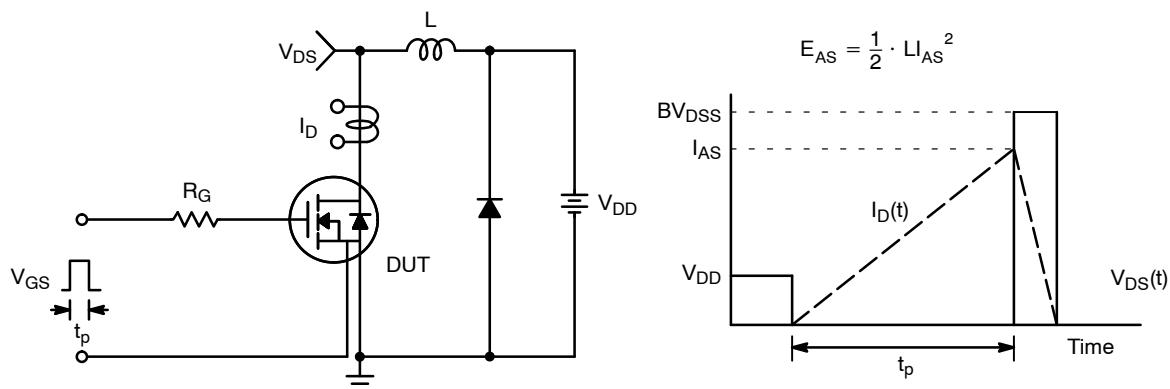


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

NTMT190N65S3HF

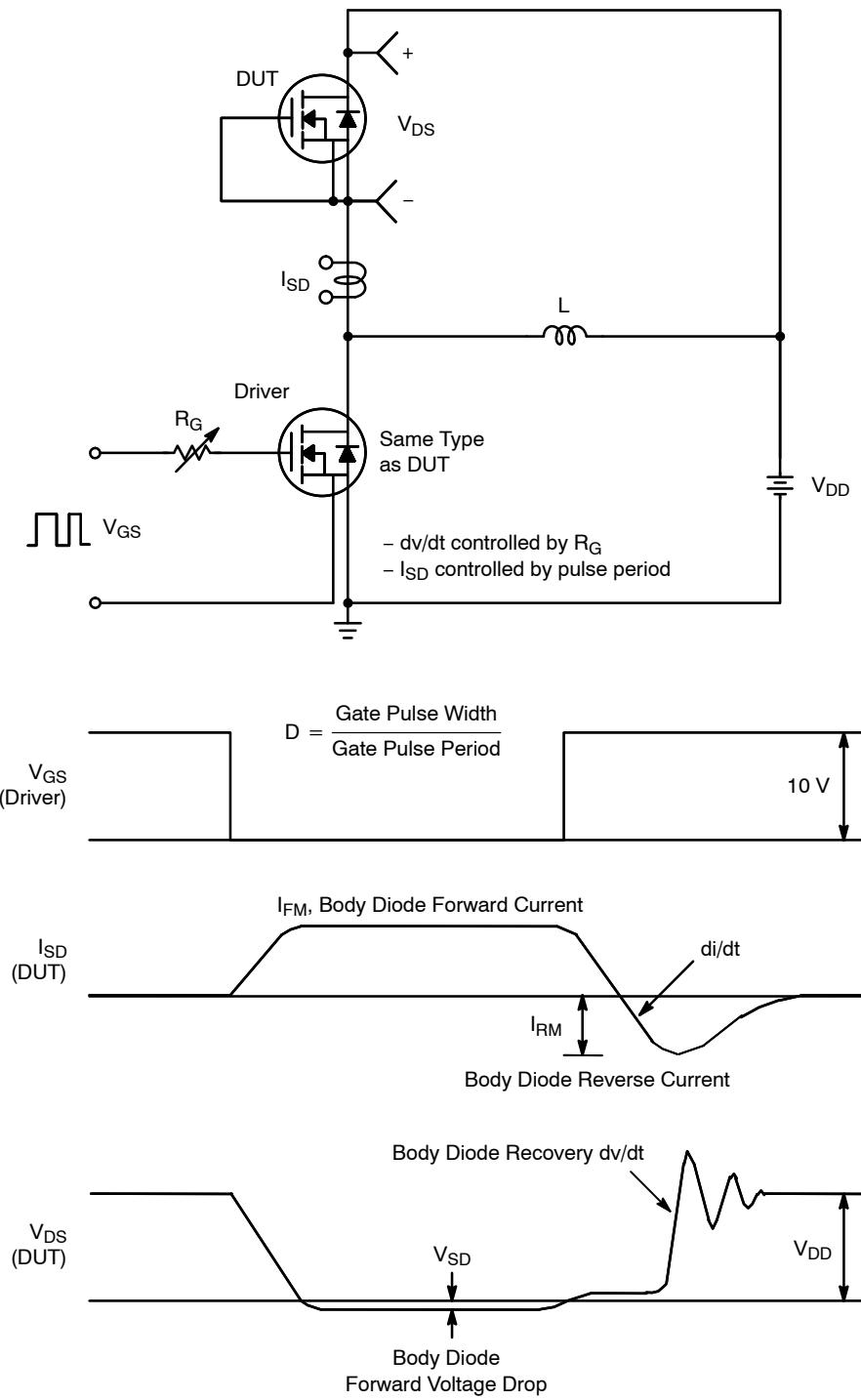


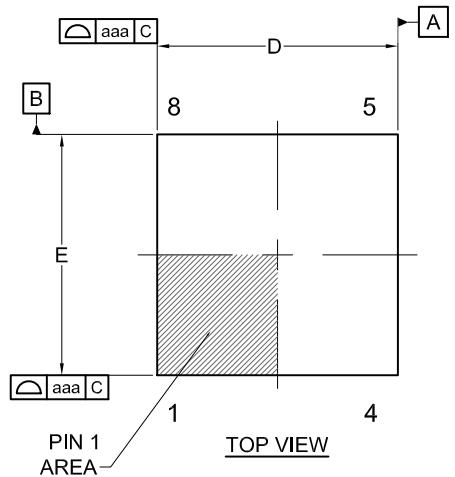
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

PACKAGE DIMENSIONS

TDFN4 8x8, 2P

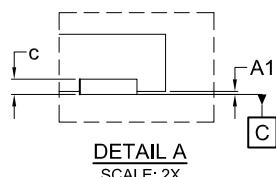
CASE 520AB

ISSUE 0

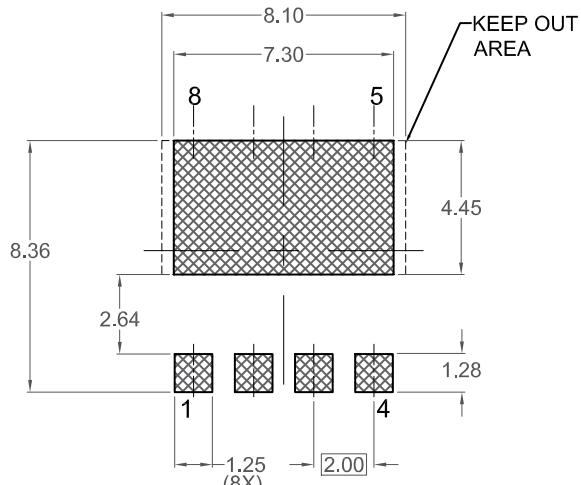
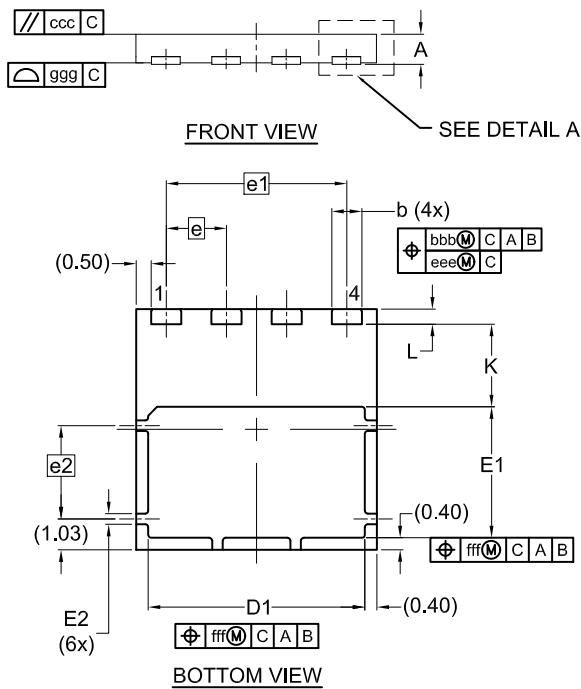


NOTES: UNLESS OTHERWISE SPECIFIED

- 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, SODERRM/D.

SUPERFET is a registered trademark of Semiconductor Components Industries, LLC. FRFET is a registered trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

onsemi, **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**'s product/patent coverage may be accessed at 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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

onsemi Website: 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

