

# MOSFET – Power, N-Channel, SUPERFET® V, FAST

600 V, 185 mΩ, 15 A



ON Semiconductor®

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

## NTMT185N60S5H

### Description

The SUPERFET V MOSFET is the fifth generation high voltage super-junction (SJ) MOSFET family from ON Semiconductor. SUPERFET V delivers best-in-class FOMs ( $R_{DS(ON)} \cdot Q_G$  and  $R_{DS(ON)} \cdot E_{OSS}$ ) to improve not only heavy load but also light load efficiency. The 600 V SUPERET V series provides design benefits through reduced conduction and switching losses, while supporting extreme MOSFET  $dV_{DS}/dt$  ratings at 120 V/ns. Consequently, the SUPERFET V MOSFET FAST series helps maximize system efficiency and power density.

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 V 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).

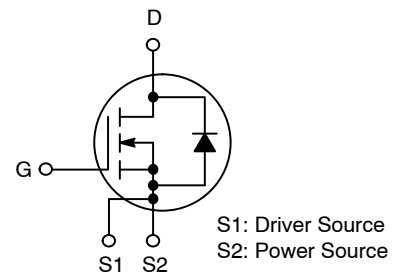
### Features

- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 148 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 25 \text{ nC}$ )
- Low Time Related Output Capacitance (Typ.  $C_{oss(tr)} = 372 \text{ pF}$ )
- 100% Avalanche Tested
- Kelvin Source Configuration and Low Parasitic Source Inductance
- MSL1 Qualified
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

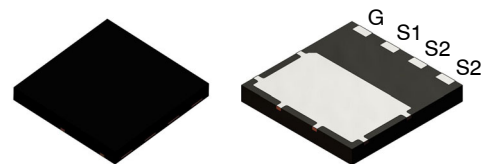
### Applications

- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter

$V_{DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
600 V	185 mΩ @ 10 V	15 A

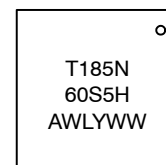


POWER MOSFET



TDFN4 8x8 2P  
CASE 520AB

### MARKING DIAGRAM



T185N60S5H = 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.

# NTMT185N60S5H

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

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage	600	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)	15
		- Continuous (T <sub>C</sub> = 100°C)	9
I <sub>DM</sub>	Drain Current	- Pulsed (Note 1)	53
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	124	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	3.6	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	1.16	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)	116
		- Derate Above 25°C	0.93
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> ≤ 7.5 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.	1.08	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	45	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Reel Size	Tape Width	Shipping Quantity†
NTMT185N60S5H	T185N60S5H	TDFN4	13"	13.3 mm	3000 Units / 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.

# NTMT185N60S5H

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### 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	600	–	–	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	650	–	–	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> = 600 V, V <sub>GS</sub> = 0 V	–	–	2	μA
		V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C	–	1	–	
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> = 1.4 mA	2.7	–	4.3	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 7.5 A	–	148	185	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 7.5 A	–	18	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 250 kHz	–	1350	–	pF
C <sub>oss</sub>	Output Capacitance		–	25	–	pF
C <sub>oss(tr)</sub>	Time Related Output Capacitance	I <sub>D</sub> = Constant, V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	372	–	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	–	42	–	pF
Q <sub>g(tot)</sub>	Total Gate Charge	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 7.5 A, V <sub>GS</sub> = 10 V	–	25	–	nC
Q <sub>gs</sub>	Gate to Source Charge		–	7	–	nC
Q <sub>gd</sub>	Gate to Drain Charge		–	8	–	nC
ESR	Equivalent Series Resistance		f = 1 MHz	–	0.9	–

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 7.5 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 10 Ω	–	18	–	ns
t <sub>r</sub>	Turn-On Rise Time		–	8	–	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	52	–	ns
t <sub>f</sub>	Turn-Off Fall Time		–	4.3	–	ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current	–	–	15	A	
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current	–	–	53	A	
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 7.5 A	–	–	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>DD</sub> = 400 V, I <sub>SD</sub> = 7.5 A, dI <sub>F</sub> /dt = 100 A/μs	–	213	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	2.4	–	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.

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## TYPICAL CHARACTERISTICS

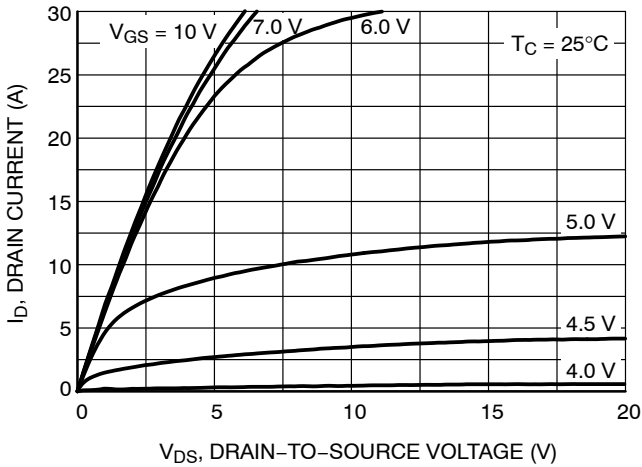


Figure 1. On-Region Characteristics

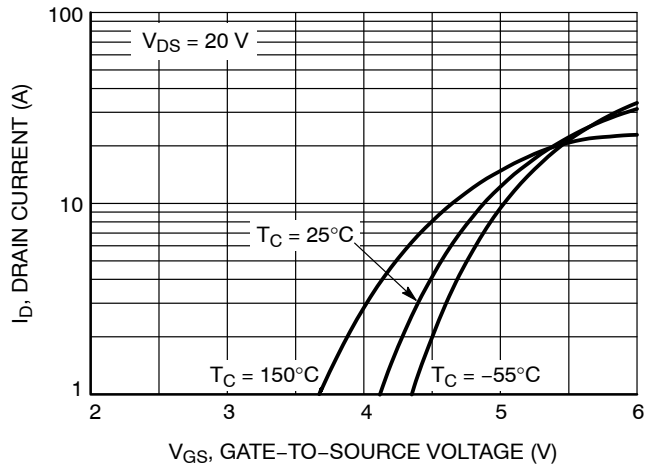


Figure 2. Transfer Characteristics

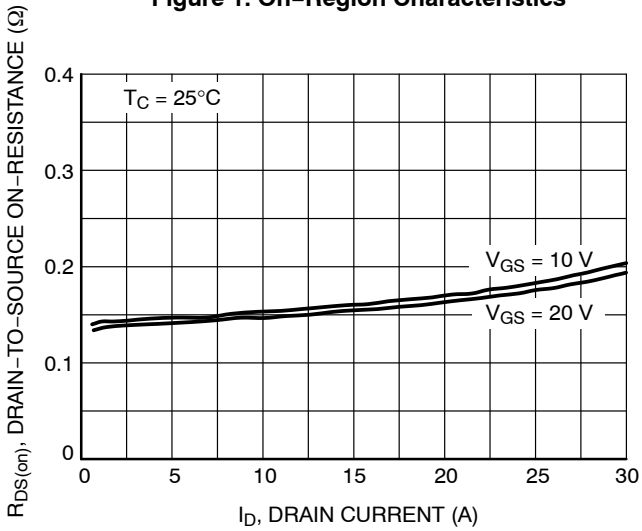


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

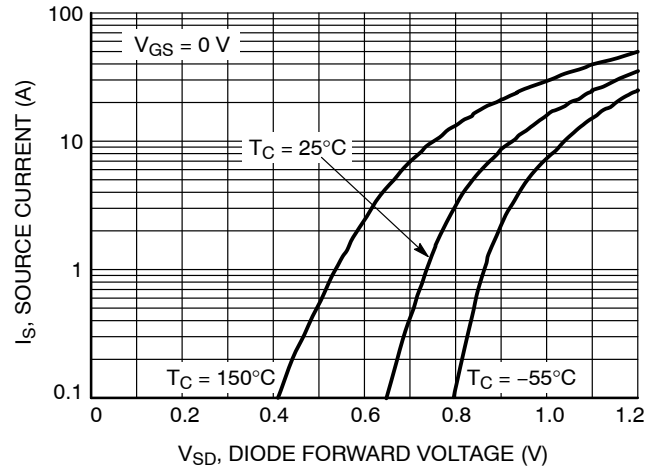


Figure 4. Diode Forward Voltage vs. Source Current

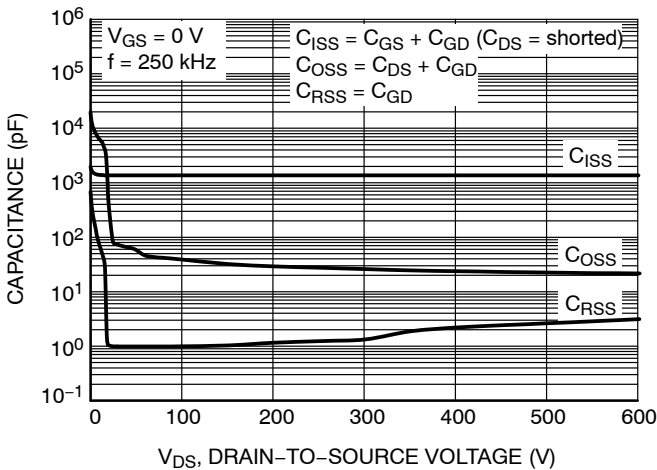


Figure 5. Capacitance Characteristics

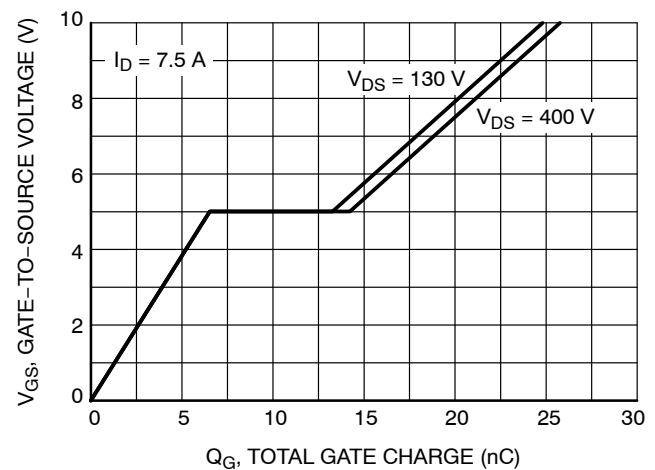
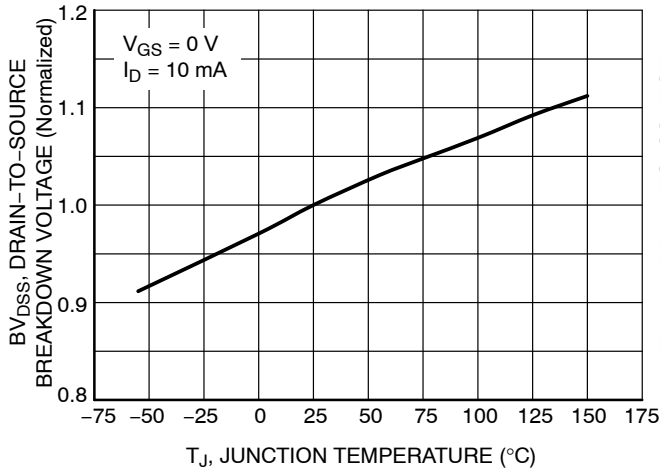


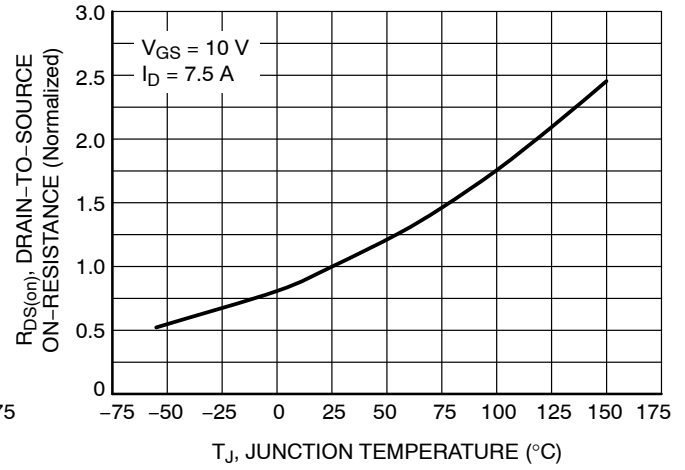
Figure 6. Gate Charge Characteristics

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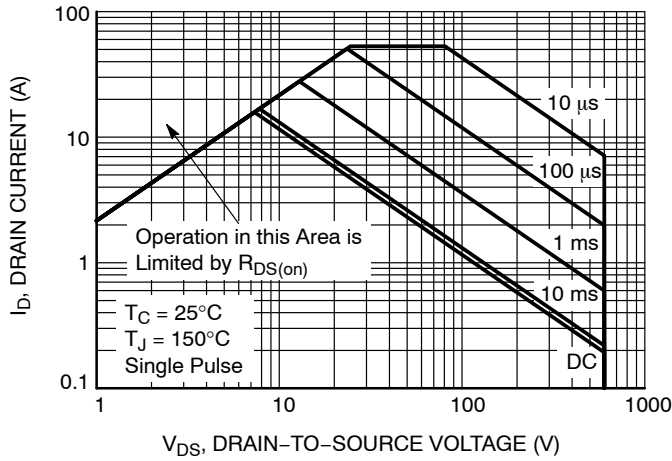
## TYPICAL CHARACTERISTICS



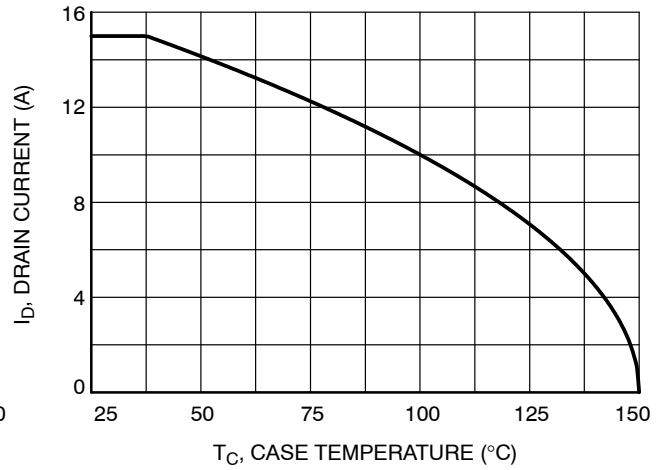
**Figure 7. Breakdown Voltage Variation vs. Temperature**



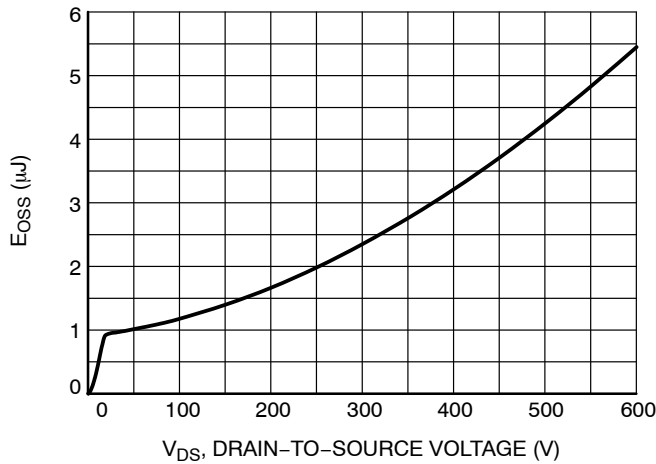
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum Drain Current vs. Case Temperature**



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

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## TYPICAL CHARACTERISTICS

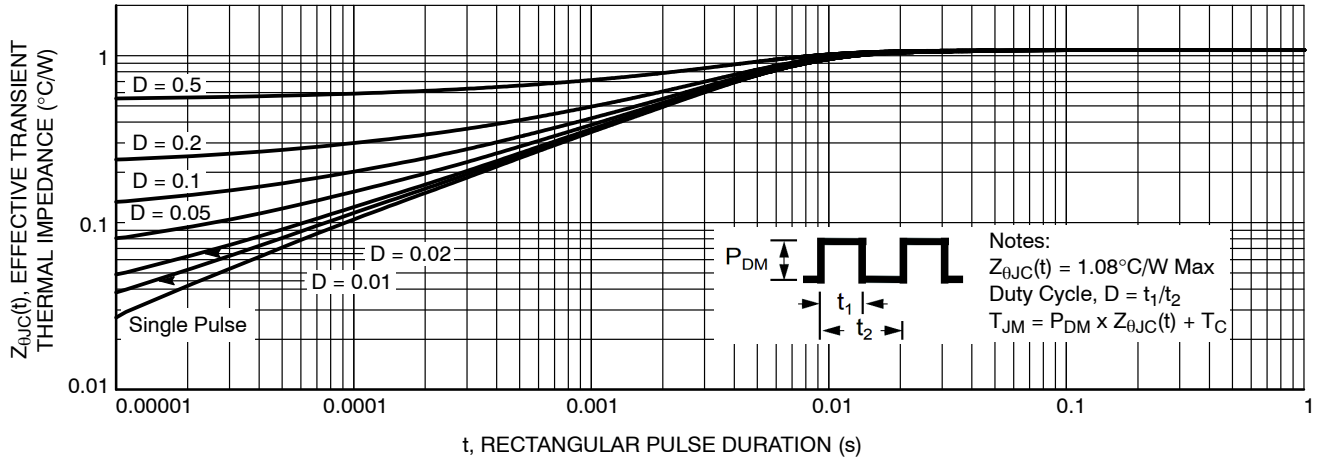


Figure 12. Transient Thermal Impedance

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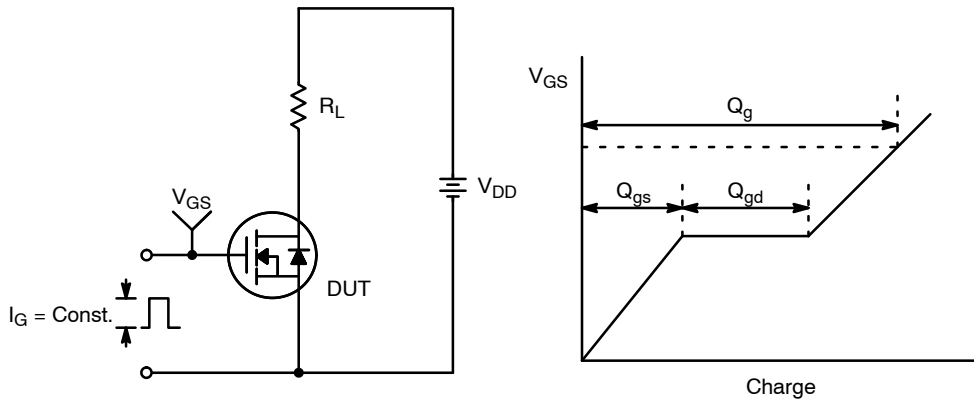


Figure 13. Gate Charge Test Circuit & Waveform

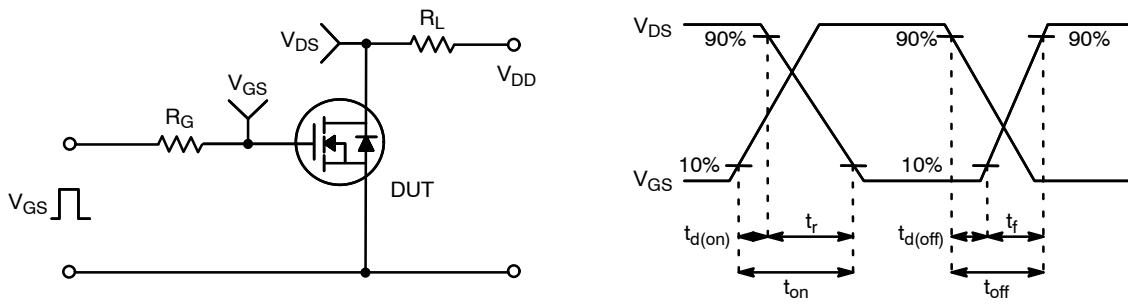


Figure 14. Resistive Switching Test Circuit & Waveforms

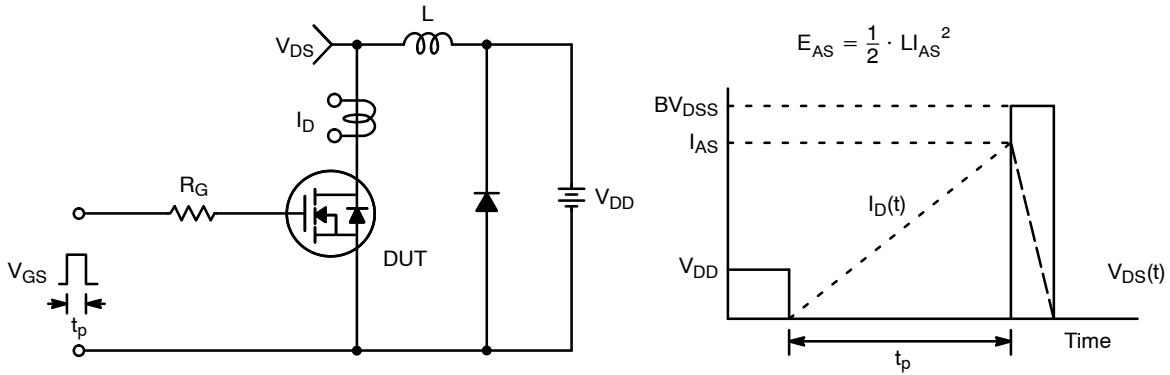
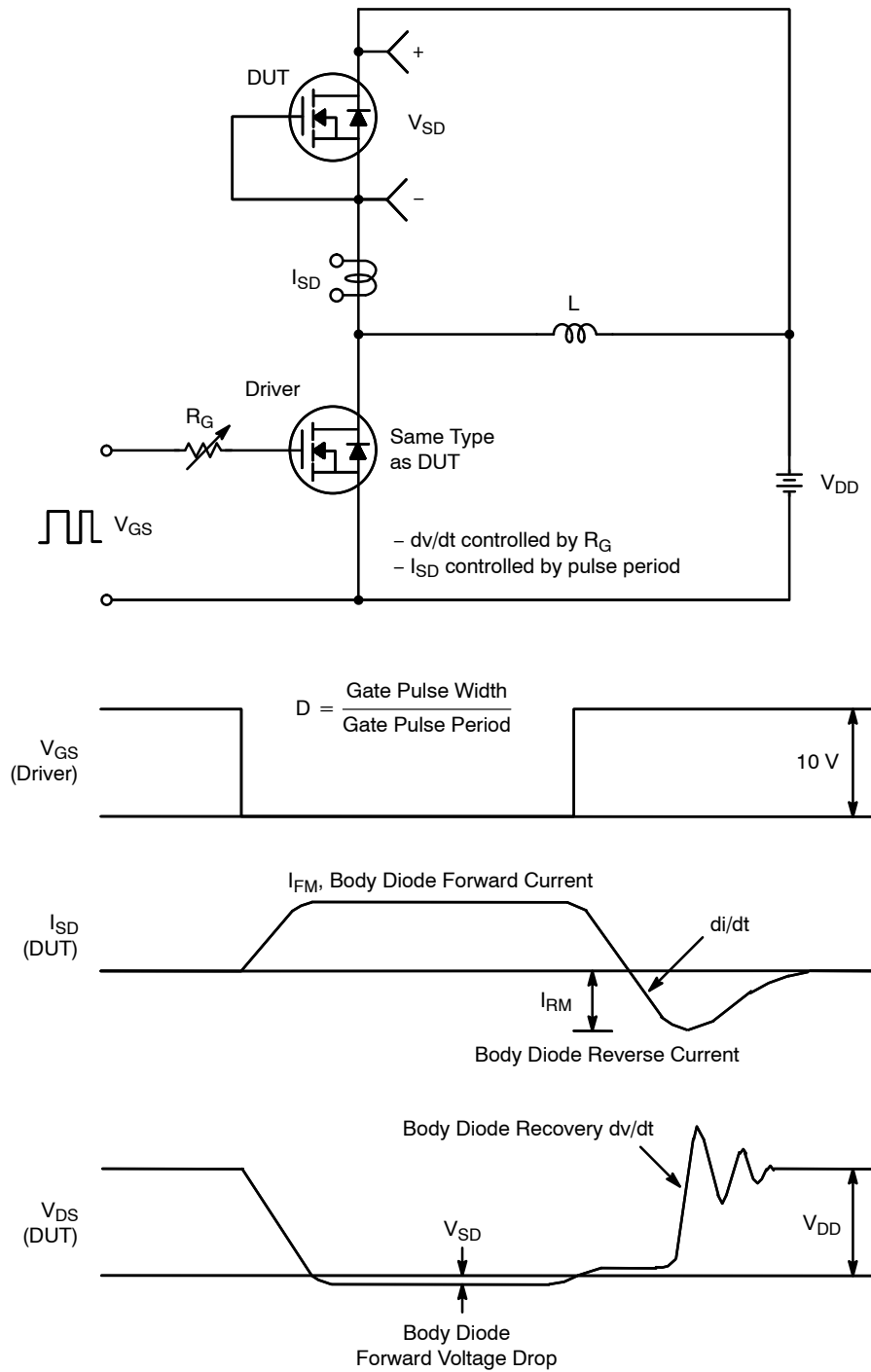


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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

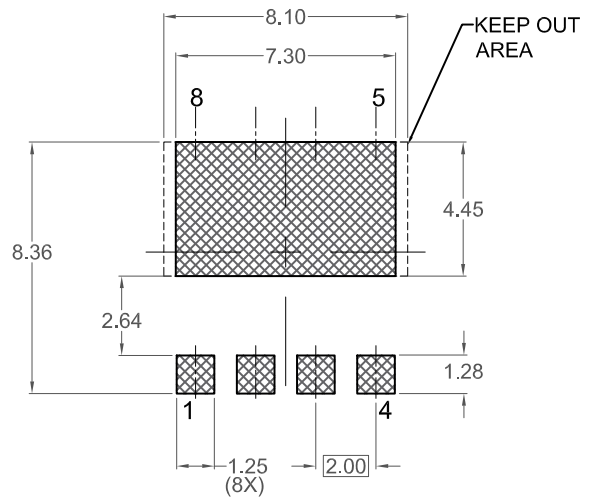
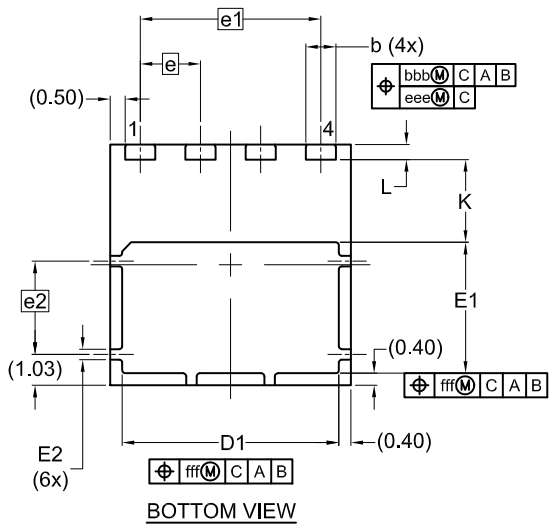
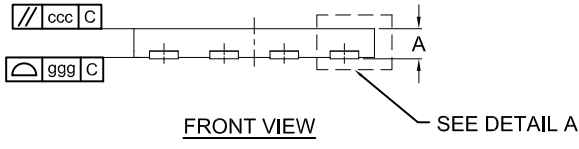
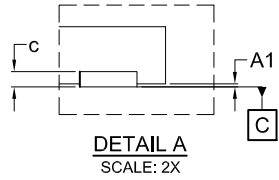
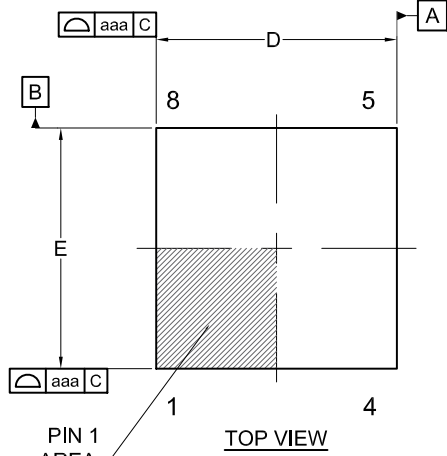
# NTMT185N60S5H

## 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**  
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