

# MOSFET – Power, N-Channel, Shielded Gate

**60 V, 5.2 mΩ, 78 A**

**NTTFS5D1N06HL**

## General Description

This N-Channel MOSFET is produced using onsemi's advanced MOSFET process that incorporates Shielded Gate technology. This process has been optimized to minimize on-state resistance and yet maintain superior switching performance with best in class soft body diode.

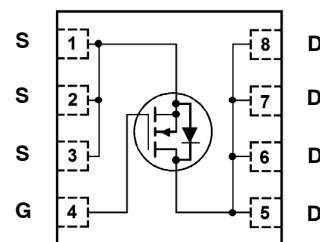
## Features

- Shielded Gate MOSFET Technology
- Max  $r_{DS(on)} = 5.2 \text{ m}\Omega$  at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 16 \text{ A}$
- Max  $r_{DS(on)} = 7.1 \text{ m}\Omega$  at  $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 13 \text{ A}$
- Lowers Switching Noise/EMI
- MSL1 Robust Package Design
- 100% UIL Tested
- RoHS Compliant

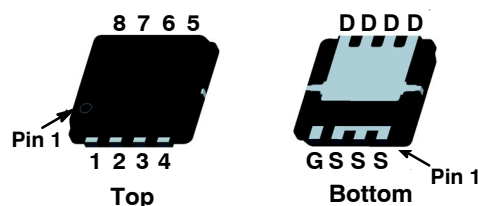
## Applications

- Primary DC-DC MOSFET
- Synchronous Rectifier in DC-DC and AC-DC
- Motor Drive

## ELECTRICAL CONNECTION

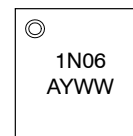


N-Channel MOSFET



WDFN8  
(3.3x3.3, 0.65 P)  
CASE 511DY

## MARKING DIAGRAM



1N06	= Device Code
A	= Assembly Location
Y	= Year Code
WW	= Work Week Code

## ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

# NTTFS5D1N06HL

## MOSFET MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Ratings	Unit
$V_{DS}$	Drain to Source Voltage	60	V
$V_{GS}$	Gate to Source Voltage	$\pm 20$	V
$I_D$	Drain Current –Continuous $T_C = 25^\circ\text{C}$ (Note 5)	78	A
	–Continuous $T_C = 100^\circ\text{C}$ (Note 5)	49	
	–Continuous $T_A = 25^\circ\text{C}$ (Note 1a)	18	
	–Pulsed (Note 4)	216	
$E_{AS}$	Single Pulse Avalanche Energy (Note 3)	72	mJ
$P_D$	Power Dissipation $T_C = 25^\circ\text{C}$	63	W
	Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a)	3.2	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	$-55$ to $+150$	$^\circ\text{C}$

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.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	2	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	39	

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

### OFF CHARACTERISTICS

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\ \mu\text{A}, V_{GS} = 0\ \text{V}$	60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , referenced to $25^\circ\text{C}$		37		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 48\ \text{V}, V_{GS} = 0\ \text{V}$			10	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = +20\ \text{V}, V_{DS} = 0\ \text{V}$			100	nA

### ON CHARACTERISTICS

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 80\ \mu\text{A}$	1.2	1.6	2.0	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 80\ \mu\text{A}$ , referenced to $25^\circ\text{C}$		-5.2		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\ \text{V}, I_D = 16\ \text{A}$		4.4	5.2	m $\Omega$
		$V_{GS} = 4.5\ \text{V}, I_D = 13\ \text{A}$		5.6	7.1	

### DYNAMIC CHARACTERISTICS

$C_{ISS}$	Input Capacitance	$V_{DS} = 30\ \text{V}, V_{GS} = 0\ \text{V}, f = 1\ \text{MHz}$		1610		pF
$C_{OSS}$	Output Capacitance			313		
$C_{RSS}$	Reverse Transfer Capacitance			12.2		
$R_G$	Gate Resistance			0.9		$\Omega$

### SWITCHING CHARACTERISTICS

$t_{d(ON)}$	Turn – On Delay Time	$V_{DD} = 30\ \text{V}, I_D = 16\ \text{A}, V_{GS} = 4.5\ \text{V}, R_{GEN} = 2.5\ \Omega$		14		ns
$t_{rd(ON)}$	Rise Time			24		
$t_{d(OFF)}$	Turn – Off Delay Time			41.3		
$t_f$	Fall Time			12.2		

# NTTFS5D1N06HL

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

### SWITCHING CHARACTERISTICS

$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V to } 10\text{ V}$		22.5		nC
$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V to } 4.5\text{ V}$		10.3		
$Q_{gs}$	Gate to Source Charge	$V_{DD} = 30\text{ V}$ $I_D = 16\text{ A}$		5		
$Q_{gd}$	Gate to Drain "Miller" Charge			3		

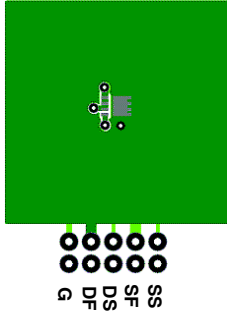
### DRAIN-SOURCE DIODE CHARACTERISTICS

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 16\text{ A (Note 2)}$		0.8	1.2	V
		$V_{GS} = 0\text{ V}, I_S = 16\text{ A (Note 2)}$		0.66		
$t_{rr}$	Reverse Recovery Time	$I_F = 16\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		35.1		ns
$Q_{rr}$	Reverse Recovery Charge			37		nC

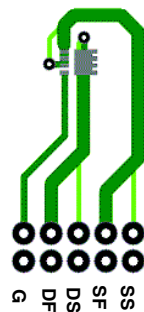
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR-4 material.  $R_{\theta CA}$  is determined by the user's board design.



a)  $53^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



b)  $125^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0%.
- $E_{AS}$  of 72 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1\text{ mH}$ ,  $I_{AS} = 12\text{ A}$ ,  $V_{DD} = 48\text{ V}$ ,  $V_{GS} = 10\text{ V}$ . 100% test at  $L = 1\text{ mH}$ ,  $I_{AS} = 12\text{ A}$ .
- Pulsed  $I_D$  please refer to SOA graph for more details.
- Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

TYPICAL CHARACTERISTICS

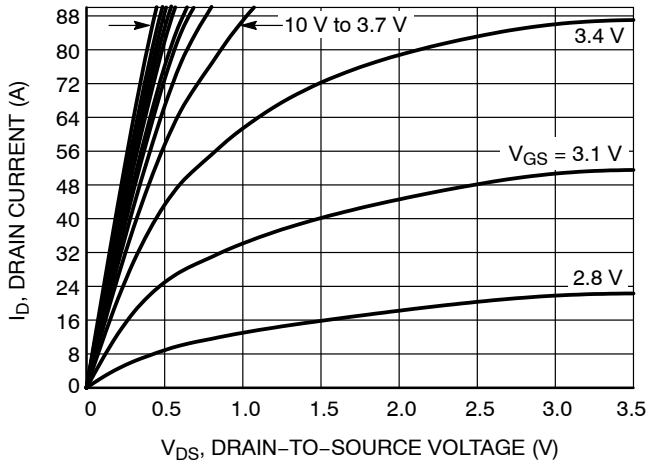


Figure 1. On-Region Characteristics

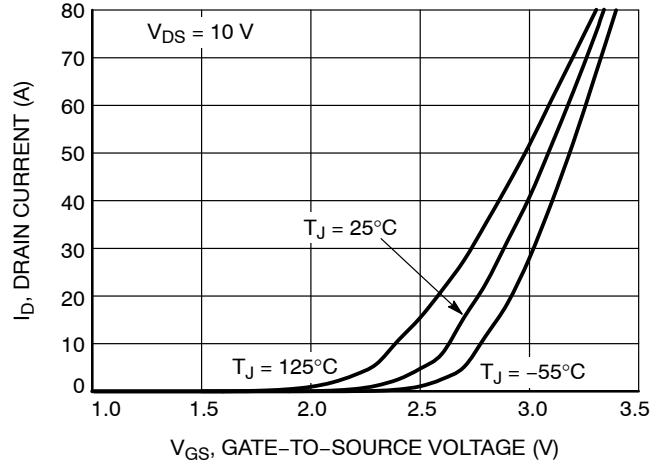


Figure 2. Transfer Characteristics

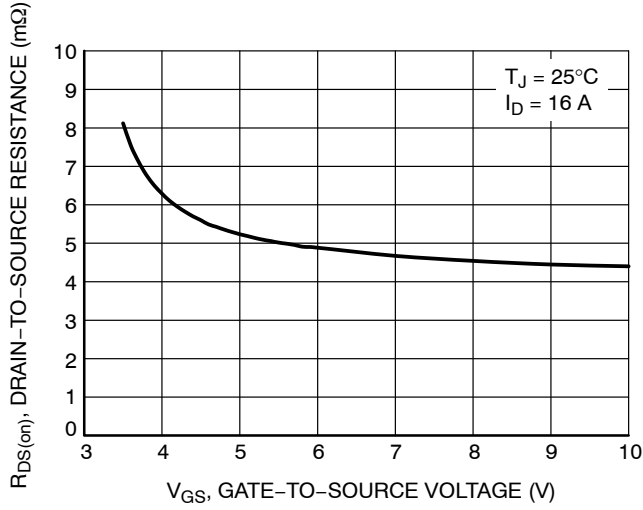


Figure 3. On-Resistance vs. Gate-to-Source Voltage

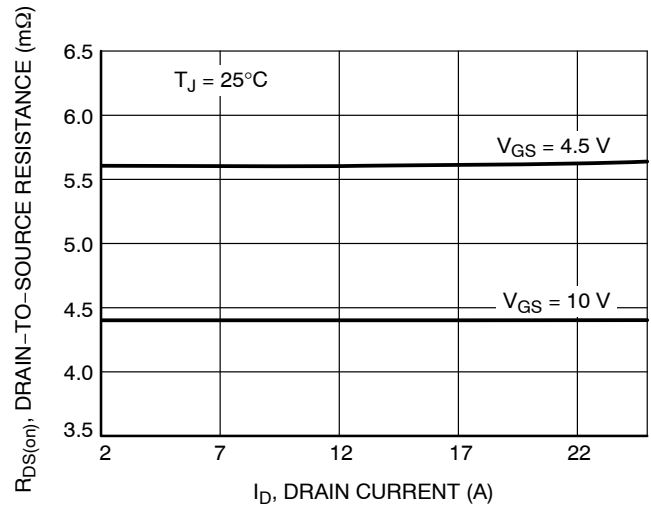


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

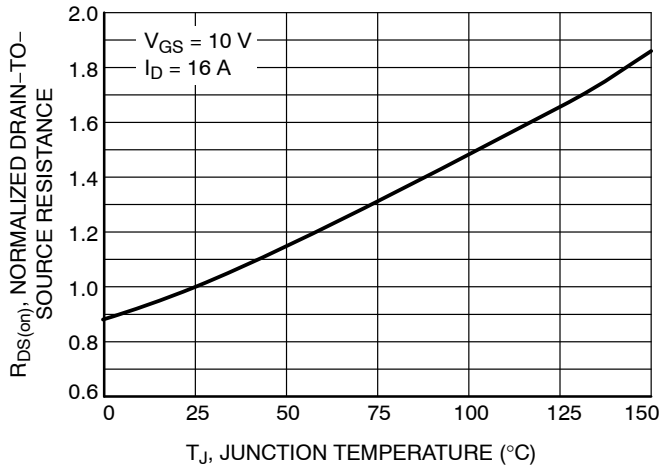


Figure 5. On-Resistance Variation with Temperature

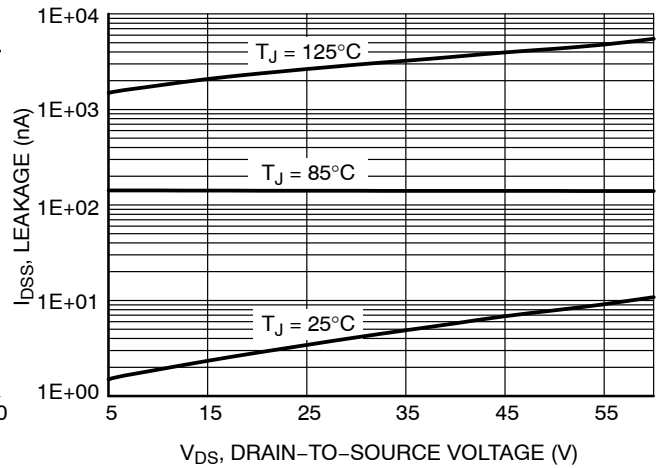


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (continue)

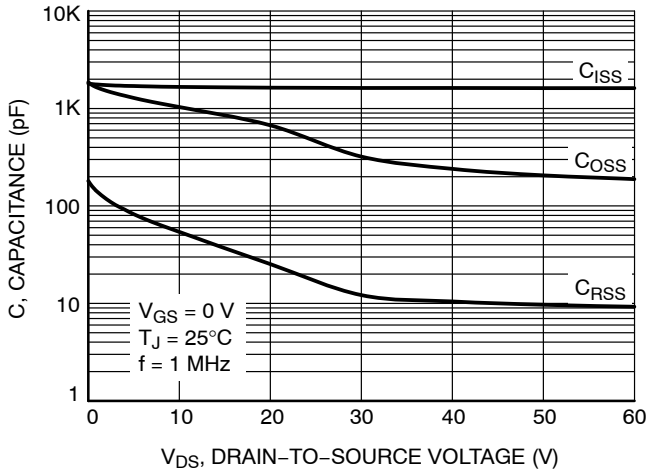


Figure 7. Capacitance Variation

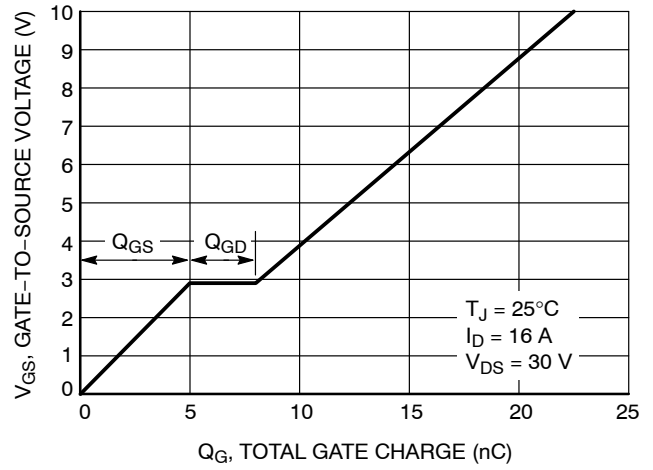


Figure 8. Gate-to-Source Voltage vs. Total Charge

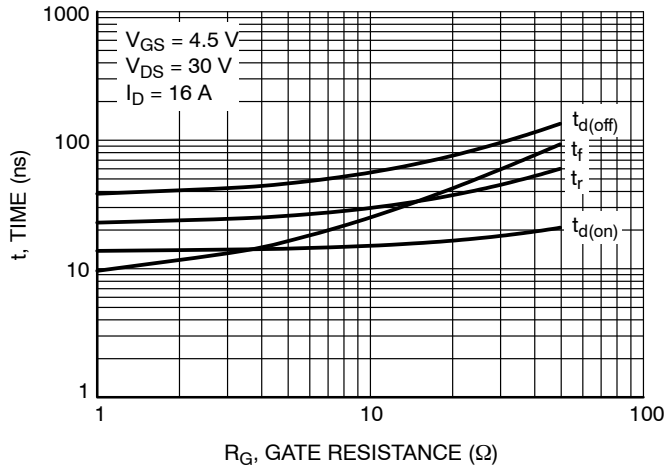


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

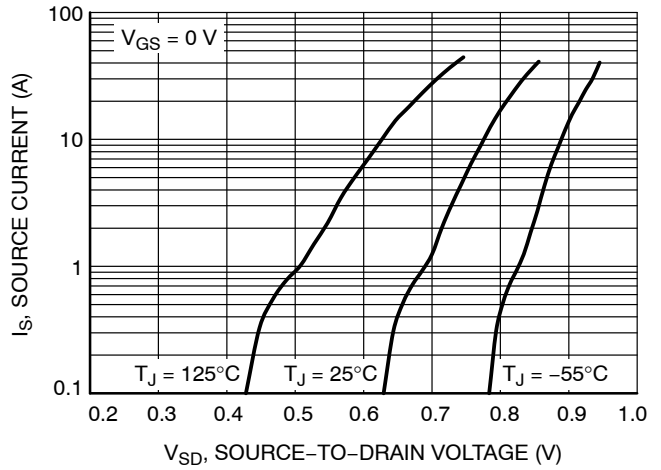


Figure 10. Diode Forward Voltage vs. Current

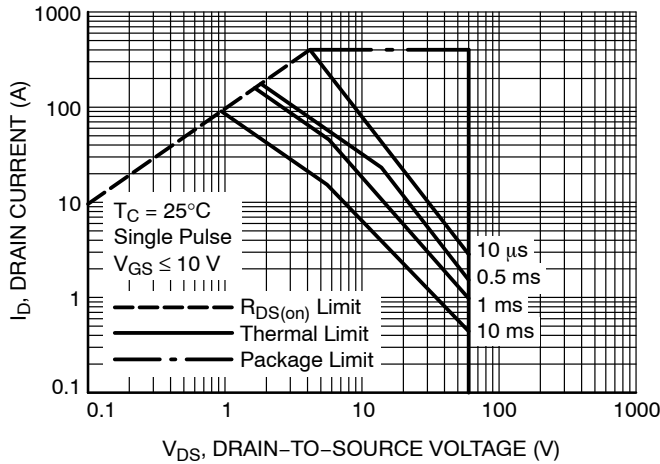


Figure 11. Maximum Rated Forward Biased Safe Operating Area

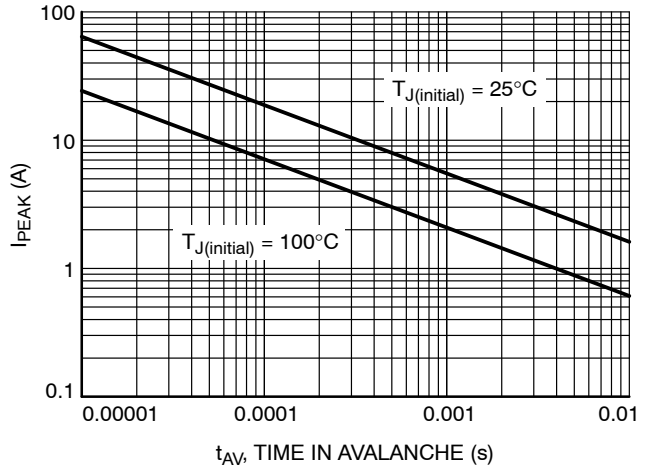


Figure 12. Maximum Drain Current vs. Time in Avalanche

# NTTFS5D1N06HL

## TYPICAL CHARACTERISTICS (continue)

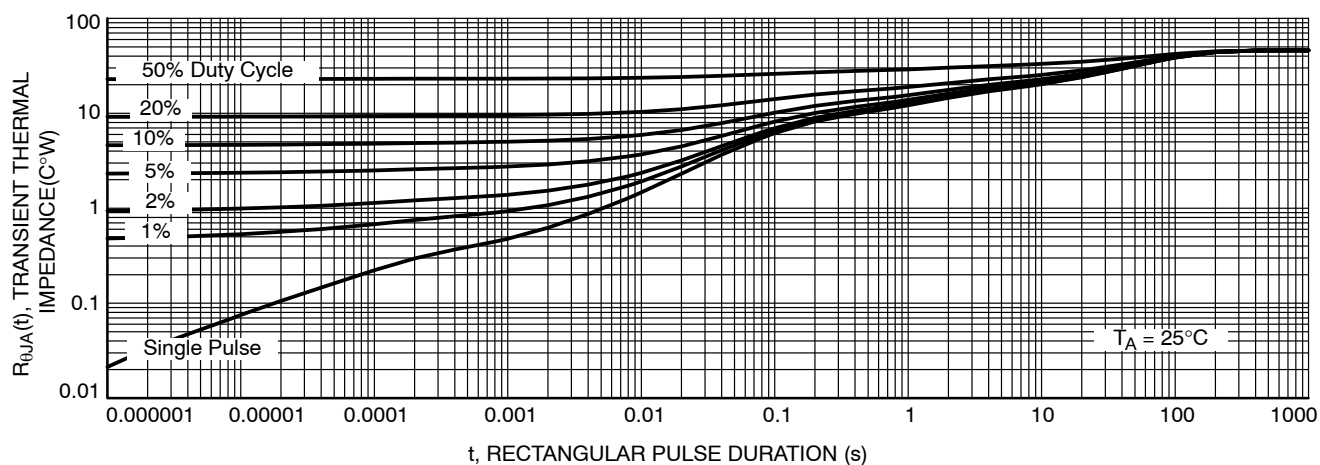


Figure 13. Thermal Response

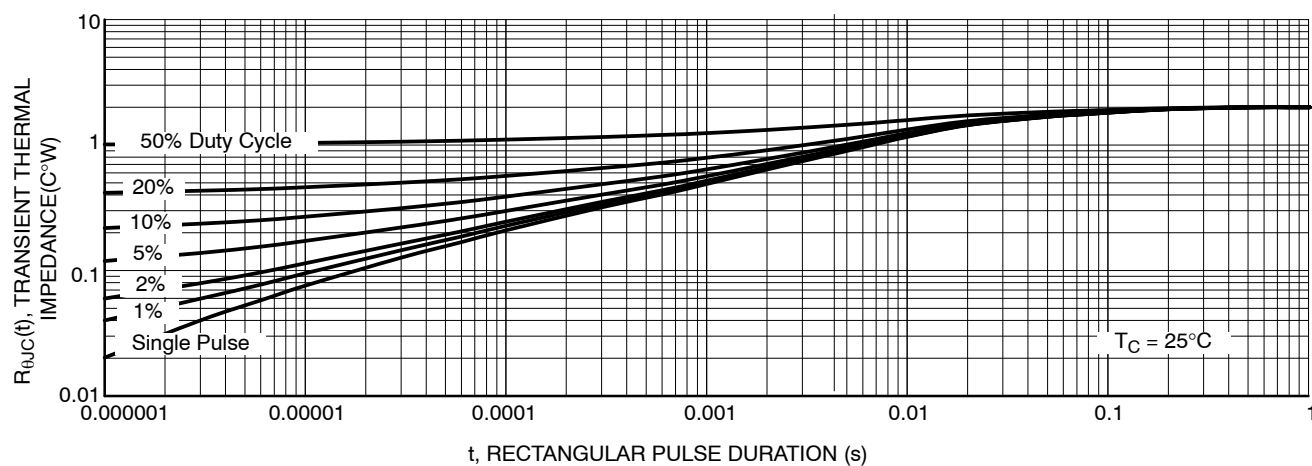


Figure 14. Thermal Response

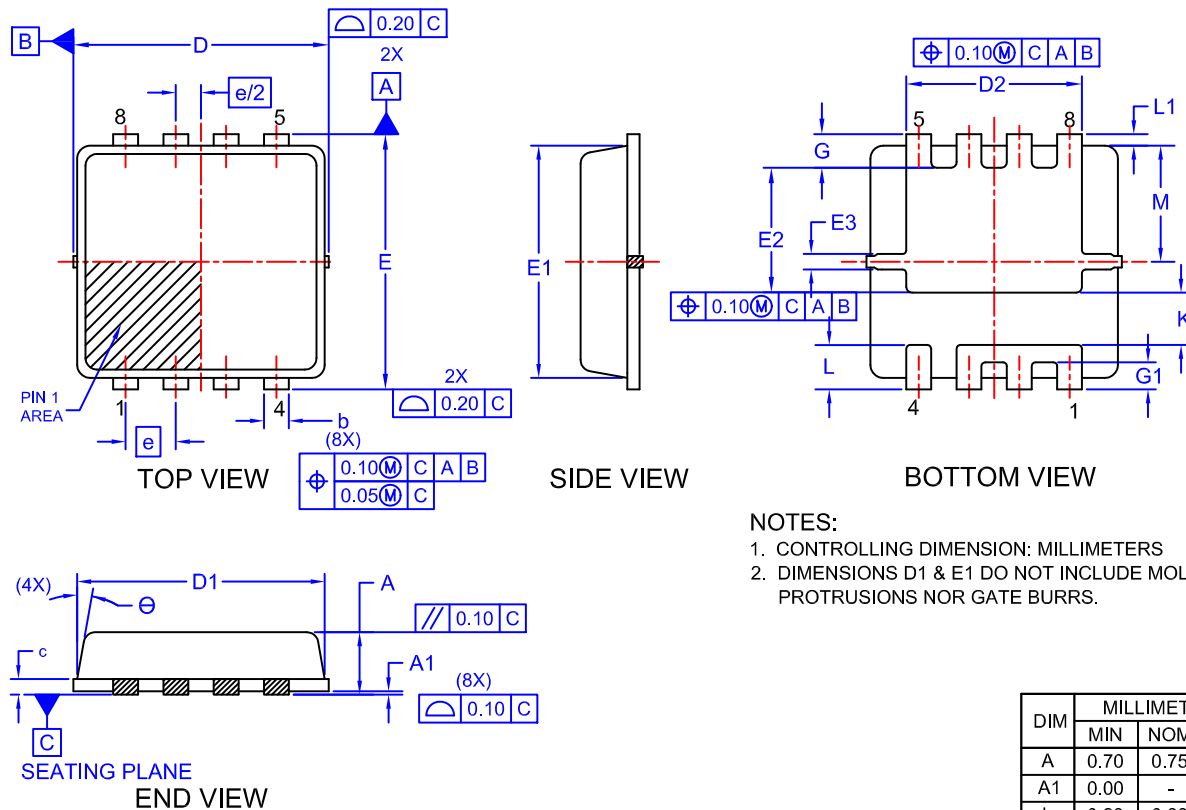
### PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
1N06	NTTFS5D1N06HLTAG	WDFN8 (3.3x3.3)	7"	12 mm	1500 Tape & Reel

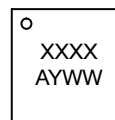
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

**WDFN8 3.3x3.3, 0.65P**  
CASE 511DY  
ISSUE A

DATE 21 AUG 2018


**NOTES:**

1. CONTROLLING DIMENSION: MILLIMETERS
2. DIMENSIONS D1 & E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS NOR GATE BURRS.

**GENERIC MARKING DIAGRAM\***


XXXX = Specific Device Code  
A = Assembly Location  
Y = Year Code  
WW = Work Week Code

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	-	0.05
b	0.23	0.33	0.43
c	0.15	0.20	0.25
D	3.20	3.30	3.40
D1	2.95	3.13	3.30
D2	1.98	2.20	2.40
E	3.20	3.30	3.40
E1	2.80	3.00	3.15
E2	1.40	1.60	1.80
E3	0.15	0.25	0.40
e	0.65 BSC		
G	0.30	0.43	0.55
G1	0.25	0.35	0.45
K	0.55	0.75	0.95
L	0.35	0.52	0.65
L1	0.06	0.15	0.30
M	1.35	1.50	1.60
Θ	0	-	12

\*This information is generic. Please refer to device data sheet for actual part marking.  
Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

<b>DOCUMENT NUMBER:</b>	<b>98AON90827G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>WDFN8 3.3x3.3, 0.65P</b>	<b>PAGE 1 OF 1</b>

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the 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. onsemi does not convey any license under its patent rights nor the rights of others.

**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](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.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)