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# MOSFET – Power, Single, N-Channel

## 100 V, 4.3 mΩ, 113 A



ON Semiconductor®

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## NTMFS4D2N10MD

### Features

- Shielded Gate MOSFET Technology
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- Low  $Q_{RR}$ , Soft Recovery Body Diode
- Low  $Q_{OSS}$  to Improve Light Load Efficiency
- These Devices are Pb-Free, Halogen Free/BFR Free, Beryllium Free and are RoHS Compliant

### Typical Applications

- Primary Switch in Isolated DC-DC Converter
- Synchronous Rectification (SR) in DC-DC and AC-DC
- AC-DC Adapters (USB PD) SR
- Load Switch, Hotswap, and ORing Switch
- BLDC Motor and Solar Inverter

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

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	100	V
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$ 113 A
			$P_D$ 132 W
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ 16.4 A
			$P_D$ 2.8 W
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ 16.4 A
Power Dissipation $R_{\theta JA}$ (Notes 1, 2)			$P_D$ 2.8 W
Pulsed Drain Current	$T_A = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$	$I_{DM}$ 763	A
Operating Junction and Storage Temperature Range	$T_J$ , $T_{stg}$	-55 to +150	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	110	A
Single Pulse Drain-to-Source Avalanche Energy ( $I_{AV} = 18 \text{ A}$ ) (Note 6)	$E_{AS}$	486	mJ
Lead Temperature Soldering Reflow for Soldering Purposes (1/8" from case for 10 s)	$T_L$	300	$^\circ\text{C}$

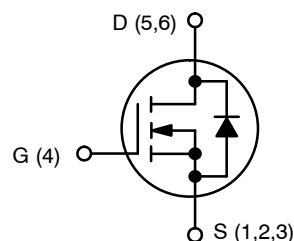
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE RATINGS

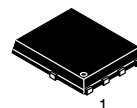
Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	0.95	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	45	

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface-mounted on FR4 board using 1 in<sup>2</sup> pad size, 1 oz. Cu pad.

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
100 V	4.3 mΩ @ 10 V	113 A
	7.1 mΩ @ 6 V	

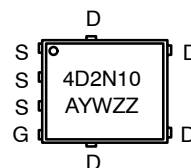


N-CHANNEL MOSFET



DFN5 (SO-8FL) CASE 488AA STYLE 1

### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

### ORDERING INFORMATION

Device	Package	Shipping†
NTMFS4D2N10MDT1G	DFN5 (Pb-Free)	1500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NTMFS4D2N10MD

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	100			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 250\ \mu\text{A}$ , ref to $25^\circ\text{C}$		60		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 80\text{ V}$	$T_J = 25^\circ\text{C}$		1.0	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		100	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 239\ \mu\text{A}$	2		4	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	$I_D = 239\ \mu\text{A}$ , ref to $25^\circ\text{C}$		-7.9		mV/ $^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 46\text{ A}$		3.8	4.3	$\text{m}\Omega$
		$V_{GS} = 6\text{ V}, I_D = 23\text{ A}$		5.7	7.1	
Forward Transconductance	$g_{FS}$	$V_{DS} = 8\text{ V}, I_D = 46\text{ A}$		105		S
Gate-Resistance	$R_G$	$T_A = 25^\circ\text{C}$		0.97	1.6	$\Omega$

## CHARGES & CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 50\text{ V}$		3100		$\text{pF}$
Output Capacitance	$C_{OSS}$			800		
Reverse Transfer Capacitance	$C_{RSS}$			23		
Output Charge	$Q_{OSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 50\text{ V}$		63.4		$\text{nC}$
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 6\text{ V}, V_{DS} = 50\text{ V}, I_D = 46\text{ A}$		25		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 50\text{ V}, I_D = 46\text{ A}$		40	60	
Threshold Gate Charge	$Q_{G(TH)}$			10		
Gate-to-Source Charge	$Q_{GS}$			15		
Gate-to-Drain Charge	$Q_{GD}$			6.7	10	
Plateau Voltage	$V_{GP}$			5.0		

## SWITCHING CHARACTERISTICS (Note 3)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 50\text{ V}, I_D = 46\text{ A}, R_G = 6\ \Omega$		21		ns
Rise Time	$t_r$			9.5		
Turn-Off Delay Time	$t_{d(OFF)}$			34		
Fall Time	$t_f$			6.5		

## DRAIN-SOURCE DIODE CHARACTERISTICS

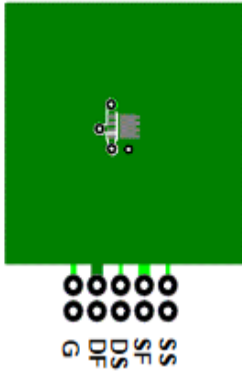
Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 46\text{ A}$	$T_J = 25^\circ\text{C}$		0.85		V
			$T_J = 125^\circ\text{C}$		0.73		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, di_S/dt = 1000\text{ A}/\mu\text{s}, I_S = 23\text{ A}$		23.1		ns	
Reverse Recovery Charge	$Q_{RR}$			196		nC	
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, di_S/dt = 100\text{ A}/\mu\text{s}, I_S = 46\text{ A}$		52.6		ns	
Reverse Recovery Charge	$Q_{RR}$			66.1		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.

3. Switching characteristics are independent of operating junction temperatures

4.  $R_{\theta JA}$  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.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

## NTMFS4D2N10MD



a) 45°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



b) 111°C/W when mounted on a minimum pad of 2 oz copper.

5. Pulse Test: pulse width < 300  $\mu$ s, duty cycle < 2%.
6.  $E_{AS}$  of 486 mJ is based on started  $T_J = 25^\circ\text{C}$ ,  $I_{AS} = 18$  A,  $V_{DD} = 90$  V,  $V_{GS} = 15$  V. 100% test at  $I_{AS} = 51.5$  A.
7. As an N-ch device, the negative  $V_{GS}$  rating is for low duty cycle pulse occurrence only. No continuous rating is implied.

# NTMFS4D2N10MD

## TYPICAL CHARACTERISTICS

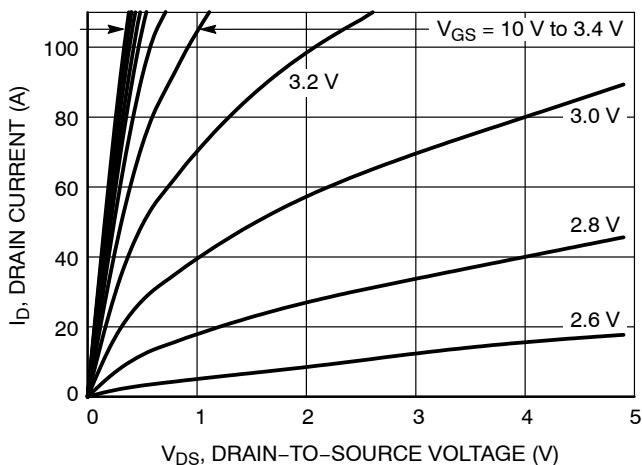


Figure 1. On-Region Characteristics

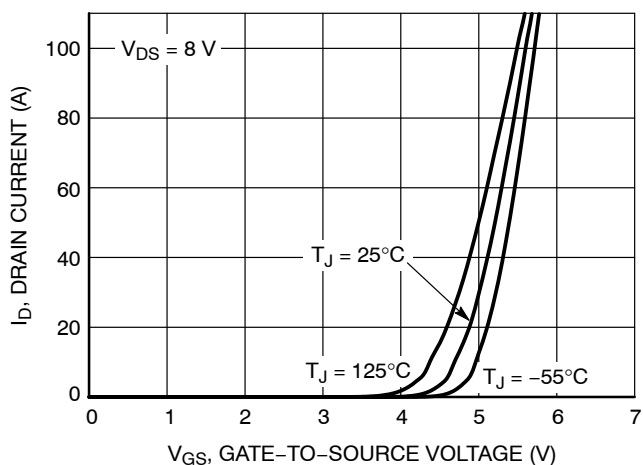


Figure 2. Transfer Characteristics

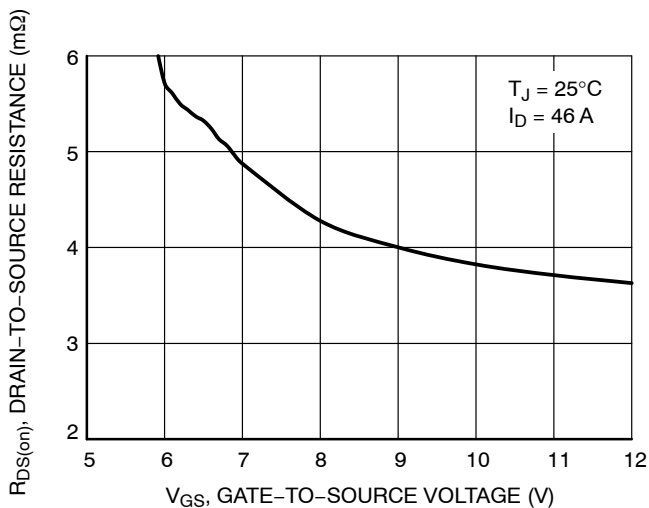


Figure 3. On-Resistance vs. Gate-to-Source Voltage

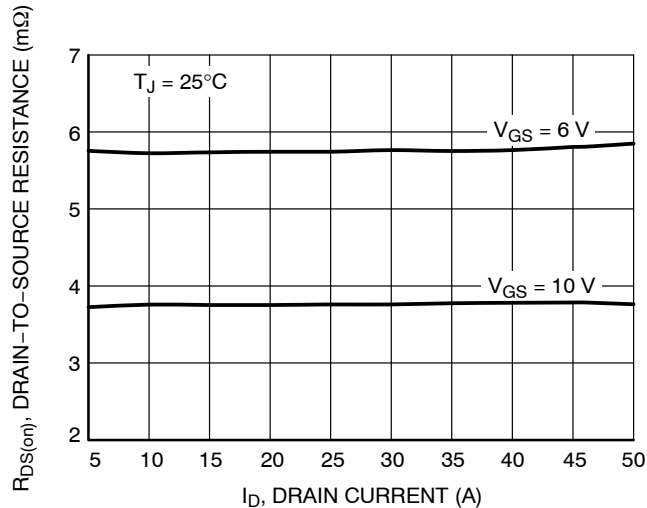


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

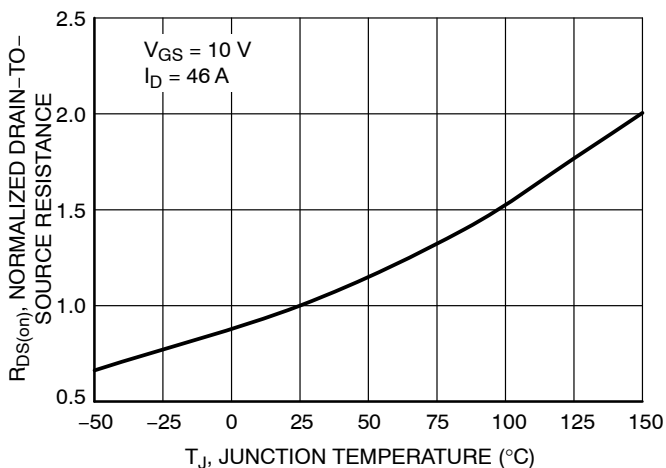


Figure 5. On-Resistance Variation with Temperature

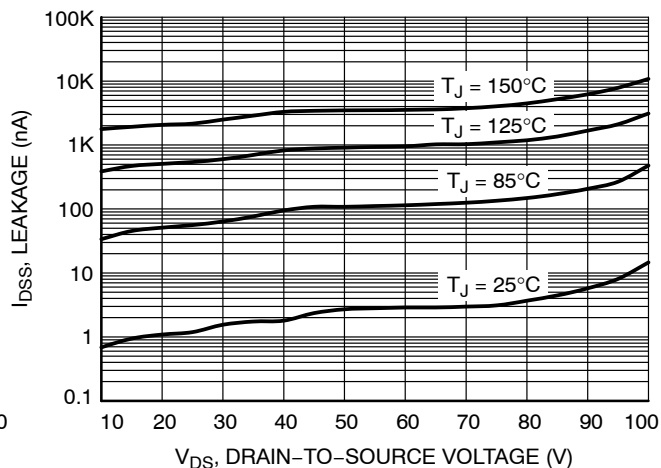


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTMFS4D2N10MD

## TYPICAL CHARACTERISTICS

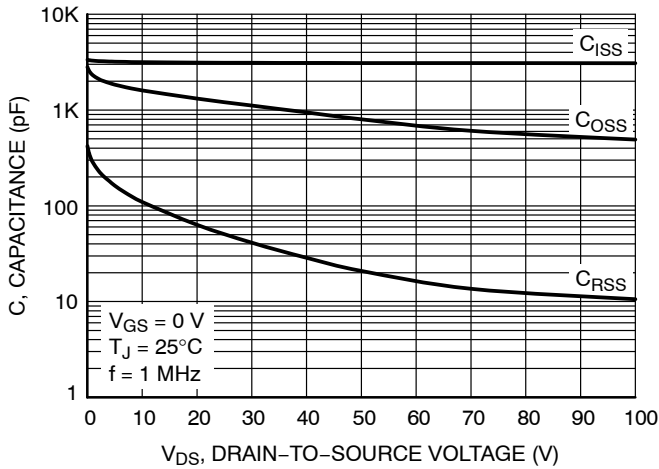


Figure 7. Capacitance Variation

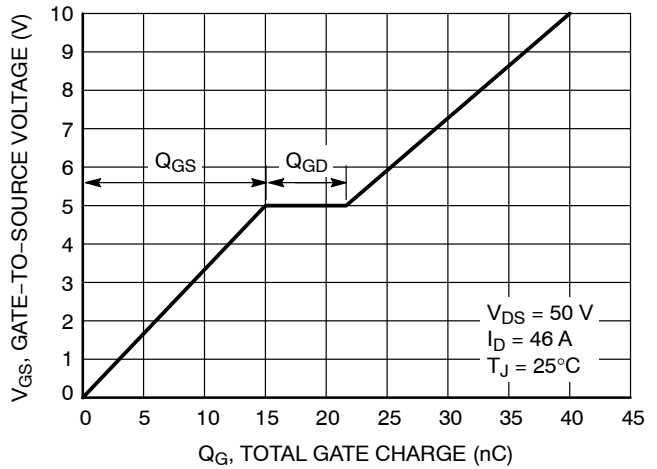


Figure 8. Gate-to-Source vs. Total Charge

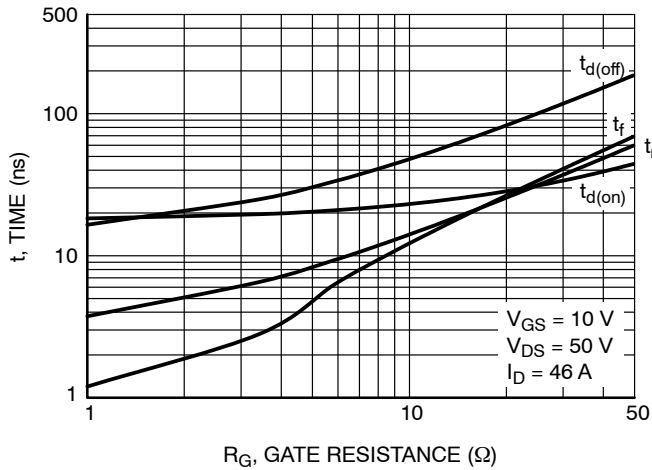


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

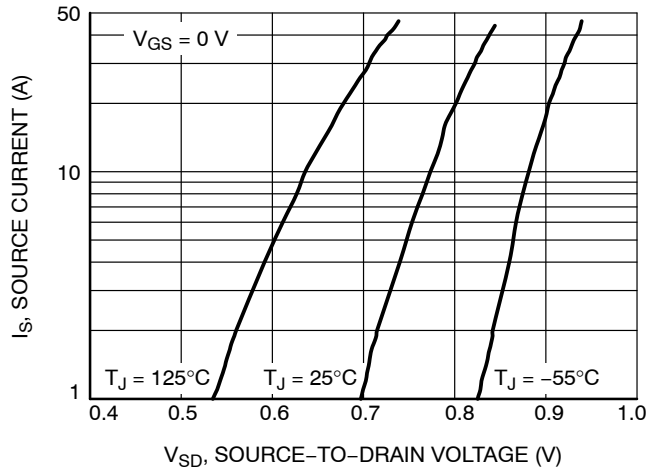


Figure 10. Diode Forward Voltage vs. Current

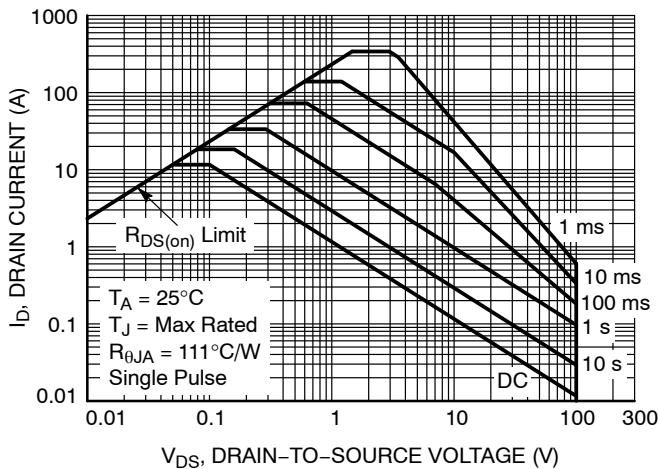


Figure 11. Maximum Rated Forward Biased Safe Operating Area

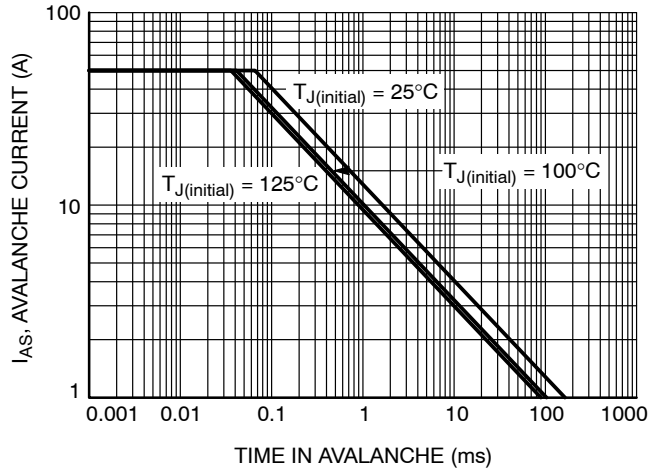


Figure 12.  $I_{PEAK}$  vs. Time in Avalanche

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## TYPICAL CHARACTERISTICS

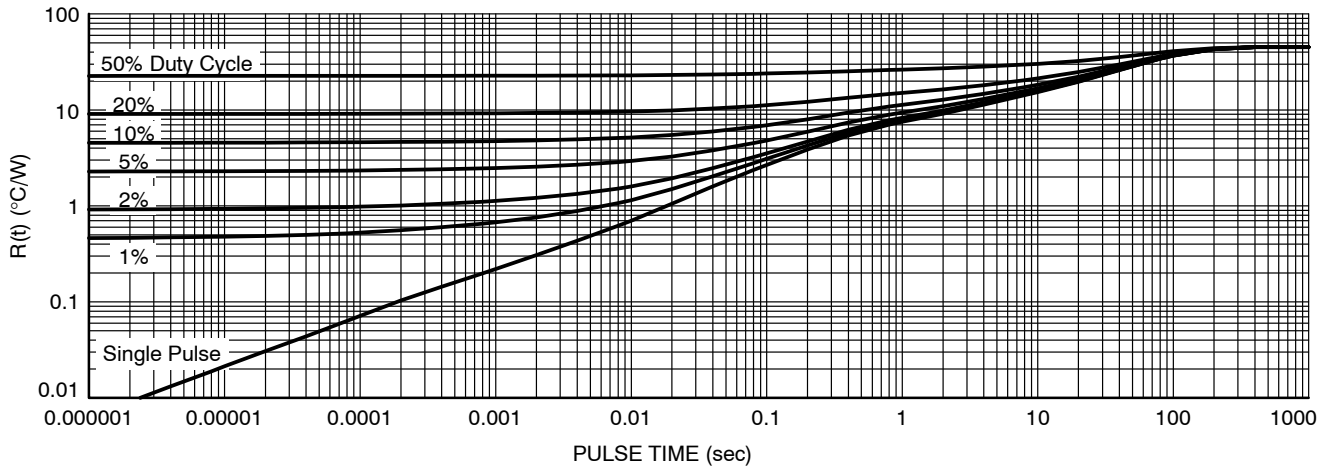


Figure 13. Thermal Characteristics

# NTMFS4D2N10MD

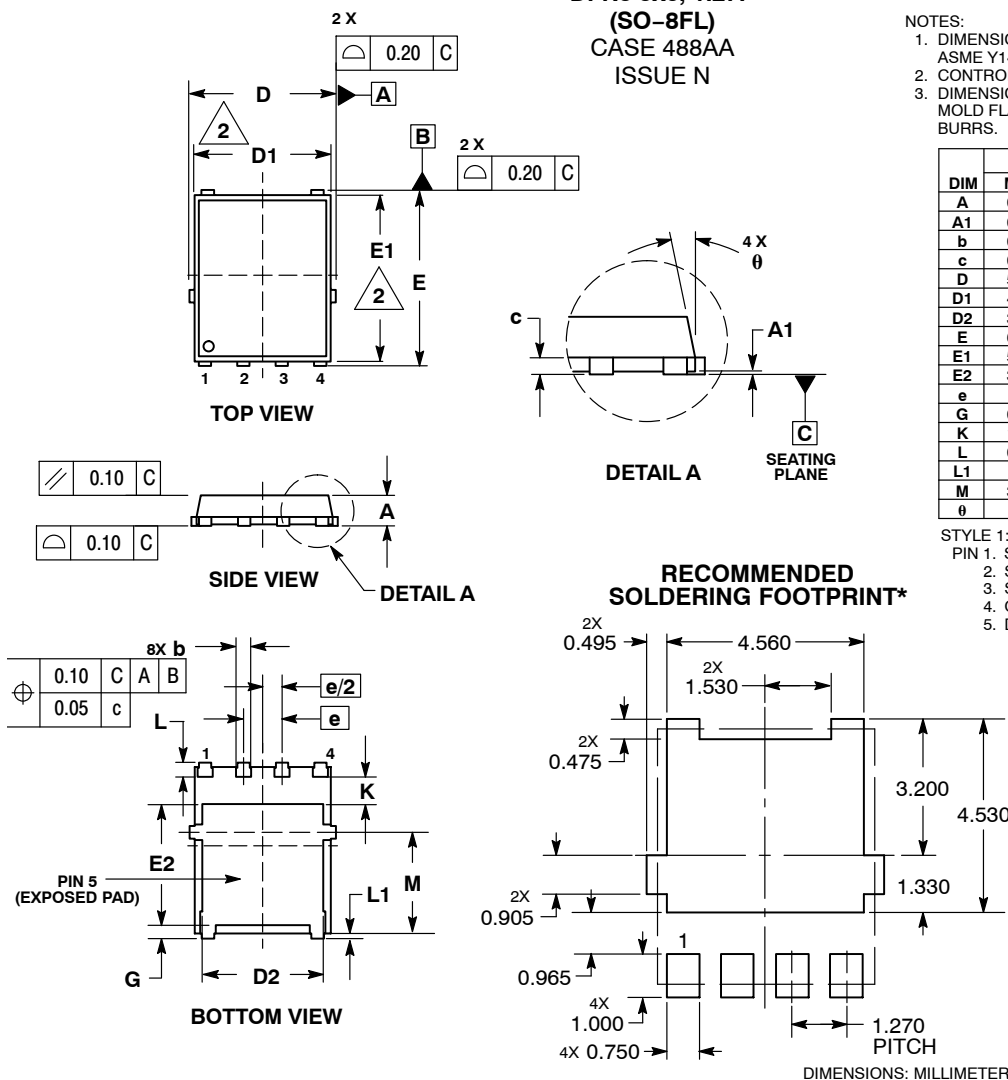
## PACKAGE DIMENSIONS

DFN5 5x6, 1.27P  
(SO-8FL)  
CASE 488AA  
ISSUE N

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	0.33	0.41	0.51
c	0.23	0.28	0.33
D	5.00	5.15	5.30
D1	4.70	4.90	5.10
D2	3.80	4.00	4.20
E	6.00	6.15	6.30
E1	5.70	5.90	6.10
E2	3.45	3.65	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
K	1.20	1.35	1.50
L	0.51	0.575	0.71
L1	0.125 REF		
M	3.00	3.40	3.80
θ	0°	---	12°

- STYLE 1:
1. SOURCE
  2. SOURCE
  3. SOURCE
  4. GATE
  5. DRAIN



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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