

# NTMFS4965NF

## Power MOSFET

30 V, 65 A, Single N-Channel, SO-8 FL

### Features

- Integrated Schottky Diode
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- CPU Power Delivery
- Synchronous Rectification for DC-DC Converters
- Low Side Switching
- Telecom Secondary Side Rectification

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

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DS}$	30	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JA}$ (Note 1)	$I_D$	$T_A = 25^\circ\text{C}$	23.9	A
		$T_A = 85^\circ\text{C}$	17.2	
Power Dissipation $R_{\theta JA}$ (Note 1)	$P_D$	3.04	W	
Continuous Drain Current $R_{\theta JA} \leq 10$ sec	$I_D$	$T_A = 25^\circ\text{C}$	36	A
		$T_A = 85^\circ\text{C}$	26	
Power Dissipation $R_{\theta JA}, t \leq 10$ sec	$P_D$	7.0	W	
Continuous Drain Current $R_{\theta JA}$ (Note 2)	$I_D$	$T_A = 25^\circ\text{C}$	17.5	A
		$T_A = 85^\circ\text{C}$	12.6	
Power Dissipation $R_{\theta JA}$ (Note 2)	$P_D$	1.63	W	
Continuous Drain Current $R_{\theta JC}$ (Note 1)	$I_D$	$T_C = 25^\circ\text{C}$	65	A
		$T_C = 85^\circ\text{C}$	47	
Power Dissipation $R_{\theta JC}$ (Note 1)	$P_D$	22.73	W	
Pulsed Drain Current	$I_{DM}$	195	A	
Current limited by package	$I_{Dmaxpkg}$	100	A	
Operating Junction and Storage Temperature	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	64	A	
Drain to Source $dV/dt$	$dV/dt$	6	V/ns	
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 50$ V, $V_{GS} = 10$ V, $I_L = 33$ A <sub>pk</sub> , $L = 0.1$ mH, $R_G = 25$ $\Omega$ )	EAS	54	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

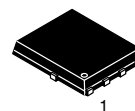
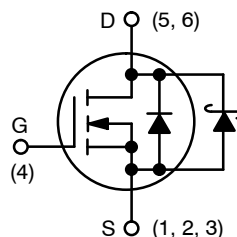


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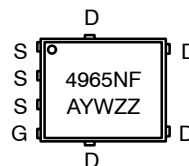
$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
30 V	3.4 m $\Omega$ @ 10 V	65 A
	5.0 m $\Omega$ @ 4.5 V	

### N-CHANNEL MOSFET



SO-8 FLAT LEAD  
CASE 488AA  
STYLE 1

### MARKING DIAGRAM



4965NF = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Lot Traceability

### ORDERING INFORMATION

Device	Package	Shipping†
NTMFS4965NFT1G	SO-8FL (Pb-Free)	1500 / Tape & Reel
NTMFS4965NFT3G	SO-8FL (Pb-Free)	5000 / 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.

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

# NTMFS4965NF

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	5.5	°C/W
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	41.15	
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	76.9	
Junction-to-Ambient – $t \leq 10$ sec	$R_{\theta JA}$	17.86	

1. Surface-mounted on FR4 board using 1 sq-in pad, 2 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size of 100 mm<sup>2</sup>.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1.0\text{ mA}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 10\text{ mA}$ , referenced to $25^\circ\text{C}$		15		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$   $T_J = 25^\circ\text{C}$			500	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 1.0\text{ mA}$	1.2	1.6	2.3	V	
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	$I_D = 10\text{ mA}$ , referenced to $25^\circ\text{C}$		5.0		mV/°C	
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 30\text{ A}$		2.7	3.4	m $\Omega$
			$I_D = 15\text{ A}$		2.7		
		$V_{GS} = 4.5\text{ V}$	$I_D = 30\text{ A}$		4.0	5.0	
			$I_D = 15\text{ A}$		4.0		
Forward Transconductance	$g_{FS}$	$V_{DS} = 1.5\text{ V}, I_D = 15\text{ A}$		43		S	

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 15\text{ V}$		2100		pF
Output Capacitance	$C_{OSS}$			900		
Reverse Transfer Capacitance	$C_{RSS}$			60		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}; I_D = 30\text{ A}$		14.2		nC
Threshold Gate Charge	$Q_{G(TH)}$			1.8		
Gate-to-Source Charge	$Q_{GS}$			5.9		
Gate-to-Drain Charge	$Q_{GD}$			4.2		
Total Gate Charge	$Q_{G(TOT)}$		$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		30.5	

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		11		ns
Rise Time	$t_r$			32		
Turn-Off Delay Time	$t_{d(OFF)}$			21		
Fall Time	$t_f$			6.0		

3. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
4. Switching characteristics are independent of operating junction temperatures.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS (Note 4)</b>						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 15\text{ A}, R_G = 3.0\ \Omega$		8.5		ns
Rise Time	$t_r$			26.5		
Turn-Off Delay Time	$t_{d(OFF)}$			26		
Fall Time	$t_f$			4.5		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V},$ $I_S = 2\text{ A}$	$T_J = 25^\circ\text{C}$		0.4	0.7	V
			$T_J = 125^\circ\text{C}$		0.33		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 2\text{ A}$		36.5		ns	
Charge Time	$t_a$			18			
Discharge Time	$t_b$			18.5			
Reverse Recovery Charge	$Q_{RR}$			32			nC

## PACKAGE PARASITIC VALUES

Source Inductance	$L_S$	$T_A = 25^\circ\text{C}$		0.65		nH
Drain Inductance	$L_D$			0.20		
Gate Inductance	$L_G$			1.5		
Gate Resistance	$R_G$			1.0		

3. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
4. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

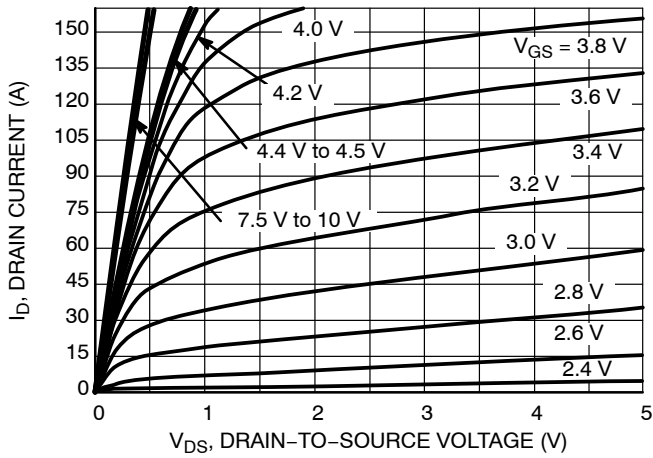


Figure 1. On-Region Characteristics

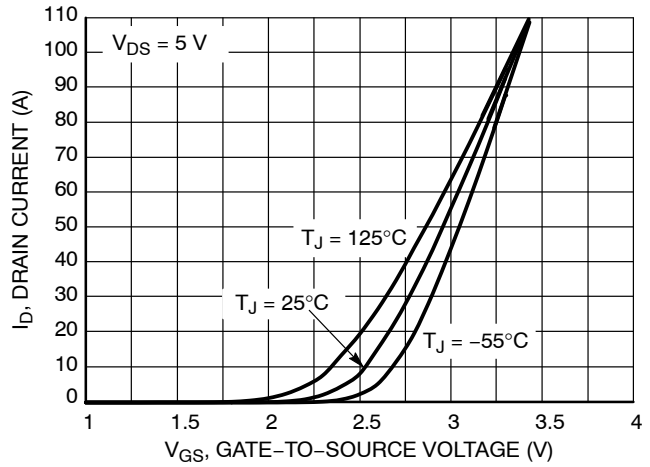


Figure 2. Transfer Characteristics

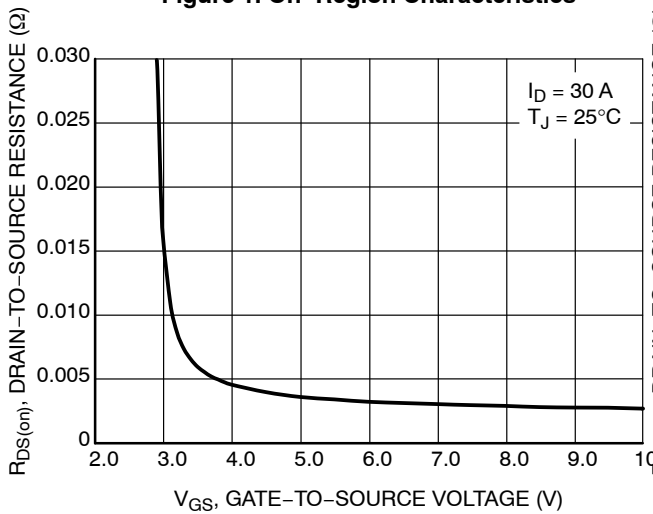


Figure 3. On-Resistance vs. Gate-to-Source Voltage

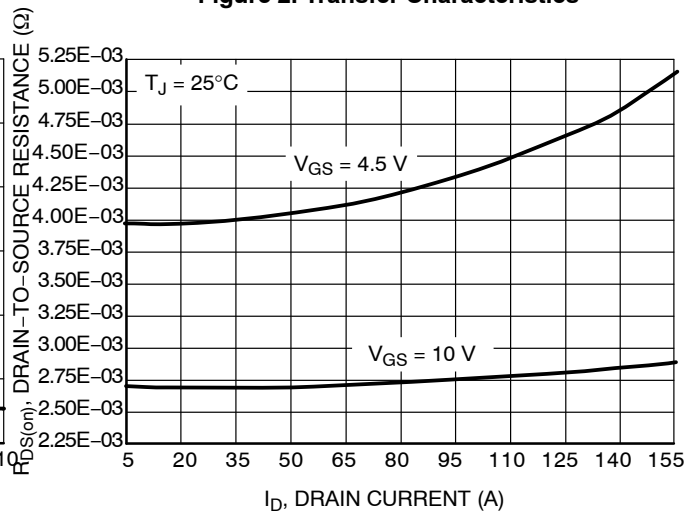


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

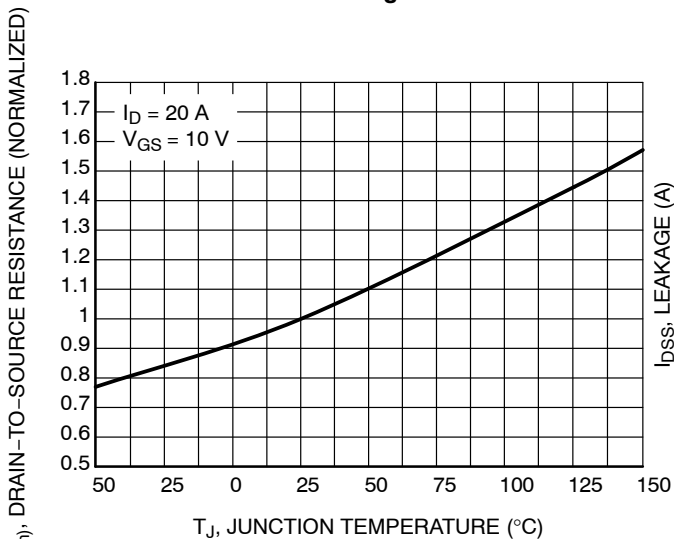


Figure 5. On-Resistance Variation with Temperature

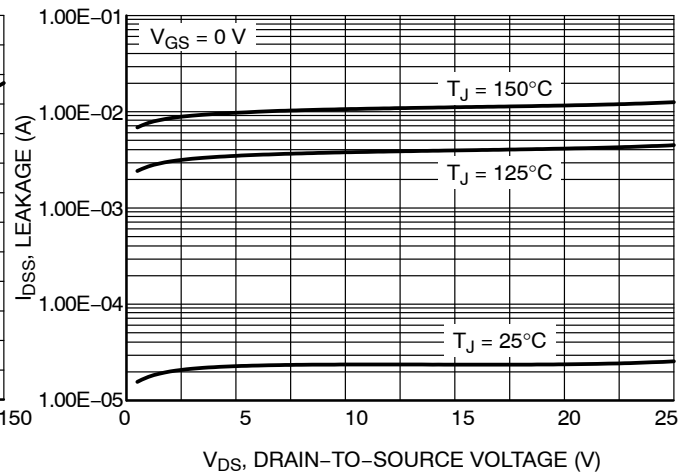


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

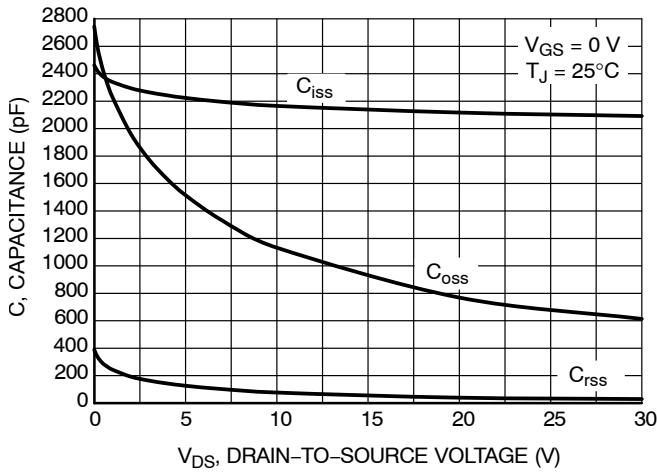


Figure 7. Capacitance Variation

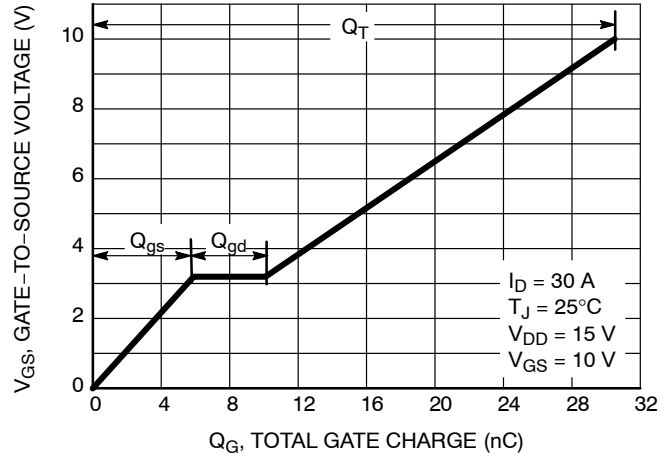


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

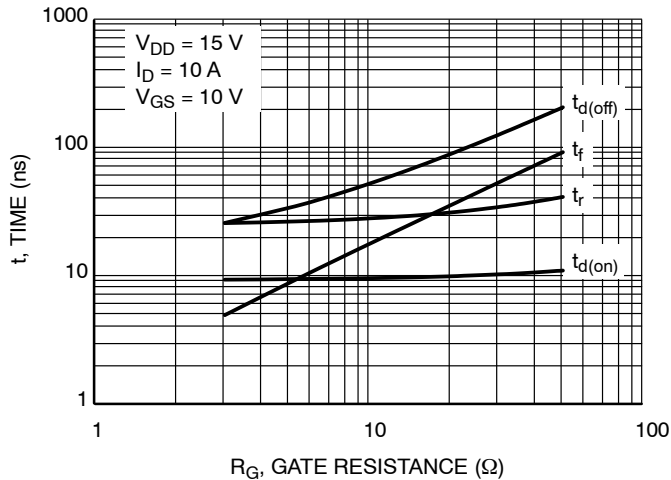


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

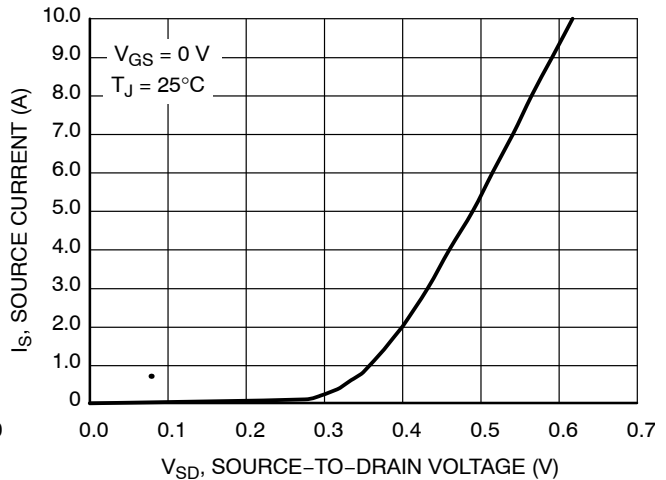


Figure 10. Diode Forward Voltage vs. Current

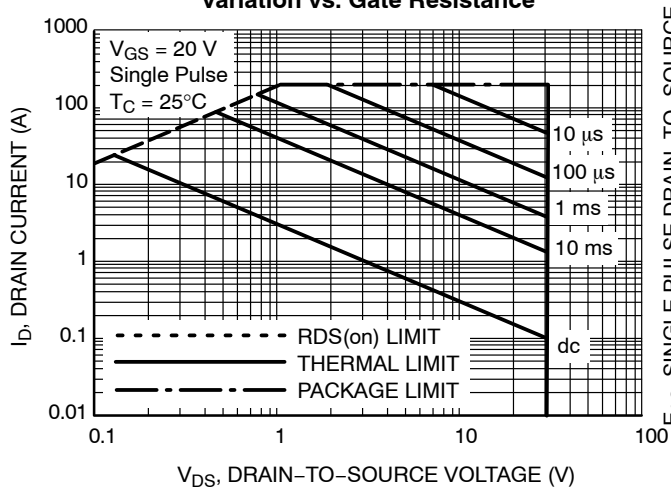


Figure 11. Maximum Rated Forward Biased Safe Operating Area

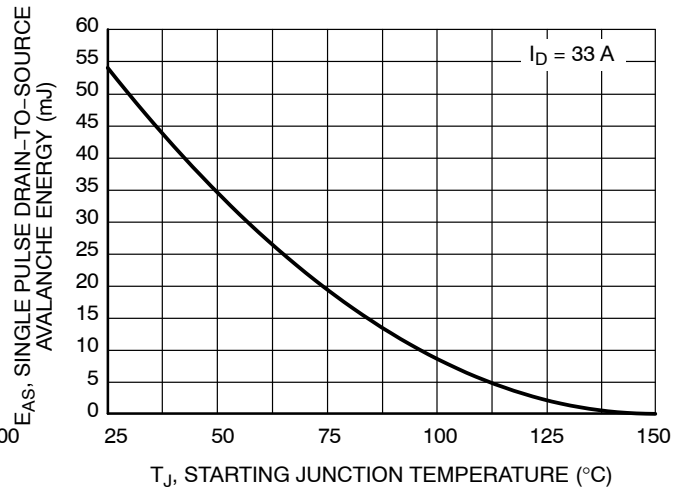


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

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## TYPICAL PERFORMANCE CURVES

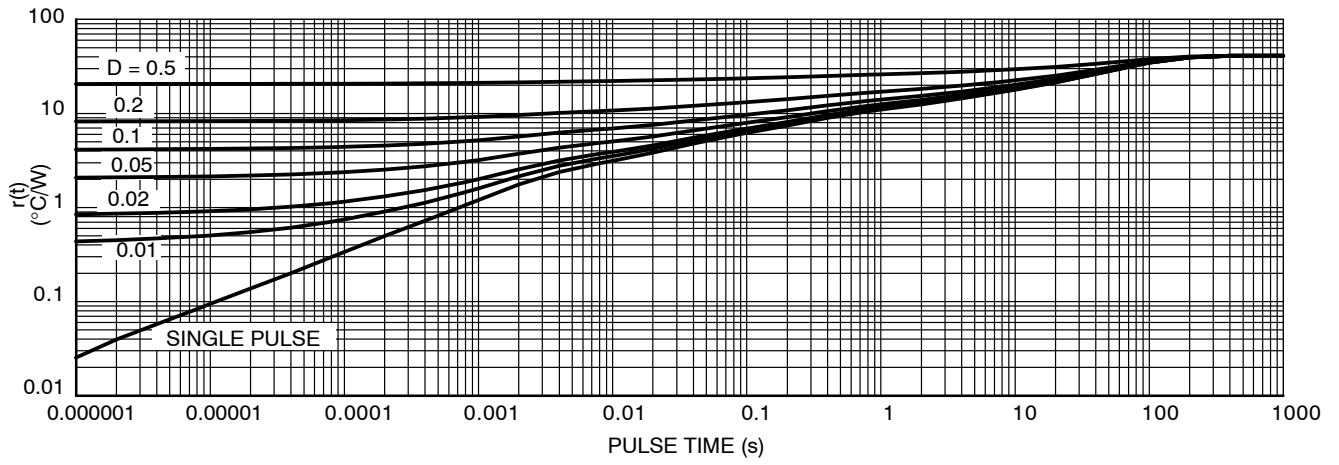
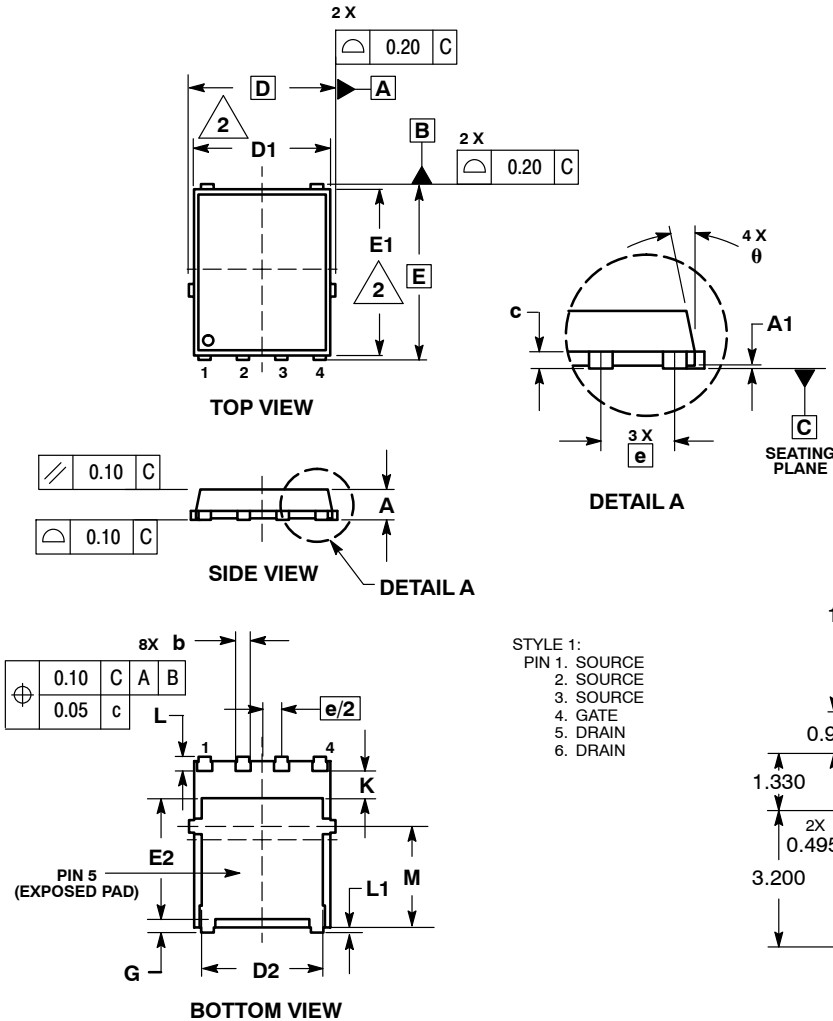


Figure 13. Thermal Response

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## PACKAGE DIMENSIONS

DFN5 5x6, 1.27P (SO8 FL)  
CASE 488AA  
ISSUE G

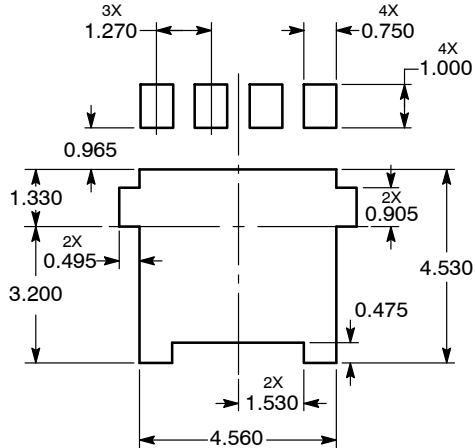


### NOTES:

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	5.15 BSC		
D1	4.50	4.90	5.10
D2	3.50	---	4.22
E	6.15 BSC		
E1	5.50	5.80	6.10
E2	3.45	---	4.30
e	1.27 BSC		
G	0.51	0.61	0.71
K	1.20	1.35	1.50
L	0.51	0.61	0.71
L1	0.05	0.17	0.20
M	3.00	3.40	3.80
θ	0°	---	12°

### SOLDERING FOOTPRINT\*



\*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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