

# NTMD4184PF

## Power MOSFET and Schottky Diode

-30 V, -4.0 A, Single P-Channel with 20 V, 2.2 A, Schottky Barrier Diode

### Features

- FETKY™ Surface Mount Package Saves Board Space
- Independent Pin-Out for MOSFET and Schottky Allowing for Design Flexibility
- Low  $R_{DS(on)}$  MOSFET and Low  $V_F$  Schottky to Minimize Conduction Losses
- Optimized Gate Charge to Minimize Switching Losses
- This is a Pb-Free Device

### Applications

- Disk Drives
- DC-DC Converters
- Printers

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

Rating	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DSS}$	-30	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JA}$ (Note 1)	$I_D$	$T_A = 25^\circ\text{C}$	-3.3	A
		$T_A = 70^\circ\text{C}$	-2.6	
Power Dissipation $R_{\theta JA}$ (Note 1)	$P_D$	1.6	W	
Continuous Drain Current $R_{\theta JA}$ (Note 2)	$I_D$	$T_A = 25^\circ\text{C}$	-2.3	A
		$T_A = 70^\circ\text{C}$	-1.8	
Power Dissipation $R_{\theta JA}$ (Note 2)	$P_D$	0.77	W	
Continuous Drain Current $R_{\theta JA} t < 10$ s (Note 1)	$I_D$	$T_A = 25^\circ\text{C}$	-4.0	A
		$T_A = 70^\circ\text{C}$	-3.2	
Power Dissipation $R_{\theta JA} t < 10$ s (Note 1)	$P_D$	2.31	W	
Pulsed Drain Current	$I_{DM}$	-10	A	
$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$				
Operating Junction and Storage Temperature	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	-1.3	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

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

Peak Repetitive Reverse Voltage	$V_{RRM}$	20	V	
DC Blocking Voltage	$V_R$	20	V	
Average Rectified Forward Current, (Note 1)	Steady State	$I_F$	2.2	A
		$t < 10$ s	3.2	



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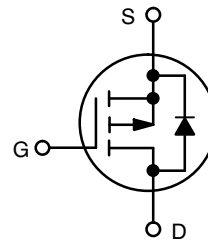
<http://onsemi.com>

### P-CHANNEL MOSFET

$V_{(BR)DSS}$	$R_{DS(on)}$ Max	$I_D$ Max
-30 V	95 m $\Omega$ @ -10 V	-4.0 A
	165 m $\Omega$ @ -4.5 V	

### SCHOTTKY DIODE

$V_R$ Max	$V_F$ Max	$I_F$ Max
20 V	0.58 V	2.2 A

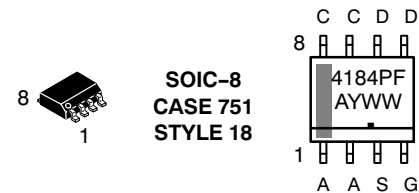


P-Channel MOSFET



Schottky Diode

### MARKING DIAGRAM & PIN ASSIGNMENT



4184PF = Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ■ = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
NTMD4184PFR2G	SOIC-8 (Pb-Free)	2500/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.

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## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter MOSFET & Schottky	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	79	°C/W
Junction-to-Ambient – $t \leq 10$ s Steady State (Note 1)	$R_{\theta JA}$	54	
Junction-to-FOOT (Drain) Equivalent to $R_{\theta JC}$	$R_{\theta JF}$	50	
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	163	

1. Surface-mounted on FR4 board using 1 inch sq pad size, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	-30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			30		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = -24\text{ V}$	$T_J = 25^\circ\text{C}$		-1.0	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		-10	
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	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	-1.0		-3.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			4.4		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -3.0\text{ A}$		70	95	m $\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -1.5\text{ A}$		120	165	
Forward Transconductance	$g_{FS}$	$V_{DS} = -1.5\text{ V}, I_D = -3.0\text{ A}$		5.0		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -10\text{ V}$		280	360	pF
Output Capacitance	$C_{OSS}$			80	110	
Reverse Transfer Capacitance	$C_{RSS}$			52	80	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.0\text{ A}$		2.8	4.2	nC
Threshold Gate Charge	$Q_{G(TH)}$			0.4		
Gate-to-Source Charge	$Q_{GS}$			1.1		
Gate-to-Drain Charge	$Q_{GD}$			1.1		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.0\text{ A}$		5.8	8.8	nC

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}, I_D = -1.0\text{ A}, R_G = 6.0\ \Omega$		7.2	15	ns
Rise Time	$t_r$			12	24	
Turn-Off Delay Time	$t_{d(OFF)}$			18	36	
Fall Time	$t_f$			2.6	6.0	

### DRAIN-TO-SOURCE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_D = -1.3\text{ A}$	$T_J = 25^\circ\text{C}$		-0.8	-1.0	V
			$T_J = 125^\circ\text{C}$		0.7		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = -1.3\text{ A}$		12.8		ns	
Charge Time	$t_a$			10			
Discharge Time	$t_b$			2.8			
Reverse Recovery Time	$Q_{RR}$			7.4			nC

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

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
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## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Maximum Instantaneous Forward Voltage	$V_F$	$I_F = 1.0\text{ A}$	$T_J = 25^\circ\text{C}$		0.43	0.50	V
			$T_J = 125^\circ\text{C}$		0.35	0.39	
		$I_F = 2.0\text{ A}$	$T_J = 25^\circ\text{C}$		0.5	0.58	
			$T_J = 125^\circ\text{C}$		0.45	0.53	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 10\text{ V}$	$T_J = 25^\circ\text{C}$		0.001	0.02	mA
			$T_J = 125^\circ\text{C}$		1.2	14	
		$V_R = 20\text{ V}$	$T_J = 25^\circ\text{C}$		0.004	0.05	
			$T_J = 125^\circ\text{C}$		2.0	18	

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

## TYPICAL CHARACTERISTICS

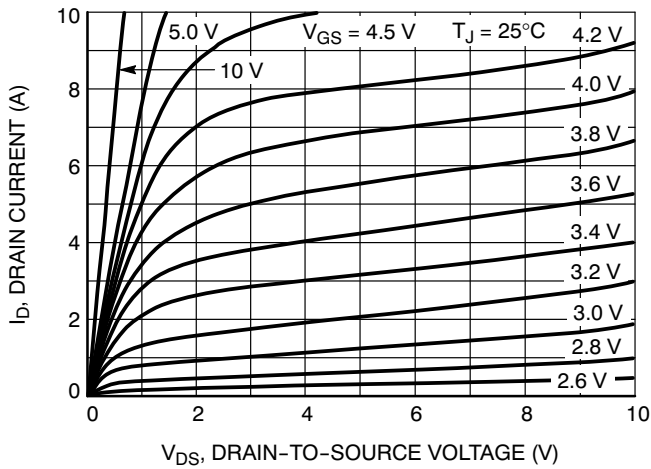


Figure 1. On-Region Characteristics

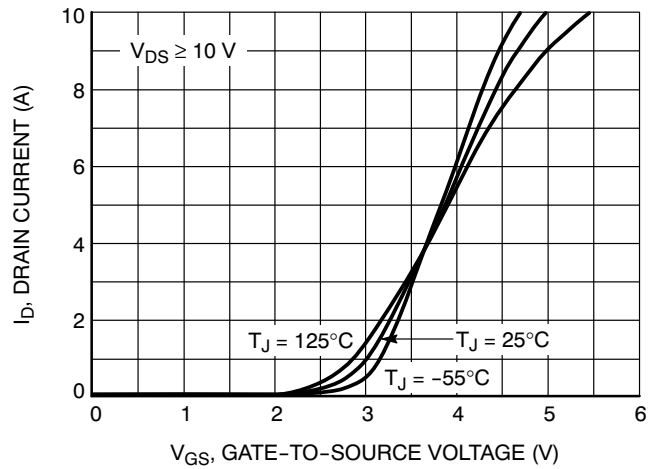


Figure 2. Transfer Characteristics

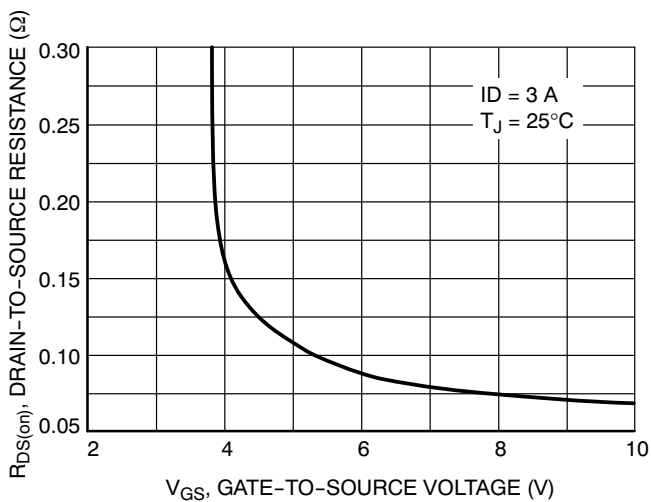


Figure 3. On-Resistance vs. Gate Voltage

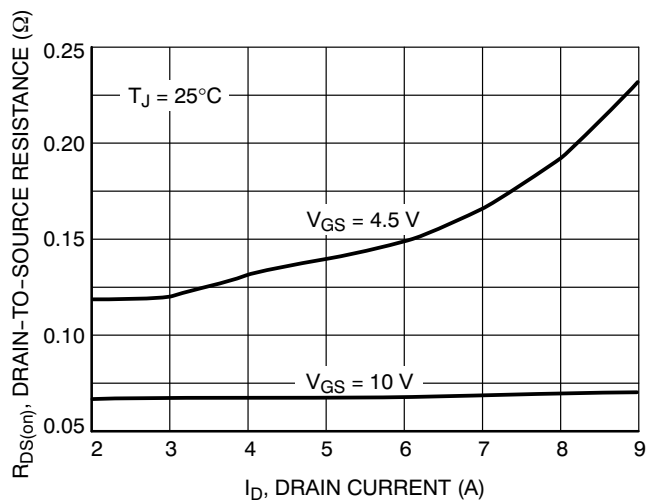


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

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## TYPICAL CHARACTERISTICS

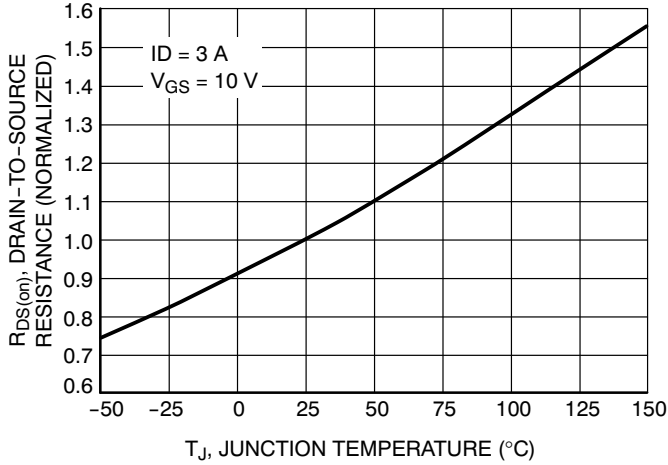


Figure 5. On-Resistance Variation with Temperature

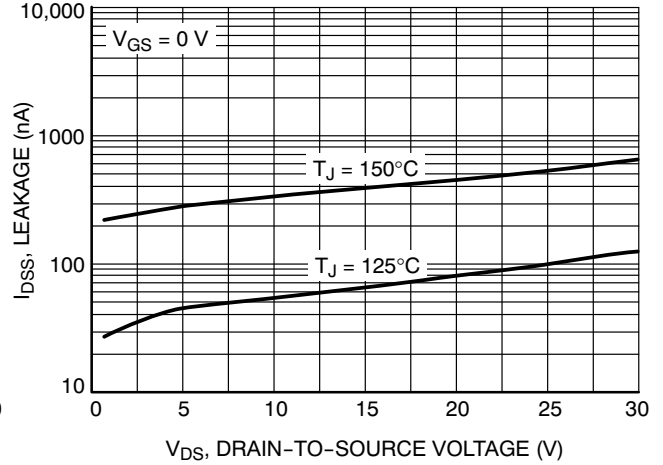


Figure 6. Drain-to-Source Leakage Current vs. Voltage

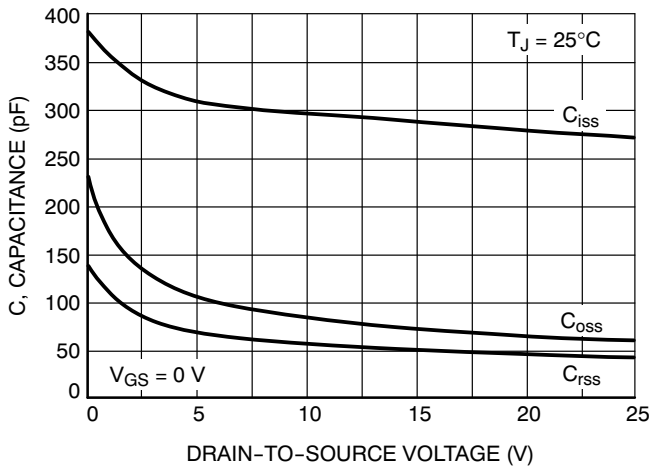


Figure 7. Capacitance Variation

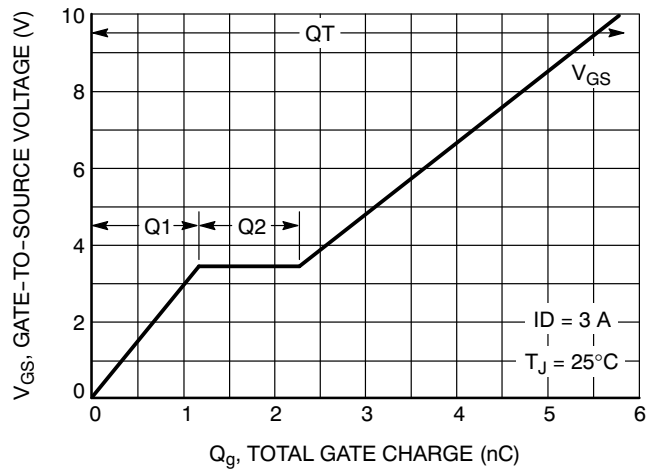


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

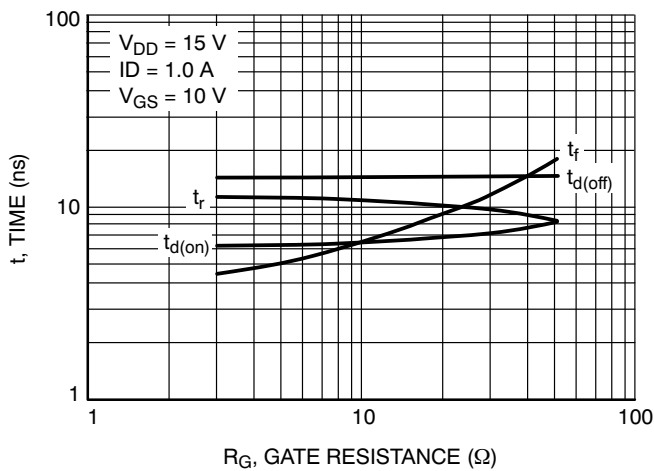


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

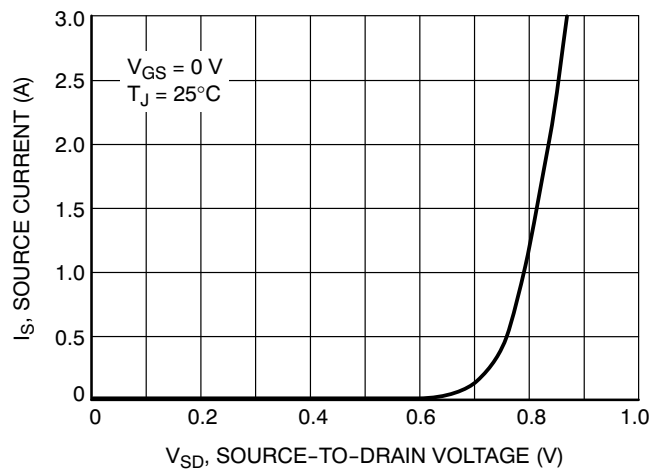


Figure 10. Diode Forward Voltage vs. Current

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## TYPICAL CHARACTERISTICS

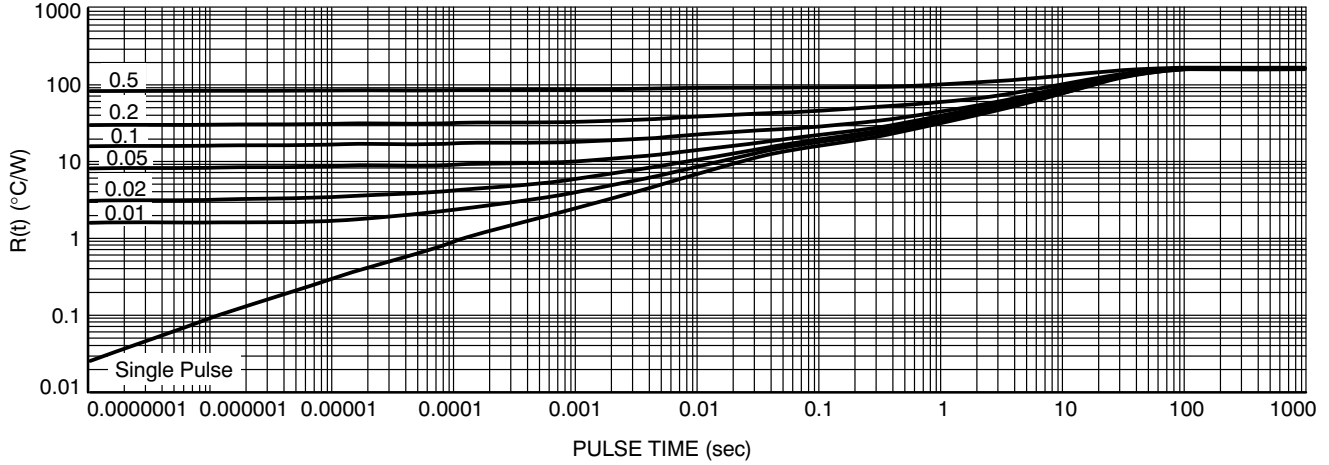


Figure 11. Thermal Response -  $R_{\theta JA}$  at Steady State (min pad)

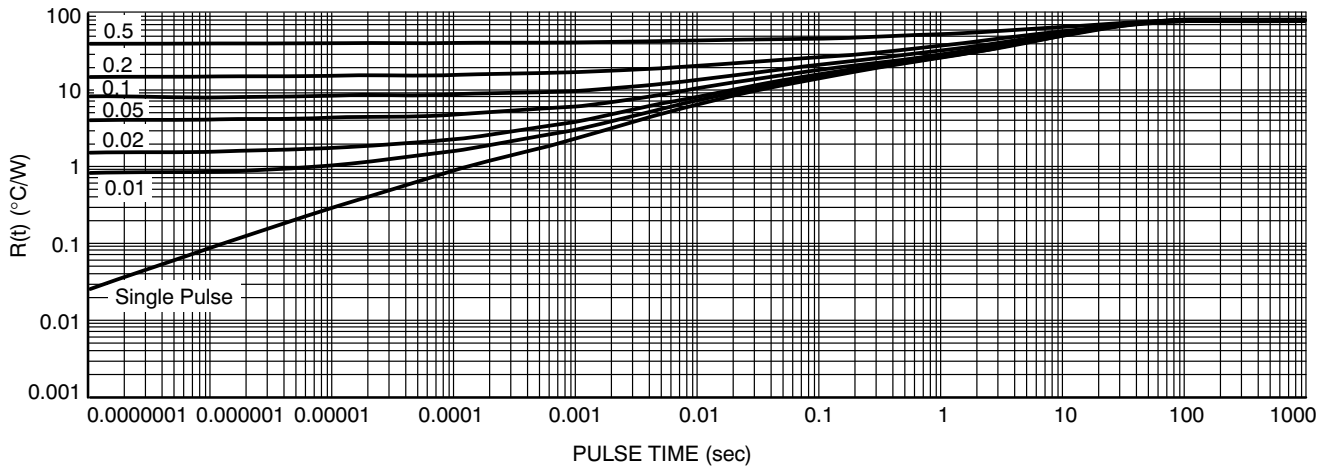


Figure 12. Thermal Response -  $R_{\theta JA}$  at Steady State (1 inch sq pad)

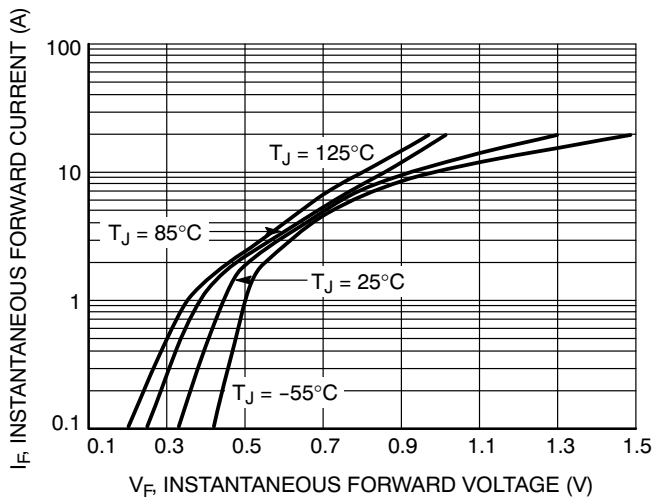


Figure 13. Typical Forward Voltage

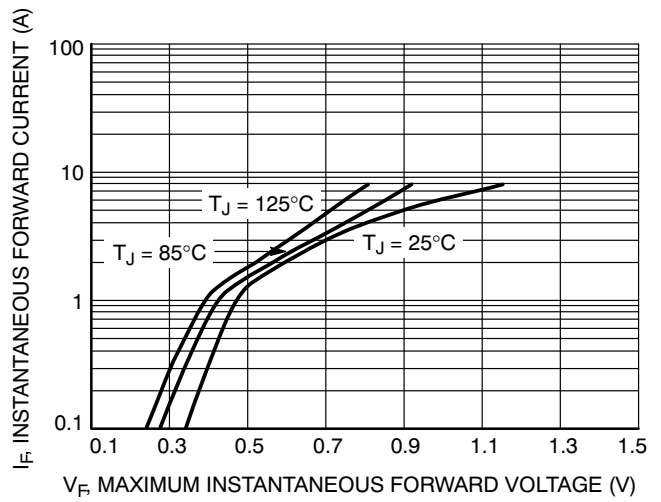


Figure 14. Maximum Forward Voltage

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## TYPICAL CHARACTERISTICS

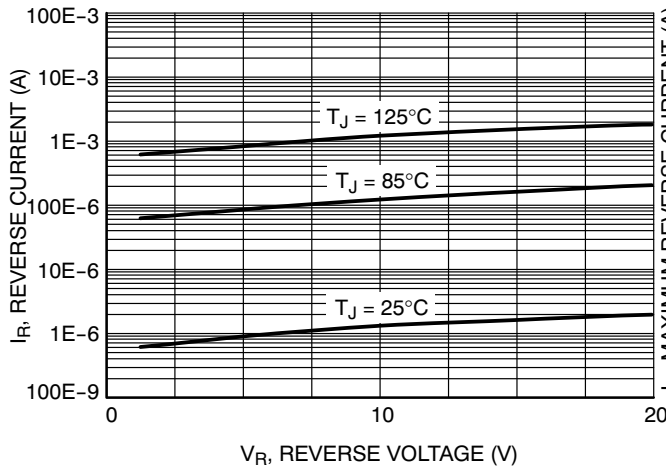


Figure 15. Typical Reverse Current

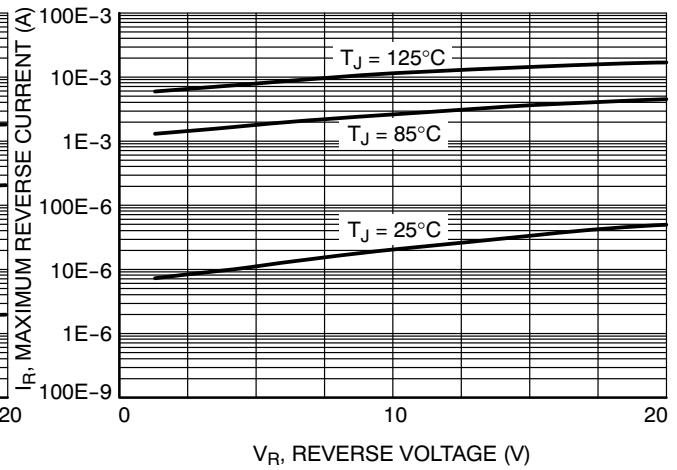


Figure 16. Maximum Reverse Current

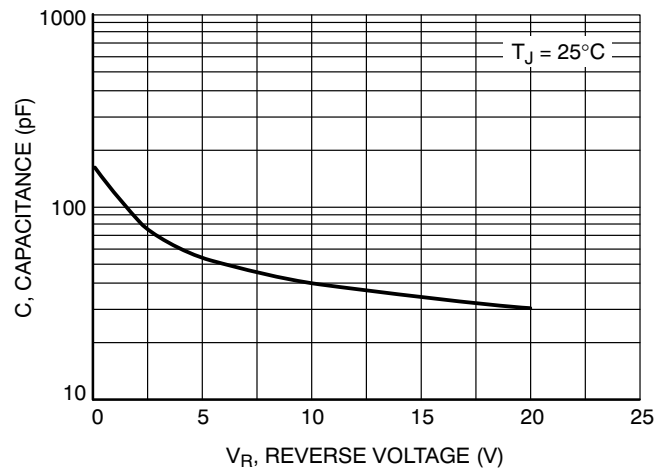
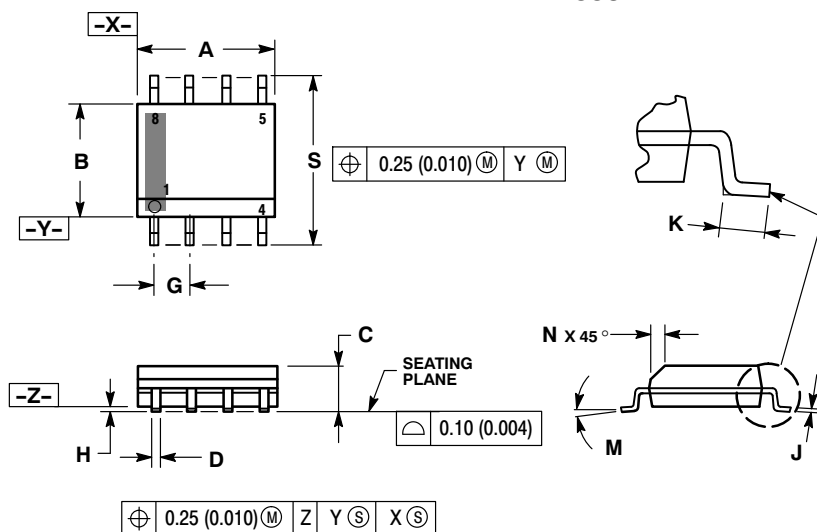


Figure 17. Capacitance

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## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AH

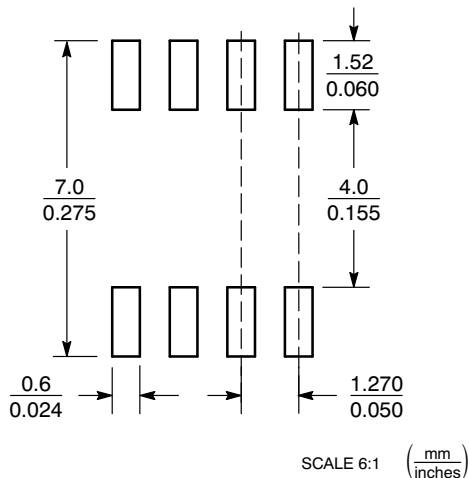


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

### SOLDERING FOOTPRINT\*



**STYLE 18:**

- PIN 1. ANODE
- 2. ANODE
- 3. SOURCE
- 4. GATE
- 5. DRAIN
- 6. DRAIN
- 7. CATHODE
- 8. CATHODE

\*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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