

# NTMS10P02R2

## Power MOSFET -10 Amps, -20 Volts P-Channel Enhancement-Mode Single SO-8 Package

### Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Miniature SO-8 Surface Mount Package
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- SO-8 Mounting Information Provided

### Applications

- Power Management in Portable and Battery-Powered Products, i.e.: Cellular and Cordless Telephones and PCMCIA Cards

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	-20	Vdc
Gate-to-Source Voltage - Continuous	$V_{GS}$	$\pm 12$	Vdc
Thermal Resistance - Junction-to-Ambient (Note 1.)	$R_{\theta JA}$	50	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	2.5	W
Continuous Drain Current @ $25^\circ\text{C}$	$I_D$	-10	A
Continuous Drain Current @ $70^\circ\text{C}$	$I_D$	-8.0	A
Maximum Operating Power Dissipation	$P_D$	0.6	W
Maximum Operating Drain Current	$I_D$	-5.5	A
Pulsed Drain Current (Note 3.)	$I_{DM}$	-50	A
Thermal Resistance - Junction-to-Ambient (Note 2.)	$R_{\theta JA}$	80	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.6	W
Continuous Drain Current @ $25^\circ\text{C}$	$I_D$	-8.8	A
Continuous Drain Current @ $70^\circ\text{C}$	$I_D$	-6.4	A
Maximum Operating Power Dissipation	$P_D$	0.4	W
Maximum Operating Drain Current	$I_D$	-4.5	A
Pulsed Drain Current (Note 3.)	$I_{DM}$	-44	A
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = -20$ Vdc, $V_{GS} = -4.5$ Vdc, Peak $I_L = 5.0$ Apk, $L = 40$ mH, $R_G = 25 \Omega$ )	$E_{AS}$	500	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

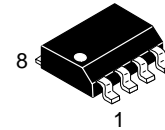
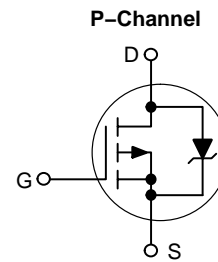
1. Mounted onto a 2" square FR-4 Board (1" sq. Cu 0.06" thick single sided),  $t = 10$  seconds.
2. Mounted onto a 2" square FR-4 Board (1" sq. Cu 0.06" thick single sided),  $t =$  steady state.
3. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2%.



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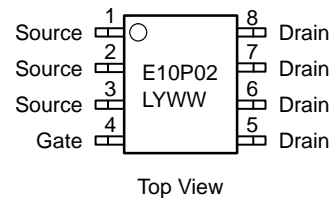
<http://onsemi.com>

**-10 AMPERES  
-20 VOLTS  
14 m $\Omega$  @  $V_{GS} = -4.5$  V**



**SO-8  
CASE 751  
STYLE 12**

### MARKING DIAGRAM & PIN ASSIGNMENT



E10P02 = Device Code  
L = Assembly Location  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping†
NTMS10P02R2	SO-8	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.

# NTMS10P02R2

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted) (Note 4.)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	-20 -	- -12.1	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 25°C) (V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 70°C)	I <sub>DSS</sub>	- -	- -	-1.0 -5.0	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = -12 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	-100	nAdc
Gate-Body Leakage Current (V <sub>GS</sub> = +12 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	100	nAdc

### ON CHARACTERISTICS

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μAdc) Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	-0.6 -	-0.88 2.8	-1.20 -	Vdc mV/°C
Static Drain-to-Source On-State Resistance (V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -10 Adc) (V <sub>GS</sub> = -2.5 Vdc, I <sub>D</sub> = -8.8 Adc)	R <sub>DS(on)</sub>	- -	0.012 0.017	0.014 0.020	Ω
Forward Transconductance (V <sub>DS</sub> = -10 Vdc, I <sub>D</sub> = -10 Adc)	g <sub>FS</sub>	-	30	-	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = -16 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	-	3100	3640	pF
Output Capacitance		C <sub>OSS</sub>	-	1100	1670	
Reverse Transfer Capacitance		C <sub>rSS</sub>	-	475	1010	

### SWITCHING CHARACTERISTICS (Notes 5. & 6.)

Turn-On Delay Time	(V <sub>DD</sub> = -10 Vdc, I <sub>D</sub> = -1.0 Adc, V <sub>GS</sub> = -4.5 Vdc, R <sub>G</sub> = 6.0 Ω)	t <sub>d(on)</sub>	-	25	35	ns
Rise Time		t <sub>r</sub>	-	40	65	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	110	190	
Fall Time		t <sub>f</sub>	-	110	190	
Turn-On Delay Time	(V <sub>DD</sub> = -10 Vdc, I <sub>D</sub> = -10 Adc, V <sub>GS</sub> = -4.5 Vdc, R <sub>G</sub> = 6.0 Ω)	t <sub>d(on)</sub>	-	25	-	ns
Rise Time		t <sub>r</sub>	-	100	-	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	100	-	
Fall Time		t <sub>f</sub>	-	125	-	
Total Gate Charge	(V <sub>DS</sub> = -10 Vdc, V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -10 Adc)	Q <sub>tot</sub>	-	48	70	nC
Gate-Source Charge		Q <sub>gs</sub>	-	6.5	-	
Gate-Drain Charge		Q <sub>gd</sub>	-	17	-	

### BODY-DRAIN DIODE RATINGS (Note 5.)

Diode Forward On-Voltage	(I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	- -	-0.72 -0.60	-1.2 -	Vdc
Diode Forward On-Voltage	(I <sub>S</sub> = -10 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = -10 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	- -	-0.90 -0.75	- -	Vdc
Reverse Recovery Time	(I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc, di <sub>S</sub> /dt = 100 A/μs)	t <sub>rr</sub>	-	65	100	ns
		t <sub>a</sub>	-	25	-	
		t <sub>b</sub>	-	40	-	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	-	0.075	-	μC

4. Handling precautions to protect against electrostatic discharge is mandatory.
5. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.
6. Switching characteristics are independent of operating junction temperature.

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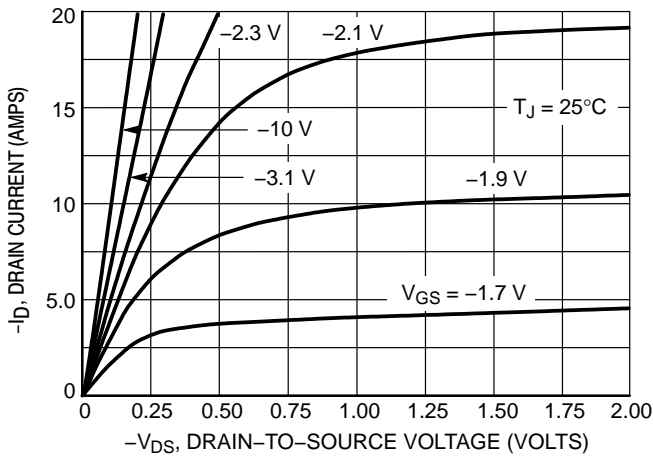


Figure 1. On-Region Characteristics

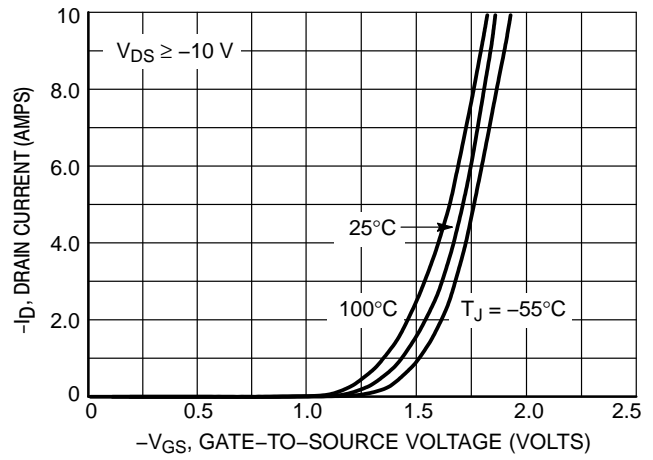


Figure 2. Transfer Characteristics

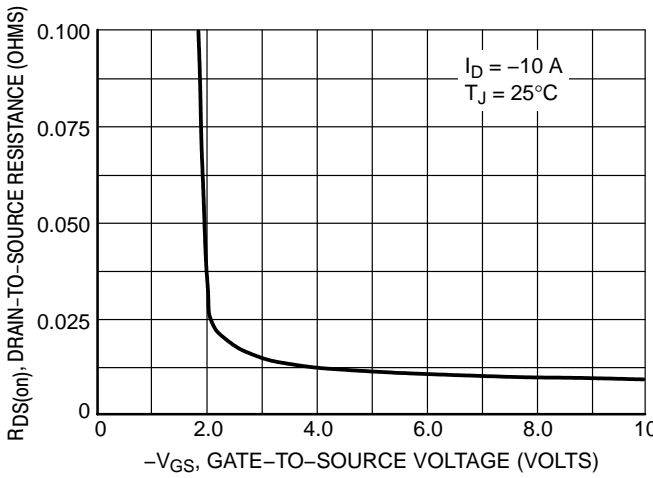


Figure 3. On-Resistance versus Gate-To-Source Voltage

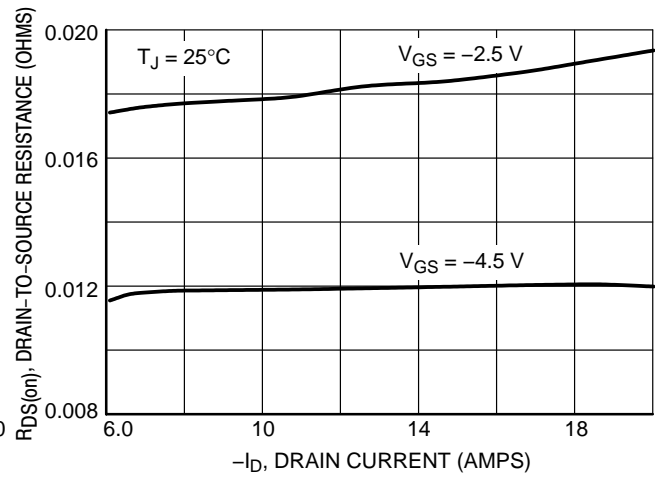


Figure 4. On-Resistance versus Drain Current and Gate Voltage

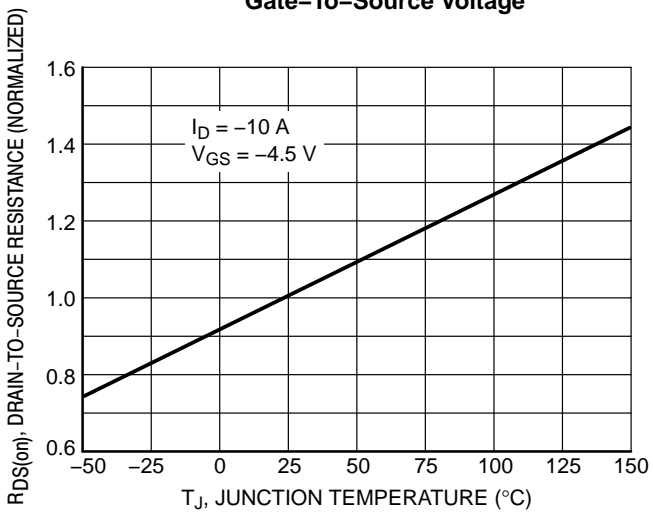


Figure 5. On-Resistance Variation with Temperature

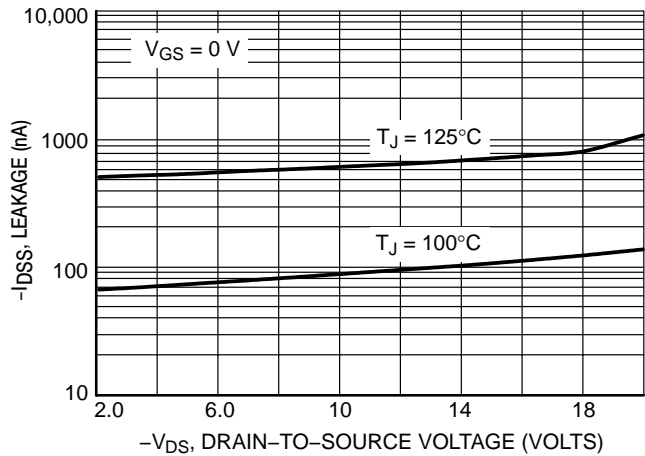
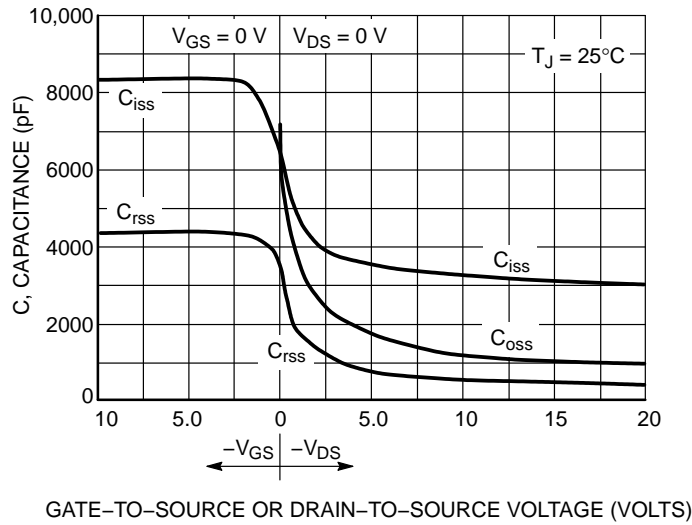
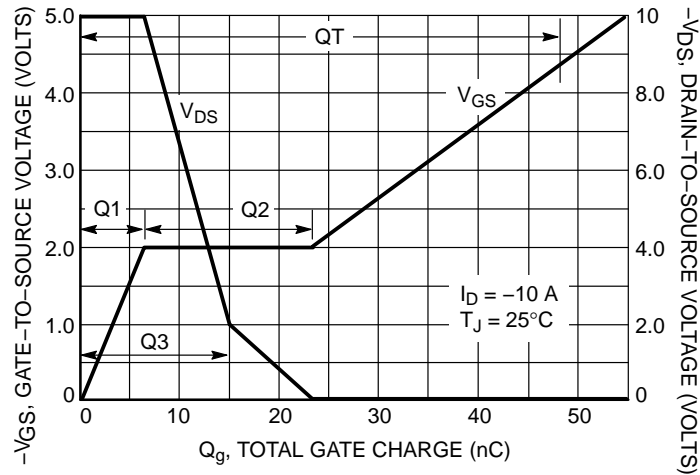


Figure 6. Drain-To-Source Leakage Current versus Voltage

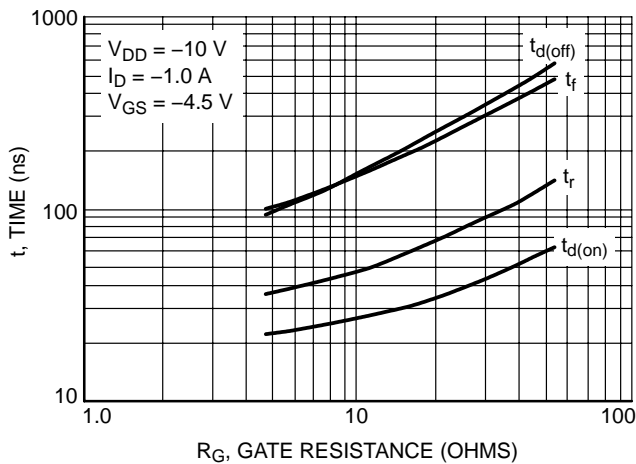
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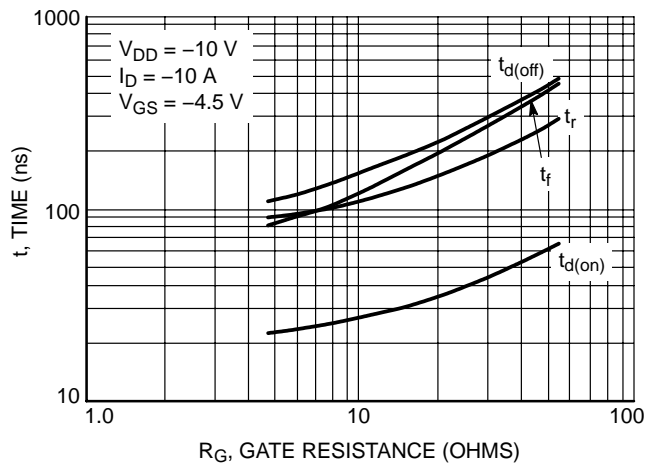
**Figure 7. Capacitance Variation**



**Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge**



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



**Figure 10. Resistive Switching Time Variation versus Gate Resistance**

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## DRAIN-TO-SOURCE DIODE CHARACTERISTICS

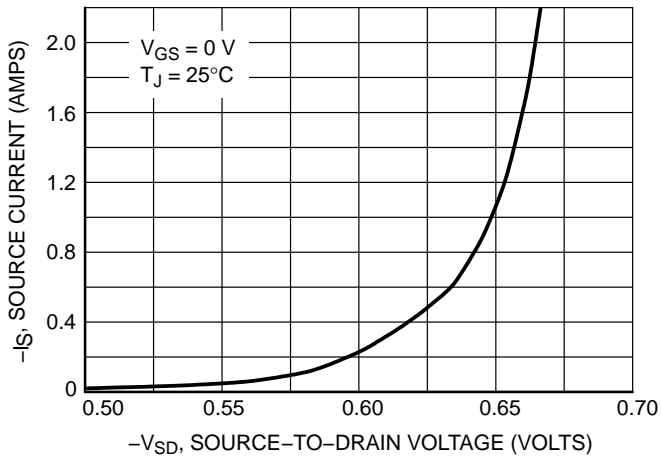


Figure 11. Diode Forward Voltage versus Current

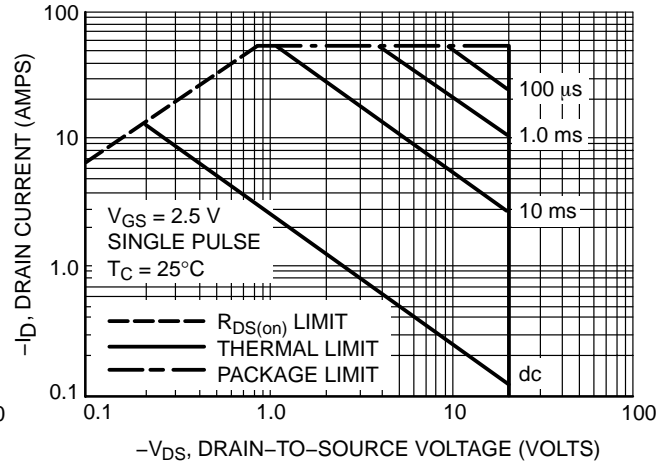


Figure 12. Maximum Rated Forward Biased Safe Operating Area

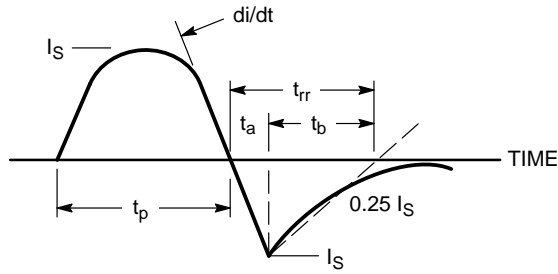


Figure 13. Diode Reverse Recovery Waveform

## TYPICAL ELECTRICAL CHARACTERISTICS

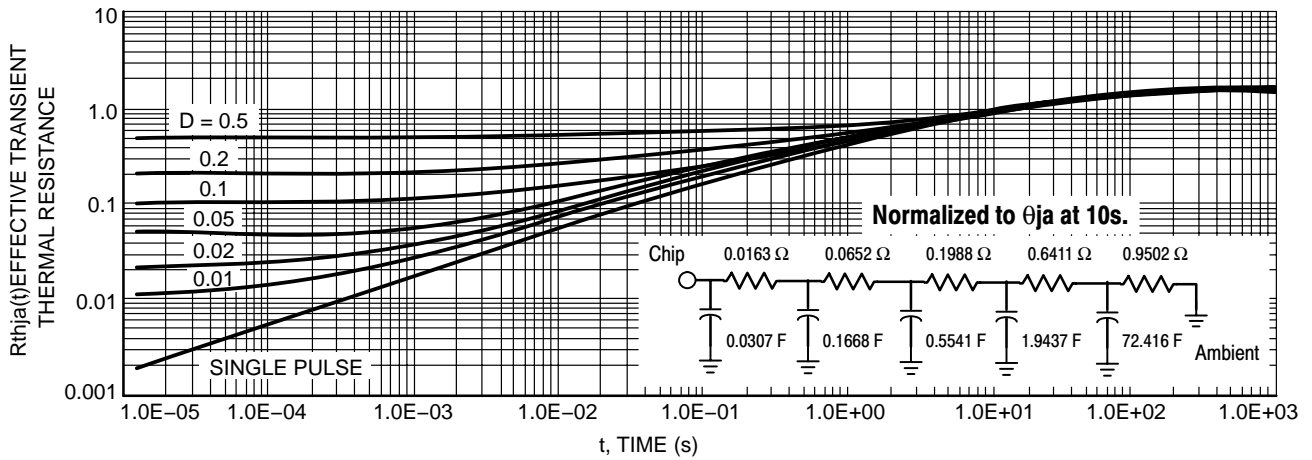
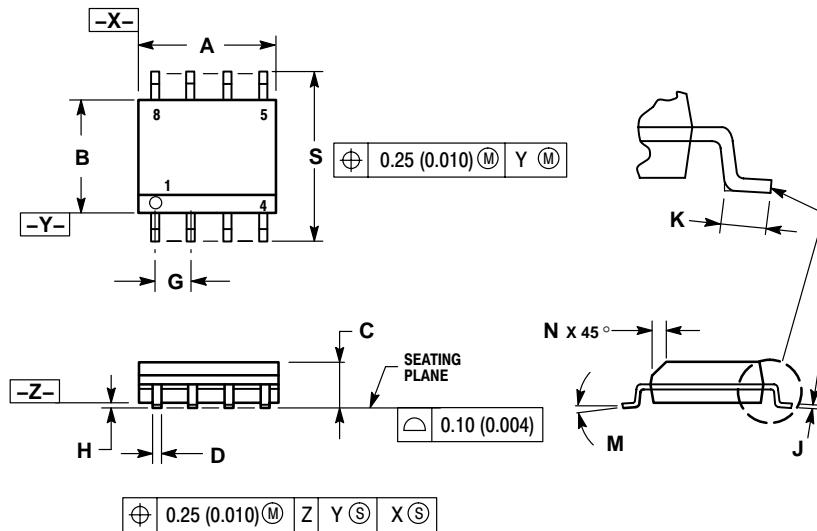


Figure 14. Thermal Response

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## PACKAGE DIMENSIONS

SO-8  
CASE 751-07  
ISSUE AA



**NOTES:**

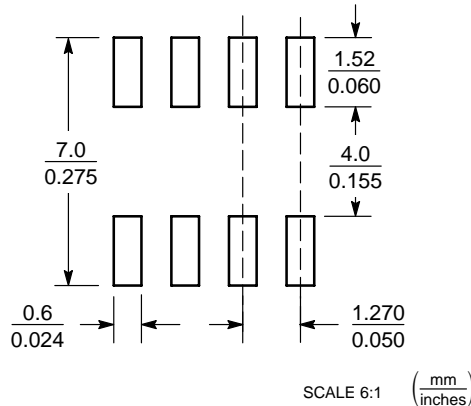
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL 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

**STYLE 12:**

1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

**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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