

# NTMSD2P102LR2

## FETKY™

### Power MOSFET and Schottky Diode Dual SO-8 Package

#### Features

- High Efficiency Components in a Single SO-8 Package
- High Density Power MOSFET with Low  $R_{DS(on)}$ , Schottky Diode with Low  $V_F$
- Logic Level Gate Drive
- Independent Pin-Outs for MOSFET and Schottky Die Allowing for Flexibility in Application Use
- Less Component Placement for Board Space Savings
- SO-8 Surface Mount Package, Mounting Information for SO-8 Package Provided
- Pb-Free Package is Available

#### Applications

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

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	-20	V
Gate-to-Source Voltage – Continuous	$V_{GS}$	$\pm 10$	V
Thermal Resistance, Junction-to-Ambient (Note 1)	$R_{\theta JA}$	175	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	0.71	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	-2.3	A
Continuous Drain Current @ $T_A = 100^\circ\text{C}$	$I_D$	-1.45	A
Pulsed Drain Current (Note 4)	$I_{DM}$	-9.0	A
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	105	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.19	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	-2.97	A
Continuous Drain Current @ $T_A = 100^\circ\text{C}$	$I_D$	-1.88	A
Pulsed Drain Current (Note 4)	$I_{DM}$	-12	A
Thermal Resistance, Junction-to-Ambient (Note 3)	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	2.0	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	-3.85	A
Continuous Drain Current @ $T_A = 100^\circ\text{C}$	$I_D$	-2.43	A
Pulsed Drain Current (Note 4)	$I_{DM}$	-15	A
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = -20\text{ Vdc}$ , $V_{GS} = -4.5\text{ Vdc}$ , Peak $I_L = -5.0\text{ Apk}$ , $L = 28\text{ mH}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	350	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8" from Case for 10 Seconds	$T_L$	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.

1. Minimum FR-4 or G-10 PCB, Steady State.
2. Mounted onto a 2" square FR-4 Board (1" sq. 2 oz Cu 0.06" thick single sided), Steady State.
3. Mounted onto a 2" square FR-4 Board (1" sq. 2 oz Cu 0.06" thick single sided),  $t \leq 10$  seconds.
4. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.



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#### MOSFET

**-2.3 AMPERES, -20 VOLTS**

**90 m $\Omega$  @  $V_{GS} = -4.5\text{ V}$**

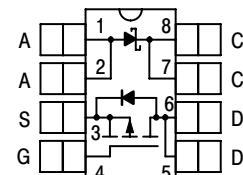
#### SCHOTTKY DIODE

**2.0 AMPERES, 20 VOLTS**

**580 mV @  $I_F = 2.0\text{ A}$**

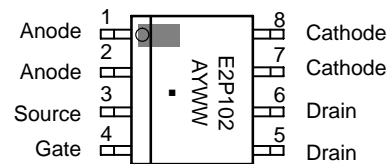


SO-8  
CASE 751  
STYLE 18



TOP VIEW

#### MARKING DIAGRAM & PIN ASSIGNMENTS



(Top View)

E2P102 = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

#### ORDERING INFORMATION

Device	Package	Shipping†
NTMSD2P102LR2	SO-8	2500/Tape & Reel
NTMSD2P102LR2G	SO-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.

# NTMSD2P102LR2

## SCHOTTKY MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage DC Blocking Voltage	V <sub>RRM</sub> V <sub>R</sub>	20	V
Average Forward Current (Note 5) (Rated V <sub>R</sub> , T <sub>A</sub> = 100°C)	I <sub>O</sub>	1.0	A
Peak Repetitive Forward Current (Note 5) (Rated V <sub>R</sub> , Square Wave, 20 kHz, T <sub>A</sub> = 105°C)	I <sub>FRM</sub>	2.0	A
Non-Repetitive Peak Surge Current (Note 5) (Surge Applied at Rated Load Conditions, Half-Wave, Single Phase, 60 Hz)	I <sub>FSM</sub>	20	A

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (Note 6)

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 -	- -12.7	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = -16 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 25°C) (V <sub>DS</sub> = -16 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	- -	- -	-1.0 -25	μAdc
Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = -20 Vdc, T <sub>J</sub> = 25°C)	I <sub>DSS</sub>	-	-	-2.0	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = -10 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	-100	nAdc
Gate-Body Leakage Current (V <sub>GS</sub> = +10 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>	-0.5 -	-0.90 2.5	-1.5 -	Vdc mV/°C
Static Drain-to-Source On-State Resistance (V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -2.4 Adc) (V <sub>GS</sub> = -2.7 Vdc, I <sub>D</sub> = -1.2 Adc) (V <sub>GS</sub> = -2.5 Vdc, I <sub>D</sub> = -1.2 Adc)	R <sub>DS(on)</sub>	- - -	0.070 0.100 0.110	0.090 0.130 0.150	Ω
Forward Transconductance (V <sub>DS</sub> = -10 Vdc, I <sub>D</sub> = -1.2 Adc)	g <sub>FS</sub>	-	4.2	-	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>	-	550	750	pF
Output Capacitance		C <sub>oss</sub>	-	200	300	
Reverse Transfer Capacitance		C <sub>rss</sub>	-	100	175	

5. Mounted onto a 2" square FR-4 Board (1" sq. 2 oz Cu 0.06" thick single sided), t ≤ 10 seconds.
6. Handling precautions to protect against electrostatic discharge is mandatory.

# NTMSD2P102LR2

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (continued) (Note 7)

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>SWITCHING CHARACTERISTICS</b> (Notes 8 & 9)						
Turn-On Delay Time	$(V_{DD} = -10 \text{ Vdc}, I_D = -2.4 \text{ Adc}, V_{GS} = -4.5 \text{ Vdc}, R_G = 6.0 \Omega)$	$t_{d(on)}$	–	10	20	ns
Rise Time		$t_r$	–	35	65	
Turn-Off Delay Time		$t_{d(off)}$	–	33	60	
Fall Time		$t_f$	–	29	55	
Turn-On Delay Time	$(V_{DD} = -10 \text{ Vdc}, I_D = -1.2 \text{ Adc}, V_{GS} = -2.7 \text{ Vdc}, R_G = 6.0 \Omega)$	$t_{d(on)}$	–	15	–	ns
Rise Time		$t_r$	–	40	–	
Turn-Off Delay Time		$t_{d(off)}$	–	35	–	
Fall Time		$t_f$	–	35	–	
Total Gate Charge	$(V_{DS} = -16 \text{ Vdc}, V_{GS} = -4.5 \text{ Vdc}, I_D = -2.4 \text{ Adc})$	$Q_{tot}$	–	10	18	nC
Gate-Source Charge		$Q_{gs}$	–	1.5	–	
Gate-Drain Charge		$Q_{gd}$	–	5.0	–	

## BODY-DRAIN DIODE RATINGS (Note 8)

Diode Forward On-Voltage	$(I_S = -2.4 \text{ Adc}, V_{GS} = 0 \text{ Vdc})$ $(I_S = -2.4 \text{ Adc}, V_{GS} = 0 \text{ Vdc}, T_J = 125^\circ\text{C})$	$V_{SD}$	–	-0.88 -0.75	-1.0 –	Vdc
Reverse Recovery Time	$(I_S = -2.4 \text{ Adc}, V_{GS} = 0 \text{ Vdc}, di_S/dt = 100 \text{ A}/\mu\text{s})$	$t_{rr}$	–	37	–	ns
		$t_a$	–	16	–	
		$t_b$	–	21	–	
Reverse Recovery Stored Charge		$Q_{RR}$	–	0.025	–	μC

## SCHOTTKY RECTIFIER ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (Note 8)

Maximum Instantaneous Forward Voltage	$I_F = 1.0 \text{ Adc}$ $I_F = 2.0 \text{ Adc}$	$V_F$	<b>T<sub>J</sub> = 25°C</b>	<b>T<sub>J</sub> = 125°C</b>	V
			0.47 0.58	0.39 0.53	
Maximum Instantaneous Reverse Current	$V_R = 20 \text{ Vdc}$	$I_R$	<b>T<sub>J</sub> = 25°C</b>	<b>T<sub>J</sub> = 125°C</b>	mA
			0.05	10	
Maximum Voltage Rate of Change	$V_R = 20 \text{ Vdc}$	$dV/dt$	10,000		V/μs

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

# NTMSD2P102LR2

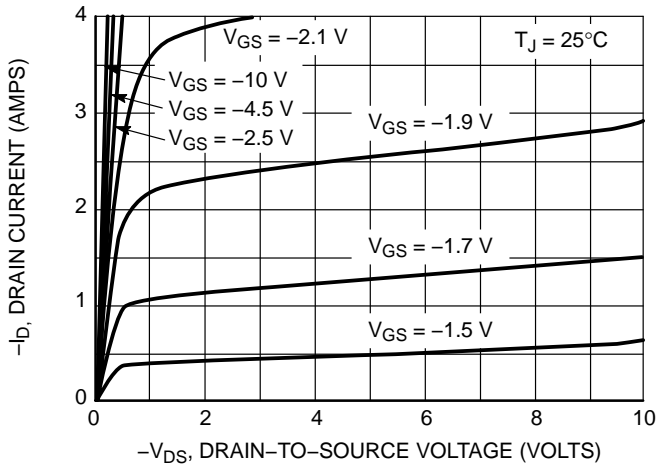


Figure 1. On-Region Characteristics.

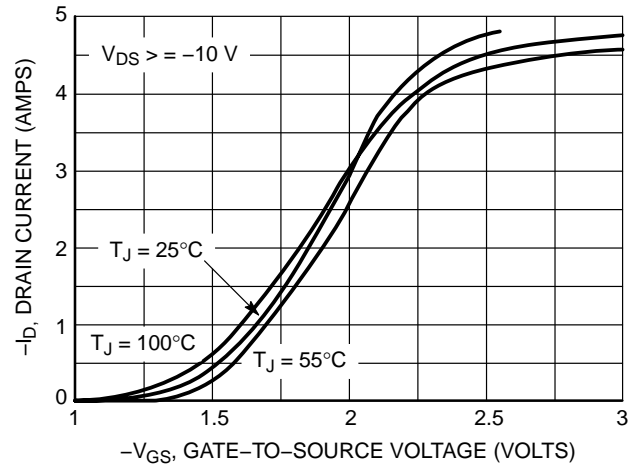


Figure 2. Transfer Characteristics.

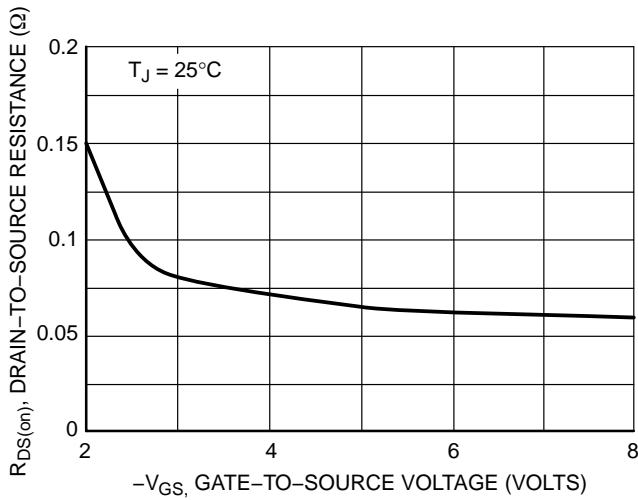


Figure 3. On-Resistance vs. Gate-to-Source Voltage.

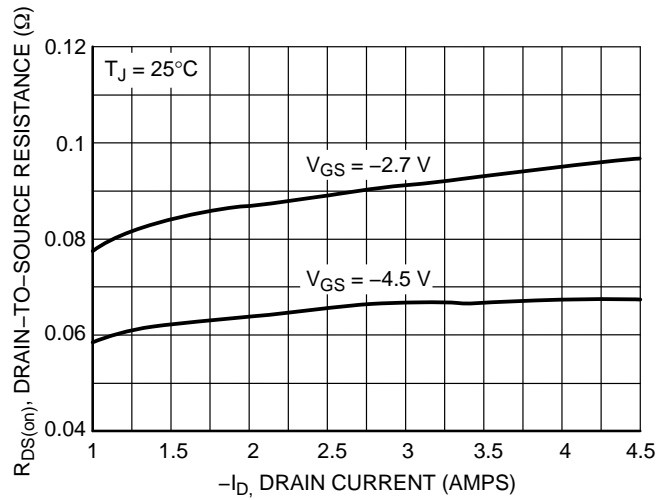


Figure 4. On-Resistance vs. Drain Current and Gate Voltage.

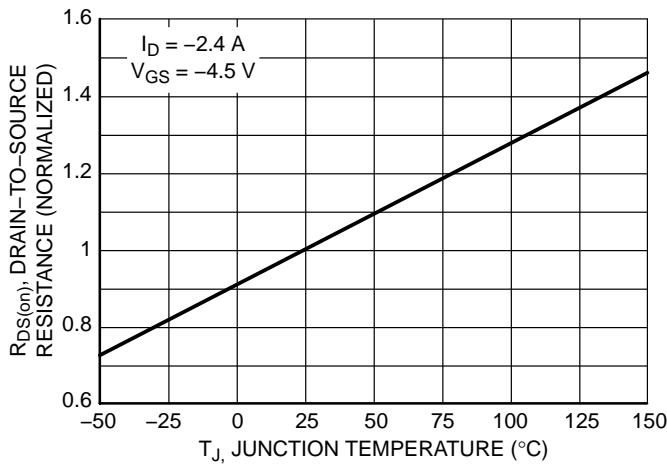


Figure 5. On-Resistance Variation with Temperature.

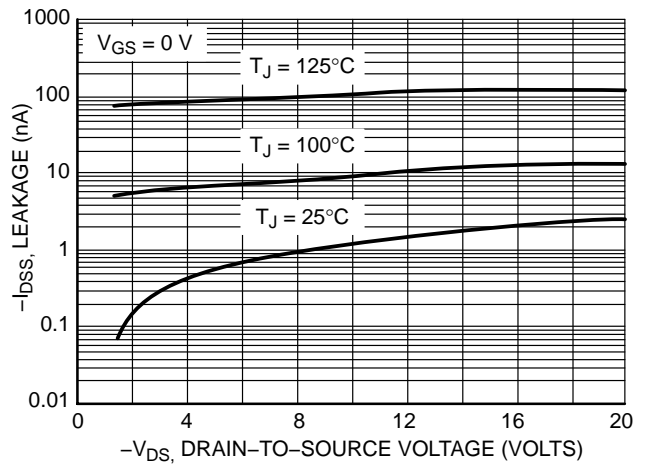


Figure 6. Drain-to-Source Leakage Current vs. Voltage.

# NTMSD2P102LR2

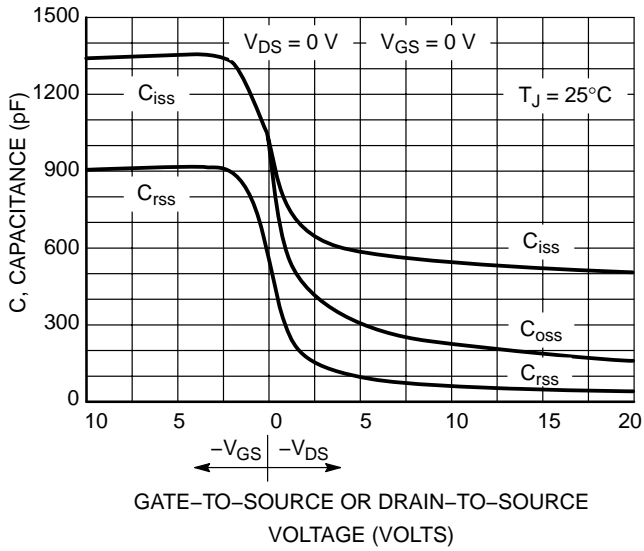


Figure 7. Capacitance Variation

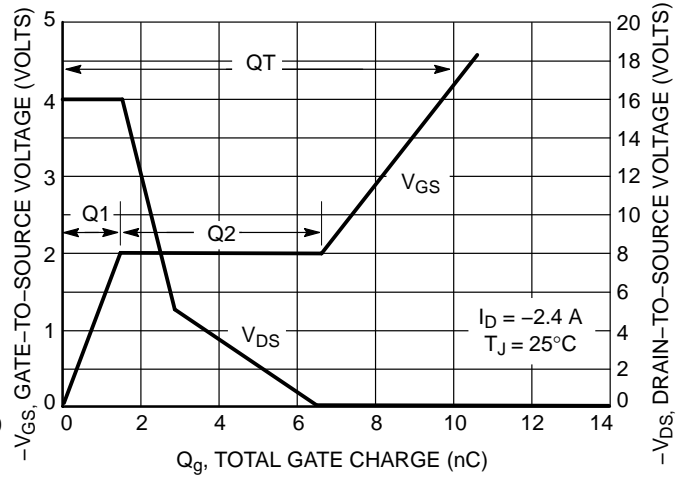


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

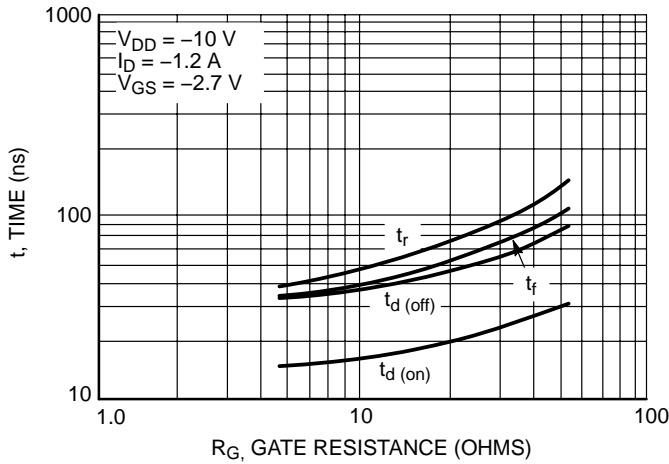


Figure 9. Resistive Switching Time Variation versus Gate Resistance

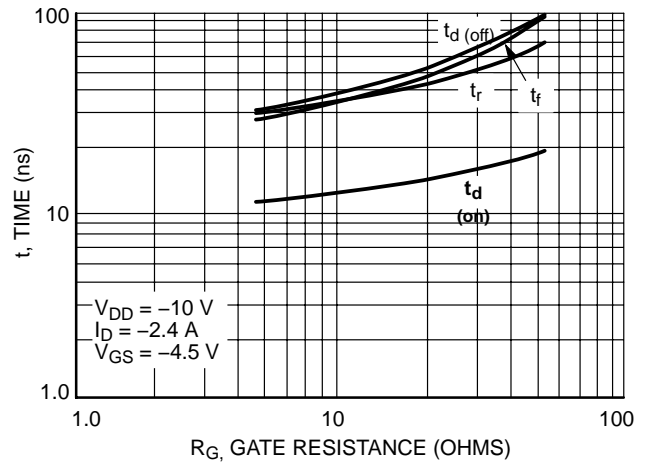


Figure 10. Resistive Switching Time Variation versus Gate Resistance

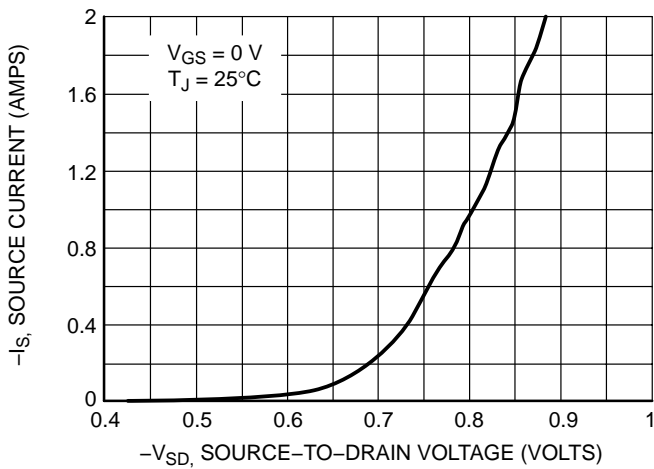


Figure 11. Diode Forward Voltage versus Current

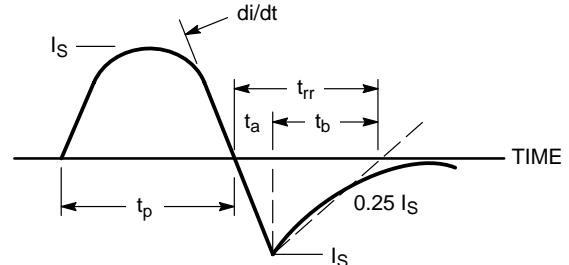


Figure 12. Diode Reverse Recovery Waveform

# NTMSD2P102LR2

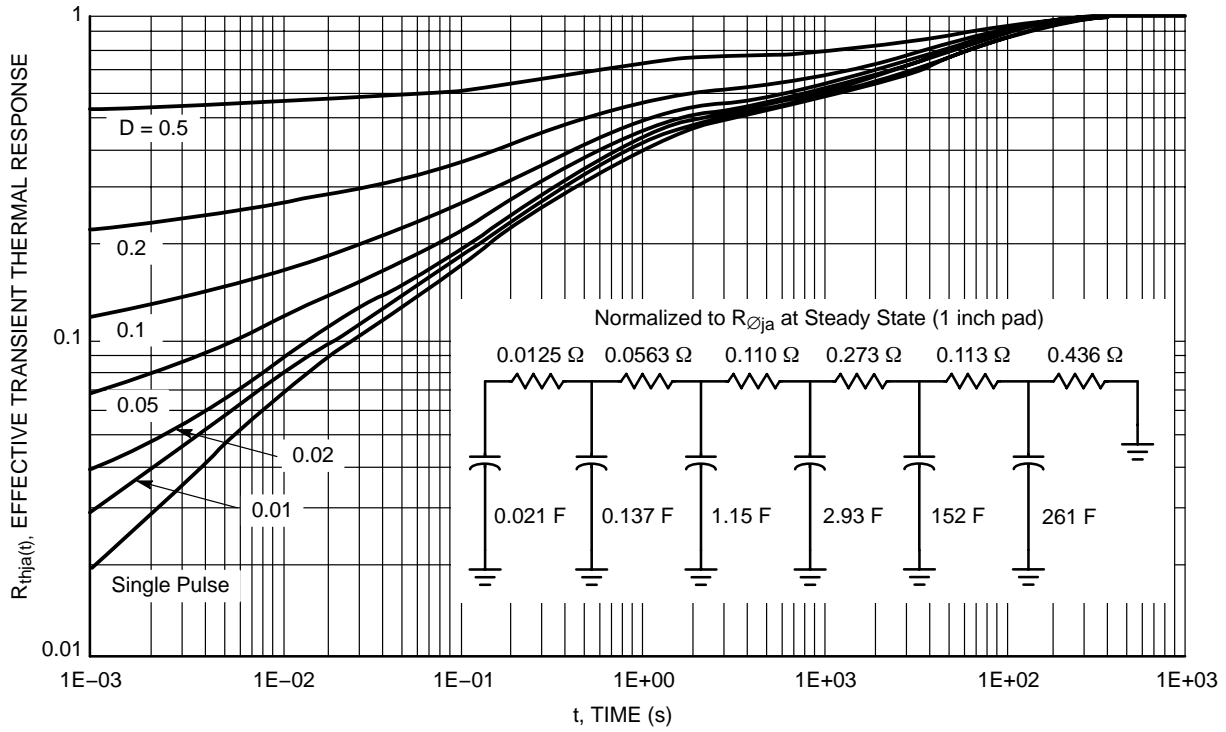


Figure 13. FET Thermal Response

## TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

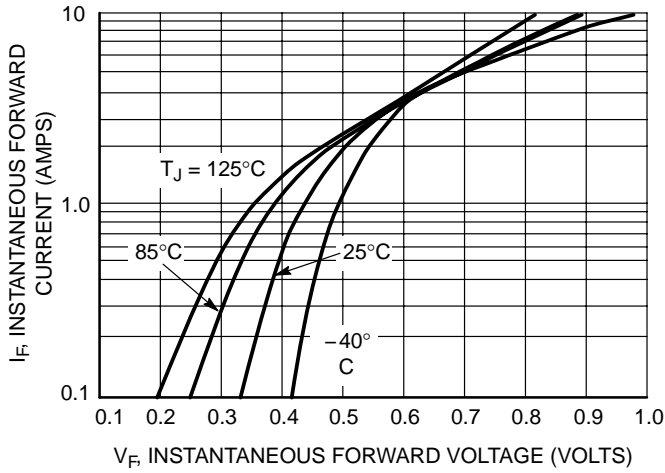


Figure 14. Typical Forward Voltage

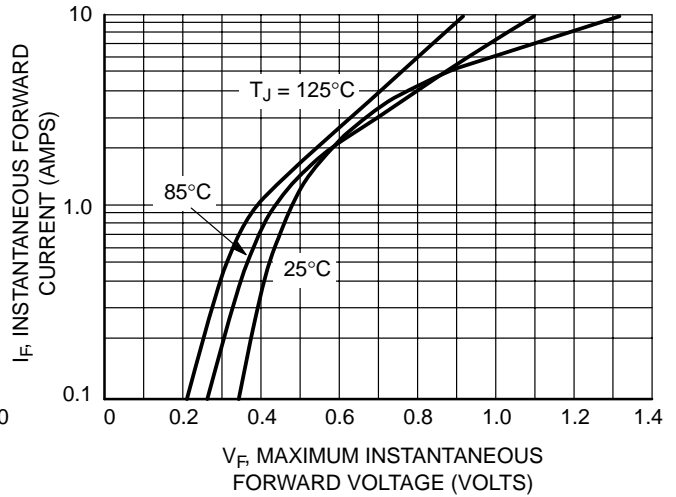


Figure 15. Maximum Forward Voltage

# NTMSD2P102LR2

## TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

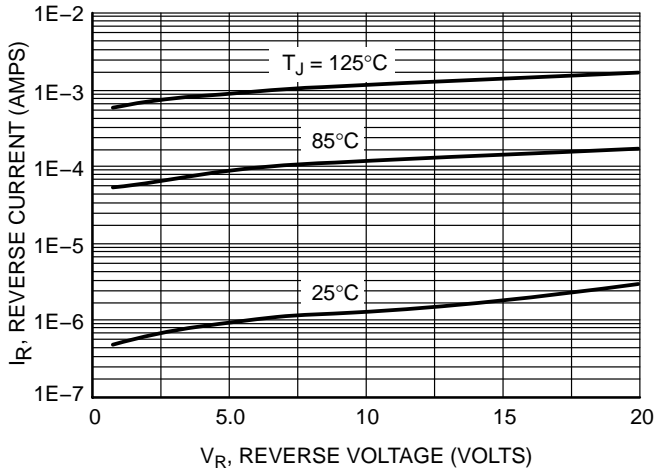


Figure 16. Typical Reverse Current

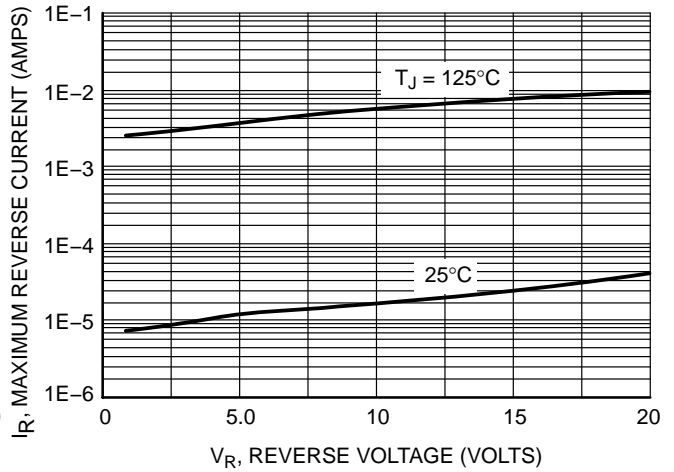


Figure 17. Maximum Reverse Current

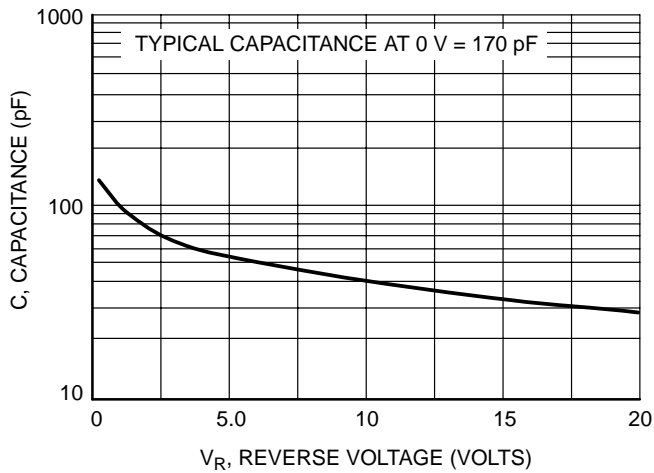


Figure 18. Typical Capacitance

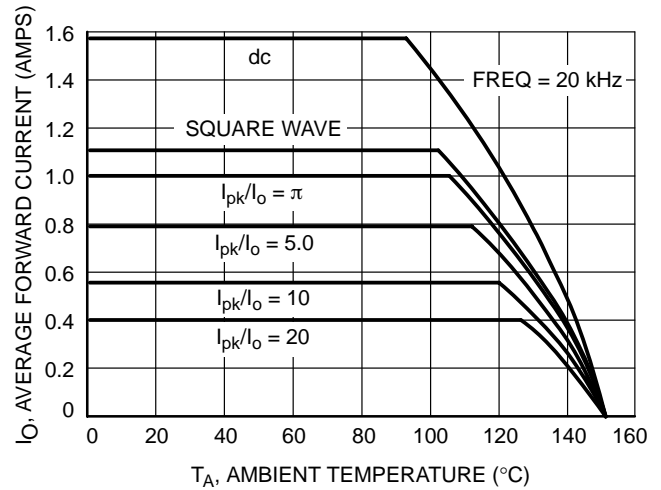


Figure 19. Current Derating

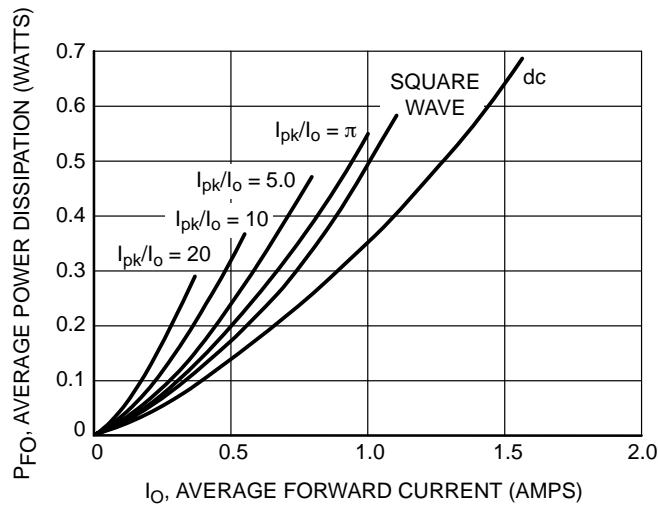


Figure 20. Forward Power Dissipation

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## TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

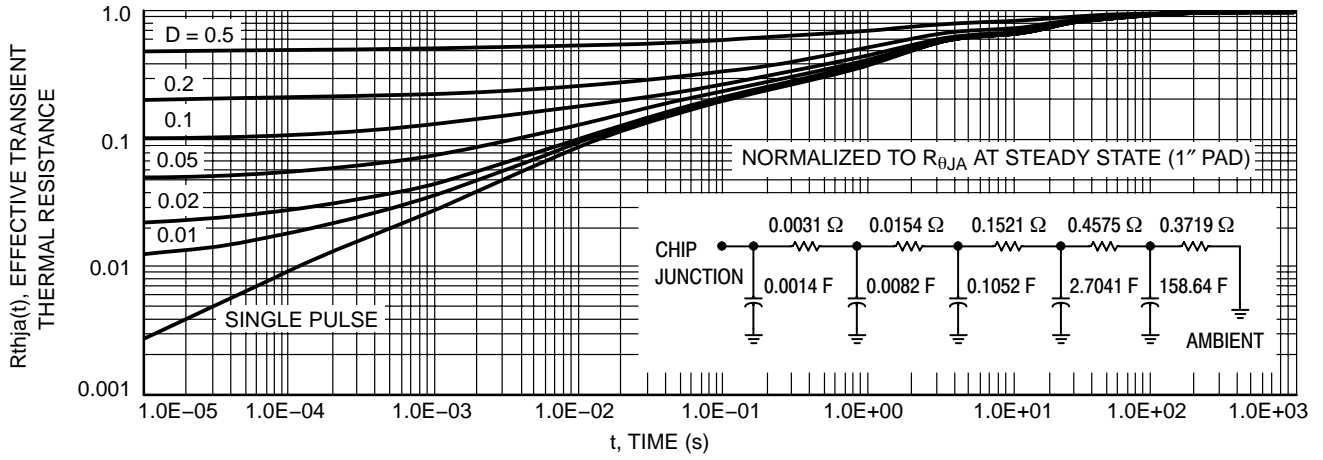


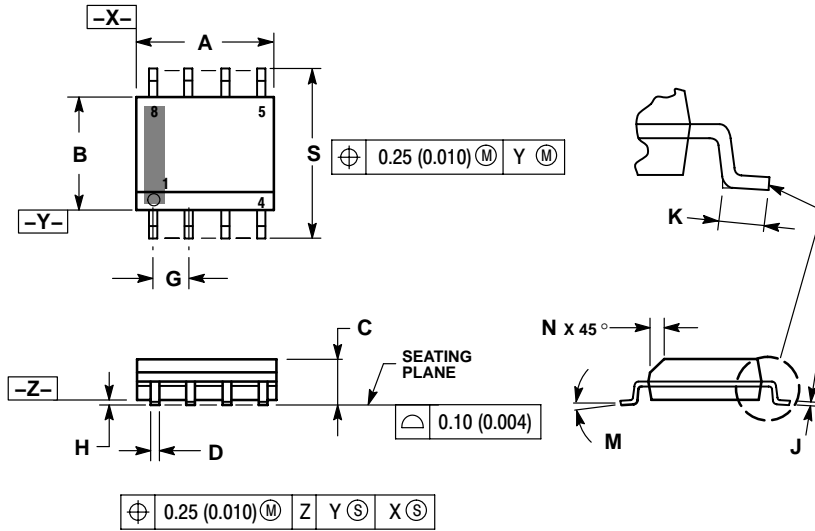
Figure 21. Schottky Thermal Response



# NTMSD2P102LR2

## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AH



### NOTES:

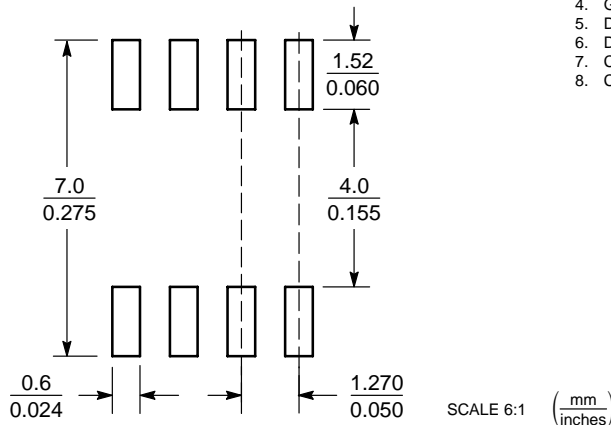
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

### STYLE 18:

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

### 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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