

# NTR4501N, NVR4501N

## Power MOSFET

20 V, 3.2 A, Single N-Channel, SOT-23



ON Semiconductor®

<http://onsemi.com>

### Features

- Leading Planar Technology for Low Gate Charge / Fast Switching
- 2.5 V Rated for Low Voltage Gate Drive
- SOT-23 Surface Mount for Small Footprint
- NVR Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Load/Power Switch for Portables
- Load/Power Switch for Computing
- DC-DC Conversion

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

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V <sub>DSS</sub>	20	V	
Gate-to-Source Voltage		V <sub>GS</sub>	±12	V	
Continuous Drain Current (Note 1)	Steady State	I <sub>D</sub>	T <sub>A</sub> = 25°C	3.2	A
			T <sub>A</sub> = 85°C	2.4	A
Steady State Power Dissipation (Note 1)		P <sub>D</sub>	1.25	W	
Pulsed Drain Current	t <sub>p</sub> = 10 μs	I <sub>DM</sub>	10.0	A	
Operating Junction and Storage Temperature		T <sub>J</sub> , T <sub>stg</sub>	-55 to 150	°C	
Continuous Source Current (Body Diode)		I <sub>S</sub>	1.6	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		T <sub>L</sub>	260	°C	

### THERMAL RESISTANCE RATINGS

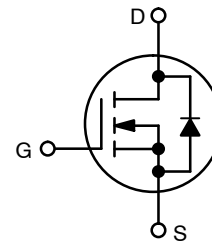
Parameter	Symbol	Max	Unit
Junction-to-Ambient (Note 1)	R <sub>θJA</sub>	100	°C/W
Junction-to-Ambient (Note 2)	R <sub>θJA</sub>	300	

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.

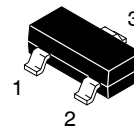
1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Surface-mounted on FR4 board using the minimum recommended pad size.

V <sub>(BR)DSS</sub>	R <sub>DS(on) Typ</sub>	I <sub>D Max</sub> (Note 1)
20 V	70 mΩ @ 4.5 V	3.6 A
	88 mΩ @ 2.5 V	3.1 A

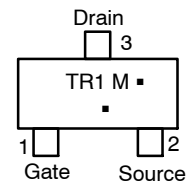
### N-Channel



### MARKING DIAGRAM & PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



TR1 = Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

### ORDERING INFORMATION

Device	Package	Shipping†
NTR4501NT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NVR4501NT1G	SOT-23 (Pb-Free)	3000 / 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.

# NTR4501N, NVR4501N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage (Note 3)	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	20	24.5		V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			22		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$			1.5	$\mu\text{A}$
		$V_{DS} = 16\text{ V}, T_J = 85^\circ\text{C}$			10	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$			$\pm 100$	nA

## ON CHARACTERISTICS

Gate Threshold Voltage (Note 3)	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	0.65		1.2	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-2.3		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 3.6\text{ A}$		70	80	m $\Omega$
		$V_{GS} = 2.5\text{ V}, I_D = 3.1\text{ A}$		88	105	
Forward Transconductance	$g_{FS}$	$V_{DS} = 5.0\text{ V}, I_D = 3.6\text{ A}$		9		S

## CHARGES AND CAPACITANCES

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 10\text{ V}$		200		pF
Output Capacitance	$C_{oss}$			80		
Reverse Transfer Capacitance	$C_{rss}$			50		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}, I_D = 3.6\text{ A}$		2.4	6.0	nC
Gate-to-Source Gate Charge	$Q_{GS}$			0.5		
Gate-to-Drain Charge	$Q_{GD}$			0.6		

## SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}, I_D = 3.6\text{ A}, R_G = 6.0\ \Omega$		6.5	13	ns
Rise Time	$t_r$			12	24	
Turn-Off Delay Time	$t_{d(off)}$			12	24	
Fall Time	$t_f$			3	6	

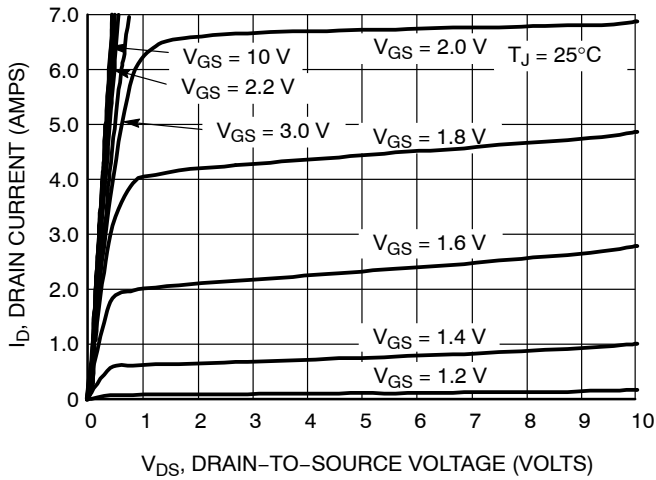
## SOURCE-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_{SD} = 1.6\text{ A}$		0.8	1.2	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 1.6\text{ A}$		7.1		ns
Charge Time	$t_a$			5		
Discharge Time	$t_b$			1.9		
Reverse Recovery Charge	$Q_{RR}$			3.0		

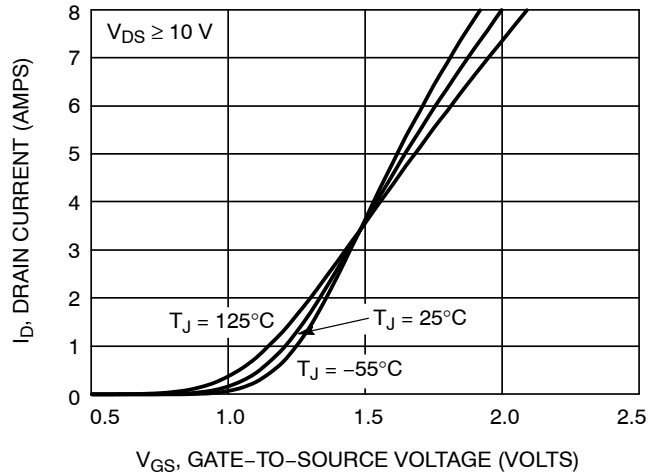
3. Pulse Test: Pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

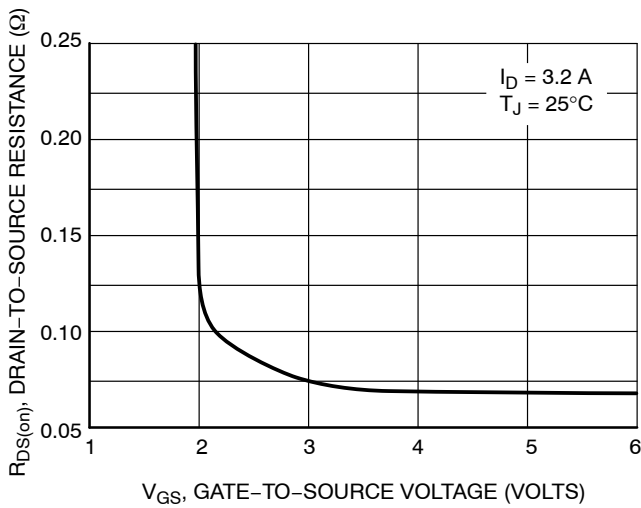
# NTR4501N, NVR4501N



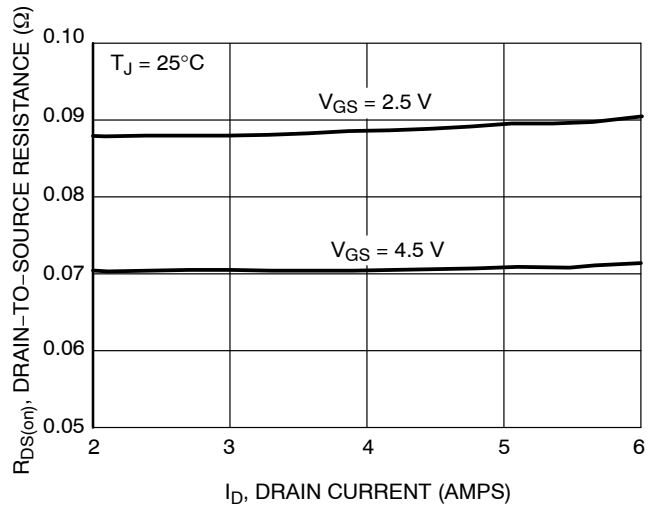
**Figure 1. On-Region Characteristics**



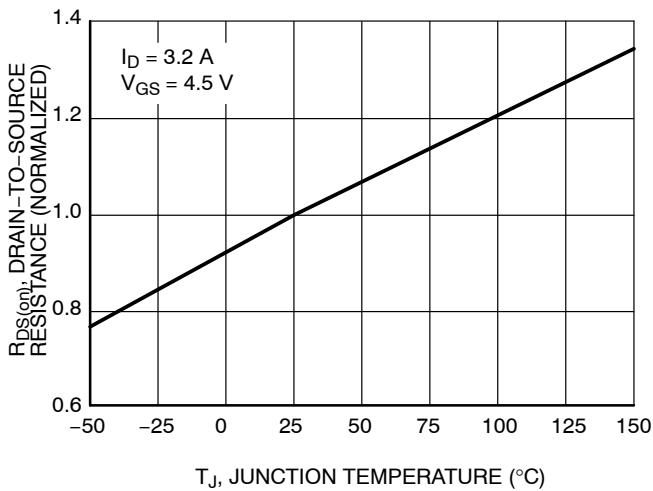
**Figure 2. Transfer Characteristics**



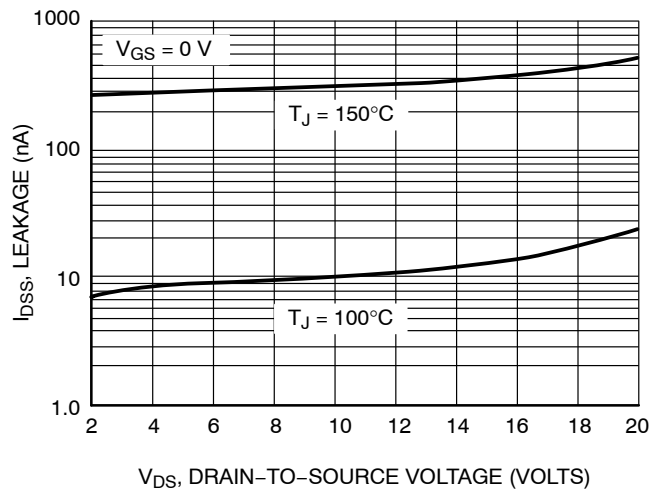
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



**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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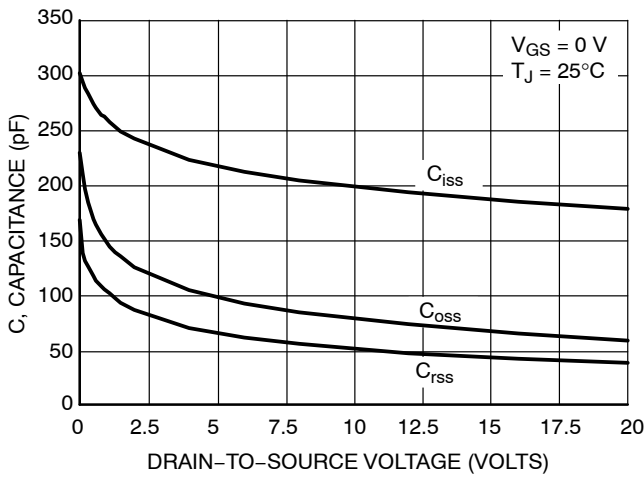


Figure 7. Capacitance Variation

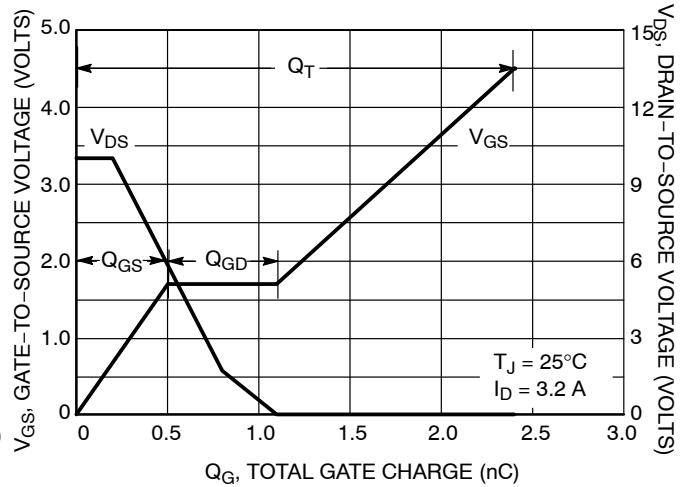


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

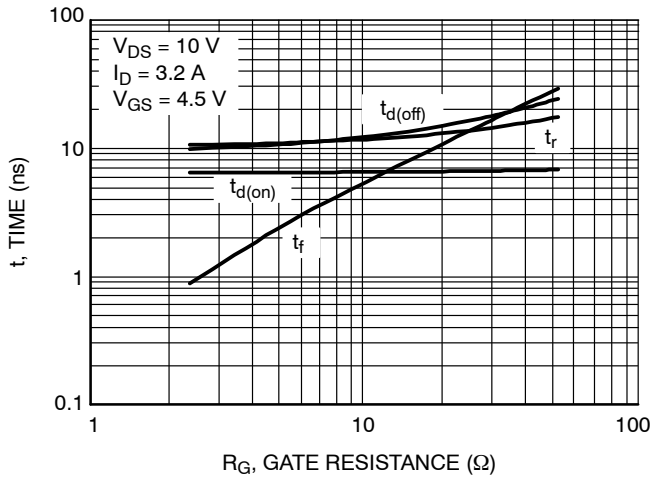


Figure 9. Resistive Switching Time Variation versus Gate Resistance

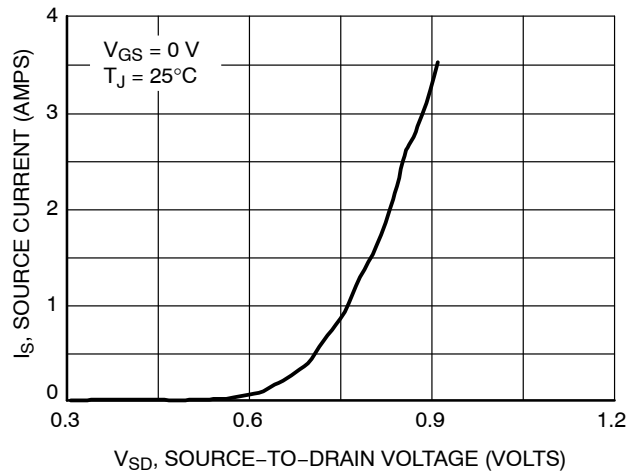


Figure 10. Diode Forward Voltage versus Current

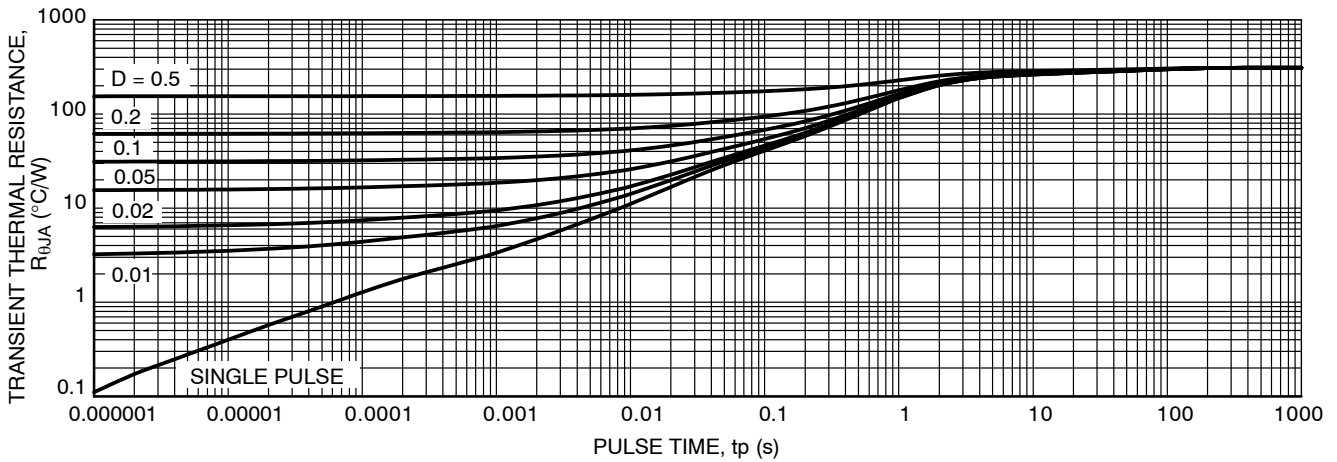
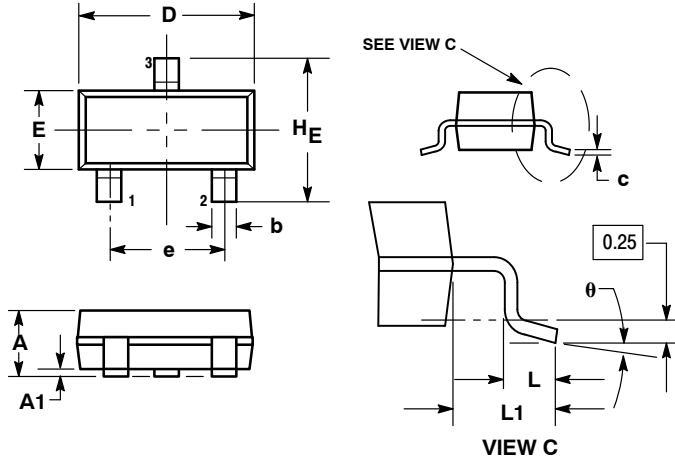


Figure 11. Thermal Response

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## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AP

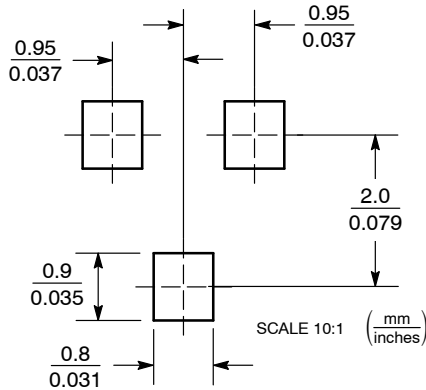


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
HE	2.10	2.40	2.64	0.083	0.094	0.104
θ	0°	---	10°	0°	---	10°

- STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. 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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