

# NTR1P02T1

## Power MOSFET

### -20 V, -1 A, P-Channel SOT-23 Package

#### Features

- Ultra Low On-Resistance Provides Higher Efficiency and Extends Battery Life  
 $R_{DS(on)} = 0.180 \Omega, V_{GS} = -10 \text{ V}$   
 $R_{DS(on)} = 0.280 \Omega, V_{GS} = -4.5 \text{ V}$
- Power Management in Portable and Battery-Powered Products
- Miniature SOT-23 Surface Mount Package Saves Board Space
- Mounting Information for SOT-23 Package Provided

#### Applications

- DC-DC Converters
- Computers
- Printers
- PCMCIA Cards
- Cellular and Cordless Telephones

#### 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	$V_{GS}$	$\pm 20$	V
Drain Current			A
- Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	-1.0	
- Pulsed Drain Current ( $t_p \leq 1 \mu\text{s}$ )	$I_{DM}$	-2.67	
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	400	mW
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$
Thermal Resistance - Junction-to-Ambient	$R_{\theta JA}$	300	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$

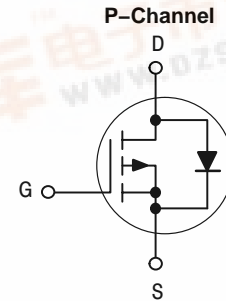
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.



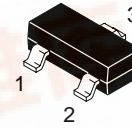
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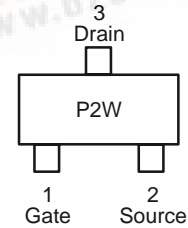
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
-20 V	148 m $\Omega$ @ -10 V	-1.0 A



#### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



P2 = Specific Device Code  
W = Work Week

#### ORDERING INFORMATION

Device	Package	Shipping†
NTR1P02T1	SOT-23	3000/Tape & Reel
NTR1P02T3	SOT-23	10,000/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.



# NTR1P02T1

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Drain-to-Source Breakdown Voltage ( $V_{GS} = 0\text{ V}$ , $I_D = -10\ \mu\text{A}$ ) (Positive Temperature Coefficient)	$V_{(BR)DSS}$	-20	32		V mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current ( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 25^\circ\text{C}$ ) ( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ )	$I_{DSS}$			-1.0 -10	$\mu\text{A}$
Gate-Body Leakage Current ( $V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$ )	$I_{GSS}$			$\pm 100$	nA

## ON CHARACTERISTICS (Note 1)

Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = -250\ \mu\text{A}$ ) (Negative Temperature Coefficient)	$V_{GS(th)}$	-1.1	-1.9 -4.0	-2.3	V mV/ $^\circ\text{C}$
Static Drain-to-Source On-State Resistance ( $V_{GS} = -10\text{ V}$ , $I_D = -1.5\text{ A}$ ) ( $V_{GS} = -4.5\text{ V}$ , $I_D = -0.75\text{ A}$ )	$R_{DS(on)}$		0.148 0.235	0.180 0.280	$\Omega$

## DYNAMIC CHARACTERISTICS

Input Capacitance ( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$		165		pF
Output Capacitance ( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{oss}$		110		
Reverse Transfer Capacitance ( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$		35		

## SWITCHING CHARACTERISTICS (Note 2)

Turn-On Delay Time ( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )	$t_{d(on)}$		7.0		ns
Rise Time ( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )	$t_r$		9.0		
Turn-Off Delay Time ( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )	$t_{d(off)}$		9.0		
Fall Time ( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )	$t_f$		3.0		
Total Gate Charge ( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )	$Q_{tot}$		2.5		nC
Gate-Source Charge ( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )	$Q_{gs}$		0.75		
Gate-Drain Charge ( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )	$Q_{gd}$		1.0		

## BODY-DRAIN DIODE RATINGS (Note 1)

Diode Forward On-Voltage (Note 2) ( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ ) ( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ )	$V_{SD}$		-0.8 -0.6	-1.0	V
Reverse Recovery Time ( $I_S = -1\text{ A}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )	$t_{rr}$		13.5		ns
	$t_a$		10.5		
	$t_b$		3.0		
Reverse Recovery Stored Charge ( $I_S = -1\text{ A}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )	$Q_{RR}$		0.008		$\mu\text{C}$

1. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
2. Switching characteristics are independent of operating junction temperature.

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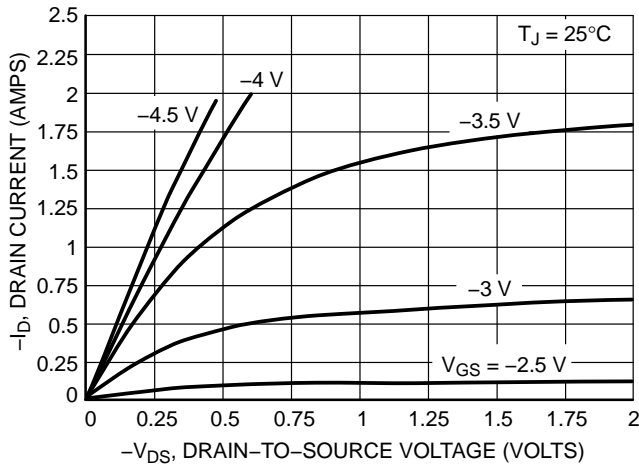


Figure 1. On-Region Characteristics

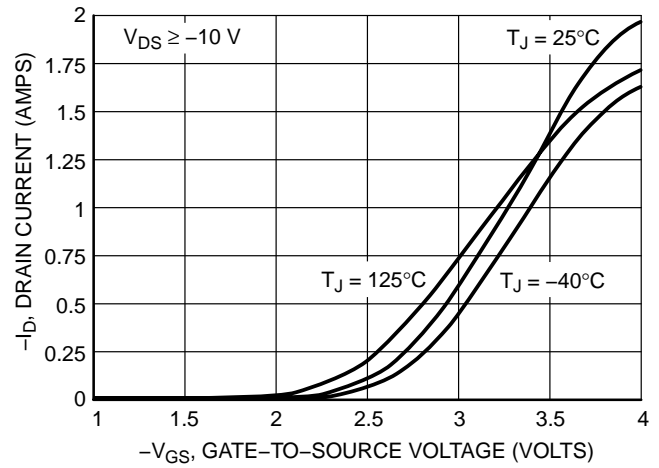


Figure 2. Transfer Characteristics

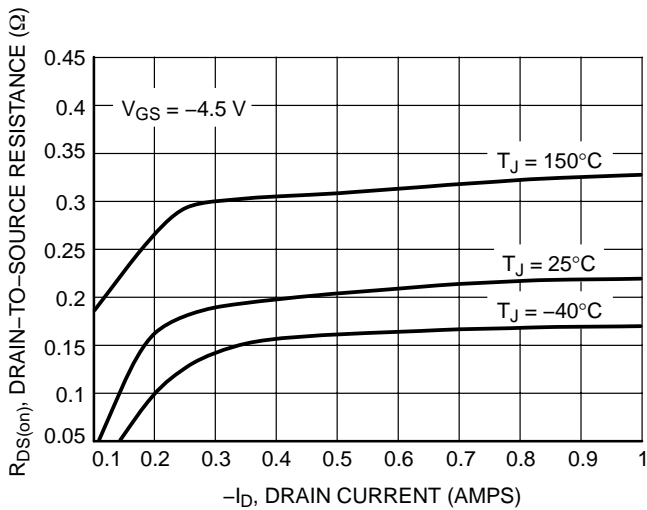


Figure 3. On-Resistance versus Drain Current and Temperature

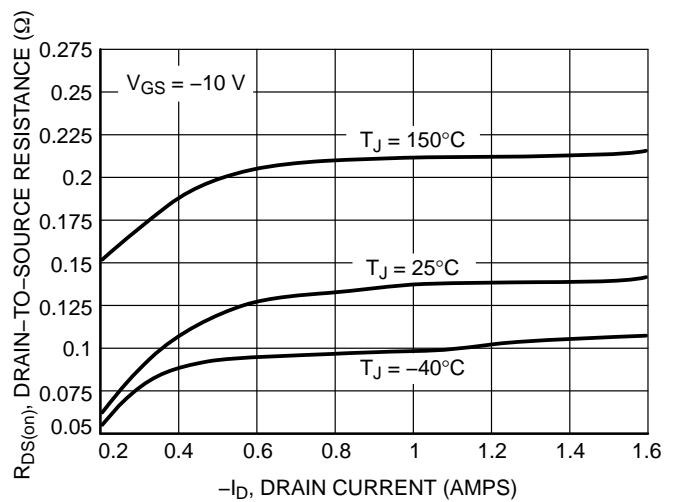


Figure 4. On-Resistance versus Drain Current and Temperature

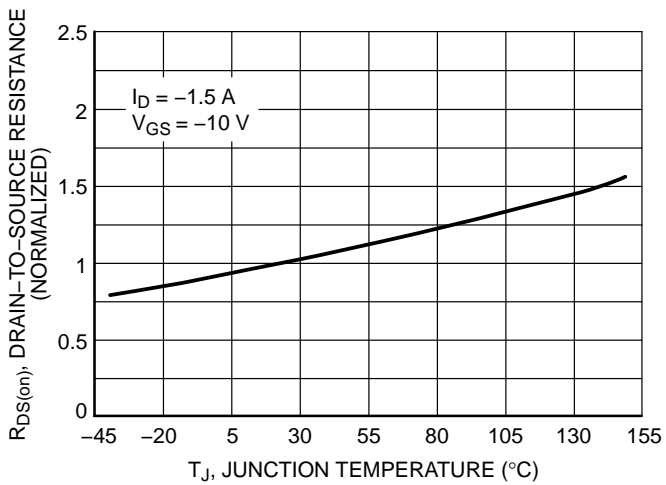


Figure 5. On-Resistance Variation with Temperature

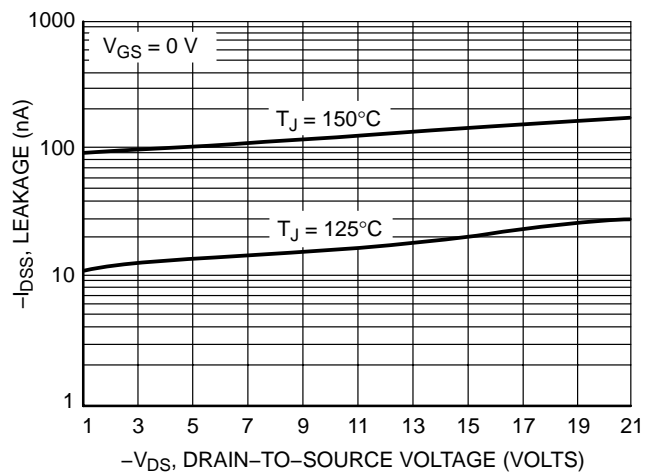


Figure 6. Drain-to-Source Leakage Current versus Voltage

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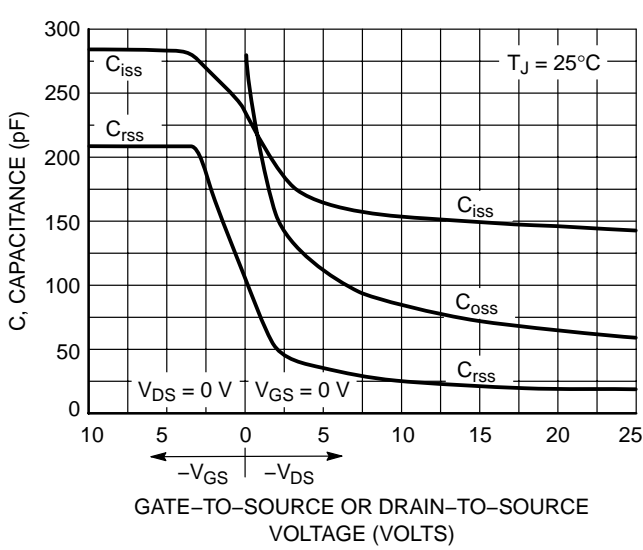


Figure 7. Capacitance Variation

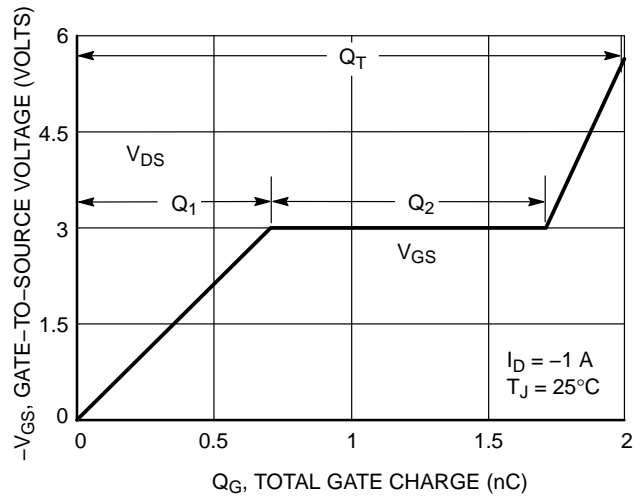


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

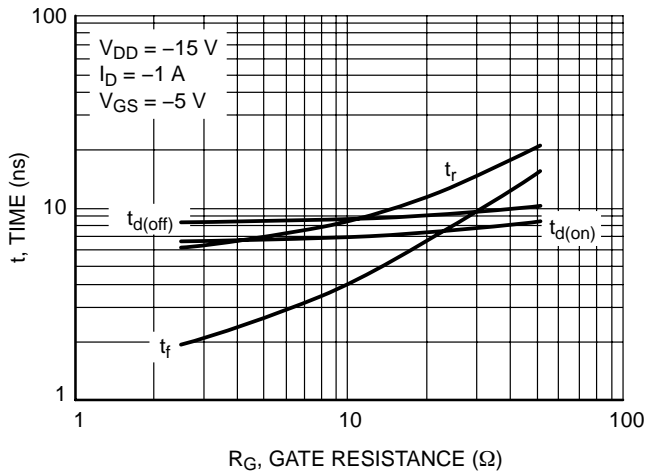


Figure 9. Resistive Switching Time Variation versus Gate Resistance

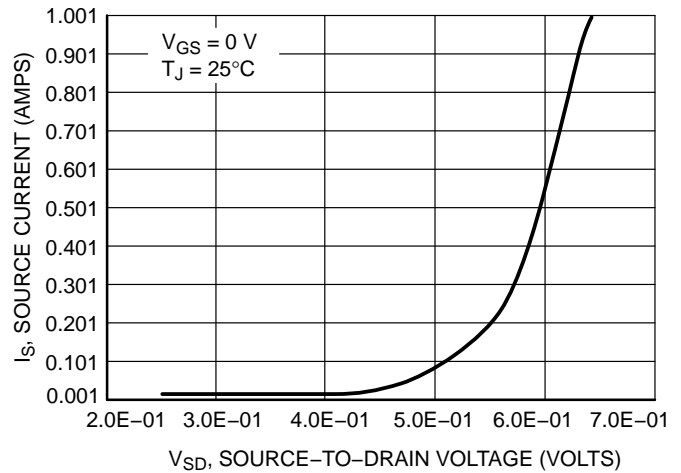
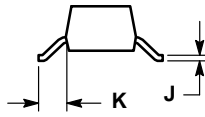
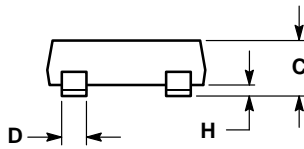
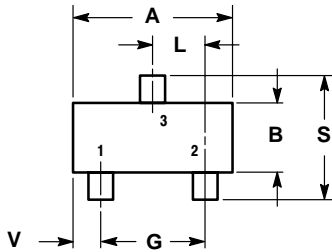


Figure 10. Diode Forward Voltage versus Current

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## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-09  
ISSUE AJ



NOTES:

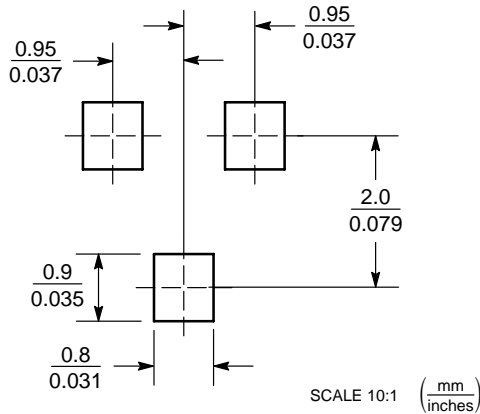
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01, -02, AND -06 OBSOLETE, NEW STANDARD 318-09.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0385	0.0498	0.99	1.26
D	0.0140	0.0200	0.36	0.50
G	0.0670	0.0826	1.70	2.10
H	0.0040	0.0098	0.10	0.25
J	0.0034	0.0070	0.085	0.177
K	0.0180	0.0236	0.45	0.60
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.0984	2.10	2.50
V	0.0177	0.0236	0.45	0.60


STYLE 21:

1. GATE
2. SOURCE
3. DRAIN

### SOLDERING FOOTPRINT\*



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