

# NTR1P02, NVR1P02

## 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
- 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

- 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	$^\circ\text{C}/\text{W}$
Maximum Lead Temperature for Soldering Purposes, (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$

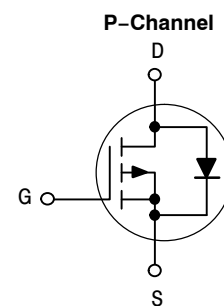
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



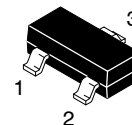
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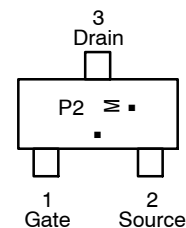
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
-20 V	148 m $\Omega$ @ -10 V	-1.0 A



### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



P2 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping†
NTR1P02T1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NTR1P02T3G	SOT-23 (Pb-Free)	10000 / Tape & Reel
NVR1P02T1G*	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 Specification Brochure, BRD8011/D.

# NTR1P02, NVR1P02

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Drain-to-Source Breakdown Voltage (V <sub>GS</sub> = 0 V, I <sub>D</sub> = -10 μA) (Positive Temperature Coefficient)	V <sub>(BR)DSS</sub>	-20	32		V mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 25°C) (V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C)	I <sub>DSS</sub>			-1.0 -10	μA
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V)	I <sub>GSS</sub>			±100	nA

## ON CHARACTERISTICS (Note 1)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA) (Negative Temperature Coefficient)	V <sub>GS(th)</sub>	-1.1	-1.9 -4.0	-2.3	V mV/°C
Static Drain-to-Source On-State Resistance (V <sub>GS</sub> = -10 V, I <sub>D</sub> = -1.5 A) (V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.75 A)	R <sub>DS(on)</sub>		0.148 0.235	0.180 0.280	Ω

## DYNAMIC CHARACTERISTICS

Input Capacitance (V <sub>DS</sub> = -5 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>iss</sub>		165		pF
Output Capacitance (V <sub>DS</sub> = -5 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>oss</sub>		110		
Reverse Transfer Capacitance (V <sub>DS</sub> = -5 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>rss</sub>		35		

## SWITCHING CHARACTERISTICS (Note 2)

Turn-On Delay Time (V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1 A, V <sub>GS</sub> = -5 V, R <sub>G</sub> = 2.5 Ω)	t <sub>d(on)</sub>		7.0		ns
Rise Time (V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1 A, V <sub>GS</sub> = -5 V, R <sub>G</sub> = 2.5 Ω)	t <sub>r</sub>		9.0		
Turn-Off Delay Time (V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1 A, V <sub>GS</sub> = -5 V, R <sub>G</sub> = 2.5 Ω)	t <sub>d(off)</sub>		9.0		
Fall Time (V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1 A, V <sub>GS</sub> = -5 V, R <sub>G</sub> = 2.5 Ω)	t <sub>f</sub>		3.0		
Total Gate Charge (V <sub>DS</sub> = -15 V, V <sub>GS</sub> = -5 V, I <sub>D</sub> = -0.8 A)	Q <sub>tot</sub>		2.5		nC
Gate-Source Charge (V <sub>DS</sub> = -15 V, V <sub>GS</sub> = -5 V, I <sub>D</sub> = -0.8 A)	Q <sub>gs</sub>		0.75		
Gate-Drain Charge (V <sub>DS</sub> = -15 V, V <sub>GS</sub> = -5 V, I <sub>D</sub> = -0.8 A)	Q <sub>gd</sub>		1.0		

## BODY-DRAIN DIODE RATINGS (Note 1)

Diode Forward On-Voltage (Note 2) (I <sub>S</sub> = -0.6 A, V <sub>GS</sub> = 0 V) (I <sub>S</sub> = -0.6 A, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C)	V <sub>SD</sub>		-0.8 -0.6	-1.0	V
Reverse Recovery Time (I <sub>S</sub> = -1 A, dI <sub>S</sub> /dt = 100 A/μs, V <sub>GS</sub> = 0 V)	t <sub>rr</sub>		13.5		ns
	t <sub>a</sub>		10.5		
	t <sub>b</sub>		3.0		
Reverse Recovery Stored Charge (I <sub>S</sub> = -1 A, dI <sub>S</sub> /dt = 100 A/μs, V <sub>GS</sub> = 0 V)	Q <sub>RR</sub>		0.008		μC

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
2. Switching characteristics are independent of operating junction temperature.

# NTR1P02, NVR1P02

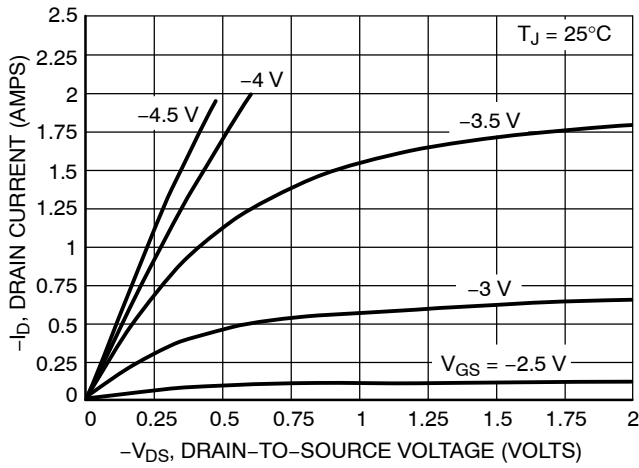


Figure 1. On-Region Characteristics

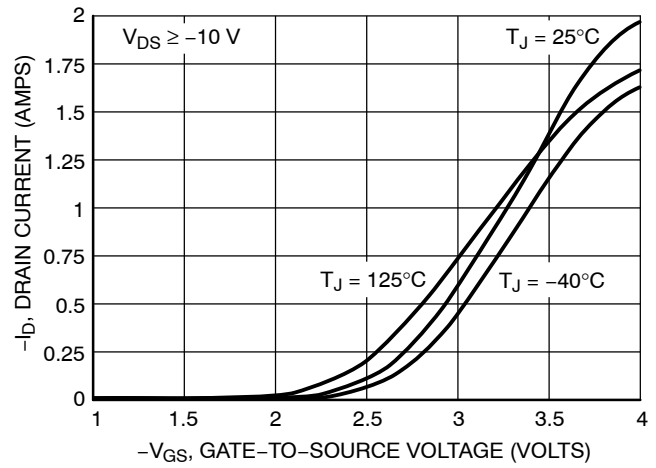


Figure 2. Transfer Characteristics

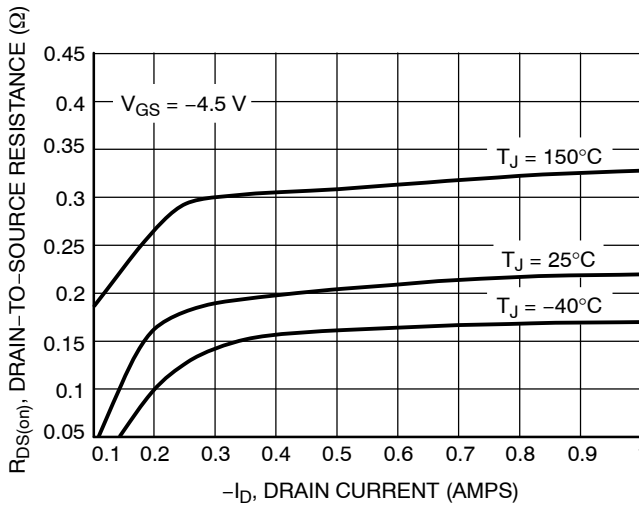


Figure 3. On-Resistance versus Drain Current and Temperature

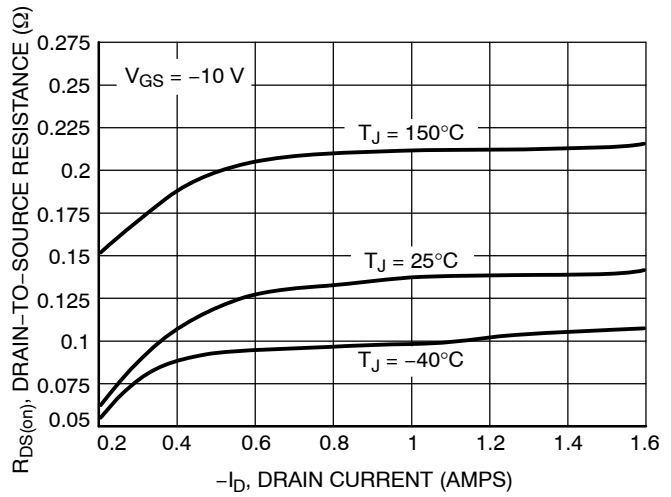


Figure 4. On-Resistance versus Drain Current and Temperature

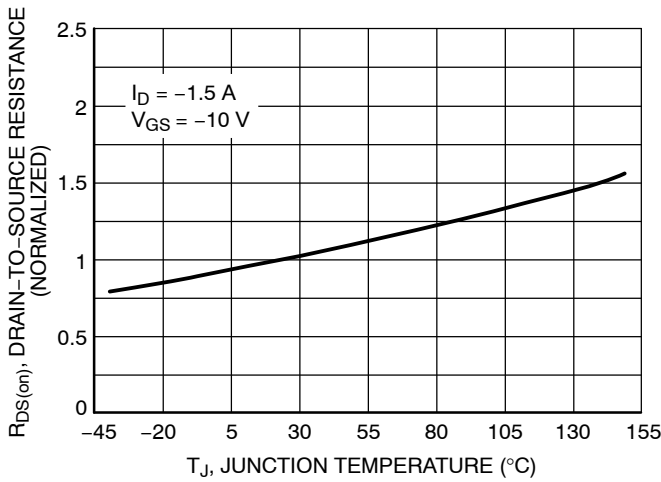


Figure 5. On-Resistance Variation with Temperature

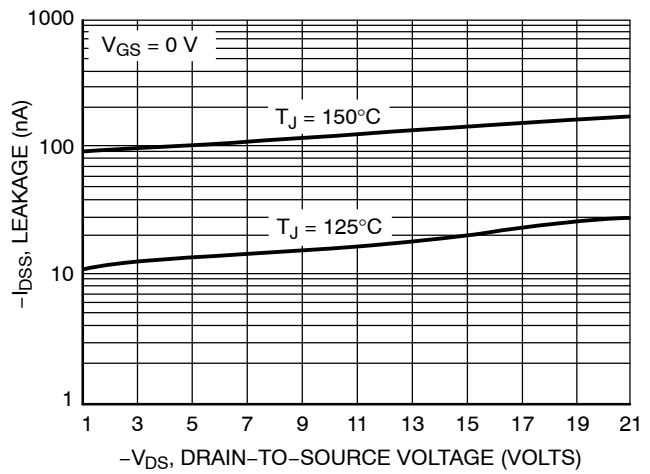


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTR1P02, NVR1P02

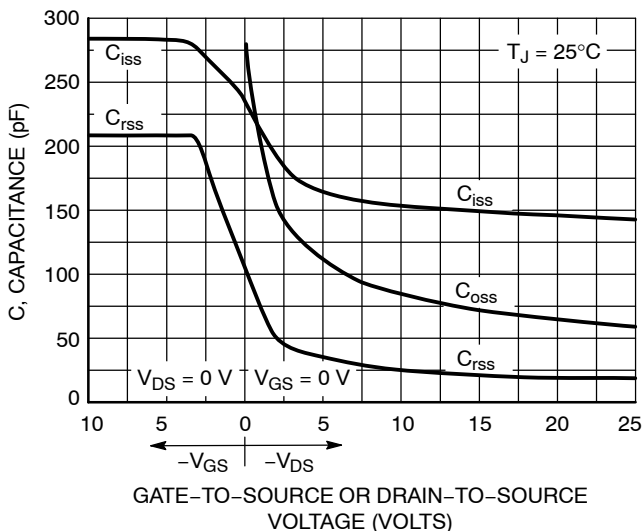


Figure 7. Capacitance Variation

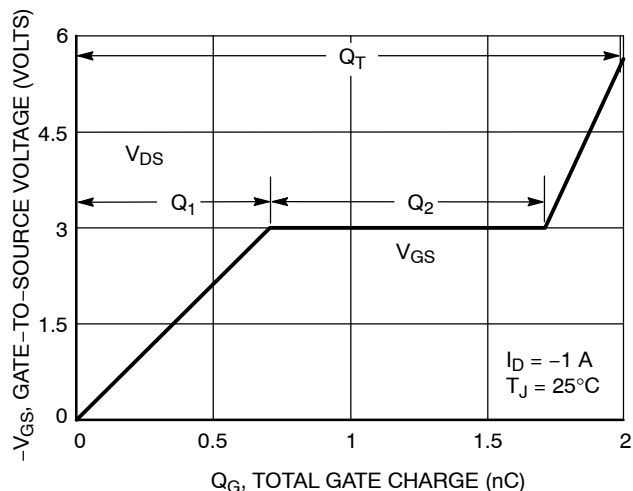


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

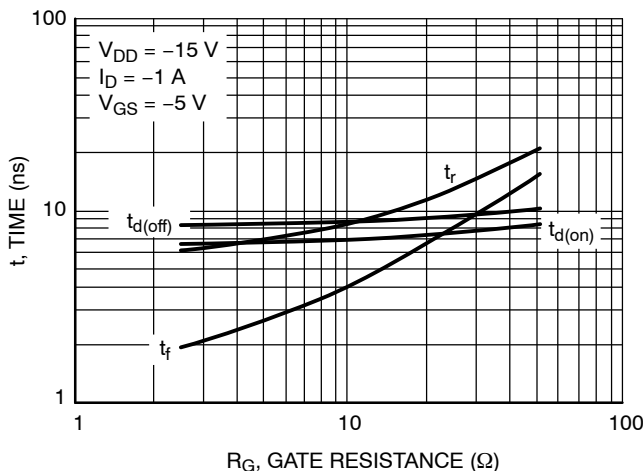


Figure 9. Resistive Switching Time Variation versus Gate Resistance

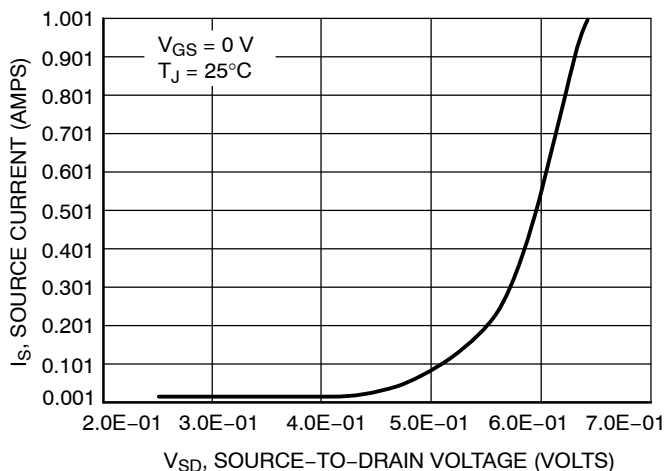
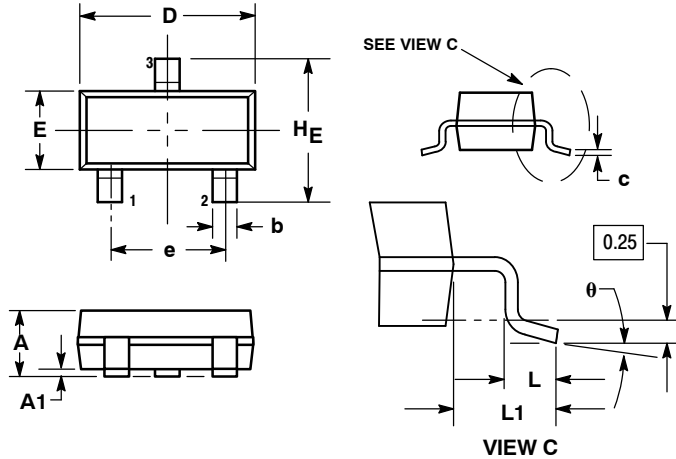


Figure 10. Diode Forward Voltage versus Current

# NTR1P02, NVR1P02

## PACKAGE DIMENSIONS

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



NOTES:

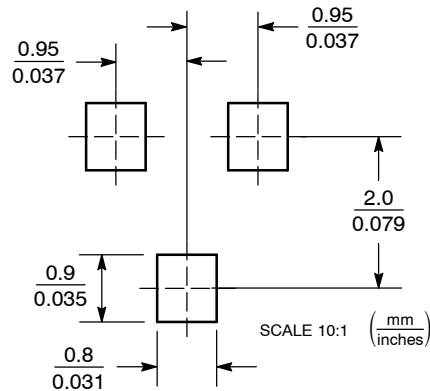
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

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:

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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