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# NTR1P02L, NVTR01P02L

## MOSFET – Power, P-Channel, SOT-23

**-20 V, -1.3 A**

These miniature surface mount MOSFETs low  $R_{DS(on)}$  assure minimal power loss and conserve energy, making these devices ideal for use in space sensitive power management circuitry. Typical applications are DC-DC converters and power management in portable and battery-powered products such as computers, printers, PCMCIA cards, cellular and cordless telephones.

### Features

- Low  $R_{DS(on)}$  Provides Higher Efficiency and Extends Battery Life
- Miniature SOT-23 Surface Mount Package Saves Board Space
- NVTR Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- Pb-Free and Halide-Free Packages are Available

### 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	$V_{GS}$	$\pm 12$	V
Drain Current – Continuous @ $T_A = 25^\circ\text{C}$ – Pulsed Drain Current ( $t_p \leq 10 \mu\text{s}$ )	$I_D$ $I_{DM}$	-1.3 -4.0	A A
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	$^\circ\text{C}$

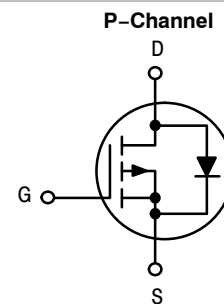
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



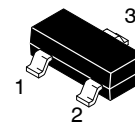
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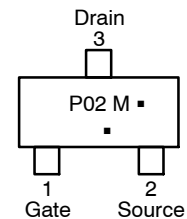
$V_{(BR)DSS}$	$R_{DS(on)}$ Max	$I_D$ Max
-20 V	220 m $\Omega$ @ -4.5 V	-1.3 A



### MARKING DIAGRAM & PIN ASSIGNMENT



**SOT-23  
CASE 318  
STYLE 21**



P02 = Specific Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)  
\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

Device	Package	Shipping†
NTR1P02LT1G	SOT-23 (Pb-Free)	3000 Tape & Reel
NTR1P02LT3G	SOT-23 (Pb-Free)	10,000 Tape & Reel
NVTR01P02LT1G	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.

# NTR1P02L, NVTR01P02L

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

Parameter	Test Condition	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$(V_{GS} = 0\text{ V}, I_D = -10\ \mu\text{A})$	$V_{(BR)DSS}$	-20			V
Zero Gate Voltage Drain Current	$(V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V})$ $(V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C})$	$I_{DSS}$			-1.0 -10	$\mu\text{A}$
Gate-Body Leakage Current	$(V_{GS} = \pm 12\text{ V}, V_{DS} = 0\text{ V})$	$I_{GSS}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 1)

Gate Threshold Voltage	$(V_{DS} = V_{GS}, I_D = -250\ \mu\text{A})$	$V_{GS(th)}$	-0.7	-1.0	-1.25	V
Static Drain-to-Source On-Resistance	$(V_{GS} = -4.5\text{ V}, I_D = -0.75\text{ A})$ $(V_{GS} = -2.5\text{ V}, I_D = -0.5\text{ A})$	$r_{DS(on)}$		0.140 0.200	0.22 0.35	$\Omega$

### DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{DS} = -5.0\text{ V})$	$C_{iss}$		225		pF
Output Capacitance	$(V_{DS} = -5.0\text{ V})$	$C_{oss}$		130		
Transfer Capacitance	$(V_{DS} = -5.0\text{ V})$	$C_{rss}$		55		

### SWITCHING CHARACTERISTICS (Note 2)

Turn-On Delay Time	$(V_{GS} = -4.5\text{ V}, V_{DD} = -5.0\text{ V}, I_D = -1.0\text{ A}, R_L = 5.0\ \Omega, R_G = 6.0\ \Omega)$	$t_{d(on)}$		7.0		ns
Rise Time		$t_r$		15		
Turn-Off Delay Time		$t_{d(off)}$		18		
Fall Time		$t_f$		9		
Total Gate Charge	$(V_{DS} = -16\text{ V}, I_D = -1.5\text{ A}, V_{GS} = -4.5\text{ V})$	$Q_T$		3.1		nC

### SOURCE-DRAIN DIODE CHARACTERISTICS

Continuous Current		$I_S$			-0.6	A
Pulsed Current		$I_{SM}$			-0.75	
Forward Voltage (Note 2)	$(V_{GS} = 0\text{ V}, I_S = -0.6\text{ A})$	$V_{SD}$			-1.0	V
Reverse Recovery Time	$(I_S = -1.0\text{ A}, V_{GS} = 0\text{ V}, di_S/dt = 100\text{ A}/\mu\text{s})$	$t_{rr}$		16		ns
		$t_a$		11		
		$t_b$		5.5		
Reverse Recovery Stored Charge		$Q_{RR}$		8.5		nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

# NTR1P02L, NVTR01P02L

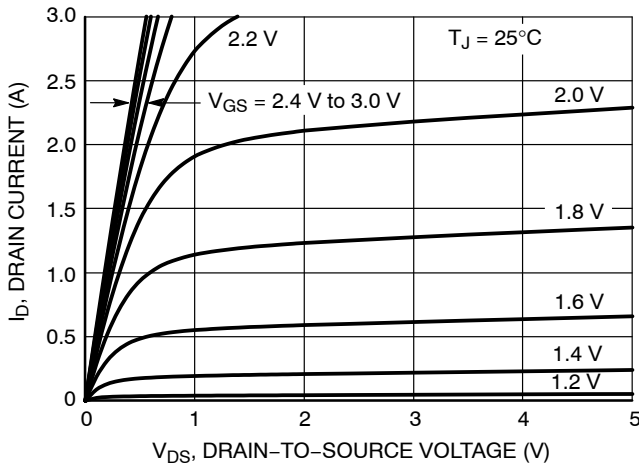


Figure 1. On-Region Characteristics

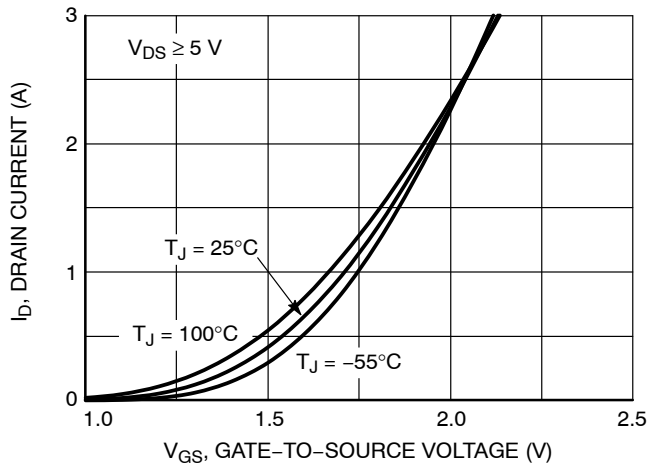


Figure 2. Transfer Characteristics

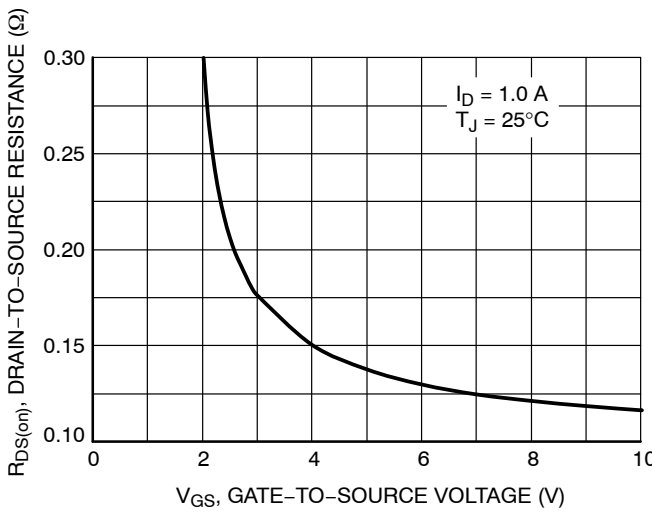


Figure 3. On-Resistance vs. Gate-to-Source Voltage

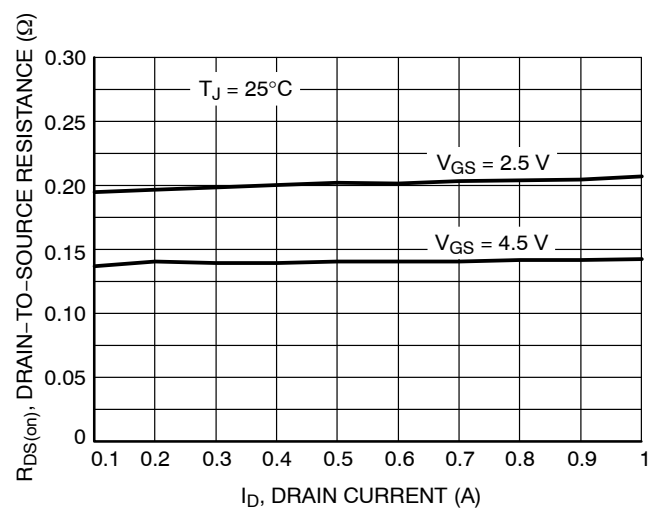


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

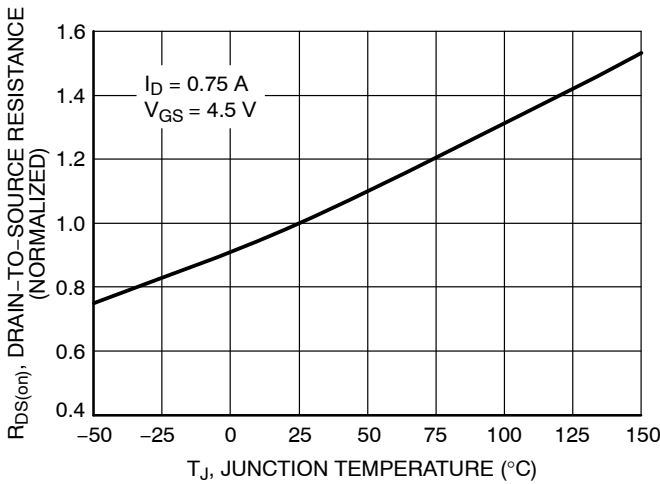


Figure 5. On-Resistance Variation with Temperature

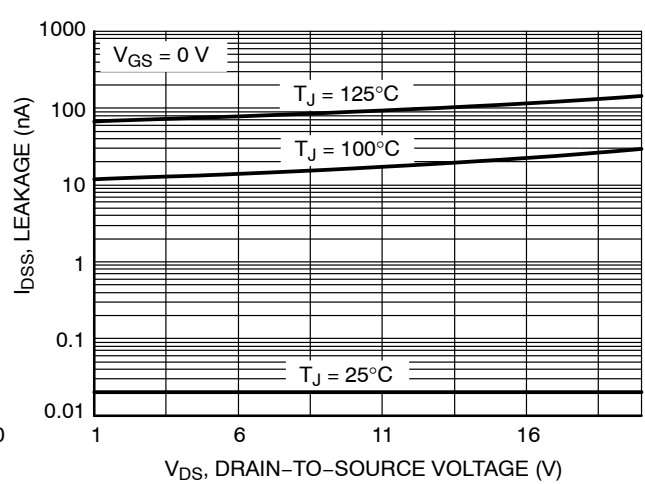


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTR1P02L, NVTR01P02L

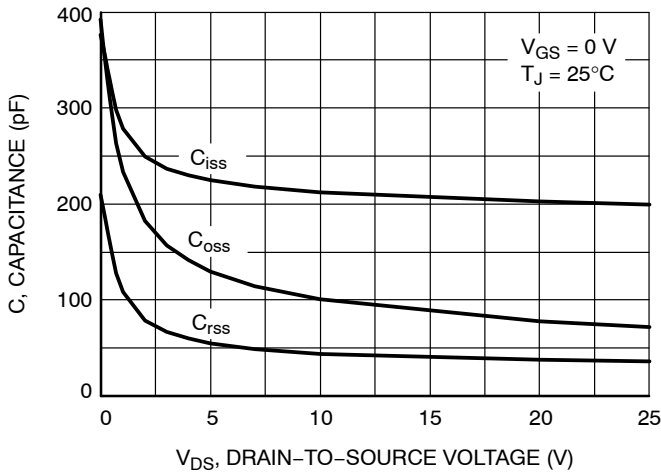


Figure 7. Capacitance Variation

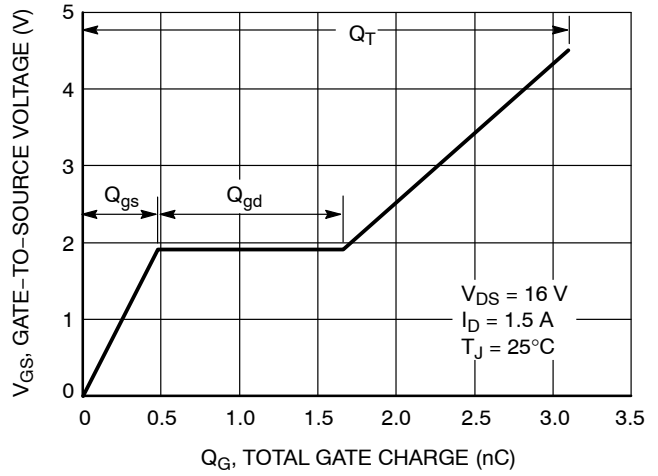


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

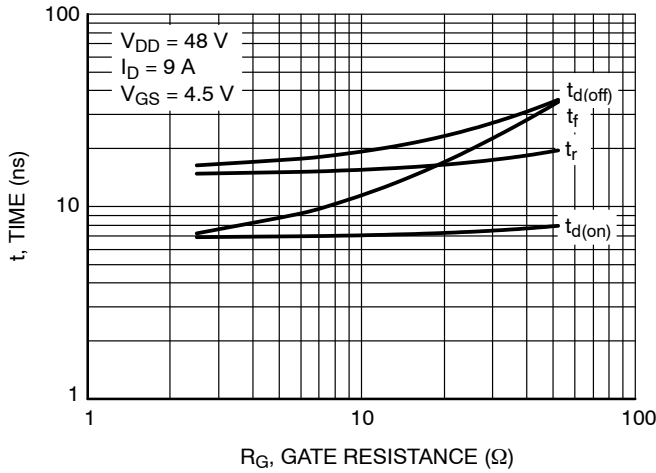


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

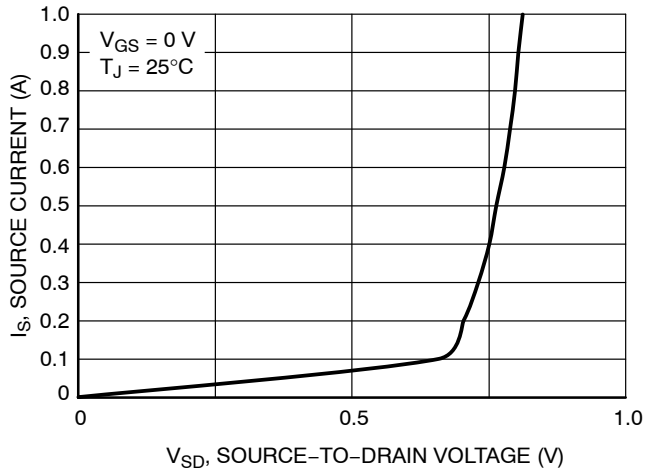


Figure 10. Diode Forward Voltage vs. Current

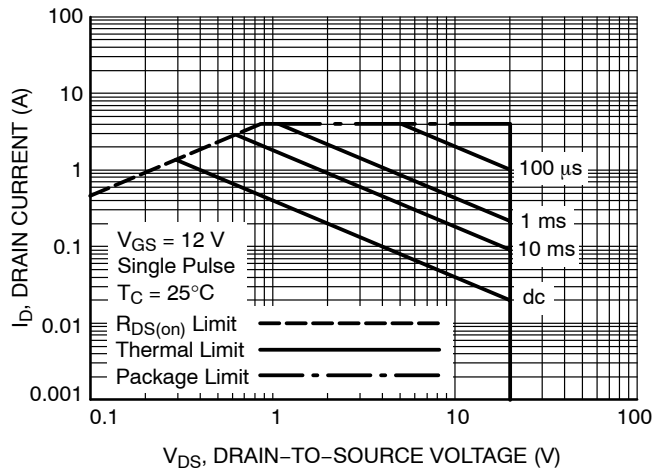


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



**SOT-23 (TO-236)**  
CASE 318-08  
ISSUE AS

DATE 30 JAN 2018

SCALE 4:1



**NOTES:**

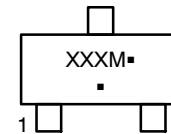
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
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	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
HE	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

**RECOMMENDED SOLDERING FOOTPRINT**



**GENERIC MARKING DIAGRAM\***



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

STYLE 1 THRU 5:  
CANCELLED

STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

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

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

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