NTR1P02, NVR1P02

MOSFET – Power, P-Channel, SOT-23
-20 V, -1 A

Features

- Ultra Low On−Resistance Provides Higher Efficiency and Extends Battery Life
  $R_{DS(on)}$ = 0.180 Ω, V_{GS} = −10 V
  $R_{DS(on)}$ = 0.280 Ω, V_{GS} = −4.5 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°C unless otherwise noted)

Rating	Symbol	Value	Unit
Drain−to−Source Voltage	V_{DSS}	−20	V
Gate−to−Source Voltage − Continuous	V_{GS}	±20	V
Drain Current − Continuous @ T_A = 25°C − Pulsed Drain Current ($t_p \le 1$ μs)	 I_D I_{DM}	 −1.0 −2.67	A
Total Power Dissipation @ T_A = 25°C	P_D	400	mW
Operating and Storage Temperature Range	T_J, T_{stg}	− 55 to 150	°C
Thermal Resistance; Junction−to−Ambient	$R_{\theta JA}$	300	°C/W
Maximum Lead Temperature for Soldering Purposes, (1/8″ from case for 10 s)	T_L	260	°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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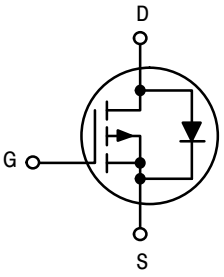
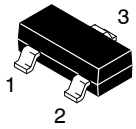
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	I_D MAX
−20 V	148 mΩ @ −10 V	−1.0 A

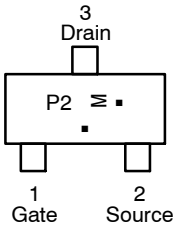
P−Channel



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.

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ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain−to−Source Breakdown Voltage (V_{GS} = 0 V, I_D = −10 μA) (Positive Temperature Coefficient)	$V_{(BR)DSS}$	−20	 32		V mV/°C
Zero Gate Voltage Drain Current (V_{DS} = −20 V, V_{GS} = 0 V, T_J = 25°C) (V_{DS} = −20 V, V_{GS} = 0 V, T_J = 150°C)	I_{DSS}			 −1.0 −10	μA
Gate−Body Leakage Current (V_{GS} = ±20 V, V_{DS} = 0 V)	I_{GSS}			±100	nA
ON CHARACTERISTICS (Note 1)					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = −250 μA) (Negative Temperature Coefficient)	$V_{GS(th)}$	−1.1	−1.9 −4.0	−2.3	V mV/°C
Static Drain−to−Source On−State Resistance (V_{GS} = −10 V, I_D = −1.5 A) (V_{GS} = −4.5 V, I_D = −0.75 A)	$R_{DS(on)}$		 0.148 0.235	 0.180 0.280	Ω
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = −5 V, V_{GS} = 0 V, f = 1.0 MHz)	C_{iss}		165		pF
Output Capacitance (V_{DS} = −5 V, V_{GS} = 0 V, f = 1.0 MHz)	C_{oss}		110		
Reverse Transfer Capacitance (V_{DS} = −5 V, V_{GS} = 0 V, f = 1.0 MHz)	C_{rss}		35		
SWITCHING CHARACTERISTICS (Note 2)					
Turn−On Delay Time (V_{DD} = −15 V, I_D = −1 A, V_{GS} = −5 V, R_G = 2.5 Ω)	$t_{d(on)}$		7.0		ns
Rise Time (V_{DD} = −15 V, I_D = −1 A, V_{GS} = −5 V, R_G = 2.5 Ω)	t_r		9.0		
Turn−Off Delay Time (V_{DD} = −15 V, I_D = −1 A, V_{GS} = −5 V, R_G = 2.5 Ω)	$t_{d(off)}$		9.0		
Fall Time (V_{DD} = −15 V, I_D = −1 A, V_{GS} = −5 V, R_G = 2.5 Ω)	t_f		3.0		
Total Gate Charge (V_{DS} = −15 V, V_{GS} = −5 V, I_D = −0.8 A)	Q_{tot}		2.5		nC
Gate−Source Charge (V_{DS} = −15 V, V_{GS} = −5 V, I_D = −0.8 A)	Q_{gs}		0.75		
Gate−Drain Charge (V_{DS} = −15 V, V_{GS} = −5 V, I_D = −0.8 A)	Q_{gd}		1.0		
BODY−DRAIN DIODE RATINGS (Note 1)					
Diode Forward On−Voltage (Note 2) (I_S = −0.6 A, V_{GS} = 0 V) (I_S = −0.6 A, V_{GS} = 0 V, T_J = 150°C)	V_{SD}		 −0.8 −0.6	−1.0	V
Reverse Recovery Time (I_S = −1 A, dI_S/dt = 100 A/μs, V_{GS} = 0 V)	t_{rr}		13.5		ns
	t_a		10.5		
	t_b		3.0		
Reverse Recovery Stored Charge (I_S = −1 A, dI_S/dt = 100 A/μs, V_{GS} = 0 V)	Q_{RR}		0.008		μC

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 ≤ 300 μs, Duty Cycle ≤ 2%.
2. Switching characteristics are independent of operating junction temperature.

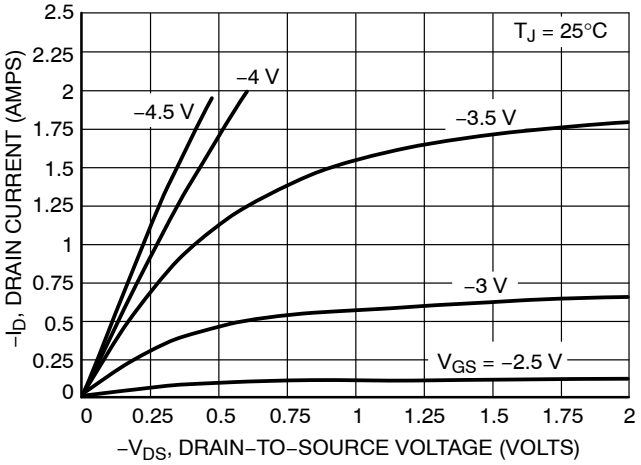

Figure 1. On−Region Characteristics

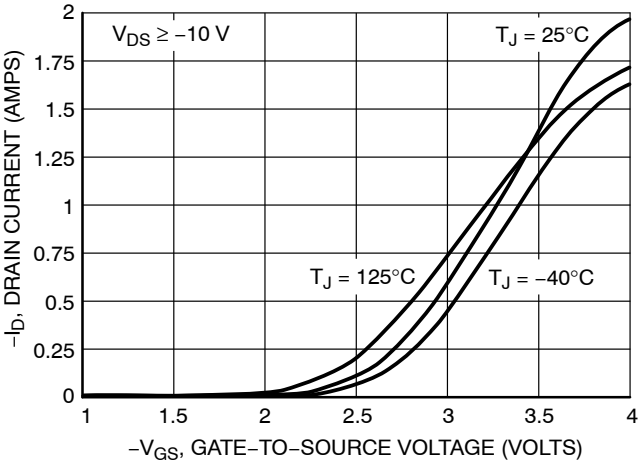

Figure 2. Transfer Characteristics

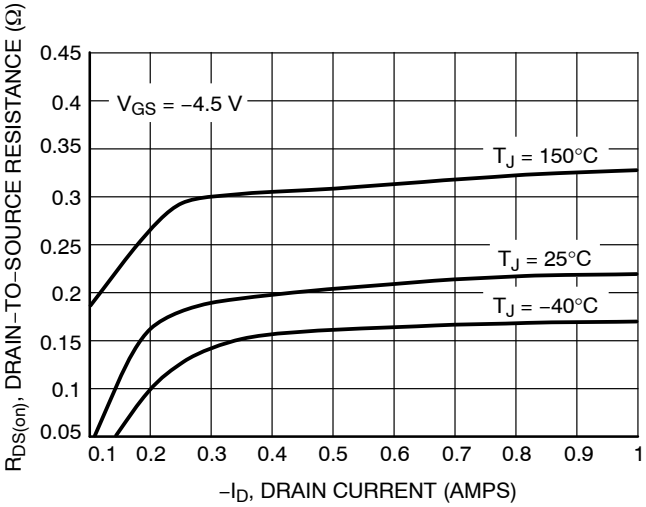

Figure 3. On−Resistance versus Drain Current and Temperature

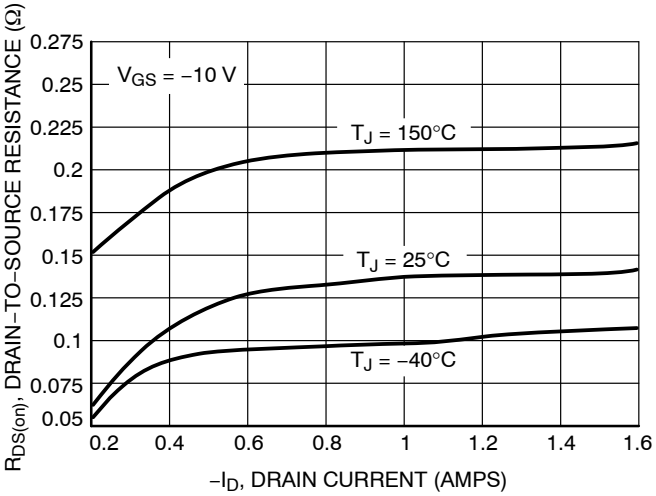

Figure 4. On−Resistance versus Drain Current and Temperature

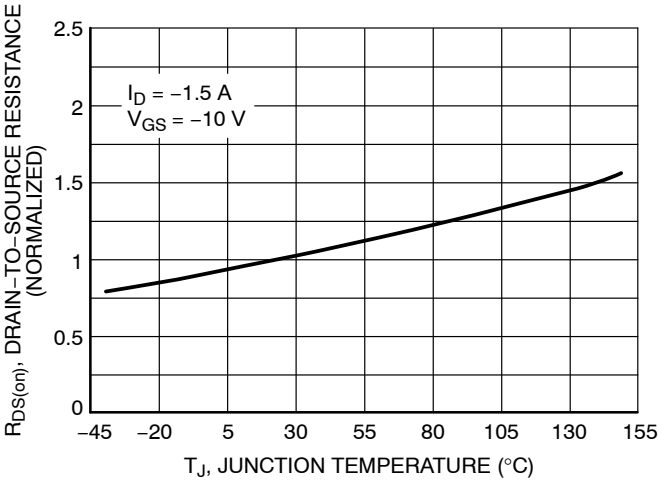

Figure 5. On−Resistance Variation with Temperature

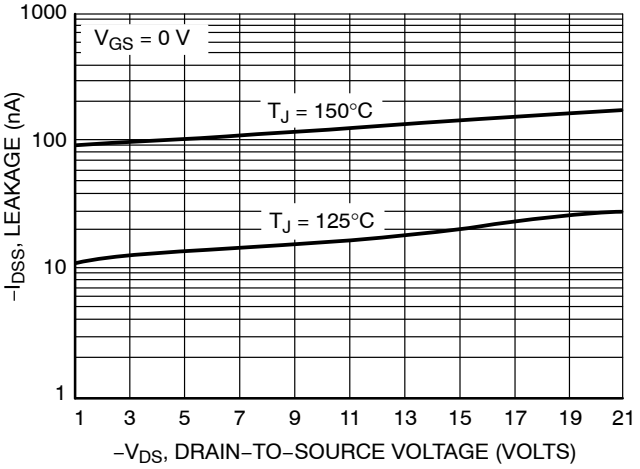

Figure 6. Drain−to−Source Leakage Current versus Voltage

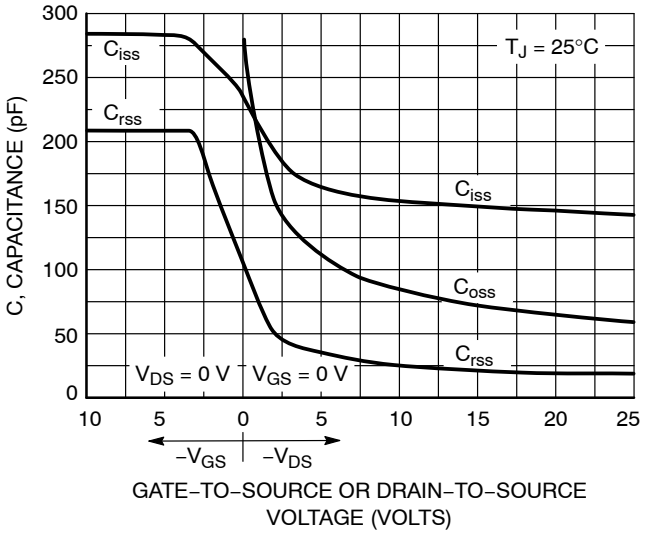

Figure 7. Capacitance Variation

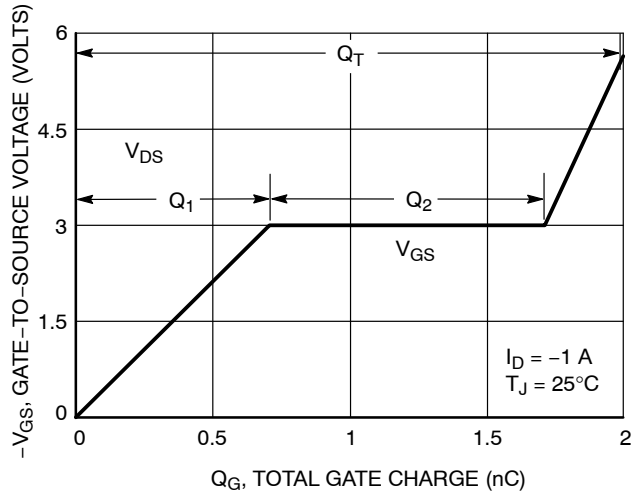

Figure 8. Gate−to−Source and Drain−to−Source Voltage versus Total Charge

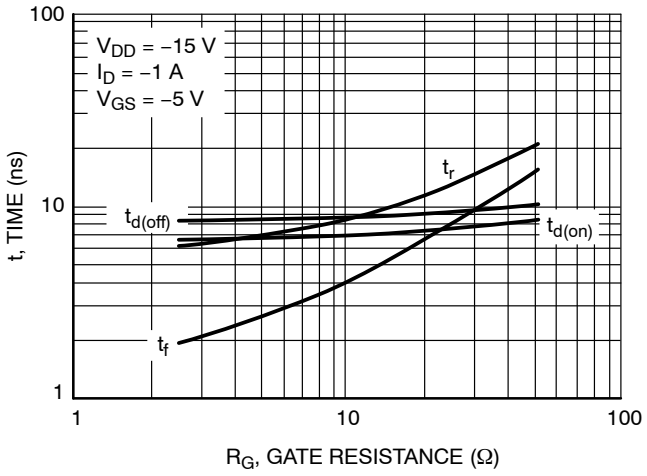

Figure 9. Resistive Switching Time Variation versus Gate Resistance

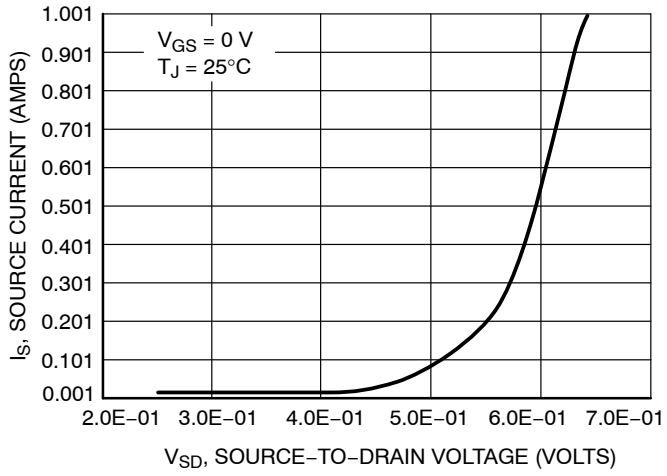

Figure 10. Diode Forward Voltage versus Current

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

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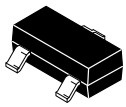
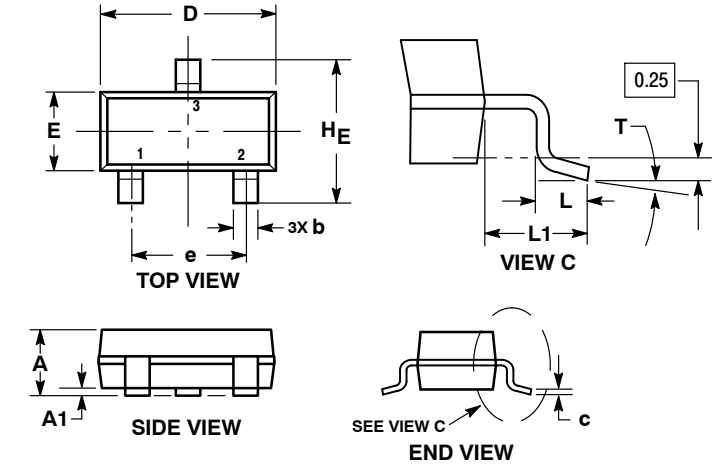


SOT−23 (TO−236)
CASE 318−08
ISSUE AS

DATE 30 JAN 2018

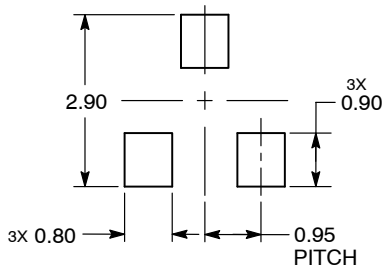
SCALE 4:1



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.

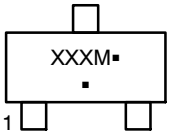
	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
H_E	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	−−−	10°	0°	−−−	10°

RECOMMENDED SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

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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