# NTR1P02LT1, NTR1P02LT1H

# Power MOSFET

## –20 V, –1.3 A, P–Channel SOT–23 Package

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
- Pb–Free and Halide–Free Packages are Available

**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 | $V_{GS}$ | ±12 | V |
| Drain Current<br>– Continuous @ $T_A$ = 25°C<br>– Pulsed Drain Current ($t_p \le 10$ μs) | <br>$I_D$<br>$I_{DM}$ | <br>–1.3<br>–4.0 | <br>A<br>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 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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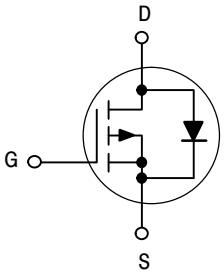
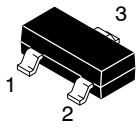
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max | $I_D$ Max |
|---|---|---|
| –20 V | 220 mΩ | –1.3 A |

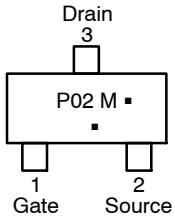
**P–Channel**




**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† |
|---|---|---|
| NTR1P02LT1 | SOT–23 | 3000 Tape & Reel |
| NTR1P02LT1G | SOT–23 (Pb–Free) | 3000 Tape & Reel |
| NTR1P02LT1H | SOT–23 (Halide–Free) | 3000 Tape & Reel |
| NTR1P02LT3G | SOT–23 (Pb–Free) | 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 Specifications Brochure, BRD8011/D.

**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) | | $V_{(BR)DSS}$ | −20 | | | V |
| Zero Gate Voltage Drain Current ($V_{DS}$ = −16 V, $V_{GS}$ = 0 V)<br>($V_{DS}$ = −16 V, $V_{GS}$ = 0 V, $T_J$ = 125°C) | | $I_{DSS}$ | | | −1.0<br>−10 | μA |
| Gate−Body Leakage Current ($V_{GS}$ = ± 12 V, $V_{DS}$ = 0 V) | | $I_{GSS}$ | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 1) | | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = $V_{GS}$, $I_D$ = −250 μA) | | $V_{GS(th)}$ | −0.7 | −1.0 | −1.25 | V |
| Static Drain−to−Source On−Resistance ($V_{GS}$ = −4.5 V, $I_D$ = −0.75 A)<br>($V_{GS}$ = −2.5 V, $I_D$ = −0.5 A) | | $r_{DS(on)}$ | | 0.135<br>0.190 | 0.22<br>0.35 | Ω |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | ($V_{DS}$ = −5.0 V) | $C_{iss}$ | | 225 | | pF |
| Output Capacitance | ($V_{DS}$ = −5.0 V) | $C_{oss}$ | | 130 | | |
| Transfer Capacitance | ($V_{DG}$ = −5.0 V) | $C_{rss}$ | | 55 | | |
| **SWITCHING CHARACTERISTICS** (Note 2) | | | | | | |
| Turn−On Delay Time | ($V_{DD}$ = −5.0 V, $I_D$ = −1.0 A, $R_L$ = 5.0 Ω, $R_G$ = 6.0 Ω) | $t_{d(on)}$ | | 7.0 | | ns |
| Rise Time | | $t_r$ | | 15 | | |
| Turn−Off Delay Time | | $t_{d(off)}$ | | 18 | | |
| Fall Time | | $t_f$ | | 20 | | |
| Total Gate Charge | ($V_{DS}$ = −16 V, $I_D$ = −1.5 A, $V_{GS}$ = −4.0 V) | $Q_T$ | | 5500 | | pC |
| **SOURCE−DRAIN DIODE CHARACTERISTICS** | | | | | | |
| Continuous Current | | $I_S$ | | | −0.6 | A |
| Pulsed Current | | $I_{SM}$ | | | −0.75 | |
| Forward Voltage (Note 2) ($V_{GS}$ = 0 V, $I_S$ = −0.6 A) | | $V_{SD}$ | | | −1.0 | V |
| Reverse Recovery Time | ($I_S$ = −1.0 A, $V_{GS}$ = 0 V, $dI_S/dt$ = 100 A/μs) | $t_{rr}$ | | 16 | | ns |
| | | $t_a$ | | 11 | | |
| | | $t_b$ | | 5.5 | | |
| Reverse Recovery Stored Charge | | $Q_{RR}$ | | 0.0085 | | μC |

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

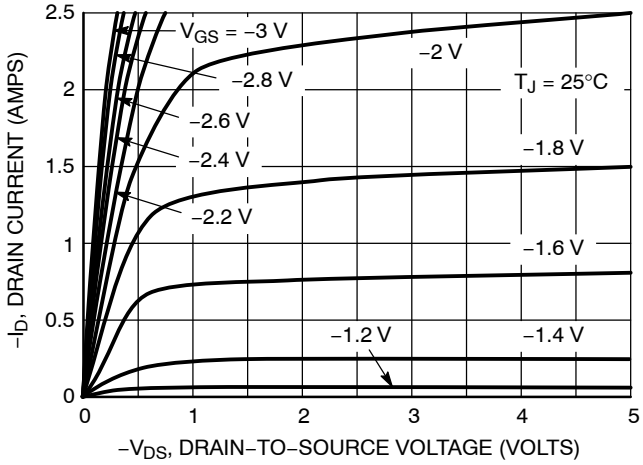



**Figure 1. On−Region Characteristics**

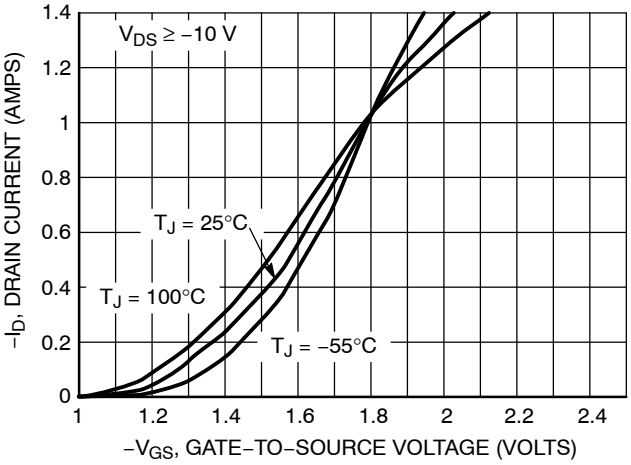



**Figure 2. Transfer Characteristics**

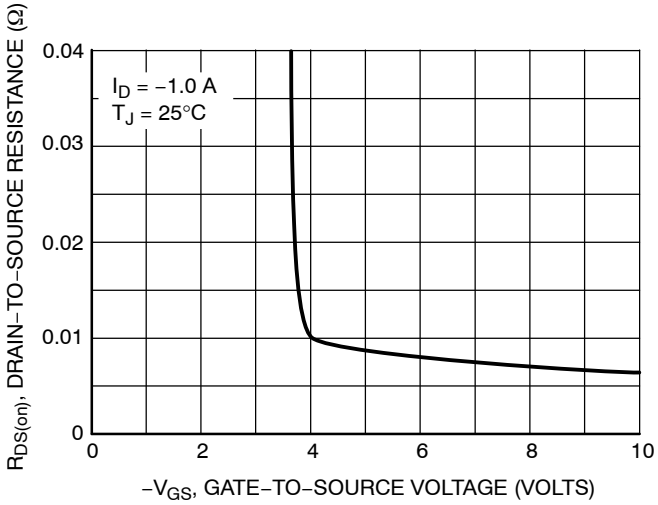



**Figure 3. On−Resistance versus Gate−to−Source Voltage**

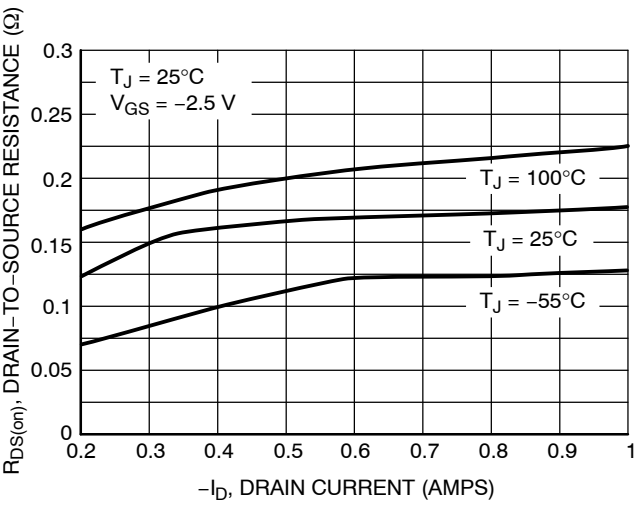



**Figure 4. On−Resistance versus Drain Current and Gate Voltage**

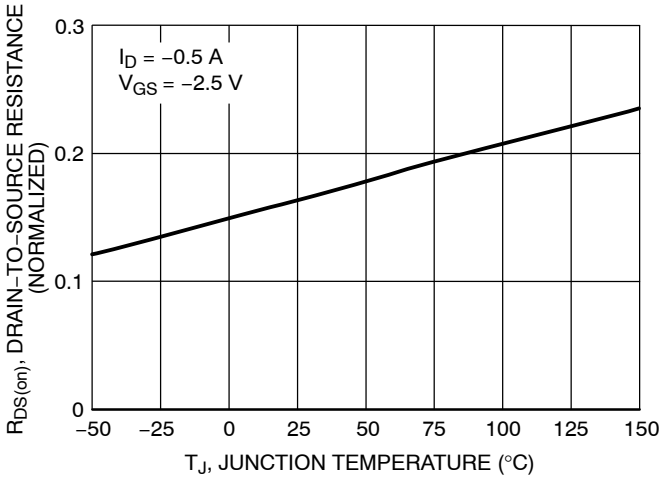



**Figure 5. On−Resistance Variation with Temperature**

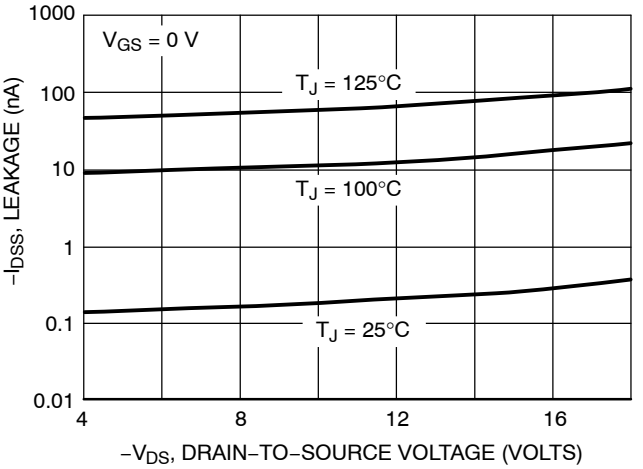



**Figure 6. Drain−to−Source Leakage Current versus Voltage**

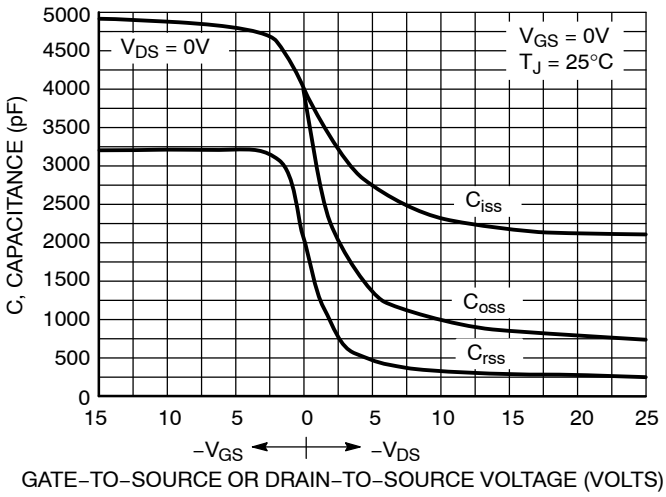



**Figure 7. Capacitance Variation**

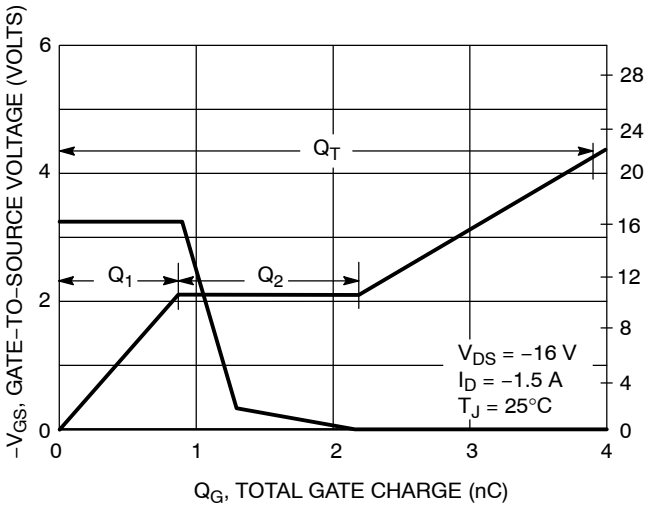



**Figure 8. Gate−to−Source and Drain−to−Source Voltage versus Total Charge**

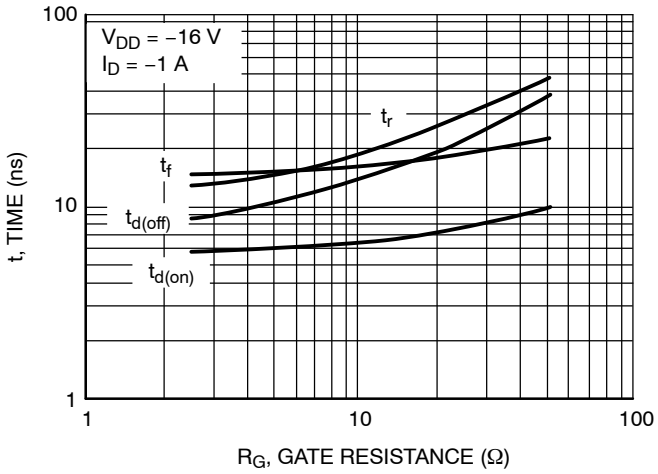



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

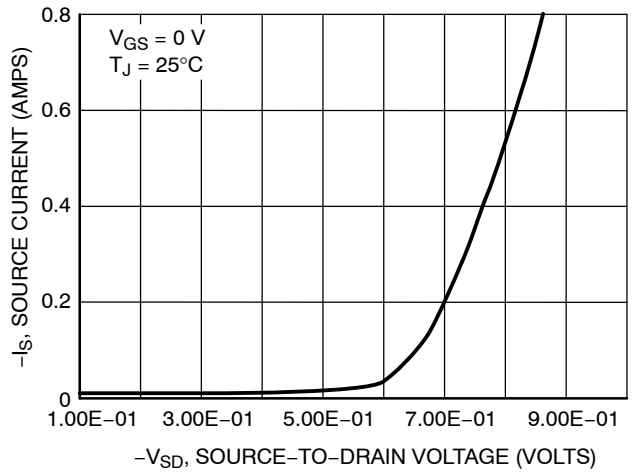
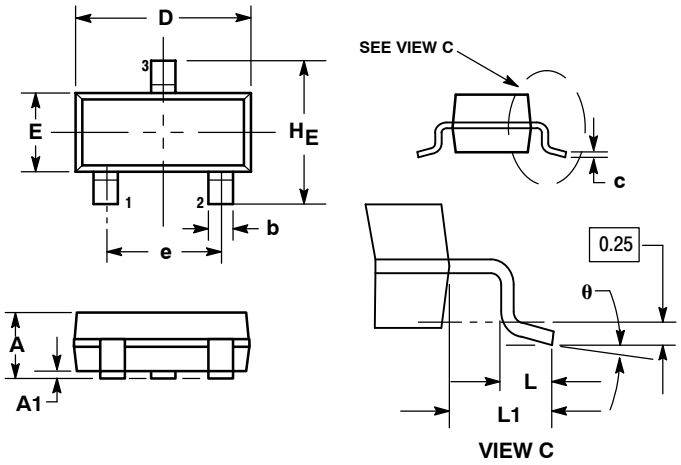



**Figure 10. Diode Forward Voltage versus Current**

## PACKAGE DIMENSIONS

**SOT−23 (TO−236)**
CASE 318−08
ISSUE AP

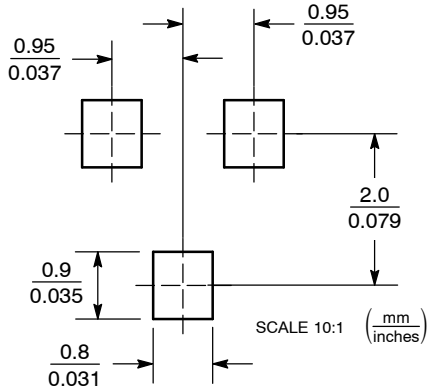



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | 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 |
| $H_E$ | 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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