

# NTR4171P

## Power MOSFET

–30 V, –3.5 A, Single P–Channel, SOT–23

### Features

- Low  $R_{DS(on)}$  at Low Gate Voltage
- Low Threshold Voltage
- High Power and Current Handling Capability
- This is a Pb–Free Device

### Applications

- Load Switch
- Optimized for Battery and Load Management Applications in Portable Equipment like Cell Phones, PDA's, Media Players, etc.

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                         |                        | Symbol         | Value                    | Unit             |
|-------------------------------------------------------------------|------------------------|----------------|--------------------------|------------------|
| Drain–to–Source Voltage                                           |                        | $V_{DS}$       | –30                      | V                |
| Gate–to–Source Voltage                                            |                        | $V_{GS}$       | $\pm 12$                 | V                |
| Continuous Drain Current (Note 1)                                 | Steady State           | $I_D$          | $T_A = 25^\circ\text{C}$ | A                |
|                                                                   |                        |                | $T_A = 85^\circ\text{C}$ |                  |
|                                                                   | $t \leq 5 \text{ s}$   |                | $T_A = 25^\circ\text{C}$ |                  |
| Power Dissipation (Note 1)                                        | Steady State           | $P_D$          | $T_A = 25^\circ\text{C}$ | W                |
|                                                                   | $t \leq 5 \text{ s}$   |                |                          |                  |
| Pulsed Drain Current                                              | $t_p = 10 \mu\text{s}$ | $I_{DM}$       | –15.0                    | A                |
| Operating Junction and Storage Temperature                        |                        | $T_J, T_{stg}$ | –55 to 150               | $^\circ\text{C}$ |
| Source Current (Body Diode)                                       |                        | $I_S$          | –1.0                     | mA               |
| 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.

### THERMAL RESISTANCE RATINGS

| Parameter                                            | Symbol          | Max | Unit                      |
|------------------------------------------------------|-----------------|-----|---------------------------|
| Junction–to–Ambient – Steady State (Note 1)          | $R_{\theta JA}$ | 260 | $^\circ\text{C}/\text{W}$ |
| Junction–to–Ambient – $t \leq 10 \text{ s}$ (Note 1) | $R_{\theta JA}$ | 100 |                           |

1. Surface–mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces)

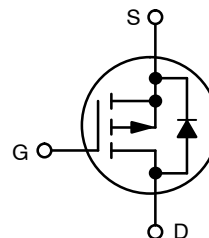


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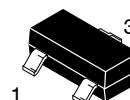
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| –30 V         | 75 m $\Omega$ @ –10 V    | –2.2 A            |
|               | 110 m $\Omega$ @ –4.5 V  | –1.8 A            |
|               | 150 m $\Omega$ @ –2.5 V  | –1.0 A            |

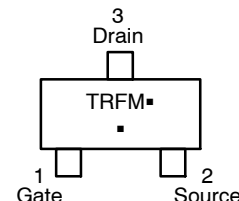
### P–CHANNEL MOSFET



### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT–23  
CASE 318  
STYLE 21



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

### ORDERING INFORMATION

| Device      | Package          | Shipping†         |
|-------------|------------------|-------------------|
| NTR4171PT1G | SOT–23 (Pb–Free) | 3000/Tape & Reel  |
| NTR4171PT3G | SOT–23 (Pb–Free) | 10000/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.

# NTR4171P

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

| Parameter                                                 | Symbol            | Test Condition                                                                                                                               | Min | Typ | Max          | Units                |
|-----------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |                                                                                                                                              |     |     |              |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$                                                                                         | -30 |     |              | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = -250\text{ }\mu\text{A}$ , Reference to $25^\circ\text{C}$                                                                            |     | 24  |              | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -24\text{ V}, T_J = 25^\circ\text{C}$<br>$V_{GS} = 0\text{ V}, V_{DS} = -24\text{ V}, T_J = 85^\circ\text{C}$ |     |     | -1.0<br>-5.0 | $\mu\text{A}$        |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$                                                                                              |     |     | $\pm 0.1$    | $\mu\text{A}$        |

## ON CHARACTERISTICS (Note 3)

|                                            |                  |                                                  |      |       |      |                      |
|--------------------------------------------|------------------|--------------------------------------------------|------|-------|------|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\text{ }\mu\text{A}$ | -0.7 | -1.15 | -1.4 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                  |      | 3.5   |      | mV/ $^\circ\text{C}$ |
| Drain-to-Source On-Resistance              | $R_{DS(on)}$     | $V_{GS} = -10\text{ V}, I_D = -2.2\text{ A}$     |      | 50    | 75   | m $\Omega$           |
|                                            |                  | $V_{GS} = -4.5\text{ V}, I_D = -1.8\text{ A}$    |      | 60    | 110  |                      |
|                                            |                  | $V_{GS} = -2.5\text{ V}, I_D = -1.0\text{ A}$    |      | 90    | 150  |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = -5.0\text{ V}, I_D = -2.2\text{ A}$    |      | 7.0   |      | S                    |

## CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                           |  |      |  |          |
|------------------------------|--------------|---------------------------------------------------------------------------|--|------|--|----------|
| Input Capacitance            | $C_{iss}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz},$<br>$V_{DS} = -15\text{ V}$     |  | 720  |  | pF       |
| Output Capacitance           | $C_{oss}$    |                                                                           |  | 95   |  |          |
| Reverse Transfer Capacitance | $C_{rss}$    |                                                                           |  | 65   |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -10\text{ V}, V_{DS} = -15\text{ V},$<br>$I_D = -3.5\text{ A}$  |  | 15.6 |  | nC       |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                           |  | 0.7  |  |          |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                           |  | 1.6  |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                           |  | 2.6  |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -15\text{ V},$<br>$I_D = -3.5\text{ A}$ |  | 7.4  |  | nC       |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                           |  | 0.7  |  |          |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                           |  | 1.6  |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                           |  | 2.6  |  |          |
| Gate Resistance              | $R_G$        |                                                                           |  | 6.1  |  | $\Omega$ |

## SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 4)

|                     |              |                                                                                                  |  |     |  |    |
|---------------------|--------------|--------------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = -10\text{ V}, V_{DS} = -15\text{ V},$<br>$I_D = -3.5\text{ A}, R_G = 6\text{ }\Omega$  |  | 8.0 |  | ns |
| Rise Time           | $t_r$        |                                                                                                  |  | 11  |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                                  |  | 32  |  |    |
| Fall Time           | $t_f$        |                                                                                                  |  | 14  |  |    |
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = -4.5\text{ V}, V_{DS} = -15\text{ V},$<br>$I_D = -3.5\text{ A}, R_G = 6\text{ }\Omega$ |  | 9.0 |  | ns |
| Rise Time           | $t_r$        |                                                                                                  |  | 16  |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                                  |  | 25  |  |    |
| Fall Time           | $t_f$        |                                                                                                  |  | 22  |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |                                                                                        |  |      |      |    |
|-------------------------|----------|----------------------------------------------------------------------------------------|--|------|------|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}, T_J = 25^\circ\text{C}$                     |  | -0.8 | -1.2 | V  |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, I_S = -1.0\text{ A},$<br>$dI_{SD}/dt = 100\text{ A}/\mu\text{s}$ |  | 14   |      | ns |
| Charge Time             | $t_a$    |                                                                                        |  | 10   |      |    |
| Discharge Time          | $t_b$    |                                                                                        |  | 4.0  |      |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                                        |  | 8.0  |      | nC |

2. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces)

3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$

4. Switching characteristics are independent of operating junction temperatures

# TYPICAL CHARACTERISTICS

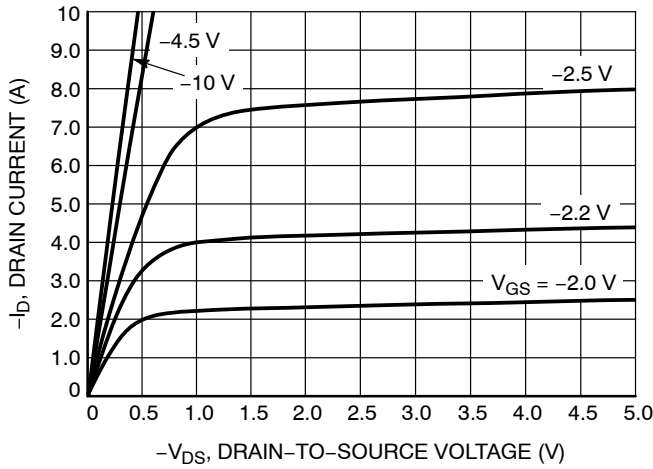


Figure 1. On-Region Characteristics

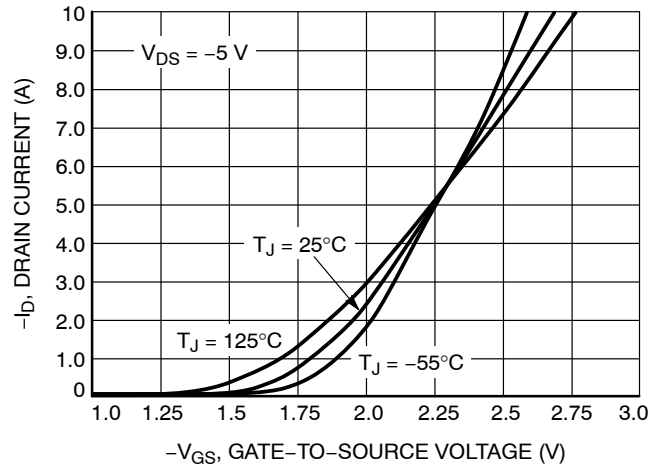


Figure 2. Transfer Characteristics

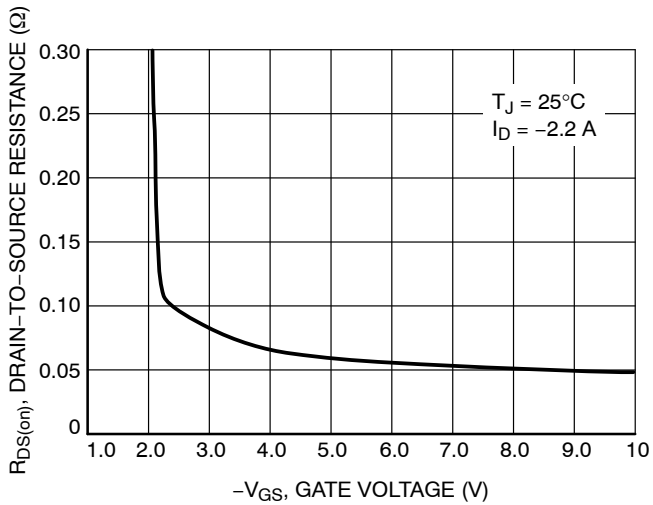


Figure 3. On-Resistance vs. Gate-to-Source Voltage

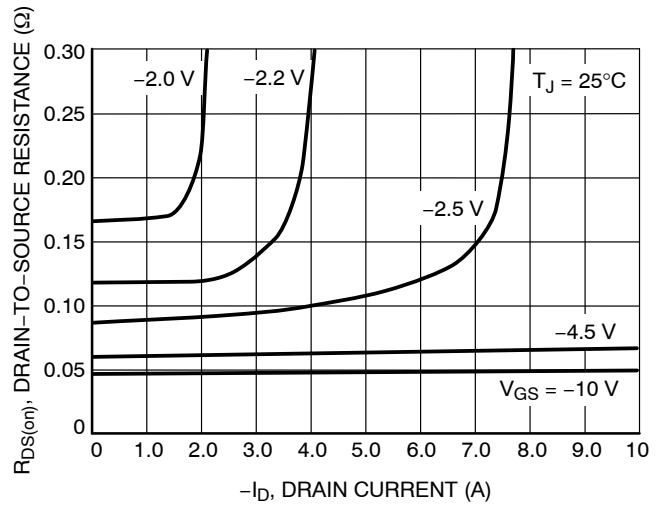


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

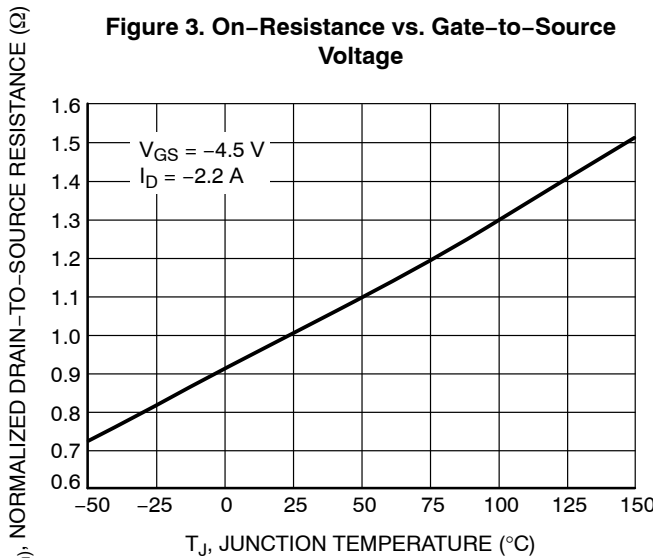


Figure 5. On-Resistance Variation with Temperature

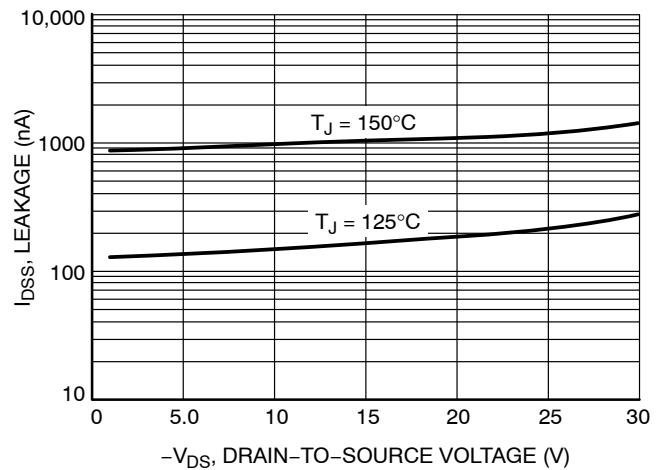


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

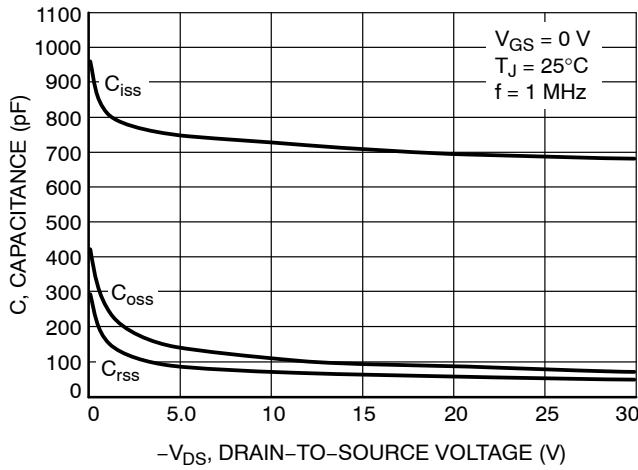


Figure 7. Capacitance Variation

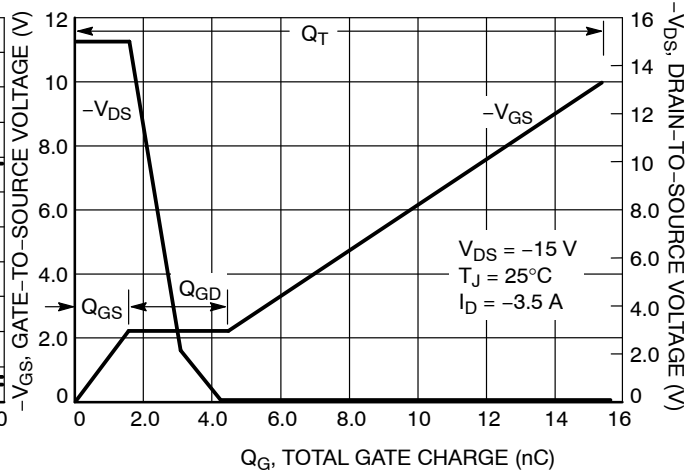


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

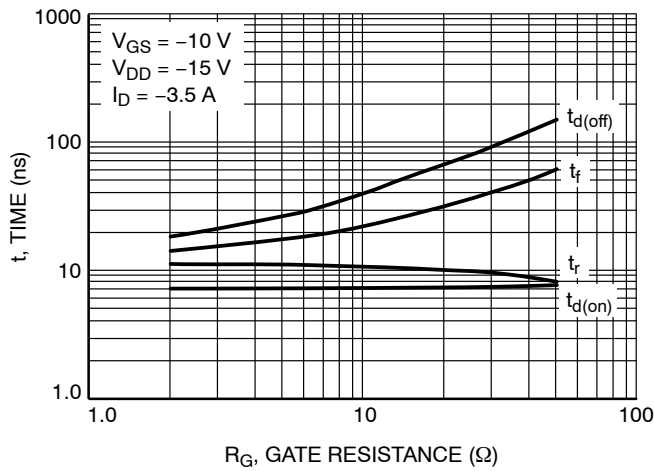


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

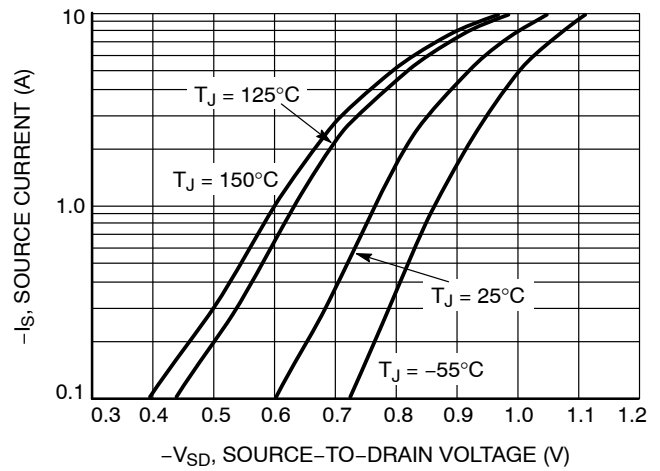


Figure 10. Diode Forward Voltage vs. Current

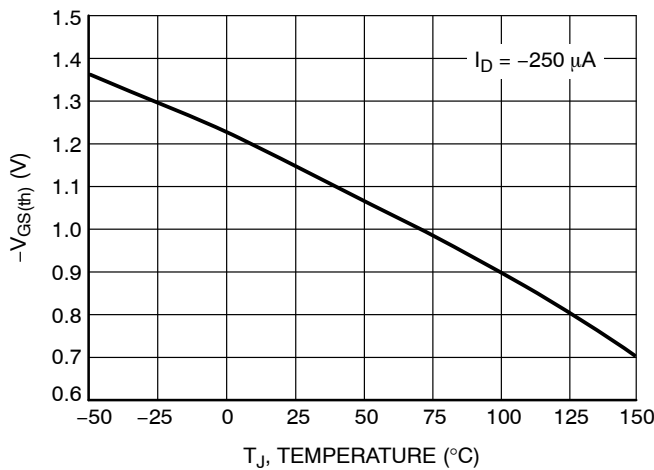


Figure 11. Threshold Voltage

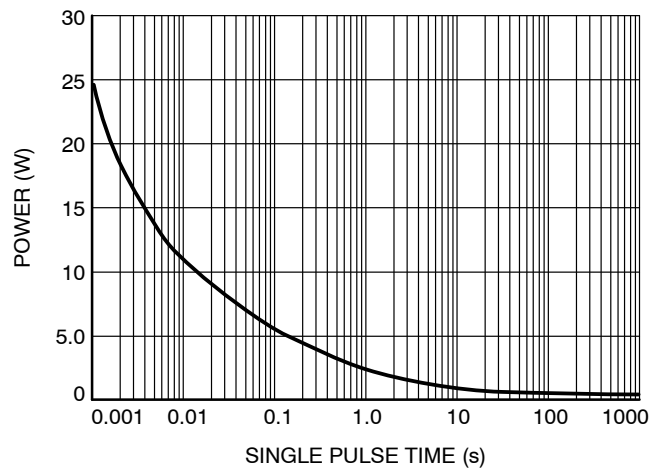


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

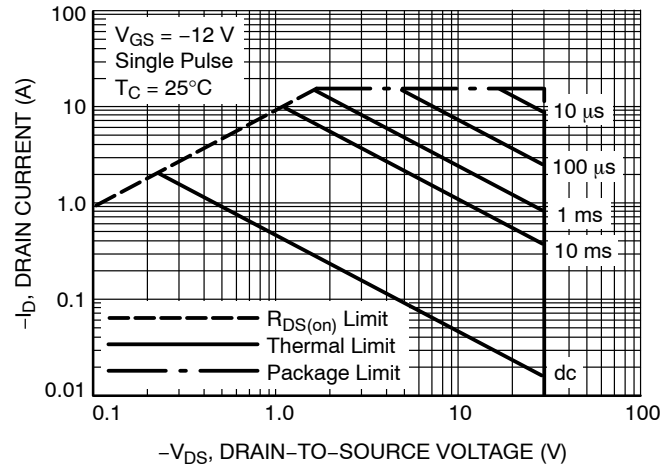


Figure 13. Maximum Rated Forward Biased Safe Operating Area

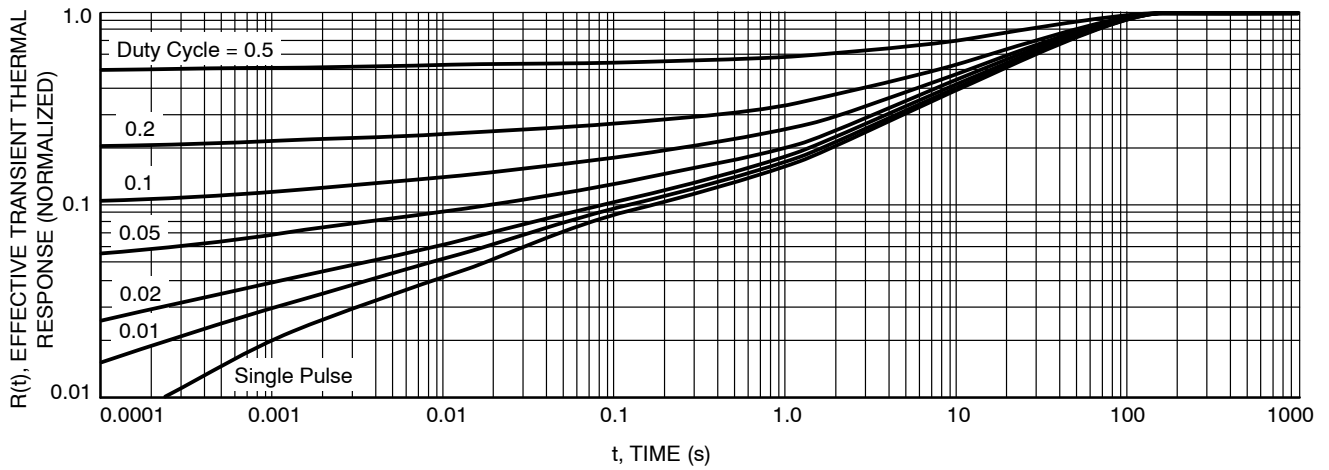


Figure 14. FET Thermal Response

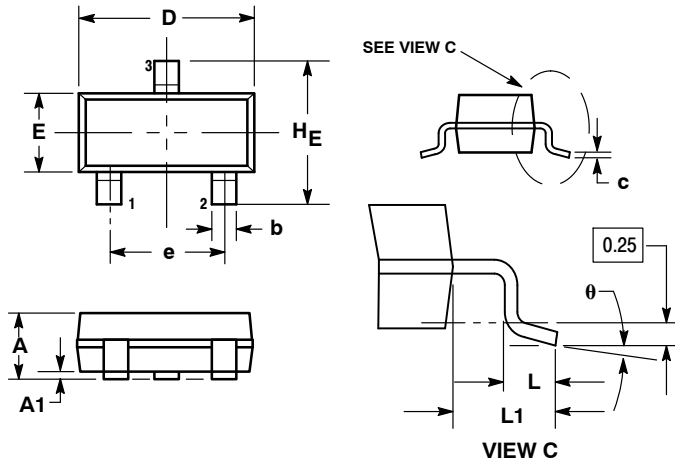
# NTR4171P

## PACKAGE DIMENSIONS

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

### 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 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

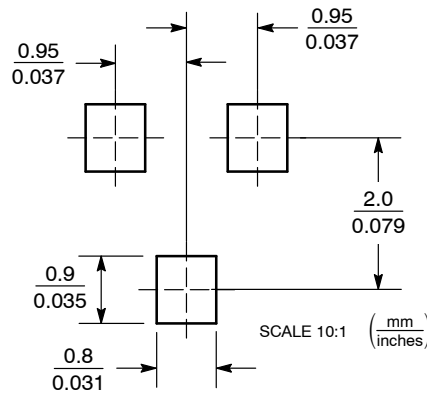


| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.040 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| 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 |
| H_E | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |

### 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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