

# NTK3139P

## Power MOSFET

-20 V, -780 mA, Single P-Channel with ESD Protection, SOT-723



ON Semiconductor®

<http://onsemi.com>

### Features

- P-channel Switch with Low  $R_{DS(on)}$
- 44% Smaller Footprint and 38% Thinner than SC-89
- Low Threshold Levels Allowing 1.5 V  $R_{DS(on)}$  Rating
- Operated at Low Logic Level Gate Drive
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Load/Power Switching
- Interfacing, Logic Switching
- Battery Management for Ultra Small Portable Electronics

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

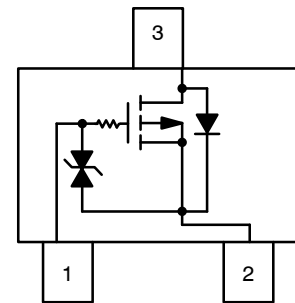
| Parameter   |                        | Symbol                   | Value                    | Unit             |    |
|---|------------------------|--------------------------|--------------------------|------------------|----|
| Drain-to-Source Voltage   |                        | $V_{DSS}$                | -20                      | V                |    |
| Gate-to-Source Voltage  |                        | $V_{GS}$                 | $\pm 6$                  | V                |    |
| Continuous Drain Current (Note 1)                                 | Steady State           | $I_D$                    | $T_A = 25^\circ\text{C}$ | -780             | mA |
|   |                        |                          | $T_A = 85^\circ\text{C}$ | -570             |    |
|   | $t \leq 5 \text{ s}$   | $T_A = 25^\circ\text{C}$ | -870                     |                  |    |
| Power Dissipation (Note 1)  | Steady State           | $P_D$                    | $T_A = 25^\circ\text{C}$ | 450              | mW |
|   | $t \leq 5 \text{ s}$   |                          | 550                      |                  |    |
| Continuous Drain Current (Note 2)                                 | Steady State           | $I_D$                    | $T_A = 25^\circ\text{C}$ | -660             | mA |
|   |                        |                          | $T_A = 85^\circ\text{C}$ | -480             |    |
|   |                        |                          | $T_A = 25^\circ\text{C}$ | $P_D$            |    |
| Pulsed Drain Current  | $t_p = 10 \mu\text{s}$ | $I_{DM}$                 | -1.2                     | A                |    |
| Operating Junction and Storage Temperature                        |                        | $T_J, T_{STG}$           | -55 to 150               | $^\circ\text{C}$ |    |
| 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.

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

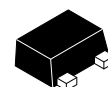
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP       | $I_D$ Max |
|---------------|------------------------|-----------|
| -20 V         | 0.38 $\Omega$ @ -4.5 V | -780 mA   |
|               | 0.52 $\Omega$ @ -2.5 V | -660 mA   |
|               | 0.70 $\Omega$ @ -1.8 V | -100 mA   |
|               | 0.95 $\Omega$ @ -1.5 V | -100 mA   |

### SOT-723 (3-LEAD)



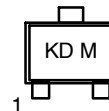
Top View

- 1 - Gate
- 2 - Source
- 3 - Drain



SOT-723  
CASE 631AA  
STYLE 5

### MARKING DIAGRAM



- KD = Specific Device Code
- M = Date Code

### ORDERING INFORMATION

| Device      | Package            | Shipping†          |
|-------------|--------------------|--------------------|
| NTK3139PT1G | SOT-723<br>Pb-Free | 4000 / Tape & Reel |
| NTK3139PT1H |                    |                    |
| NTK3139PT5G |                    |                    |
| NTK3139PT5H |                    | 8000 / 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.

# NTK3139P

## THERMAL RESISTANCE RATINGS

| Parameter   | Symbol          | Max | Unit |
|---|-----------------|-----|------|
| Junction-to-Ambient – Steady State (Note 3)             | $R_{\theta JA}$ | 280 | °C/W |
| Junction-to-Ambient – $t = 5$ s (Note 3)                | $R_{\theta JA}$ | 228 |      |
| Junction-to-Ambient – Steady State Minimum Pad (Note 4) | $R_{\theta JA}$ | 400 |      |

3. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)  
 4. Surface mounted on FR4 board using the minimum recommended pad size

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|   |                   |   |                           |       |           |         |
|---|-------------------|---|---------------------------|-------|-----------|---------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0$ V, $I_D = -250$ $\mu$ A                  | -20                       |       |           | V       |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = -250$ $\mu$ A, Reference to $25^\circ\text{C}$ |                           | -16.5 |           | mV/°C   |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0$ V,<br>$V_{DS} = -16$ V                   | $T_J = 25^\circ\text{C}$  |       | -1.0      | $\mu$ A |
|   |                   |   | $T_J = 125^\circ\text{C}$ |       | -2.0      |         |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0$ V, $V_{GS} = \pm 4.5$ V                  |                           |       | $\pm 2.0$ | $\mu$ A |

### ON CHARACTERISTICS (Note 5)

|  |                  |  |       |      |      |          |
|--|------------------|--|-------|------|------|----------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}$ , $I_D = -250$ $\mu$ A | -0.45 |      | -1.2 | V        |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |  |       | 2.4  |      | mV/°C    |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = -4.5$ V, $I_D = -780$ mA       |       | 0.38 | 0.48 | $\Omega$ |
|  |                  | $V_{GS} = -2.5$ V, $I_D = -660$ mA       |       | 0.52 | 0.67 |          |
|  |                  | $V_{GS} = -1.8$ V, $I_D = -100$ mA       |       | 0.70 | 0.95 |          |
|  |                  | $V_{GS} = -1.5$ V, $I_D = -100$ mA       |       | 0.95 | 2.20 |          |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = -10$ V, $I_D = -540$ mA        |       | 1.2  |      | S        |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |           |   |  |     |     |    |
|------------------------------|-----------|---|--|-----|-----|----|
| Input Capacitance            | $C_{ISS}$ | $V_{GS} = 0$ V, $f = 1$ MHz, $V_{DS} = -16$ V |  | 113 | 170 | pF |
| Output Capacitance           | $C_{OSS}$ |   |  | 15  | 25  |    |
| Reverse Transfer Capacitance | $C_{RSS}$ |   |  | 9.0 | 15  |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5$ V (Note 6)

|                    |              |  |  |      |  |    |
|--------------------|--------------|--|--|------|--|----|
| Turn On Delay Time | $t_{d(ON)}$  | $V_{GS} = -4.5$ V, $V_{DS} = -10$ V,<br>$I_D = -200$ mA, $R_G = 10$ $\Omega$ |  | 9.0  |  | ns |
| Rise Time          | $t_r$        |  |  | 5.8  |  |    |
| TurnOff Delay Time | $t_{d(OFF)}$ |  |  | 32.7 |  |    |
| Fall Time          | $t_f$        |  |  | 20.3 |  |    |

### DRAIN SOURCE DIODE CHARACTERISTICS

|                         |          |  |                          |  |      |      |    |
|-------------------------|----------|--|--------------------------|--|------|------|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0$ V, $I_S = -350$ mA  | $T_J = 25^\circ\text{C}$ |  | -0.8 | -1.2 | V  |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0$ V, $dI_{SD}/dt = 100$ A/ $\mu$ s,<br>$I_S = -1.0$ A, $V_{DD} = -20$ V |                          |  | 13.2 |      | ns |
| Charge Time             | $t_a$    |  |                          |  | 11.8 |      |    |
| Discharge Time          | $t_b$    |  |                          |  | 1.4  |      |    |
| Reverse Recovery Charge | $Q_{RR}$ |  |                          |  | 5.0  |      | nC |

5. Pulse Test: pulse width = 300  $\mu$ s, duty cycle = 2%  
 6. Switching characteristics are independent of operating junction temperatures

TYPICAL CHARACTERISTICS

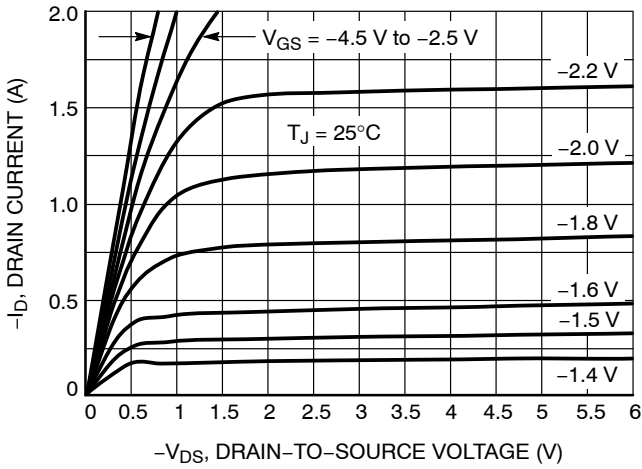


Figure 1. On-Region Characteristics

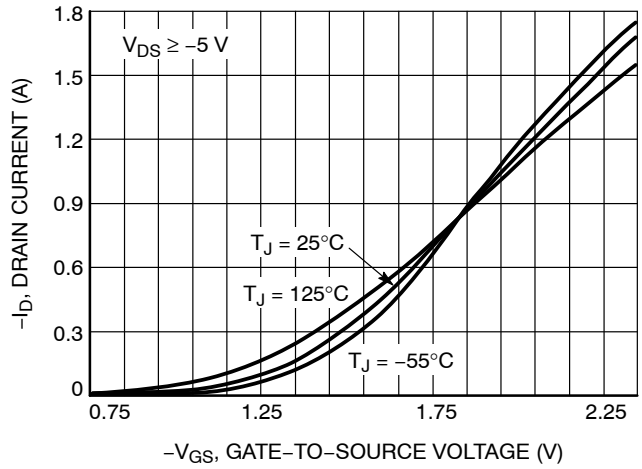


Figure 2. Transfer Characteristics

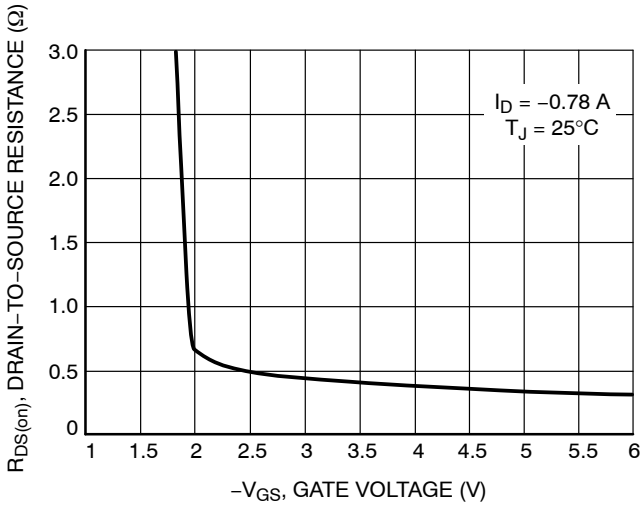


Figure 3. On-Resistance vs. Gate-to-Source Voltage

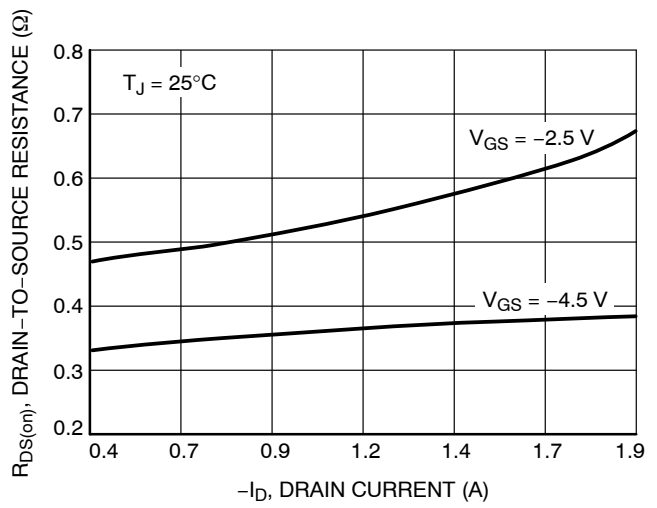


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

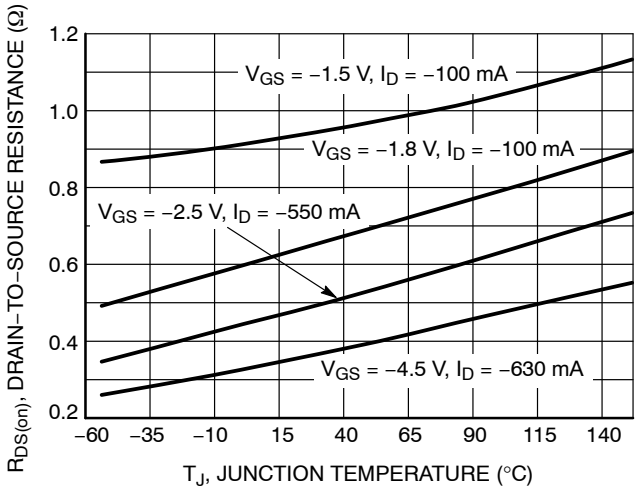


Figure 5. On-Resistance Variation with Temperature

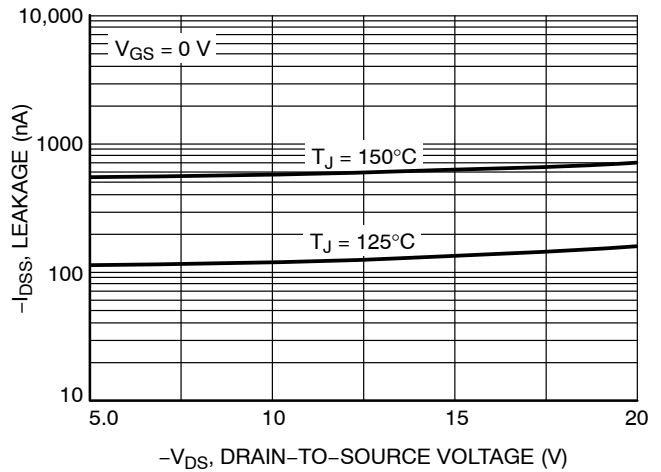


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

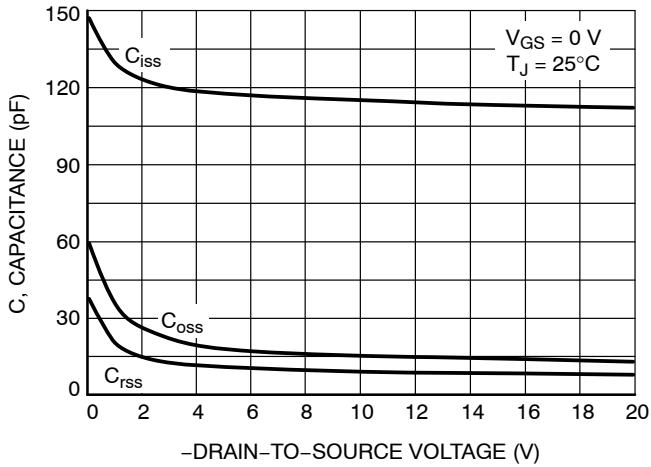


Figure 7. Capacitance Variation

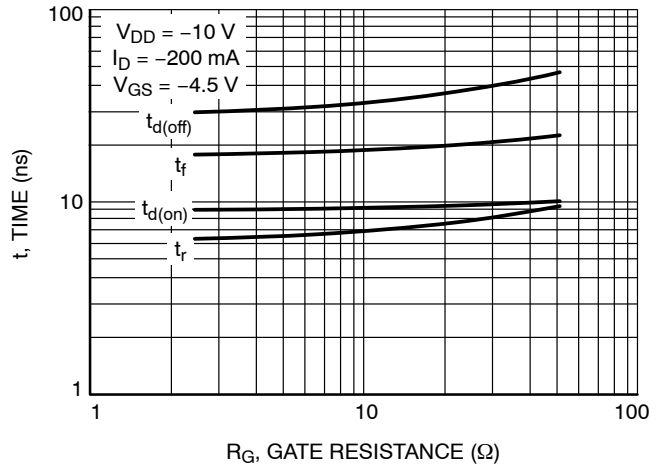


Figure 8. Resistive Switching Time Variation vs. Gate Resistance

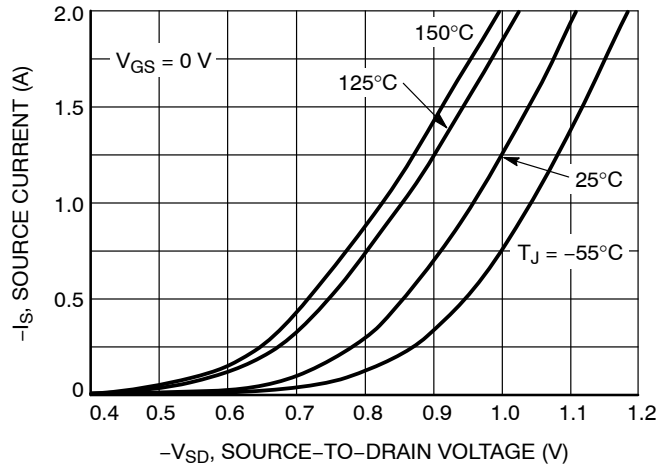
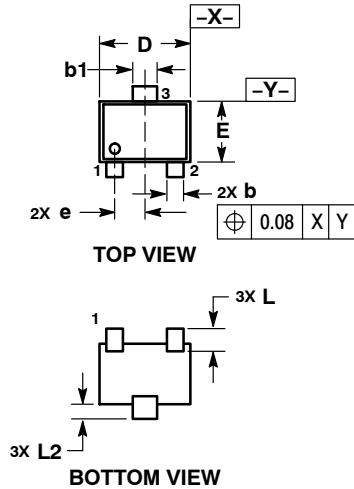


Figure 9. Diode Forward Voltage vs. Current

# NTK3139P

## PACKAGE DIMENSIONS

### SOT-723 CASE 631AA ISSUE D



#### NOTES:

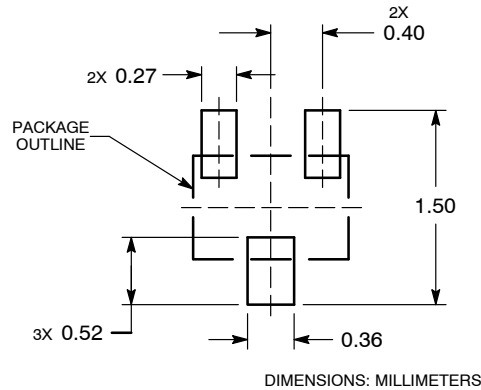
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

| DIM            | MILLIMETERS |      |      |
|----------------|-------------|------|------|
|                | MIN         | NOM  | MAX  |
| A              | 0.45        | 0.50 | 0.55 |
| b              | 0.15        | 0.21 | 0.27 |
| b1             | 0.25        | 0.31 | 0.37 |
| C              | 0.07        | 0.12 | 0.17 |
| D              | 1.15        | 1.20 | 1.25 |
| E              | 0.75        | 0.80 | 0.85 |
| e              | 0.40 BSC    |      |      |
| H <sub>E</sub> | 1.15        | 1.20 | 1.25 |
| L              | 0.29 REF    |      |      |
| L2             | 0.15        | 0.20 | 0.25 |

#### STYLE 5:

1. GATE
2. SOURCE
3. DRAIN

### RECOMMENDED 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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