

# NTR4101P, NTRV4101P

## MOSFET – Power, Single P-Channel, Trench, SOT-23 –20 V

### Features

- Leading –20 V Trench for Low  $R_{DS(on)}$
- –1.8 V Rated for Low Voltage Gate Drive
- SOT-23 Surface Mount for Small Footprint
- NTRV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Load/Power Management for Portables
- Load/Power Management for Computing
- Charging Circuits and Battery Protection

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

| Parameter   | Symbol                                 | Value                    | Unit       |                  |
|---|--|--------------------------|------------|------------------|
| Drain-to-Source Voltage   | $V_{DS}$                               | –20                      | V          |                  |
| Gate-to-Source Voltage  | $V_{GS}$                               | $\pm 8.0$                | V          |                  |
| Continuous Drain Current (Note 1)   | Steady State                           | $T_A = 25^\circ\text{C}$ | $I_D$ –2.4 | A                |
|   |  | $T_A = 85^\circ\text{C}$ | –1.7       |                  |
|   | $t \leq 10$ s                          | $T_A = 25^\circ\text{C}$ | –3.2       |                  |
| Power Dissipation (Note 1)  | Steady State                           | $T_A = 25^\circ\text{C}$ | $P_D$ 0.73 | W                |
|   |  | $t \leq 10$ s            | 1.25       |                  |
| Continuous Drain Current (Note 2)   | Steady State                           | $T_A = 25^\circ\text{C}$ | $I_D$ –1.8 | A                |
|   |  | $T_A = 85^\circ\text{C}$ | –1.3       |                  |
|   |  | $T_A = 25^\circ\text{C}$ | $P_D$ 0.42 |                  |
| Pulsed Drain Current  | $t_p = 10$ $\mu\text{s}$               | $I_{DM}$                 | –18        | A                |
| ESD Capability (Note 3)   | $C = 100$ pF,<br>$R_S = 1500$ $\Omega$ | ESD                      | 225        | V                |
| Operating Junction and Storage Temperature  | $T_J$ ,<br>$T_{STG}$                   | –55 to 150               |            | $^\circ\text{C}$ |
| Source Current (Body Diode)   | $I_S$                                  | –2.4                     |            | A                |
| Single Pulse Drain-to-Source Avalanche Energy ( $V_{GS} = -8$ V, $I_L = -1.8$ Apk, $L = 10$ mH, $R_G = 25$ $\Omega$ ) | EAS                                    | 16                       |            | mJ               |
| 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.

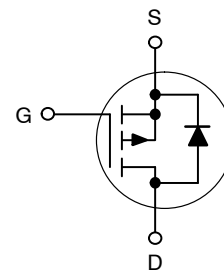


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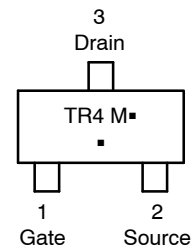
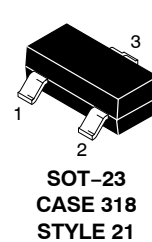
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| $V_{(BR)DSS}$ | $R_{DS(ON)}$ TYP        | $I_D$ MAX |
|---------------|-------------------------|-----------|
| –20 V         | 70 m $\Omega$ @ –4.5 V  | –3.2 A    |
|               | 90 m $\Omega$ @ –2.5 V  |           |
|               | 112 m $\Omega$ @ –1.8 V |           |

### P-Channel MOSFET



### MARKING DIAGRAM & PIN ASSIGNMENT



TR4 = Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package             | Shipping†          |
|--------------|---------------------|--------------------|
| NTR4101PT1G  | SOT-23<br>(Pb-Free) | 3000 / Tape & Reel |
| NTRV4101PT1G |                     |                    |

†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.

# NTR4101P, NTRV4101P

## THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol          | Max | Unit |
|---|-----------------|-----|------|
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 170 | °C/W |
| Junction-to-Ambient – $t < 10$ s (Note 1)   | $R_{\theta JA}$ | 100 |      |
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 300 |      |

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)
- Surface-mounted on FR4 board using the minimum recommended pad size.
- ESD Rating Information: HBM Class 0

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|  |               |     |  |           |               |
|--|---------------|-----|--|-----------|---------------|
| Drain-to-Source Breakdown Voltage (Note 4)<br>( $V_{GS} = 0$ V, $I_D = -250$ $\mu\text{A}$ ) | $V_{(BR)DSS}$ | -20 |  |           | V             |
| Zero Gate Voltage Drain Current (Note 4)<br>( $V_{GS} = 0$ V, $V_{DS} = -16$ V)              | $I_{DSS}$     |     |  | -1.0      | $\mu\text{A}$ |
| Gate-to-Source Leakage Current<br>( $V_{GS} = \pm 8.0$ V, $V_{DS} = 0$ V)                    | $I_{GSS}$     |     |  | $\pm 100$ | nA            |

### ON CHARACTERISTICS

|   |              |      |                 |                  |            |
|---|--------------|------|-----------------|------------------|------------|
| Gate Threshold Voltage (Note 4)<br>( $V_{GS} = V_{DS}$ , $I_D = -250$ $\mu\text{A}$ )   | $V_{GS(th)}$ | -0.4 | -0.72           | -1.2             | V          |
| Drain-to-Source On-Resistance<br>( $V_{GS} = -4.5$ V, $I_D = -1.6$ A)<br>( $V_{GS} = -2.5$ V, $I_D = -1.3$ A)<br>( $V_{GS} = -1.8$ V, $I_D = -0.9$ A) | $R_{DS(on)}$ |      | 70<br>90<br>112 | 85<br>120<br>210 | m $\Omega$ |
| Forward Transconductance ( $V_{DS} = -5.0$ V, $I_D = -2.3$ A)   | $g_{FS}$     |      | 7.5             |                  | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                               |   |              |     |     |          |
|-------------------------------|---|--------------|-----|-----|----------|
| Input Capacitance             | $(V_{GS} = 0$ V, $f = 1$ MHz, $V_{DS} = -10$ V)       | $C_{iss}$    | 675 |     | pF       |
| Output Capacitance            |   | $C_{oss}$    | 100 |     |          |
| Reverse Transfer Capacitance  |   | $C_{rss}$    | 75  |     |          |
| Total Gate Charge             | $(V_{GS} = -4.5$ V, $V_{DS} = -10$ V, $I_D = -1.6$ A) | $Q_{G(tot)}$ | 7.5 | 8.5 | nC       |
| Gate-to-Source Gate Charge    | $(V_{DS} = -10$ V, $I_D = -1.6$ A)                    | $Q_{GS}$     | 1.2 |     | nC       |
| Gate-to-Drain "Miller" Charge | $(V_{DS} = -10$ V, $I_D = -1.6$ A)                    | $Q_{GD}$     | 2.2 |     | nC       |
| Gate Resistance               |   | $R_G$        | 6.5 |     | $\Omega$ |

### SWITCHING CHARACTERISTICS (Note 5)

|                     |   |              |      |  |    |
|---------------------|---|--------------|------|--|----|
| Turn-On Delay Time  | $(V_{GS} = -4.5$ V, $V_{DS} = -10$ V,<br>$I_D = -1.6$ A, $R_G = 6.0$ $\Omega$ ) | $t_{d(on)}$  | 7.5  |  | ns |
| Rise Time           |   | $t_r$        | 12.6 |  |    |
| Turn-Off Delay Time |   | $t_{d(off)}$ | 30.2 |  |    |
| Fall Time           |   | $t_f$        | 21.0 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |   |          |  |       |      |    |
|-------------------------|---|----------|--|-------|------|----|
| Forward Diode Voltage   | $(V_{GS} = 0$ V, $I_S = -2.4$ A)  | $V_{SD}$ |  | -0.82 | -1.2 | V  |
| Reverse Recovery Time   | $(V_{GS} = 0$ V,<br>$dI_{SD}/dt = 100$ A/ $\mu\text{s}$ , $I_S = -1.6$ A) | $t_{rr}$ |  | 12.8  | 15   | ns |
| Charge Time             |   | $t_a$    |  | 9.9   |      | ns |
| Discharge Time          |   | $t_b$    |  | 3.0   |      | ns |
| Reverse Recovery Charge |   | $Q_{rr}$ |  | 1008  |      | 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.

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

# NTR4101P, NTRV4101P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

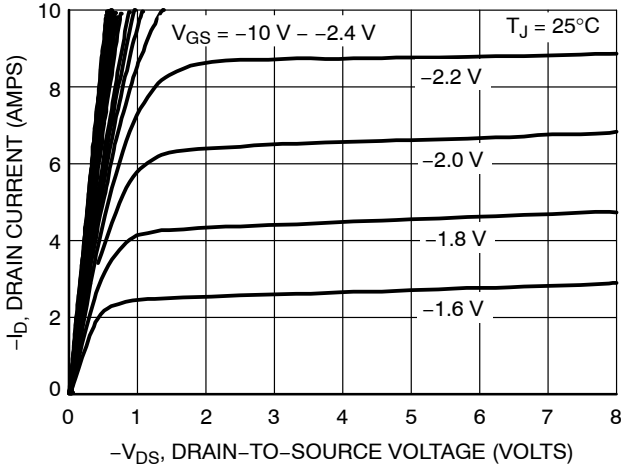


Figure 1. On-Region Characteristics

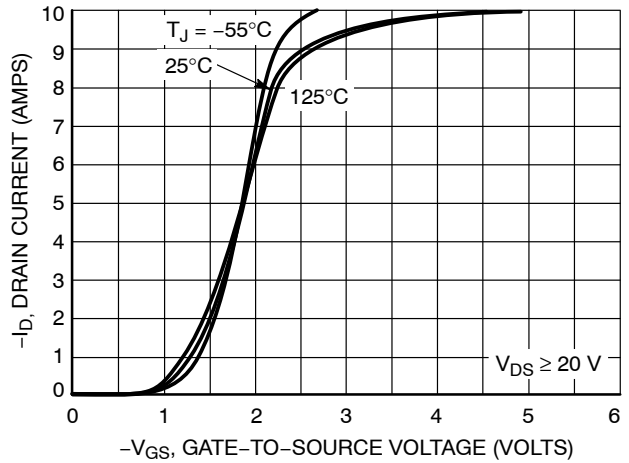


Figure 2. Transfer Characteristics

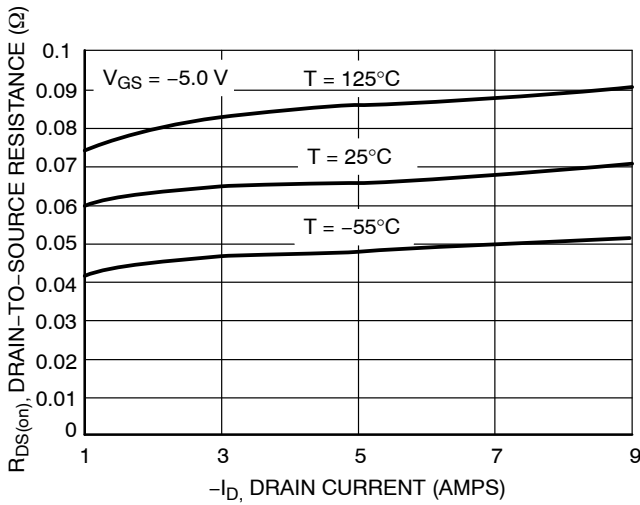


Figure 3. On-Resistance vs. Drain Current and Temperature

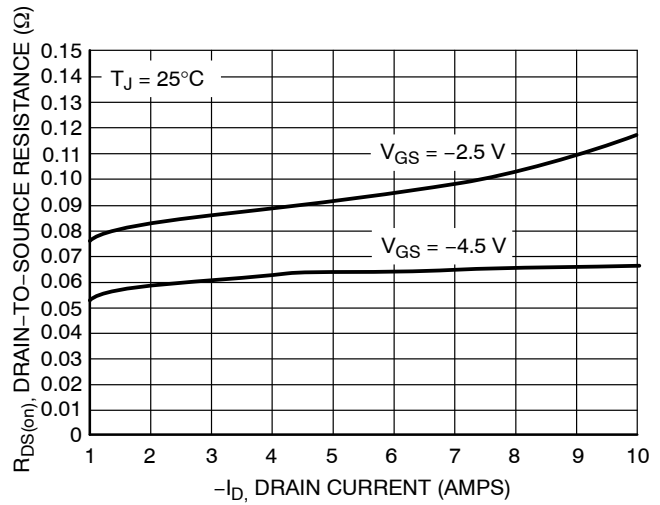


Figure 4. On-Resistance vs. Drain Current and Temperature

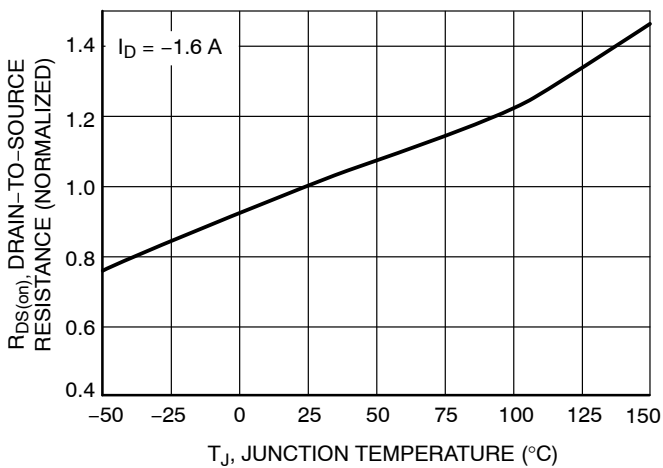


Figure 5. On-Resistance Variation with Temperature

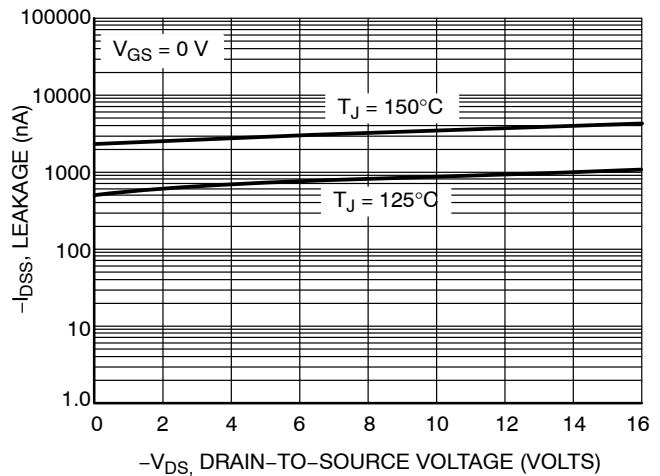


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTR4101P, NTRV4101P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

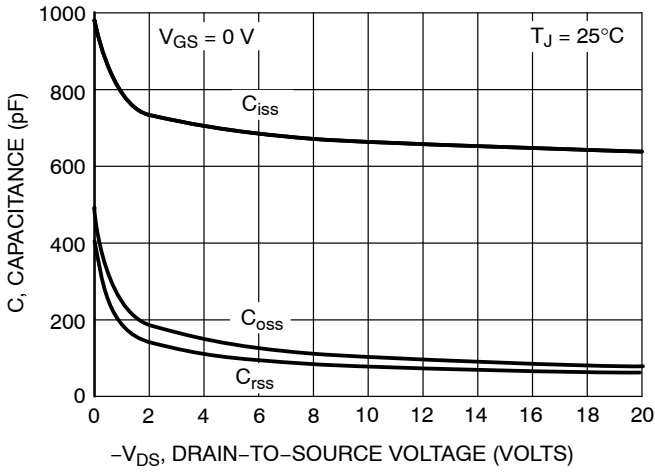


Figure 7. Capacitance Variation

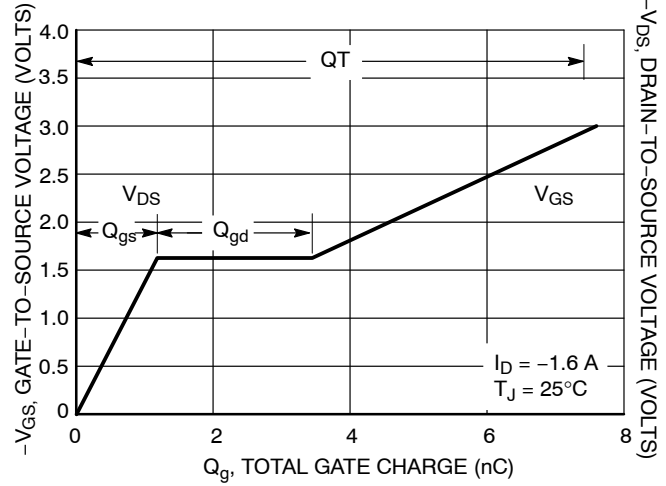


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Gate Charge

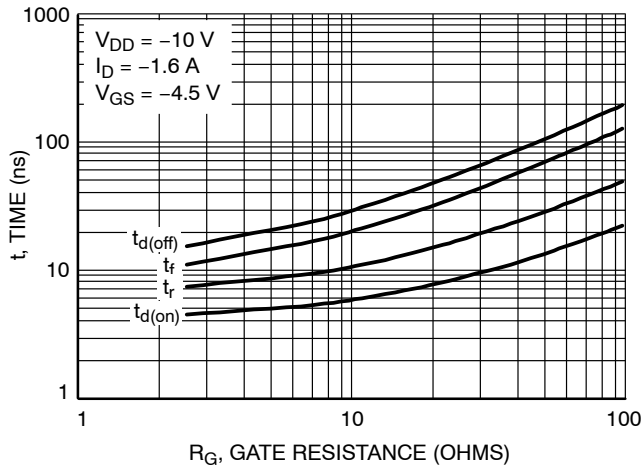


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

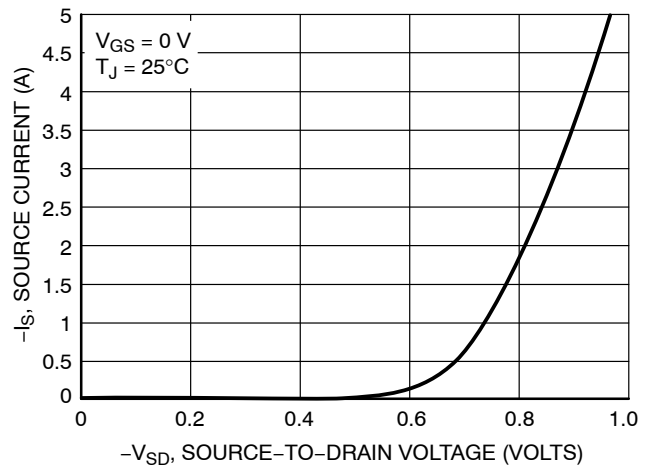


Figure 10. Diode Forward Voltage vs. Current

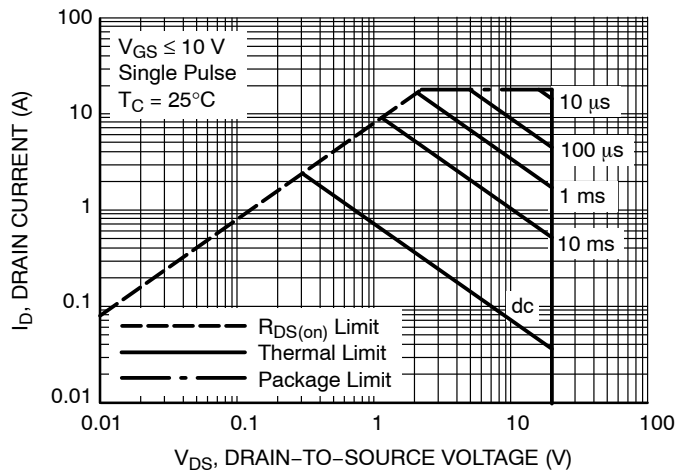
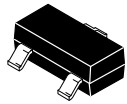


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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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.

| 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:<br>CANCELLED                                | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR       | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE          | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE           | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE      |
| STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          | STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE          | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE      |
| STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE         |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN           | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT         | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE          |
| STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION | STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE     | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE          |

|                         |                        |  |
|-------------------------|------------------------|--|
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