

# NTR4503N, NVTR4503N

## MOSFET – Power, Single, N-Channel, SOT-23 30 V, 2.5 A

### Features

- Leading Planar Technology for Low Gate Charge / Fast Switching
- 4.5 V Rated for Low Voltage Gate Drive
- SOT-23 Surface Mount for Small Footprint (3 x 3 mm)
- NV 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 Conversion
- Load/Power Switch for Portables
- Load/Power Switch for Computing

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

| Parameter                                                         |                               |                               | Symbol         | Value      | Unit               |
|-------------------------------------------------------------------|-------------------------------|-------------------------------|----------------|------------|--------------------|
| Drain-to-Source Voltage                                           |                               |                               | $V_{DSS}$      | 30         | V                  |
| Gate-to-Source Voltage                                            |                               |                               | $V_{GS}$       | $\pm 20$   | V                  |
| Continuous Drain Current (Note 1)                                 | Steady State                  | $T_A = 25^{\circ}\text{C}$    | $I_D$          | 2.0        | A                  |
|                                                                   |                               | $T_A = 85^{\circ}\text{C}$    |                | 1.5        |                    |
|                                                                   | $t \leq 10\text{ s}$          | $T_A = 25^{\circ}\text{C}$    |                | 2.5        |                    |
| Power Dissipation (Note 1)                                        | Steady State                  | $T_A = 25^{\circ}\text{C}$    | $P_D$          | 0.73       | W                  |
| Continuous Drain Current (Note 2)                                 | Steady State                  | $T_A = 25^{\circ}\text{C}$    | $I_D$          | 1.5        | A                  |
|                                                                   |                               | $T_A = 85^{\circ}\text{C}$    |                | 1.1        |                    |
| Power Dissipation (Note 2)                                        |                               | $T_A = 25^{\circ}\text{C}$    | $P_D$          | 0.42       | W                  |
| Pulsed Drain Current                                              | $t_p = 10\text{ }\mu\text{s}$ |                               | $I_{DM}$       | 10         | A                  |
| Operating Junction and Storage Temperature                        |                               |                               | $T_J, T_{stg}$ | -55 to 150 | $^{\circ}\text{C}$ |
| Source Current (Body Diode)                                       |                               |                               | $I_S$          | 2.0        | A                  |
| Peak Source Current (Diode Forward)                               |                               | $t_p = 10\text{ }\mu\text{s}$ | $I_{SM}$       | 4.0        | A                  |
| 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.

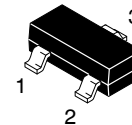
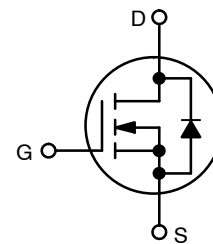


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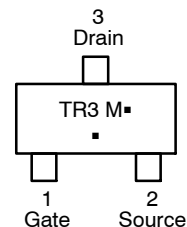
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP       | $I_D$ MAX |
|---------------|------------------------|-----------|
| 30 V          | 85 m $\Omega$ @ 10 V   | 2.5 A     |
|               | 105 m $\Omega$ @ 4.5 V |           |

### N-Channel



SOT-23  
CASE 318  
STYLE 21

### MARKING DIAGRAM/ PIN ASSIGNMENT



TR3 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package          | Shipping†          |
|--------------|------------------|--------------------|
| NTR4503NT1G  | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| NVTR4503NT1G | 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.

## NTR4503N, NVTR4503N

### 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 |      |

1. Surface-mounted on FR4 board using 1 in sq pad size.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

# NTR4503N, NVTR4503N

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|-----------|--------|-----------------|-----|-----|-----|-------|
|-----------|--------|-----------------|-----|-----|-----|-------|

### OFF CHARACTERISTICS

|                                   |                      |                                                                       |    |    |      |    |
|-----------------------------------|----------------------|-----------------------------------------------------------------------|----|----|------|----|
| Drain-to-Source Breakdown Voltage | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                        | 30 | 36 |      | V  |
| Zero Gate Voltage Drain Current   | I <sub>DSS</sub>     | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V                         |    |    | 1.0  | μA |
|                                   |                      | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V, T <sub>J</sub> = 125°C |    |    | 10   |    |
| Gate-to-Source Leakage Current    | I <sub>GSS</sub>     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V                        |    |    | ±100 | nA |

### ON CHARACTERISTICS (Note 3)

|                               |                     |                                                             |     |      |     |    |
|-------------------------------|---------------------|-------------------------------------------------------------|-----|------|-----|----|
| Gate Threshold Voltage        | V <sub>GS(TH)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA | 1.0 | 1.75 | 3.0 | V  |
| Drain-to-Source On-Resistance | R <sub>DS(on)</sub> | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.5 A              |     | 85   | 110 | mΩ |
|                               |                     | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 2.0 A             |     | 105  | 140 |    |
| Forward Transconductance      | g <sub>FS</sub>     | V <sub>DS</sub> = 4.5 V, I <sub>D</sub> = 2.5 A             |     | 5.3  |     | S  |

### CHARGES AND CAPACITANCES

|                              |                     |                                                                            |  |     |     |    |
|------------------------------|---------------------|----------------------------------------------------------------------------|--|-----|-----|----|
| Input Capacitance            | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz,<br>V <sub>DS</sub> = 15 V              |  | 135 |     | pF |
| Output Capacitance           | C <sub>oss</sub>    |                                                                            |  | 52  |     |    |
| Reverse Transfer Capacitance | C <sub>rss</sub>    |                                                                            |  | 15  |     |    |
| Input Capacitance            | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz,<br>V <sub>DS</sub> = 24 V              |  | 130 | 250 | pF |
| Output Capacitance           | C <sub>oss</sub>    |                                                                            |  | 42  | 75  |    |
| Reverse Transfer Capacitance | C <sub>rss</sub>    |                                                                            |  | 13  | 25  |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 15 V,<br>I <sub>D</sub> = 2.5 A  |  | 3.6 | 7.0 | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |                                                                            |  | 0.3 |     |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |                                                                            |  | 0.6 |     |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |                                                                            |  | 0.7 |     |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 24 V,<br>I <sub>D</sub> = 2.5 A |  | 1.9 |     | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |                                                                            |  | 0.3 |     |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |                                                                            |  | 0.6 |     |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |                                                                            |  | 0.9 |     |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |                     |                                                                                                   |  |      |     |    |
|---------------------|---------------------|---------------------------------------------------------------------------------------------------|--|------|-----|----|
| Turn-On Delay Time  | t <sub>d(on)</sub>  | V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 15 V,<br>I <sub>D</sub> = 1 A, R <sub>G</sub> = 6 Ω     |  | 5.8  | 12  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                                   |  | 5.8  | 10  |    |
| Turn-Off Delay Time | t <sub>d(off)</sub> |                                                                                                   |  | 14   | 25  |    |
| Fall Time           | t <sub>f</sub>      |                                                                                                   |  | 1.6  | 5.0 |    |
| Turn-On Delay Time  | t <sub>d(on)</sub>  | V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 24 V,<br>I <sub>D</sub> = 2.5 A, R <sub>G</sub> = 2.5 Ω |  | 4.8  |     | ns |
| Rise Time           | t <sub>r</sub>      |                                                                                                   |  | 6.7  |     |    |
| Turn-Off Delay Time | t <sub>d(off)</sub> |                                                                                                   |  | 13.6 |     |    |
| Fall Time           | t <sub>f</sub>      |                                                                                                   |  | 1.8  |     |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |                 |                                                                                  |  |      |     |    |
|-------------------------|-----------------|----------------------------------------------------------------------------------|--|------|-----|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 2.0 A                                    |  | 0.85 | 1.2 | V  |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 2.0 A,<br>dI <sub>S</sub> /dt = 100 A/μs |  | 9.2  |     | ns |
| Reverse Recovery Charge | Q <sub>RR</sub> |                                                                                  |  | 4.0  |     | 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.

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

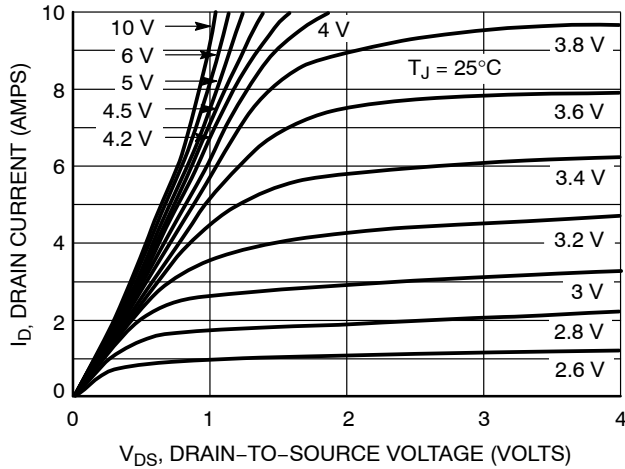


Figure 1. On-Region Characteristics

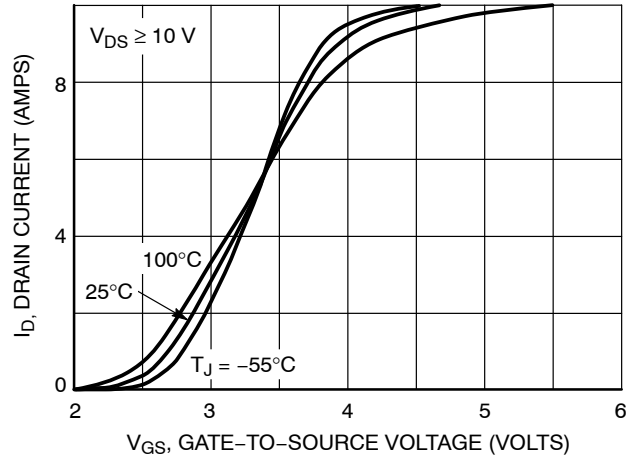


Figure 2. Transfer Characteristics

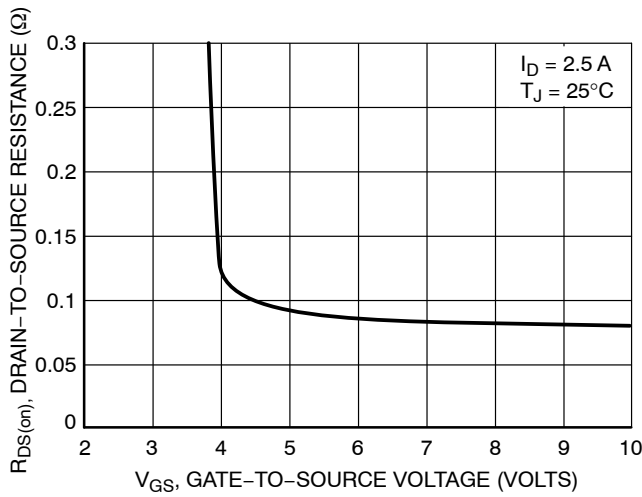


Figure 3. On-Resistance vs. Gate-to-Source Voltage

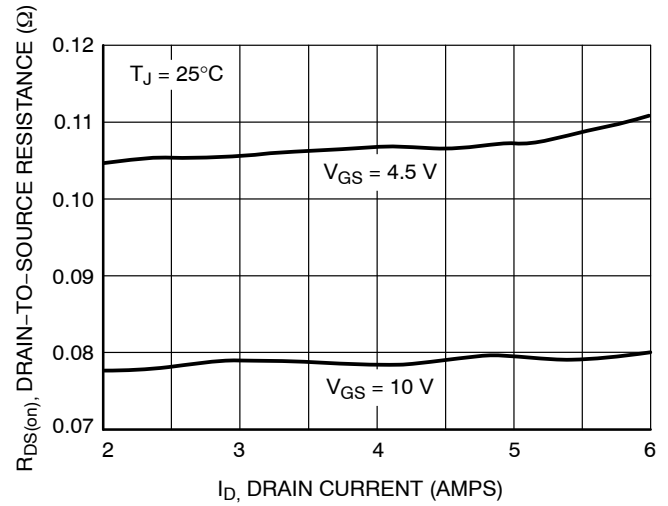


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

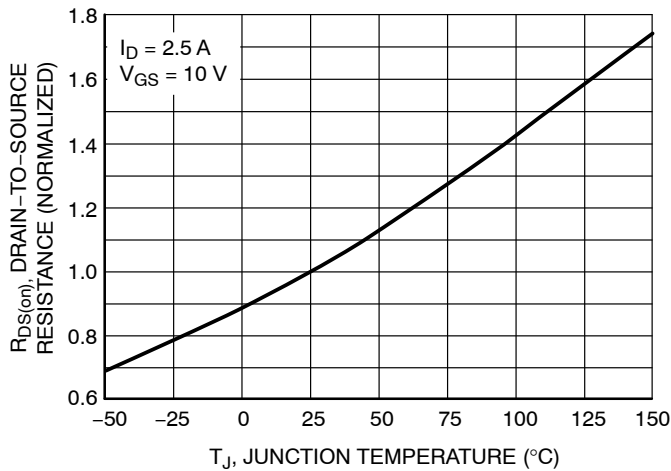


Figure 5. On-Resistance Variation with Temperature

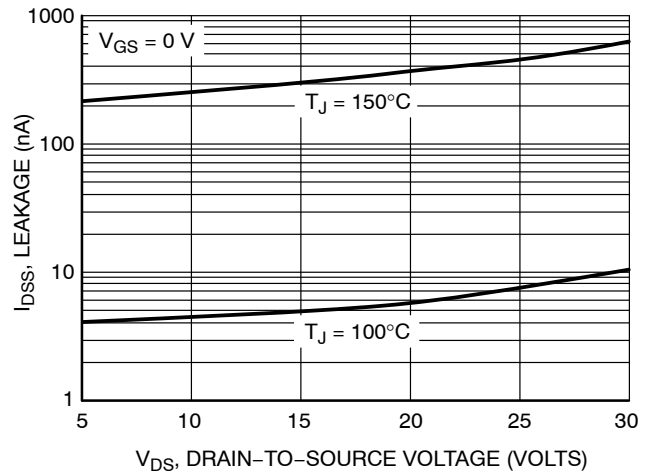


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

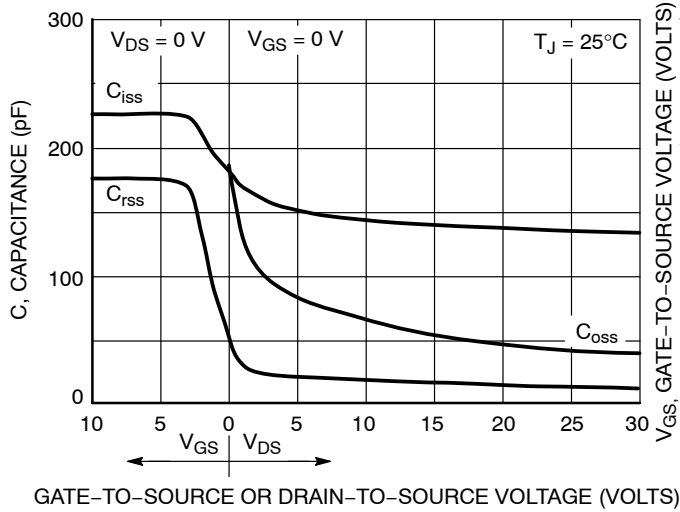


Figure 7. Capacitance Variation

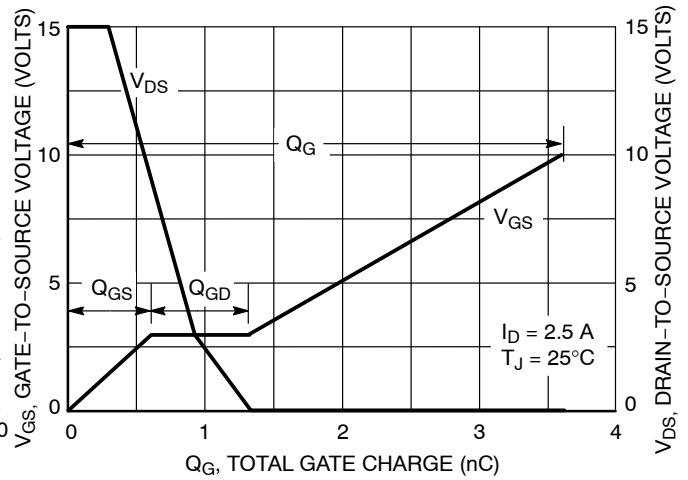


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

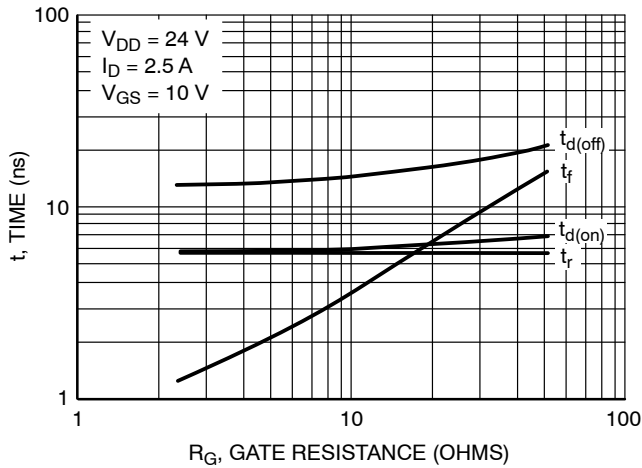


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

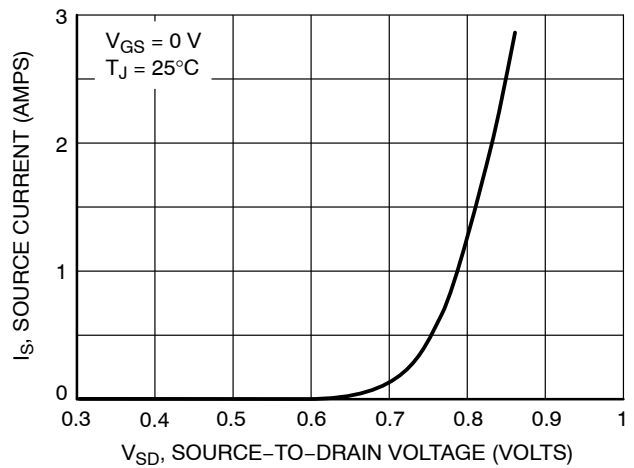


Figure 10. Diode Forward Voltage vs. Current



SCALE 4:1

**SOT-23 (TO-236) 2.90x1.30x1.00 1.90P**  
**CASE 318**  
**ISSUE AU**

DATE 14 AUG 2024



| MILLIMETERS |      |      |      |
|-------------|------|------|------|
| DIM         | MIN  | NOM  | MAX  |
| A           | 0.89 | 1.00 | 1.11 |
| A1          | 0.01 | 0.06 | 0.10 |
| b           | 0.37 | 0.44 | 0.50 |
| c           | 0.08 | 0.14 | 0.20 |
| D           | 2.80 | 2.90 | 3.04 |
| E           | 1.20 | 1.30 | 1.40 |
| e           | 1.78 | 1.90 | 2.04 |
| L           | 0.30 | 0.43 | 0.55 |
| L1          | 0.35 | 0.54 | 0.69 |
| HE          | 2.10 | 2.40 | 2.64 |
| T           | 0°   | ---  | 10°  |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSIONS: 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.

**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. Some products may not follow the Generic Marking.



**RECOMMENDED MOUNTING FOOTPRINT**

\* For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

**STYLES ON PAGE 2**

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