

# NTR1P02, NVR1P02

## MOSFET – Power, P-Channel, SOT-23 -20 V, -1 A

### Features

- Ultra Low On-Resistance Provides Higher Efficiency and Extends Battery Life  
 $R_{DS(on)} = 0.180 \Omega, V_{GS} = -10 \text{ V}$   
 $R_{DS(on)} = 0.280 \Omega, V_{GS} = -4.5 \text{ V}$
- Power Management in Portable and Battery-Powered Products
- Miniature SOT-23 Surface Mount Package Saves Board Space
- Mounting Information for SOT-23 Package Provided
- NVR 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 Converters
- Computers
- Printers
- PCMCIA Cards
- Cellular and Cordless Telephones

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

| Rating   | Symbol          | Value      | Unit               |
|--|-----------------|------------|--------------------|
| Drain-to-Source Voltage  | $V_{DSS}$       | -20        | V                  |
| Gate-to-Source Voltage – Continuous  | $V_{GS}$        | $\pm 20$   | V                  |
| Drain Current  | $I_D$           | -1.0       | A                  |
| – Continuous @ $T_A = 25^\circ\text{C}$                                    |                 |            |                    |
| – Pulsed Drain Current ( $t_p \leq 1 \mu\text{s}$ )                        | $I_{DM}$        | -2.67      |                    |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$                         | $P_D$           | 400        | mW                 |
| Operating and Storage Temperature Range                                    | $T_J, T_{stg}$  | -55 to 150 | $^\circ\text{C}$   |
| Thermal Resistance; Junction-to-Ambient                                    | $R_{\theta JA}$ | 300        | $^\circ\text{C/W}$ |
| Maximum Lead Temperature for Soldering Purposes, (1/8" from case for 10 s) | $T_L$           | 260        | $^\circ\text{C}$   |

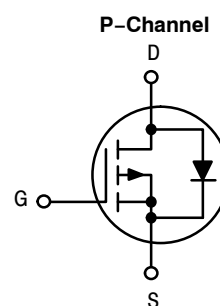
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



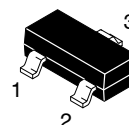
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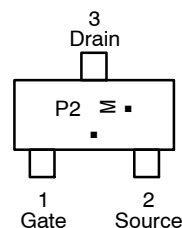
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP       | $I_D$ MAX |
|---------------|------------------------|-----------|
| -20 V         | 148 m $\Omega$ @ -10 V | -1.0 A    |



### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



P2 = Specific Device Code  
M = Date Code  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device     | Package          | Shipping†           |
|------------|------------------|---------------------|
| NTR1P02T1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel  |
| NTR1P02T3G | SOT-23 (Pb-Free) | 10000 / Tape & Reel |
| NVR1P02T1G | 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.

# NTR1P02, NVR1P02

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

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

### OFF CHARACTERISTICS

|  |               |     |    |             |                           |
|--|---------------|-----|----|-------------|---------------------------|
| Drain-to-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ V}$ , $I_D = -10\ \mu\text{A}$ )<br>(Positive Temperature Coefficient)  | $V_{(BR)DSS}$ | -20 | 32 |             | V<br>mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 25^\circ\text{C}$ )<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) | $I_{DSS}$     |     |    | -1.0<br>-10 | $\mu\text{A}$             |
| Gate-Body Leakage Current ( $V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$ )   | $I_{GSS}$     |     |    | $\pm 100$   | nA                        |

### ON CHARACTERISTICS (Note 1)

|  |              |      |                |                |                           |
|--|--------------|------|----------------|----------------|---------------------------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = -250\ \mu\text{A}$ )<br>(Negative Temperature Coefficient)  | $V_{GS(th)}$ | -1.1 | -1.9<br>-4.0   | -2.3           | V<br>mV/ $^\circ\text{C}$ |
| Static Drain-to-Source On-State Resistance<br>( $V_{GS} = -10\text{ V}$ , $I_D = -1.5\text{ A}$ )<br>( $V_{GS} = -4.5\text{ V}$ , $I_D = -0.75\text{ A}$ ) | $R_{DS(on)}$ |      | 0.148<br>0.235 | 0.180<br>0.280 | $\Omega$                  |

### DYNAMIC CHARACTERISTICS

|   |           |  |     |  |    |
|---|-----------|--|-----|--|----|
| Input Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )            | $C_{iss}$ |  | 165 |  | pF |
| Output Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )           | $C_{oss}$ |  | 110 |  |    |
| Reverse Transfer Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ ) | $C_{rss}$ |  | 35  |  |    |

### SWITCHING CHARACTERISTICS (Note 2)

|   |              |  |      |  |    |
|---|--------------|--|------|--|----|
| Turn-On Delay Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )  | $t_{d(on)}$  |  | 7.0  |  | ns |
| Rise Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )           | $t_r$        |  | 9.0  |  |    |
| Turn-Off Delay Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ ) | $t_{d(off)}$ |  | 9.0  |  |    |
| Fall Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\ \Omega$ )           | $t_f$        |  | 3.0  |  |    |
| Total Gate Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                       | $Q_{tot}$    |  | 2.5  |  | nC |
| Gate-Source Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                      | $Q_{gs}$     |  | 0.75 |  |    |
| Gate-Drain Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                       | $Q_{gd}$     |  | 1.0  |  |    |

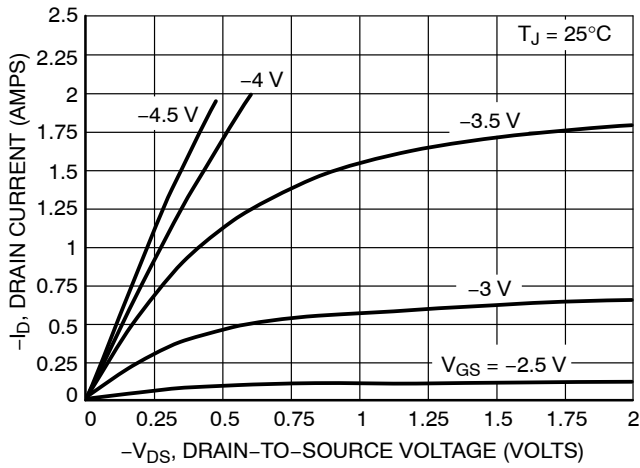
### BODY-DRAIN DIODE RATINGS (Note 1)

|   |          |  |              |      |               |
|---|----------|--|--------------|------|---------------|
| Diode Forward On-Voltage (Note 2)<br>( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ )<br>( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) | $V_{SD}$ |  | -0.8<br>-0.6 | -1.0 | V             |
| Reverse Recovery Time<br>( $I_S = -1\text{ A}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )   | $t_{rr}$ |  | 13.5         |      | ns            |
|   | $t_a$    |  | 10.5         |      |               |
|   | $t_b$    |  | 3.0          |      |               |
| Reverse Recovery Stored Charge<br>( $I_S = -1\text{ A}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )  | $Q_{RR}$ |  | 0.008        |      | $\mu\text{C}$ |

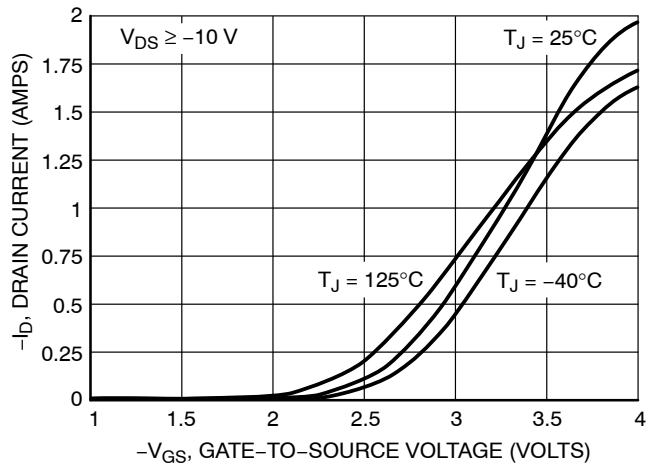
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

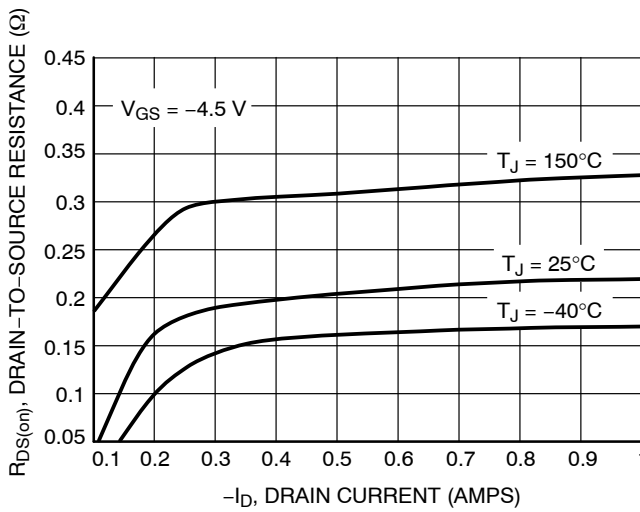
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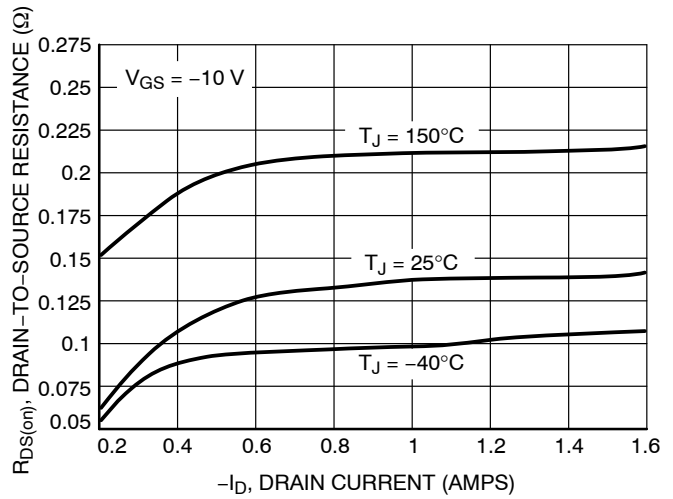
**Figure 1. On-Region Characteristics**



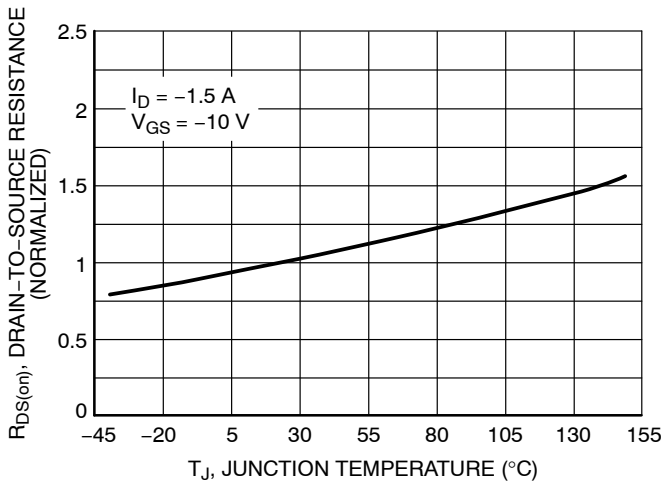
**Figure 2. Transfer Characteristics**



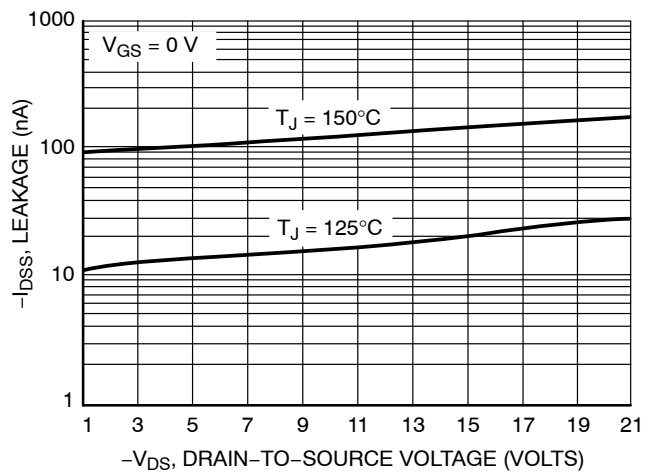
**Figure 3. On-Resistance versus Drain Current and Temperature**



**Figure 4. On-Resistance versus Drain Current and Temperature**

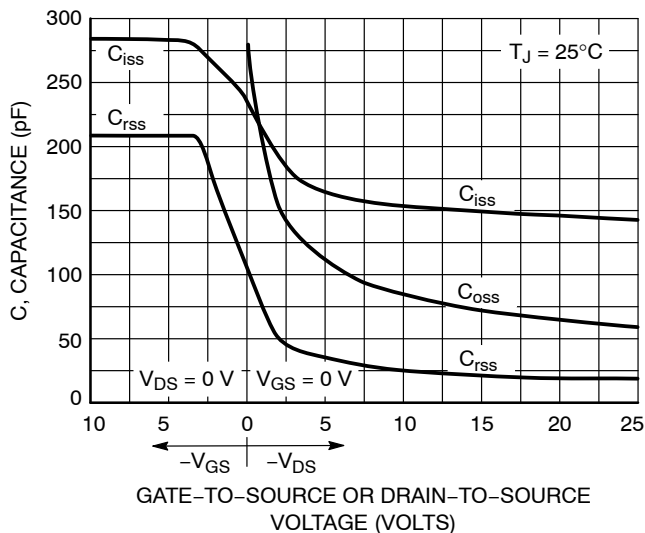


**Figure 5. On-Resistance Variation with Temperature**

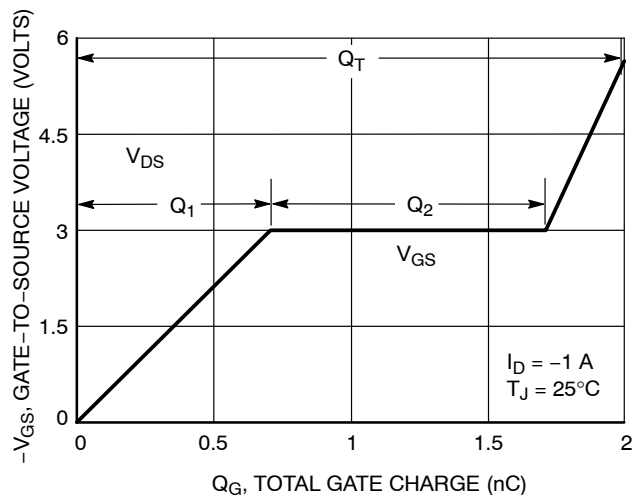


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

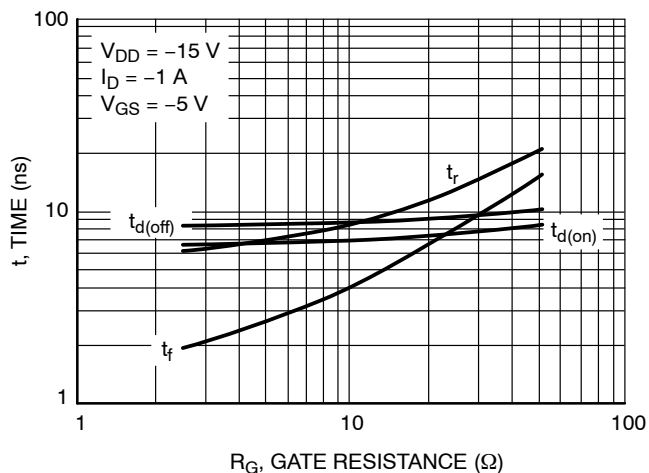
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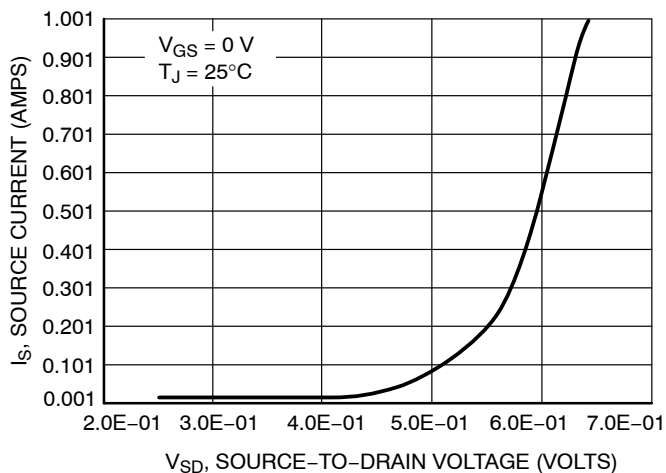
**Figure 7. Capacitance Variation**



**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**



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.



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

**STYLES ON PAGE 2**

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

DATE 14 AUG 2024

STYLE 1 THRU 5:  
CANCELLED

STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

|                         |   |   |
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