

# Complementary Bias Resistor Transistors

## R1 = 2.2 kΩ, R2 = ∞ kΩ

### NSBC123TPDP6

#### NPN and PNP Transistors with Monolithic Bias Resistor Network

This series of digital transistors is designed to replace a single device and its external resistor bias network. The Bias Resistor Transistor (BRT) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space.

#### Features

- S and NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

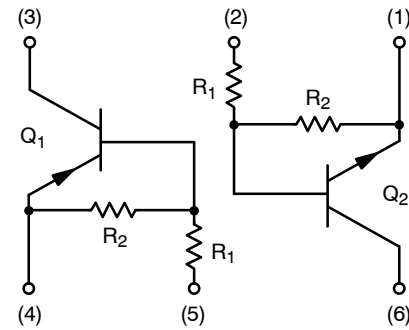
#### MAXIMUM RATINGS

(T<sub>A</sub> = 25°C both polarities Q1 (PNP) and Q2 (NPN), unless otherwise noted)

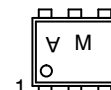
| Rating                         | Symbol               | Max | Unit |
|--------------------------------|----------------------|-----|------|
| Collector-Base Voltage         | V <sub>CBO</sub>     | 50  | Vdc  |
| Collector-Emitter Voltage      | V <sub>CEO</sub>     | 50  | Vdc  |
| Collector Current – Continuous | I <sub>C</sub>       | 100 | mAdc |
| Input Forward Voltage          | V <sub>IN(fwd)</sub> | 12  | Vdc  |
| Input Reverse Voltage          | V <sub>IN(rev)</sub> | 6   | Vdc  |
| –NPN                           |                      | 5   |      |
| –PNP                           |                      |     |      |

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.

#### PIN CONNECTIONS



#### MARKING DIAGRAMS



SOT-963  
CASE 527AD

A = Specific Device Code  
M = Date Code\*

\*Date Code orientation may vary depending upon manufacturing location.

#### ORDERING INFORMATION

| Device          | Package | Shipping <sup>†</sup> |
|-----------------|---------|-----------------------|
| NSBC123TPDP6T5G | SOT-963 | 3000 / Tape & Reel    |

<sup>†</sup>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](#).

# NSBC123TPDP6

## THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|----------------|--------|-----|------|
|----------------|--------|-----|------|

### NSBC123TPDP6 (SOT-963) One Junction Heated

|                                                                                                                  |                  |                          |             |
|------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|-------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 1)<br>(Note 2)<br>Derate above 25°C (Note 1)<br>(Note 2) | P <sub>D</sub>   | 231<br>269<br>1.9<br>2.2 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)                                                  | R <sub>θJA</sub> | 540<br>464               | °C/W        |

### NSBC123TPDP6 (SOT-963) Both Junction Heated (Note 3)

|                                                                                                                  |                                   |                          |             |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------|-------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 1)<br>(Note 2)<br>Derate above 25°C (Note 1)<br>(Note 2) | P <sub>D</sub>                    | 339<br>408<br>2.7<br>3.3 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)                                                  | R <sub>θJA</sub>                  | 369<br>306               | °C/W        |
| Junction and Storage Temperature Range                                                                           | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

1. FR-4 @ 100 mm<sup>2</sup>, 1 oz. copper traces, still air.
2. FR-4 @ 500 mm<sup>2</sup>, 1 oz. copper traces, still air.
3. Both junction heated values assume total power is sum of two equally powered channels.

# NSBC123TPDP6

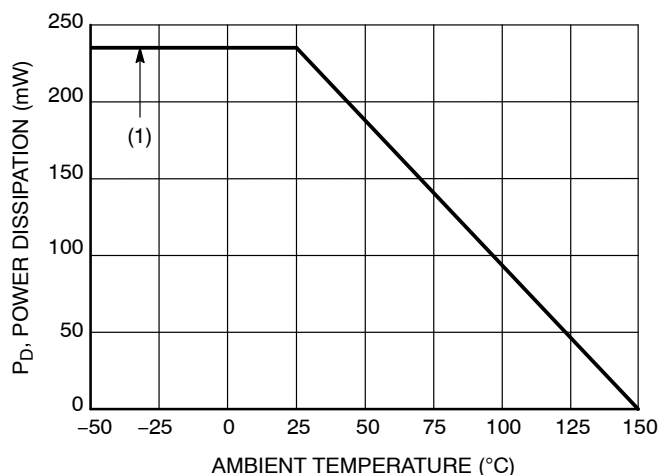
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  both polarities  $Q_1$  (PNP) and  $Q_2$  (NPN), unless otherwise noted)

| Characteristic                                                                        | Symbol        | Min | Typ | Max | Unit |
|---------------------------------------------------------------------------------------|---------------|-----|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>                                                            |               |     |     |     |      |
| Collector–Base Cutoff Current<br>( $V_{CB} = 50\text{ V}$ , $I_E = 0$ )               | $I_{CBO}$     | –   | –   | 100 | nAdc |
| Collector–Emitter Cutoff Current<br>( $V_{CE} = 50\text{ V}$ , $I_B = 0$ )            | $I_{CEO}$     | –   | –   | 500 | nAdc |
| Emitter–Base Cutoff Current<br>( $V_{EB} = 6.0\text{ V}$ , $I_C = 0$ )                | $I_{EBO}$     | –   | –   | 4.0 | mAdc |
| Collector–Base Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )     | $V_{(BR)CBO}$ | 50  | –   | –   | Vdc  |
| Collector–Emitter Breakdown Voltage (Note 4)<br>( $I_C = 2.0\text{ mA}$ , $I_B = 0$ ) | $V_{(BR)CEO}$ | 50  | –   | –   | Vdc  |

## ON CHARACTERISTICS

|                                                                                                                                                                 |               |     |            |      |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|------------|------|------------------|
| DC Current Gain (Note 4)<br>( $I_C = 5.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ )                                                                                  | $h_{FE}$      | 160 | 350        | –    |                  |
| Collector–Emitter Saturation Voltage (Note 4)<br>( $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ )                                                               | $V_{CE(sat)}$ | –   | –          | 0.25 | Vdc              |
| Input Voltage (off)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 100\text{ }\mu\text{A}$ ) (NPN)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 100\text{ }\mu\text{A}$ ) (PNP) | $V_{i(off)}$  | –   | 0.6<br>0.6 | –    | Vdc              |
| Input Voltage (on)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 10\text{ mA}$ ) (NPN)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 10\text{ mA}$ ) (PNP)                      | $V_{i(on)}$   | –   | 0.9<br>0.9 | –    | Vdc              |
| Output Voltage (on)<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 2.5\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ )                                                          | $V_{OL}$      | –   | –          | 0.2  | Vdc              |
| Output Voltage (off)<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 0.25\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ )                                                        | $V_{OH}$      | 4.9 | –          | –    | Vdc              |
| Input Resistor                                                                                                                                                  | $R_1$         | 1.5 | 2.2        | 2.9  | $\text{k}\Omega$ |
| Resistor Ratio                                                                                                                                                  | $R_1/R_2$     | –   | –          | –    |                  |

4. Pulsed Condition: Pulse Width = 300 msec, Duty Cycle  $\leq 2\%$ .



(1) SOT–963; 100 mm<sup>2</sup>, 1 oz. copper trace

**Figure 1. Derating Curve**

TYPICAL CHARACTERISTICS – NPN TRANSISTOR  
NSBC123TPDP6

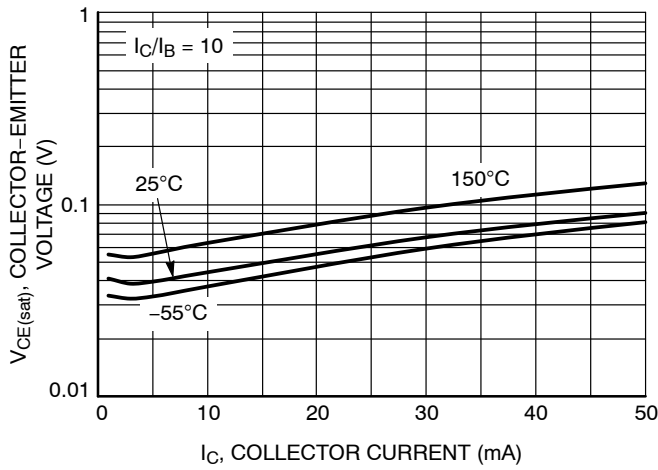


Figure 2.  $V_{CE(sat)}$  vs.  $I_C$

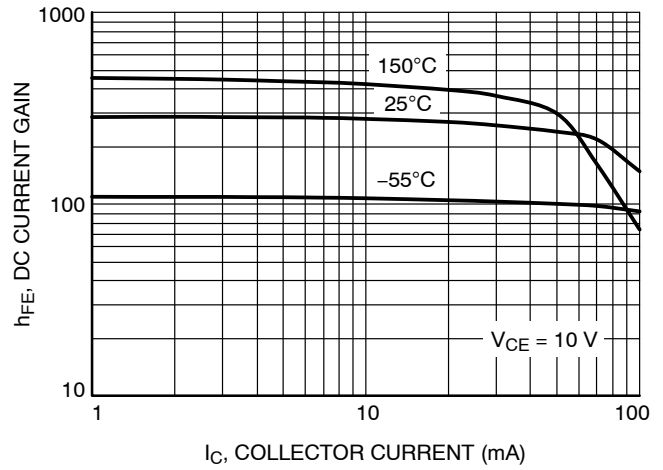


Figure 3. DC Current Gain

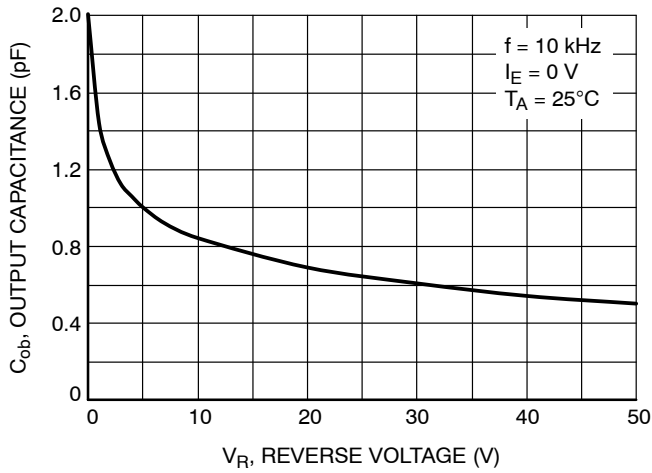


Figure 4. Output Capacitance

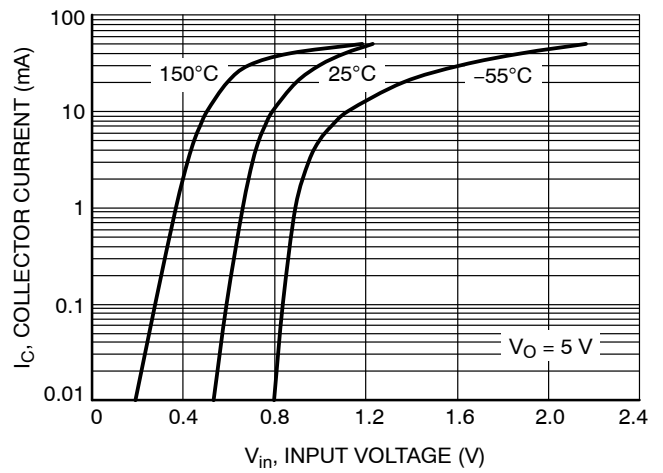


Figure 5. Output Current vs. Input Voltage

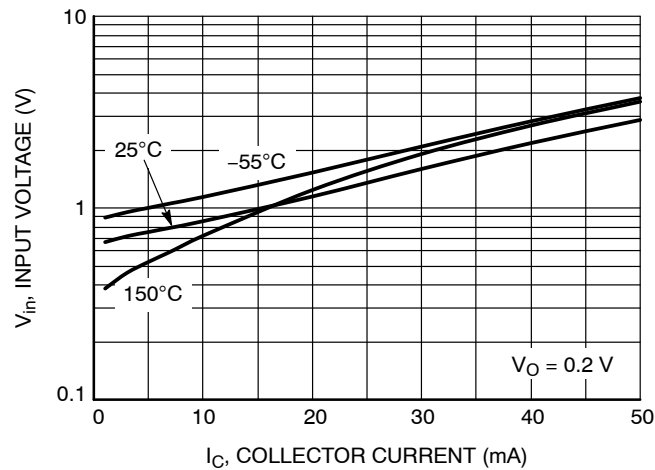


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – PNP TRANSISTOR  
NSBC123TPDP6

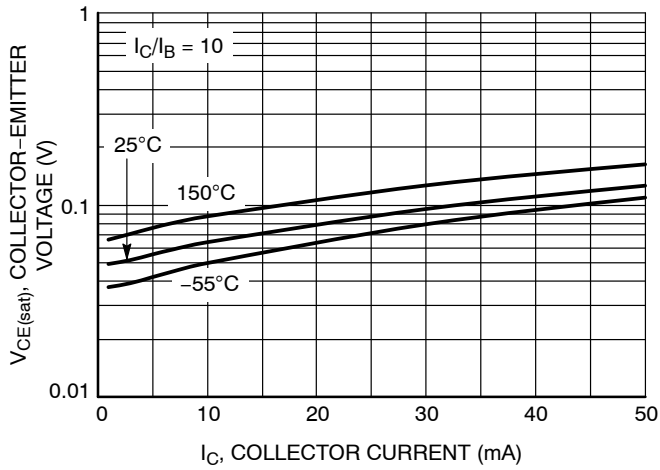


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

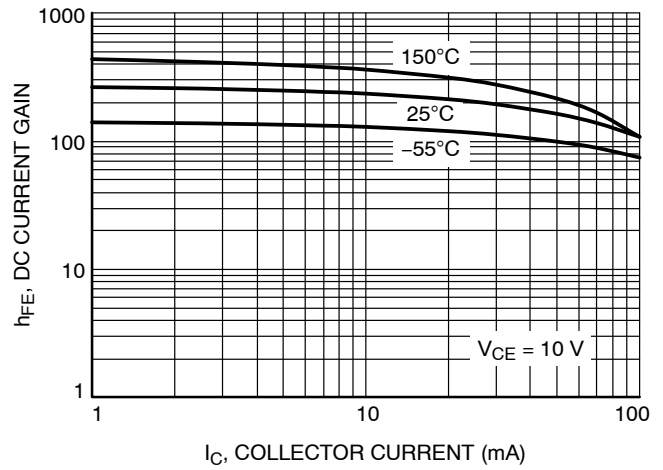


Figure 8. DC Current Gain

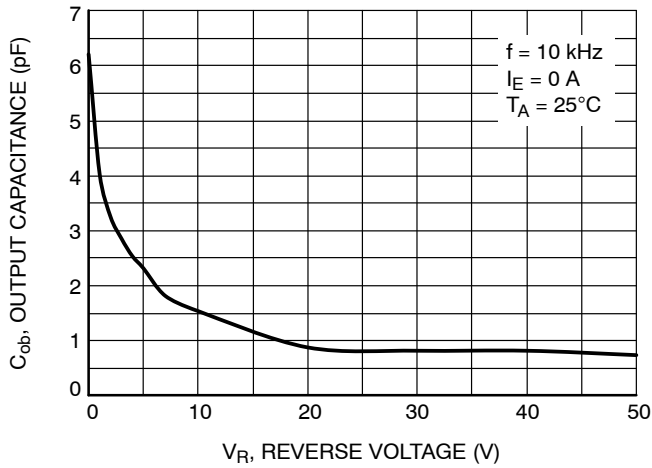


Figure 9. Output Capacitance

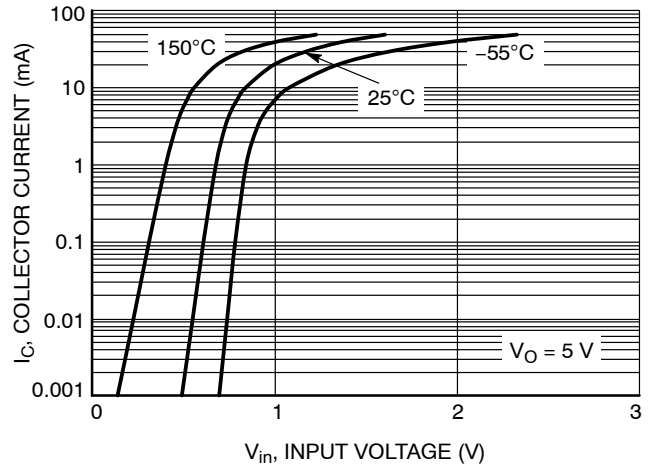


Figure 10. Output Current vs. Input Voltage

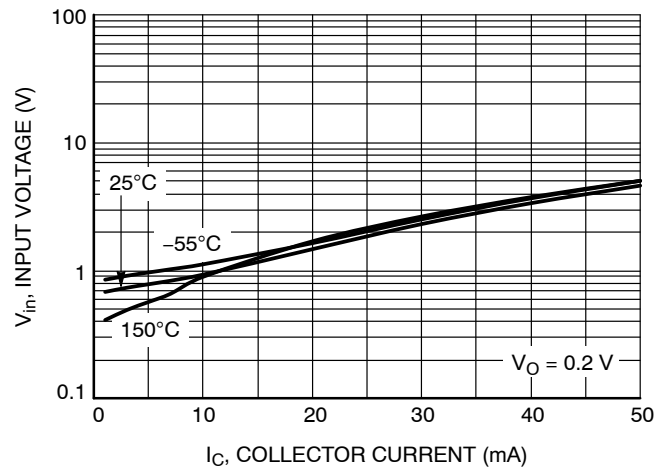
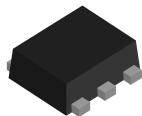


Figure 11. Input Voltage vs. Output Current

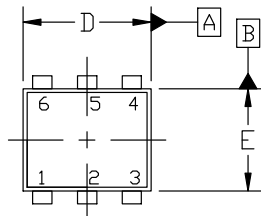


**SOT-963 1.00x1.00x0.37, 0.35P**  
**CASE 527AD**  
**ISSUE F**

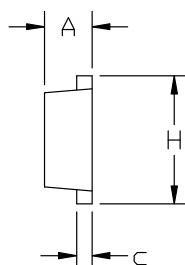
DATE 20 FEB 2024

NOTES:

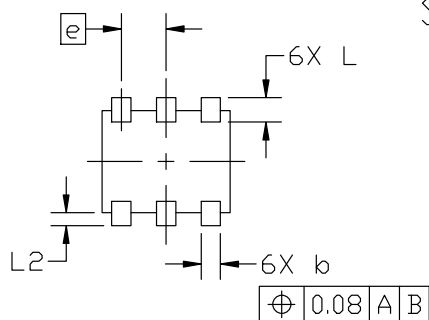
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.



TOP VIEW

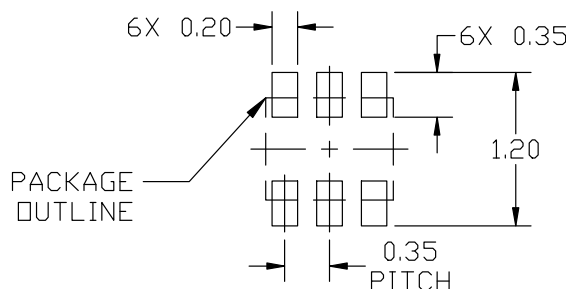


SIDE VIEW



BOTTOM VIEW

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.34        | 0.37 | 0.40 |
| b   | 0.10        | 0.15 | 0.20 |
| c   | 0.07        | 0.12 | 0.17 |
| D   | 0.95        | 1.00 | 1.05 |
| E   | 0.75        | 0.80 | 0.85 |
| e   | 0.35 BSC    |      |      |
| H   | 0.95        | 1.00 | 1.05 |
| L   | 0.19 REF    |      |      |
| L2  | 0.05        | 0.10 | 0.15 |



RECOMMENDED MOUNTING  
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.

STYLE 1:

- PIN 1. EMITTER 1  
2. BASE 1  
3. COLLECTOR 2  
4. EMITTER 2  
5. BASE 2  
6. COLLECTOR 1

STYLE 2:

- PIN 1. EMITTER 1  
2. EMITTER 2  
3. BASE 2  
4. COLLECTOR 2  
5. BASE 1  
6. COLLECTOR 1

STYLE 3:

- PIN 1. CATHODE 1  
2. CATHODE 1  
3. ANODE/ANODE 2  
4. CATHODE 2  
5. CATHODE 2  
6. ANODE/ANODE 1

STYLE 4:

- PIN 1. COLLECTOR  
2. COLLECTOR  
3. BASE  
4. EMITTER  
5. COLLECTOR  
6. COLLECTOR

STYLE 5:

- PIN 1. CATHODE  
2. CATHODE  
3. ANODE  
4. ANODE  
5. CATHODE  
6. CATHODE

STYLE 6:

- PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE

STYLE 7:

- PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. ANODE  
6. CATHODE

STYLE 8:

- PIN 1. DRAIN  
2. DRAIN  
3. GATE  
4. SOURCE  
5. DRAIN  
6. DRAIN

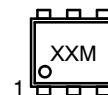
STYLE 9:

- PIN 1. SOURCE 1  
2. GATE 1  
3. DRAIN 2  
4. SOURCE 2  
5. GATE 2  
6. DRAIN 1

STYLE 10:

- PIN 1. CATHODE 1  
2. N/C  
3. CATHODE 2  
4. ANODE 2  
5. N/C  
6. ANODE 1

**GENERIC  
MARKING DIAGRAM\***



XX = Specific Device Code  
M = Month Code

\*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.

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