

# NPN Transistor with Zener Diode

## NSM6056MT1G

### Features

- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Driving Circuit
- Switching Applications

### MAXIMUM RATINGS – NPN TRANSISTOR

| Rating                         | Symbol    | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector – Emitter Voltage    | $V_{CEO}$ | 40    | V    |
| Collector – Base Voltage       | $V_{CBO}$ | 60    | V    |
| Emitter – Base Voltage         | $V_{EBO}$ | 6.0   | V    |
| Collector Current – Continuous | $I_C$     | 600   | mA   |
| Collector Current – Peak       | $I_{CM}$  | 900   | mA   |

### MAXIMUM RATINGS – ZENER DIODE

| Rating                                  | Symbol | Value | Unit |
|-----------------------------------------|--------|-------|------|
| Forward Voltage @ $I_F = 10 \text{ mA}$ | $V_F$  | 0.9   | V    |

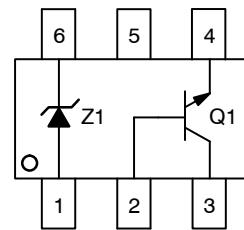
### THERMAL CHARACTERISTICS

| Rating                                                                   | Symbol          | Max         | Unit               |
|--------------------------------------------------------------------------|-----------------|-------------|--------------------|
| Total Device Dissipation FR-5 Board, (Note 1) @ $T_A = 25^\circ\text{C}$ | $P_D$           | 380         | mW                 |
| Thermal Resistance from Junction-to-Ambient                              | $R_{\theta JA}$ | 328         | $^\circ\text{C/W}$ |
| Junction and Storage Temperature Range                                   | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$   |

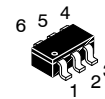
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. FR-4 Minimum Pad.

## NPN Transistor with Zener Diode

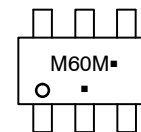


PINOUT:  
 PIN 1. ANODE  
 2. BASE  
 3. COLLECTOR  
 4. EMITTER  
 5. NC/COLLECTOR  
 6. CATHODE



SC-74  
 CASE 318F

### MARKING DIAGRAM



M60 = Device Code  
 M = Date Code\*  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

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

### ORDERING INFORMATION

| Device      | Package         | Shipping†        |
|-------------|-----------------|------------------|
| NSM6056MT1G | SC-74 (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.

# NSM6056MT1G

## NPN TRANSISTOR – ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                    | Symbol               | Min | Max | Unit |
|---------------------------------------------------------------------------------------------------|----------------------|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>                                                                        |                      |     |     |      |
| Collector – Emitter Breakdown Voltage (Note 3)<br>(I <sub>C</sub> = 1.0 mAdc, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –   | Vdc  |
| Collector – Base Breakdown Voltage<br>(I <sub>C</sub> = 0.1 mAdc, I <sub>E</sub> = 0)             | V <sub>(BR)CBO</sub> | 60  | –   | Vdc  |
| Emitter – Base Breakdown Voltage<br>(I <sub>E</sub> = 0.1 mAdc, I <sub>C</sub> = 0)               | V <sub>(BR)EBO</sub> | 6.0 | –   | Vdc  |
| Base Cutoff Current<br>(V <sub>CE</sub> = 35 Vdc, V <sub>EB</sub> = 0.4 Vdc)                      | I <sub>BEV</sub>     | –   | 0.1 | μAdc |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 35 Vdc, V <sub>EB</sub> = 0.4 Vdc)                 | I <sub>CEX</sub>     | –   | 0.1 | μAdc |

## ON CHARACTERISTICS (Note 3)

|                                                                                                                                                                                                                                                                                                                  |                      |                             |                         |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|-------------------------|-----|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 2.0 Vdc) | h <sub>FE</sub>      | 20<br>40<br>80<br>100<br>40 | –<br>–<br>–<br>300<br>– | –   |
| Collector – Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                         | V <sub>CE(sat)</sub> | –<br>–                      | 0.4<br>0.75             | Vdc |
| Base – Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                              | V <sub>BE(sat)</sub> | 0.75<br>–                   | 0.95<br>1.2             | Vdc |

## SMALL – SIGNAL CHARACTERISTICS

|                                                                                                         |                 |     |     |                    |
|---------------------------------------------------------------------------------------------------------|-----------------|-----|-----|--------------------|
| Current – Gain – Bandwidth Product<br>(I <sub>C</sub> = 20 mAdc, V <sub>CE</sub> = 10 Vdc, f = 100 MHz) | f <sub>T</sub>  | 250 | –   | MHz                |
| Collector – Base Capacitance<br>(V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)            | C <sub>cb</sub> | –   | 6.5 | pF                 |
| Emitter – Base Capacitance<br>(V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)              | C <sub>eb</sub> | –   | 30  | pF                 |
| Input Impedance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                   | h <sub>ie</sub> | 1.0 | 15  | kΩ                 |
| Voltage Feedback Ratio<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)            | h <sub>re</sub> | 0.1 | 8.0 | X 10 <sup>-4</sup> |
| Small – Signal Current Gain<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)       | h <sub>fe</sub> | 40  | 500 | –                  |
| Output Admittance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                 | h <sub>oe</sub> | 1.0 | 30  | μmhos              |

## SWITCHING CHARACTERISTICS

|              |                                                                                                                |                |   |     |    |
|--------------|----------------------------------------------------------------------------------------------------------------|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 Vdc, V <sub>EB</sub> = 2.0 Vdc,<br>I <sub>C</sub> = 150 mAdc, I <sub>B1</sub> = 15 mAdc) | t <sub>d</sub> | – | 15  | ns |
| Rise Time    |                                                                                                                | t <sub>r</sub> | – | 20  |    |
| Storage Time | (V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 150 mAdc,<br>I <sub>B1</sub> = I <sub>B2</sub> = 15 mAdc)          | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |                                                                                                                | t <sub>f</sub> | – | 30  |    |

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

## ZENER DIODE – ELECTRICAL CHARACTERISTICS (V<sub>F</sub> = 0.9 Max @ I<sub>F</sub> = 10 mA for all types)

| Device      | Test<br>Current<br>I <sub>zt</sub> mA | Zener Voltage V <sub>Z</sub> |      | Z <sub>ZK</sub> I <sub>Z</sub><br>= 0.5<br>mA Ω<br>Max | Z <sub>ZT</sub><br>I <sub>Z</sub> = I <sub>ZT</sub><br>@ 10%<br>Mod Ω<br>Max | Max<br>IR @ V <sub>R</sub> |     | dV <sub>Z</sub> /dt (mV/k)<br>@ I <sub>ZT1</sub> = 5 mA |     | C pF Max @<br>V <sub>R</sub> = 0<br>f = 1 MHz |
|-------------|---------------------------------------|------------------------------|------|--------------------------------------------------------|------------------------------------------------------------------------------|----------------------------|-----|---------------------------------------------------------|-----|-----------------------------------------------|
|             |                                       | Min                          | Max  |                                                        |                                                                              | μA                         | V   | Min                                                     | Max |                                               |
| NSM6056MT1G | 5.0                                   | 5.49                         | 5.73 | 200                                                    | 40                                                                           | 1.0                        | 2.0 | –2.0                                                    | 2.5 | 200                                           |

# NSM6056MT1G

## TYPICAL ELECTRICAL CHARACTERISTICS – NPN TRANSISTOR

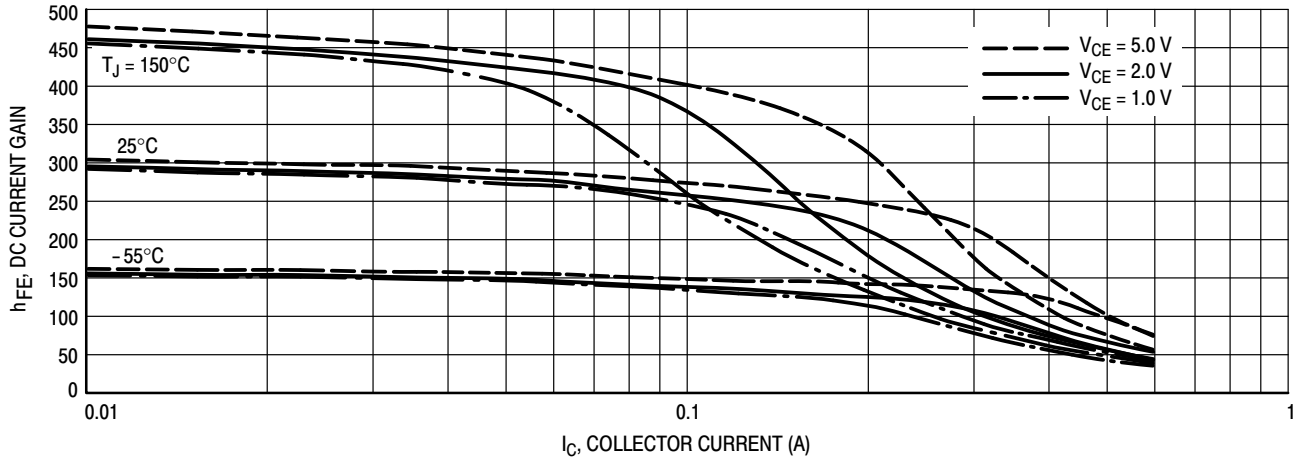


Figure 1. DC Current Gain

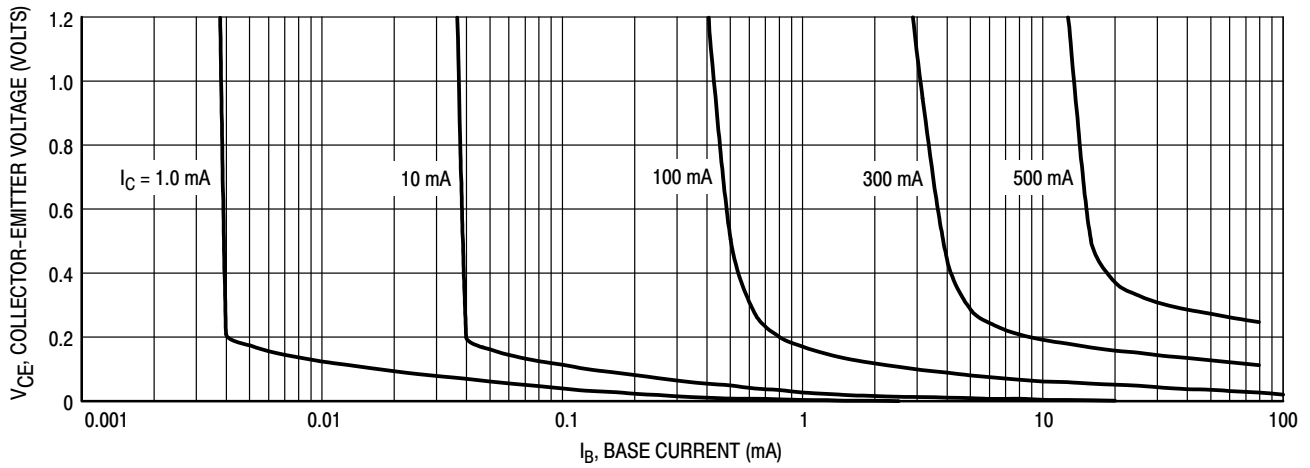


Figure 2. Collector Saturation Region

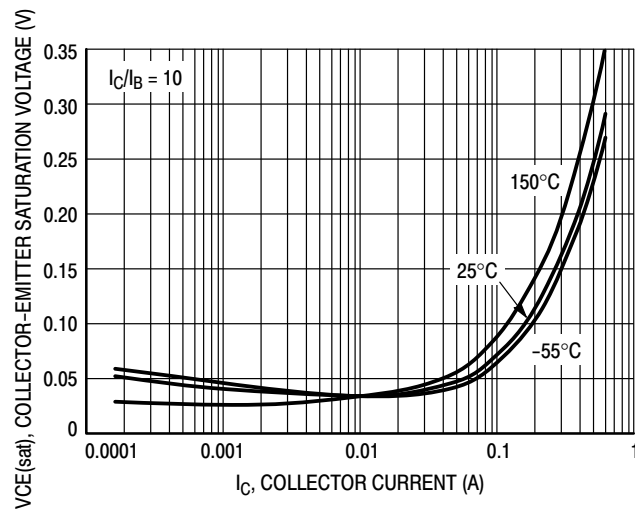


Figure 3. Collector-Emmitter Saturation Voltage vs. Collector Current

TYPICAL ELECTRICAL CHARACTERISTICS – NPN TRANSISTOR

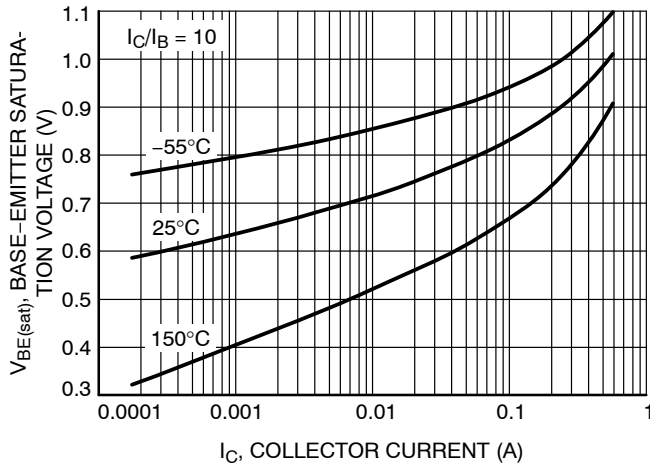


Figure 4. Base-Emitter Saturation Voltage vs. Collector Current

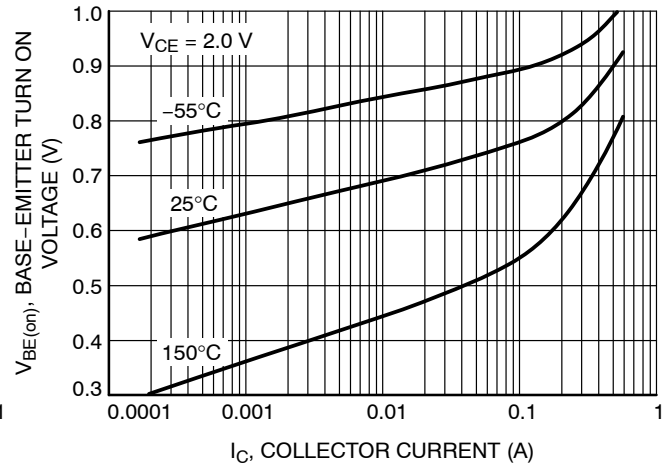


Figure 5. Base-Emitter Turn On Voltage vs. Collector Current

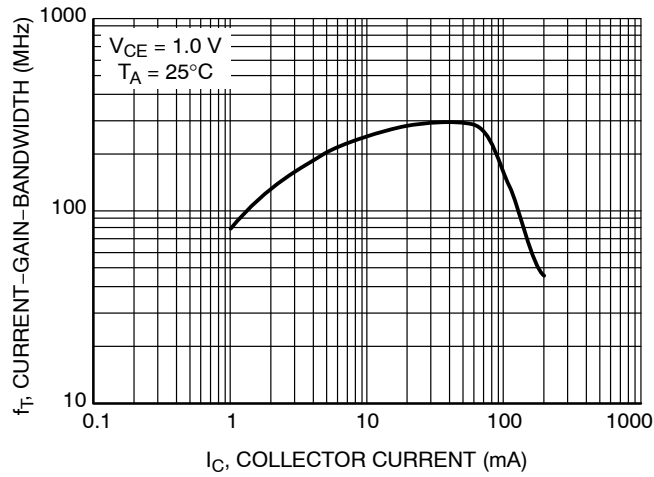


Figure 6. Current-Gain-Bandwidth Product

TYPICAL ELECTRICAL CHARACTERISTICS – ZENER DIODE

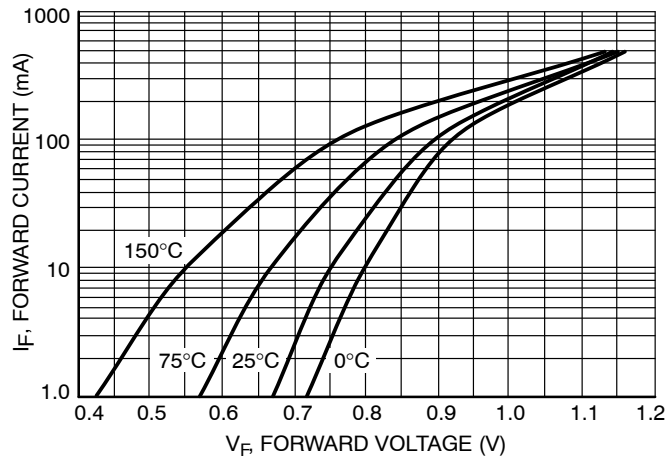


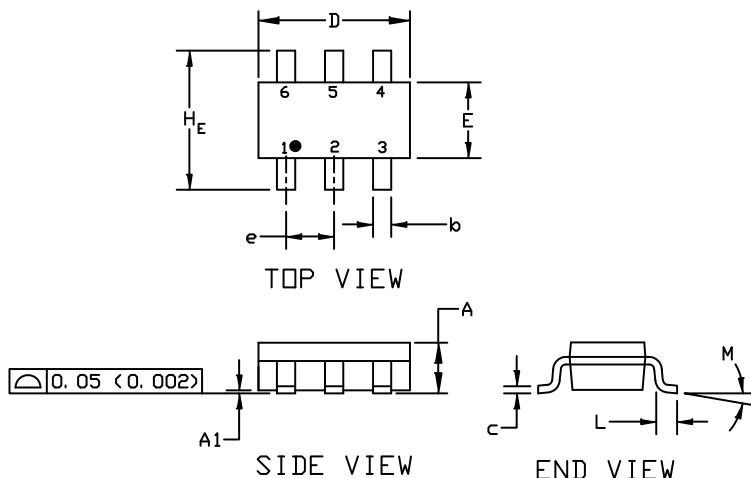
Figure 7. Typical Forward Voltage



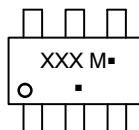
SCALE 2:1

SC-74  
CASE 318F  
ISSUE P

DATE 07 OCT 2021



GENERIC  
MARKING DIAGRAM\*



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

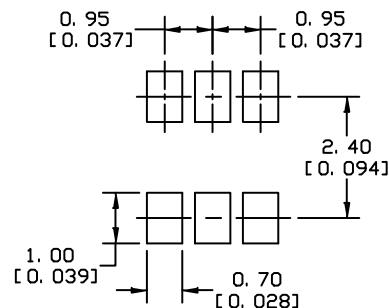
(Note: Microdot may be in either location)

\*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.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCHES
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.

| DIM            | MILLIMETERS |      |      | INCHES |       |       |
|----------------|-------------|------|------|--------|-------|-------|
|                | MIN.        | NOM. | MAX. | MIN.   | NOM.  | MAX.  |
| A              | 0.90        | 1.00 | 1.10 | 0.035  | 0.039 | 0.043 |
| A1             | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b              | 0.25        | 0.37 | 0.50 | 0.010  | 0.015 | 0.020 |
| c              | 0.10        | 0.18 | 0.26 | 0.004  | 0.007 | 0.010 |
| D              | 2.90        | 3.00 | 3.10 | 0.114  | 0.118 | 0.122 |
| E              | 1.30        | 1.50 | 1.70 | 0.051  | 0.059 | 0.067 |
| e              | 0.85        | 0.95 | 1.05 | 0.034  | 0.037 | 0.041 |
| H <sub>E</sub> | 2.50        | 2.75 | 3.00 | 0.099  | 0.108 | 0.118 |
| L              | 0.20        | 0.40 | 0.60 | 0.008  | 0.016 | 0.024 |
| M              | 0*          | ---  | 10*  | 0*     | ---   | 10*   |



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

SOLDERING FOOTPRINT

|                                                                                                         |                                                                                                                      |                                                                                                                   |                                                                                                                                                |                                                                                                               |                                                                                                       |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. CATHODE<br>5. ANODE<br>6. CATHODE     | <b>STYLE 2:</b><br>PIN 1. NO CONNECTION<br>2. COLLECTOR<br>3. EMITTER<br>4. NO CONNECTION<br>5. COLLECTOR<br>6. BASE | <b>STYLE 3:</b><br>PIN 1. EMITTER 1<br>2. BASE 1<br>3. COLLECTOR 2<br>4. EMITTER 2<br>5. BASE 2<br>6. COLLECTOR 1 | <b>STYLE 4:</b><br>PIN 1. COLLECTOR 2<br>2. EMITTER 1/EMITTER 2<br>3. COLLECTOR 1<br>4. EMITTER 3<br>5. BASE 1/BASE 2/COLLECTOR 3<br>6. BASE 3 | <b>STYLE 5:</b><br>PIN 1. CHANNEL 1<br>2. ANODE<br>3. CHANNEL 2<br>4. CHANNEL 3<br>5. CATHODE<br>6. CHANNEL 4 | <b>STYLE 6:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. CATHODE<br>5. CATHODE<br>6. CATHODE |
| <b>STYLE 7:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. DRAIN 2<br>4. SOURCE 2<br>5. GATE 2<br>6. DRAIN 1 | <b>STYLE 8:</b><br>PIN 1. EMITTER 1<br>2. BASE 2<br>3. COLLECTOR 2<br>4. EMITTER 2<br>5. BASE 1<br>6. COLLECTOR 1    | <b>STYLE 9:</b><br>PIN 1. EMITTER 2<br>2. BASE 2<br>3. COLLECTOR 1<br>4. EMITTER 1<br>5. BASE 1<br>6. COLLECTOR 2 | <b>STYLE 10:</b><br>PIN 1. ANODE/CATHODE<br>2. BASE<br>3. EMITTER<br>4. COLLECTOR<br>5. ANODE<br>6. CATHODE                                    | <b>STYLE 11:</b><br>PIN 1. EMITTER<br>2. BASE<br>3. ANODE/CATHODE<br>4. ANODE<br>5. CATHODE<br>6. COLLECTOR   |                                                                                                       |

|                         |                    |                                                                                                                                                                                     |
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