

# SMF05CT1G, SMF12CT1G, SMF15CT1G, SMF24CT1G, SZSMF12CT1G

## ESD Protection Diode Array, 5-Line

This 5-line surge protection array is designed for application requiring transient voltage protection capability. It is intended for use in over-transient voltage and ESD sensitive equipment such as computers, printers, automotive electronics, networking communication and other applications. This device features a monolithic common anode design which protects five independent lines in a single SC-88 package.

### Features

- Protects up to 5-Line in a Single SC-88 Package
- Peak Power Dissipation – 100 W (8 x 20  $\mu$ s Waveform)
- ESD Rating of Class 3B (Exceeding 8 kV) per Human Body Model and Class C (Exceeding 400 V) per Machine Model.
- Compliance with IEC 61000-4-2 (ESD) 15 kV (Air), 8 kV (Contact)
- Flammability Rating of UL 94 V-0
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- Pb-Free Packages are Available\*

### Applications

- Hand-Held Portable Applications
- Networking and Telecom
- Automotive Electronics
- Serial and Parallel Ports
- Notebooks, Desktops, Servers

### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise specified)

| Symbol            | Rating   | Value      | Unit |
|-------------------|--|------------|------|
| P <sub>PK 1</sub> | Peak Power Dissipation<br>8 x 20 $\mu$ s Double Exponential Waveform<br>(Note 1) | 100        | W    |
| T <sub>J</sub>    | Operating Junction Temperature Range   | -40 to 125 | °C   |
| T <sub>STG</sub>  | Storage Temperature Range  | -55 to 150 | °C   |
| T <sub>L</sub>    | Lead Solder Temperature (10 s)   | 260        | °C   |
| ESD               | Human Body Model (HBM)   | 16000      | V    |
|                   | Machine Model (MM)   | 400        |      |
|                   | IEC 61000-4-2 Air (ESD)  | 15000      |      |
|                   | IEC 61000-4-2 Contact (ESD)  | 15000      |      |

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. Nonrepetitive current pulse per Figure 3.

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



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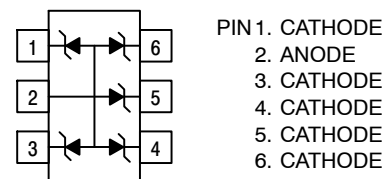
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**SC-88 FIVE SURGE  
PROTECTION  
100 W PEAK POWER**

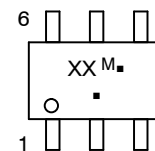


SC-88  
CASE 419B  
STYLE 24

### PIN ASSIGNMENT



### MARKING DIAGRAM



XX = Specific Device Code  
6J = SMF05C  
6K = SZSMF12C/SMF12C  
6L = SMF15C  
6M = SMF24C  
M = Date Code  
■ = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

# SMF05CT1G, SMF12CT1G, SMF15CT1G, SMF24CT1G, SZSMF12CT1G

## SMF05CT1G ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

| Parameter                  | Symbol           | Conditions                                    | Min | Typ  | Max  | Unit |
|----------------------------|------------------|---|-----|------|------|------|
| Reverse Working Voltage    | V <sub>RWM</sub> | (Note 2)                                      |     |      | 5.0  | V    |
| Breakdown Voltage          | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA, (Note 3)               | 6.2 |      | 7.2  | V    |
| Reverse Leakage Current    | I <sub>R</sub>   | V <sub>RWM</sub> = 5 V                        |     | 0.07 | 5.0  | μA   |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 5 A (8 x 20 μs Waveform)    |     |      | 9.8  | V    |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 8 A (8 x 20 μs Waveform)    |     |      | 12.5 | V    |
| Maximum Peak Pulse Current | I <sub>PP</sub>  | 8 x 20 μs Waveform                            |     |      | 8.0  | A    |
| Capacitance                | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz (Line to GND) |     | 80   | 130  | pF   |

## SMF12CT1G ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

| Parameter                  | Symbol           | Conditions                                    | Min  | Typ  | Max | Unit |
|----------------------------|------------------|---|------|------|-----|------|
| Reverse Working Voltage    | V <sub>RWM</sub> | (Note 2)                                      |      |      | 12  | V    |
| Breakdown Voltage          | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA, (Note 3)               | 13.3 |      | 15  | V    |
| Reverse Leakage Current    | I <sub>R</sub>   | V <sub>RWM</sub> = 12 V                       |      | 0.01 | 0.1 | μA   |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 3 A (8 x 20 μs Waveform)    |      |      | 21  | V    |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 6 A (8 x 20 μs Waveform)    |      |      | 23  | V    |
| Maximum Peak Pulse Current | I <sub>PP</sub>  | 8 x 20 μs Waveform                            |      |      | 6.0 | A    |
| Capacitance                | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz (Line to GND) |      | 40   | 60  | pF   |

## SMF15CT1G ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C, unless otherwise specified)

| Parameter                  | Symbol           | Conditions                                    | Min | Typ  | Max | Unit |
|----------------------------|------------------|---|-----|------|-----|------|
| Reverse Working Voltage    | V <sub>RWM</sub> | (Note 2)                                      |     |      | 15  | V    |
| Breakdown Voltage          | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA, (Note 3)               | 17  |      | 19  | V    |
| Reverse Leakage Current    | I <sub>R</sub>   | V <sub>RWM</sub> = 15 V                       |     | 0.01 | 1.0 | μA   |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 1 A (8 x 20 μs Waveform)    |     |      | 23  | V    |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 5 A (8 x 20 μs Waveform)    |     |      | 29  | V    |
| Maximum Peak Pulse Current | I <sub>PP</sub>  | 8 x 20 μs Waveform                            |     |      | 5.0 | A    |
| Capacitance                | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz (Line to GND) |     | 33   | 45  | pF   |

## SMF24CT1G ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C, unless otherwise specified)

| Parameter                  | Symbol           | Conditions                                    | Min  | Typ  | Max | Unit |
|----------------------------|------------------|---|------|------|-----|------|
| Reverse Working Voltage    | V <sub>RWM</sub> | (Note 2)                                      |      |      | 24  | V    |
| Breakdown Voltage          | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA, (Note 3)               | 26.7 |      | 32  | V    |
| Reverse Leakage Current    | I <sub>R</sub>   | V <sub>RWM</sub> = 24 V                       |      | 0.01 | 1.0 | μA   |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 1 A (8 x 20 μs Waveform)    |      |      | 40  | V    |
| Clamping Voltage           | V <sub>C</sub>   | I <sub>PP</sub> = 2.5 A (8 x 20 μs Waveform)  |      |      | 44  | V    |
| Maximum Peak Pulse Current | I <sub>PP</sub>  | 8 x 20 μs Waveform                            |      |      | 2.5 | A    |
| Capacitance                | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz (Line to GND) |      | 21   | 25  | pF   |

- Surge protection devices are normally selected according to the working peak reverse voltage (V<sub>RWM</sub>), which should be equal or greater than the DC or continuous peak operating voltage level.
- V<sub>BR</sub> is measured at pulse test current I<sub>T</sub>.
- Include SZ-prefix devices where applicable.

# SMF05CT1G, SMF12CT1G, SMF15CT1G, SMF24CT1G, SZSMF12CT1G

## TYPICAL PERFORMANCE CURVES

( $T_J = 25^\circ\text{C}$  unless otherwise specified)

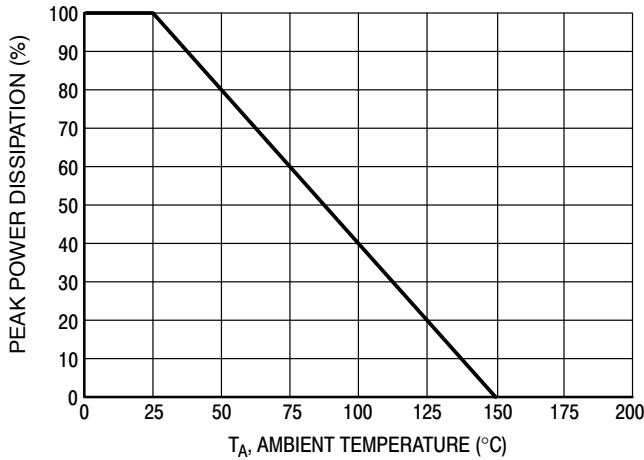


Figure 1. Pulse Derating Curve

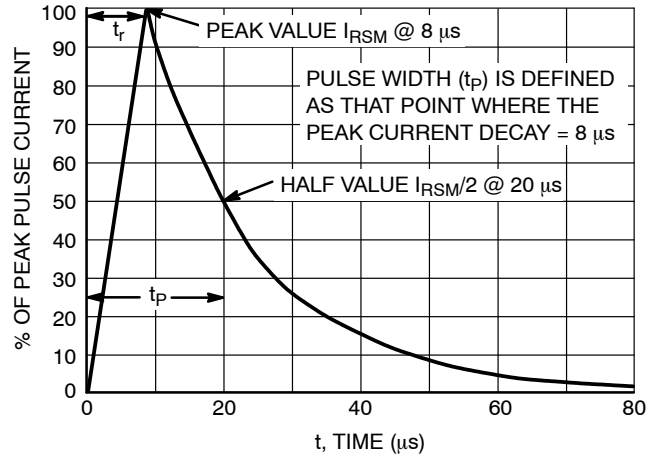


Figure 2.  $8 \times 20 \mu\text{s}$  Pulse Waveform

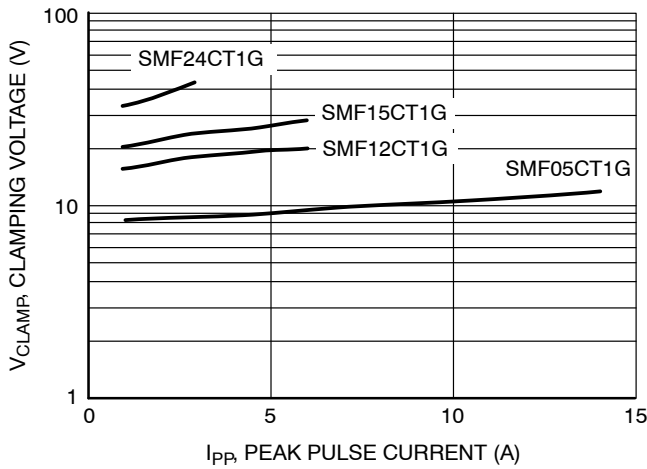


Figure 3. Clamping Voltage vs Peak Pulse Current

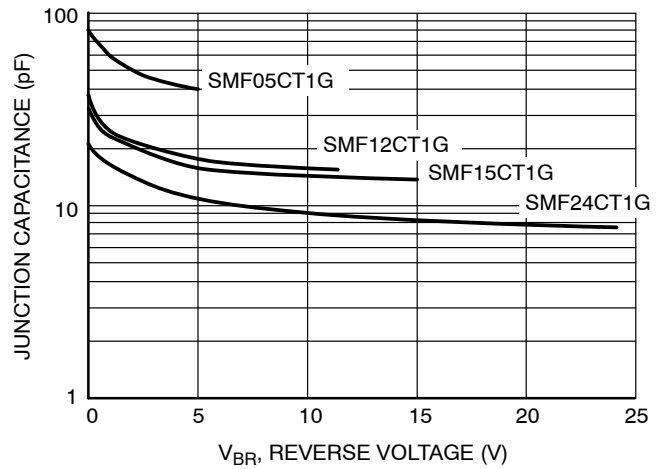


Figure 4. Junction Capacitance vs Reverse Voltage

### ORDERING INFORMATION

| Device     | Package            | Shipping <sup>†</sup> |
|------------|--------------------|-----------------------|
| SMF05CT1G  | SC-88<br>(Pb-Free) | 3,000 / Tape & Reel   |
| SMF05CT2G* | SC-88<br>(Pb-Free) | 3,000 / Tape & Reel   |
| SMF12CT1G  | SC-88<br>(Pb-Free) | 3,000 / Tape & Reel   |
| SMF15CT1G  | SC-88<br>(Pb-Free) | 3,000 / Tape & Reel   |
| SMF24CT1G  | SC-88<br>(Pb-Free) | 3,000 / 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.

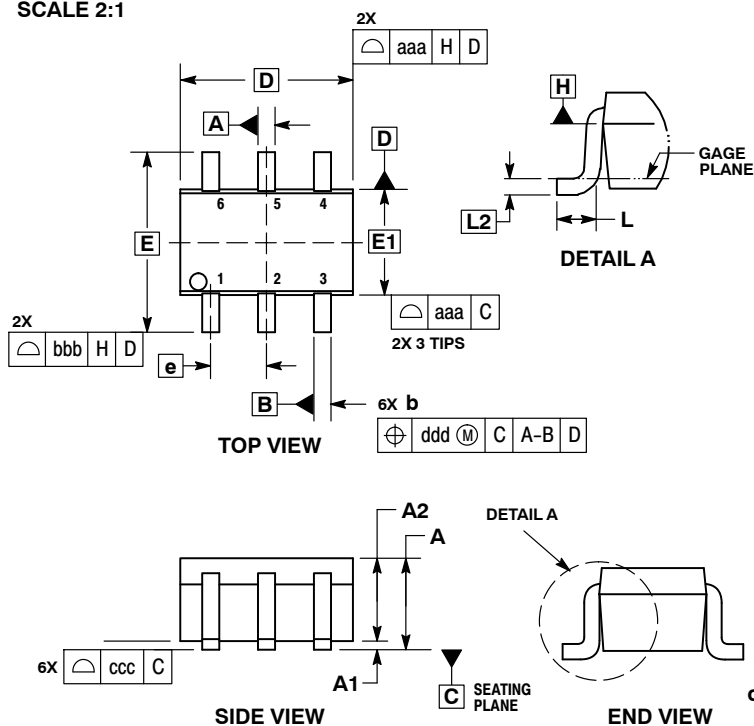
\*The "T2" suffix refers to an alternate tape & reel orientation.



1  
SCALE 2:1

SC-88/SC70-6/SOT-363  
CASE 419B-02  
ISSUE Y

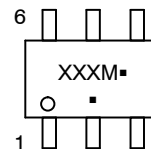
DATE 11 DEC 2012



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
  4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
  5. DATUMS A AND B ARE DETERMINED AT DATUM H.
  6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
  7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| DIM | MILLIMETERS |      |      | INCHES    |       |       |
|-----|-------------|------|------|-----------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN       | NOM   | MAX   |
| A   | ---         | ---  | 1.10 | ---       | ---   | 0.043 |
| A1  | 0.00        | ---  | 0.10 | 0.000     | ---   | 0.004 |
| A2  | 0.70        | 0.90 | 1.00 | 0.027     | 0.035 | 0.039 |
| b   | 0.15        | 0.20 | 0.25 | 0.006     | 0.008 | 0.010 |
| C   | 0.08        | 0.15 | 0.22 | 0.003     | 0.006 | 0.009 |
| D   | 1.80        | 2.00 | 2.20 | 0.070     | 0.078 | 0.086 |
| E   | 2.00        | 2.10 | 2.20 | 0.078     | 0.082 | 0.086 |
| E1  | 1.15        | 1.25 | 1.35 | 0.045     | 0.049 | 0.053 |
| e   | 0.65 BSC    |      |      | 0.026 BSC |       |       |
| L   | 0.26        | 0.36 | 0.46 | 0.010     | 0.014 | 0.018 |
| L2  | 0.15 BSC    |      |      | 0.006 BSC |       |       |
| aaa | 0.15        |      |      | 0.006     |       |       |
| bbb | 0.30        |      |      | 0.012     |       |       |
| ccc | 0.10        |      |      | 0.004     |       |       |
| ddd | 0.10        |      |      | 0.004     |       |       |

### GENERIC MARKING DIAGRAM\*



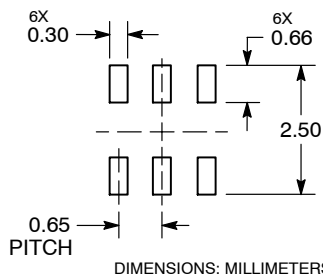
XXX = Specific Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or position may vary depending upon manufacturing 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.

### RECOMMENDED SOLDERING 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.

### STYLES ON PAGE 2

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**SC-88/SC70-6/SOT-363**  
**CASE 419B-02**  
**ISSUE Y**

DATE 11 DEC 2012

|   |   |  |  |  |  |
|---|---|--|--|--|--|
| <b>STYLE 1:</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 2:</b><br>CANCELLED  | <b>STYLE 3:</b><br>CANCELLED   | <b>STYLE 4:</b><br>PIN 1. CATHODE<br>2. CATHODE<br>3. COLLECTOR<br>4. EMITTER<br>5. BASE<br>6. ANODE               | <b>STYLE 5:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. COLLECTOR<br>4. EMITTER<br>5. BASE<br>6. CATHODE                 | <b>STYLE 6:</b><br>PIN 1. ANODE 2<br>2. N/C<br>3. CATHODE 1<br>4. ANODE 1<br>5. N/C<br>6. CATHODE 2          |
| <b>STYLE 7:</b><br>PIN 1. SOURCE 2<br>2. DRAIN 2<br>3. GATE 1<br>4. SOURCE 1<br>5. DRAIN 1<br>6. GATE 2           | <b>STYLE 8:</b><br>CANCELLED  | <b>STYLE 9:</b><br>PIN 1. EMITTER 2<br>2. EMITTER 1<br>3. COLLECTOR 1<br>4. BASE 1<br>5. BASE 2<br>6. COLLECTOR 2  | <b>STYLE 10:</b><br>PIN 1. SOURCE 2<br>2. SOURCE 1<br>3. GATE 1<br>4. DRAIN 1<br>5. DRAIN 2<br>6. GATE 2           | <b>STYLE 11:</b><br>PIN 1. CATHODE 2<br>2. CATHODE 2<br>3. ANODE 1<br>4. CATHODE 1<br>5. CATHODE 1<br>6. ANODE 2   | <b>STYLE 12:</b><br>PIN 1. ANODE 2<br>2. ANODE 2<br>3. CATHODE 1<br>4. ANODE 1<br>5. ANODE 1<br>6. CATHODE 2 |
| <b>STYLE 13:</b><br>PIN 1. ANODE<br>2. N/C<br>3. COLLECTOR<br>4. EMITTER<br>5. BASE<br>6. CATHODE                 | <b>STYLE 14:</b><br>PIN 1. VREF<br>2. GND<br>3. GND<br>4. IOUT<br>5. VEN<br>6. VCC                            | <b>STYLE 15:</b><br>PIN 1. ANODE 1<br>2. ANODE 2<br>3. ANODE 3<br>4. CATHODE 3<br>5. CATHODE 2<br>6. CATHODE 1     | <b>STYLE 16:</b><br>PIN 1. BASE 1<br>2. EMITTER 2<br>3. COLLECTOR 2<br>4. BASE 2<br>5. EMITTER 1<br>6. COLLECTOR 1 | <b>STYLE 17:</b><br>PIN 1. BASE 1<br>2. EMITTER 1<br>3. COLLECTOR 2<br>4. BASE 2<br>5. EMITTER 2<br>6. COLLECTOR 1 | <b>STYLE 18:</b><br>PIN 1. VIN1<br>2. VCC<br>3. VOUT2<br>4. VIN2<br>5. GND<br>6. VOUT1                       |
| <b>STYLE 19:</b><br>PIN 1. IOUT<br>2. GND<br>3. GND<br>4. V CC<br>5. V EN<br>6. V REF                             | <b>STYLE 20:</b><br>PIN 1. COLLECTOR<br>2. COLLECTOR<br>3. BASE<br>4. EMITTER<br>5. COLLECTOR<br>6. COLLECTOR | <b>STYLE 21:</b><br>PIN 1. ANODE 1<br>2. N/C<br>3. ANODE 2<br>4. CATHODE 2<br>5. N/C<br>6. CATHODE 1               | <b>STYLE 22:</b><br>PIN 1. D1 (i)<br>2. GND<br>3. D2 (j)<br>4. D2 (c)<br>5. VBUS<br>6. D1 (c)                      | <b>STYLE 23:</b><br>PIN 1. Vn<br>2. CH1<br>3. Vp<br>4. N/C<br>5. CH2<br>6. N/C                                     | <b>STYLE 24:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. CATHODE<br>5. CATHODE<br>6. CATHODE       |
| <b>STYLE 25:</b><br>PIN 1. BASE 1<br>2. CATHODE<br>3. COLLECTOR 2<br>4. BASE 2<br>5. EMITTER<br>6. COLLECTOR 1    | <b>STYLE 26:</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 27:</b><br>PIN 1. BASE 2<br>2. BASE 1<br>3. COLLECTOR 1<br>4. EMITTER 1<br>5. EMITTER 2<br>6. COLLECTOR 2 | <b>STYLE 28:</b><br>PIN 1. DRAIN<br>2. DRAIN<br>3. GATE<br>4. SOURCE<br>5. DRAIN<br>6. DRAIN                       | <b>STYLE 29:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. COLLECTOR<br>4. EMITTER<br>5. BASE/ANODE<br>6. CATHODE          | <b>STYLE 30:</b><br>PIN 1. SOURCE 1<br>2. DRAIN 2<br>3. DRAIN 2<br>4. SOURCE 2<br>5. GATE 1<br>6. DRAIN 1    |

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