

# MUN5331DW1, NSBC123EPDXV6

## Complementary Bias Resistor Transistors R1 = 2.2 kΩ, R2 = 2.2 kΩ

### 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

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

#### MAXIMUM RATINGS

(T<sub>A</sub> = 25°C both polarities Q<sub>1</sub> (PNP) & Q<sub>2</sub> (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> | 10  | Vdc  |

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.

#### ORDERING INFORMATION

| Device            | Package | Shipping <sup>†</sup> |
|-------------------|---------|-----------------------|
| MUN5331DW1T1G     | SOT-363 | 3,000 / Tape & Reel   |
| NSVMUN5331DW1T1G* | SOT-363 | 3,000 / Tape & Reel   |
| NSBC123EPDXV6T1G  | SOT-563 | 4,000 / Tape & Reel   |

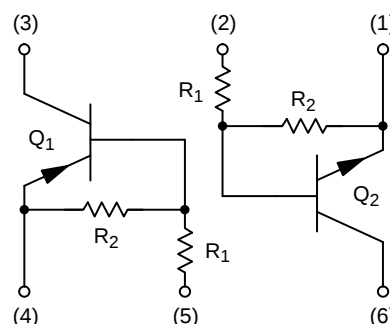
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



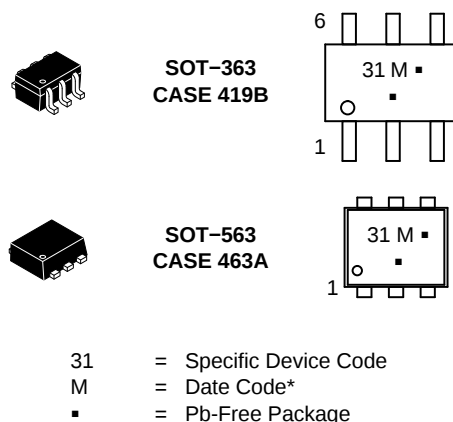
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#### PIN CONNECTIONS



#### MARKING DIAGRAMS



(Note: Microdot may be in either location)

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

# MUN5331DW1, NSBC123EPDXV6

## THERMAL CHARACTERISTICS

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

### MUN5331DW1 (SOT-363) ONE JUNCTION HEATED

|                                                                                         |                                              |                 |                          |                            |
|-----------------------------------------------------------------------------------------|----------------------------------------------|-----------------|--------------------------|----------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | (Note 1)<br>(Note 2)<br>(Note 1)<br>(Note 2) | $P_D$           | 187<br>256<br>1.5<br>2.0 | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction to Ambient                                              | (Note 1)<br>(Note 2)                         | $R_{\theta JA}$ | 670<br>490               | $^\circ\text{C/W}$         |

### MUN5331DW1 (SOT-363) BOTH JUNCTION HEATED (Note 3)

|                                                                                         |                                              |                 |                          |                            |
|-----------------------------------------------------------------------------------------|----------------------------------------------|-----------------|--------------------------|----------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | (Note 1)<br>(Note 2)<br>(Note 1)<br>(Note 2) | $P_D$           | 250<br>385<br>2.0<br>3.0 | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction to Ambient                                              | (Note 1)<br>(Note 2)                         | $R_{\theta JA}$ | 493<br>325               | $^\circ\text{C/W}$         |
| Thermal Resistance,<br>Junction to Lead                                                 | (Note 1)<br>(Note 2)                         | $R_{\theta JL}$ | 188<br>208               | $^\circ\text{C/W}$         |
| Junction and Storage Temperature Range                                                  |                                              | $T_J, T_{stg}$  | -55 to +150              | $^\circ\text{C}$           |

### NSBC123EPDXV6 (SOT-563) ONE JUNCTION HEATED

|                                                                                         |                      |                 |            |                            |
|-----------------------------------------------------------------------------------------|----------------------|-----------------|------------|----------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | (Note 1)<br>(Note 1) | $P_D$           | 357<br>2.9 | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction to Ambient                                              | (Note 1)             | $R_{\theta JA}$ | 350        | $^\circ\text{C/W}$         |

### NSBC123EPDXV6 (SOT-563) BOTH JUNCTION HEATED (Note 3)

|                                                                                         |                      |                 |             |                            |
|-----------------------------------------------------------------------------------------|----------------------|-----------------|-------------|----------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | (Note 1)<br>(Note 1) | $P_D$           | 500<br>4.0  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction to Ambient                                              | (Note 1)             | $R_{\theta JA}$ | 250         | $^\circ\text{C/W}$         |
| Junction and Storage Temperature Range                                                  |                      | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

- FR-4 @ Minimum Pad.
- FR-4 @  $1.0 \times 1.0$  Inch Pad.
- Both junction heated values assume total power is sum of two equally powered channels.

# MUN5331DW1, NSBC123EPDXV6

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

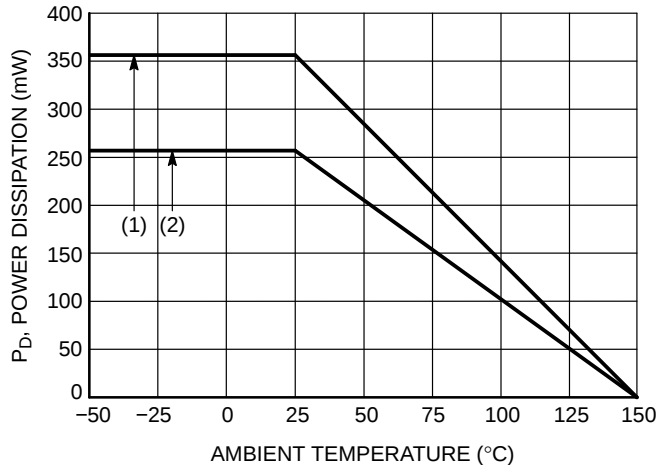
| Characteristic                                                                        | Symbol        | Min | Typ | Max | Unit |
|---------------------------------------------------------------------------------------|---------------|-----|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>                                                            |               |     |     |     |      |
| 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>( $V_{EB} = 6.0\text{ V}$ , $I_C = 0$ )                | $I_{EBO}$     | –   | –   | 2.3 | 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>( $I_C = 5.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ )                                                                | $h_{FE}$      | 8.0    | 15         | –      |            |
| Collector-Emitter Saturation Voltage (Note 4)<br>( $I_C = 10\text{ mA}$ , $I_B = 5.0\text{ mA}$ )                                             | $V_{CE(sat)}$ | –      | –          | 0.25   | V          |
| Input Voltage (Off)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 1.0\text{ mA}$ ) (NPN)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 1.0\text{ mA}$ ) (PNP) | $V_{i(off)}$  | –<br>– | 1.3<br>1.2 | –<br>– | Vdc        |
| Input Voltage (On)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 20\text{ mA}$ ) (NPN)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 20\text{ mA}$ ) (PNP)    | $V_{i(on)}$   | –<br>– | 1.8<br>1.9 | –<br>– | 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    | k $\Omega$ |
| Resistor Ratio                                                                                                                                | $R_1/R_2$     | 0.8    | 1.0        | 1.2    |            |

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.

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



(1) SOT-363; 1.0 x 1.0 Inch Pad  
(2) SOT-563; Minimum Pad

Figure 1. Derating Curve

TYPICAL CHARACTERISTICS – NPN TRANSISTOR  
MUN5331DW1, NSBC123EPDXV6

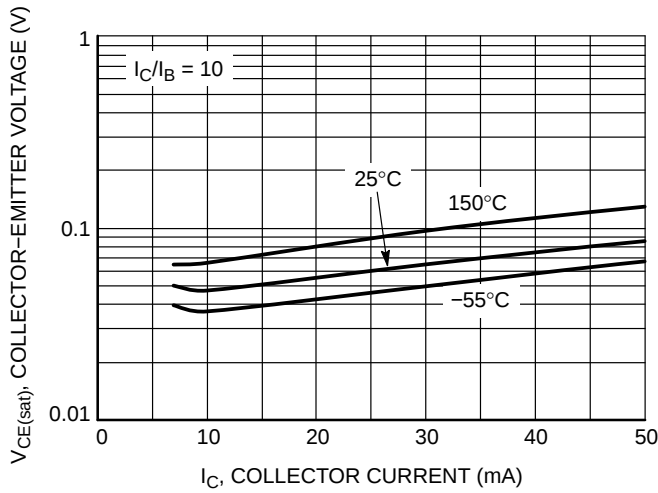


Figure 2.  $V_{CE(sat)}$  vs.  $I_C$

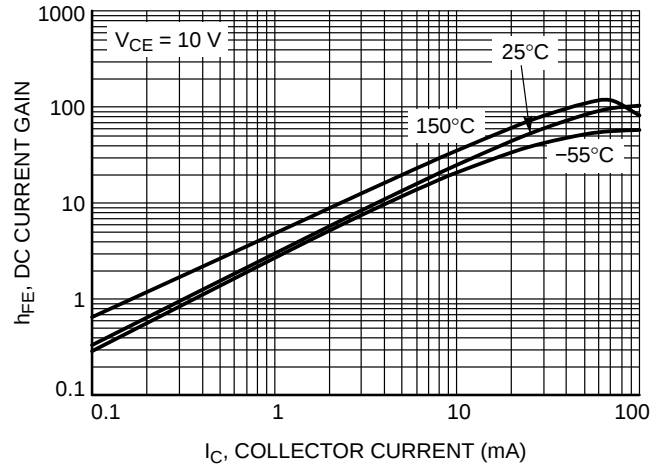


Figure 3. DC Current Gain

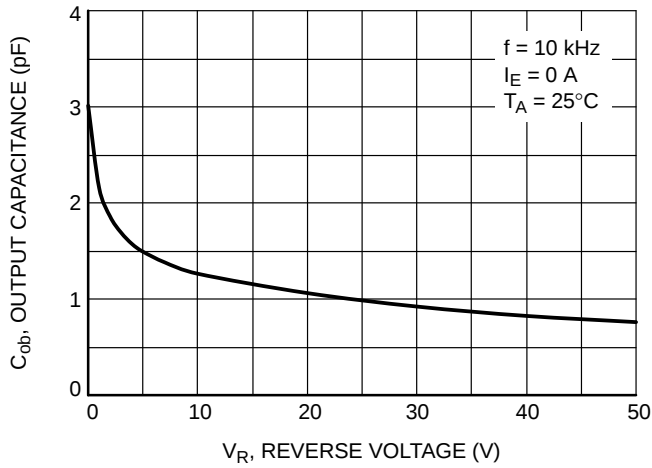


Figure 4. Output Capacitance

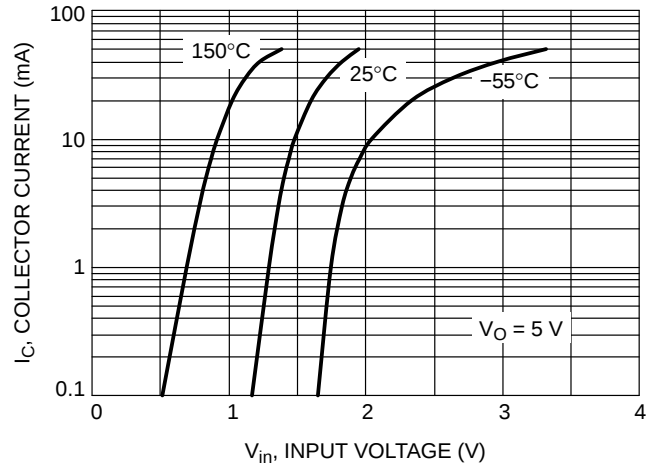


Figure 5. Output Current vs. Input Voltage

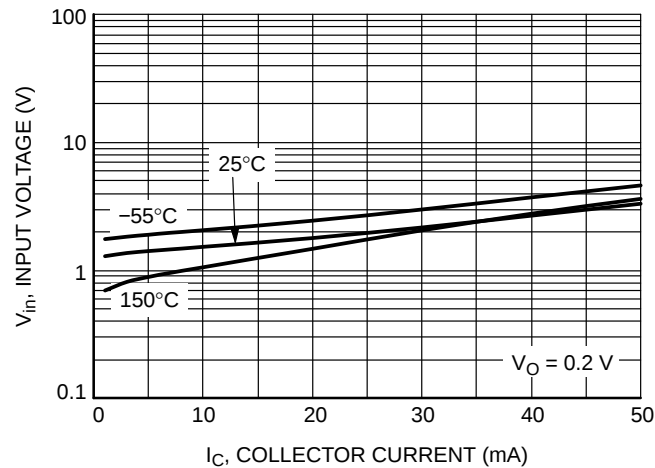


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – PNP TRANSISTOR  
MUN5331DW1, NSBC123EPDXV6

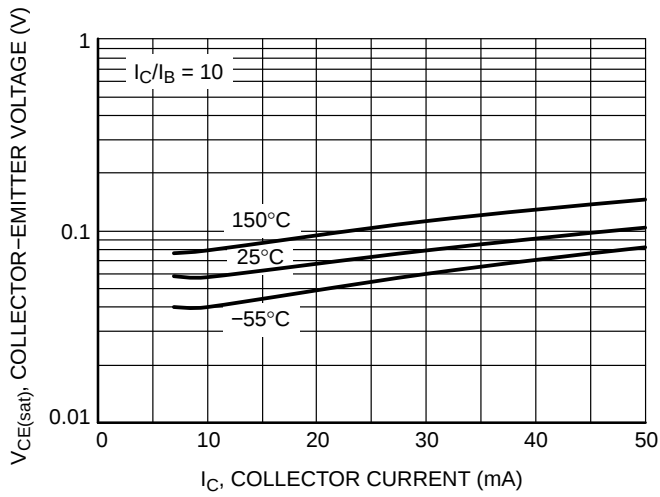


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

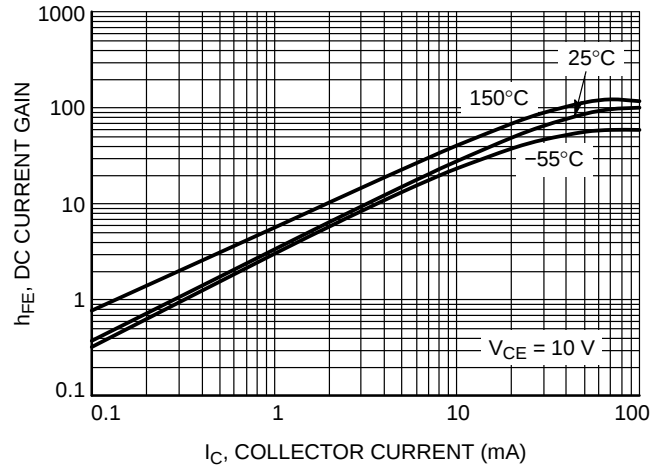


Figure 8. DC Current Gain

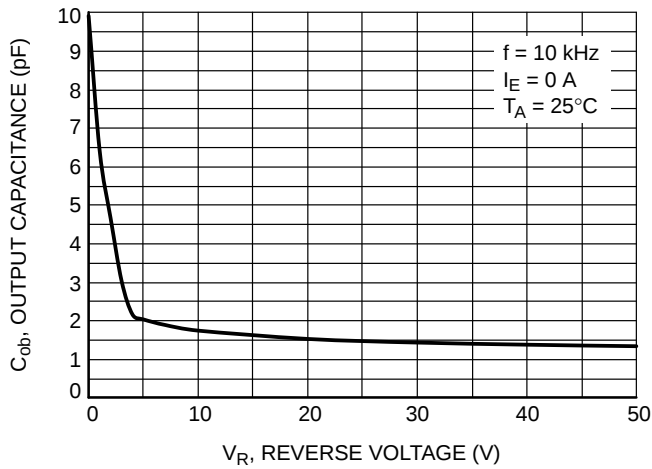


Figure 9. Output Capacitance

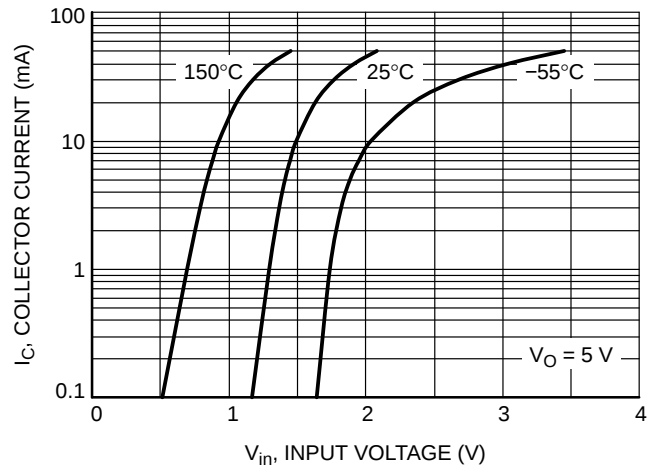


Figure 10. Output Current vs. Input Voltage

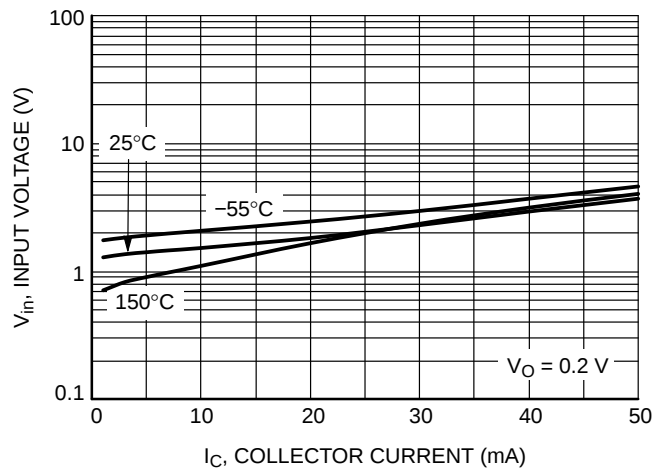


Figure 11. Input Voltage vs. Output Current

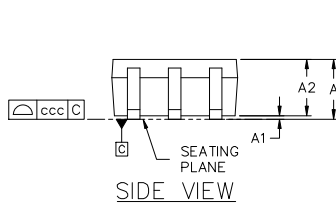


SC-88 2.00x1.25x0.90, 0.65P  
CASE 419B-02  
ISSUE Z

DATE 18 APR 2024

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5-2018.
2. ALL DIMENSION ARE IN 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.



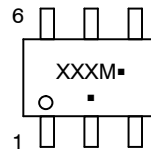
| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | ---         | ---  | 1.10 |
| A1  | 0.00        | ---  | 0.10 |
| A2  | 0.70        | 0.90 | 1.00 |
| b   | 0.15        | 0.20 | 0.25 |
| c   | 0.08        | 0.15 | 0.22 |
| D   | 2.00 BSC    |      |      |
| E   | 2.10 BSC    |      |      |
| E1  | 1.25 BSC    |      |      |
| e   | 0.65 BSC    |      |      |
| L   | 0.26        | 0.36 | 0.46 |
| L2  | 0.15 BSC    |      |      |
| aaa | 0.15        |      |      |
| bbb | 0.30        |      |      |
| ccc | 0.10        |      |      |
| ddd | 0.10        |      |      |



RECOMMENDED MOUNTING FOOTPRINT\*

\* FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

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. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

|                  |                             |                                                                                                                                                                                  |
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SC-88 2.00x1.25x0.90, 0.65P  
CASE 419B-02  
ISSUE Z

DATE 18 APR 2024

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

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

|                  |                             |                                                                                                                                                                                     |
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**SOT-563-6 1.60x1.20x0.55, 0.50P**  
**CASE 463A**  
**ISSUE J**

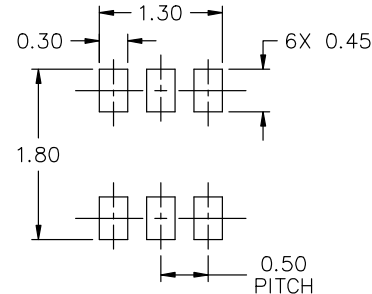
DATE 15 FEB 2024

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5-2018.
2. ALL DIMENSION ARE IN MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.



| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.50        | 0.55 | 0.60 |
| b   | 0.17        | 0.22 | 0.27 |
| c   | 0.08        | 0.13 | 0.18 |
| D   | 1.50        | 1.60 | 1.70 |
| E   | 1.10        | 1.20 | 1.30 |
| e   | 0.50 BSC    |      |      |
| H   | 1.50        | 1.60 | 1.70 |
| L   | 0.10        | 0.20 | 0.30 |



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

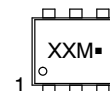
STYLE 9:  
PIN 1. SOURCE 1  
2. GATE 1  
3. DRAIN 2  
4. SOURCE 2  
5. GATE 2  
6. DRAIN 1

STYLE 10:  
PIN 1. CATHODE 1  
2. N/C  
3. CATHODE 2  
4. ANODE 2  
5. N/C  
6. ANODE 1

STYLE 11:  
PIN 1. EMITTER 2  
2. BASE 2  
3. COLLECTOR 1  
4. EMITTER 1  
5. BASE 1  
6. COLLECTOR 2

\* FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

**GENERIC MARKING DIAGRAM\***



XX = Specific Device Code  
M = Month 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.

|                         |                                        |                                                                                                                                                                                  |
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