

# MUN2232, MMUN2232L, MUN5232, DTC143EE, DTC143EM3, NSBC143EF3

## Digital Transistors (BRT) R1 = 4.7 kΩ, R2 = 4.7 kΩ

### NPN 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)

| 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> | 30  | Vdc  |
| Input Reverse Voltage          | V <sub>IN(rev)</sub> | 10  | Vdc  |

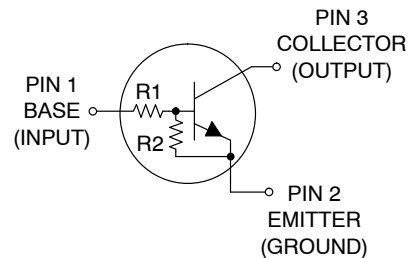
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



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#### PIN CONNECTIONS



#### MARKING DIAGRAMS



XXX = Specific 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

See detailed ordering, marking, and shipping information in the package dimensions section on page 2 of this data sheet.

# MUN2232, MMUN2232L, MUN5232, DTC143EE, DTC143EM3, NSBC143EF3

**Table 1. ORDERING INFORMATION**

| Device                        | Part Marking | Package                    | Shipping†           |
|-------------------------------|--------------|----------------------------|---------------------|
| MUN2232T1G, SMUN2232T1G       | 8J           | SC-59<br>(Pb-Free)         | 3000 / Tape & Reel  |
| MMUN2232LT1G, NSVMMUN2232LT1G | A8J          | SOT-23<br>(Pb-Free)        | 3000 / Tape & Reel  |
| NSVMMUN2232LT3G               | A8J          | SOT-23<br>(Pb-Free)        | 10000 / Tape & Reel |
| MUN5232T1G, SMUN5232T1G       | 8J           | SC-70/SOT-323<br>(Pb-Free) | 3000 / Tape & Reel  |
| DTC143EET1G                   | 8J           | SC-75<br>(Pb-Free)         | 3000 / Tape & Reel  |
| DTC143EM3T5G                  | 8J           | SOT-723<br>(Pb-Free)       | 8000 / Tape & Reel  |
| NSBC143EF3T5G                 | P            | SOT-1123<br>(Pb-Free)      | 8000 / Tape & Reel  |

†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.



- (1) SC-75 and SC-70/SOT323; Minimum Pad
- (2) SC-59; Minimum Pad
- (3) SOT-23; Minimum Pad
- (4) SOT-1123; 100 mm<sup>2</sup>, 1 oz. copper trace
- (5) SOT-723; Minimum Pad

**Figure 1. Derating Curve**

**MUN2232, MMUN2232L, MUN5232, DTC143EE, DTC143EM3, NSBC143EF3**

**Table 2. THERMAL CHARACTERISTICS**

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

**THERMAL CHARACTERISTICS (SC-59) (MUN2232)**

|  |                                   |                          |             |
|--|-----------------------------------|--------------------------|-------------|
| 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>                    | 230<br>338<br>1.8<br>2.7 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)  | R <sub>θJA</sub>                  | 540<br>370               | °C/W        |
| Thermal Resistance,<br>Junction to Lead (Note 1)<br>(Note 2)   | R <sub>θJL</sub>                  | 264<br>287               | °C/W        |
| Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

**THERMAL CHARACTERISTICS (SOT-23) (MMUN2232L)**

|  |                                   |                          |             |
|--|-----------------------------------|--------------------------|-------------|
| 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>                    | 246<br>400<br>2.0<br>3.2 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)  | R <sub>θJA</sub>                  | 508<br>311               | °C/W        |
| Thermal Resistance,<br>Junction to Lead (Note 1)<br>(Note 2)   | R <sub>θJL</sub>                  | 174<br>208               | °C/W        |
| Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

**THERMAL CHARACTERISTICS (SC-70/SOT-323) (MUN5232)**

|  |                                   |                          |             |
|--|-----------------------------------|--------------------------|-------------|
| 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>                    | 202<br>310<br>1.6<br>2.5 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)  | R <sub>θJA</sub>                  | 618<br>403               | °C/W        |
| Thermal Resistance,<br>Junction to Lead (Note 1)<br>(Note 2)   | R <sub>θJL</sub>                  | 280<br>332               | °C/W        |
| Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

**THERMAL CHARACTERISTICS (SC-75) (DTC143EE)**

|  |                                   |                          |             |
|--|-----------------------------------|--------------------------|-------------|
| 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>                    | 200<br>300<br>1.6<br>2.4 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)  | R <sub>θJA</sub>                  | 600<br>400               | °C/W        |
| Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

**THERMAL CHARACTERISTICS (SOT-723) (DTC143EM3)**

|  |                                   |                          |             |
|--|-----------------------------------|--------------------------|-------------|
| 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>                    | 260<br>600<br>2.0<br>4.8 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)  | R <sub>θJA</sub>                  | 480<br>205               | °C/W        |
| Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C          |

- FR-4 @ Minimum Pad.
- FR-4 @ 1.0 x 1.0 Inch Pad.
- FR-4 @ 100 mm<sup>2</sup>, 1 oz. copper traces, still air.
- FR-4 @ 500 mm<sup>2</sup>, 1 oz. copper traces, still air.

**MUN2232, MMUN2232L, MUN5232, DTC143EE, DTC143EM3, NSBC143EF3**

**Table 2. THERMAL CHARACTERISTICS**

| Characteristic  | Symbol          | Max                      | Unit                       |
|---|-----------------|--------------------------|----------------------------|
| <b>THERMAL CHARACTERISTICS (SOT-1123) (NSBC143EF3)</b>  |                 |                          |                            |
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$ (Note 3)<br>(Note 4)<br>Derate above $25^\circ\text{C}$ (Note 3)<br>(Note 4) | $P_D$           | 254<br>297<br>2.0<br>2.4 | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient<br>(Note 3)<br>(Note 4)   | $R_{\theta JA}$ | 493<br>421               | $^\circ\text{C/W}$         |
| Thermal Resistance, Junction to Lead<br>(Note 3)  | $R_{\theta JL}$ | 193                      | $^\circ\text{C/W}$         |
| Junction and Storage Temperature Range  | $T_J, T_{stg}$  | -55 to +150              | $^\circ\text{C}$           |

- FR-4 @ Minimum Pad.
- FR-4 @ 1.0 x 1.0 Inch Pad.
- FR-4 @ 100 mm<sup>2</sup>, 1 oz. copper traces, still air.
- FR-4 @ 500 mm<sup>2</sup>, 1 oz. copper traces, still air.

**Table 3. ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , 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>( $V_{EB} = 6.0\text{ V}, I_C = 0$ )                                | $I_{EBO}$     | -   | -   | 1.5  | mAdc       |
| Collector-Base Breakdown Voltage<br>( $I_C = 10\ \mu\text{A}, I_E = 0$ )                           | $V_{(BR)CBO}$ | 50  | -   | -    | Vdc        |
| Collector-Emitter Breakdown Voltage (Note 5)<br>( $I_C = 2.0\text{ mA}, I_B = 0$ )                 | $V_{(BR)CEO}$ | 50  | -   | -    | Vdc        |
| <b>ON CHARACTERISTICS</b>  |               |     |     |      |            |
| DC Current Gain (Note 5)<br>( $I_C = 5.0\text{ mA}, V_{CE} = 10\text{ V}$ )                        | $h_{FE}$      | 15  | 30  | -    |            |
| Collector-Emitter Saturation Voltage (Note 5)<br>( $I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$ )     | $V_{CE(sat)}$ | -   | -   | 0.25 | Vdc        |
| Input Voltage (off)<br>( $V_{CE} = 5.0\text{ V}, I_C = 100\ \mu\text{A}$ )                         | $V_{i(off)}$  | -   | 1.2 | 0.5  | Vdc        |
| Input Voltage (on)<br>( $V_{CE} = 0.3\text{ V}, I_C = 20\text{ mA}$ )                              | $V_{i(on)}$   | 2.5 | 2.0 | -    | 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   | R1            | 3.3 | 4.7 | 6.1  | k $\Omega$ |
| Resistor Ratio   | $R_1/R_2$     | 0.8 | 1.0 | 1.2  |            |

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

TYPICAL CHARACTERISTICS  
MUN2232, MMUN2232L, MUN5232, DTC143EE, DTC143EM3

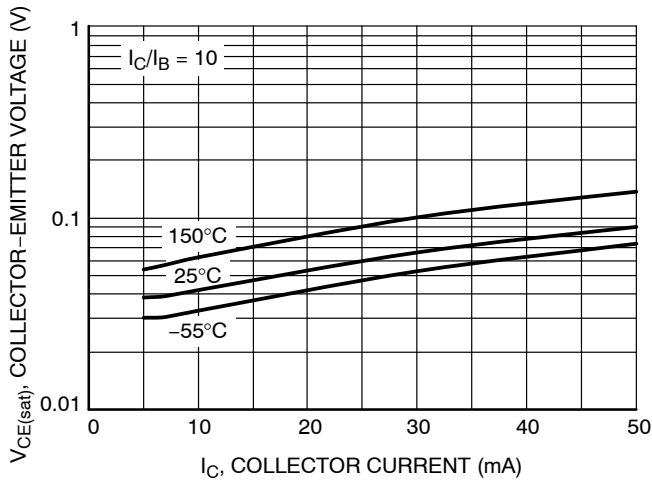


Figure 2.  $V_{CE(sat)}$ , vs.  $I_C$

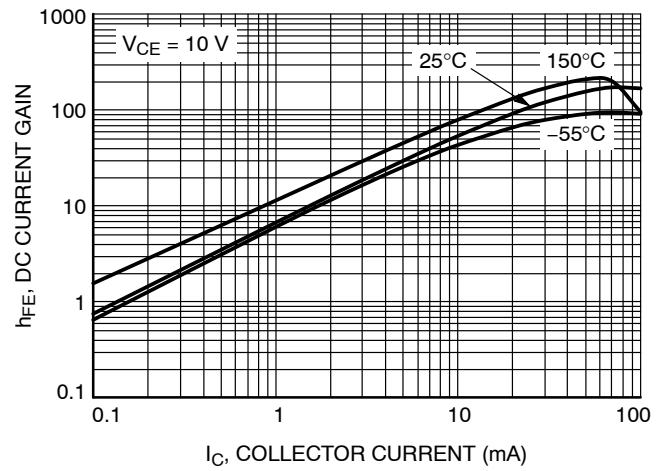


Figure 3. DC Current Gain

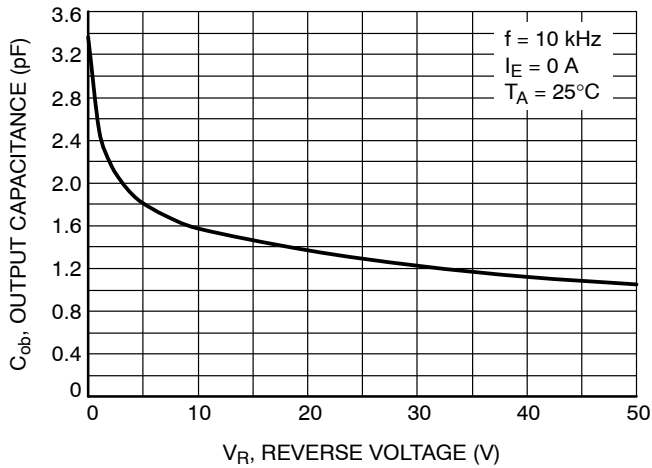


Figure 4. Output Capacitance

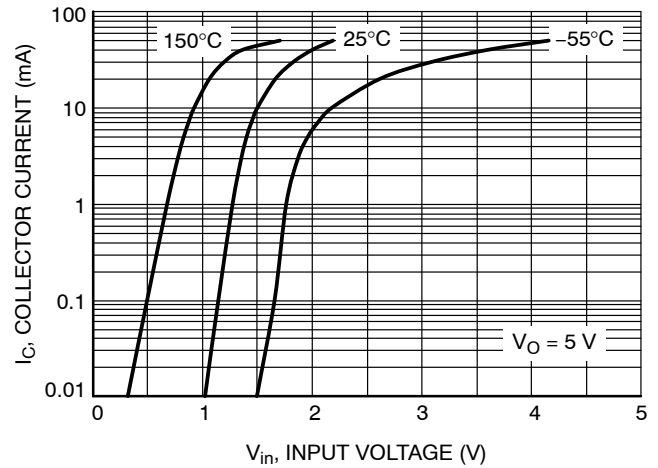


Figure 5. Output Current vs. Input Voltage

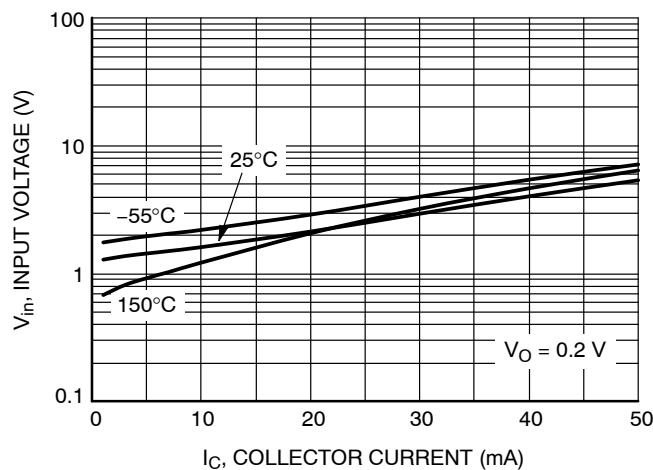


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – NSBC143EF3

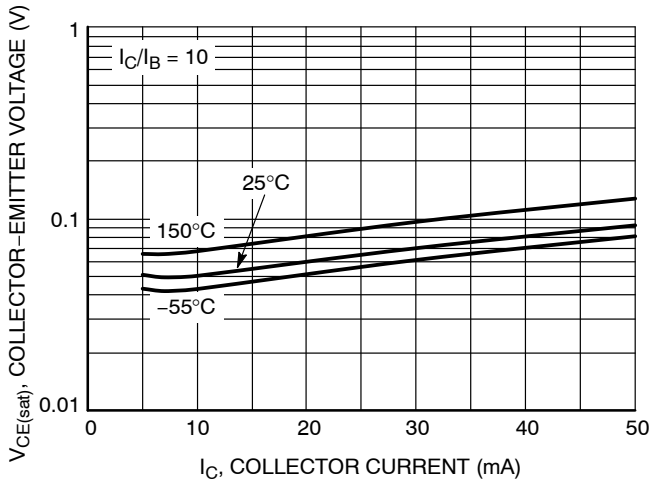


Figure 7.  $V_{CE(sat)}$ , vs.  $I_C$

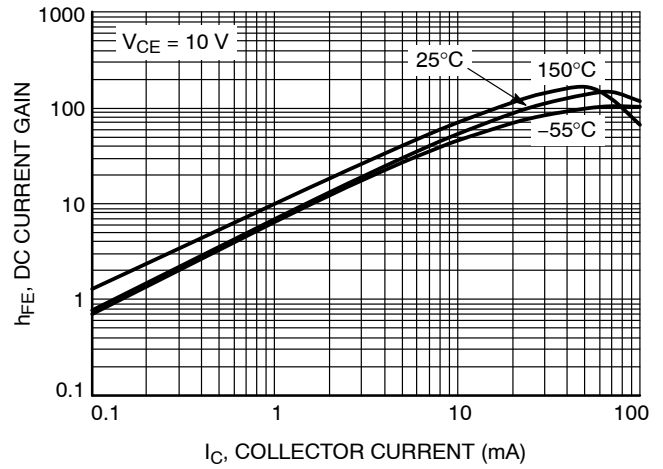


Figure 8. DC Current Gain

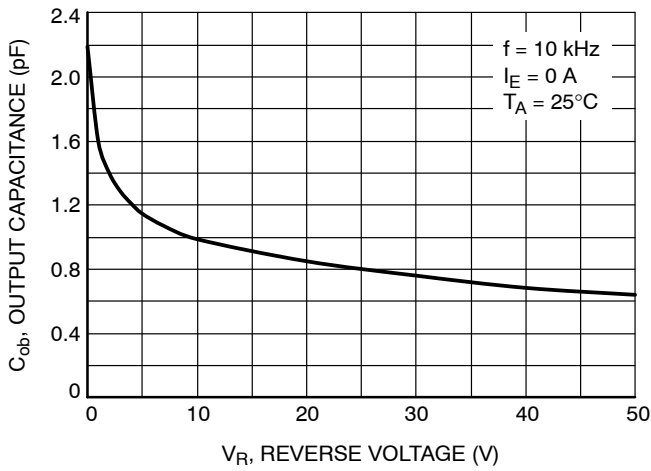


Figure 9. Output Capacitance

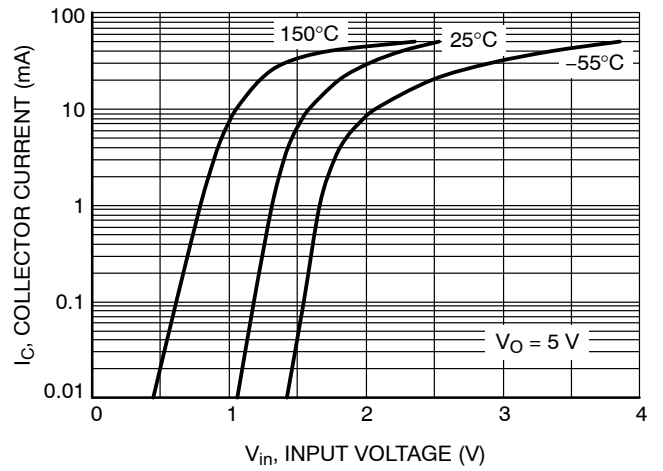


Figure 10. Output Current vs. Input Voltage

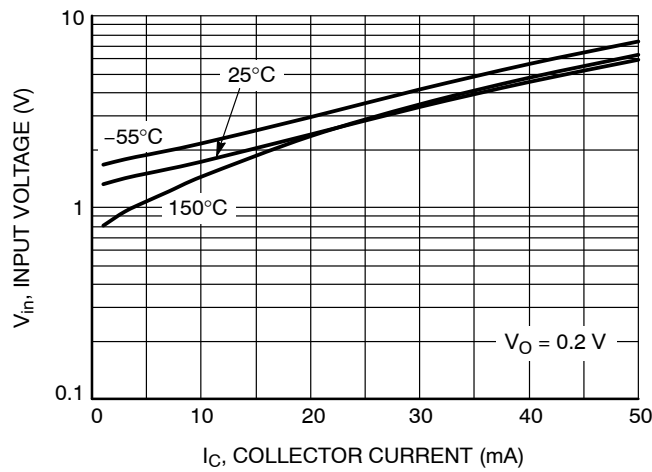


Figure 11. Input Voltage vs. Output Current

PACKAGE DIMENSIONS

SC-59  
CASE 318D-04  
ISSUE H



- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 1.00        | 1.15 | 1.30 | 0.039  | 0.045 | 0.051 |
| A1  | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b   | 0.35        | 0.43 | 0.50 | 0.014  | 0.017 | 0.020 |
| c   | 0.09        | 0.14 | 0.18 | 0.003  | 0.005 | 0.007 |
| D   | 2.70        | 2.90 | 3.10 | 0.106  | 0.114 | 0.122 |
| E   | 1.30        | 1.50 | 1.70 | 0.051  | 0.059 | 0.067 |
| e   | 1.70        | 1.90 | 2.10 | 0.067  | 0.075 | 0.083 |
| L   | 0.20        | 0.40 | 0.60 | 0.008  | 0.016 | 0.024 |
| HE  | 2.50        | 2.80 | 3.00 | 0.099  | 0.110 | 0.118 |

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

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.

PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AP



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  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.

| DIM      | MILLIMETERS |      |      | INCHES |       |       |
|----------|-------------|------|------|--------|-------|-------|
|          | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A        | 0.89        | 1.00 | 1.11 | 0.035  | 0.040 | 0.044 |
| A1       | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b        | 0.37        | 0.44 | 0.50 | 0.015  | 0.018 | 0.020 |
| c        | 0.09        | 0.13 | 0.18 | 0.003  | 0.005 | 0.007 |
| D        | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E        | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e        | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.081 |
| L        | 0.10        | 0.20 | 0.30 | 0.004  | 0.008 | 0.012 |
| L1       | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.029 |
| HE       | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| $\theta$ | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

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

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.



PACKAGE DIMENSIONS

SC-70 (SOT-323)  
CASE 419-04  
ISSUE N



- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |      |      | INCHES    |       |       |
|-----|-------------|------|------|-----------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN       | NOM   | MAX   |
| A   | 0.80        | 0.90 | 1.00 | 0.032     | 0.035 | 0.040 |
| A1  | 0.00        | 0.05 | 0.10 | 0.000     | 0.002 | 0.004 |
| A2  | 0.70 REF    |      |      | 0.028 REF |       |       |
| b   | 0.30        | 0.35 | 0.40 | 0.012     | 0.014 | 0.016 |
| c   | 0.10        | 0.18 | 0.25 | 0.004     | 0.007 | 0.010 |
| D   | 1.80        | 2.10 | 2.20 | 0.071     | 0.083 | 0.087 |
| E   | 1.15        | 1.24 | 1.35 | 0.045     | 0.049 | 0.053 |
| e   | 1.20        | 1.30 | 1.40 | 0.047     | 0.051 | 0.055 |
| e1  | 0.65 BSC    |      |      | 0.026 BSC |       |       |
| L   | 0.20        | 0.38 | 0.56 | 0.008     | 0.015 | 0.022 |
| HE  | 2.00        | 2.10 | 2.40 | 0.079     | 0.083 | 0.095 |

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

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.

PACKAGE DIMENSIONS

SC-75/SOT-416  
CASE 463  
ISSUE F



- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS |      |      | INCHES   |       |       |
|-----|-------------|------|------|----------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN      | NOM   | MAX   |
| A   | 0.70        | 0.80 | 0.90 | 0.027    | 0.031 | 0.035 |
| A1  | 0.00        | 0.05 | 0.10 | 0.000    | 0.002 | 0.004 |
| b   | 0.15        | 0.20 | 0.30 | 0.006    | 0.008 | 0.012 |
| C   | 0.10        | 0.15 | 0.25 | 0.004    | 0.006 | 0.010 |
| D   | 1.55        | 1.60 | 1.65 | 0.059    | 0.063 | 0.067 |
| E   | 0.70        | 0.80 | 0.90 | 0.027    | 0.031 | 0.035 |
| e   | 1.00 BSC    |      |      | 0.04 BSC |       |       |
| L   | 0.10        | 0.15 | 0.20 | 0.004    | 0.006 | 0.008 |
| HE  | 1.50        | 1.60 | 1.70 | 0.061    | 0.063 | 0.065 |

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

SOLDERING FOOTPRINT\*



SCALE 10:1 ( $\frac{\text{mm}}{\text{inches}}$ )

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

PACKAGE DIMENSIONS

SOT-723  
CASE 631AA-01  
ISSUE D



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN         | NOM  | MAX  |
| A   | 0.45        | 0.50 | 0.55 |
| b   | 0.15        | 0.21 | 0.27 |
| b1  | 0.25        | 0.31 | 0.37 |
| C   | 0.07        | 0.12 | 0.17 |
| D   | 1.15        | 1.20 | 1.25 |
| E   | 0.75        | 0.80 | 0.85 |
| e   | 0.40 BSC    |      |      |
| H E | 1.15        | 1.20 | 1.25 |
| L   | 0.29 REF    |      |      |
| L2  | 0.15        | 0.20 | 0.25 |

STYLE 1:

1. BASE
2. EMITTER
3. COLLECTOR

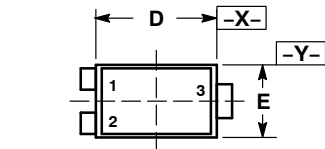
RECOMMENDED  
SOLDERING FOOTPRINT\*



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

PACKAGE DIMENSIONS

SOT-1123  
CASE 524AA  
ISSUE C



TOP VIEW

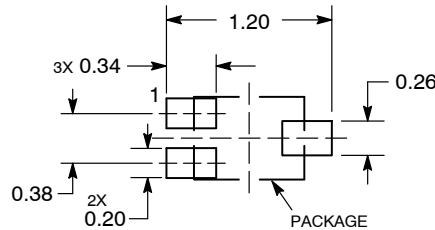


SIDE VIEW



BOTTOM VIEW

SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| MILLIMETERS |       |      |
|-------------|-------|------|
| DIM         | MIN   | MAX  |
| A           | 0.34  | 0.40 |
| b           | 0.15  | 0.28 |
| b1          | 0.10  | 0.20 |
| c           | 0.07  | 0.17 |
| D           | 0.75  | 0.85 |
| E           | 0.55  | 0.65 |
| e           | 0.35  | 0.40 |
| HE          | 0.95  | 1.05 |
| L           | 0.185 | REF  |
| L2          | 0.05  | 0.15 |

STYLE 1:

1. BASE
2. EMITTER
3. COLLECTOR

\*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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