

# NSBC114EF3T5G Series

Preferred Devices

## Digital Transistors (BRT)

### NPN Silicon Surface Mount Transistors with Monolithic Bias Resistor Network

This new series of digital transistors is designed to replace a single device and its external resistor bias network. The digital transistor contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The digital transistor eliminates these individual components by integrating them into a single device. The use of a digital transistor can reduce both system cost and board space. The device is housed in the SOT-1123 package which is designed for low power surface mount applications.

#### Features

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- The SOT-1123 Package can be Soldered using Wave or Reflow.
- Available in 4 mm, 8000 Unit Tape & Reel
- These are Pb-Free Devices
- These are Halide-Free Devices

#### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Rating                    | Symbol    | Value | Unit |
|---------------------------|-----------|-------|------|
| Collector-Base Voltage    | $V_{CBO}$ | 50    | Vdc  |
| Collector-Emitter Voltage | $V_{CEO}$ | 50    | Vdc  |
| Collector Current         | $I_C$     | 100   | mAdc |

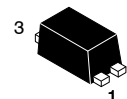
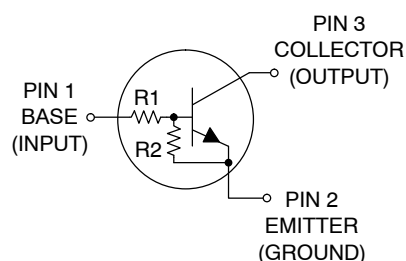
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



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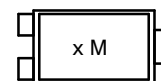
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## NPN SILICON DIGITAL TRANSISTORS



SOT-1123  
CASE 524AA  
STYLE 1

#### MARKING DIAGRAM



- x = Device Code
- M = Date Code
- G or ■ = Pb-Free Package

#### ORDERING INFORMATION

| Device        | Package               | Shipping†        |
|---------------|-----------------------|------------------|
| NSBC114EF3T5G | 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.

#### DEVICE MARKING INFORMATION

See specific marking information in the device marking table on page 2 of this data sheet.

## NSBC114EF3T5G Series

### THERMAL CHARACTERISTICS

| Characteristic   | Symbol          | Max         | Unit                       |
|--|-----------------|-------------|----------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$ (Note 1)<br>Derate above $25^\circ\text{C}$ | $P_D$           | 254<br>2.0  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance (Note 1)<br>Junction-to-Ambient   | $R_{\theta JA}$ | 493         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$ (Note 2)<br>Derate above $25^\circ\text{C}$ | $P_D$           | 297<br>2.4  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction-to-Ambient (Note 2)  | $R_{\theta JA}$ | 421         | $^\circ\text{C}/\text{W}$  |
| Thermal Resistance Junction-to-Lead 3 (Note 1)   | $R_{\theta JL}$ | 193         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature   | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

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.

### DEVICE MARKING AND RESISTOR VALUES

| Device        | Marking* | R1 (k) | R2 (k) | Package               | Shipping†        |
|---------------|----------|--------|--------|-----------------------|------------------|
| NSBC114EF3T5G | A (0°)   | 10     | 10     | SOT-1123<br>(Pb-Free) | 8000/Tape & Reel |
| NSBC124EF3T5G | L (0°)   | 22     | 22     |                       |                  |
| NSBC144EF3T5G | D (0°)   | 47     | 47     |                       |                  |
| NSBC114YF3T5G | J (0°)   | 10     | 47     |                       |                  |
| NSBC123TF3T5G | T (0°)   | 2.2    | ∞      |                       |                  |
| NSBC143EF3T5G | P (0°)   | 4.7    | 4.7    |                       |                  |
| NSBC143ZF3T5G | R (0°)   | 4.7    | 47     |                       |                  |
| NSBC123JF3T5G | V (0°)   | 2.2    | 47     |                       |                  |
| NSBC144WF3T5G | Q (0°)   | 47     | 22     |                       |                  |
| NSBC114TF3T5G | K (90°)  | 10     | ∞      |                       |                  |
| NSBC115TF3T5G | P (90°)  | 100    | ∞      |                       |                  |

†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.

\*(XX°) = Degree rotation in the clockwise direction.

## NSBC114EF3T5G Series

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

| Characteristic   | Symbol                      | Min | Typ | Max  | Unit |
|--|-----------------------------|-----|-----|------|------|
| <b>OFF CHARACTERISTICS</b>   |                             |     |     |      |      |
| Collector–Base Cutoff Current (V <sub>CB</sub> = 50 V, I <sub>E</sub> = 0)   | I <sub>CBO</sub>            | –   | –   | 100  | nAdc |
| Collector–Emitter Cutoff Current (V <sub>CE</sub> = 50 V, I <sub>B</sub> = 0)  | I <sub>CEO</sub>            | –   | –   | 500  | nAdc |
| Emitter–Base Cutoff Current<br>(V <sub>EB</sub> = 6.0 V, I <sub>C</sub> = 0)   | I <sub>EBO</sub>            | –   | –   | 0.5  | mAdc |
|  | NSBC114EF3T5G               | –   | –   | 0.2  |      |
|  | NSBC124EF3T5G               | –   | –   | 0.1  |      |
|  | NSBC144EF3T5G               | –   | –   | 0.2  |      |
|  | NSBC114YF3T5G               | –   | –   | 0.9  |      |
|  | NSBC114TF3T5G               | –   | –   | 4.0  |      |
|  | NSBC123TF3T5G               | –   | –   | 0.1  |      |
|  | NSBC115TF3T5G               | –   | –   | 1.5  |      |
|  | NSBC143EF3T5G               | –   | –   | 0.18 |      |
|  | NSBC143ZF3T5G               | –   | –   | 0.2  |      |
|  | NSBC123JF3T5G               | –   | –   | 0.13 |      |
|  | NSBC144WF3T5G               | –   | –   |      |      |
| Collector–Base Breakdown Voltage (I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0)  | V <sub>(BR)CBO</sub>        | 50  | –   | –    | Vdc  |
| Collector–Emitter Breakdown Voltage (Note 3)<br>(I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0)  | V <sub>(BR)CEO</sub>        | 50  | –   | –    | Vdc  |
| <b>ON CHARACTERISTICS (Note 3)</b>   |                             |     |     |      |      |
| DC Current Gain<br>(V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)   | h <sub>FE</sub>             | 35  | 60  | –    |      |
|  | NSBC114EF3T5G               | 60  | 100 | –    |      |
|  | NSBC124EF3T5G               | 80  | 140 | –    |      |
|  | NSBC144EF3T5G               | 80  | 140 | –    |      |
|  | NSBC114YF3T5G               | 160 | 350 | –    |      |
|  | NSBC114TF3T5G/NSBC115TF3T5G | 15  | 30  | –    |      |
|  | NSBC123TF3T5G               | 80  | 200 | –    |      |
|  | NSBC143EF3T5G               | 80  | 140 | –    |      |
|  | NSBC143ZF3T5G               | 80  | 140 | –    |      |
|  | NSBC123JF3T5G               | 80  | 140 | –    |      |
|  | NSBC144WF3T5G               | 80  | 140 | –    |      |
| Collector–Emitter Saturation Voltage (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA)<br>NSBC114EF3T5G/NSBC124EF3T5G/NSBC144EF3T5G<br>NSBC114YF3T5G/NSBC144WF3T5G/NSBC123JF3T5G<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)<br>NSBC143EF3T5G/NSBC143ZF3T5G/NSBC123TF3T5G/<br>NSBC114TF3T5G<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)<br>NSBC115TF3T5G | V <sub>CE(sat)</sub>        | –   | –   | 0.25 | Vdc  |
| Output Voltage (on)<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 2.5 V, R <sub>L</sub> = 1.0 kΩ)  | V <sub>OL</sub>             | –   | –   | 0.2  | Vdc  |
|  | NSBC114TF3T5G               | –   | –   | 0.2  |      |
|  | NSBC114EF3T5G               | –   | –   | 0.2  |      |
|  | NSBC124EF3T5G               | –   | –   | 0.2  |      |
|  | NSBC114YF3T5G               | –   | –   | 0.2  |      |
|  | NSBC123TF3T5G               | –   | –   | 0.2  |      |
|  | NSBC143EF3T5G               | –   | –   | 0.2  |      |
|  | NSBC143ZF3T5G               | –   | –   | 0.2  |      |
|  | NSBC123JF3T5G               | –   | –   | 0.2  |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0 kΩ)   | NSBC144EF3T5G               | –   | –   | 0.2  |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 4.0 V, R <sub>L</sub> = 1.0 kΩ)   | NSBC144WF3T5G               | –   | –   | 0.2  |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ)   | NSBC115TF3T5G               | –   | –   | 0.2  |      |

3. Pulse Test: Pulse Width < 300 μs, Duty Cycle < 2.0%.

## NSBC114EF3T5G Series

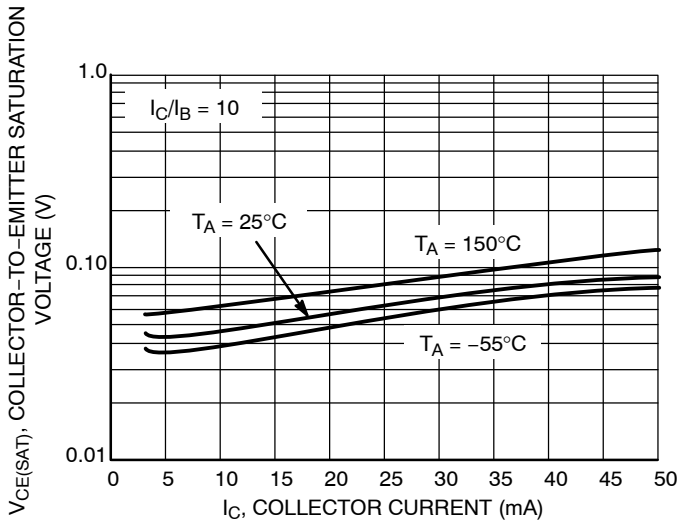
### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic   | Symbol                         | Min  | Typ   | Max  | Unit |
|--|--------------------------------|--|---|--|------|
| <b>ON CHARACTERISTICS</b> (Note 4)   |                                |  |   |  |      |
| Output Voltage (off) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.5 V, R <sub>L</sub> = 1.0 kΩ)<br>NSBC114EF3T5G/NSBC124EF3T5G/NSBC144EF3T5G<br>NSBC144YF3T5G/NSBC143EF3T5G/NSBC123JF3T5G<br>NSBC144WF3T5G<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ)<br>NSBC123TF3T5G/NSBC143ZF3T5G/NSBC114TF3T5G/<br>NSBC115TF3T5G | V <sub>OH</sub>                | 4.9  | –   | –  | Vdc  |
| Input Resistor   | R1                             | 7.0<br>7.0<br>15.4<br>32.9<br>7.0<br>1.5<br>3.3<br>3.3<br>1.54<br>32.9<br>70 | 10<br>10<br>22<br>47<br>10<br>2.2<br>4.7<br>4.7<br>2.2<br>47<br>100 | 13<br>13<br>28.6<br>61.1<br>13<br>2.9<br>6.1<br>6.1<br>2.86<br>61.1<br>130 | kΩ   |
| Resistor Ratio   | R <sub>1</sub> /R <sub>2</sub> | 0.8<br>0.17<br>–<br>0.055<br>0.038<br>1.7                                    | 1.0<br>0.21<br>–<br>0.1<br>0.047<br>2.1                             | 1.2<br>0.25<br>–<br>0.185<br>0.056<br>2.6                                  |      |

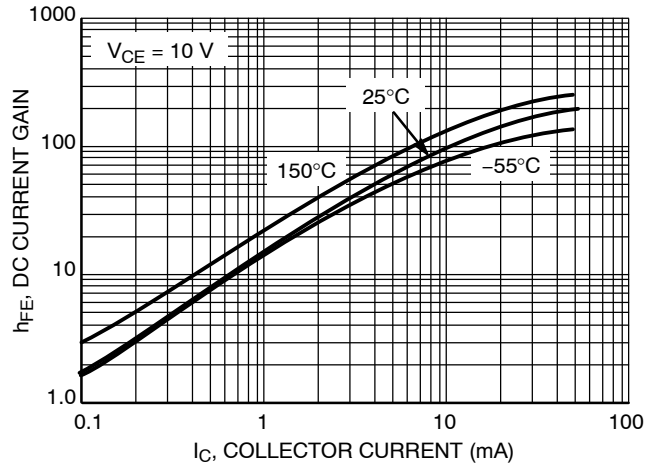
4. Pulse Test: Pulse Width < 300 μs, Duty Cycle < 2.0%.

# NSBC114EF3T5G Series

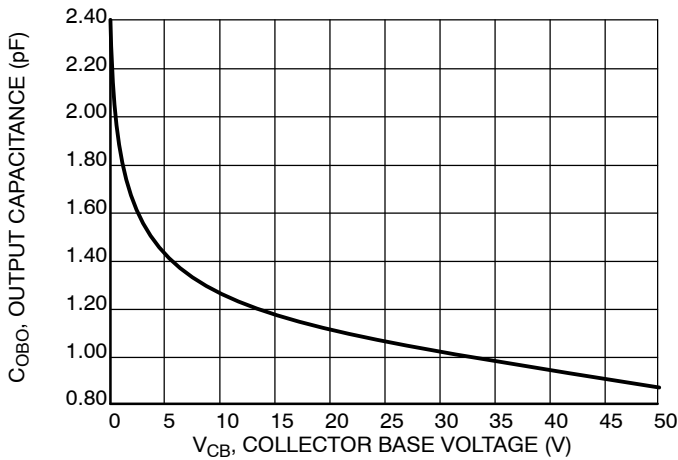
## TYPICAL ELECTRICAL CHARACTERISTICS – NSBC114EF3T5G



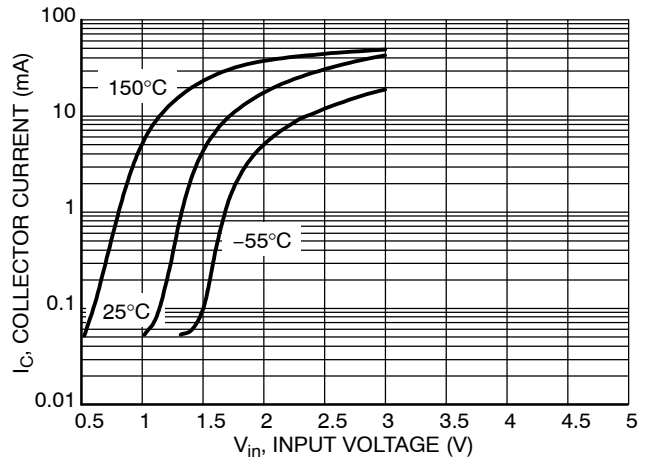
**Figure 1.  $V_{CE(sat)}$  vs.  $I_C$**



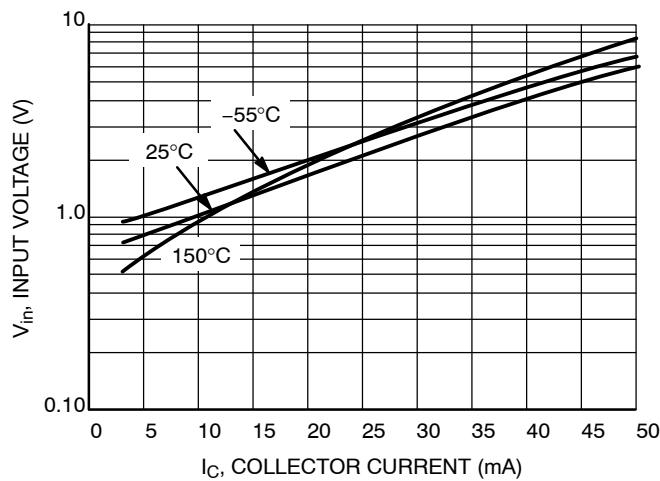
**Figure 2. DC Current Gain**



**Figure 3. Output Capacitance**



**Figure 4. Output Current vs. Input Voltage**



**Figure 5. Input Voltage vs. Output Current**

# NSBC114EF3T5G Series

## TYPICAL APPLICATIONS FOR NPN BRTs

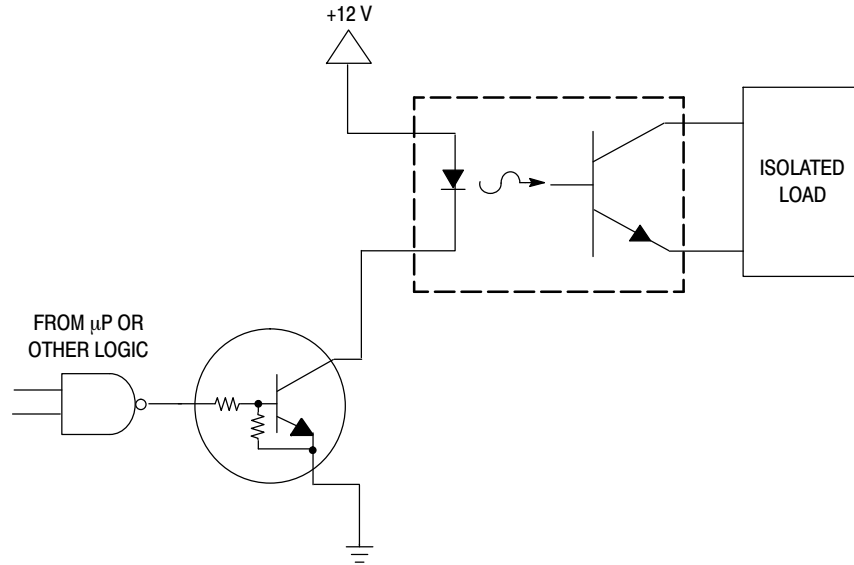


Figure 6. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

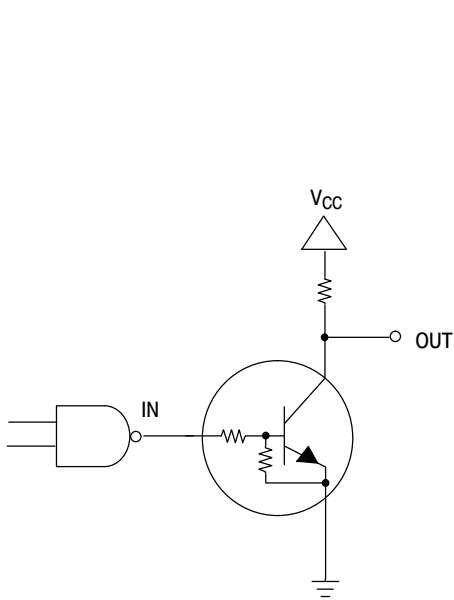


Figure 7. Open Collector Inverter: Inverts the Input Signal

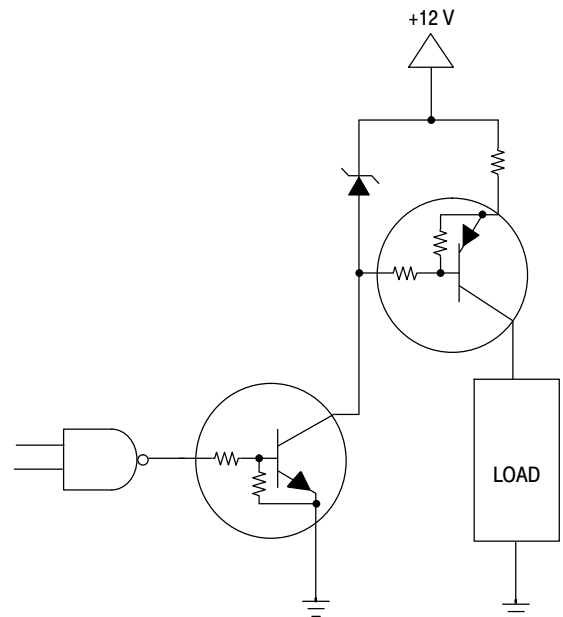
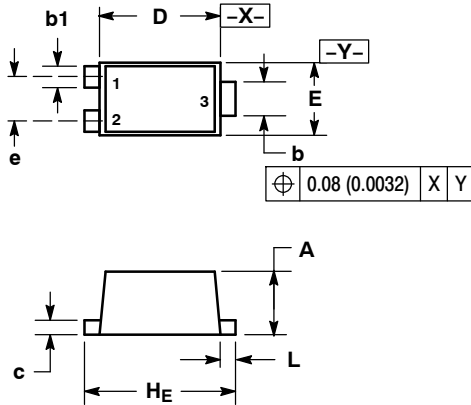


Figure 8. Inexpensive, Unregulated Current Source

# NSBC114EF3T5G Series

## PACKAGE DIMENSIONS

SOT-1123  
CASE 524AA-01  
ISSUE B



**NOTES:**

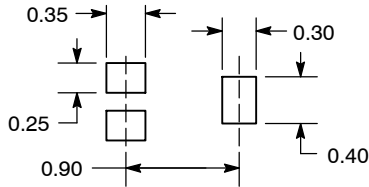
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.34        | 0.37 | 0.40 | 0.013  | 0.015 | 0.016 |
| b   | 0.15        | 0.22 | 0.28 | 0.006  | 0.009 | 0.011 |
| b1  | 0.10        | 0.15 | 0.20 | 0.004  | 0.006 | 0.008 |
| c   | 0.07        | 0.12 | 0.17 | 0.003  | 0.005 | 0.007 |
| D   | 0.75        | 0.80 | 0.85 | 0.030  | 0.031 | 0.033 |
| E   | 0.55        | 0.60 | 0.65 | 0.022  | 0.024 | 0.026 |
| e   | 0.35        | ---  | 0.40 | 0.014  | ---   | 0.016 |
| HE  | 0.95        | 1.00 | 1.05 | 0.037  | 0.039 | 0.041 |
| L   | 0.05        | 0.10 | 0.15 | 0.002  | 0.004 | 0.006 |

**STYLE 1:**


1. BASE
2. EMITTER
3. COLLECTOR

### SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*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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