

# MUN5313DW1, NSBC144EPDXV6, NSBC144EPDP6

## Complementary Bias Resistor Transistors R1 = 47 kΩ, R2 = 47 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> | 40  | 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> |
|----------------------------------------|---------|-----------------------|
| MUN5313DW1T1G,<br>SMUN5313DW1T1G*      | SOT-363 | 3,000/Tape & Reel     |
| SMUN5313DW1T3G*                        | SOT-363 | 10,000/Tape & Reel    |
| NSBC144EPDXV6T1G<br>NSVBC144EPDXV6T1G* | SOT-563 | 4,000/Tape & Reel     |
| NSBC144EPDXV6T5G                       | SOT-563 | 8,000/Tape & Reel     |
| NSBC144EPDP6T5G                        | SOT-963 | 8,000/Tape & Reel     |

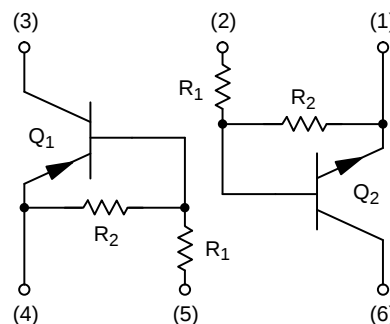
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



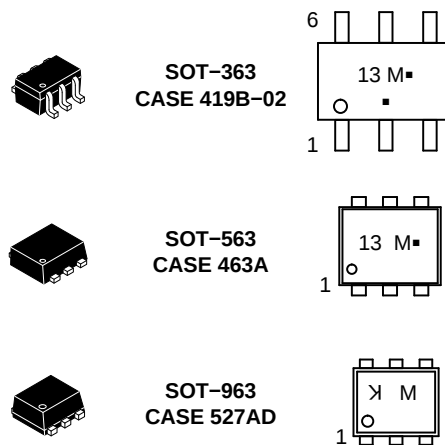
ON Semiconductor®

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#### PIN CONNECTIONS



#### MARKING DIAGRAMS



13/K = 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.

# MUN5313DW1, NSBC144EPDXV6, NSBC144EPDP6

## THERMAL CHARACTERISTICS

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

### MUN5313DW1 (SOT-363) ONE JUNCTION HEATED

|                                                                                                                  |                  |                          |                 |
|------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|-----------------|
| 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>   | 187<br>256<br>1.5<br>2.0 | mW<br><br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)                                                  | R <sub>θJA</sub> | 670<br>490               | °C/W            |

### MUN5313DW1 (SOT-363) BOTH JUNCTION HEATED (Note 3)

|                                                                                                                  |                                   |                          |                 |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------|-----------------|
| 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>                    | 250<br>385<br>2.0<br>3.0 | mW<br><br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)<br>(Note 2)                                                  | R <sub>θJA</sub>                  | 493<br>325               | °C/W            |
| Thermal Resistance,<br>Junction to Lead (Note 1)<br>(Note 2)                                                     | R <sub>θJL</sub>                  | 188<br>208               | °C/W            |
| Junction and Storage Temperature Range                                                                           | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150              | °C              |

### NSBC144EPDXV6 (SOT-563) ONE JUNCTION HEATED

|                                                                                          |                  |            |             |
|------------------------------------------------------------------------------------------|------------------|------------|-------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 1)<br>Derate above 25°C (Note 1) | P <sub>D</sub>   | 357<br>2.9 | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)                                      | R <sub>θJA</sub> | 350        | °C/W        |

### NSBC144EPDXV6 (SOT-563) BOTH JUNCTION HEATED (Note 3)

|                                                                                          |                                   |             |             |
|------------------------------------------------------------------------------------------|-----------------------------------|-------------|-------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 1)<br>Derate above 25°C (Note 1) | P <sub>D</sub>                    | 500<br>4.0  | mW<br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 1)                                      | R <sub>θJA</sub>                  | 250         | °C/W        |
| Junction and Storage Temperature Range                                                   | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C          |

### NSBC144EPDP6 (SOT-963) ONE JUNCTION HEATED

|                                                                                                                  |                  |                          |                 |
|------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|-----------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 4)<br>(Note 5)<br>Derate above 25°C (Note 4)<br>(Note 5) | P <sub>D</sub>   | 231<br>269<br>1.9<br>2.2 | MW<br><br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 4)<br>(Note 5)                                                  | R <sub>θJA</sub> | 540<br>464               | °C/W            |

### NSBC144EPDP6 (SOT-963) BOTH JUNCTION HEATED (Note 3)

|                                                                                                                  |                                   |                          |                 |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------|-----------------|
| Total Device Dissipation<br>T <sub>A</sub> = 25°C (Note 4)<br>(Note 5)<br>Derate above 25°C (Note 4)<br>(Note 5) | P <sub>D</sub>                    | 339<br>408<br>2.7<br>3.3 | MW<br><br>mW/°C |
| Thermal Resistance,<br>Junction to Ambient (Note 4)<br>(Note 5)                                                  | R <sub>θJA</sub>                  | 369<br>306               | °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 × 1.0 Inch Pad.
- Both junction heated values assume total power is sum of two equally powered channels.
- 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.

# MUN5313DW1, NSBC144EPDXV6, NSBC144EPDP6

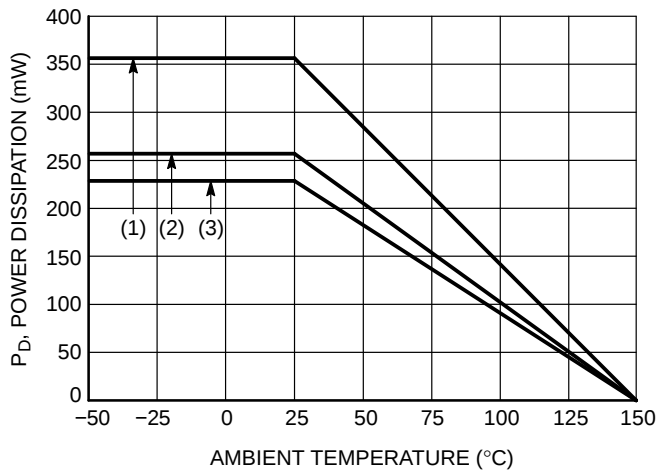
## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ both polarities $Q_1$ (PNP) & $Q_2$ (NPN), unless otherwise noted)

| 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>( $V_{EB} = 6.0\text{ V}$ , $I_C = 0$ )                | $I_{EBO}$     | –   | –   | 0.1 | 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 6)<br>( $I_C = 2.0\text{ mA}$ , $I_B = 0$ ) | $V_{(BR)CEO}$ | 50  | –   | –   | Vdc  |

## ON CHARACTERISTICS

|                                                                                                                                                                 |               |        |            |        |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|------------|--------|------------|
| DC Current Gain (Note 6)<br>( $I_C = 5.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ )                                                                                  | $h_{FE}$      | 80     | 140        | –      |            |
| Collector-Emitter Saturation Voltage (Note 6)<br>( $I_C = 10\text{ mA}$ , $I_B = 0.3\text{ mA}$ )                                                               | $V_{CE(sat)}$ | –      | –          | 0.25   | V          |
| Input Voltage (Off)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 100\text{ }\mu\text{A}$ ) (NPN)<br>( $V_{CE} = 5.0\text{ V}$ , $I_C = 100\text{ }\mu\text{A}$ ) (PNP) | $V_{i(off)}$  | –<br>– | 1.2<br>1.2 | –<br>– | Vdc        |
| Input Voltage (On)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 3.0\text{ mA}$ ) (NPN)<br>( $V_{CE} = 0.2\text{ V}$ , $I_C = 3.0\text{ mA}$ ) (PNP)                    | $V_{i(on)}$   | –<br>– | 1.9<br>2.0 | –<br>– | Vdc        |
| Output Voltage (On)<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 3.5\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ )                                                          | $V_{OL}$      | –      | –          | 0.2    | Vdc        |
| Output Voltage (Off)<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 0.5\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ )                                                         | $V_{OH}$      | 4.9    | –          | –      | Vdc        |
| Input Resistor                                                                                                                                                  | $R_1$         | 32.9   | 47         | 61.1   | k $\Omega$ |
| Resistor Ratio                                                                                                                                                  | $R_1/R_2$     | 0.8    | 1.0        | 1.2    |            |

6. 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
- (3) SOT-963; 100 mm<sup>2</sup>, 1 oz. Copper Trace

Figure 1. Derating Curve

TYPICAL CHARACTERISTICS – NPN TRANSISTOR  
MUN5313DW1, NSBC144EPDXV6

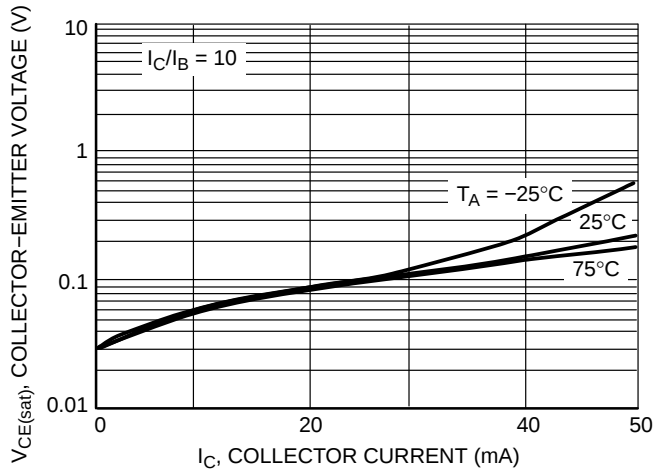


Figure 2.  $V_{CE(sat)}$  vs.  $I_C$

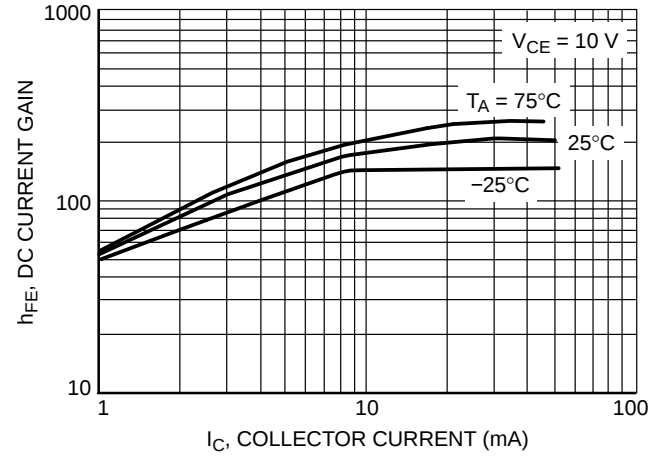


Figure 3. DC Current Gain

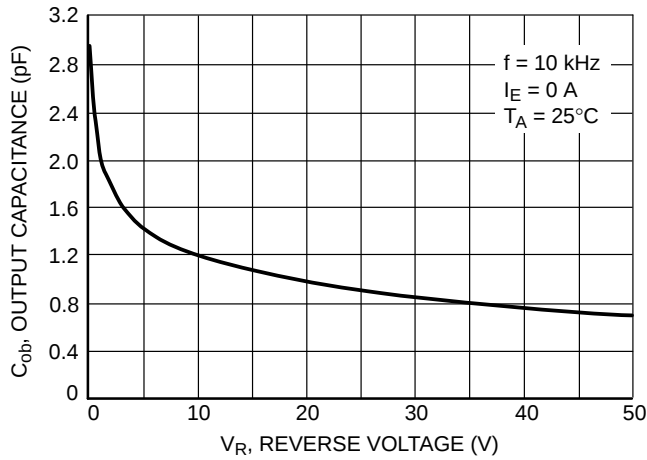


Figure 4. Output Capacitance

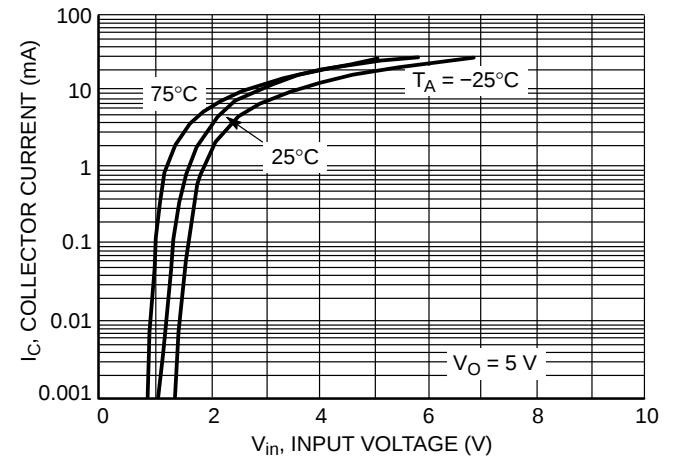


Figure 5. Output Current vs. Input Voltage

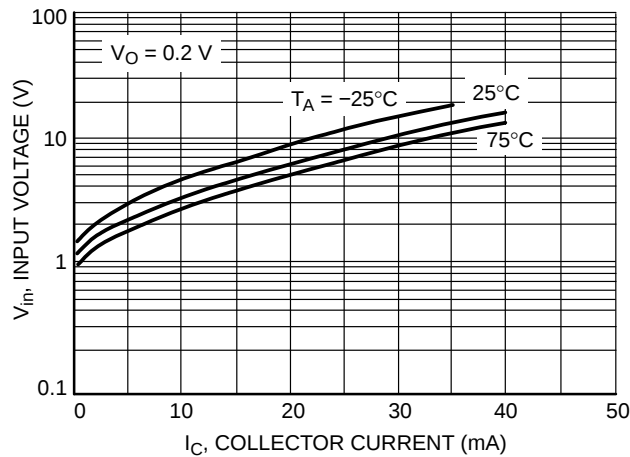


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – PNP TRANSISTOR  
MUN5313DW1, NSBC144EPDXV6

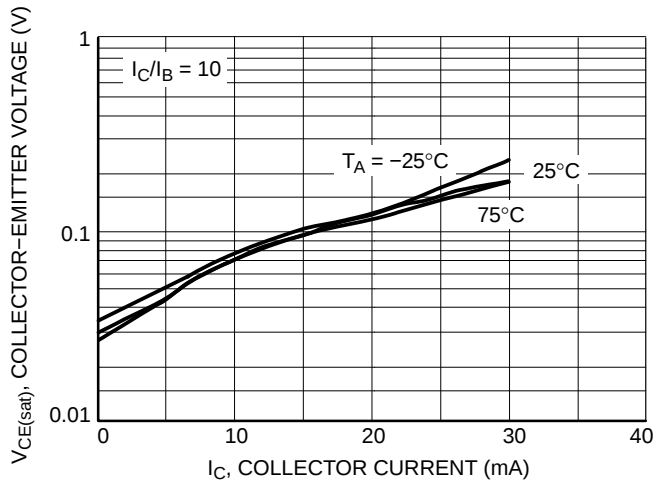


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

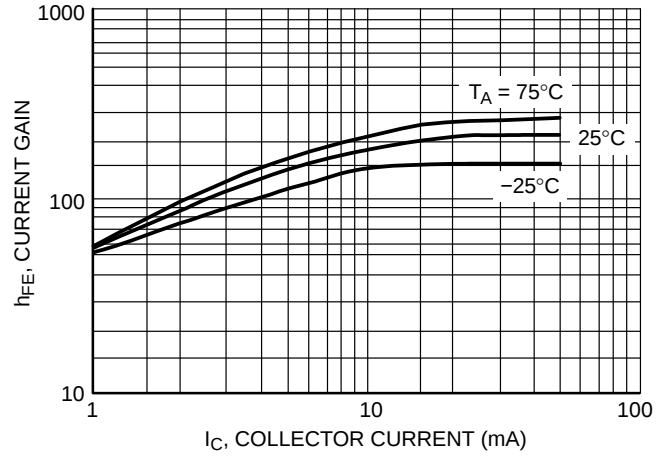


Figure 8. DC Current Gain

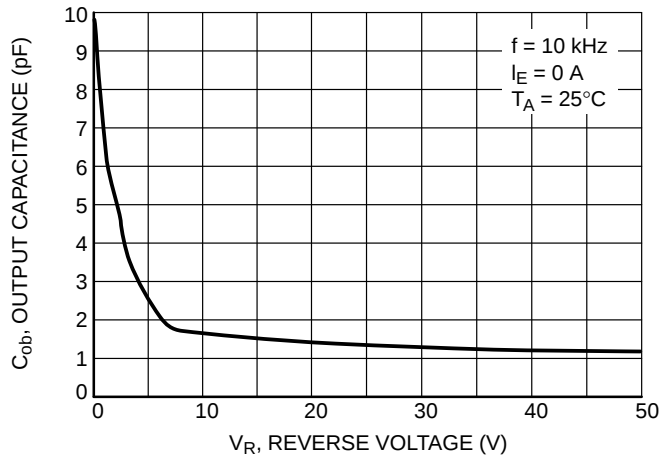


Figure 9. Output Capacitance

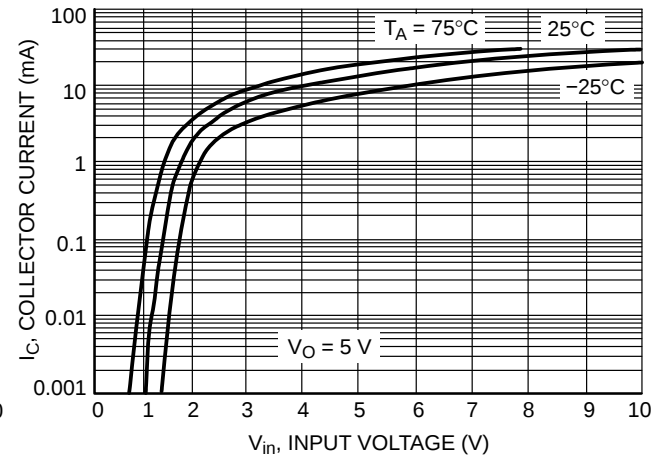


Figure 10. Output Current vs. Input Voltage

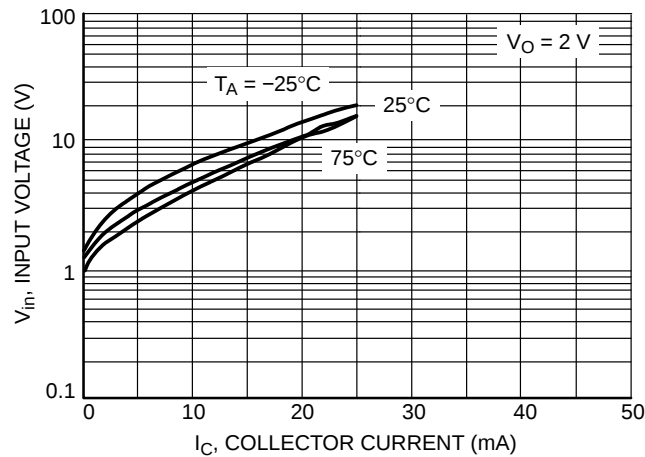


Figure 11. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – NPN TRANSISTOR  
NSBC144EPDP6

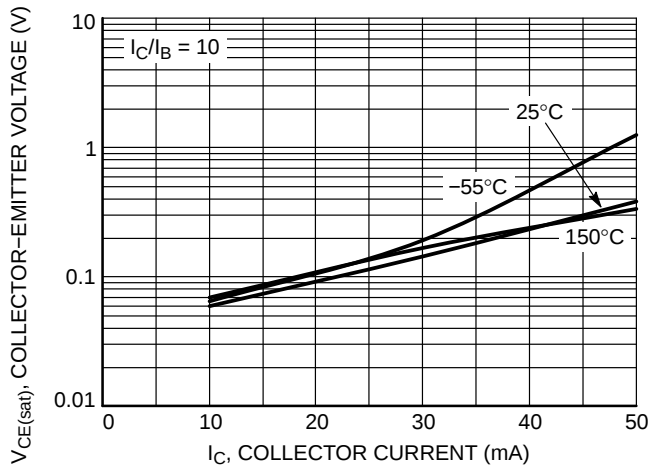


Figure 12.  $V_{CE(sat)}$  vs.  $I_C$

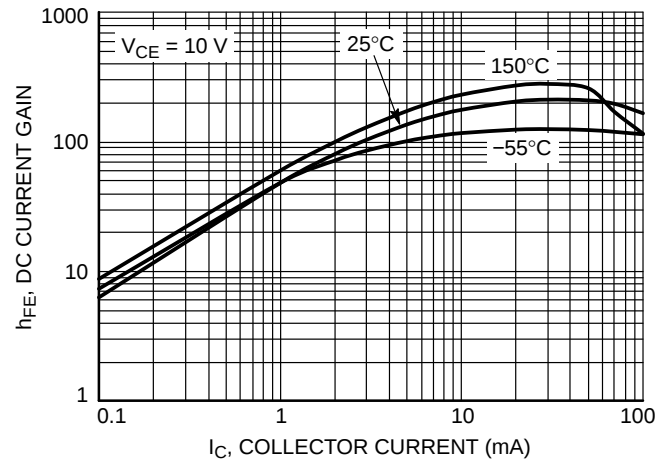


Figure 13. DC Current Gain

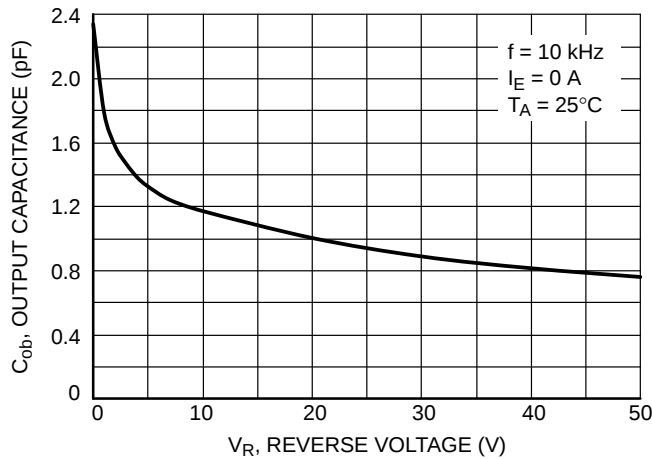


Figure 14. Output Capacitance

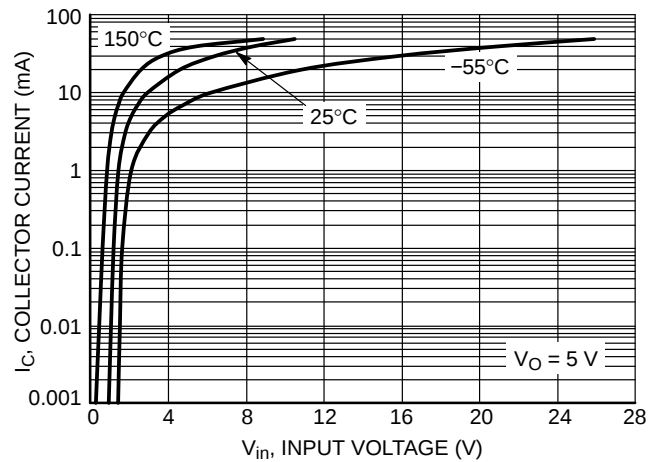


Figure 15. Output Current vs. Input Voltage

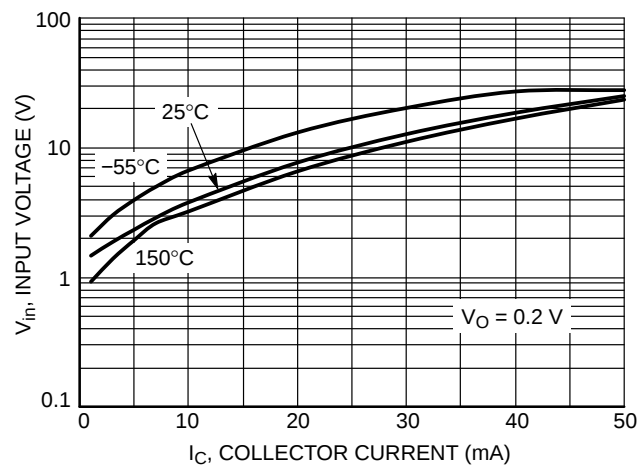


Figure 16. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – PNP TRANSISTOR  
NSBC144EPDP6

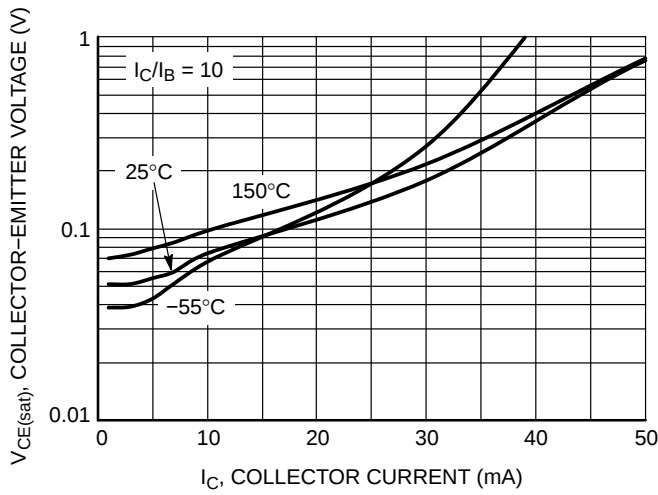


Figure 17.  $V_{CE(sat)}$  vs.  $I_C$

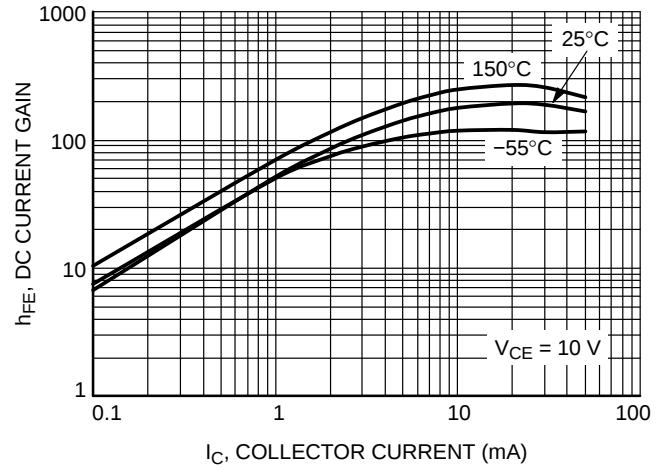


Figure 18. DC Current Gain

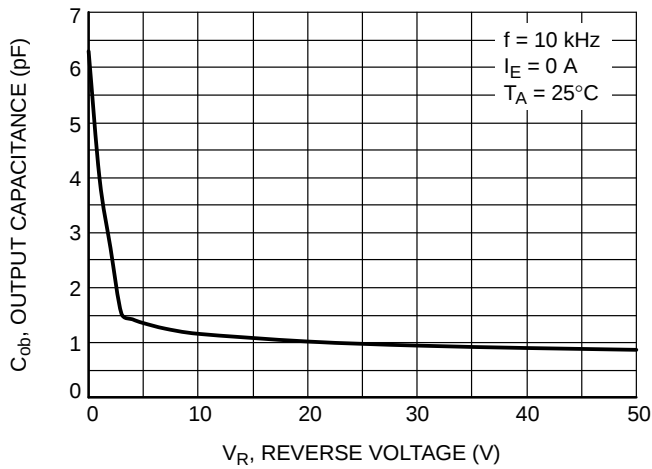


Figure 19. Output Capacitance

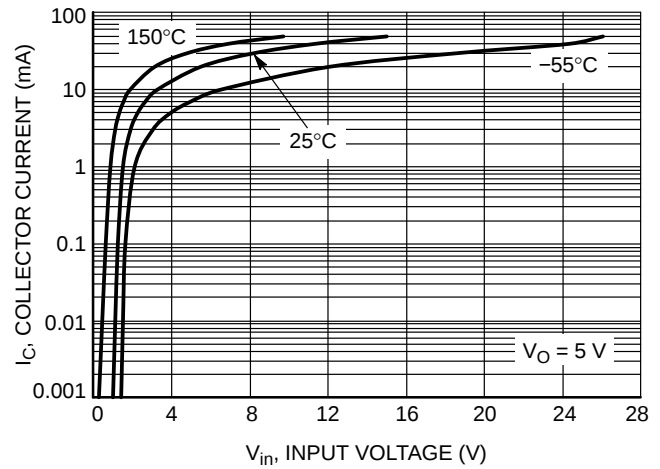


Figure 20. Output Current vs. Input Voltage

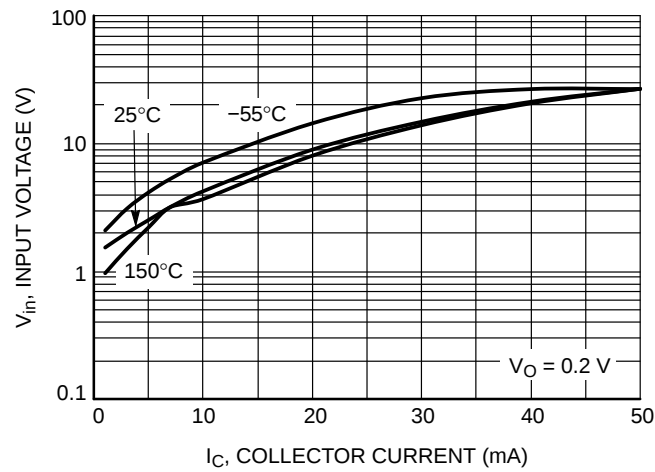


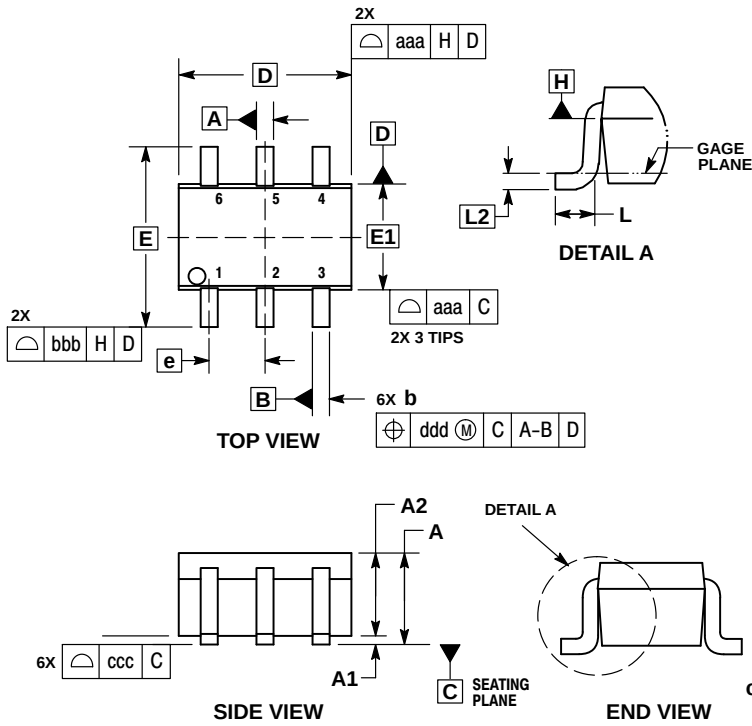
Figure 21. Input Voltage vs. Output Current

## PACKAGE DIMENSIONS

SC-88/SC70-6/SOT-363

CASE 419B-02

ISSUE Y

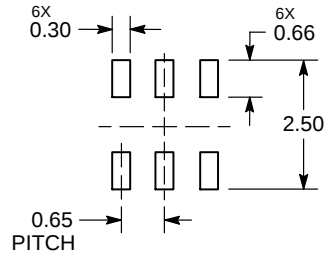


## NOTES:

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     |       |       |

## RECOMMENDED SOLDERING FOOTPRINT\*

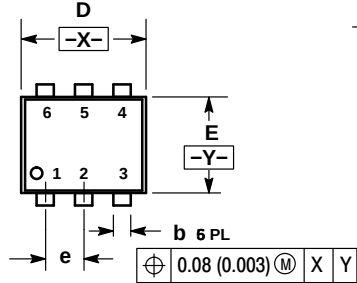


DIMENSIONS: MILLIMETERS

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

# PACKAGE DIMENSIONS

## SOT-563, 6 LEAD CASE 463A ISSUE G

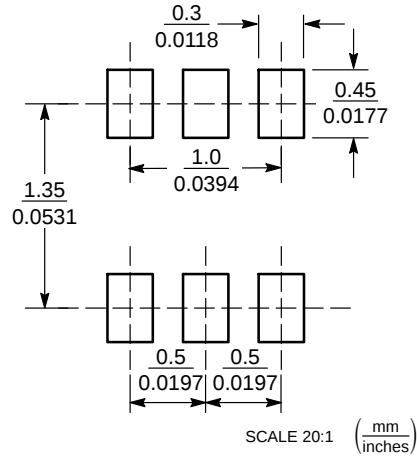


### NOTES:

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.

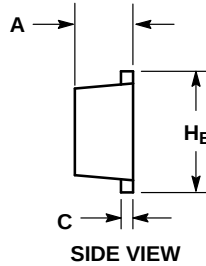
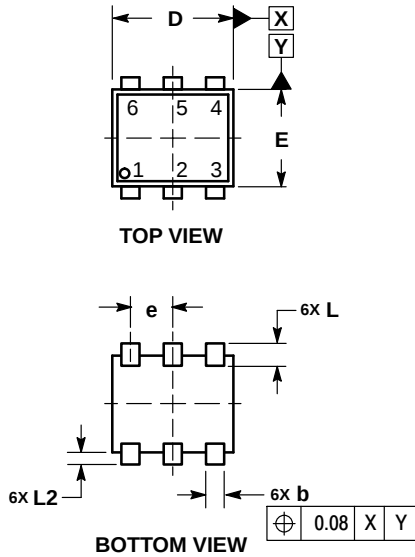
| DIM            | MILLIMETERS |      |      | INCHES   |       |       |
|----------------|-------------|------|------|----------|-------|-------|
|                | MIN         | NOM  | MAX  | MIN      | NOM   | MAX   |
| A              | 0.50        | 0.55 | 0.60 | 0.020    | 0.021 | 0.023 |
| b              | 0.17        | 0.22 | 0.27 | 0.007    | 0.009 | 0.011 |
| C              | 0.08        | 0.12 | 0.18 | 0.003    | 0.005 | 0.007 |
| D              | 1.50        | 1.60 | 1.70 | 0.059    | 0.062 | 0.066 |
| E              | 1.10        | 1.20 | 1.30 | 0.043    | 0.047 | 0.051 |
| e              | 0.5 BSC     |      |      | 0.02 BSC |       |       |
| L              | 0.10        | 0.20 | 0.30 | 0.004    | 0.008 | 0.012 |
| H <sub>E</sub> | 1.50        | 1.60 | 1.70 | 0.059    | 0.062 | 0.066 |

## 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.

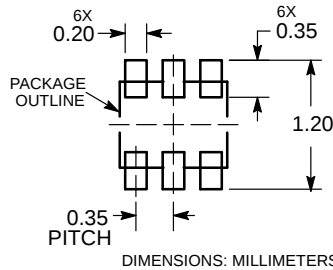
## PACKAGE DIMENSIONS

SOT-963  
CASE 527AD  
ISSUE E

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
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 |      |      |
|----------------|-------------|------|------|
|                | MIN         | NOM  | MAX  |
| A              | 0.34        | 0.37 | 0.40 |
| b              | 0.10        | 0.15 | 0.20 |
| C              | 0.07        | 0.12 | 0.17 |
| D              | 0.95        | 1.00 | 1.05 |
| E              | 0.75        | 0.80 | 0.85 |
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RECOMMENDED  
MOUNTING 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.

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