

# NST3946DXV6T1G, NST3946DXV6T5G

## Complementary General Purpose Transistor

The NST3946DXV6T1 device is a spin-off of our popular SOT-23/SOT-323 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-563 six-leaded surface mount package. By putting two discrete devices in one package, this device is ideal for low-power surface mount applications where board space is at a premium.

- $h_{FE}$ , 100–300
- Low  $V_{CE(sat)}$ ,  $\leq 0.4$  V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

**Table 1. MAXIMUM RATINGS**

| Rating                                           | Symbol    | Value                 | Unit |
|--------------------------------------------------|-----------|-----------------------|------|
| Collector–Emitter Voltage<br>(NPN)<br>(PNP)      | $V_{CEO}$ | 40<br>–40             | Vdc  |
| Collector–Base Voltage<br>(NPN)<br>(PNP)         | $V_{CBO}$ | 60<br>–40             | Vdc  |
| Emitter–Base Voltage<br>(NPN)<br>(PNP)           | $V_{EBO}$ | 6.0<br>–5.0           | Vdc  |
| Collector Current – Continuous<br>(NPN)<br>(PNP) | $I_C$     | 200<br>–200           | mAdc |
| Electrostatic Discharge                          | ESD       | HBM>16000,<br>MM>2000 | V    |

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.

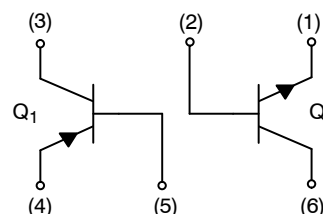


**ON Semiconductor®**

<http://onsemi.com>



**SOT-563  
CASE 463A**



**NST3946DXV6T1\***

\*Q1 PNP  
Q2 NPN

### MARKING DIAGRAM



46 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device         | Package              | Shipping†         |
|----------------|----------------------|-------------------|
| NST3946DXV6T1G | SOT-563<br>(Pb-Free) | 4,000/Tape & Reel |
| NST3946DXV6T5G | SOT-563<br>(Pb-Free) | 8,000/Tape & Reel |

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

# NST3946DXV6T1G, NST3946DXV6T5G

**Table 2. THERMAL CHARACTERISTICS**

| Characteristic (One Junction Heated)          | Symbol          | Max                                | Unit        |
|-----------------------------------------------|-----------------|------------------------------------|-------------|
| Total Device Dissipation<br>Derate above 25°C | $P_D$           | 357<br>(Note 1)<br>2.9<br>(Note 1) | mW<br>mW/°C |
| Thermal Resistance<br>Junction-to-Ambient     | $R_{\theta JA}$ | 350<br>(Note 1)                    | °C/W        |
| Characteristic (Both Junctions Heated)        | Symbol          | Max                                | Unit        |
| Total Device Dissipation<br>Derate above 25°C | $P_D$           | 500<br>(Note 1)<br>4.0<br>(Note 1) | mW<br>mW/°C |
| Thermal Resistance Junction-to-Ambient        | $R_{\theta JA}$ | 250<br>(Note 1)                    | °C/W        |
| Junction and Storage Temperature Range        | $T_J, T_{stg}$  | 55 to +150                         | °C          |

1. FR-4 @ Minimum Pad

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

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

### OFF CHARACTERISTICS

|                                                                                                                                                  |                |               |             |           |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|-------------|-----------|------|
| Collector – Emitter Breakdown Voltage (Note 2)<br>( $I_C = 1.0 \text{ mAdc}, I_B = 0$ )<br>( $I_C = -1.0 \text{ mAdc}, I_B = 0$ )                | (NPN)<br>(PNP) | $V_{(BR)CEO}$ | 40<br>–40   | –<br>–    | Vdc  |
| Collector – Base Breakdown Voltage<br>( $I_C = 10 \text{ }\mu\text{Adc}, I_E = 0$ )<br>( $I_C = -10 \text{ }\mu\text{Adc}, I_E = 0$ )            | (NPN)<br>(PNP) | $V_{(BR)CBO}$ | 60<br>–40   | –<br>–    | Vdc  |
| Emitter – Base Breakdown Voltage<br>( $I_E = 10 \text{ }\mu\text{Adc}, I_C = 0$ )<br>( $I_E = -10 \text{ }\mu\text{Adc}, I_C = 0$ )              | (NPN)<br>(PNP) | $V_{(BR)EBO}$ | 6.0<br>–5.0 | –<br>–    | Vdc  |
| Base Cutoff Current<br>( $V_{CE} = 30 \text{ Vdc}, V_{EB} = 3.0 \text{ Vdc}$ )<br>( $V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$ )      | (NPN)<br>(PNP) | $I_{BL}$      | –<br>–      | 50<br>–50 | nAdc |
| Collector Cutoff Current<br>( $V_{CE} = 30 \text{ Vdc}, V_{EB} = 3.0 \text{ Vdc}$ )<br>( $V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$ ) | (NPN)<br>(PNP) | $I_{CEX}$     | –<br>–      | 50<br>–50 | nAdc |

### ON CHARACTERISTICS (Note 2)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |               |                                                                |                                                        |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------|----------------------------------------------------------------|--------------------------------------------------------|-----|
| DC Current Gain<br>( $I_C = 0.1 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ )<br><br>( $I_C = -0.1 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$ )<br>( $I_C = -1.0 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$ )<br>( $I_C = -10 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$ )<br>( $I_C = -50 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$ )<br>( $I_C = -100 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$ ) | (NPN)<br><br><br><br><br><br>(PNP) | $h_{FE}$      | 40<br>70<br>100<br>60<br>30<br><br>60<br>80<br>100<br>60<br>30 | –<br>–<br>300<br>–<br>–<br><br>–<br>–<br>300<br>–<br>– | –   |
| Collector – Emitter Saturation Voltage<br>( $I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$ )<br>( $I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$ )<br><br>( $I_C = -10 \text{ mAdc}, I_B = -1.0 \text{ mAdc}$ )<br>( $I_C = -50 \text{ mAdc}, I_B = -5.0 \text{ mAdc}$ )                                                                                                                                                                                                                                                                                                                                                    | (NPN)<br><br><br>(PNP)             | $V_{CE(sat)}$ | –<br>–<br><br>–<br>–                                           | 0.2<br>0.3<br><br>–0.25<br>–0.4                        | Vdc |
| Base – Emitter Saturation Voltage<br>( $I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$ )<br>( $I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$ )<br><br>( $I_C = -10 \text{ mAdc}, I_B = -1.0 \text{ mAdc}$ )<br>( $I_C = -50 \text{ mAdc}, I_B = -5.0 \text{ mAdc}$ )                                                                                                                                                                                                                                                                                                                                                         | (NPN)<br><br><br>(PNP)             | $V_{BE(sat)}$ | 0.65<br>–<br><br>–0.65<br>–                                    | 0.85<br>0.95<br><br>–0.85<br>–0.95                     | Vdc |

# NST3946DXV6T1G, NST3946DXV6T5G

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

| Characteristic                                                                                                                                                                                                   | Symbol                             | Min        | Max         | Unit               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------|-------------|--------------------|
| <b>SMALL-SIGNAL CHARACTERISTICS</b>                                                                                                                                                                              |                                    |            |             |                    |
| Current-Gain – Bandwidth Product<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)<br>(I <sub>C</sub> = -10 mAdc, V <sub>CE</sub> = -20 Vdc, f = 100 MHz)                                     | (NPN)<br>(PNP)<br>f <sub>T</sub>   | 300<br>250 | –<br>–      | MHz                |
| Output Capacitance<br>(V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)<br>(V <sub>CB</sub> = -5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)                                                              | (NPN)<br>(PNP)<br>C <sub>obo</sub> | –<br>–     | 4.0<br>4.5  | pF                 |
| Input Capacitance<br>(V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)<br>(V <sub>EB</sub> = -0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)                                                               | (NPN)<br>(PNP)<br>C <sub>ibo</sub> | –<br>–     | 8.0<br>10.0 | pF                 |
| Input Impedance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mAdc, f = 1.0 kHz)                                                    | (NPN)<br>(PNP)<br>h <sub>ie</sub>  | 1.0<br>2.0 | 10<br>12    | k Ω                |
| Voltage Feedback Ratio<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mAdc, f = 1.0 kHz)                                             | (NPN)<br>(PNP)<br>h <sub>re</sub>  | 0.5<br>0.1 | 8.0<br>10   | X 10 <sup>-4</sup> |
| Small-Signal Current Gain<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mAdc, f = 1.0 kHz)                                          | (NPN)<br>(PNP)<br>h <sub>fe</sub>  | 100<br>100 | 400<br>400  | –                  |
| Output Admittance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mAdc, f = 1.0 kHz)                                                  | (NPN)<br>(PNP)<br>h <sub>oe</sub>  | 1.0<br>3.0 | 40<br>60    | μmhos              |
| Noise Figure<br>(V <sub>CE</sub> = 5.0 Vdc, I <sub>C</sub> = 100 μAdc, R <sub>S</sub> = 1.0 k Ω, f = 1.0 kHz)<br>(V <sub>CE</sub> = -5.0 Vdc, I <sub>C</sub> = -100 μAdc, R <sub>S</sub> = 1.0 k Ω, f = 1.0 kHz) | (NPN)<br>(PNP)<br>NF               | –<br>–     | 5.0<br>4.0  | dB                 |

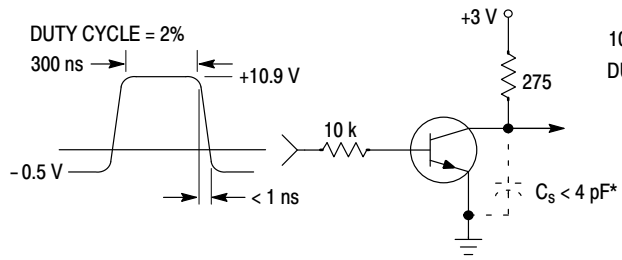
## SWITCHING CHARACTERISTICS

|                                                                                                                                  |                                  |        |            |    |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|------------|----|
| Delay Time<br>(V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = -0.5 Vdc)<br>(V <sub>CC</sub> = -3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc) | (NPN)<br>(PNP)<br>t <sub>d</sub> | –<br>– | 35<br>35   | ns |
| Rise Time<br>(I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 1.0 mAdc)<br>(I <sub>C</sub> = -10 mAdc, I <sub>B1</sub> = -1.0 mAdc)  | (NPN)<br>(PNP)<br>t <sub>r</sub> | –<br>– | 35<br>35   |    |
| Storage Time<br>(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mAdc)<br>(V <sub>CC</sub> = -3.0 Vdc, I <sub>C</sub> = -10 mAdc) | (NPN)<br>(PNP)<br>t <sub>s</sub> | –<br>– | 200<br>225 | ns |
| Fall Time<br>(I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc)<br>(I <sub>B1</sub> = I <sub>B2</sub> = -1.0 mAdc)                   | (NPN)<br>(PNP)<br>t <sub>f</sub> | –<br>– | 50<br>75   |    |

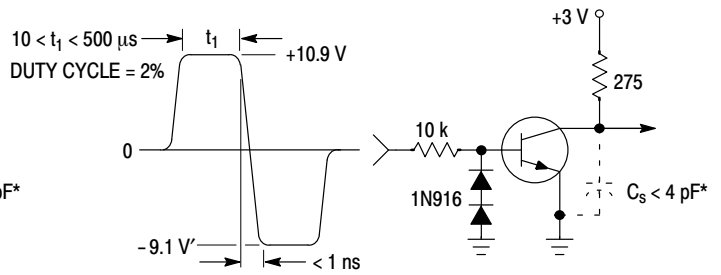
2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

# NST3946DXV6T1G, NST3946DXV6T5G

(NPN)



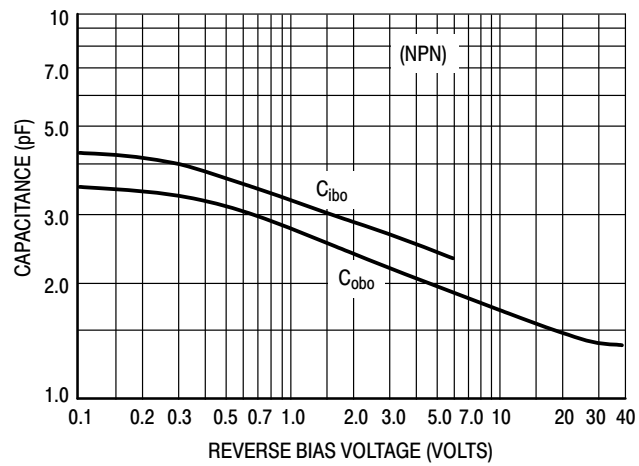
**Figure 1. Delay and Rise Time  
Equivalent Test Circuit**



**Figure 2. Storage and Fall Time  
Equivalent Test Circuit**

\* Total shunt capacitance of test jig and connectors

## TYPICAL TRANSIENT CHARACTERISTICS



**Figure 3. Capacitance**

(NPN)

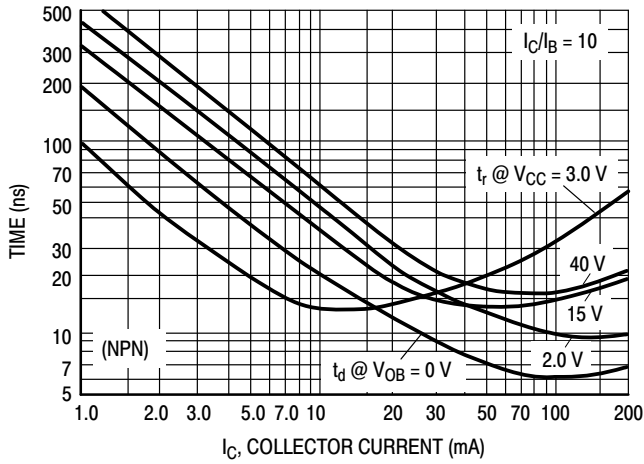


Figure 4. Turn-On Time

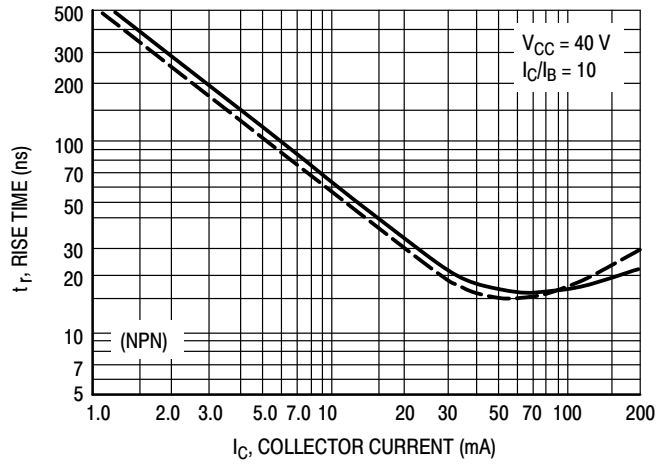


Figure 5. Rise Time

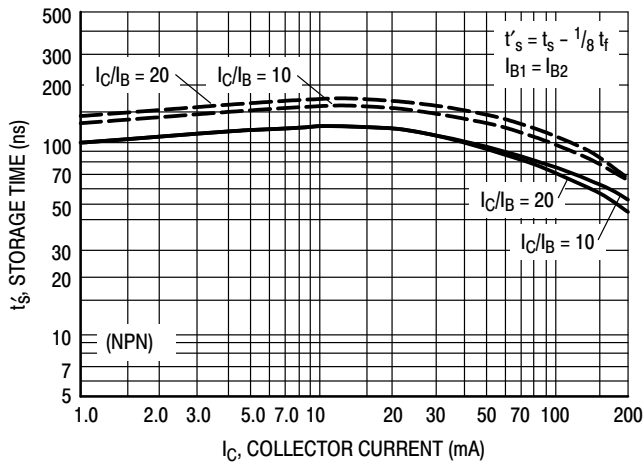


Figure 6. Storage Time

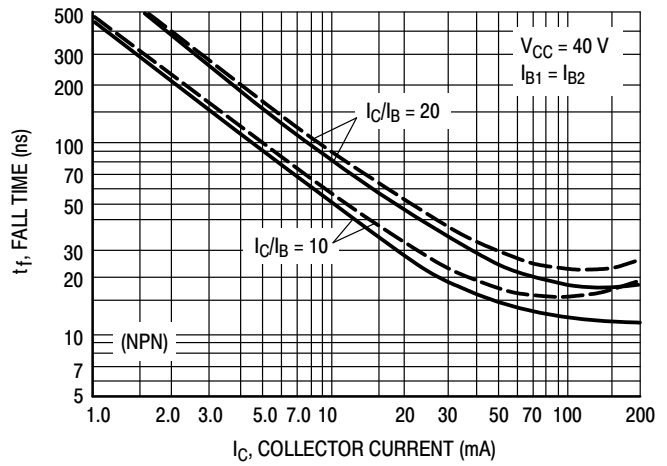


Figure 7. Fall Time

### TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

( $V_{CE} = 5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)

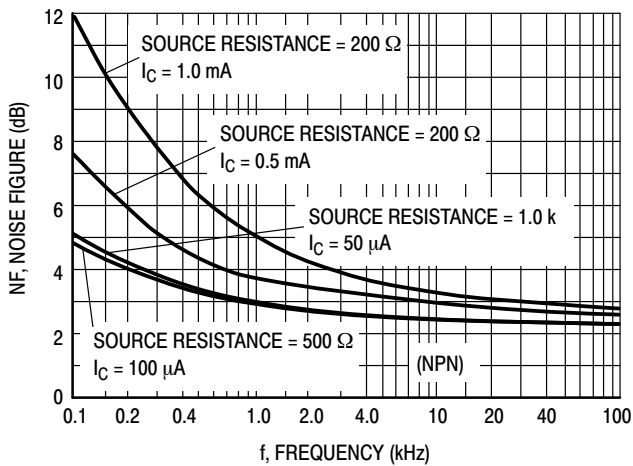


Figure 8. Noise Figure

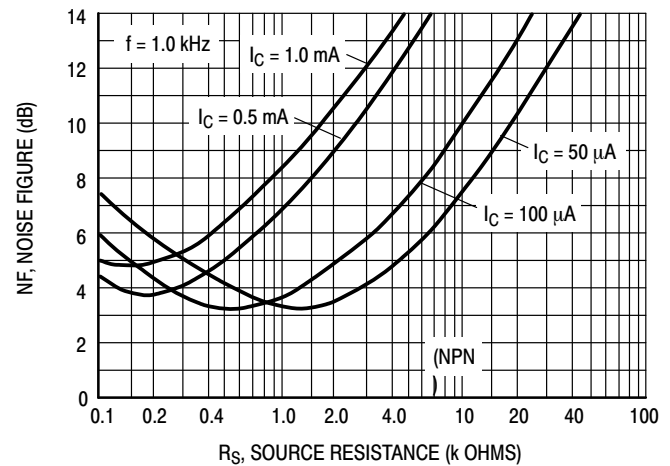


Figure 9. Noise Figure

# NST3946DXV6T1G, NST3946DXV6T5G

(NPN)

## h PARAMETERS

( $V_{CE} = 10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$ )

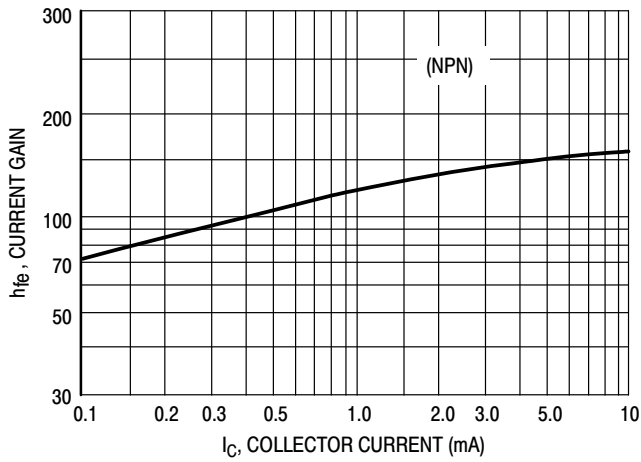


Figure 10. Current Gain

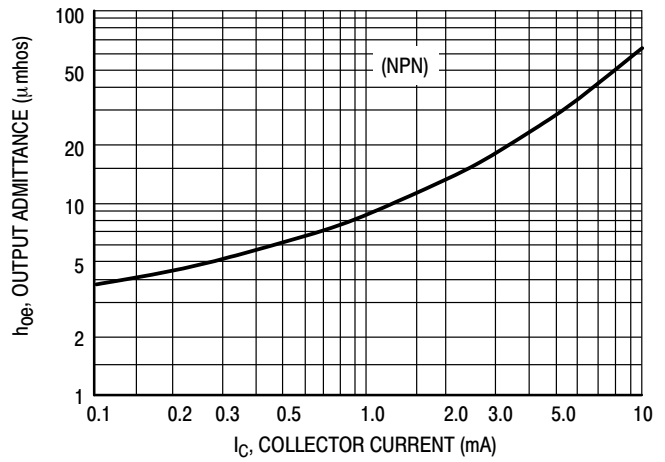


Figure 11. Output Admittance

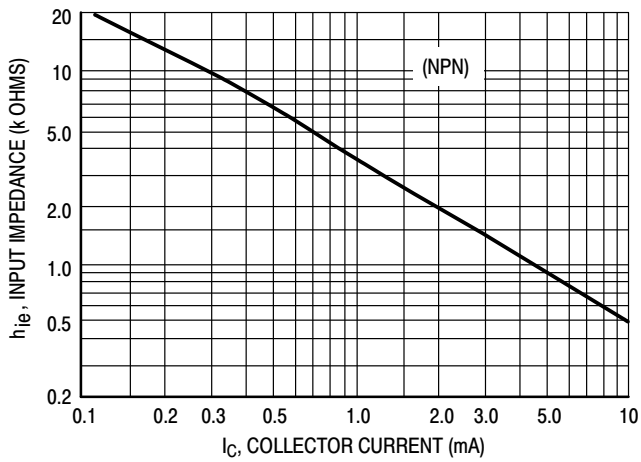


Figure 12. Input Impedance

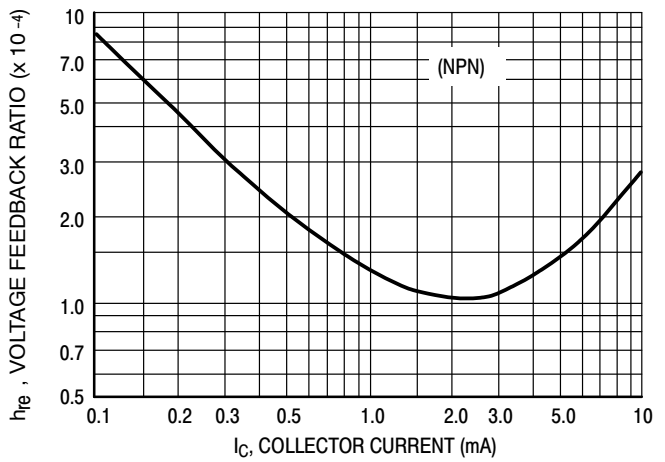


Figure 13. Voltage Feedback Ratio

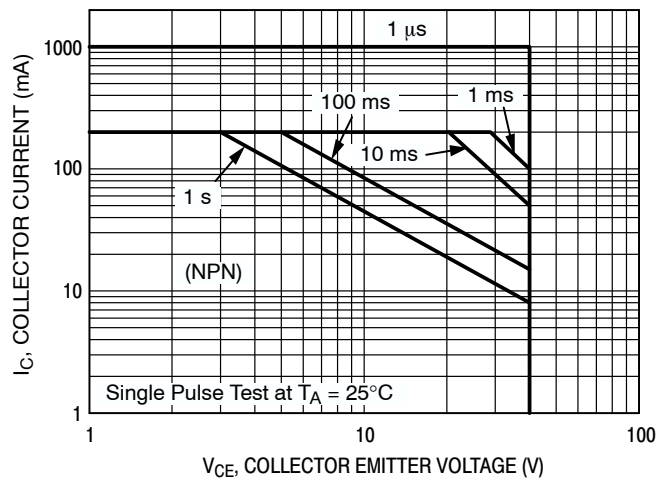


Figure 14. Safe Operating Area

# NST3946DXV6T1G, NST3946DXV6T5G

(NPN)

## TYPICAL STATIC CHARACTERISTICS

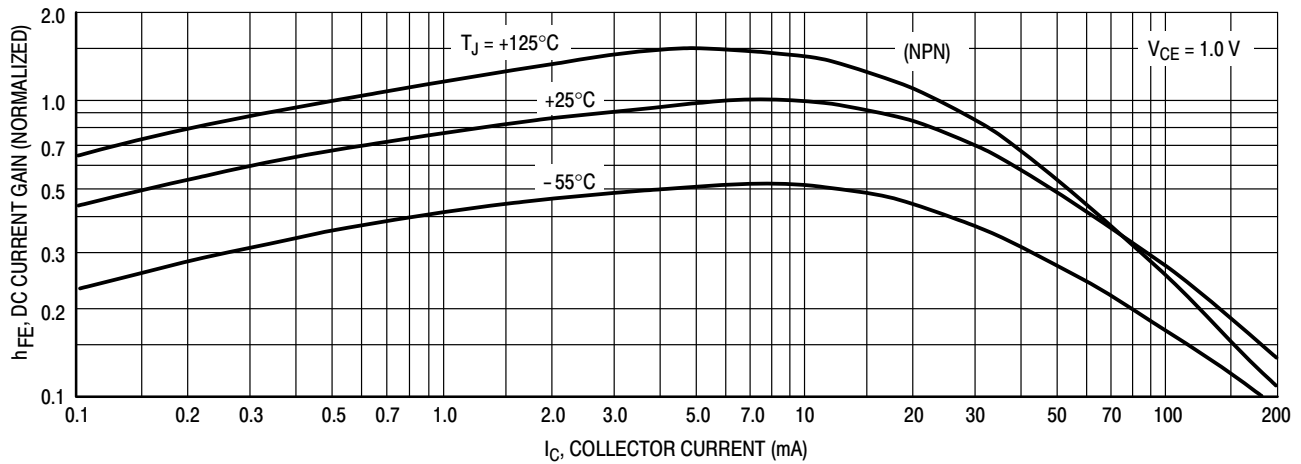


Figure 15. DC Current Gain

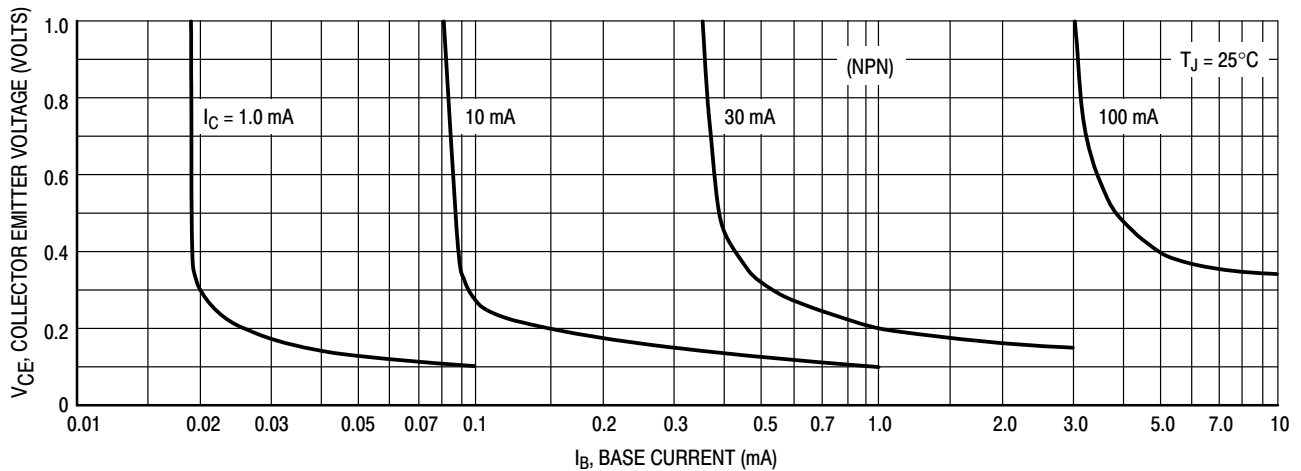


Figure 16. Collector Saturation Region

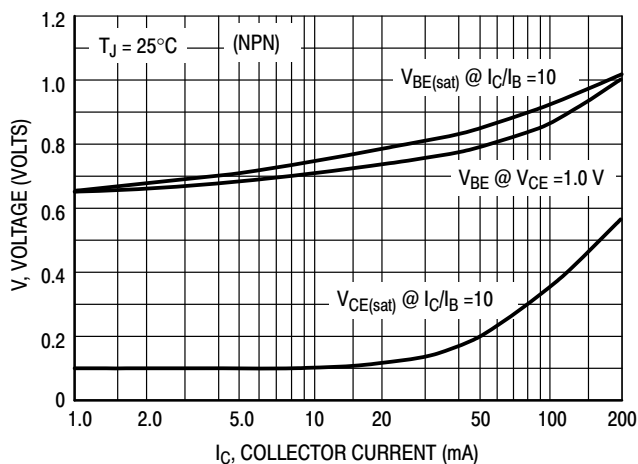


Figure 17. "ON" Voltages

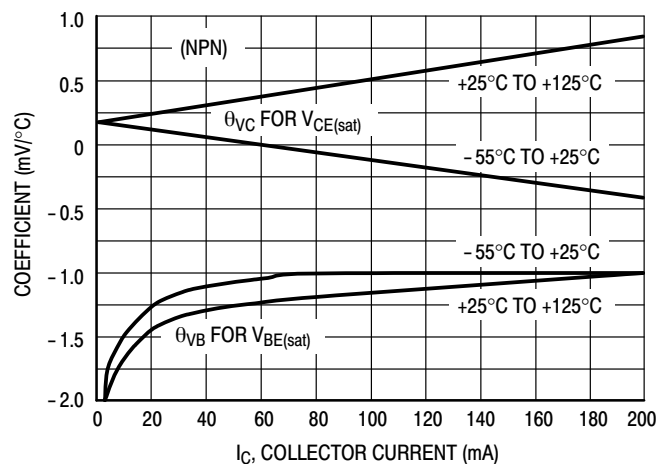


Figure 18. Temperature Coefficients

# NST3946DXV6T1G, NST3946DXV6T5G

(PNP)

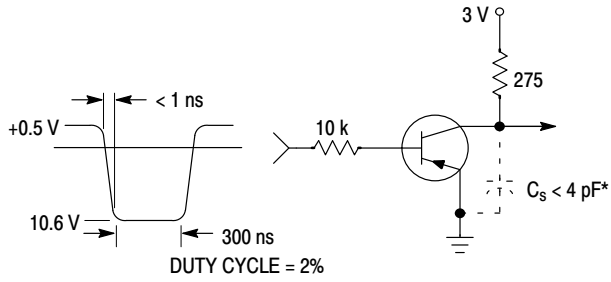


Figure 19. Delay and Rise Time Equivalent Test Circuit

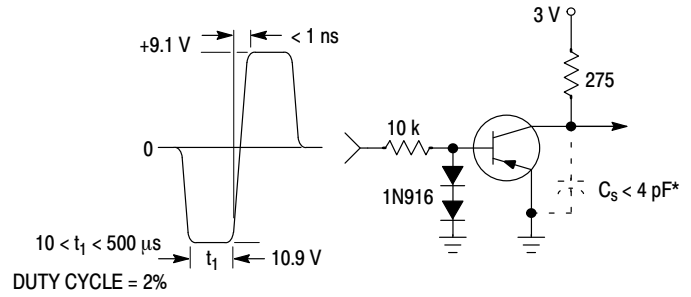


Figure 20. Storage and Fall Time Equivalent Test Circuit

## TYPICAL TRANSIENT CHARACTERISTICS

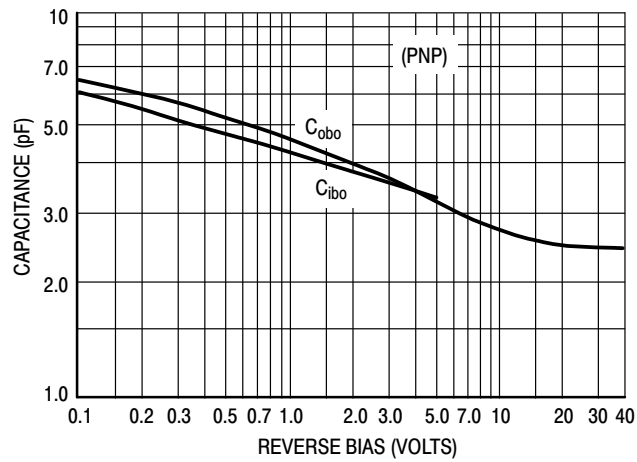


Figure 21. Capacitance

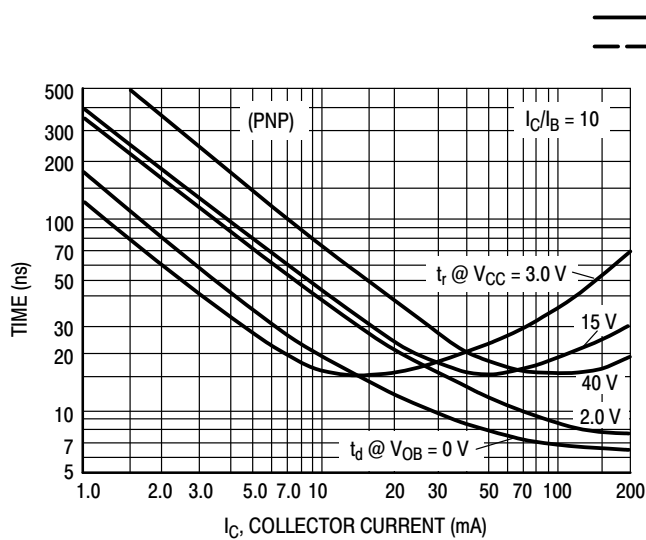


Figure 22. Turn-On Time

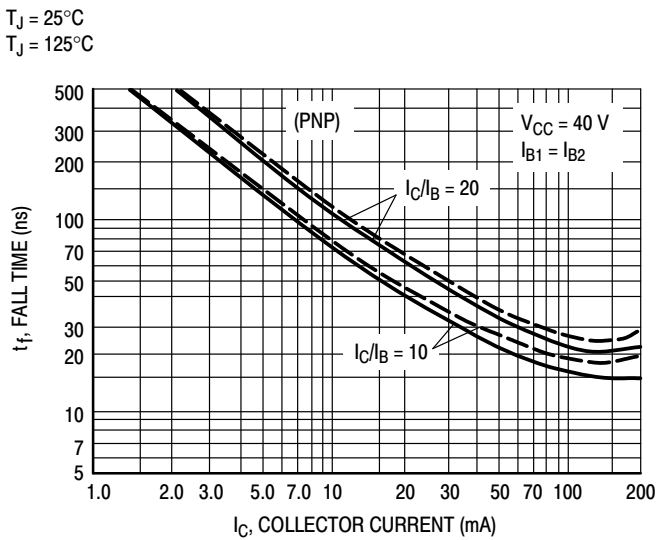


Figure 23. Fall Time

(PNP)

# **TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS** **NOISE FIGURE VARIATIONS**

( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)

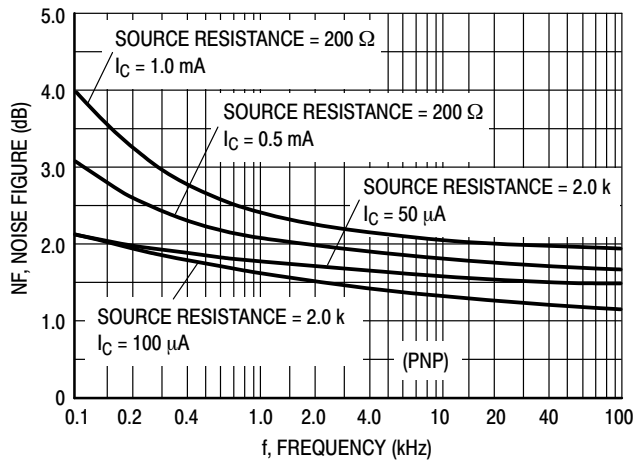


Figure 24.

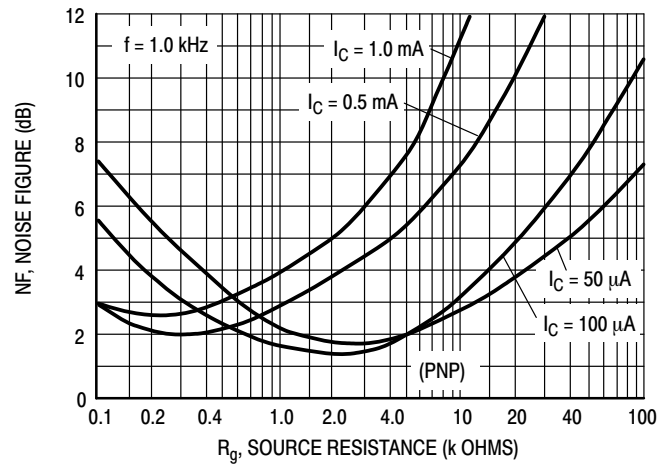


Figure 25.

## **h PARAMETERS**

( $V_{CE} = -10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )

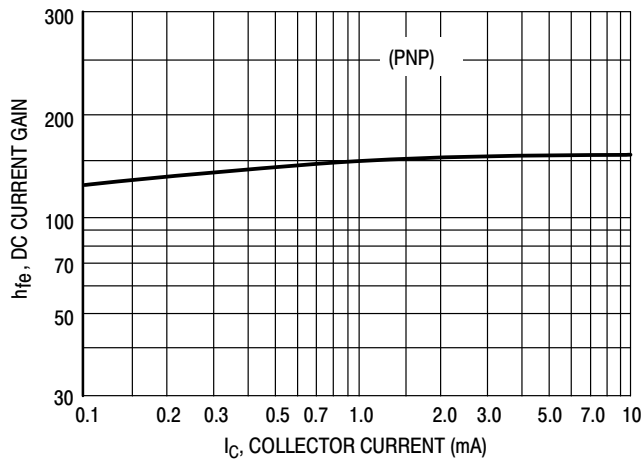


Figure 26. Current Gain

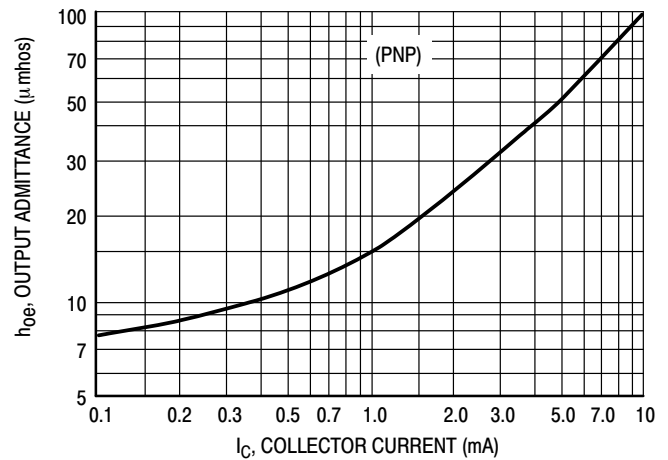


Figure 27. Output Admittance

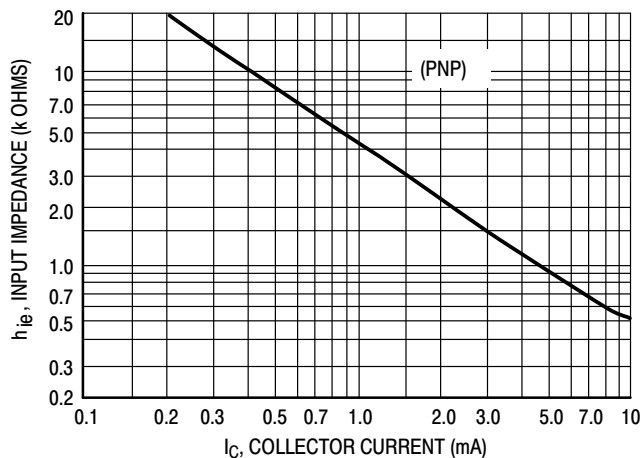


Figure 28. Input Impedance

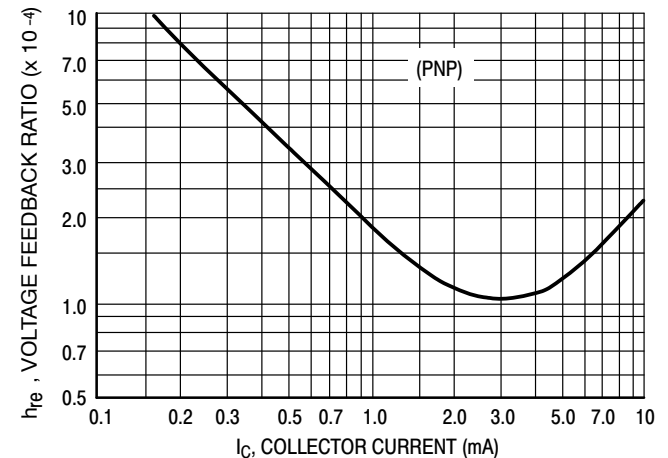


Figure 29. Voltage Feedback Ratio

(PNP)

TYPICAL STATIC CHARACTERISTICS

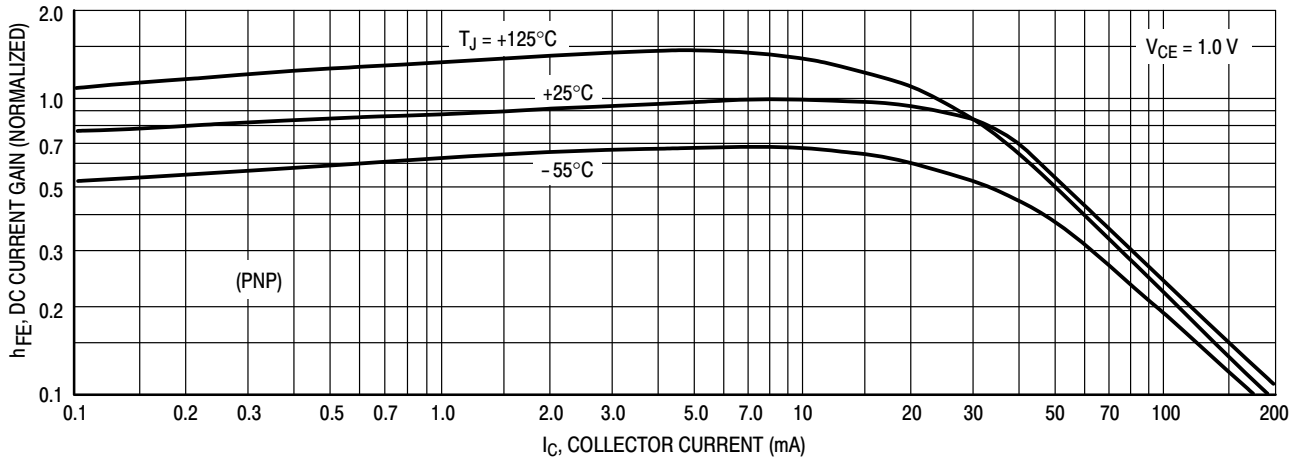


Figure 30. DC Current Gain

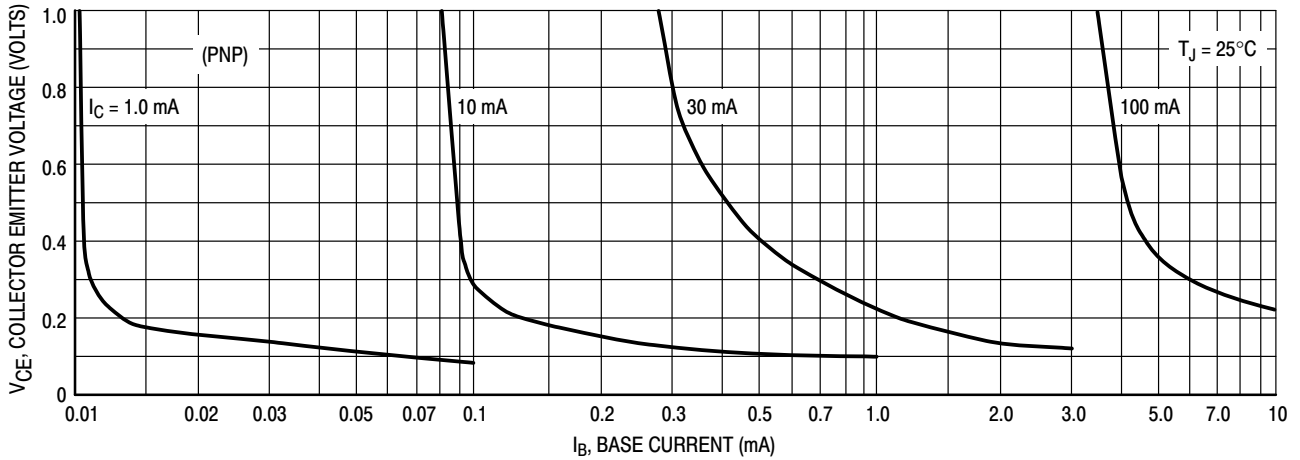


Figure 31. Collector Saturation Region

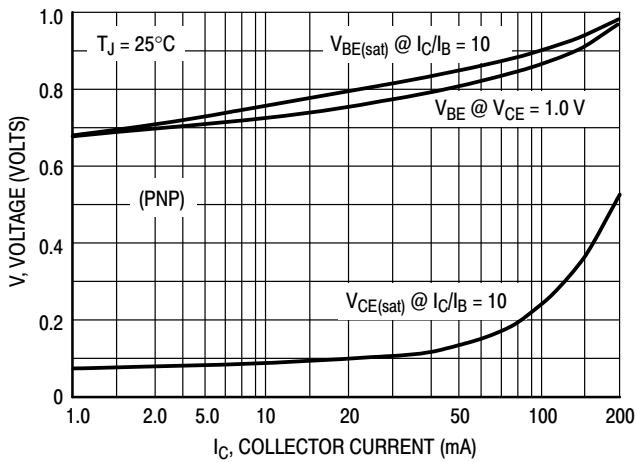


Figure 32. "ON" Voltages

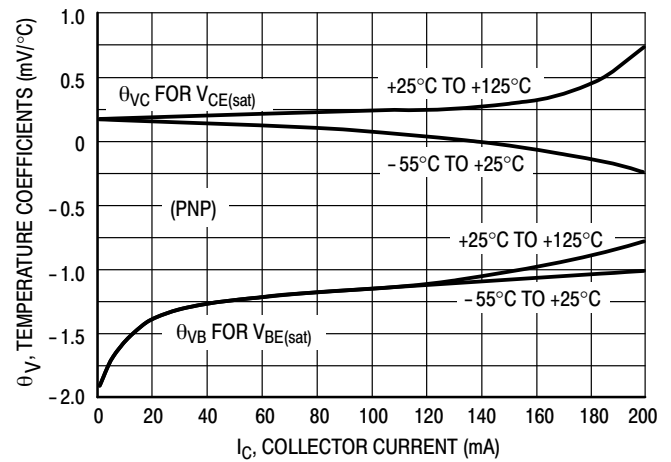
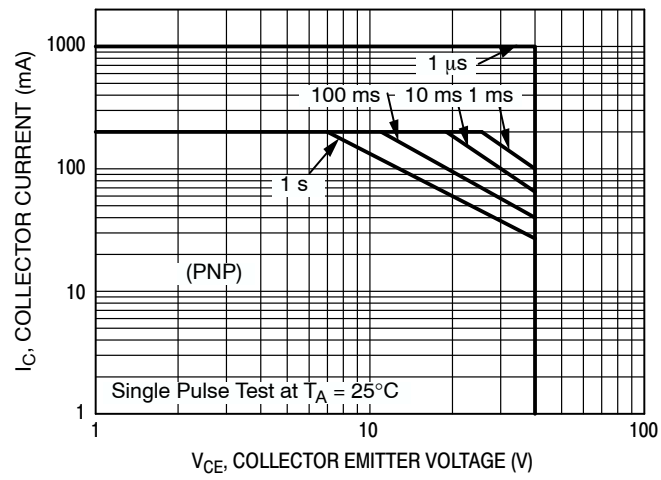


Figure 33. Temperature Coefficients

# NST3946DXV6T1G, NST3946DXV6T5G



**Figure 34. Safe Operating Area**

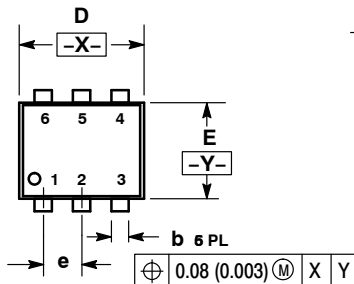
# NST3946DXV6T1G, NST3946DXV6T5G

## PACKAGE DIMENSIONS

### SOT-563, 6 LEAD

CASE 463A

ISSUE F

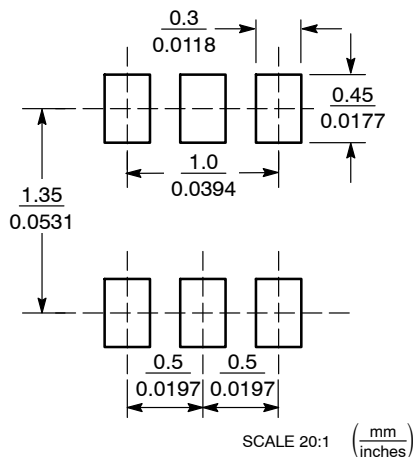


#### NOTES:

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.

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