

NST3946DXV6

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 $V_{CE(sat)}$, ≤ 0.4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- 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

Table 1. MAXIMUM RATINGS

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

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.

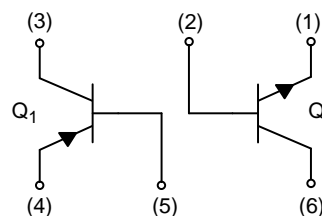


ON Semiconductor®

<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 (Pb-Free) | 4,000 / Tape & Reel |
| NSVT3946DXV6T1G | SOT-563 (Pb-Free) | 4,000 / Tape & Reel |
| NST3946DXV6T5G | SOT-563 (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.

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Table 2. THERMAL CHARACTERISTICS

| Characteristic (One Junction Heated) | | Symbol | Max | Unit |
|---|--------------------------|-----------------|------------------------------------|-------------|
| Total Device Dissipation Derate above 25°C | $T_A = 25^\circ\text{C}$ | P_D | 357 (Note 1) 2.9 (Note 1) | mW mW/°C |
| Thermal Resistance Junction-to-Ambient | | $R_{\theta JA}$ | 350 (Note 1) | °C/W |
| Characteristic (Both Junctions Heated) | | Symbol | Max | Unit |
| Total Device Dissipation Derate above 25°C | $T_A = 25^\circ\text{C}$ | P_D | 500 (Note 1) 4.0 (Note 1) | mW mW/°C |
| Thermal Resistance Junction-to-Ambient | | $R_{\theta JA}$ | 250 (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) ($I_C = 1.0\text{ mAdc}, I_B = 0$) ($I_C = -1.0\text{ mAdc}, I_B = 0$) | (NPN) (PNP) | $V_{(BR)CEO}$ | 40 -40 | - - | Vdc |
| Collector – Base Breakdown Voltage ($I_C = 10\text{ }\mu\text{A dc}, I_E = 0$) ($I_C = -10\text{ }\mu\text{A dc}, I_E = 0$) | (NPN) (PNP) | $V_{(BR)CBO}$ | 60 -40 | - - | Vdc |
| Emitter – Base Breakdown Voltage ($I_E = 10\text{ }\mu\text{A dc}, I_C = 0$) ($I_E = -10\text{ }\mu\text{A dc}, I_C = 0$) | (NPN) (PNP) | $V_{(BR)EBO}$ | 6.0 -5.0 | - - | Vdc |
| Base Cutoff Current ($V_{CE} = 30\text{ Vdc}, V_{EB} = 3.0\text{ Vdc}$) ($V_{CE} = -30\text{ Vdc}, V_{EB} = -3.0\text{ Vdc}$) | (NPN) (PNP) | I_{BL} | - - | 50 -50 | nA dc |
| Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}, V_{EB} = 3.0\text{ Vdc}$) ($V_{CE} = -30\text{ Vdc}, V_{EB} = -3.0\text{ Vdc}$) | (NPN) (PNP) | I_{CEX} | - - | 50 -50 | nA dc |
| ON CHARACTERISTICS (Note 2) | | | | | |
| DC Current Gain ($I_C = 0.1\text{ mA dc}, V_{CE} = 1.0\text{ Vdc}$) ($I_C = 1.0\text{ mA dc}, V_{CE} = 1.0\text{ Vdc}$) ($I_C = 10\text{ mA dc}, V_{CE} = 1.0\text{ Vdc}$) ($I_C = 50\text{ mA dc}, V_{CE} = 1.0\text{ Vdc}$) ($I_C = 100\text{ mA dc}, V_{CE} = 1.0\text{ Vdc}$) ($I_C = -0.1\text{ mA dc}, V_{CE} = -1.0\text{ Vdc}$) ($I_C = -1.0\text{ mA dc}, V_{CE} = -1.0\text{ Vdc}$) ($I_C = -10\text{ mA dc}, V_{CE} = -1.0\text{ Vdc}$) ($I_C = -50\text{ mA dc}, V_{CE} = -1.0\text{ Vdc}$) ($I_C = -100\text{ mA dc}, V_{CE} = -1.0\text{ Vdc}$) | (NPN) (PNP) | h_{FE} | 40 70 100 60 30 60 80 100 60 30 | - - 300 - - - - 300 - - | - |
| Collector – Emitter Saturation Voltage ($I_C = 10\text{ mA dc}, I_B = 1.0\text{ mA dc}$) ($I_C = 50\text{ mA dc}, I_B = 5.0\text{ mA dc}$) ($I_C = -10\text{ mA dc}, I_B = -1.0\text{ mA dc}$) ($I_C = -50\text{ mA dc}, I_B = -5.0\text{ mA dc}$) | (NPN) (PNP) | $V_{CE(sat)}$ | - - - - | 0.2 0.3 -0.25 -0.4 | Vdc |
| Base – Emitter Saturation Voltage ($I_C = 10\text{ mA dc}, I_B = 1.0\text{ mA dc}$) ($I_C = 50\text{ mA dc}, I_B = 5.0\text{ mA dc}$) ($I_C = -10\text{ mA dc}, I_B = -1.0\text{ mA dc}$) ($I_C = -50\text{ mA dc}, I_B = -5.0\text{ mA dc}$) | (NPN) (PNP) | $V_{BE(sat)}$ | 0.65 - -0.65 - | 0.85 0.95 -0.85 -0.95 | Vdc |

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ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (continued)

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

SWITCHING CHARACTERISTICS

| | | | | |
|--|----------------------------------|--------|------------|----|
| Delay Time (V _{CC} = 3.0 Vdc, V _{BE} = -0.5 Vdc) (V _{CC} = -3.0 Vdc, V _{BE} = 0.5 Vdc) | t _d (NPN) (PNP) | – – | 35 35 | ns |
| Rise Time (I _C = 10 mAdc, I _{B1} = 1.0 mAdc) (I _C = -10 mAdc, I _{B1} = -1.0 mAdc) | t _r (NPN) (PNP) | – – | 35 35 | |
| Storage Time (V _{CC} = 3.0 Vdc, I _C = 10 mAdc) (V _{CC} = -3.0 Vdc, I _C = -10 mAdc) | t _s (NPN) (PNP) | – – | 200 225 | ns |
| Fall Time (I _{B1} = I _{B2} = 1.0 mAdc) (I _{B1} = I _{B2} = -1.0 mAdc) | t _f (NPN) (PNP) | – – | 50 75 | |

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.

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

NST3946DXV6

(NPN)

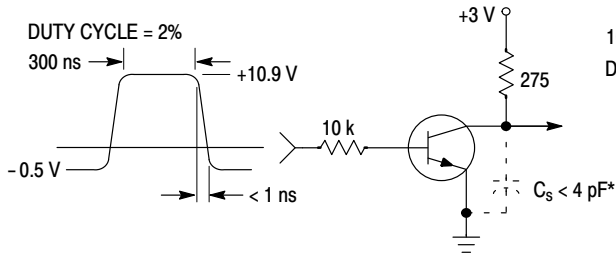


Figure 1. Delay and Rise Time Equivalent Test Circuit

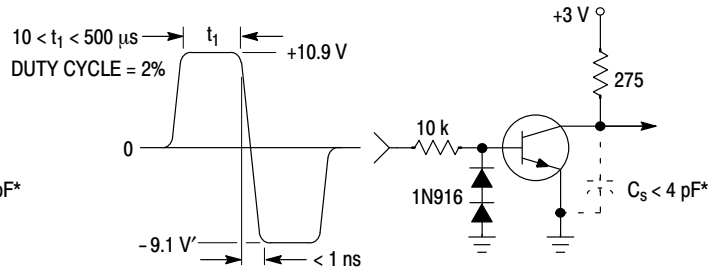


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

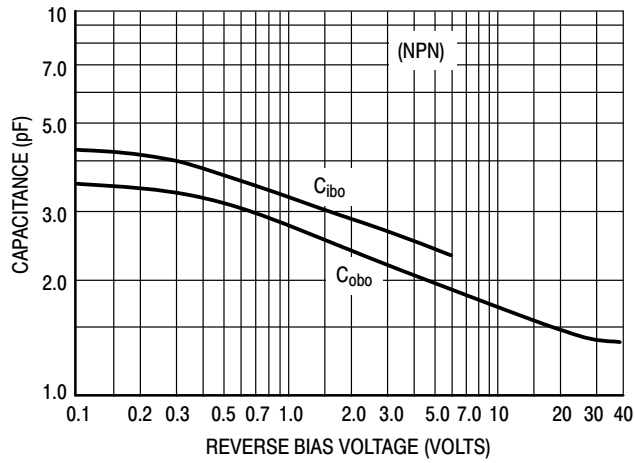


Figure 3. Capacitance

NST3946DXV6

(NPN)

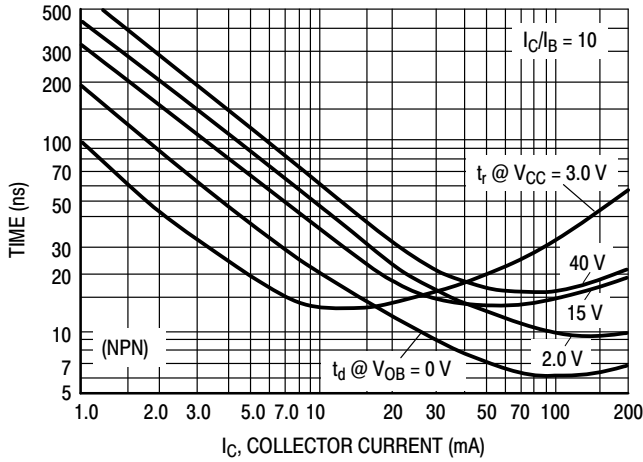


Figure 4. Turn-On Time

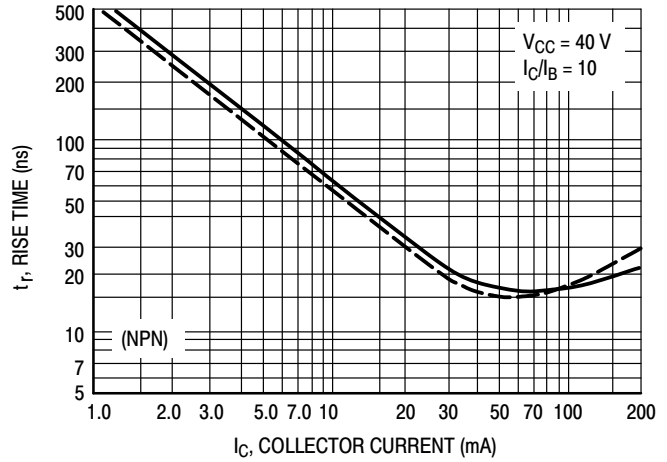


Figure 5. Rise Time

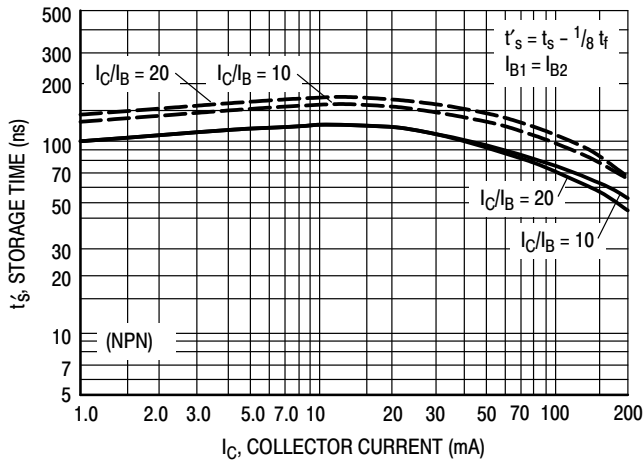


Figure 6. Storage Time

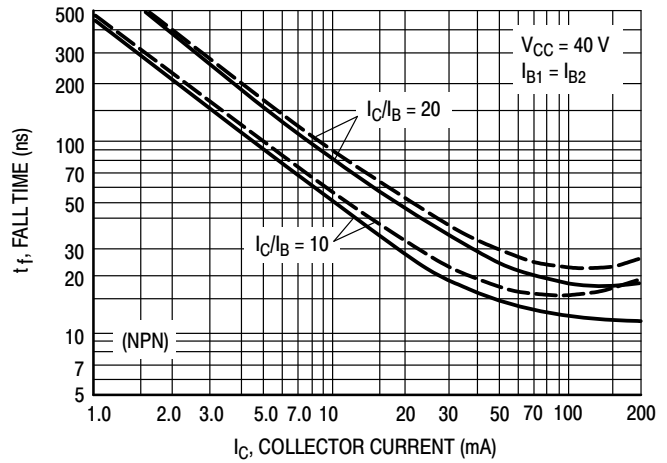


Figure 7. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

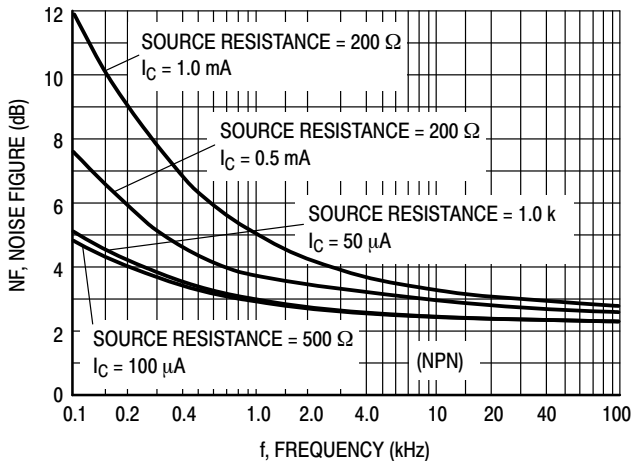


Figure 8. Noise Figure

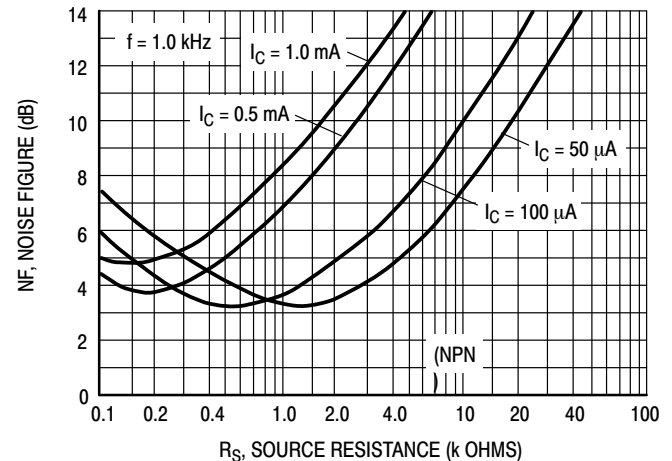


Figure 9. Noise Figure

NST3946DXV6

(NPN)

h PARAMETERS

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

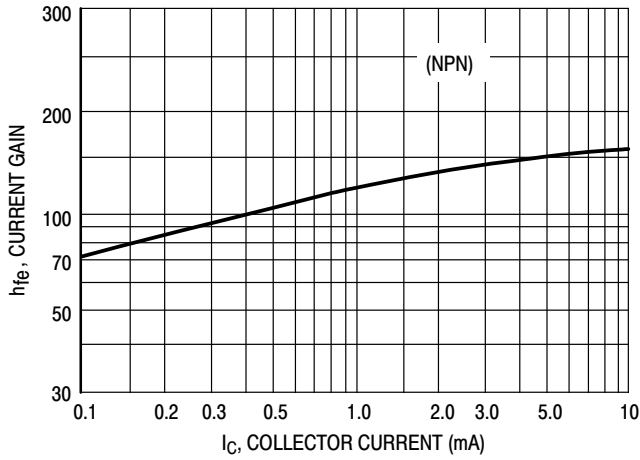


Figure 10. Current Gain

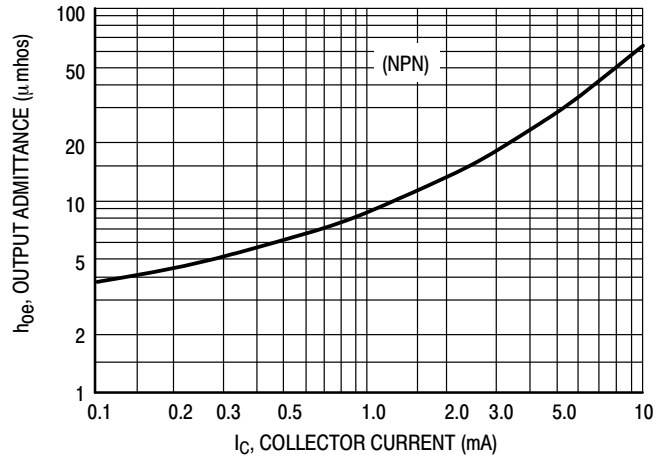


Figure 11. Output Admittance

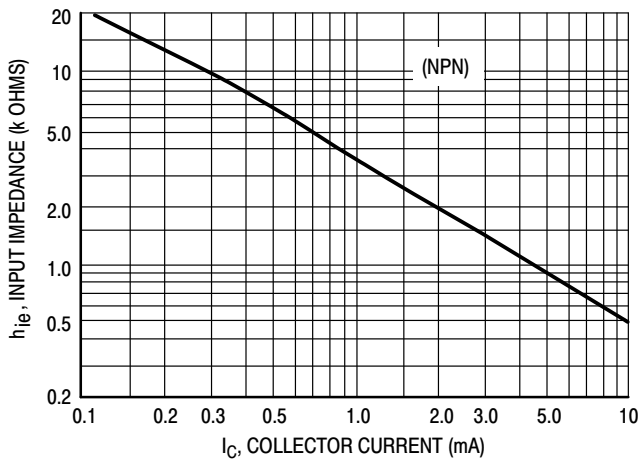


Figure 12. Input Impedance

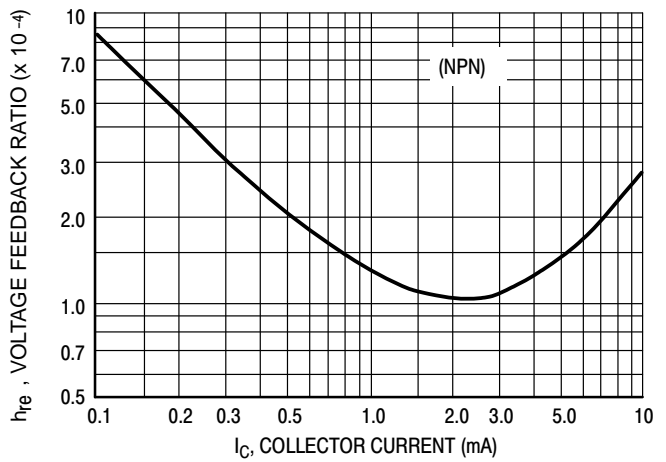


Figure 13. Voltage Feedback Ratio

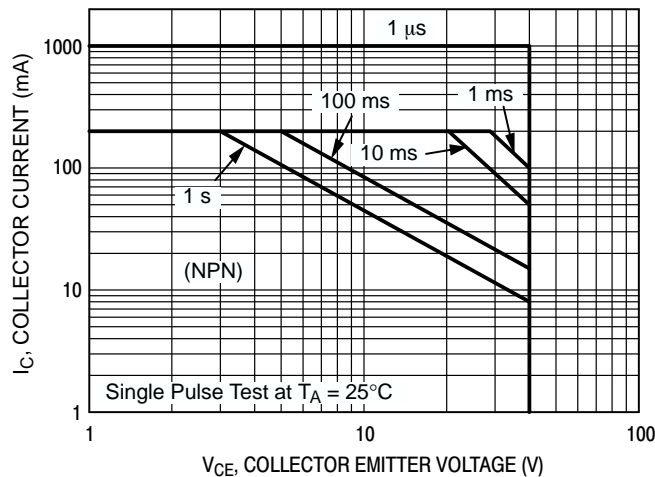


Figure 14. Safe Operating Area

NST3946DXV6

(NPN)

TYPICAL STATIC CHARACTERISTICS

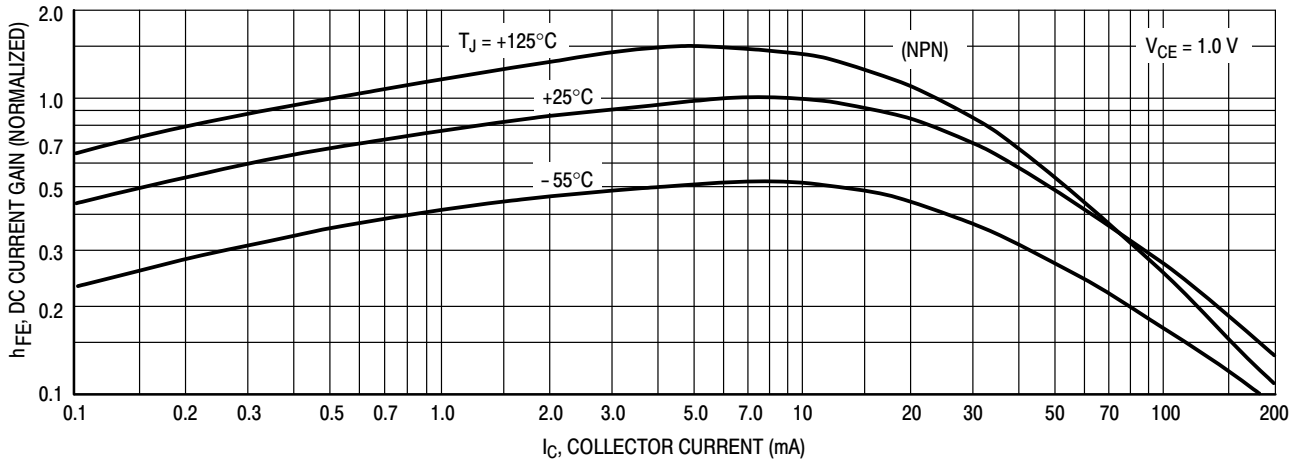


Figure 15. DC Current Gain

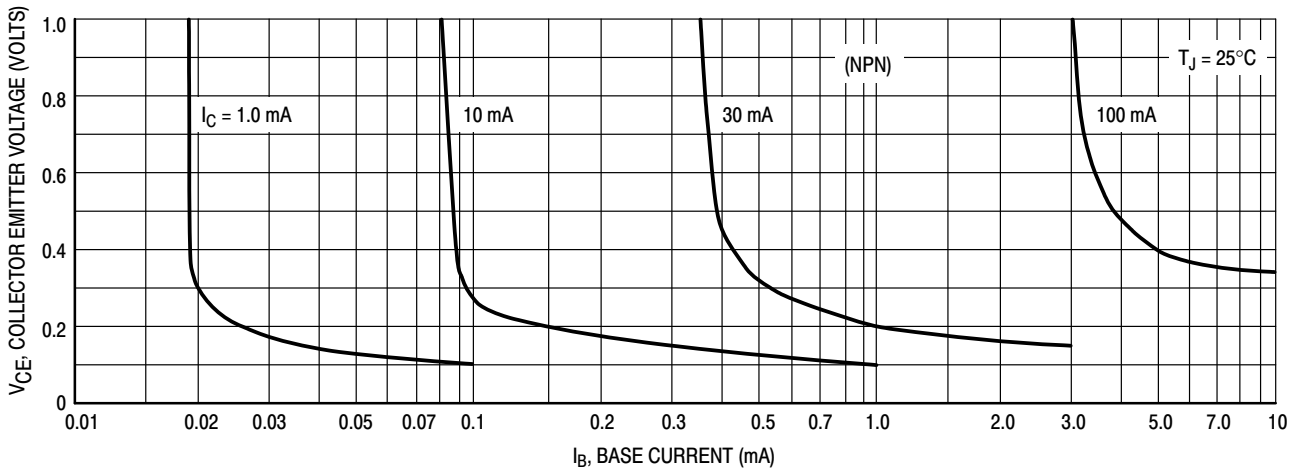


Figure 16. Collector Saturation Region

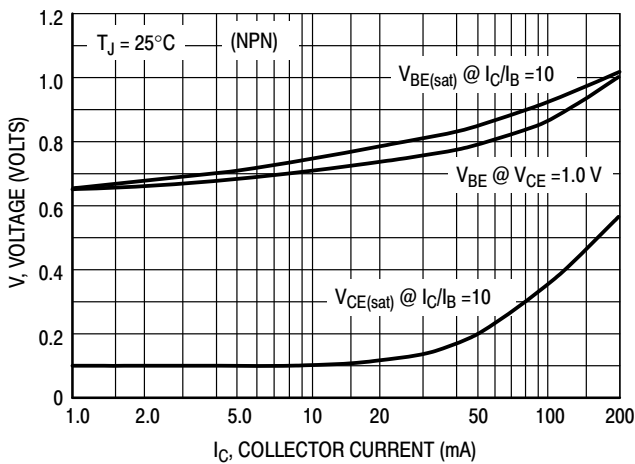


Figure 17. "ON" Voltages

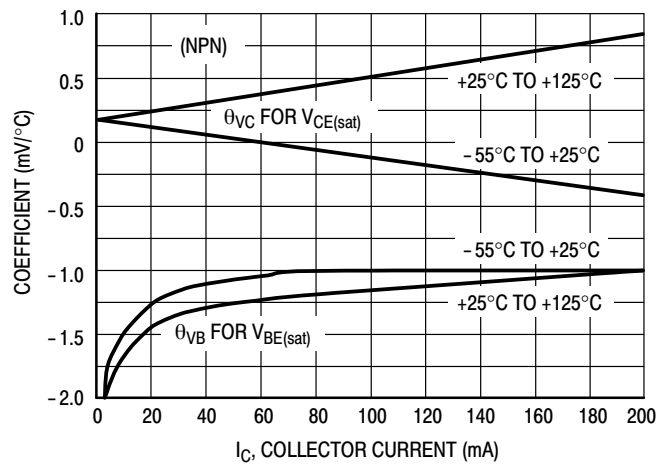


Figure 18. Temperature Coefficients

NST3946DXV6

(PNP)

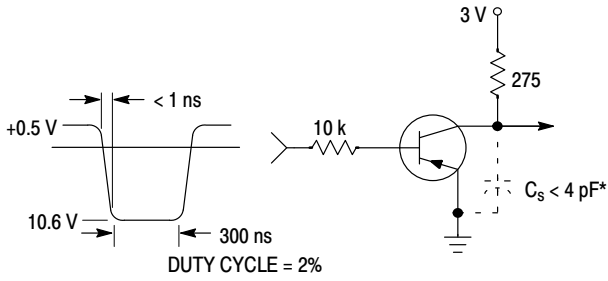


Figure 19. Delay and Rise Time Equivalent Test Circuit

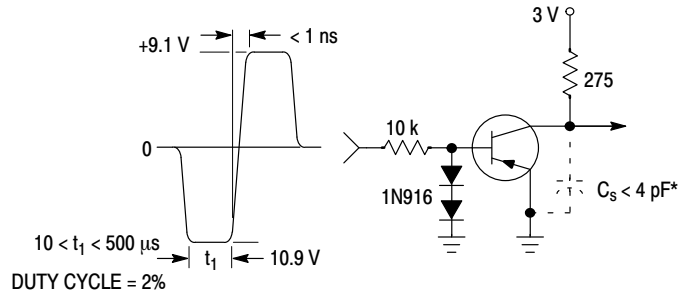


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

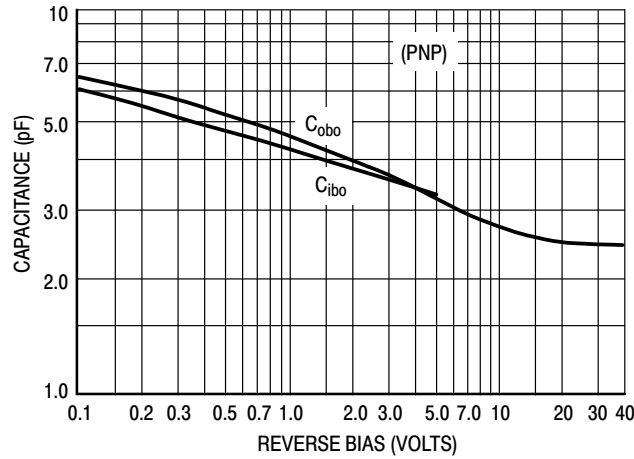


Figure 21. Capacitance

— $T_J = 25^\circ\text{C}$
 - - - $T_J = 125^\circ\text{C}$

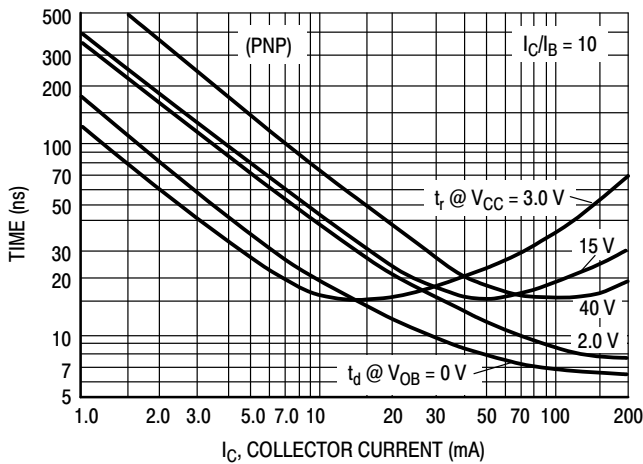


Figure 22. Turn-On Time

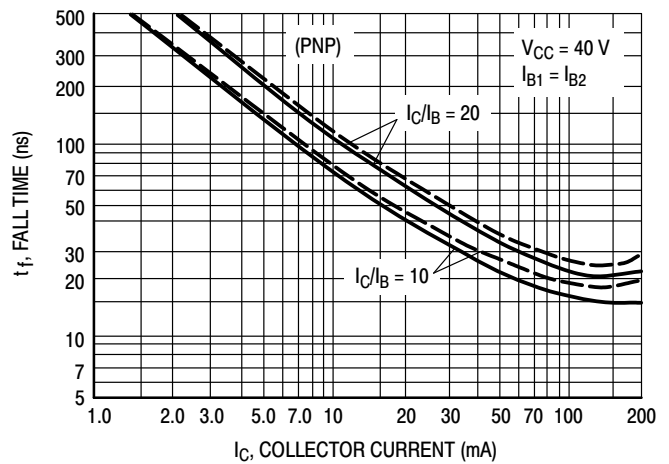


Figure 23. Fall Time

NST3946DXV6

(PNP)

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

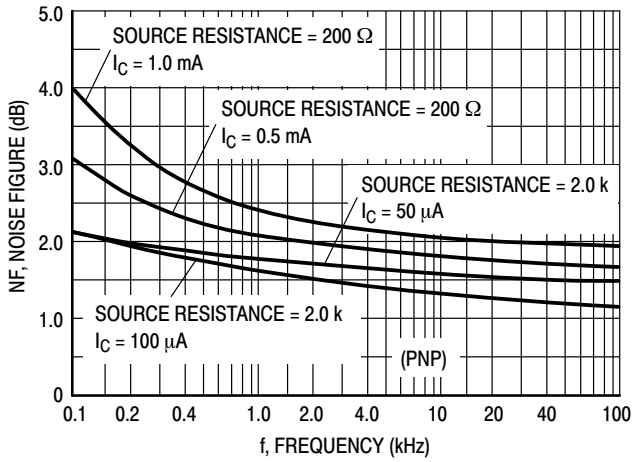


Figure 24.

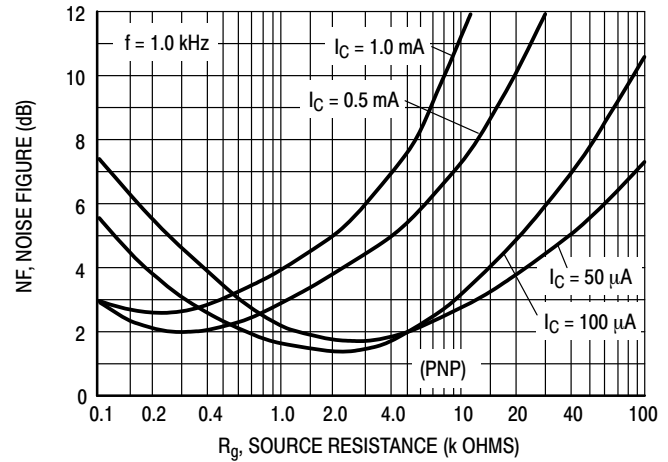


Figure 25.

h PARAMETERS

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

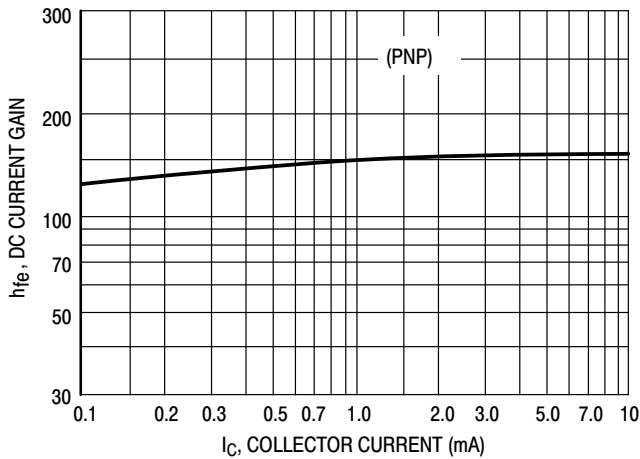


Figure 26. Current Gain

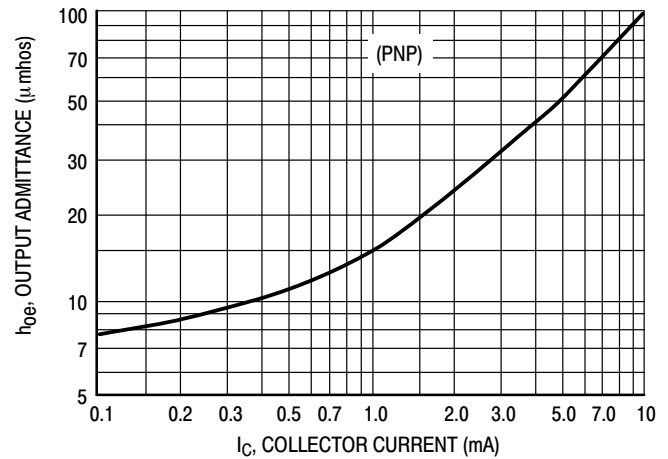


Figure 27. Output Admittance

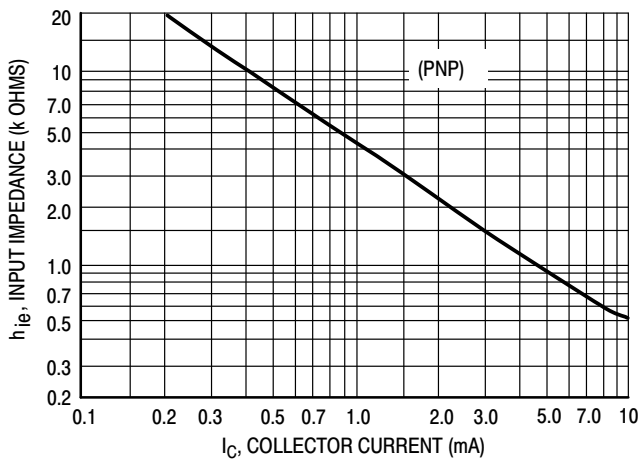


Figure 28. Input Impedance

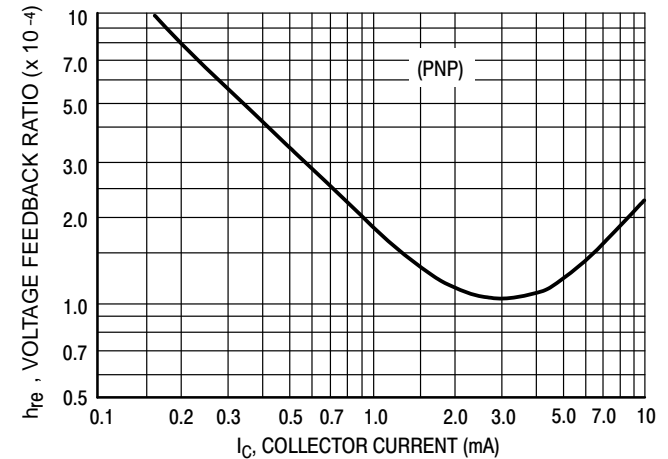


Figure 29. Voltage Feedback Ratio

NST3946DXV6

(PNP)

TYPICAL STATIC CHARACTERISTICS

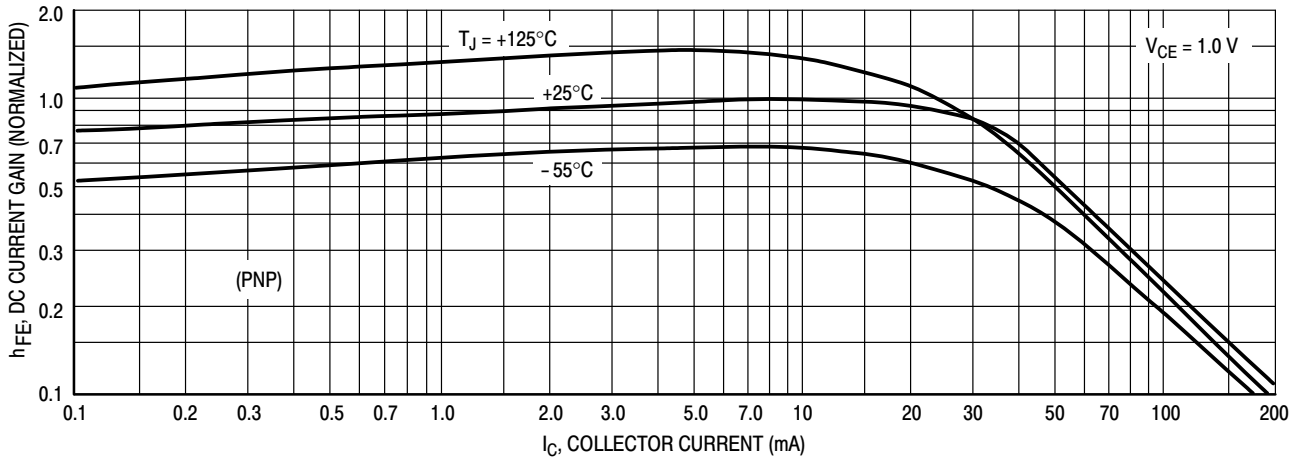


Figure 30. DC Current Gain

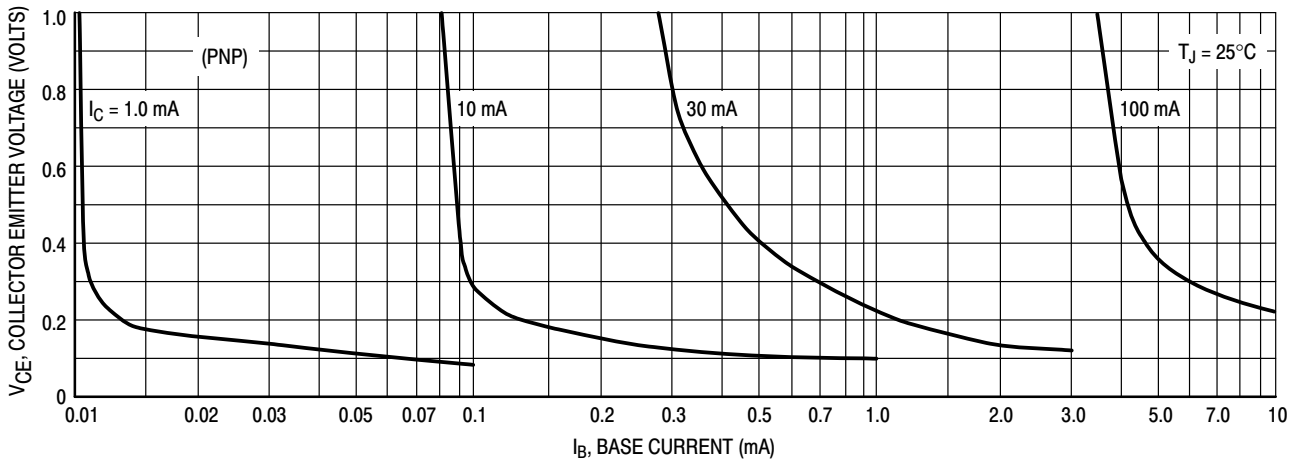


Figure 31. Collector Saturation Region

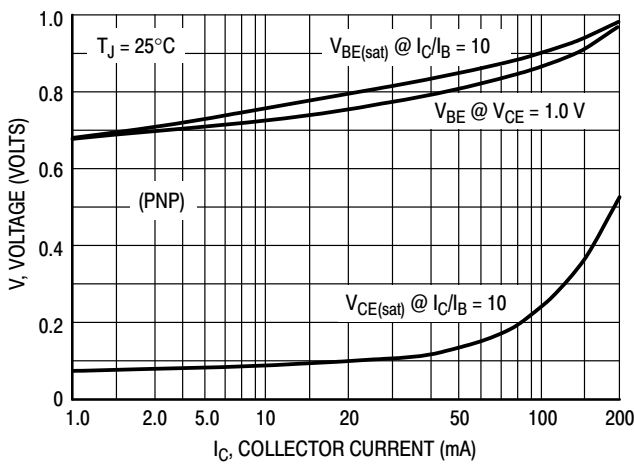


Figure 32. "ON" Voltages

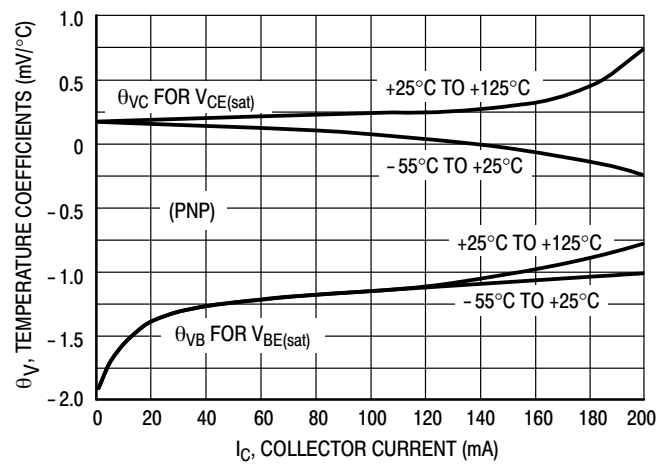


Figure 33. Temperature Coefficients

NST3946DXV6

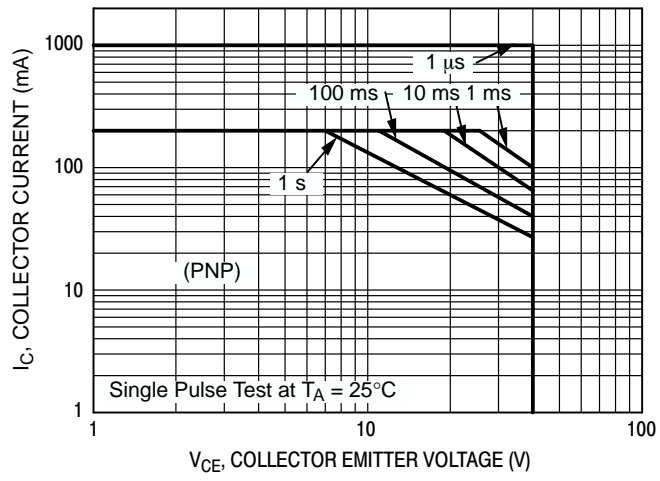


Figure 34. Safe Operating Area

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



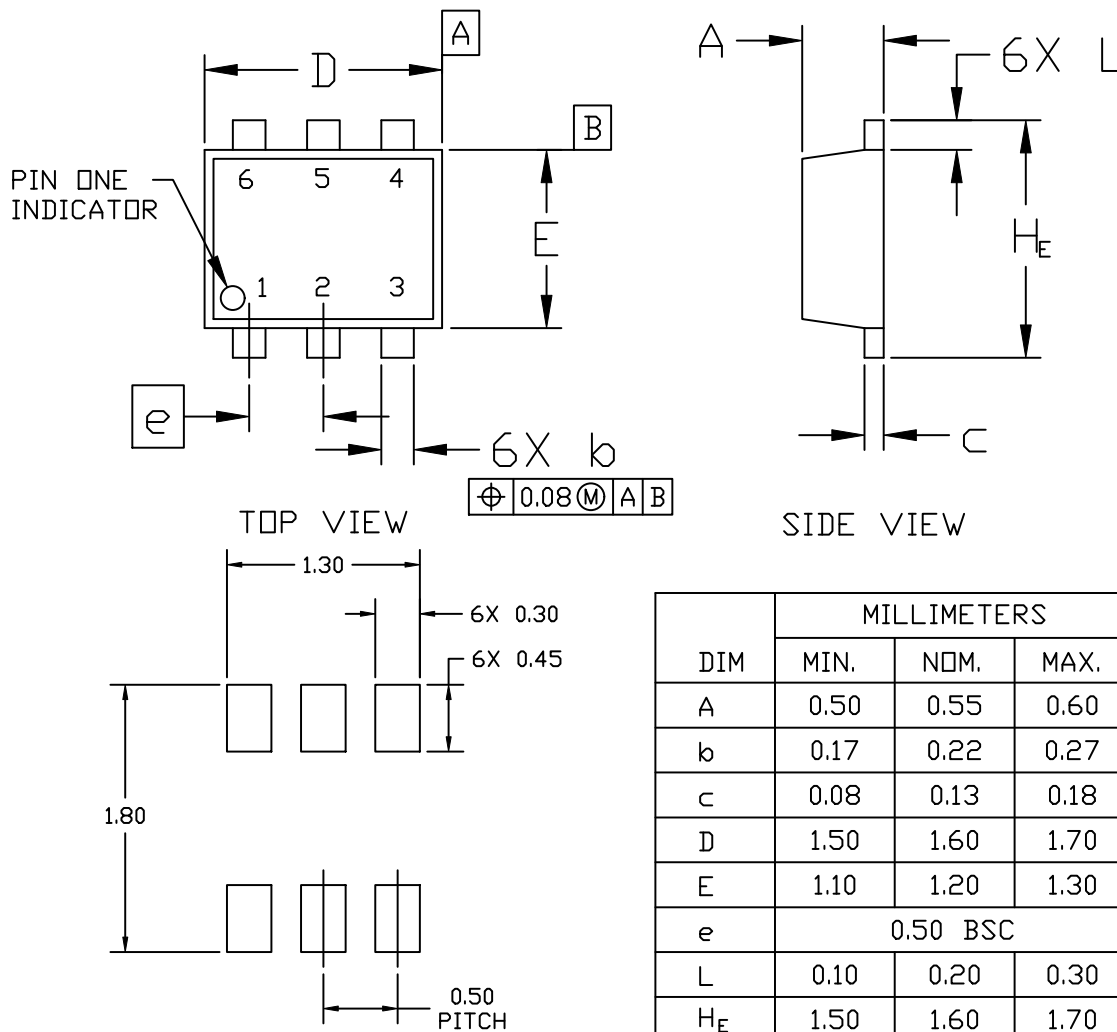
SCALE 4:1

SOT-563, 6 LEAD
CASE 463A
ISSUE H

DATE 26 JAN 2021

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: 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 | | |
| L | 0.10 | 0.20 | 0.30 |
| H _E | 1.50 | 1.60 | 1.70 |

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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| DESCRIPTION: | SOT-563, 6 LEAD | PAGE 1 OF 2 |

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ISSUE H

DATE 26 JAN 2021

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

**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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