

# 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  $V_{CE(sat)}$ ,  $\leq 0.4$  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.

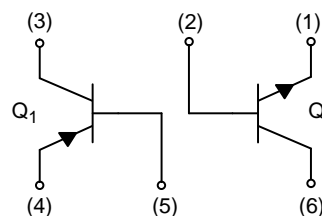


**ON Semiconductor®**

<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.

# NST3946DXV6

**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
<b>OFF CHARACTERISTICS</b>					
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
<b>ON CHARACTERISTICS</b> (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 ( $T_A = 25^\circ\text{C}$ unless otherwise noted) (continued)

Characteristic		Symbol	Min	Max	Unit
<b>SMALL-SIGNAL CHARACTERISTICS</b>					
Current-Gain – Bandwidth Product ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ ) ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	(NPN) (PNP)	$f_T$	300 250	– –	MHz
Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ ) ( $V_{CB} = -5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	(NPN) (PNP)	$C_{obo}$	– –	4.0 4.5	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ ) ( $V_{EB} = -0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	(NPN) (PNP)	$C_{ibo}$	– –	8.0 10.0	pF
Input Impedance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ ) ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	(NPN) (PNP)	$h_{ie}$	1.0 2.0	10 12	k $\Omega$
Voltage Feedback Ratio ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ ) ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	(NPN) (PNP)	$h_{re}$	0.5 0.1	8.0 10	$\times 10^{-4}$
Small-Signal Current Gain ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ ) ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	(NPN) (PNP)	$h_{fe}$	100 100	400 400	–
Output Admittance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ ) ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	(NPN) (PNP)	$h_{oe}$	1.0 3.0	40 60	$\mu\text{mhos}$
Noise Figure ( $V_{CE} = 5.0\text{ Vdc}$ , $I_C = 100\text{ }\mu\text{Adc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ ) ( $V_{CE} = -5.0\text{ Vdc}$ , $I_C = -100\text{ }\mu\text{Adc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	(NPN) (PNP)	NF	– –	5.0 4.0	dB

## SWITCHING CHARACTERISTICS

Delay Time ( $V_{CC} = 3.0\text{ Vdc}$ , $V_{BE} = -0.5\text{ Vdc}$ ) ( $V_{CC} = -3.0\text{ Vdc}$ , $V_{BE} = 0.5\text{ Vdc}$ )	(NPN) (PNP)	$t_d$	– –	35 35	ns
Rise Time ( $I_C = 10\text{ mAdc}$ , $I_{B1} = 1.0\text{ mAdc}$ ) ( $I_C = -10\text{ mAdc}$ , $I_{B1} = -1.0\text{ mAdc}$ )	(NPN) (PNP)	$t_r$	– –	35 35	
Storage Time ( $V_{CC} = 3.0\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ ) ( $V_{CC} = -3.0\text{ Vdc}$ , $I_C = -10\text{ mAdc}$ )	(NPN) (PNP)	$t_s$	– –	200 225	ns
Fall Time ( $I_{B1} = I_{B2} = 1.0\text{ mAdc}$ ) ( $I_{B1} = I_{B2} = -1.0\text{ mAdc}$ )	(NPN) (PNP)	$t_f$	– –	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  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

# NST3946DXV6

(NPN)

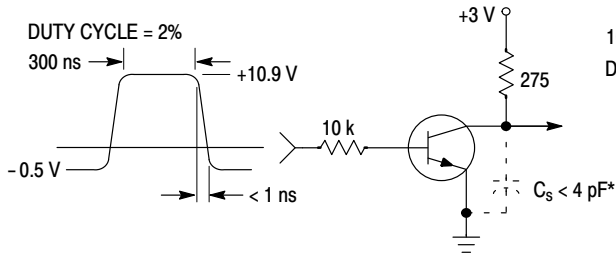


Figure 1. Delay and Rise Time Equivalent Test Circuit

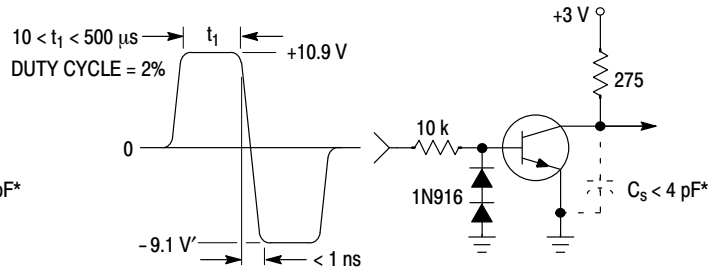


Figure 2. Storage and Fall Time Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

## TYPICAL TRANSIENT CHARACTERISTICS

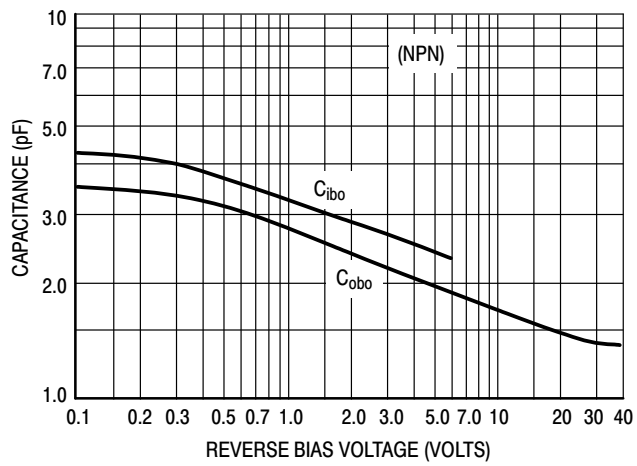


Figure 3. Capacitance

# NST3946DXV6

(NPN)

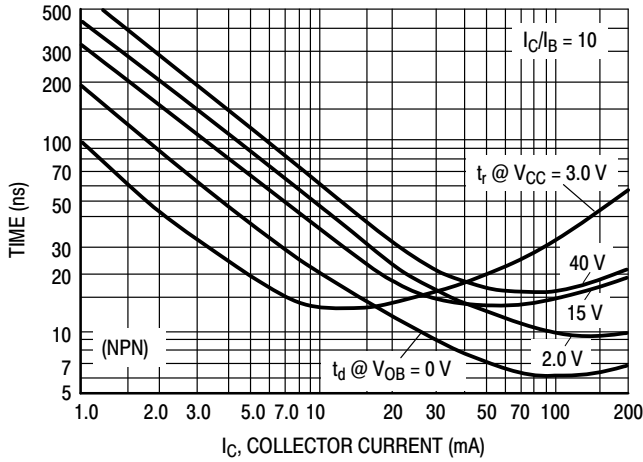


Figure 4. Turn-On Time

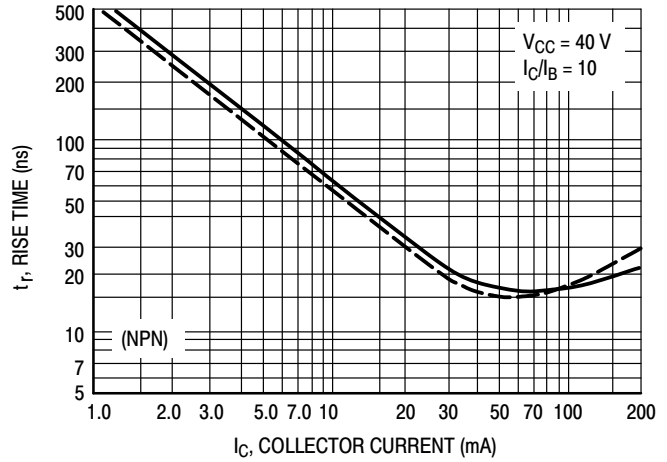


Figure 5. Rise Time

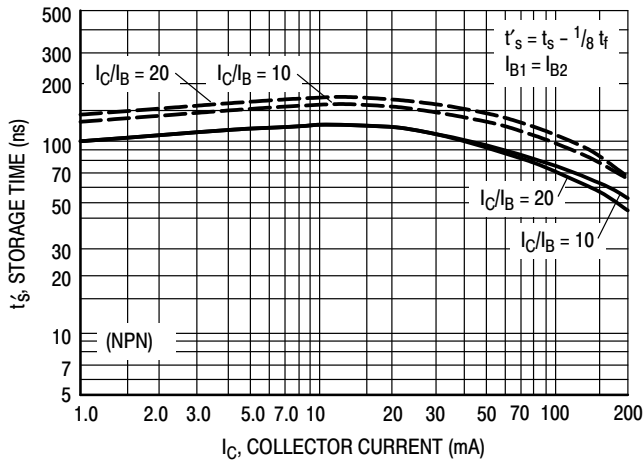


Figure 6. Storage Time

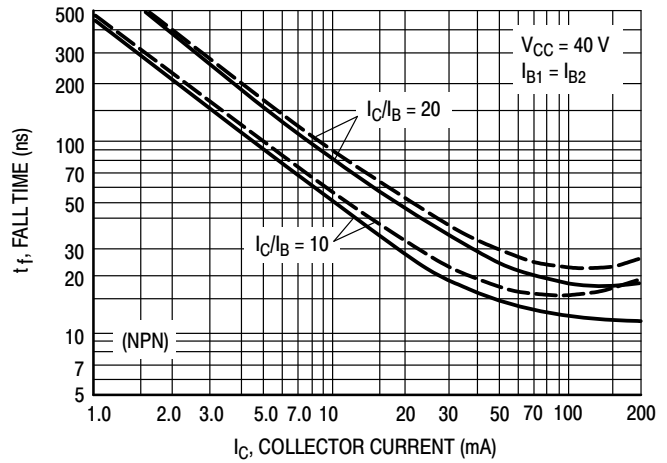


Figure 7. Fall Time

## TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

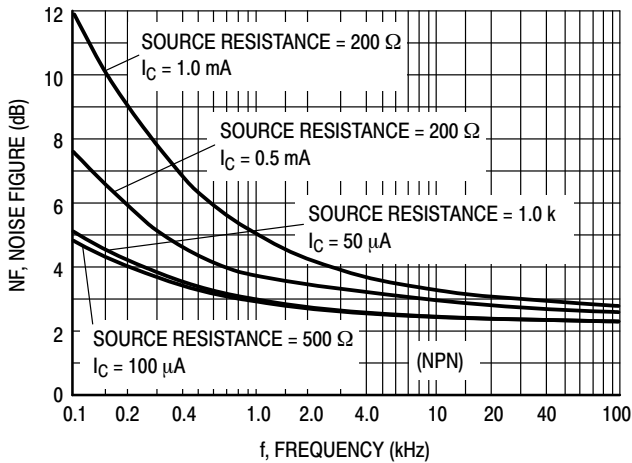


Figure 8. Noise Figure

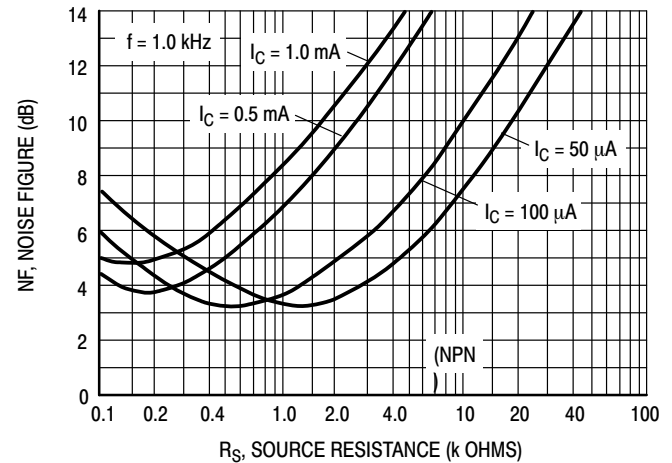


Figure 9. Noise Figure

# NST3946DXV6

(NPN)

## h PARAMETERS

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

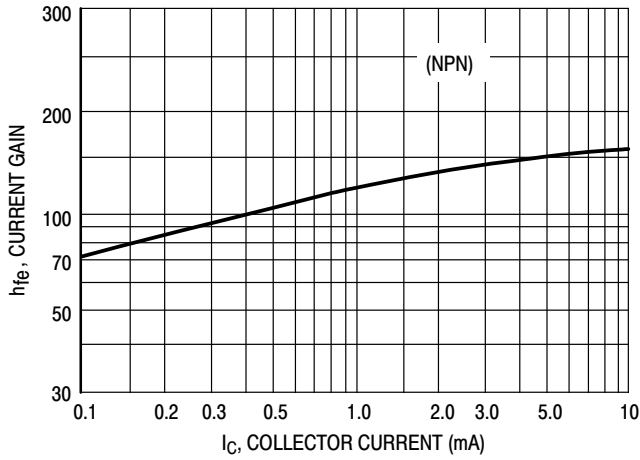


Figure 10. Current Gain

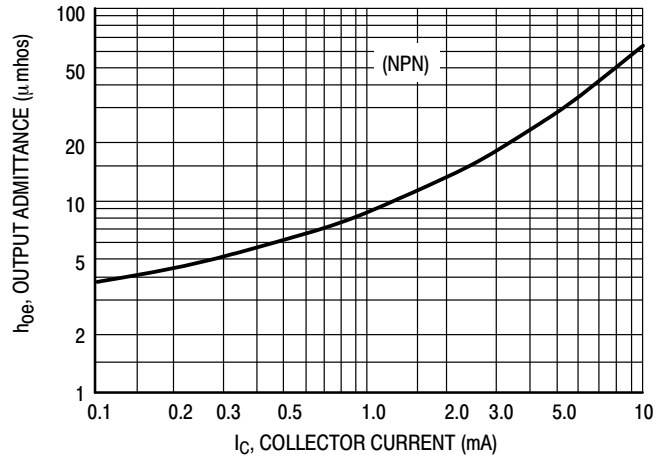


Figure 11. Output Admittance

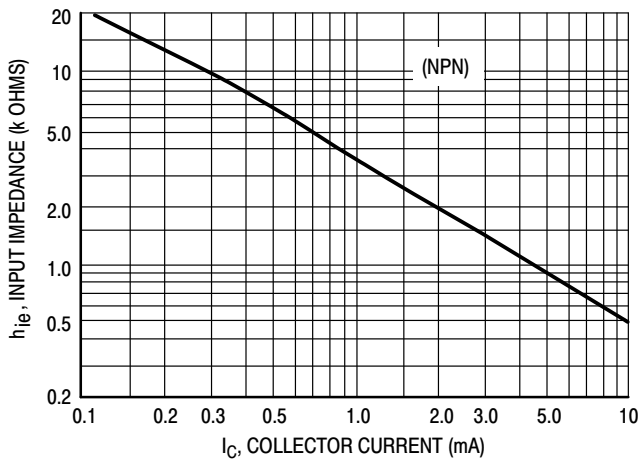


Figure 12. Input Impedance

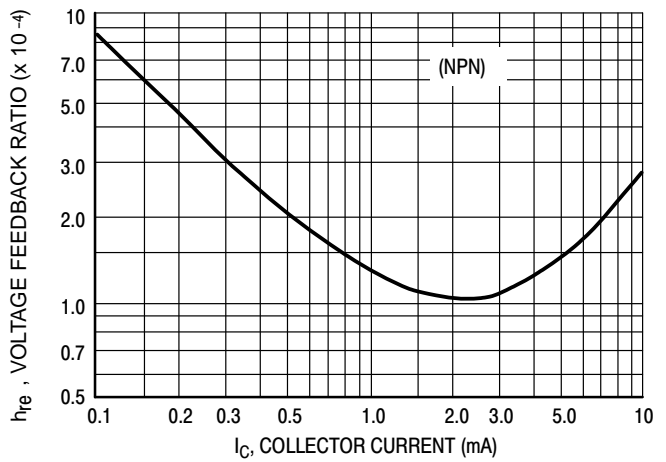


Figure 13. Voltage Feedback Ratio

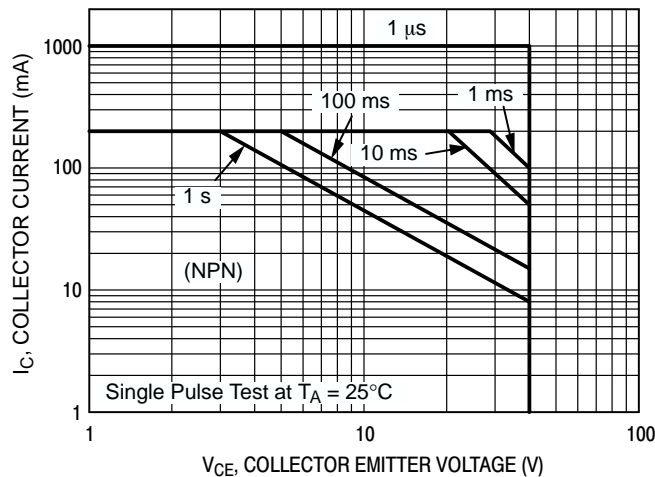


Figure 14. Safe Operating Area

# NST3946DXV6

(NPN)

## TYPICAL STATIC CHARACTERISTICS

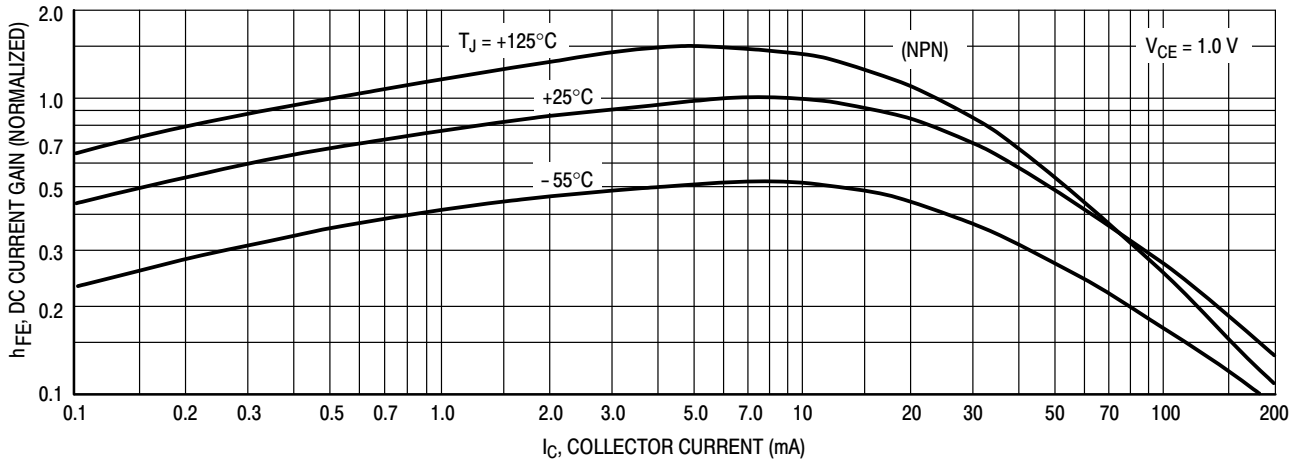


Figure 15. DC Current Gain

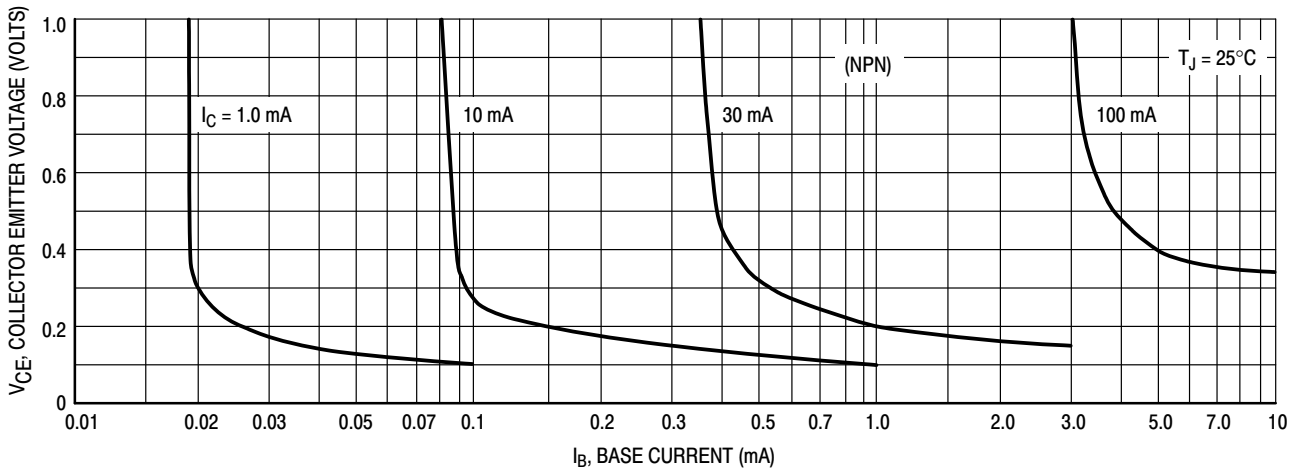


Figure 16. Collector Saturation Region

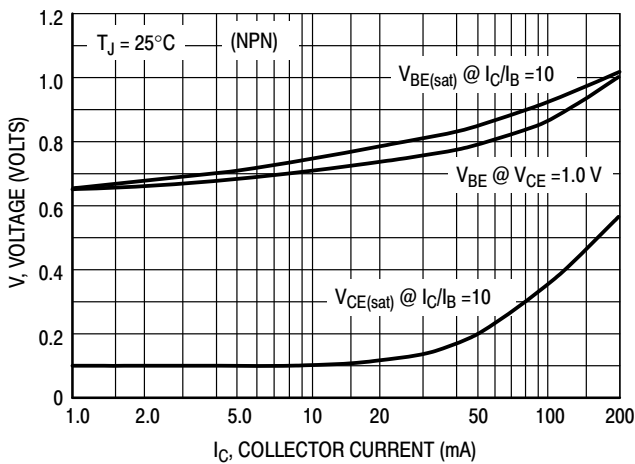


Figure 17. "ON" Voltages

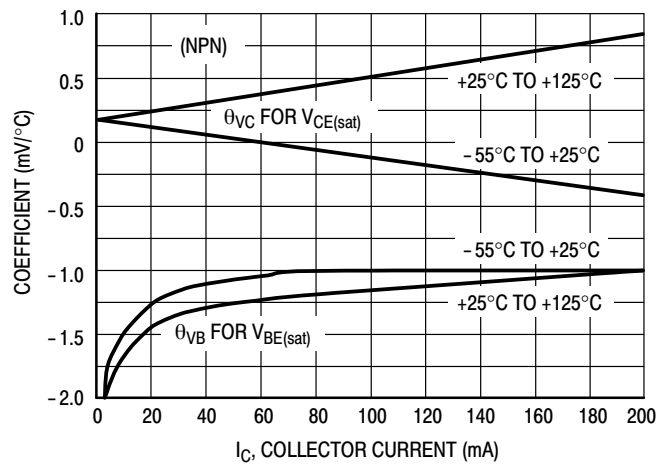


Figure 18. Temperature Coefficients

# NST3946DXV6

(PNP)

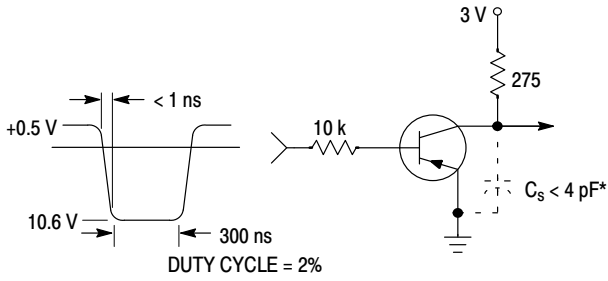


Figure 19. Delay and Rise Time Equivalent Test Circuit

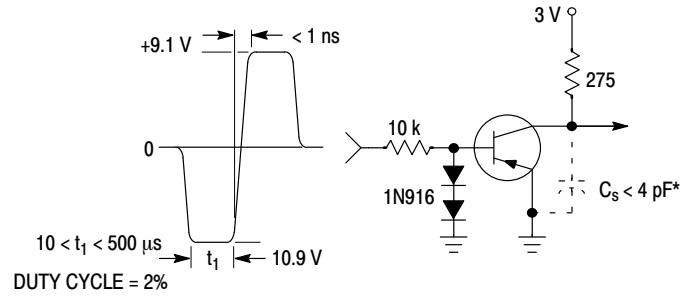


Figure 20. Storage and Fall Time Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

## TYPICAL TRANSIENT CHARACTERISTICS

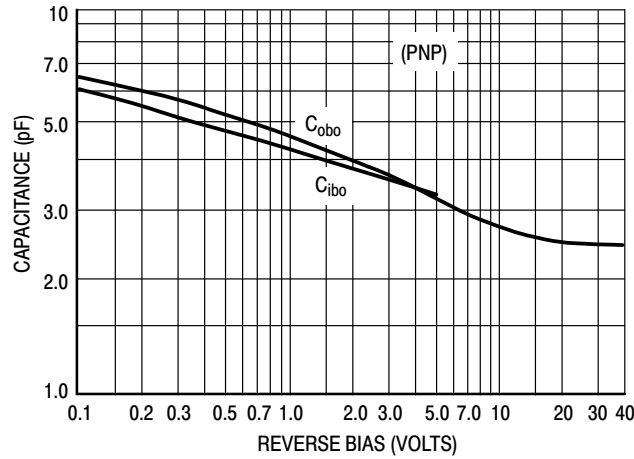


Figure 21. Capacitance

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

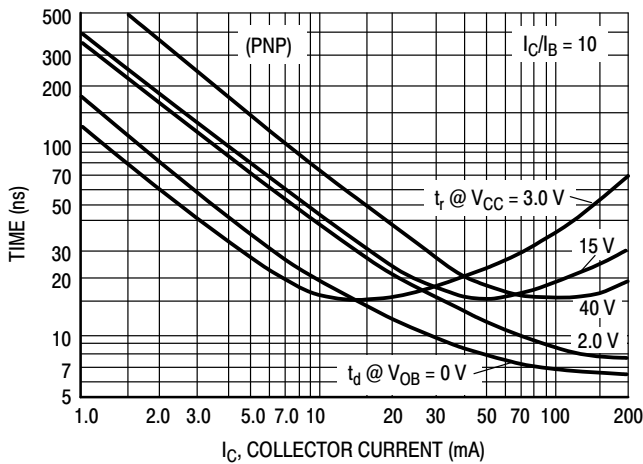


Figure 22. Turn-On Time

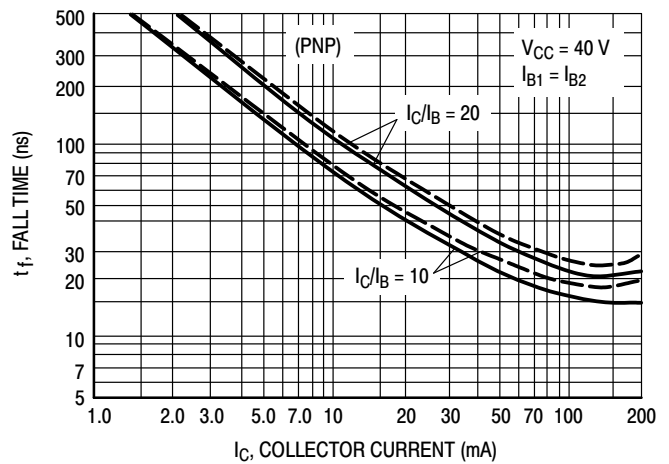


Figure 23. Fall Time



# 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)

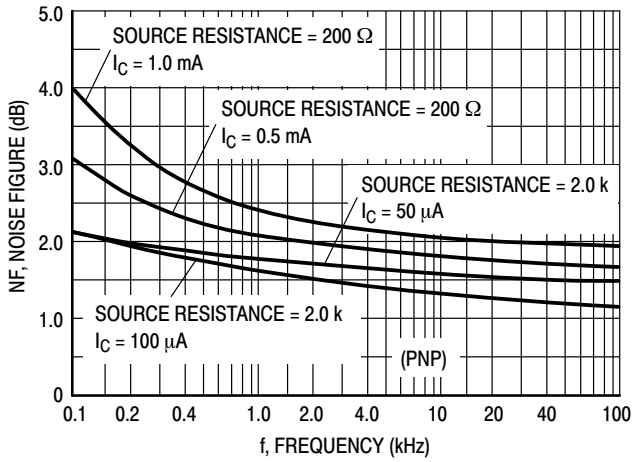


Figure 24.

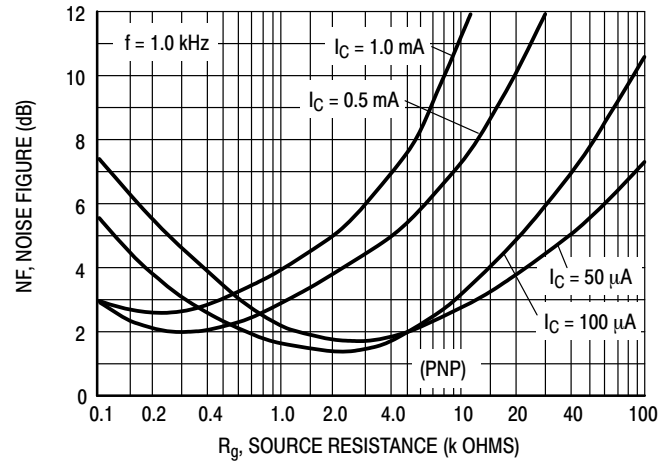


Figure 25.

## h PARAMETERS

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

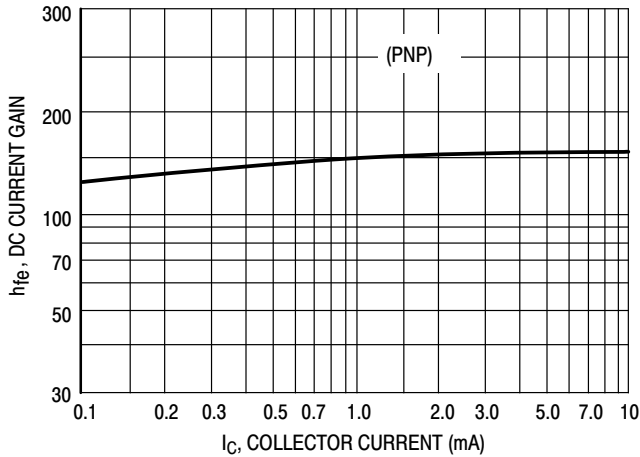


Figure 26. Current Gain

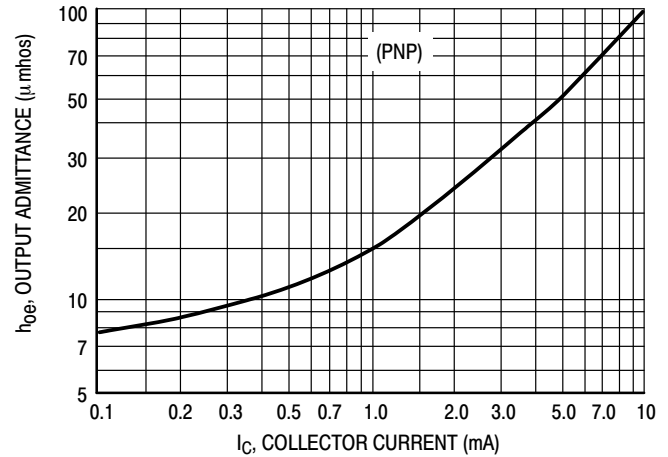


Figure 27. Output Admittance

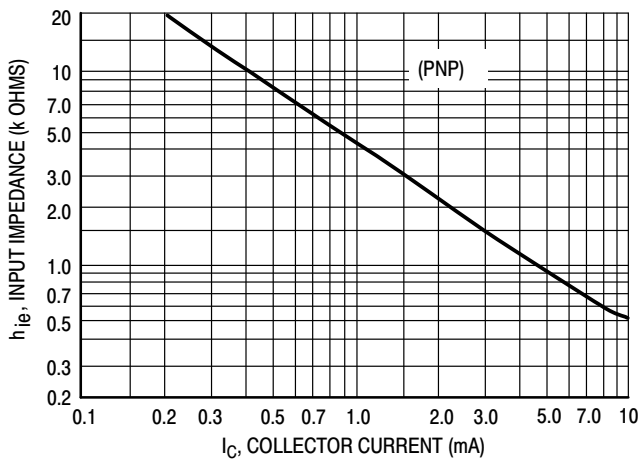


Figure 28. Input Impedance

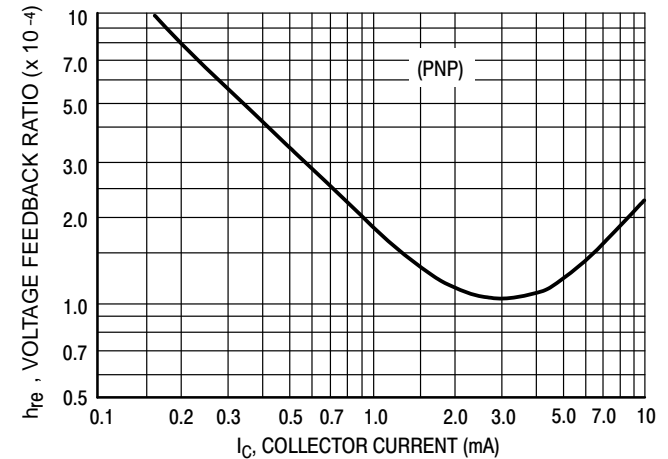


Figure 29. Voltage Feedback Ratio

# NST3946DXV6

(PNP)

## TYPICAL STATIC CHARACTERISTICS

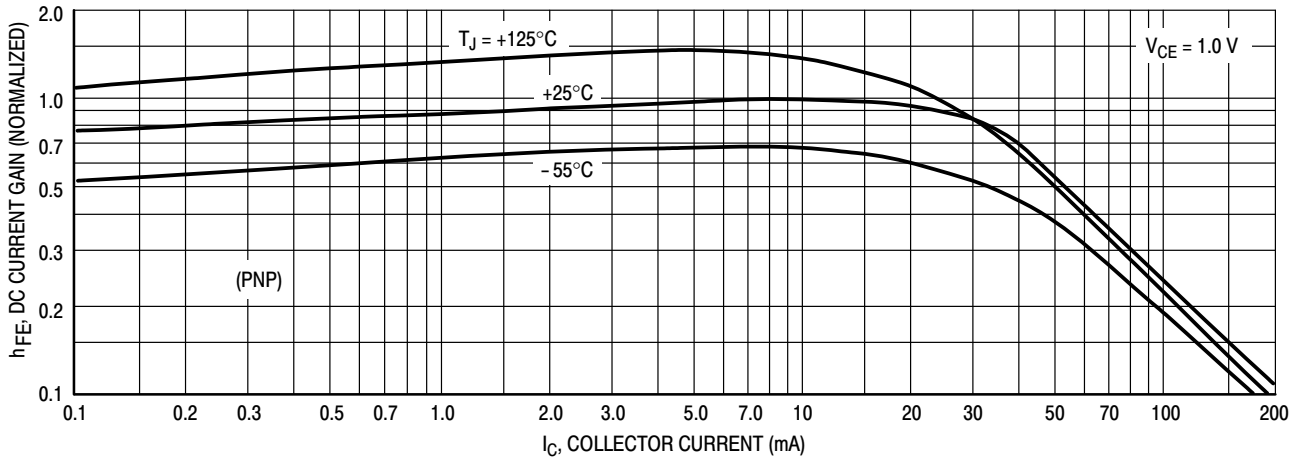


Figure 30. DC Current Gain

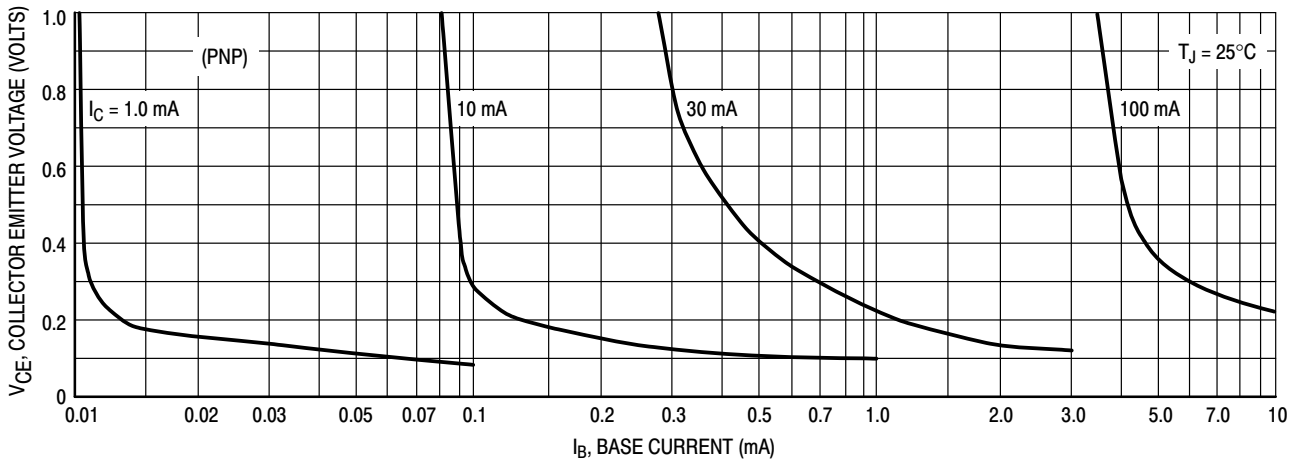


Figure 31. Collector Saturation Region

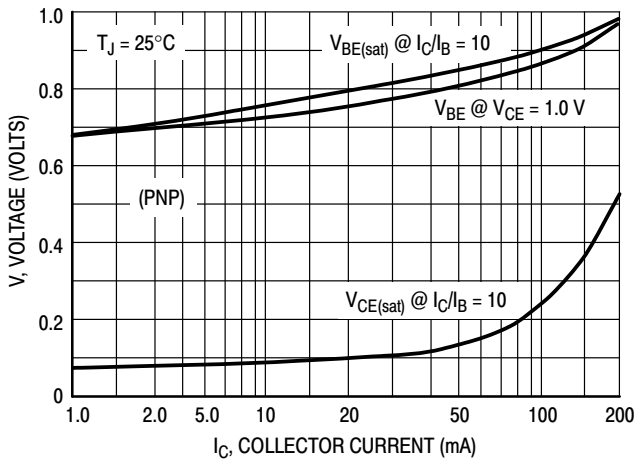


Figure 32. "ON" Voltages

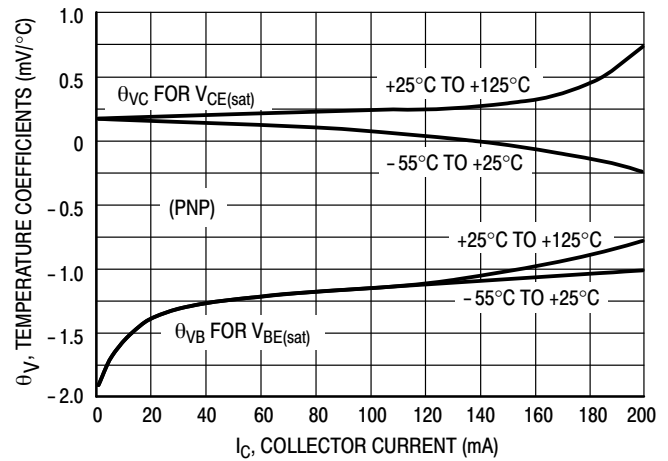


Figure 33. Temperature Coefficients

# NST3946DXV6

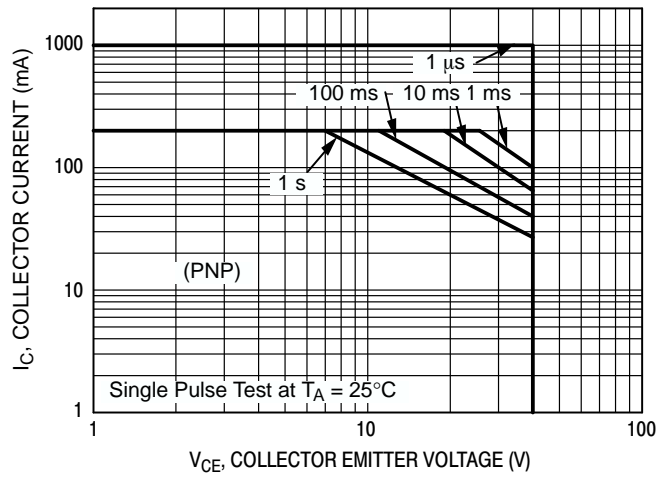
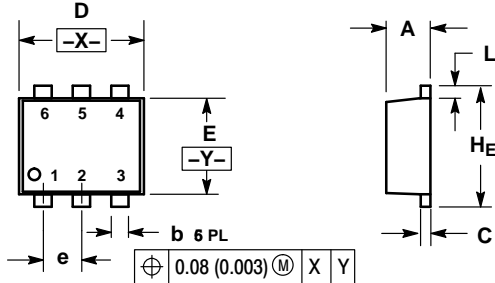


Figure 34. Safe Operating Area

# NST3946DXV6

## PACKAGE DIMENSIONS

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

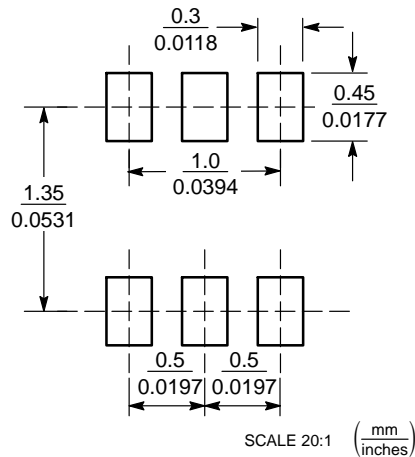


#### NOTES:

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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