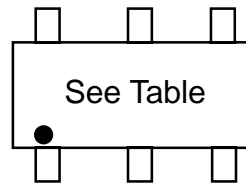


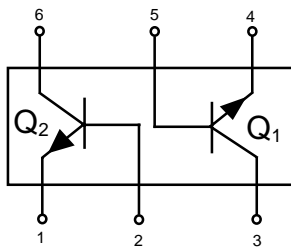
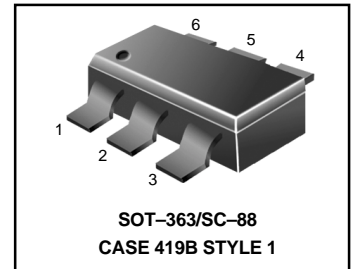
# Dual General Purpose Transistors

The MBT3904DW1T1, MBT3906DW1T1, and MBT3946DW1T1 devices are spin-offs of our popular SOT-23/SOT-323 three-leaded devices. They are designed for general purpose amplifier applications and are housed in the SOT-363 six-leaded surface mount package. By putting two discrete devices in one package, these devices are ideal for low-power surface mount applications where board space is at a premium.

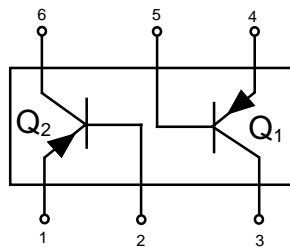
- $h_{FE}$ , 100–300
- Low  $V_{CE(sat)}$ , 3.0–4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7-inch/3,000 Unit Tape and Reel



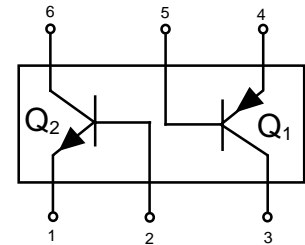
**MBT3904DW1T1**  
**MBT3906DW1T1**  
**MBT3946DW1T1**



**MBT3904DW1T1**



**MBT3906DW1T1**



**MBT3946DW1T1**

\*Q<sub>1</sub> same as MBT3906DW1T1  
 Q<sub>2</sub> same as MBT3904DW1T1

## MAXIMUM RATINGS

Rating	Symbol	Voltage	Unit
Collector–Emitter Voltage	$V_{CEO}$		V
MBT3904DW1T1 (NPN)		40	
MBT3906DW1T1 (PNP)		–40	
Collector–Base Voltage	$V_{CBO}$		V
MBT3904DW1T1 (NPN)		60	
MBT3906DW1T1 (PNP)		–40	
Emitter–Base Voltage	$V_{EBO}$		V
MBT3904DW1T1 (NPN)		6.0	
MBT3906DW1T1 (PNP)		–5.0	
Collector Current –Continuous	$I_C$		mAdc
MBT3904DW1T1 (NPN)		200	
MBT3906DW1T1 (PNP)		–200	
Electrostatic Discharge	ESD	HBM>16000, MM>2000	V

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation(1) $T_A = 25^\circ\text{C}$	$P_D$	150	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	833	$^\circ\text{C/W}$
Junction and Storage Temperature	$T_J, T_{stg}$	–55 to +150	$^\circ\text{C}$

## ORDERING INFORMATION

Device	Package	Shipping
MBT3904DW1T1	SOT-363	3000 Units/Reel
MBT3906DW1T1	SOT-363	3000 Units/Reel
MBT3946DW1T1	SOT-363	3000 Units/Reel

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (2) ( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ ) MBT3904DW1T1 (NPN) ( $I_C = -1.0\text{ mAdc}$ , $I_B = 0$ ) MBT3906DW1T1 (PNP)	$V_{(BR)CEO}$	40 -40	— —	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10\ \mu\text{Adc}$ , $I_E = 0$ ) MBT3904DW1T1 (NPN) ( $I_C = -10\ \mu\text{Adc}$ , $I_E = 0$ ) MBT3906DW1T1 (PNP)	$V_{(BR)CBO}$	60 -40	— —	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10\ \mu\text{Adc}$ , $I_C = 0$ ) MBT3904DW1T1 (NPN) ( $I_E = -10\ \mu\text{Adc}$ , $I_C = 0$ ) MBT3906DW1T1 (PNP)	$V_{(BR)EBO}$	6.0 -5.0	— —	Vdc
Base Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ ) MBT3904DW1T1 (NPN) ( $V_{CE} = -30\text{ Vdc}$ , $V_{EB} = -3.0\text{ Vdc}$ ) MBT3906DW1T1 (PNP)	$I_{BL}$	— —	50 -50	nAdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ ) MBT3904DW1T1 (NPN) ( $V_{CE} = -30\text{ Vdc}$ , $V_{EB} = -3.0\text{ Vdc}$ ) MBT3906DW1T1 (PNP)	$I_{CEX}$	— —	50 -50	nAdc
<b>ON CHARACTERISTICS (2)</b>				
DC Current Gain ( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) MBT3904DW1T1 (NPN) ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 50\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 100\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = -0.1\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ ) MBT3906DW1T1 (PNP) ( $I_C = -1.0\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ ) ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ ) ( $I_C = -50\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ ) ( $I_C = -100\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ )	$h_{FE}$	40 70 100 60 30 60 80 100 60 30	— — — — — — — — — —	Vdc
Collector–Emitter Saturation Voltage ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ ) MBT3904DW1T1 (NPN) ( $I_C = 50\text{ mAdc}$ , $I_B = 5.0\text{ mAdc}$ ) ( $I_C = -10\text{ mAdc}$ , $I_B = -1.0\text{ mAdc}$ ) MBT3906DW1T1 (PNP) ( $I_C = -50\text{ mAdc}$ , $I_B = -5.0\text{ mAdc}$ )	$V_{CE(sat)}$	— — — —	0.2 0.3 -0.25 -0.4	Vdc
Base–Emitter Saturation Voltage ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ ) MBT3904DW1T1 (NPN) ( $I_C = 50\text{ mAdc}$ , $I_B = 5.0\text{ mAdc}$ ) ( $I_C = -10\text{ mAdc}$ , $I_B = -1.0\text{ mAdc}$ ) MBT3906DW1T1 (PNP) ( $I_C = -50\text{ mAdc}$ , $I_B = -5.0\text{ mAdc}$ )	$V_{BE(sat)}$	0.65 — -0.65 —	0.85 0.95 -0.85 -0.95	Vdc
<b>SMALL–SIGNAL CHARACTERISTICS</b>				
Current–Gain — Bandwidth Product ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ ) MBT3904DW1T1 (NPN) ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -20\text{ Vdc}$ , $f = 100\text{ MHz}$ ) MBT3906DW1T1 (PNP)	$f_T$	300 250	— —	MHz
Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ ) MBT3904DW1T1 (NPN) ( $V_{CB} = -5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ ) MBT3906DW1T1 (PNP)	$C_{obo}$	— —	4.0 4.5	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ ) MBT3904DW1T1 (NPN) ( $V_{EB} = -0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ ) MBT3906DW1T1 (PNP)	$C_{ibo}$	— —	8.0 10.0	pF

2. Pulse Test: Pulse Width  $\leq 300\text{ ms}$ ; Duty Cycle  $\leq 2.0\%$ .

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

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

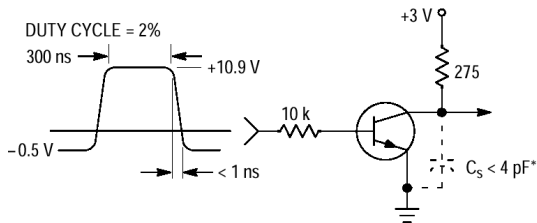
Characteristic	Symbol	Min	Max	Unit
Input Impedance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	h <sub>ie</sub>	1.0	10	k Ω
(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)		2.0	12	
Voltage Feedback Ratio (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	h <sub>re</sub>	0.5	8.0	X 10 <sup>-4</sup>
(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)		0.1	10	
Small-Signal Current Gain (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	h <sub>fe</sub>	100	400	—
(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)		100	400	
Output Admittance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	h <sub>oe</sub>	1.0	40	μhos
(V <sub>CE</sub> = -10 Vdc, I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)		3.0	60	
Noise Figure (V <sub>CE</sub> = 5.0 Vdc, I <sub>C</sub> = 100 μA <sub>dc</sub> , R <sub>S</sub> = 1.0 k Ω, f = 1.0 kHz)	NF	—	5.0	dB
(V <sub>CE</sub> = -5.0 Vdc, I <sub>C</sub> = -100 μA <sub>dc</sub> , R <sub>S</sub> = 1.0 k Ω, f = 1.0 kHz)		—	4.0	

**SWITCHING CHARACTERISTICS**

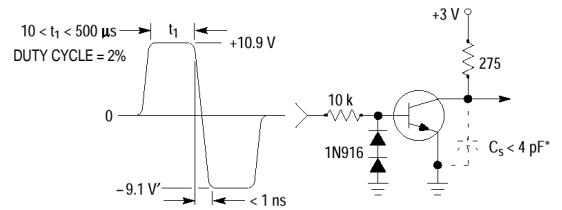
Delay Time (V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = -0.5 Vdc)	MBT3904DW1T1 (NPN)	t <sub>d</sub>	—	35	ns
(V <sub>CC</sub> = -3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc)	MBT3906DW1T1 (PNP)		—	35	
Rise Time (I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B1</sub> = 1.0 mA <sub>dc</sub> )	MBT3904DW1T1 (NPN)	t <sub>r</sub>	—	35	ns
(I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B1</sub> = -1.0 mA <sub>dc</sub> )	MBT3906DW1T1 (PNP)		—	35	
Storage Time (V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mA <sub>dc</sub> )	MBT3904DW1T1 (NPN)	t <sub>s</sub>	—	200	ns
(V <sub>CC</sub> = -3.0 Vdc, I <sub>C</sub> = -10 mA <sub>dc</sub> )	MBT3906DW1T1 (PNP)		—	225	
Fall Time (I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mA <sub>dc</sub> )	MBT3904DW1T1 (NPN)	t <sub>f</sub>	—	50	ns
(I <sub>B1</sub> = I <sub>B2</sub> = -1.0 mA <sub>dc</sub> )	MBT3906DW1T1 (PNP)		—	70	

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

**MBT3904DW1T1 (NPN)**



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

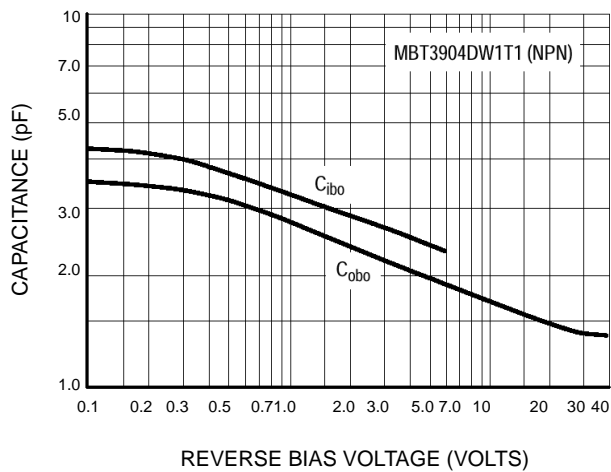


**Figure 2. Storage and Fall Time Equivalent Test Circuit**

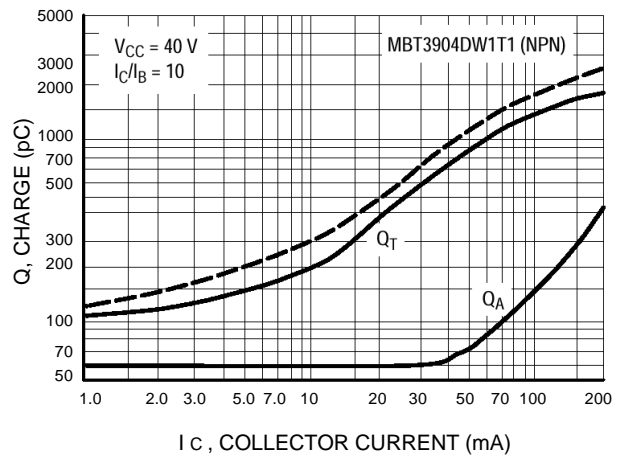
\* Total shunt capacitance of test jig and connectors

**TYPICAL TRANSIENT CHARACTERISTICS**

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



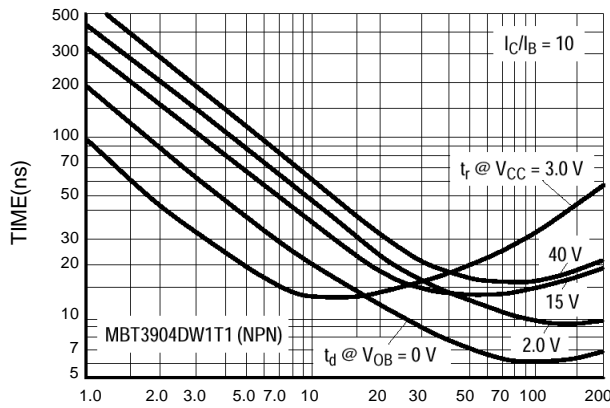
**Figure 3. Capacitance**



**Figure 4. Charge Data**

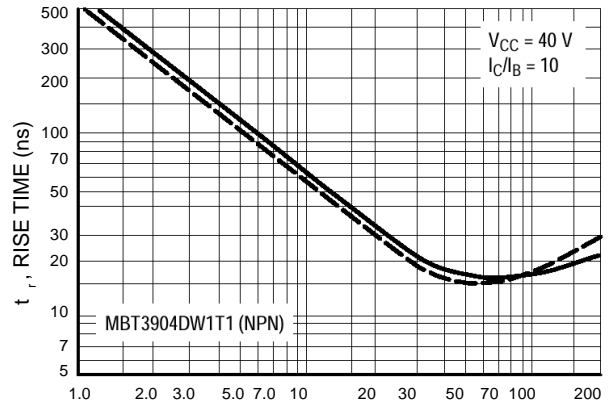
**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

**MBT3904DW1T1 (NPN)**



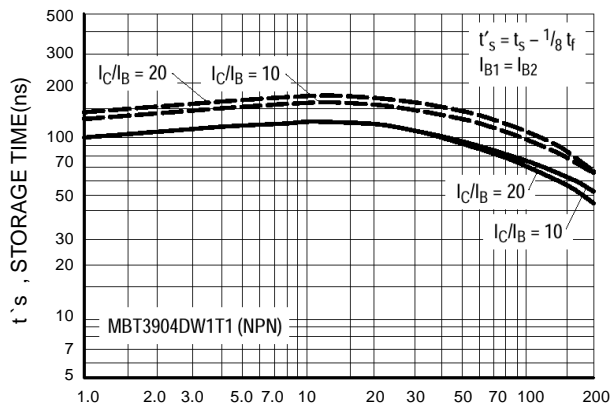
I<sub>C</sub>, COLLECTOR CURRENT (mA)

**Figure 5. Turn-On Time**



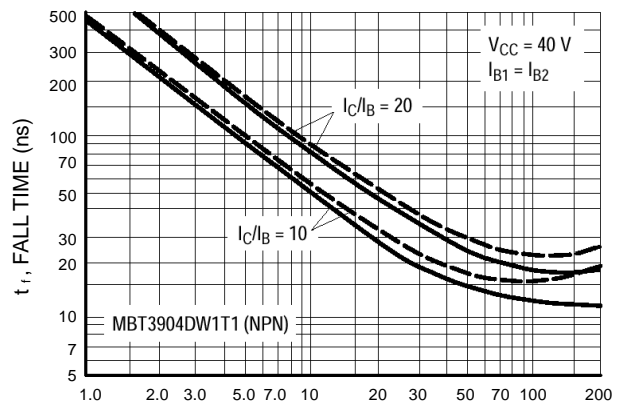
I<sub>C</sub>, COLLECTOR CURRENT (mA)

**Figure 6. Rise Time**



I<sub>C</sub>, COLLECTOR CURRENT (mA)

**Figure 7. Storage Time**



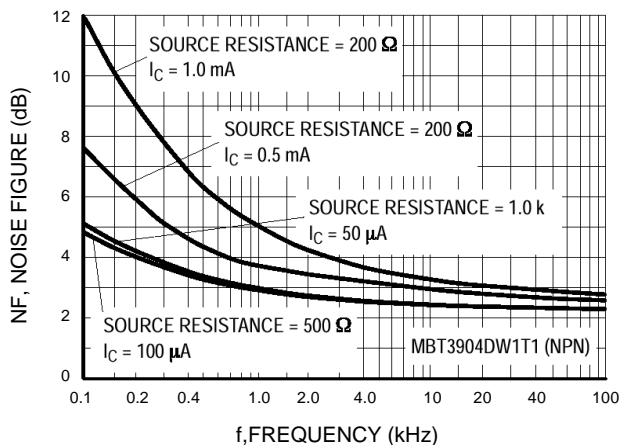
I<sub>C</sub>, COLLECTOR CURRENT (mA)

**Figure 8. Fall Time**

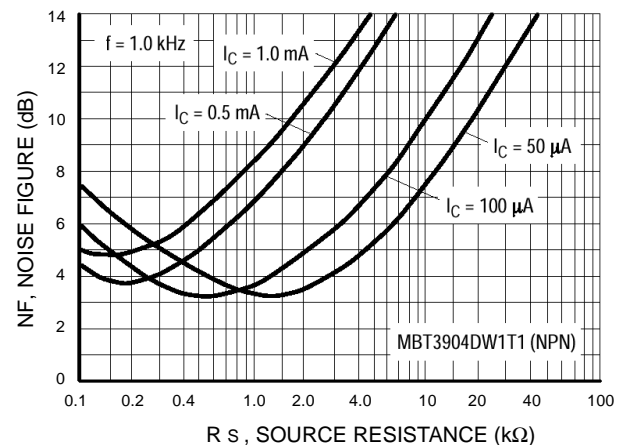
**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS**

**NOISE FIGURE VARIATIONS**

(V = 5.0 Vdc, T = 25°C, Bandwidth = 1.0 Hz)



**Figure 9. Noise Figure**



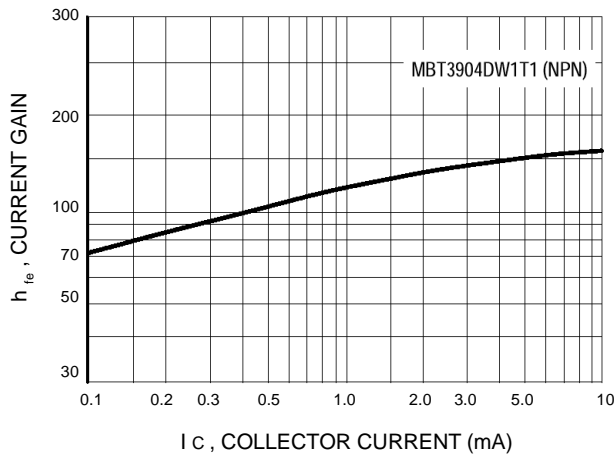
**Figure 10. Noise Figure**

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

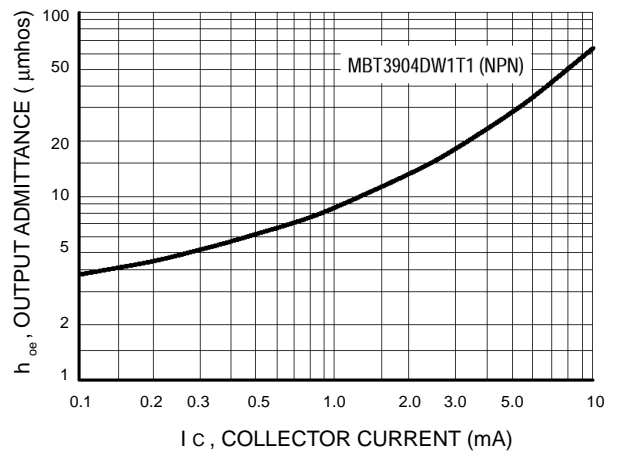
**MBT3904DW1T1 (NPN)**

**h PARAMETERS**

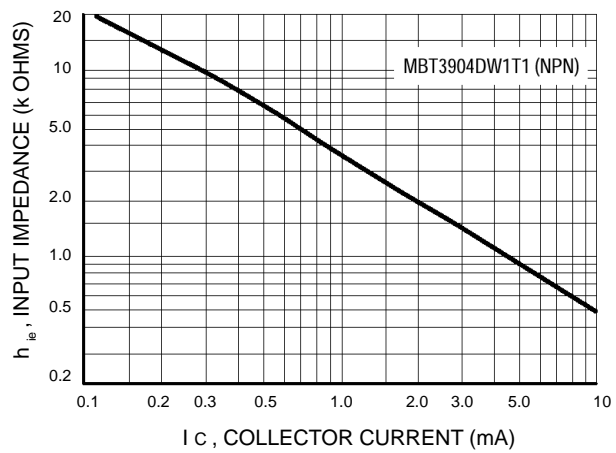
( $V_{CE} = 10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$ )



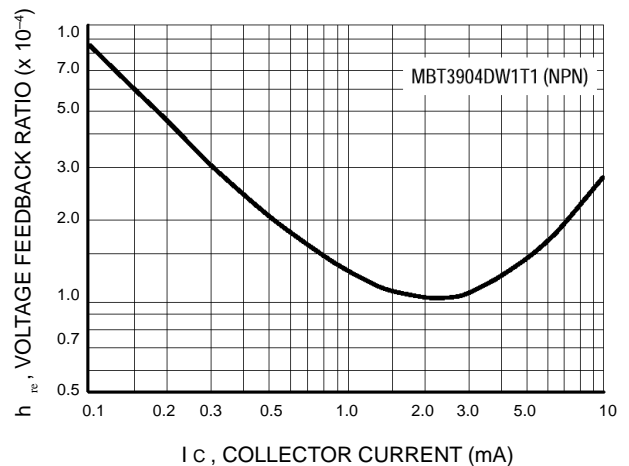
**Figure 11. Current Gain**



**Figure 12. Output Admittance**



**Figure 13. Input Impedance**



**Figure 14. Voltage Feedback Ratio**

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

**MBT3904DW1T1 (NPN)  
TYPICAL STATIC CHARACTERISTICS**

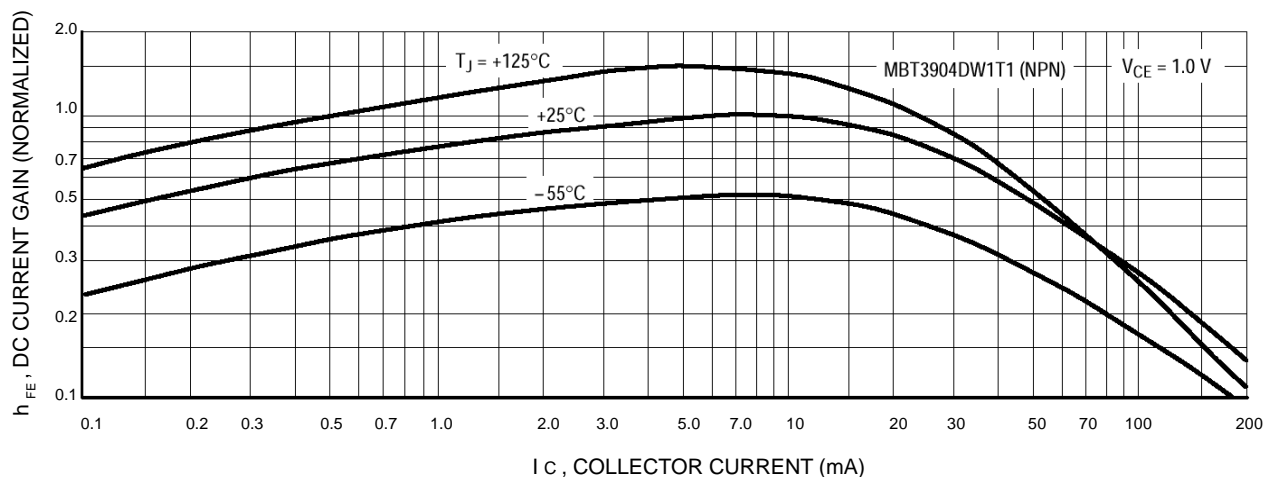


Figure 15. DC Current Gain

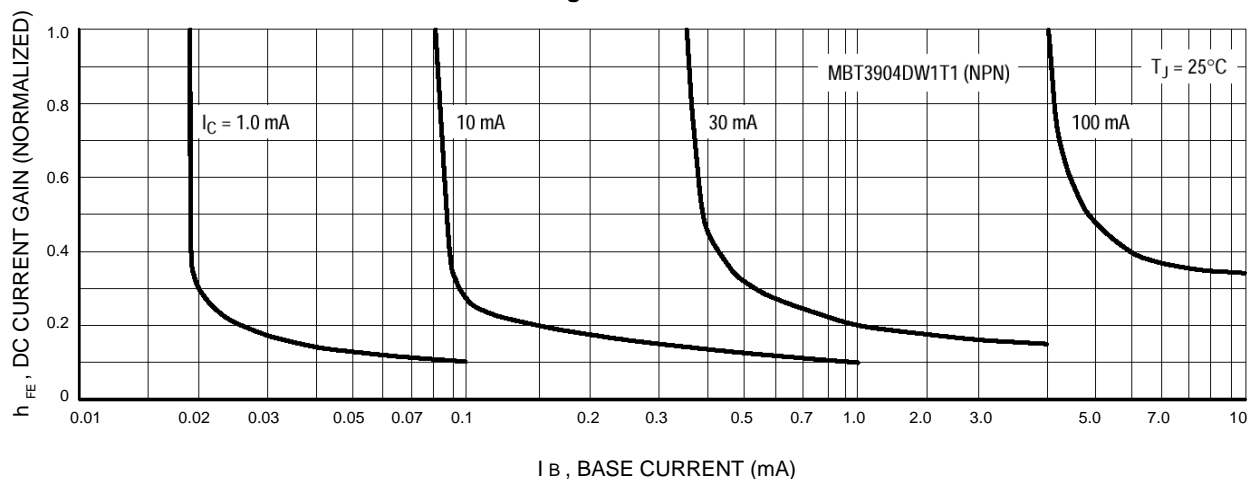


Figure 16. Collector Saturation Region

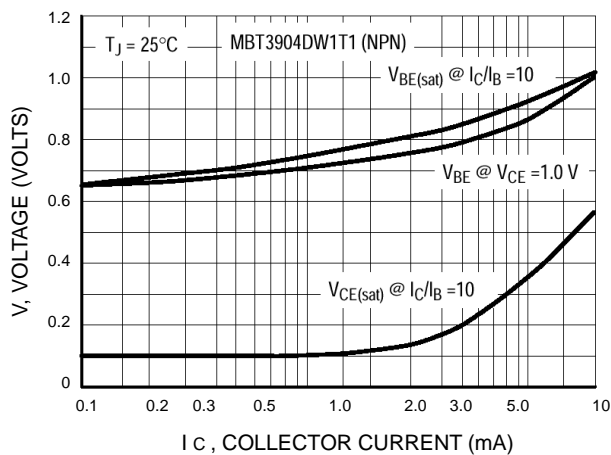


Figure 17. "ON" Voltages

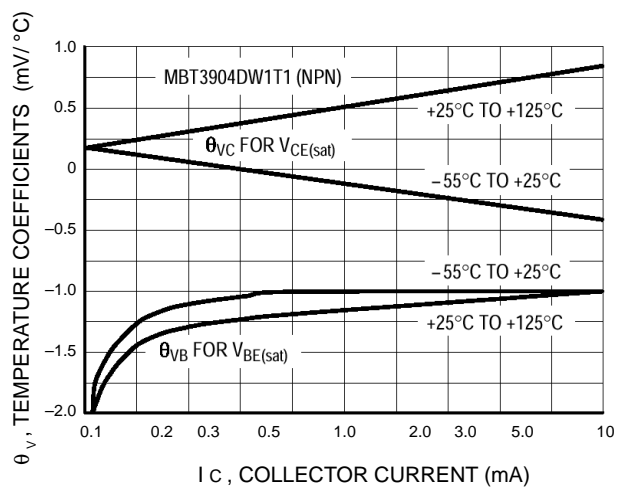
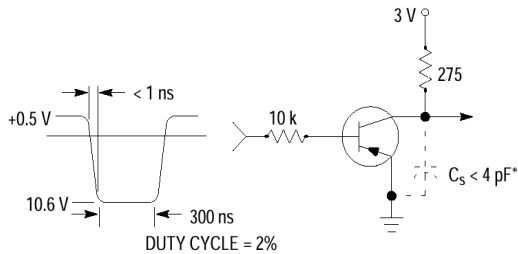


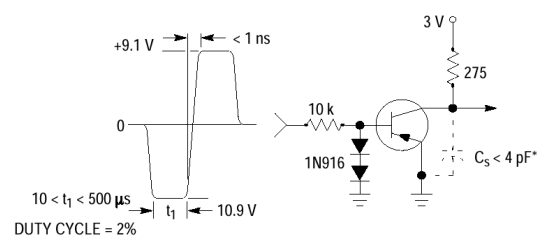
Figure 18. Temperature Coefficients

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

**MBT3906DW1T1 (PNP)**



**Figure 19. Delay and Rise Time Equivalent Test Circuit**

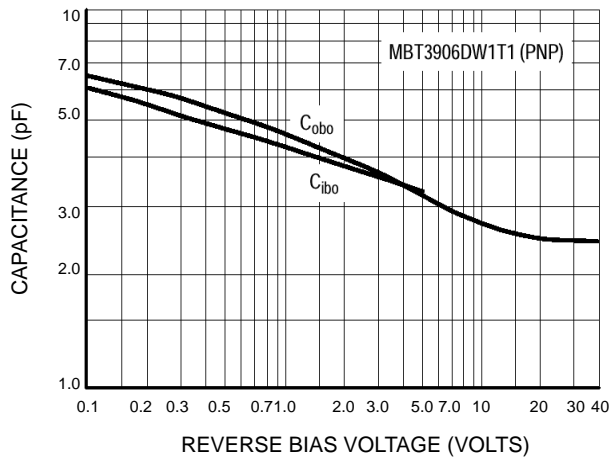


**Figure 20. Storage and Fall Time Equivalent Test Circuit**

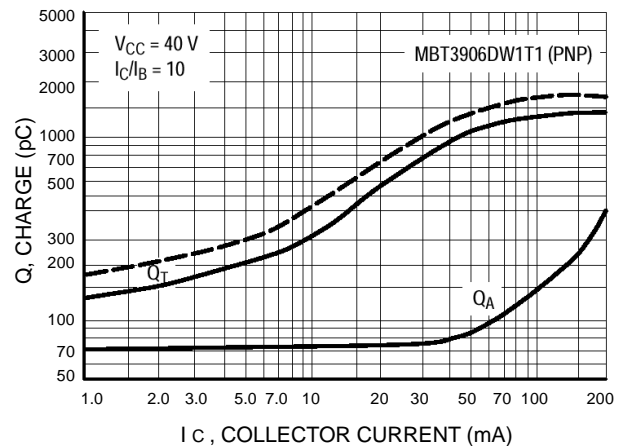
\* Total shunt capacitance of test jig and connectors

**TYPICAL TRANSIENT CHARACTERISTICS**

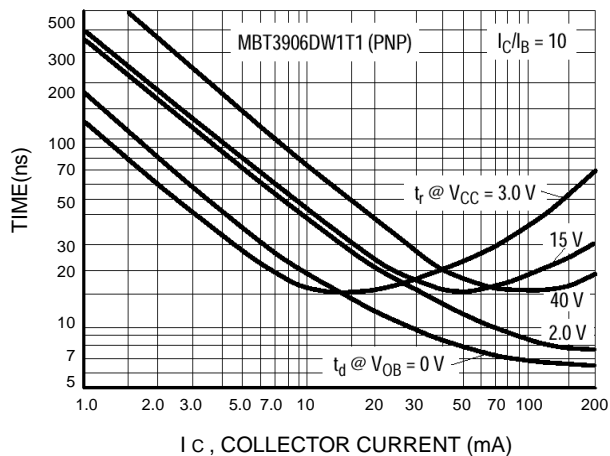
—  $T_J = 25^\circ\text{C}$   
 - - -  $T_J = 125^\circ\text{C}$



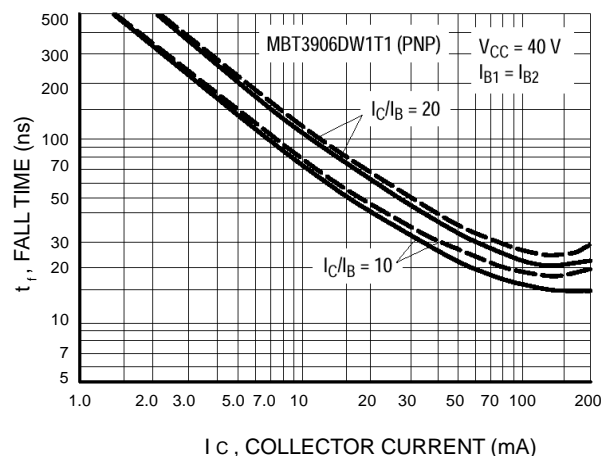
**Figure 21. Capacitance**



**Figure 22. Charge Data**



**Figure 23. Turn-On Time**



**Figure 24. Fall Time**



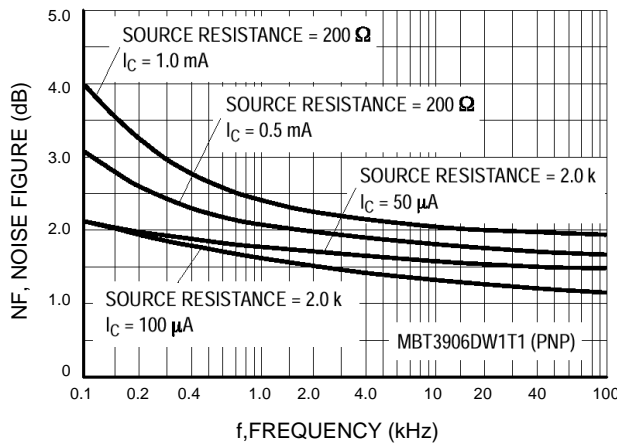
**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

**MBT3906DW1T1 (PNP)**

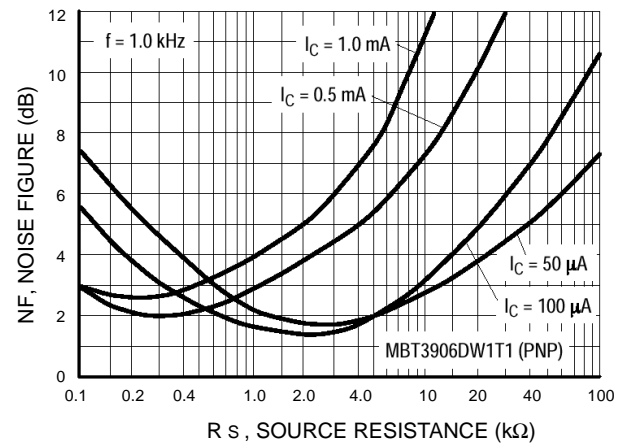
**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS**

**NOISE FIGURE VARIATIONS**

( $V = -5.0$  Vdc,  $T = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)



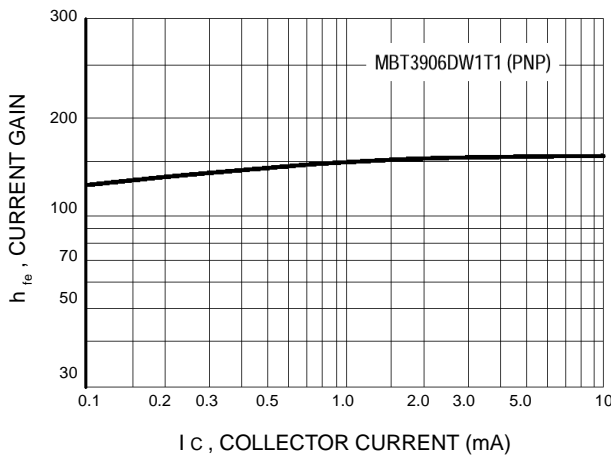
**Figure 25. Noise Figure**



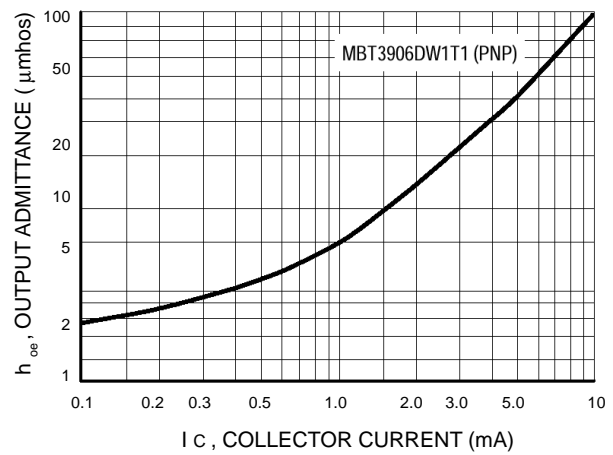
**Figure 26. Noise Figure**

**h PARAMETERS**

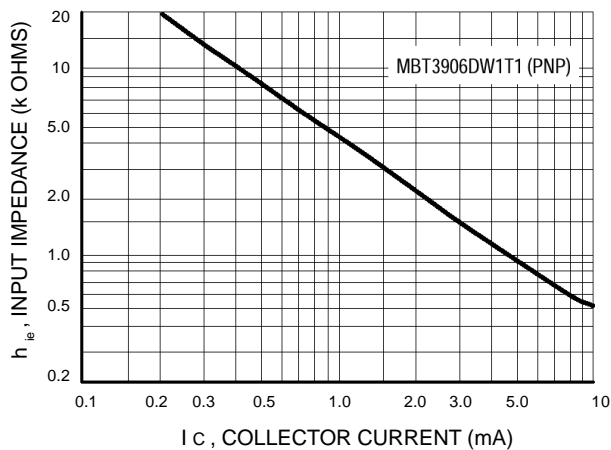
( $V_{CE} = -10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )



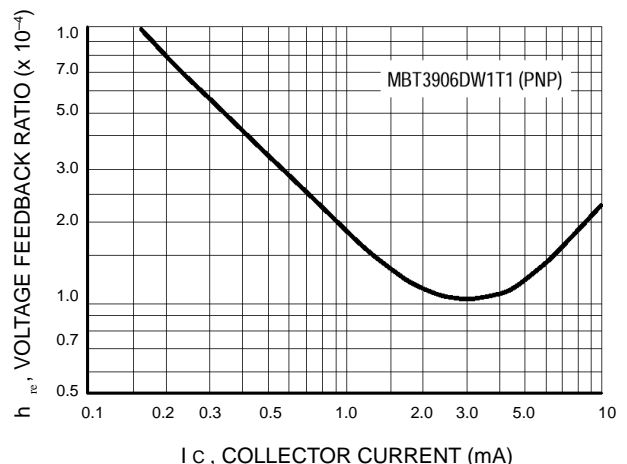
**Figure 27. Current Gain**



**Figure 28. Output Admittance**



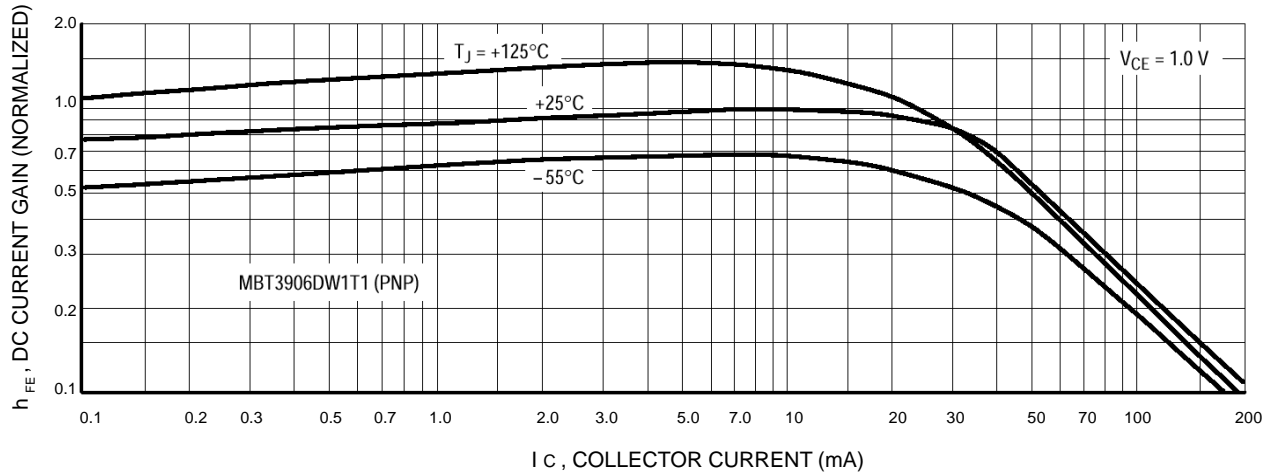
**Figure 29. Input Impedance**



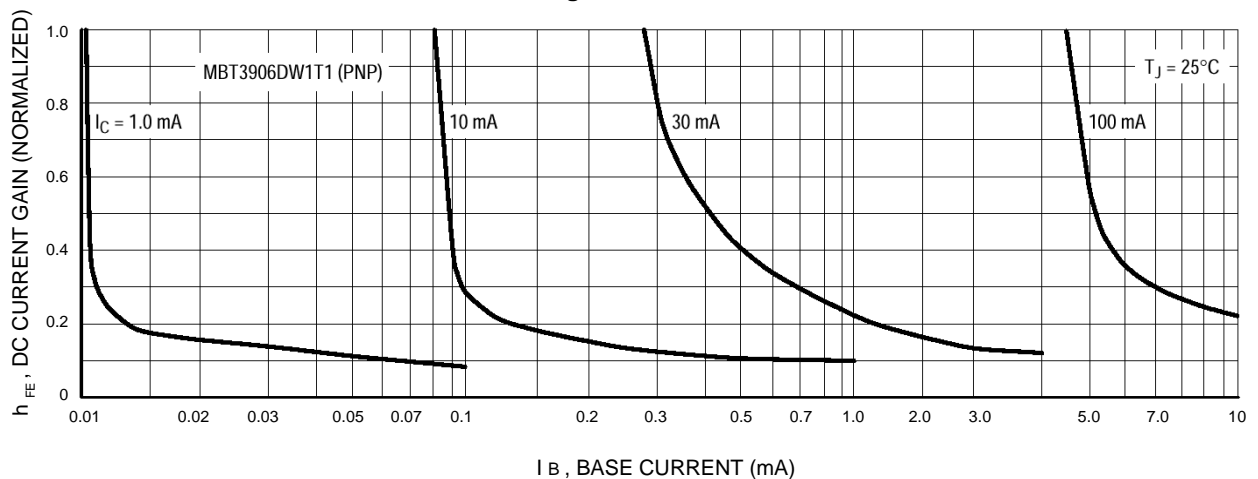
**Figure 30. Voltage Feedback Ratio**

**MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1**

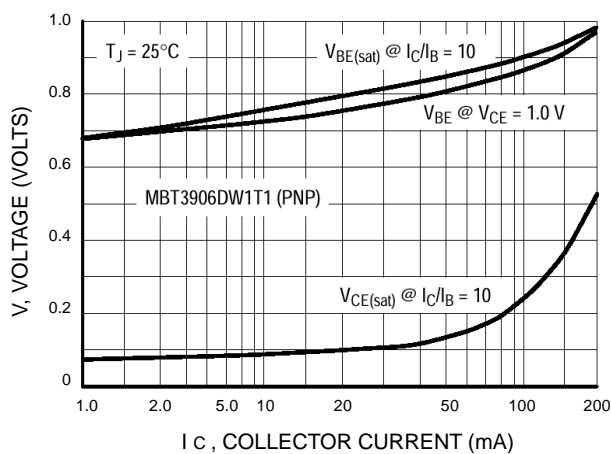
**MBT3906DW1T1 (PNP)  
TYPICAL STATIC CHARACTERISTICS**



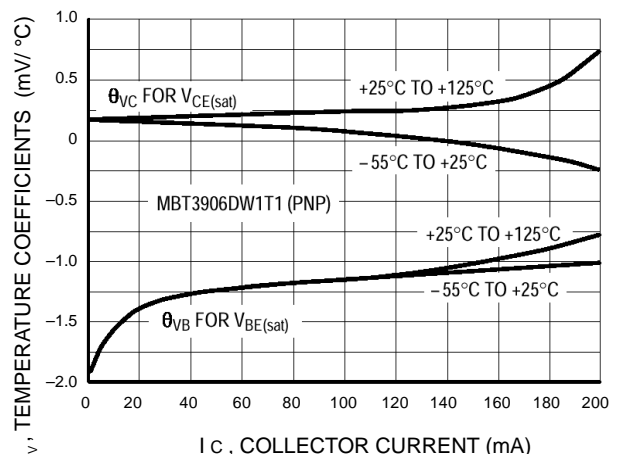
**Figure 31. DC Current Gain**



**Figure 32. Collector Saturation Region**



**Figure 33. "ON" Voltages**



**Figure 34. Temperature Coefficients**