



# General Purpose Transistors

**NPN and PNP Silicon**

These transistors are designed for general purpose amplifier applications. They are housed in the SC-89 which is designed for low power surface mount applications.

- Pb-Free Package is available.

**DEVICE MARKING AND ORDERING INFORMATION**

Device	Marking	Package	Shipping
MMBT3904T	MA	SC-89	3000/Tape&Reel
MMBT3906T	2A	SC-89	3000/Tape&Reel

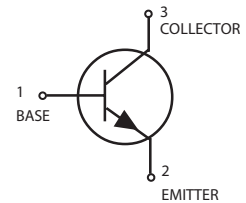
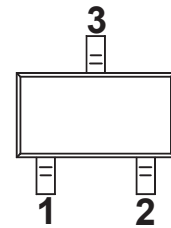
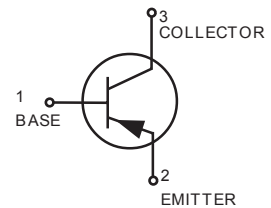
**MAXIMUM RATINGS**

Rating		Symbol	Value	Unit
Collector–Emitter Voltage	MMBT3904T	$V_{CEO}$	40	Vdc
	MMBT3906T		– 40	
Collector–Base Voltage	MMBT3904T	$V_{CBO}$	60	Vdc
	MMBT3906T		– 40	
Emitter–Base Voltage	MMBT3904T	$V_{EBO}$	6.0	Vdc
	MMBT3906T		– 5.0	
Collector Current — Continuous	MMBT3904T	$I_C$	200	mAdc
	MMBT3906T		– 200	

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Total Device Dissipation (1) $T_A=25\text{ }^\circ\text{C}$	$P_D$	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	$^\circ\text{C}$

SC-89 / SOT-523

**MMBT3904T****MMBT3906T**

# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

### 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)					
( $I_C = 1.0\text{ mA}$ , $I_B = 0$ )	MMBT3904T	$V_{(BR)CEO}$	40	—	Vdc
( $I_C = -1.0\text{ mA}$ , $I_B = 0$ )	MMBT3906T		-40	—	
Collector–Base Breakdown Voltage					
( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )	MMBT3904T	$V_{(BR)CBO}$	60	—	Vdc
( $I_C = -10\text{ }\mu\text{A}$ , $I_E = 0$ )	MMBT3906T		-40	—	
Emitter–Base Breakdown Voltage					
( $I_E = 10\text{ }\mu\text{A}$ , $I_C = 0$ )	MMBT3904T	$V_{(BR)EBO}$	6.0	—	Vdc
( $I_E = -10\text{ }\mu\text{A}$ , $I_C = 0$ )	MMBT3906T		-5.0	—	
Base Cutoff Current					
( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ )	MMBT3904T	$I_{BL}$	—	50	nAdc
( $V_{CE} = -30\text{ Vdc}$ , $V_{EB} = -3.0\text{ Vdc}$ )	MMBT3906T		—	-50	
Collector Cutoff Current					
( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ )	MMBT3904T	$I_{CEX}$	—	50	nAdc
( $V_{CE} = -30\text{ Vdc}$ , $V_{EB} = -3.0\text{ Vdc}$ )	MMBT3906T		—	-50	

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.
2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS (2)</b>				
DC Current Gain	$h_{FE}$			—
(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )	MMBT3904T	40	—	
(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		70	—	
(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		100	300	
(I <sub>C</sub> = 50 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		60	—	
(I <sub>C</sub> = 100 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		30	—	
(I <sub>C</sub> = -0.1 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )	MMBT3906T	60	—	
(I <sub>C</sub> = -1.0 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )		80	—	
(I <sub>C</sub> = -10 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )		100	300	
(I <sub>C</sub> = -50 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )		60	—	
(I <sub>C</sub> = -100 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )		30	—	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>			V <sub>dc</sub>
(I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> )	MMBT3904T	—	0.2	
(I <sub>C</sub> = 50 mA <sub>dc</sub> , I <sub>B</sub> = 5.0 mA <sub>dc</sub> )		—	0.3	
(I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B</sub> = -1.0 mA <sub>dc</sub> )	MMBT3906T	—	-0.25	
(I <sub>C</sub> = -50 mA <sub>dc</sub> , I <sub>B</sub> = -5.0 mA <sub>dc</sub> )		—	-0.4	
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>			V <sub>dc</sub>
(I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> )	MMBT3904T	0.65	0.85	
(I <sub>C</sub> = 50 mA <sub>dc</sub> , I <sub>B</sub> = 5.0 mA <sub>dc</sub> )		—	0.95	
(I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B</sub> = -1.0 mA <sub>dc</sub> )	MMBT3906T	-0.65	-0.85	
(I <sub>C</sub> = -50 mA <sub>dc</sub> , I <sub>B</sub> = -5.0 mA <sub>dc</sub> )		—	-0.95	

### SMALL-SIGNAL CHARACTERISTICS

	Symbol	Min	Max	Unit
Current-Gain — Bandwidth Product	f <sub>T</sub>			MHz
(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 20 V <sub>dc</sub> , f = 100 MHz)	MMBT3904T	300	—	
(I <sub>C</sub> = -10 mA <sub>dc</sub> , V <sub>CE</sub> = -20 V <sub>dc</sub> , f = 100 MHz)	MMBT3906T	250	—	
Output Capacitance	C <sub>obo</sub>			pF
(V <sub>CB</sub> = 5.0 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)	MMBT3904T	—	4.0	
(V <sub>CB</sub> = -5.0 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)	MMBT3906T	—	4.5	
Input Capacitance	C <sub>ibo</sub>			pF
(V <sub>EB</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)	MMBT3904T	—	8.0	
(V <sub>EB</sub> = -0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)	MMBT3906T	—	10.0	
Input Impedance	h <sub>ie</sub>			kΩ
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904T	1.0	10	
(V <sub>CE</sub> = -10 V <sub>dc</sub> , I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3906T	2.0	12	
Voltage Feedback Ratio	h <sub>re</sub>			X 10 <sup>-4</sup>
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904T	0.5	8.0	
(V <sub>CE</sub> = -10 V <sub>dc</sub> , I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3906T	0.1	10	
Small-Signal Current Gain	h <sub>fe</sub>			—
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904T	100	400	
(V <sub>CE</sub> = -10 V <sub>dc</sub> , I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3906T	100	400	
Output Admittance	h <sub>oe</sub>			μmhos
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904T	1.0	40	
(V <sub>CE</sub> = -10 V <sub>dc</sub> , I <sub>C</sub> = -1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3906T	3.0	60	
Noise Figure	NF			dB
(V <sub>CE</sub> = 5.0V <sub>dc</sub> , I <sub>C</sub> = 100μA <sub>dc</sub> , R <sub>S</sub> = 1.0 kΩ, f = 1.0kHz)	MMBT3904T	—	5.0	
(V <sub>CE</sub> = -5.0V <sub>dc</sub> , I <sub>C</sub> = -100 μA <sub>dc</sub> , R <sub>S</sub> = 1.0 kΩ, f = 1.0kHz)	MMBT3906T	—	4.0	

# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

### SWITCHING CHARACTERISTICS

		Symbol	Min	Max	Unit
Delay Time ( $V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$ ) ( $V_{CC} = -3.0 \text{ Vdc}$ , $V_{BE} = 0.5 \text{ Vdc}$ )	MMBT3904T	$t_d$	—	35	ns
	MMBT3906T		—	35	
Rise Time ( $I_C = 10 \text{ mAdc}$ , $I_{B1} = 1.0 \text{ mAdc}$ ) ( $I_C = -10 \text{ mAdc}$ , $I_{B1} = -1.0 \text{ mAdc}$ )	MMBT3904T	$t_r$	—	35	ns
	MMBT3906T		—	35	
Storage Time ( $V_{CC} = 3.0 \text{ Vdc}$ , $I_C = 10 \text{ mAdc}$ ) ( $V_{CC} = -3.0 \text{ Vdc}$ , $I_C = -10 \text{ mAdc}$ )	MMBT3904T	$t_s$	—	200	ns
	MMBT3906T		—	225	
Fall Time ( $I_{B1} = I_{B2} = 1.0 \text{ mAdc}$ ) ( $I_{B1} = I_{B2} = -1.0 \text{ mAdc}$ )	MMBT3904T	$t_f$	—	50	ns
	MMBT3906T		—	75	

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

### MMBT3904T

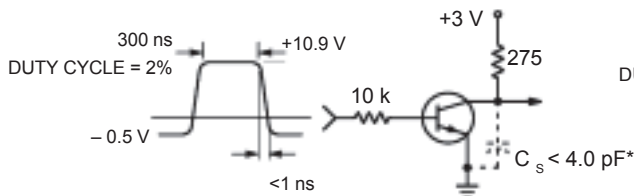


Figure 1. Delay and Rise Time  
Equivalent Test Circuit

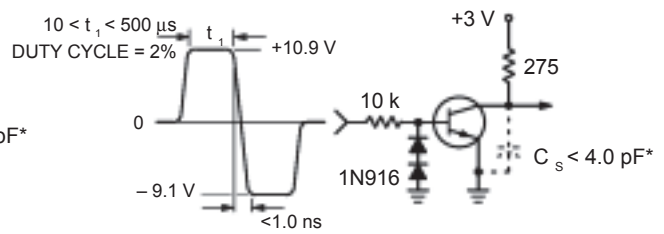


Figure 2. Storage and Fall Time  
Equivalent Test Circuit

\*Total shunt capacitance of test jig and connectors

### TYPICAL TRANSIENT CHARACTERISTICS

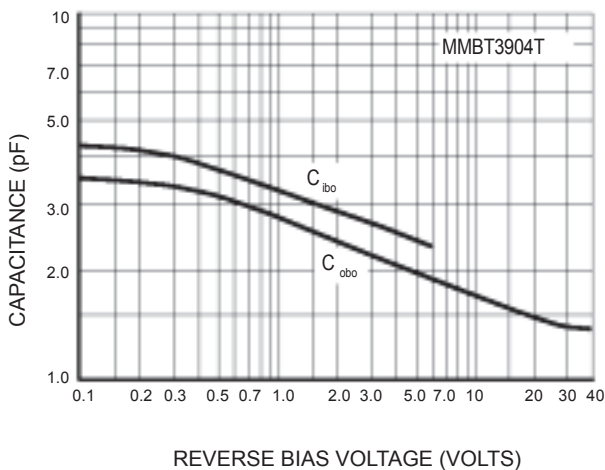


Figure 3. Capacitance

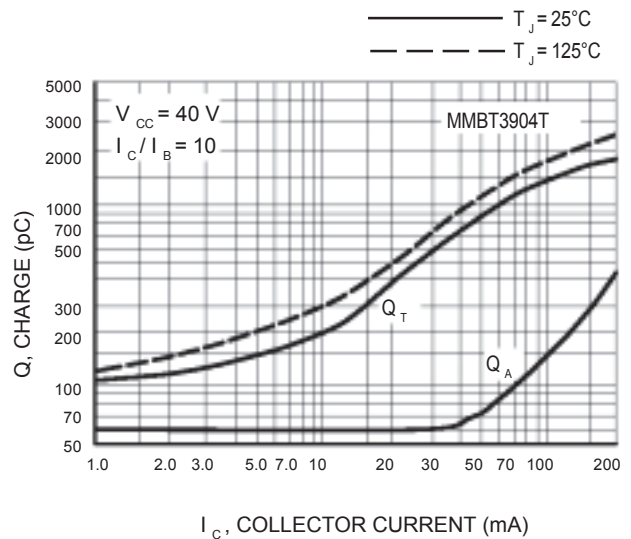


Figure 4. Charge Data

# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

### MMBT3904T

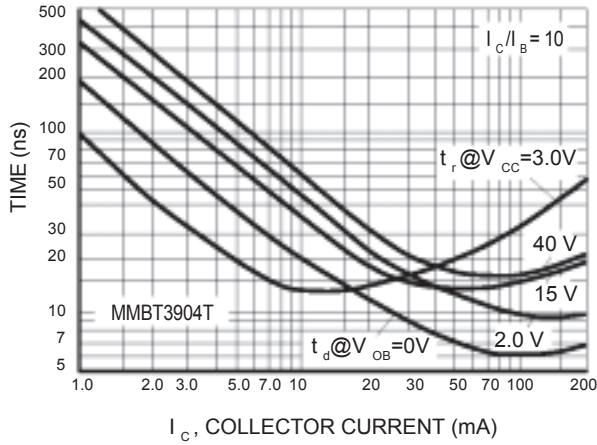


Figure 5. Turn-On Time

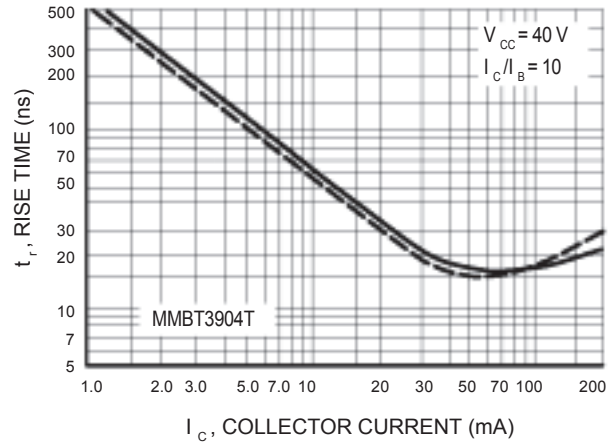


Figure 6. Rise Time

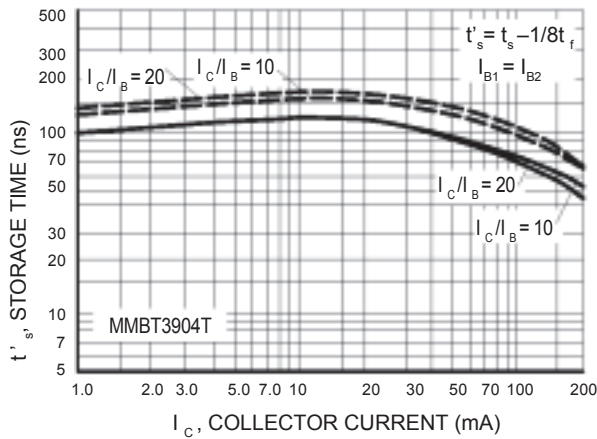


Figure 7. Storage Time

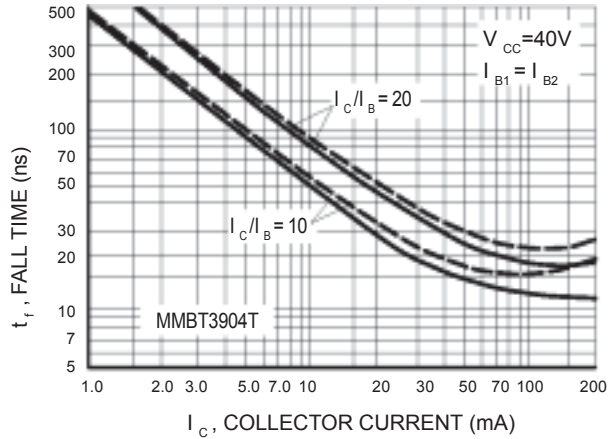


Figure 8. Fall Time

### TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

#### NOISE FIGURE VARIATIONS

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

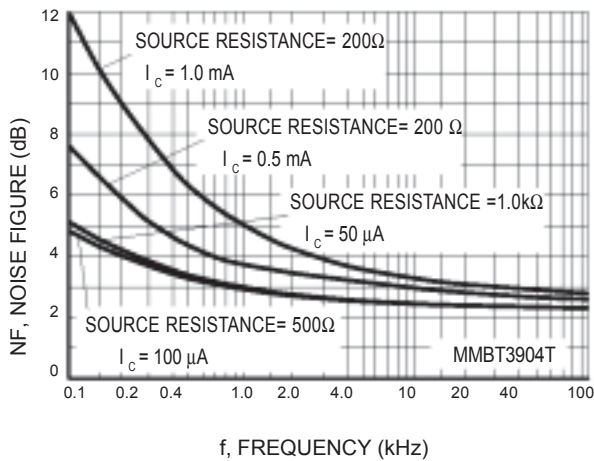


Figure 9. Noise Figure

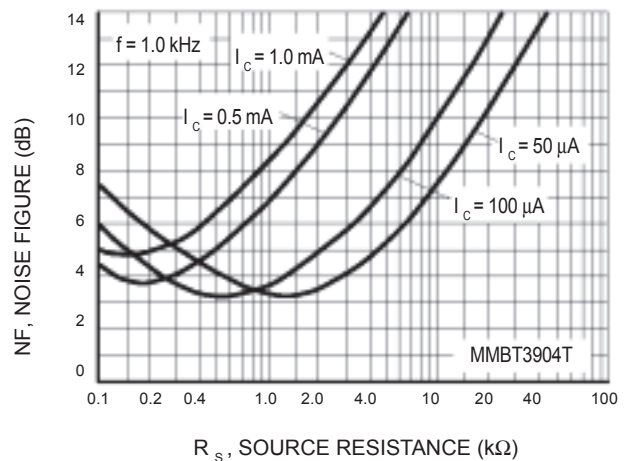


Figure 10. Noise Figure

# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

### h PARAMETERS

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

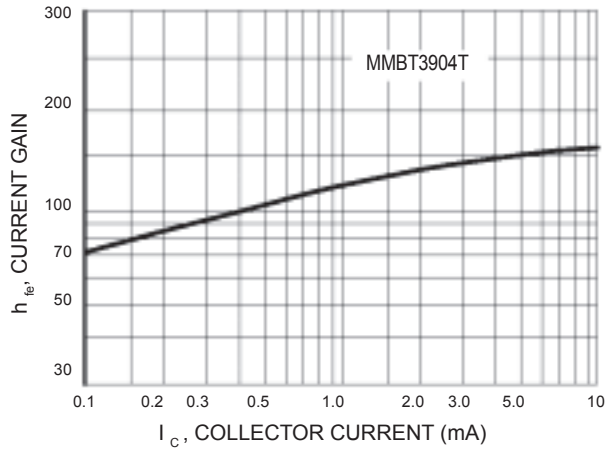


Figure 11. Current Gain

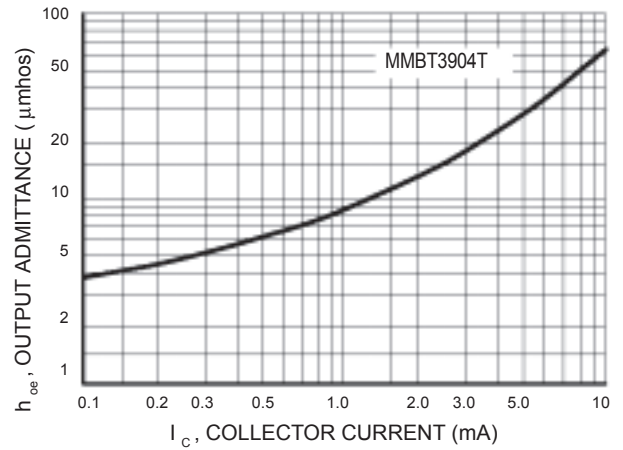


Figure 12. Output Admittance

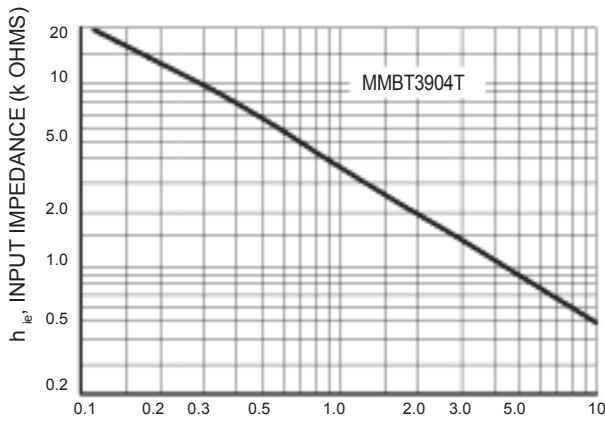


Figure 13. Input Impedance

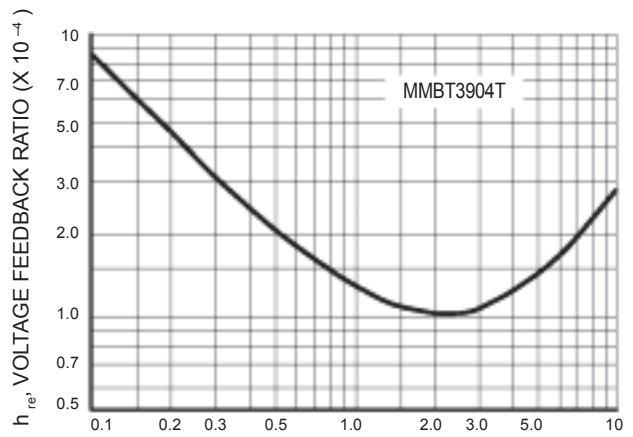
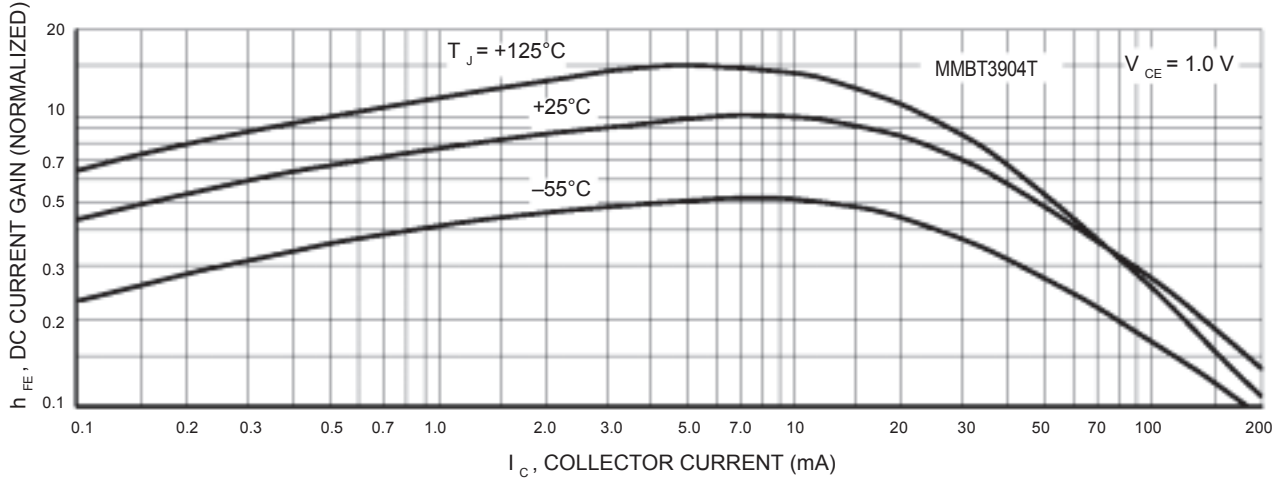


Figure 14. Voltage Feedback Ratio

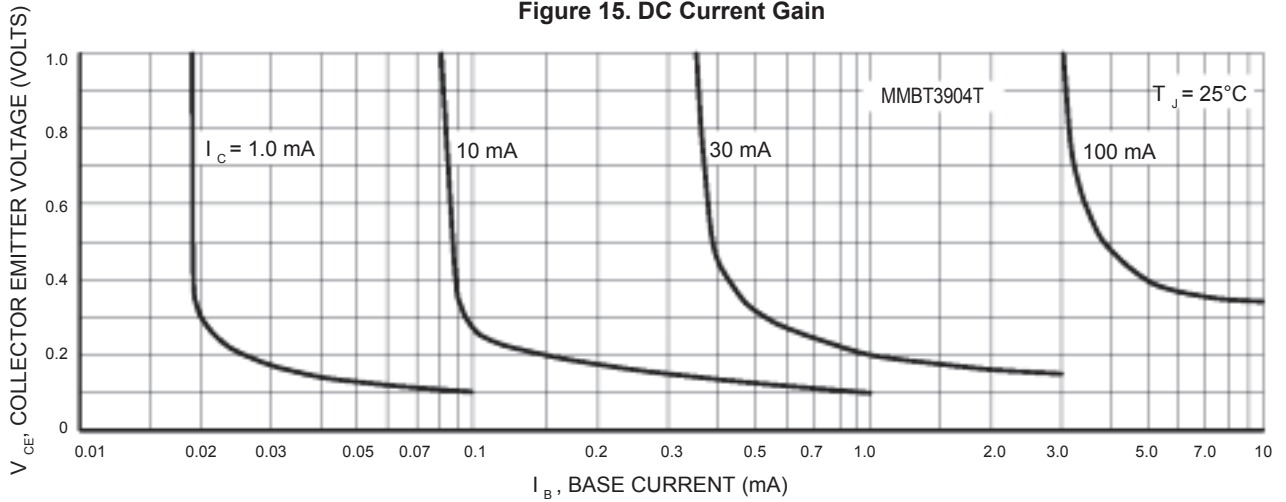
# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

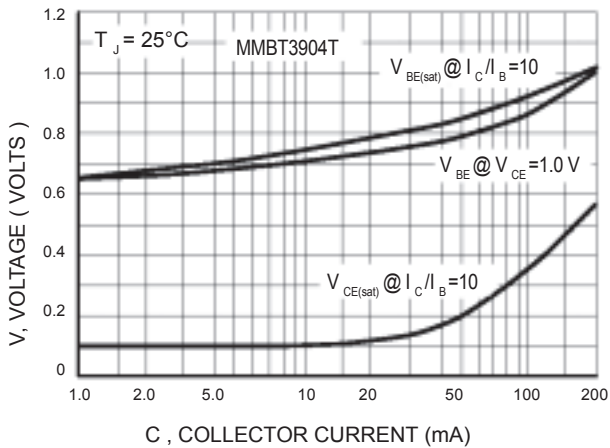
**MMBT3904T**  
**TYPICAL STATIC CHARACTERISTICS**



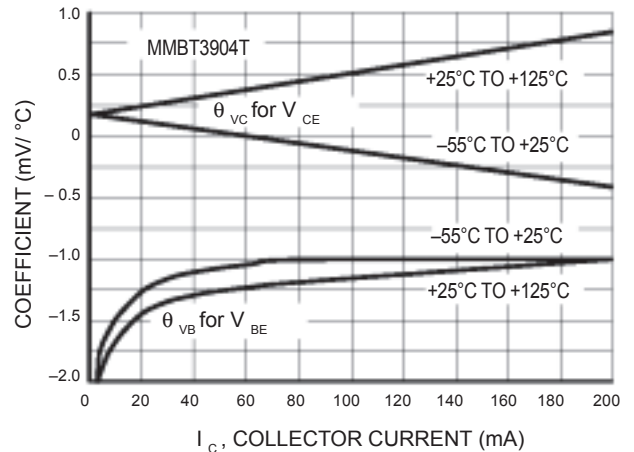
**Figure 15. DC Current Gain**



**Figure 16. Collector Saturation Region**



**Figure 17. "ON" Voltages**

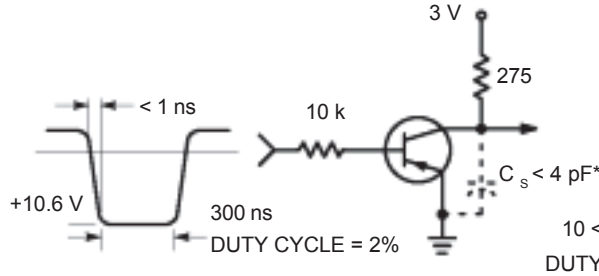


**Figure 18. Temperature Coefficients**

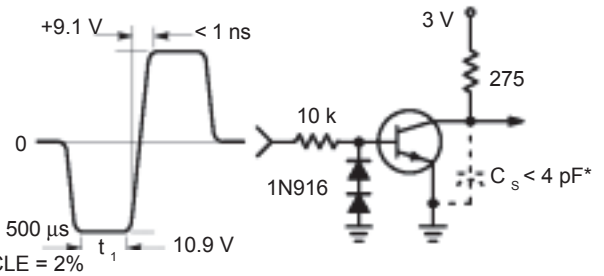
# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

MMBT3906T



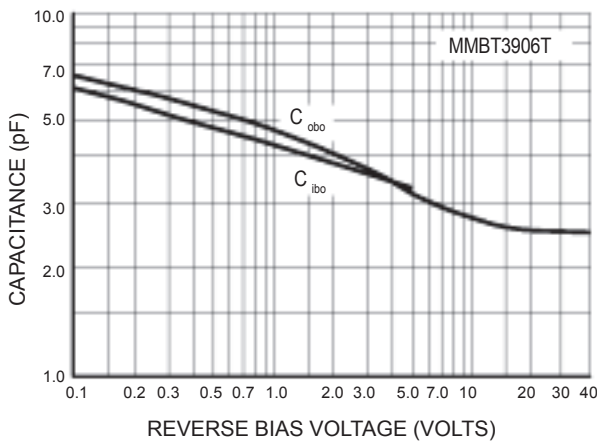
**Figure 19. Delay and Rise Time**  
Equivalent Test Circuit



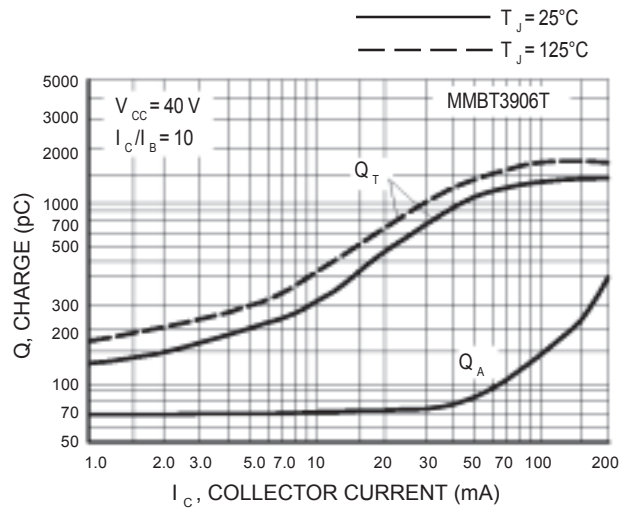
**Figure 20. Storage and Fall Time**  
Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

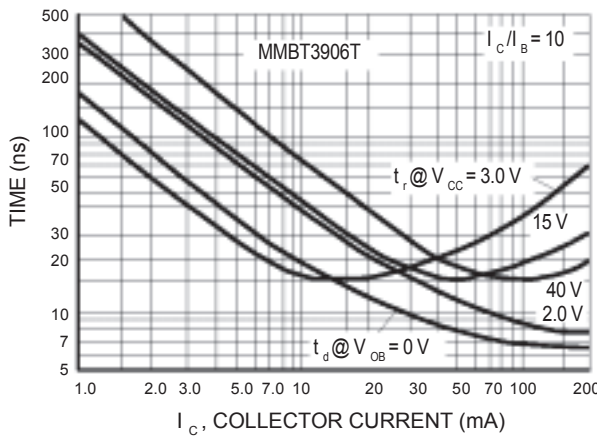
### TYPICAL TRANSIENT CHARACTERISTICS



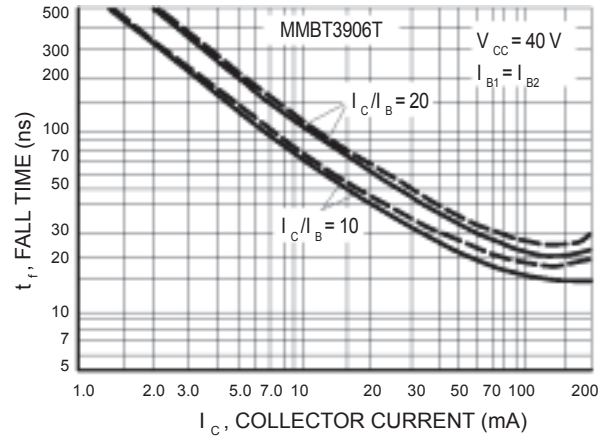
**Figure 21. Capacitance**



**Figure 22. Charge Data**



**Figure 23. Turn-On Time**



**Figure 24. Fall Time**



# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

### MMBT3906T

#### TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

##### NOISE FIGURE VARIATIONS

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

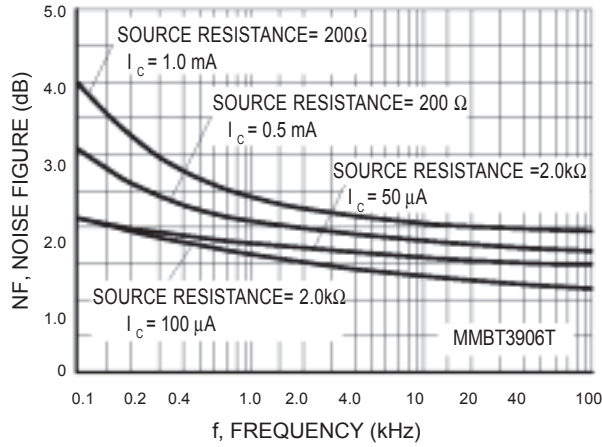


Figure 25

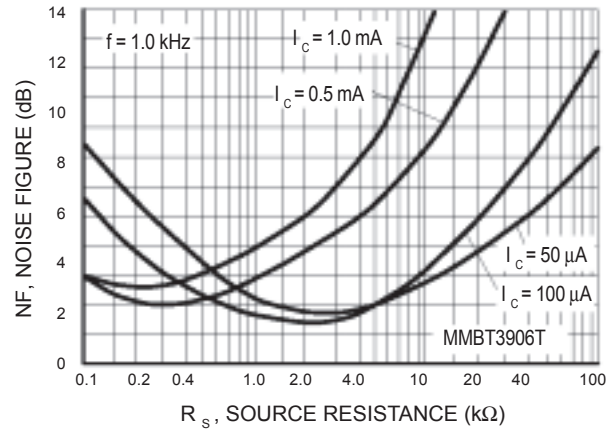


Figure 26

#### h PARAMETERS

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

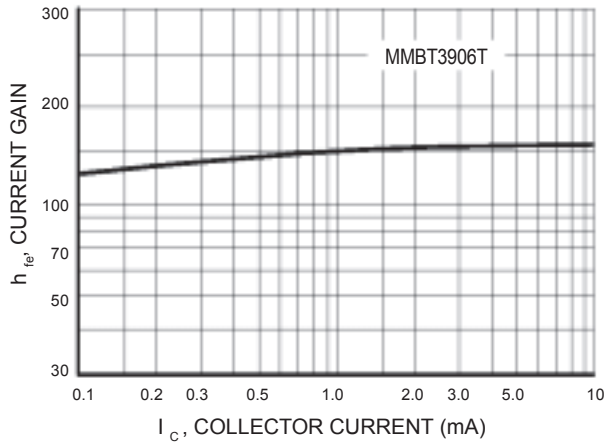


Figure 27. Current Gain

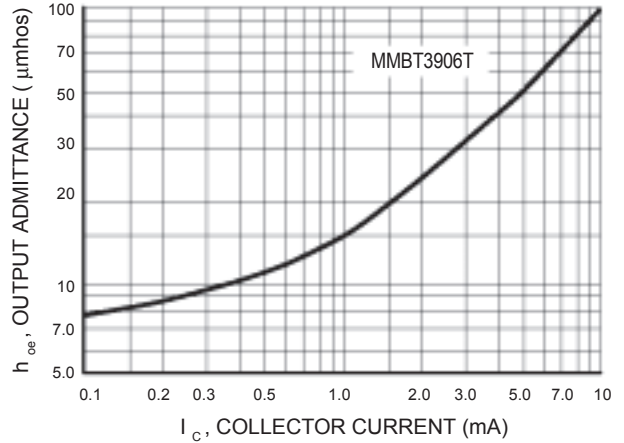


Figure 28. Output Admittance

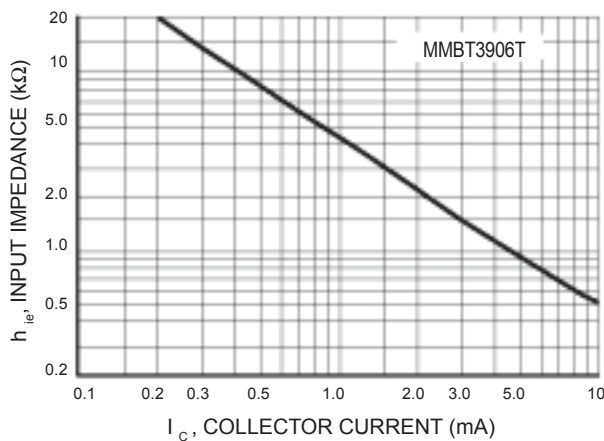


Figure 29. Input Impedance

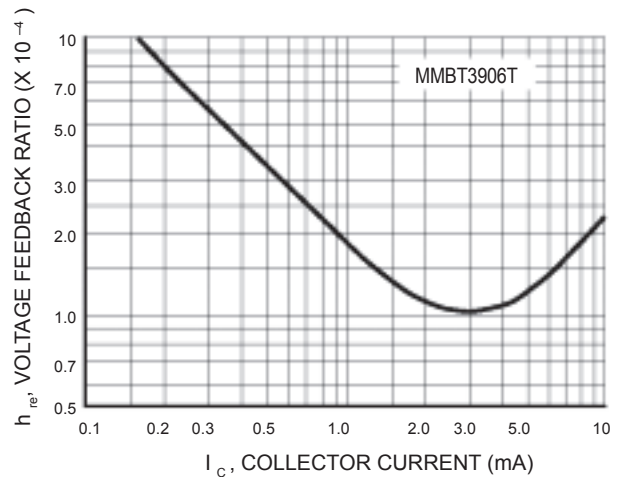
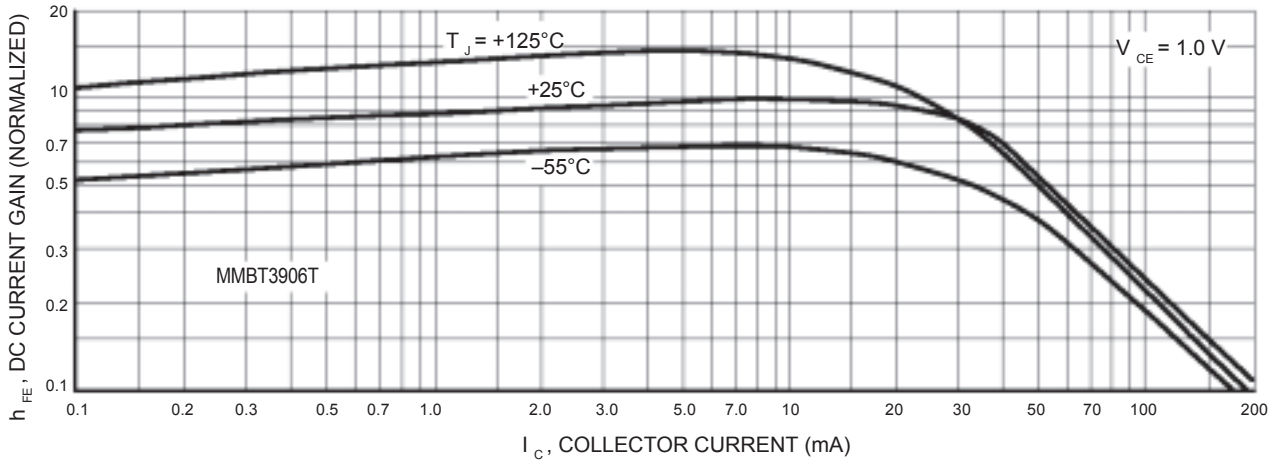


Figure 30. Voltage Feedback Ratio

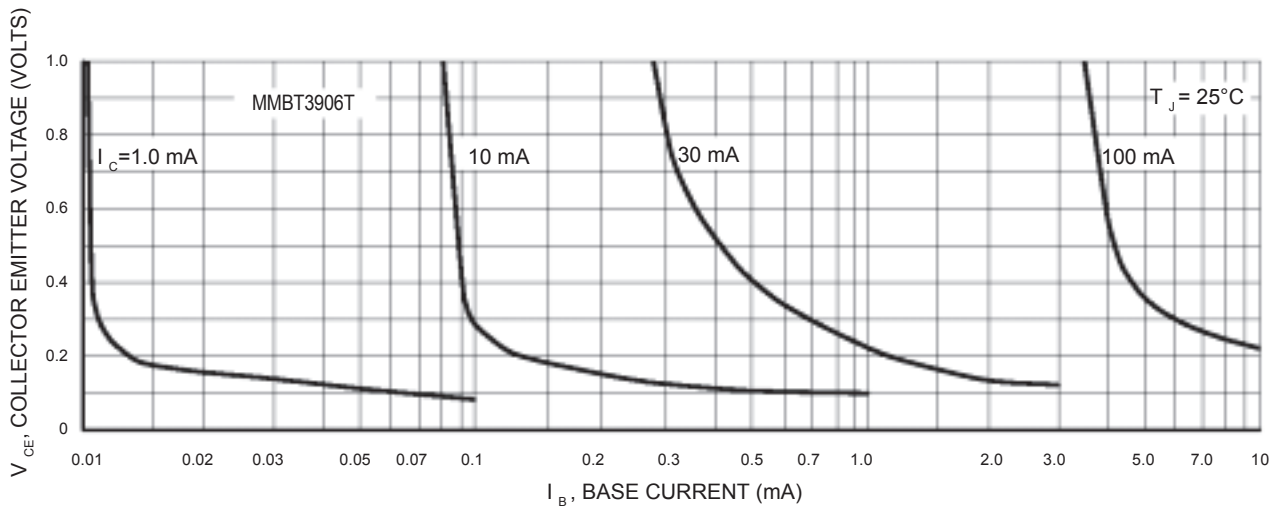
# DEVICE CHARACTERISTICS

## MMBT3904T/MMBT3906T

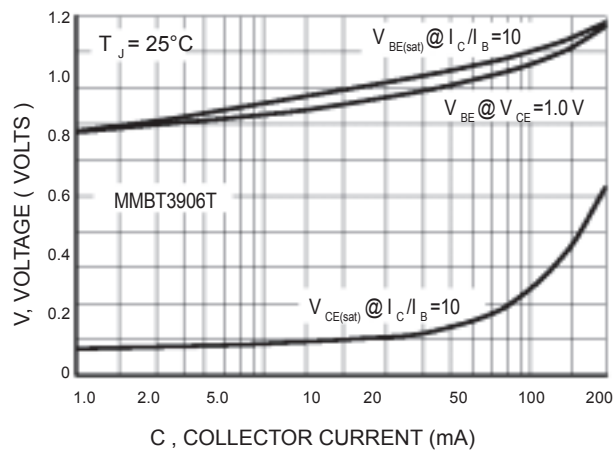
**MMBT3906T**  
**STATIC CHARACTERISTICS**



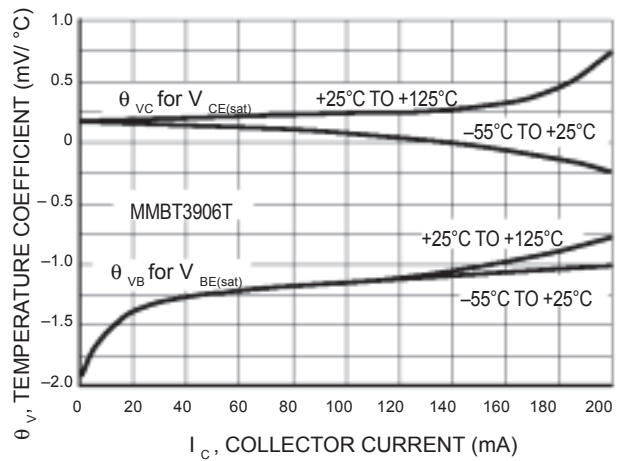
**Figure 31. DC Current Gain**



**Figure 32. Collector Saturation Region**



**Figure 33. "ON" Voltages**

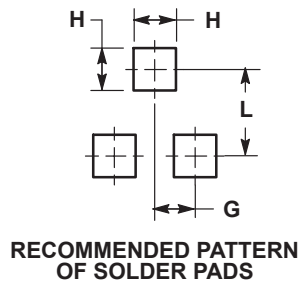
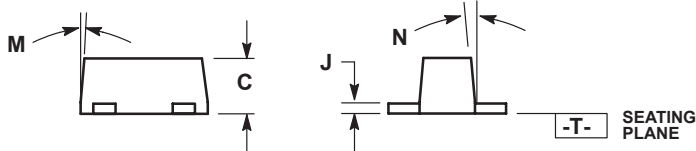
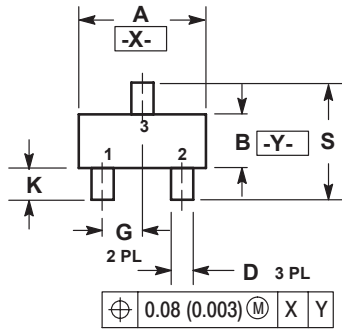


**Figure 34. Temperature Coefficients**

# PACKAGE OUTLINE & DIMENSIONS

## MMBT3904T/MMBT3906T

SC-89 / SOT-523



### 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.
4. 463C-01 OBSOLETE, NEW STANDARD 463C-02.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.60	1.70	0.059	0.063	0.067
B	0.75	0.85	0.95	0.030	0.034	0.040
C	0.60	0.70	0.80	0.024	0.028	0.031
D	0.23	0.28	0.33	0.009	0.011	0.013
G	0.50 BSC			0.020 BSC		
H	0.53 REF			0.021 REF		
J	0.10	0.15	0.20	0.004	0.006	0.008
K	0.30	0.40	0.50	0.012	0.016	0.020
L	1.10 REF			0.043 REF		
M	---	---	10 °	---	---	10 °
N	---	---	10 °	---	---	10 °
S	1.50	1.60	1.70	0.059	0.063	0.067