

# General Purpose Transistors

**NPN**  
**MMBT3904WT1**  
**PNP**  
**MMBT3906WT1**

## NPN and PNP Silicon

These transistors are designed for general purpose amplifier applications. They are housed in the SOT-323/SC-70 which is designed for low power surface mount applications.

- We declare that the material of product compliance with RoHS requirements.

**Pb-Free package is available**

RoHS product for packing code suffix "G"

Halogen free product for packing code suffix "H"

Moisture Sensitivity Level 1



SOT-323

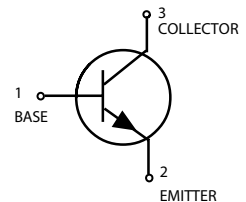
**GENERAL PURPOSE  
AMPLIFIER TRANSISTORS  
SURFACE MOUNT**

## DEVICE MARKING AND ORDERING INFORMATION

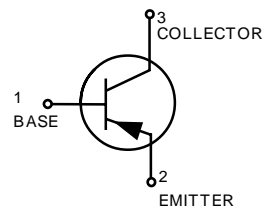
Device	Marking	Package	Shipping
MMBT3904WT1	AM	SOT-323/SC-70	3000/Tape&Reel
MMBT3906WT1	2A	SOT-323/SC-70	3000/Tape&Reel

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	MMBT3904WT1	$V_{CEO}$	40	Vdc
	MMBT3906WT1		-40	
Collector-Base Voltage	MMBT3904WT1	$V_{CBO}$	60	Vdc
	MMBT3906WT1		-40	
Emitter-Base Voltage	MMBT3904WT1	$V_{EBO}$	6.0	Vdc
	MMBT3906WT1		-5.0	
Collector Current — Continuous	MMBT3904WT1	$I_C$	200	mAdc
	MMBT3906WT1		-200	



**MMBT3904WT1**



**MMBT3906WT1**

## 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	$^\circ\text{C}$

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage (2) (I <sub>C</sub> = 1.0 mA, I <sub>B</sub> = 0)	MMBT3904WT1	V <sub>(BR)CEO</sub>	40	—	Vdc
(I <sub>C</sub> = -1.0 mA, I <sub>B</sub> = 0)	MMBT3906WT1		- 40	—	
Collector–Base Breakdown Voltage (I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0)	MMBT3904WT1	V <sub>(BR)CBO</sub>	60	—	Vdc
(I <sub>C</sub> = -10 μA, I <sub>E</sub> = 0)	MMBT3906WT1		- 40	—	
Emitter–Base Breakdown Voltage (I <sub>E</sub> = 10 μA, I <sub>C</sub> = 0)	MMBT3904WT1	V <sub>(BR)EBO</sub>	6.0	—	Vdc
(I <sub>E</sub> = -10 μA, I <sub>C</sub> = 0)	MMBT3906WT1		- 5.0	—	
Base Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)	MMBT3904WT1	I <sub>BL</sub>	—	50	nAdc
(V <sub>CE</sub> = -30 Vdc, V <sub>EB</sub> = -3.0 Vdc)	MMBT3906WT1		—	-50	
Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)	MMBT3904WT1	I <sub>CEX</sub>	—	50	nAdc
(V <sub>CE</sub> = -30 Vdc, V <sub>EB</sub> = -3.0 Vdc)	MMBT3906WT1		—	- 50	

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

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

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## 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> )	MMBT3904WT1	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> )	MMBT3906WT1	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> )	MMBT3904WT1	—	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> )	MMBT3906WT1	—	-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> )	MMBT3904WT1	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> )	MMBT3906WT1	-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

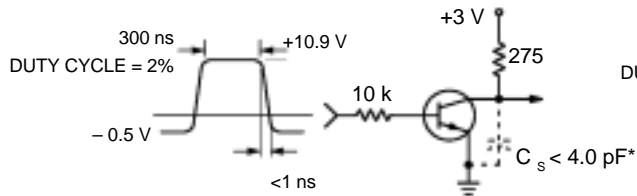
Current-Gain — Bandwidth Product	$f_T$			MHz
(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 20 V <sub>dc</sub> , f = 100 MHz)	MMBT3904WT1	300	—	
(I <sub>C</sub> = -10 mA <sub>dc</sub> , V <sub>CE</sub> = -20 V <sub>dc</sub> , f = 100 MHz)	MMBT3906WT1	250	—	
Output Capacitance	C <sub>obo</sub>			pF
(V <sub>CB</sub> = 5.0 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)	MMBT3904WT1	—	4.0	
(V <sub>CB</sub> = -5.0 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)	MMBT3906WT1	—	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)	MMBT3904WT1	—	8.0	
(V <sub>EB</sub> = -0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)	MMBT3906WT1	—	10.0	
Input Impedance	$h_{ie}$			kΩ
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904WT1	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)	MMBT3906WT1	2.0	12	
Voltage Feedback Ratio	$h_{re}$			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)	MMBT3904WT1	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)	MMBT3906WT1	0.1	10	
Small-Signal Current Gain	$h_{fe}$			—
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904WT1	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)	MMBT3906WT1	100	400	
Output Admittance	$h_{oe}$			μmhos
(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)	MMBT3904WT1	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)	MMBT3906WT1	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)	MMBT3904WT1	—	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)	MMBT3906WT1	—	4.0	

### SWITCHING CHARACTERISTICS

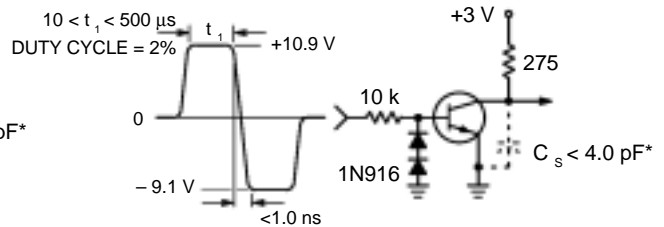
Delay Time ( $V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$ )	MMBT3904WT1	$t_d$	—	3.5	
( $V_{CC} = -3.0 \text{ Vdc}$ , $V_{BE} = 0.5 \text{ Vdc}$ )	MMBT3906WT1		—	35	ns
Rise Time ( $I_C = 10 \text{ mAdc}$ , $I_{B1} = 1.0 \text{ mAdc}$ )	MMBT3904WT1	$t_r$	—	3.5	
( $I_C = -10 \text{ mAdc}$ , $I_{B1} = -1.0 \text{ mAdc}$ )	MMBT3906WT1		—	35	ns
Storage Time ( $V_{CC} = 3.0 \text{ Vdc}$ , $I_C = 10 \text{ mAdc}$ )	MMBT3904WT1	$t_s$	—	200	
( $V_{CC} = -3.0 \text{ Vdc}$ , $I_C = -10 \text{ mAdc}$ )	MMBT3906WT1		—	225	ns
Fall Time ( $I_{B1} = I_{B2} = 1.0 \text{ mAdc}$ )	MMBT3904WT1	$t_f$	—	5.0	
( $I_{B1} = I_{B2} = -1.0 \text{ mAdc}$ )	MMBT3906WT1		—	75	ns

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

#### MMBT3904WT1



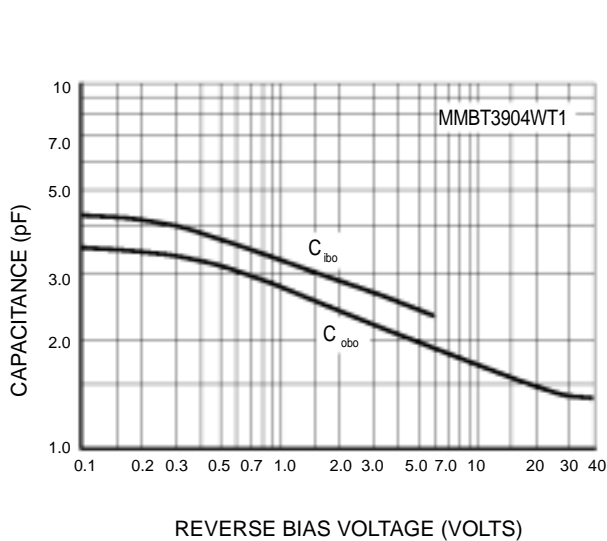
**Figure 1. Delay and Rise Time**  
Equivalent Test Circuit



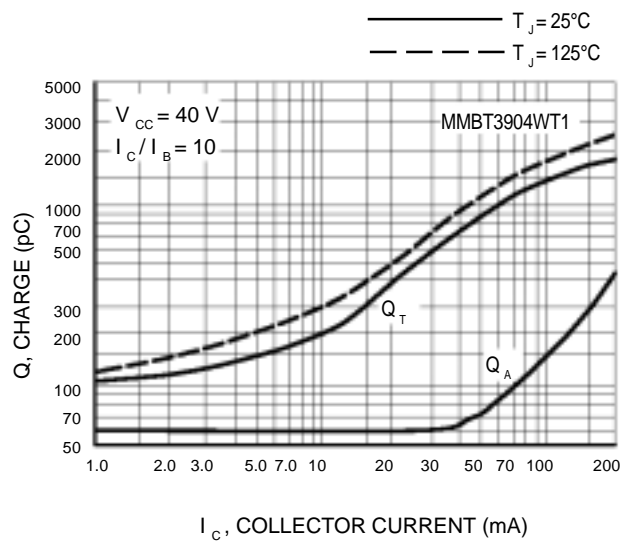
**Figure 2. Storage and Fall Time**  
Equivalent Test Circuit

\*Total shunt capacitance of test jig and connectors

### TYPICAL TRANSIENT CHARACTERISTICS



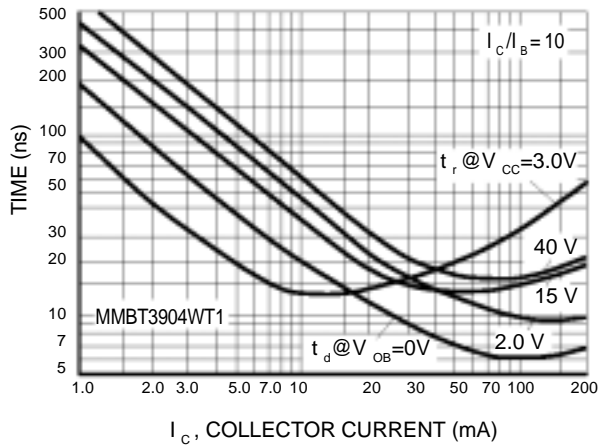
**Figure 3. Capacitance**



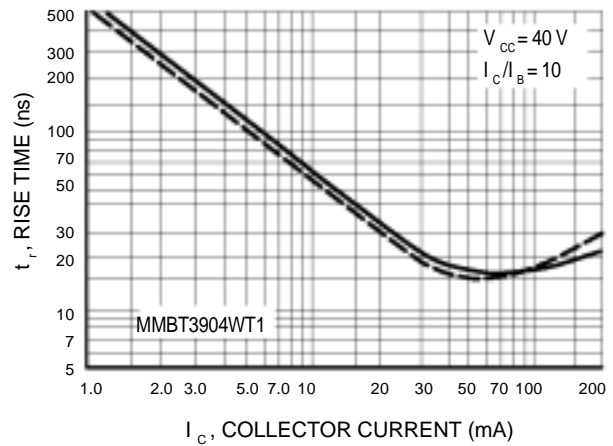
**Figure 4. Charge Data**

**General Purpose Transistors**

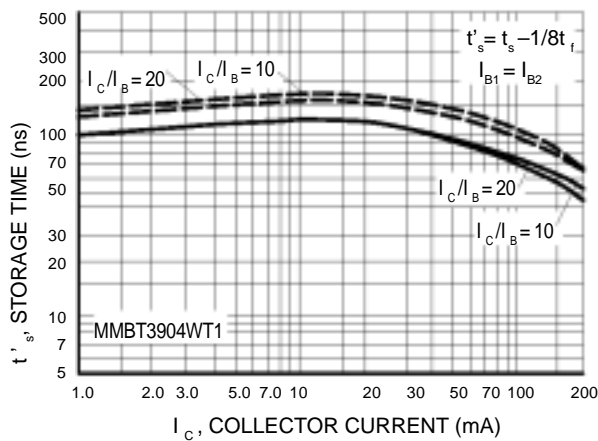
**MMBT3904WT1G**



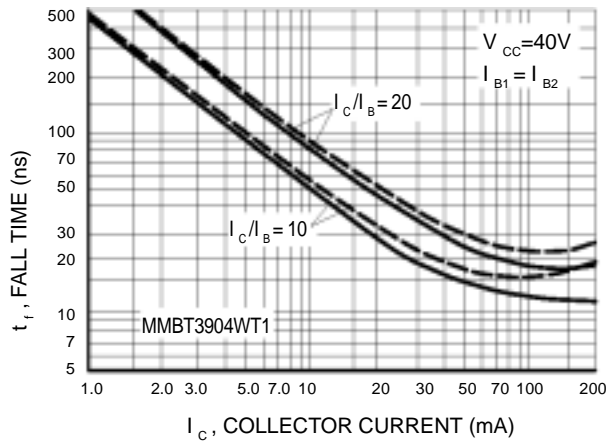
**Figure 5. Turn-On Time**



**Figure 6. Rise Time**



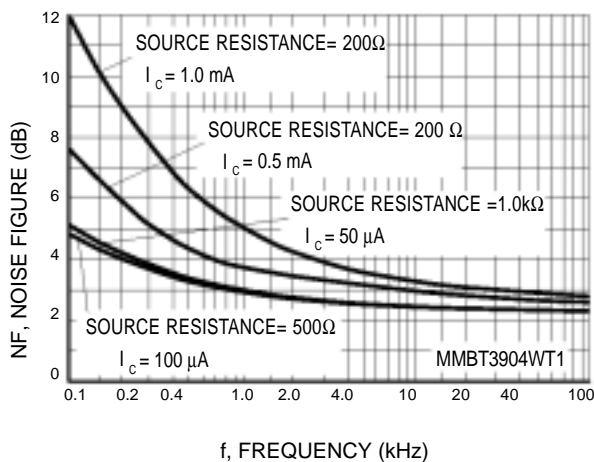
**Figure 7. Storage Time**



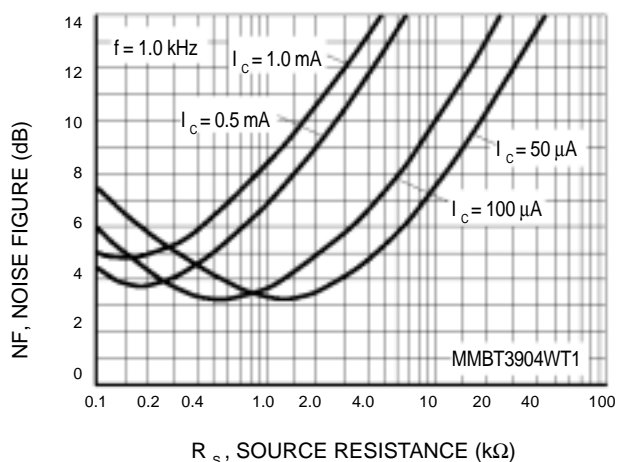
**Figure 8. Fall Time**

**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**

# General Purpose Transistors

**NPN**  
**MMBT3904WT1**  
**PNP**  
**MMBT3906WT1**

## h PARAMETERS

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

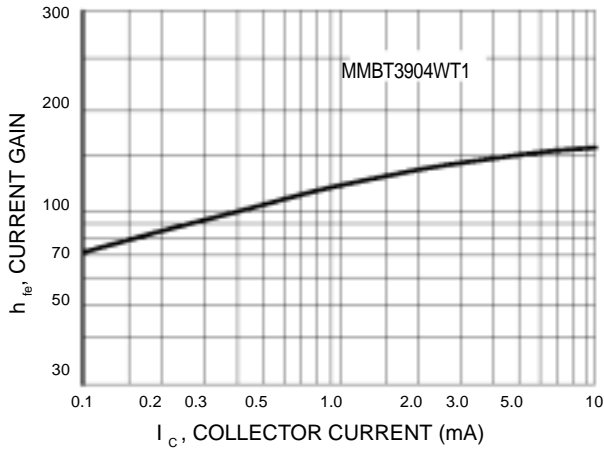


Figure 11. Current Gain

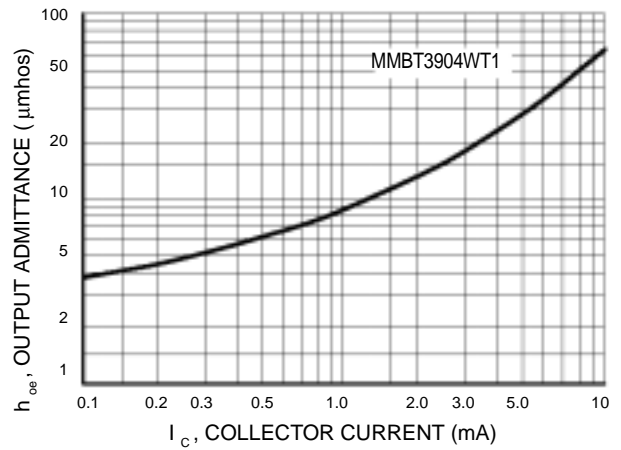


Figure 12. Output Admittance

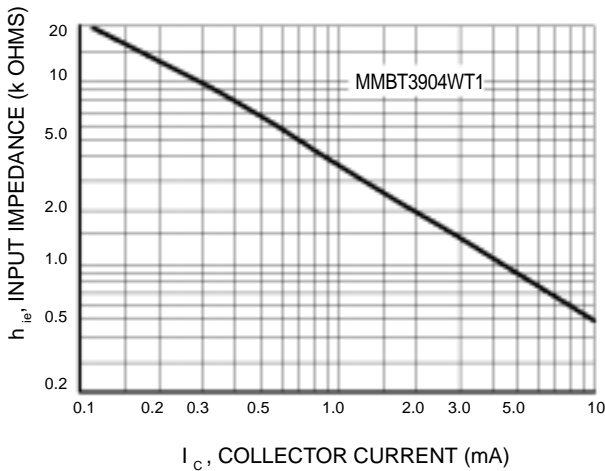


Figure 13. Input Impedance

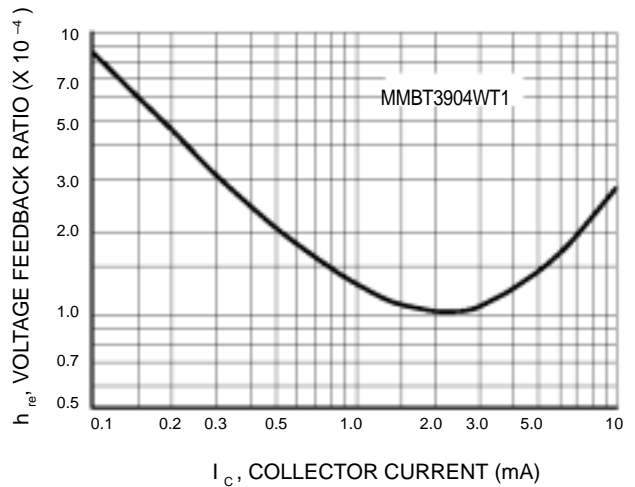
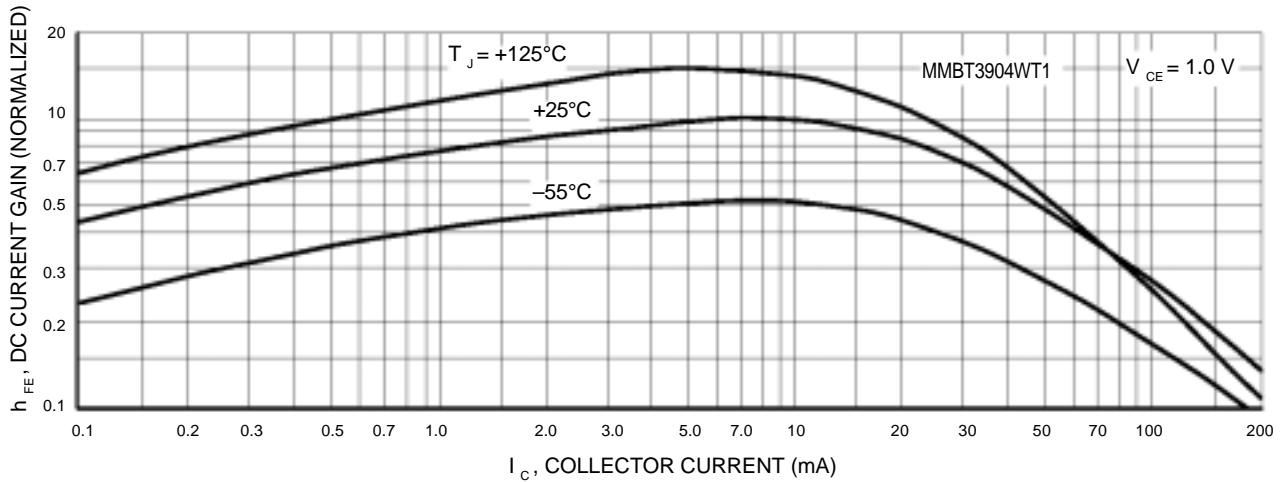


Figure 14. Voltage Feedback Ratio

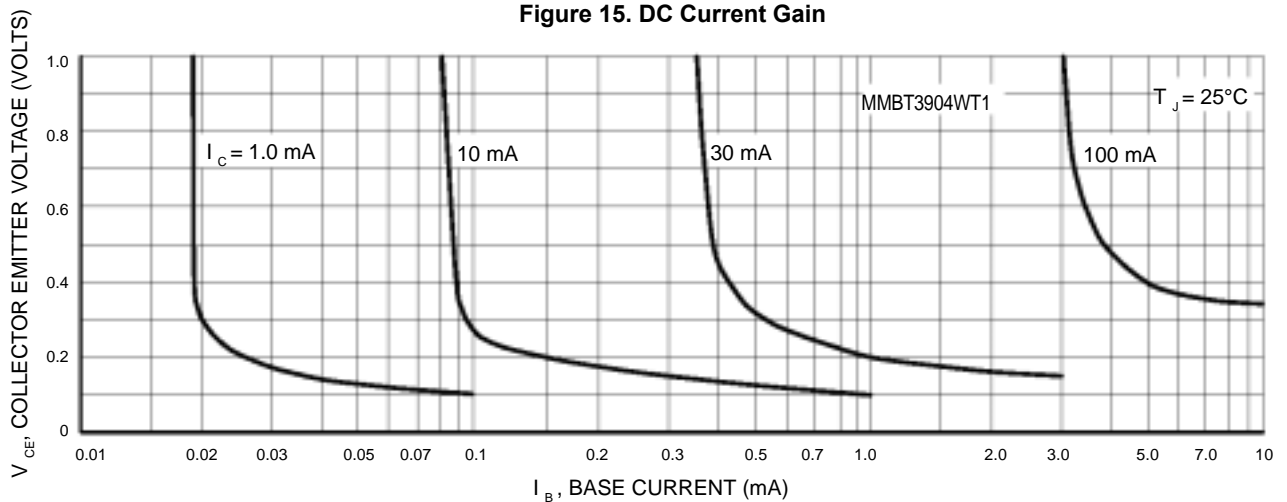


## General Purpose Transistors

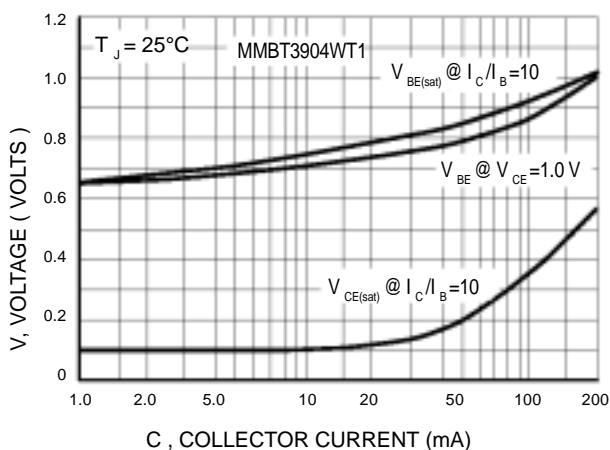
**MMBT3904WT1**  
**TYPICAL STATIC CHARACTERISTICS**



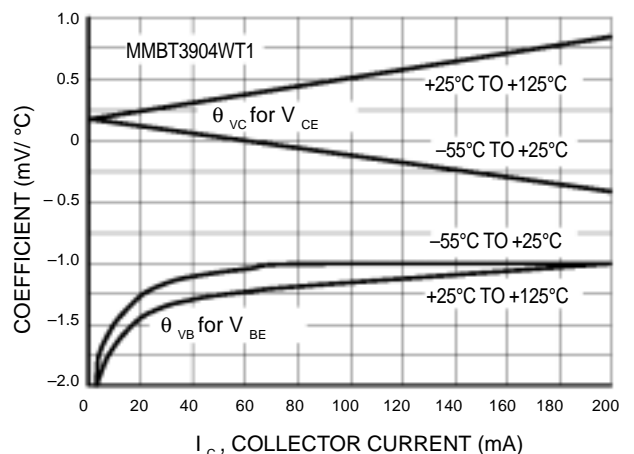
**Figure 15. DC Current Gain**



**Figure 16. Collector Saturation Region**



**Figure 17. "ON" Voltages**

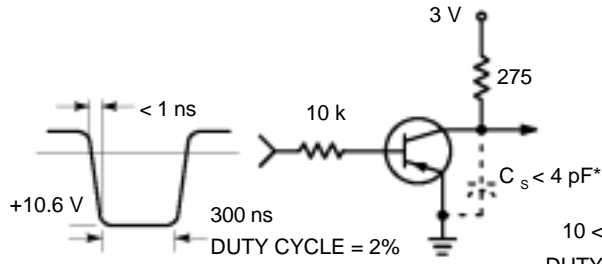


**Figure 18. Temperature Coefficients**

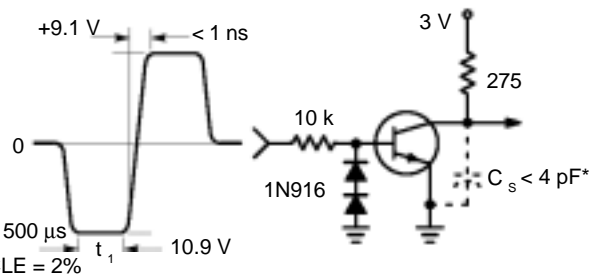
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MMBT3906WT1



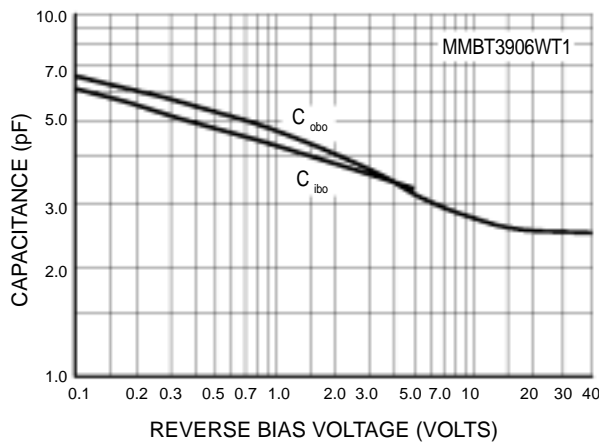
**Figure 19. Delay and Rise Time**  
**Equivalent Test Circuit**



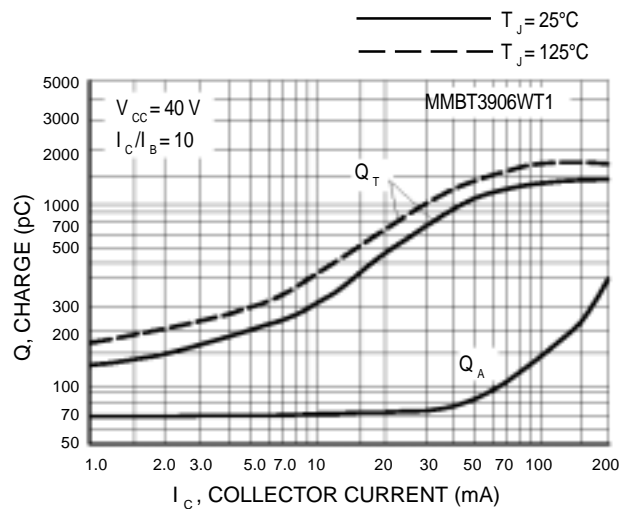
**Figure 20. Storage and Fall Time**  
**Equivalent Test Circuit**

\* Total shunt capacitance of test jig and connectors

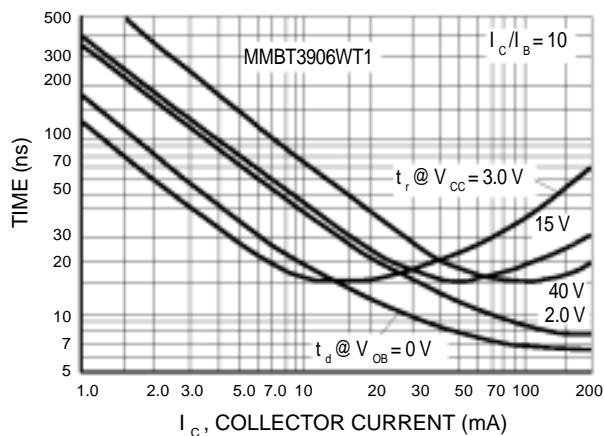
## TYPICAL TRANSIENT CHARACTERISTICS



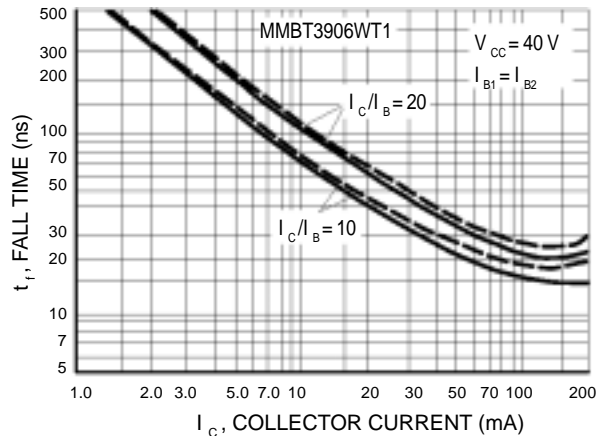
**Figure 21. Capacitance**



**Figure 22. Charge Data**



**Figure 23. Turn-On Time**



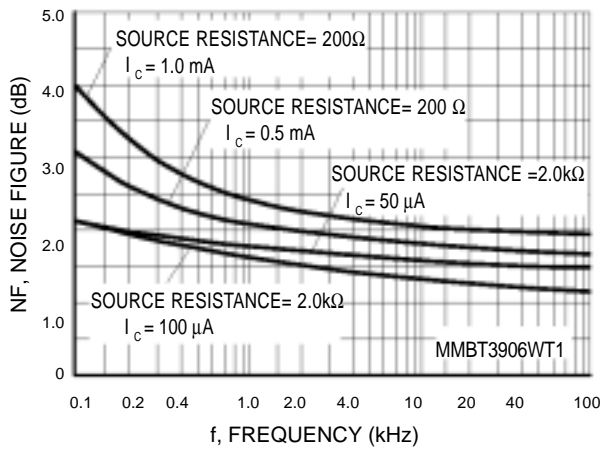
**Figure 24. Fall Time**



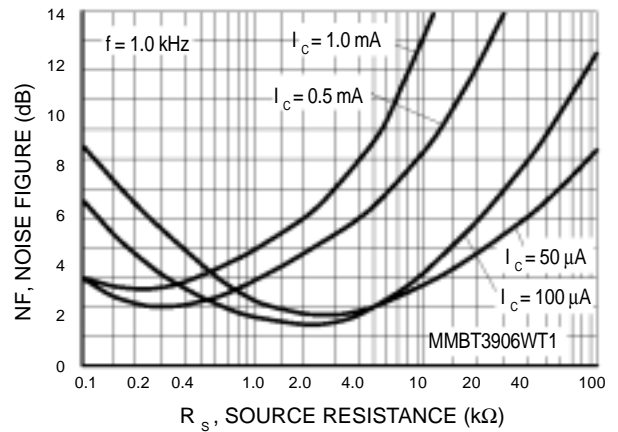
**General Purpose Transistors**

**MMBT3906WT1**  
**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS**  
**NOISE FIGURE VARIATIONS**

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



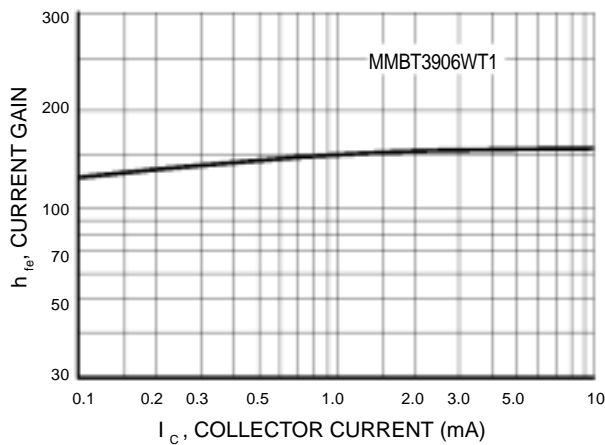
**Figure 25**



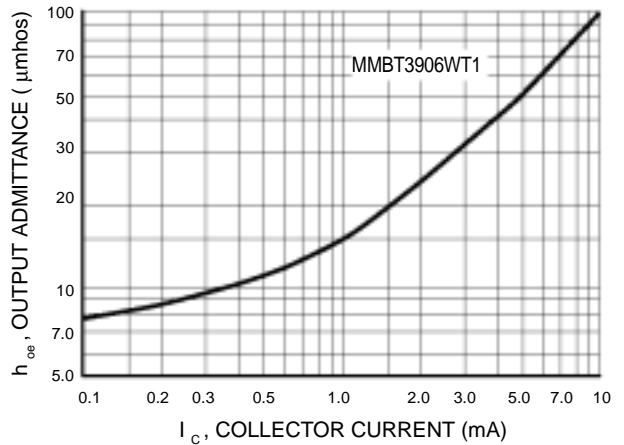
**Figure 26**

**h PARAMETERS**

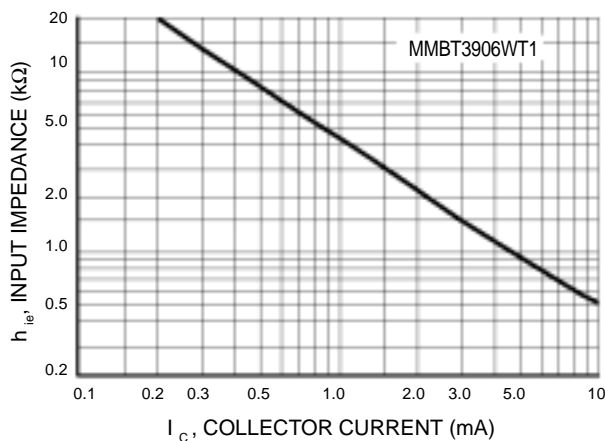
( $V_{CE} = -10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )



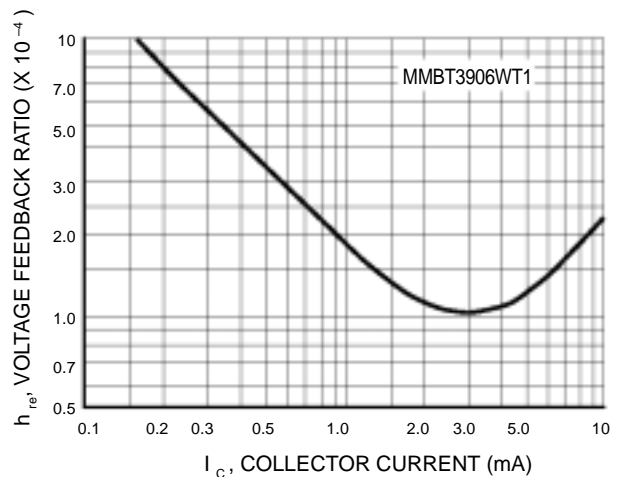
**Figure 27. Current Gain**



**Figure 28. Output Admittance**



**Figure 29. Input Impedance**

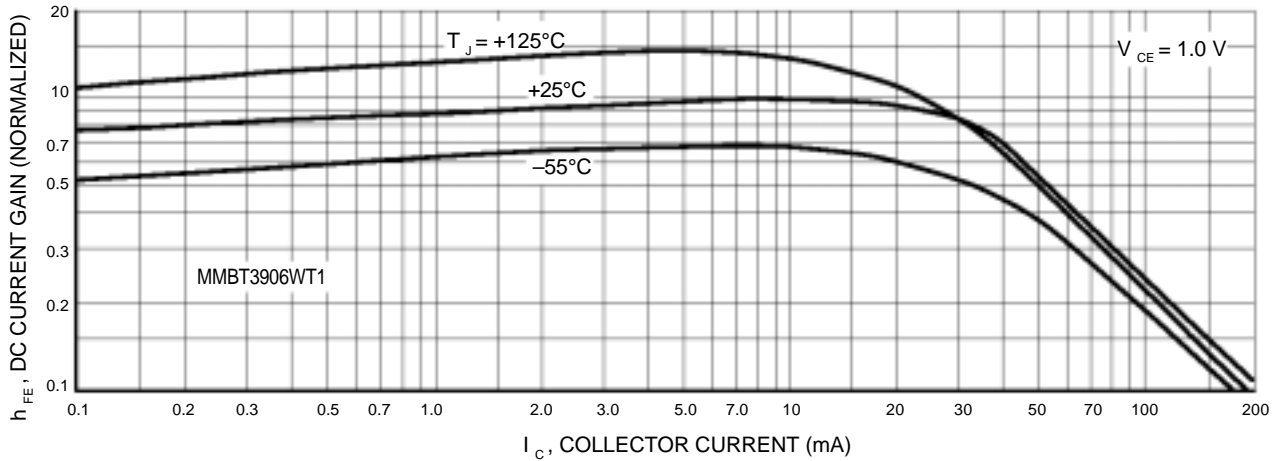


**Figure 30. Voltage Feedback Ratio**

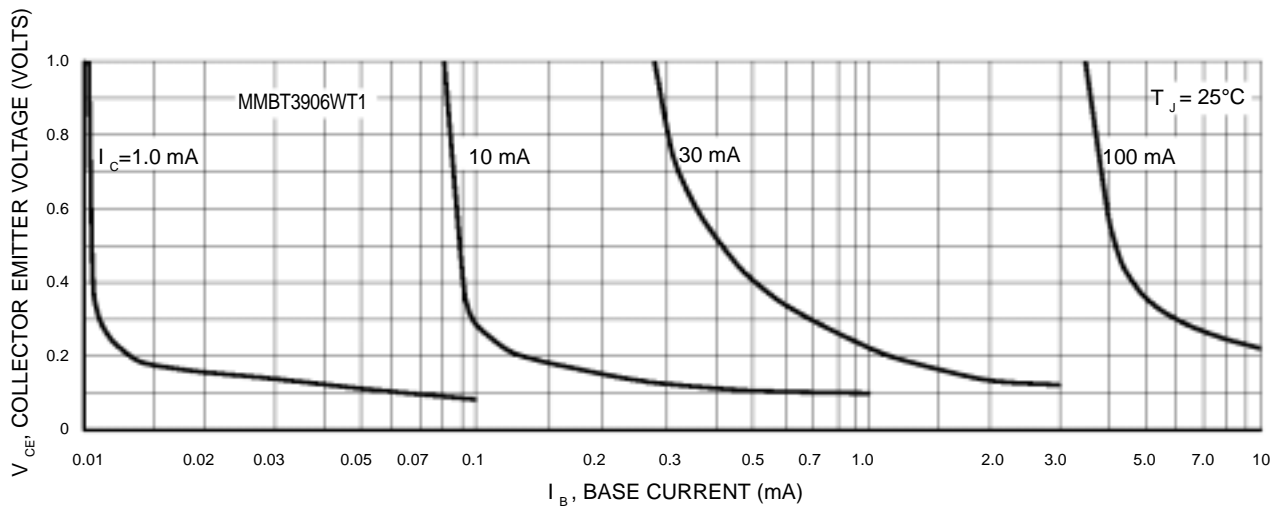
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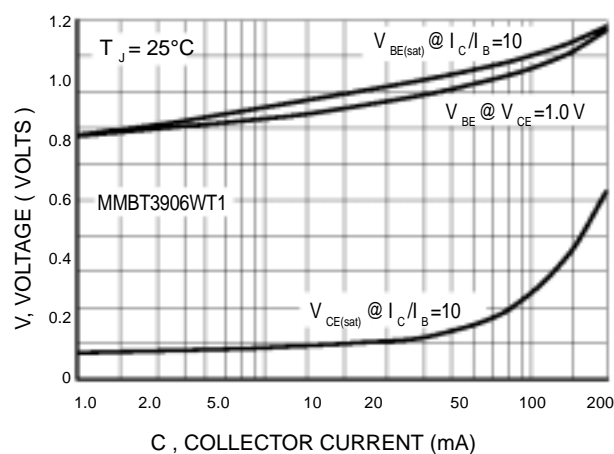
**MMBT3906WT1**  
**STATIC CHARACTERISTICS**



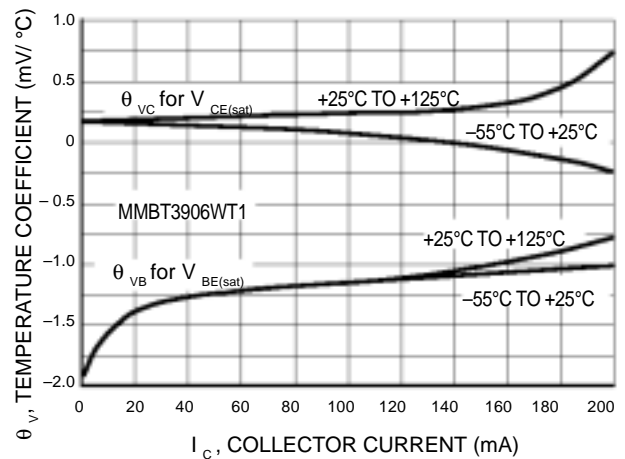
**Figure 31. DC Current Gain**



**Figure 32. Collector Saturation Region**

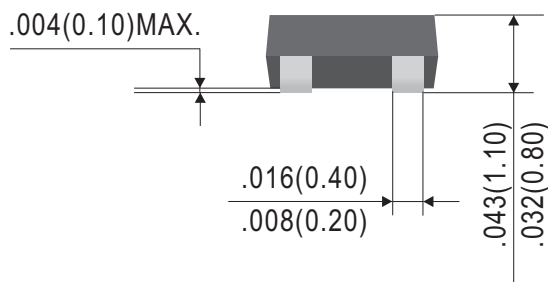
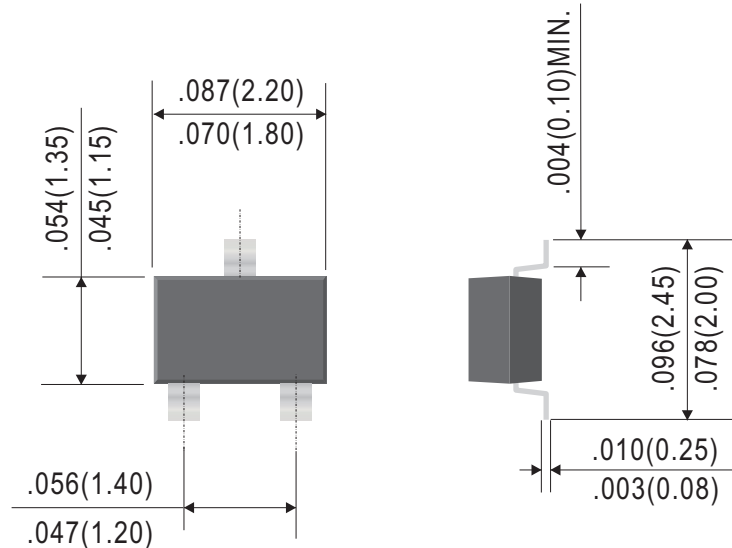


**Figure 33. "ON" Voltages**



**Figure 34. Temperature Coefficients**

**SOT-323**



Dimensions in inches and (millimeters)

**Ordering Information:**

Device PN	Packing
Part Number G <sup>(1)</sup> -WS	Tape&Reel: 3 Kpcs/Reel

Note: (1) RoHS product for packing code suffix "G" ; Halogen free product for packing code suffix "H"

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