

# General Purpose Transistors

**MMBT3906TT1**

## PNP Silicon

### FEATURE

- Simplifies Circuit Design.
- RoHS product for packing code suffix "G"  
Halogen free product for packing code suffix "H"

### ORDERING INFORMATION

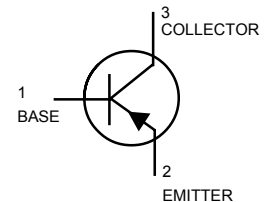
Device	Marking	Shipping
MMBT3906TT1	2A	3000/Tape & Reel



SOT-523

### MAXIMUM RATINGS

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



### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-4 Board(1) $T_A = 25^\circ\text{C}$	$P_D$	200	mW
Derate above $25^\circ\text{C}$		1.6	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	600	$^\circ\text{C}/\text{W}$
Total Device Dissipation FR-4 Board (2), $T_A = 25^\circ\text{C}$	$P_D$	300	mW
Derate above $25^\circ\text{C}$		2.4	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	400	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

### DEVICE MARKING

MMBT3906TT1 = 2A

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage (3) ( $I_C = -1.0\text{ mAdc}, I_B = 0$ )	$V_{(BR)CEO}$	- 40	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = -10\ \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	- 40	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -10\ \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	- 5.0	—	Vdc
Base Cutoff Current ( $V_{CE} = -30\text{ Vdc}, V_{EB} = -3.0\text{ Vdc}$ )	$I_{BL}$	—	- 50	nAdc
Collector Cutoff Current ( $V_{CE} = -30\text{ Vdc}, V_{EB} = -3.0\text{ Vdc}$ )	$I_{CEX}$	—	- 50	nAdc

1. FR-4 Minimum Pad.
2. FR-4 1.0 x 1.0 Inch Pad.
3. Pulse Width  $\leq 300\ \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .



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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS (3)</b>				
DC Current Gain (I <sub>C</sub> = -0.1 mA <sub>dc</sub> , V <sub>CE</sub> = -1.0 V <sub>dc</sub> )	h <sub>FE</sub>	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 (I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B</sub> = -1.0 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	—	-0.25	V <sub>dc</sub>
(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 (I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B</sub> = -1.0 mA <sub>dc</sub> )	V <sub>BE(sat)</sub>	-0.65	-0.85	V <sub>dc</sub>
(I <sub>C</sub> = -50 mA <sub>dc</sub> , I <sub>B</sub> = -5.0 mA <sub>dc</sub> )		—	-0.95	

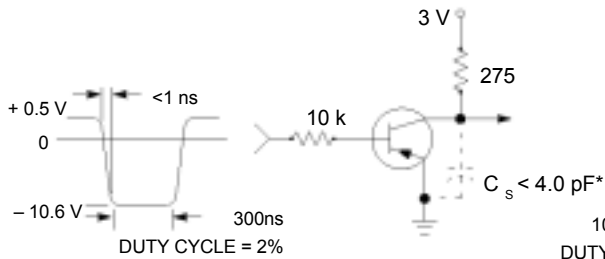
#### SMALL-SIGNAL CHARACTERISTICS

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

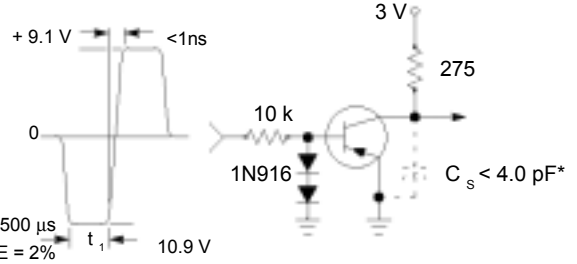
#### SWITCHING CHARACTERISTICS

Delay Time	(V <sub>CC</sub> = -3.0 V <sub>dc</sub> , V <sub>BE</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B1</sub> = -1.0 mA <sub>dc</sub> )	t <sub>d</sub>	—	35	ns
Rise Time		t <sub>d</sub>	—	35	
Storage Time	(V <sub>CC</sub> = -3.0 V <sub>dc</sub> , I <sub>C</sub> = -10 mA <sub>dc</sub> , I <sub>B1</sub> = I <sub>B2</sub> = -1.0 mA <sub>dc</sub> )	t <sub>s</sub>	—	225	ns
Fall Time		t <sub>f</sub>	—	75	

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



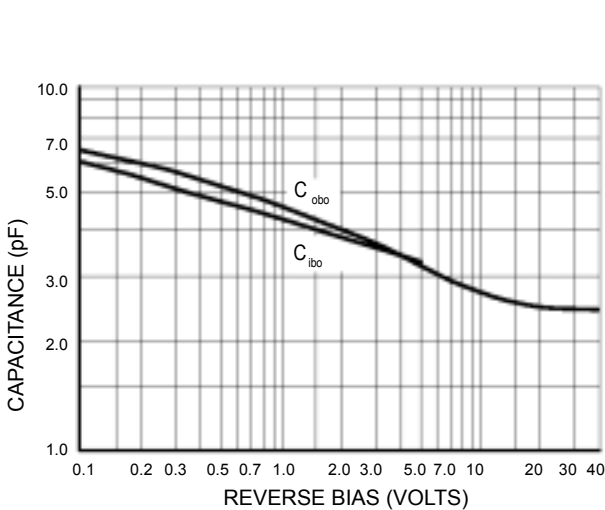
**Figure 1. Delay and Rise Time Equivalent Test Circuit**



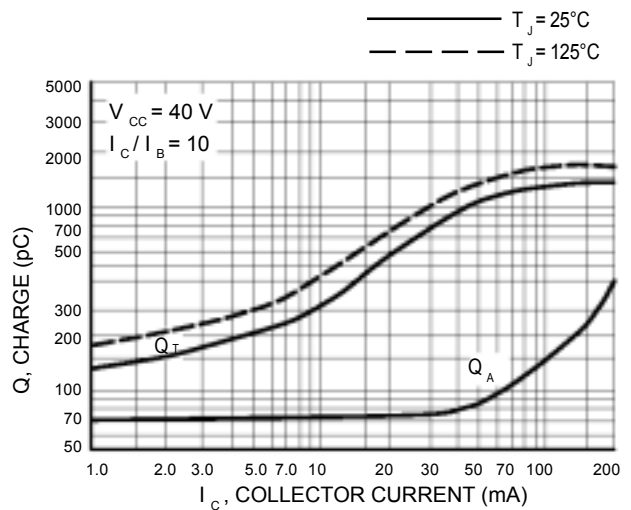
**Figure 2. Storage and Fall Time Equivalent Test Circuit**

\*Total shunt capacitance of test jig and connectors

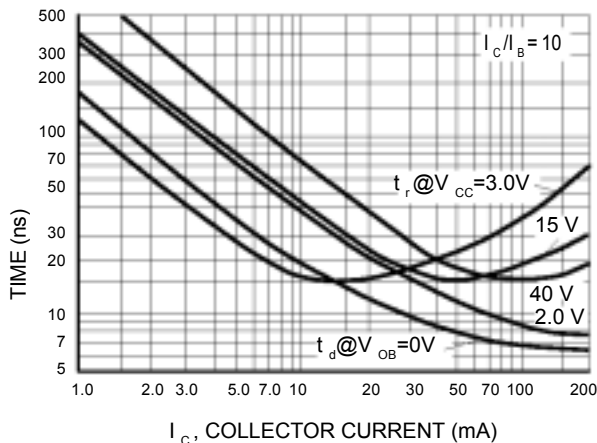
**TYPICAL TRANSIENT CHARACTERISTICS**



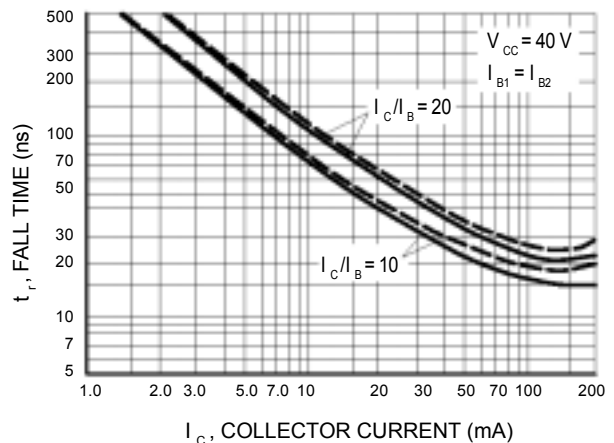
**Figure 3. Capacitance**



**Figure 4. Charge Data**



**Figure 5. Turn-On Time**



**Figure 6. Fall Time**



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#### TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

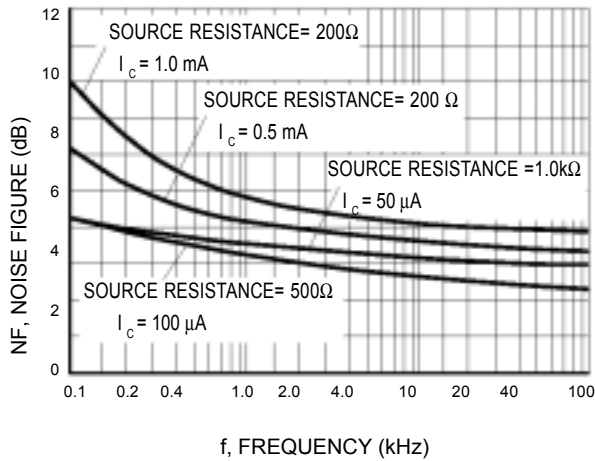


Figure 7. Noise Figure

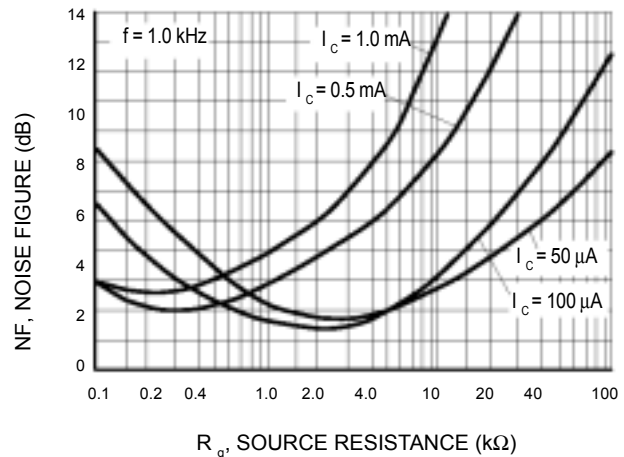


Figure 8. Noise Figure

#### h PARAMETERS

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

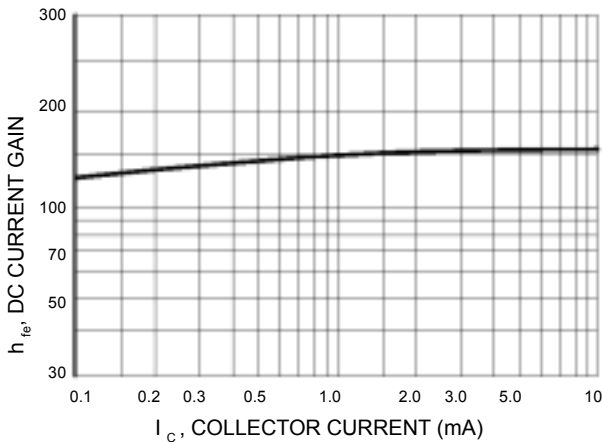


Figure 9. Current Gain

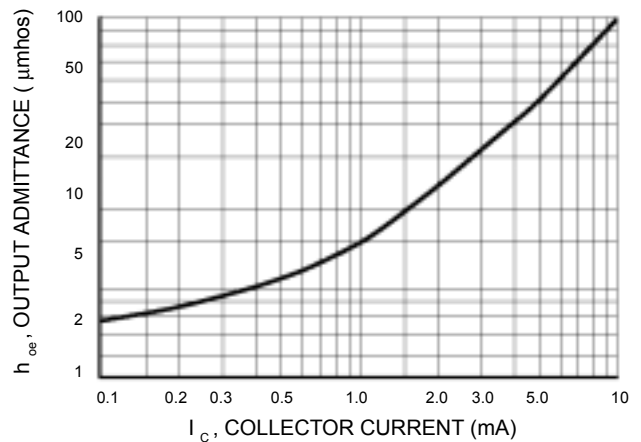


Figure 10. Output Admittance

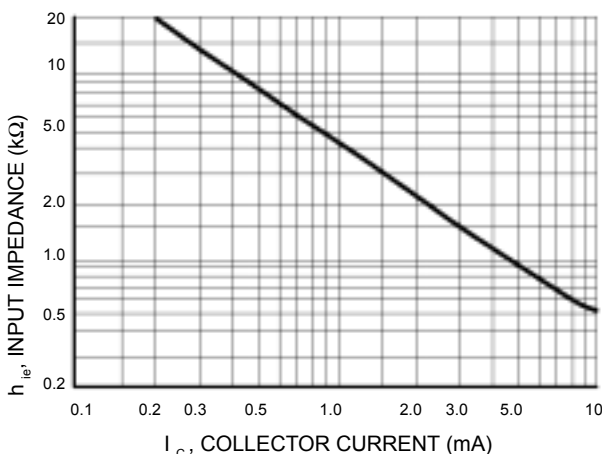


Figure 11. Input Impedance

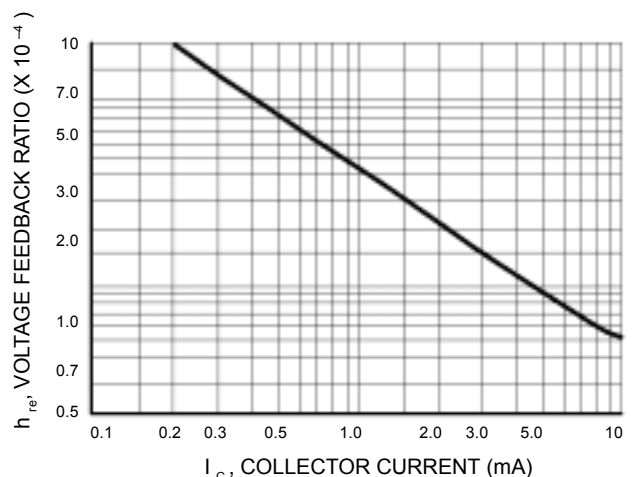
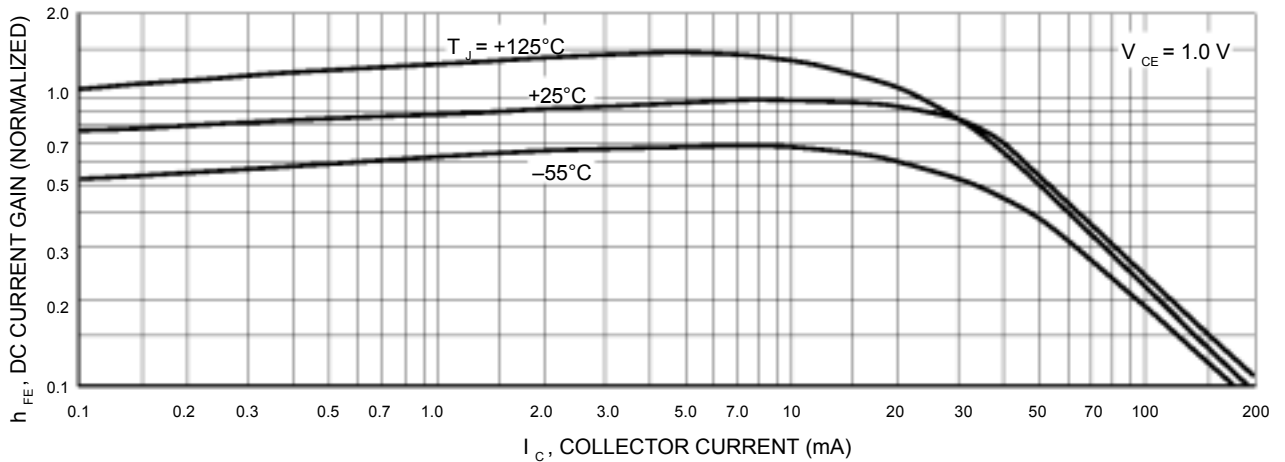
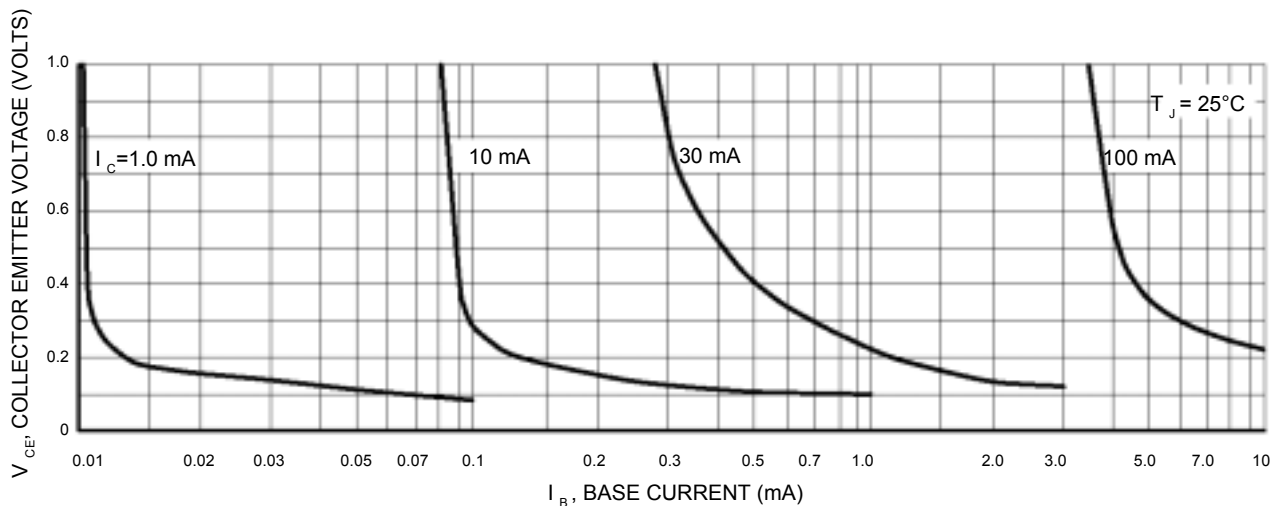


Figure 12. Voltage Feedback Ratio

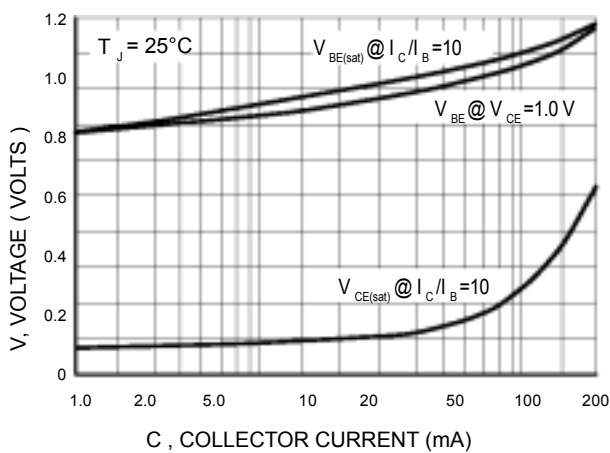
**TYPICAL STATIC CHARACTERISTICS**



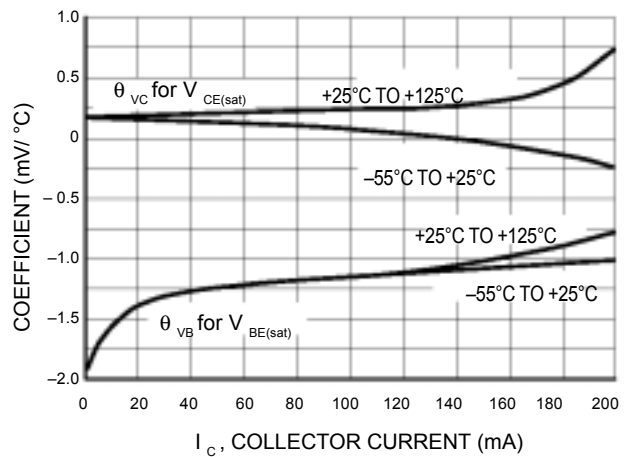
**Figure 13. DC Current Gain**



**Figure 14. Collector Saturation Region**

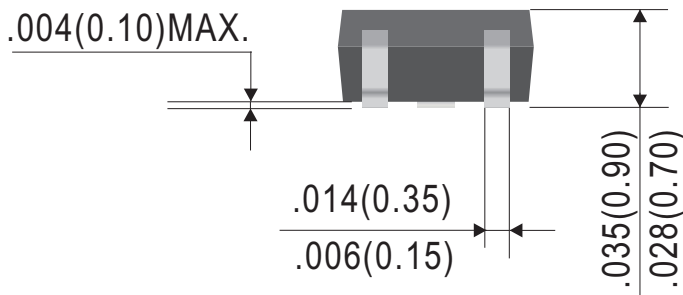
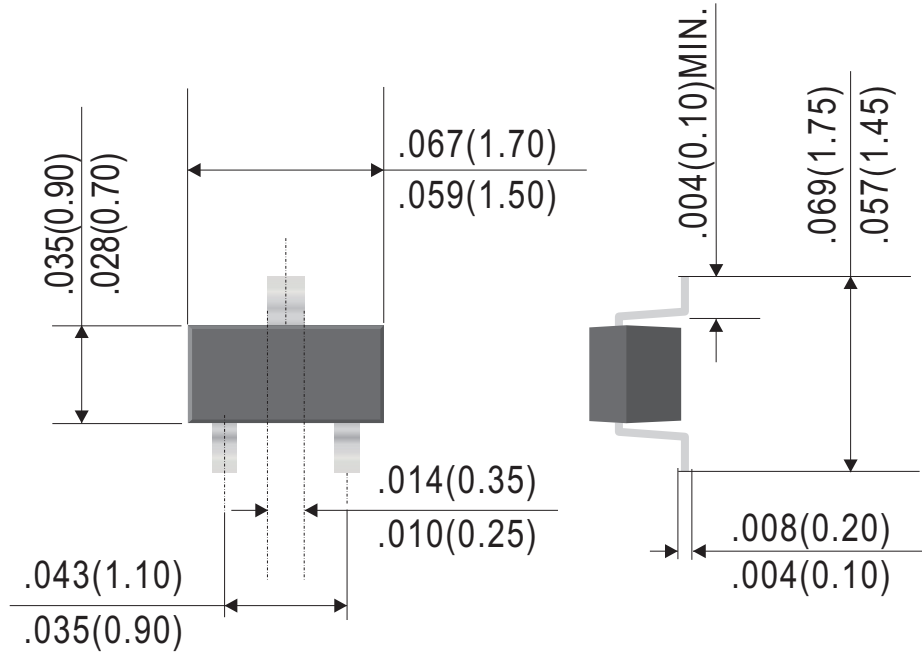


**Figure 15. "ON" Voltages**



**Figure 16. Temperature Coefficients**

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Dimensions in inches and (millimeters)