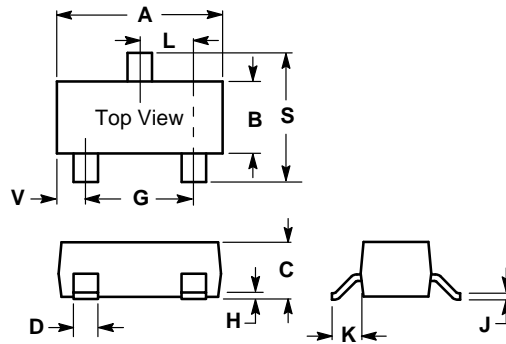
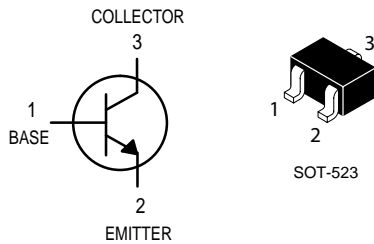


RoHS Compliant Product

**FEATURES**

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906FW)
- Ideal for Medium Power Amplification and Switching



SOT-523		
Dim	Min	Max
A	1.500	1.700
B	0.750	0.850
C	0.700	0.900
D	0.250	0.350
G	0.900	1.100
H	0.000	0.100
J	0.100	0.200
K	0.220	0.500
L	0.400	0.600
S	1.500	1.700
V	0.200	0.400
All Dimension in mm		

**MAXIMUM RATINGS**

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

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR–5 Board <sup>(1)</sup> $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200	mW
		1.6	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient <sup>(1)</sup>	$R_{\theta JA}$	600	$^\circ\text{C}/\text{W}$
Total Device Dissipation <sup>(2)</sup> Alumina Substrate, <sup>(2)</sup> $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300	mW
		2.4	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient <sup>(2)</sup>	$R_{\theta JA}$	400	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

**DEVICE MARKING**

MMBT3904FW = 1N, AM

**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 ( $I_C = 10 \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	60	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10 \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	6.0	—	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. Alumina =  $1.0 \times 1.0$  Inch Pad.

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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS(3)</b>				
DC Current Gain (1) ( $I_C = 0.1 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 10 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 50 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 100 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ )	$H_{FE}$	40 70 100 60 30	— — 300 — —	—
Collector–Emitter Saturation Voltage (3) ( $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$ ) ( $I_C = 50 \text{ mA}$ , $I_B = 5.0 \text{ mA}$ )	$V_{CE(sat)}$	— —	0.2 0.3	Vdc
Base–Emitter Saturation Voltage (3) ( $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$ ) ( $I_C = 50 \text{ mA}$ , $I_B = 5.0 \text{ mA}$ )	$V_{BE(sat)}$	0.65 —	0.85 0.95	Vdc

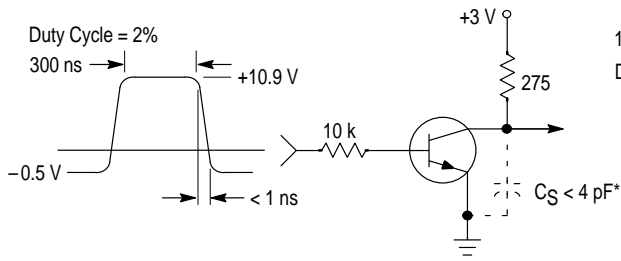
**SMALL–SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product ( $I_C = 10 \text{ mA}$ , $V_{CE} = 20 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	300	—	MHz
Output Capacitance ( $V_{CB} = 5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{obo}$	—	4.0	pF
Input Capacitance ( $V_{EB} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ibo}$	—	8.0	pF
Input Impedance ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mA}$ , $f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	10	k ohms
Voltage Feedback Ratio ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mA}$ , $f = 1.0 \text{ kHz}$ )	$h_{re}$	0.5	8.0	$\times 10^{-4}$
Small–Signal Current Gain ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mA}$ , $f = 1.0 \text{ kHz}$ )	$h_{fe}$	100	400	—
Output Admittance ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mA}$ , $f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	40	$\mu\text{mhos}$
Noise Figure ( $V_{CE} = 5.0 \text{ Vdc}$ , $I_C = 100 \mu\text{A}$ , $R_S = 1.0 \text{ k ohms}$ , $f = 1.0 \text{ kHz}$ )	NF	—	5.0	dB

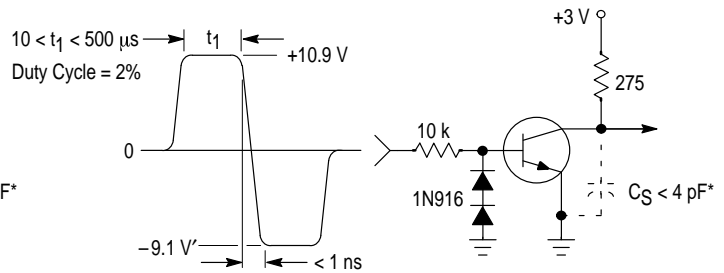
**SWITCHING CHARACTERISTICS**

Delay Time	( $V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$ , $I_C = 10 \text{ mA}$ , $I_{B1} = 1.0 \text{ mA}$ )	$t_d$	—	35	ns
Rise Time		$t_r$	—	35	
Storage Time	( $V_{CC} = 3.0 \text{ Vdc}$ , $I_C = 10 \text{ mA}$ , $I_{B1} = I_{B2} = 1.0 \text{ mA}$ )	$t_s$	—	200	ns
Fall Time		$t_f$	—	50	

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



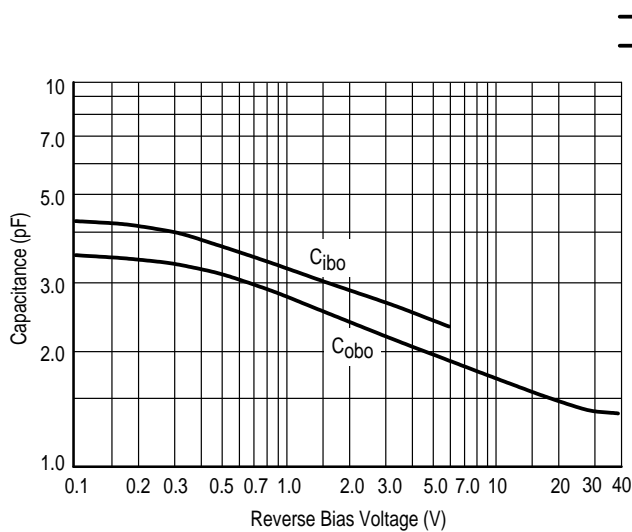
**Figure 1. Delay and Rise Time Equivalent Test Circuit**



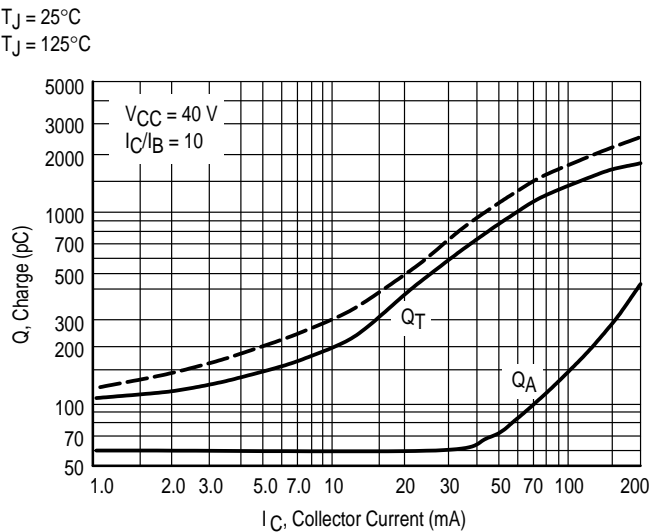
**Figure 2. Storage and Fall Time Equivalent Test Circuit**

\* Total shunt capacitance of test jig and connectors

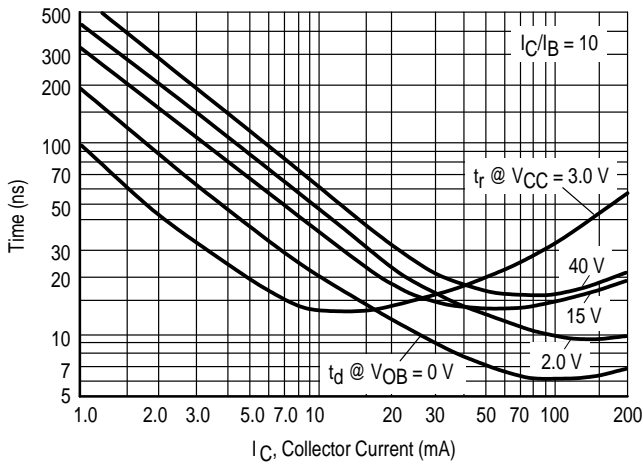
**TYPICAL TRANSIENT CHARACTERISTICS**



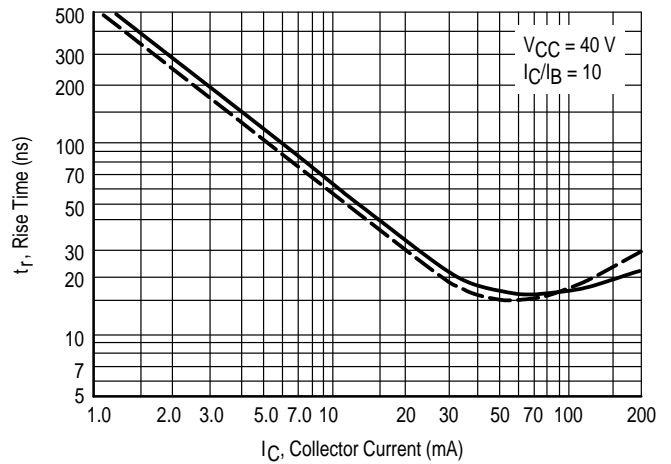
**Figure 3. Capacitance**



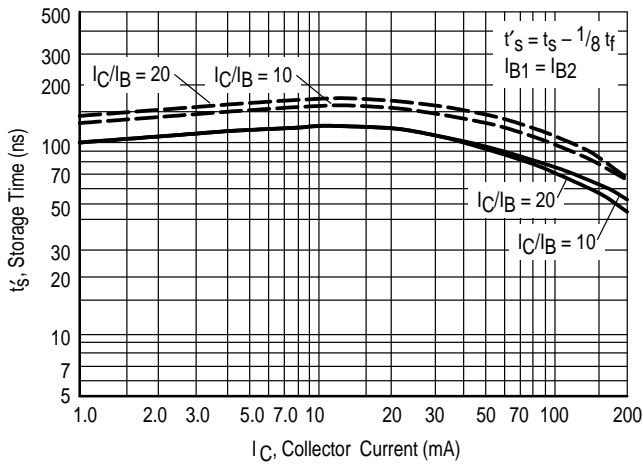
**Figure 4. Charge Data**



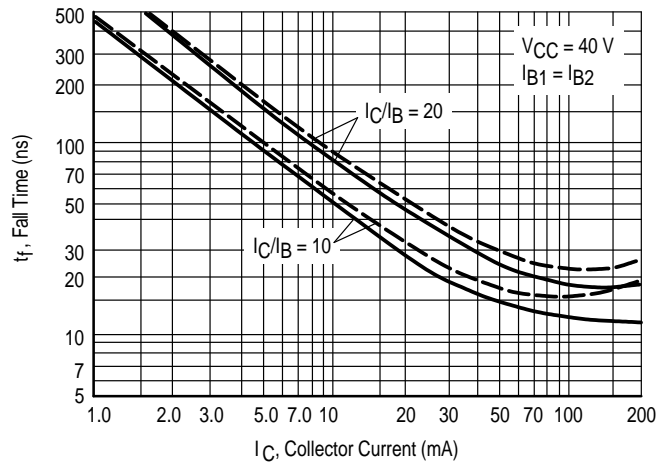
**Figure 5. Turn-On Time**



**Figure 6. Rise Time**



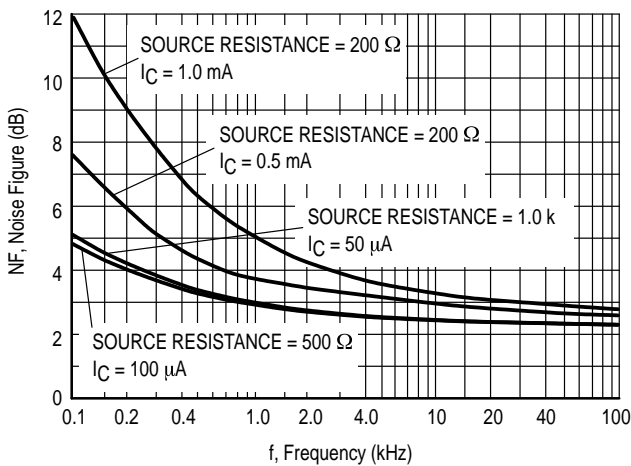
**Figure 7. Storage Time**



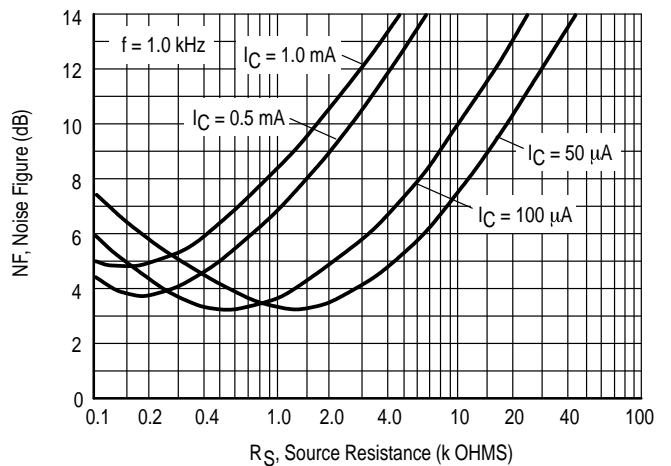
**Figure 8. Fall Time**

**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.**



**Figure 10.**

**h PARAMETERS**

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

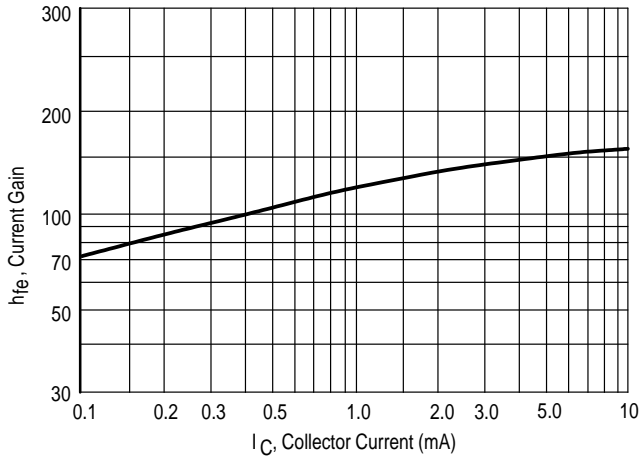


Figure 11. Current Gain

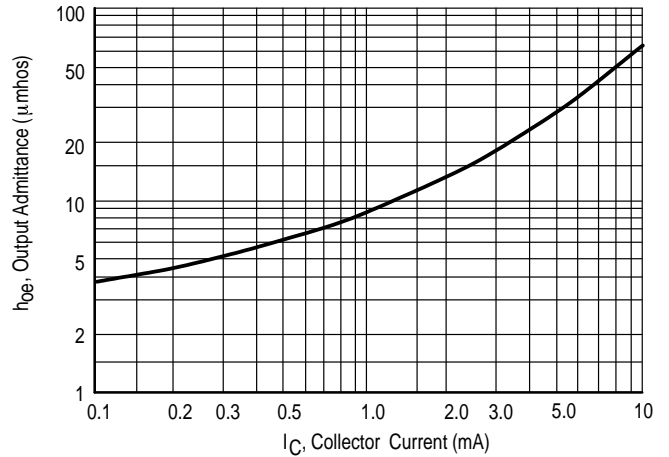


Figure 12. Output Admittance

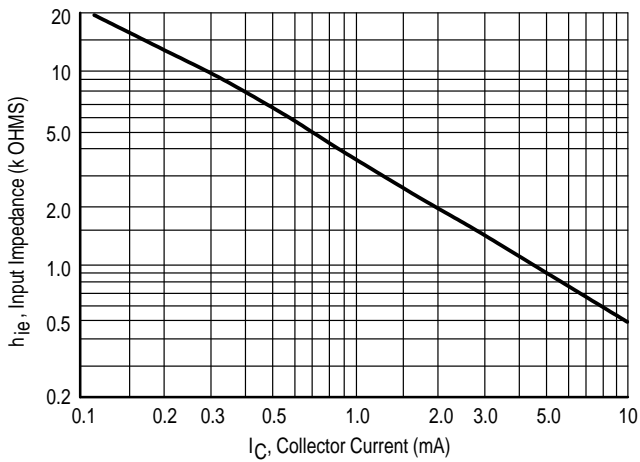


Figure 13. Input Impedance

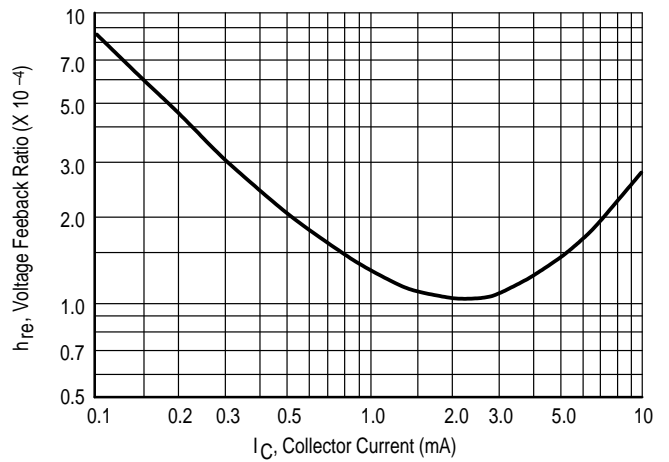


Figure 14. Voltage Feedback Ratio

**TYPICAL STATIC CHARACTERISTICS**

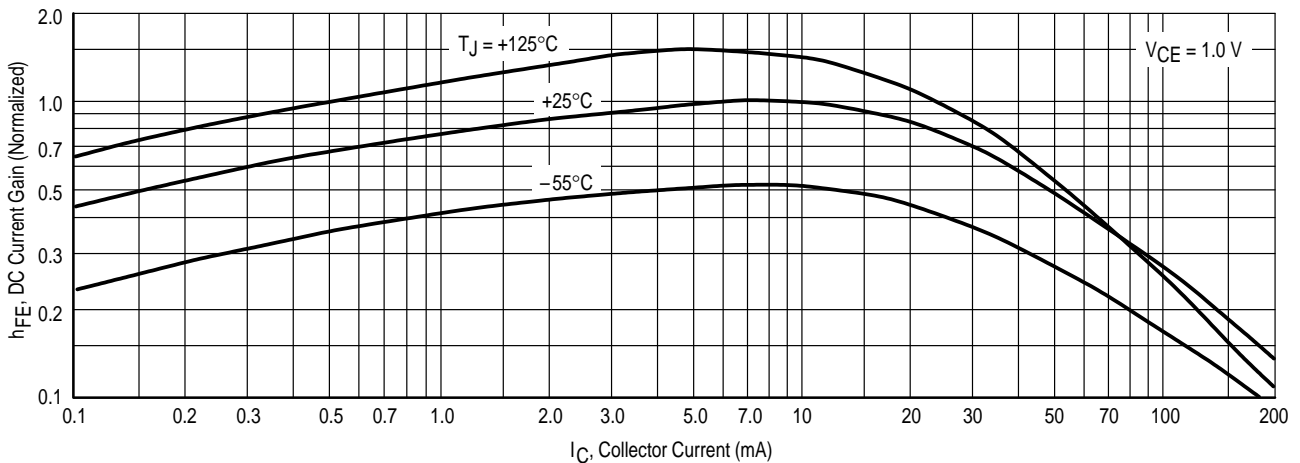


Figure 15. DC Current Gain

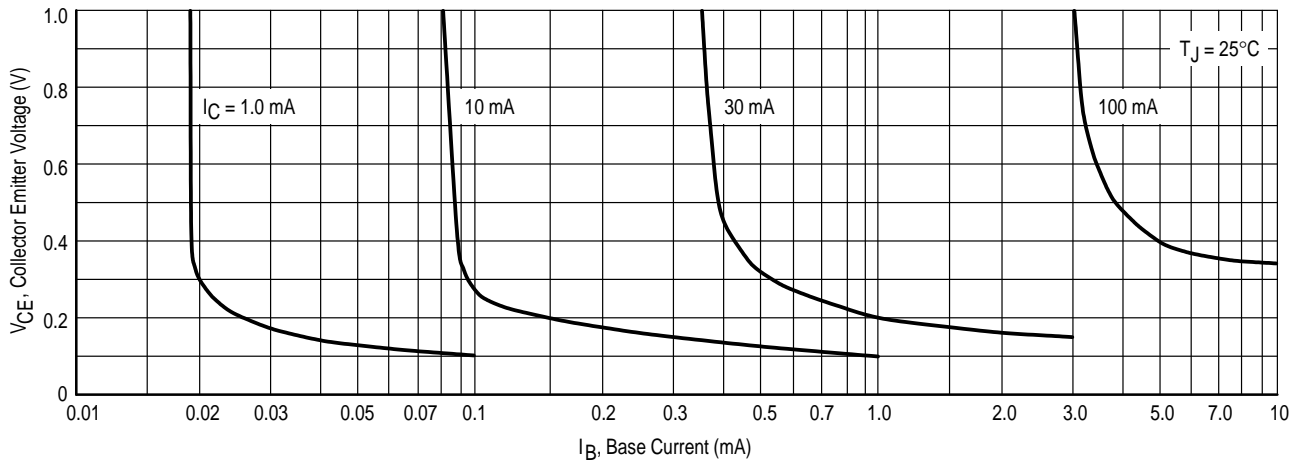


Figure 16. Collector Saturation Region

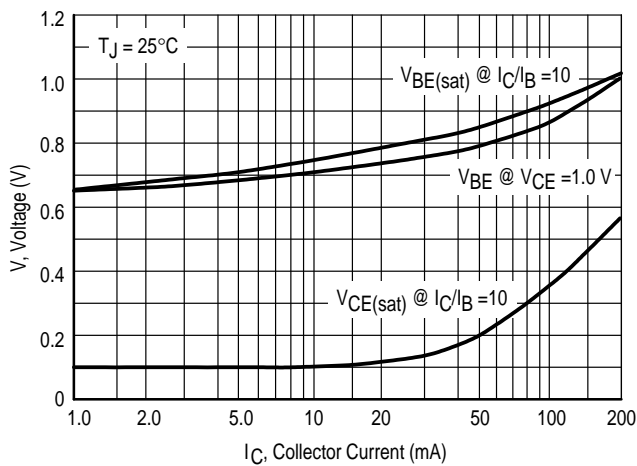


Figure 17. "ON" Voltages

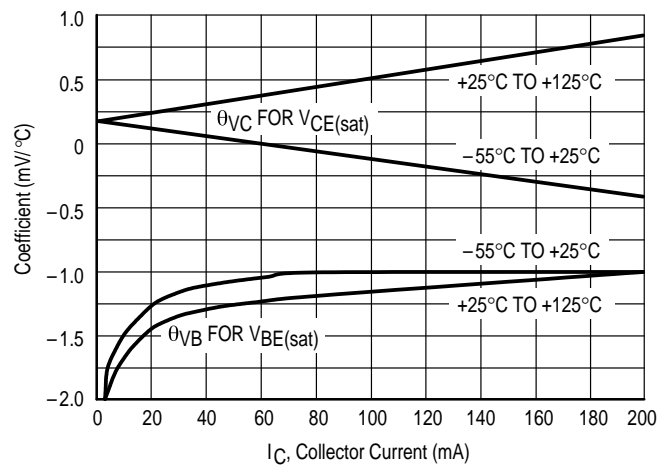


Figure 18. Temperature Coefficients