

RoHS Compliant Product  
A suffix of "-C" specifies halogen & lead-free

## FEATURES

- Simplifies Circuit Design.
- We Declare that the material of product compliance with RoHS requirements.

## MARKING

MA

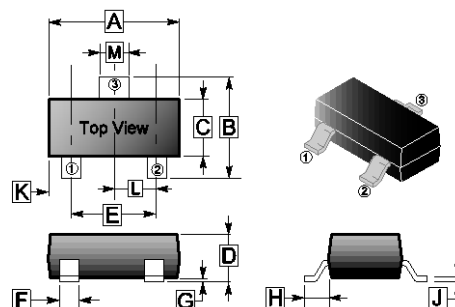
## PACKAGE INFORMATION

Package	MPQ	Leader Size
SOT-523	4K	7 inch

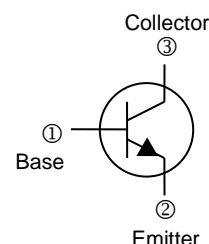
## ORDER INFORMATION

Part Number	Type
MMBT3904T-C	Lead (Pb)-free and Halogen-free

### SOT-523



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	1.50	1.70	G	-	0.10
B	1.45	1.75	H	-	0.55 REF.
C	0.70	0.90	J	0.08	0.20
D	0.60	0.90	K	-	-
E	0.90	1.10	L	-	0.50 TYP.
F	0.15	0.35	M	0.25	0.40



## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub>=25°C unless otherwise specified)

Parameter	Symbol	Ratings	Unit	
Collector-Base Voltage	V <sub>CB0</sub>	60	V	
Collector-Emitter Voltage	V <sub>CE0</sub>	40		
Emitter-Base Voltage	V <sub>EB0</sub>	6		
Collector Current-Continuous	I <sub>c</sub>	200	mA	
Total Device Dissipation FR-4 Board <sup>1</sup>	P <sub>d</sub>	T <sub>A</sub> =25°C	200	mW
		Derate above 25°C	1.6	mW/°C
Thermal Resistance, Junction-Ambient	R <sub>θJA</sub>	600	°C/W	
Total Device Dissipation FR-4 Board <sup>2</sup>	P <sub>d</sub>	T <sub>A</sub> =25°C	300	mW
		Derate above 25°C	2.4	mW/°C
Thermal Resistance, Junction-Ambient	R <sub>θJA</sub>	400	°C/W	
Junction & Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55~150	°C	

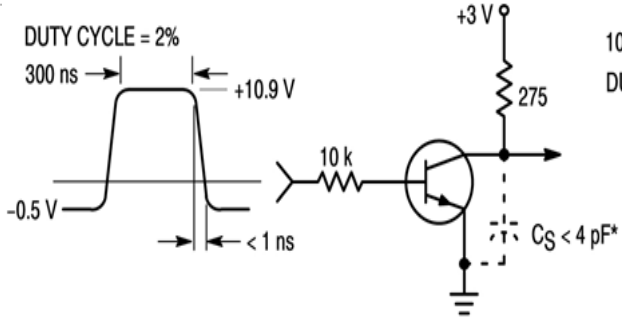
**ELECTRICAL CHARACTERISTICS** ( $T_A=25^\circ\text{C}$  unless otherwise specified)

Characteristic	Symbol	Min.	Max.	Unit	Test Conditions
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	-	V	$I_C=10\mu\text{A}$
Collector-Emitter Breakdown Voltage <sup>3</sup>	$V_{(BR)CEO}$	40	-		$I_C=1\text{mA}$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6.0	-		$I_E=10\mu\text{A}$
Collector Cut-Off Current	$I_{BL}$	-	50	nA	$V_{CE}=30\text{V}, V_{EB}=3\text{V}$
Emitter Cut-Off Current	$I_{CEX}$	-	50	nA	$V_{CE}=30\text{V}, V_{BE}=3\text{V}$
DC Current Gain <sup>3</sup>	$h_{FE}$	40	-		$I_C=0.1\text{mA}, V_{CE}=1\text{V}$
		70	-		$I_C=1\text{mA}, V_{CE}=1\text{V}$
		100	300		$I_C=10\text{mA}, V_{CE}=1\text{V}$
		60	-		$I_C=50\text{mA}, V_{CE}=1\text{V}$
		30	-		$I_C=100\text{mA}, V_{CE}=1\text{V}$
Collector-Emitter Saturation Voltage <sup>3</sup>	$V_{CE(sat)}$	-	0.2	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.3		$I_C=50\text{mA}, I_B=5\text{mA}$
Base-Emitter Saturation Voltage <sup>3</sup>	$V_{BE(sat)}$	0.65	0.85	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.95		$I_C=50\text{mA}, I_B=5\text{mA}$
Current-Gain-Bandwidth Product	$f_T$	200	-	MHz	$V_{CE}=20\text{V}, I_C=10\text{mA}, f=100\text{MHz}$
Output Capacitance	$C_{obo}$	-	4.0	pF	$V_{CB}=5\text{V}, I_E=0, f=1\text{MHz}$
Input Capacitance	$C_{ibo}$	-	8.0	pF	$V_{BE}=0.5\text{V}, I_E=0, f=1\text{MHz}$
Input Impedance	$h_{ie}$	1.0	10	pF	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Voltage Feedback Ratio	$h_{re}$	0.5	8.0	$\times 10^{-4}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Small-Signal Current Gain	$h_{fe}$	100	400	-	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Output Admittance	$h_{oe}$	1.0	40	$\mu\text{mhos}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Noise Figure	NF	-	5.0	dB	$V_{CE}=5\text{V}, I_C=100\mu\text{A}, R_S=1\text{k}\Omega, f=1\text{kHz}$
Delay Time	$T_d$	-	35	nS	$V_{CC}=3\text{V}, V_{BE}=0.5\text{V}, I_C=10\text{mA}, I_{B1}=1\text{mA}$
Rise Time	$T_r$	-	35		
Storage Time	$T_s$	-	200	nS	$V_{CC}=3\text{V}, I_C=10\text{mA}, I_{B1}=I_{B2}=1\text{mA}$
Fall Time	$T_f$	-	50		

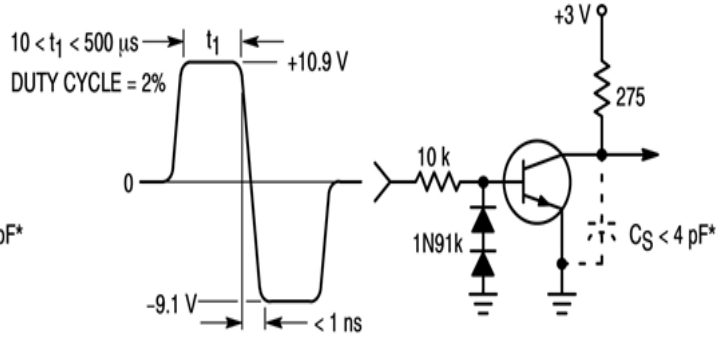
Notes:

- FR-4 Minimum Pad.
- FR-4 1.0 X 1.0 Inch Pad.
- Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

**CHARACTERISTIC CURVES**

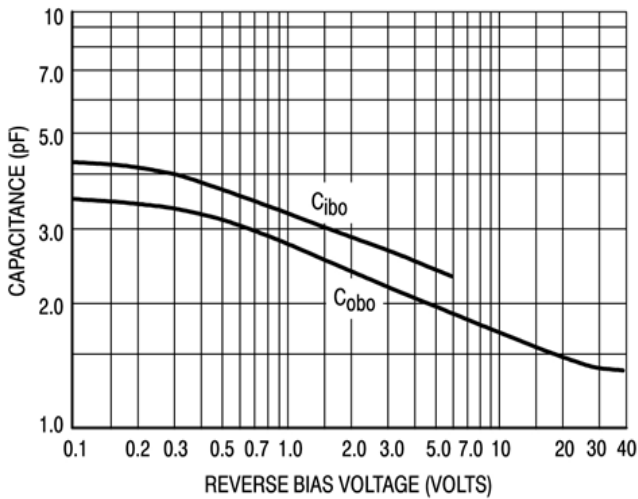


**Figure 1. Delay and Rise Time Equivalent Test Circuit**

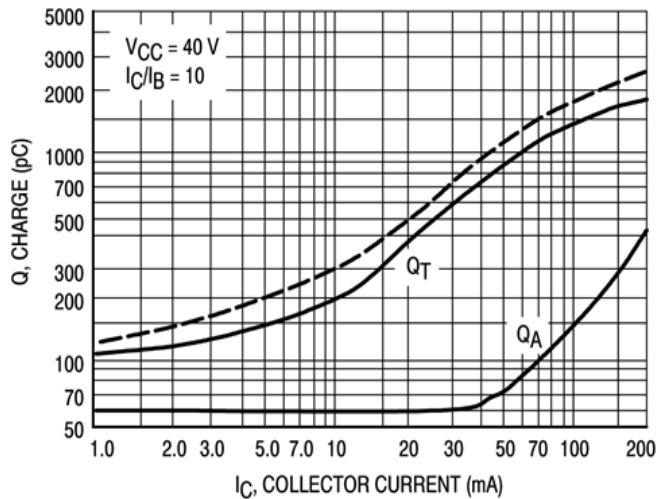


**Figure 2. Storage and Fall Time Equivalent Test Circuit**

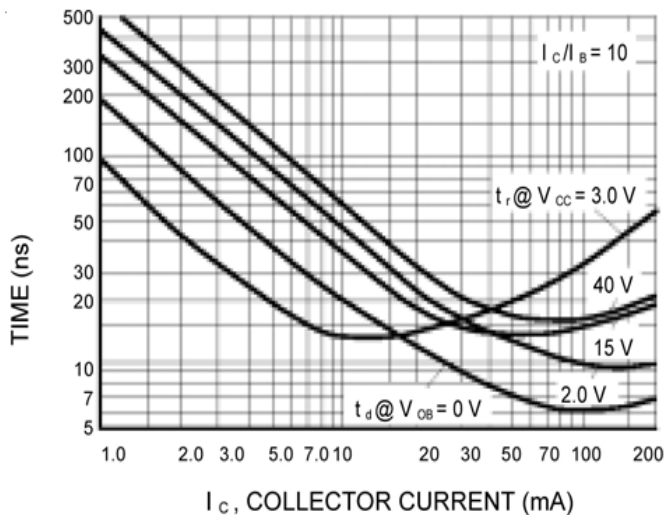
\* Total shunt capacitance of test jig and connectors



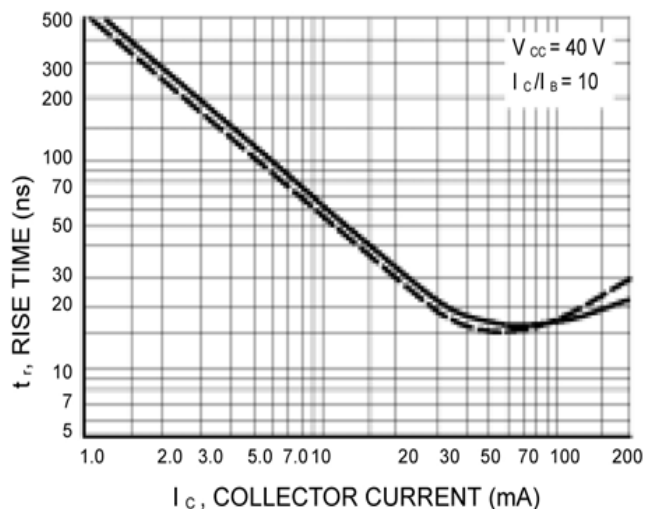
**Figure 3. Capacitance**



**Figure 4. Charge Data**

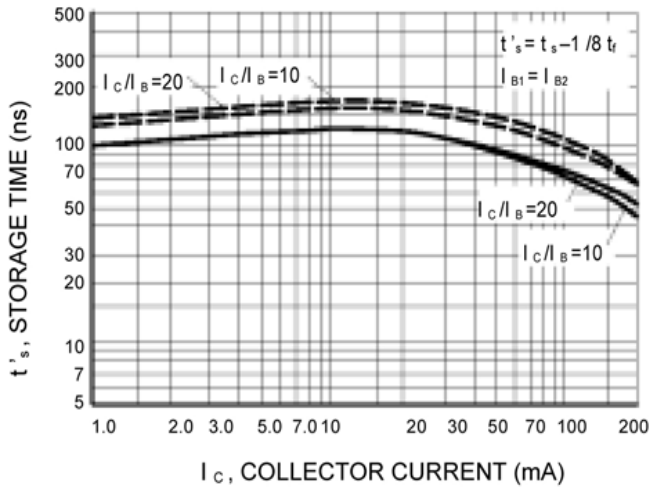


**Figure 5. Turn-On Time**

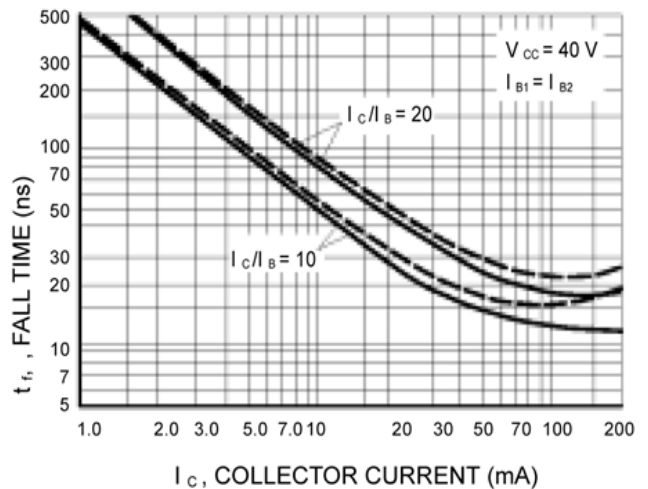


**Figure 6. Rise Time**

**CHARACTERISTIC CURVES**



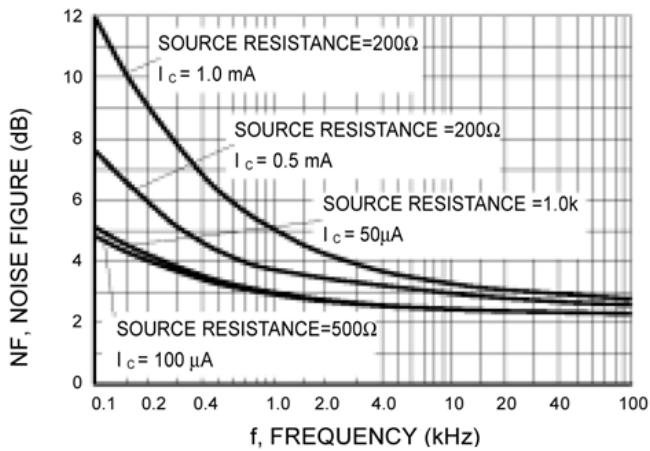
**Figure 7. Storage Time**



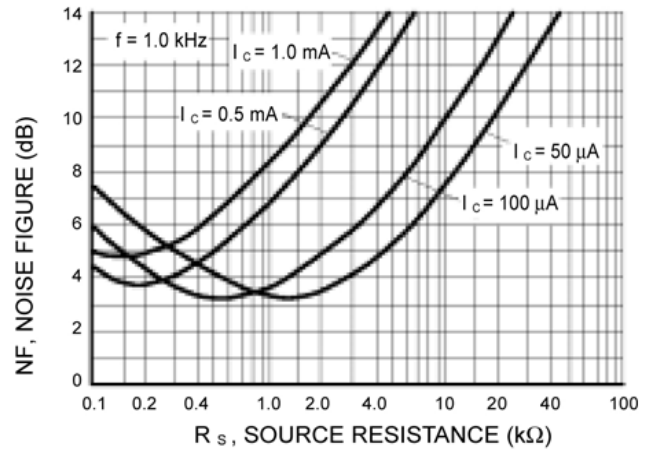
**Figure 8. Fall Time**

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

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



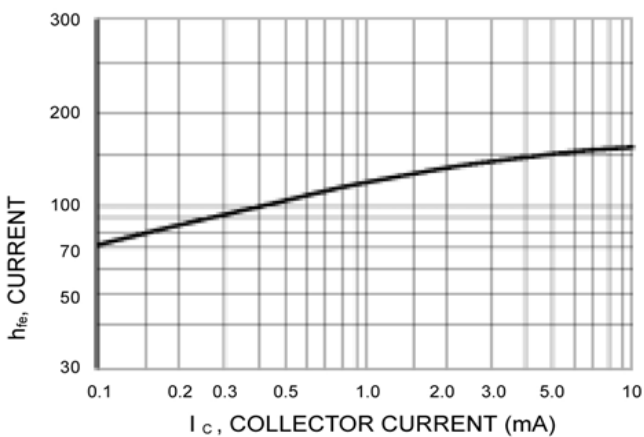
**Figure 9. Noise Figure**



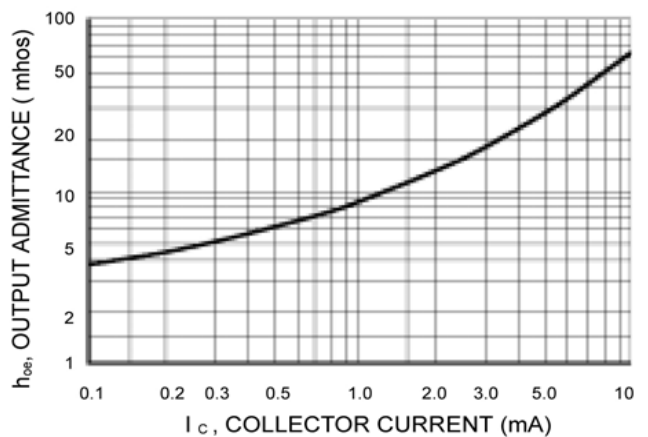
**Figure 10. Noise Figure**

**h PARAMETERS**

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

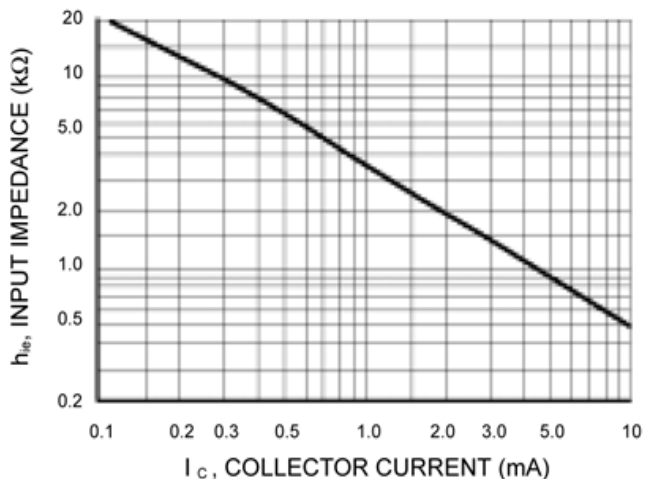


**Figure 11. Current Gain**

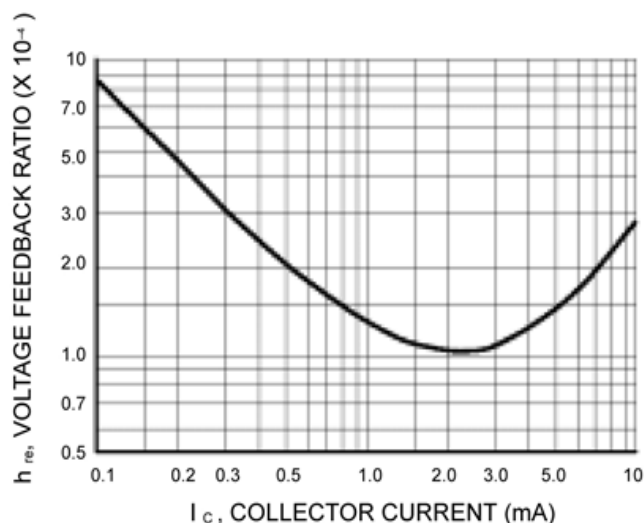


**Figure 12. Output Admittance**

**CHARACTERISTIC CURVES**

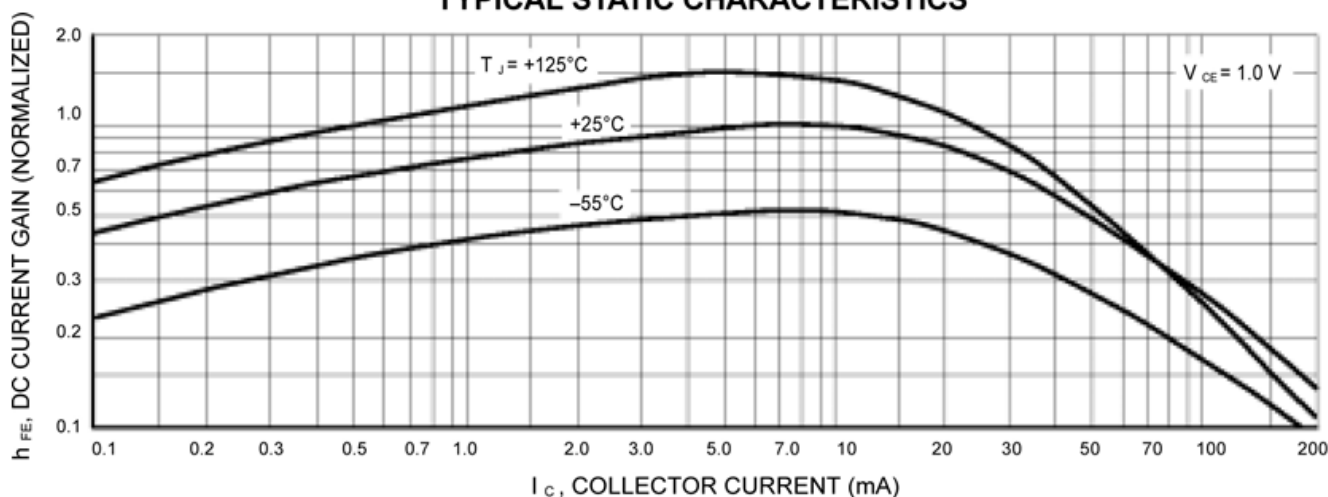


**Figure 13. Input Impedance**

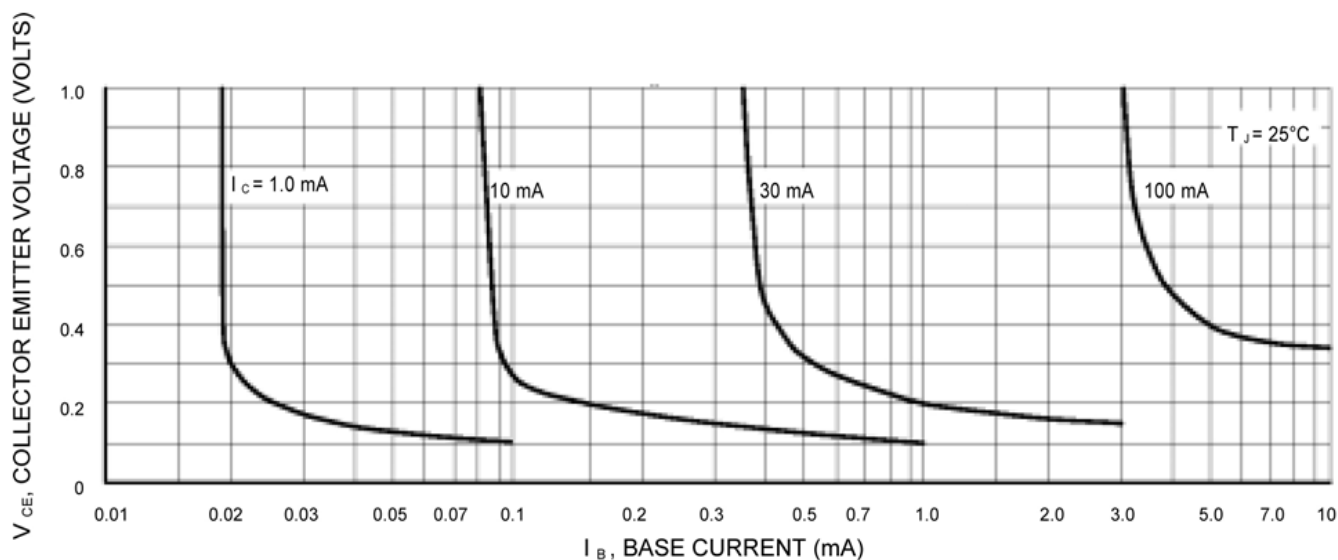


**Figure 14. Voltage Feedback Ratio**

**TYPICAL STATIC CHARACTERISTICS**

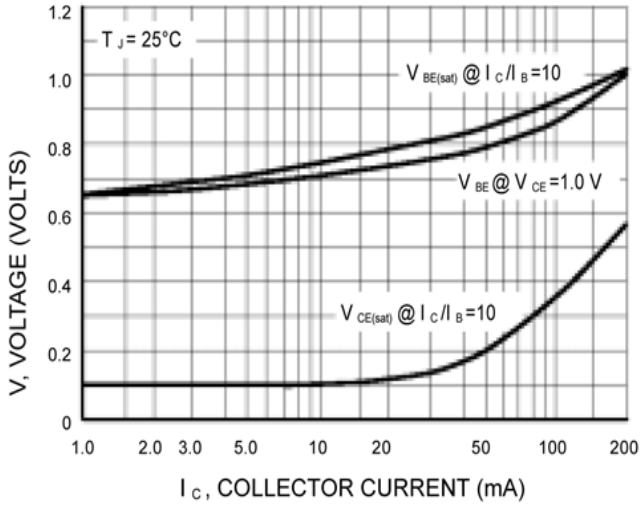


**Figure 15. DC Current Gain**

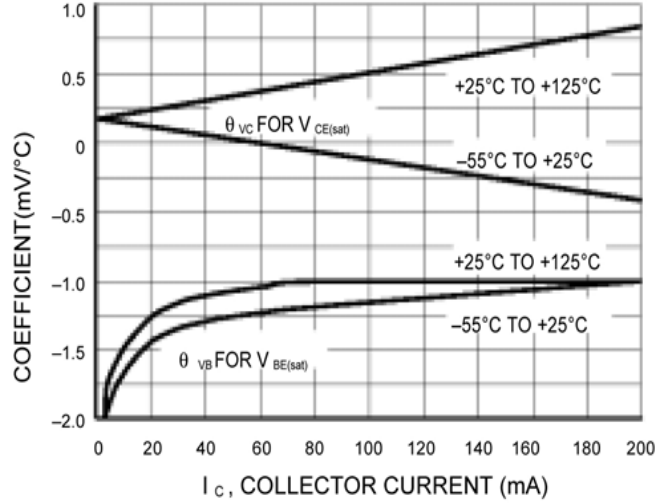


**Figure 16. Collector Saturation Region**

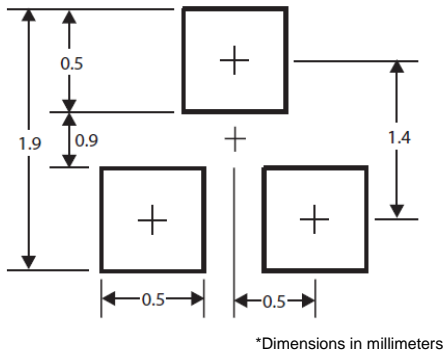
**CHARACTERISTIC CURVES**



**Figure 17. "ON" Voltages**



**Figure 18. Temperature Coefficients**



**Figure 19. Mounting Pad Layout**