

# General Purpose Transistor

- Pb-Free Package May be Available. The G-Suffix Denotes a Pb-Free Lead Finish

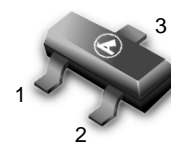
**LMBT4401LT1**

## ORDERING INFORMATION

Device	Package	Shipping
LMBT4401LT1	SOT-23	3000/Tape & Reel
LMBT4401LT1G	SOT-23	3000/Tape & Reel

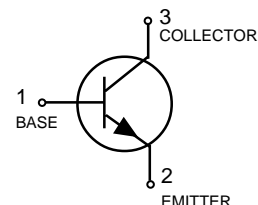
## MAXIMUM RATINGS

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	$I_C$	600	mAdc


**SOT-23**

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board, (1) $T_A = 25^\circ\text{C}$	$P_D$	225	mW
Derate above $25^\circ\text{C}$		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, (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	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$



## DEVICE MARKING

LMBT4401LT1 = 2X

## 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 ( $I_C = 0.1 \text{ mAdc}, I_E = 0$ )	$V_{(BR)CBO}$	60	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 0.1 \text{ mAdc}, I_C = 0$ )	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{BEV}$	—	0.1	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{CEX}$	—	0.1	$\mu\text{Adc}$

- FR-5 =  $1.0 \times 0.75 \times 0.062 \text{ in.}$
- Alumina =  $0.4 \times 0.3 \times 0.024 \text{ in.}$  99.5% alumina.
- Pulse Test: Pulse Width  $< 300 \mu\text{s}$ ; Duty Cycle  $< 2.0\%$ .

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**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 ( $I_C = 0.1 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$ )	$h_{FE}$	20	—	—
( $I_C = 1.0 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$ )		40	—	
( $I_C = 10 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$ )		80	—	
( $I_C = 150 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$ )		100	300	
( $I_C = 500 \text{ mA dc}, V_{CE} = 2.0 \text{ V dc}$ )		40	—	
Collector–Emitter Saturation Voltage ( $I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$ )	$V_{CE(sat)}$	—	0.4	Vdc
( $I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$ )		—	0.75	
Base–Emitter Saturation Voltage ( $I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$ )	$V_{BE(sat)}$	0.75	0.95	Vdc
( $I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$ )		—	1.2	

**SMALL–SIGNAL CHARACTERISTICS**

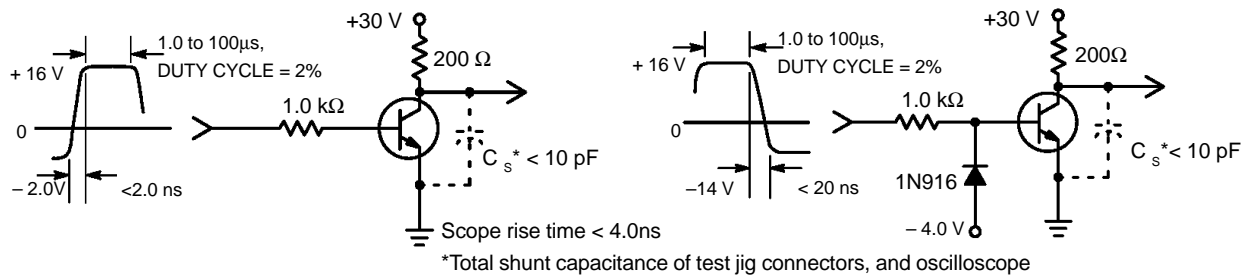
Current–Gain — Bandwidth Product ( $I_C = 20 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 100 \text{ MHz}$ )	$f_T$	250	—	MHz
Collector–Base Capacitance ( $V_{CB} = 5.0 \text{ V dc}, I_E = 0, f = 1.0 \text{ MHz}$ )	$C_{cb}$	—	6.5	pF
Emitter–Base Capacitance ( $V_{EB} = 0.5 \text{ V dc}, I_C = 0, f = 1.0 \text{ MHz}$ )	$C_{eb}$	—	30	pF
Input Impedance ( $V_{CE} = 10 \text{ V dc}, I_C = 1.0 \text{ mA dc}, f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	15	k $\Omega$
Voltage Feedback Ratio ( $V_{CE} = 10 \text{ V dc}, I_C = 1.0 \text{ mA dc}, f = 1.0 \text{ kHz}$ )	$h_{re}$	0.1	8.0	$\times 10^{-4}$
Small–Signal Current Gain ( $V_{CE} = 10 \text{ V dc}, I_C = 1.0 \text{ mA dc}, f = 1.0 \text{ kHz}$ )	$h_{fe}$	40	500	—
Output Admittance ( $V_{CE} = 10 \text{ V dc}, I_C = 1.0 \text{ mA dc}, f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	30	$\mu\text{mhos}$

**SWITCHING CHARACTERISTICS**

Delay Time	( $V_{CC} = 30 \text{ V dc}, V_{EB} = 2.0 \text{ V dc}$ )	$t_d$	—	15	ns
Rise Time	( $I_C = 150 \text{ mA dc}, I_{B1} = 15 \text{ mA dc}$ )	$t_r$	—	20	
Storage Time	( $V_{CC} = 30 \text{ V dc}, I_C = 150 \text{ mA dc}$ )	$t_s$	—	225	ns
Fall Time	( $I_{B1} = I_{B2} = 15 \text{ mA dc}$ )	$t_f$	—	30	

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

**SWITCHING TIME EQUIVALENT TEST CIRCUITS**

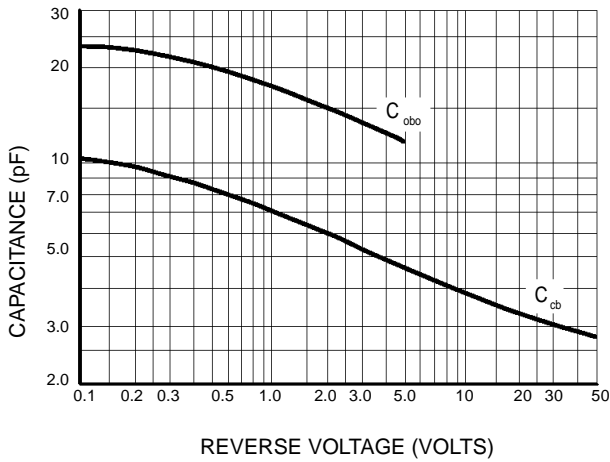


**Figure 1. Turn–On Time**

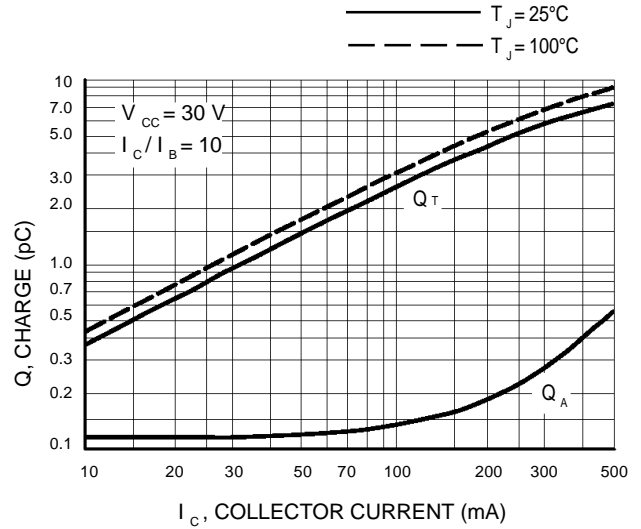
**Figure 2. Turn–Off Time**

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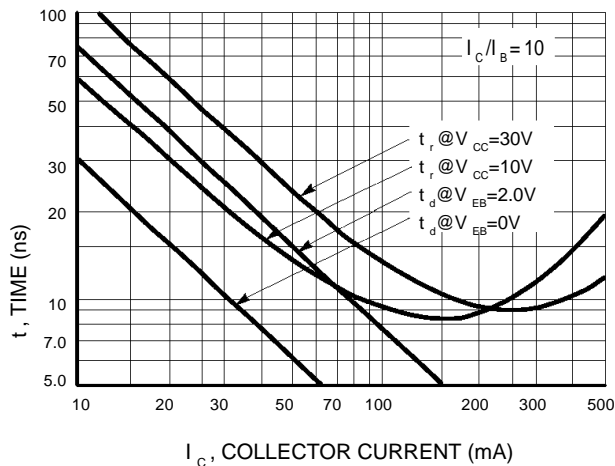
**TRANSIENT CHARACTERISTICS**



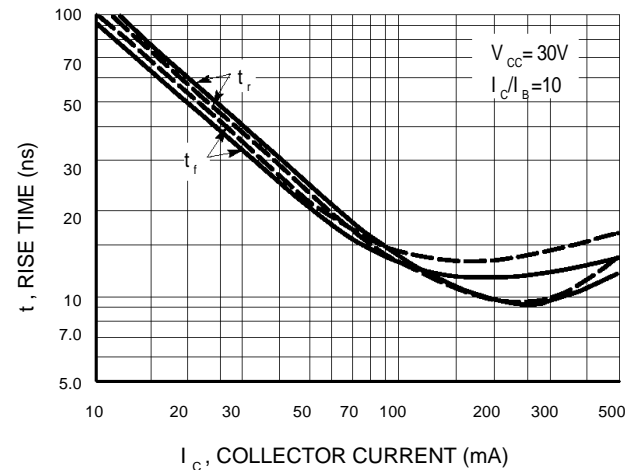
**Figure 3. Capacitance**



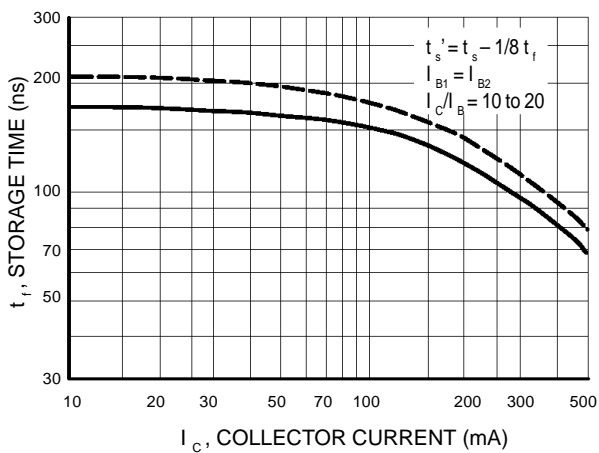
**Figure 4. Charge Data**



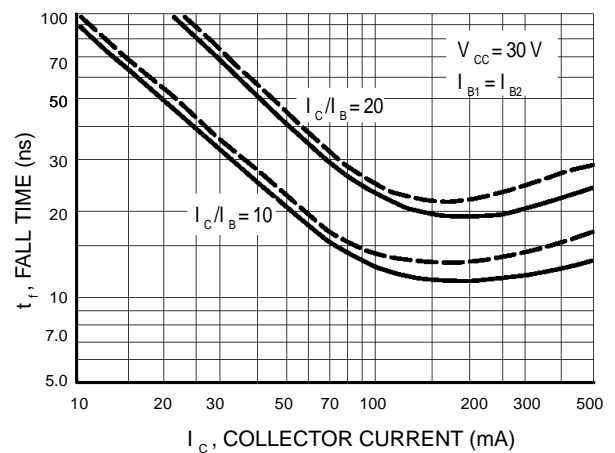
**Figure 5. Turn-On Time**



**Figure 6. Rise and Fall Time**



**Figure 7. Storage Time**



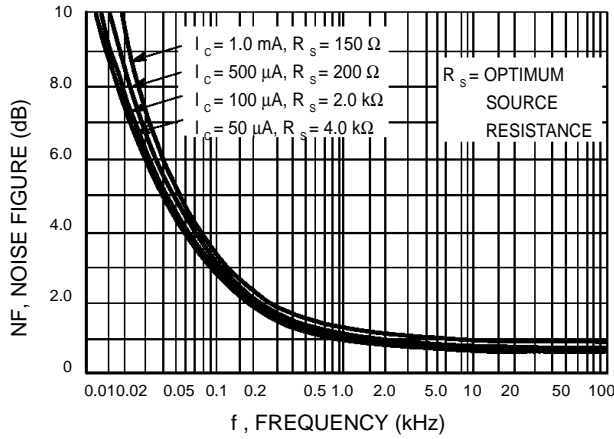
**Figure 8. Fall Time**

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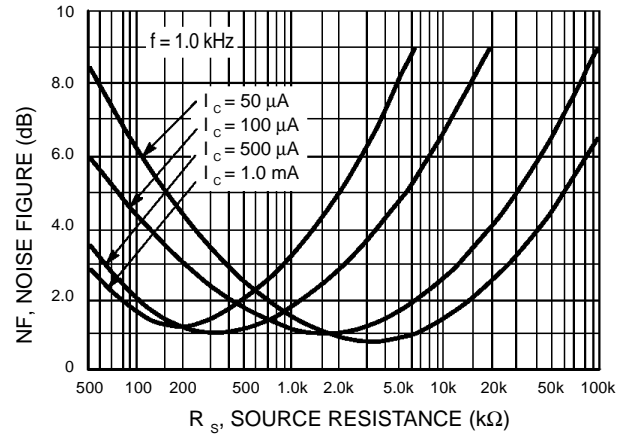
**SMALL-SIGNAL CHARACTERISTICS**

**NOISE FIGURE**

$V_{CE} = 10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$   
Bandwidth = 1.0 Hz



**Figure 9. Frequency Effects**

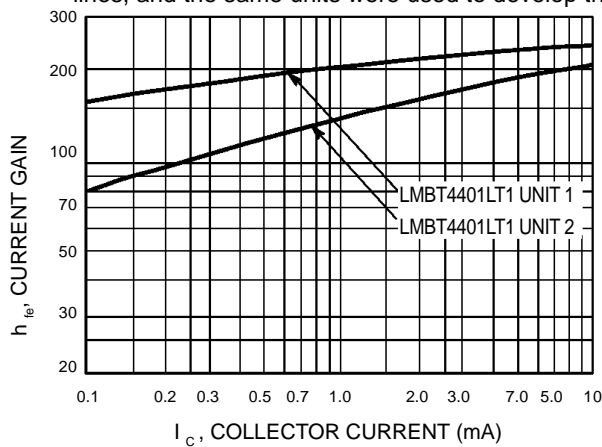


**Figure 10. Source Resistance Effects**

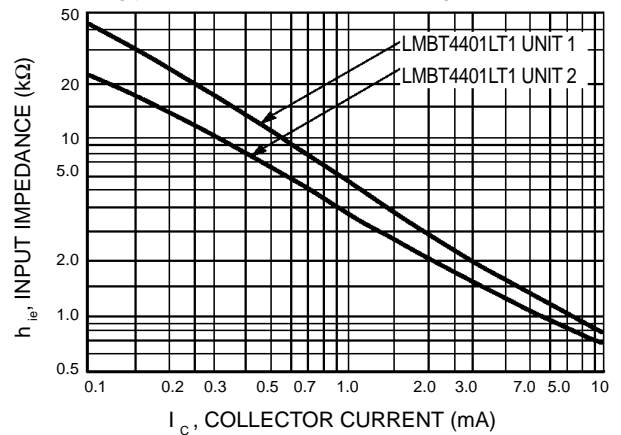
**h PARAMETERS**

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

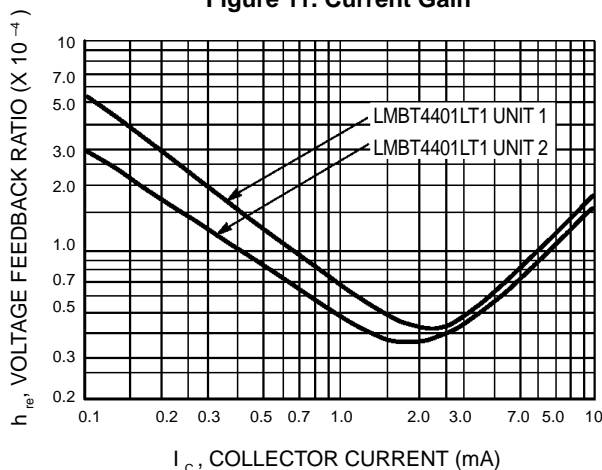
This group of graphs illustrates the relationship between  $h_{fe}$  and other “h” parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected from the LMBT4401LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.



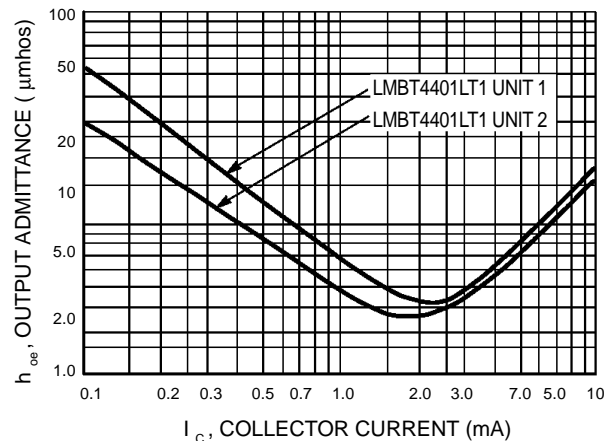
**Figure 11. Current Gain**



**Figure 12. Input Impedance**



**Figure 13. Voltage Feedback Ratio**



**Figure 14. Output Admittance**

LMBT4401LT1

STATIC CHARACTERISTICS

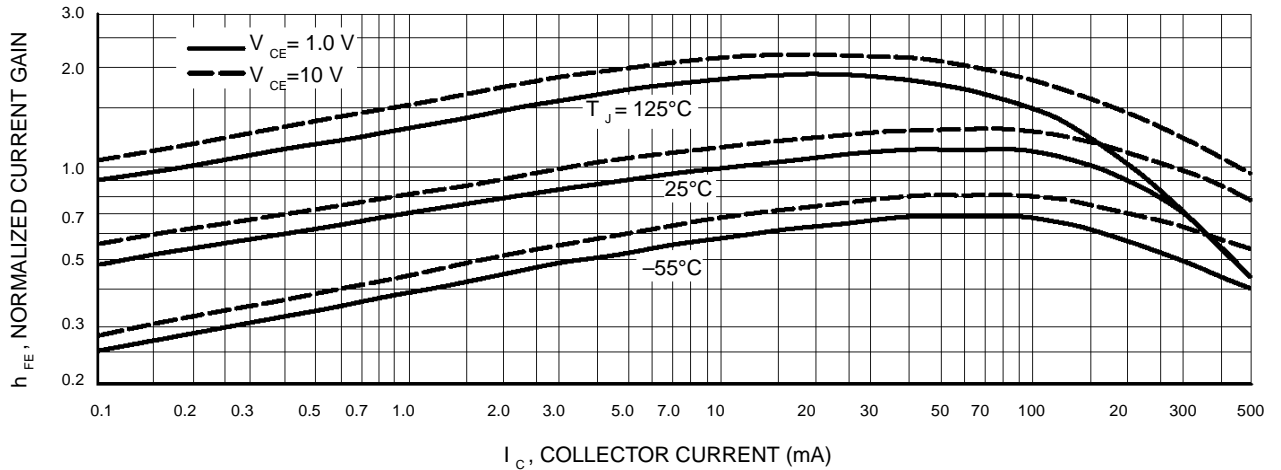


Figure 15. DC Current Gain

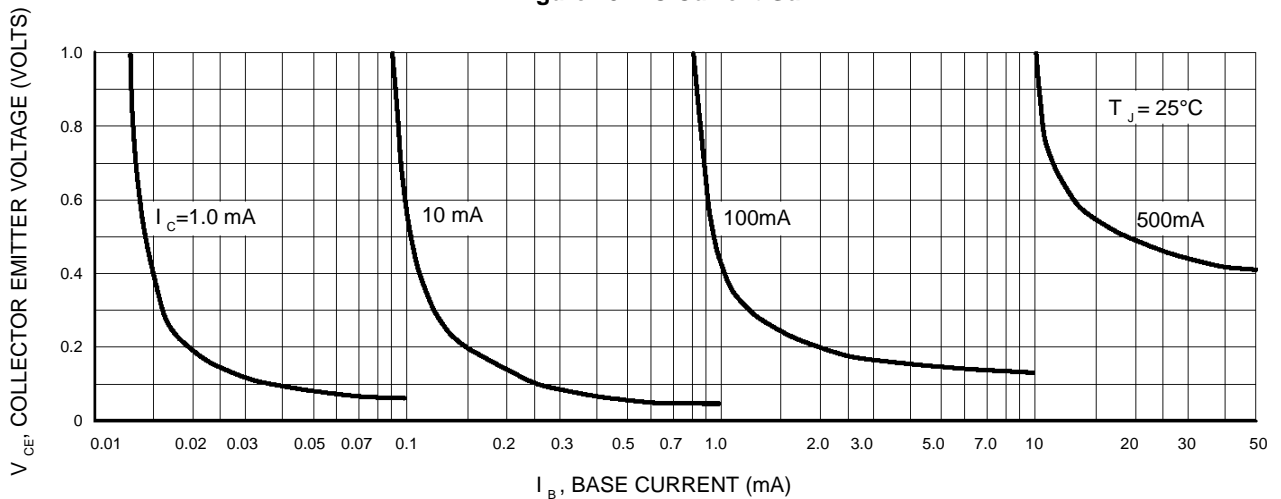


Figure 16. Collector Saturation Region

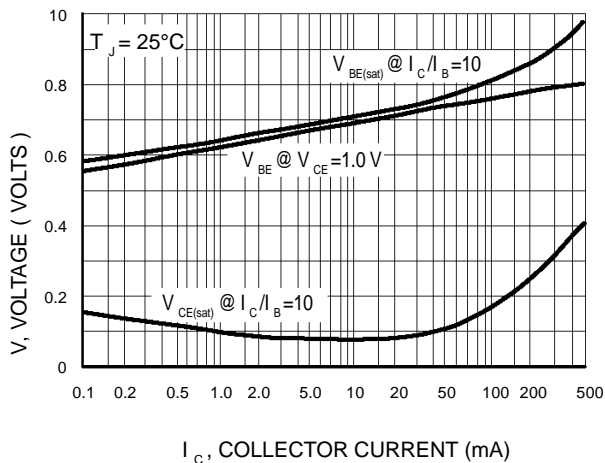


Figure 17. "On" Voltages

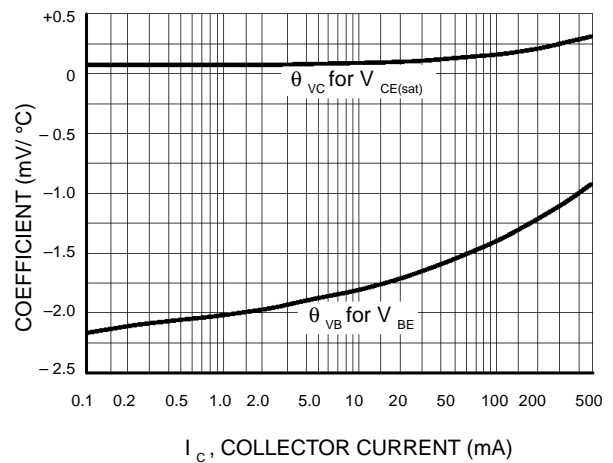
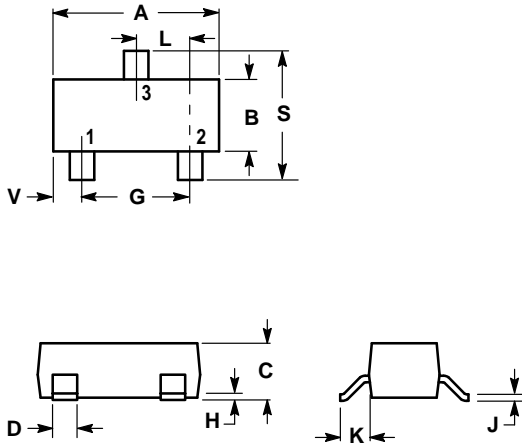


Figure 18. Temperature Coefficients

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**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

- PIN 1. BASE  
 2. EMITTER  
 3. COLLECTOR

