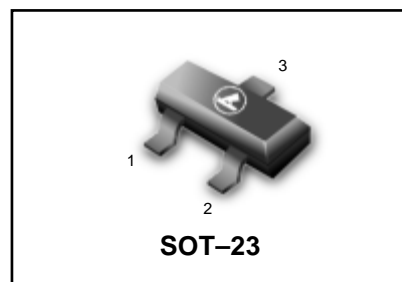


# General Purpose Transistor

- Pb-Free Package May be Available. The G-Suffix Denotes a Pb-Free Lead Finish
- We declare that the material of product compliance with RoHS requirements.
- S- Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

**LMBT3904LT1G**  
**S-LMBT3904LT1G**

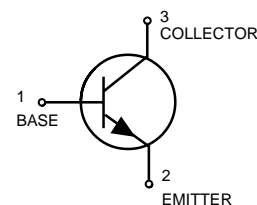


## ORDERING INFORMATION

Device	Marking	Shipping
LMBT3904LT1G S-LMBT3904LT1G	1AM	3000/Tape & Reel
LMBT3904LT3G S-LMBT3904LT3G	1AM	10000/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	$I_C$	200	mAdc



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

## 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) ( $I_C = 1.0 \text{ mAdc}$ )	$V_{(BR)CEO}$	40	—	Vdc
Collector-Base Breakdown Voltage ( $I_C = 10 \mu\text{Adc}$ )	$V_{(BR)CBO}$	60	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 10 \mu\text{Adc}$ )	$V_{(BR)EBO}$	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-5 =  $1.0 \times 0.75 \times 0.062 \text{ in.}$
2. Alumina =  $0.4 \times 0.3 \times 0.024 \text{ in.}$  99.5% alumina.
3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

**LMBT3904LT1G,S-LMBT3904LT1G**
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

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

**SMALL-SIGNAL CHARACTERISTICS**

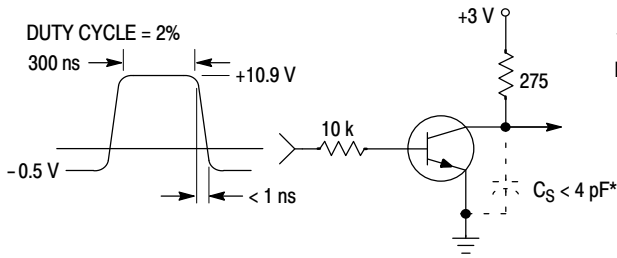
Current-Gain — Bandwidth Product ( $I_C = 10 \text{ mAdc}$ , $V_{CE} = 20 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	300	—	MHz
Output Capacitance ( $V_{CB} = 5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{obo}$	—	4.0	pF
Input Capacitance ( $V_{EB} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0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

**SWITCHING CHARACTERISTICS**

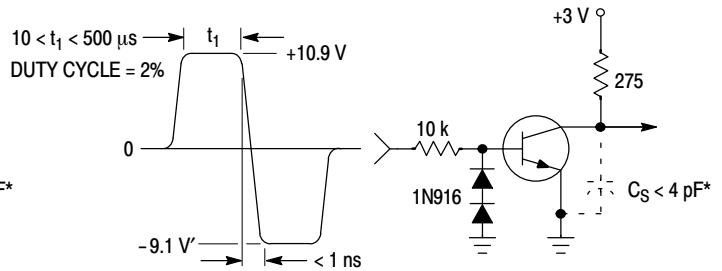
Delay Time ( $V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$ )	$t_d$	—	35	ns
Rise Time ( $I_C = 10 \text{ mAdc}$ , $I_{B1} = 1.0 \text{ mAdc}$ )	$t_r$	—	35	ns
Storage Time ( $V_{CC} = 3.0 \text{ Vdc}$ )	$t_s$	—	200	ns
Fall Time ( $I_C = 10 \text{ mAdc}$ , $I_{B1} = I_{B2} = 1.0 \text{ mAdc}$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

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

**LMBT3904LT1G,S-LMBT3904LT1G**



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

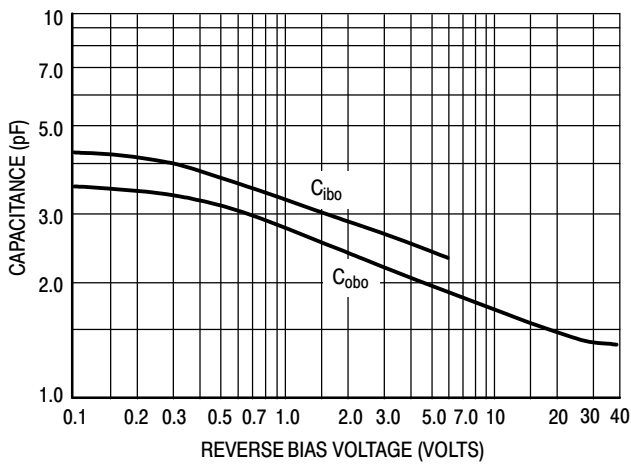


**Figure 2. Storage and Fall Time Equivalent Test Circuit**

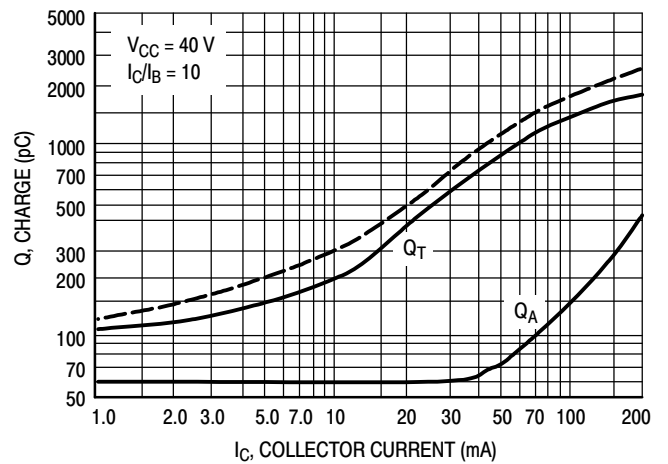
\* Total shunt capacitance of test jig and connectors

**TYPICAL TRANSIENT CHARACTERISTICS**

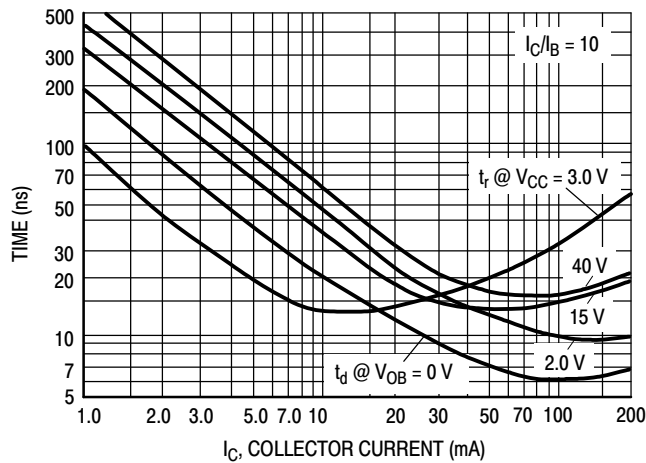
—  $T_J = 25^\circ\text{C}$   
 - - -  $T_J = 125^\circ\text{C}$



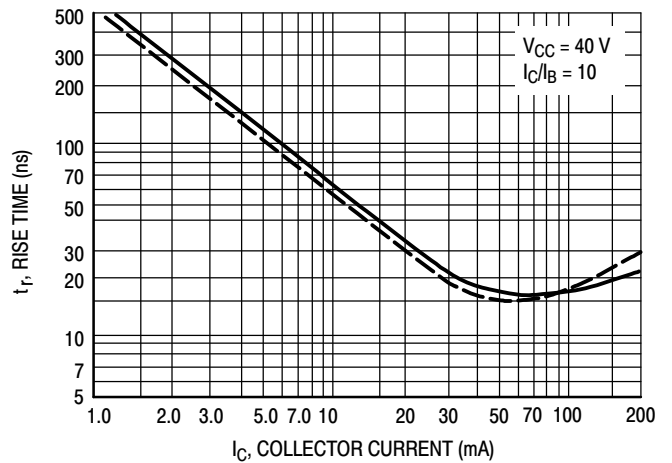
**Figure 3. Capacitance**



**Figure 4. Charge Data**

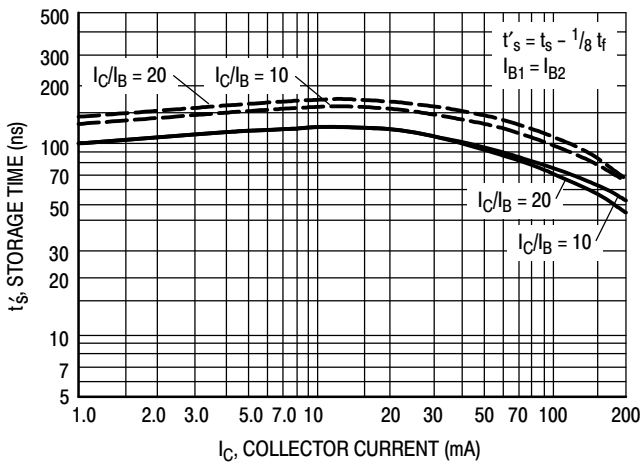


**Figure 5. Turn-On Time**

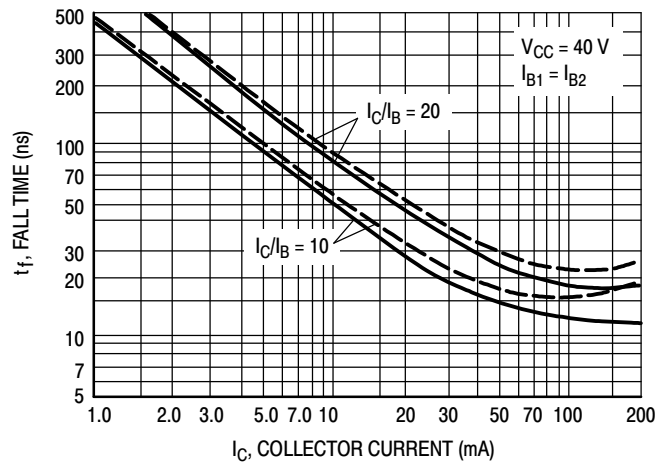


**Figure 6. Rise Time**

**LMBT3904LT1G,S-LMBT3904LT1G**



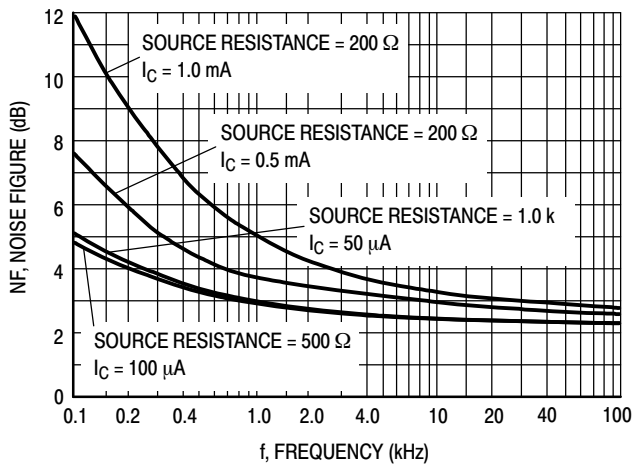
**Figure 7. Storage Time**



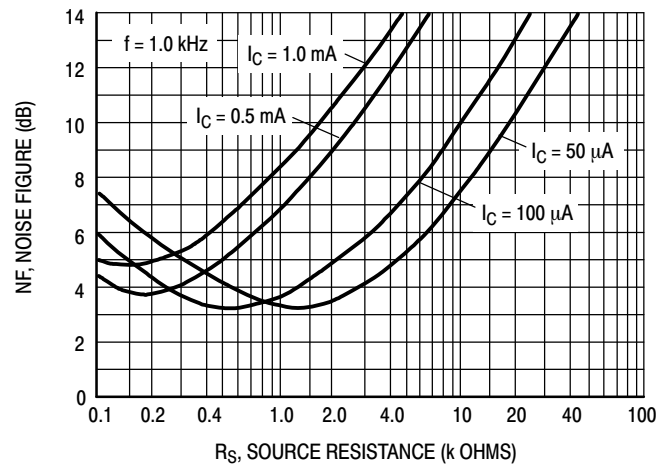
**Figure 8. Fall Time**

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

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



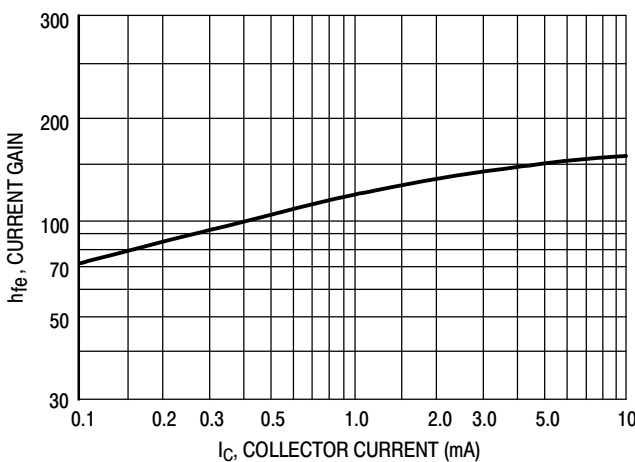
**Figure 9.**



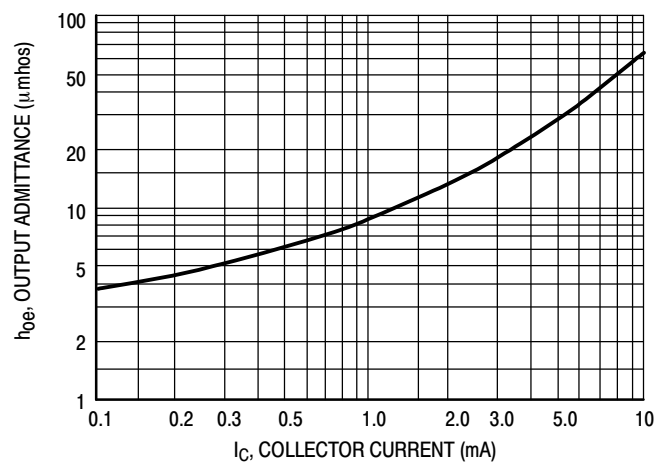
**Figure 10.**

**h PARAMETERS**

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

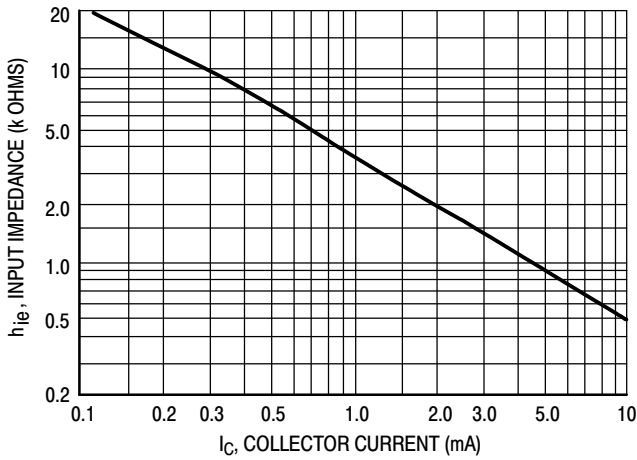


**Figure 11. Current Gain**

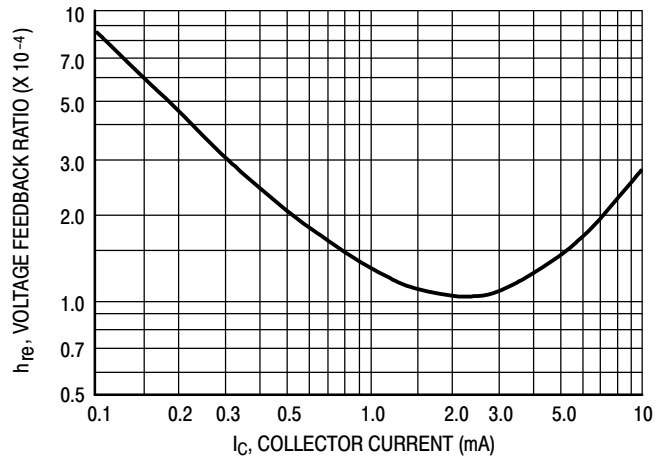


**Figure 12. Output Admittance**

**LMBT3904LT1G,S-LMBT3904LT1G**

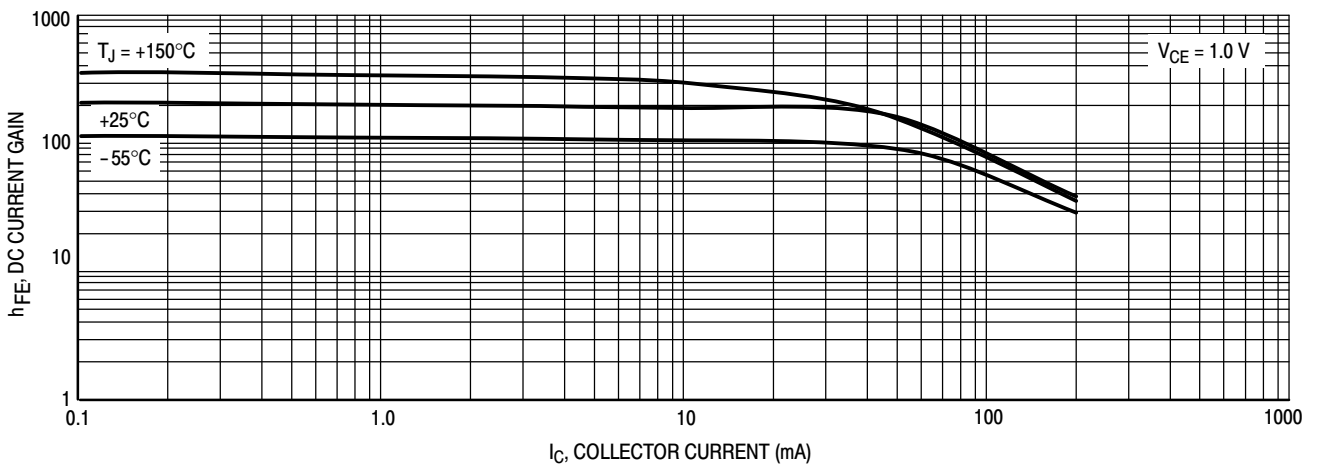


**Figure 13. Input Impedance**

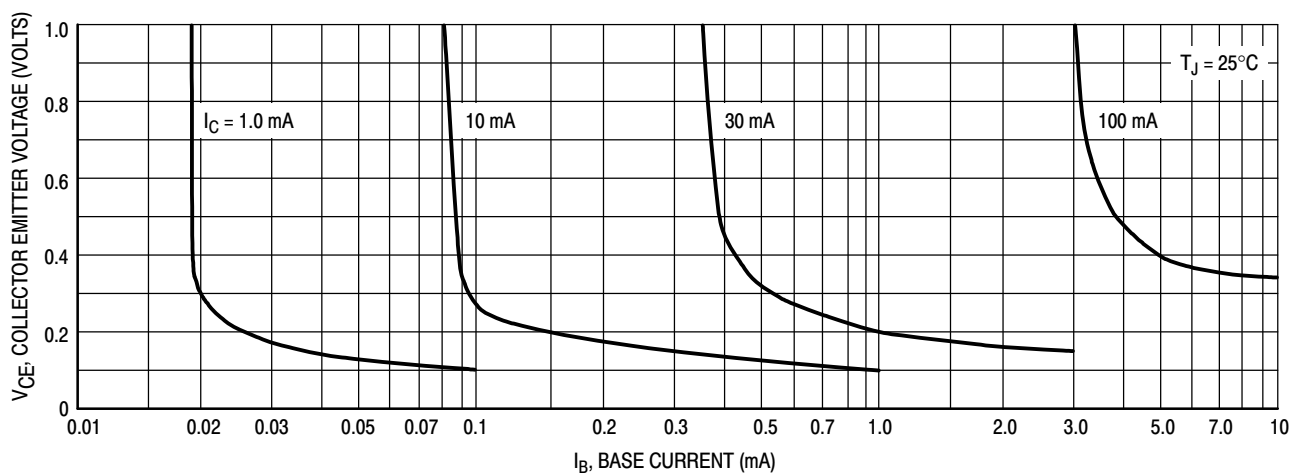


**Figure 14. Voltage Feedback Ratio**

**TYPICAL STATIC CHARACTERISTICS**



**Figure 15. DC Current Gain**



**Figure 16. Collector Saturation Region**

LMBT3904LT1G,S-LMBT3904LT1G

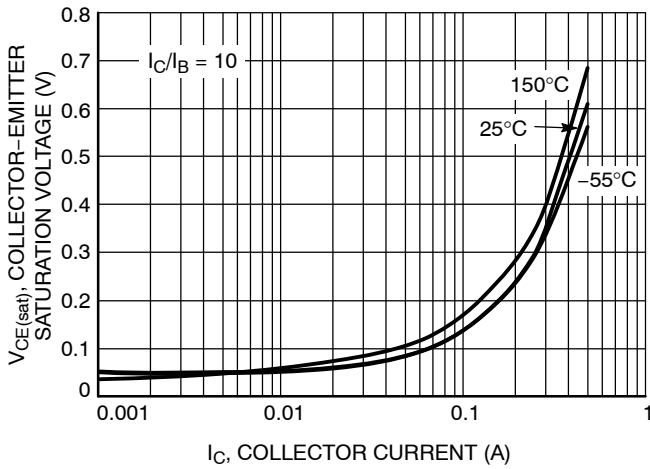


Figure 17. Collector Emitter Saturation Voltage vs. Collector Current

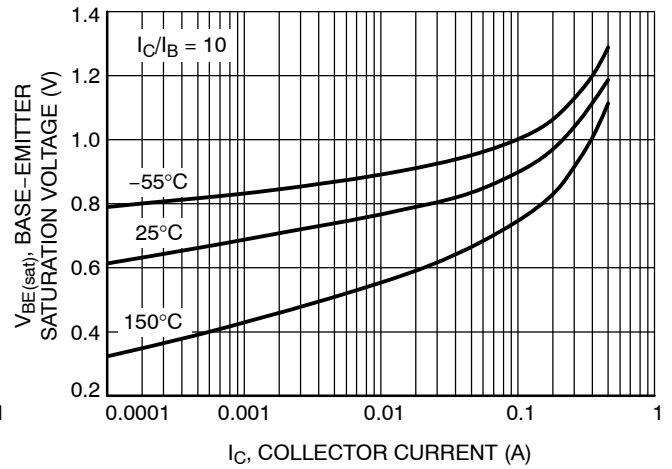


Figure 18. Base Emitter Saturation Voltage vs. Collector Current

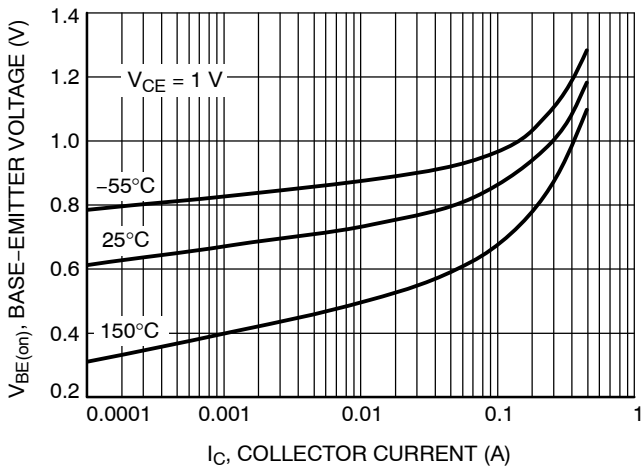


Figure 19. Base Emitter Voltage vs. Collector Current

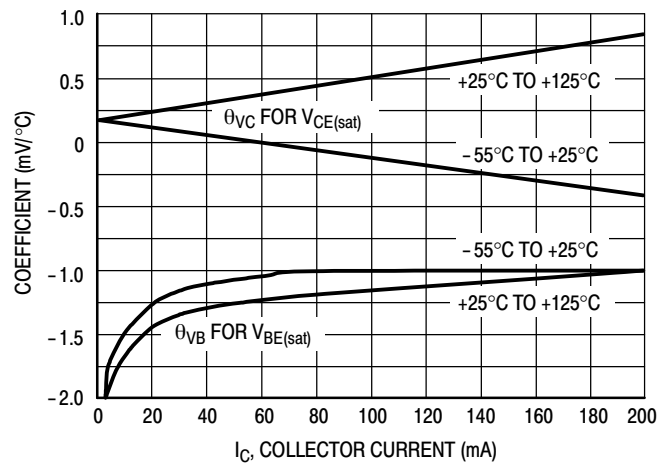


Figure 20. Temperature Coefficients

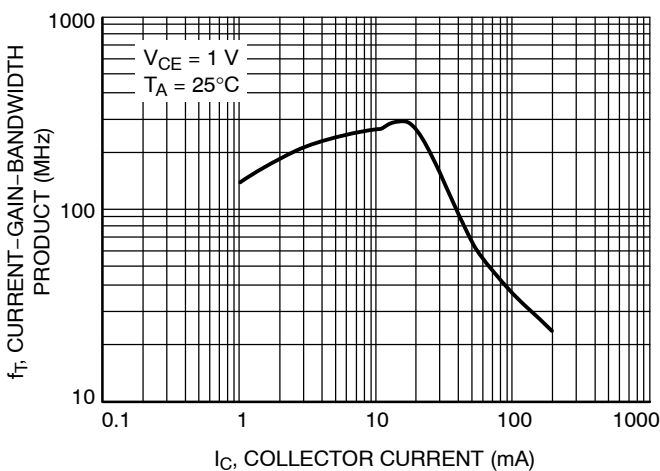


Figure 21. Current Gain Bandwidth vs. Collector Current

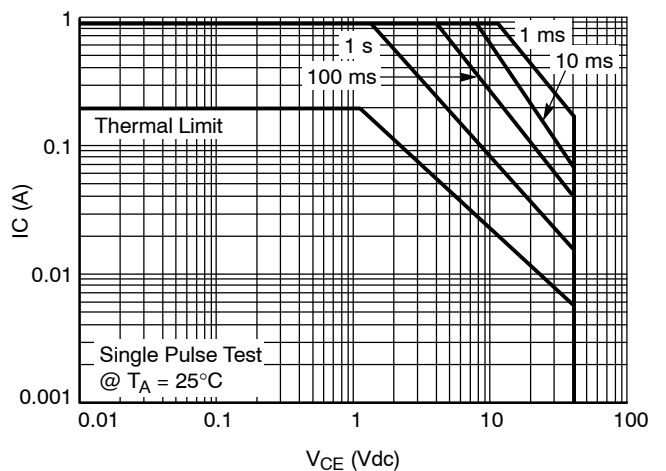
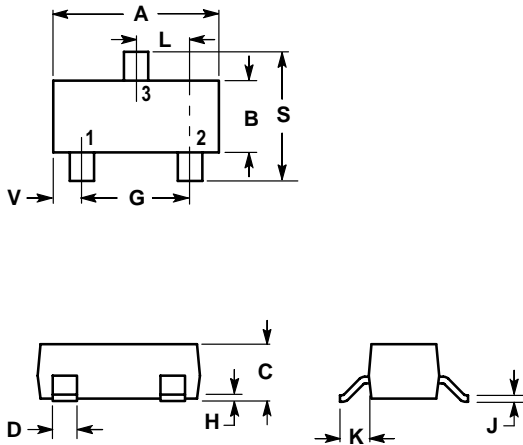


Figure 22. Safe Operating Area

**LMBT3904LT1G,S-LMBT3904LT1G**
**SOT-23**

**NOTES:**

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

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

- PIN 1. BASE  
 2. EMITTER  
 3. COLLECTOR

