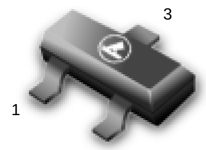
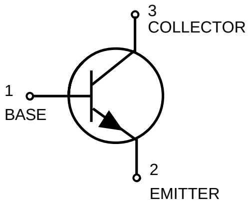
General Purpose Transistor

LMBT3904LT1G
S-LMBT3904LT1G

- 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.



SOT–23



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°C	P_D	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate, (2) T_A = 25°C	P_D	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature	T_J , T_{stg}	–55 to +150	°C

ELECTRICAL CHARACTERISTICS (T$_A$ = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage(3) (I_C = 1.0 mAdc)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage (I_C = 10 µAdc)	$V_{(BR)CBO}$	60	—	Vdc
Emitter–Base Breakdown Voltage (I_E = 10 µAdc)	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current (V_{CE}= 30 Vdc, V_{EB} = 3.0 Vdc,)	I_{BL}	—	50	nAdc
Collector Cutoff Current (V_{CE} = 30Vdc, V_{EB} = 3.0Vdc)	I_{CEX}	—	50	nAdc

1. FR–5 = 1.0 x 0.75 x 0.062 in.
2. Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.
3. Pulse Test: Pulse Width ≤300 µs, Duty Cycle ≤2.0%.

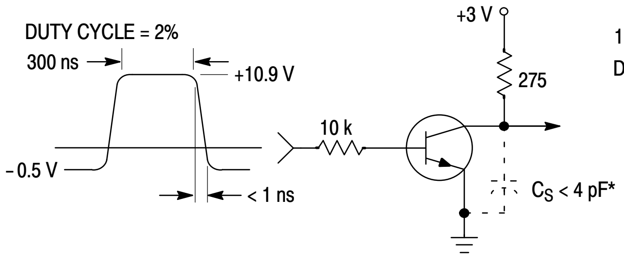
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

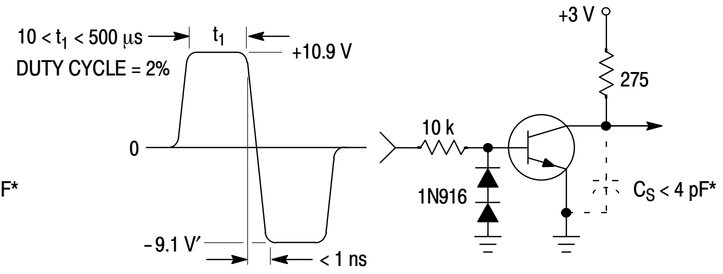
Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS (3)				
DC Current Gain(1)	h_{FE}			—
(I_C =0.1 mAdc, V_{CE} =1.0 Vdc)		40	—	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		70	—	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		100	300	
(I_C = 50mAdc, V_{CE} = 1.0Vdc)		60	—	
(I_C = 100mAdc, V_{CE} =1.0 Vdc)		30	—	
Collector–Emitter Saturation Voltage	$V_{CE(sat)}$			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)(3)		—	0.2	
(I_C = 50 mAdc, I_B = 5.0mAdc)		—	0.3	
Base–Emitter Saturation Voltage(3)	$V_{BE(sat)}$			Vdc
(I_C = 10 mAdc, I_B = 1.0mAdc)		0.65	0.85	
(I_C = 50mAdc, I_B = 5.0mAdc)		—	0.95	
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain — Bandwidth Product (I_C = 10mAdc, V_{CE}= 20Vdc, f = 100MHz)	f_T	300	—	MHz
Output Capacitance (V_{CB} = 5.0Vdc, I_E = 0, f = 1.0 MHz)	C_{obo}	—	4.0	pF
Input Capacitance (VEB = 0.5Vdc, I_C = 0, f = 1.0 MHz)	C_{ibo}	—	8.0	pF
Input Impedancen (V_{CE} = 10Vdc, I_C = 1.0mAdc, f = 1.0 kHz)	h_{ie}	1.0	10	kΩ
Voltage Feedback Ratio (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	h_{re}	0.5	8.0	$X10^{-4}$
Small–Signal Current Gain (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	h_{fe}	100	400	—
Output Admittance (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	h_{oe}	1.0	40	µmhos
Noise Figure (V_{CE} = 5.0 Vdc, I_C = 100µAdc, R_S = 1.0 k Ω, f = 1.0 kHz)	NF	—	5.0	dB

SWITCHING CHARACTERISTICS

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

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





* Total shunt capacitance of test jig and connectors

Figure 1. Delay and Rise Time Equivalent Test Circuit

Figure 2. Storage and Fall Time Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

—— T_J = 25°C
– – T_J = 125°C

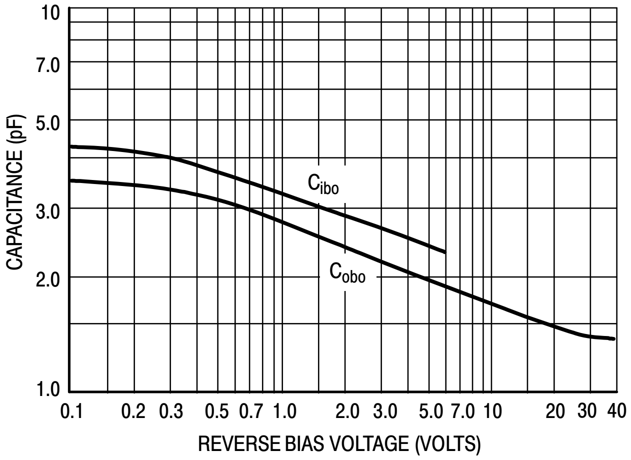


Figure 3. Capacitance

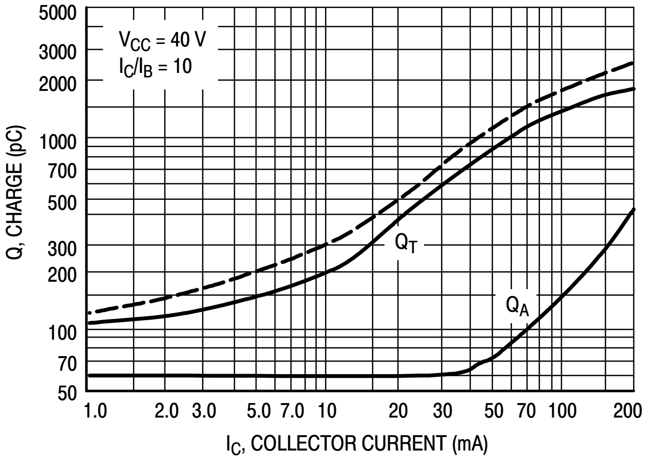


Figure 4. Charge Data

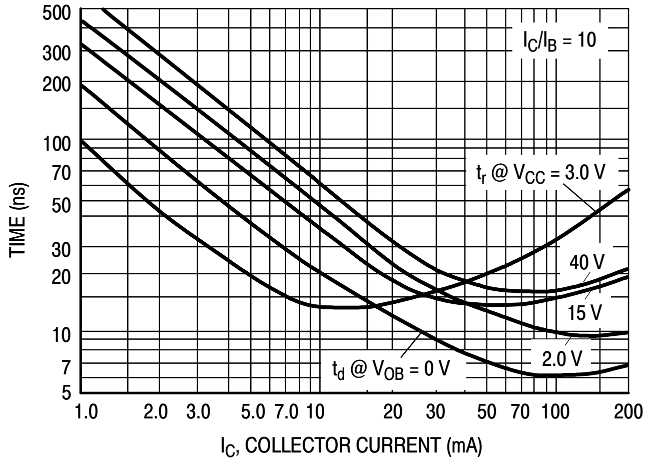


Figure 5. Turn – On Time

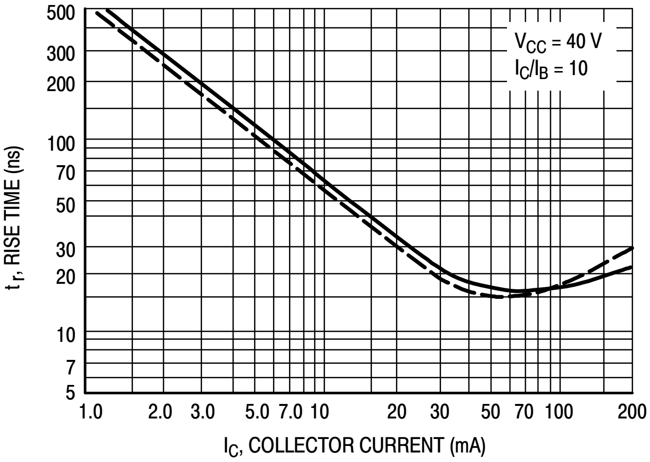


Figure 6. Rise Time

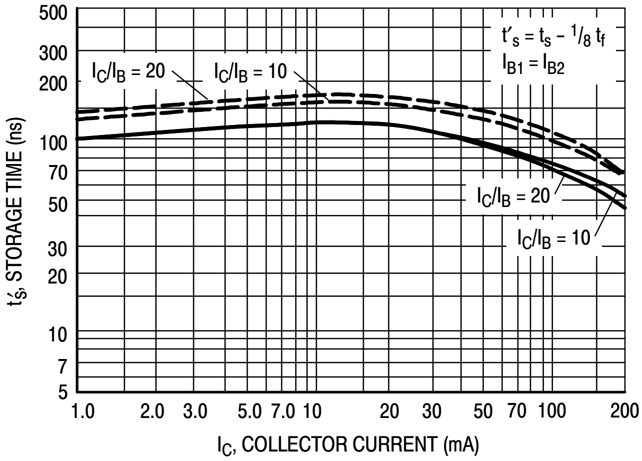


Figure 7. Storage Time

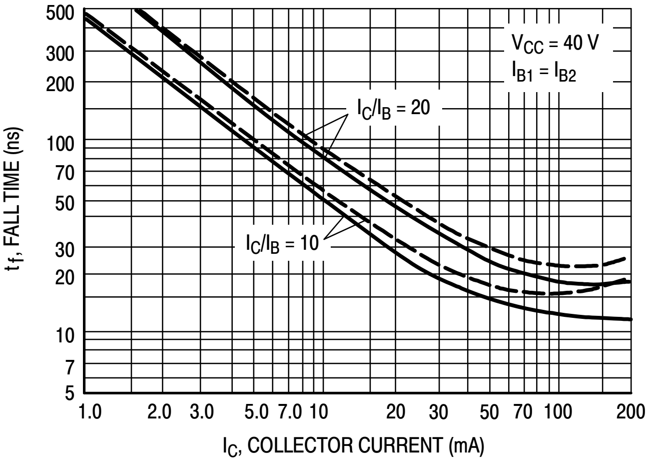


Figure 8. Fall Time

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

(V_{CE} = 5.0 Vdc, T_A = 25°C, Bandwidth = 1.0 Hz)

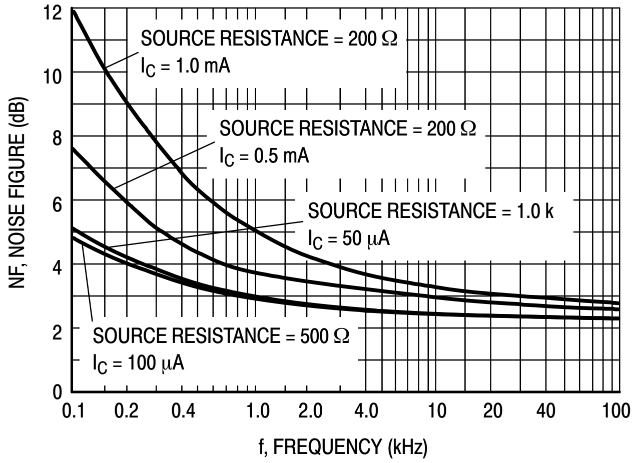


Figure 9.

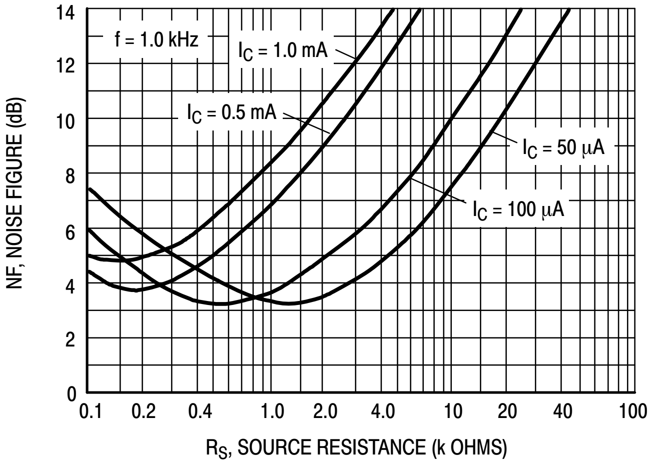


Figure 10.

h PARAMETERS

(V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C)

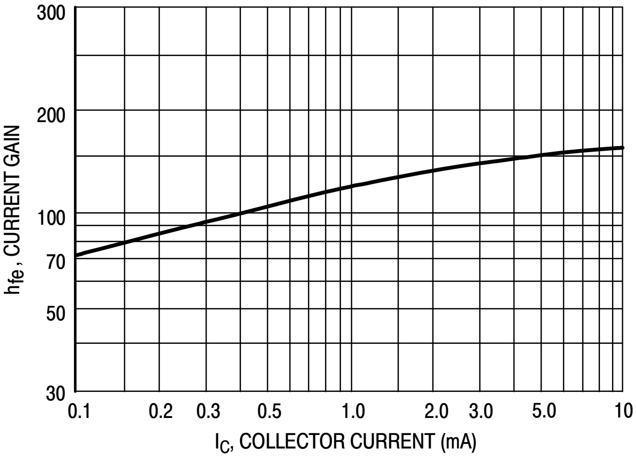


Figure 11. Current Gain

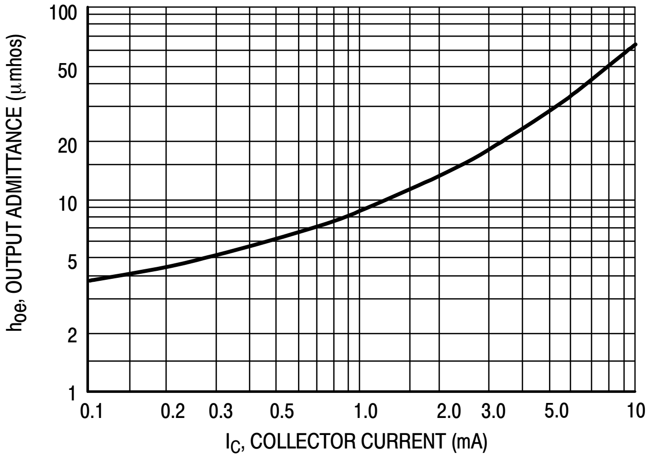


Figure 12. Output Admittance

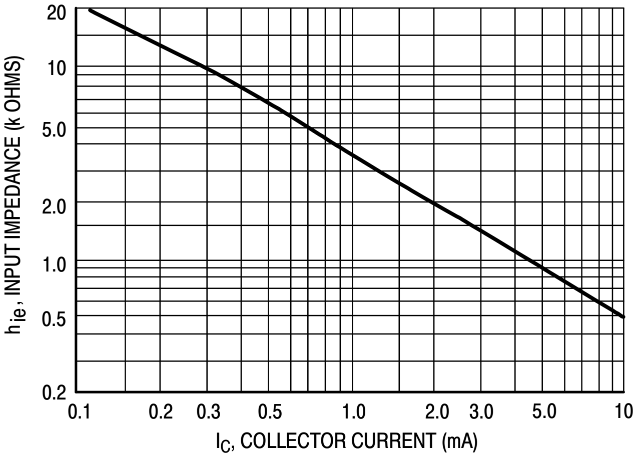


Figure 13. Input Impedance

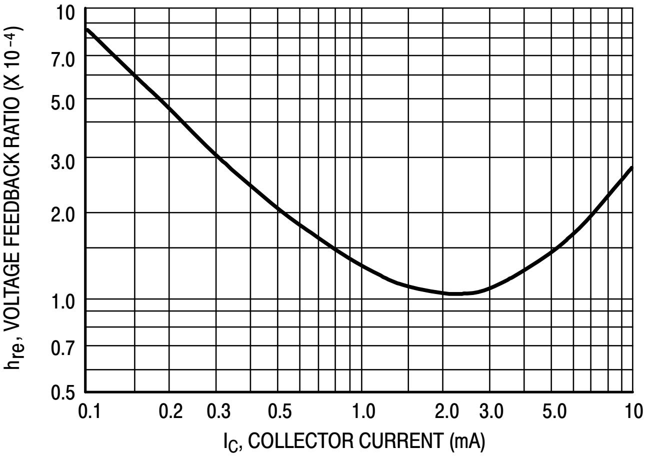


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

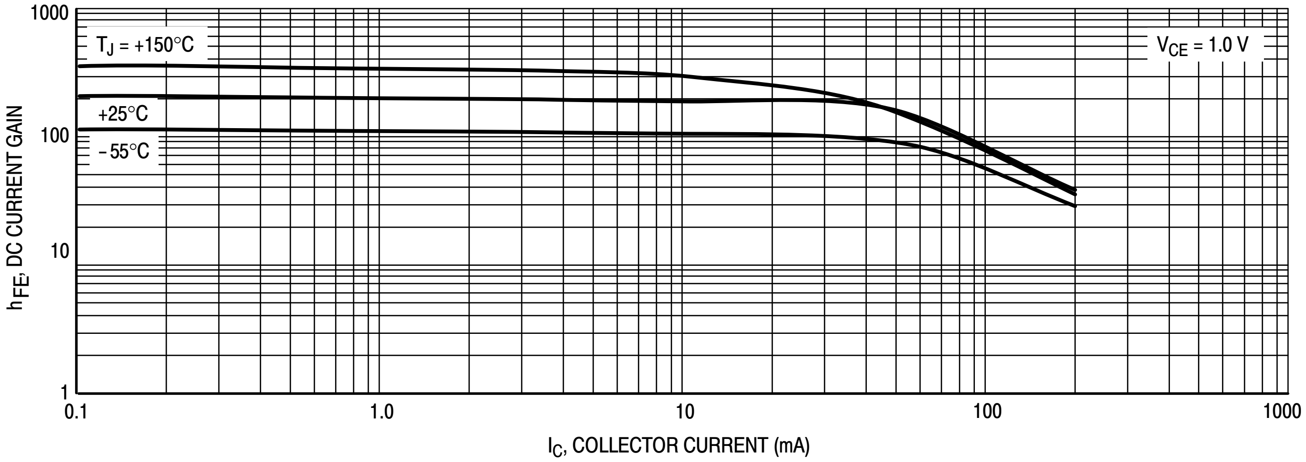


Figure 15. DC Current Gain

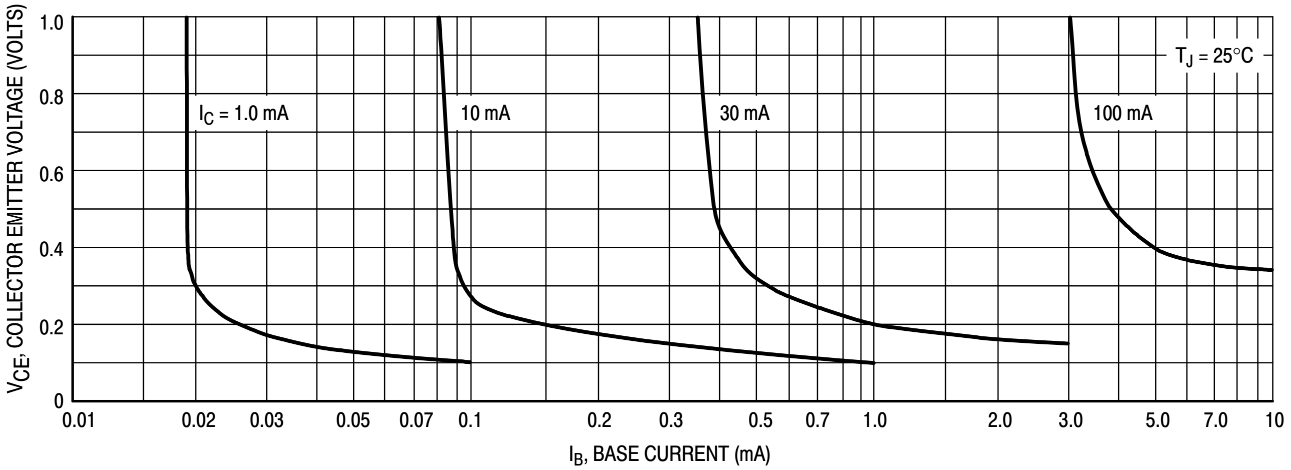


Figure 16. Collector Saturation Region

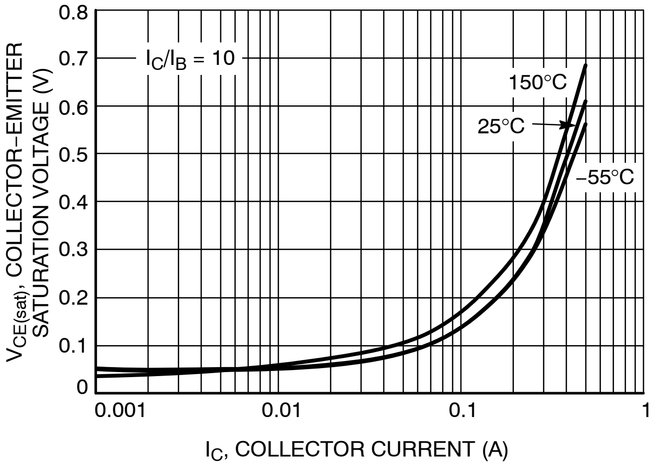


Figure 17. Collector Emitter Saturation Voltage vs. Collector Current

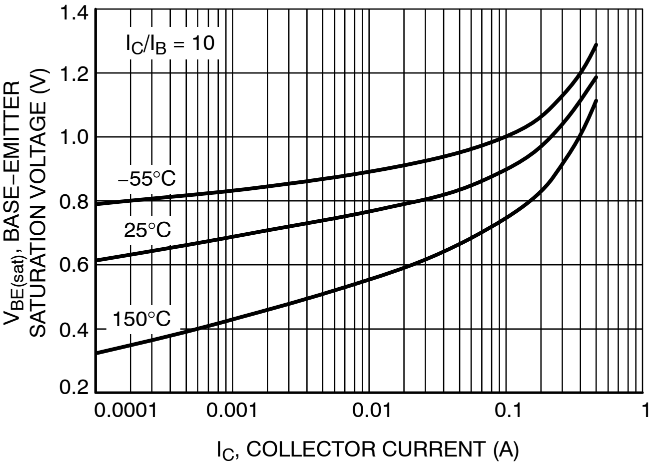


Figure 18. Base Emitter Saturation Voltage vs. Collector Current

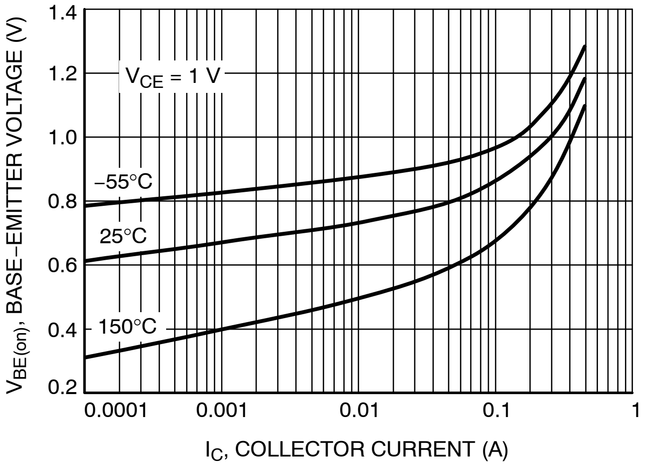


Figure 19. Base Emitter Voltage vs. Collector Current

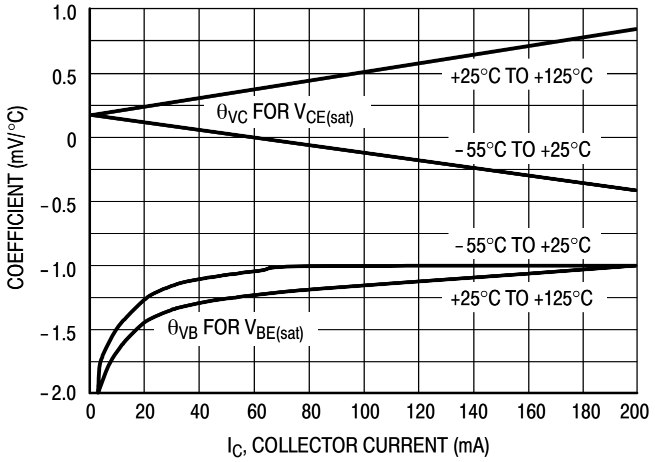


Figure 20. Temperature Coefficients

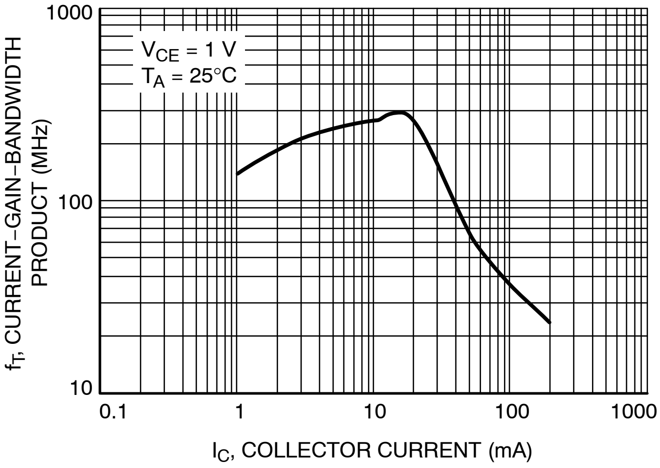


Figure 21. Current Gain Bandwidth vs. Collector Current

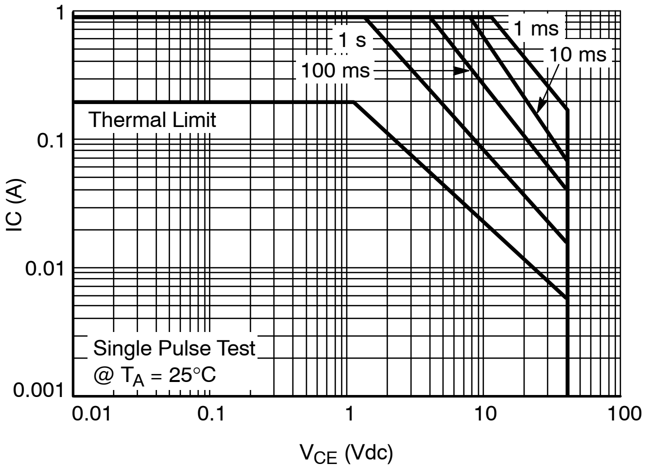


Figure 22. Safe Operating Area

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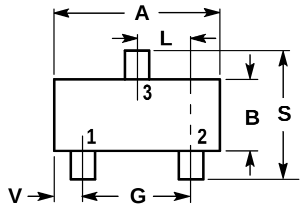

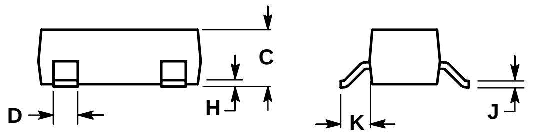

NOTES:

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