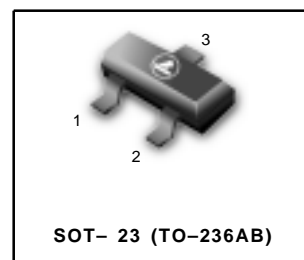


# Low Noise Transistor

## PNP Silicon

- We declare that the material of product compliance with RoHS requirements.

### LMBT5087LT1G



### ORDERING INFORMATION

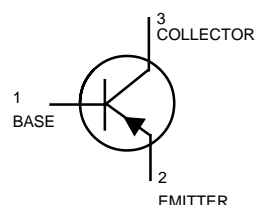
Device	Marking	Shipping
LMBT5087LT1G	2Q	3000/Tape & Reel
LMBT5087LT3G	2Q	10000/Tape & Reel

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	- 50	Vdc
Collector–Base Voltage	$V_{CBO}$	- 50	Vdc
Emitter–Base Voltage	$V_{EBO}$	- 3.0	Vdc
Collector Current — Continuous	$I_C$	- 50	mAdc

### DEVICE MARKING

LMBT5087LT1G =2Q



### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation RF-5 Board (1) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	225	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C/W}$
Total Device Dissipation Alumina Substrate, (2) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C/W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55to+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 ( $I_C = -1.0\text{ mAdc}, I_E = 0$ )	$V_{(BR)CEO}$	- 50	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = -100\ \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	- 50	—	Vdc
Collector Cutoff Current ( $V_{CB} = -10\text{ Vdc}, I_E = 0$ ) ( $V_{CB} = -35\text{ Vdc}, I_E = 0$ )	$I_{CBO}$	—	-10 -50	n Adc

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.

**LMBT5087LT1G**
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
<b>DC CHARACTERISTICS</b>				
DC Current Gain ( $I_C = -100\mu\text{Adc}$ , $V_{CE} = -5.0\text{ Vdc}$ )	$h_{FE}$	250	800	—
( $I_C = -1.0\text{ mAdc}$ , $V_{CE} = -5.0\text{ Vdc}$ )		250	—	
( $I_C = -10\text{ mAdc}$ , $V_{CE} = -5.0\text{ Vdc}$ )		250	—	
Collector–Emitter Saturation Voltage ( $I_C = -10\text{ mAdc}$ , $I_B = -1.0\text{ mAdc}$ )	$V_{CE(sat)}$	—	-0.3	Vdc
Base–Emitter Saturation Voltage ( $I_C = -10\text{ mAdc}$ , $I_B = -1.0\text{ mAdc}$ )	$V_{BE(sat)}$	—	-0.85	Vdc

**SMALL–SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product ( $I_C = -500\mu\text{Adc}$ , $V_{CE} = -5.0\text{ Vdc}$ , $f = 20\text{ MHz}$ )	$f_T$	40	—	MHz
Output Capacitance ( $V_{CB} = -5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	—	4.0	pF
Small–Signal Current Gain ( $I_C = -1.0\text{ mAdc}$ , $V_{CE} = -5.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	250	900	—
Noise Figure ( $I_C = -20\text{ mAdc}$ , $V_{CE} = -5.0\text{ Vdc}$ , $R_S = 10\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	NF	—	2.0	dB
( $I_C = -100\mu\text{Adc}$ , $V_{CE} = -5.0\text{ Vdc}$ , $R_S = 3.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )		—	2.0	

### LMBT5087LT1G

#### TYPICAL NOISE CHARACTERISTICS

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

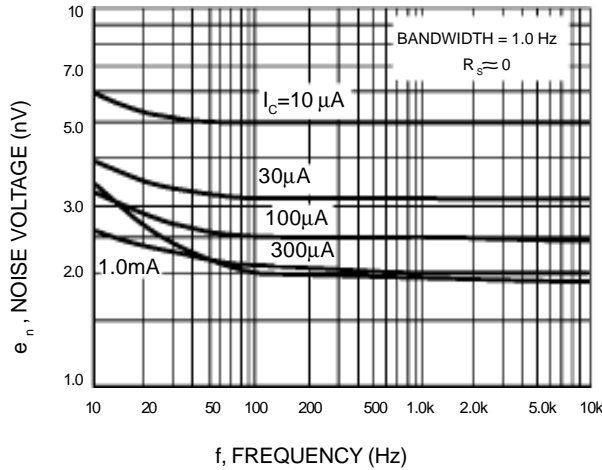


Figure 1. Noise Voltage

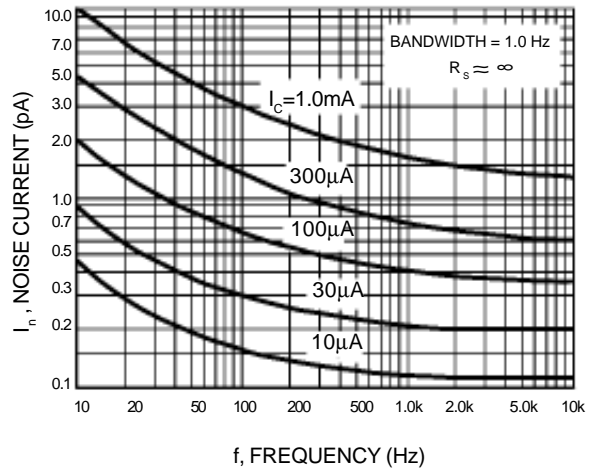


Figure 2. Noise Current

#### NOISE FIGURE CONTOURS

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

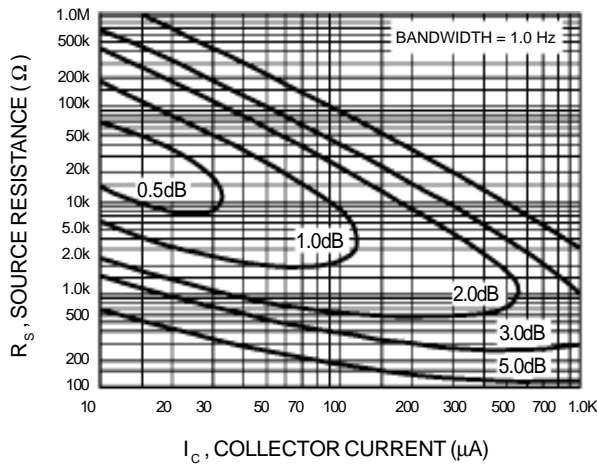


Figure 3. Narrow Band, 100 Hz

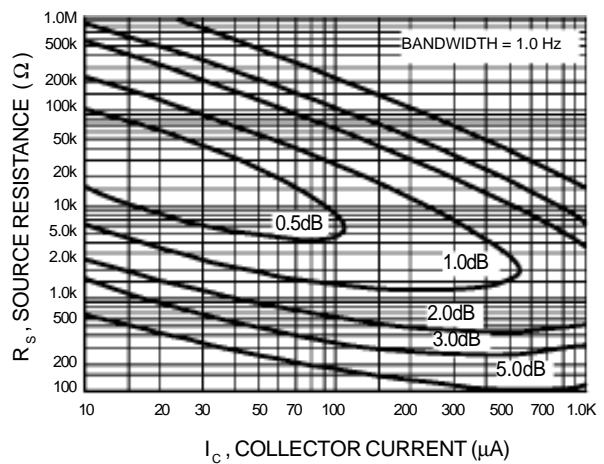


Figure 4. Narrow Band, 1.0 kHz

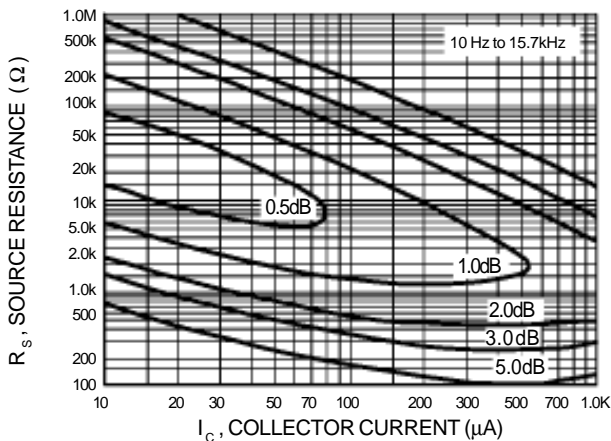


Figure 5. Wideband

Noise Figure is Defined as:

$$NF = 20 \log_{10} \left( \frac{e_n^2 + 4KTR_s + I_n^2 R_s^2}{4KTR_s} \right)^{1/2}$$

$e_n$  = Noise Voltage of the Transistor referred to the input. (Figure 3)

$I_n$  = Noise Current of the Transistor referred to the input. (Figure 4)

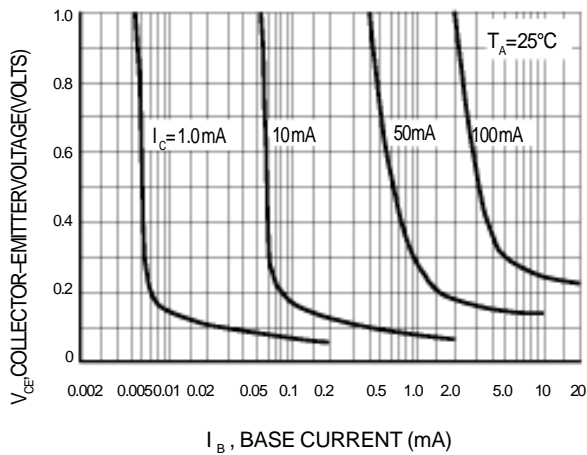
$K$  = Boltzman's Constant ( $1.38 \times 10^{-23}$  J/°K)

$T$  = Temperature of the Source Resistance (°K)

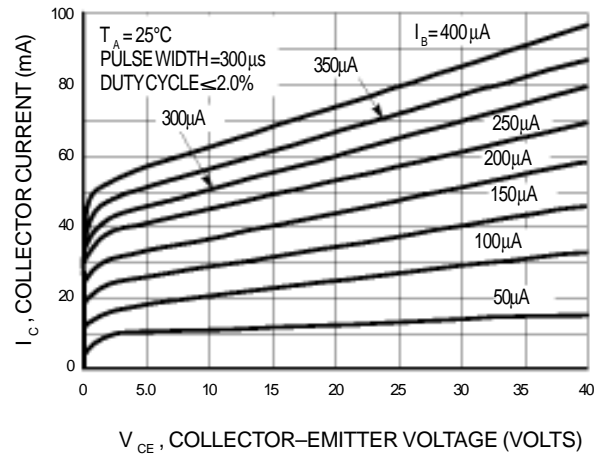
$R_s$  = Source Resistance ( $\Omega$ )

**LMBT5087LT1G**

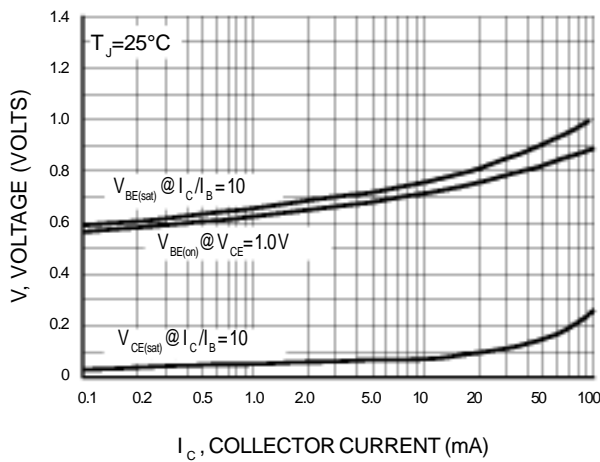
**TYPICAL STATIC CHARACTERISTICS**



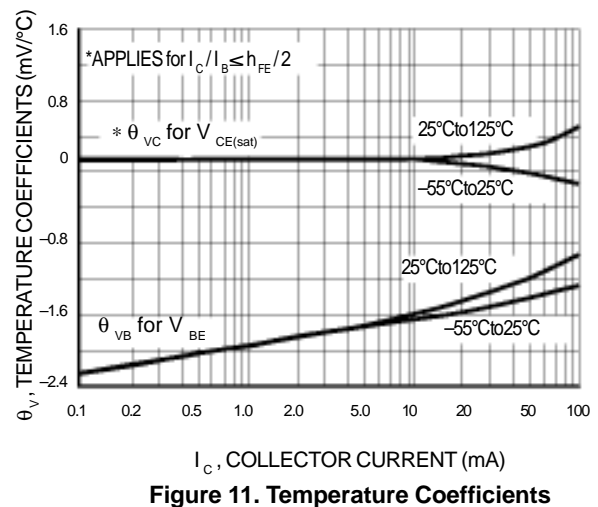
**Figure 6. Collector Saturation Region**



**Figure 7. Collector Characteristics**



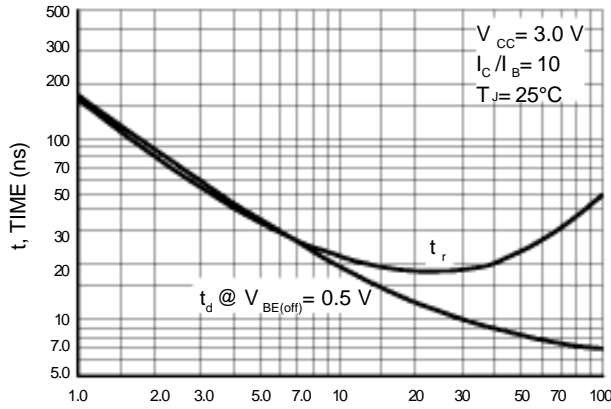
**Figure 10. "On" Voltages**



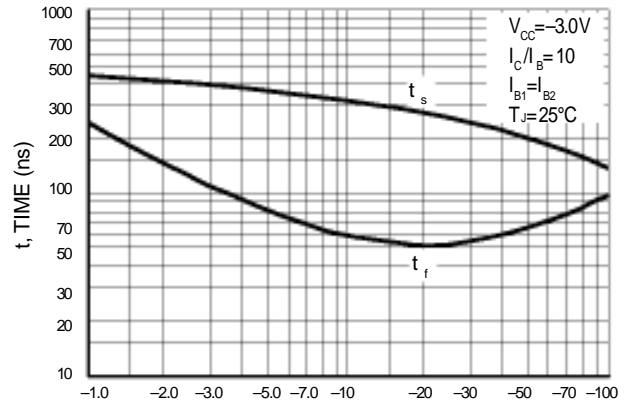
**Figure 11. Temperature Coefficients**

**LMBT5087LT1G**

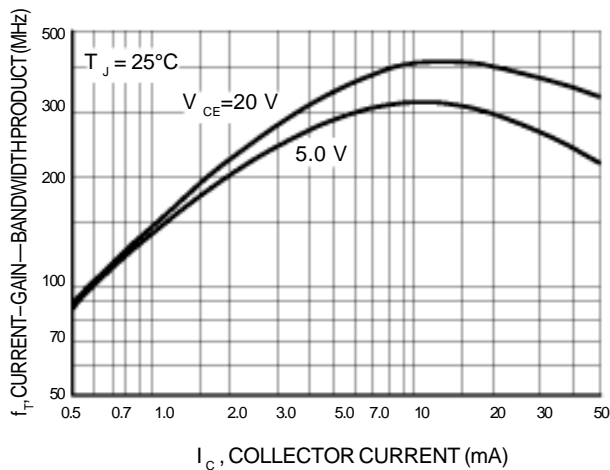
**TYPICAL DYNAMIC CHARACTERISTICS**



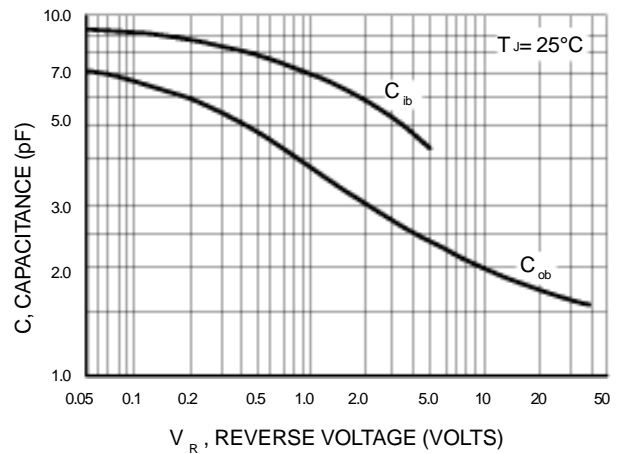
**Figure 10. Turn-On Time**



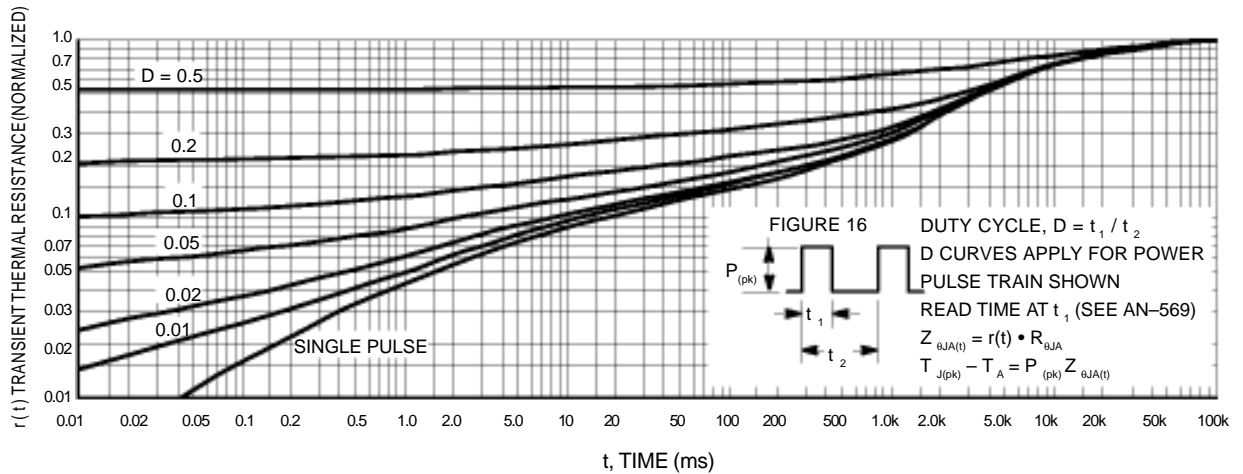
**Figure 11. Turn-Off Time**



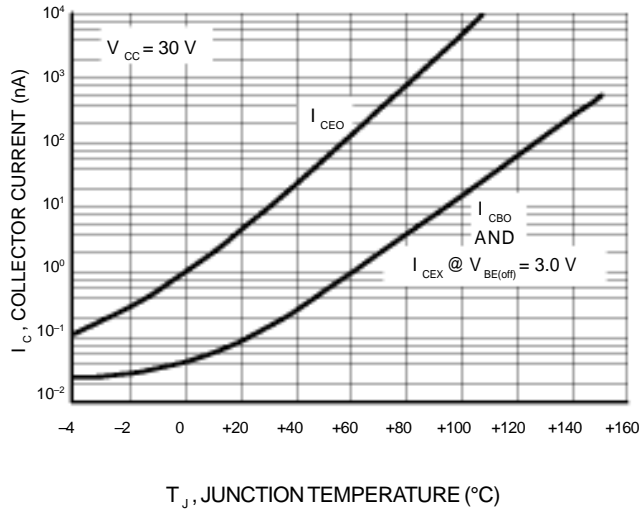
**Figure 12. Current-Gain — Bandwidth Product**



**Figure 13. Capacitance**



**Figure 14. Thermal Response**

**LMBT5087LT1G**


**Figure 15. Typical Collector Leakage Current**

**DESIGN NOTE: USE OF THERMAL RESPONSE DATA**

A train of periodical power pulses can be represented by the model as shown in Figure 16. Using the model and the device thermal response the normalized effective transient thermal resistance of Figure 14 was calculated for various duty cycles.

To find  $Z_{\theta JA(t)}$ , multiply the value obtained from Figure 14 by the steady state value  $R_{\theta JA}$ .

Example:

Dissipating 2.0 watts peak under the following conditions:

$t_1 = 1.0\text{ ms}$ ,  $t_2 = 5.0\text{ ms}$ . ( $D = 0.2$ )

Using Figure 16 at a pulse width of 1.0 ms and  $D = 0.2$ , the reading of  $r(t)$  is 0.22.

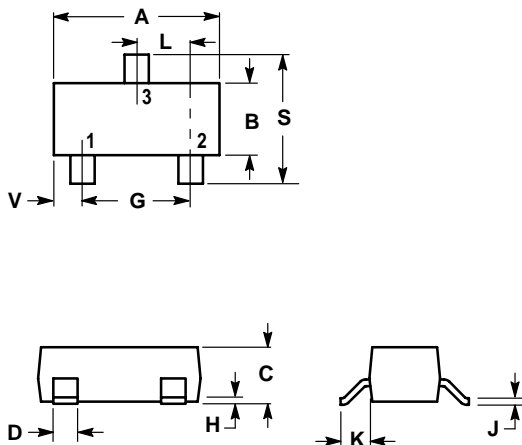
The peak rise in junction temperature is therefore

$$\Delta T = r(t) \times P_{(pk)} \times R_{\theta JA} = 0.22 \times 2.0 \times 200 = 88^\circ\text{C}.$$

For more information, see AN-569.

**LMBT5087LT1G**
**SOT-23**
**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

