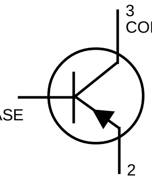
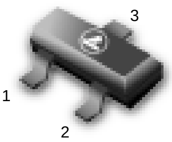
Low Noise Transistor

PNP Silicon

MMBT5087LT1





CASE 318–08, STYLE 6
SOT– 23 (TO–236AB)

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

MMBT5087LT=2Q

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation RF-5 Board (1) T_A=25 °C Derate above 25°C	P_D	225 1.8	mW mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate, (2) T_A = 25°C Derate above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature	T_J, T_{stg}	–55to+150	°C

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (I_C = –1.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	– 50	—	Vdc
Collector–Base Breakdown Voltage (I_C = –100 µAdc, I_E = 0)	$V_{(BR)CBO}$	– 50	—	Vdc
Collector Cutoff Current	I_{CBO}			n Adc
(V_{CB} = –10 Vdc, I_E= 0)		—	–10	
(V_{CB} = –35 Vdc, I_E= 0)		—	–50	

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.

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

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS				
DC Current Gain	h_{FE}			—
(I_C = –100µAdc, V_{CE} = –5.0 Vdc)		250	800	
(I_C = –1.0 mAdc, V_{CE} = –5.0 Vdc)		250	—	
(I_C = –10 mAdc, V_{CE} = –5.0 Vdc)		250	—	
Collector–Emitter Saturation Voltage (I_C = –10 mAdc, I_B = –1.0 mAdc)	$V_{CE(sat)}$	—	– 0.3	Vdc
Base–Emitter Saturation Voltage (I_C = –10 mAdc, I_B = –1.0 mAdc)	$V_{BE(sat)}$	—	– 0.85	Vdc
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain — Bandwidth Product (I_C = –500 µAdc, V_{CE}= –5.0 Vdc, f = 20 MHz)	f_T	40	—	MHz
Output Capacitance (V_{CB}= –5.0 Vdc, I_E = 0, f = 1.0 MHz)	C_{obo}	—	4.0	pF
Small–Signal Current Gain (I_C= –1.0mAdc, V_{CE} = –5.0Vdc, f = 1.0 kHz)	h_{fe}	250	900	—
Noise Figure	NF			dB
(I_C = –20 mAdc, V_{CE}= –5.0 Vdc, R_S=10kΩ, f = 1.0 kHz)		—	2.0	
(I_C = –100µAdc, V_{CE}= –5.0 Vdc, R_S=3.0kΩ, f = 1.0 kHz)		—	2.0	

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TYPICAL NOISE CHARACTERISTICS

(V_{CE} = – 5.0 Vdc, T_A = 25°C)

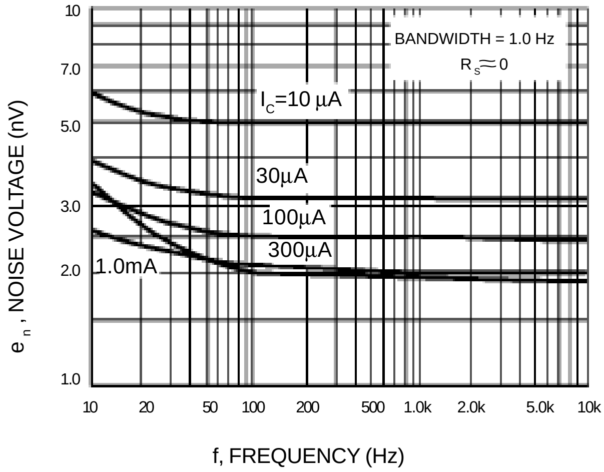

Figure 1. Noise Voltage

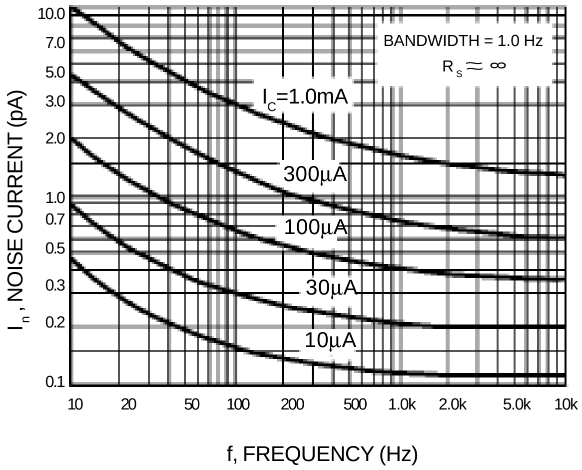

Figure 2. Noise Current

NOISE FIGURE CONTOURS

(V_{CE} = – 5.0 Vdc, T_A = 25°C)

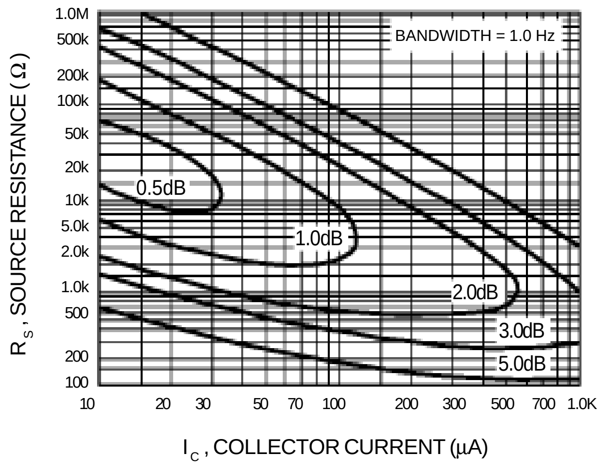

Figure 3. Narrow Band, 100 Hz

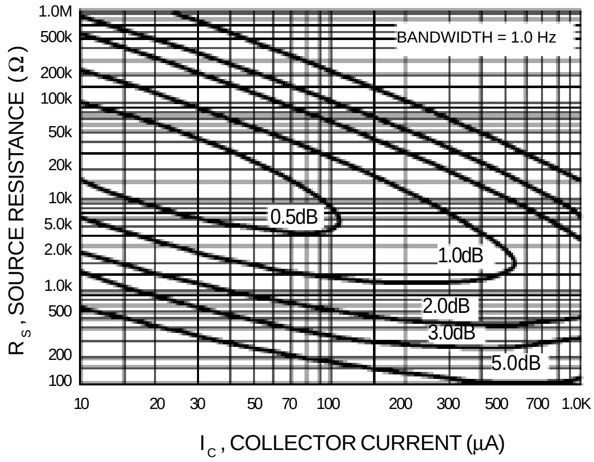

Figure 4. Narrow Band, 1.0 kHz

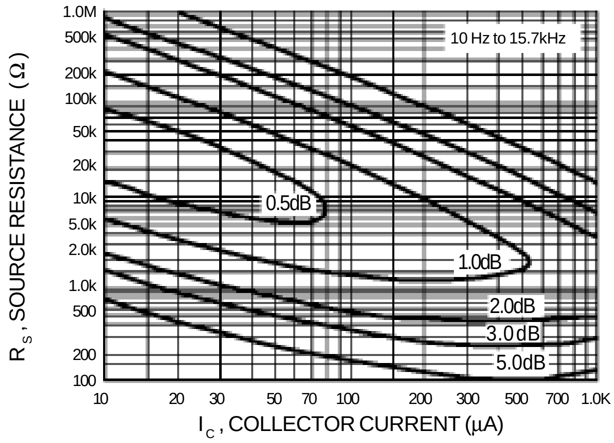

Figure 5. Wideband

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 x 10^{-23} j/°K)
T = Temperature of the Source Resistance (°K)
R_S = Source Resistance (Ω)

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TYPICAL STATIC CHARACTERISTICS

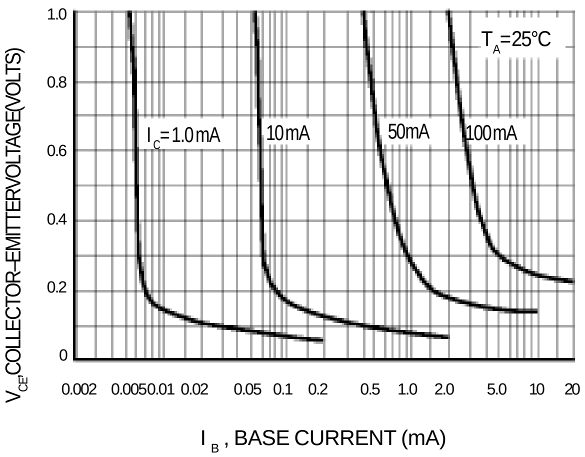

Figure 6. Collector Saturation Region

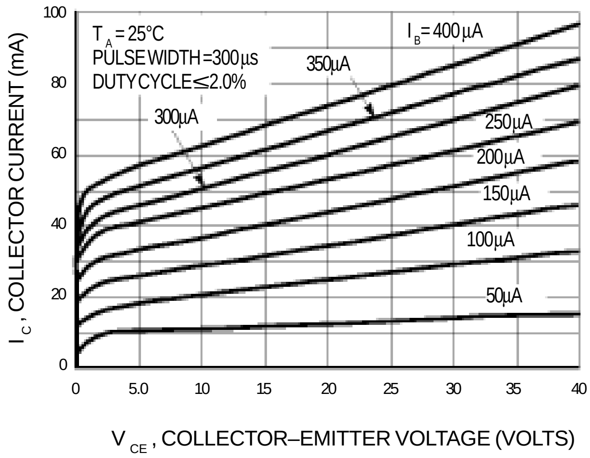

Figure 7. Collector Characteristics

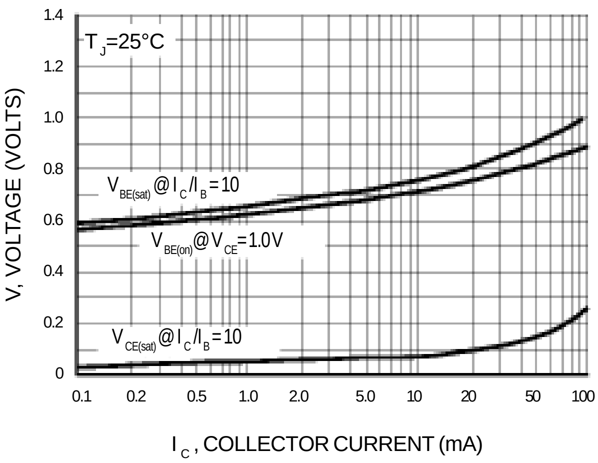

Figure 10. "On" Voltages

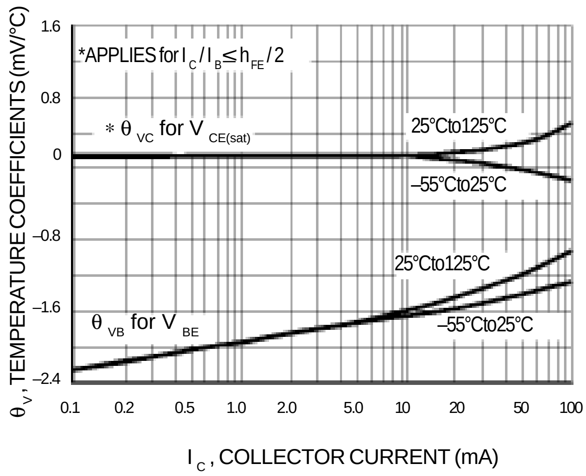

Figure 11. Temperature Coefficients

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TYPICAL DYNAMIC CHARACTERISTICS

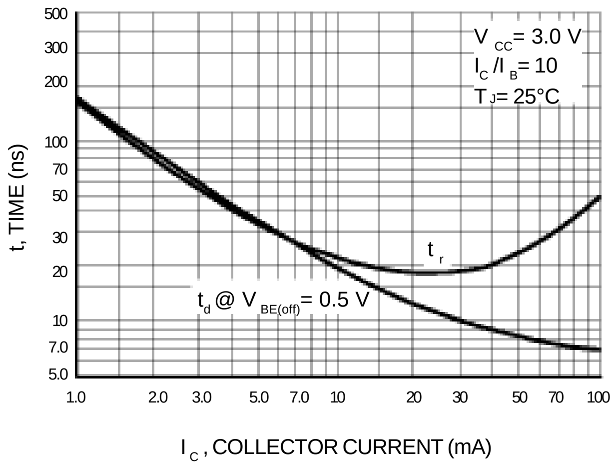

Figure 10. Turn–On Time

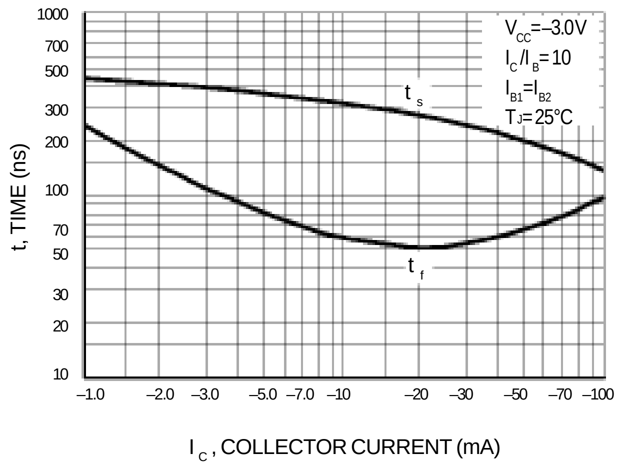

Figure 11. Turn–Off Time

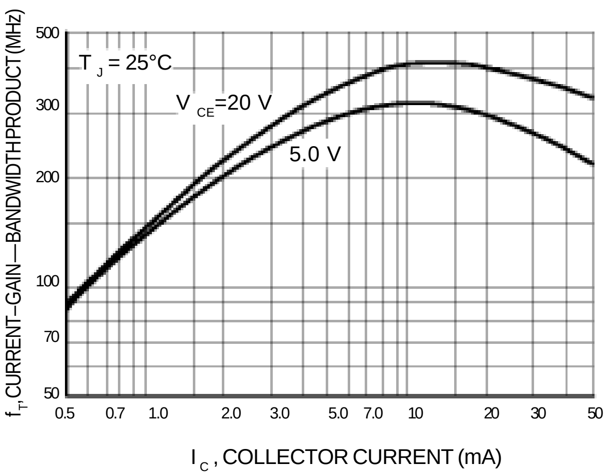

Figure 12. Current–Gain — Bandwidth Product

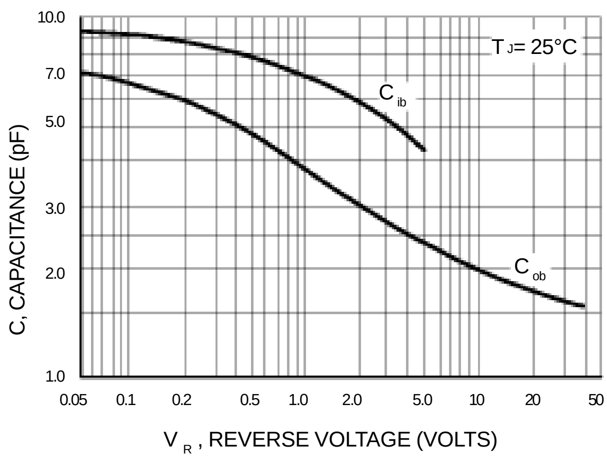

Figure 13. Capacitance

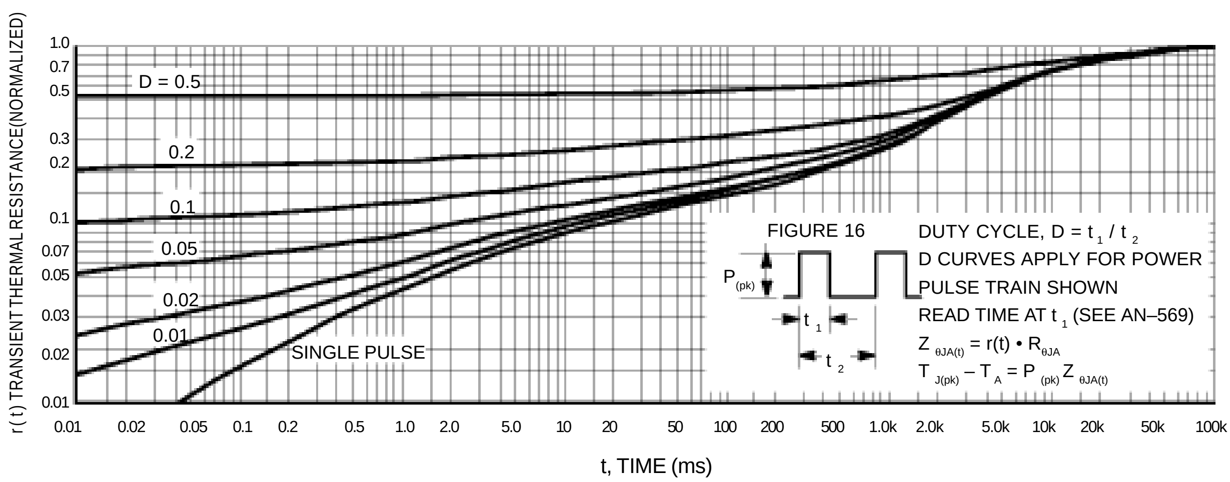

Figure 14. Thermal Response

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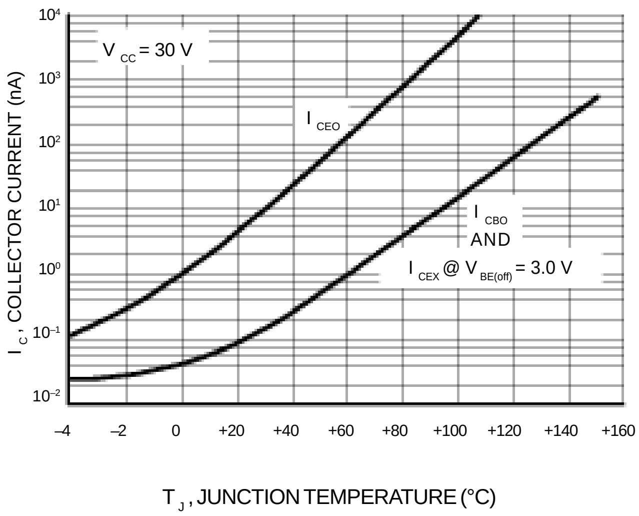

Figure 15. Typical Collector Leakage Current

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 ms, t_2 = 5.0 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

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

For more information, see AN–569.