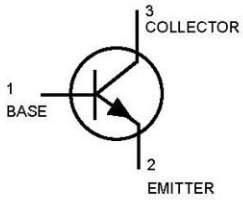
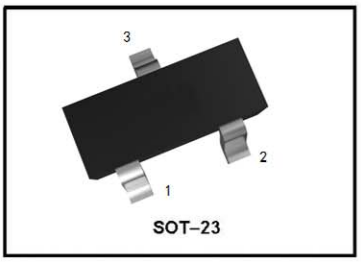
MMBT3904

NPN Silicon





● 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	165	mW
Derate above 25°C		1.3	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	745	°C/W
Total Device Dissipation Alumina Substrate, (2) T_A = 25°C	P_D	200	mW
Derate above 25°C		1.6	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	625	°C/W
Junction and Storage Temperature	T_J , T_{stg}	–55 to +150	°C

● DEVICE MARKING

MMBT3904 = 1AM

● 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, I_B = 0)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage (I_C = 10 µAdc, I_E = 0)	$V_{(BR)CBO}$	60	—	Vdc
Emitter–Base Breakdown Voltage (I_E = 10 µAdc, I_C = 0)	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current (V_{CE}= 30 Vdc, V_{EB} = 3.0 Vdc,)	I_{BL}	—	100	nAdc
Collector Cutoff Current (V_{CE} = 30Vdc, I_{EB} = 3.0Vdc)	I_{CEX}	—	100	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	

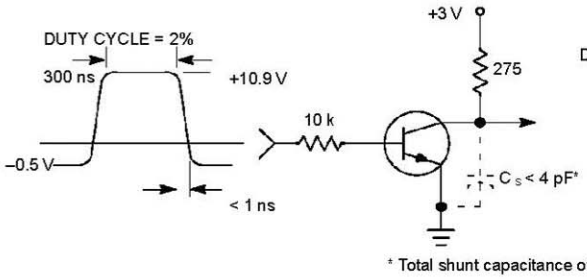
● **SMALL–SIGNAL CHARACTERISTICS**

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 (V_{EB}= 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	pF
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	θmhos
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} = 10 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

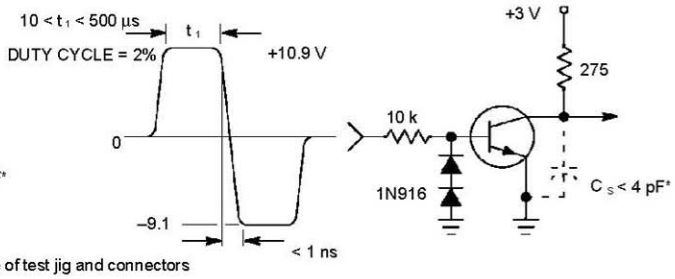


Figure 2. Storage and Fall Time Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

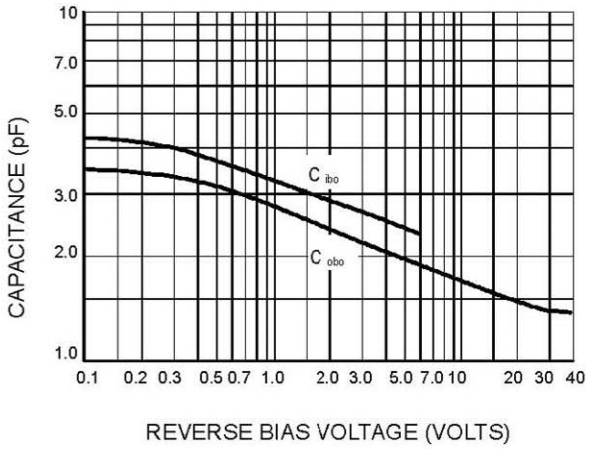


Figure 3. Capacitance

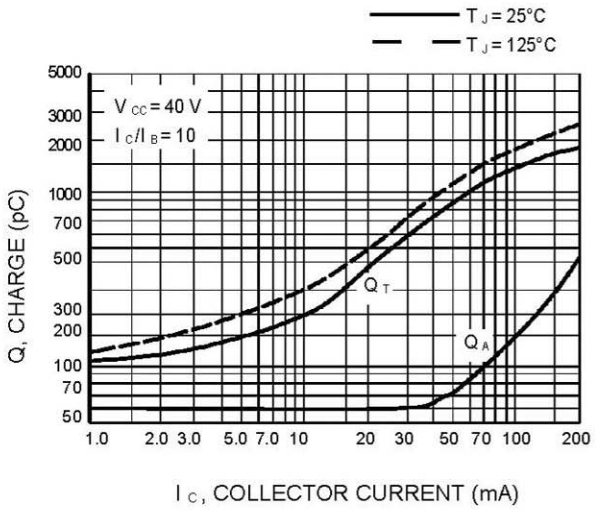


Figure 4. Charge Data

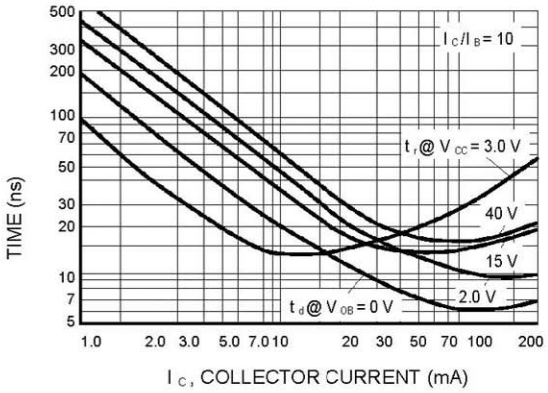


Figure 5. Turn–On Time

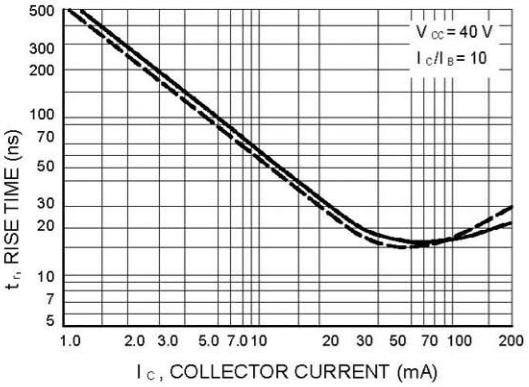


Figure 6. Rise Time

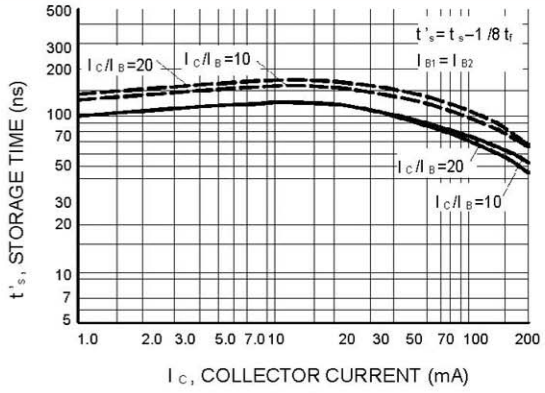


Figure 7. Storage Time

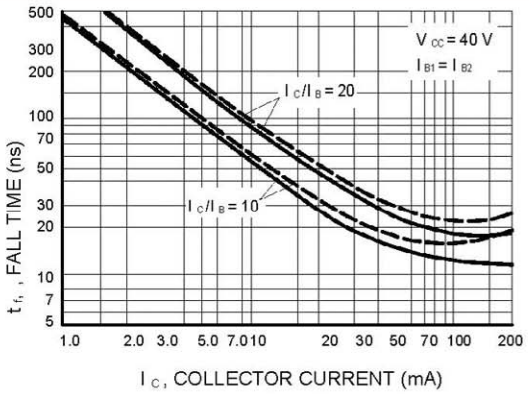


Figure 8. Fall Time

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

(V CE = 5.0 Vdc, T A = 25°C, Bandwidth = 1.0 Hz)

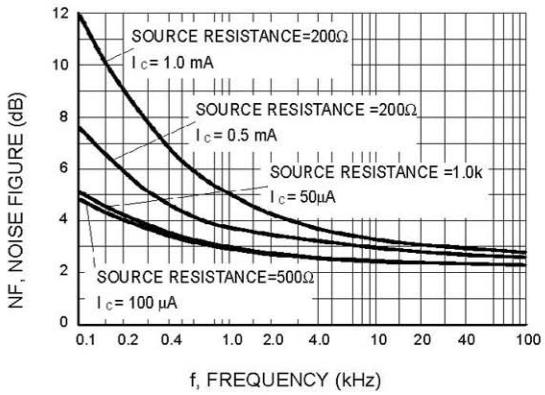


Figure 9.

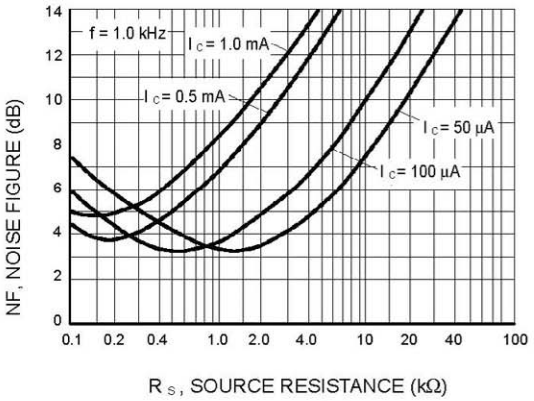


Figure 10.

h PARAMETERS

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

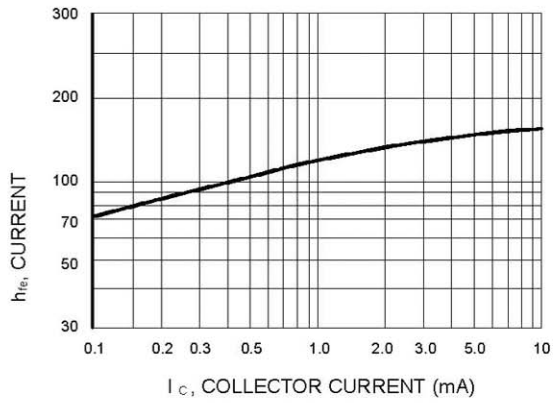


Figure 11. Current Gain

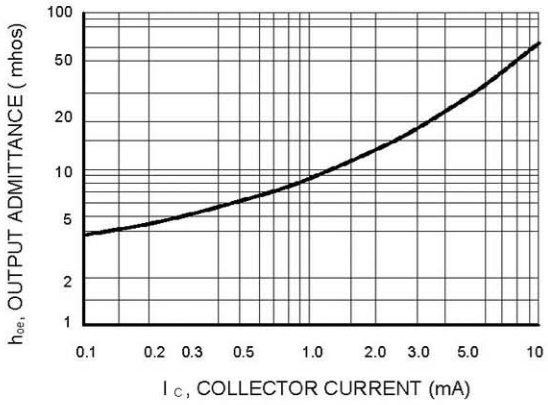


Figure 12. Output Admittance

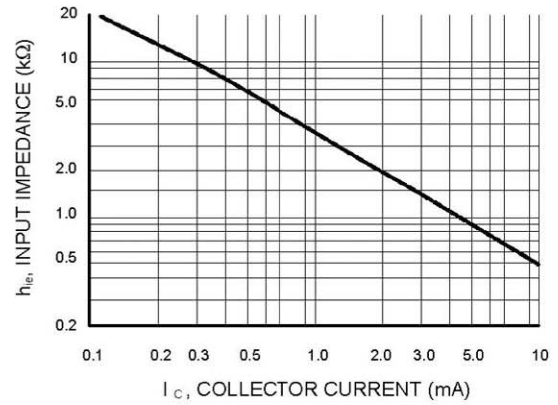


Figure 13. Input Impedance

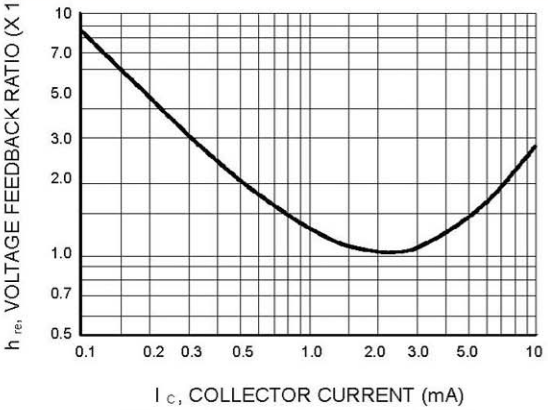


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

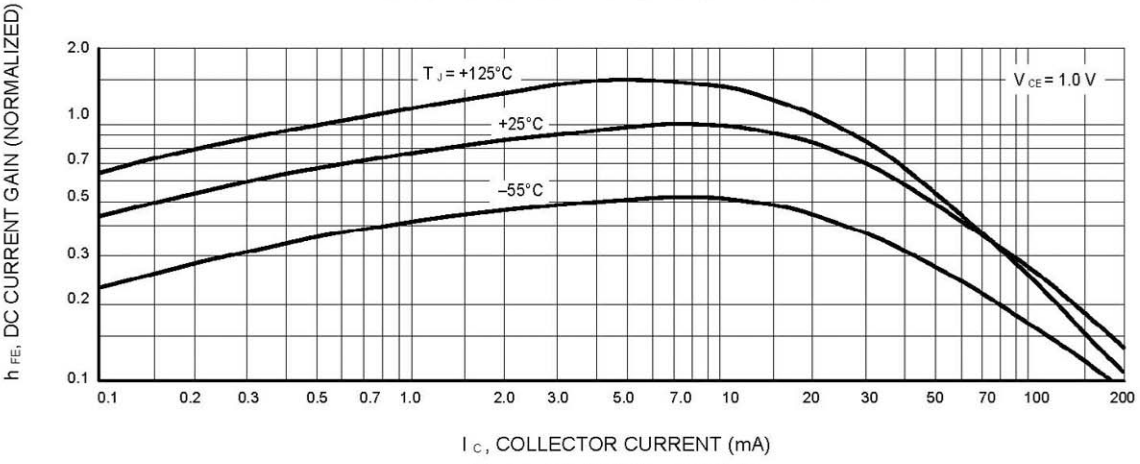


Figure 15. DC Current Gain

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