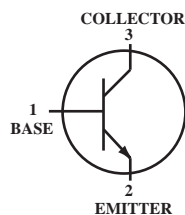


General Purpose NPN Silicon Transistor

 Lead(Pb)-Free



SC-89
SOT-523F

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

Characteristics	Symbol	Max	Unit
Total Device Dissipation FR-5 Board ⁽¹⁾ T _A =25°C Derate above 25°C	P _D	200	mW
Thermal Resistance, Junction to Ambient	R _{θJA}	1.6	mW/°C
Thermal Resistance, Junction to Ambient	R _{θJA}	600	°C/W
Total Device Dissipation Alumina Substrate, ⁽²⁾ T _A =25°C Derate above 25°C	P _D	300	mW
Thermal Resistance, Junction to Ambient	R _{θJA}	2.4	mW/°C
Thermal Resistance, Junction to Ambient	R _{θJA}	400	°C/W
Junction Temperature	T _J	-55 to +150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

Device Marking

MMBT3904T=MA

Electrical Characteristics (T_A=25°C Unless Otherwise noted)

Characteristics	Symbol	Min	Max	Unit
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Off Characteristics

Collector-Emitter Breakdown Voltage ⁽³⁾ (I _C =1.0mA, I _B =0)	V _{(BR)CEO}	40	-	V
Collector-Base Breakdown Voltage (I _C =10 μA, I _E =0)	V _{(BR)CBO}	60	-	V
Emitter-Base Breakdown Voltage (I _E =10 μA, I _C =0)	V _{(BR)EBO}	6.0	-	V
Base Cutoff Current (V _{CE} =30V, V _{EB} =3.0V)	I _{BL}	-	50	nA
Collector Cutoff Current (V _{CE} =30V, V _{EB} =3.0V)	I _{CEX}	-	50	nA

1. FR-4 Minimum Pad.

2. FR-4 1.0 x 1.0 Inch Pad.

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

Electrical Characteristics ($T_A=25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristics	Symbol	Min	Max	Unit
DC Current Gain ($I_C=0.1\text{ mA}, V_{CE}=1.0\text{V}$) ($I_C=1.0\text{ mA}, V_{CE}=1.0\text{V}$) ($I_C=10\text{ mA}, V_{CE}=1.0\text{V}$) ($I_C=50\text{ mA}, V_{CE}=1.0\text{V}$) ($I_C=100\text{ mA}, V_{CE}=1.0\text{V}$)	H_{FE}	40 70 100 60 30	- - 300 - -	-
Collector-Emitter Saturation Voltage ⁽³⁾ ($I_C=10\text{ mA}, I_B=1.0\text{mA}$) ($I_C=50\text{ mA}, I_B=5.0\text{mA}$)	$V_{CE(sat)}$	- -	0.2 0.3	V
Base-Emitter Saturation Voltage ⁽³⁾ ($I_C=10\text{ mA}, I_B=1.0\text{ mA}$) ($I_C=50\text{ mA}, I_B=5.0\text{ mA}$)	$V_{BE(sat)}$	0.65 -	0.85 0.95	V

Small-signal Characteristics

Current-Gain-Bandwidth Product ($I_C=10\text{ mA}, V_{CE}=20\text{ V}, f=100\text{MHz}$)	f_T	200	-	MHz
Output Capacitance ($V_{CB}=5.0\text{ V}, I_E=0, f=1.0\text{MHz}$)	C_{obo}	-	4.0	pF
Input Capacitance ($V_{EB}=0.5\text{ V}, I_C=0, f=1.0\text{MHz}$)	C_{ibo}	-	8.0	pF
Input Impedance ($V_{CE}=10\text{ V}, I_C=1.0\text{ mA}, f=1.0\text{ kHz}$)	h_{ie}	1.0	10	k Ω
Voltage Feedback Ratio ($V_{CE}=10\text{ V}, I_C=1.0\text{ mA}, f=1.0\text{ kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain ($V_{CE}=10\text{ V}, I_C=1.0\text{ mA}, f=1.0\text{ kHz}$)	h_{fe}	100	400	-
Output Admittance ($V_{CE}=10\text{ V}, I_C=1.0\text{ mA}, f=1.0\text{ kHz}$)	h_{oe}	1.0	40	umhos
Noise Figure ($V_{CE}=5.0\text{ V}, I_C=100\text{ }\mu\text{A}, R_S=1.0\text{ k}\Omega, f=1.0\text{ kHz}$)	NF	-	5.0	dB

Switching Characteristics

Delay Time	(V _{cc} = 3.0 V, V _{BE} = 0.5 V I _c = 10 mA, I _{B1} = 1.0 mA)	t _d	-	35	ns
Rise Time		t _r	-	35	
Storage Time	(V _{cc} = 3.0 V, I _c = 10 mA, I _{B1} =I _{B2} = 1.0 mA)	t _s	-	200	ns
Fall Time		t _f	-	50	

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

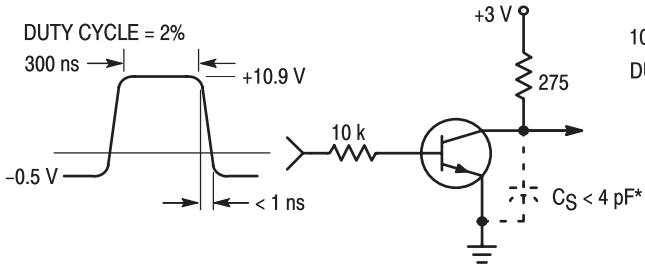


Figure 1. Delay and Rise Time Equivalent Test Circuit

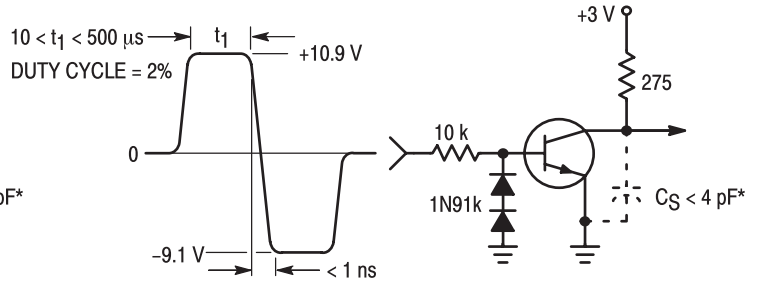


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

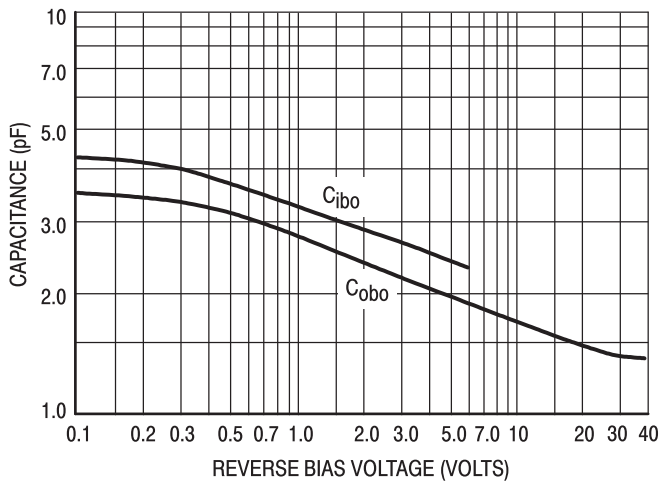


Figure 3. Capacitance

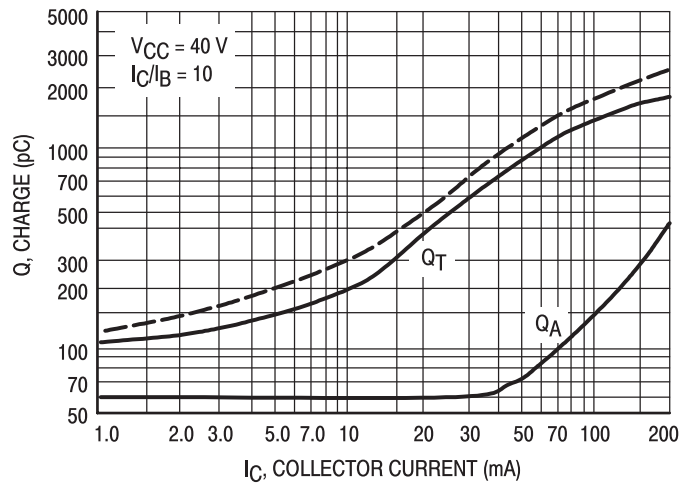


Figure 4. Charge Data

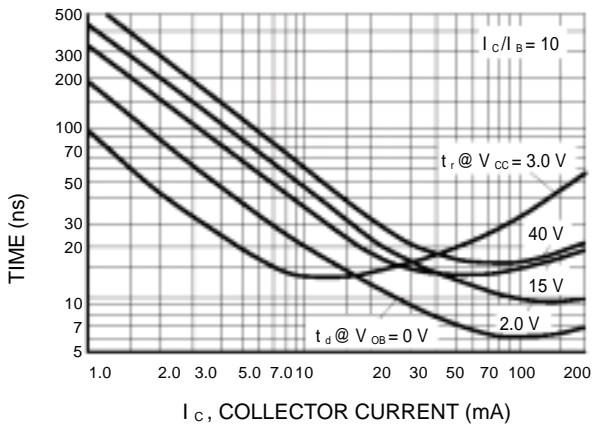


Figure 5. Turn-On Time

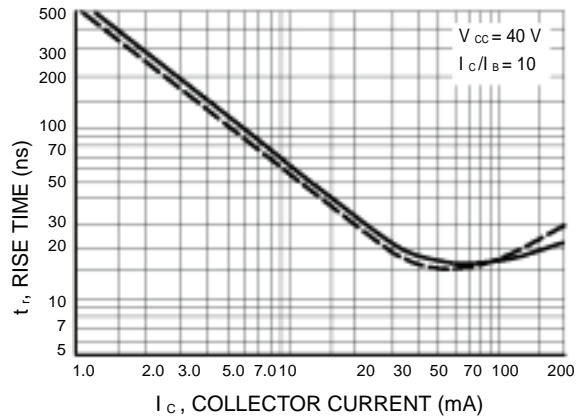


Figure 6. Rise Time

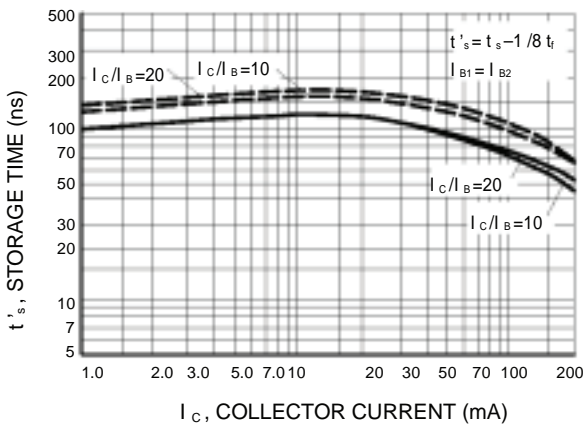


Figure 7. Storage Time

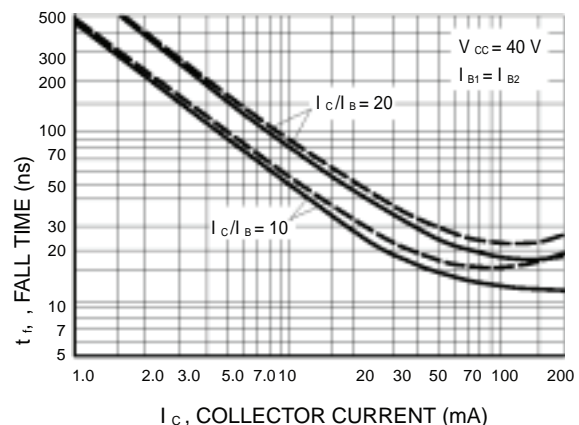


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

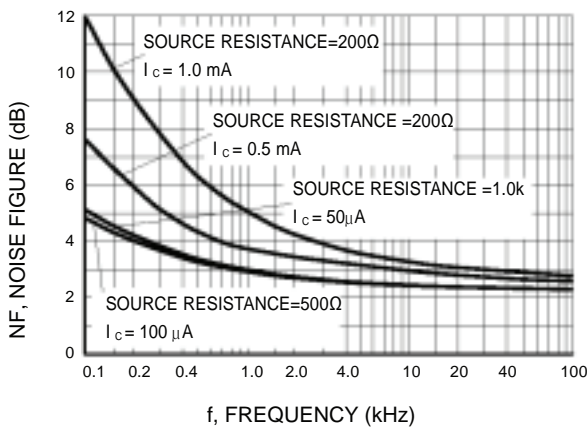


Figure 9.

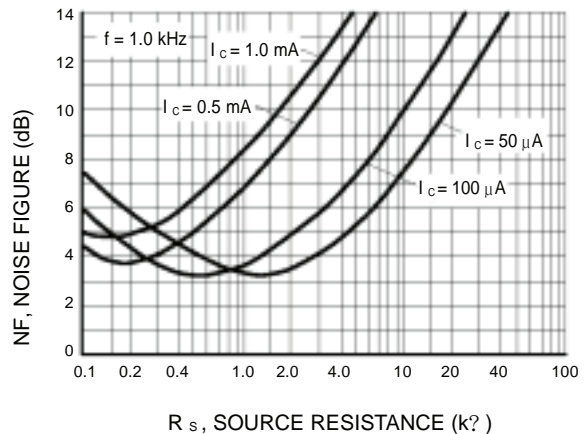


Figure 10.

h PARAMETERS

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

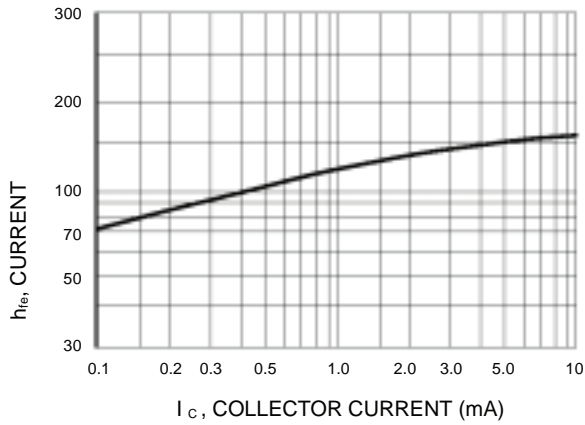


Figure 11. Current Gain

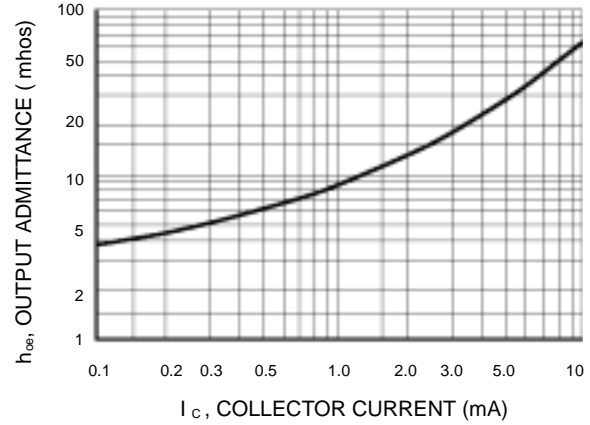


Figure 12. Output Admittance

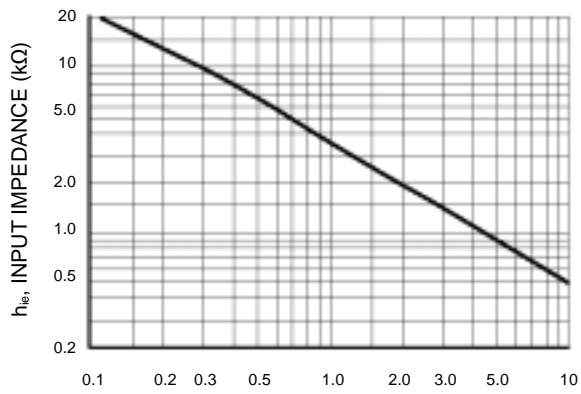


Figure 13. Input Impedance

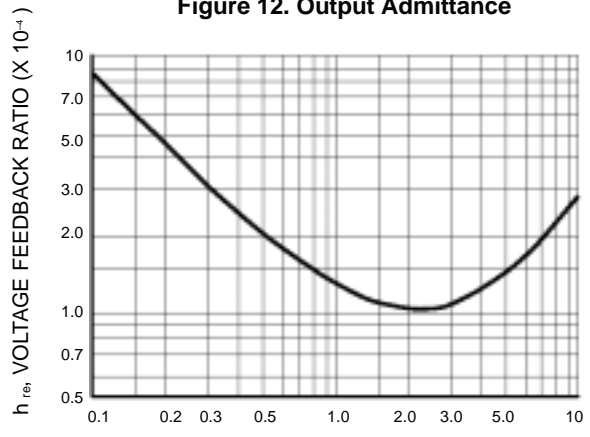


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

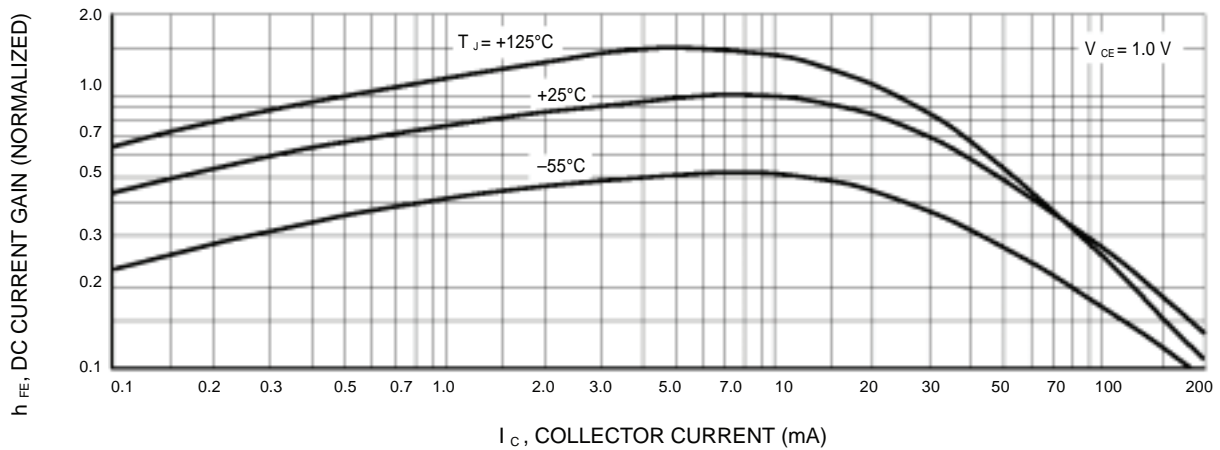


Figure 15. DC Current Gain

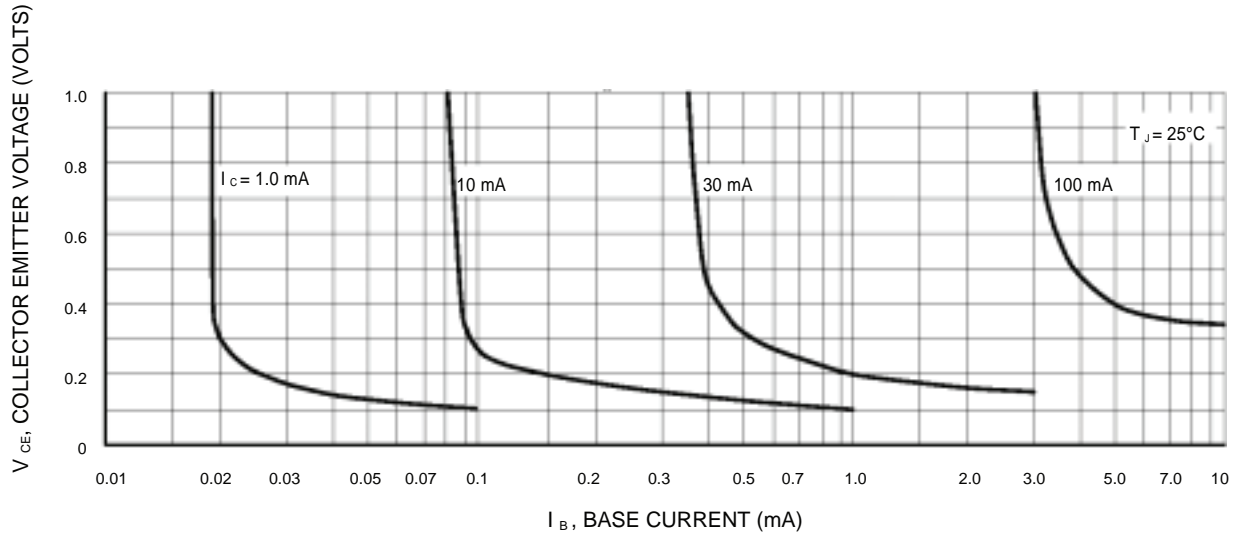


Figure 16. Collector Saturation Region

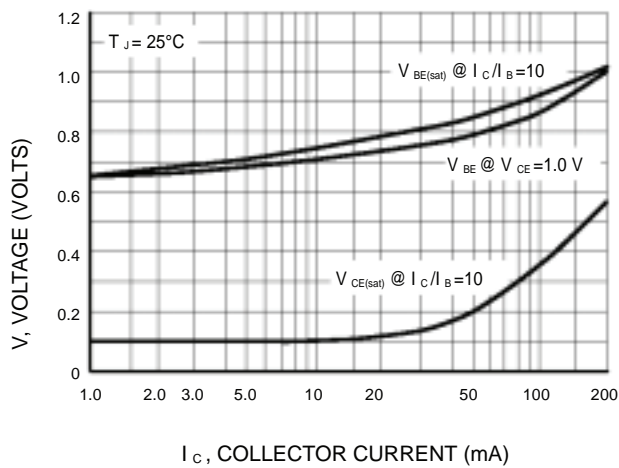


Figure 17. "ON" Voltages

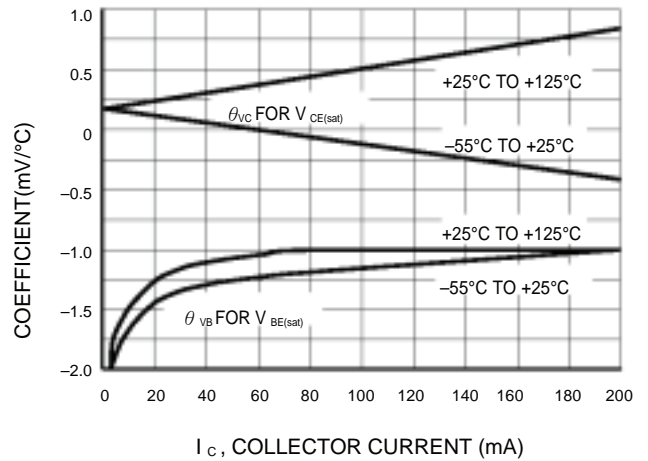


Figure 18. Temperature Coefficients

SC-89 Package Outline Dimensions

Unit:mm

