

**SOT-23 BIPOLAR TRANSISTORS
TRANSISTOR(NPN)**

FEATURES

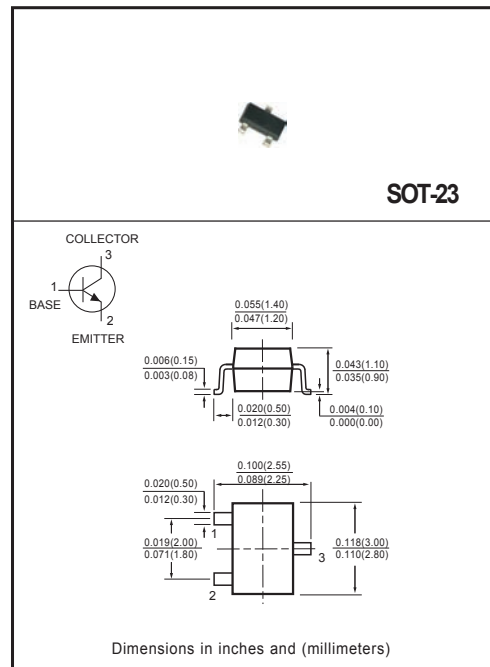
- * Power dissipation
P_{CM} 0.2 W(T_{amb}=25°C)
- * Collector current
I_{CM} 0.2 A
- * Collector-base voltage
V_{(BR)CBO}: 60 V
- * Operating and storage junction temperature range
T_J,T_{stg}: -55°Cto+150°C

MECHANICAL DATA

- * Case: Molded plastic
- * Epoxy: UL 94V-O rate flame retardant
- * Lead: MIL-STD-202E method 208C guaranteed
- * Mounting position: Any
- * Weight: 0.008 gram

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25 °C ambient temperature unless otherwise specified.
Single phase, half wave, 60 Hz, resistive or inductive load.
For capacitive load, derate current by 20%.



MAXIMUM RATINGS (@ T_A = 25°C unless otherwise noted)

RATINGS	SYMBOL	VALUE	UNITS
Max. Steady State Power Dissipation ⁽¹⁾ @T _A =25°C Derate above 25°C	P _D	300	mW
Max. Operating Temperature Range	T _J	150	°C
Storage Temperature Range	T _{STG}	-55 to +150	°C

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

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS
Thermal Resistance Junction to Ambient	R θ _{JA}	-	-	417	°C/W

Notes : 1.Alumina=0.4*0.3*0.024in.99.5% alumina
2." Fully ROHS Compliant "," 100% Sn plating (Pb-free)".

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 ($I_C= 1\text{mA}_{dc}$, $I_B= 0$)	$V_{(BR)CEO}$	40	-	Vdc
Collector-Base Breakdown Voltage ($I_C= 10\mu\text{A}_{dc}$, $I_E= 0$)	$V_{(BR)CBO}$	60	-	Vdc
Emitter-Base Breakdown Voltage ($I_E= 100\mu\text{A}_{dc}$, $I_C= 0$)	$V_{(BR)EBO}$	6.0	-	Vdc
Base Cutoff Current ($V_{CE}= 30\text{Vdc}$, $V_{EB}= 3.0\text{Vdc}$)	I_{BL}	-	50	nAdc
Collector Cutoff Current ($V_{CE}= 30\text{Vdc}$, $V_{EB}= 3.0\text{Vdc}$)	I_{CEX}	-	50	nAdc

ON CHARACTERISTICS(1)

DC Current Gain ($I_C= 0.1\text{mA}_{dc}$, $V_{CE}= 1.0\text{Vdc}$) ($I_C= 1.0\text{mA}_{dc}$, $V_{CE}= 1.0\text{Vdc}$) ($I_C= 10\text{mA}_{dc}$, $V_{CE}= 1.0\text{Vdc}$) ($I_C= 50\text{mA}_{dc}$, $V_{CE}= 1.0\text{Vdc}$) ($I_C= 100\text{mA}_{dc}$, $V_{CE}= 1.0\text{Vdc}$)	h_{FE}	40 70 100 60 30	- - 300 - -	-
Collector-Emitter Saturation Voltage ($I_C= 10\text{mA}_{dc}$, $I_B= 1.0\text{mA}_{dc}$) ($I_C= 50\text{mA}_{dc}$, $I_B= 5.0\text{mA}_{dc}$)	$V_{CE(sat)}$	- -	0.2 0.3	Vdc
Base-Emitter Saturation Voltage ($I_C= 10\text{mA}_{dc}$, $I_B= 1.0\text{mA}_{dc}$) ($I_C= 50\text{mA}_{dc}$, $I_B= 5.0\text{mA}_{dc}$)	$V_{BE(sat)}$	0.65 -	0.85 0.95	Vdc

SMALL-SIGNAL CHARACTERISTICS

Current-Gain-Bandwidth Product ($I_C= 10\text{mA}_{dc}$, $V_{CE}= 20\text{Vdc}$, $f= 100\text{MHz}$)	f_T	300	-	MHz
Output Capacitance ($V_{CB}= 5.0\text{Vdc}$, $I_E= 0$, $f= 1.0\text{MHz}$)	C_{obo}	-	4.0	pF
Input Capacitance ($V_{EB}= 0.5\text{Vdc}$, $I_C= 0$, $f= 1.0\text{MHz}$)	C_{ibo}	-	8.0	pF
Input Impedance ($V_{CE}= 10\text{Vdc}$, $I_C= 1.0\text{mA}_{dc}$, $f= 1.0\text{kHz}$)	h_{ie}	1.0	10	kohms
Voltage Feedback Ratio ($V_{CE}= 10\text{Vdc}$, $I_C= 1.0\text{mA}_{dc}$, $f= 1.0\text{kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain ($V_{CE}= 10\text{Vdc}$, $I_C= 1.0\text{mA}_{dc}$, $f= 1.0\text{kHz}$)	h_{fe}	100	400	-
Output Admittance ($V_{CE}= 10\text{Vdc}$, $I_C= 1.0\text{mA}_{dc}$, $f= 1.0\text{kHz}$)	h_{oe}	1.0	40	umhos
Noise Figure ($V_{CE}= 5.0\text{Vdc}$, $I_C= 100\mu\text{A}_{dc}$, $R_S= 1.0\text{kohms}$, $f= 1.0\text{kHz}$)	NF	-	5.0	dB

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC}= 3.0\text{Vdc}$, $V_{BE}= -0.5\text{Vdc}$, $I_C= 10\text{mA}_{dc}$, $I_{B1}= 1.0\text{mA}_{dc}$)	t_d	-	35	ns
Rise Time		t_r	-	35	
Storage Time	$(V_{CC}= 3.0\text{Vdc}$, $I_C= 10\text{mA}_{dc}$, $I_{B1}= I_{B2}= 1.0\text{mA}_{dc}$)	t_s	-	200	ns
Fall Time		t_f	-	50	

Note : Pulse Test: Pulse Width \leq 300ms,Duty Cycle \leq 2.0%

RATING AND CHARACTERISTICS CURVES (MMBT3904)

— $T_J=25^\circ\text{C}$ - - $T_J=125^\circ\text{C}$

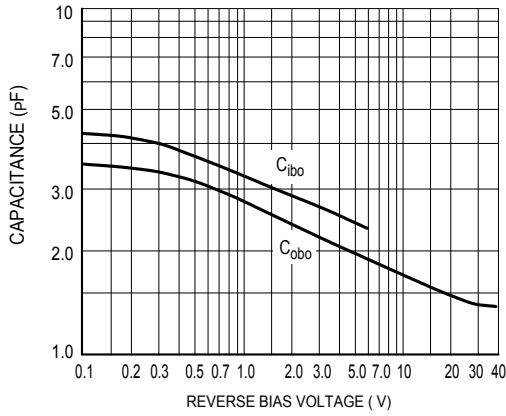


Figure 1. Capacitance

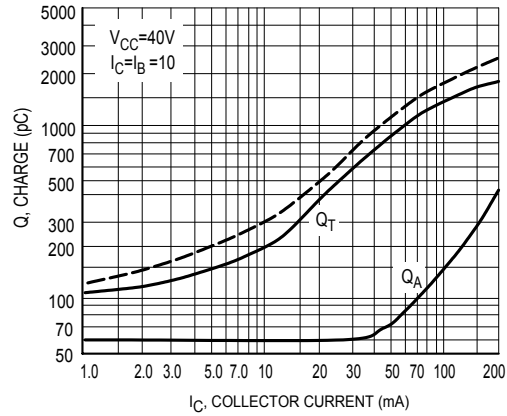


Figure 2. Charge Data

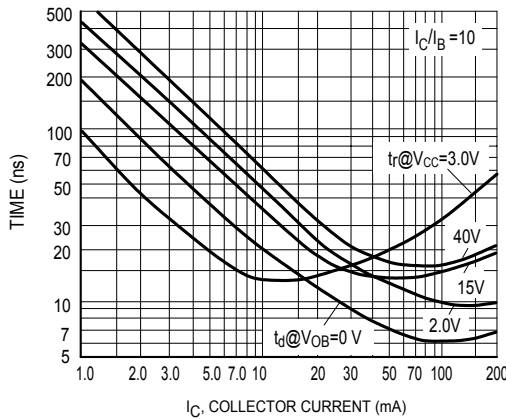


Figure 3. Turn-On Time

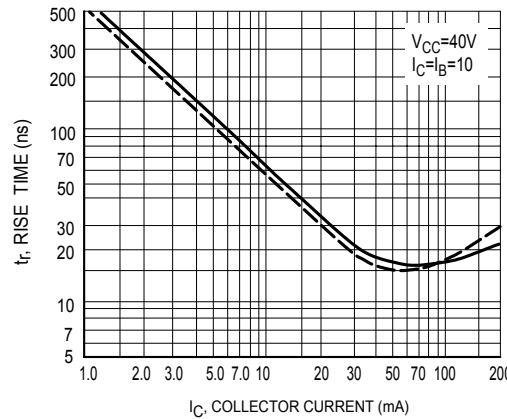


Figure 4. Rise Time

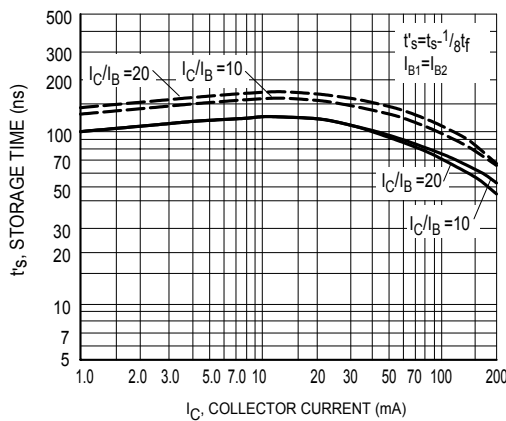


Figure 5. Storage Time

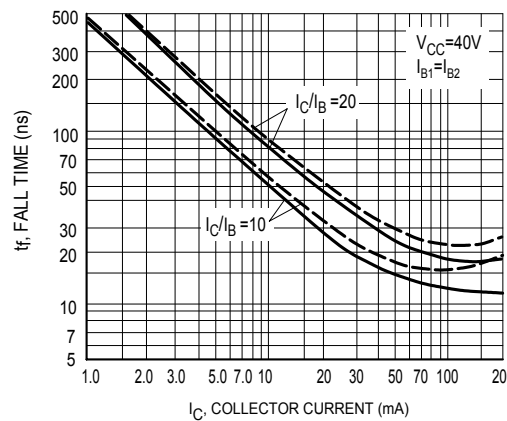


Figure 6. Fall Time

RATING AND CHARACTERISTICS CURVES (MMBT3904)

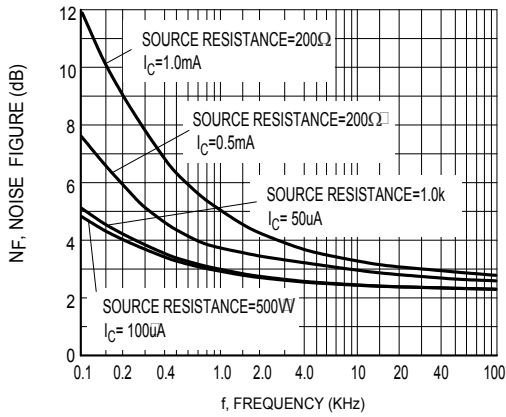


Figure 7.

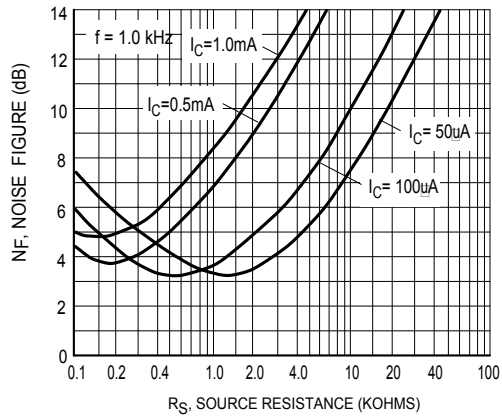


Figure 8.

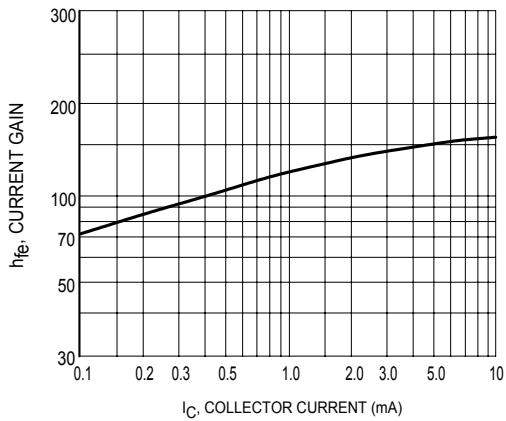


Figure 9. Current Gain

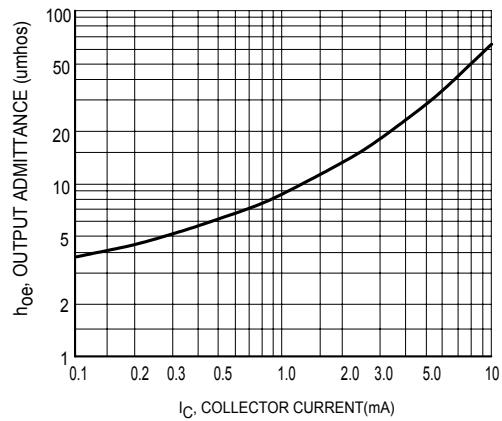


Figure 10. Output Admittance

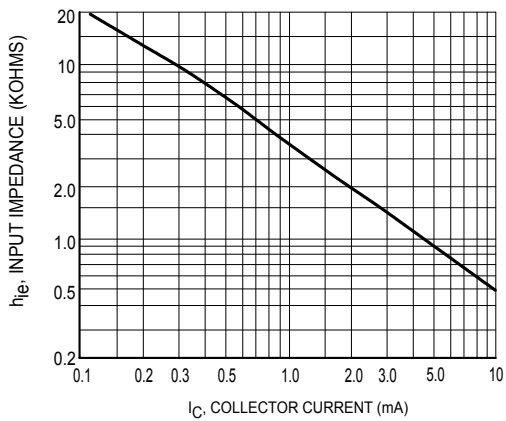


Figure 11. Input Impedance

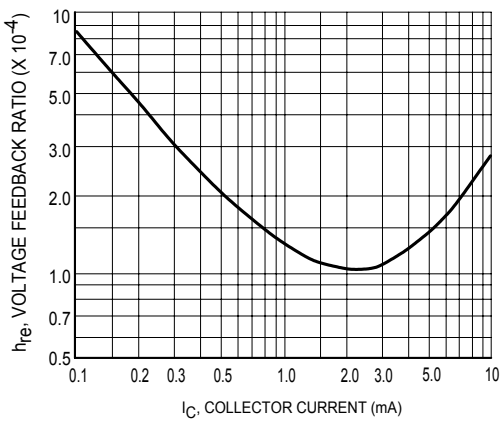


Figure 12. Voltage Feedback Ratio

RATING AND CHARACTERISTICS CURVES (MMBT3904)

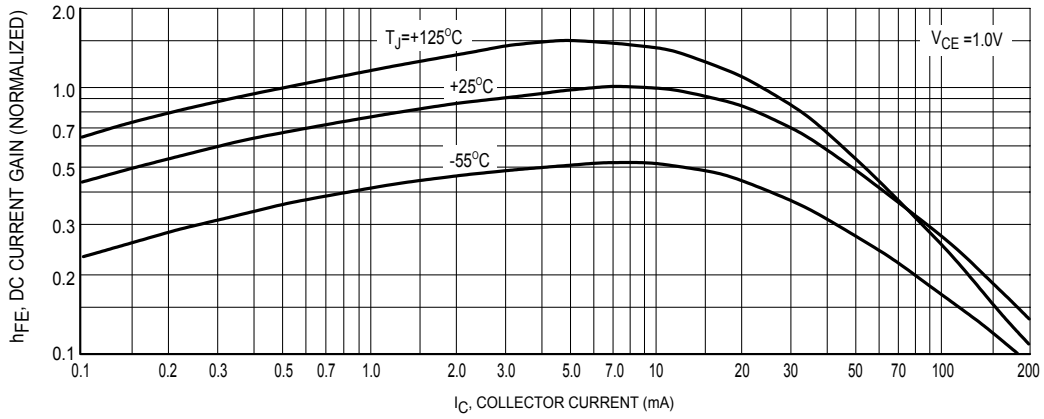


Figure 13. DC Current Gain

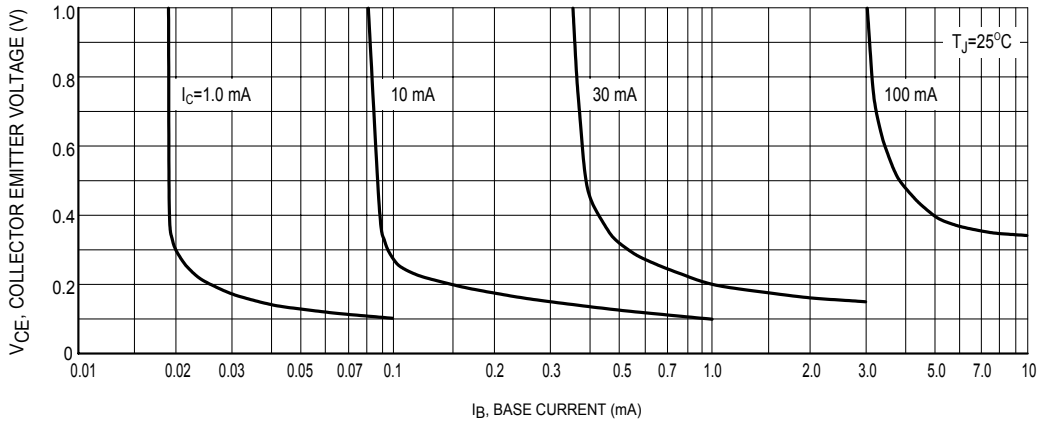


Figure 14. Collector Saturation Region

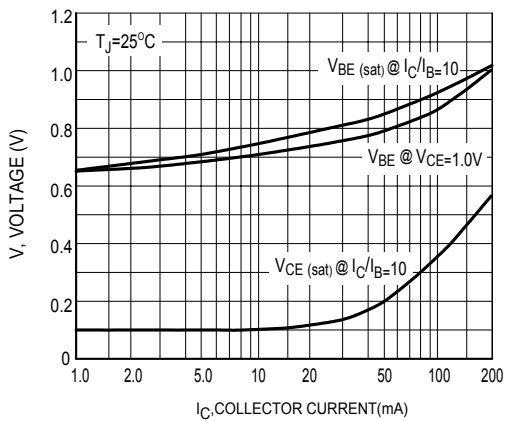


Figure 15. "ON" Voltages

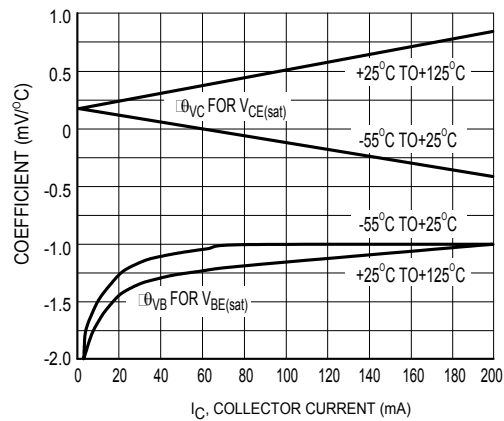


Figure 16. Temperature Coefficients

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