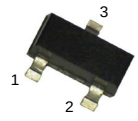
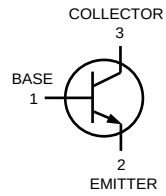
General Purpose Transistor

NPN Silicon

MMBT3904



SOT-23



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 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}	-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 Breakdowe Voltage[3] (I_C=1.0mAdc, I_B=0)	$V_{(BR)CEO}$	40	-	Vdc
Collector-Base Breakdowe Voltage (I_C=10 uAdc, I_E=0)	$V_{(BR)CBO}$	60	-	Vdc
Emitter-Base Breakdowe Voltage (I_E=10 uAdc, I_C=0)	$V_{(BR)EBO}$	6.0	-	Vdc
Base Cutoff Current (V_{CE}=30 Vdc, V_{EB}=3.0 Vdc)	I_{BL}	-	50	nAdc
Collector Cutoff Current (V_{CE}=30 Vdc, V_{EB}=3.0 Vdc)	I_{CEX}	-	50	nAdc

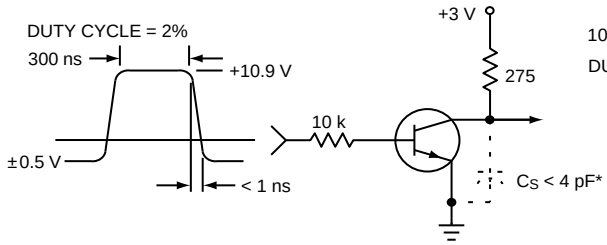
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted) (Continued)

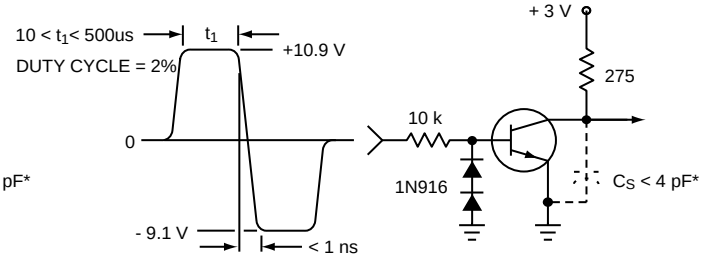
Characteristic	Symbol	Min.	Max.	Unit
ON CHARACTERISTICS(3)				
DC Current Gain (I_C=0.1 mAdc, V_{CE}=1.0 Vdc) (I_C=1.0 mAdc, V_{CE}=1.0 Vdc) (I_C=10 mAdc, V_{CE}=1.0 Vdc) (I_C=50 mAdc, V_{CE}=1.0 Vdc) (I_C=100 mAdc, V_{CE}=1.0 Vdc)	H_{FE}	 40 70 100 60 30	 - - 300 - -	-
Collector-Emitter Saturation Voltage(3) (I_C=10 mAdc, I_B=1.0 mAdc) (I_C=50 mAdc, I_B=5.0 mAdc)	V_{CE}(sat)	 - -	 0.2 0.3	Vdc
Base-Emitter Saturation Voltage(3) (I_C=10 mAdc, I_B=1.0 mAdc) (I_C=50 mAdc, I_B=5.0 mAdc)	V_{BE}(sat)	 0.65 -	 0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTIC				
Current-Gain-Bandwidth Product (I_C=10 mAdc, V_{CE}=20 Vdc, f=100 MHz)	f_T	300	-	MHz
Output Capacitance (V_{CB}=5.0 Vdc, I_E=0, f=1.0 MHz)	Cobo	-	4.0	pF
Input Capacitance (V_{EB}=0.5 Vdc, I_C=0, f=1.0 MHz)	Cibo	-	8.0	pF
Input Impedance (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hie	1.0	10	k ohms
Voltage Feedback Ratio (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hre	0.5	8.0	X 10^{-4}
Small-Signal Current Gain (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hfe	100	400	-
Output Admittance (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hoe	1.0	40	u mhos
Noise Figure (V_{CE}=5.0 Vdc, I_C=100 uAdc, R_S=1.0 k ohm, f=1.0 kHz)	NF	-	5.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V_{CC}=3.0 Vdc, V_{BE}=-0.5 Vdc, I_C=10 mAdc, I_{B1}=1.0 mAdc)	td	-	35	nS
Rise Time		tr	-	35	
Storage Time	(V_{CC}=3.0 Vdc, I_C=10 mAdc, I_{B1}=I_{B2}=1.0 mAdc)	ts	-	200	nS
Fall Time		tf	-	50	

(1) FR-5=1.0 x 0.75 x 0.062in.
(2) Alumina=0.4 x 0.3 x 0.024in. 99.5% alumina.
(3) Pulse Test : Pulse Width ≦ 300uS, 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

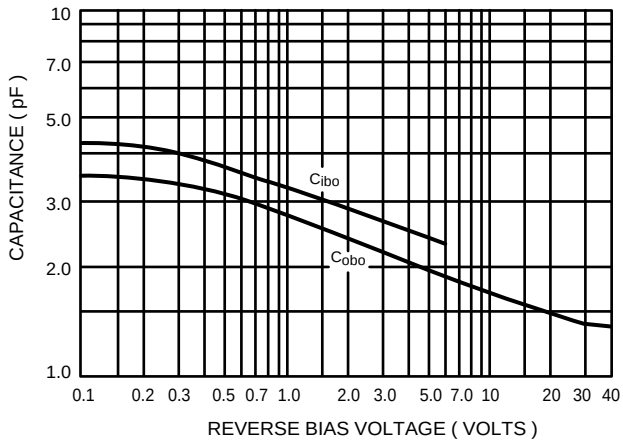


Figure 3. Capacitance

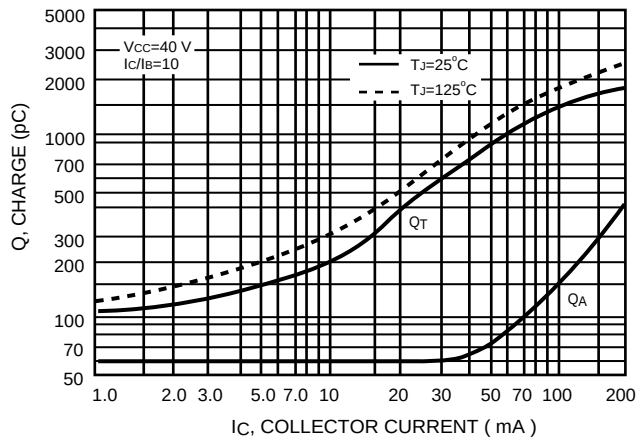


Figure 4. Charge Data

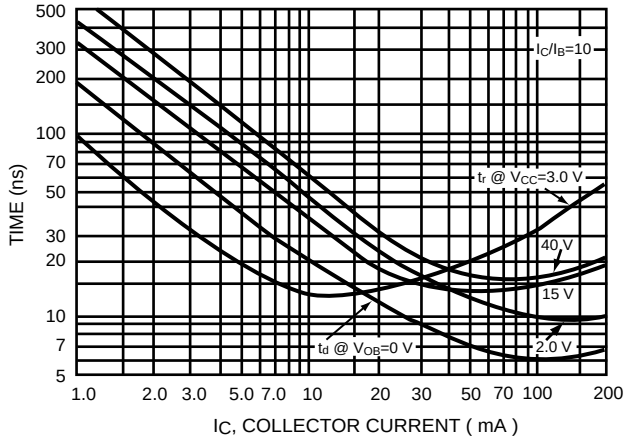


Figure 5. Turn-On Time

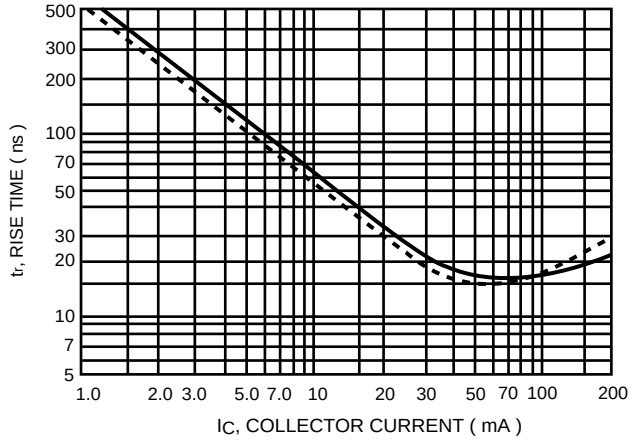


Figure 6. Rise Time

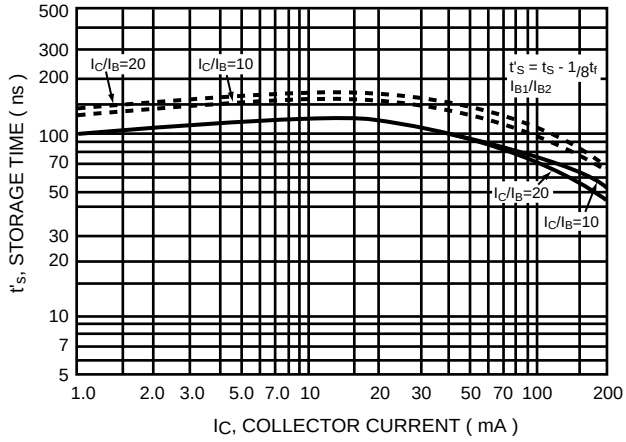


Figure 7. Storage Time

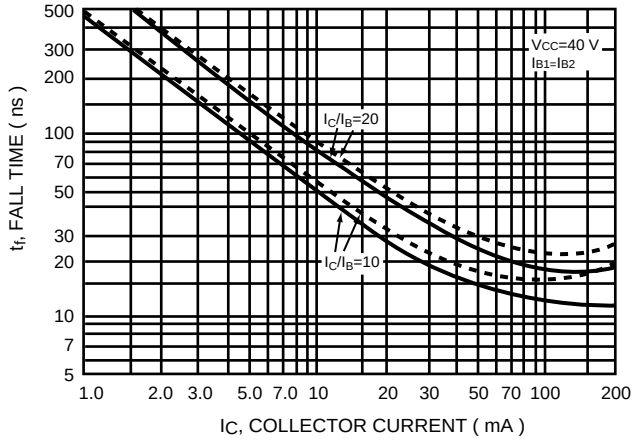


Figure 8. Fall Time

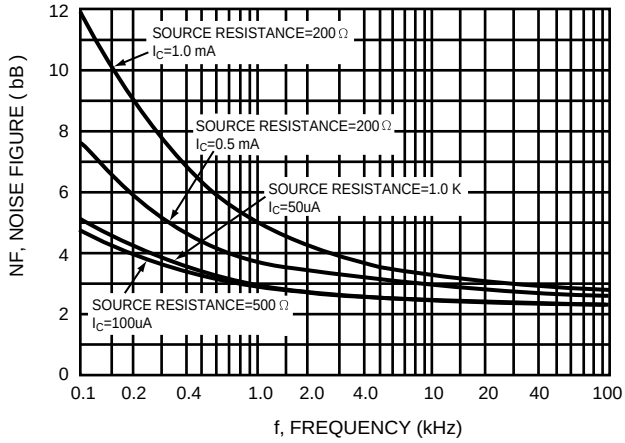


Figure 9.

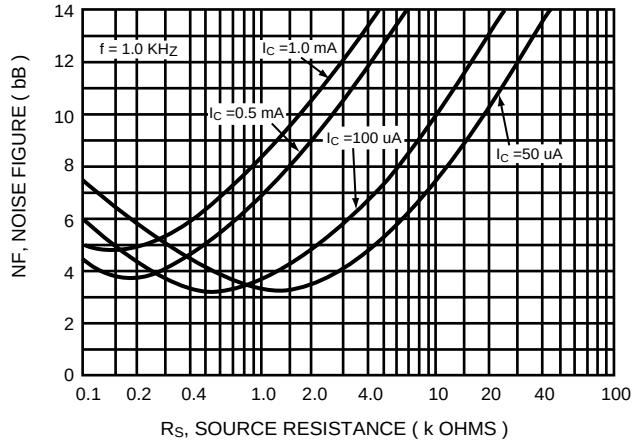


Figure 10.

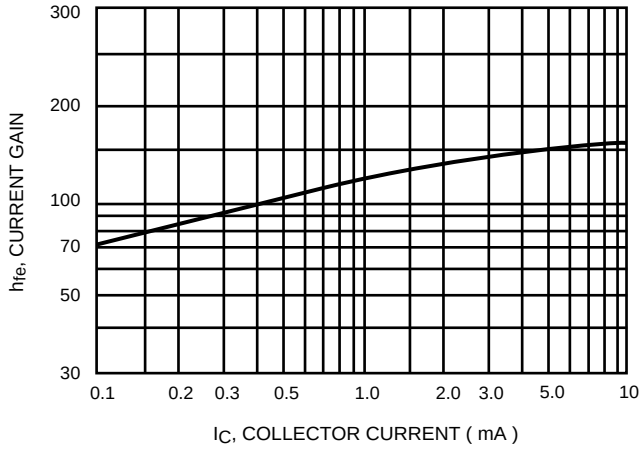


Figure 11. Current Gain

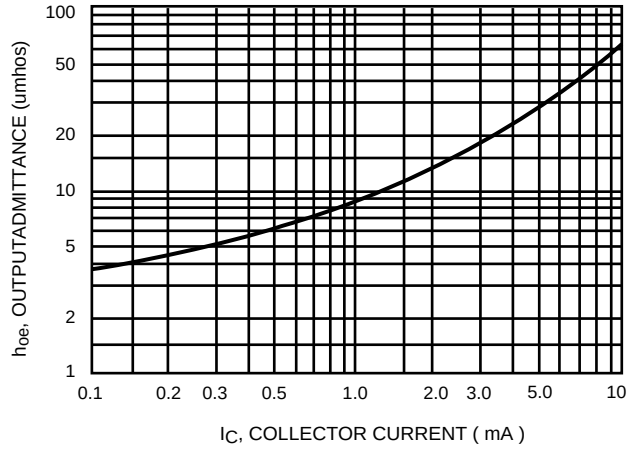


Figure 12. Output Admittance

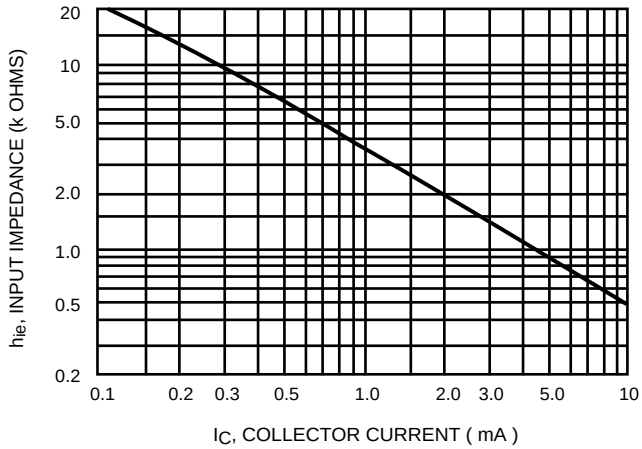


Figure 13. Input Impedance

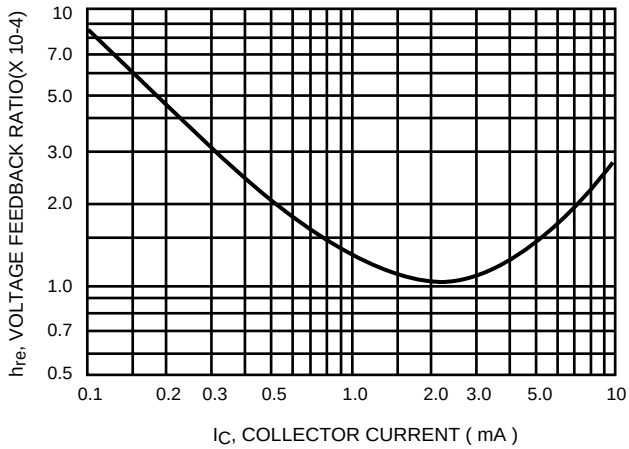


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

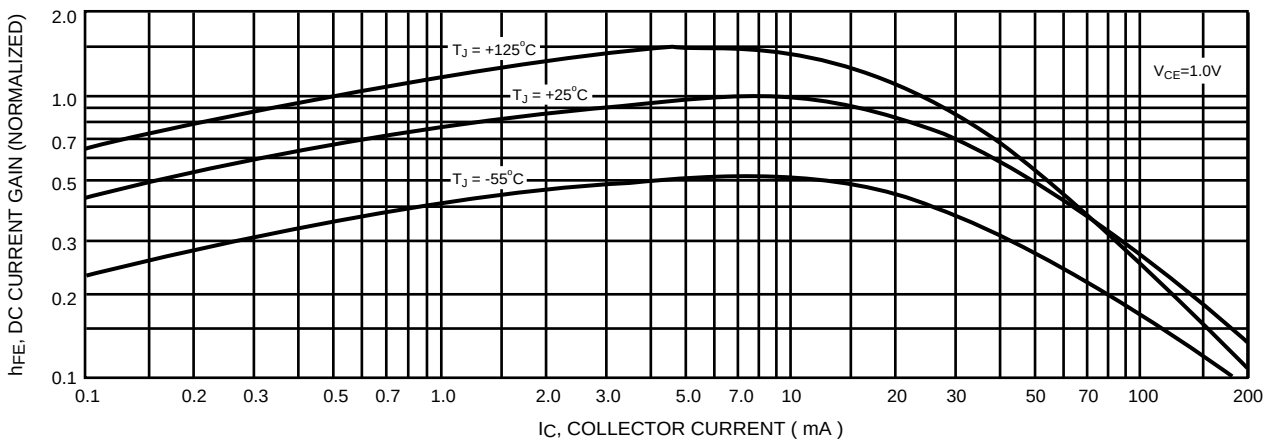


Figure 15. DC Current Gain

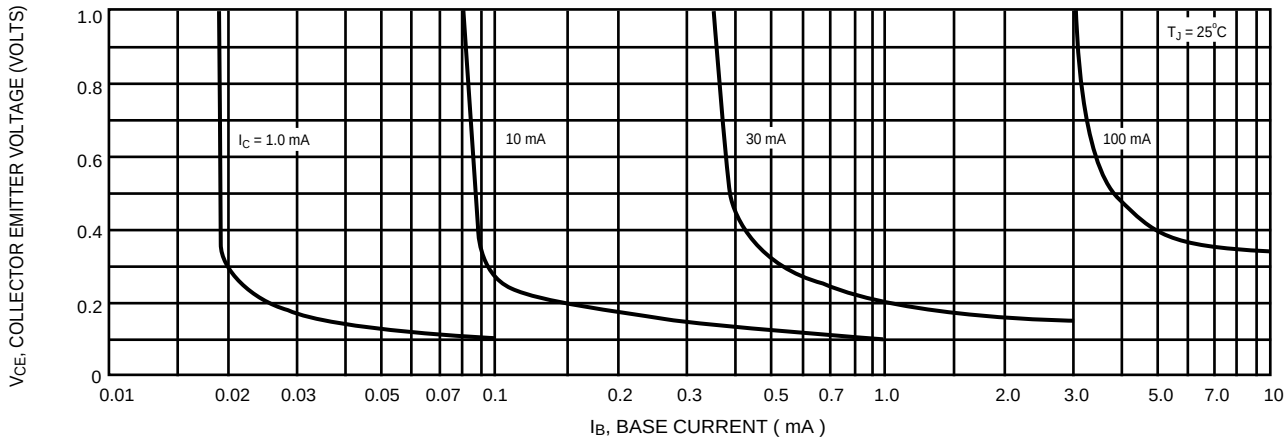


Figure 16. Collector Saturation Region

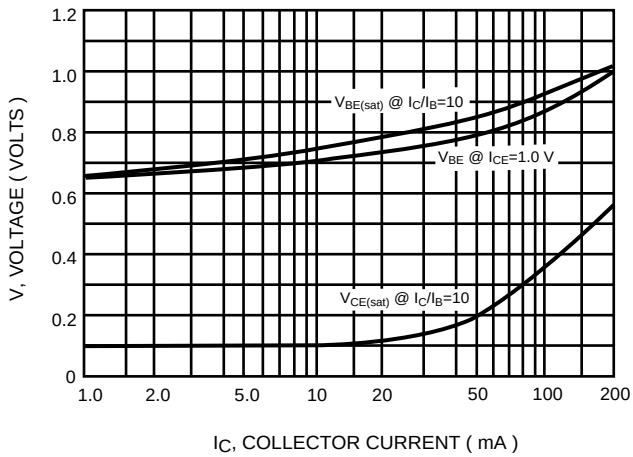


Figure 17. " ON " Voltage

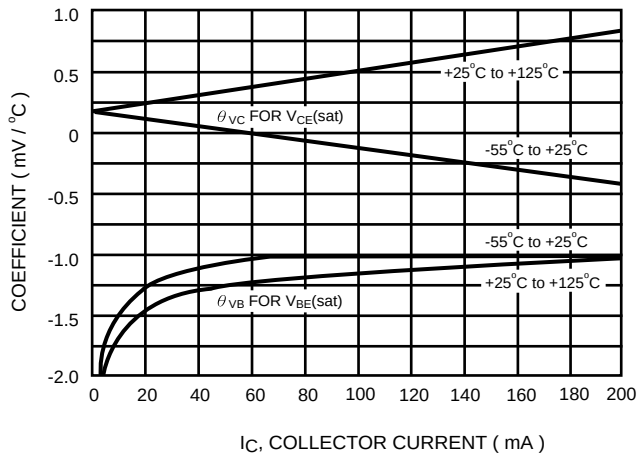


Figure 18. Temperature Coefficients