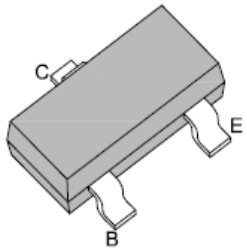
SMD General Purpose Transistor (NPN)



SOT-23

Features

- NPN Silicon Epitaxial Planar Transistor for Switching and Amplifier Applications
- RoHS compliance

Mechanical Data

Case:	SOT-23, Plastic Package
Terminals:	Solderable per MIL-STD-202G, Method 208
Weight:	0.008 gram

Maximum Ratings *(T Ambient=25ºC unless noted otherwise)*

Symbol	Description	MMBT3904	Unit	Conditions
V_{CEO}	Collector-Emitter Voltage	40	V	
V_{CBO}	Collector-Base Voltage	60	V	
V_{EBO}	Emitter-Base Voltage	6.0	V	
I_C	Collector Current	200	mA	
P_D	Total Device Power Dissipation(Note 1)	225	mW	T_A=25 ˚C
		1.8	mW/°C	Derate above 25 ˚C
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	556	°C /W	
P_D	Total Device Power Dissipation, Alumina Substrate (Note 2)	300	mW	T_A=25 ˚C
		2.4	mW/°C	Derate above 25 ˚C
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	417	°C /W	
T_J	Junction Temperature	-55 to +150	°C	
T_{STG}	Storage Temperature Range	-55 to +150	°C	

Note: 1. FR-5 Board=25.4 x 19.05 x 1.58 mm (1.0 x 0.75 x 0.062 inches.)
2. Alumina Substrate=10.16 x 7.62 x 0.61 mm (0.4 x 0.3 x 0.024 inches.) 99.5% alumina.

Electrical Characteristics *($T_{Ambient}$=25°C unless noted otherwise)*

Off Characteristics

Symbol	Description	Min.	Max.	Unit	Conditions
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage (Pulse width ≤300μs, Duty Cycle ≤2.0%)	40	-	V	I_C=1mA, I_B=0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	60	-	V	I_C=10μA, I_E=0
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	6.0	-	V	I_E=10μA, I_C=0
I_{BL}	Base Cut-off Current	-	50	nA	V_{EB}=3V, V_{CE}=30V
I_{CEX}	Collector Cut-off Current	-	50	nA	V_{EB}=3V, V_{CE}=30V

On Characteristics

Symbol	Description	Min.	Max.	Unit	Conditions
h_{FE}	D.C. Current Gain	40	-		V_{CE}=1V, I_C=0.1mA
		70	-		V_{CE}=1V, I_C=1mA
		100	300		V_{CE}=1V, I_C=10mA
		60	-		V_{CE}=1V, I_C=50mA
		30	-		V_{CE}=1V, I_C=100mA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	-	0.2	V	I_C=10mA, I_B=1mA
		-	0.3		I_C=50mA, I_B=5mA
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	0.65	0.85	V	I_C=10mA, I_B=1mA
		-	0.95		I_C=50mA, I_B=5mA

Small-signal Characteristics

Symbol	Description	Min.	Max.	Unit	Conditions
f_T	Current Gain-Bandwidth Product	300	-	MHz	V_{CE}=20V, I_C=10mA, f=100MHz
C_{OBO}	Output Capacitance	-	4.0	pF	V_{CB}=5V, f=1.0MHz, I_E=0
C_{IBO}	Input Capacitance	-	8.0	pF	V_{EB}=0.5V, f=1.0MHz, I_C=0
h_{ie}	Input Impedance	1.0	10	kohms	V_{CE}=10V, I_C=1mA, f=1kHz
h_{re}	Voltage Feedback Ratio	0.5	8.0	x 10^{-4}	V_{CE}=10V, I_C=1mA, f=1kHz
h_{fe}	Small-Signal Current Gain	100	400	-	V_{CE}=10V, I_C=1mA, f=1kHz
h_{oe}	Output Admittance	1.0	40	UMHOS	V_{CE}=10V, I_C=1mA, f=1kHz
NF	Noise Figure	-	5.0	dB	V_{CE}=5V, I_C=100μA, Rs=1.0kohms, f=1kHz

Switching Characteristics

Symbol	Description	Min.	Max.	Unit	Conditions
t_d	Delay Time	-	35	ns	V_{CC}=3V, V_{BE}=-0.5V I_C=10mA, I_{B1}=1mA
t_r	Rise Time	-	35		
t_s	Storage Time	-	200		V_{CC}=3V, I_C=10mA, I_{B1}= I_{B2}=1mA
t_f	Fall Time	-	50		

Equivalent Test Circuit

Fig.1- Delay and Rise Time

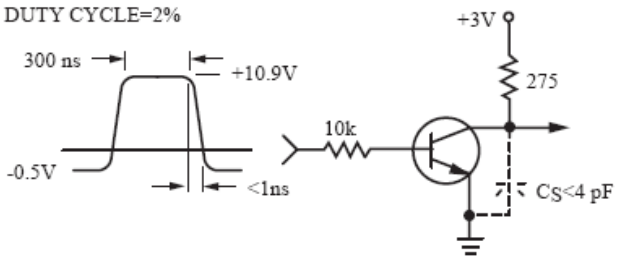
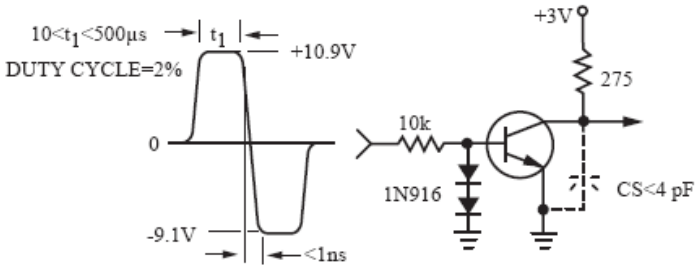


Fig.2- Storage and Fall Time



Total Shunt Capacitance of test jig and connectors

Typical Characteristics Curves (▬ T_J =25°C --- T_J =125°C)

Fig.3- Capacitance

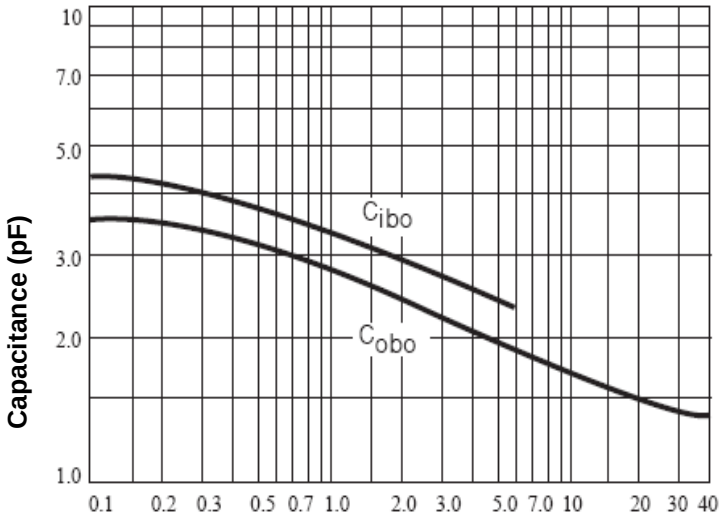


Fig.4- Charge Data

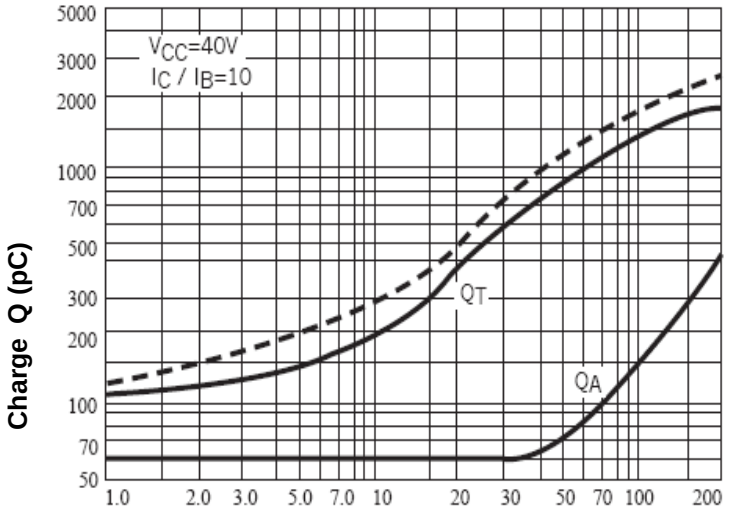


Fig.5- Turn-On Time

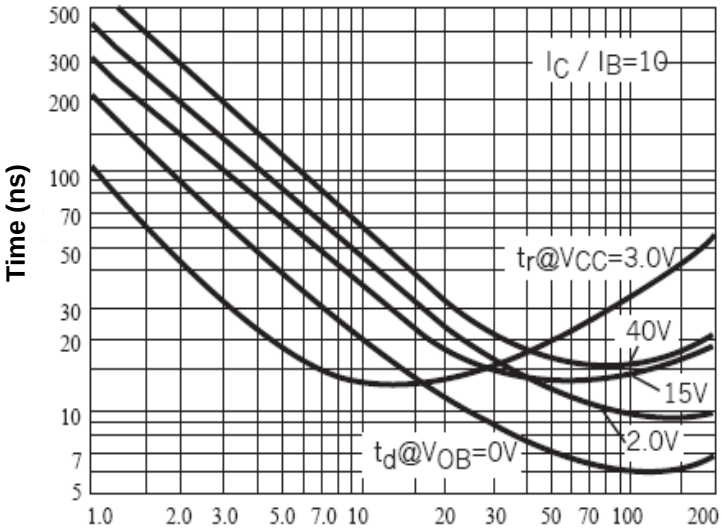


Fig.6- Rise Time

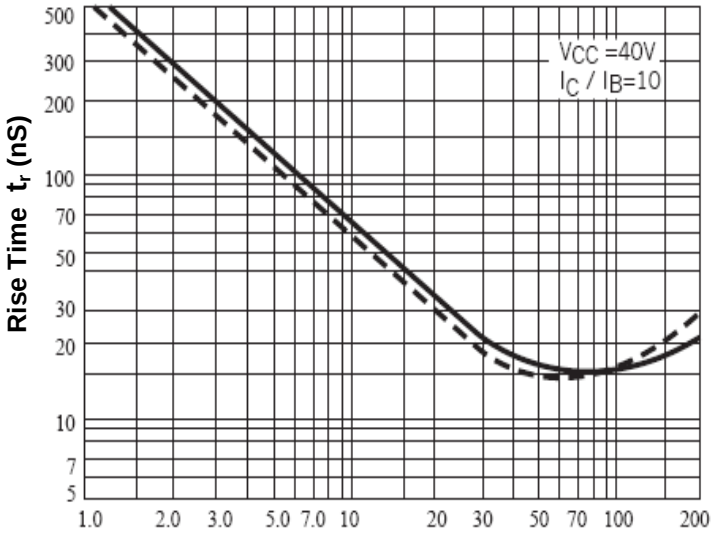


Fig.7- Storage Time

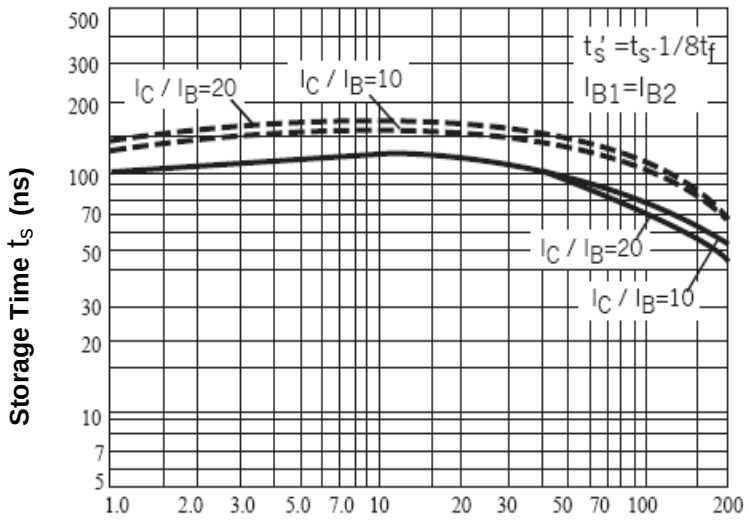
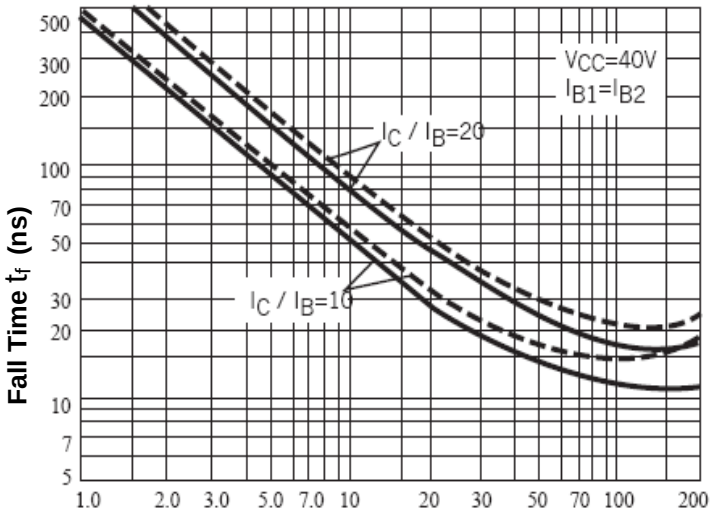


Fig.8- Fall Time



Typical Audio Small-Signal Characteristics Noise Figure Variations

(V_{CE}=5.0 V. T_A=25°C, Bandwidth=1.0Hz)

Fig.9- Noise Figure

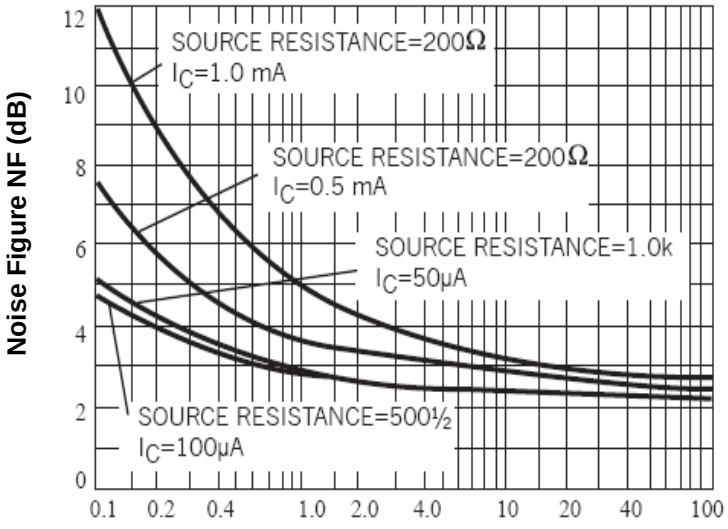
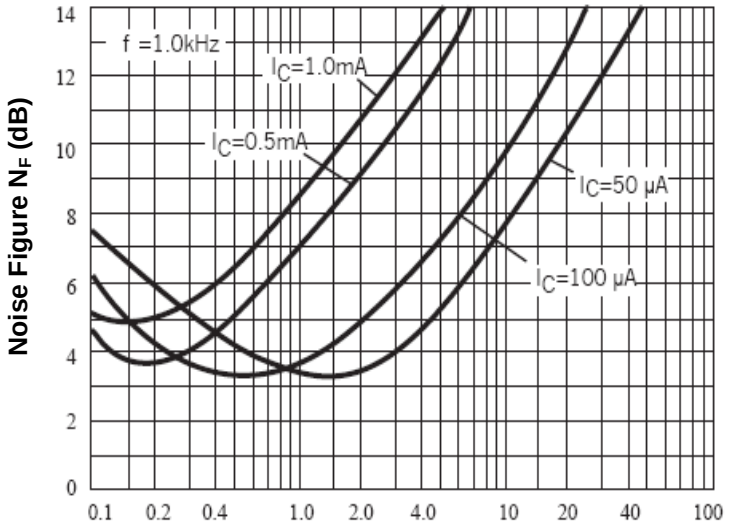


Fig.10- Noise Figure



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

Fig.11- Current Gain

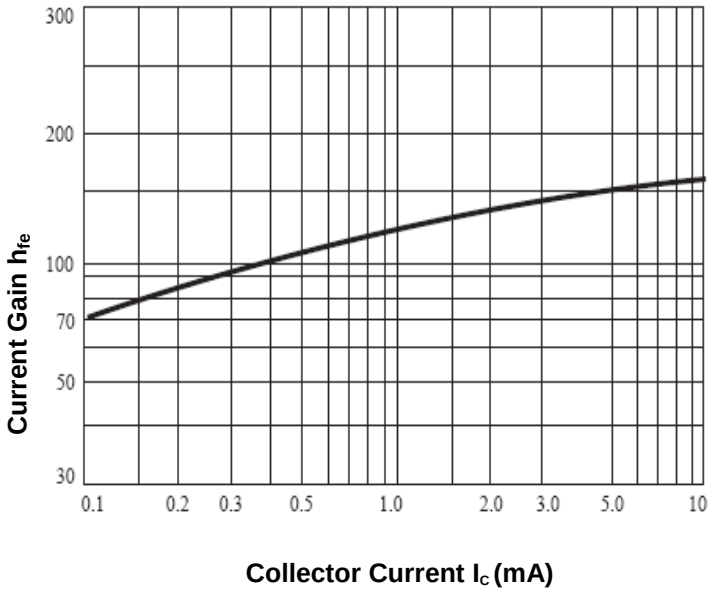


Fig.12- Output Admittance

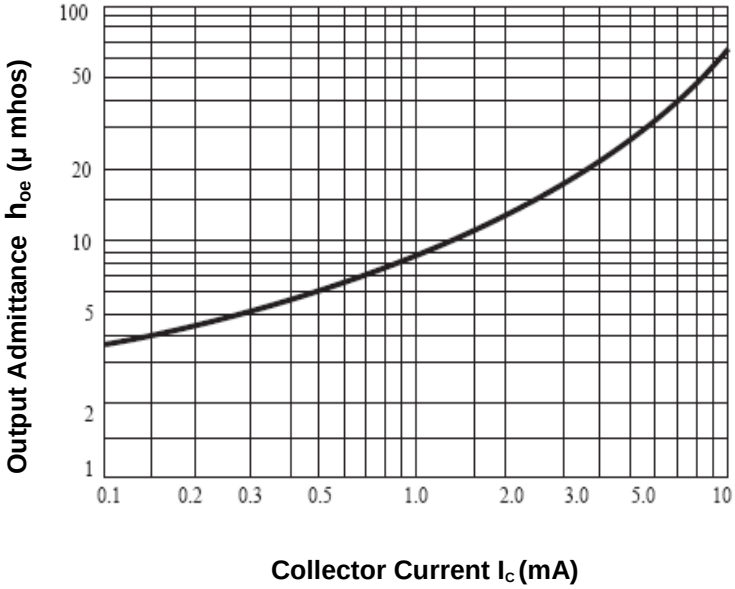


Fig.13- Input Impedance

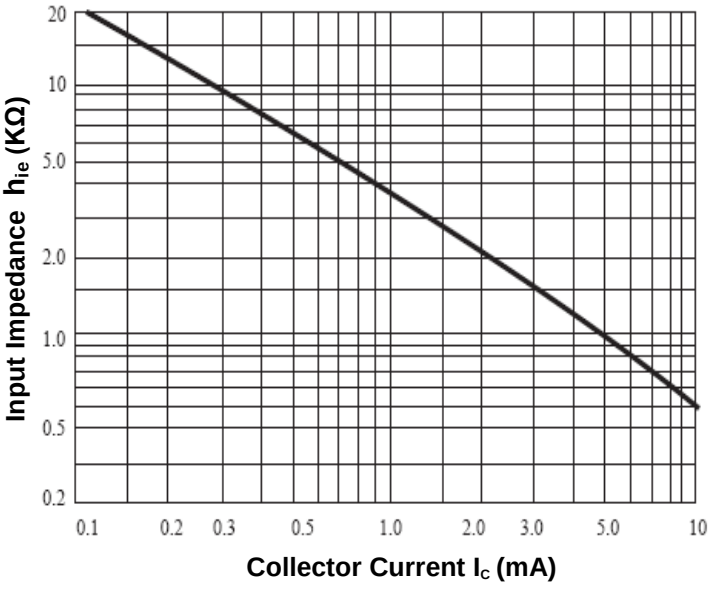
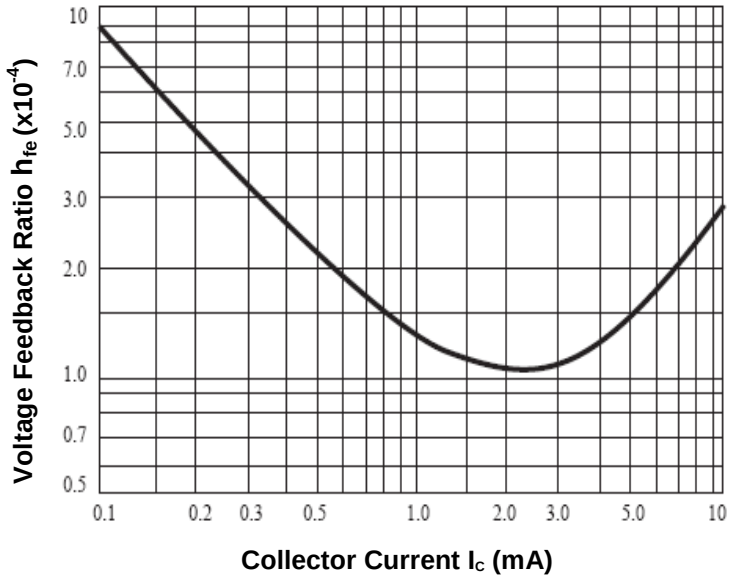


Fig.14- Voltage Feedback Ratio



Typical Static Characteristics

Fig.15- DC Current Gain

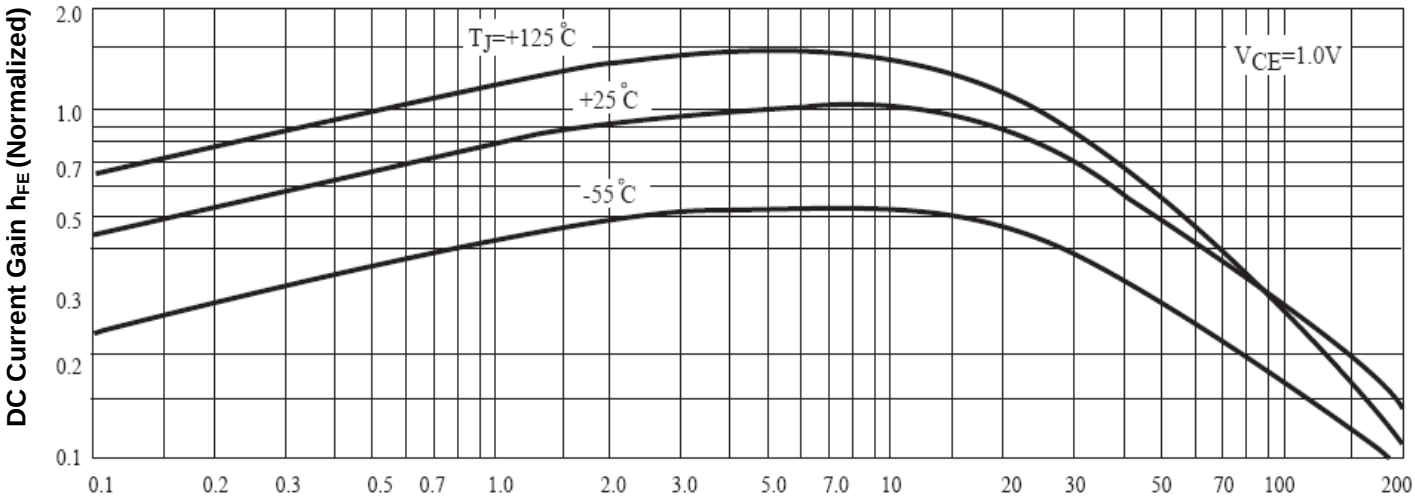


Fig.16- Collector Saturation Region

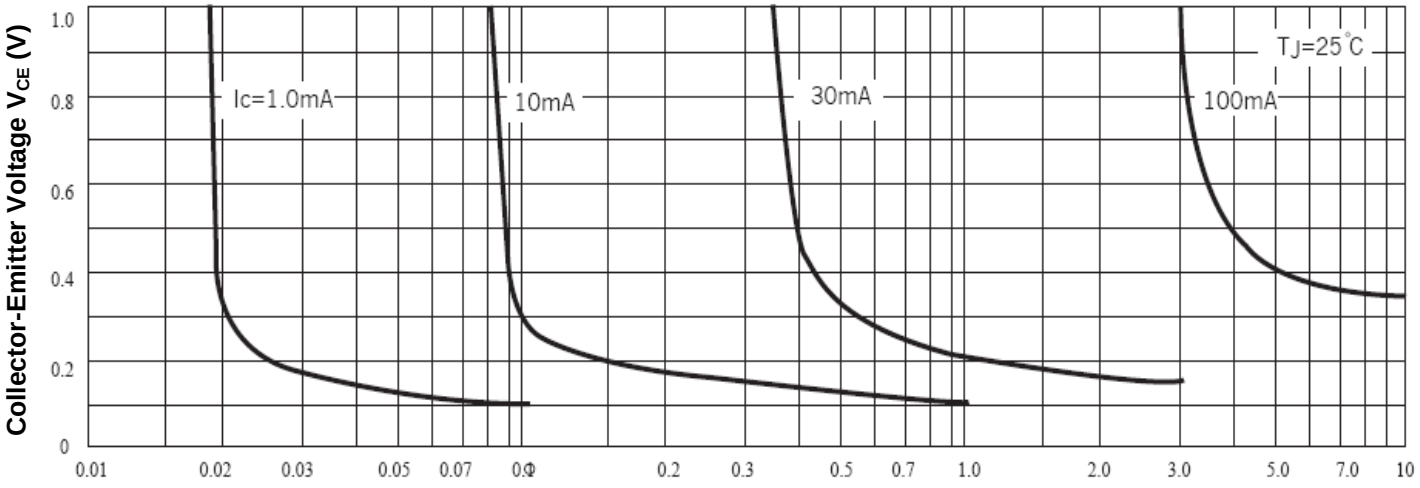


Fig.17- "On" Voltage

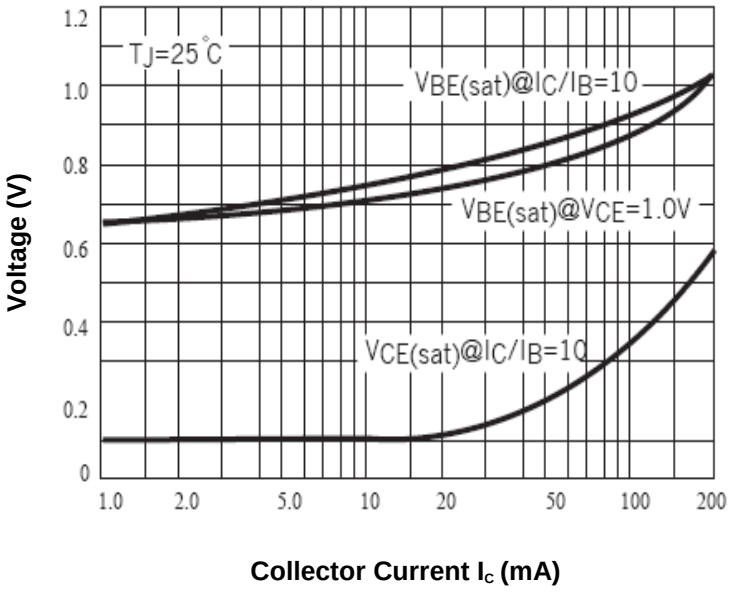
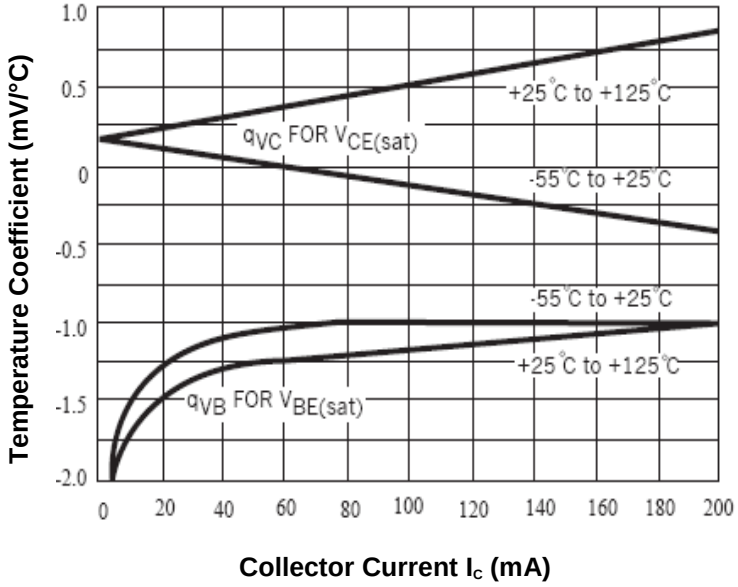


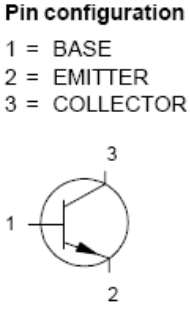
Fig.18- Temperature Coefficients

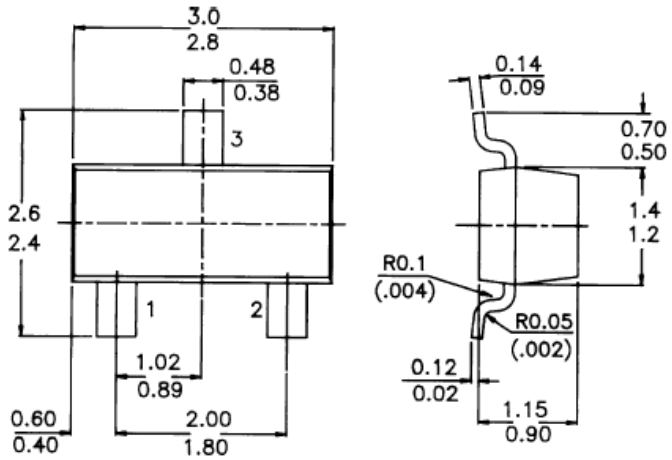


Device Marking: MMBT3904=1A/1AM/ZC

Dimensions in mm

SOT-23





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