MMBT3904

200mA Silicon NPN Epitaxial Planar Transistor

Features

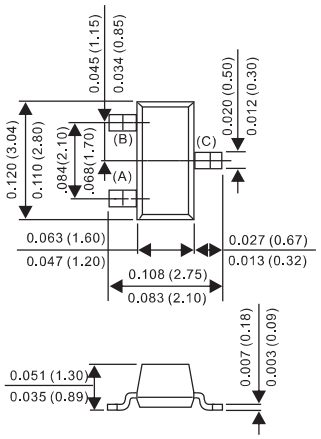
- High collector-emitterbreakdien voltage. (BV_{CEO} 40V Min.@I_C=1mA)
- Small load switch transistor with high gain and low stauration voltage, is designed for general purpose amflifier and switching applications at collector current.
- Capable of 225mW power dissipation.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Suffix "-H" indicates Halogen free part, ex. MMBT3904-H.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any

Package outline

SOT-23



Dimensions in inches and (millimeters)

Maximum ratings (AT T_A=25°C unless otherwise noted)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base voltage		V_{CBO}			60	V
Collector-emitter voltage		V_{CEO}			40	V
Emitter-base voltage		V_{EBO}			6.0	V
Collector current - continuous		I_C			200	mA
Total device dissipation FR-5 board (Note 1)	T_A = 25°C	P_D			225	mW
	Derate above 25°C				1.8	mW/°C
Thermal resistance(Note 1)	Junction to ambient	$R_{\theta JA}$			556	°C/W
Thermal resistance(Note 1)	Junction to case	$R_{\theta JC}$			300	°C/W
Total device dissipation alumina substrate(Note 2)	T_A = 25°C	P_D			300	mW
	Derate above 25°C				2.4	mW/°C
Thermal resistance(Note 2)	Junction to ambient	$R_{\theta JA}$			417	°C/W
Thermal resistance(Note 2)	Junction to case	$R_{\theta JC}$			225	°C/W
Operating junction temperature range		T_J	-55		+150	°C
Storage temperature range		T_{STG}	-55		+150	°C

Notes 1: FR-5 = 1.0 X 0.75 X0.062 in.
2: Alumina = 0.4 X 0.3 X 0.024 in. 99.5% alumina.

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Electrical characteristics (AT T_A=25°C unless otherwise noted)

Off characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base breakdown voltage	I_C = 10uA, I_E = 0	$V_{(BR)CBO}$	60			V
Collector-emitter breakdown voltage	I_C = 1mA, I_B = 0	$V_{(BR)CEO}$	40			V
Emitter-base breakdown voltage	I_E = 10uA, 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

On characteristics(3)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
DC current gain	I_C = 0.1mA, V_{CE} = 1.0V	h_{FE}	40			-
	I_C = 1.0mA, V_{CE} = 1.0V		70			
	I_C = 10mA, V_{CE} = 1.0V		100		300	
	I_C = 50mA, V_{CE} = 1.0V		60			
	I_C = 100mA, V_{CE} = 1.0V		30			
Collector-emitter saturation voltage(3)	I_C = 10mA, I_B = 1.0mA	$V_{CE(sat)}$			0.2	V
	I_C = 50mA, I_B = 5.0mA				0.3	
Base-emitter saturation voltage(3)	I_C = 10mA, I_B = 1.0mA	$V_{BE(sat)}$	0.65		0.85	V
	I_C = 50mA, I_B = 5.0mA				0.95	

3.Pulse test : pukse width ≦ 300us, duty cycle ≦ 2.0%.

Small-signal characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Current-gain-bandwidth product	I_C = 10mA, V_{CE} = 20V, f = 100MHz	f_T	300			MHz
Output capacitance	V_{CB} = 5.0V, I_E = 0, f = 1.0MHz	C_{obo}			4.0	pF
Input capacitance	V_{EB} = 0.5V, I_C = 0, f = 1.0MHz	C_{ibo}			8.0	pF
Input impedance	V_{CE} = 10V, I_C = 1.0mA, f = 1.0KHz	h_{ie}	1.0		10	kohms
Voltage feeback radio	V_{CE} = 10V, I_C = 1.0mA, f = 1.0KHz	h_{re}	0.5		8.0	x 10^{-4}
Small-signal current gain	V_{CE} = 10V, I_C = 1.0mA, f = 1.0KHz	h_{fe}	100		400	-
Output admittance	V_{CE} = 10V, I_C = 1.0mA, f = 1.0KHz	h_{oe}	1.0		40	umhos
Noise figure	V_{CE} = 5.0V, I_C = 100uA, Rs = 1.0K ohms, f = 1.0KHZ	NF			5.0	dB

Switching characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Delay time	V_{CC} = 3.0V, V_{BE} = -0.5V, I_C = 10mA, I_{B1} = 1.0mA	td			35	ns
Rise time		tr			35	
Storage time	V_{CC} = 3.0V, I_C =10mA, I_{B1} = I_{B2} = 1.0mA	ts			200	
Fall time		tf			50	

Switching time equivalent test circuits

Figure 1. Delay and Rise Time Equivalent Test Circuit

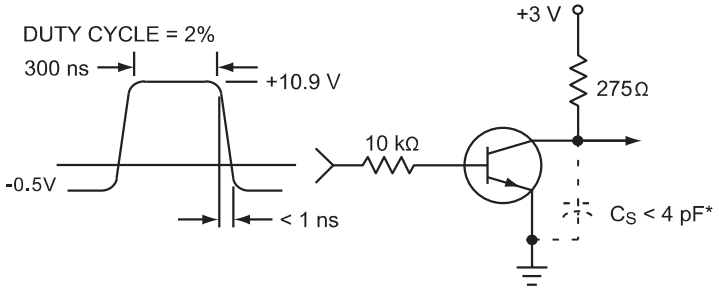
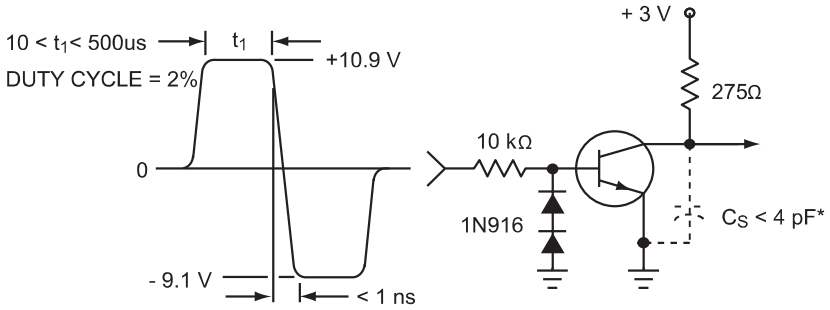


Figure 2. Storage and Fall Time Equivalent Test Circuit



* Total shunt capacitance of test jig and connectors

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TYPICAL TRANSIENT CHARACTERISTICS

Figure 3. Capacitance

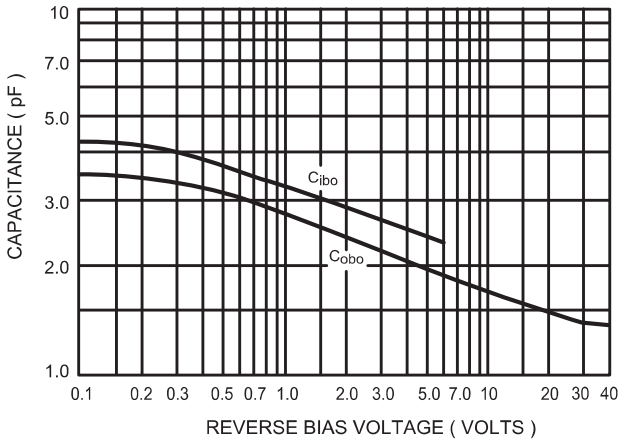


Figure 4. Charge Data

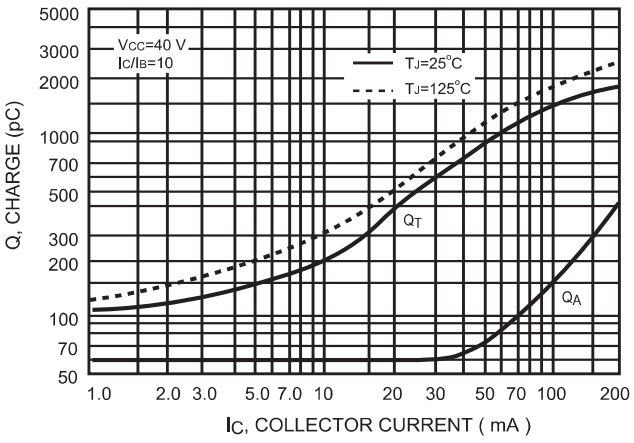


Figure 5. Turn-On Time

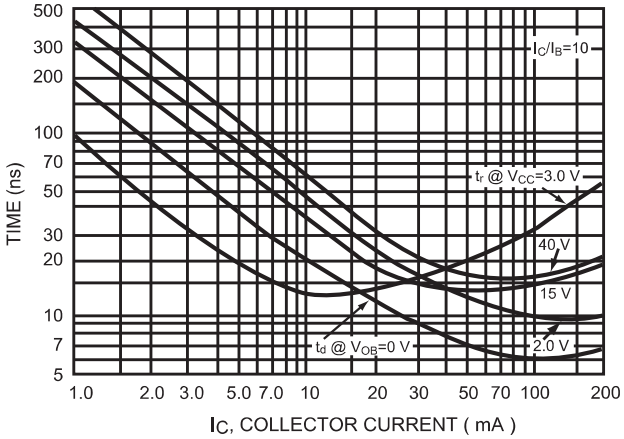


Figure 6. Rise Time

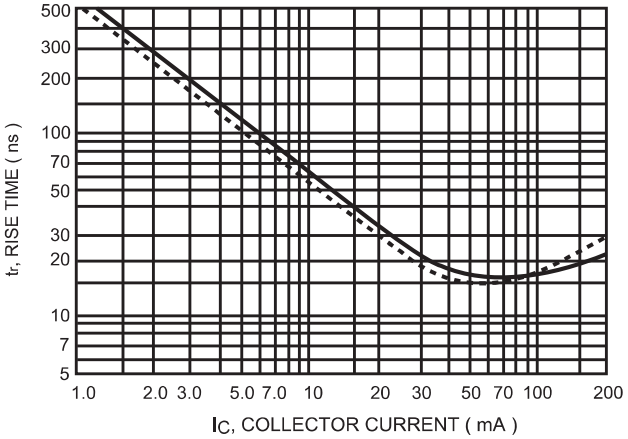


Figure 7. Storage Time

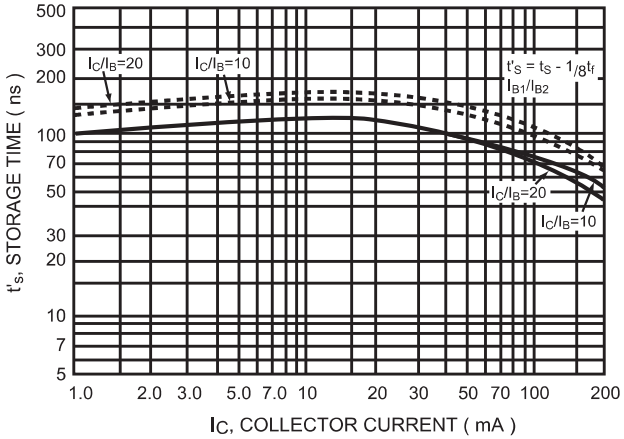
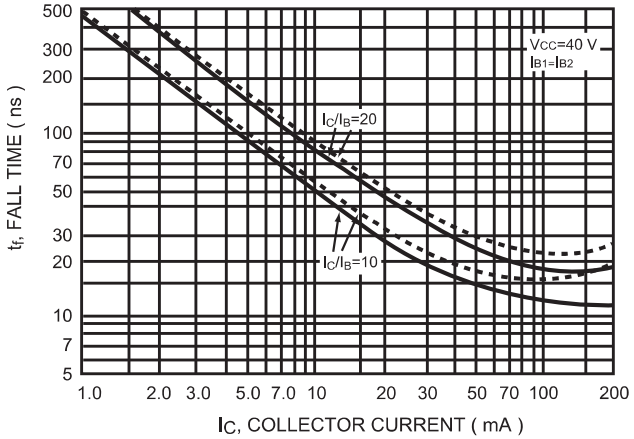


Figure 8. Fall Time



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TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

(VCE=5.0 V. TA=25 °C, Bandwidth=1.0Hz)

Figure 9.

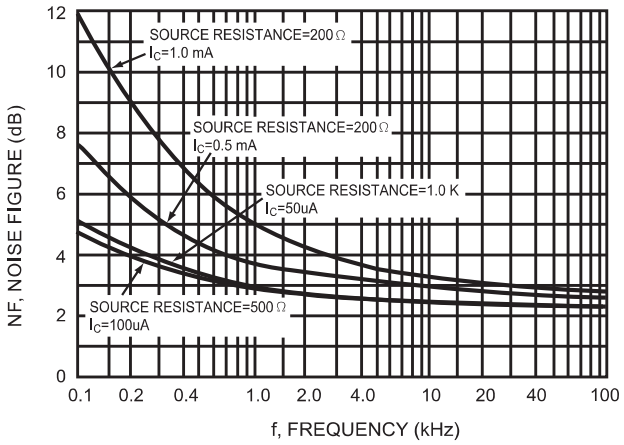
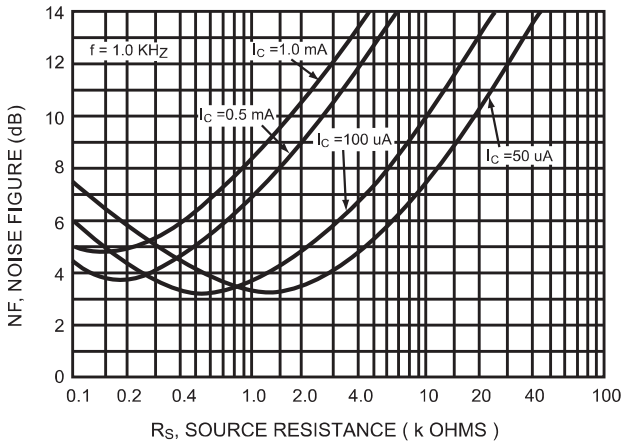


Figure 10.



h PARAMETERS

(VCE=10 V, f=1.0 kHz, TA=25 °C)

Figure 11. Current Gain

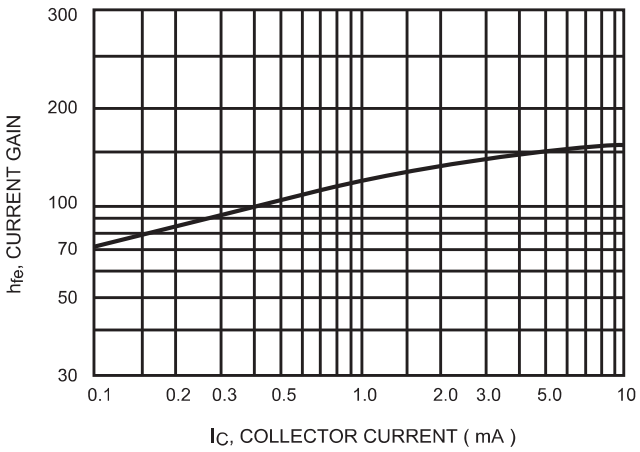


Figure 12. Output Admittance

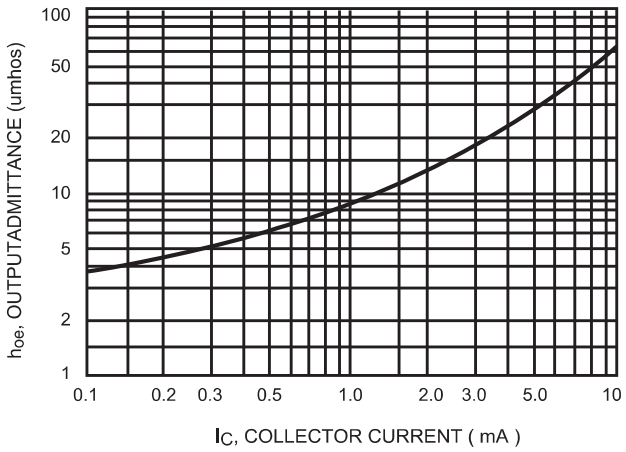


Figure 13. Input Impedance

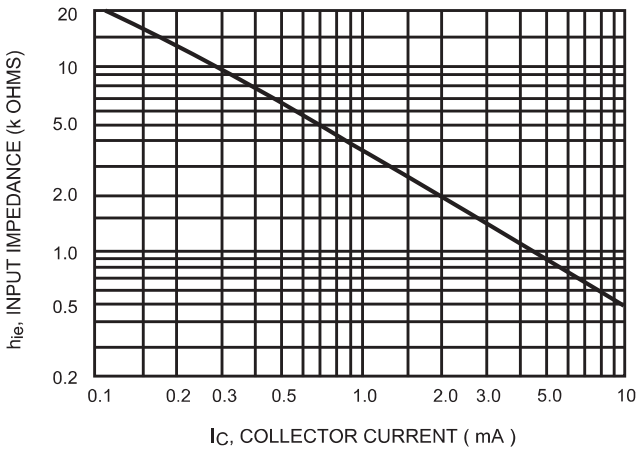
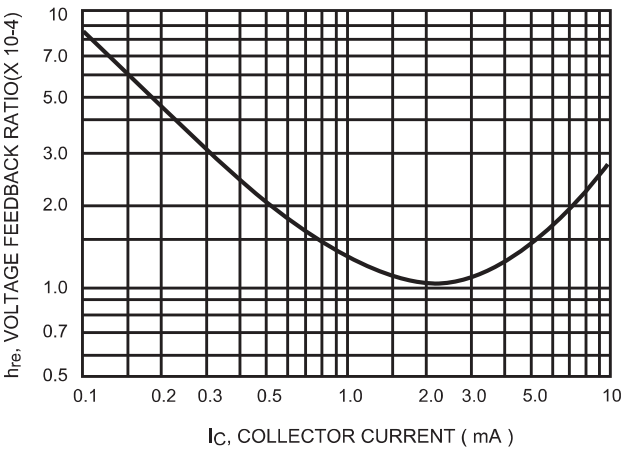


Figure 14. Voltage Feedback Ratio



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TYPICAL STATIC CHARACTERISTICS

Figure 15. DC Current Gain

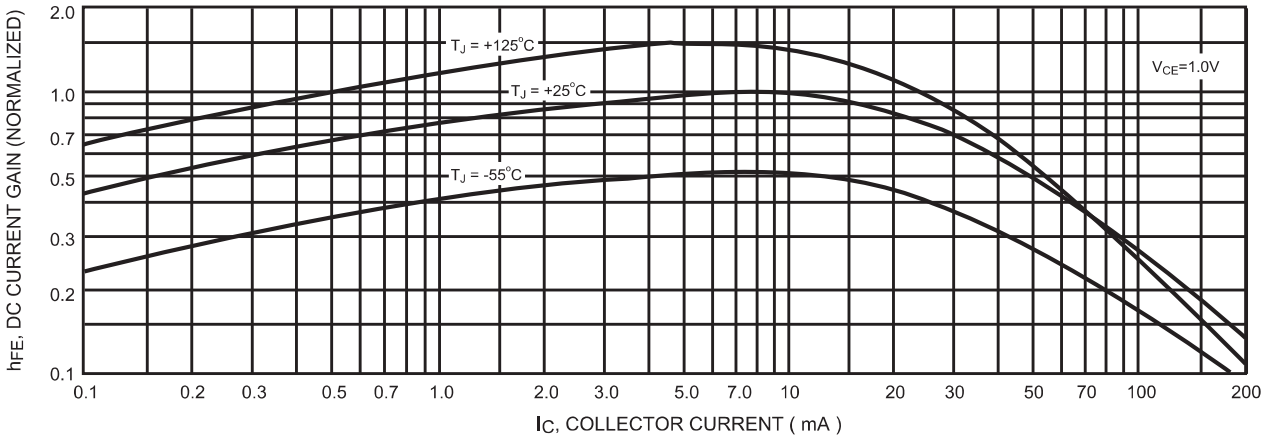


Figure 16. Collector Saturation Region

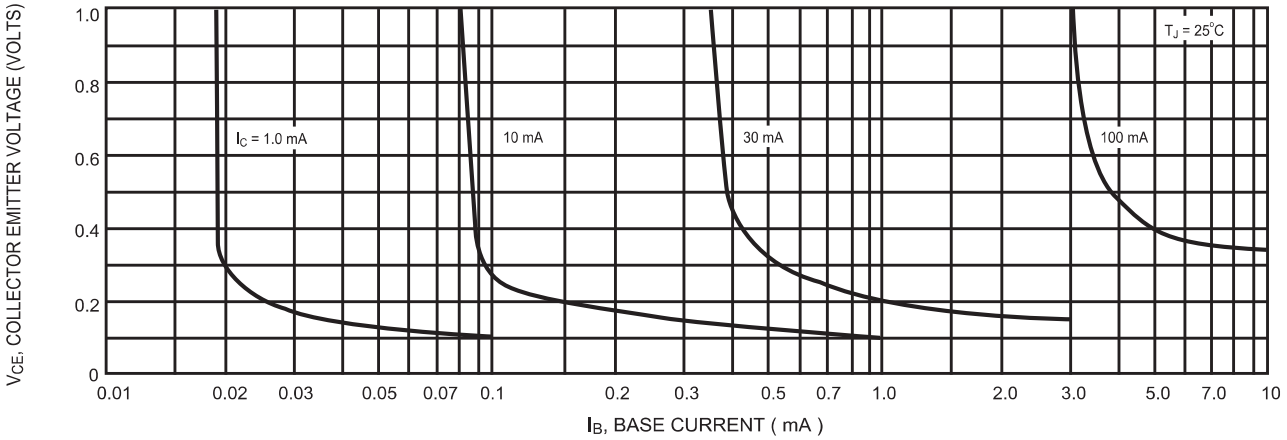


Figure 17. " ON " Voltage

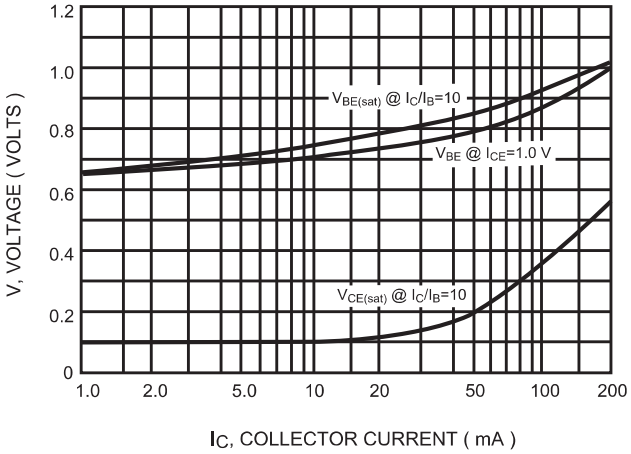
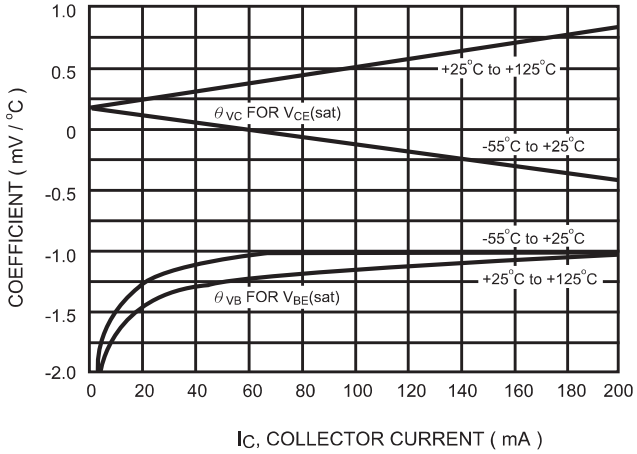


Figure 18. Temperature Coefficients



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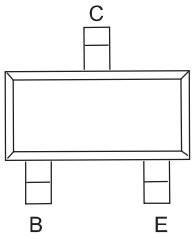
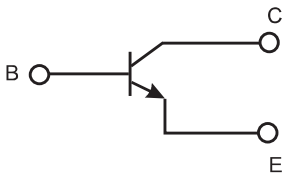
Pinning information

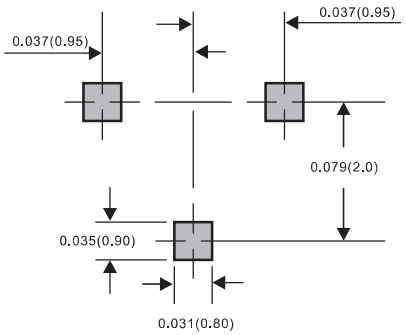
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
MMBT3904	1AM

Suggested solder pad layout

SOT-23



Dimensions in inches and (millimeters)