FMBT3904

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FMBT3904

200mA Silicon NPN Epitaxial Planar Transistor

Features

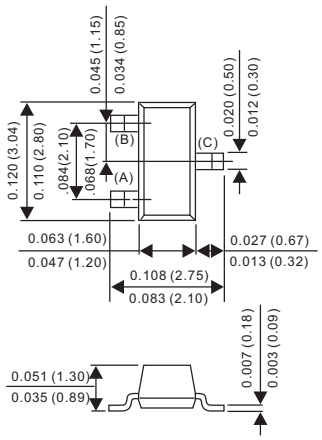
- High collector-emitterbreakdien voltage. (BV_{CEO} = 40V@I_C=1mA)
- Small load switch transistor with high gain and low stauration voltage, is designed for general purpose amflifier and switching applications at collector current.
- Capable of 225mW power dissipation.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Suffix "-H" indicates Halogen free part, ex. FMBT3904-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
- Weight : Approximated 0.008 gram

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		I_C			200	mA
Total device dissipation FR-5 board (1)	T_A = 25°C	P_D			225	mW
	Derate above 25°C	P_D			1.8	mW/°C
Thermal resistance	Junction to ambient	$R_{\theta JA}$			556	°C/W
Total device dissipation alumina substrate(2)	T_A = 25°C	P_D			300	mW
	Derate above 25°C	P_D			2.4	mW/°C
Thermal resistance	Junction to ambient	$R_{\theta JA}$			417	°C/W
Operating temperature		T_J	-55		+150	°C
Storage temperature		T_{STG}	-65		+150	

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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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(3)	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	

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	

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Switching time equivalent test circuits

Figure 1. Delay and Rise Time Equivalent Test Circuit

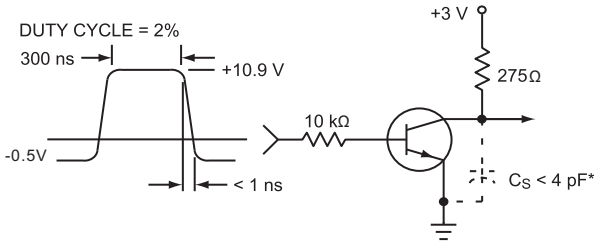
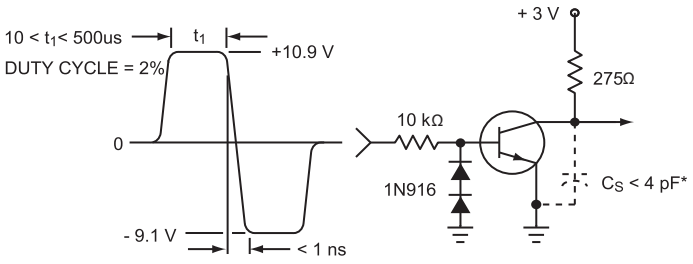


Figure 2. Storage and Fall Time Equivalent Test Circuit



* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

Figure 3. Capacitance

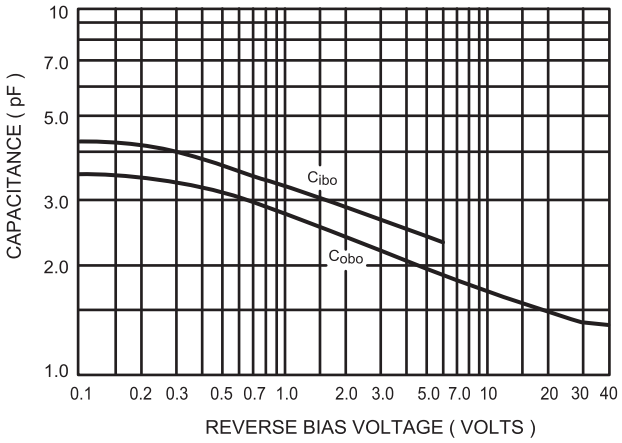


Figure 4. Charge Data

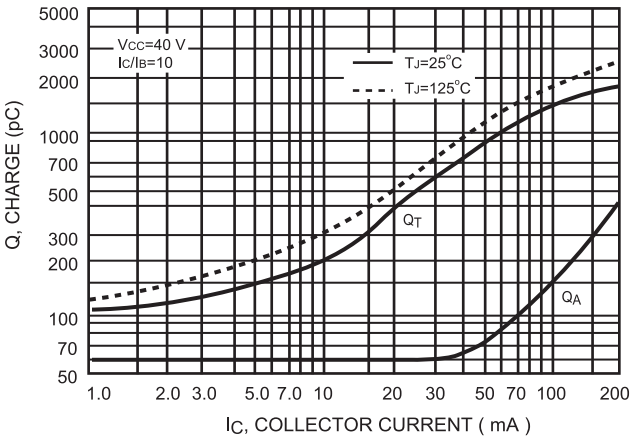


Figure 5. Turn-On Time

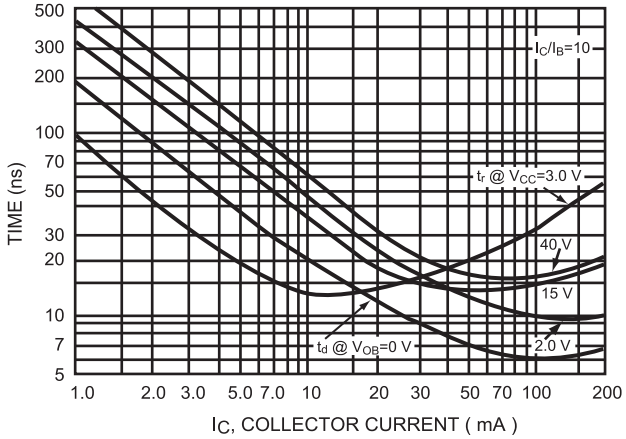


Figure 6. Rise Time

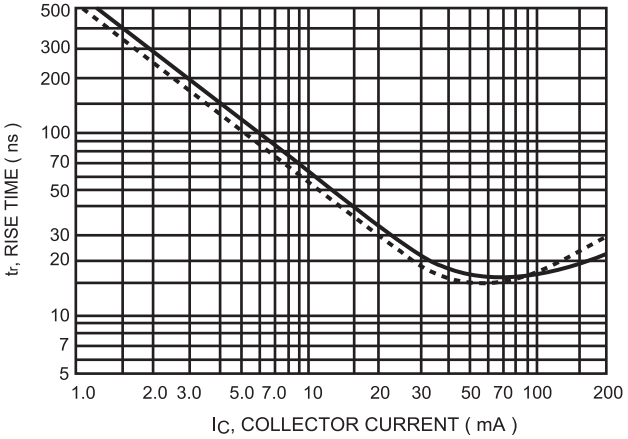


Figure 7. Storage Time

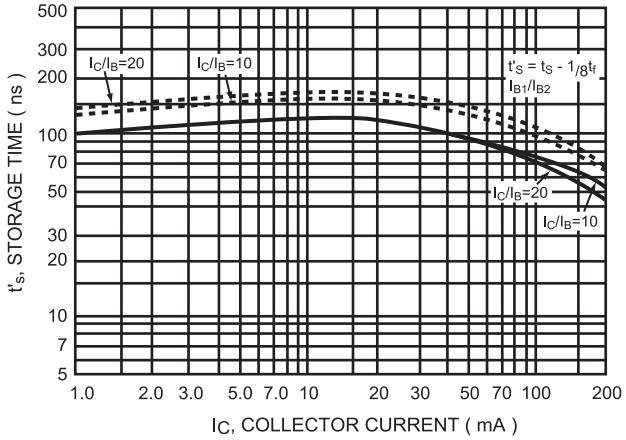
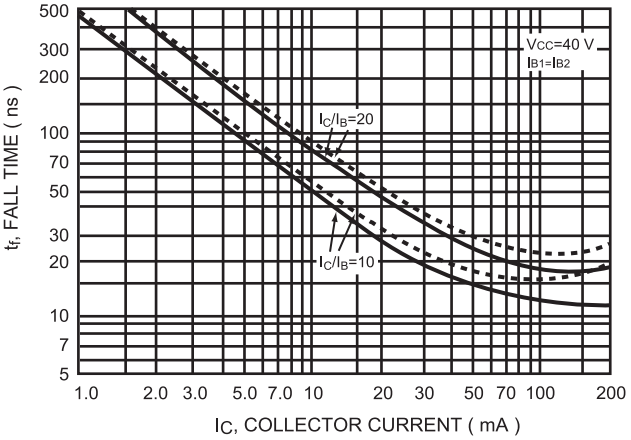


Figure 8. Fall Time



TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

Figure 9.

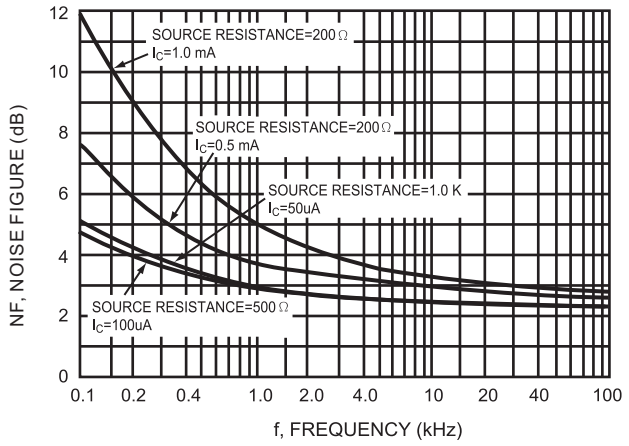
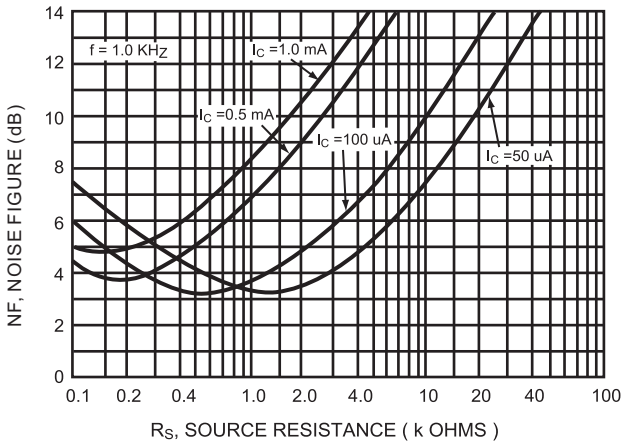


Figure 10.



h PARAMETERS

(VCE=10 V, f=1.0 kHz, TA=25 °C)

Figure 11. Current Gain

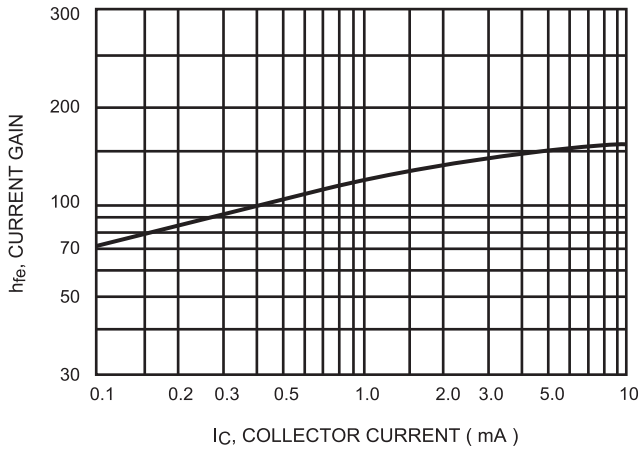


Figure 12. Output Admittance

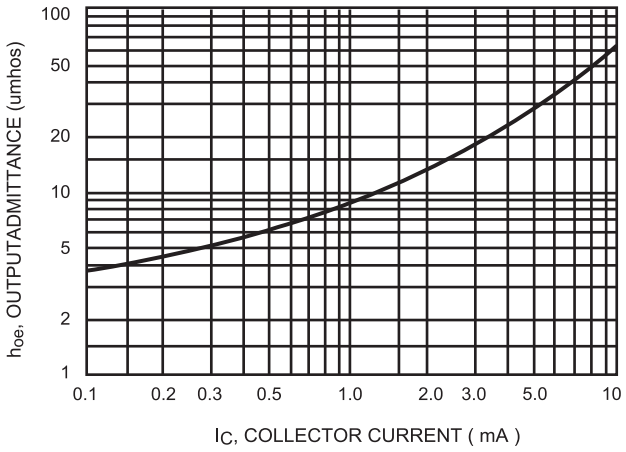


Figure 13. Input Impedance

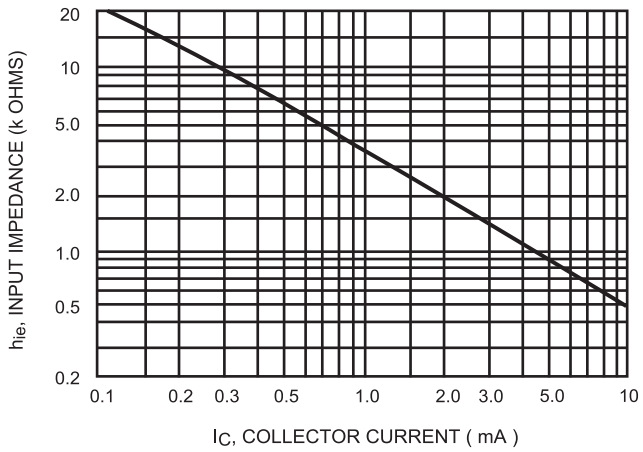
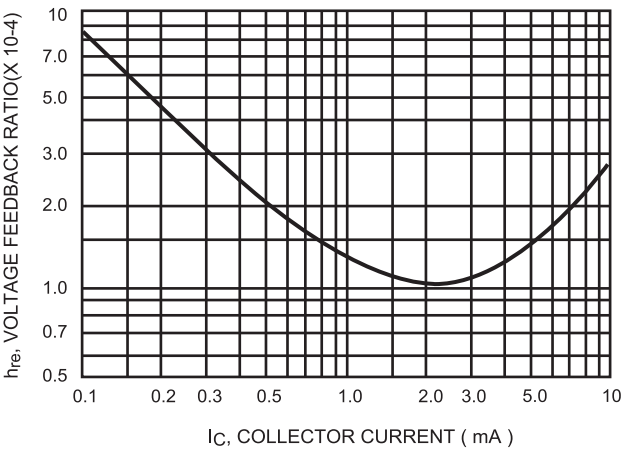


Figure 14. Voltage Feedback Ratio



TYPICAL STATIC CHARACTERISTICS

Figure 15. DC Current Gain

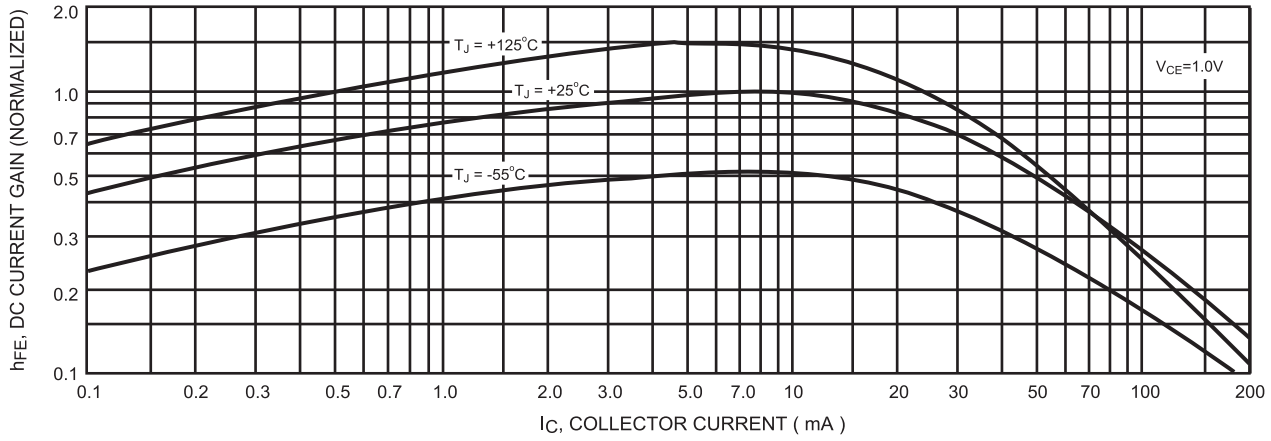


Figure 16. Collector Saturation Region

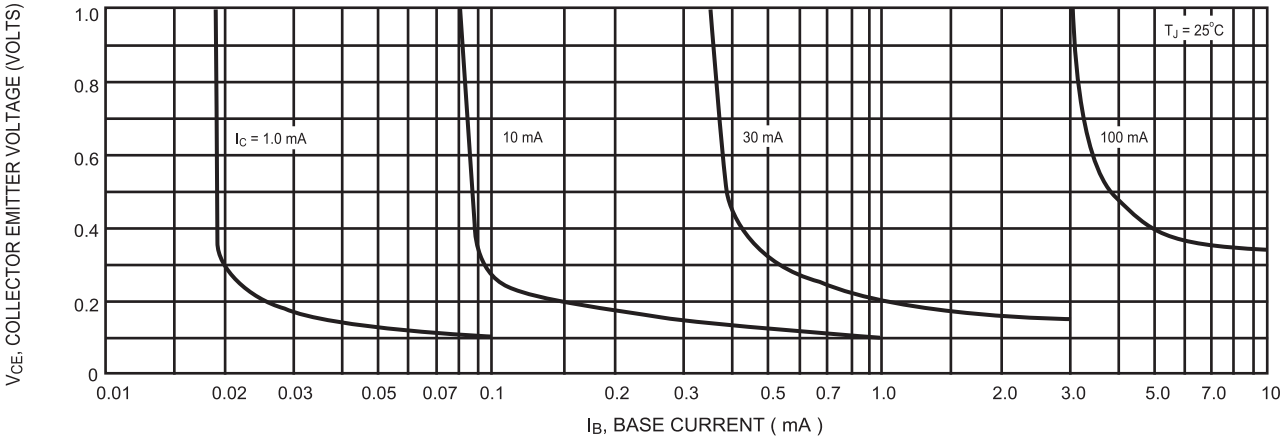


Figure 17. " ON " Voltage

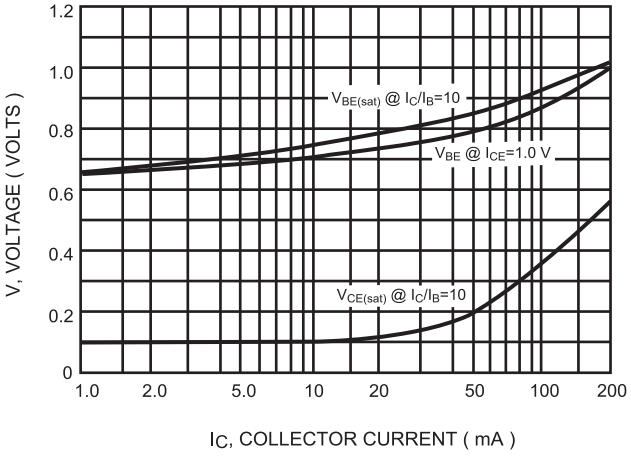
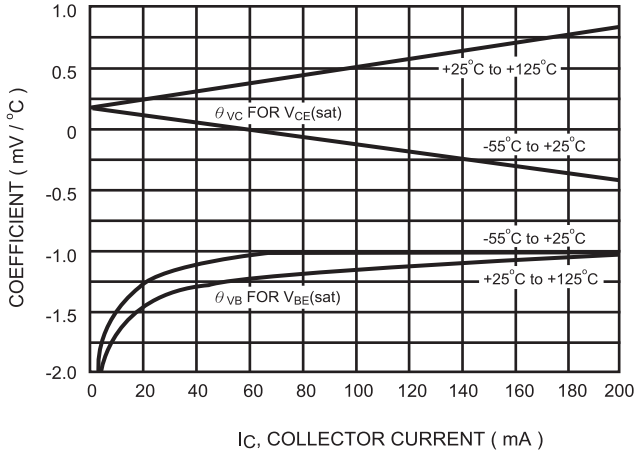
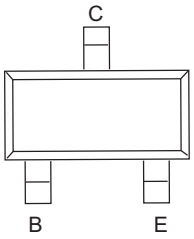
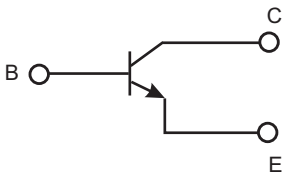


Figure 18. Temperature Coefficients



FMBT3904

Pinning information

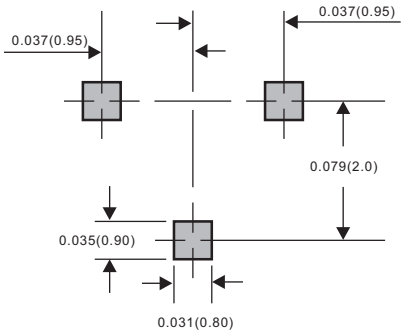
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
FMBT3904	1AM
	LF
	K1N

Suggested solder pad layout

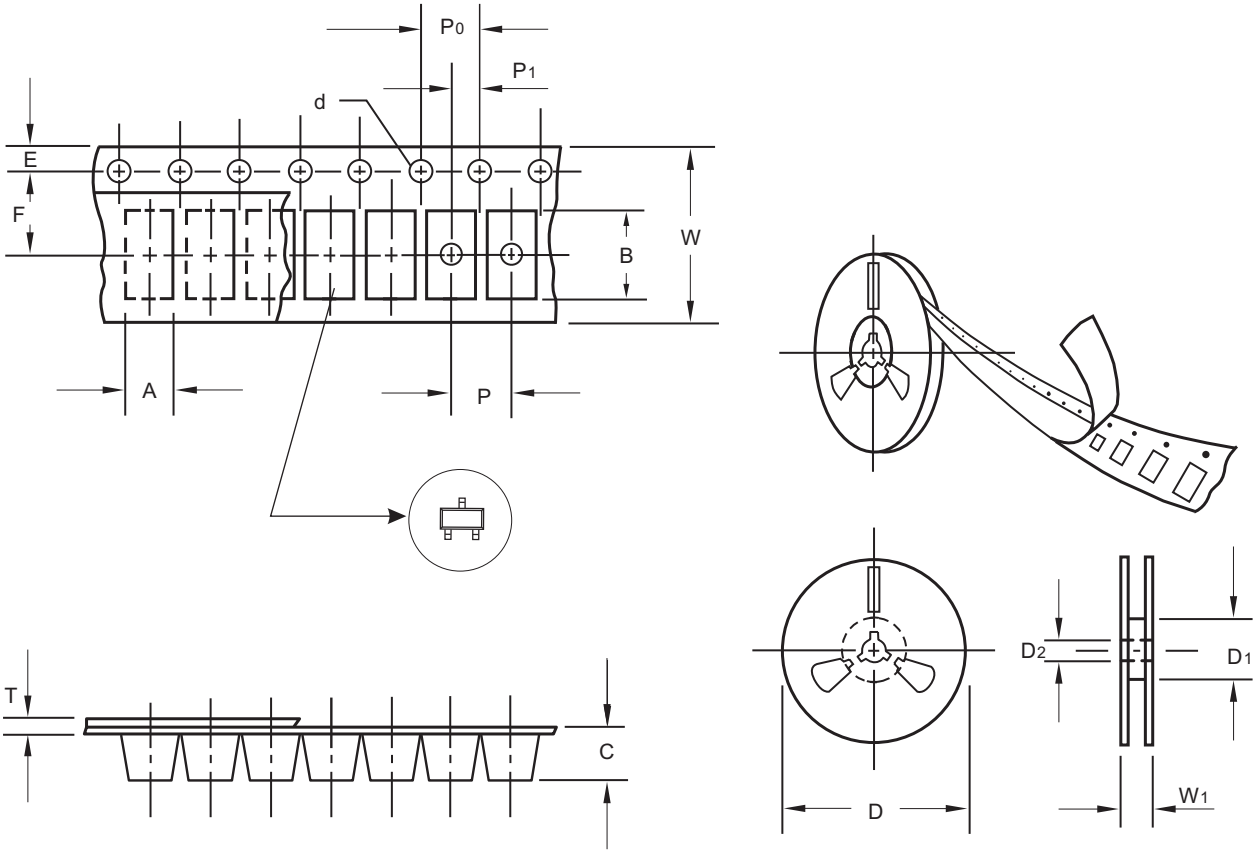
SOT-23



Dimensions in inches and (millimeters)

FMBT3904

Packing information



unit:mm

Item	Symbol	Tolerance	SOT-23
Carrier width	A	0.1	3.15
Carrier length	B	0.1	2.77
Carrier depth	C	0.1	1.22
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D_1	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D_1	min	55.00
Feed hole diameter	D_2	0.5	13.00
Sprocket hole position	E	0.1	1.75
Punch hole position	F	0.1	3.50
Punch hole pitch	P	0.1	4.00
Sprocket hole pitch	P_0	0.1	4.00
Embossment center	P_1	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W_1	1.0	12.0

Note:Devices are packed in accor dance with EIA standar RS-481-A and specifications listed above.

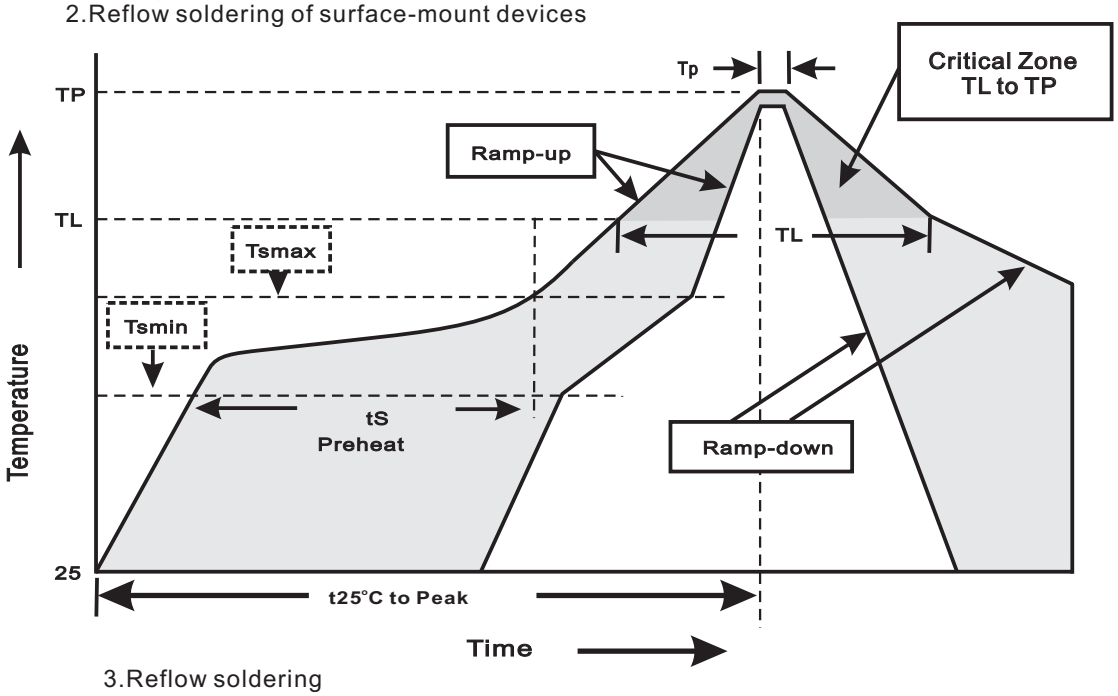
FMBT3904

Reel packing

PACKAGE	REEL SIZE	REEL (pcs)	COMPONENT SPACING (m/m)	BOX (pcs)	INNER BOX (m/m)	REEL DIA, (m/m)	CARTON SIZE (m/m)	CARTON (pcs)	APPROX. GROSS WEIGHT (kg)
SOT-23	7"	3,000	4.0	30,000	183*183*123	178	382*262*387	240,000	11.6

Suggested thermal profiles for soldering processes

1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile Feature	Soldering Condition
Average ramp-up rate(T_L to T_P)	<3°C/sec
Preheat -Temperature Min(Tsmin) -Temperature Max(Tsmax) -Time(min to max)(t_s)	 150°C 200°C 60~120sec
Tsmax to T_L -Ramp-upRate	 <3°C/sec
Time maintained above: -Temperature(T_L) -Time(t_L)	 217°C 60~260sec
Peak Temperature(T_P)	255°C-0/+5°C
Time within 5°C of actual Peak Temperature(t_P)	10~30sec
Ramp-down Rate	<6°C/sec
Time 25°C to Peak Temperature	<6minutes

FMBT3904

High reliability test capabilities

Item Test	Conditions
1. Steady State Operating Life	P_D=225mW Test Duration:1000hrs
2. High Temperature Reverse Bias	Tj=150℃, V_{CE}=80% related volage, 1000hrs
3. Temperature Cycle	-55℃(15min) to 150℃(15min)Air to Air Transition Time<20sec Test Cycles:1000cycle
4. Autoclave	P=2atm Ta=121℃ RH=100% Test Duration:96hrs
5. High Temperature Storage Life	Ta=150℃ Test Duration:1000hrs
6. Solderability	245℃,5sec
7. High Temperature High Humidity Reverse Bias	Ta=85℃, 85%RH, V_{CE}=80% related volage, 1000hrs
8. Resistance to Soldering Heat	260℃,10sec