

FMBT3904

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FMBT3904

General Purpose Transistor NPN Silicon

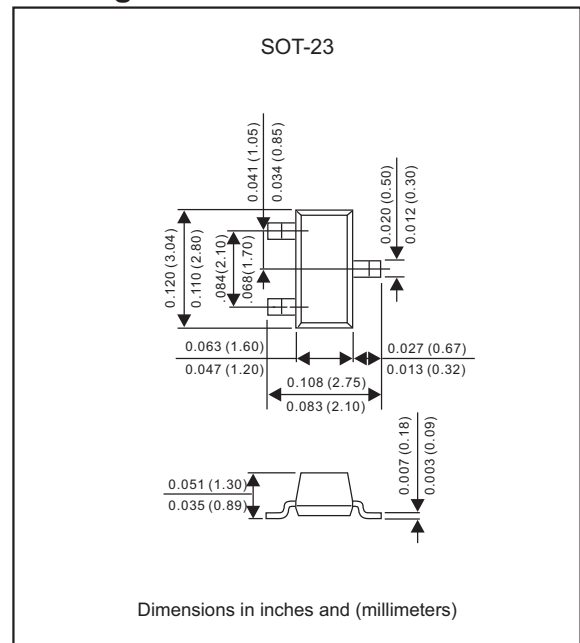
Features

- High collector-emitter breakdown voltage
- Small load switch transistor with high gain and low saturation voltage, is designed for general purpose amplifier and switching applications at collector current
- Capable of 225mW power dissipation
- Lead-free parts meet RoHS requirements
- 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



Maximum ratings (AT $T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Limits	Unit
Collector-base voltage	V_{CB0}	60	V
Collector-emitter voltage	V_{CE0}	40	V
Emitter-base voltage	V_{EB0}	6.0	V
Collector current - continuous	I_C	200	mA

Thermal characteristics

Parameter	Symbol	Limits	Unit
Total device dissipation FR-5 board (Note 1) @ $T_A=25^\circ\text{C}$	P_D	225	mW
Derate above 25°C		1.8	mW/ $^\circ\text{C}$
Thermal resistance junction to ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Thermal resistance junction to case	$R_{\theta JC}$	300	$^\circ\text{C}/\text{W}$
Operating junction temperature range	T_J	-55 to +150	$^\circ\text{C}$
Storage temperature range	T_{STG}	-55 to +150	$^\circ\text{C}$

Note 1: FR-5 = 1.0 X 0.75 X 0.062 in.

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Electrical characteristics (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted)**Off characteristics**

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Collector-base breakdown voltage	$I_C = 10\mu\text{A}$, $I_E = 0$	$V_{(BR)CBO}$	60			V
Collector-emitter breakdown voltage	$I_C = 1.0\text{mA}$, $I_B = 0$	$V_{(BR)CEO}$	40			V
Emitter-base breakdown voltage	$I_E = 10\mu\text{A}$, $I_C = 0$	$V_{(BR)EBO}$	6.0			V
Base cutoff current	$V_{CE} = 30\text{V}$, $V_{EB} = 3.0\text{V}$	I_{BL}			50	nA
Collector cutoff current	$V_{CE} = 30\text{V}$, $V_{EB} = 3.0\text{V}$	I_{CEX}			50	nA

On characteristics(2)

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

2. Pulse test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2.0\%$.

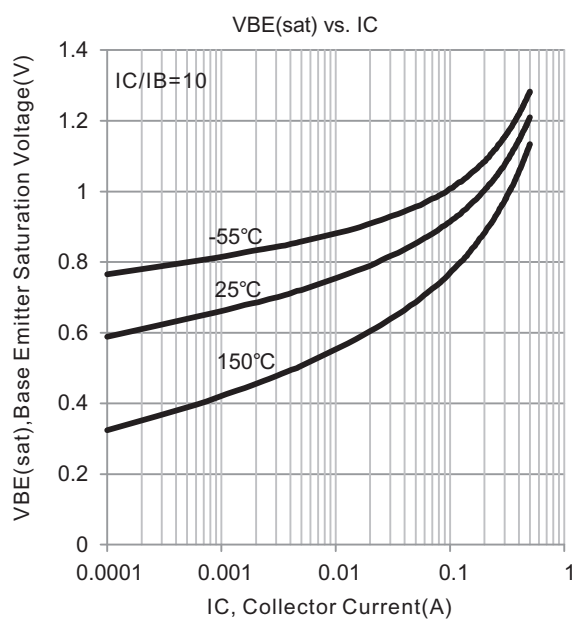
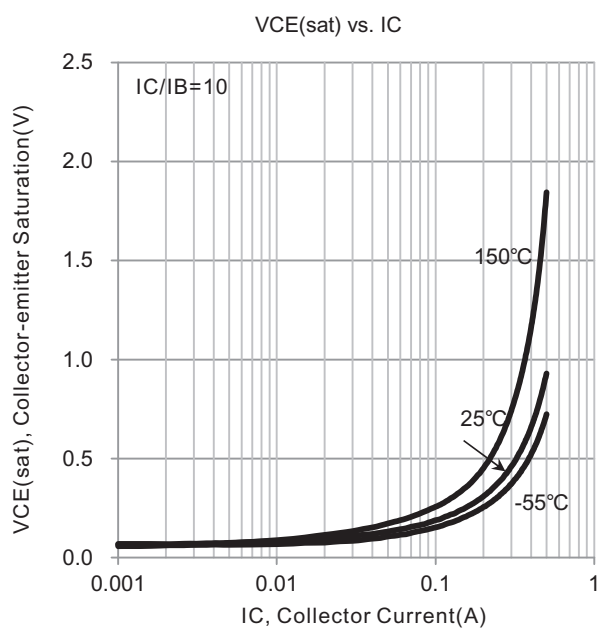
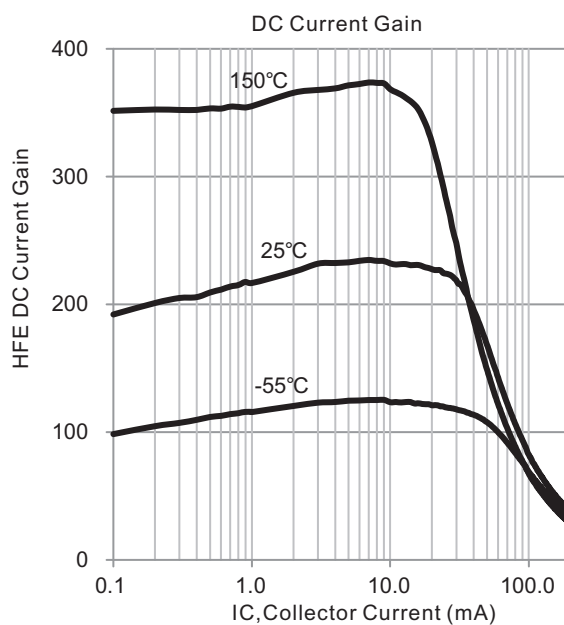
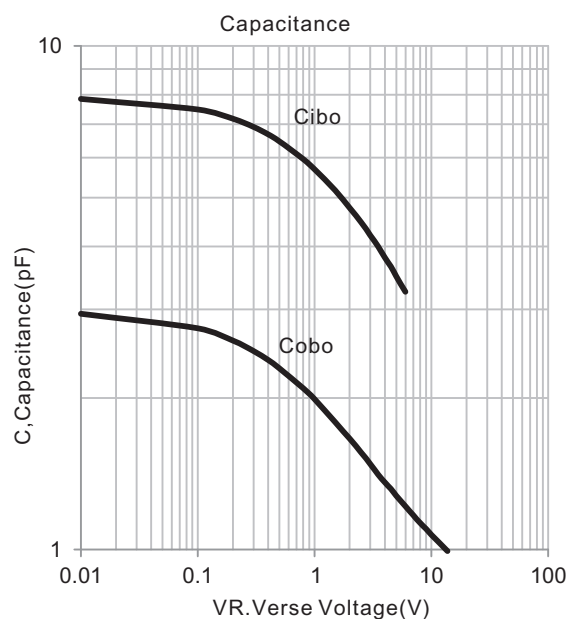
Small-signal characteristics

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Current-gain-bandwidth product	$I_C = 10\text{mA}$, $V_{CE} = 20\text{V}$, $f = 100\text{MHz}$	f_T	300			MHz
Output capacitance	$V_{CB} = 5.0\text{V}$, $I_E = 0$, $f = 1.0\text{MHz}$	C_{obo}			4.0	pF
Input capacitance	$V_{EB} = 0.5\text{V}$, $I_C = 0$, $f = 1.0\text{MHz}$	C_{ibo}			8.0	pF

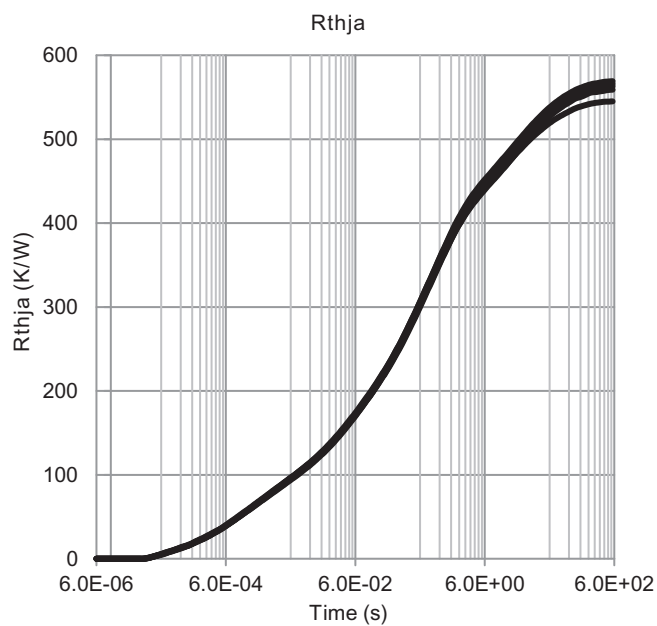
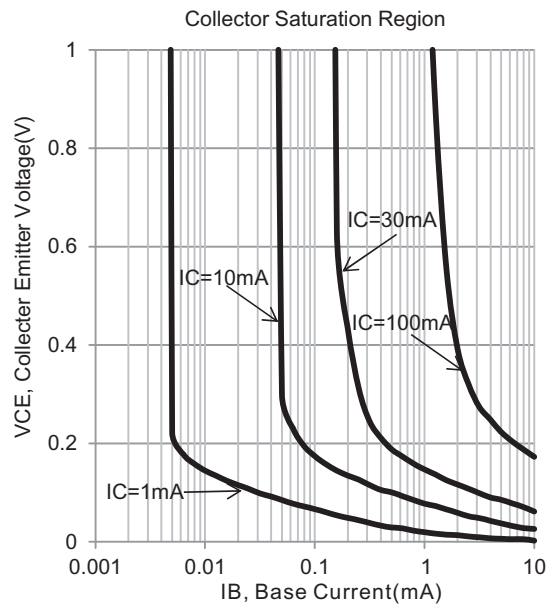
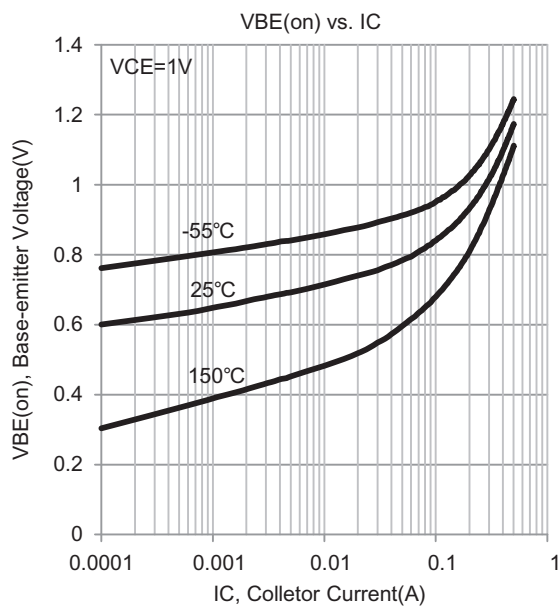
Switching characteristics

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Delay time	$V_{CC} = 3.0\text{V}$, $V_{BE} = -0.5\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = 1.0\text{mA}$	t_d			35	ns
Rise time		t_r			35	
Storage time	$V_{CC} = 3.0\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = I_{B2} = 1.0\text{mA}$	t_s			200	
Fall time		t_f			50	

Rating and characteristic curves (FMBT3904)

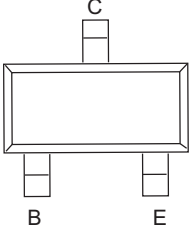
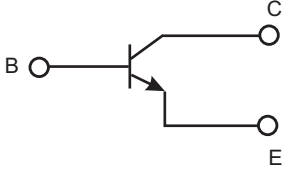


Rating and characteristic curves (FMBT3904)



FMBT3904

Pinning information

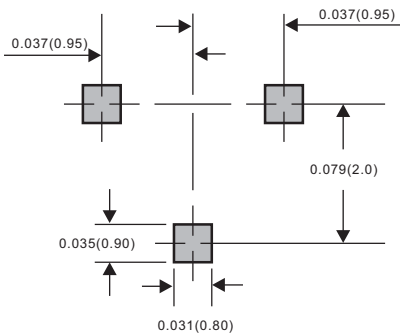
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
FMBT3904	1AM

Suggested solder pad layout

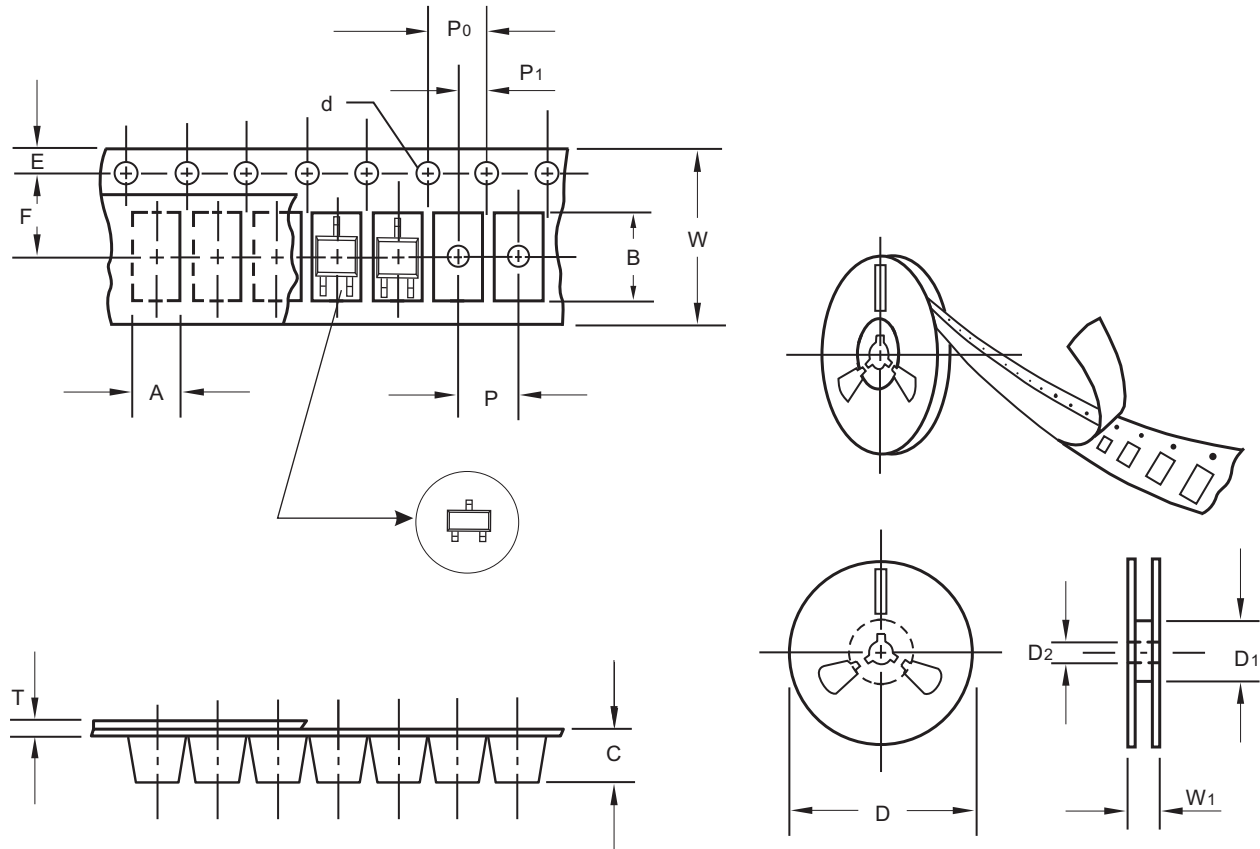
SOT-23



Dimensions in inches and (millimeters)

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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	D1	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D1	min	55.00
Feed hole diameter	D2	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	P0	0.1	4.00
Embossment center	P1	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W1	1.0	12.0

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

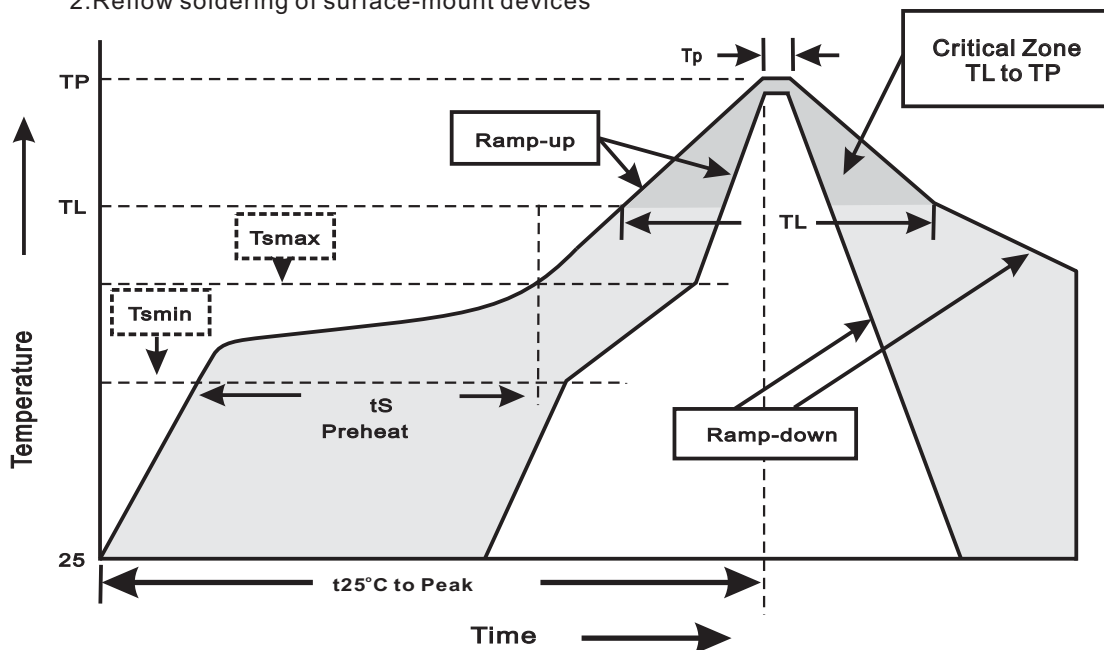
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Reel packing

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*123*183	178	382*257*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(T_{smin}) -Temperature Max(T_{smax}) -Time(min to max)(t_s)	150°C 200°C 60~120sec
T_{smax} 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

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High reliability test capabilities

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