

FMBT3904W**List**

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FMBT3904W

General Purpose NPN Silicon Transistor

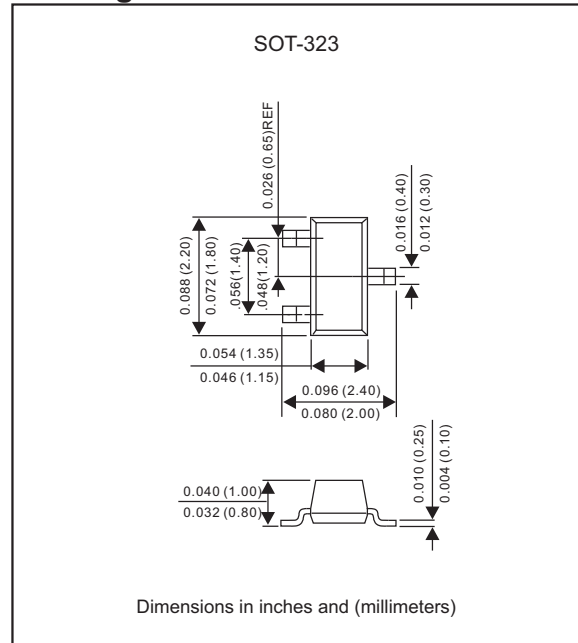
Features

- High collector-emitter breakdown voltage ($BV_{CEO} = 40V @ I_C = 1mA$)
- 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 150mW power dissipation
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex.FMBT3904W-H

Mechanical data

- Epoxy: UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-323
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any
- Weight : Approximated 0.006 gram

Package outline



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

Parameter	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) @ $T_A = 25^\circ C$ Derate above $25^\circ C$	P_D			150 1.2	mW mW/ $^\circ C$
Thermal resistance junction to ambient	$R_{\theta JA}$			833	$^\circ C/W$
Operating junction temperature range	T_J	-55		+150	$^\circ C$
Storage temperature range	T_{STG}	-55		+150	$^\circ C$

1. FR-5 = 1.0×0.75×0.062 in.

FMBT3904W**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	$I_C = 1\text{mA}$, $I_B = 0$	$V_{(BR)CEO}$	40			V
Emitter-base breakdown voltage	$I_E = 10\mu\text{A}$, $I_C = 0$	$V_{(BR)EBO}$	6.0			V
Base cutoff current	$V_{CE} = 30\text{Vdc}$, $V_{EB} = 3.0\text{Vdc}$	I_{BL}			50	nA
Collector cutoff current	$V_{CE} = 30\text{Vdc}$, $V_{EB} = 3.0\text{Vdc}$	I_{CEX}			50	nA

On characteristics(Note 1)

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	V
Base-emitter saturation voltage	$I_C = 10\text{mA}$, $I_B = 1.0\text{mA}$	$V_{BE(sat)}$	0.65		0.85	V
	$I_C = 50\text{mA}$, $I_B = 5.0\text{mA}$				0.95	V

Small-signal characteristics

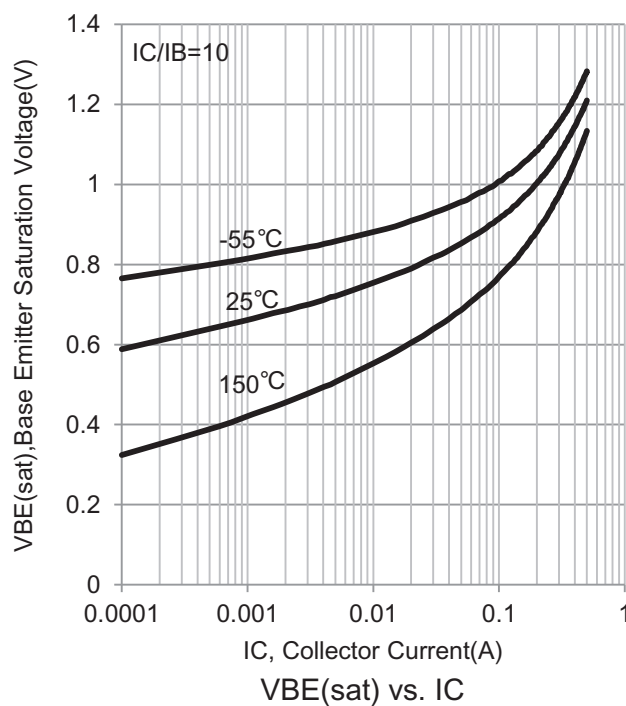
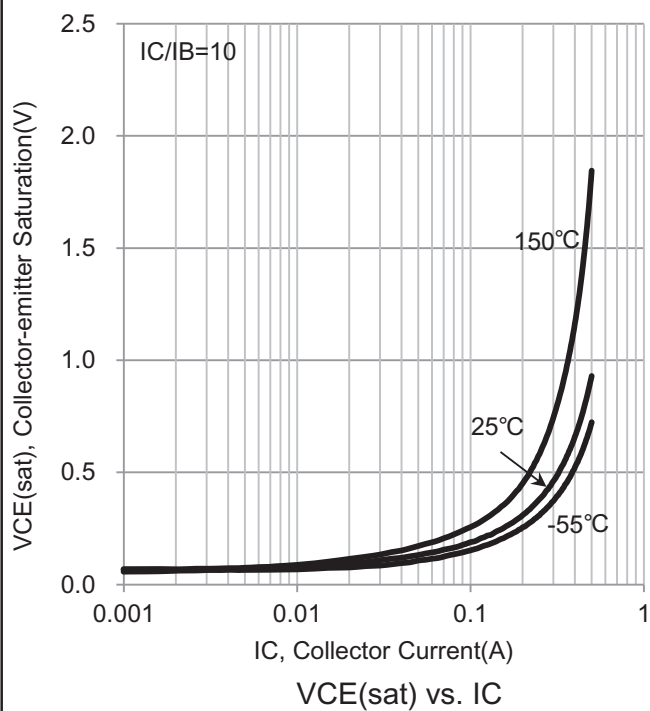
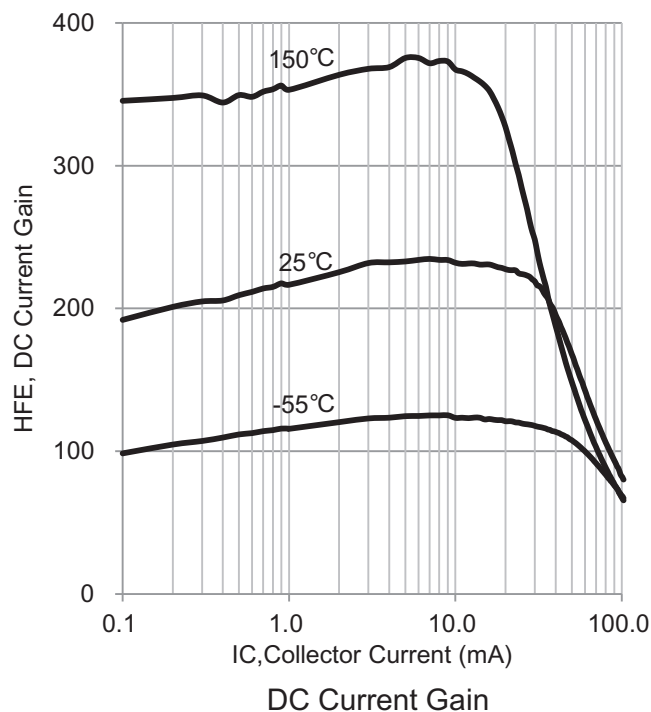
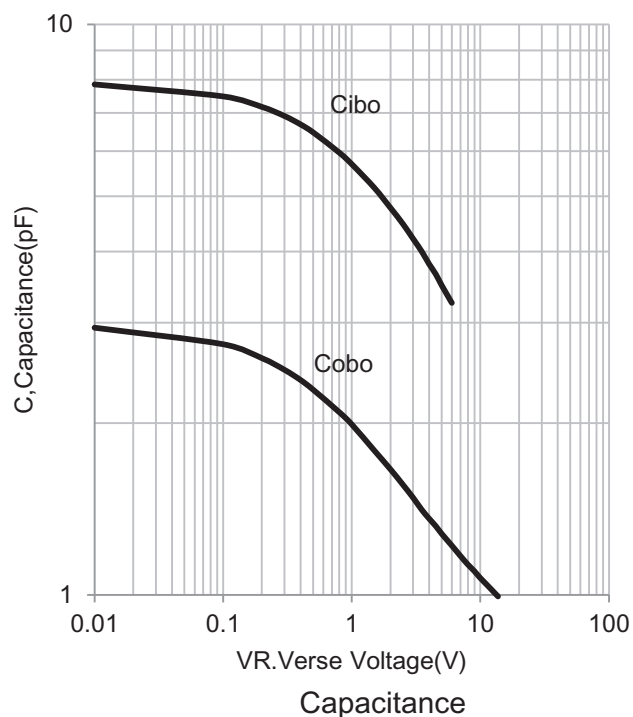
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Current-gain-bandwidth product	$I_C = 10\text{mA}$, $V_{CE} = 20\text{V}$, $f = 100\text{MHz}$	f_T	300			MHz
Output capacitance	$V_{CB} = 5.0\text{V}$, $I_E = 0$, $f = 1.0\text{MHz}$	C_{obo}			4.0	pF
Input capacitance	$V_{EB} = 0.5\text{V}$, $I_C = 0$,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

Switching characteristics

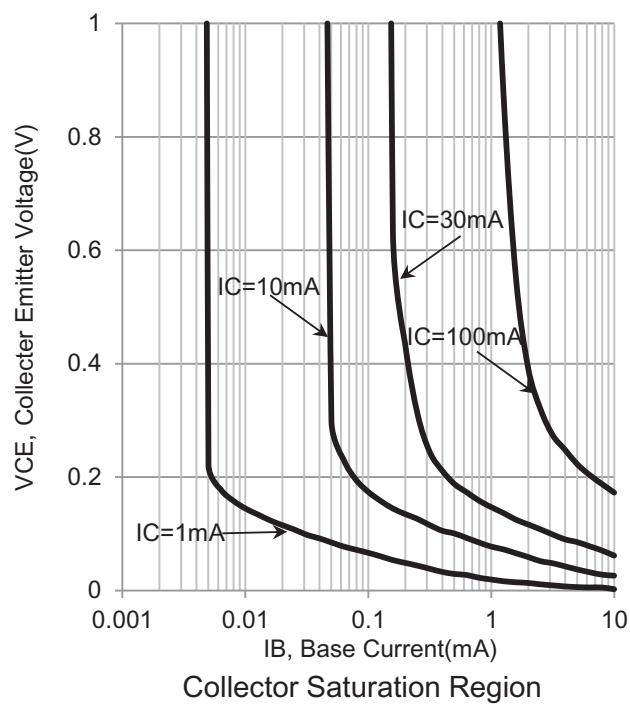
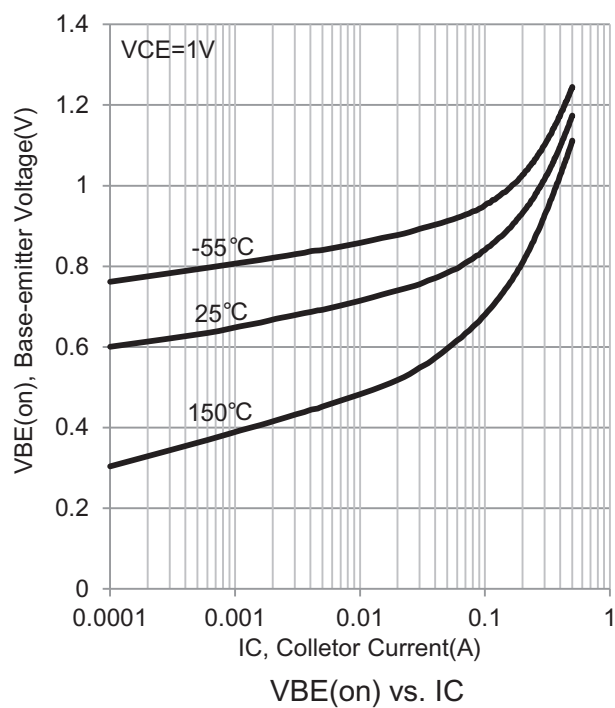
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Delay time	$V_{CC} = 3.0\text{V}$, $V_{BE} = -0.5\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = 1.0\text{mA}$	t_d			35	ns
Rise time		t_r			35	ns
Storage time	$V_{CC} = 3.0\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = I_{B2} = 1.0\text{mA}$	t_s			200	ns
Fall time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

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

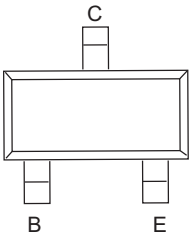
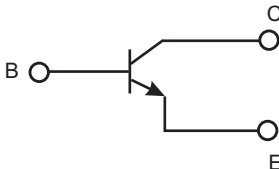
Rating and characteristic curves (FMBT3904W)



Rating and characteristic curves (FMBT3904W)

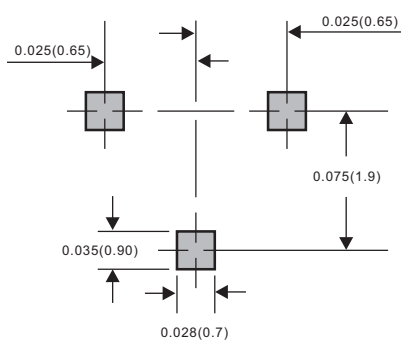


FMBT3904W**Pinning information**

Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

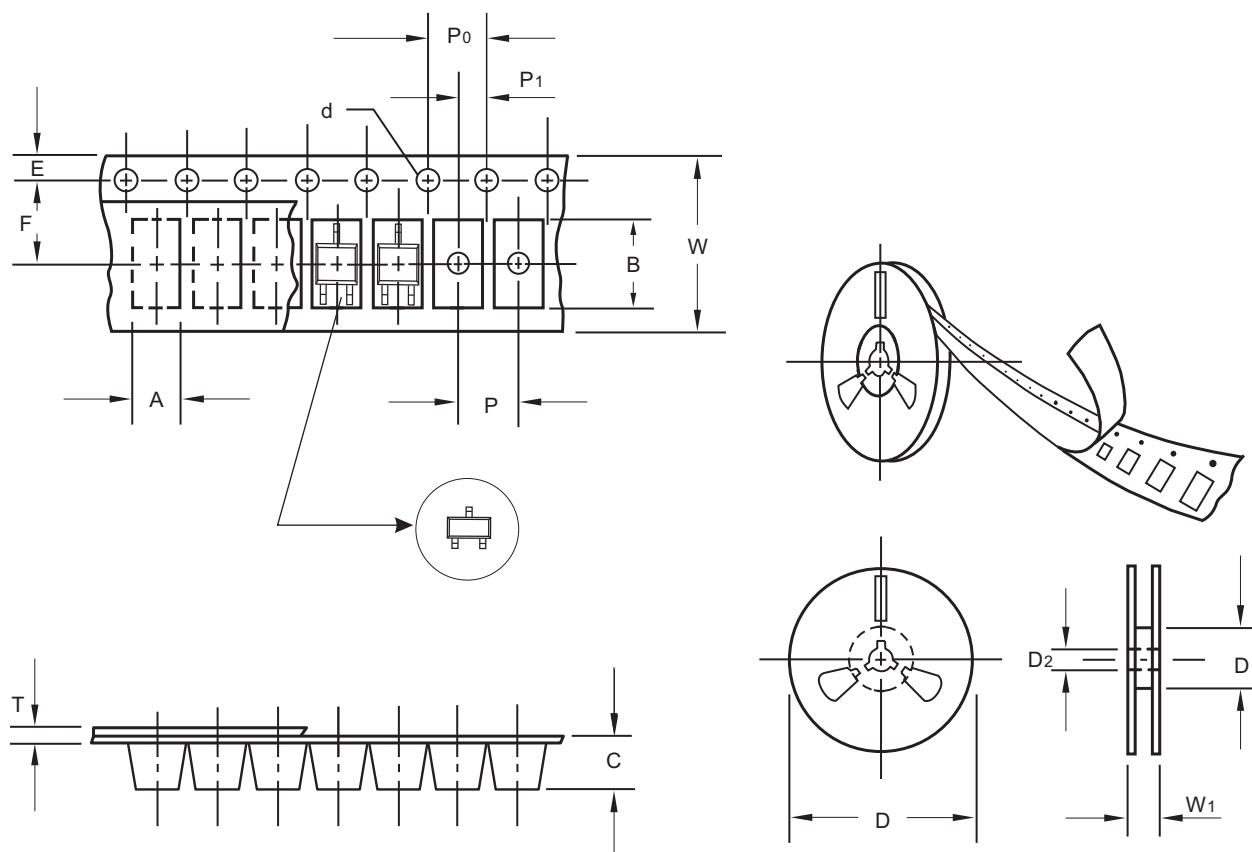
Type number	Marking code
FMBT3904W	AM

Suggested solder pad layout**SOT-323**

Dimensions in inches and (millimeters)

FMBT3904W

Packing information



unit:mm

Item	Symbol	Tolerance	SOT-323
Carrier width	A	0.1	2.25
Carrier length	B	0.1	2.55
Carrier depth	C	0.1	1.19
Sprocket hole	d	0.1	1.55
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	62.00
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	11.40

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

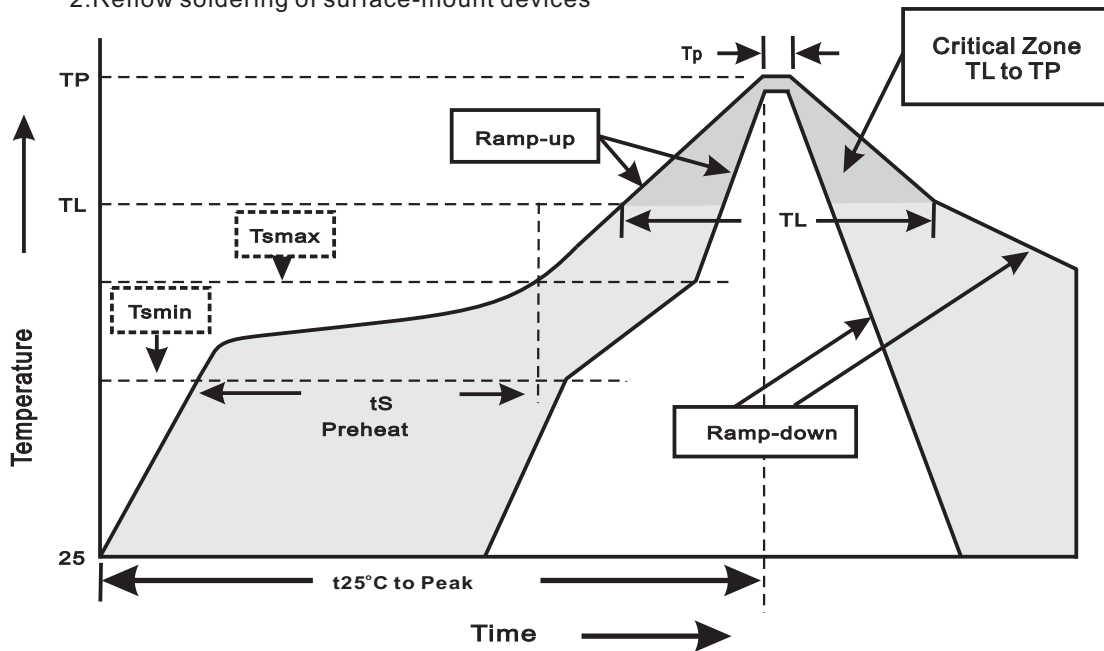
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Reel packing

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-323	7"	3,000	4.0	30,000	183*123*183	178	382*257*387	240,000	9.5

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 _{smmin}) -Temperature Max(T _{smmax}) -Time(min to max)(t _s)	150°C 200°C 60~120sec
T _{smmax} 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	$P_D=150\text{mW}$ Test Duration:1000hrs
2. High Temperature Reverse Bias	$T_J=150^\circ\text{C}$, $V_{CE}=80\%$ related volage, 1000hrs
3. Temperature Cycle	$-55^\circ\text{C}(15\text{min})$ to $150^\circ\text{C}(15\text{min})$ 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