FMBT3904-Q1

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FMBT3904-Q1

General Purpose Transistor
NPN Silicon

Features

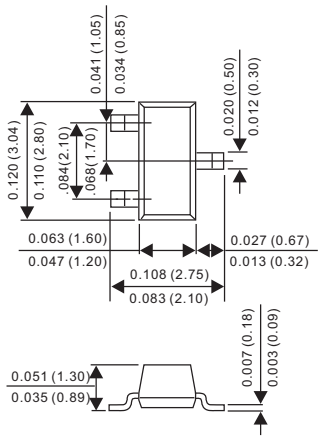
- High collector-emitterbreakdien voltage (B_{VCEO} 40V Min.@I_C=1mA)
- Small load switch transistor with high gain and low stauration voltage, is designed for general purpose amflifier and switching applications at collector current
- Capable of 225mW power dissipation
- Lead-free parts meet RoHS requirements
- Qualified to AEC-Q101 standards for high reliability
- Suffix "-H" indicates Halogen free part, ex. FMBT3904-Q1-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	Symbol	Limits	Unit
Collector-emitter voltage	V_{CEO}	40	V
Collector-base voltage	V_{CBO}	60	V
Emitter-base voltage	V_{EBO}	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°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
Operating junction temperature range		T_J	-55 to +150	°C
Storage temperature range		T_{STG}	-55 to +150	°C

Note 1: FR-5 = 1.0 X 0.75 X0.062 in.

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

Off characteristics

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Collector-emitter breakdown voltage	I_C = 1mA, I_B = 0	$V_{(BR)CEO}$	40			V
Collector-base breakdown voltage	I_C = 10μA, I_E = 0	$V_{(BR)CBO}$	60			V
Emitter-base breakdown voltage	I_E = 10μA, I_C = 0	$V_{(BR)EBO}$	6.0			V
Collector cutoff current	V_{CE} = 30V, V_{EB} = 3.0V	I_{CEX}			50	nA
Base cutoff current	V_{CE} = 30V, V_{EB} = 3.0V	I_{BL}			50	nA

On characteristics(2)

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	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	I_C = 10mA, I_B = 1.0mA	$V_{BE(sat)}$	0.65		0.85	V
	I_C = 50mA, I_B = 5.0mA				0.95	

Small-signal characteristics

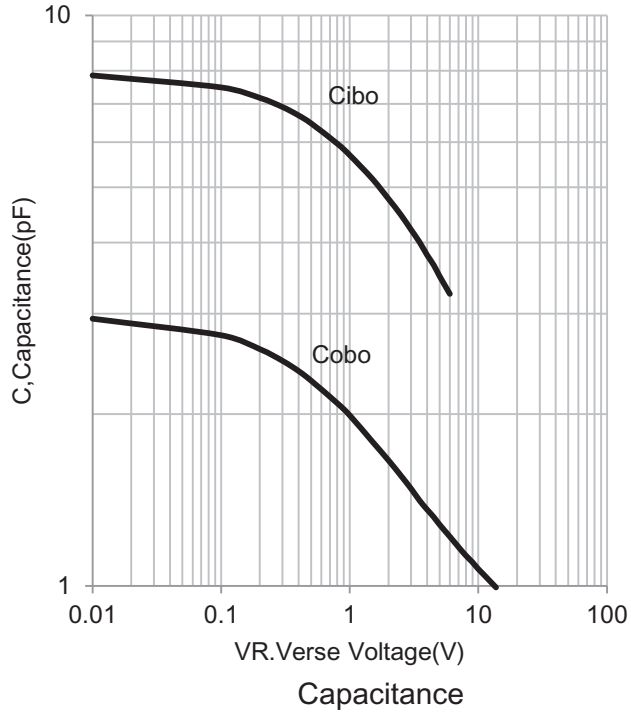
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Current-gain-bandwidth product	I_C = 10mA, V_{CE} = 20V, f = 100MHz	f_T	300			MHz
Output capacitance	V_{CB} = 5.0V, I_E = 0, f = 1.0MHz	C_{obo}			4.0	pF
Input capacitance	V_{EB} = 0.5V, I_C = 0, f = 1.0MHz	C_{ibo}			8.0	pF

Switching characteristics

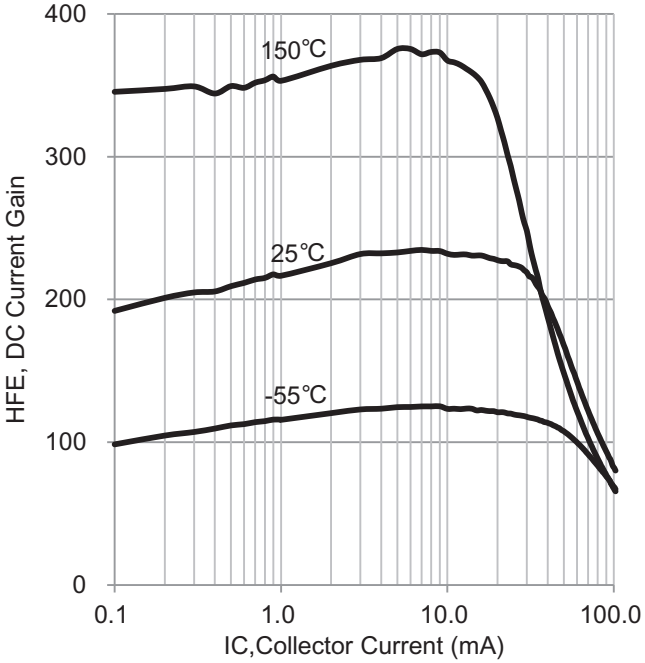
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Delay time	V_{CC} = 3.0V, V_{BE} = -0.5V, I_C = 10mA, I_{B1} = 1.0mA	td			35	ns
Rise time		tr			35	
Storage time	V_{CC} = 3.0V, IC =10mA, I_{B1} = I_{B2} = 1.0mA	ts			200	
Fall time		tf			50	

2.Pulse test : pulse width ≦ 300μs, duty cycle ≦ 2.0%.

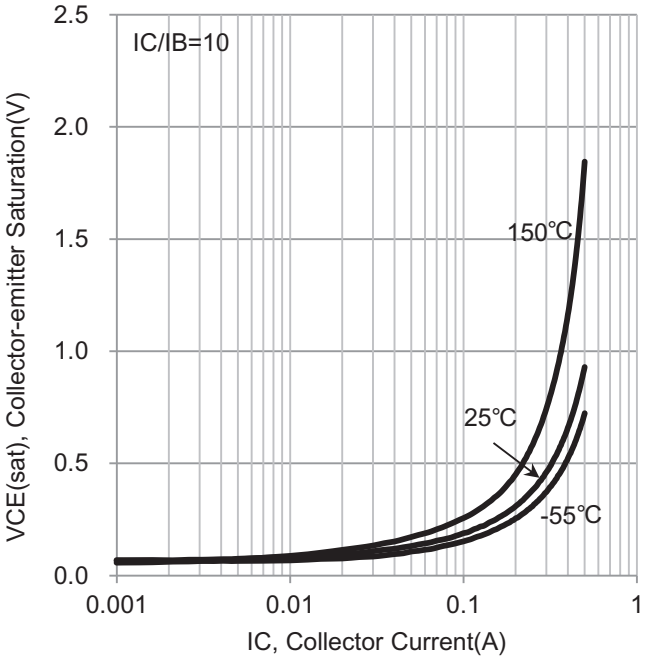
Rating and characteristic curves (FMBT3904-Q1)



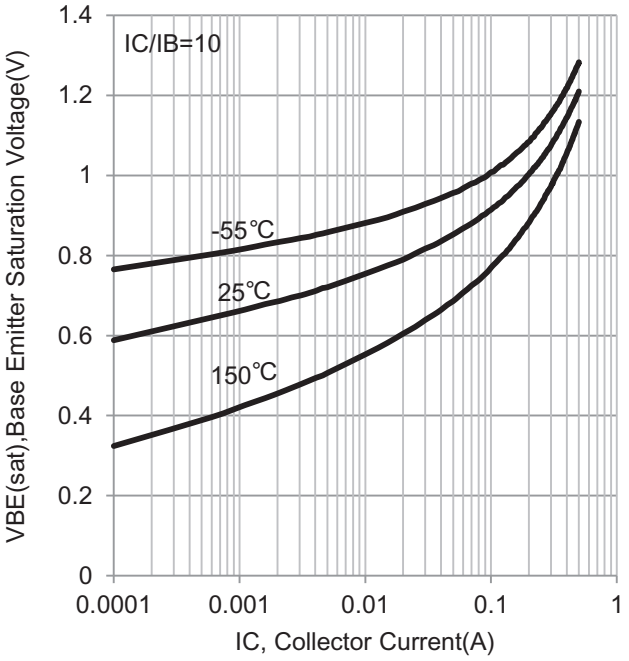
Capacitance



DC Current Gain

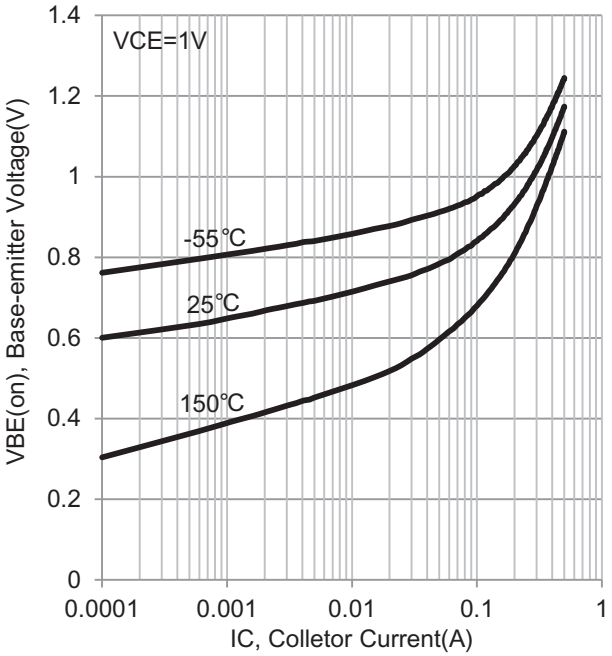


VCE(sat) vs. IC

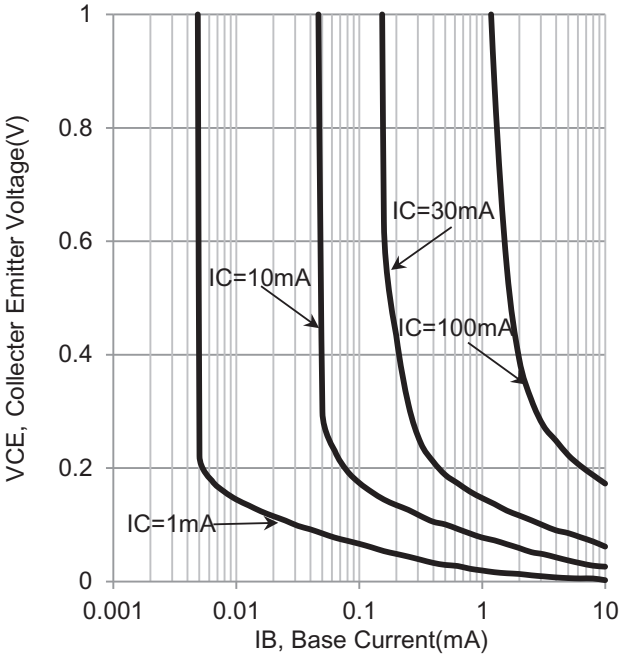


VBE(sat) vs. IC

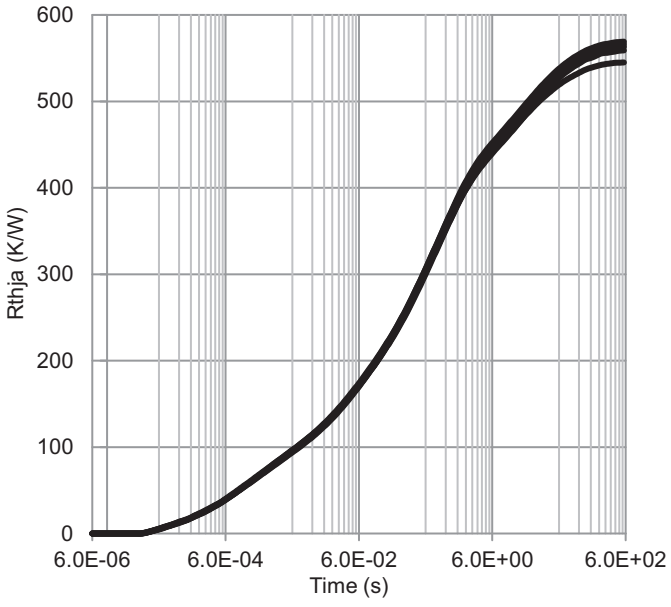
Rating and characteristic curves (FMBT3904-Q1)



VBE(on) vs. IC



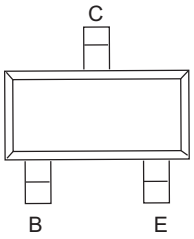
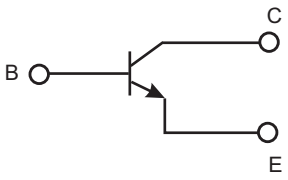
Collector Saturation Region



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Pinning information

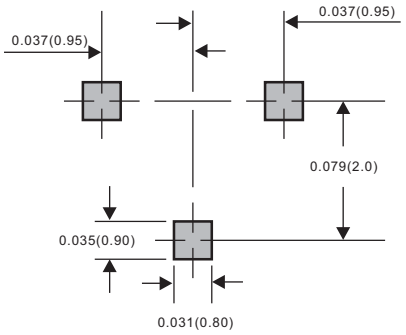
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
FMBT3904-Q1	1AM

Suggested solder pad layout

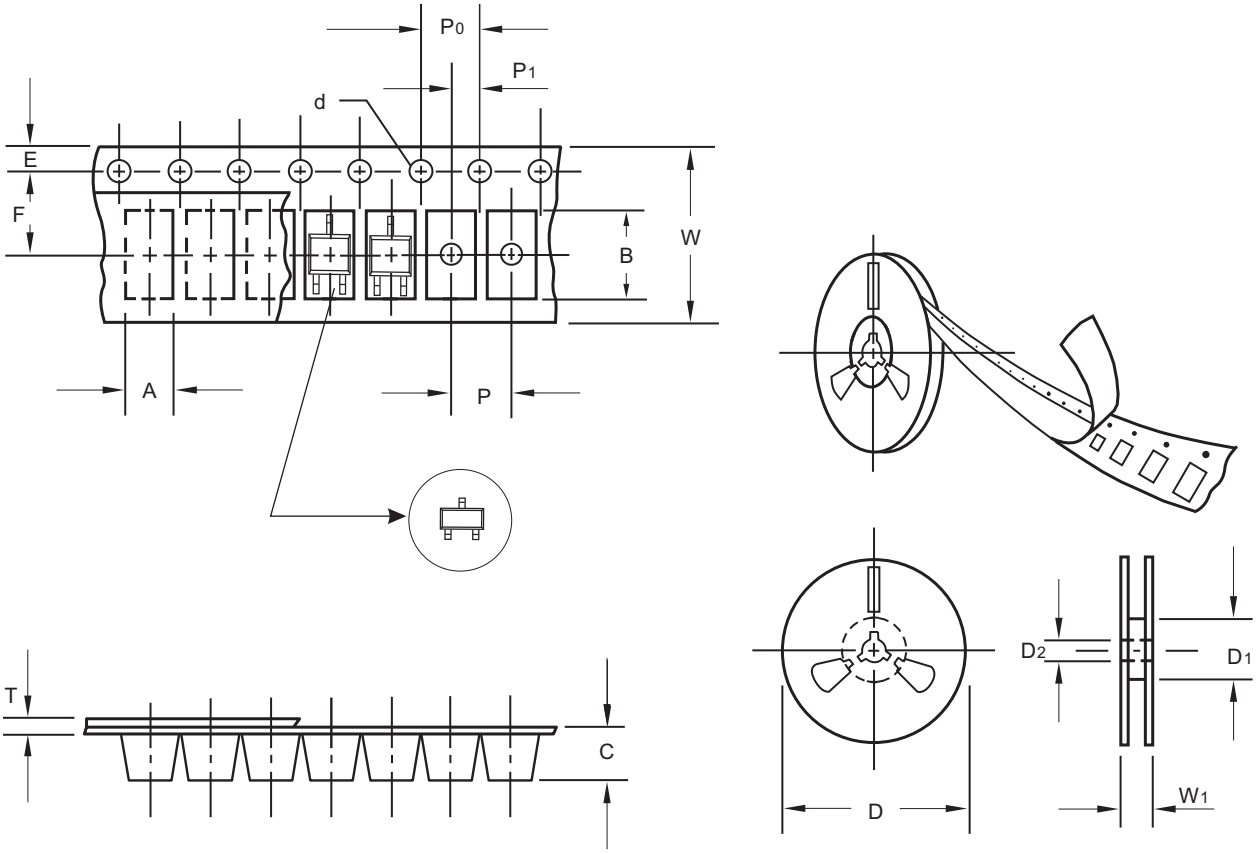
SOT-23



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	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.

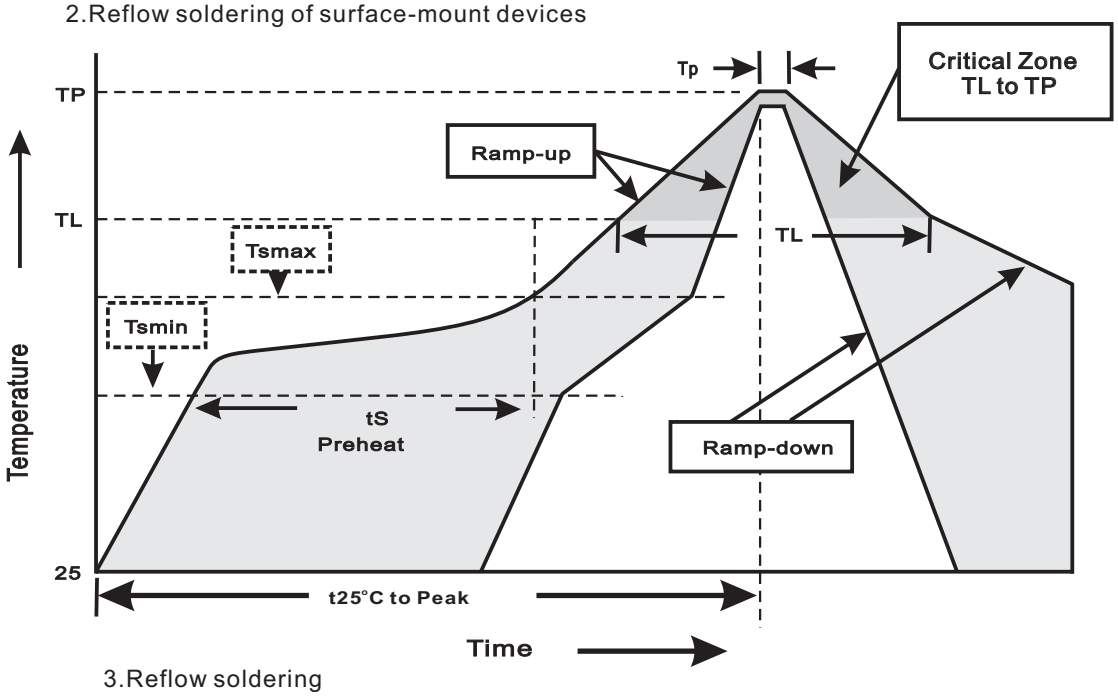
FMBT3904-Q1

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(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

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High reliability test capabilities

Item Test	Conditions	Reference
1. MSL Preconditioning	24hr bake@125℃+168hrs@85℃ /85%RH+3xIR@260℃+1flux immersion+alcohol+DI H2O rinse	JESD22-A113
2. Intermittent Operating Life	Ta=25℃, ΔTj≥100℃ On/Off=2min Test Duration:1000hrs	MIL-STD-750E METHOD 1037
3. High Temperature Reverse Bias	V_{CE}=80%B_{VCEO} (Tj=150℃)Test Duration:1000hrs	JESD22-A108
4. High Temperature Storage Life	Ta=125℃ Test Duration:1000hrs	JESD22 A-103
5. Temperature Cycle	-55℃(15min) to 150℃(15min)Test Cycles:1000cycles	JESD22 A-104
6. Autoclave	P=2atm Ta=121℃ RH=100% Test Duration:96hrs	JESD22 A-102
7. Solderability	245±5℃ for 5sec	J-STD-002
8. Moisture Resistance	Ta=85℃/85% Relative humidity Test Duration:1000hrs	MIL-STD-750E METHOD 1021.2
9. Resistance To Solder Heat	260±5℃ for 10sec	JESD22 B-106
10. High Temperature High Humidity Reverse Bias	Ta=85℃, 85%RH, V_{CE}=80%B_{VCEO} Test Duration:1000hrs	JESD22-A101