

管理号: T1-E08

**STANDARD SPECIFICATION****产品规格书**

客户 Customer: \_\_\_\_\_

客户料号 Customer P/N NO.: \_\_\_\_\_

产品描述 Product Description: SF-1610 32.768KHZ 12.5PF ±20PPMTKD 料号 TKD P/N. NO.: SF16YK32768D31T025产品标准: Pb free RoHS 2.0 REACH HF**客户批准 Customer Approval :**

(请批准后回签一份 PLEASE RETURN A COPY WITH APPROVAL)

**泰晶科技股份有限公司**

TKD SCIENCE AND TECHNOLOGY CO., LTD.

批准 APPROVED	审核 CHECK	制作 DESIGNER
熊峰	毛璇	刘嫚

**REVISION RECORD**

Rev	Date	NO.	Description of Revision History
00	2025-12-25		New Publication



## 1. 石英晶体参数规格 QUARTZ CRYSTAL UNIT SPECIFICATION

※描述 Description : Quartz Crystal

※产品型别 Product Type : SF-1610

※测量设备 Measure equipment : S&amp;A 250B

※电气特性 Electrical Characteristics

	项目 Item	代码 Symbol	电气特性规格 Electrical Specification				备注 Notes
			下限 Min.	中心 Typ.	上限 Max.	单位 Units	
1	一般频率 Nominal Frequency	F0	32.768000			KHz	
2	振荡模式 Oscillation Mode	-	Fundamental			-	
3	负载电容 Load Capacitance	CL	12.5			pF	
4	频率公差 Frequency Tolerance	-	-20	-	20	ppm	At 25°C ± 3°C
5	等效串联电阻 Equivalent Series Resistance	ESR	-	-	90	KΩ	
6	驱动功率 Drive Level	DL	-	0.1	0.5	μW	
7	斜率 Parabolic Coefficient	-	-	-	-0.04	PPM/°C <sup>2</sup>	
8	动作温度 Operating Temperature	-	-40	-	85	°C	
9	储存温度 Storage Temperature	-	-55	-	125	°C	
10	老化率 Aging	-	-3	-	3	ppm	Per Year
11	绝缘阻抗 Insulation Resistance	-	500	-	-	MΩ	At DC 100V
12	并联电容 Shunt Capacitance	C0	-	1.25	-	pF	
13	动态电容 Motional Capacitance	C1	-	6.50	-	fF	

## 备注 Notes:

## 1. 超声波清洗 Ultrasonic cleaning

一般的清洁液或超声波清洗方法可以用来清洗我们的产品。但是，在某些情况下，超声波清洗机在我们产品的振荡频率上会产生共振，从而使器件的电气特性恶化，甚至损坏器件的整体结构。因此，建议超声波清洗前进行验证测试。General cleaning solutions or ultrasonic cleaning method may be used to clean our products. However, under certain circumstances, ultrasonic cleaning machine could generate resonance at the oscillation frequency of our products and thus deteriorate the electrical characteristics in devices, and even damage the overall structure of devices. Therefore, verification test is recommended before cleaning.

## 2. 超声波焊接 Ultrasonic welding

避免使用超声波焊接进行安装和加工，这种方法有可能使晶体产品内部产生过大的振动扩散，成为特性退化而不振动的的原因。Avoid mounting and processing by Ultrasonic welding this method has a possibility of an excessive vibration spreading inside the crystal products and becoming the cause of characteristic deterioration and not oscillating.

## 3. 储存温度说明 Storage temperature description

储存温度仅适用于产品，而包装材料储存温度 5°C~40°C。Storage Temperature is only for the product itself, the temperature for the packing material is 5°C~40°C.

## 4. 手工焊建议条件 Recommended conditions for manual welding

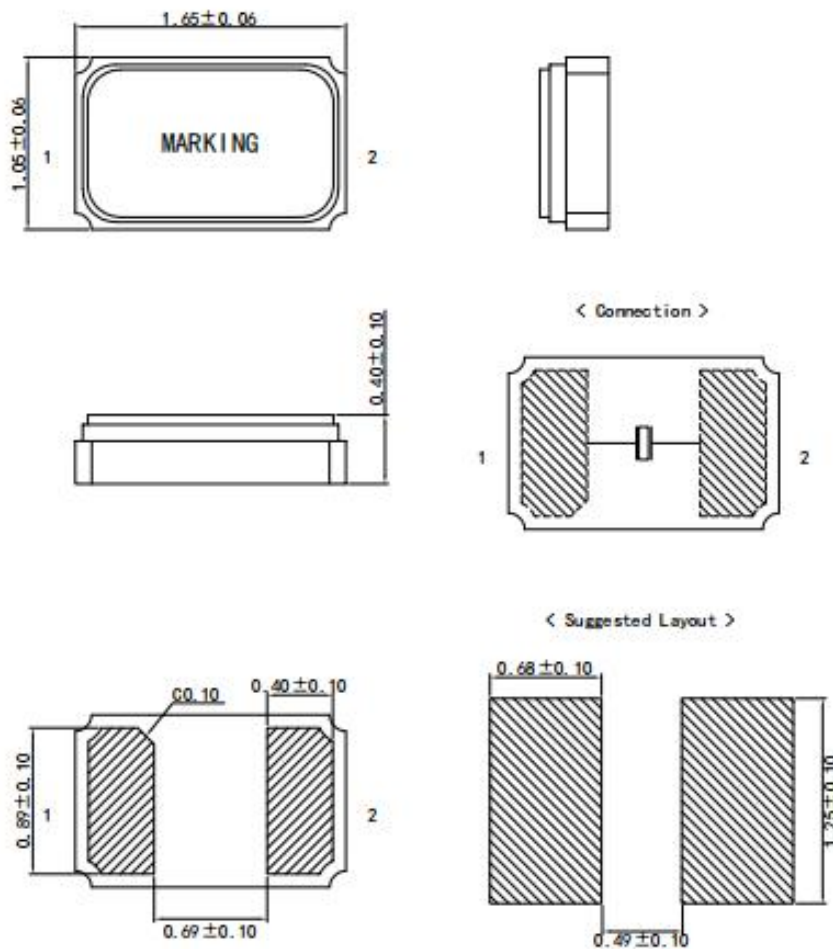
温度：350±10°C，时间：3秒 Max，次数：2次 Max。Temperature: 350 ± 10 °C, Time: 3 sec max, Re-solder times: twice max.

## 5. 本产品不应用于有毒、有害或腐蚀性环境，如汞、氯、硫、酸碱环境等。This product should not be used in toxic, harmful, or corrosive environments such as mercury, chlorine, sulfur, acid-base environments etc.

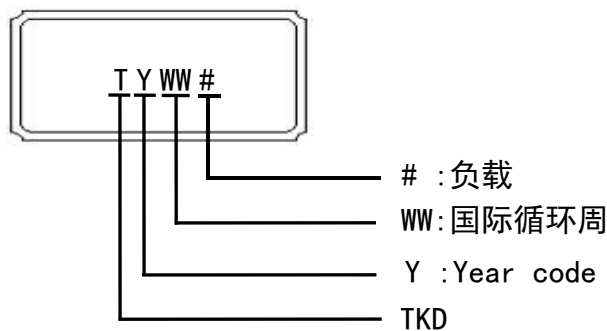
## 6. 应用场景说明 Application scenario description

TKD 产品设计专用于一般及特定电子应用，未经确认，不得用于超出预期领域，如空间技术、交通工具控制、军事武器开发等关键领域，以免引发安全、健康、财产或社会重大风险。仅限预期用途，特定用途产品无额外保证。如需特定用途产品，请提前咨询 TKD 销售代表。TKD products are designed specifically for general and specific electronic applications. Without confirmation, they should not be used in critical areas beyond expectations, such as space technology, vehicle control, military weapon development, etc., to avoid significant risks to safety, health, property, or society. For intended use only, there is no additional guarantee for specific use products. If you need products for specific purposes, please consult TKD sales representatives in advance.

## 2. 产品图纸 DIMENSIONS (Units:mm)



## 3. 印字 MARKING



Year : 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

Code : 1 2 3 4 5 6 7 8 9 0

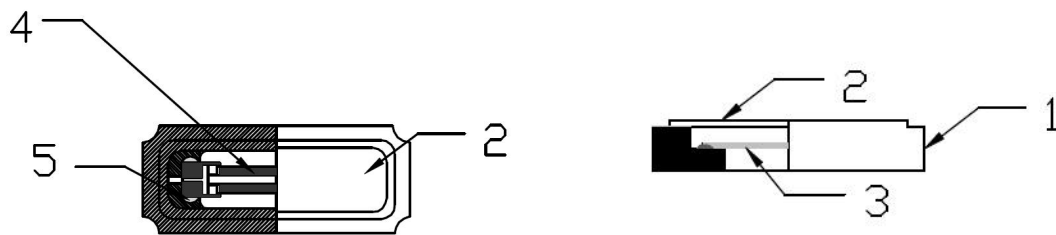
(\*The Year code will be cycled every ten years.)

WW : 国际循环周

#负载 : A→12.5PF、B→9PF、C→7PF、D→6PF

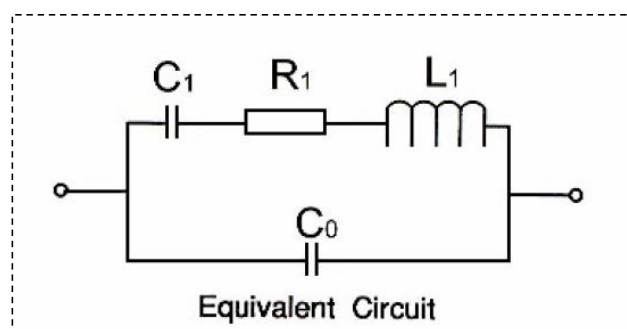
字体颜色 : 黑体

## 4. 内部结构产品图纸 INSIDE STRUCTURE



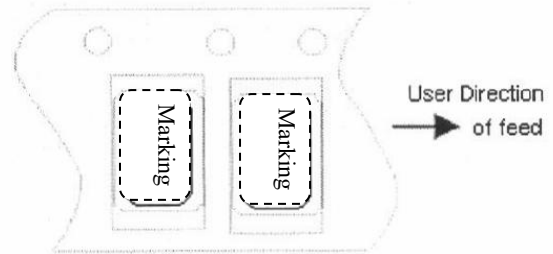
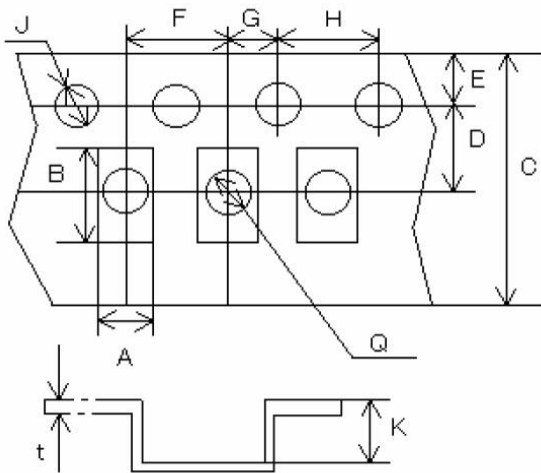
No.	组件 COMPONENTS	材料成份 MATERIALS
1	基座 Package	陶瓷 Ceramic (Al2O3)
2	外壳 LID	KV 合金 KV (Fe/Co/Ni)
3	水晶片 Crystal blank	二氧化硅 SiO <sub>2</sub>
4	电极 Electrode	Au、Cr (Au+Cr)
5	接着剂 Adhesive	树脂、银粉 Resin、Ag

## 5. 等效电路图 EQUIVALENT CIRCUIT



6. 包装 PACKING (Units:mm)

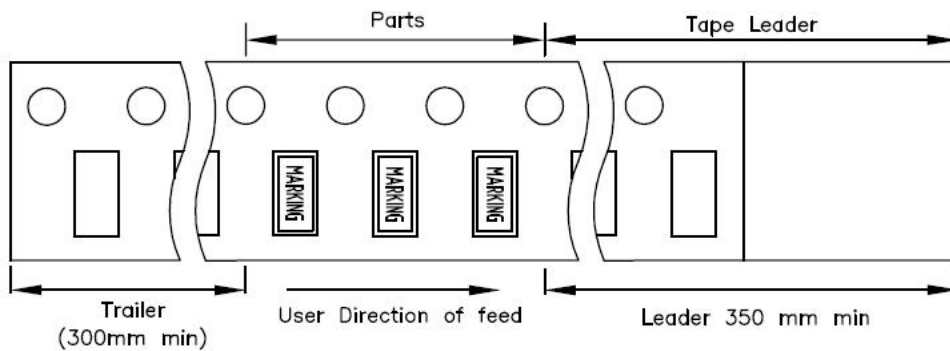
※载带类型 CARRIER TYPE



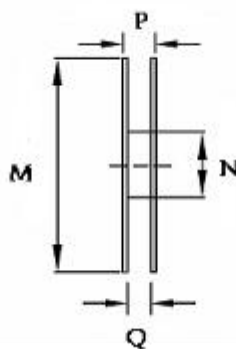
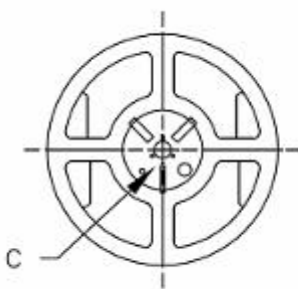
Start & End Point

A	B	C	D	E	F	G	H	J	K	t
1.15	1.78	8.0	3.5	1.75	4.0	2.0	4.0	1.5	0.65	0.25

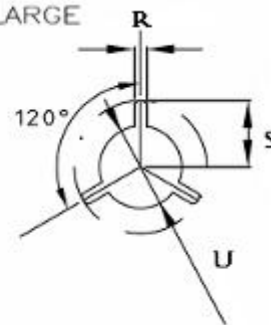
备注 REMARK:



※圆卷 REEL: 3000 PCS/Reel



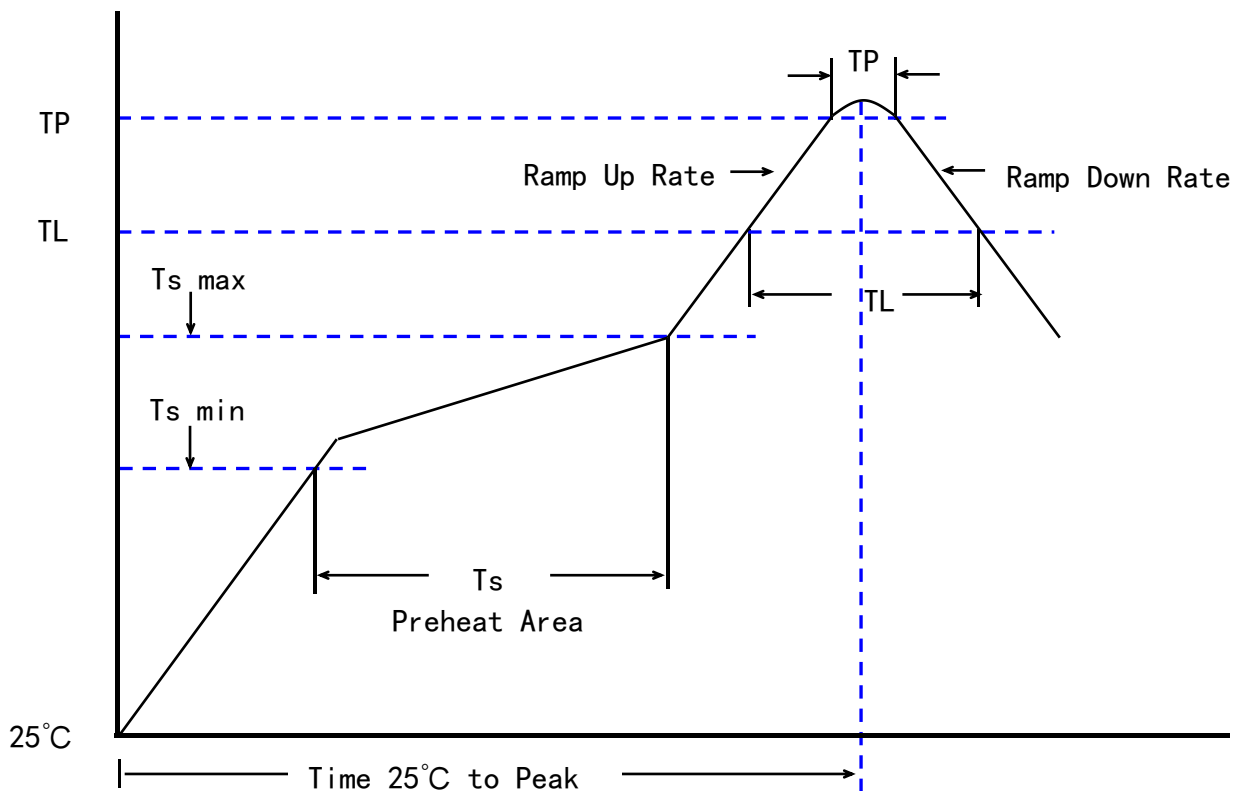
C.ENLARGE



M	N	P	Q	R	S	U
178	60.2	11.5	8.0	2.5	11.0	13.0

## 7. 回流焊温度曲线 REFLOW PROFILES

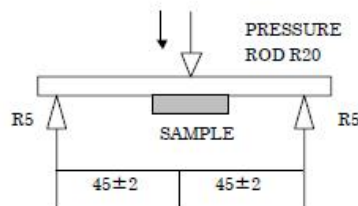
参考标准 REFER: JEDEC J-STD-020D	
Profiles Feature	Pb-Free Assembly
Preheat/Soak	
Temperature Min (Ts min)	150°C
Temperature Max (Ts max)	200°C
Time (Ts) from (Ts min to Ts max)	60-120 seconds
Ramp-up rate (TL to TP)	3°C/second max.
Liquidous temperature (TL)	217°C
Time (TL) maintained above TL	60-150 seconds
Peak/Classification Temperature (TP)	260±5°C
Time within 5°C of actual Peak Temperature (TP)	20~40 seconds
Ramp-down rate (TP to TL)	6°C/second max.
Time 25 ° C to peak temperature	8 minutes max.
Suggest reflow times	3 Times max

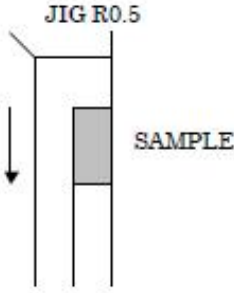
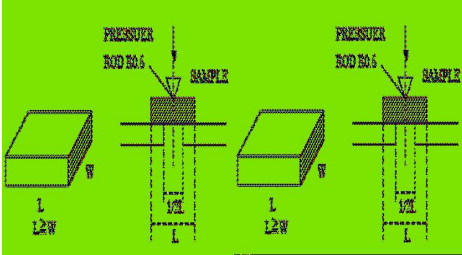


## 8. 可靠性试验 RELIABILITY SPECIFICATION

参考标准 REFER		JIS C 6701											
NO.	项目 ITEM	测试条件 CONDITIONS	测试标准 Criteria										
1	高温试验 HIGH TEMPERATURE	<p>温度<math>125 \pm 2^{\circ}\text{C}</math>存储<math>500 \pm 12</math>小时；然后在常温(<math>25 \pm 2^{\circ}\text{C}</math>)下静置2H以上24H内使用250B测试特性参数。 如果客户的温度要求是高于标准, 温度测试必须完成客户的需求。</p> <p>STORED AT <math>125 \pm 2^{\circ}\text{C}</math> for <math>500 \pm 12\text{H}</math>. THE CHARACTERISTIC PARAMETERS OF 250B MUST BE TESTED IN 24H AFTER BEING STATIC FOR MORE THAN 2H AT ROOM TEMPERATURE (<math>25 \pm 2^{\circ}\text{C}</math>). IF CUSTOMER'S TEMPERATURE REQUEST IS HIGHER THAN THE STANDARD, TEMPERATURE TEST MUST BE DONE FOR CUSTOMER REQUIREMENTS.</p>	A. C										
2	低温试验 LOW TEMPERATURE	<p>温度<math>-40 \pm 2^{\circ}\text{C}</math>存储<math>500 \pm 12</math>小时；然后在常温(<math>25 \pm 2^{\circ}\text{C}</math>)下静置2H以上24H内测试250B。 如果客户的温度要求是高于标准, 温度测试必须完成客户的需求。</p> <p>STORED AT <math>-40 \pm 2^{\circ}\text{C}</math> for <math>500 \pm 12\text{H}</math>. THE CHARACTERISTIC PARAMETERS OF 250B MUST BE TESTED IN 24H AFTER BEING STATIC FOR MORE THAN 2H AT ROOM TEMPERATURE (<math>25 \pm 2^{\circ}\text{C}</math>). IF CUSTOMER'S TEMPERATURE REQUEST IS HIGHER THAN THE STANDARD, TEMPERATURE TEST MUST BE DONE FOR CUSTOMER REQUIREMENTS.</p>	A. C										
3	高温高湿 HIGH TEMP. & HUMIDITY	<p>温度 <math>85 \pm 2^{\circ}\text{C}</math>, 湿度 85%环境下存储 <math>500 \pm 12</math> 小时；然后在常温(<math>25 \pm 2^{\circ}\text{C}</math>)下静置 2H 以上 24H 内测试 250B。</p> <p>STORED AT <math>85 \pm 2^{\circ}\text{C}</math> AND HUMIDITY 85% FOR <math>500 \pm 12\text{H}</math>. THE CHARACTERISTIC PARAMETERS OF 250B MUST BE TESTED IN 24H AFTER BEING STATIC FOR MORE THAN 2H AT ROOM TEMPERATURE (<math>25 \pm 2^{\circ}\text{C}</math>).</p>	A. C. D										
4	温度冲击 TEMPERATURE SHOCK	<p>晶振单元应运行 100 个温度冲击, 然后在常温(<math>25 \pm 2^{\circ}\text{C}</math>)下静置 2H 以上 24H 内测试 250B。每个温度冲击条件如下:</p> <table border="0"> <tr> <td style="padding-right: 20px;">温度</td> <td>持续时间</td> </tr> <tr> <td>1. <math>-40+0/-6^{\circ}\text{C}</math></td> <td>30 <math>\pm</math> 3MINUTES 分钟</td> </tr> <tr> <td>2. <math>25^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></td> <td>2 <math>\sim</math> 3MINUTES 分钟</td> </tr> <tr> <td>3. <math>125+4/-0^{\circ}\text{C}</math></td> <td>30 <math>\pm</math> 3MINUTES 分钟</td> </tr> <tr> <td>4. <math>25^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></td> <td>2 <math>\sim</math> 3MINUTES 分钟</td> </tr> </table> <p>THE CRYSTAL UNIT SHALL BE SUBJECTED TO 100 SUCCESSIVE CHANGE OF TEMPERATURE CYCLES. THE CHARACTERISTIC PARAMETERS OF 250B MUST BE TESTED IN 24H AFTER BEING STATIC FOR MORE THAN 2H AT ROOM TEMPERATURE (<math>25 \pm 2^{\circ}\text{C}</math>).</p>	温度	持续时间	1. $-40+0/-6^{\circ}\text{C}$	30 $\pm$ 3MINUTES 分钟	2. $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$	2 $\sim$ 3MINUTES 分钟	3. $125+4/-0^{\circ}\text{C}$	30 $\pm$ 3MINUTES 分钟	4. $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$	2 $\sim$ 3MINUTES 分钟	A. C
温度	持续时间												
1. $-40+0/-6^{\circ}\text{C}$	30 $\pm$ 3MINUTES 分钟												
2. $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$	2 $\sim$ 3MINUTES 分钟												
3. $125+4/-0^{\circ}\text{C}$	30 $\pm$ 3MINUTES 分钟												
4. $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$	2 $\sim$ 3MINUTES 分钟												

5	可焊性 SOLDERABILITY	焊锡温度 $245 \pm 5^{\circ}\text{C}$ ，时间 $2 \pm 0.6$ 秒，无铅锡料，加助焊剂。 THE LEAD IS IMMERSSED IN A $245 \pm 5^{\circ}\text{C}$ SOLDER BATH WITHIN $2 \pm 0.6$ SECONDS.	F
6	氦漏 FINE LEAK	$5.0 \sim 5.5$ Kgf / $\text{cm}^2$ 的氦气加压 2 小时 HELIUM BOMBING $5.0 \sim 5.5$ Kgf / $\text{cm}^2$ , FOR 2 HOURS.	E
7	耐焊接热性 WELDING HEAT RESISTANCE	过回流焊 3 次，最高温度&时间 $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ， $15 \pm 5$ Sec；然后在常温 ( $25 \pm 2^{\circ}\text{C}$ ) 下静置 4H 以上 24H 内测试 250B。 3 REFLAWS, THE MAXIMUM TEMPERATURE & TIME IS $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , $15 \pm 5$ SEC. THE CHARACTERISTIC PARAMETERS OF 250B MUST BE TESTED IN 24H AFTER BEING STATIC FOR MORE THAN 4H AT ROOM TEMPERATURE ( $25 \pm 2^{\circ}\text{C}$ ).	A. C
8	跌落 FREE FALL	从 100cm 的高度自由落体 3 次，落在坚硬的木板上。 FREE DROPPING FROM 100cm HEIGHT 3 TIMES ON A HARD	B. C
9	振动 VIBRATION	振动频率：10~55Hz，振幅(全程)：扫频率 0.75oct/min，加速度峰值 5g，3 个方向(X, Y, Z) 各 2 小时。 FREQUENCY: 10~55Hz AMPLITUDE (TOTAL EXCURSION): THE SCANNING FREQUENCY IS 0.75OCT/MIN, AND THE PEAK ACCELERATION IS 5G. SWEEP TIME: 3 DIRECTION (X, Y, Z) EACH FOR 2 Hrs.	A. C
10	板弯曲 TERMINAL STRENGTH	将样品焊接在 PCB 板，在样品的反面施加一个 10N 的力，直到折板弯曲达到 3mm，维持 5 秒钟。 WELD THE SAMPLE ONTO THE PCB BOARD AND APPLY A FORCE OF 10N ON THE REVERSE SIDE OF THE SAMPLE UNTIL THE BENDING OF THE BOARD REACHES 3MM, THEN MAINTAIN THIS STATE FOR 5 SECONDS.	A. C



11	折板推力试验 STICKING TENDENCY	<p>在 R0.5 的可移动治具上最终施加一个 10N 的力, 维持 10 秒钟。 A R0.5 JIG SHALL BE USED TO APPLY A 10N DEAD LOAD IN THE DIRECTION INDICATED BY THE ARROW TO THE ELEMENT AND RETAIN IT FOR 10 SECONDS.</p> 	A. C
12	本体荷重试验 ELEMENT ASSEMBLY STRENGTH	<p>在样品的中心位置施加一个力, 维持 10 秒钟。 样品 &gt; 1.6*1.2mm 10N; 样品 ≤ 1.6*1.2mm 5N APPLY A FORCE AT THE CENTER OF THE SAMPLE FOR 10 SECONDS. IF THE SAMPLE IS GREATER THAN 1.6x1.2MM, APPLY 10N; IF THE SAMPLE IS LESS THAN OR EQUAL TO 1.6x1.2MM, APPLY 5N.</p> 	A. C
13	机械冲击 Mechanical Shock	<p>100g, 6ms, 半正弦冲击脉冲 6轴*3次 100G, 6MS, HALF SINE SHOCK PULSE, 6AXIS*3TIMES</p>	A. C

**SPECIFICATIONS**

A	FREQUENCY CHANGE PERMITTED.	$\Delta F \leq 10\text{PPM}$
B	FREQUENCY CHANGE PERMITTED.	$\Delta F \leq 20\text{PPM}$
C	EQUIVALENT SERIES RESISTANCE CHANGE PERMITTED.	$\Delta CI \leq 5K\Omega$ or 20% Make use larger value
D	INSULATION RESISTANCE	$> 500M\Omega$
E	LEAK RATE LESS THAN	$< 1*1E-9 \text{ Pa} \cdot \text{m}^3/\text{sec}$
F	A NEW UNIFORM COATING OF SOLDER SHALL COVER A MINIMUM 95% OF THE SURFACE	

Remark:

※ Each test done independently

※ Measurement condition: Electrical characteristics measured by S&A250B or equivalent.