

RELIABILITY TESTS - STANDARD

Reference JIS C 5101-1, JIS C 5101-4 and JIS 60068-2

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
1	Shelf life	Upper category temperature Duration: 1000h	JIS C 5101-4 No. 4.17 JIS C 5101-1 No. 4.25	10 pcs	$ \begin{array}{ll} & \Delta C/C_R \leq 20\% \text{ of initial value}^{[2]} \\ & 2. tan\delta \leq 2 \text{ times spec. limit}^{[2]} \\ & 3. I_{LEAK} \leq \text{spec. limit} \\ & 4. No \text{ visible damage} \\ & 5. No \text{ leakage of electrolyte} \\ & 6. Marking \text{ legible} \end{array} $
2	Tempera- ture cycling	 Lower category temperature: 30mins Temperature change: 3mins Upper category temperature: 30mins Temperature change: 3mins Step 1 to 4 as a cycle Cycle: 10 cycles 	JIS C 5101-4 No. 4.7 JIS C 5101-1 No. 4.16	10 pcs	1. $ \Delta C/C_R \le 5\%$ of initial value 2. $\tan \delta \le \text{spec. limit}$ 3. $I_{\text{LEAK}} \le \text{spec. limit}$ 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
3	Unbiased humidity	Temperature: 40°C Humidity: 90 ~ 95%RH Duration: • 250h for general purpose grade products ^[1] • 500hfor long life grade products ^[1]	JIS C 5101-4 No. 4.12 JIS C 5101-1 No. 4.22	10 pcs	 ΔC/C_R ≤ 20% of initial value for general purpose grade products^[1] ΔC/C_R ≤ 10% of initial value for long life grade products^[1] tanδ ≤ 1.2 times of spec. limit I_{LEAK} ≤ spec. limit No visible damage No leakage of electrolyte Marking legible
4	Endurance (load Life)	Upper category temperature V _R applied Duration: specified or see detail specification	JIS C 5101-4 No. 4.13 JIS C 5101-1 No. 4.23	10 pcs	1. $ \Delta C/C_R \le 20\%$ of initial value ^[2] 2. $tan \delta \le 2$ times spec. $limit^{[2]}$ 3. $l_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
5	Endurance (Load ripple current life)	Upper category temperature I_R and V_R applied $AC + DC \approx V_R$ Duration: specified or see detail specification	JIS C 5101-4 No. 4.13 JIS C 5101-1 No. 4.23	10 pcs	$ \begin{array}{ll} 1. & \Delta C/C_R \leq 20\% \text{ of initial value}^{[2]} \\ 2. & \tan\delta \leq 2 \text{ times spec. limit}^{[2]} \\ 3. & I_{LEAK} \leq \text{spec. limit} \\ 4. & \text{No visible damage} \\ 5. & \text{No leakage of electrolyte} \\ 6. & \text{Marking legible} \end{array} $
6	Solvent resistance of marking	 a. Solvent to be used: IPA b. Solvent temperature: 23°C ± 5°C c. Conditioning: Method 1 (with rubbing) d. Rubbing material: Cotton wool e. Recovery time: Not applicable, unless otherwise stated in the detail specification 	JIS C 5101-1 No. 4.32 JIS C 60068- 2-45 3.1.2	5 pcs	See detail specification



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No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
7	Vibration	 a. Frequency: 10 ~ 55 Hz b. Swing (single peak) and acceleration: 0.75mm or 98m/s² c. Test direction and duration: X, Y, Z each on for 2h 	JIS C 5101-4 No. 4.8 JIS C 5101-1 No. 4.17	10 pcs	Taking from the vibration table static placed in the horizontal to test the box and carton appearance, test the electri- cal characteristics. 1. $ \Delta C/C_R \le 5\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
8	Resistance to solder heat	Max. temperature: 260°C (0 ~ +3°C) Duration: 10s ± 1s	JIS C 5101-4 No. 4.5 JIS C 5101-1 No. 4.14	10 pcs	1. $ \Delta C/C_R \le 5\%$ of initial value 2. $tan\delta \le spec$. limit 3. $I_{LEAK} \le spec$. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
9	Solderability	Max. temperature: 245°C± 5°C Duration: 2s ± 0.5s	JIS C 5101-4 No. 4.6 JIS C 5101-1 No. 4.15	10 pcs	The surface soldering attachment is greater than 95% soldering should brightness and equality, non-soldering needle hole, drop weld or concentrate at some points are not allowed
10	Characteristics at high and low tempera- ture	The capacitors shall be measured at each temperature step Step 1: 20°C Capacitance, Tangent of loss angle, Imped- ance (at the same frequency as step 2) Step 2: Lower category temperature • Imped- ance Step 3: Upper category temperature • Leak- age current See detail specification	JIS C 5101-4 No. 4.19 JIS C 5101-1 No. 4.29	10 pcs	See detail specification
11	Substrate bending	 The SMD capacitor shall be mounted on an epoxide woven glass printed board as described: a. The capacitance of the SMD capacitor shall be measured as specified in 4.7 and in the relevant sectional specification. b. The capacitor shall be subjected to JIS C 60068-2-21, test Ue, using the conditions as prescribed in the relevant specification for the deflection D and the number of bends. c. The capacitance of the SMD capacitor shall be measured as specified in (a) with the board in the bent position 	JIS C 5101-1 No. 4.35 JIS C 60068.2.21	5 pcs	The change of capacitance shall not exceed the limits prescribed by the relevant specification
12	Terminal strength	Test method: Following model picture means: Put the samples solder on the glass epoxy resin board, profile added force is 17.7N (1.8kg), time within 60±1 s See detail specification	JIS C 5101-1 No. 4.13 JIS C 5104-1 No. 4.4	10 pcs	See detail specification



RELIABILITY TESTS - STANDARD

Reference JIS C 5101-1, JIS C 5101-4 and JIS 60068-2

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
13	Surge voltage	 a. Test temp.: Max. temp. for long life grade products^[1] or Room temp. for general purpose grade products^[1] b. Add surge voltage to the connections: 1.15·V_R when V_R ≤ 315V 1.10·V_R when V_R > 315V c. 6 mins as a cycle (charge time 30s, dis- charge time 330s) d. Cycle: 1000 cycles 	JIS C 5101-4 No. 4.14 JIS C 5101-1 No. 4.26	10 pcs	1. $ \Delta C/C_R \le 15\%$ of initial value 2. $tan\delta \le spec$. limit 3. $I_{LEAK} \le spec$. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
14	Pressure relief	See detail specification (aim at $\phi \ge 10$ mm)	JIS C 5101-4 No. 4.16 JIS C 5101-1 No. 4.28	10 pcs	Device shall open without danger of explosion or fire
15	Storage at low tempera- ture	Duration: 16h or 4h after thermal stability has been reached Temperature: -40°C	JIS C 5101-4 No. 4.18 JIS C 5101-1 No. 4.25	10 pcs	1. $ \Delta C/C_R \le 10\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible

Note:

- General purpose grade: lifetime (V_R applied) ≤ 2000 hours.
 Long life grade: lifetime (V_R applied) > 2000 hours.
- [2] $\Delta C/C_R \& \tan \delta$ criterion, please refer to CapXon datasheet.





Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
1	High temperature exposure (Storage at upper cate- gory temper- ature	Test temp: Upper category temperature No voltage applied Duration: 1000h Pre-treatment for measurements shall be conducted after application of DC working voltage for 30 minutes Measurement at 24h after test conclusion	MIL-STD-202 Method 108	77 pcs	1. $ \Delta C/C_R \le 20\%$ of initial value ^[2] 2. $\tan \delta \le 2$ times spec. $\liminf^{[2]}$ 3. $I_{LEAK} \le$ spec. \liminf 4. No visible damage
2	Temperature cycling	StageTemperatureTime1Lower category temperatureWithin 30min2Temperature changeWithin 1min3Upper category temperature changeWithin 30min4Temperature changeWithin 1minStage 1 to 4 is one cycle Test time: 1000 cyclesExample test conclusion	JESD22 Method JA- 104	77 pcs	1. $ \Delta C/C_R \le 10\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
3	Biased Humidity	Temperature: 85°C Humidity: 85%RH Applied voltage: V _R Duration: 1000h Measurement at 24h after test conclusion	MIL-STD-202 Method 103	77 pcs	1. $ \Delta C/C_R \le 20\%$ of initial value 2. $tan\delta \le 1.2$ times spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
4	Operational life	Test temp: Upper category temperature V _R applied (& I _R applied if specified) Duration: specified or see detail specifica- tion Measurement at 24h after test conclusion	MIL-STD-202 Method 108	77 pcs	$ \begin{array}{ll} 1. & \Delta C/C_R \leq 20\% \text{ of initial value}^{[2]} \\ 2. & \tan\delta \leq 2 \text{ times spec. } \limit^{[2]} \\ 3. & I_{LEAK} \leq \text{spec. } \limit \\ 4. & \text{No visible damage} \\ 5. & \text{No leakage of electrolyte} \\ \end{array} $
5	Resistance to solvents	 a. Solvent to be used: IPA b. Soak time: Using the brush according to mark place to brush with 10 times after 180s, repeat above step again with 2 times (namely is total 3 times) c. After test place in air nature drying d. Test temperature: 25°C 	MIL-STD-202 Method 215	5 pcs	 No visible damage Marking legible
6	Mechanical shock	 a. Pulse shape: Half-sine waveform b. Max. acceleration: 980m/s² (100g·s) c. Pulse duration time: 6ms d. Direction: X, Y, Z on 6 faces e. Shock time: 3 times in one face, 18 times in total 	MIL-STD-202 Method 213	30 pcs	1. $ \Delta C/C_R \le 5\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage 5. No leakage of electrolyte





Reference MIL-STD-202, JESD22, J-STD-002and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
7	Vibration	 a. 10Hz ~ 2kHz ~ 10Hz (20min) b. Amplitude (Double peaks): 1.5mm @10 ~ 55Hz c. Acceleration: 49m/s² (5g/s) @55 ~ 2kHz d. X direction 4h Y direction 4h Z direction 4h Total: 12h 	MIL-STD- 202 Method 204	30 pcs	1. $ \Delta C/C_R \le 5\%$ of initial value 2. $tan \delta \le spec$. limit 3. $I_{LEAK} \le spec$. limit 4. No visible damage 5. No leakage of electrolyte
8	Resistance to solder heat	 a. Kind of solder: H60A or equal b. Below diagram shows the products which in soldering stove of the 3times reflow soldering. c. When finish the first time and the samples temperature cool off and become stable then will proceed the 2nd time. d. When finish the 2nd time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature cool off and become stable then will proceed the 3rd time. The provide time and the samples temperature time and the samples temperature time and the samples temperature to CapXon datasheet) 	MIL-STD- 202 Method 210	30 pcs	1. $ \Delta C/C_R \le 15\%$ of initial value 2. $\tan \delta \le \text{spec. limit}$ 3. $I_{\text{LEAK}} \le \text{spec. limit}$ 4. No visible damage 5. No leakage of electrolyte * Products expanding $\le \emptyset$ 6.3mm below 0.2mm $\ge \emptyset$ 8mm below 0.3mm
9	Solderabil- ity	 SMD Reflow solder method a. Kind of solder: Sn96.5%; Ag3%; Cu0.5% b. Pre-handle: 155°C, 4Hours+15min c. Solder stove temp.: 245°C ± 5°C d. Solder solvent: Resin alcohol solution (25 wts%) or resin IPA solution e. Immerse time: within 5+0/-0.5 secs f. Immerse speed: 25±2.5mm/s 	J-STD-002	15 pcs	Up to immerse position, above 95% area of surroundings sur- face shall be cover by the new soldering





Reference MIL-STD-202, JESD22, J-STD-002and AEC-Q200

No.	Test	٦ Speci	est fication	Test Standard	Sample Quantity	Test Criteria				
		a. In different e deposit the p	nvironment to roducts					Products with lo temperatu	Products with lower category temperature -40°C	
		Stage	Temp. (°C)		30 pcs	stage 2 stage 3	a a Impedance comparison	Comparison of temp section	Magnification	
		1 (initial value)	20±2					Z-25°C / Z+20°C	According to spec.	
		2	-25±3					Z-40°C / Z+20°C	According to spec.	
10	Electrical char-	3	-40±3	User				Products with lower category temperature -55°C		
10	acterization	4	20±2	spec.				Comparison of temp section	Magnification	
		5	Upper category temperature±2					Z-25°C / Z+20°C	According to spec.	
		6	20±2					Z-55°C / Z+20°C	According to spec.	
		 b. Test frequence c. Each stage of time of hot b ture stability 	cy: 120Hz time: Reached alance (tempera-			stage 5	1. Δ 2. ta 3. l _{LE}	C/C _R ≤ 30% of initi nδ ≤ spec. limit _{AK} ≤ 5 times spec. li	al value mit	
11	Board flex (SMD)	 a. Put the test s the PCB boar mm(length) > b. Curing test of as follows: Support Support Addus 340 PCB under test c. Curve central Minimum 2m d. Duration time 60s ± 5s e. Curve times: 	ample solder on d, size of 100 40 mm (width) the fixed method	AEC-Q200 -005	30 pcs	1. $ \Delta C/C_R \le 5\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. No visible damage				





Reference MIL-STD-202, JESD22, J-STD-002and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
12	Terminal strength (SMD)	Test method: Following model picture means: Put the samples solder on the glass epoxy resin board, profile added force is 17.7N (1.8kg), time within $60s \pm 1s$ filter for the same set of the set	AEC-Q200 -006	30 pcs	 ΔC/C_R ≤ 5% of initial value tanδ ≤ spec. limit I_{LEAK} ≤ spec. limit No unusual or loose situation on terminals
13	Surge voltage	 a. Test temp.: Max. temp. for long life grade products^[1] or Room temp. for general purpose grade products^[1] b. Add surge voltage to the connections: 1.15·V_R when V_R ≤ 315V 1.10·V_R when V_R > 315V c. 6 min as a cycle (charge time 30s, discharge time 330 s for a cycle) d. Cycle: 1000 cycles 	JIS C 5101-1 No. 4.26	30 pcs	1. $ \Delta C/C_R \le 15\%$ of initial value 2. $tan \delta \le spec.$ limit 3. $I_{LEAK} \le spec.$ limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible

Note:

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