

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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value^[2] $\tan\delta \leq 2$ times spec. limit^[2] $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte Marking legible
2	Temperature cycling	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 5\%$ of initial value $\tan\delta \leq$ spec. limit $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte Marking legible
3	Unbiased humidity	Temperature: 40°C Humidity: 90 ~ 95%RH Duration: <ul style="list-style-type: none"> 250h for general purpose grade products^[1] 500h for long life grade products^[1] 	JIS C 5101-4 No. 4.12 JIS C 5101-1 No. 4.22	10 pcs	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value for general purpose grade products^[1] $\Delta C/C_R \leq 10\%$ of initial value for long life grade products^[1] $\tan\delta \leq 1.2$ times of spec. limit $I_{LEAK} \leq$ 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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value^[2] $\tan\delta \leq 2$ times spec. limit^[2] $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte 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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value^[2] $\tan\delta \leq 2$ times spec. limit^[2] $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte Marking legible
6	Solvent resistance of marking	<ol style="list-style-type: none"> Solvent to be used: IPA Solvent temperature: 23°C ± 5°C Conditioning: Method 1 (with rubbing) Rubbing material: Cotton wool 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/s ² 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 electrical characteristics. 1. $ \Delta C/C_R \leq 5\%$ of initial value 2. $\tan\delta \leq \text{spec. limit}$ 3. $I_{LEAK} \leq \text{spec. limit}$ 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 \leq 5\%$ of initial value 2. $\tan\delta \leq \text{spec. limit}$ 3. $I_{LEAK} \leq \text{spec. limit}$ 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 point are not allowed
10	Characteristics at high and low temperature	The capacitors shall be measured at each temperature step Step 1: 20°C Capacitance tangent of loss angle Impedance (at the same frequency as step 2) Step 2: Lower category temperature ▪ Impedance Step 3: Upper category temperature ▪ Leakage 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

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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, discharge 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 \leq 15\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible
14	Pressure relief	See detail specification (aim at $\phi \geq 10\text{mm}$)	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 temperature	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 \leq 10\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible

Note:

 [1] General purpose grade: lifetime (V_R applied) ≤ 2000 hours.

 Long life grade: lifetime (V_R applied) > 2000 hours.

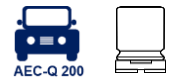
 [2] $\Delta C/C_R$ & $\tan\delta$ criterion, please refer to CapXon datasheet.

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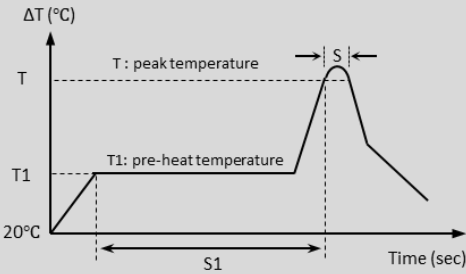
Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria															
1	High temperature exposure (Storage at upper category temperature)	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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value $\tan\delta \leq 2$ times spec. limit $I_{LEAK} \leq$ spec. limit No visible damage 															
2	Temperature cycling	<table border="1"> <thead> <tr> <th>Stage</th> <th>Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Lower category temperature</td> <td>Within 30min</td> </tr> <tr> <td>2</td> <td>Temperature change</td> <td>Within 1min</td> </tr> <tr> <td>3</td> <td>Upper category temperature</td> <td>Within 30min</td> </tr> <tr> <td>4</td> <td>Temperature change</td> <td>Within 1min</td> </tr> </tbody> </table> <p>Stage 1 to 4 is one cycle Test time: 1000 cycles Measurement at 24h after test conclusion</p>	Stage	Temperature	Time	1	Lower category temperature	Within 30min	2	Temperature change	Within 1min	3	Upper category temperature	Within 30min	4	Temperature change	Within 1min	JESD22 Method JA-104	77 pcs	<ol style="list-style-type: none"> $\Delta C/C_R \leq 10\%$ of initial value $\tan\delta \leq$ spec. limit $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte Marking legible
Stage	Temperature	Time																		
1	Lower category temperature	Within 30min																		
2	Temperature change	Within 1min																		
3	Upper category temperature	Within 30min																		
4	Temperature change	Within 1min																		
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	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value $\tan\delta \leq 1.2$ times spec. limit $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte Marking legible 															
4	Operational life	Test temp: Upper category temperature V_R applied (& I_R applied if specified) Duration: specified or see detail specification Measurement at 24h after test conclusion	MIL-STD-202 Method 108	77 pcs	<ol style="list-style-type: none"> $\Delta C/C_R \leq 20\%$ of initial value $\tan\delta \leq 2$ times spec. limit $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte 															
5	Resistance to solvents	<ol style="list-style-type: none"> Solvent to be used: IPA 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) After test place in air nature drying Test temperature: 25°C 	MIL-STD-202 Method 215	5 pcs	<ol style="list-style-type: none"> No visible damage Marking legible 															
6	Mechanical shock	<ol style="list-style-type: none"> Pulse shape: Half-sine waveform Max. acceleration: 980m/s²(100gs) Pulse duration time: 6ms Direction: X, Y, Z Shock time: 10 times in one direction, 30 times in total 	MIL-STD-202 Method 213	30 pcs	<ol style="list-style-type: none"> $\Delta C/C_R \leq 5\%$ of initial value $\tan\delta \leq$ spec. limit $I_{LEAK} \leq$ spec. limit No visible damage No leakage of electrolyte 															

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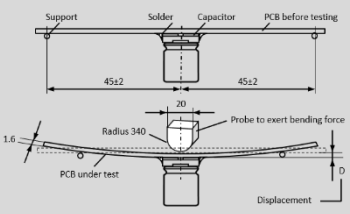
Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria																	
7	Vibration	a. 10Hz ~ 2kHz ~ 10Hz (20min) b. Amplitude (unimodal): 0.35mm@10 ~ 55Hz c. Acceleration: 49m/s ² (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 \leq 5\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ 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 2 nd time. d. When finish the 2 nd time and the samples temperature cool off and become stable then will proceed the 3 rd time.  <table border="1" data-bbox="316 1276 798 1433"> <thead> <tr> <th></th> <th>T</th> <th>T1</th> <th>Maximum temperature</th> </tr> </thead> <tbody> <tr> <td>4φ</td> <td></td> <td></td> <td rowspan="4">260°C</td> </tr> <tr> <td>6.3φ</td> <td>> 245°C</td> <td>> 183°C</td> </tr> <tr> <td>8φ</td> <td>S</td> <td>S1</td> </tr> <tr> <td>10φ</td> <td>25~35 secs</td> <td>90~120 secs</td> </tr> </tbody> </table> e. Temperature rises velocity: 1°C/s ~ 4°C/s (Temperature profile please refer to CapXon datasheet)		T	T1	Maximum temperature	4φ			260°C	6.3φ	> 245°C	> 183°C	8φ	S	S1	10φ	25~35 secs	90~120 secs	MIL-STD-202 Method 210	30 pcs	1. $ \Delta C/C_R \leq 15\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. No visible damage 5. No leakage of electrolyte * Products expanding $\leq \varnothing 6.3\text{mm}$ below 0.2mm $\geq \varnothing 8\text{mm}$ below 0.3mm
	T	T1	Maximum temperature																			
4φ			260°C																			
6.3φ	> 245°C	> 183°C																				
8φ	S	S1																				
10φ	25~35 secs	90~120 secs																				
9	Solderability	SMD Reflow solder method a. Kind of solder: Sn96.5%; Ag3%; Cu0.5% b. Pre-handle: 155°C prepares heat for 4h c. Solder stove temp.: 235 ± 3°C d. Solder solvent: Resin alcohol solution (25 wts%) or resin IPA solution e. Immerse time: within 3 ± 0.5s f. Immerse speed: 25 ± 2.5mm/s	J-STD-002	15 pcs	Up to immerse position, above 95% area of surroundings surface shall be cover by the new soldering																	

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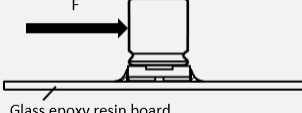
Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria																	
10	Electrical characterization	a. In different environment to deposit the products	User spec.	30 pcs	<table border="1"> <tr> <td rowspan="6" style="writing-mode: vertical-rl; transform: rotate(180deg);">Impedance comparison</td> <td colspan="2">Products with lower category temperature -40°C</td> </tr> <tr> <td>Comparison of temp section</td> <td>Magnification</td> </tr> <tr> <td>Z-25°C / Z+20°C</td> <td>According to spec.</td> </tr> <tr> <td>Z-40°C / Z+20°C</td> <td>According to spec.</td> </tr> <tr> <td colspan="2">Products with lower category temperature -55°C</td> </tr> <tr> <td>Comparison of temp section</td> <td>Magnification</td> </tr> <tr> <td>Z-25°C / Z+20°C</td> <td>According to spec.</td> </tr> <tr> <td>Z-55°C / Z+20°C</td> <td>According to spec.</td> </tr> </table>	Impedance comparison	Products with lower category temperature -40°C		Comparison of temp section	Magnification	Z-25°C / Z+20°C	According to spec.	Z-40°C / Z+20°C	According to spec.	Products with lower category temperature -55°C		Comparison of temp section	Magnification	Z-25°C / Z+20°C	According to spec.	Z-55°C / Z+20°C	According to spec.
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Stage	Temp. (°C)																					
1 (initial value)	20 ± 2																					
2	-25 ± 3																					
3	-40 ± 3																					
4	20 ± 2																					
5	Upper category temperature ± 2																					
6	20 ± 2																					
11	Board flex (SMD)	a. Put the test sample solder on the PCB board, size of 100 mm(length) x 40 mm (width) b. Curing test of the fixed method as follows:  c. Curve central point moves: Minimum 2mm d. Duration time after curving: 60 ± 5s e. Curve times: 1 time	AEC-Q200-005	30 pcs	1. $ \Delta C/C_R \leq 5\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. No visible damage																	

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Reference MIL-STD-202, JESD22, J-STD-002 and 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 ± 1s  Pad size: See dedicated packaging information	AEC-Q200-006	30 pcs	1. $ \Delta C/C_R \leq 5\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. 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 \leq 15\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. No visible damage 5. No leakage of electrolyte 6. Marking legible

Note:

- [1] General purpose grade: lifetime (V_R applied) ≤ 2000 hours.
 Long life grade: lifetime (V_R applied) > 2000 hours.