

## 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	1. $ \Delta C/C_R  \leq 20\%$ of initial value <sup>[1]</sup> 2. $\tan\delta \leq 2$ times spec. limit <sup>[1]</sup> 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 6. Marking legible
2	Temperature cycling	a. Lower category temperature: 30mins b. Temperature change: 3mins c. Upper category temperature: 30mins d. 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  \leq 5\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 6. Marking legible
3	Unbiased humidity	Temperature: $60^\circ\text{C} \pm 2^\circ\text{C}$ Humidity: 90 ~ 95% RH Duration: 1000h	JIS C 5101-4 No. 4.12  JIS C 5101-1 No. 4.22	10 pcs	1. $ \Delta C/C_R  \leq 20\%$ of initial value 2. $\tan\delta \leq 1.5$ times of spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 6. 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  \leq 20\%$ of initial value <sup>[1]</sup> 2. $\tan\delta \leq 1.5$ times spec. limit <sup>[1]</sup> 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 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	1. $ \Delta C/C_R  \leq 20\%$ of initial value <sup>[1]</sup> 2. $\tan\delta \leq 1.5$ times spec. limit <sup>[1]</sup> 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 6. Marking legible
6	Solvent resistance of marking	a. Solvent to be used: IPA b. Solvent temperature: $23^\circ\text{C} \pm 5^\circ\text{C}$ 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
7	Vibration	a. Frequency: 10 ~ 55 Hz b. Swing (single peak) and acceleration: 0.75mm or $98\text{m/s}^2$ 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. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 6. Marking legible

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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
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. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. ESR $\leq$ spec. limit 5. No visible damage 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 60s ± 1s 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: 15°C ~ 35°C b. Add surge voltage to the connections: 1.25·V <sub>R</sub> when V <sub>R</sub> ≤ 100V 1.15·V <sub>R</sub> when V <sub>R</sub> > 100V c. 6 min as a cycle (charge time 30s, discharge time 330s) d. Cycles: 1000 cycles	JIS C 5101-4 No. 4.14  JIS C 5101-1 No. 4.26	10 pcs	1. $ \Delta C/C_R  \leq 10\%$ of initial value 2. $\tan\delta \leq \text{spec. limit}$ 3. $I_{LEAK} \leq \text{spec. limit}$ 4. $ESR \leq \text{spec. limit}$ 5. No visible damage 6. Marking legible
14	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. $\tan\delta \leq \text{spec. limit}$ 3. $I_{LEAK} \leq \text{spec. limit}$ 4. $ESR \leq \text{spec. limit}$ 5. No visible damage 6. Marking legible

**Note:**

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

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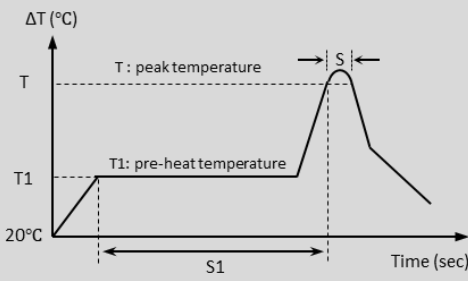
## Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

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	1. $ \Delta C/C_R  \leq 20\%$ of initial value 2. $\tan\delta \leq 2$ times spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. $ESR \leq$ spec. limit 5. 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> Stage 1 to 4 is one cycle Test time: 1000 cycles Measurement at 24h after test conclusion	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	1. $ \Delta C/C_R  \leq 10\%$ of initial value 2. $\tan\delta \leq$ spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. $ESR \leq$ spec. limit 5. No visible damage 6. 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	1. $ \Delta C/C_R  \leq 20\%$ of initial value 2. $\tan\delta \leq 1.2$ times spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. $ESR \leq$ spec. limit 5. No visible damage 6. 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	1. $ \Delta C/C_R  \leq 20\%$ of initial value 2. $\tan\delta \leq 2$ times spec. limit 3. $I_{LEAK} \leq$ spec. limit 4. $ESR \leq$ spec. limit 5. No visible damage															
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: $25^\circ\text{C} \pm 5^\circ\text{C}$	MIL-STD-202 Method 215	5 pcs	1. No visible damage 2. Marking legible															
6	Mechanical shock	a. Pulse shape: Half-sine waveform b. Max. acceleration: $980\text{m/s}^2(100\text{g})$ c. Pulse duration time: 6ms d. Direction: X, Y, Z e. Shock time: 10 times in one direction, 30 times in total	MIL-STD-202 Method 213	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. $ESR \leq$ spec. limit 5. No visible damage															

## RELIABILITY TESTS ▪ AUTOMOTIVE



## 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 <sup>2</sup> (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. ESR $\leq$ spec. limit 5. No visible damage																	
8	Resistance to solder heat	a. Kind of solder: H60A or equal b. Below diagram shows the products which in soldering stove of the 3 times reflow soldering c. When finish the first time and the samples temperature col off and become stable then will proceed the 2 <sup>nd</sup> time d. When finish the 2 <sup>nd</sup> time and the samples temperature col off and become stable then will proceed the 3 <sup>rd</sup> time  <table border="1" data-bbox="331 1294 829 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>&gt; 245°C</td> <td>&gt; 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. ESR $\leq$ spec. limit 5. No visible damage  * 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°C $\pm$ 3°C d. Solder solvent: Resin alcohol solution (25 wts%) or resin IPA solution e. Immerse time: within 3s $\pm$ 0.5s f. Immerse speed: 25 $\pm$ 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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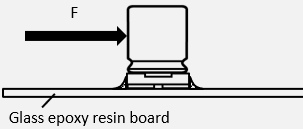
Reference MIL-STD-202, JESD22, J-STD-002 and AEC-Q200

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"><b>Products with lower category temperature -40°C</b></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"><b>Products with lower category temperature -55°C</b></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	<b>Products with lower category temperature -40°C</b>		Comparison of temp section	Magnification	Z-25°C / Z+20°C	According to spec.	Z-40°C / Z+20°C	According to spec.	<b>Products with lower category temperature -55°C</b>		Comparison of temp section	Magnification	Z-25°C / Z+20°C	According to spec.	Z-55°C / Z+20°C	According to spec.
		Impedance comparison					<b>Products with lower category temperature -40°C</b>															
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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: <div style="text-align: center;"> </div> c. Curve central point moves: Minimum 2mm d. Duration time after curving: 60s ± 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. $ESR \leq$ spec. limit 5. No visible damage																	

## RELIABILITY TESTS ▪ AUTOMOTIVE



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: 15°C ~ 35°C b. Add surge voltage to the connections: 1.25·V <sub>R</sub> when V <sub>R</sub> ≤ 100V 1.15·V <sub>R</sub> when V <sub>R</sub> > 100V c. 6 min as a cycle (charge time 30s, discharge time 330s) d. Cycles: 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. ESR ≤ spec. limit 5. No visible damage 6. Marking legible