

## **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> <li> ΔC/C<sub>R</sub>  ≤ 20% of initial value<sup>[1]</sup></li> <li>tanδ ≤ 2 times spec. limit<sup>[1]</sup></li> <li>I<sub>LEAK</sub> ≤ spec. limit</li> <li>ESR ≤ 2 times spec. limit</li> <li>No visible damage</li> <li>Marking legible</li> </ol>
2	Temperature cycling	<ul> <li>a. Lower category temperature: 30mins</li> <li>b. Temperature change: 3mins</li> <li>c. Upper category temperature: 30mins</li> <li>d. Temperature change: 3mins</li> <li>Step 1 to 4 as a cycle</li> <li>Cycle: 10 cycles</li> </ul>	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. $\text{ESR} \le \text{spec. limit}$ 5. No visible damage 6. Marking legible
3	Unbiased Humidity	Temperature: 60°C±2°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  \le 20\%$ of initial value 2. $\tan \delta \le 1.5$ times of spec. limit 3. $I_{LEAK} \le$ spec. limit 4. ESR $\le 1.5$ times spec. limit 5. No visible damage 6. Marking legible
4	Endurance (load Life)	Upper category temperature V <sub>R</sub> applied Duration: specified or see detail specifica- tion	JIS C 5101-4 No. 4.13 JIS C 5101-1 No. 4.23	10 pcs	$ \begin{array}{ll}  \Delta C/C_R  \leq 20\% \text{ of initial value}^{[1]} \\ \text{2. } \tan\delta \leq 1.5 \text{ times spec. limit}^{[1]} \\ \text{3. } I_{\text{LEAK}} \leq \text{spec. limit} \\ \text{4. } \text{ESR} \leq 2 \text{ times spec. limit} \\ \text{5. } \text{No visible damage} \\ \text{6. } \text{Marking legible} \end{array} $
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}  \Delta C/C_R  \leq 20\% \text{ of initial value}^{[1]} \\ \text{2. } \tan\delta \leq 1.5 \text{ times spec. limit}^{[1]} \\ \text{3. } I_{\text{LEAK}} \leq \text{spec. limit} \\ \text{4. } ESR \leq \text{spec. limit} \\ \text{5. } \text{No visible damage} \\ \text{6. } \text{Marking legible} \end{array} $
6	Solvent resistance of marking	<ul> <li>a. Solvent to be used: IPA</li> <li>b. Solvent temperature: 23°C ± 5°C</li> <li>c. Conditioning: Method 1 (with rubbing)</li> <li>d. Rubbing material: Cotton wool</li> <li>e. Recovery time: Not applicable, unless otherwise stated in the detail specification</li> </ul>	JIS C 5101-1 No. 4.32 JIS C 60068- 2-45 3.1.2	5 pcs	See detail specification
7	Vibration	<ul> <li>a. Frequency: 10 ~ 55 Hz</li> <li>b. Swing (single peak) and acceleration: 0.75mm or 98m/s<sup>2</sup></li> <li>c. Test direction and duration: X, Y, Z each one for 2h</li> </ul>	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  \le 5\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. ESR $\le$ 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  \le 5\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. ESR $\le$ 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 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 • Im- pedance 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	Terminal strength	<ul> <li>a. Use different lead wire diameter to added weights, vertical resistance pull for 10s ± 1s.</li> <li>b. Fix the capacitor, use the different lead wire diameter to added weights, bending angle to 90° with the terminal, then against the direction to do the same operation for a cycle, as rules to operate two cycles</li> </ul>	JIS C 5101-1 No. 4.13 JIS C 5104-1 No. 4.4	10 pcs	The tested terminals are not allowed those following defective situations: flexible, broken and touch defects
12	Surge voltage	<ul> <li>a. Test temp: 15°C~35°C.</li> <li>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> &gt;100V</li> <li>c. 6 min as a cycle (charge time 30s, discharge time 330s)</li> <li>d. Cycles: 1000 cycles</li> </ul>	JIS C 5101-4 No. 4.14 JIS C 5101-1 No. 4.26	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. ESR $\le spec$ . limit 5. No visible damage 6. Marking legible
13	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  \le 10\%$ of initial value 2. $\tan \delta \le$ spec. limit 3. $I_{LEAK} \le$ spec. limit 4. ESR $\le$ spec. limit 5. No visible damage 6. Marking legible

#### Note:

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



# **RELIABILITY TESTS • AUTOMOTIVE**

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

Test Test Sample Test No. Test Quantity **Specification** Standard Criteria High Test temp: Upper category temperature 1.  $|\Delta C/C_R| \le 20\%$  of initial value<sup>[1]</sup> temperature No voltage applied Duration: 1000h exposure 2.  $tan\delta \leq 2$  times spec.  $limit^{[1]}$ MIL-STD-202 Pre-treatment for measurements shall be 77 pcs 1 (Storage at 3. I<sub>LEAK</sub> ≤ spec. limit Method 108 conducted after application of DC working upper cate-4. ESR ≤ spec. limit gory tempervoltage for 30 minutes 5. No visible damage ature Measurement at 24h after test conclusion Time Temperature Stage Lower category Within 30min 1 1.  $|\Delta C/C_R| \le 10\%$  of initial value temperature 2 Temperature change Within 1min 2.  $tan\delta \leq spec$ . limit JESD22 Upper category Temperature 3. I<sub>LEAK</sub> ≤ spec. limit Within 30min 2 Method JA-77 pcs temperature cycling 4. ESR  $\leq$  spec. limit 4 Temperature change Within 1min 104 5. No visible damage Stage 1 to 4 is one cycle 6. Marking legible Test time: 1000 cycles Measurement at 24h after test conclusion Temperature: 85°C 1.  $|\Delta C/C_R| \le 20\%$  of initial value Humidity: 85%RH 2.  $tan\delta \le 1.2$  times spec. limit Biased Applied voltage: V<sub>R</sub> MII-STD-202 3.  $I_{LEAK} \leq$  spec. limit 3 77 pcs humidity Duration: 1000h Method 103 4. ESR  $\leq$  spec. limit Test condition: Measurement at 24h after 5. No visible damage test conclusion 6. Marking legible 1.  $|\Delta C/C_R| \le 20\%$  of initial value<sup>[1]</sup> Test temp: Upper category temperature V<sub>R</sub> applied (& I<sub>R</sub> applied if specified) 2.  $tan\delta \le 2$  times spec.  $limit^{[1]}$ Operational MIL-STD-202 Duration: specified or see detail specifica-77 pcs 4 3.  $I_{LEAK} \leq$  spec. limit life Method 108 tion 4. ESR ≤ spec. limit Measurement at 24h after test conclusion 5. No visible damage Terminal wire Force/Weight Diameter (mm) (±10%) 5N (0.51kg)  $0.3 < d \le 0.5$ 0.5 < d ≤ 0.8 10N (1.02kg) 0.8 < d ≤ 1.25 20N (2.04kg) 40N (4.08kg) Snap-In terminals 1. Fix the tested capacitor, then add the hammer of above weight on the lead pin continuously, keep for 10s ± 1s. Tensile MIL-STD-202 strength 5 30 pcs No visible damage Terminal Method 211 Force/Weight (THT) Diameter Times (±10%) (mm) 0.3 < d ≤ 0.5 2.5N (0.255Kg) 3 0.5 < d ≤ 0.8 5N (0.51Kg) 3 0.8 < d ≤ 1.25 10N (1.02Kg) 3 2. Fix the capacitor, use the wire diameter to added weights, bending angle to 90° with the terminal, then against the direction to do the same operation for a cycle, as rules to operate 3 cycles.



# **RELIABILITY TESTS • AUTOMOTIVE**



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

No.	Test	Test Specification	Test Standard	Sample Quantity	Test Criteria
6	Resistance to solvents	<ul> <li>a. Solvent to be used: IPA</li> <li>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)</li> <li>c. After test place in air nature drying</li> <li>d. Test temperature: 25°C± 5°C</li> </ul>	MIL-STD-202 Method 215	5 pcs	<ol> <li>No visible damage</li> <li>Marking legible</li> </ol>
7	Mechanical shock	<ul> <li>a. Pulse shape: Half-sine waveform</li> <li>b. Max. acceleration: 980m/s<sup>2</sup> (100g·s)</li> <li>c. Pulse duration time: 6ms</li> <li>d. Direction: X, Y, Z on 6 faces</li> <li>e. Shock time: 3 times in one face, 18 times in total</li> </ul>	MIL-STD-202 Method 213	30 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. $\text{ESR} \le \text{spec. limit}$ 5. No visible damage
8	Vibration	<ul> <li>a. 10Hz ~ 2kHz ~ 10Hz (20min)</li> <li>b. Amplitude (Double peaks): 1.50mm @10 ~ 55Hz</li> <li>c. Acceleration: 49m/s<sup>2</sup> (5g·s) @55Hz ~ 2kHz</li> <li>d. X direction 4h Y direction 4h Z direction 4h Total: 12h</li> </ul>	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. ESR $\le$ spec. limit 5. No visible damage
9	Resistance to solder heat	<ul> <li>DIP solder groove immerse method</li> <li>a. Kind of solder: Sn 96.5%; Ag 3%; Cu 0.5%</li> <li>b. Solder stove temp: 260°C -0°C/+5°C</li> <li>c. Immerse time: 10s± 1s</li> <li>d. The tested terminal must be soldered into the groove with a speed of: 25mm/s ± 6mm/s</li> <li>e. Solder within 1.5mm of device body for lead</li> <li>f. Immerse time: once</li> <li>g. Test condition: Measurement at 24h after test conclusion</li> </ul>	MIL-STD-202 Method 210	30 pcs	<ol> <li> ΔC/C<sub>R</sub>  ≤ 5% of initial value</li> <li>tanδ ≤ spec. limit</li> <li>I<sub>LEAK</sub> ≤ spec. limit</li> <li>ESR ≤ spec. limit</li> <li>No visible damage</li> </ol>
10	Solderability	<ul> <li>DIP solder groove immerse method</li> <li>a. Kind of solder: Sn 96.5%; Ag 3%; Cu 0.5%</li> <li>b. Pre-handle: 155°C, 4Hours+15min</li> <li>c. Solder stove temp.: 245°C ± 5°C</li> <li>d. Solder solvent: Resin alcohol solution (25 wts%) or resin IPA solution</li> <li>e. Immerse time: within 5 +0/-0.5secs</li> <li>f. Immerse speed: 25±2.5mm/s</li> </ul>	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-002and AEC-Q200

No.	Test	Spec	Test ification	Test Standard	Sample Quantity	Test Criteria			
11	Electrical charac- terization	a. In different deposit the	environment to products		30 pcs	stage 2 stage 3	Impedance comparison	Products with lower category temperature -40°C	
		Stage	Temp. (°C)					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.
		3	-40±3					Products with lower category temperature -55°C	
		4	20±2	User 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.
		<ul> <li>b. Test freque</li> <li>c. Each stage</li> <li>time of hot</li> <li>ture stabilit</li> </ul>	ncy: 120Hz of time: Reached balance (tempera- y)			stage 5	1. $ \Delta C/C_R  ≤ 30\%$ of initial value ge 5 2. tanδ ≤ spec. limit 3. $I_{LEAK} ≤ 5$ times spec. limit		
12	Surge voltage	<ul> <li>a. Testtemp.:</li> <li>b. Add surge v nections: 1.25·V<sub>R</sub> w 1.15·V<sub>R</sub> w</li> <li>c. 6 min as a c 30s, dischard</li> <li>d. Cycles: 1000</li> </ul>	$15^{\circ}$ °C ~ $35^{\circ}$ °C. voltage to the con- hen V <sub>R</sub> ≤ 100V hen V <sub>R</sub> > 100V cycle (charge time rge time 330s) 0 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. $ESR \le$ spec. limit 5. No visible damage 6. Marking legible			

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