Reliability Testing Procedures

RFI Suppression and Safety Capacitor Testing according to EN 132 400 and IEC 60384-1.

Reliability Parameter	Test	Tested according to	Condition to be satisfied after testing
Voltage Proof	**V_t**	EN 132 400, Test 4.2.1. - the voltage shall be raised from near zero to the test voltage V_t at a rate not exceeding 150 V/s, where for : Class X1 Capacitors $V_t = 2*V_{rms} + 1500$ V~, 1 minute Class Y1 Capacitors $V_t = 4000$ V~, 1 min Class Y2 Capacitors $V_t = 2* V_{rms} + 1500$ V~, 1 minute	no permanent breakdown or flash-overs during the test period
Impulse Voltage		EN 132 400, Test 4.13. - 24 impulses of the same polarity shall be applied to the capacitor. The time between impulses shall be no less than 10 s, where for : Class X1 Capacitors $V_p = 4$ kV Class Y1 Capacitors $V_p = 8$ kV Class Y2 Capacitors $V_p = 5$ kV	no self-healing breakdowns or flash-overs
AC/DC Bias Reliability	**AC/DC Life Test**	EN 132 400, Test 4.14, 1000 h at UCT, where : - for X Class Capacitors : at V = 1,25 V_{rms} and once per hour the voltage shall be increased to 1000 V~ for 0,1 s - for Y Class Capacitors : at V = 1,7 V_{rms} and once per hour the voltage shall be increased to 1000 ~ for 0,1 s	no visable damage $\lvert\Delta C/C\rvert < 20$ % $\Delta\tan\delta < 0{,}008$ IR greater than 50 % of the applicable limits no permanent breakdown or flash-over during Voltage proof
Charge and Discharge		EN 132 400, Test 4.15. - 10,000 cycles of charge and discharge at the rate of one operation per minute with the test voltage of SQRT(2) * V_{rms}, discharge rate adjusted to 100 V/µs	$\lvert\Delta C/C\rvert < 10$ % $\Delta\tan\delta < 0{,}008$ IR greater than 50 % of the applicable limits
Capacitance - Temperature Characteristics		Measuerement of capacitance and tan δ in the temperature chamber at 20 °C and at UCT and LTC	within specification
Radio-Frequency Characteristics		EN 132 400, test 4.16. - measurement of capacitor impedance over a range of frequencies	within specification
Capacitance - Voltage Characteristics		Measuerement of capacitance and tan δ at 20 °C with applied rated voltage	within specification
Environmental and Storage Reliability	**Climatic Sequence**	EN 132 400, Test 4.11. a) Dry heat, 16 h, UCT, Test Ba, IEC 68-2-2 b) Damp heat, cyclic, the first cycle : 55 °C, 93 % RH, 24 h, test Db, IEC 68-2-1 c) Cold, LCT, 2 h, Test Aa, IEC 68-2-1 d) Damp heat cyclic, remaining 5 cycles : 55 °C, 93 % RH, 24 h /cycle, test Bd, IEC 68-2-30	no visable damage $\lvert\Delta C/C\rvert < 20$ % $\Delta\tan\delta < 0{,}008$ IR greater than 50 % of the applicable limits no permanent breakdown or flash-over during Voltage proof
	Thermal Shock	EN 132 400, Test 4.6, Test Na, IEC 68-2-14, 5 cycles UCT/LCT, 30 minutes	no visible damage
	Steady State Damp Heat	EN 132 400, Test 4.12, Test Ca, IEC 68-2-3, 56 days, 40 °C, 93 % RH	no visable damage $\lvert\Delta C/C\rvert < 20$ % $\Delta\tan\delta < 0{,}008$ IR greater than 50 % of the applicable limits no permanent breakdown or flash-over during Voltage proof
	Storage Test	IEC 68-2-2, Test Ba 1000 h at maximum storage temeprature	no visible damage $\lvert\Delta C/C\rvert < 20$ % $\Delta\tan\delta < 0{,}008$ IR greater than 50 % of the applicable limits no permanent breakdown of flash-over during voltage proof
Mechanical Reliability	**Solderability**	EN 132 400, Test 4.5., Test Ta, IEC 68-2-20 , solder bath and reflow method	Solderable at shipment and after 2 years of storage - limits*
	Resistance to Soldering Heat	EN 132 400, Test 4.4., Test Tb, IEC 68-2-20, solder bath and reflow method	no visible damage $\lvert\Delta C/C\rvert < 10$ %
	Robustness of Termination	EN 132 400, Test 4.3. , Test Ua, IEC 68-2-21	no visible damage
	Vibration	en 132 400, Test 4.7., Test Fc, IEC 68-2-6, Frequency range 10 to 55 Hz Amplitude 0.75 mm or 98 m/s² Total duration 6 h (3 x 2 h) Waveshape - half sine	no visible damage
	Mechanical Shock	EN 132 400, Test 4.9, Test Ea, IEC 68-2-27 Acceleration = 490 m/s², 100 g 6ms and 50 g 11 ms, Waveshape - half sine Number of shocks = 3 x 6	$\lvert\Delta C/C\rvert < 10$ % tan δ within specification no visible damage

* storage, criteria > 95 % must be covered by solder for reflow meniscus