



CAPACITOR Introduction to ESPEC Capacitor Measurement System

Capacitor Manufacturing Process and Evaluation Items

Development of vehicle and IoT/5G technologies has led to development of new and mass-production of existing advanced electronic products, including multi-layer ceramic capacitors (MLCC). Demand for reliability evaluations is increasing in step with these developments. Acceptance inspection is increasingly performed by assembly manufacturers who purchase capacitors that have already undergone testing by the capacitor manufacturer.



MLCC Failure Causes and Importance of Reliability Evaluations

Electronic parts, including capacitors, have become smaller and more highly functional in recent years. Self-heating is increasing and joint surfaces with boards are being reduced,

highlighting the need to ensure the reliability of solder joint and insulation deterioration.

To evaluate these characteristics appropriately, reliability testing is necessary.

Primary test standards for capacitors

- AEC-Q200 (standards for passive parts)
- X8R (EIA compliant/change in electrostatic capacity is within ±15% at -55 to 150°C), etc.

• IEC 60384-8: 2015 (change in electrostatic capacity is within ±20% at -55 to 125°C), etc.



Insulation degradation occurs mainly due to moisture and impurities in the air at various locations, such as between a board and MLCC, as well as the surface and interlayer of an MLCC. Conduction failures occur when an MLCC mounted on a board is exposed to temperature changes, and eventually its joint surface is broken due to board distortion and material deterioration.

Inside of element Element void, board warp. Moisture absorption Terman fatigue, solder quantity

short open Insulation Capacity drop deterioration Element surface Flux residue, dew conder ntity moisture adsorption short Insulation

deterioration

Moisture absorption

Dew condensation

n. Shock on electrode and solder materials, thermal fatigue

erosion/peeling

open

Electrode

Solder joint Thermal fatigue, solder quantity

Impact,

bending

CS#0 SSISECSS

open Solder crack

Customizable combination of system and

chamber according to evaluation aims

Capacitor Failure Causes and Evaluation System

Evaluation aims	Evaluation items	Failure causes/factors (1)	Failure causes/factors (2)	Test elements	Recommended system
Reliability evaluations (life evaluations)	Insulation deterioration short	Surface leak	Electro-Chemical Migration	• Use under constant temperature and humidity conditions	 AMI + temperature and humidity chamber AMI + HAST
		Internal leak	Crack	• Thermal stress	• AMI + high temperature chamber • AMI + air to air thermal shock chamber
			Void Delamination ★ Crack ★	 Mixing of foreign substances, incompatible processing conditions, excessive mechanical stress 	• AMI + temperature and humidity chamber • AMI + high temperature chamber
			Voltage breakdown	 Voltage application (rated value, overvoltage) 	 High voltage AMI AMQ + temperature and humidity chamber (with DC bias)
	Conduction failure open	Break of solder joint/ capacitor elements	Crack ★	 Thermal stress Excessive mechanical stress during board mounting 	 AMR + air to air thermal shock chamber AMQ + air to air thermal shock chamber (with DC bias)
		Electrode connection failure	External electrode erosion ★	• External electrode abnormality due to thermal stress	• AMR + air to air thermal shock chamber
Characteristics evaluations	Variation in electrostatic capacity	_	—	 Temperature and humidity conditions Voltage application 	 AMQ + temperature and humidity chamber AMQ + temperature chamber (with AC/DC bias low voltage)
	Low ESR characteristic	_	—	High-accuracy parameter measurement	
Performance evaluations	Testing under various conditions	_	—	High-accuracy parameter measurement Power equipment custom specifications	 AMQ + temperature and humidity chamber AMI individual power supply, increasing current capacity, etc.

 \star Acceptance inspection is performed by assembly manufacturers.

Capacitor Evaluation System

Evaluation items **16 ANQ** [Capacitor/Inductor Temperature Characteristic Evaluation System]



Model	AMQ-**-C			
Measurement	AC four-terminal pair measurement			
method	(measuring cable tip)			
Measurement	Min. 1 minute to 1500 minutes			
interval	(variable in 1 minute increments)			
The number of	t o 64 ch, 128 ch*			
test channels	Custom specifications apply.			
Measurement	Measured frequency: 20 Hz to 1 MHz * 100 MHz-compliant type is also available.			
range	Dielectric tangent: 0.0001 to 10.0000 tan δ Impedance: 10 m Ω to 100 M Ω			

This system is used to measure the temperature and frequency characteristics of capacitors and inductors. It automatically records the electrostatic capacity (C), loss factor (D), and impedance (Z) of a sample under arbitrarily set measurement conditions.

Download the catalog here!

Evaluation items
2 4 7
AMR [Conductor Resistance Evaluation System]



AMR-**-UA			
AC application specifications			
40 to 280 ch/rack			
1 mΩ to 3 kΩ			

This system is used for real-time measurement of conductor resistance in temperature cycle testing of the temperature chamber by applying high and low temperatures alternately to evaluate the capacitor joint under heat stress and board distortion. For assembly evaluation of parts other than capacitors, the UD type (Direct electric current application type) is also available.



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Evaluation items

 \mathbf{AMI} [Electro-chemical Migration Evaluation System]





This system is used to measure insulation resistance (leakage current) by applying voltage to a sample. When used with a temperature and humidity chamber, this system allows for efficient evaluation of insulation deterioration under various stress conditions, such as temperature, humidity, and voltage. Migration is fully recorded without sampling measurement.



Evaluation items 1 6 AMQ [Capacitor/Inductor Temperature Characteristic Evaluation System] + DC Bias Application



Evaluation items

3 5 8 HAST Chamber + AMI Plus Common Specifications







Basically, AMI uses one power supply per channel. By consolidating the power supplies for multiple channels, many channels can be evaluated with a small number of pins when the AMI is connected to the HAST chamber with a limited number of pins.

Evaluation items



Measurement Jig



Jig for chip capacitor It is used by interposing chip capacitors among gold plates Springs on one side allow it to be adjusted for various sizes of samples.



Tip clip jig It is used by interposing chip capacitors between clip tips.



Jig for radial Jig for radial-type capacitor. It is used by interposing the lead between electrodes.



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