

<u>www.niccomp.com</u> | technical support: <u>tpmg@niccomp.com</u>

MLCC - Ceramic Chip Capacitors / Failure Mode Study

Potential Failure Causes, Accelerators, Behavior

Cause	Sources	Indications	Behavior	Remedy
Electrical Overstress; AC current or Pulse current	Poor design choice or inappropriate component selection	 Self heating (I²ESR), Increased leakage current Discoloration over time In severe cases melting of solder alloy and component displacement, 	Decreased IR (increased LC) typically leading to short or open condition	Alternate lower loss dielectric MLCC or film capacitor
Electrical Overstress; Voltage	Poor design choice or inappropriate component selection	Micro-cracking within ceramicDielectric punctureExternal flashover	Decreased IR (increased LC) typically leading to short or open condition	Higher voltage rated component or alternate capacitor type
Mechanical Stress	 Component test or tape operations Component placement Centering jaws Post reflow PCB Flexure or Shock PCB depanelization Impact damage to PCB 	Damage to MLCC bodyCracking observed in ceramic	Immediate or latent IR failure; increasing LC or erratic LC leading to short	 Machine set-up, maintenance and operator training Placement pressure PCB Routing Flexible soft terminal MLCCs
Thermal Stress	 Hand Soldering PCB Rework Wave – flow soldering Forced cooling – quenching Subsequent PCB soldering processes 	Cracking observed in ceramicLeaching of terminal metallization	Immediate or latent IR failure; increasing LC or erratic LC leading to short	 Training and control Reduce heating – cooling rates
Intrinsic Defect	Contamination in ceramicImproper pressing or sintering	High porosity or voids in ceramicKnit-line voiding or crackingFiring cracks	 Immediate or latent LC; increasing LC leading to short Early HALT test failure 	Material control and clean room particle control Pressing and Sintering controls
lonic or metal conduction	PC residues, flux residues, water type, saponifier, assembly aids, sealers or coatings & external sources	Electrochemical migration (dendrite growth) or corrosion	Decreased IR (increased LC) over time and operating temp & RH	IQC, alternate materials, cleaning upgrade and alternate sealers