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AN105 09/08

Application Note

TESTING AND SCREENING FOR HIGH VOLTAGE CERAMIC CAPACITORS

OVERVIEW

For High Voltage Ceramic Capacitors both Multilayer and Disc the most common definition for High Voltage are components at or above 500VDC to 20,000VDC rated voltages. Below is a summary of the testing conditions that are called out in the High Voltage Ceramic Capacitor Military specification, MIL-PRF-49467C which is available in its entirety at www.dscc.dla.mil. The conditions listed below and additional tests are used and combined when increase reliability for the applications are needed. For commercial applications simple bench testing may be adequate. Increased screening techniques may be required for applications such as Military Radar, Avionics, Missile guidance, Medical applications. Maximum reliability would be non-repairable applications such as spacecraft and high level military programs.

Below we have outlined various screening tests that you may choose as a menu of options for your application. For further information and consultation please feel free to contact us at any time.

COMMERCIAL/INDUSTRIAL APPLICATIONS

As a minimum CalRamic Technologies will test 100% of the components to the following tests at room temperature IAW MIL-PRF-49467C.

- Dielectric Withstanding Voltage at 1.2X rated voltage.
- Insulation Resistance @500VDC, 100,000 megohm min. or 1000 megohm-uf min.
- Capacitance/Dissipation Factor, 1Khz, 1VRMS
- Final Visual Inspection

GROUND BASED MILITARY/MEDICAL APPLICATIONS

For these applications a minimum of Group A screening IAW MIL-PRF-49467C per Table IV below. Note that in Group A screening Partial Discharge screening is required and may be omitted in certain cases to reduce cost.

Table IV: Group A Inspection

Inspection	Requirement Paragraph	Test Method Paragraph	Sampling Procedure
<u>Subgroup 1</u>			
Thermal Shock	3.6	4.8.2.1	100% Inspection
Voltage Conditioning	3.6	4.8.2.2	
Partial Discharge (when specified, see 3.1)	3.10	4.8.6	
<u>Subgroup 2</u>			
Radiograph Inspection <u>1/</u>	3.2.4	4.8.20	See Table V
<u>Subgroup 3</u>			
Visual and Mechanical Examination: <u>2/</u>	3.4 and 3.4.1	4.8.1	13 Samples 0 Failures
Material			
Physical Dimensions	3.1		
Interface Requirements	3.5		
(Other than physical dimensions) <u>2/</u>			
Marking <u>3/</u>	3.25		
Workmanship	3.27		
<u>Subgroup 4</u>			
Solderability	3.13	4.8.9	5 Samples 0 Failures
<p><u>1/</u> Molded and encapsulated case types only, see 3.1. Not applicable to conformal coated parts.</p> <p><u>2/</u> The manufacturer may request the deletion of the visual or mechanical examination provided an in-line or process control system to assure the visual and mechanical requirements are met can be validated and approved by the qualifying activity. Deletion of these examinations does not relieve the manufacturer from meeting these requirements in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of these examinations</p> <p><u>3/</u> Marking defects are based of visual examination only.</p> <p><u>4/</u> Defective units from subgroups 1 and 2 tests may be used. Parts subjected to this test shall not be delivered. The manufacturer may request the deletion of subgroup 4 solderability test, provided an in-line or process control system for assessing and assuring the solderability of leads can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of the test.</p>			

SPACE LEVEL/NON-REPAIRABLE APPLICATIONS

For these applications where absolute reliability is a concern, Group A screening IAW MIL-PRF-49467C with Partial Discharge Testing should be required. In addition, a Group B sample from the lot of capacitors should be run. In some cases, Ultrasound testing (C-SAM) should be run after lead attach and prior to coating. Note that C-SAM testing is not called out in the Mil specification listed above.

Below is the Group B testing Table VI as called out in 49467C

Table VI: Periodic Group B Inspection

Inspection	Requirement Paragraph	Test Method Paragraph	Number of Sample Units to be Inspected		Number of Defectives Permitted <u>2/</u>	
<u>Subgroup 1 (Every 6 Months)</u> Terminal Strength Resistance to Soldering Heat Moisture Resistance	3.18 3.11 3.19	4.8.14 4.8.7 4.8.15	12	<u>2/</u>	1	1
<u>Subgroup 2 (Every 6 Months)</u> Voltage-Temperature Limits <u>3/</u> Low Temperature Storage Marking Legibility (Laser Marking Only)	3.14 3.23 3.25.1	4.8.10 4.8.19 4.8.1.1	6		1	
<u>Subgroup 3 (Every 6 Months)</u> Resistance to Solvents	3.21	4.8.17	<u>4/</u> 4		1	
<u>Subgroup 4 (Every 6 Months)</u> Life (at elevated ambient temperature) Partial Discharge	3.22 3.10	4.8.18 4.8.6	10 minimum per style		1	
<p><u>1/</u> A sample unit having one or more defects shall be charged as a single defective.</p> <p><u>2/</u> Samples shall be representative of the highest capacitance value of each style manufactured during the sample period</p> <p><u>3/</u> Samples shall be selected from a minimum of two lots per sampling period when more than one lot of dielectric is used.</p> <p><u>4/</u> When more than one marking type is used (see 3.21), an additional four samples shall be added for each additional marking type.</p>						