
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 rated at or above 500 VDC to 20,000 VDC. 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 Group A testing listed below and additional inspections such as Group B Inspection, are used and combined where increased reliability for certain applications are needed.

For commercial / industrial applications simple bench testing may be adequate, but for high reliability applications such as Military Radar, Avionics, Missile guidance and Medical systems, enhanced screening techniques may be required. Maximum reliability would be required for non-repairable, system critical 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 subject 100% of the HV components to the following room temperature tests, IAW the latest revision of MIL-PRF-49467.

- ⚡ Dielectric Withstanding Voltage (DWV) @ $1.2 \times WVDC$
- ⚡ Insulation Resistance @ 500 VDC, 100,000 Megohm (M Ω) minimum, or 1000 Megohm- microfarad (M Ω - μ F) minimum, w/e is less
- ⚡ Capacitance @ 1 KHz & 1 VRMS
- ⚡ Dissipation Factor @ 1KHz & 1 VRMS
- ⚡ Final Visual / Mechanical Inspection (13 piece sample)

Ground Based Military / Medical Applications

For these applications it is recommended as a minimum, that Group A inspection IAW the latest revision of MIL-PRF-49467 per Table IV below, be performed. It should be noted that in Group A inspection, Partial Discharge inspection is a requirement, but that in certain cases this test is sometimes omitted to reduce cost. CalRamic Technologies applications team is available to discuss your specific requirements and whether Partial Discharge testing should be given consideration.

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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>	3.24	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 (Other than physical dimensions) <u>2/</u>	3.5		
Marking <u>3/</u>	3.25		
Workmanship	3.27		
<u>Subgroup 4</u>			
Solderability	3.13	4.8.9	5 Samples 0 Failures

1/ Molded and encapsulated case types only, see 3.1. Not applicable to conformal coated parts.

2/ 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

3/ Marking defects are based of visual examination only.

4/ 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.

Table V: Sampling Plans For Subgroup 2 (Group A Inspection)

Lot Size	Sample Size	Lot Size	Sample Size
1 – 13	100%	1,201 – 3,200	42
14 – 150	13	3,201 – 10,000	50
151 – 280	20	10,001 – 35,000	60
281 – 500	29	35,001 – 150,000	74
501 – 1,200	34	150,001 – 500,000	90

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Space Level / Non-Repairable Applications

For “system critical” applications where absolute reliability is a concern, Group A screening IAW the latest revision of MIL- PRF-49467 with Partial Discharge testing should be required. In some instances, non-destructive Ultrasound examination (C- SAM) should be performed after lead attach and prior to coating. It should be noted that C-SAM testing is not called out in the M49467 specification listed above but that it has proven to be an extremely effective means of detecting and eliminating internal delaminations and voids, especially when performed in conjunction with Partial Discharge testing.

In addition, strong consideration should be given to submitting a sample from the same lot of capacitors to some form of Group B Inspection. Group B Inspection has proven to be a very effective means of gauging the suitability of a capacitor design for use in system critical applications. Inspection can be performed as a single lot inspection similar to qualification, or where multiple production lots may be required, it can be employed on an ongoing basis to ensure process stability and continued long term reliability. Below is the Group B testing Table VI as called out in M49467.

Table VI: Periodic Group B Inspection

Inspection	Requirement Paragraph	Test Method Paragraph	Number of Sample Units to be Inspected		Number of Defects Permitted	
					<u>1/</u>	<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		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 4.10.19 4.8.1.1	6	<u>2/</u>	1	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 3 months)</u> Life (at elevated ambient temperature) Partial Discharge	3.22 3.10	4.8.18 4.8.6	10 minimum per style		1	

1/ A sample unit having one or more defects shall be charged as a single defect.

2/ Samples shall be representative of the highest capacitance value of each style manufactured during the sampling period.

3/ Samples shall be selected from a minimum of two lots per sampling period when more than one lot of dielectric is used.

4/ When more than one marking type is used (see 3.21), an additional four samples shall be added for each additional marking type.

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