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ProtectiCap™ Surface Coated MLCC

Contents

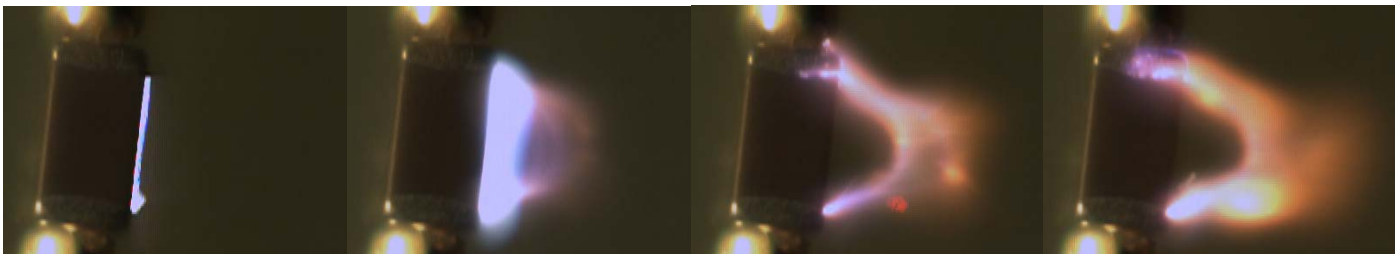
Introduction 2
Surface Arcing 2
Summary of Testing 3
Range and Ordering Information 5

Introduction

Syfer ProtectiCap™ high voltage, surface mount, multi layer ceramic capacitors are designed specifically to reduce the occurrence of surface arcing in high voltage applications. The range incorporates 1206 to 2220 EIA case sizes in voltages from 2kV to 5kV and enables use without the need for conformal coating post soldering. The addition of the ProtectiCap™ range maintains Syfer's position as world leader in high voltage MLCC with parts such as a 1206 3kV 1.5nF now available. ProtectiCap™ capacitors should provide benefits in power supply, lighting ballast, inverter, voltage multiplier and many other high voltage applications

Surface Arcing

Surface arcing, arc-over, flash-over, corona discharge, these are all terms for the same thing, an undesirable high voltage discharge which can cause interference and/or component failure. Surface arcing occurs when the dielectric strength of the surface environment is exceeded. High potential difference between the opposing terminations can lead to partial ionisation of the air which can then break down completely and allow a spark to discharge, this spark is visible, audible and the associated corona discharge will create electrical noise.



Pictures showing the propagation of surface arc.

The arc inception voltage is the voltage at which arcing will commence, there are several factors which can affect this.

1. Humidity. At levels of high humidity surface arcing is more prevalent, this explains the sometimes seasonal nature of arcing problems and also why there are more issues in geographical areas of high humidity.
2. Surface Contamination. Solder balls, flux residue and other contaminents which have been deposited during manufacturing, processing and assembly.
3. Dielectric Type. Higher dielectric constant materials are more susceptible, also higher capacitance values. C0G/NP0 is not usually affected.
4. PCB design. Oversize pads, vias underneath capacitors, buried layers and geometries which inhibit good cleaning can all contribute to arcing problems.

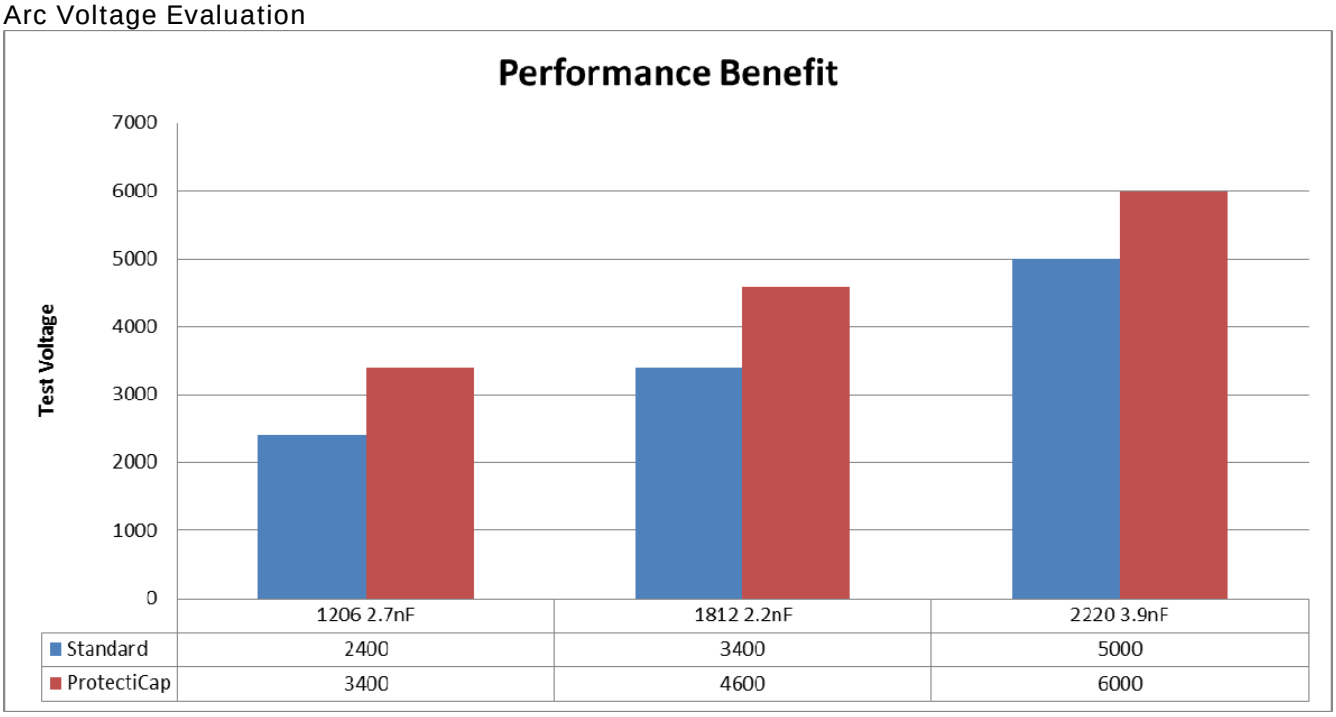
To combat surface arcing pads should be well spaced and not have sharp corners and PCBs should be cleaned post soldering. Environmental factors such as humidity are more difficult to control which is why most vendors' high voltage MLCC may require the PCB to be conformal coated.

ProtectiCap™ provides consistent performance advantages without the need for confomal coating of the PCB. Syfer employ a unique set of processes to apply a low permittivity glass coating to an already optimised high voltage MLCC design. The sealed, smooth finish and low dielectric constant allows for higher voltages and capacitance values in smaller case sizes, a prime example of this is the 1206P3K00102KXT which would previously only have been available in an 1808 case size.

Summary of Testing

Syfer have undertaken a significant program of testing in order to evaluate the performance of the ProtectiCap™ range. The minimum arc inception voltage has been evaluated across the range and shows an improvement in performance of a minimum of 1000V over standard parts.

Arc Voltage Evaluation



The above shows the performance benefit with respect to surface arcing in bulk testing across the range of sizes. The tests were performed on Syfer line testers and the graph shows the maximum test voltage before any arcing occurs. Voltage was supplied instantaneously with a current limit of 50mA.

Qualification Testing

In order to verify the reliability and consistency of performance of the ProtectiCap™ range a test regime has been assembled based on our extensive knowledge of high reliability products. Standard test methods have been employed from various international specifications including AEC-Q200, IECQ-IECC and MIL standards. The table below shows the tests, methods, criteria and results with the ProtectiCap™ parts meeting all requirements.

Test	Reference	Sample size per lot	Accept on number failed	Additional Requirements	Result
J-STD-020D Moisture/Reflow	Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices	25	0	1.24hr bake @ 125degC. 2.Moisture soak for 168hre 85/85. 3.PCB assembly (3X260deg reflow). 4.External Visual. 5.Electrical Test	Pass
AEC-Q200 test 3. High Temp Storage	MIL-STD-202 method 108	77	0	Unpowered 1000 hours @ 150°C.	Pass
AEC-Q200 test 4. Temperature cycling	JESD22 method JA-104	77	0	1000 cycles (-55°C to 125°C)	Pass
DPA	EIA-469	50	0	25 width/25 length	Pass
Moisture Resistance	MIL-STD-202 method 106	77	0	t = 24 hours/cycle. Unpowered.	Pass
Biased Humidity	MIL-STD-202 method 103	77	0	1000 hrs 85°C/85%RH. 1.5 Vdc and Rated Voltage.	Pass
Operational Life	MIL-STD-202 method 108	77	0	Rated Voltage @ 125°C.	Pass
External Visual	MIL-STD-883 method 2009	<1812 = 125 1812 = 200 >1812 = 315	0	Inspect device construction and workmanship. Electrical test not required.	Pass
Physical dimensions	JESD22 metdod JB-100	5	0	Verify physical dimensions to the device specification.	Pass
Mechanical shock	MIL-STD-202 method 213	30	0	Figure 1 of method 213 SMD: Condition F.	Pass
Vibration	MIL-STD-202 method 204	30	0	5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000Hz.	Pass
Resistance to Soldering Heat	MIL-STD-202 method 210	30	0	Condition B No pre-heat of samples.	Pass
Thermal Shock	MIL-STD-202 method 107	30	0	(-55/+125°C). 300 cycles. Max transfer time: 20 s. Dwell time: 15 minutes. Air-Air.	Pass
Solderability	J-STD-002 (JESD22-B102)	15	0	Aged solderability test. Use dry heat. 150 °C for 16 hrs.	Pass
Syfer standard solderability test	IEC 60068-2-58 test Td	5	0	Immersion in 60/40 (Sn/Pb) solder at 235 ± 5°C for 2 ± 0.5 seconds. Coverage shall exceed 95%.	Pass
Electrical characteristics	Standard Syfer 100% electrical	200-400 units	0	As per standard Syfer test conditions.	Pass
Board flex	AEC-Q200-005	30	0	3 mm deflection Class I 2 mm deflection Class II	Pass
Terminal strength	AEC-Q200-006	30	0	Force of 1.8kg for 60 seconds	Pass
Beam Load Test	AEC-Q200-003	30	0		Pass

Range and Ordering Information

Capacitance Values

X7R

100pF - 33nF

Electrical

Operating Temperature

-55°C to +125°C

Temperature Coefficient of Capacitance
(Typical)

±15%

Insulation Resistance
Time constant (Ri xCr) (whichever is the least)

100GΩ or 1000s

Ageing Rate

Typical 1% per time decade

Mechanical

Termination Material

See ordering information below

Solderability

IEC 60068-2-58. Passed 3 times reflow profile defined in J-STD-020

Lead Free Soldering

This range is fully compliant with the RoHS and WEEE directives and parts are compatible with lead free solders.

Climatic Category

55/125/56

Reeled Quantities

See Capacitance tables

Chip Size	1206	1210	1808	1812	2220
Min Cap	100pF	330pF	100pF	150pF	220pF
2000V	3.3nF	5.6nF	5.6nF	12nF	33nF
2500V	2.7nF	4.7nF	4.7nF	8.2nF	22nF
3000V	1.5nF	3.3nF	3.3nF	4.7nF	10nF
4000V	-	-	2.2nF	3.3nF	6.8nF
5000V	-	-	-	-	4.7nF
7" Reel	2,500	2,000	1,500	500/1,000*	500/1,000*
13" Reel	10,000	8,000	6,000	2,000/4,000*	2,000/4,000*

NOTE: Other capacitance values may become available, please contact our Sales Office if you need values other than those shown in the above table. For dimensions and soldering information, please go to our website (www.syfer.com) or see our MLC Catalogue.

*Reel quantity depends on chip thickness. Please contact sales office.

1206	P	2K0	0102	K	X	T
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric**	**Packaging**
1206 1210 1808 1812 2220	**P** = ProtectiCap™ (FlexiCap™ termination base with Ni barrier, 100% matte tin plating)	2K0 = 2000V 2K5 = 2500V 3K0 = 3000V 4K0 = 4000V 5K0 = 5000V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of 0's following Example 0102=1000pF	J = ±5% K = ±10% M = ±20%	**X** = X7R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs

For further information on our ProtectiCap™, other ranges, or for technical assistance please contact our Sales Department on +44 1603 723310 or by Email at sales@syfer.co.uk