

1 Overview

NANOWAVE Technologies Inc. offers high value single layer chip capacitors (SLC) based on high-dielectric Constant Grain Boundary Layer Ceramics.

The capacitors range from 150 pF (120×10^{-12} F) to 20 nF (20×10^{-9} F).

The chip capacitors offer excellent electrical (breakdown) and temperature stability, high reliability and a very large range of operating temperature. The main application for these capacitors can be found in high reliability RF circuits.

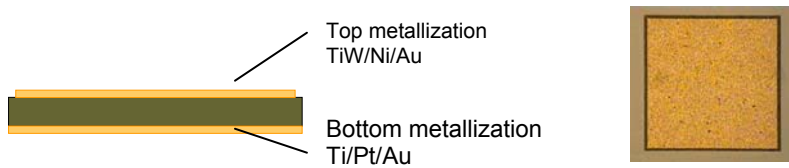


Fig 1: Cross sectional diagram (left) and top view photograph (right)

The chip capacitors passed wire bond (0.001" diameter wire, automated ball bonder) and pull testing (ave = 7.95 grams, Std Dev 1.52)

2 Applications

The chip capacitors can be used in the following applications:

- Microwave Integrated Circuits and MMIC packages
- Broadband RF Bypass and matching circuits
- Can replace Multi-layer-capacitors (MLC) for hybrid assemblies to reduce size.

3 Electrical and Mechanical Specifications

Parameter	min	typ	max	unit	Conditions/Remarks
Capacitance value	0.150		20	nF	
Specified Voltage	25.0			V	
Insulation resistance	10.0			Gohm	
Operating temperature range	-55		+125	°C	
Temperature coefficient $\Delta C/C$			± 15	%	
Dielectric loss			0.025		@ 1kHz and 1 MHz
Equivalent series resistance			100	mohm	@ 1GHz
Size (L, W)	0.254		3.0	mm	
Thickness		0.127		mm	

Additional features:

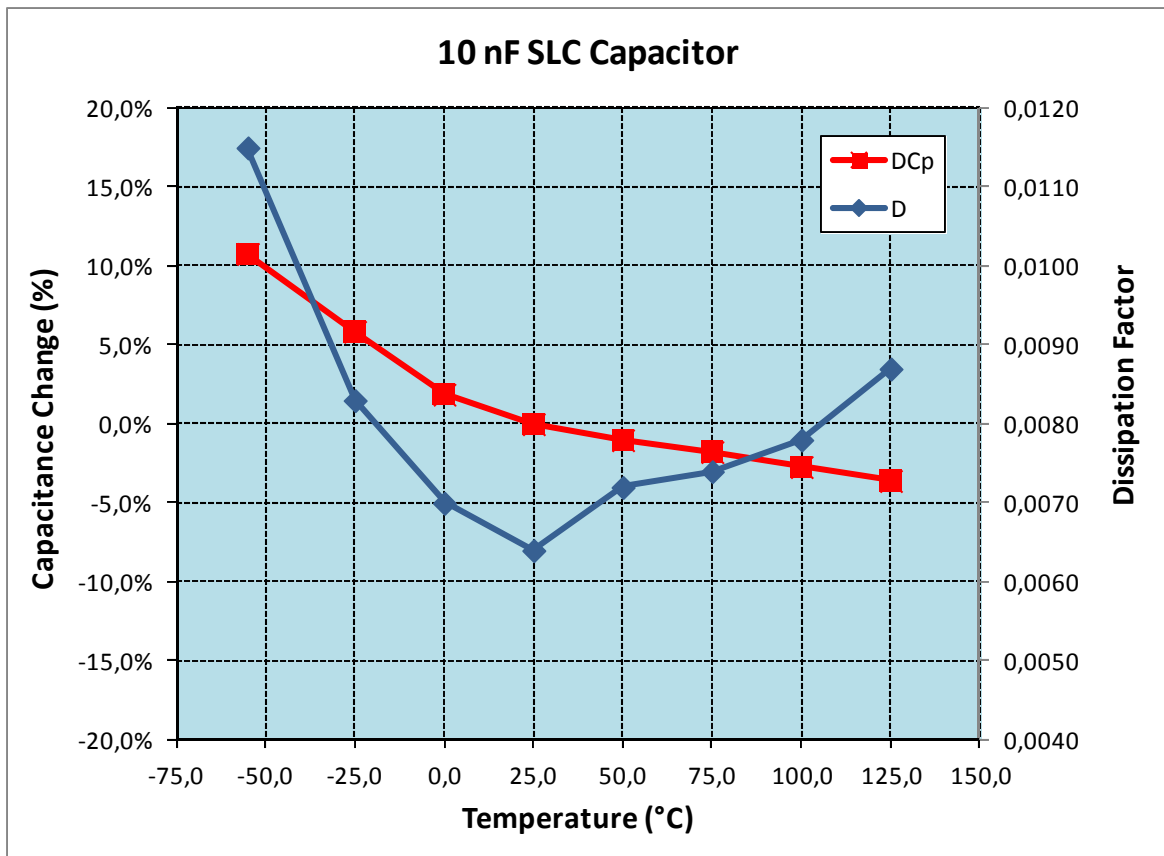
- Lead Free
- Thin film gold termination over barrier layer suitable for chip and wire hybrids as well as soldering.
- Bordered termination for automated assemblies.

4 Typical Performance Characteristics

4.1 Applicable Documents

- PQP0002: Qualification Plan for Single Layer Chip Capacitor
- MS6099175: Single Layer ceramic Capacitor Manufacturing Procedure
- SCD6094104: Specification Control Document for Nanowave Manufactured Single Layer Chip Capacitors
- MIL-C-49464A: General Specification for Established Reliability, Capacitor Chips Single Layer, Fixed, Parallel Plate, and Ceramic Dielectric

4.2 Temperature Characteristics



4.3 Qualification Test Results

For the Qualification Test a total number of 10 samples were randomly selected from the production batch.

4.3.1 Dielectric Strength Test

Condition: 62.5 V (250 % of specified voltage)
60 sec / sample
Visual inspection and measurement of capacitance and D factor

#	Before		After		Visual Inspection
	Cp(nF)	D Factor	Cp(nF)	D Factor	
1	13,916	0,0069	13,891	0,0068	No discoloration or disintegration; No breakdown
2	12,972	0,0080	12,897	0,0082	No discoloration or disintegration; No breakdown
3	11,694	0,0063	11,679	0,0063	No discoloration or disintegration; No breakdown
4	12,018	0,0060	11,981	0,0061	No discoloration or disintegration; No breakdown
5	13,233	0,0072	13,191	0,0070	No discoloration or disintegration; No breakdown
6	14,094	0,0073	14,016	0,0068	No discoloration or disintegration; No breakdown
7	14,352	0,0086	14,319	0,0083	No discoloration or disintegration; No breakdown
8	13,556	0,0066	13,527	0,0065	No discoloration or disintegration; No breakdown
9	11,381	0,0062	11,358	0,0062	No discoloration or disintegration; No breakdown
10	13,862	0,0064	13,85	0,0064	No discoloration or disintegration; No breakdown

Result: high-capacitance chip capacitors demonstrate excellent voltage breakdown behaviour.

4.3.2 Insulation Resistance

Condition: 25.0 V
2 min / sample
measurement of capacitance, D factor and resistance

#	Cp(nF)	D Factor	IR (Megaohms)
1	12,40	0,0046	9,06
2	13,59	0,0055	6,43
3	12,88	0,0046	7,88
4	12,45	0,0075	6,82
5	14,02	0,0050	4,88
6	13,94	0,0057	5,86
7	13,61	0,0053	7,60
8	13,22	0,0047	7,58

Result: average insulation resistance (IR): > 7 Megaohms

4.3.3 Temperature Cycling

Condition: -55 °C to +125 °C
 100 cycles, 10 min per cycle
 measurement of capacitance, D factor and resistance

#	Before Temp Cycling			After Temp Cycling		
	Cp (nF)	D	IR (MΩ)	Cp (nF)	D	IR (MΩ)
1	12,31	0,0009	7,85	12,36	0,0011	7,65
2	12,43	0,0014	6,21	12,57	0,0012	6,06
3	12,83	0,0012	3,13	12,87	0,0015	3,03
4	11,96	0,0031	7,35	12,25	0,0033	7,38
5	13,89	0,0012	3,70	13,92	0,0010	3,86
6	13,76	0,0009	4,67	13,72	0,0012	4,65
7	13,48	0,0012	7,71	13,53	0,0014	7,58
8	13,12	0,0008	7,34	13,15	0,0011	7,22

Results: no damages observed
 Change of capacitance after test: < 0.7%
 Change of D factor after test: 10.0%
 Change of insulation resistance (IR): < 1.2%

4.3.4 Life Test

Condition: 50 V (200% of specified voltage)
 125 °C temperature
 Duration: 1,000 hrs
 measurement of capacitance, D factor and resistance

#	Before Life Test			500 hrs			1,000 hrs		
	Cp (nF)	D	IR (MΩ)	Cp (nF)	D	IR (MΩ)	Cp (nF)	D	IR (MΩ)
1	13,888	0,0025	2,96	13,1560	0,0018	3,25	12,170	0,0015	3,45
2	14,094	0,0018	3,14	13,2560	0,0019	2,56	12,255	0,0008	2,36
3	13,659	0,0015	3,14	12,7450	0,0011	3,3	11,856	0,0014	3,15
4	11,74	0,0008	27,55	11,2130	0,0012	24,56	10,577	0,0010	23,36
5	13,36	0,0007	5,37	12,8780	0,0012	4,58	11,950	0,0015	4,32
6	12,868	0,0011	13,38	12,2500	0,0009	15,64	11,458	0,0008	14,98
7	13,788	0,0014	4,99	13,1050	0,0009	5,25	11,999	0,0016	5,21
8	13,976	0,0027	4,26	13,4600	0,0026	4,56	12,380	0,0023	4,49
9	12,201	0,0011	7,32	11,5590	0,0014	7,22	10,616	0,0011	7,06

Results: Average capacitance changed by less than 12% after 1,000 hrs at 125°C.
 Average D factor improved by more than 10% during Life Test.
 Average insulation resistance (IR) dropped by less than 5% during test.