

High Reliability Chip - X7R 16Vdc to 10kVdc

A range of MLC chip capacitors in Stable EIA Class II dielectric with special testing for long term reliability. They are designed for optimum reliability; burned in at elevated voltage and temperature, and 100% physically and electrically inspected to ascertain conformance to strict performance criteria. Units may be tested in accordance with MIL-PRF-55681, MIL-PRF-123, MIL-PRF-49467, or customer SCD.

Designed for surface mount application with nickel barrier terminations making them suitable for solder wave and reflow solder board attachment as well as vapor phase attachment for part sizes 2225 or smaller. Silver-palladium terminations are also available for hybrid use with conductive epoxy.

Class II X7R chips are used as decoupling, by-pass, filtering and transient voltage suppression elements and exhibit +/-15% temperature coefficient and predictable variation of electrical properties with time, temperature and voltage.

They find application for High Reliability use such as medical implanted devices, aerospace, airborne and military use as well as consumer uses requiring safety margins not attainable with commercial products.

Standard EIA case sizes and available C/V values are listed below - special sizes, thicknesses and other voltage ratings are available; please contact the sales office for information.

Capacitance and voltage selection for popular chip sizes

Size	0402	0504	0603	0805	1005	1206	1210	1515	1808	1812	1825			
Min cap.	121	121	121	121	121	121	121	151	151	151	151	471	471	
Tmax inches: mm:	0.024 0.61	0.044 1.12	0.035 0.89	0.054 1.37	0.054 1.37	0.064 1.63	0.065 1.63	0.130 3.02	0.065 1.63	0.080* 2.03	0.065 1.63	0.100* 2.54	0.080 2.03	0.140* 3.56
16V	472	333	223	104	124	274	474	105	394	684	824	824	155	225
25V	472	333	223	104	124	274	474	824	394	564	824	824	155	225
50V	472	333	223	823	104	224	394	824	334	474	684	684	125	185
100V	392	273	183	563	683	154	274	684	224	334	474	474	105	185
200V	182	123	822	223	333	823	124	394	124	154	224	394	564	105
250V	102	822	562	183	273	393	823	224	683	104	124	124	394	684
300V	•	•	•	103	123	273	563	184	563	683	104	154	274	474
400V	•	•	•	682	682	183	333	104	333	393	563	124	184	334
500V	•	•	•	472	472	123	273	823	273	333	473	683	124	274
600V	•	•	•	332	272	682	153	563	183	223	273	473	823	184
800V†	•	•	•	222	182	472	103	333	103	123	183	273	563	104
1kV†	•	•	•	122	821	222	562	183	562	822	103	183	333	563
1.5kV†	•	•	•	•	•	102	222	822	272	332	392	822	123	273
2kV†	•	•	•	•	•	471	102	392	122	152	182	332	682	123
3kV†	•	•	•	•	•	•	•	102	391	471	821	152	152	332
4kV†	•	•	•	•	•	•	•	•	181	271	391	681	821	182
5kV†	•	•	•	•	•	•	•	•	•	•	•	•	561	102
6kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
7kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
8kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
9kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
10kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•

† Units rated above 800V may require conformal coating to preclude arcing over chip surface. Maximum voltage for MIL-PRF-123 tested parts is 1kV.

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- For dielectric characteristics see page 6.
- For dimensions see page 12.
- For termination options see pages 3 & 15.
- For capacitance tolerances available see page 15.
- For ordering information see page 15.

Note: Maximum capacitance values are shown below as 3 digit code: 2 significant figures followed by the no. of zeros e.g. 183 = 18,000pF.

Capacitance and voltage selection for popular chip sizes

	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565	Size
	102	471	471	471	102	102	102	102	102	102	102	222	222	Min cap.
	0.180 4.57	0.080 2.03	0.080 2.03	0.150* 3.81	0.180 4.57	0.250 6.35	0.250 6.35	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	inches Tmax mm
	185	125	185	275	225	475	475	825	825	106	126	186	226	16V
	155	125	185	225	225	475	475	685	825	106	126	186	206	25V
	155	125	155	225	155	395	395	685	685	825	106	156	186	50V
	125	824	125	185	125	335	335	565	685	685	825	106	156	100V
	105	474	564	125	125	275	275	475	475	565	685	825	106	200V
	684	394	394	684	804	225	225	475	475	565	685	825	106	250V
	564	224	334	684	684	185	185	335	335	395	475	685	825	300V
	334	154	184	394	394	105	105	185	225	225	275	335	565	400V
	224	154	154	334	274	684	684	125	155	155	185	275	395	500V
	154	823	104	224	184	474	474	824	824	105	155	225	275	600V
	104	563	683	124	124	334	334	564	684	824	125	185	225	800V [†]
	563	273	393	823	683	184	184	394	474	474	684	105	125	1kV [†]
	123	123	153	333	333	823	823	184	184	224	274	474	564	1.5kV [†]
	123	562	822	153	153	473	473	104	104	124	184	224	334	2kV [†]
	272	182	222	392	562	223	223	333	473	473	683	104	154	3kV [†]
	182	821	102	222	272	123	123	183	223	273	393	563	823	4kV [†]
	102	561	561	122	182	682	822	103	153	183	273	393	473	5kV [†]
	•	•	•	•	•	472	562	682	103	123	183	273	333	6kV [†]
	•	•	•	•	•	•	392	472	682	822	123	183	273	7kV [†]
	•	•	•	•	•	•	272	392	562	682	103	153	183	8kV [†]
	•	•	•	•	•	•	222	272	392	472	682	123	153	9kV [†]
	•	•	•	•	•	•	152	222	332	392	562	822	123	10kV [†]

* Denotes non standard chip thickness.
Order code needs to have an 'X' inserted together with the dimension in inches e.g. X080 where dimension is 0.080"

Chip Ordering Information



Prefix	Case Size	Dielectric	Capacitance	Capacitance Tolerance	Voltage	Termination	Special Thickness	High Reliability Testing	Packaging	Marking	High Reliability Test Criteria
XX	1206	N	472	J	101	N	X050	H	T	M	HB

Capacitance Code

1st two digits are significant, third digit denotes number of zeros, R = decimal
Examples:

1R0	= 1.0pF
120	= 12pF
471	= 470pF
102	= 1,000pF
273	= 0.027μF
474	= 0.47μF
105	= 1.0μF

Special Thickness

None	Standard thickness as per Novacap catalog specifications
X	Denotes a special thickness other than standard. Specify in inches if required. (As shown above X = 0.050")

Packaging

None	Bulk
T	Tape & Reel
W	Waffle Pack

Marking

None	Unmarked
M	Marked *Marking not available on sizes ≤ 0603

High Reliability Testing

None	Standard product
H	High Reliability Testing
H	High Temp Screening

Hi-Reliability Testing Criteria

HB	MIL-PRF-55681 Group A
HV	MIL-PRF-49467 Group A
HS	MIL-PRF-123 Group A

Dielectric Codes

N	C0G/NP0	Ultra Stable
M	C0G/NP0	Ultra Stable Magnetic Free
F	C0G/NP0	High Temp. (up to 160°C)
D	C0G/NP0	High Temp. (up to 200°C)
K	R3L	Ultra Stable
R	R2D	Pulse Energy
Y	Y5V	General Purpose
Z	Z5U	General Purpose
B	X7R	Stable
C	X7R	Stable Magnetic Free
X	BX	MIL
S	X8R	High Temp. (up to 150°C)
E	Class II	High Temp. (up to 200°C)
G	Class II	High Temp. (up to 160°C)
W	X5R	Stable
RN	Lead free C0G/NP0	Ultra Stable
RB	Lead free X7R	Stable
BB	X7R BME	Stable
BW	X5R BME	Stable

Voltage Code

1st two digits are significant, third digit denotes number of zeros. For example:

160	= 16 Volts
101	= 100 Volts
501	= 500 Volts
102	= 1,000 Volts
502	= 5,000 Volts
103	= 10,000 Volts

Termination Codes

P	Palladium Silver	
PR	Palladium Silver*	
K	Solderable Palladium Silver*	
N	Nickel Barrier*	100% tin
Y	Nickel Barrier	90% tin, 10% lead
NG	Nickel Barrier Gold Flash*	
C	FlexiCap™/Nickel Barrier*	100% tin
D	FlexiCap™/Nickel Barrier	90% tin, 10% lead
B	Copper Barrier*	100% tin
E	Copper Barrier	90% tin, 10% lead
S	Silver*	

* Indicates RoHS terminations

Capacitance Tolerance Codes

Code	Tolerance	Capacitance Tolerance Codes										Positive VTC		
		C0G/NP0			R3L	R2D	Y5V Z5U	X7R	BX	X8R	Class II		X5R	
	* Not RF series	N	M	F/D	K	R	Y/Z	B	C	X	S	E/G	W	P
B	±0.10pF	•	•											
C	±0.25pF	•	•		•									
D	±0.50pF	•	•		•									
F	±1%	•	•	•										
G	±2%	•	•	•	•									
J	±5%	•	•	•	•	•		•*	•	•*	•	•		
K	±10%	•	•	•	•	•		•	•	•	•	•	•	•
M	±20%	•		•	•	•	•	•	•	•	•	•	•	•
Z	+80% -20%	•				•	•	•*						•
P	+100% -0%	•				•	•	•*						•

Prefix Definitions

None	Standard chip	
RF	Improved ESR Capacitor	p. 23
LS	Y ³ Certified Safety Capacitor	p. 42 - 43
ES	Y ² Certified Safety Capacitor	p. 42 - 43
ST	Stacked Capacitor Assembly	p. 48 - 53
SM	Stacked Hi-Rel Capacitor Assembly	p. 48 - 53
CR	Cap-Rack Capacitor Array	p. 54
RC	Bleed Resistor	p. 58 - 61

Technical Information

Novacap provides application notes throughout this catalog as a guide to chip selection and attachment methods. Refer to the Novacap Technical Brochure found at www.novacap.com for more details. This technical information includes the nature of capacitance, dielectric properties, electrical properties, classes of dielectrics, ferroelectric behavior, test standards, and high reliability test plans. Please do not hesitate to contact the sales office for any product or technical assistance.

Capacitor Size

Size availability is based primarily on capacitance values and voltage rating. Smaller units are generally less expensive. Because mass affects the thermal shock susceptibility of chip capacitors, size selection should consider the soldering method used to attach the chip to the board. Sizes 1812 and smaller can be wave, vapor phase, or reflow soldered. Larger units require reflow soldering.

Chip Selection

Multilayer capacitors (MLC) are categorized by dielectric performance with temperature. The Temperature Coefficient of Capacitance describes the variance of capacitance value with temperature. The choice of components is therefore largely determined by the temperature stability required of the device and the size necessary for the desired capacitance value and voltage rating.

Packaging

Units are available reeled, in waffle pack, or bulk packaged. Bar coded labels are standard for reeled and bulk packaging.

Primary Dielectric Types

COG/NP0:

Ultra stable Class I dielectric, with negligible dependence of capacitance on temperature, voltage, frequency, and time. Used in circuitry requiring very stable performance.

X7R:

Stable Class II dielectric, with predictable change in properties across a temperature range of -55°C to +125°C. Used as blocking, decoupling, bypassing, and frequency discriminating elements. This dielectric is ferroelectric and provides higher capacitance than Class I materials.

BX:

The military specification for ceramic chip capacitors (MIL-PRF-55681) defines a mid-K stable dielectric designated as BX. The BX specification has voltage temperature limits in addition to temperature limits of capacitance. The BX dielectric is limited to ±15% maximum change in capacitance between 25°C and -55°C or +125°C and also has a voltage restriction of +15% / -25% maximum change in capacitance between 25°C and -55°C or +125°C at rated voltage.

Z5U/Y5V:

General purpose Class III dielectrics with higher dielectric constant and greater variation of properties over temperature and voltage. Very high capacitance per volume is attainable for general purpose applications where stability over a wide temperature range is not critical.

Dielectric Termination Combinations

Dielectric	Code	Palladium Silver	Palladium Silver	Solderable Palladium Silver	Nickel Barrier 100% tin	Nickel Barrier 90/10% tin/lead	Nickel Barrier Gold flash	FlexiCap™/Nickel Barrier 100% tin	FlexiCap™/Nickel Barrier 90/10% tin/lead	Copper Barrier 100% tin	Copper Barrier 90/10% tin/lead	Solderable Silver
		RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS
COG/NP0	N/RN	•	•	•	•	•	•	•	•			•
R3L	K	•	•	•	•	•	•	•	•			
X7R	B/RB	•	•	•	•	•	•	•	•			•
X7R BME	BB				•	•	•					
X5R BME	BW				•	•	•					
BX	X	•	•	•	•	•	•	•	•			•
Y5V	Y							•	•			
Z5U	Z							•	•			
COG/NP0 (Mag free)	M	•	•	•						•	•	
X7R (Mag free)	C	•	•	•						•	•	
X8R	S	•	•	•	•	•		•	•			•
COG/NP0 (160°C)	F	•	•	•	•	•		•	•			•
COG/NP0 (200°C)	D			•								•
Class II (160°C)	G	•	•	•	•	•		•	•			•
Class II (200°C)	E			•								•
Pulse Power	P	•	•	•								
R2D	R	•	•	•								

Termination Material

We recommend the following termination types:

Solder Attachment:

- N** Nickel Barrier, 100% matte tin plated - RoHS
 - C** FlexiCap™ with Nickel Barrier, 100% tin plated - RoHS
 - Y** Nickel Barrier, tin-lead plated
 - D** FlexiCap™ Nickel Barrier, tin-lead plated
 - B** Copper Barrier 100% matte tin plated - RoHS
 - E** Copper Barrier, tin-lead plated
 - K** Solderable Palladium Silver - RoHS (suitable for conductive epoxy attach)
 - S** Solderable Silver - RoHS
- Conductive Epoxy attachment:**
- P** Palladium Silver
 - PR** Palladium Silver - RoHS
 - NG** Nickel Barrier Gold Flash - RoHS (suitable for soldering attach)

X7R (B) Stable and RoHS 2013 (RB) type

Operating temperature range:	-55°C to 125°C
Temperature coefficient :	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



X7R (C) Stable Non Magnetic

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



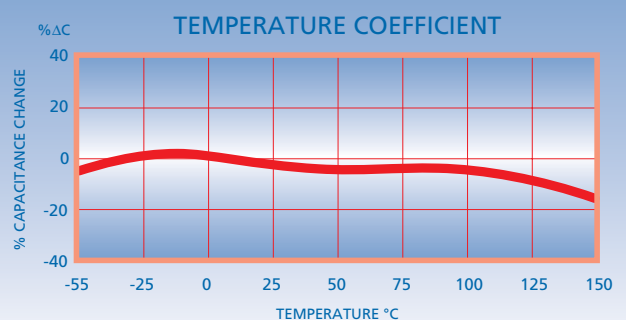
BX (X) Stable

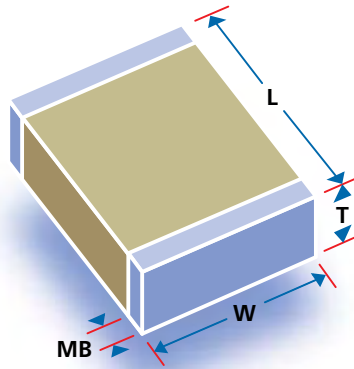
Operating temperature range:	-55°C to 125°C
Temperature coefficient:	±15% ΔC Max.
Temp-voltage coefficient:	+15% -25% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



X8R (S) Stable

Operating temperature range:	-55°C to 150°C
Temp. coefficient ≤150°C:	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @150°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C





Dimensions - inches (mm)

Size	Length (L)	Width (W)	Max. Thickness (T)*	Termination Band (MB)
0402	0.040 ± 0.004 (1.02 ± 0.102)	0.020 ± 0.004 (0.508 ± 0.102)	0.024 (0.610)	0.010 ± 0.006 (0.254 ± 0.152)
0504	0.050 ± 0.006 (1.27 ± 0.152)	0.040 ± 0.006 (1.02 ± 0.152)	0.044 (1.12)	0.014 ± 0.006 (0.356 ± 0.152)
RF0505	0.055 +0.015 -0.010 (1.4 +0.38 -0.25)	0.055 ± 0.015 (1.40 ± 0.381)	0.057 (1.45)	0.014 ± 0.006 (0.356 ± 0.152)
0603	0.060 ± 0.006 (1.52 ± 0.152)	0.030 ± 0.006 (0.762 ± 0.152)	0.035 (0.889)	0.014 ± 0.006 (0.356 ± 0.152)
0805	0.080 ± 0.008 (2.03 ± 0.203)	0.050 ± 0.008 (1.27 ± 0.203)	0.054 (1.37)	0.020 ± 0.010 (0.508 ± 0.254)
0907	0.090 ± 0.008 (2.29 ± 0.203)	0.070 ± 0.008 (1.78 ± 0.203)	0.060 (1.52)	0.020 ± 0.010 (0.508 ± 0.254)
1005	0.100 ± 0.008 (2.54 ± 0.203)	0.050 ± 0.008 (1.27 ± 0.203)	0.054 (1.37)	0.020 ± 0.010 (0.508 ± 0.254)
RF1111	0.110+0.025 -0.010 (2.79 +0.64 -0.25)	0.110 ± 0.015 (2.79 ± 0.381)	0.102 (2.59)	0.020 ± 0.010 (0.508 ± 0.254)
1206	0.125 ± 0.008 (3.18 ± 0.203)	0.060 ± 0.008 (1.52 ± 0.203)	0.064 (1.63)	0.020 ± 0.010 (0.508 ± 0.254)
1210	0.125 ± 0.008 (3.18 ± 0.203)	0.100 ± 0.008 (2.54 ± 0.203)	0.065 (1.65)	0.020 ± 0.010 (0.508 ± 0.254)
1515	0.150 ± 0.015 (3.81 ± 0.381)	0.150 ± 0.015 (3.81 ± 0.381)	0.130 (3.30)	0.030 ± 0.015 (0.762 ± 0.381)
1808	0.180 ± 0.012 (4.57 ± 0.305)	0.080 ± 0.008 (2.03 ± 0.203)	0.065 (1.65)	0.024 ± 0.014 (0.610 ± 0.356)
1812	0.180 ± 0.012 (4.57 ± 0.305)	0.125 ± 0.008 (3.18 ± 0.203)	0.065 (1.65)	0.024 ± 0.014 (0.610 ± 0.356)
1825	0.180 ± 0.012 (4.57 ± 0.305)	0.250 ± 0.015 (6.35 ± 0.381)	0.080 (2.03)	0.024 ± 0.014 (0.610 ± 0.356)
2020	0.200 ± 0.015 (5.08 ± 0.381)	0.200 ± 0.015 (5.08 ± 0.381)	0.180 (4.57)	0.024 ± 0.014 (0.610 ± 0.356)
2221	0.220 ± 0.015 (5.59 ± 0.381)	0.210 ± 0.015 (5.33 ± 0.381)	0.080 (2.03)	0.030 ± 0.015 (0.762 ± 0.381)
2225	0.220 ± 0.015 (5.59 ± 0.381)	0.250 ± 0.015 (6.35 ± 0.381)	0.080 (2.03)	0.030 ± 0.015 (0.762 ± 0.381)
2520	0.250 ± 0.015 (6.35 ± 0.381)	0.200 ± 0.015 (5.08 ± 0.381)	0.180 (4.57)	0.030 ± 0.015 (0.762 ± 0.381)
RF2525	0.230 +0.020 -0.012 (5.84 +0.51 -0.30)	0.250 ± 0.015 (6.35 ± 0.381)	0.165 (4.19)	0.030 ± 0.015 (0.762 ± 0.381)
3333	0.330 ± 0.017 (8.38 ± 0.432)	0.330 ± 0.017 (8.38 ± 0.432)	0.250 (6.35)	0.030 ± 0.015 (0.762 ± 0.381)
3530	0.350 ± 0.018 (8.89 ± 0.457)	0.300 ± 0.015 (7.62 ± 0.381)	0.250 (6.35)	0.030 ± 0.015 (0.762 ± 0.381)
4040	0.400 ± 0.020 (10.2 ± 0.508)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
4540	0.450 ± 0.023 (11.4 ± 0.584)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
5440	0.540 ± 0.027 (13.7 ± 0.686)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
5550	0.550 ± 0.028 (14.0 ± 0.711)	0.500 ± 0.025 (12.7 ± 0.635)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
6560	0.650 ± 0.033 (16.5 ± 0.838)	0.600 ± 0.030 (15.2 ± 0.762)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
7565	0.750 ± 0.038 (19.1 ± 0.965)	0.650 ± 0.033 (16.5 ± 0.838)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)

* Non standard thicknesses are available - consult the sales office for details.

High Reliability Testing



Our High Rel products are designed for optimum reliability and are burned in at elevated voltage and temperature levels. They are 100% electrically inspected to ascertain conformance to a strict performance criteria.

Applications for High Reliability products include medical implanted devices, aerospace, airborne, various military applications, and consumer uses requiring safety margins not attainable with conventional product.

We have the ability to test surface mount and leaded capacitors to High Reliability standards as detailed below, or to customer SCD.

Military performance specifications are designed and written for the voltage/capacitance ratings of the individual product slash numbers associated with the specification.

Some of the requirements of the military document may not apply to the NOVACAP High Reliability product. The following details the intent of the individual military specifications available for test and the deviations that may apply.

Product voltage ratings outside of the intended military specification will follow the NOVACAP voltage test potential outlined.

Contact the sales office with any requirements or deviations that are not covered here.

Environmental Testing

We also have the capability to perform all the Environmental Group B, Group C, and Qualification testing to the referenced military specifications.

Testing abilities include the following:

- Nondestructive internal examination
- Destructive physical analysis
- Radiographic inspection
- Terminal strength
- Resistance to soldering heat
- Voltage-temperature limits
- Temperature coefficient
- Moisture resistance
- Humidity, steady state, low voltage
- Vibration
- Resistance to solvents
- Life
- Thermal shock and immersion
- Low temperature storage
- Barometric pressure
- Shock, specified pulse
- Mechanical shock
- Constant acceleration
- Wire bond evaluation
- Partial discharge (corona)
- 200°C Voltage Conditioning

Military Performance Specifications

MIL-PRF-55681 (GROUP A)

General purpose military high reliability specification for surface mount sizes 0805 through 2225 in 50V and 100V.

- VOLTAGE CONDITIONING
- 100 HRS, 2X VDCW, 125°C
- DWV, IR, 125°C IR, CAP, DF TEST
- VISUAL & MECH. INSPECTION (AQL SAMPLE PLAN)
- SOLDERABILITY, SAMPLE 13(0)
- 8% PDA MAXIMUM

MIL-PRF-123 (GROUP A)

The specification affords an increased reliability level over MIL-PRF-55681 for space, missile and other high reliability applications such as medical implantable or life support equipment. The specification covers surface mount sizes 0805 through 2225 in 50V rating and various radial / axial leaded products in 50V, 100V, and 200V ratings.

- THERMAL SHOCK, 20 CYCLES
- VOLTAGE CONDITIONING 168/264 HRS, 2X VDCW, 125°C
- DWV, IR, 125°C IR, CAP, DF TEST
- VISUAL & MECH. INSPECTION SAMPLE 20(0)
- DPA⁽¹⁾
- PDA, 3% (0.1%), 5% (0.2%) MAX⁽²⁾

MIL-PRF-39014 (GROUP A)

The specification covers general military purpose radial / axial leaded and encapsulated product in 50V, 100V, and 200V ratings.

- THERMAL SHOCK, 5 CYCLES
- VOLTAGE CONDITIONING 96 HRS, 2X VDCW, 125°C
- DWV, IR, 125°C IR, CAP, DF TEST
- VISUAL & MECH. INSPECTION (AQL SAMPLE PLAN)
- SOLDERABILITY, SAMPLE 13(0)
- 8% PDA MAXIMUM

MIL-PRF-49467 (GROUP A)

General purpose military high reliability specification for radial leaded epoxy coated. The specification covers sizes 1515 through 13060 with 600V, 1000V, 2000V, 3000V, 4000V, and 5000V ratings.

- THERMAL SHOCK, 5 CYCLES
- VOLTAGE CONDITIONING 96 HRS, RATED VDCW, 125°C
- PARTIAL DISCHARGE (OPTION) ⁽³⁾
- DWV, IR, 125°C IR, CAP, DF TEST
- VISUAL & MECH. INSPECTION SAMPLE 13(0)
- SOLDERABILITY, SAMPLE 5(0)
- 10% PDA MAXIMUM

MIL-PRF-49470 (DSCC 87106) (GROUP A)

General purpose military high reliability specification for stacked and leaded capacitors for switch mode power supplies. The specification covers sizes 2225 through 120200 in 50V, 100V, 200V and 500V ratings.

- THERMAL SHOCK, 5 CYCLES
- VOLTAGE CONDITIONING 96 HRS, 2X VDCW⁽⁴⁾, 125°C
- DWV, IR, 125°C IR, CAP, DF TEST
- VISUAL & MECH. INSPECTION SAMPLE 13(0)
- SOLDERABILITY, SAMPLE 5(0)
- 10% PDA MAXIMUM

MIL-PRF-38534

Specification for Hybrid Microcircuits with a section for Element Evaluation on passive components.

There are two classification levels of reliability. Class H is for a standard military quality level. Class K is for the highest reliability level intended for space application.

Novacap will perform a 100-hour burn-in on all Class K products. Novacap assumes Class K Subgroup 3 samples will be unmounted and Subgroup 4 (wirebond) shall not apply unless otherwise stated.

NOVACAP TEST VOLTAGE (VDC)

This test potential shall be used on all High Reliability Testing unless otherwise specified.

	WVDC	DWV	V/C*
<200		2.5X Rated	2.0X Rated
250		500V	400V
300		500V	400V
400		600V	500V
500		750V	600V
600		750V	600V
*V/C Is Voltage Conditioning.	>700	1.2X Rated	1.0X Rated

(1) MIL-PRF-123 DPA shall be per TABLE XIV AQL requirements unless otherwise specified.

(2) MIL-PRF-123 allowable PDA shall be 3% overall and 0.1% in the last 48 hours for capacitance/voltage values listed in MIL-PRF-123, and be 5% overall and 0.2% in the last 48 hours for capacitance/voltage values beyond MIL-PRF-123.

(3) MIL-PRF-49467 standard Group A is without Partial Discharge. Partial Discharge test is optional and must be specified.

(4) MIL-PRF-49470 (DSCC 87106) 500V rated product has Voltage Conditioning at 1.2X VDCW.

Product Reliability Groups



Novacap's management has defined and documented our Quality Policy.

Quality at Novacap is the enhancement of customer satisfaction by meeting our customer requirements in all our dealings with

*Our Customers
Our Vendors
The Environment*

Our system for quality is to attain effective, continuous, measurable improvement through systematic prevention of defects and errors in all activities.

Quality and customer satisfaction are the responsibility of every Novacap employee.

Certifications and Approvals

Novacap is certified to ISO 9001:2008, Certificate #FM75371.

10 DSCC approvals for radial leaded high voltage capacitors rated 1KV through 10KV. (87043, 87046, 87040, 87047, 87114, 87076, 89044, 87070, 87077, and 87081)

DSCC approval for 87106 stacked leaded switch mode power supply capacitors.

UL, TÜV and CSA approvals for Isolation Surge Protection Capacitors, Class Y² and Y³ in both COG and X7R dielectrics.



ISO 9001:2008
FM 75371



	Standard Commercial Capacitors	HH MIL-PRF-38534 Class H	HB MIL-PRF-55681	HK MIL-PRF-38534 Class K	HS MIL-PRF-123
Standard	■	■			
High Reliability			■	■	■
Typical Termination Options					
P: Silver Palladium	■	■	■	■	■
N: Silver base with Nickel Barrier (100% Matte Tin Plating)	■	■	□	□	□
Y: Silver base with Nickel Barrier (Tin/Lead Plating with min 10% Lead)	■	■	■	■	■
C: FlexiCap™ with Nickel Barrier (100% Matte Tin Plating)	■	■	□	□	□
D: FlexiCap™ with Nickel Barrier (Tin/Lead Plating with min 10% Lead)	■	■	■	■	■
■ Termination available. □ Termination available but generally not requested for Military/Space Grade components. Please discuss with Novacap Sales.					
Documentation					
Certificate of Conformance	S	S	S	S	S
Electrical Test Report (10 piece read and record report)	O	S	O	S	O
Full Data Package	O	O	S	S	S
S = Test conducted as standard. O = Optional test. Please discuss with Novacap Sales.					



Lot Testing

	Standard Commercial Capacitors	HH MIL-PRF-38534 Class H	HB MIL-PRF-55681	HK MIL-PRF-38534 Class K	HS MIL-PRF-123
Destructive Physical Analysis (DPA)	S	S	S	S	S
CSAM (C-Mode Scanning Acoustic Microscopy)	O	O	O	O	O
Plating Thickness Verification	S	S	S	S	S
Solderability*	S	S	S	S	S
Electrical Characteristics (DWW, IR, Cap, DF)	S	S	S	S	S
Sample Visual Inspection	S	S	S	S	S
100% Visual Inspection	O	O	O	S	S
Thermal Shock -55°C to +125°C	O	O	O	O	S
100% Burn-In**	O	O	S	S	S
100% Hot IR	O	O	O	O	S
Hot IR sample test (at rated voltage)	O	O	S	S	S
10 Piece Sample Temp Cycling, Constant Acceleration, Burn-In	O	O	O	S	O
Life Sample Test	O	O	O	O	O
Humidity Sample Test	O	O	O	O	O
Resistance to Soldering Heat Sample Test	O	O	O	O	O
Terminal Strength Sample Test	O	O	O	O	O
Group B Testing	N/A	N/A	N/A	N/A	O
Group C Testing	N/A	N/A	O	O	O

S = Test conducted as standard.

O = Optional test. Please discuss with Novacap Sales.

* Solderability and plating thickness verification does not apply to palladium/silver terminations.

** Burn-In for MIL-PRF-55681 and MIL-PRF-38534 Class K is 100 hours. Burn-In for MIL-PRF-123 is 168 to 264 hours.

Lot Test Details



DPA	Destructive Physical Analysis, Device is mounted in an epoxy plug and cross sectioned, with a fine grit sand paper while examining the internal construction of the device per relevant sections of EIA 469 and NOVACAP's internal design criteria.
CSAM	C-Mode Scanning Acoustic Microscopy; A method of non-destructive analysis is of the internal construction of a device per MIL-PRF-123. The optional test is to assure the highest quality of internal microstructure.
Plating Thickness Verification	X-Ray fluorescent (XRF) equipment/instrument is utilized to verify the plating thickness of a device according to NOVACAP's criteria.
Solderability	Determines the ability for solder to wet/adhere to the termination by dipping the component into molten solder according to MIL-STD-202 Method 208.
Electrical Characteristics (DWV, IR, Cap, DF)	DWV: Dielectric Withstanding Voltage, Determines the ability of the dielectric to withstand accelerated voltage without breaking down. IR: Insulation Resistance; The insulation resistance is a measure of the capability of a material To withstand leakage of current under a VDC potential gradient.
Sample Visual Inspection	Is an AQL level inspection, which is based on lot size and consists of a bulk scan under microscope between 7-10X magnification.
100% Visual Inspection	Each side of every part in a lot is subjected to inspection under microscope between 7-10X magnification in accordance with MIL-PRF-123 Appendix B.
Thermal Shock -55°C to +125°C	Devices are subjected to sudden temperature extremes (hot and cold) to determine the physical integrity of the components. All parts receive 20 cycles in accordance with MIL-PRF-123.
100% Burn-In	A method of screening infantile failures by testing at accelerated conditions. Product groups HB and HK follow the guidelines of MIL-PRF-55681. The parts receive a 100% Burn-in at 125°C and a voltage specified in page 27 for 100 hours. Product group HS follows the guidelines of MIL-PRF-123. The parts receive a 100% Burn-in at 125°C and a voltage specified in page 27 for a minimum of 168 and a maximum of 264 hours. The Burn-In may be terminated at any time between the hours of 168 and 264 when failures are less than 0.1% or 1 pieces during the last 48 hours of the test.
100% Hot IR	Tested for IR at rated voltage and elevated temperatures.
Hot IR sample test	A sample that is tested for IR at rated voltage and elevated temperatures.
10 Piece Sample Temp Cycling, Constant Acceleration, Burn-In	The 10 piece sample is tested in accordance with MIL-PRF-38534 TABLE C-III Subgroup 3. The tests include Temperature Cycling per MIL-STD-883 Method 1010 Condition C, Constant Acceleration per MIL-STD-883 Method 2001 with 3,000g's in Y1 direction, Burn-in according to MIL-PRF-55681, and Visual inspection.
Life Sample Test	A test that determines the long-term reliability of a device that is performed at accelerated electrical and environmental conditions. Life test for product groups HH, HB, and HK shall be in accordance with MIL PRF-55681. Life test for product group HS shall be in accordance with MIL-PRF-123.
Humidity Sample Test	Humidity, steady state, low voltage test in accordance with MIL-PRF-202 method 103 condition A with the capacitor requirements of MIL-PRF-55681/MIL-PRF-123. A twelve piece sample is tested with accept on zero failures.
Resistance to Soldering Heat Sample Test	The ability of a device to withstand soldering temperatures. Capacitors shall be tested in accordance with MIL-STD-202 Method 210 with applicable detail of MIL-PRF-55681/MIL-PRF-123.
Terminal Strength Sample Test	It is the strength of the adhesion of the termination to the ceramic body. Capacitors shall be tested in accordance with MIL-STD-202 Method 211 Test Condition A with applicable details of MIL-PRF-123. A six piece sample is tested with accept on zero failures.
Group B Testing	Group B environmental testing for product group HS shall consist of the tests specified in table XII of MIL-PRF-123 and shall be performed on sample units from lots that have been subjected to and have passed group A inspection. Copies of Group B data shall be forwarded to purchaser with parts. Parts may not be shipped until the conclusion of life test.
Group C Testing	Group C environmental testing shall consist of the tests specified in table XI of MIL-PRF-55681 for product groups HB and HK. Testing shall consist of the tests specified in table XIII of MIL-PRF-123 for product group HS. Tests shall be performed on sample units from lots that have been subjected to and have passed group A inspection. Copies of Group C data shall be forwarded to purchaser with parts. Parts may not be shipped until the conclusion of life test.