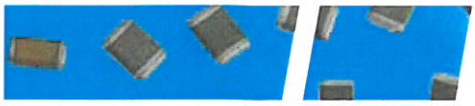


Commercial Chip - BX

Manufactured with layer thickness, and minimal voltage coefficient, to meet BX requirements. BX characteristics are identical to X7R dielectric with the added restriction that the Temperature-Voltage Coefficient (TVC) does not exceed -25% DC at rated voltage, over -55°C to 125°C operating temperature.

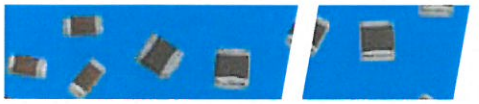
High Reliability Testing available: HB = MIL-PRF-55681 Group A. HK = MIL-PRF-38534 Class K. HS = MIL-PRF-123 Group A

- 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.

BX - Capacitance and Voltage Selection

Size	0402	0504	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
Min cap.	121	121	121	121	121	121	121	151	151	471	471	471
16V	562	393	273	104	124	274	474	564	105	185	155	225
25V	472	333	223	104	124	274	474	564	105	155	125	185
50V	182	183	123	473	683	124	274	274	564	125	125	155
100V	681	682	472	183	183	473	104	104	184	394	334	474
200V	221	182	122	562	822	153	273	333	563	104	823	124
250V	•	681	391	182	272	472	103	103	223	563	473	683
300V	•	•	•	122	122	332	562	682	123	393	333	473
400V	•	•	•	681	681	182	332	392	562	183	183	223
500V	•	•	•	391	471	102	222	222	392	123	103	153



Commercial Chip - Z5U & Y5V

General purpose Class III dielectrics, very stable with time, exhibiting +22% to -56% (Z5U) and +22% -82% (Y5V) temperature coefficients with very high capacitance density - typically aging less than 4% per decade.

They find application in by-pass and decoupling functions along with other applications where capacitance change over the operating temperature range is not critical.

FlexiCap™ is the preferred termination to reduce the chance of mechanical cracking due to board flexure.

END OF LIFE DATE 12/31/16

LAST BUY DEADLINE 8/31/16

CONTACT NOVACAP SALES FOR ASSISTANCE

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 and 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
HK	MIL-PRF-38534 Class K
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
P	Positive VTC	Pulse Power
RN	NP0	RoHS 2013 ≤ 200V
RB	X7R	RoHS 2013 ≤ 200V

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

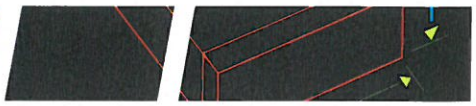
Prefix Definitions

None	Standard chip	
RF	Improved ESR Capacitor	p. 23
LS	Y³ Certified Safety Capacitor	p. 42 - 43
ES	Y² 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

Capacitance Tolerance Codes

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

Technical Summary



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

C0G/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

		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
Dielectric	**Code**	**P**	**PR**	**K**	**N**	**Y**	**NG**	**C**	**D**	**B**	**E**	**S**
C0G/NP0	N/RN	•	•	•	•	•	•	•	•			•
R3L	K	•	•	•	•	•	•	•	•			
X7R	B/RB	•	•	•	•	•	•	•	•			•
X5R	W				•	•	•					
BX	X	•	•	•	•	•	•	•	•			•
Y5V	Y				•	•		•	•			
Z5U	Z				•	•		•	•			
C0G/NP0 (Mag free)	M	•	•	•						•	•	
X7R (Mag free)	C	•	•	•						•	•	
X8R	S	•	•	•	•	•		•	•			•
C0G/NP0 (160°C)	F	•	•	•	•	•		•	•			•
C0G/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:

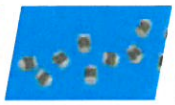
Solder Attachment:

- **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
- **S** Solderable Silver - RoHS

Conductive Epoxy attachment:

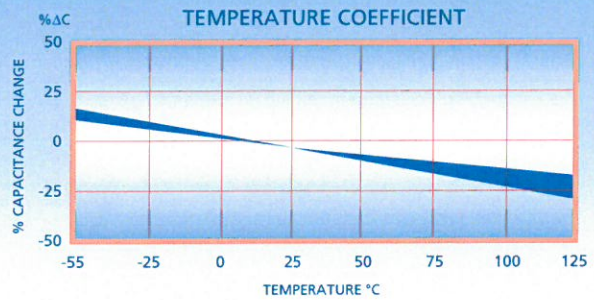
- **P** Palladium Silver
- **PR** Palladium Silver - RoHS
- **NG** Nickel Barrier Gold Flash, also suitable for soldering attachment - RoHS

Dielectric Characteristics



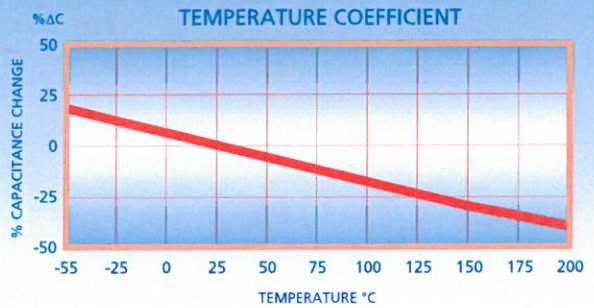
R3L (K) Ultra Stable

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	-2200 ±500 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance @25°C: @125°C:	>1000ΩF or >10000ΩF whichever is less >100ΩF or >1000ΩF whichever is less
Dielectric withstanding voltage ≤200V: 201-500V: >500V:	250% 150% or 500V whichever is greater 120% or 750V whichever is greater
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for Capacitance ≤100pF



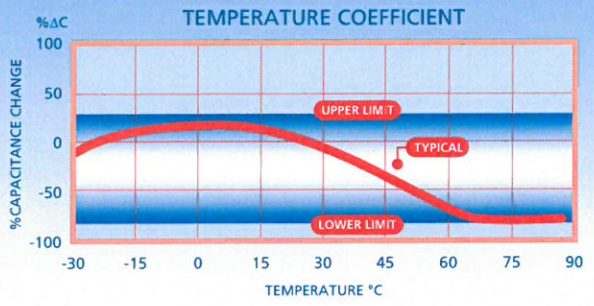
R2D (R) Pulse Energy

Operating temperature range:	-55°C to 200°C
Temperature coefficient:	-2200 ±500 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance @25°C: @200°C:	>100GΩ or >1000ΩF whichever is less >1GΩ or >10ΩF whichever is less
Dielectric withstanding voltage:	120%
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



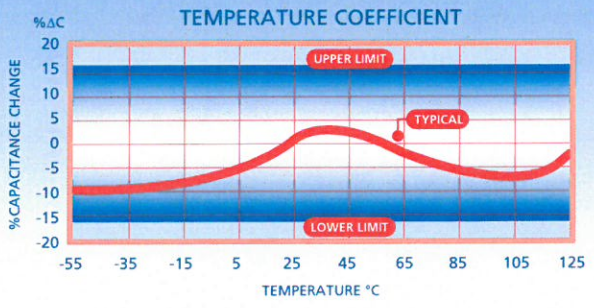
Y5V (Y) General Purpose

Operating temperature range:	-30°C to 85°C
Temperature coefficient:	+22% -82% ΔC Max.
Dissipation factor >25V rating: ≤25V rating:	5.0% max 7.0% max
Insulation resistance @25%:	>10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage ≤200V: 250V:	250% 150%
Ageing rate:	4.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C

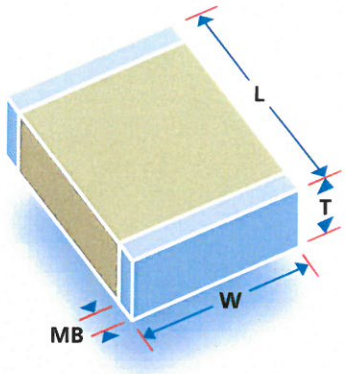


Z5U (Z) General Purpose

Operating temperature range:	+10°C to 85°C
Temperature coefficient:	+22% -56% ΔC Max.
Dissipation factor:	4.0% max @ 25°C
Insulation resistance @25%	>10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage ≤200V: 250V:	250% 150%
Ageing rate:	4.0% per decade
Test parameters:	1KHz, 0.5 ±0.2 VRMS, 25°C



Chip Dimensions



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.