

Commercial Chip - R3L 16Vdc to 5kVdc

A range of commercial MLC chip capacitors in R3L dielectric. This is a Class I temperature compensating N2200 dielectric with an energy density that exceeds conventional Class I materials. R3L has a predictable negative temperature coefficient, low loss, stable electrical properties with time, voltage, and frequency. The components are non-piezoelectric and are well suited for repetitive high current and pulse type applications. With exceptionally low ESR, ESL, and low signal distortion applications include power supply filtering, energy storage, coupling/decoupling and snubber.



Capacitance and voltage selection for popular chip sizes

Size	0402	0504	0603	0805	1206	1210	1515	1808	1812	1825	2020
Min cap.	1R5	2R2	2R2	2R2	8R2	220	220	220	390	680	101
Tmax inches: mm:	0.024 0.61	0.044 1.12	0.035 0.89	0.054 1.37	0.064 1.63	0.065 1.63	0.130 3.02	0.065 1.63	0.065 1.63	0.080 2.03	0.180 4.57
16V	391	472	222	103	223	473	823	473	104	184	154
25V	391	472	222	103	223	473	823	473	104	184	154
50V	391	472	222	103	223	393	683	333	683	184	154
100V	391	472	222	103	223	393	683	333	683	154	124
200V	221	272	122	472	123	223	473	223	393	104	104
250V	121	152	821	332	103	183	473	183	333	823	823
300V	•	•	•	222	562	123	333	103	223	563	683
400V	•	•	•	182	392	103	223	103	223	563	683
500V	•	•	•	182	392	822	223	822	183	473	563
600V	•	•	•	152	272	682	123	682	153	333	393
800V†	•	•	•	821	152	392	103	392	103	153	223
1kV†	•	•	•	471	102	222	822	222	562	123	153
1.5kV†	•	•	•	•	471	122	392	122	272	682	103
2kV†	•	•	•	•	271	561	182	561	122	332	562
3kV†	•	•	•	•	•	•	102	271	681	152	272
4kV†	•	•	•	•	•	•	471	151	331	821	152
5kV†	•	•	•	•	•	•	•	•	•	561	102

† Units rated above 800V may require conformal coating to preclude arcing over chip surface

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- For dielectric characteristics see page 5.
- 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. R denotes decimal e.g. 2R7 = 2.7pF.

Capacitance and voltage selection for popular chip sizes

	2221	2225	2520	3333	3530	4040	4540	5440	5550	6560	7565	Size
	101	101	101	151	151	151	151	151	151	221	391	Min cap.
	0.080 2.03	0.080 2.03	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
	184	224	224	334	334	564	564	684	824	125	185	16V
	184	224	184	334	334	564	564	684	824	125	185	25V
	184	224	184	334	334	564	564	684	824	125	185	50V
	154	184	184	334	334	474	564	684	824	125	155	100V
	104	124	154	224	224	394	394	474	684	105	125	200V
	823	104	124	184	184	334	334	394	564	824	105	250V
	563	683	104	184	184	274	274	334	474	684	824	300V
	473	563	823	154	154	224	224	274	394	564	684	400V
	393	473	683	124	124	224	224	274	334	474	564	500V
	333	393	563	104	104	184	184	224	274	394	474	600V
	223	273	393	563	563	104	124	124	184	274	334	800V [†]
	123	153	223	473	473	823	104	104	154	224	274	1kV [†]
	562	822	123	333	333	563	563	563	104	154	184	1.5kV [†]
	332	392	682	223	223	393	473	473	683	104	124	2kV [†]
	152	182	332	103	103	223	273	273	393	563	683	3kV [†]
	821	102	182	682	682	123	153	153	223	273	393	4kV [†]
	561	821	122	392	392	822	103	103	123	183	223	5kV [†]

[†] Units rated above 800V may require conformal coating to preclude arcing over chip surface

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	Dielectric										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:

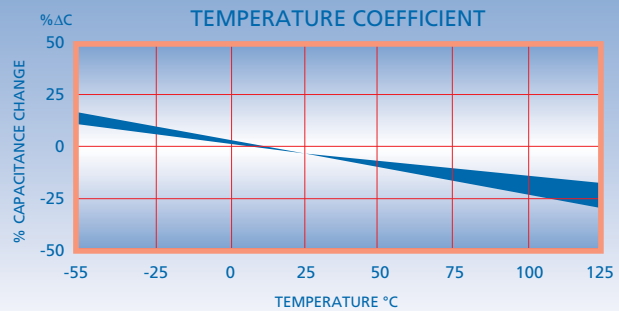
- N** Nickel Barrier, 100% matte tin plated - RoHS
 - C** FlexiCap™ with Nickel Barrier, 100% tin plated - RoHS
 - Y** Nickel Barrier, tin-lead plated
 - D** FlexiCap™ Nickel Barrier, tin-lead plated
 - B** Copper Barrier 100% matte tin plated - RoHS
 - E** Copper Barrier, tin-lead plated
 - K** Solderable 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)

Dielectric Characteristics



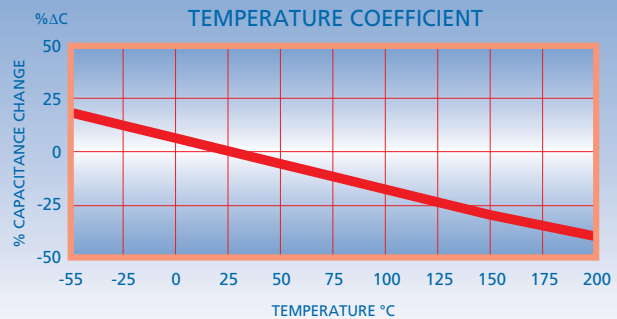
R3L (K) Ultra Stable

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: >1000ΩF or >10000ΩF whichever is less @125°C: >100ΩF or >1000ΩF 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:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for Capacitance ≤100pF



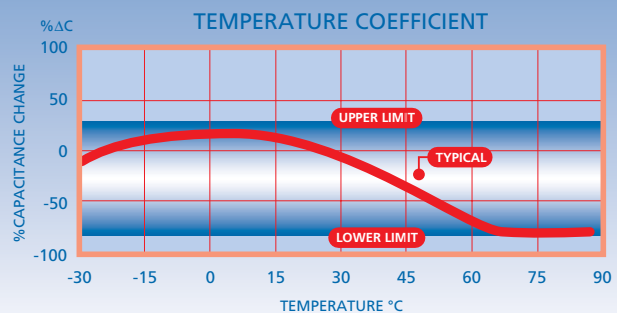
R2D (R) Pulse Energy

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: >100GΩ or >1000ΩF whichever is less @200°C: >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



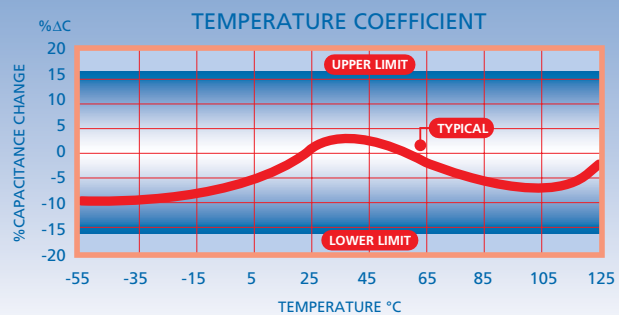
Y5V (Y) General Purpose

Operating temperature range:	-30°C to 85°C
Temperature coefficient:	+22% -82% ΔC Max.
Dissipation factor	>25V rating: 5.0% max ≤25V rating: 7.0% max
Insulation resistance @25%:	>10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 250V: 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: 250% 250V: 150%
Ageing rate:	4.0% per decade
Test parameters:	1KHz, 0.5 ±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.